2006 TRANSMISSION

Automatic Transaxle - 4T65-E - Overhaul

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Description of Usage	Ref. No.	Qty	Size	Specification	
				Metric	English
2-1 Servo to Case	103	3	M8x1.25x25	25 N.m	18 lb ft
Accumulator Cover to Case	131	11	M6x1.0x28	12 N.m	106 lb in
Case Cover to Case	434	3	M6x1.0x40	12 N.m	106 lb in
Case Cover to Case	436	3	M6x1.0x30	12 N.m	106 lb in
Case Cover to Driven Sprocket Support	435	3	M8x1.25x50	25 N.m	18 lb ft
Case Cover to Driven Sprocket Support (TORX®)	433	1	M6x1.0x32	12 N.m	106 lb in
Case to Drive Sprocket Support	524	4	M8x1.25x23	25 N.m	18 lb ft
Case Extension to Case	5	4	M10x1.5x35	36 N.m	26 lb ft
Case Side Cover to Case	56	9	M8x1.25x25	25 N.m	18 lb ft
Case Side Cover to Case (Stud)	58	4	M8x1.25x25	25 N.m	18 lb ft
Case Side Cover to Case (TORX® Special)	57	4	M8x1.25x21	25 N.m	18 lb ft
Detent Spring to Case Cover	805	1	M6x1.0x16	12 N.m	106 lb in
Forward Band Servo Cover to Case	12	3	M6x1.0x20	12 N.m	106 lb in
Oil Cooler Quick Connector	62	1	9/16-18 UNF	32 N.m	23 lb ft
Oil Cooler Quick Connector	61	1	9/16-18 UNF	32 N.m	23 lb ft
Oil Pan to Case	23	20	M6x1.0x18	14 N.m	10 lb ft
Oil Pressure Test Hole Plug	38	1	1/8-27 NPTF	12 N.m	106 lb in
Pump Body to Case	206	2	M6x1.0x95	16 N.m	11 lb ft

Pump Body to Case	231	9	M6x1.0x87.5	12 N.m	106 lb in
Pump Cover to Case Cover	207	9	M6x1.0x85	12 N.m	106 lb in
Pump Cover to Case Cover	230	2	M6x1.0x95	12 N.m	106 lb in
Pump Cover to Pump Body	205	1	M6x1.0x20	8 N.m	70 lb in
Speed Sensor to Case	9	1	M8x1.25x12	12 N.m	106 lb in
TFP Switch to Case	379	1	M6x1.0x87.5	16 N.m	11 lb ft
TFP Switch to Case Cover	375	2	M6x1.0x60	12 N.m	106 lb in
TFP Switch to Valve Body	381	1	M6x1.0x20	8 N.m	70 lb in
Transfer Case Lower Brace to Transfer Case	903	2	M8x10.9x25	31 N.m	23 lb ft
Transfer Case Side Brace to Transfer Case	903	3	M8x10.9x25	31 N.m	23 lb ft
Transfer Case Side Brace to Transmission	903	2	M8x10.9x25	31 N.m	23 lb ft
Transmission to Transfer Case Lower Brace	904	1	M10x9.8x35	56 N.m	41 lb ft
Transfer Case to Transmission	907	2	M10x9.8x35	40 N.m	30 lb ft
Transfer Case to Transmission					
• First Pass	909	2	M10x10.9x120	35 N.m	26 lb ft
• Final Pass				160 degrees	
Transfer Case to Transmission					
• First Pass	910	1	M10x9.8x35	35 N.m	26 lb ft
• Final Pass				70 degrees	
Valve Body to Case	374	3	M6x1.0x65	12 N.m	106 lb in
Valve Body to Case	384	1	M6x1.0x85	12 N.m	106 lb in
Valve Body to Case Cover	376	1	M6x1.0x30	12 N.m	106 lb in
Valve Body to Case Cover	378	4	M6x1.0x55	12 N.m	106 lb in
Valve Body to Case Cover (TORX®)	377	2	M6x1.0x45	12 N.m	106 lb in
Valve Body to Driven	380	1	M8x1.25x90	25 N.m	18 lb ft

Sprocket Support					
Reference Number refers to the callout number on the disassembled view.					

END PLAY SPECIFICATIONS

End Play Specifications

ID Number	Dimension (mm)	Dimension (in)	Color
Differential Carrier/Case Thrust Washer (714) Selection Guide			
1	1.40-1.50	0.055-0.059	Orange
2	1.50-1.60	0.059-0.062	White
3	1.60-1.70	0.062-0.066	Blue
4	1.70-1.80	0.066-0.070	Pink
5	1.80-1.90	0.070-0.074	Brown
6	1.90-2.00	0.074-0.078	Green
7	2.00-2.10	0.078-0.082	Black
8	2.10-2.20	0.082-0.086	Purple
9	2.20-2.30	0.086-0.091	Purple/White
10	2.30-2.40	0.091-0.095	Purple/Blue
Bearing/Input Clutch Hub Selective Thrust Washer (630) Selection Guide			
1	2.90-3.00	0.114-0.118	Orange/Green
2	3.05-3.15	0.120-0.124	Orange/Black
3	3.20-3.30	0.126-0.130	No Color
4	3.35-3.45	0.132-0.136	White
5	3.50-3.60	0.138-0.142	Blue
6	3.65-3.75	0.144-0.148	Pink
7	3.80-3.90	0.150-0.154	Brown
8	3.95-4.05	0.156-0.159	Green
9	4.10-4.20	0.161-0.165	Black
10	4.25-4.35	0.167-0.171	Purple
11	4.40-4.50	0.173-0.177	Purple/White

TRANSFER CASE SELECTIVE WASHER SPECIFICATIONS

Transfer Case Selective Washer Specifications

Dimension A		Dimension B		End Play without Selective Washer		Selective Washer Color	Selective Washer Size	
Metric	English	Metric	English	Metric	English		Metric	English
23.23-23.12 mm	.914-.910 in	19.98-20.23 mm	.786-.796 in	3.25-2.89 mm	.128-.114 in	Light Blue	2.67 mm	.105 in

23.12-23.01 mm	.910-.906 in	19.98-20.23 mm	.786-.796 in	3.14-2.78 mm	.124-.109 in	Light Green	2.56 mm	.100 in
23.01-22.90 mm	.906-.901 in	19.98-20.23 mm	.786-.796 in	3.03-2.67 mm	.119-.105 in	White	2.45 mm	.096 in
22.90-22.79 mm	.901-.897 in	19.98-20.23 mm	.786-.796 in	2.92-2.56 mm	.115-.101 in	Orange	2.34 mm	.092 in
22.79-22.68 mm	.897-.892 in	19.98-20.23 mm	.786-.796 in	2.81-2.45 mm	.110-.096 in	Pink	2.23 mm	.088 in
22.68-22.57 mm	.892-.888 in	19.98-20.23 mm	.786-.796 in	2.70-2.34 mm	.106-.092 in	No Color	2.12 mm	.083 in
22.57-22.46 mm	.888-.884 in	19.98-20.23 mm	.786-.796 in	2.59-2.23 mm	.102-.087 in	Black	2.01 mm	.079 in
23.23-23.12 mm	.914-.910 in	20.23-20.48 mm	.796-.806 in	3.00-2.64 mm	.118-.103 in	White	2.45 mm	.096 in
23.12-23.01 mm	.910-.906 in	20.23-20.48 mm	.796-.806 in	2.89-2.53 mm	.114-.099 in	Orange	2.34 mm	.092 in
23.01-22.90 mm	.906-.901 in	20.23-20.48 mm	.796-.806 in	2.78-2.42 mm	.110-.095 in	Pink	2.23 mm	.088 in
22.90-22.79 mm	.901-.897 in	20.23-20.48 mm	.796-.806 in	2.67-2.31 mm	.105-.090 in	No Color	2.12 mm	.083 in
22.79-22.68 mm	.897-.892 in	20.23-20.48 mm	.796-.806 in	2.56-2.20 mm	.101-.086 in	Black	2.01 mm	.079 in
22.68-22.57 mm	.892-.888 in	20.23-20.48 mm	.796-.806 in	2.45-2.09 mm	.096-.082 in	Purple	1.90 mm	.074 in
22.57-22.46 mm	.888-.884 in	20.23-20.48 mm	.796-.806 in	2.34-1.98 mm	.092-.077 in	Brown	1.79 mm	.070 in
23.23-23.12 mm	.914-.910 in	20.48-20.72 mm	.806-.816 in	2.75-2.40 mm	.108-.094 in	Pink	2.23 mm	.088 in

23.12-23.01 mm	.910-.906 in	20.48-20.72 mm	.806-.816 in	2.64-2.29 mm	.104-.090 in	No Color	2.12 mm	.083 in
23.01-22.90 mm	.906-.901 in	20.48-20.72 mm	.806-.816 in	2.53-2.18 mm	.100-.085 in	Black	2.01 mm	.079 in
22.90-22.79 mm	.901-.897 in	20.48-20.72 mm	.806-.816 in	2.42-2.07 mm	.095-.081 in	Purple	1.90 mm	.074 in
22.79-22.68 mm	.897-.892 in	20.48-20.72 mm	.806-.816 in	2.31-1.96 mm	.091-.077 in	Brown	1.79 mm	.070 in
22.68-22.57 mm	.892-.888 in	20.48-20.72 mm	.806-.816 in	2.20-1.85 mm	.087-.072 in	Dark Blue	1.68 mm	.066 in
22.57-22.46 mm	.888-.884 in	20.48-20.72 mm	.806-.816 in	2.09-1.74 mm	.082-.068 in	Dark Green	1.57 mm	.061 in

TRANSMISSION GENERAL SPECIFICATIONS

Transmission General Specifications

Name	Hydra-matic 4T65-E
RPO Codes	M15/MN7/M76
Production Location	Warren, MI
Vehicle Platform (Engine/Transmission) Usage	H, W, U, B
Transaxle Drive	Transverse Mounted Front Wheel Drive
1st Gear Ratio	2.921:1
2nd Gear Ratio	1.568:1
3rd Gear Ratio	1.000:1
4th Gear Ratio	0.705:1
Reverse	2.385:1
Torque Converter Size (Diameter of Torque Converter Turbine)	245 mm (M15) 258 mm (MN7) 245 mm, 258 mm (M76)
Pressure Taps	Line Pressure
Transaxle Fluid Type	Dexron™ III
Transaxle Fluid Capacity (Approximate)	Bottom Pan Removal: 7.0 L (7.4 qts) Complete Overhaul: 9.5 L (10.0 qts) Dry: 12.7 L (13.4 qts)
Transaxle Type: 4	Four Forward Gears

Transaxle Type: T	Transverse Mount
Transaxle Type: 65	Product Series
Transaxle Type: E	Electronic Controls
Chain Ratios (Designates Number of Teeth on the Drive/Driven Sprockets)	35/35 37/33
Final Drive Ratios	2.86, 3.05, 3.29
Overall Final Drive Ratios	2.86, 3.05, 2.93, 3.29
Position Quadrant	P, R, N, D, 3, 2, 1 or P, R, N, OD, 2, 1
Case Material	Die Cast Aluminum
Transaxle Weight Dry	87.9 kg (194.2 lbs)
Transaxle Weight Wet	97.0 kg (214.4 lbs)
Maximum Trailer Towing Capacity	907 kg (2000 lbs)
Maximum Gross Vehicle Weight (GVW)	2903 kg (6,400 lbs)

FLUID CAPACITY SPECIFICATIONS

Fluid Capacity Specifications

Application	Specification	
	Metric	English
Bottom Pan Removal (2WD)	7.0 L	7.4 qt
Bottom Pan Removal (AWD)	7.4 L	7.8 qt
Complete Overhaul (2WD)	9.5 L	10.0 qt
Complete Overhaul (AWD)	9.9 L	10.4 qt
Dry (2WD)	12.7 L	13.4 qt
Dry (AWD)	13.1 L	13.8 qt

MODEL BUILD INFORMATION (MN7)

Model Build Information (RPO MN7)

Transmission Model	CAB	CBB	CHB	FCB
Platform	W	W	H	C
Carline	C, P	P	P	B
Engine Displacement	3.8L	3.8L	3.8L	3.8L
Engine RPO	L67	L32	L67	L67
Eng Vin ID	1	-	1	1
Overall	2.93	3.29	2.93	2.93
Sprocket, Drive/Driven	37/33	35/35	37/33	37/33
Final Drive Ratio	3.29	3.29	3.29	3.29
Final Drive	HD	HD	HD	HD
Output Shaft	LONG	LONG	LONG	LONG

Converter Code	-	-	JZFM	JSFM
Converter K-Factor	RI15	RI15	RI15	133K
Converter Type	ECCC	ECCC	ECCC	ECCC
IMS	YES	YES	YES	YES

- HD = Heavy Duty
- IMS = Internal Mode Switch
- SSC = Case Aluminum Structural Side Cover Pan
- STD = Standard
- VSS = Vehicle Speed Sensor
- K-factor = Torque converter numeric rating - combines stall speed and torque multiplication ratings

This table does not identify all unique build items and this table may be subject to change.

MODEL BUILD INFORMATION (M15)

Model Build Information (RPO M15)

Transmission Model	**LBB**	**LCB**	**LDB**	**RDB**	**RNB**	**BCB**
Platform	W	W	W	W	W	B, U
Carline	B, C, P	C	C	C	B	B, C, O, P
Engine Displacement	3.8L	3.8L	3.8L	3.4L	3.1L	3.4L
Engine RPO	L36	L36	L36	LA1	LG8	LA1
Eng Vin ID	K	K	K	E	J	E
Overall	3.05	3.29	3.29	2.86	3.05	3.29
Sprocket, Drive/Driven	35/35	35/35	35/35	35/35	35/35	35/35
Final Drive Ratio	3.05	3.29	3.29	2.86	3.05	3.29
Final Drive	STD	STD	STD	STD	STD	STD
Output Shaft	STD	STD	STD	STD	STD	STD
Converter Code	FLQB	FLQB	FLQB	FDQB	FDKB	FLQB
Converter K-Factor	163K	163K	163K	180K	180K	163K
Converter Type	ECCC	ECCC	ECCC	ECCC	ECCC	ECCC
IMS	YES	YES	YES	YES	YES	YES

- HD = Heavy Duty
- IMS = Internal Mode Switch
- SSC = Case Aluminum Structural Side Cover Pan
- STD = Standard

- VSS = Vehicle Speed Sensor
- K-factor = Torque converter numeric rating - combines stall speed and torque multiplication ratings

This table does not identify all unique build items and this table may be subject to change.

MODEL BUILD INFORMATION (M76)

Model Build Information (RPO M76)

Transmission Model	VCB	CXB
Platform	B	B, U
Carline	B	C, B, P, O
Engine Displacement	3.6L	3.4L
Engine RPO	LY7	LA1
Eng Vin ID	7	E
Overall	3.29	3.29
Sprocket, Drive/Driven	35/35	35/35
Final Drive Ratio	3.29	3.29
Final Drive	AWD	AWD
Output Shaft	STD	STD
Converter Code	-	FLQB
Converter K-Factor	RI15	163K
Converter Type	ECCC	ECCC
IMS	YES	YES

- HD = Heavy Duty
- IMS = Internal Mode Switch
- SSC = Case Aluminum Structural Side Cover Pan
- STD = Standard
- VSS = Vehicle Speed Sensor
- K-factor = Torque converter numeric rating - combines stall speed and torque multiplication ratings

This table does not identify all unique build items and this table may be subject to change.

COMPONENT LOCATOR

DISASSEMBLED VIEWS

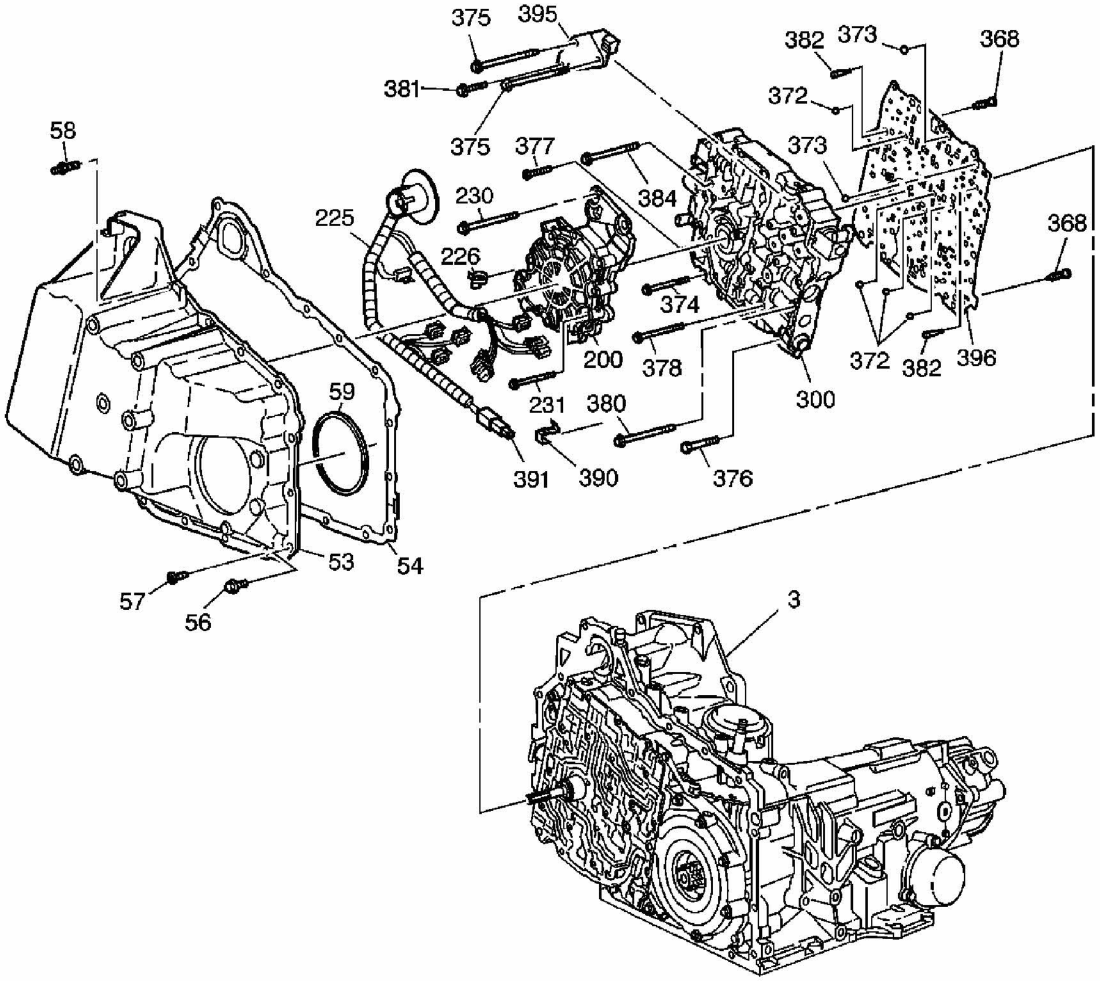
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Fig. 1: Case and Associated Parts Disassembled View (1 of 4)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 1

Callout	Component Name
3	Transmission Case Assembly
53	Control Valve Body Cover
54	Control Valve Body Cover Gasket
56	Control Valve Body Cover Bolt M 8 X 1.25 X 25
57	Control Valve Body Cover TORX® Head Bolt M 8 X 1.25 X 21
58	Control Valve Body Cover to Case Stud M 8 X 1.25 X 24
59	Control Valve Body Cover to Case Cover Seal
200	Oil Pump Assembly - Model Dependent
200	Oil Pump Assembly - Model Dependent
225	Wiring Harness Assembly (IMS)
226	Wiring Harness Clip

230	Pump Cover to Case Cover Bolt M 6 X 1.0 X 95.0
231	Pump Body to Case Bolt M6 X 1.0 X 87.5
300	Control Valve Body Assembly - Model Dependent
300	Control Valve Body Assembly - Model Dependent
368	Spacer Plate and Gaskets/Control Valve Body Bolt
368	Spacer Plate and Gaskets/Control Valve Body Bolt
372	1/4 Ball Check Valve
372	5/16 Ball Check Valve
373	Ball Check Valve
373	Ball Check Valve
374	Control Valve Body Bolt M 6 X 1.0 X 65.0
375	Control Valve Body to Case Bolt M 6 X 1.0 X 60.0
375	Control Valve Body to Case Bolt M 6 X 1.0 X 60.0
376	Control Valve Body to Case Bolt M 6 X 1.0 X 30.0
377	Control Valve Body to Case Cover Bolt M 6 X 1.0 X 45.0
378	Control Valve Body to Case Cover Bolt M 6 X 1.0 X 55.0
380	Control Valve Body to Case Bolt M 8 X 1.25 X 90.0
381	Control Valve Body to Case Bolt M 6 X 1 X 20.0
382	TCC Solenoid Valve Screen/Seal Assembly
382	TCC Solenoid Valve Screen/Seal Assembly
384	Control Valve Body to Case Bolt M 6 X 1.0 X 85.0
390	Temperature Sensor Clip
391	Transmission Fluid Temperature Sensor
391	Transmission Fluid Temperature Sensor
395	Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly
396	Control Valve Body Spacer Plate and Gasket Assembly

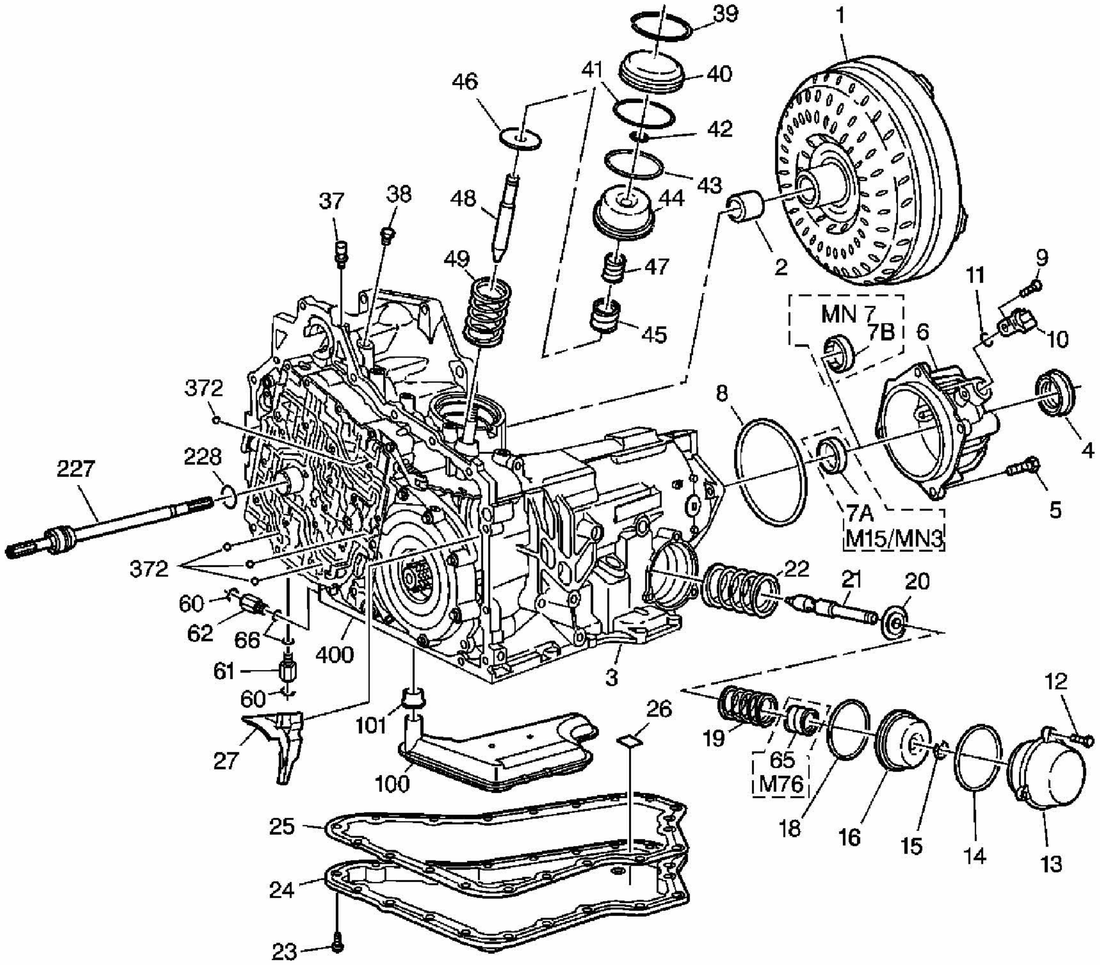
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Fig. 2: Case & Associated Parts (2 Of 4)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	Torque Converter Assembly
2	Torque Converter Bushing
3	Transmission Case
4	Right Axle Oil Seal Assembly
5	Case Extension Bolt M 10 X 1.5 X 35.0
6	Case Extension Assembly
7a	Front Differential Carrier Bushing
7b	Output Shaft Bearing Assembly
8	Case Extension Seal
9	Vehicle Speed Sensor Bolt M 8 X 1.25 X 12.0
10	Vehicle Speed Sensor Assembly
11	Vehicle Speed Sensor O-Ring Seal

12	FWD Servo Cover Bolt M 6 X 1.0 X 20.0
13	Forward Band Servo Cover
14	Forward Band Servo Cover Seal
15	Forward Band Servo Pin Retaining Ring
16	Forward Band Servo Piston
18	Forward Band Servo Piston Oil Seal Ring
19	Forward Band Servo Piston Cushion Outer Spring
20	Forward Servo Cushion Spring Retainer
21	Forward Band Servo Piston Apply Pin
22	Forward Band Servo Piston Return Spring
23	Transmission Oil Pan Bolt M 6 X 1.0 X 17.0
24	Transmission Oil Pan
25	Transmission Oil Pan Gasket
26	Transmission Oil Pan Magnet
27	Oil Dam
37	Transmission Vent Assembly
38	Oil Pressure Test Hole Plug 1/8 - 27 NPTF
39	Reverse Band Servo Cover Retaining Ring
40	Reverse Band Servo Cover
41	Reverse Band Servo Cover O-Ring Seal
42	Reverse Band Servo Pin Retaining Ring
43	Reverse Band Servo Piston Oil Seal Ring
44	Reverse Band Servo Piston
45	Reverse Band Servo Piston Cushion Spring
46	Reverse Band Servo Piston Cushion Spring Retainer
47	Reverse Band Servo Piston Cushion Spring Inner
48	Reverse Band Servo Piston Apply Pin
49	Reverse Band Servo Piston Return Spring
60	Clip, Oil Cooler Quick Connect
60	Clip, Oil Cooler Quick Connect
61	Transmission Oil Cooler Pipe Fitting 9/16-18 UNF
62	Transmission Oil Cooler Pipe Fitting 9/16-18 UNF
65	Forward Band Servo Piston Cushion Inner Spring
66	Oil Cooler Pipe Fitting O-Ring Seal
100	Transmission Oil Filter Assembly
101	Transmission Oil Filter Seal Assembly
227	Oil Pump Drive Shaft Assembly
228	Oil Pump Drive Shaft Seal

	Case Cover Ball Check Valve
372	Case Cover Ball Check Valve
400	Complete Case Cover Assembly

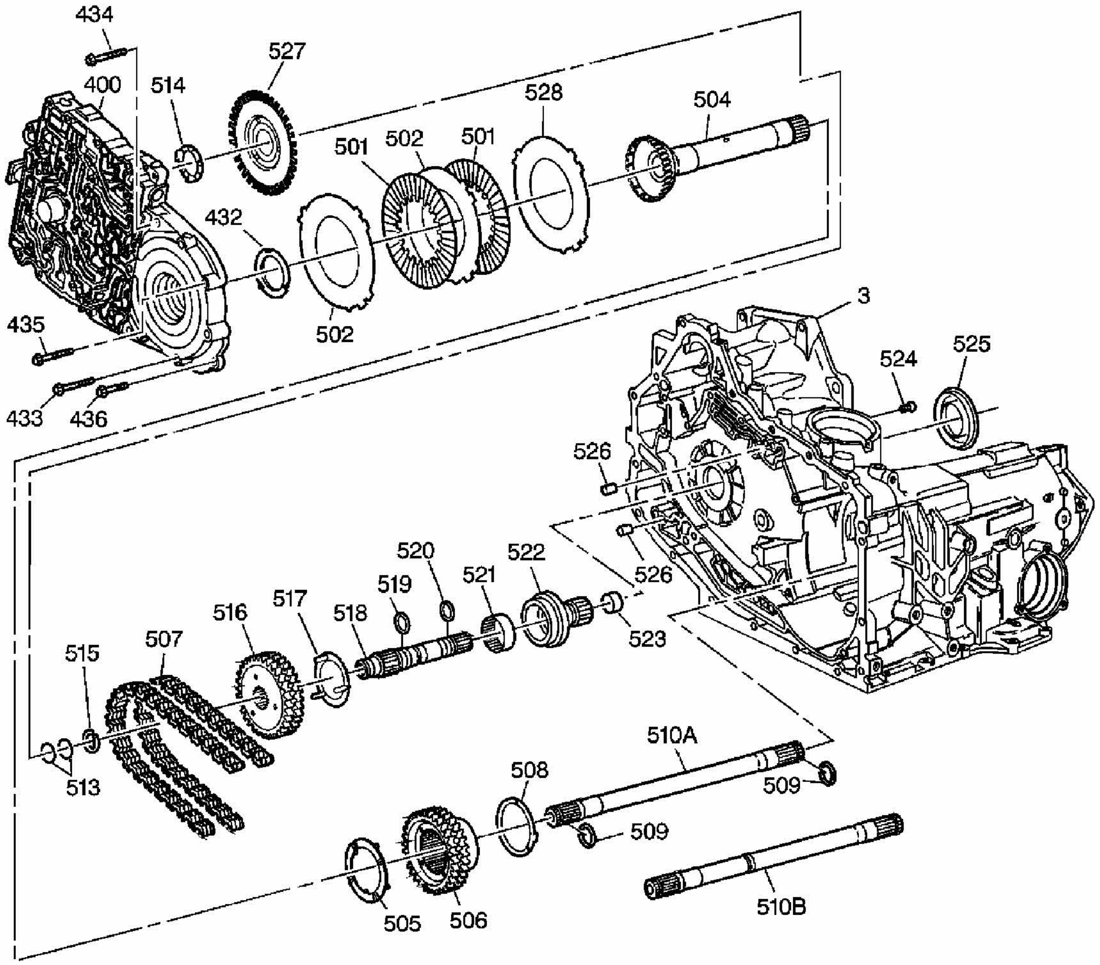
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Fig. 3: Case and Associated Parts Disassembled View (3 of 4) - Without Touch Activated Power
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
3	Transmission Case
400	Complete Case Cover Assembly
432	4th Clutch Shaft Thrust Washer
433	Case Cover Bolt/Screw TORX® Special M6 X 1.0 X 32.0
434	Case Cover Bolt/Screw M6 X 1.0 X 40.0
435	Case Cover Bolt/Screw M8 X 1.25 X 50.0
436	Case Cover Bolt/Screw M6 X 1.0 X 30.0

501	4th Clutch Fiber Plate Assembly
501	4th Clutch Fiber Plate Assembly
502	4th Clutch Steel Plate
502	4th Clutch Steel Plate
504	4th Clutch Shaft Assembly
505	4th Clutch Shaft Thrust Washer
506	Driven Sprocket
507	Drive Link Assembly
508	Driven Sprocket Thrust Washer
509	Drive Shaft Retaining Ring
510a	Standard Output Shaft
510b	Heavy Duty Output Shaft
513	Turbine Shaft Oil Seal Ring
514	Drive Sprocket Thrust Washer
515	Drive Sprocket Retaining Ring
516	Drive Sprocket
517	Drive Sprocket Thrust Washer
518	Turbine Shaft
519	Turbine Shaft Oil Seal Ring
520	Turbine Shaft O-Ring Seal
521	Drive Sprocket Support Bearing Assembly
522	Drive Sprocket Support
523	Drive Sprocket Support Bushing
524	Drive Sprocket Support Bolt/Screw M8 X 1.25 X 24.0
525	Torque Converter Oil Seal Assembly
526	Case Cover Pin
526	Case Cover Pin
527	Speed Sensor Reluctor Wheel Assembly
528	4th Clutch Apply Plate

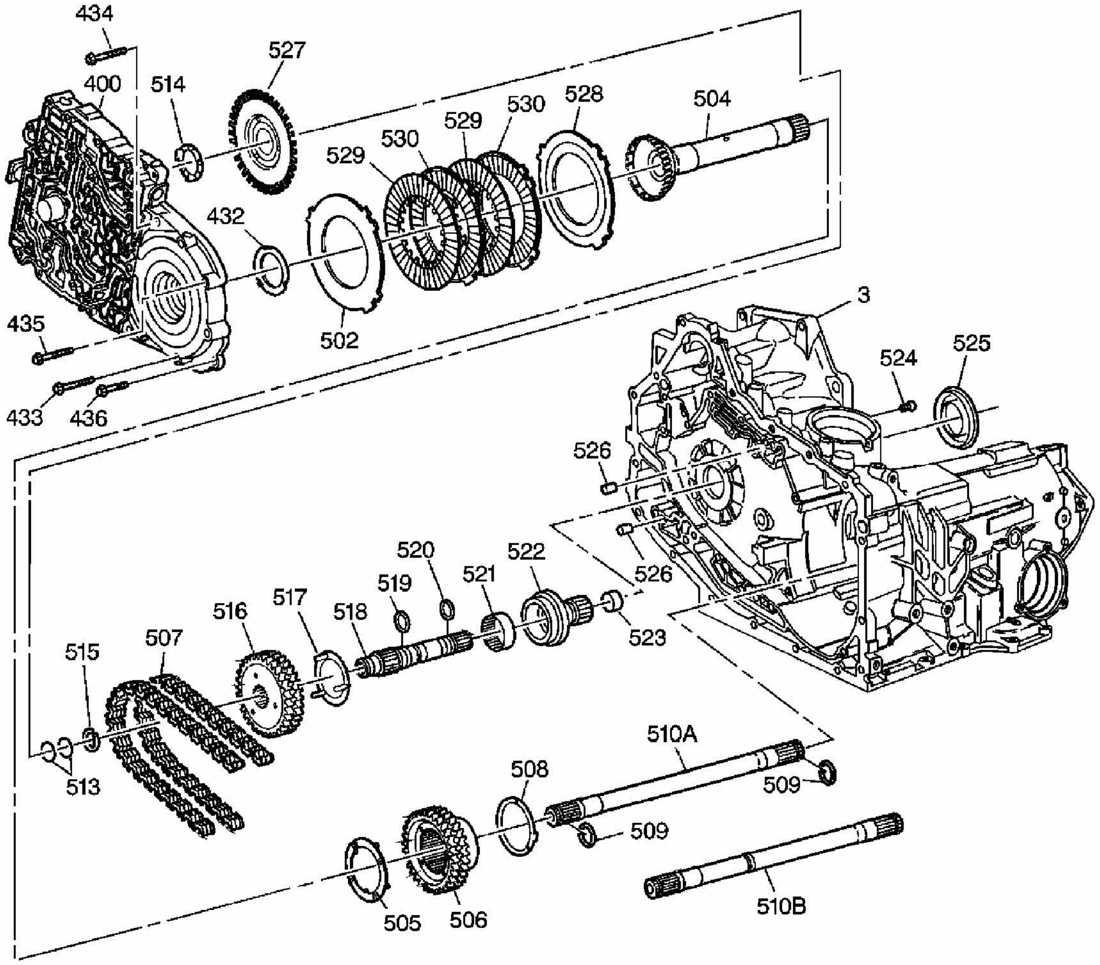
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Fig. 4: Case and Associated Parts Disassembled View (3 of 4) - With Touch Activated Power
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
3	Transmission Case
400	Complete Case Cover Assembly
432	4th Clutch Shaft Thrust Washer
433	Case Cover Bolt/Screw TORX® Special M6 X 1.0 X 32.0
434	Case Cover Bolt/Screw M6 X 1.0 X 40.0
435	Case Cover Bolt/Screw M8 X 1.25 X 50.0
436	Case Cover Bolt/Screw M6 X 1.0 X 30.0
502	4th Clutch Steel Plate
504	4th Clutch Shaft Assembly
505	4th Clutch Shaft Thrust Washer
506	Driven Sprocket

507	Drive Link Assembly
508	Driven Sprocket Thrust Washer
509	Drive Shaft Retaining Ring
510a	Standard Output Shaft
510b	Heavy Duty Output Shaft
513	Turbine Shaft Oil Seal Ring
514	Drive Sprocket Thrust Washer
515	Drive Sprocket Retaining Ring
516	Drive Sprocket
517	Drive Sprocket Thrust Washer
518	Turbine Shaft
519	Turbine Shaft Oil Seal Ring
520	Turbine Shaft O-Ring Seal
521	Drive Sprocket Support Bearing Assembly
522	Drive Sprocket Support
523	Drive Sprocket Support Bushing
524	Drive Sprocket Support Bolt/Screw M8 X 1.25 X 24.0
525	Torque Converter Oil Seal Assembly
526	Case Cover Pin
526	Case Cover Pin
527	Speed Sensor Reluctor Wheel Assembly
528	4th Clutch Apply Plate
529	4th Clutch Fiber Plate Assembly
529	4th Clutch Fiber Plate Assembly
530	4th Clutch Steel Plate
530	4th Clutch Steel Plate

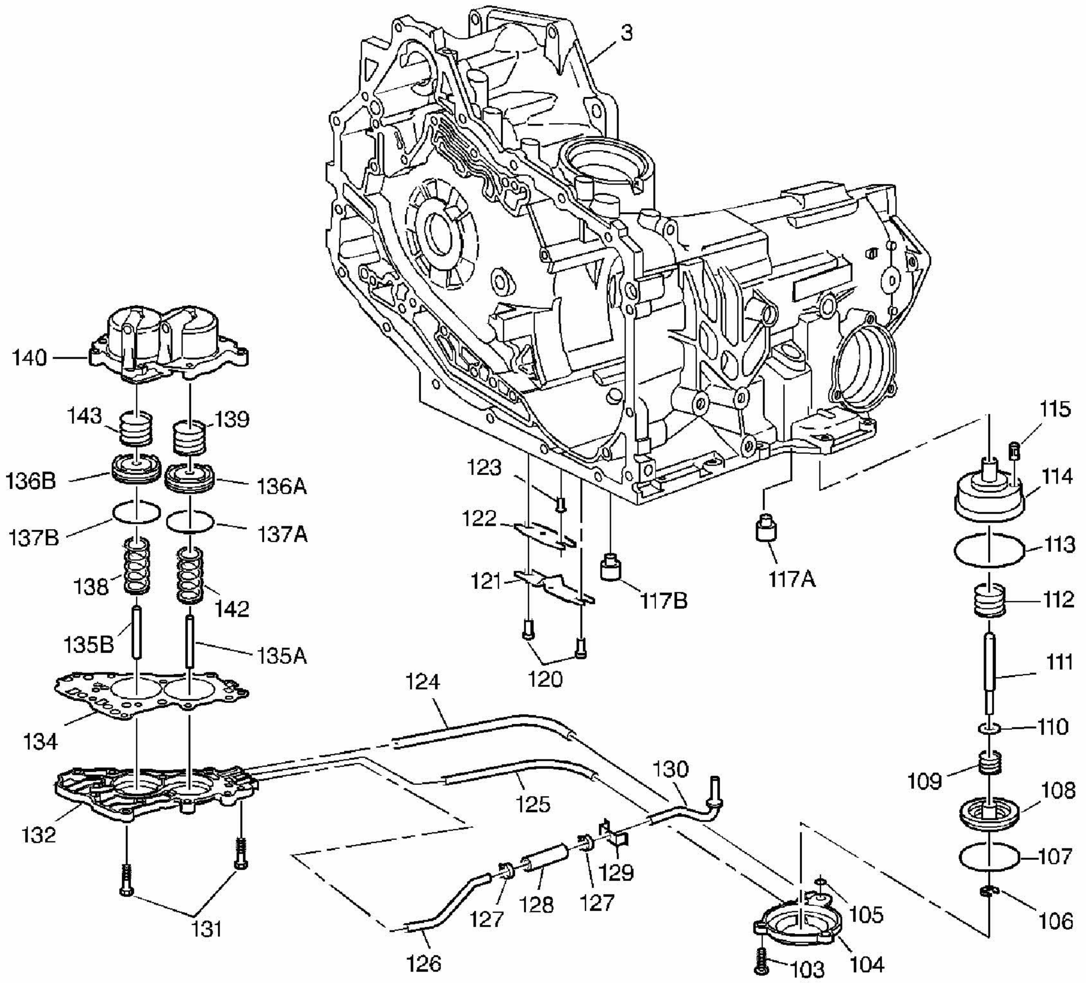
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Fig. 5: Case and Associated Parts Disassembled View (4 of 4)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
3	Transmission Case Assembly
103	2-1 Manual Band Servo Cover Bolt/Screw M8 X 1.25 X 25.0 (3)
104	2-1 Manual Band Servo Cover
105	2-1 Manual Band Servo Cover Seal
106	2-1 Manual Band Servo Piston Pin Retaining Ring
107	2-1 Manual Band Servo Piston Seal
108	2-1 Manual Band Servo Piston
109	2-1 Manual Band Servo Piston Cushion Spring
110	2-1 Manual Band Servo Piston Spring Retainer
111	2-1 Manual Band Servo Piston Pin
112	2-1 Manual Band Servo Piston Spring

113	2-1 Manual Band Servo Piston Cylinder O-Ring Seal
114	2-1 Manual Band Servo Piston Cylinder
115	2-1 Manual Band Servo Exhaust Screen Assembly
117a	Forward Band Anchor Pin
117b	Reverse Band Anchor Pin
120	Thermo Element Plate Pin
121	Thermo Element
122	Thermo Element Plate
123	Thermo Element Plate Center Pin
124	Forward Band Servo Oil Pipe
125	2-1 Manual Band Servo Oil Pipe
126	Lube Oil Pipe
127	Lube Oil Hose Clamp
127	Lube Oil Hose Clamp
128	Lube Oil Hose
129	Lube Oil Pipe Retainer
130	Lube Oil Pipe and Washer Assembly
131	Accumulator Cover Bolt/Screw M6 X 1.0 X 28.0 (11)
132	Accumulator Cover
134	Accumulator Cover Spacer Plate Assembly
135a	1-2 Accumulator Piston Pin
135b	2-3 Accumulator Piston Pin
136a	1-2 Accumulator Piston
136b	2-3 Accumulator Piston
137a	1-2 Accumulator Piston Oil Seal Ring
137b	2-3 Accumulator Piston Oil Seal Ring
138	2-3 Accumulator Piston Outer Spring
139	1-2 Accumulator Piston Cushion Spring
140	1-2 and 2-3 Accumulator Housing
142	1-2 Accumulator Piston Outer Spring
143	2-3 Accumulator Piston Cushion Spring

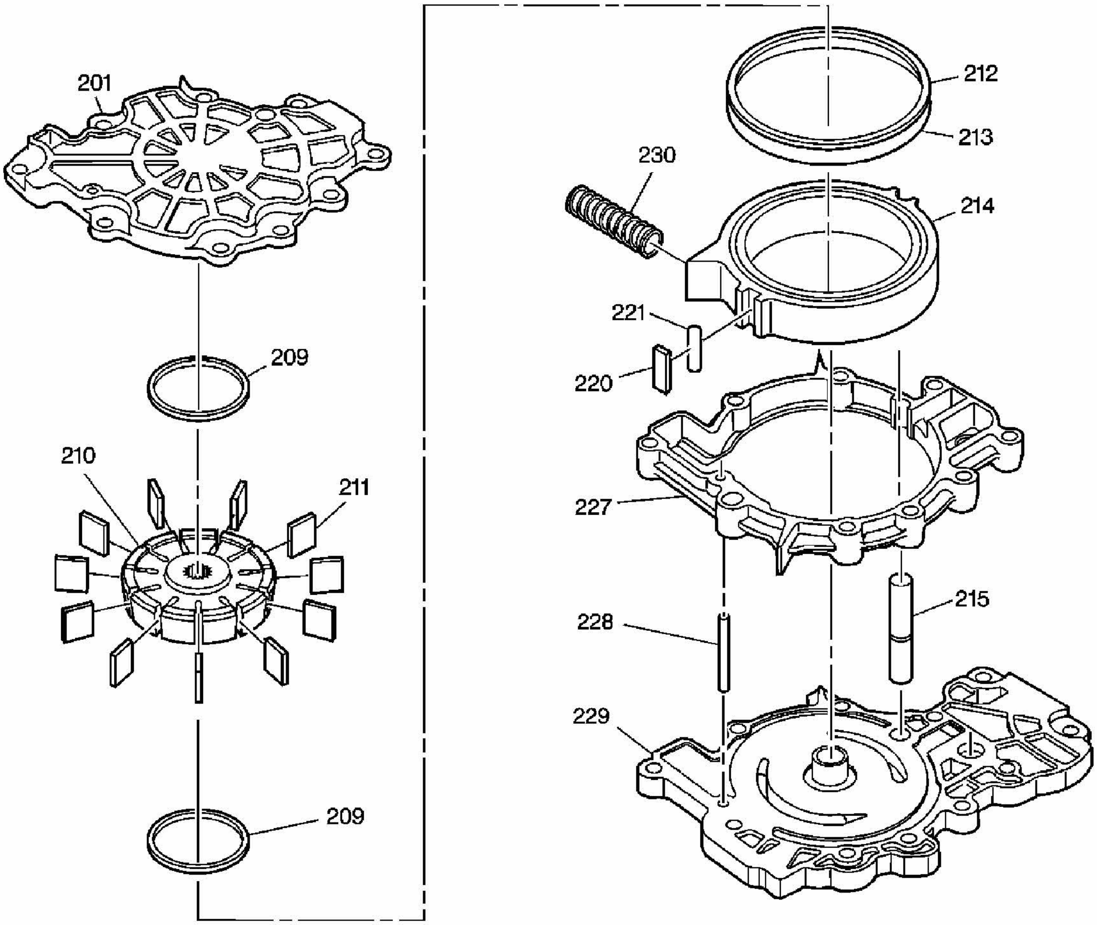

Fig. 6: Oil Pump Assembly
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 6

Callout	Component Name
201	Pump Cover
209	Oil Pump Vane Ring
209	Oil Pump Vane Ring
210	Oil Pump Selective Rotor
211	Oil Pump Selective Vane
212	Oil Pump Slide Oil Seal Ring
213	Oil Pump Slide O-Ring Seal
214	Oil Pump Selective Slide
215	Oil Pump Slide Pivot Pin
220	Oil Pump Slide Seal
221	Oil Pump Slide Seal Support
227	Oil Pump Body
228	Oil Pump Body Alignment Pin

229	Oil Pump Base
230	Oil Pump Prime Spring

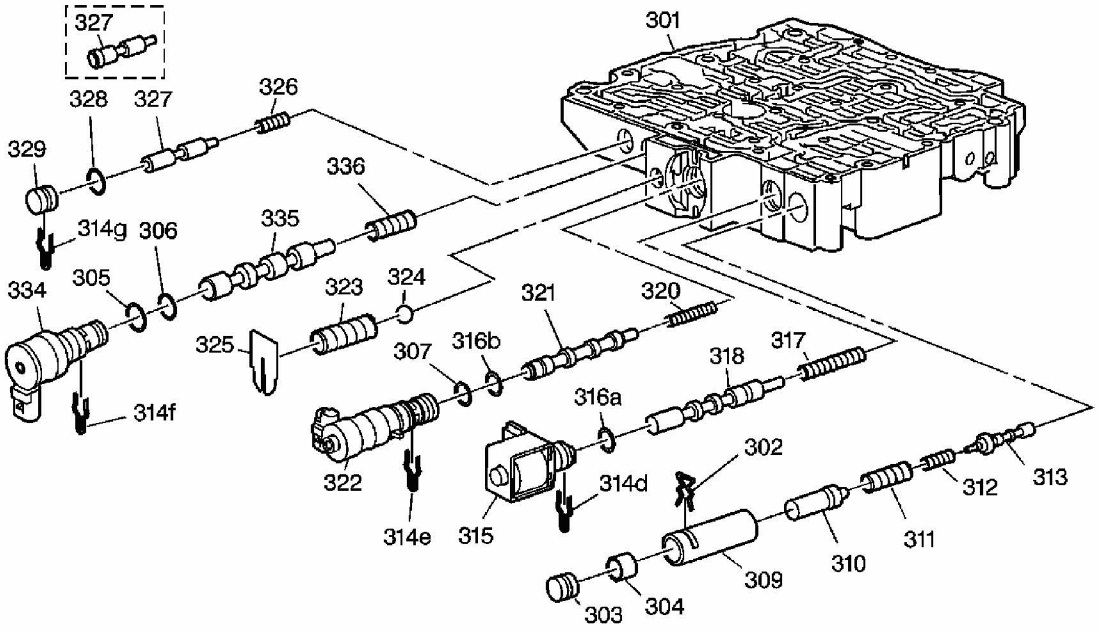
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Fig. 7: Control Valve Body Assembly Disassembled View - (1 of 2)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 7

Callout	Component Name
301	Control Valve Body Machined
302	Line Boost Valve and Bushing Retainer
303	Line Boost Valve Bore Plug
304	Line Boost Valve
305	TCC PWM Solenoid Valve O-Ring Seal
306	TCC PWM Solenoid Valve O-Ring Seal
307	Pressure Control Solenoid Valve O-Ring Seal
309	Reverse Boost Valve Bushing
310	Reverse Boost Valve
311	Pressure Regulator Valve Spring Outer
312	Pressure Regulator Valve Inner Spring
313	Pressure Regulator Valve
314d	1-2, 3-4 Shift Solenoid Valve Retainer
314e	Pressure Control Solenoid Valve Retainer
314f	TCC PWM Solenoid Valve Retainer
314g	TCC Regulator Apply Valve Bore Plug Retainer

315	1-2, 3-4 Shift Solenoid Valve Assembly
316a	1-2, 3-4 Shift Solenoid Valve O-Ring Seal
316b	Pressure Control Solenoid Valve O-Ring Seal
317	1-2 Shift Valve Spring
318	1-2 Shift Valve
320	Torque Signal Regulator Valve Spring
321	Torque Signal Regulator Valve
322	Pressure Control Solenoid Valve Assembly
323	Line Pressure Relief Valve Spring
324	Line Pressure Relief Valve
325	Line Pressure Relief Valve Spring Retainer
326	TCC Regulator Apply Valve Spring
327	TCC Regulator Apply Valve - Some Models have touch activated Power
327	TCC Regulator Apply Valve - Some Models have touch activated Power
328	TCC Regulator Apply Valve Bore Plug O-Ring Seal
329	TCC Regulator Apply Valve Bore Plug
334	TCC PWM Solenoid Valve Assembly
335	TCC Control Valve
336	TCC Control Valve Spring

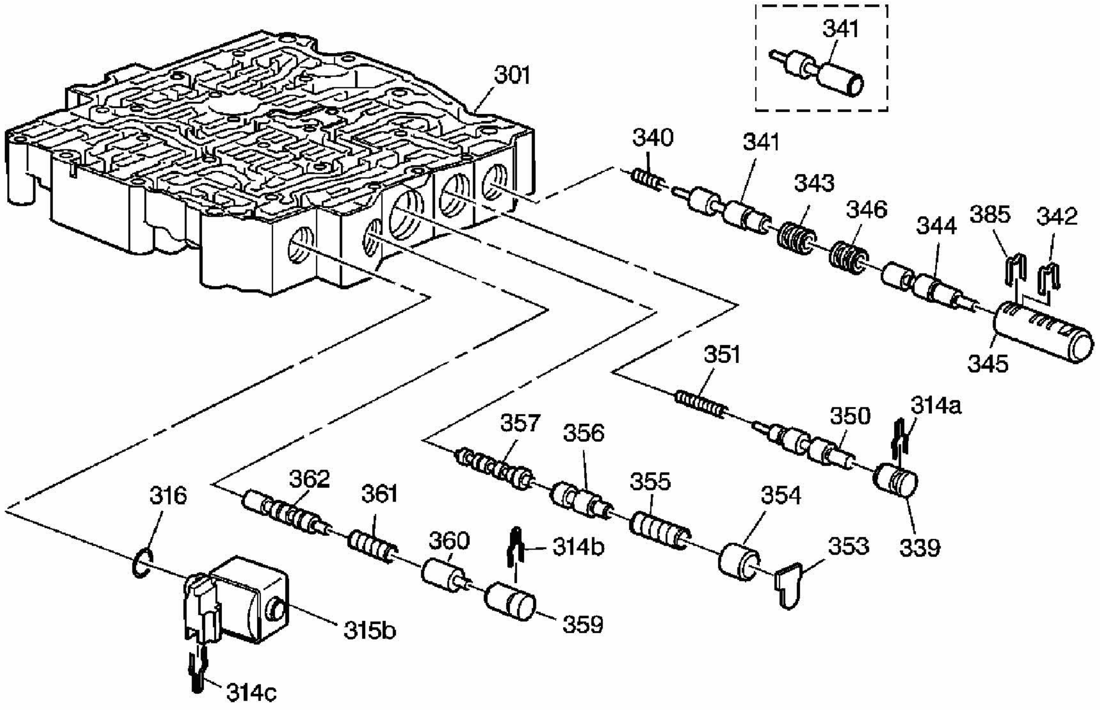
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Fig. 8: Control Valve Body Assembly Disassembled View - (2 of 2)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 8

Callout	Component Name
301	Machined Control Valve Body
314a	1-2 Accumulator Valve Retainer
314b	4-3 Manual Downshift Valve Retainer
314c	2-3 Shift Solenoid Valve Retainer
315b	2-3 Shift Solenoid Valve Assembly
316	O-Ring Seal
339	1-2 Accumulator Valve Bore Plug
340	3-4 Accumulator Valve Spring
341	3-4 Accumulator Valve
341	3-4 Accumulator Valve - Some Models
342	2-3 Accumulator Valve Bore Plug Retainer
343	2-3 Accumulator Valve Bore Plug
344	2-3 Accumulator Valve
345	2-3 Accumulator Valve Bushing
346	2-3 Accumulator Valve Spring
350	1-2 Accumulator Valve
351	1-2 Accumulator Valve Spring
353	3-2 Manual Downshift Valve Retainer
354	3-2 Manual Downshift Valve Bore Plug
355	3-2 Manual Downshift Valve Spring
356	3-2 Manual Downshift Valve
357	2-3 Shift Valve
359	4-3 Manual Downshift Valve Bore Plug
360	4-3 Manual Downshift Valve
361	4-3 Manual Downshift Valve Spring
362	3-4 Shift Valve
385	2-3 Accumulator Valve Bushing Assembly Retainer

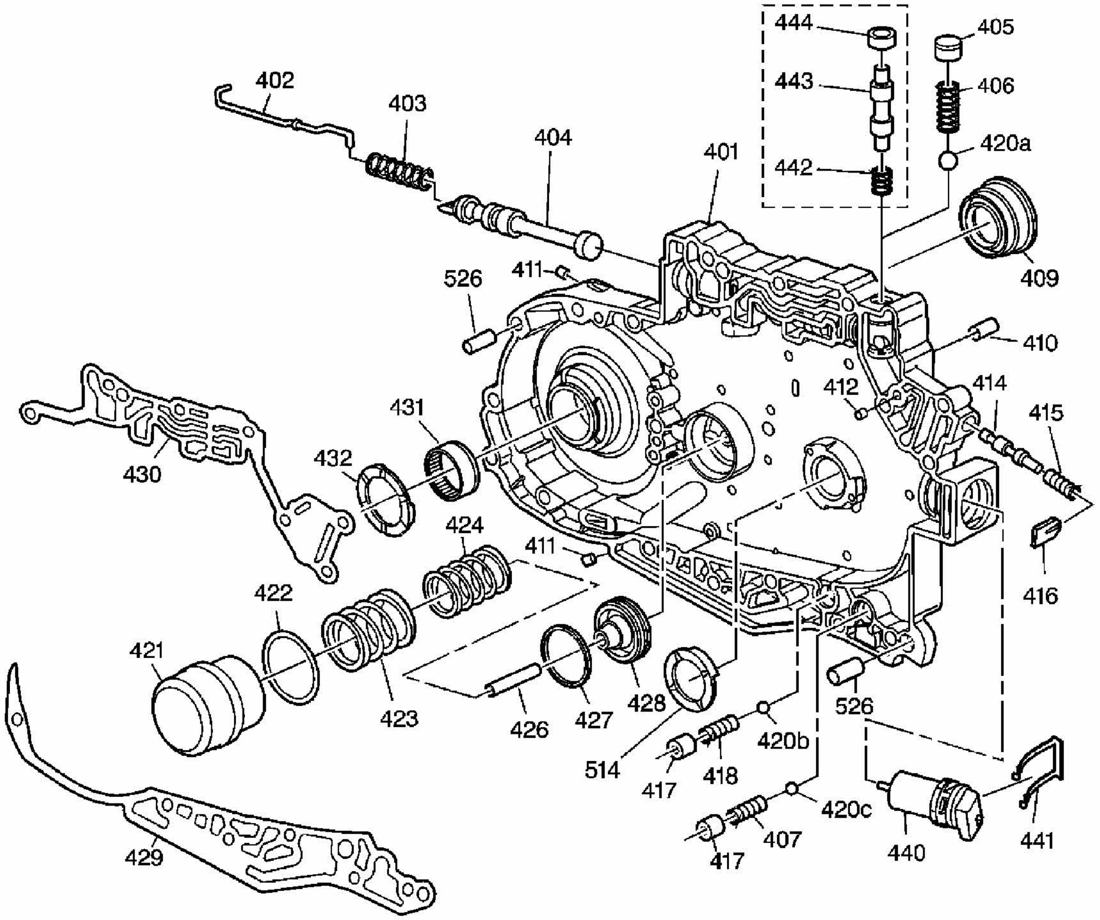
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Fig. 9: Identifying Case Cover Assembly
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 9

Callout	Component Name
401	Case Cover
402	Manual Valve Link
403	Manual Valve Link Spring
404	Manual Valve
405	Low Blow Off Ball Valve Bore Plug
406	Low Blow Off Ball Valve Spring
407	Cooler Ball Valve Spring
409	Left Side Axle Oil Seal Assembly
410	Control Valve Body Alignment Sleeve
411	Bore Plug
411	Bore Plug
412	Orificed Cup Plug
414	Actuator Feed Limit Valve

415	Actuator Feed Limit Valve Spring
416	Actuator Feed Limit Valve Spring Retainer
417	Ball Valve Bore Plug
418	TCC Blow Off Ball Valve Spring
420a	Low Blow Off Ball Valve
420b	TCC Blow Off Ball Valve
420c	Cooler Ball Valve
421	3-4 Accumulator Piston Cylinder
422	3-4 Accumulator Piston Cylinder O-Ring Seal
423	3-4 Accumulator Piston Outer Spring
424	3-4 Accumulator Piston Inner Spring
426	3-4 Accumulator Piston Pin
427	3-4 Accumulator Piston Oil Seal Ring
428	3-4 Accumulator Piston
429	Case Cover Lower Gasket
430	Case Cover Upper Gasket
431	Front Wheel Drive Shaft Bearing Assembly
432	Fourth Clutch Shaft Thrust Washer
440	Input Speed Sensor Assembly
441	Input Speed Sensor Clip
442	Low Regulator Valve Spring 3-4 Accumulator Valve - Some Models have touch activated Power
443	Low Regulator Valve 3-4 Accumulator Valve - Some Models have touch activated Power
444	Low Regulator Valve Bore Plug 3-4 Accumulator Valve - Some Models have touch activated Power
514	Drive Sprocket/Case Cover Thrust Washer
526	Case Cover Dowel Pin
526	Case Cover Dowel Pin

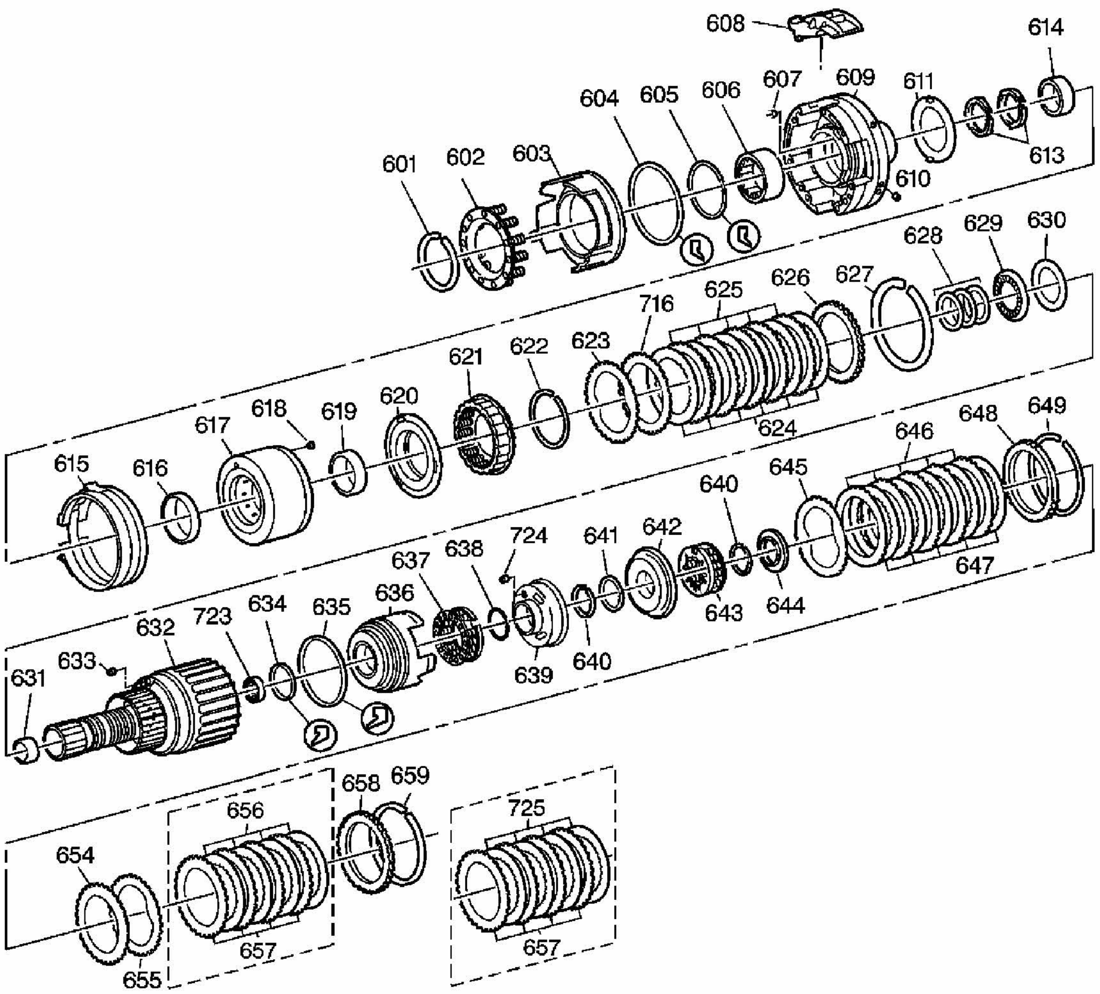
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Fig. 10: Internal Components Disassembled View (1 of 2)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 10

Callout	Component Name
601	4th Clutch Spring Retaining Ring
602	4th Clutch Piston Return Spring Assembly
603	4th Clutch Piston Assembly
604	4th Clutch Piston Seal Outer
605	4th Clutch Piston Seal Inner
606	Drawn Cup Bearing Assembly
607	Orificed Cup Plug
608	Drive Link Lube Scoop
609	Driven Sprocket Support Assembly
610	Cup Plug
611	Thrust Washer Driven Sprocket Support 2nd Clutch Drum

613	Oil Seal Ring
614	Driven Sprocket Support Bushing
615	Reverse Band Assembly
616	75.5 OD X 8.0 Bushing
617	2nd Clutch Housing
618	Check Valve Retainer and Ball Assembly 2nd Clutch
619	70.0 OD X 11.0 Bushing
620	2nd Clutch Piston w/Molded Seal
621	2nd Clutch Apply Ring and Release Spring Assembly
622	Retaining Ring
623	2nd Clutch Plate Waved
624	2nd Clutch Plate Assembly Fiber
625	2nd Clutch Reaction Plate Steel
626	Backing Support Ring Plate Steel
627	2nd Clutch Retaining Ring Outer
628	Oil Seal Ring Input Shaft
629	Thrust Bearing Support Sprocket/Thrust Washer
630	Selective Thrust Washer Bearing/Input Clutch Hub
631	Input Shaft Bushing
632	Input Housing Sleeve and Shaft Assembly
633	Check Valve Retainer and Ball Assembly
634	Input Clutch Piston Seal Inner
635	Input Clutch Piston Seal Outer
636	Input Clutch Piston
637	Input Clutch Spring and Retainer Assembly
638	O-Ring Seal
639	3rd Clutch Piston Housing
640	Retaining Ring 3rd Clutch Piston Housing/Input Shaft
640	Retaining Ring 3rd Clutch Piston Housing/Input Shaft
641	3rd Clutch Piston Seal Inner
642	3rd Clutch Piston and Seal Assembly
643	3rd Clutch Spring Retainer and Guide Assembly
644	Thrust Bearing Assembly
645	3rd Clutch Plate Waved
646	3rd Clutch Plate Assembly OD Spline
647	3rd Clutch Plate Assembly ID Spline
648	3rd Clutch Backing Plate
649	3rd Clutch Backing Plate Retaining Ring

	Input Clutch Apply Plate
655	Input Clutch Plate Waved
656	Input Clutch Plate Assembly Fiber - Sprag Model
657	Input Clutch Plate Steel
657	Input Clutch Plate Steel
658	Input Clutch Backing Plate Steel
659	Input Clutch Backing Plate Retaining Ring
716	2nd Clutch Apply Reaction Plate Tapered
723	4th Clutch Shaft to Input Housing Bearing
724	3rd Clutch Piston Housing Ball Check Valve Assembly
725	Input Clutch Plate Assembly Fiber - Pawl Model

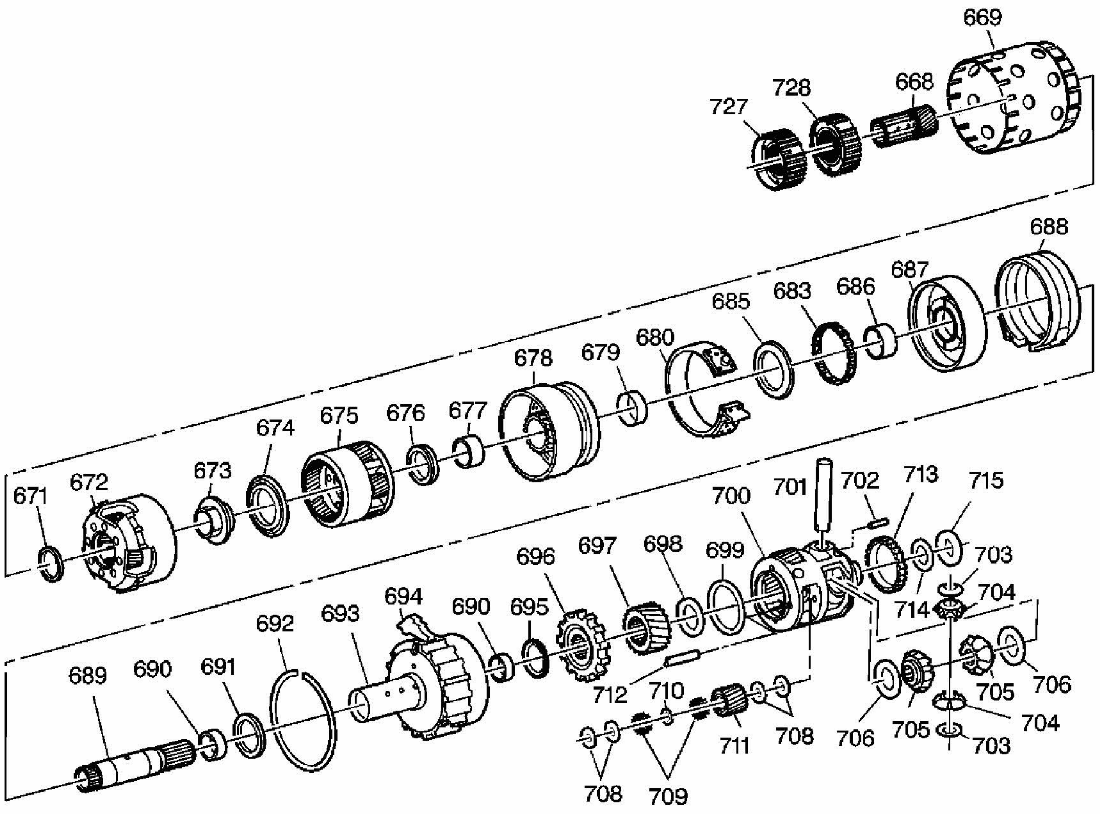
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Fig. 11: Internal Components Disassembled View (2 of 2)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 11

Callout	Component Name
668	Input Sun Gear
669	Reverse Reaction Drum
671	Input Sun Gear Thrust Bearing Assembly

672	Input Complete Carrier Assembly
673	Input Carrier/Reaction Carrier Lube Dam
674	Input/Reaction Carrier Thrust Bearing Assembly
675	Reaction Complete Carrier Assembly
676	Reaction Carrier/Sun Gear Thrust Bearing Assembly
677	Left Hand Reaction Sun Gear Bushing
678	Reaction Sun/Drum Gear Assembly
679	Right Hand Reaction Sun Gear Bushing
680	2/1 Manual Band Assembly
683	1/2 Support Roller Clutch Assembly
685	Thrust Bearing Assembly
686	1/2 Support Bushing
687	1/2 Support and Drum
688	Forward Band Assembly
689	Final Drive Sun Gear Shaft
690	Final Drive Internal Gear Bushing
690	Final Drive Internal Gear Bushing
691	Bearing 1/2 Support/Internal Gear
692	Retaining Ring Final Drive Internal Gear
693	Final Drive Internal Gear
694	Park Pawl Assembly
695	Thrust Bearing Assembly Internal Gear/Parking Gear
696	Parking Gear
697	Final Drive Sun Gear
698	Carrier/Sun Gear Thrust Bearing Assembly
699	Spiral Pinion Gear Pin Retaining Ring
700	Differential/Final Drive Carrier Assembly
701	Differential Pinion Shaft
702	Differential Pinion Shaft Retaining Pin
703	Thrust Washer Differential Pinion
703	Thrust Washer Differential Pinion
704	Differential Pinon Gear
704	Differential Pinon Gear
705	Differential Side Gear MN7 has unique left/right gears
705	Differential Side Gear MN7 has unique left/right gears
706	Bronze Thrust Washer Differential Side Gear
706	Bronze Thrust Washer Differential Side Gear
708	Pinion Thrust Washer Steel

	Pinion Thrust Washer Steel
709	Roller Needle Bearing
710	Pinion Needle Bearing Spacer
711	Final Drive Planetary Pinion Gear
712	Planetary Pinion Gear Pin
713	Vehicle Speed Sensor Reluctor Wheel
714	Differential Carrier/Case Washer Thrust
715	Thrust Bearing Assembly
727	3rd Clutch Pawl Assembly
728	Input Clutch Pawl Assembly

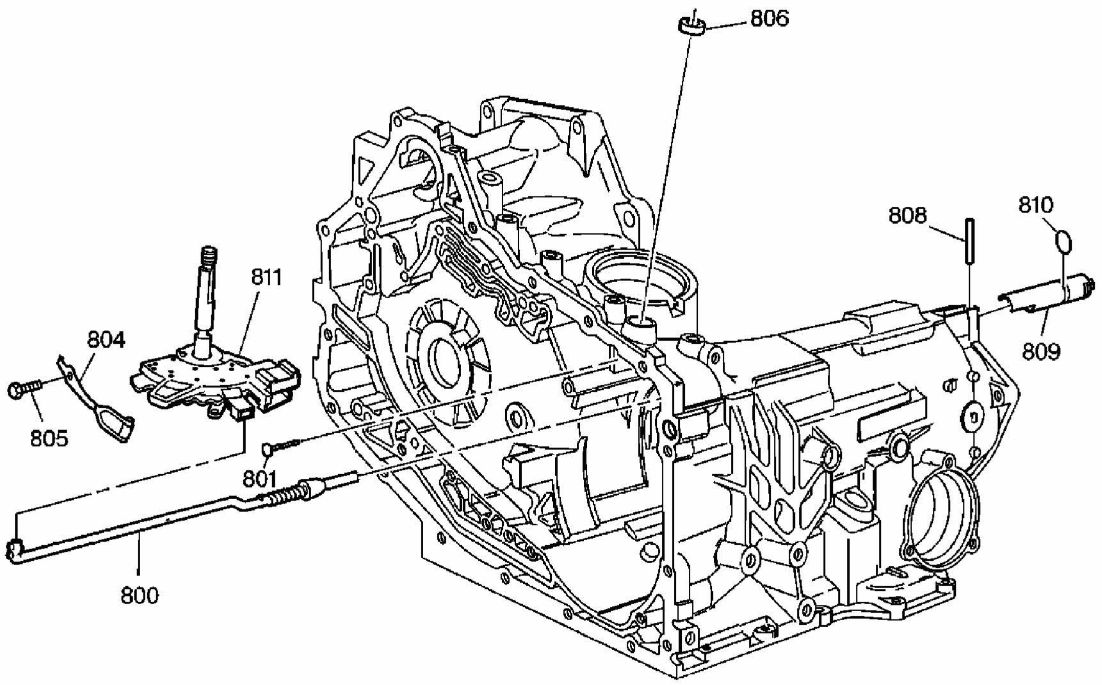

Fig. 12: Manual Shaft and Parking System Assembly Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 12

Callout	Component Name
800	Park Pawl Actuator Assembly
801	Manual Shift Shaft Pin
804	Manual Shift Detent Assembly
805	Manual Shift Detent Bolt/Screw
806	Manual Shift Shaft Seal Assembly
808	Park Pawl Actuator Guide Pin
809	Park Pawl Actuator Guide

810	Park Pawl Actuator Guide O-Ring Seal
811	Lever Assembly-Manual Shaft Detent with Internal Mode Switch (IMS)

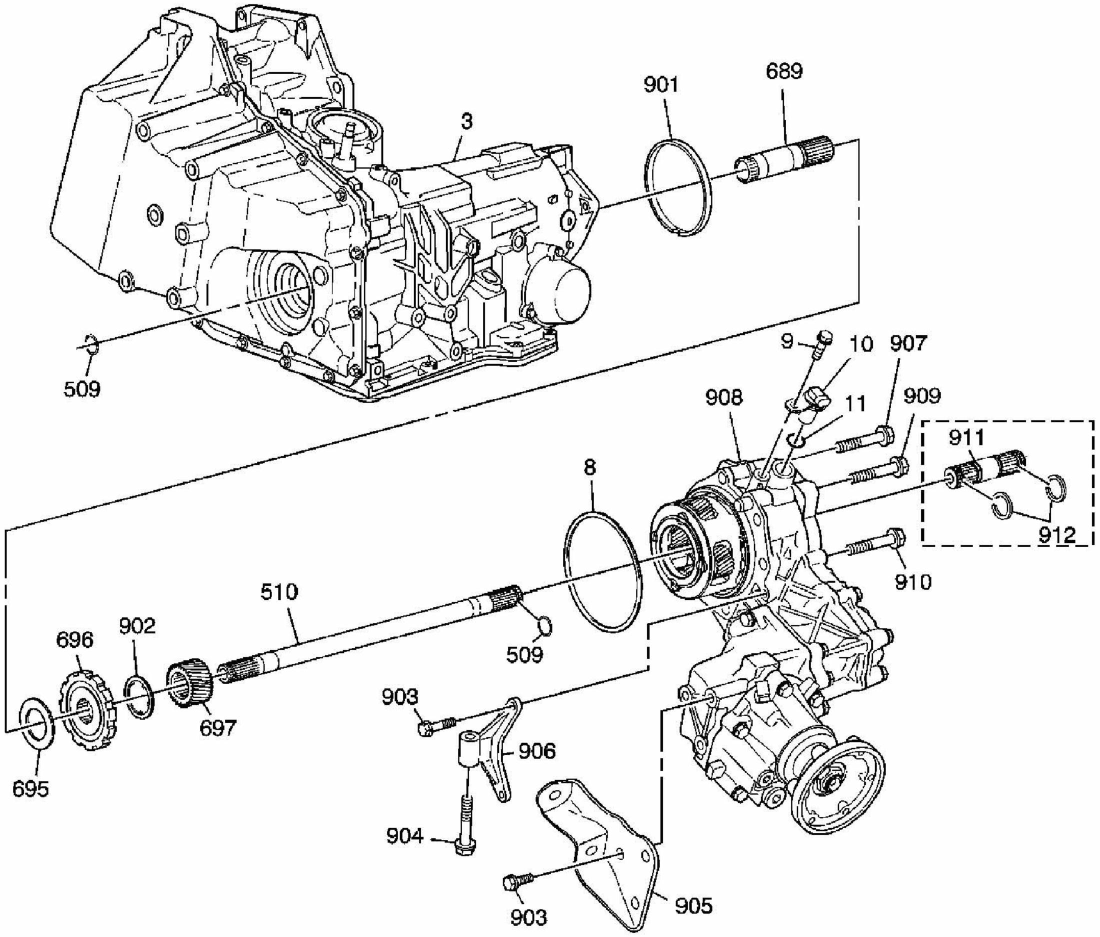
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Fig. 13: Transmission to Transfer Case Components Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 13

Callout	Component Name
3	Transmission Case
8	Case Extension Seal
9	Vehicle Speed Sensor Bolt M8 X 1.25 X 12.0
10	Vehicle Speed Sensor Assembly
11	Vehicle Speed Sensor O-Ring Seal
509	Output Shaft Snap Ring
509	Output Shaft Snap Ring
510	Output Shaft
689	Final Drive Sun Gear Shaft

695	Parking Gear Thrust Bearing
696	Parking Gear
697	Final Drive Sun Gear
901	Oil Dam
902	Selective Washer
903	Brace Bolts
903	Brace Bolts
904	Transfer Case Lower Brace Bolt
905	Side Brace
906	Lower Brace
907	Transfer Case to Case Bolts
908	Transfer Case Assembly
909	Transfer Case to Case Bolts
910	Transfer Case to Case Bolts
911	Output Stub Shaft
912	Output Stub Shaft Snap Ring

AUTOMATIC TRANSMISSION ELECTRONIC COMPONENT VIEWS

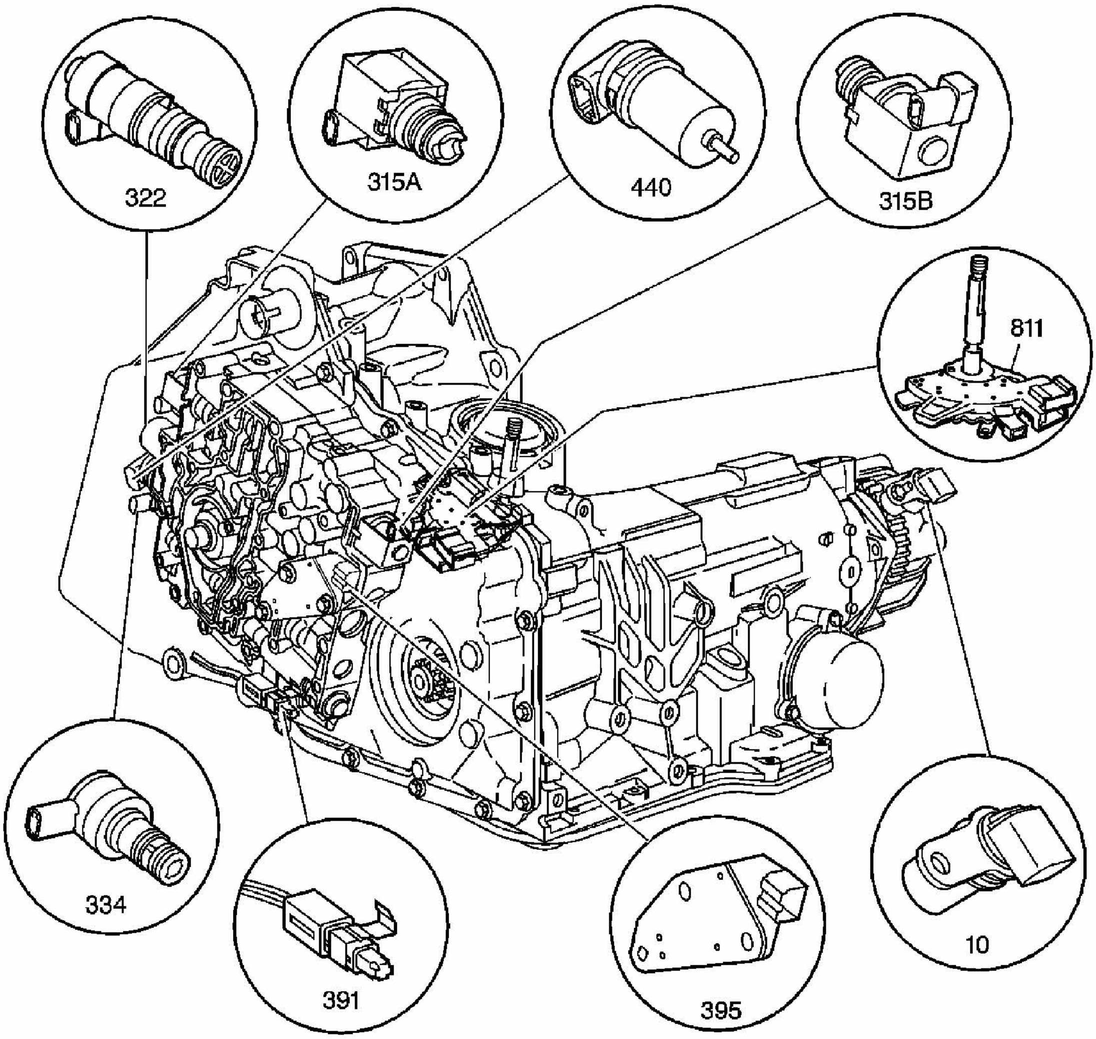

Fig. 14: Internal Electronic Component Locations
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 14

Callout	Component Name
10	Vehicle Speed Sensor (VSS) Assembly
315a	1-2, 3-4 Shift Solenoid (SS) Valve Assembly
315b	2-3 Shift Solenoid (SS) Valve Assembly
322	Pressure Control (PC) Solenoid Valve Assembly
334	Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Valve Assembly
391	Transmission Fluid Temperature (TFT) Sensor
395	Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly
440	Automatic Transmission Input Shaft Speed (A/T ISS) Sensor Assembly

811	Lever Assembly-Manual Shaft Detent with Shift Position Switch - Internal Mode Switch (IMS)

COMPONENT LOCATION

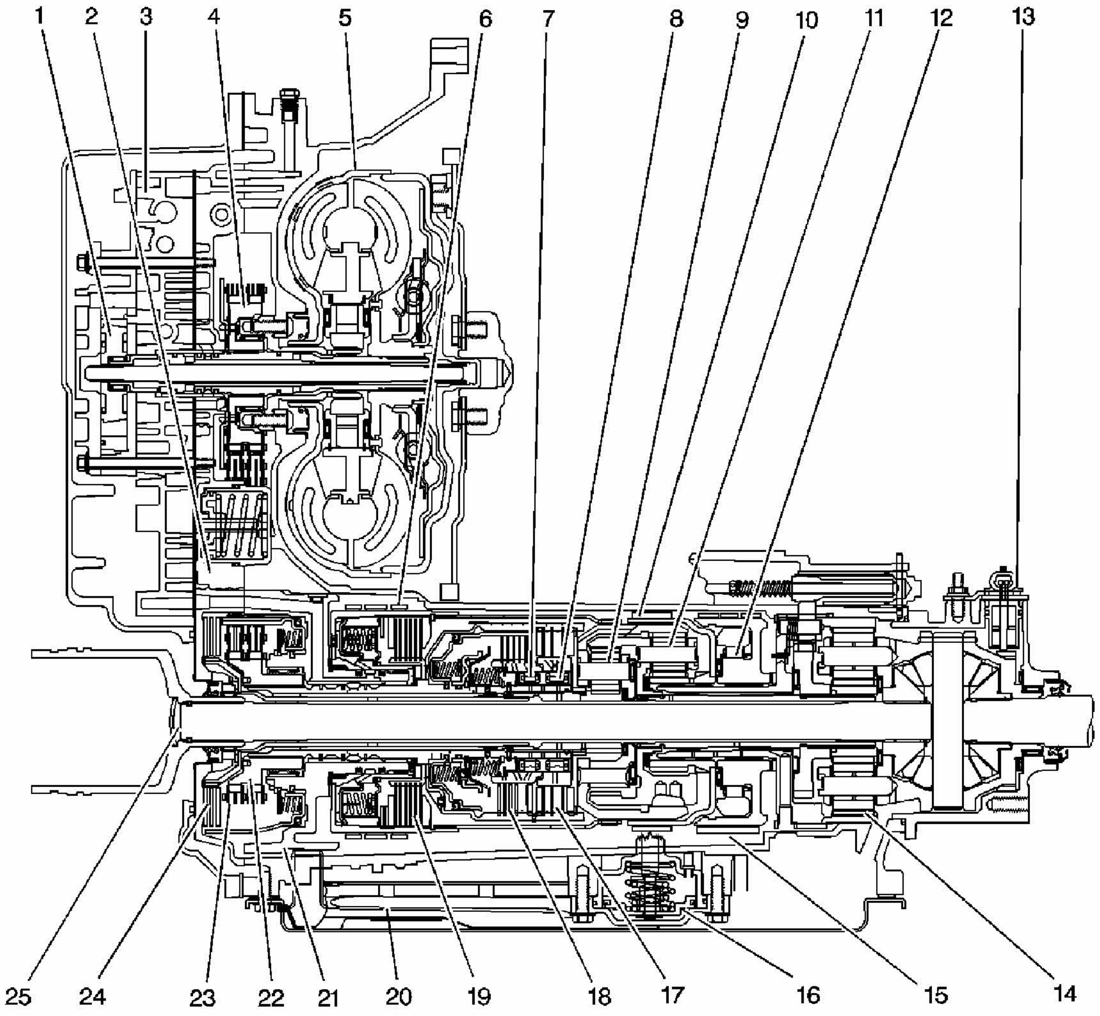

Fig. 15: Transmission Major Components Location
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 15

Callout	Component Name
1	Oil Pump Assembly
2	Case Cover Assembly
3	Control Valve Body Assembly
4	Drive Sprocket
5	Torque Converter Assembly
6	Reverse Band Assembly
7	Third Clutch Pawl Assembly

8	Input Clutch Pawl Assembly
9	Input Carrier Assembly
10	2-1 Manual Band Assembly
11	Reaction Carrier Assembly
12	1/2 Support Roller Clutch Assembly
13	Vehicle Speed Sensor Assembly
14	Final Drive/Differential Carrier Assembly
15	Forward Band Assembly
16	2-1 Manual Band Servo Assembly
17	Input Clutch Assembly
18	Third Clutch Assembly
19	Second Clutch Assembly
20	Oil Filter Assembly
21	Driven Sprocket Support Assembly
22	Driven Sprocket
23	Drive Link Assembly
24	Fourth Clutch Assembly
25	Output Shaft

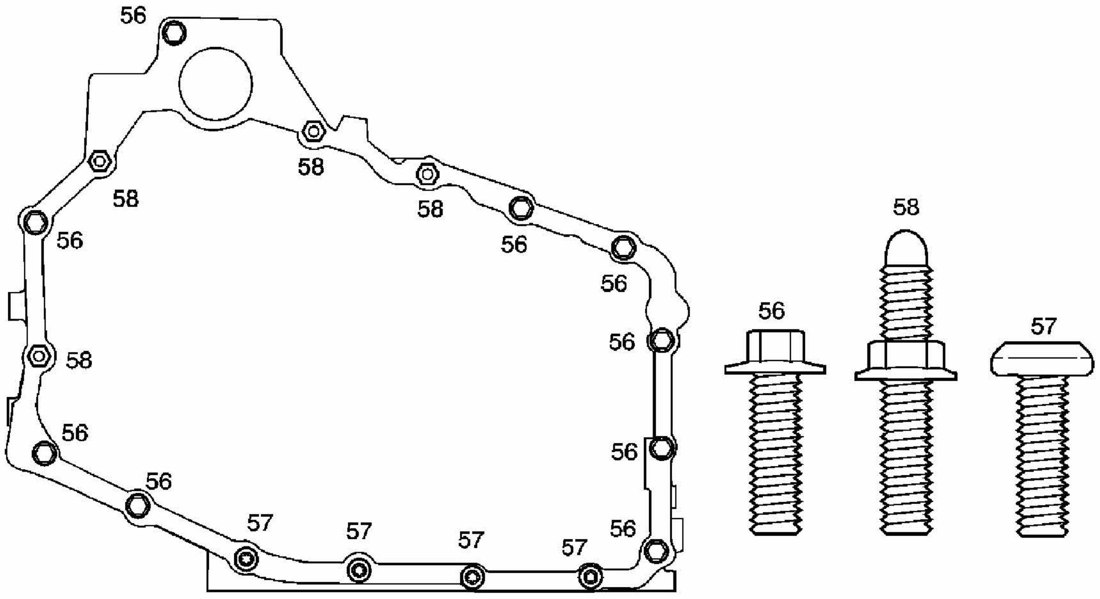

Fig. 16: Case Side Cover Bolts Location
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 16

Callout	Component Name
56	Side Cover Bolt/Screw M8 X 1.25 X 25.0 (9)

57	Side Cover Bolt/Screw M8 X 1.25 X 21.0 (4)
58	Side Cover Bolt/Screw M8 X 1.25 X 24.0 (4)

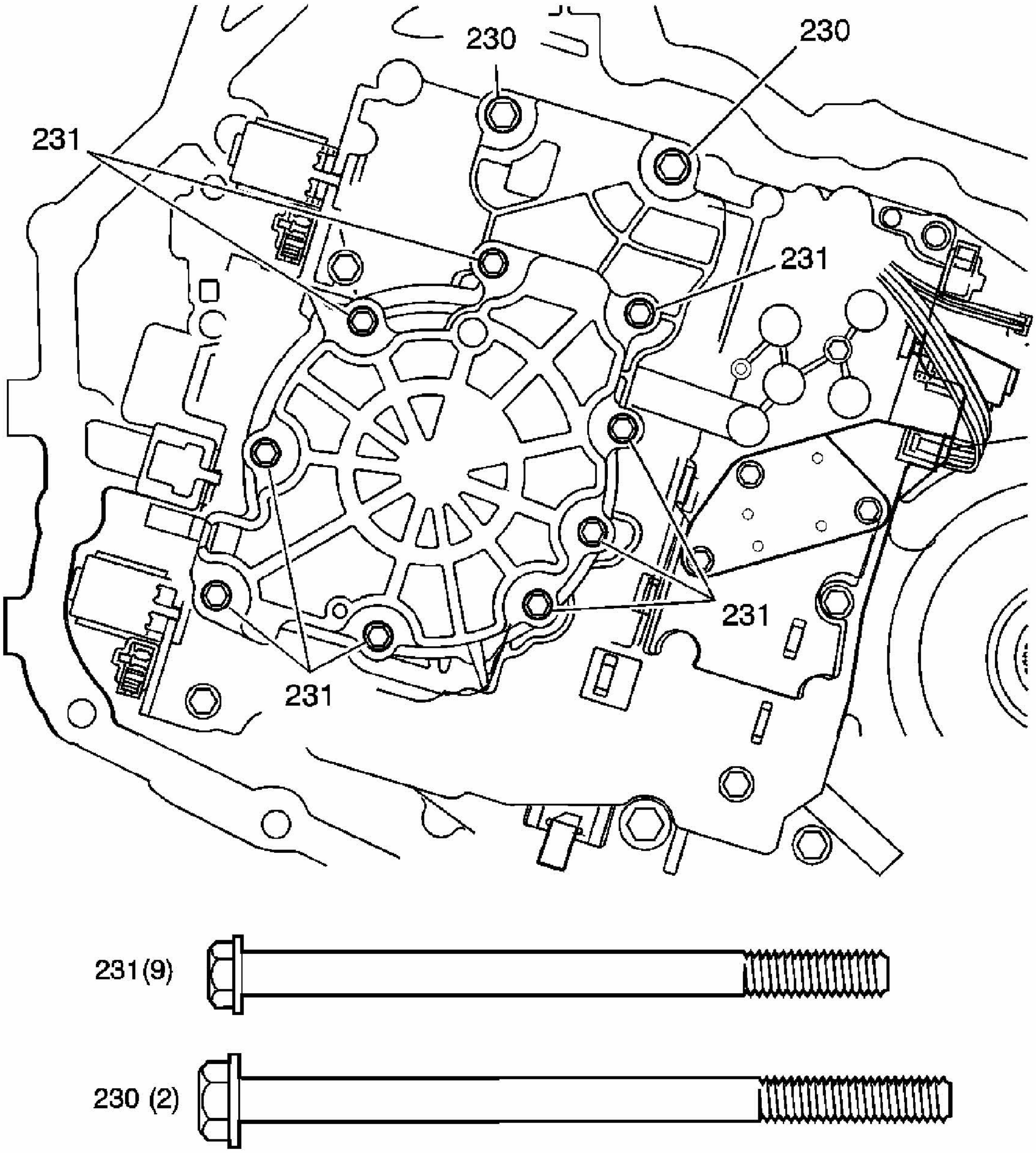

Fig. 17: Oil Pump Bolts Location - 3 Piece Pump
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 17

Callout	Component Name
230	Pump Body to Case Bolt M6 X 1.0 X 95.0 (2)
230	Pump Body to Case Bolt M6 X 1.0 X 95.0 (2)
231	Pump Cover to Case Cover Bolt M6 X 1.0 X 87.5 (9)

231	Pump Cover to Case Cover Bolt M6 X 1.0 X 87.5 (9)
231	Pump Cover to Case Cover Bolt M6 X 1.0 X 87.5 (9)
231	Pump Cover to Case Cover Bolt M6 X 1.0 X 87.5 (9)

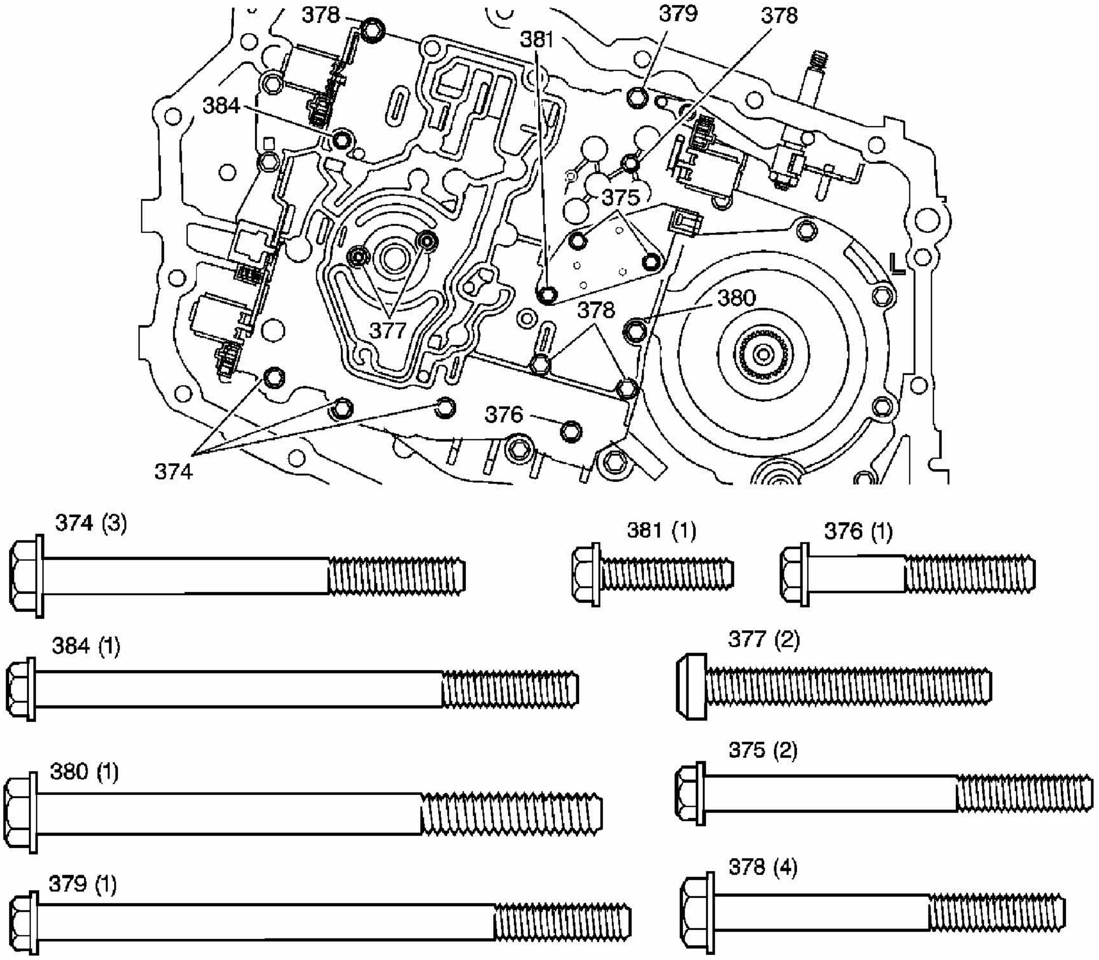
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Fig. 18: Control Valve Body Bolts Location
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 18

Callout	Component Name
374	Control Valve Body Bolt/Screw M6 X 1.0 X 65.0 (3)
375	Control Valve Body Bolt/Screw M6 X 1.0 X 60.0 (2)
376	Control Valve Body Bolt/Screw M6 X 1.0 X 30.0 (1)
377	Control Valve Body Bolt/Screw M6 X 1.0 X 45.0 (2)
378	Control Valve Body Bolt/Screw M6 X 1.0 X 55.0 (3)
379	Control Valve Body Bolt/Screw M6 X 1.0 X 87.5 (1)
380	Control Valve Body Bolt/Screw M8 X 1.0 X 90.0 (1)
381	Control Valve Body Bolt/Screw M6 X 1.0 X 20.0 (1)

384	Control Valve Body Bolt/Screw M6 X 1.0 X 85.0 (1)

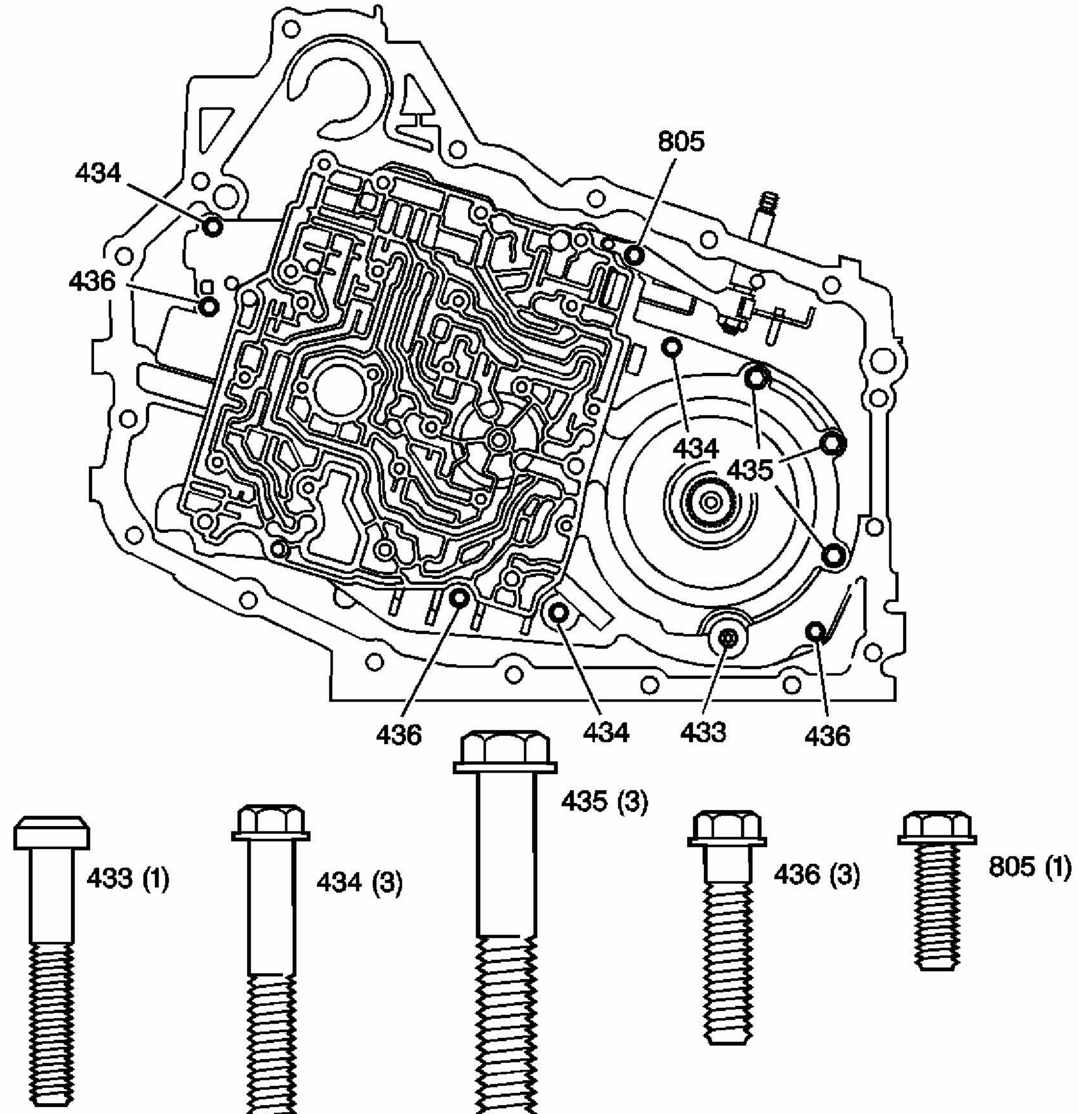
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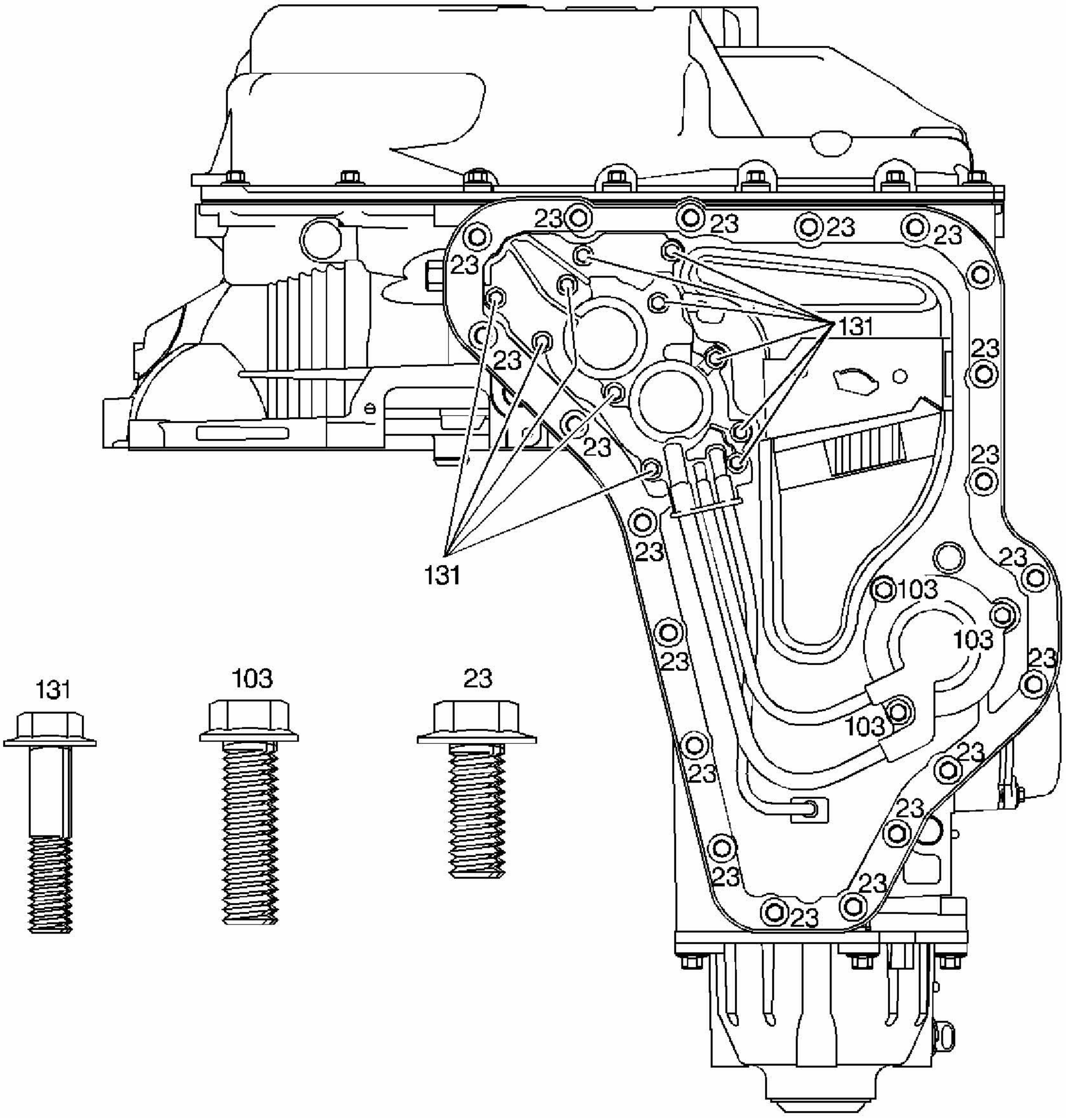
Fig. 19: Case Cover Bolts Location
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 19

Callout	Component Name
433	Case Cover Bolt/Screw TORX® Plus Special M6 X 1.0 X 32.0 (1)
434	Case Cover Bolt/Screw M6 X 1.0 X 40.0 (3)
435	Case Cover Bolt/Screw M8 X 1.25 X 50.0 (3)
436	Case Cover Bolt/Screw M6 X 1.0 X 30.0 (3)

805	Case Cover Bolt/Screw M6 X 1.0 X 16.0 (1)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23
23
23
23
23

Fig. 20: Bottom Pan, Accumulator Cover and Manual 2-1 Band Servo Cover Bolts Location
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 20

Callout	Component Name
23	Transmission Oil Pan Bolt M6 X 1.0 X 17.0 (20)
103	2-1 Manual Band Servo Cover Bolt/Screw M8 X 1.25 X 25.0 (3)
131	Accumulator Cover Bolt/Screw M6 X 1.0 X 28.0 (11)

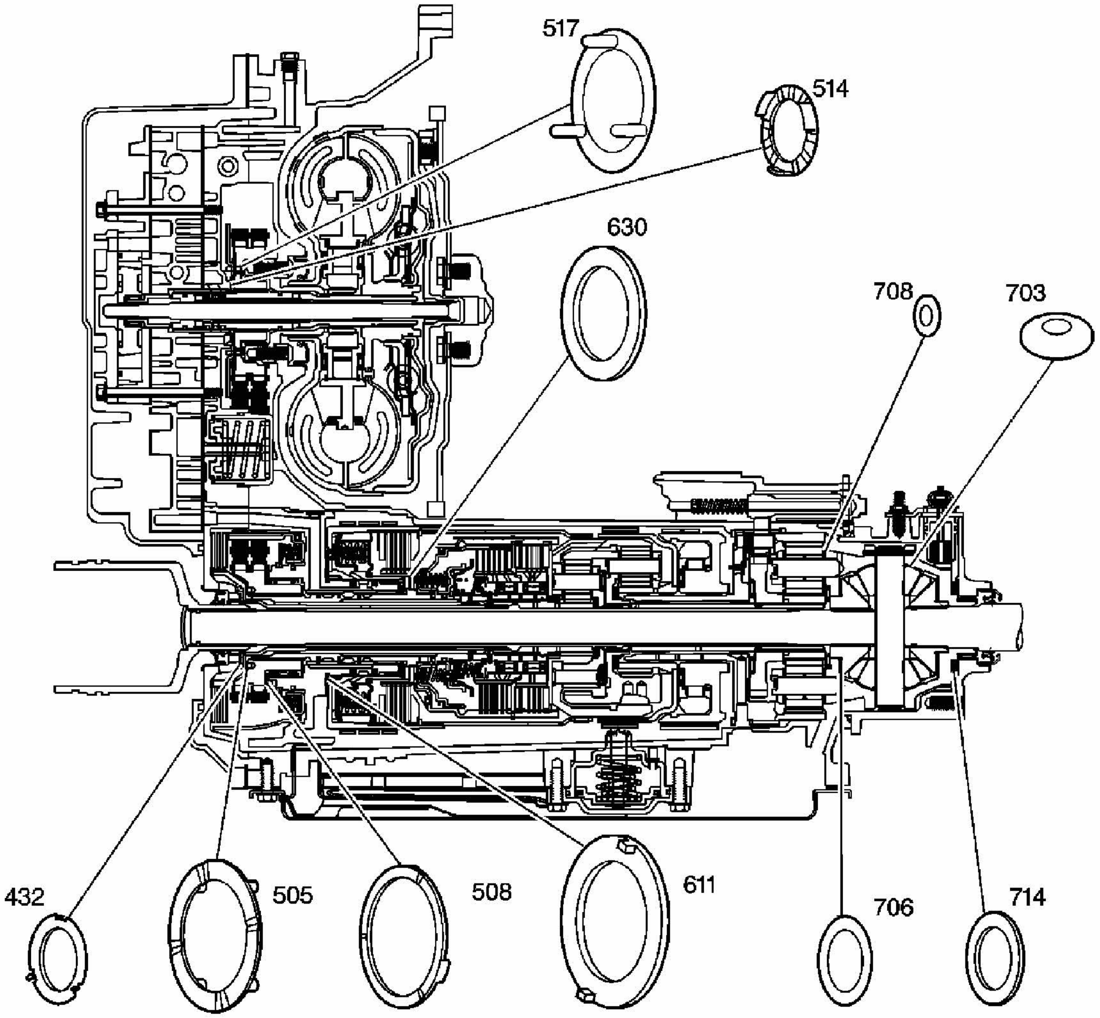


Fig. 21: Thrust Washers
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 21

Callout	Component Name
432	Fourth Clutch Shaft Thrust Washer
505	Fourth Clutch Shaft Thrust Washer
508	Driven Sprocket Thrust Washer
514	Drive Sprocket Thrust Washer
517	Drive Sprocket Thrust Washer
611	Second Clutch Housing Thrust Washer
630	Input Clutch Housing Thrust Washer Selective
703	Differential Pinion Thrust Washer
706	Differential Side Gear Thrust Washer Bronze
708	Planetary Pinion Gear Thrust Washer Steel
714	Differential Carrier/Case Thrust Washer

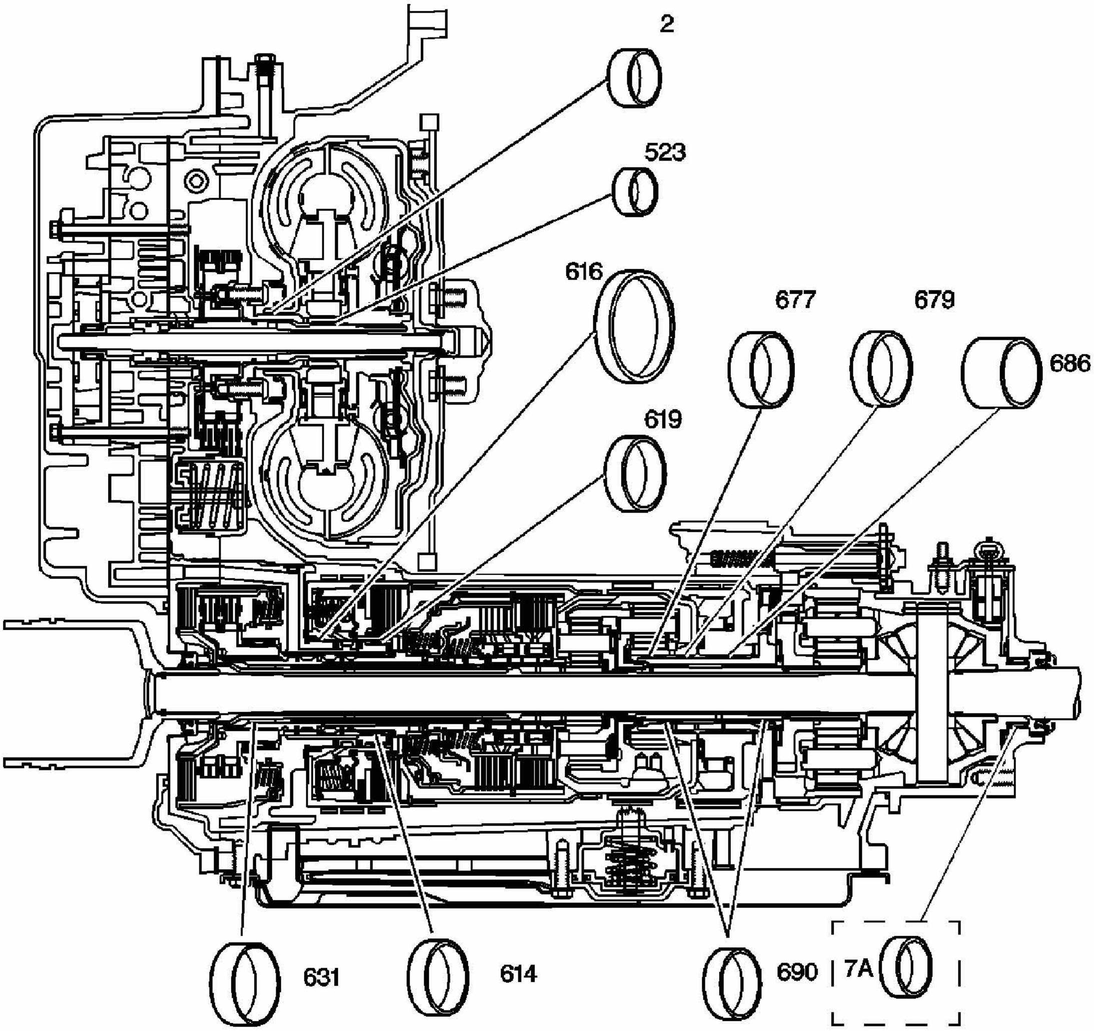


Fig. 22: Bushings Location
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 22

Callout	Component Name
2	Torque Converter Bushing
7a	Front Differential Carrier Bushing M15 and MN3 Models Only
523	Turbine Shaft Bushing
614	Second Clutch Housing Bushing
616	Second Clutch Housing Front Bushing
619	Second Clutch Housing Rear Bushing
631	Input Shaft Bushing
677	Reaction Sun Gear Bushing Left Side
679	Reaction Sun Gear Bushing Right Side
686	1-2 Support Drum Bushing

690	Front Differential Carrier Internal Gear Bushing

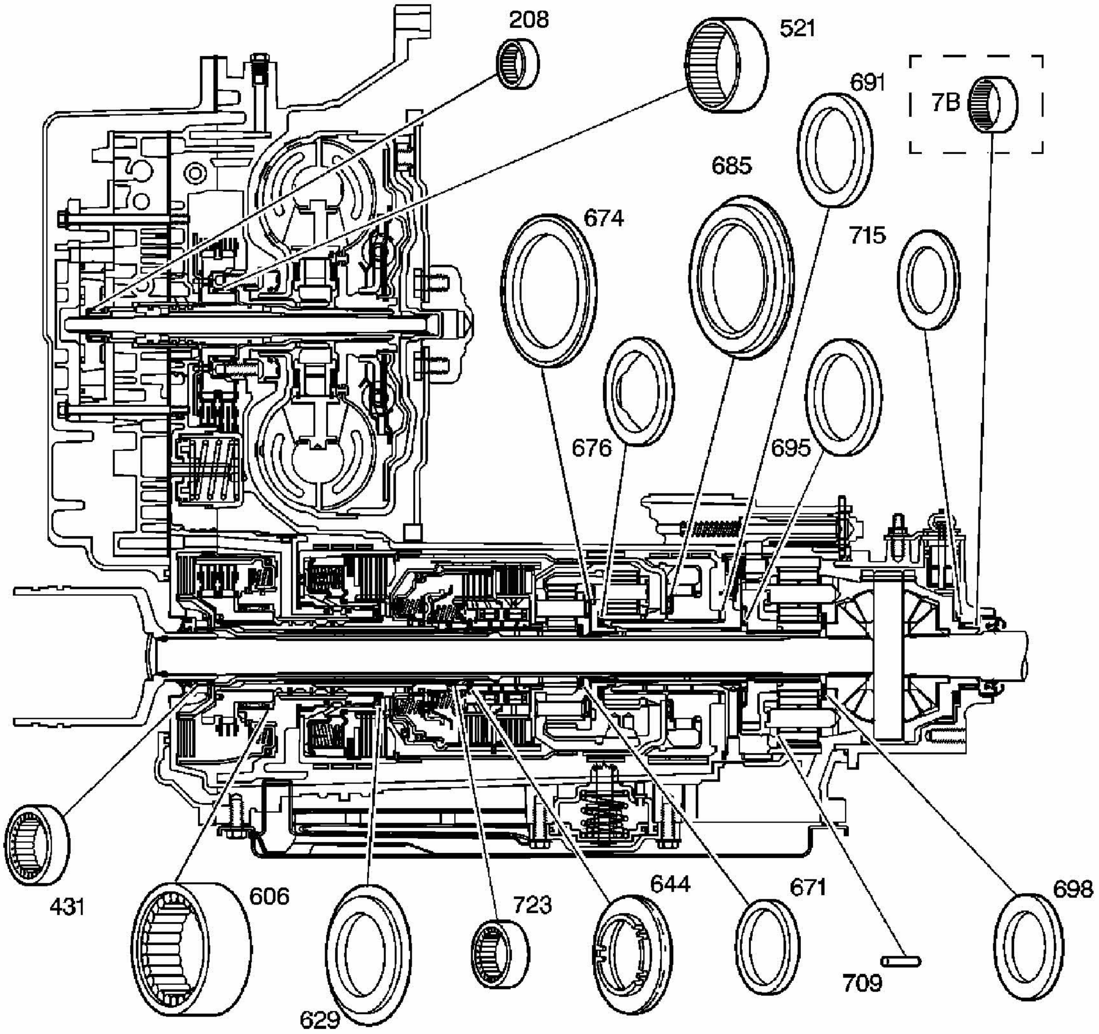


Fig. 23: Identifying Bearings
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 23

Callout	Component Name
7b	Output Shaft Bearing Assembly MN7 Models Only
208	Oil Pump Drive Shaft Bearing
431	Front Wheel Drive Shaft Bearing
521	Drive Sprocket Bearing Assembly
606	Driven Sprocket Bearing Assembly
629	Input Clutch Housing Thrust Bearing Assembly
644	Input Shaft Thrust Bearing Assembly
671	Input Sun Gear Thrust Bearing Assembly

674	Reaction Carrier Thrust Bearing Assembly
676	Reaction Sun Gear Thrust Bearing Assembly
685	1-2 Drum Support Thrust Bearing
691	Final Drive Gear Internal Thrust Bearing
695	Front Differential Carrier Internal Gear Thrust Bearing
698	Front Differential Carrier Sun Gear Thrust Bearing
709	Front Differential Carrier Planetary Pinion Bearing
715	Front Differential Carrier Thrust Bearing
723	Input Clutch Housing Thrust Bearing

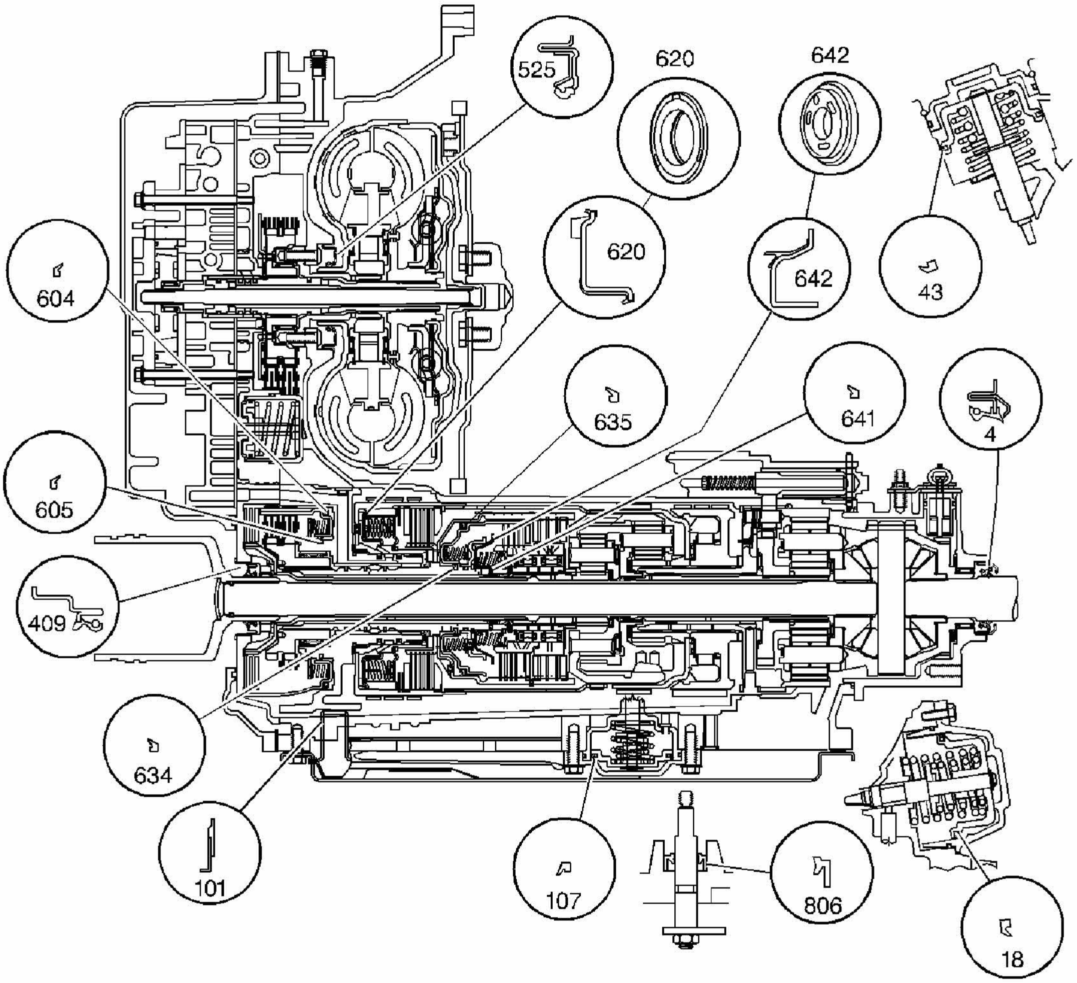


Fig. 24: Lip Seals Location
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 24

Callout	Component Name
4	Front Wheel Drive Shaft Oil Seal Assembly Right Side

18	Forward Band Servo Piston Oil Seal Ring
43	Reverse Band Servo Piston Oil Seal Ring
101	Automatic Transmission Oil Filter Seal
107	Manual 2-1 Band Servo Piston Seal
409	Front Wheel Drive Shaft Oil Seal Assembly Left Side
525	Torque Converter Oil Seal Assembly
604	Fourth Clutch Piston Seal Outer
605	Fourth Clutch Piston Seal Inner
620	Second Clutch Piston and Seal Assembly
620	Second Clutch Piston and Seal Assembly
634	Input Clutch Piston Seal Inner
635	Input Clutch Piston Seal Outer
641	Third Clutch Piston Seal Inner
642	Third Clutch Piston and Seal Assembly
642	Third Clutch Piston and Seal Assembly
806	Manual Shift Shaft Seal

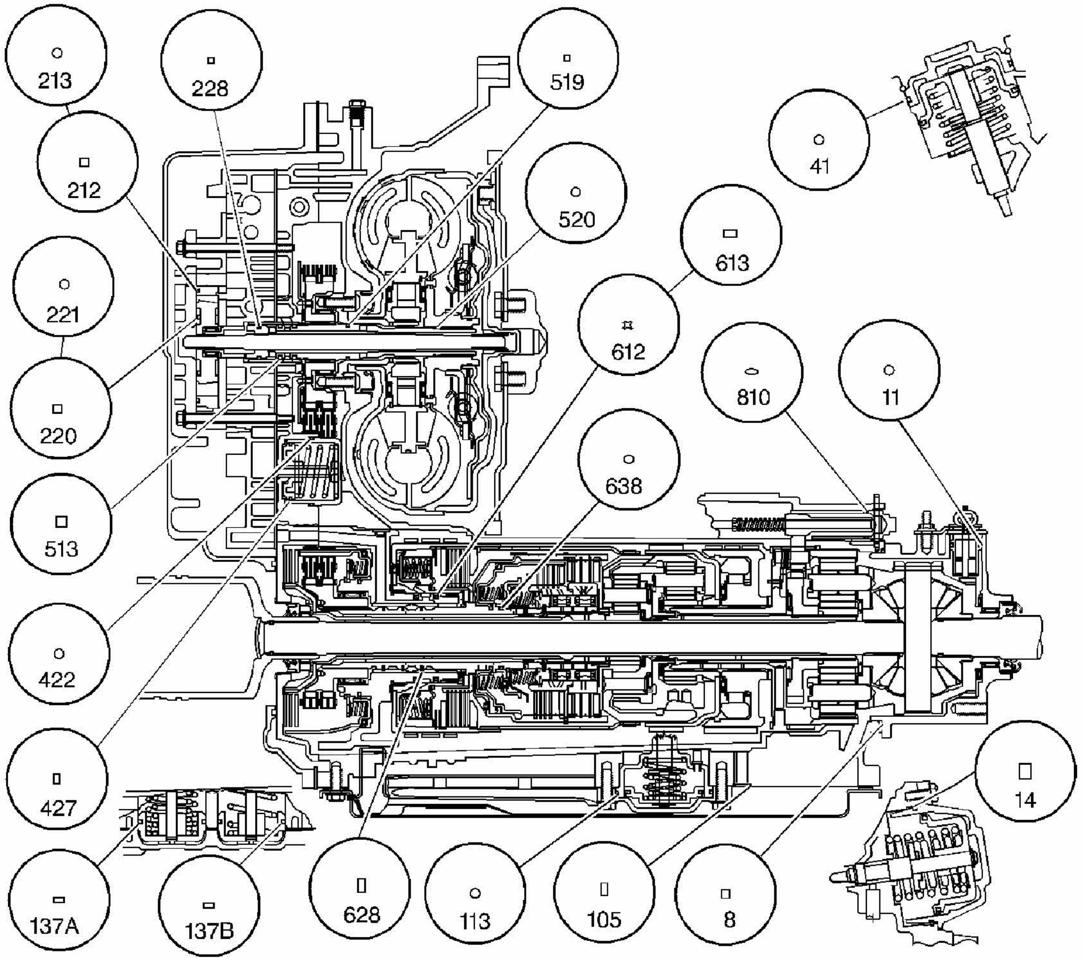

213
228
519
212
520
41
613
221
612
810
11
220
638
513
422
427
14
137A
137B
628
113
105
8

Fig. 25: Square and O-Ring Seals Location
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 25

Callout	Component Name
8	Automatic Transmission Case Extension Seal
11	Vehicle Speed Sensor O-Ring Seal
14	Forward Band Servo Cover Seal
41	Reverse Band Servo Cover O-Ring Seal
105	Manual 2-1 Band Servo Cover Seal
113	Manual 2-1 Band Servo Piston Cylinder O-Ring Seal
137a	1-2 Accumulator Piston Oil Seal Ring
137b	2-3 Accumulator Piston Oil Seal Ring
212	Automatic Transmission Oil Pump Slide Oil Seal Ring
213	Automatic Transmission Oil Pump Slide O-Ring Seal
220	Automatic Transmission Oil Pump Slide Seal

221	Automatic Transmission Oil Pump Slide Seal Support
228	Automatic Transmission Oil Pump Drive Shaft Seal
422	3-4 Accumulator Piston Cylinder O-Ring Seal
427	3-4 Accumulator Piston Oil Seal
513	Turbine Shaft Oil Seal Ring
519	Turbine Shaft Oil Seal Ring
520	Turbine Shaft O-Ring Seal
612	Second Clutch Housing Oil Seal Ring Four Lobe Seal
613	Second Clutch Housing Oil Seal Ring
628	Input Clutch Housing Oil Seal Ring
638	Third Clutch Housing O-Ring Seal
810	Park Pawl Actuator Guide O-Ring Seal

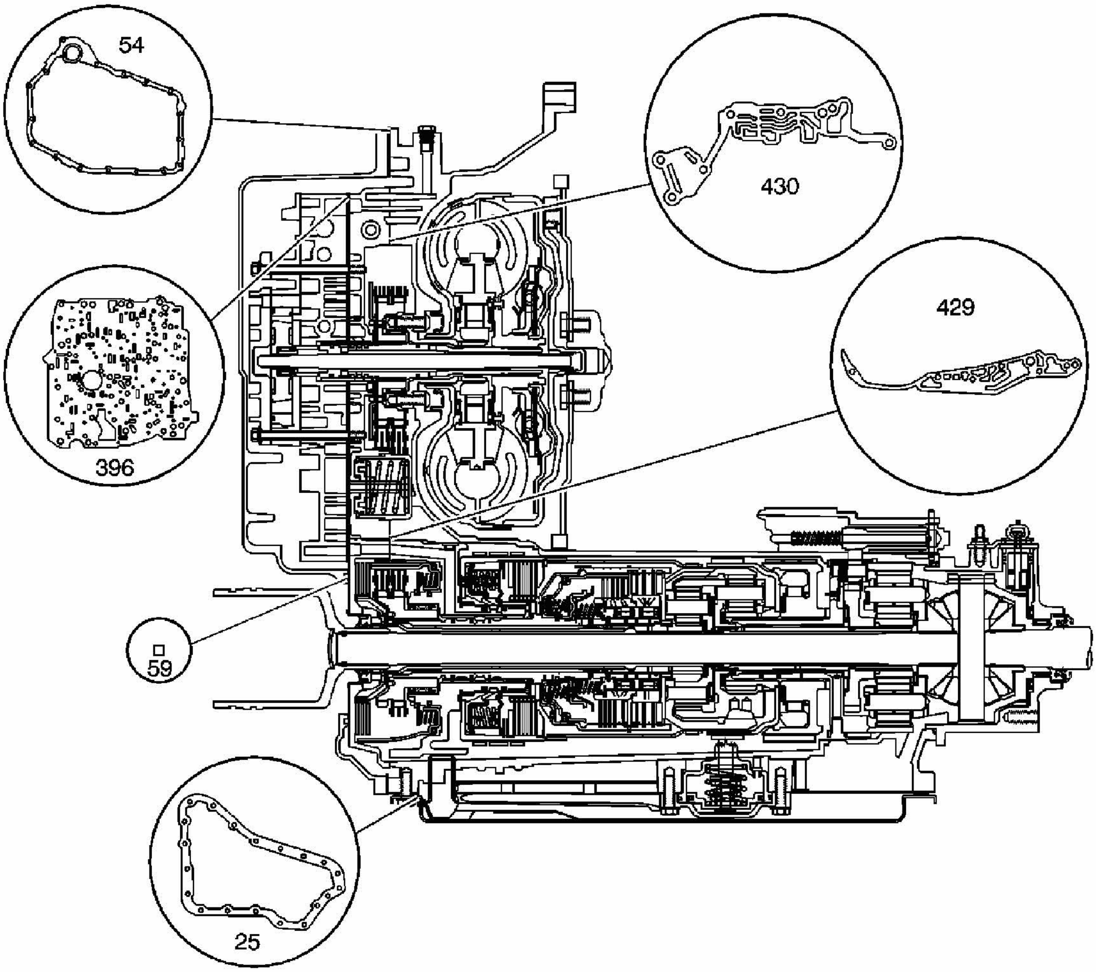


Fig. 26: Gaskets Location
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 26

Callout	Component Name
25	Oil Pan Gasket
54	Case Side Cover Gasket
59	Case Side Cover Inner Gasket
396	Control Valve Body Spacer Plate and Gasket Assembly
429	Case Cover Lower Gasket
430	Case Cover Upper Gasket

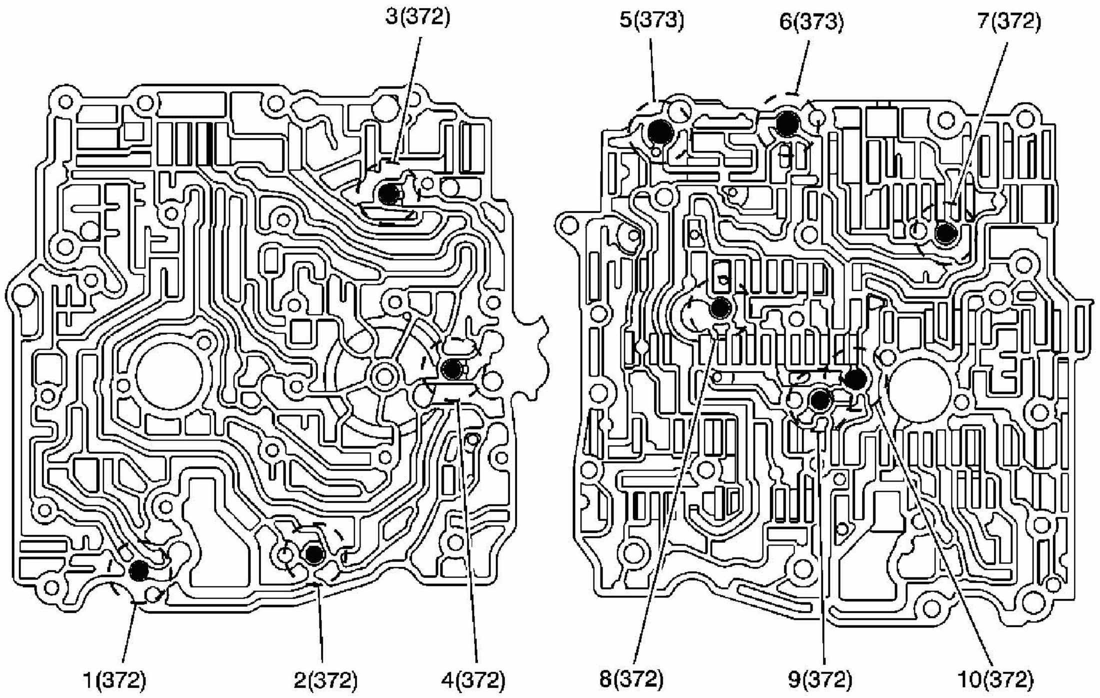


Fig. 27: Ball Check Valves Location
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 27

Callout	Component Name
1	TCC Apply-Release
2	2nd-2nd Clutch
3	Input Clutch-PRN
4	3rd Clutch-Lo/1st
5	Reverse-Reverse Servo Large
6	D4-Servo Apply
7	Lo-Lo/1st
8	D2-Manual 2-1 Servo Feed
9	3rd-3rd Clutch
10	Line-Lo/1st Gear

REPAIR INSTRUCTIONS

TORQUE CONVERTER ASSEMBLY REMOVAL

CAUTION: The torque converter weighs approximately 65 lbs. Personal injury may result if you lift the torque converter improperly.

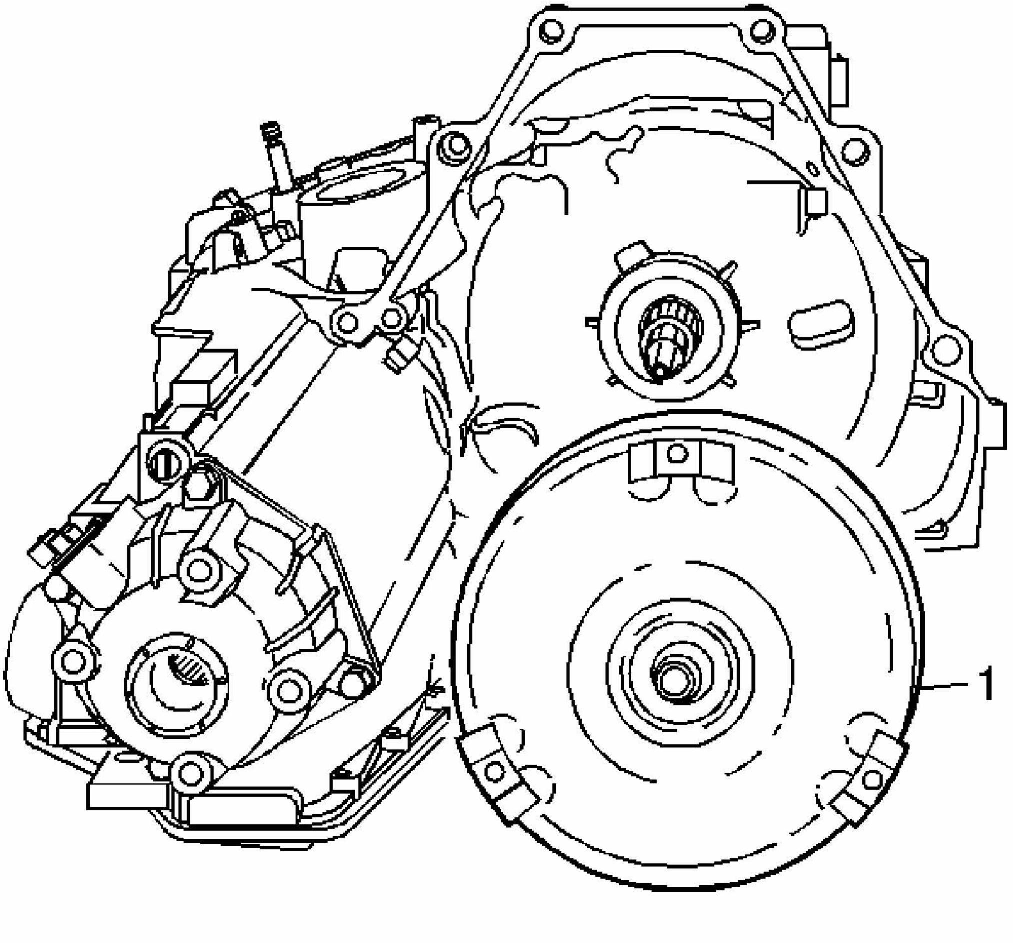


Fig. 28: View Of Torque Converter Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the torque converter assembly (1).

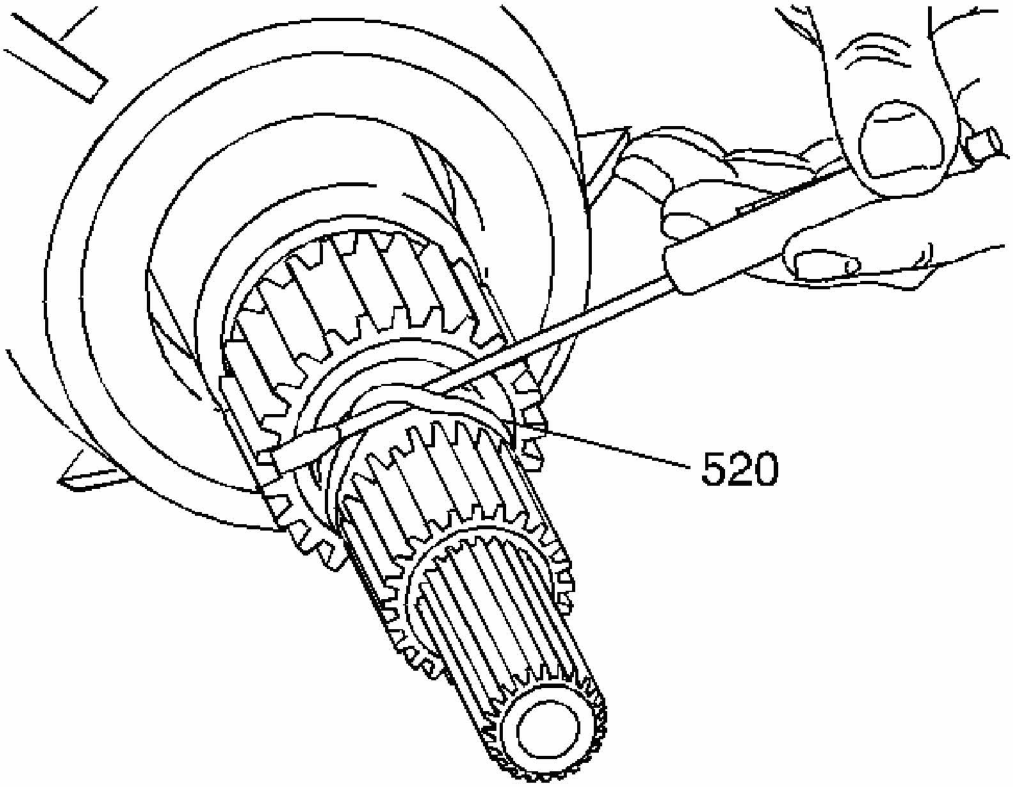


Fig. 29: Identifying Turbine Shaft O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

2. Remove the turbine shaft O-ring seal (520).

TRANSMISSION SUPPORT FIXTURE ASSEMBLE

Tools Required

- **J 3289-20** Holding Fixture Base
- **J 28664-B** Transmission Holding Fixture. See **Special Tools**.
- **J44465** Holding Fixture Adapter. See **Special Tools**.

Procedure

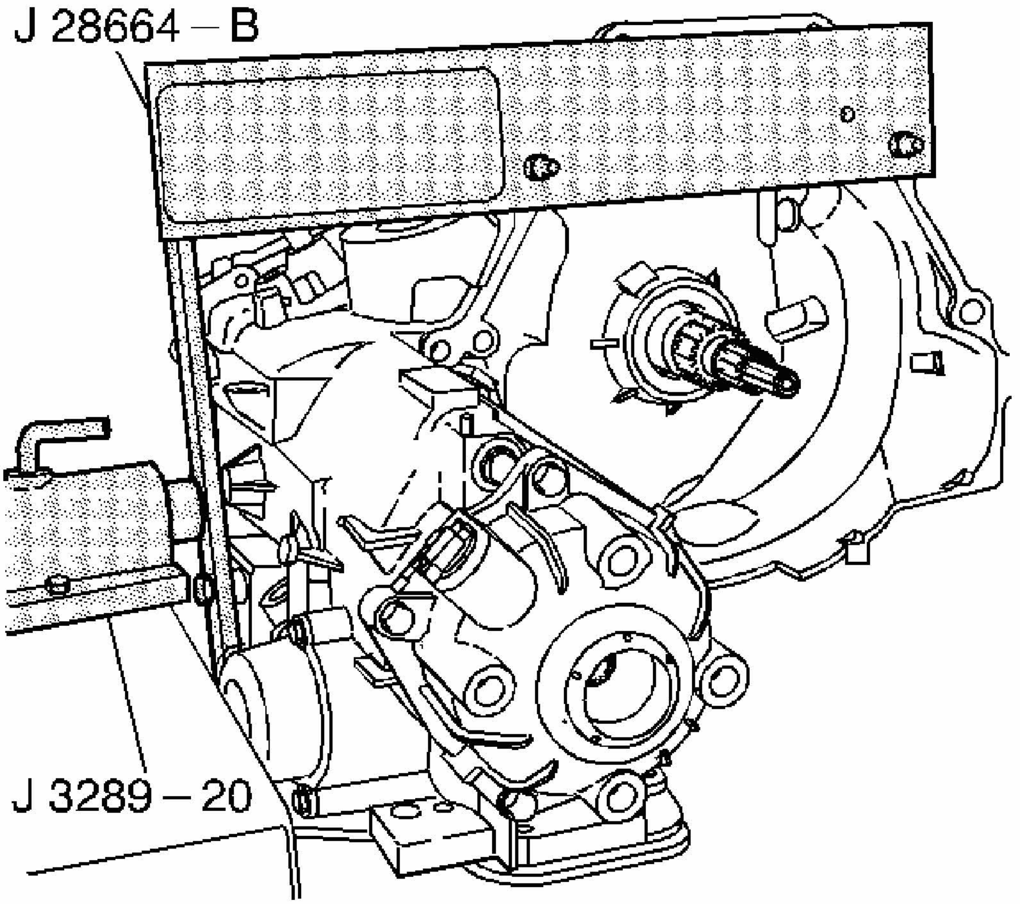


Fig. 30: J 28664-B & J 3289-20 Installed Onto Transmission
Courtesy of GENERAL MOTORS CORP.

1. Install **J44465** onto **J 28664-B** . See **Special Tools**.
2. Install **J 28664-B** onto the transmission. See **Special Tools**.
3. Install the transmission and holding fixture into **J 3289-20** .
4. Insert the pin into **J 3289-20** in order to hold the transmission in the desired position.

TRANSFER CASE REMOVAL

Tools Required

- **J 6125-1B** Slide Hammer
- **J 44467** Output Shaft Assembly Remover and Installer. See **Special Tools**.
- **J 44755** Holding Fixture

Removal Procedure

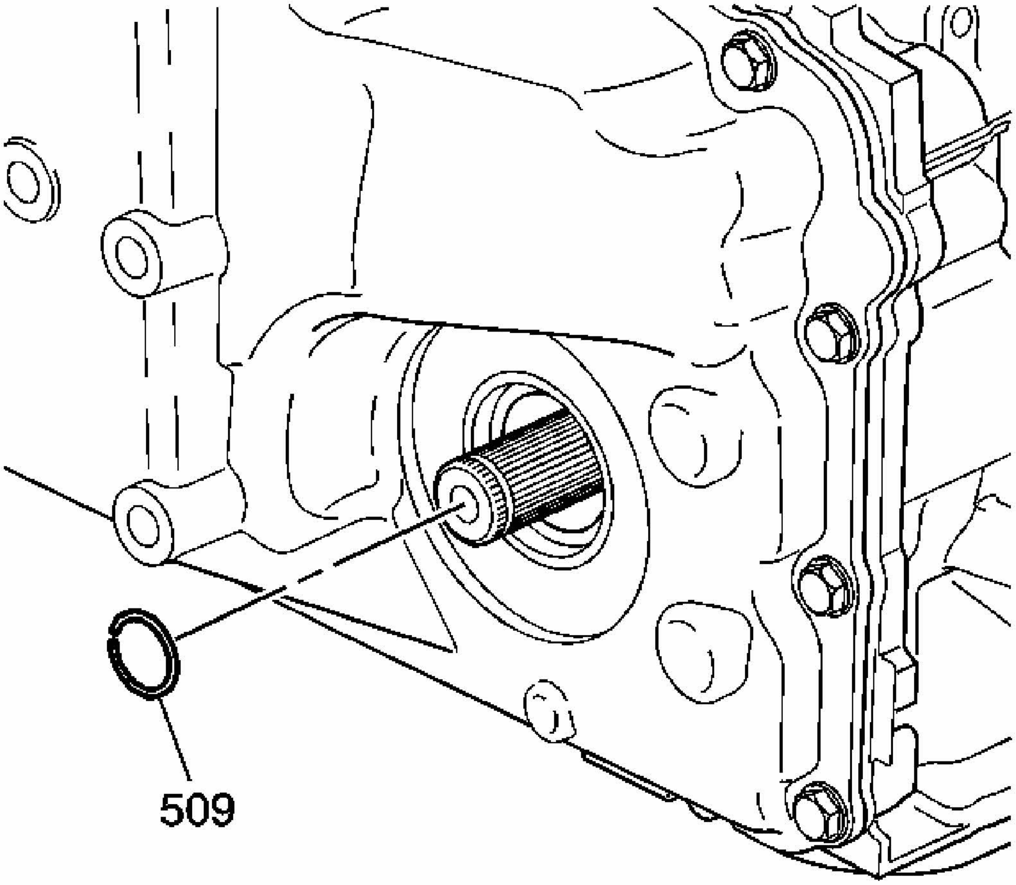


Fig. 31: Identifying Drive Shaft Retaining Ring
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Transmission oil circulates between the transmission assembly and the transfer case. In situations where transmission related failures circulate debris into the transfer case, the transfer case must be disassembled, cleaned and inspected for damage. Refer to Internal Components Cleaning and Inspection .

1. Remove the drive shaft retaining ring (509).

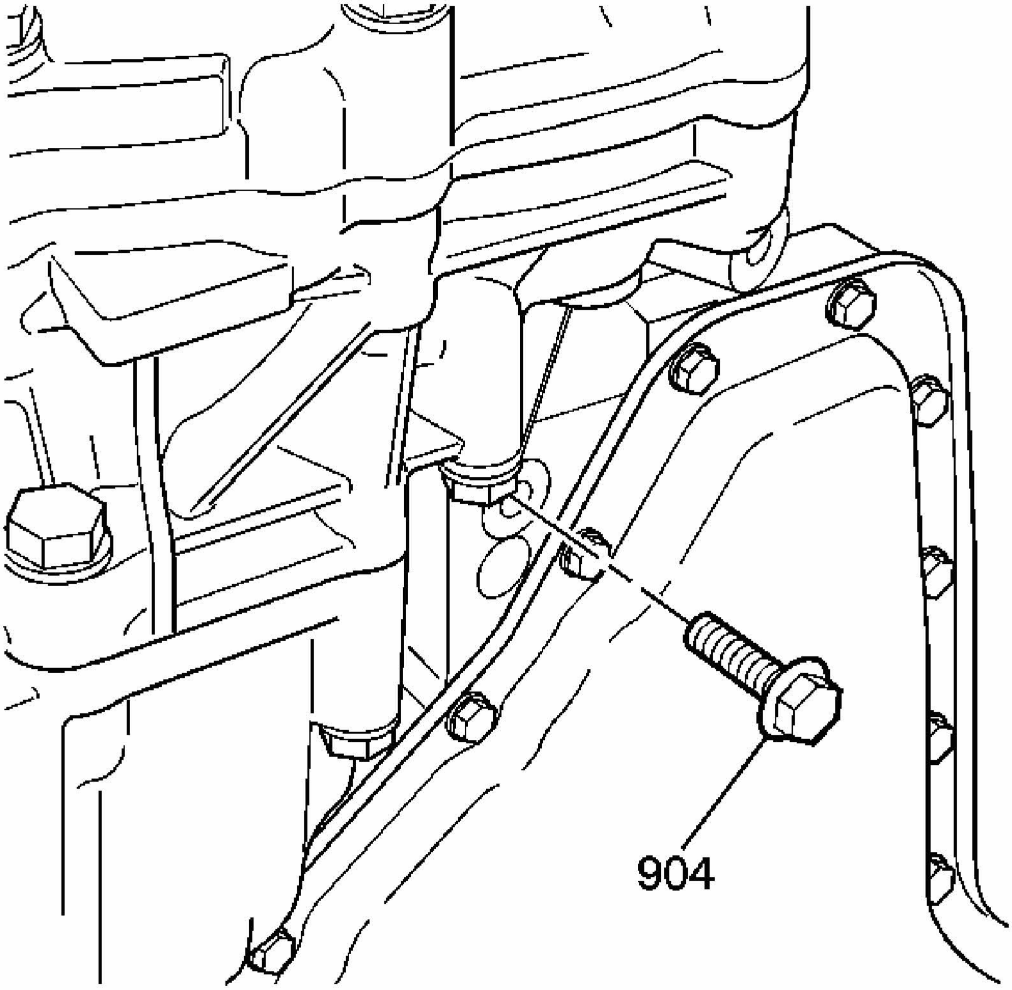


Fig. 32: Identifying Transfer Case Lower Brace To Case Bolt
Courtesy of GENERAL MOTORS CORP.

2. Rotate the transaxle 90 degrees.
3. Remove the transfer case lower brace bolt (904).

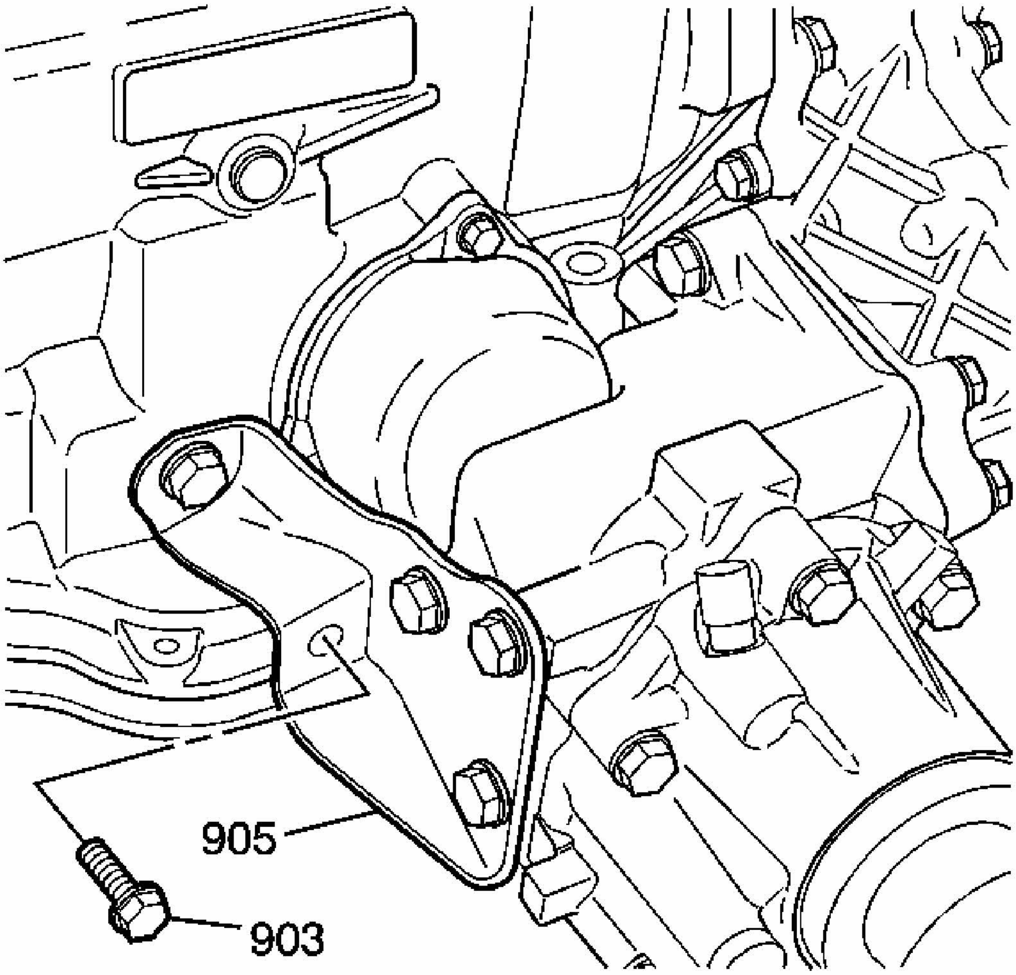


Fig. 33: Locating Transfer Case Side Brace & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Rotate the transaxle 90 degrees.
5. Remove the transfer case side brace bolts (903). Remove the side brace (905).

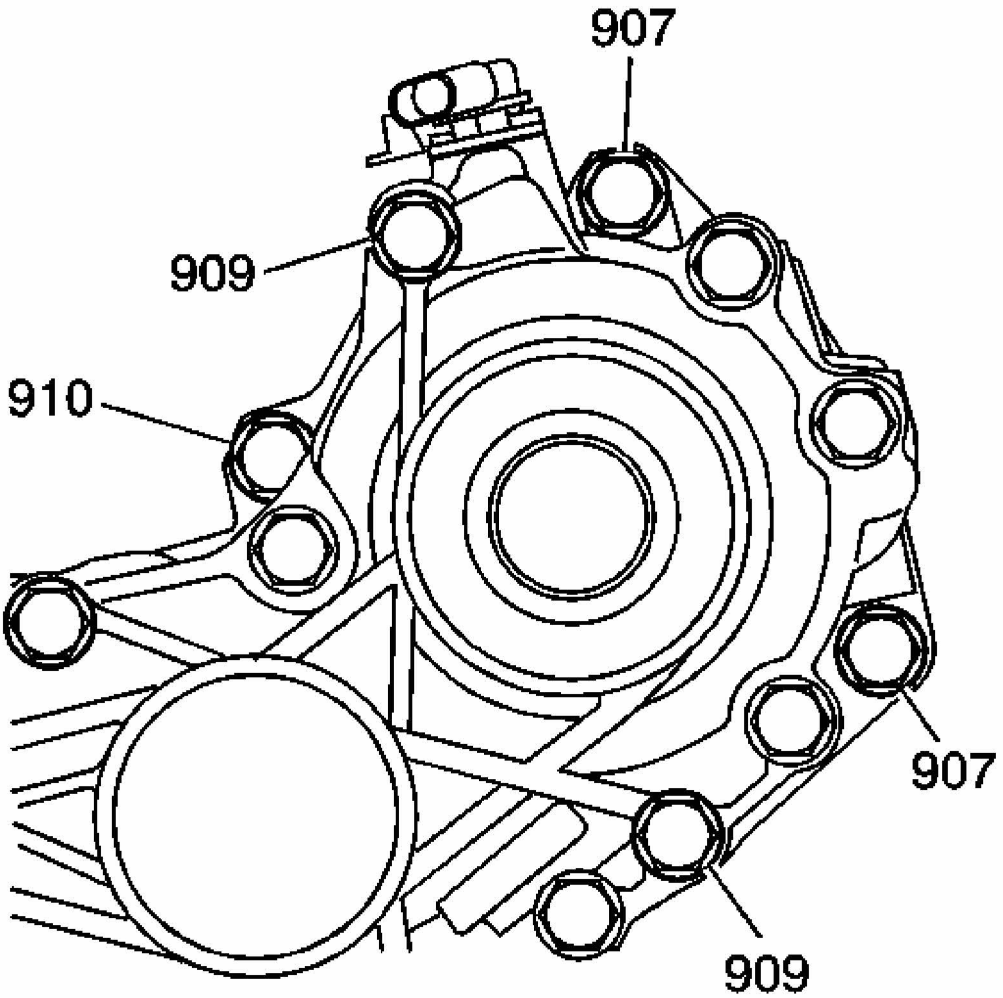


Fig. 34: View Of Transfer Case To Case Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the transfer case to case bolts (907, 909, 910).

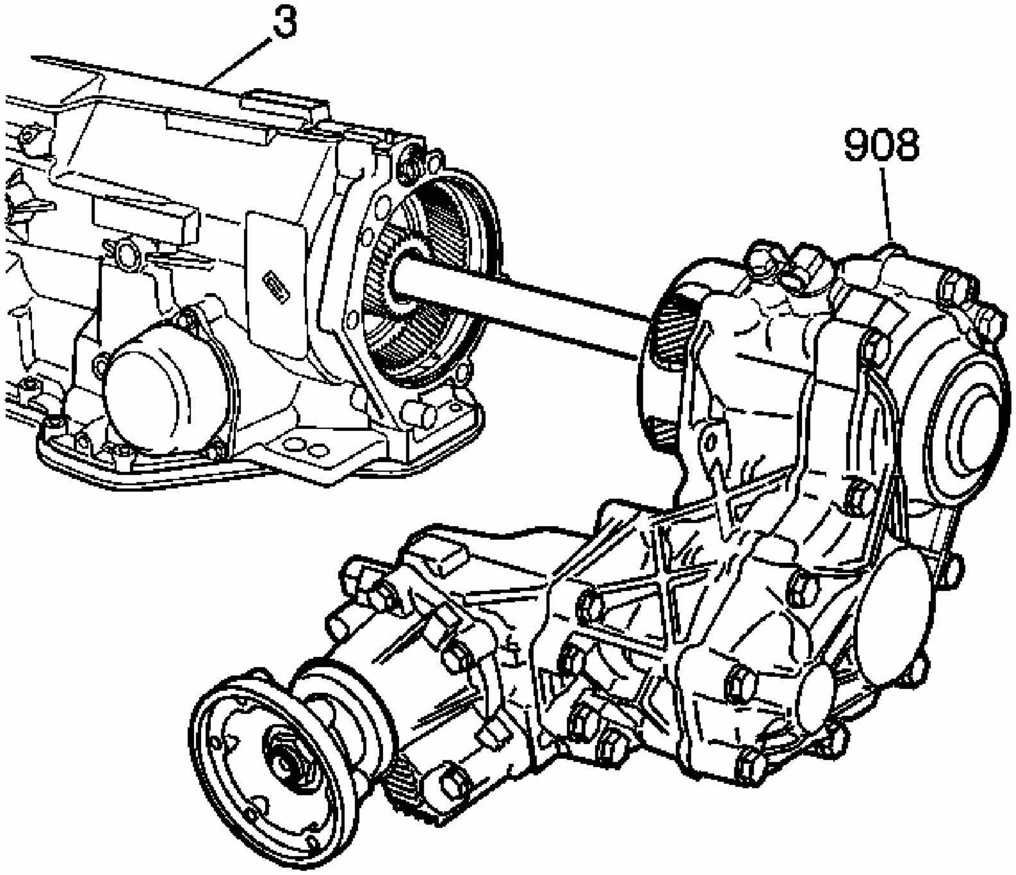


Fig. 35: Removing Transfer Case Assembly From Transmission Case
Courtesy of GENERAL MOTORS CORP.

CAUTION: This component weighs approximately 60 lbs. Personal injury may result if you lift the component improperly.

NOTE: During removal of the transfer case/output shaft, do not use excessive force or damage to the bushings may occur.

7. Remove the transfer case assembly (908) from the transmission case (3).

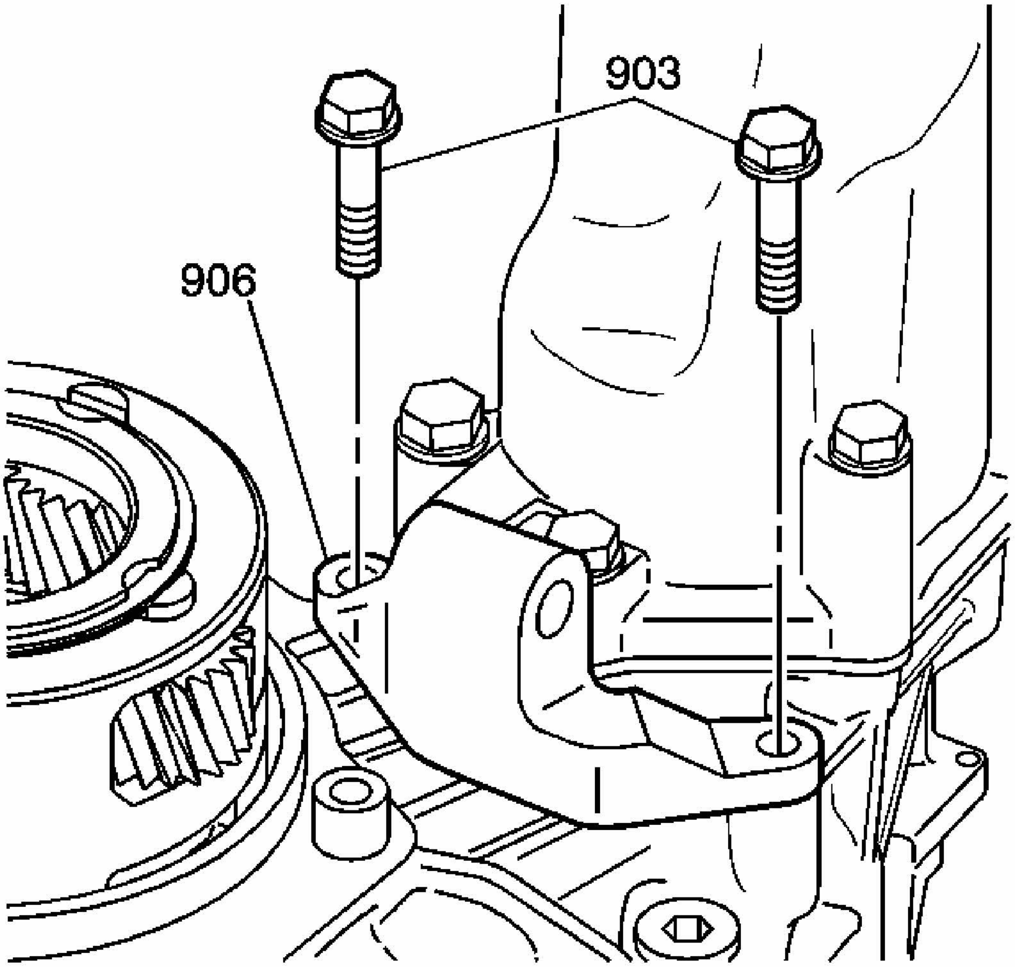


Fig. 36: View Of Transfer Case Lower Brace Bolts & Brace
Courtesy of GENERAL MOTORS CORP.

8. Remove the transfer case lower brace bolts (903).
9. Remove the transfer case lower brace (906).

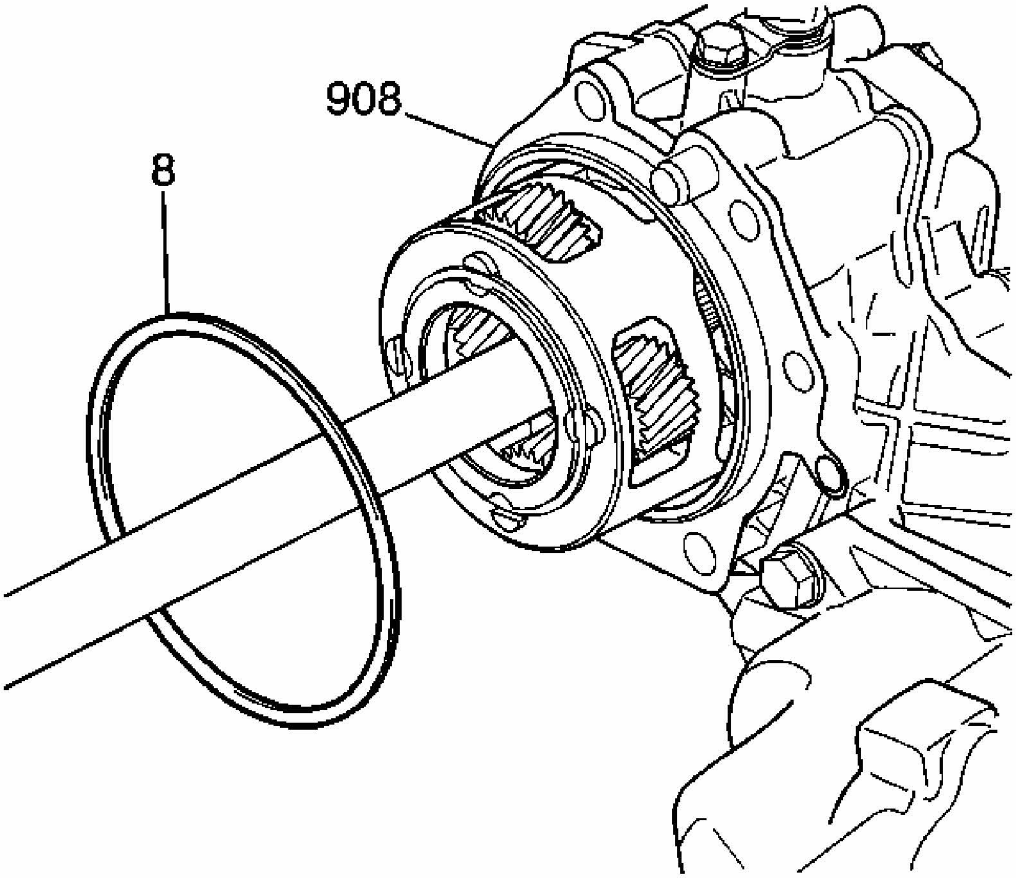


Fig. 37: Locating Case Extension Seal
Courtesy of GENERAL MOTORS CORP.

10. Remove the case extension seal (8) from the transfer case (908).

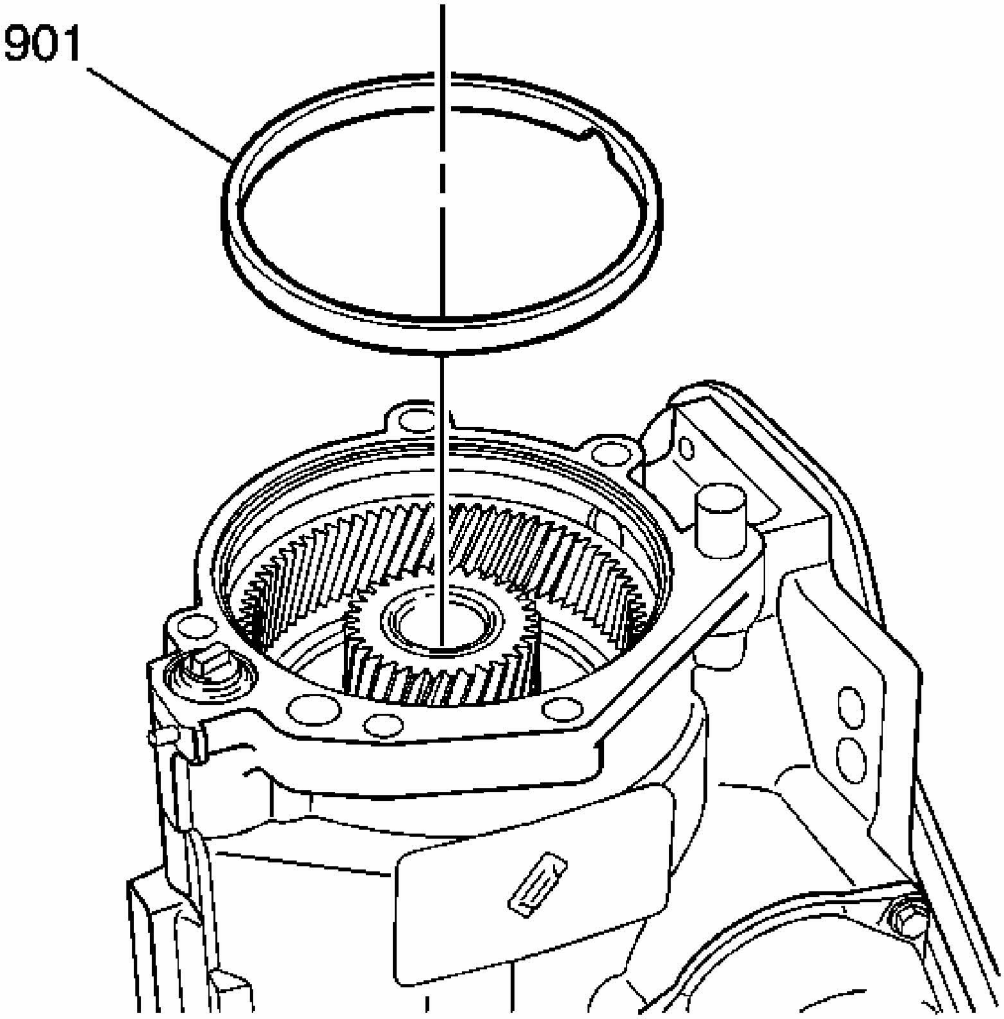


Fig. 38: View Of Oil Dam
Courtesy of GENERAL MOTORS CORP.

11. Position the transaxle so that the case side cover is facing down.
12. Remove the oil dam (901) from the transaxle.

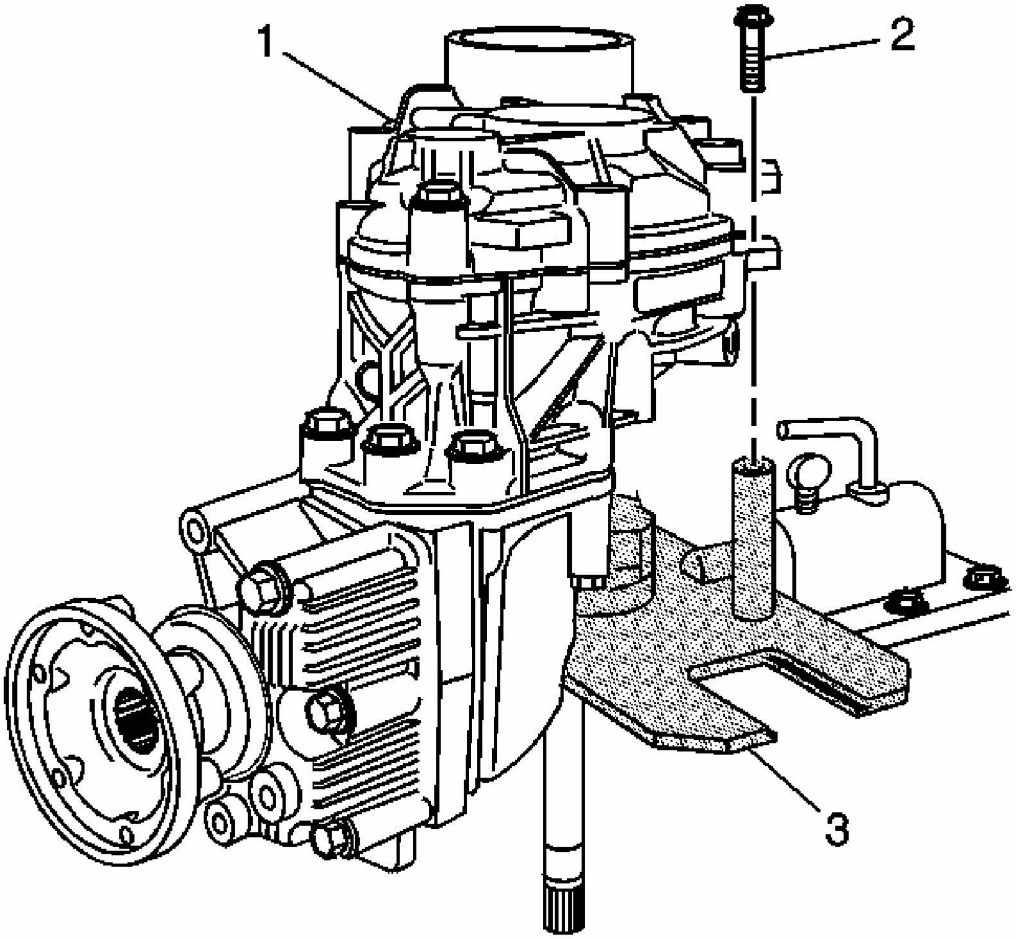


Fig. 39: Identifying J 44755
Courtesy of GENERAL MOTORS CORP.

13. Install the transfer case assembly onto the **J 44755** . Position the carrier onto the post of the fixture.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

14. Install the retaining bolts.

Tighten: Tighten the retaining bolts to 50 N.m (37 lb ft).

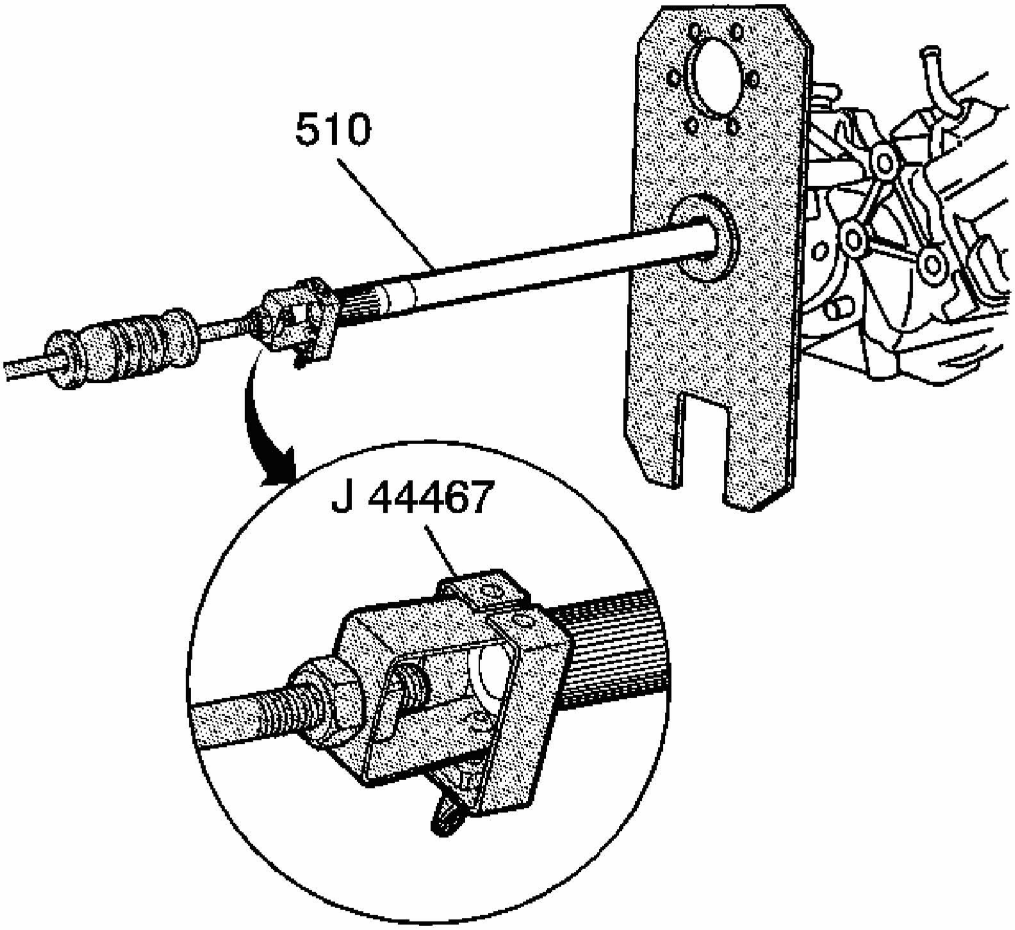


Fig. 40: View Of J 6125-1B & J 44467
Courtesy of GENERAL MOTORS CORP.

15. Attach the **J 6125-1B** to **J 44467** . See **Special Tools**. Install the **J 44467** into the snap ring groove on the output shaft (510). See **Special Tools**. Tighten **J 44467** securely to the output shaft. See **Special Tools**.
16. Remove the output shaft with the slide hammer impact.

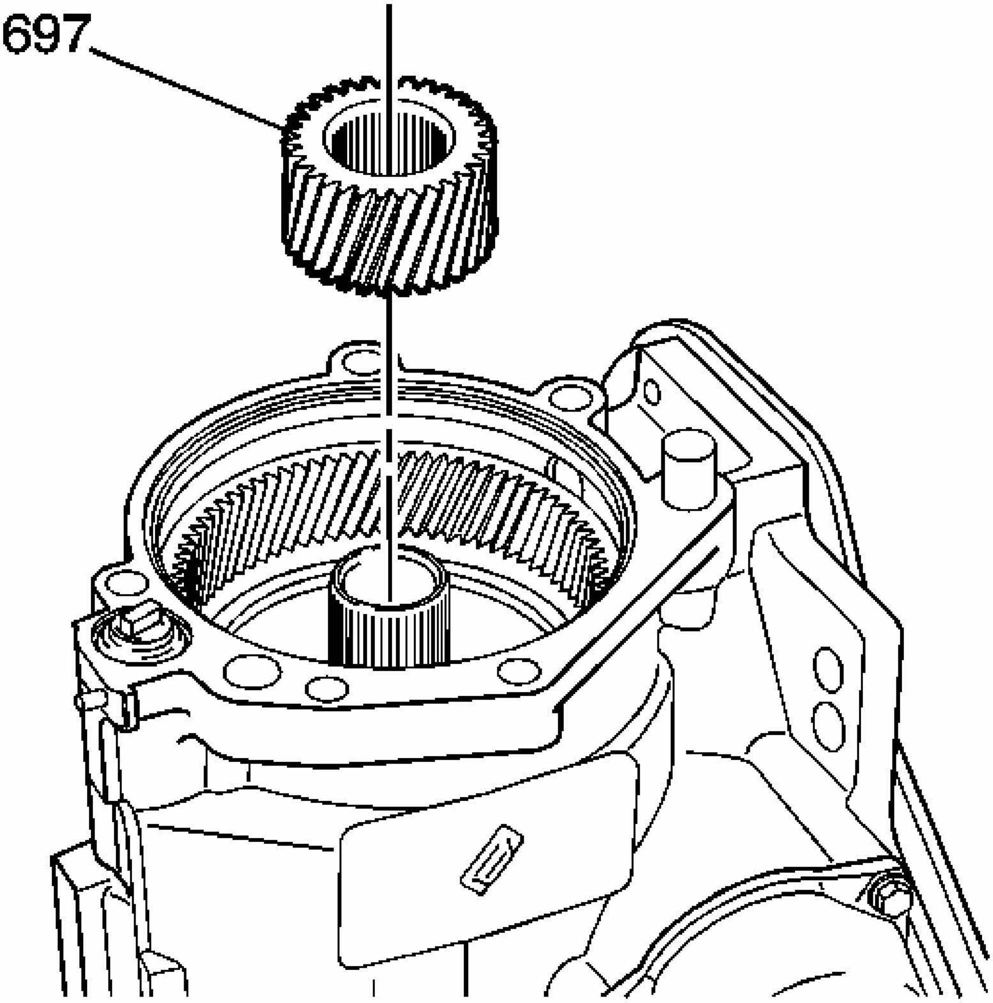


Fig. 41: Locating Final Drive Sun Gear
Courtesy of GENERAL MOTORS CORP.

17. Remove the final drive sun gear (697).

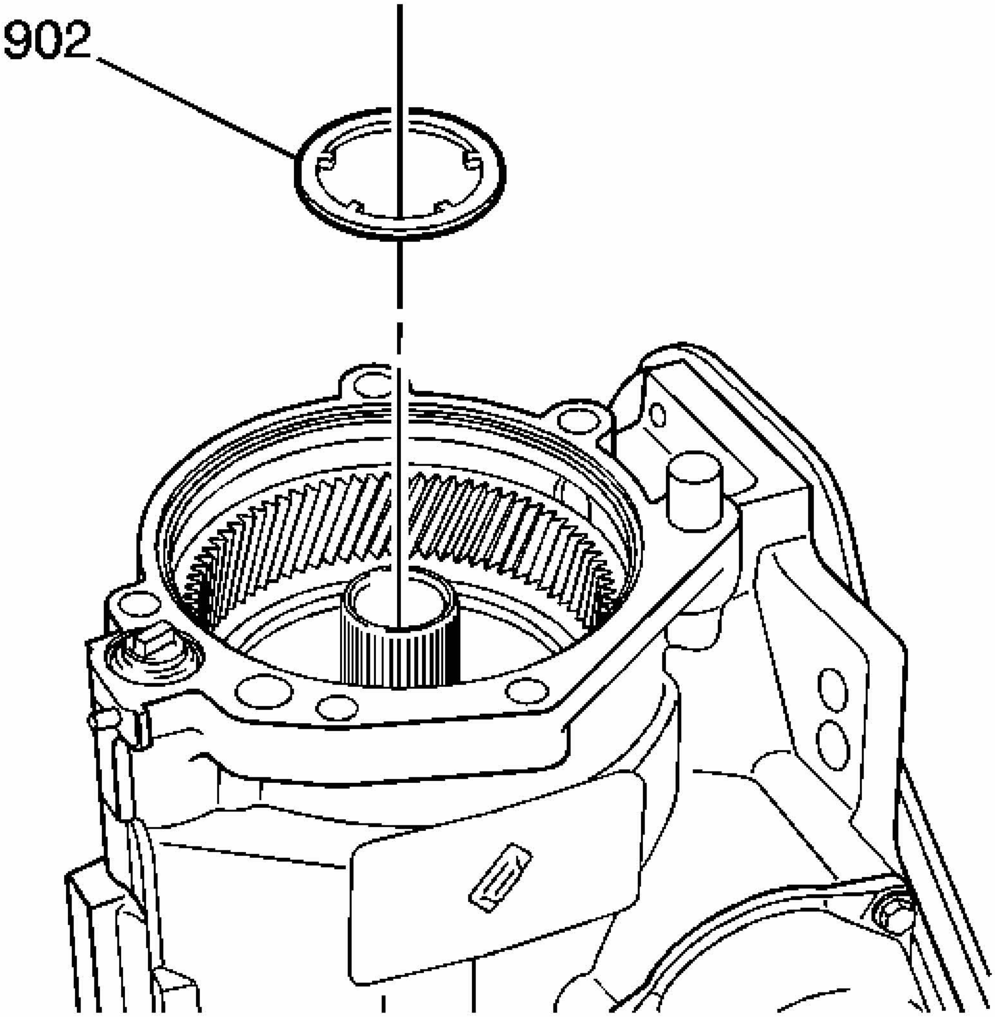


Fig. 42: View Of Selective Washer
Courtesy of GENERAL MOTORS CORP.

18. Remove the selective washer (902).

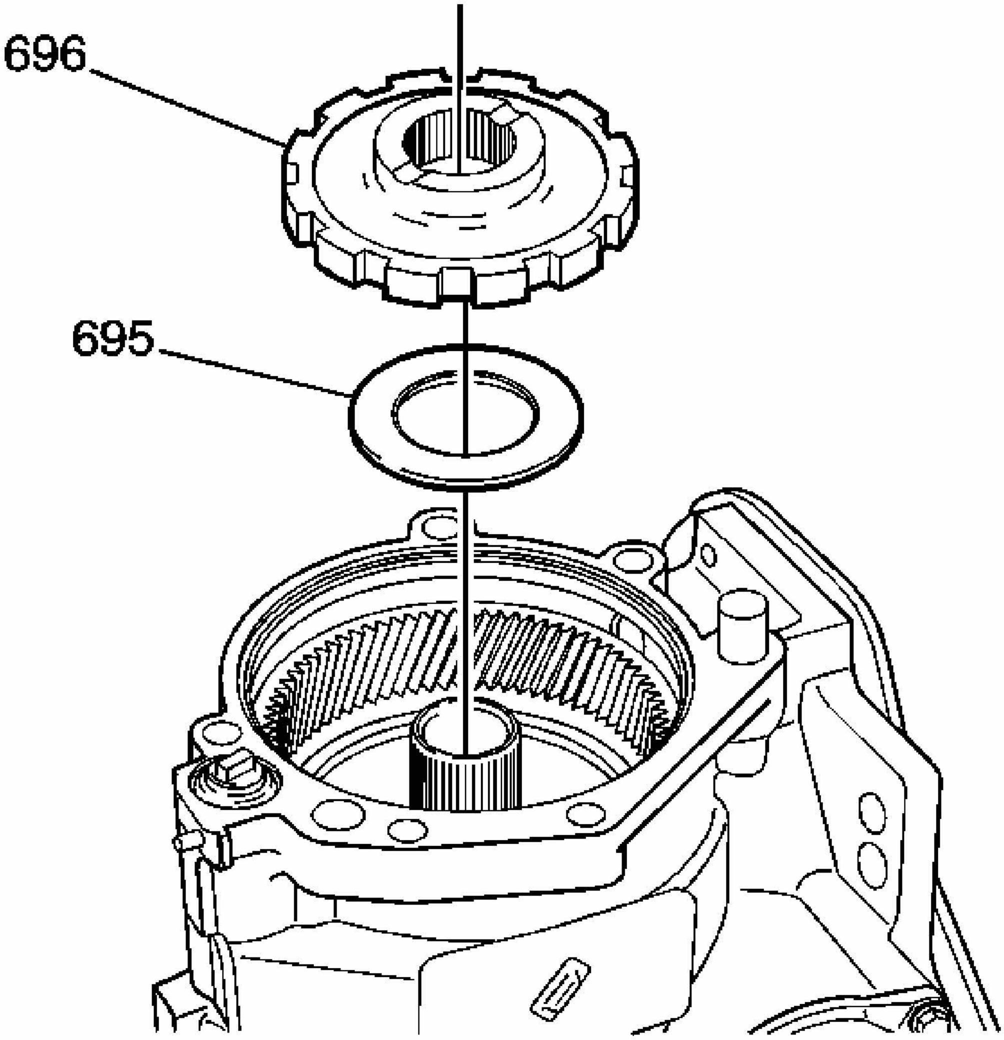


Fig. 43: View Of Park Gear Thrust Bearing & Park Gear
Courtesy of GENERAL MOTORS CORP.

19. Remove the parking gear (696) and the parking gear thrust bearing (695).

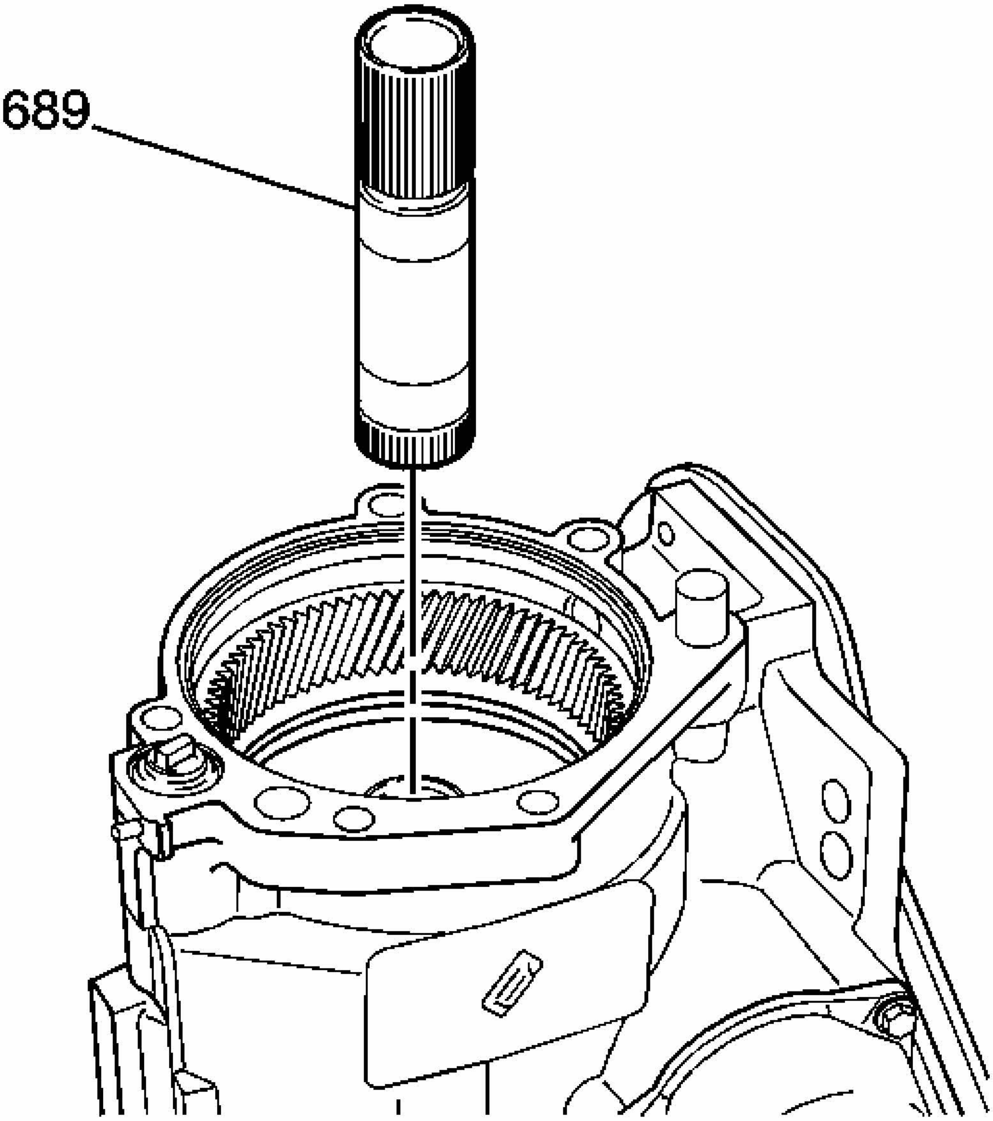


Fig. 44: Identifying Final Drive Sun Gear Shaft
Courtesy of GENERAL MOTORS CORP.

20. Remove the final drive sun gear shaft (689).

REVERSE SERVO REMOVAL

Removal Procedure

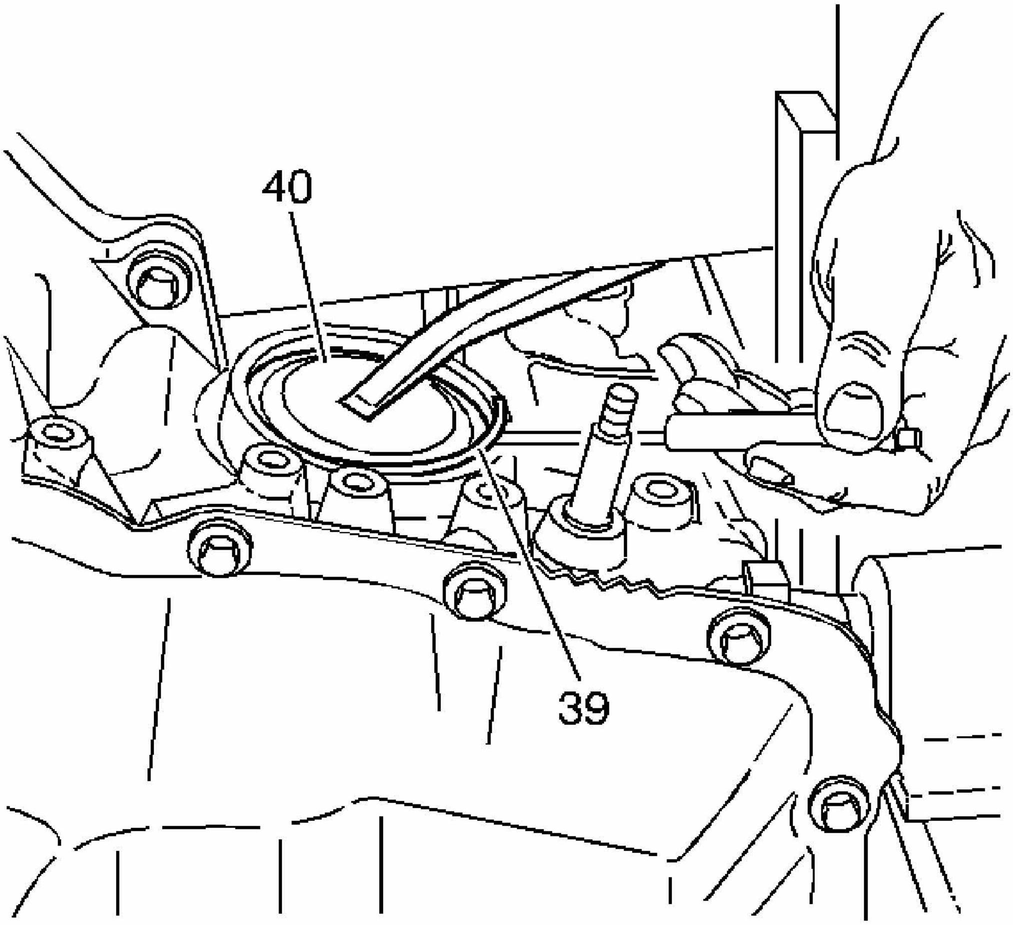


Fig. 45: Removing/Installing Reverse Servo Cover Snap Ring
Courtesy of GENERAL MOTORS CORP.

1. Use a long screwdriver in order to depress the reverse band servo cover (40) by prying against the transmission holding fixture.
2. Use a small screwdriver in order to pry out the retaining ring (39) from the reverse band servo cover.

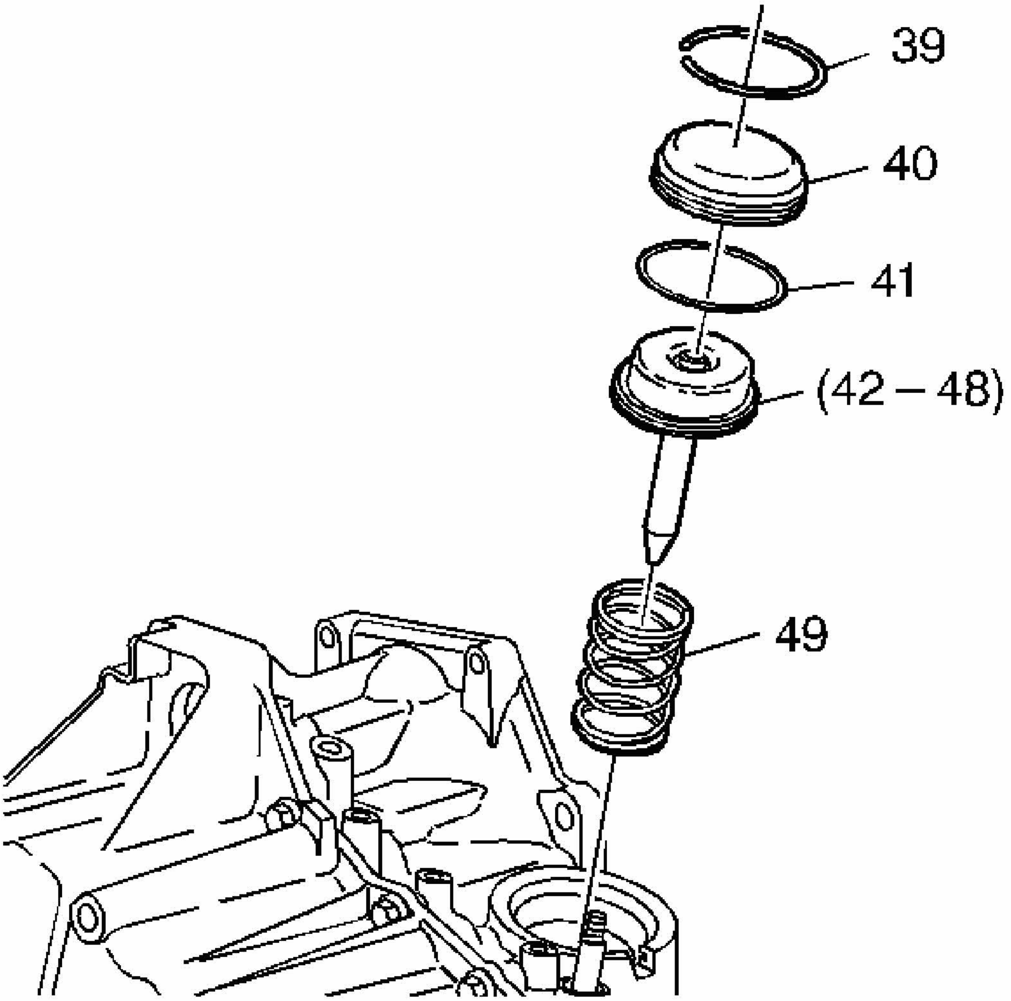


Fig. 46: Identifying Reverse Servo Assembly Components
Courtesy of GENERAL MOTORS CORP.

3. Remove the long screwdriver. The servo assembly will push the servo cover (40) up.
4. Remove the servo cover (40) and the servo cover O-ring seal (41).
5. Remove the reverse band servo assembly (42-48).
6. Remove the reverse band servo piston spring (49).

FORWARD SERVO REMOVAL

Removal Procedure

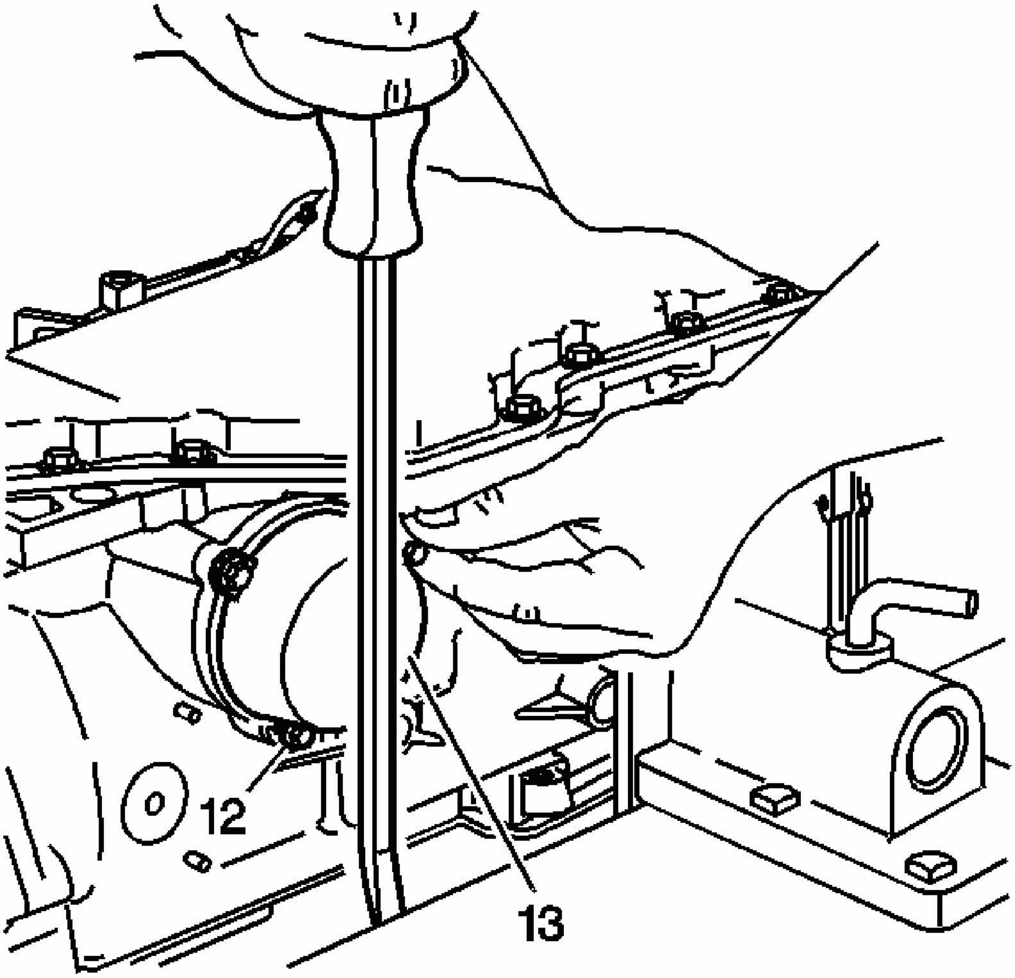


Fig. 47: Compressing Forward Band Servo Assembly
Courtesy of GENERAL MOTORS CORP.

1. Position the transmission so that the oil pan is facing up.
2. Use a long screwdriver in order to compress the forward band servo assembly cover (13) by prying against the work bench.
3. Hold the servo assembly compressed.

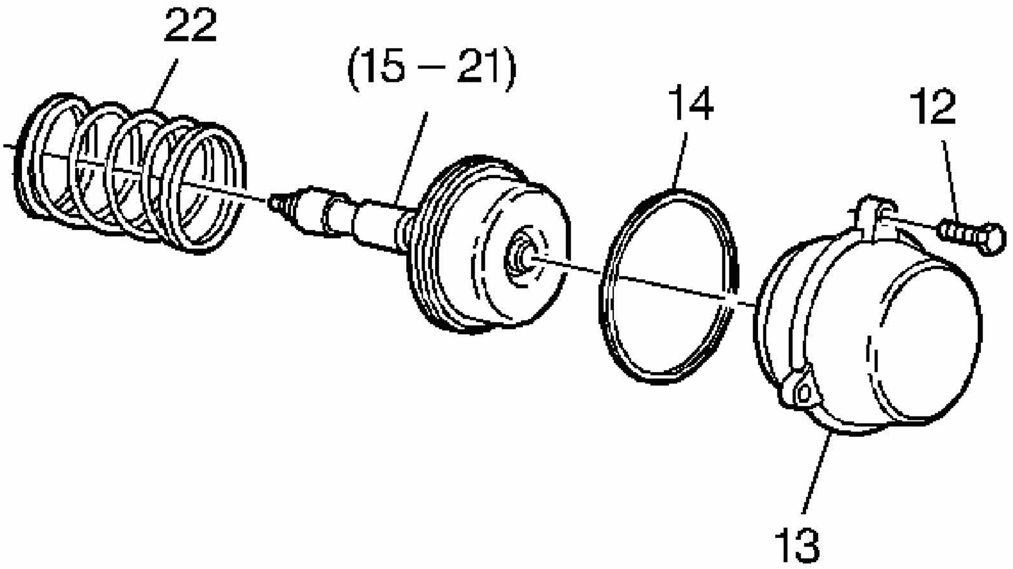


Fig. 48: View Of Servo Assembly
Courtesy of GENERAL MOTORS CORP.

4. Remove the three forward band servo cover bolts (12).
5. Remove the long screwdriver. The servo assembly will push the servo cover out. If the servo cover does not push out, tap it with a rubber mallet.
6. Remove the servo cover (13) and remove the cover seal (14).
7. Remove the servo assembly (15-21).
8. Remove the piston spring (22) from the forward band servo.

PAN AND FILTER ASSEMBLY REMOVAL

Removal Procedure

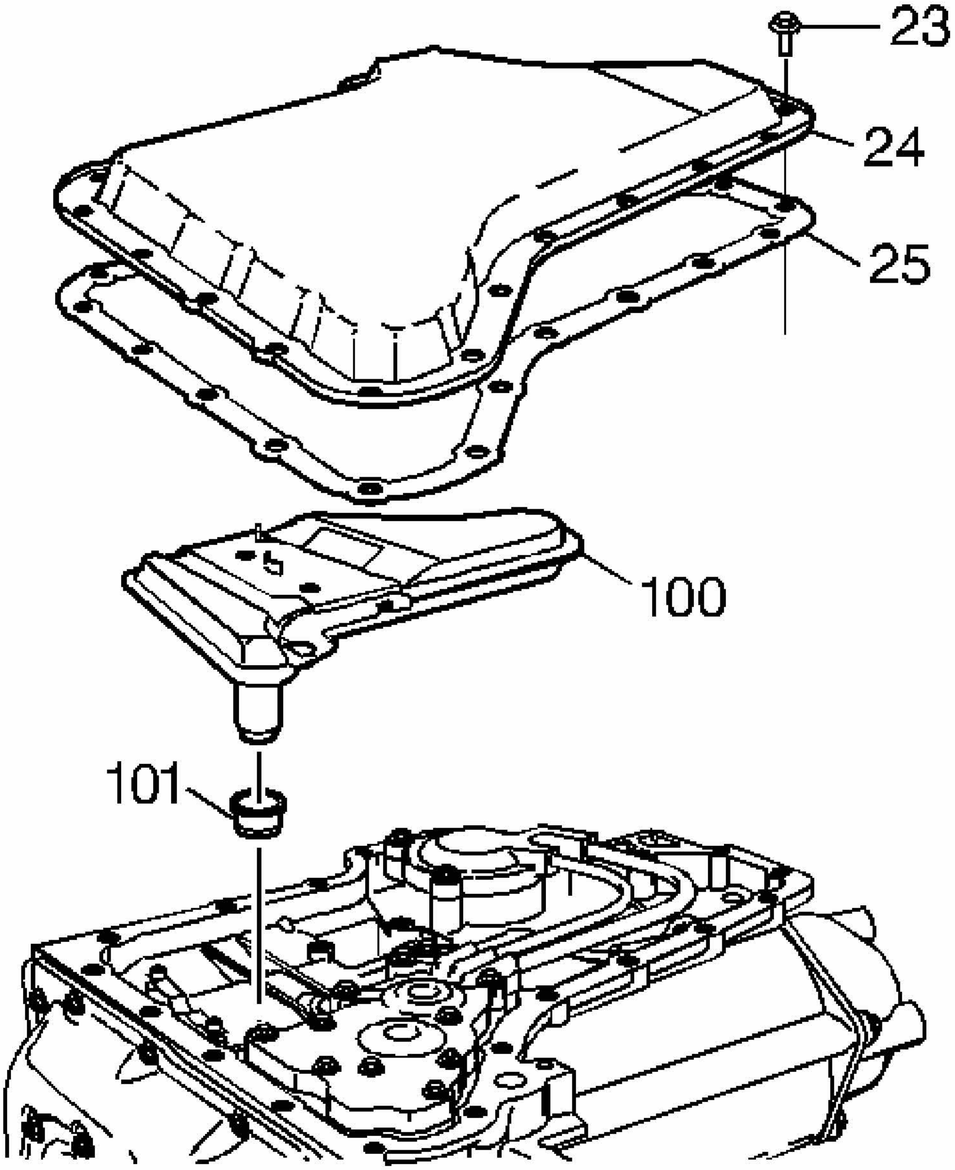


Fig. 49: Removing Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the 20 oil pan bolts (23).
2. Remove the oil pan (24).
3. Remove the oil pan gasket (25).
4. Use a screwdriver in order to pry the oil filter assembly (100) out of the case. Do not damage the case sealing surface.

5. Use a small screwdriver in order to pry the oil filter seal assembly (101) out of the case. Do not damage the case sealing surface.

TRANSMISSION FLUID FILTER INSPECTION

Inspection Procedure

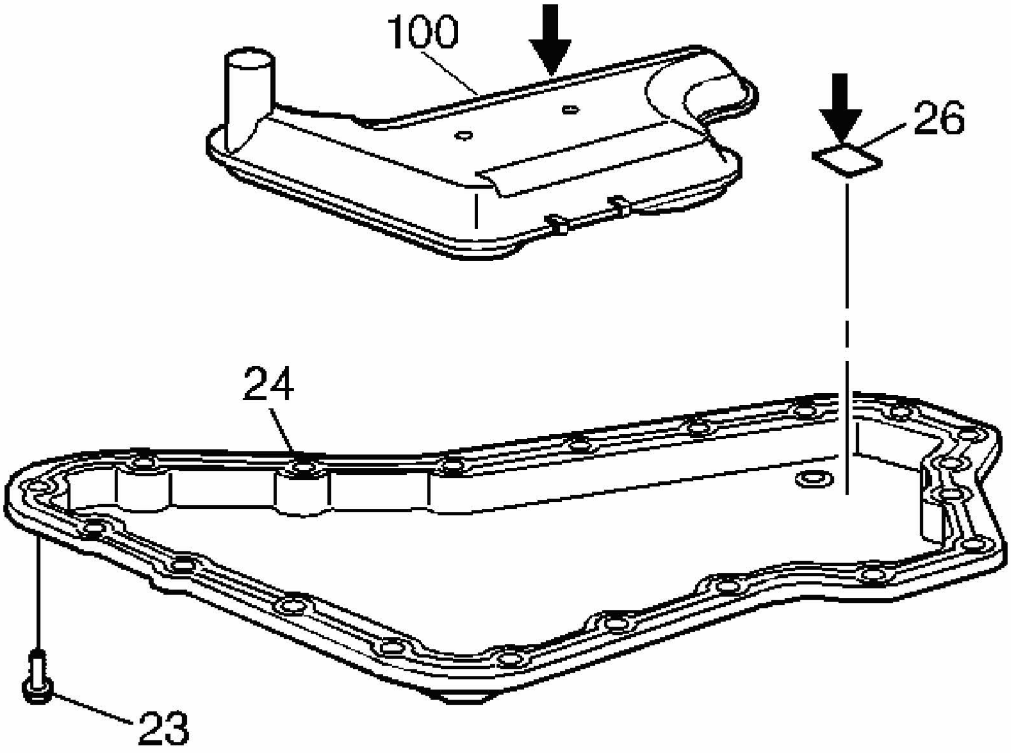


Fig. 50: Inspecting Oil Pan Magnet & Filter
Courtesy of GENERAL MOTORS CORP.

1. Inspect the oil pan magnet (26) for steel particles. Excessive amounts of steel shavings indicate internal transmission damage.
2. Use a screwdriver or side cutters in order to open the oil filter assembly (100), by cutting or prying the metal crimping away from the top of the filter and by pulling the filter apart.
3. Inspect the filter (100) for excessive amounts of the following:
    - Clutch plate assembly fiber material, indicating clutch distress
    - Bronze slivers, indicating bushing wear
    - Steel particles, indicating internal transmission damage

ACCUMULATOR ASSEMBLY AND 2-1 BAND SERVO REMOVAL

Removal Procedure

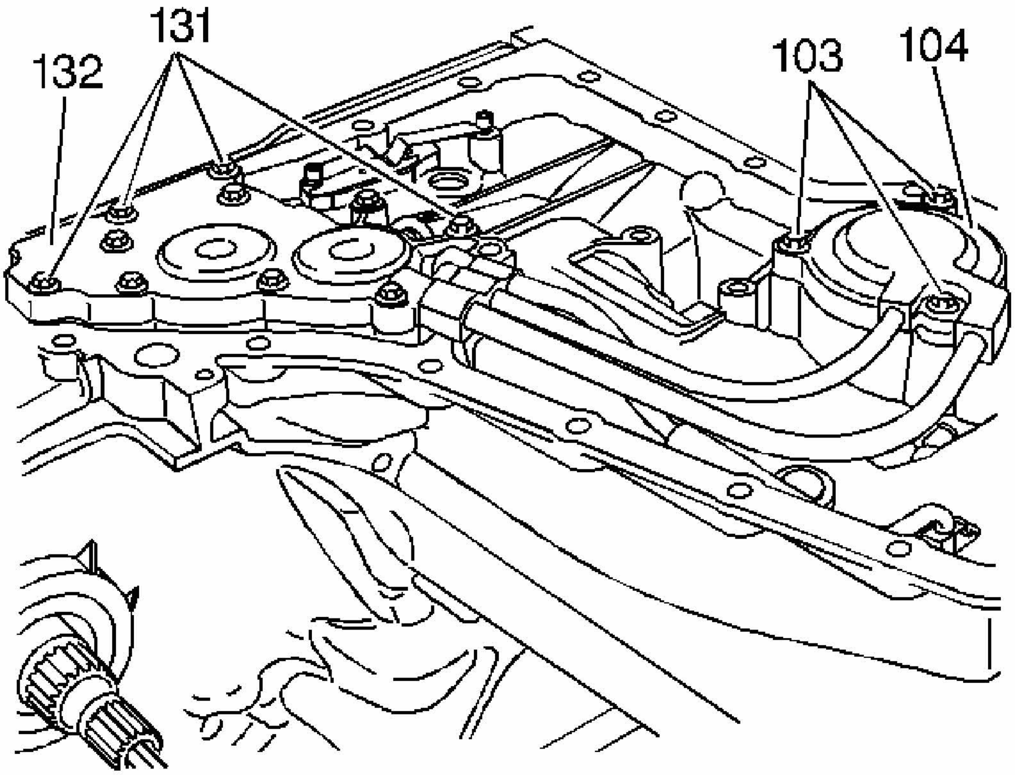


Fig. 51: Removing Accumulator Cover & Manual 2-1 Band Servo Cover Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the four indicated accumulator cover bolts (131) from the 1-2 and 2-3 accumulator cover (132).
2. Remove the three indicated bolts (103) from the manual 2-1 band servo cover (104).

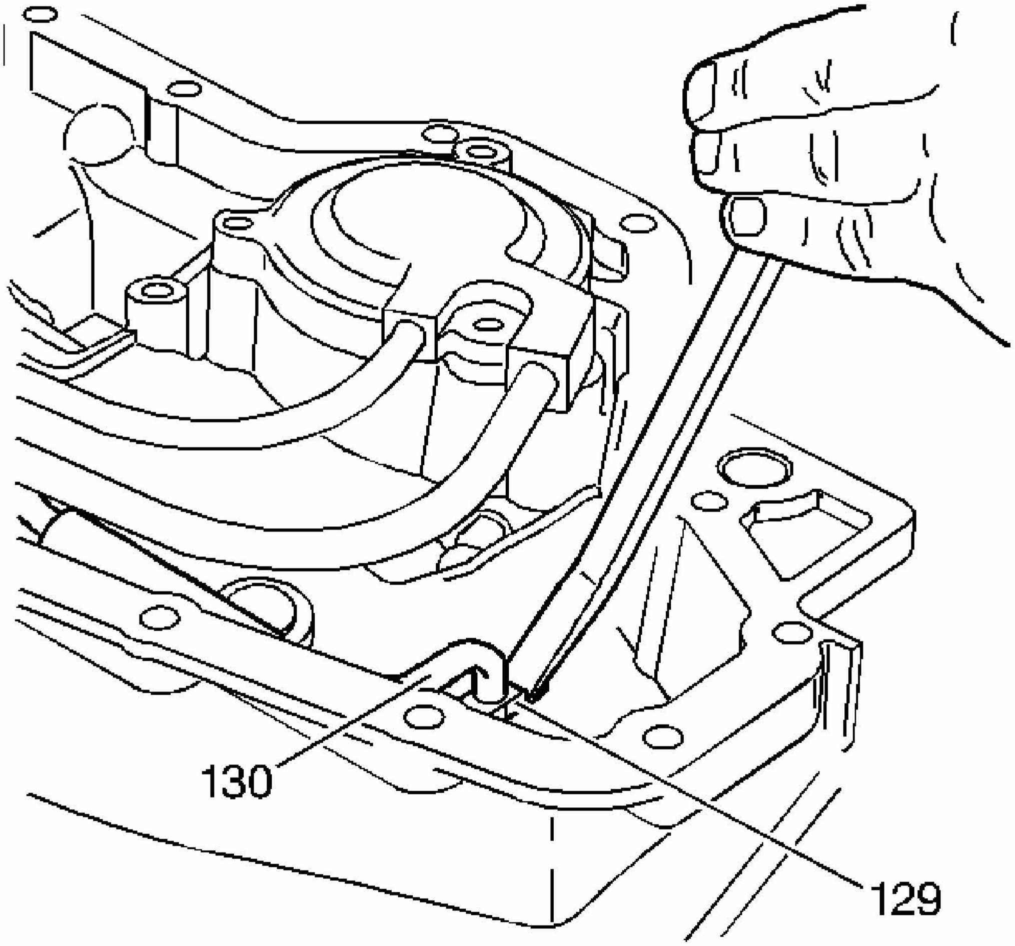


Fig. 52: Prying Out Lube Oil Pipe Retainer
Courtesy of GENERAL MOTORS CORP.

3. Use a large screwdriver in order to gently pry the lube oil pipe retainer (129) from the case.
4. Remove the lube oil pipe (130) from the front differential carrier internal gear lube hole.

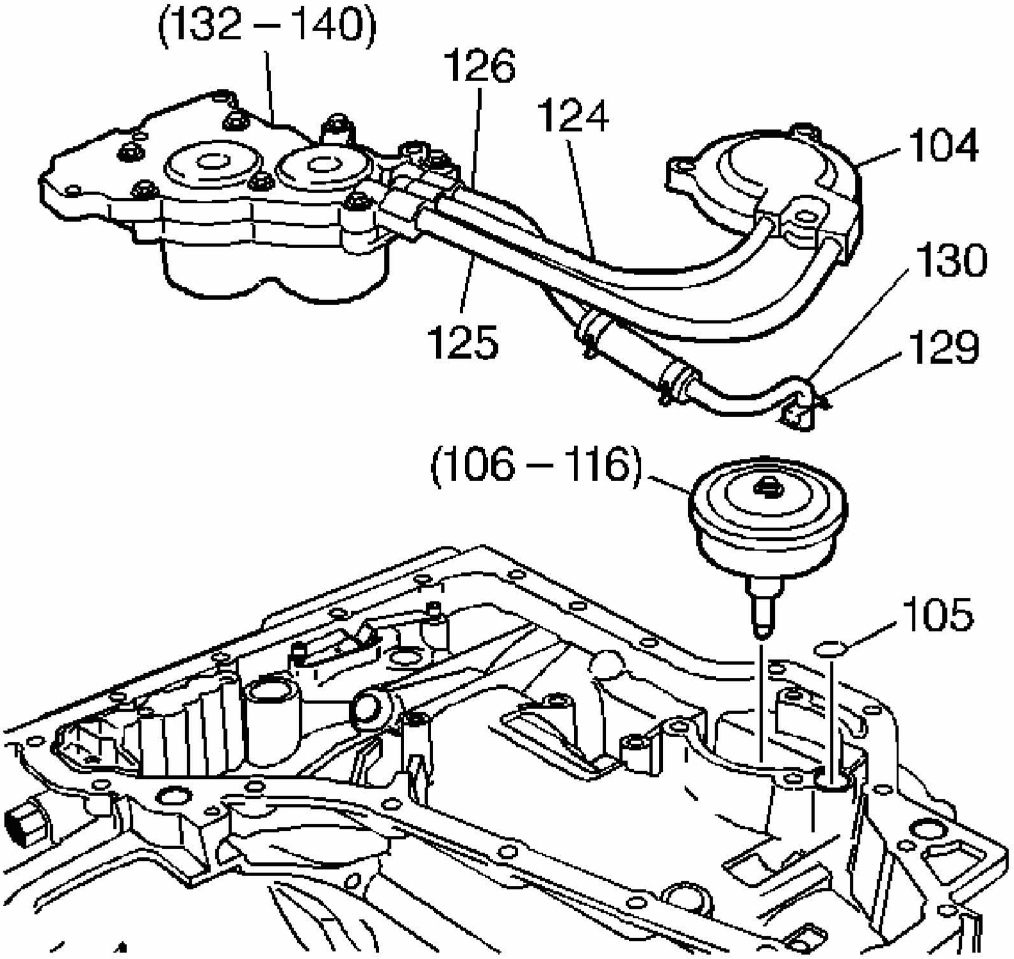


Fig. 53: Disconnecting 1-2 & 2-3 Accumulator Assembly & Manual 2-1 Band Servo Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: **Do not twist or damage the pipe assembly when removing the pipe assembly.**

5. Remove the 1-2 and 2-3 accumulator assembly (132-140), the pipe assembly (124-126) and the manual 2-1 band servo cover (104).
6. Remove the manual 2-1 band servo assembly (106-116) out of the case at the same time.
7. Remove the cover seal (105) from the manual 2-1 band servo assembly.

CONTROL VALVE BODY COVER AND GASKETS DISASSEMBLE

Disassembly Procedure

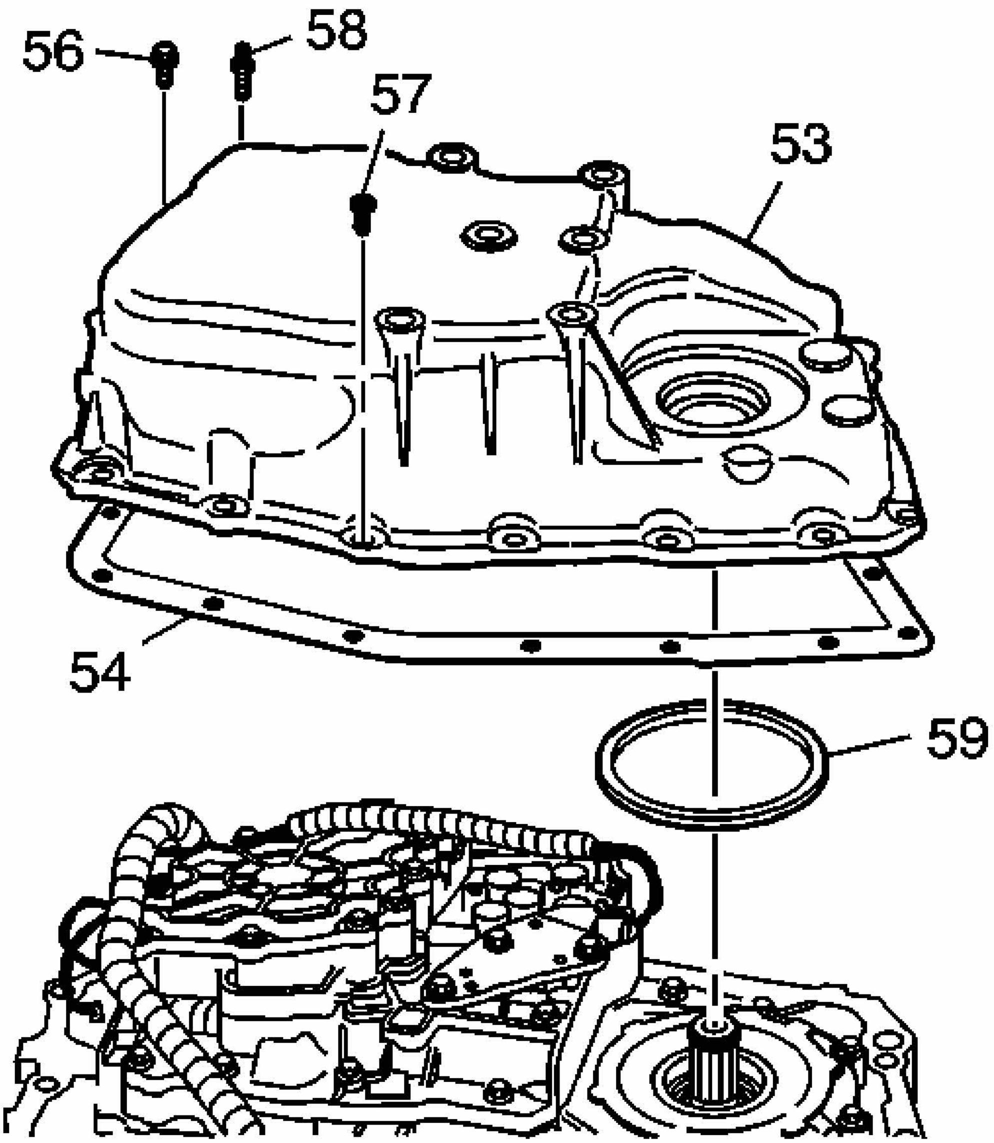


Fig. 54: View Of Control Valve Body Cover Bolts
Courtesy of GENERAL MOTORS CORP.

1. Position the transaxle so that the control valve body cover (53) is facing up.
2. Remove the 17 control valve body cover bolts:
   - 9 flanged bolts (56)
   - 4 TORX bolts (57)

- 4 stud bolts (58)

3. Remove the cover (53), outer gasket (54) and inner gasket (59).

WIRING HARNESS REMOVAL

Removal Procedure

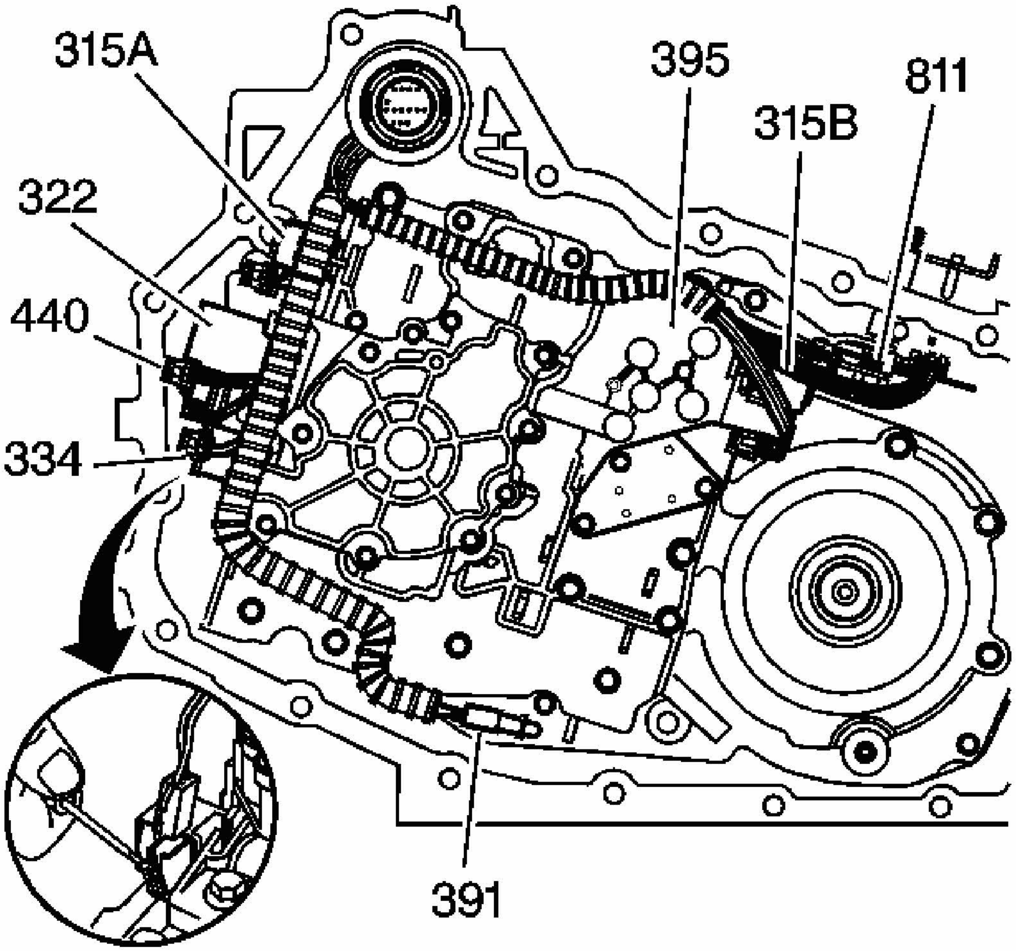


Fig. 55: Disconnecting Wiring Harness Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

1. Using a small screwdriver, pry the wiring harness (224/225) electrical connectors off of the following components:
   - Automatic transaxle fluid pressure manual valve position switch assembly (395)
   - 1-2, 3-4 Shift solenoid valve assembly (315A)
   - 2-3 Shift solenoid valve assembly (315B)

- TCC PWM solenoid valve assembly (334)
- Pressure control solenoid valve assembly (322)
- Automatic transaxle input speed sensor assembly (440)
- IMS (811)

2. Gently pull the automatic transaxle fluid temperature sensor (391) from it's clip.

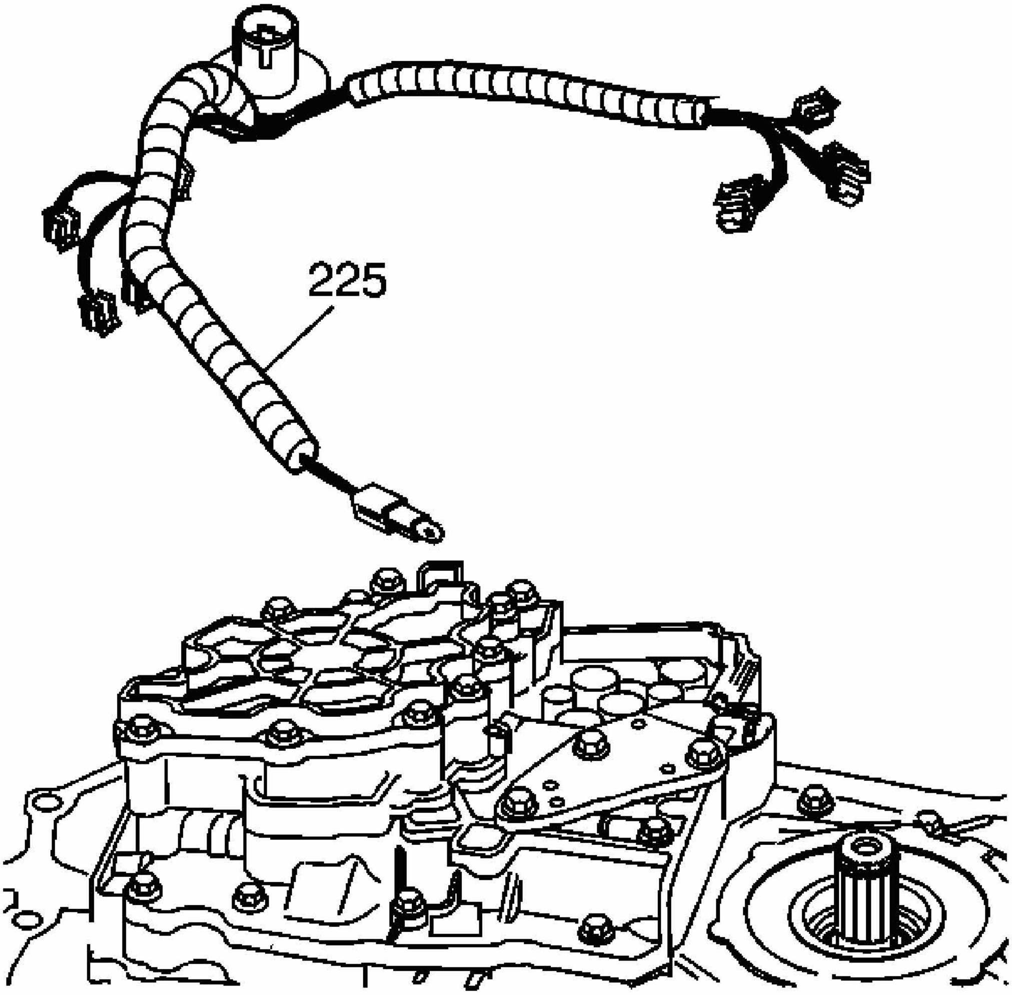


Fig. 56: Identifying Wiring Harness Assembly
Courtesy of GENERAL MOTORS CORP.

3. Lift the wiring harness assembly (225) off of the transaxle.

OIL PUMP REMOVAL

Removal Procedure

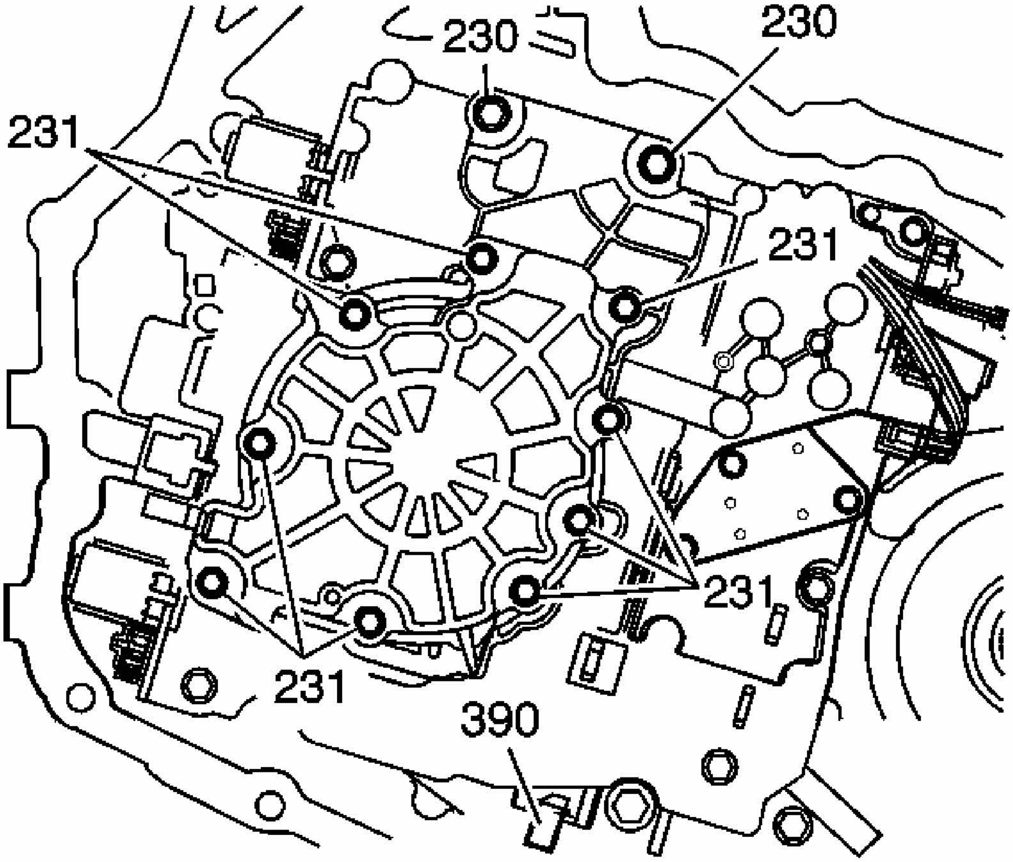


Fig. 57: Locating Oil Pump Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the eleven indicated oil pump bolts (230, 231).
2. Do not remove the one oil pump cover bolt (205) at this time.
3. Remove the one wiring harness clip (390).

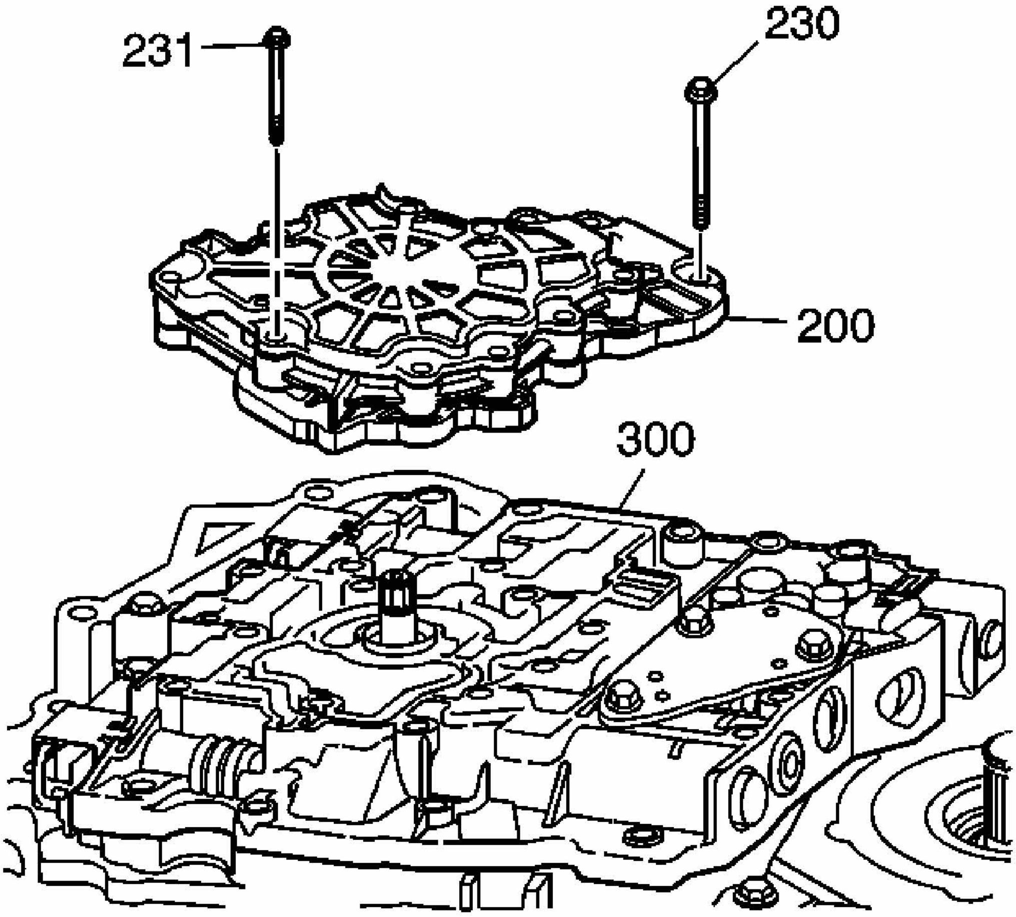
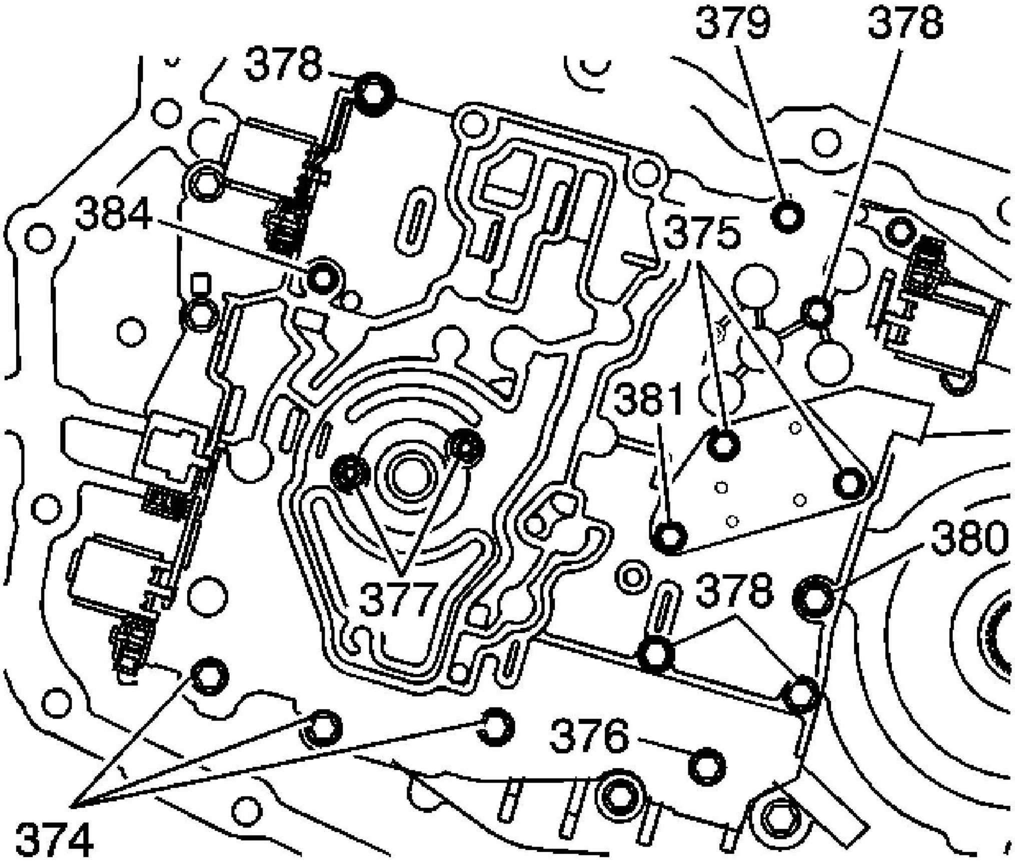


Fig. 58: Locating Oil Pump Assembly
Courtesy of GENERAL MOTORS CORP.

4. Lift the oil pump assembly (200) off of the control valve body (300).
5. Set the oil pump assembly (200) on its cover.

CONTROL VALVE BODY ASSEMBLY REMOVAL

Removal Procedure


379
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374

Fig. 59: Installing Valve Body Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the indicated control valve body bolts (374-381, 384).

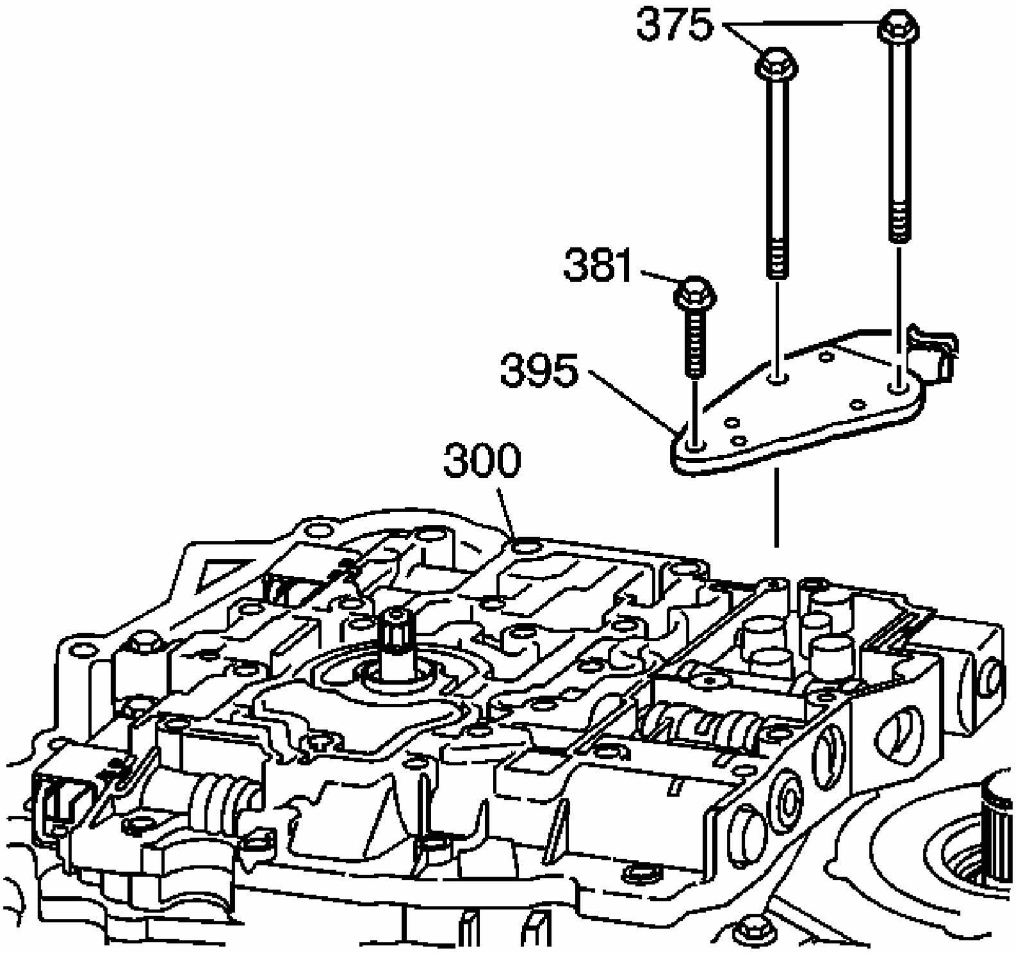


Fig. 60: Removing/Installing Transmission Fluid Pressure (TFP) Manual Valve
Courtesy of GENERAL MOTORS CORP.

2. Carefully lift the fluid pressure manual valve position switch assembly (395) off of the control valve body (300). Handle the switch assembly carefully, it is very delicate.

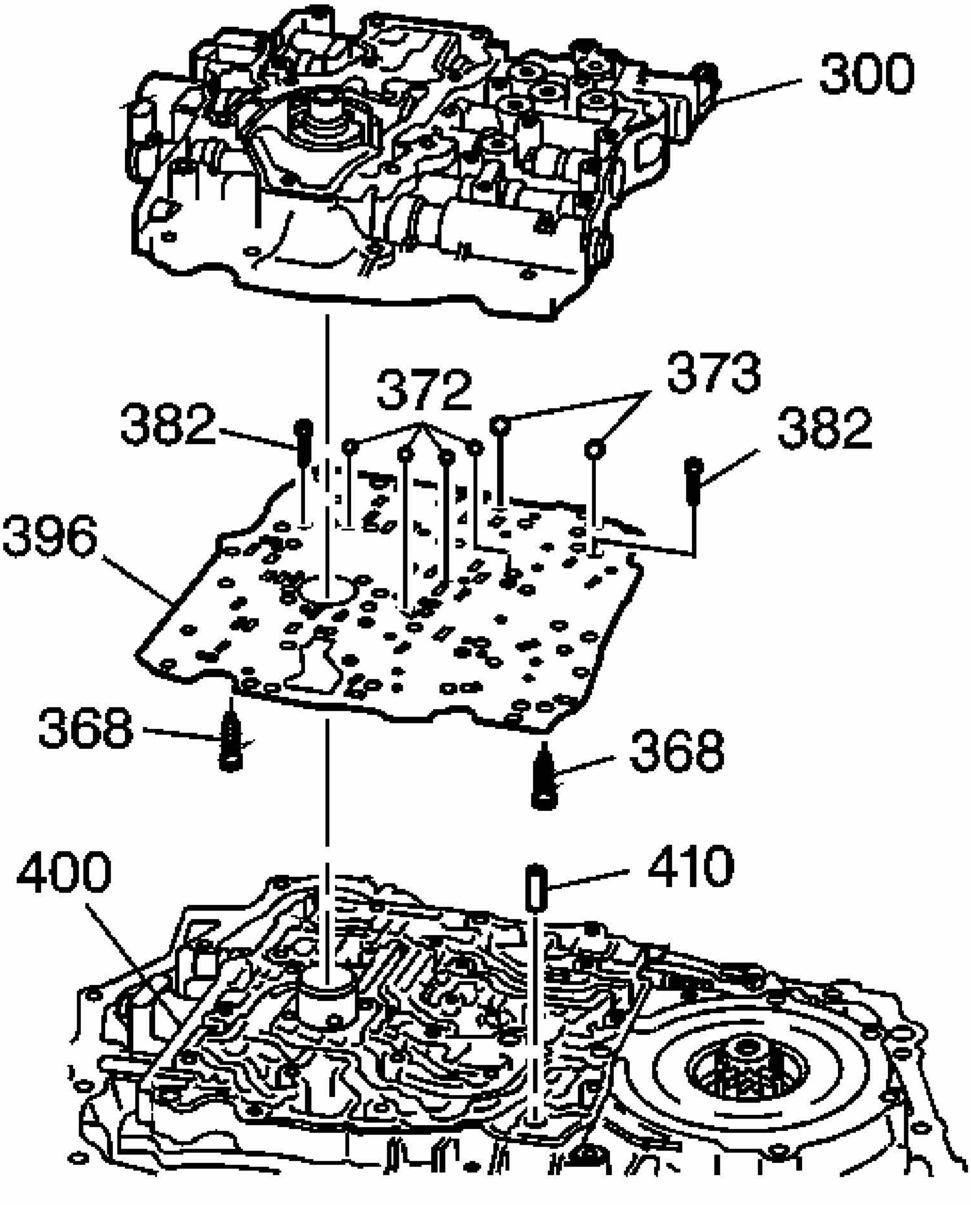


Fig. 61: Identifying Control Valve Body Assembly Components
Courtesy of GENERAL MOTORS CORP.

3. Remove the control valve body assembly (300).
4. Remove the two retainers (368) from the valve body assembly.

IMPORTANT: The bonded spacer plate gasket assembly is not re-useable and should be replaced any time it is removed

from the transmission.

5. Remove the spacer plate and gasket assembly (396) and discard with the two screen/seal assemblies (382) from the valve body (300).
    - Remove the six ball check valves (372, 373) from the valve body (300).
    - Remove the case cover pin (410).

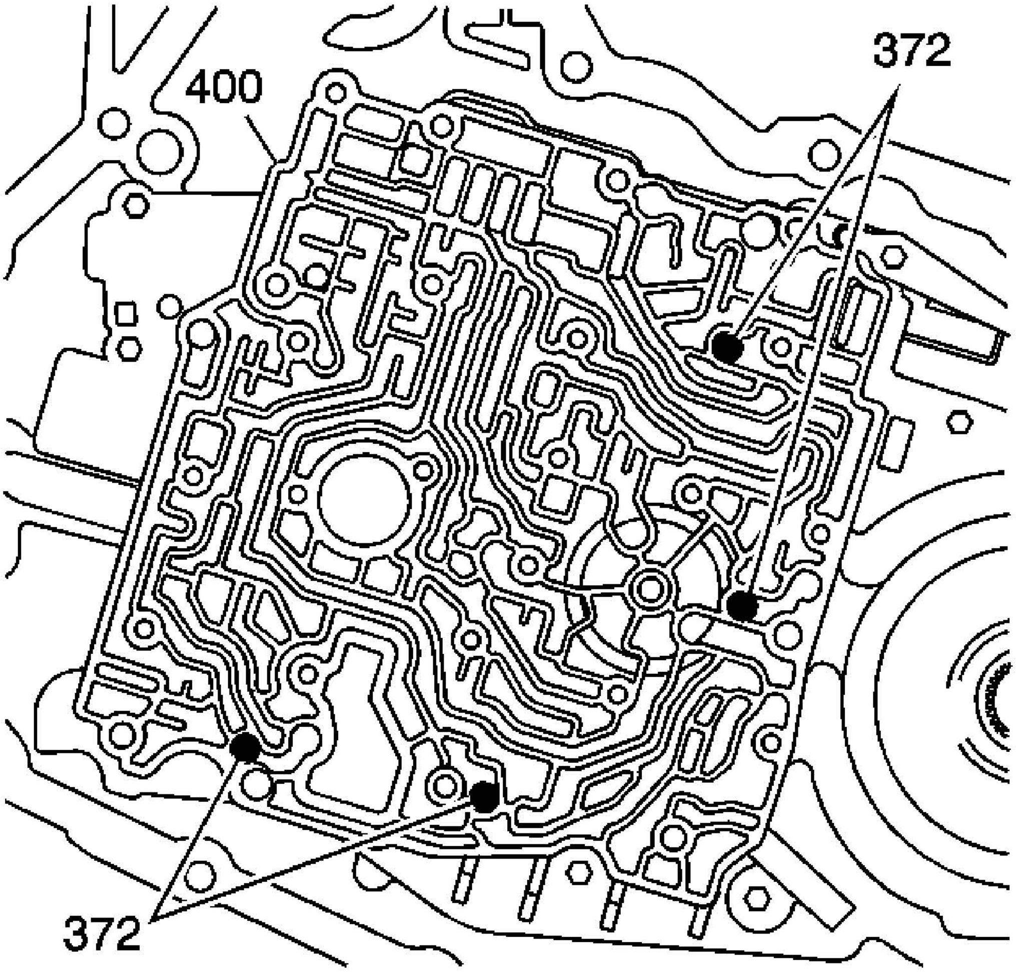


Fig. 62: Locating Ball Check Valves In Case Cover
Courtesy of GENERAL MOTORS CORP.

6. Remove the four ball check valves (372) from the case cover (400).

OIL PUMP DRIVE SHAFT REMOVAL

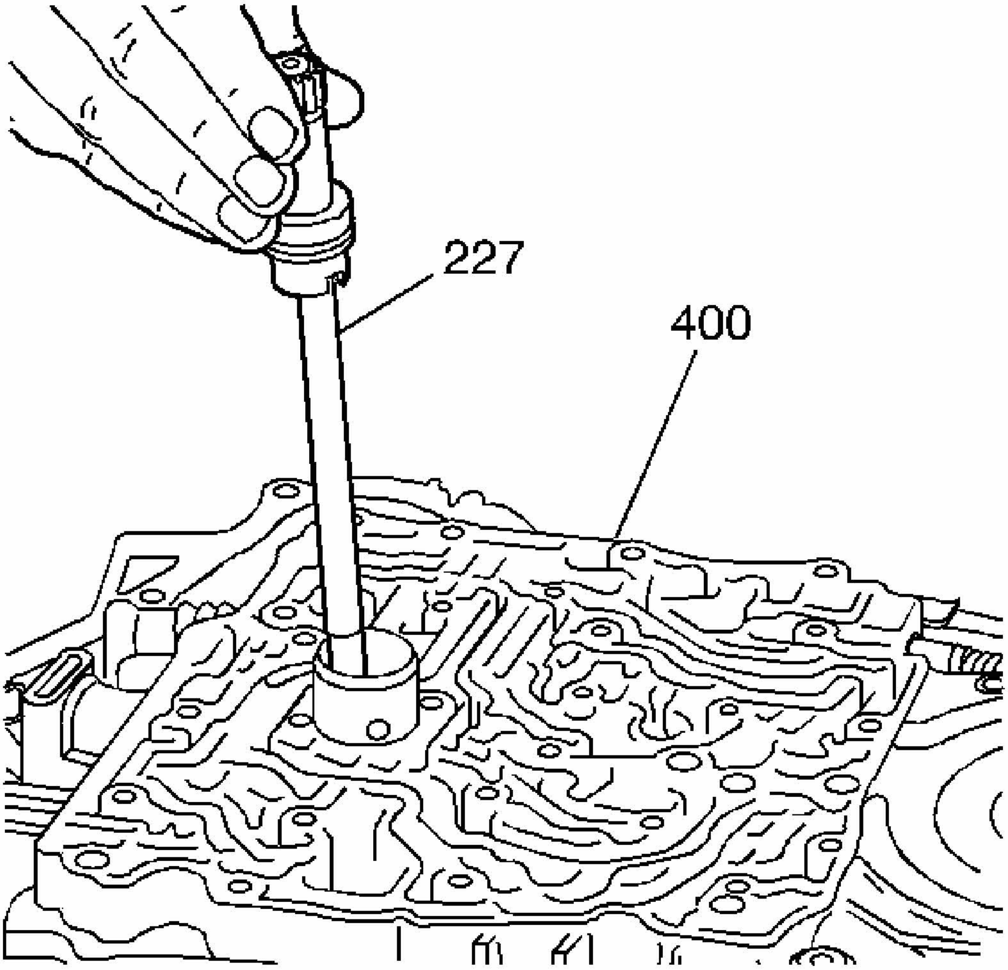


Fig. 63: Removing Oil Pump Drive Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

Remove the oil pump drive shaft assembly (227) from the case cover (400).

VEHICLE SPEED SENSOR REMOVAL

Removal Procedure

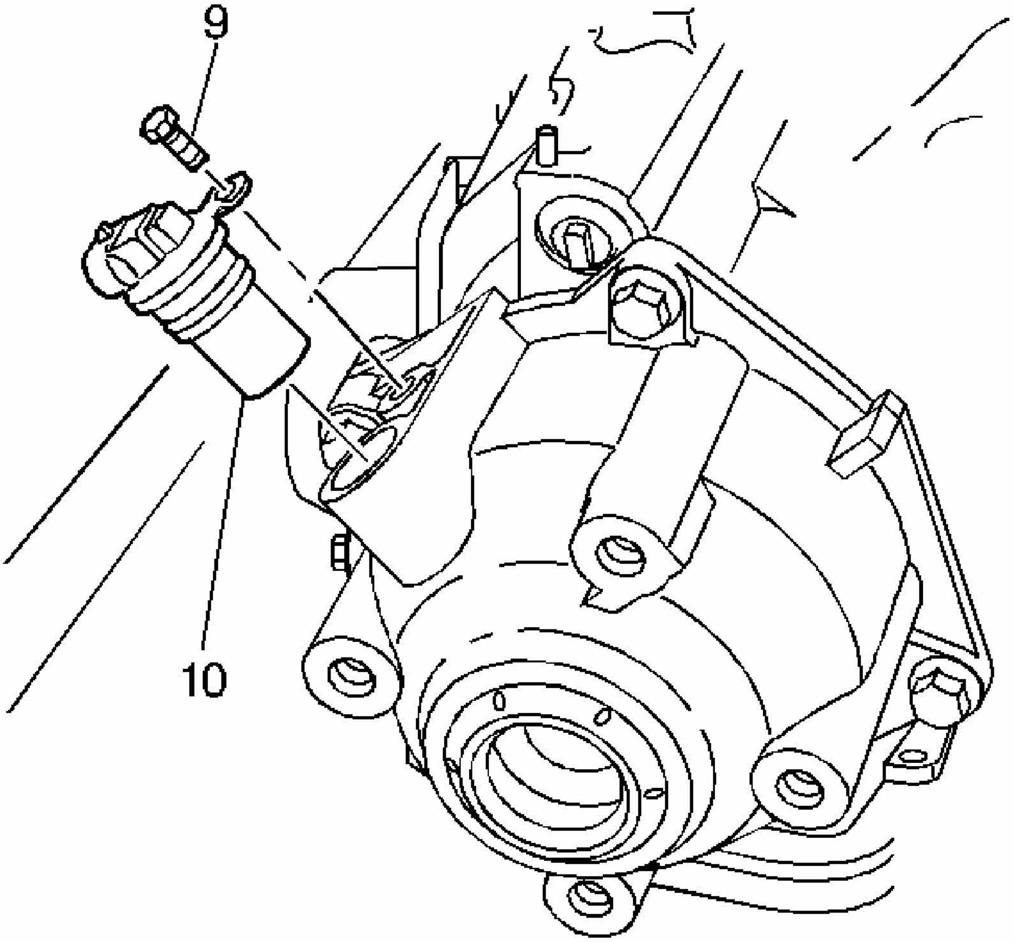


Fig. 64: Identifying Vehicle Speed Sensor (VSS)
Courtesy of GENERAL MOTORS CORP.

1. Position the transmission so that the vehicle speed sensor (10) is facing up.
2. Remove the vehicle speed sensor bolt (9).

IMPORTANT: Handle the speed sensor carefully.

3. Remove the vehicle speed sensor (10).

OUTPUT SHAFT REMOVAL

Tools Required

J 42562 Axle Removal Wedge. See **Special Tools**.

Removal Procedure

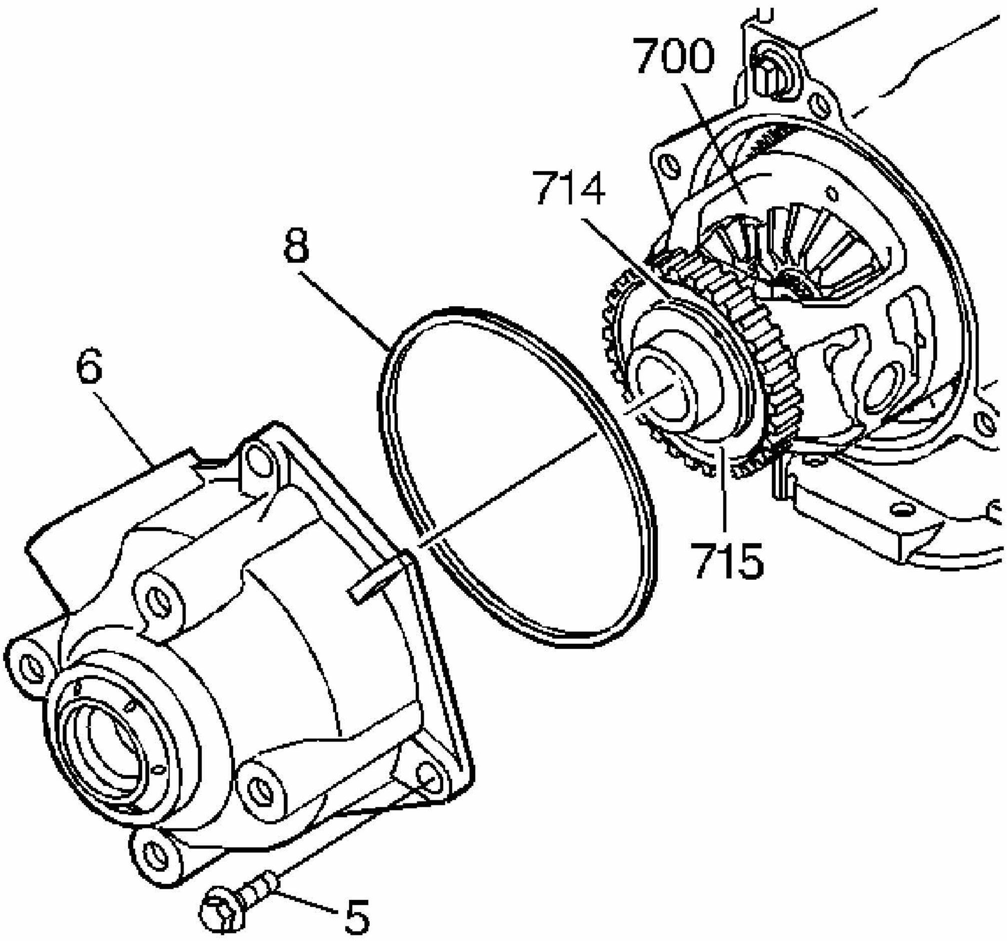


Fig. 65: View Of Case Extension Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the four case extension bolts (5).
2. Remove the case extension assembly (6) and remove the extension seal (8).
3. Leave the differential carrier thrust washer (714) and the bearing (715) on the carrier.

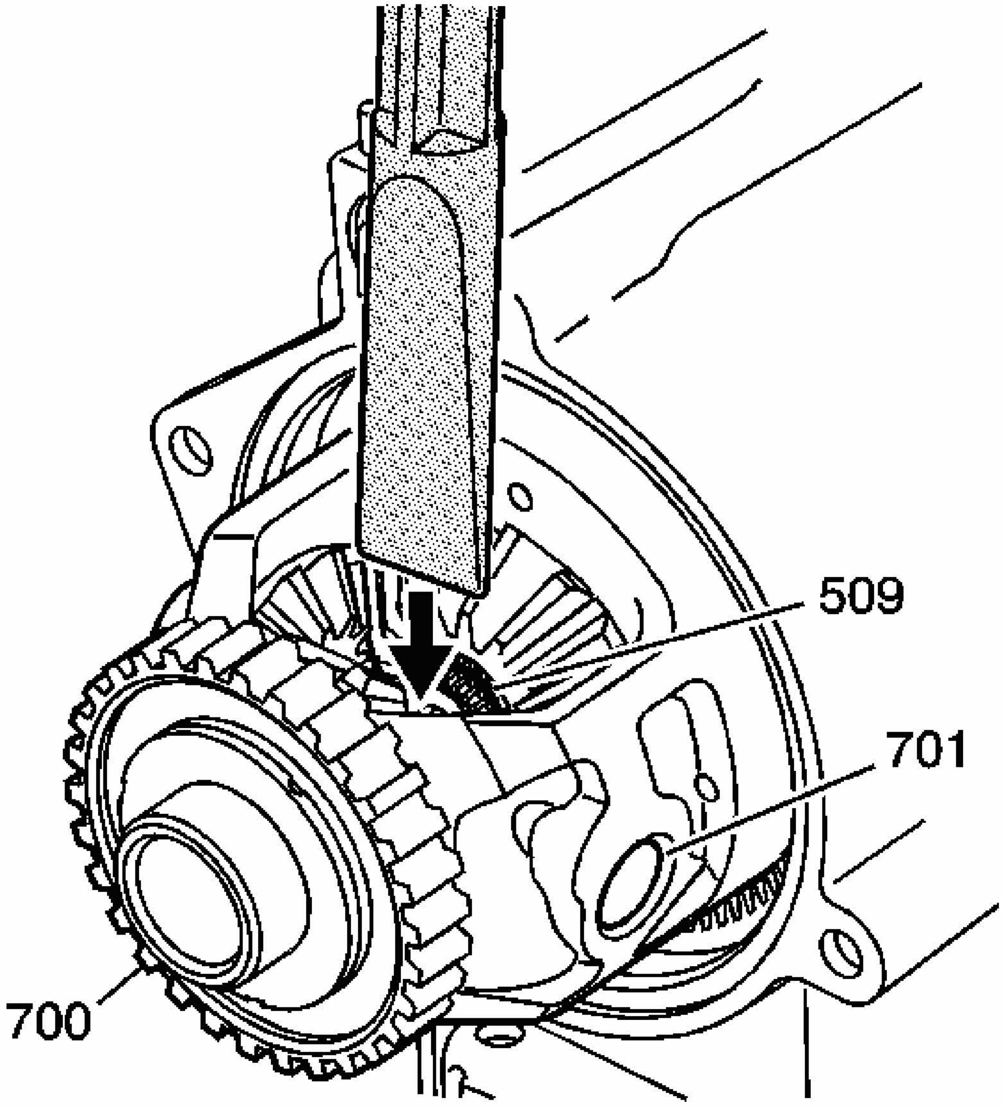


Fig. 66: View Of Compression Ring, Pinion Shaft And Speed Sensor Trigger
Courtesy of GENERAL MOTORS CORP.

4. Rotate the differential carrier until the end of the output shaft can be seen and the differential pinion shaft (701) is in a horizontal position.
5. Place the **J 42562** Axle Removal Wedge between the end of the output shaft and the differential pinion shaft. See **Special Tools**.
6. Using a hammer, hit the end of the axle removal tool in order to compress the output shaft compression ring (509) and push the output shaft through the differential side gear.

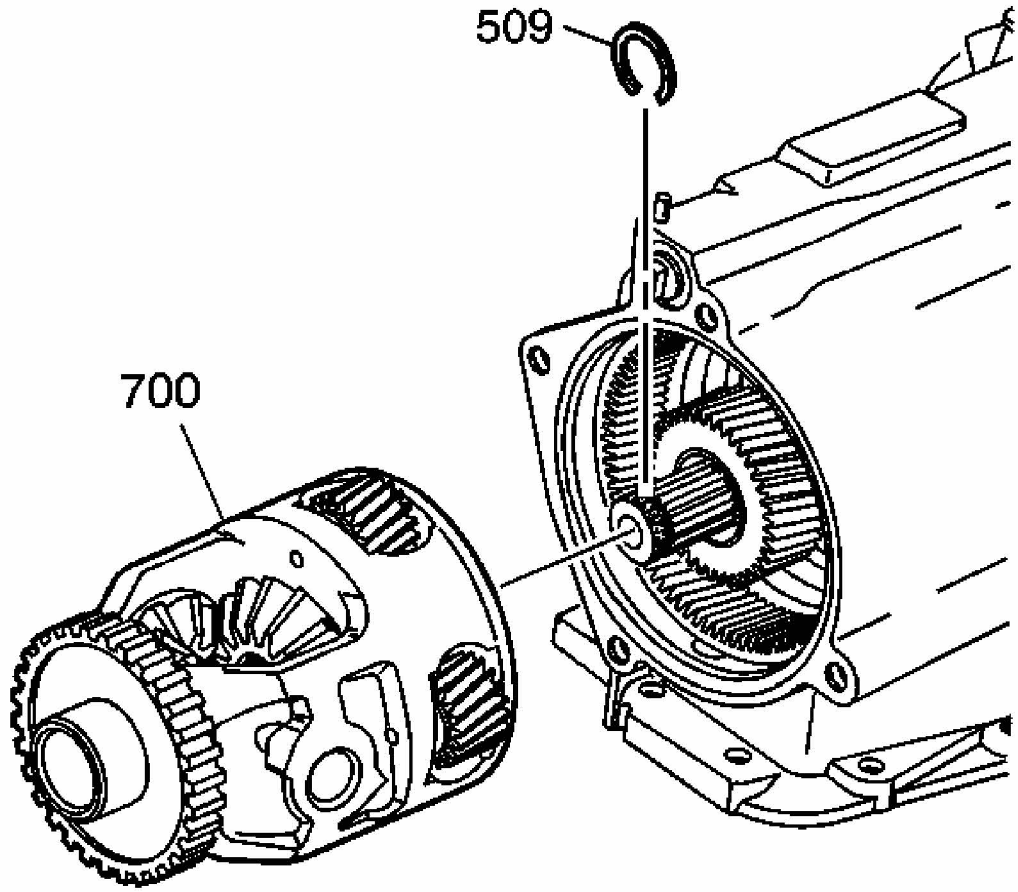


Fig. 67: Identifying Output Shaft Differential Carrier & Compression Ring
Courtesy of GENERAL MOTORS CORP.

7. Remove the differential carrier assembly (700).
8. Using snap ring pliers remove the compression ring (509) from the output shaft.

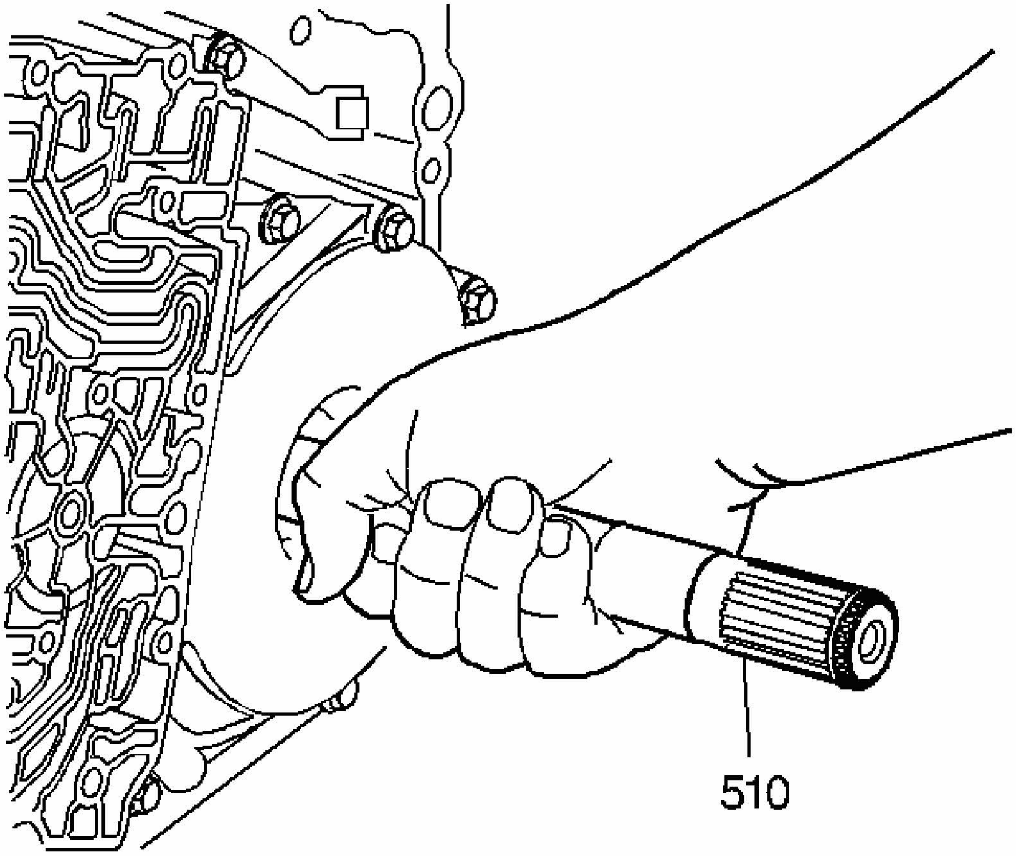


Fig. 68: Removing/Installing Output Shaft
Courtesy of GENERAL MOTORS CORP.

9. Pull the output shaft (510) out of the transmission.

FRONT DIFFERENTIAL CARRIER END PLAY CHECK (FWD ONLY)

Tools Required

- **J 8001** Dial Indicator Set
- **J 25025-8** Dial Indicator Mounting Post. See **Special Tools**.
- **J 26958-10A** Adapter Plug
- **J 28585** Snap Ring Remover

Procedure

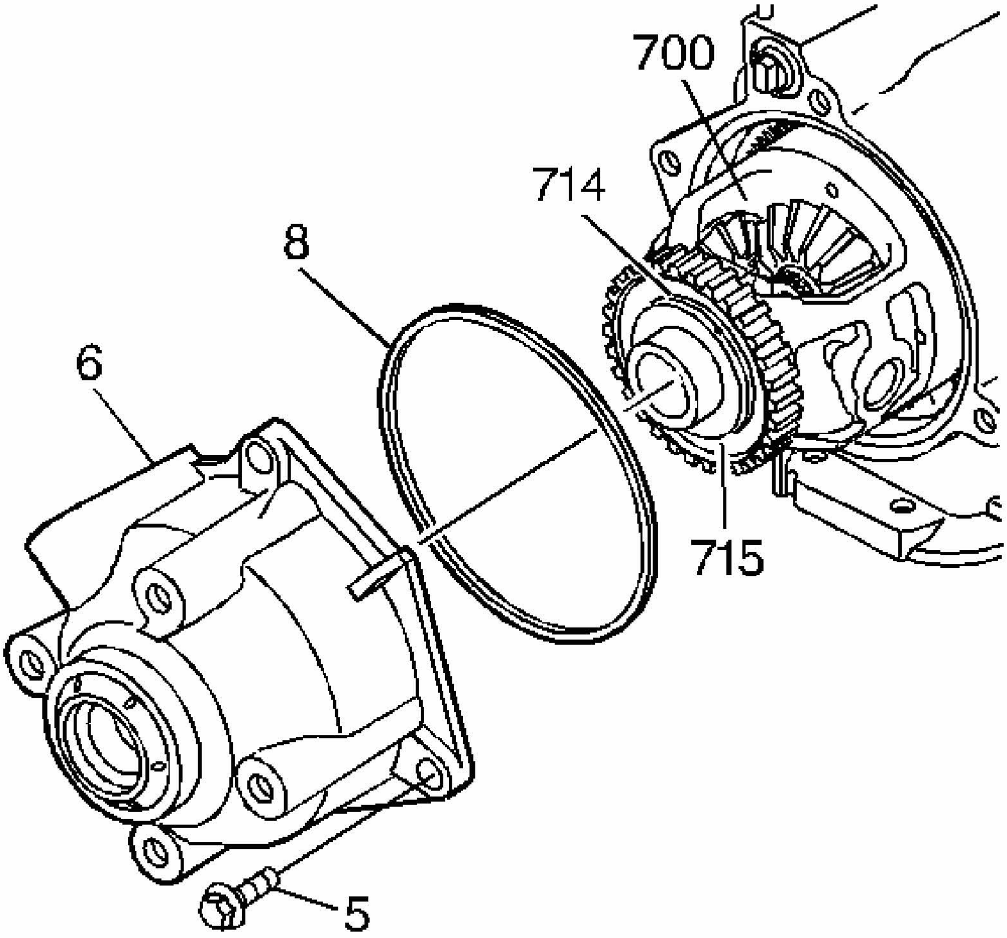


Fig. 69: View Of Case Extension Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

1. If the final drive assembly (700) has been removed it must be reinstalled.
2. Make sure that the thrust washer (714) and the bearing (715) are still on the differential carrier.
3. Install the case extension seal (8) onto the case extension (6).
4. Install the case extension assembly (6) onto the transmission case.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

5. Install only two of the four case extension bolts (5).

Tighten: Do not torque the bolts. Tighten them only until the case extension is fully seated.

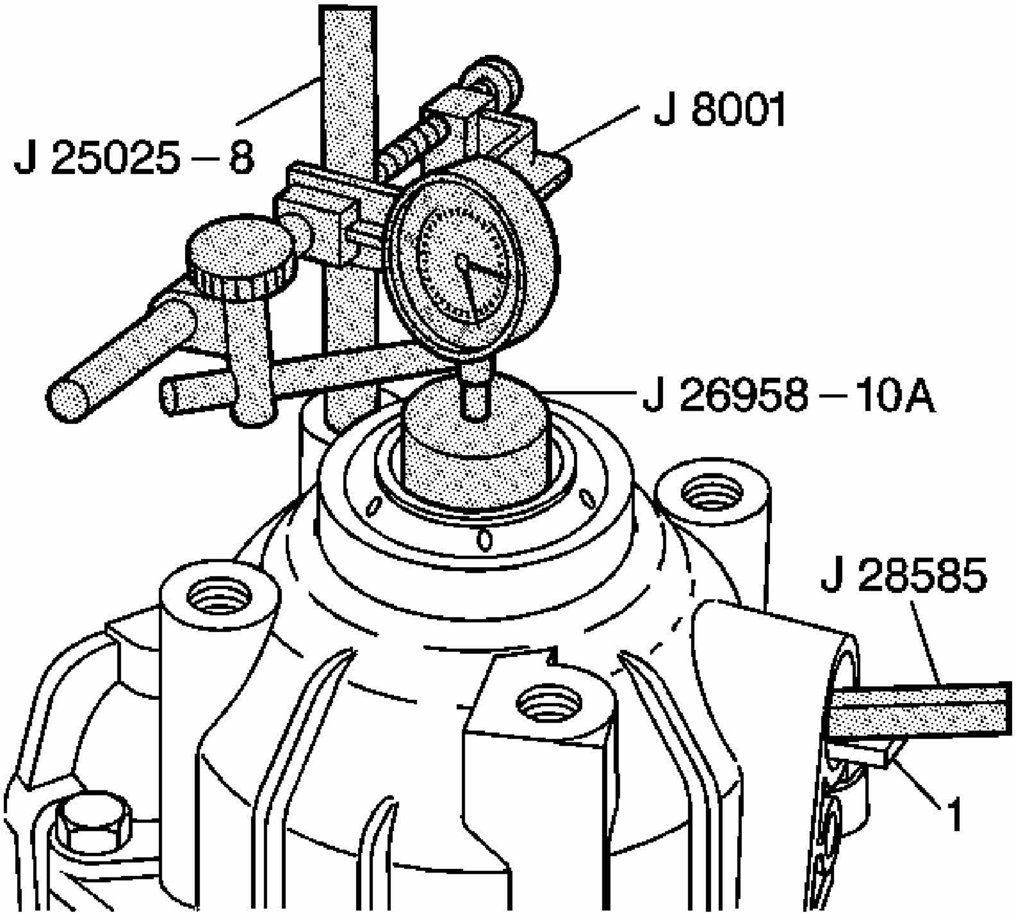


Fig. 70: Installing J 25025-8, J 26958-10A & J 8001 To Transmission Case
Courtesy of GENERAL MOTORS CORP.

6. Position the transmission so that the case extension is facing upward.
7. Install **J 25025-8** , **J 26958-10A** and **J 8001** .
8. Set the dial indicator to zero.

NOTE: **Use a piece of wood or rubber while prying with J 28585 or a large screwdriver, to prevent damage to VSS bore.**

9. Use **J 28585** or a large screwdriver in order to lift the differential carrier. Pry up on the vehicle speed sensor reluctor wheel through the sensor hole in the case extension.

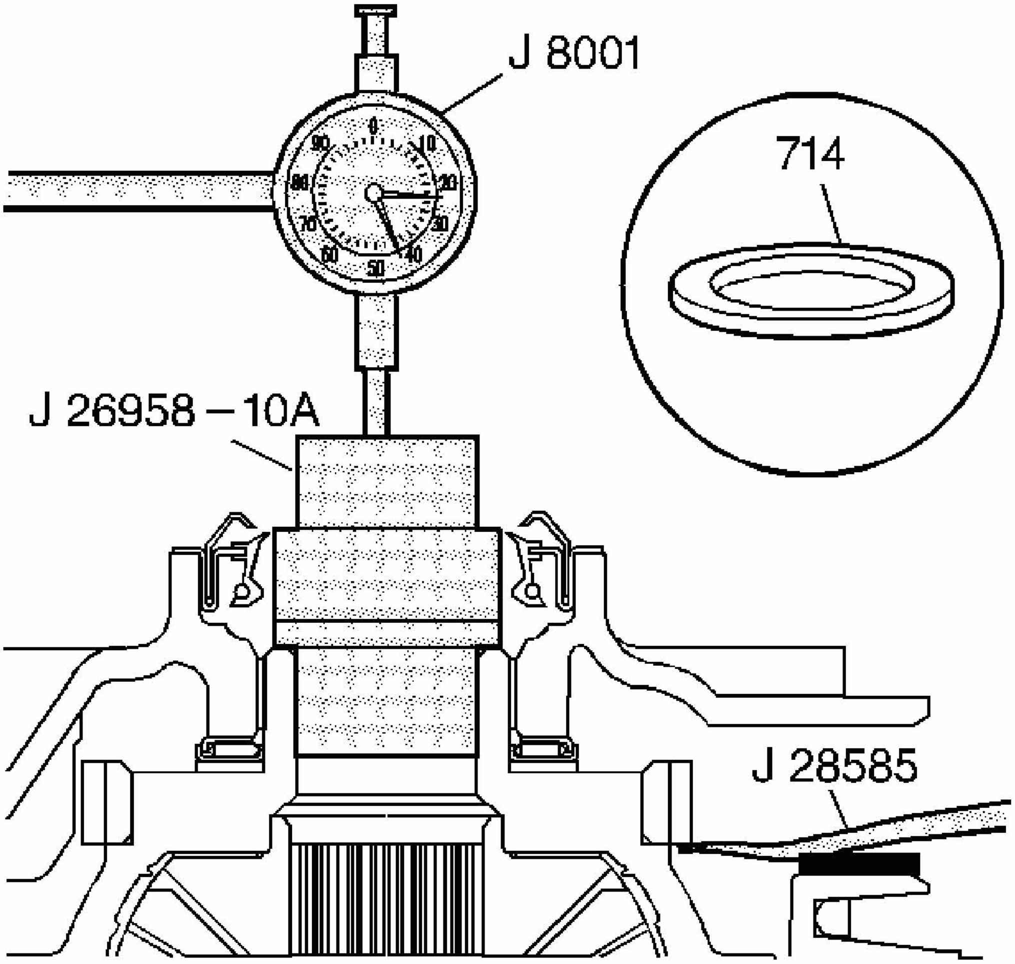


Fig. 71: Measuring Differential Carrier/Case Thrust Washer
Courtesy of GENERAL MOTORS CORP.

10. Note the dial indicator reading before changing the carrier thrust washer (714).
    - If the dial indicator reading is less than 0.12 mm (0.005 in), install the next smaller size thrust washer, then recheck.
    - If the dial indicator reading is greater than 0.62 mm (0.025 in), install the next larger size thrust washer, then recheck.
    - If the dial indicator reading is 0.12-0.62 mm (0.005-0.025 in), the thrust washer is correct.

    Refer to the Differential Carrier/Case Thrust Washer (714) Selection Guide in **End Play Specifications** .

11. Remove **J 8001** , **J 25025-8** and **J 26958-10A** . See Special Tools.

MANUAL VALVE LINK AND OIL DAM REMOVAL

Removal Procedure

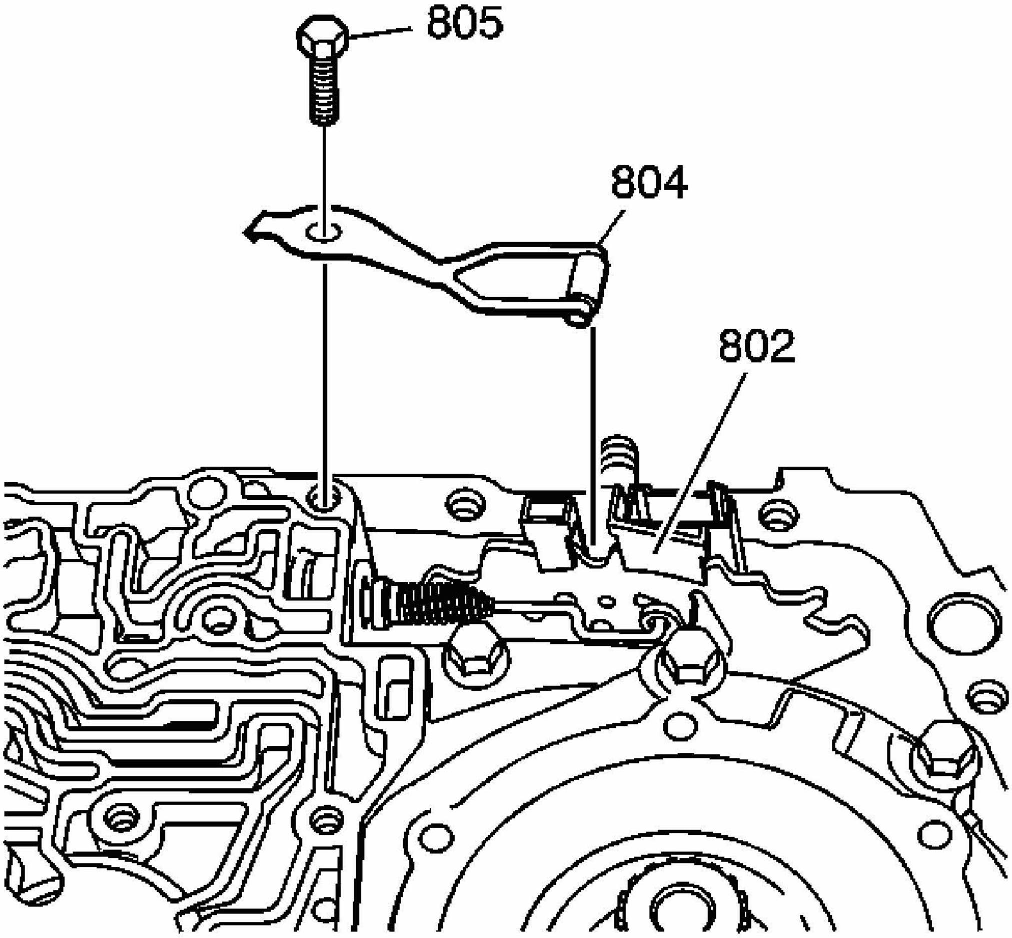


Fig. 72: Locating Manual Shift Detent Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the manual shift detent bolt (805).
2. Remove the manual shift detent assembly (804).

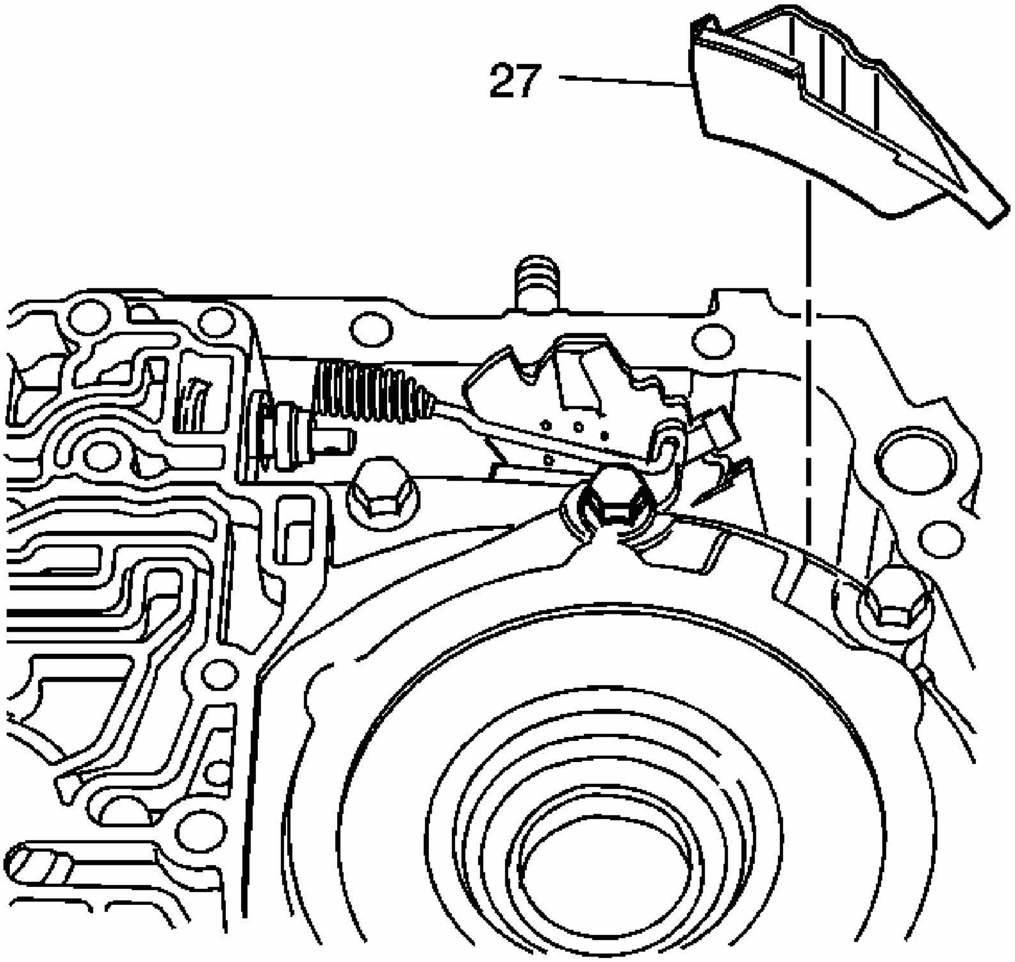


Fig. 73: View Of Oil Dam
Courtesy of GENERAL MOTORS CORP.

3. Compress the manual valve link spring (403) from the manual valve (404).
4. Lift the manual valve link (402) off of the manual valve (404).
5. Position the manual valve link (402) so that the valve will not interfere with the case cover removal.
6. Remove the oil dam (27) from the case.

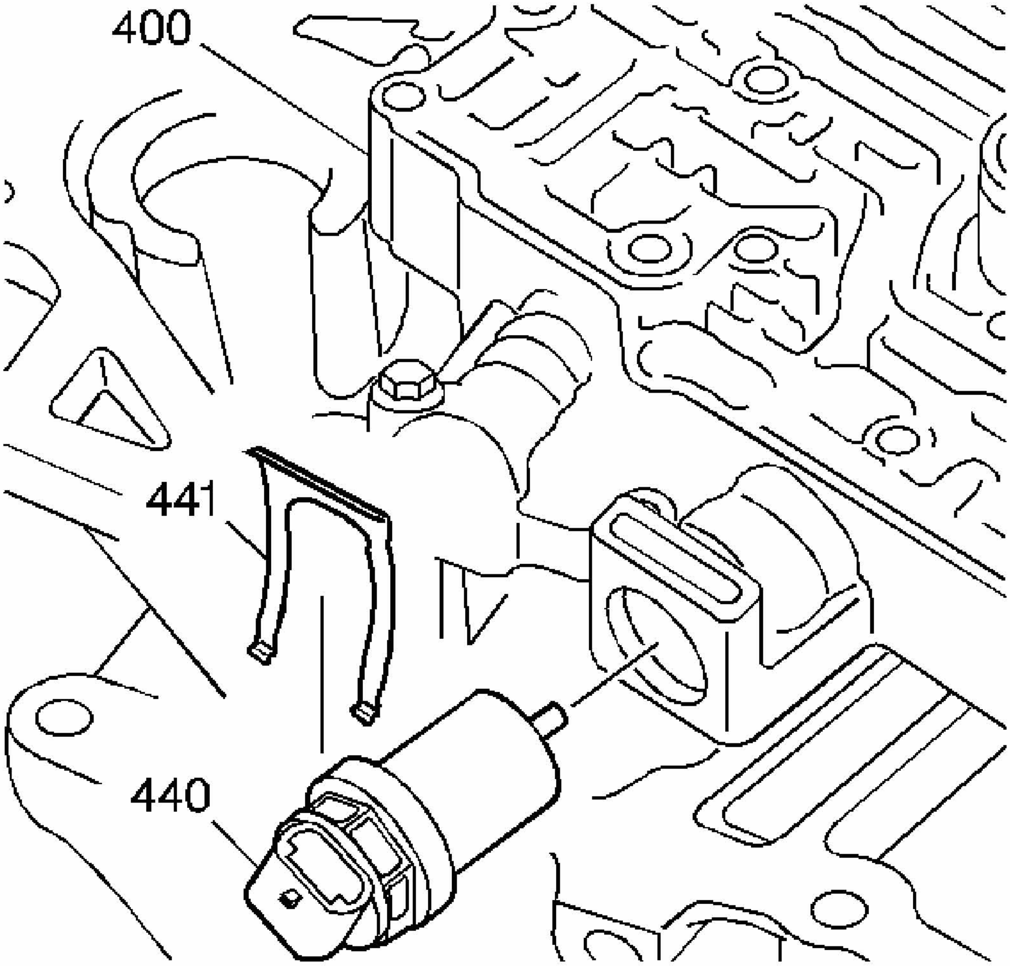


Fig. 74: View Of Input Speed Sensor
Courtesy of GENERAL MOTORS CORP.

7. Using a small screwdriver, pry the input speed sensor clip (441) out of the case cover (400).

IMPORTANT: Handle the speed sensor carefully.

8. Carefully pull the input speed sensor (440) out of the case cover (400).

DRIVE AXLE OIL SEAL REMOVAL - LEFT SIDE

Tools Required

- **J 23129** Seal Remover
- **J 6125-1B** Slide Hammer

Removal Procedure

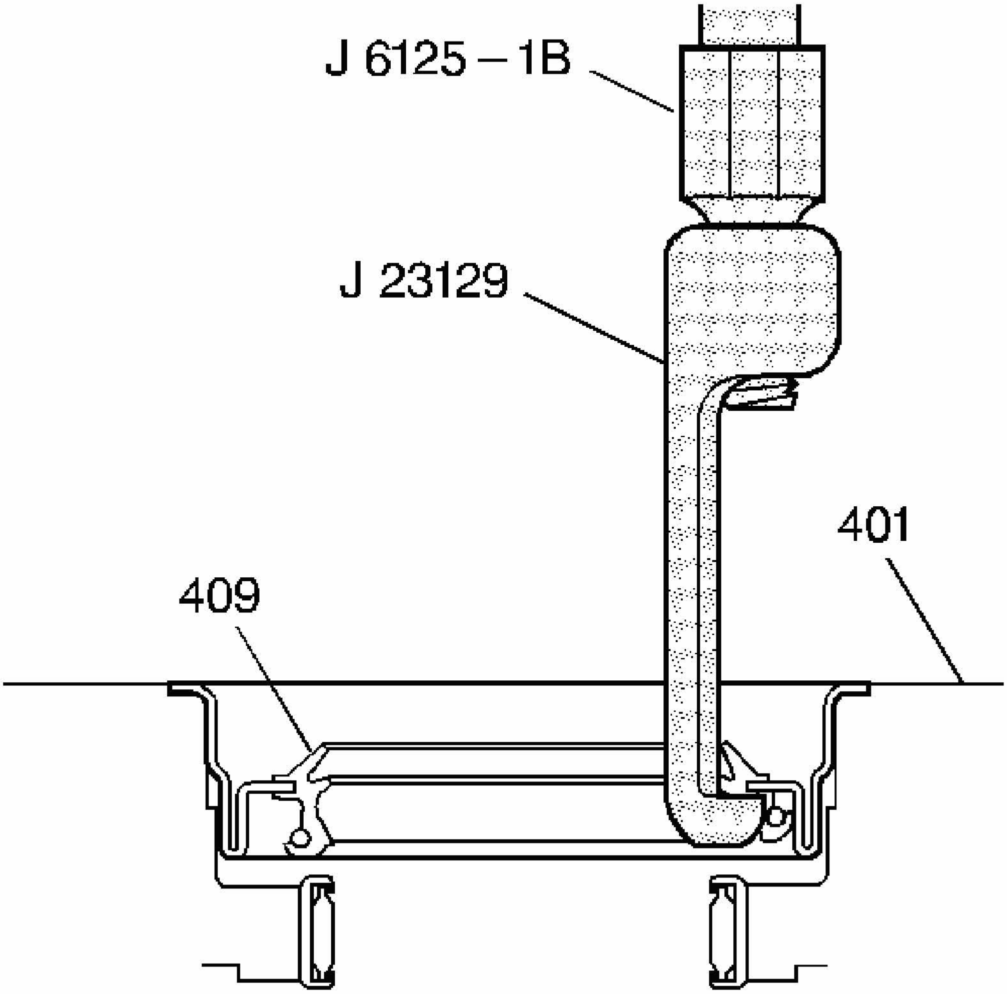


Fig. 75: Removing Left Front Wheel Drive Shaft Oil Seal
Courtesy of GENERAL MOTORS CORP.

Use **J 23129** and **J 6125-1B** in order to remove the axle oil seal assembly (409) from the case cover (401).

CASE COVER REMOVAL

Tools Required

J44538 Torx® 30+. See **Special Tools**.

Removal Procedure

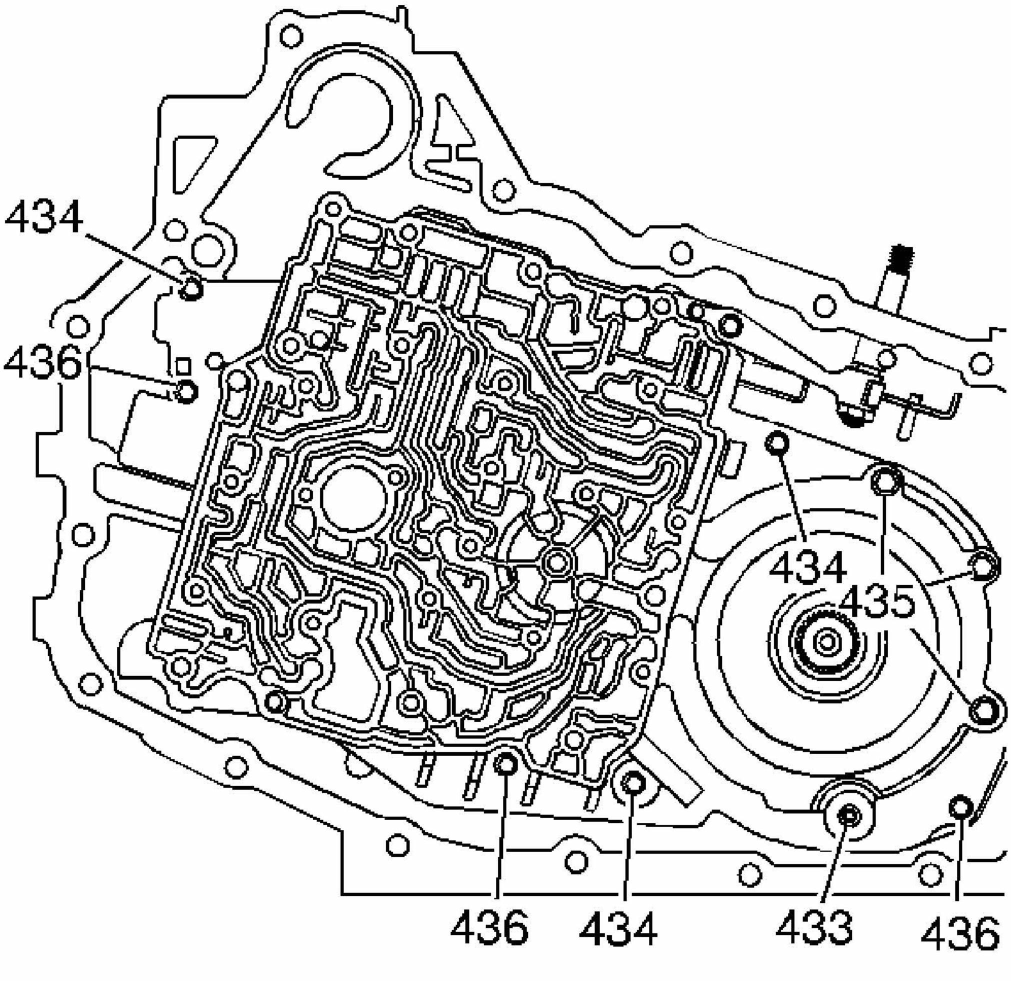


Fig. 76: Identifying Transaxle Case Cover Bolts Locations
Courtesy of GENERAL MOTORS CORP.

1. Remove the indicated case cover bolts (434-436).
2. Use **J44538** to remove case cover bolt (433). See **Special Tools**.

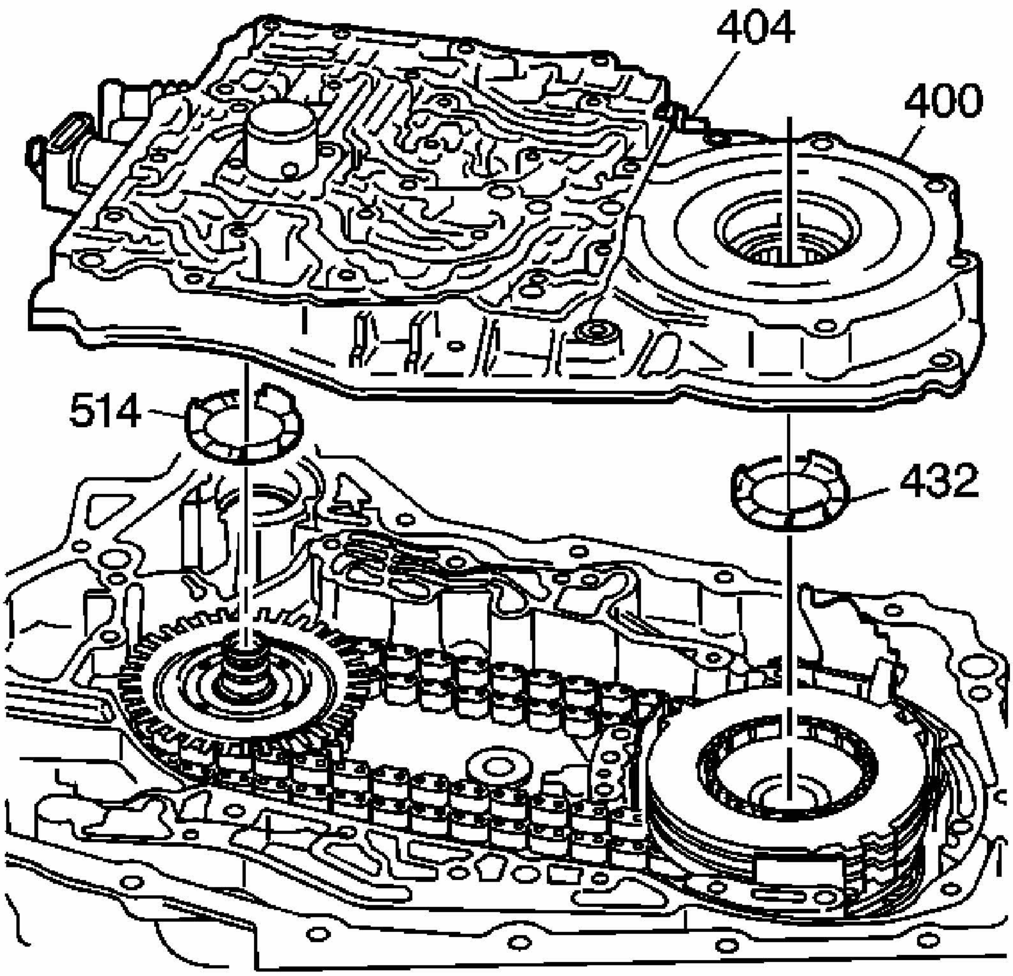


Fig. 77: Identifying Fourth Clutch Shaft Thrust Washer & Drive Sprocket/Case Cover Thrust Washer
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Be sure to hold the manual valve (404) in place.

3. Lift the case cover assembly (400) off of the case.
4. Remove the thrust washer (432).

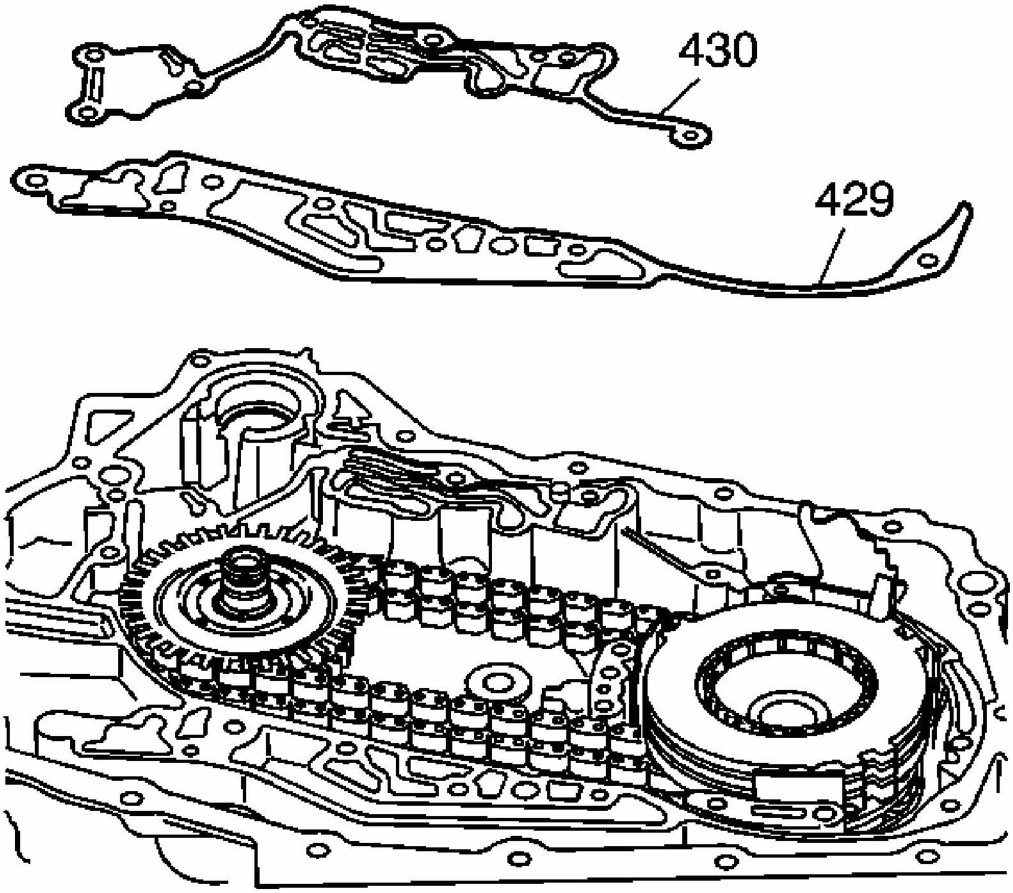


Fig. 78: View Of Case Cover Upper & Lower Gasket
Courtesy of GENERAL MOTORS CORP.

5. Remove the upper (430) and the lower (429) case cover gaskets.

FOURTH CLUTCH COMPONENTS REMOVAL

Removal Procedure

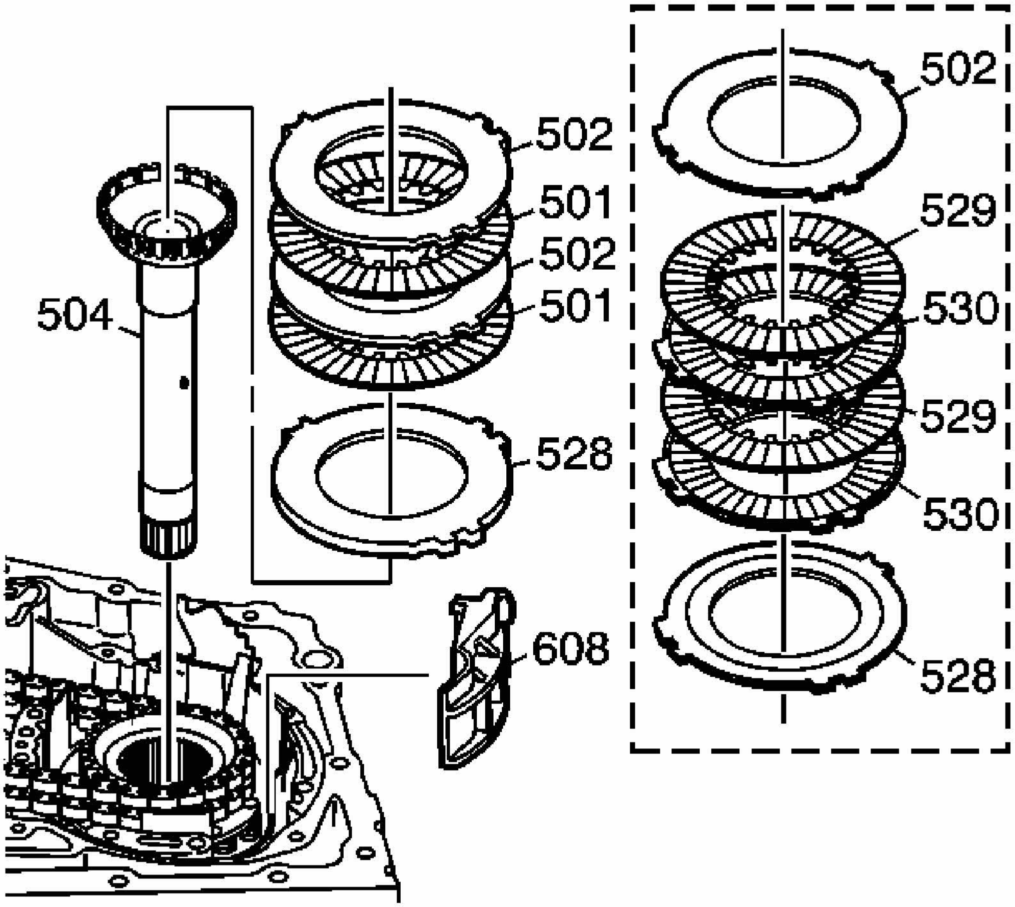

502
501
502
501
504
528
608
502
529
530
529
530
528

Fig. 79: Identifying Fourth Clutch Components
Courtesy of GENERAL MOTORS CORP.

1. Remove the fourth clutch fiber and steel plates (501, 502) or (529, 530),some models.
2. Remove the fourth clutch apply plate (528).
3. Remove the fourth clutch shaft assembly (504).
4. Remove the drive link lube scoop (608).

DRIVE LINK STRETCH CHECK

Checking Procedure

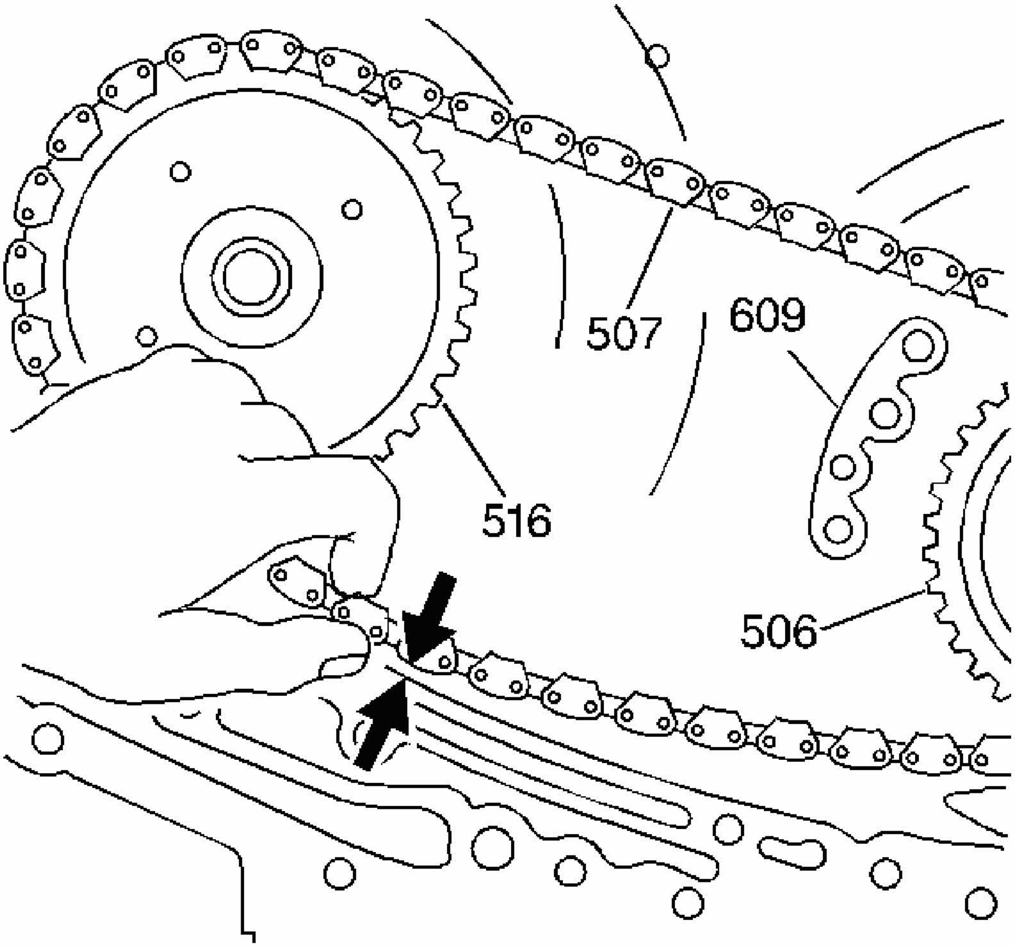


Fig. 80: Measuring Drive Link Stretch
Courtesy of GENERAL MOTORS CORP.

1. Make sure that the driven sprocket support (609) and both sprockets (506, 516) are fully seated.
2. Pull the drive link assembly (507) toward the case at the indicated location.
3. Measure the distance between the case and the drive link assembly (507):
    - If the measurement is 3.2 mm (1/8 in) or greater, reuse the drive link assembly (507).
    - If the measurement is less than 3.2 mm (1/8 in), replace the drive link assembly (507).

DRIVE SPROCKET, DRIVEN SPROCKET AND DRIVE LINK REMOVAL

Removal Procedure

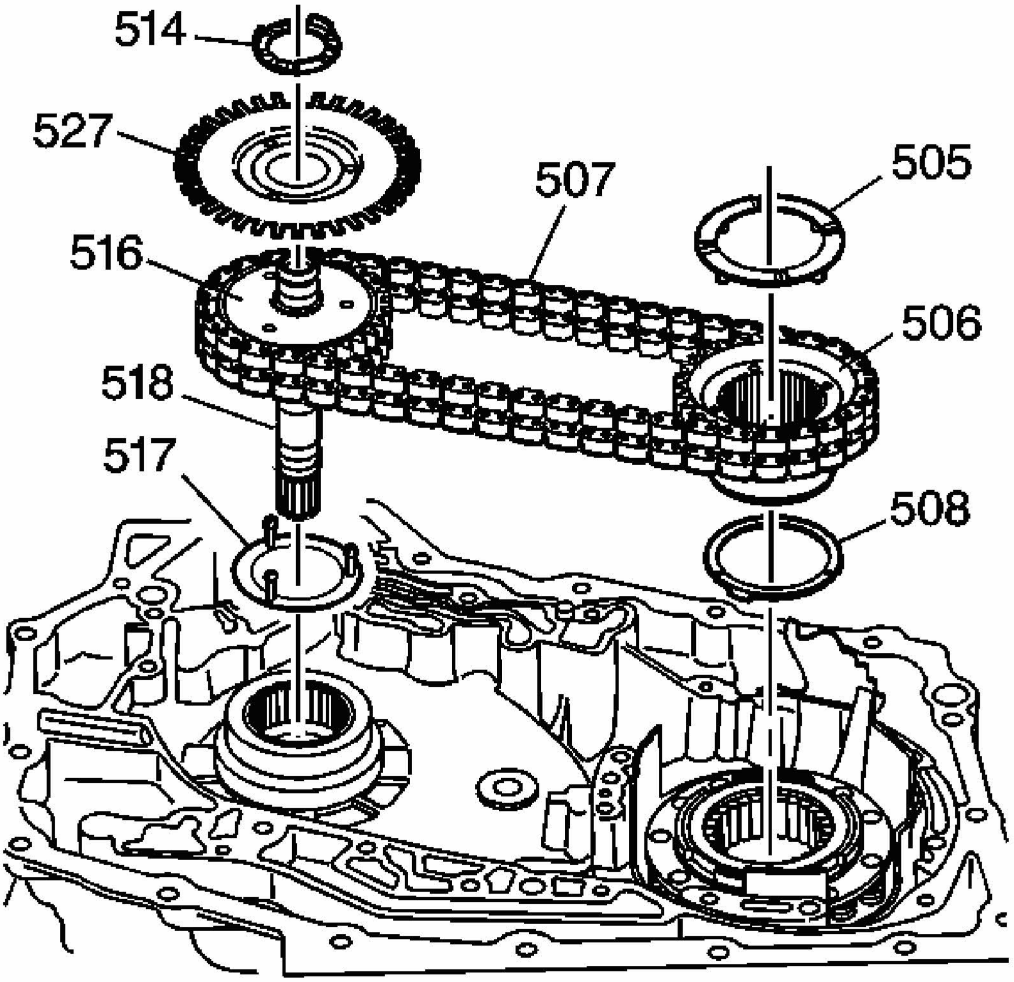


Fig. 81: View Of Drive Sprocket, Driven Sprocket and Drive Link Components
Courtesy of GENERAL MOTORS CORP.

1. Remove the fourth clutch shaft thrust washer (505).
2. Remove the drive sprocket thrust washer (514). It may be stuck to the case cover
3. Remove the speed sensor reluctor wheel (527).
4. Note the location of the master link on the drive link assembly (507).
    - It is the one link that is a different color than the rest.
    - It may be facing up or down towards the case.
    - The drive link assembly (507) must be in the same position during assembly.
5. Lift the drive and driven sprockets (516, 506) with the drive link assembly (507) out of the case.

  - Lift both sides evenly
  - It may be necessary to tap the turbine shaft (518) up gently with a rubber mallet
6. Remove the drive and driven sprocket thrust washers (517, 508). They may be stuck to the sprockets

DRIVEN SPROCKET SUPPORT ASSEMBLY REMOVAL

Removal Procedure

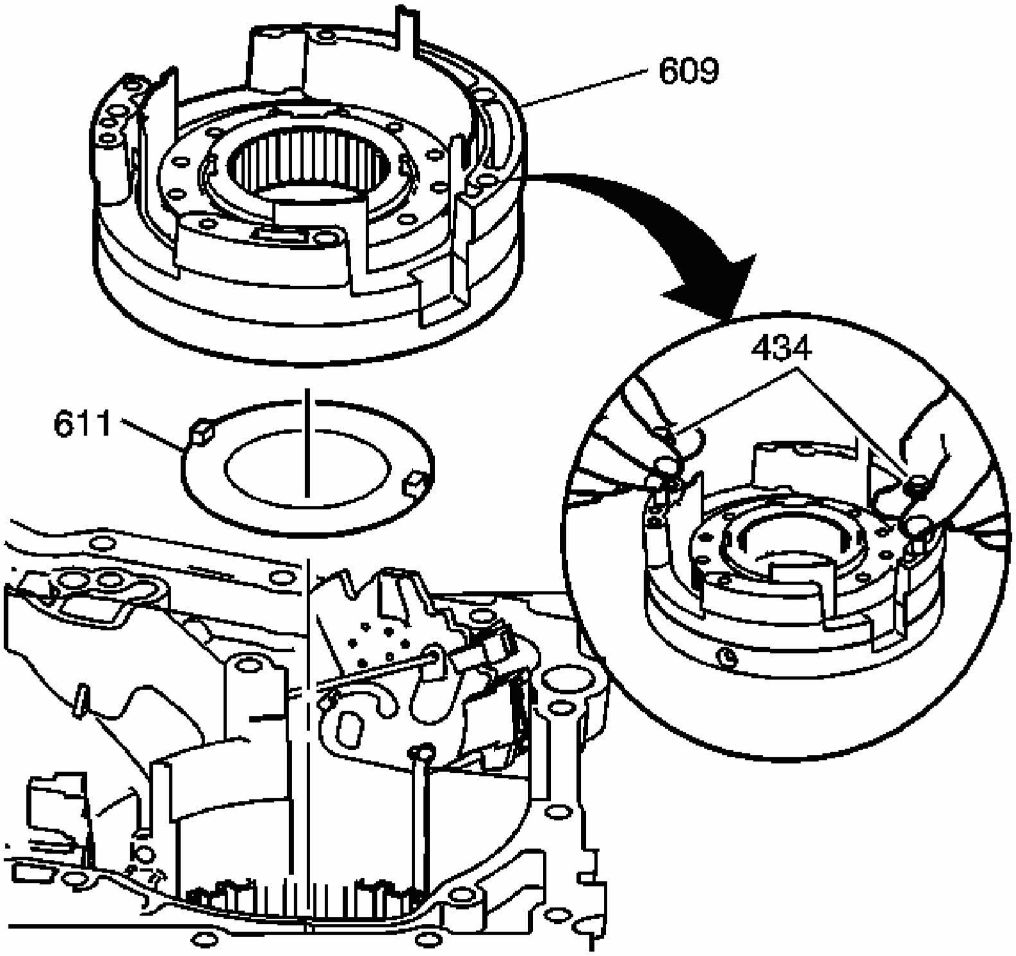


Fig. 82: Identifying Driven Sprocket Support Assembly
Courtesy of GENERAL MOTORS CORP.

1. With your fingers, insert two 13 mm channel plate bolts (434) into the driven sprocket support assembly (609).
2. Grasp the bolts and lift the support assembly from the case.

3. Remove the thrust washer (611) from the second clutch housing. The washer may be stuck to the support assembly.

SECOND CLUTCH AND INPUT CLUTCH REMOVAL

Tool Required:

J 33381-A Clutch Assembly Remover/Installer. See **Special Tools**.

Removal Procedure

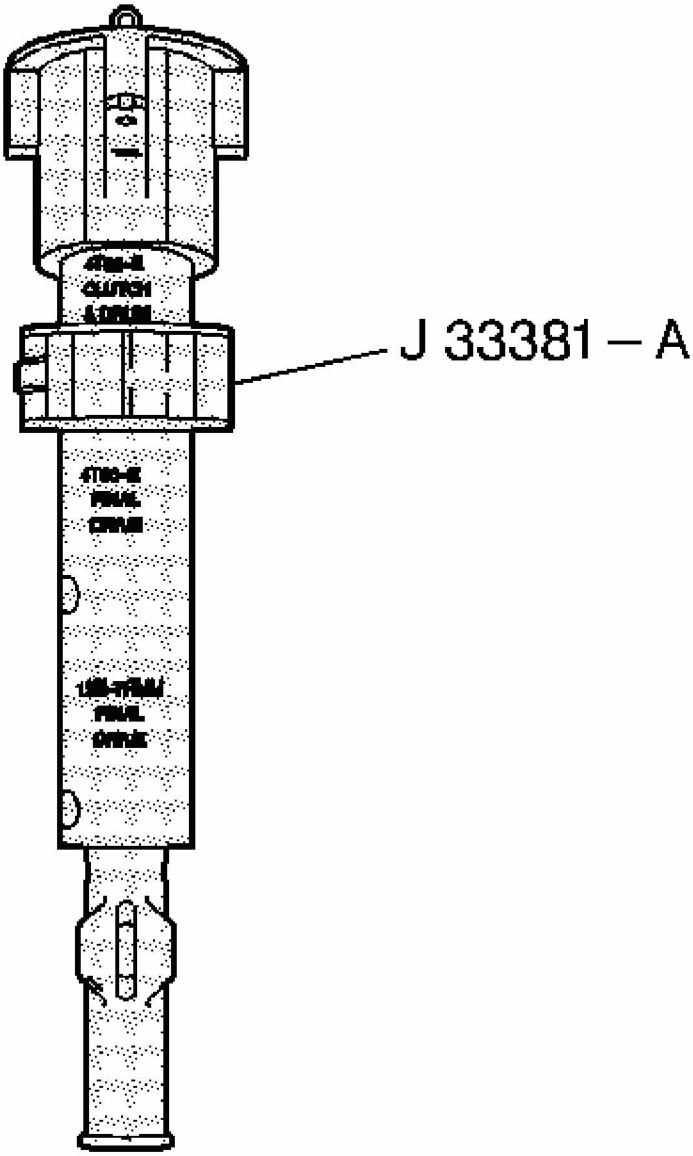


Fig. 83: View Of J 33381-A
Courtesy of GENERAL MOTORS CORP.

1. Adjust the collar on tool **J 33381-A** to the 4T65-E CLUTCH & DRUM setting. See **Special Tools**. Make sure that the threaded rod is fully loosened.

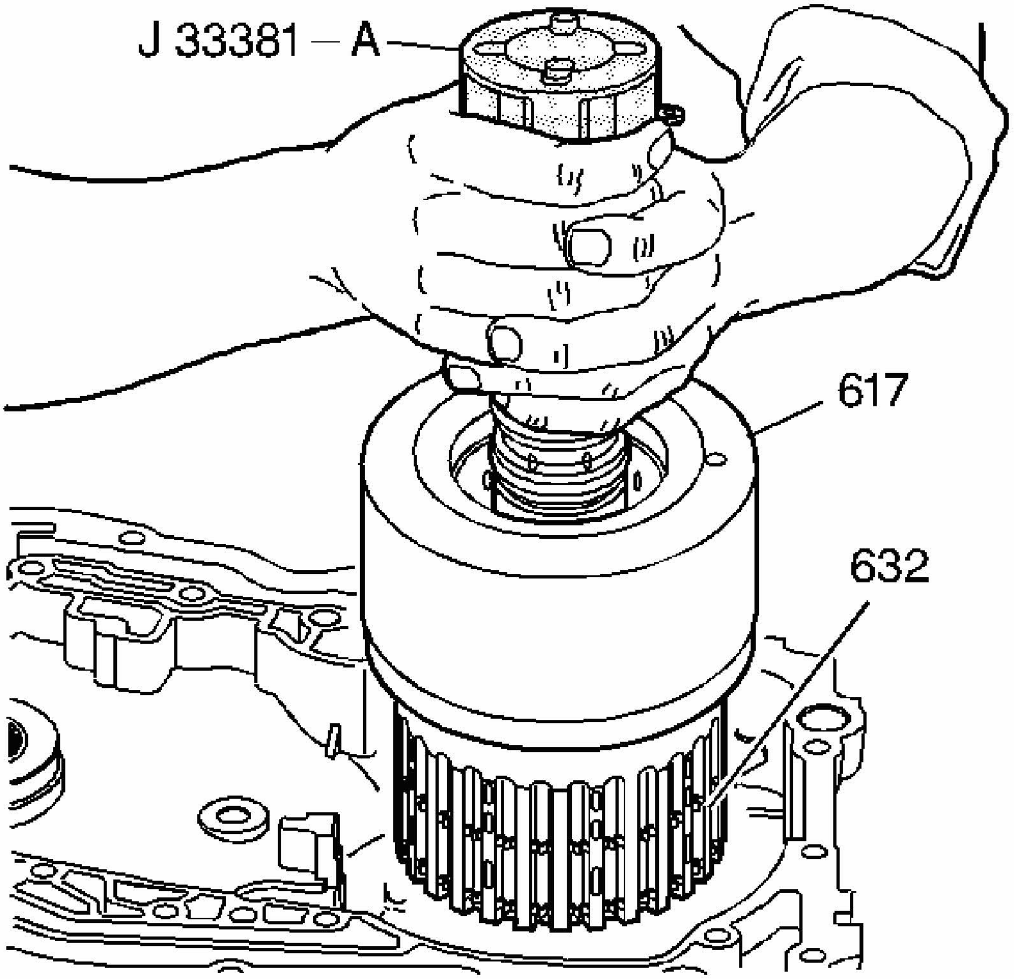


Fig. 84: Installing J 33381-A Onto Input Clutch Housing Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install **J 33381-A** into the second clutch housing assembly (617). See **Special Tools**.
3. Tighten the threaded rod of **J 33381-A** until the rod is finger tight. See **Special Tools**.
4. Lift up **J 33381-A** with the second clutch housing (617) and the input clutch housing (632) attached. See **Special Tools**. The sprag clutch assemblies will also be attached.
5. Place the complete assembly on the bench.
6. Loosen the threaded rod of **J 33381-A** . See **Special Tools**.
7. Remove **J 33381-A** from the assembly. See **Special Tools**.

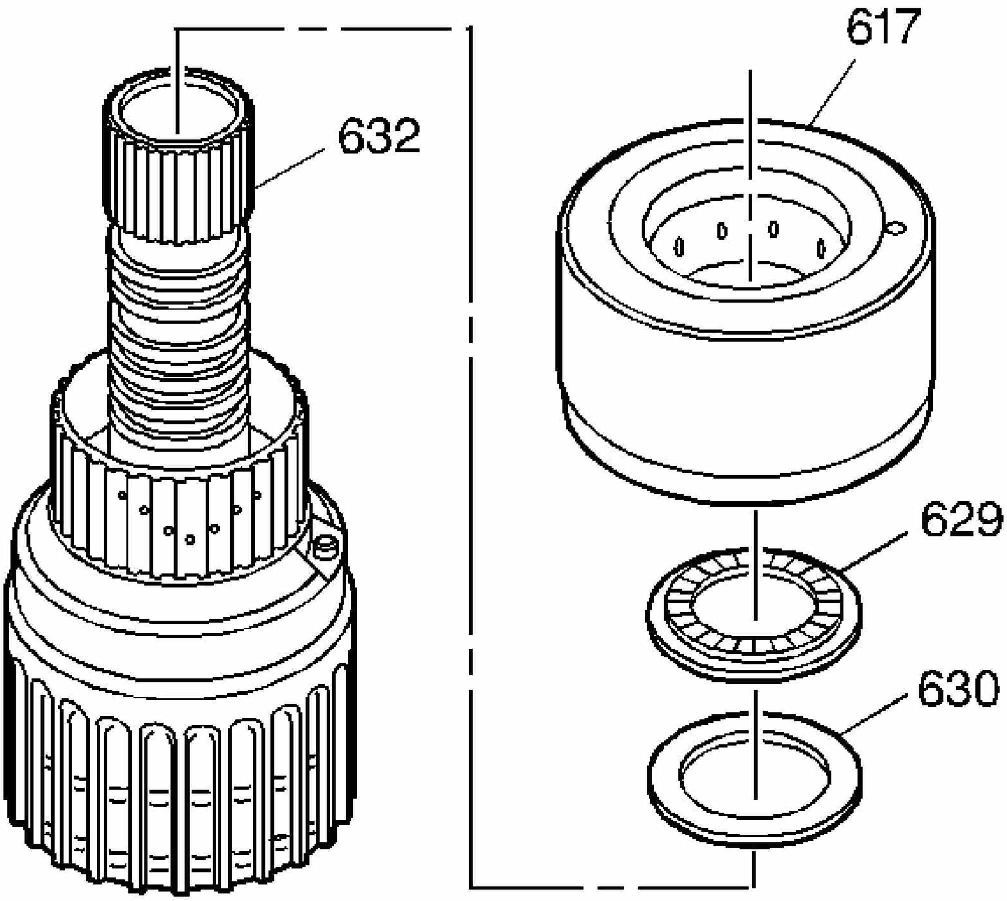


Fig. 85: Identifying Second Clutch Housing & Input Clutch Components
Courtesy of GENERAL MOTORS CORP.

8. Lift the second clutch housing (617) off of the input clutch housing.
9. Remove the input clutch housing thrust bearing (629) from the input housing.
10. Remove the selective thrush washer (630) from the input clutch housing (632).

REVERSE BAND REMOVAL

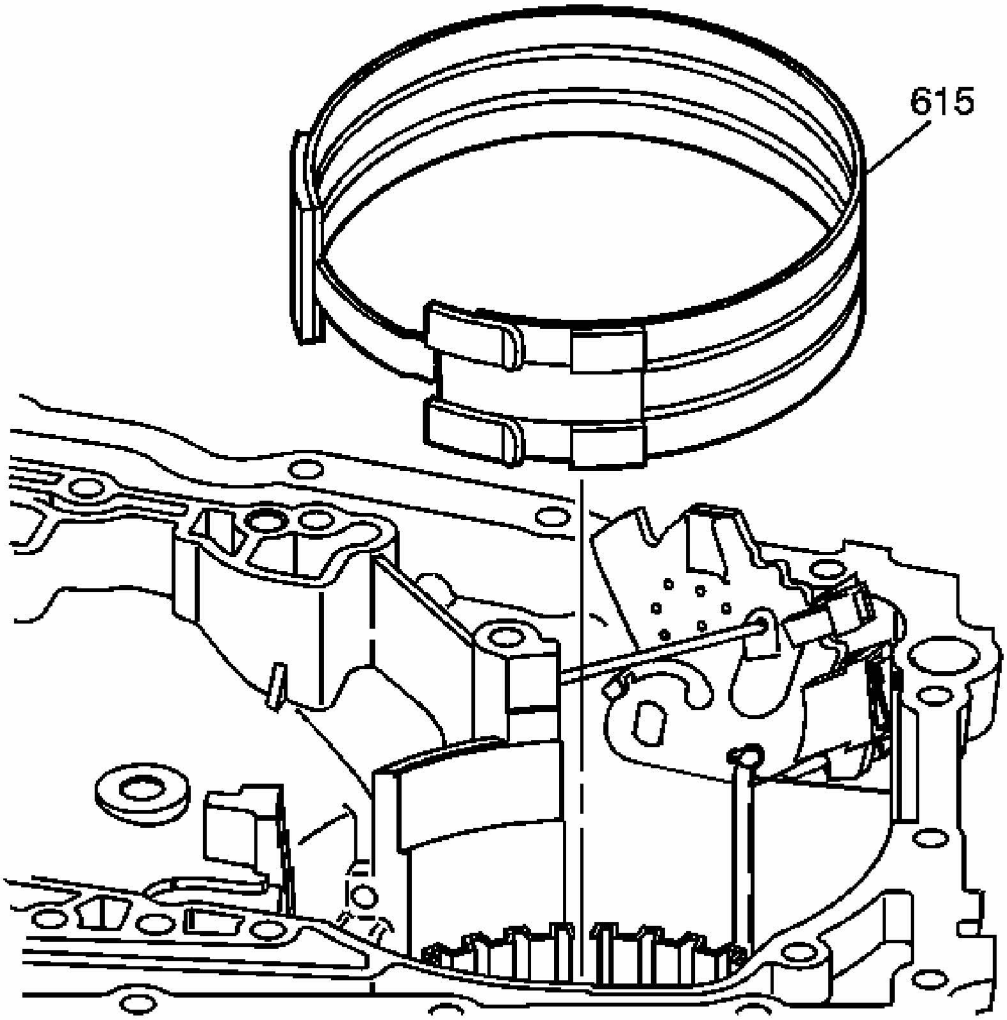


Fig. 86: View Of Reverse Band Assembly
Courtesy of GENERAL MOTORS CORP.

Tilt the band in order to disengage the band from the anchor pin in the case. Remove the reverse band assembly (615).

REVERSE REACTION DRUM REMOVAL

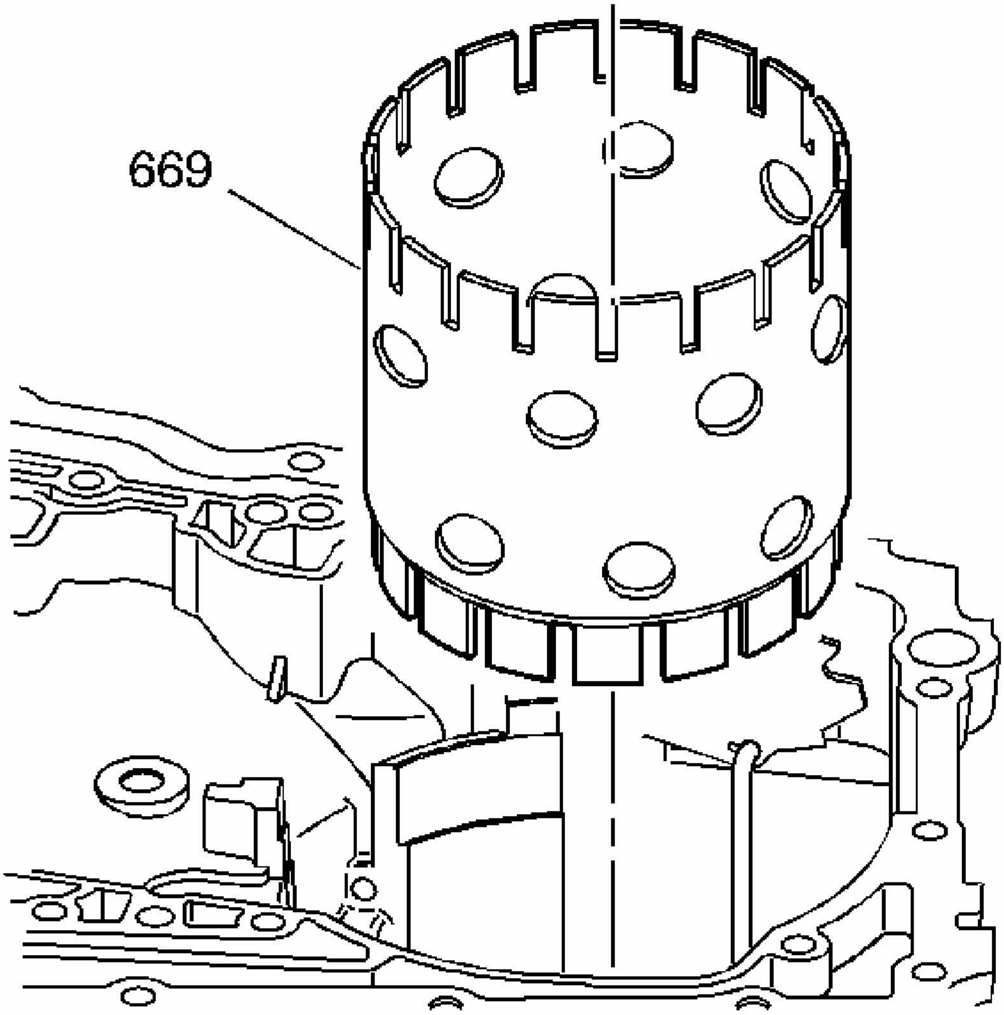


Fig. 87: View Of Reverse Reaction Drum
Courtesy of GENERAL MOTORS CORP.

Remove the reverse reaction drum (669).

CASE EXTENSION ASSEMBLY REMOVAL

Removal Procedure

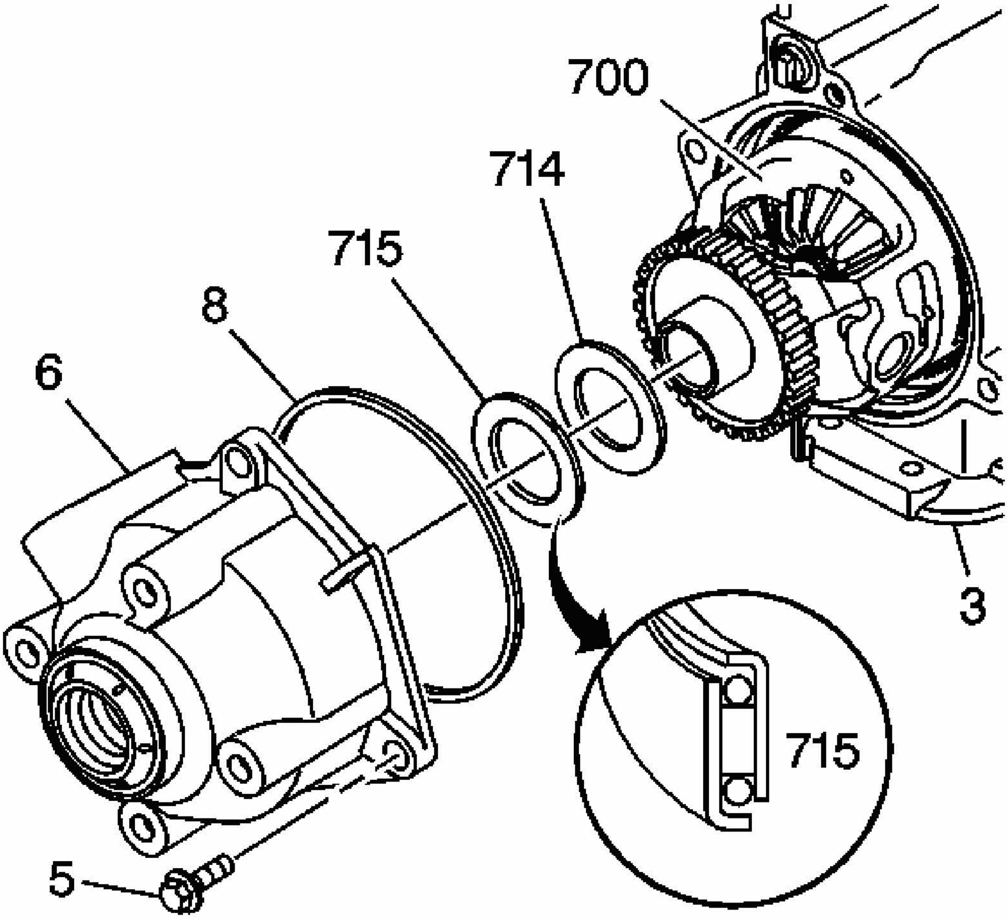


Fig. 88: Locating Differential/Final Drive Carrier Assembly Thrust Bearing
Courtesy of GENERAL MOTORS CORP.

1. Remove the two case extension bolts (5).
2. Remove the case extension assembly (6) and remove the seal (8).
3. Remove the differential carrier thrust washer (715).
4. Remove the differential carrier thrust bearing (714).

DIFFERENTIAL CARRIER AND COMPONENTS REMOVAL

Removal Procedure

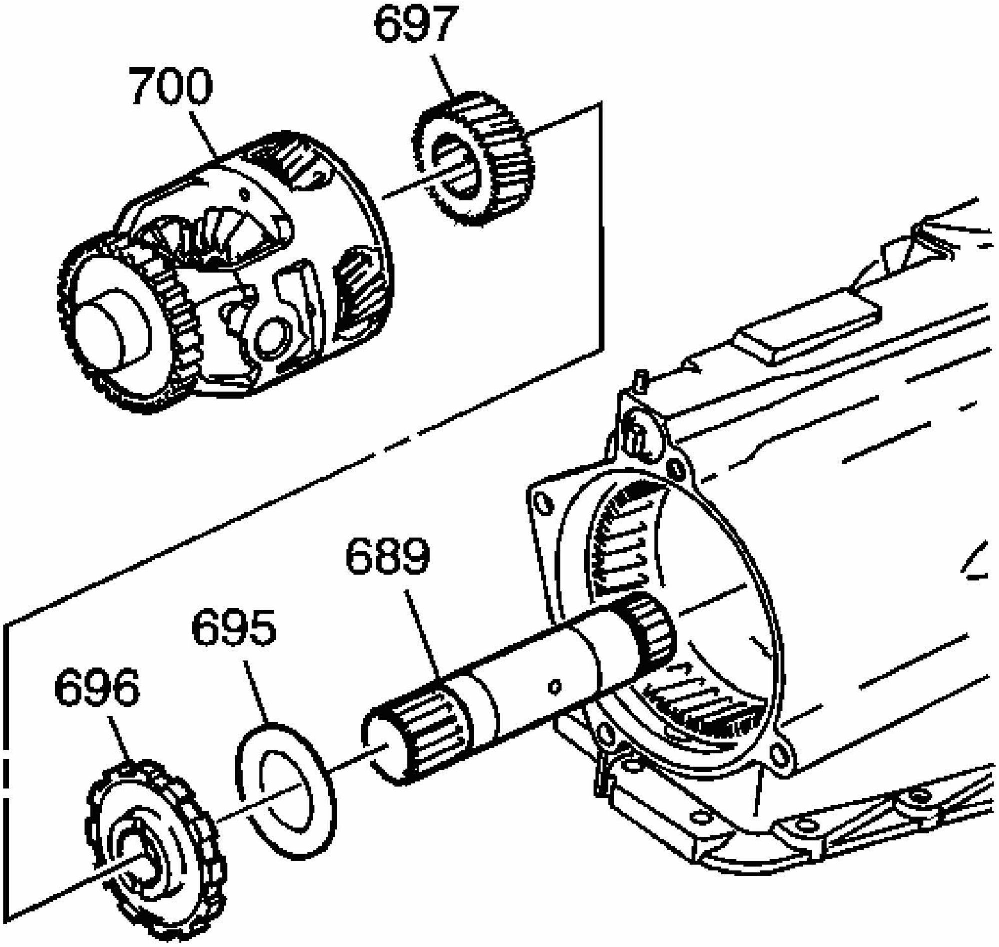


Fig. 89: View Of Differential Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the differential carrier assembly (700).
2. Remove the differential carrier sun gear (697).
3. Remove the park gear (696).
4. Remove the thrust bearing (695) from the differential carrier internal gear.
5. Remove the shaft differential carrier sun gear (689).

INPUT AND REACTION CARRIER REMOVAL

Removal Procedure

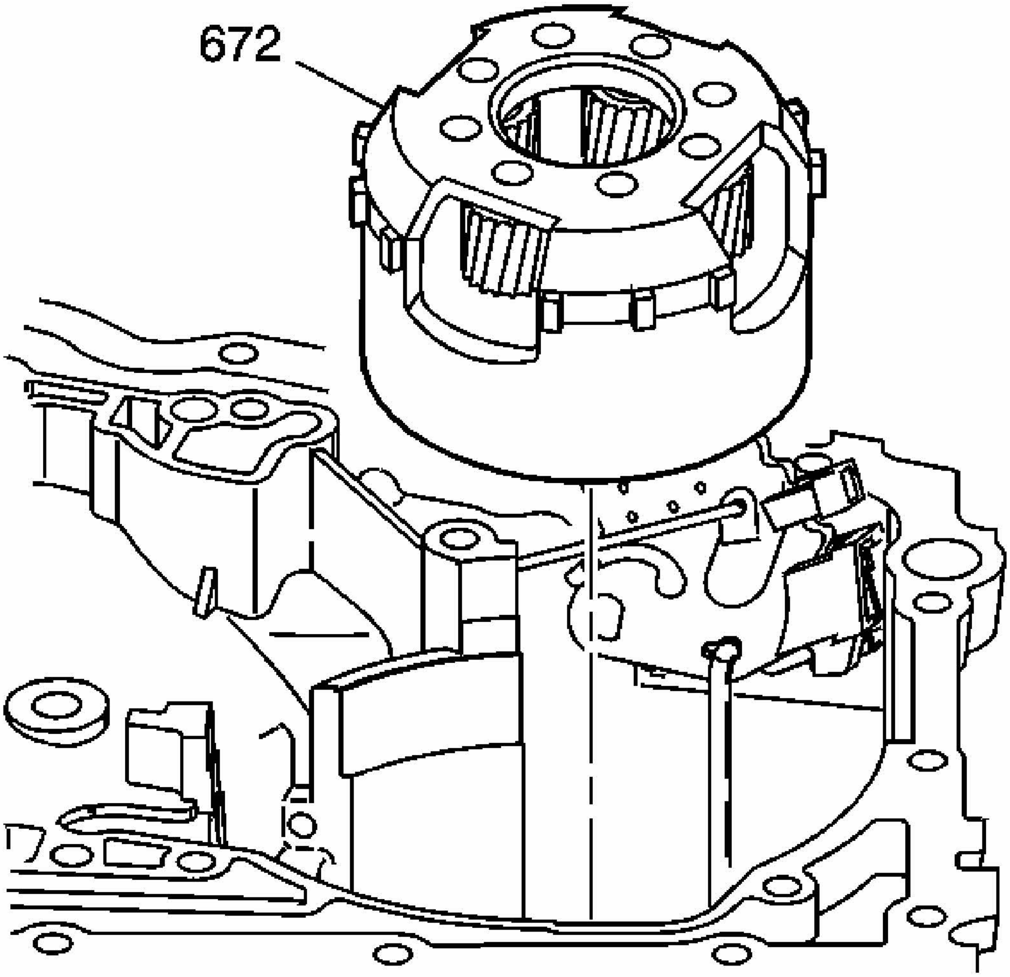


Fig. 90: Identifying Input Carrier Assembly
Courtesy of GENERAL MOTORS CORP.

1. Position the transmission so that the case cover joint is facing upward.
2. Remove the input carrier assembly (672).

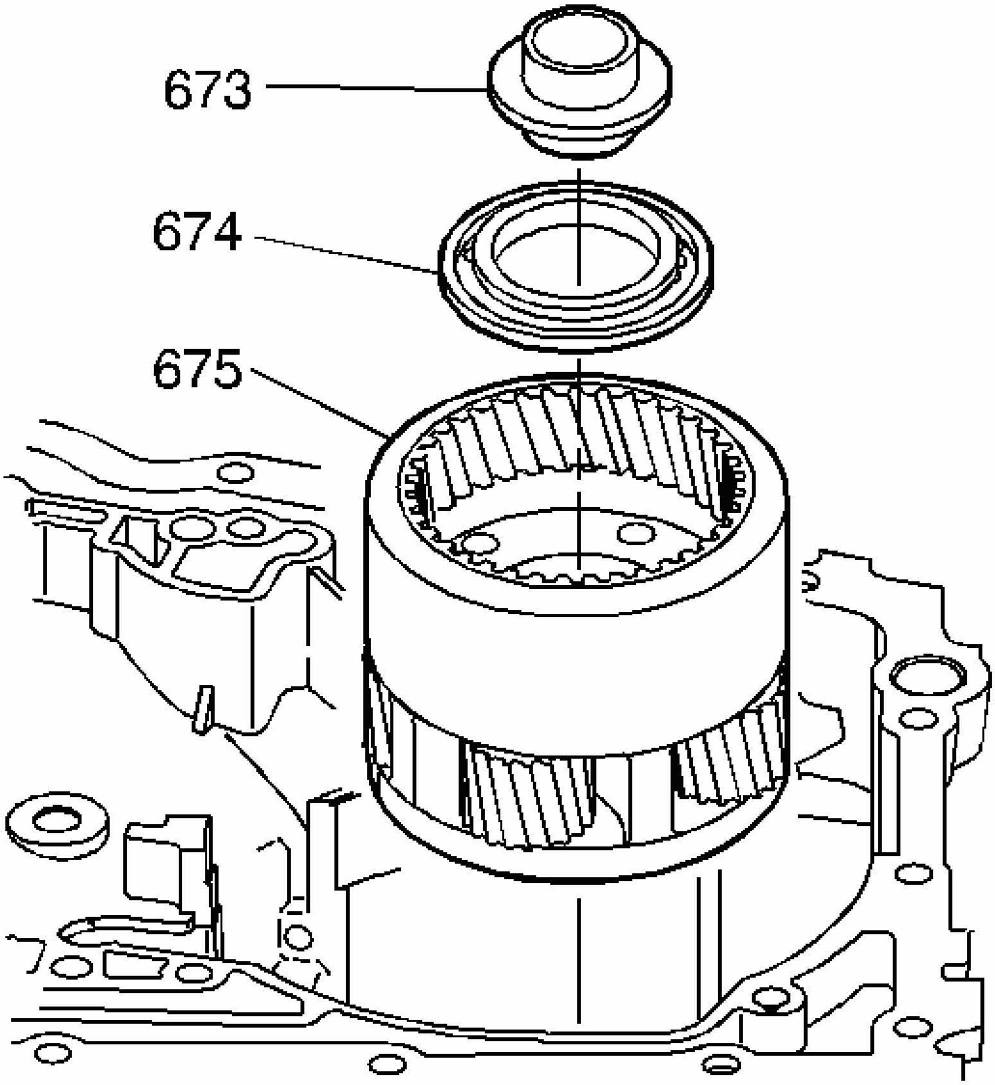


Fig. 91: Locating Reaction Carrier Lube Dam & Thrust Bearing
Courtesy of GENERAL MOTORS CORP.

3. Remove the input carrier, reaction carrier lube dam (673). The dam may be stuck to the input carrier assembly.
4. Remove the thrust bearing (674) from the reaction carrier.
5. Remove the reaction carrier assembly (675).

REACTION SUN GEAR AND MANUAL 2-1 BAND REMOVAL

Removal Procedure

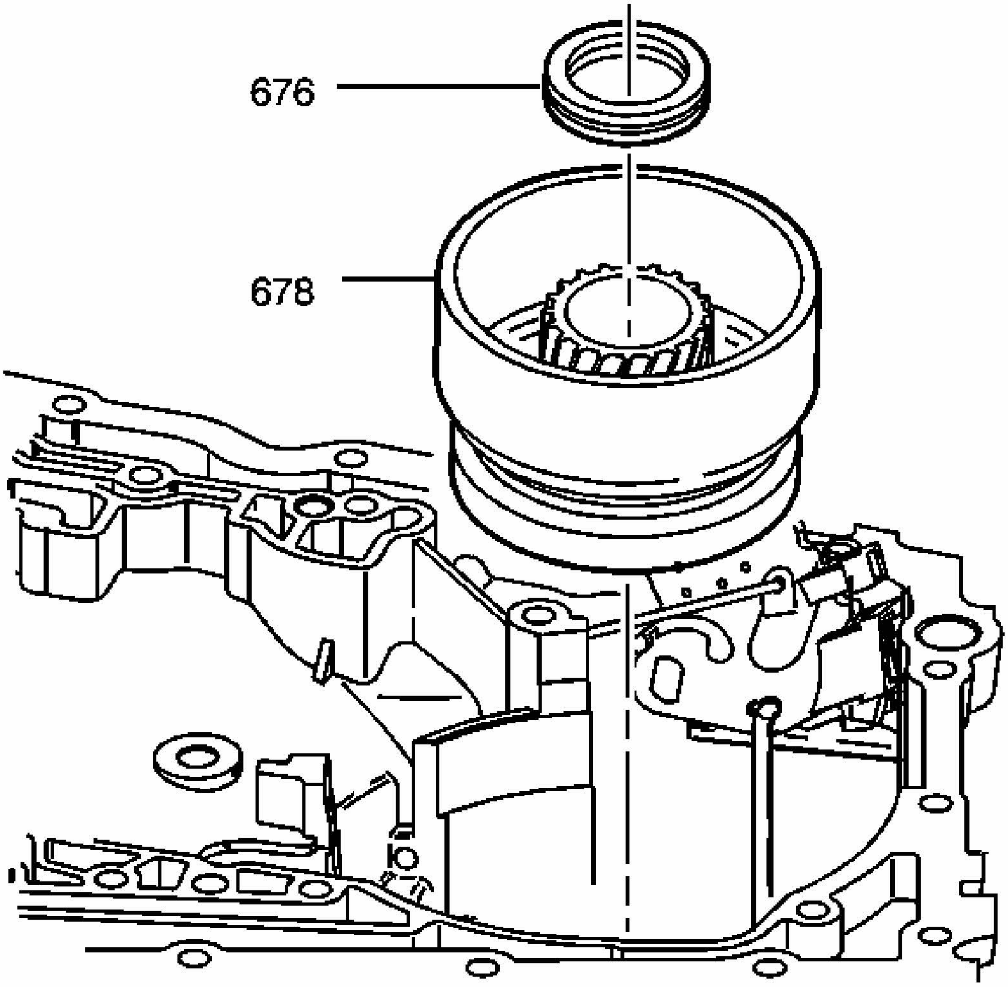


Fig. 92: Identifying Reaction Sun Gear Assembly & Thrust Bearing
Courtesy of GENERAL MOTORS CORP.

1. Remove the thrust bearing (676) from the reaction sun gear.
2. Remove the reaction sun gear assembly (678).

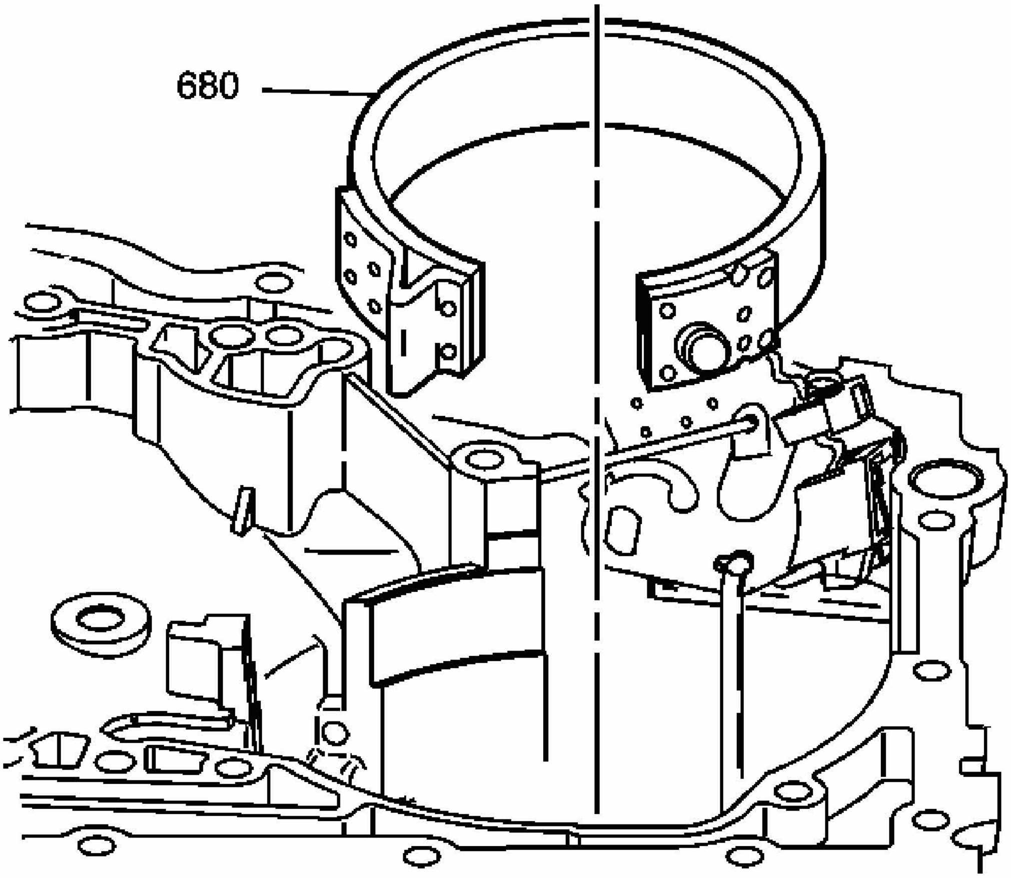


Fig. 93: View Of Manual 2-1 Band Assembly
Courtesy of GENERAL MOTORS CORP.

3. Tilt the band in order to disengage the manual 2-1 band assembly (680) from the anchor pin. Remove the manual 2-1 band assembly from the case.

1-2 SUPPORT DRUM AND FORWARD BAND REMOVAL

Tools Required

J 38358-A 1-2 Support Remover and Installer

Removal Procedure

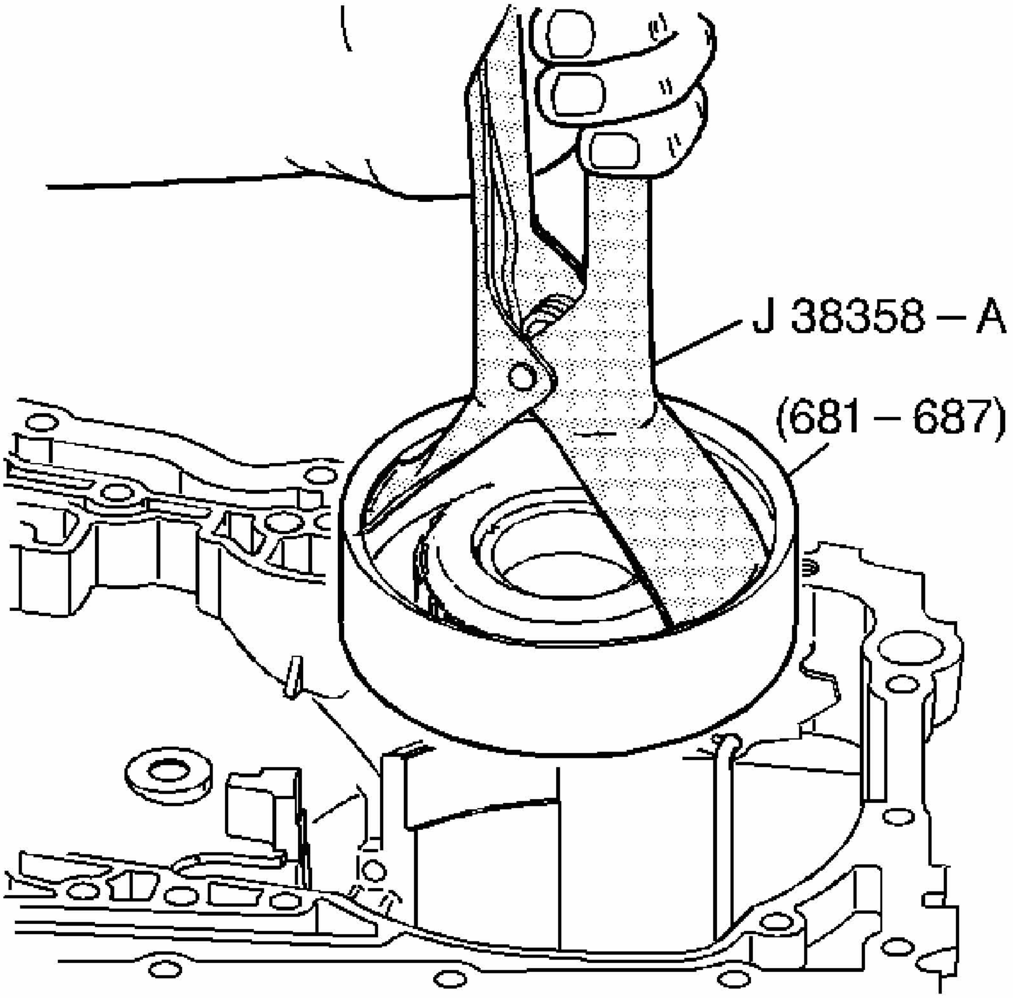


Fig. 94: Removing 1-2 Support Drum Out Of The Case Using J 38358-A
Courtesy of GENERAL MOTORS CORP.

1. Install **J 38358-A** onto the 1-2 support drum assembly (681-687).
2. Lift **J 38358-A** with the 1-2 support drum out of the case.

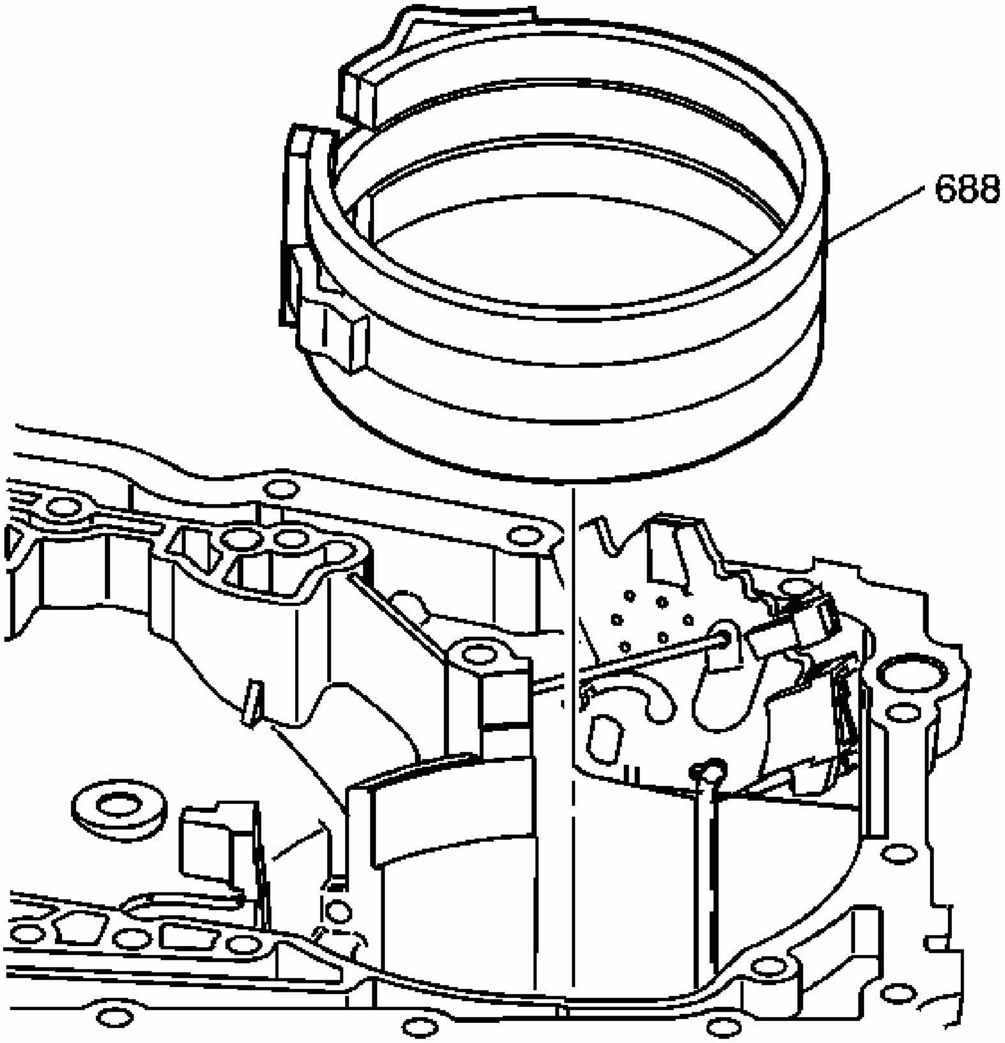


Fig. 95: Locating Forward Band Assembly
Courtesy of GENERAL MOTORS CORP.

3. Tilt the forward band assembly (688) in order to disengage the band from the anchor pin in the case. Remove the forward band assembly.

DIFFERENTIAL CARRIER INTERNAL GEAR REMOVAL

Tools Required

J 28585 Snap Ring Remover

Removal Procedure

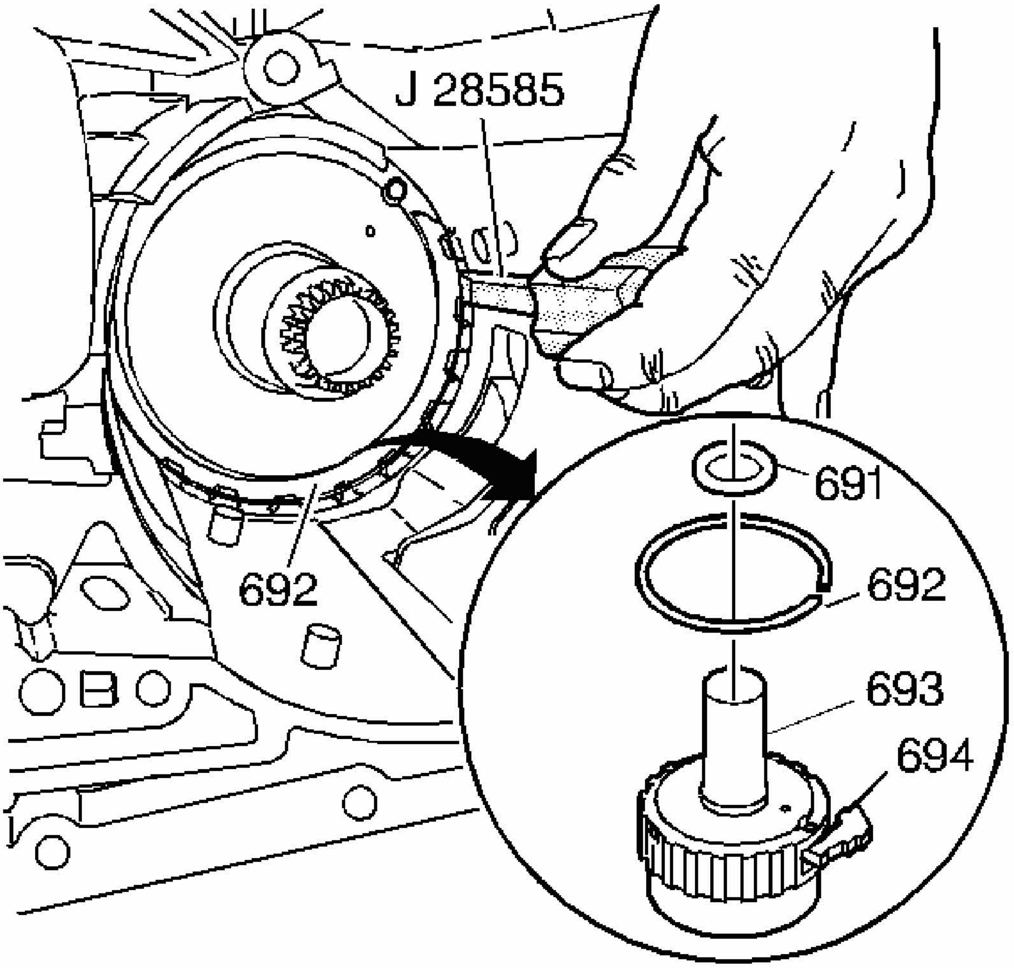


Fig. 96: View Of Differential Carrier Internal Gear Snap Ring & Thrust Washer
Courtesy of GENERAL MOTORS CORP.

1. Remove the bearing (691) from the differential carrier internal gear.
2. Use **J 28585** or a large screwdriver in order to remove the differential carrier internal gear snap ring (692).

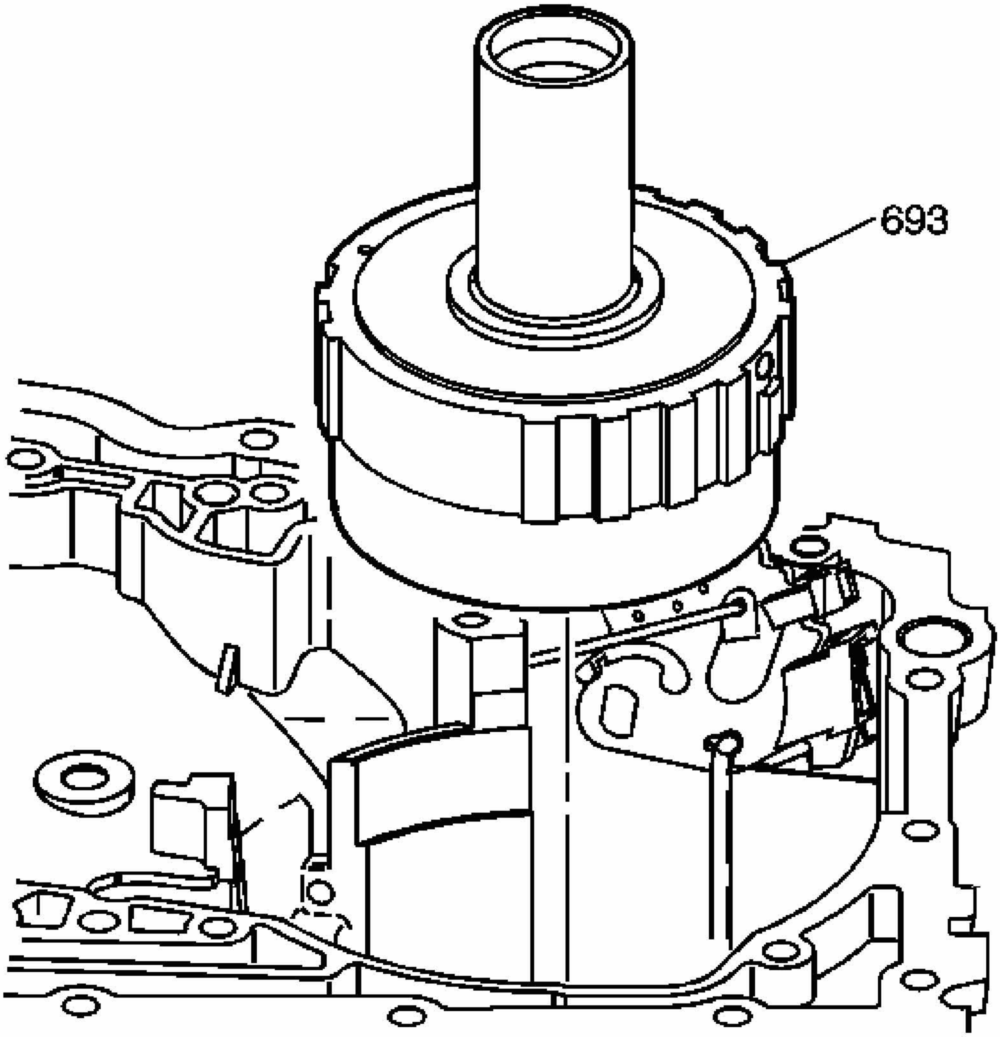


Fig. 97: Removing Differential Carrier Internal Gear Assembly
Courtesy of GENERAL MOTORS CORP.

3. Lift the differential carrier internal gear assembly (693) out of the case by depressing the park pawl assembly in order to clear the case.

MANUAL SHIFT SHAFT POSITION (INTERNAL MODE) SWITCH AND PARKING SYSTEM COMPONENTS REMOVAL

Removal Procedure

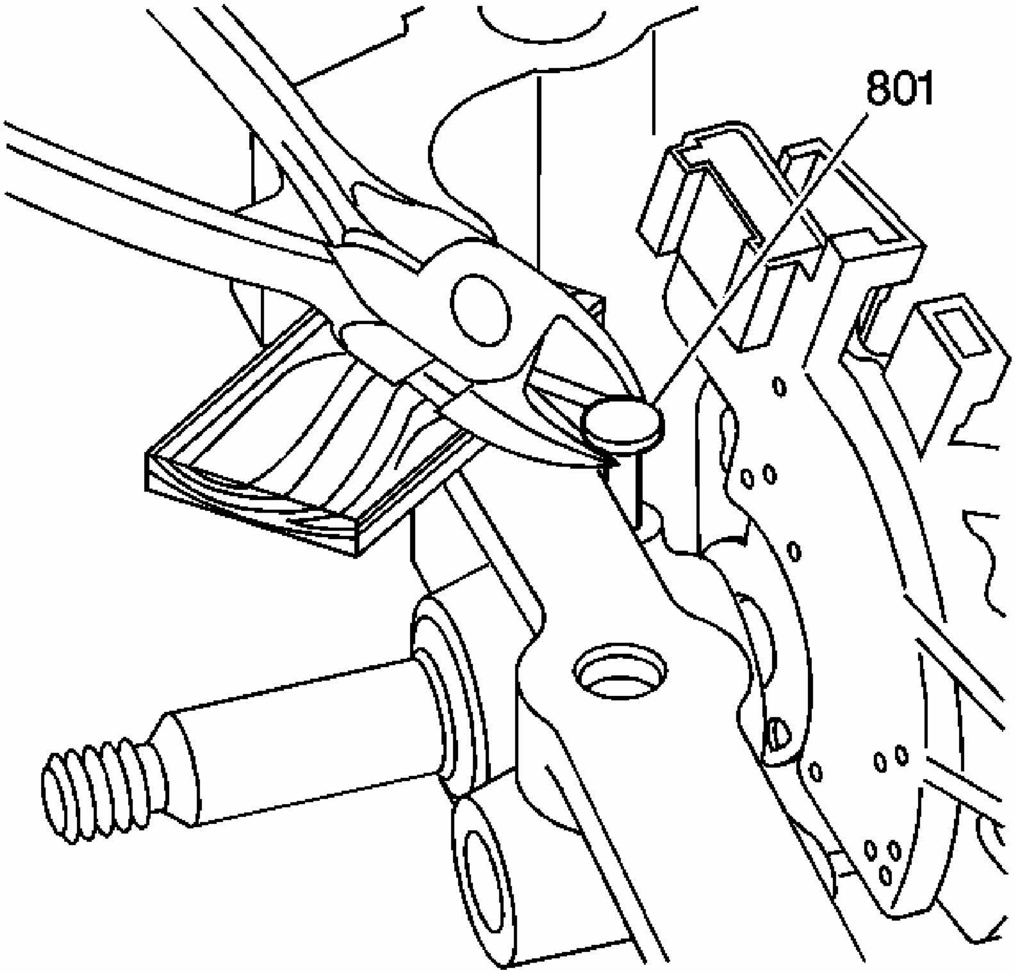


Fig. 98: Removing Manual Shift Shaft Pin
Courtesy of GENERAL MOTORS CORP.

NOTE: Use a piece of wood or rubber when prying with side cutters to remove the manual shaft pin, to prevent damage to the case.

1. Use side cutting pliers in order to remove the manual shift shaft pin (801).

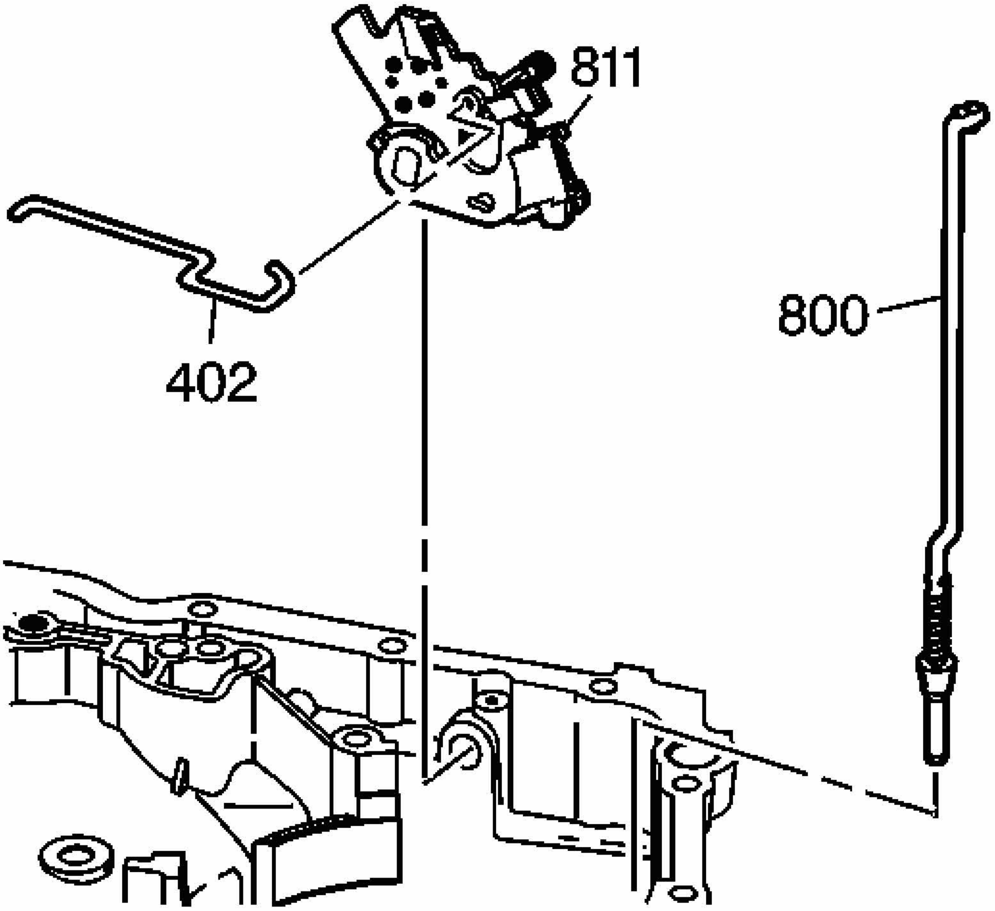


Fig. 99: Removing IMS/Detent Lever Assembly & Park Pawl Actuator Assembly
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the manual valve link (402) from the IMS/detent lever assembly (811).

IMPORTANT: The IMS/detent lever (811) should be removed as an assembly.

3. Remove the internal mode switch (IMS)/detent lever (811) and remove the park pawl actuator assembly (800).

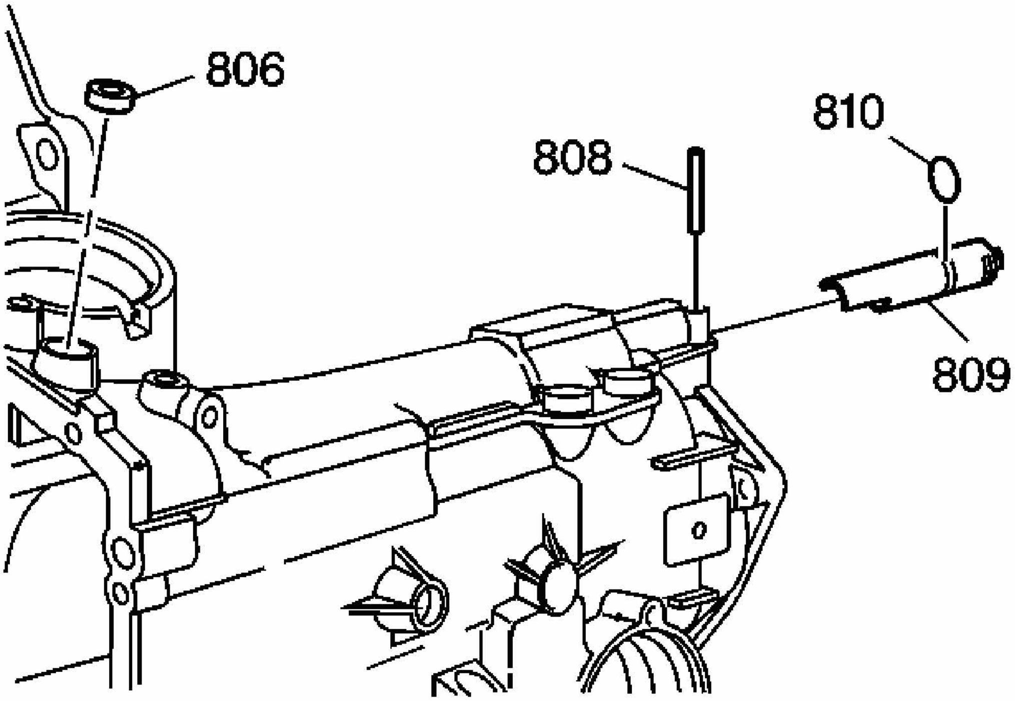


Fig. 100: Locating Park Pawl Actuator Components
Courtesy of GENERAL MOTORS CORP.

4. Position the transmission so that the reverse band servo bore is facing upward.
5. Use a small screwdriver in order to pry the manual shift shaft seal (806) from the case.
6. Remove the park pawl actuator guide pin (808).
7. Remove the park pawl actuator guide assembly (809) from the case.
8. Remove the actuator guide seal (810) from the guide.

CASE ASSEMBLY INSPECTION

Inspection Procedure

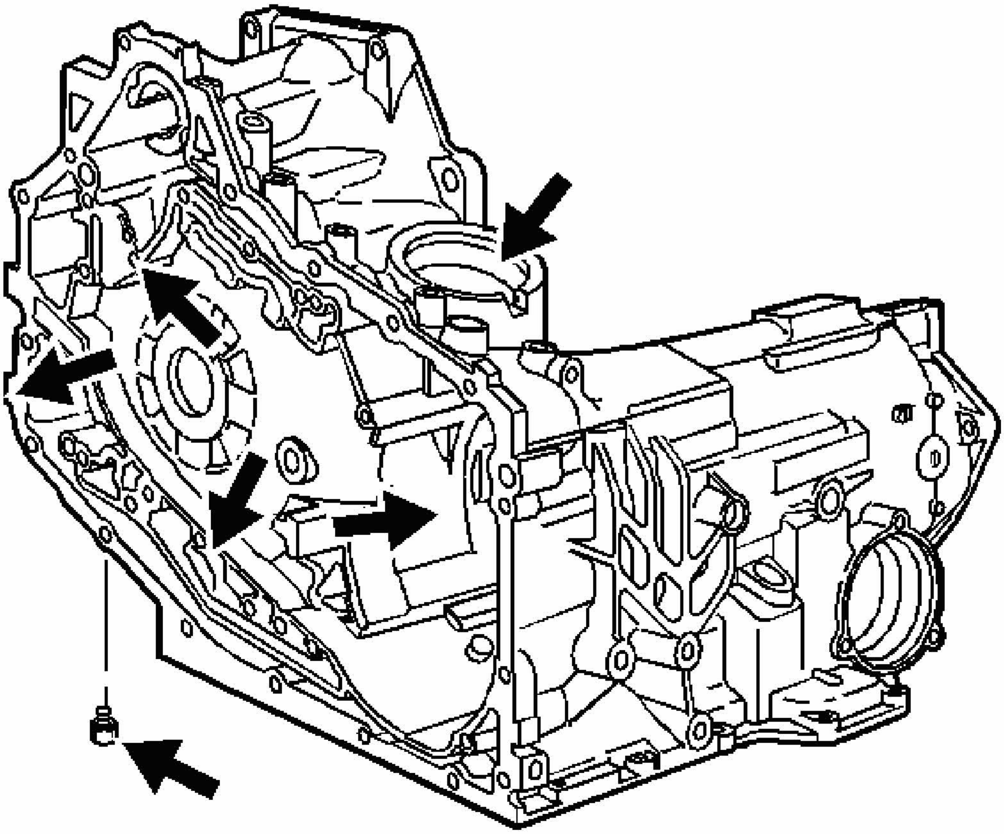


Fig. 101: Transmission Case Inspection Points
Courtesy of GENERAL MOTORS CORP.

1. Inspect the components that are still on the transmission case for the following conditions:
    - Loose, cross-threaded or damaged pipe fittings on the transmission oil cooler
    - A loose, missing or damaged transmission name plate
2. Inspect the transmission case for the following conditions:
    - Gasket sealing surfaces that are damaged or which have porosity
    - Bolt or screw holes that are stripped or damaged (repair with a thread insert)
    - Damaged or porous case oil passages
    - Damaged snap ring grooves or housing splines
    - Loose, missing or damaged band anchor pins
    - Damaged or porous case surfaces
    - Plugged drain back holes for the torque converter oil seal

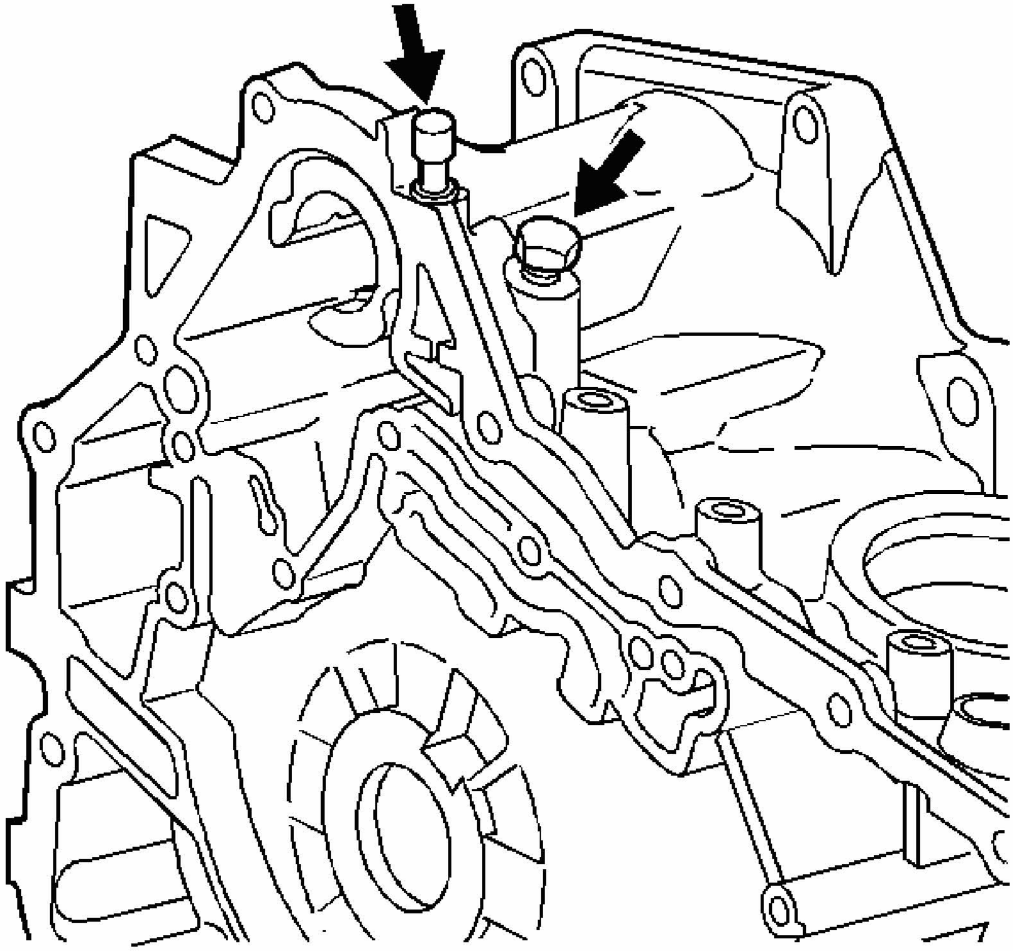


Fig. 102: View Of Vent Assembly & Oil Pressure Test Hole Plug
Courtesy of GENERAL MOTORS CORP.

3. Inspect the components that are still on the transmission case for the following conditions:
    - A loose, plugged or damaged transmission vent assembly
    - A loose, cross-threaded or damaged oil pressure test hole plug

CASE COMPONENTS DISASSEMBLE

Disassembly Procedure

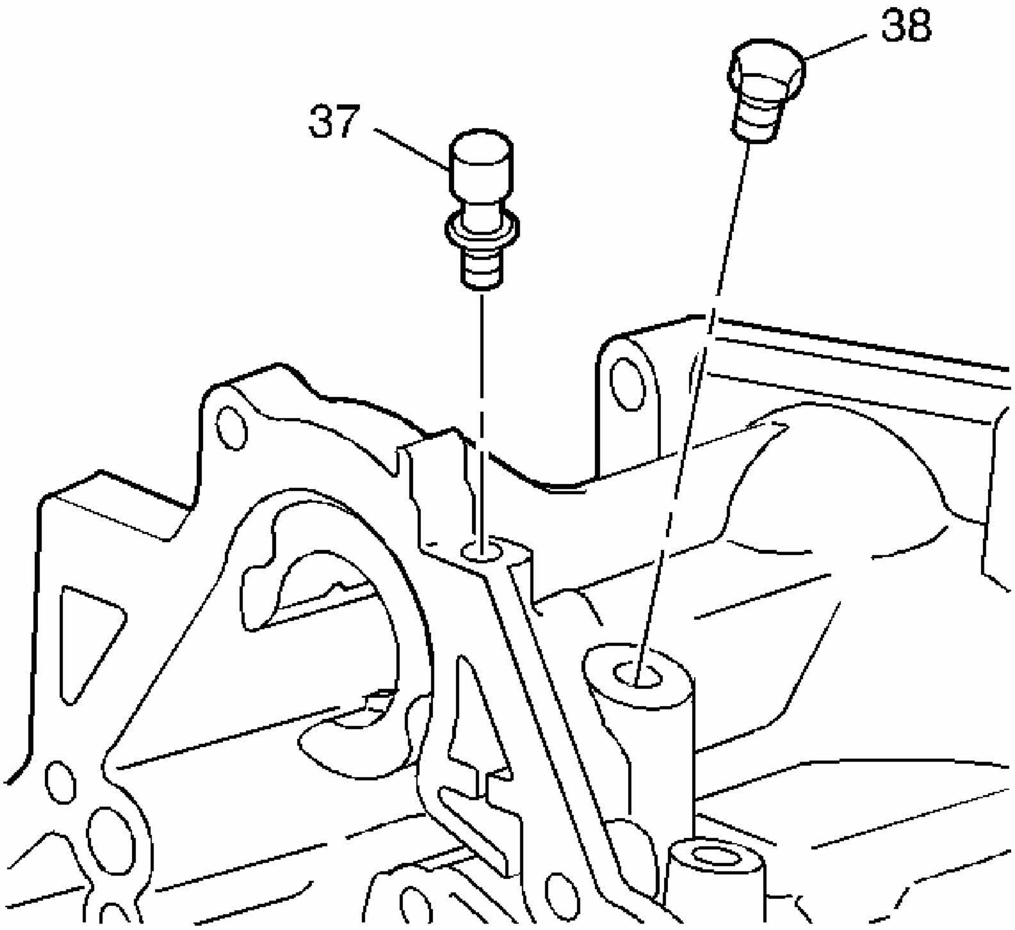


Fig. 103: View Of Vent Assembly & Oil Pressure Test Hole Plug
Courtesy of GENERAL MOTORS CORP.

1. Inspect the vent for damage or being plugged. If the vent is damaged, use channel locks and a large screwdriver in order to remove the vent assembly (37).
2. Remove the oil pressure test hole plug (38).

CASE COMPONENTS ASSEMBLE

Assembly Procedure

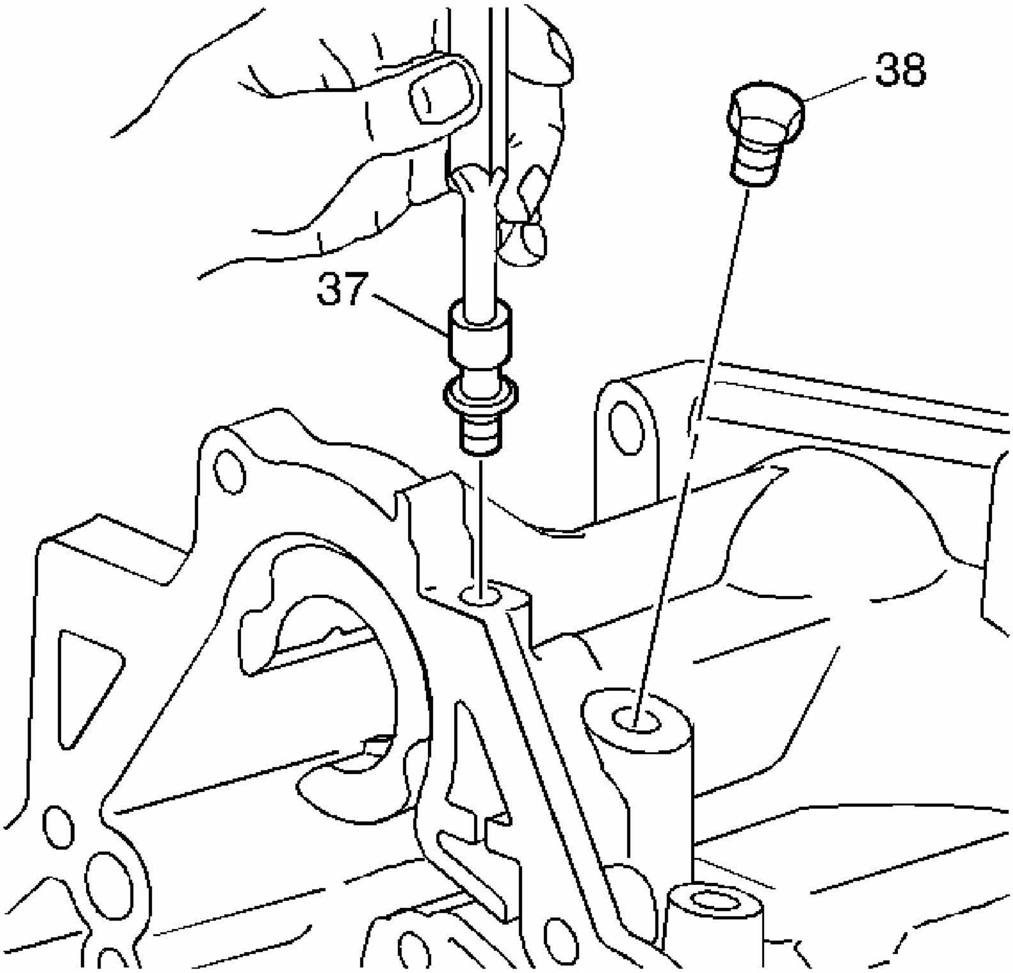


Fig. 104: Installing Oil Pressure Test Hole Plug & Vent Assembly
Courtesy of GENERAL MOTORS CORP.

1. Use a hammer and a punch in order to install the vent assembly (37), if necessary.
2. Apply sealant GM P/N 12345382 to the oil pressure test hole plug (38).

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

3. Install the oil pressure test hole plug (38).

Tighten: Tighten the oil pressure test hole plug (38) to 12 N.m (106 lb in).

TORQUE CONVERTER OIL SEAL REMOVAL

Tools Required

- **J 41103** Torque Converter Seal Remover Set
- **J 41103-1** Torque Converter Seal Puller Legs
- **J 41103-2** Torque Converter Seal Puller Bridge
- **J 41103-3** Torque Converter Seal Support Body

Removal Procedure

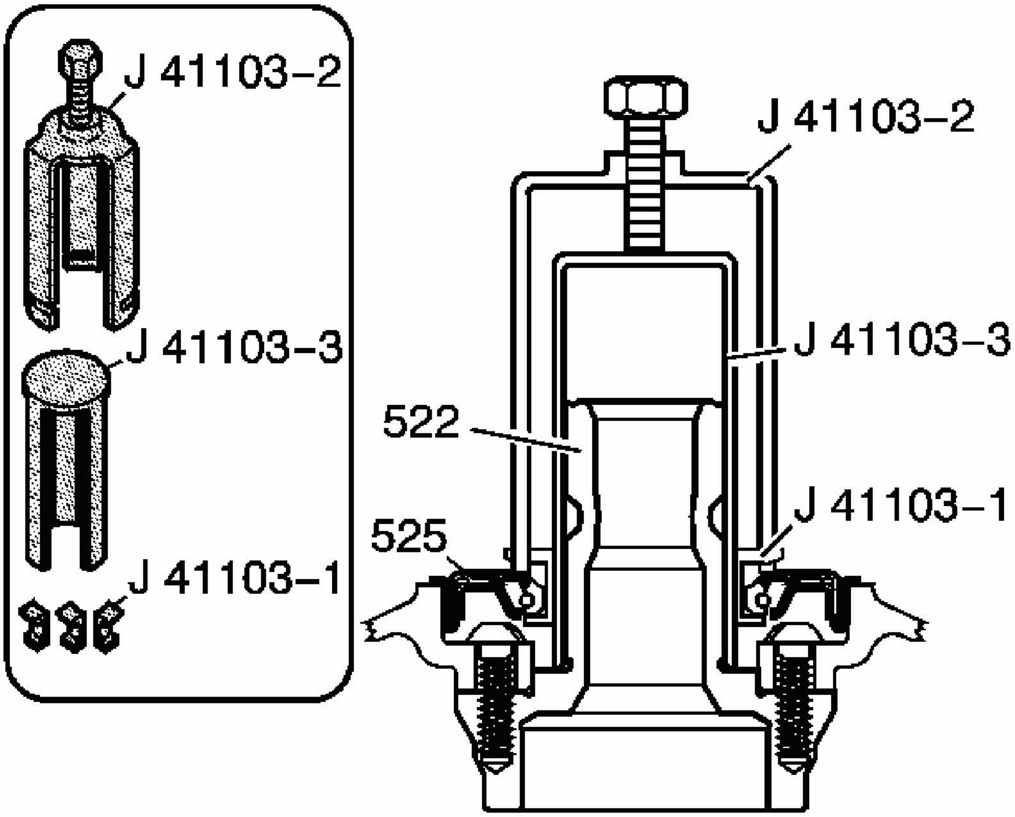


Fig. 105: Cross Sectional View Of J 41103 Components
Courtesy of GENERAL MOTORS CORP.

1. Insert the three **J 41103-1** puller legs under the Torque Converter Seal (525).
2. Insert the **J 41103-3** support body over the drive sprocket support (522).
3. Insert the **J 41103-2** puller bridge over the **J 41103-3** support body. Connect the **J 41103-1** puller legs into the slots on the **J 41103-2** bridge.

IMPORTANT: The puller legs will damage the torque converter seal (525).

Discard the torque converter seal (525) after removal.

4. Tighten the forcing screw on the **J 41103-2** puller bridge until the **J 41103-1** puller legs remove the torque converter seal (525).

DRIVE SPROCKET SUPPORT REMOVAL

Tools Required

- **J 23907** Universal Slide Hammer and Puller
- **J 26941** Drive Sprocket Support Bearing Remover

Removal Procedure

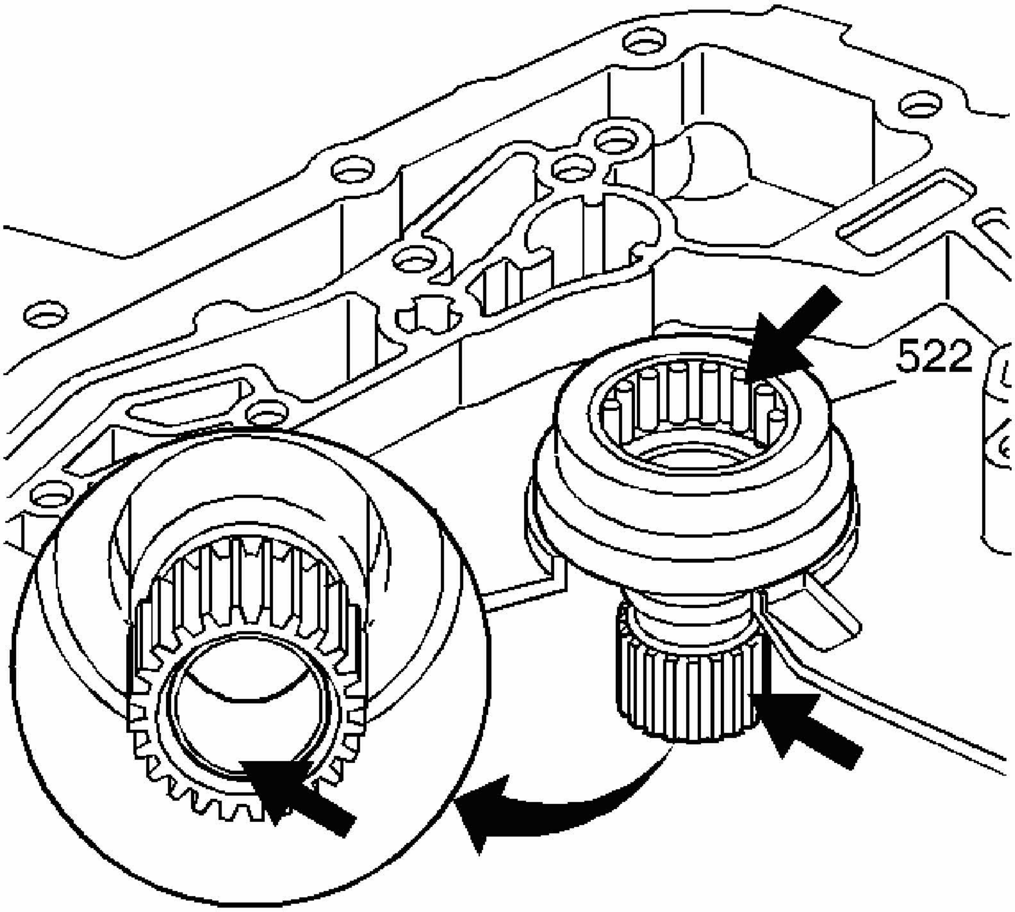


Fig. 106: Inspection Areas On Drive Sprocket Support
Courtesy of GENERAL MOTORS CORP.

1. Inspect the drive sprocket support (522) for the following conditions:
   - Damaged splines
   - A damaged drive sprocket support bearing
   - A damaged turbine shaft bushing (pressed inside the support)
2. Remove the drive sprocket support bearing only if the bearing is damaged.
3. Remove the drive sprocket support assembly only if the support is damaged.

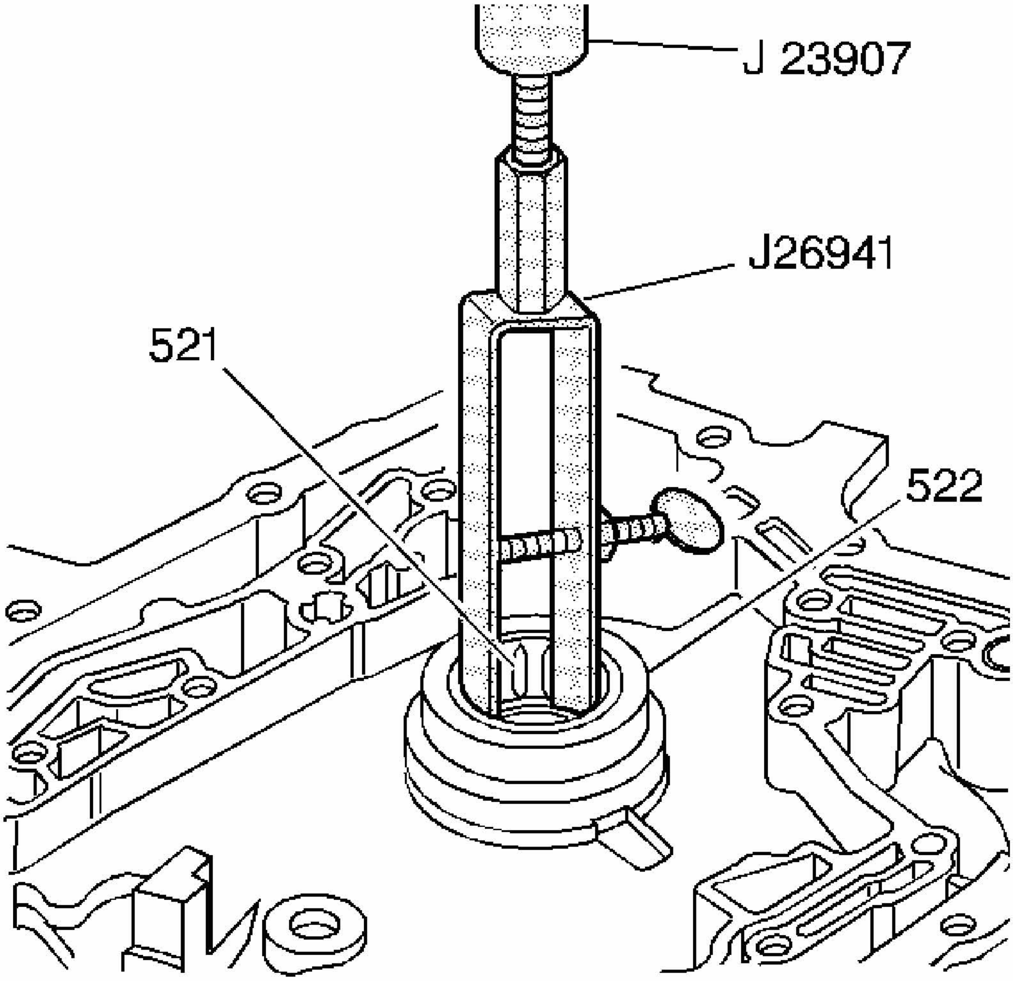


Fig. 107: Removing Bearing Assembly From Drive Sprocket Support
Courtesy of GENERAL MOTORS CORP.

4. Assemble **J 23907** and **J 26941** .
5. Use **J 23907** and **J 26941** in order to remove the bearing assembly (521) from the drive sprocket support.

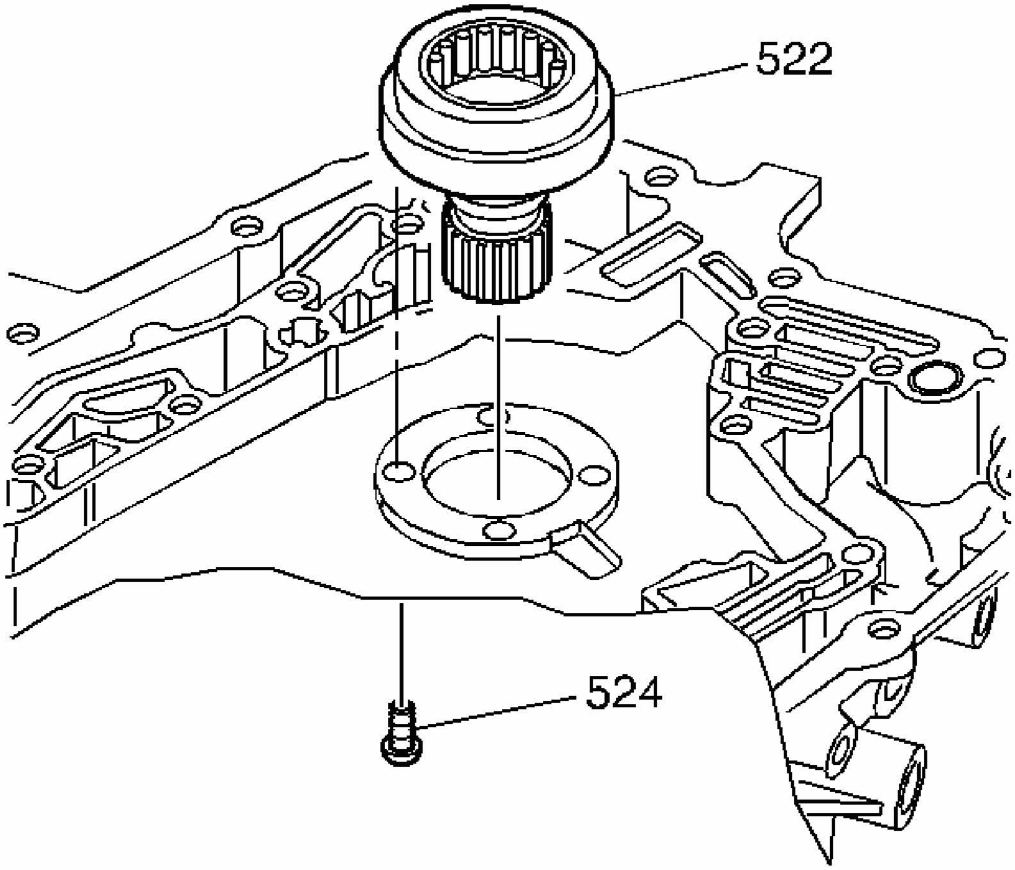


Fig. 108: Locating Drive Sprocket Support Assembly
Courtesy of GENERAL MOTORS CORP.

6. Remove the four drive sprocket support bolts (524).
7. Remove the drive sprocket support assembly (522).

DRIVE SPROCKET SUPPORT ASSEMBLE

Tools Required

- **J 8092** Driver Handle
- **J 28677** Drive Sprocket Support Bearing Installer. See **Special Tools**.
- **J 36850** Transmission Assembly Lubricant

Assembly Procedure

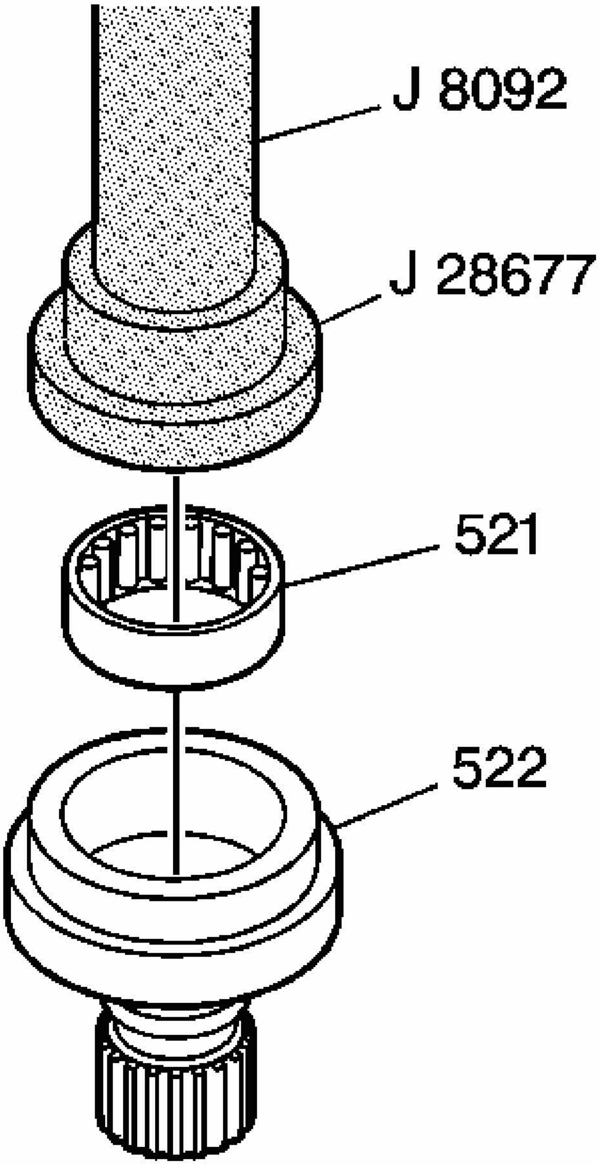


Fig. 109: Pressing In Drive Sprocket Support Bearing With J 8092 & J 28677
Courtesy of GENERAL MOTORS CORP.

1. Assemble **J 28677** and **J 8092** . See **Special Tools**.
2. Lubricate drive sprocket support bearing (521) with **J 36850** .

IMPORTANT: When installing the new bearing the part number should be visible (facing upward).

3. Using the assembled tool, press in the drive sprocket support bearing (521).

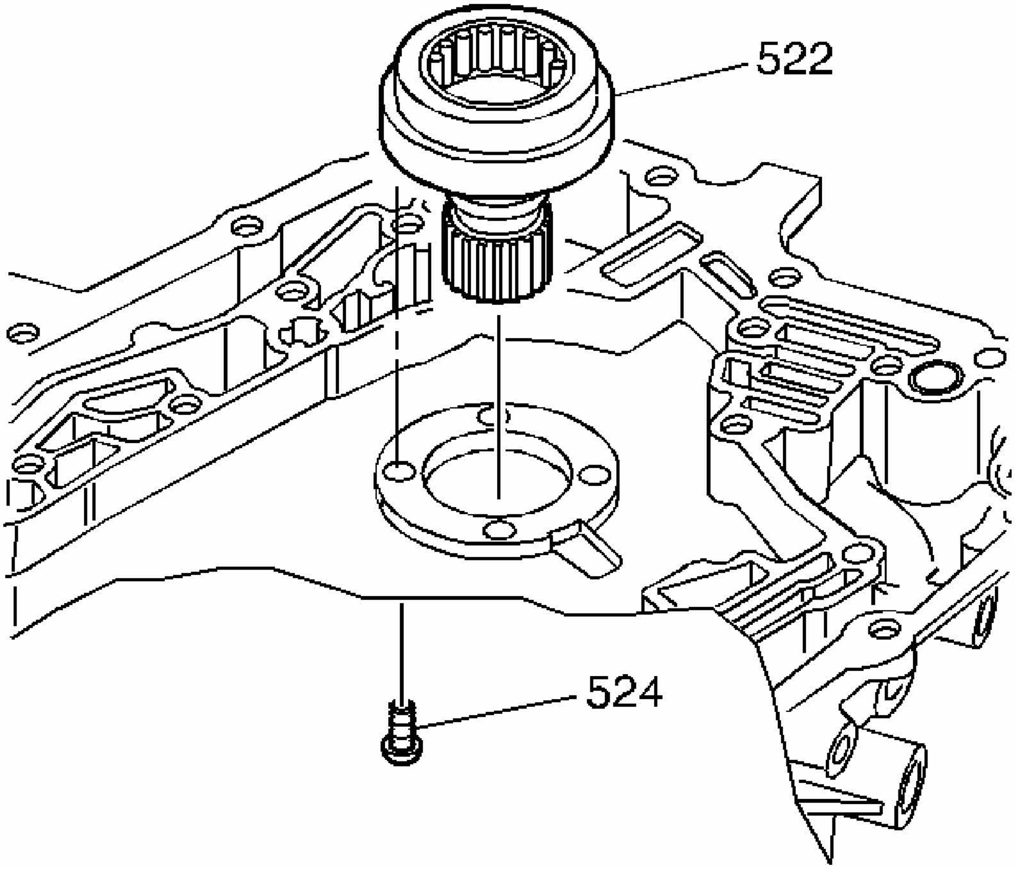


Fig. 110: Locating Drive Sprocket Support Assembly
Courtesy of GENERAL MOTORS CORP.

4. Install the drive sprocket support assembly (522).

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

5. Install the four drive sprocket support bolts (524).

Tighten: Tighten the bolts to 25 N.m (18 lb ft).

TORQUE CONVERTER OIL SEAL ASSEMBLE

Tools Required

J 28540-A Converter Seal Installer

Assembly Procedure

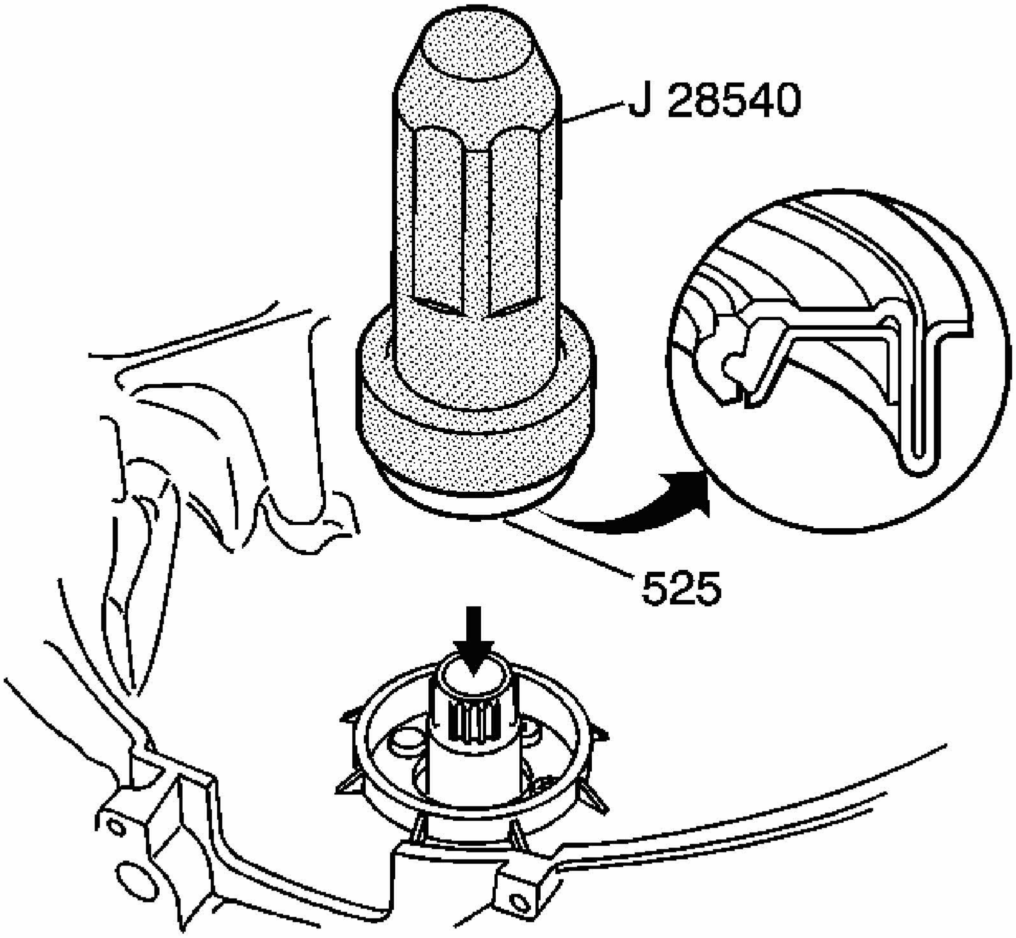


Fig. 111: Identifying J 28540-A
Courtesy of GENERAL MOTORS CORP.

NOTE: Install the seal onto the tool before installing into the case to prevent damage to the seal.

Use **J 28540-A** and a mallet in order to install the torque converter oil seal (525).

MANUAL SHIFT SHAFT POSITION (INTERNAL MODE) SWITCH AND PARKING SYSTEM COMPONENTS INSTALLATION

Installation Procedure

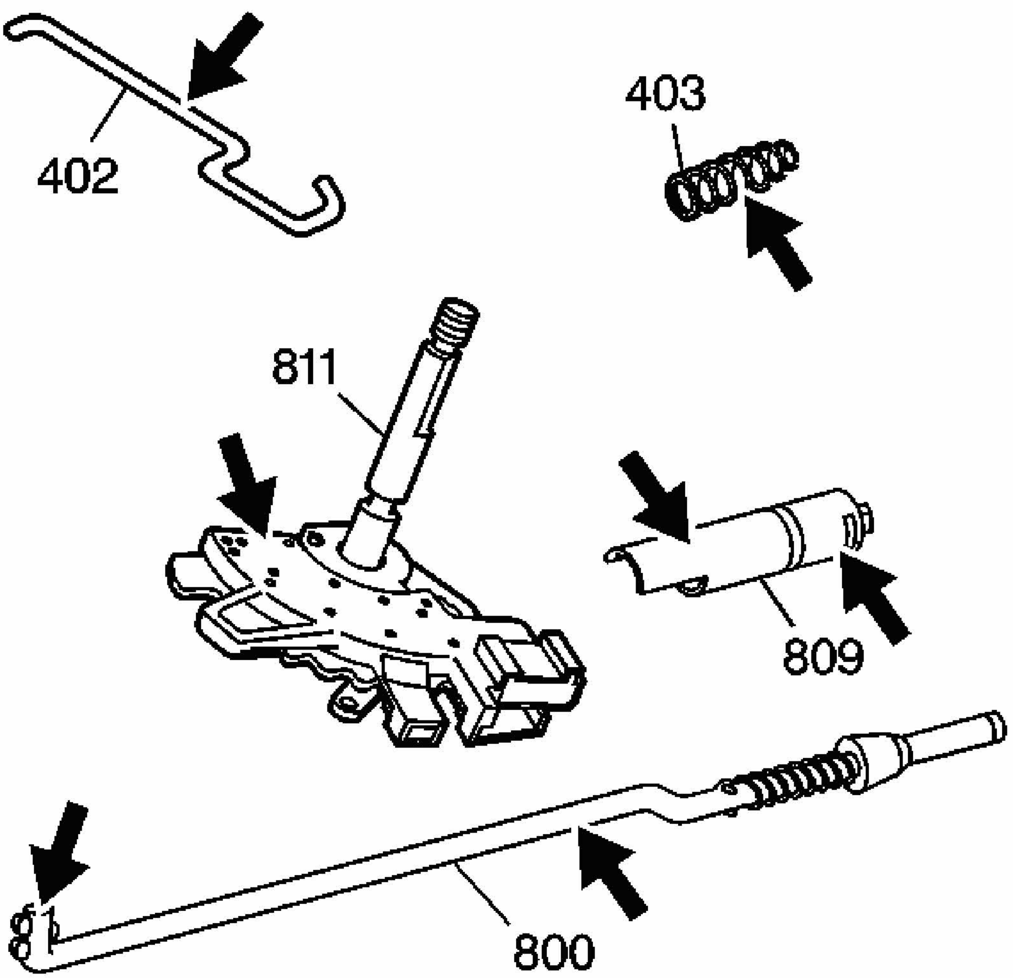


Fig. 112: Locating Inspection Areas In Park System Components
Courtesy of GENERAL MOTORS CORP.

1. Inspect the park system components for the following conditions:
   - A worn park pawl actuator guide (809)
   - A damaged or bent park pawl actuator assembly (800)
   - A damaged internal mode switch (IMS) detent lever (811)
   - A bent or damaged manual valve link (402)
   - A kinked or bent manual valve link spring (403)

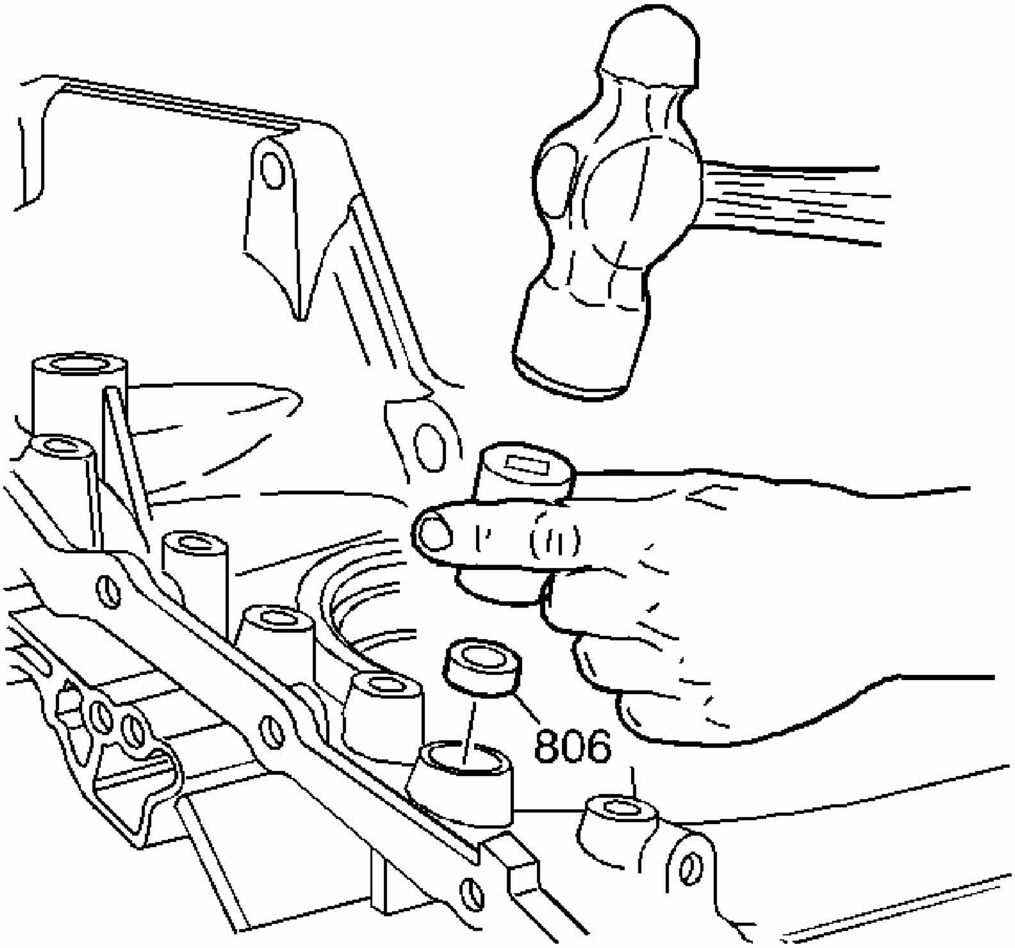


Fig. 113: Installing Manual Shift Shaft Seal Assembly
Courtesy of GENERAL MOTORS CORP.

2. Use a 9/16 inch socket and a hammer in order to install the manual shift shaft seal assembly (806) into the case.

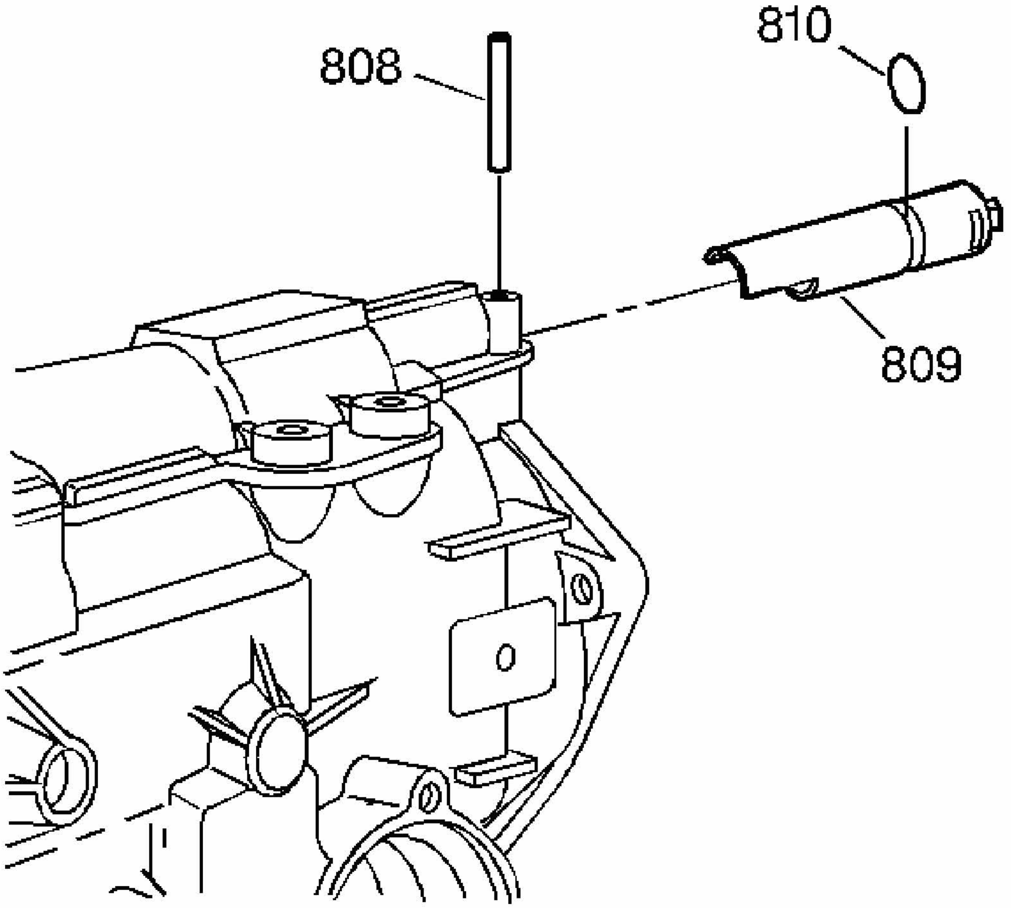


Fig. 114: View Of Park Pawl Actuator Guide O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

3. Install a new park pawl actuator guide O-ring seal (810) onto the park pawl actuator guide (809).
4. Install the actuator guide assembly into the case.
5. Align the slot for the actuator guide pin (808) in the park pawl with the pin hole in the case.
6. Use a mallet in order to install the actuator guide pin (808).

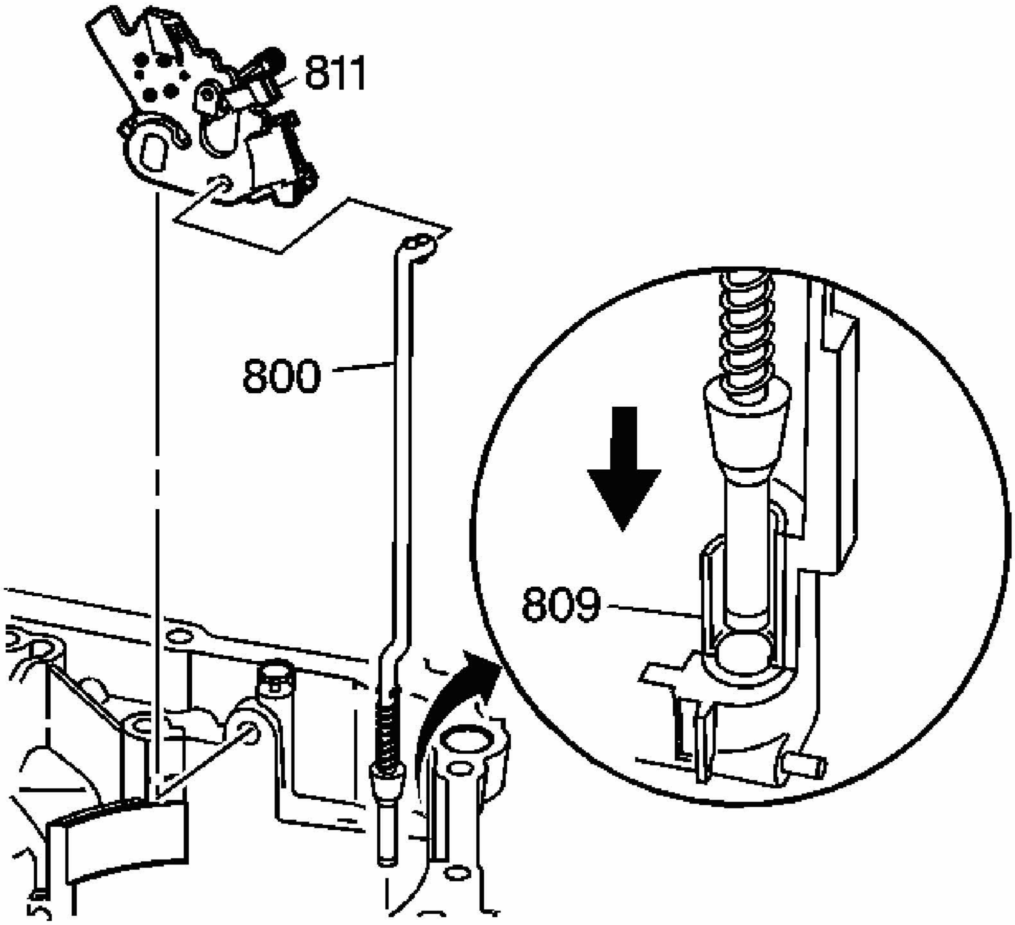


Fig. 115: Expanded View Of Park Pawl Actuator Assembly
Courtesy of GENERAL MOTORS CORP.

7. Assemble the IMS (811) onto the park pawl actuator assembly (800).
8. Install the IMS detent lever assembly (811) and the park pawl actuator assembly (800) into the case.

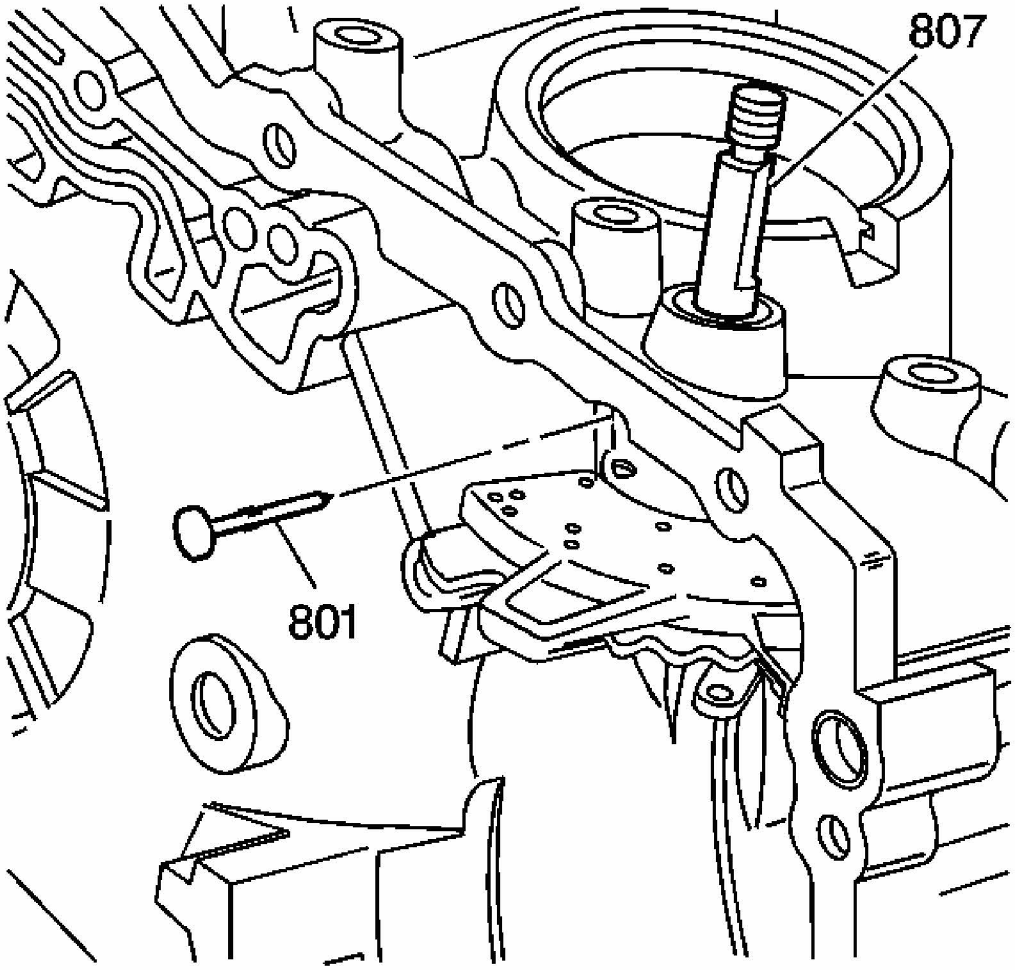


Fig. 116: Installing Manual Shift Shaft Pin
Courtesy of GENERAL MOTORS CORP.

9. Align the groove for the manual shift shaft pin with the pin hole in the case.
10. Use a mallet in order to install the manual shift shaft pin (801).

DIFFERENTIAL CARRIER INTERNAL GEAR ASSEMBLE

Tools Required

J 28585 Snap Ring Remover

Assembly Procedure

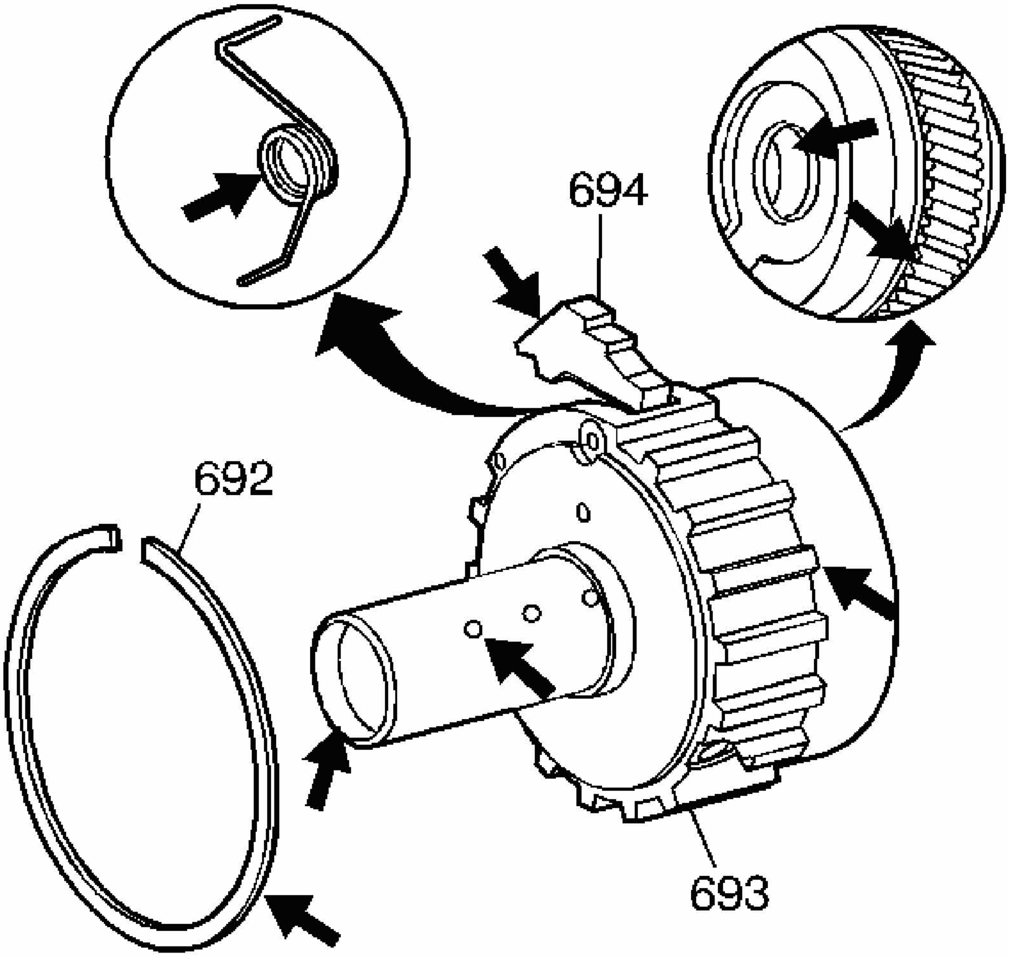


Fig. 117: Identifying Differential Carrier Internal Gear Assembly Inspection Areas
Courtesy of GENERAL MOTORS CORP.

1. Inspect the differential carrier internal gear assembly (693) for the following conditions:
    - Damaged or worn bushings
    - Plugged lube oil holes
    - Damaged case splines
    - Damaged or worn gear teeth
    - A damaged or worn park pawl assembly (694)
    - A damaged snap ring (692)

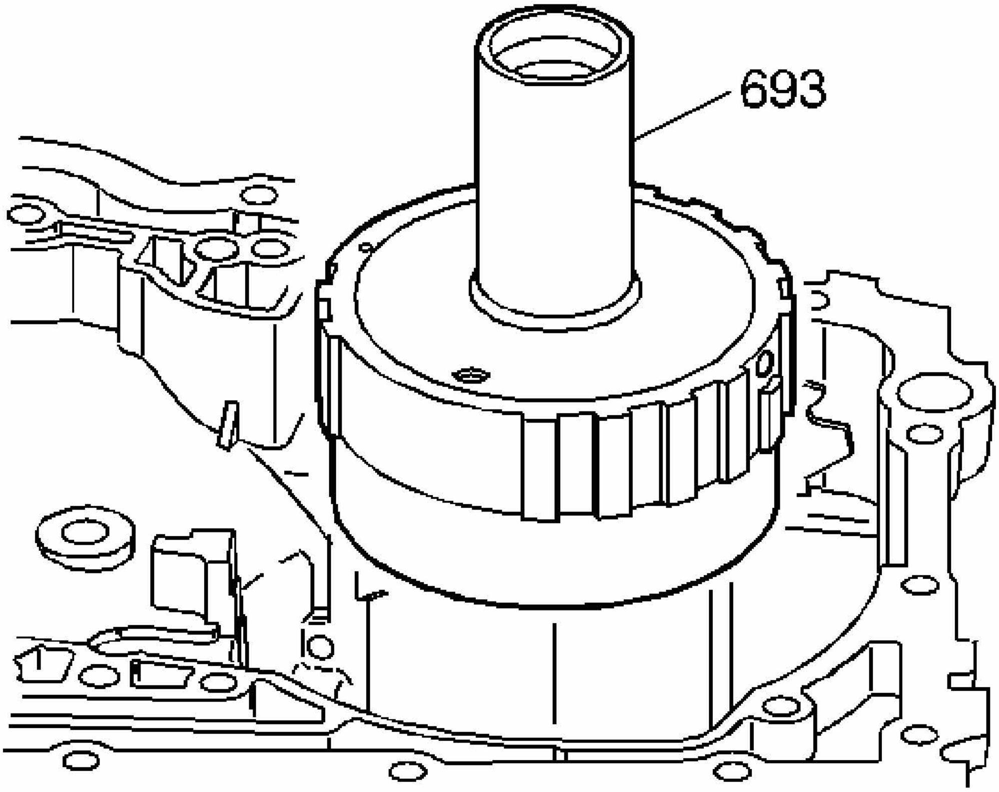


Fig. 118: View Of Differential Carrier Internal Gear Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install the differential carrier internal gear assembly (693) into the case. Align the park pawl assembly with the park pawl actuator assembly.

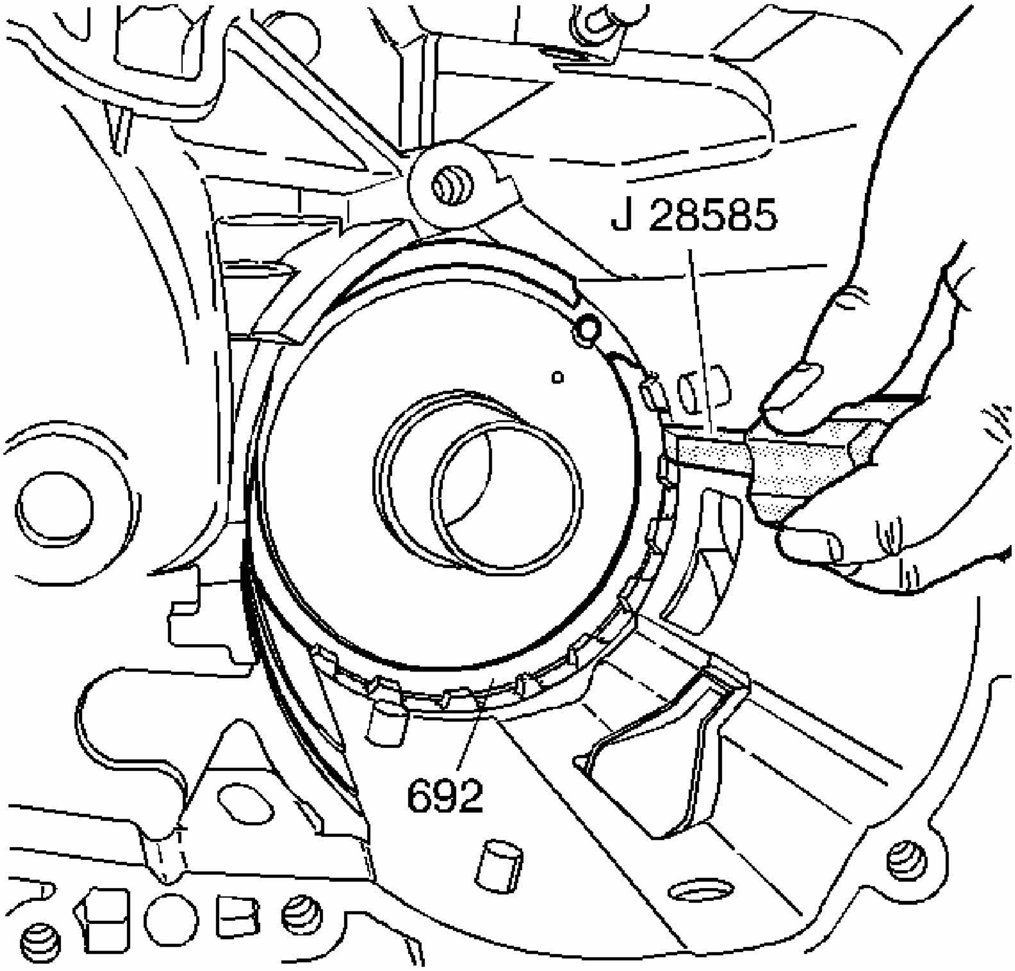


Fig. 119: Using J 28585 To Install The Snap Ring Into The Case
Courtesy of GENERAL MOTORS CORP.

3. Use **J 28585** or a long screwdriver in order to install the snap ring (692) into the case as shown.

DIFFERENTIAL CARRIER INSPECTION (FWD ONLY)

Inspection Procedure

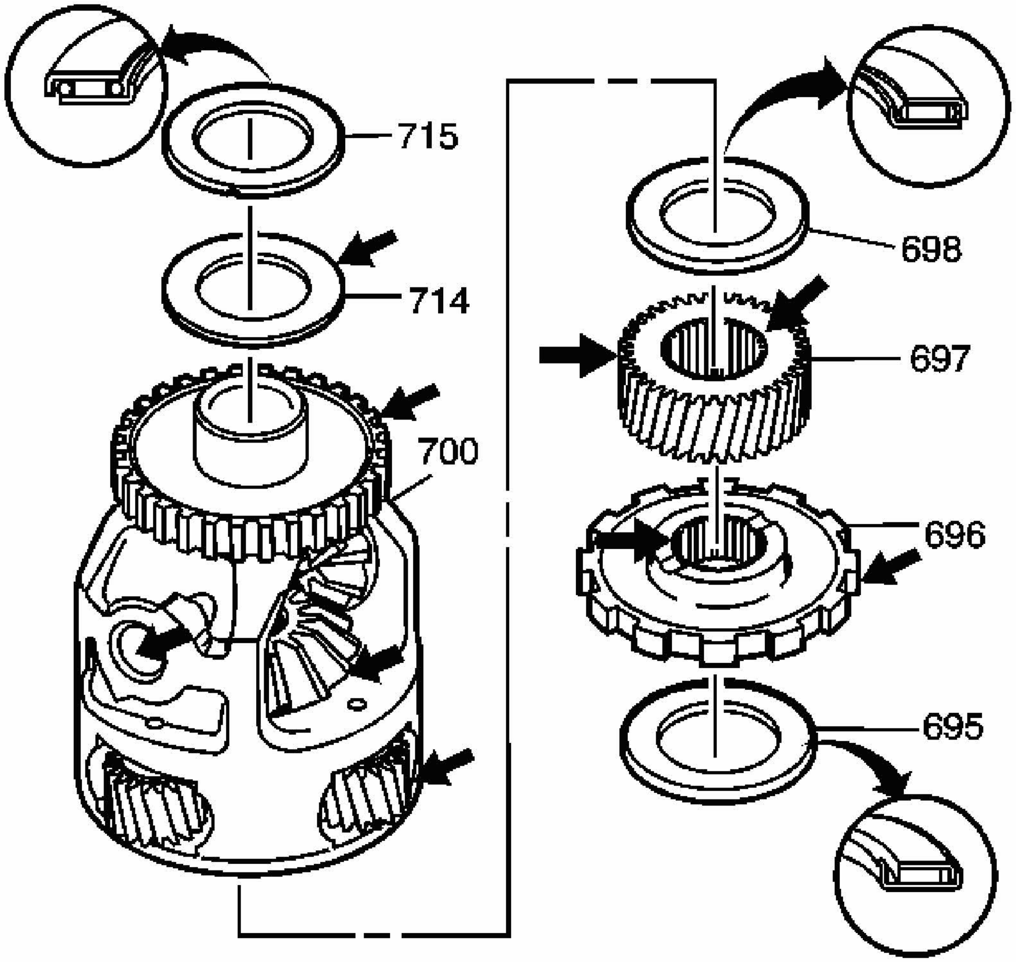


Fig. 120: Exploded View Of Differential Carrier Assembly (FWD Only)
Courtesy of GENERAL MOTORS CORP.

1. Inspect the differential carrier assembly (700) for the following conditions:
   - Damaged or worn teeth, bearing rollers, washers or pins on the differential planetary pinion gear
   - Damaged or worn teeth or splines on the final drive sun gear (697)
   - Damaged or worn teeth, splines or thrust washers on the differential side gear
   - Damaged or worn teeth, thrust washers or shaft on the differential pinion gear
   - Damaged or worn lugs or splines on the parking gear (696)
   - A damaged vehicle speed sensor reluctor wheel
   - Damaged internal gear/parking gear thrust bearing (695), differential carrier/sun gear thrust bearing (698) or differential carrier/case thrust bearing (715)

- A damaged or worn differential carrier/case selective thrust washer (714)
- A damaged differential/final drive carrier housing (700)

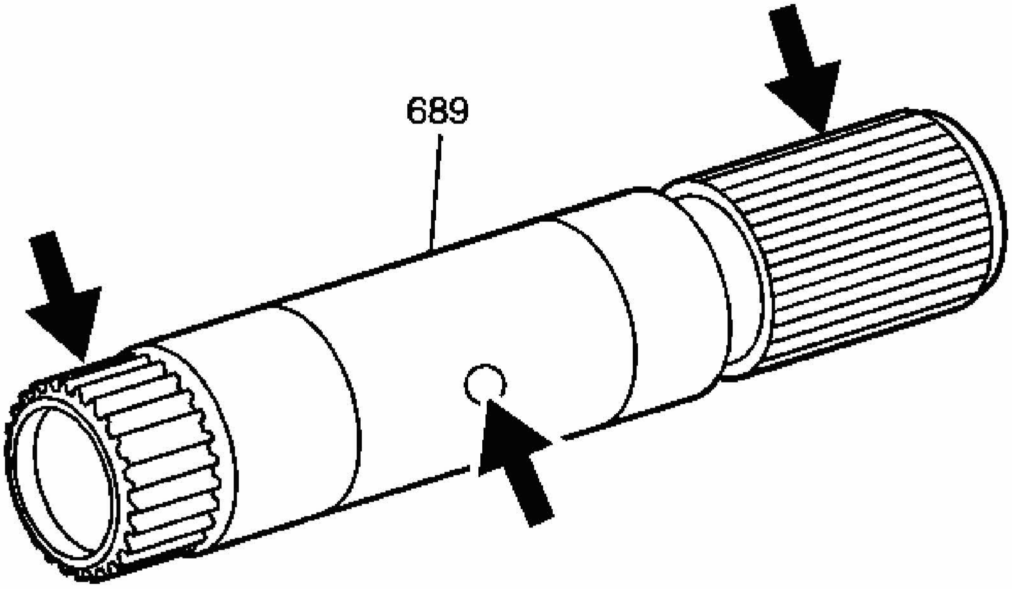


Fig. 121: Inspecting Sun Gear Shaft
Courtesy of GENERAL MOTORS CORP.

2. Inspect the final drive sun gear shaft (689) for the following conditions:
    - Damaged or worn splines
    - Cracks at lube oil holes
    - Damaged or worn bearing journals

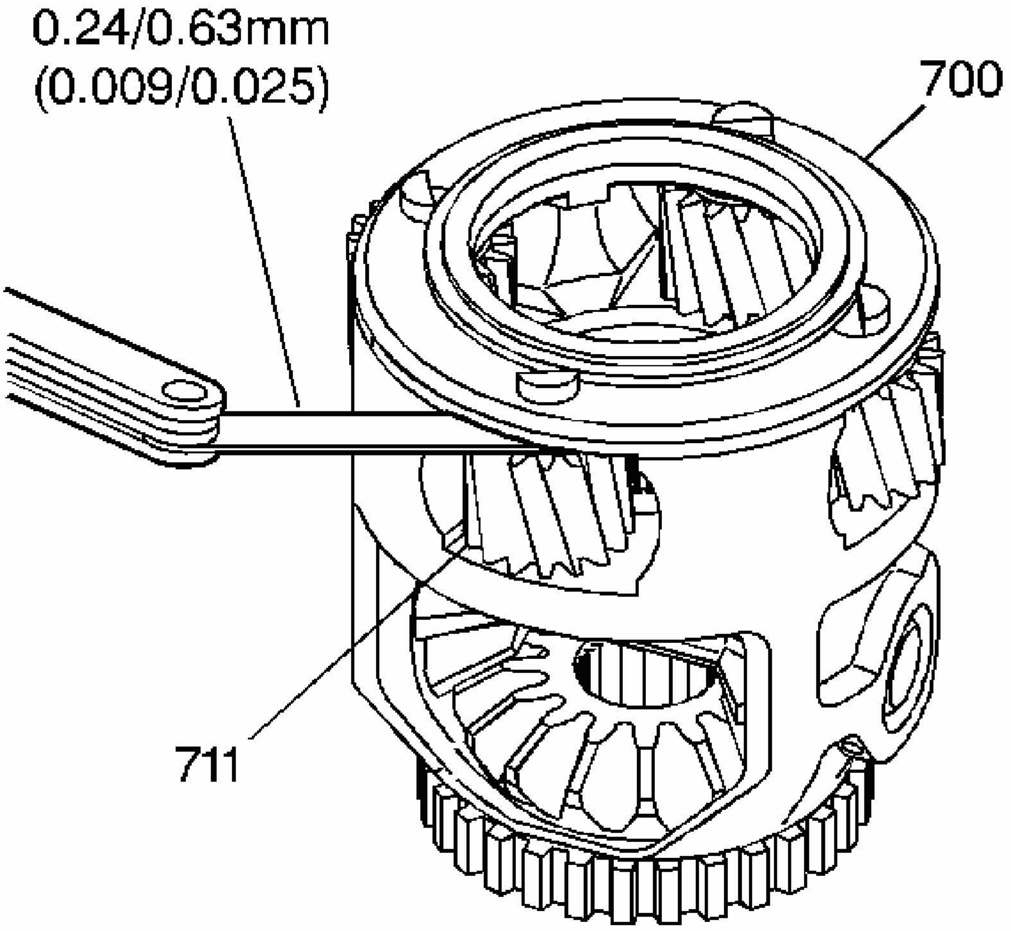


Fig. 122: Measuring Differential Carrier Planetary Pinion Gear End Play
Courtesy of GENERAL MOTORS CORP.

3. Use a feeler gauge in order to measure the end play of the differential carrier planetary pinion gear.

   Specification: End play should be 0.24-0.63 mm (0.009-0.025 in).

4. If the end play check or the component inspection indicates a condition, repair the differential/final drive carrier assembly (700).

DIFFERENTIAL CARRIER DISASSEMBLE (FWD ONLY)

Disassembly Procedure

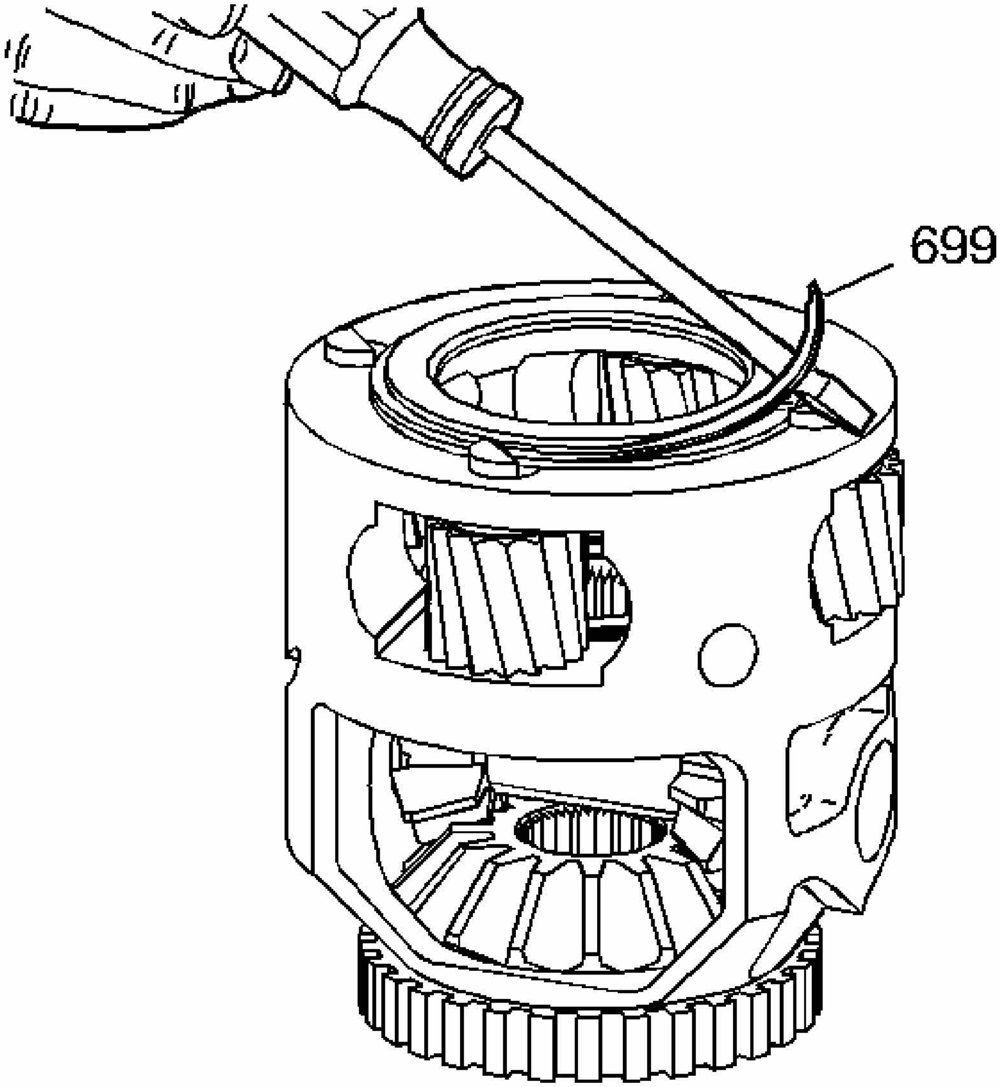


Fig. 123: Using Screwdriver To Remove Front Differential Carrier Snap Ring
Courtesy of GENERAL MOTORS CORP.

1. Use a screwdriver in order to remove the snap ring (699) from the front differential carrier.

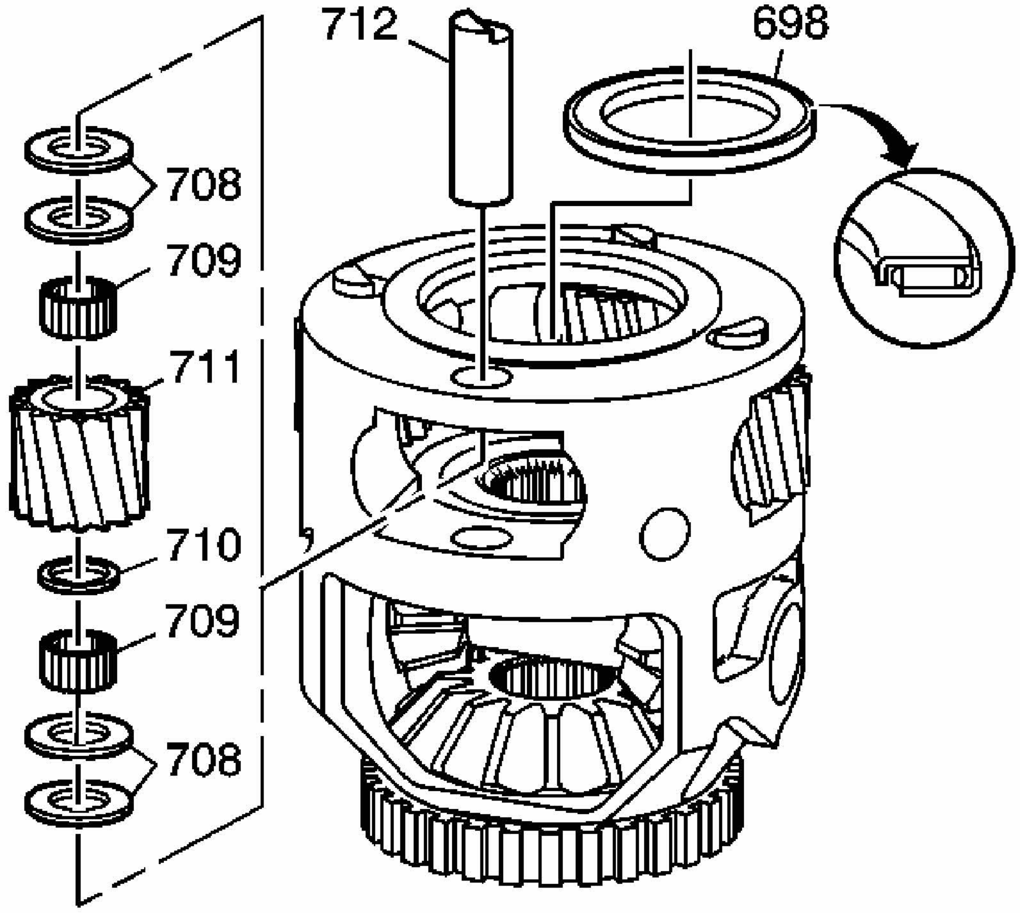


Fig. 124: Exploded View Of Pinion Gears, Washers and Bearings
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Keep all washers and bearings together with the planetary pinion gear and pin. The pinion gears, washers and bearings must be reinstalled in the original locations.

2. Remove the first planetary pinion by removing the following parts:
    1. The planetary pinion gear pin (712)
    2. The pinion thrust washers (708)
    3. The pinion gear roller bearings (709)
    4. The bearing roller spacer (710)
    5. The pinion (711)
3. Remove the remaining planetary pinions in the same way.

4. Remove the differential carrier sun gear thrust bearing assembly (698).

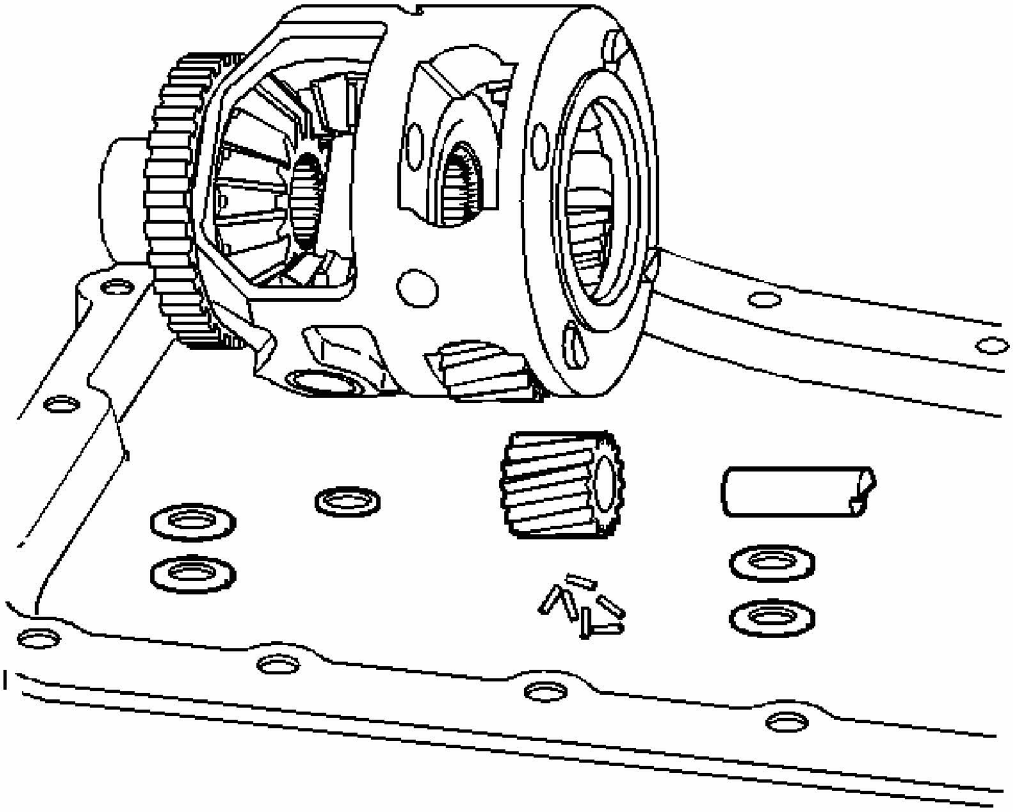


Fig. 125: Ensuring Containment Of Final Drive Carrier Components
Courtesy of GENERAL MOTORS CORP.

5. Place the final drive carrier components into an oil pan in order to make sure that none of the bearing rollers are lost.

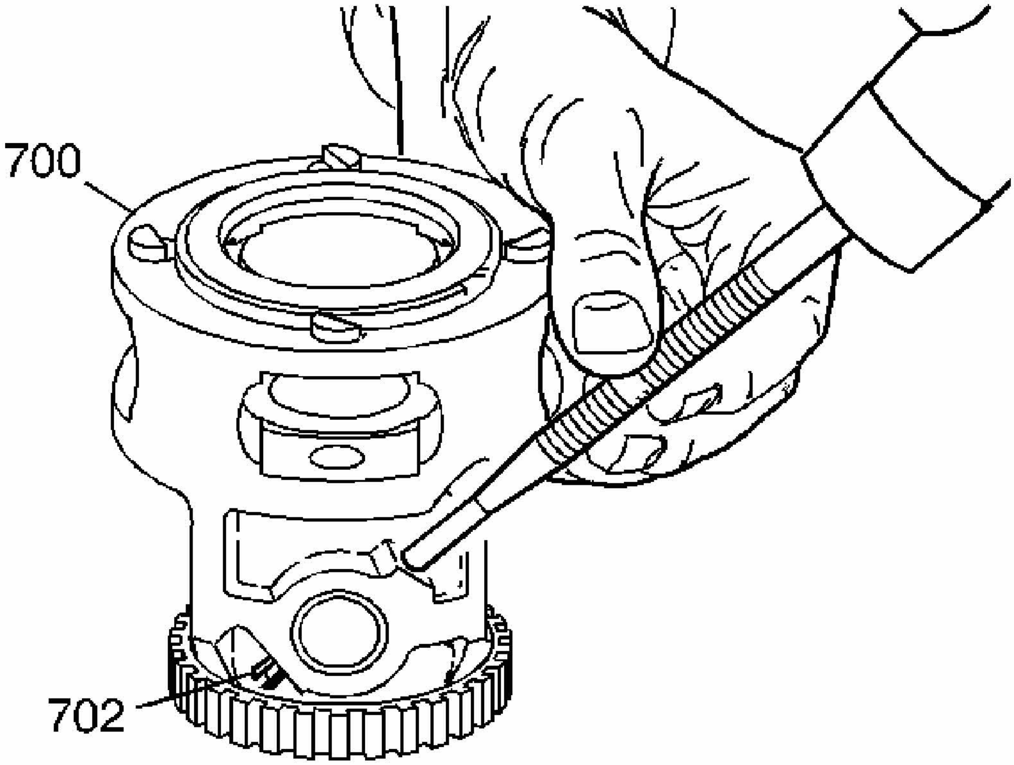


Fig. 126: Removing Differential Pinion Gear Shaft Pin With Drift Punch
Courtesy of GENERAL MOTORS CORP.

6. Use a drift punch and a mallet in order to remove the differential pinion gear shaft pin (702).

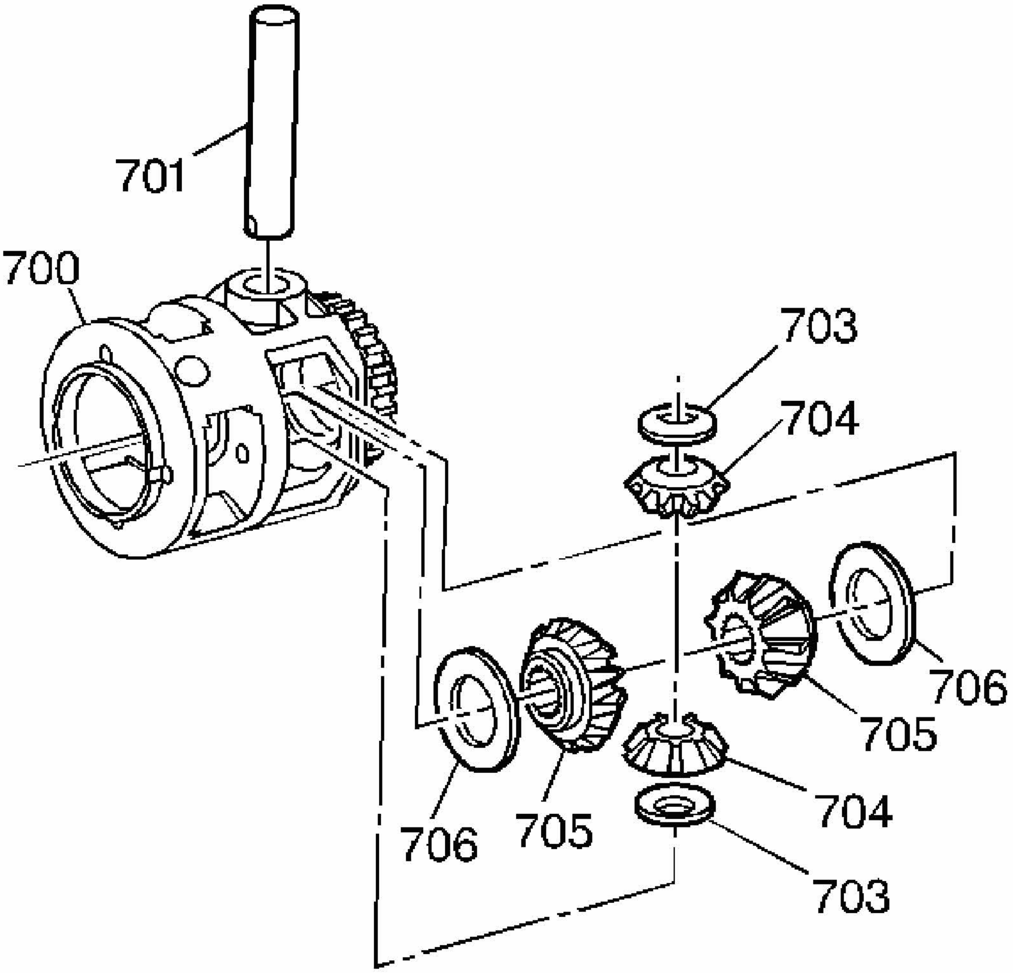


Fig. 127: Expanded View Of Differential Carrier Assembly
Courtesy of GENERAL MOTORS CORP.

7. Remove the differential pinion shaft (701).
8. Remove the differential pinion gears (704).
9. Remove the differential pinion gear thrust washers (703).
10. Remove the differential side gears (705).
11. Remove the differential side gear thrust washers (706).

DIFFERENTIAL CARRIER ASSEMBLE (FWD ONLY)

Tools Required

J 36850 Assembly Lubricant (or equivalent)

Assembly Procedure

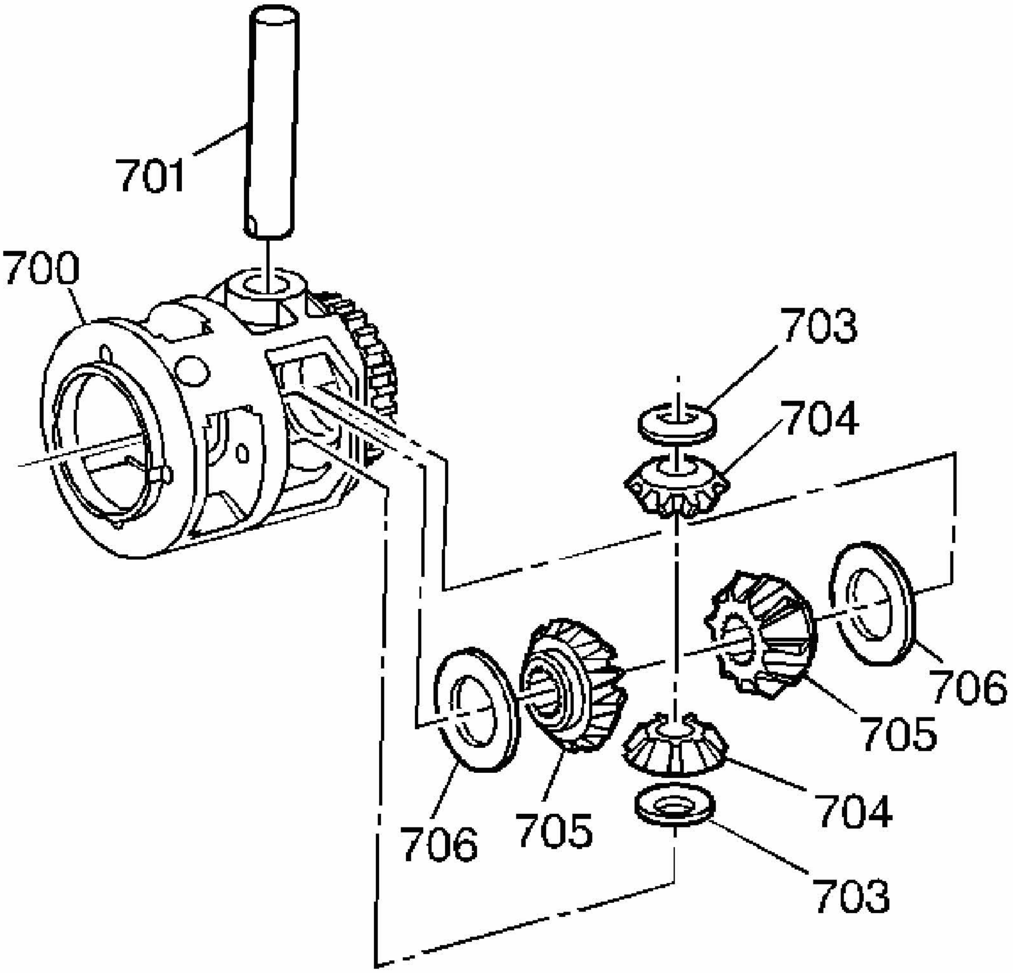


Fig. 128: Expanded View Of Differential Carrier Assembly
Courtesy of GENERAL MOTORS CORP.

1. Affix the differential side gear thrust washers (706) to the side gears (705). Apply **J 36850** or equivalent.
2. Install the side gears (705) with the thrust washers into the differential carrier housing (700).
3. Affix the differential pinion thrust washers (703) to the pinion gears (704). Apply **J 36850** or equivalent.
4. Install the pinion gears with thrust washers into the differential carrier housing (700). Rotate the pinion gears into position.
5. Install the differential pinion shaft (701) into the differential carrier housing.

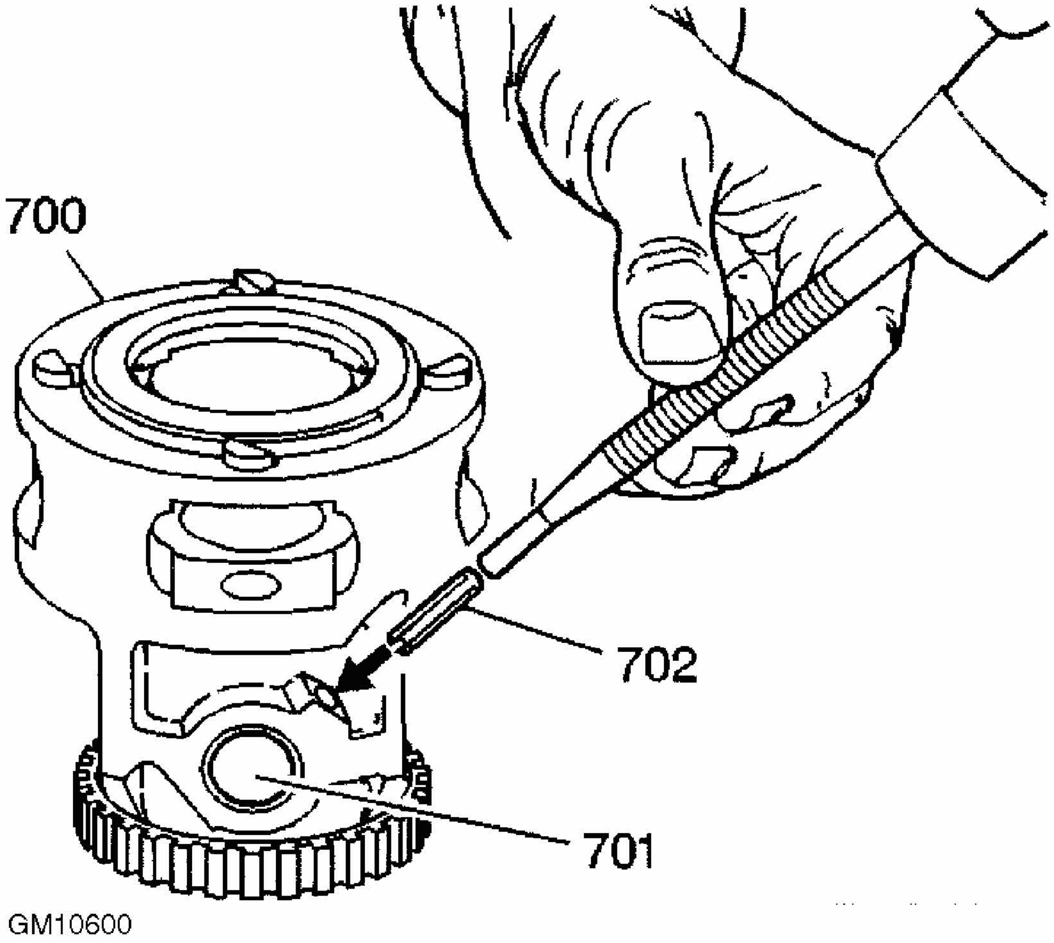


Fig. 129: Installing Pinion Gear Shaft Pin
Courtesy of GENERAL MOTORS CORP.

6. Align the hole in the pinion gear shaft (701) to the hole in the differential carrier housing (700).
7. Use a drift punch and a mallet in order to install the pinion gear shaft pin (702) into the differential carrier housing (700).

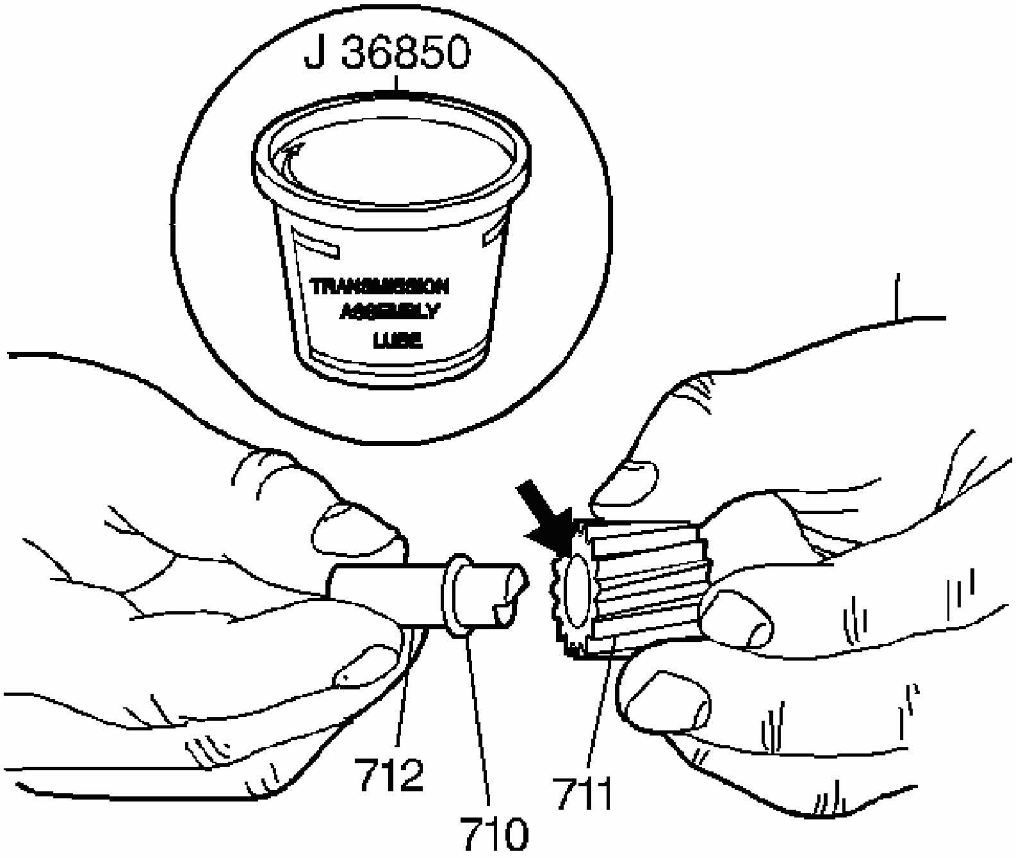


Fig. 130: Inserting Bearing Roller Spacer Onto The Pin Planetary Pinion Gear
Courtesy of GENERAL MOTORS CORP.

8. Apply **J 36850** or equivalent to the inside of a differential carrier planetary pinion gear (711).
9. For each planetary pinion gear, insert a bearing roller spacer (710) onto the pin (712). The spacer must be inserted between the two rows of bearing rollers.

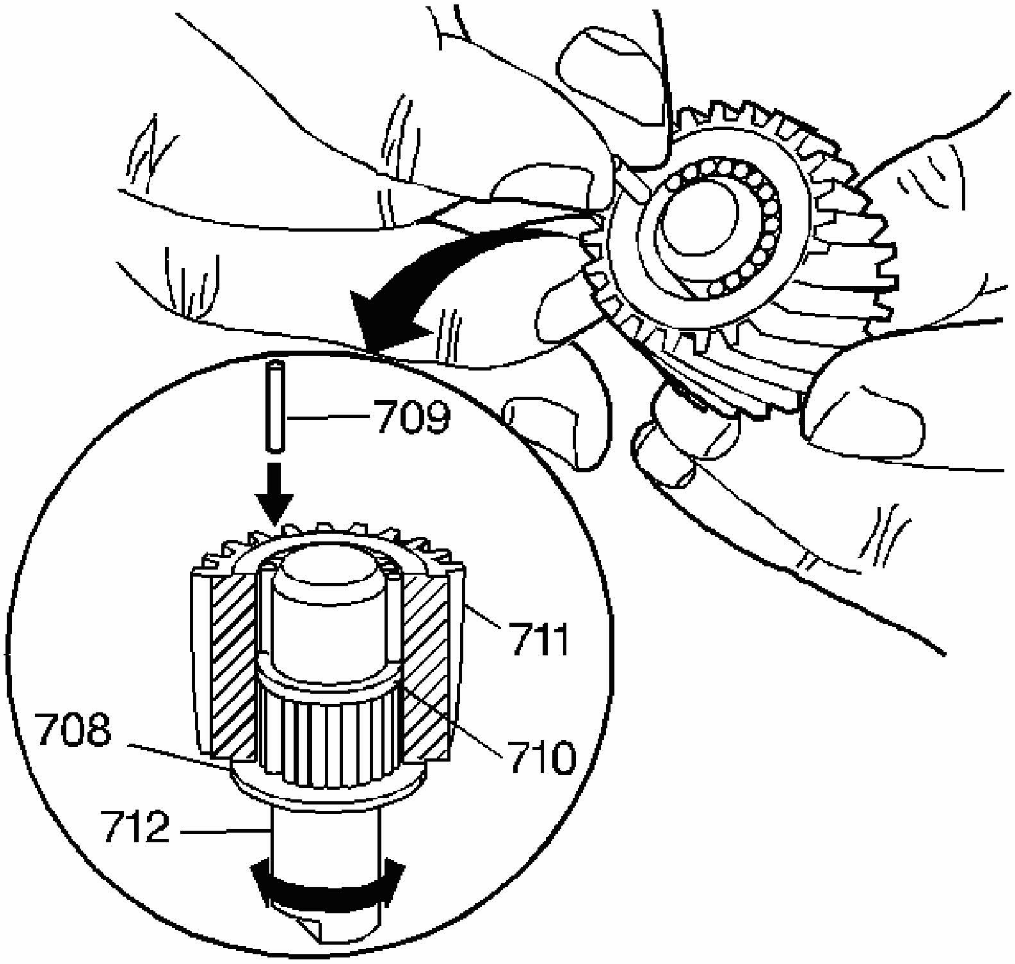


Fig. 131: Assembling Bearing Rollers
Courtesy of GENERAL MOTORS CORP.

10. For each planetary pinion gear, assemble the bearing rollers (709) into the gear (711) one at a time.
    - Use plenty of **J 36850** or equivalent in order to aid assembly
    - Use a washer (708) on the bottom of the pinion gear (711) in order to help hold the bearing rollers (709) in place.
    - The number of rollers in the pinion gear is model dependent:
        - The 3.05/3.06 and 3.29/3.33 ratio differential carriers have two rows of 22 rollers (44 total)
        - The 2.86/2.84 ratio differential carriers have two rows of 18 rollers (36 total)
    - Occasionally twist the pinion gear pin (712) in order to help align the rollers

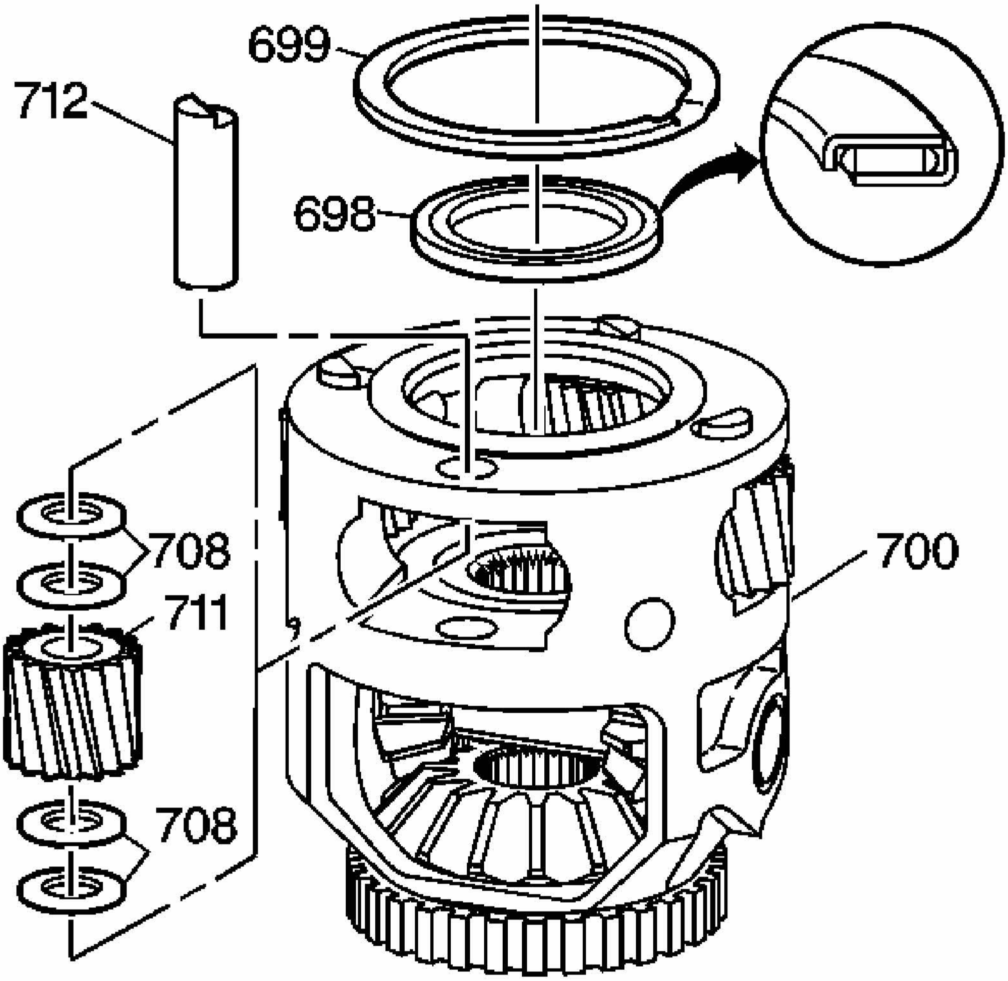


Fig. 132: Installing Differential Carrier Sun Gear Thrust Bearing
Courtesy of GENERAL MOTORS CORP.

11. Install the differential carrier sun gear thrust bearing (698) into the carrier housing.
12. Remove each planetary pinion gear pin (712) from its pinion gear (711). Be careful not to move the rollers out of position.
13. Affix two pinion gear thrust washers (708) on each side of the pinion gear (711). Apply **J 36850** or equivalent.

IMPORTANT: Make sure that the pinion is installed in the same way that it was removed. If the gear is installed upside down, noise may result, because of the change in the gear wear pattern.

14. Install the pinion gear assemblies (711) into the carrier housing (700).
15. Install each planetary pinion gear pin (712).
16. Install the snap ring (699) over the planetary pinion gear pins.

VEHICLE SPEED SENSOR RELUCTOR WHEEL DISASSEMBLE (FWD ONLY)

Tools Required

J 22888-D Universal Bearing Puller. See **Special Tools**.

Disassembly Procedure

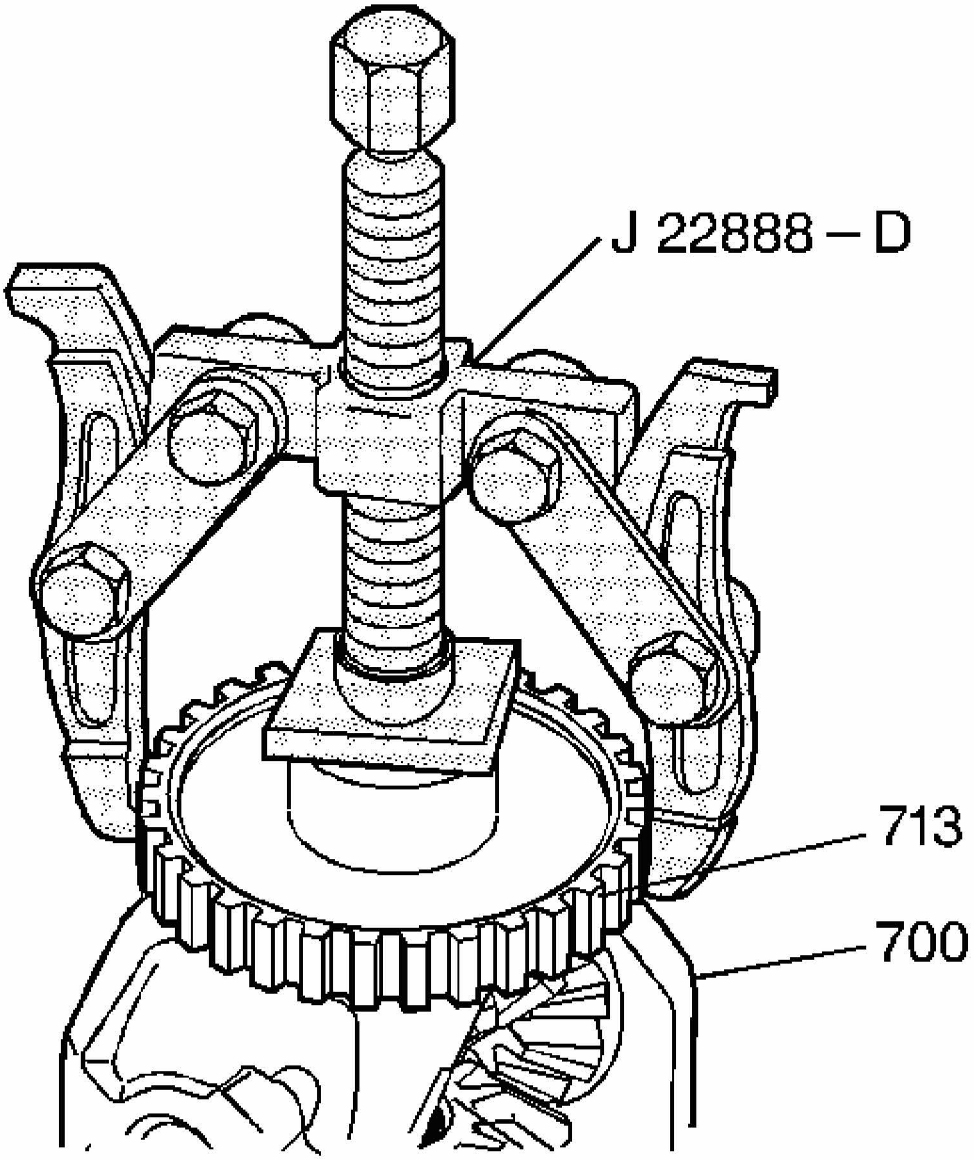


Fig. 133: Removing Vehicle Speed Sensor Reluctor Wheel
Courtesy of GENERAL MOTORS CORP.

1. Do not remove the vehicle speed sensor reluctor wheel (713) unless the wheel is damaged.
2. Use **J 22888-D** and a piece of flat metal stock in order to remove the vehicle speed sensor reluctor wheel (713). See **Special Tools**.

VEHICLE SPEED SENSOR RELUCTOR WHEEL ASSEMBLE (FWD ONLY)

Assembly Procedure

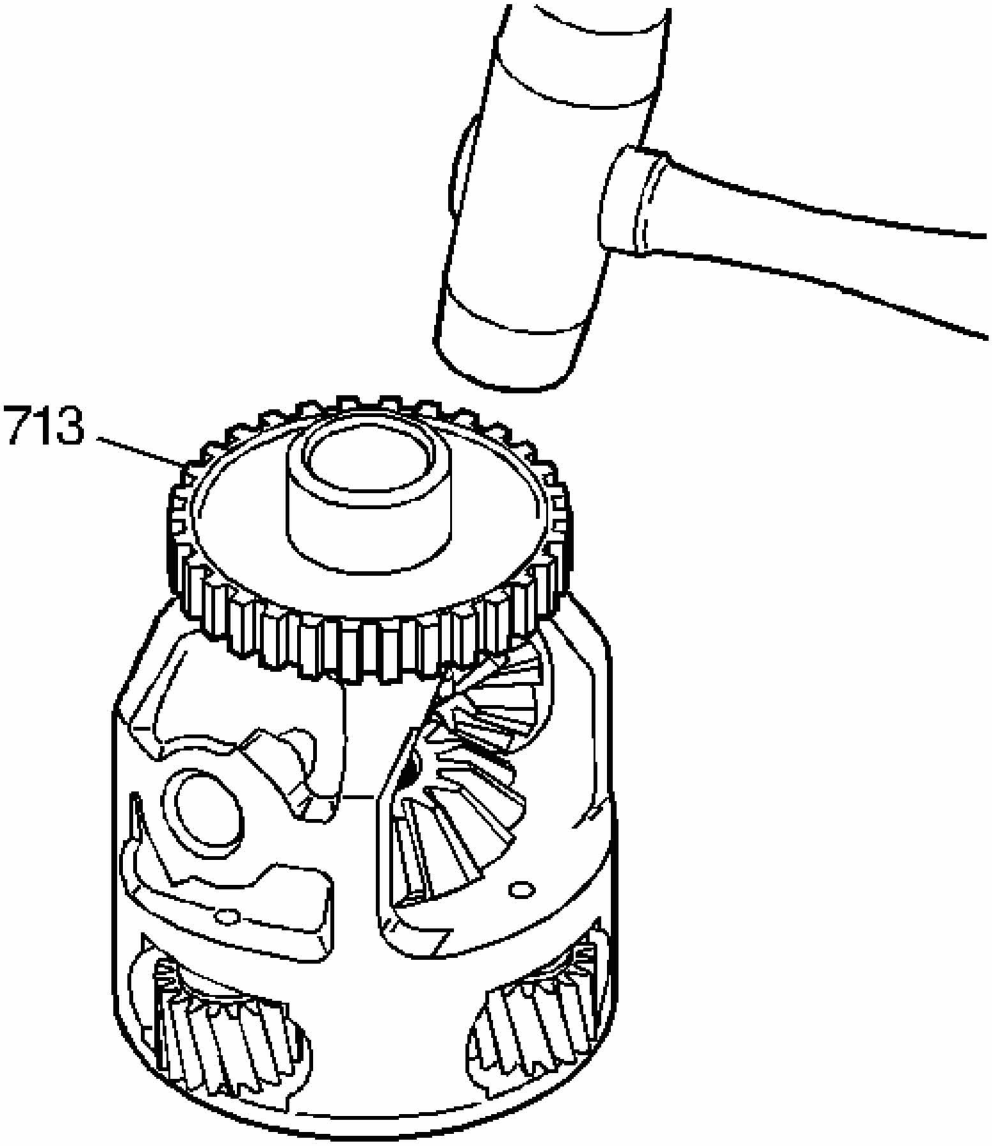


Fig. 134: Installing Vehicle Speed Sensor Reluctor Wheel
Courtesy of GENERAL MOTORS CORP.

1. Warm the vehicle speed sensor reluctor wheel before installation
2. Use a plastic mallet in order to install the vehicle speed sensor reluctor wheel (713) onto the differential carrier housing. Tap evenly around the reluctor wheel with the mallet until fully seated.

DIFFERENTIAL CARRIER COMPONENTS ASSEMBLE (FWD ONLY)

Tools Required

J 36850 Assembly Lubricant (or equivalent)

Assembly Procedure

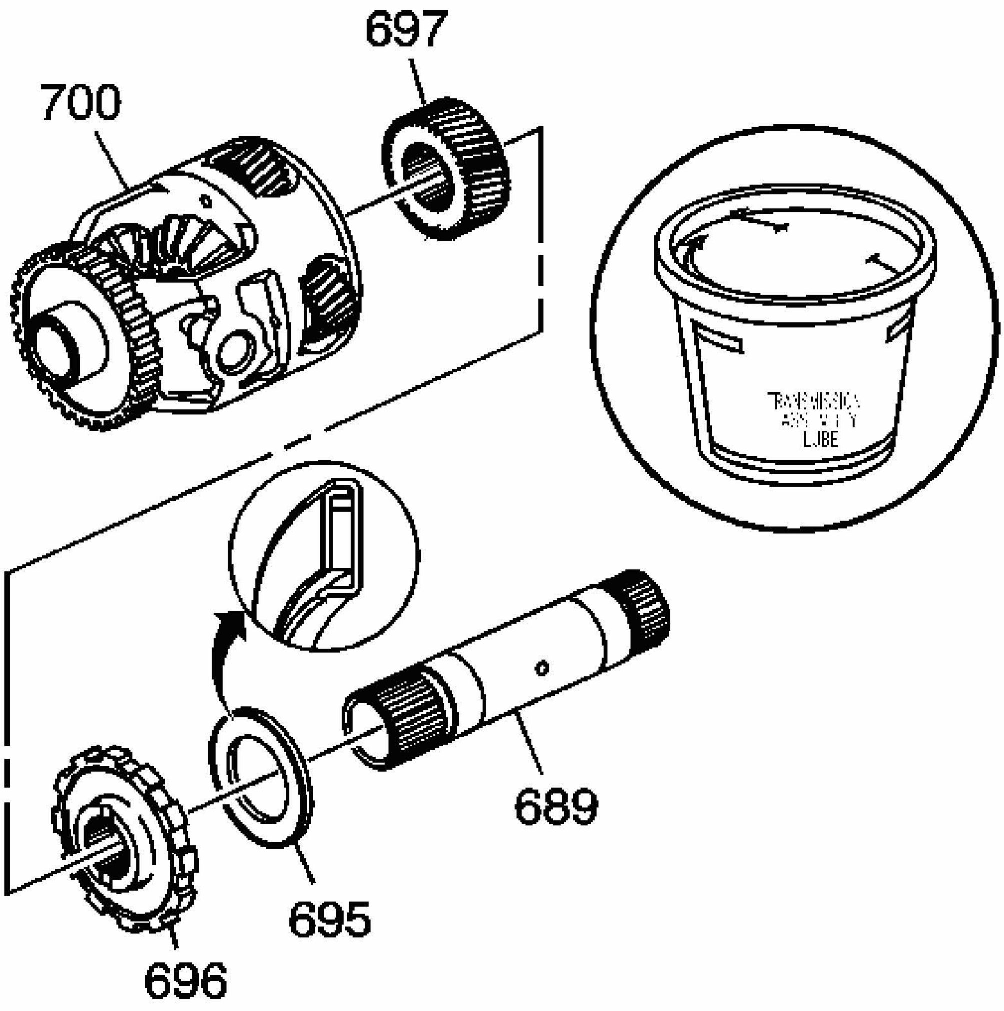


Fig. 135: Assembling Differential Carrier
Courtesy of GENERAL MOTORS CORP.

1. Assemble the final drive sun gear (697) with the chamfered side toward the parking gear (696) into the differential/final drive carrier assembly (700).
2. Assemble the parking gear (696) onto the final drive sun gear shaft (689)

3. Assemble the final drive sun gear shaft/parking gear assembly (689/696) into the final drive sun gear (697).

IMPORTANT: Apply J 36850 or equivalent to the parking gear side of the bearing (695).

4. Assemble the internal gear/parking gear thrust bearing (695) to the parking gear (696).

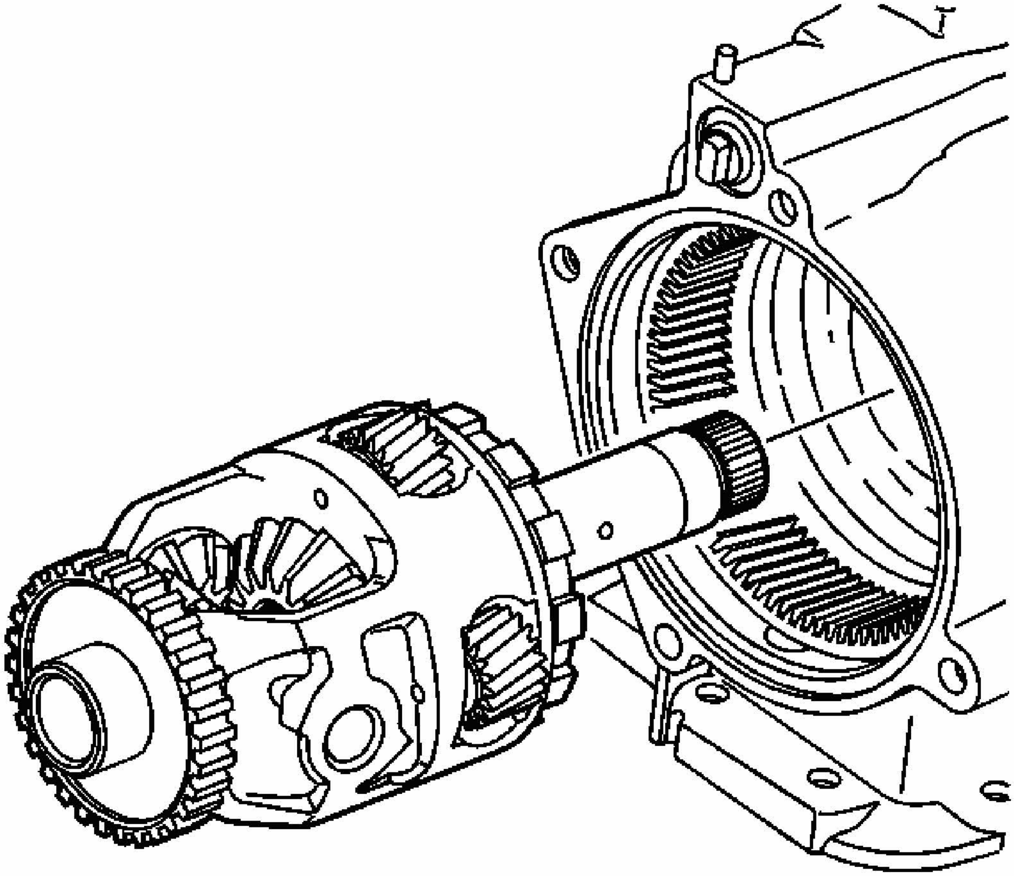


Fig. 136: Installing Differential Carrier
Courtesy of GENERAL MOTORS CORP.

5. Install the differential/final drive carrier assembly into the case.

CASE EXTENSION ASSEMBLE (FWD ONLY)

Assembly Procedure

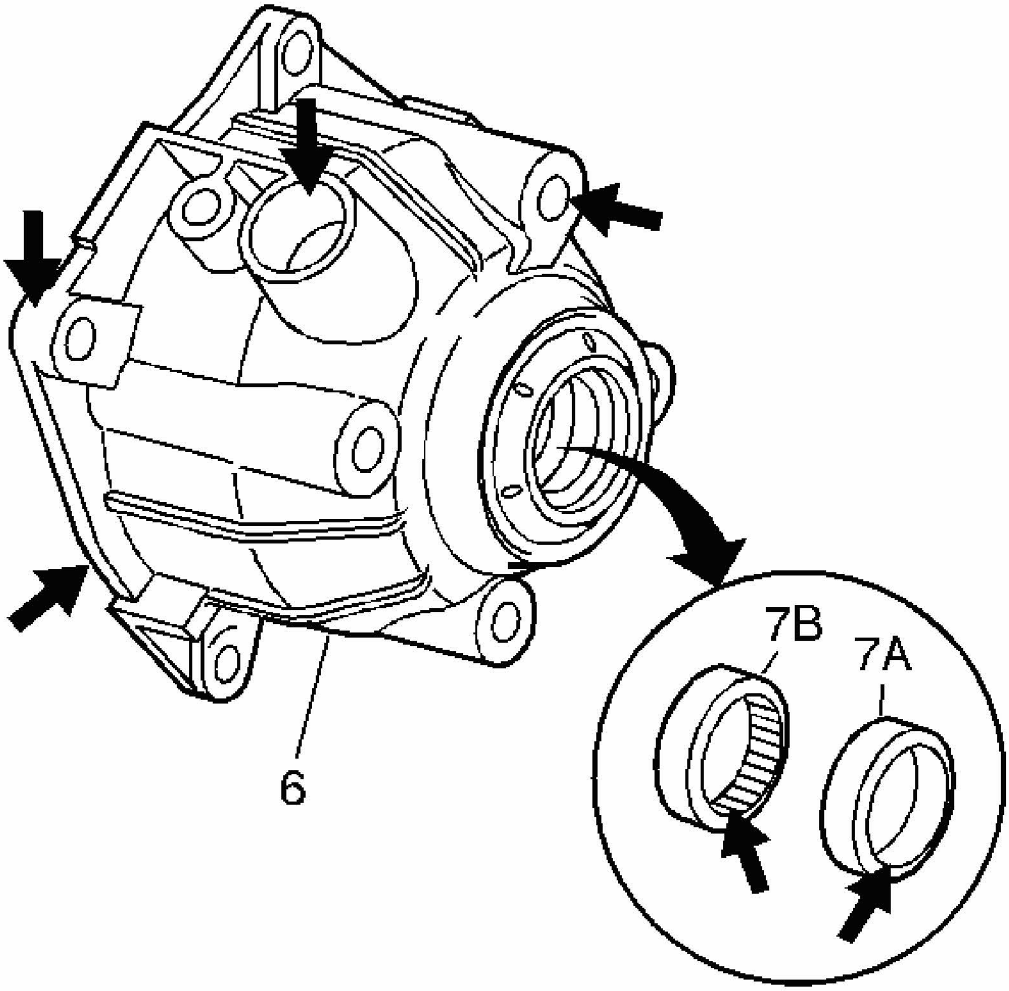


Fig. 137: Inspecting Case Extension Housing
Courtesy of GENERAL MOTORS CORP.

1. Inspect the case extension assembly (6) for the following conditions:
   - A damaged or porous sealing surface for the case extension seal
   - A damaged or porous sealing surface for the vehicle speed sensor
   - A damaged or porous sealing surface for the right drive shaft oil seal assembly
   - Damaged bolt holes
   - A worn or damaged front differential carrier bushing (7A) or output shaft bearing assembly (7B)
   - A porous or damaged case extension housing

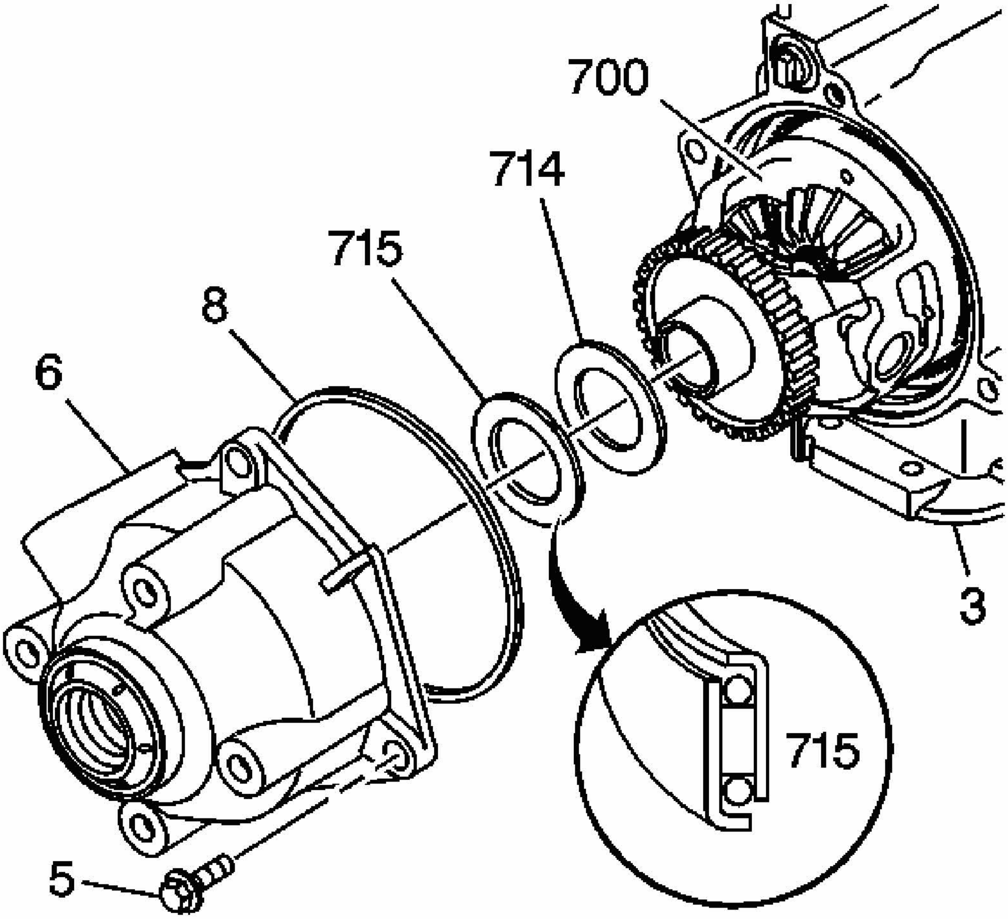


Fig. 138: Locating Differential/Final Drive Carrier Assembly Thrust Bearing
Courtesy of GENERAL MOTORS CORP.

2. Install the differential carrier/case selective thrust washer (714) onto the differential/final drive carrier assembly (700).
3. Install the thrust bearing (715) onto the differential/final drive carrier assembly (700).
4. Affix the seal (8) onto the case extension (6).
5. Install the case extension assembly (6) onto the case (3).

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

6. Install only two case extension bolts (5) for later removal.

Tighten: Tighten the bolts until the extension is flush to the case.

7. Perform end play check, refer to **Differential Carrier End Play Check (FWD Only)**.

FORWARD BAND ASSEMBLE

Assembly Procedure

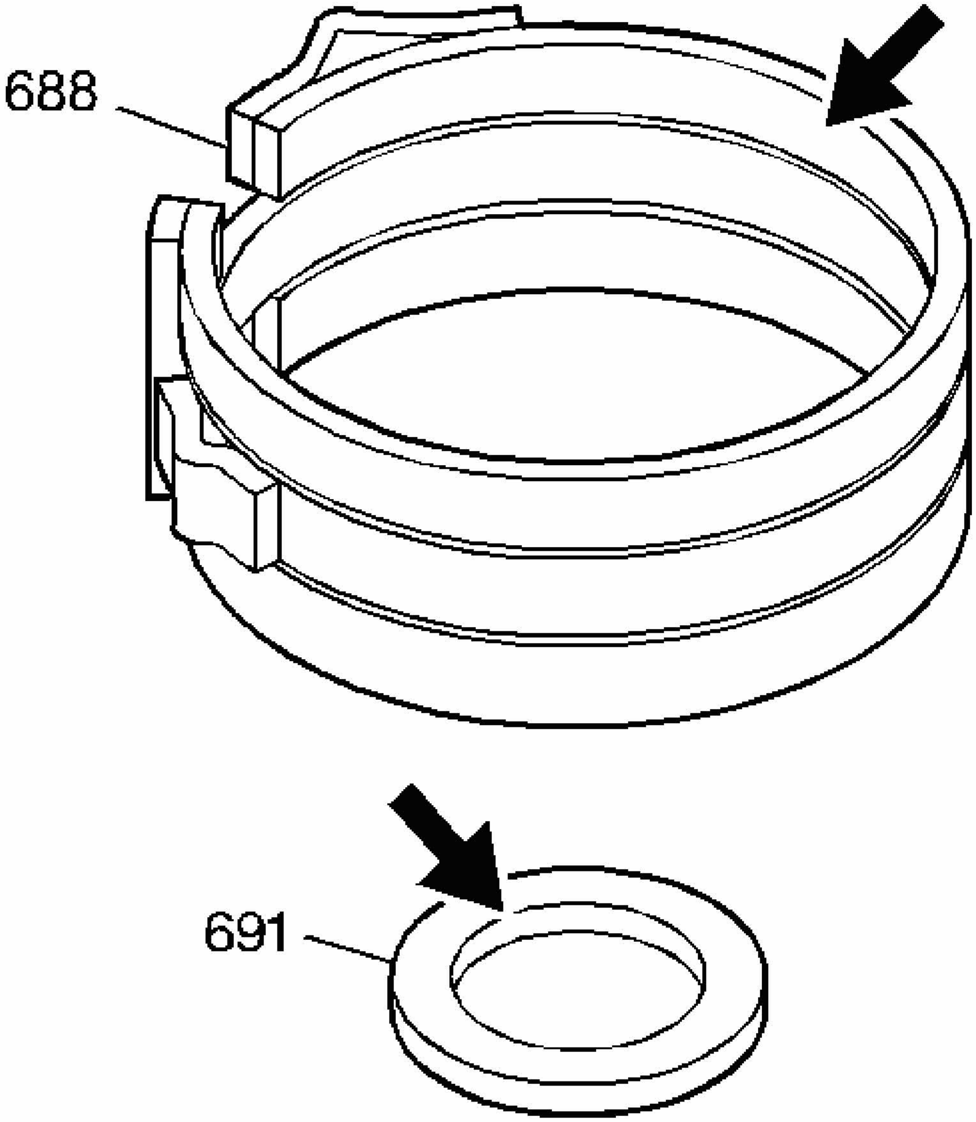


Fig. 139: View Of Forward Band Assembly Inspection Areas
Courtesy of GENERAL MOTORS CORP.

1. Inspect the forward band assembly (688) for the following conditions:

- Damaged or severely worn friction material
- Damaged apply or anchor pin features

2. Inspect the bearing (691) from the differential carrier internal gear for damage.

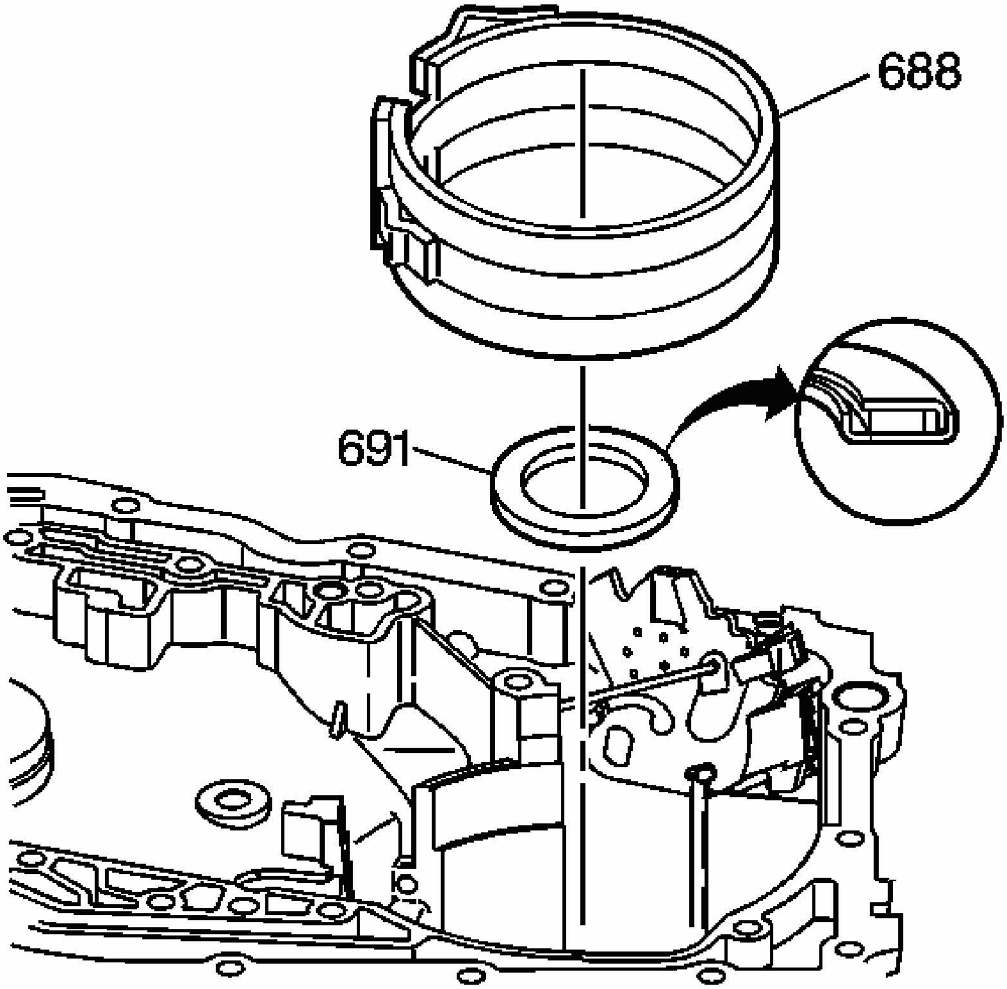


Fig. 140: Identifying Forward Band Assembly & Bearing
Courtesy of GENERAL MOTORS CORP.

3. Position the transmission case so that the flange for the case cover is facing up.
4. Install the bearing (691) for the differential carrier internal gear into the case. Position as indicated.
5. Install the forward band assembly (688) into the case.
    - Locate the band assembly onto the forward band anchor pin

- Position the band apply pin feature in the opening of the case

1-2 SUPPORT ROLLER CLUTCH DISASSEMBLE

Disassembly Procedure

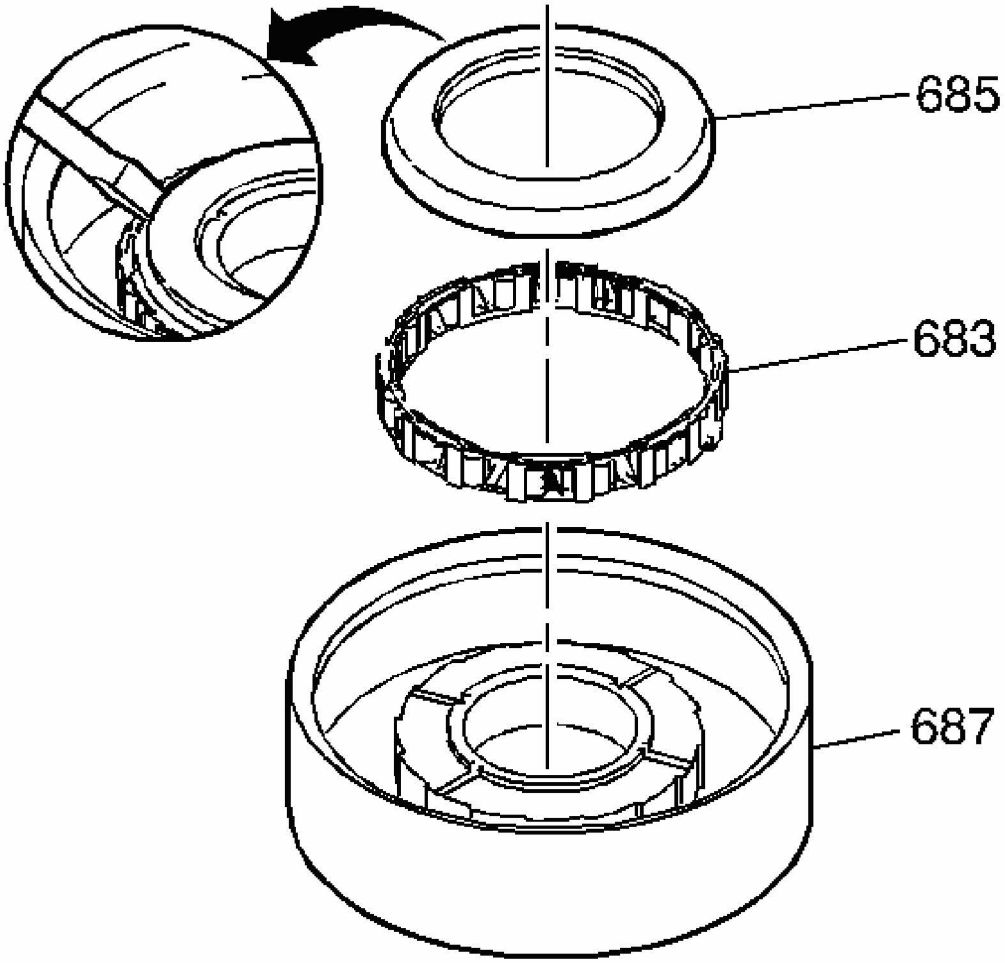


Fig. 141: Prying Thrust Bearing Off 1-2 Support Drum
Courtesy of GENERAL MOTORS CORP.

1. Use a small screwdriver in order to gently pry the thrust bearing (685) off of the 1-2 support drum (687).
2. Lift the 1-2 clutch roller assembly (683) out of the 1-2 support drum.

1-2 SUPPORT ROLLER CLUTCH ASSEMBLE

Assembly Procedure

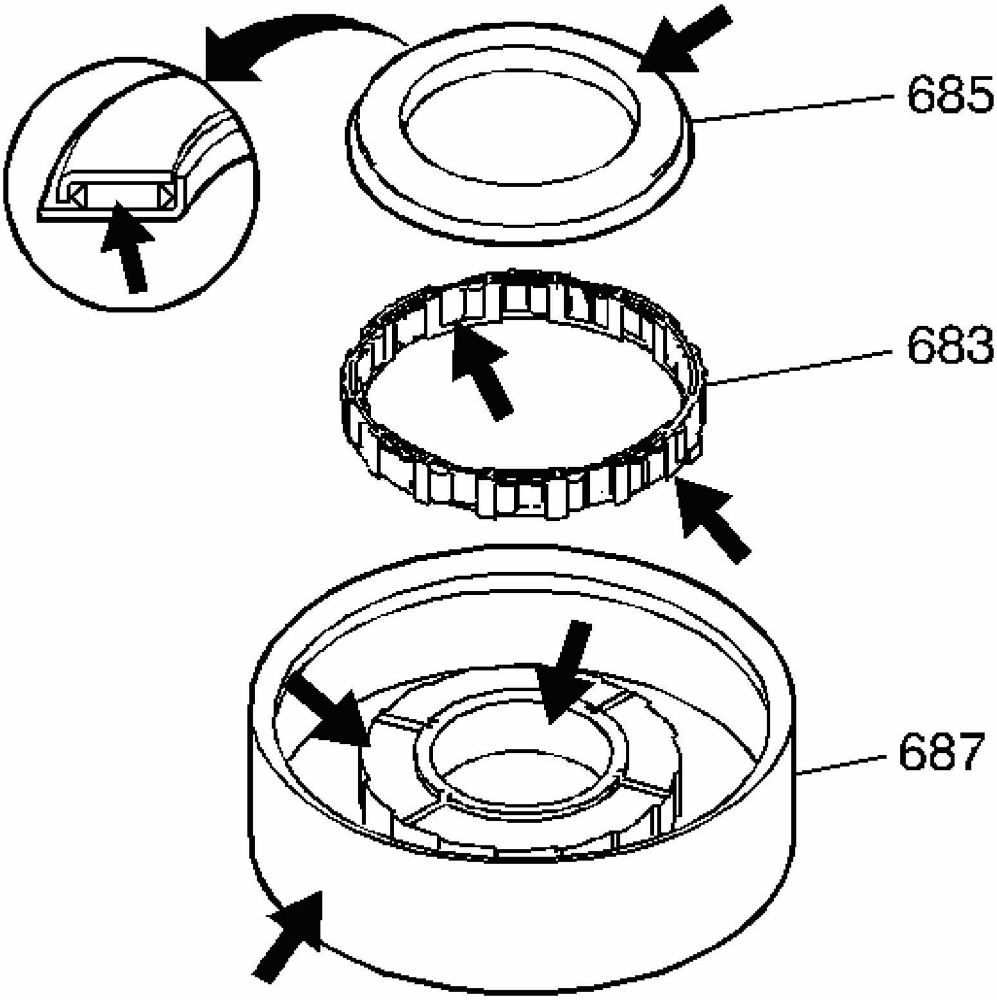


Fig. 142: Locating Inspection Areas On 1-2 Support Roller Clutch Components
Courtesy of GENERAL MOTORS CORP.

1. Inspect the 1-2 support roller clutch components for the following conditions:
    - A scored or burned contact surface for the manual 2-1 band on the 1-2 support drum (687)
    - A damaged or worn forward drum bushing
    - A damaged or worn inner race of the 1-2 support roller clutch
    - A damaged or worn 1-2 clutch roller assembly (683)
    - A damaged thrust bearing (685)

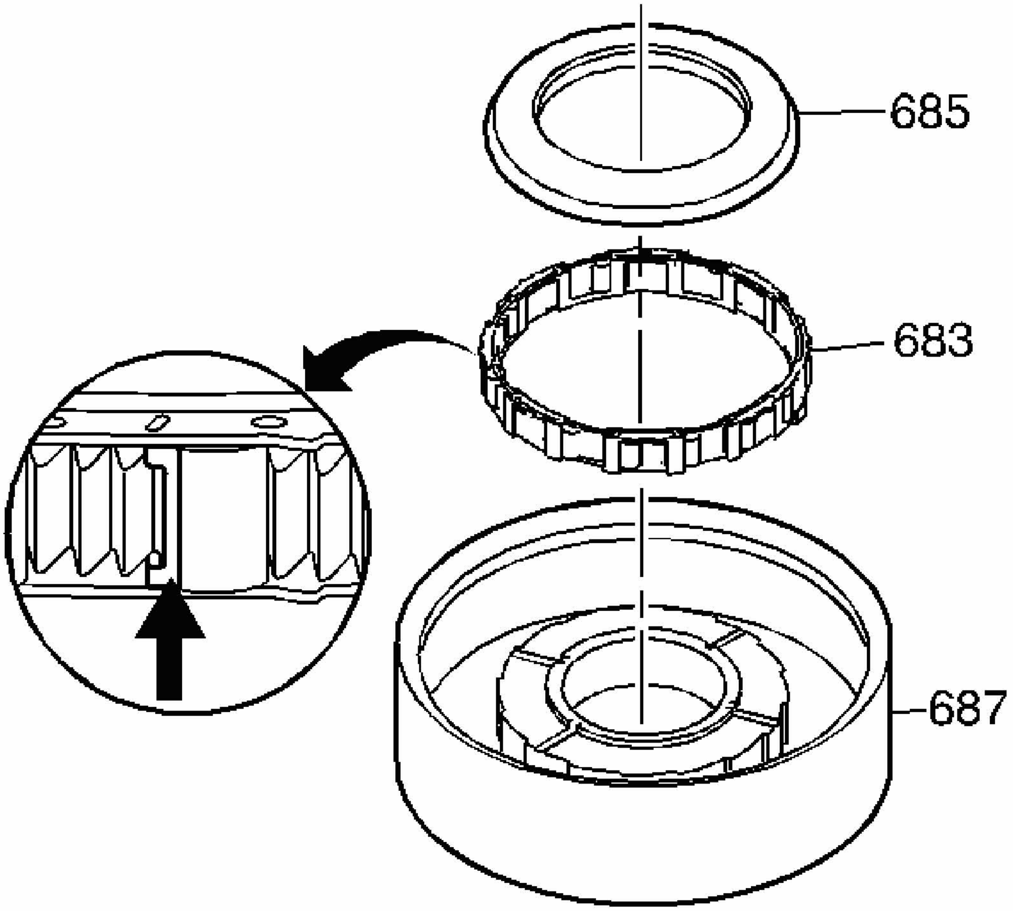


Fig. 143: Expanded View Of 1-2 Clutch Roller Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Note the position of the cage assembly to the inner race.

2. Install the 1-2 clutch roller assembly (683) into the 1-2 support drum.
3. Install the thrust bearing (685) onto the 1-2 support drum (687). Press down with hand pressure only.

1-2 SUPPORT ROLLER CLUTCH FUNCTIONAL CHECK

Checking Procedure

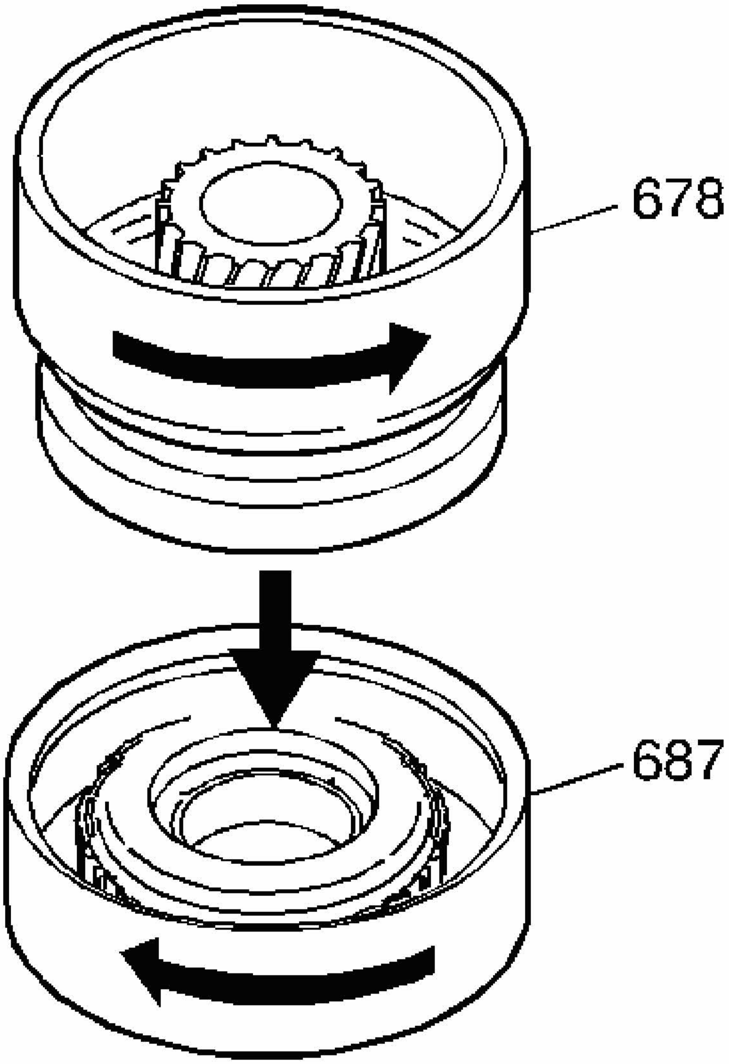


Fig. 144: Identifying 1-2 Support Drum Assembly
Courtesy of GENERAL MOTORS CORP.

1. Position the 1-2 support drum assembly (687) on the bench as shown.
2. Install the reaction sun gear assembly (678) into the 1-2 support drum (687).
3. Rotate the components as indicated by the arrows:
    - The roller clutch should move freely in the indicated directions
    - The roller clutch should lock in the direction opposite of that indicated
4. If the roller clutch does not function as described, reassemble the clutch correctly or replace the assembly.

1-2 SUPPORT DRUM ASSEMBLE

Tools Required

J 38358-A 1-2 Support Remover/Installer

Assembly Procedure

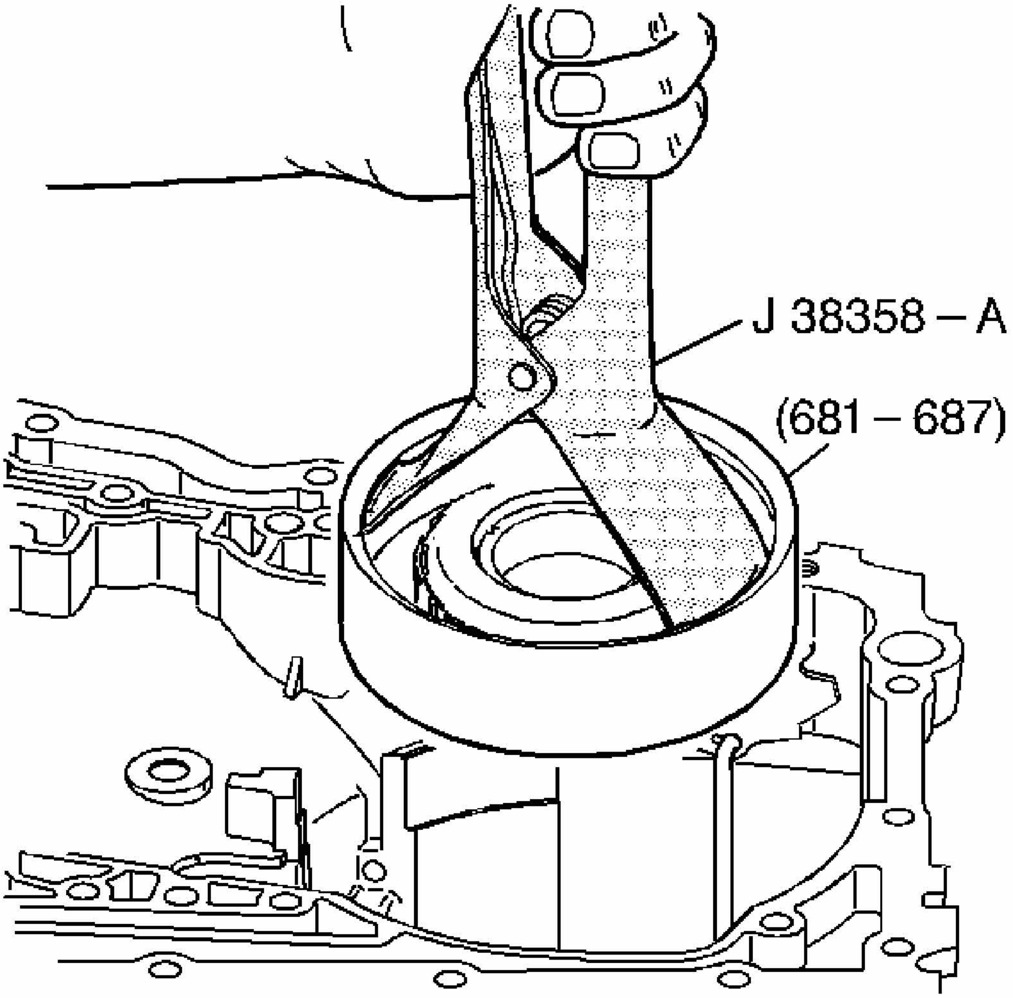


Fig. 145: Removing 1-2 Support Drum Out Of The Case Using J 38358-A
Courtesy of GENERAL MOTORS CORP.

Use **J 38358-A** in order to assemble the 1-2 support drum assembly (681-687) into the case.

2-1 MANUAL BAND ASSEMBLE

Assembly Procedure

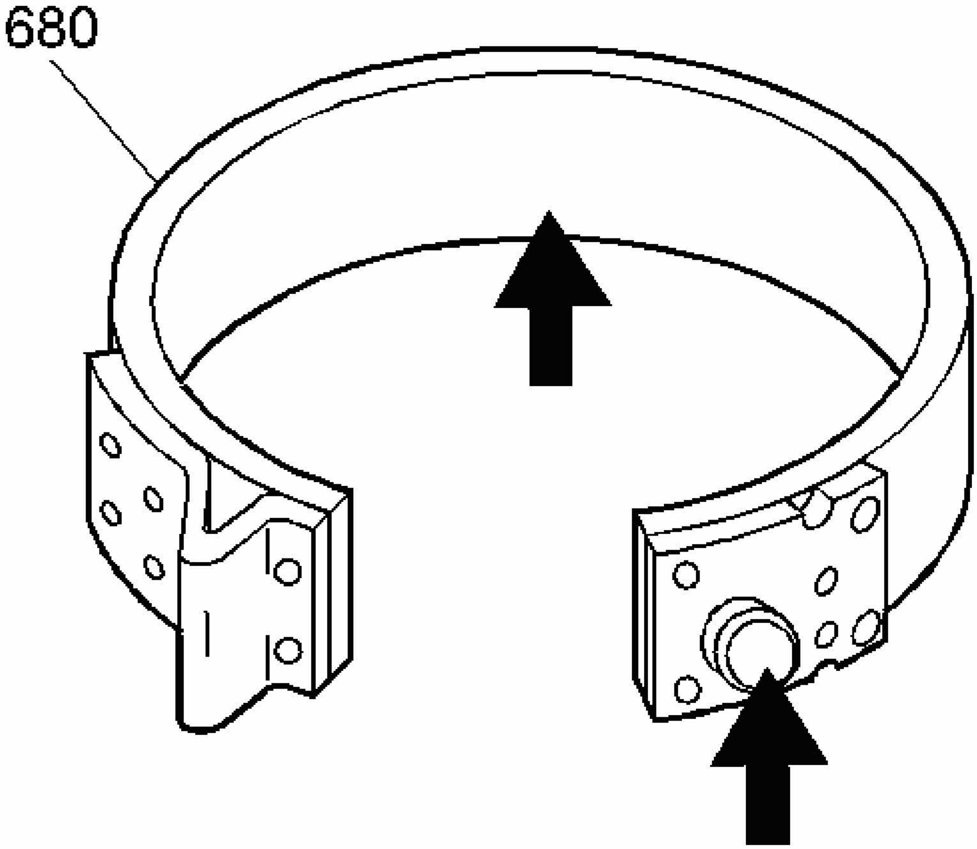


Fig. 146: Identifying Inspection Areas On 2-1 Manual Band
Courtesy of GENERAL MOTORS CORP.

1. Inspect the 2-1 manual band (680) for the following:
    - Cracked or separated friction material
    - Burnt friction material
    - Cracks around the apply lugs

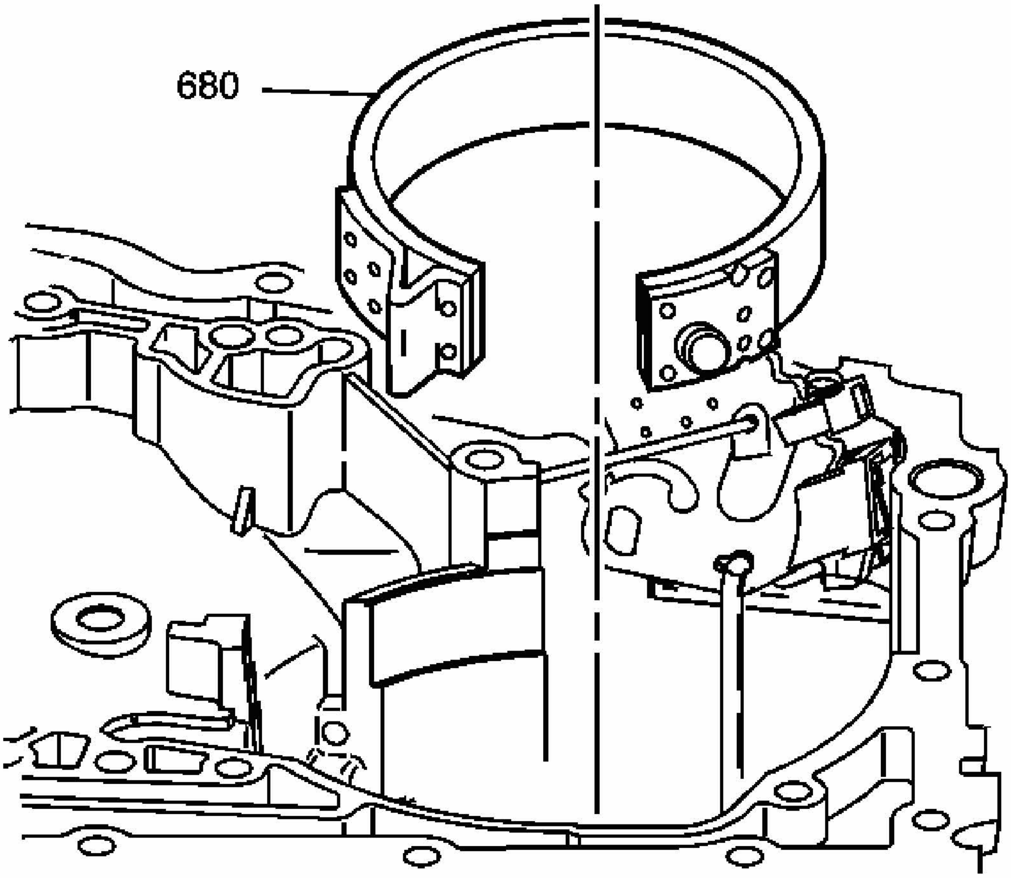


Fig. 147: View Of Manual 2-1 Band Assembly
Courtesy of GENERAL MOTORS CORP.

2. Squeeze the manual 2-1 band assembly (680) and install the assembly into the case.
3. Position the band on the anchor pin.

REACTION SUN GEAR AND DRUM ASSEMBLE

Assembly Procedure

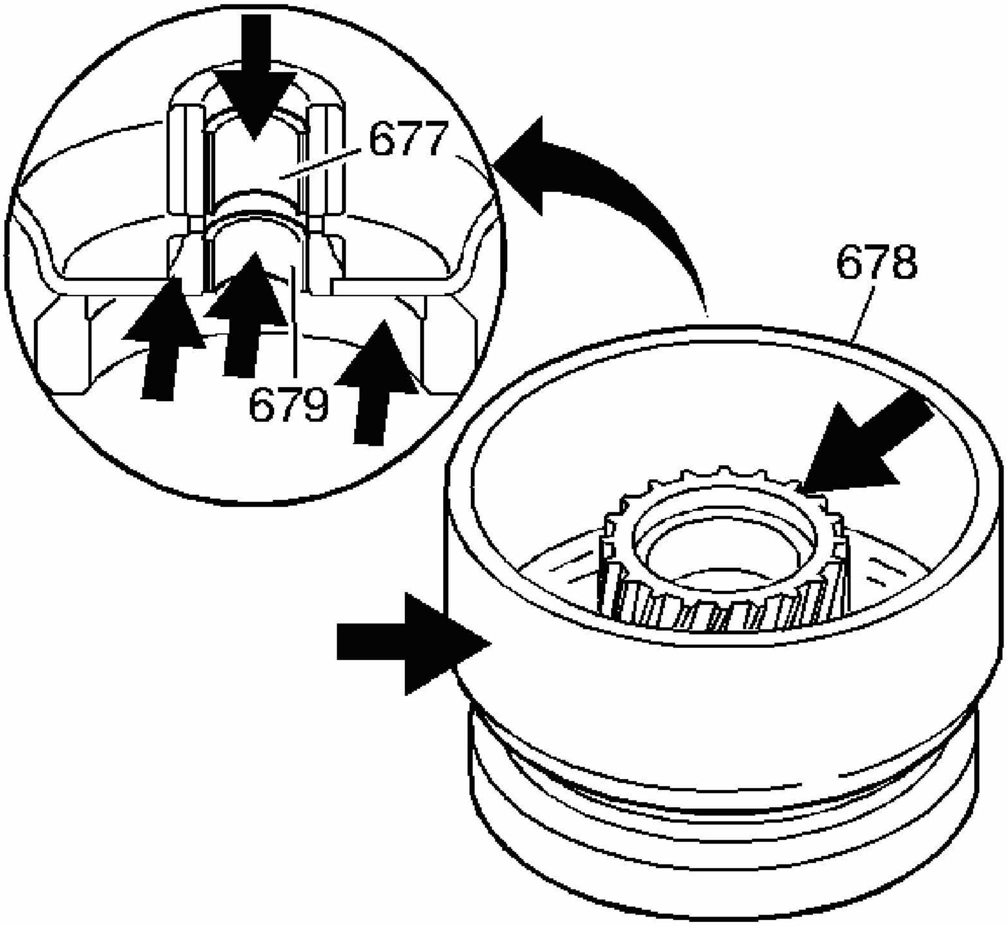


Fig. 148: Locating Inspection Areas On Reaction Sun Gear and Drum
Courtesy of GENERAL MOTORS CORP.

1. Inspect the reaction sun gear and drum assembly (678) for the following:
    - Worn or scored bushings
    - Damaged reaction sun gear teeth
    - The band apply area of the drum for discoloration or wear
    - The welds connecting the sun gear to the drum for voids or cracks
    - A worn or damaged 1-2 support outer race

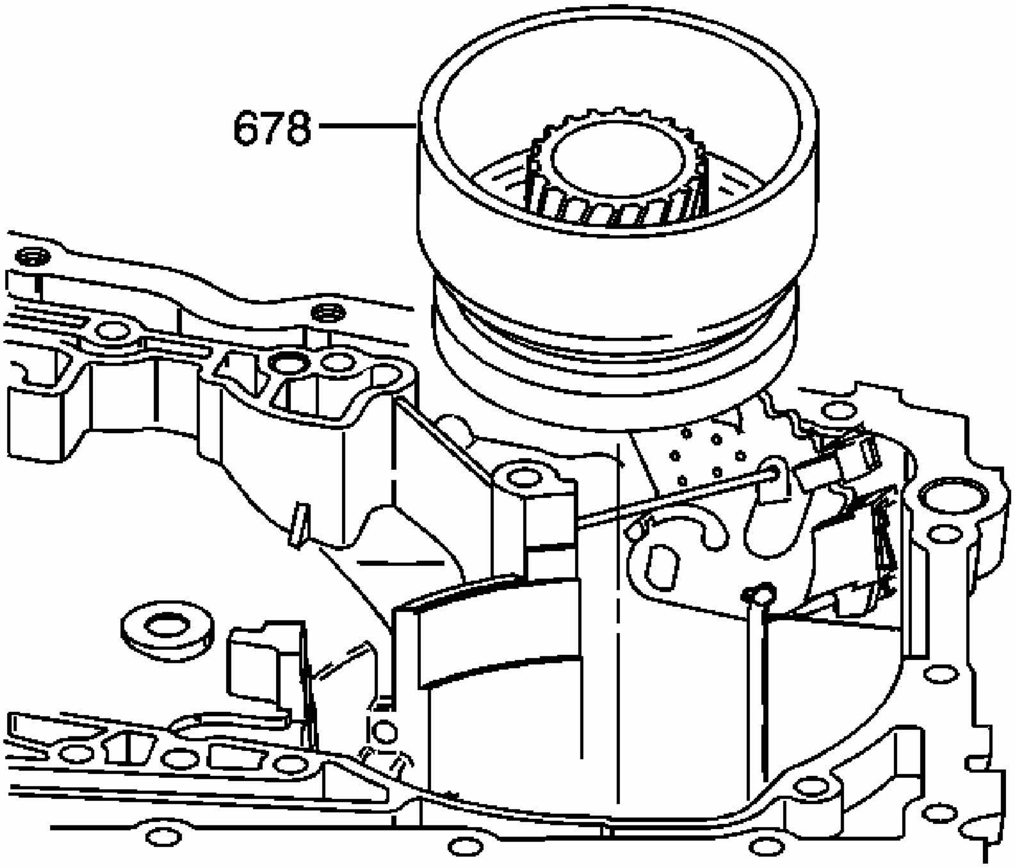


Fig. 149: Installing Reaction Sun Gear And Drum Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install the reaction sun gear and drum assembly (678) into the case.
3. Check that the lugs engage with the 1-2 support roller clutch inner race.

INPUT AND REACTION CARRIER PINION END PLAY CHECK

Checking Procedure

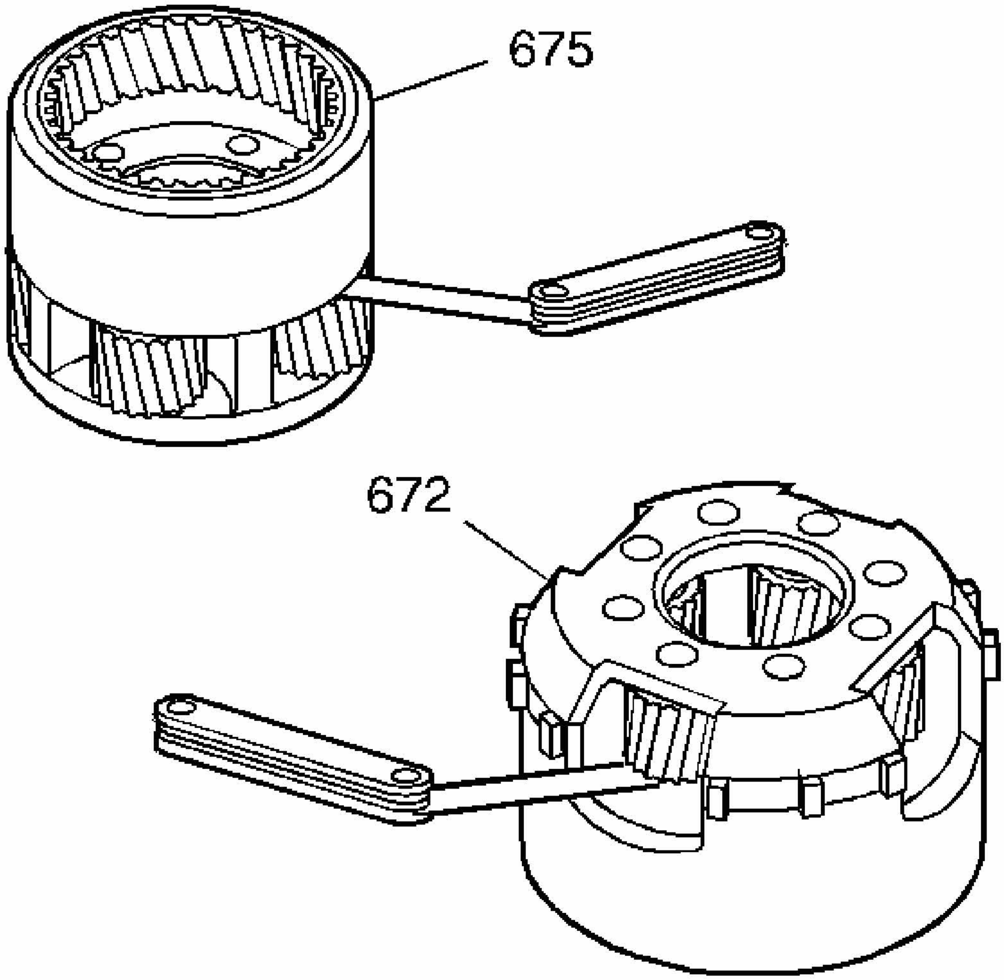


Fig. 150: Checking Input and Reaction Carrier Pinion End Play With Feeler Gage
Courtesy of GENERAL MOTORS CORP.

1. Use feeler gages in order to check for excessive pinon gear end play in the input carrier assembly (672) and in the reaction carrier assembly (675).
2. End play should measure 0.23-0.77 mm (0.009-0.030 in).

INPUT AND REACTION CARRIER ASSEMBLE

Tool Required

J 36850 Assembly Lubricant (or equivalent)

Assembly Procedure

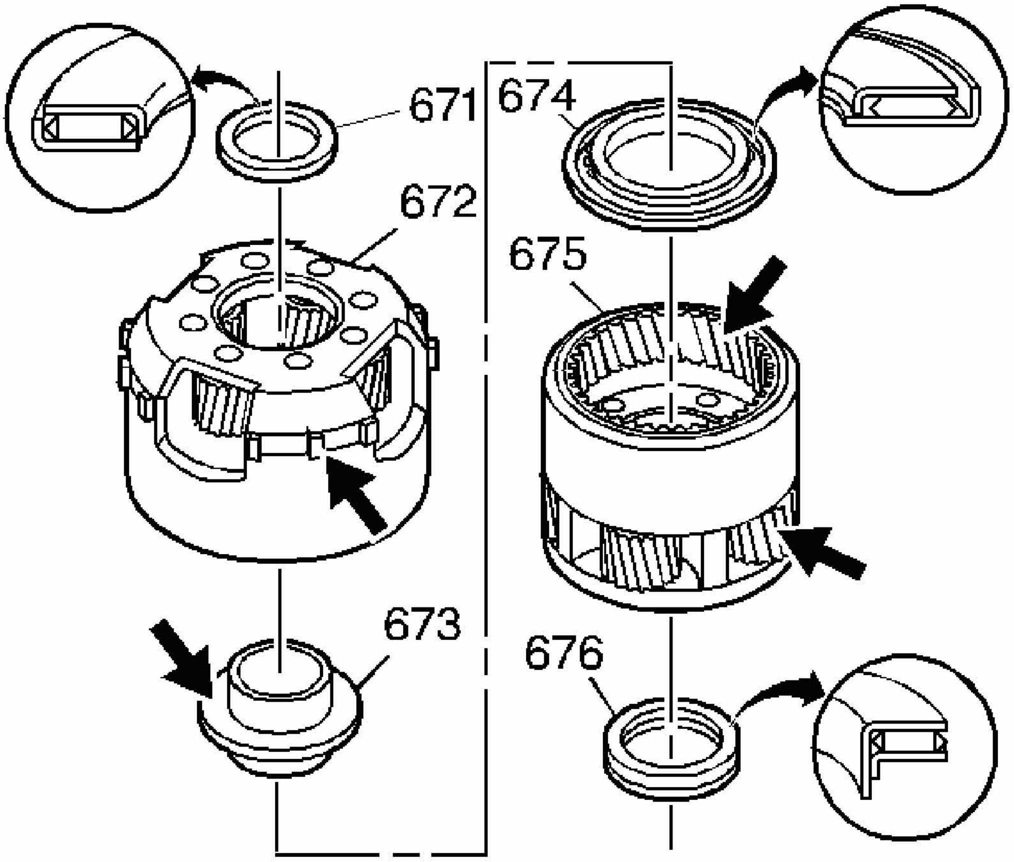


Fig. 151: Input & Reaction Carrier Components Inspection Areas
Courtesy of GENERAL MOTORS CORP.

1. Inspect the thrust bearings (671, 674, 676) for the following:
    - A damaged cage
    - Damaged or missing rollers
2. Inspect the reaction carrier assembly (675) for the following:
    - Damage to the pinion teeth
    - Damage to the internal gear teeth
3. Inspect the input carrier assembly (672) for the following:
    - Damage to the pinion teeth
    - Damage to the spline teeth

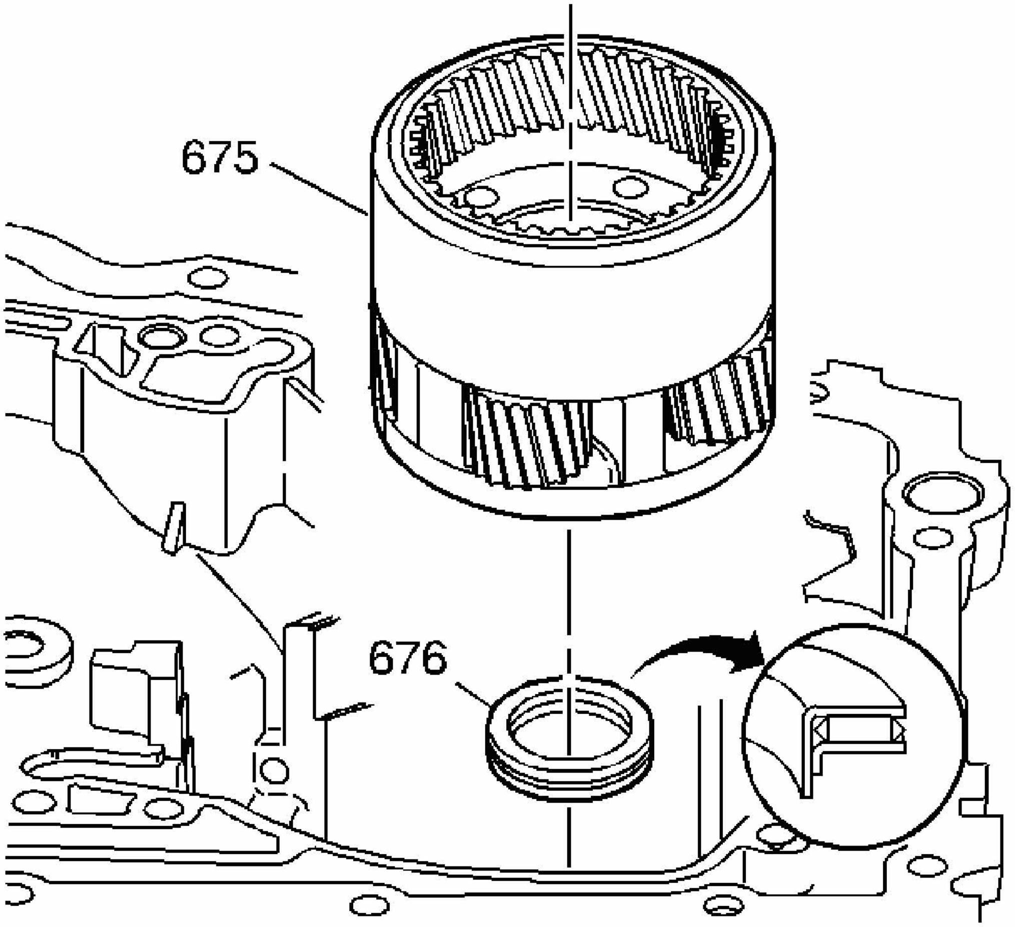


Fig. 152: Identifying Reaction Carrier/Sun Gear Thrust Bearing
Courtesy of GENERAL MOTORS CORP.

4. Install the reaction carrier/sun gear thrust bearing (676) into the reaction carrier assembly (675). Use **J 36850** or equivalent in order to retain the bearing.
5. Install the reaction carrier assembly (675) into the case and rotate the carrier so that the pinions engage the reaction sun gear.

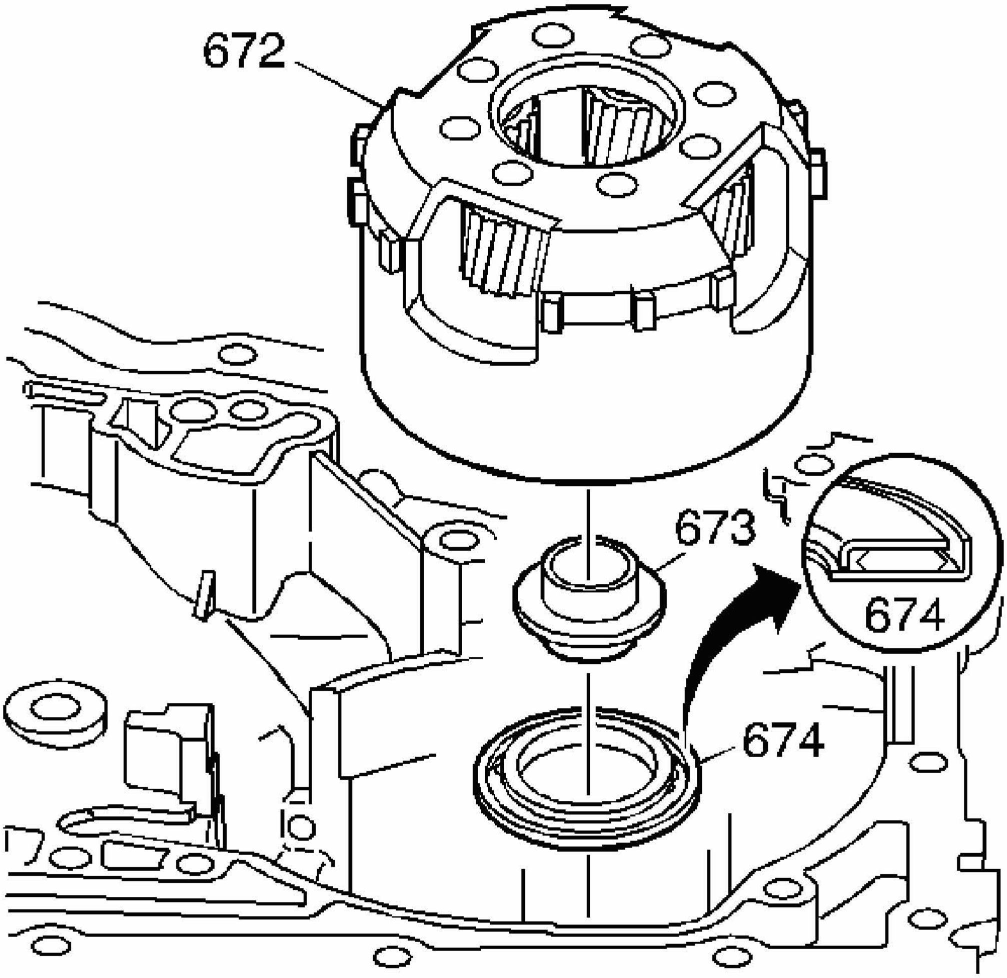


Fig. 153: Installing Input/Reaction Carrier Thrust Bearing
Courtesy of GENERAL MOTORS CORP.

6. Install the input/reaction carrier thrust bearing (674) into the input carrier assembly (672). Use **J 36850** or equivalent in order to retain the bearing.
7. Install the input carrier/reaction carrier lube dam (673) into the input carrier assembly (672). Use **J 36850** or equivalent in order to retain the lube dam.
8. Insert the input carrier assembly (672) into the case and rotate the carrier so that the pinions engage the reaction carrier internal gear.

REVERSE REACTION DRUM ASSEMBLE

Assembly Procedure

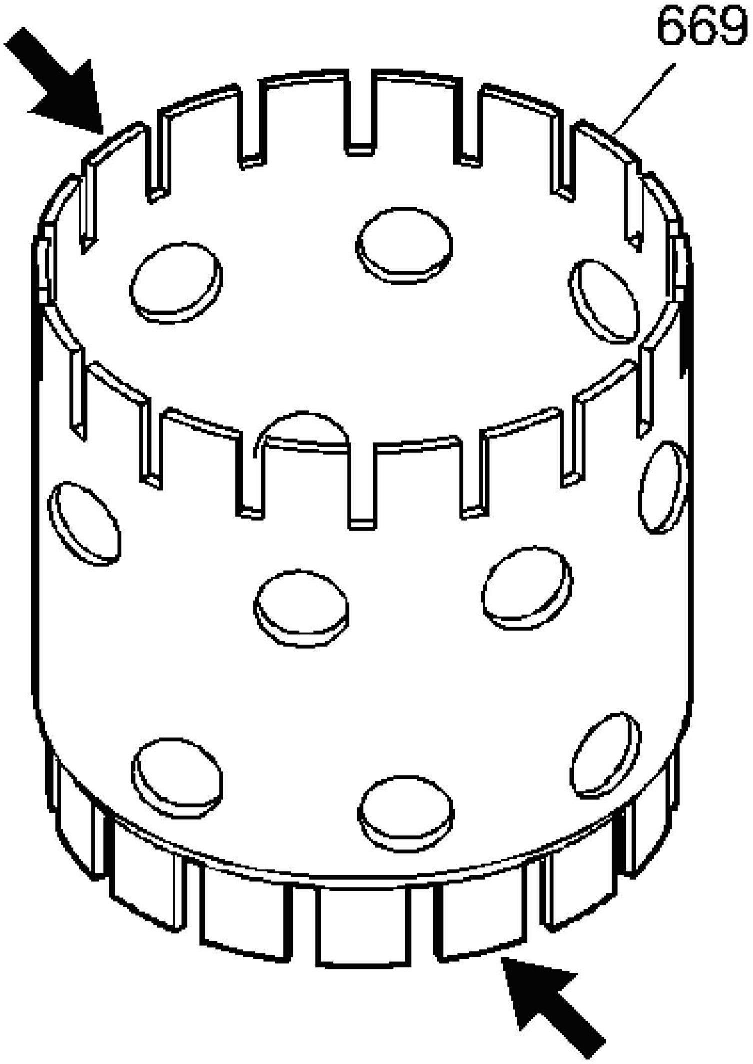


Fig. 154: Inspection Areas On Reverse Reaction Drum
Courtesy of GENERAL MOTORS CORP.

1. Inspect the reverse reaction drum (669) for the following:
    - Cracks
    - Damaged splines
    - Distortion

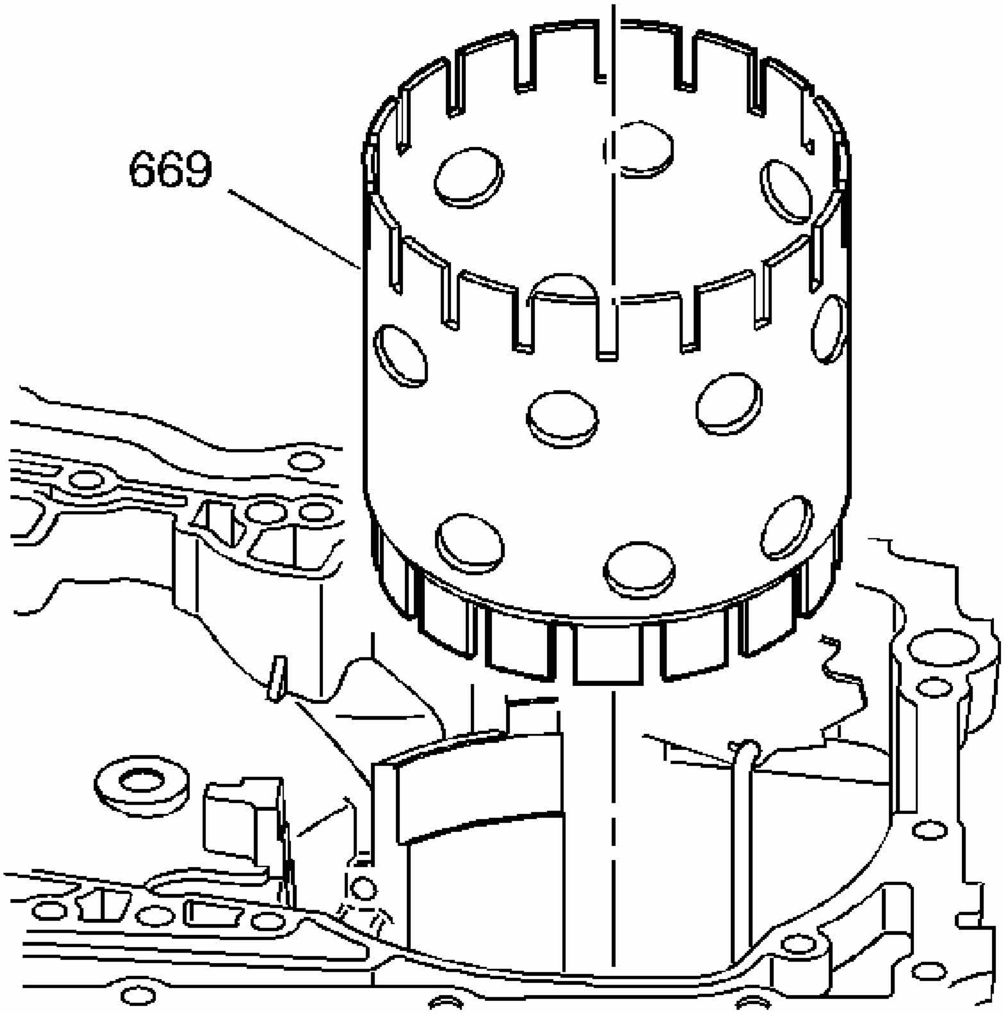


Fig. 155: View Of Reverse Reaction Drum
Courtesy of GENERAL MOTORS CORP.

2. Install the reverse reaction drum (669) into the case and engage the drum onto the input carrier splines.

INPUT AND THIRD CLUTCH PAWL DISASSEMBLE

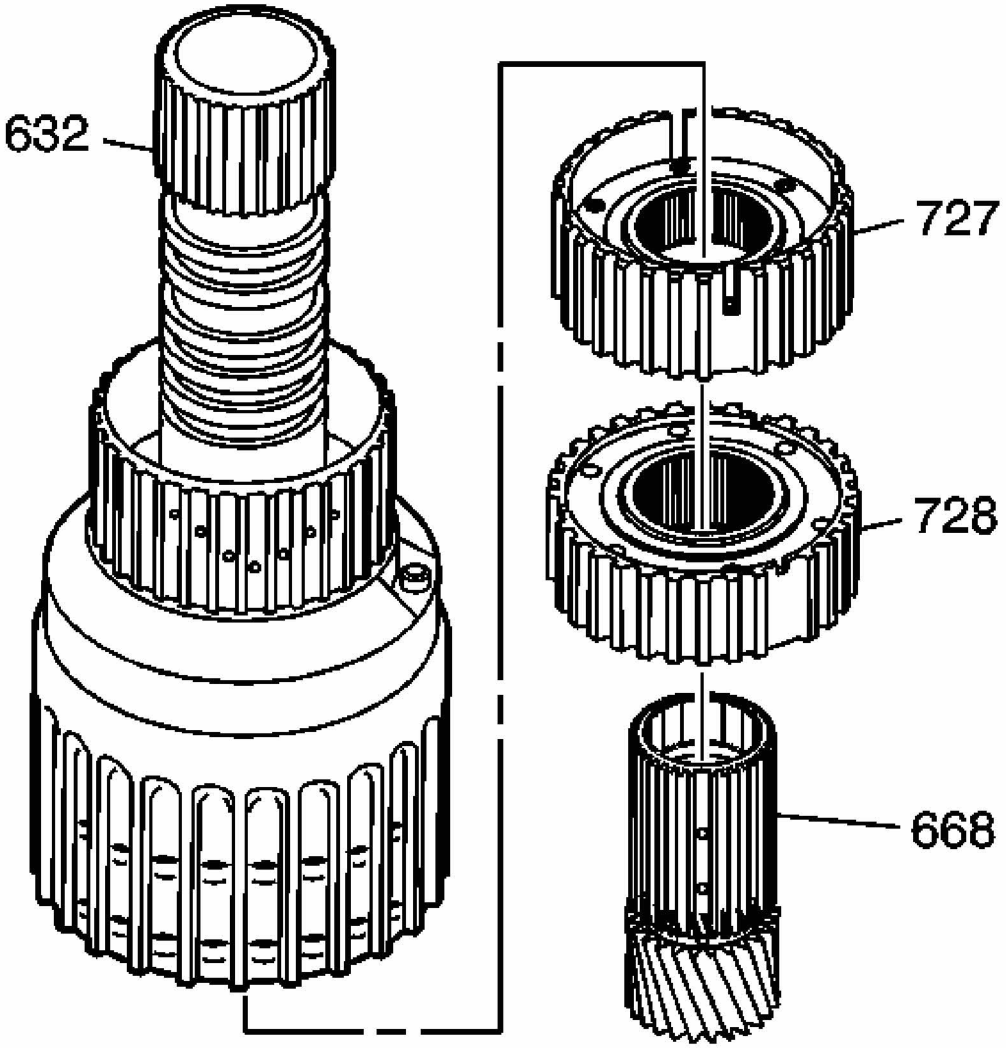


Fig. 156: View Of Sprag Clutch Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The third and input clutch pawl assemblies (727, 728) are serviced as assemblies, do not disassemble.

Disassemble the third and input clutch pawl assemblies (727, 728) and input sungear shaft (668) from the input clutch housing assembly (632).

INPUT AND THIRD CLUTCH PAWL ASSEMBLE

Assembly Procedure

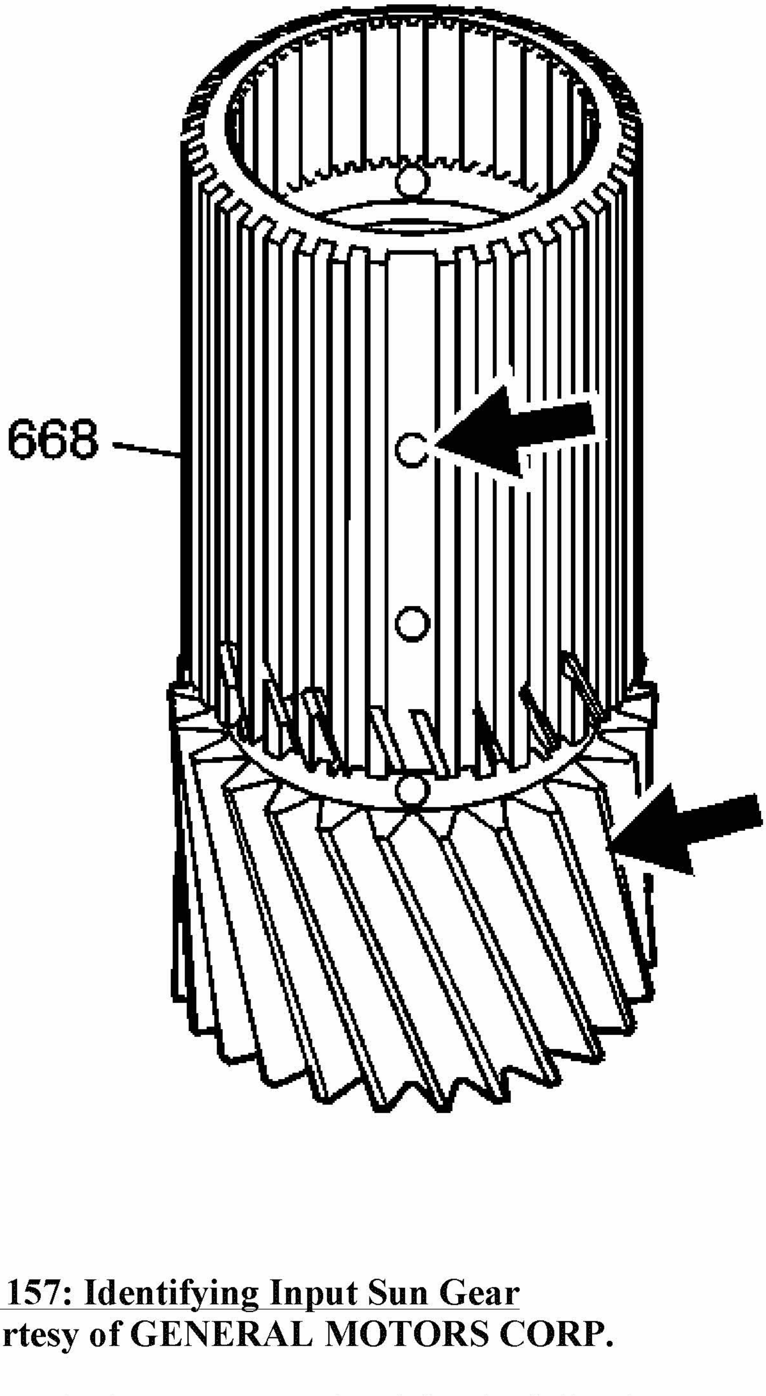


Fig. 157: Identifying Input Sun Gear
Courtesy of GENERAL MOTORS CORP.

1. Inspect the input sun gear (668) for the following:
    - Worn or damaged splines
    - Plugged lube holes or cracks

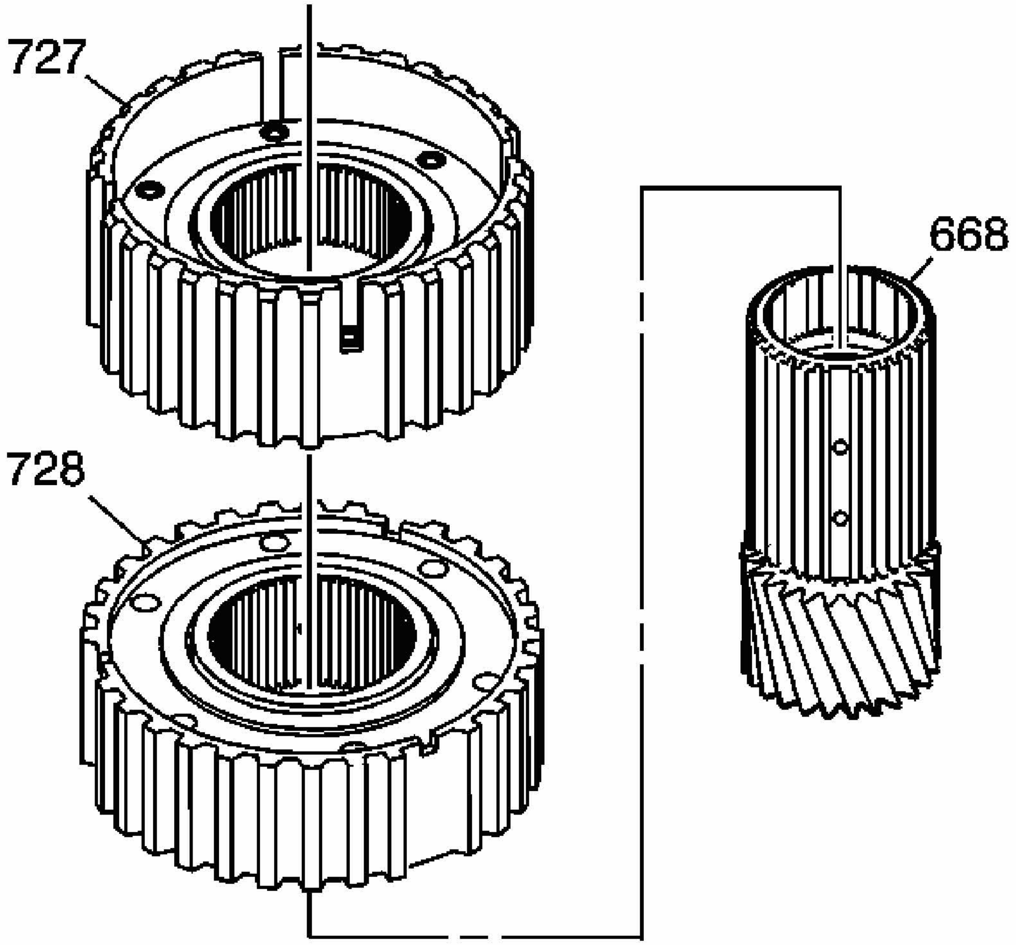


Fig. 158: Inspecting Third And Input Pawl Clutches
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The third and input clutch pawl assemblies are serviced as assemblies.

2. Inspect the third and input clutches pawl for the following:
   - Worn or damaged splines
   - Wear or cracks
3. Install the input clutch pawl assembly (728) onto the input sun gear shaft (668).
4. Install the third clutch pawl assembly (727) onto the input sun gear (668).

INPUT AND THIRD CLUTCH PAWL FUNCTIONAL CHECK

Checking Procedure

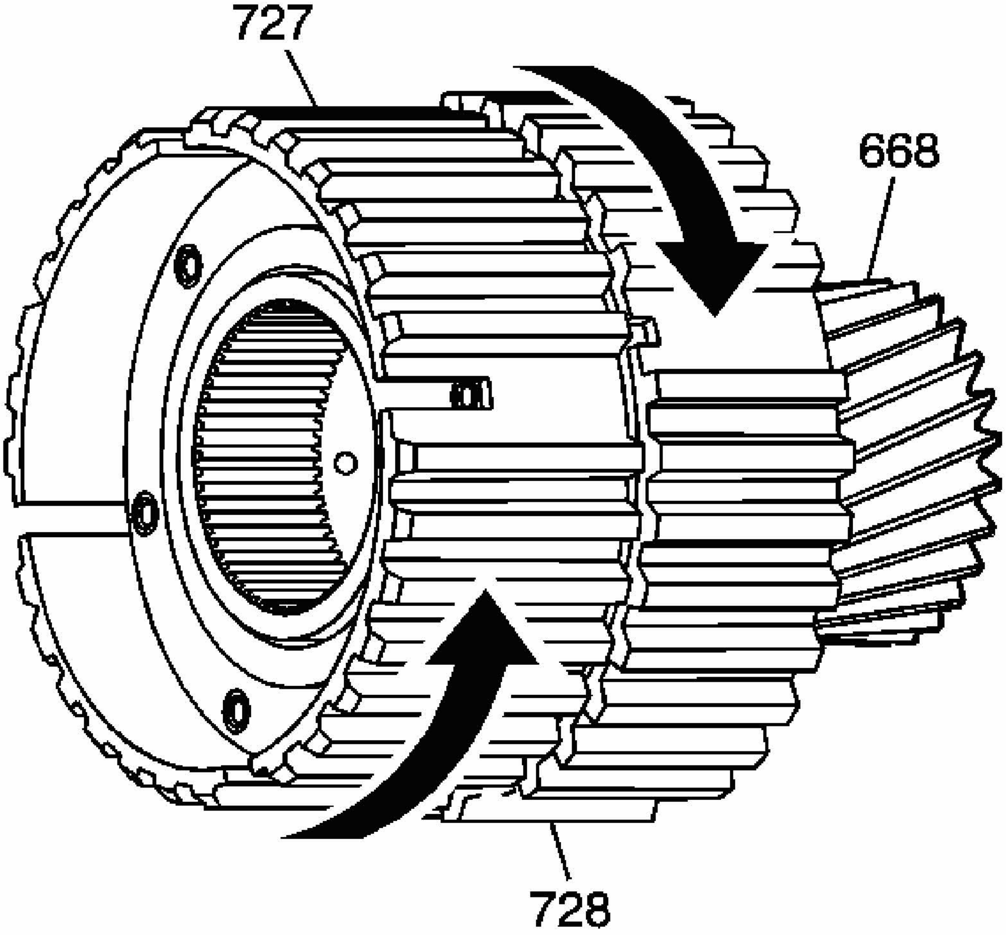


Fig. 159: Identifying Input & Third Clutch Pawl Components
Courtesy of GENERAL MOTORS CORP.

1. Hold the input sun gear (668) stationary in the position shown.
2. The third clutch pawl outer race (727) should rotate only in the direction shown by the arrow and not in the opposite direction.
3. The input clutch pawl assembly (728) should rotate only in the direction shown by the arrow and not in the opposite direction.

INPUT CLUTCH AND THIRD CLUTCH DISASSEMBLE

Tools Required

- **J 23327** Clutch Spring Compressor

- **J 25018-A** Clutch Spring Compressor Adapter
- **J 8059** Snap Ring Pliers. See **Special Tools**.

Disassembly Procedure

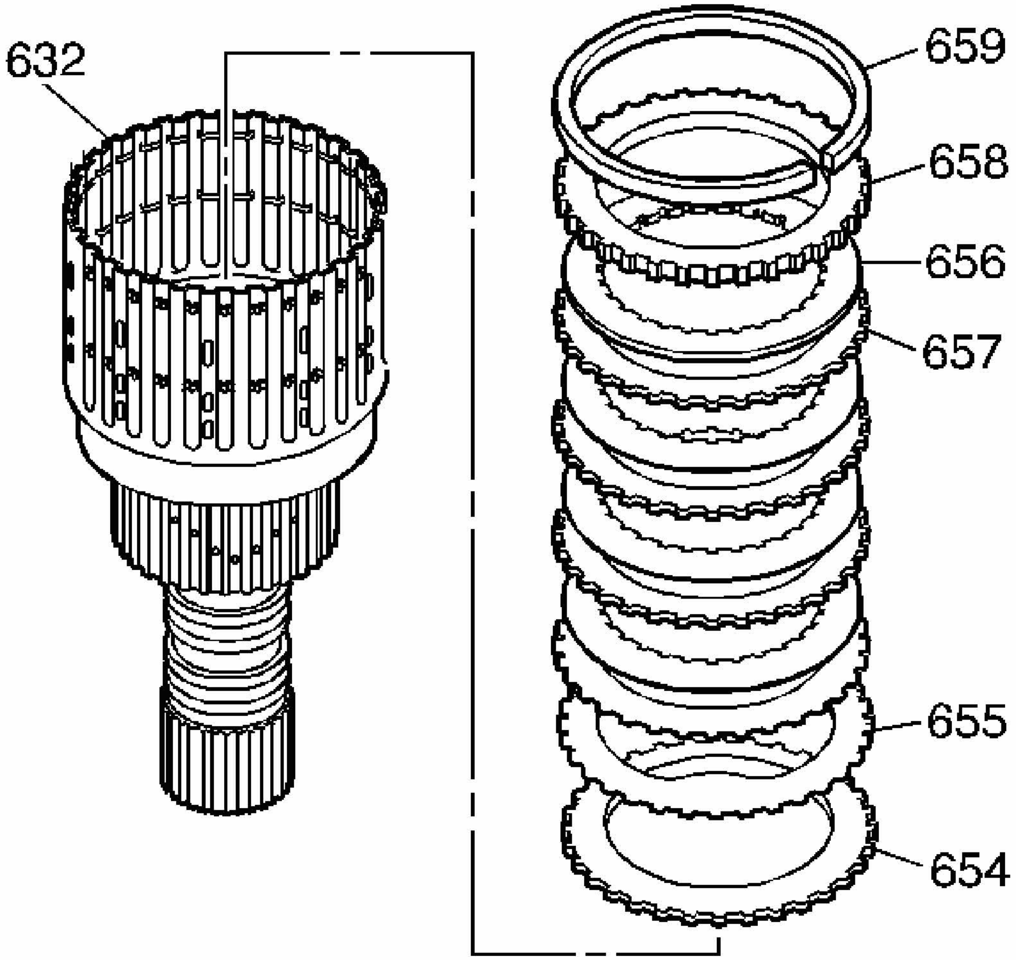


Fig. 160: View Of Input Clutch Plate Assemblies
Courtesy of GENERAL MOTORS CORP.

1. Use a flat blade screwdriver in order to remove the retaining ring (659) from the input shaft and housing assembly (632).
2. Remove the input clutch backing plate (658).
3. Remove all of the input clutch plate assemblies (656, 657).
4. Remove the input clutch waved plate (655) and the input clutch apply plate (654).

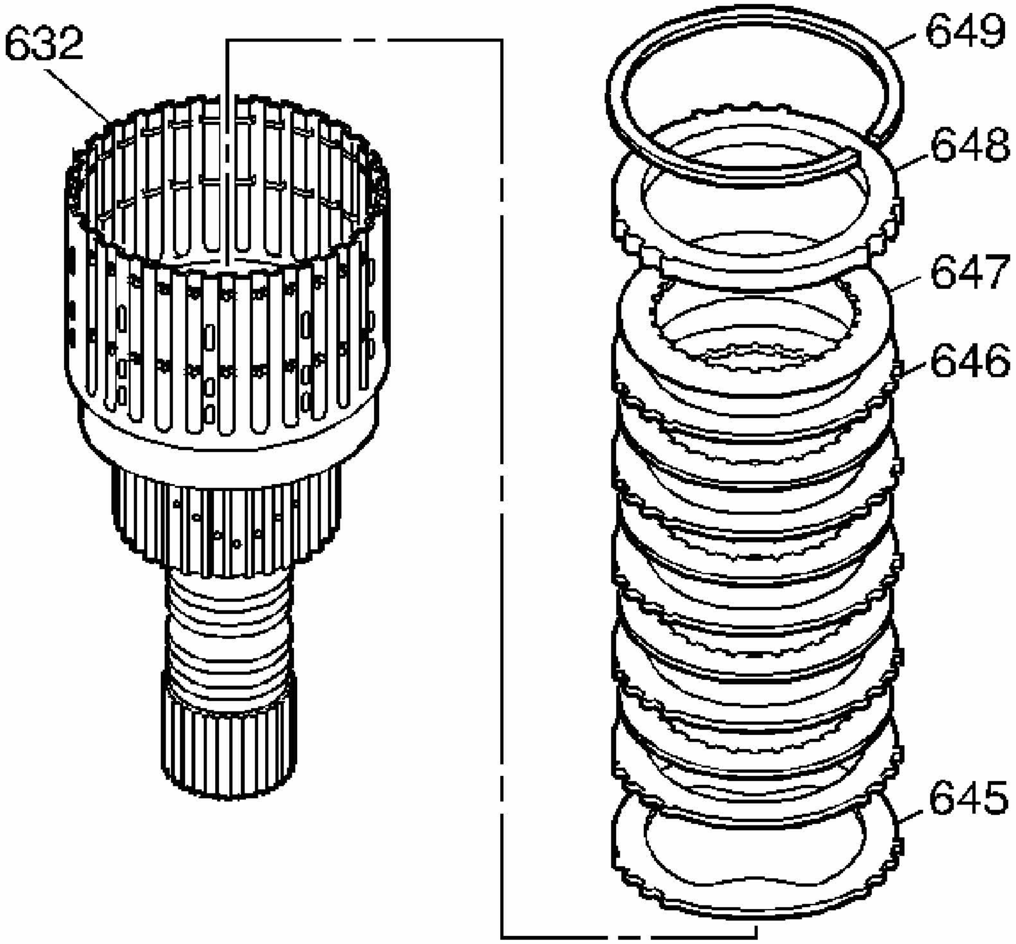


Fig. 161: Identifying Third Clutch Plates Assemblies
Courtesy of GENERAL MOTORS CORP.

5. Use a flat blade screwdriver in order to remove the retaining ring (649) from the input shaft and housing assembly (632).
6. Remove the third clutch backing plate (648)
7. Remove the third clutch plate assemblies (646, 647).
8. Remove the third clutch waved plate (645).

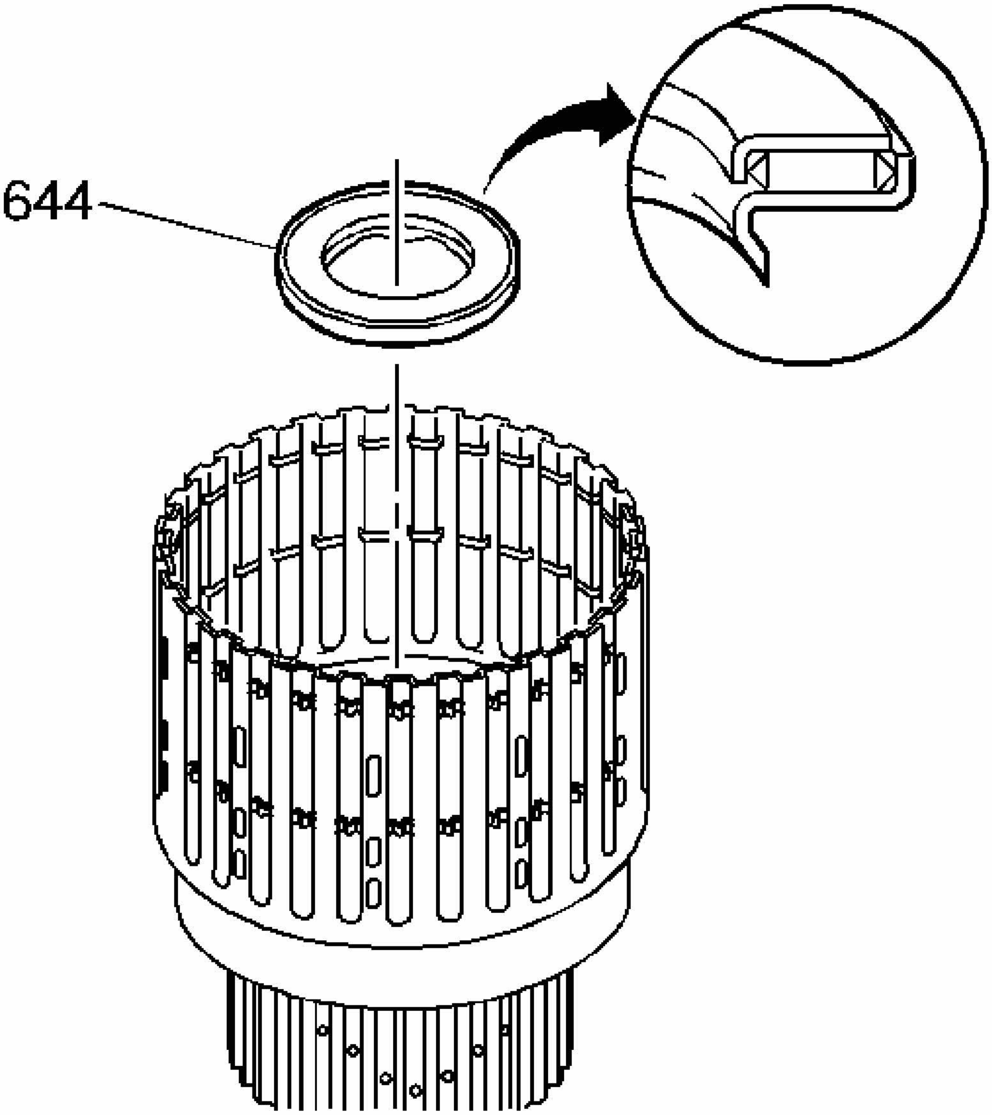


Fig. 162: Locating Input Shaft Thrust Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

9. Remove the input shaft thrust bearing assembly (644).

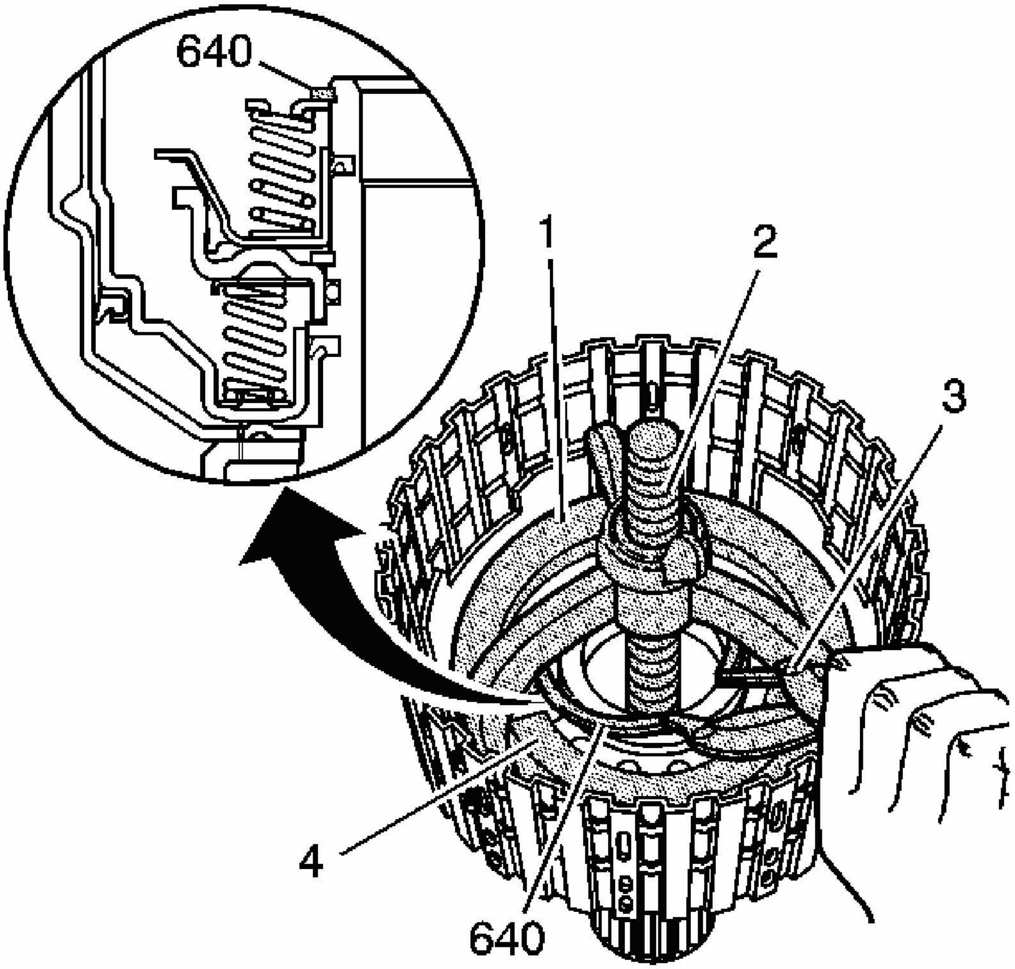


Fig. 163: Compressing The Third Clutch Spring Retainer And Guide Assembly Using J 23327, J 25018-A & J 8059
Courtesy of GENERAL MOTORS CORP.

10. Use **J 23327** and **J 25018-A** in order to compress the third clutch spring retainer and guide assembly.

IMPORTANT: Do not overexpand the retaining ring during removal.

11. Use **J 8059** in order to remove the retaining ring (640) from the input shaft and housing assembly. See Special Tools.
12. Remove **J 23327** and **J 25018-A** from the input shaft and housing assembly.

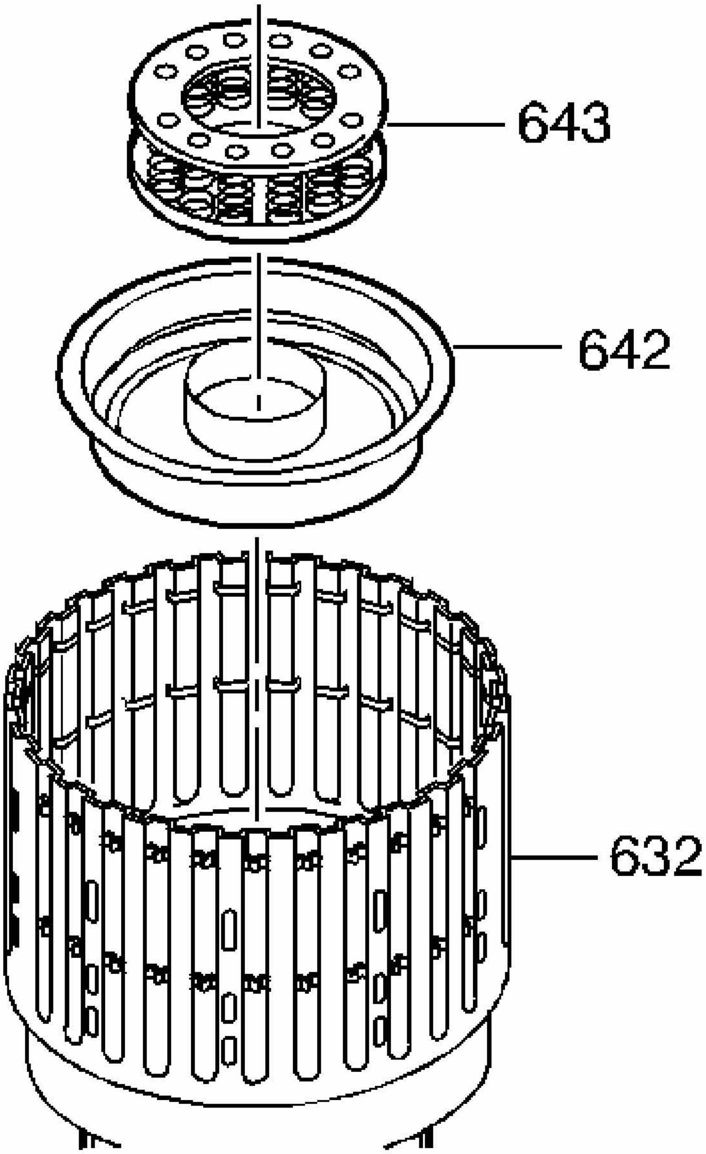


Fig. 164: Locating Third Clutch Piston And Seal Assembly
Courtesy of GENERAL MOTORS CORP.

13. Remove the third clutch retainer and guide spring assembly (643).
14. Remove the third clutch piston and seal assembly (642).

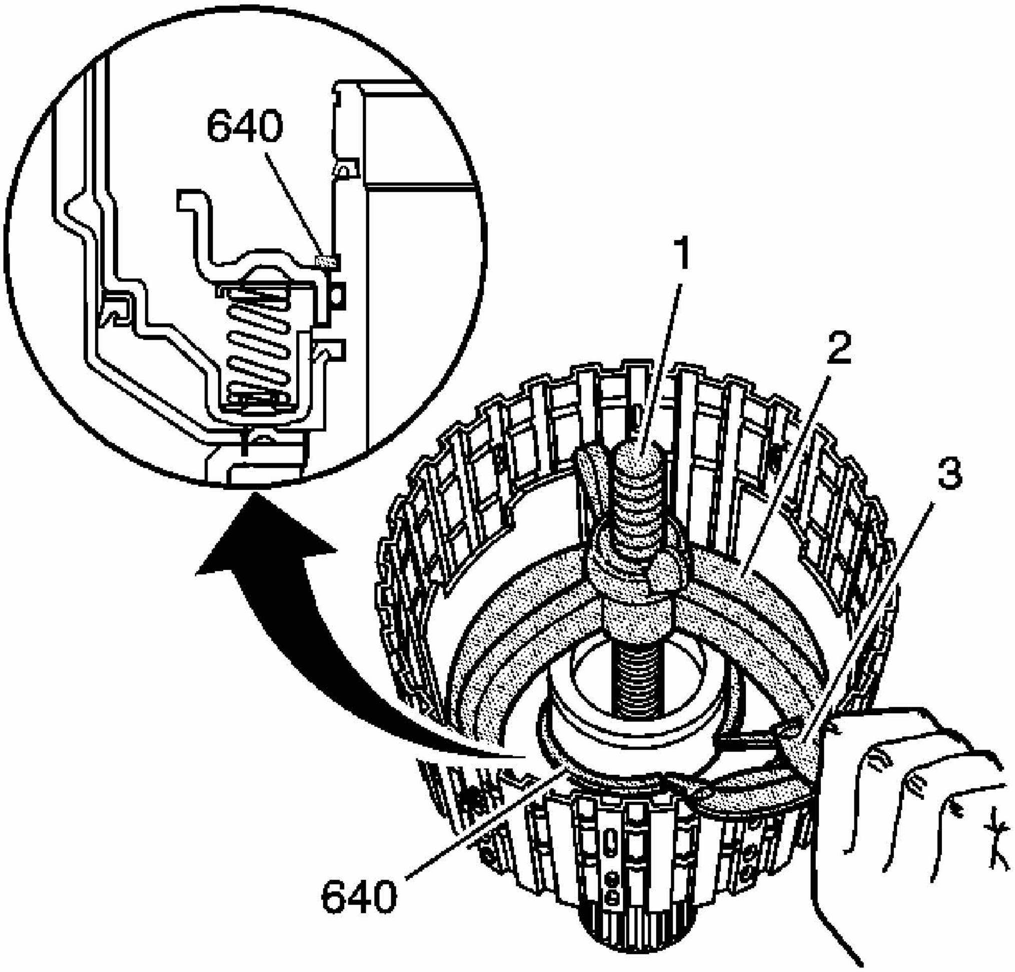


Fig. 165: Compressing The Input Clutch Spring And Retainer Assembly Using J 23327 & J 8059
Courtesy of GENERAL MOTORS CORP.

15. Use **J 23327** in order to compress the input clutch spring and retainer assembly.

IMPORTANT: Do not overexpand the retainer ring during removal.

16. Use **J 8059** in order to remove the retainer ring (640) from the input shaft and housing assembly. See **Special Tools**.
17. Remove **J 23327** from the input shaft and housing assembly.

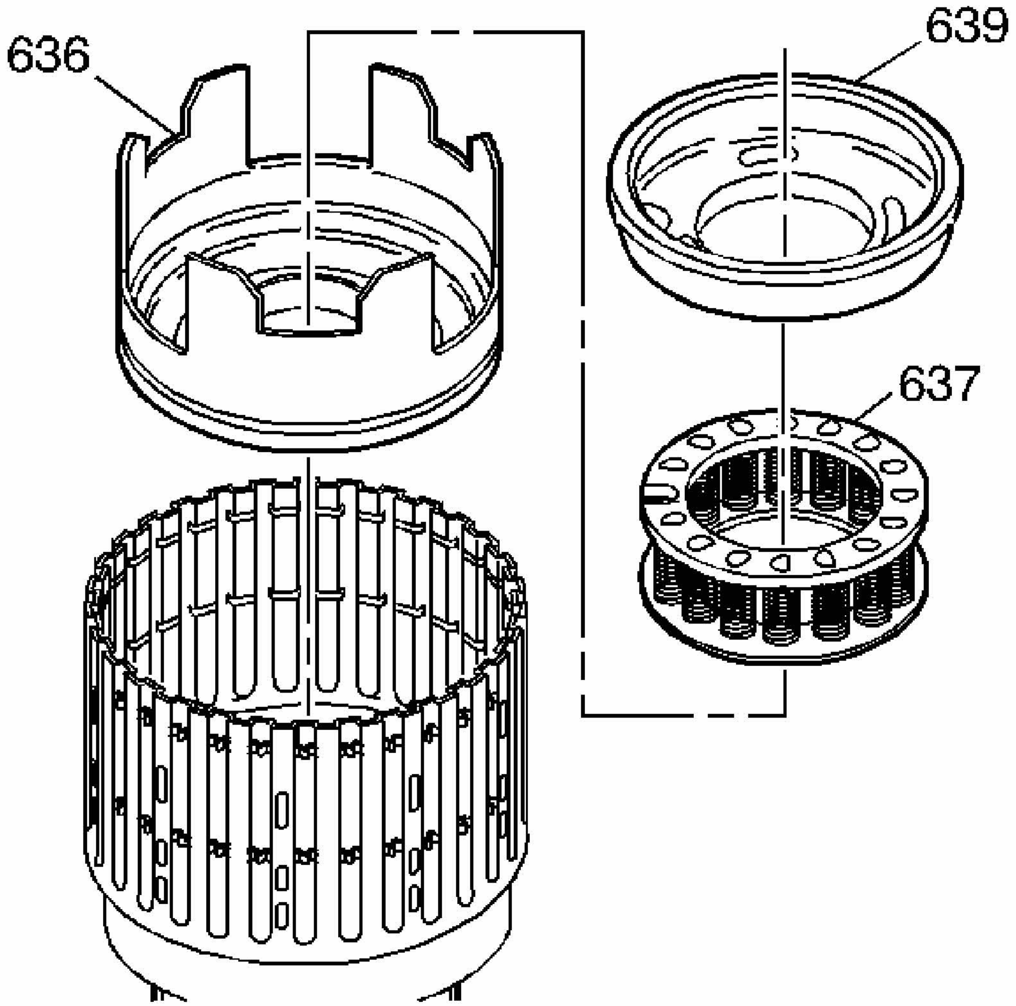


Fig. 166: View Of Input Clutch Piston Assembly
Courtesy of GENERAL MOTORS CORP.

18. Remove the third clutch piston housing (639).
19. Remove the input clutch spring and retainer assembly (637).
20. Remove the input clutch piston assembly (636).

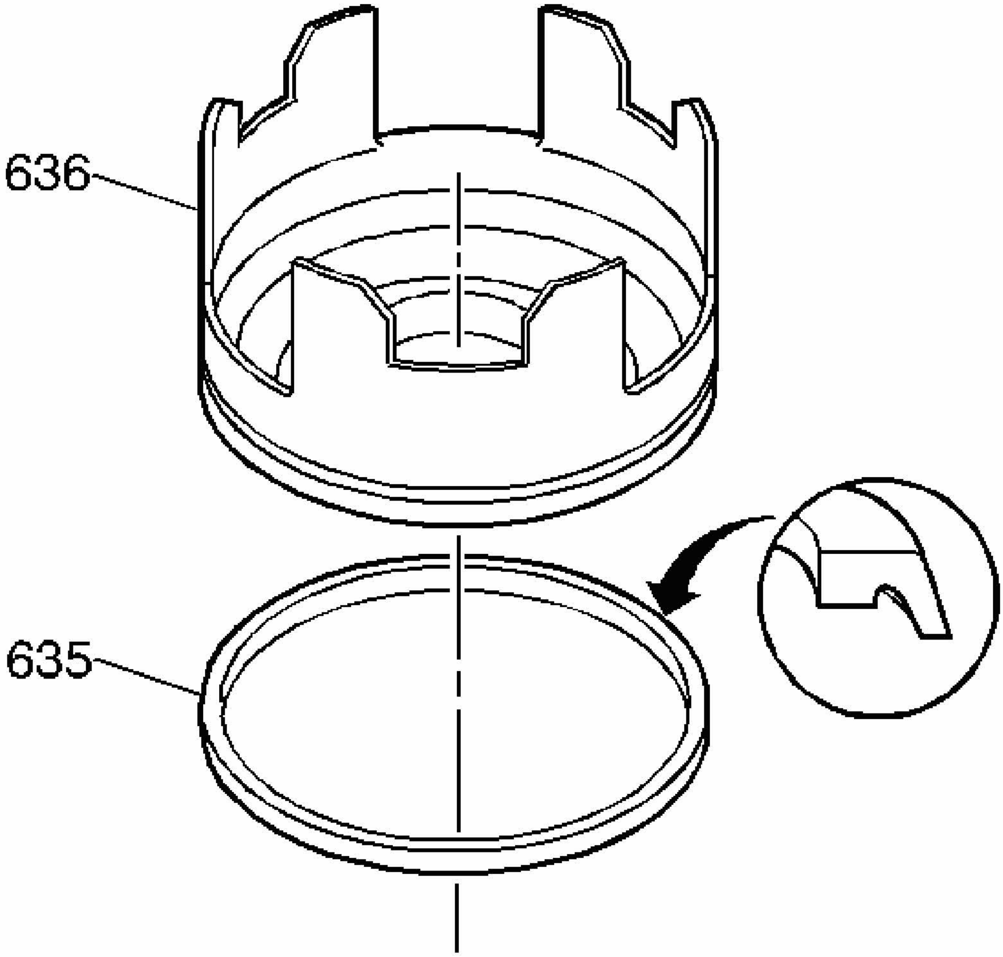


Fig. 167: Identifying Input Clutch Piston Outer Seal
Courtesy of GENERAL MOTORS CORP.

21. Remove the input clutch piston outer seal (635).

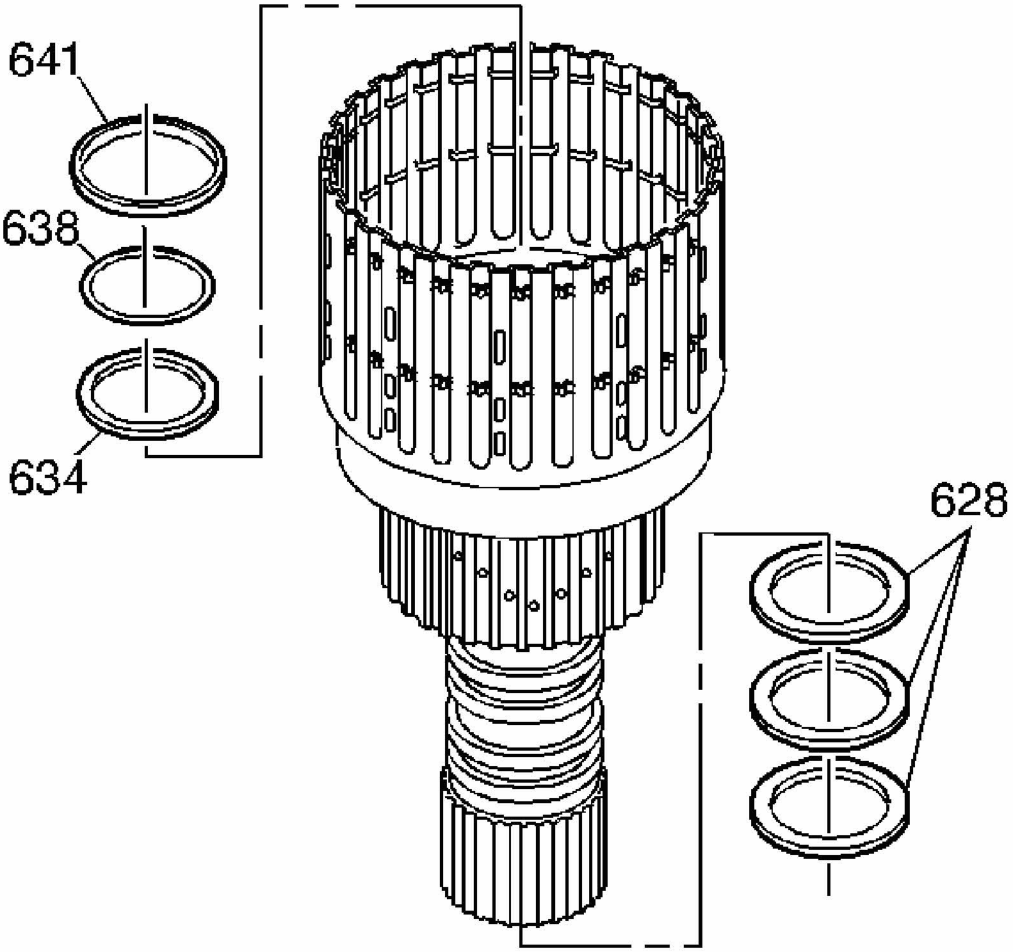


Fig. 168: Identifying Third & Input Clutch Components
Courtesy of GENERAL MOTORS CORP.

22. Remove the third clutch piston inner seal (641).
23. Remove the third clutch housing O-ring seal (638).
24. Remove the input clutch piston inner seal (634).

NOTE: **Do not damage the grooves on the shaft, when removing the oil seal rings.**

25. Cut the input shaft oil seal rings (628).
26. Remove the input shaft oil seal rings (628).

INPUT CLUTCH HOUSING ASSEMBLY INSPECTION

Inspection Procedure

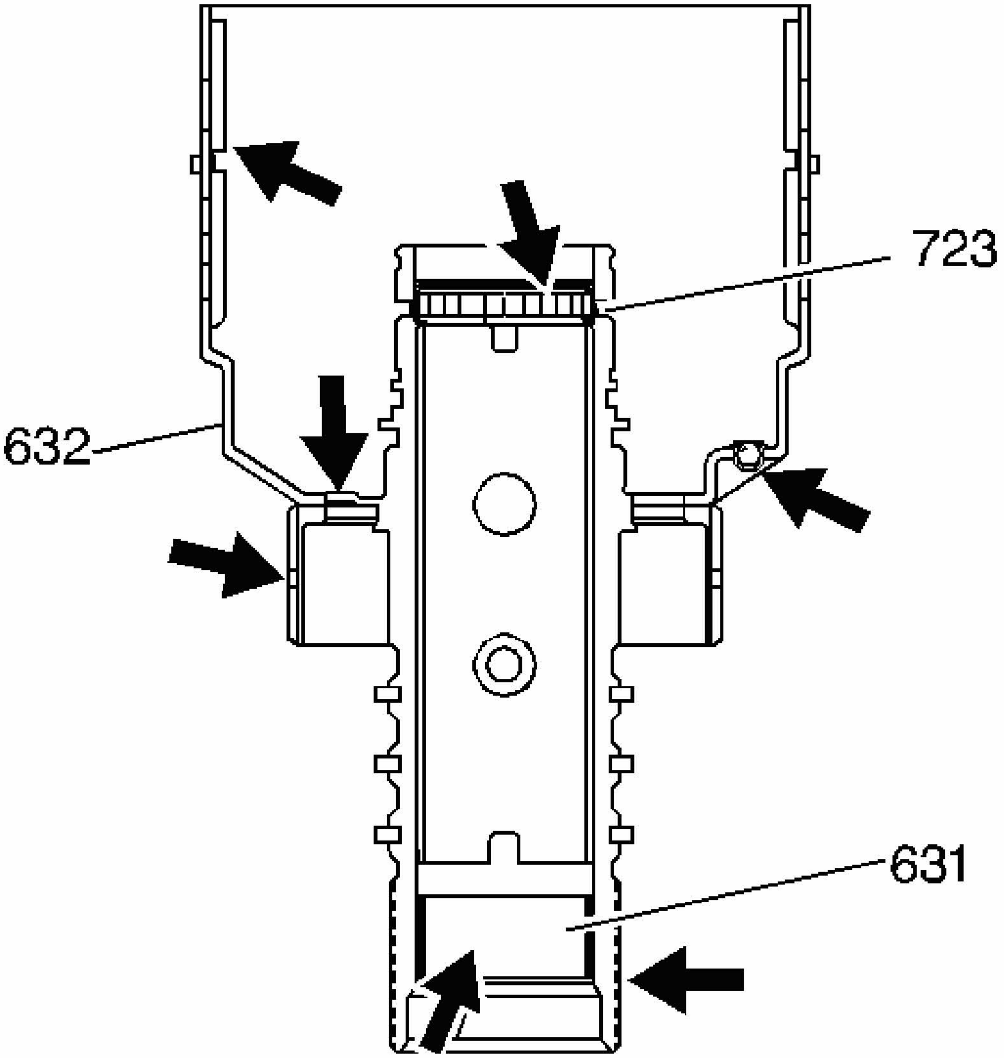


Fig. 169: Cross Sectional View Of Inspection Areas In Input Clutch Housing
Courtesy of GENERAL MOTORS CORP.

1. Inspect the input clutch housing assembly (632) for the following:
    - Plugged feed passages
    - Worn or damaged splines
    - Input shaft bushing (631) wear
    - Seal ring groove nicks or burrs
    - Cracks or blocked fluid passages in the input shaft

  - Damage or wear to the thrust bearing (723) in the input clutch housing
2. With the ball check valve assembly in its seated position in transmission fluid, inspect the assembly for leaks.

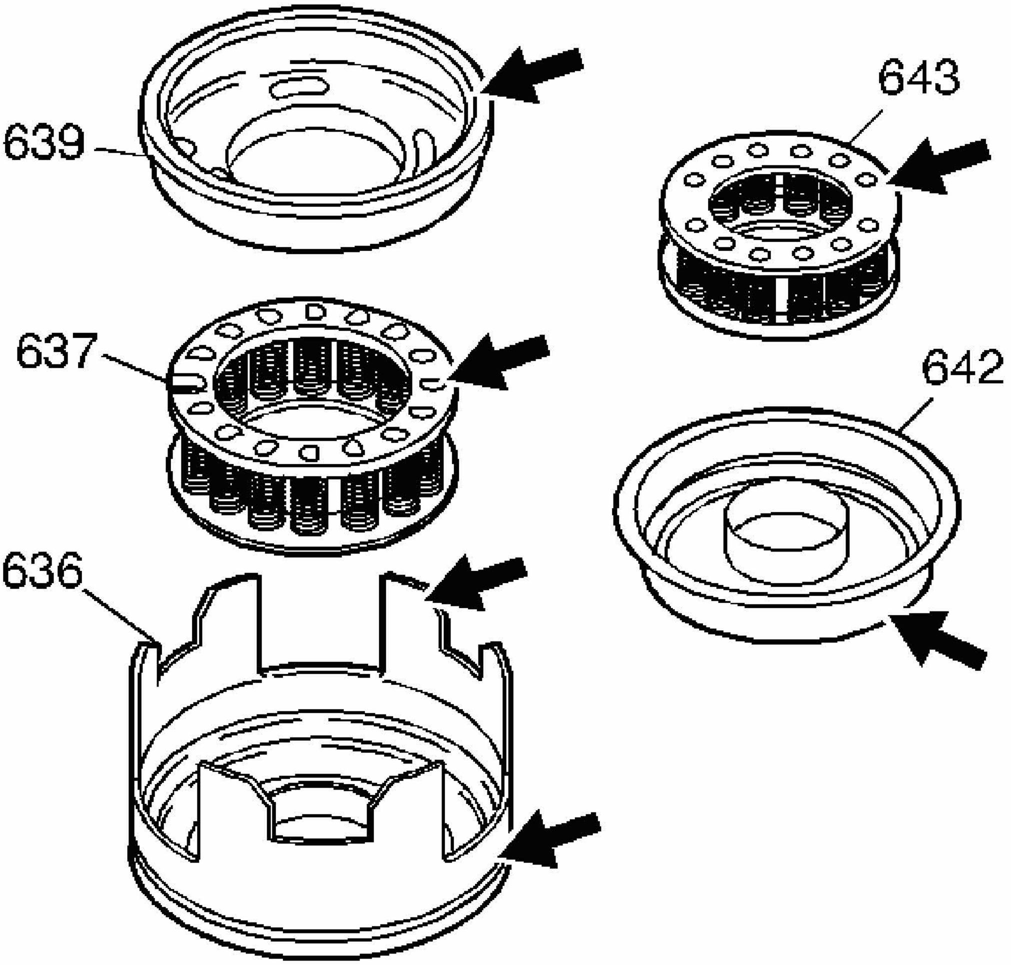


Fig. 170: Inspection Areas On Input Clutch Piston Components
Courtesy of GENERAL MOTORS CORP.

3. Inspect the input clutch piston (636) for the following:
  - Cracks or damage to seal grooves
  - Wear on piston lugs
4. Inspect the input clutch spring and retainer assembly (637) for a damaged cage and distorted or missing springs.
5. Inspect the third clutch piston housing (639) for damage.

6. Inspect the third clutch spring retainer and guide assembly (643) for a damaged cage and distorted or missing springs.

IMPORTANT: Do not attempt to reuse the third clutch piston and seal assembly.

7. Replace the third clutch piston and seal assembly (642).

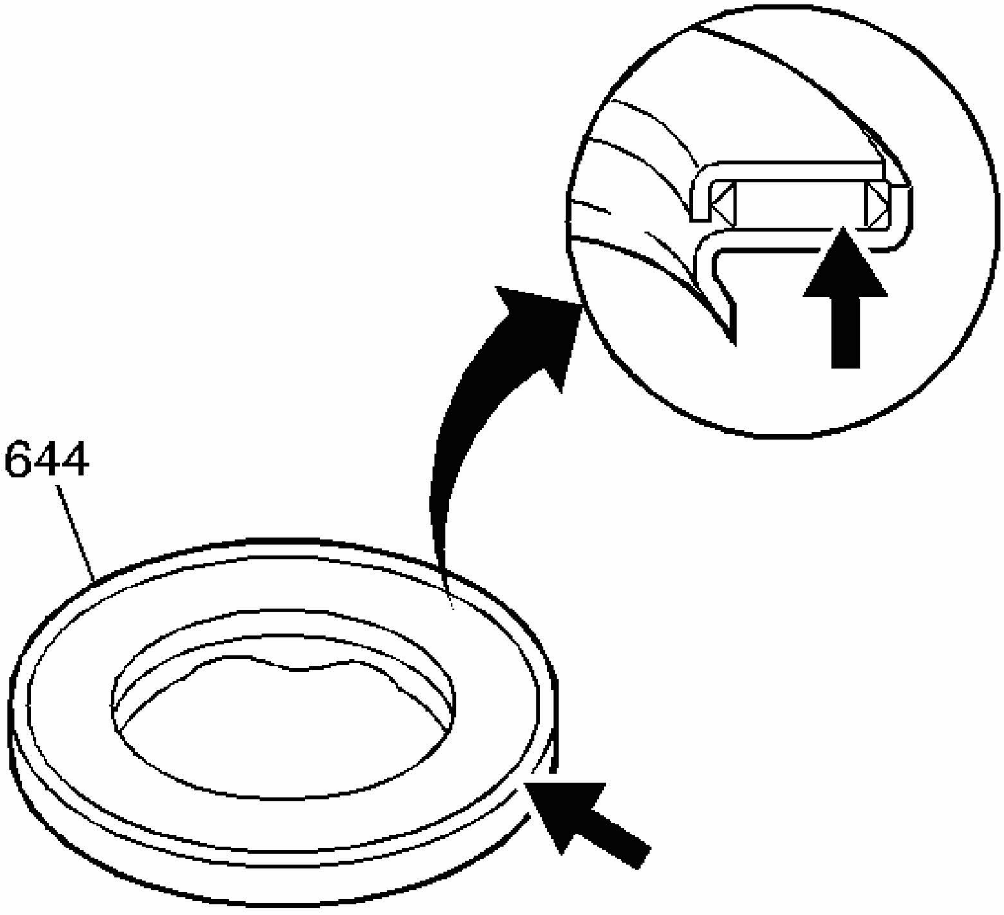


Fig. 171: View Of Input Shaft Thrust Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

8. Inspect the input shaft thrust bearing assembly (644) for damage or wear.

INPUT CLUTCH HOUSING BALL CHECK VALVE DISASSEMBLE

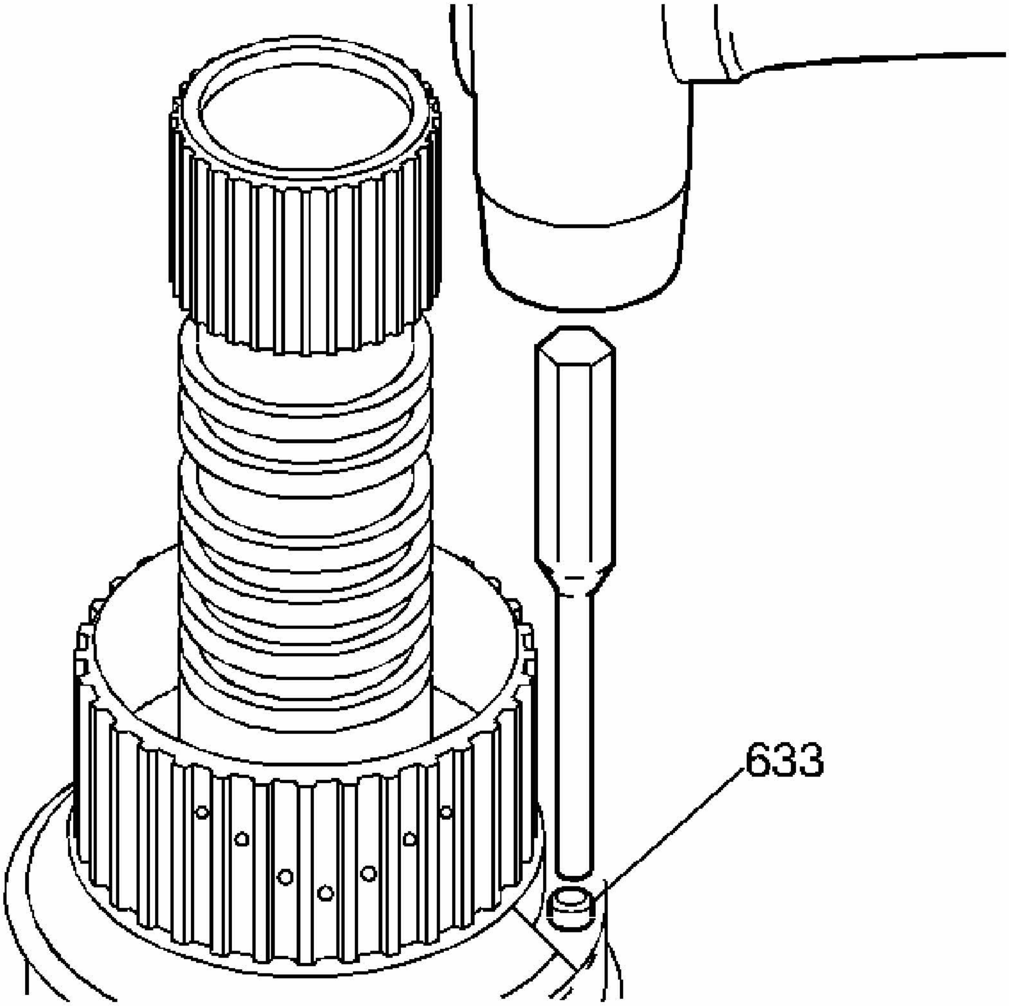


Fig. 172: Removing Input Clutch Housing Ball Check Valve
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Perform this procedure only if the inspection or leak check procedure indicated a problem.

Use a 6.25 mm (1/4 in) drift and mallet in order to remove the ball check valve assembly (633) from the input clutch housing.

INPUT CLUTCH HOUSING BALL CHECK VALVE ASSEMBLE

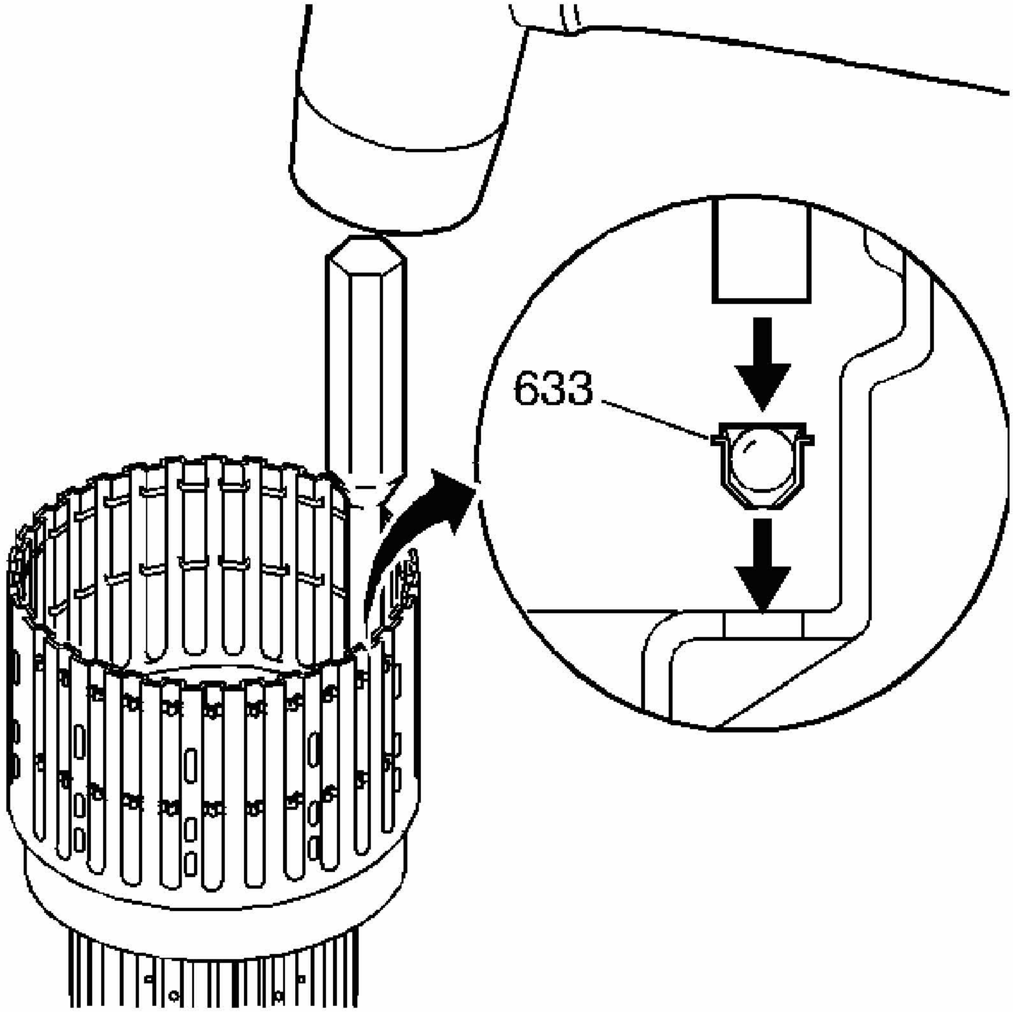


Fig. 173: Inserting Input Clutch Housing Ball Check Valve
Courtesy of GENERAL MOTORS CORP.

Use a 9.5 mm (3/8 in) drift punch and mallet in order to assemble a new ball check valve assembly (633) into the input clutch housing.

INPUT CLUTCH AND THIRD CLUTCH ASSEMBLE

Tools Required

- **J 8059** Snap Ring Pliers. See **Special Tools**.
- **J 23327** Clutch Spring Compressor
- **J 25018-A** Clutch Spring Compressor Adapter

- **J 37361** Input Clutch Inner Piston Seal Protector. See **Special Tools**.
- **J 37362** Third Clutch Inner Piston Seal Protector. See **Special Tools**.

Assembly Procedure

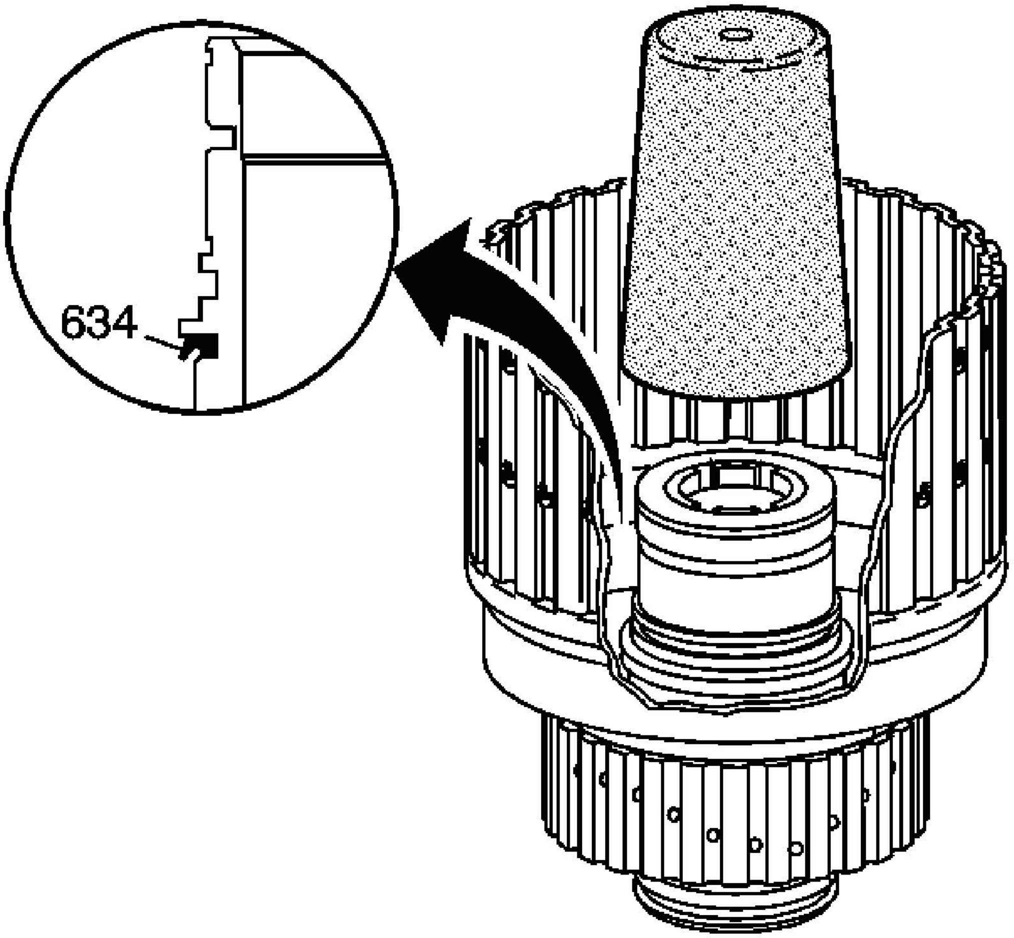


Fig. 174: Identifying Input Clutch Piston Inner Seal
Courtesy of GENERAL MOTORS CORP.

1. Use transmission fluid in order to lubricate the new input clutch piston inner seal (634).
2. Use **J 37361** in order to install the new seal. See **Special Tools**.

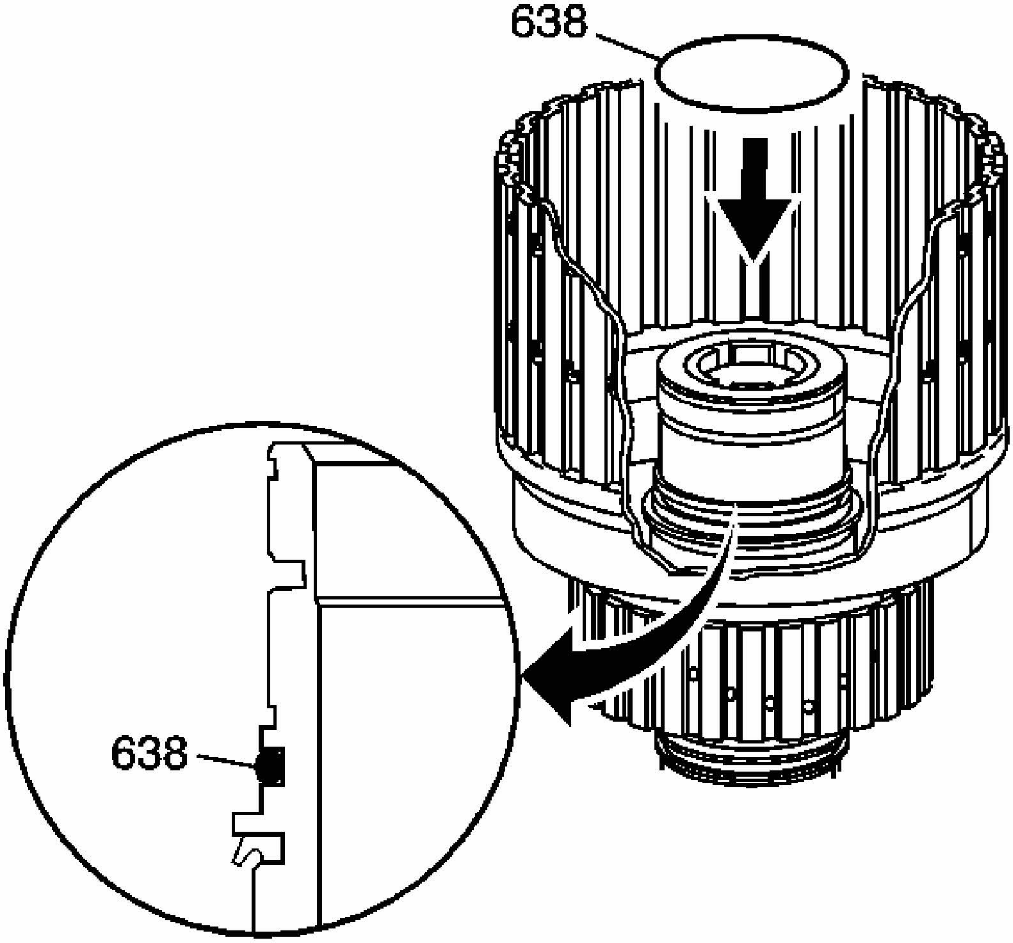


Fig. 175: View Of Third Clutch Housing O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

3. Insert a new third clutch housing O-ring seal (638) in the input shaft and housing assembly.

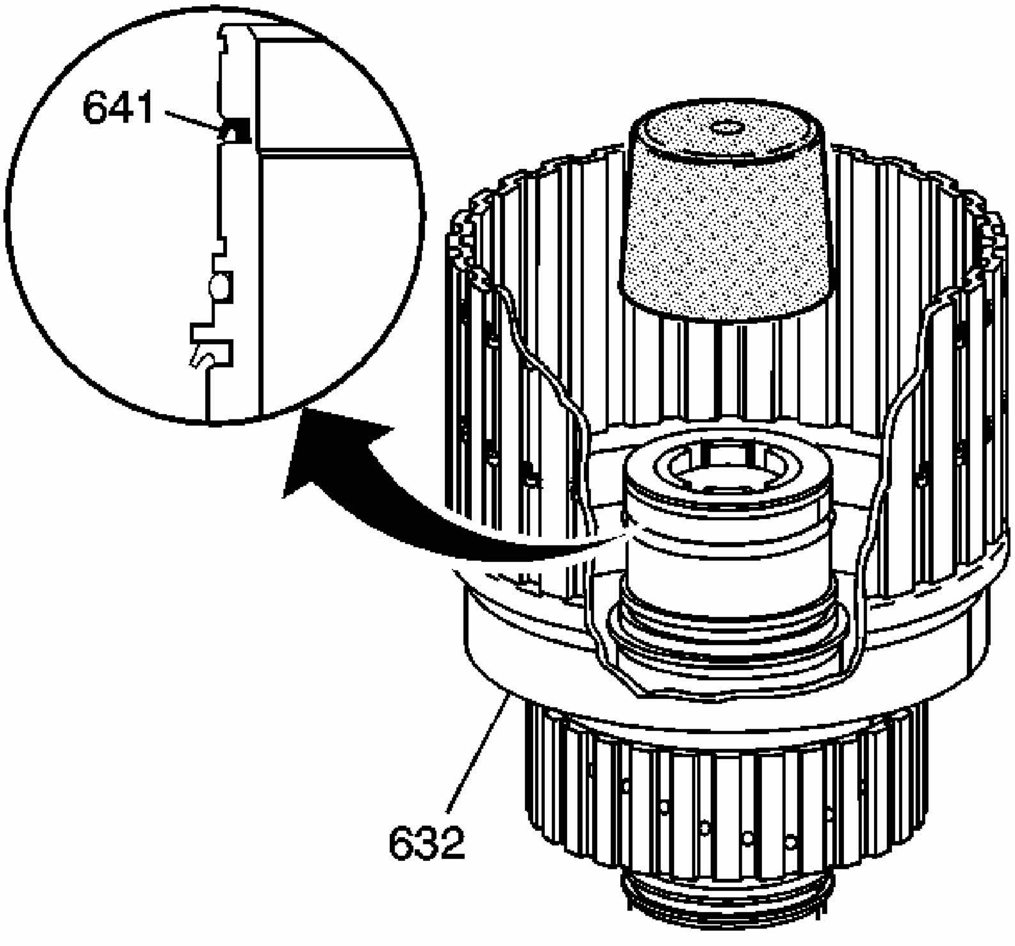


Fig. 176: Locating Clutch Piston Inner Seal
Courtesy of GENERAL MOTORS CORP.

4. Use transmission fluid in order to lubricate the new third clutch piston inner seal (641).
5. Use **J 37362** in order to install the seal in the input shaft and housing assembly (632). See Special Tools.

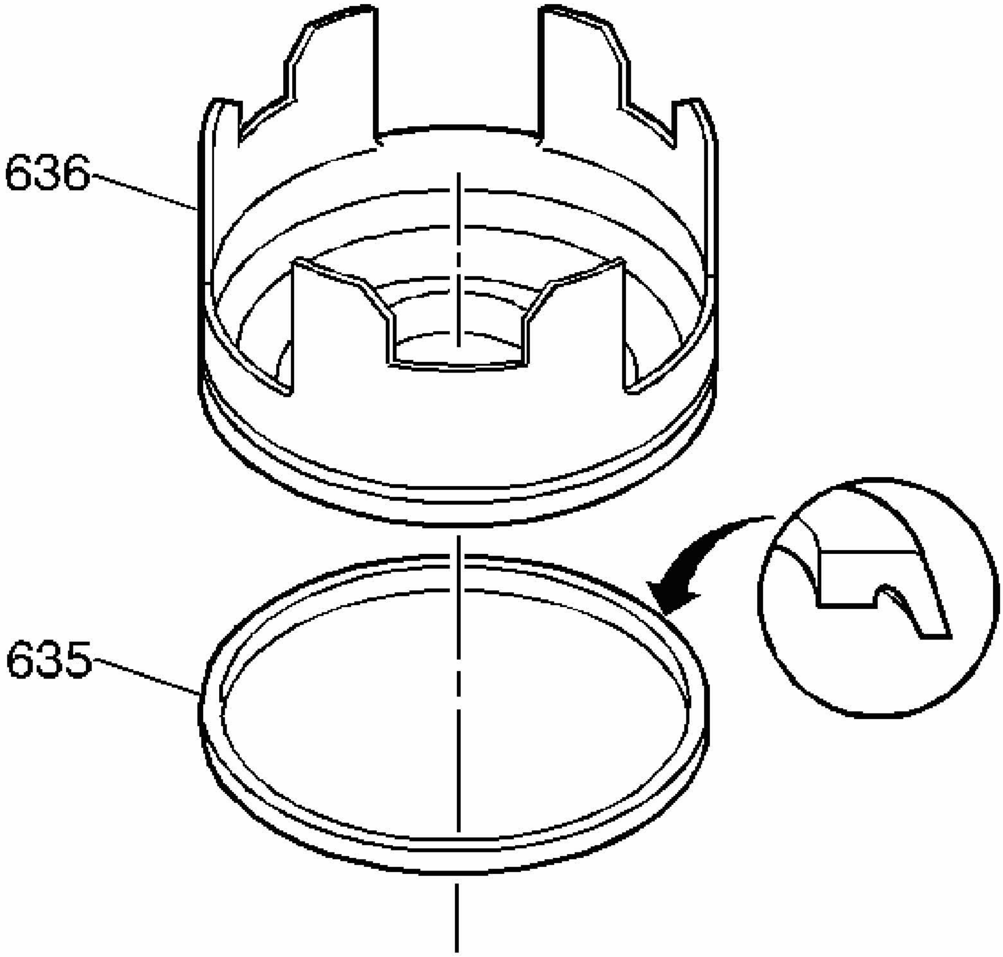


Fig. 177: Identifying Input Clutch Piston Outer Seal
Courtesy of GENERAL MOTORS CORP.

6. Use transmission fluid in order to lubricate the new input clutch piston outer seal (635).
7. Insert the new seal onto the input clutch piston assembly (636).

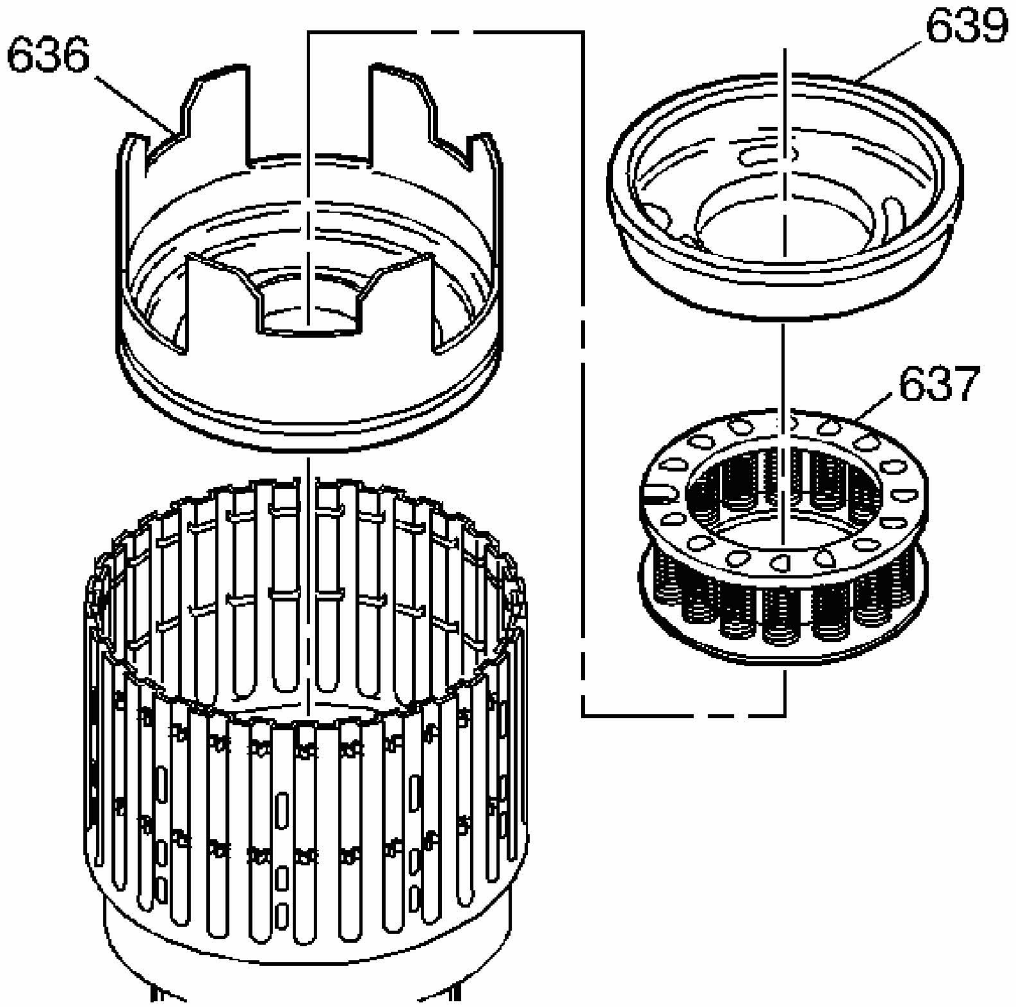


Fig. 178: View Of Input Clutch Piston Assembly
Courtesy of GENERAL MOTORS CORP.

8. Install the input clutch piston assembly (636) into the input shaft and housing assembly.
9. Install the input clutch spring and retainer assembly (637) into the input shaft and housing assembly.
10. Install the third clutch piston housing (639) into the input shaft and housing assembly.

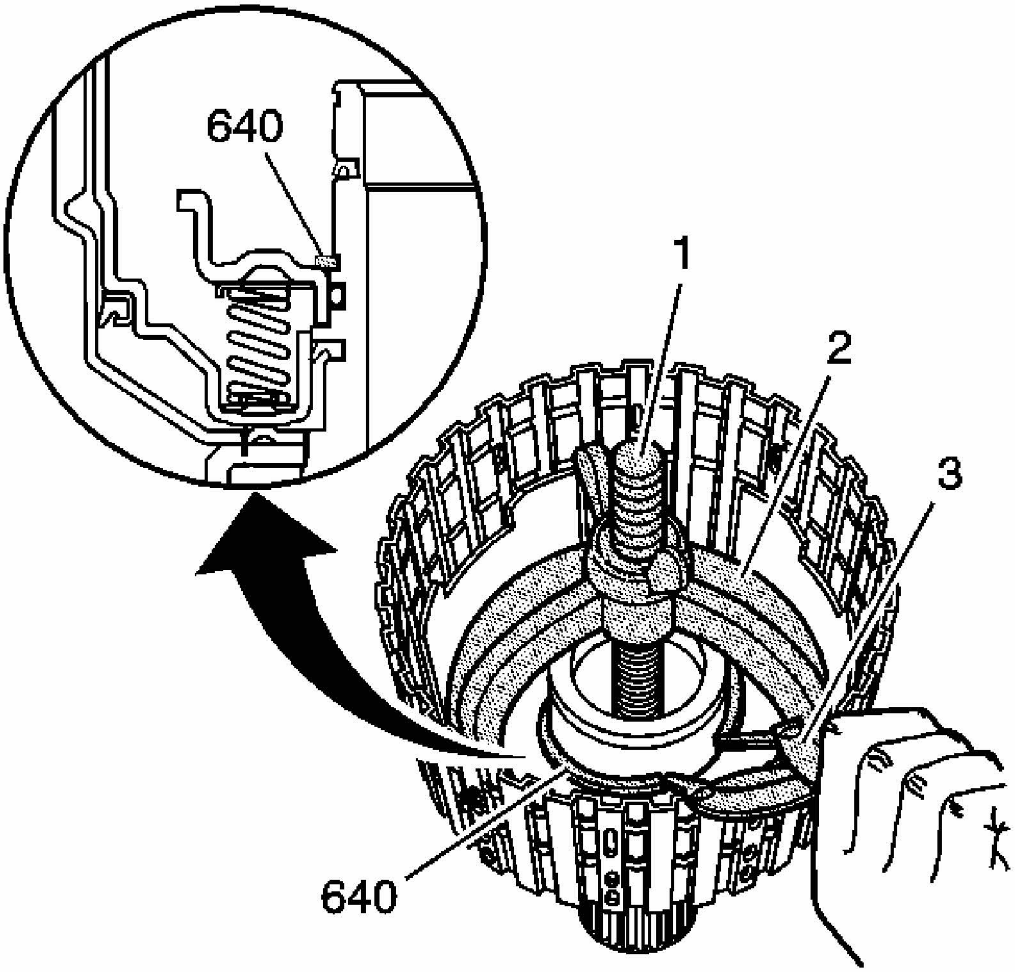


Fig. 179: Compressing The Input Clutch Spring And Retainer Assembly Using J 23327 & J 8059
Courtesy of GENERAL MOTORS CORP.

11. Use **J 23327** (1,2) and **J 8059** (3) in order to install the third clutch piston housing retaining ring (640) in the input shaft and housing assembly. See **Special Tools**.
12. Remove the **J 23327** (1,2).

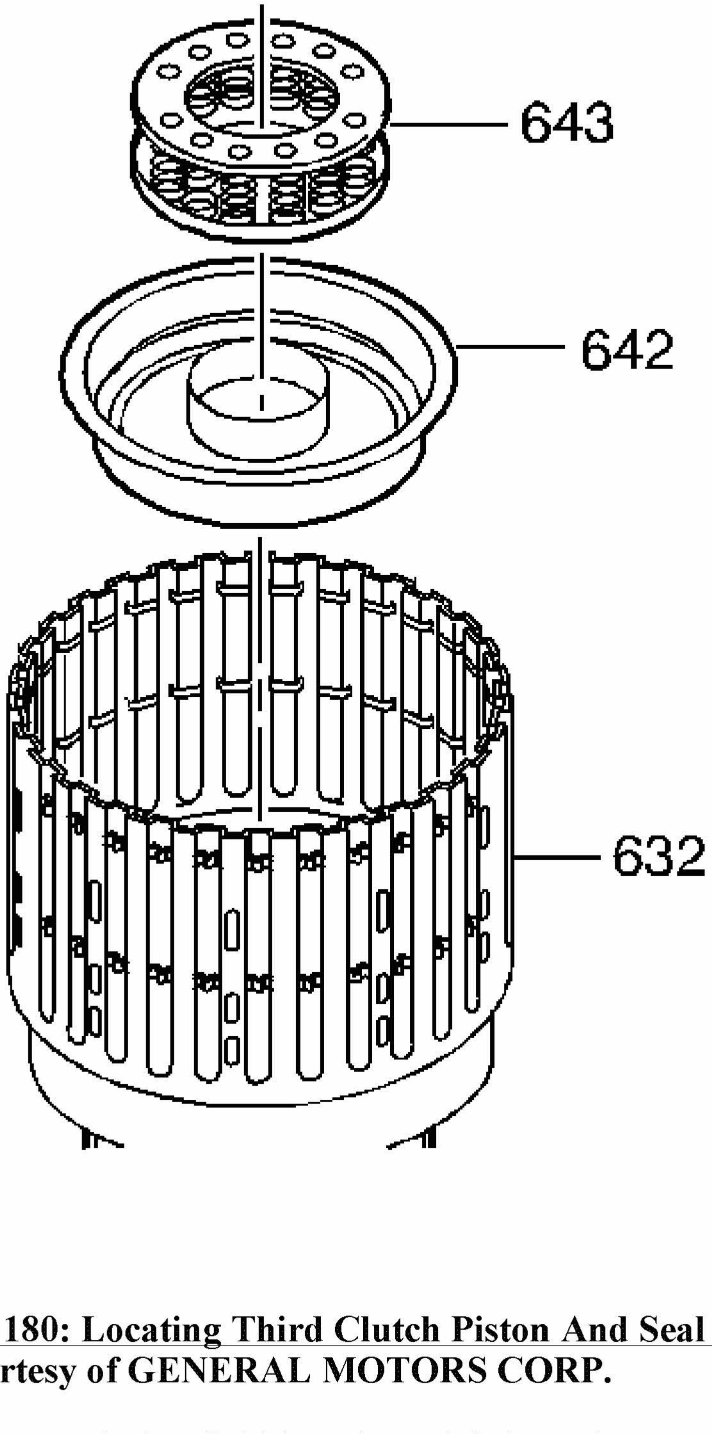


Fig. 180: Locating Third Clutch Piston And Seal Assembly
Courtesy of GENERAL MOTORS CORP.

13. Use transmission fluid in order to lubricate the new third clutch piston and seal assembly (642). Install the third clutch piston and seal assembly (642) into the input shaft and housing assembly (632).
14. Install the third clutch spring retainer and guide assembly (643) into the input shaft and housing assembly (632).

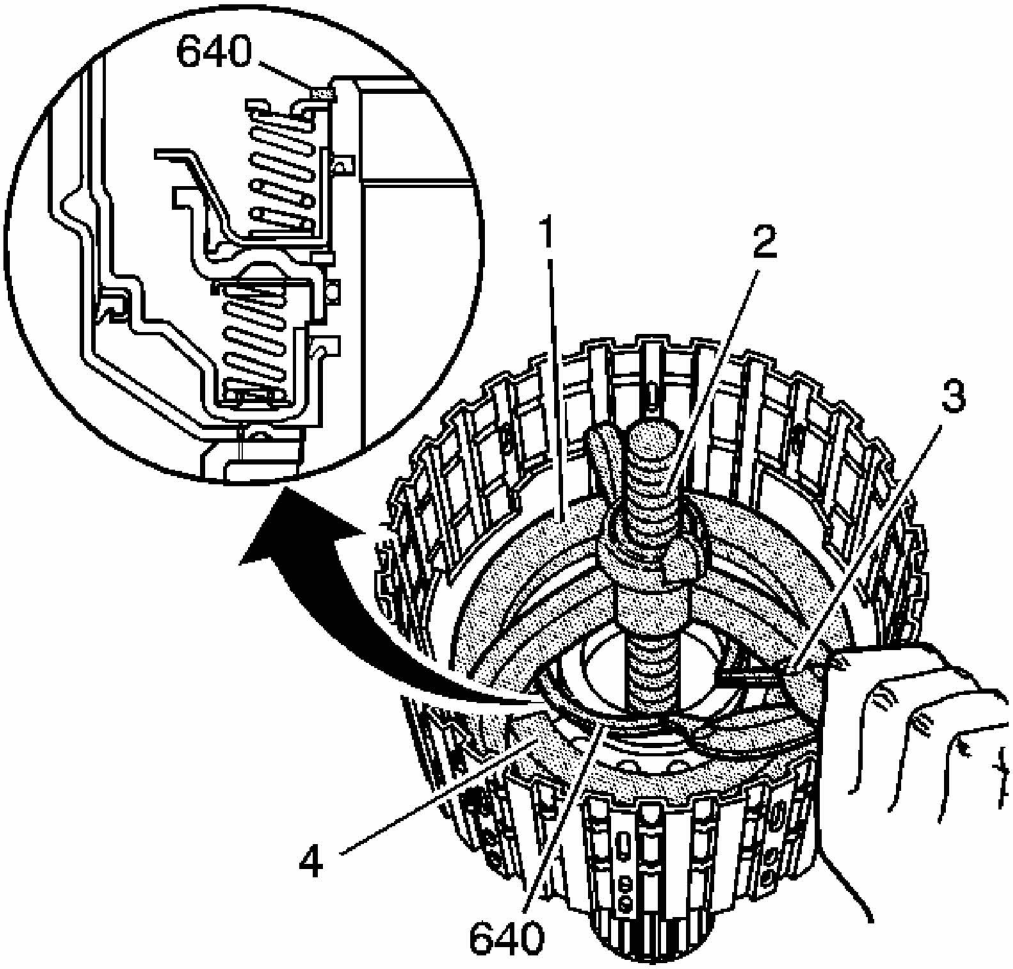


Fig. 181: Compressing The Third Clutch Spring Retainer And Guide Assembly Using J 23327, J 25018-A & J 8059
Courtesy of GENERAL MOTORS CORP.

15. Use **J 23327** (1,2), **J 25018-A** (4) and **J 8059** (3) in order to install the third clutch spring retainer and guide assembly retaining ring (640). See **Special Tools**.
16. Remove the **J 23327** (1,2).

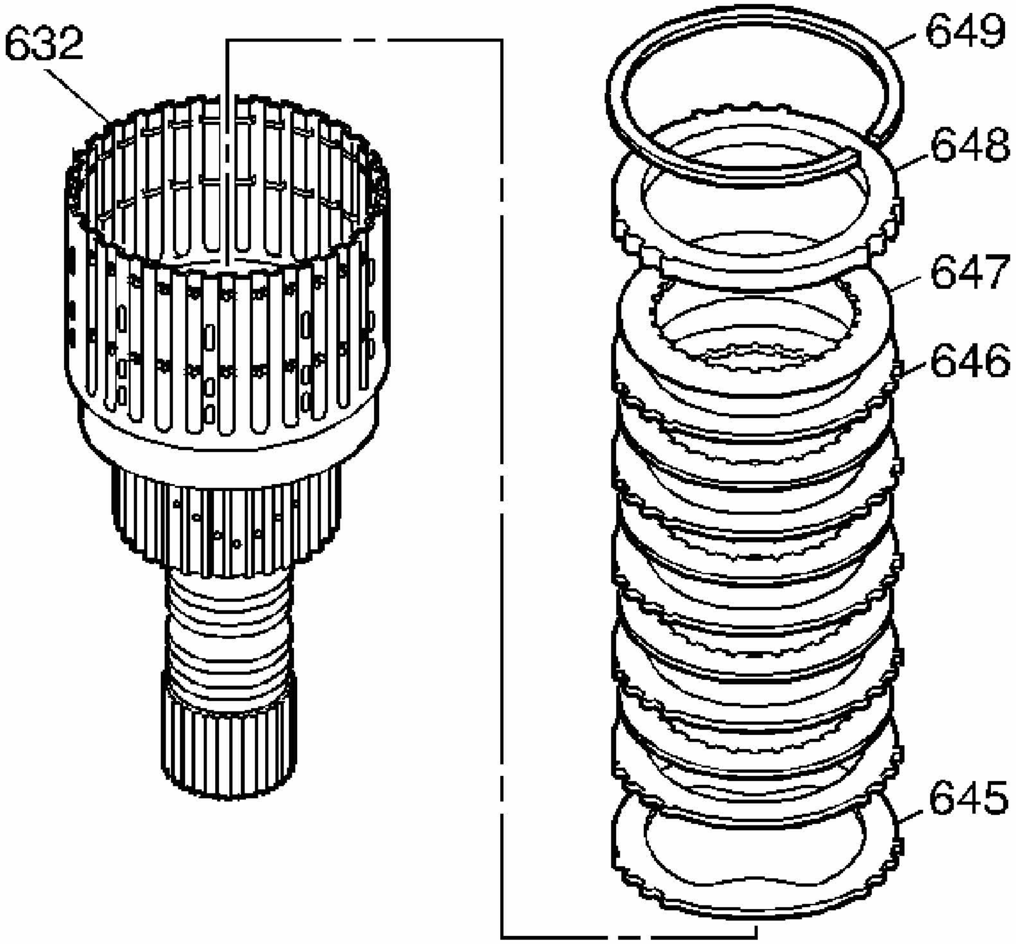


Fig. 182: Identifying Third Clutch Plates Assemblies
Courtesy of GENERAL MOTORS CORP.

17. Insert the third clutch waved plate (645) into the input shaft and housing assembly (632).

IMPORTANT: Place the first externally splined plate with its steel side against the waved plate. Place the fiber side of all plates face upward.

18. Insert the third clutch plates assemblies into the input housing. Start by inserting a third clutch plate (646) with external splines. Alternate with the internally splined clutch plates (647).
19. Insert the third clutch backing plate (648) with the word UP facing upward.
20. Insert the retaining ring (649) into the input shaft and housing assembly (632).

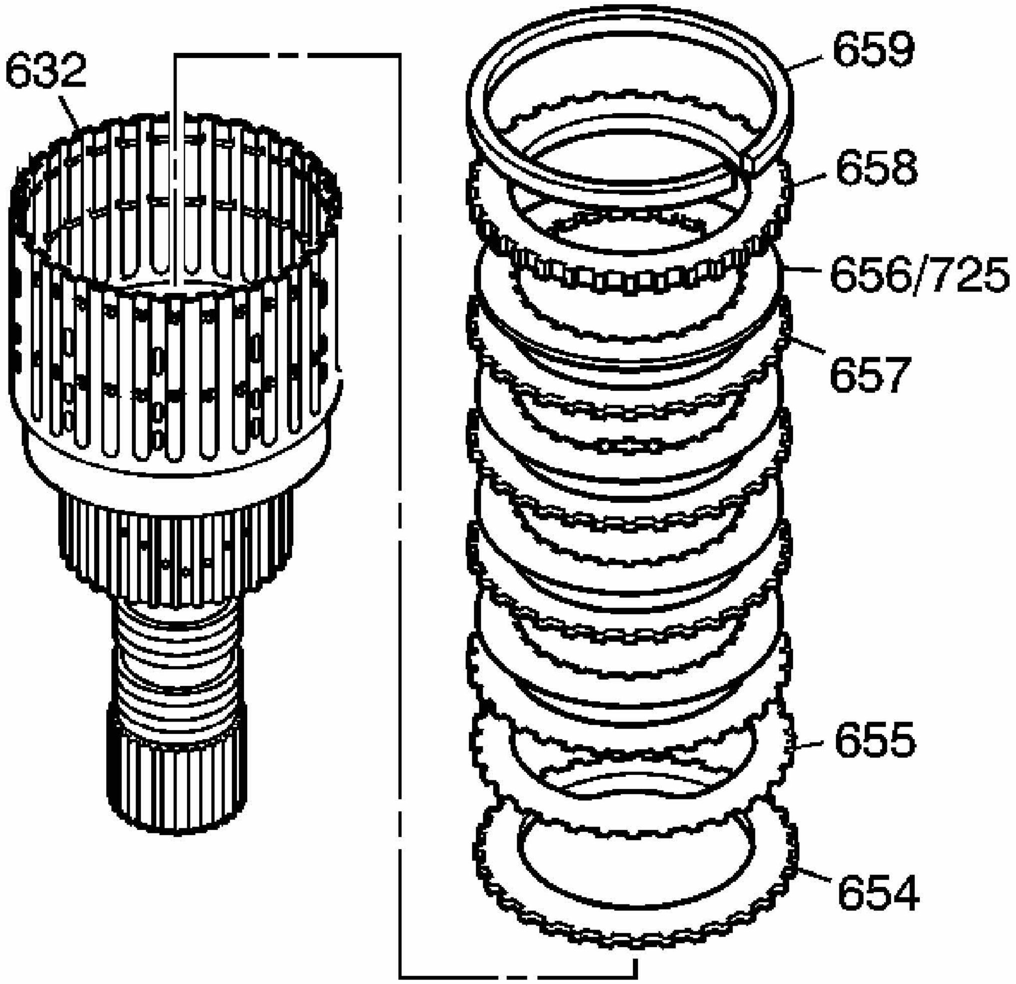


Fig. 183: View Of Sprag Clutch Assembly Plates
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Models using the input clutch pawl assembly requires specific clutch plates (725), with 30 teeth. The sprag clutch assembly plates (656) have 32 teeth.

21. Insert the input clutch apply plate (654) into the input shaft and housing assembly (632), so that the notched side of the teeth are facing downward against the retaining ring on the third clutch backing plate.
22. Install the input clutch waved plate (655).
23. Install the input clutch plates (656/725, 657) starting with an input clutch steel plate (657) and alternating with input clutch fiber plate assemblies (656).

24. Insert the input clutch backing plate (658) with the tapered side of the teeth facing upward.
25. Insert the retaining ring (659) in the input shaft and housing assembly (632).

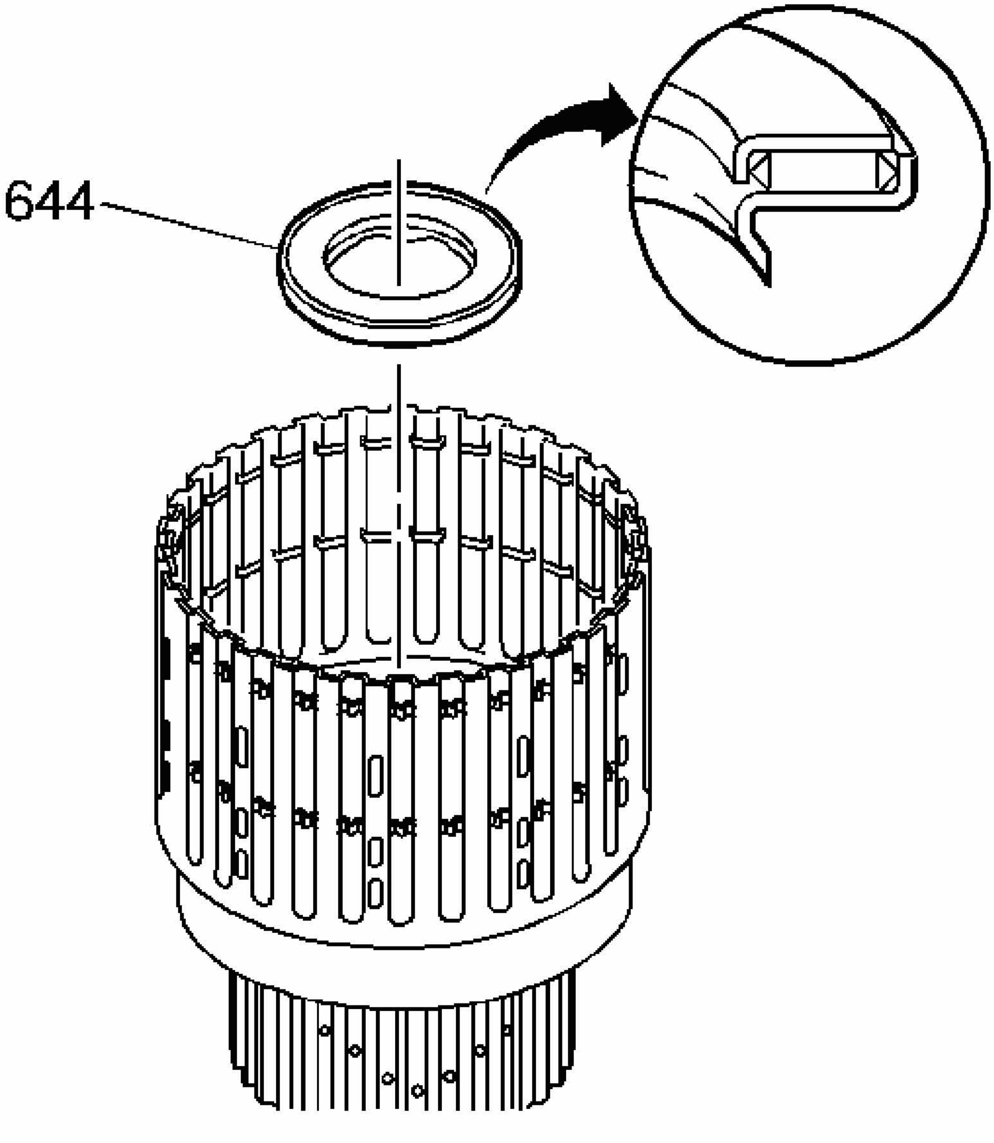


Fig. 184: Locating Input Shaft Thrust Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

26. Insert the input shaft thrust bearing assembly (644).

INPUT CLUTCH AND THIRD CLUTCH FUNCTIONAL AIR CHECK

Checking Procedure

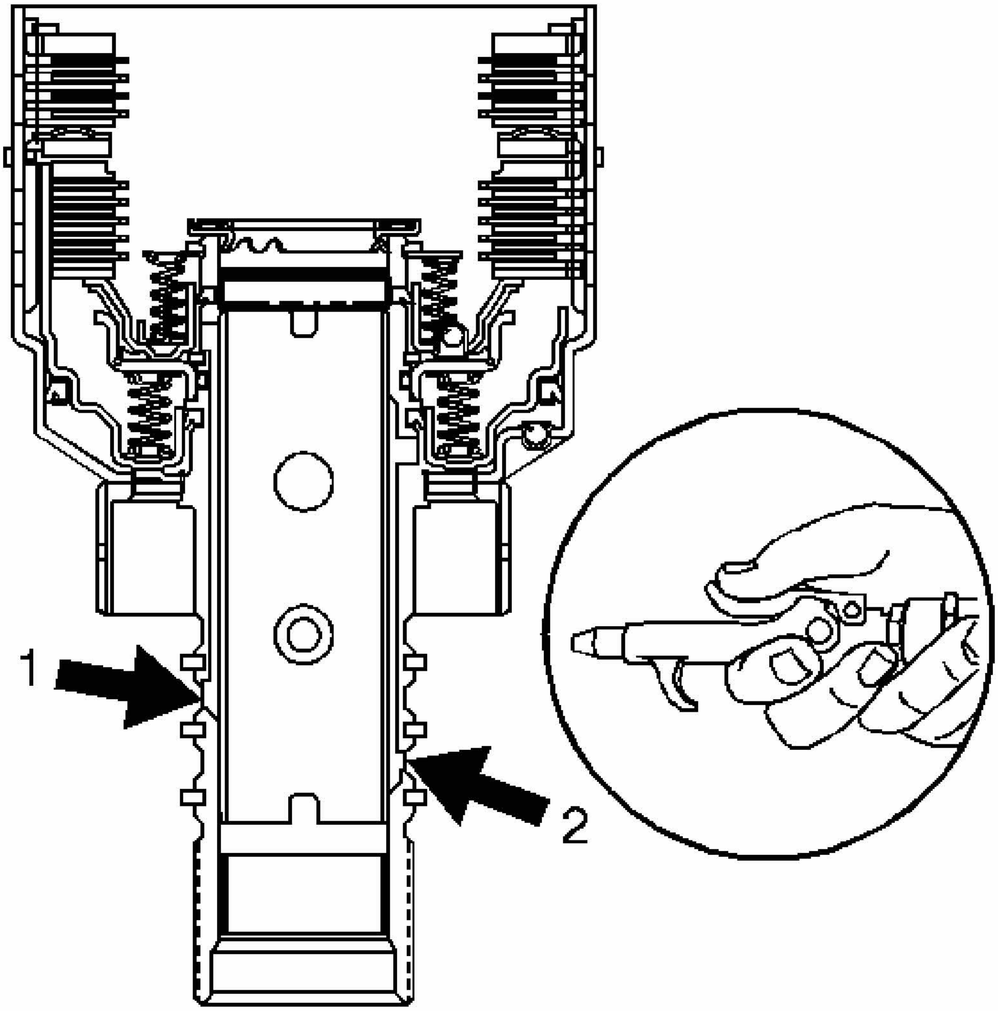


Fig. 185: Locating Fluid Passages
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not exceed the recommended amount of air pressure or it may damage or cause seals to roll.

1. Use a rubber tipped air nozzle in order to apply a maximum 138 kPa (20 psi) at each indicated fluid passage.
2. Listen for the following:
    - The third clutch (1) assembly to apply

- The input clutch (2) assembly to apply

INPUT CLUTCH HOUSING OIL SEAL RINGS ASSEMBLE

Tools Required

J 34741-A Input Seal Installer contains:. See **Special Tools**.

- **J 34741-1** Adjustable Seal Protector. See **Special Tools**.
- **J 34741-2** Seal Pusher. See **Special Tools**.
- **J 34741-3** Seal Sizer. See **Special Tools**.

Assembly Procedure

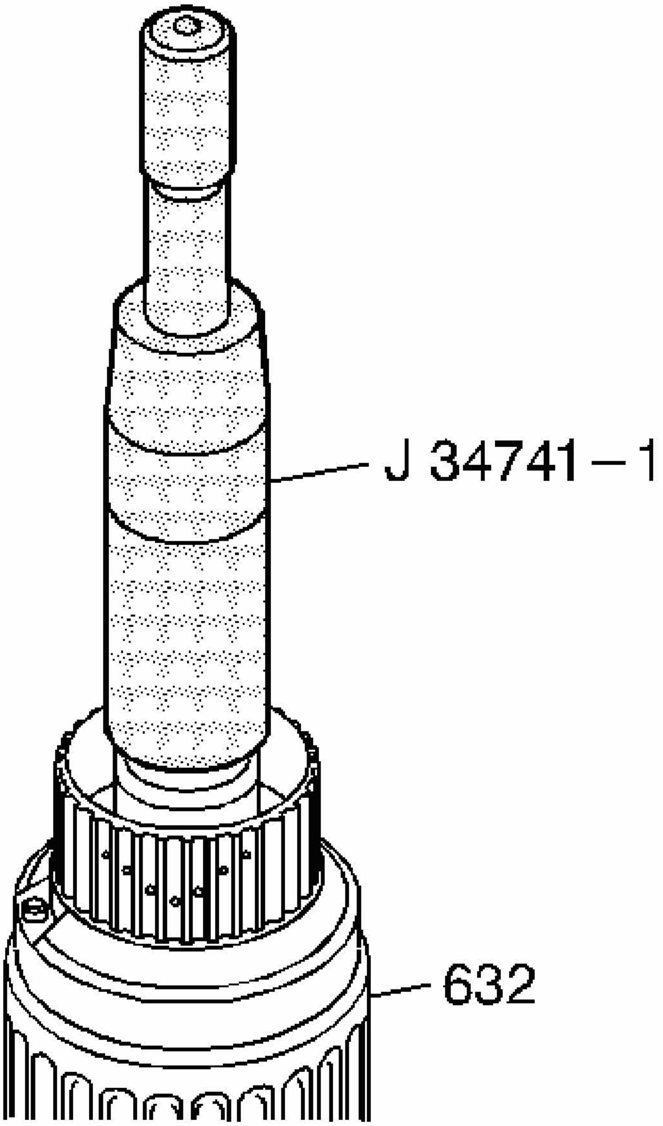


Fig. 186: Installing J 34741-1 Into The Input Clutch Housing
Courtesy of GENERAL MOTORS CORP.

1. Install **J 34741-1** into the input clutch housing (632). See **Special Tools**. Adjust **J 34741-1** so that the bottom of the seal installer aligns with the lowest seal ring groove. See **Special Tools**.
2. Use transmission fluid in order to lubricate the oil seal ring for the input clutch housing. Position the ring on the **J 34741-1** . See **Special Tools**.

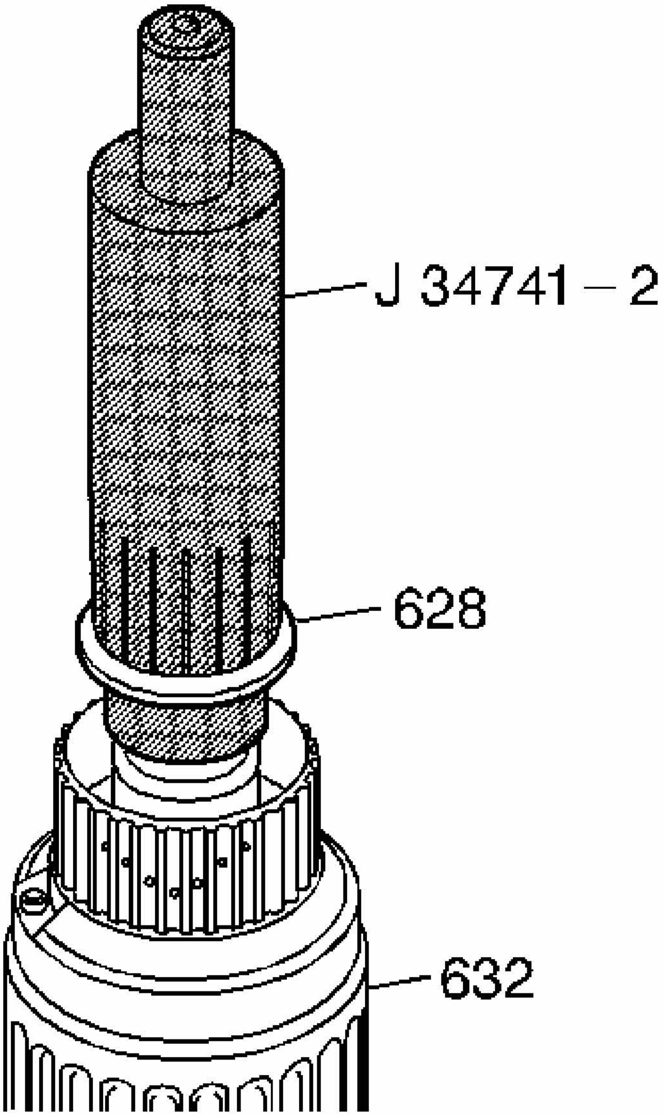


Fig. 187: Using J 34741-2 & J 34741-1 To Install Seal Rings
Courtesy of GENERAL MOTORS CORP.

3. Position **J 34741-2** onto the **J 34741-1** . See **Special Tools**. Push the seal (628) into the seal ring groove.

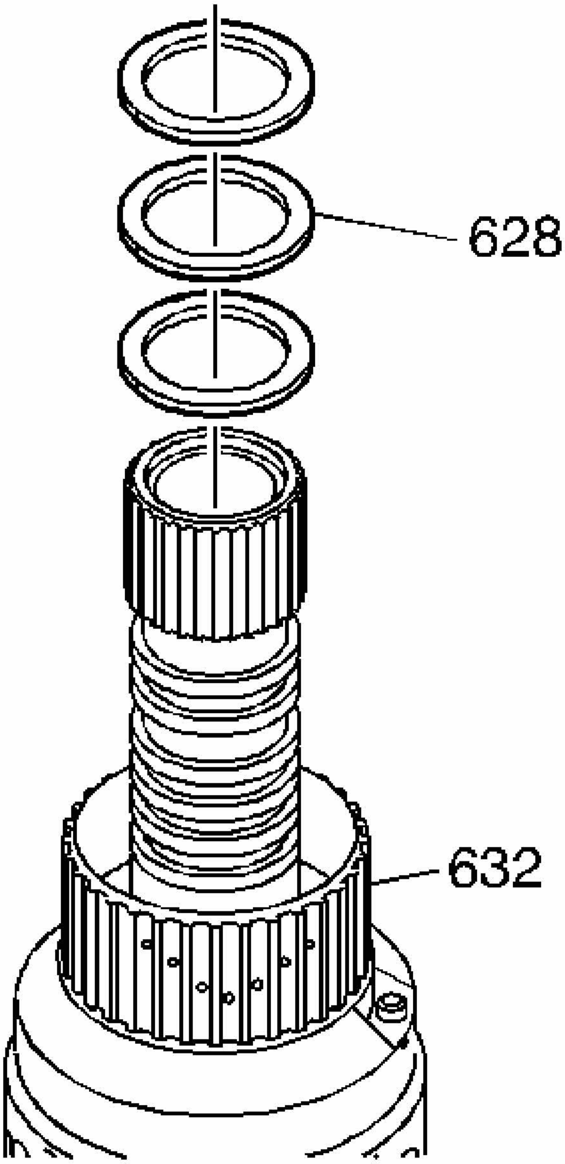


Fig. 188: Locating Second & Third Seal Rings
Courtesy of GENERAL MOTORS CORP.

4. Repeat this procedure for the second and the third seal rings (628).

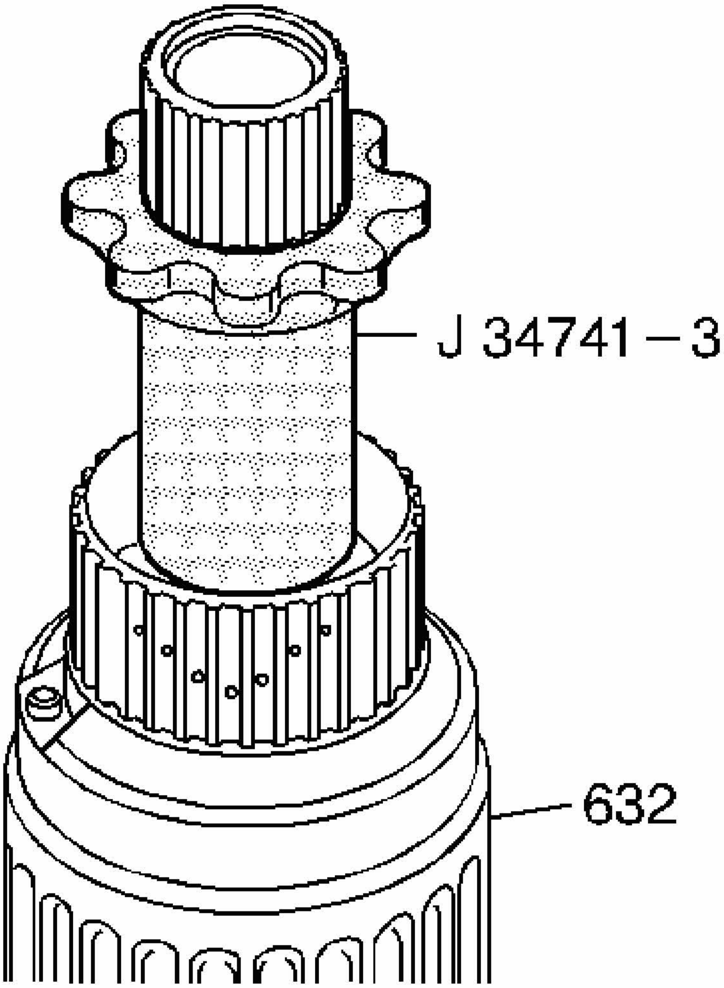


Fig. 189: Installing J 34741-3 Over The Seals
Courtesy of GENERAL MOTORS CORP.

5. Remove the input seal installer.
6. Use a twisting motion in order to assemble **J 34741-3** over the seals. See Special Tools.
7. Leave **J 34741-3** in place until the input clutch housing assembly (632) is assembled into the transmission. See Special Tools.

INPUT CLUTCH HOUSING, INPUT CLUTCH PAWL AND THIRD CLUTCH PAWL ASSEMBLE

Assembly Procedure

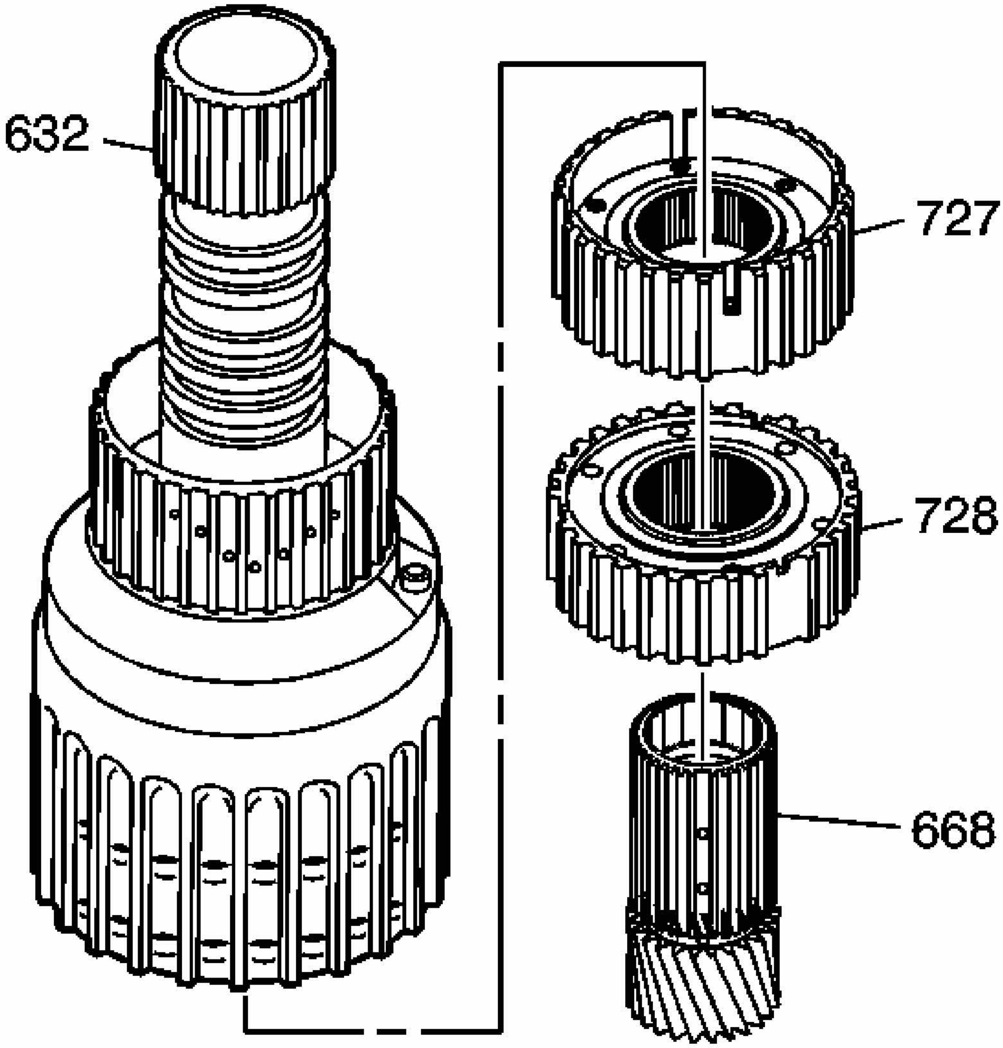


Fig. 190: View Of Sprag Clutch Assembly
Courtesy of GENERAL MOTORS CORP.

1. Use a small screwdriver in order to align the teeth of the input clutch plate assembly and the third clutch plate assembly. This will ease installation of the clutch pawl assembly.

IMPORTANT: Make sure that the clutch pawl assembly is fully seated into the housing.

2. Insert the combined input clutch pawl (728), third clutch pawl (727) and input sun gear (668) assembly into the input clutch housing assembly (632).

INPUT CLUTCH HOUSING END PLAY CHECK (FWD ONLY)

Tools Required

- **J 26958** Output Shaft Loading and Aligning Tool. See **Special Tools**.
- **J 26958-10B** Adapter Plug. See **Special Tools**.
- **J 33381-A** Final Drive Remover and Installer. See **Special Tools**.
- **J 33386-A** Input Shaft End Play Tool. See **Special Tools**.
- **J 38385** Output Shaft Loading Tool Adapter. See **Special Tools**.
- **J 43425** Output Shaft Loading Tool Adapter. See **Special Tools**.

Checking Procedure

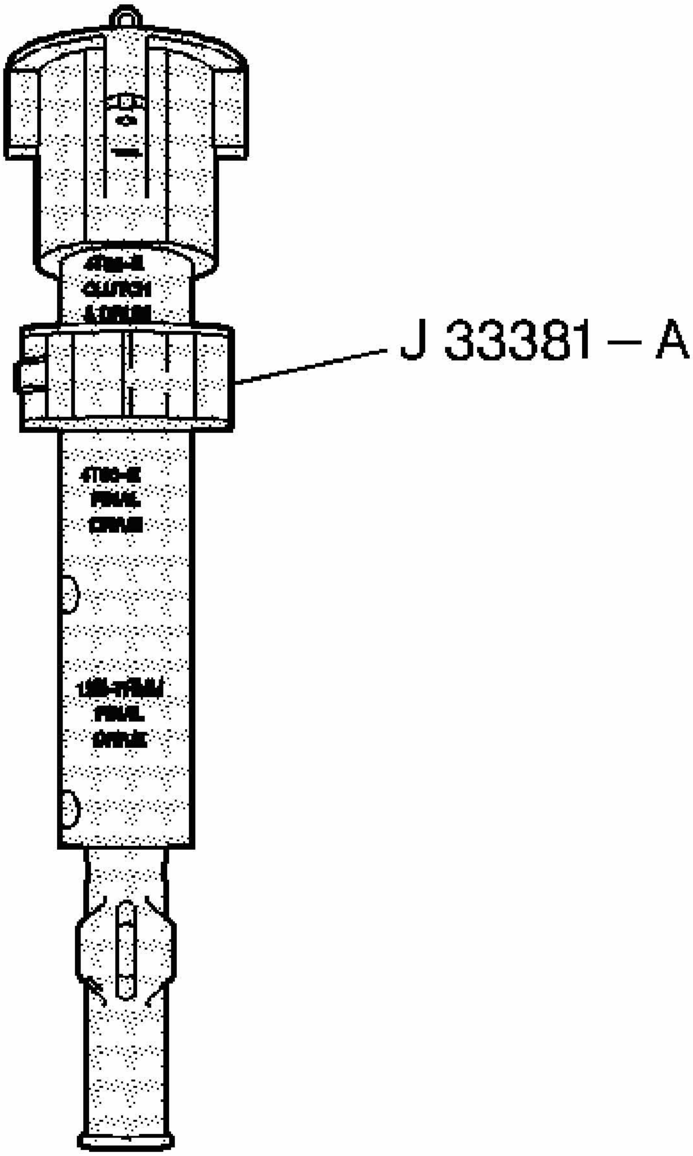


Fig. 191: View Of J 33381-A
Courtesy of GENERAL MOTORS CORP.

1. Adjust the collar on tool **J 33381-A** to the 4T65-E CLUTCH & DRUM setting. See **Special Tools**.

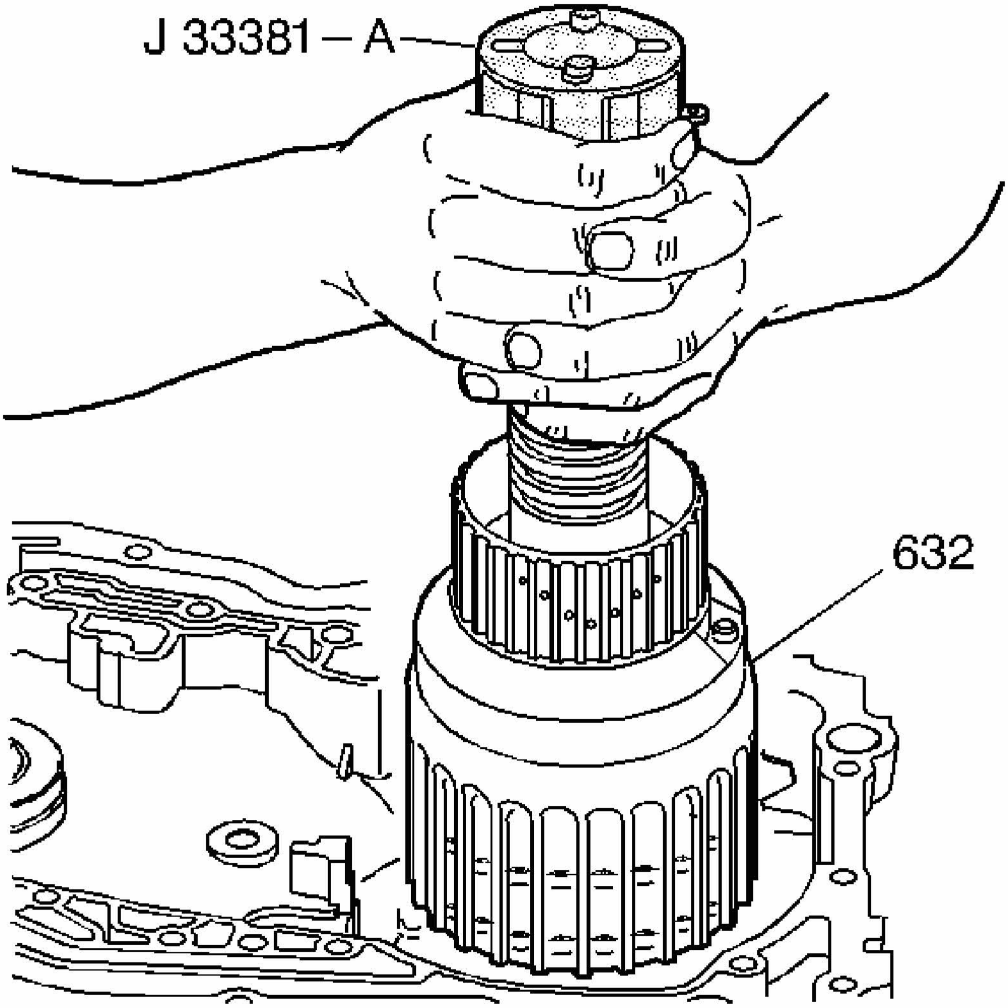


Fig. 192: Installing J 33381-A Into Input Clutch Housing
Courtesy of GENERAL MOTORS CORP.

2. Install **J 33381-A** into the input clutch housing assembly (632). See **Special Tools**.
3. Tighten the threaded rod of **J 33381-A** until the rod is finger tight. See **Special Tools**.
4. Use **J 33381-A** in order to lift the input clutch housing assembly (632). See **Special Tools**. The sprag clutch assemblies will also be attached.
5. Install the assembly (632) into the case. Be sure that the assembly is down all the way.
6. Remove **J 33381-A** from the assembly. See **Special Tools**.

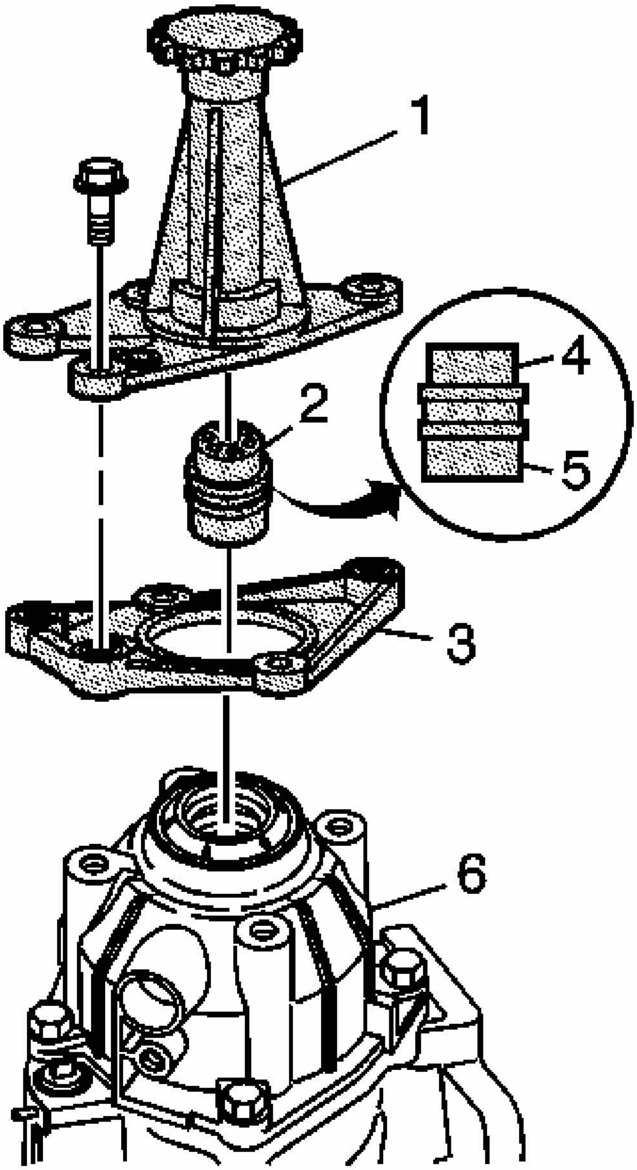


Fig. 193: View Of J 26958, J 26958-10B & J 38385 Or J 43425
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The tool J 38385 (3) is used on a standard duty transmission and J 43425 (3) is used on a heavy duty transmission. See Special Tools.

7. Install **J 38385** (3) for a standard duty transmission or **J 43425** (3) for a heavy duty

transmission. See **Special Tools**.

IMPORTANT: The tool J 26958-10B (2) is model specific and can be used on a standard duty and a heavy duty transmission. See Special Tools. This tool has a small end (4) and a larger end (5). Standard duty would use the smaller end (4) facing down and a heavy duty would use the larger end (5) facing down.

8. Install **J 26958-10B** (2) depending on model. See **Special Tools**. Standard duty uses this tool with the smaller end (4) facing down. Heavy duty uses this tool with the larger end (5) facing down.

IMPORTANT: Install bolts and tighten securely to prevent tool deflection during end play measurement.

9. Install **J 26958** (1) onto the case extension (6). See **Special Tools**.

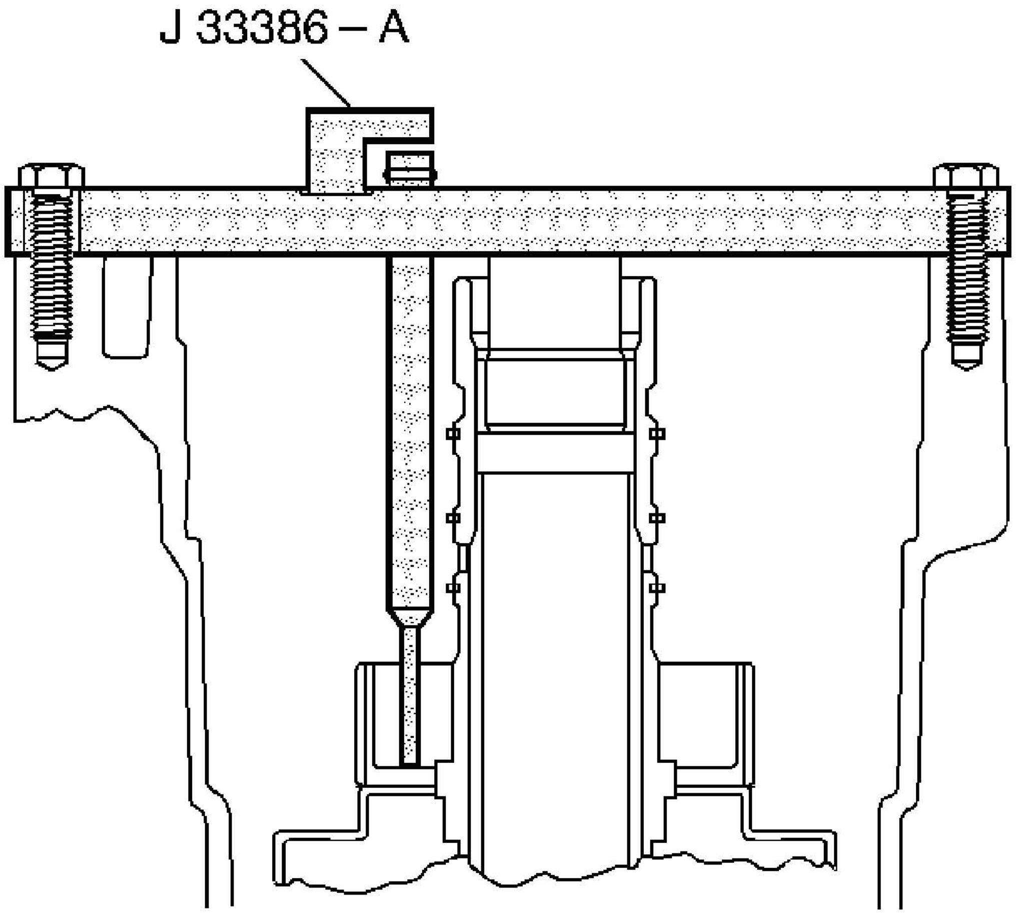


Fig. 194: View Of J 33386-A Installed Onto Transmission Case
Courtesy of GENERAL MOTORS CORP.

10. Using two bolts, install **J 33386-A** onto the case. See **Special Tools**.
11. Tighten the bolts in order to securely hold **J 33386-A** . See **Special Tools**.
12. Tighten **J 26958** finger tight in order to eliminate differential carrier end play. See **Special Tools**.

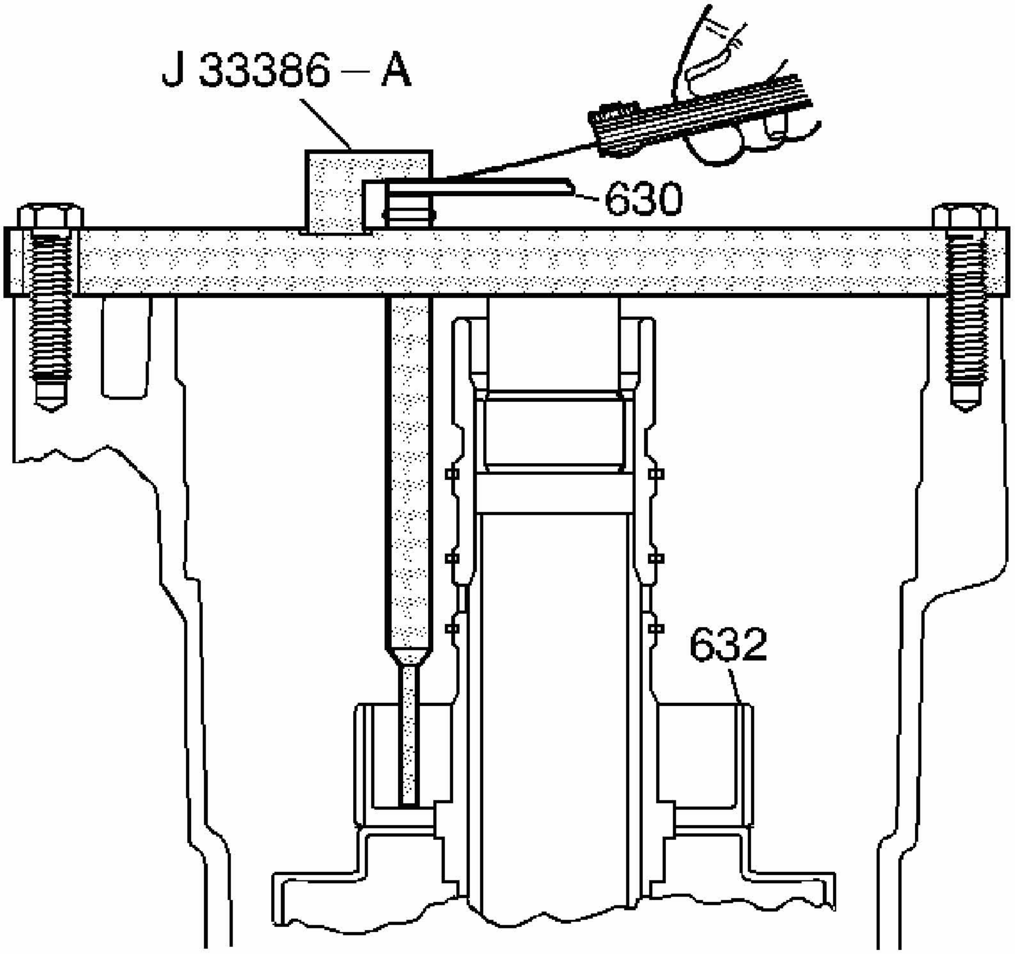


Fig. 195: Measuring Clearance Between J 33386-A & Thrust Washer
Courtesy of GENERAL MOTORS CORP.

13. Insert the thrust washer (630) from the input clutch housing into **J 33386-A** as indicated. See **Special Tools**. If the thrush washer will not fit into **J 33386-A** , select the next size smaller thrust washer and recheck. See **Special Tools**.
14. Use a feeler gauge in order to measure the clearance between **J 33386-A** and the thrust washer (630). See **Special Tools**.
    - If the clearance is less than 0.0521 mm (0.006 in), use the current size thrust washer.
    - If the clearance is 0.0521 mm (0.006 in) or more, select the next size larger thrust washer and recheck.

    Refer to the Bearing/Input Clutch Hub Selective Thrust Washer (630) Selection

Guide in **End Play Specifications** .

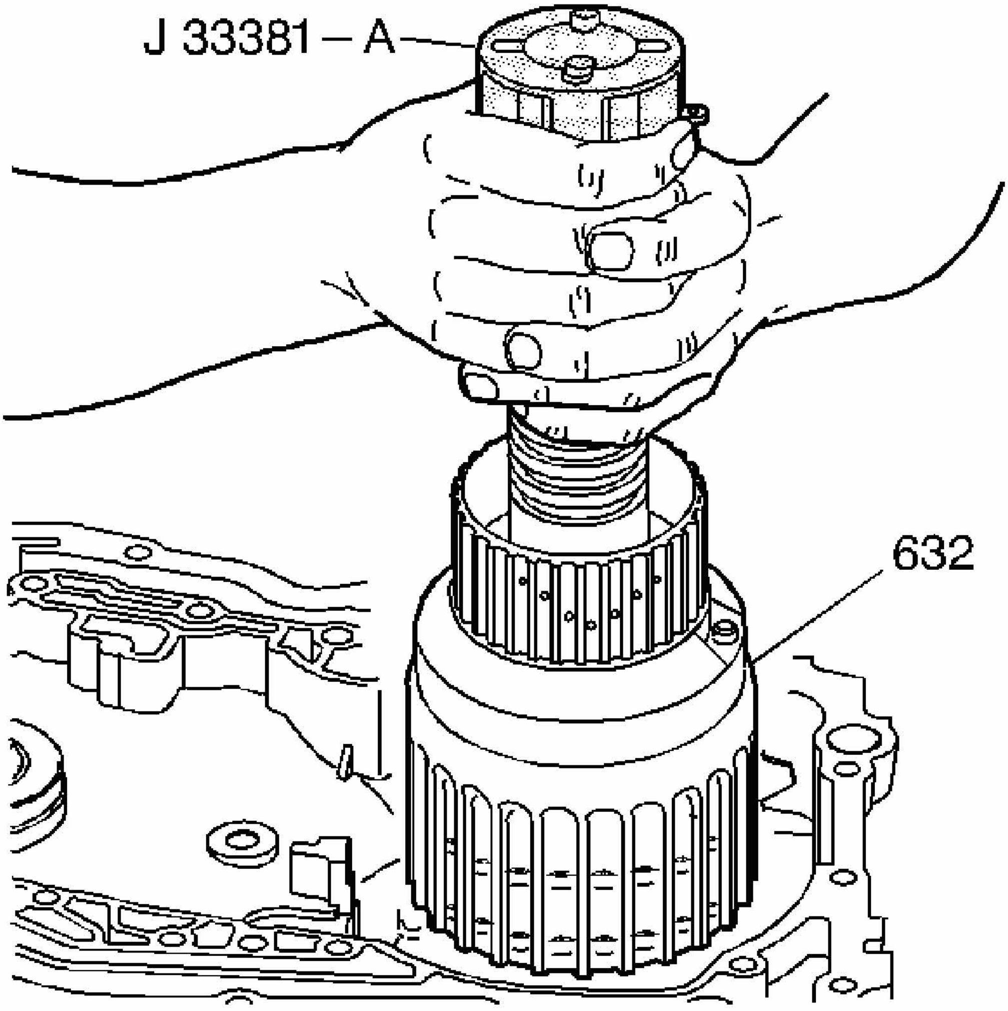


Fig. 196: Installing J 33381-A Into Input Clutch Housing
Courtesy of GENERAL MOTORS CORP.

15. Remove **J 33386-A** . See **Special Tools**.
16. Adjust the collar on tool **J 33381-A** to the 4T65-E CLUTCH & DRUM setting. See **Special Tools**. Make sure that the threaded rod is fully loosened.
17. Install **J 33381-A** into the input clutch housing (632). See **Special Tools**.
18. Tighten the threaded rod of **J 33381-A** until the rod is finger tight. See **Special Tools**.
19. Use **J 33381-A** in order to lift the input clutch housing assembly (632). See **Special Tools**. The sprag clutch assemblies will also be attached.

20. Remove the assembly (632) from the case.

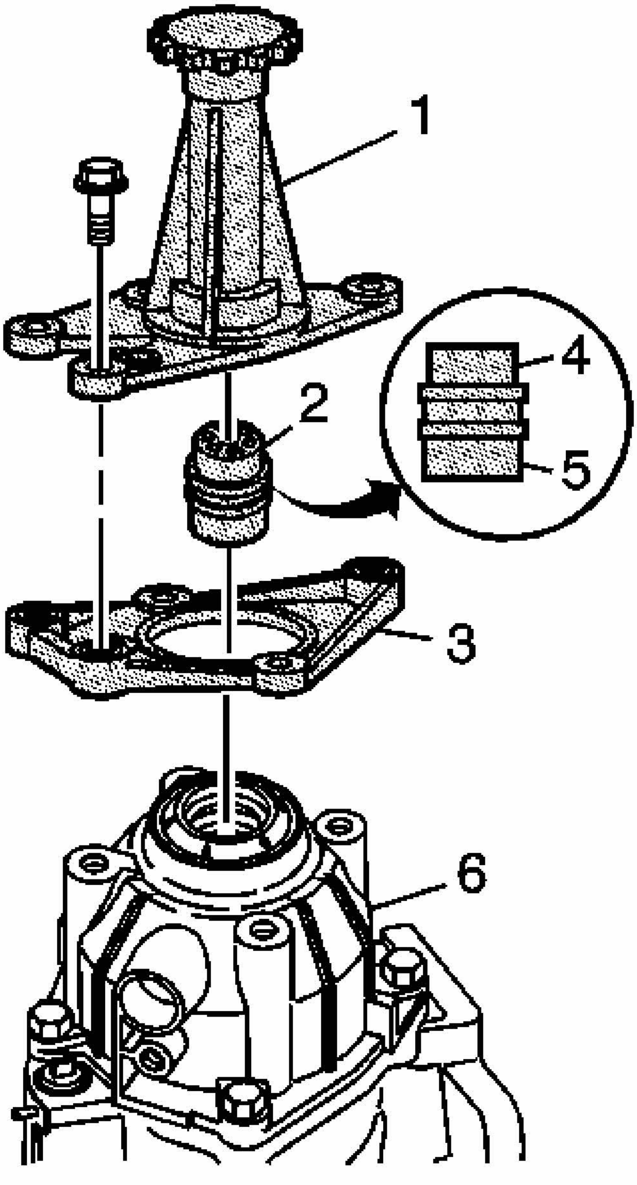


Fig. 197: View Of J 26958, J 26958-10B & J 38385 Or J 43425
Courtesy of GENERAL MOTORS CORP.

21. Position the transmission so that the oil pan is facing down.
22. Remove **J 26958** (1), **J 26958-10B** (2) and **J 38385** (3) or **J 43425** (3). See **Special Tools**.

INPUT CLUTCH HOUSING END PLAY CHECK (FWD ONLY)

Tools Required

- **J 33381-A** Final Drive Remover and Installer. See **Special Tools**.
- **J 33386-A** Input Shaft End Play Tool. See **Special Tools**.
- **J 36850** Assembly Lubricant
- **J 44472** End Play Checking Tool. See **Special Tools**.

Checking Procedure

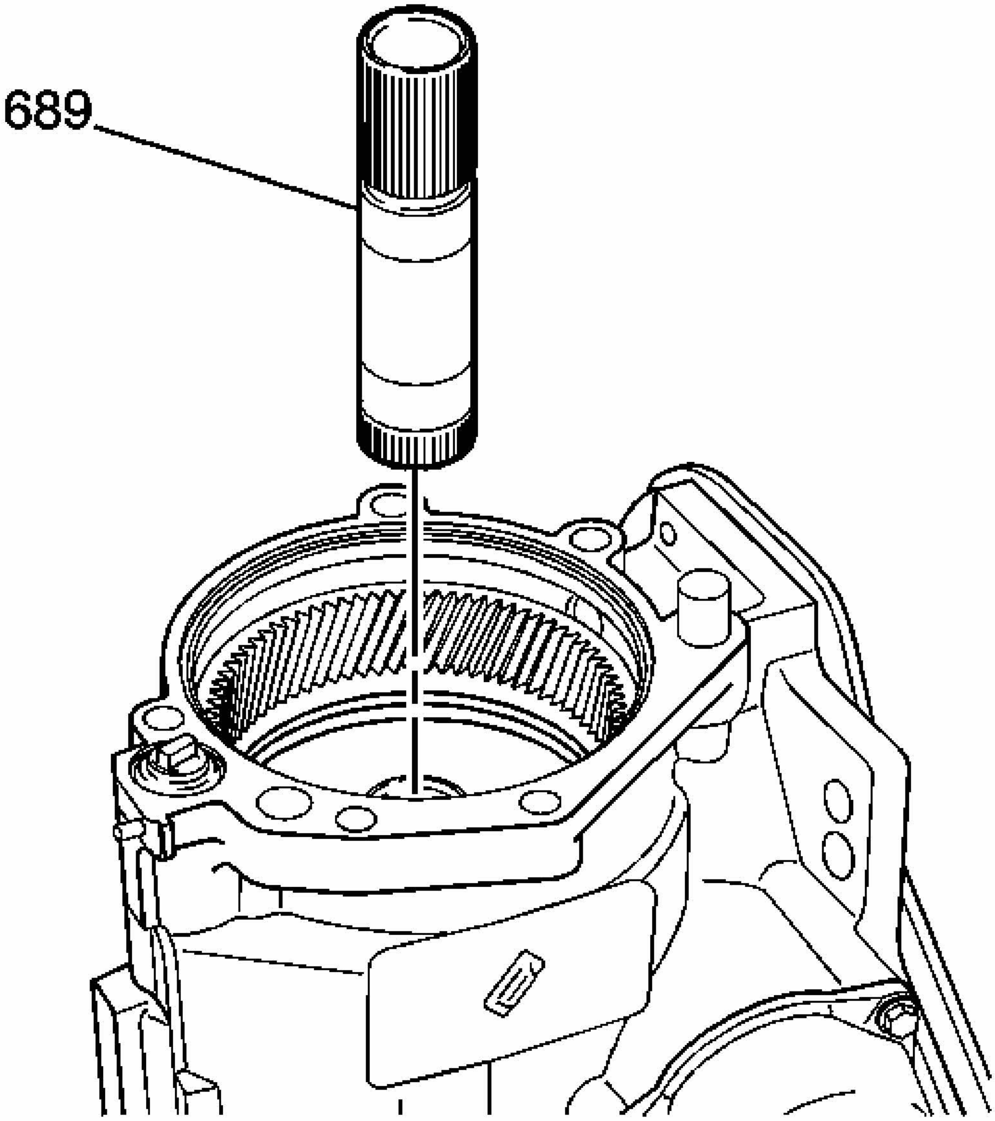


Fig. 198: Identifying Final Drive Sun Gear Shaft
Courtesy of GENERAL MOTORS CORP.

1. Install the final drive sun gear shaft (689).

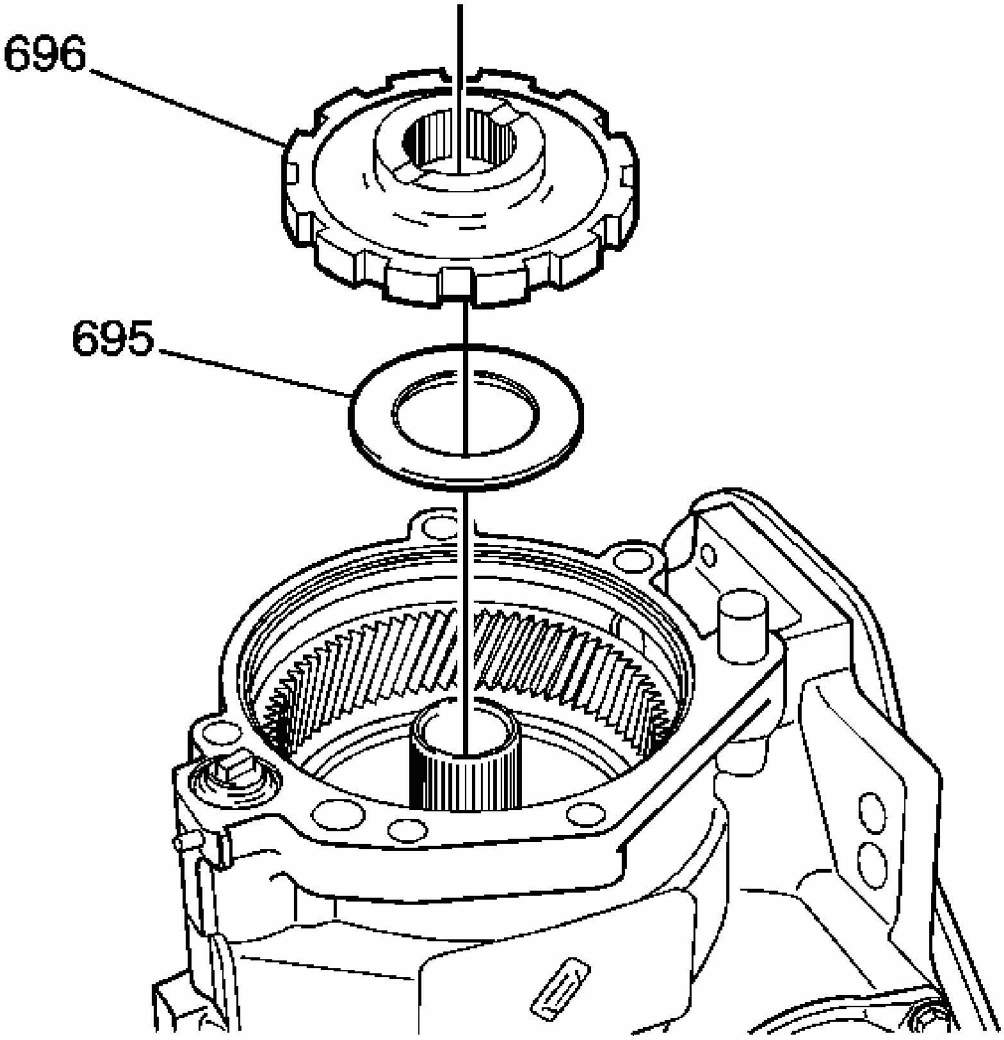


Fig. 199: View Of Park Gear Thrust Bearing & Park Gear
Courtesy of GENERAL MOTORS CORP.

2. Use **J 36850** or equivalent in order to retain the parking gear thrust bearing (695) to the parking gear (696).
3. Install the parking gear thrust bearing (695) and the parking gear (696).

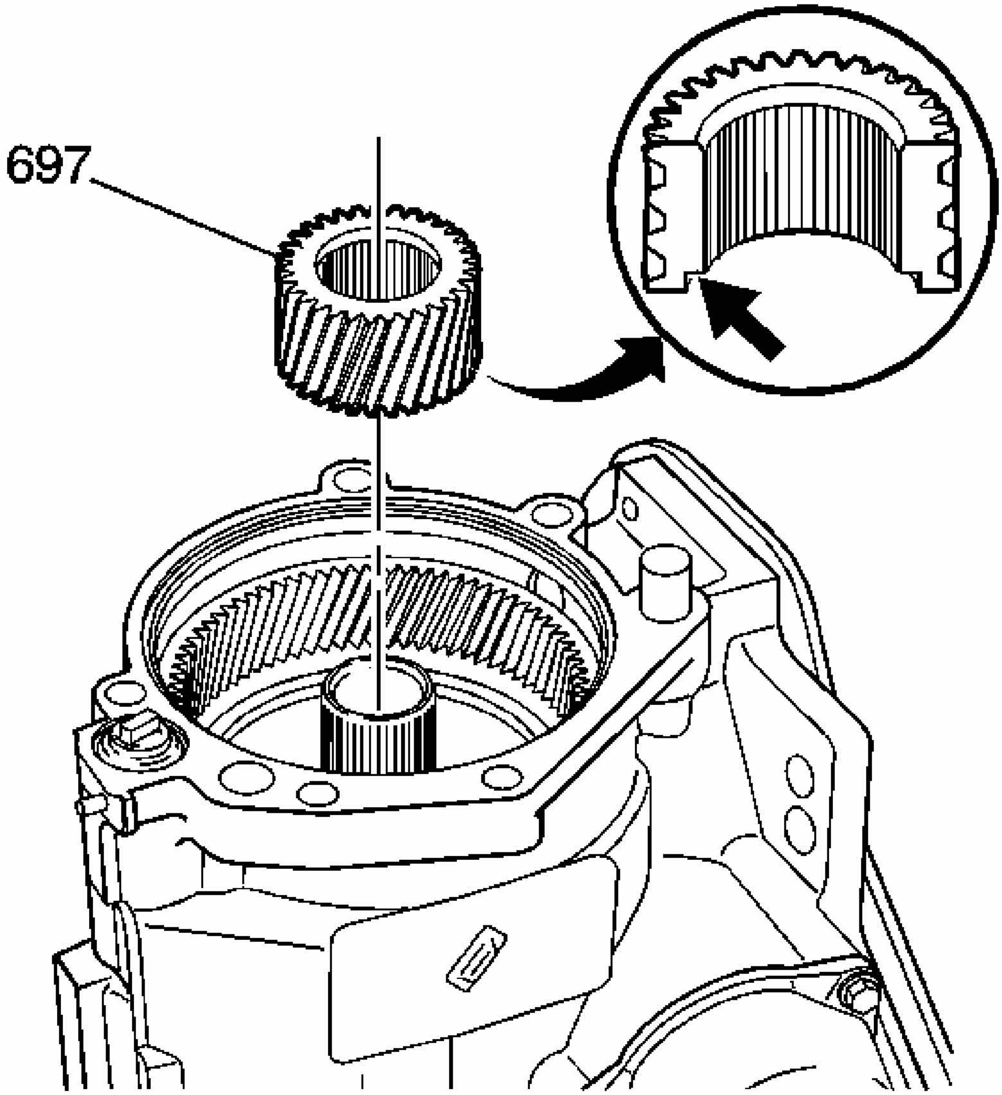


Fig. 200: Identifying Final Drive Sun Gear
Courtesy of GENERAL MOTORS CORP.

4. Install the final drive sun gear (697).

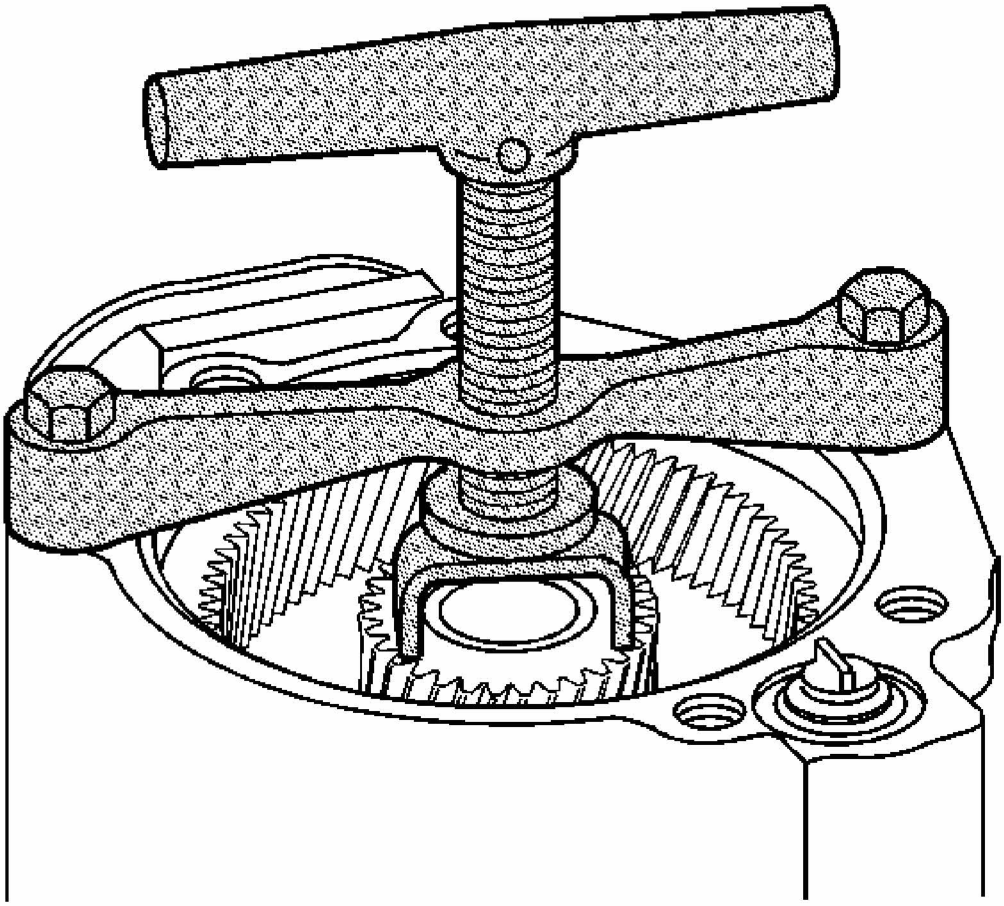


Fig. 201: J 44472 Installed Onto Transmission Case
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Install bolts and tighten securely to prevent tool deflection during end play measurement.

5. Install **J 44472** . See Special Tools.

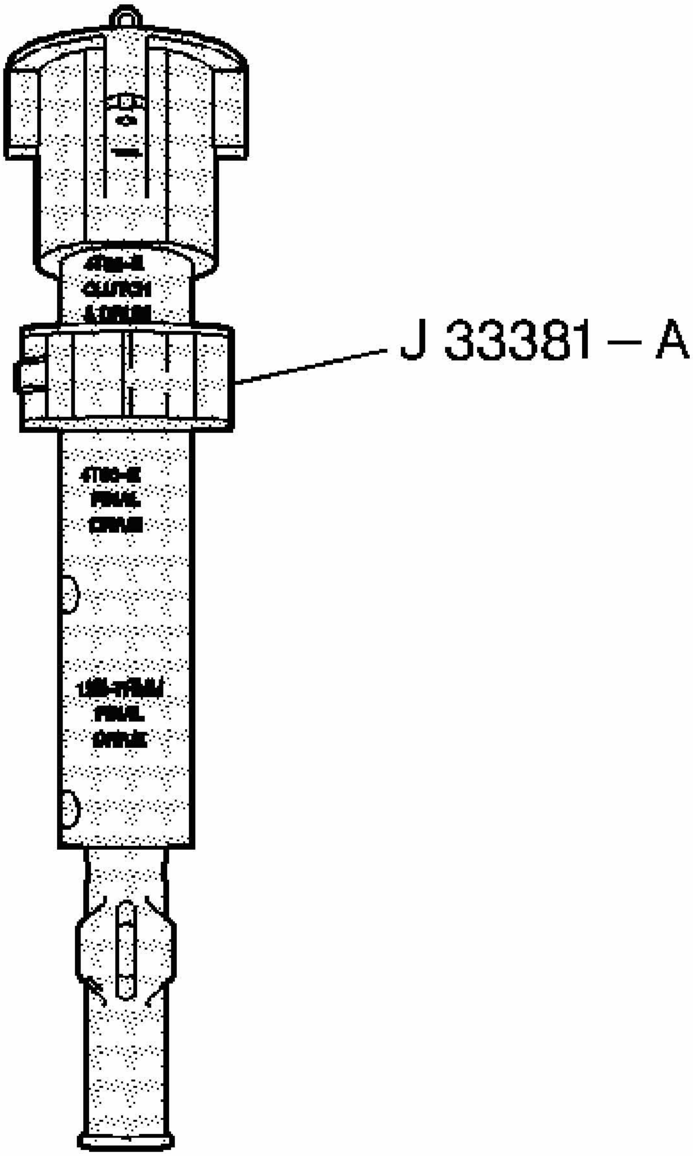


Fig. 202: View Of J 33381-A
Courtesy of GENERAL MOTORS CORP.

6. Adjust the collar on tool **J 33381-A** to the 4T65-E CLUTCH & DRUM setting. See **Special Tools**.

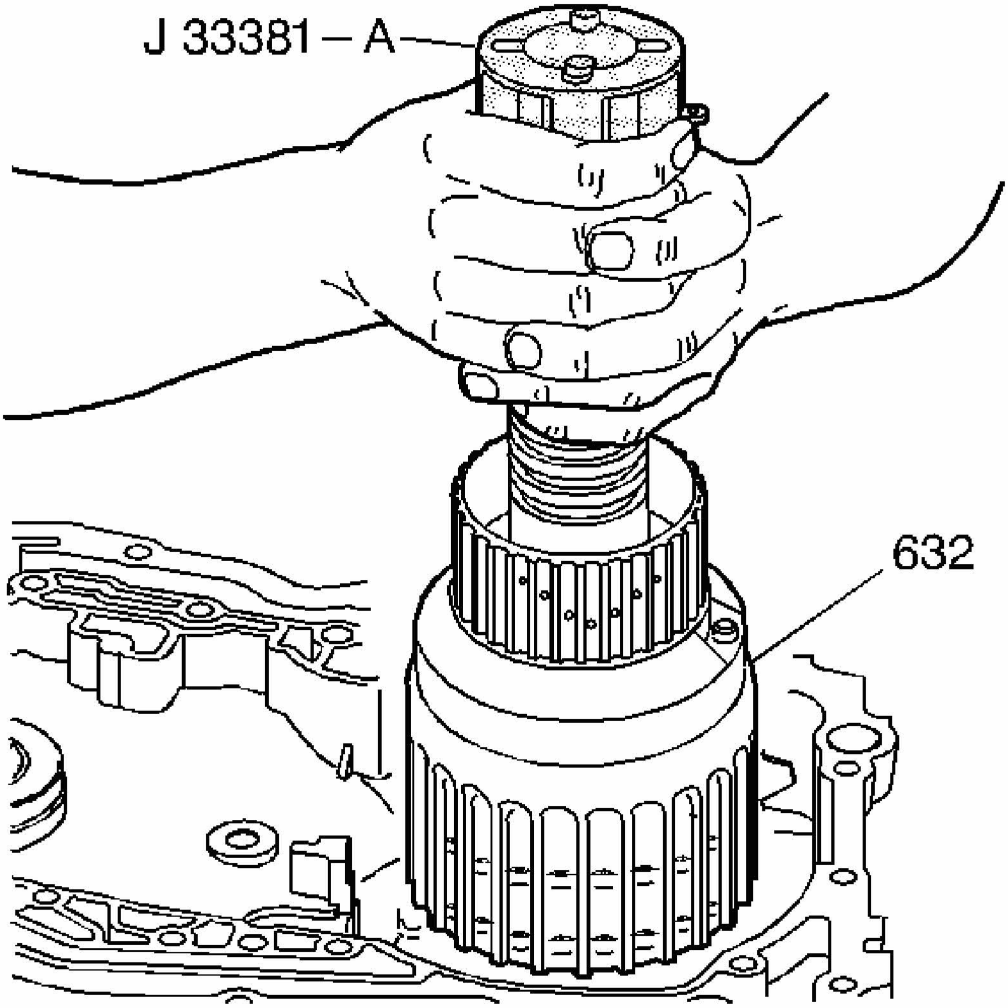


Fig. 203: Installing J 33381-A Into Input Clutch Housing
Courtesy of GENERAL MOTORS CORP.

7. Install **J 33381-A** into the input clutch housing assembly (632). See **Special Tools**.
8. Tighten the threaded rod of **J 33381-A** until the rod is finger tight. See **Special Tools**.
9. Use **J 33381-A** in order to lift the input clutch housing assembly (632). See **Special Tools**. The sprag clutch assemblies will also be attached.
10. Install the assembly (632) into the case. Be sure that the assembly is down all the way.
11. Remove **J 33381-A** from the assembly. See **Special Tools**.

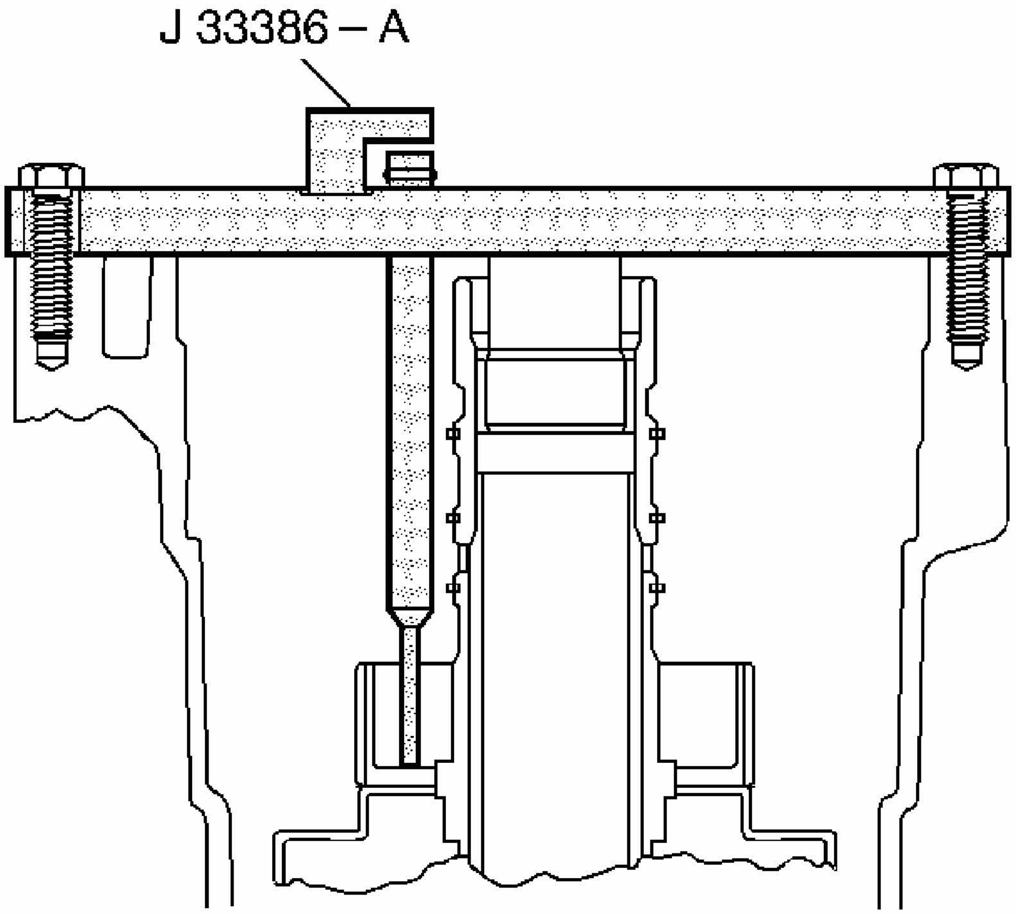


Fig. 204: View Of J 33386-A Installed Onto Transmission Case
Courtesy of GENERAL MOTORS CORP.

12. Using two bolts, install **J 33386-A** onto the case. See **Special Tools**.
13. Tighten the bolts in order to securely hold **J 33386-A** . See **Special Tools**.
14. Tighten **J 44472** finger tight in order to eliminate differential carrier end play. See **Special Tools**.

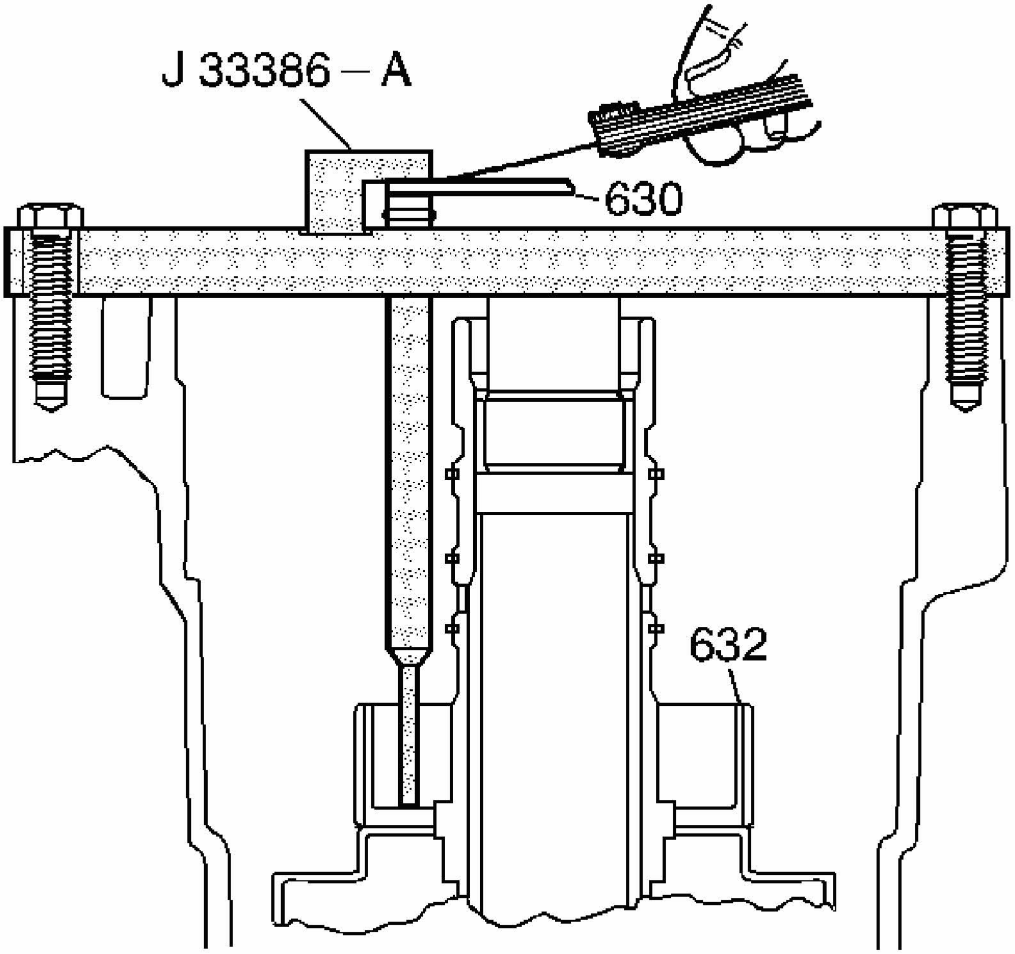


Fig. 205: Measuring Clearance Between J 33386-A & Thrust Washer
Courtesy of GENERAL MOTORS CORP.

15. Insert the thrust washer (630) from the input clutch housing into **J 33386-A** as indicated. See **Special Tools**. If the thrush washer will not fit into **J 33386-A** , select the next size smaller thrust washer and recheck. See **Special Tools**.
16. Use a feeler gauge in order to measure the clearance between **J 33386-A** and the thrust washer (630). See **Special Tools**.
    - If the clearance is less than 0.0521 mm (0.006 in), use the current size thrust washer.
    - If the clearance is 0.0521 mm (0.006 in) or more, select the next size larger thrust washer and recheck.

    Refer to the Bearing/Input Clutch Hub Selective Thrust Washer (630) Selection

Guide in **End Play Specifications** .

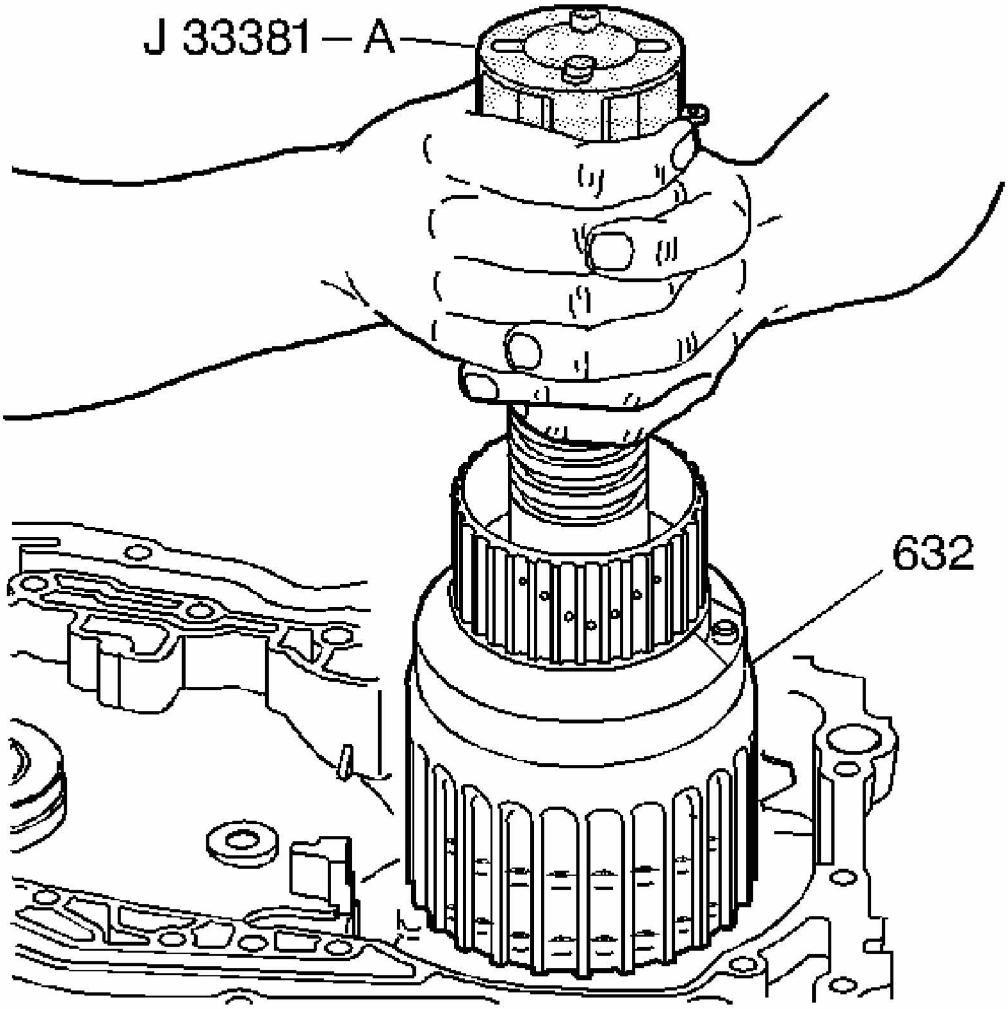


Fig. 206: Installing J 33381-A Into Input Clutch Housing
Courtesy of GENERAL MOTORS CORP.

17. Remove **J 33386-A** . See **Special Tools**.
18. Adjust the collar on tool **J 33381-A** to the 4T65-E CLUTCH & DRUM setting. See **Special Tools**. Make sure that the threaded rod is fully loosened.
19. Install **J 33381-A** into the input clutch housing (632). See **Special Tools**.
20. Tighten the threaded rod of **J 33381-A** until the rod is finger tight. See **Special Tools**.
21. Use **J 33381-A** in order to lift the input clutch housing assembly (632). See **Special Tools**. The sprag clutch assemblies will also be attached.

22. Remove the assembly (632) from the case.

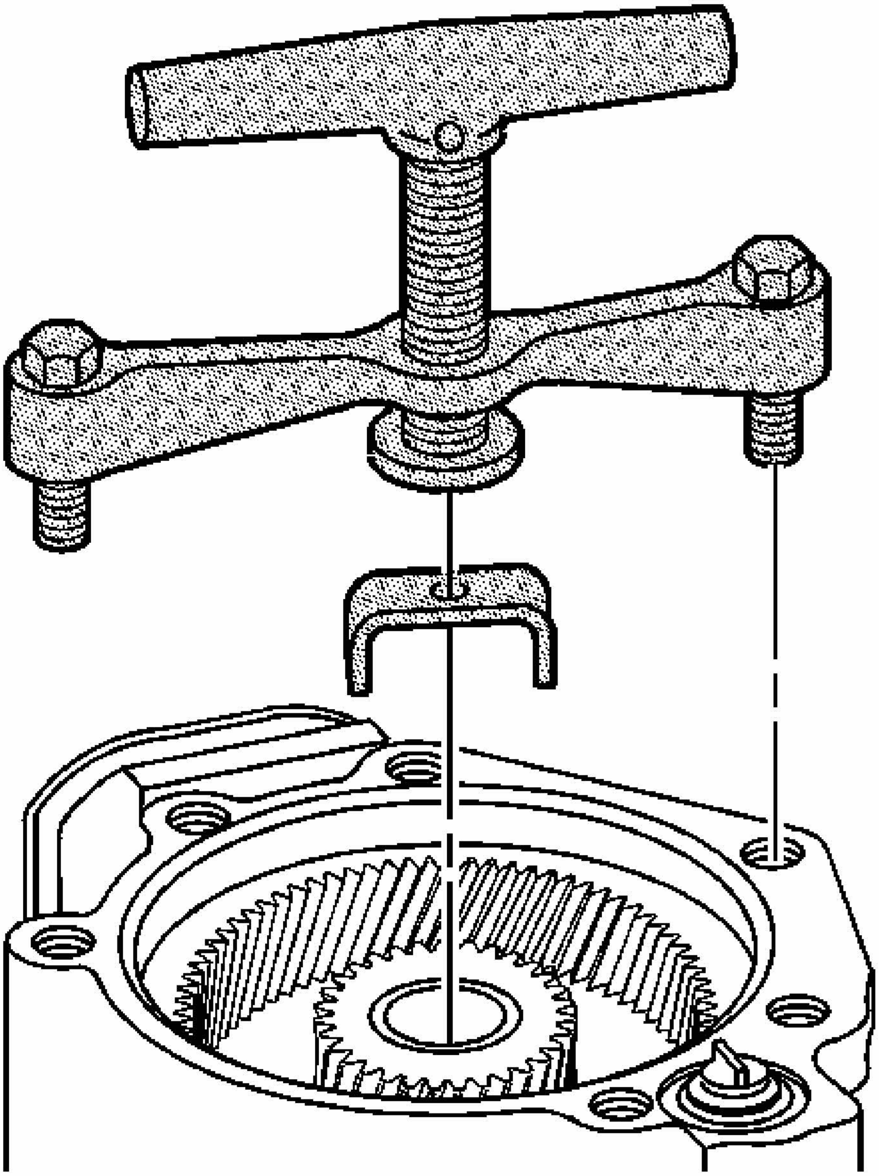


Fig. 207: View Of J 44472
Courtesy of GENERAL MOTORS CORP.

23. Position the transmission so that the oil pan is facing down.
24. Remove **J 44472** . See **Special Tools**.

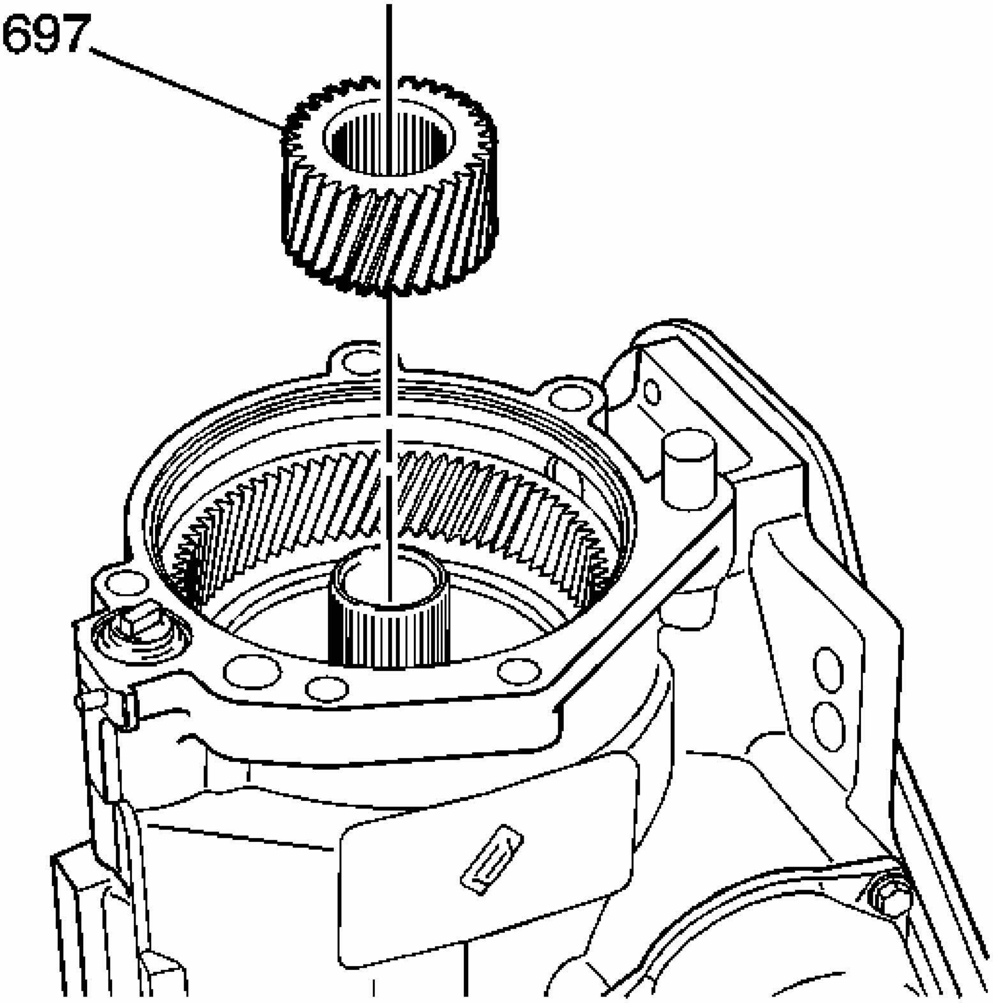


Fig. 208: Locating Final Drive Sun Gear
Courtesy of GENERAL MOTORS CORP.

25. Remove the final drive sun gear (697).

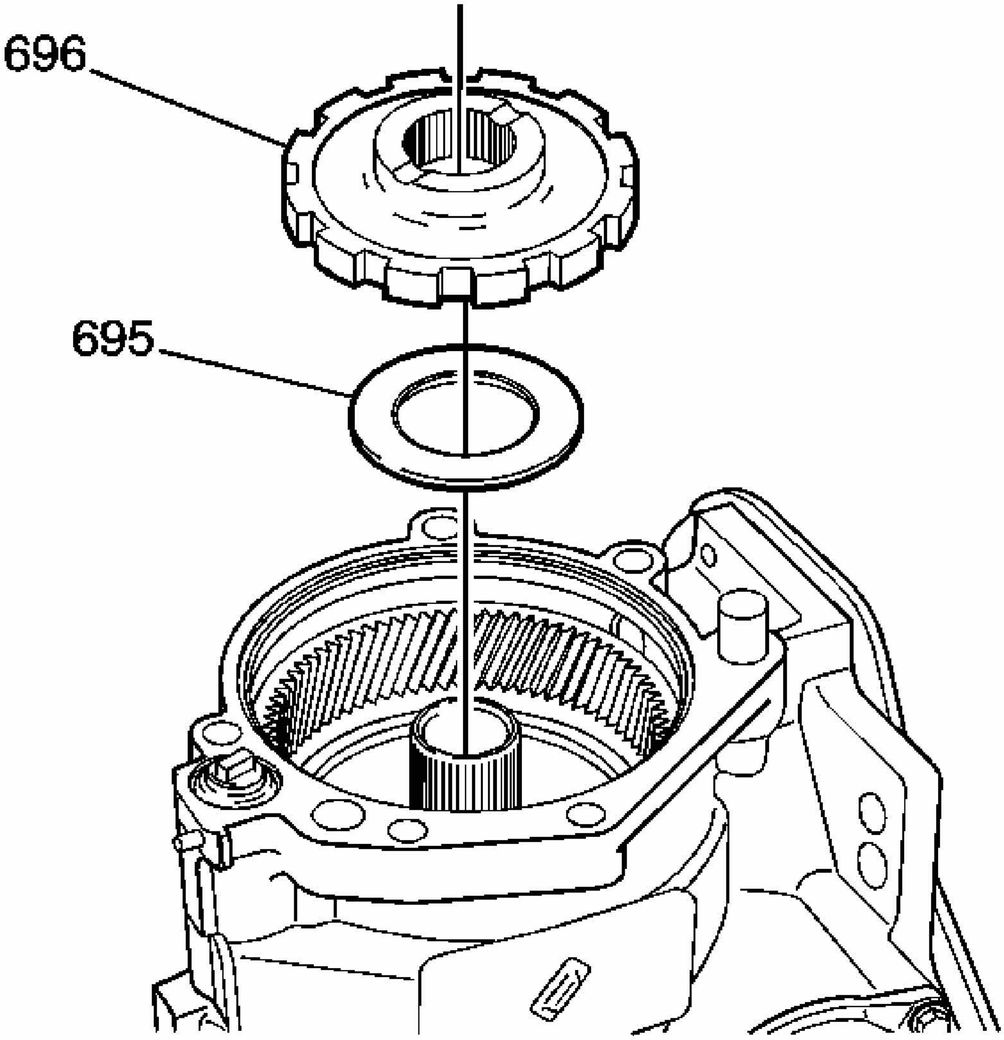


Fig. 209: View Of Park Gear Thrust Bearing & Park Gear
Courtesy of GENERAL MOTORS CORP.

26. Remove the parking gear (696) and the parking gear thrust bearing (695).

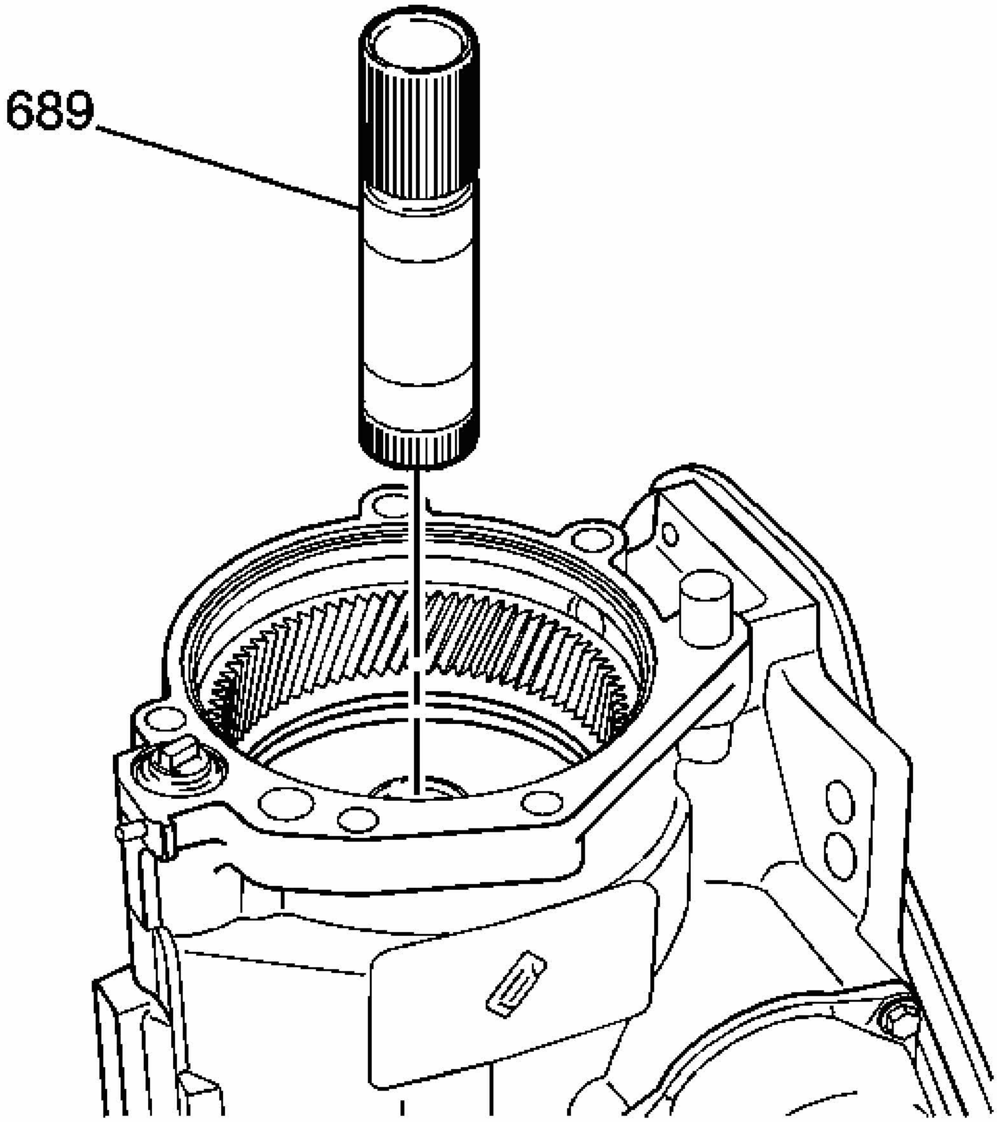


Fig. 210: Identifying Final Drive Sun Gear Shaft
Courtesy of GENERAL MOTORS CORP.

27. Remove the final drive sun gear shaft (689).

SECOND CLUTCH DISASSEMBLE

Tools Required:

- **J 23327** Clutch Spring Compressor

- **J 38734** Spring Compressor Adapter

Disassembly Procedure

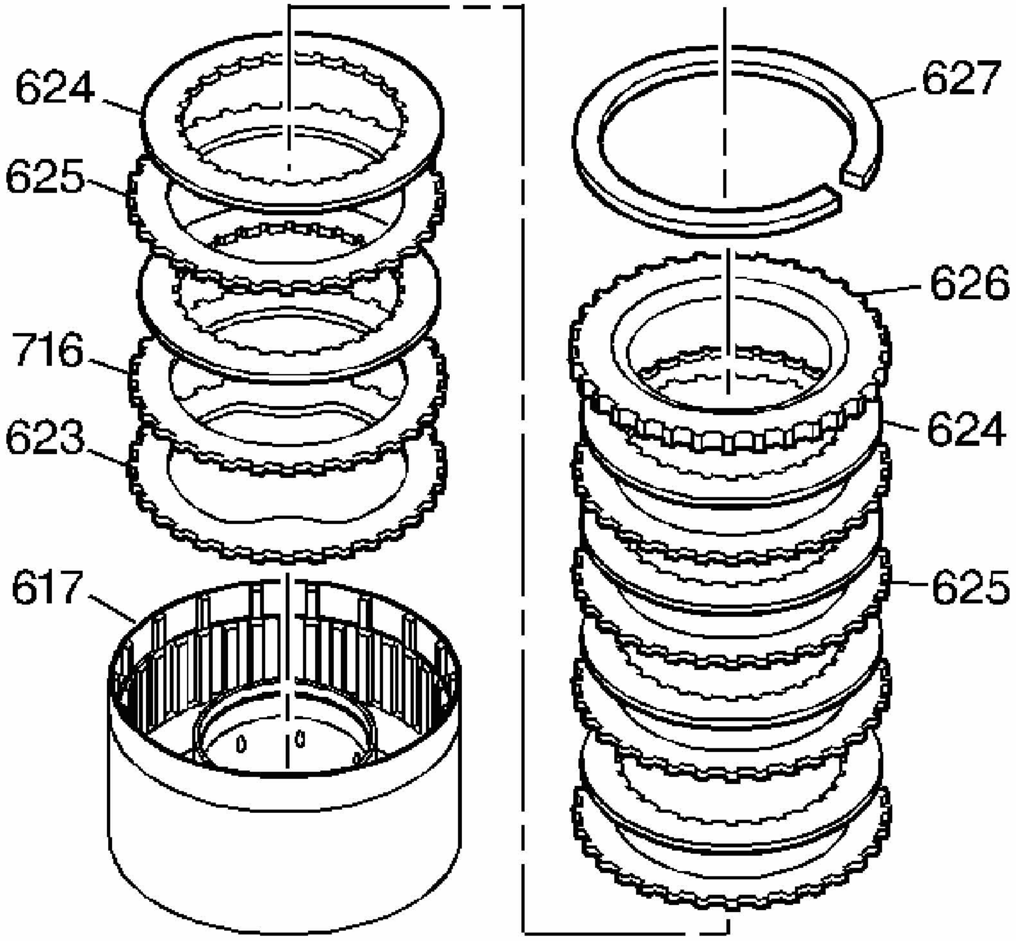


Fig. 211: View Of Second Clutch Plate Assembly
Courtesy of GENERAL MOTORS CORP.

1. Use a flat blade screwdriver in order to remove the retaining ring (627) from the second clutch housing.
2. Remove the second clutch backing plate (626). Remove the alternating second clutch fiber plates (624). Remove the second clutch steel plates (625).
3. Remove the second clutch apply plate (716). Remove the second clutch waved plate (623).

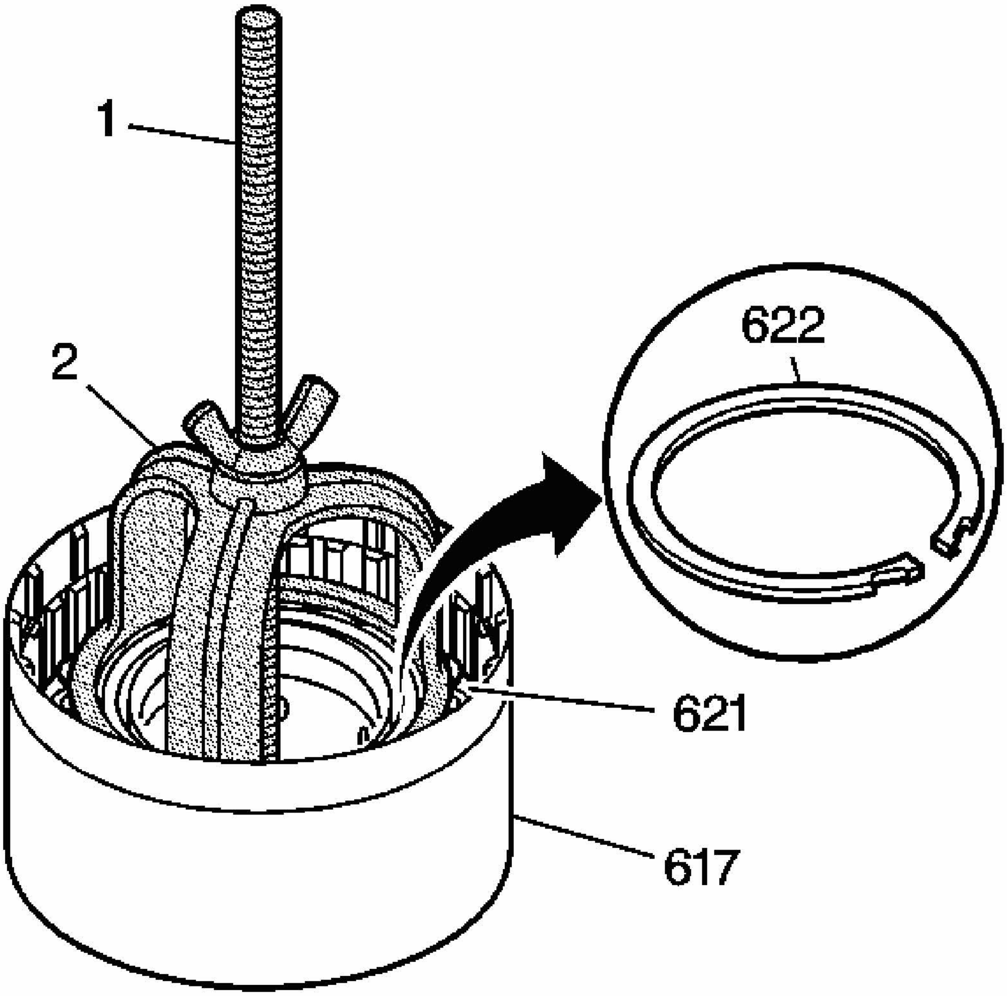


Fig. 212: Using J 23327 & J 38734 To Compress The Second Clutch Piston Spring
Courtesy of GENERAL MOTORS CORP.

4. Use **J 23327** (1) and **J 38734** (2) in order to compress the second clutch piston spring (621).
5. Remove the retaining ring (622).
6. Remove **J 23327** and **J 38734** from the second clutch housing (617).

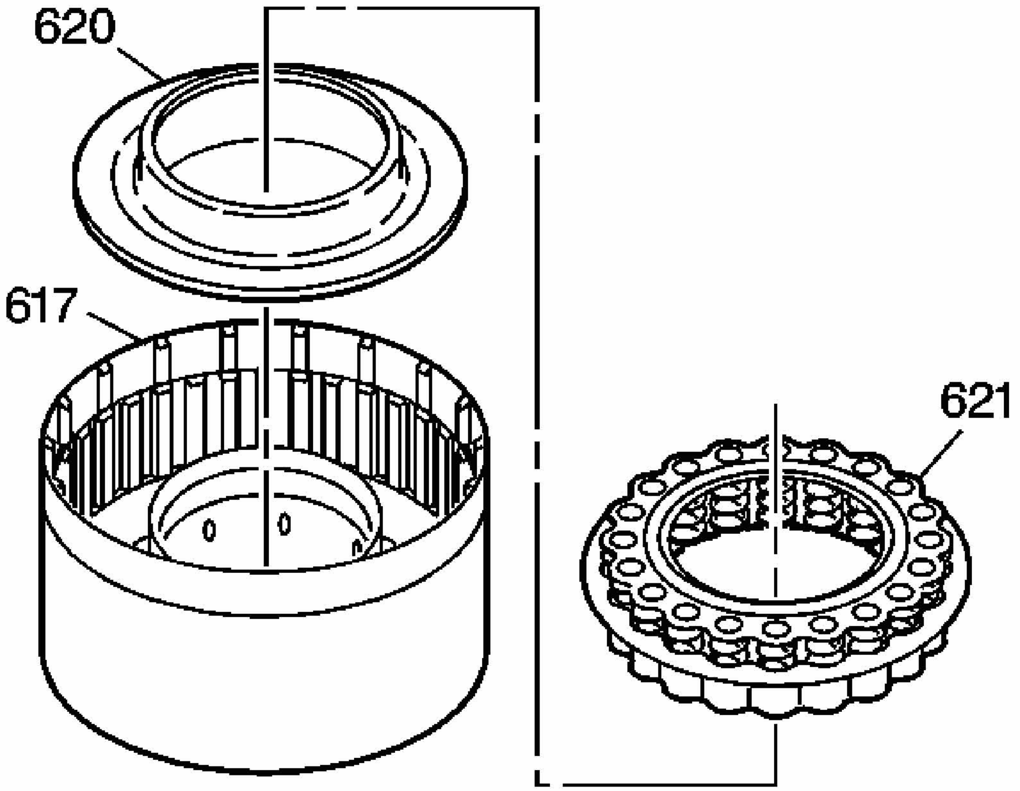


Fig. 213: Identifying Second Clutch Spring Assembly
Courtesy of GENERAL MOTORS CORP.

7. Remove the second clutch spring assembly (621).
8. Remove the second clutch piston assembly (620).

SECOND CLUTCH HOUSING ASSEMBLY INSPECTION

Inspection Procedure

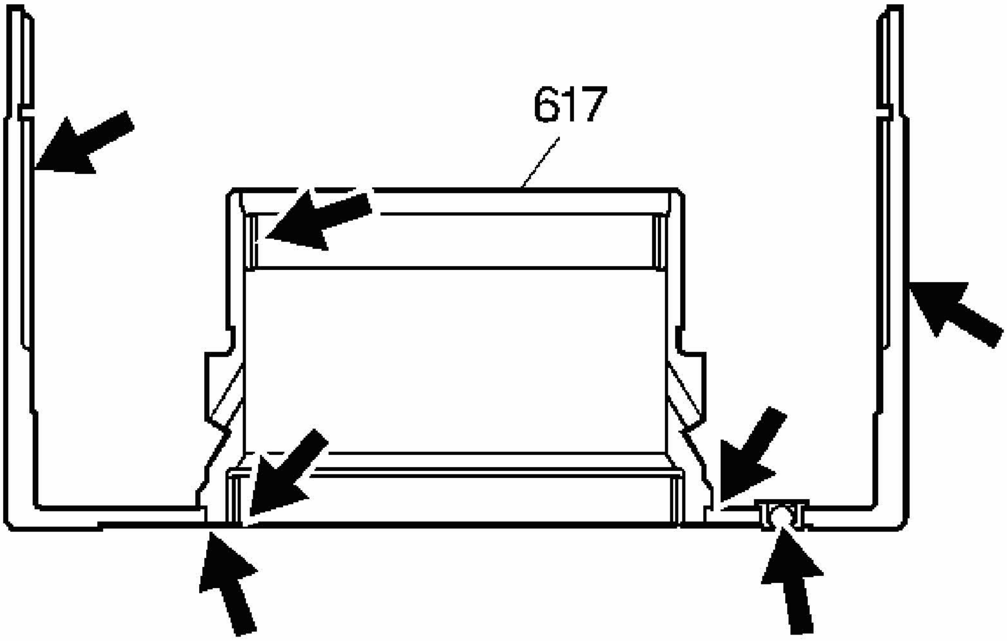


Fig. 214: Locating Inspection Areas On Second Clutch Housing Assembly
Courtesy of GENERAL MOTORS CORP.

1. Inspect the second clutch housing assembly (617) for the following:
    - A leaking or damaged ball check valve in the second clutch housing. Turn the housing in order to seat the check ball. Use transmission fluid in order to check for leaks.
    - Scored or worn bushings
    - Discolored band surface or wear on the drum caused by excess heat
    - Flatness of the band surface on the drum
    - Damaged reverse reaction drum splines
    - Cracks in welds

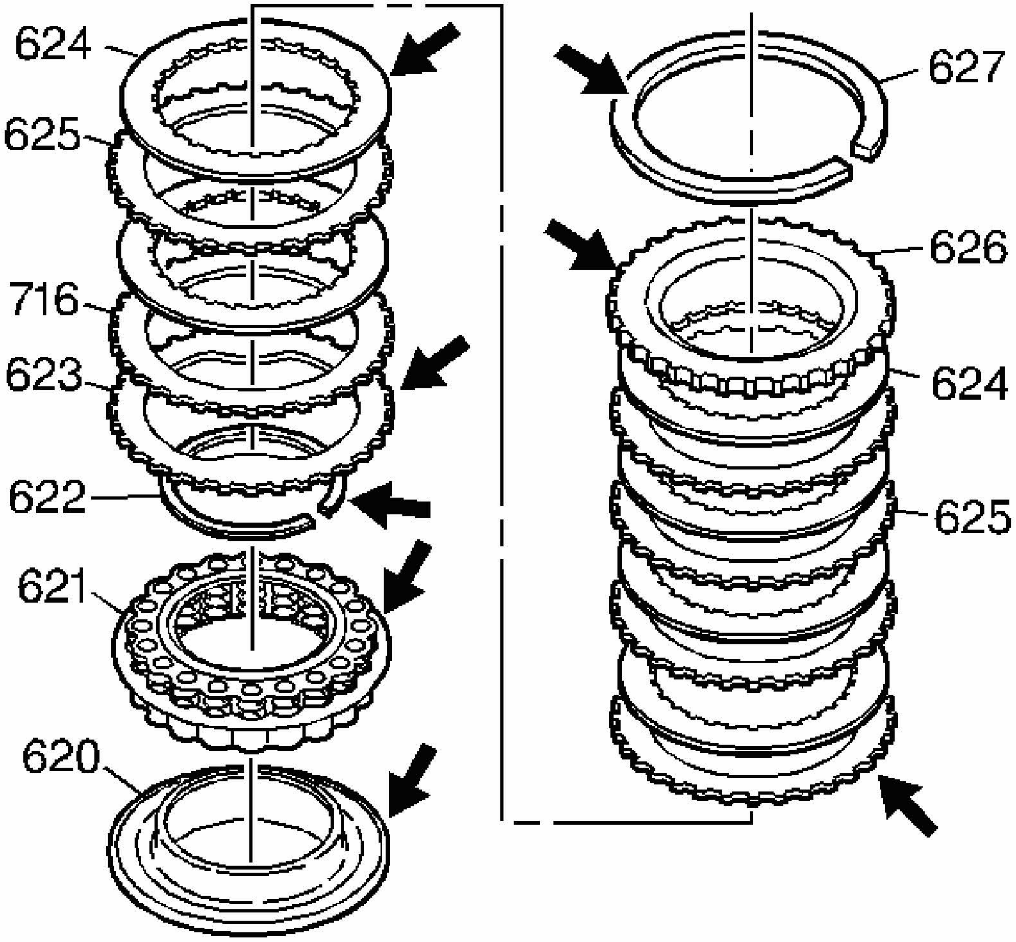


Fig. 215: Inspection Areas On Second Clutch Assembly
Courtesy of GENERAL MOTORS CORP.

2. Inspect the backing plate (626) and the waved plate (623) of the second clutch for cracks or heat spots.
3. Inspect the steel plates (625) and the apply plate (716) of the second clutch for wear.
4. Inspect the fiber plates (624) of the second clutch for wear, flaking or lining separation.
5. Inspect the spring assembly (621) of the second clutch for damage to the ring cage. Check for distorted or missing springs.
6. Inspect the spring snap ring (622) of the second clutch for damage. Inspect the snap ring (627) of the second clutch backing plate for damage.

SECOND CLUTCH HOUSING BALL CHECK VALVE DISASSEMBLE

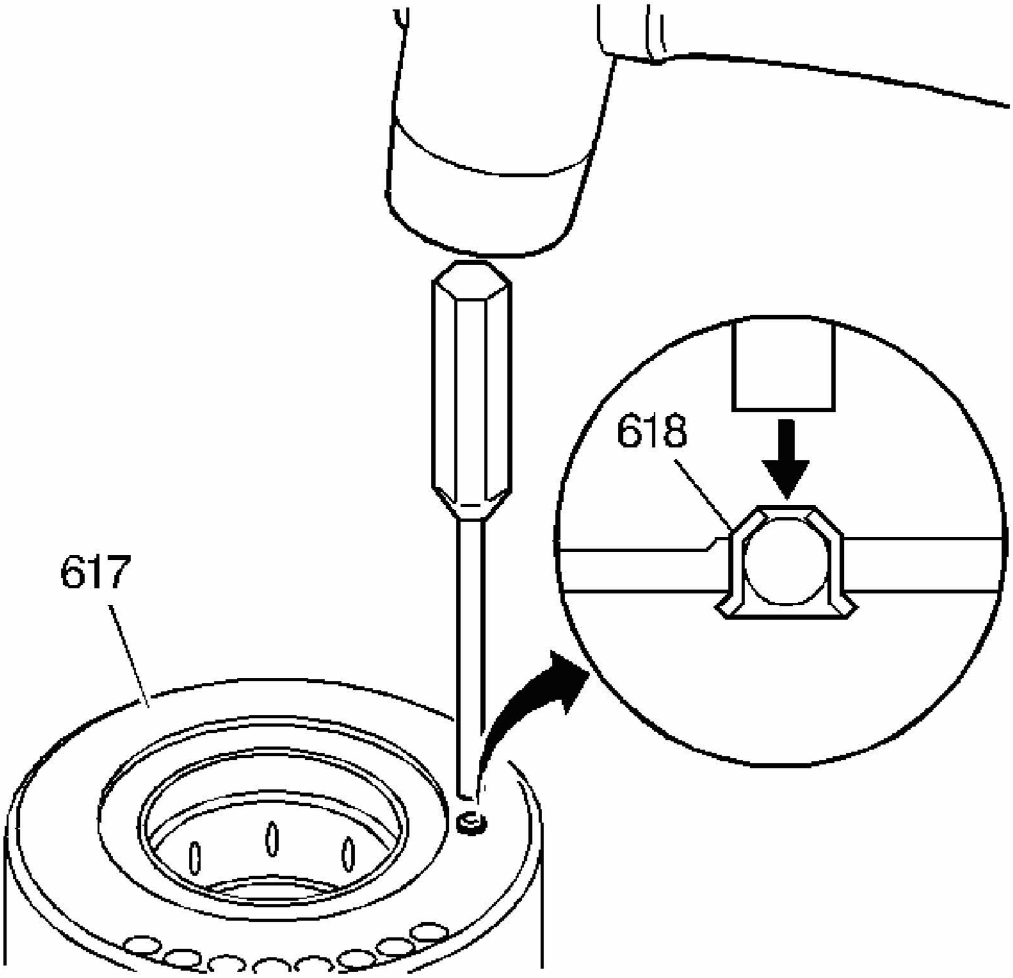


Fig. 216: Removing Ball Check Valve Assembly In Second Clutch Housing
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If the ball check valve assembly (618) does not leak, do not remove the assembly.

Use a 6.25 mm (1/4 in) drift and a mallet in order to remove the ball check valve assembly (618) from the second clutch housing (617).

SECOND CLUTCH HOUSING BALL CHECK VALVE ASSEMBLE

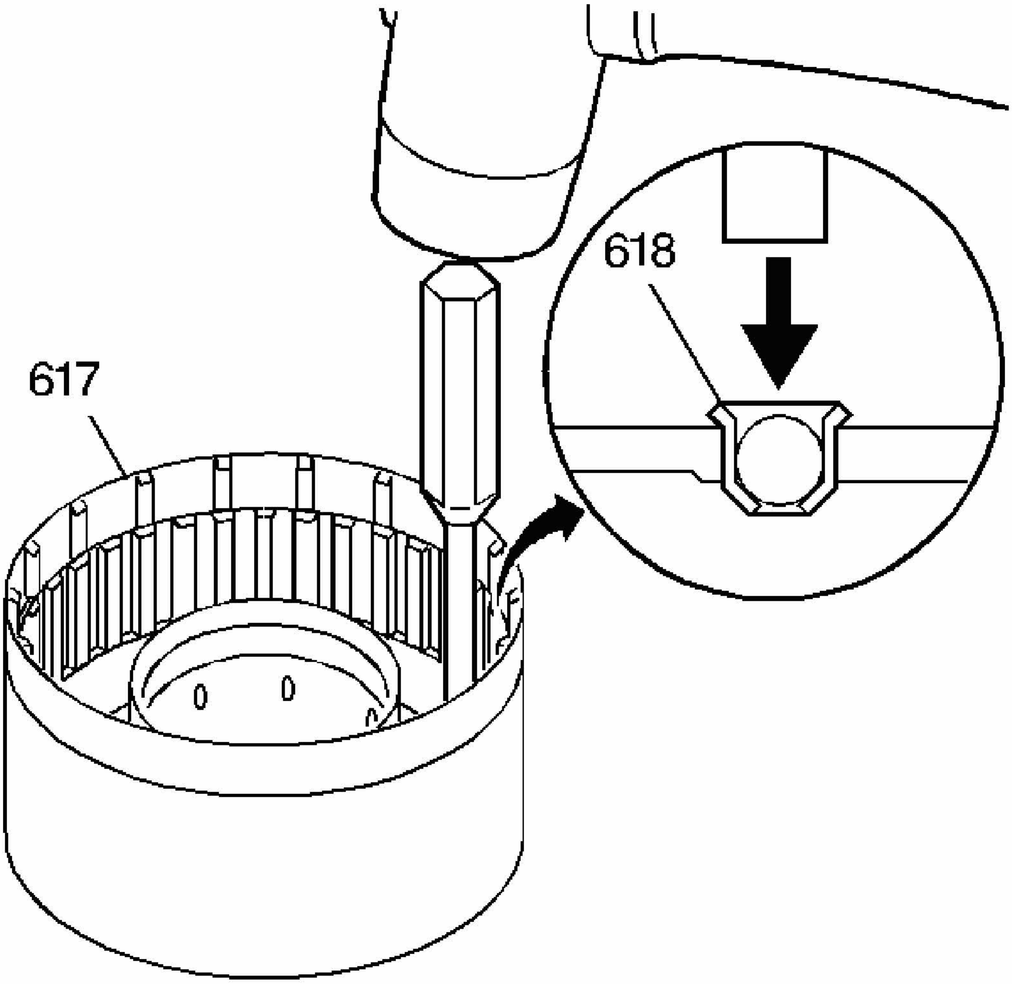


Fig. 217: Identifying Ball Check Valve Assembly In Second Clutch Housing
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If the ball check valve assembly (618) does not leak, do not remove the assembly.

Use a 6.25 mm (1/4 in) drift and a mallet in order to remove the ball check valve assembly (618) from the second clutch housing (617).

SECOND CLUTCH ASSEMBLE

Tools Required:

- **J 23327** Clutch Spring Compressor
- **J 38734** Spring Compressor Adapter

- **J 41992-1** Protector. See **Special Tools**.
- **J 41992-2** Adapter. See **Special Tools**.
- **J 41992-3** Installer. See **Special Tools**.

Assembly Procedure

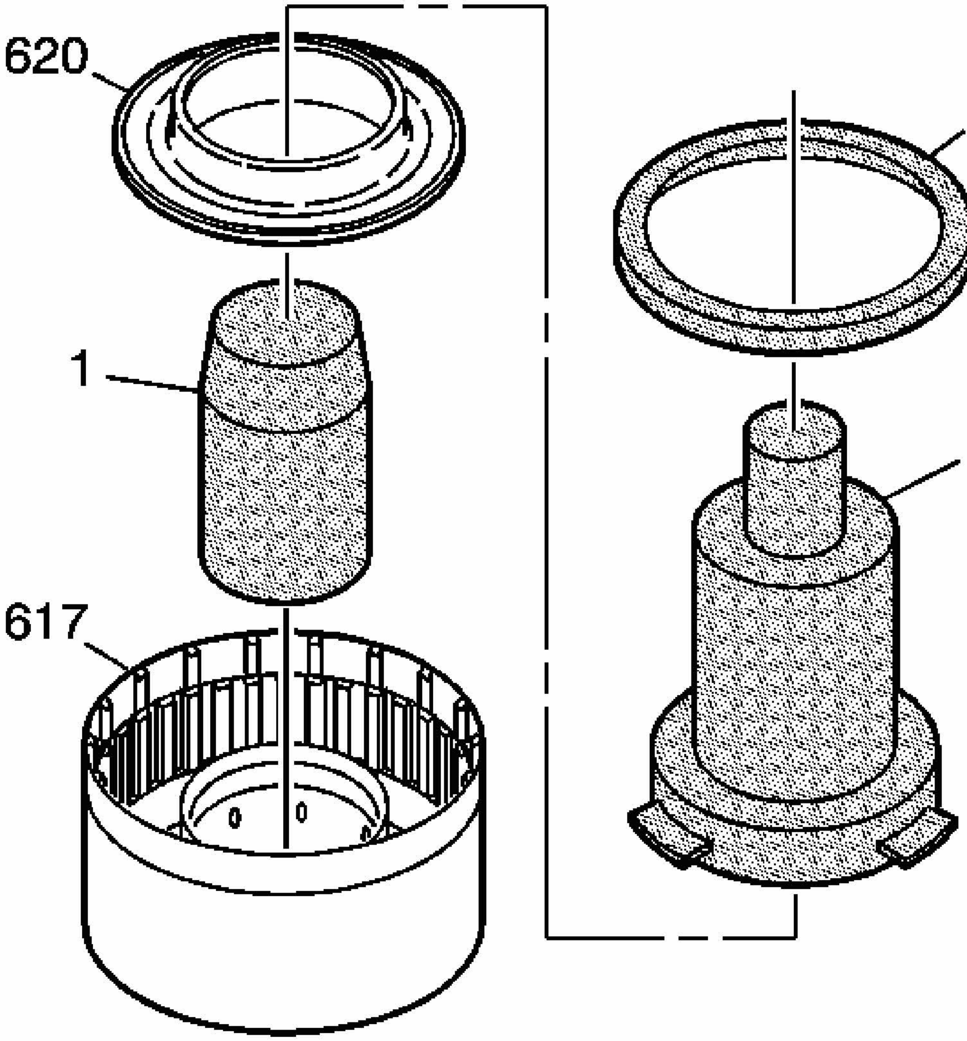


Fig. 218: Installing Second Clutch Piston
Courtesy of GENERAL MOTORS CORP.

1. Install **J 41992-2** (1) into the second clutch housing (617). See **Special Tools**.
2. Install the second clutch piston (620) and **J 41992-3** (3) into **J 41992-1** (2) protector. See **Special Tools**.

3. Install the second clutch piston and tool assembly into the second clutch housing assembly (617).
4. Use hand pressure to press down on **J 41992-3** (3) until the second clutch piston (620) is seated. See **Special Tools**.
5. Remove **J 41992-1** (2), **J 41992-2** (1) and **J 41992-3** (3). See **Special Tools**. If necessary, gently tap with a punch through the center of the second clutch housing to remove the tools.

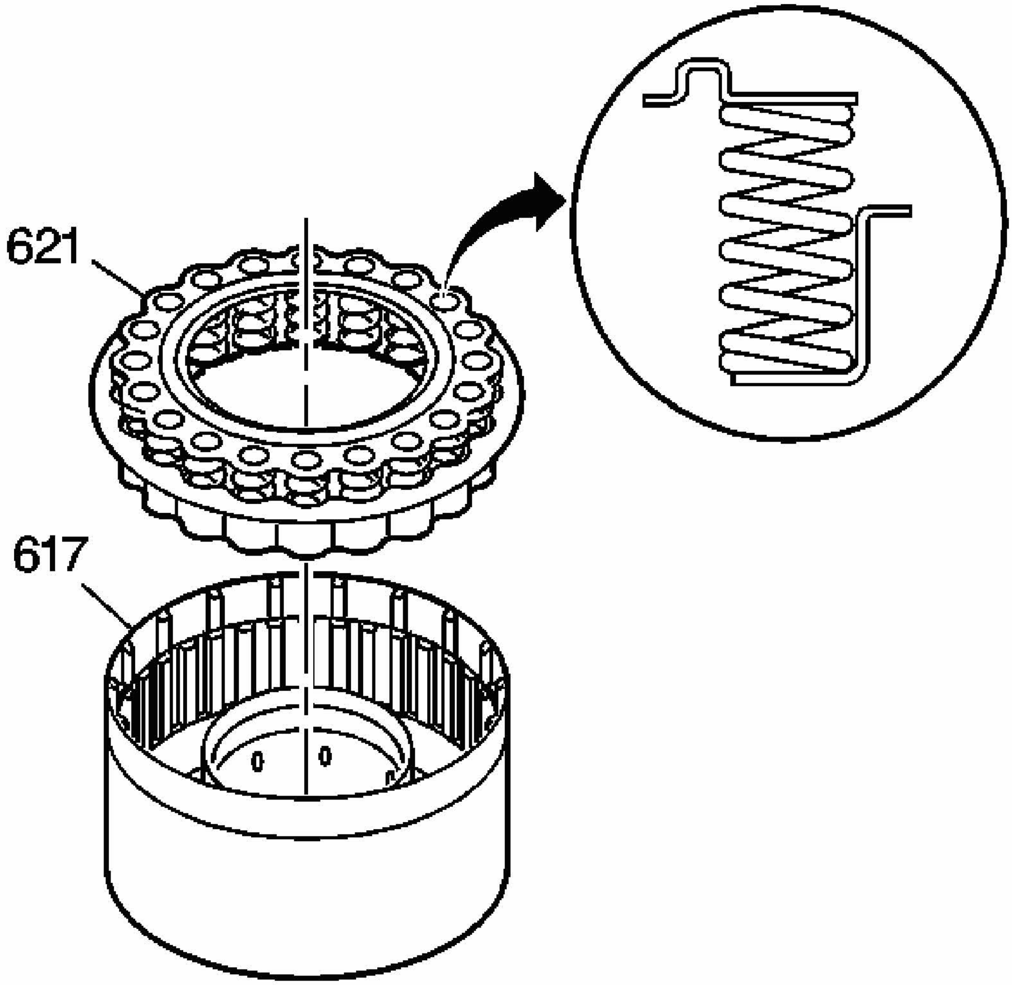


Fig. 219: View Of Second Clutch Spring Assembly
Courtesy of GENERAL MOTORS CORP.

6. Assemble the second clutch spring assembly (621) into the second clutch housing assembly (617).

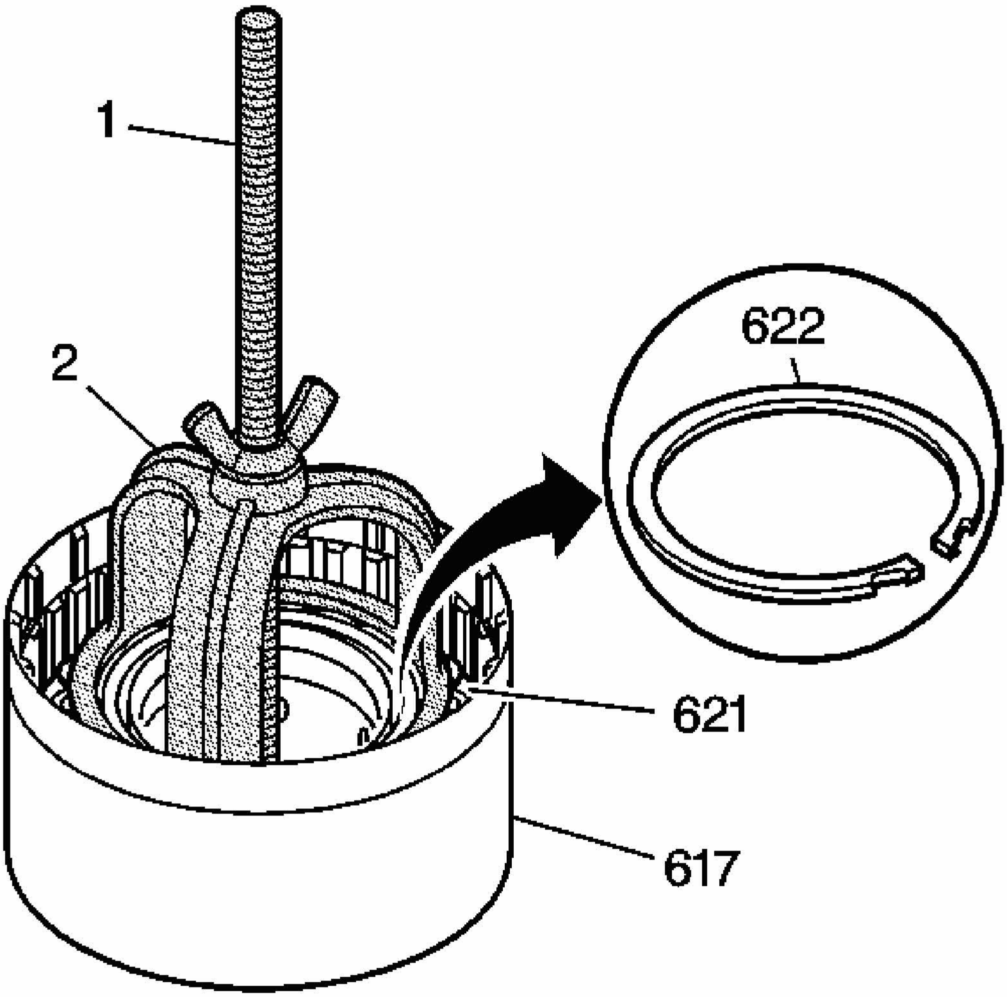


Fig. 220: Using J 23327 & J 38734 To Compress The Second Clutch Piston Spring
Courtesy of GENERAL MOTORS CORP.

7. Use **J 23327** (1) and **J 38734** (2) in order to compress the second clutch piston spring (621).
8. Install the second clutch spring assembly retainer ring (622).
9. Remove **J 23327** and **J 38734** from the second clutch housing (617).

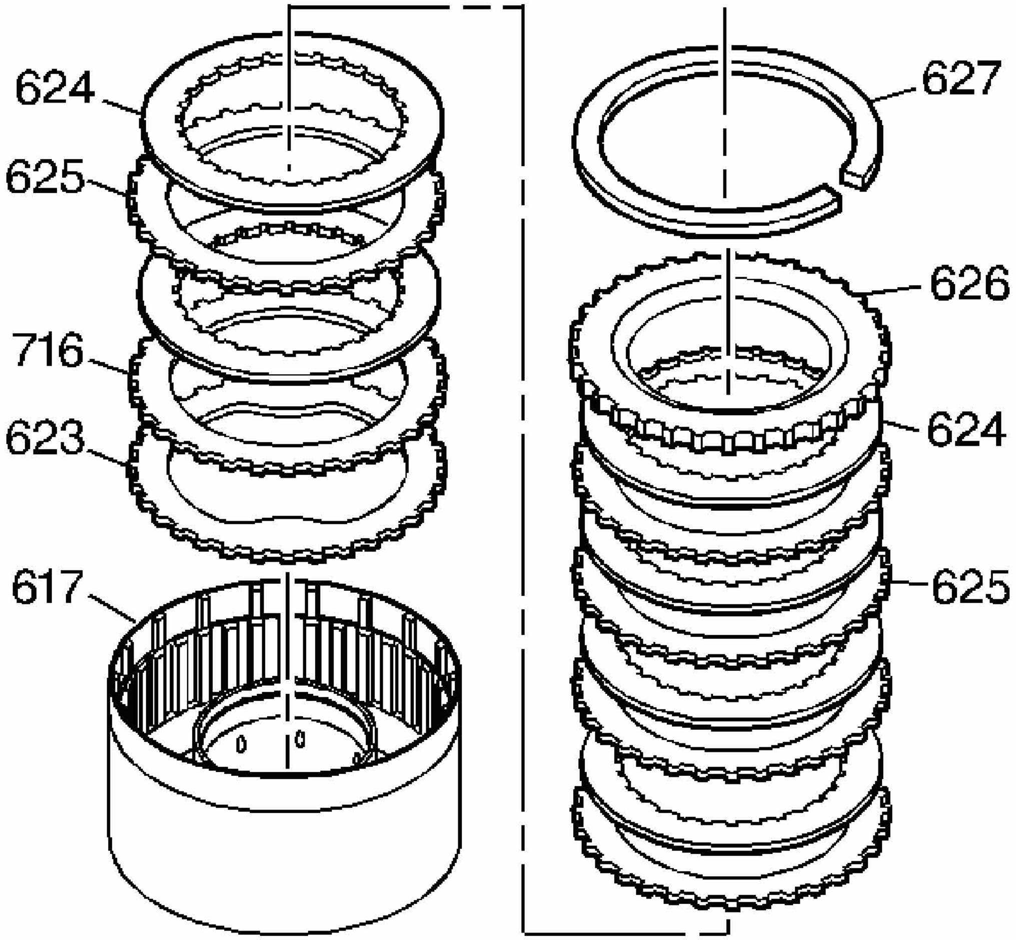


Fig. 221: View Of Second Clutch Plate Assembly
Courtesy of GENERAL MOTORS CORP.

10. Install the second clutch waved plate (623) into the second clutch housing (617).
11. Install the second clutch apply plate (716) into the second clutch housing (617) with the marking DN or DOWN toward the piston.
12. Install the second clutch fiber plate assemblies (624) and the second clutch steel plates (625), starting with a fiber plate assembly.
13. Assemble the remaining plates, alternating between steel and fiber.
14. Install the second clutch backing plate (626) into the housing.
15. Install the second clutch backing plate retaining ring (627).

REVERSE BAND ASSEMBLE

Assembly Procedure

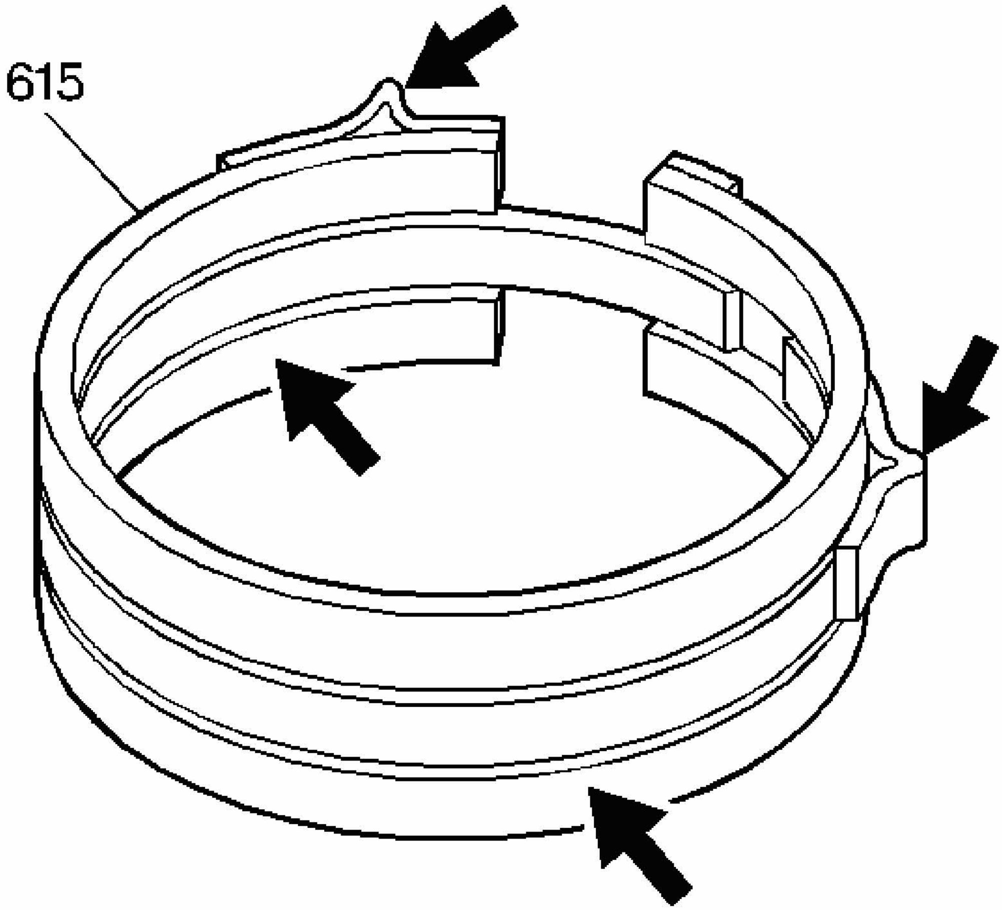


Fig. 222: Reverse Band Assembly Inspection Areas
Courtesy of GENERAL MOTORS CORP.

1. Inspect the reverse band assembly (615) for the following:
    - Cracks
    - Scoring
    - Lining separation
    - Wear of the fiber material
2. Inspect the apply lug for cracks.

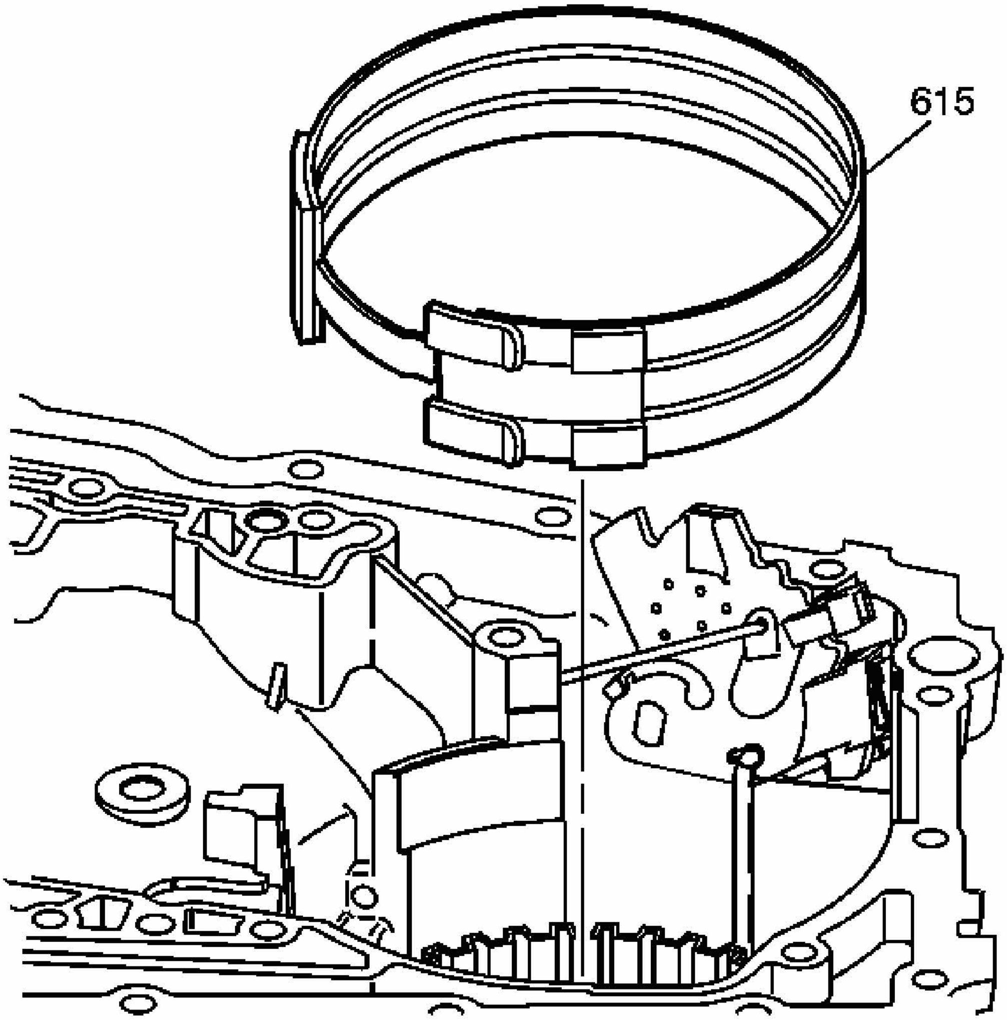


Fig. 223: View Of Reverse Band Assembly
Courtesy of GENERAL MOTORS CORP.

3. Install the reverse band assembly (615) into the case with the band end aligned on the anchor pin in the case.

DRIVEN SPROCKET SUPPORT COMPONENTS DISASSEMBLE

Tools Required

J 4670-01 Clutch Spring Compressor. See Special Tools.

Disassembly Procedure

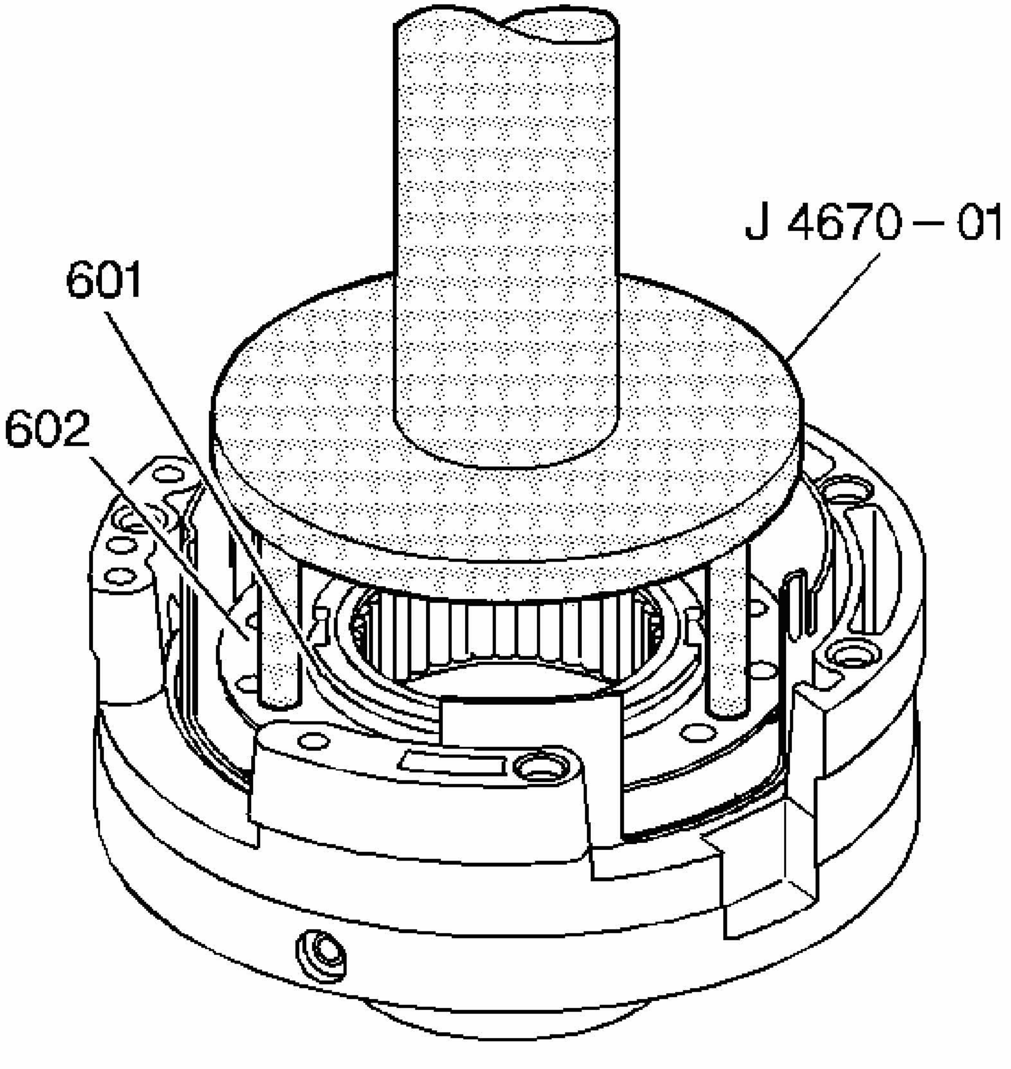


Fig. 224: Using J 4670-01 To Compress The Fourth Clutch Spring Assembly
Courtesy of GENERAL MOTORS CORP.

1. Use **J 4670-01** clutch spring compressor in order to compress the fourth clutch spring assembly (602). See **Special Tools**. Remove the snap ring (601) from the driven sprocket support assembly.

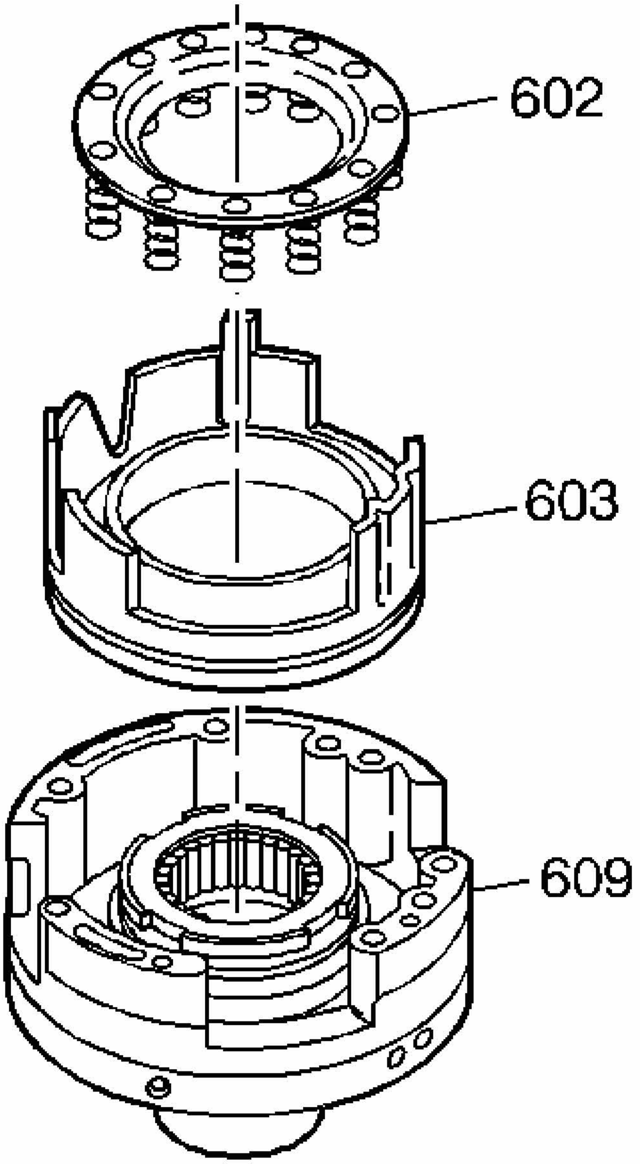


Fig. 225: Removing Spring Assembly & Fourth Clutch Piston Assembly
Courtesy of GENERAL MOTORS CORP.

2. Remove the spring assembly (602) and remove the fourth clutch piston assembly (603) from the driven sprocket support assembly (609).

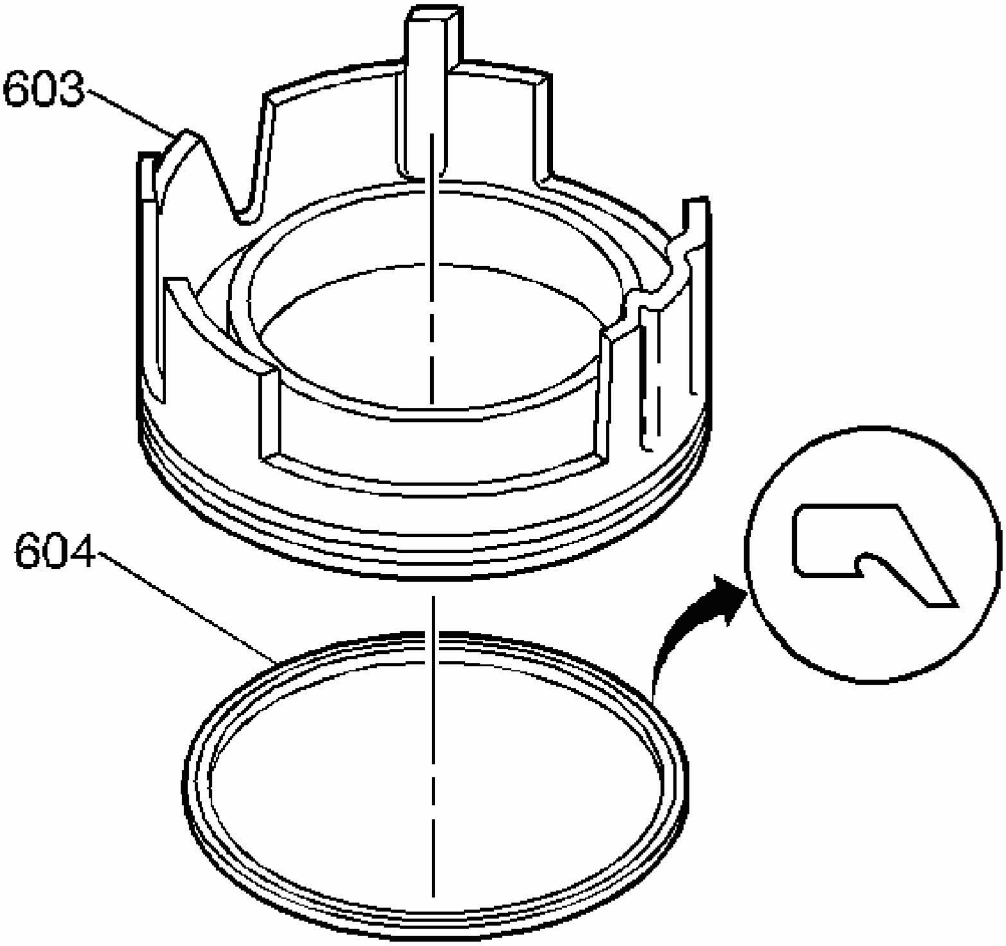


Fig. 226: Locating Fourth Clutch Piston Outer Seal
Courtesy of GENERAL MOTORS CORP.

3. Remove the outer seal (604) from the fourth clutch piston (603).

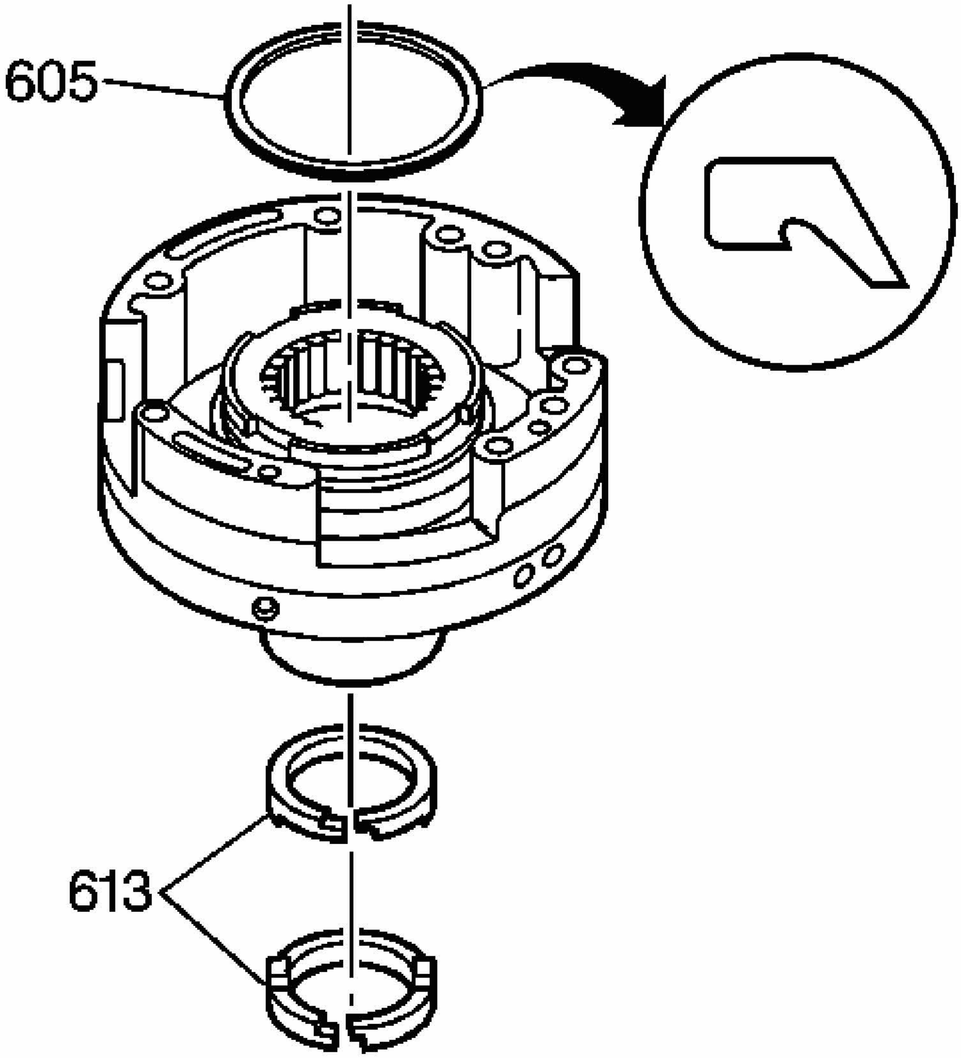


Fig. 227: Removing Inner Seal & Oil Seal Rings From Driven Sprocket Support
Courtesy of GENERAL MOTORS CORP.

4. Remove the inner seal (605) for the fourth clutch piston from the driven sprocket support assembly hub.
5. Remove the oil seal rings (613) from the driven sprocket support.

DRIVEN SPROCKET SUPPORT COMPONENTS INSPECTION

Inspection Procedure

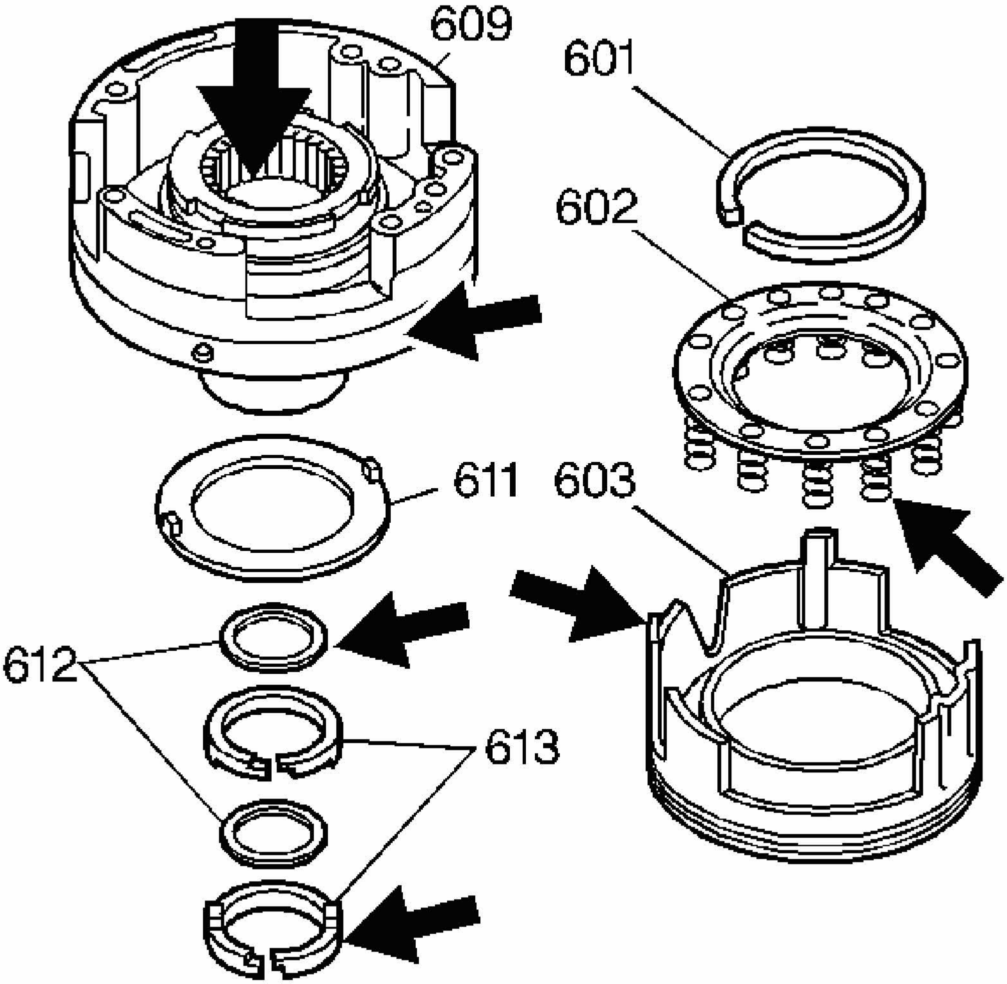


Fig. 228: Inspection Areas On Driven Sprocket Support Assembly
Courtesy of GENERAL MOTORS CORP.

1. Inspect the driven sprocket support assembly (609) for the following:
    - Worn or cut oil seal rings (612)
    - Rolled or cut second clutch housing oil seal ring seals (613)
    - Damage to the piston seal surface in the driven sprocket support assembly
    - Blocked or porous oil passages in the driven sprocket support assembly
    - A leaking or missing cup plug
2. Inspect the fourth clutch piston (603) for damage.
3. Inspect the thrust washer (611) from the second clutch housing for cracks or distortion.
4. Inspect the fourth clutch spring assembly (602) for distorted or missing springs.

5. Inspect the driven sprocket bearing assembly for foreign material and missing, flat or damaged rollers.
6. Replace the Teflon® seal rings (613) under the following conditions:
    - The rings are cut or damaged
    - You are performing a complete overhaul
7. Inspect all seal ring grooves for debris, burrs or damage.

DRIVEN SPROCKET SUPPORT BEARING DISASSEMBLE

Tools Required

- **J 34129** Bearing Remover. See **Special Tools**.
- **J 8092** Driver Handle

Disassembly Procedure

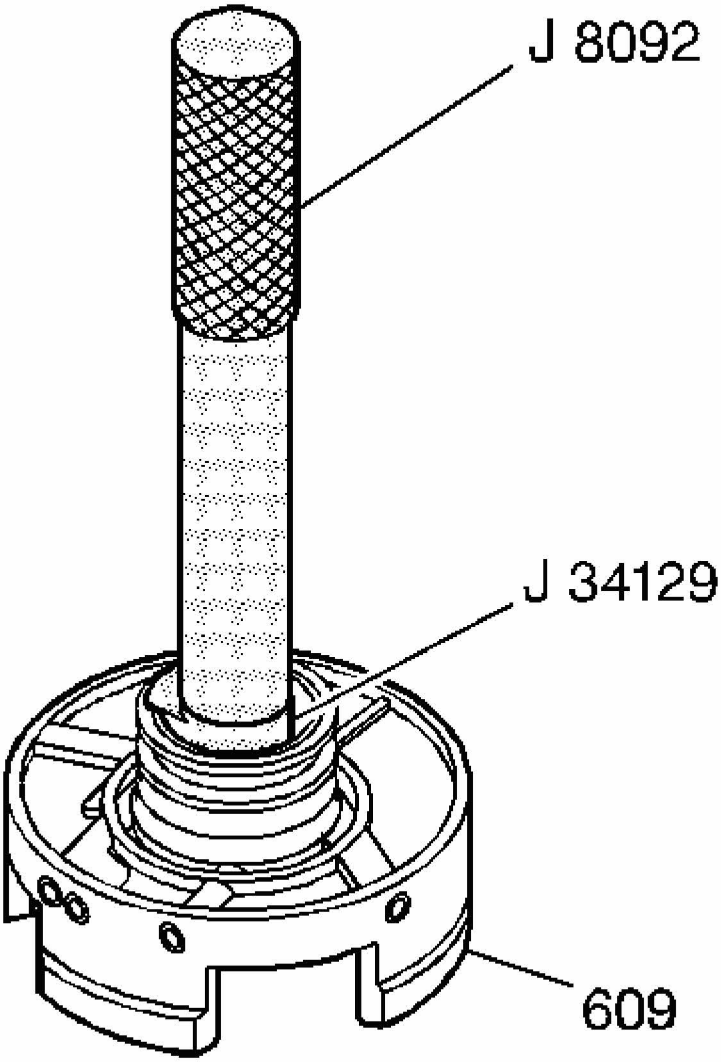


Fig. 229: Removing Driven Sprocket Support Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

Use **J 34129** , **J 8092** and a hammer in order to remove the driven sprocket support bearing assembly from the driven sprocket support assembly (609).

DRIVEN SPROCKET SUPPORT BEARING ASSEMBLE

Tools Required

- **J 34126** Bearing Installer. See **Special Tools**.
- **J 8092** Driver Handle

Assembly Procedure

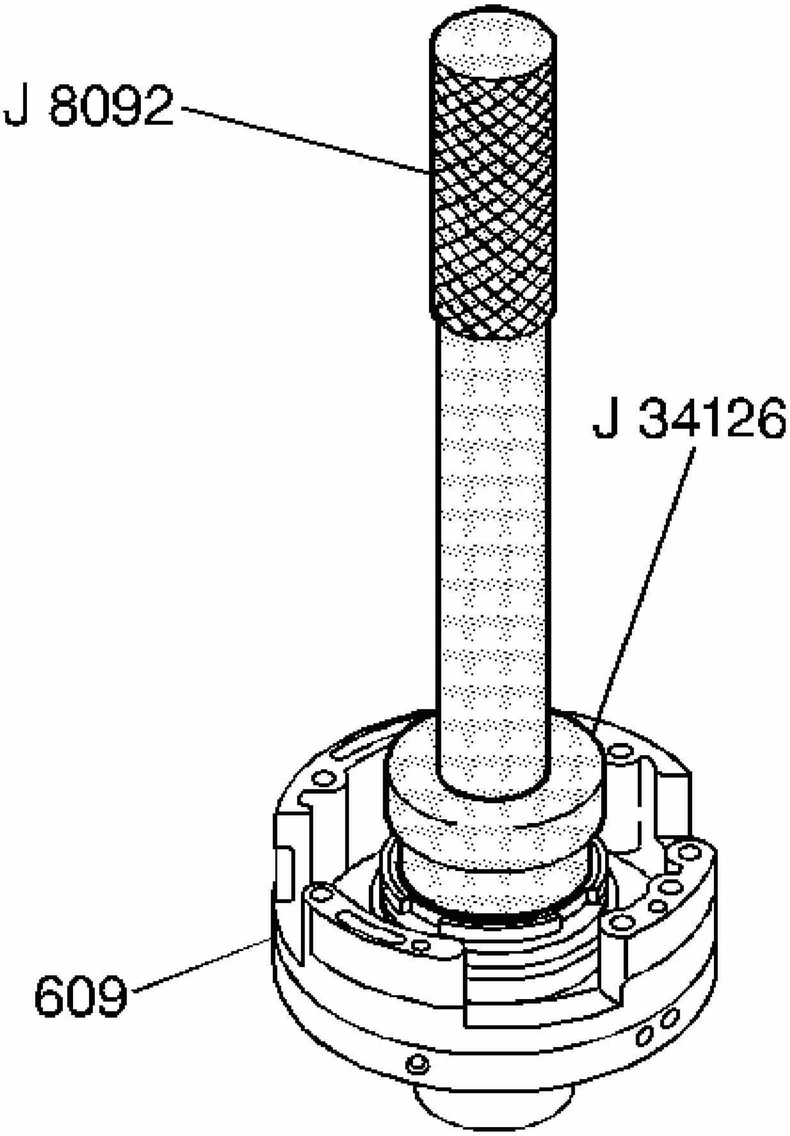


Fig. 230: Using J 34126 & J 8092 To Install Driven Sprocket Support Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Position the driven sprocket support bearing assembly so that markings on the edge are facing up.

Use **J 34126** , **J 8092** and a hammer in order to seat the driven sprocket support bearing assembly flush with or below the driven sprocket support assembly (609) hub.

DRIVEN SPROCKET SUPPORT COMPONENTS ASSEMBLE

Tools Required

J 4670-01 Clutch Spring Compressor. See **Special Tools**.

Assembly Procedure

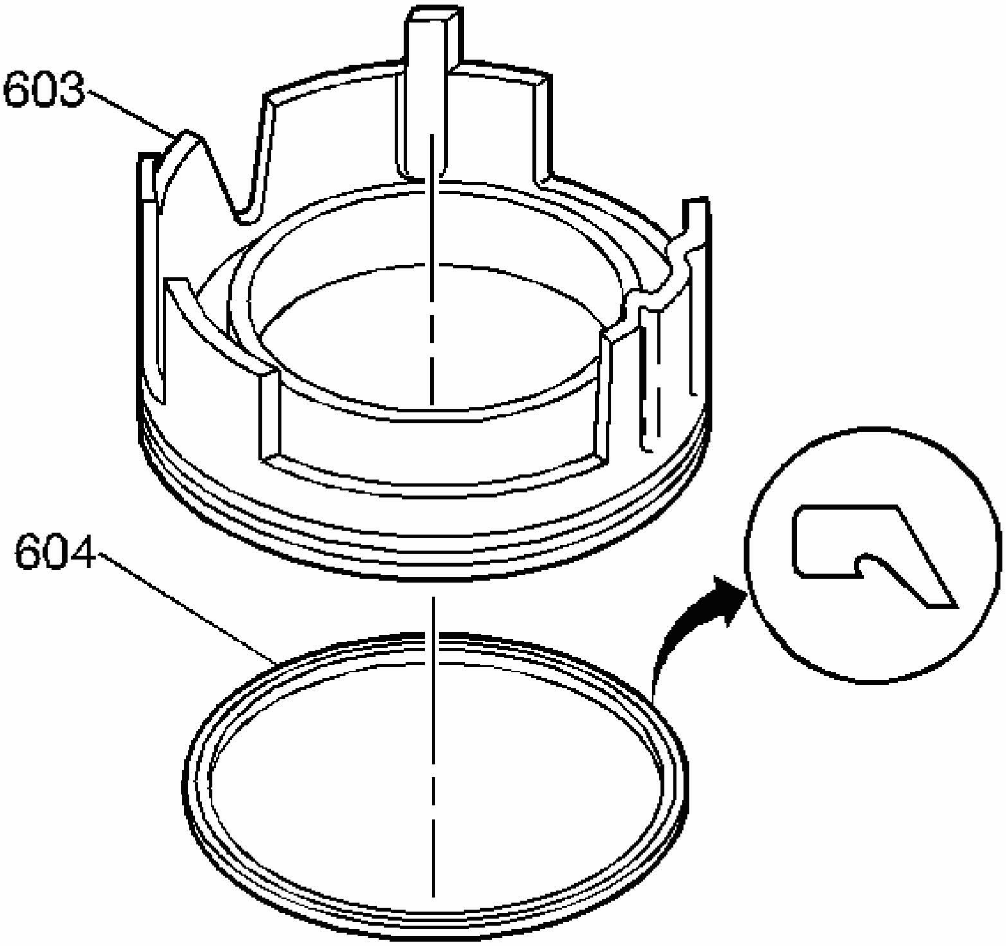


Fig. 231: Locating Fourth Clutch Piston Outer Seal
Courtesy of GENERAL MOTORS CORP.

1. Use transmission fluid in order to lubricate a new fourth clutch piston outer seal (604). Install the seal onto the fourth clutch piston assembly (603).

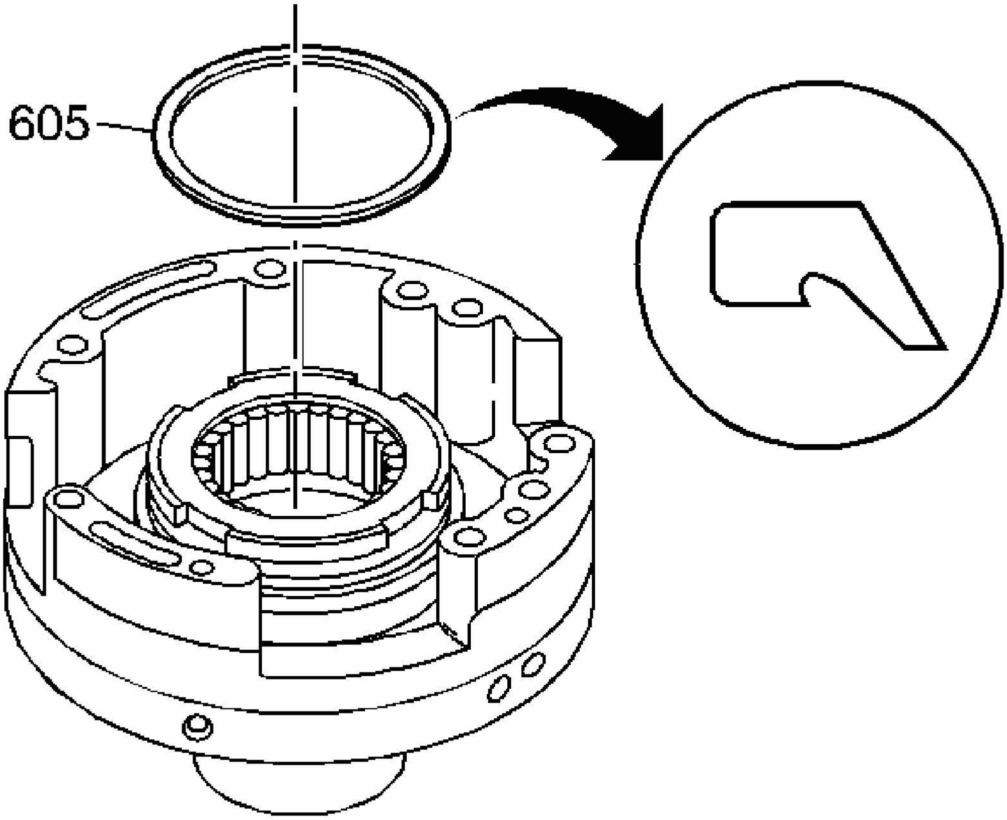


Fig. 232: Identifying Fourth Clutch Piston Inner Seal
Courtesy of GENERAL MOTORS CORP.

2. Use transmission fluid in order to lubricate a new fourth clutch piston inner seal (605). Install the seal into the driven sprocket support hub.

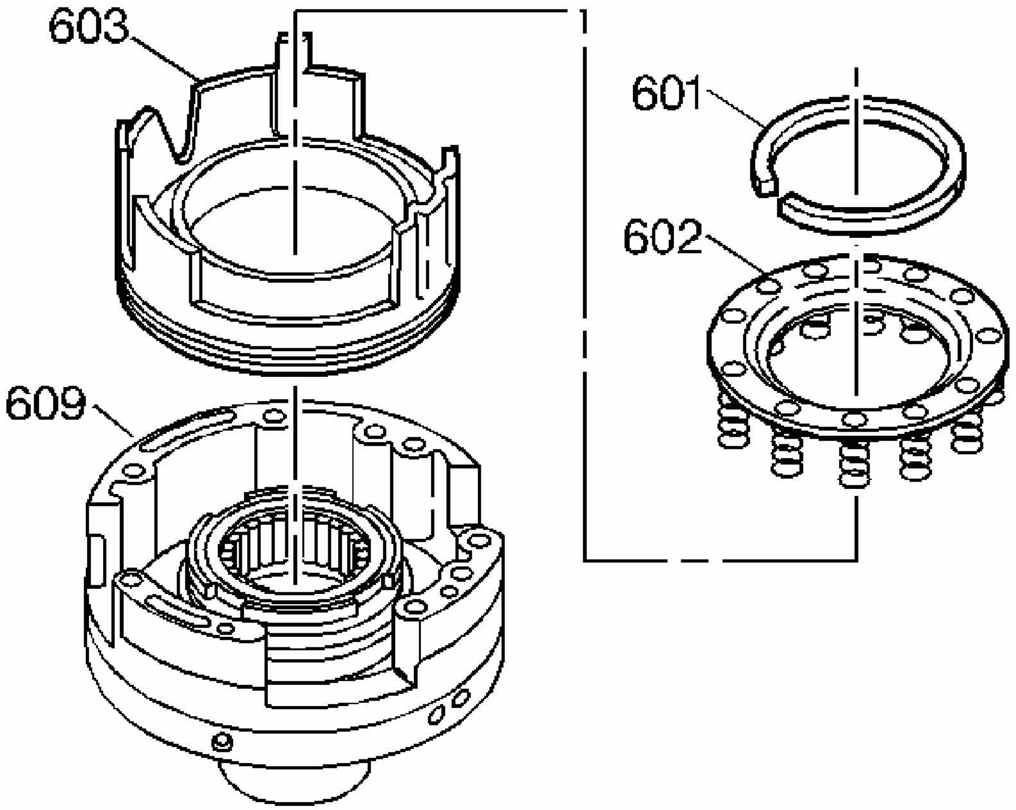


Fig. 233: Assembling Fourth Clutch Piston Assembly Into Driven Sprocket Support
Courtesy of GENERAL MOTORS CORP.

3. Insert the fourth clutch piston assembly (603) into the driven sprocket support (609) and align as shown.
4. Insert the fourth clutch return spring assembly (602) into the piston.

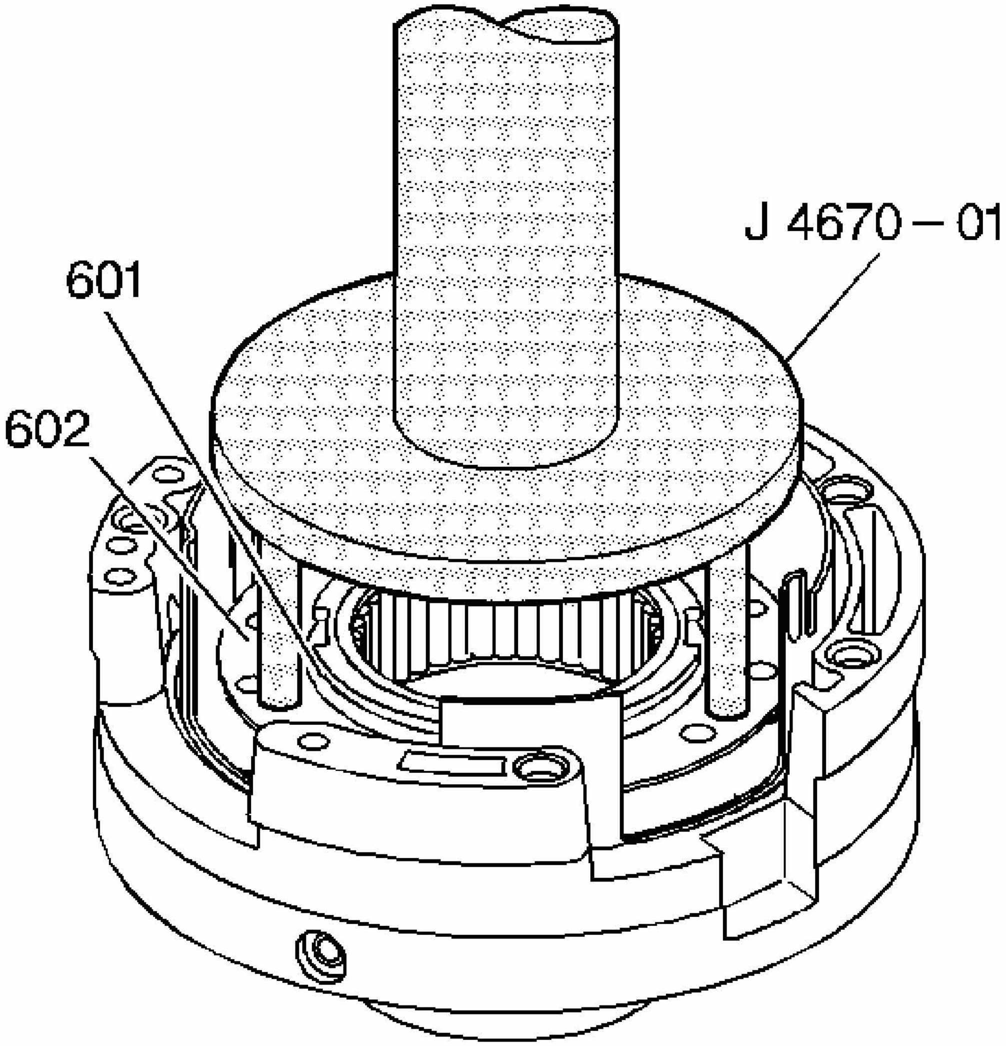


Fig. 234: Using J 4670-01 To Compress The Fourth Clutch Spring Assembly
Courtesy of GENERAL MOTORS CORP.

5. Use **J 4670-01** in order to install the fourth clutch spring retaining ring (601). See **Special Tools**.

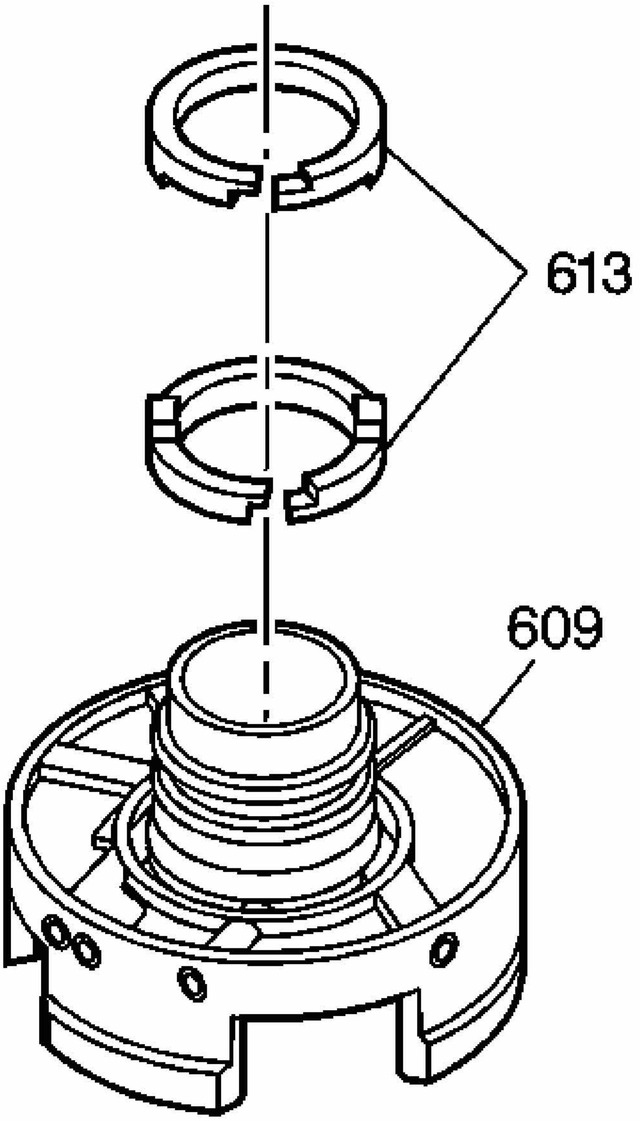


Fig. 235: Installing Second Clutch Housing Oil Seal Rings
Courtesy of GENERAL MOTORS CORP.

6. If you are installing new second clutch housing oil seal rings (613), lubricate the rings. Install the oil seal rings (613) onto the driven sprocket support hub (609).

FOURTH AND SECOND CLUTCH FUNCTIONAL AIR CHECK

Checking Procedure

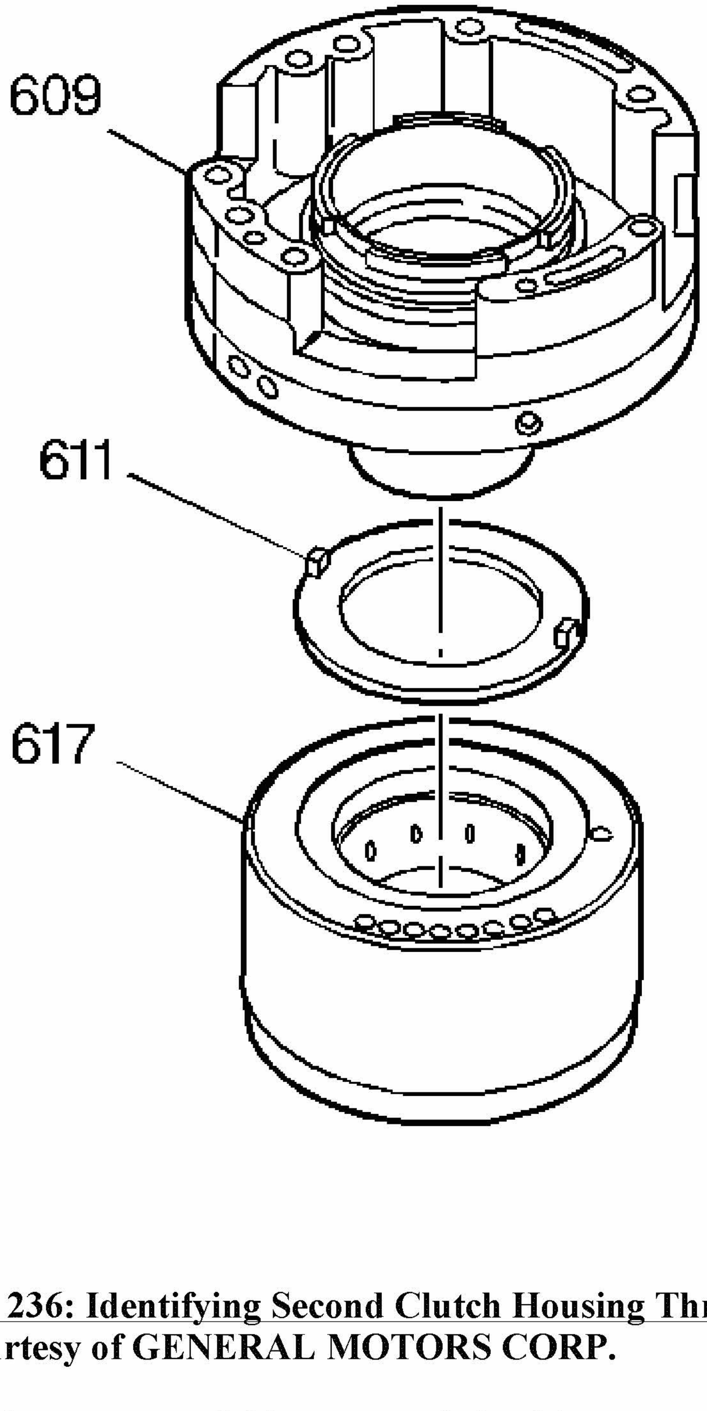


Fig. 236: Identifying Second Clutch Housing Thrust Washer
Courtesy of GENERAL MOTORS CORP.

1. For the purposes of this test, attach the driven sprocket support assembly (609) and the second clutch housing thrust washer (611) onto the second clutch housing assembly (617).

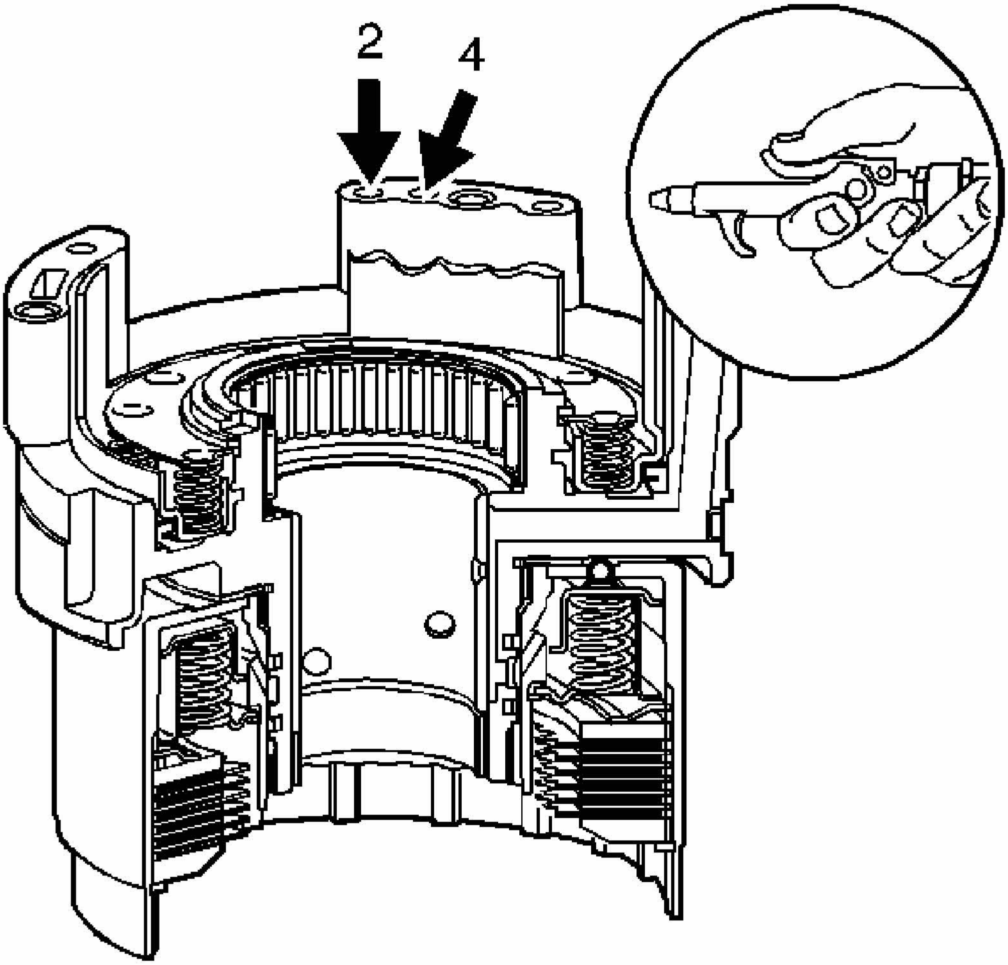


Fig. 237: Blowing Air Into Feed Holes
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not exceed the recommended amount of air pressure or it may damage or cause seals to roll.

2. Apply 138 kPa (20 psi) to the feed holes marked 2 and 4 and listen for the second and fourth clutches to apply.
3. Hold the pressure for five seconds. If the clutches do not apply and hold, then disassemble the driven sprocket support components. Inspect all of the seals and clutches for proper assembly. When finished, repeat the functional check.

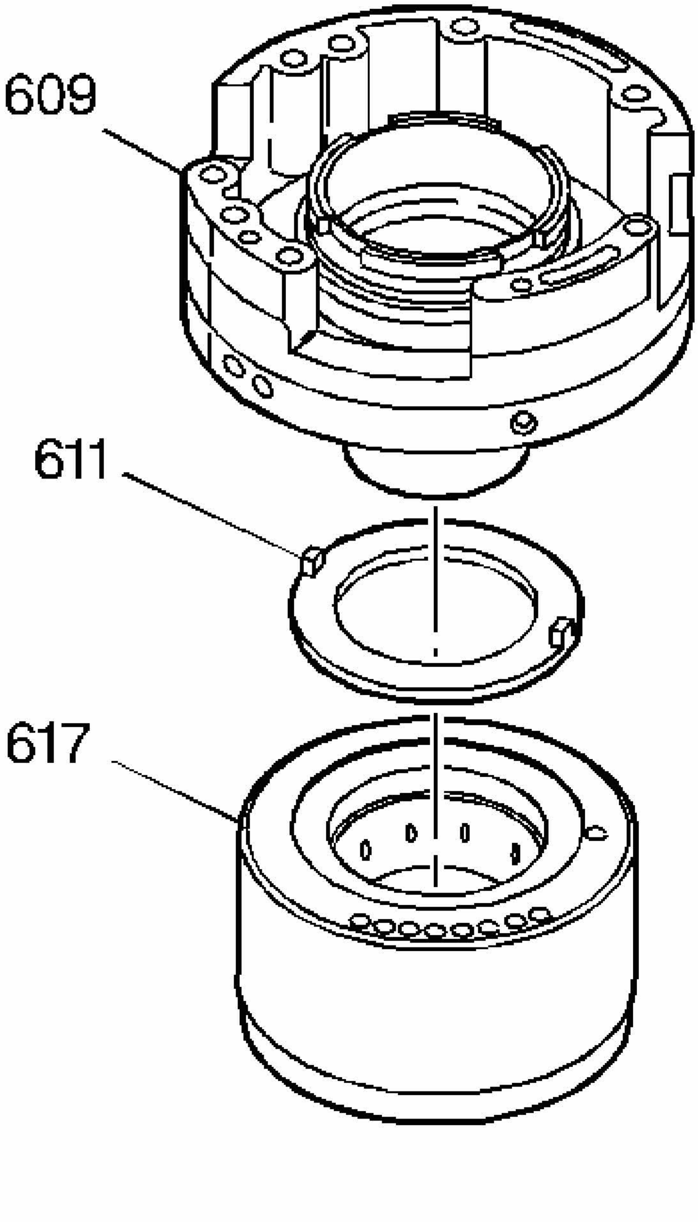


Fig. 238: Identifying Second Clutch Housing Thrust Washer
Courtesy of GENERAL MOTORS CORP.

4. When the clutches apply and hold correctly, remove the driven sprocket support assembly (609) and the second clutch housing thrust washer (611) from the second clutch housing assembly (617).

SECOND, INPUT, THIRD AND SPRAG CLUTCHES ASSEMBLE

Tools Required

J 33381-A Clutch Assembly Remover/Installer. See **Special Tools**.

Assembly Procedure

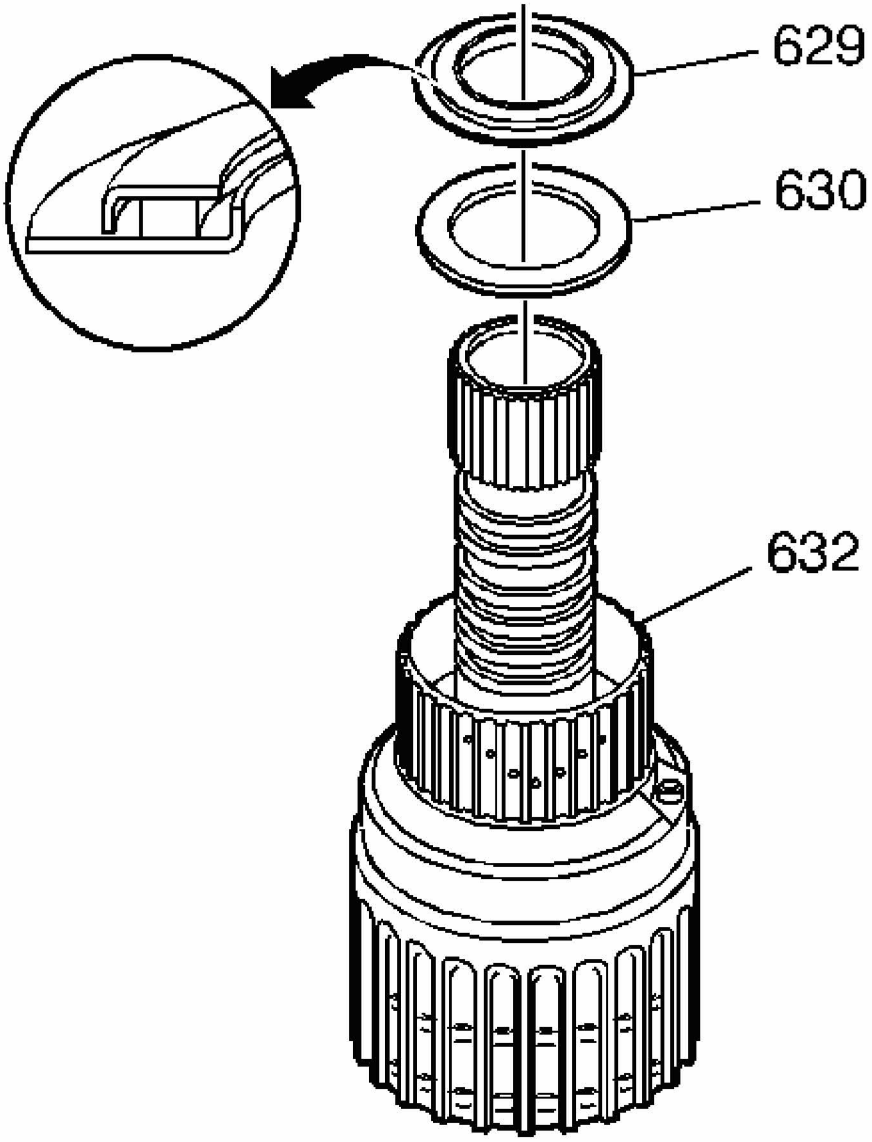


Fig. 239: Installing Thrust Bearing Assembly & Selective Thrust Washer
Courtesy of GENERAL MOTORS CORP.

1. Install the selective thrust washer (630) and the thrust bearing assembly (629) onto the input clutch housing assembly (632).

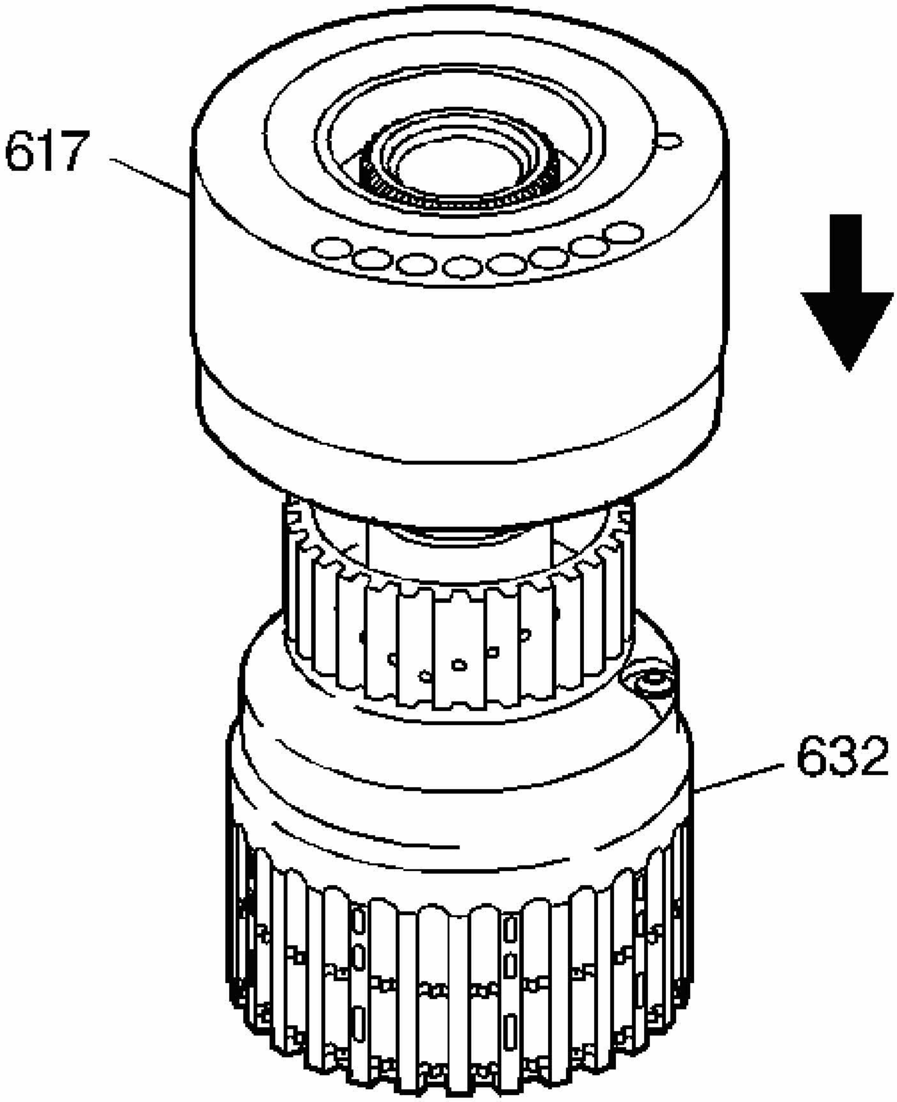


Fig. 240: Installing Second Clutch Housing Assembly Onto Second Clutch Hub
Courtesy of GENERAL MOTORS CORP.

2. Use a small screwdriver in order to align the second clutch teeth so that they slide onto the second clutch hub of the input clutch housing assembly (632).
3. Install the second clutch housing assembly (617) onto the second clutch hub of the input clutch housing assembly (632).

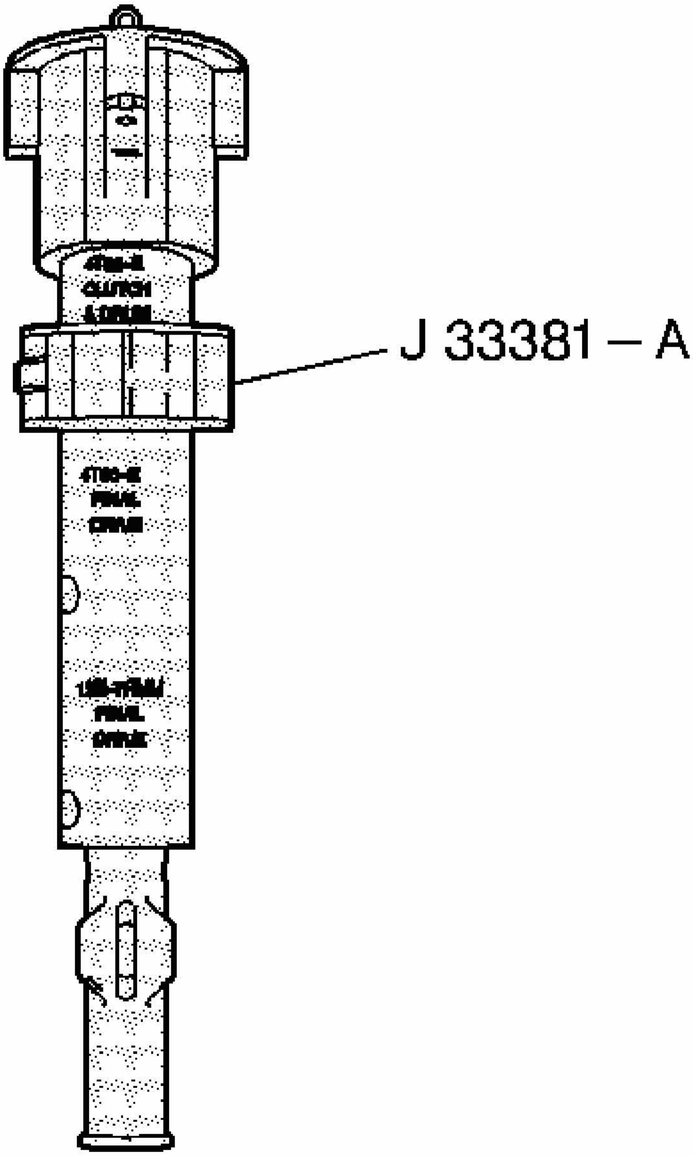


Fig. 241: View Of J 33381-A
Courtesy of GENERAL MOTORS CORP.

4. Adjust the collar on **J 33381-A** to 4T65-E CLUTCH & DRUM. See **Special Tools**. Make sure that the threaded rod is fully loosened.

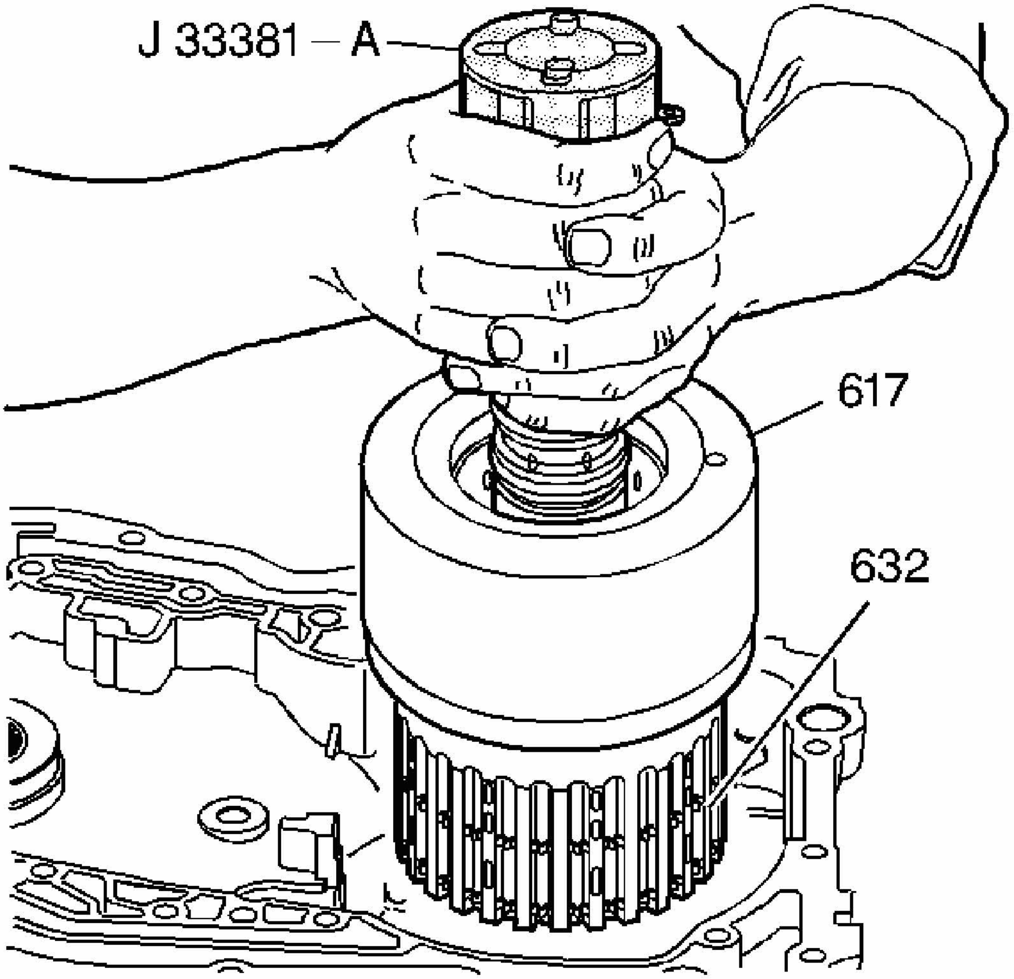


Fig. 242: Installing J 33381-A Onto Input Clutch Housing Assembly
Courtesy of GENERAL MOTORS CORP.

5. Install **J 33381-A** into the input clutch housing assembly (632). See **Special Tools**.
6. Tighten the threaded rod of **J 33381-A** until the rod is finger tight. See **Special Tools**.
7. Use **J 33381-A** in order to lift the input and second clutch housing assembly (617, 632). See **Special Tools**. The sprag clutch assemblies will also be attached.

IMPORTANT: After you have installed the input and second clutch housing assembly, confirm that the top of the second clutch housing (617) is approximately 1/2 inch above the top of the reverse band assembly.

8. Install the input and second clutch housing assembly (617, 632) into the case. Be sure

that the assembly is down all the way.

DRIVEN SPROCKET SUPPORT ASSEMBLE

Tools Required

J 36850 Assembly Lubricant (or equivalent)

Assembly Procedure

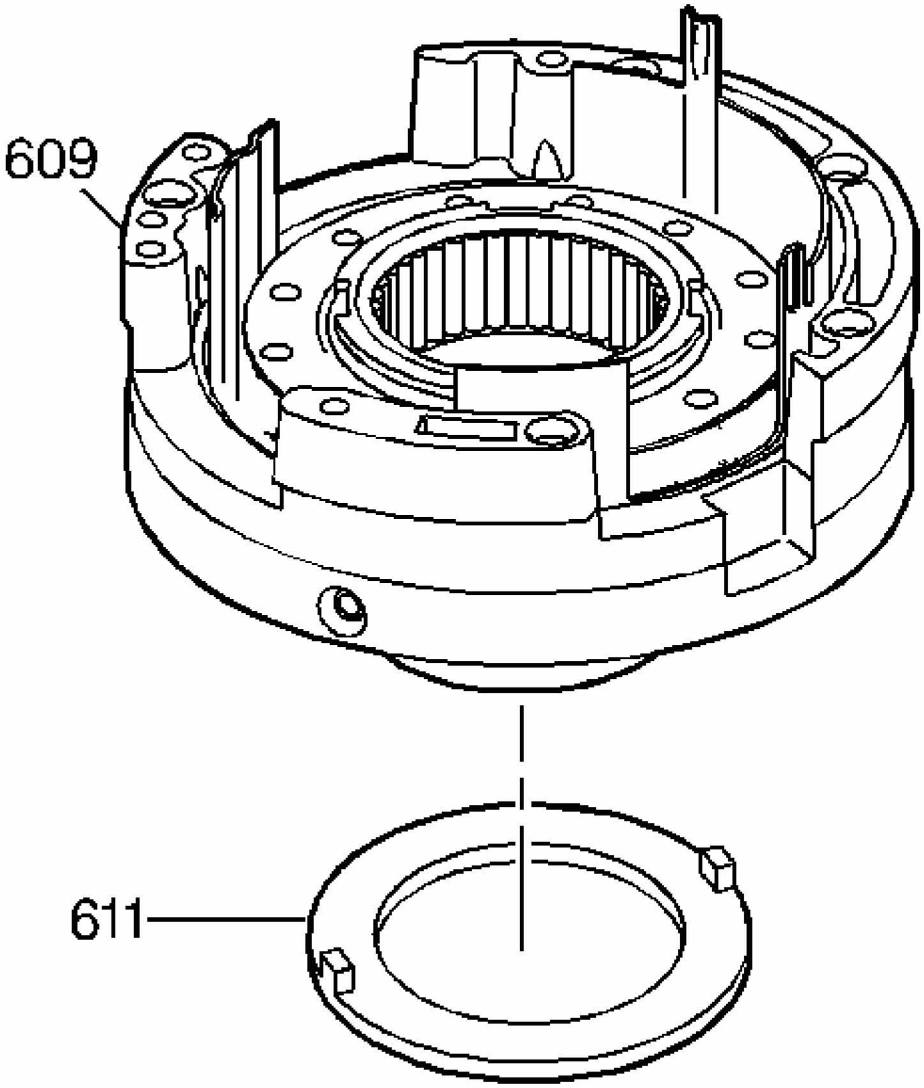


Fig. 243: View Of Second Clutch Housing Thrust Washer
Courtesy of GENERAL MOTORS CORP.

1. Use **J 36850** or equivalent in order to secure the second clutch housing thrust washer (611) to the driven sprocket support assembly (609).

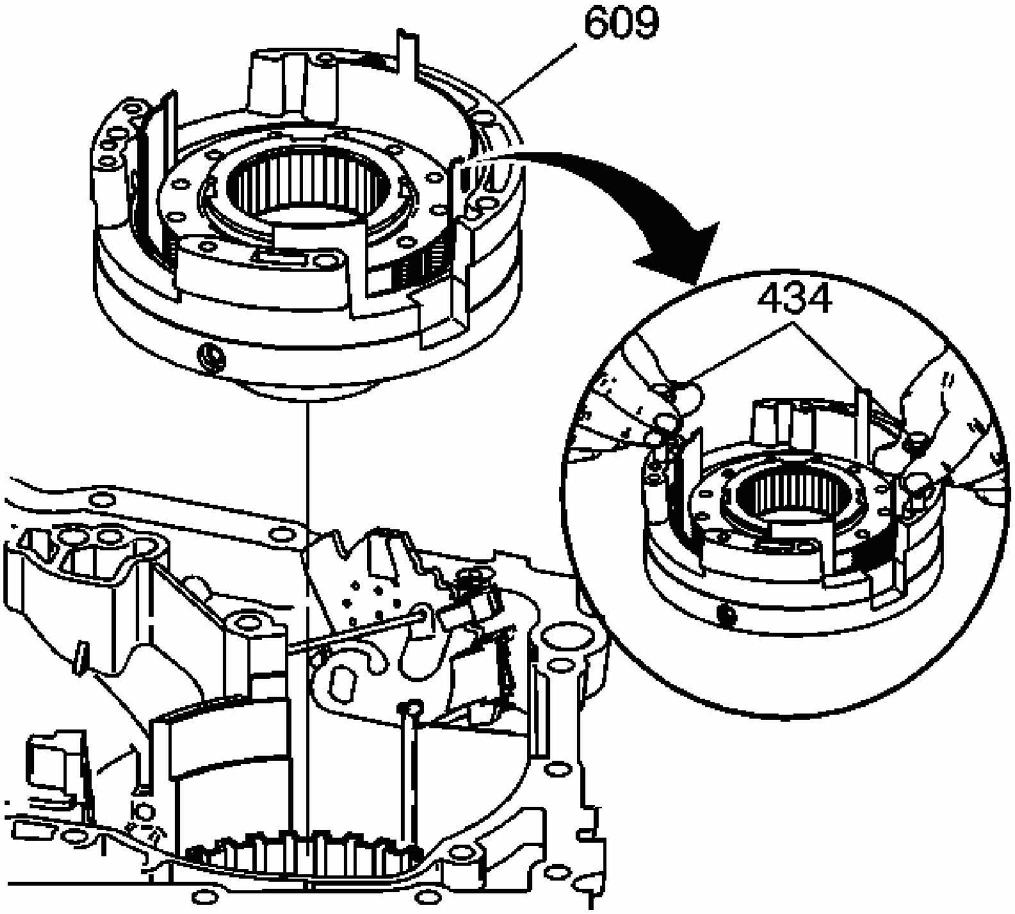


Fig. 244: Installing Case Cover Bolts Into Driven Sprocket Support Assembly
Courtesy of GENERAL MOTORS CORP.

2. Finger start two 13 mm case cover bolts (434) into the driven sprocket support assembly (609).

IMPORTANT: If the driven sprocket support assembly (609) is not flush with or slightly below the case, then one of the clutches is not fully seated.

3. Using the bolts (434), lift the driven sprocket support assembly (609) into the case and align as shown. The top of the driven sprocket support assembly (609) should be flush with the case.

DRIVE SPROCKET AND TURBINE SHAFT DISASSEMBLE

Disassembly Procedure

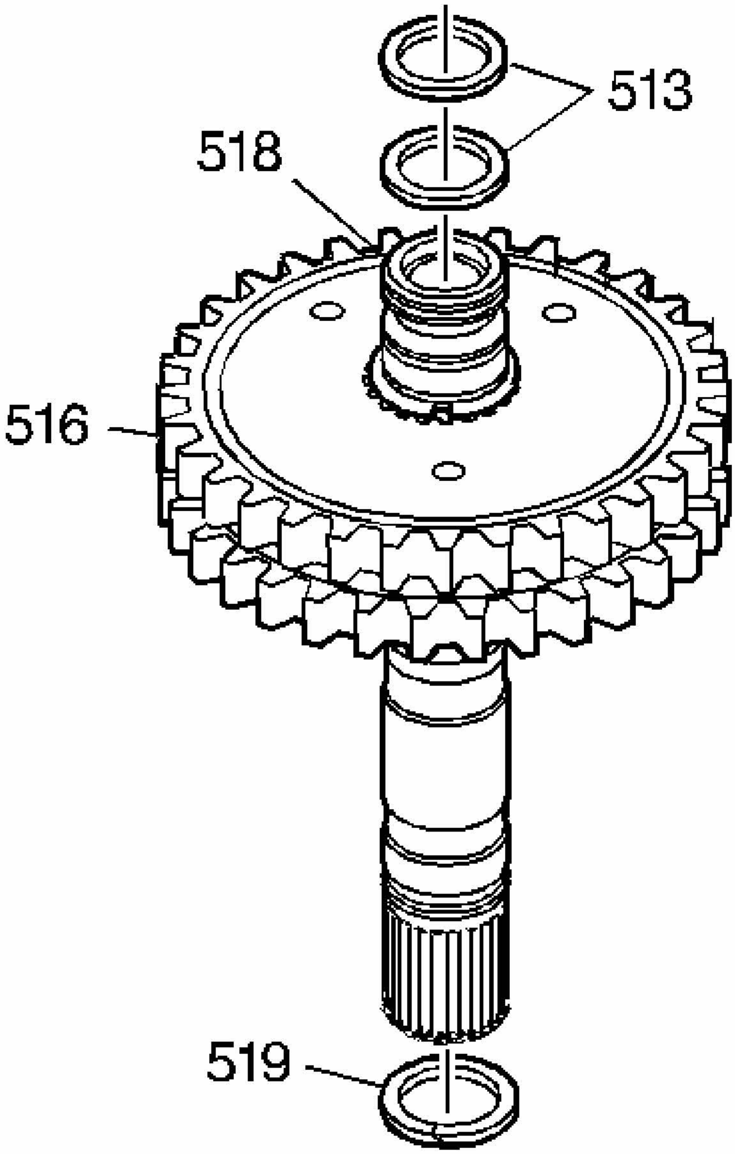


Fig. 245: Removing Oil Seal Rings From Turbine Shaft
Courtesy of GENERAL MOTORS CORP.

NOTE: **Do not damage the grooves on the shaft, when removing the oil seal rings.**

1. Cut the oil seal rings (513, 519) from the turbine shaft (518).
2. Remove the oil seal rings (513, 519).

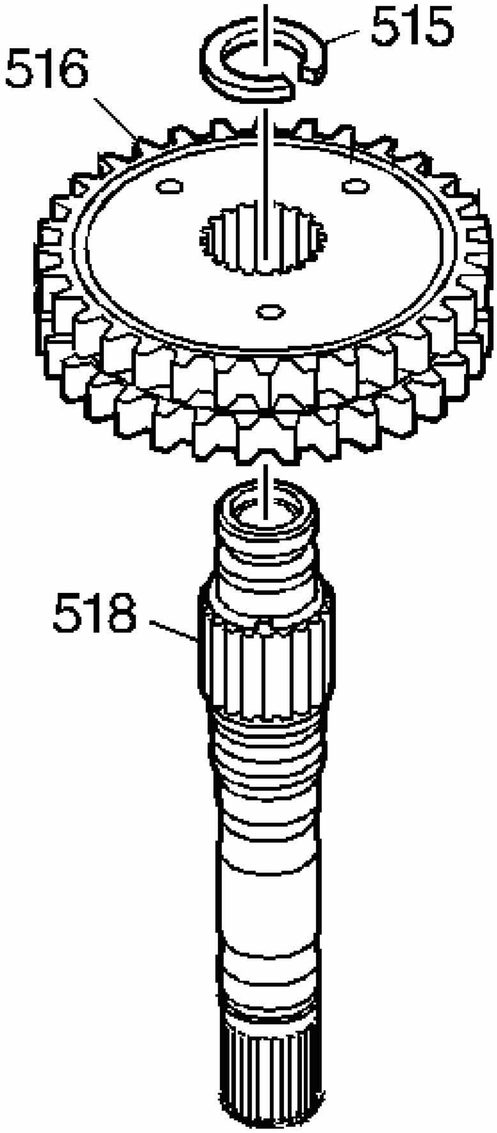


Fig. 246: View Of Turbine Drive Sprocket & Retaining Ring
Courtesy of GENERAL MOTORS CORP.

3. Remove the drive sprocket retaining ring (515).
4. Remove the drive sprocket (516) from the turbine shaft (518).

DRIVE SPROCKET AND TURBINE SHAFT ASSEMBLE

Tools Required

- **J 29569-1** Turbine Shaft Seal Installer (Chain Side) Expander
- **J 29569-2** Turbine Shaft Seal Installer (Chain Side) Compressor
- **J 29829-1A** Turbine Shaft Seal Installer (Converter Side) Expander. See **Special Tools**.
- **J 29829-2** Turbine Shaft Seal Installer (Converter Side) Compressor. See **Special Tools**.
- **J 36850** Assembly Lubricant (or equivalent)

Assembly Procedure

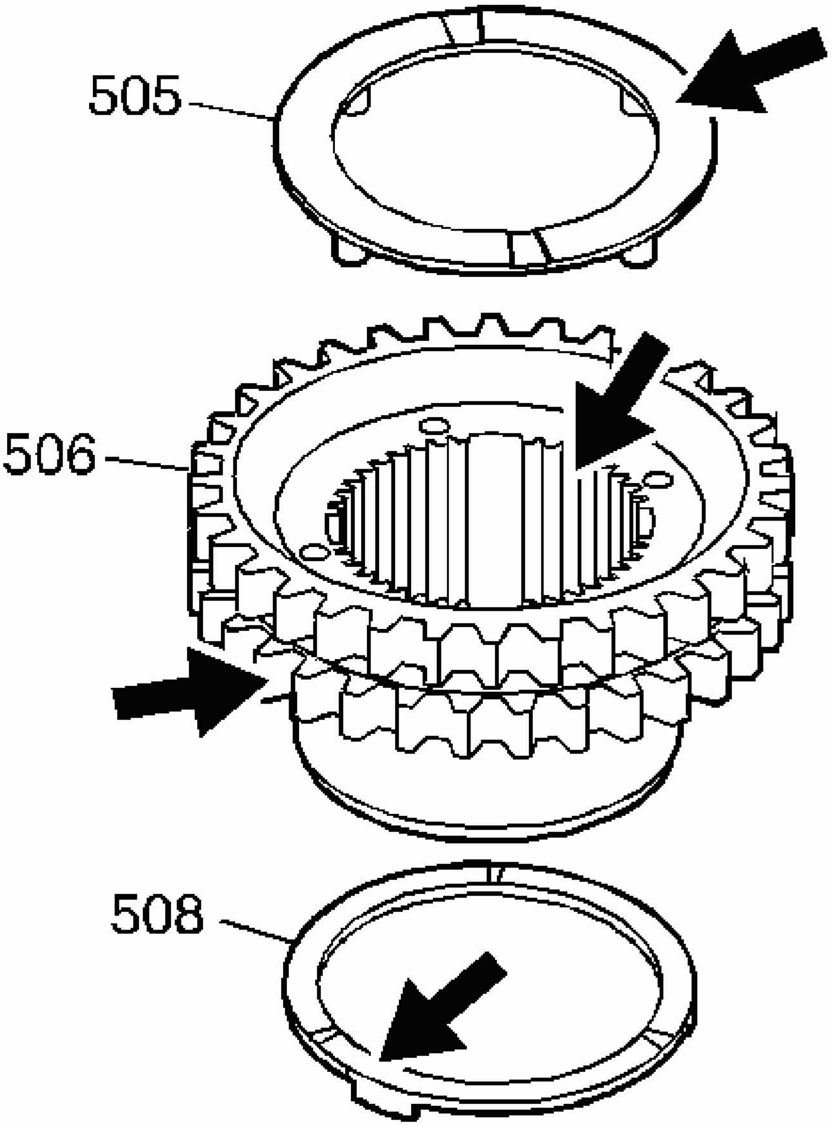


Fig. 247: Identifying Driven Sprockets Inspection Areas
Courtesy of GENERAL MOTORS CORP.

1. Inspect the driven sprocket (506) for the following:
   - Worn or chipped teeth
   - Uniform teeth size
   - Stripped or damaged splines
   - Bearing surface damage

2. Inspect the fourth clutch shaft thrust washer (505) and the driven sprocket thrust washer (508) for wear or cracks.

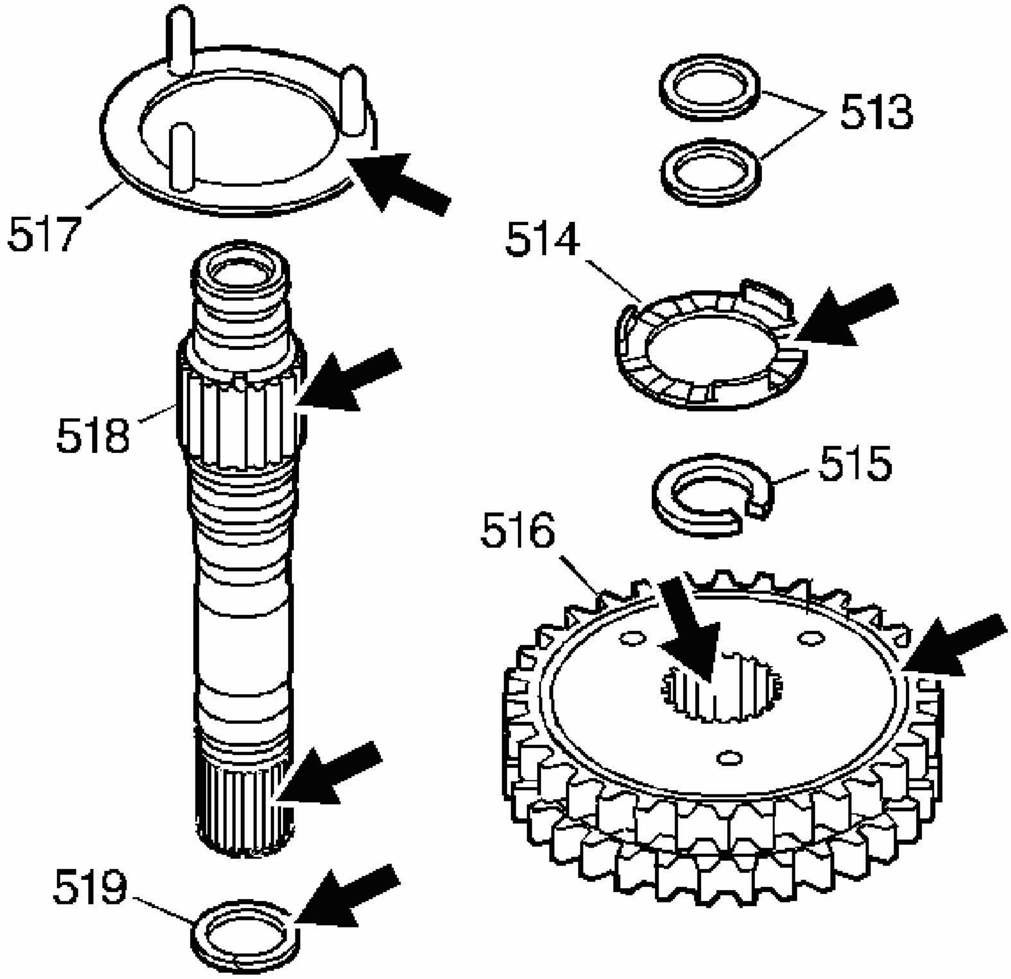


Fig. 248: Drive Sprocket & Components Inspection Areas
Courtesy of GENERAL MOTORS CORP.

3. Inspect the drive sprocket (516) for the following:
    - Worn or chipped teeth
    - Uniform teeth size
    - Stripped or damaged splines
    - Bearing surface damage
4. Inspect the turbine shaft (518) for the following:
    - A cracked sleeve

- Damaged bushing journals
- Stripped or damaged splines

5. Inspect the drive sprocket thrust washers (514, 517) for wear or cracks.

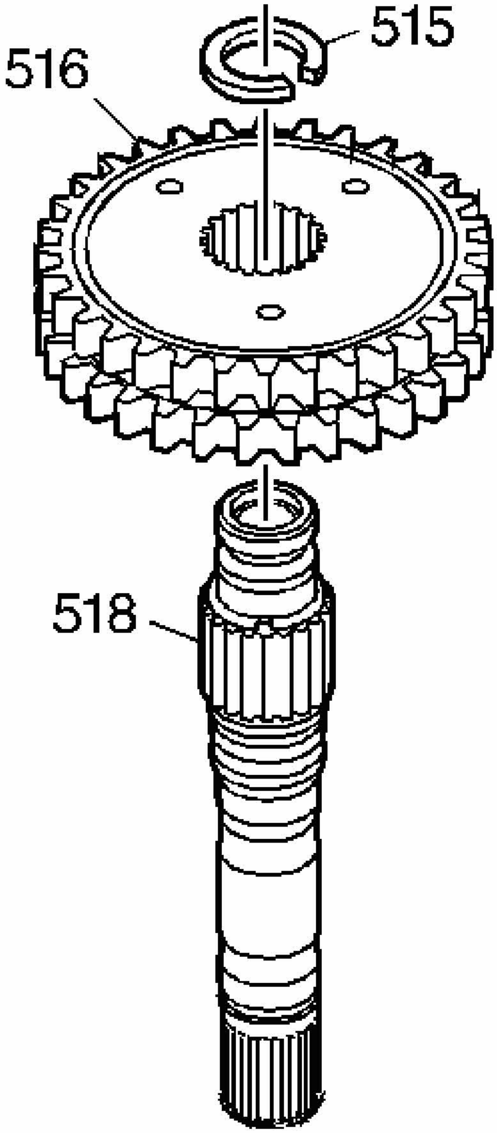


Fig. 249: View Of Turbine Drive Sprocket & Retaining Ring
Courtesy of GENERAL MOTORS CORP.

6. Insert the turbine shaft (518) into the drive sprocket (516) and attach the drive sprocket retaining ring (515).

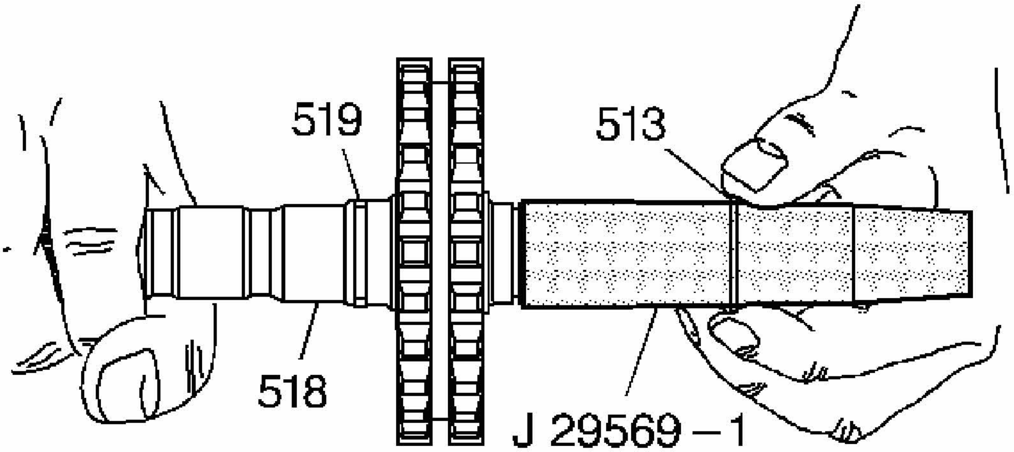


Fig. 250: Sliding Turbine Shaft Oil Seal Rings Into Position
Courtesy of GENERAL MOTORS CORP.

7. Install **J 29569-1** onto the turbine shaft (518). Coat the tool shaft with **J 36850** or equivalent.
8. Slide the turbine shaft oil seal rings (513) into position.

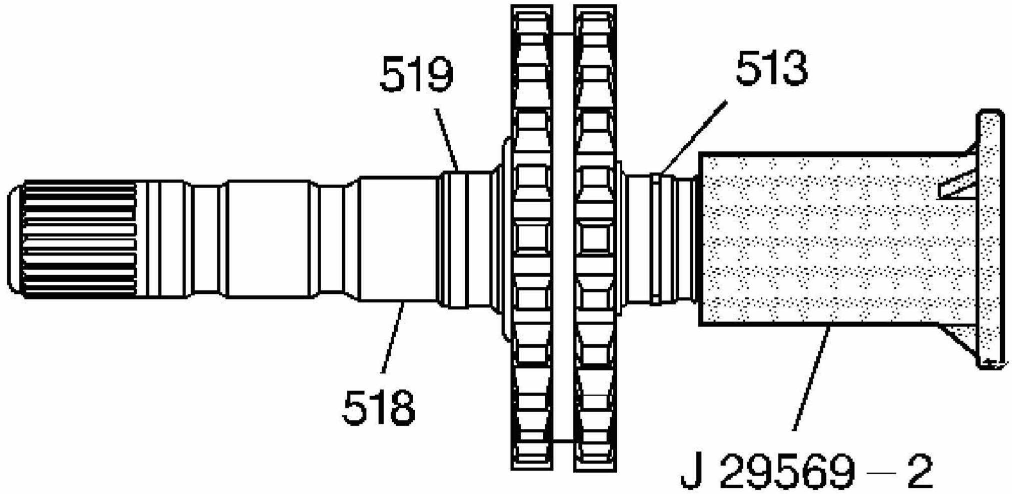


Fig. 251: Sizing Turbine Shaft Oil Seal Rings With J 29569-2
Courtesy of GENERAL MOTORS CORP.

9. Use **J 29569-2** in order to size the turbine shaft oil seal rings (513).

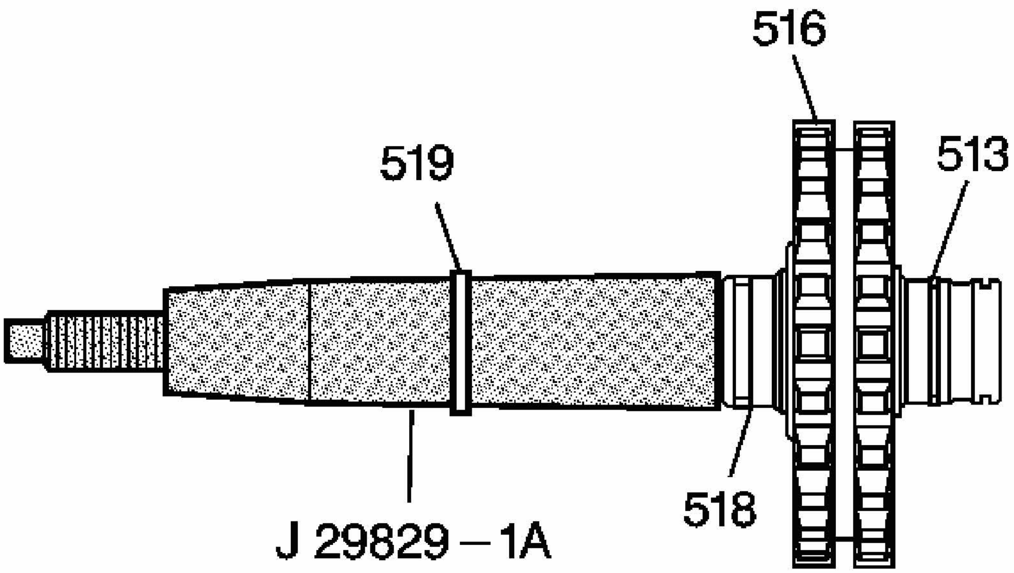


Fig. 252: Installing J 29829-1A On Turbine Shaft
Courtesy of GENERAL MOTORS CORP.

10. Install **J 29829-1A** onto the turbine shaft (518). See **Special Tools**. Coat the tool shaft with **J 36850** or equivalent.
11. Slide the turbine shaft oil seal ring (519) into position.

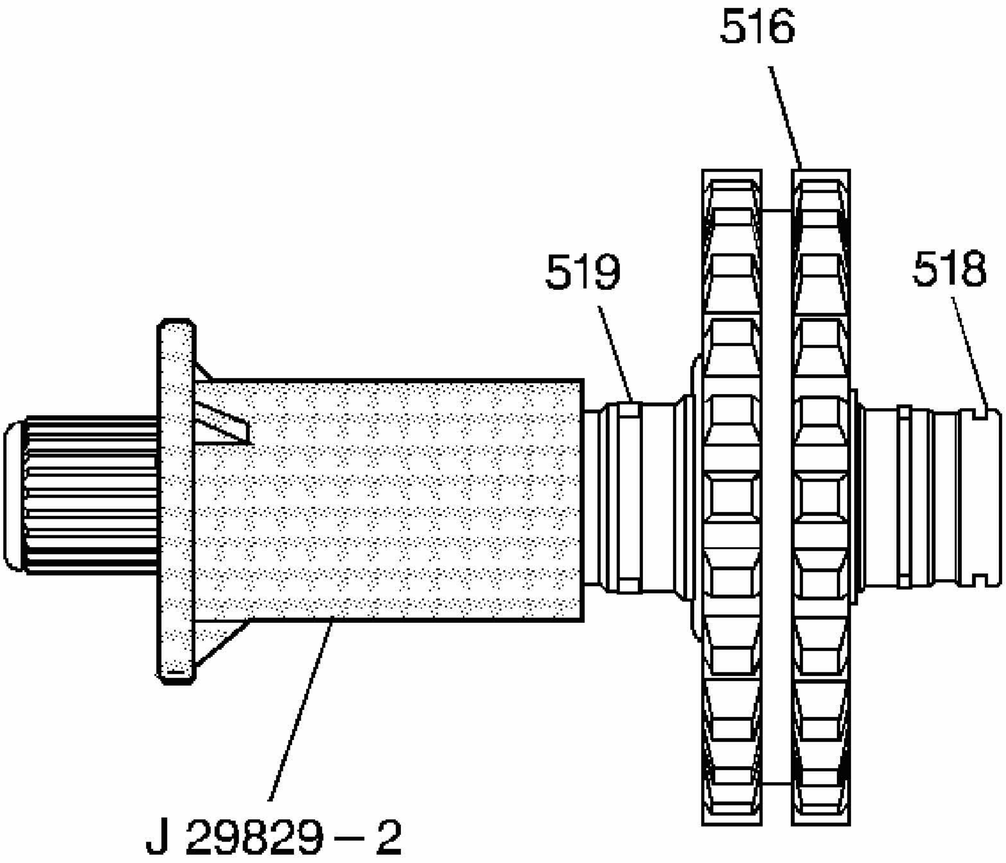


Fig. 253: Using J 29829-2 To Size The Turbine Shaft Oil Seal Ring
Courtesy of GENERAL MOTORS CORP.

12. Use **J 29829-2** in order to size the turbine shaft oil seal ring (519). See **Special Tools**.

DRIVE AND DRIVEN SPROCKET COMPONENTS ASSEMBLE

Tools Required

J 36850 Assembly Lubricant (or equivalent)

Assembly Procedure

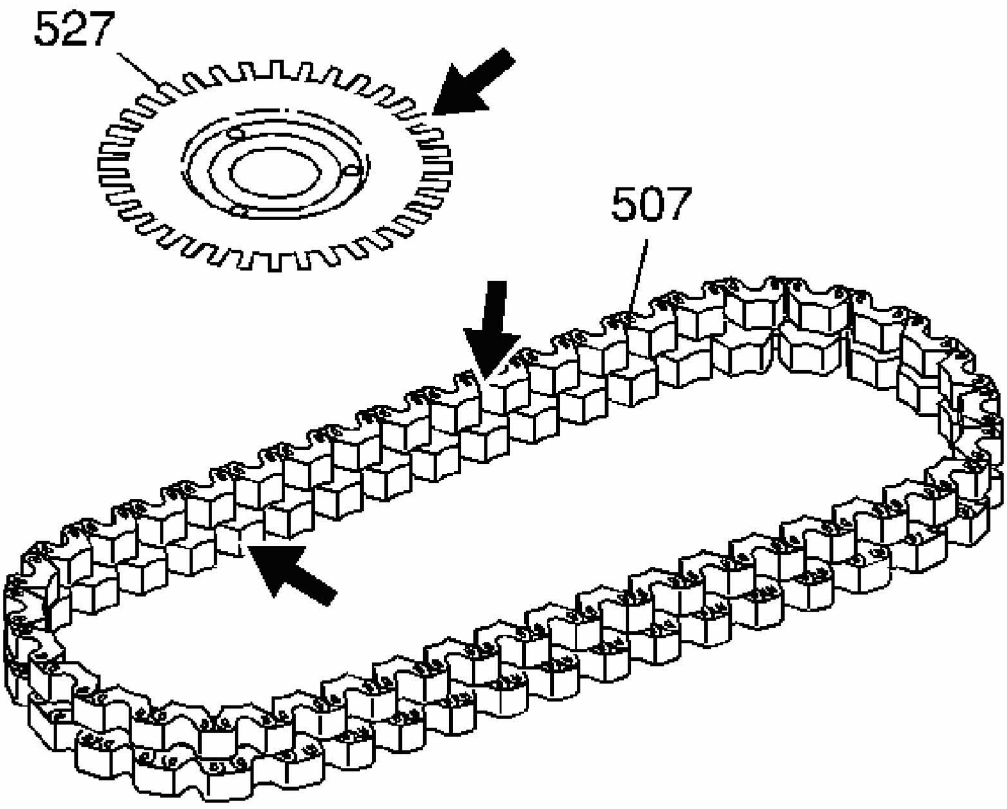


Fig. 254: Inspection Areas On Drive Link Assembly
Courtesy of GENERAL MOTORS CORP.

1. Inspect the drive link assembly (507) for damaged, cracked or binding links.
2. Inspect the input speed sensor reluctor wheel (527) for damaged reluctor teeth, worn or damaged thrust surface or damaged or missing locating pins.

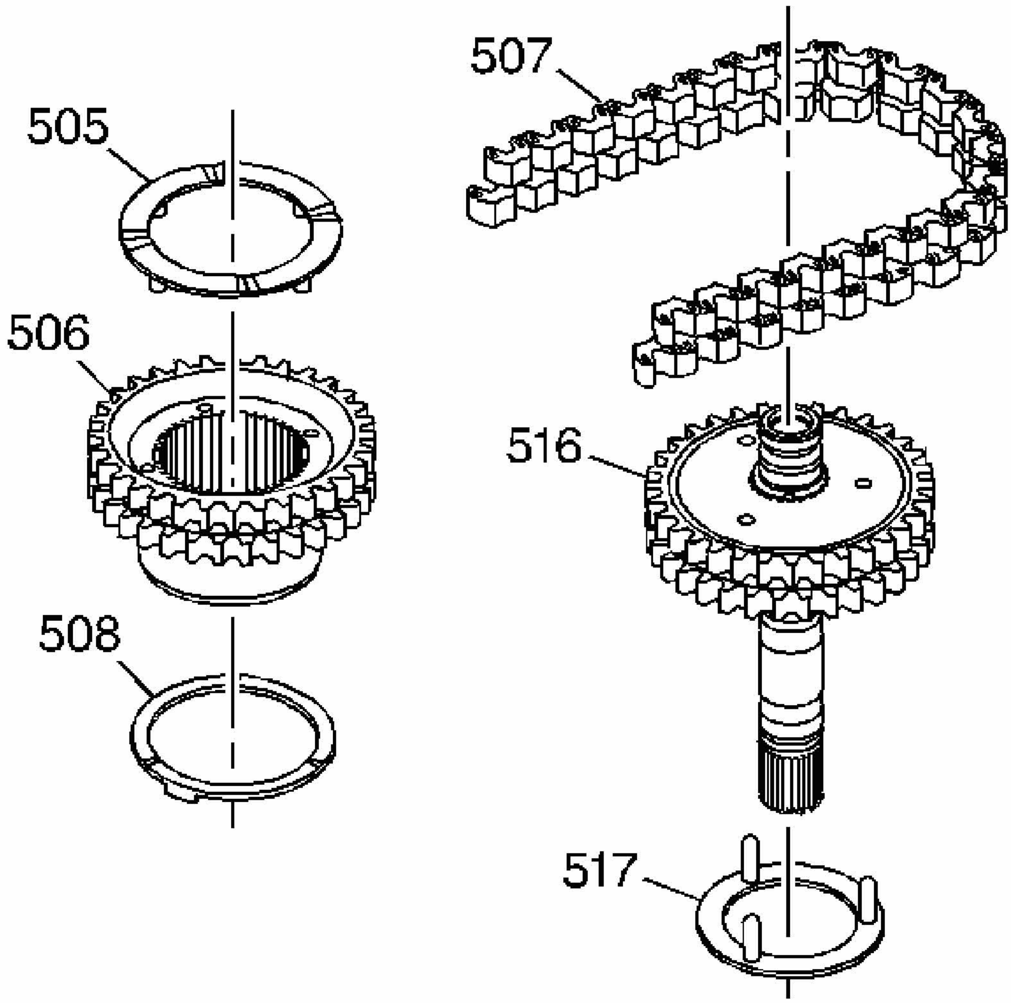


Fig. 255: Installing Drive & Driven Sprockets Into Drive Link Assembly
Courtesy of GENERAL MOTORS CORP.

3. Use **J 36850** or equivalent in order to retain the drive sprocket thrust washer (517) onto the drive sprocket (516).
4. Use **J 36850** or equivalent in order to retain the driven sprocket thrust washer (508) onto the driven sprocket (506).

IMPORTANT: The drive link assembly must be installed correctly.

5. Assemble the drive (516) and driven (506) sprockets into the drive link assembly (507) according to one of the following criteria:

- If the old drive link is being reinstalled, position both drive link assemblies with the master link (different color) facing up or down, whichever way it was found during disassembly
- If a new drive link assembly is being installed, position both drive link assemblies with the master link facing upward.

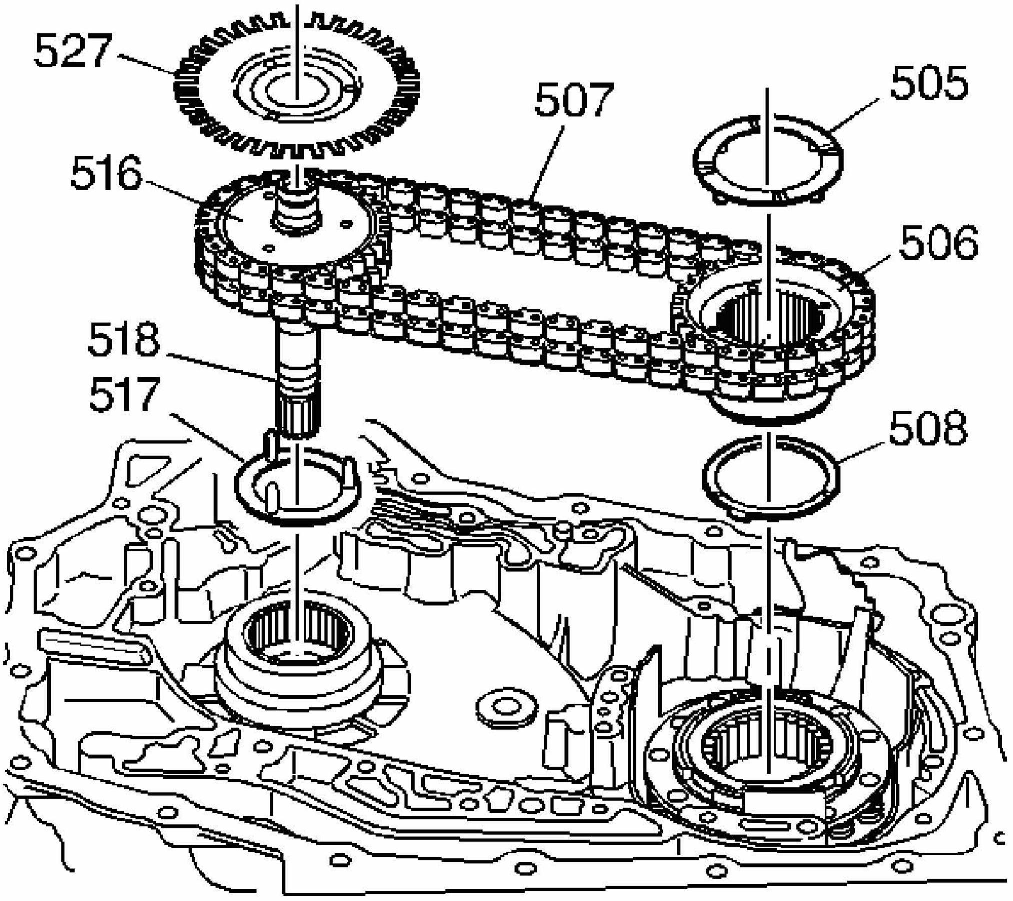


Fig. 256: View Of Drive Link Assembly & Sprockets
Courtesy of GENERAL MOTORS CORP.

6. Install the drive link assembly (507) and the sprockets (506, 516) into the case by hand. A slight rocking motion may be required in order to work the sprockets into place.
7. Install the input speed sensor reluctor wheel (527) onto the drive sprocket (516).
8. Install the 4th clutch shaft thrust washer (505) onto the driven sprocket (506).

FOURTH CLUTCH COMPONENTS ASSEMBLE

Assembly Procedure

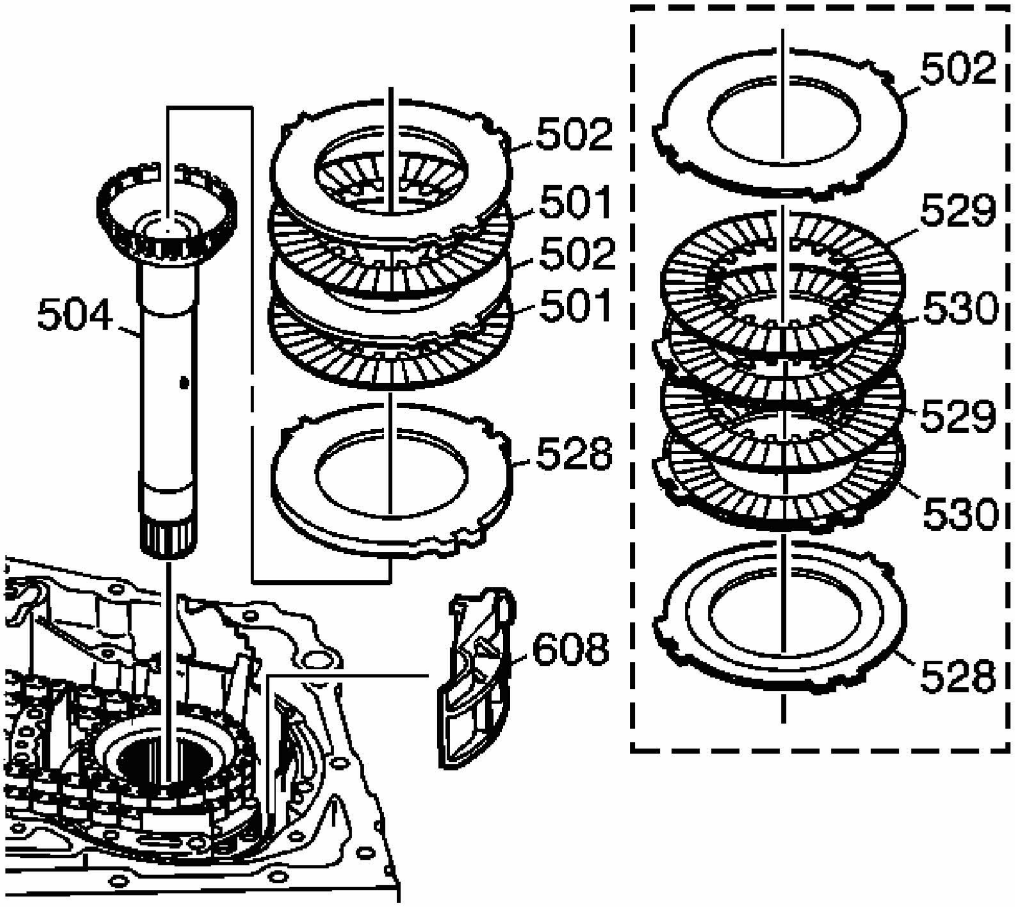


Fig. 257: Identifying Fourth Clutch Assembly
Courtesy of GENERAL MOTORS CORP.

1. Inspect the fourth clutch assembly for the following conditions:
    - Wear or damage to the steel plates (502, 528)
    - Peened splines, flaking or worn fiber on the fiber plate assemblies (501), (529) and (530)
2. Inspect the fourth clutch shaft assembly (504) for the following conditions:
    - Cut or worn fourth clutch plate splines
    - Stripped input sun gear splines
    - A damaged bushing journal
    - Cracks or damage to the hub or shaft

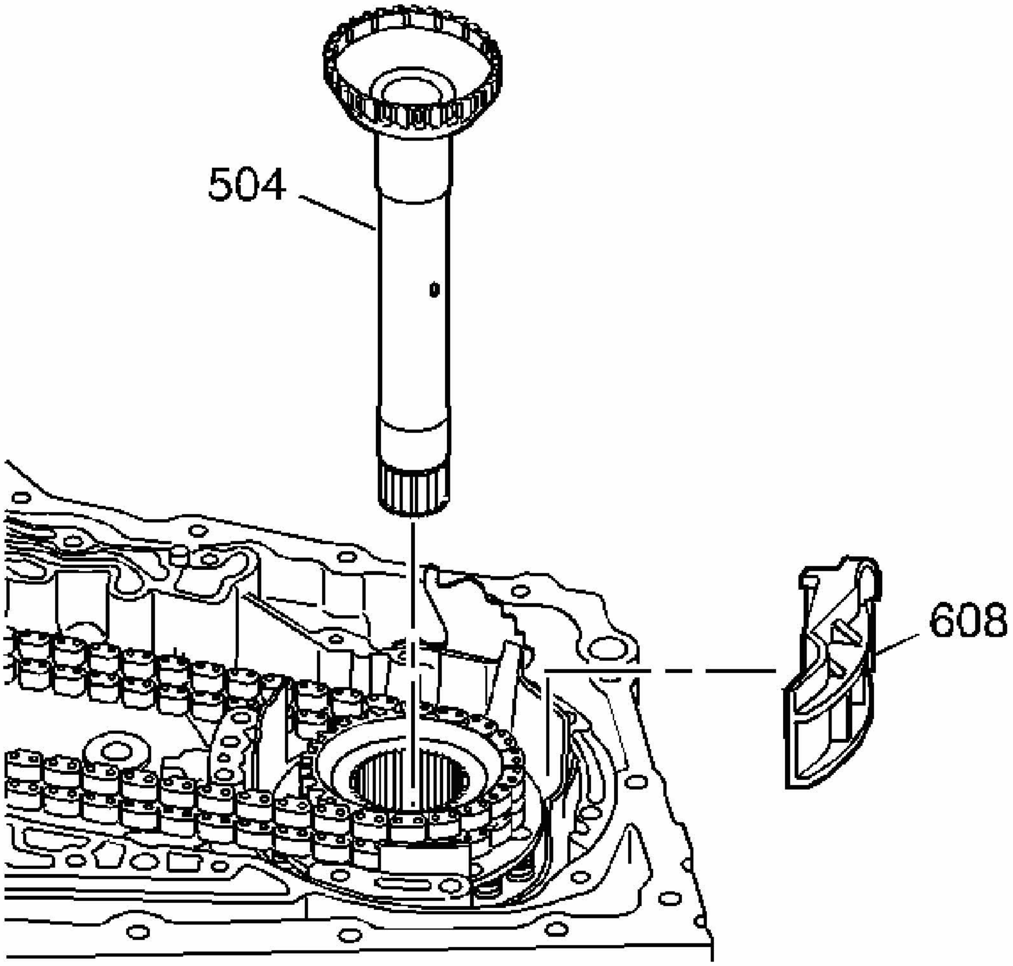


Fig. 258: Locating Fourth Clutch Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

3. Install the fourth clutch shaft assembly (504) into the case through the driven sprocket. The fourth clutch shaft assembly (504) must fully seat into the input sun gear.
4. Install the drive link lube scoop (608) into the case.

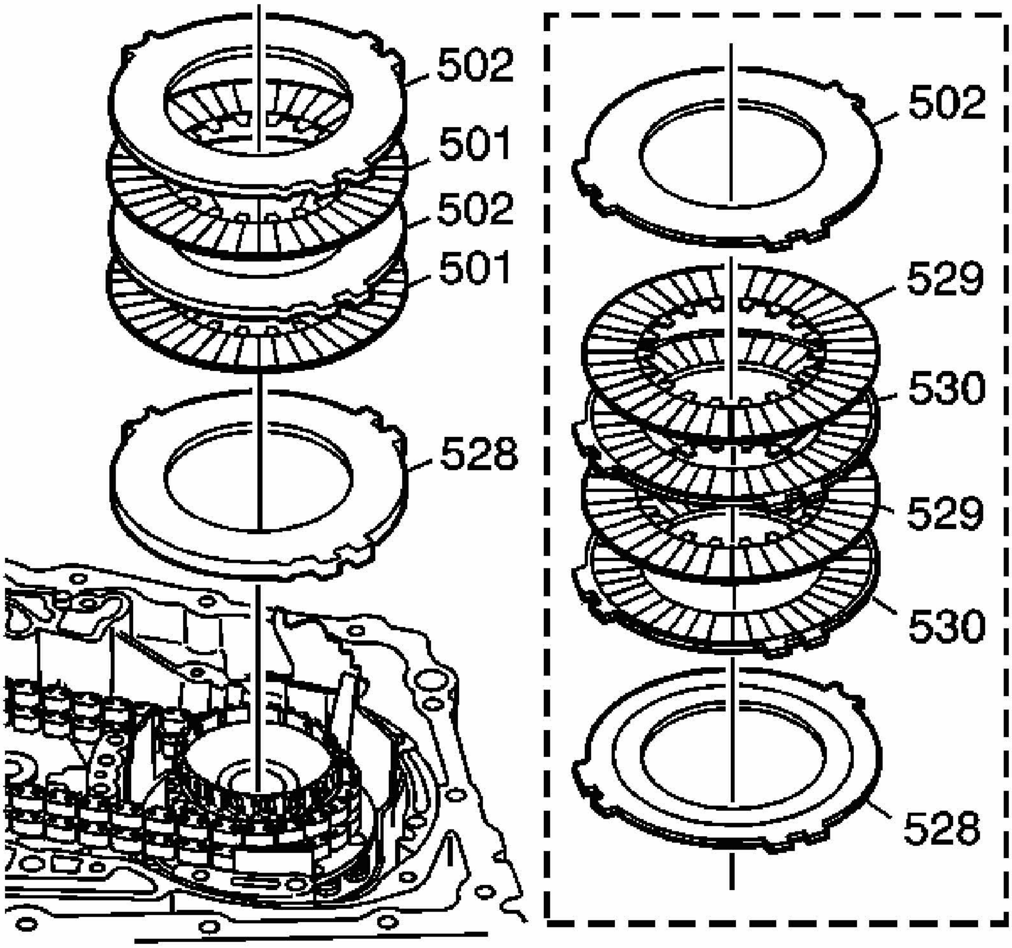


Fig. 259: Identifying Fourth Clutch Components
Courtesy of GENERAL MOTORS CORP.

5. Install the fourth clutch apply plate (528) over the fourth clutch shaft assembly and into the driven sprocket support with the machined side towards the driven sprocket.
6. Install the remaining fourth clutch plates, starting with a fiber plate assembly (501) and alternating with steel plates (502). Some models use fiber on one side of each inner and outer plate (529, 530). Install with the fiber side up.
7. The fourth clutch steel plates (502, 528) should align with the driven sprocket support as shown.

CASE COVER COMPONENTS DISASSEMBLE (WITHOUT TOUCH ACTIVATED POWER)

Disassembly Procedure

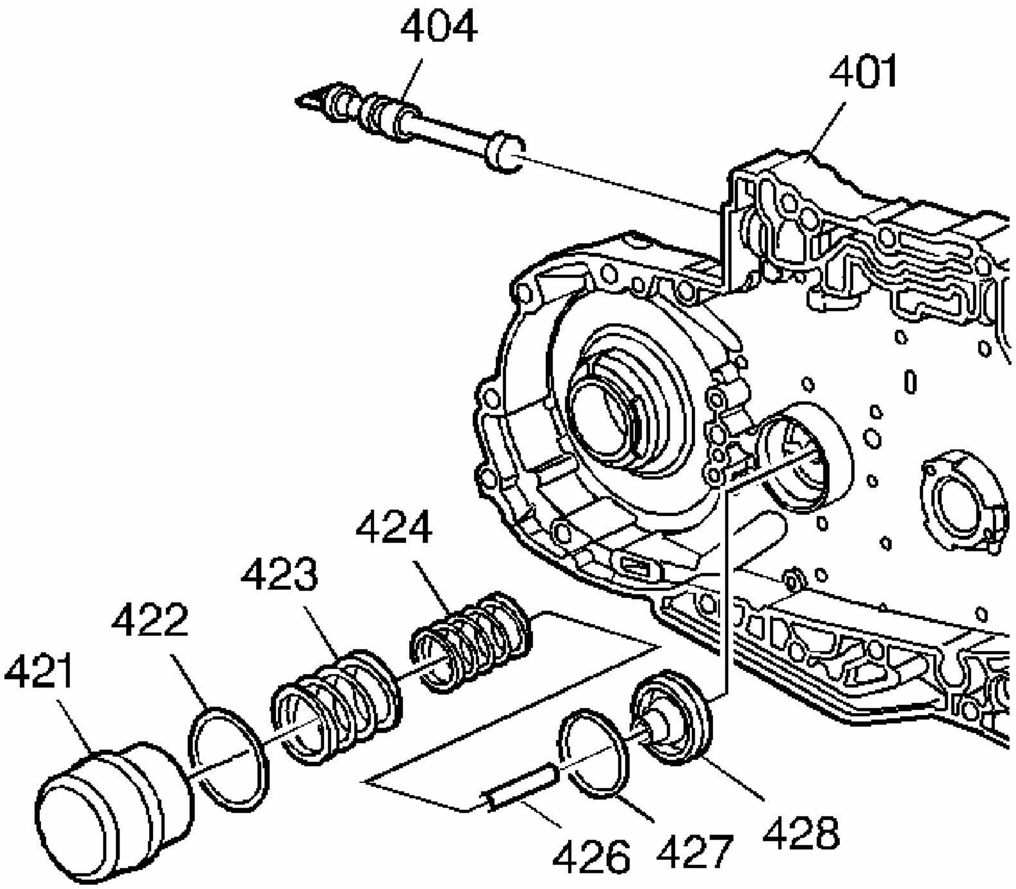


Fig. 260: Locating 3-4 Accumulator Piston Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not remove any of the bore plugs unless inspection indicates that replacement is necessary.

1. Remove the manual valve (404).
2. Remove the 3-4 accumulator piston cylinder (421) and the 3-4 accumulator piston O-ring seal (422). Use low pressure compressed air from the valve body side if necessary for removal.
3. Remove the 3-4 accumulator piston outer spring (423) and inner spring (424).
4. Remove the 3-4 accumulator piston (428).
5. Remove the 3-4 accumulator piston pin (426) from the valve body side of the case cover (401).

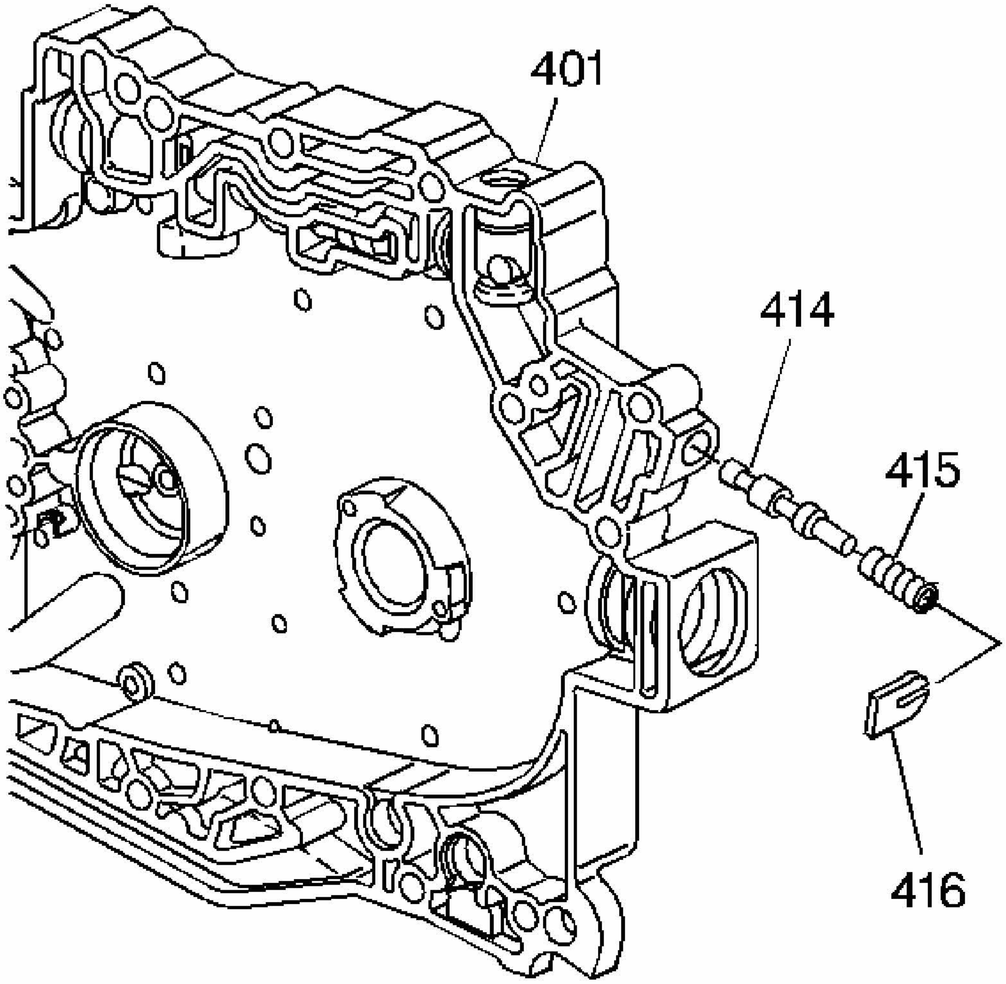


Fig. 261: Identifying 3-4 Accumulator Piston Pin, Valve Body & Case Cover
Courtesy of GENERAL MOTORS CORP.

CAUTION: Valve Springs can be tightly compressed. Use care when removing retainers and plugs. Personal injury could result.

6. Remove the actuator feed limit valve spring retainer (416).
7. Remove the actuator feed limit valve spring (415).
8. Remove the actuator feed limit valve (414).

CASE COVER COMPONENTS DISASSEMBLE (WITH TOUCH ACTIVATED POWER)

Disassembly Procedure

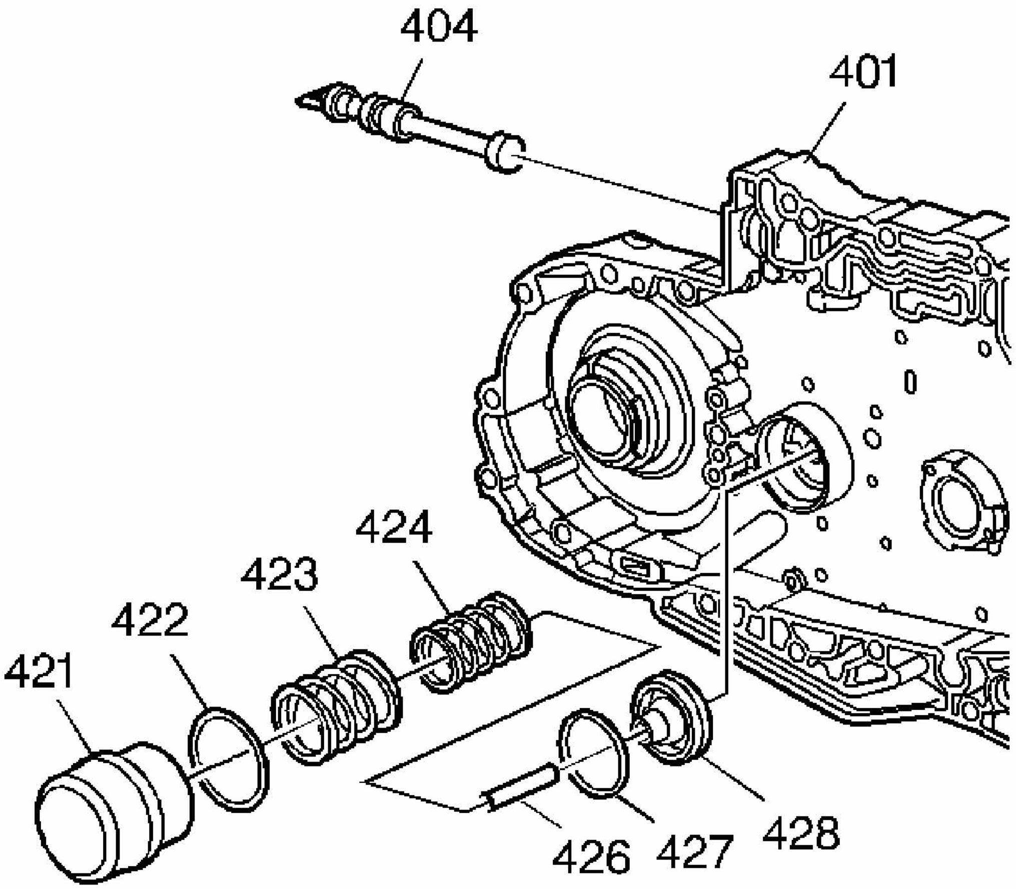


Fig. 262: Locating 3-4 Accumulator Piston Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not remove any of the bore plugs unless inspection indicates that replacement is necessary.

1. Remove the manual valve (404).
2. Remove the 3-4 accumulator piston cylinder (421) and the 3-4 accumulator piston O-ring seal (422). Use low pressure compressed air from the valve body side if necessary for removal.
3. Remove the 3-4 accumulator piston outer spring (423) and inner spring (424).
4. Remove the 3-4 accumulator piston (428).
5. Remove the 3-4 accumulator piston pin (426) from the valve body side of the case cover (401).

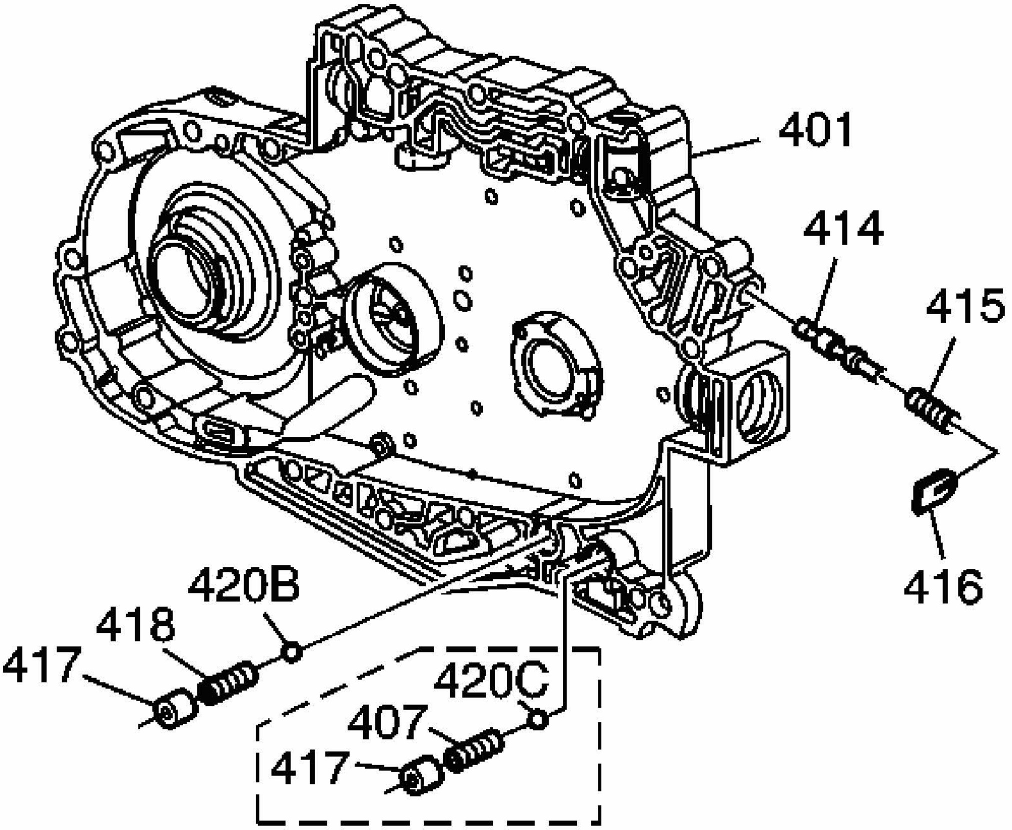


Fig. 263: Expanded View Of Case Cover Components
Courtesy of GENERAL MOTORS CORP.

CAUTION: Valve Springs can be tightly compressed. Use care when removing retainers and plugs. Personal injury could result.

6. Remove the actuator feed limit valve spring retainer (416).
7. Remove the actuator feed limit valve spring (415).
8. Remove the actuator feed limit valve (414).
9. Remove the low regulator valve bore plug (444).
10. Remove the low regulator valve (443).
11. Remove the low regulator valve spring (442).

CASE COVER COMPONENTS INSPECTION (WITHOUT TOUCH ACTIVATED POWER)

Inspection Procedure

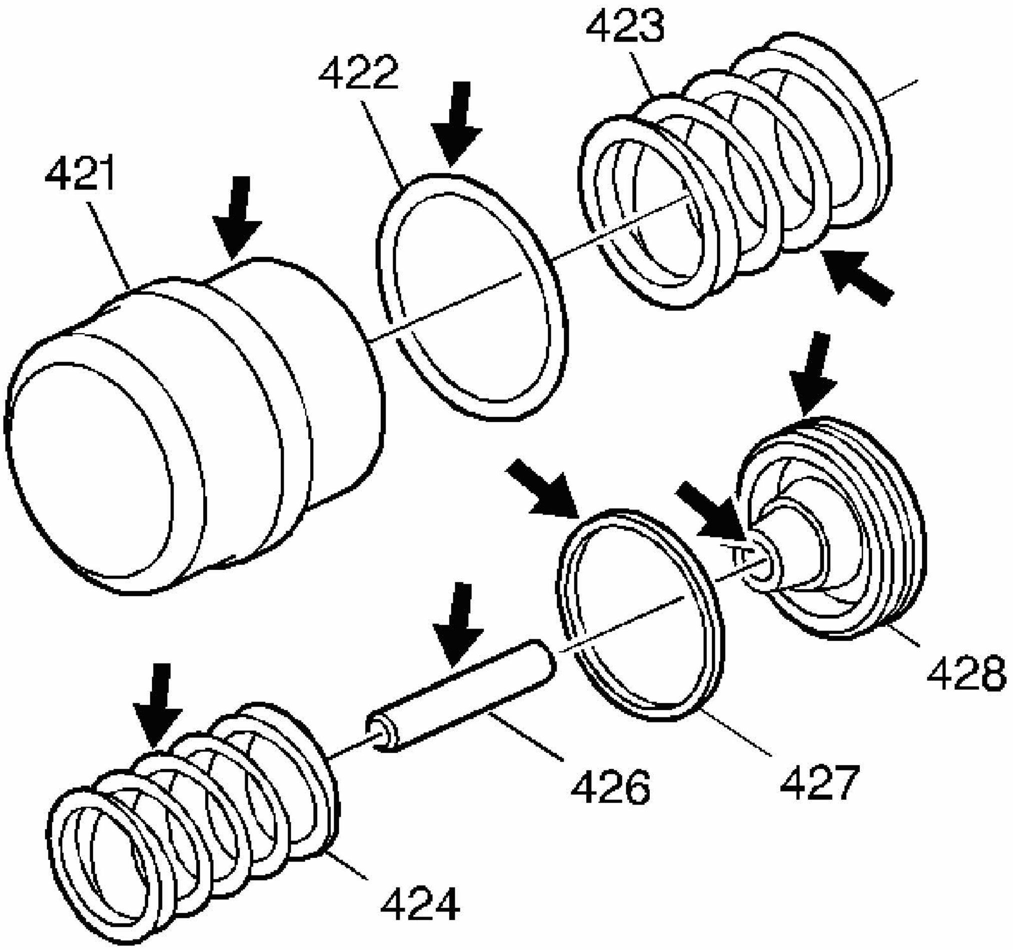


Fig. 264: Identifying 3-4 accumulator piston Inspection Areas
Courtesy of GENERAL MOTORS CORP.

1. Inspect the 3-4 accumulator piston (428) for the following conditions:
    - Porosity
    - A scored pin bore
    - A nicked piston seal groove
2. Inspect the 3-4 accumulator piston pin (426) for scoring and free movement in the 3-4 accumulator piston bore.
3. Inspect the 3-4 accumulator outer spring (423) and inner spring (424) for distorted or broken coils.
4. Inspect the 3-4 accumulator piston cylinder (421) for the following conditions:
    - Porosity or cracks

- A rough or scored seal surface
- A cut seal (422)

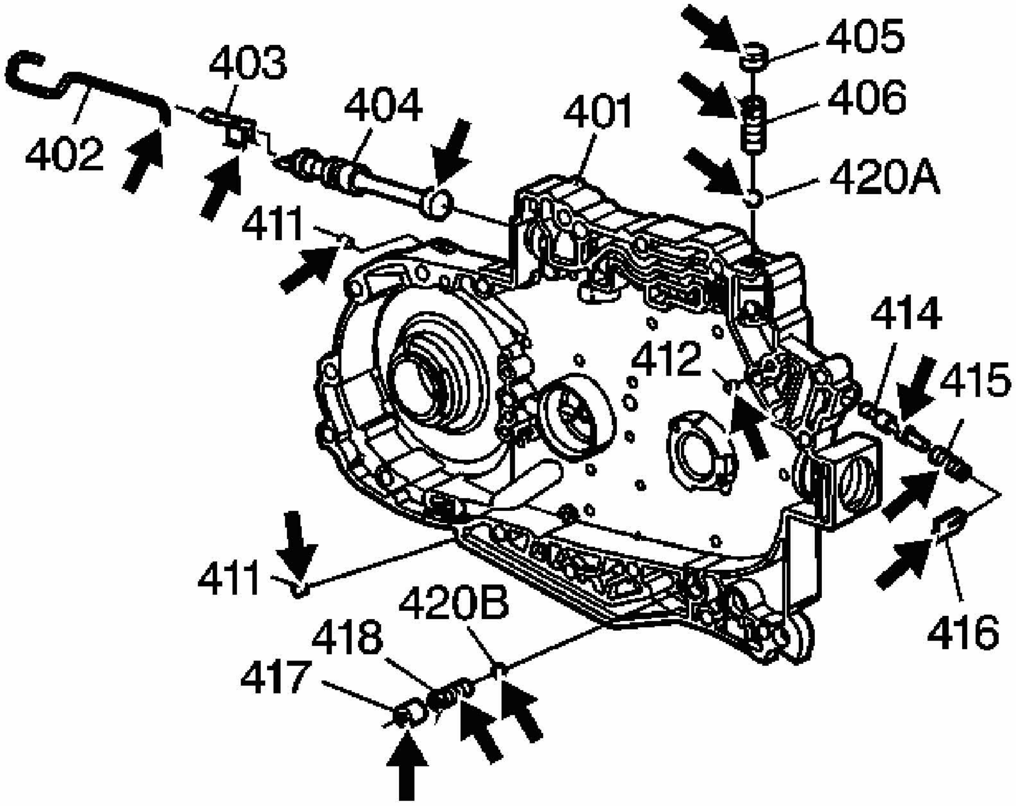


Fig. 265: Identifying Case Cover Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not remove the blowoff valves unless the ball valves are damaged.

5. Inspect the low blow off ball valve (420A), the low blow off ball valve spring (406) and the low blow off ball valve bore plug (405).
6. Inspect the TCC blow off ball valve (420B), the TCC blow off ball valve spring (418) and the TCC blow off ball valve bore plug (417).
7. Inspect the manual valve (404), the manual valve link (402) and the manual valve clip (403) for damage.
8. Inspect the manual valve (404) for binding or looseness in the case cover assembly (401).

9. Inspect the case cover bore plugs (411) and the orificed cup plug (412). Correct the following conditions:
   - Plug is loose
   - Plug is missing
   - Orifice is plugged

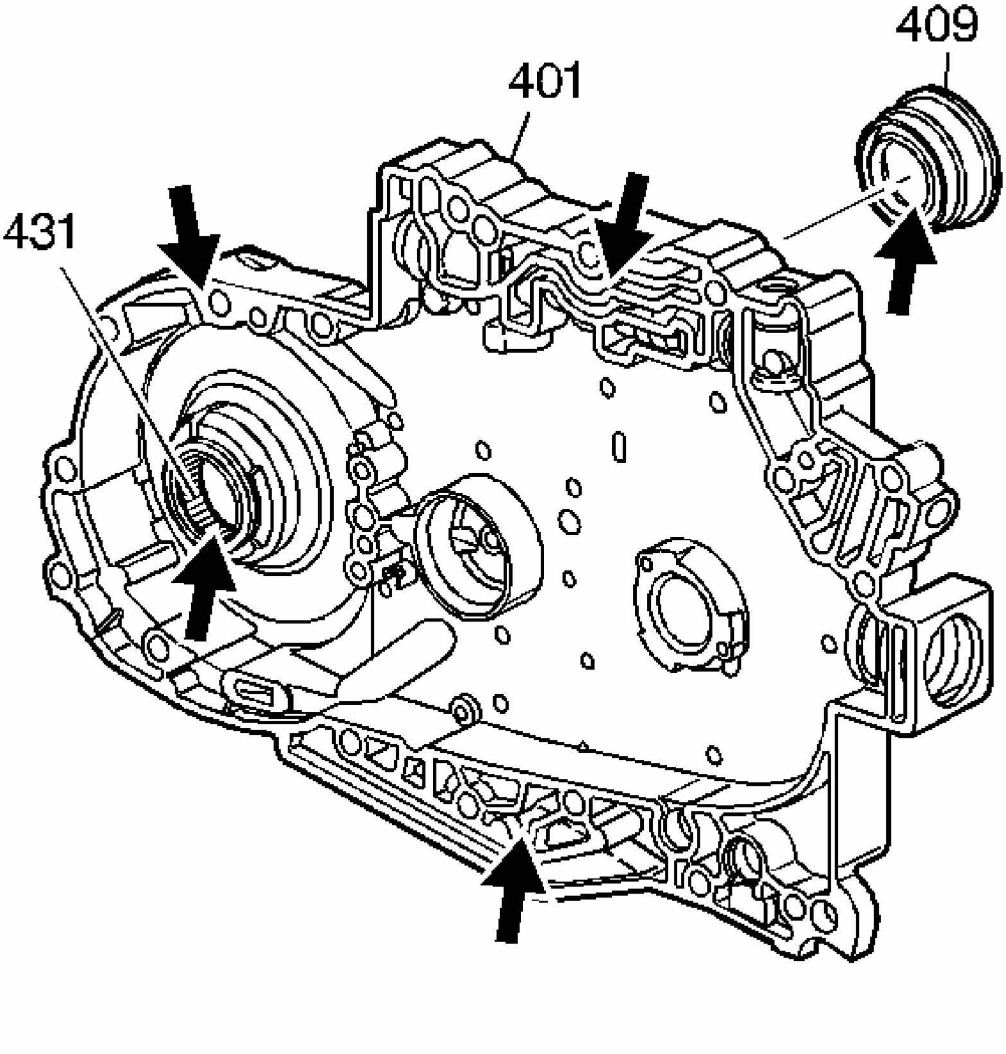


Fig. 266: Locating Inspection Areas On Drive Shaft Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not remove the drive shaft bearing (431) unless the bearing is damaged.

10. Inspect the drive shaft bearing assembly (431).

11. Inspect the axle oil seal assembly (409) for a missing garter spring or for a cut lip seal.
12. Inspect the case cover (401) for the following:
    - Porosity
    - Interconnected fluid passages
    - Cracks or rough machined surfaces

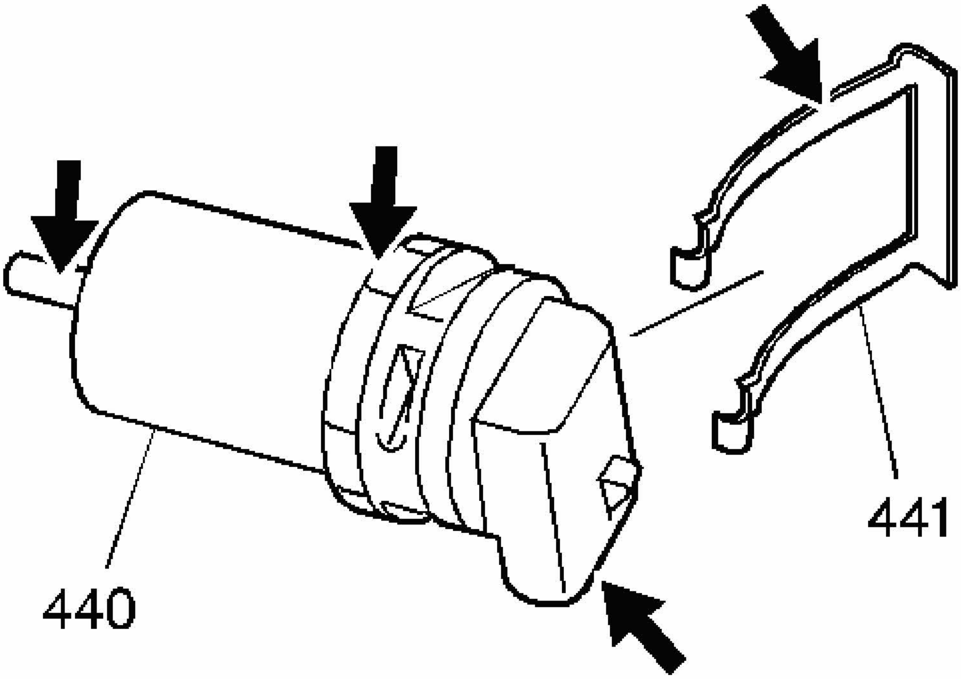


Fig. 267: Inspecting Input Speed Sensor
Courtesy of GENERAL MOTORS CORP.

13. Inspect the input speed sensor assembly (440) for the following conditions:
    - Damaged or missing magnet
    - Damaged housing
    - Bent or missing electrical terminals
    - Damaged input speed sensor clip (441)

CASE COVER COMPONENTS INSPECTION (WITH TOUCH ACTIVATED POWER)

Inspection Procedure

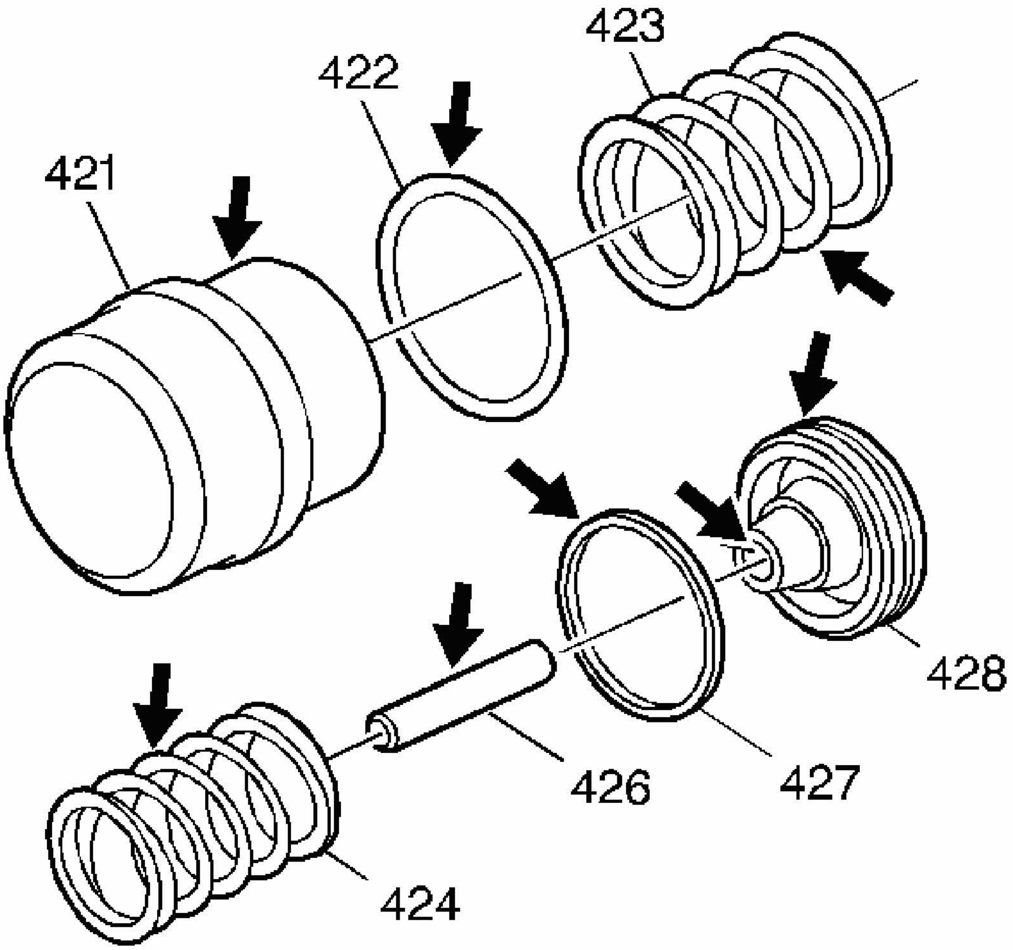


Fig. 268: Identifying 3-4 accumulator piston Inspection Areas
Courtesy of GENERAL MOTORS CORP.

1. Inspect the 3-4 accumulator piston (428) for the following conditions:
    - Porosity
    - A scored pin bore
    - A nicked piston seal groove
2. Inspect the 3-4 accumulator piston pin (426) for scoring and free movement in the 3-4 accumulator piston bore.
3. Inspect the 3-4 accumulator outer spring (423) and inner spring (424) for distorted or broken coils.
4. Inspect the 3-4 accumulator piston cylinder (421) for the following conditions:
    - Porosity or cracks

- A rough or scored seal surface
- A cut seal (422)

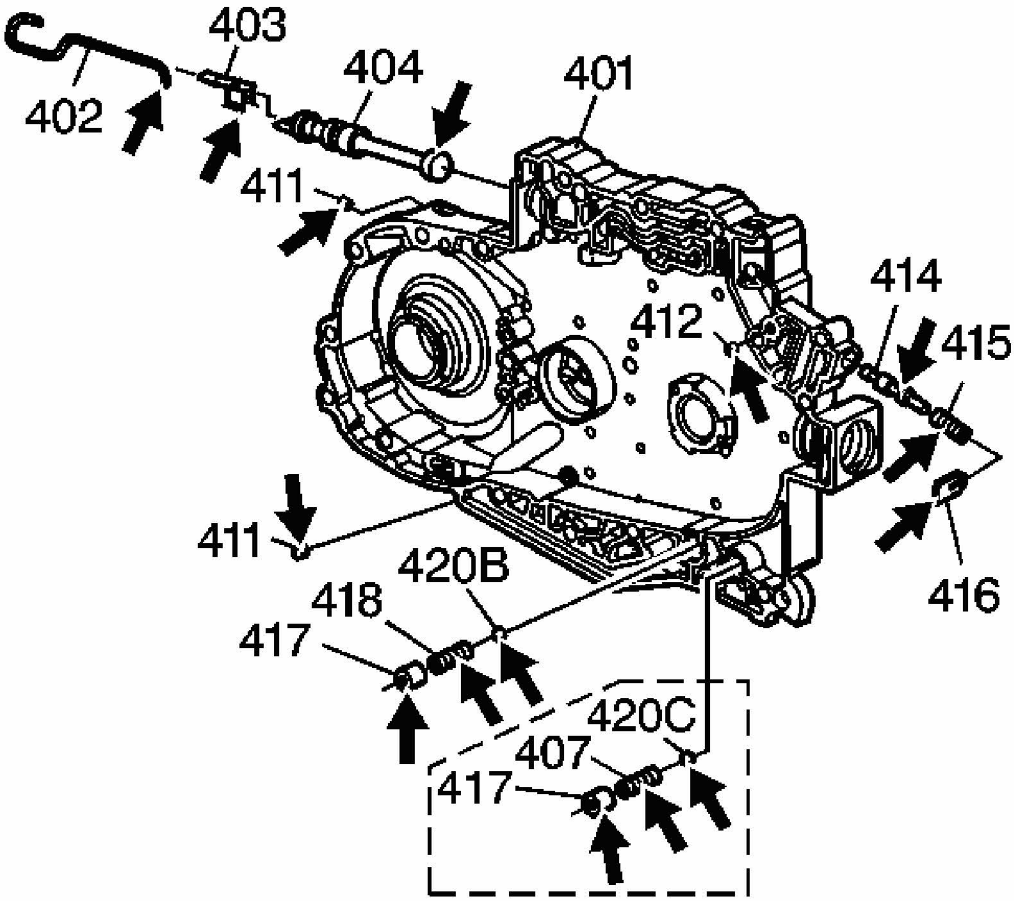


Fig. 269: View Of Case Cover Assembly Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not remove the blowoff valves unless the ball valves are damaged.

5. Inspect the low regulator valve spring (422), the low regulator valve (443) and the low regulator valve bore plug (444).
6. Inspect the TCC blow off ball valve (420B), the TCC blow off ball valve spring (418) and the TCC blow off ball valve bore plug (417).
7. Inspect the manual valve (404), the manual valve link (402) and the manual valve clip (403) for damage.

8. Inspect the manual valve (404) for binding or looseness in the case cover assembly (401).
9. Inspect the case cover bore plugs (411) and the orificed cup plug (412). Correct the following conditions:
   - Plug is loose
   - Plug is missing
   - Orifice is plugged

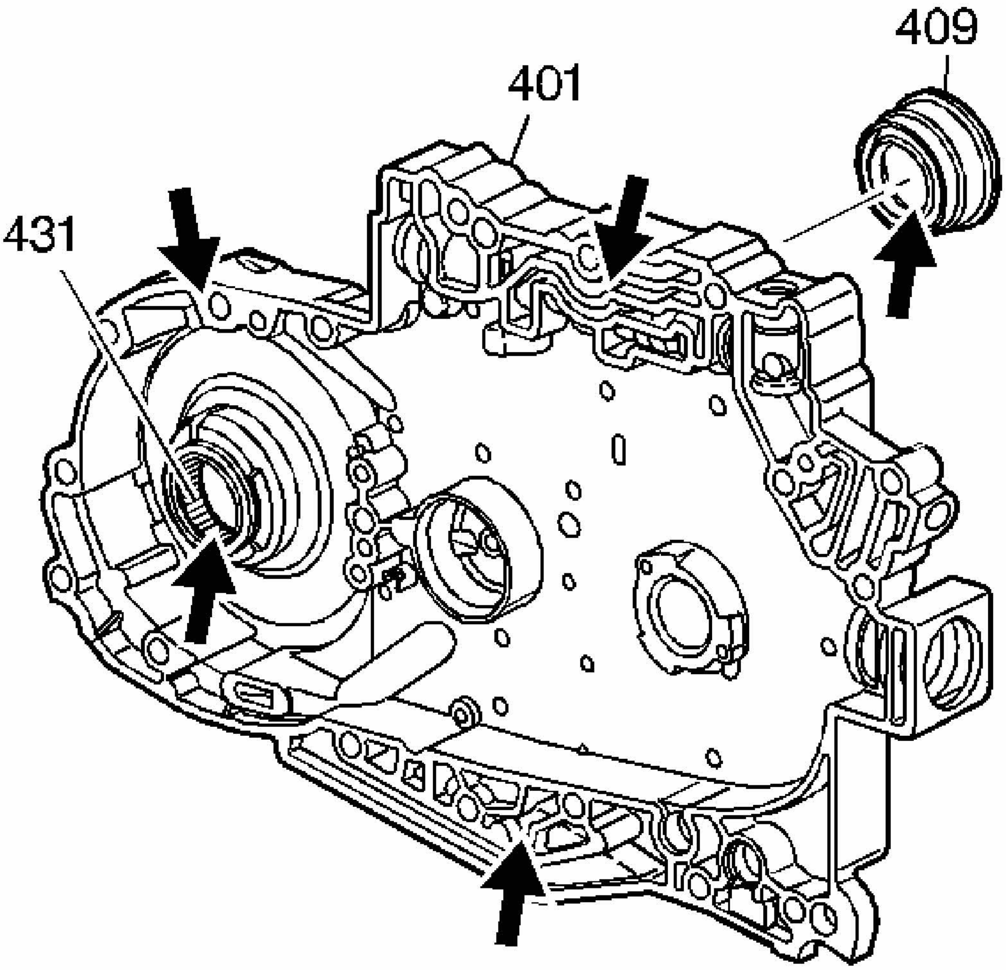


Fig. 270: Locating Inspection Areas On Drive Shaft Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not remove the drive shaft bearing (431) unless the bearing is damaged.

10. Inspect the drive shaft bearing assembly (431).
11. Inspect the axle oil seal assembly (409) for a missing garter spring or for a cut lip seal.
12. Inspect the case cover (401) for the following:
    - Porosity
    - Interconnected fluid passages
    - Cracks or rough machined surfaces

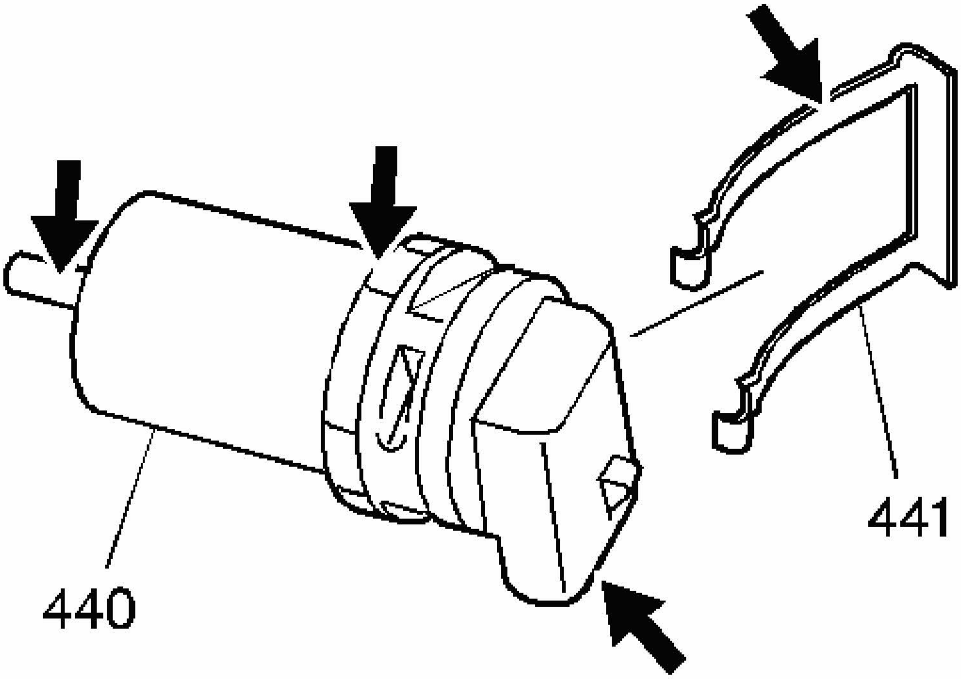


Fig. 271: Inspecting Input Speed Sensor
Courtesy of GENERAL MOTORS CORP.

13. Inspect the input speed sensor assembly (440) for the following conditions:
    - Damaged or missing magnet
    - Damaged housing
    - Bent or missing electrical terminals
    - Damaged input speed sensor clip (441)

CASE COVER BEARING DISASSEMBLE

Tools REquired

- **J 8092** Driver Handle
- **J 41991** Driveshaft Bearing Remover/Installer. See **Special Tools**.

Disassembly Procedure

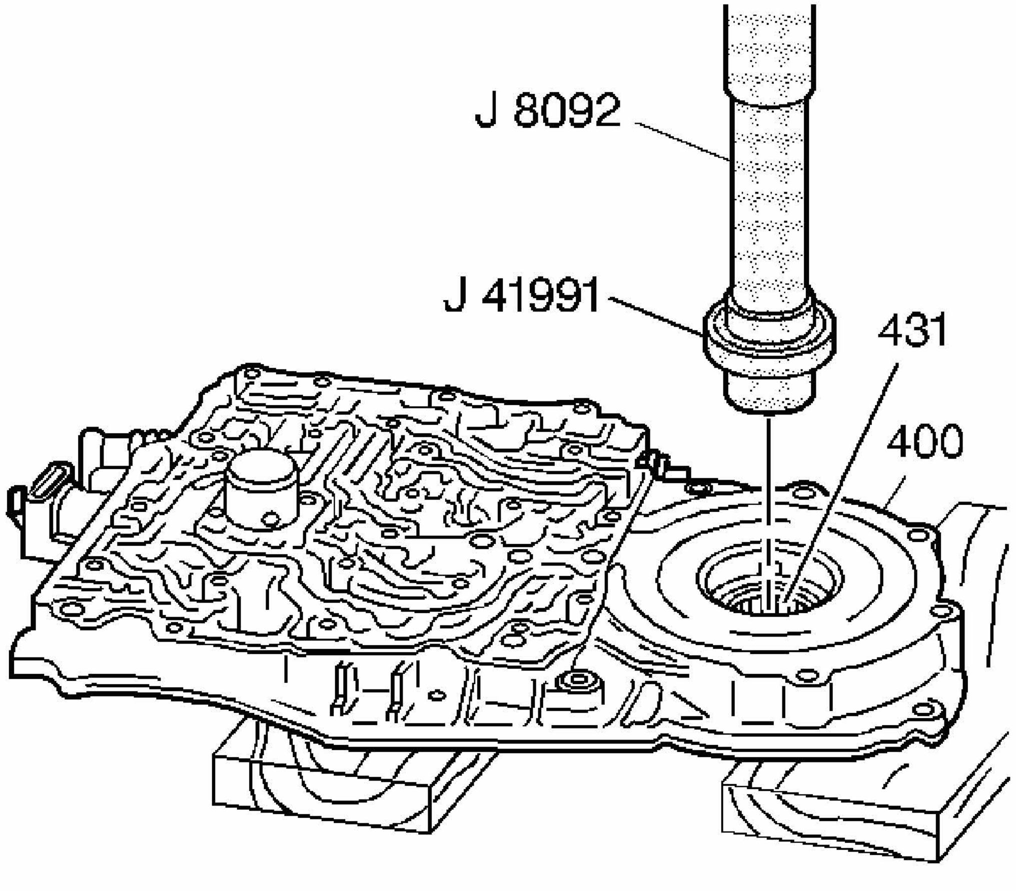


Fig. 272: Pressing Out Drive Shaft Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

1. Assemble **J 8092** and **J 41991** for bearing removal. See **Special Tools**.
2. Place the case cover (400) on a clean, flat surface with the spacer plate mating surface up.
3. Using the assembled tool, press the drive shaft bearing assembly (431) from the case cover (400).

CASE COVER BEARING ASSEMBLE

Tools REquired

- **J 8092** Driver Handle
- **J 41991** Driveshaft Bearing Remover/Installer. See **Special Tools**.

Assembly Procedure

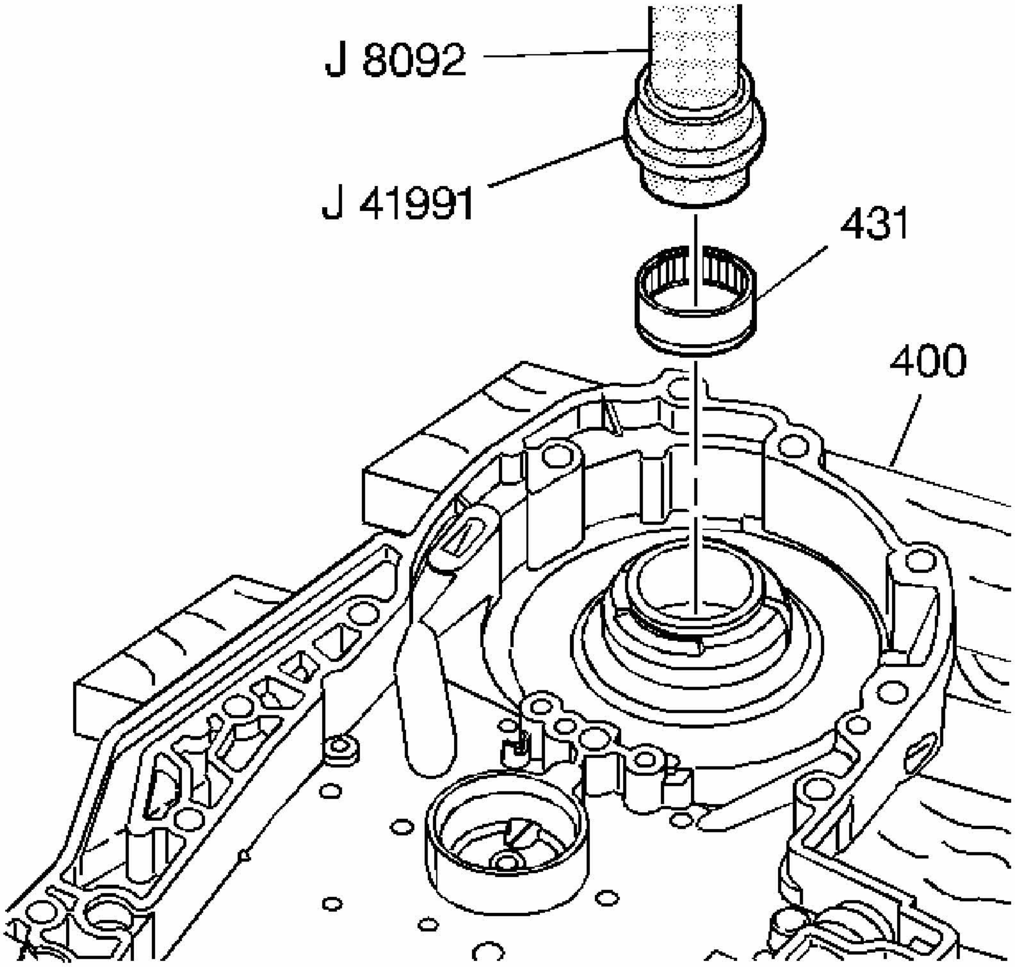


Fig. 273: Pressing Drive Shaft Bearing In With J 8092 & J 41991
Courtesy of GENERAL MOTORS CORP.

1. Assemble **J 8092** and **J 41991** for bearing installation. See **Special Tools**.
2. Place the case cover (400) on a clean, flat surface with the case mating surface up.

IMPORTANT: When installing the new bearing the part number should be visible (facing upward).

3. Using the assembled tool, press the drive shaft bearing (431) into the case cover (400).

DRIVE SHAFT OIL SEAL ASSEMBLE - LEFT SIDE

Tools Required

J 34115 Left Side Axle Seal Installer. See **Special Tools**.

Assembly Procedure

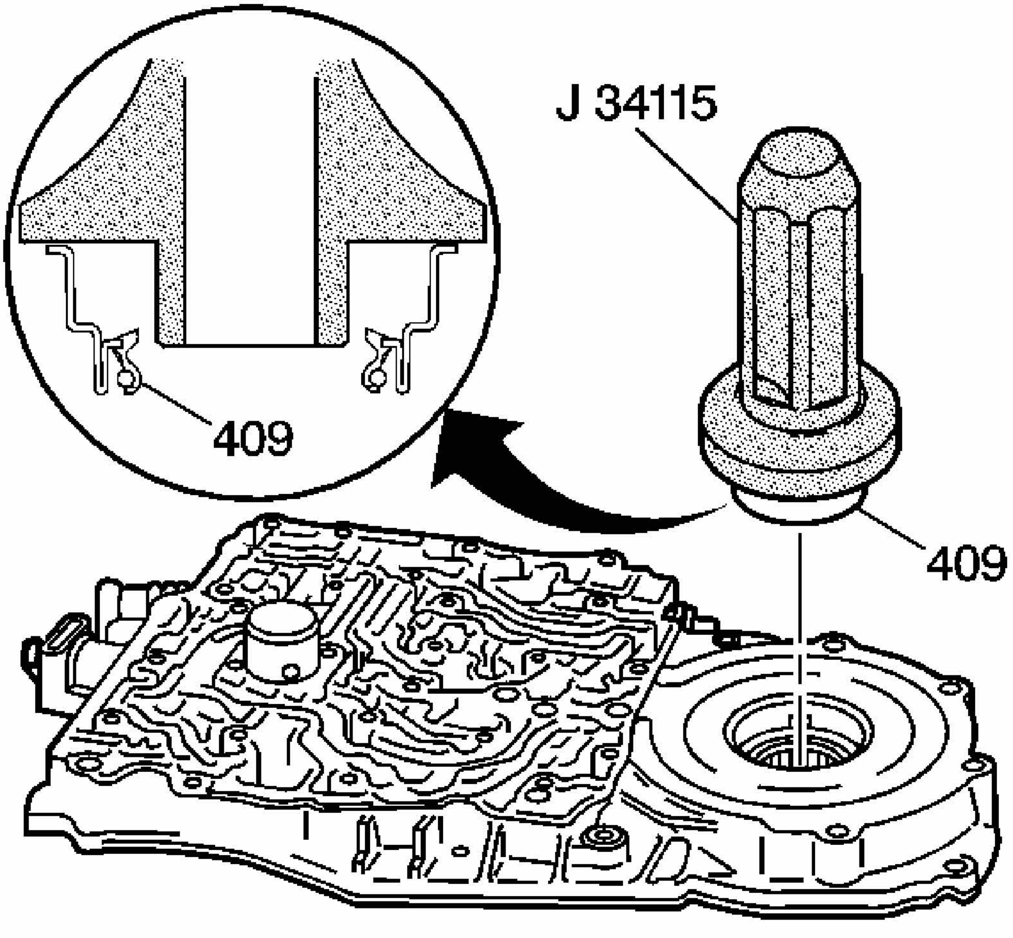


Fig. 274: Installing Left Side Axle Oil Seal Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: **Install the seal onto the tool before installing into the case to prevent damage to the seal.**

IMPORTANT: When you remove a drive axle from the transmission for any reason, inspect the axle sealing surface (tripot shank) for corrosion. If corrosion is evident, clean the surface with a 320 grit cloth or equivalent. Clean off any remaining debris with automatic transmission fluid. Wipe the surface dry and reinstall the drive axle free of any build up.

Use **J 34115** in order to install the left side axle oil seal assembly (409). See **Special Tools**.

CASE COVER COMPONENTS ASSEMBLE (WITHOUT TOUCH ACTIVATED POWER)

Assembly Procedure

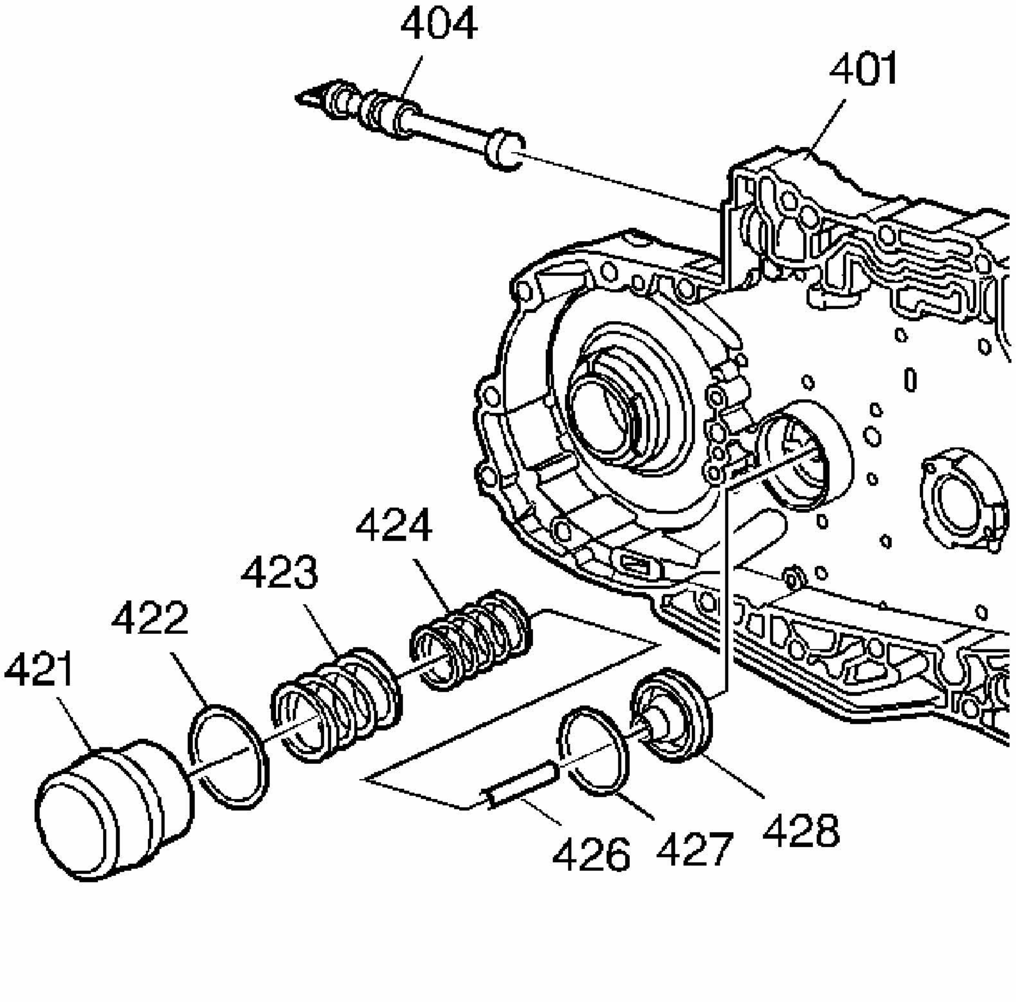


Fig. 275: Locating 3-4 Accumulator Piston Components
Courtesy of GENERAL MOTORS CORP.

1. Install a new 3-4 accumulator piston cylinder O-ring seal (422) onto the 3-4

accumulator piston cylinder (421).

2. Install the 3-4 accumulator piston outer spring (423) and inner spring (424) into the 3-4 accumulator piston cylinder (421).
3. Install a new 3-4 accumulator piston seal (427) onto the 3-4 accumulator piston (428).
4. Insert the 3-4 accumulator piston (428) into the 3-4 accumulator piston cylinder (421).
5. Using a slight twisting motion, insert the 3-4 accumulator piston cylinder (421) into the case cover (401).
6. Insert the 3-4 accumulator piston pin (426) through the front of the case cover (401) and into the 3-4 accumulator piston (428).
7. Install the manual valve (404) into the case cover (401).

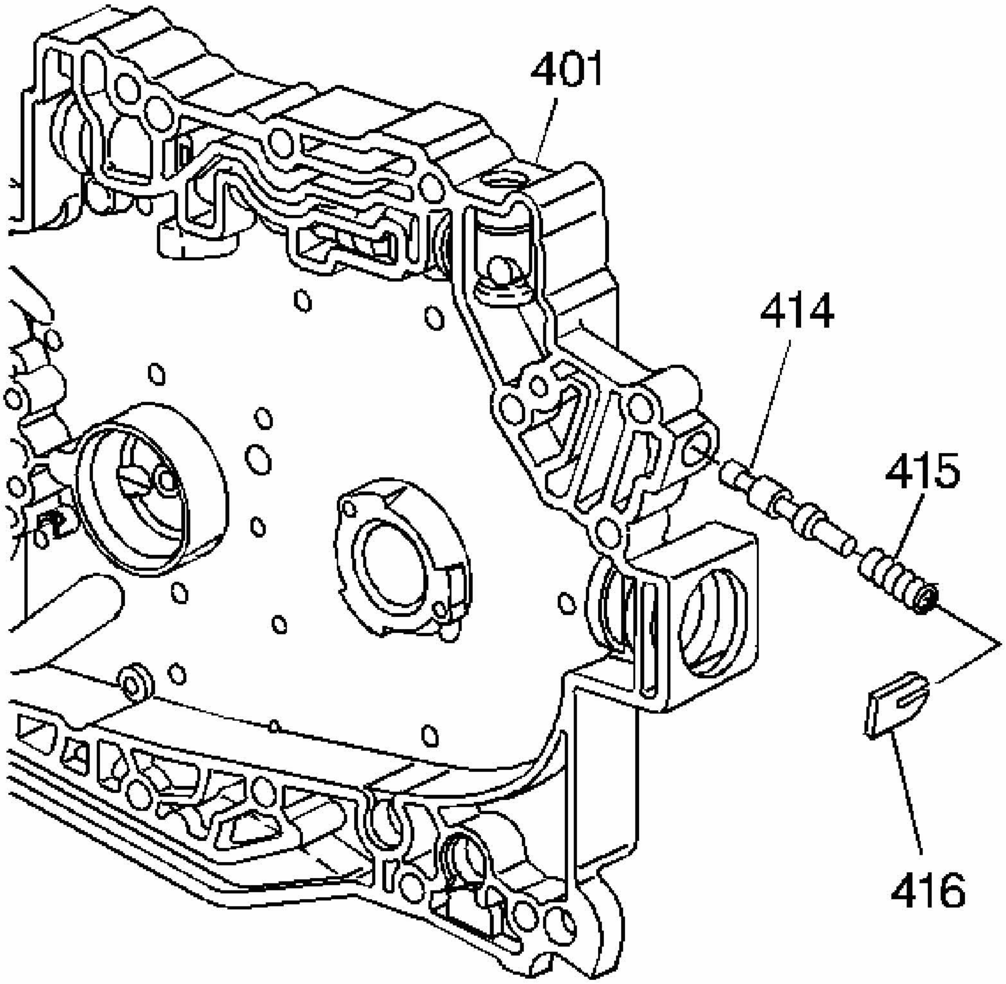


Fig. 276: Identifying Actuator Feed Limit Valve & Case Cover

Courtesy of GENERAL MOTORS CORP.

8. Install the actuator feed limit valve (414) into the case cover (401).
9. Install the actuator feed limit valve spring (415) into the case cover (401).
10. Install the actuator feed limit valve spring retainer (416) into the case cover (401).

CASE COVER COMPONENTS ASSEMBLE (WITH TOUCH ACTIVATED POWER)

Assembly Procedure

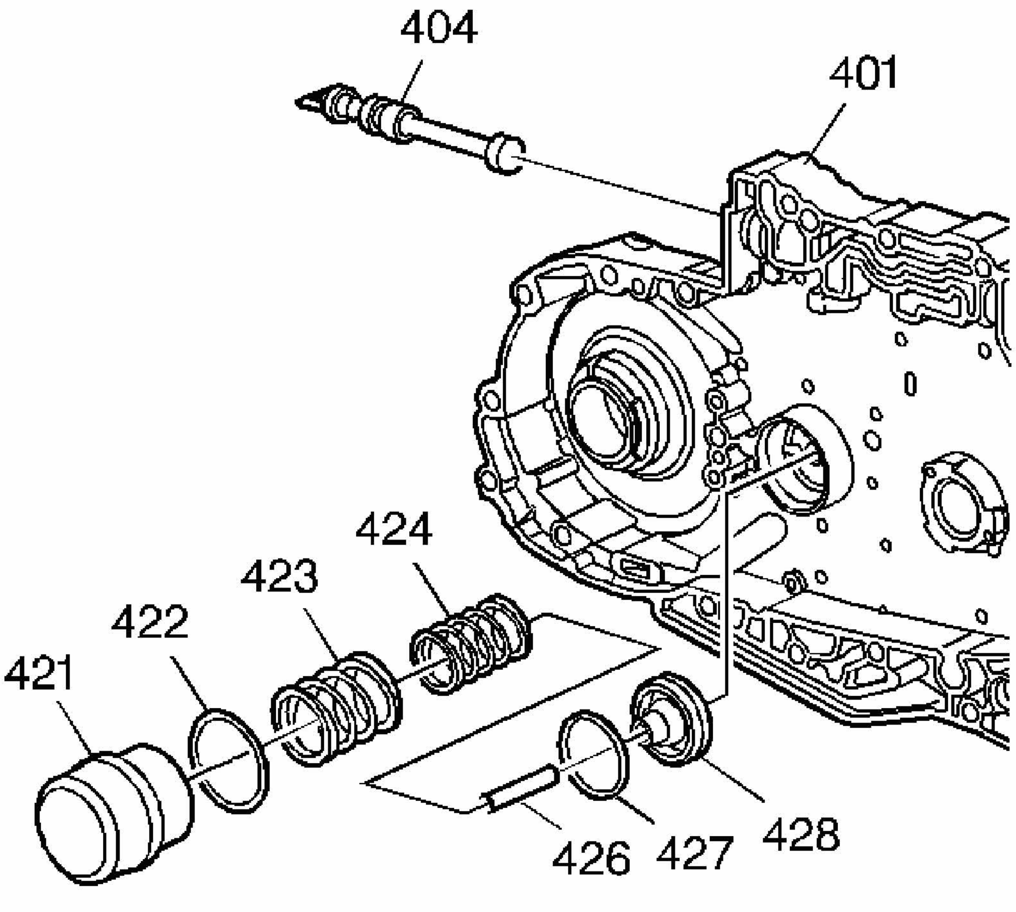


Fig. 277: Locating 3-4 Accumulator Piston Components
Courtesy of GENERAL MOTORS CORP.

1. Install a new 3-4 accumulator piston cylinder O-ring seal (422) onto the 3-4 accumulator piston cylinder (421).
2. Install the 3-4 accumulator piston outer spring (423) and inner spring (424) into the 3-4 accumulator piston cylinder (421).

3. Install a new 3-4 accumulator piston seal (427) onto the 3-4 accumulator piston (428).
4. Insert the 3-4 accumulator piston (428) into the 3-4 accumulator piston cylinder (421).
5. Using a slight twisting motion, insert the 3-4 accumulator piston cylinder (421) into the case cover (401).
6. Insert the 3-4 accumulator piston pin (426) through the front of the case cover (401) and into the 3-4 accumulator piston (428).
7. Install the manual valve (404) into the case cover (401).

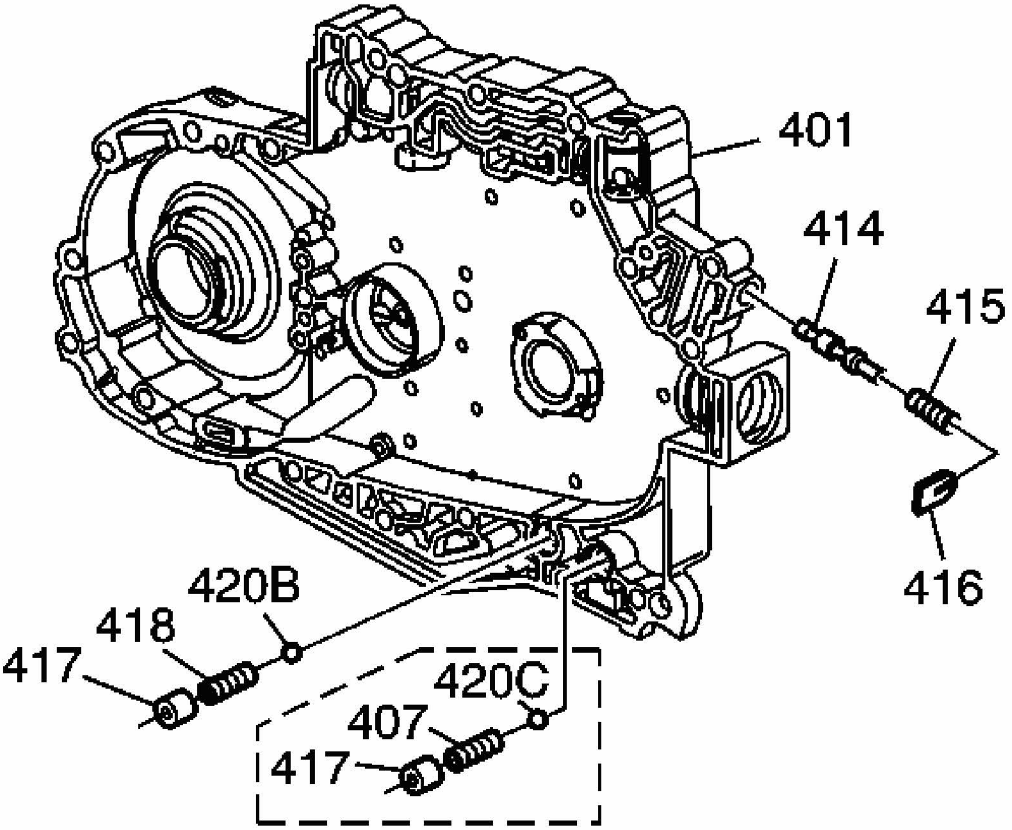


Fig. 278: Expanded View Of Case Cover Components
Courtesy of GENERAL MOTORS CORP.

8. Install the actuator feed limit valve (414) into the case cover (401).
9. Install the actuator feed limit valve spring (415) into the case cover (401).
10. Install the actuator feed limit valve spring retainer (416) into the case cover (401).
11. Install the low regulator valve spring (442).
12. Install the low regulator valve (443).

13. Install the low regulator valve bore plug (444).

CASE COVER AND GASKETS ASSEMBLE

Tools Required

- **J 36850** Assembly Lubricant (or equivalent)
- **J44538** TORX® 30+. See **Special Tools**.

Assembly Procedure

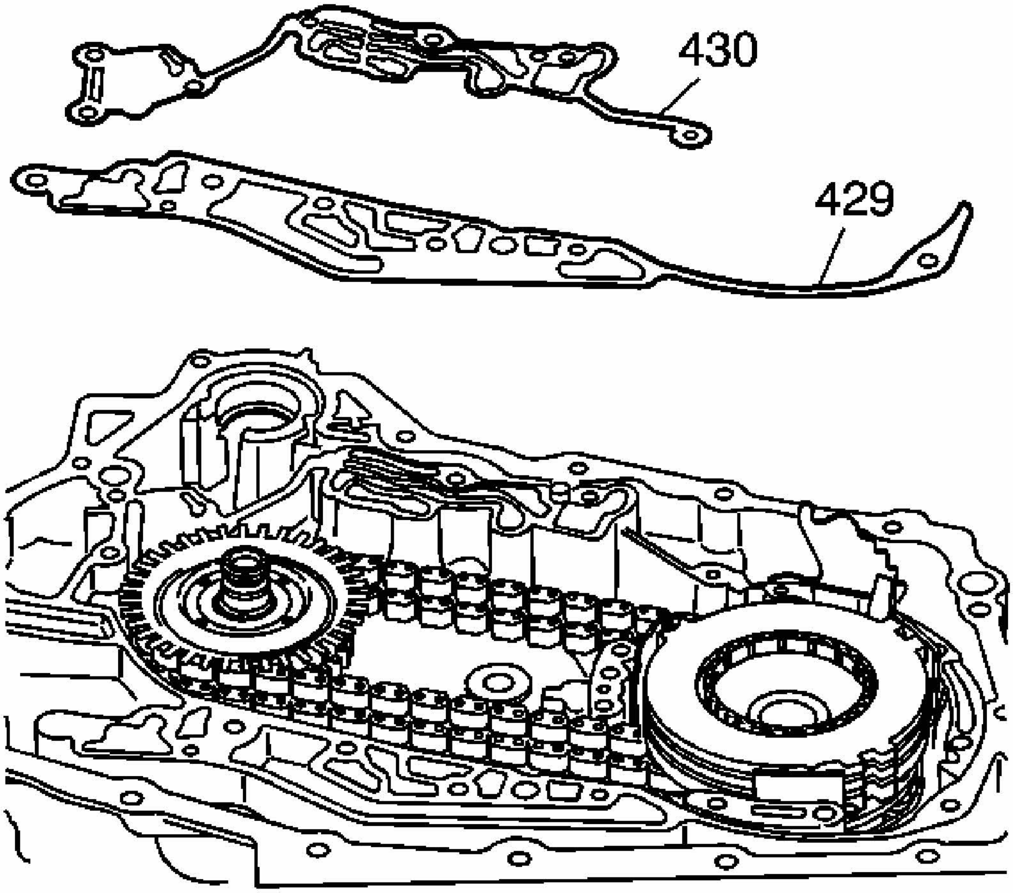


Fig. 279: View Of Case Cover Upper & Lower Gasket
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **Do not use any type of adhesive or sealer when assembling the gaskets. You may use J 36850 or equivalent as an aid.**

1. Install the case cover upper gasket (430) and the case cover lower gasket (429) on the case.

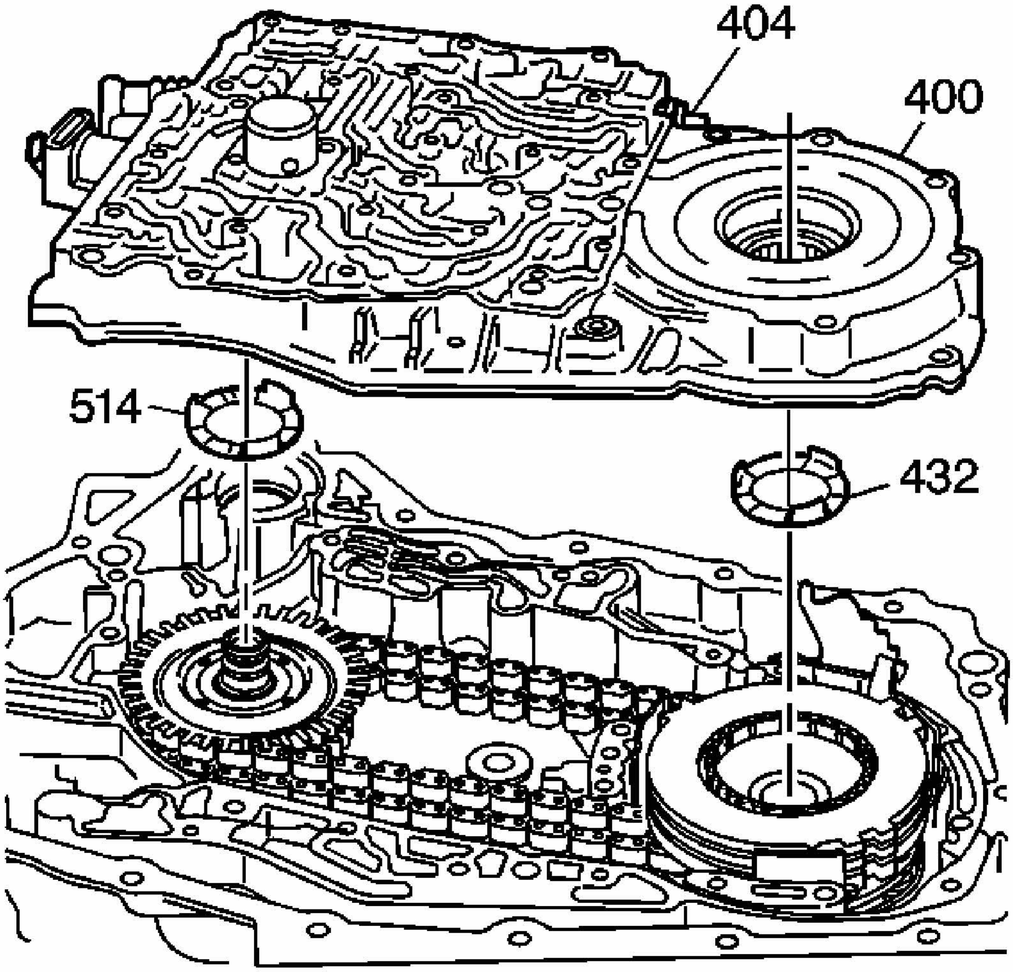


Fig. 280: Identifying Fourth Clutch Shaft Thrust Washer & Drive Sprocket/Case Cover Thrust Washer
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Be careful to not move the gaskets.

2. Use **J 36850** or equivalent in order to retain the fourth clutch shaft thrust washer (432) and the drive sprocket/case cover thrust washer (514) to the case cover (400).

IMPORTANT: Do not install the case cover over the IMS. The IMS must

move freely.

3. Make sure that the manual valve (404) is held in place and assemble the case cover (400) onto the pins in the case.

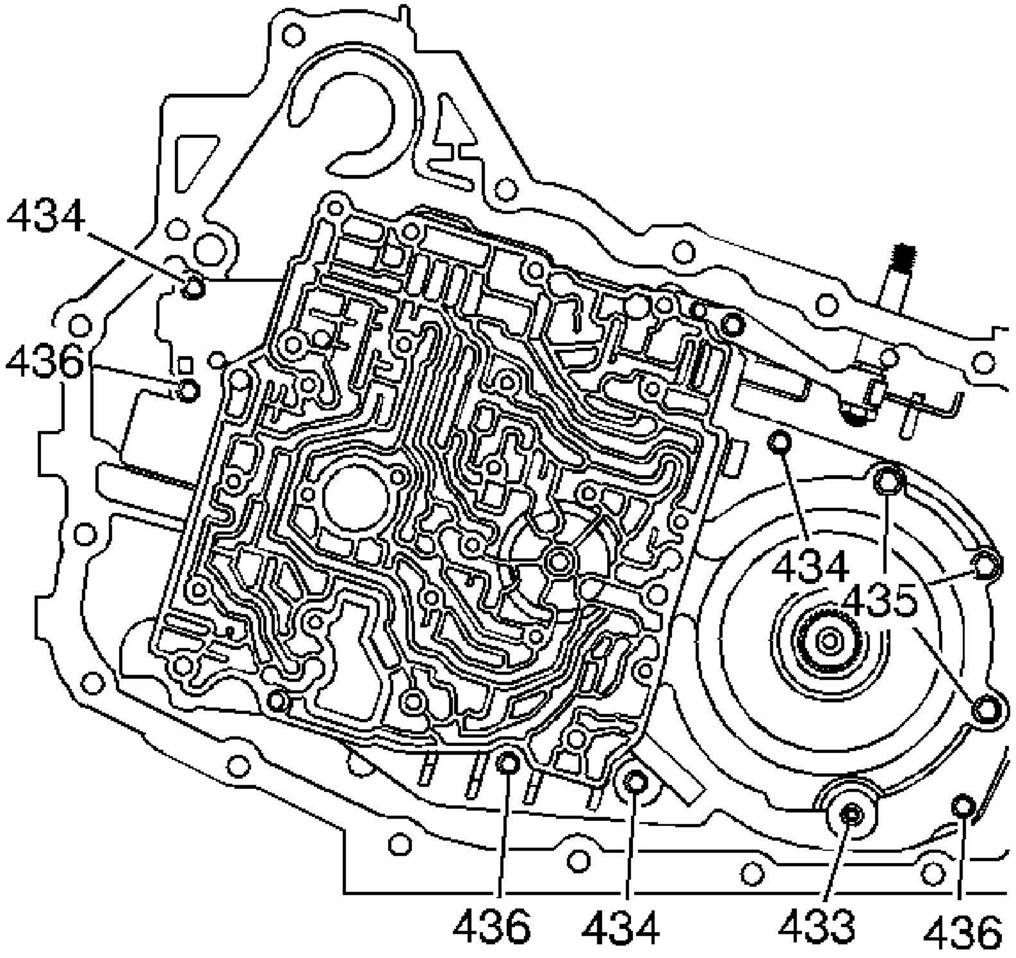


Fig. 281: Transaxle Case Cover Bolts Locations
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

IMPORTANT: **Do not use an impact wrench.**

4. Finger start all transaxle case cover bolts (433-436) into the locations noted.

   Tighten:

   - Tighten the M 6 size bolts (434, 436) to 12 N.m (106 lb in).
   - Tighten the M 8 size bolts (435) to 25 N.m (18 lb ft).
   - Tighten the M 6 size bolts (433) to 12 N.m (106 lb in) using **J44538** . See **Special Tools**.

MANUAL VALVE LINK AND OIL DAM ASSEMBLE

Assembly Procedure

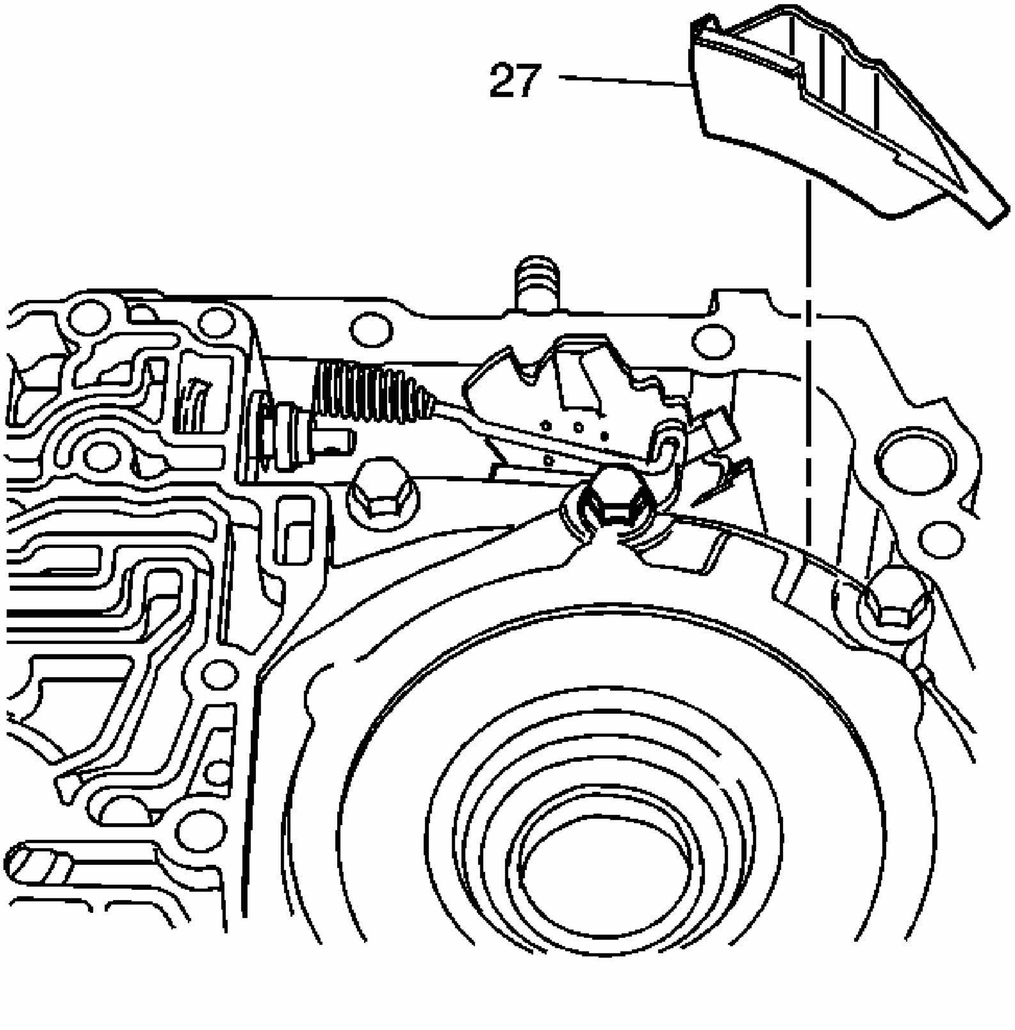


Fig. 282: View Of Oil Dam
Courtesy of GENERAL MOTORS CORP.

1. Install the oil dam (27) into the case.
2. Assemble the manual valve link onto the manual shift detent lever/IMS detent lever.

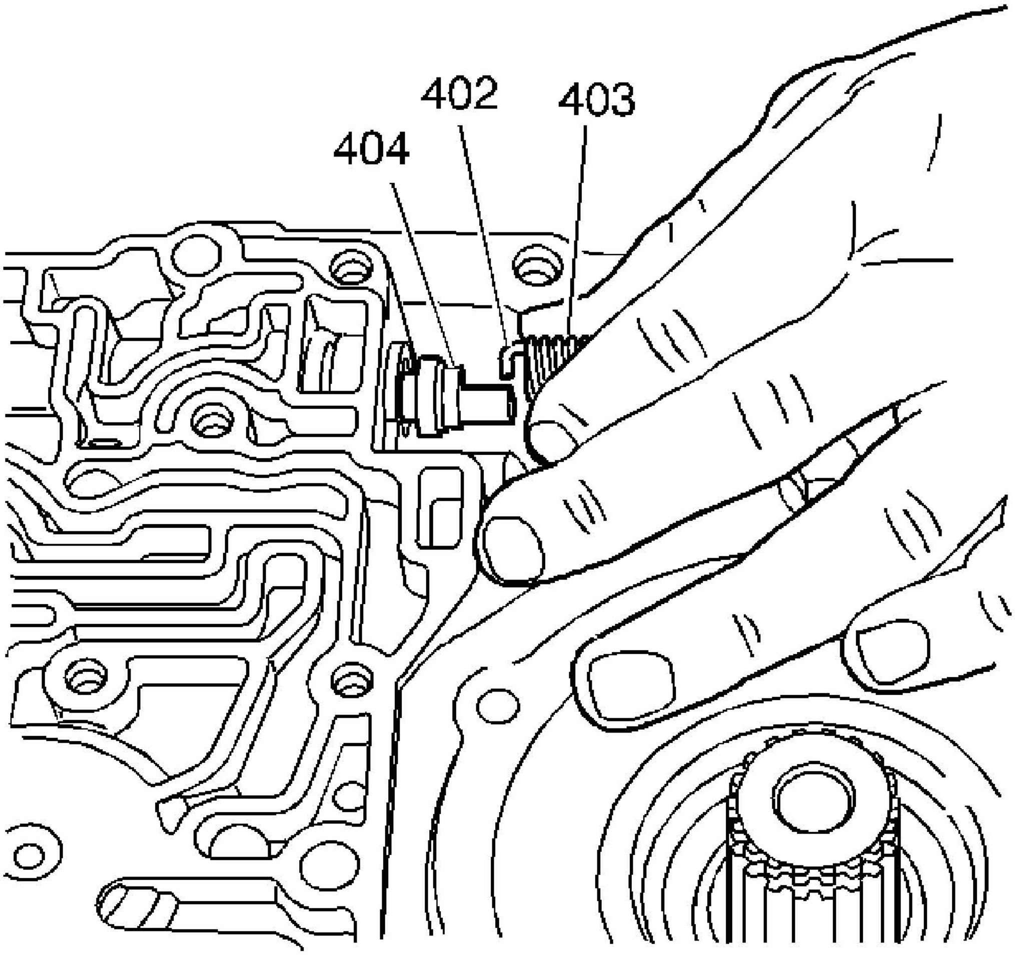


Fig. 283: Connecting Manual Valve Link To Manual Valve
Courtesy of GENERAL MOTORS CORP.

3. Connect the manual valve link (402) to the manual valve (404).
4. Install the manual valve link spring (403).

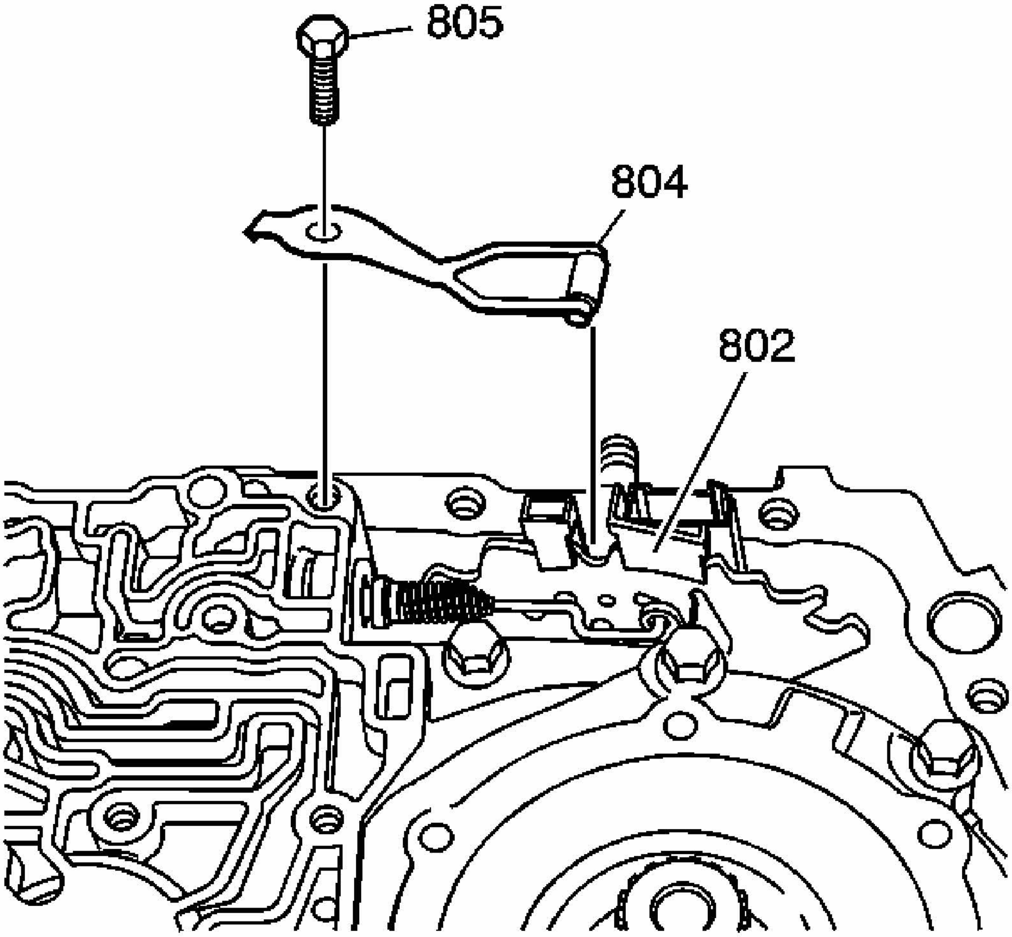


Fig. 284: Locating Manual Shift Detent Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

5. Install the manual shift detent assembly (804) and the manual shift detent bolt (805).

Tighten: Tighten the bolt to 12 N.m (106 lb in).

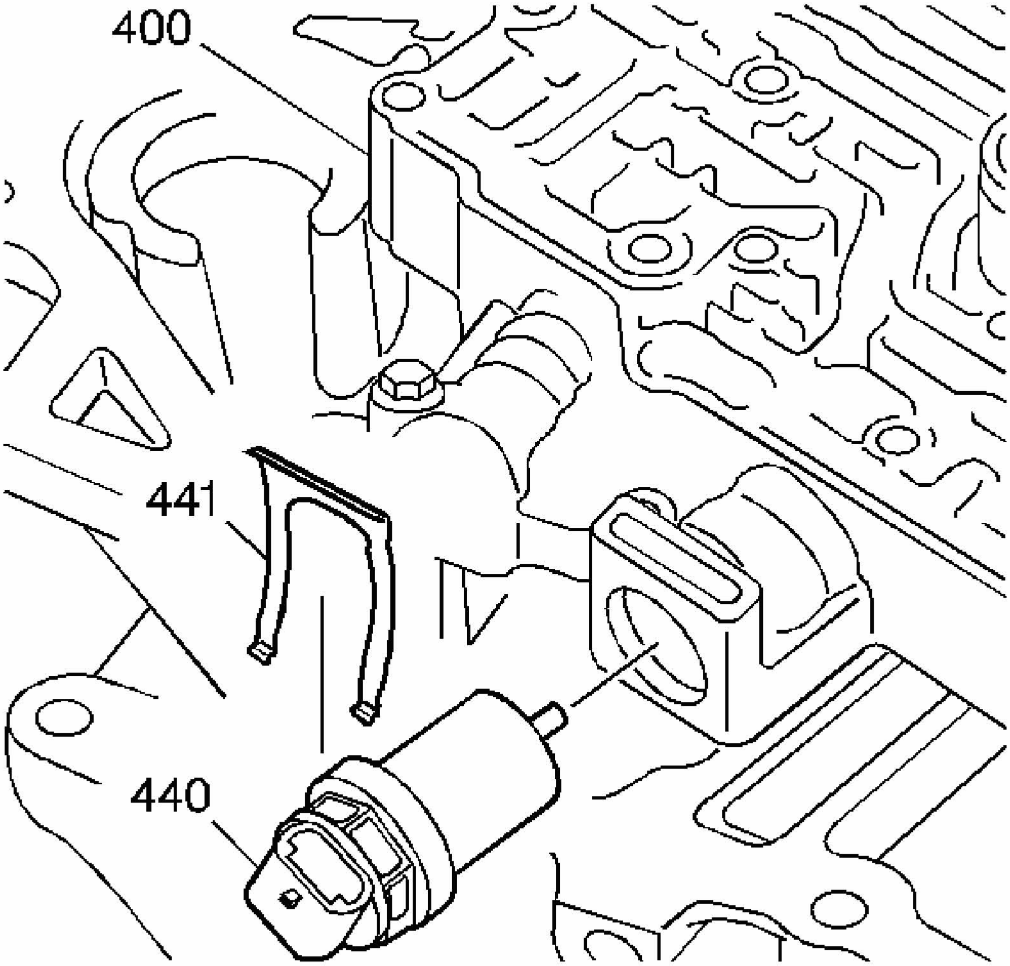


Fig. 285: View Of Input Speed Sensor
Courtesy of GENERAL MOTORS CORP.

6. Carefully install the input speed sensor (440) into the case cover (400).
7. Install the input speed sensor clip (441) into the case cover (400).

DIFFERENTIAL CARRIER END PLAY CHECK (FWD ONLY)

Tools Required

- **J 8001** Dial Indicator Set
- **J 25025-8** Dial Indicator Mounting Post. See Special Tools.
- **J 26958-10A** Adapter Plug
- **J 28585** Snap Ring Remover

Checking Procedure

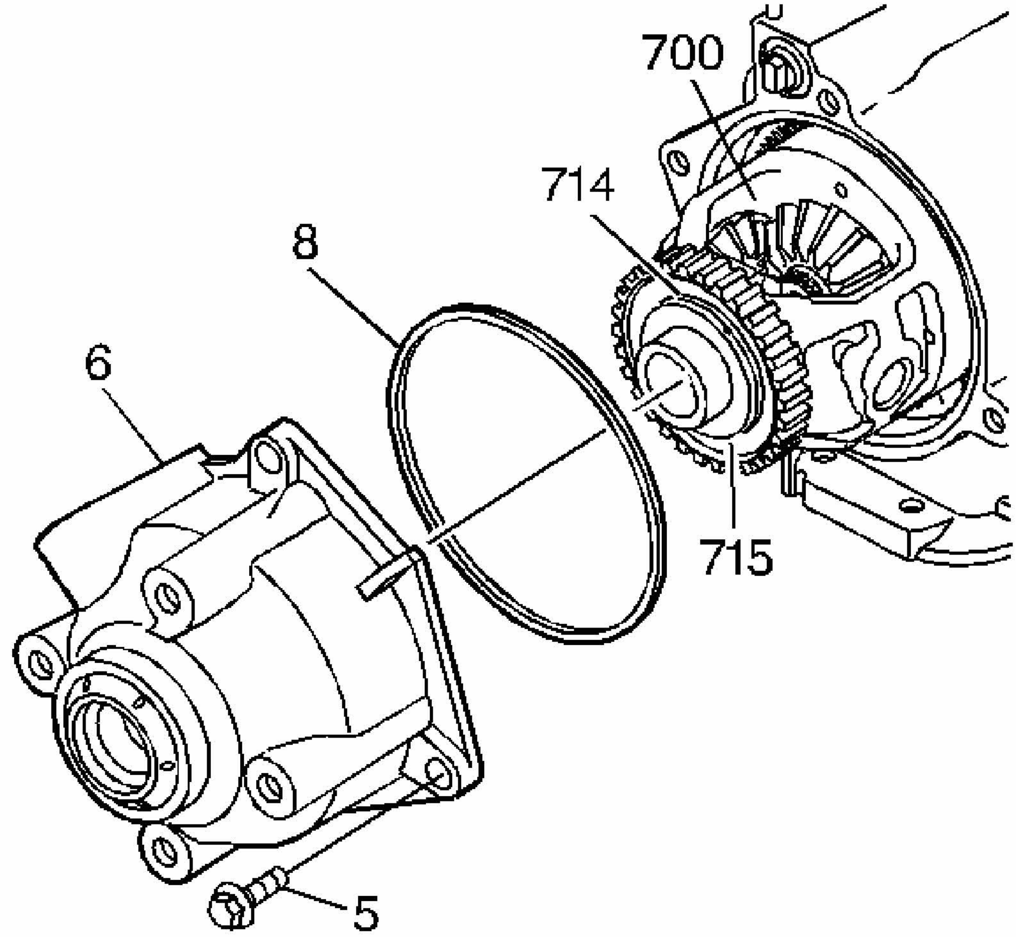


Fig. 286: View Of Case Extension Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Make sure that the differential carrier/case thrust washer (714) and the thrust bearing (715) are still on the differential/final drive carrier assembly (700).
2. Install the case extension seal (8) onto the case extension (6).
3. Install the case extension assembly (6) onto the transmission (3).

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

4. Install only two of the four case extension bolts (5).

Tighten: Do not torque the bolts. Tighten them only until the case extension is fully seated.

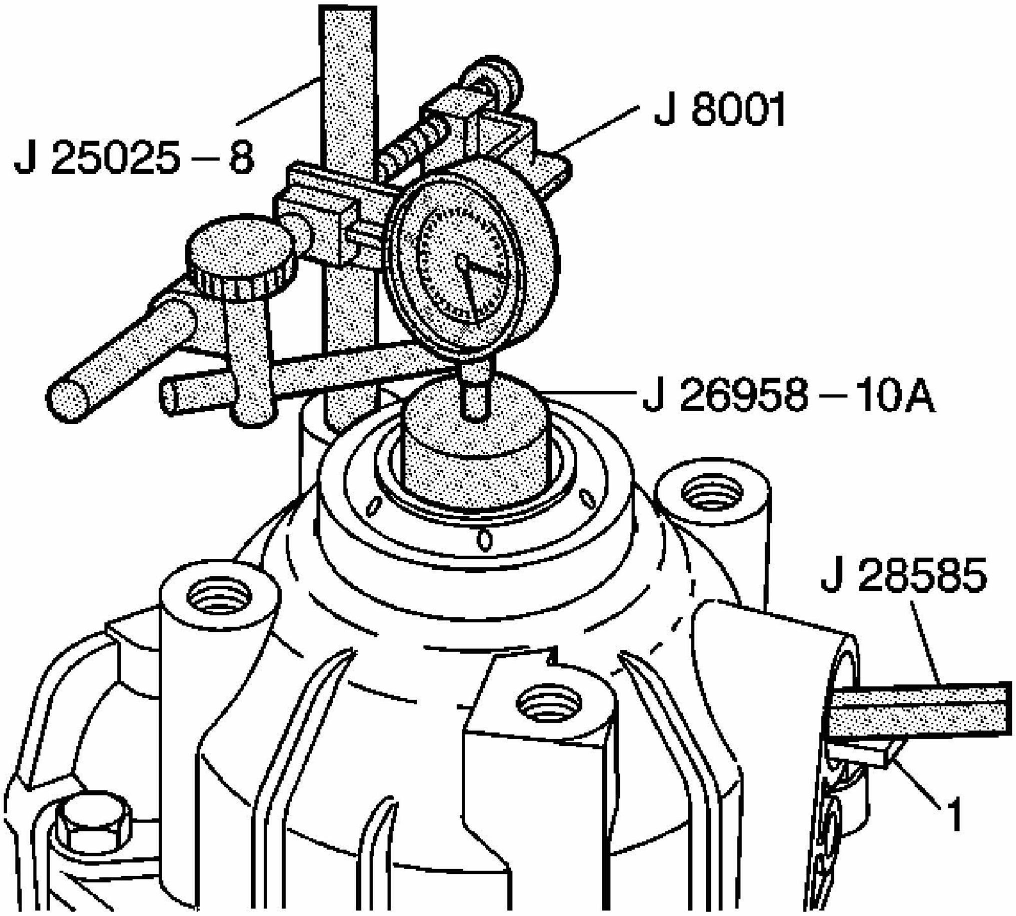


Fig. 287: Installing J 25025-8, J 26958-10A & J 8001 To Transmission Case
Courtesy of GENERAL MOTORS CORP.

5. Position the transmission so that the case extension is facing upward.
6. Install **J 25025-8** , **J 26958-10A** and **J 8001** . See Special Tools.
7. Set the dial indicator to zero.

NOTE: Use a piece of wood or rubber while prying with J 28585 or a large screwdriver, to prevent damage to VSS bore.

8. Use **J 28585** or a large screwdriver in order to lift the differential/final drive carrier assembly. Pry up on the vehicle speed sensor reluctor wheel through the vehicle speed sensor hole in the case extension.

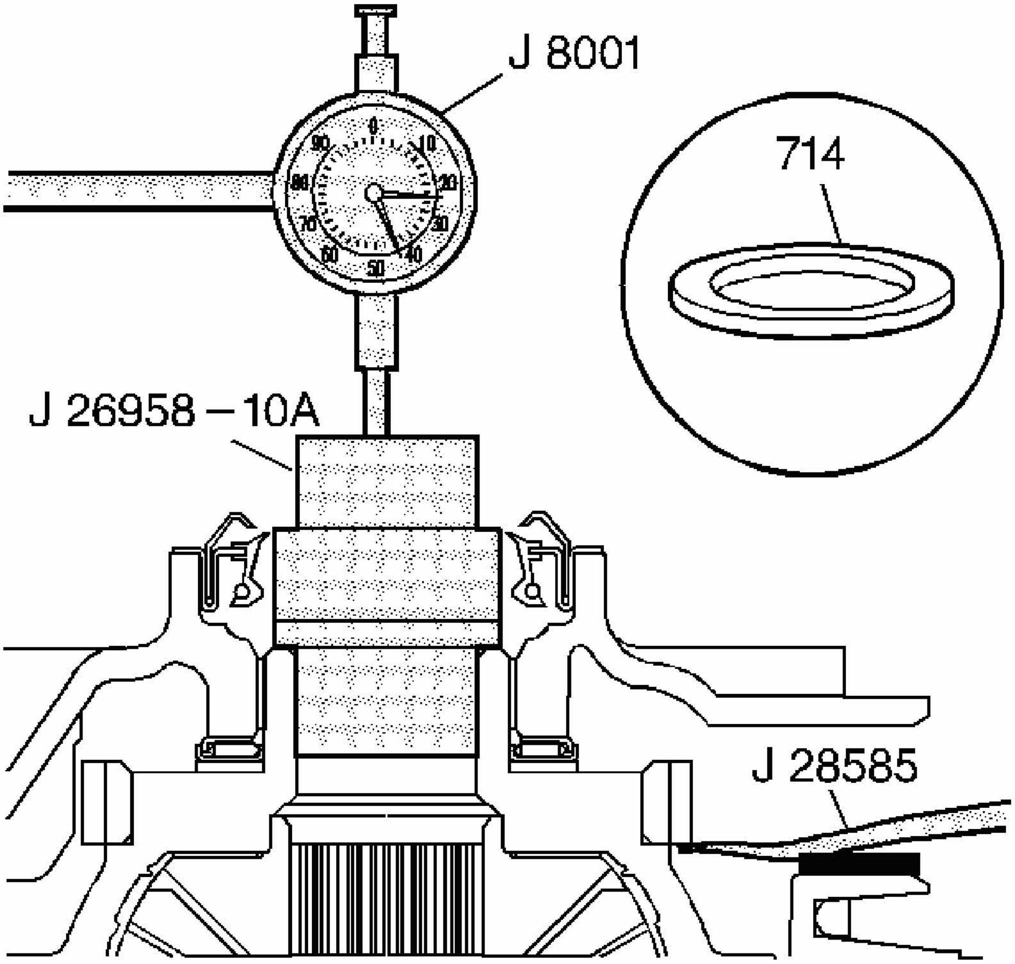


Fig. 288: Measuring Differential Carrier/Case Thrust Washer
Courtesy of GENERAL MOTORS CORP.

9. Note the dial indicator reading before changing the differential carrier/case thrust washer (714):
   - If the dial indicator reading is less than 0.12 mm (0.005 in), install the next smaller size thrust washer, then recheck.
   - If the dial indicator reading is greater than 0.62 mm (0.025 in), install the next larger size thrust washer, then recheck.
   - If the dial indicator reading is 0.12-0.62 mm (0.005-0.025 in), the thrust washer is correct.
10. Remove **J 8001** and **J 25025-8** . See **Special Tools**.
11. Install the case extension bolts (5).

Tighten: Tighten the case extension bolts to 36 N.m (26 lb ft).

DRIVE SHAFT OIL SEAL DISASSEMBLE - RIGHT SIDE (FWD ONLY)

Tools Required

- **J 23129** Seal Remover
- **J 6125-1B** Slide Hammer

Disassembly Procedure

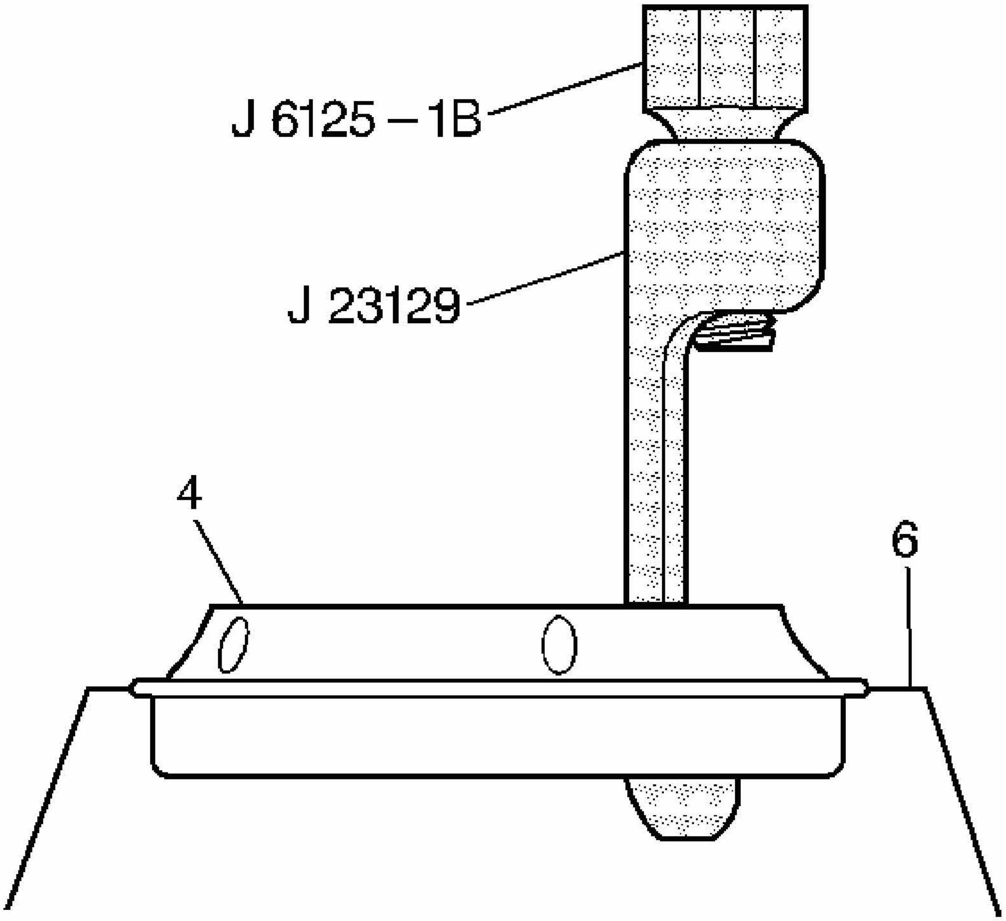


Fig. 289: Removing Right Front Wheel Drive Shaft Oil Seal
Courtesy of GENERAL MOTORS CORP.

Use**J 23129** and **J 6125-1B** in order to remove the axle oil seal assembly (4) from the case extension assembly (6).

DRIVE SHAFT OIL SEAL ASSEMBLE - RIGHT SIDE (FWD ONLY)

Tools Required

- **J 29130** Axle Seal Installer. See Special Tools.
- **J 8092** Driver Handle

Assembly Procedure

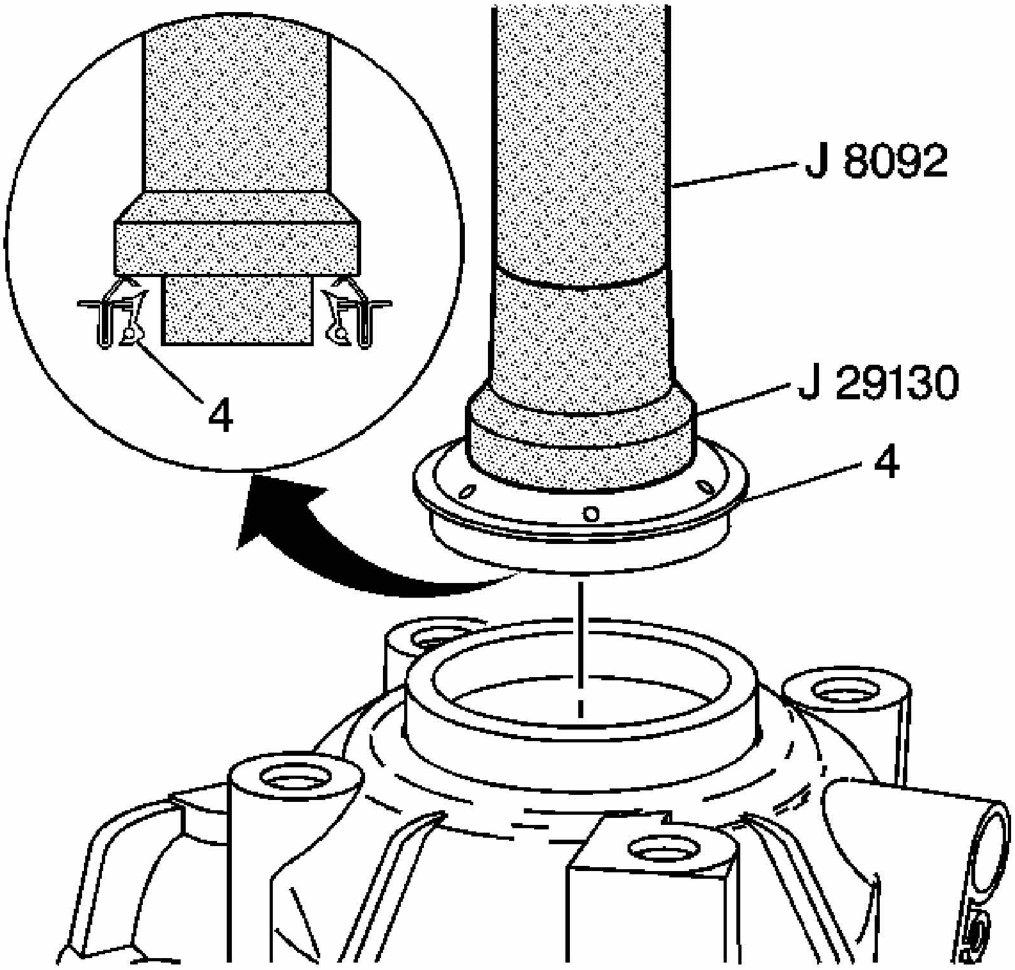


Fig. 290: Installing Axle Oil Seal With J 29130 & J 8092
Courtesy of GENERAL MOTORS CORP.

NOTE: **Install the seal onto the tool before installing into the case to prevent damage to the seal.**

IMPORTANT: Inspect the axle oil seal assembly (4). Be sure that the seal was not damaged during assembly. Check that the garter spring was not dislodged.

Use **J 29130** and **J 8092** in order to install the axle oil seal assembly (4) on the case extension assembly.

VEHICLE SPEED SENSOR ASSEMBLE (FWD ONLY)

Assembly Procedure

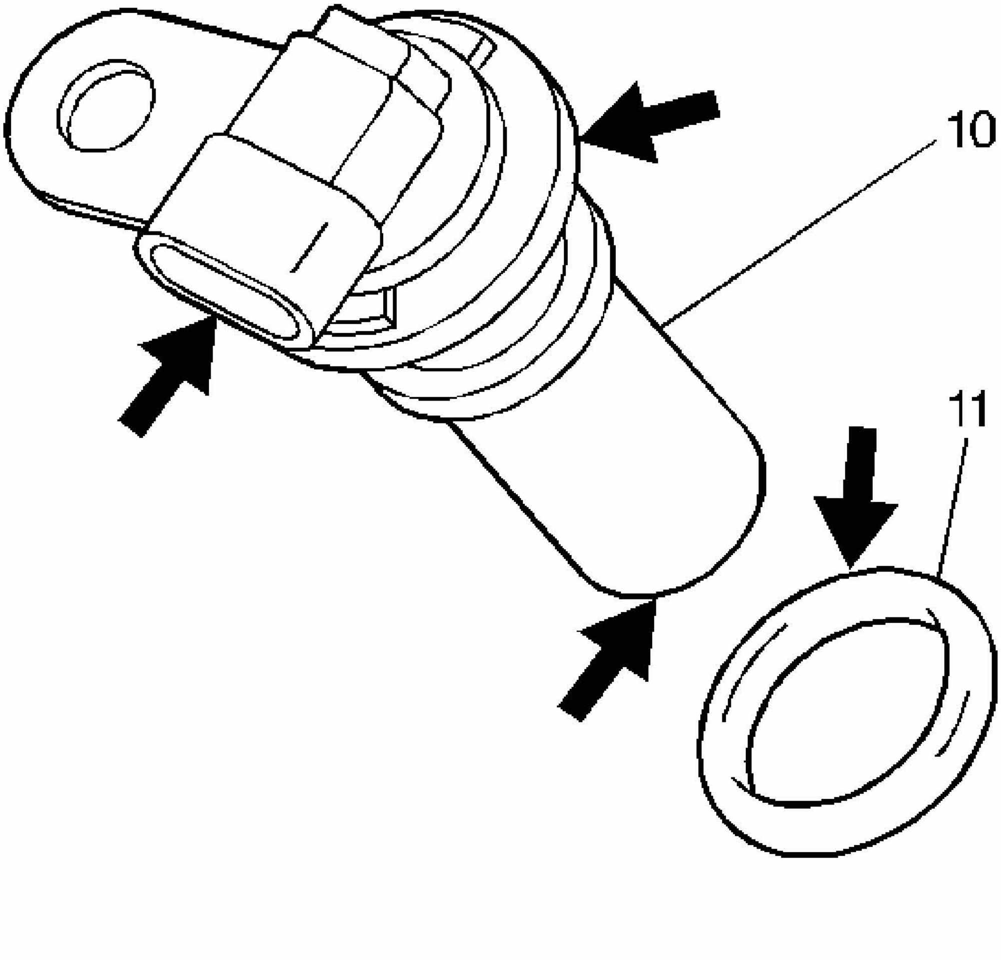


Fig. 291: View Of VSS & O-Ring
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Handle the vehicle speed sensor assembly carefully.

1. Inspect the vehicle speed sensor assembly (10) and the vehicle speed sensor O-ring seal (11) for the following conditions:
   - Damaged connector
   - Cracked housing
   - Signs of rotor damage
   - Cuts or nicks on the O-ring seal
2. Install a new O-ring seal (11) on the vehicle speed sensor assembly (10).

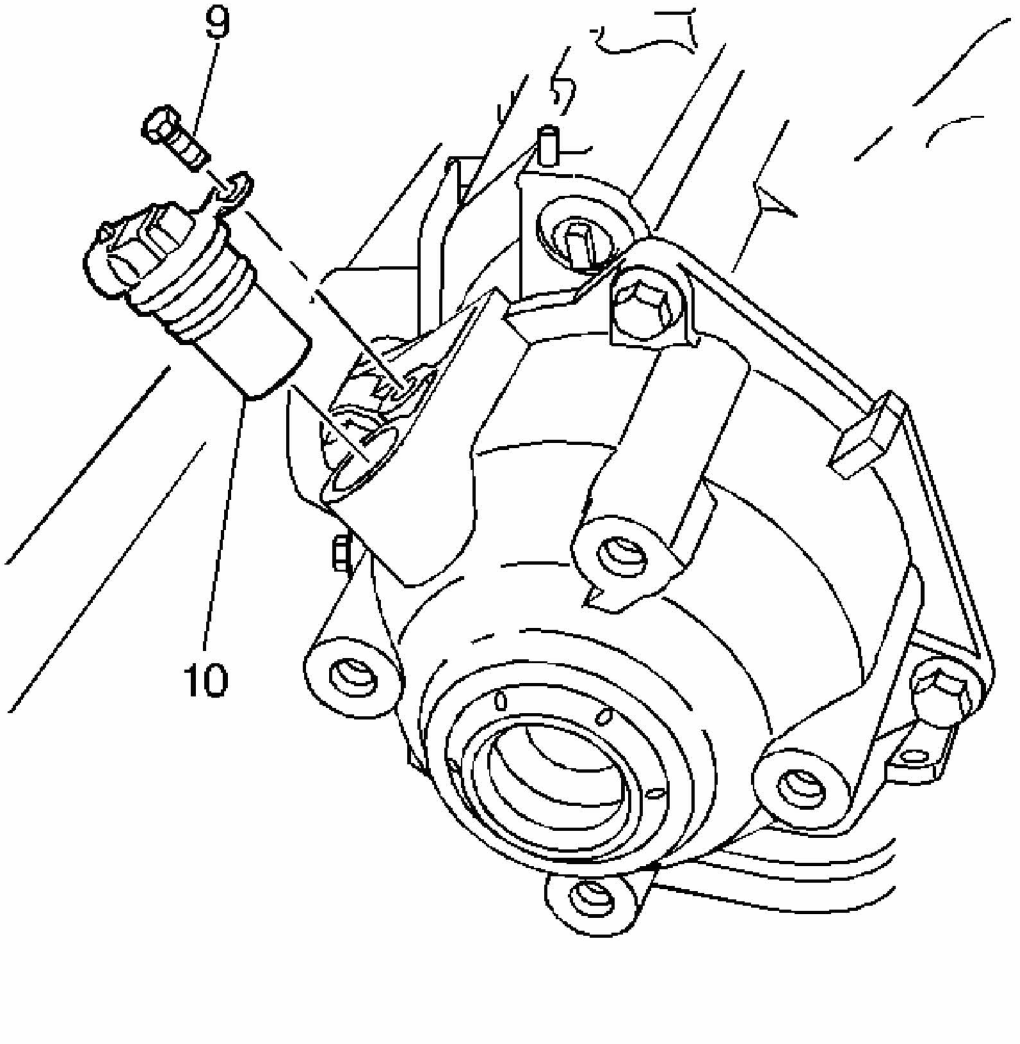


Fig. 292: Identifying Vehicle Speed Sensor (VSS)
Courtesy of GENERAL MOTORS CORP.

3. Install the vehicle speed sensor assembly (10) into the case extension.

NOTE: **Refer to FASTENER NOTICE in Cautions and**

Notices.

4. Install the vehicle speed sensor bolt (9).

   Tighten: Tighten the bolt to 12 N.m (106 lb in).

CONTROL VALVE BODY CLEAN

Cleaning Procedure

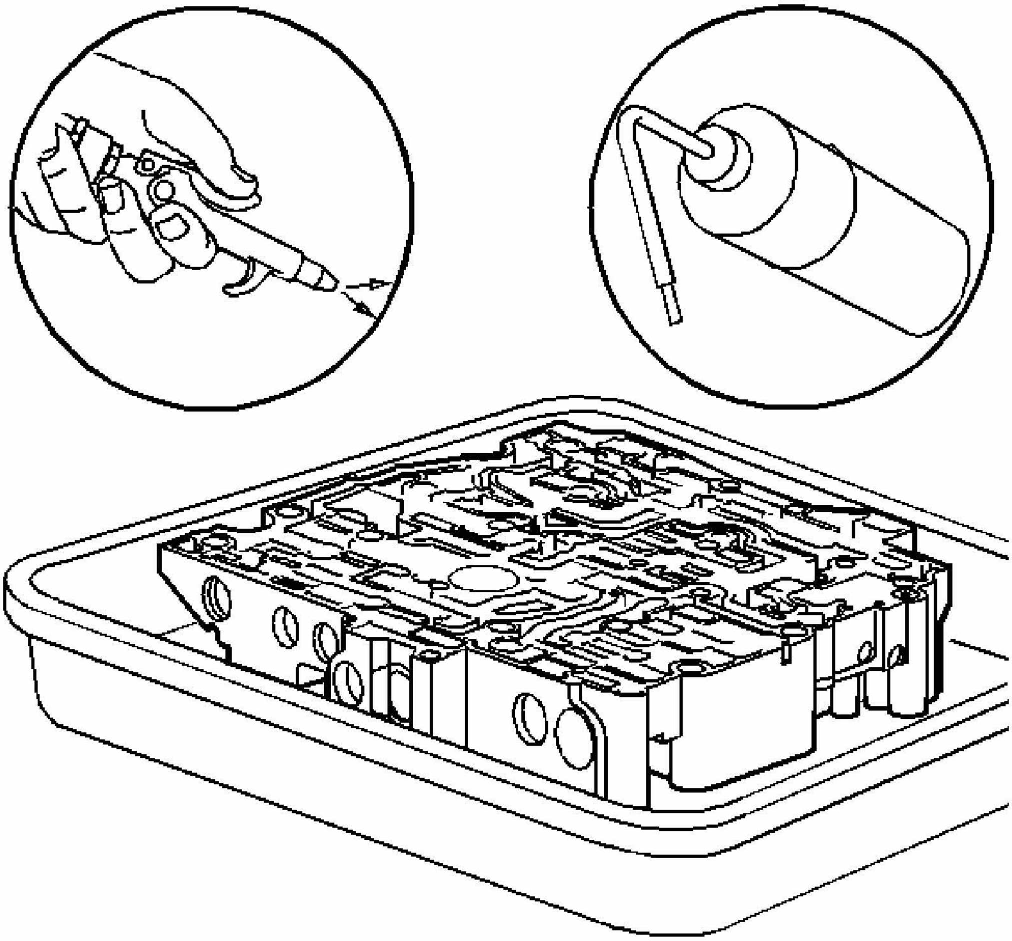


Fig. 293: Blowing Air In Control Valve Body
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not use solvent in order to clean the solenoid valves or the neoprene seals.

1. Clean the control valve body thoroughly in clean solvent.

IMPORTANT: In the following steps, handle the parts carefully in order to avoid nicks and scratches.

2. Move the valves with a pick or a small screwdriver in order to dislodge any dirt or debris.
3. Use an air nozzle in order to dry the control valve body and to blow out all of the passages.
4. Gently probe the small passages with a piece of identification tag wire or the equivalent.

CONTROL VALVE BODY INSPECTION

Inspection Procedure

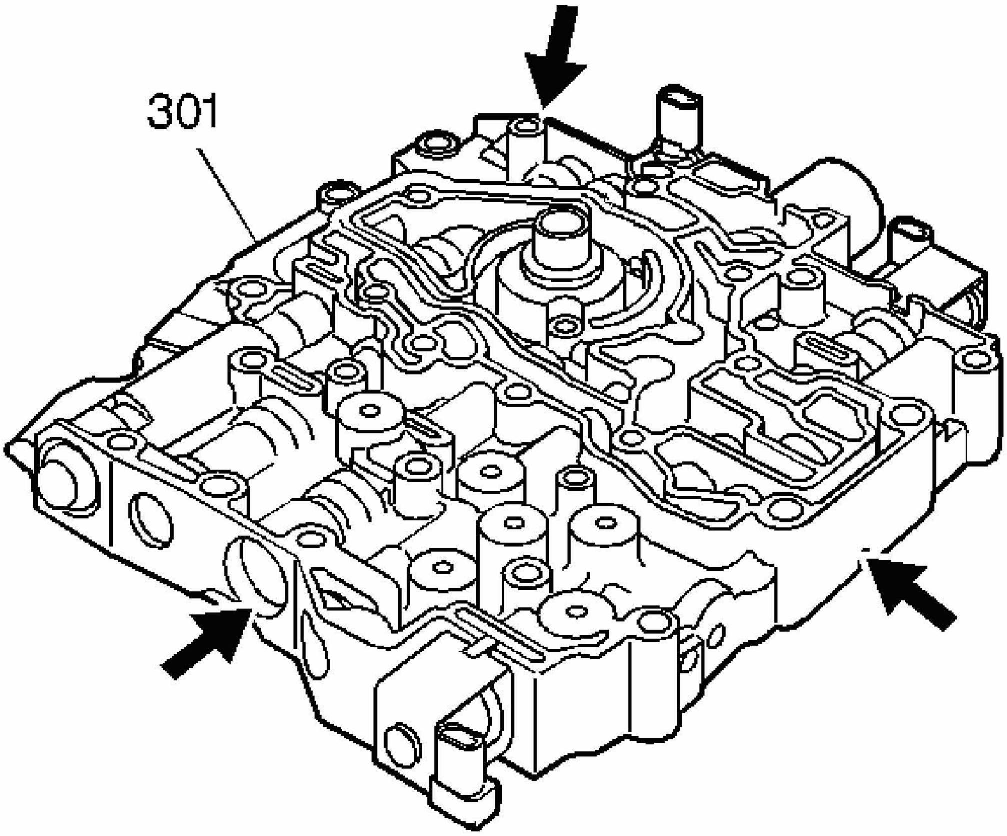


Fig. 294: Identifying Control Valve Body Inspection Points

Courtesy of GENERAL MOTORS CORP.

1. Inspect the control valve body (301) for the following conditions:
    - Worn or damaged oil pump drive shaft bearing journal (not serviceable separately from the control valve body)
    - Damaged or porous casting
    - Damaged sealing surfaces
    - Debris in fluid passages

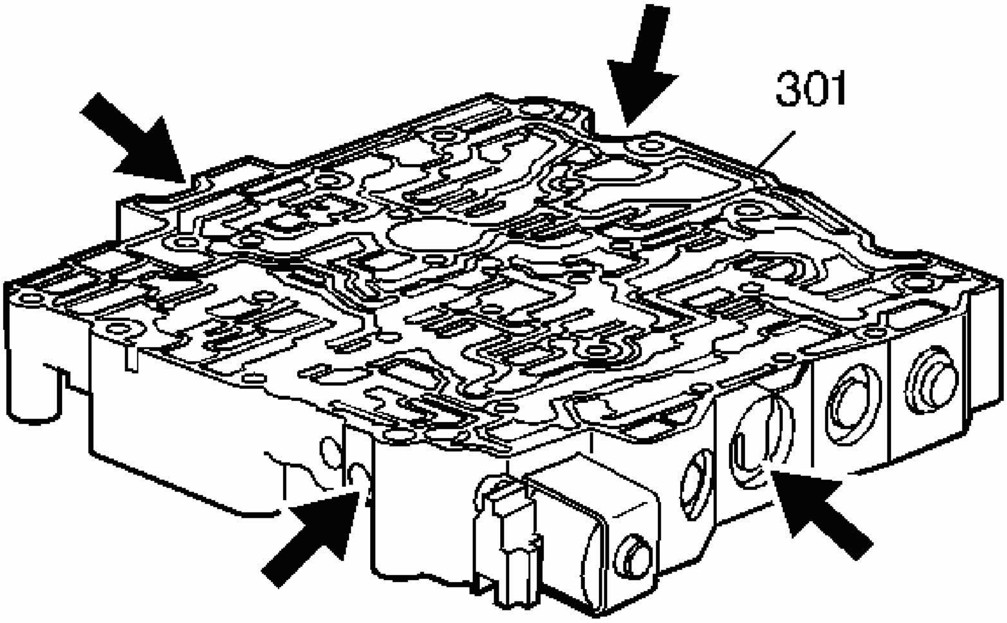


Fig. 295: Inspection Areas Of Control Valve Body
Courtesy of GENERAL MOTORS CORP.

2. Use a small pick or screwdriver. Before disassembly, inspect the control valve body (301) components for the following conditions:
    - Valves binding or sticking in their bores or bushings
    - Broken, missing or damaged springs
    - Missing or damaged retainers
    - Damaged solenoid valves
    - Debris in valve line-ups or solenoid valves

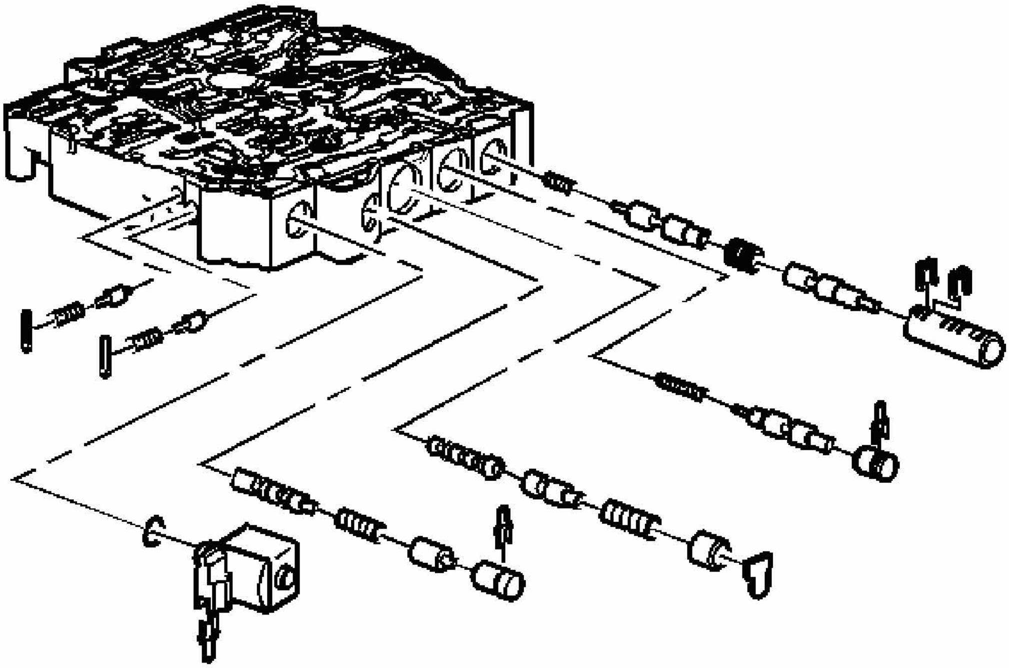


Fig. 296: Expanded View Of Control Valve Body
Courtesy of GENERAL MOTORS CORP.

3. During disassembly, inspect the control valve body for the following conditions:
   - Worn or damaged valves, valve bores or bushings
   - Broken, missing or damaged springs
   - Missing or damaged retainers
   - Damaged solenoid valves
   - Debris in valve line-ups or solenoid valves

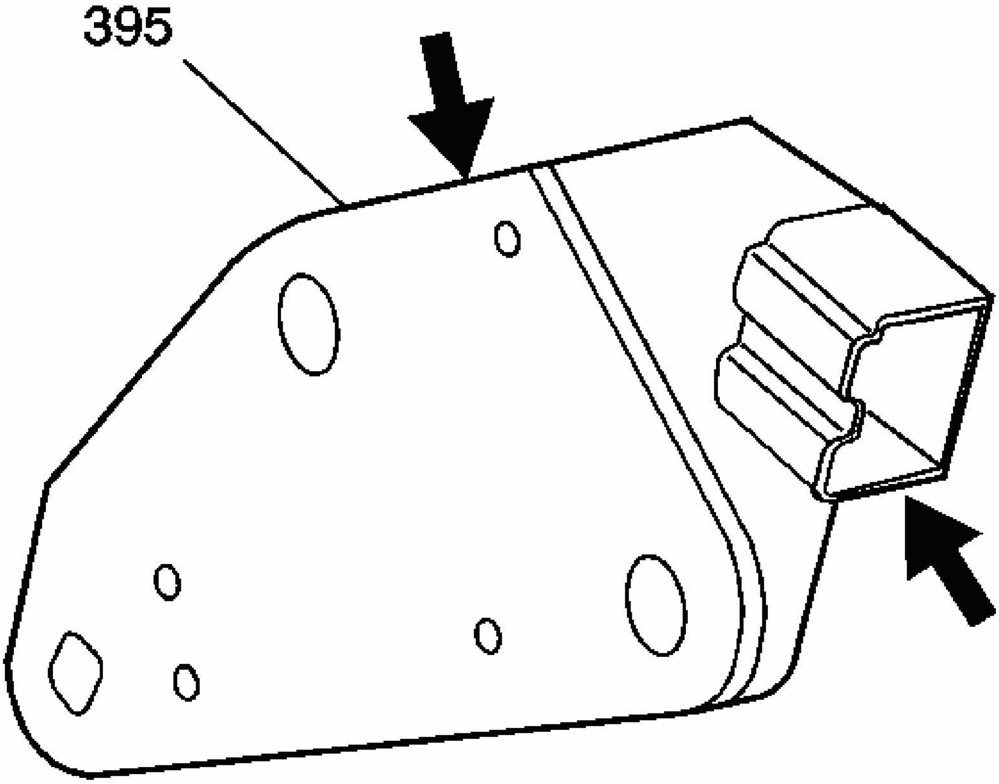


Fig. 297: View Of Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly
Courtesy of GENERAL MOTORS CORP.

4. Inspect the transmission fluid pressure (TFP) manual valve position switch assembly (395) for the following conditions:
    - Damaged electrical connector terminals
    - Damaged seals
    - Damaged switch membranes
    - Debris on the switch membranes

CONTROL VALVE BODY DISASSEMBLE (WITHOUT TOUCH ACTIVATED POWER)

Disassembly Procedure

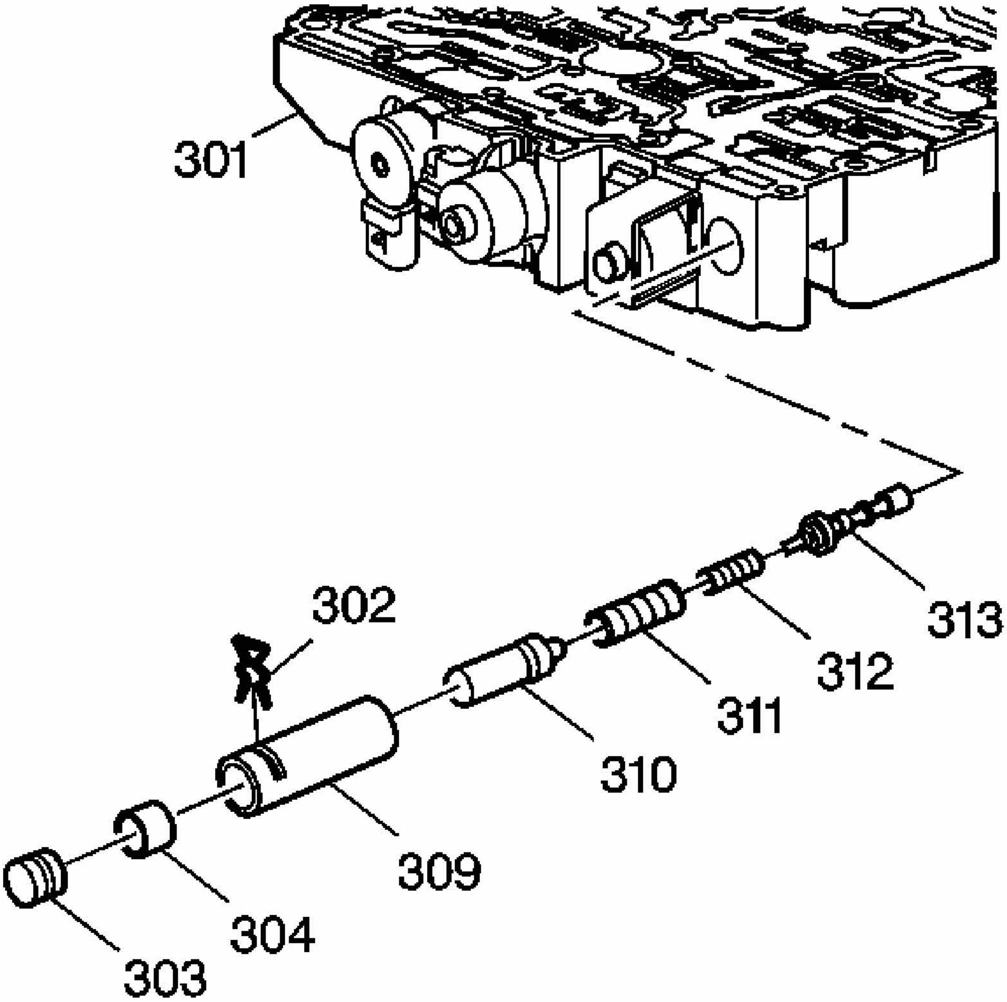


Fig. 298: View Of Reverse Boost Valve Bushing Assembly Components
Courtesy of GENERAL MOTORS CORP.

CAUTION: Valve Springs can be tightly compressed. Use care when removing retainers and plugs. Personal injury could result.

IMPORTANT: Position the control valve body assembly on a clean surface during disassembly.

IMPORTANT: All valves, springs and bushings must be laid out on a clean surface. Lay them exactly the way they are removed to aid reassembly.

1. Using a small screwdriver or pick, remove the line boost valve and bushing retainer (302) from the control valve body (301).
2. Remove the line boost valve bore plug (303), line boost valve (304), reverse boost valve bushing (309), reverse boost valve (310), pressure regulator valve outer and inner springs (311, 312) and pressure regulator valve (313) from the control valve body (301).

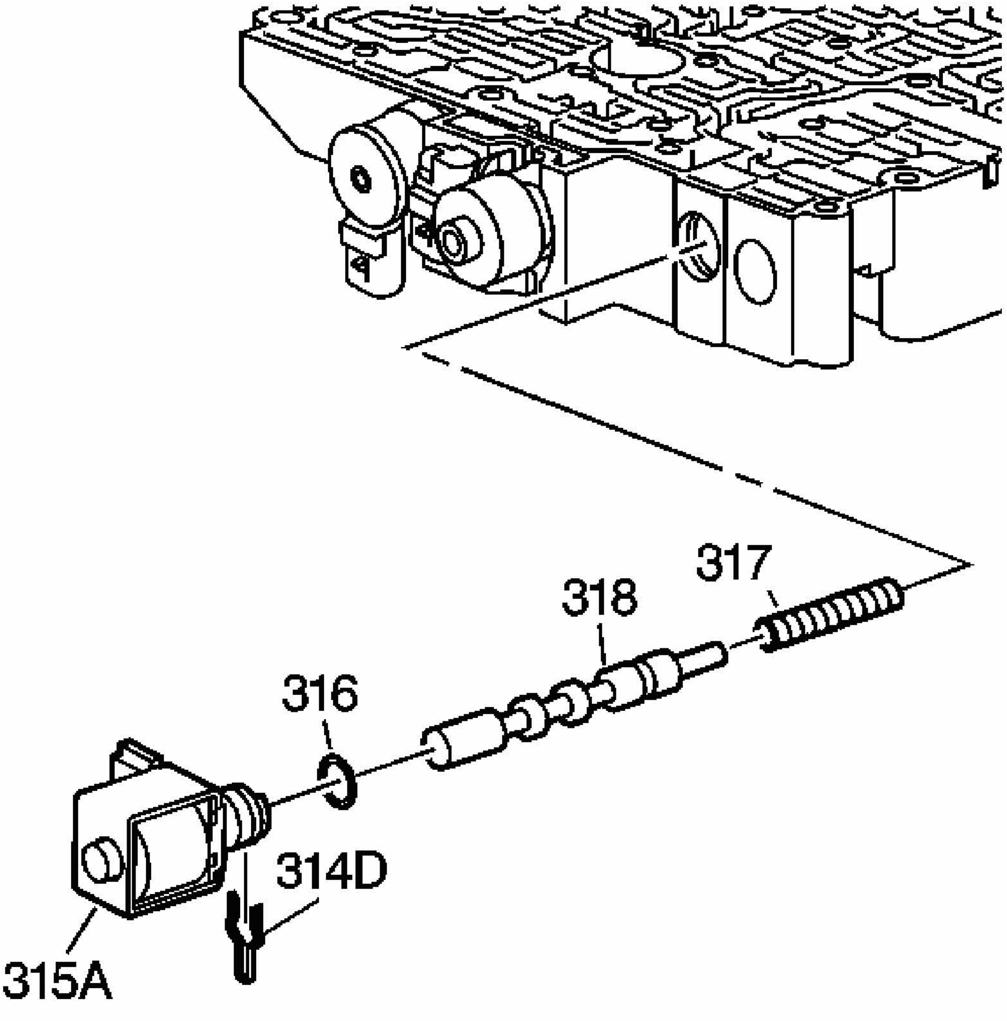


Fig. 299: Identifying 1-2, 3-4 Shift Solenoid (SS) Valve Components
Courtesy of GENERAL MOTORS CORP.

3. Using a small screwdriver or pick, remove the 1-2, 3-4 shift solenoid valve retainer (314D) from the control valve body (301).
4. Remove the 1-2, 3-4 shift solenoid (SS) valve (315A), 1-2 shift valve (318) and 1-2

shift valve spring (317) from the control valve body (301).

5. Remove the O-ring seal (316) from the 1-2, 3-4 SS valve (315A) ONLY if it is damaged.

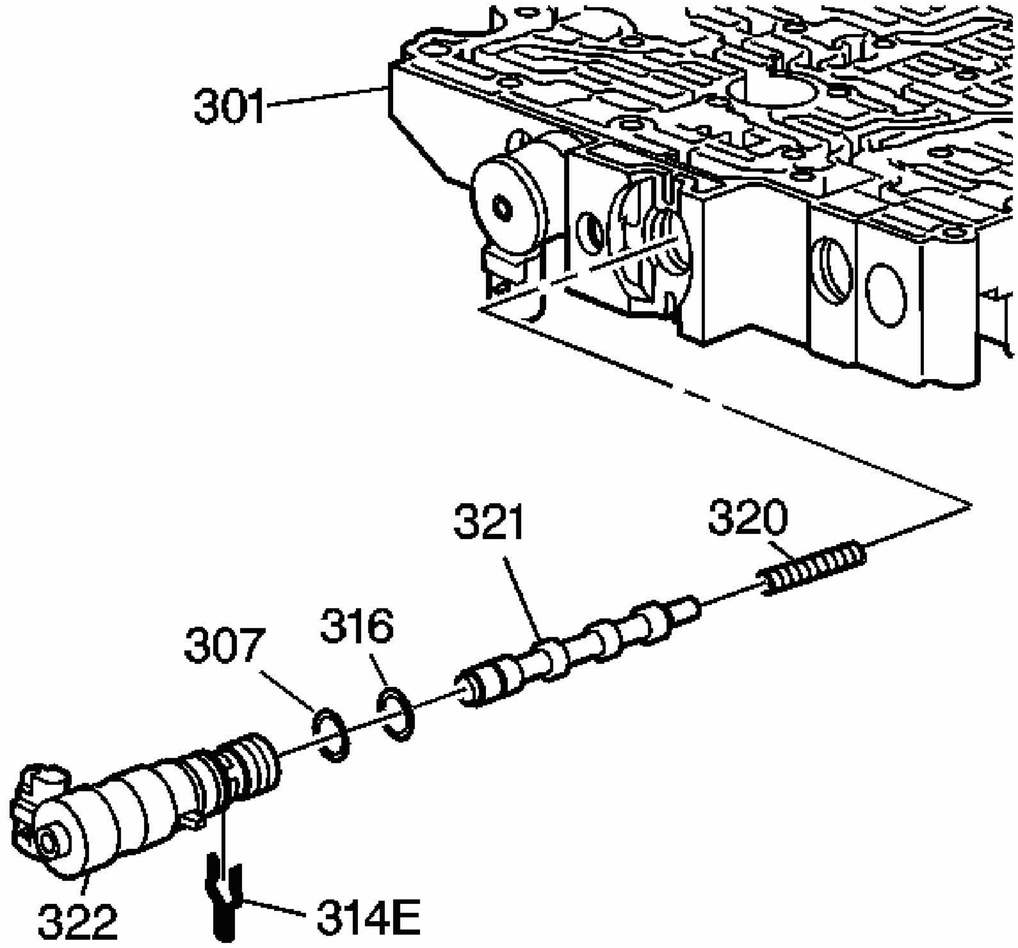


Fig. 300: View Of PC Solenoid Valve & Torque Signal Regulator Valve
Courtesy of GENERAL MOTORS CORP.

6. Using a small screwdriver or pick, remove the pressure control solenoid valve retainer (314E) from the control valve body (301).
7. Remove the pressure control (PC) solenoid valve (322), torque signal regulator valve (321) and torque signal regulator valve spring (320) from the control valve body (301).
8. Remove the O-ring seals (307, 316) from the PC solenoid valve (322) ONLY if they are damaged.

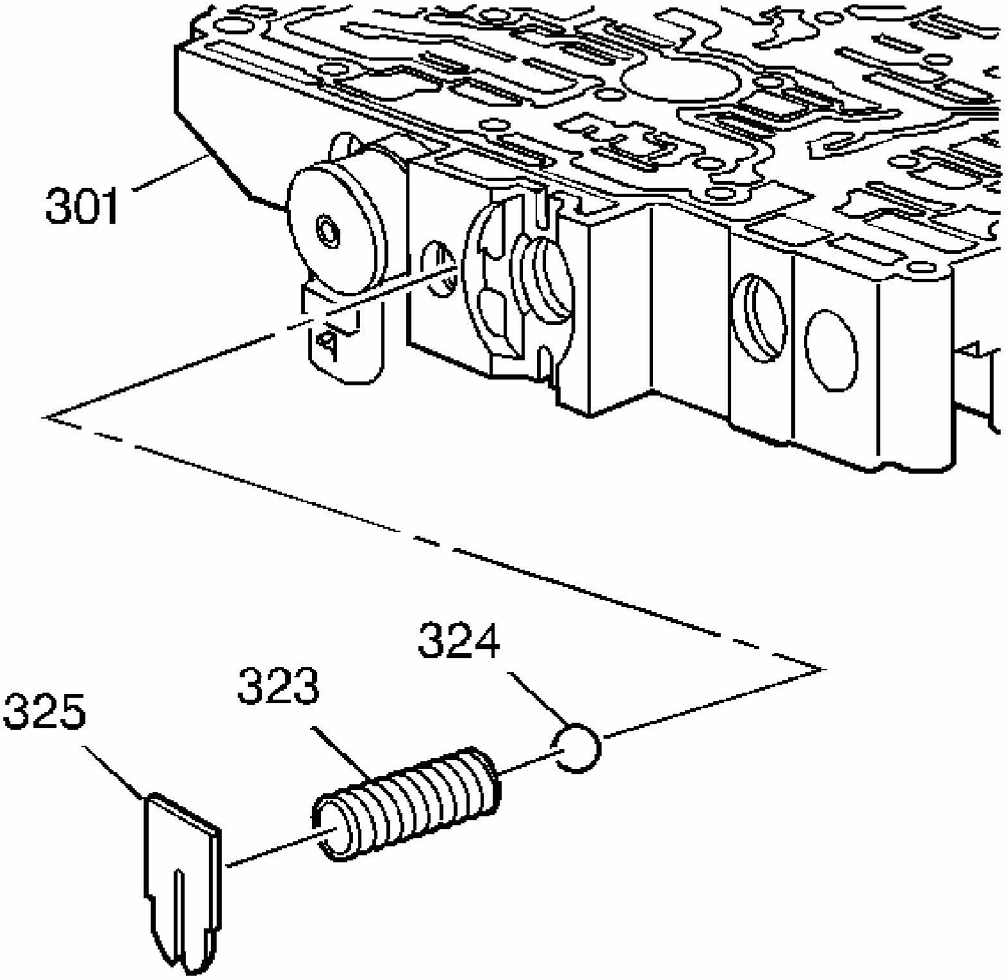


Fig. 301: Locating Line Pressure Relief Valve Assembly
Courtesy of GENERAL MOTORS CORP.

9. Using a small screwdriver or pick, remove the line pressure relief valve spring retainer (325) from the control valve body (301).
10. Remove the line pressure relief valve spring (323) and the line pressure relief valve (324) from the control valve body (301).

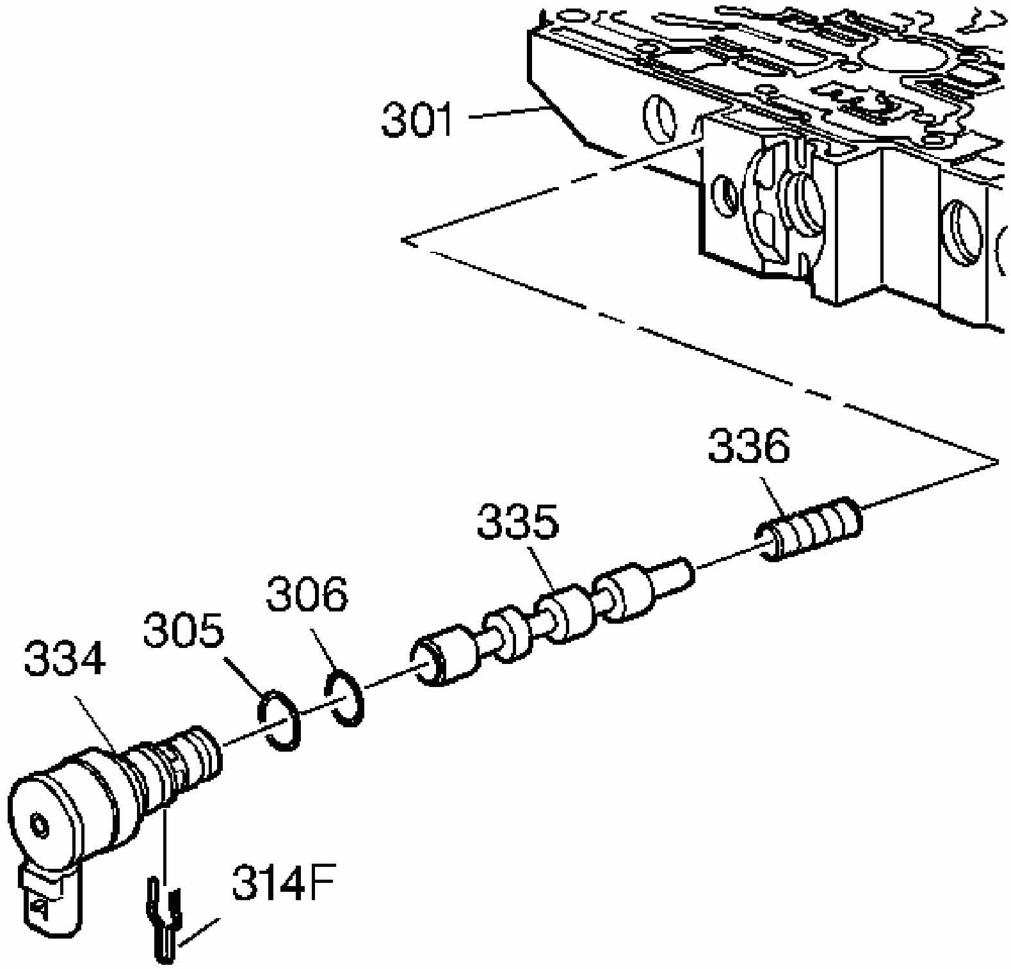


Fig. 302: View Of TCC PWM Solenoid
Courtesy of GENERAL MOTORS CORP.

11. Using a small screwdriver or pick, remove the TCC PWM solenoid valve retainer (314F) from the control valve body (301).
12. Remove the TCC PWM solenoid valve (334), TCC control valve (335) and TCC control valve spring (336) from the control valve body (301).
13. Remove the O-ring seals (305, 306) from the TCC PWM solenoid valve (334) ONLY if they are damaged.

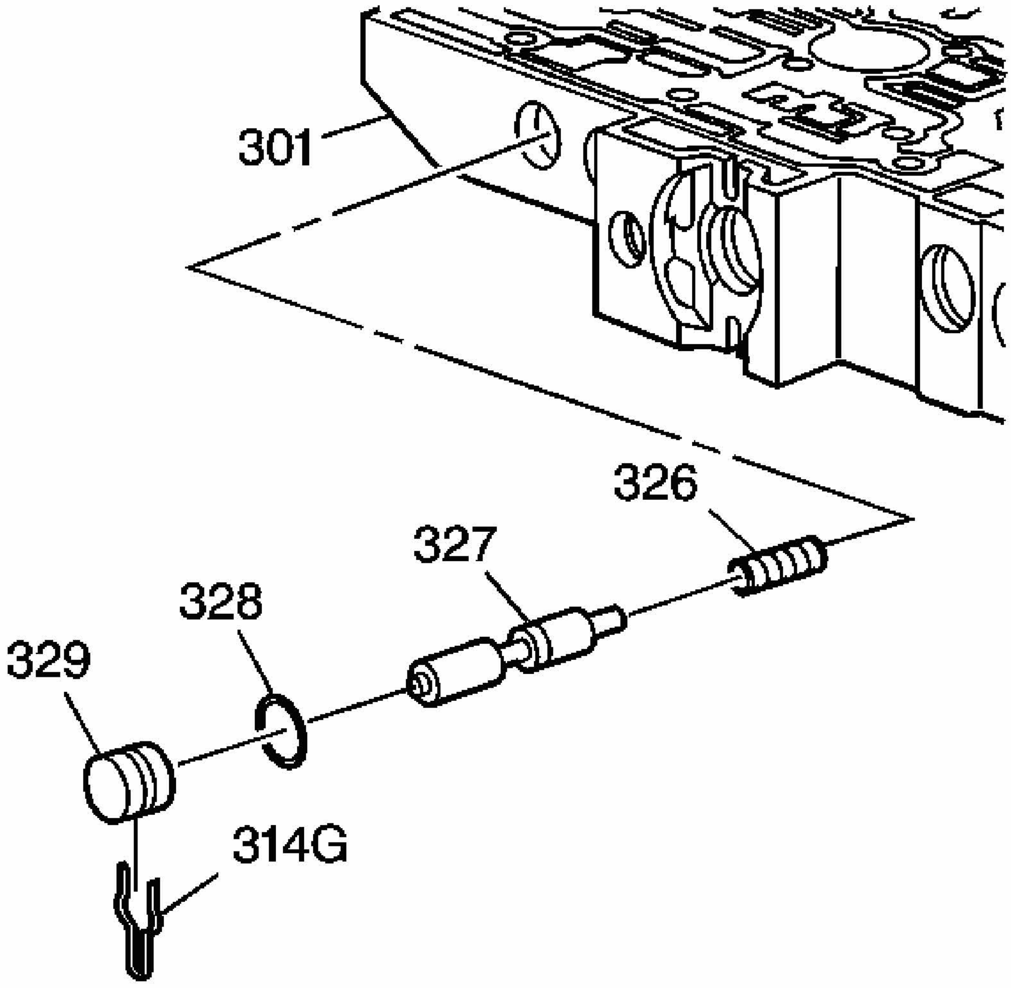


Fig. 303: Identifying TCC Regulator Apply Valve
Courtesy of GENERAL MOTORS CORP.

14. Using a small screwdriver or pick, remove the TCC regulator apply valve bore plug retainer (314G) from the control valve body (301).
15. Remove the TCC regulator apply valve bore plug (329), O-ring seal (328), TCC regulator apply valve (327) and TCC regulator apply valve spring (326) from the control valve body (301).

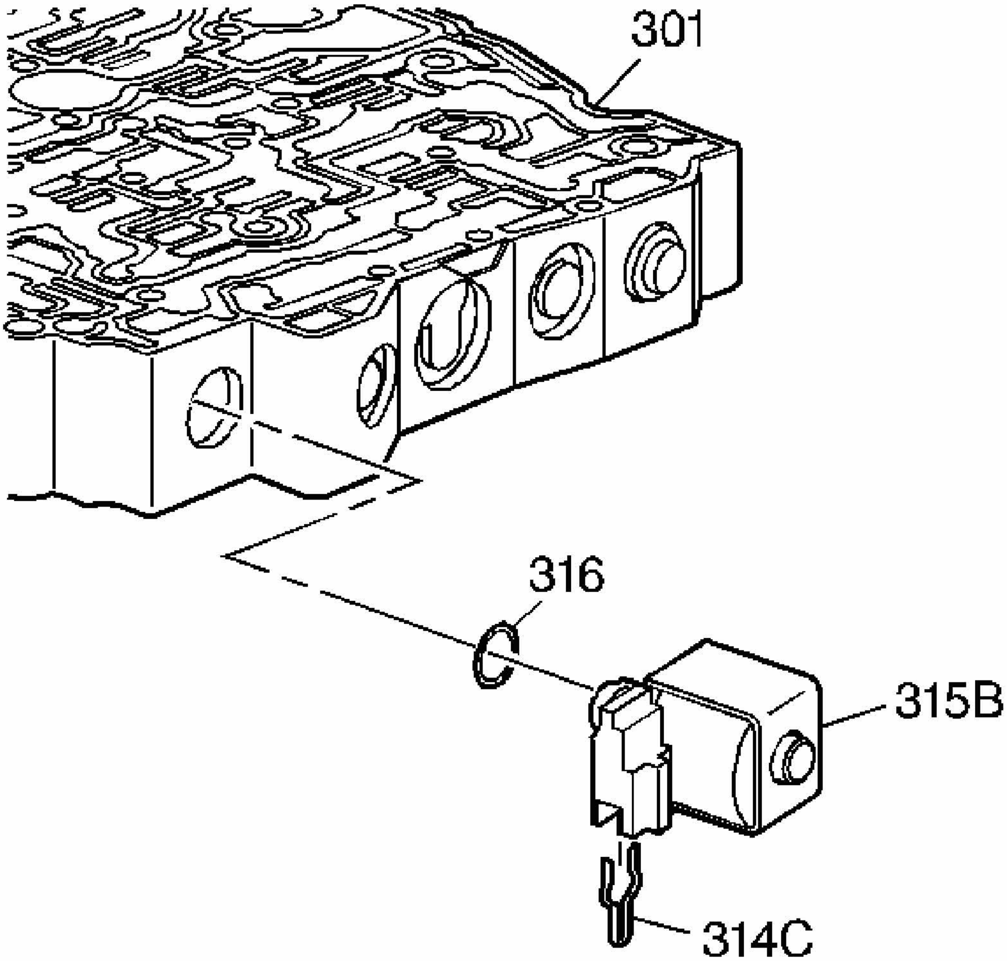


Fig. 304: View Of 2-3 Shift Solenoid & O-Ring
Courtesy of GENERAL MOTORS CORP.

16. Using a small screwdriver or pick, remove the 2-3 shift solenoid valve retainer (314C) from the control valve body (301).
17. Remove the 2-3 shift solenoid (SS) valve (315B) from the control valve body (301).
18. Remove the O-ring seal (316) from the 2-3 SS valve (315B) ONLY if it is damaged.

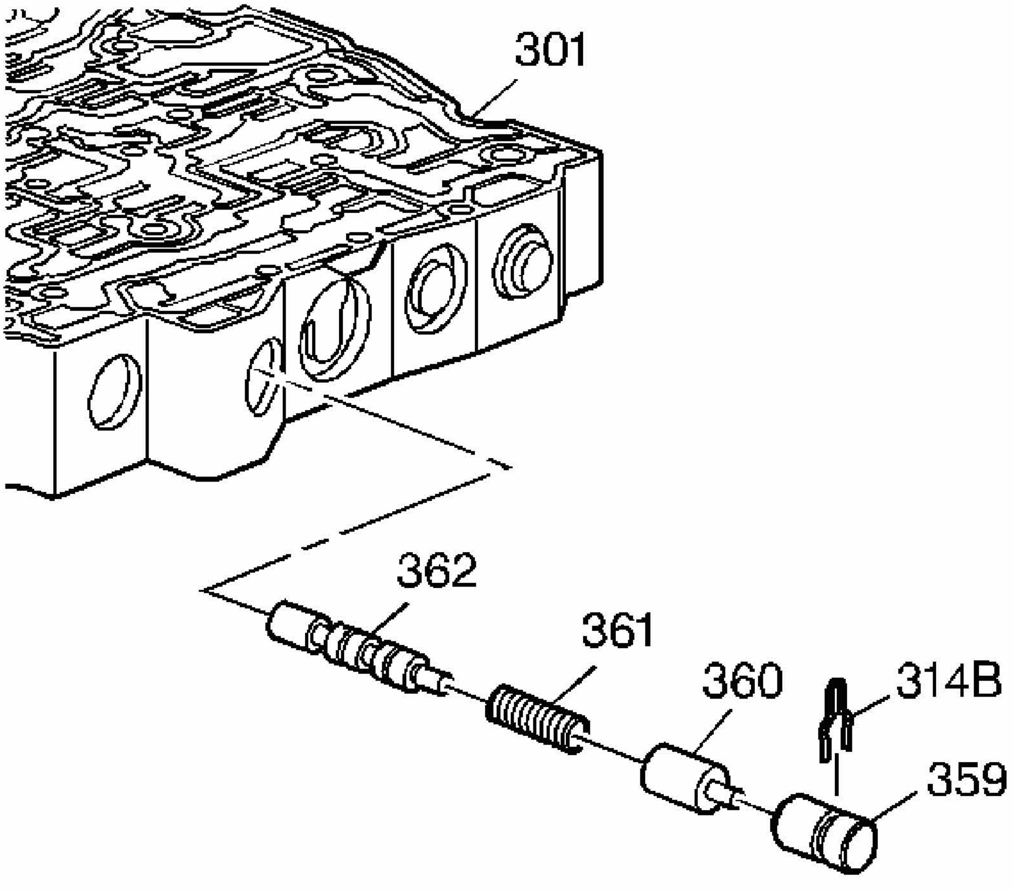


Fig. 305: View Of 3-4 Shift Valve & 4-3 Manual Downshift Valve Components
Courtesy of GENERAL MOTORS CORP.

19. Using a small screwdriver or pick, remove the 4-3 manual downshift valve retainer (314B) from the control valve body (301).
20. Remove the 4-3 manual downshift valve bore plug (359), 4-3 manual downshift valve (360), 4-3 manual downshift valve spring (361) and 3-4 shift valve (362) from the control valve body (301).

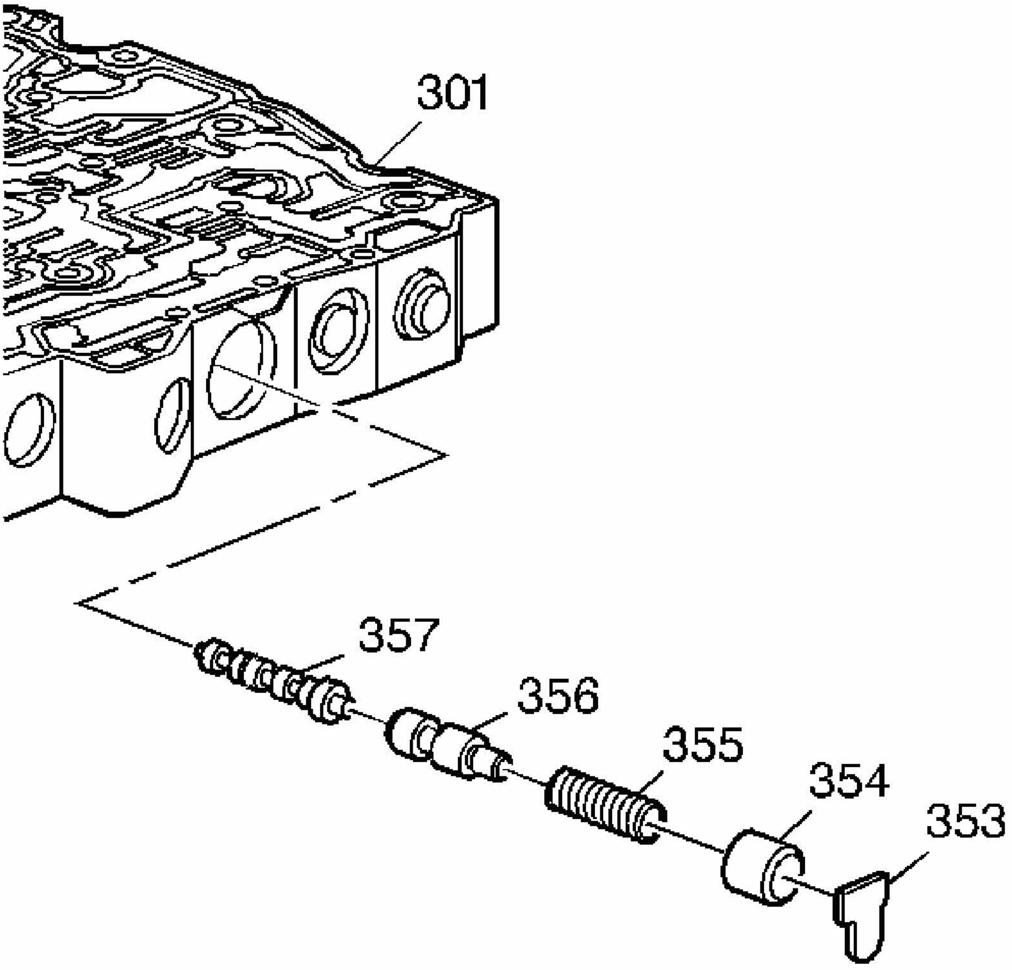


Fig. 306: Identifying 3-2 Manual Downshift Valve & 2-3 Shift Valve
Courtesy of GENERAL MOTORS CORP.

21. Using a small screwdriver or pick, remove the 3-2 manual downshift valve retainer (353) from the control valve body (301).
22. Remove the 3-2 manual downshift valve bore plug (354), 3-2 manual downshift valve spring (355), 3-2 manual downshift valve (356) and 2-3 shift valve (357) from the control valve body (301).

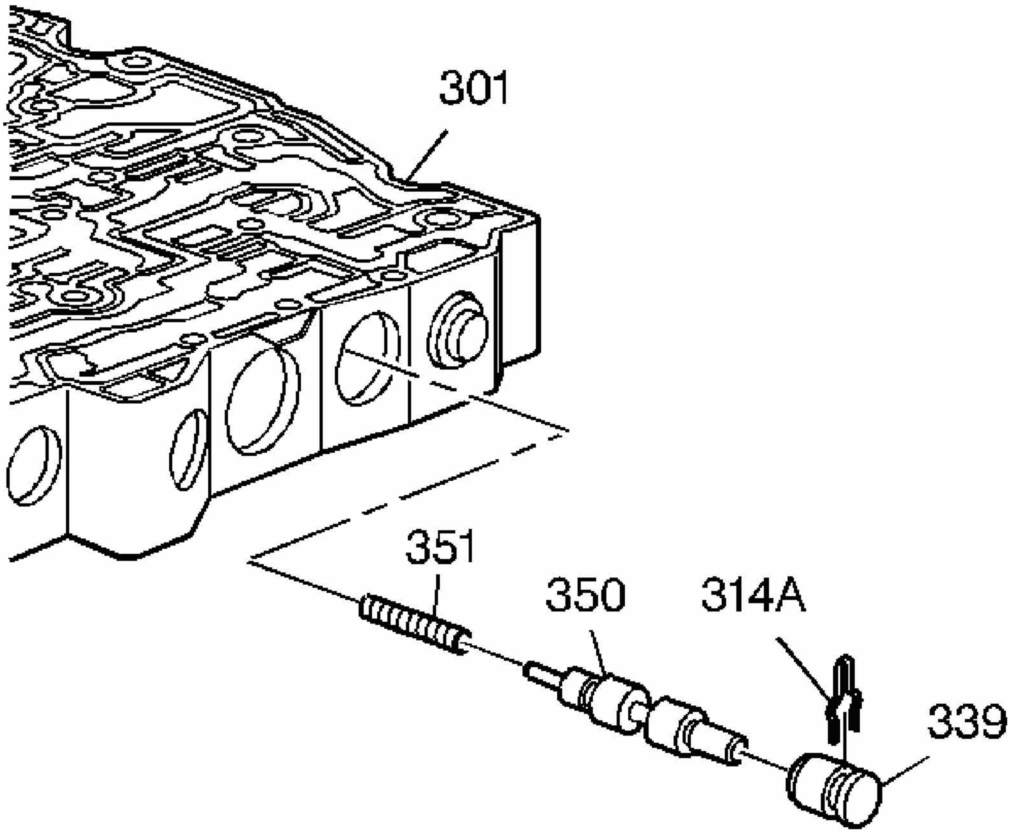


Fig. 307: Locating 1-2 Accumulator Valve & 1-2 Accumulator Valve Spring
Courtesy of GENERAL MOTORS CORP.

23. Using a small screwdriver or pick, remove the 1-2 accumulator valve retainer (314A) from the control valve body (301).
24. Remove the 1-2 accumulator valve bore plug (339), 1-2 accumulator valve (350) and 1-2 accumulator valve spring (351) from the control valve body (301).

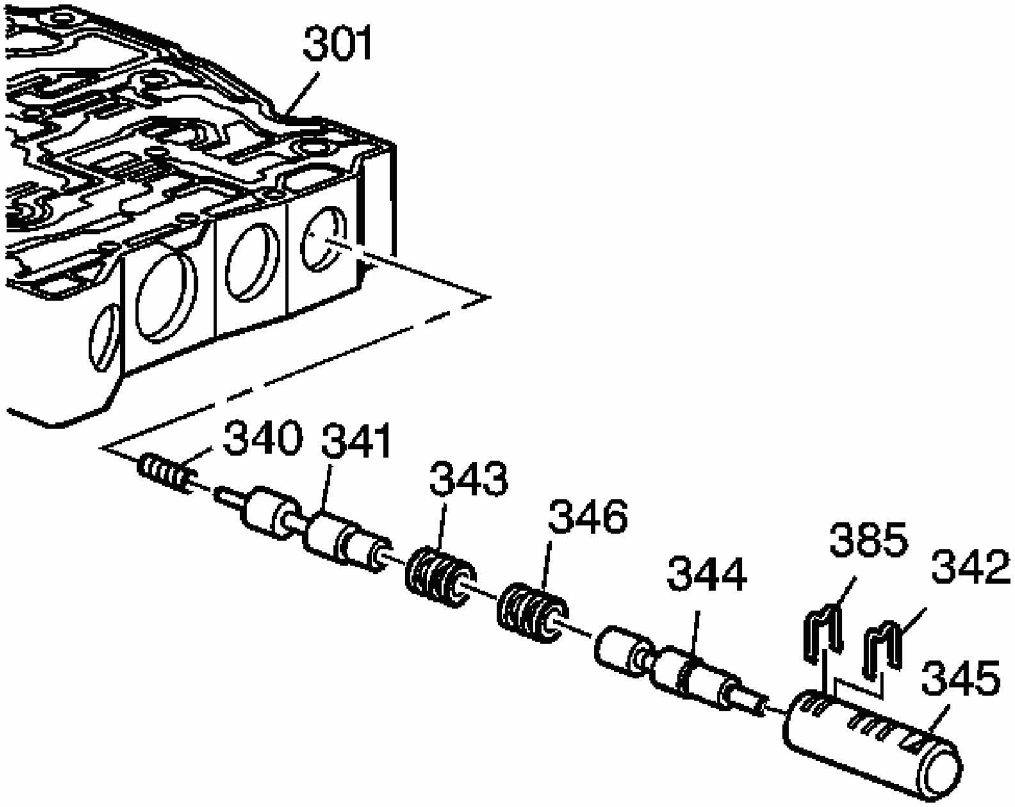


Fig. 308: View Of 2-3 Accumulator Valve & 3-4 Accumulator Valve Components
Courtesy of GENERAL MOTORS CORP.

25. Using a small screwdriver or pick, remove the 2-3 accumulator valve bushing assembly retainer (385) from the control valve body (301).
26. Remove the 2-3 accumulator valve bushing assembly (345), 3-4 accumulator valve (341) and 3-4 accumulator valve spring (340) from the control valve body (301).
27. Using a small screwdriver or pick, remove the 2-3 accumulator valve bore plug retainer (342) from the 2-3 accumulator valve bushing (345).
28. Remove the 2-3 accumulator valve bore plug (343), the 2-3 accumulator valve spring (346) and the 2-3 accumulator valve (344) from the 2-3 accumulator valve bushing (345).

CONTROL VALVE BODY DISASSEMBLE (WITH TOUCH ACTIVATED POWER)

Disassembly Procedure

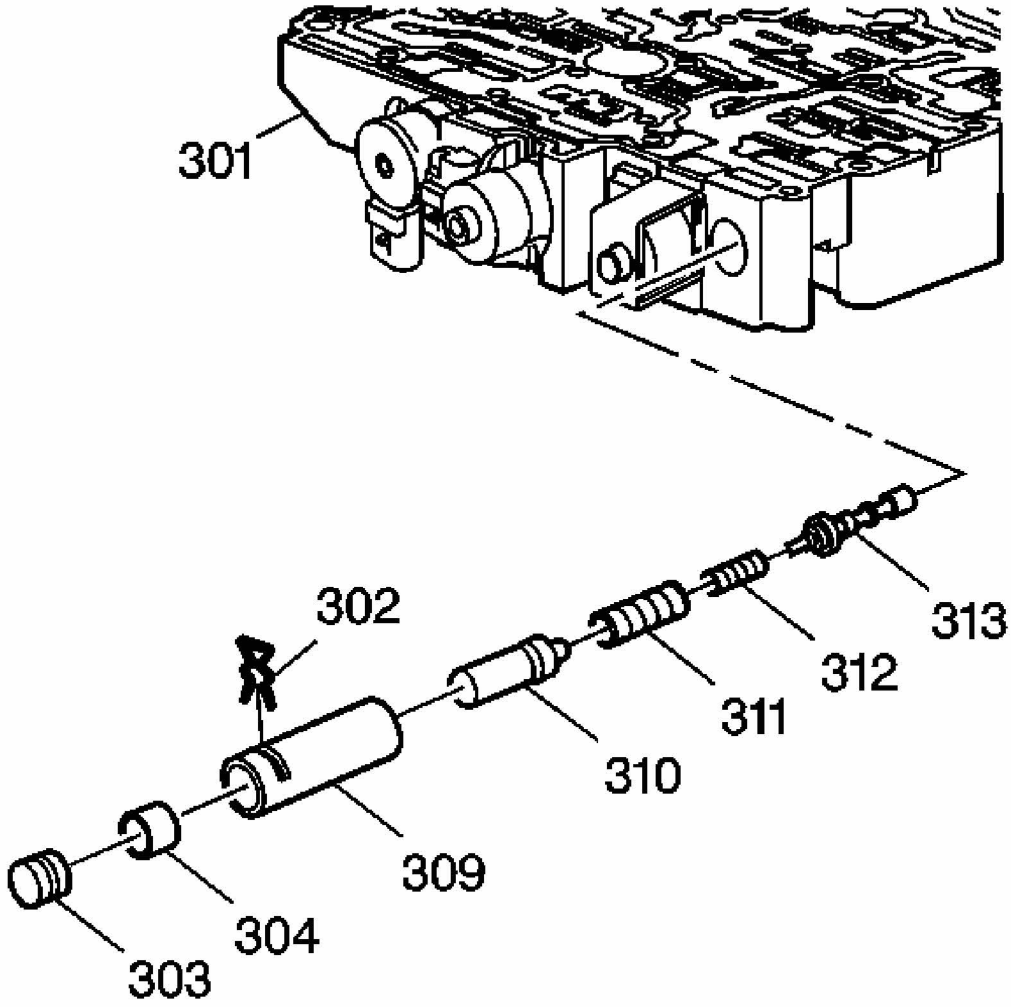


Fig. 309: View Of Reverse Boost Valve Bushing Assembly Components
Courtesy of GENERAL MOTORS CORP.

CAUTION: Valve Springs can be tightly compressed. Use care when removing retainers and plugs. Personal injury could result.

IMPORTANT: Position the control valve body assembly on a clean surface during disassembly.

IMPORTANT: All valves, springs and bushings must be laid out on a clean surface. Lay them exactly the way they are removed to aid reassembly.

1. Using a small screwdriver or pick, remove the line boost valve and bushing retainer (302) from the control valve body (301).
2. Remove the line boost valve bore plug (303), line boost valve (304), reverse boost valve bushing (309), reverse boost valve (310), pressure regulator valve outer and inner springs (311, 312) and pressure regulator valve (313) from the control valve body (301).

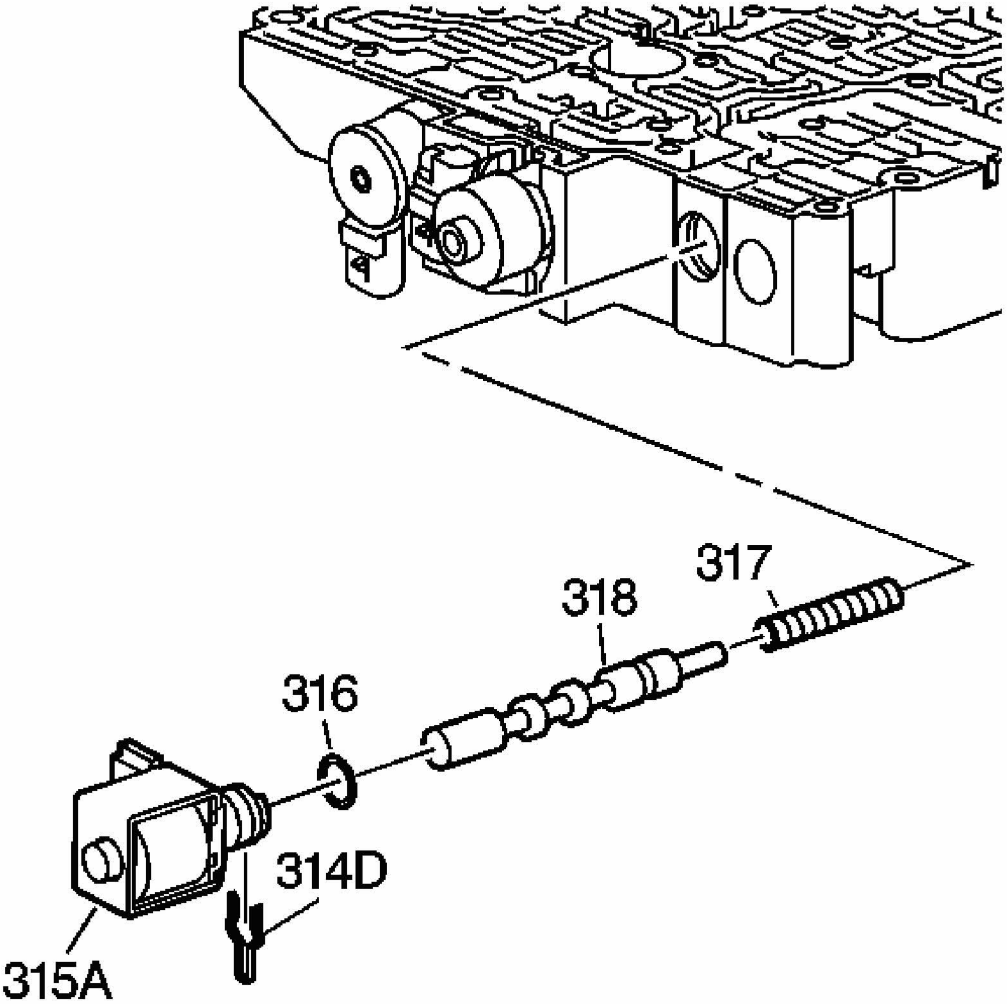


Fig. 310: Identifying 1-2, 3-4 Shift Solenoid (SS) Valve Components
Courtesy of GENERAL MOTORS CORP.

3. Using a small screwdriver or pick, remove the 1-2, 3-4 shift solenoid valve retainer (314D) from the control valve body (301).
4. Remove the 1-2, 3-4 shift solenoid (SS) valve (315A), 1-2 shift valve (318) and 1-2

shift valve spring (317) from the control valve body (301).

5. Remove the O-ring seal (316) from the 1-2, 3-4 SS valve (315A) ONLY if it is damaged.

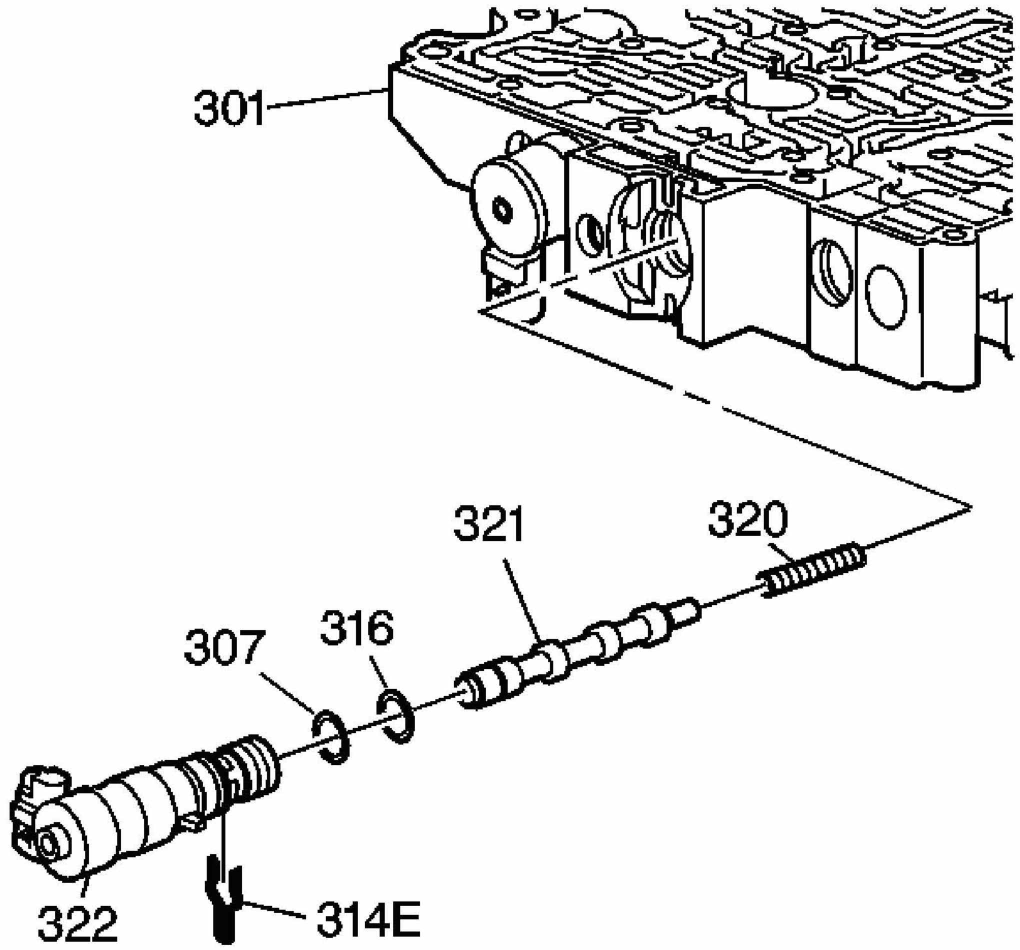


Fig. 311: View Of PC Solenoid Valve & Torque Signal Regulator Valve
Courtesy of GENERAL MOTORS CORP.

6. Using a small screwdriver or pick, remove the pressure control solenoid valve retainer (314E) from the control valve body (301).
7. Remove the pressure control (PC) solenoid valve (322), torque signal regulator valve (321) and torque signal regulator valve spring (320) from the control valve body (301).
8. Remove the O-ring seals (307, 316) from the PC solenoid valve (322) ONLY if they are damaged.

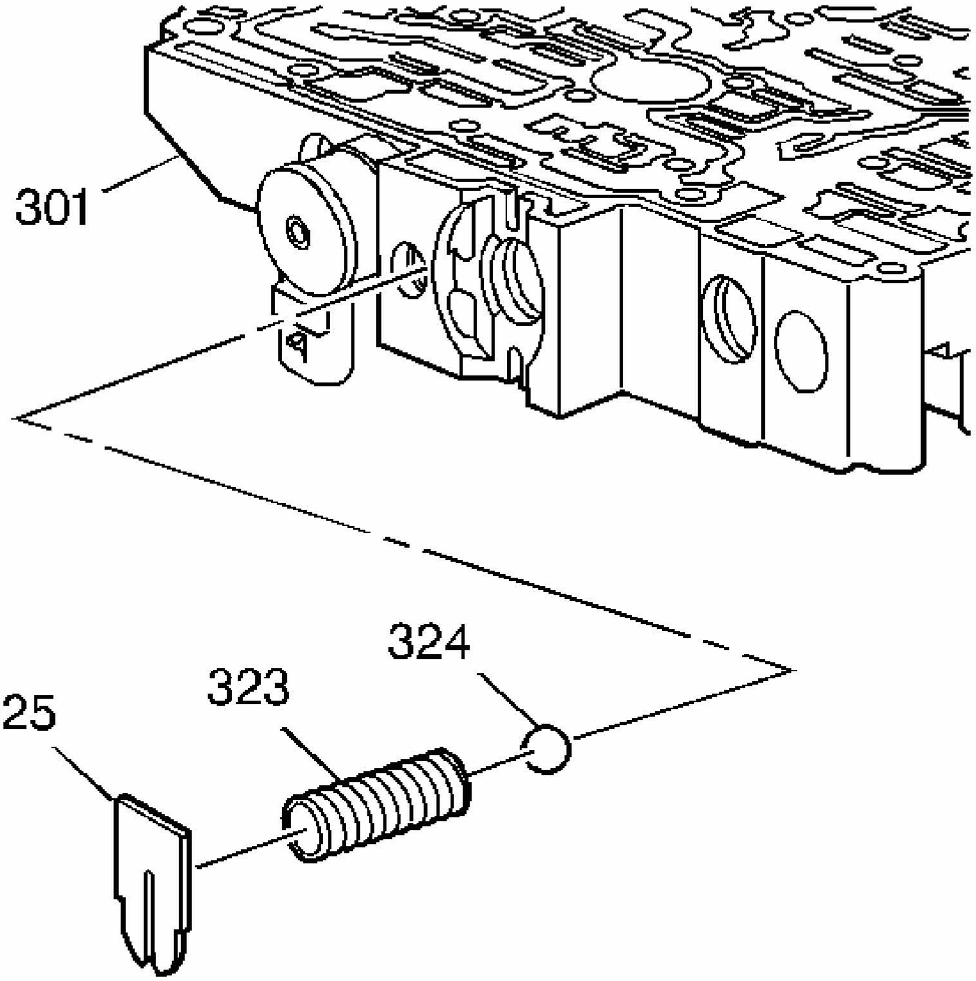


Fig. 312: Locating Line Pressure Relief Valve Assembly
Courtesy of GENERAL MOTORS CORP.

9. Using a small screwdriver or pick, remove the line pressure relief valve spring retainer (325) from the control valve body (301).
10. Remove the line pressure relief valve spring (323) and the line pressure relief valve (324) from the control valve body (301).

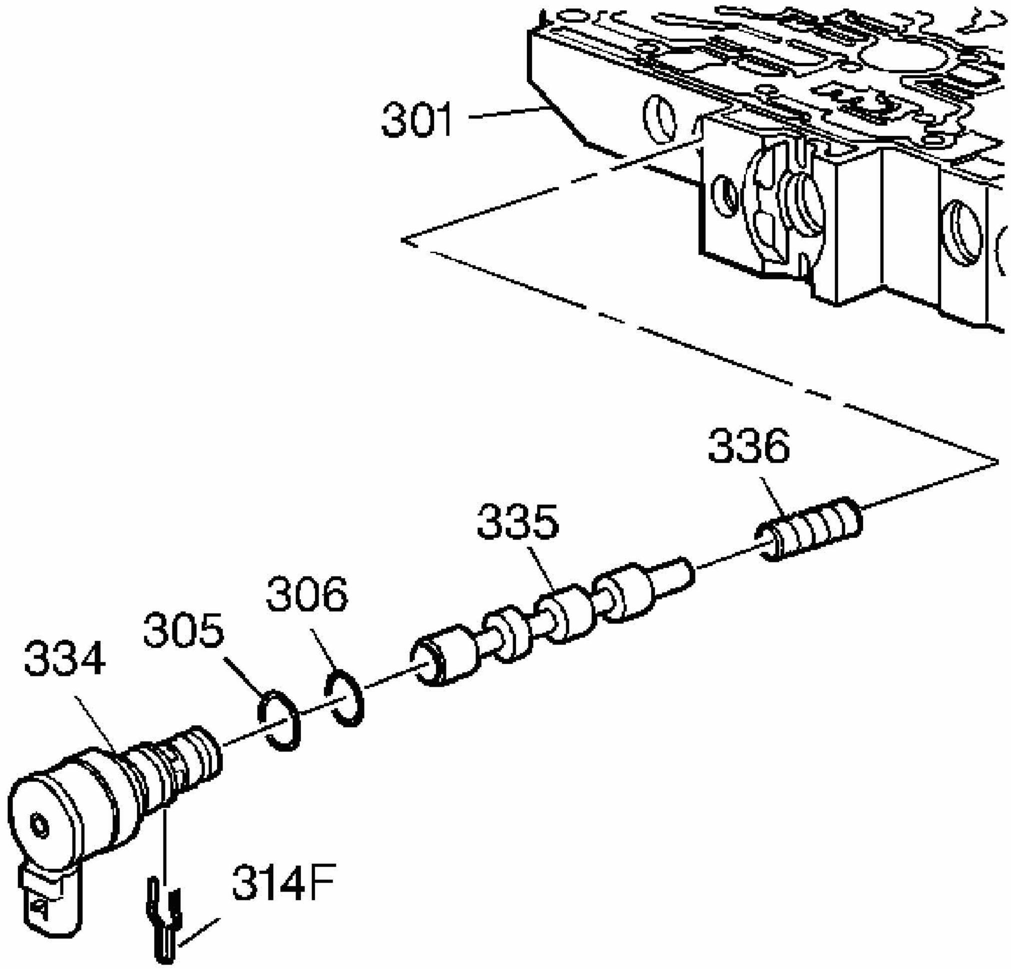


Fig. 313: View Of TCC PWM Solenoid
Courtesy of GENERAL MOTORS CORP.

11. Using a small screwdriver or pick, remove the TCC PWM solenoid valve retainer (314F) from the control valve body (301).
12. Remove the TCC PWM solenoid valve (334), TCC control valve (335) and TCC control valve spring (336) from the control valve body (301).
13. Remove the O-ring seals (305, 306) from the TCC PWM solenoid valve (334) ONLY if they are damaged.

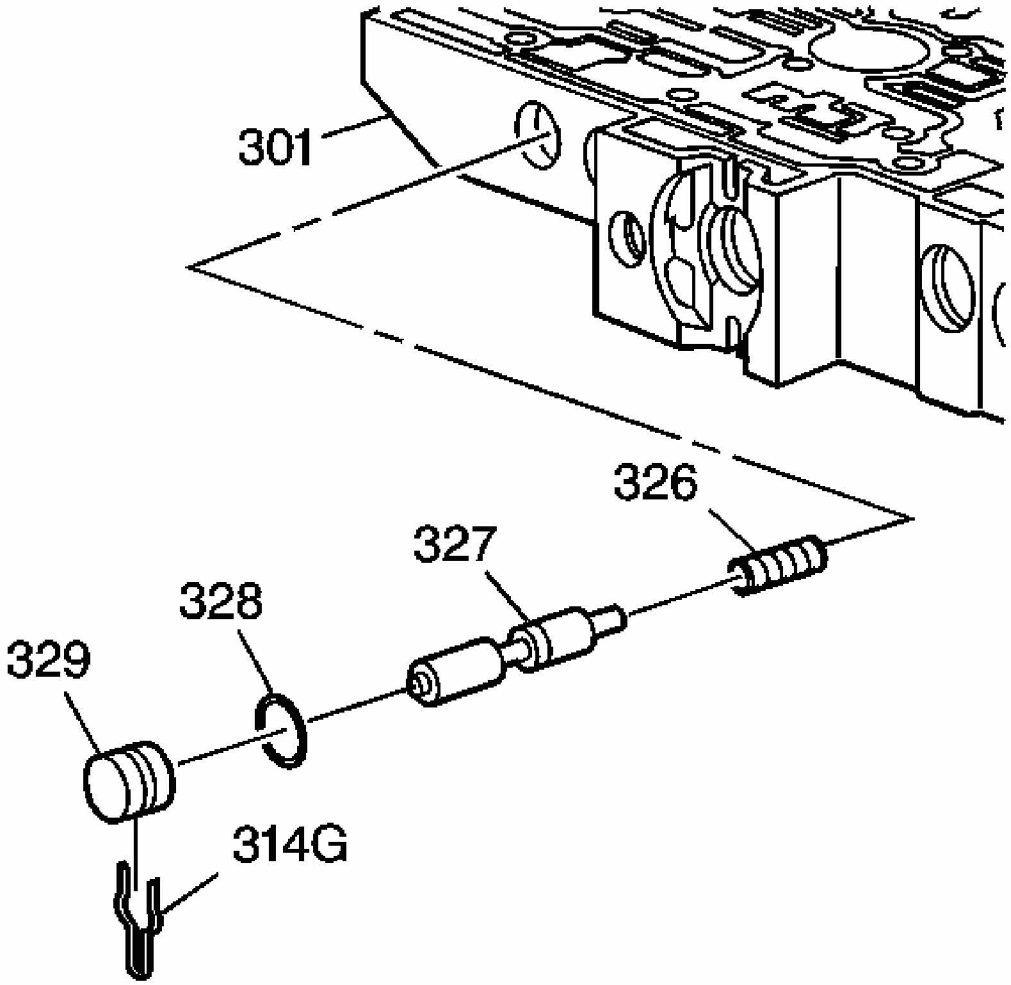


Fig. 314: Identifying TCC Regulator Apply Valve
Courtesy of GENERAL MOTORS CORP.

14. Using a small screwdriver or pick, remove the TCC regulator apply valve bore plug retainer (314G) from the control valve body (301).
15. Remove the TCC regulator apply valve bore plug (329), O-ring seal (328), TCC regulator apply valve (327) and TCC regulator apply valve spring (326) from the control valve body (301).

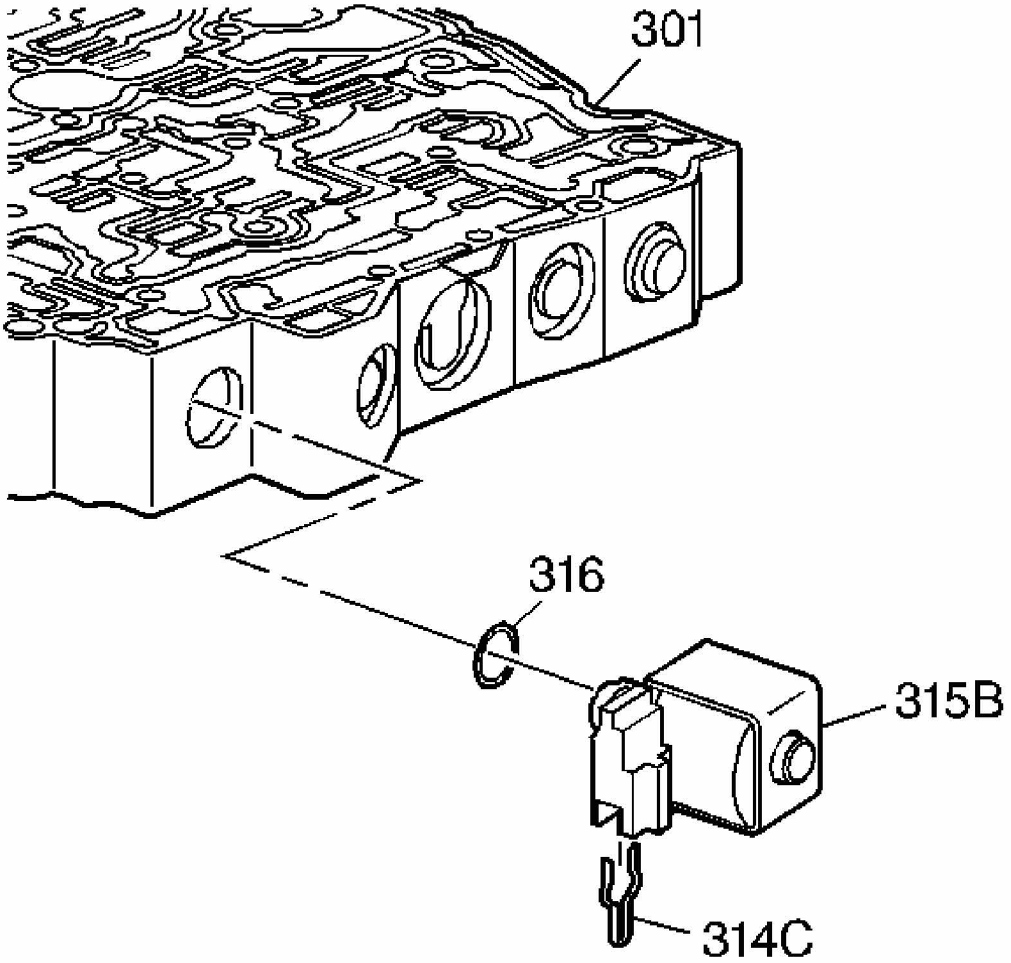


Fig. 315: View Of 2-3 Shift Solenoid & O-Ring
Courtesy of GENERAL MOTORS CORP.

16. Using a small screwdriver or pick, remove the 2-3 shift solenoid valve retainer (314C) from the control valve body (301).
17. Remove the 2-3 shift solenoid (SS) valve (315B) from the control valve body (301).
18. Remove the O-ring seal (316) from the 2-3 SS valve (315B) ONLY if it is damaged.

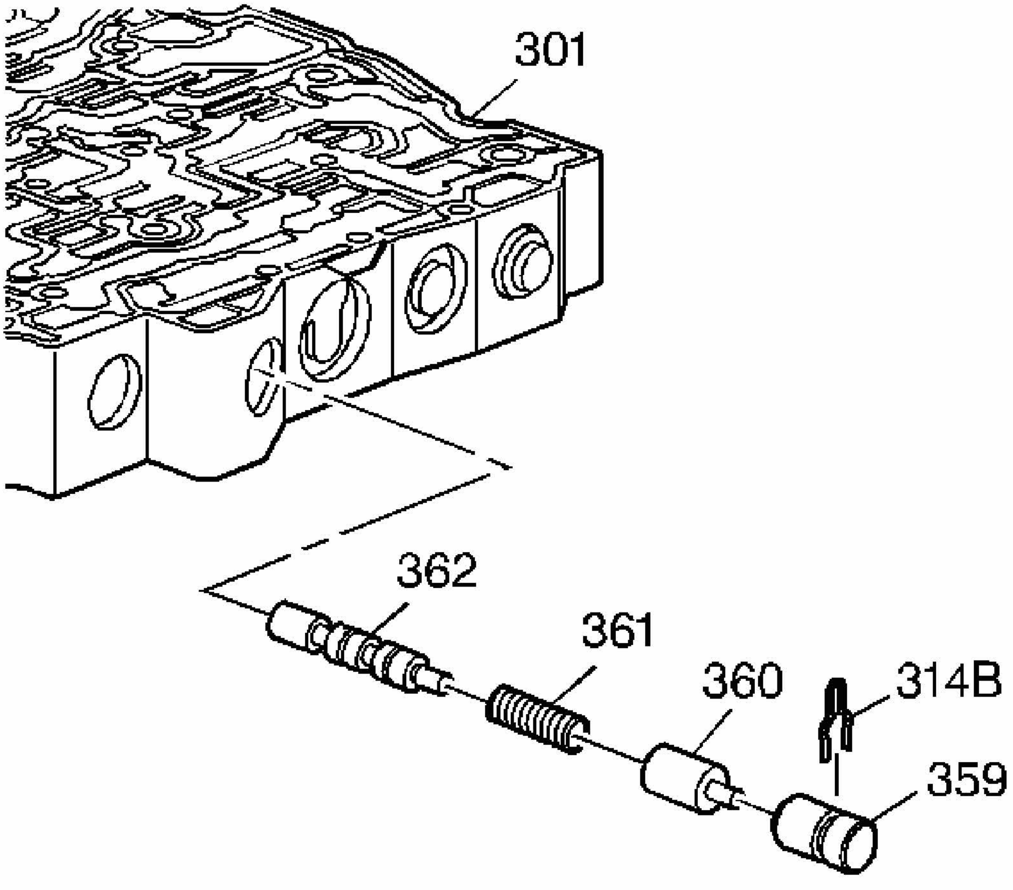


Fig. 316: View Of 3-4 Shift Valve & 4-3 Manual Downshift Valve Components
Courtesy of GENERAL MOTORS CORP.

19. Using a small screwdriver or pick, remove the 4-3 manual downshift valve retainer (314B) from the control valve body (301).
20. Remove the 4-3 manual downshift valve bore plug (359), 4-3 manual downshift valve (360), 4-3 manual downshift valve spring (361) and 3-4 shift valve (362) from the control valve body (301).

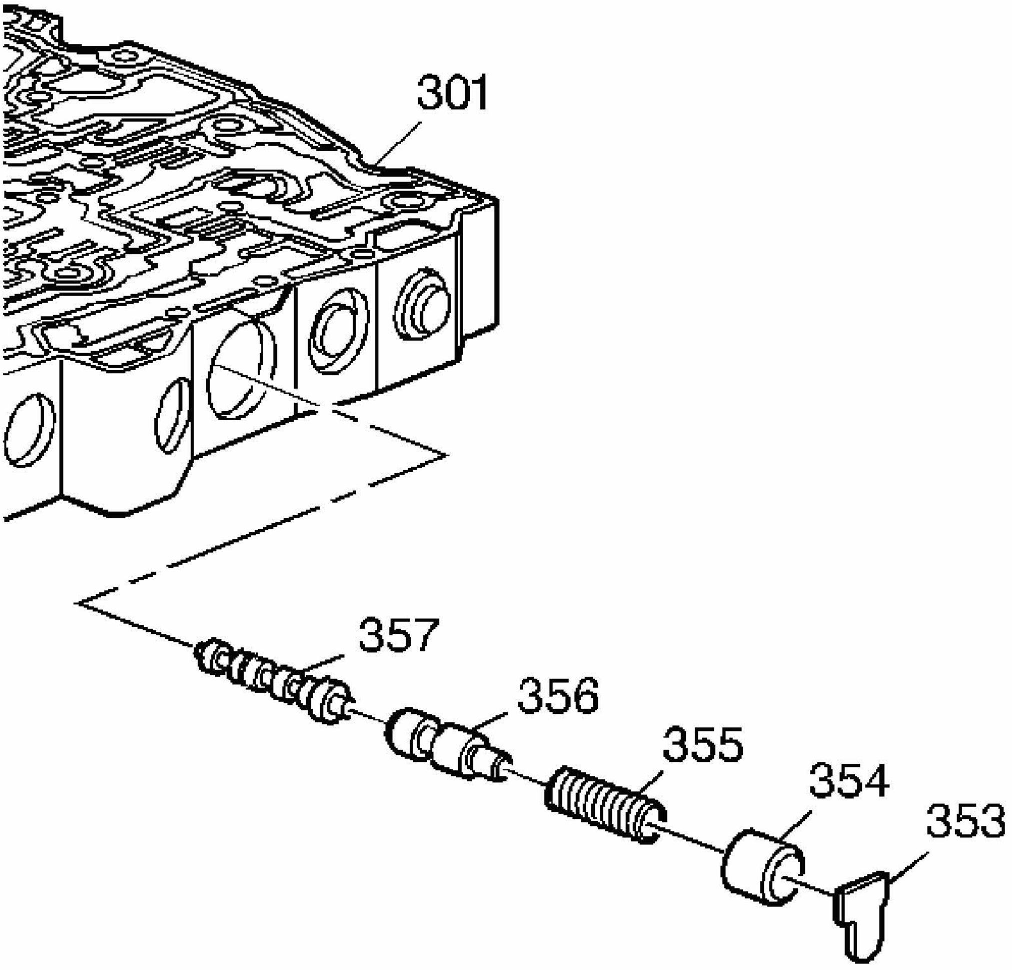


Fig. 317: Identifying 3-2 Manual Downshift Valve & 2-3 Shift Valve
Courtesy of GENERAL MOTORS CORP.

21. Using a small screwdriver or pick, remove the 3-2 manual downshift valve retainer (353) from the control valve body (301).
22. Remove the 3-2 manual downshift valve bore plug (354), 3-2 manual downshift valve spring (355), 3-2 manual downshift valve (356) and 2-3 shift valve (357) from the control valve body (301).

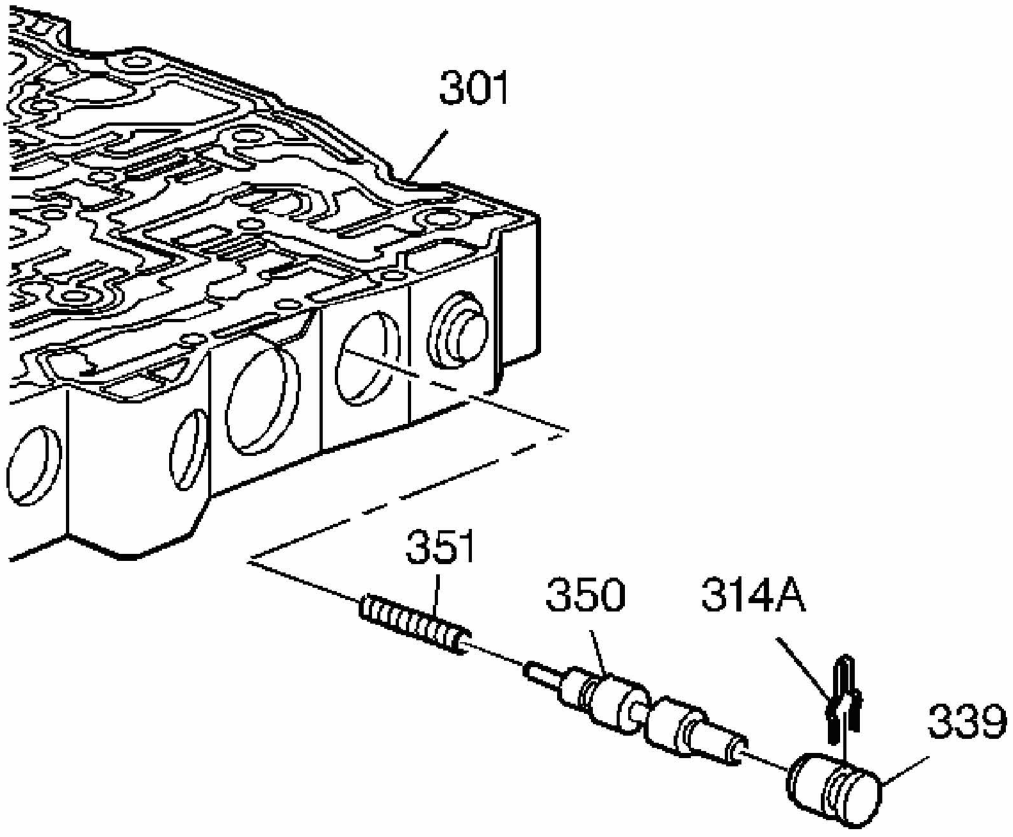


Fig. 318: Locating 1-2 Accumulator Valve & 1-2 Accumulator Valve Spring
Courtesy of GENERAL MOTORS CORP.

23. Using a small screwdriver or pick, remove the 1-2 accumulator valve retainer (314A) from the control valve body (301).
24. Remove the 1-2 accumulator valve bore plug (339), 1-2 accumulator valve (350) and 1-2 accumulator valve spring (351) from the control valve body (301).

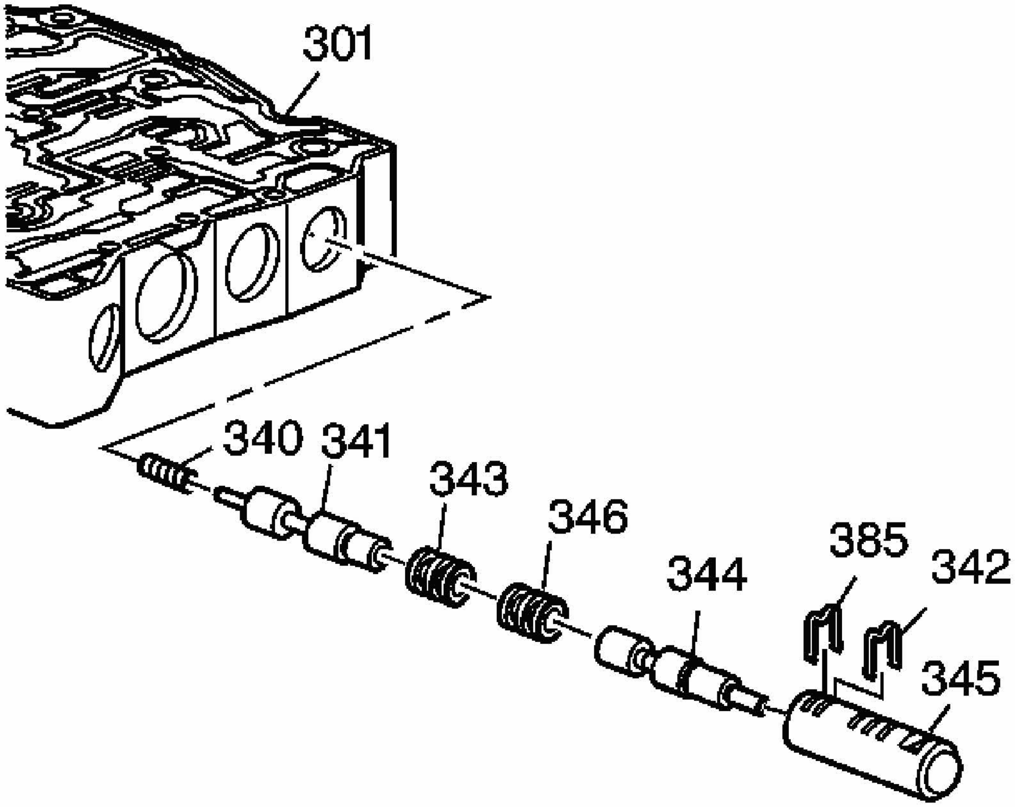


Fig. 319: View Of 2-3 Accumulator Valve & 3-4 Accumulator Valve Components
Courtesy of GENERAL MOTORS CORP.

25. Using a small screwdriver or pick, remove the 2-3 accumulator valve bushing assembly retainer (385) from the control valve body (301).
26. Remove the 2-3 accumulator valve bushing assembly (345), 3-4 accumulator valve (341) and 3-4 accumulator valve spring (340) from the control valve body (301).
27. Using a small screwdriver or pick, remove the 2-3 accumulator valve bore plug retainer (342) from the 2-3 accumulator valve bushing (345).
28. Remove the 2-3 accumulator valve bore plug (343), the 2-3 accumulator valve spring (346) and the 2-3 accumulator valve (344) from the 2-3 accumulator valve bushing (345).

CONTROL VALVE BODY ASSEMBLE (WITHOUT TOUCH ACTIVATED POWER)

Assembly Procedure

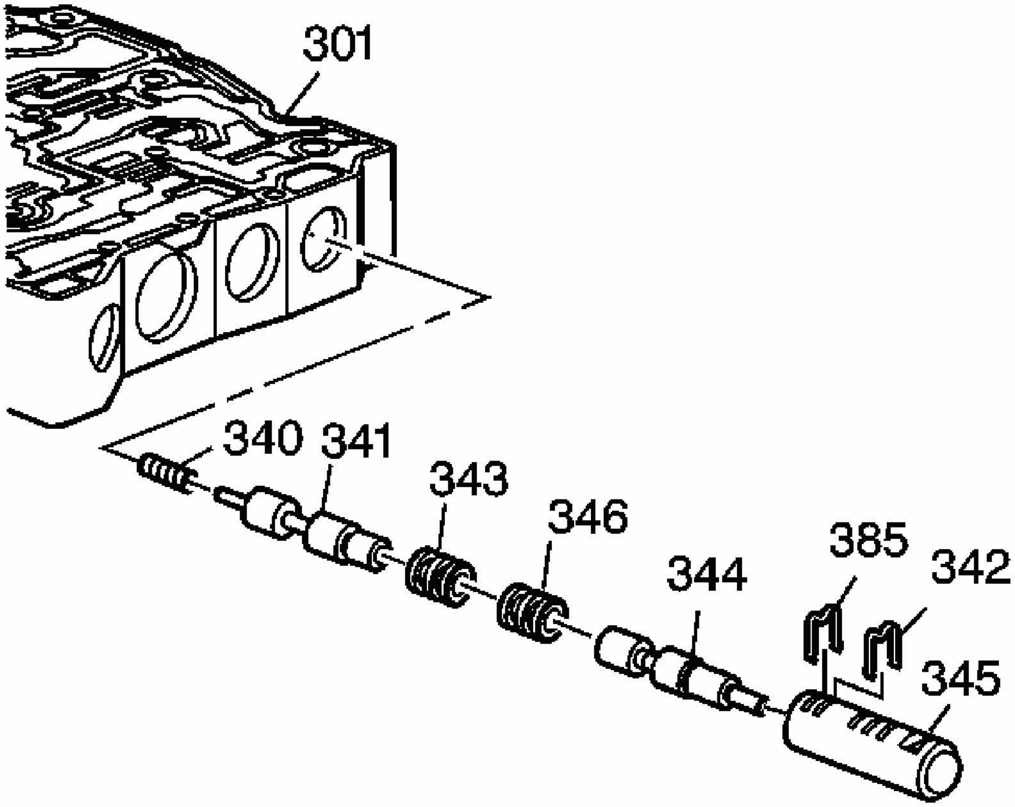


Fig. 320: View Of 2-3 Accumulator Valve & 3-4 Accumulator Valve Components
Courtesy of GENERAL MOTORS CORP.

1. Install the 2-3 accumulator valve (344), the 2-3 accumulator valve spring (346) and the 2-3 accumulator valve bore plug (343) into the 2-3 accumulator valve bushing (345).
2. Install the 2-3 accumulator valve bore plug retainer (342) in the 2-3 accumulator valve bushing (345), into the slot indicated.
3. Install the 3-4 accumulator valve spring (340), the 3-4 accumulator valve (341) and the 2-3 accumulator valve bushing (345) into the control valve body (301).
4. Hold the 2-3 accumulator valve bushing assembly (345) in the control valve body (301). Install the 2-3 accumulator valve bushing assembly retainer (385) into the slot indicated.

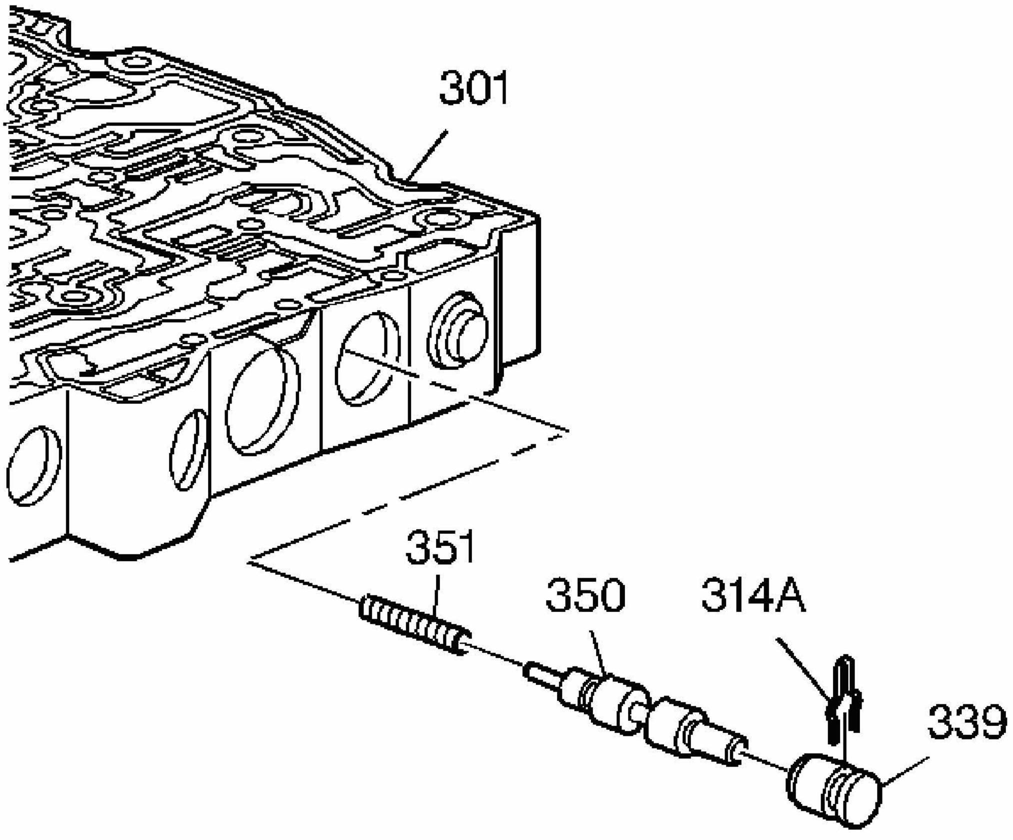


Fig. 321: Locating 1-2 Accumulator Valve & 1-2 Accumulator Valve Spring
Courtesy of GENERAL MOTORS CORP.

5. Install the 1-2 accumulator valve spring (351), the 1-2 accumulator valve (350) and the 1-2 accumulator valve bore plug (339) into the control valve body (301).
6. Hold the 1-2 accumulator valve bore plug (339) in the control valve body (301). Install the 1-2 accumulator valve retainer (314A) into the control valve body (301).

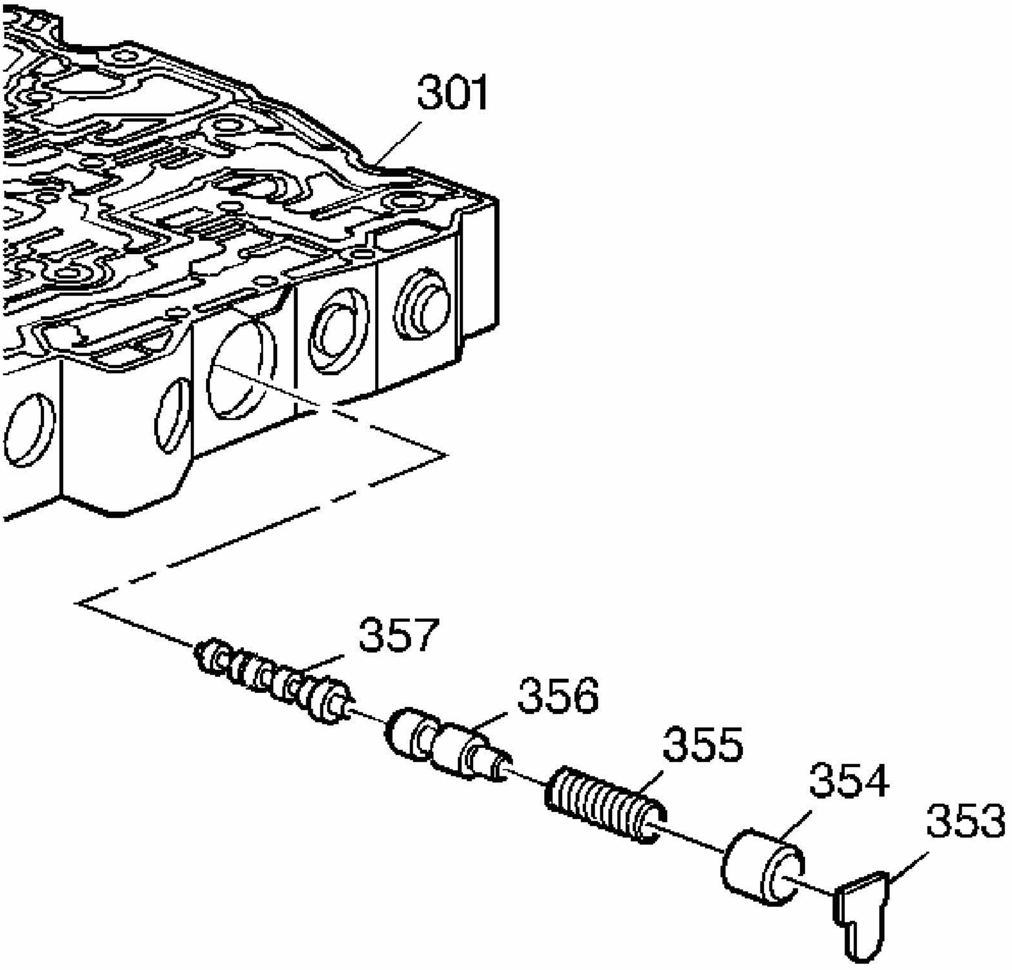


Fig. 322: Identifying 3-2 Manual Downshift Valve & 2-3 Shift Valve
Courtesy of GENERAL MOTORS CORP.

7. Install the 2-3 shift valve (357), the 3-2 manual downshift valve (356), the 3-2 manual downshift valve spring (355) and the 3-2 manual downshift valve bore plug (354) into the control valve body (301).
8. Hold the 3-2 manual downshift valve bore plug (354) in the control valve body (301). Install the 3-2 manual downshift valve retainer (353) into the control valve body (301).

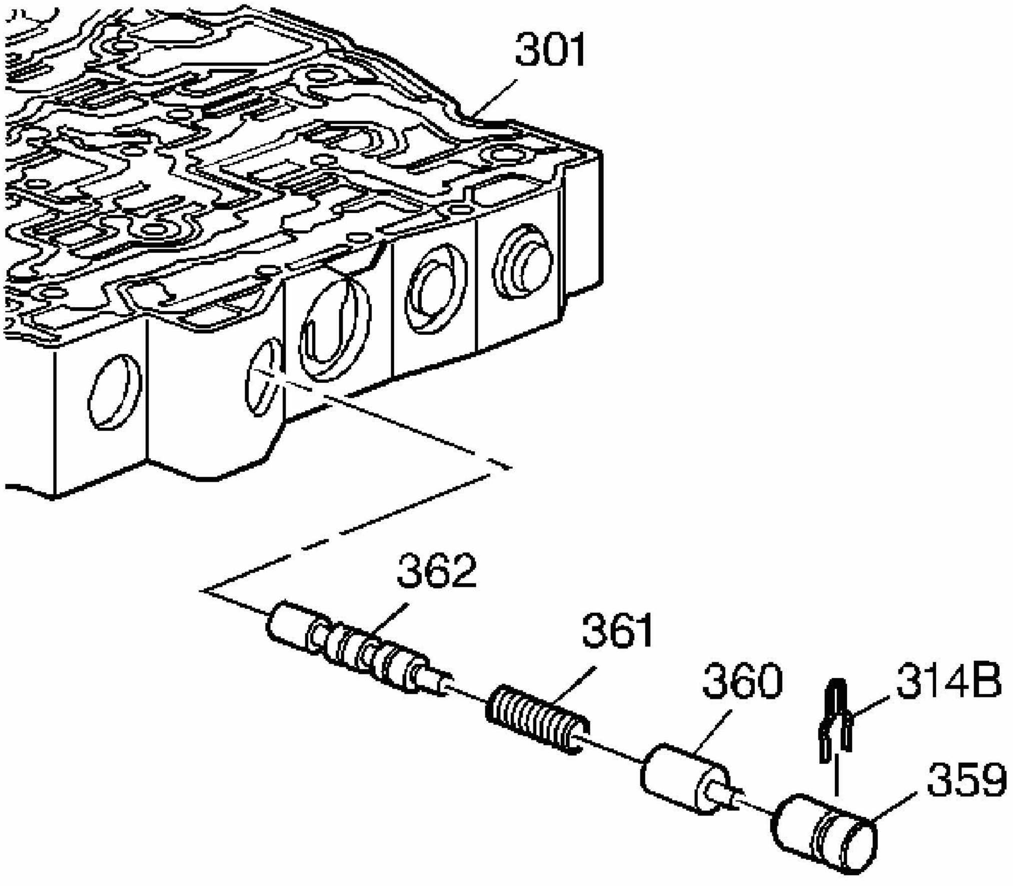


Fig. 323: View Of 3-4 Shift Valve & 4-3 Manual Downshift Valve Components
Courtesy of GENERAL MOTORS CORP.

9. Install the 3-4 shift valve (362), the 4-3 manual downshift valve spring (361), the 4-3 manual downshift valve (360) and the 4-3 manual downshift valve bore plug (359) into the control valve body (301).
10. Hold the 4-3 manual downshift valve bore plug (359) in the control valve body (301). Install the 4-3 manual downshift valve retainer (314B) into the control valve body (301).

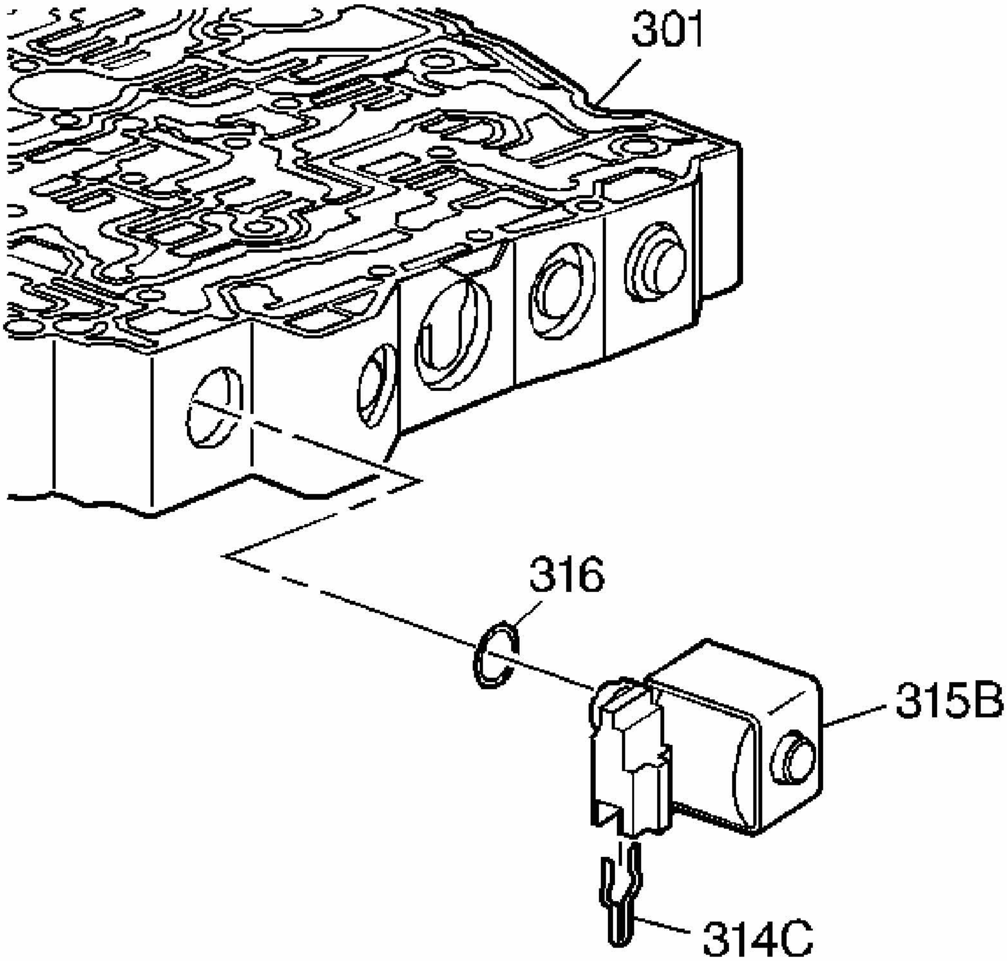


Fig. 324: View Of 2-3 Shift Solenoid & O-Ring
Courtesy of GENERAL MOTORS CORP.

11. Install a new O-ring seal (316) onto the 2-3 shift solenoid (SS) valve (315B), if it was removed.
12. Install the 2-3 SS valve (315B) into the control valve body (301).
13. Install the 2-3 shift solenoid valve retainer (314C) into the control valve body (301).

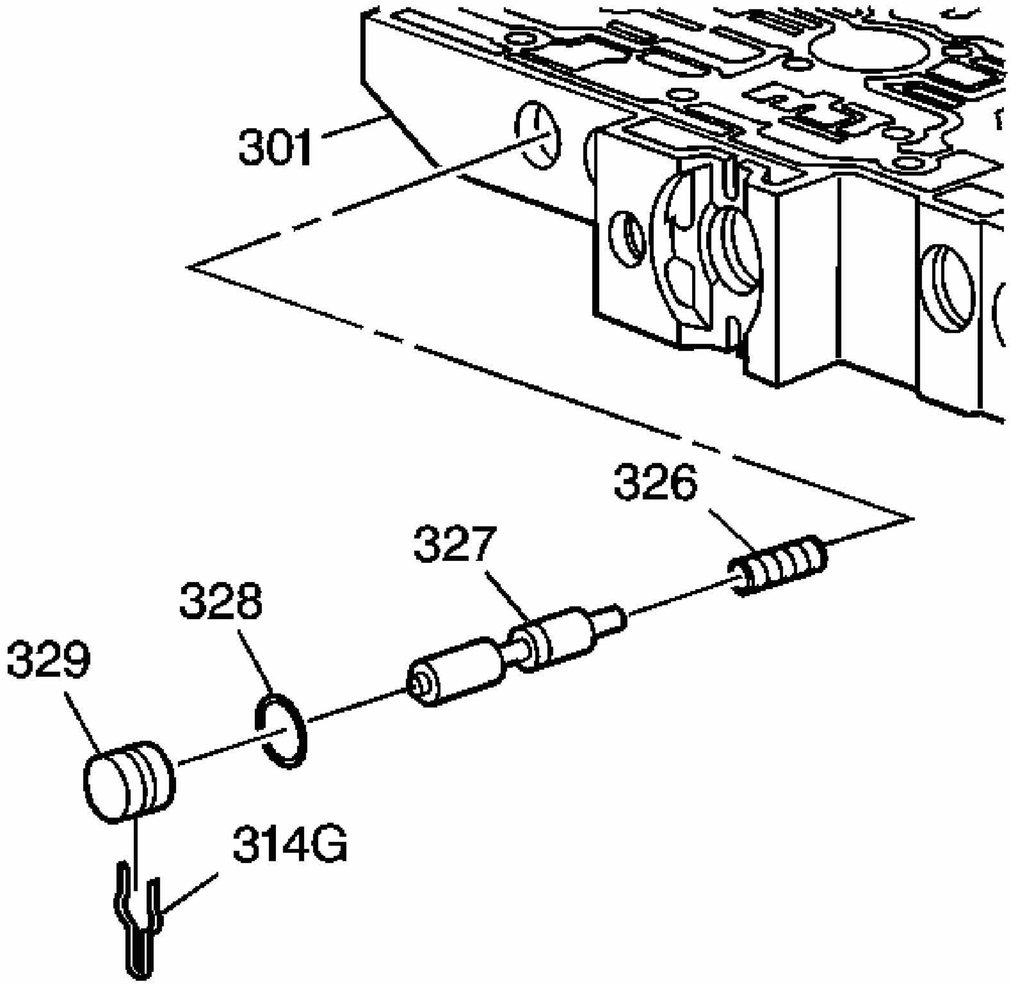


Fig. 325: Identifying TCC Regulator Apply Valve
Courtesy of GENERAL MOTORS CORP.

14. Install the TCC regulator apply valve bore plug O-ring seal (328) onto the TCC regulator apply valve bore plug (329).
15. Install the TCC regulator apply valve spring (326), the TCC regulator apply valve (327) and the TCC regulator apply valve bore plug (329) into the control valve body (301).
16. Hold the TCC regulator apply valve bore plug (329) in the control valve body (301). Install the TCC regulator apply valve bore plug retainer (314G) into the control valve body (301).

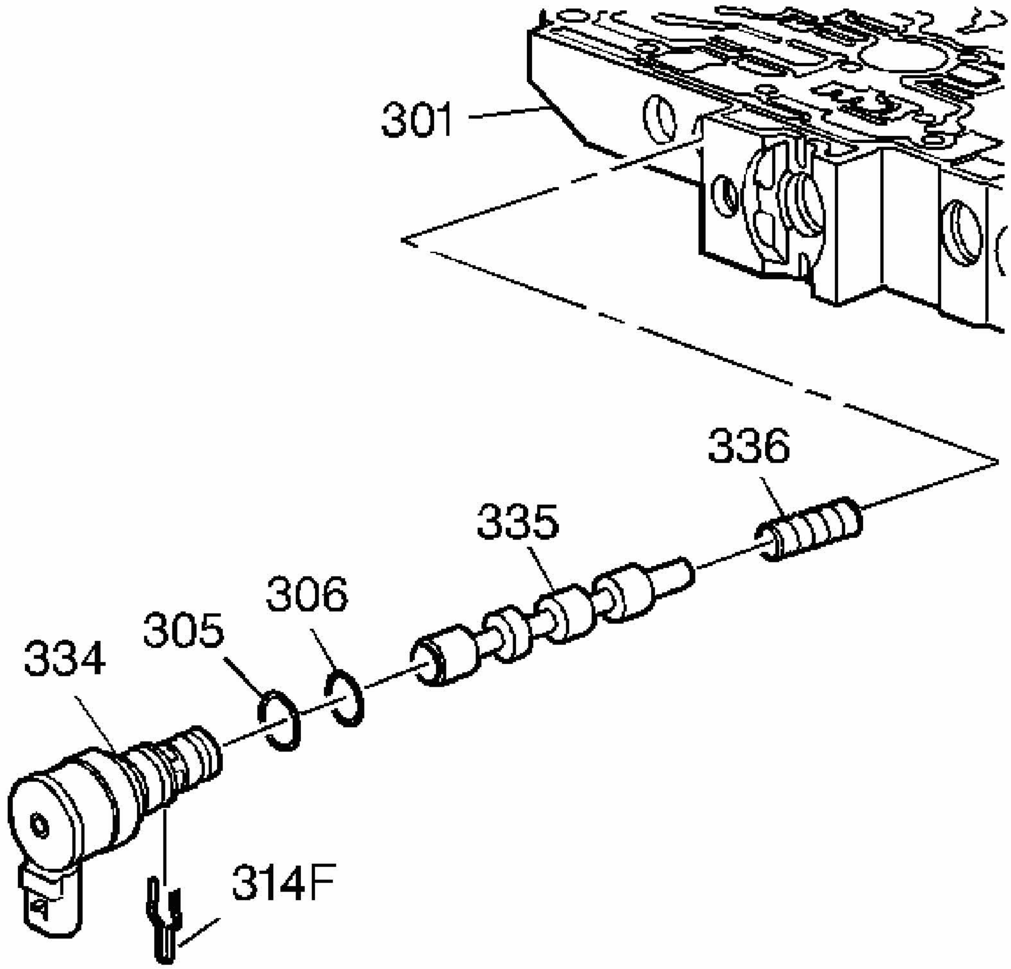


Fig. 326: View Of TCC PWM Solenoid
Courtesy of GENERAL MOTORS CORP.

17. Install new O-ring seals (305, 306) onto the TCC PWM solenoid valve (334) if they had been removed.
18. Install the TCC control valve spring (336), the TCC control valve (335) and the TCC PWM solenoid valve (334) into the control valve body (301).
19. Hold the TCC PWM solenoid valve (334) in the control valve body (301). Install the TCC PWM solenoid valve retainer (314F) into the control valve body (301).

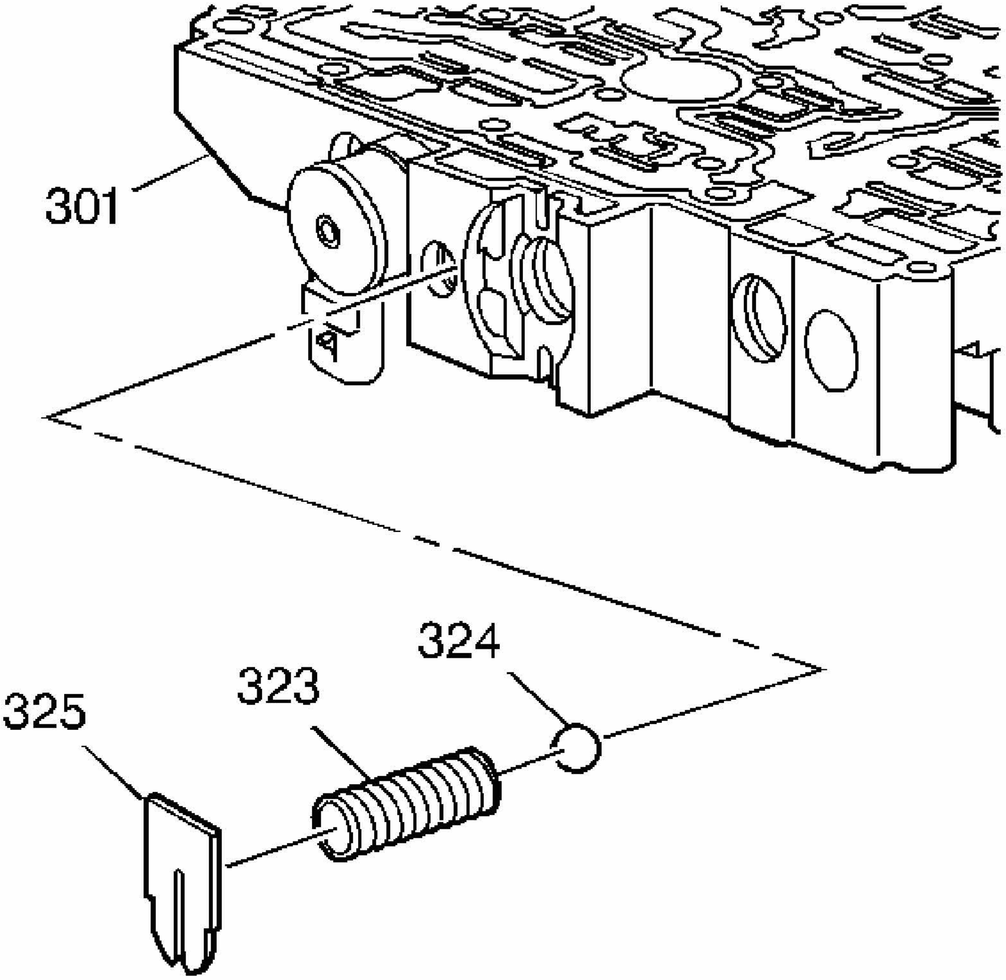


Fig. 327: Locating Line Pressure Relief Valve Assembly
Courtesy of GENERAL MOTORS CORP.

20. Install the line pressure relief valve (324) and the line pressure relief valve spring (323) into the control valve body (301).
21. Compress the line pressure relief valve spring (323) into the control valve body (301). Install the line pressure relief valve spring retainer (325) into the control valve body (301).

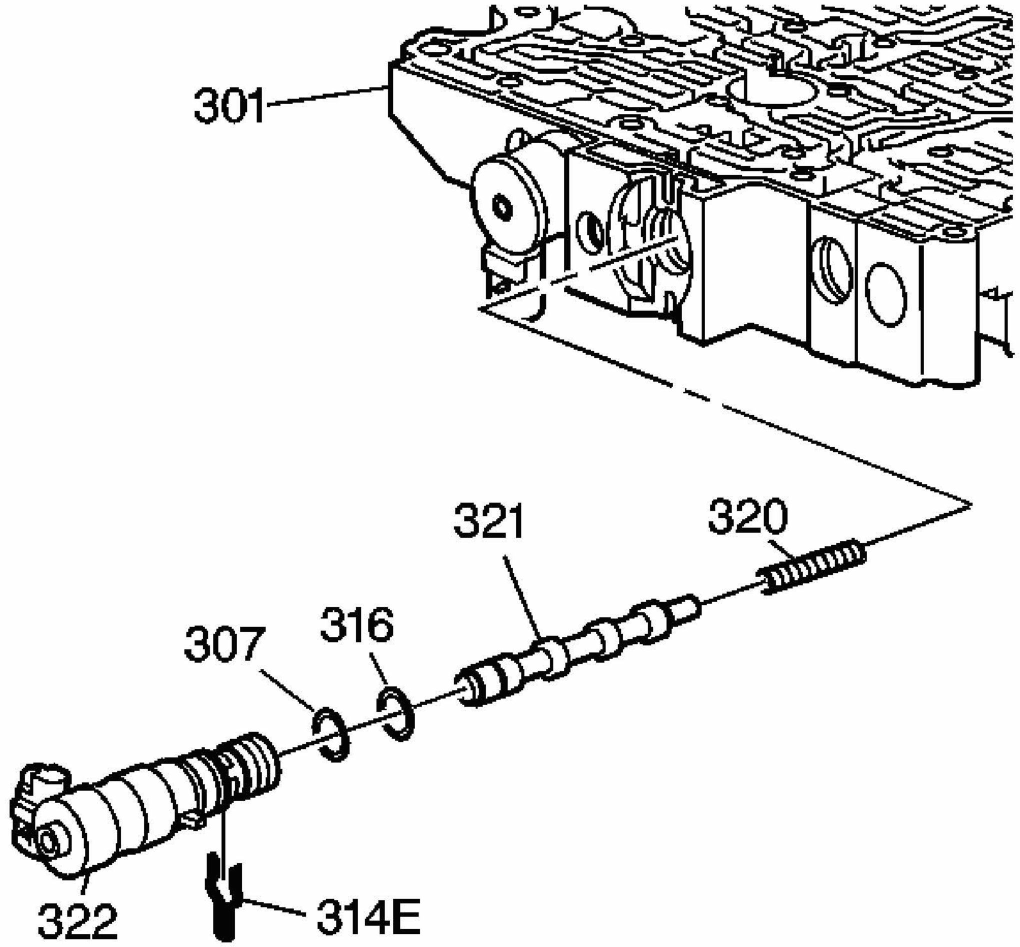


Fig. 328: View Of PC Solenoid Valve & Torque Signal Regulator Valve
Courtesy of GENERAL MOTORS CORP.

22. Install new O-ring seals (307, 316) onto the pressure control (PC) solenoid valve (322), if they had been removed.
23. Install the torque signal regulator valve spring (320), the torque signal regulator valve (321) and the PC solenoid valve (322) into the control valve body (301).
24. Hold the PC solenoid valve (322) in the control valve body (301). Install the pressure control solenoid valve retainer (314E) into the control valve body (301).

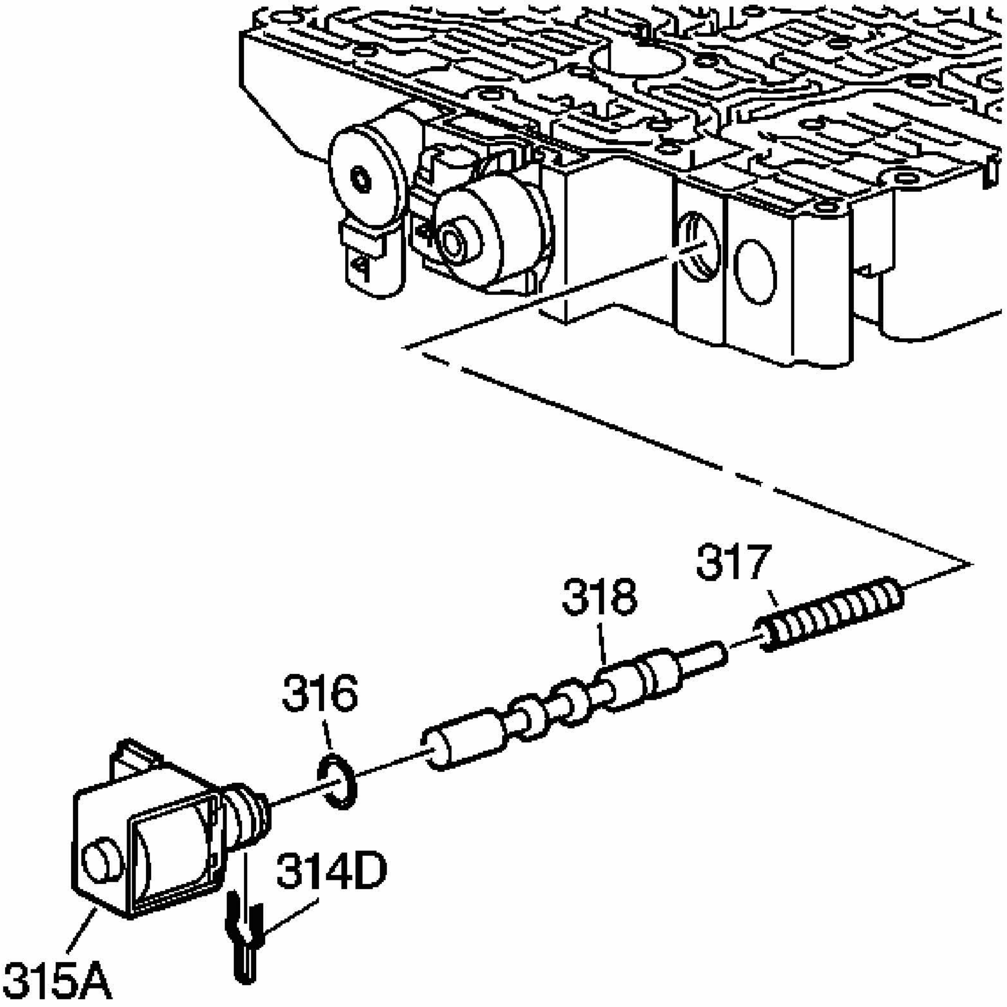


Fig. 329: Identifying 1-2, 3-4 Shift Solenoid (SS) Valve Components
Courtesy of GENERAL MOTORS CORP.

25. Install a new O-ring seal (316) onto the 1-2, 3-4 shift solenoid (SS) valve (315A), if it was removed.
26. Install the 1-2 shift valve spring (317), the 1-2 shift valve (318) and the 1-2, 3-4 SS valve (315A) into the control valve body (301).
27. Hold the 1-2, 3-4 SS valve (315A) in the control valve body (301). Install the 1-2, 3-4 shift solenoid valve retainer (314D) into the control valve body (301).

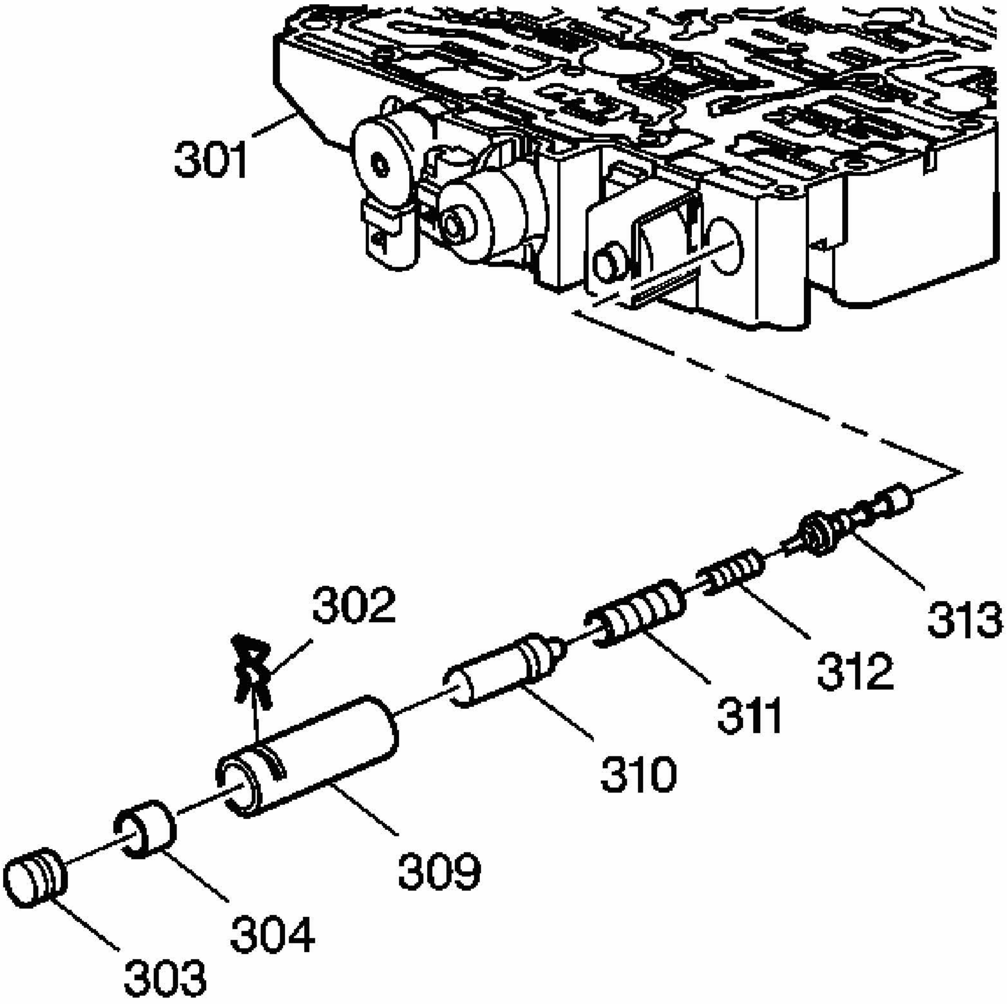


Fig. 330: View Of Reverse Boost Valve Bushing Assembly Components
Courtesy of GENERAL MOTORS CORP.

28. Install the reverse boost valve (310), the line boost valve (304) and the line boost valve bore plug (303) into the reverse boost valve bushing (309).
29. Install the pressure regulator valve (313), the pressure regulator valve outer and inner springs (311, 312) and the reverse boost valve bushing assembly (309) into the control valve body (301).
30. Hold the reverse boost valve bushing assembly (309) in the control valve body (301). Install the line boost valve and bushing retainer (302) into the control valve body (301).

CONTROL VALVE BODY ASSEMBLE (WITH TOUCH ACTIVATED POWER)

Assembly Procedure

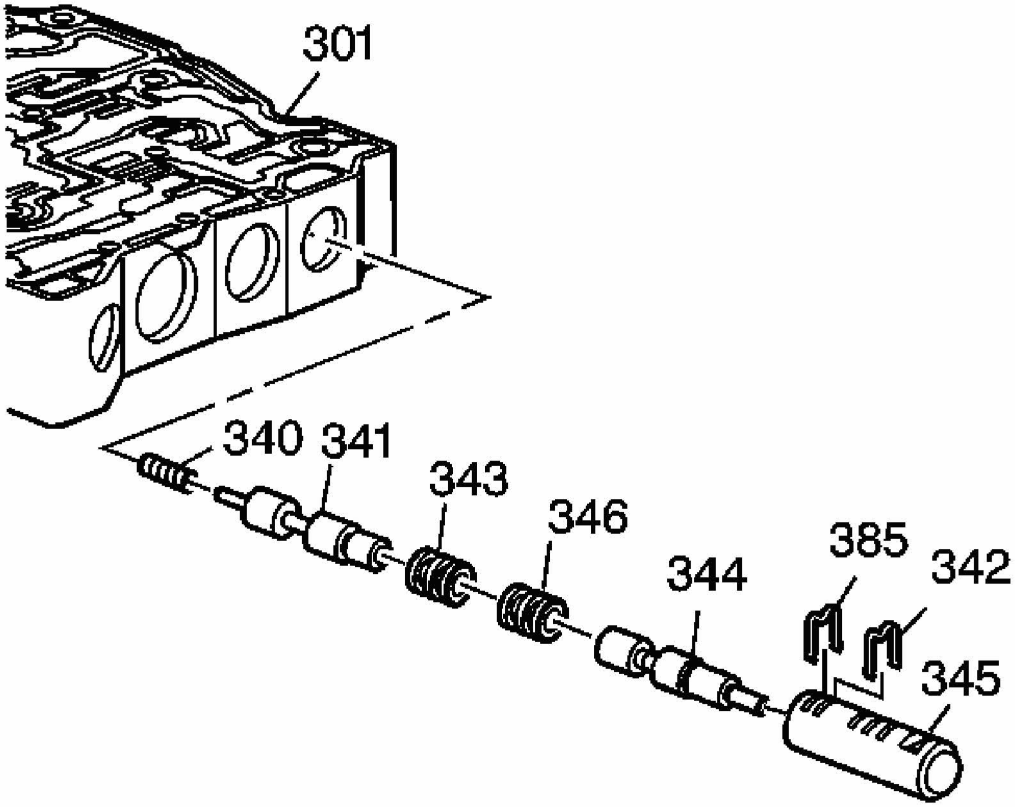


Fig. 331: View Of 2-3 Accumulator Valve & 3-4 Accumulator Valve Components
Courtesy of GENERAL MOTORS CORP.

1. Install the 2-3 accumulator valve (344), the 2-3 accumulator valve spring (346) and the 2-3 accumulator valve bore plug (343) into the 2-3 accumulator valve bushing (345).
2. Install the 2-3 accumulator valve bore plug retainer (342) in the 2-3 accumulator valve bushing (345), into the slot indicated.
3. Install the 3-4 accumulator valve spring (340), the 3-4 accumulator valve (341) and the 2-3 accumulator valve bushing (345) into the control valve body (301).
4. Hold the 2-3 accumulator valve bushing assembly (345) in the control valve body (301). Install the 2-3 accumulator valve bushing assembly retainer (385) into the slot indicated.

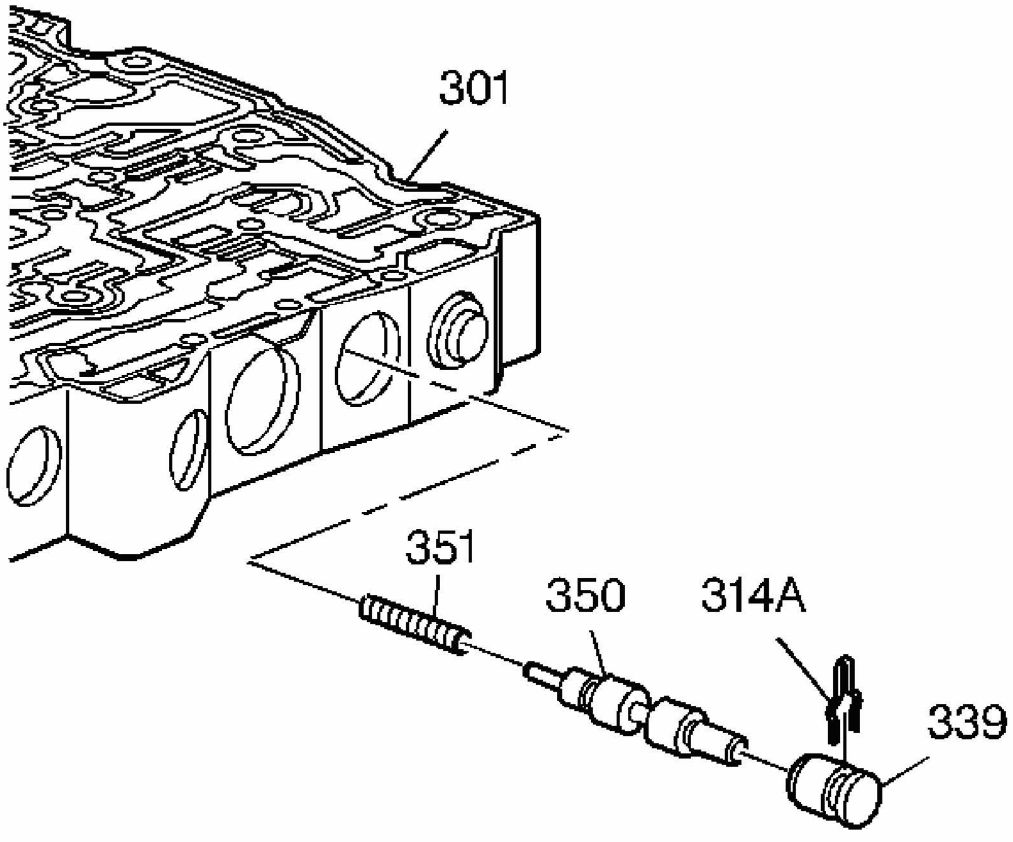


Fig. 332: Locating 1-2 Accumulator Valve & 1-2 Accumulator Valve Spring
Courtesy of GENERAL MOTORS CORP.

5. Install the 1-2 accumulator valve spring (351), the 1-2 accumulator valve (350) and the 1-2 accumulator valve bore plug (339) into the control valve body (301).
6. Hold the 1-2 accumulator valve bore plug (339) in the control valve body (301). Install the 1-2 accumulator valve retainer (314A) into the control valve body (301).

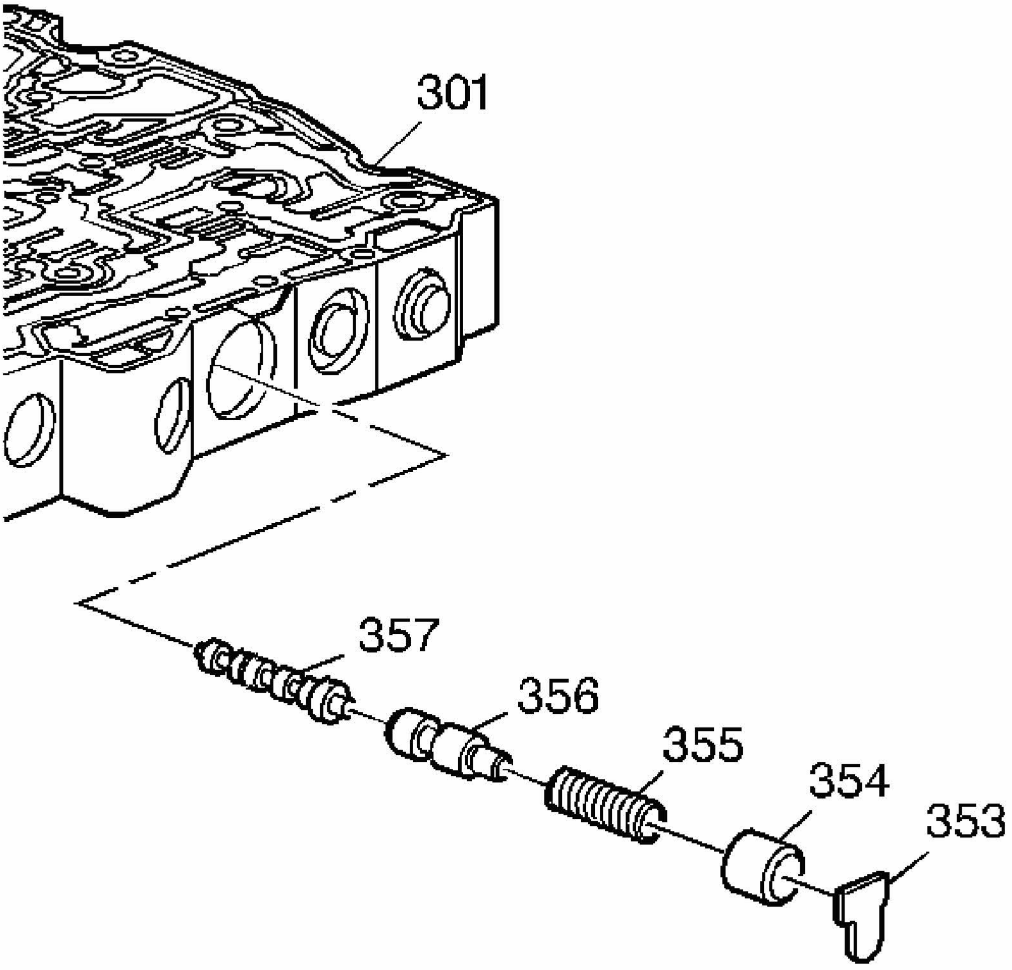


Fig. 333: Identifying 3-2 Manual Downshift Valve & 2-3 Shift Valve
Courtesy of GENERAL MOTORS CORP.

7. Install the 2-3 shift valve (357), the 3-2 manual downshift valve (356), the 3-2 manual downshift valve spring (355) and the 3-2 manual downshift valve bore plug (354) into the control valve body (301).
8. Hold the 3-2 manual downshift valve bore plug (354) in the control valve body (301). Install the 3-2 manual downshift valve retainer (353) into the control valve body (301).

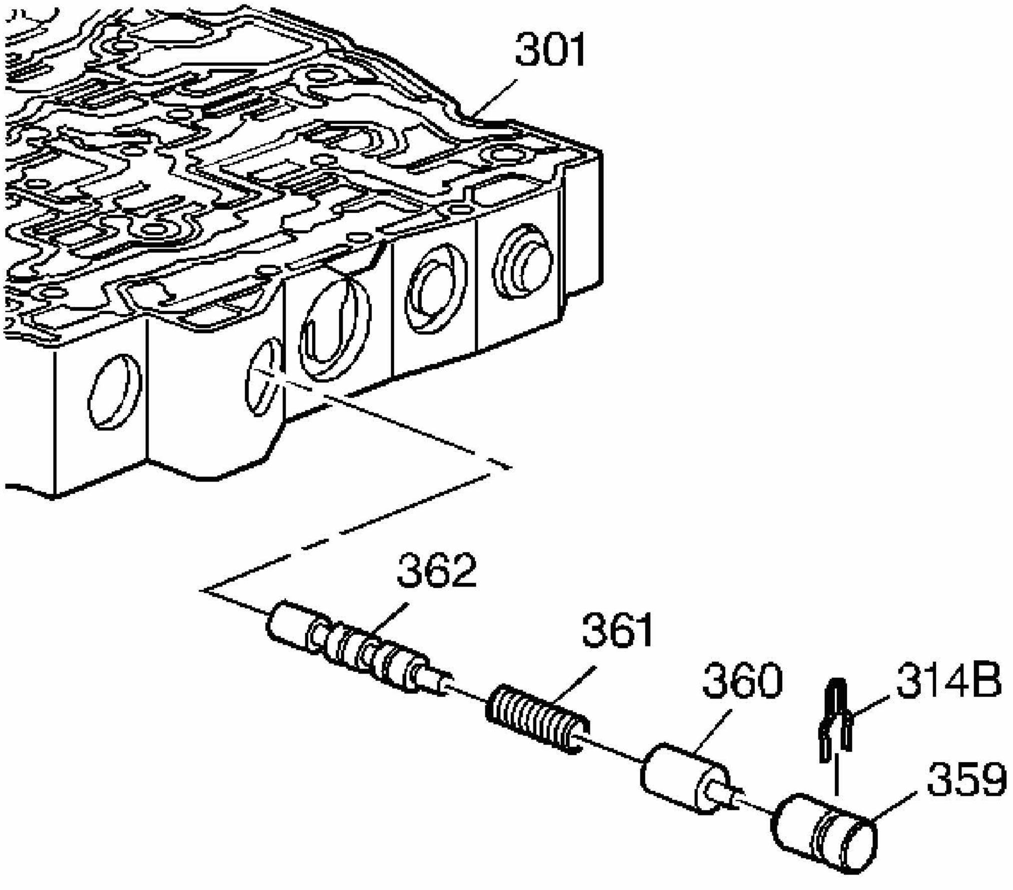


Fig. 334: View Of 3-4 Shift Valve & 4-3 Manual Downshift Valve Components
Courtesy of GENERAL MOTORS CORP.

9. Install the 3-4 shift valve (362), the 4-3 manual downshift valve spring (361), the 4-3 manual downshift valve (360) and the 4-3 manual downshift valve bore plug (359) into the control valve body (301).
10. Hold the 4-3 manual downshift valve bore plug (359) in the control valve body (301). Install the 4-3 manual downshift valve retainer (314B) into the control valve body (301).

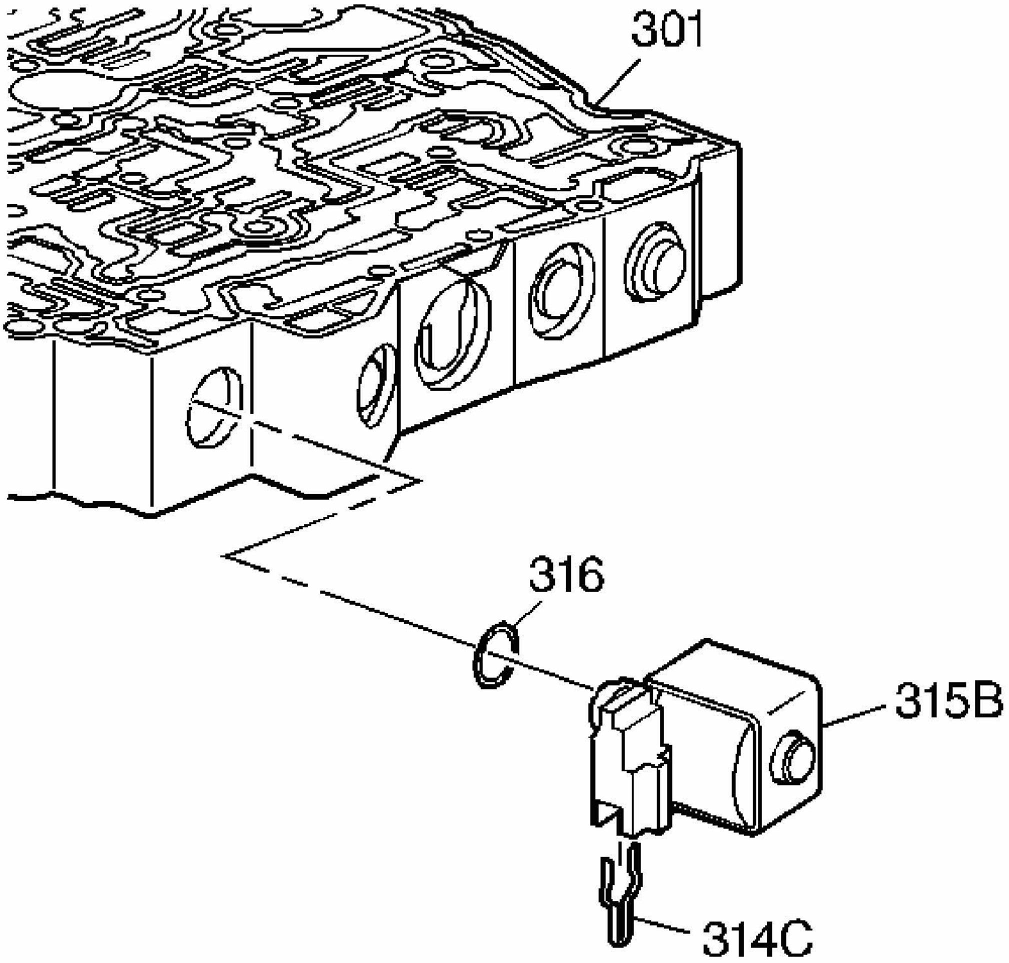


Fig. 335: View Of 2-3 Shift Solenoid & O-Ring
Courtesy of GENERAL MOTORS CORP.

11. Install a new O-ring seal (316) onto the 2-3 shift solenoid (SS) valve (315B), if it was removed.
12. Install the 2-3 SS valve (315B) into the control valve body (301).
13. Install the 2-3 shift solenoid valve retainer (314C) into the control valve body (301).

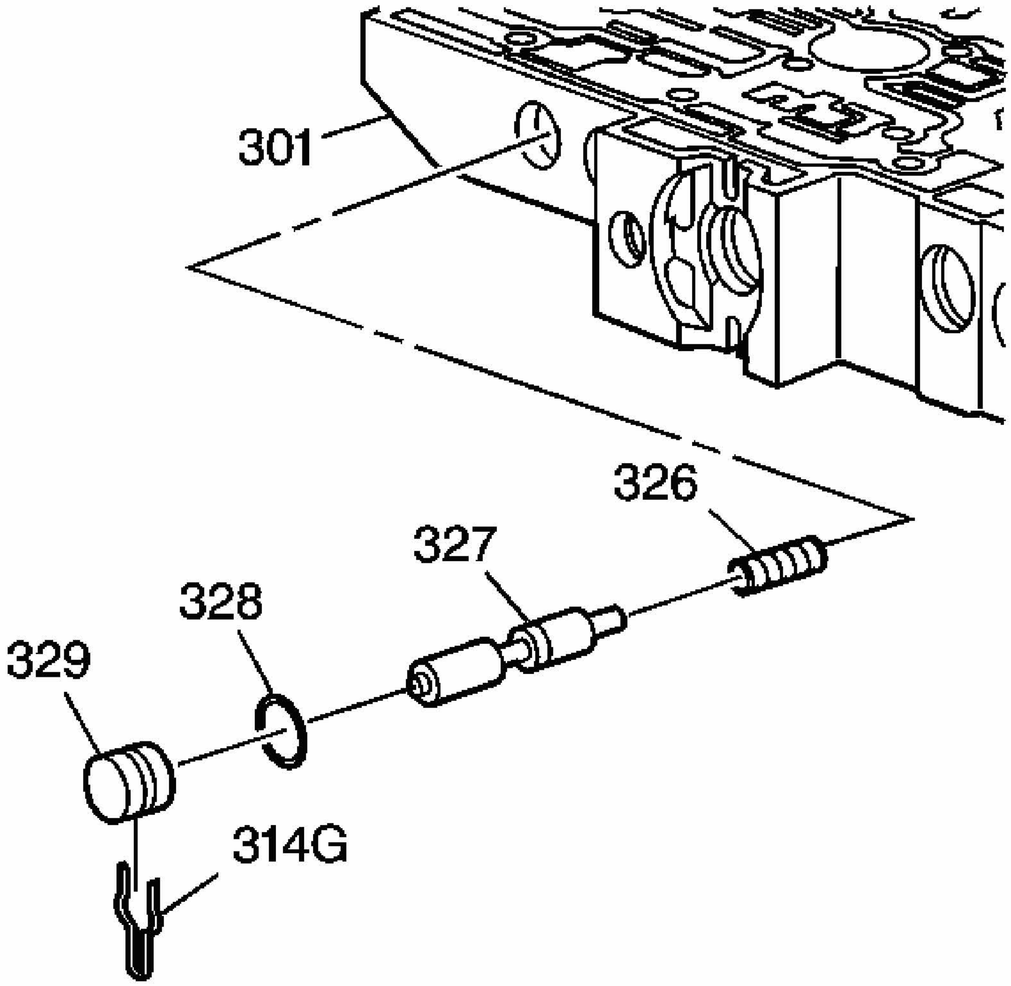


Fig. 336: Identifying TCC Regulator Apply Valve
Courtesy of GENERAL MOTORS CORP.

14. Install the TCC regulator apply valve bore plug O-ring seal (328) onto the TCC regulator apply valve bore plug (329).
15. Install the TCC regulator apply valve spring (326), the TCC regulator apply valve (327) and the TCC regulator apply valve bore plug (329) into the control valve body (301).
16. Hold the TCC regulator apply valve bore plug (329) in the control valve body (301). Install the TCC regulator apply valve bore plug retainer (314G) into the control valve body (301).

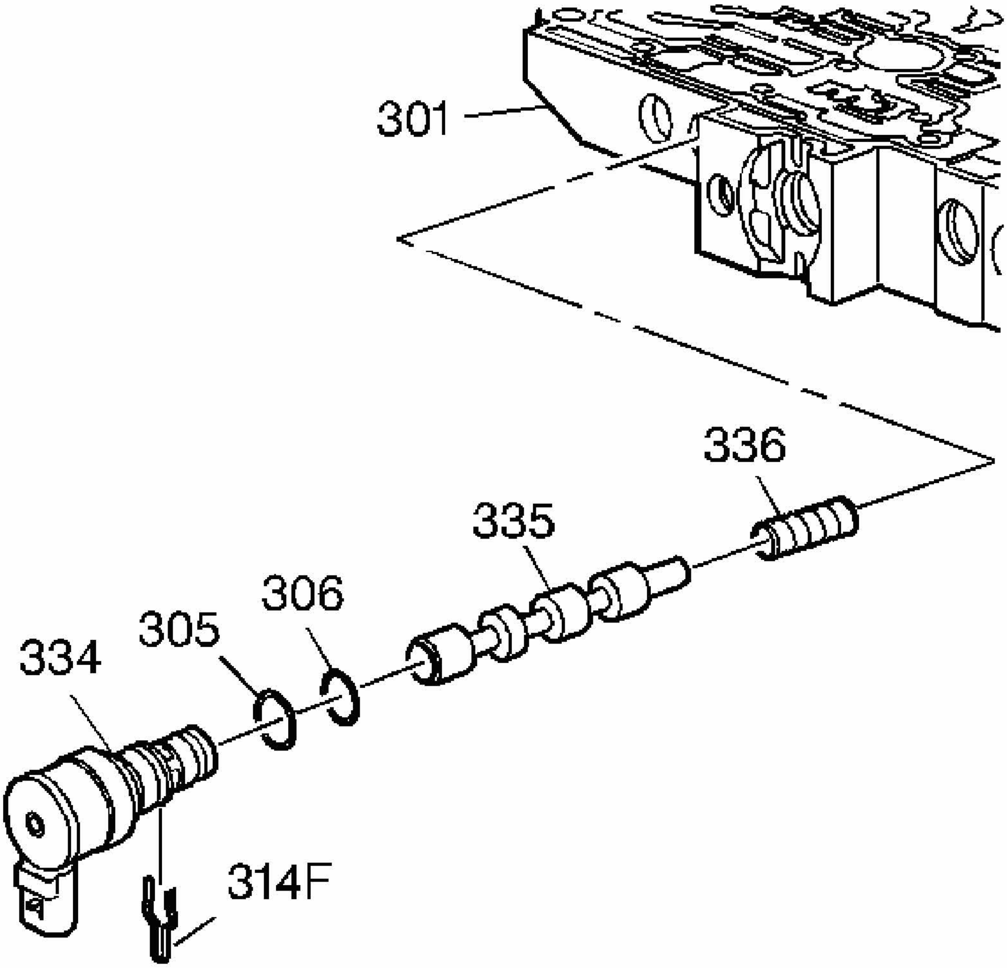


Fig. 337: View Of TCC PWM Solenoid
Courtesy of GENERAL MOTORS CORP.

17. Install new O-ring seals (305, 306) onto the TCC PWM solenoid valve (334) if they had been removed.
18. Install the TCC control valve spring (336), the TCC control valve (335) and the TCC PWM solenoid valve (334) into the control valve body (301).
19. Hold the TCC PWM solenoid valve (334) in the control valve body (301). Install the TCC PWM solenoid valve retainer (314F) into the control valve body (301).

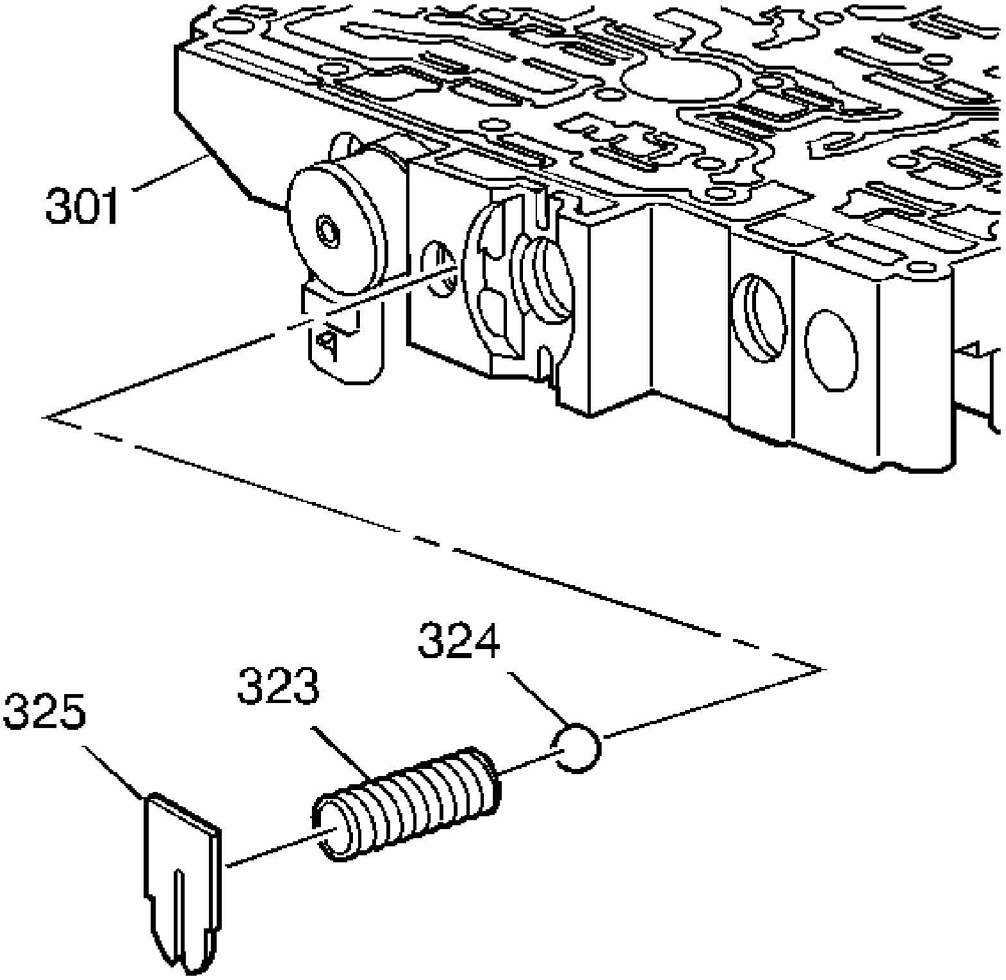


Fig. 338: Locating Line Pressure Relief Valve Assembly
Courtesy of GENERAL MOTORS CORP.

20. Install the line pressure relief valve (324) and the line pressure relief valve spring (323) into the control valve body (301).
21. Compress the line pressure relief valve spring (323) into the control valve body (301). Install the line pressure relief valve spring retainer (325) into the control valve body (301).

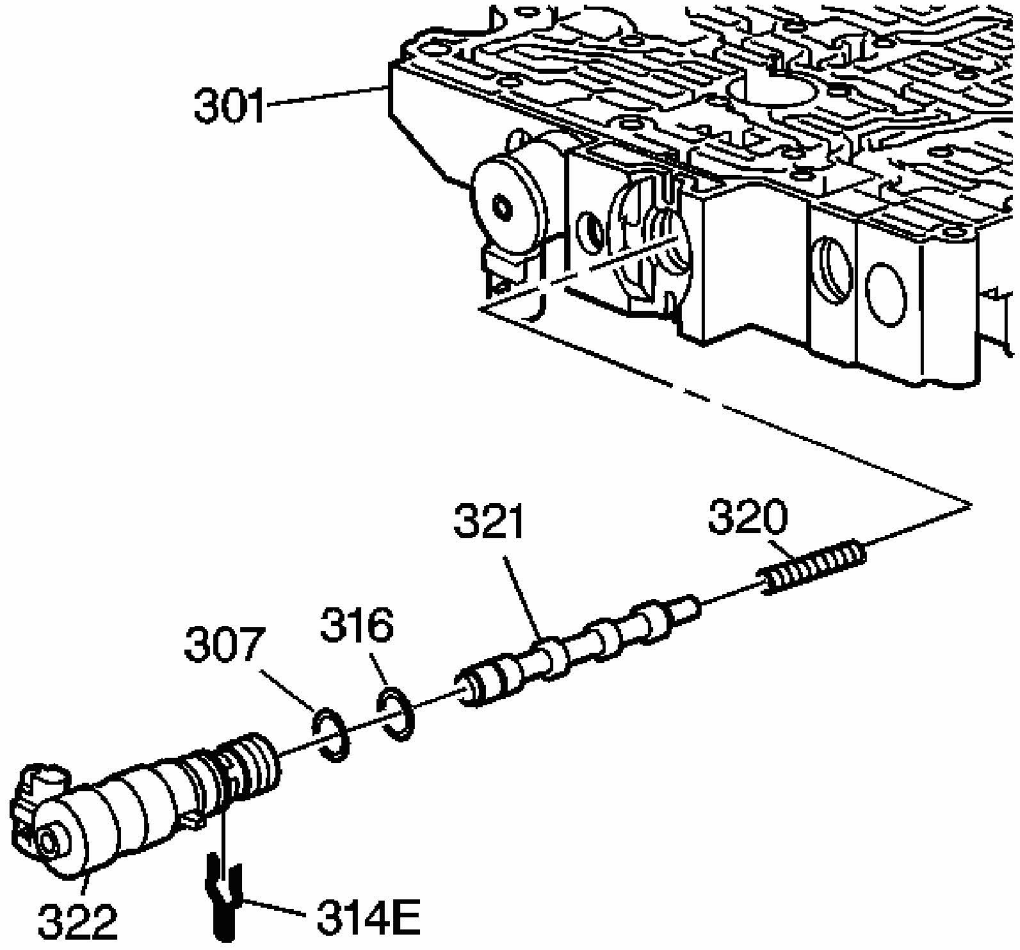


Fig. 339: View Of PC Solenoid Valve & Torque Signal Regulator Valve
Courtesy of GENERAL MOTORS CORP.

22. Install new O-ring seals (307, 316) onto the pressure control (PC) solenoid valve (322), if they had been removed.
23. Install the torque signal regulator valve spring (320), the torque signal regulator valve (321) and the PC solenoid valve (322) into the control valve body (301).
24. Hold the PC solenoid valve (322) in the control valve body (301). Install the pressure control solenoid valve retainer (314E) into the control valve body (301).

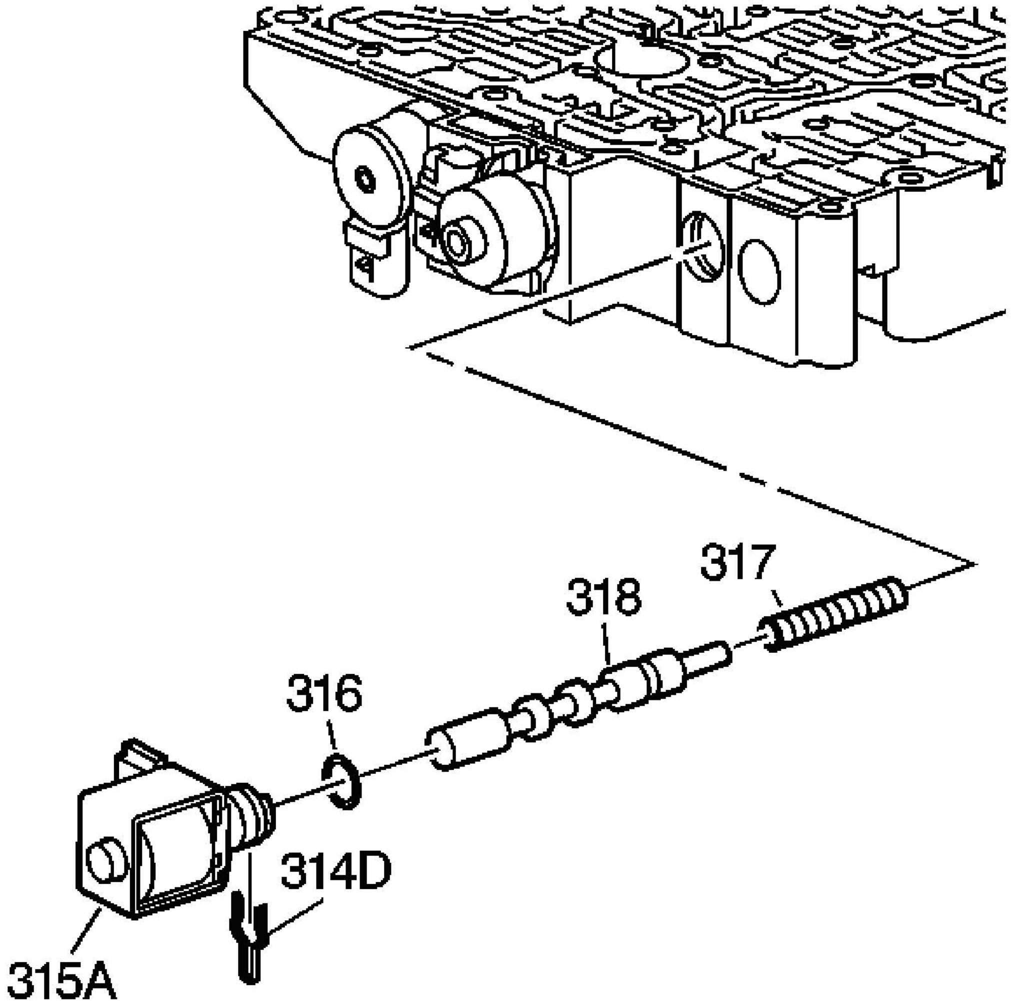


Fig. 340: Identifying 1-2, 3-4 Shift Solenoid (SS) Valve Components
Courtesy of GENERAL MOTORS CORP.

25. Install a new O-ring seal (316) onto the 1-2, 3-4 shift solenoid (SS) valve (315A), if it was removed.
26. Install the 1-2 shift valve spring (317), the 1-2 shift valve (318) and the 1-2, 3-4 SS valve (315A) into the control valve body (301).
27. Hold the 1-2, 3-4 SS valve (315A) in the control valve body (301). Install the 1-2, 3-4 shift solenoid valve retainer (314D) into the control valve body (301).

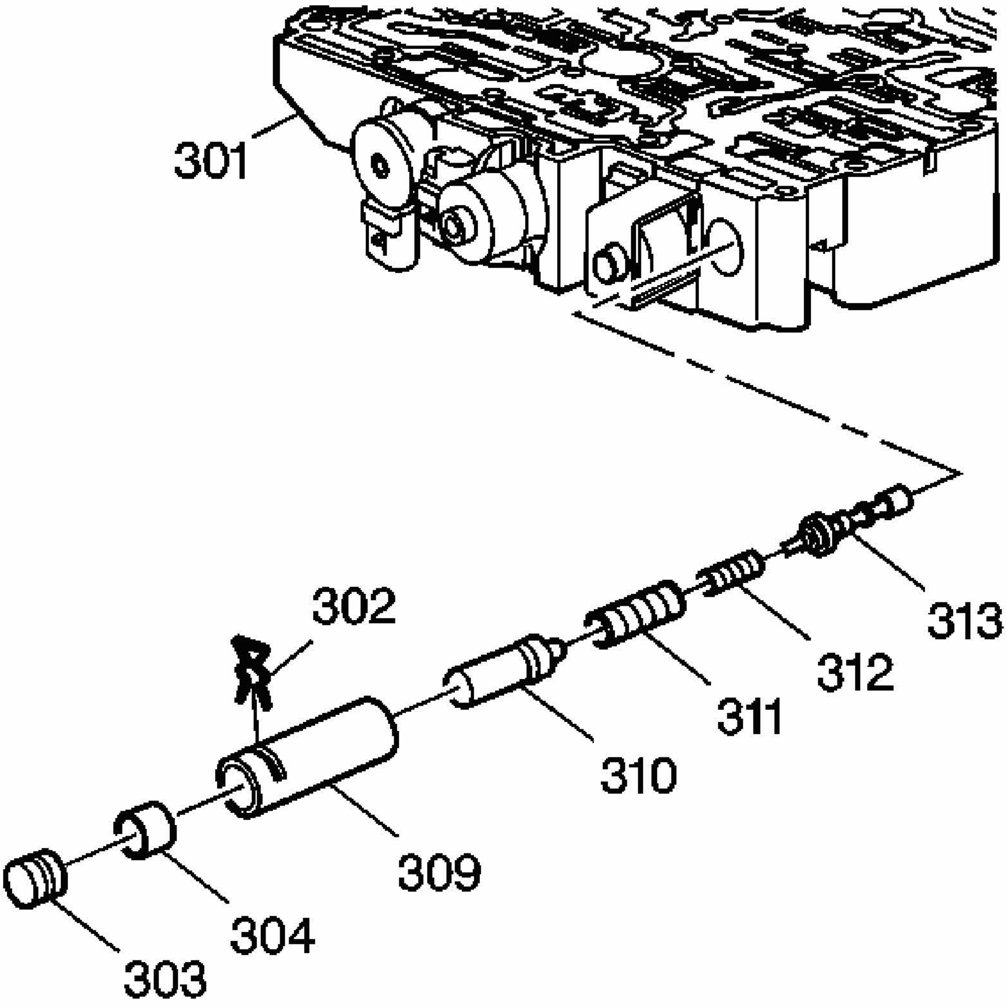


Fig. 341: View Of Reverse Boost Valve Bushing Assembly Components
Courtesy of GENERAL MOTORS CORP.

28. Install the reverse boost valve (310), the line boost valve (304) and the line boost valve bore plug (303) into the reverse boost valve bushing (309).
29. Install the pressure regulator valve (313), the pressure regulator valve outer and inner springs (311, 312) and the reverse boost valve bushing assembly (309) into the control valve body (301).
30. Hold the reverse boost valve bushing assembly (309) in the control valve body (301). Install the line boost valve and bushing retainer (302) into the control valve body (301).

OIL PUMP DRIVE SHAFT ASSEMBLE

Assembly Procedure

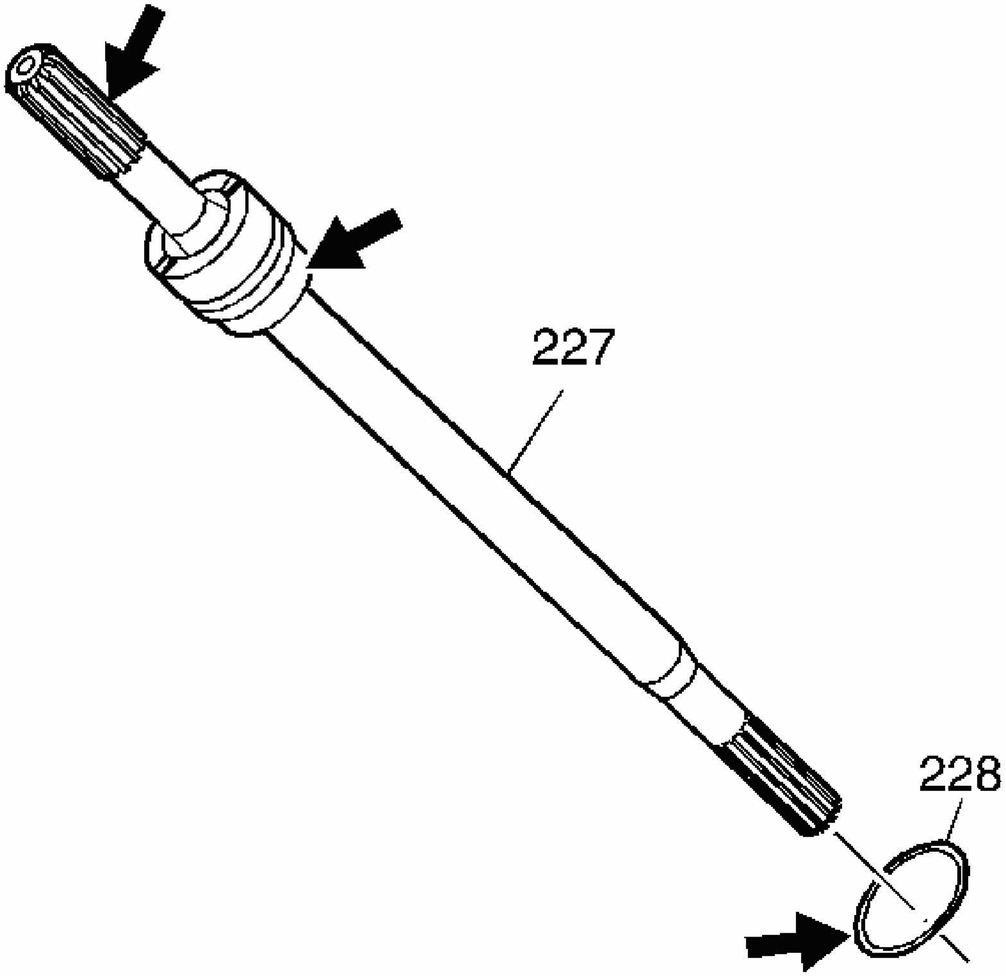


Fig. 342: Inspection Areas On Oil Pump Drive Shaft
Courtesy of GENERAL MOTORS CORP.

1. Inspect the oil pump drive shaft (227) for the following:
    - A scored or rough journal surface
    - Stripped or burred splines
    - A cut or damaged seal
2. Install a new oil pump drive shaft seal (228) onto the oil pump drive shaft (227).

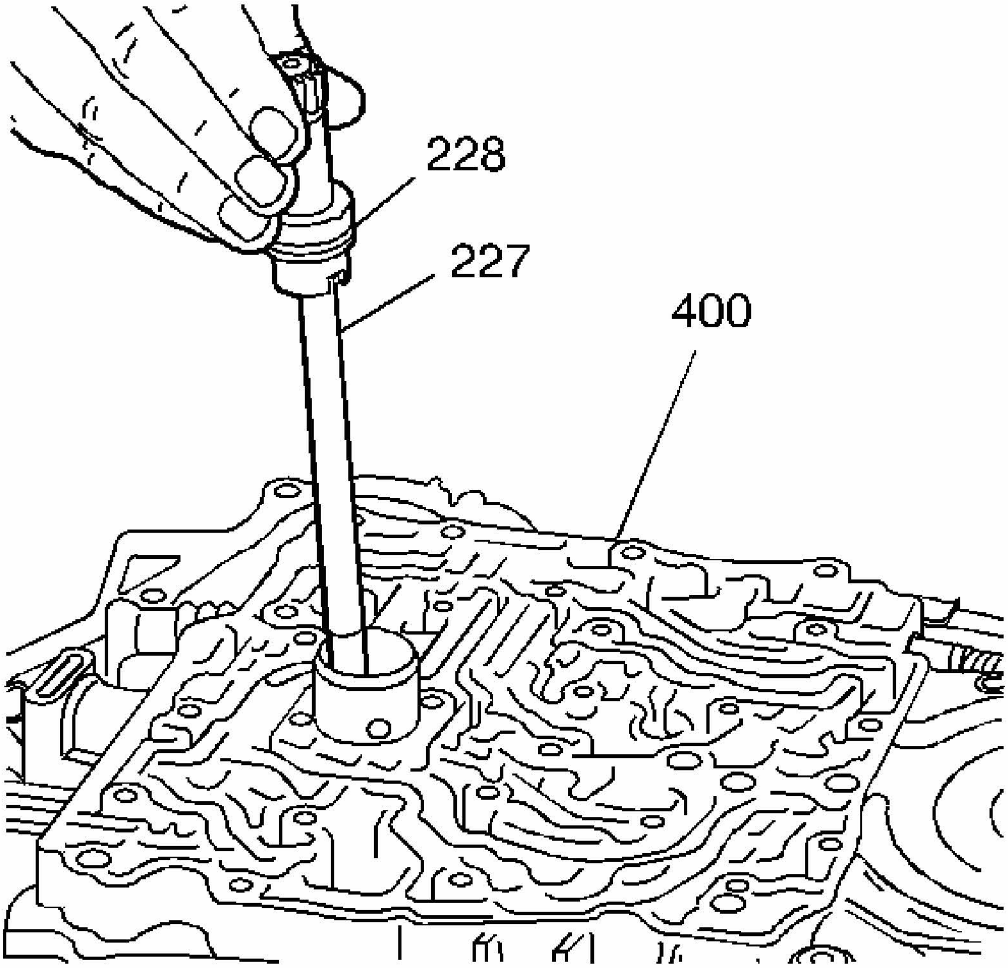


Fig. 343: Installing Oil Pump Drive Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

3. Install the oil pump drive shaft assembly (227) into the case cover (400).

CONTROL VALVE BODY AND SPACER PLATE ASSEMBLE

Tools Required

J 36850 Assembly Lubricant (or equivalent)

Assembly Procedure

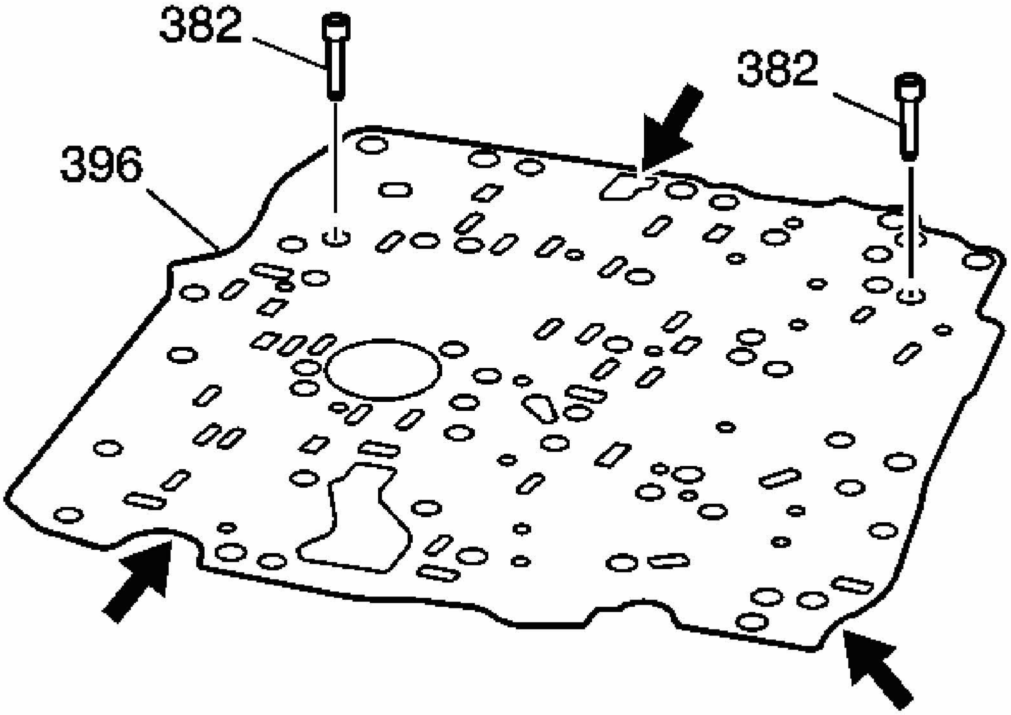


Fig. 344: View Of Control Valve Body Spacer Plate And Gasket Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The bonded spacer plate gasket assembly is not re-useable and should be replaced any time it is removed from the transmission.

1. Inspect the control valve body spacer plate and gasket assembly (396) for the following root cause:
    - Plugged holes
    - Damaged gasket sealing surfaces
    - Plugged or damaged screen/seal assemblies (382)

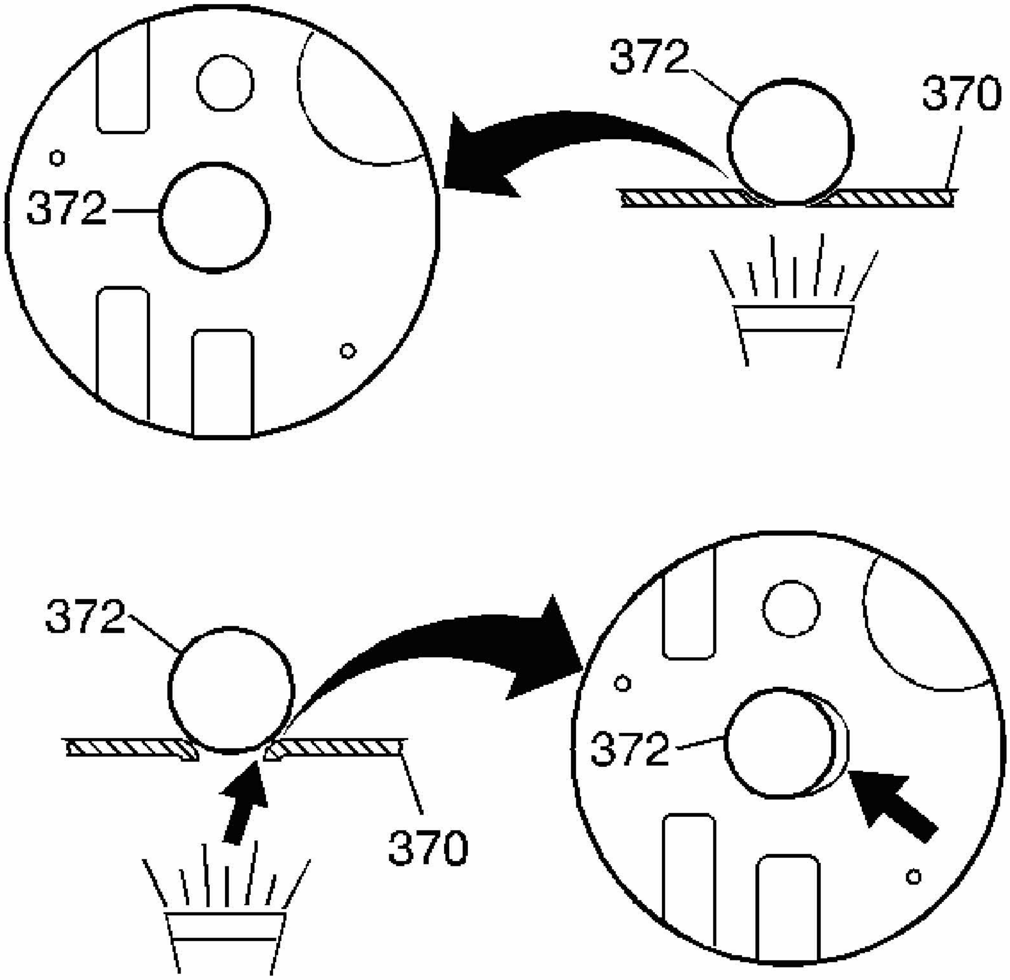


Fig. 345: Inspecting Valves For Excessive Peening
Courtesy of GENERAL MOTORS CORP.

2. Inspect each ball check valve seat (one at a time) on the spacer plate (370) for excessive peening.
    - Place a ball check valve (372) on each seat
    - Use a flashlight to look for visible light between the ball check valve and the seat.

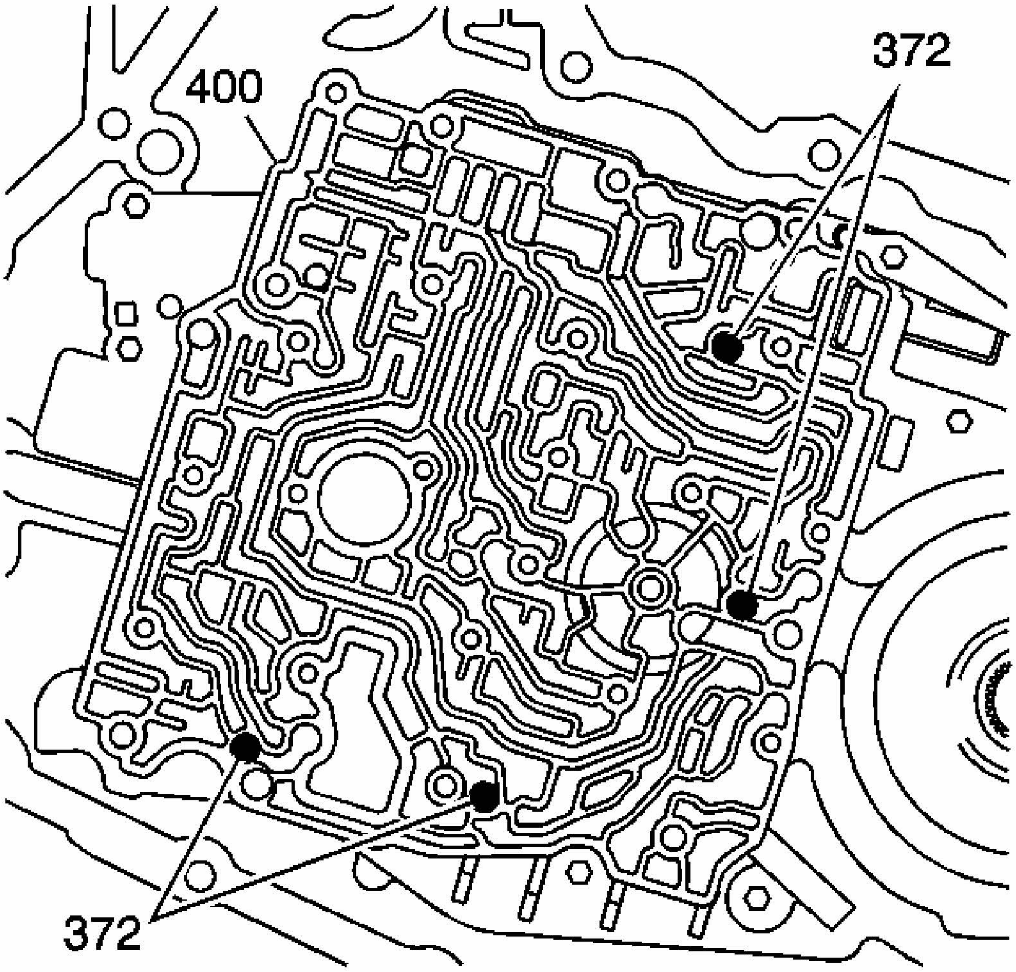


Fig. 346: Locating Ball Check Valves In Case Cover
Courtesy of GENERAL MOTORS CORP.

3. Install 4 ball check valves (372) into the case cover (400), in the positions shown. Use **J 36850** or equivalent in order to hold the ball check valves in the case cover (400).

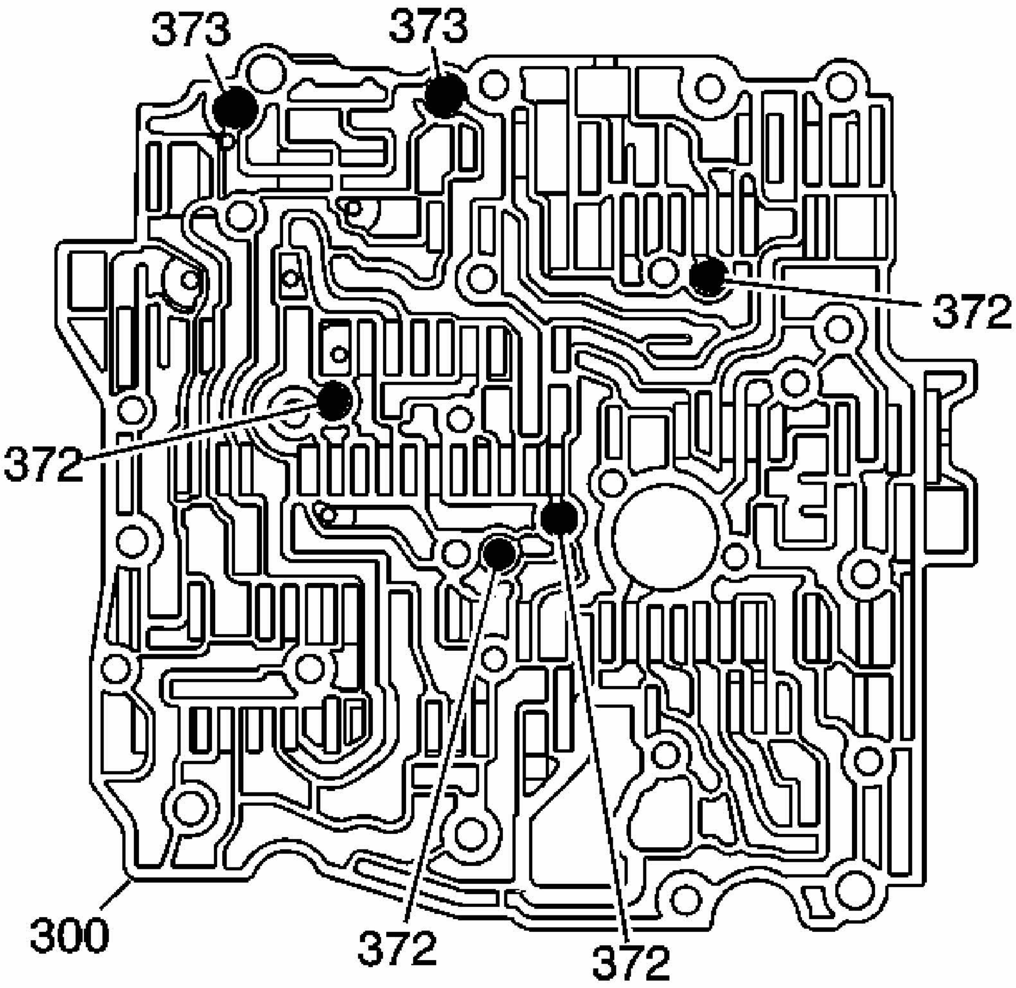


Fig. 347: Locating Ball Check Valves In Valve Body
Courtesy of GENERAL MOTORS CORP.

4. Install the 2 larger ball check valves (373) and the 4 smaller ball check valves (372) into the control valve body (300). Use **J 36850** or equivalent in order to retain the ball check valves in the control valve body (300).

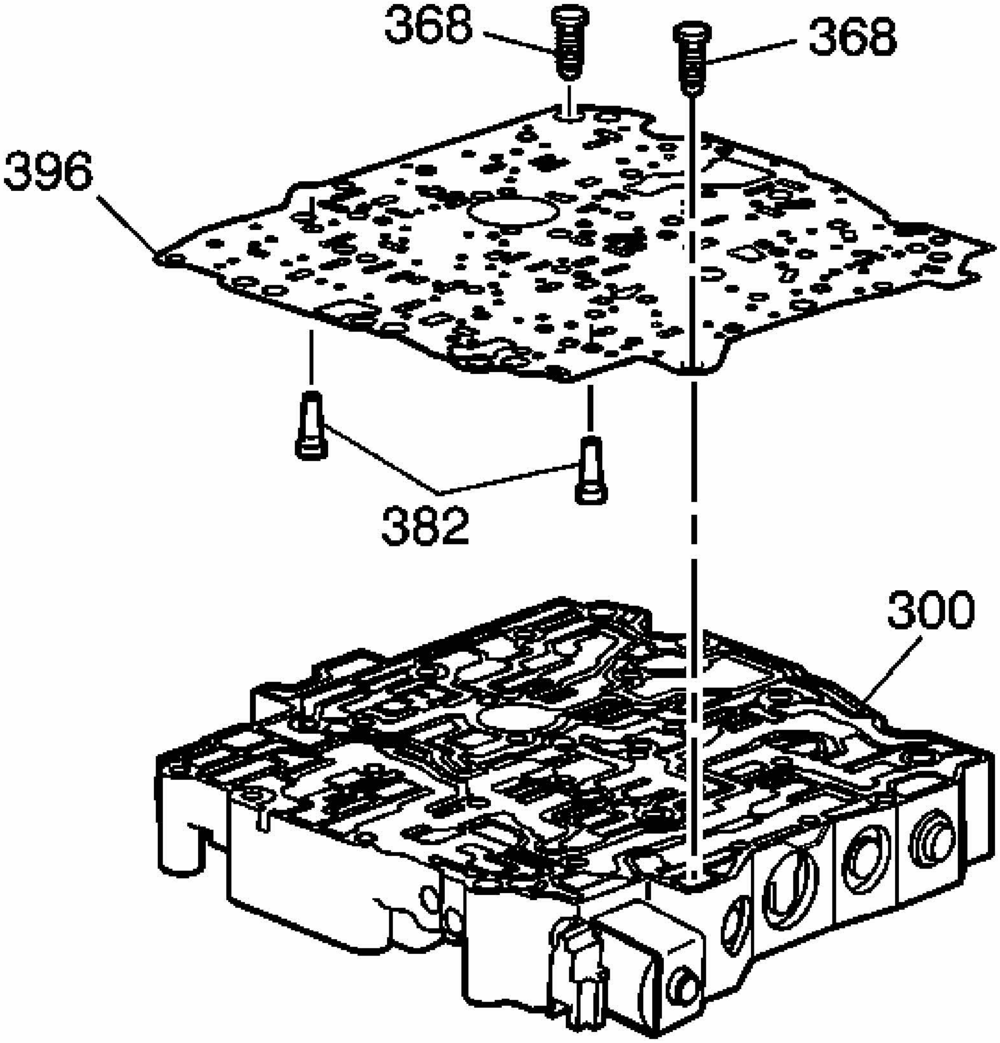


Fig. 348: Locating Screen/Seal Assemblies And Spacer Plate
Courtesy of GENERAL MOTORS CORP.

5. Install the screen/seal assemblies (382) into the spacer plate and gasket assembly (396).

IMPORTANT: The bonded spacer plate gasket assembly is not reuseable and should be replaced any time it is removed from the transmission.

6. Install the NEW spacer plate and gasket assembly (396) onto the control valve body (300).
7. Install the bolts (368) to hold the spacer plate and gaskets onto the control valve body

(300).

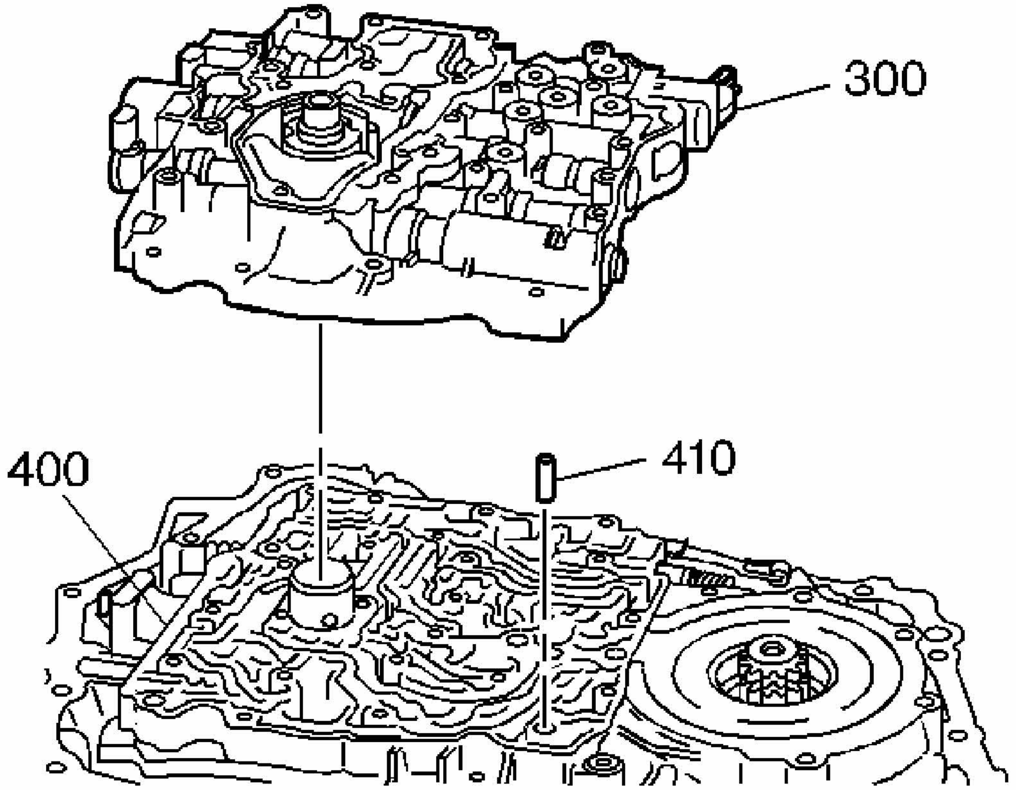


Fig. 349: Installing Control Valve Body Alignment Sleeve Into Case Cover
Courtesy of GENERAL MOTORS CORP.

8. Install the control valve body alignment sleeve (410) into the case cover (400).

IMPORTANT:

- **Use the control valve body alignment sleeve (410) and turbine shaft sleeve in the case cover (400) as guides.**
- **Be sure that the ball check valves do not drop out of the control valve body (300) during assembly.**

9. Install the control valve body (300) onto the case cover (400).

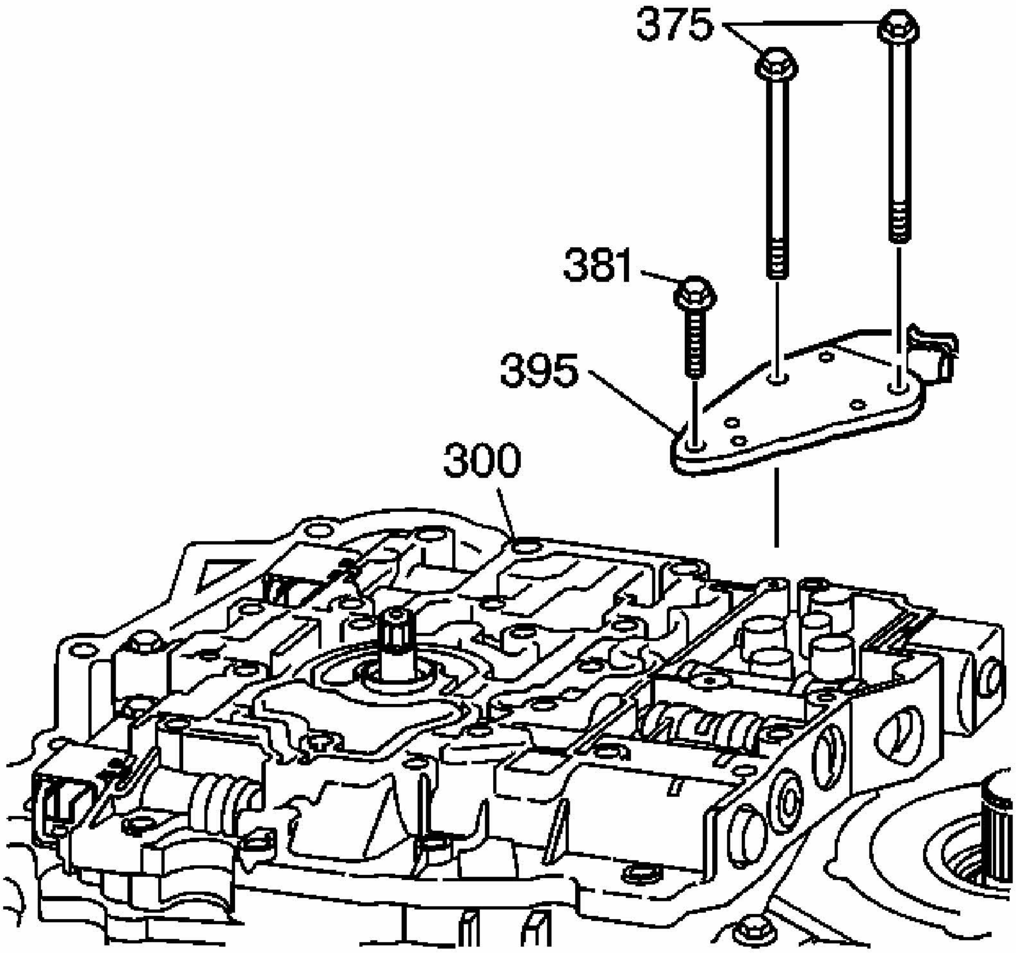


Fig. 350: Removing/Installing Transmission Fluid Pressure (TFP) Manual Valve
Courtesy of GENERAL MOTORS CORP.

10. Install the transmission fluid pressure (TFP) manual valve position switch assembly (395) onto the control valve body (300).

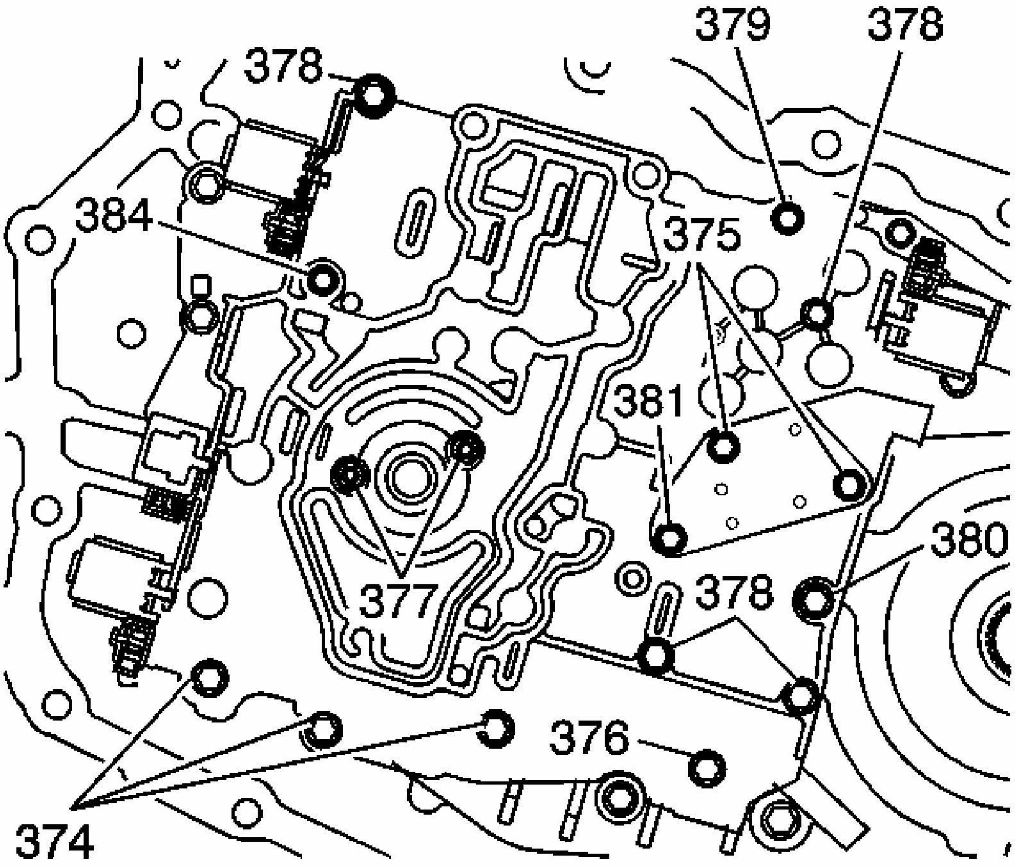


Fig. 351: Installing Valve Body Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **Finger start the bolts to prevent cross-threading.**

11. Install the control valve body bolts (374-381, 384) as indicated.

IMPORTANT:

- **Tighten the bolts in a spiral pattern starting with the bolts at the center of the control valve body.**
- **If the bolts are tightened at random, valve bores may become distorted and inhibit proper valve operation.**

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

12. Tighten the control valve body bolts (374-381, 384).

    Tighten:

    - 374 - 12 N.m (106 lb in)
    - 375 - 12 N.m (106 lb in)
    - 376 - 12 N.m (106 lb in)
    - 377 - 12 N.m (106 lb in)
    - 378 - 12 N.m (106 lb in)
    - 379 - 16 N.m (11 lb ft)
    - 380 - 25 N.m (18 lb ft)
    - 381 - 8 N.m (70 lb in)
    - 384 - 12 N.m (106 lb in)

OIL PUMP COMPONENTS DISASSEMBLE

Disassembly Procedure

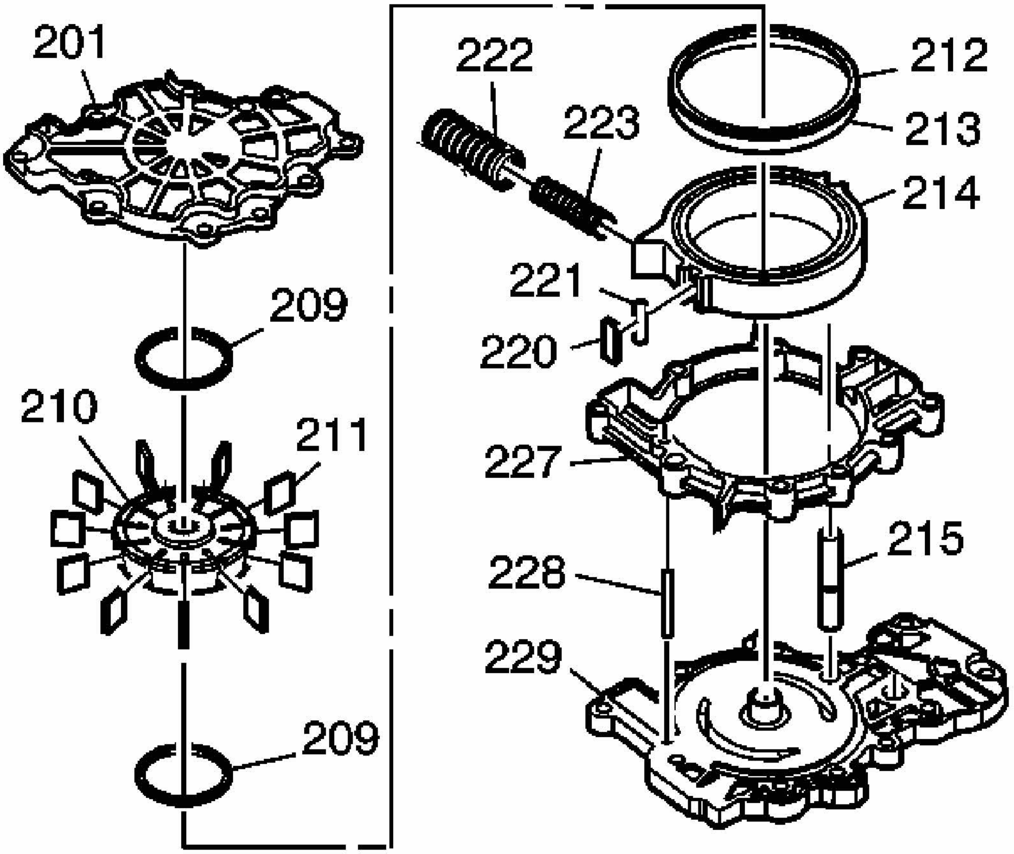


Fig. 352: View Of Oil Pump Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The oil pump assembly has a pump slide, seal, vanes and rotor that are factory selected for size. Do not switch parts with another pump.

1. Remove the oil pump cover (201).
2. Remove the pump rotor (210) and the vane rings (209).
3. Remove the vanes (211), the oil seal ring (212) and the slide O-ring seal (213).

CAUTION: Valve springs can be tightly compressed. Use care when removing retainers and plugs. Personal injury could result.

4. Remove the outer and the inner oil pump prime springs (222, 223).

5. Remove the pump slide seal (220) and the slide seal support (221).
6. Remove the pump slide pivot pin (215).
7. Remove the pump body (227) from the pump base (229).
8. Remove the pump pivot pin (228).

OIL PUMP COMPONENTS ASSEMBLE

Assembly Procedure

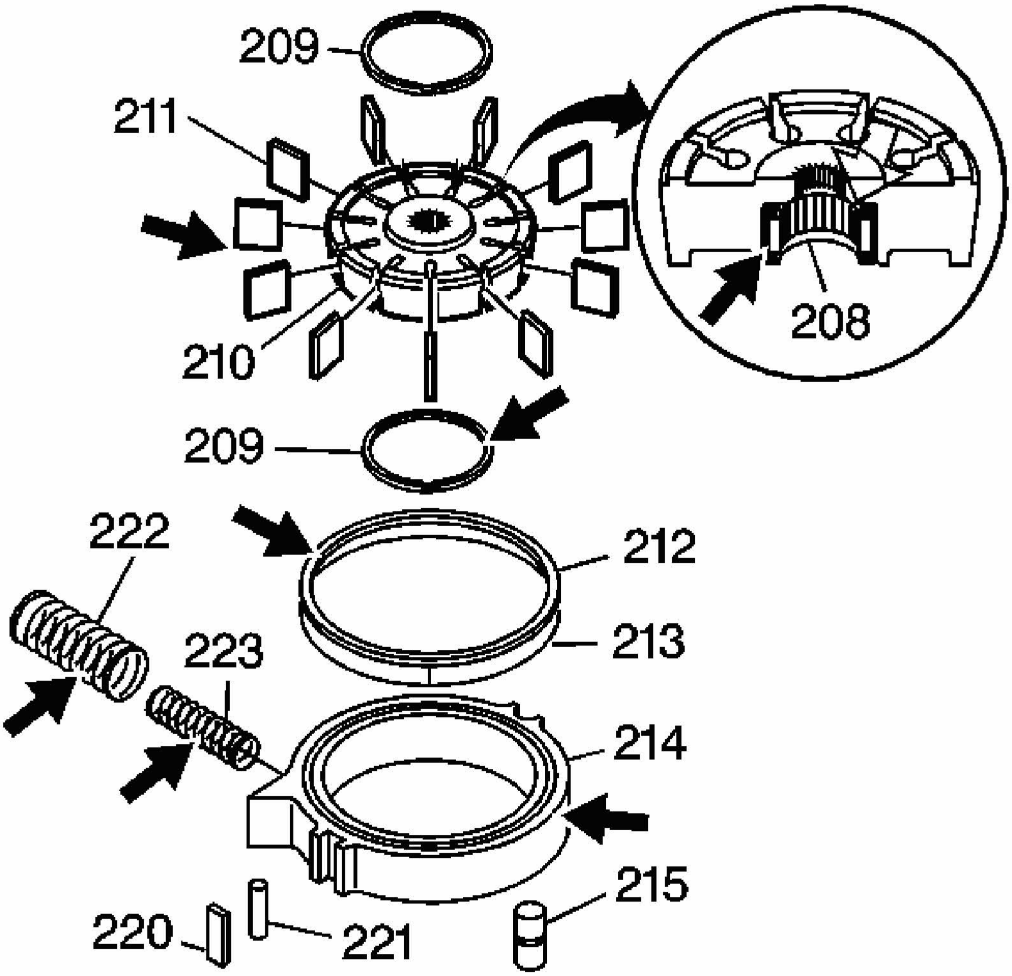


Fig. 353: Oil Pump Components Inspection
Courtesy of GENERAL MOTORS CORP.

1. Inspect the oil pump for:
    - Worn, scored or gouged pump slide (214)

- Cracks, wear or damage to the rotor (210) or the vanes (211)
- Cuts or damage to the seals (212, 213, 220, 221)
- Broken priming springs (222, 223)
- Damaged oil pump drive shaft bearing (208) - the bearing is not serviced separately from the rotor.

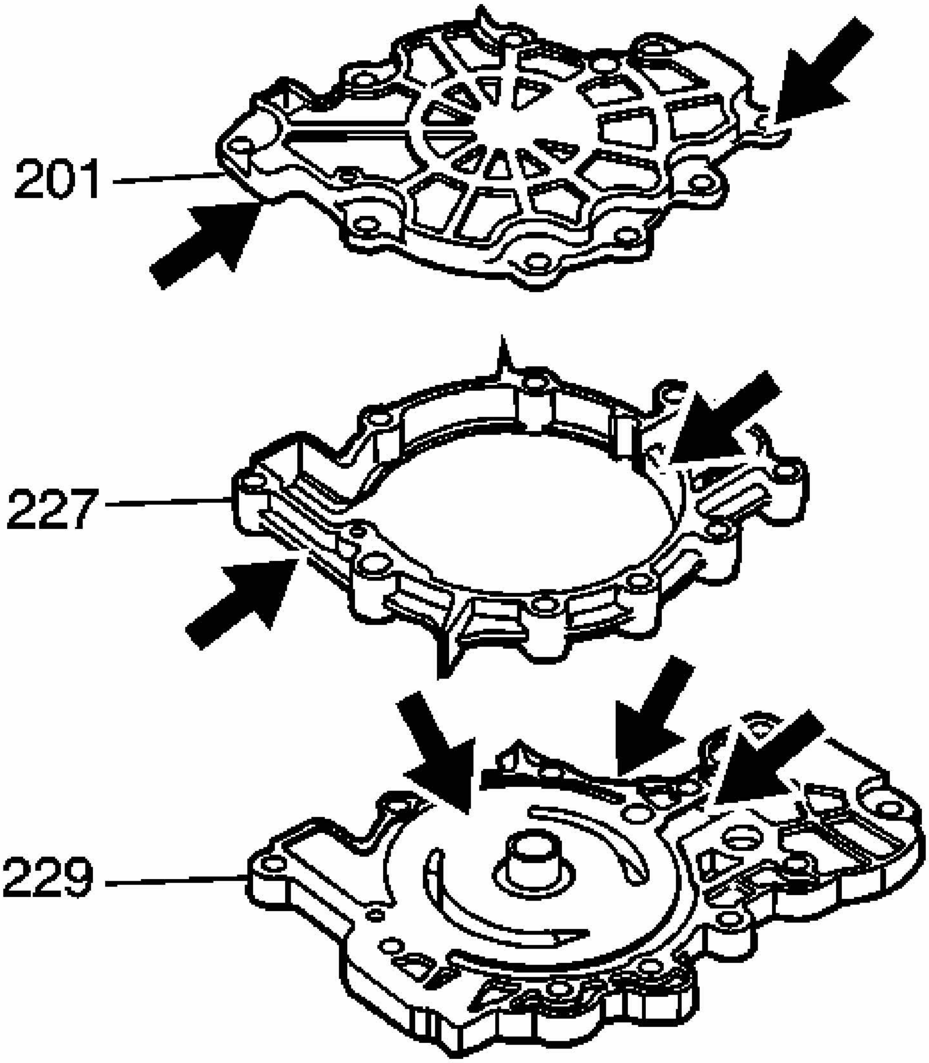


Fig. 354: Inspecting Areas On Oil Pump Body
Courtesy of GENERAL MOTORS CORP.

2. Inspect the oil pump body (228) and the base (229) for:

- Porosity
- A worn, scored or damaged pump pocket
- Interconnected oil passages
- Damaged machined surfaces

3. Inspect the oil pump cover (201) for cracks, wear or gouges from the pump vanes.

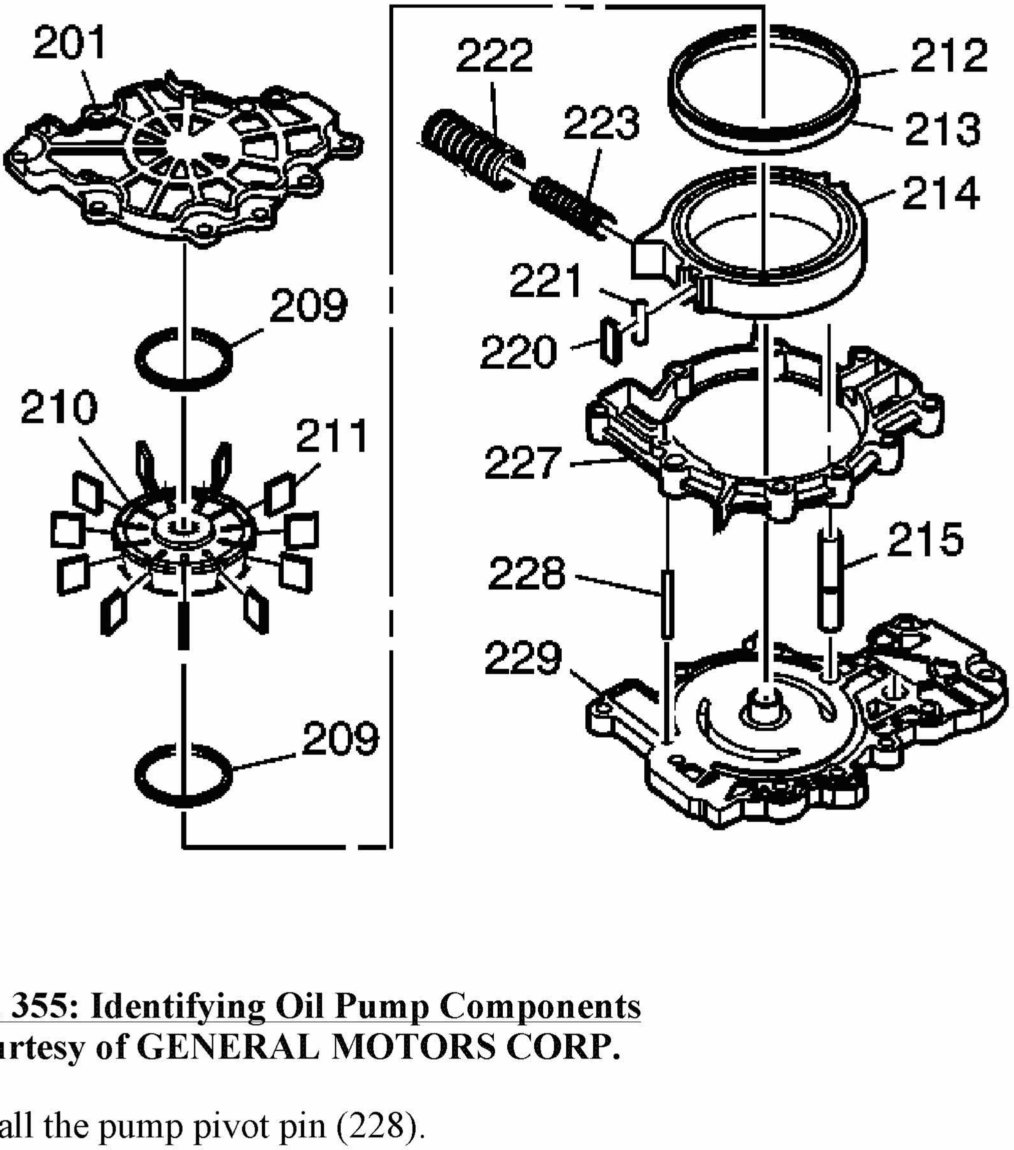


Fig. 355: Identifying Oil Pump Components
Courtesy of GENERAL MOTORS CORP.

4. Install the pump pivot pin (228).
5. Install the pump body (227) onto the pump base (229).
6. Install the pivot slide pin (215).
7. Insert the pump slide seal (221) and the pump slide seal (220) into the pump slide (214).
8. Insert the pump slide (214) and the slide pivot pin (215) into the pump body (227).

9. Install the outer and inner priming springs (222, 223) as an assembly into the pump body (227).
10. Install the first vane ring into the pump body (227).
11. Insert the pump slide O-ring seal (213) and pump slide seal ring (212) into the pump slide (214).
12. Insert the rotor (210) into the pump body (227).
13. Install the pump vanes (211) into the rotor (210). The pump vane must be flush with the top of the rotor.
14. Install the second vane ring (209) onto the top of the rotor (210).

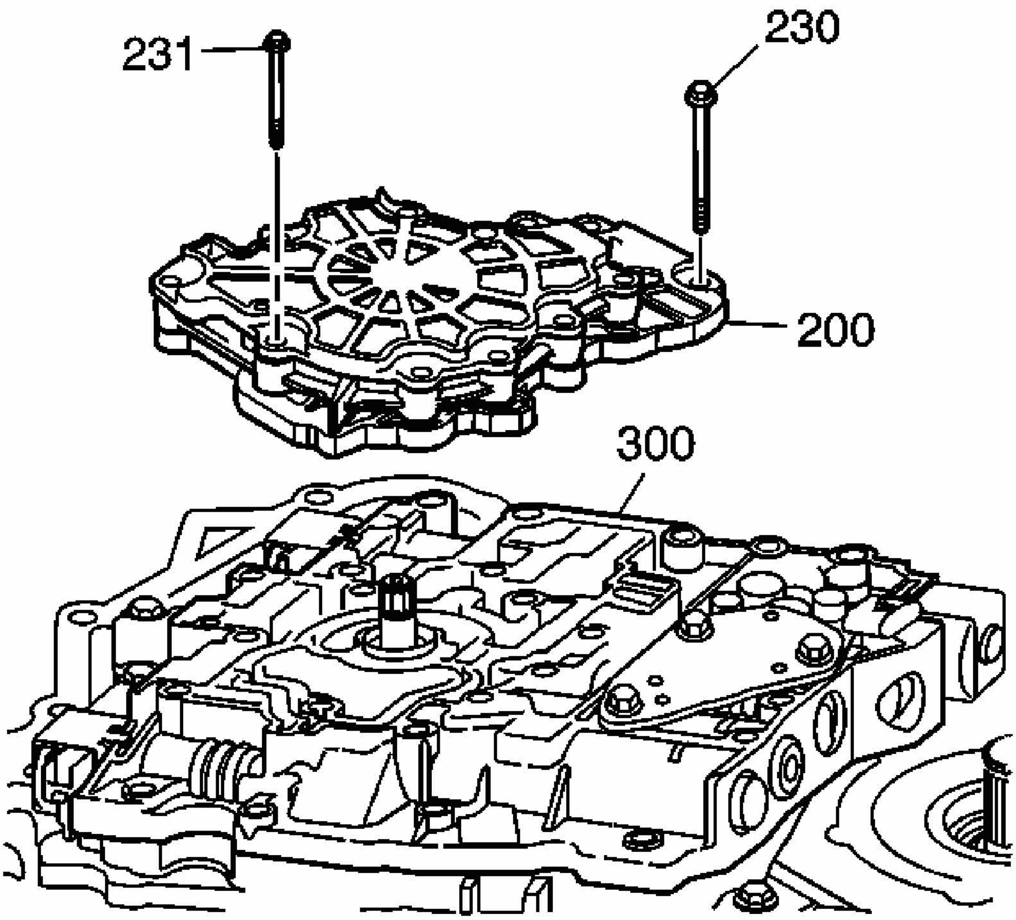


Fig. 356: Locating Oil Pump Assembly
Courtesy of GENERAL MOTORS CORP.

15. Install the oil pump assembly (200) onto the control valve assembly (300).

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

16. Install the two pump body to case bolts (230) and the nine pump cover to case cover bolts (231).

    Tighten: Tighten the bolts to 12 N.m (106 lb in).

WIRING HARNESS ASSEMBLE

Assembly Procedure

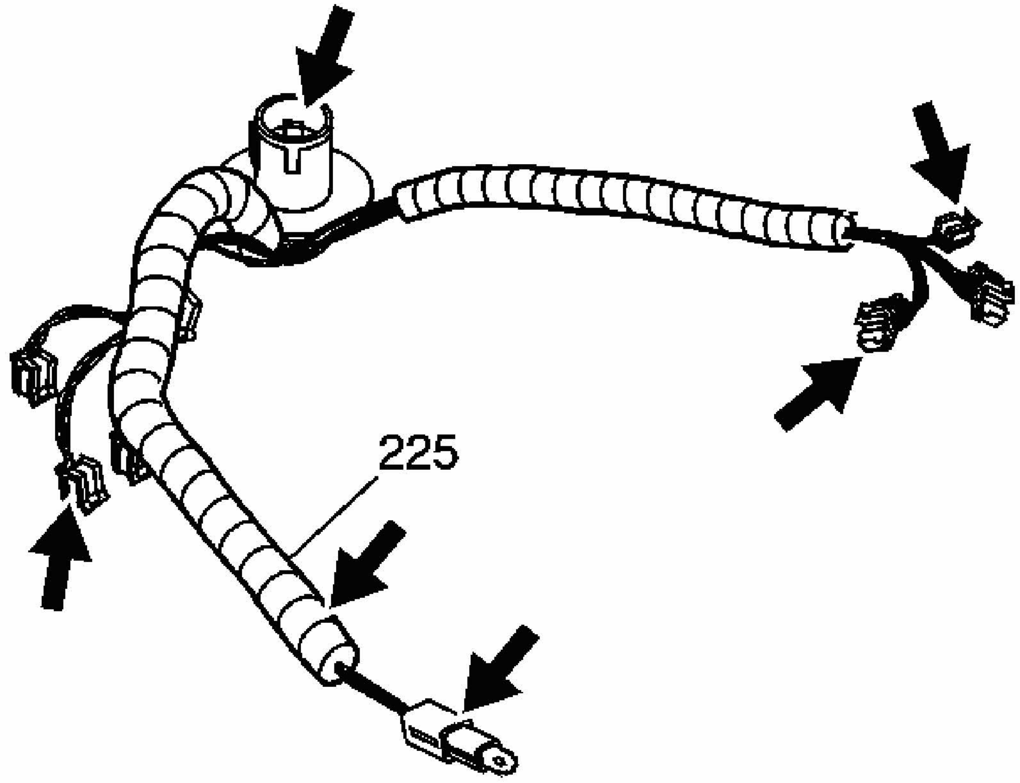


Fig. 357: View Of Wiring Harness Assembly
Courtesy of GENERAL MOTORS CORP.

1. Inspect the wiring harness assembly (225) for:
    - Cut or pinched wires
    - Cut wire insulation
    - Bent or broken electrical connectors

- Damaged terminal pins

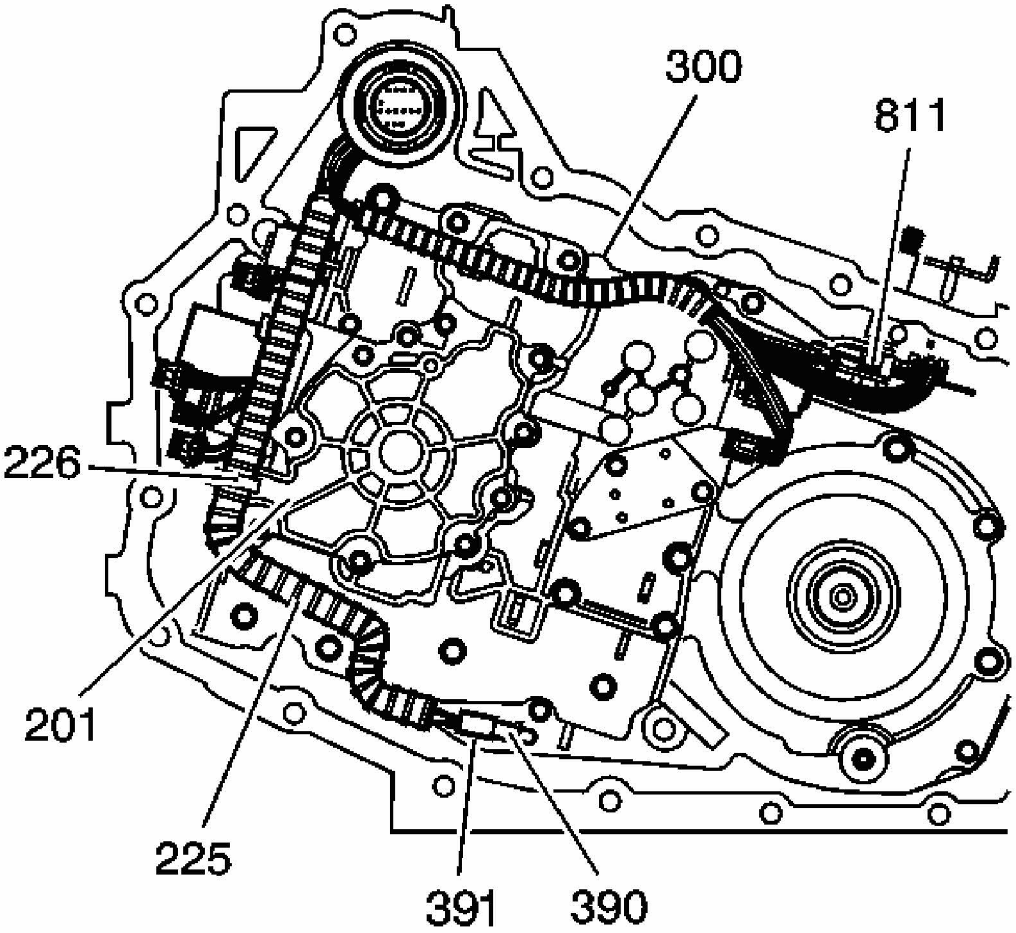


Fig. 358: Aligning Wire Harness Onto Control Valve Body
Courtesy of GENERAL MOTORS CORP.

2. Position the wire harness assembly (225) onto the control valve body (300) and the pump cover (201).
3. Mate each connector into its respective electrical component and engage the locking tabs.
4. Secure the wiring harness conduit into the retaining clip (226) on the pump cover (201).
5. Assemble the fluid temperature sensor (391) into the temperature sensor clip (390).

CONTROL VALVE BODY COVER AND GASKET ASSEMBLE

Tools Required

J 36850 Assembly Lubricant (or equivalent)

Assembly Procedure

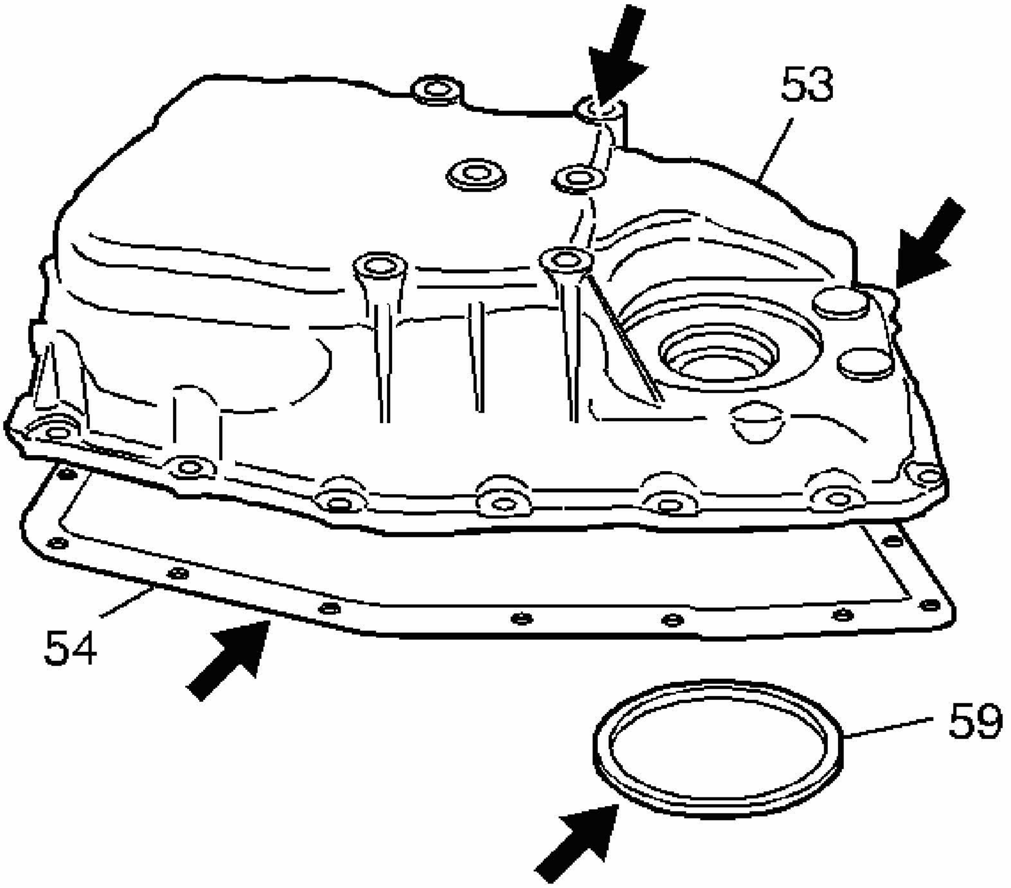


Fig. 359: Inspecting Case Side Cover
Courtesy of GENERAL MOTORS CORP.

1. Inspect the control valve body cover (53) for the following conditions:
    - Damaged or porous gasket sealing surfaces
    - Damaged or porous casting surfaces
    - Damaged or stripped bolt holes
2. Inspect the control valve body cover gaskets (54, 59) for damage. The gaskets are reusable if they are NOT damaged.

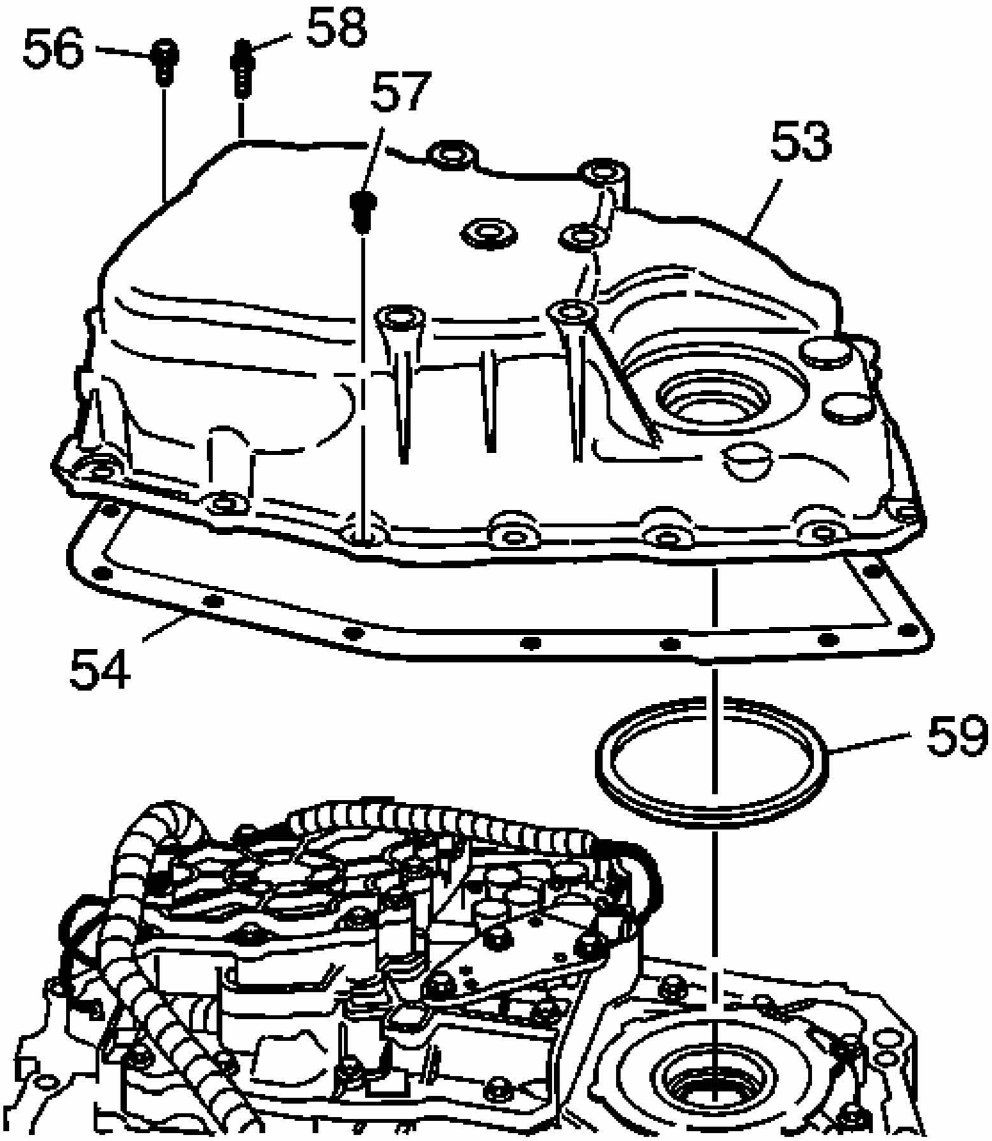


Fig. 360: Locating Control Valve Body Cover Gasket
Courtesy of GENERAL MOTORS CORP.

3. Assemble the control valve body cover inner gasket (59) to the control valve body cover (53). Use **J 36850** or equivalent to retain the gasket in position.
4. Install the control valve body cover gasket (54) and control valve body cover (53) onto the case. Make sure the gaskets and electrical connector are positioned correctly.

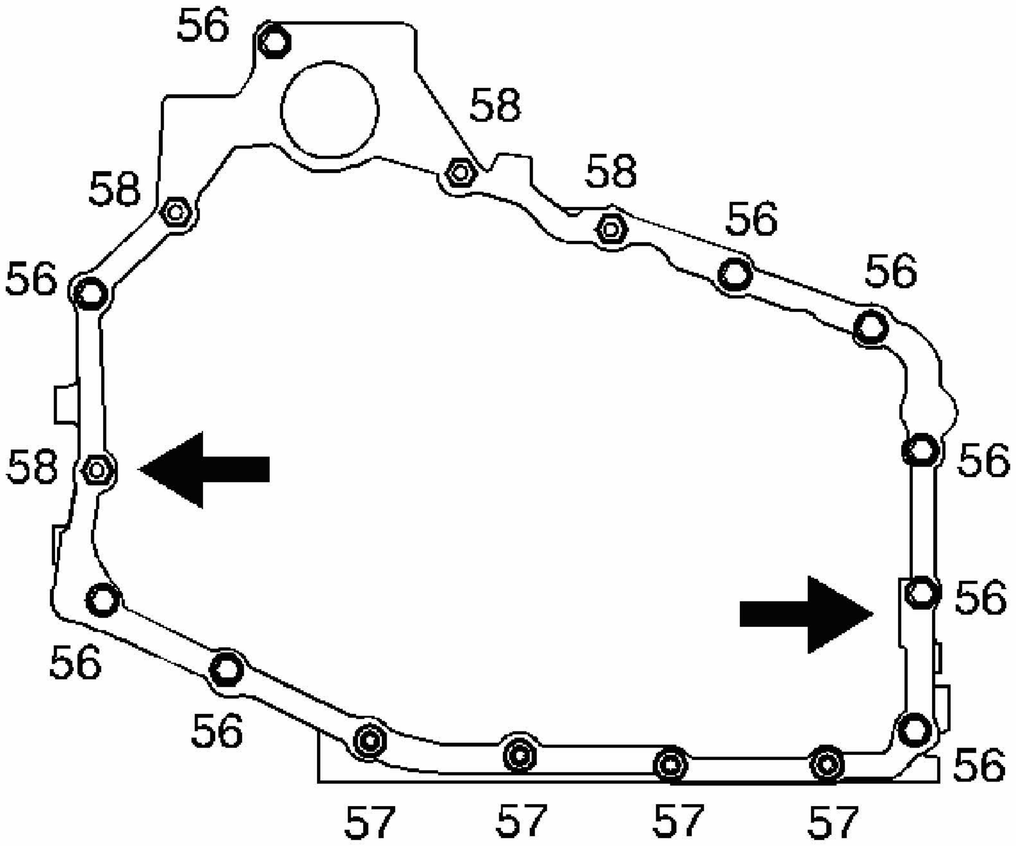


Fig. 361: Identifying Control Valve Body Cover Bolt & Control Valve Body Cover To Case Stud Bolt
Courtesy of GENERAL MOTORS CORP.

5. Install control valve body cover bolt (56) and one control valve body cover to case stud bolt (58) in the locations shown. These bolts will properly locate the control valve body cover and gasket to the case.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

6. Install the remaining bolts as indicated:
   - Nine control valve body cover bolts (56)
   - Four control valve body cover TORX® head bolts (57)
   - Four control valve body cover to case stud bolts (58)

   Tighten: Tighten all bolts to 25 N.m (18 lb ft).

THERMO ELEMENT ADJUSTMENT

Tools Required

J 34094-A Thermal Element Height Gauge. See **Special Tools**.

Adjustment Procedure

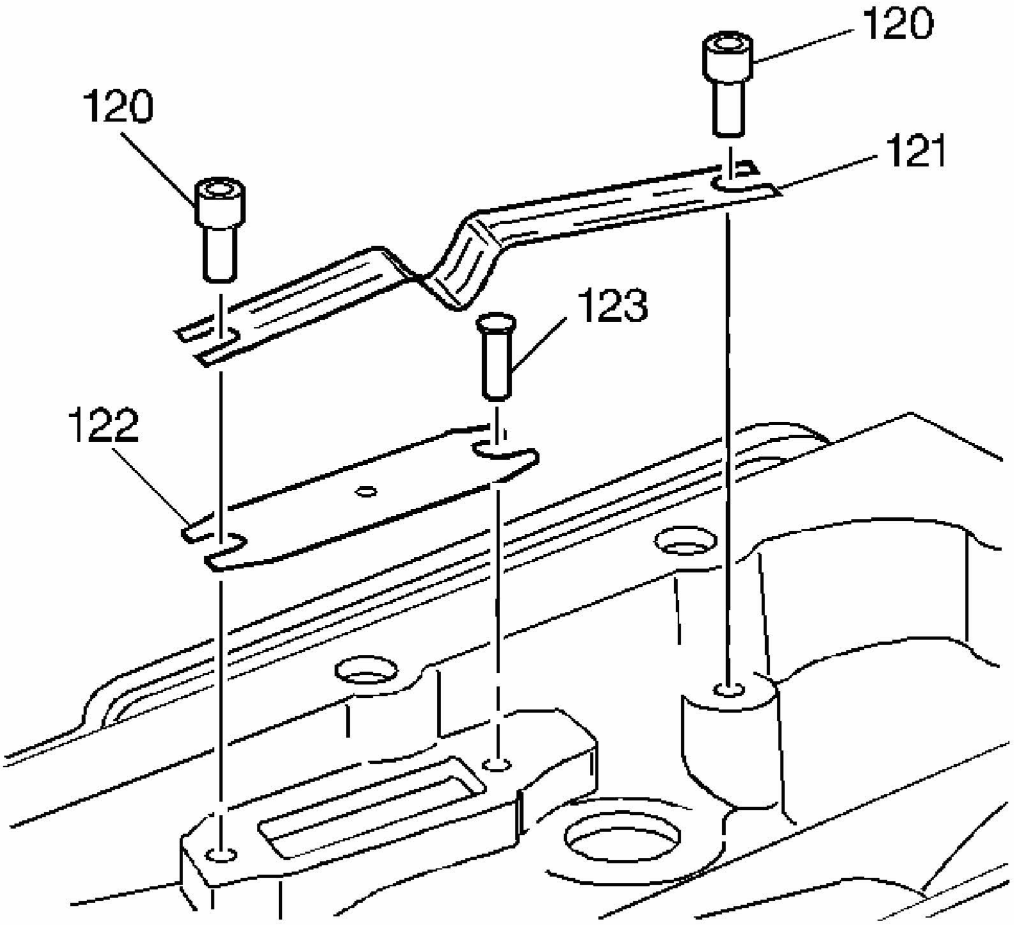


Fig. 362: Removing Thermo Element
Courtesy of GENERAL MOTORS CORP.

1. Remove the thermo element plate pins (120).
2. Remove the thermo element (121) and the thermo element plate (122).

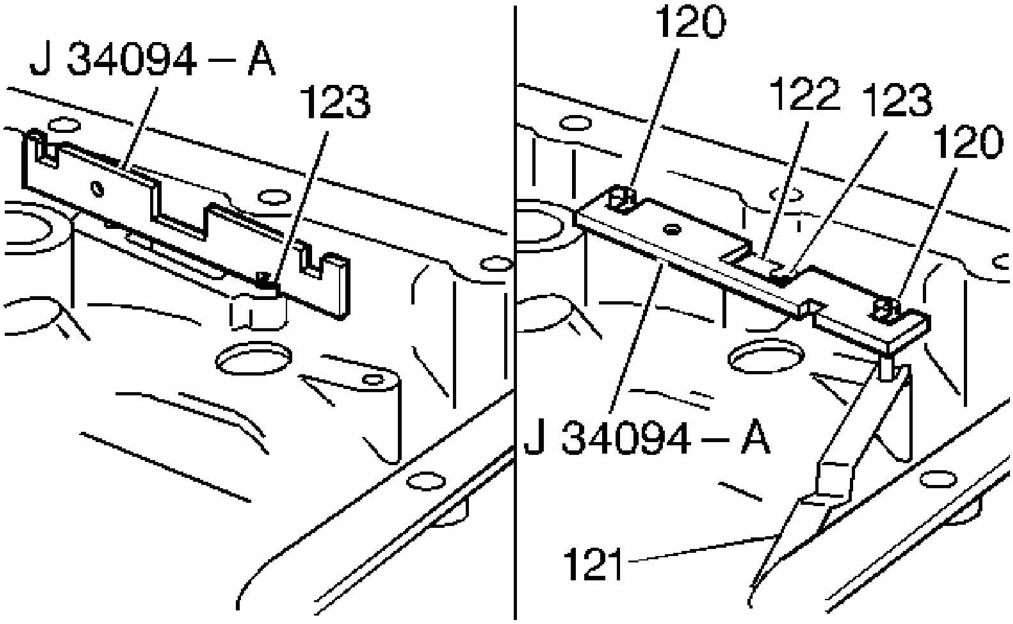


Fig. 363: Using J 34094-A To Set The Height Of The Thermo Element Plate Center Pin
Courtesy of GENERAL MOTORS CORP.

3. Use **J 34094-A** in order to set the height of the thermo element plate center pin (123). See **Special Tools**.
4. Install the thermo element plate (122).
5. Use **J 34094-A** in order to set the height of the thermo element plate pin (120) that is farthest from the accumulators. See **Special Tools**.
6. Use **J 34094-A** in order to set the height of the second thermo element plate pin (120). See **Special Tools**.

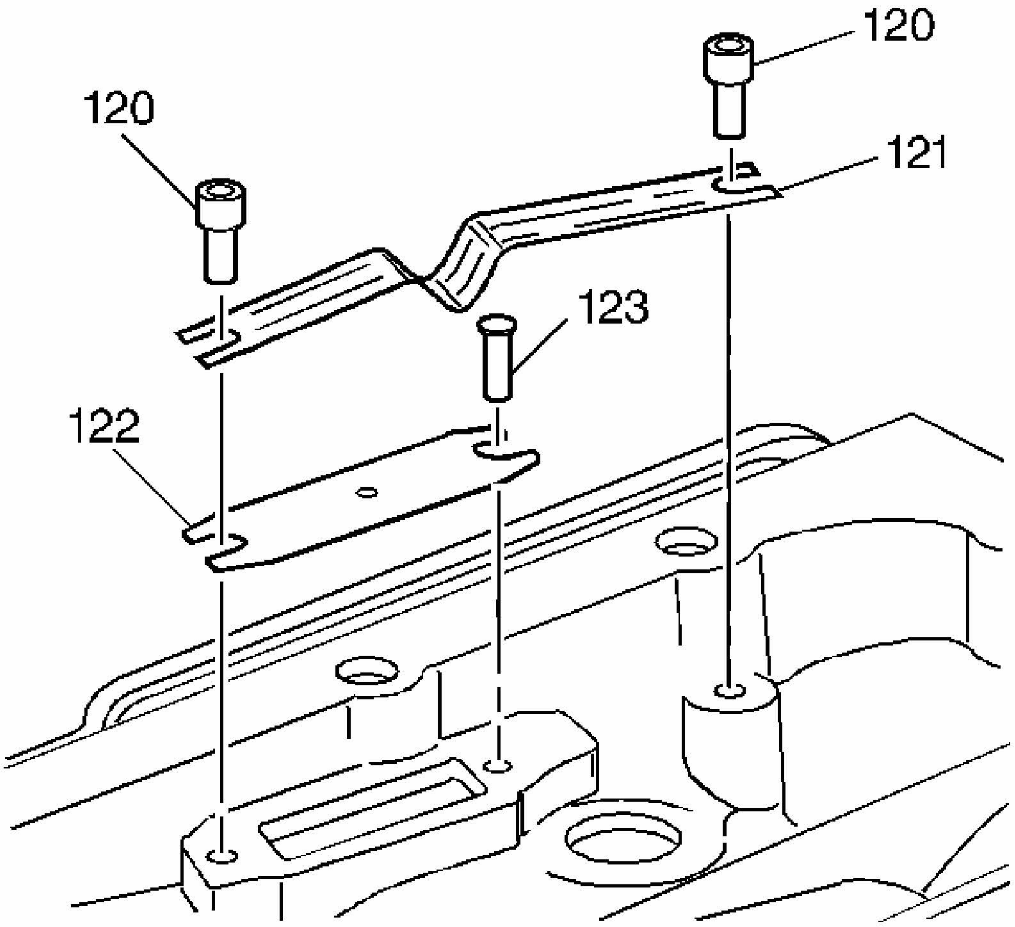


Fig. 364: Removing Thermo Element
Courtesy of GENERAL MOTORS CORP.

7. Carefully install the thermo element (121) between the two thermo element plate pins (120).
8. The V in the thermo element (121) must contact the thermo element plate (123).

2-1 MANUAL BAND SERVO DISASSEMBLE

Disassembly Procedure

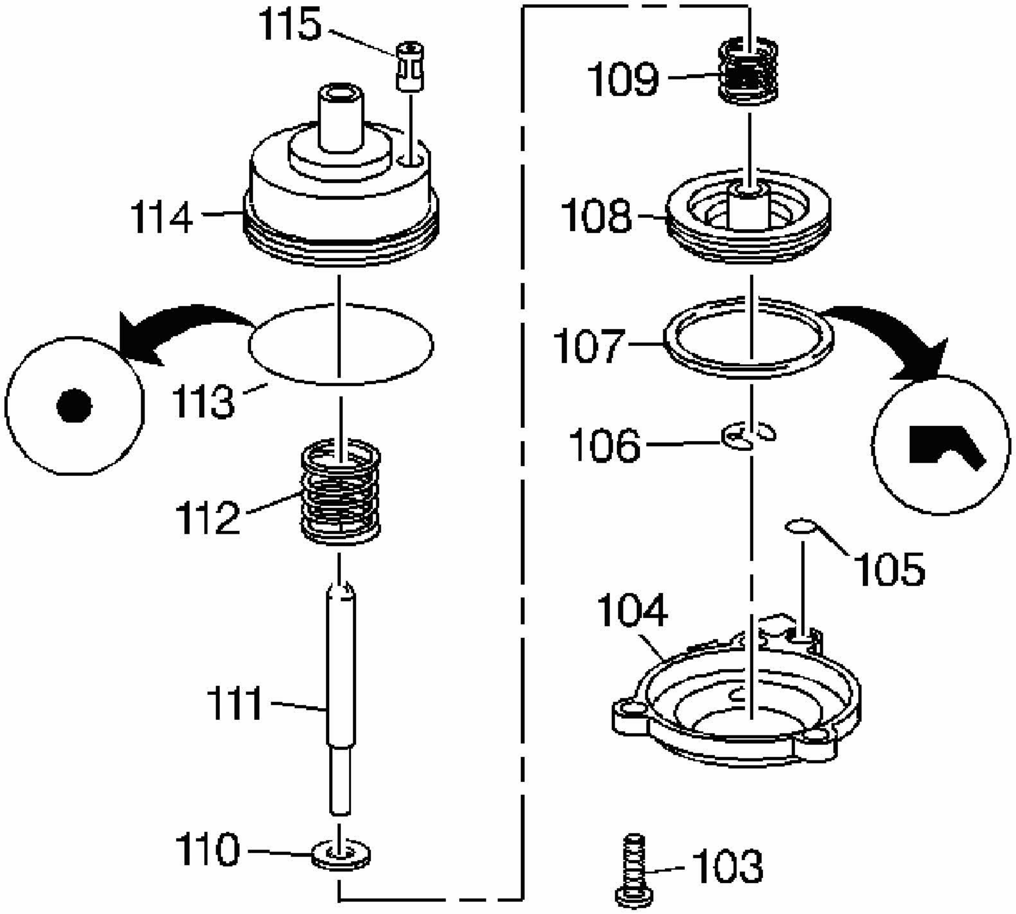


Fig. 365: Locating 2-1 Manual Band Servo Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the servo piston cylinder (114) from the servo cover (104).
2. Remove the O-ring seal (113) from the servo piston cylinder (114).
3. Remove the servo piston assembly (106-111), the servo piston spring (112) and the servo exhaust screen (115) from the servo piston cylinder (114).
4. Remove the servo piston seal (107) from the servo piston (108).
5. Use a small screwdriver in order to remove the servo piston pin retaining ring (106) from the servo piston pin (111).
6. Remove the servo piston (108), the servo piston cushion spring (109) and the servo piston spring retainer (110) from the servo piston pin (111).

2-1 MANUAL BAND SERVO ASSEMBLE

Assembly Procedure

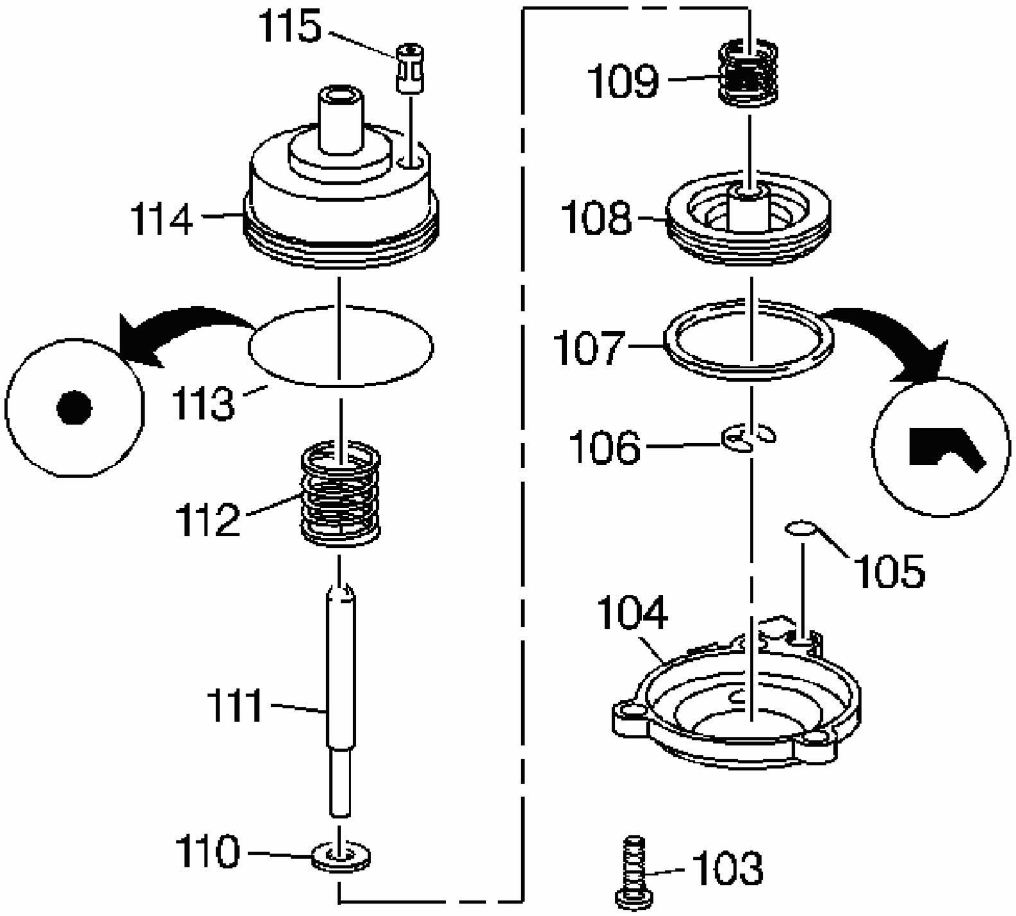


Fig. 366: Locating 2-1 Manual Band Servo Assembly
Courtesy of GENERAL MOTORS CORP.

1. Inspect the components of the 2-1 manual band servo for the following conditions:
    - A damaged, worn or porous servo piston cylinder (114)
    - A damaged, worn or porous servo piston (108)
    - A damaged or worn servo piston pin (111)
    - A broken or damaged servo piston spring (112)
    - A broken or damaged servo piston cushion spring (109)
    - A damaged or plugged servo exhaust screen (115)
    - A damaged servo cover seal (105)
    - A damaged servo piston seal (107)

- A damaged servo piston cylinder O-ring seal (113)

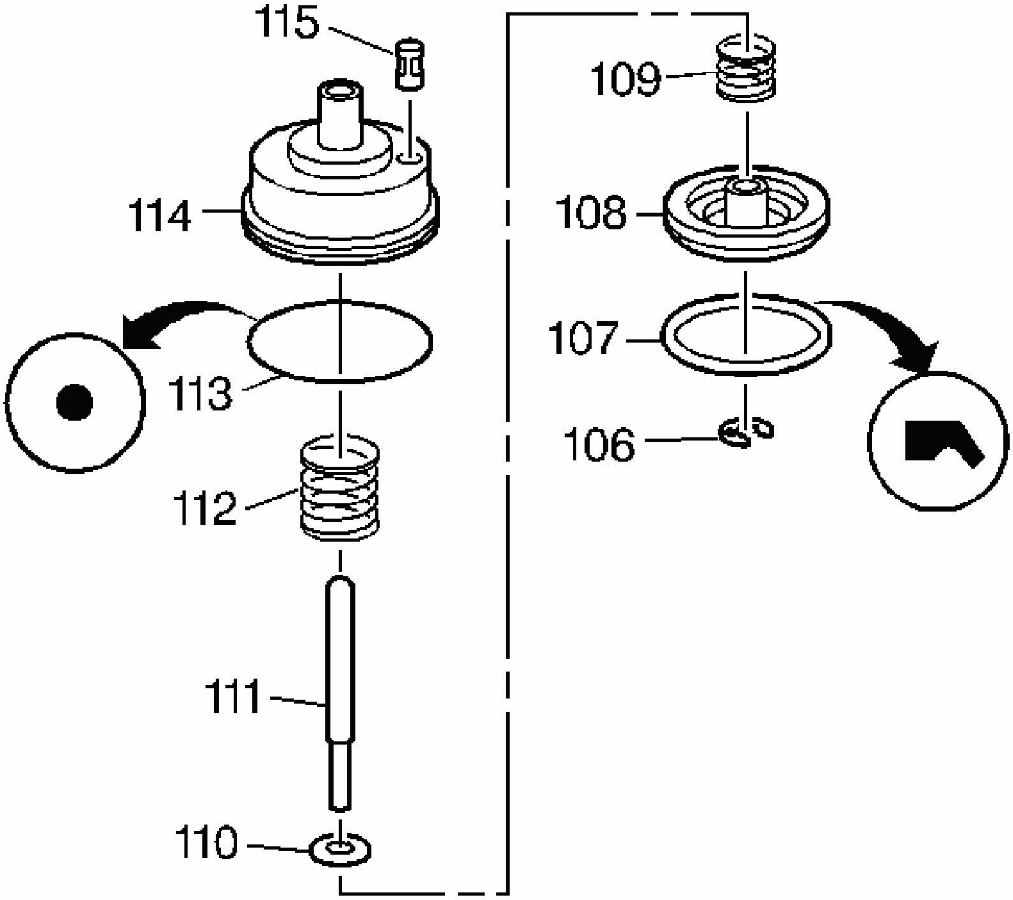


Fig. 367: Assembling Components Of 2-1 Manual Band Servo
Courtesy of GENERAL MOTORS CORP.

2. Assemble the servo piston spring retainer (110), the servo piston cushion spring (109) and the servo piston (108) onto the servo piston pin (111).
3. Use a small screwdriver in order to install the servo piston pin retaining ring (106).
4. Install the servo piston seal (107) onto the servo piston (108). Lubricate the servo piston seal (107) with automatic transmission fluid.
5. Assemble the servo exhaust screen (115) and the servo piston cylinder O-ring seal (113) onto the servo piston cylinder (114). Lubricate the servo piston cylinder O-ring seal (113) with automatic transmission fluid.
6. Attach the servo piston spring (112) to the servo piston assembly (106-111).
7. Install the servo piston and spring assembly (106-112) into the servo piston cylinder

assembly (113-115) and set the assemblies aside.

ACCUMULATOR COMPONENTS DISASSEMBLE

Disassembly Procedure

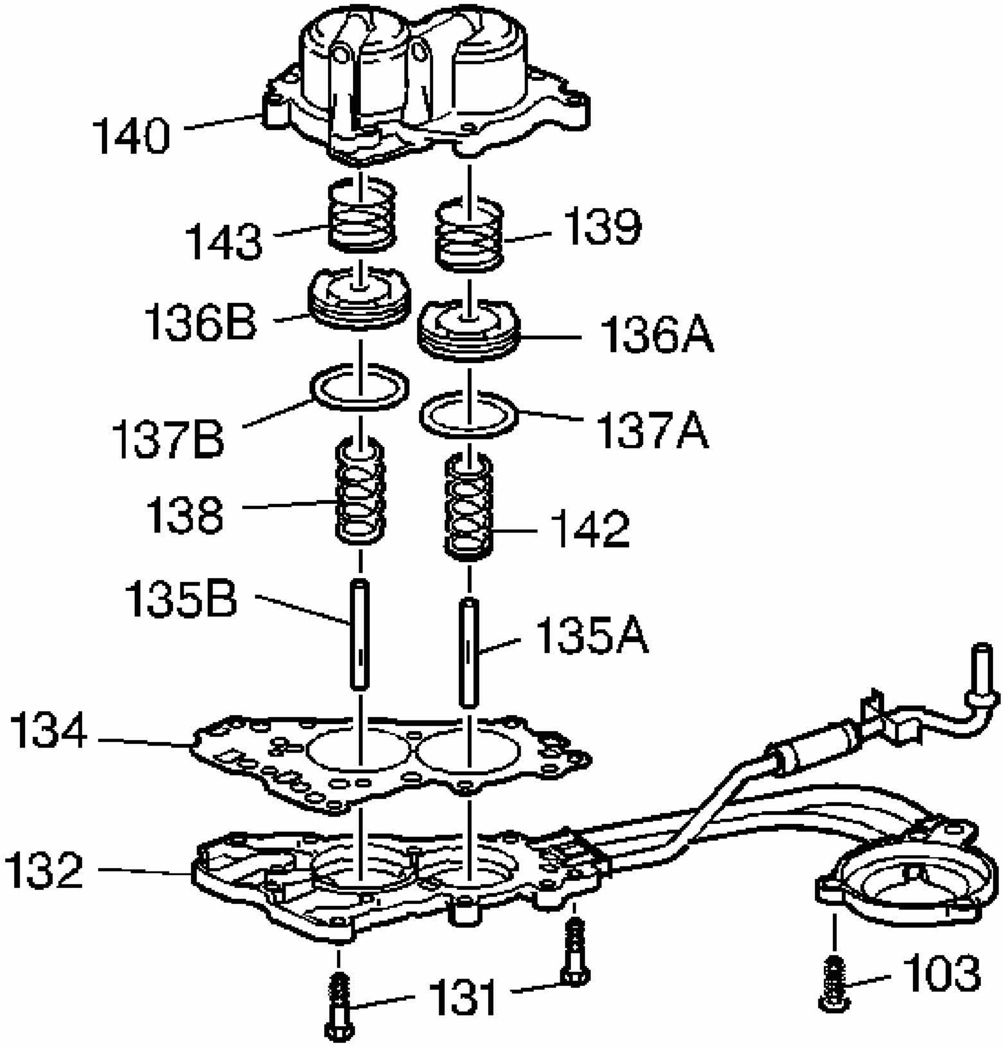

140
143
139
136B
136A
137B
137A
138
142
135B
135A
134
132
131
103

Fig. 368: Expanded View Of Accumulator Components
Courtesy of GENERAL MOTORS CORP.

1. Remove the seven remaining accumulator cover bolts (131) from the accumulator assembly.
2. Remove the accumulator cover (132) and the spacer plate assembly (134) from the accumulator housing assembly (140).

3. Remove the 1-2 and 2-3 accumulator pistons (136A/B), piston pins (135A/B), outer springs (138, 142 - springs are model dependent) and cushion springs (139, 143 - springs are model dependent) from the accumulator housing (140).
4. Remove the piston oil seal rings (137A/B) from the 1-2 and 2-3 accumulator pistons (136A/B).

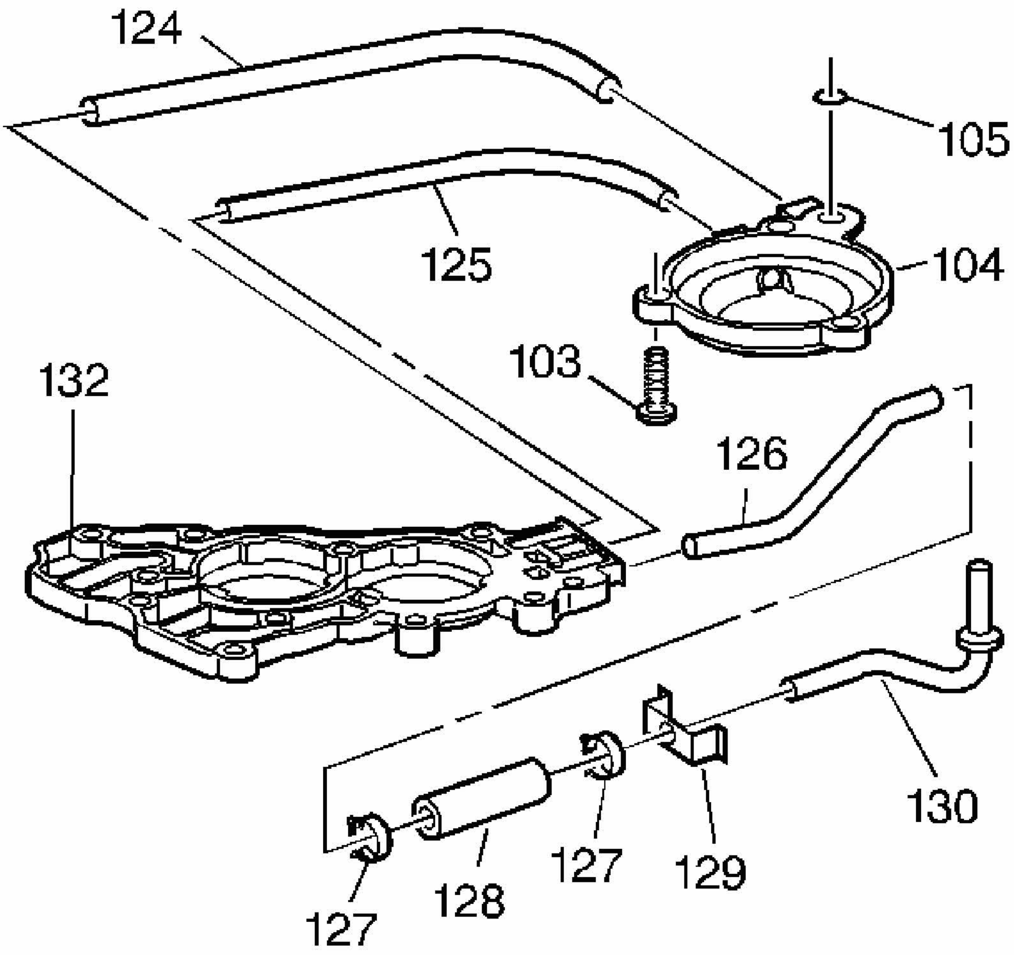


Fig. 369: Disconnecting Accumulator Cover From 2-1 Manual Band Servo Cover
Courtesy of GENERAL MOTORS CORP.

5. Disassemble the forward band servo and 2-1 manual band servo oil pipes (124, 125) and the lube oil pipe assembly (126-130) from the accumulator cover (132) and the 2-1 manual band servo cover (104).
6. Disassemble the lube oil pipe (126), the hose clamps (127), the hose (128), the lube oil pipe retainer (129) and the lube oil pipe and washer assembly (130).

ACCUMULATOR COMPONENTS ASSEMBLE

Assembly Procedure

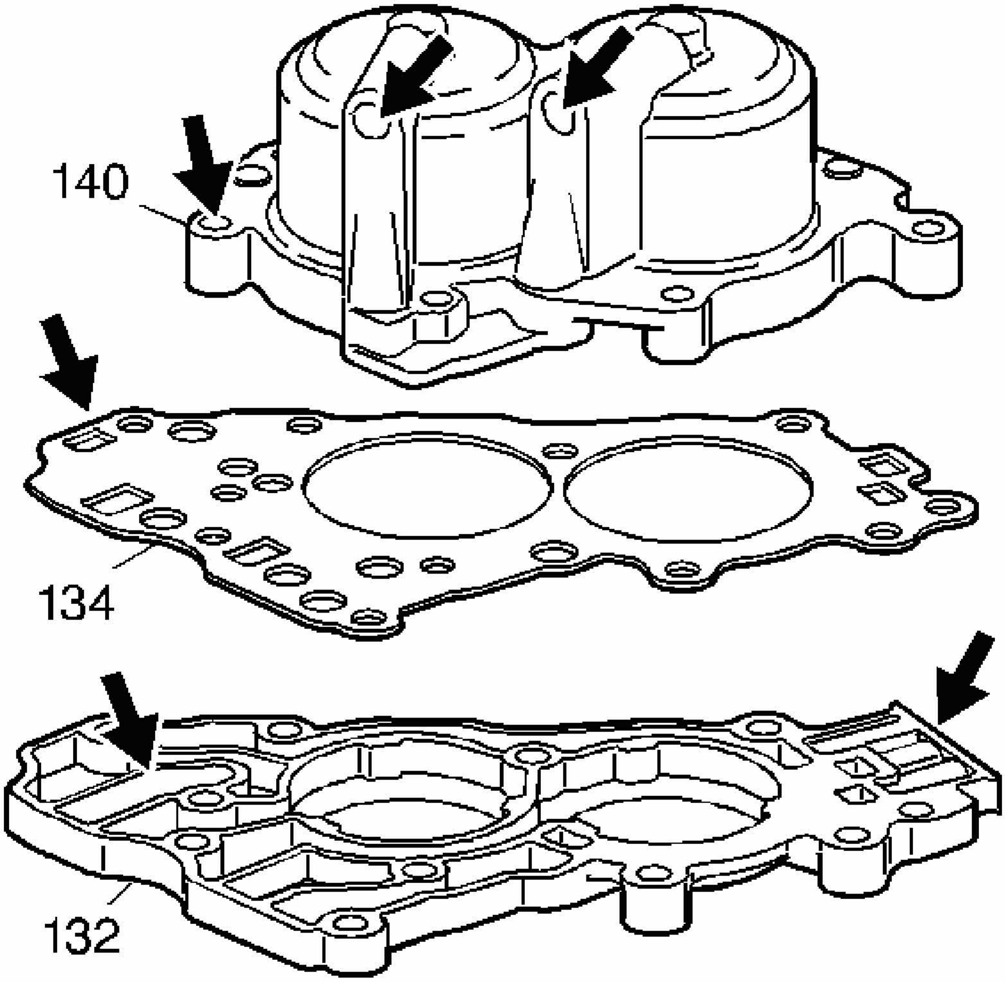


Fig. 370: View Of Accumulator Housing, Cover Spacer Plate Assembly & Cover
Courtesy of GENERAL MOTORS CORP.

1. Inspect the accumulator housing (140), the accumulator cover spacer plate assembly (134) and the accumulator cover (132) for the following conditions:
   - Damaged lube and servo oil pipe holes in the accumulator cover (132)
   - Damaged, improperly machined or porous accumulator cover (132)
   - Bent or damaged accumulator cover spacer plate assembly (134)
   - Stripped or damaged bolt holes in the accumulator housing (140)

- Damaged, worn, improperly machined or porous accumulator housing (140)
- Leaking, loose or missing cup plugs in the accumulator housing (140)

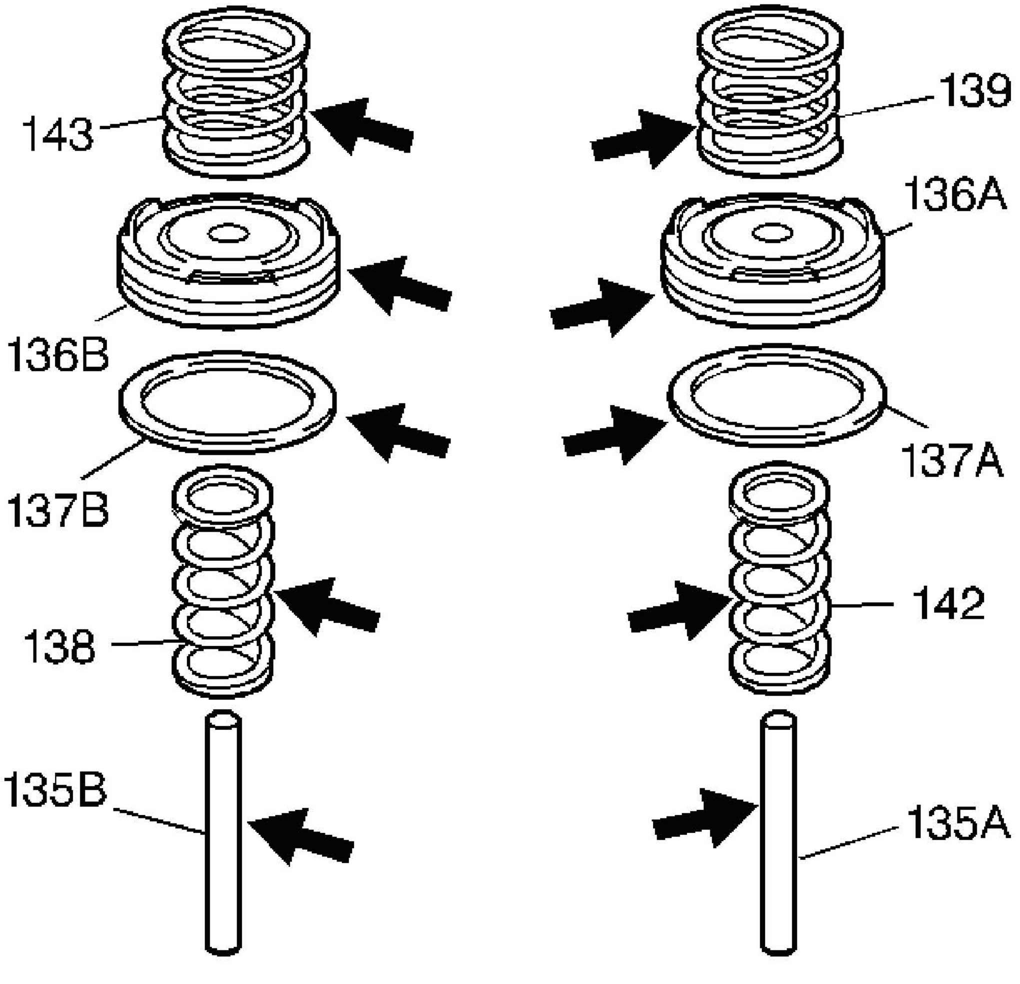


Fig. 371: Accumulator Pistons, Springs, Seals And Pins Inspection Areas
Courtesy of GENERAL MOTORS CORP.

2. Inspect the accumulator pistons, springs, seals and pins for the following conditions:
    - Broken or collapsed piston outer springs (138, 142)
    - Broken or collapsed piston cushion springs (139, 143)
    - Bent or worn accumulator piston pins (135A/B)
    - Damaged, worn or porous accumulator pistons (136A/B)
    - Damaged accumulator piston seals (137A/B)

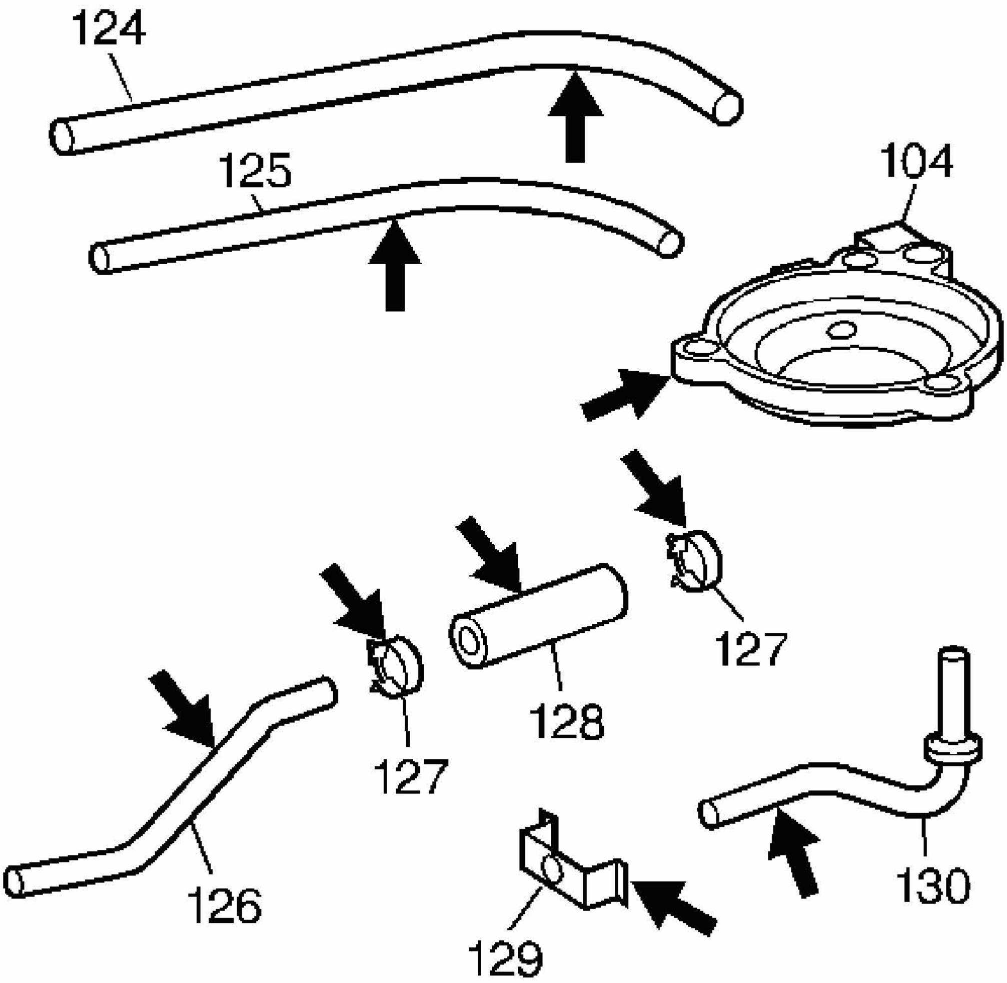


Fig. 372: Identifying Servo And Lube Oil Pipe Components
Courtesy of GENERAL MOTORS CORP.

3. Inspect the servo and lube oil pipe components (124-130) and the 2-1 manual band servo cover (104) for the following conditions:
   - Damaged lube and servo oil pipe holes in the servo cover (104)
   - Damaged, improperly machined or porous servo cover (104)
   - Bent, plugged or damaged lube and servo oil pipes (124, 125, 126, 130)
   - Plugged or damaged lube oil hose (128)
   - Damaged hose clamps (127)
   - Damaged lube oil pipe retainer (129)
   - Missing lube oil pipe washer (130)

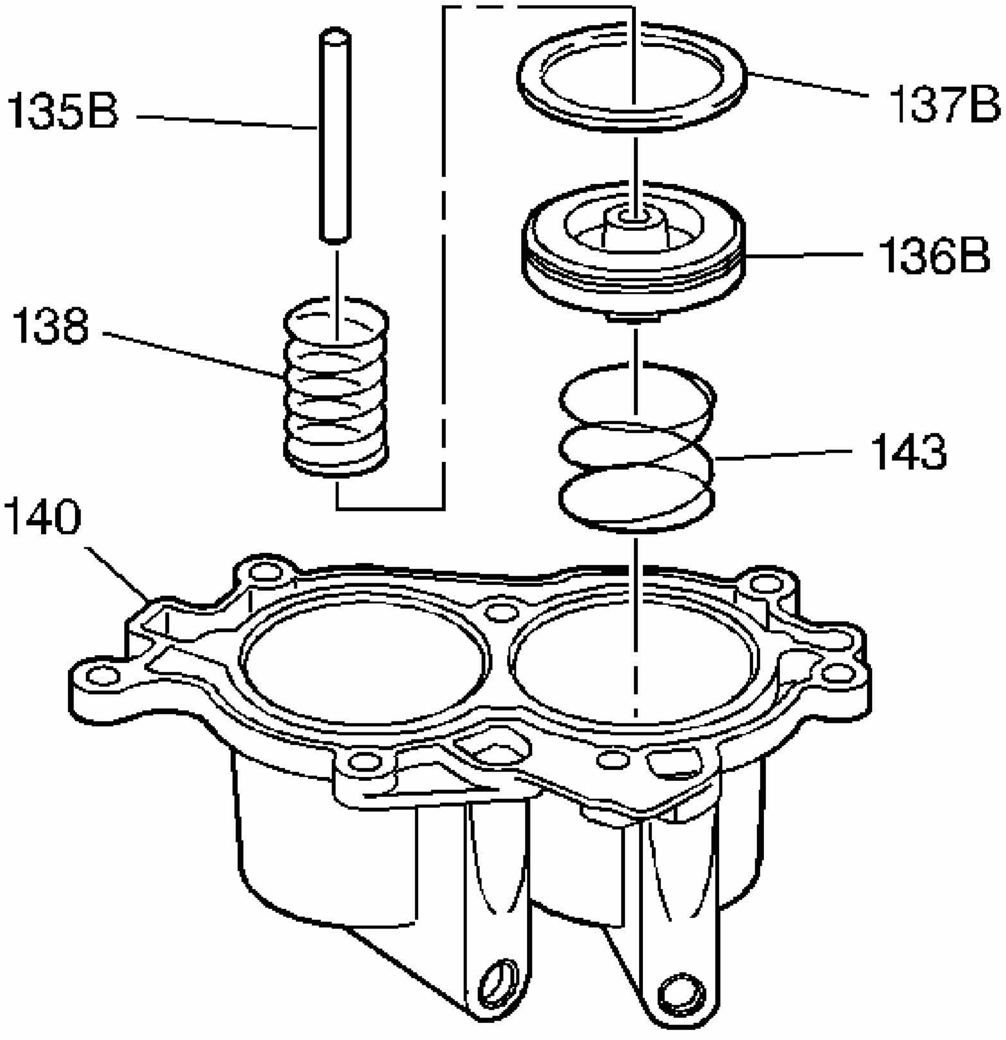


Fig. 373: Locating 2-3 Accumulator Piston Components
Courtesy of GENERAL MOTORS CORP.

4. Install the 2-3 accumulator piston oil seal ring (137B) onto the 2-3 accumulator piston (136B). Lubricate the oil seal ring with automatic transmission fluid.
5. Assemble the 2-3 accumulator piston pin (135B) and piston (136B).

IMPORTANT: Do not mix up spring or pistons/springs. Be sure to install the correct springs in the correct bore.

6. Install the 2-3 accumulator piston springs (138, 143) and piston assembly (136B) into the accumulator housing (140).

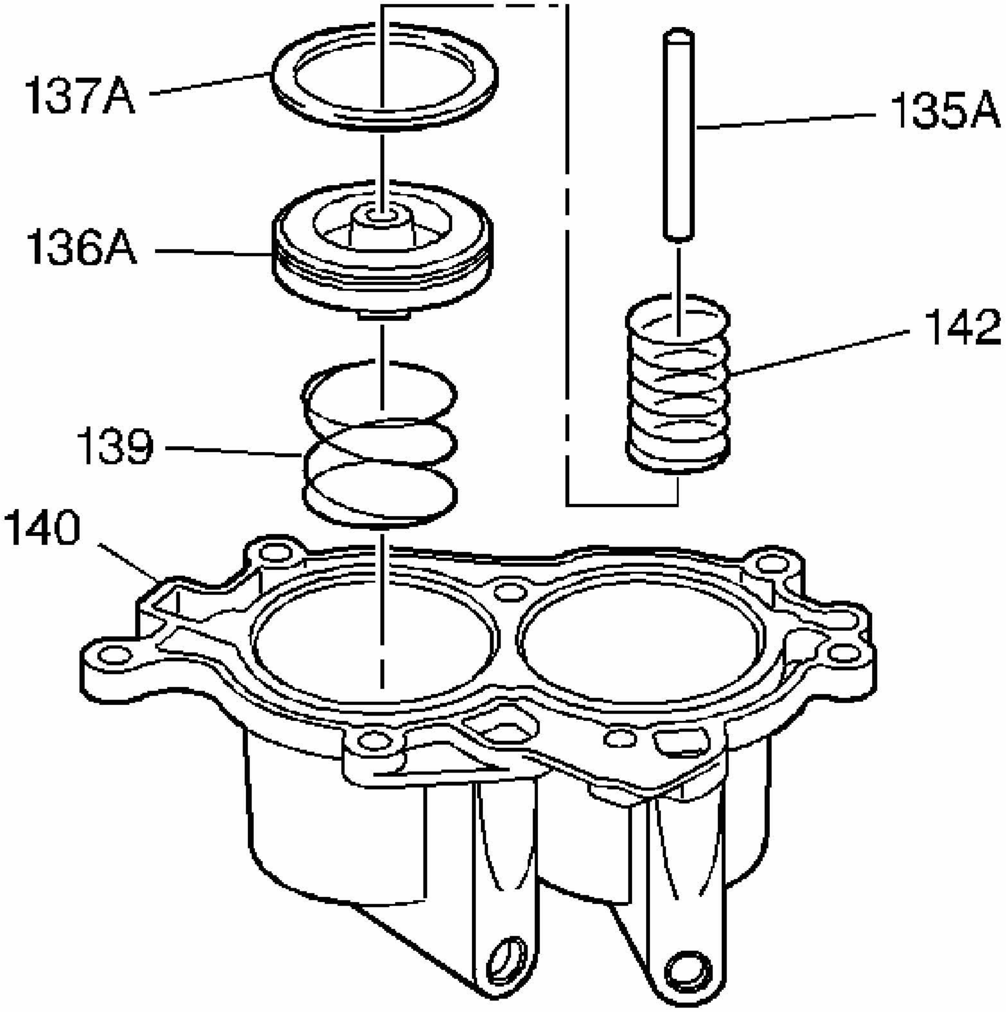


Fig. 374: View Of 1-2 Accumulator Piston Components
Courtesy of GENERAL MOTORS CORP.

7. Install the 1-2 accumulator piston oil seal ring (137A) onto the 1-2 accumulator piston (136A). Lubricate the oil seal ring with automatic transmission fluid.
8. Assemble the 1-2 accumulator piston pin (135A) and piston (136A).

IMPORTANT: Do not mix up spring or pistons/springs. Be sure to install the correct springs in the correct bore.

9. Install the 1-2 accumulator piston springs (139, 142) and the piston assembly (136A) into the accumulator housing (140).

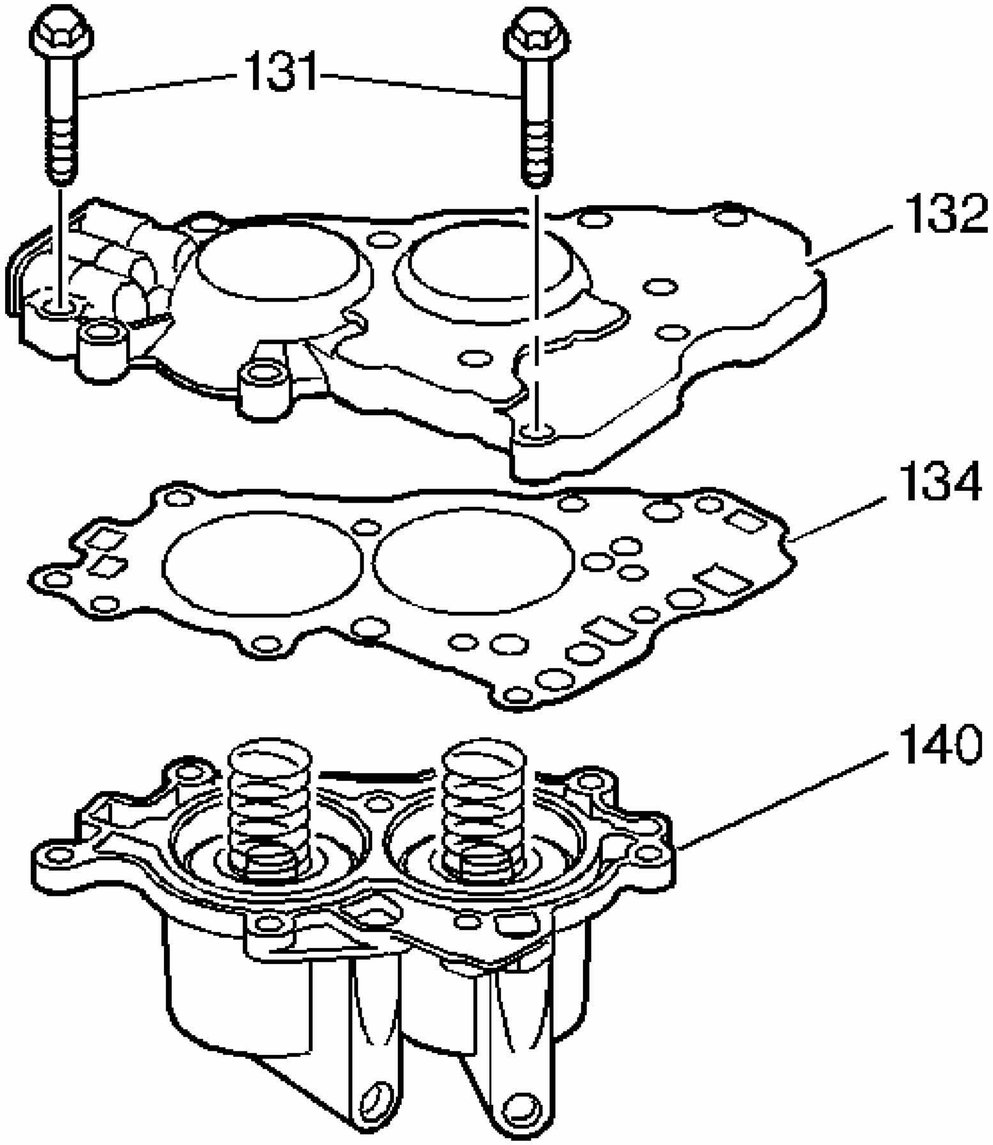


Fig. 375: Installing Accumulator Cover Bolts
Courtesy of GENERAL MOTORS CORP.

10. Assemble the accumulator cover spacer plate assembly (134) and the accumulator cover (132) onto the accumulator housing (140).

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

11. Install seven accumulator cover bolts (131).

    Tighten: Tighten the accumulator cover bolts to 12 N.m (106 lb in).

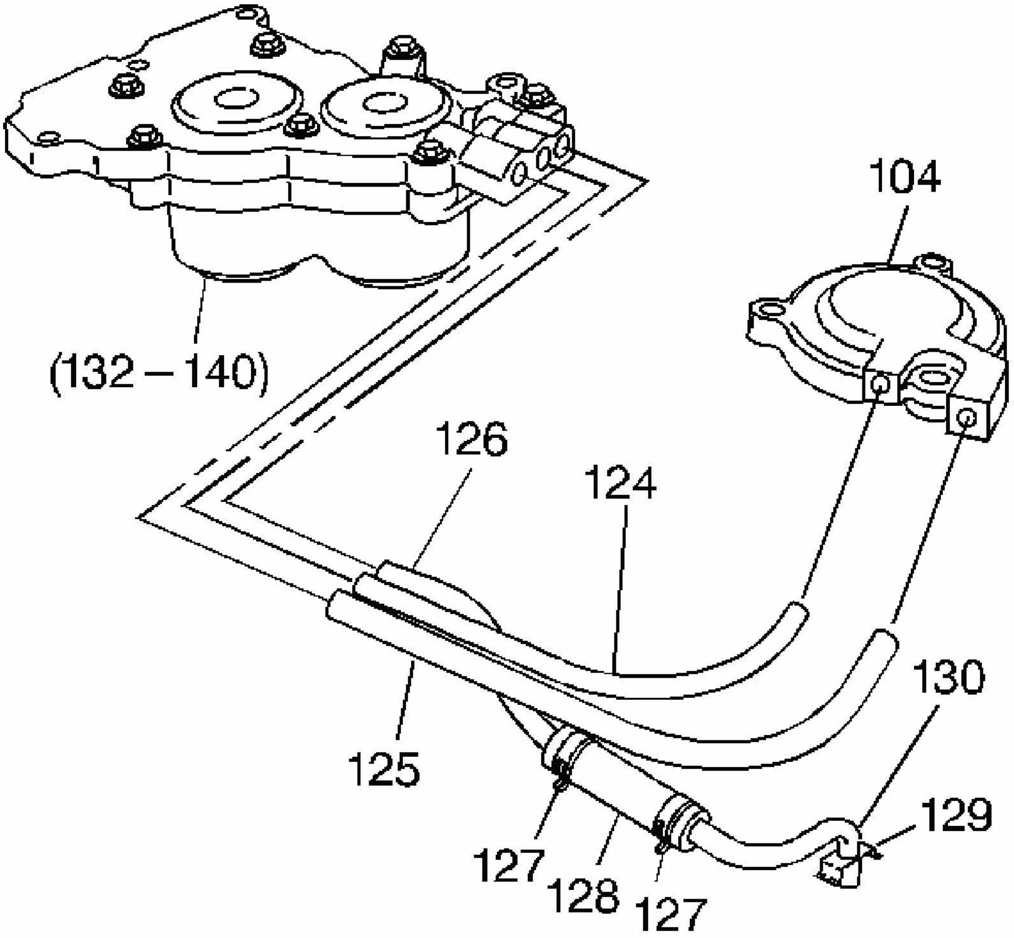


Fig. 376: Connecting 2-1 Manual Band Servo Cover To Accumulator Assembly
Courtesy of GENERAL MOTORS CORP.

12. Assemble the lube oil pipe (126), hose (128), hose clamps (127), pipe retainer (129) and pipe with washer (130).
13. Assemble the 2-1 manual band servo and forward band servo oil pipes (124, 125) into the accumulator assembly (132-140).
14. Assemble the 2-1 manual band servo and forward band servo oil pipes (124, 125) into the 2-1 manual band servo cover (104).
15. Install the lube oil pipe assembly (126-130) into the accumulator assembly (132-140).

ACCUMULATOR ASSEMBLY, 2-1 BAND SERVO ASSEMBLE

Assembly Procedure

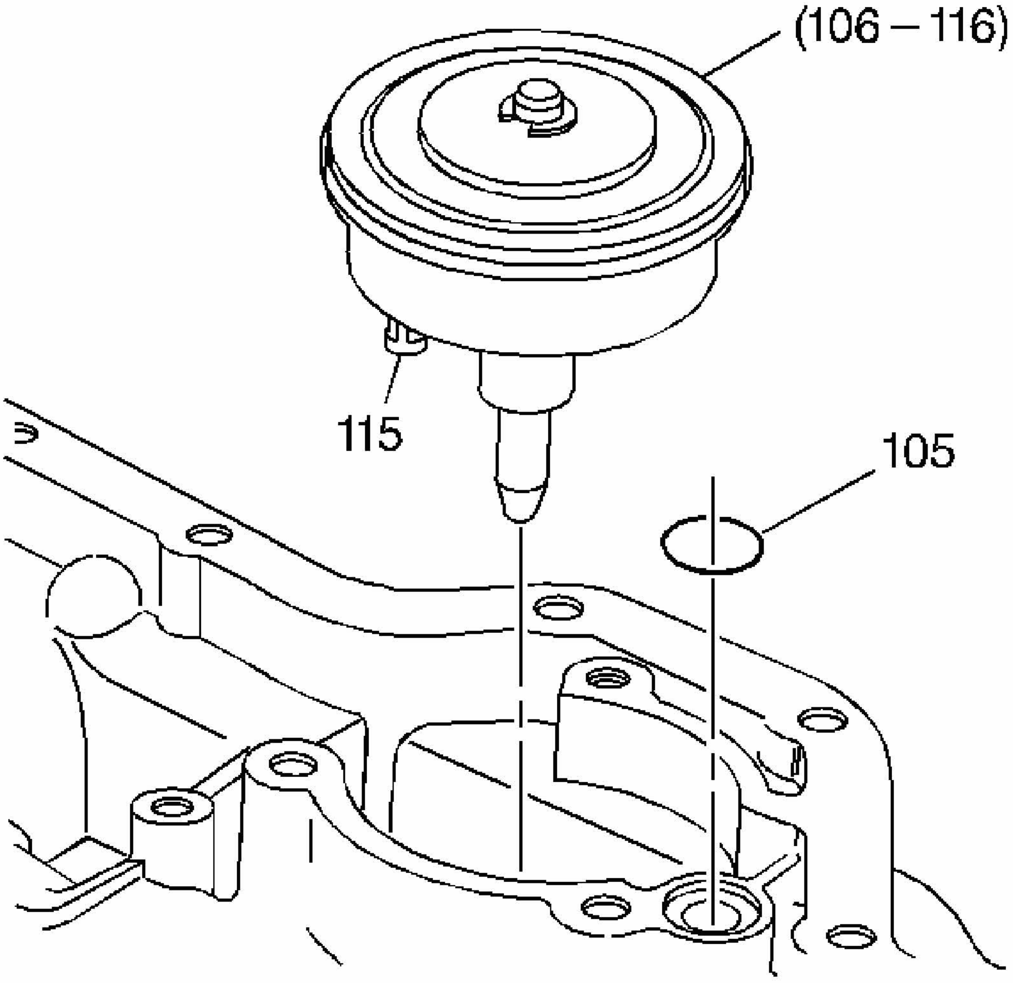


Fig. 377: Identifying 2-1 Manual Band Servo Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the 2-1 manual band servo cover seal (105) into the case. Lubricate the 2-1 manual band servo cover seal (105) with automatic transmission fluid.

NOTE: Do not damage the 2-1 manual band servo exhaust screen on installation.

2. Install the 2-1 manual band servo assembly (106-116) into the case. Make sure that the 2-1 manual band servo pin engages the 2-1 manual band assembly.

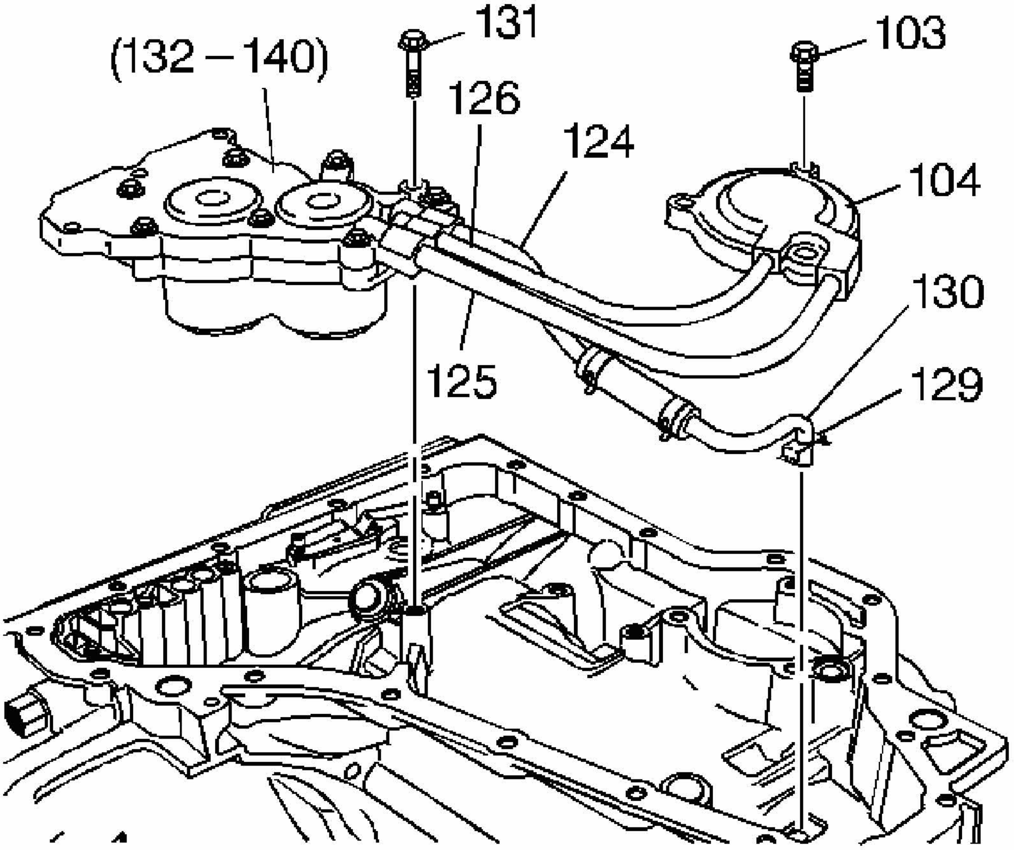


Fig. 378: Installing Accumulator And 2-1 Manual Band Servo Cover Assembly
Courtesy of GENERAL MOTORS CORP.

3. Install the accumulator (132-140) and 2-1 manual band servo cover assembly (104) into the case.
4. Install the lube oil pipe and washer assembly (130) through the case and into the lube hole in the differential carrier internal gear.
5. Use a screwdriver in order to lock the lube oil pipe retainer (129) into the case.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

6. Install the three 2-1 manual band servo cover bolts (103).

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

7. Install the four accumulator cover bolts (131).

Tighten: Tighten the bolts to 12 N.m (106 lb in).

OIL PAN AND FILTER ASSEMBLE

Assembly Procedure

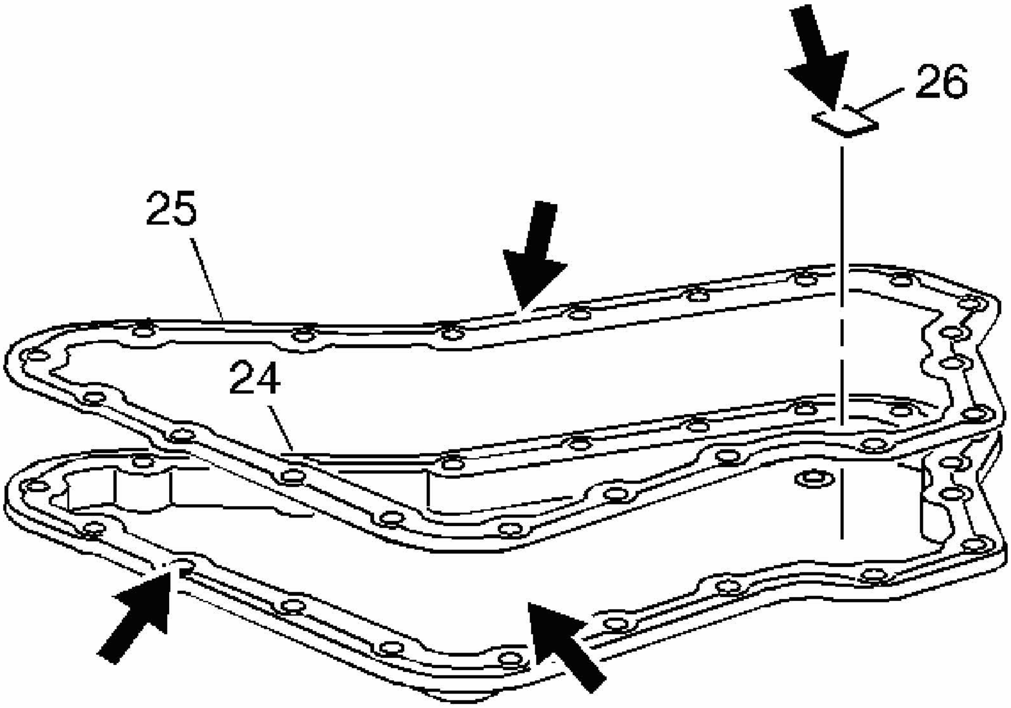


Fig. 379: Oil Pan Gasket
Courtesy of GENERAL MOTORS CORP.

1. Inspect the oil pan (24) for the following conditions:
   - A damaged sealing surface
   - A dented or cracked bottom surface
2. Inspect the oil pan gasket (25) for the following conditions:
   - A bent or damaged seal core
   - A damaged rubber seal surface
   - A damaged gasket
3. Inspect the oil pan magnet (26) for damage or misalignment
4. Clean the oil pan (24), the oil pan gasket (25) and the oil pan magnet (26) in order to remove any sediment.

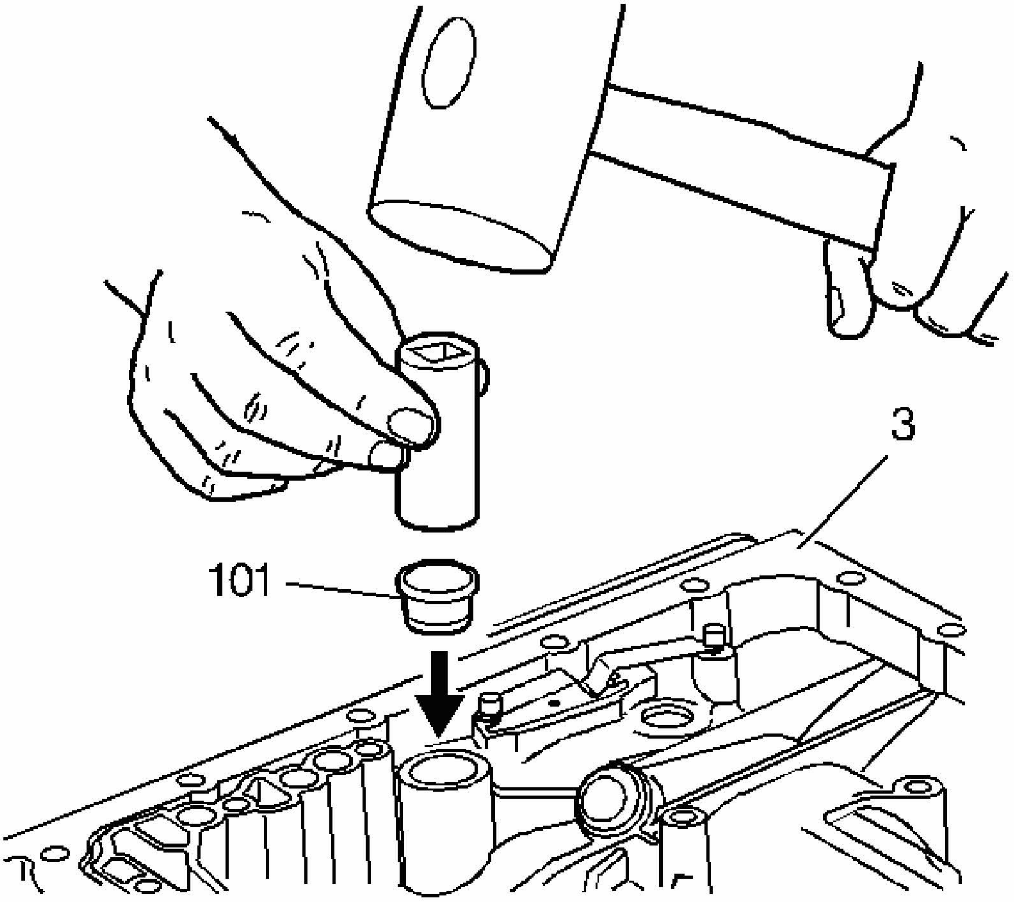


Fig. 380: Installing Oil Filter Seal Assembly
Courtesy of GENERAL MOTORS CORP.

5. Position the transmission so that the oil pan sealing surface is facing upward.
6. Lubricate the oil filter seal assembly (101) with transmission fluid.
7. Using a socket and a plastic mallet, gently tap the oil filter seal assembly (101) into the case (3).

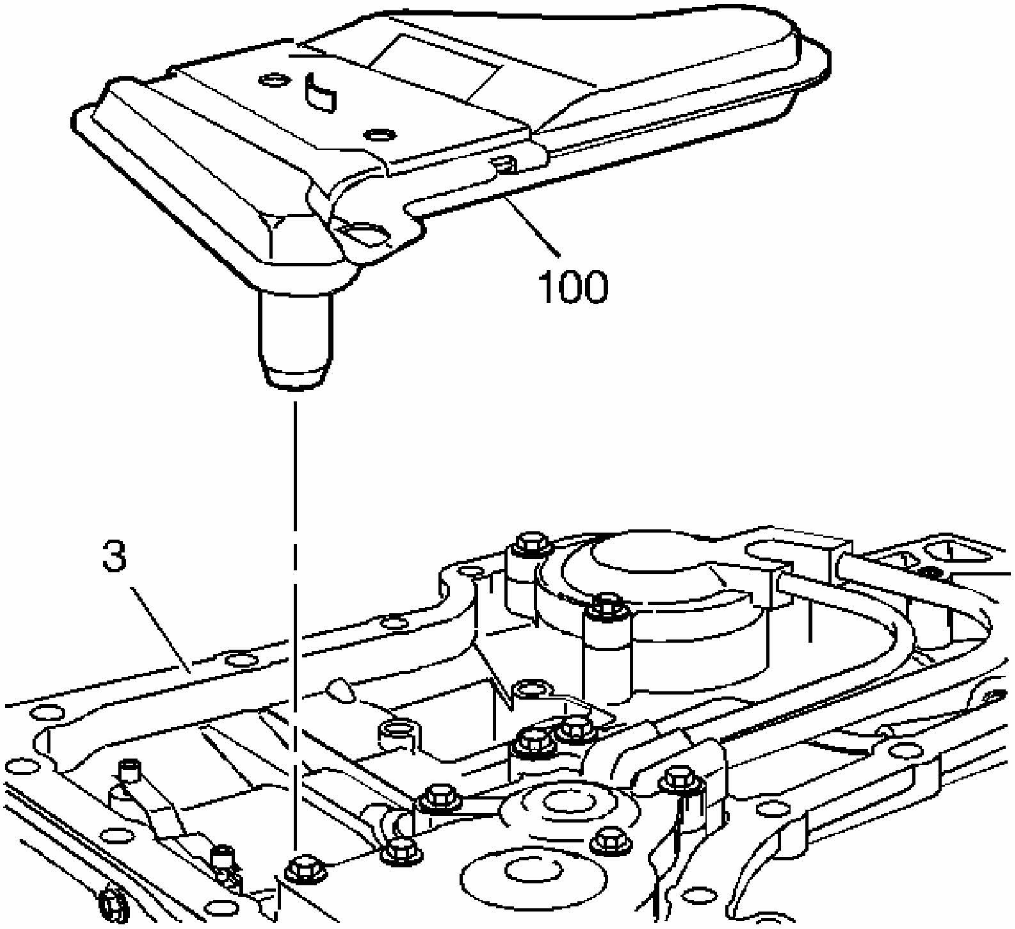


Fig. 381: Identifying Oil Filter Assembly
Courtesy of GENERAL MOTORS CORP.

8. Install the oil filter assembly (100) into the case (3).

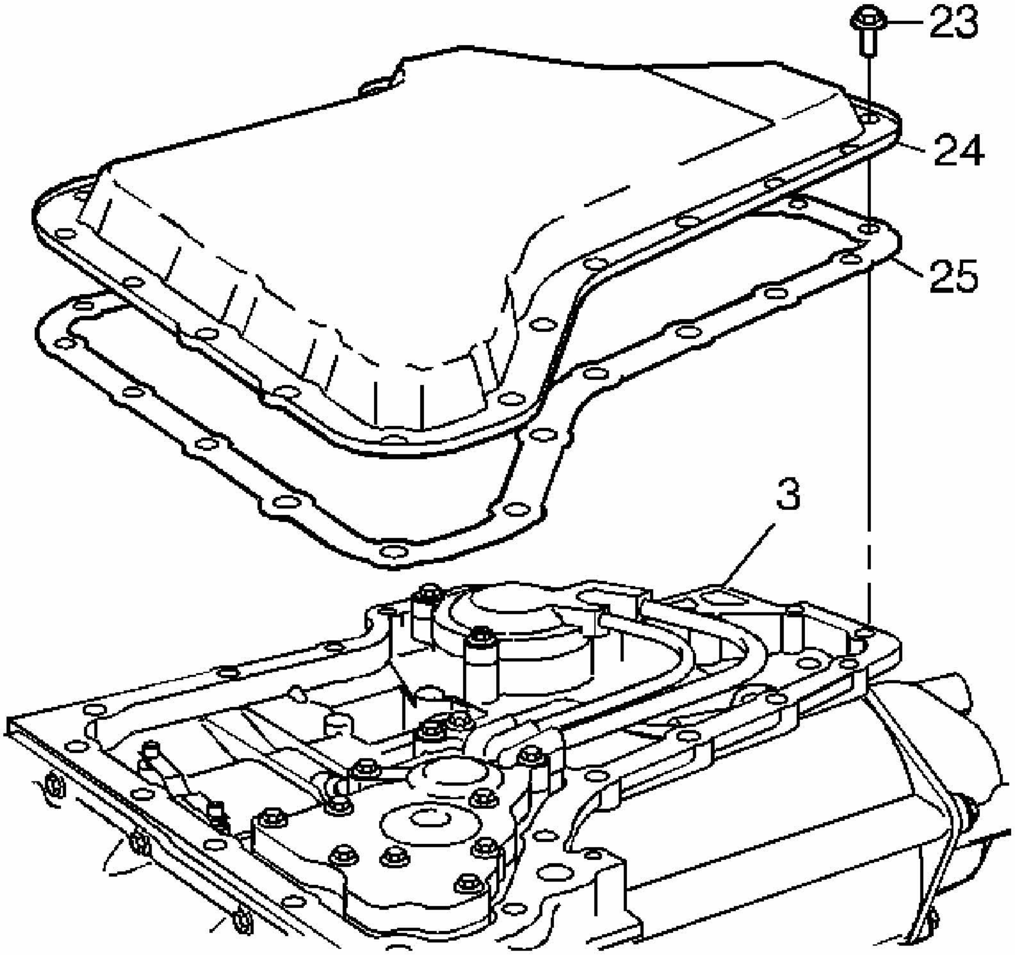


Fig. 382: Locating Oil Pan & Gasket
Courtesy of GENERAL MOTORS CORP.

9. Install the oil pan gasket (25) onto the case (3). The old gasket is reusable if the gasket is not damaged.
10. Install the oil pan (24) onto the case (3).

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

11. Install the 20 oil pan bolts (23).

Tighten: Tighten the bolts to 14 N.m (10 lb ft).

FORWARD BAND SERVO COMPONENTS DISASSEMBLE

Disassembly Procedure

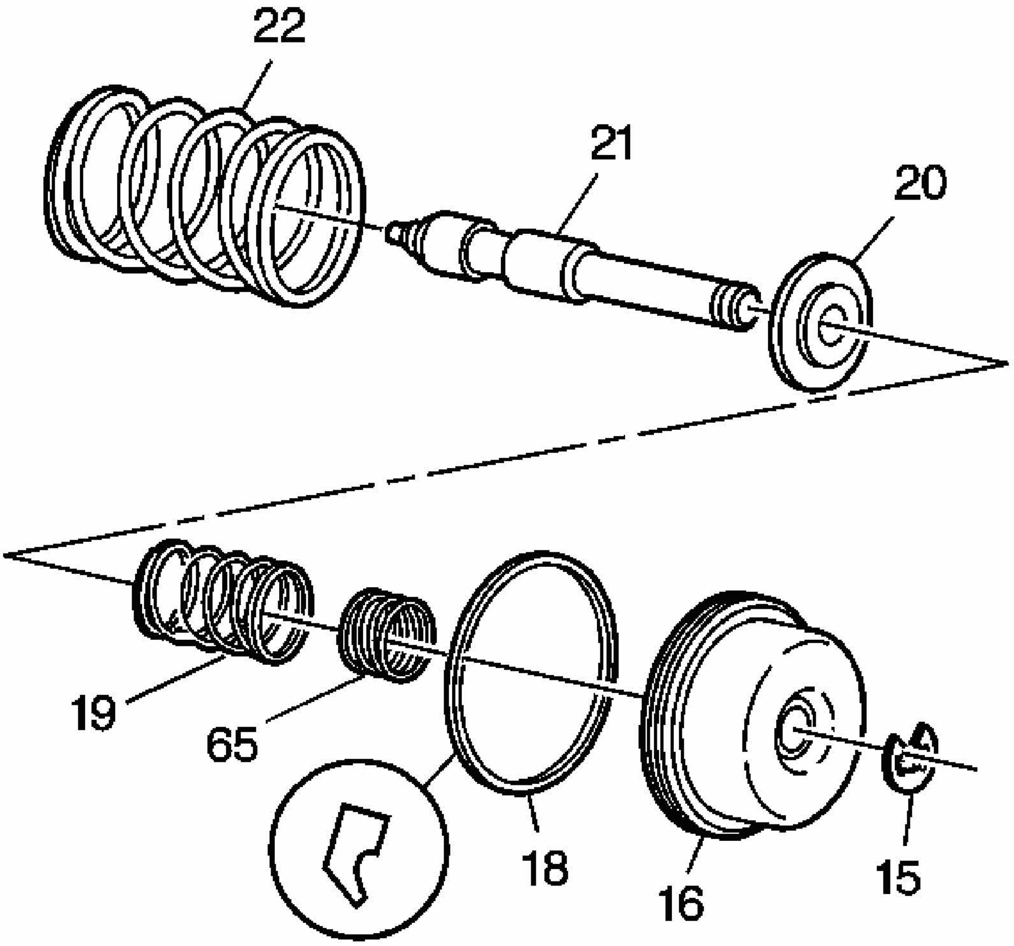


Fig. 383: Identifying Servo Piston & Components
Courtesy of GENERAL MOTORS CORP.

1. Disassemble the servo piston return spring (22) from the forward band servo assembly.
2. Remove the servo piston oil seal ring (18) from the servo piston (16).
3. Using a small screwdriver, remove the servo pin retaining ring (15) from the servo piston apply pin (21).
4. Disassemble the servo piston (16), the servo piston cushion inner spring (65), the servo piston cushion outer spring (19), the servo cushion spring retainer (20) and the servo piston apply pin (21).

FORWARD BAND SERVO ASSEMBLE

Assembly Procedure

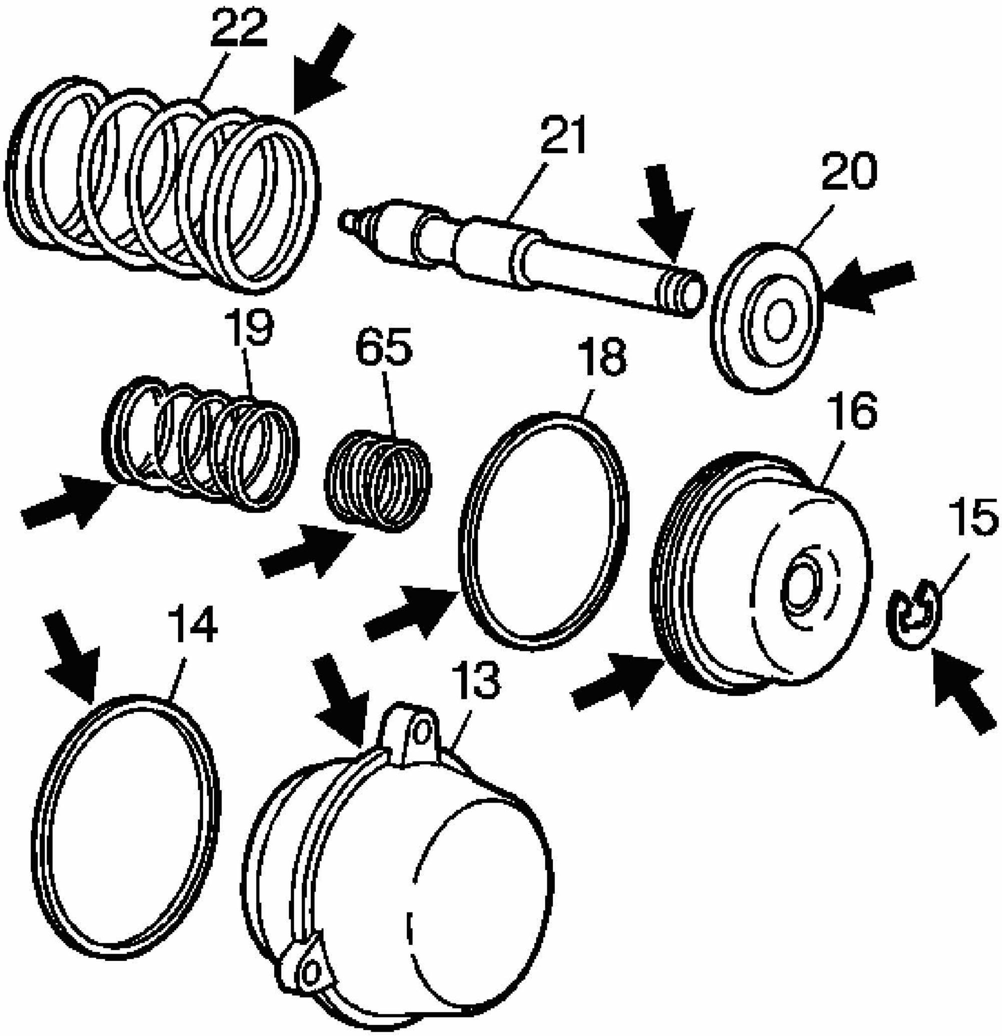


Fig. 384: Inspection Areas On Forward Band Servo
Courtesy of GENERAL MOTORS CORP.

1. Inspect the forward band servo components for the following conditions:
    - Damaged, worn or porous servo piston (16)
    - Damaged servo piston oil seal ring (18)
    - Damaged, worn or porous servo cover (13)
    - Damaged servo cover seal (14)
    - Broken or collapsed servo piston return spring (22)
    - Broken or collapsed servo piston cushion inner spring (65)
    - Broken or collapsed servo piston cushion outer spring (19)

- Damaged or worn servo piston apply pin (21)

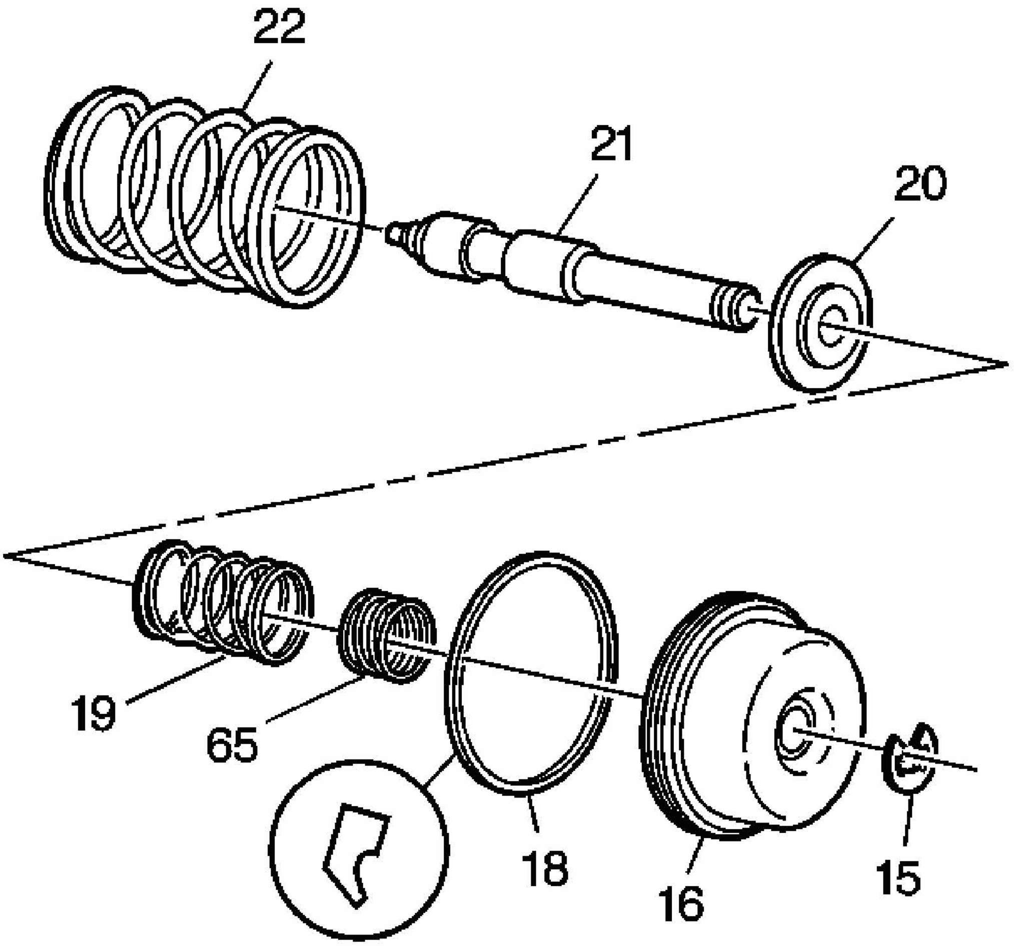


Fig. 385: Identifying Servo Piston & Components
Courtesy of GENERAL MOTORS CORP.

2. Assemble the servo piston (16), the servo piston cushion outer spring (19), the servo piston cushion inner spring (65), the servo cushion spring retainer (20) and the servo piston apply pin (21).
3. Install the servo pin retaining ring (15) onto the servo piston apply pin (21).
4. Install the servo piston oil seal ring (18) onto the servo piston (16).
5. Assemble the servo piston return spring (22) onto the servo assembly.

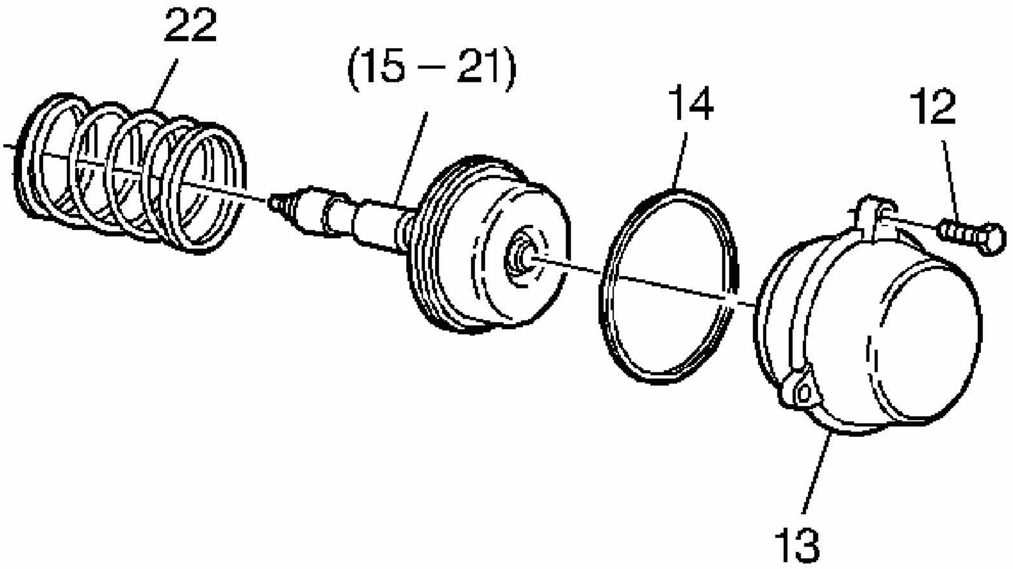


Fig. 386: View Of Servo Assembly
Courtesy of GENERAL MOTORS CORP.

6. Position the transmission so that the oil pan is facing up.
7. Install the servo cover seal (14) onto the servo cover (13).
8. Assemble the servo assembly (15-22) into the servo cover (13). Pivot the servo assembly (15-22) into the servo cover (13) in order to prevent the piston oil seal ring from being damaged.
9. Install the servo and cover assembly (13-22) into the case.

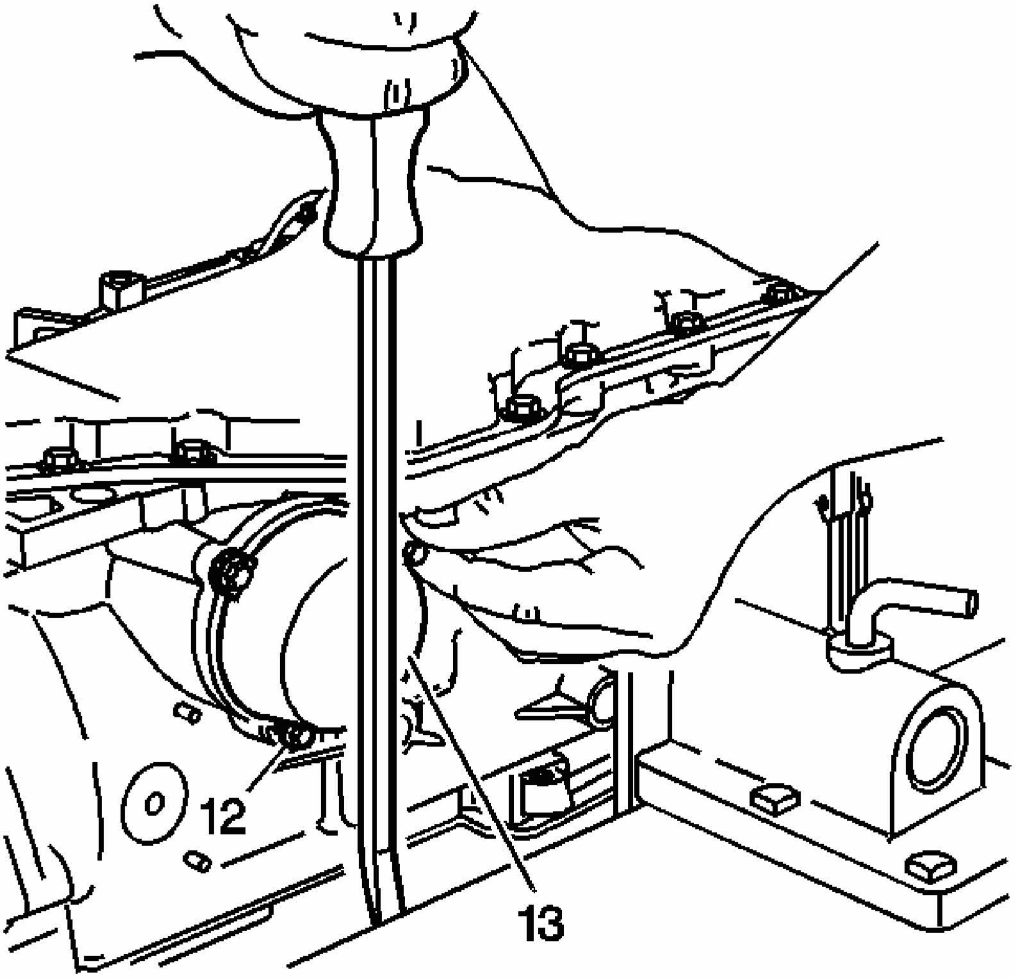


Fig. 387: Compressing Forward Band Servo Assembly
Courtesy of GENERAL MOTORS CORP.

10. Using a long screwdriver, pry against the work bench in order to compress the forward band servo assembly (13).
11. Hold the servo assembly compressed.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

12. Install the 3 forward band servo cover bolts (12).

Tighten: Tighten the bolts to 12 N.m (106 lb in).

13. Remove the long screwdriver.

REVERSE BAND SERVO COMPONENTS DISASSEMBLE

Disassembly Procedure

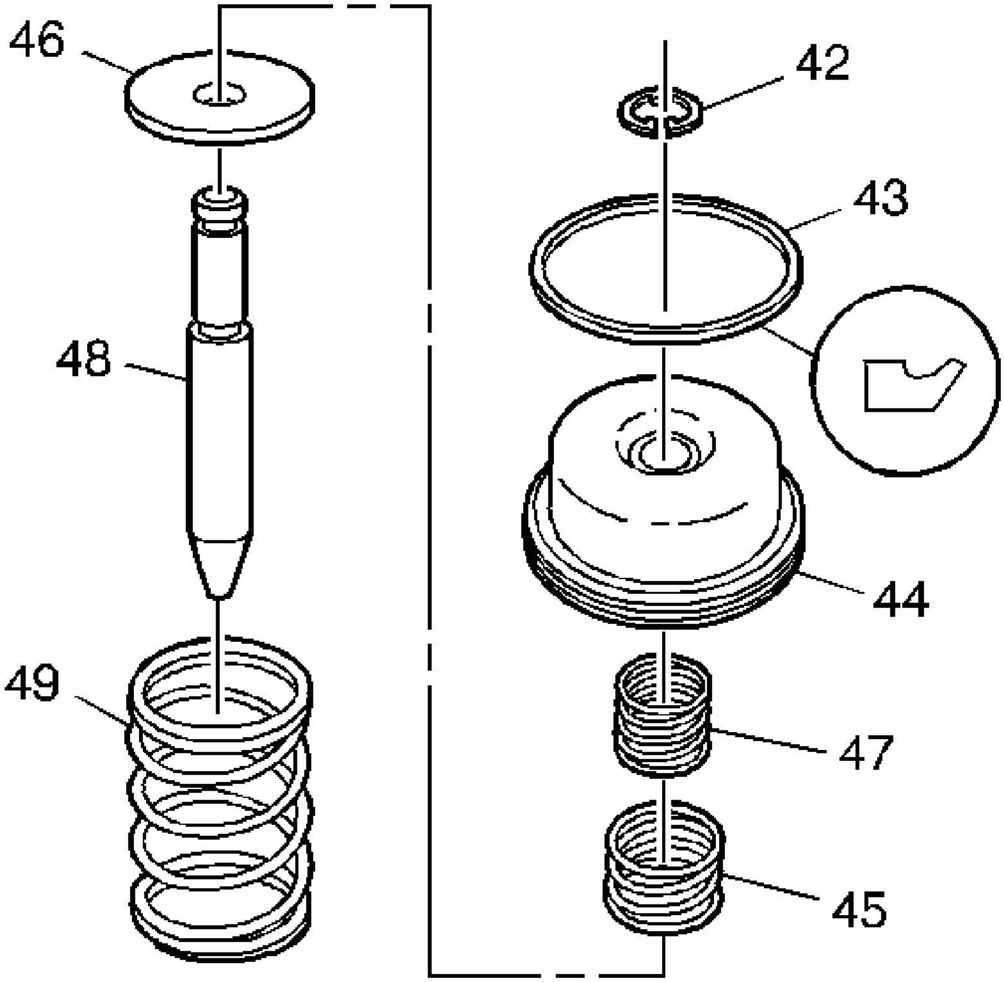


Fig. 388: View Of Reverse Band Servo Assembly Components
Courtesy of GENERAL MOTORS CORP.

1. Disassemble the reverse band servo piston return spring (49) from the reverse band servo assembly.
2. Remove the servo piston oil seal ring (43) from the servo piston (44).
3. Using a small screwdriver, remove the servo pin retaining ring (42) from the servo piston apply pin (48).

4. Disassemble the servo piston (44), the servo piston cushion springs (45, 47), the servo piston cushion spring retainer (46) and servo piston apply pin (48).

REVERSE BAND SERVO ASSEMBLE

Assembly Procedure

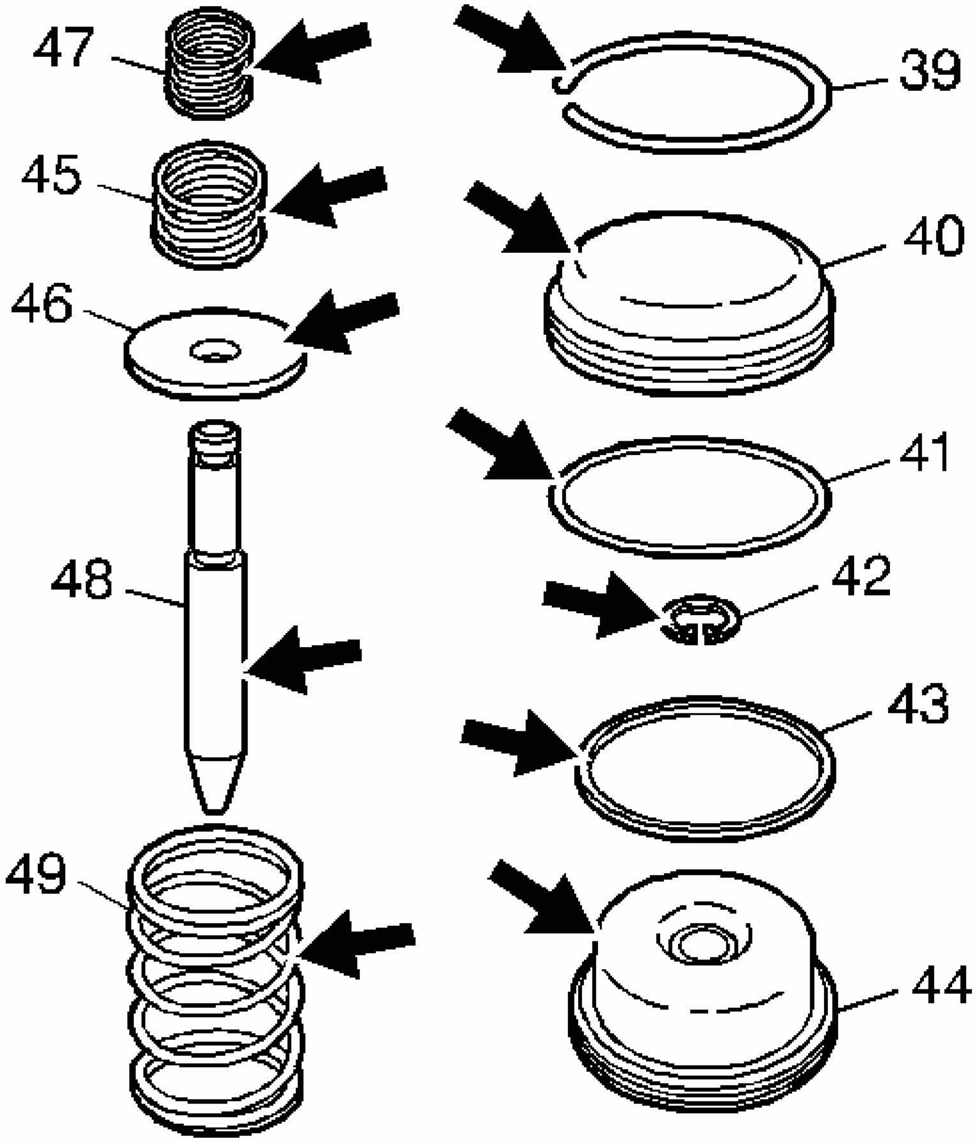


Fig. 389: Inspection Areas On Reverse Band Servo
Courtesy of GENERAL MOTORS CORP.

1. Inspect the reverse band servo components for the following conditions:
    - Damaged, worn or porous servo piston (44)
    - Damaged servo piston oil seal ring (43)
    - Damaged, worn or porous servo cover (40)
    - Damaged servo cover O-ring seal (41)
    - Damaged servo cover retaining ring (39)
    - Broken or collapsed servo piston return spring (49)
    - Broken or collapsed servo piston cushion springs (45, 47)
    - Damaged or worn servo piston apply pin (48)

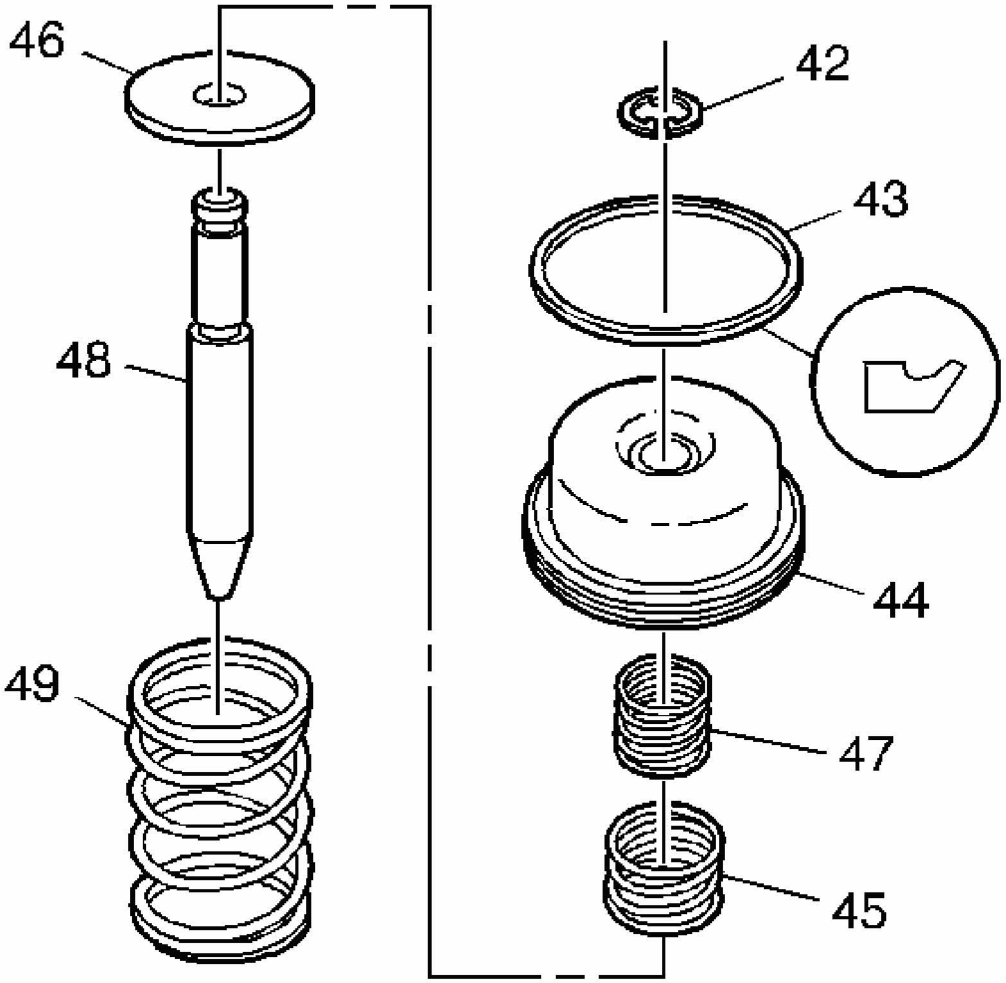


Fig. 390: View Of Reverse Band Servo Assembly Components
Courtesy of GENERAL MOTORS CORP.

2. Assemble the servo piston (44), the servo piston cushion springs (45, 47), the servo piston cushion spring retainer (46) and the servo piston apply pin (48).
3. Install the servo pin retaining ring (42) onto the servo piston apply pin (48).
4. Install the servo piston oil seal ring (43) onto the servo piston (44).
5. Assemble the servo piston return spring (49) onto the servo assembly.

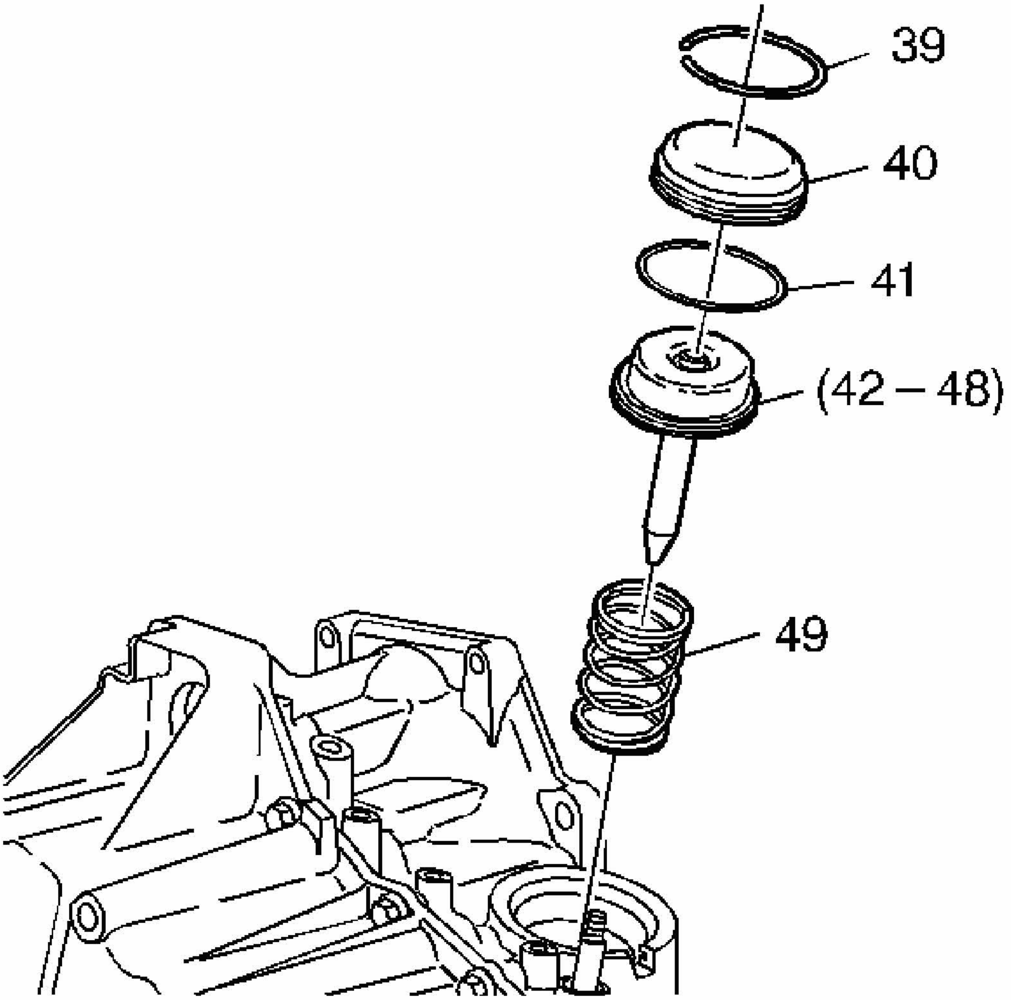


Fig. 391: Identifying Reverse Servo Assembly Components
Courtesy of GENERAL MOTORS CORP.

6. Position the transmission so that the oil pan is facing down.
7. Install the servo cover O-ring seal (41) onto the servo cover (40).
8. Install the servo and cover assembly (40-49) into the case.

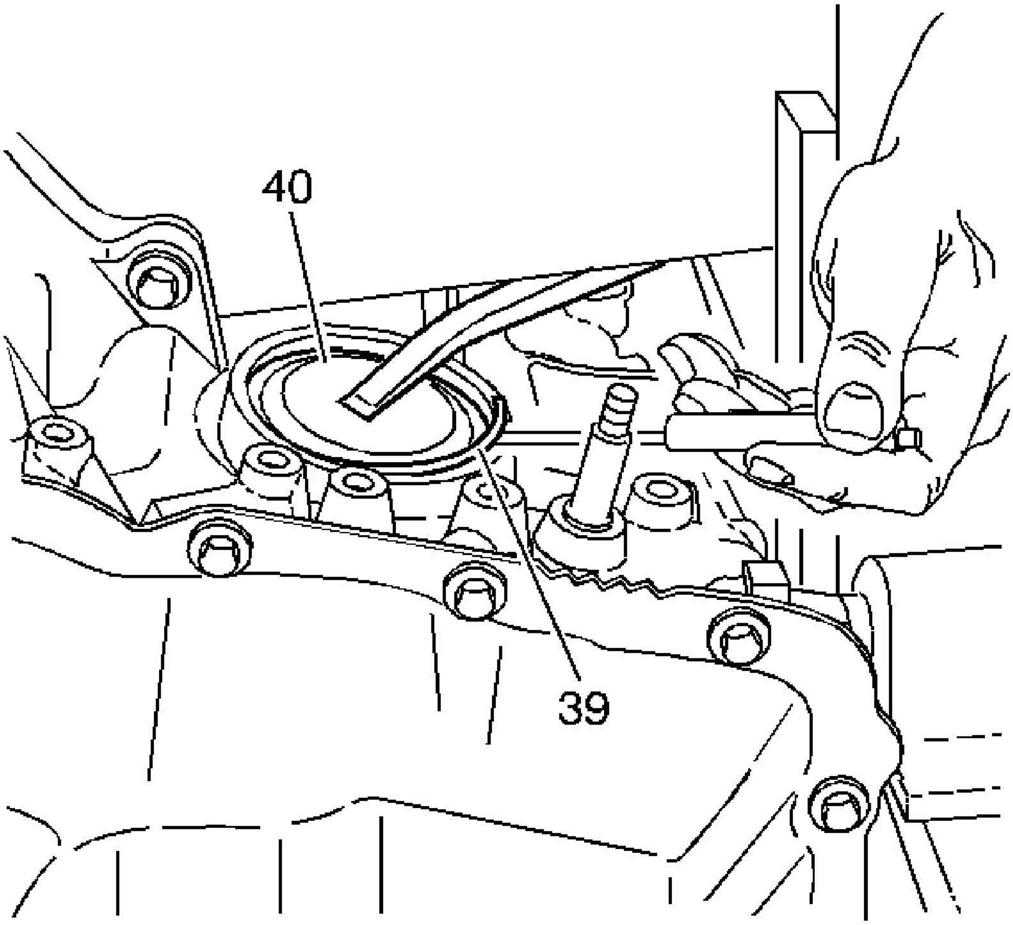


Fig. 392: Removing/Installing Reverse Servo Cover Snap Ring
Courtesy of GENERAL MOTORS CORP.

9. Use a long screwdriver in order to depress the reverse band servo cover (40) by prying against the transmission holding fixture.
10. Hold the reverse band servo assembly compressed.
11. Use a small screwdriver in order to install the reverse band servo cover retaining ring (39).
12. Remove the long screwdriver.

TRANSMISSION TO TRANSFER CASE END PLAY CHECK (F4WD ONLY)

Tools Required

- **J 36850** Assembly Lubricant (or equivalent)
- **J 44472** End Play Checking Tool. See **Special Tools**.

Checking Procedure

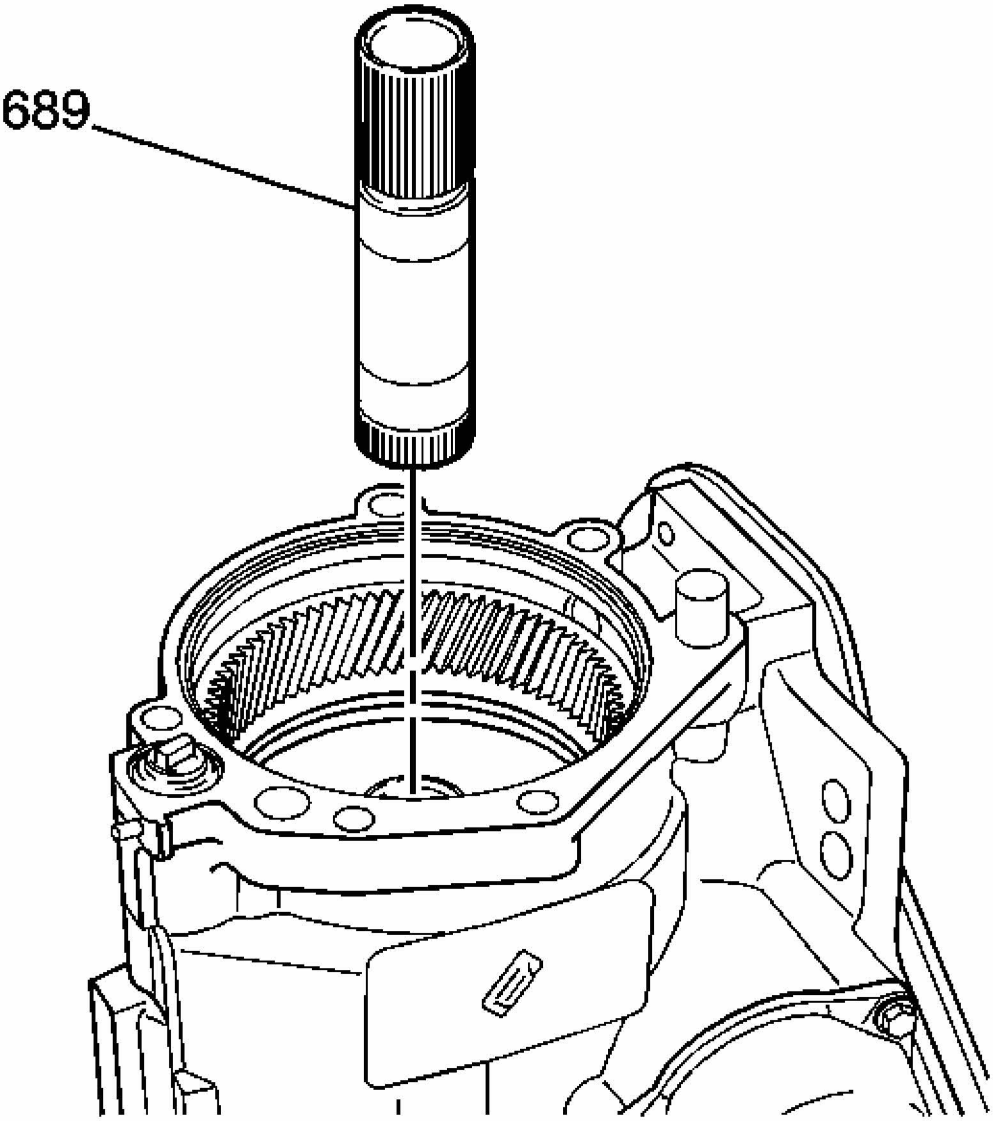


Fig. 393: Identifying Final Drive Sun Gear Shaft
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Transmission oil circulates between the transmission assembly and the transfer case. In situations where transmission related failures circulate debris into the transfer case, the transfer case must be disassembled, cleaned and inspected for damage. Refer to Internal

Components Cleaning and Inspection .

1. Position the transaxle so that the case side cover is facing down.
2. Install the final drive sun gear shaft (689).

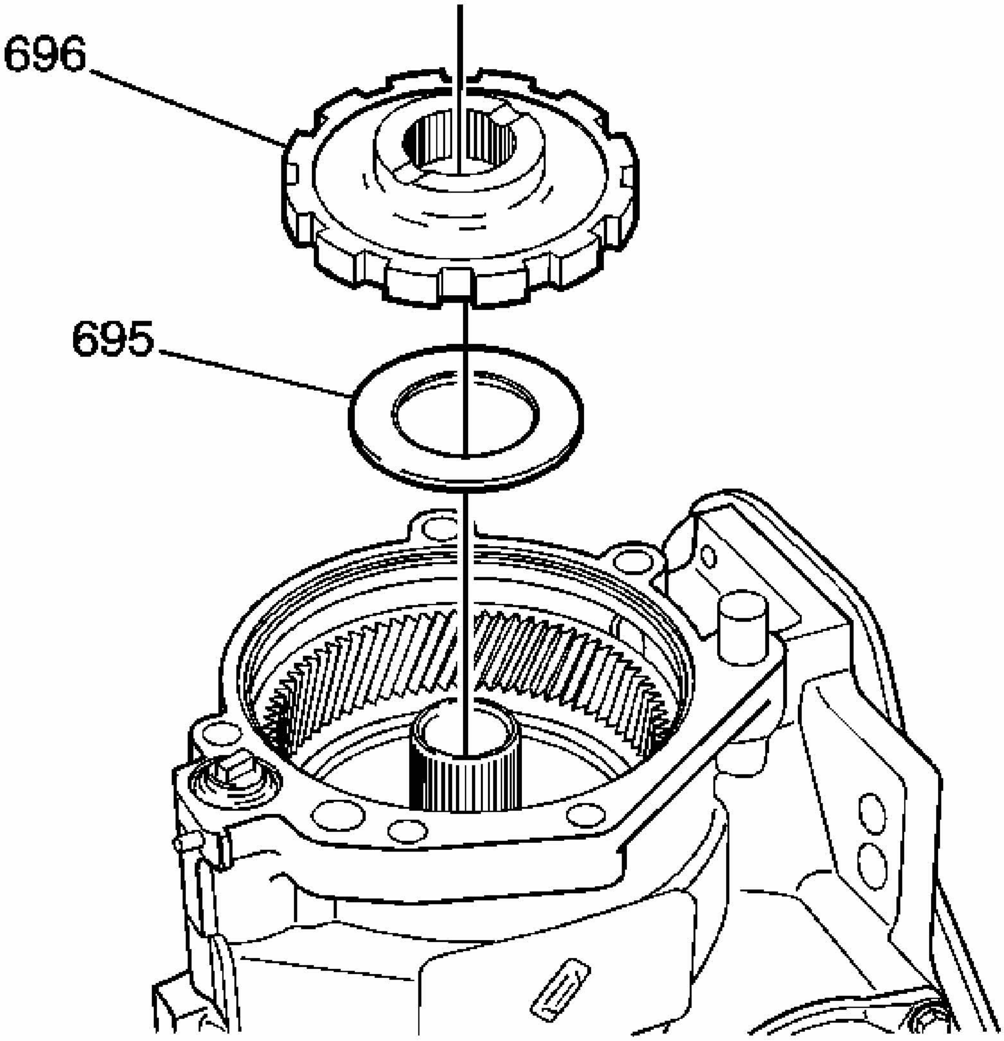


Fig. 394: View Of Park Gear Thrust Bearing & Park Gear
Courtesy of GENERAL MOTORS CORP.

NOTE: **The park gear thrust bearing (695) must be retained in the park gear (696) when installing the transfer case to the transmission or damage may occur.**

3. Use **J 36850** or equivalent in order to retain the parking gear thrust bearing (695) to the parking gear (696).

   Install the parking gear thrust bearing (695) and the parking gear (696).

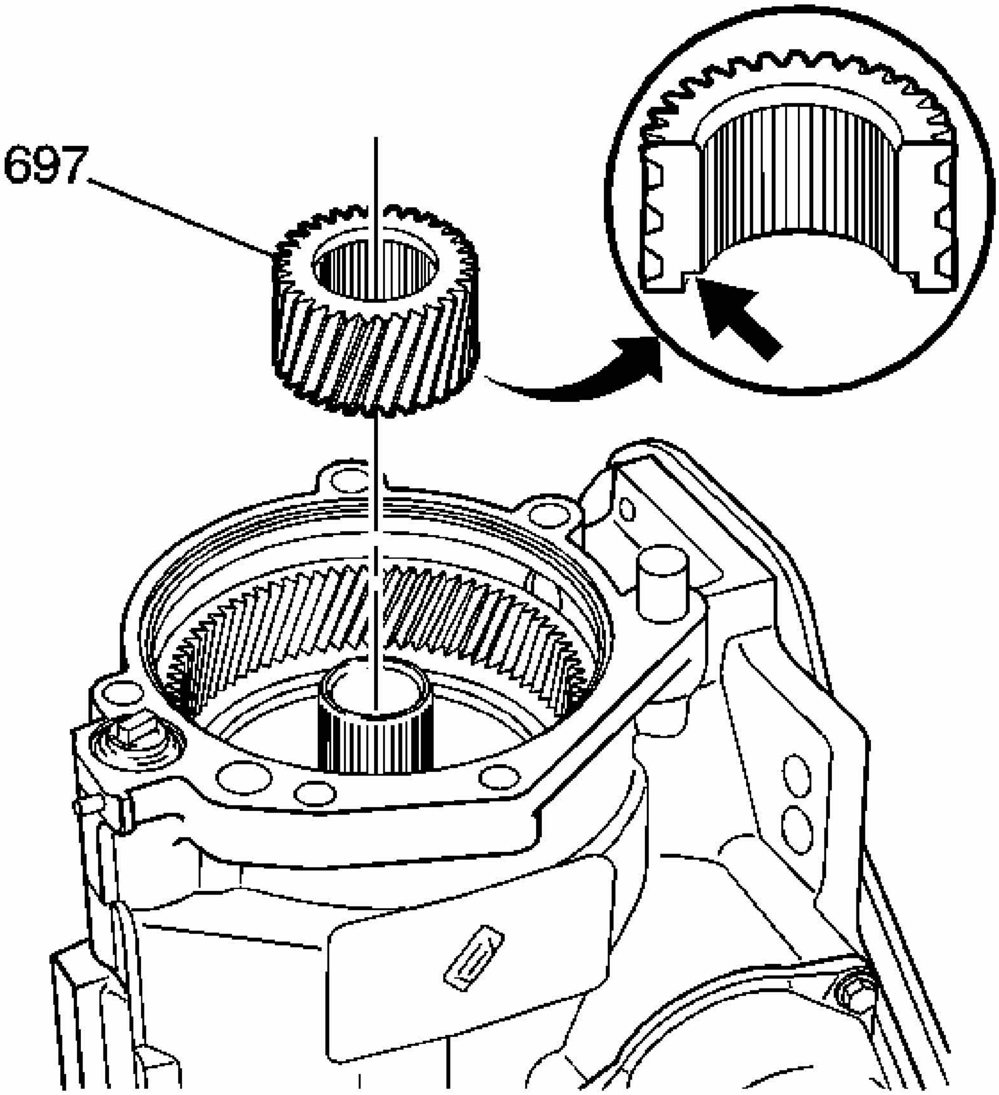


Fig. 395: Identifying Final Drive Sun Gear
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The counterbore on the final drive sun gear installs towards the parking gear.

4. Install the final drive sun gear (697).

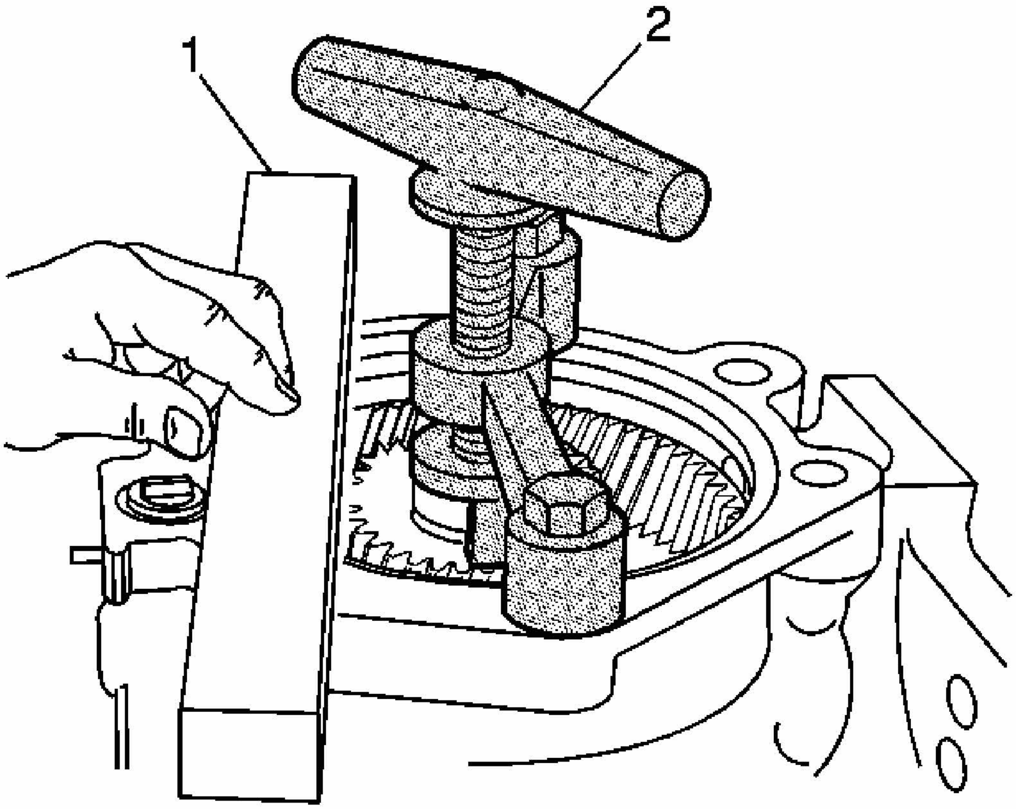


Fig. 396: Installing J 44472 Onto Transmission Case
Courtesy of GENERAL MOTORS CORP.

5. Install the gauge bar (1) onto the case mounting surface.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

IMPORTANT: **Install bolts to J 44472 and tighten securely to prevent tool deflection during end play measurement. See Special Tools.**

6. Install **J 44472** (2) onto the transmission. See **Special Tools**.

Tighten: Tighten **J 44472** to remove end play. See **Special Tools**. Hand tighten only.

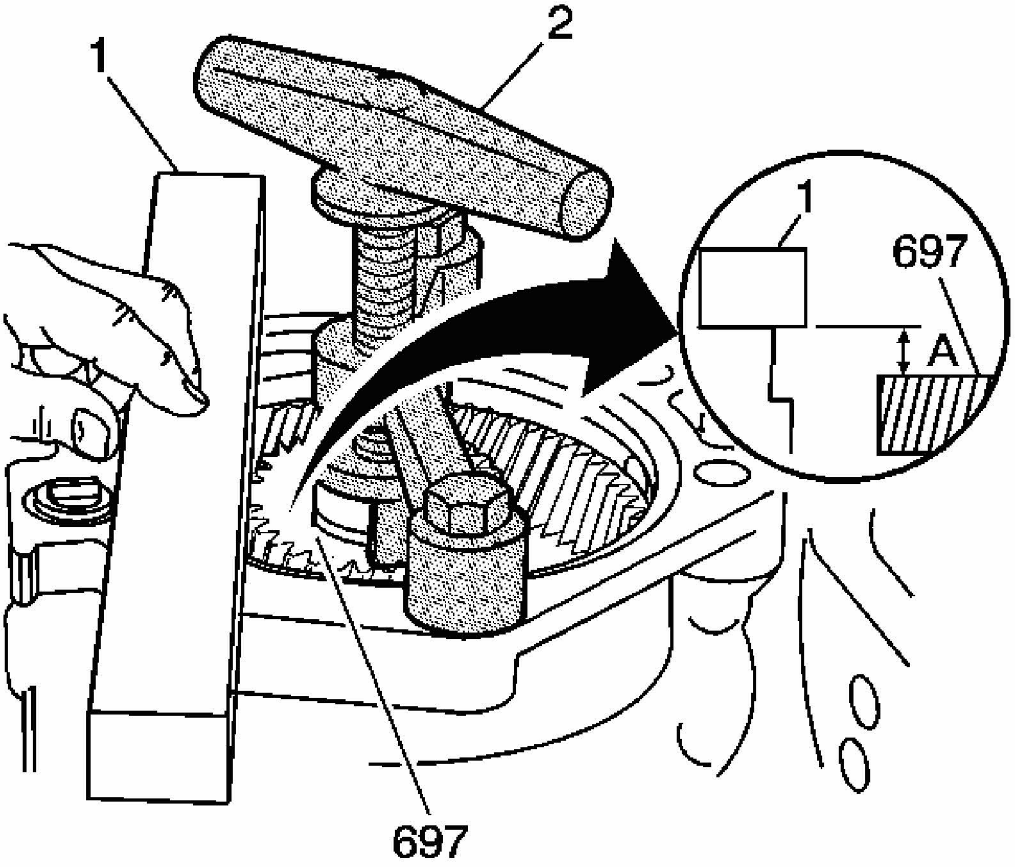


Fig. 397: Measuring Dimension A
Courtesy of GENERAL MOTORS CORP.

7. Measure the distance from the case mounting surface, bottom of the gauge bar (1) to the top of the final drive sun gear (697). This measurement is dimension A, refer to **Transfer Case Selective Washer Specifications**.
8. Remove the gauge bar (1) and **J 44472** (2). See **Special Tools**.

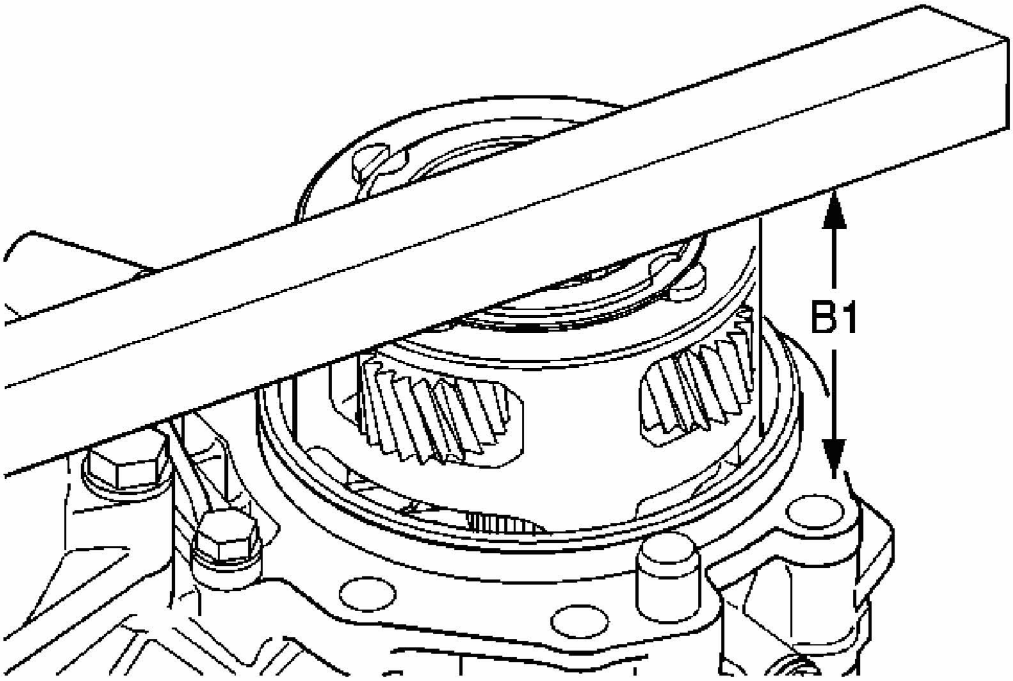


Fig. 398: Identifying Dimension B1
Courtesy of GENERAL MOTORS CORP.

9. Install the gauge bar onto the carrier.
10. Measure the distance from the bottom of the gauge bar to the transfer case. This measurement is Dimension B1.

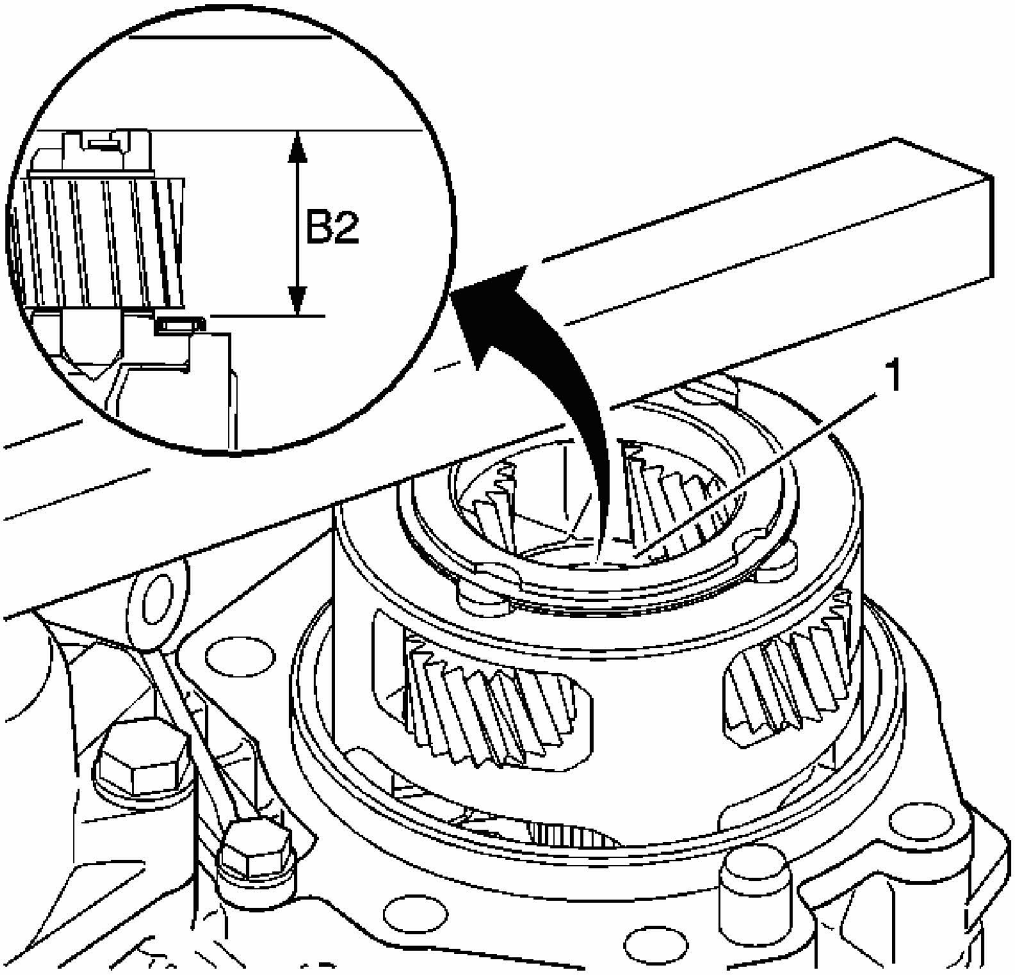


Fig. 399: Measuring Dimension B2
Courtesy of GENERAL MOTORS CORP.

11. Measure the distance from the bottom of the gauge bar to the thrust bearing (1). This measurement is Dimension B2.
12. Subtract Dimension B2 from Dimension B1. This Dimension is B. Refer to **Transfer Case Selective Washer Specifications**.
13. Remove the gauge bar from the transfer case.

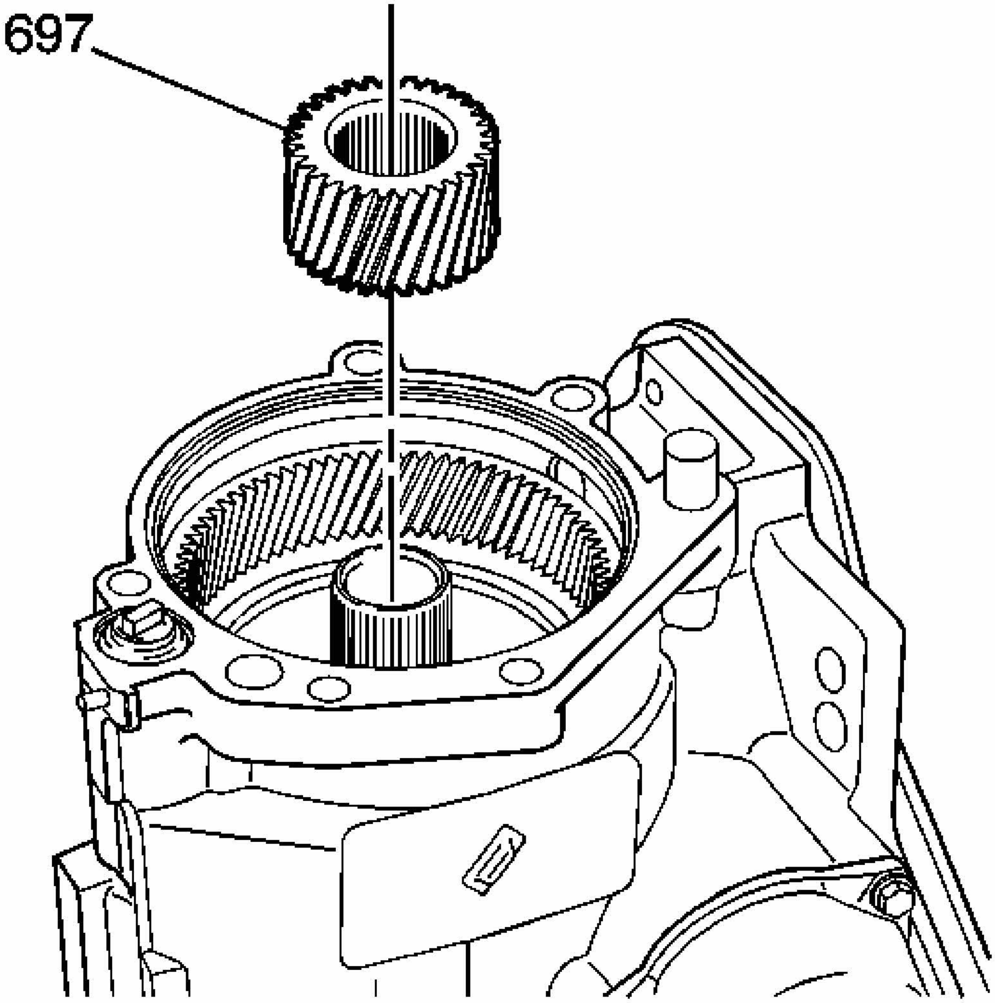


Fig. 400: Locating Final Drive Sun Gear
Courtesy of GENERAL MOTORS CORP.

14. Remove the final drive sun gear (697).

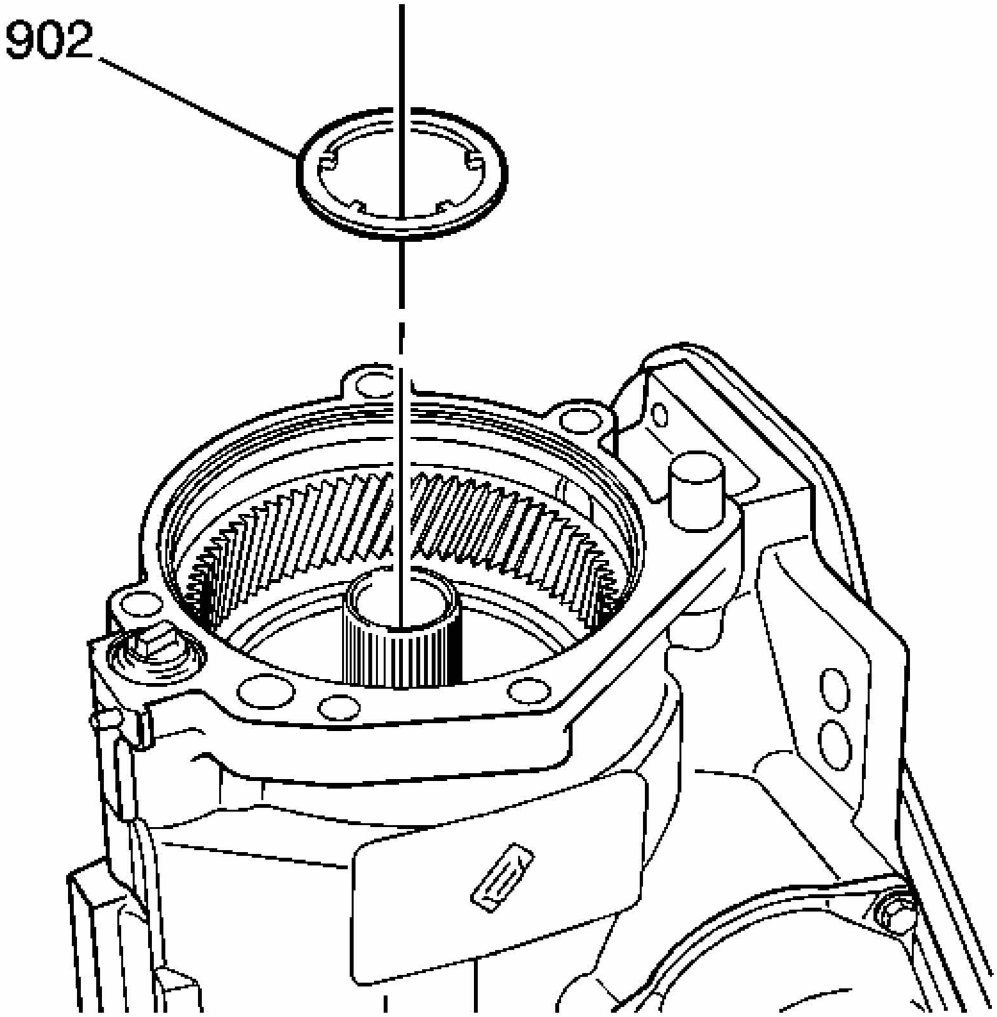


Fig. 401: View Of Selective Washer
Courtesy of GENERAL MOTORS CORP.

15. Refer to **Transfer Case Selective Washer Specifications**.

    Install the selective washer (902).

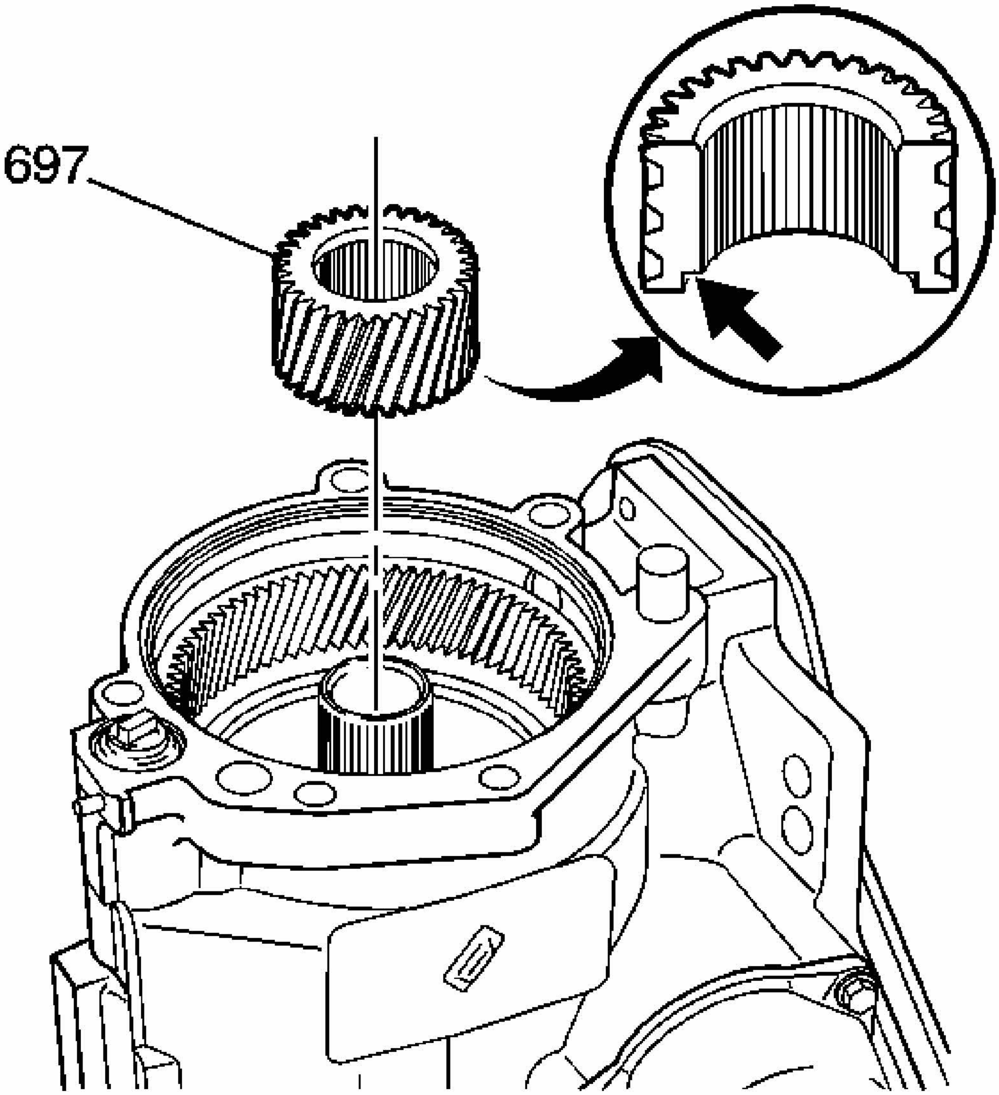


Fig. 402: Identifying Final Drive Sun Gear
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The counterbore on the final drive sun gear installs towards the parking gear.

16. Install the final drive sun gear (697).

TRANSFER CASE INSTALLATION

Tools Required

J 36850 Assembly Lubricant (or equivalent)

Installation Procedure

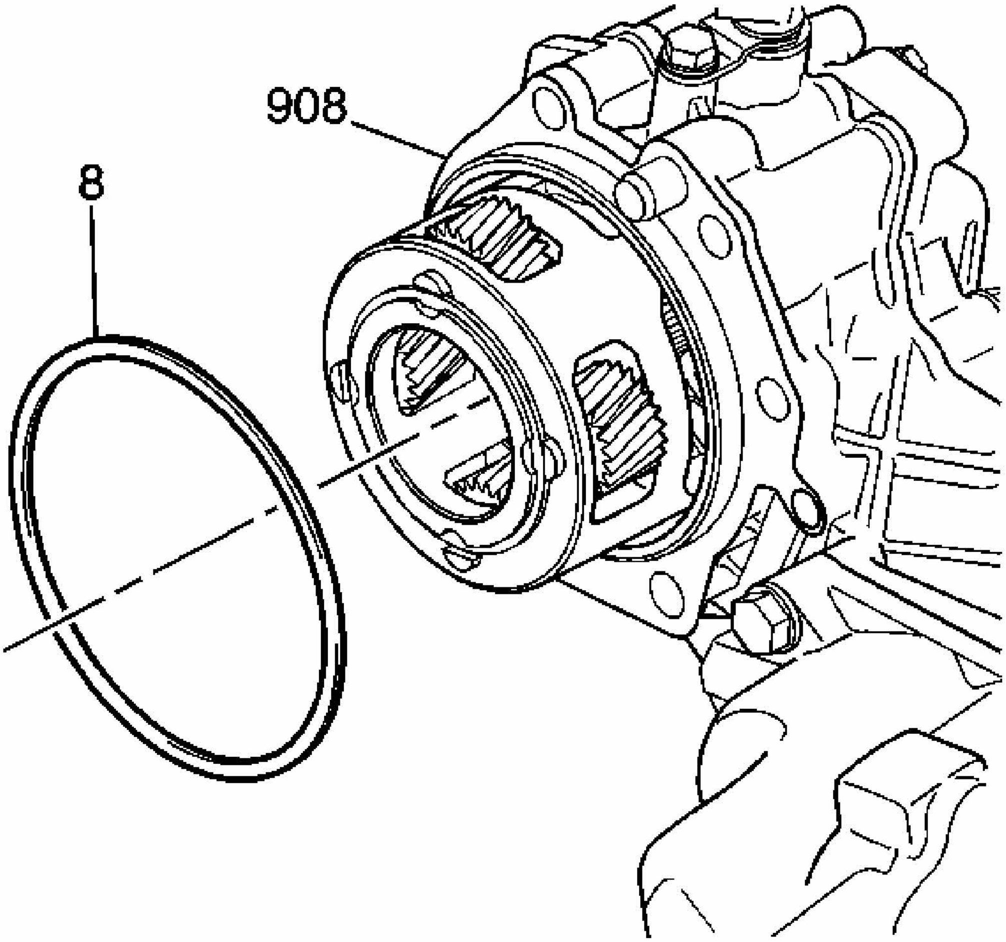


Fig. 403: View Of Case Extension Seal
Courtesy of GENERAL MOTORS CORP.

1. Install the case extension seal (8) using **J 36850** in order to retain.

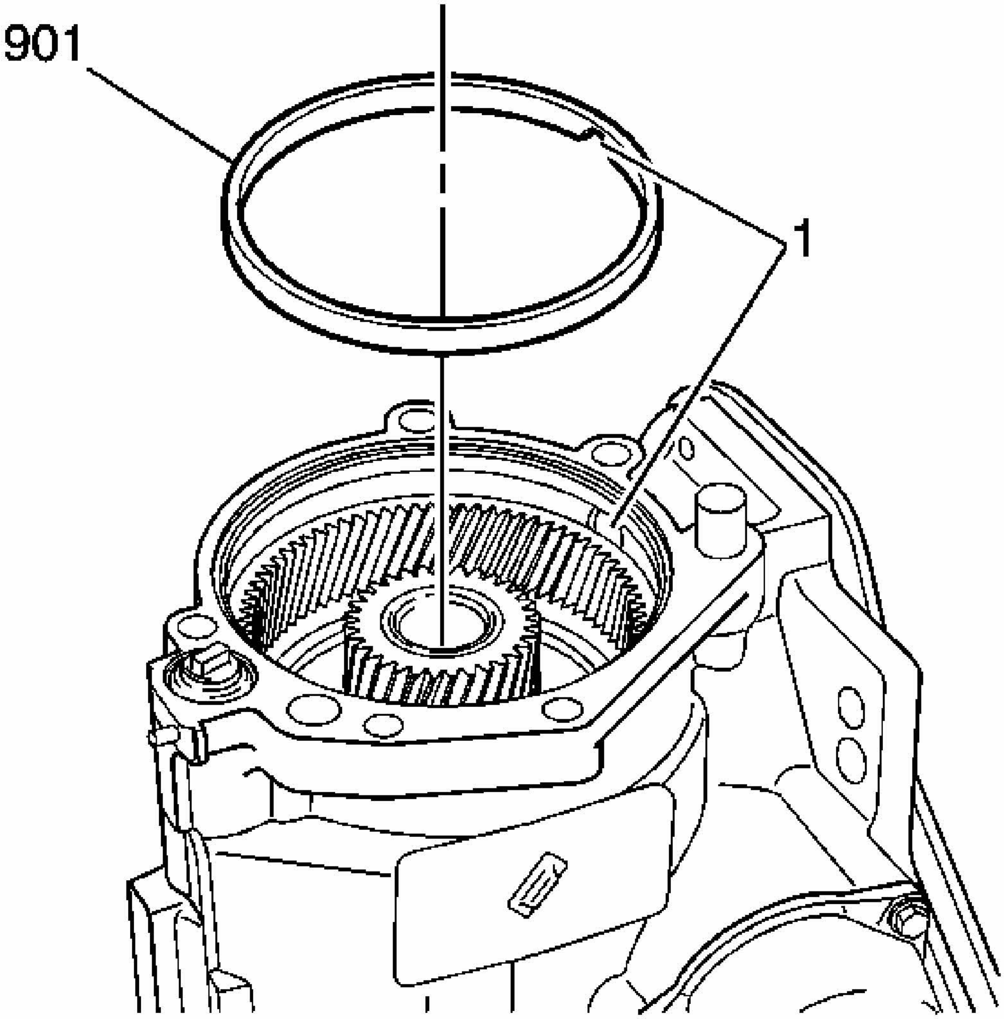


Fig. 404: Identifying Oil Dam
Courtesy of GENERAL MOTORS CORP.

NOTE: **The oil dam must be installed with the oil passage notch aligned to the passage in the case. Incorrect alignment will cause oil flow stoppage and damage to the transmission.**

2. Line up the notch (1) to the hole in the case and install the oil dam (901).

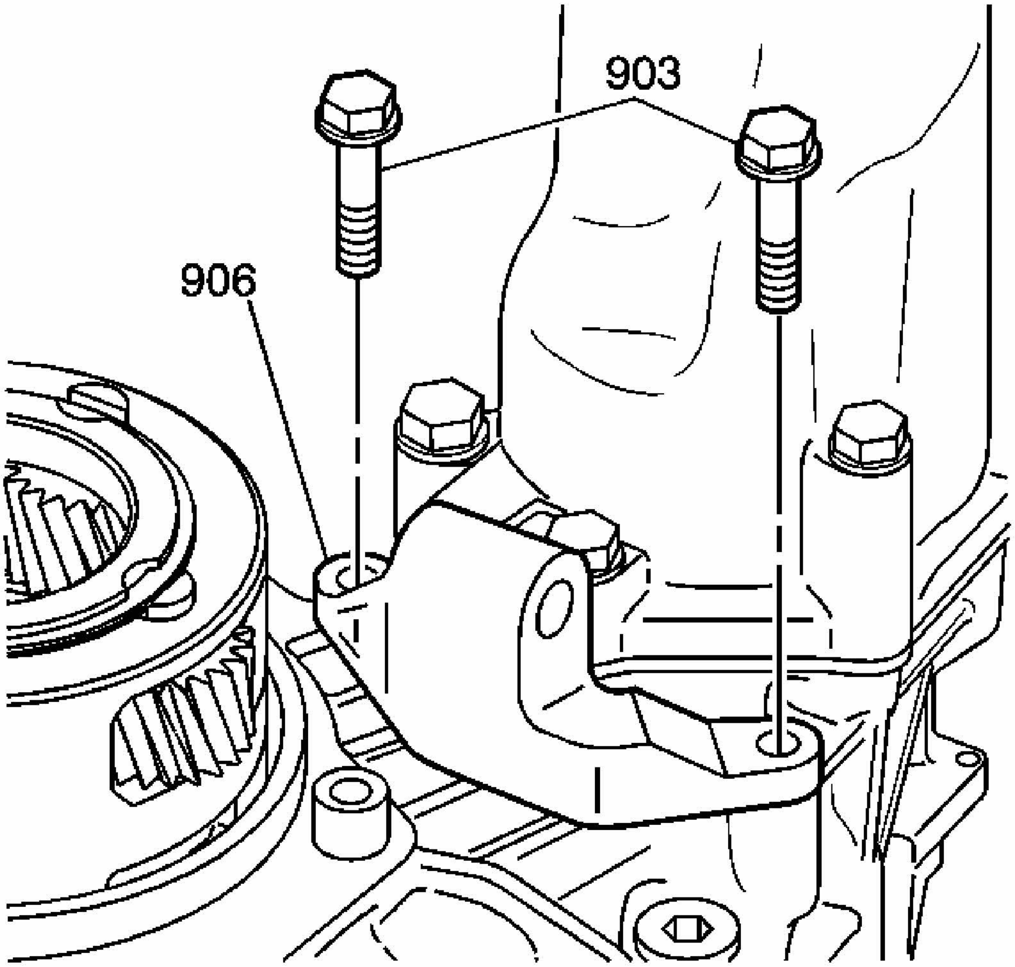


Fig. 405: View Of Transfer Case Lower Brace Bolts & Brace
Courtesy of GENERAL MOTORS CORP.

3. Install the transfer case lower brace (906).
4. Install the transfer case lower brace bolts (903). Hand tighten.

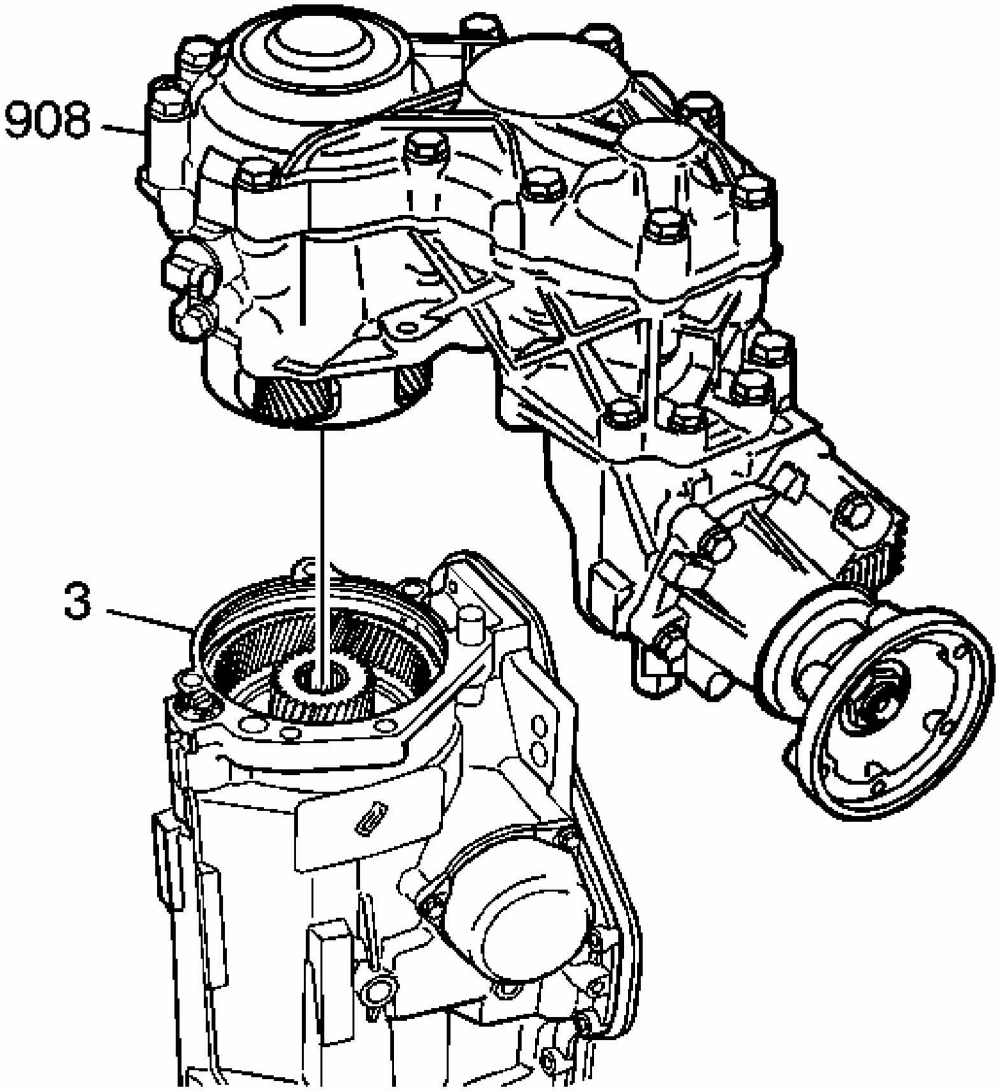


Fig. 406: View Of Transfer Case Assembly
Courtesy of GENERAL MOTORS CORP.

CAUTION: This component weighs approximately 60 lbs. Personal injury may result if you lift the component improperly.

NOTE: The park gear thrust bearing (695) must be retained in the park gear (696) when installing the transfer case to the transmission or damage may occur.

IMPORTANT: When the transfer case is installed onto the transmission, there should be no gap between these parts. If a gap exists, check the park gear thrust bearing for proper retention to the park gear.

5. Install the transfer case assembly (908) onto the transmission case (3).

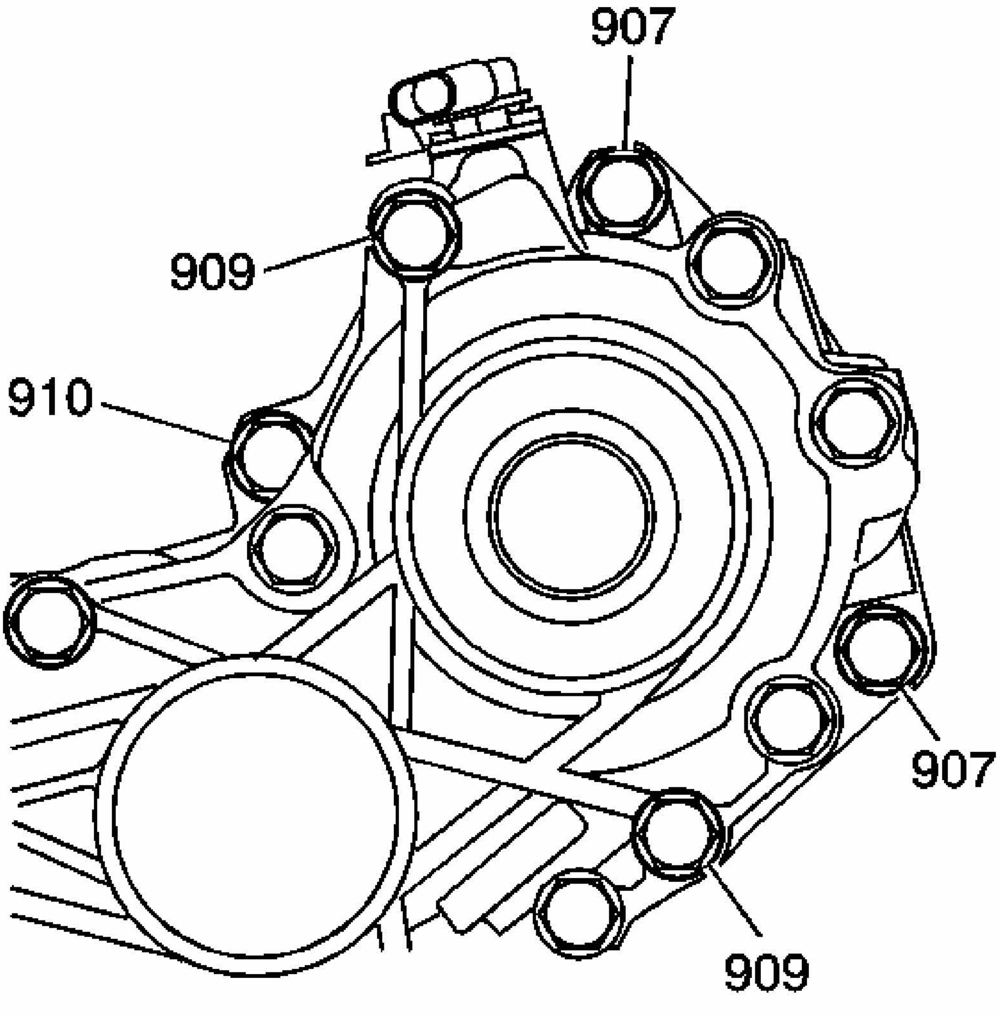


Fig. 407: View Of Transfer Case To Case Bolts
Courtesy of GENERAL MOTORS CORP.

6. Install the 5 transfer case to case bolts (907, 909, 910).

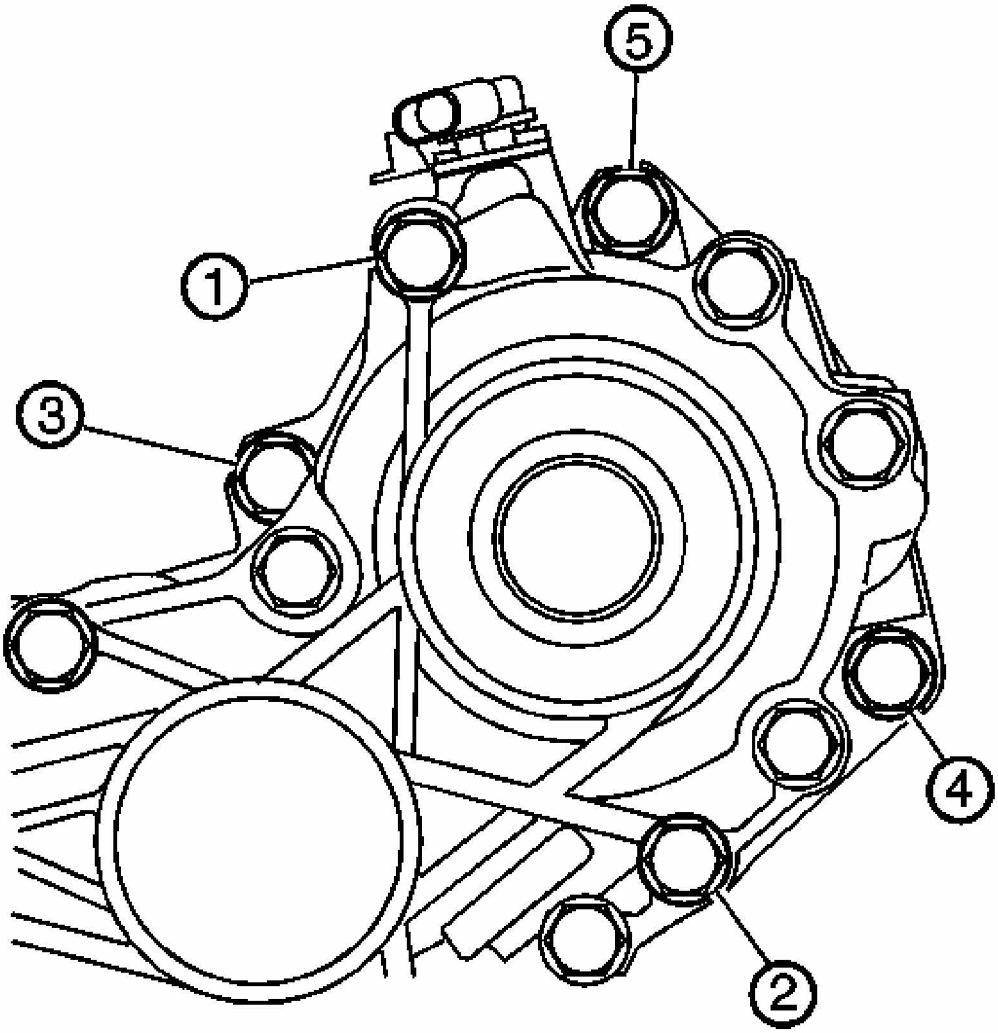


Fig. 408: Identifying Case Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE:	**Do not use air powered tools in order to assemble or disassemble transmissions. Use hand tools in order to properly determine bolt tightness. Improper bolt torque can contribute to transmission repair conditions and this information, which is vital to diagnosis, can only be detected when using hand tools.**
NOTE:	**Refer to FASTENER NOTICE in Cautions and Notices.**

7. Torque the bolts in the following sequence:

   Tighten 2 transfer case bolts (1, 2):

   Tighten:
   1. First pass 35 N.m (26 lb ft)
   2. Final Pass an additional 160 degrees

8. Tighten 1 transfer case bolt (3):

   Tighten:
   1. First pass 35 N.m (26 lb ft)
   2. Final Pass an additional 70 degrees

9. Tighten 2 transfer case bolts (4, 5):

   Tighten: Tighten transfer case bolts (4, 5) to 40 N.m (30 lb ft).

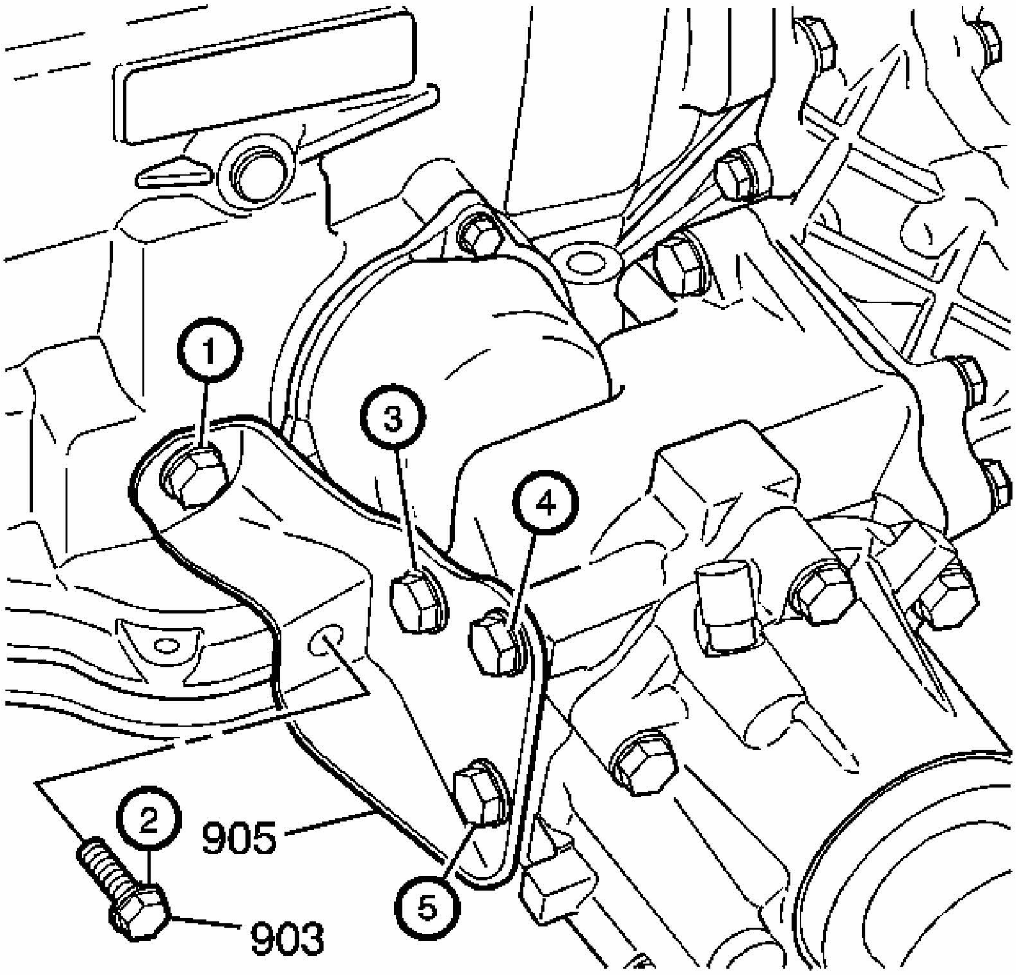


Fig. 409: View Of Transfer Case Side Brace
Courtesy of GENERAL MOTORS CORP.

10. Install the transfer case side brace (905) to case.
11. Install the transfer case side brace to case bolts (903). Hand tighten the bolts.
12. Torque the bolts in the following sequence (1, 2, 3, 4, 5).

Tighten: Tighten the transfer case side brace bolts to 31 N.m (23 lb ft).

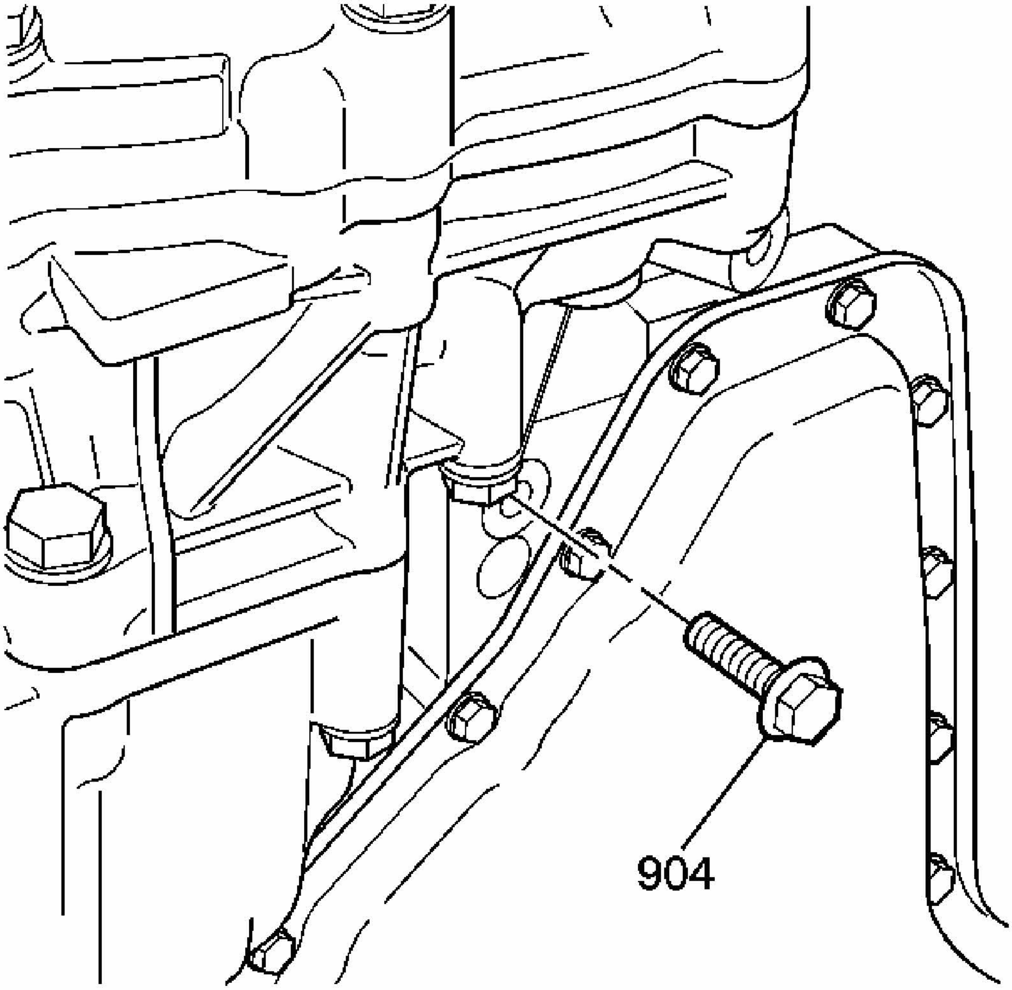


Fig. 410: Identifying Transfer Case Lower Brace To Case Bolt
Courtesy of GENERAL MOTORS CORP.

13. Install the transfer case lower brace to case bolt (904).

    Tighten: Tighten the transfer case lower brace bolt to 56 N.m (42 lb ft).

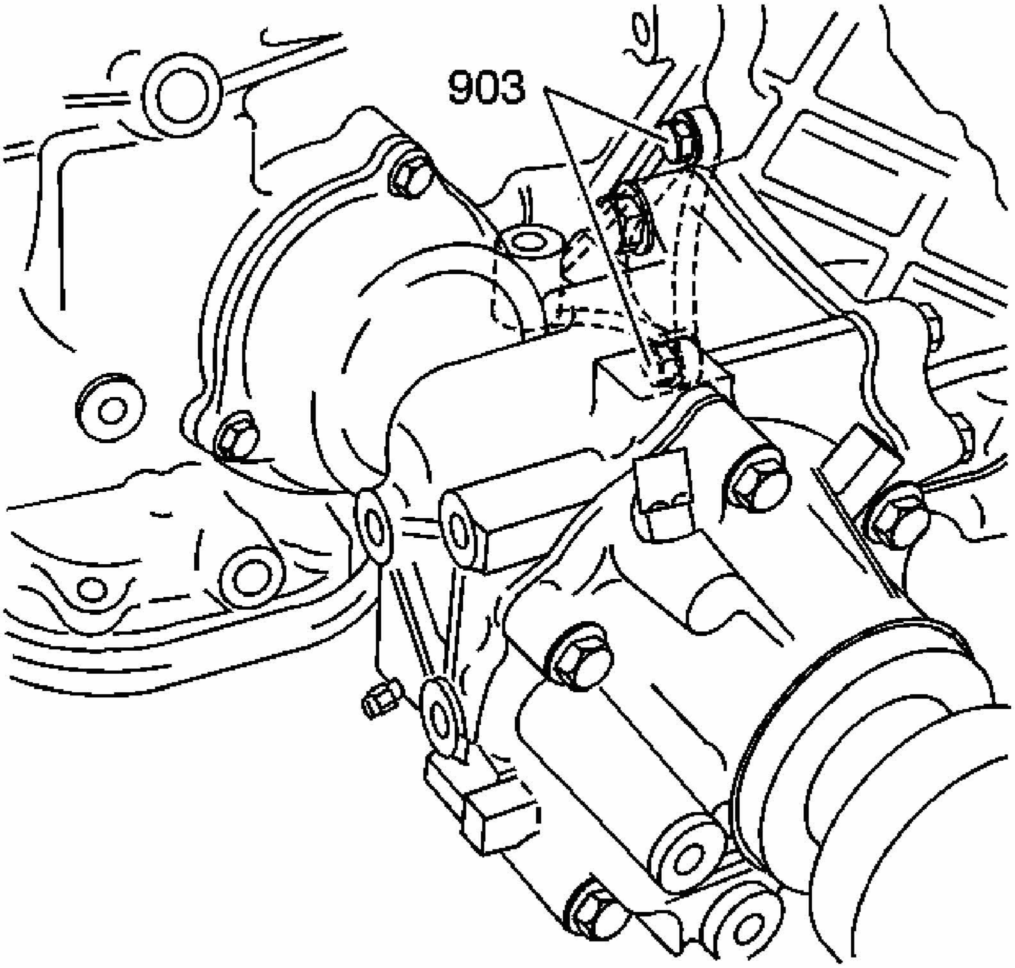


Fig. 411: Locating Transfer Case Lower Brace To Transfer Case Bolts
Courtesy of GENERAL MOTORS CORP.

14. Tighten the transfer case lower brace to case bolts (903).

    Tighten: Tighten the transfer case lower brace bolts to 31 N.m (23 lb ft).

OUTPUT SHAFT ASSEMBLE

Assembly Procedure

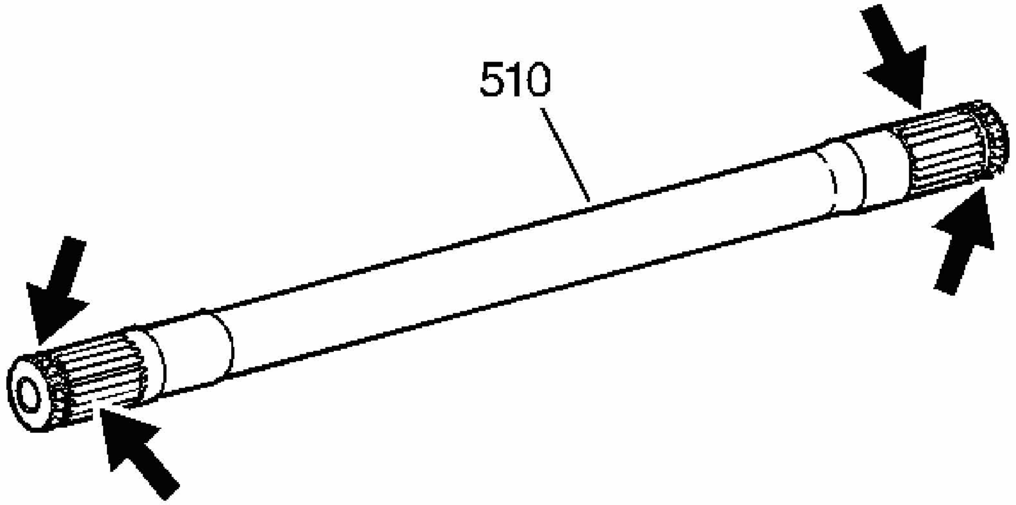


Fig. 412: Output Shaft Inspection Areas
Courtesy of GENERAL MOTORS CORP.

1. Inspect the output shaft (510) for:
    - Damaged bushing journals
    - Stripped splines
    - Snap ring groove damage

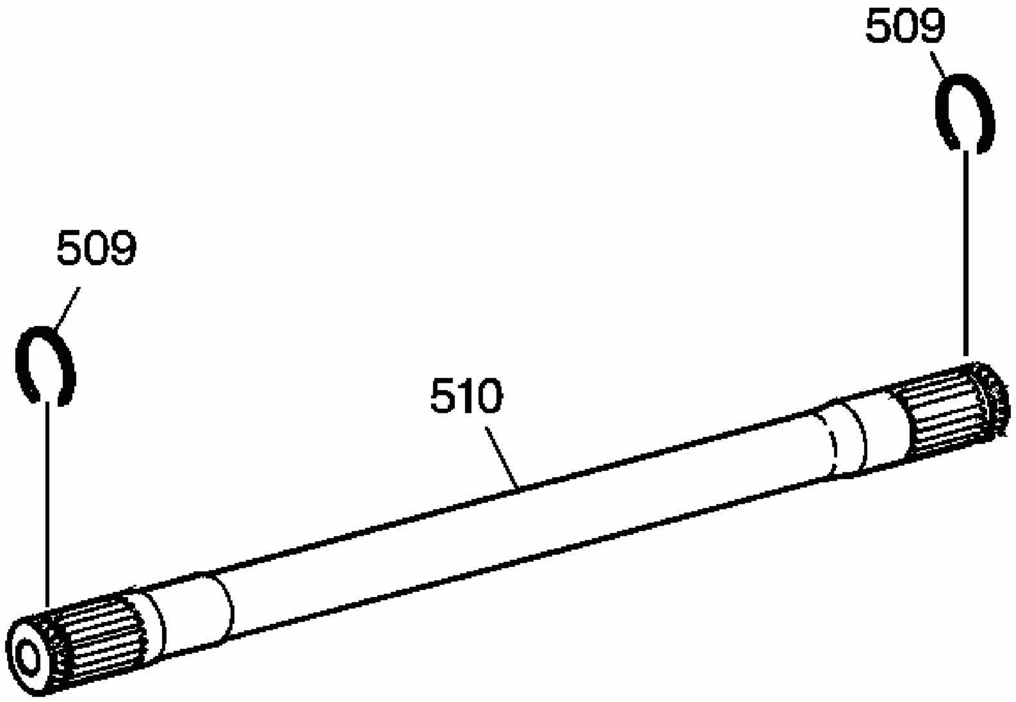


Fig. 413: Drive Axle Retainer Rings & Output Shaft
Courtesy of GENERAL MOTORS CORP.

2. Affix the outboard drive shaft retaining ring (509) and the inboard drive shaft retaining ring (509) onto the output shaft (510).

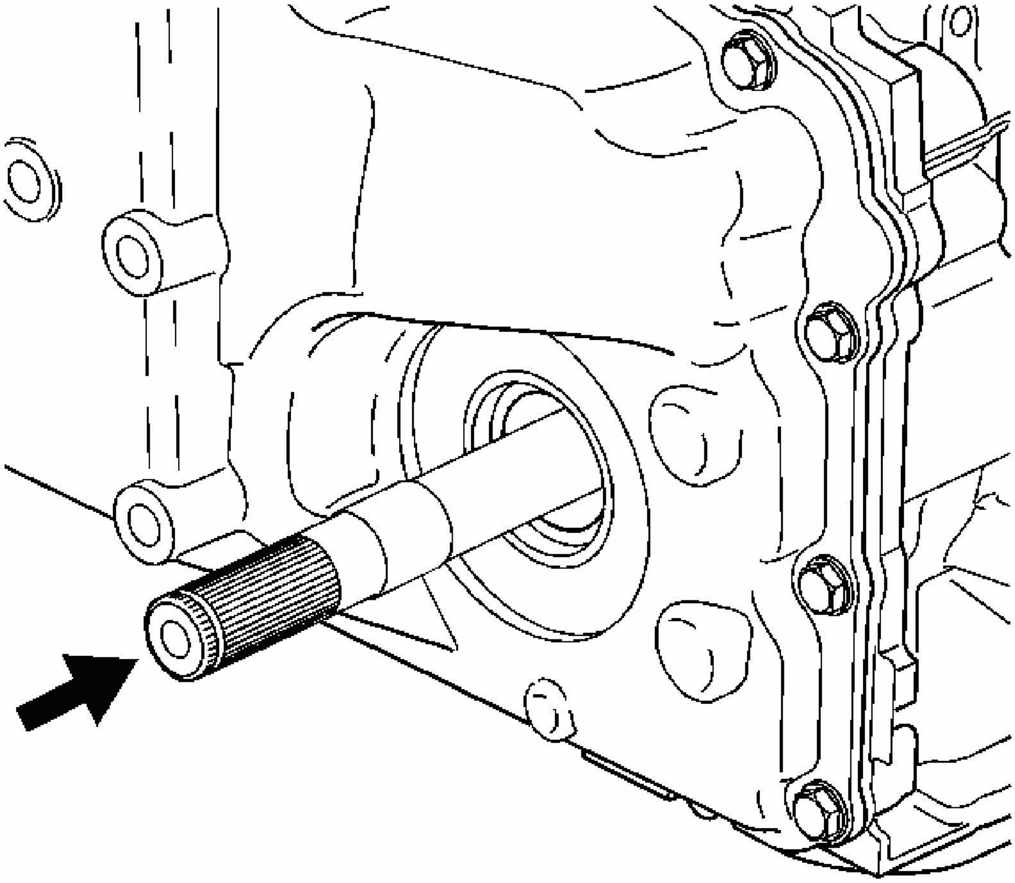


Fig. 414: View Of Output Shaft
Courtesy of GENERAL MOTORS CORP.

3. Rotate the transmission so that the oil pan flange faces downward.

NOTE: Do not push to hard during installation of the output shaft (510) or damage to the bushings or bearings may occur.

IMPORTANT: The output shaft (510) must be installed with the short splines toward the final drive assembly.

4. Carefully install the output shaft (510) into the transmission. Extend the shaft through the differential side gear.

TRANSMISSION HOLDING FIXTURE DISASSEMBLE

Tools Required

- **J 28664-B** Transmission Holding Fixture. See Special Tools.
- **J 3289-20** Holding Fixture Base
- **J44465** Holding Fixture Adapter. See Special Tools.

Assembly Procedure

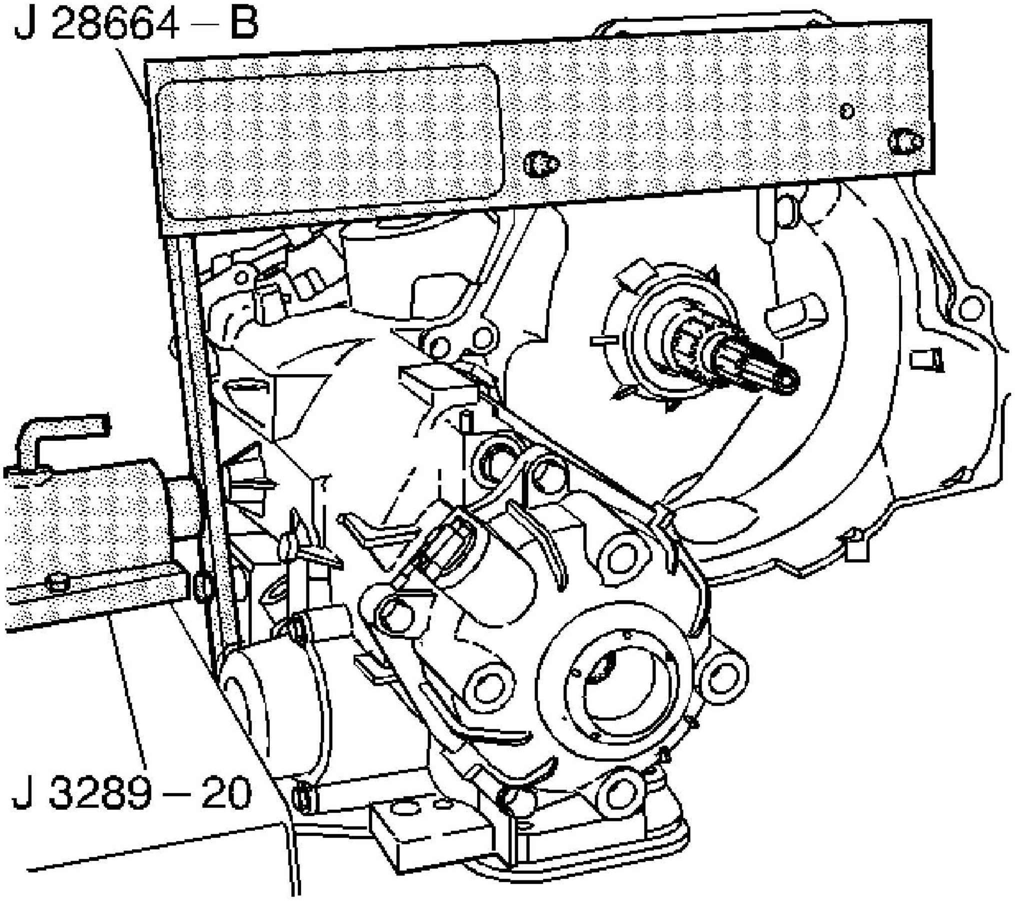


Fig. 415: View Of J 28664-B & J 3289-20 Installed Onto Transmission
Courtesy of GENERAL MOTORS CORP.

1. Remove the pin from **J 3289-20** .
2. Remove the transmission and **J 28664-B** from **J 3289-20** . See Special Tools.
3. Remove **J 28664-B** from the transmission. See Special Tools.
4. Remove **J44465** from **J 28664-B** . See Special Tools.

TORQUE CONVERTER INSPECTION

Tools Required

- **J 8001** Dial Indicator Set
- **J 26900-13** Magnetic Indicator Base
- **J 35138** Torque Converter End Play Checking Tool

Inspection Procedure

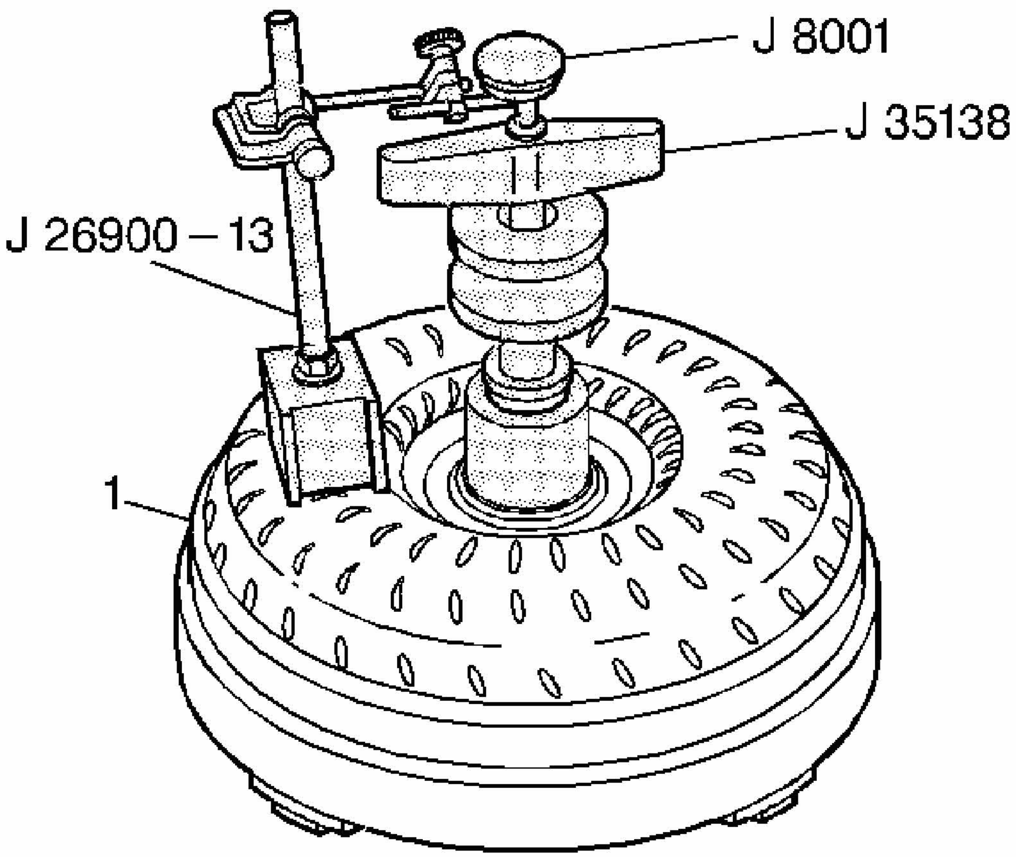


Fig. 416: View Of J 26900-13, J 8001 & J 35138 Installed On Torque Converter
Courtesy of GENERAL MOTORS CORP.

1. Position the torque converter (1) on the bench with the flywheel lugs facing down.
2. Install **J 26900-13** , **J 35138** and **J 8001** onto the torque converter (1).
3. Set the dial indicator to 0.
4. Lift **J 35138** and note the dial indicator reading:
    - The torque converter end play should be 0.5 mm (0.020 in) or less

- If the end play is too high, replace the torque converter (1)

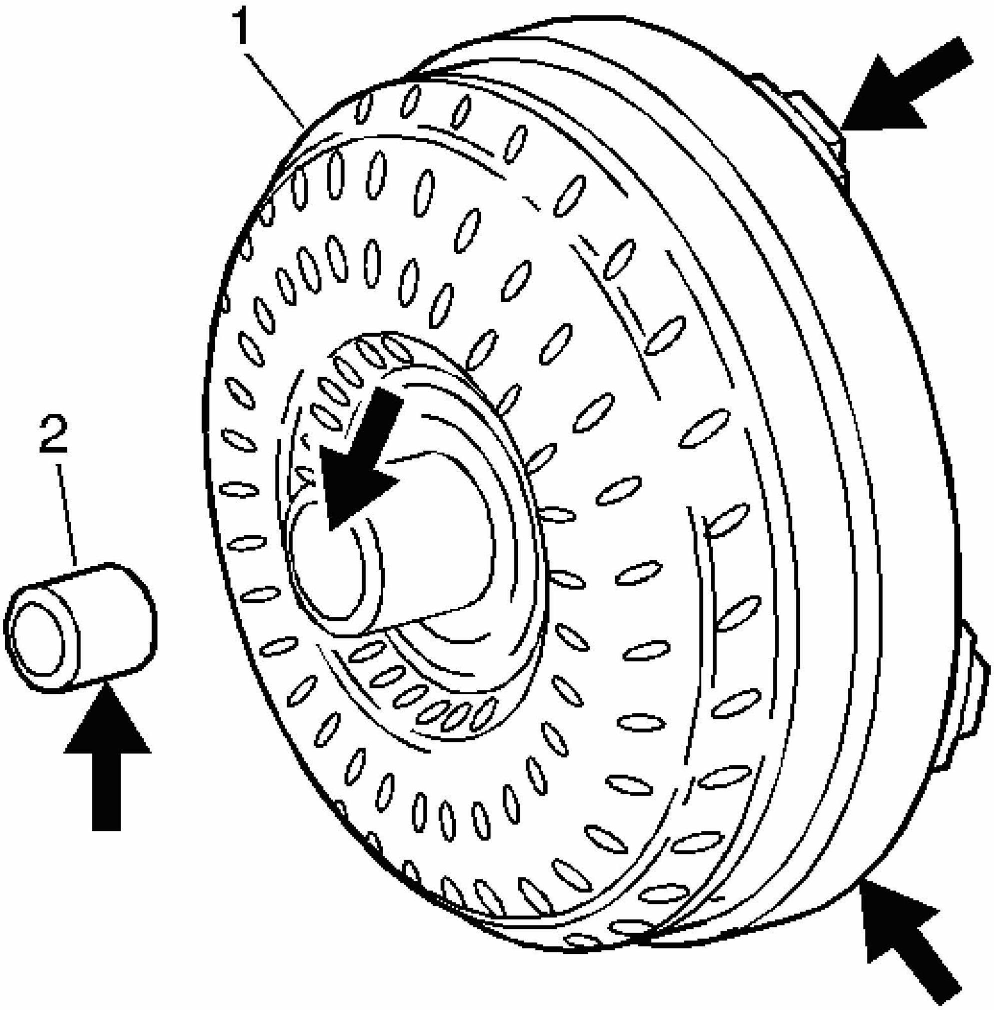


Fig. 417: Inspection Areas On Torque Converter
Courtesy of GENERAL MOTORS CORP.

5. Inspect and replace the torque converter (1) for the following conditions:
    - Overheated (torque converter will be blue in color)
    - Leaking at the weld areas
    - A damaged torque converter pilot
    - Evidence of metal particles in the converter, the oil cooler or the cooler pipes
    - A damaged torque converter stator, a damaged pump or a damaged turbine

- A damaged or worn torque converter bushing (2)
- Contaminated automatic transmission fluid due to engine coolant

6. Inspect the torque converter for stripped bolt hole threads. If found, repair the torque converter.

TORQUE CONVERTER ASSEMBLE

Tool Required

J 36850 Assembly Lubricant (or equivalent)

Assembly Procedure

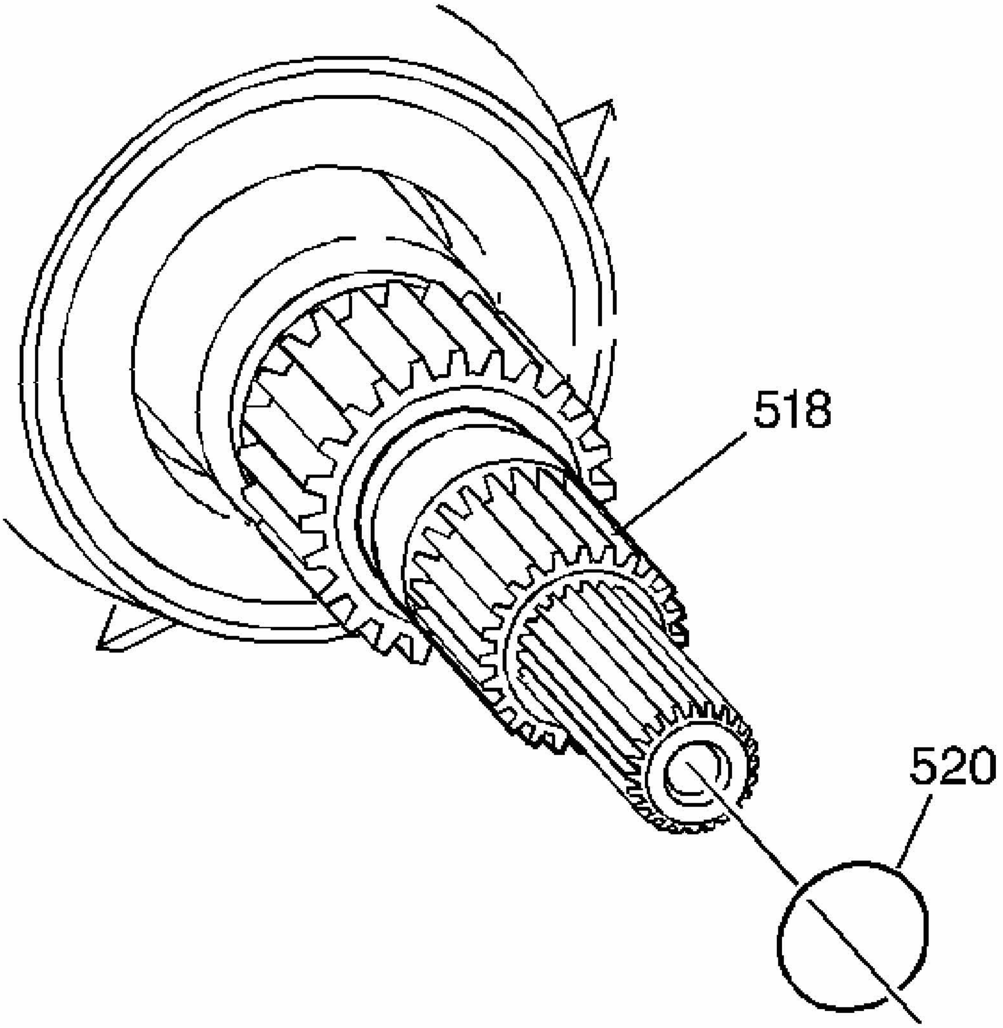


Fig. 418: Installing Turbine Shaft O-Ring Seal On Turbine Shaft
Courtesy of GENERAL MOTORS CORP.

1. Apply **J 36850** or equivalent to a new turbine shaft O-ring seal (520).
2. Apply **J 36850** or equivalent to the turbine shaft (518) splines.
3. Install the turbine shaft O-ring seal (520) onto the turbine shaft (518).

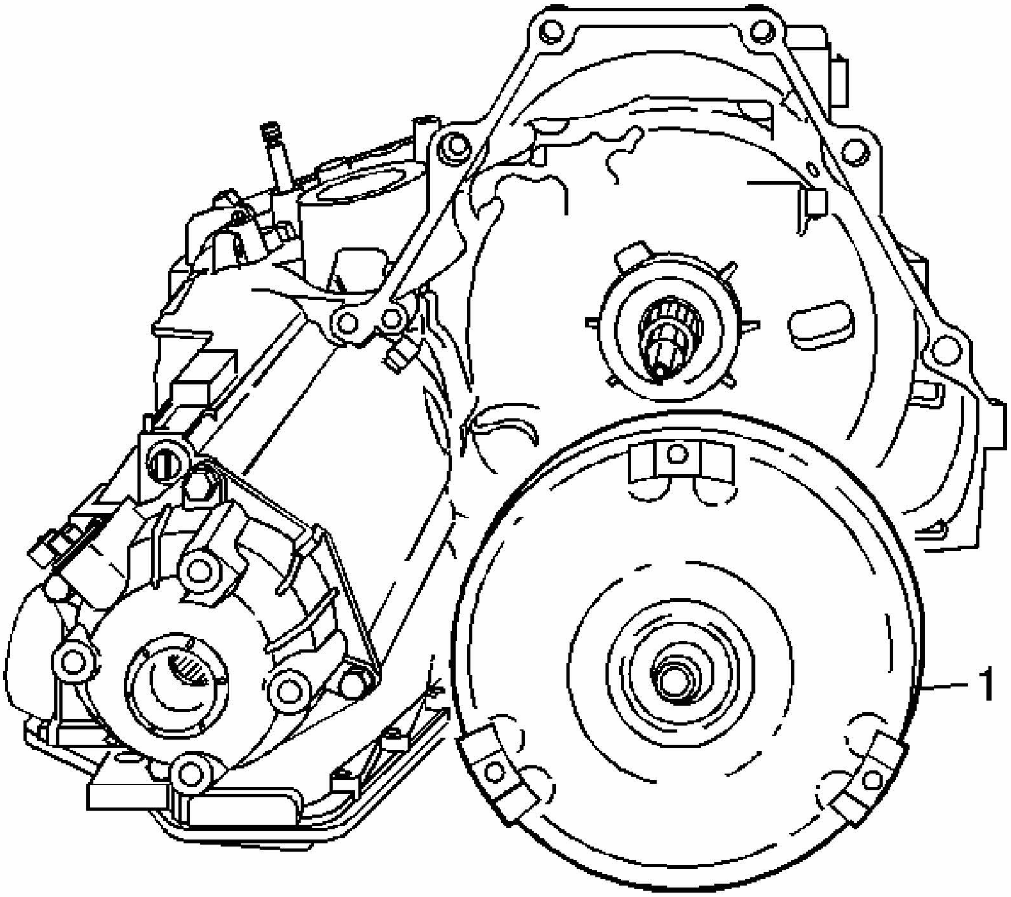


Fig. 419: View Of Torque Converter Assembly
Courtesy of GENERAL MOTORS CORP.

CAUTION: The torque converter weighs approximately 65 lbs. Personal injury may result if you lift the torque converter improperly.

4. Install the torque converter assembly (1).

DESCRIPTION AND OPERATION

PARK OR NEUTRAL - ENGINE RUNNING (PARK - WITHOUT TOUCH ACTIVATED POWER)

When the gear selector lever is in the PARK (P) position and the engine is running, fluid is drawn into the oil pump and line pressure is then directed to the following control devices:

Pressure Regulator Valve (313)

Regulates pump output (line pressure) in response to torque signal fluid pressure acting on the boost valve, spring force and line pressure acting on the end of the valve. Line pressure is directed to the manual valve, 3 accumulator valves, torque signal regulator valve, pressure relief valve, TCC regulator valve, #10 ball check valve and 2-3 shift valve, 3-2 manual downshift valve, 3-4 shift valve, 2-3 shift solenoid valve, #3 ball check valve and input clutch and actuator feed limit valve.

Actuator Feed Limit Valve (414)

Line pressure is routed to the valve and limited to a maximum pressure as it passes through the valve and enters the actuator feed circuit. Actuator feed is then routed to the pressure control solenoid valve and into the 1-2, 3-4 shift solenoid valve.

Pressure Control (PC) Solenoid Valve (322)

Controlled by the PCM, the PC solenoid valve regulates filtered actuator feed pressure entering the torque signal circuit. Torque signal fluid is then routed to the pressure regulator valve, the 1-2, 2-3 and 3-4 accumulator valves.

Torque Signal Regulator Valve (321)

Regulates line pressure into the torque signal fluid circuit. This regulation is controlled by filtered actuator feed fluid pressure from the PC solenoid valve.

Line Pressure Relief Valve (324)

Exhausts line pressure above 1,690-2,480 kPa (450-360 psi).

Manual Valve (404)

The manual valve is moved to the NEUTRAL position and blocks line pressure from entering the Reverse fluid circuit. The reverse fluid circuit is opened to an exhaust at the manual valve.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly (34)

The automatic transmission fluid pressure (TFP) switch is attached to the valve body and consists of one fluid pressure switch that monitors TCC release pressure. This switch is used as a diagnostic tool to confirm that the TCC is actually off when it has been commanded off by the PCM.

The TCC release switch is a normally closed pressure switch. A normally closed switch allows current to flow from the positive contact through the switch to ground when no fluid is present. Fluid pressure moves the diaphragm to disconnect the positive and ground contacts, opening the switch and stopping current flow. This change in switch state electronically signals the PCM that the TCC is released.

1-2, 3-4 Shift Solenoid Valve (315A)

Controlled by the powertrain control module (PCM), the 1-2, 3-4 shift solenoid (SS) valve is energized (On) in PARK range. Actuator feed pressure moves the 1-2 shift valve (318) against spring pressure and directs line fluid into the 1-2, 3-4 signal passage. 1-2, 3-4 signal fluid is then directed to the 3-4 shift valve (362).

2-3 Shift Solenoid Valve (315B)

Controlled by the powertrain control module (PCM), the 2-3 shift solenoid (SS) valve is energized (On) in PARK range and directs line pressure into the 2-3 signal passage. 2-3 signal fluid directed to the 4-3 manual downshift valve (360) and moves the valve against spring pressure and also the 3-2 manual downshift valve (356).

1-2 Shift Valve (318)

1-2 signal fluid pressure holds the valve in the downshift position against spring force.

2-3 Shift Valve (357)

In PARK range, line pressure passes through the 2-3 shift valve (357) and line pressure feeds the input clutch feed passage. Line pressure then passes through the 3-4 shift valve (362) and around the #3 ball check valve (372), located in the case cover) in order to apply the input clutch. Although the input clutch is applied and the input sprag is holding, these conditions are not effective because neither the forward band assembly (688) nor the reverse band assembly (615) is applied.

1-2, 2-3 and 3-4 Accumulator Valves (350, 344, 341)

Line pressure is regulated into accumulator fluid pressure. This regulation is basically controlled by torque signal fluid pressure acting on the end of the valve.

1-2, 2-3 and 3-4 Accumulator Assemblies

Accumulator fluid is routed to each of the accumulator assemblies in preparation for upshifts. The fluid routed to the 1-2, 2-3 and 3-4 accumulators is orificed.

Pressure Regulator Valve (313) (Torque Converter/Cooler and Lube Circuits)

Line pressure at the valve enters the converter feed circuit which is then routed to the TCC control valve.

TCC Control Valve (335)

Spring pressure holds the valve in the released position. Converter feed fluid is directed to the release circuit. Release fluid seats #1 ball check valve and feeds the TCC blow-off. Release fluid feeds the TCC on the cover side of the pressure plate, exits the TCC through the apply circuit, then feeds the cooler circuit at the TCC control valve. Cooler fluid passes through the ball check valve, through the cooler, then returns to the transmission and feeds the rear lube circuit. A front lube circuit is fed from orificed line pressure.

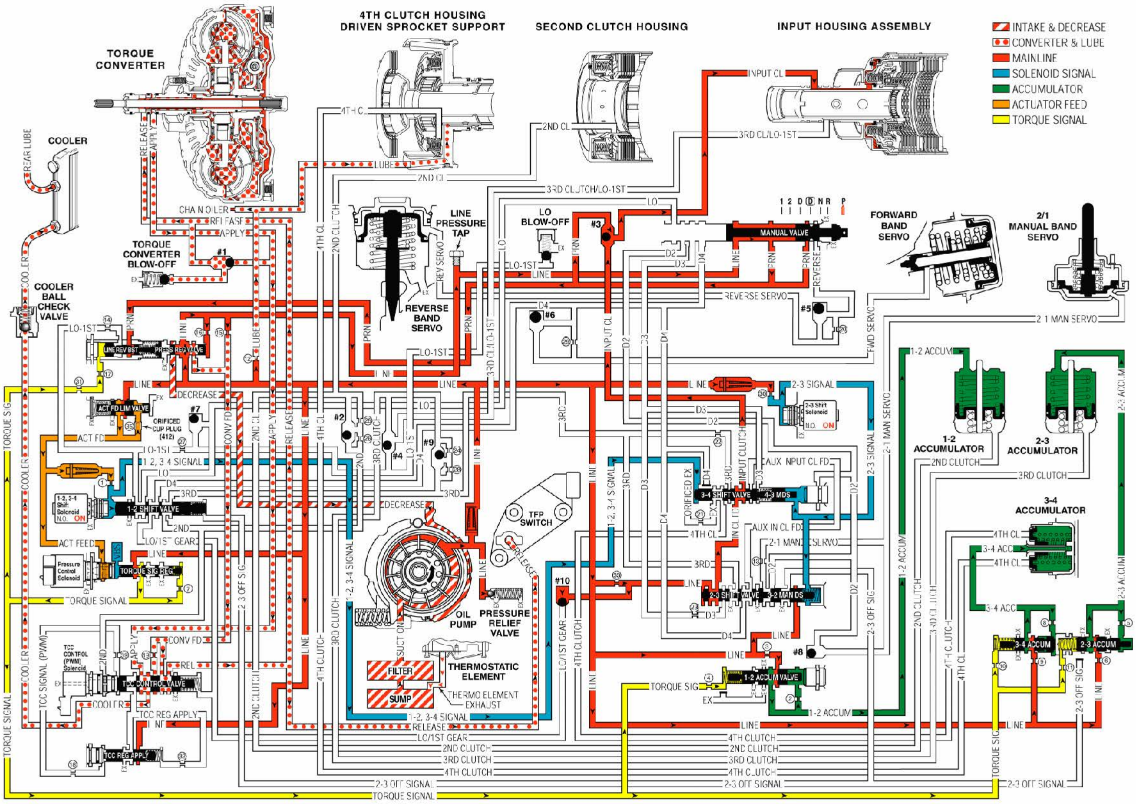

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAIN LINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
COOLER
REAR LUBE
TORQUE CONVERTER BLOW-OFF
COOLER BALL CHECK VALVE
LINE PRESSURE TAP
LO BLOW-OFF
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
REVERSE BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
FILTER
SUMP
1-2 SHIFT VALVE
2-3 SHIFT VALVE
3-4 SHIFT VALVE
TCC CONTROL VALVE
TCC REG APPLY
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
LINE
TORQUE SIGNAL
2-3 OFF SIGNAL

Fig. 420: Park - Engine Running - Without Touch Activated Power Fluid Flow Diagram

Courtesy of GENERAL MOTORS CORP.

PARK OR NEUTRAL - ENGINE RUNNING (PARK - WITH TOUCH ACTIVATED POWER)

When the gear selector lever is in the PARK (P) position and the engine is running, fluid is drawn into the oil pump and line pressure is then directed to the following control devices:

Pressure Regulator Valve (313)

Regulates pump output (line pressure) in response to torque signal fluid pressure acting on the boost valve, spring force and line pressure acting on the end of the valve. Line pressure is directed to the manual valve, 3 accumulator valves, torque signal regulator valve, pressure relief valve, TCC regulator valve, #10 ball check valve and 2-3 shift valve, 3-2 manual downshift valve, 3-4 shift valve, 2-3 shift solenoid valve, #3 ball check valve and input clutch and actuator feed limit valve.

Actuator Feed Limit Valve (414)

Line pressure is routed to the valve and limited to a maximum pressure as it passes through the valve and enters the actuator feed circuit. Actuator feed is then routed to the pressure control solenoid valve and into the 1-2, 3-4 shift solenoid valve.

Pressure Control (PC) Solenoid Valve (322)

Controlled by the PCM, the PC solenoid valve regulates filtered actuator feed pressure entering the torque signal circuit. Torque signal fluid is then routed to the pressure regulator valve, the 1-2, 2-3 and 3-4 accumulator valves.

Torque Signal Regulator Valve (321)

Regulates line pressure into the torque signal fluid circuit. This regulation is controlled by filtered actuator feed fluid pressure from the PC solenoid valve.

Line Pressure Relief Valve (324)

Exhausts line pressure above 1,690-2,480 kPa (450-360 psi).

Manual Valve (404)

The manual valve is moved to the NEUTRAL position and blocks line pressure from entering the Reverse fluid circuit. The reverse fluid circuit is opened to an exhaust at the manual valve.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly (34)

The automatic transmission fluid pressure (TFP) switch is attached to the valve body and consists of one fluid pressure switch that monitors TCC release pressure. This switch is used as a diagnostic tool to confirm that the TCC is actually off when it has been commanded off by the PCM.

The TCC release switch is a normally closed pressure switch. A normally closed switch allows current to flow from the positive contact through the switch to ground when no fluid is present. Fluid pressure moves the diaphragm to disconnect the positive and ground contacts, opening the switch and stopping current flow. This change in switch state electronically signals the PCM that the TCC is released.

1-2, 3-4 Shift Solenoid Valve (315A)

Controlled by the powertrain control module (PCM), the 1-2, 3-4 shift solenoid (SS) valve is energized (On) in PARK range. Actuator feed pressure moves the 1-2 shift valve (318) against spring pressure and directs line fluid into the 1-2, 3-4 signal passage. 1-2, 3-4 signal fluid is then directed to the 3-4 shift valve (362).

2-3 Shift Solenoid Valve (315B)

Controlled by the powertrain control module (PCM), the 2-3 shift solenoid (SS) valve is energized (On) in PARK range and directs line pressure into the 2-3 signal passage. 2-3 signal fluid directed to the 4-3 manual downshift valve (360) and moves the valve against spring pressure and also the 3-2 manual downshift valve (356).

1-2 Shift Valve (318)

1-2 signal fluid pressure holds the valve in the downshift position against spring force.

2-3 Shift Valve (357)

In PARK range, line pressure passes through the 2-3 shift valve (357) and line pressure feeds the input clutch feed passage. Line pressure then passes through the 3-4 shift valve (362) and around the #3 ball check valve (372), located in the case cover) in order to apply the input clutch. Although the input clutch is applied and the input sprag is holding, these conditions are not effective because neither the forward band assembly (688) nor the reverse band assembly (615) is applied.

1-2, 2-3 and 3-4 Accumulator Valves (350, 344, 341)

Line pressure is regulated into accumulator fluid pressure. This regulation is basically controlled by torque signal fluid pressure acting on the end of the valve.

1-2, 2-3 and 3-4 Accumulator Assemblies

Accumulator fluid is routed to each of the accumulator assemblies in preparation for upshifts. The fluid routed to the 1-2, 2-3 and 3-4 accumulators is orificed.

Pressure Regulator Valve (313) (Torque Converter/Cooler and Lube Circuits)

Line pressure at the valve enters the converter feed circuit which is then routed to the TCC control valve.

TCC Control Valve (335)

Spring pressure holds the valve in the released position. Converter feed fluid is directed to the release circuit. Release fluid seats #1 ball check valve and feeds the TCC blow-off. Release fluid feeds the TCC on the cover side of the pressure plate, exits the TCC through the apply circuit, then feeds the cooler circuit at the TCC control valve. Cooler fluid passes through the ball check valve, through the cooler, then returns to the transmission and feeds the rear lube circuit. A front lube circuit is fed from orificed line pressure.

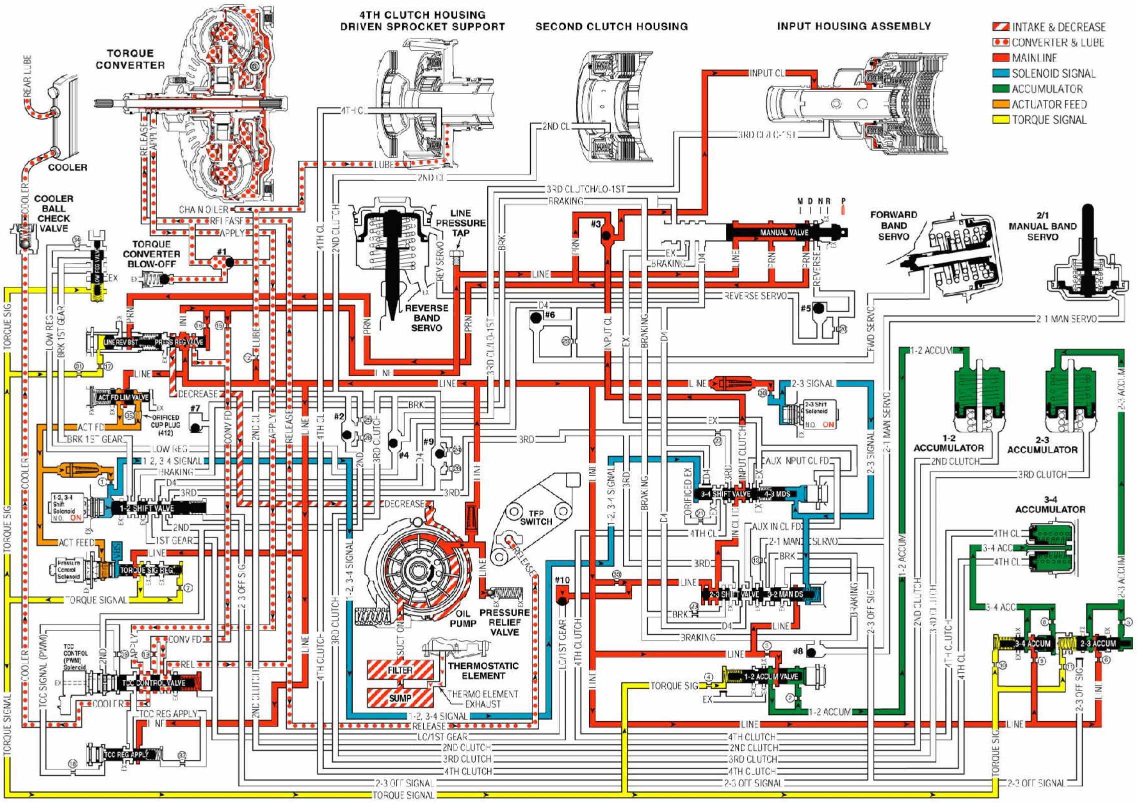

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
REAR LUBE
COOLER
COOLER BALL CHECK VALVE
TORQUE CONVERTER BLOW-OFF
LINE PRESSURE TAP
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
FILTER
SUMP
1-2 SHIFT VALVE
2-3 SHIFT VALVE
3-4 SHIFT VALVE
TCC CONTROL VALVE
TCC REG APPLY
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
ACT FD LIM VALVE
TORQUE SIG REG
ORIFICED CUP PLUG (412)

Fig. 421: Park - Engine Running - With Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

PARK OR NEUTRAL - ENGINE RUNNING (NEUTRAL-WITHOUT TOUCH ACTIVATED POWER)

When the gear selector lever is moved from the REVERSE position to the NEUTRAL position the following changes occur to the hydraulic and electrical systems.

Manual Valve (404)

The manual valve is moved to the NEUTRAL position and blocks line pressure from entering the Reverse fluid circuit. The reverse fluid circuit is opened to an exhaust at the manual valve.

Reverse Band Assembly (615)

Reverse fluid exhausts from the reverse servo, the #5 ball check valve unseats, allowing reverse servo fluid to quickly exhaust at the manual valve and the reverse band releases, shifting the transmission into NEUTRAL.

Pressure Regulator Valve (313) (Torque Converter/Cooler and Lube Circuits)

Line pressure at the valve enters the converter feed circuit which is then routed to the TCC control valve.

TCC Control Valve (335)

Spring pressure holds the valve in the released position. Converter feed fluid is directed to the release circuit. Release fluid seats #1 ball check valve and feeds the TCC blow-off. Release fluid feeds the TCC on the cover side of the pressure plate, exits the TCC through the apply circuit, then feeds the cooler circuit at the TCC control valve. Cooler fluid passes through the ball check valve, through the cooler, then returns to the transmission and feeds the rear lube circuit. A front lube circuit is fed from orificed line pressure.

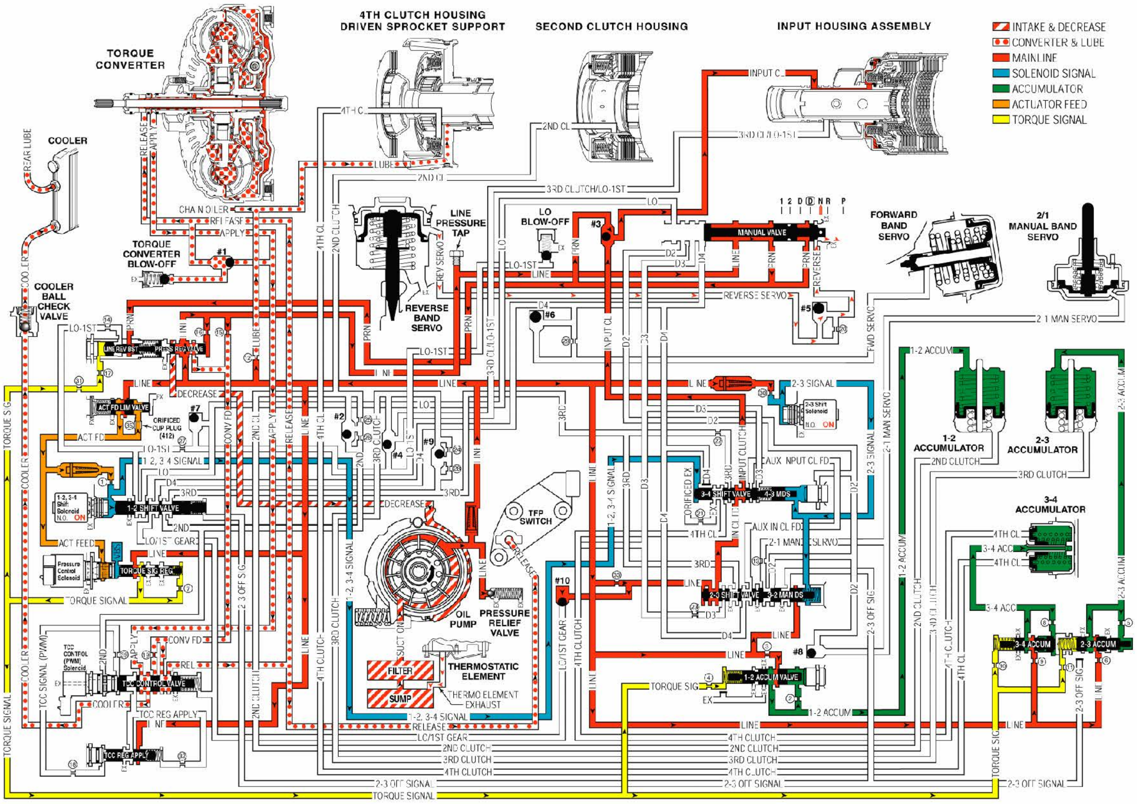

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAIN LINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
COOLER
REAR LUBE
TORQUE CONVERTER BLOW-OFF
COOLER BALL CHECK VALVE
LINE PRESSURE TAP
REVERSE BAND SERVO
LO BLOW-OFF
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
FILTER
SUMP
1-2 SHIFT VALVE
2-3 SHIFT VALVE
3-4 SHIFT VALVE
TCC CONTROL VALVE
TCC REG APPLY
TORQUE SIG REG
ACT FD LIM VALVE
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
ORIFICED CUP PLUG (412)

Fig. 422: Neutral - Engine Running - Without Touch Activated Power Fluid Flow Diagram

Courtesy of GENERAL MOTORS CORP.

PARK OR NEUTRAL - ENGINE RUNNING (NEUTRAL - WITH TOUCH ACTIVATED POWER)

When the gear selector lever is moved from the REVERSE position to the NEUTRAL position the following changes occur to the hydraulic and electrical systems.

Manual Valve (404)

The manual valve is moved to the NEUTRAL position and blocks line pressure from entering the Reverse fluid circuit. The reverse fluid circuit is opened to an exhaust at the manual valve.

Reverse Band Assembly (615)

Reverse fluid exhausts from the reverse servo, the #5 ball check valve unseats, allowing reverse servo fluid to quickly exhaust at the manual valve and the reverse band releases, shifting the transmission into NEUTRAL.

Pressure Regulator Valve (313) (Torque Converter/Cooler and Lube Circuits)

Line pressure at the valve enters the converter feed circuit which is then routed to the TCC control valve.

TCC Control Valve (335)

Spring pressure holds the valve in the released position. Converter feed fluid is directed to the release circuit. Release fluid seats #1 ball check valve and feeds the TCC blow-off. Release fluid feeds the TCC on the cover side of the pressure plate, exits the TCC through the apply circuit, then feeds the cooler circuit at the TCC control valve. Cooler fluid passes through the ball check valve, through the cooler, then returns to the transmission and feeds the rear lube circuit. A front lube circuit is fed from orificed line pressure.

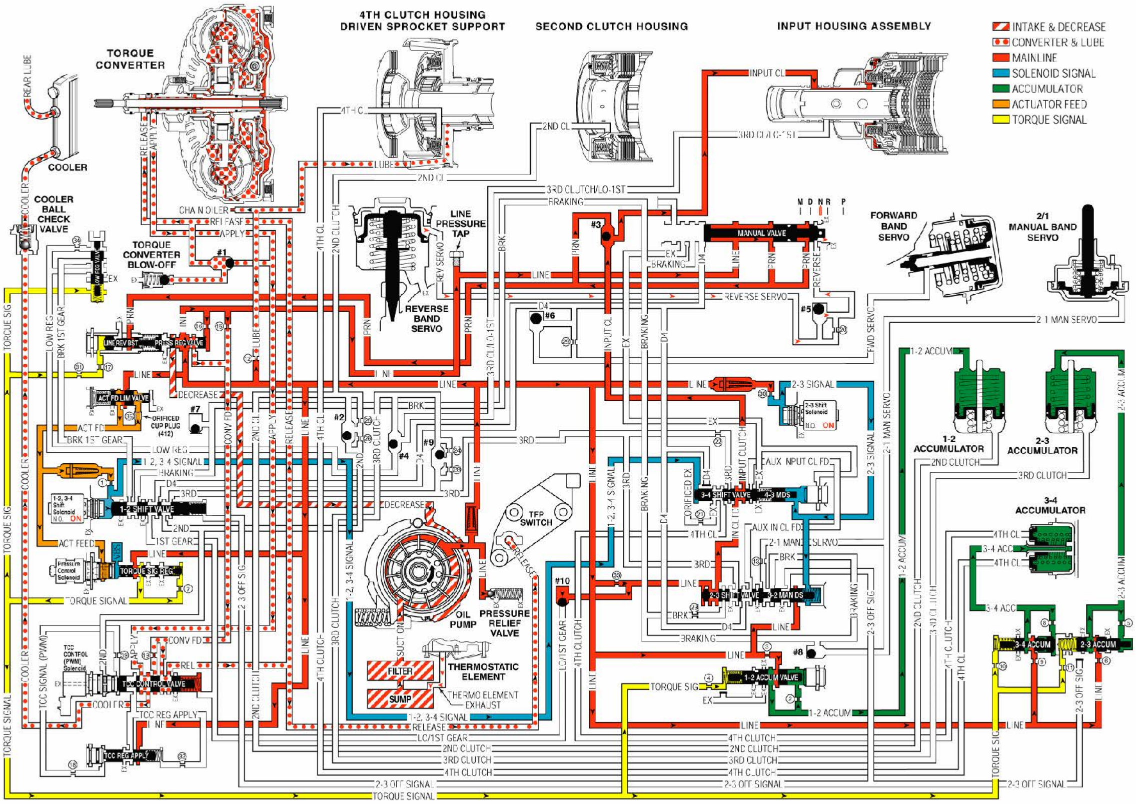

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
REAR LUBE
COOLER
COOLER BALL CHECK VALVE
TORQUE CONVERTER BLOW-OFF
LINE PRESSURE TAP
REVERSE BAND SERVO
MANUAL VALVE
M D N R P
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
PRESS REG VALVE
ACT FD LIM VALVE
ORIFICED CUP PLUG (412)
1-2, 3-4 Shift Solenoid N.O. ON
1-2 SHIFT VALVE
Pressure Control Solenoid
TORQUE SIG REG
TCC CONTROL (PWM) Solenoid
TCC CONTROL VALVE
TCC REG APPLY
2-3 Shift Solenoid N.O. ON
3-4 SHIFT VALVE
4-3 MDS
2-3 SHIFT VALVE
3-2 MDS
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
THERMO ELEMENT EXHAUST
FILTER
SUMP
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
TORQUE SIGNAL
2-3 OFF SIGNAL
LINE
4TH CLUTCH
2ND CLUTCH
3RD CLUTCH
LC/1ST GEAR

Fig. 423: Neutral - Engine Running - With Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

REVERSE (WITHOUT TOUCH ACTIVATED POWER)

When the gear selector lever is moved to the REVERSE (R) position (from the PARK position) the following changes occur in the transmission's hydraulic and electrical systems.

Pressure Regulator Valve (313)

Increases (or decreases) in line pressure is primarily influenced by changes in the throttle position as a result of the changing operating conditions of the vehicle.

Manual Valve (404)

Is moved manually to the right through the gear selector lever and allows line pressure to enter the reverse fluid passage through the PRN fluid passage.

Number 5 Ball Check Valve (373)

Located in the control valve body, (300), it blocks the reverse servo feed passage forcing reverse fluid through an orifice in the spacer plate (370) into the reverse servo passage. When the manual valve (404) is moved out of reverse, the ball check valve unseats allowing reverse servo fluid to exhaust through the ball seat instead of through the orifice.

Reverse Servo Assembly (39-40)

Applies the reverse band (615) in response to reverse servo fluid pressure feeding into the servo cover (40) side of the reverse servo piston (44).

Reverse Band Assembly (615)

Wraps around the second clutch housing (617) and holds the input carrier (672), through the reverse reaction drum (669), allowing the vehicle to move in reverse.

Input Clutch

Remains applied from PARK to REVERSE and becomes effective as the reverse band applies. The input sprag holds at this time.

Pressure Regulator Valve (313) (Torque Converter/Cooler and Lube Circuits)

Line pressure at the valve enters the converter feed circuit which is then routed to the TCC control valve.

TCC Control Valve (335)

Spring pressure holds the valve in the released position. Converter feed fluid is directed to the release circuit. Release fluid seats #1 ball check valve and feeds the TCC blow-off. Release fluid feeds the TCC on the cover side of the pressure plate, exits the TCC through the apply circuit, then feeds the cooler circuit at the TCC control valve. Cooler fluid passes through the ball check valve, through the cooler, then returns to the transmission and feeds the rear lube circuit. A front lube circuit is fed from orificed line pressure.

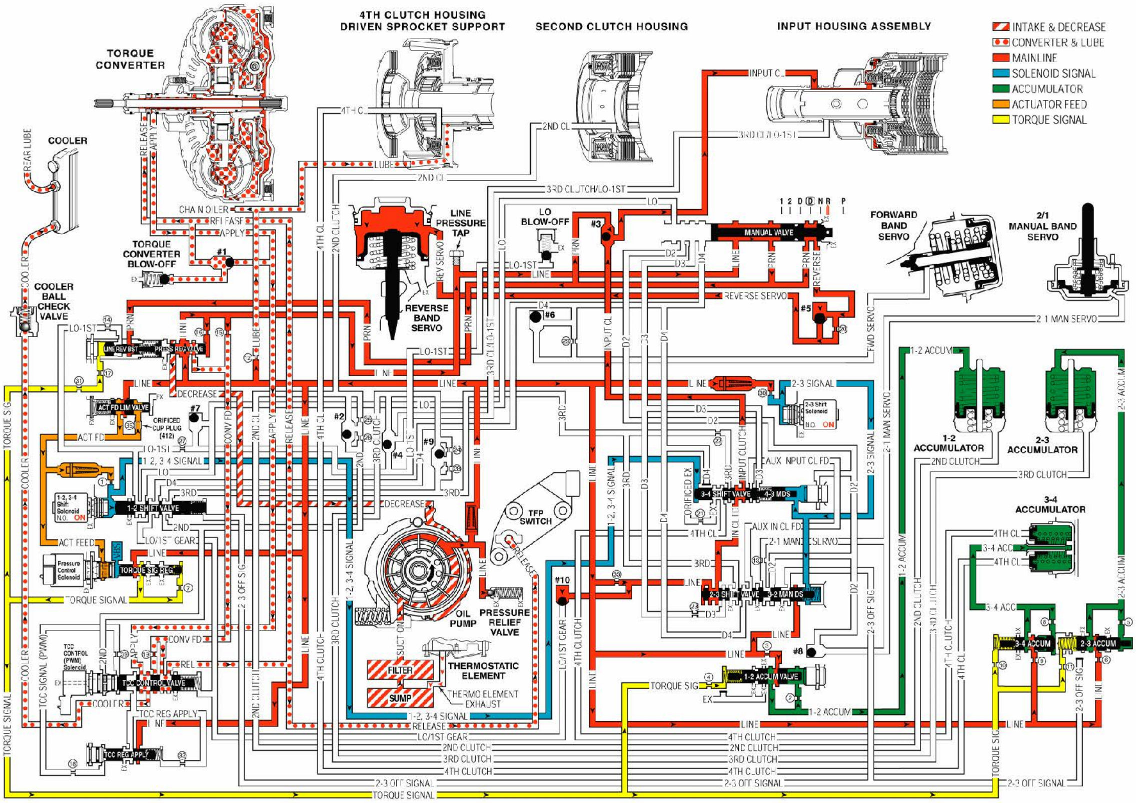

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
COOLER
TORQUE CONVERTER BLOW-OFF
COOLER BALL CHECK VALVE
LINE PRESSURE TAP
REVERSE BAND SERVO
LO BLOW-OFF
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
FILTER
SUMP
THERMOSTATIC ELEMENT
THERMO ELEMENT EXHAUST
1-2 SHIFT VALVE
2-3 SHIFT VALVE
3-4 SHIFT VALVE
TORQUE SIG REG
TCC CONTROL VALVE
TCC REG APPLY
ACT FD LIM VALVE
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
2-3 Shift Solenoid
1-2, 3-4 Shift Solenoid
Pressure Control Solenoid
TCC CONTROL (PWM) Solenoid

Fig. 424: Reverse - Without Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

REVERSE (WITH TOUCH ACTIVATED POWER)

When the gear selector lever is moved to the REVERSE (R) position (from the PARK position) the following changes occur in the transmission's hydraulic and electrical systems.

Pressure Regulator Valve (313)

Increases (or decreases) in line pressure is primarily influenced by changes in the throttle position as a result of the changing operating conditions of the vehicle.

Manual Valve (404)

Is moved manually to the right through the gear selector lever and allows line pressure to enter the reverse fluid passage through the PRN fluid passage.

Number 5 Ball Check Valve (373)

Located in the control valve body, (300), it blocks the reverse servo feed passage forcing reverse fluid through an orifice in the spacer plate (370) into the reverse servo passage. When the manual valve (404) is moved out of reverse, the ball check valve unseats allowing reverse servo fluid to exhaust through the ball seat instead of through the orifice.

Reverse Servo Assembly (39-40)

Applies the reverse band (615) in response to reverse servo fluid pressure feeding into the servo cover (40) side of the reverse servo piston (44).

Reverse Band Assembly (615)

Wraps around the second clutch housing (617) and holds the input carrier (672), through the reverse reaction drum (669), allowing the vehicle to move in reverse.

Input Clutch

Remains applied from PARK to REVERSE and becomes effective as the reverse band applies. The input sprag holds at this time.

Pressure Regulator Valve (313) (Torque Converter/Cooler and Lube Circuits)

Line pressure at the valve enters the converter feed circuit which is then routed to the TCC control valve.

TCC Control Valve (335)

Spring pressure holds the valve in the released position. Converter feed fluid is directed to the release circuit. Release fluid seats #1 ball check valve and feeds the TCC blow-off. Release fluid feeds the TCC on the cover side of the pressure plate, exits the TCC through the apply circuit, then feeds the cooler circuit at the TCC control valve. Cooler fluid passes through the ball check valve, through the cooler, then returns to the transmission and feeds the rear lube circuit. A front lube circuit is fed from orificed line pressure.

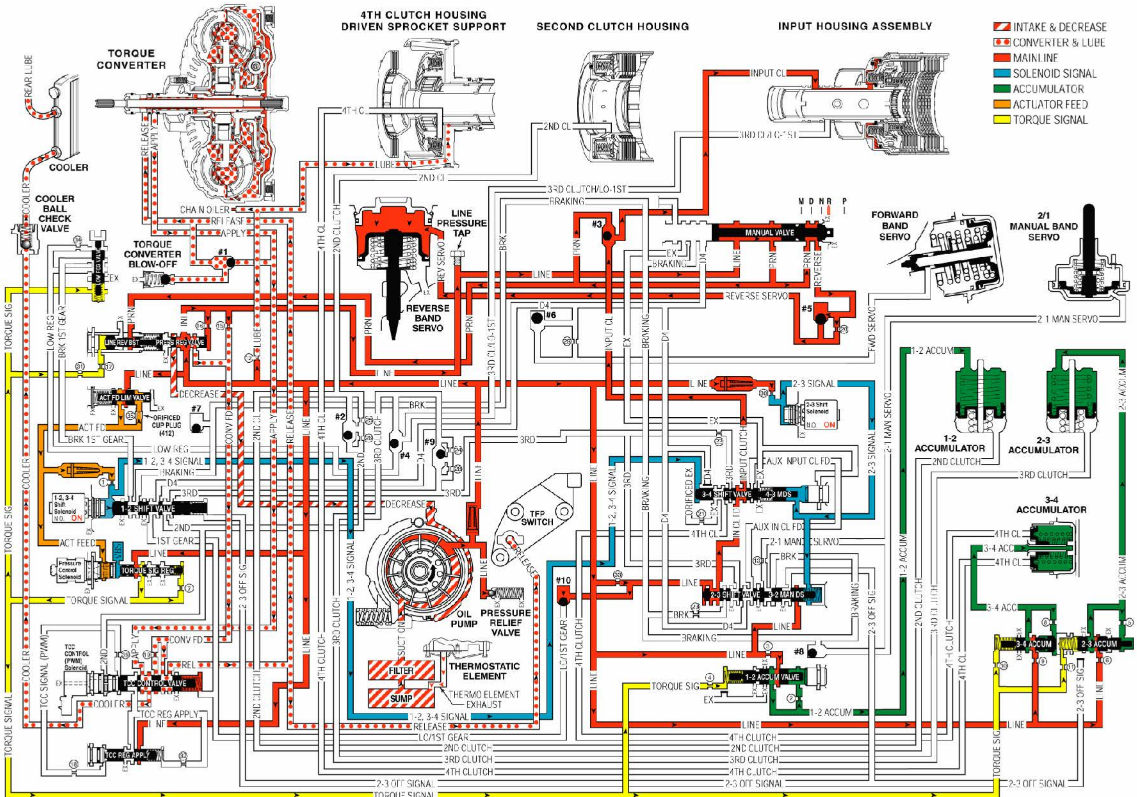

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
REAR LUBE
COOLER
COOLER BALL CHECK VALVE
TORQUE CONVERTER BLOW-OFF
LINE PRESSURE TAP
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
P R N D M
INPUT CL
2ND CL
3RD CLUTCH/LO-1ST BRAKING
REVERSE SERVO
LINE
RELEASE
APPLY
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
LINE BST
PRESS REG VALVE
ACT FD LIM VALVE
ORIFICED CUP PLUG (412)
DECREASE
1-2 SHIFT VALVE
1-2, 3-4 Shift Solenoid
2-3 Shift Solenoid
TORQUE SIG REG
TCC CONTROL VALVE
TCC REG APPLY
TCC CONTROL (PWM) Solenoid
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
FILTER
SUMP
THERMOSTATIC ELEMENT
3-4 SHIFT VALVE
4-3 MDS
2-3 SHIFT VALVE
3-2 MAN DS
1-2 ACCUM VALVE
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
3-4 ACCUM
2-3 ACCUM
TORQUE SIGNAL
2-3 OFF SIGNAL
4TH CLUTCH
2ND CLUTCH
3RD CLUTCH
LO/1ST GEAR
1-2, 3-4 SIGNAL

Fig. 425: Reverse - With Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, FIRST GEAR (WITHOUT TOUCH ACTIVATED POWER)

When the gear selector lever is moved to the Overdrive (D) position from the NEUTRAL (N) position the following changes occur to shift the transmission into Overdrive Range - First Gear.

Manual Valve (404)

Is moved by the gear selector lever and allows line pressure to enter the D4 passage.

Number 6 Ball Check Valve (372)

Located in the control valve body (300), blocks forward servo apply passage forcing D4 pressure to the forward servo boost valve (367), the forward servo feed orifice on the spacer plate (370). When the manual valve (404) is moved from DRIVE to PARK or NEUTRAL, the ball check valve unseats to allow for a quick exhaust of servo apply fluid and release of the forward band assembly (688).

Forward Servo Assembly (15-22)

Applies and holds the forward band (688) during all forward gear drive ranges.

Forward Band Assembly (688)

Wraps around and holds the 1-2 support outer race (687) during all forward gear drive ranges.

1-2 Shift Solenoid (SS) Valve (315A)

Energized (ON) by the PCM, high pressure in the 1-2, 3-4 signal fluid circuit holds the 12 shift valve in the downshift position. 1-2, 3-4 signal fluid also is routed to the 3-4 shift valve, but is not effective.

2-3 Shift Solenoid (SS) Valve (315B)

Energized (ON) by the PCM, high pressure in the 2-3 signal fluid circuit holds the 2-3 and 3-4 shift valves in the downshift position.

Input Clutch

Remains applied from NEUTRAL to DRIVE and becomes effective as the forward band applies. The input sprag holds at this time.

1-2 Support Roller Clutch

The 1-2 support roller clutch holds when the forward band is applied.

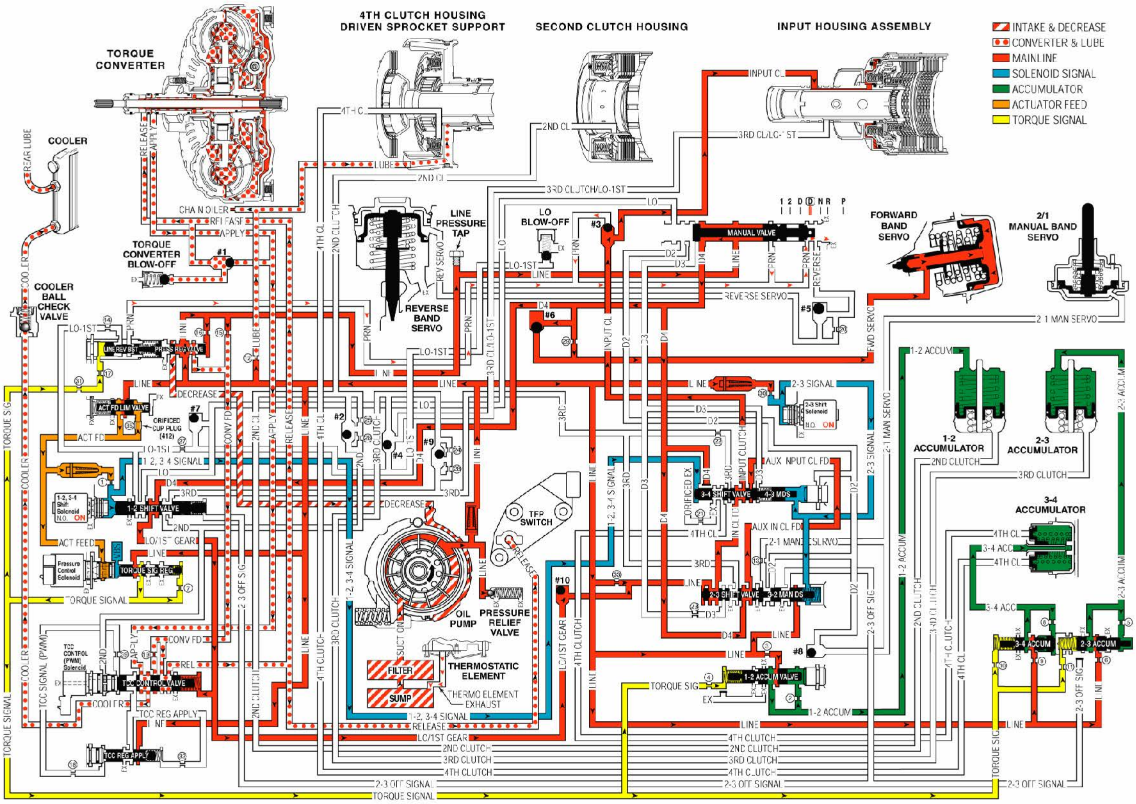

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAIN LINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
COOLER
TORQUE CONVERTER BLOW-OFF
COOLER BALL CHECK VALVE
LINE PRESSURE TAP
LO BLOW-OFF
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
FILTER
SUMP
THERMOSTATIC ELEMENT
THERMO ELEMENT EXHAUST

Fig. 426: Overdrive Range, First Gear - Without Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, FIRST GEAR (WITH TOUCH ACTIVATED POWER)

When the gear selector lever is moved to the Overdrive (D) position from the NEUTRAL (N) position the following changes occur to shift the transmission into Overdrive Range - First Gear.

Manual Valve (404)

Is moved by the gear selector lever and allows line pressure to enter the D4 passage.

Number 6 Ball Check Valve (372)

Located in the control valve body (300), blocks forward servo apply passage forcing D4 pressure to the forward servo boost valve (367), the forward servo feed orifice on the spacer plate (370). When the manual valve (404) is moved from DRIVE to PARK or NEUTRAL, the ball check valve unseats to allow for a quick exhaust of servo apply fluid and release of the forward band assembly (688).

Forward Servo Assembly (15-22)

Applies and holds the forward band (688) during all forward gear drive ranges.

Forward Band Assembly (688)

Wraps around and holds the 1-2 support outer race (687) during all forward gear drive ranges.

1-2 Shift Solenoid (SS) Valve (315A)

Energized (ON) by the PCM, high pressure in the 1-2, 3-4 signal fluid circuit holds the 12 shift valve in the downshift position. 1-2, 3-4 signal fluid also is routed to the 3-4 shift valve, but is not effective.

2-3 Shift Solenoid (SS) Valve (315B)

Energized (ON) by the PCM, high pressure in the 2-3 signal fluid circuit holds the 2-3 and 3-4 shift valves in the downshift position.

Input Clutch

Remains applied from NEUTRAL to DRIVE and becomes effective as the forward band applies. The input sprag holds at this time.

1-2 Support Roller Clutch

The 1-2 support roller clutch holds when the forward band is applied.

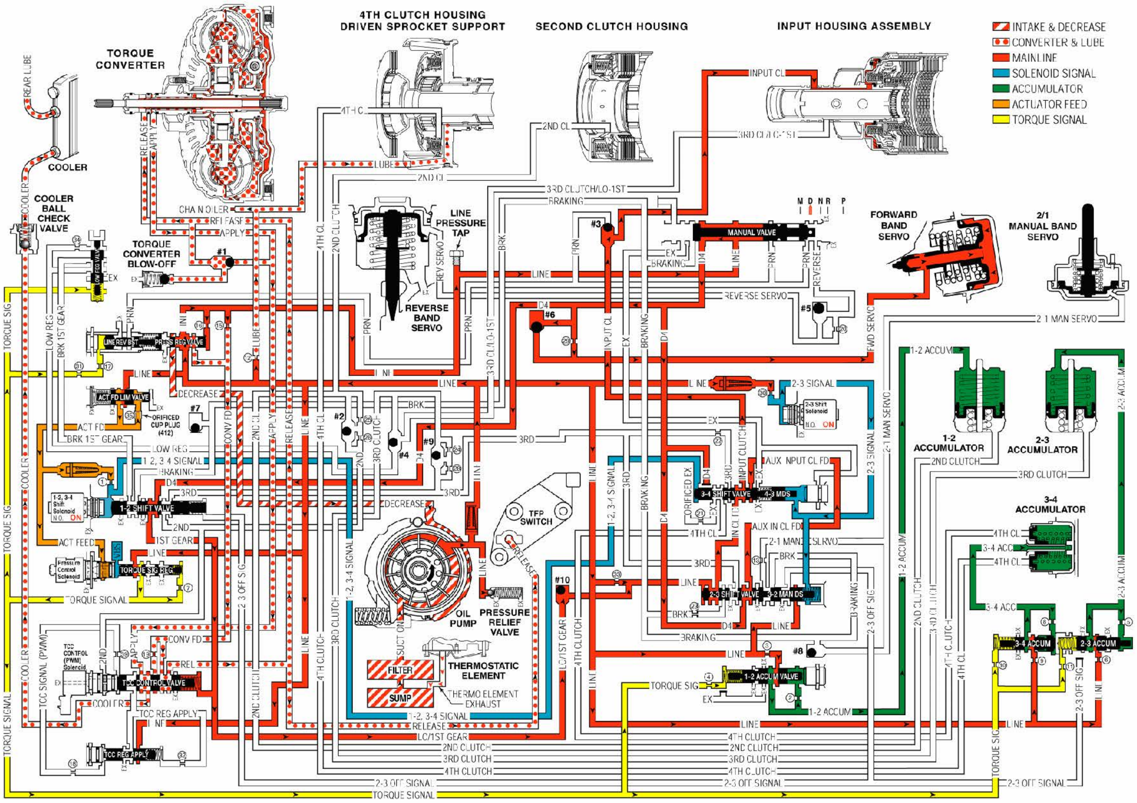

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
REAR LUBE
COOLER
COOLER BALL CHECK VALVE
TORQUE CONVERTER BLOW-OFF
LINE PRESSURE TAP
REVERSE BAND SERVO
MANUAL VALVE
M D N R P
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
LOW REG VALVE
LINE REV BST
PRESS REG VALVE
ACT FD LIM VALVE
ORIFICED CUP PLUG (412)
1-2, 3-4 Shift Solenoid N.O. ON
1-2 SHIFT VALVE
Pressure Control Solenoid
TORQUE SIG REG
TCC CONTROL (PWM) Solenoid
TCC CONTROL VALVE
TCC REG APPLY
2-3 Shift Solenoid N.O. ON
3-4 SHIFT VALVE
4-3 MDS
2-3 SHIFT VALVE
2-1 MAN DS
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
FILTER
SUMP
THERMO ELEMENT EXHAUST
LINE
D4
PRN
REVERSE SERVO
FWD SERVO
2-1 MAN SERVO
INPUT CL
2ND CL
3RD CLUTCH/LO-1ST
4TH CL
BRAKING
LUBE
RELEASE
APPLY
DECREASE
CONV FD
1-2, 3-4 SIGNAL
2-3 SIGNAL
2-3 OFF SIG
TORQUE SIGNAL
LC/1ST GEAR
2ND CLUTCH
3RD CLUTCH
4TH CLUTCH
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10

Fig. 427: Overdrive Range, First Gear - With Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, SECOND GEAR (WITHOUT TOUCH ACTIVATED POWER)

As the speed of the vehicle increases, the powertrain control module (PCM) receives input signals from various engine and transmission sensors. The PCM uses this data to de-energize 1-2, 3-4 shift solenoid valve in order to shift the transmission into second gear at the appropriate time.

1-2, 3-4 Shift Solenoid (SS) Valve (315A)

De-energized (OFF) by the PCM, it exhausts 1-2, 3-4 signal fluid through the solenoid thereby creating a low 1-2, 3-4 signal fluid pressure in the circuit. Low 1-2, 3-4 signal fluid pressure allows the 1-2 shift valve to move to the upshift position.

1-2 Shift Valve (318)

With the 1-2, 3-4 SS valve OFF, spring pressure moves the valve allowing D4 pressure to enter the 2nd fluid passage directing 2nd fluid to the Number 2 ball check valve.

Number 2 Ball Check Valve (372)

Located in the case cover (400), 2nd fluid seats the ball check valve and is forced through an orifice into the 2nd clutch passage to apply the 2nd clutch.

Second Clutch

2nd clutch fluid pressure applies the Second clutch to shift the transmission into Overdrive Range - Second gear.

Input Clutch

Remains applied, but is now ineffective.

Input Sprag Clutch

Overruns as the second clutch applies.

Forward Band

Remains applied.

1-2 Support Roller Clutch

Continues to hold while the forward band is applied.

1-2 Accumulator

2nd clutch fluid is also routed to the 1-2 accumulator piston. 2nd Clutch fluid pressure, in addition to 1-2 assist spring force, moves the piston against spring force and 1-2 accumulator feed fluid pressure. This action absorbs initial 2nd clutch fluid pressure to cushion the second clutch apply. The movement of the 1-2 accumulator piston forces some accumulator fluid out of the accumulator.

1-2 Accumulator Valve

1-2 accumulator feed fluid forced from the 1-2 accumulator is routed back to the 1-2 accumulator valve. This pressure forces the 1-2 accumulator valve against spring force and the torque signal fluid pressure to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the second clutch apply.

TCC Control Pulse Width Modulated (PWM) Solenoid Valve

2nd fluid is routed to the TCC control PWM solenoid. Under normal operating conditions the TCC control PWM solenoid is OFF in Second gear and blocks 2nd fluid from entering the TCC signal fluid circuit.

Torque Converter Clutch

With the TCC control PWM solenoid OFF the converter clutch is released in Second gear. Under normal operating conditions the TCC is released in Second gear. However, TCC apply could vary depending on vehicle application and may be calibrated to apply in Overdrive Range - Second Gear.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch

Release fluid pressure routed to the TFP manual valve position switch signals the PCM that the TCC is released.

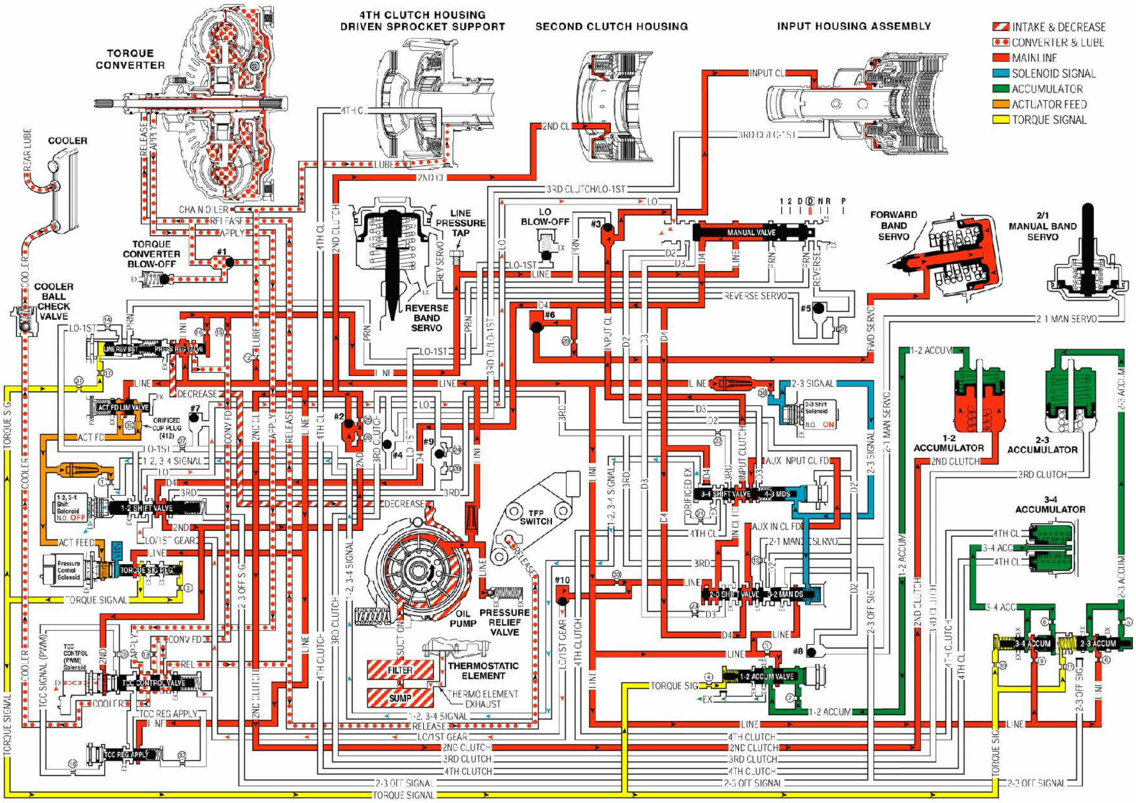

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
COOLER
REAR LUBE
TORQUE CONVERTER BLOW-OFF
COOLER BALL CHECK VALVE
LINE PRESSURE TAP
LO BLOW-OFF
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
ACT FD LIMIT VALVE
ORIFICED CUP PLUG (412)
1-2 SHIFT VALVE
1-2, 3-4 Shift Solenoid N.O. OFF
Pressure Control Solenoid
TORQUE SIG. REG.
TCC CONTROL (PWM) Solenoid
TCC CONTROL VALVE
TCC REG APPLY
2-3 Shift Solenoid N.O. ON
3-4 SHIFT VALVE
4-3 MDS
2-3 SHIFT VALVE
2-1 MAN DS
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
FILTER
SUMP
THERMOSTATIC ELEMENT
THERMO ELEMENT EXHAUST
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
LINE
D4
D3
D2
LO/1ST GEAR
2ND CLUTCH
3RD CLUTCH
4TH CLUTCH
2-3 OFF SIGNAL
TORQUE SIGNAL
RELEASE
APPLY

Fig. 428: Overdrive Range, Second Gear - Without Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, SECOND GEAR (WITH TOUCH ACTIVATED POWER)

As the speed of the vehicle increases, the powertrain control module (PCM) receives input signals from various engine and transmission sensors. The PCM uses this data to de-energize 1-2, 3-4 shift solenoid valve in order to shift the transmission into second gear at the appropriate time.

1-2, 3-4 Shift Solenoid (SS) Valve (315A)

De-energized (OFF) by the PCM, it exhausts 1-2, 3-4 signal fluid through the solenoid thereby creating a low 1-2, 3-4 signal fluid pressure in the circuit. Low 1-2, 3-4 signal fluid pressure allows the 1-2 shift valve to move to the upshift position.

1-2 Shift Valve (318)

With the 1-2, 3-4 SS valve OFF, spring pressure moves the valve allowing D4 pressure to enter the 2nd fluid passage directing 2nd fluid to the Number 2 ball check valve.

Number 2 Ball Check Valve (372)

Located in the case cover (400), 2nd fluid seats the ball check valve and is forced through an orifice into the 2nd clutch passage to apply the 2nd clutch.

Second Clutch

2nd clutch fluid pressure applies the Second clutch to shift the transmission into Overdrive Range - Second gear.

Input Clutch

Remains applied, but is now ineffective.

Input Sprag Clutch

Overruns as the second clutch applies.

Forward Band

Remains applied.

1-2 Support Roller Clutch

Continues to hold while the forward band is applied.

1-2 Accumulator

2nd clutch fluid is also routed to the 1-2 accumulator piston. 2nd Clutch fluid pressure, in addition to 1-2 assist spring force, moves the piston against spring force and 1-2 accumulator feed fluid pressure. This action absorbs initial 2nd clutch fluid pressure to cushion the second clutch apply. The movement of the 1-2 accumulator piston forces some accumulator fluid out of the accumulator.

1-2 Accumulator Valve

1-2 accumulator feed fluid forced from the 1-2 accumulator is routed back to the 1-2 accumulator valve. This pressure forces the 1-2 accumulator valve against spring force and the torque signal fluid pressure to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the second clutch apply.

TCC Control Pulse Width Modulated (PWM) Solenoid Valve

2nd fluid is routed to the TCC control PWM solenoid. Under normal operating conditions the TCC control PWM solenoid is OFF in Second gear and blocks 2nd fluid from entering the TCC signal fluid circuit.

Torque Converter Clutch

With the TCC control PWM solenoid OFF the converter clutch is released in Second gear. Under normal operating conditions the TCC is released in Second gear. However, TCC apply could vary depending on vehicle application and may be calibrated to apply in Overdrive Range - Second Gear.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch

Release fluid pressure routed to the TFP manual valve position switch signals the PCM that the TCC is released.

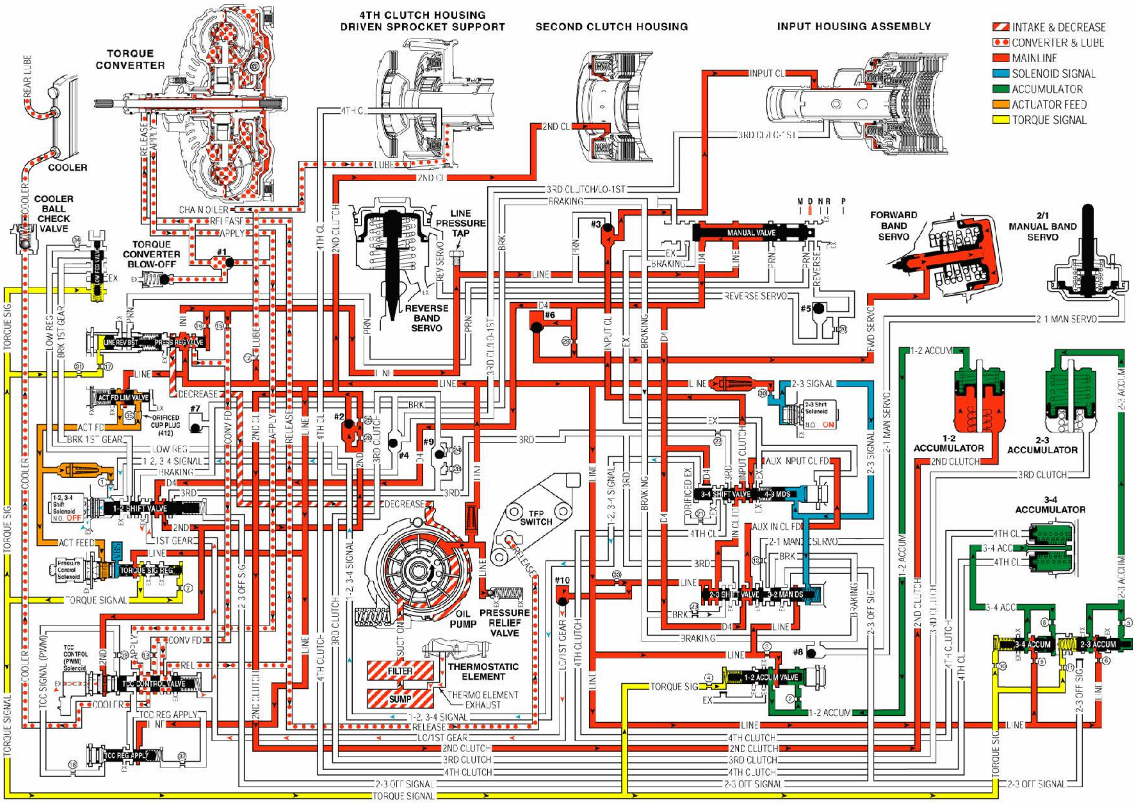

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
COOLER
COOLER BALL CHECK VALVE
TORQUE CONVERTER BLOW-OFF
LINE PRESSURE TAP
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
FILTER
SUMP
THERMOSTATIC ELEMENT
THERMO ELEMENT EXHAUST
1-2 SHIFT VALVE
TORQUE SIG REG
TCC CONTROL VALVE
TCC REG APPLY
3-4 SHIFT VALVE
4-3 MDS
2-3 SHIFT VALVE
3-2 MAN DS
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
2-3 Shift Solenoid N.O. ON
1-2, 3-4 Shift Solenoid N.O. OFF

Fig. 429: Overdrive Range, Second Gear - With Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, THIRD GEAR - TORQUE CONVERTER CLUTCH NOT APPLIED (WITHOUT TOUCH ACTIVATED POWER)

As the speed of the vehicle increases, the powertrain control module (PCM) receives input signals from various engine and transmission sensors. The PCM uses this data to energize the 2-3 shift solenoid (SS) valve in order to shift the transmission into third gear at the appropriate time.

2-3 Shift Solenoid (SS) Valve (315)

De-energizes, allowing 2-3 signal fluid to exhaust through the solenoid. Spring pressure forces the 4-3 manual downshift valve (360) to move while line pressure moves the 2-3 shift valve (357) and 3-2 manual downshift valve (356).

Number 9 Ball Check Valve (372)

Located in the control valve body (300), forces 3rd fluid through a feed orifice and into the

3rd clutch passage.

Number 4 Ball Check Valve (372)

Located in the case cover (400), directs 3rd clutch fluid into the 3rd clutch/lo-1st passage to apply the 3rd clutch.

2-3 Shift Valve (357)

When shifted, allows D4 fluid to enter the 3rd passage to stroke the 2-3 accumulator piston (136) and apply the 3rd clutch. The 2-3 shift valve also allows input clutch apply fluid to exhaust into the D3 passage and out at the manual valve (404). And provides 2-3 off signal fluid to the 1-2 shift valve.

Third Clutch

3rd clutch/lo-1st fluid pressure applies the third clutch to shift the transmission into Third gear.

Third Roller Clutch

Holds as third clutch applies.

Input Clutch

In third gear, the input clutch is released allowing input clutch apply fluid to exhaust through the 3-4 shift valve (362) into the input clutch feed passage. At the 2-3 shift valve (357), exhausting input clutch apply fluid is directed into the D3 passage and out the manual valve (404).

Forward Band

Remains applied, but is ineffective.

1-2 Support Roller Clutch

Overruns as third clutch is applied.

2-3 Accumulator

Third clutch feed fluid is also routed to the 2-3 accumulator piston. This fluid pressure moves the piston against spring force and 2-3 accumulator feed fluid pressure. This action absorbs initial third clutch fluid pressure to cushion the third clutch apply. The movement of the 2-3 accumulator piston forces some accumulator fluid out of the accumulator.

2-3 Accumulator Valve

Excess 2-3 accumulator feed fluid is routed back to the 2-3 accumulator valve. This fluid pressure moves the accumulator valve against spring force and torque signal fluid pressure to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the third clutch apply.

Torque Converter Clutch

TCC apply could vary depending on vehicle application and may be calibrated to apply in Overdrive Range - Third Gear.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch

Release fluid pressure routed to the TFP manual valve position switch signals the PCM that the TCC is released.

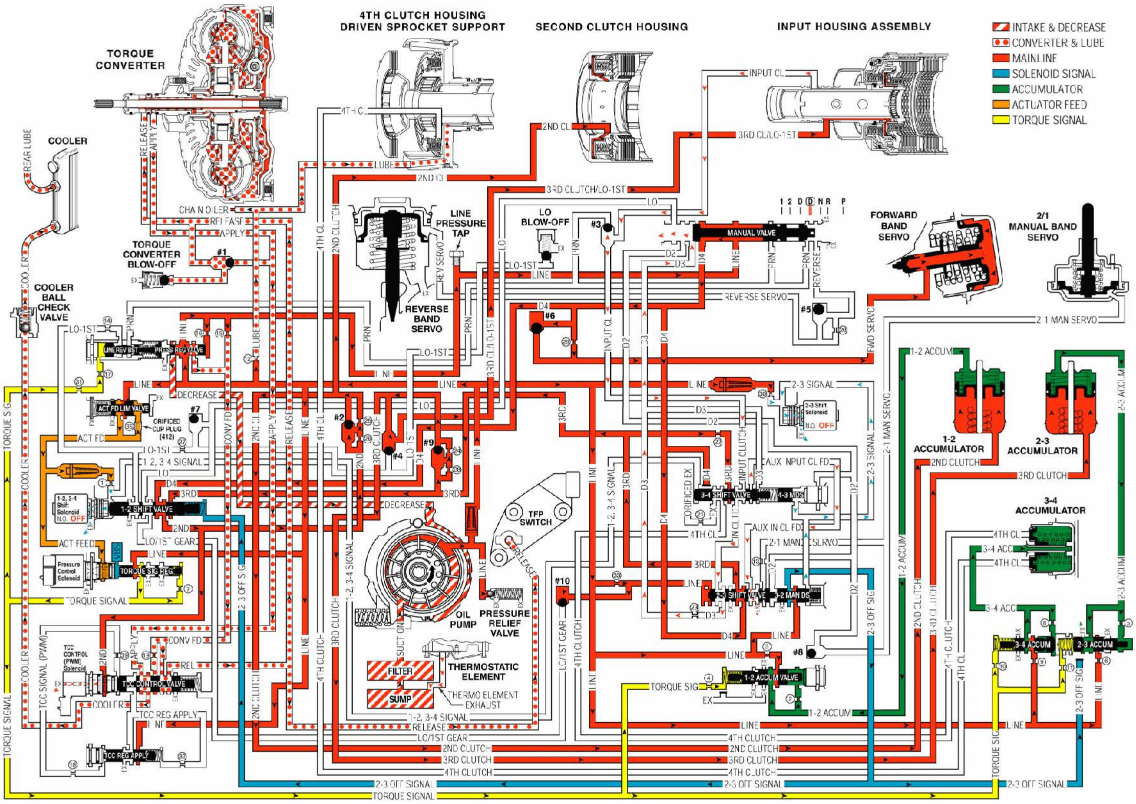

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAIN LINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
COOLER
TORQUE CONVERTER BLOW-OFF
COOLER BALL CHECK VALVE
LINE PRESSURE TAP
REVERSE BAND SERVO
LO BLOW-OFF
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
ACT FD LIM VALVE
ORIFICED CUP PLUG (#12)
1-2 SHIFT VALVE
1-2, 3-4 Shift Solenoid N.O. OFF
2-3 Shift Solenoid N.O. OFF
Pressure Control Solenoid
TORQUE SIG REG
TCC CONTROL (PWM) Solenoid
TCC CONTROL VALVE
TCC REG APPLY
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
THERMO ELEMENT EXHAUST
FILTER
SUMP
3-4 SHIFT VALVE
2-3 SHIFT VALVE
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
1 2 D D N R P

Fig. 430: Overdrive Range, Third Gear - Torque Converter Clutch (TCC) Not Applied - Without Touch Activated Power Fluid Flow Diagram

Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, THIRD GEAR - TORQUE CONVERTER CLUTCH NOT APPLIED (WITH TOUCH ACTIVATED POWER)

As the speed of the vehicle increases, the powertrain control module (PCM) receives input signals from various engine and transmission sensors. The PCM uses this data to energize the 2-3 shift solenoid (SS) valve in order to shift the transmission into third gear at the appropriate time.

2-3 Shift Solenoid (SS) Valve (315)

De-energizes, allowing 2-3 signal fluid to exhaust through the solenoid. Spring pressure forces the 4-3 manual downshift valve (360) to move while line pressure moves the 2-3 shift valve (357) and 3-2 manual downshift valve (356).

Number 9 Ball Check Valve (372)

Located in the control valve body (300), forces 3rd fluid through a feed orifice and into the 3rd clutch passage.

Number 4 Ball Check Valve (372)

Located in the case cover (400), directs 3rd clutch fluid into the 3rd clutch/lo-1st passage to apply the 3rd clutch.

2-3 Shift Valve (357)

When shifted, allows D4 fluid to enter the 3rd passage to stroke the 2-3 accumulator piston (136) and apply the 3rd clutch. The 2-3 shift valve also allows input clutch apply fluid to exhaust into the D3 passage and out at the manual valve (404). And provides 2-3 off signal fluid to the 1-2 shift valve.

Third Clutch

3rd clutch/lo-1st fluid pressure applies the third clutch to shift the transmission into Third gear.

Third Roller Clutch

Holds as third clutch applies.

Input Clutch

In third gear, the input clutch is released allowing input clutch apply fluid to exhaust through the 3-4 shift valve (362) into the input clutch feed passage. At the 2-3 shift valve (357), exhausting input clutch apply fluid is directed into the D3 passage and out the manual valve (404).

Forward Band

Remains applied, but is ineffective.

1-2 Support Roller Clutch

Overruns as third clutch is applied.

2-3 Accumulator

Third clutch feed fluid is also routed to the 2-3 accumulator piston. This fluid pressure moves the piston against spring force and 2-3 accumulator feed fluid pressure. This action absorbs initial third clutch fluid pressure to cushion the third clutch apply. The movement of the 2-3 accumulator piston forces some accumulator fluid out of the accumulator.

2-3 Accumulator Valve

Excess 2-3 accumulator feed fluid is routed back to the 2-3 accumulator valve. This fluid pressure moves the accumulator valve against spring force and torque signal fluid pressure to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the third clutch apply.

Torque Converter Clutch

TCC apply could vary depending on vehicle application and may be calibrated to apply in Overdrive Range - Third Gear.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch

Release fluid pressure routed to the TFP manual valve position switch signals the PCM that the TCC is released.

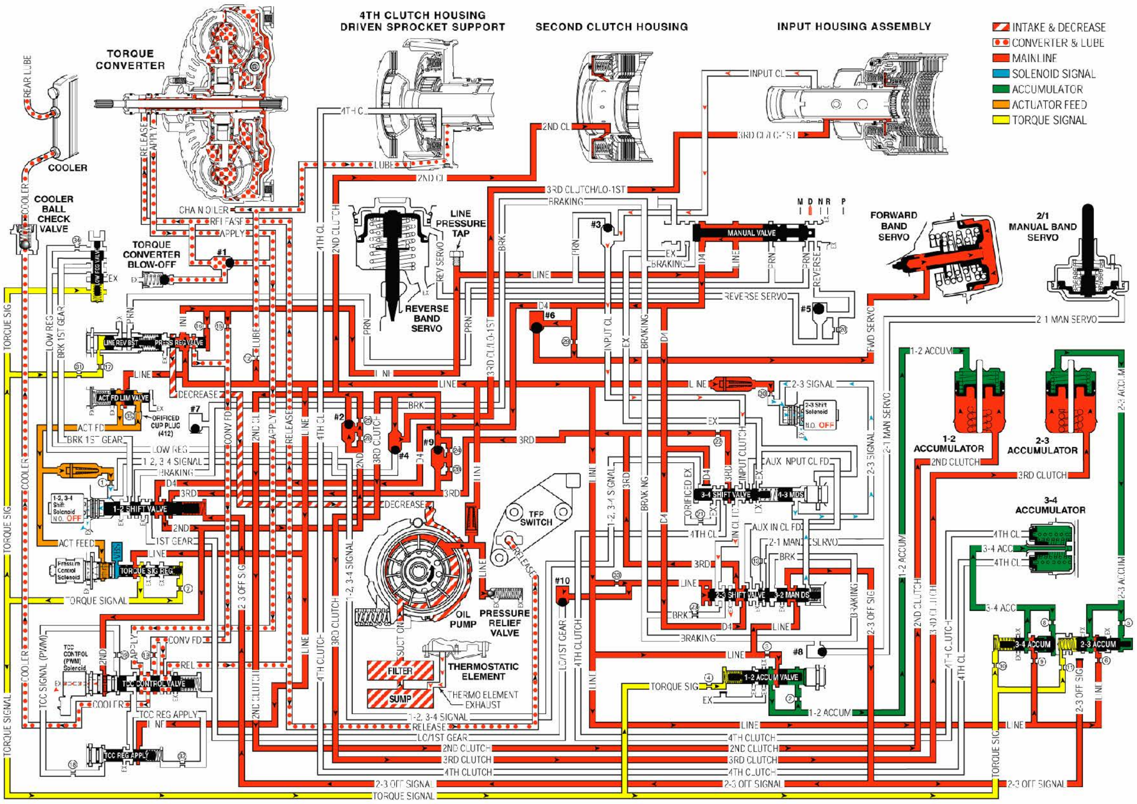

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
▨ INTAKE & DECREASE
▨ CONVERTER & LUBE
🟥 MAINLINE
🟦 SOLENOID SIGNAL
🟩 ACCUMULATOR
🟧 ACTUATOR FEED
🟨 TORQUE SIGNAL
COOLER
COOLER BALL CHECK VALVE
TORQUE CONVERTER BLOW-OFF
LINE PRESSURE TAP
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
FILTER
SUMP
THERMO ELEMENT EXHAUST
1-2 SHIFT VALVE
2-3 SHIFT VALVE
3-4 SHIFT VALVE
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
TCC CONTROL VALVE
TCC REG APPLY
TORQUE SIG REG
ACT FD LIM VALVE
PRESS REG VALVE
LINE
2ND CLUTCH
3RD CLUTCH
4TH CLUTCH
TORQUE SIGNAL
2-3 OFF SIGNAL
REVERSE SERVO
REAR LUBE

Fig. 431: Overdrive Range, Third Gear - Torque Converter Clutch (TCC) Not Applied - With Touch Activated Power Fluid Flow Diagram

Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, FOURTH GEAR - TORQUE CONVERTER CLUTCH NOT APPLIED (WITHOUT TOUCH ACTIVATED POWER)

As the speed of the vehicle continues to increase, the powertrain control module (PCM) monitors the input signals from various engine and transmission sensors. The PCM uses this data to energize the 1-2, 3-4 shift solenoid (SS) valve in order to shift the transmission into fourth gear at the appropriate time.

1-2, 3-4 Shift Solenoid (SS) Valve (315)

Energizes to prevent fluid from exhausting out of the line passage and the 1-2, 3-4 signal fluid passage.

1-2 Shift Valve (318)

Is held against 1-2, 3-4 signal fluid pressure by spring pressure and 2-3 off signal fluid pressure at the end of the valve.

3-4 Shift Valve (362)

When 1-2, 3-4 signal fluid shifts the 3-4 shift valve against spring force, it allows 3rd fluid to enter the 4th clutch fluid passage. 4th clutch fluid is forced through a feed orifice before stroking the 3-4 accumulator piston (428) and applying the fourth clutch.

Fourth Clutch

4th Clutch fluid pressure applies the fourth clutch to shift the transmission to fourth gear.

Third Clutch

Remains applied, but is ineffective.

Third Roller Clutch

Overruns as fourth clutch is applied. In third gear, the input clutch is released allowing input clutch apply fluid to exhaust through the 3-4 shift valve (362) into the input clutch feed passage. At the 2-3 shift valve (357), exhausting input clutch apply fluid is directed into the D3 passage and out the manual valve (404).

Second Clutch

Remains applied.

Forward Band

Remains applied, but is ineffective.

1-2 Support Roller Clutch

Continues to overrun.

3-4 Accumulator

4th clutch fluid is also routed to the 3-4 accumulator piston. 4th clutch fluid pressure moves the piston against spring force and 3-4 accumulator feed fluid pressure. This action absorbs initial 4th clutch fluid pressure to cushion the 4th clutch apply. The movement of the 3-4 accumulator piston forces some accumulator fluid out of the accumulator.

3-4 Accumulator Valve

Excess 3-4 accumulator feed fluid is routed back to the 3-4 accumulator valve. This fluid pressure moves the accumulator valve against spring force and torque signal fluid pressure to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the fourth clutch apply.

Torque Converter Clutch

TCC apply could vary depending on vehicle application and may be calibrated to apply in Overdrive Range - Fourth Gear.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch

Release fluid pressure routed to the TFP manual valve position switch signals the PCM that the TCC is released.

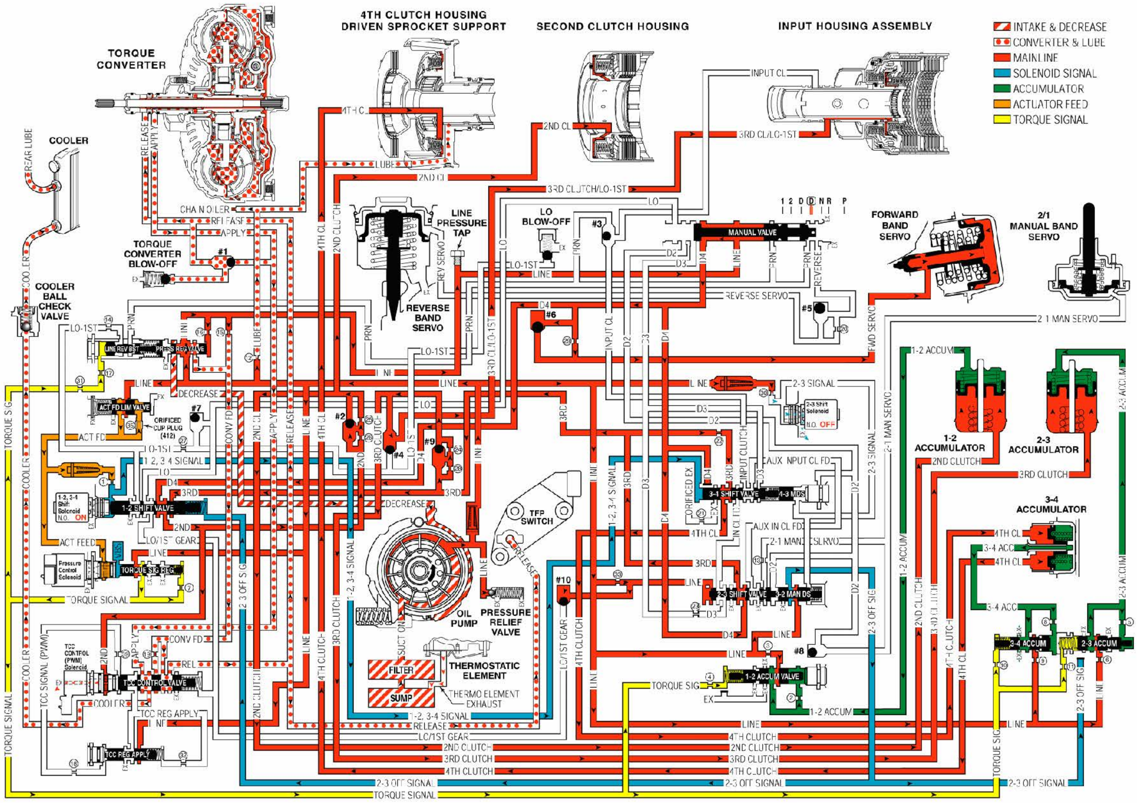

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
COOLER
TORQUE CONVERTER BLOW-OFF
COOLER BALL CHECK VALVE
LINE PRESSURE TAP
LO BLOW-OFF
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
ACT FD LIM VALVE
1-2 SHIFT VALVE
TORQUE SIG REG
TCC CONTROL VALVE
TCC REG APPLY
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
FILTER
SUMP
THERMOSTATIC ELEMENT
THERMO ELEMENT EXHAUST
3-4 SHIFT VALVE
4-3 MDS
2-3 SHIFT VALVE
3-2 MAN DS
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
2-3 Shift Solenoid N.O. OFF
1-2, 3-4 Shift Solenoid N.O. ON
Pressure Control Solenoid
TCC CONTROL (PWM) Solenoid

Fig. 432: Overdrive Range, Fourth Gear - TCC Not Applied - Without Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, FOURTH GEAR - TORQUE CONVERTER CLUTCH NOT APPLIED (WITH TOUCH ACTIVATED POWER)

As the speed of the vehicle continues to increase, the powertrain control module (PCM) monitors the input signals from various engine and transmission sensors. The PCM uses this data to energize the 1-2, 3-4 shift solenoid (SS) valve in order to shift the transmission into fourth gear at the appropriate time.

1-2, 3-4 Shift Solenoid (SS) Valve (315)

Energizes to prevent fluid from exhausting out of the line passage and the 1-2, 3-4 signal fluid passage.

1-2 Shift Valve (318)

Is held against 1-2, 3-4 signal fluid pressure by spring pressure and 2-3 off signal fluid pressure at the end of the valve.

3-4 Shift Valve (362)

When 1-2, 3-4 signal fluid shifts the 3-4 shift valve against spring force, it allows 3rd fluid to enter the 4th clutch fluid passage. 4th clutch fluid is forced through a feed orifice before stroking the 3-4 accumulator piston (428) and applying the fourth clutch.

Fourth Clutch

4th Clutch fluid pressure applies the fourth clutch to shift the transmission to fourth gear.

Third Clutch

Remains applied, but is ineffective.

Third Roller Clutch

Overruns as fourth clutch is applied. In third gear, the input clutch is released allowing input clutch apply fluid to exhaust through the 3-4 shift valve (362) into the input clutch feed passage. At the 2-3 shift valve (357), exhausting input clutch apply fluid is directed into the D3 passage and out the manual valve (404).

Second Clutch

Remains applied.

Forward Band

Remains applied, but is ineffective.

1-2 Support Roller Clutch

Continues to overrun.

3-4 Accumulator

4th clutch fluid is also routed to the 3-4 accumulator piston. 4th clutch fluid pressure moves the piston against spring force and 3-4 accumulator feed fluid pressure. This action absorbs initial 4th clutch fluid pressure to cushion the 4th clutch apply. The movement of the 3-4 accumulator piston forces some accumulator fluid out of the accumulator.

3-4 Accumulator Valve

Excess 3-4 accumulator feed fluid is routed back to the 3-4 accumulator valve. This fluid pressure moves the accumulator valve against spring force and torque signal fluid pressure to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the fourth clutch apply.

Torque Converter Clutch

TCC apply could vary depending on vehicle application and may be calibrated to apply in Overdrive Range - Fourth Gear.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch

Release fluid pressure routed to the TFP manual valve position switch signals the PCM that the TCC is released.

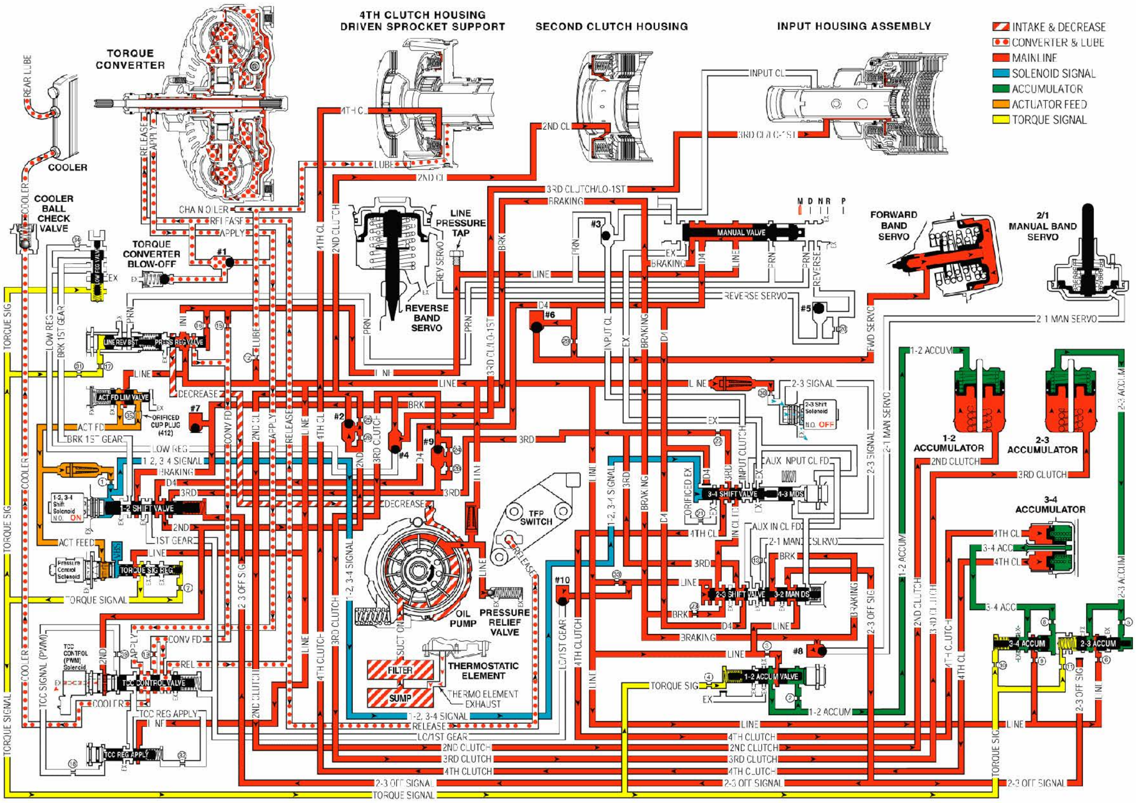

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
REAR LUBE
COOLER
COOLER BALL CHECK VALVE
TORQUE CONVERTER BLOW-OFF
LINE PRESSURE TAP
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
2-3 Shift Solenoid
OFF
1-2, 3-4 Shift Solenoid
ON
1-2 SHIFT VALVE
3-4 SHIFT VALVE
2-3 SHIFT VALVE
3-2 MAN DS
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
THERMO ELEMENT EXHAUST
FILTER
SUMP
TCC CONTROL (PWM) Solenoid
TCC CONTROL VALVE
TCC REG APPLY
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
ACT FD LIM VALVE
ORIFICED CUP PLUG (412)
TORQUE SIG REG
Pressure Control Solenoid
LINE
TORQUE SIGNAL
2-3 OFF SIGNAL
4TH CLUTCH
3RD CLUTCH
2ND CLUTCH
LO/1ST GEAR
RELEASE
1-2, 3-4 SIGNAL
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10

Fig. 433: Overdrive Range, Fourth Gear - TCC Not Applied - With Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, FOURTH GEAR - TORQUE CONVERTER CLUTCH APPLIED (WITHOUT TOUCH ACTIVATED POWER)

The torque converter clutch applies during third or fourth gear operation after the powertrain control module (PCM) receives the appropriate input signals to energize the TCC control (PWM) solenoid. To apply the torque converter clutch, the following changes take place in the electrical and hydraulic systems:

TCC Control (PWM) Solenoid

When conditions are appropriate, the PCM energizes the TCC control (PWM) solenoid to initiate the TCC apply. The solenoid is pulse width modulated (PWM) to provide a smooth TCC apply (refer to the appropriate electrical controls information for a detailed description of the TCC control (PWM) solenoid operation). When energized, the TCC control (PWM) solenoid modulates 2nd fluid into the TCC signal (PWM) fluid circuit.

TCC Regulator Valve

TCC signal (PWM) fluid pressure modulates the valve against spring force and TCC regulated apply fluid pressure. This action directs line pressure into the TCC regulated apply fluid circuit in relation to vehicle operating conditions.

TCC Control Valve

Modulated TCC signal (PWM) fluid pressure moves the valve against spring force in relation to vehicle operating conditions. This action regulates TCC regulated apply fluid into the TCC apply fluid circuit. At the same time, the TCC release fluid circuit is opened to an orificed exhaust. In this position the valve directs converter feed fluid to feed the cooler fluid circuit.

Torque Converter Clutch

TCC apply fluid is routed to the torque converter clutch at the same time TCC release fluid exhausts from the torque converter clutch. TCC apply fluid pressure applies the TCC.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch

Release fluid also exhausts from the TFP manual valve position switch and the TFP manual valve position switch signals the PCM that the TCC is engaged.

Cooler Check Valve

Located in either the case cover or cooler line fitting depending on model. Allows cooler fluid to pass through the cooler and provide lubrication for the transmission. It also prevents converter drainback when the engine is off.

Number 1 Ball Check Valve (372)

Located in the case cover (400), blocks TCC release fluid while sending TCC apply fluid to the torque converter clutch blow-off valve (417-20).

Converter Clutch Blow-off Valve

Limits maximum TCC apply pressure to prevent torque converter damage.

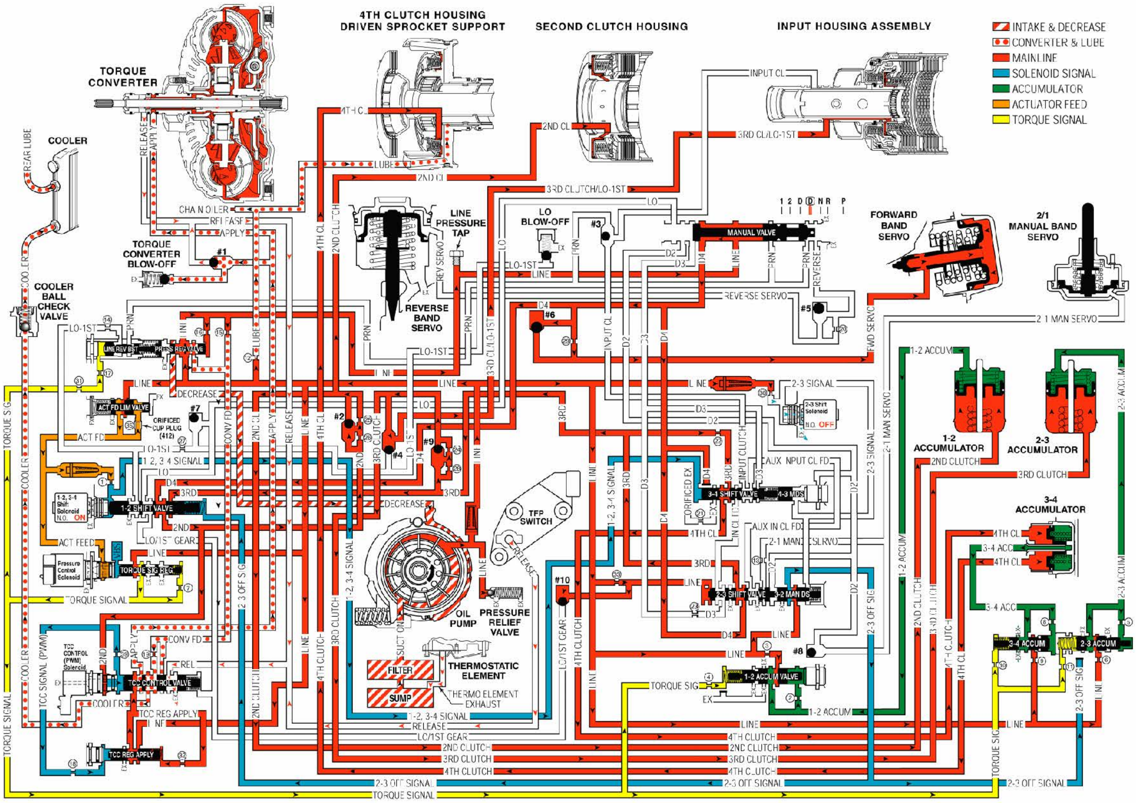

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
COOLER
REAR LUBE
TORQUE CONVERTER BLOW-OFF
COOLER BALL CHECK VALVE
LINE PRESSURE TAP
REVERSE BAND SERVO
LO BLOW-OFF
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
ACT FD LIM VALVE
ORIFICED CUP PLUG (#12)
1-2 SHIFT VALVE
1-2, 3-4 Shift Solenoid N.O. ON
Pressure Control Solenoid
TORQUE SIG REG
TCC CONTROL (PWM) Solenoid
TCC CONTROL VALVE
TCC REG APPLY
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
FILTER
SUMP
THERMOSTATIC ELEMENT
THERMO ELEMENT EXHAUST
3-4 SHIFT VALVE
4-3 MDS
2-3 Shift Solenoid N.O. OFF
2-3 SHIFT VALVE
3-2 MAN DS
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
1 2 D D N R P
LINE
TORQUE SIGNAL
2-3 OFF SIGNAL
RELEASE
APPLY
LO/1ST GEAR
2ND CLUTCH
3RD CLUTCH
4TH CLUTCH
1-2 ACCUM

Fig. 434: Overdrive Range, Fourth Gear - TCC Applied - Without Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, FOURTH GEAR - TORQUE CONVERTER CLUTCH APPLIED (WITH TOUCH ACTIVATED POWER)

The torque converter clutch applies during third or fourth gear operation after the powertrain control module (PCM) receives the appropriate input signals to energize the TCC control (PWM) solenoid. To apply the torque converter clutch, the following changes take place in the electrical and hydraulic systems:

TCC Control (PWM) Solenoid

When conditions are appropriate, the PCM energizes the TCC control (PWM) solenoid to initiate the TCC apply. The solenoid is pulse width modulated (PWM) to provide a smooth TCC apply (refer to the appropriate electrical controls information for a detailed description of the TCC control (PWM) solenoid operation). When energized, the TCC control (PWM) solenoid modulates 2nd fluid into the TCC signal (PWM) fluid circuit.

TCC Regulator Valve

TCC signal (PWM) fluid pressure modulates the valve against spring force and TCC regulated apply fluid pressure. This action directs line pressure into the TCC regulated apply fluid circuit in relation to vehicle operating conditions.

TCC Control Valve

Modulated TCC signal (PWM) fluid pressure moves the valve against spring force in relation to vehicle operating conditions. This action regulates TCC regulated apply fluid into the TCC apply fluid circuit. At the same time, the TCC release fluid circuit is opened to an orificed exhaust. In this position the valve directs converter feed fluid to feed the cooler fluid circuit.

Torque Converter Clutch

TCC apply fluid is routed to the torque converter clutch at the same time TCC release fluid exhausts from the torque converter clutch. TCC apply fluid pressure applies the TCC.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch

Release fluid also exhausts from the TFP manual valve position switch and the TFP manual valve position switch signals the PCM that the TCC is engaged.

Cooler Check Valve

Located in either the case cover or cooler line fitting depending on model. Allows cooler fluid to pass through the cooler and provide lubrication for the transmission. It also prevents converter drainback when the engine is off.

Number 1 Ball Check Valve (372)

Located in the case cover (400), blocks TCC release fluid while sending TCC apply fluid to the torque converter clutch blow-off valve (417-20).

Converter Clutch Blow-off Valve

Limits maximum TCC apply pressure to prevent torque converter damage.

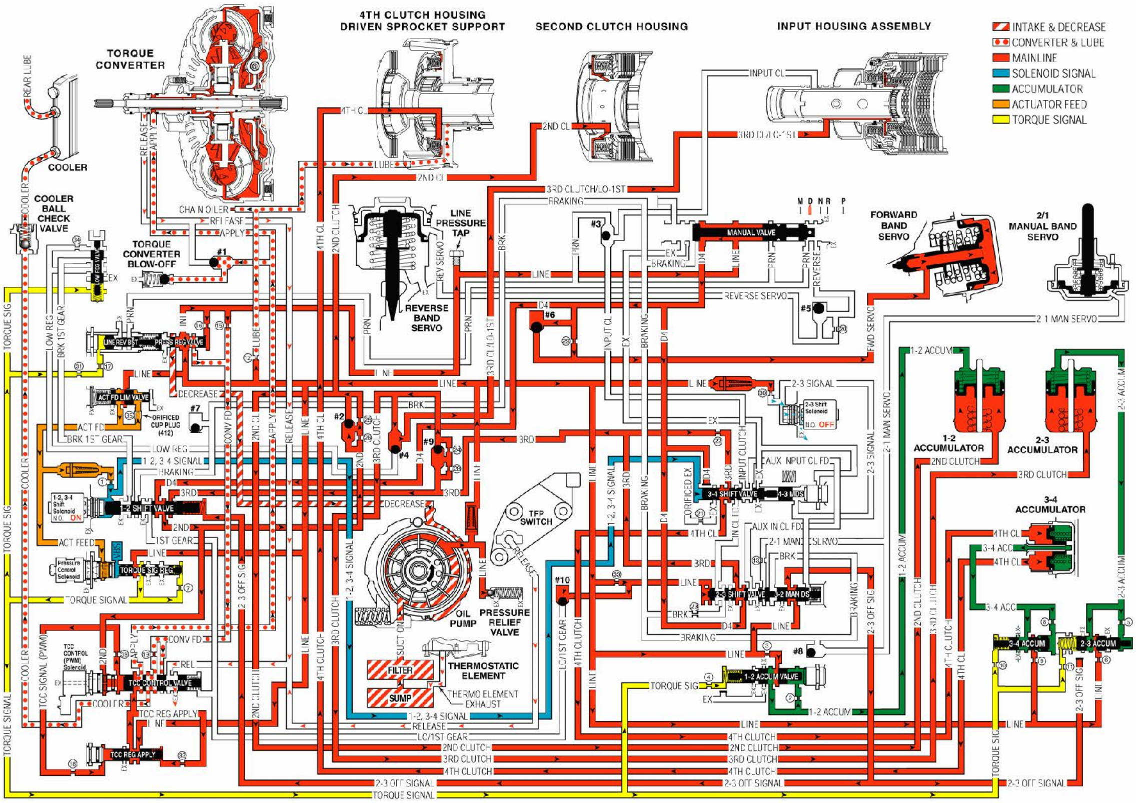

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
REAR LUBE
COOLER
COOLER BALL CHECK VALVE
TORQUE CONVERTER BLOW-OFF
LINE PRESSURE TAP
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
2-3 Shift Solenoid N.O. OFF
1-2, 3-4 Shift Solenoid N.O. ON
1-2 SHIFT VALVE
3-4 SHIFT VALVE
2-3 SHIFT VALVE
TORQUE SIG REG
TCC CONTROL VALVE
TCC REG APPLY
TCC CONTROL (PWM) Solenoid
Pressure Control Solenoid
ACT FD LIM VALVE
ORIFICED CUP PLUG (#12)
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
FILTER
SUMP
THERMOSTATIC ELEMENT
THERMO ELEMENT EXHAUST
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
M D N R P

Fig. 435: Overdrive Range, Fourth Gear - TCC Applied - With Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, 4-3 DOWNSHIFT - TORQUE CONVERTER CLUTCH NOT APPLIED (WITHOUT TOUCH ACTIVATED POWER)

When the transmission is operating in Fourth gear, a 4-3 downshift will occur if there is a significant change (increase) in the throttle position or if the load on the engine is increased. When the 4-3 downshift occurs, the torque converter clutch will release prior to the shift occurring which results in the following changes in the hydraulic system:

Pressure Control (PC) Solenoid

During the downshift, except for a coastdown, the PCM senses the increase in throttle position or engine load and increases the PC solenoid duty cycle. The increase in duty cycle increases output fluid pressure from the PC solenoid, thereby increasing torque signal fluid pressure at the torque signal regulator valve.

Pressure Regulator Valve

Increased torque signal fluid pressure acting on the line boost valve increases line pressure at the pressure regulator valve.

TCC Control (PWM) Solenoid Valve

As the throttle position changes, the throttle position sensor provides input to the PCM indicating throttle angle. The PCM then lowers the ON/OFF cycle time of the TCC control PWM solenoid valve, lowering TCC signal (PWM) fluid pressure.

TCC Control Valve

Lowered TCC signal (PWM) fluid pressure allows the valve to move with spring pressure, allowing converter feed fluid into the TCC release circuit. TCC release fluid is then routed to the torque converter pressure plate and disengages the torque converter clutch, TCC apply fluid from the torque converter clutch pressure plate is then routed back through its circuit to the converter clutch control valve. TCC apply fluid passes through the valve and enters the cooler circuit.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch

When the TCC is in the release position, TCC release fluid pressure is routed to the TFP manual valve position switch. This fluid pressure signals the PCM that the TCC is in the released position.

1-2, 3-4 Shift Solenoid (SS) Valve (315)

De-energizes, allowing 1-2, 3-4 signal fluid at the 3-4 shift valve (362) to exhaust through the solenoid.

3-4 Shift Valve (362)

When 1-2, 3-4 signal fluid exhausts, spring force moves the valve allowing 4th clutch fluid to exhaust through the valve.

Fourth Clutch

Fourth Clutch fluid is exhausted at the 3-4 shift valve and the driven support ball check valve. Fourth clutch return spring pressure moves the fourth clutch piston and releases the fourth clutch.

3-4 Accumulator

4th Clutch fluid exhausts from the accumulator. Spring force and 3-4 accumulator feed fluid pressure move the accumulator piston to the Third gear position.

3-4 Accumulator Valve

The accumulator valve regulates line pressure into the 3-4 accumulator fluid circuit to fill the 3-4 accumulator. This regulation is basically controlled by torque signal fluid pressure. Increased torque signal fluid pressure regulates accumulator fluid to a higher pressure. Note: The clutch and band application information is the same as Overdrive Range - Third Gear.

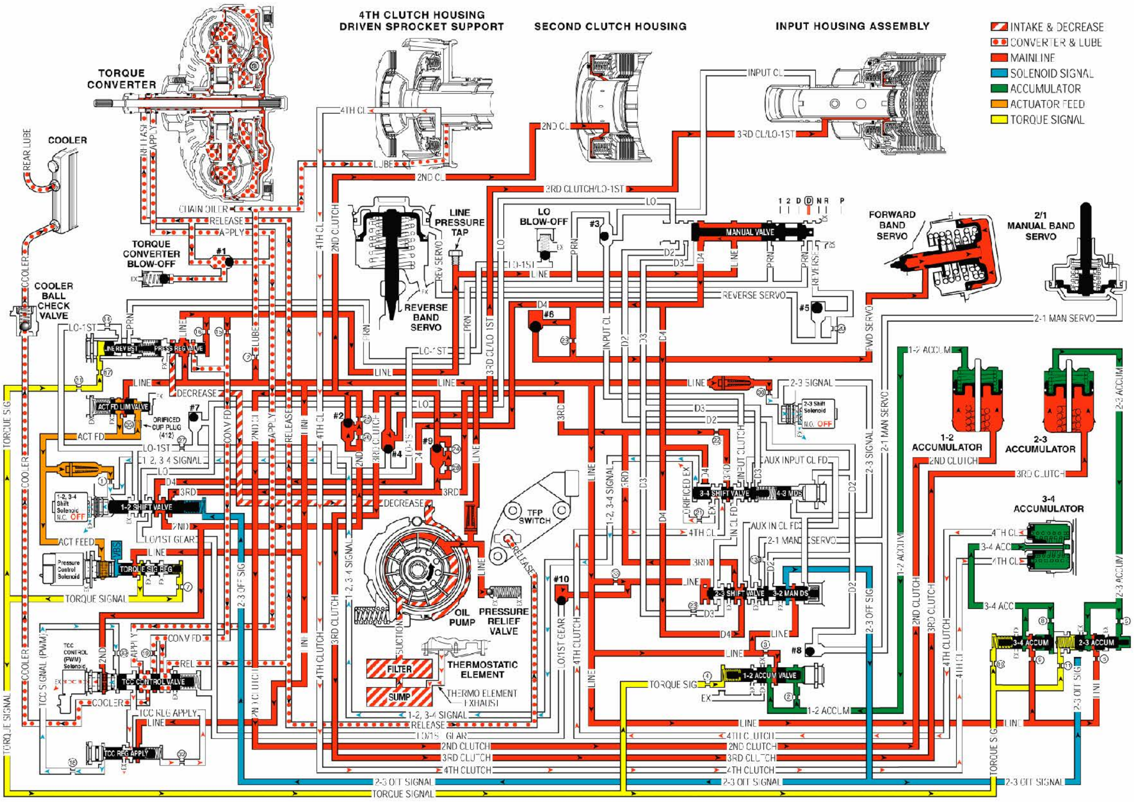

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAIN LINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
COOLER
TORQUE CONVERTER BLOW-OFF
COOLER BALL CHECK VALVE
LINE PRESSURE TAP
LO BLOW-OFF
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
1-2 SHIFT VALVE
TORQUE SIG REG
TCC CONTROL VALVE
TCC REG APPLY
ACT FD LIMIT VALVE
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
FILTER
SUMP
THERMOSTATIC ELEMENT
THERMO ELEMENT EXHAUST
3-4 SHIFT VALVE
2-3 SHIFT VALVE
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
2-3 Shift Solenoid N.C. OFF
1-2, 3-4 Shift Solenoid N.C. OFF
Pressure Control Solenoid
TCC CONTROL (PWM) Solenoid
TORQUE SIGNAL
2-3 OFF SIGNAL
LINE

Fig. 436: Overdrive Range, 4-3 Downshift - TCC Not Applied - Without Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, 4-3 DOWNSHIFT - TORQUE CONVERTER CLUTCH NOT APPLIED (WITH TOUCH ACTIVATED POWER)

When the transmission is operating in Fourth gear, a 4-3 downshift will occur if there is a significant change (increase) in the throttle position or if the load on the engine is increased. When the 4-3 downshift occurs, the torque converter clutch will release prior to the shift occurring which results in the following changes in the hydraulic system:

Pressure Control (PC) Solenoid

During the downshift, except for a coastdown, the PCM senses the increase in throttle position or engine load and increases the PC solenoid duty cycle. The increase in duty cycle increases output fluid pressure from the PC solenoid, thereby increasing torque signal fluid pressure at the torque signal regulator valve.

Pressure Regulator Valve

Increased torque signal fluid pressure acting on the line boost valve increases line pressure at the pressure regulator valve.

TCC Control (PWM) Solenoid Valve

As the throttle position changes, the throttle position sensor provides input to the PCM indicating throttle angle. The PCM then lowers the ON/OFF cycle time of the TCC control PWM solenoid valve, lowering TCC signal (PWM) fluid pressure.

TCC Control Valve

Lowered TCC signal (PWM) fluid pressure allows the valve to move with spring pressure, allowing converter feed fluid into the TCC release circuit. TCC release fluid is then routed to the torque converter pressure plate and disengages the torque converter clutch, TCC apply fluid from the torque converter clutch pressure plate is then routed back through its circuit to the converter clutch control valve. TCC apply fluid passes through the valve and enters the cooler circuit.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch

When the TCC is in the release position, TCC release fluid pressure is routed to the TFP manual valve position switch. This fluid pressure signals the PCM that the TCC is in the released position.

1-2, 3-4 Shift Solenoid (SS) Valve (315)

De-energizes, allowing 1-2, 3-4 signal fluid at the 3-4 shift valve (362) to exhaust through the solenoid.

3-4 Shift Valve (362)

When 1-2, 3-4 signal fluid exhausts, spring force moves the valve allowing 4th clutch fluid to exhaust through the valve.

Fourth Clutch

Fourth Clutch fluid is exhausted at the 3-4 shift valve and the driven support ball check valve. Fourth clutch return spring pressure moves the fourth clutch piston and releases the fourth clutch.

3-4 Accumulator

4th Clutch fluid exhausts from the accumulator. Spring force and 3-4 accumulator feed fluid pressure move the accumulator piston to the Third gear position.

3-4 Accumulator Valve

The accumulator valve regulates line pressure into the 3-4 accumulator fluid circuit to fill the 3-4 accumulator. This regulation is basically controlled by torque signal fluid pressure. Increased torque signal fluid pressure regulates accumulator fluid to a higher pressure. Note: The clutch and band application information is the same as Overdrive Range - Third Gear.

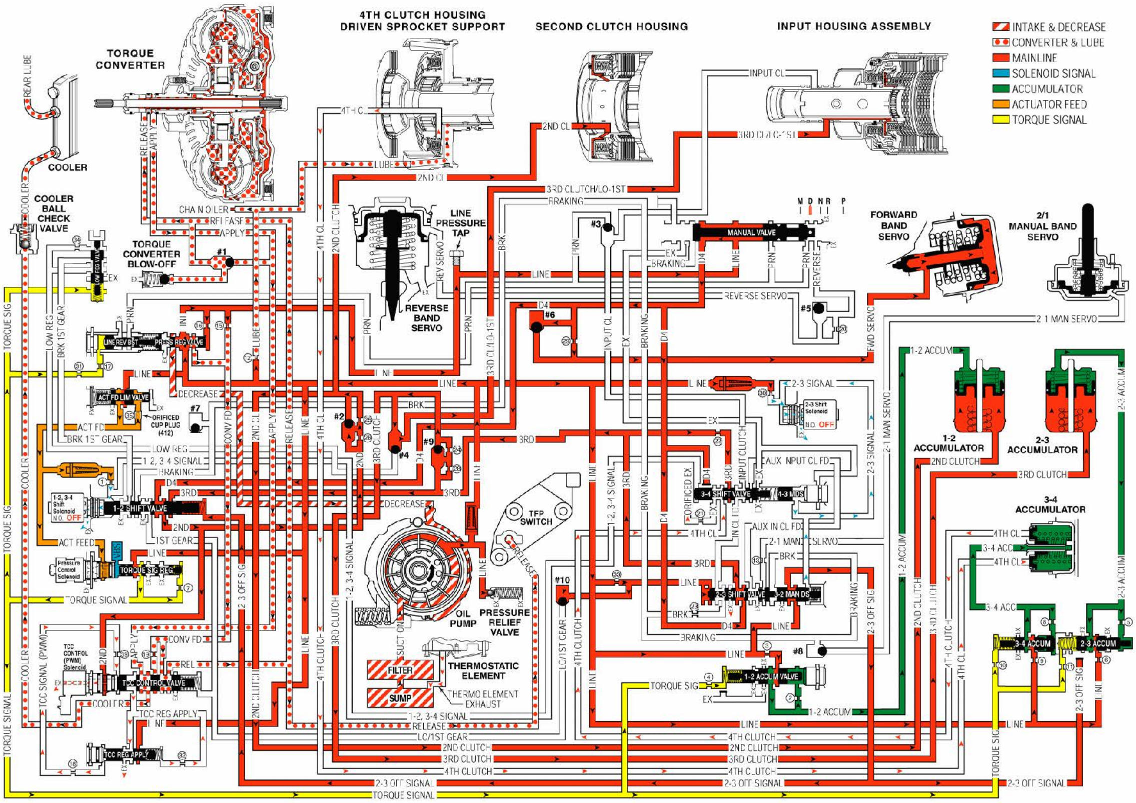

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
COOLER
COOLER BALL CHECK VALVE
TORQUE CONVERTER BLOW-OFF
LINE PRESSURE TAP
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
FILTER
SUMP
1-2 SHIFT VALVE
2-3 SHIFT VALVE
3-4 SHIFT VALVE
TCC CONTROL VALVE
TCC REG APPLY
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
TORQUE SIGNAL
2-3 OFF SIGNAL

Fig. 437: Overdrive Range, 4-3 Downshift - TCC Not Applied - With Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

DRIVE RANGE, MANUAL THIRD (FROM OVERDRIVE RANGE) (WITHOUT TOUCH ACTIVATED POWER)

A manual 4-3 downshift is accomplished by moving the gear selector lever to the Manual Third (3) position. In Manual Third the transmission is hydraulically prevented from upshifting into Fourth gear under any conditions. Also, the input clutch is applied in Manual Third range to provide engine compression braking in 3rd gear. The following information explains the additional changes during a manual 4-3 downshift as compared to a forced 4-3 downshift. Refer to Overdrive Range: 4-3 Downshift for a complete description of a 4-3 downshift.

Manual Valve

The manual valve moves into the Manual Third (3) position and line pressure enters the D3 fluid circuit.

2-3 Shift Valve (357)

Allows D3 fluid to enter the input clutch feed passage and directs it to the 3-4 shift valve (362).

3-4 Shift Valve (362)

Is downshift when D3 fluid is fed to the valve. In this position input clutch feed fluid enters the input clutch passage. 4th clutch fluid is exhausted through an orifice.

Number 3 Ball Check Valve (372)

Located in the case cover (400), it is seated against the PRN passage allowing input clutch fluid to apply the input clutch.

1-2, 3-4 Shift Solenoid (SS) Valve (315)

When de-energized, it allows 1-2, 3-4 signal fluid from the 3-4 shift valve (362) to exhaust through the solenoid. However, this event does not have to occur in order to achieve a manual 4-3 downshift.

Manual Third-Second and First Gears

The transmission operates the same in Manual Third as in Overdrive range with the exception of Fourth gear being prevented. The transmission will upshift and downshift between First, Second and Third gears as in Overdrive range. However, engine compression braking is not available in Manual Third - First gear and the vehicle will coast when the throttle is released.

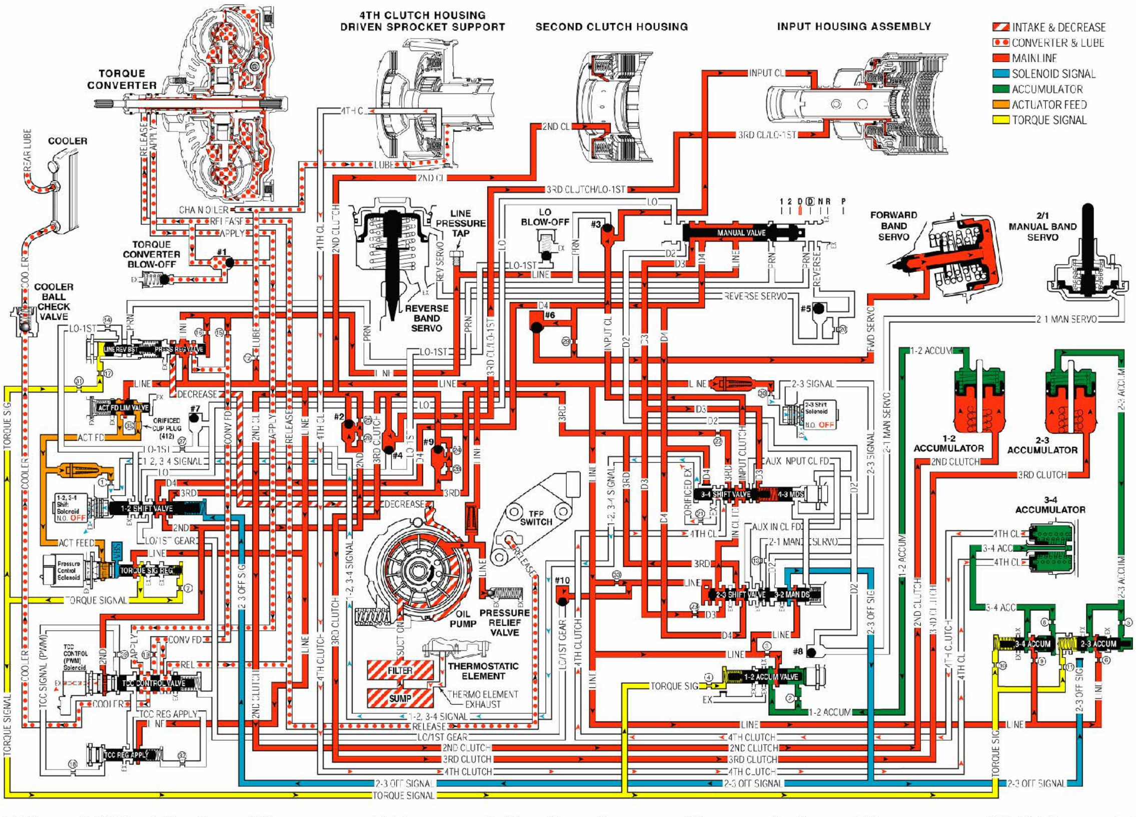

4TH CLUTCH HOUSING
DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
TORQUE CONVERTER
COOLER
TORQUE CONVERTER BLOW-OFF
COOLER BALL CHECK VALVE
LINE PRESSURE TAP
LO BLOW-OFF
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
REVERSE BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
FILTER
SUMP
1-2 SHIFT VALVE
2-3 SHIFT VALVE
3-4 SHIFT VALVE
4-3 MDS
3-2 MAN DS
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
TCC CONTROL VALVE
TCC REG APPLY
TORQUE SIG REG
ACT FD LIM VALVE
LINE BOOST
PRESS REG VALVE
2-3 Shift Solenoid N.O. OFF
1-2, 3-4 Shift Solenoid N.O. OFF
Pressure Control Solenoid
TCC CONTROL (PWM) Solenoid

Fig. 438: Drive Range, Manual 3rd - from Overdrive Range - Without Touch Activated Power Fluid Flow Diagram

Courtesy of GENERAL MOTORS CORP.

MANUAL THIRD GEAR (WITH TOUCH ACTIVATED POWER)

A manual 4-3 downshift is accomplished by moving the gear selector lever to the Manual position. In Manual the transmission is hydraulically prevented from upshifting into Fourth gear under any conditions. Also, the input clutch is applied in Manual range to provide engine compression braking in 3rd gear. The following information explains the additional changes during a manual 4-3 downshift as compared to a forced 4-3 downshift. Refer to Overdrive Range: 4-3 Downshift for a complete description of a 4-3 downshift.

Manual Valve

The manual valve moves into the Manual position and line pressure enters the braking fluid circuit.

2-3 Shift Valve (357)

Allows braking fluid to enter the input clutch feed passage and directs it to the 3-4 shift valve (362).

3-4 Shift Valve (362)

Is downshift when D3 fluid is fed to the valve. In this position input clutch feed fluid enters the input clutch passage. 4th clutch fluid is exhausted through an orifice.

Number 3 Ball Check Valve (372)

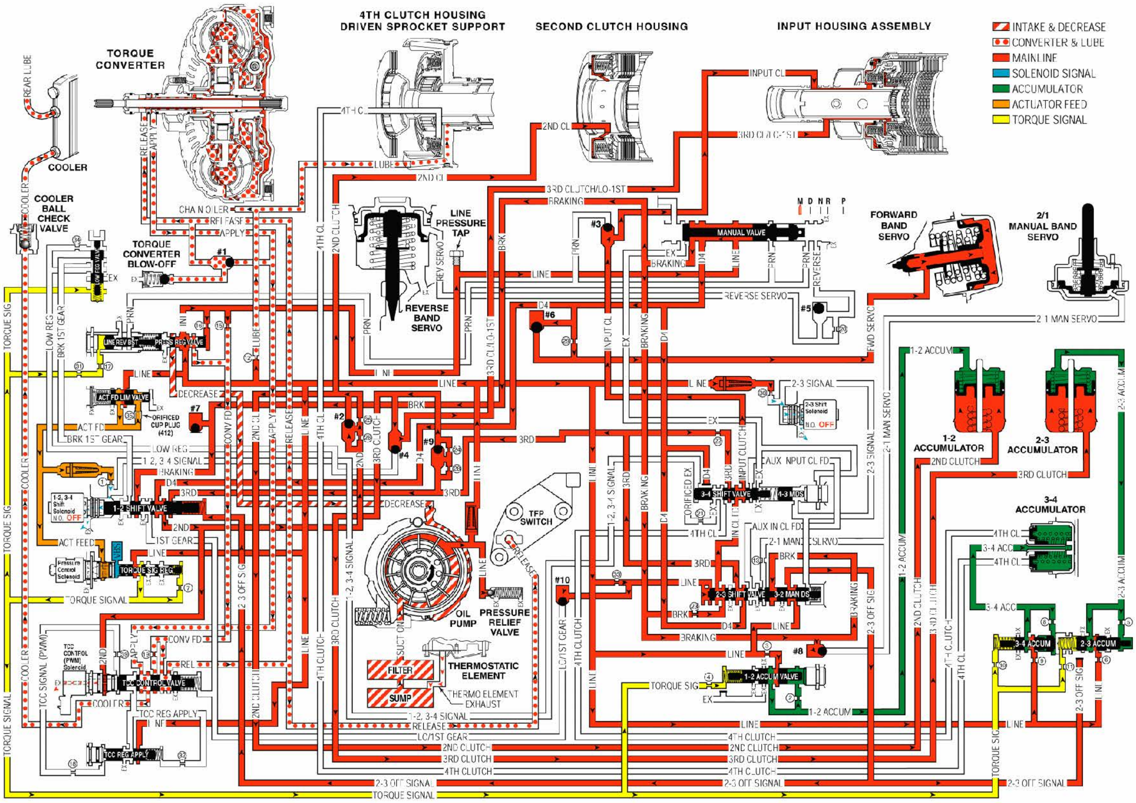
Located in the case cover (400), it is seated against the PRN passage allowing input clutch fluid to apply the input clutch.

1-2, 3-4 Shift Solenoid (SS) Valve (315)

When de-energized, it allows 1-2, 3-4 signal fluid from the 3-4 shift valve (362) to exhaust through the solenoid. However, this event does not have to occur in order to achieve a manual 4-3 downshift.

Manual Third-Second and First Gears

The transmission operates the same in Manual Third as in Overdrive range with the exception of Fourth gear being prevented. The transmission will upshift and downshift between First, Second and Third gears as in Overdrive range. However, engine compression braking is not available in Manual Third - First gear and the vehicle will coast when the throttle is released.


TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
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CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
REAR LUBE
COOLER
COOLER BALL CHECK VALVE
TORQUE CONVERTER BLOW-OFF
LINE PRESSURE TAP
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
FILTER
SUMP
THERMO ELEMENT EXHAUST
1-2 SHIFT VALVE
2-3 SHIFT VALVE
3-4 SHIFT VALVE
TCC CONTROL VALVE
TCC REG APPLY
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
M D N R P
LINE
D4
2ND CL
3RD CLUTCH/LO-1ST
4TH CL
INPUT CL
BRAKING
REVERSE SERVO
2-1 MAN SERVO
TORQUE SIGNAL
2-3 OFF SIGNAL
1-2-3-4 SIGNAL
LC/1ST GEAR
2ND CLUTCH
3RD CLUTCH
4TH CLUTCH
RELEASE
APPLY
CONV FD
DECREASE
EX

Fig. 439: Drive Range, Manual 3rd - from Overdrive Range - With Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

DRIVE RANGE, MANUAL SECOND (FROM DRIVE, MANUAL THIRD) (WITHOUT TOUCH ACTIVATED POWER)

When the gear selector lever is moved to the Manual Second (D2) gear range, the manual valve moves and allows line pressure to enter the D2 fluid passage. The transmission reacts by shifting immediately into second gear range and is prevented from upshifting into either Third or Fourth gear.

Manual Valve (404)

Is moved by the gear selector lever allowing line pressure to enter the D2 passage.

Number 8 Ball Check Valve (372)

Located in the control valve body (300), is fed D2 fluid from the manual valve (404) and directs it to the 2-3 shift valve (357).

2-3 Shift Valve (357)

When shifted by D2 fluid, it allows D2 to enter the manual 2-1 servo feed passage to stroke the manual 2-1 servo assembly (104-115) and allows 3rd fluid to exhaust.

Manual 2-1 Servo Assembly (104-115)

Applies the manual 2-1 band (680) during manual second and manual first gear ranges.

Number 4 Ball Check Valve (372)

Located in the case cover (400), it directs 3rd clutch/lo-1st exhaust fluid into the 3rd clutch passage, releasing the 3rd clutch.

2-3 Shift Solenoid (SS) Valve (315)

When energized, it allows line pressure to enter the 2-3 signal fluid passage and sends it to the 4-3 manual downshift valve (360) and 3-2 manual downshift valve (356). However, this event does not have to occur in order to achieve a manual 3-2 downshift.

3-2 Manual Downshift Valve (356)

Is shifted by 2-3 signal fluid and prevents the 2-3 shift valve (357) from upshifting.

Pressure Control (PC) Solenoid

The PCM increases the PC solenoid duty cycle to increase the operating range of torque signal fluid pressure in Manual Second. This provides increased line pressure for the additional torque requirements during engine compression braking and increased engine load in Manual Second.

Torque Converter Clutch

The PCM will release the TCC before downshifting into Manual Second. The TCC will not re-apply in Second gear under normal operating conditions.

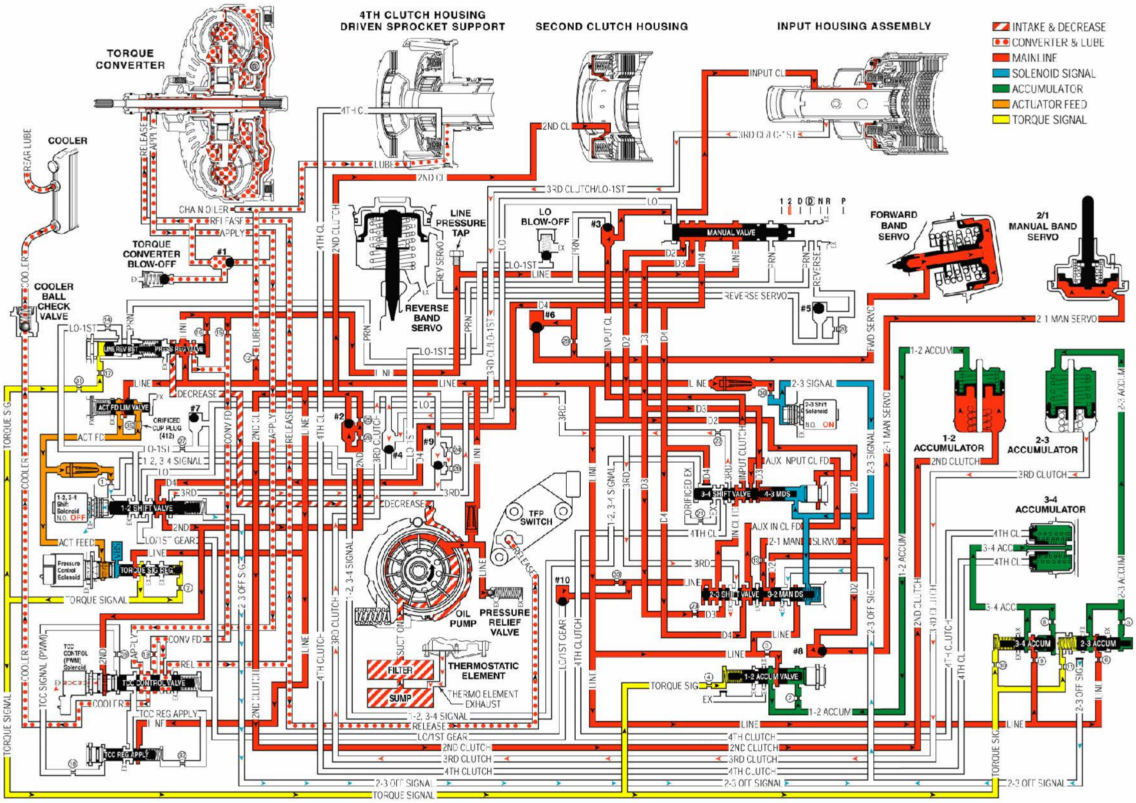

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
COOLER
TORQUE CONVERTER BLOW-OFF
COOLER BALL CHECK VALVE
LINE PRESSURE TAP
LO BLOW-OFF
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
1-2 SHIFT VALVE
3-4 SHIFT VALVE
4-3 MDS
2-3 SHIFT VALVE
3-2 MAN DS
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
THERMO ELEMENT EXHAUST
FILTER
SUMP
TORQUE SIG REG
TCC CONTROL VALVE
TCC REG APPLY
ACT FD LIM VALVE
2-3 Shift Solenoid N.O. ON
1-2, 3-4 Shift Solenoid N.O. OFF
Pressure Control Solenoid
TCC CONTROL (PWM) Solenoid
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
LINE
DECREASE
TORQUE SIGNAL
2-3 OFF SIGNAL
LO/1ST GEAR
2ND CLUTCH
3RD CLUTCH
4TH CLUTCH
RELEASE
1-2, 3-4 SIGNAL

Fig. 440: Drive Range, Manual 2nd - from Drive, Manual 3rd - Without Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

MANUAL SECOND GEAR (WITH TOUCH ACTIVATED POWER)

When the gear selector lever is moved to the Manual gear range, the manual valve moves and allows line pressure to enter the Braking fluid passage. The transmission reacts by shifting immediately into second gear range and is prevented from upshifting into either Third or Fourth gear.

Manual Valve (404)

Is moved by the gear selector lever allowing line pressure to enter the braking passage.

Number 8 Ball Check Valve (372)

Located in the control valve body (300), is fed braking fluid from the manual valve (404) and directs it to the 2-3 shift valve (357).

2-3 Shift Valve (357)

When shifted by braking fluid, it allows 3rd fluid to exhaust.

3-2 Manual Downshift Valve (356)

Is shifted by 2-3 signal fluid and prevents the 2-3 shift valve (357) from upshifting. It also allows braking fluid to enter the manual 2-1 servo feed passage to stroke the manual 2-1 servo assembly (104-115).

Manual 2-1 Servo Assembly (104-115)

Applies the manual 2-1 band (680) during manual second and manual first gear ranges.

Number 4 Ball Check Valve (372)

Located in the case cover (400), it directs 3rd clutch/lo-reg exhaust fluid into the 3rd clutch passage, releasing the 3rd clutch.

2-3 Shift Solenoid (SS) Valve (315)

When energized, it allows line pressure to enter the 2-3 signal fluid passage and sends it to the 4-3 manual downshift valve (360) and 3-2 manual downshift valve (356).

Pressure Control (PC) Solenoid

The PCM increases the PC solenoid duty cycle to increase the operating range of torque signal fluid pressure in Manual Second. This provides increased line pressure for the additional torque requirements during engine compression braking and increased engine load in Manual Second.

Torque Converter Clutch

The PCM will release the TCC before downshifting into Manual Second. The TCC will not re-apply in Second gear under normal operating conditions.

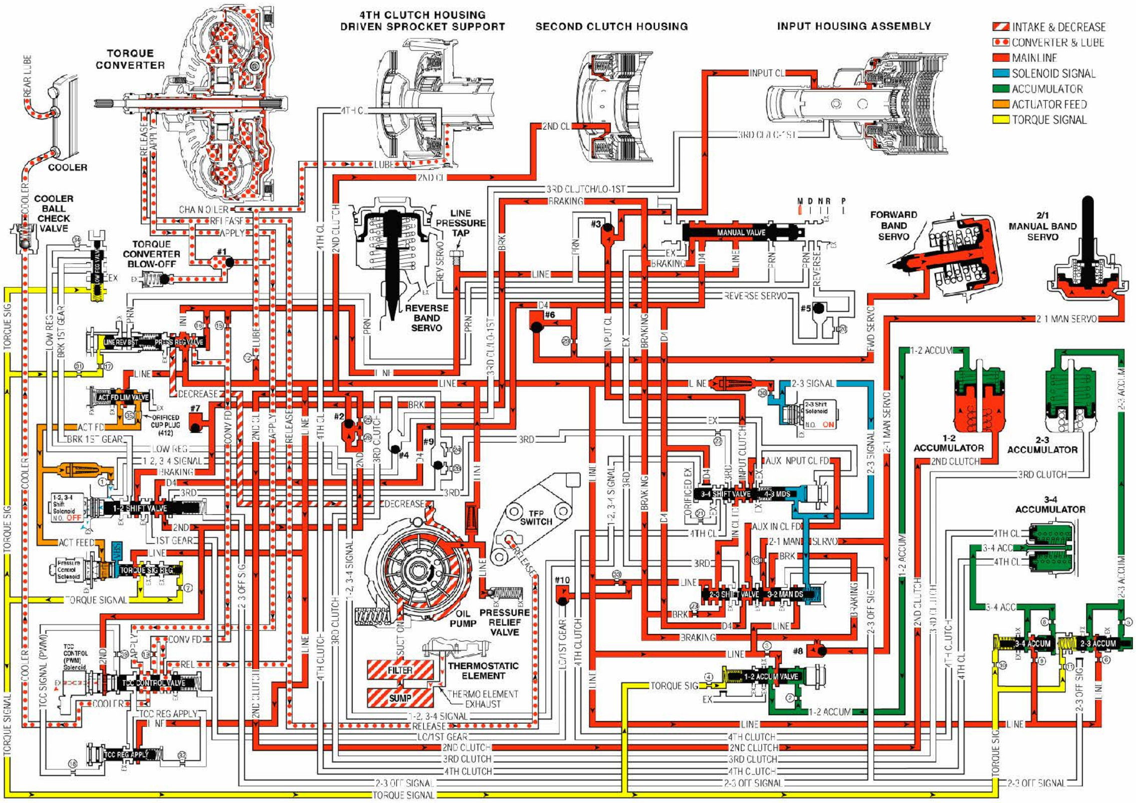

TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
INTAKE & DECREASE
CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
REAR LUBE
COOLER
COOLER BALL CHECK VALVE
TORQUE CONVERTER BLOW-OFF
LINE PRESSURE TAP
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
FILTER
SUMP
THERMOSTATIC ELEMENT
THERMO ELEMENT EXHAUST
1-2 SHIFT VALVE
2-3 SHIFT VALVE
3-4 SHIFT VALVE
4-3 MDS
3-2 MAN DS
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
TCC CONTROL VALVE
TCC REG APPLY
TORQUE SIG REG
ACT FD LIM VALVE
PRESS REG VALVE
2-3 Shift Solenoid N.O. ON
1-2, 3-4 Shift Solenoid N.O. OFF
TCC CONTROL (PWM) Solenoid
Pressure Control Solenoid
ORIFICED CUP PLUG (412)
M D N R P

Fig. 441: Drive Range, Manual 2nd - from Drive, Manual 3rd - With Touch Activated Power
Courtesy of GENERAL MOTORS CORP.

DRIVE RANGE, MANUAL FIRST (FROM DRIVE, MANUAL SECOND) (WITHOUT TOUCH ACTIVATED POWER)

A manual 2-1 downshift is initiated by moving the gear selector lever to the Manual First (1) position. However, the transmission will not downshift into First gear until vehicle speed is below approximately 60 km/h (37 mph). At higher vehicle speeds the PCM will keep 1-2 shift solenoid (SS) valve de-energized (OFF) and the transmission will operate in Manual First - Second Gear. In Manual First the transmission is electronically prevented from upshifting into Third or Fourth gears under any conditions. Also, the third clutch is applied in Manual First - First Gear to provide engine compression braking.

Manual Valve (404)

Line pressure is routed into the Lo fluid circuit when the selector lever is moved into the Manual First (1) position. Line pressure continues to feed the D4, D3 and D2 fluid circuits as in Manual Second.

Number 7 Ball Check Valve (372)

Located in the control valve body (300), directs Lo fluid to the 1-2 shift valve (318).

1-2 Shift Valve (318)

When shifted against spring force, allows Lo fluid to enter the Lo-1st passage to the pressure regulator valve (313). During release of the 2nd clutch, exhausting 2nd fluid passes through the valve and enters the 3rd fluid passage.

Lo Blow Off Valve (407)

A relief valve that exhausts excess Lo fluid pressures above 448 kPa (65 psi) from the 3rd clutch apply circuit.

Number 4 Ball Check Valve (372)

Located in the case cover (400), it seats against 3rd clutch fluid allowing Lo-1st fluid to enter the 3rd clutch fluid passage and apply the 3rd clutch.

1-2, 3-4 Shift Solenoid (SS) Valve (315)

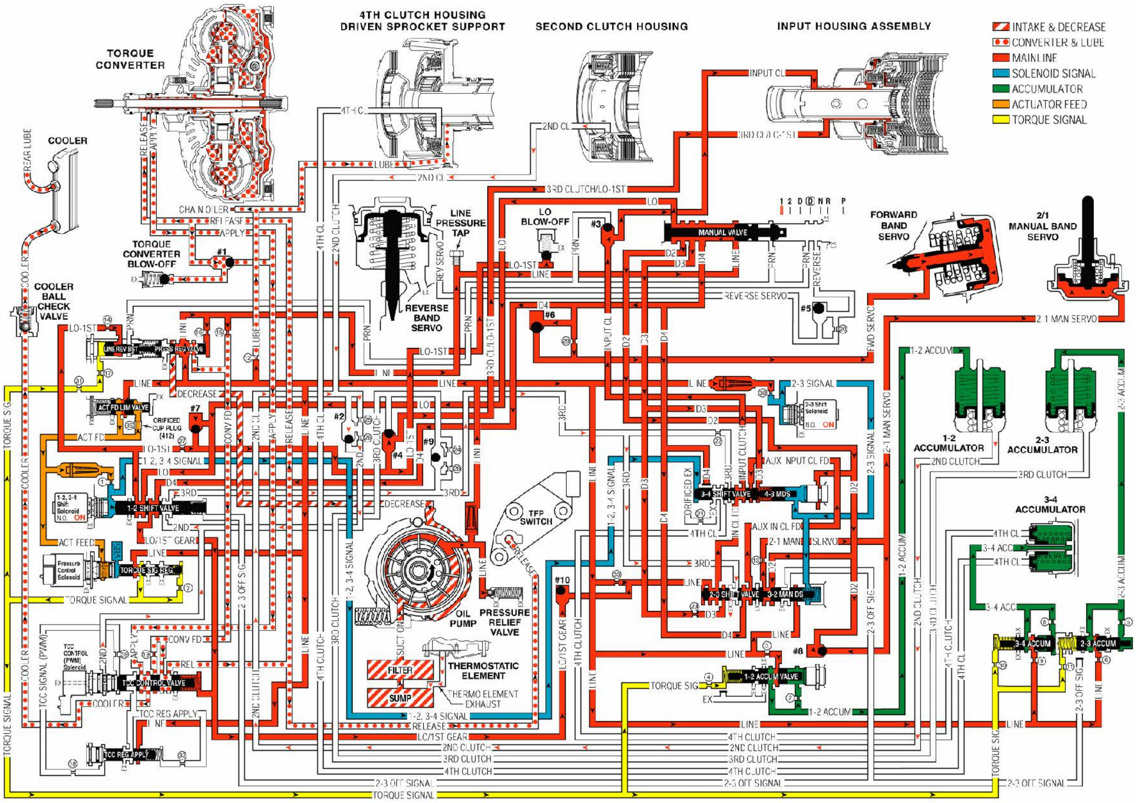
Energizes, allowing line pressure to feed into the 1-2, 3-4 signal fluid passage and to the 3-4 shift valve (362).

Number 2 Ball Check Valve (372)

Located in the case cover (400), forces exhausting 2nd clutch apply fluid through an orifice into the 2nd clutch passage and to the 1-2 shift valve (318).

Pressure Regulator Valve

Lo fluid is directed through the 1-2 shift valve (318) into the Lo-1st fluid passage. Lo-1st fluid is sent to the pressure regulator valve (313) to boost line pressure and at the same time to the Lo blow off valve (407). The addition of Lo-1st fluid pressure increases the operating range of line pressure in Manual First.


TORQUE CONVERTER
4TH CLUTCH HOUSING DRIVEN SPROCKET SUPPORT
SECOND CLUTCH HOUSING
INPUT HOUSING ASSEMBLY
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CONVERTER & LUBE
MAINLINE
SOLENOID SIGNAL
ACCUMULATOR
ACTUATOR FEED
TORQUE SIGNAL
COOLER
REAR LUBE
TORQUE CONVERTER BLOW-OFF
COOLER BALL CHECK VALVE
LINE PRESSURE TAP
REVERSE BAND SERVO
LO BLOW-OFF
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
1-2 SHIFT VALVE
1-2, 3-4 Shift Solenoid
ACT FD LIMIT VALVE
ORIFICED CUP PLUG (412)
Pressure Control Solenoid
TORQUE SIGNAL REG
TCC CONTROL (PWM) Solenoid
TCC CONTROL VALVE
TCC REG APPLY
2-3 Shift Solenoid
3-4 SHIFT VALVE
4-3 MDS
3-2 SHIFT VALVE
3-2 MAN DS
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
FILTER
SUMP
THERMO ELEMENT EXHAUST
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
LINE
LO-1ST
D2
D3
D4
2ND CLUTCH
3RD CLUTCH
4TH CLUTCH
INPUT CL
LC/1ST GEAR
RELEASE
APPLY
CONV FD
2-3 OFF SIGNAL
TORQUE SIGNAL
REVERSE SERVO
2-1 MAN SERVO
DECREASE
P R N D D D 2 1

Fig. 442: Drive Range, Manual 1st - from Drive, Manual 2nd - Without Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

MANUAL FIRST GEAR (WITH TOUCH ACTIVATED POWER)

A manual 2-1 downshift is initiated by moving the gear selector lever to the Manual position. However, the transmission will not downshift into First gear until vehicle speed is below approximately 60 km/h (37 mph). At higher vehicle speeds the PCM will keep 1-2 shift solenoid (SS) valve de-energized (OFF) and the transmission will operate in Manual - Second Gear. Also, the third clutch is applied in Manual First - First Gear to provide engine compression braking.

Manual Valve (404)

Line pressure is routed into the braking circuit when the selector lever is moved into the Manual position. Line pressure continues to feed the D4 in Manual.

Number 7 Ball Check Valve (372)

Located in the control valve body (300), directs braking to the 1-2 shift valve (318).

1-2 Shift Valve (318)

When shifted against spring force, allows braking to enter the braking-1st gear passage to the low regulator valve (313). During release of the 2nd clutch, exhausting 2nd fluid passes through the valve and enters the 3rd fluid passage.

Lo Blow Valve (443)

When shifted against spring force, allows braking first gear fluid to be directed into low reg fluid passage.

Number 4 Ball Check Valve (372)

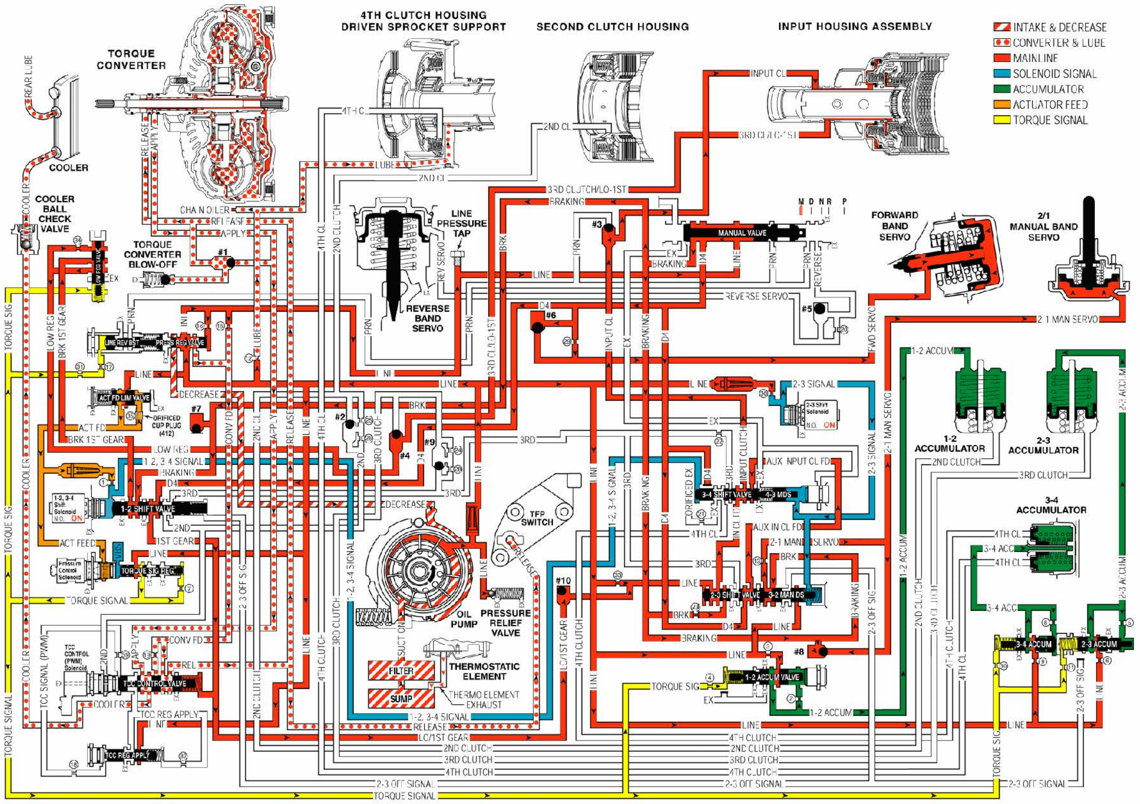
Located in the case cover (400), it seats against 3rd clutch fluid allowing low reg fluid to enter the 3rd clutch/lo-1st fluid passage and apply the 3rd clutch.

1-2, 3-4 Shift Solenoid (SS) Valve (315)

Energizes, allowing line pressure to feed into the 1-2, 3-4 signal fluid passage and to the 3-4 shift valve (362).

Number 2 Ball Check Valve (372)

Located in the case cover (400), forces exhausting 2nd clutch apply fluid through an orifice into the 2nd clutch passage and to the 1-2 shift valve (318).


4TH CLUTCH HOUSING
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▨ INTAKE & DECREASE
▨ CONVERTER & LUBE
🟥 MAINLINE
🟦 SOLENOID SIGNAL
🟩 ACCUMULATOR
🟧 ACTUATOR FEED
🟨 TORQUE SIGNAL
TORQUE CONVERTER
COOLER
COOLER BALL CHECK VALVE
TORQUE CONVERTER BLOW-OFF
LINE PRESSURE TAP
REVERSE BAND SERVO
MANUAL VALVE
FORWARD BAND SERVO
2/1 MANUAL BAND SERVO
1-2 ACCUMULATOR
2-3 ACCUMULATOR
3-4 ACCUMULATOR
TFP SWITCH
OIL PUMP
PRESSURE RELIEF VALVE
THERMOSTATIC ELEMENT
FILTER
SUMP
1-2 SHIFT VALVE
3-4 SHIFT VALVE
2-3 SHIFT VALVE
1-2 ACCUM VALVE
3-4 ACCUM
2-3 ACCUM
TCC CONTROL VALVE
TCC REG APPLY
TORQUE SIG

Fig. 443: Drive Range, Manual 1st - from Drive, Manual 2nd - With Touch Activated Power Fluid Flow Diagram
Courtesy of GENERAL MOTORS CORP.

FLUID PASSAGES

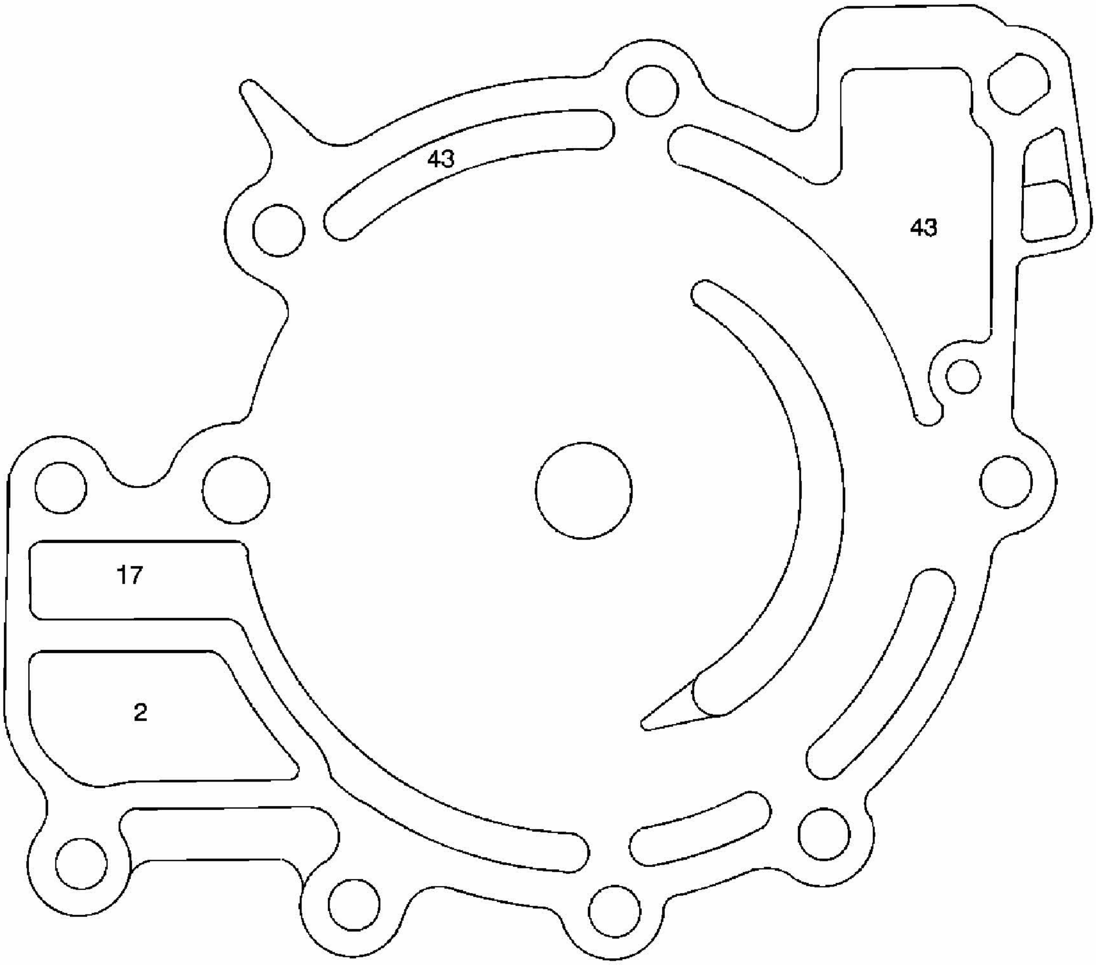


Fig. 444: Oil Pump Cover Fluid Passages - Oil Pump Body Side
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 444

Callout	Component Name
2	Line
17	Decrease
43	Casting Void
43	Casting Void

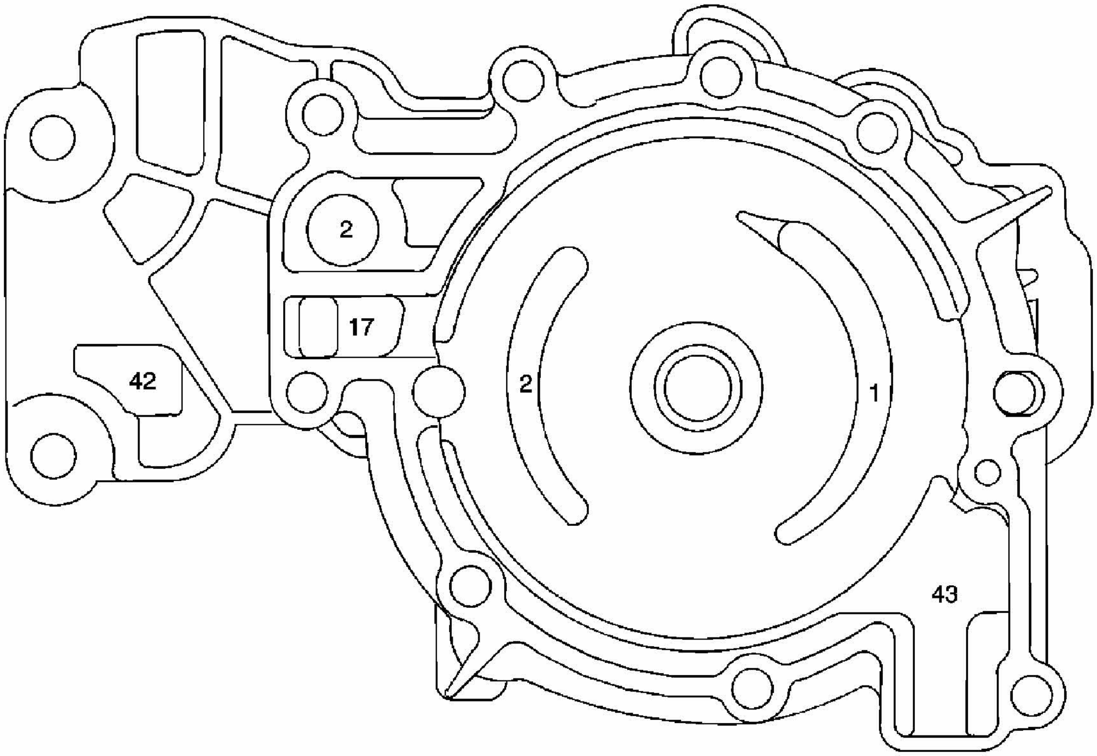


Fig. 445: Oil Pump Body Fluid Passages - Oil Pump Cover Side
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 445

Callout	Component Name
1	Suction
2	Line
2	Line
17	Decrease
42	Exhaust
43	Casting Void

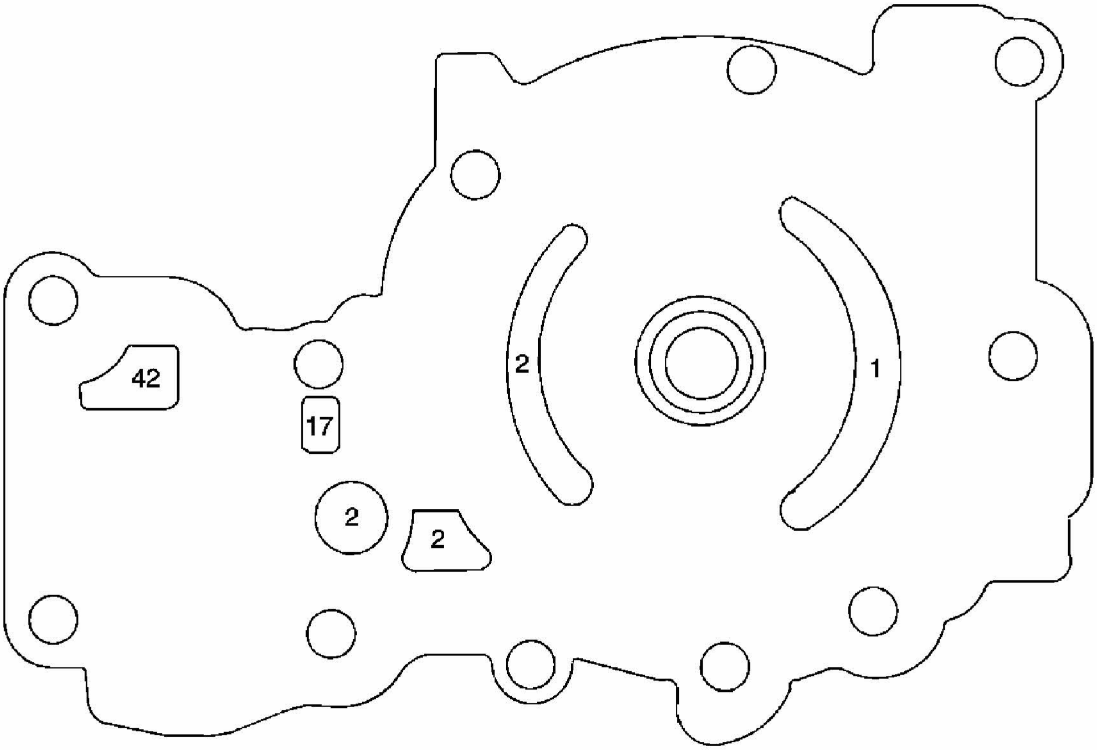
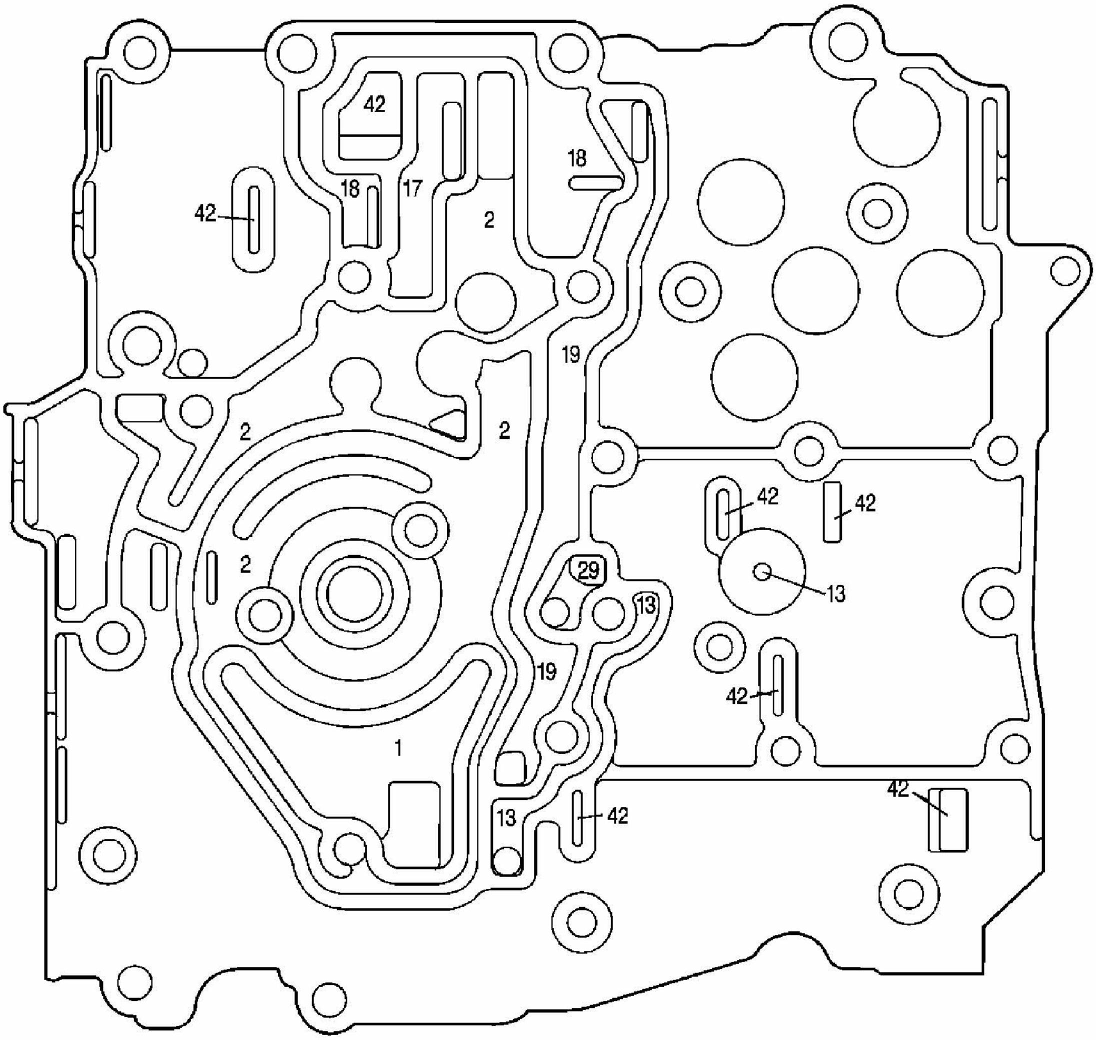


Fig. 446: Oil Pump Body Fluid Passages - Control Valve Body Side
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 446

Callout	Component Name
1	Suction
2	Line
2	Line
2	Line
17	Decrease
42	Exhaust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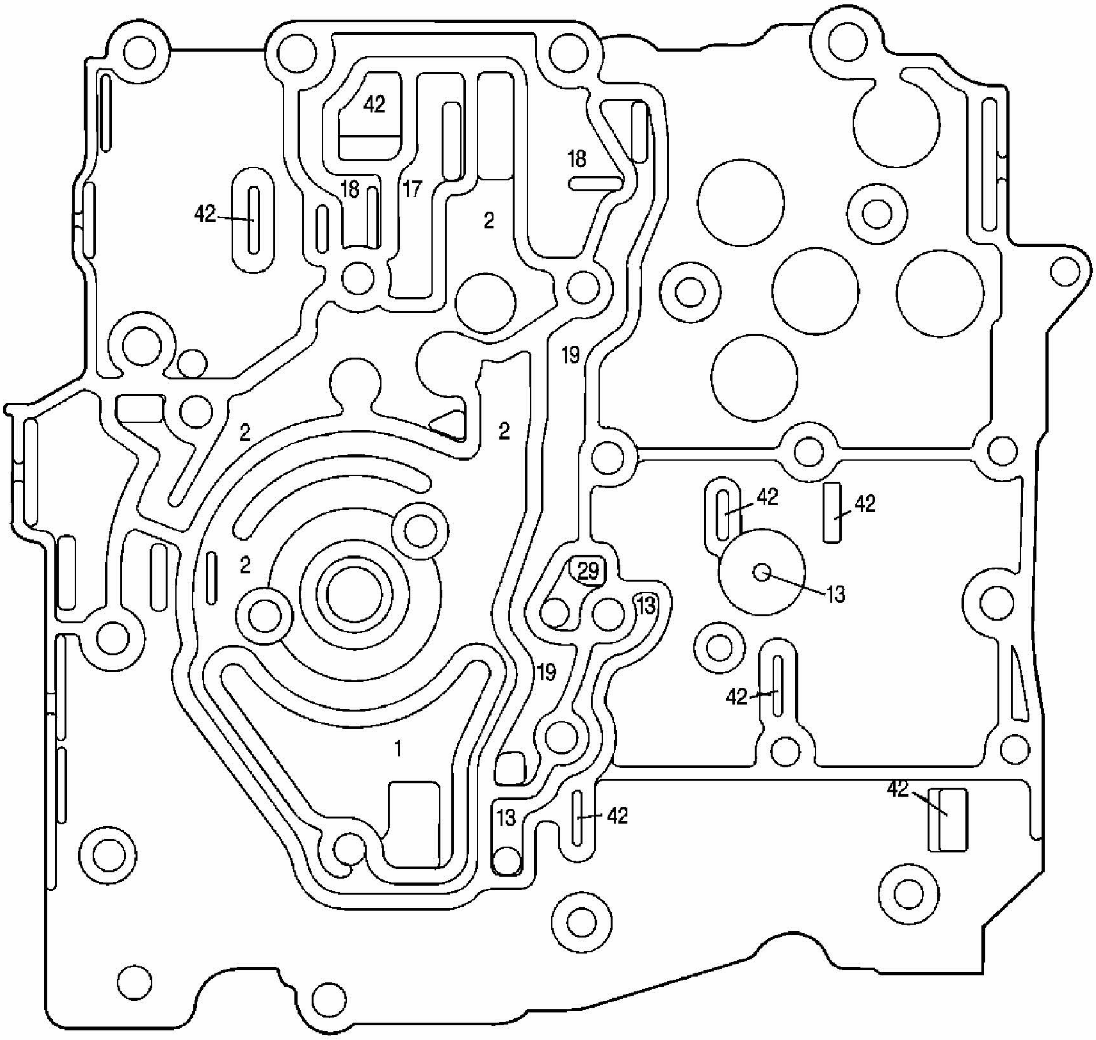
17
42
2
19
2
2
2
29
13
42
42
13
19
42
1
13
42
42

Fig. 447: Control Valve Body Fluid Passages - Oil Pump Body Side - Without Touch Activated Power
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 447

Callout	Component Name
1	Suction
2	Line
2	Line
2	Line
2	Line
13	TCC Release
13	TCC Release
13	TCC Release
17	Decrease

18	D4
18	D4
18	D4
19	Forward Servo
19	Forward Servo
29	3rd
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust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17
2
19
2
2
42
42
2
29
13
13
19
42
1
13
42
42

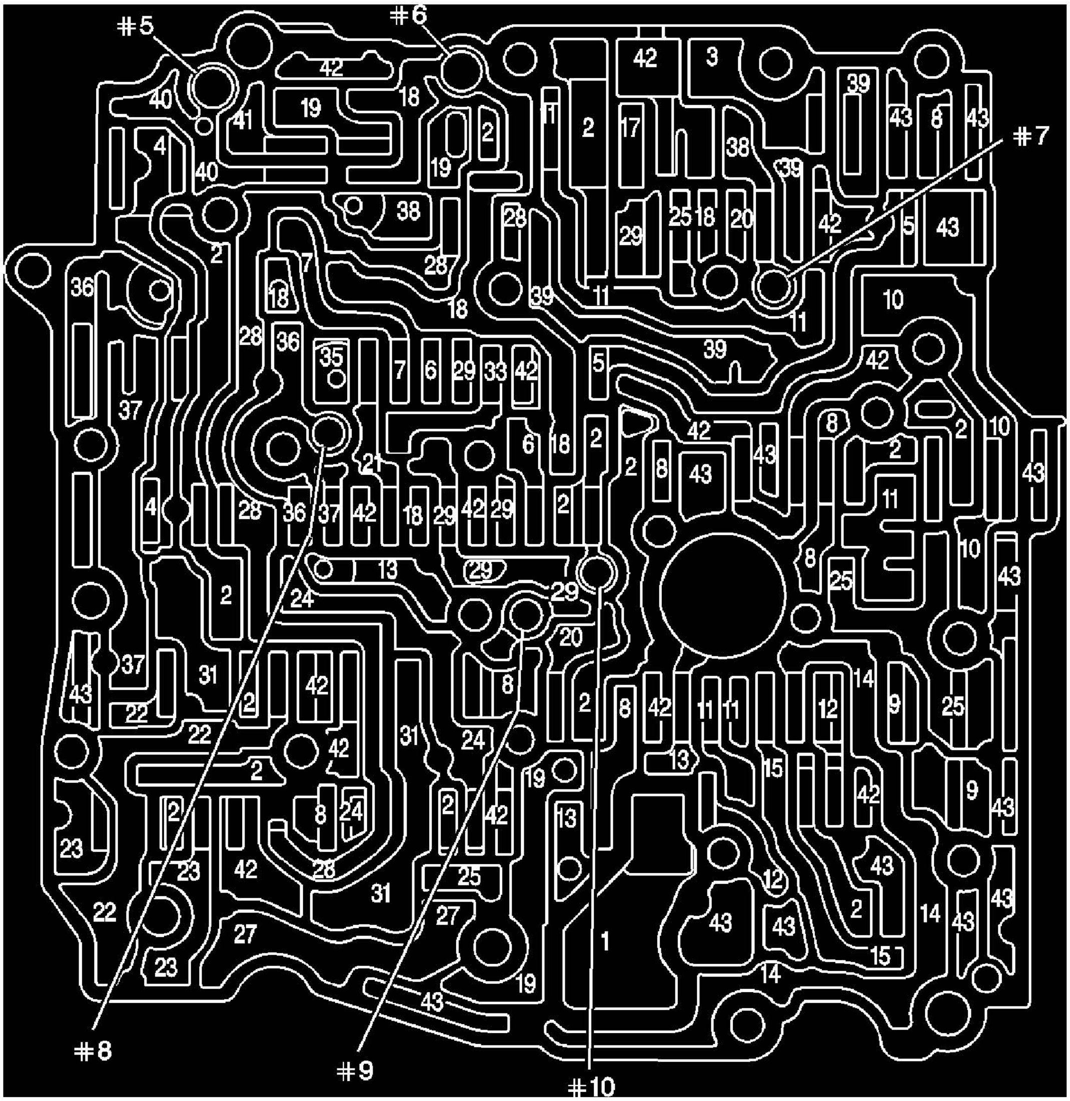
Fig. 448: Control Valve Body Fluid Passages - Oil Pump Body Side - With Touch

Activated Power

Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 448

Callout	Component Name
1	Suction
2	Line
2	Line
2	Line
2	Line
13	TCC Release
13	TCC Release
13	TCC Release
17	Decrease
18	D4
18	D4
18	D4
19	Forward Servo
19	Forward Servo
29	3rd
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust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11
10
11
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36
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7
6
29
33
42
5
39
42
37
21
6
18
2
8
2
10
42
2
8
43
43
43
4
28
36
37
42
18
29
42
29
2
2
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8
2
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42
11
11
12
14
9
25
42
2
19
13
15
42
9
43
2
8
24
42
13
2
23
23
42
28
31
25
12
43
22
27
27
43
43
2
14
43
43
1
15
23
19
43
14
#8
#9
#10

Fig. 449: Control Valve Body Fluid Passages - Case Cover Side - Without Touch Activated Power
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 449

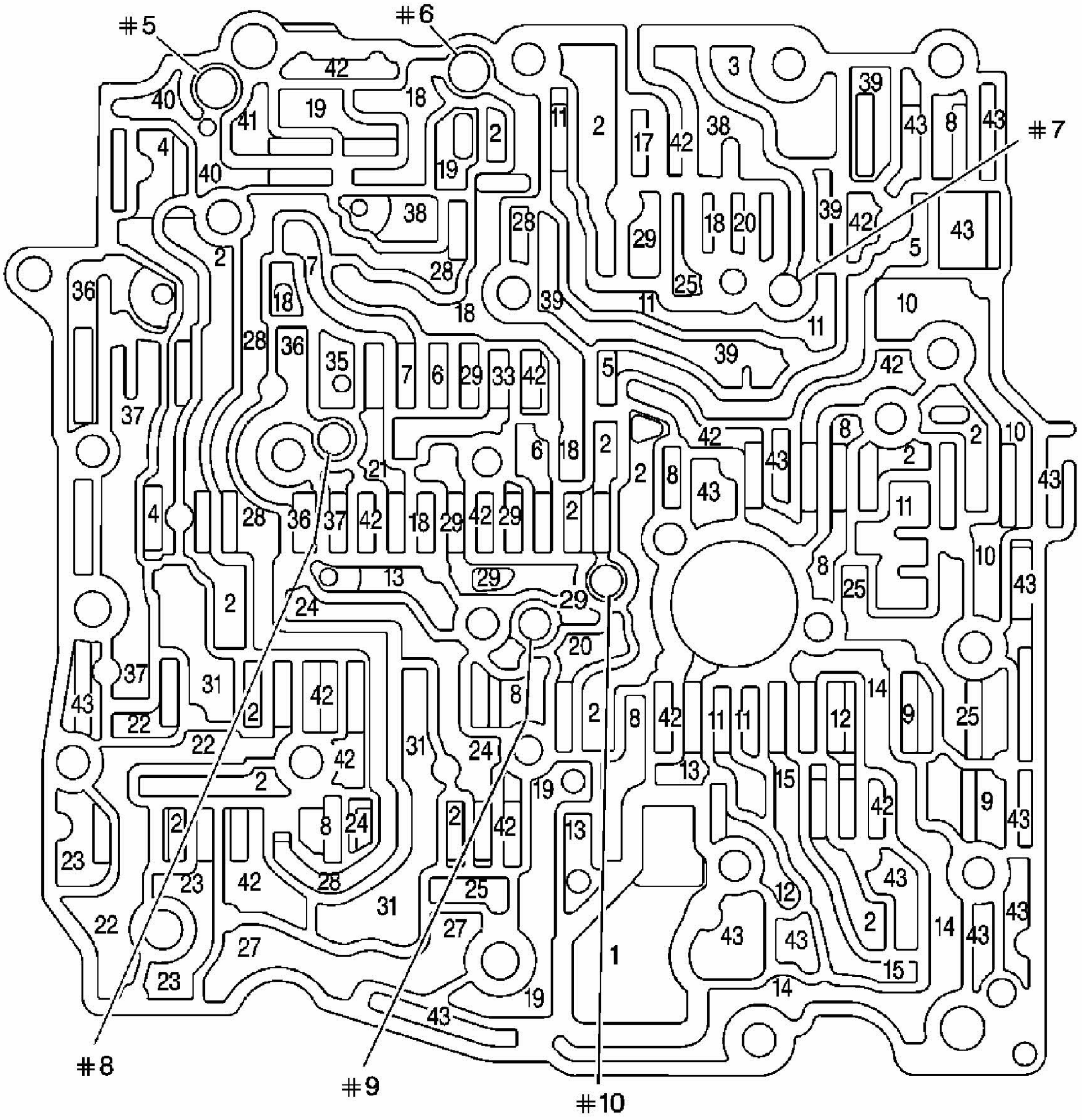
Callout	Component Name
1	Suction
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line

2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
3	PRN
4	2-3 Signal
4	2-3 Signal
5	1-2, 3-4 Signal
5	1-2, 3-4 Signal
6	Input Clutch Feed
6	Input Clutch Feed
7	Input Clutch
7	Input Clutch
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
9	TCC Signal (PWM)
9	TCC Signal (PWM)
10	Actuator Feed
10	Actuator Feed
10	Actuator Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
12	TCC Regulated Apply
12	TCC Regulated Apply

	TCC Release
13	TCC Release
13	TCC Release
14	TCC Apply
14	TCC Apply
14	TCC Apply
15	Cooler
15	Cooler
17	Decrease
18	D4
18	D4
18	D4
18	D4
18	D4
18	D4
19	Forward Servo
19	Forward Servo
19	Forward Servo
19	Forward Servo
20	Lo/1st Gear
20	Lo/1st Gear
21	Auxiliary Input Clutch Feed
22	1-2 Accumulator
22	1-2 Accumulator
22	1-2 Accumulator
23	2-3 Accumulator
23	2-3 Accumulator
23	2-3 Accumulator
24	3-4 Accumulator
24	3-4 Accumulator
24	3-4 Accumulator
25	2nd
25	2nd
25	2nd
25	2nd
27	2nd Clutch
27	2nd Clutch
28	2-3 Off Signal

	2-3 Off Signal
28	2-3 Off Signal
28	2-3 Off Signal
28	2-3 Off Signal
29	3rd
29	3rd
29	3rd
29	3rd
29	3rd
29	3rd
31	3rd Clutch
31	3rd Clutch
31	3rd Clutch
33	4th Clutch
35	D3
36	D2
36	D2
36	D2
37	Manual 2-1 Servo
37	Manual 2-1 Servo
37	Manual 2-1 Servo
38	Lo
38	Lo
39	Lo-1st
39	Lo-1st
39	Lo-1st
39	Lo-1st
40	Reverse
40	Reverse
41	Reverse Servo
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust

	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
#5	Ball Check Valve
#6	Ball Check Valve
#7	Ball Check Valve
#8	Ball Check Valve
#9	Ball Check Valve
#10	Ball Check Valve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#8
#9
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19
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18
20
39
42
5
43
2
28
7
25
11
36
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18
39
11
10
28
36
35
7
6
29
33
42
5
39
42
37
8
2
10
6
18
2
42
43
21
2
8
43
43
4
28
36
37
42
18
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42
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2
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29
8
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43
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2
8
42
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22
2
42
31
24
13
2
19
15
42
9
43
2
8
24
2
42
13
23
23
42
28
25
43
31
27
12
22
43
43
2
14
43
27
1
15
23
19
14
43

Fig. 450: Control Valve Body Fluid Passages - Case Cover Side - With Touch Activated Power
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 450

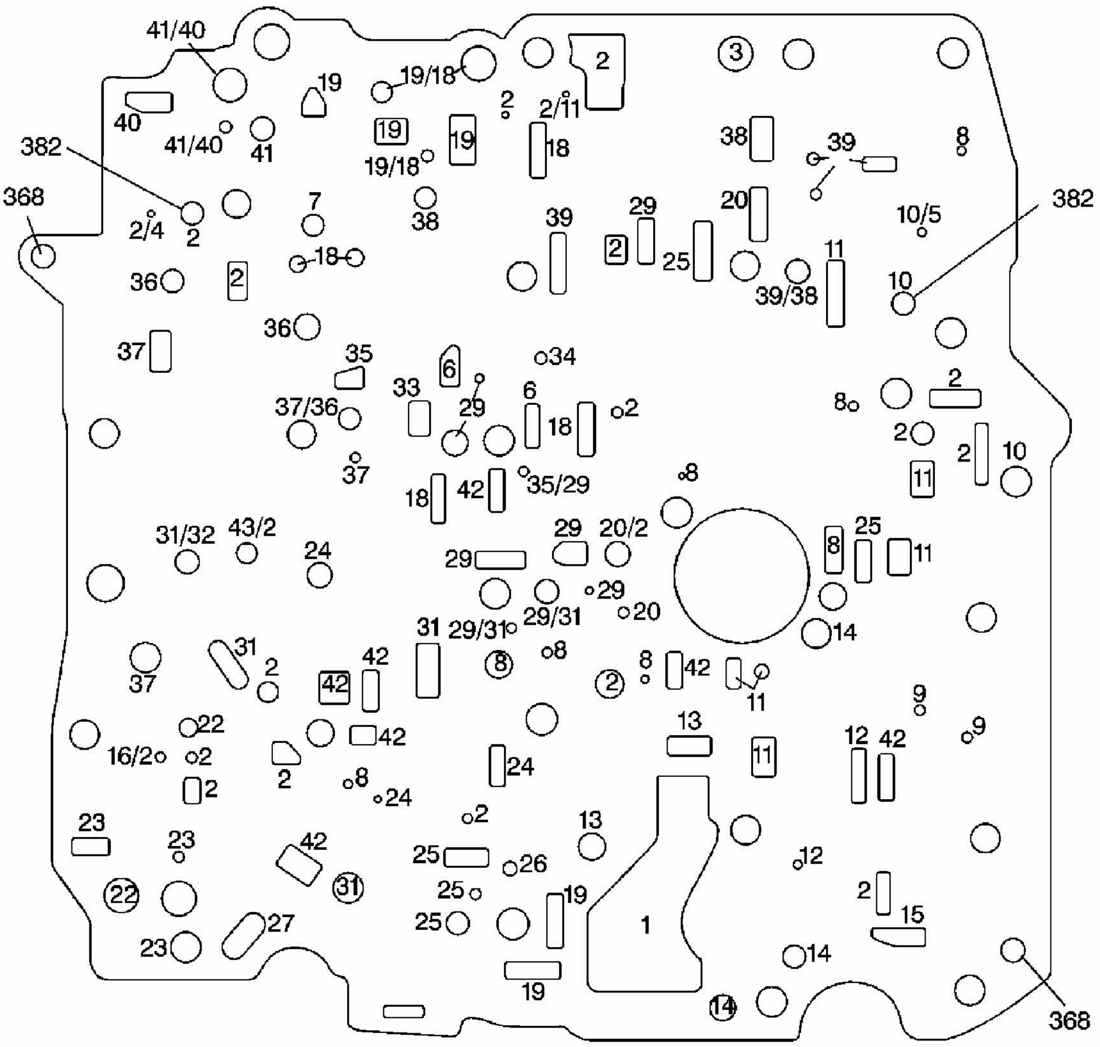
Callout	Component Name
1	Suction
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line

2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
3	PRN
4	2-3 Signal
4	2-3 Signal
5	1-2, 3-4 Signal
5	1-2, 3-4 Signal
6	Input Clutch Feed
6	Input Clutch Feed
7	Input Clutch
7	Input Clutch
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
9	TCC Signal (PWM)
9	TCC Signal (PWM)
10	Actuator Feed
10	Actuator Feed
10	Actuator Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
12	TCC Regulated Apply
12	TCC Regulated Apply

	TCC Release
13	TCC Release
13	TCC Release
14	TCC Apply
14	TCC Apply
14	TCC Apply
15	Cooler
15	Cooler
17	Decrease
18	D4
18	D4
18	D4
18	D4
18	D4
18	D4
19	Forward Servo
19	Forward Servo
19	Forward Servo
19	Forward Servo
20	Lo/1st Gear
20	Lo/1st Gear
21	Auxiliary Input Clutch Feed
22	1-2 Accumulator
22	1-2 Accumulator
22	1-2 Accumulator
23	2-3 Accumulator
23	2-3 Accumulator
23	2-3 Accumulator
24	3-4 Accumulator
24	3-4 Accumulator
24	3-4 Accumulator
25	2nd
25	2nd
25	2nd
25	2nd
27	2nd Clutch
27	2nd Clutch
28	2-3 Off Signal

	2-3 Off Signal
28	2-3 Off Signal
28	2-3 Off Signal
28	2-3 Off Signal
29	3rd
29	3rd
29	3rd
29	3rd
29	3rd
29	3rd
31	3rd Clutch
31	3rd Clutch
31	3rd Clutch
33	4th Clutch
35	D3
36	D2
36	D2
36	D2
37	Manual 2-1 Servo
37	Manual 2-1 Servo
37	Manual 2-1 Servo
38	Lo
38	Lo
39	Lo-1st
39	Lo-1st
39	Lo-1st
39	Lo-1st
40	Reverse
40	Reverse
41	Reverse Servo
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust

	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
#5	Ball Check Valve
#6	Ball Check Valve
#7	Ball Check Valve
#8	Ball Check Valve
#9	Ball Check Valve
#10	Ball Check Valve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23
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2
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12
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26
22
31
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19
2
15
1
23
27
25
14
19
14
368

Fig. 451: Spacer Plate Fluid Passages - Without Touch Activated Power
Courtesy of GENERAL MOTORS CORP.

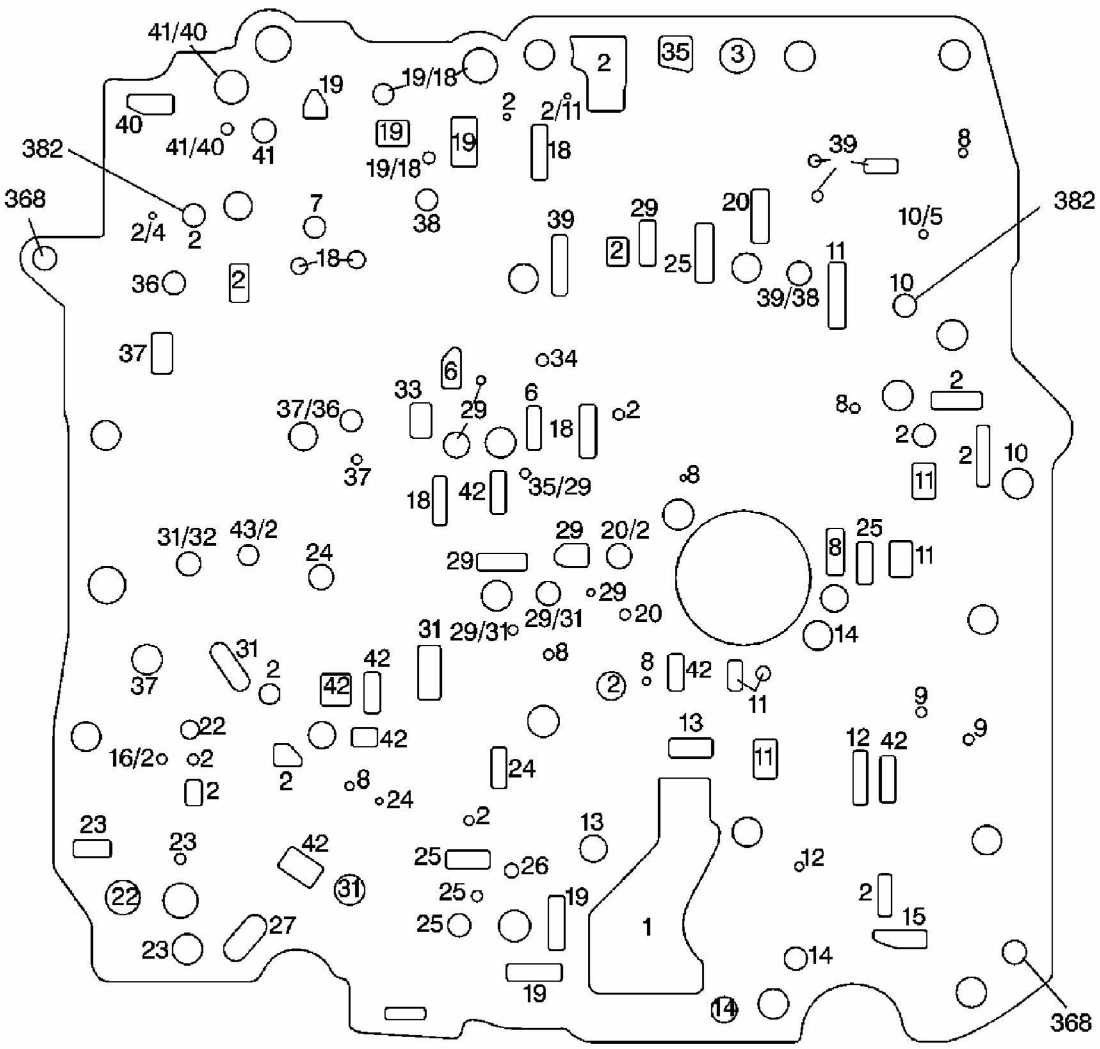
Callouts For Fig. 451

Callout	Component Name
1	Suction
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line

2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2/4	Line/2-3 Signal
2/11	Line/Converter Feed
3	PRN
6	Input Clutch Feed
6	Input Clutch Feed
7	Input Clutch
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
9	TCC Signal (PWM)
9	TCC Signal (PWM)
10	Actuator Feed
10	Actuator Feed
10/5	Actuator Feed/1-2, 3-4 Signal
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
12	TCC Regulated Apply
12	TCC Regulated Apply
13	TCC Release
13	TCC Release
14	TCC Apply
14	TCC Apply
14	TCC Apply
15	

	Cooler
16/2	Lube/Line
18	D4
18	D4
18	D4
18	D4
19	Forward Servo
19	Forward Servo
19	Forward Servo
19	Forward Servo
19	Forward Servo
19/18	Forward Servo/D4
19/18	Forward Servo/D4
20	Lo/1st Gear
20	Lo/1st Gear
20/2	Lo/1st Gear/Line
22	1-2 Accumulator
22	1-2 Accumulator
23	2-3 Accumulator
23	2-3 Accumulator
23	2-3 Accumulator
24	3-4 Accumulator
24	3-4 Accumulator
24	3-4 Accumulator
25	2nd
25	2nd
25	2nd
25	2nd
25	2nd
26	2nd Exhaust
27	2nd Clutch
29	3rd
29	3rd
29	3rd
29	3rd
29	3rd
29/31	3rd/3rd Clutch
29/31	3rd/3rd Clutch

	3rd Clutch
31	3rd Clutch
31	3rd Clutch
31/32	3rd Clutch/3rd Clutch/Lo-1st
33	4th Clutch
34	4th Clutch Exhaust
35	D3
35/29	D3/3rd
36	D2
36	D2
37	Manual 2-1 Servo
37	Manual 2-1 Servo
37	Manual 2-1 Servo
37/36	Manual 2-1 Servo/D2
38	Lo
38	Lo
39	Lo-1st
39	Lo-1st
39/38	Lo-1st/Lo
40	Reverse
41	Reverse Servo
41/40	Reverse Servo/Reverse
41/40	Reverse Servo/Reverse
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
43/2	Casting Void/Line
368	Spacer Plate and Gaskets/Control Valve Body Bolt Hole
368	Spacer Plate and Gaskets/Control Valve Body Bolt Hole
382	TCC Solenoid Valve Screen/Seal Assembly
382	TCC Solenoid Valve Screen/Seal Assembly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19
2
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25
1
27
23
14
19
14
368

Fig. 452: Spacer Plate Fluid Passages - With Touch Activated Power
Courtesy of GENERAL MOTORS CORP.

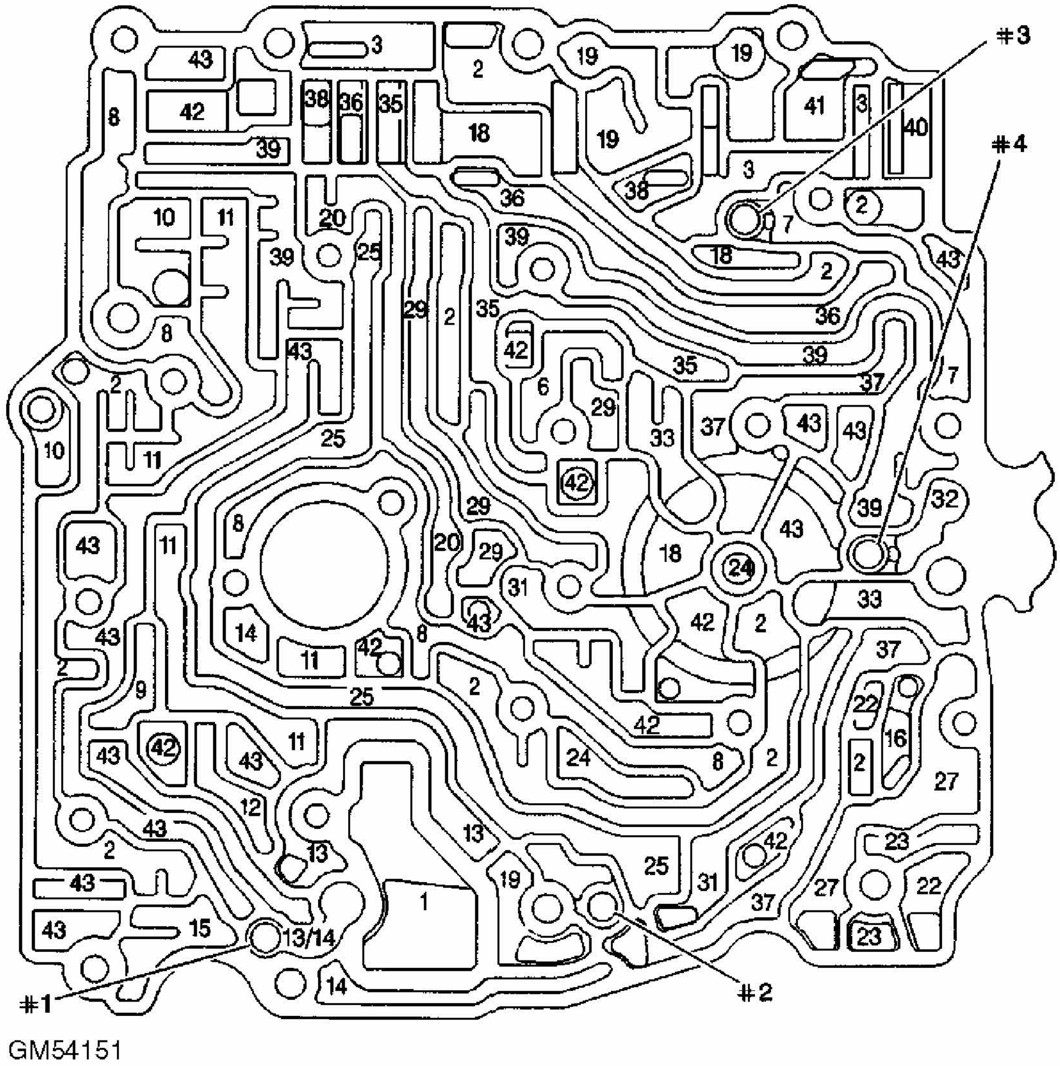
Callouts For Fig. 452

Callout	Component Name
1	Suction
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line

2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2/4	Line/2-3 Signal
2/11	Line/Converter Feed
3	PRN
6	Input Clutch Feed
6	Input Clutch Feed
7	Input Clutch
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
9	TCC Signal (PWM)
9	TCC Signal (PWM)
10	Actuator Feed
10	Actuator Feed
10/5	Actuator Feed/1-2, 3-4 Signal
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
12	TCC Regulated Apply
12	TCC Regulated Apply
13	TCC Release
13	TCC Release
14	TCC Apply
14	TCC Apply
14	TCC Apply
15	

	Cooler
16/2	Lube/Line
18	D4
18	D4
18	D4
18	D4
19	Forward Servo
19	Forward Servo
19	Forward Servo
19	Forward Servo
19	Forward Servo
19/18	Forward Servo/D4
19/18	Forward Servo/D4
20	Lo/1st Gear
20	Lo/1st Gear
20/2	Lo/1st Gear/Line
22	1-2 Accumulator
22	1-2 Accumulator
23	2-3 Accumulator
23	2-3 Accumulator
23	2-3 Accumulator
24	3-4 Accumulator
24	3-4 Accumulator
24	3-4 Accumulator
25	2nd
25	2nd
25	2nd
25	2nd
25	2nd
26	2nd Exhaust
27	2nd Clutch
29	3rd
29	3rd
29	3rd
29	3rd
29	3rd
29/31	3rd/3rd Clutch
29/31	3rd/3rd Clutch

	3rd Clutch
31	3rd Clutch
31	3rd Clutch
31/32	3rd Clutch/3rd Clutch/Lo-1st
33	4th Clutch
34	4th Clutch Exhaust
35	D3
35/29	D3/3rd
36	D2
36	D2
37	Manual 2-1 Servo
37	Manual 2-1 Servo
37	Manual 2-1 Servo
37/36	Manual 2-1 Servo/D2
38	Lo
38	Lo
39	Lo-1st
39	Lo-1st
39/38	Lo-1st/Lo
40	Reverse
41	Reverse Servo
41/40	Reverse Servo/Reverse
41/40	Reverse Servo/Reverse
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
43/2	Casting Void/Line
368	Spacer Plate and Gaskets/Control Valve Body Bolt Hole
368	Spacer Plate and Gaskets/Control Valve Body Bolt Hole
382	TCC Solenoid Valve Screen/Seal Assembly
382	TCC Solenoid Valve Screen/Seal Assembly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11
20
39
25
2
7
2
18
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43
39
29
2
35
36
8
42
39
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35
37
7
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43
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22
43
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43
15
13/14
23
14
#1
#2
GM54151

Fig. 453: Case Cover Fluid Passages - Control Valve Body Side - Without Touch Activated Power

Courtesy of GENERAL MOTORS CORP.

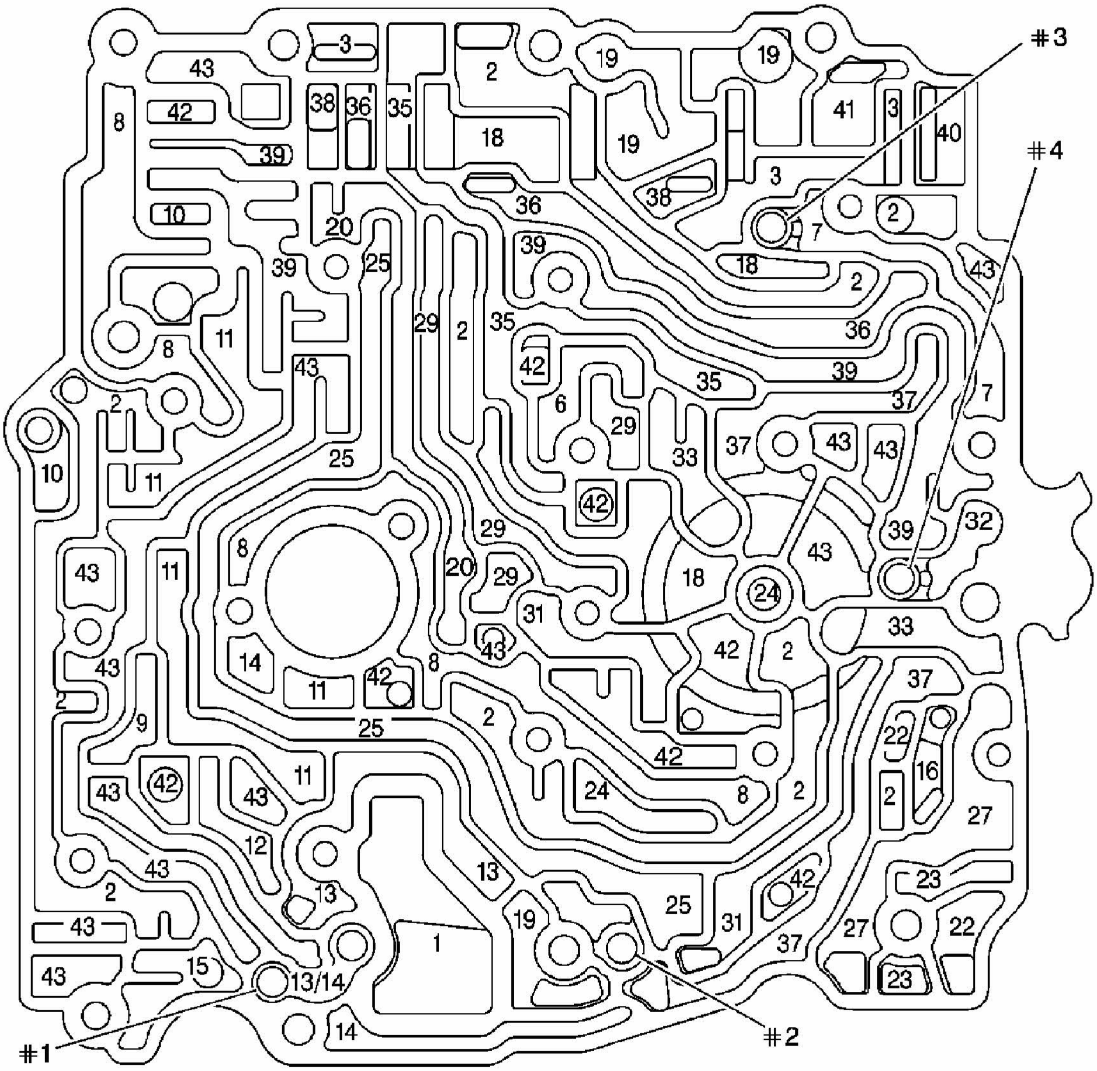
Callouts For Fig. 453

Callout	Component Name
1	Suction
2	Line
2	Line
2	Line
2	Line
2	Line

2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
3	PRN
3	PRN
3	PRN
6	Input Clutch Feed
7	Input Clutch
7	Input Clutch
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
9	TCC Signal (PWM)
10	Actuator Feed
10	Actuator Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
12	TCC Regulated Apply
13	TCC Release
13	TCC Release
13/14	TCC Release/TCC Apply
14	TCC Apply
14	TCC Apply
15	Cooler
16	Lube
18	D4
18	D4
18	D4
19	Forward Servo
19	Forward Servo

	Forward Servo
19	Forward Servo
20	Lo/1st Gear
20	Lo/1st Gear
22	1-2 Accumulator
22	1-2 Accumulator
23	2-3 Accumulator
23	2-3 Accumulator
24	3-4 Accumulator
24	3-4 Accumulator
25	2nd
25	2nd
25	2nd
25	2nd
27	2nd Clutch
27	2nd Clutch
29	3rd
29	3rd
29	3rd
29	3rd
31	3rd Clutch
31	3rd Clutch
32	3rd Clutch/Lo-1st
33	4th Clutch
33	4th Clutch
35	D3
35	D3
35	D3
36	D2
36	D2
36	D2
37	Manual 2-1 Servo
37	Manual 2-1 Servo
37	Manual 2-1 Servo
37	Manual 2-1 Servo
38	Lo
38	Lo
39	Lo-1st

	Lo-1st
39	Lo-1st
39	Lo-1st
39	Lo-1st
40	Reverse
41	Reverse Servo
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
#1	Ball Check Valve
#2	Ball Check Valve
#3	Ball Check Valve
#4	Ball Check Valve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#4
#1
#2
43
3
2
19
19
8
42
38
36
35
18
19
41
3
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39
3
10
38
36
20
7
2
39
25
39
18
2
43
8
11
29
2
35
36
43
42
35
39
2
6
29
37
7
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11
25
33
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43
43
42
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32
8
43
11
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29
18
43
24
31
43
33
43
14
42
2
11
42
8
37
2
9
25
2
22
42
16
43
42
11
43
24
8
2
2
27
12
43
13
2
13
42
23
43
19
25
31
27
22
37
1
43
15
13/14
23
14

Fig. 454: Case Cover Fluid Passages - Control Valve Body Side - With Touch Activated Power

Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 454

Callout	Component Name
1	Suction
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line
2	Line

2	Line
2	Line
2	Line
3	PRN
3	PRN
3	PRN
6	Input Clutch Feed
7	Input Clutch
7	Input Clutch
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
8	Torque Signal
9	TCC Signal (PWM)
10	Actuator Feed
10	Actuator Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
11	Converter Feed
12	TCC Regulated Apply
13	TCC Release
13	TCC Release
13/14	TCC Release/TCC Apply
14	TCC Apply
14	TCC Apply
15	Cooler
16	Lube
18	D4
18	D4
18	D4
19	Forward Servo
19	Forward Servo
19	Forward Servo
19	Forward Servo
20	Lo/1st Gear

	Lo/1st Gear
22	1-2 Accumulator
22	1-2 Accumulator
23	2-3 Accumulator
23	2-3 Accumulator
24	3-4 Accumulator
24	3-4 Accumulator
25	2nd
25	2nd
25	2nd
25	2nd
27	2nd Clutch
27	2nd Clutch
29	3rd
29	3rd
29	3rd
29	3rd
31	3rd Clutch
31	3rd Clutch
32	3rd Clutch/Lo-1st
33	4th Clutch
33	4th Clutch
35	D3
35	D3
35	D3
36	D2
36	D2
36	D2
37	Manual 2-1 Servo
37	Manual 2-1 Servo
37	Manual 2-1 Servo
37	Manual 2-1 Servo
38	Lo
38	Lo
39	Lo-1st
39	Lo-1st
39	Lo-1st
39	Lo-1st

	Lo-1st
40	Reverse
41	Reverse Servo
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
43	Casting Void
#1	Ball Check Valve
#2	Ball Check Valve
#3	Ball Check Valve
#4	Ball Check Valve

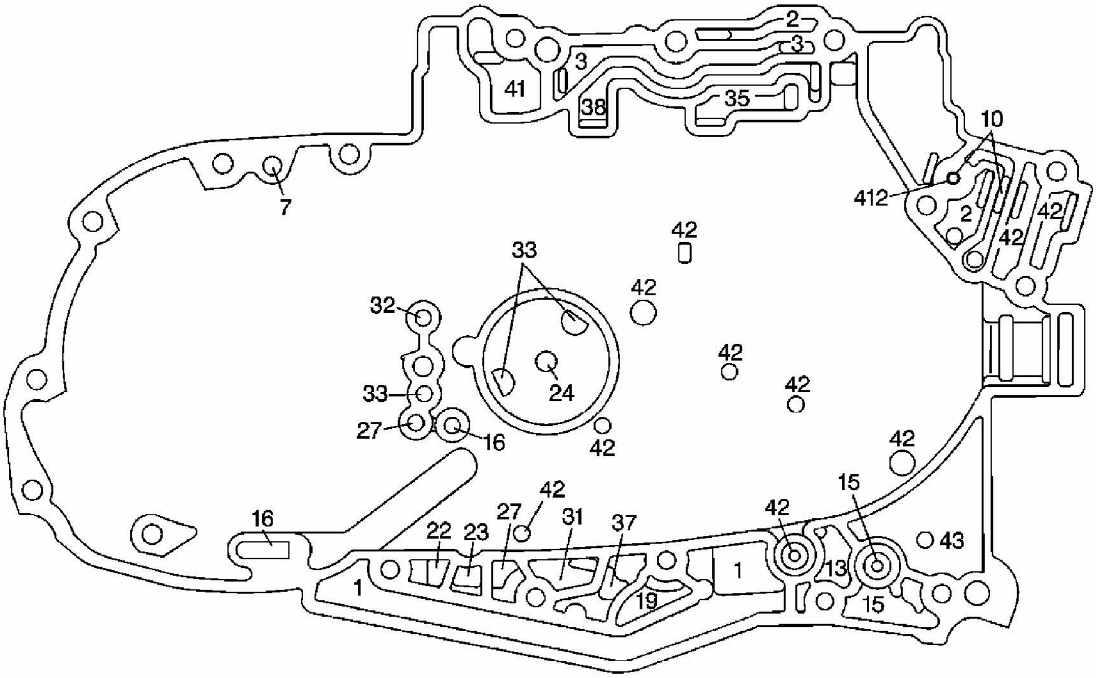

2
3
3
41
38
35
10
412
2
42
42
7
42
33
42
32
42
24
33
27
16
42
42
42
15
42
16
22
23
27
31
37
42
43
1
1
13
19
15

Fig. 455: Case Cover Fluid Passages - Case Side - Without Touch Activated Power
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 455

Callout	Component Name
1	Suction
1	Suction
2	Line
2	Line
3	PRN
3	PRN
7	Input Clutch
10	Actuator Feed
13	TCC Release
15	Cooler
15	Cooler
16	Lube
16	Lube
19	Forward Servo
22	1-2 Accumulator
23	2-3 Accumulator
24	3-4 Accumulator
27	2nd Clutch

27	2nd Clutch
31	3rd Clutch
32	3rd Clutch/Lo-1st
33	4th Clutch
33	4th Clutch
35	D3
37	Manual 2-1 Servo
38	Lo
41	Reverse Servo
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
43	Casting Void
412	Orificed Cup Plug

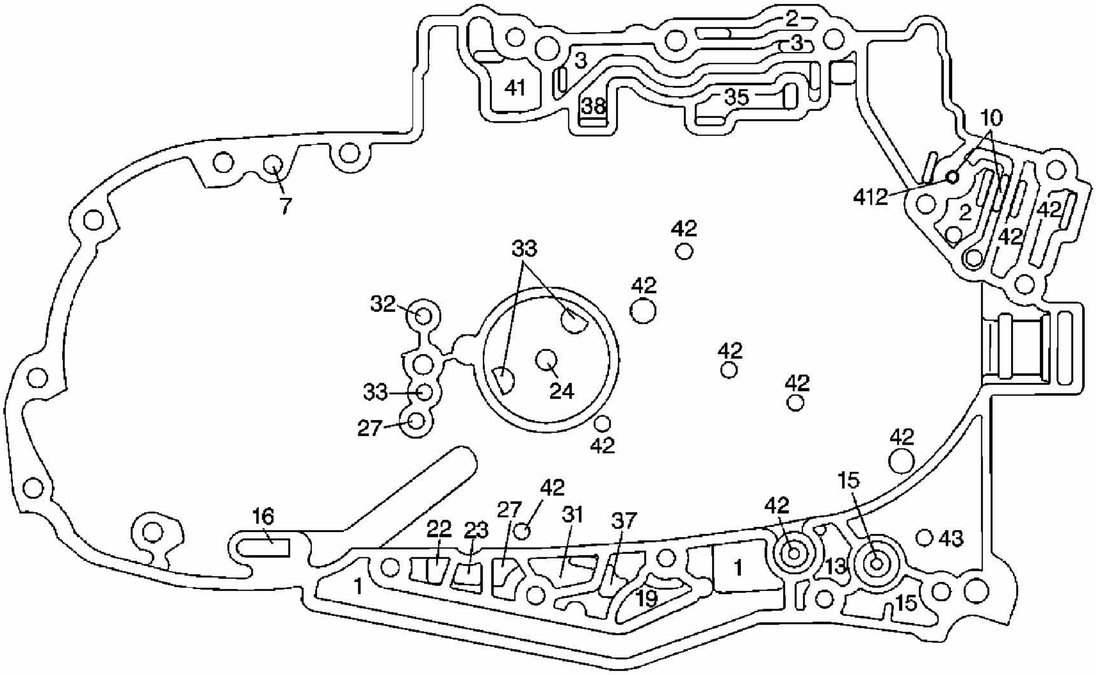

2
3
3
41
38
35
10
412
2
42
42
7
42
33
42
32
24
33
27
42
42
42
42
15
16
42
27
31
37
22
23
42
1
19
1
13
15
43

Fig. 456: Case Cover Fluid Passages - Case Side - With Touch Activated Power

Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 456

Callout	Component Name
1	Suction
1	Suction
2	Line
2	Line
3	PRN
3	PRN
7	Input Clutch
10	Actuator Feed
13	TCC Release
15	Cooler
15	Cooler
16	Lube
16	Lube
19	Forward Servo
22	1-2 Accumulator
23	2-3 Accumulator
24	3-4 Accumulator
27	2nd Clutch
27	2nd Clutch
31	3rd Clutch
32	3rd Clutch/Lo-1st
33	4th Clutch
33	4th Clutch
35	D3
37	Manual 2-1 Servo
38	Lo
41	Reverse Servo
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust
42	Exhaust

42	Exhaust
42	Exhaust
43	Casting Void
412	Orificed Cup Plug

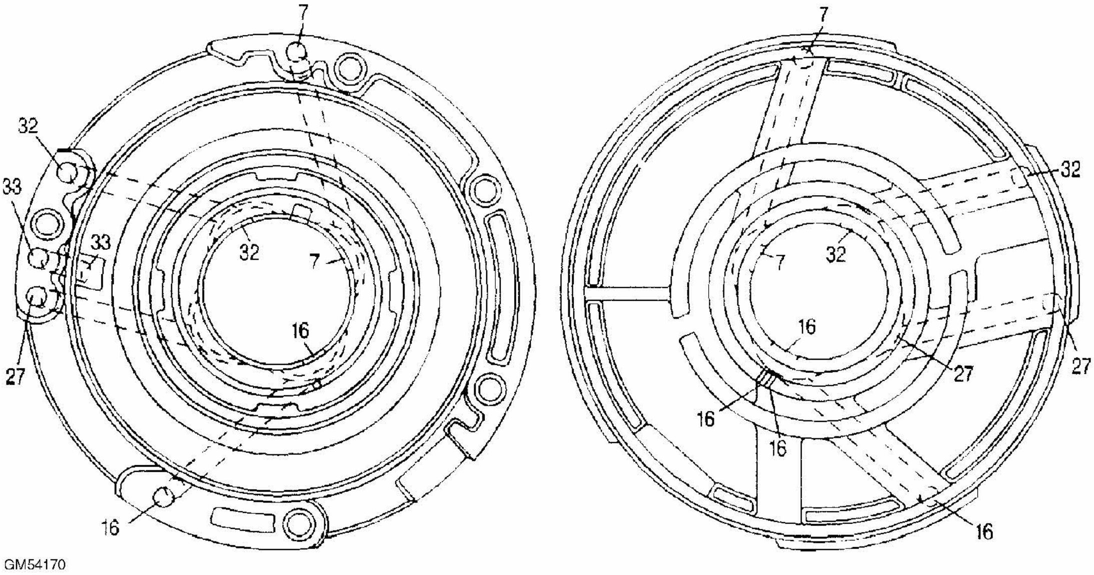


Fig. 457: Driven Sprocket Support Fluid Passages
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 457

Callout	Component Name
7	Input Clutch
7	Input Clutch
7	Input Clutch
7	Input Clutch
16	Lube
16	Lube
16	Lube
16	Lube
16	Lube
16	Lube
27	2nd Clutch
27	2nd Clutch
27	2nd Clutch
32	3rd Clutch/Lo-1st
32	3rd Clutch/Lo-1st

32	3rd Clutch/Lo-1st
32	3rd Clutch/Lo-1st
33	4th Clutch
33	4th Clutch

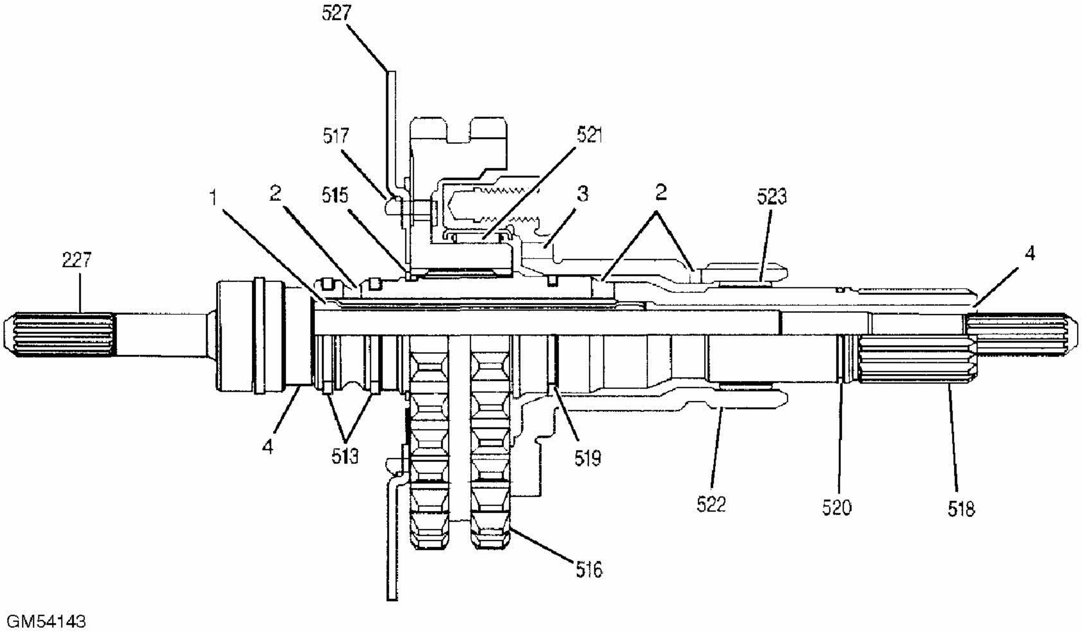


Fig. 458: Oil Pump Drive Shaft and Drive Sprocket Support Fluid Passages
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 458

Callout	Component Name
1	Steel Sleeve
2	TCC Apply Passage
2	TCC Apply Passage
3	Converter Seal Drainback Passage
4	TCC Release Passage
4	TCC Release Passage
227	Oil Pump Drive Shaft Assembly
513	Turbine Shaft Oil Seal Ring
515	Drive Sprocket Retaining Ring
516	Drive Sprocket
517	Drive Sprocket Thrust Washer
518	Turbine Shaft
519	Turbine Shaft Oil Seal Ring

520	Turbine Shaft O-Ring Seal
521	Drive Sprocket Bearing Assembly
522	Drive Sprocket Support
523	Drive Sprocket Support Bushing
527	Vehicle Speed Sensor Reluctor Wheel Assembly

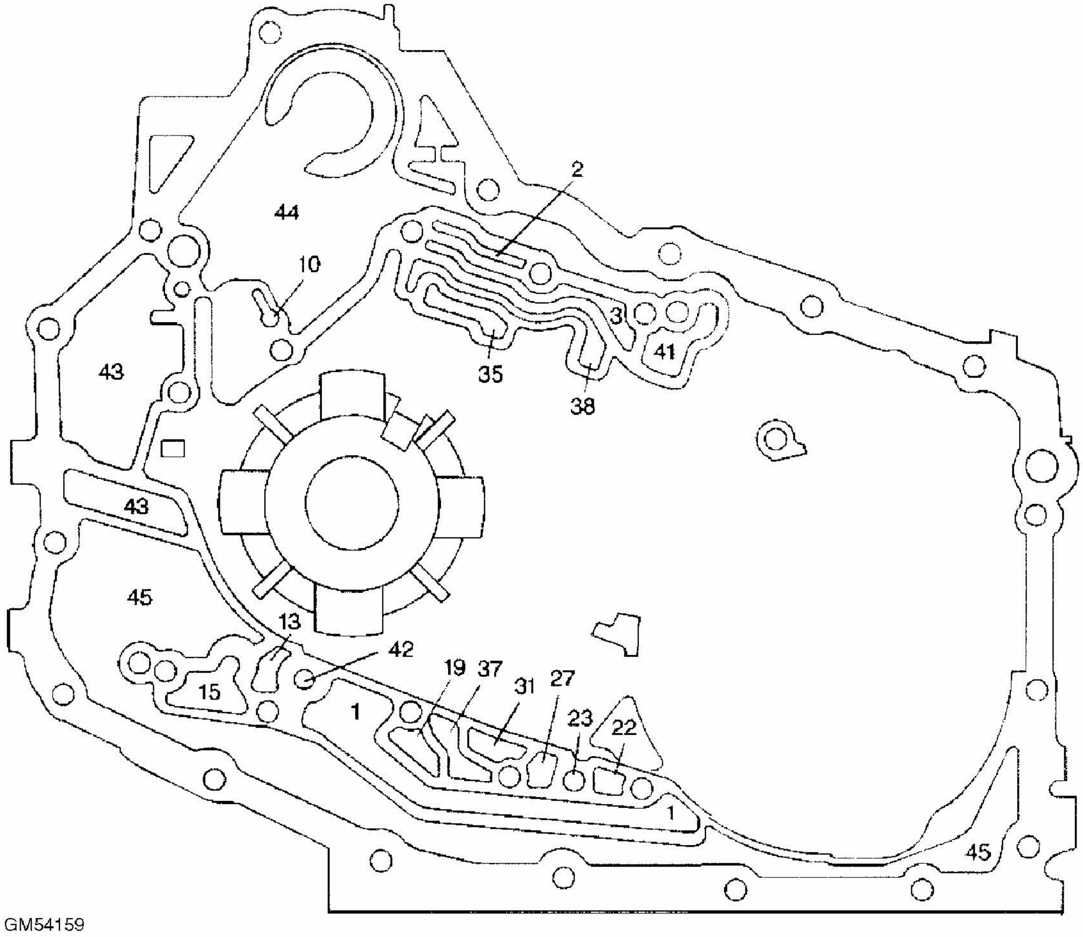

2
44
10
3
41
35
38
43
43
45
13
42
15
1
19
37
31
27
23
22
1
45
GM54159

Fig. 459: Case Fluid Passages (Case Cover Side)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 459

Callout	Component Name
1	Suction
1	Suction
2	Line
3	PRN
10	Actuator Feed
13	TCC Release

15	Cooler
19	Forward Servo
22	1-2 Accumulator
23	2-3 Accumulator
27	2nd Clutch
31	3rd Clutch
35	D3
37	Manual 2-1 Servo
38	Lo
41	Reverse Servo
42	Exhaust
43	Casting Void
43	Casting Void
44	Vent
45	Thermo Element Exhaust
45	Thermo Element Exhaust

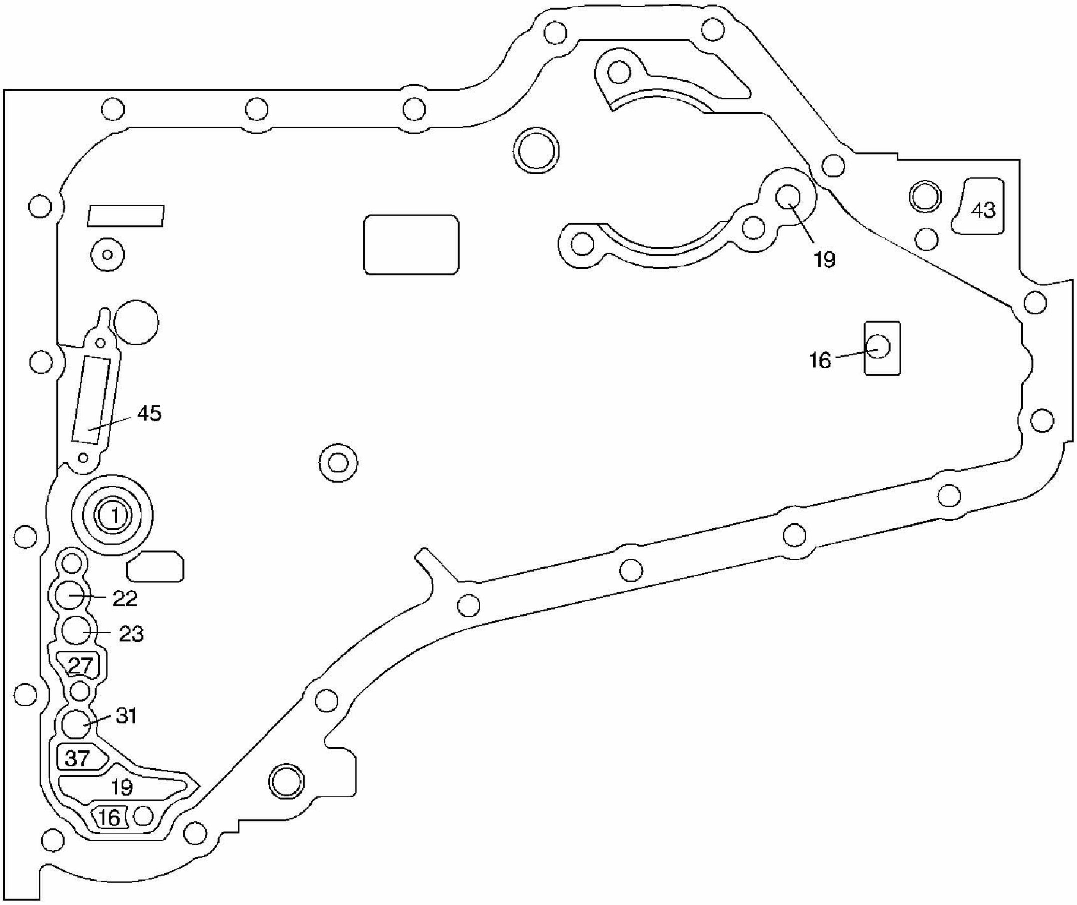


Fig. 460: Case Fluid Passages (Bottom)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 460

Callout	Component Name
1	Suction
16	Lube
16	Lube
19	Forward Servo
19	Forward Servo
22	1-2 Accumulator
23	2-3 Accumulator
27	2nd Clutch
31	3rd Clutch
37	Manual 2-1 Servo
43	Casting Void
45	Thermo Element Exhaust

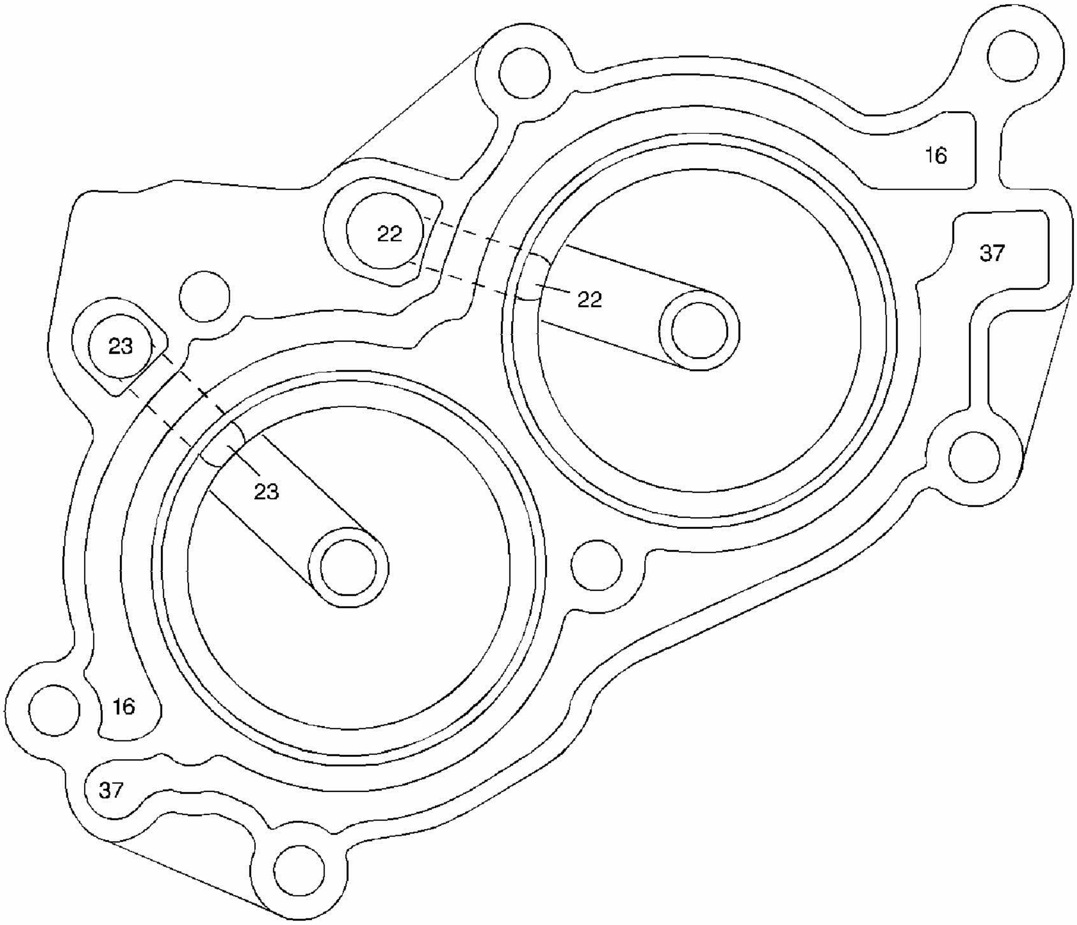


Fig. 461: 1-2 and 2-3 Accumulator Housing Fluid Passages
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 461

Callout	Component Name
16	Lube
16	Lube
22	1-2 Accumulator
22	1-2 Accumulator
23	2-3 Accumulator
23	2-3 Accumulator
37	Manual 2-1 Servo
37	Manual 2-1 Servo

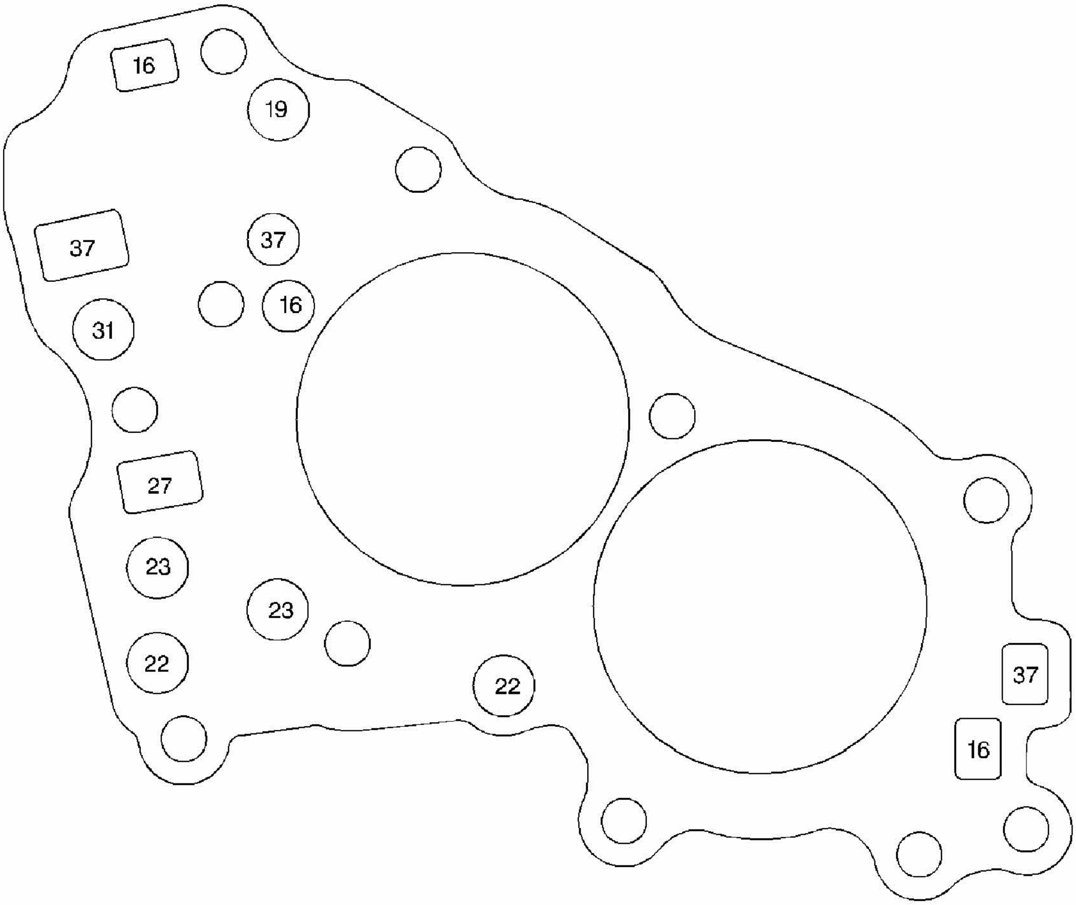


Fig. 462: Accumulator Cover Spacer Plate Fluid Passages
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 462

Callout	Component Name
16	Lube
16	Lube
16	Lube
19	Forward Servo
22	1-2 Accumulator
22	1-2 Accumulator
23	2-3 Accumulator
23	2-3 Accumulator
27	2nd Clutch
31	3rd Clutch
37	Manual 2-1 Servo
37	Manual 2-1 Servo

37	Manual 2-1 Servo

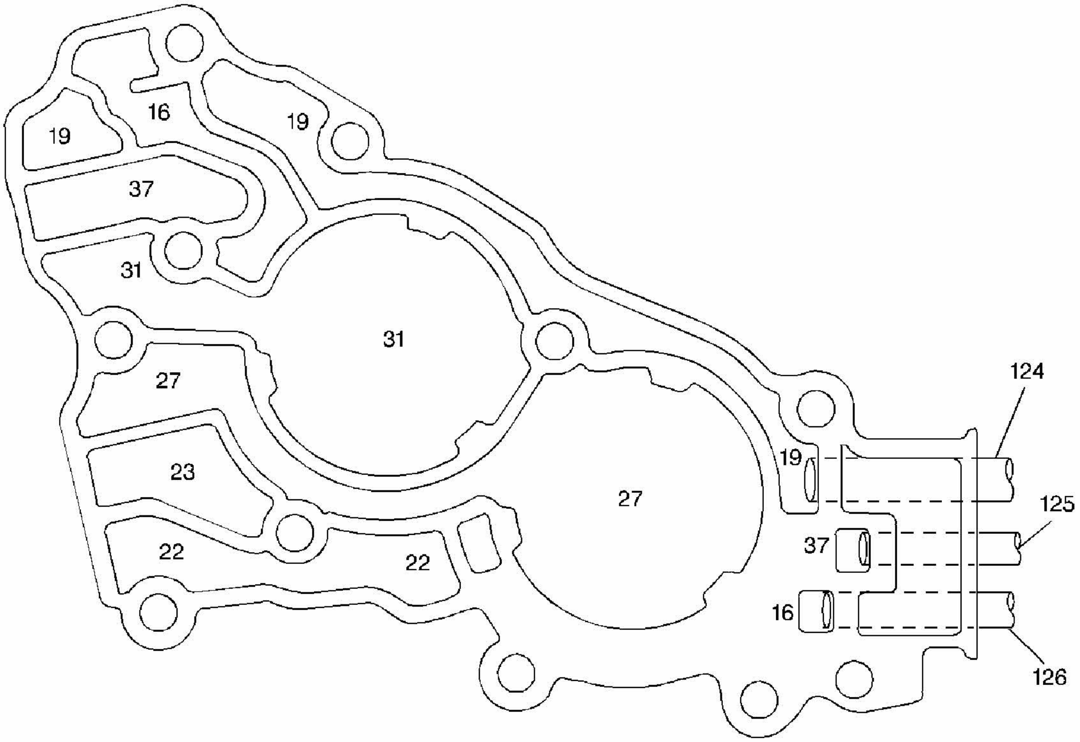


Fig. 463: Accumulator Cover Fluid Passages
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 463

Callout	Component Name
16	Lube
16	Lube
19	Forward Servo
19	Forward Servo
19	Forward Servo
22	1-2 Accumulator
22	1-2 Accumulator
23	2-3 Accumulator
27	2nd Clutch
27	2nd Clutch
31	3rd Clutch
31	3rd Clutch
37	Manual 2-1 Servo
37	Manual 2-1 Servo

124	Forward Band Servo Oil Pipe
125	Manual 2-1 Band Servo Oil Pipe
126	Lube Oil Pipe

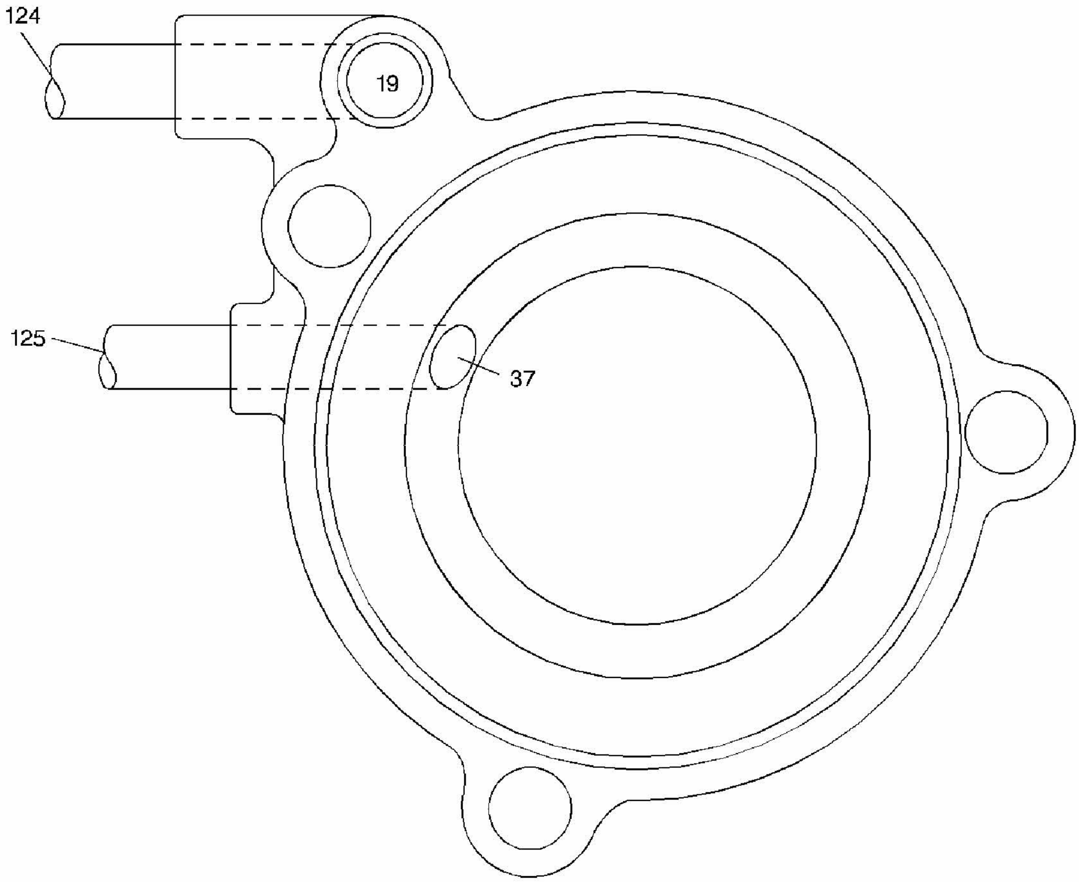


Fig. 464: Manual 2-1 Band Servo Cover Fluid Passages
Courtesy of GENERAL MOTORS CORP.

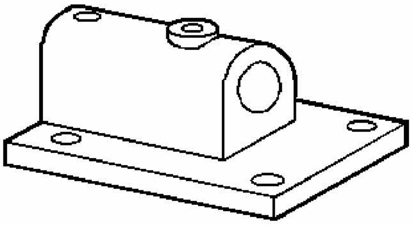
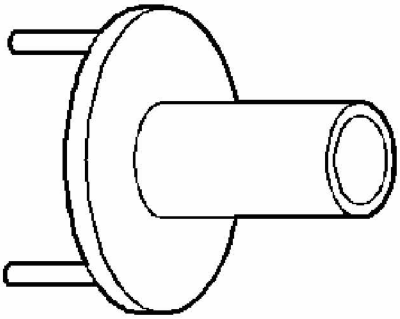
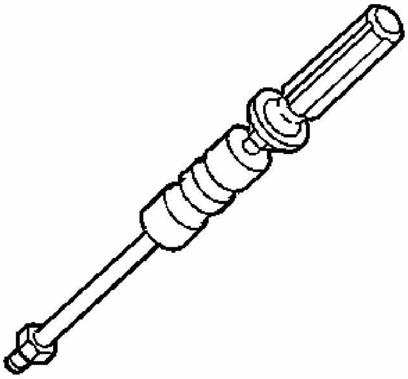
Callouts For Fig. 464

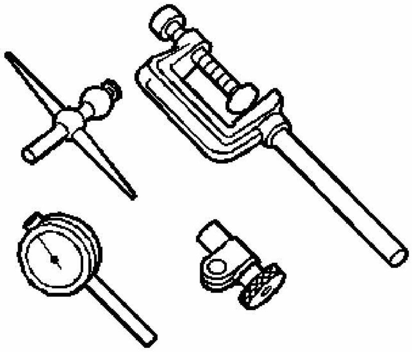
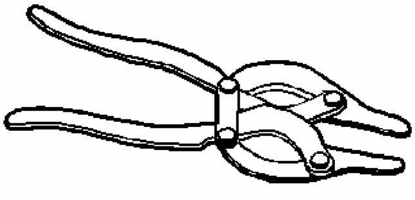
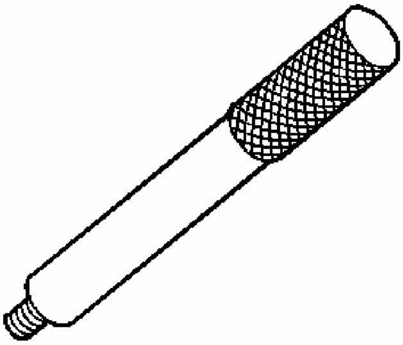
Callout	Component Name
19	Forward Servo
37	Manual 2-1 Servo
124	Forward Band Servo Oil Pipe
125	Manual 2-1 Band Servo Oil Pipe

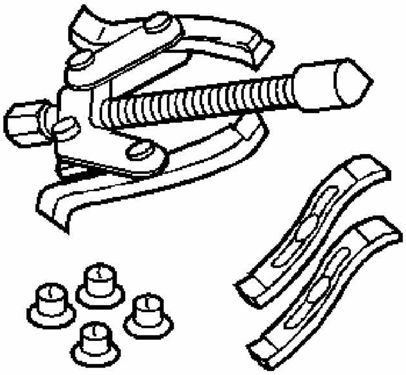
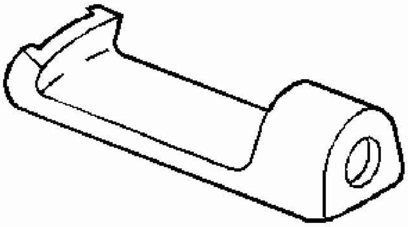
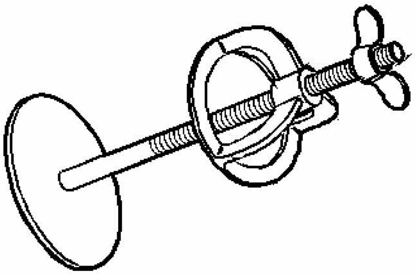
SPECIAL TOOLS AND EQUIPMENT

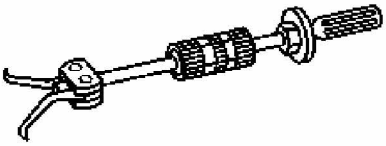
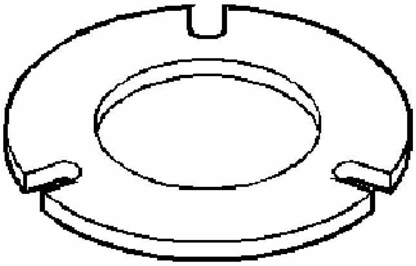
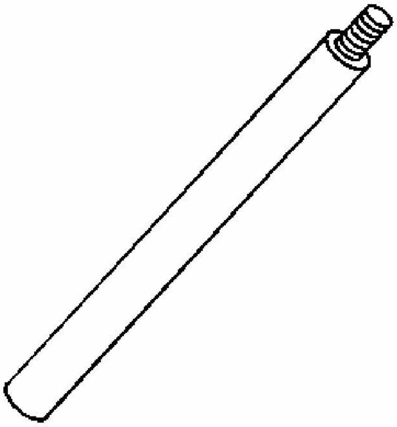
SPECIAL TOOLS

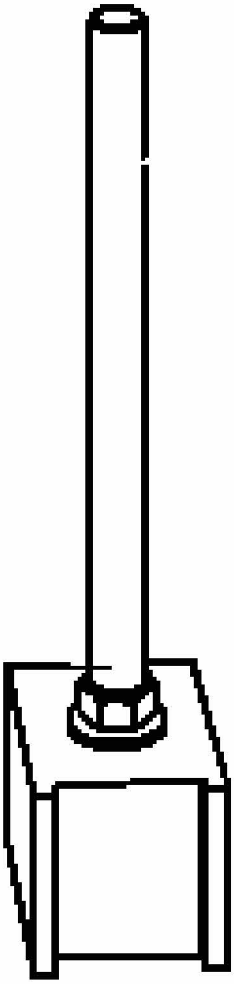
Special Tools

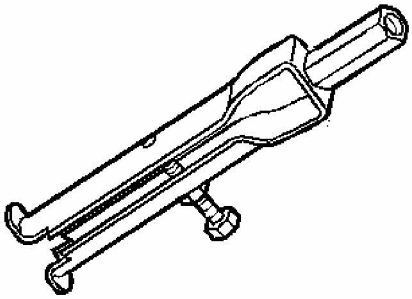
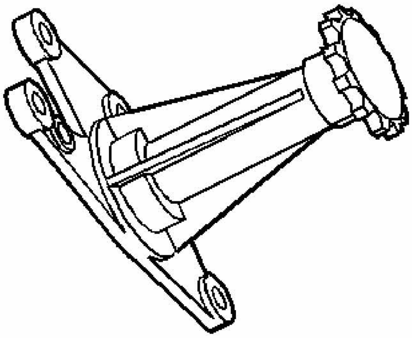
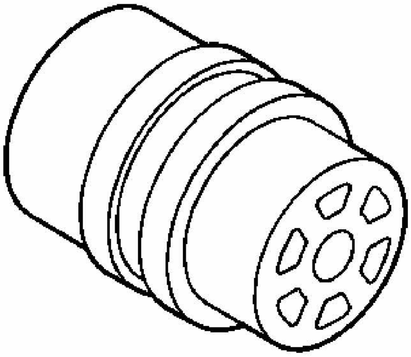
Illustration	Tool Number/Description
	J 3289-20 Holding Fixture Base Assembly
	J 4670-01 4th Clutch Spring Compressor
	J 6125-1B Slide Hammer

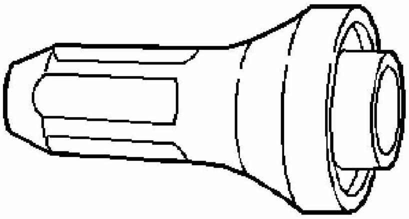
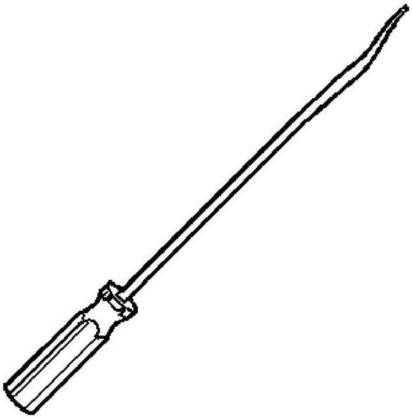
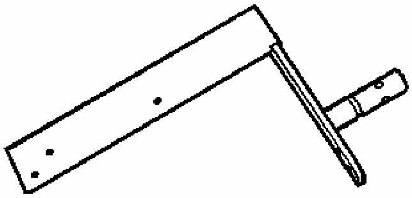
	J 8001 Dial Indicator Set
	J 8059 Snap Ring Plier
	J 8092 Universal Driver Handle
	J 22888-D Universal Bearing Puller

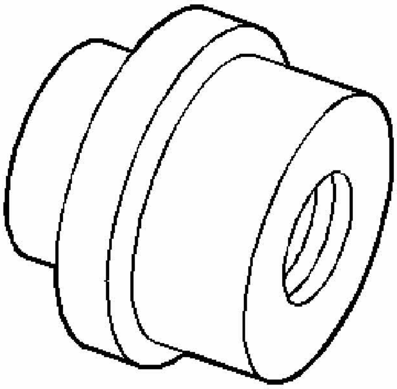
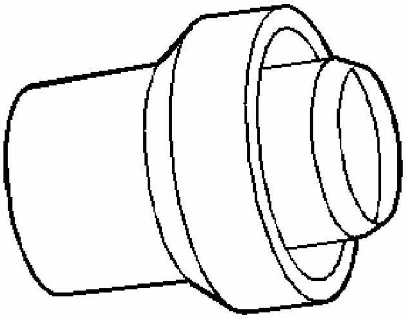
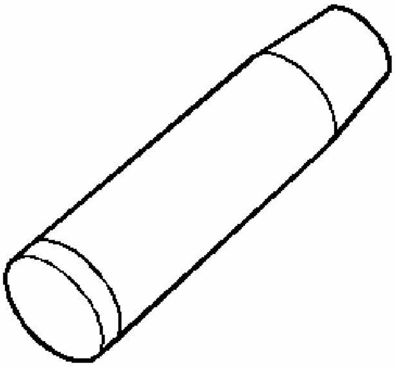
	
	J 23129 Universal Seal Remover - use with J 6125-1B
	J 23327 Clutch Spring Compressor
	J 23907 Slide Hammer with Bearing Adapter

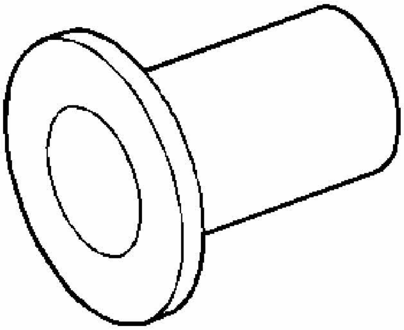
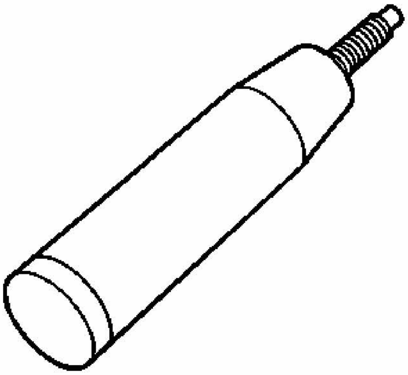
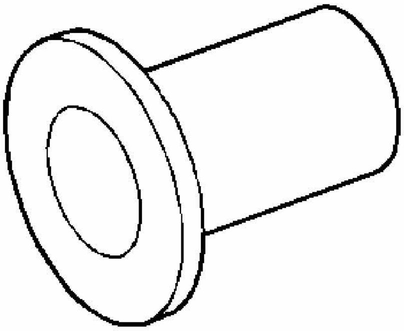
	
	J 25018-A Clutch Spring Compressor Adapter
	J 25025-8 Dial Indicator Mounting Post

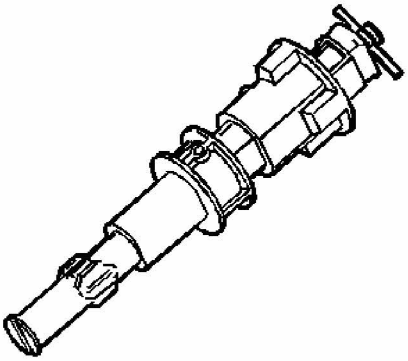
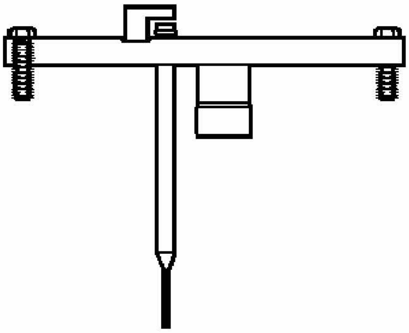
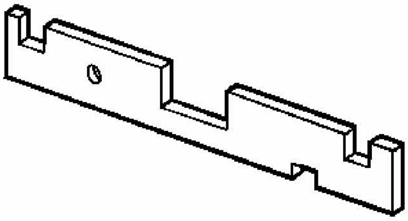
	J 26900-13 Magnetic Indicator Base
	J 26941 Bushing/Bearing Remover

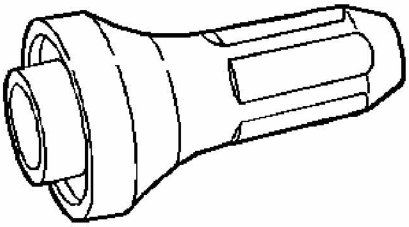
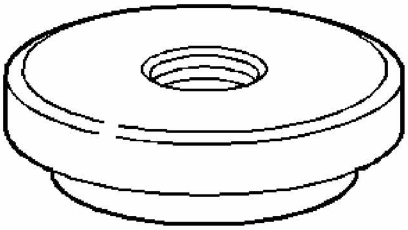
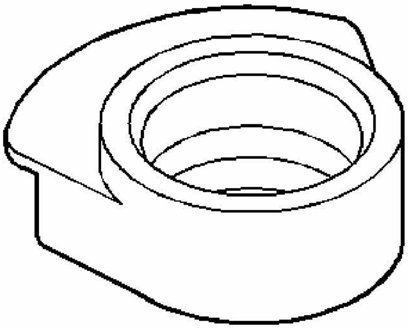
	
	J 26958 Output Shaft Loading and Aligning Tool
	J 26958-10B Adapter Plug
	J 28540-A

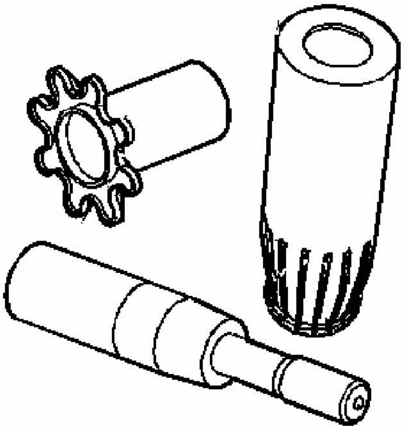
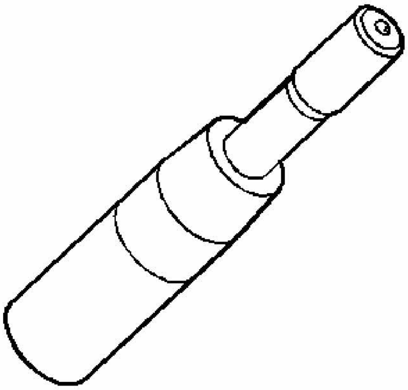
	Torque Converter Seal Installer
	J 28585 Snap Ring Remover
	J 28664-B Transmission Holding Fixture
	J 28677 Drive Sprocket Support Bearing Installer

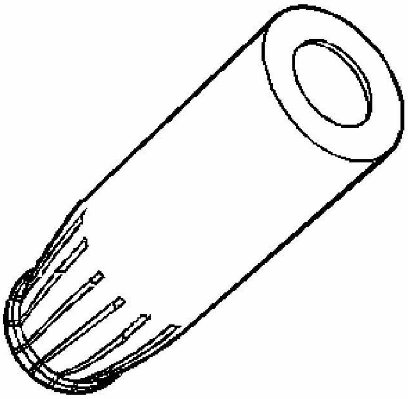
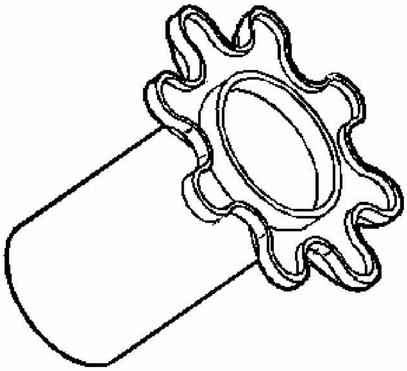
	
	J 29130 Axle Shaft Seal Installer
	J 29569-1 Turbine Shaft Seal Installer - Expander

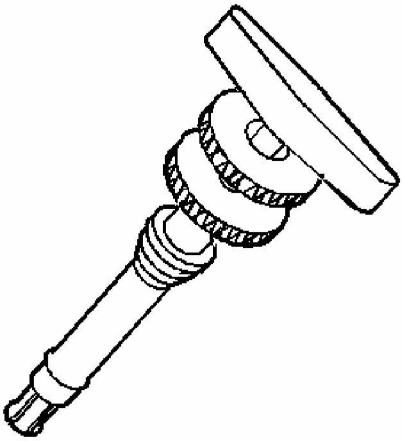
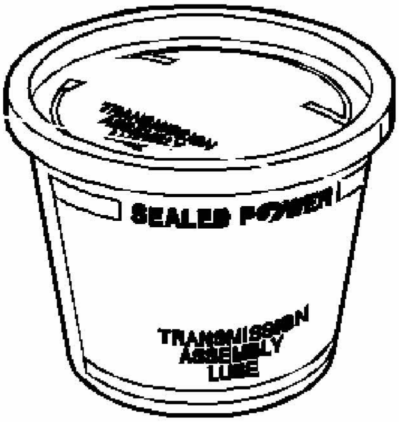
	J 29569-2 Turbine Shaft Seal Installer - Compressor
	J 29829-1A Turbine Shaft Seal Installer - Expander
	J 29829-2 Turbine Shaft Seal Installer - Compressor

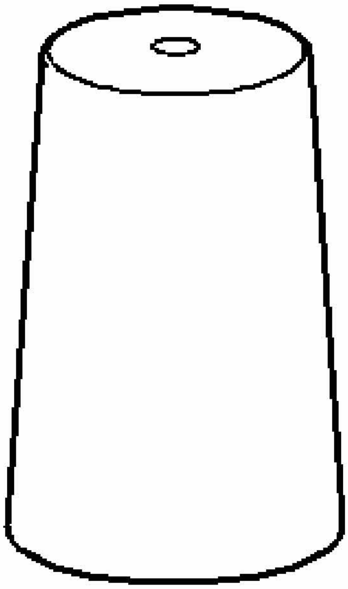
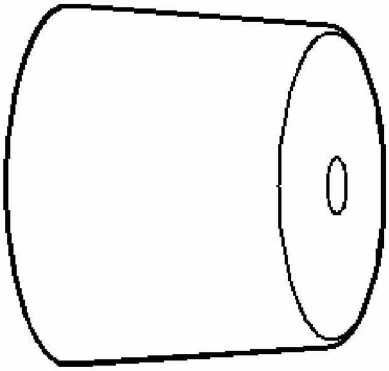
	J 33381-A Clutch Assembly Remover/Installer
	J 33386-A Input Shaft End Play Tool
	J 34094-A Thermo Element Height Gauge
	J 34115 Left Side Axle Seal Installer

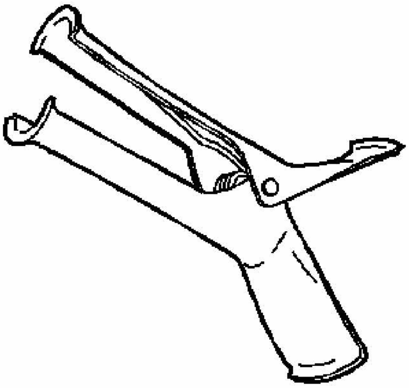
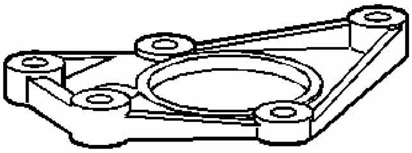
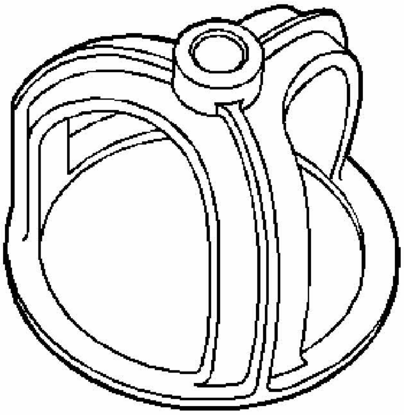
	
	J 34126 Driven Sprocket Bearing Installer
	J 34129 Driven Sprocket Support Bearing Remover
	J 34741-A Input Shaft Seal Installer Set

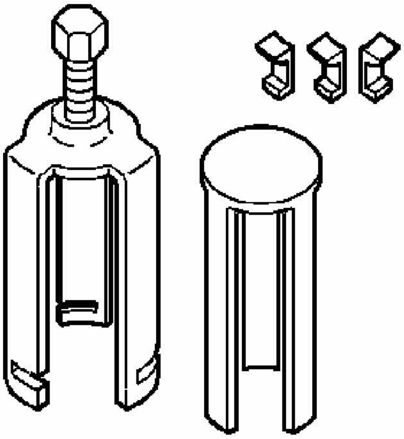
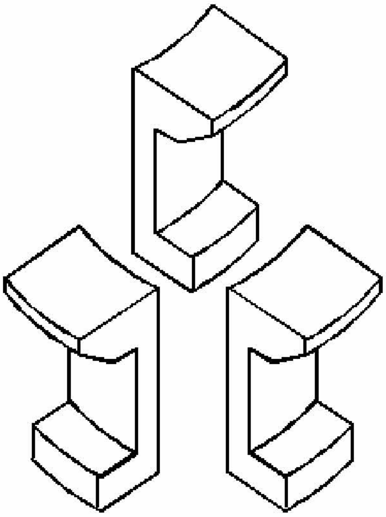
	
	J 34741-1 Input Shaft Seal Installer
	J 34741-2 Input Shaft Seal Pusher

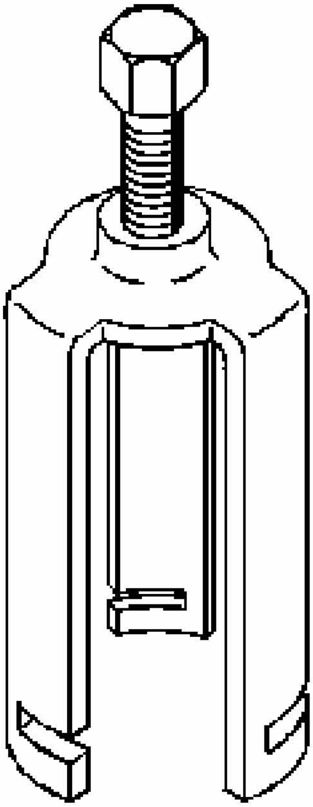
	
	J 34741-3 Input Shaft Seal Compressor
	J 35138 Torque Converter End Play Fixture

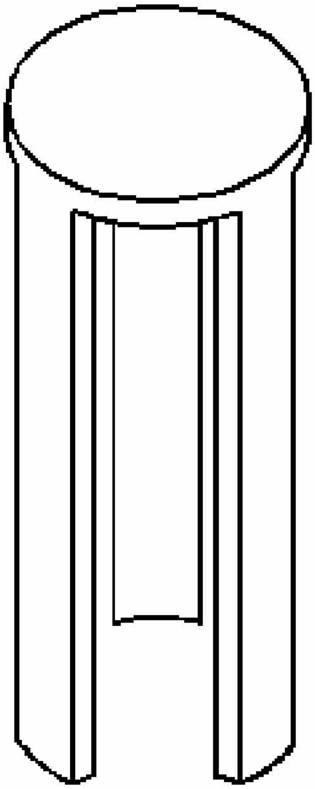
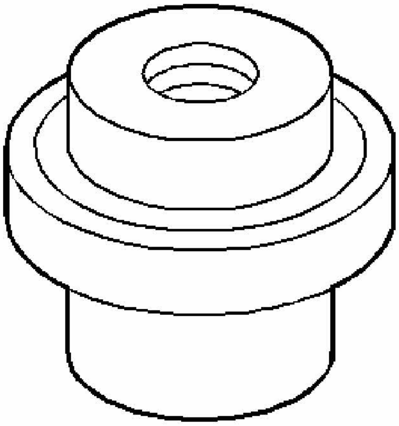
	
 SEALED POWER TRANSMISSION ASSEMBLY LUBE	J 36850 Assembly Lubricant
	J 37361 Input Clutch Piston Seal Protector

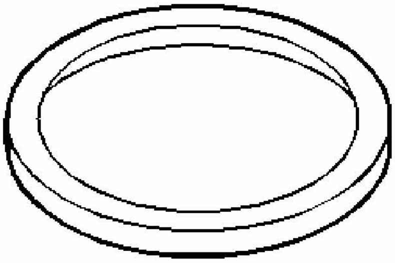
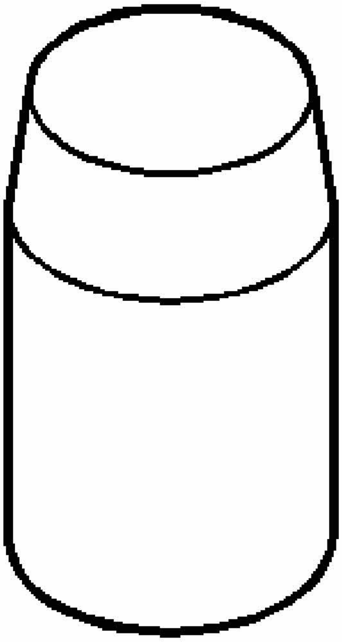
	
	J 37362 Third Clutch Piston Seal Protector
	J 38358-A

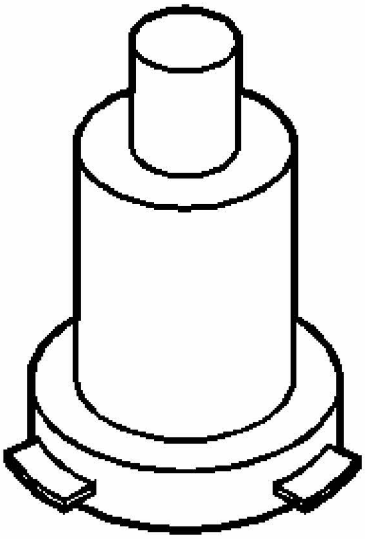
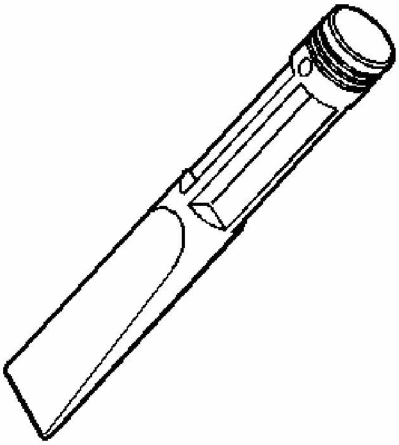
	1-2 Support Remover Installer
	J 38385 Output Shaft Loading Tool Adapter
	J 38734 Intermediate Spring Compressor Adapter

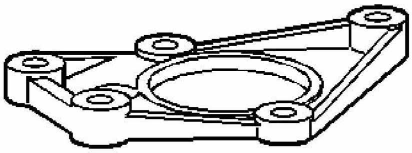
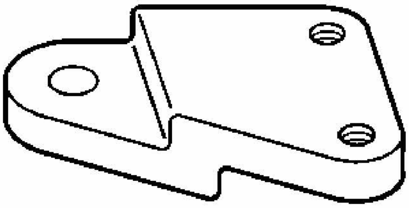
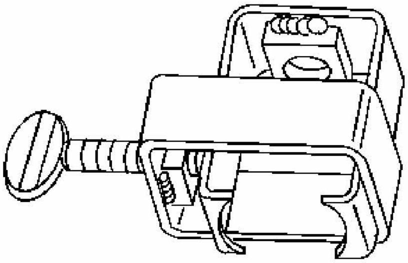
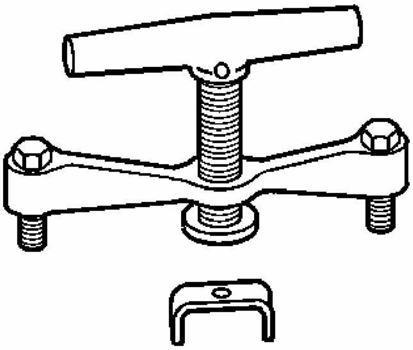
	J 41103 Torque Converter Seal Remover Set
	J 41103-1 Torque Converter Seal Puller Legs

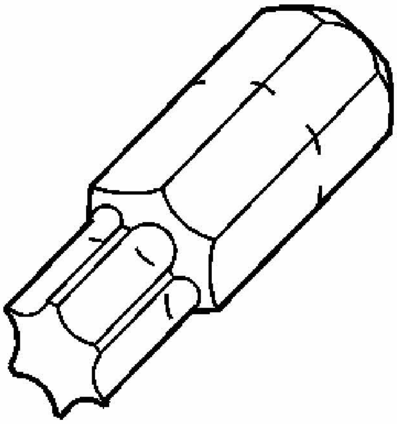
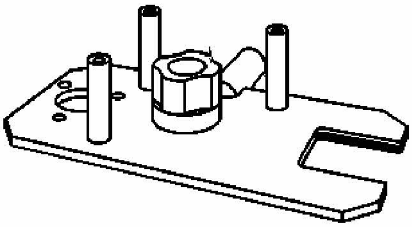
	J 41103-2 Torque Converter Seal Puller Bridge
	J 41103-3

	Torque Converter Seal Support Body
	J 41991 Side Cover Bearing Remover/Installer

	J 41992-1 2nd Clutch Piston Protector
	J 41992-2 2nd Clutch Piston Adapter

	J 41992-3 2nd Clutch Piston Installer
	J 42562 Axle Removal Wedge
	J 43425 Output Shaft Loading Tool Adapter

	
	J 44465 Holding Fixture Adapter
	J 44467 Output Shaft Assembly Remover and Installer
	J 44472 End Play Checking Tool

	J 44538 TORX® 30+
	J 44755 Holding Fixture

2006 BRAKES

Antilock Brake System - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Pipe Fittings at Brake Pressure Modulator Valve (BPMV) and Master Cylinder	24 N.m	18 lb ft
Brake Pressure Modulator Valve (BPMV) and Electronic Brake Control Module (EBCM) Assembly to Mounting Bracket	10 N.m	89 lb in
Electronic Brake Control Module (EBCM) to Brake Pressure Modulator Valve (BPMV)	5 N.m	44 lb in
I/P Cluster Trim Plate Screws	2 N.m	18 lb in
Mounting Bracket Nut/Bolt Assembly to Shock Tower	10 N.m	89 lb in
Mounting Bracket Nut Assembly to Shock Tower	3 N.m	27 lb in

SCHEMATIC AND ROUTING DIAGRAMS

ABS SCHEMATIC ICONS

ABS Schematic Icons

Icon	Icon Definition
	IMPORTANT: **Twisted-pair wires provide an effective shield that helps protect sensitive electronic components from electrical interference. If the wires were covered with shielding, install new shielding. In order to prevent electrical interference from degrading the performance of the connected components, you must maintain the proper specification when making any repairs to the twisted-pair wires shown :** ● **The wires must be twisted a minimum of 9 turns per 31 cm (12 in) as measured anywhere along the length of the wires.**

⚠	● **The outside diameter of the twisted wires must not exceed 6.0 mm (0.25 in).**

ABS SCHEMATICS

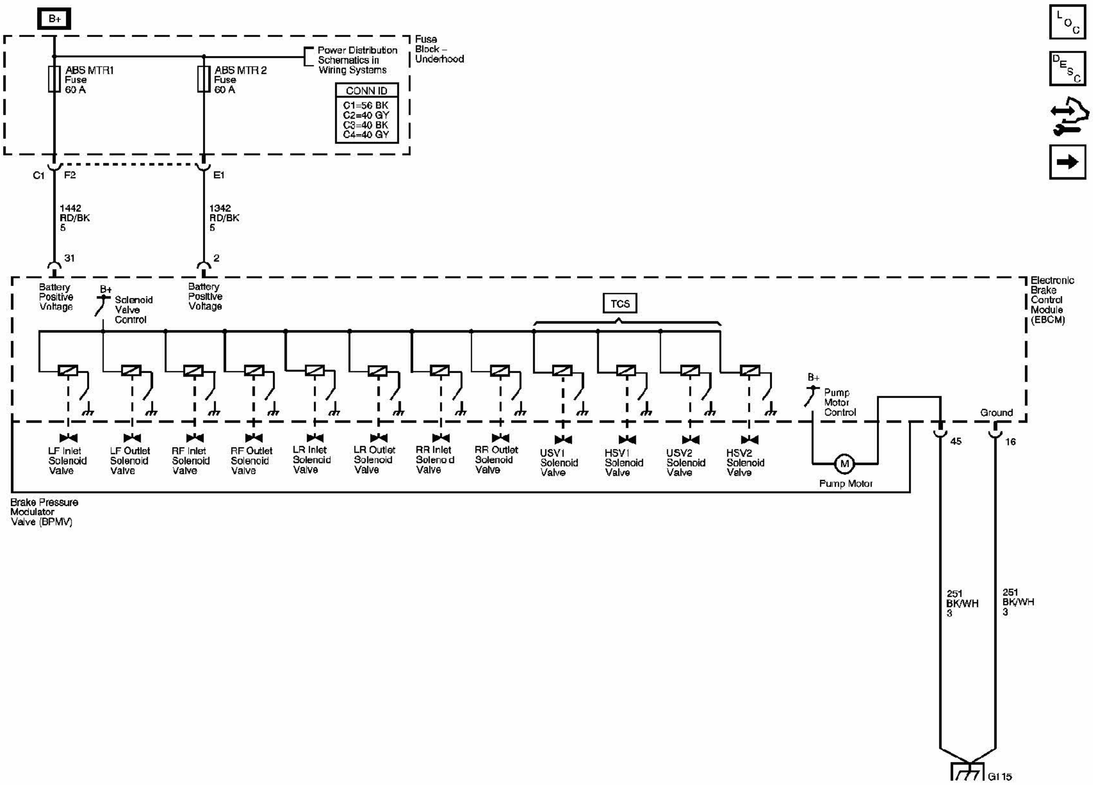

B+
Fuse Block – Underhood
Power Distribution Schematics in Wiring Systems
ABS MTR1 Fuse 60 A
ABS MTR 2 Fuse 60 A
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
C1
F2
E1
1442 RD/BK 5
1342 RD/BK 5
31
2
Battery Positive Voltage
B+
Solenoid Valve Control
Battery Positive Voltage
TCS
Electronic Brake Control Module (EBCM)
B+
Pump Motor Control
Ground
45
16
LF Inlet Solenoid Valve
LF Outlet Solenoid Valve
RF Inlet Solenoid Valve
RF Outlet Solenoid Valve
LR Inlet Solenoid Valve
LR Outlet Solenoid Valve
RR Inlet Solenoid Valve
RR Outlet Solenoid Valve
USV1 Solenoid Valve
HSV1 Solenoid Valve
USV2 Solenoid Valve
HSV2 Solenoid Valve
M
Pump Motor
Brake Pressure Modulator Valve (BPMV)
251 BK/WH 3
251 BK/WH 3
G115

Fig. 1: Power, Ground, and Brake Pressure Modulator Valves - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

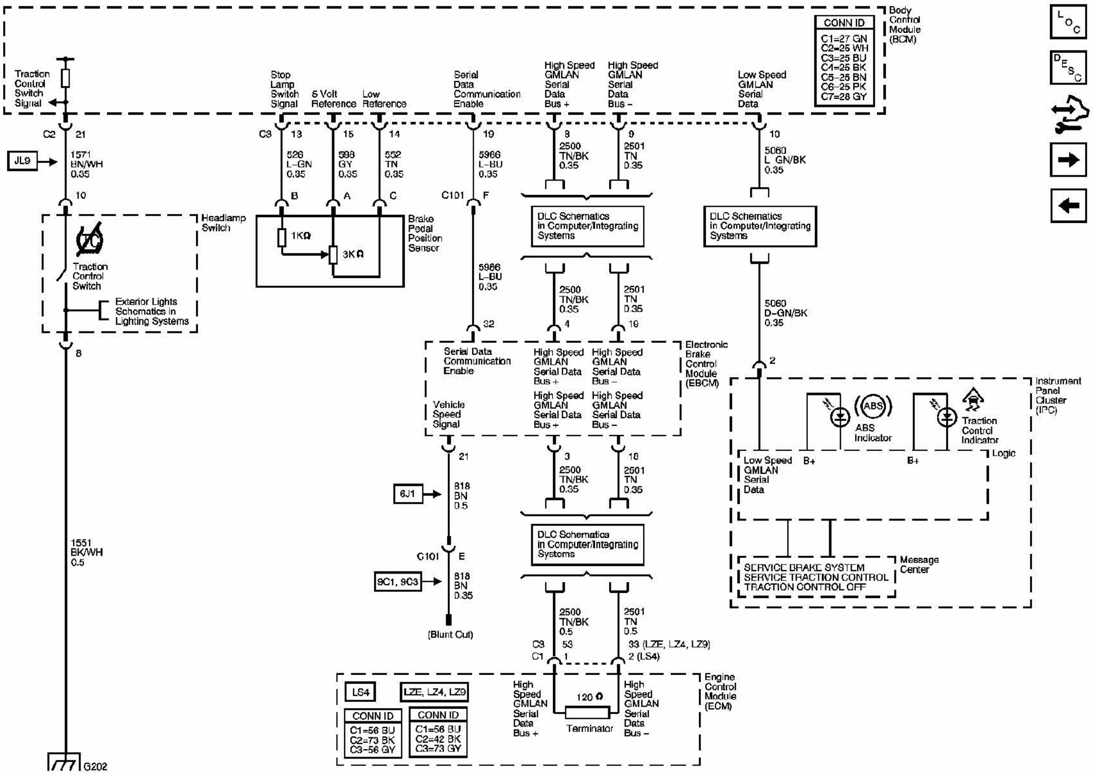

Body Control Module (BCM)
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Traction Control Switch Signal
Stop Lamp Switch Signal
5 Volt Reference
Low Reference
Serial Data Communication Enable
High Speed GMLAN Serial Data Bus +
High Speed GMLAN Serial Data Bus –
Low Speed GMLAN Serial Data
C2
21
C3
13
15
14
19
8
9
10
JL9
1571 BN/WH 0.35
526 L–GN 0.35
598 GY 0.35
552 TN 0.35
5966 L–BU 0.35
2500 TN/BK 0.35
2501 TN 0.35
5060 L GN/BK 0.35
10
B
A
C
C101
F
Headlamp Switch
Traction Control Switch
Exterior Lights Schematics in Lighting Systems
1KΩ
3KΩ
Brake Pedal Position Sensor
DLC Schematics in Computer/Integrating Systems
DLC Schematics in Computer/Integrating Systems
5986 L–BU 0.35
2500 TN/BK 0.35
2501 TN 0.35
5060 D–GN/BK 0.35
8
32
4
19
2
Electronic Brake Control Module (EBCM)
Serial Data Communication Enable
High Speed GMLAN Serial Data Bus +
High Speed GMLAN Serial Data Bus –
Vehicle Speed Signal
High Speed GMLAN Serial Data Bus +
High Speed GMLAN Serial Data Bus –
Instrument Panel Cluster (IPC)
ABS
ABS Indicator
Traction Control Indicator
Logic
Low Speed GMLAN Serial Data
B+
B+
Message Center
SERVICE BRAKE SYSTEM
SERVICE TRACTION CONTROL
TRACTION CONTROL OFF
21
3
18
6J1
818 BN 0.5
2500 TN/BK 0.35
2501 TN 0.35
DLC Schematics in Computer/Integrating Systems
1551 BK/WH 0.5
C101
E
9C1, 9C3
818 BN 0.35
(Blunt Cut)
2500 TN/BK 0.5
2501 TN 0.5
C3
C1
53
1
33 (LZE, LZ4, LZ9)
2 (LS4)
Engine Control Module (ECM)
LS4
LZE, LZ4, LZ9
CONN ID
C1=56 BU
C2=73 BK
C3=56 GY
CONN ID
C1=58 BU
C2=42 BK
C3=73 GY
High Speed GMLAN Serial Data Bus +
120 Ω
Terminator
High Speed GMLAN Serial Data Bus –
G202

Fig. 2: Indicators, ABS, and Traction Control - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

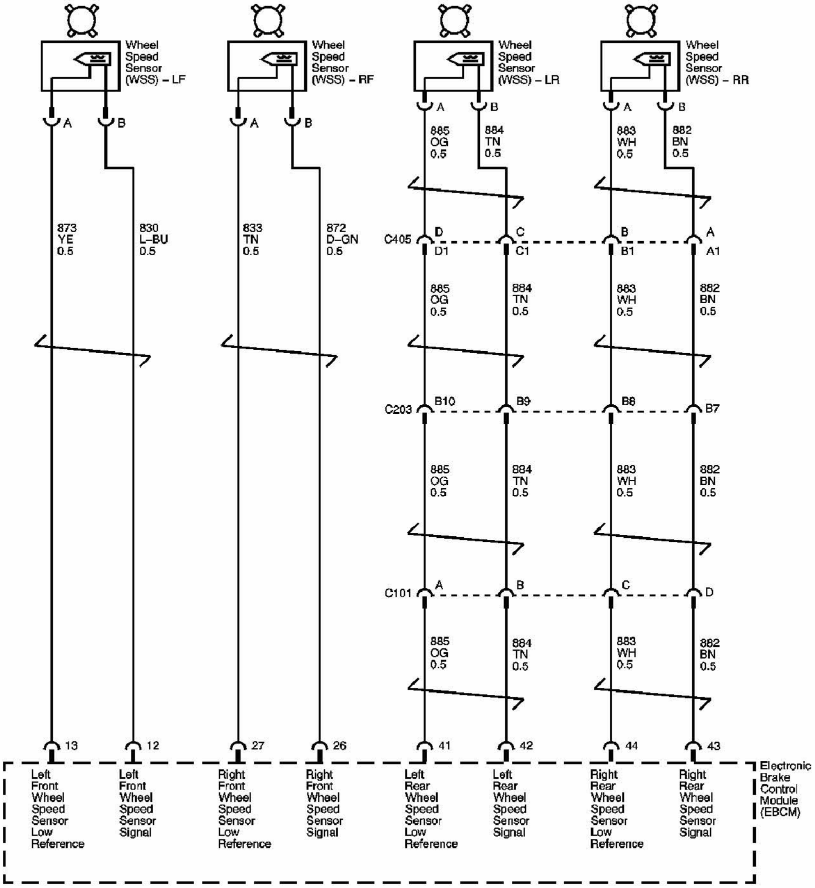

Wheel Speed Sensor (WSS) - LF
Wheel Speed Sensor (WSS) - RF
Wheel Speed Sensor (WSS) - LR
Wheel Speed Sensor (WSS) - RR
A
B
873 YE 0.5
830 L-BU 0.5
833 TN 0.5
872 D-GN 0.5
885 OG 0.5
884 TN 0.5
883 WH 0.5
882 BN 0.5
C405
D
C
B
A
D1
C1
B1
A1
C203
B10
B9
B8
B7
C101
A
B
C
D
13
12
27
26
41
42
44
43
Left Front Wheel Speed Sensor Low Reference
Left Front Wheel Speed Sensor Signal
Right Front Wheel Speed Sensor Low Reference
Right Front Wheel Speed Sensor Signal
Left Rear Wheel Speed Sensor Low Reference
Left Rear Wheel Speed Sensor Signal
Right Rear Wheel Speed Sensor Low Reference
Right Rear Wheel Speed Sensor Signal
Electronic Brake Control Module (EBCM)

Fig. 3: Wheel Speed Sensors - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

ABS COMPONENT VIEWS

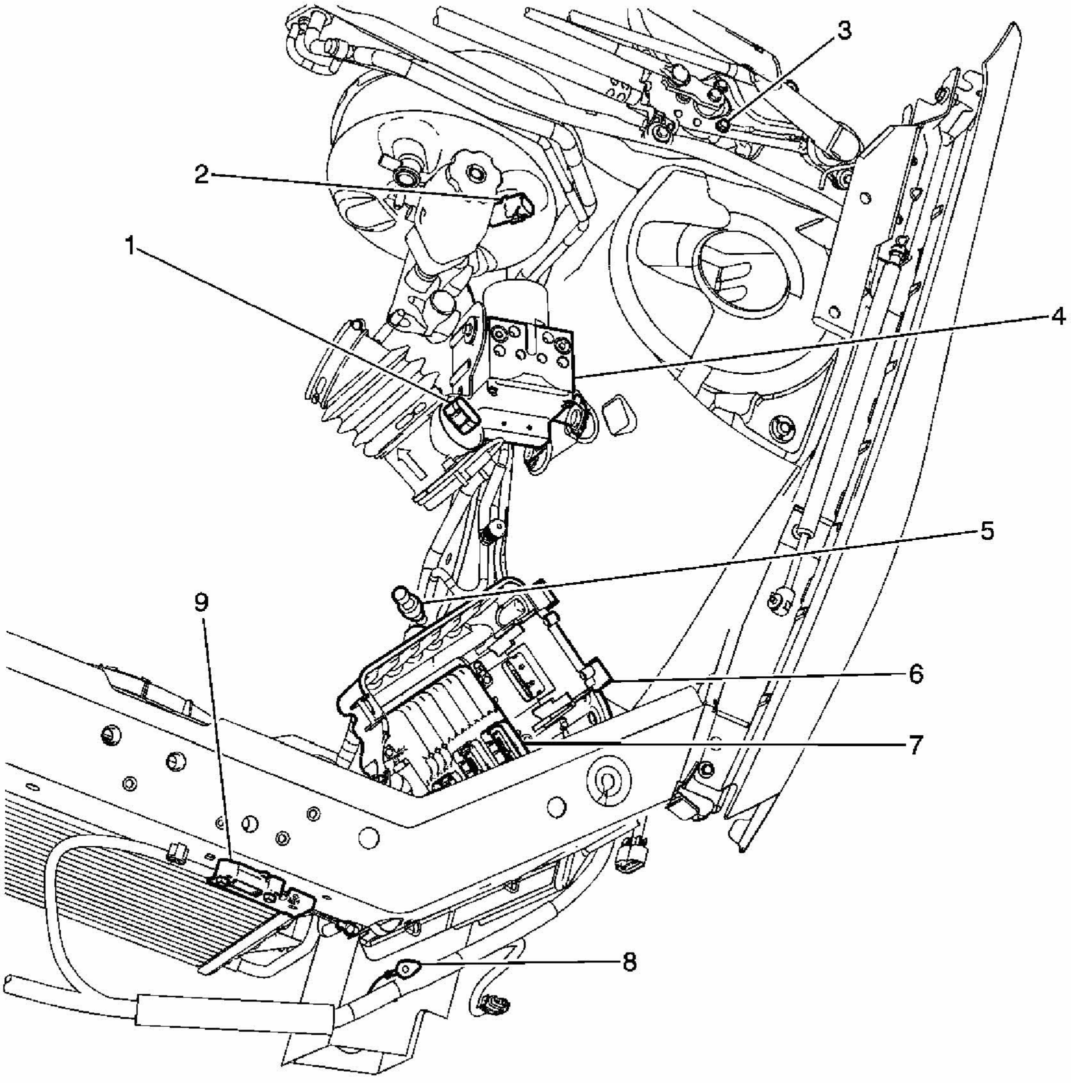


Fig. 4: LF of the Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	Mass Air Flow (MAF) / Intake Air Temperature (IAT) Sensor
2	Brake Fluid Level Switch
3	Windshield Wiper Motor
4	Electronic Brake Control Module (EBCM)
5	A/C Refrigerant Pressure Sensor
6	Transmission Control Module (TCM)
7	Engine Control Module (ECM)
8	G101

9	Inflatable Restraint Front end Sensor - Left

ABS CONNECTOR END VIEWS

Electronic Brake Control Module (EBCM)

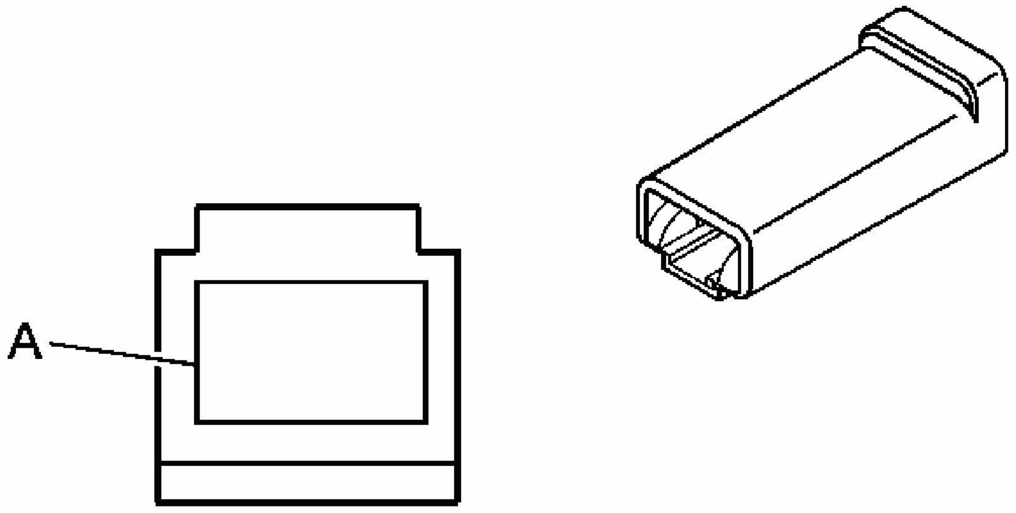


Fig. 5: Electronic Brake Control Module Connector End View
Courtesy of GENERAL MOTORS CORP.

ABS Connector End Views

Connector Part Information

- OEM: 15492334
- Service: See Catalog
- Description: 46-Way F Receptacle 0.64 6.3 Sealed

Terminal Part Information

- Pins: 2, 31
- Terminal/Tray: 7116-4142-02/10
- Core/Insulation Crimp: D/3
- Release Tool/Test Probe: 12094430/J-35616-42 (RD)

- Pins: 16, 45
- Terminal/Tray: 7116-4141-02/10

- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: 12094430/J-35616-42 (RD)

- Pins: 3, 4, 18, 19, 32, 12, 13, 21, 26, 27, 41, 42, 43, 44
- Terminal/Tray: 638551-1/16
- Core/Insulation Crimp: Pins 3, 4, 18, 19, 32 - J/J
- Core/Insulation Crimp: Pins 12, 13, 21, 26, 27, 41, 42, 43, 44 - K/K
- Release Tool/Test Probe: 15315247/J-35616-64A (L-BU)

Electronic Brake Control Module (EBCM)

Pin	Wire Color	Circuit No.	Function
1	-	-	Not Used
2	RD/BK	1342	Battery Positive Voltage
3	TN/BK	2500	High Speed GMLAN Serial Data Bus+
4	TN/BK	2500	High Speed GMLAN Serial Data Bus+
5-11	-	-	Not Used
12	L-BU	830	Left Front Wheel Speed Sensor Signal
13	YE	873	Left Front Wheel Speed Sensor Low Reference
14-15	-	-	Not Used
16	BK/WH	251	Ground
17	-	-	Not Used
18	TN	2501	High Speed GMLAN Serial Data Bus-
19	TN	2501	High Speed GMLAN Serial Data Bus-
20	-	-	Not Used
21	BN	818	Vehicle Speed Signal
22-25	-	-	Not Used
26	D-GN	872	Right Front Wheel Speed Sensor Signal
27	TN	833	Right Front Wheel Speed Sensor Low Reference
28-30	-	-	Not Used
31	RD/BK	1442	Battery Positive Voltage
32	L-BU	5986	TBD

33-40	-	-	Not Used
41	OG	885	Left Rear Wheel Speed Sensor Low Reference
42	TN	884	Left Rear Wheel Speed Sensor Signal
43	BN	882	Right Rear Wheel Speed Sensor Signal
44	WH	883	Right Rear Wheel Speed Sensor Low Reference
45	BK/WH	251	Ground
46	-	-	Not Used

Wheel Speed Sensor (WSS) - LF

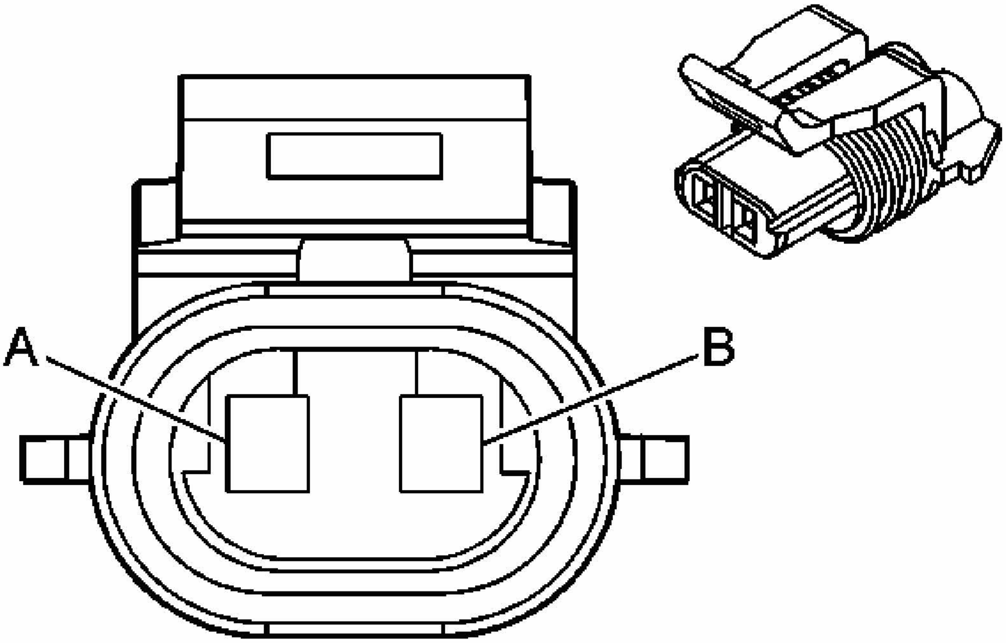


Fig. 6: Connector End Views
Courtesy of GENERAL MOTORS CORP.

ABS Connector End Views

Connector Part Information

- OEM: 12052644

- Service: See Catalog
- Description: 2-Way F Metri-Pack 150 Sealed (L-GY)

Terminal Part Information

- Terminal/Tray: 12048074/2
- Core/Insulation Crimp: E/1
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Wheel Speed Sensor (WSS) - LF

Pin	Wire Color	Circuit No.	Function
A	YE	873	Left Front Wheel Speed Sensor Low Reference
B	L-BU	830	Left Front Wheel Speed Sensor Signal

Wheel Speed Sensor (WSS) - RF

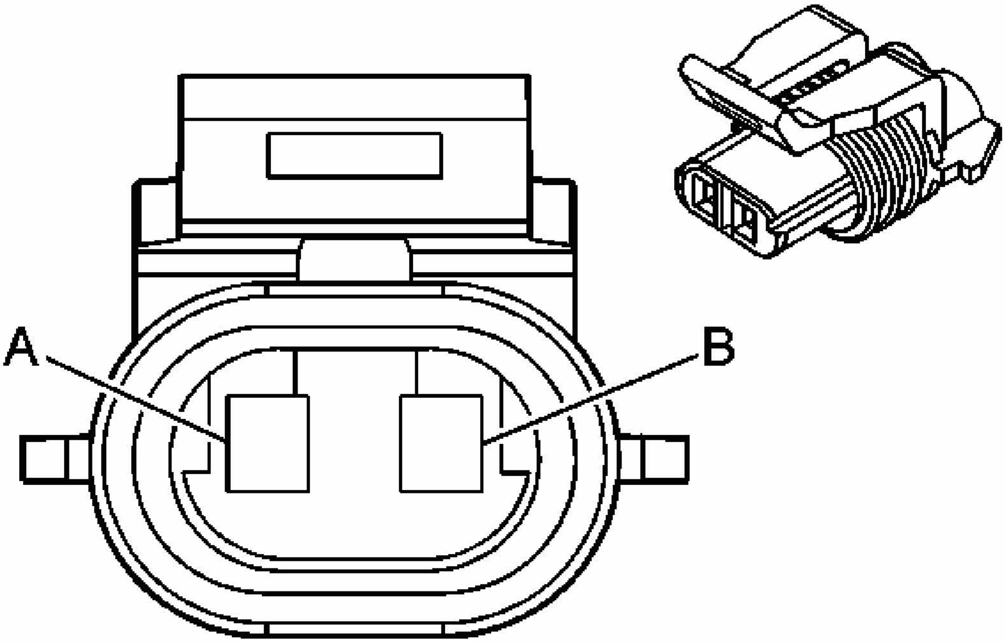


Fig. 7: Connector End Views
Courtesy of GENERAL MOTORS CORP.

ABS Connector End Views

Connector Part Information

- OEM: 12052644
- Service: See Catalog
- Description: 2-Way F Metri-Pack 150 Sealed (L-GY)

Terminal Part Information

- Terminal/Tray: 12048074/2
- Core/Insulation Crimp: E/1
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Wheel Speed Sensor (WSS) - RF

Pin	Wire Color	Circuit No.	Function
A	TN	833	Right Front Wheel Speed Sensor Low Reference
B	D-GN	872	Right Front Wheel Speed Sensor Signal

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC C0035-C0050	MULTIPLE VALUES refer to reference in column to the left
DTCs C0110 04, C0110 61	Pump Motor Circuit Open Circuit, Pump Motor Circuit Actuator Stuck
DTC C0161	TCS Brake Switch Circuit
DTC C0179	System Thermal High
DTC C0201	Antilock Brake System (ABS) Enable Relay Contact Circuit
DTC C0245	As the wheel spins, the wheel speed sensor produces an AC signal. The electronic brake control module (EBCM) uses the frequency of the AC signal to calculate the wheel speed.
DTC C0550	Electronic Control Unit (ECU) Performance
DTC C0899	Device Voltage Low
DTC C0900	Device Voltage High

DIAGNOSTIC STARTING POINT - ANTILOCK BRAKE SYSTEM

Begin the system diagnosis with **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL OUTPUT CONTROLS

Electronic Brake Control Module (EBCM)

Scan Tool Output Control	Additional Menu Selection(s)	Description
ABS Relay	-	Commands the ABS relay ON and OFF.
Automated Bleed	-	Used in order to bleed the ABS hydraulics. Refer to **ABS Automated Bleed Procedure**.
Automated Test	-	Cycles each solenoid valve and the pump motor in order to verify component operation. This test is identical to the Initialization Sequence. If a malfunction is detected, the EBCM will set the appropriate DTCs. The DTCs will be displayed upon completion of the test.
LF Inlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
LF Outlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
LR Inlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
LR Outlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
RF Inlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
RF Outlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
RR Inlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
RR Outlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
TIM Reset	-	Used in order to reset the tire inflation monitor.

SCAN TOOL DATA LIST

Electronic Brake Control Module (EBCM)

Ignition is ON, engine OFF, and vehicle is stationary.

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
ABS Active	ABS Data	Yes/No	No
ABS Failed	ABS Data	Yes/No	No
Battery Voltage Signal	ABS/TCS Data	Volts	Varies
BPP Signal	ABS Data	Released/Applied	Released
Brake Fluid Level Status	ABS Data	OK/Low	OK
Delivered Torque	TCS Data	%	Varies
DRP Active	ABS Data	Yes/No	No
DRP Disabled	ABS Data	Yes/No	No
Engine Drag Control Failed	ABS Data	Yes/No	No
Left Front Wheel Speed	ABS/TCS Data	km/h or mph	0
Left Rear Wheel Speed	ABS/TCS Data	km/h or mph	0
LF Inlet Valve Solenoid	ABS Data	On/Off	Off
LF Outlet Valve Solenoid	ABS Data	On/Off	Off
LR Inlet Valve Solenoid	ABS Data	On/Off	Off
LR Outlet Valve Solenoid	ABS Data	On/Off	Off
Panic Brake Assist Failed	ABS Data	No/Yes	No
Pump Motor Commanded Voltage	ABS/TCS Data	Volts	Varies
Requested Torque	TCS Data	%	Varies
Right Front Wheel Speed	ABS/TCS Data	km/h or mph	0
Right Rear Wheel Speed	ABS/TCS Data	km/h or mph	0
RF Inlet Valve Solenoid	ABS Data	On/Off	Off
RF Outlet Valve Solenoid	ABS Data	On/Off	Off
RR Inlet Valve	ABS Data	Active/Inactive	Off

Solenoid			
RR Outlet Valve Solenoid	ABS Data	On/Off	Off
TCS Active	TCS Data	Yes/No	No
TCS Failed	TCS Data	Yes/No	No

SCAN TOOL DATA DEFINITIONS

The Antilock Brake System (ABS) scan tool data definitions contain a brief description of all ABS related parameters available on the scan tool. The parameters available on the scan tool are listed below in alphanumeric order.

ABS Active

The scan tool displays if the ABS system is performing antilock braking.

ABS Failed

The scan tool displays the working state of the ABS system.

ABS Pump Motor

The scan tool displays On/Off. The scan tool displays On when the ABS pump motor is commanded on.

Battery Voltage Signal

The scan tool displays the approximate voltage supplied by the battery and charging system.

BPP Signal:

The scan tool displays the applied state of the brake pedal position sensor.

Brake Fluid Level Status

The scan tool displays if the brake fluid is Low or OK.

Delivered Torque

The scan tool displays between 11% and 90%. The powertrain control module (PCM) provides the percentage of engine torque that is currently applied to the wheels. The lower the percentage the less torque applied to the wheels.

DRP Active

The scan tool displays if the electronic brake control module (EBCM) is performing dynamic rear proportioning.

DRP Disabled

The scan tool displays if the EBCM is no longer able to perform dynamic rear proportioning.

Engine Drag Control Failed:

The scan tool displays if the EBCM is no longer able to perform engine drag control.

Left Front Wheel Speed

The scan tool displays the actual speed of the left front wheel.

Left Rear Wheel Speed

The scan tool displays the actual speed of the left rear wheel.

LF Inlet Valve Command

The scan tool displays the commanded state of the left front inlet valve solenoid.

LF Outlet Valve Command

The scan tool displays the commanded state of the left front outlet valve solenoid.

LR Inlet Valve Command

The scan tool displays the commanded state of the left rear inlet valve solenoid.

LR Outlet Valve Command

The scan tool displays the commanded state of the left front outlet valve solenoid.

Pump Motor Commanded Voltage

The scan tool displays the voltage applied to the ABS pump motor

Requested Torque

The scan tool displays between 11% and 90%. The PCM provides the percentage of engine torque that is currently applied to the wheels. The lower the percentage the less torque applied to the wheels.

Right Front Wheel Speed

The scan tool displays the actual speed of the left front wheel.

Right Rear Wheel Speed

The scan tool displays the actual speed of the left rear wheel.

RF Inlet Valve Command

The scan tool displays the commanded state of the left front inlet valve solenoid.

RF outlet Valve Command

The scan tool displays On/Off. The scan tool displays On when the right front outlet valve solenoid is commanded on.

RR Inlet Valve Command

The scan tool displays the commanded state of the left rear inlet valve solenoid.

RR Outlet Valve Command

The scan tool displays the commanded state of the left front outlet valve solenoid.

TCS Active

The scan tool displays if the EBCM is requesting torque reduction from the PCM.

TCS Failed

The scan tool displays if the EBCM is no longer able to perform traction control.

ENHANCED DIAGNOSTICS

History Data

Enhanced diagnostic information is found in the History Data function of the scan tool. Enhanced diagnostic information provides the service technician with specific malfunction occurrence information.

The scan tool will display the last 3 DTCs to occur, one at a time. The DTC with the most recent occurrence will be displayed first. Each DTC will include the following:

- The number of drive cycles since the DTC last occurred.
- The number of occurrences for the DTC since the scan tool DTC information was last

cleared.

The most recent DTC will also display various data parameters with values from the time of the DTC occurrence.

Diagnostic Strategy

In difficult diagnostic situations use the above information to identify malfunction occurrence trends. Ask question such as the following:

- Did the malfunction only occur once over a large number of drive cycles, indicating an unusual condition present when it occurred?
- Does the malfunction occur infrequently over a large number of drive cycles, indicating that special diagnostic techniques may be required to identify the source of the malfunction?

A malfunction that occurs more frequently increases the odds of finding the cause of the malfunction.

Use the information in order to determine if a DTC is intermittent. Use the information in order to determine if the DTC has not set for long periods of time due to weather changes or a repair prior to this visit.

DTC C0035-C0050

DTC Descriptor

DTC C0035 00

Left Front Wheel Speed Sensor Circuit No Additional Information

DTC C0035 0F

Left Front Wheel Speed Sensor Circuit Erratic Signal

DTC C0035 18

Left Front Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

DTC C0040 00

Right Front Wheel Speed Sensor Circuit No Additional Information

DTC C0040 0F

Right Front Wheel Speed Sensor Circuit Erratic Signal

DTC C0040 18

Right Front Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

DTC C0045 00

Left Rear Wheel Speed Sensor Circuit No Additional Information

DTC C0045 0F

Left Rear Wheel Speed Sensor Circuit Erratic Signal

DTC C0045 18

Left Rear Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

DTC C0050 00

Right Rear Wheel Speed Sensor Circuit No Additional Information

DTC C0050 0F

Right Rear Wheel Speed Sensor Circuit Erratic Signal

DTC C0050 18

Right Rear Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC C0035-C0050

Circuit	Short to Ground	Open or High Resistance	Short to Voltage	Signal Performance
Left Front Sensor Signal	C0035 00	C0035 00	C0035 00	C0035 0F C0035 18
Left Front Sensor Low Reference	C0035 00	C0035 00	C0035 00	C0035 0F C0035 18
Right Front Sensor Signal	C0040 00	C0040 00	C0040 00	C0040 0F C0040 18
Right Front Sensor Low Reference	C0040 00	C0040 00	C0040 00	C0040 0F C0040 18

Left Rear Sensor Signal	C0045 00	C0045 00	C0045 00	C0045 0F[1] C0045 18
Left Rear Sensor Low Reference	C0045 00	C0045 00	C0045 00	C0045 0F[1] C0045 18
Right Rear Sensor Signal	C0050 00	C0050 00	C0050 00	C0050 0F[1] C0050 18
Right Rear Sensor Low Reference	C0050 00	C0050 00	C0050 00	C0050 0F[1] C0050 18
[1] Damaged rear Wheel Speed Sensor Ring can cause code to set.				

Circuit/System Description

As the wheel spins, the wheel speed sensor produces an AC signal. The electronic brake control module (EBCM) uses the frequency of the AC signal to calculate the wheel speed.

Conditions for Running the DTC

C0035 00 - C0050 00

- The ignition is ON.
- Ignition voltage is greater than 8 volts.

C0035 0F - C0050 0F

- The ignition is ON.
- Ignition voltage is greater than 8 volts.
- The brake pedal is not pressed.
- A DTC is not set for the other wheel speed circuit on the same axle.

C0035 18 - C0050 18

- The ignition is ON.
- Ignition voltage is greater than 8 volts.
- The brake pedal is not pressed.
- No other wheel speed circuit DTCs are set.
- At least 2 other wheel speeds are not 0 km/h (0 mph).

Conditions for Setting the DTC

C0035 00 - C0050 00

- An open is detected on the wheel speed sensor signal circuit.

- A short to ground is detected on the wheel speed sensor signal circuit.
- A short to voltage is detected on the wheel speed sensor signal circuit.

C0035 0F - C0050 0F

The EBCM detects a rapid variation in the wheel speed. The wheel speed changes by 20 km/h (12 mph) or more in 0.01 second. The change must occur 3 times with no more than 0.2 second between occurrences.

C0035 18 - C0050 18

- One wheel speed is 0 km/h (0 mph).
- The remaining wheel speeds are greater than 8 km/h (5 mph).
- The difference between the remaining wheel speeds is less than 11 km/h (7 mph) from each other.

OR

- The 2 wheel speed sensor inputs are 0 and DTCs are set.
- The 2 suspect wheel speeds equal zero for 6 seconds.
- The other wheel speeds are greater than 16 km/h (10 mph).
- The other wheel speeds are within 11 km/h (7 mph) of each other.

Action Taken When the DTC Sets

- Dynamic rear proportion (DRP) is degraded.
- Multiple wheel speed faults on same axle will disable DRP and turn ON the brake warning lamp.
- ABS indicator turns ON.
- Traction Control indicator turns ON.
- Driver information center (DIC) displays the SERVICE BRAKE SYSTEM message.

Conditions for Clearing the MIL/DTC

- The condition for setting the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

- A damaged rear wheel speed sensor ring can cause failure type byte 04 (Erratic Signal) to set.

- If 2 or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.

C0035 18, 0F, 00 - C0050 18, 0F, 00

If the customer comments that the ABS indicator is ON only during moist environmental conditions; rain, snow, vehicle wash, etc., inspect the wheel speed sensor wiring for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:

1. Spray the suspected area with a 5 percent saltwater solution. To create a 5 percent saltwater solution, add 2 teaspoons of salt to 8 fl oz of water (10 g of salt to 200 ml of water).
2. Test drive the vehicle over various road surfaces: bumps, turns, etc., above 40 km/h (25 mph) for at least 30 seconds.
3. Rinse the area thoroughly when completed.

Reference Information

Schematic Reference

ABS Schematics

Connector End View Reference

ABS Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Scan Tool Data List for EBCM

Circuit/System Verification

With scan tool installed, drive the vehicle in a straight line at a speed greater than 8 km/h (5 mph). All wheel speed sensors should display the same speed.

Circuit/System Testing

Note: It is recommend that component testing is performed before circuit testing when diagnosing wheel speed sensors.

1. With the ignition OFF, disconnect the EBCM connector.
2. With the ignition ON, measure for 0 volt between the sensor signal circuit or the low reference circuit and ground at the EBCM connector.
   - If over 0 volt, repair the short to voltage in the sensor signal circuit or the low reference circuit.
3. With the ignition OFF, measure for infinite ohms of resistance between the wheel speed sensor signal or the low reference circuit and ground at the EBCM connector.
   - If less than infinite ohms, repair the short to ground in the sensor signal or the low reference circuit.
4. Measure for 850-1350 ohms of resistance between the wheel speed sensor signal and low reference circuits at the EBCM connector.
   - If greater than 1350 ohms, test for an open/high resistance in the circuit or faulty wheel speed sensor.
   - If less than 850 ohms, test for a short between the circuits or faulty wheel speed sensor.
5. If all circuits test normal, replace the EBCM.

Component Testing

1. Disconnect the wheel speed sensor connector.
2. With the ignition OFF, measure for 850-1350 ohms of resistance across the wheel speed sensor.
   - If the resistance is not between 850-1350 ohms, replace the faulty wheel speed sensor.
3. Spin the wheel, measure across the wheel speed sensor for 100 mv AC or greater.
   - If the AC voltage is less than 100 mv, replace the wheel speed sensor.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Wheel Bearing/Hub Replacement - Front**
- **Wheel Speed Sensor Replacement - Rear**
- **Control Module References** for EBCM replacement, setup, and programming

DTC C0110

DTC Descriptor

DTC C0110 04

Pump Motor Circuit Open Circuit

DTC C0110 61

Pump Motor Circuit Actuator Stuck

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The electronic brake control module (EBCM) supplies ground to activate the Antilock Brake System (ABS) pump motor. An internal system relay in the EBCM supplies battery positive voltage to the pump motor when the ignition is turned ON. The EBCM monitors pump motor feedback voltage after activation to detect a stalled or binding pump motor.

Conditions for Running the DTC

C0110 04

- System and ignition voltage is above 10.5 volts.
- The system enable relay is ON.
- The pump motor has been commanded OFF for 2.5 seconds.

C0110 61

- The ignition is ON.
- The system enable relay is ON.
- The pump motor has been commanded ON, OFF, and ON again.

Conditions for Setting the DTC

C0110 04

The EBCM detects an open in the pump motor circuit when the feedback voltage remains greater than 0.75 volt for more than 50 msec.

C00110 61

The pump motor continues to rotate briefly after activation creating a feedback voltage. The EBCM sets the code if the measured feedback voltage indicates a binding or stalled pump motor.

Action Taken When the DTC Sets

- The EBCM disables the ABS/Traction Control System (TCS) for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The Traction Control indicator turns ON.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

The pump motor is integral to the brake pressure modulator valve (BPMV). The pump motor is not serviceable.

Reference Information

Schematic Reference

ABS Schematics

Connector End View Reference

ABS Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. Ignition OFF, disconnect the EBCM harness connector and connect a test lamp between the battery positive voltage circuit terminal and chassis ground.
2. Verify that the test lamp illuminates.
    - If the test lamp does not illuminate, repair the open or high resistance in the battery positive voltage circuit.

3. Connect a test lamp between the battery positive voltage circuit and pump motor ground circuit at the EBCM connector. Verify that the test lamp illuminates.
    - If the test lamp does not illuminate, repair the open or high resistance in the pump motor ground circuit.
4. Ignition OFF, remove the EBCM from the BPMV.
5. Inspect the EBCM to BPMV connector for conditions such as damage, corrosion, or presence of brake fluid.
    - If connector corrosion or damage is evident, replace BPMV and/or EBCM as necessary.
    - If brake fluid is present, replace both BPMV and EBCM.
6. Connect the EBCM harness to the EBCM with the BPMV still separated.
7. Connect a test lamp between the pump motor circuits, internal EBCM side.
8. Ignition ON, use the scan tool to perform the Pump Motor Test.
    - If test lamp illuminates, replace the BPMV.
    - If test lamp does not illuminate, replace the EBCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Brake Pressure Modulator Valve (BPMV) Replacement**
- **Control Module References** for EBCM replacement, setup, and programming

DTC C0161

DTC Descriptor

DTC C0161

TCS Brake Switch Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The brake pedal position (BPP) sensor is an input to the body control module (BCM). The BCM activates the brake lamps when the BPP is in an applied state. The BCM then sends a brake pedal applied state status via serial data messages to the electronic brake control module (EBCM) and other electronic control modules. The BPP sensor is a potentiometer type sensor with a 5-volt reference circuit and a low reference circuit. The BCM supplies the 5-volt reference to the BPP.

Conditions for Running the DTC

The Ignition is ON.

Conditions for Setting the DTC

- Brake pedal is sensed as applied during moderate to high vehicle acceleration.
- Brake pedal state is observed as applied for 144 consecutive seconds.

Action Taken When the DTC Sets

- EBCM disables the traction control system (TCS) for the duration of the ignition cycle.
- The Traction Control indicator turns ON.
- Driver information center (DIC) displays the SERVICE TRACTION message.

Conditions for Clearing the MIL/DTC

- The condition for the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles

Diagnostic Aids

The DTC C0161 can be set if the vehicle has been driven with the brake applied during acceleration.

Reference Information

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. With the scan tool, check the vehicle for brake pedal position (BPP) related DTCs.
   - If DTC C0277 or C0297 are present, diagnose BPP DTCs.
2. Lightly apply and release the brake pedal. The stop lamps should illuminate and then turn OFF.
   - If the stop lamps do not operate properly, refer to **Symptoms - Lighting Systems** .
3. If no Lighting System problems can be found, refer to **Diagnostic Aids**.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for BCM and EBCM replacement, setup, and programming

DTC C0179

DTC Descriptor

DTC C0179 00

System Thermal High

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The electronic brake control module (EBCM) monitors Traction Control System (TCS) activation in order to calculate an estimate of the electronic brake control module (EBCM) solenoid valve temperatures. In most cases high solenoid valve temperatures are caused by extended TCS activation. If the EBCM calculates that the solenoid valve temperatures are too high, the EBCM will temporarily suspend the TCS function until the solenoid valves cool.

Conditions for Running the DTC

- The ignition is ON.
- Ignition voltage is greater than 8 volts.

Conditions for Setting the DTC

The estimated solenoid coil temperature reaches 220 degrees Celsius.

Action Taken When the DTC Sets

- EBCM disables the TCS for the duration of the ignition cycle.
- Traction control warning lamp illuminates.
- Driver information center (DIC) displays the SERVICE TRACTION CONTROL message.

Conditions for Clearing the DTC

- After the solenoid valves have cooled the EBCM automatically re-enables TCS function.

- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

Most occurrences of this DTC are caused by excessive TCS activation or braking.

Reference Information

Schematic Reference

ABS Schematics

Connector End View Reference

ABS Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List for EBCM

Circuit/System Testing

Note: Allow brakes to cool down before performing test.

1. With scan tool clear the DTC.
2. With scan tool connected test drive the vehicle under normal braking conditions and without causing TCS or ABS activation. Verify DTC C0179 resets.
   - If the DTC resets replace the EBCM.
3. Refer to **Diagnostic Aids**.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

DTC C0201

DTC Descriptor

DTC C0201

Antilock Brake System (ABS) Enable Relay Contact Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The solenoid relay, located within the electronic brake control module (EBCM), supplies battery voltage to all of the valve solenoids.

Conditions for Running the DTC

- Ignition voltage is greater than 9.5 volts.
- The solenoid relay is commanded ON.

Conditions for Setting the DTC

One or more of the fallowing conditions exists:

- The EBCM detects an open in the battery positive voltage circuit to the solenoid valve relay.
- The EBCM detects a stuck open solenoid valve relay or an open circuit between the solenoid valve relay and solenoid valves.

Action Taken When the DTC Sets

- The EBCM disables the ABS/TCS/DRP for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The Traction Control indicator turns ON.
- The red brake warning indicator turns ON.
- The driver information center (DIC) displays the SERVICE BRAKE SYSTEM/TRACTION SYSTEM message.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Reference Information

Schematic Reference

ABS Schematics

Connector End View Reference

ABS Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Verification

With the scan tool, access the ABS special functions menu and perform the ABS Motor test. The pump motor should function and no DTCs should be set.

Circuit/System Testing

Test for an open or a short to ground in the solenoid valve battery positive voltage circuit.

- If battery positive voltage circuit tests normal, replace the EBCM/BPMV assembly.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for EBCM replacement, setup, and programming

DTC C0245

DTC Descriptor

DTC C0245 Mismatched Tire

Circuit/System Description

As the wheel spins, the wheel speed sensor produces an AC signal. The electronic brake control module (EBCM) uses the frequency of the AC signal to calculate the wheel speed.

Conditions for Running the DTC

- The ignition is ON.
- Vehicle speed is greater than 14 km/h (9 mph)
- Ignition voltage is greater than 8 volts.
- The vehicle is traveling in a strait path
- Brake pedal is not applied
- Traction control is not active

Conditions for Setting the DTC

Wheel speed differences between one wheel and the others is greater than 25 percent.

Action Taken When the DTC Sets

- The EBCM disables the Antilock Brake System (ABS)
- The ABS indicator turns ON
- The EBCM disables Traction Control System (TCS)

Diagnostic Aids

Inspect tires for improper air pressure or improper size.

DTC C0550

DTC Descriptor

DTC C0550

Electronic Control Unit (ECU) Performance

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The electronic brake control module (EBCM) detects an internal malfunction.

Conditions for Running the DTC

The ignition switch is in the ON position.

Conditions for Setting the DTC

An internal EBCM malfunction exists.

Action Taken When the DTC Sets

- The EBCM disables the ABS/TCS/DRP for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The Traction Control indicator turns ON.
- The red brake warning indicator turns ON.
- The driver information center (DIC) displays the SERVICE BRAKE SYSTEM/TRACTION SYSTEM message.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Circuit/System Testing

DTC C0550 will set as result of internal (EBCM) circuit failure.

- Replace the EBCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for EBCM replacement, setup, and programming

DTC C0899

DTC Descriptor

DTC C0899

Device Voltage Low

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The electronic brake control module (EBCM) monitors the ignition voltage level available for system operation. A low voltage condition prevents the system from operating properly.

Conditions for Running the DTC

Ignition is ON.

Conditions for Setting the DTC

This fault will be set if the ignition voltage to EBCM is less than 9 volts for 100 msec.

Action Taken When the DTC Sets

- Traction Control System (TCS) and Vehicle Stability Enhancement System (VSES) for the duration of the ignition cycle.
- The TC indicator turns ON.
- The driver information center (DIC) displays the Service Stability System message.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Reference Information

Schematic Reference

ABS Schematics

Connector End View Reference

ABS Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. Measure the voltage at the battery terminals.
2. With scan tool read the ignition voltage in the EBCM data list. Verify that battery terminal voltage and ignition voltage readings do not differ more than 1 volt.
    - If more than 1 volt test the ground circuit of the EBCM for high resistance or replace the EBCM.
3. Go to **Charging System Test** .

DTC C0900

DTC Descriptor

DTC C0900

Device Voltage High

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The electronic brake control module (EBCM) monitors the ignition voltage. If the voltage level is too high, damage may result in the system. When a high voltage condition is detected, the EBCM turns OFF the system relay which removes battery voltage from the solenoid valves and pump motor.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The system voltage is greater than 16 volts for 100 msec.

Action Taken When the DTC Sets

- The EBCM disables the ABS/TCS/DRP for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The Traction Control indicator turns ON.
- The red brake warning indicator turns ON.
- The driver information center (DIC) displays the SERVICE BRAKE SYSTEM/TRACTION SYSTEM message.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

Test the charging system. Refer to **Charging System Test** .

SYMPTOMS - ANTILOCK BRAKE SYSTEM

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **ABS Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the antilock brake system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the master cylinder reservoir for the proper brake fluid level.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **ABS Indicator Inoperative**
- **ABS Indicator Always On**

ABS INDICATOR ALWAYS ON

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The instrument panel cluster (IPC) illuminates the Antilock Brake System (ABS) indicator by supplying ground to the lamp. The electronic brake control module (EBCM) sends a serial data messages to the IPC, in order to command the indicator ON or OFF.

Reference Information

Schematic Reference

ABS Schematics

Connector End View Reference

- **ABS Connector End Views**
- **INSTRUMENT PANEL, GAGES, AND CONSOLE CONNECTOR END VIEWS**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List for EBCM

Circuit/System Testing

Note: Diagnose all vehicle DTCs before using this diagnostic.

With the scan tool, select instrument panel special functions Lamp Test. Command the instrument panel warning lamps OFF.

- If the ABS warning lamp does not turn OFF, replace the IPC.
- If the ABS lamp turns OFF and there are no DTCs stored in any vehicle systems, replace the EBCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after

completing the diagnostic procedure.

Control Module References for EBCM or IPC replacement, setup, and programming

ABS INDICATOR INOPERATIVE

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The instrument panel cluster (IPC) illuminates the Antilock Brake System (ABS) indicator by supplying ground to the lamp. The electronic brake control module (EBCM) sends a serial data messages to the IPC, in order to command the indicator ON or OFF.

Reference Information

Schematic Reference

ABS Schematics

Connector End View Reference

- **ABS Connector End Views**
- **INSTRUMENT PANEL, GAGES, AND CONSOLE CONNECTOR END VIEWS**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List for EBCM

Circuit/System Testing

1. With the scan tool, select instrument panel special functions Lamp Test. Command the instrument panel lamps ON. Verify ABS lamp illuminates.
   - If the ABS lamp does not illuminate, replace the IPC.
2. Replace the EBCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for EBCM and IPC replacement, setup, and programming

TRACTION OFF INDICATOR ALWAYS ON

Circuit Description

The Low Traction indicator is controlled by the instrument cluster via serial data messages from the EBCM. When the ABS or TCS is active for 0.5 seconds, the EBCM commands the instrument cluster to turn ON the Low Traction indicator.

The Low Traction indicator will also turn ON during the instrument cluster bulb check. When the ignition switch is turned to ON, the Low Traction indicator will turn ON for approximately 3 seconds and then turn OFF.

Diagnostic Aids

The malfunction must be present during diagnosis in order to prevent unnecessary parts replacement. Always begin diagnosis with **Diagnostic System Check - Vehicle** .

Test Description

The number below refers to the step number on the diagnostic table.

> **3:** This step tests if the instrument panel cluster (IPC) is able to turn OFF the Traction Off indicator.

Traction Off Indicator Always On

Step	Action	Yes	No
Schematic Reference: ABS Schematics **Connector End View Reference: ABS Connector End Views** or **Instrument Panel, Gages, and Console Connector End Views** in Instrument Panel, Gages, and Console			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Turn OFF the ignition for 5 seconds. 2. Turn ON the ignition while observing the Traction Off indicator.		

	Does the Traction Off indicator illuminate for 2 seconds and then turn OFF?	Go to **Diagnostic Aids**	Go to **Step 3**
3	1. Install a scan tool. 2. Select the Instrument Panel Cluster (IPC) Special Functions menu on the scan tool. 3. Command the IPC lamps OFF. Does the Traction Off indicator turn OFF?	Go to **Step 5**	Go to **Step 4**
4	Replace the IPC. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 6**	-
5	Replace the electronic brake control module (EBCM). Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 6**	-
6	1. Turn OFF the ignition for 5 seconds. 2. Turn ON the ignition while observing the Traction Off indicator. Does the Traction Off indicator illuminate for 2 seconds and then turn OFF?	System OK	Go to **Step 3**

TRACTION OFF INDICATOR INOPERATIVE

Circuit Description

The Low Traction indicator is controlled by the instrument cluster via serial data messages from the EBCM. When the ABS or TCS is active for 0.5 seconds, the EBCM commands the instrument cluster to turn ON the Low Traction indicator.

The Low Traction indicator will also turn ON during the instrument cluster bulb check. When the ignition switch is turned to ON, the Low Traction indicator will turn ON for approximately 3 seconds and then turn OFF.

Diagnostic Aids

The malfunction must be present during diagnosis in order to prevent unnecessary parts replacement. Always begin diagnosis with **Diagnostic System Check - Vehicle** .

Test Description

The number below refers to the step number on the diagnostic table.

> **3:** This step tests if the instrument panel cluster (IPC) is able to turn ON the Traction Off indicator.

Traction Off Indicator Inoperative

Step	Action	Yes	No
Schematic Reference: ABS Schematics **Connector End View Reference: ABS Connector End Views** or **Instrument Panel, Gages, and Console Connector End Views** in Instrument Panel, Gages, and Console			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Turn OFF the ignition for 5 seconds. 2. Turn ON the ignition while observing the Traction Off indicator. Does the Traction Off indicator illuminate for 2 seconds and then turn OFF?	Go to **Diagnostic Aids**	Go to **Step 3**
3	1. Install a scan tool. 2. Select the Instrument Panel Cluster (IPC) Special Functions menu on the scan tool. 3. Command the IPC lamps ON. Does the Traction Off indicator turn ON?	Go to **Step 5**	Go to **Step 4**
4	Replace the IPC. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 6**	-
5	Replace the electronic brake control module (EBCM). Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 6**	-

6	1. Turn OFF the ignition for 5 seconds. 2. Turn ON the ignition while observing the Traction Off indicator. Does the Traction Off indicator illuminate for 2 seconds and then turn OFF?	System OK	Go to **Step 3**

REPAIR INSTRUCTIONS

ABS AUTOMATED BLEED PROCEDURE

Bleeding the ABS System

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

Perform a manual or pressure bleeding procedure. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** in Hydraulic Brakes. If the desired brake pedal height results are not achieved, perform the Automated Bleed Procedure.

The procedure cycles the system valves and runs the pump in order to purge the air from the secondary circuits normally closed off during normal base brake operation and bleeding. The automated bleed procedure is recommended when air ingestion is suspected in the secondary circuits, or when the brake pressure modulator valve (BPMV) has been replaced.

Automated Bleed Procedure

NOTE: The Auto Bleed Procedure may be terminated at any time during the process by pressing the EXIT button. No further Scan Tool prompts pertaining to the Auto Bleed procedure will be given. After exiting the bleed procedure, relieve bleed pressure and disconnect bleed equipment per manufacturers instructions. Failure to properly relieve pressure may result in spilled brake fluid causing damage to components and painted surfaces.

1. Raise the vehicle on a suitable support. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove all 4 tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

3. Inspect the brake system for leaks and visual damage. Refer to **Brake Fluid Loss** or **Symptoms - Hydraulic Brakes** in Hydraulic Brakes. Repair or replace as needed.
4. Inspect the battery state of charge. Refer to **Battery Inspection/Test** in Engine Electrical.
5. Install a scan tool.
6. Turn ON the ignition, with the engine OFF.
7. With the scan tool, establish communications with the electronic brake control module (EBCM). Select Special Functions. Select Automated Bleed from the Special Functions menu.
8. Bleed the base brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** in Hydraulic Brakes.
9. Follow the scan tool directions until the desired brake pedal height is achieved.
10. If the bleed procedure is aborted, a malfunction exists. Perform the following steps before resuming the bleed procedure:
    - If a DTC is detected, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** and diagnose the appropriate DTC.
    - If the brake pedal feels spongy, perform the conventional brake bleed procedure again. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** in Hydraulic Brakes.
11. When the desired pedal height is achieved, press the brake pedal in order to inspect for firmness.
12. Remove the scan tool.
13. Install the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
14. Inspect the brake fluid level. Refer to **Master Cylinder Reservoir Filling** in Hydraulic Brakes.
15. Road test the vehicle while inspecting that the pedal remains high and firm.

ELECTRONIC BRAKE CONTROL MODULE REPLACEMENT

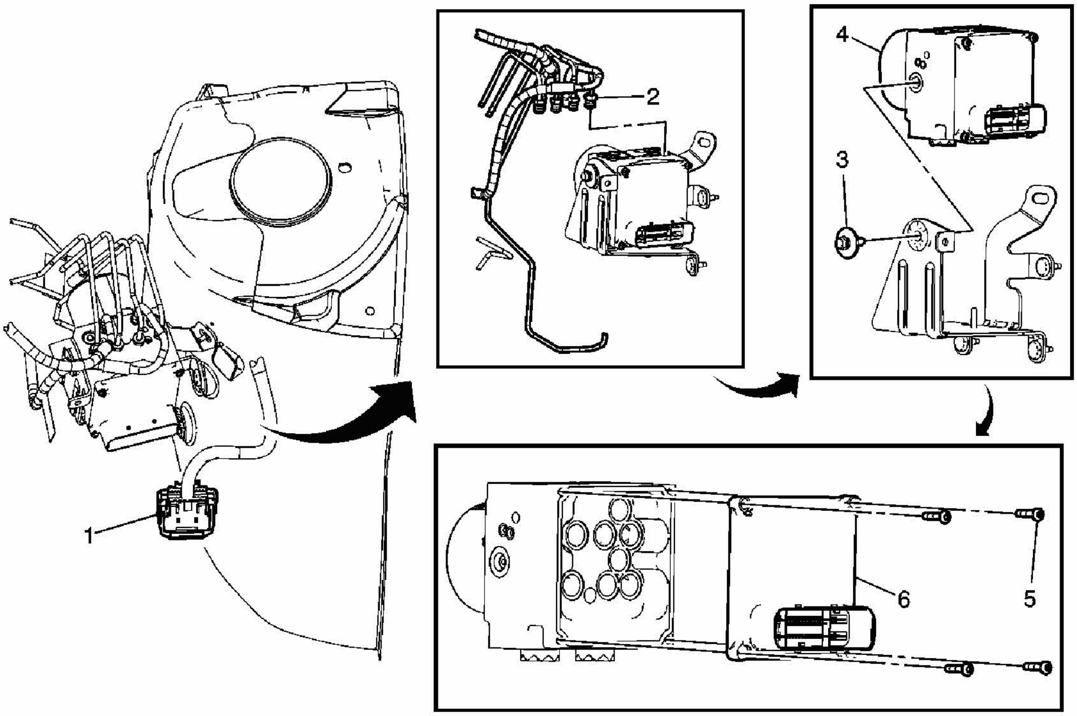


Fig. 8: Replacing Electronic Brake Control Module
Courtesy of GENERAL MOTORS CORP.

Electronic Brake Control Module Replacement

Callout	Component Name

CAUTION:
Refer to Brake Fluid Irritant Caution .

CAUTION:
Refer to Brake Fluid Effects on Paint and Electrical Components Notice .

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Remove the air cleaner assembly for the 3.5L, refer to **Air Cleaner Assembly Replacement** .
2. Remove the air cleaner assembly for the 3.9L, refer to **Air Cleaner Assembly**

Replacement

3. Remove the air cleaner assembly for the 5.3L, refer to **Air Cleaner Assembly Replacement**

1	Electrical Connector
2	Brake Pipe Fittings **Tip:** Cap or plug the brake pipes so as not to allow the brake system to become contaminated and brake fluid from leaking. **Tightening Specifications:** Tighten to 24 N.m (18 lb ft).
3	Mounting Bolt **Tightening Specifications:** Tighten to 10 N.m (89 lb in).
4	ABS Module
5	EBCM Screw **Tightening Specifications:** Tighten to 5 N.m (44 lb in).
6	Electronic Brake Control Module (EBCM) **Tip:** • If the EBCM is to be removed to service the ABS system, cover the unit so has not allow it to become contaminated. • Clean the sealing surface of the EBCM with denatured alcohol and a lint free towel. • Bleed the ABS System. Refer to **ABS Automated Bleed Procedure**.

BRAKE PRESSURE MODULATOR VALVE (BPMV) REPLACEMENT

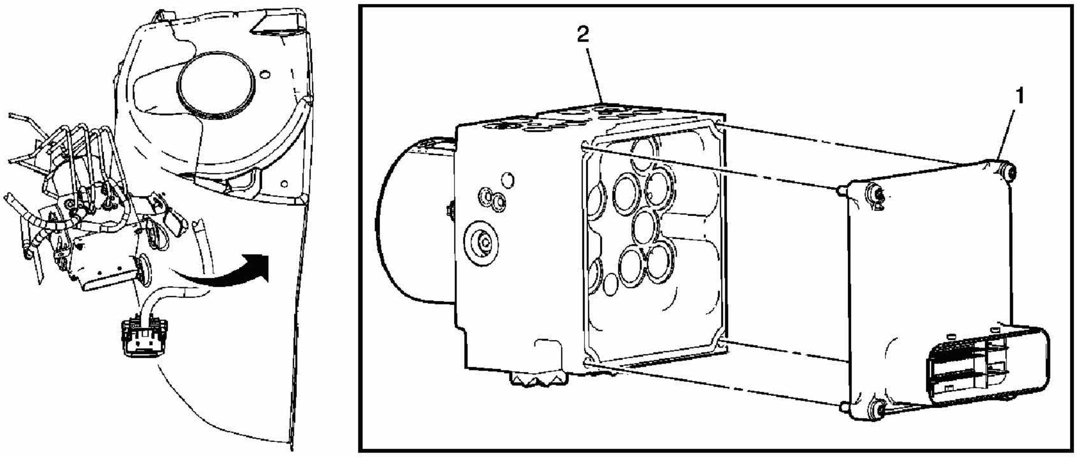


Fig. 9: Replacing Brake Pressure Modulator Valve (BPMV)
Courtesy of GENERAL MOTORS CORP.

Brake Pressure Modulator Valve (BPMV) Replacement

Callout	Component Name
CAUTION: **Refer to Brake Fluid Irritant Caution .** **CAUTION:** **Refer to Brake Fluid Effects on Paint and Electrical Components Notice .** **NOTE:** **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the Electronic Brake Control Module (EBCM). Refer to **Electronic Brake Control Module Replacement**.	
1	EBCM
2	Brake Pressure Control Module (BPMV) **Tip:** • If the BPMV is to be removed to service the ABS system, cover the unit so has not allow it to become contaminated. • Clean the sealing surface of the BPMV with denatured alcohol and a lint free towel. • Bleed the ABS System. Refer to **ABS Automated Bleed Procedure**.

BRAKE PRESSURE MODULATOR VALVE (BPMV) BRACKET REPLACEMENT

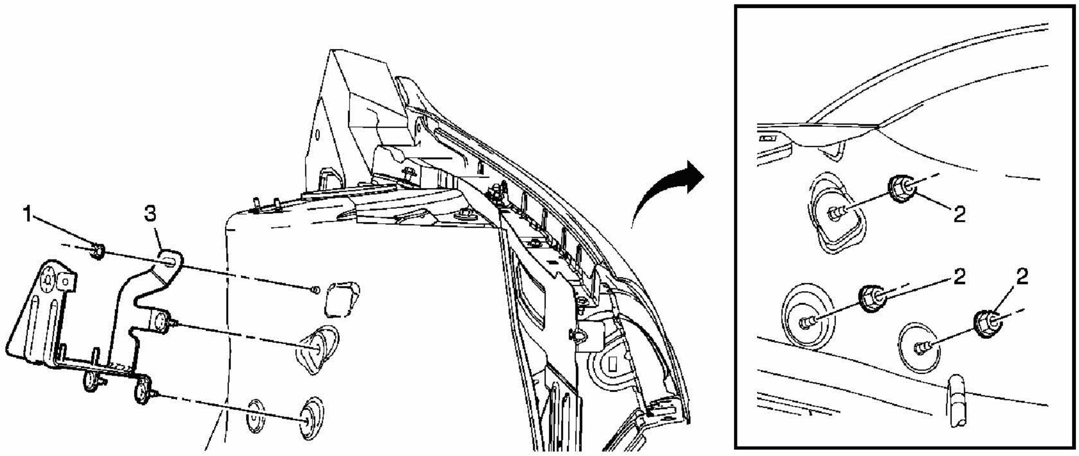


Fig. 10: Replacing Brake Pressure Modulator Valve Bracket

Courtesy of GENERAL MOTORS CORP.

Brake Pressure Modulator Valve (BPMV) Bracket Replacement

Callout	Component Name
CAUTION: **Refer to Brake Fluid Irritant Caution .** **CAUTION:** **Refer to Brake Fluid Effects on Paint and Electrical Components Notice .** **NOTE:** **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the Electronic Brake Control Module (EBCM). Refer to **Brake Pressure Modulator Valve (BPMV) Replacement**.	
1	Retaining Nut **Tightening Specification:** Tighten to 3 N.m (27 lb in).
2	Retaining Nut **Tightening Specification:** Tighten to 10 N.m (89 lb in).
3	Mounting Bracket

FRONT WHEEL SPEED SENSOR REPLACEMENT

Removal Procedure

IMPORTANT: The front wheel speed sensors and rings are integral with the hub and bearing assemblies.
If a speed sensor or a ring needs replacement, replace the entire hub and bearing assembly. Do not service the harness pigtail individually because the harness pigtail is part of the sensor. Refer to Wheel Bearing/Hub Replacement - Front in Front Suspension.

1. Raise and support the vehicle on a suitable hoist. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

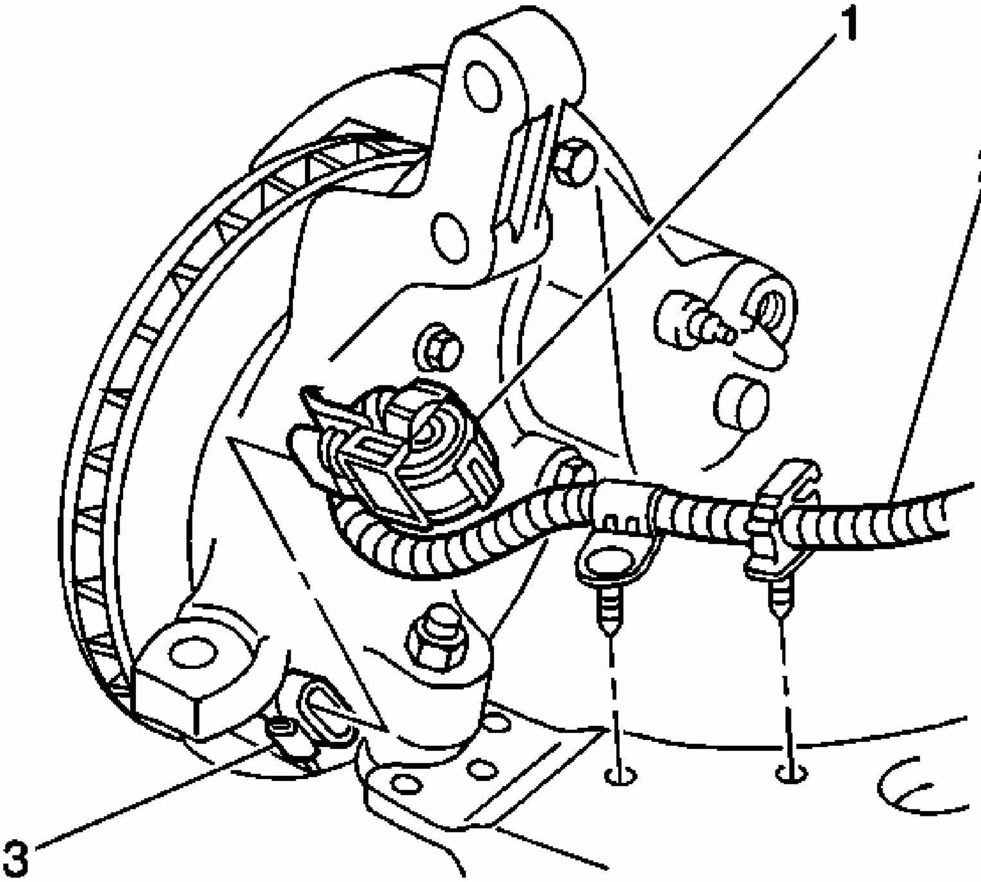


Fig. 11: Front Wheel Speed Sensor Jumper Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the front wheel speed sensor jumper harness electrical connector (1).

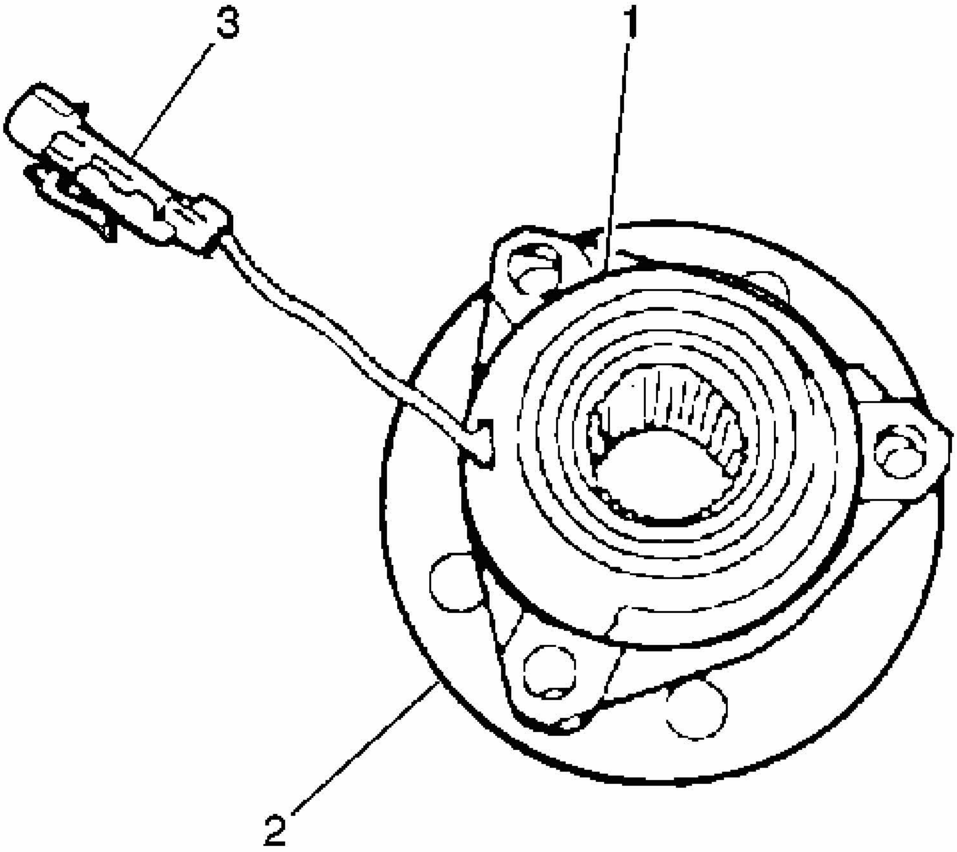


Fig. 12: Hub & Bearing Assembly - Front
Courtesy of GENERAL MOTORS CORP.

4. Remove the hub and bearing assembly (2). Refer to **Wheel Bearing/Hub Replacement - Front** in Front Suspension.

Installation Procedure

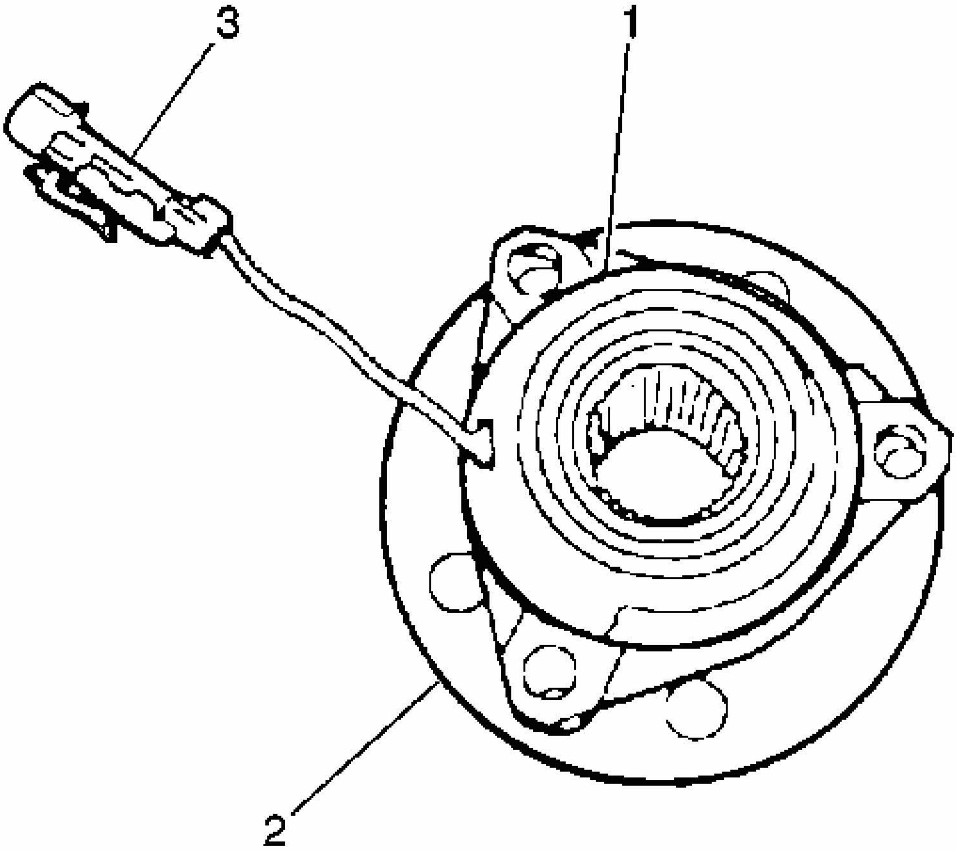


Fig. 13: Hub & Bearing Assembly - Front
Courtesy of GENERAL MOTORS CORP.

1. Install the hub and bearing assembly (2) to the vehicle. Refer to **Wheel Bearing/Hub Replacement - Front** in Front Suspension.

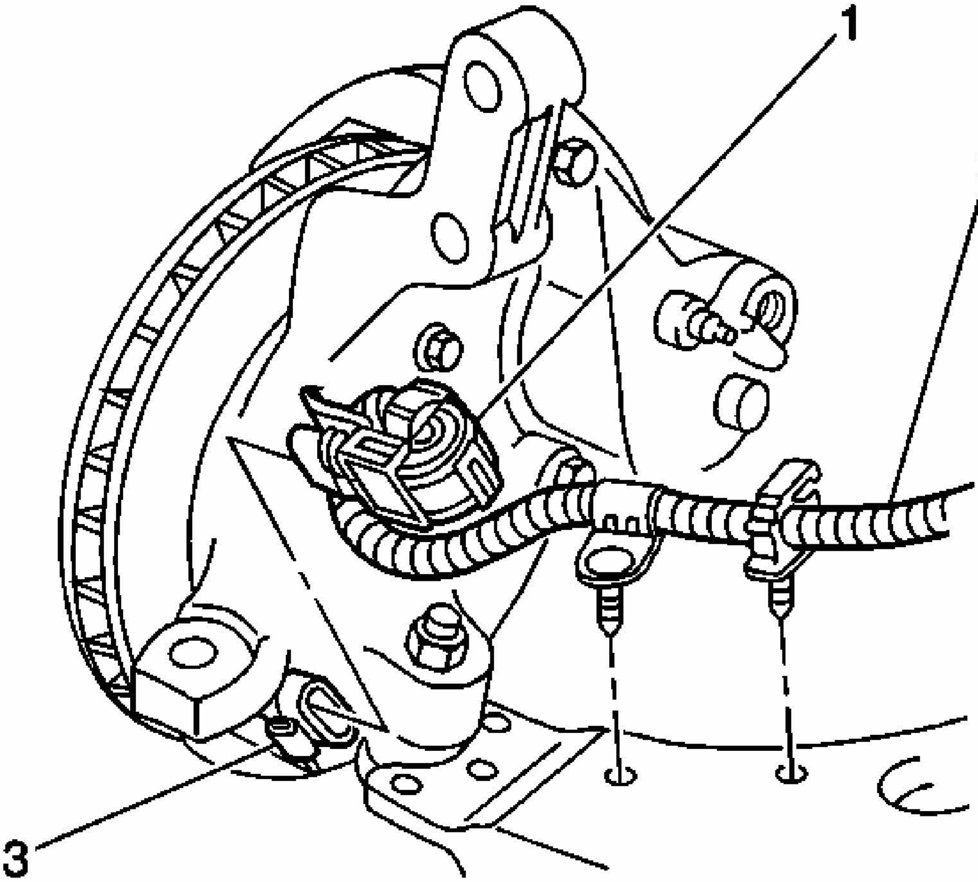


Fig. 14: Front Wheel Speed Sensor Jumper Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Install the front wheel speed sensor jumper harness electrical connector (1).
3. Install the wheel and tire assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
4. Lower the vehicle.
5. Turn the ignition switch to the ON position with the engine OFF.
6. Perform the **Diagnostic System Check - Vehicle** in Vehicle DTC Information.

REAR WHEEL SPEED SENSOR REPLACEMENT

Removal Procedure

IMPORTANT: The rear wheel speed sensors and rings are integral with the hub and bearing assemblies.

If a speed sensor or a ring needs replacement, replace the entire hub and bearing assembly. Refer to Wheel Bearing/Hub Replacement - Rear in Rear Suspension.

1. Raise and support the vehicle on a suitable hoist. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

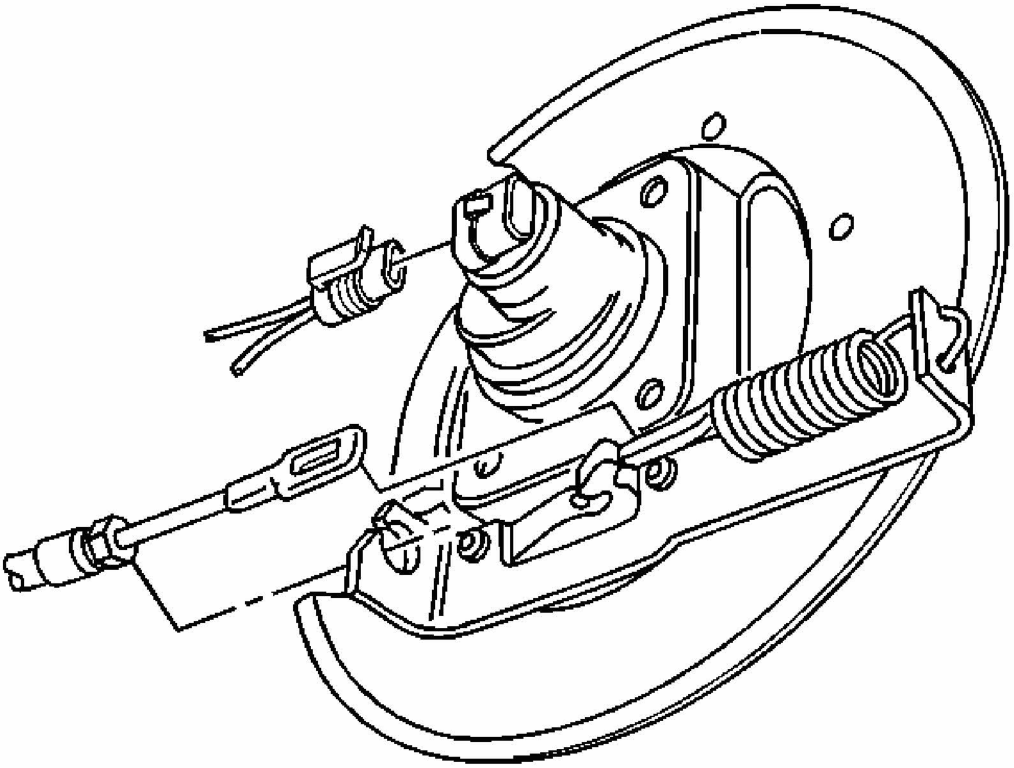


Fig. 15: View Of Rear Park Brake Cable & Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the electrical connector from the rear wheel speed sensor.

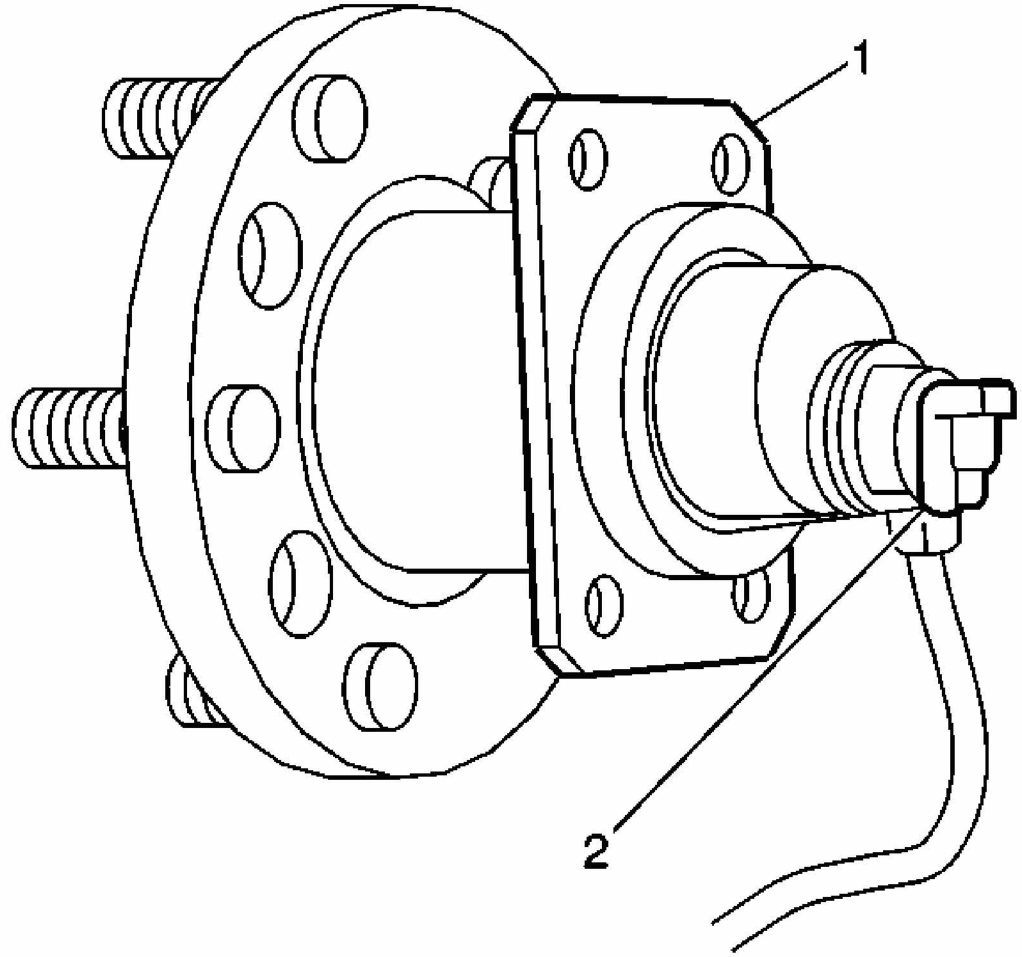


Fig. 16: Installing Hub & Bearing Assembly - Rear
Courtesy of GENERAL MOTORS CORP.

4. Remove the hub and bearing assembly (1). Refer to **Wheel Bearing/Hub Replacement - Rear** in Rear Suspension.

Installation Procedure

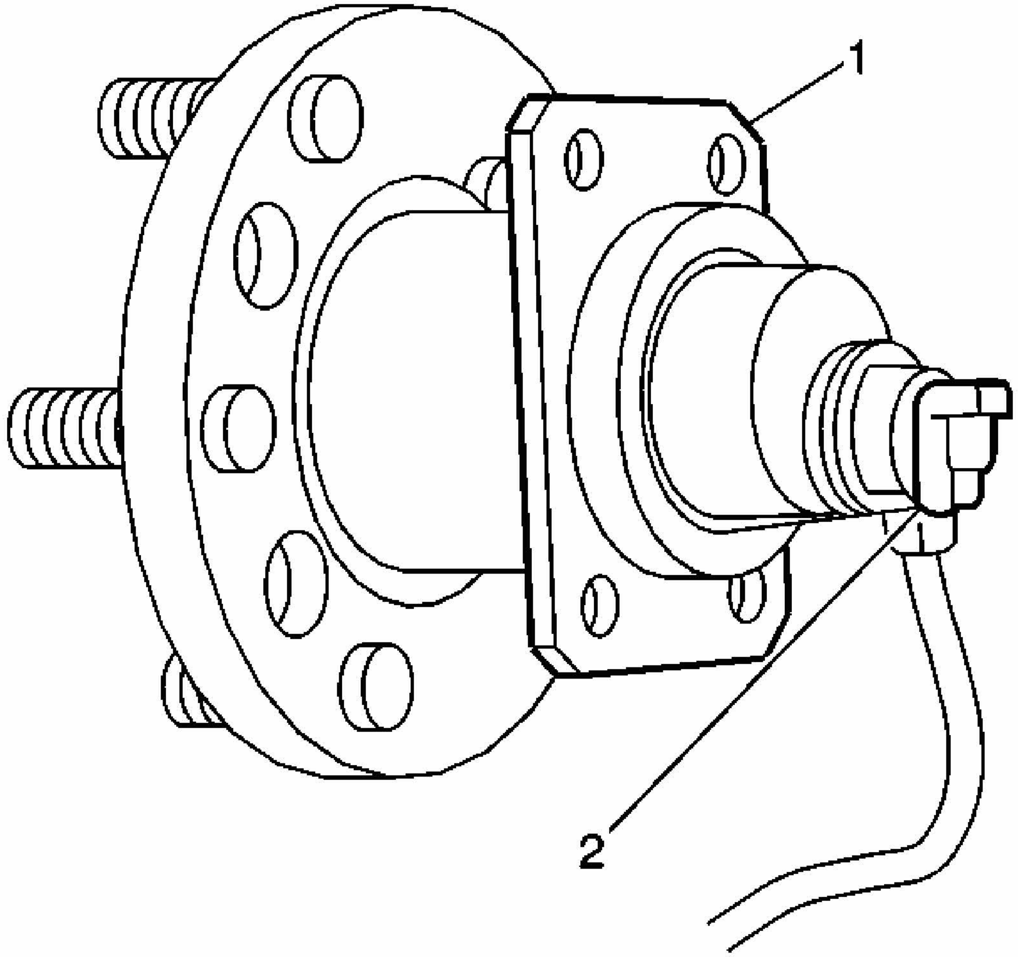


Fig. 17: Installing Hub & Bearing Assembly - Rear
Courtesy of GENERAL MOTORS CORP.

1. Install the hub and bearing assembly (1) to the vehicle. Refer to **Wheel Bearing/Hub Replacement - Rear** in Rear Suspension.

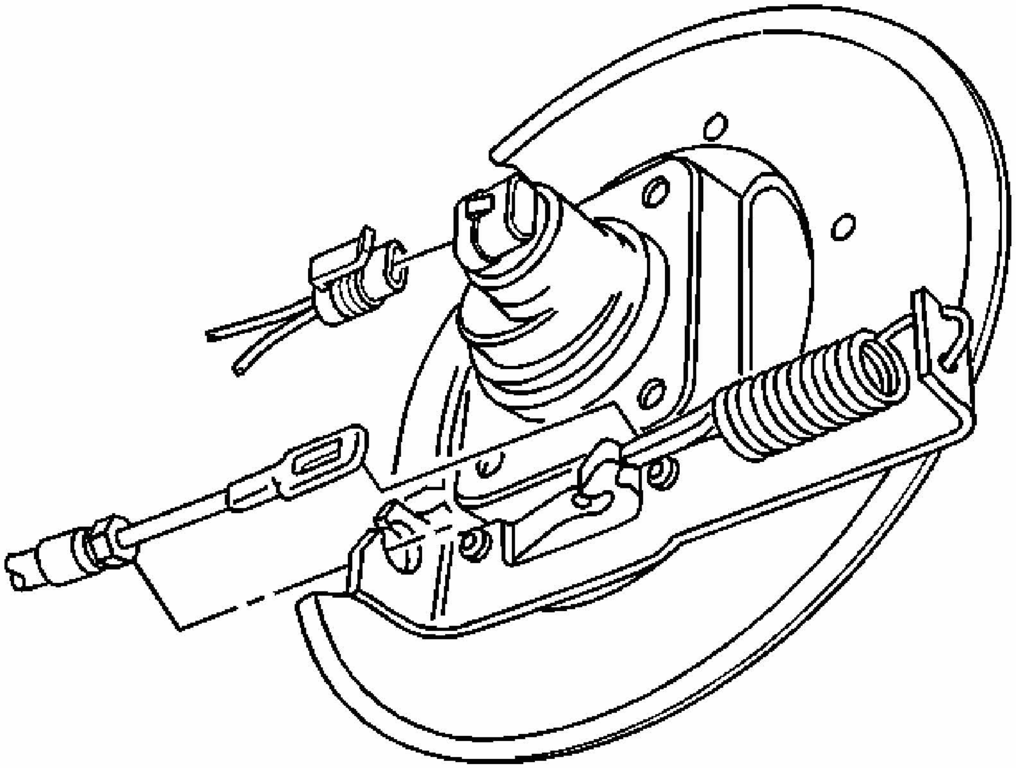


Fig. 18: View Of Rear Park Brake Cable & Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Connect the electrical connector to the rear wheel speed sensor.
3. Install the wheel and tire assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
4. Lower the vehicle.
5. Turn the ignition switch to the ON position, with the engine OFF.
6. Perform the **Diagnostic System Check - Vehicle** in Vehicle DTC Information.

TRACTION CONTROL SWITCH REPLACEMENT (IMPALA)

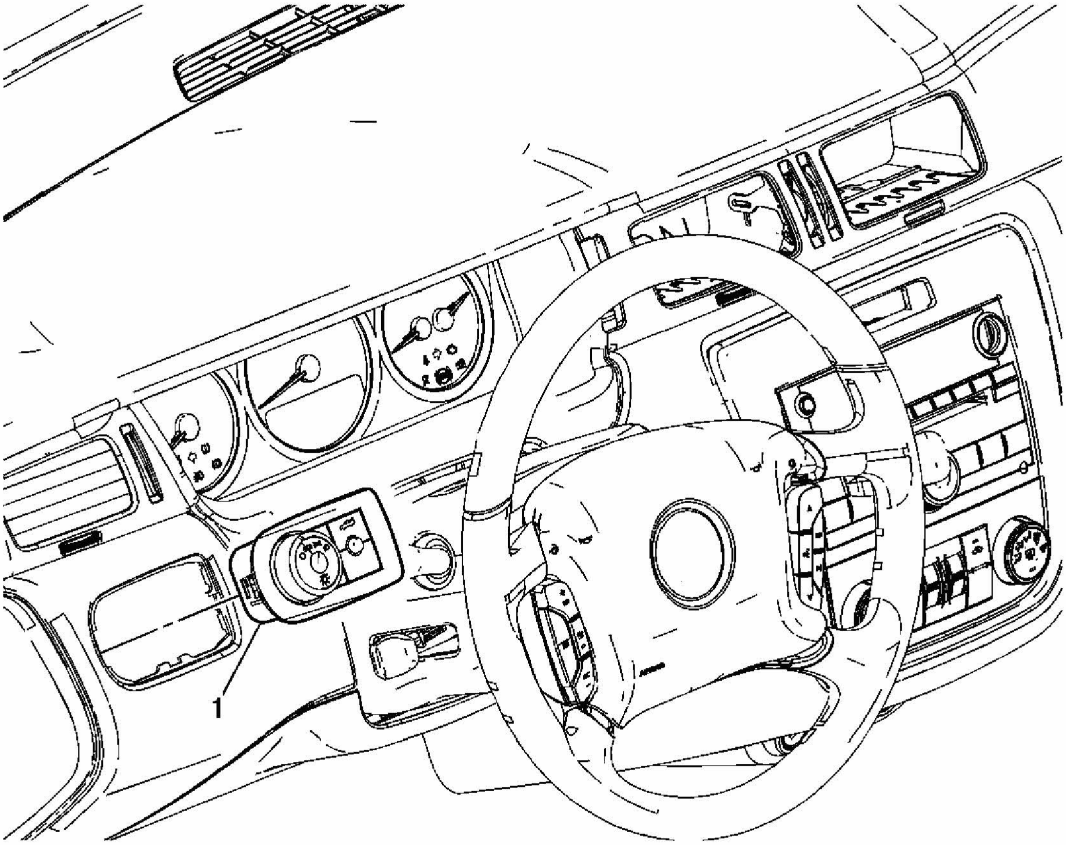


Fig. 19: Replacing Traction Control Switch
Courtesy of GENERAL MOTORS CORP.

Traction Control Switch Replacement (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .	
1	Switch Assembly, Headlamp Instrument Panel Dimmer **Tip:** - The traction control switch is part of the headlamp switch and must be serviced as an assembly. - Disconnect the electrical connector.

DESCRIPTION AND OPERATION

ABS DESCRIPTION AND OPERATION

This vehicle is equipped with an TRW 440 brake master cylinder assembly. The electronic brake control module (EBCM) and the brake pressure modulator valve (BPMV) can be serviced separately. The BPMV uses a 4-circuit configuration to control hydraulic pressure to each wheel independently.

The following vehicle performance enhancement systems are provided.

- Antilock Brake System (ABS)
- Dynamic Rear Proportioning (DRP)
- Traction Control System (TCS) (w/NW7)

The following components are involved in the operation of the above systems:

- Brake pressure modulator valve (BPMV)-The BPMV contains the hydraulic valves and pump motor that are controlled electrically by the EBCM. The BPMV uses a 4-circuit configuration with a diagonal split. The BPMV directs fluid from the reservoir of the master cylinder to the left front and right rear wheels and fluid from the other reservoir to the right front and left rear wheels. The diagonal circuits are hydraulically isolated so that a leak or malfunction in one circuit will allow continued braking ability on the other.
- Master cylinder pressure sensor-The master cylinder pressure sensor is located within the BPMV. The master cylinder pressure sensor uses a 5-volt reference and generates an output signal proportionate to the hydraulic fluid pressure which is present in the hydraulic brake circuit at the master cylinder.
- Solenoids-The solenoids are commanded ON and OFF by the EBCM to operate the appropriate valves in the BPMV.
- System relay-There are 2 system relays internal to the EBCM. The system relays are energized when the ignition is ON. The system relays supply battery positive voltage to the valve solenoids and to the ABS pump motor. This voltage is referred to as system voltage
- Traction control switch (w/NW7 and w/JL4)-TCS and vehicle stability enhancement system (VSES) is manually disabled or enabled using the traction control switch.
- Wheel speed sensors (WSS)-EBCM sends a 12-volt reference voltage signal to each wheel speed sensor. As the wheel spins, the wheel speed sensor produces a square wave DC signal voltage. The wheel speed sensor increases the signal frequency as the wheel speed increases, but does not increase the signal amplitude.
- Brake pedal position (BPP) sensor-The EBCM receives a serial data message from the body control module (BCM) to indicate that the brake pedal is applied.

Initialization Sequence

The electronic brake control module (EBCM) performs 1 initialization test each ignition cycle. The initialization of the EBCM occurs when 1 set of the following conditions occur:

- The EBCM detects that there is a minimum of 500 RPM from the powertrain control module (PCM) via a serial data message.

- The brake pedal is not applied.

OR

- The vehicle speed is greater than 16 km/h (10 mph).
- The brake pedal is applied.

Antilock Brake System (ABS) Operation

When wheel slip is detected during a brake application, an ABS event occurs. During antilock braking, hydraulic pressure in the individual wheel circuits is controlled to prevent any wheel from slipping. A separate hydraulic line and specific solenoid valves are provided for each wheel. The ABS can decrease, hold, or increase hydraulic pressure to each wheel. The ABS does not, however, increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During antilock braking, a series of rapid pulsations is felt in the brake pedal. These pulsations are caused by the rapid changes in position of the individual solenoid valves as the electronic brake control module (EBCM) responds to wheel speed sensor inputs and attempts to prevent wheel slip. These pedal pulsations are present only during antilock braking and stop when normal braking is resumed or when the vehicle comes to a stop. A ticking or popping noise may also be heard as the solenoid valves cycle rapidly. During antilock braking on dry pavement, intermittent chirping noises may be heard as the tires approach slipping. These noises and pedal pulsations are considered normal during antilock operation.

Vehicles equipped with ABS may be stopped by applying normal force to the brake pedal. Brake pedal operation during normal braking is no different than that of previous non-ABS systems. Maintaining a constant force on the brake pedal provides the shortest stopping distance while maintaining vehicle stability. The typical ABS activation sequence is as follows:

Pressure Hold

The EBCM closes the isolation valve and keeps the dump valve closed in order to isolate the slipping wheel when wheel slip occurs. This holds the pressure steady on the brake so that the hydraulic pressure does not increase or decrease.

Pressure Decrease

If a pressure hold does not correct the wheel slip condition, a pressure decrease occurs. The isolation valve remains closed and the dump valve is opened. This allows a small amount of brake fluid to escape from the hydraulic circuit into the reservoir.

Pressure Increase

After the wheel slip is corrected, a pressure increase occurs. The isolation and dump valves are returned to their off states and brake pressure in the hydraulic circuit is once again dependent on the amount of force applied to the brake pedal by the driver. If the driver applies too much pressure causing wheel slip, the ABS activation sequence reoccurs.

Dynamic Rear Proportioning (DRP) Operation

The dynamic rear proportioning (DRP) is a control system that enhances the hydraulic proportioning function of the mechanical proportioning valve in the base brake system. The DRP control system is part of the operation software in the electronic brake control module (EBCM). The DRP uses active control with existing ABS in order to regulate the vehicle's rear brake pressure.

Traction Control System (TCS)

When drive wheel slip is noted while the brake is not applied, the electronic brake control module (EBCM) will enter traction control mode. The traction control system (TCS) controls vehicle traction by applying brakes and limiting engine torque to the drive wheels. The EBCM performs the fallowing TCS operations:

- The EBCM requests the powertrain control module (PCM) to reduce the amount of torque to the drive wheels via serial data messages.
- The PCM reduces torque to the drive wheels by retarding spark timing and throttle actuator control (TAC).
- The PCM reports the amount torque delivered to the drive wheels via serial data messages.
- The EBCM applies brake pressure to the slipping wheel in order to transfer torque to the gripping wheel.

Power-Up Self-Test

The electronic brake control module (EBCM) is able to detect many malfunctions whenever the ignition is ON. However, certain failures cannot be detected unless active diagnostic tests are performed on the components. Shorted solenoid coil or motor windings, for example, cannot be detected until the components are commanded ON by the EBCM. Therefore, a power-up self-test is required at the beginning of each ignition cycle to verify correct operation of components before the various control systems can be enabled. The EBCM performs the power-up self-test when the vehicle achieves a speed greater than 10 km/h (7 mph). The system relay, solenoids, and the ABS pump motor are commanded ON and OFF to verify proper operation and the EBCM verifies the ability to return the system to base braking in the event of a failure. The power-up self-test may sometimes be heard by the driver or passengers of the vehicle.

Driver Information Indicators and Messages

The following indicators are used to inform the driver of several different conditions:

Brake System Warning Indicator

The instrument panel cluster (IPC) illuminates the brake warning indicator when any of the following instances occur.

- The body control module (BCM) detects that the park brake is engaged. The BCM sends a serial data message to the IPC requesting illumination.
- The electronic brake control module (EBCM) detects a low brake fluid condition. The EBCM sends a serial data message to the IPC requesting illumination.
- The IPC performs the bulb check.
- The IPC detects a loss of serial data communication with the EBCM.
- The EBCM detects an ABS-disabling malfunction which also disables dynamic rear proportioning (DRP). The EBCM sends a serial data message to the IPC requesting illumination.

ABS Indicator

The IPC illuminates the ABS indicator when any of the following instances occur.

- The EBCM detects an ABS-disabling malfunction. The EBCM sends a serial data message to the IPC requesting illumination.
- The IPC performs the bulb check.
- The IPC detects a loss of serial data communication with the EBCM.

SERVICE BRAKE SYSTEM Message

The IPC displays the message whenever the ABS indicator is illuminated due to an ABS fault.

BRAKE SYSTEM Fault Message

The IPC displays the message whenever the red brake warning indicator is illuminated due to a base brake or DRP fault.

SERVICE TRACTION fault Message

The IPC displays the traction fault message when either of the following instances occur:

- The EBCM detects a malfunction that requires traction control to be disabled. The EBCM sends a serial data message to the IPC requesting that the message be displayed.
- The IPC detects a loss of serial data communication with the EBCM.

2006 TRANSMISSION

Automatic Transaxle - 4T65-E - Troubleshooting - Impala

SYMPTOMS - AUTOMATIC TRANSMISSION

Symptoms - Automatic Transmission

Diagnostic Category	Diagnostic Information
DEFINITION: This table consists of eight diagnostic categories that are located in the left-hand column. Using this column, choose the appropriate category based on the operating conditions of the vehicle or transmission. After selecting a category, use the right-hand column to locate the specific symptom diagnostic information.	
Fluid Diagnosis: This category contains the following topics: • Fluid condition - appearance, contaminants, smell, overheating • Line pressure - high or low • Fluid leaks	• Refer to **Transmission Fluid Checking Procedure**. • Refer to **Incorrect Line Pressure**. • Refer to **Automatic Transmission Fluid Leaks**. • Refer to **Fluid Leak Diagnosis**.
Noise and Vibration Diagnosis: This category contains the following topics: • Noise - drive gear, final drive, whine, growl, hum, rattle, buzz, popping • Torque converter diagnosis • Noise and vibration analysis	• Refer to **Whine Noise Varying with RPM or Fluid Pressure**. • Refer to **Popping Noise**. • Refer to **Buzz Noise or High Frequency Rattle Sound**. • Refer to **Whine/Growl Noise That Changes with Vehicle Speed**. • Refer to **Final Drive Noise or Hum Noise**. • Refer to **Noise in First, Second, Third, or Fourth**. • Refer to **Noise in Random Ranges**. • Refer to **Abnormal Noise in Park or Neutral Range**. • Refer to **Torque Converter Diagnosis Procedure**. • Refer to **Noise and Vibration Analysis**.
Range Performance Diagnosis: This category contains the following topics:	• Refer to **No Park Range**. • Refer to **Slips in Reverse or No**

- No Park - No Reverse or slips - No Drive or slips - No engine braking	**Reverse**. - Refer to **Slips in Drive or No Drive**. - Refer to **Locked Up in Drive/Reverse**. - Refer to **No Engine Braking in Manual Second or Low Range**.
Shift Quality (Feel) Diagnosis: This category contains the following topics: - Harsh shifts - Soft shifts - Harsh engagement - garage shifts - Delayed engagement - garage shifts	- Refer to **Harsh or Soft 1-2 Shift Feel**. - Refer to **Harsh or Soft 2-3/3-2 Shift Feel**. - Refer to **Harsh or Soft 3-4/4-3 Shift Feel**. - Refer to **Harsh Park to Reverse/Drive Engagement**. - Refer to **Delayed Park to Reverse/Drive Engagement**.
Slipping or Missing Gears: This category contains the following topics: - No upshift - Slipping or missing gears - One forward gear only - Two forward gears only - Non-First gear start	- Refer to **Slipping or No First Gear**. - Refer to **Slipping or No Second Gear**. - Refer to **Slipping or No Third Gear**. - Refer to **Slipping or No Fourth Gear**. - Refer to **First Gear Only**. - Refer to **Second Gear Only**. - Refer to **Third Gear Only**. - Refer to **Fourth Gear Only**. - Refer to **First and Second Gear Only (2-3 Solenoid Stuck On)**. - Refer to **First and Fourth Gear Only (1-2 Solenoid Stuck On)**. - Refer to **Second and Third Gear Only (1-2 Solenoid Stuck Off)**. - Refer to **Third and Fourth Gear Only (2-3 Solenoid Stuck Off)**.
Shift Speed Diagnosis: This category contains the following topic: Incorrect shift points	Refer to **High or Low Upshift or Downshift Speed**.
Torque Converter Diagnosis:	- Refer to **Torque Converter**

This category contains the following topics: - Torque converter diagnosis - TCC does not apply - TCC does not release - TCC shudder	**Diagnosis Procedure**. - Refer to **No Torque Converter Clutch (TCC) Apply**. - Refer to **Converter Clutch Stuck On in All Gears**. - Refer to **Converter Clutch Stuck On in Second, Third and Fourth Gear**. - Refer to **Harsh Torque Converter Clutch (TCC) Apply or Release**. - Refer to **Converter Clutch Apply Rough, Slips, or Shudders**.
Symptom Cannot Be Duplicated or Symptom Not Found: This category contains the following topics: - Transmission fluid diagnosis - Road testing - Line pressure diagnosis	- Refer to **Transmission Fluid Checking Procedure**. - Refer to **Road Test Procedure**. - Refer to **Line Pressure Check Procedure**.

RANGE SELECTOR DISPLAYS INCORRECT RANGE

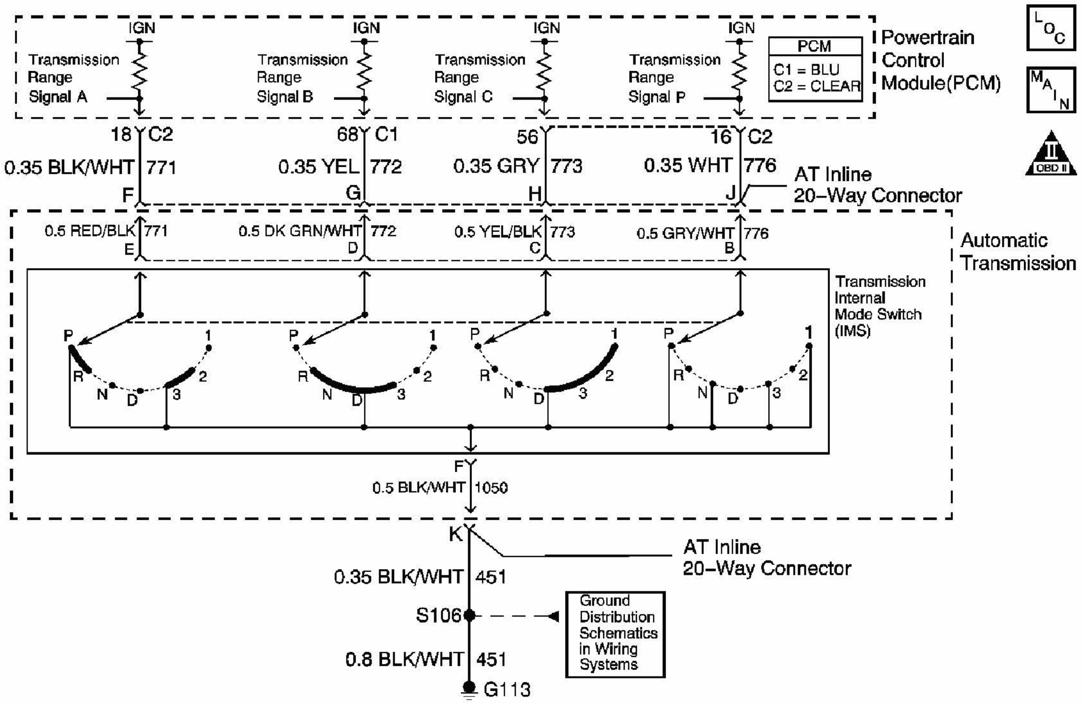

IGN
IGN
IGN
IGN
Transmission Range Signal A
Transmission Range Signal B
Transmission Range Signal C
Transmission Range Signal P
PCM
C1 = BLU
C2 = CLEAR
Powertrain Control Module(PCM)
18 C2
68 C1
56
16 C2
0.35 BLK/WHT 771
0.35 YEL 772
0.35 GRY 773
0.35 WHT 776
F
G
H
J
AT Inline 20–Way Connector
0.5 RED/BLK 771
E
0.5 DK GRN/WHT 772
D
0.5 YEL/BLK 773
C
0.5 GRY/WHT 776
B
Automatic Transmission
Transmission Internal Mode Switch (IMS)
P R N D 3 2 1
F
0.5 BLK/WHT 1050
K
AT Inline 20–Way Connector
0.35 BLK/WHT 451
S106
Ground Distribution Schematics in Wiring Systems
0.8 BLK/WHT 451
G113

Fig. 1: Identifying Transmission Internal Mode Switch Circuit
Courtesy of GENERAL MOTORS CORP.

CIRCUIT DESCRIPTION

The transmission internal mode switch (IMS) is a sliding contact switch attached to the selector detent inside the transmission side cover. The four inputs to the powertrain control module (PCM) indicate the position of the transmission range selector. The input voltage level at the PCM is high, B+, when the IMS is open and low when the switch is closed to ground. The four input parameters represented are Signals A, B, C, and P, Parity. Refer to **Transmission Internal Mode Switch Logic** .

TEST DESCRIPTION

The numbers below refer to the step numbers on the diagnostic table.

2: HI values for all signals in all ranges indicates the ground circuit is OPEN.

3: With the 20-way connector disconnected, all signals should indicate HI.

5: If one circuit affects the other, this indicates a short between the two circuits.

11: This step tests the internal transmission harness. If no fault is found in the harness, the fault will be in the switch.

Range Selector Displays Incorrect Range

Step	Action	Value(s)	Yes	No

1	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Select IMS on the scan tool. 4. Place the range selector in each transmission range: P, R, N, D4, D3, D2 and D1. Does each range selected match the scan tool IMS display?	-	Go to **Diagnostic System Check - Vehicle**	Go to **Step 2**
2	1. Select IMS A/B/C/P on the scan tool. 2. Place the range selector in each transmission range: P, R, N, D4, D3, D2 and D1. Does the IMS A/B/C/P display the specified values for each range?	HI/HI/HI/HI	Go to **Step 12**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the AT Inline 20-way connector. Additional DTCs may set. 3. Turn ON the ignition, with the engine OFF. 4. Select IMS A/B/C/P on the scan tool. Do the scan tool IMS A/B/C/P signals all indicate HI?	-	Go to **Step 4**	Go to **Step 8**
	1. Turn OFF the ignition. 2. Install the **J 44152** jumper harness on the engine side of the AT Inline 20-way connector. See **Special Tools** . 3. Turn ON the ignition, with the engine OFF. 4. Using the **J 39200** digital multimeter (DMM) and the **J 35616** GM terminal test kit, measure the voltage at the TR			

4	signal A circuit of the**J 44152** . See **Special Tools** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . 5. Measure the voltage at the TR signal B circuit of the **J 44152** . See **Special Tools** . 6. Measure the voltage at the TR signal C circuit of the **J 44152** . See **Special Tools** . 7. Measure the voltage at the TR signal P circuit of the **J 44152** . See **Special Tools** . Does the voltage measure ignition voltage at all four terminals?	-	Go to **Step 5**	Go to **Step 9**
5	Connect a fused jumper wire from the TR signal A circuit of the **J 44152** to ground while monitoring the scan tool IMS A/B/C/P parameter. See **Special Tools** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . When the TR signal A circuit is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 10**	Go to **Step 6**
6	Connect a fused jumper wire from the TR signal B circuit of the **J 44152** to ground while monitoring the scan tool IMS A/B/C/P parameter. See **Special Tools** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . When the TR signal B circuit is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 10**	Go to **Step 7**
	Connect a fused jumper wire from the TR signal C circuit of the **J 44152** to			

7	ground while monitoring the scan tool IMS A/B/C/P parameter. See **Special Tools** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . When the TR signal C circuit is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 10**	Go to **Step 11**
8	Test the TR signal circuits of the IMS that did not indicate HI for a short to ground between the PCM and the AT Inline 20-way connector. Refer to **Testing for Short to Ground** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
9	Test the TR signal circuits of the IMS that did not indicate ignition voltage for an open between the PCM and the AT Inline 20-way connector. Refer to **Testing for Continuity** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
10	Test the affected TR signal circuits of the IMS for a shorted together condition between the PCM and the AT Inline 20-way connector. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
11	Test the TR signal circuits of the IMS for an open or shorted condition between the AT Inline 20-way connector and the IMS. Refer to **Circuit Testing** . Did you find the condition?	-	Go to **Step 14**	Go to **Step 15**
12	Test the ground circuit of the IMS for an open between the AT Inline 20-way connector and the ground connection to the chassis.	-		

	Refer to **Testing for Continuity** and **Wiring Repairs** . Did you find and correct the condition?		Go to **Step 17**	Go to **Step 13**
13	Test the ground circuit of the IMS for an open between the AT Inline 20-way connector and the IMS. Refer to **Testing for Continuity** . Did you find the condition?	-	Go to **Step 14**	Go to **Step 15**
14	Replace the automatic transmission wiring harness assembly. Refer to **Wiring Harness Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
15	Replace the lever assembly-manual shaft detent with internal mode switch. Refer to **Manual Shift Shaft Position (Internal Mode) Switch and Parking System Components Removal** in Transmission Overhaul article. Did you complete the replacement?	-	Go to **Step 17**	-
16	Replace the PCM. Refer to **Control Module References** . Did you complete the replacement?	-	Go to **Step 17**	-
17	1. Turn ON the ignition, with the engine OFF. 2. With the scan tool, observe the IMS display while selecting each transmission range: P, R, N, D4, D3, D2, and D1. Does each selected transmission range match the scan tool IMS display?	-	System OK	Go to **Step 1**

TRANSMISSION FLUID CHECKING PROCEDURE

Transmission Fluid Checking Procedure

Step	Action	Value(s)	Yes	No
	1. Start the engine and allow the engine to idle until the transmission has reached the value			

1	specified. 2. Depress the brake pedal and move the shift lever through the gear ranges, pausing a few seconds in each gear. Is the fluid red or light brown?	82-93°C (180-200° F)	Go to **Step 4**	Go to **Step 2**
2	Does the fluid have a burnt odor or a dark brown color?	-	Go to **Step 11**	Go to **Step 3**
3	Does the fluid have a cloudy or milky appearance?	-	Go to **Step 10**	Go to **Step 4**
4	Check the fluid level. The vehicle must be level, with the engine running and the shift lever in the PARK range. Check both sides of the fluid level indicator, and read the lower level. The proper fluid level should be in the middle of the X-hatch. Is the fluid level too high?	-	Go to **Step 9**	Go to **Step 5**
5	Is the fluid level low?	-	Go to **Step 6**	System OK
6	Add DEXRON® VI automatic transmission fluid in increments of 0.5 L (0.5 qt) until the fluid is in the middle of the X-hatch. Check both sides of the fluid level indicator, and read the lower level. Did you add more than 1.5 L (1.6 qt) to the transmission?	-	Go to **Step 7**	Go to **Step 9**
7	Check for external leaks. Refer to **Fluid Leak Diagnosis**. Did you find any leaks?	-	Go to **Step 8**	Go to **Step 15**
8	Correct the leak condition. Did you correct the leak condition?	-	Go to **Step 15**	-
9	Remove any excess fluid to the proper level, the middle of the X-hatch. Is the fluid level satisfactory?	-	System OK	-
10	The transmission is contaminated with engine coolant. Replace the cooler. Is the replacement complete?	-	Go to **Step 12**	-
	IMPORTANT: **Transmission fluid may turn dark with**			

11	**normal use. This does not always indicate oxidation or contamination.** 1. Drain the fluid to determine if the fluid is contaminated. Refer to **Oil Pan Replacement** . 2. A very small amount of material in the bottom pan is a normal condition, but large pieces of metal or other material in the bottom pan require a transmission overhaul. Was the fluid contaminated?	-	Go to **Step 12**	Go to **Step 13**
12	Perform root cause and repair as necessary. Is the repair complete?	-	Go to **Step 13**	-
13	Flush the cooler. Refer to **Automatic Transmission Oil Cooler Flushing and Flow Test (J35944-A)** or **Automatic Transmission Oil Cooler Flushing and Flow Test (J45096)**. Has the cooler been flushed?	-	Go to **Step 14**	-
14	Change the fluid and the filter. Refer to **Oil Filter and Seal Replacement** . Is the procedure complete?	-	Go to **Step 15**	-
15	Add new fluid to the proper level, in the middle of the X-hatch. Is the procedure complete?	-	System OK	-

LINE PRESSURE CHECK PROCEDURE

TOOLS REQUIRED

J 21867 Pressure Gage

IMPORTANT:

- **Before performing a line pressure check, verify that the pressure control (PC) solenoid valve is receiving the correct electrical signal from the PCM.**
- **Some conditions may be intermittent, therefore this test should be performed at least 3 times.**

1. Install a scan tool.

CAUTION: Keep the brakes applied at all times in order to prevent unexpected vehicle motion. Personal injury may result if the vehicle moves unexpectedly.

2. Start the engine and set the parking brake.
3. Check for a stored Diagnostic Trouble Code (DTC).
4. Repair the vehicle, if necessary.
5. Check the fluid level. Refer to the **Transmission Fluid Checking Procedure**.
6. Check the manual linkage for proper adjustment.

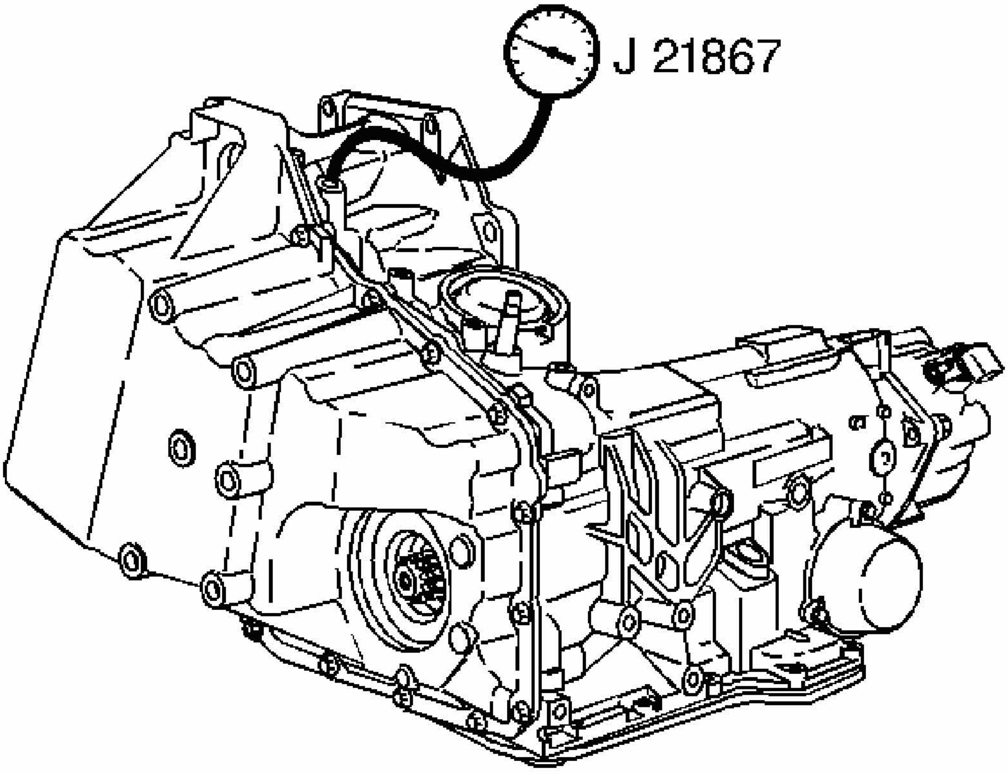


Fig. 2: Checking Line Pressure
Courtesy of GENERAL MOTORS CORP.

7. Turn the engine Off. Remove the oil pressure test hole plug and install the **J 21867** .
8. Put the gear selector in PARK range and set the parking brake.
9. Start the engine and allow the engine to warm up at idle.

NOTE: The total test running time should not be longer than 2 minutes. Running the test longer than 2 minutes may damage the transaxle.

10. Access the PC solenoid valve control test on the scan tool.
11. Increase the PC solenoid actual current from 0 to 1 amps in 0.1 amp increments. Allow the pressure to stabilize for five seconds after each pressure change. Read the corresponding line pressure on the **J 21867** .
12. Refer to the **Line Pressure** specification table. Compare the data to the table.
13. If pressure readings differ greatly from the table, refer to **Incorrect Line Pressure**.
14. Shut the engine OFF. Remove the **J 21867** .
15. Apply sealant GM P/N 12345382 (Canadian P/N 1095348) to the oil pressure test hole plug.

    NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

16. Install the oil pressure test hole plug.

    Tighten: Tighten the plug to 12 N.m (106 lb in).

ROAD TEST PROCEDURE

The following test provides a method of evaluating the condition of the automatic transmission. The test is structured so that most driving conditions would be achieved. The test is divided into the following parts:

- Electrical Function Check
- Upshift Control and Torque Converter Clutch (TCC) Apply
- Part Throttle Detent Downshifts
- Full Throttle Detent Downshifts
- Manual Downshifts
- Coasting Downshifts
- Manual Gear Range Selection
    - REVERSE
    - Manual FIRST
    - Manual SECOND
    - Manual THIRD

IMPORTANT: Complete the test in the sequence given. Incomplete testing

cannot guarantee an accurate evaluation.

Before the road test, ensure the following:

- The engine is performing properly.
- Transmission fluid level is correct. Refer to the **Transmission Fluid Checking Procedure**.
- Tire pressure is correct.

During the road test:

- Perform the test only when traffic conditions permit.
- Operate the vehicle in a controlled, safe manner.
- Observe all traffic regulations.
- View the scan tool data while conducting this test.

  Take along qualified help in order to operate the vehicle safely.

- Observe any unusual sounds or smells.

After the road test, check the following:

- Transmission fluid level. Refer to the **Transmission Fluid Checking Procedure**.
- Diagnostic Trouble Codes (DTCs) that may have set during the testing. Refer to the applicable DTC.
- Scan tool data for any abnormal readings or data.

ELECTRICAL FUNCTION CHECK

Perform this check first, in order to ensure the electronic transmission components are connected and functioning properly. If these components are not checked, a simple electrical condition could be mis-diagnosed.

1. Connect the scan tool.
2. Ensure the gear selector is in PARK and set the parking brake.
3. Start the engine.
4. Verify that the following scan tool data can be obtained and is functioning properly.

   Refer to **Scan Tool Data List** for typical data values. Data that is questionable may indicate a concern.

   - Engine Speed

- Transmission input speed (turbine)
- Transmission output speed
- Vehicle speed
- TFP manual valve position switch
- Transmission range
- Commanded gear (current gear)
- PC solenoid reference current
- PC solenoid actual current
- PC solenoid duty cycle
- Brake switch
- Engine coolant temperature
- Transmission fluid temperature
- Throttle angle
- Ignition voltage
- 1-2 shift solenoid
- 2-3 shift solenoid
- TCC solenoid duty cycle
- TCC slip speed

5. Monitor the brake switch signal while depressing and releasing the brake pedal. The scan tool should display:
    - Closed when the brake pedal is released.
    - Open when the brake pedal is depressed.
6. Check the garage shifts.
    1. Apply the brake pedal and ensure the parking brake is set.
    2. Move the gear selector through the following ranges:
        1. PARK to REVERSE
        2. REVERSE to NEUTRAL
        3. NEUTRAL to DRIVE
    3. Pause 2 to 3 seconds in each gear position.
    4. Verify the gear engagements are immediate and not harsh.

IMPORTANT:

- **Harsh engagement may be caused by any of the following conditions:**
    - **High idle speed. Compare engine idle speed to desired idle speed.**
    - **Commanded low PC solenoid current. Compare**

        PC solenoid reference current to PC solenoid actual current.
    - **A default condition caused by certain DTCs that result in maximum line pressure to prevent slippage.**
- **Soft or delayed engagement may be caused by any of the following conditions:**
    - **Low idle speed. Compare engine idle speed to desired idle speed.**
    - **Low fluid level.**
    - **Commanded high PC solenoid current. Compare PC solenoid reference current to PC solenoid actual current.**
    - **Cold transmission fluid. Check for low transmission fluid temperature.**

7. Monitor transmission range on the scan tool.
    1. Apply the brake pedal and ensure the parking brake is set.
    2. Move the gear selector through all ranges.
    3. Pause 2 to 3 seconds in each range.
    4. Return gear selector to PARK.
    5. Verify that all selector positions match the scan tool display.
8. Check throttle angle input.
    1. Apply the brake pedal and ensure the parking brake is set.
    2. Ensure the gear selector is in PARK.
    3. Monitor throttle angle while increasing and decreasing engine speed with the throttle pedal. The scan tool throttle angle should increase and decrease with engine speed.

If any of the above checks do not perform properly, record the result for reference after completion of the road test.

UPSHIFT CONTROL AND TORQUE CONVERTER CLUTCH (TCC) APPLY

The PCM calculates the upshift points based primarily on two inputs: throttle angle and vehicle speed. When the PCM determines that conditions are met for a shift to occur, the PCM commands the shift by closing or opening the ground circuit for the appropriate solenoid.

Perform the following steps:

1. Refer to the **Shift Speed** table and choose a throttle position of 12 percent, 25 percent or 50 percent. All throttle angles shown should be tested to cover the normal driving range.
2. Monitor the following scan tool parameters:
    - Throttle angle
    - Vehicle speed
    - Engine speed
    - Commanded gear
    - Slip speed
    - Solenoid states
3. Place the gear selector in the OVERDRIVE position.
4. Accelerate the vehicle using the chosen throttle angle. Hold the throttle steady.
5. As the transmission upshifts, note the vehicle speed when the shift occurs for each gear change. There should be a noticeable shift feel or engine speed change within 1 to 2 seconds of the commanded gear change.
6. Compare the shift speeds to the Shift Speed table. Refer to **Shift Speed** . Shift speeds may vary slightly due to transmission fluid temperature or hydraulic delays in responding to electronic controls.
    - Note any harsh, soft or delayed shifts or slipping.
    - Note any noise or vibration.
7. Repeat steps 1 through 6 to complete all throttle angles.

IMPORTANT: This transmission is equipped with an electronically controlled capacity clutch (ECCC). The pressure plate does not fully lock to the torque converter cover. Apply pressure on the clutch plate is controlled to maintain a small amount of slippage (about 20 RPM) in SECOND, THIRD and FOURTH gears, depending on the vehicle application. ECCC was developed to reduce the possibility of noise, vibration or chuggle caused by TCC apply. Typical apply speeds are 49-52 km/h (30-32 mph) in THIRD gear and 65-73 km/h (40-45 mph) in FOURTH gear. Full lockup is available at highway speeds on some applications.

IMPORTANT: The TCC will not engage until the engine is in closed loop operation and the vehicle speed is as shown in the Shift Speed table. Refer to Shift Speed . The vehicle must be in a near-cruise condition, not accelerating or coasting, and on a level road surface.

8. Check for TCC apply in THIRD and FOURTH gear.
    - Note the TCC apply point. When the TCC applies there should be a noticeable drop in engine speed and a drop in slip speed to below 100 RPM. If the TCC apply can not be detected:
        - Check for DTCs
        - Refer to **Torque Converter Diagnosis Procedure**
    - Refer to the **Shift Speed** table for the correct TCC apply speeds.
    - Lightly tap and release the brake pedal. The TCC will release on most applications.

PART THROTTLE DETENT DOWNSHIFT

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to 64-88 km/h (40-55 mph) in FOURTH gear.
3. Quickly increase throttle angle to greater than 50 percent.
4. Verify the following:
    - The TCC releases
    - The transmission downshifts immediately to THIRD gear

FULL THROTTLE DETENT DOWNSHIFT

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to speeds of 64-88 km/h (40-55 mph) in FOURTH gear.
3. Quickly increase throttle angle to 100 percent (WOT).
4. Verify the following:
    - The TCC releases
    - The transmission downshifts immediately to SECOND gear

MANUAL DOWNSHIFTS

The shift solenoid valves do not control the 4-3 manual downshift. The 4-3 manual downshift is hydraulic. The 3-2 and 2-1 manual downshifts are electronic. The solenoid states will change during, or shortly after a 4-3 downshift is selected.

Manual 4-3 Downshift

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to 64-88 km/h (40-55 mph) in FOURTH gear.
3. Release the throttle while moving the gear selector to THIRD.
4. Verify the following:

    - The TCC releases
    - The transmission downshifts immediately to THIRD gear
    - The engine slows the vehicle

Manual 4-2 Downshift

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to 64-72 km/h (40-45 mph).
3. Release the throttle while moving the gear selector to SECOND.
4. Verify the following:
    - The TCC releases
    - The transmission downshifts immediately to SECOND gear
    - The engine slows the vehicle

Manual 4-1 Downshift

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to 64 km/h (40 mph).
3. Release the throttle while moving the gear selector to FIRST.
4. Verify the following:
    - The TCC releases
    - The transmission downshifts immediately to SECOND Gear.
    - The engine slows the vehicle.
    - The transmission downshifts to FIRST gear at the calibrated speed, typically 48-64 km/h (30-40 mph).

COASTING DOWNSHIFTS

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to FOURTH gear with the TCC applied.
3. Release the throttle and lightly apply the brakes.
4. Verify the following:
    - The TCC releases
    - Downshifts occur at speeds shown in the Shift Speed table. Refer to **Shift Speed** .

MANUAL GEAR RANGE SELECTION

The shift solenoids control the upshifts in the manual gear ranges.

Perform the following tests using 10-15 percent throttle angle.

Reverse

1. With the vehicle stopped, move the gear selector to REVERSE.
2. Slowly accelerate the vehicle.
3. Verify that there is no noticeable slip, noise or vibration.

Manual First

1. With the vehicle stopped, move the gear selector to FIRST.
2. Accelerate the vehicle to 32 km/h (20 mph).
3. Verify the following:
    - No upshifts occur
    - The TCC does not apply
    - There is no noticeable slip, noise, or vibration

Manual Second

1. With the vehicle stopped, move the gear selector to SECOND.
2. Accelerate the vehicle to 57 km/h (35 mph).
3. Verify the following:
    - The 1-2 shift occurs
    - The 2-3 shift does not occur
    - There is no noticeable slip, noise, or vibration

Manual Third

1. With the vehicle stopped, move the gear selector to THIRD.
2. Accelerate the vehicle to 64 km/h (40 mph).
3. Verify the following:
    - The 1-2 shift occurs
    - The 2-3 shift occurs
    - There is no noticeable slip, noise, or vibration

TORQUE CONVERTER DIAGNOSIS PROCEDURE

The torque converter clutch (TCC) is applied by fluid pressure, which is controlled by a PWM solenoid valve. This solenoid valve is located inside of the automatic transmission assembly. The solenoid valve is controlled through a combination of computer controlled switches and sensors.

TORQUE CONVERTER STATOR

The torque converter stator roller clutch can have two different malfunctions.

- The stator assembly freewheels in both directions.
- The stator assembly remains locked up at all times.

POOR ACCELERATION AT LOW SPEED

If the stator is freewheeling at all times, the car tends to have poor acceleration from a standstill. At speeds above 50-55 km/h (30-35 mph), the car may act normally. For poor acceleration, you should first determine that the exhaust system is not blocked, and the transmission is in First gear when starting out.

If the engine freely accelerates to high RPM in NEUTRAL, you can assume that the engine and the exhaust system are normal. Check for poor performance in DRIVE and REVERSE to help determine if the stator is freewheeling at all times.

POOR ACCELERATION AT HIGH SPEED

If the stator is locked up at all times, performance is normal when accelerating from a standstill. Engine RPM and car speed are limited or restricted at high speeds. Visual examination of the converter may reveal a blue color from overheating.

If the converter has been removed, you can check the stator roller clutch by inserting a finger into the splined inner race of the roller clutch and trying to turn the race in both directions. You should be able to freely turn the inner race clockwise, but you should have difficulty in moving the inner race counterclockwise or you may be unable to move the race at all.

NOISE

IMPORTANT: Do not confuse this noise with pump whine noise, which is usually noticeable in PARK, NEUTRAL and all other gear ranges. Pump whine will vary with line pressure.

You may notice a torque converter whine when the vehicle is stopped and the transmission is in DRIVE or REVERSE. This noise will increase as you increase the engine RPM. The noise will stop when the vehicle is moving or when you apply the torque converter clutch, because both halves of the converter are turning at the same speed.

Perform a stall test to make sure the noise is actually coming from the converter:

1. Place your foot on the brake.
2. Put the gear selector in DRIVE.

NOTE: You may damage the transmission if you depress the accelerator for more than 6 seconds.

3. Depress the accelerator to approximately 1,200 RPM for no more than 6 seconds.

A torque converter noise will increase under this load.

TORQUE CONVERTER CLUTCH SHUDDER

The key to diagnosing torque converter clutch (TCC) shudder is to note when it happens and under what conditions.

TCC shudder which is caused by the transmission should only occur during the apply or the release of the converter clutch. Shudder should never occur after the TCC plate is fully applied.

If the shudder occurs while the TCC is applying, the problem can be within the transmission or the torque converter. Something is causing one of the following conditions to occur:

- Something is not allowing the clutch to become fully engaged.
- Something is not allowing the clutch to release.
- The clutch is releasing and applying at the same time.

One of the following conditions may be causing the problem to occur:

- Leaking turbine shaft seals
- A restricted release orifice
- A distorted clutch or housing surface due to long converter bolts
- Defective friction material on the TCC plate

IF SHUDDER OCCURS AFTER TCC HAS APPLIED

If shudder occurs after the TCC has applied, most of the time there is nothing wrong with the transmission.

As mentioned above, the TCC is not likely to slip after the TCC has been applied. Engine problems may go unnoticed under light throttle and load, but they become noticeable after the TCC apply when going up a hill or accelerating. This is due to the mechanical coupling between the engine and the transmission.

Once TCC is applied, there is no torque converter (fluid coupling) assistance. Engine or driveline vibrations could be unnoticeable before TCC engagement.

Inspect the following components in order to avoid misdiagnosis of TCC shudder. An inspection will also avoid the unnecessary disassembly of a transmission or the unnecessary replacement of a torque converter.

- Spark plugs - Inspect for cracks, high resistance or a broken insulator.
- Plug wires - Look in each end. If there is red dust (ozone) or a black substance (carbon) present, then the wires are bad. Also look for a white discoloration of the wire. This indicates arcing during hard acceleration.
- Coil-Look for a black discoloration on the bottom of the coil. This indicates arcing while the engine is misfiring.
- Fuel injector - The filter may be plugged.
- Vacuum leak - The engine will not get a correct amount of fuel. The mixture may run rich or lean depending on where the leak occurs.
- EGR valve - The valve may let in too much or too little unburnable exhaust gas and could cause the engine to run rich or lean.
- MAP/MAF sensor - Like a vacuum leak, the engine will not get the correct amount of fuel for proper engine operation.
- Carbon on the intake valves - Carbon restricts the proper flow of air/fuel mixture into the cylinders.
- Flat cam - Valves do not open enough to let the proper fuel/air mixture into the cylinders.
- Oxygen sensor - This sensor may command the engine too rich or too lean for too long.
- Fuel pressure - This may be too low.
- Engine mounts - Vibration of the mounts can be multiplied by TCC engagement.
- Axle joints - Check for vibration.
- TP Sensor - The TCC apply and release depends on the TP Sensor in many engines. If the TP Sensor is out of specification, TCC may remain applied during initial engine loading.
- Cylinder balance - Bad piston rings or poorly sealing valves can cause low power in a cylinder.
- Fuel contamination - This causes poor engine performance.

TORQUE CONVERTER EVALUATION AND DIAGNOSIS

Replace the torque converter if any of the following conditions exist:

- External leaks appear in the hub weld area.
- The converter hub is scored or damaged.
- The converter pilot is broken, damaged, or fits poorly into the crankshaft.
- You discover steel particles after flushing the cooler and the cooler lines.
- The pump is damaged, or you discover steel particles in the converter.
- The vehicle has TCC shudder and/or no TCC apply. Replace the torque converter only after all hydraulic and electrical diagnoses have been made. The converter clutch

material may be glazed.
- The converter has an imbalance which cannot be corrected. Refer to **Flexplate/Torque Converter Vibration Test**.
- The converter is contaminated with engine coolant which contains antifreeze.
- An internal failure occurs in the stator roller clutch.
- You notice excessive end play.
- Overheating produces heavy debris in the clutch.
- You discover steel particles or clutch lining material in the fluid filter or on the magnet, when no internal parts in the unit are worn or damaged. This condition indicates that lining material came from the converter.

Do not replace the torque converter if you discover any of the following symptoms:

- The oil has an odor or the oil is discolored, if there are no metal or clutch facing particles present.
- The threads in one or more of the converter bolt holes are damaged. Correct the condition with a new thread insert.
- Transmission failure did not display evidence of damaged or worn internal parts, steel particles or clutch plate lining material in the unit and inside the fluid filter.
- The vehicle has been exposed to high mileage only. An exception may exist where the lining of the torque converter clutch dampener plate has seen excess wear by vehicles operated in heavy and/or constant traffic, such as taxi, delivery, or police use.

TORQUE CONVERTER REPLACEMENT GUIDE

Torque Converter Replacement Guide

Condition	Action
Fluid	
• Transmission Fluid Oxidized/Discolored • No metal debris • Clutch fiber material	Do not replace the torque converter. Refer to **Transmission Fluid Checking Procedure**.
• Transmission Fluid Contaminated with Engine Coolant/Oil	Replace the torque converter. Refer to **Torque Converter Cover Replacement** .
• Transmission Fluid Contaminated with Sludge/Metal Particles	• Replace the torque converter if the following conditions are found: ○ Pump Damage ○ Drive sprocket support damage

	○ Turbine/stator shaft damage ○ No damage found in transmission • Do not replace the torque converter for other transmission component damage.
• Fluid Leaks from Torque Converter	• Perform the powder/dye leak check. Refer to **Fluid Leak Diagnosis**. • Replace the torque converter if the following conditions are found: ○ Leak present at weld areas-hub, lug, or closure weld ○ Hub surface is damaged-scored, raised/transferred metal ○ Bushing is damaged
Function/Appearance	
• Torque Converter Discolored/Overheated	Replace the torque converter. Refer to **Torque Converter Cover Replacement** .
• Broken/Cracked Flexplate	Replace the torque converter. Refer to **Torque Converter Cover Replacement** .
• Stripped Converter Bolt Holes	Replace the torque converter. Refer to **Torque Converter Cover Replacement** .
• Torque Converter Pilot Damaged	Replace the torque converter. Refer to **Torque Converter Cover Replacement** .
• Torque Converter Ballooning	Replace the torque converter if end play exceeds 0.7 mm (0.3 in) using **J 35138** . See **Special Tools** .
Driveability - Non TCC	
• Harsh Gear Shifts-Non TCC	Do not replace the torque converter. Refer to **Symptoms - Automatic Transmission**.
• No Drive/Slips in Drive-Non TCC	Do not replace the torque converter until completing all engine and transmission diagnostics. Refer to **Slips in Drive or No Drive**.

• Idle Surge/Rough Idle	Do not replace the torque converter. Refer to **Symptoms - Engine Controls** .
• Poor Acceleration above 48 km/h (30 mph) - Launch	Do not replace the torque converter until completing all engine and transmission diagnostics. Refer to **Symptoms - Engine Controls**
• DTC P0741-TCC Stuck OFF/High Slip-Intermittent Only	Do not replace the torque converter. Refer to **DTC P0741, P0751, or P0756** diagnostic table.
• DTC P0741-TCC Stuck OFF/High Slip	Refer to **DTC P0741, P0751, or P0756** diagnostic table.
• DTC P0742 -TCC Stuck ON	Do not replace the torque converter. Refer to **DTC P0742, P0752, or P0757** diagnostic table.
• TCC Apply/Release Shudder	Refer to **Converter Clutch Apply Rough, Slips, or Shudders**.
• TCC Chuggle	Refer to the necessary diagnostic: • **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L, **Symptoms - Engine Mechanical** in Engine Mechanical - 3.9L or **Symptoms - Engine Mechanical** in Engine Mechanical -5.3L • **Symptoms - Engine Controls** • Refer to **Symptoms - Automatic Transmission**.
Noise and Vibration	
• Noise-Whine	• Refer to **Symptoms - Automatic Transmission**. • Do not replace the torque converter if noise is present in NEUTRAL/PARK. Refer to **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L, **Symptoms - Engine Mechanical** in Engine Mechanical - 3.9L or **Symptoms - Engine Mechanical** in Engine Mechanical - 5.3L.

Vibration - Out of Balance	- Refer to **Flexplate/Torque Converter Vibration Test**. - Refer to **Vibration Analysis - Engine** .

FLEXPLATE/TORQUE CONVERTER VIBRATION TEST

ISOLATING VIBRATION

NOTE: Some engine/transaxle combinations cannot be balanced in this manner due to restricted access or limited clearances between the torque converter bolts and the engine. Ensure that the bolts do not bottom out in the lug nuts or the torque converter cover which could dent and cause internal damage.

To isolate and correct a flywheel or torque converter vibration, separate the torque converter from the flywheel to determine if vibration is in the engine or transmission.

1. With the engine at idle speed and the transmission in PARK or NEUTRAL, observe the vibration.
2. Turn the engine OFF.
3. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Remove the transmission converter cover bolts and the cover.

   Refer to **Torque Converter Cover Replacement** .

5. Mark the relationship of the converter to the flywheel.
6. Remove the bolts attaching the converter to the flywheel.

   Refer to **Flywheel to Torque Converter Bolt Replacement** .

7. Slide the torque converter away from the flywheel.
8. Rotate the flywheel and torque converter to inspect for defects or missing balance weights.

   Refer to **Engine Flywheel Cleaning and Inspection** (3.5L), **Engine Flywheel Cleaning and Inspection** (3.9L) or **Engine Flywheel Cleaning and Inspection** (5.3L) in Engine Mechanical.

9. Lower the vehicle.
10. With the engine at idle speed and the transmission in PARK or NEUTRAL, observe the vibration.

Refer to **Vibration Analysis - Engine** in Vibration Diagnosis and Correction.

11. Turn the engine OFF.

INDEXING TORQUE CONVERTER

To determine and correct a torque converter vibration, the following procedure may have to be performed several times to achieve the best possible torque converter to flywheel balance.

1. Raise and suitably support the vehicle.

   Refer to **Lifting and Jacking the Vehicle** in General Information.

2. Rotate the torque converter one bolt position.

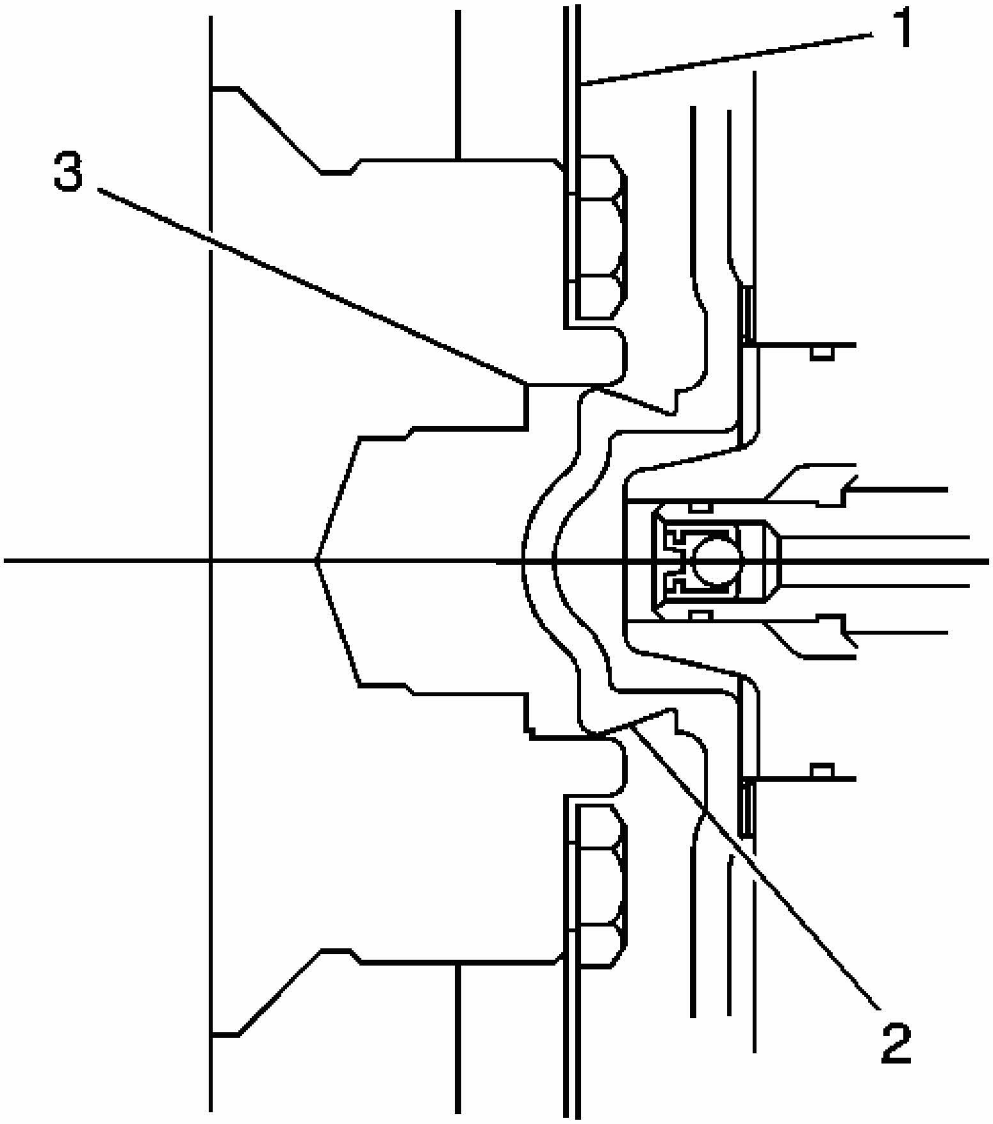


Fig. 3: View Of Torque Converter Hub In Engine Crankshaft
Courtesy of GENERAL MOTORS CORP.

3. Align the torque converter hub (2) in the engine crankshaft (3) and install the torque converter to flywheel bolts.

   Refer to **Flywheel to Torque Converter Bolt Replacement** .

4. Lower the vehicle.
5. With the engine at idle speed and the transmission in PARK or NEUTRAL, observe the

vibration.

Refer to **Noise and Vibration Analysis**.

Repeat this procedure until you obtain the best possible balance.

6. Install the transmission converter cover bolts and the cover.

   Refer to **Torque Converter Cover Replacement** .

NOISE AND VIBRATION ANALYSIS

A noise or vibration that is noticeable when the vehicle is in motion MAY NOT be the result of the transmission.

If noise or vibration is noticeable in PARK and NEUTRAL with the engine at idle, but is less noticeable as RPM increases, the cause may be from poor engine performance.

- Vibration may also be caused by a small amount of water inside the converter.
- Inspect the tires for the following conditions:
  - Uneven wear
  - Imbalance
  - Mixed sizes
  - Mixed radial and bias ply
- Inspect the suspension components for the following conditions:
  - Alignment, wear or damage
  - Loose fasteners
  - Driveline damage or wear
- Inspect the engine and transmission mounts for damage and loose bolts.
- Inspect the transmission case mounting holes for the following conditions:
  - Missing bolts, nuts, and studs
  - Stripped threads
  - Cracks
- Inspect the flywheel for the following conditions:
  - Missing or loose bolts
  - Cracks
  - Imbalance
- Inspect the torque converter for the following conditions:
  - Missing or loose bolts or lugs
  - Missing or loose balance weights

  - Imbalance caused by heat distortion or fluid contamination

CLUTCH PLATE DIAGNOSIS

COMPOSITION PLATES

Dry the plates and inspect the plates for the following conditions:

- Pitting
- Flaking
- Delamination-splitting or separation of bonded clutch material
- Wear
- Glazing
- Cracking
- Charring
- Chips or metal particles embedded in the lining

Replace a composition plate which shows any of these conditions.

STEEL PLATES

Wipe the plates dry and check the plates for heat discoloration. If the surfaces are smooth, even if color smear is indicated, you can reuse the plate. If the plate is discolored with heat spots or if the surface is scuffed, replace the plate.

CAUSES OF BURNED CLUTCH PLATES

The following conditions can result in a burned clutch plate:

- Incorrect usage of clutch or apply plates
- Engine coolant or water in the transmission fluid
- A cracked clutch piston
- Damaged or missing seals
- Low line pressure
- Valve body conditions
  - The valve body face is not flat.
  - Porosity is between channels.
  - The valve bushing clips are improperly installed.
  - The checkballs are misplaced.
- The Teflon® seal rings are worn or damaged.

ENGINE COOLANT/WATER IN TRANSMISSION

NOTE: **The antifreeze or water will deteriorate the seals, gaskets and the glue that bonds the clutch material to the pressure plate. Both conditions may cause damage to the transmission.**

If antifreeze or water has entered the transmission, perform the following:

1. Disassemble the transmission.
2. Replace all of the rubber type seals. The coolant will attack the seal material which will cause leakage.
3. Replace the composition-faced clutch plate assemblies. The facing material may separate from the steel center portion.
4. Replace all of the nylon parts - washers.
5. Replace the torque converter.
6. Thoroughly clean and rebuild the transmission, using new gaskets and oil filter.
7. Flush the cooler lines after the transmission cooler has been properly repaired or replaced.

FLUID LEAK DIAGNOSIS

GENERAL METHOD

1. Verify that the leak is transmission fluid.
2. Thoroughly clean the suspected leak area.
3. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached.
4. Park the vehicle over clean paper or cardboard.
5. Shut OFF the engine.
6. Look for fluid spots on the paper.
7. Make the necessary repairs.

POWDER METHOD

1. Thoroughly clean the suspected leak area with solvent.
2. Apply an aerosol type powder, such as foot powder, to the suspected leak area.
3. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached.
4. Shut OFF the engine.
5. Inspect the suspected leak area.
6. Trace the leak path through the powder in order to find the source of the leak.

7. Make the necessary repairs.

DYE AND BLACK LIGHT METHOD

A fluid dye and black light kit is available from various tool manufacturers.

1. Follow the manufacturer's instructions in order to determine the amount of dye to use.
2. Detect the leak with the black light.
3. Make the necessary repairs.

FIND THE CAUSE OF THE LEAK

Pinpoint the leak and trace the leak back to the source. You must determine the cause of the leak in order to repair the leak properly. For example, if you replace a gasket, but the sealing flange is bent, the new gasket will not repair the leak. You must also repair the bent flange. Before you attempt to repair a leak, check for the following conditions, and make repairs as necessary:

Gaskets

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Improperly tightened fasteners
- Dirty or damaged threads
- Warped flanges or sealing surface
- Scratches, burrs, or other damage to the sealing surface
- Damaged or worn gasket
- Cracking or porosity of the component
- Improper sealant used, where applicable
- Incorrect gasket

Seals

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Damaged seal bore
- Damaged or worn seal
- Improper installation
- Cracks in component
- Manual or output shaft surface is scratched, nicked, or damaged
- Loose or worn bearing causing excess seal wear

POSSIBLE POINTS OF FLUID LEAKS

Transmission Oil Pan

- Incorrectly tightened oil pan bolts
- Improperly installed or damaged oil pan gasket
- Damaged oil pan or mounting face
- Incorrect oil pan gasket

Case Leak

- Damaged or missing fill tube seal
- Mislocated fill tube bracket
- Damaged vehicle speed sensor seal
- Damaged manual shaft seal
- Loose or damaged oil cooler connector fittings
- Worn or damaged propeller shaft oil seal
- Loose line pressure pipe plug
- Warped
- Distorted torque converter housing
- Porous casting

Leak at the Torque Converter End

- Converter leak in the weld area
- Converter seal lip cut. Check the converter hub for damage
- Converter seal bushing moved forward and damaged
- Converter seal garter spring missing from the seal
- Porous casting of the transmission case or the oil pump

Leak at the Vent Pipe or the Fluid Fill Tube

- Overfilled system
- Water or coolant in the fluid-the fluid will appear milky.
- Transmission case porous
- Incorrect fluid level indicator
- Plugged vent
- Drain-back holes plugged
- Mispositioned oil pump to case gasket, if equipped

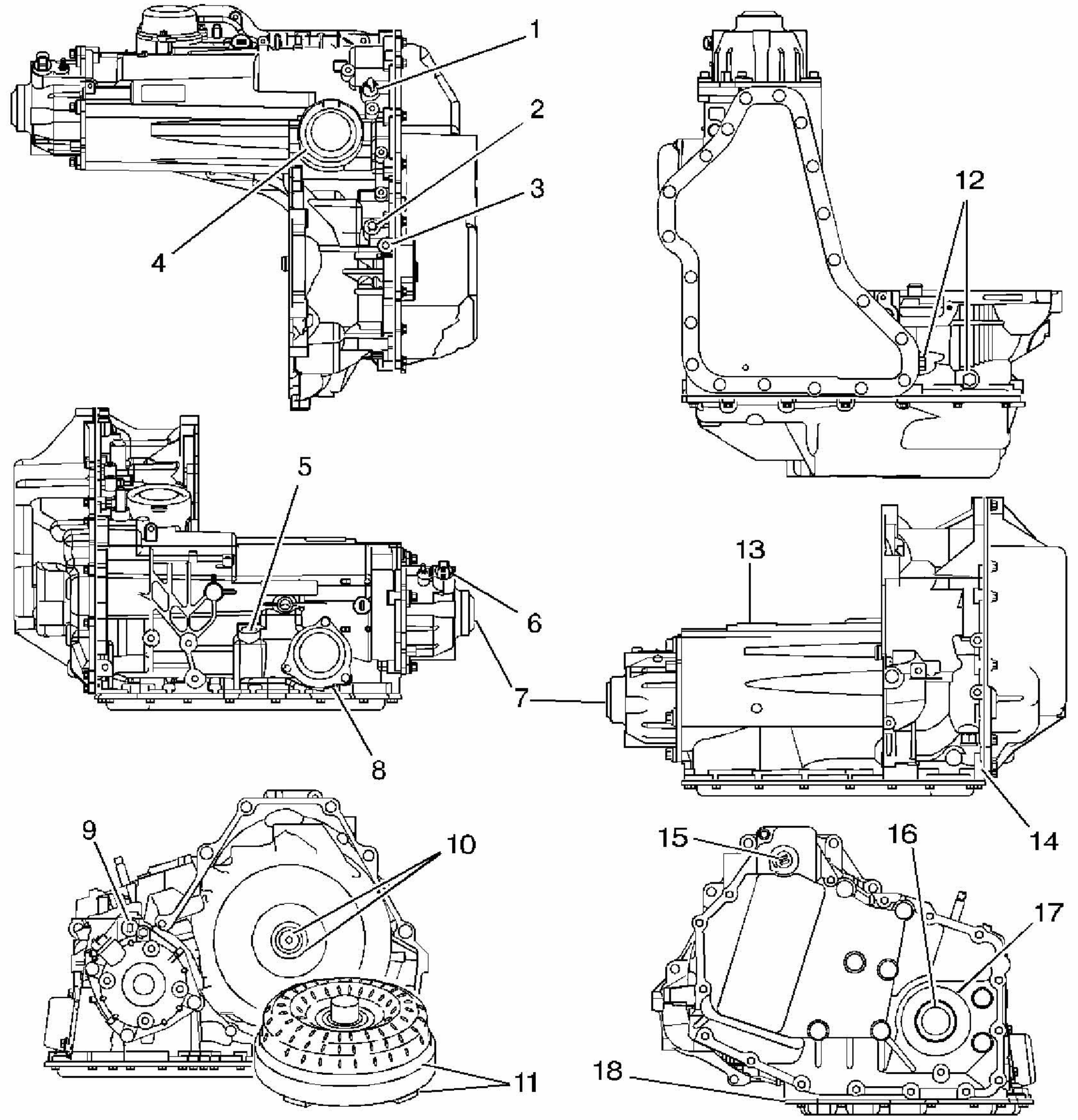


Fig. 4: Possible Leak Points
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 35

Callout	Component Name
1	Manual Shift Shaft Seal Assembly
2	Oil Pressure Test Hole Plug
3	Vent Assembly
4	Reverse Band Servo Cover Seal
5	Oil Fill Tube Seal
6	Vehicle Speed Sensor Seal
7	Drive Shaft Oil Seal Assembly (Right)

8	Forward Band Servo Cover Seal
9	Park Pawl Actuator Guide Seal
10	Torque Converter Oil Seal Assembly
11	Torque Converter Assembly (Welds/Cracks)
12	Oil Cooler Pipe Fittings
13	Case Assembly (Porosity/Cracks)
14	Case Side Cover Gasket
15	Electrical Connector Seal
16	Drive Shaft Oil Seal Assembly (Left)
17	Case Side Cover Inner Gasket
18	Oil Pan Gasket

CASE POROSITY REPAIR

Some external leaks are caused by case porosity in non-pressurized areas. You can usually repair these leaks with the transmission in the vehicle.

1. Thoroughly clean the area to be repaired with a cleaning solvent. Air dry the area.

CAUTION: Epoxy adhesive may cause skin irritations and eye damage. Read and follow all information on the container label as provided by the manufacturer.

2. Using instructions from the manufacturer, mix a sufficient amount of an epoxy to make the repair.
3. While the transmission case is still hot, apply the epoxy. You can use a clean, dry soldering acid brush to clean the area and also to apply the epoxy cement. Make certain that the area to be repaired is fully covered.
4. Allow the epoxy cement to cure for 3 hours before starting the engine.
5. Repeat the fluid leak diagnosis procedures.

SHIFT SOLENOID LEAK TEST

TOOLS REQUIRED

J 44246 Solenoid Testing Kit. See **Special Tools** .

IMPORTANT:

- **This procedure tests On/Off type solenoid valves.**
- **Visually inspect the physical condition of the solenoid before testing. Inspect the O-rings before and after the test to be sure that they are not cut or damaged.**

Leak Test Procedure

1. Remove the solenoid from the control valve body. Refer to **1-2 Shift Solenoid Valve Replacement** or **2-3 Shift Solenoid Valve Replacement** .

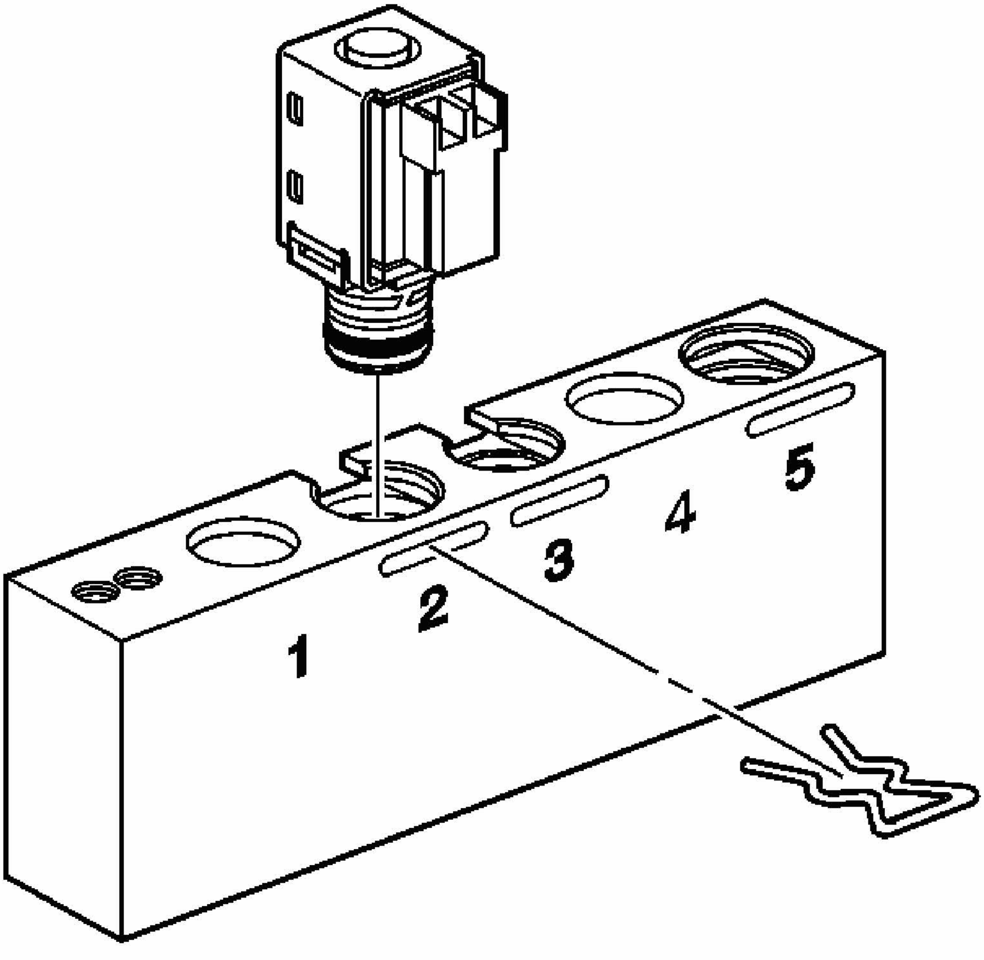


Fig. 5: Installing Valve Into Bore No. 2 Of J 44246
Courtesy of GENERAL MOTORS CORP.

2. Install the 1-2, 3-4 or the 2-3 shift solenoid valve into bore number 2 of the **J 44246** and install the factory retainer clip to retain the solenoid. See **Special Tools** .

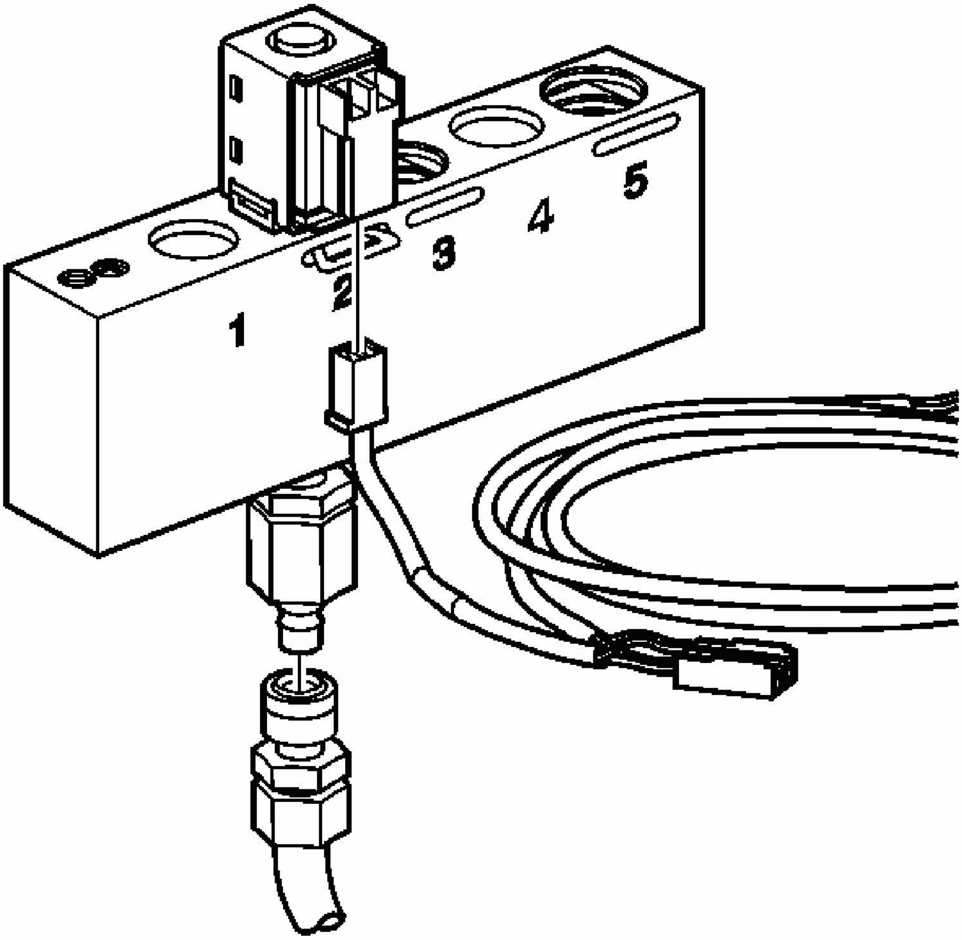


Fig. 6: Connecting Solenoid Testing Harness To Solenoid
Courtesy of GENERAL MOTORS CORP.

3. Connect the solenoid testing harness supplied with the **J 44246** to the solenoid. See Special Tools .

IMPORTANT: Do not use air pressure in excess of 827 kPa (120 psi). Excessive pressure will not allow the solenoid ball check valve to seat properly. Recommended air pressure is 345 kPa (50 psi).

4. Apply compressed air to the **J 44246** . See Special Tools .
5. Air should flow through the solenoid. If air does not flow through the solenoid, replace the solenoid.

6. Connect the solenoid testing harness to the (12 volt) positive and negative (-) battery terminals.
7. Observe if the solenoid is operating electrically. An audible clicking noise can be heard when connecting or disconnecting power.

IMPORTANT:
- **All solenoids need to be energized to seal.**
- **A small amount of air leakage is normal, 21 kPa (3 psi).**

8. Observe the air flow through the solenoid. The flow will completely or nearly completely stop. Replace the solenoid if there continues to be an obvious air leak when the solenoid is energized.

IMPORTANT: Inspect the O-rings after the test to be sure that they are not cut or damaged.

9. Install the solenoid into the control valve body. Refer to **1-2 Shift Solenoid Valve Replacement** or **2-3 Shift Solenoid Valve Replacement** .

AUTOMATIC TRANSMISSION OIL COOLER FLUSHING AND FLOW TEST (J35944-A)

GM studies indicate that plugged or restricted transmission oil coolers and pipes cause insufficient transmission lubrication and elevated operating temperatures which can lead to premature transmission wear-out. Many repeat repair cases could have been prevented by following published procedures for transmission oil cooler flushing and flow checking. This procedure includes flow checking and flushing the auxiliary transmission oil cooler, if equipped.

IMPORTANT: Use the J 35944-A or equivalent to flush the transmission oil cooler and the oil cooler pipes whenever the transaxle is removed for the following repairs: See Special Tools .

- **Torque converter**
- **Oil pump**
- **Oil pump drive shaft**
- **Drive sprocket support**
- **Transaxle overhaul complete**
- **Transaxle assembly replacement**

IMPORTANT: Use the J 35944-A or equivalent to flush the transmission oil

cooler and the oil cooler pipes whenever the transmission is removed for the following repairs: See Special Tools .

- **Torque converter**
- **Oil pump**
- **Turbine shaft**
- **Transmission overhaul complete**
- **Transmission assembly replacement**

Only GM Goodwrench DEXRON®VI automatic transmission fluid should be used when doing a repair on a GM transmission.

Time allowance for performing the cooler flow checking and flushing procedure has been included in the appropriate labor time guide operations since the 1987 model year. The service procedure steps for oil cooler flushing are as follows:

Cooler Flow Check and Flushing Steps

1. Tools Required
2. Preparation
3. Back Flush
4. Forward Flush
5. Flow Check
6. Clean-up

Tools Required

- **J 35944-A** Transmission Oil Cooler and Line Flusher. See **Special Tools** .
- **J 35944-22** Transmission Oil Cooler Flushing Fluid. See **Special Tools** .
- Measuring cup
- Funnel
- Water supply - hot water recommended
- Water hose, at least 16 mm (5/8 in) ID
- Shop air supply with water/oil filters, regulator and pressure gage
- Air chuck with clip, if available
- Oil drain container
- Pail with lid - 19 L (5 gallon)
- Eye protection
- Rubber gloves

PREPARATION

1. During the installation of the repaired or replacement transmission, do not connect the oil cooler pipes.

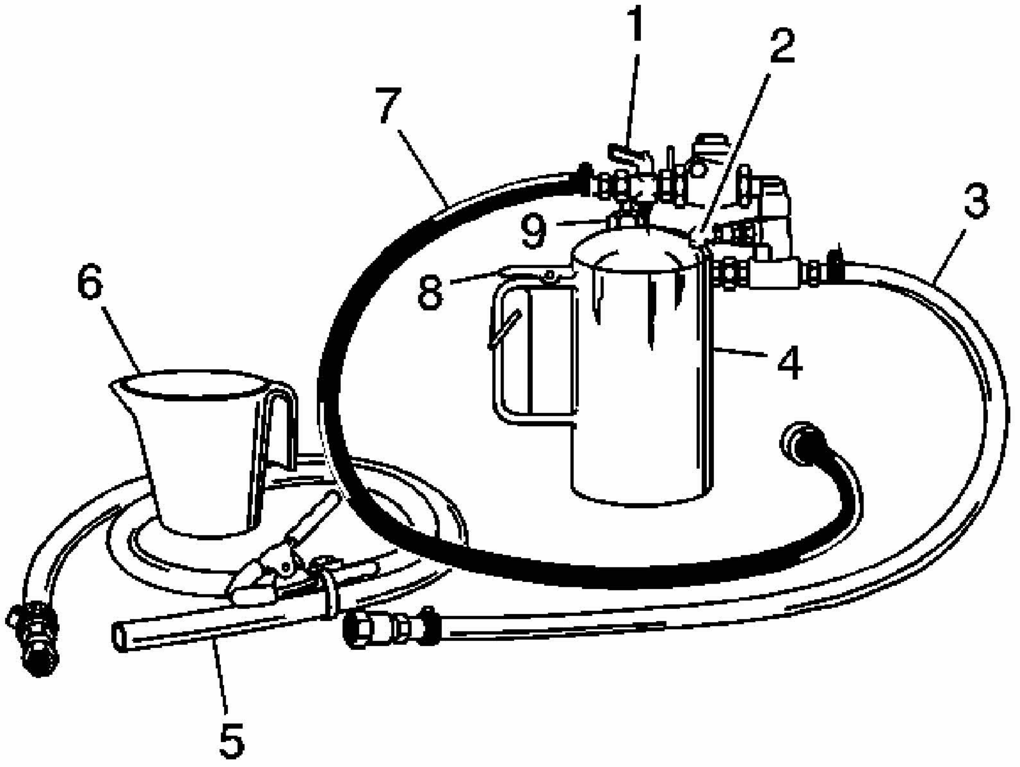


Fig. 7: Identifying Flusher Tank & Components
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not use solutions that contain alcohol or glycol. Use of solutions that contain alcohol or glycol may damage the oil cooler line flusher, oil cooler components and/or transmission components.

IMPORTANT: The J 35944-22 is environmentally safe, yet powerful enough to cut through transmission fluid to dislodge any contaminants from the cooler. See Special Tools . The safety precautions on the label, regarding potential skin and eye irritations associated with prolonged exposure, are typical precautions that apply to many similar cleaning

solutions. It should be noted that according to GM, use of other non-approved fluids for cooler flushing can have an adverse reaction to the seals inside the transmission.

2. Remove the fill cap (9) on the **J 35944-A** and fill the flusher tank (4) with 0. See **Special Tools** .6 L (20-21 oz) of **J 35944-22** , using the measuring cup (6). See **Special Tools** . Do not overfill.
3. Install the fill cap (9) on the **J 35944-A** and pressurize the flusher tank (4) to 550-700 kPa (80-100 psi), using the shop air supply at the tank air valve (2). See **Special Tools** .
4. With the water supply valve (1) on the **J 35944-A** in the OFF position, connect the water supply hose from the **J 35944-A** to the water supply at the faucet. See **Special Tools** .
5. Turn ON the water supply at the faucet.

BACK FLUSH

1. Inspect the transmission oil cooler pipes for kinks or damage. Repair as necessary.

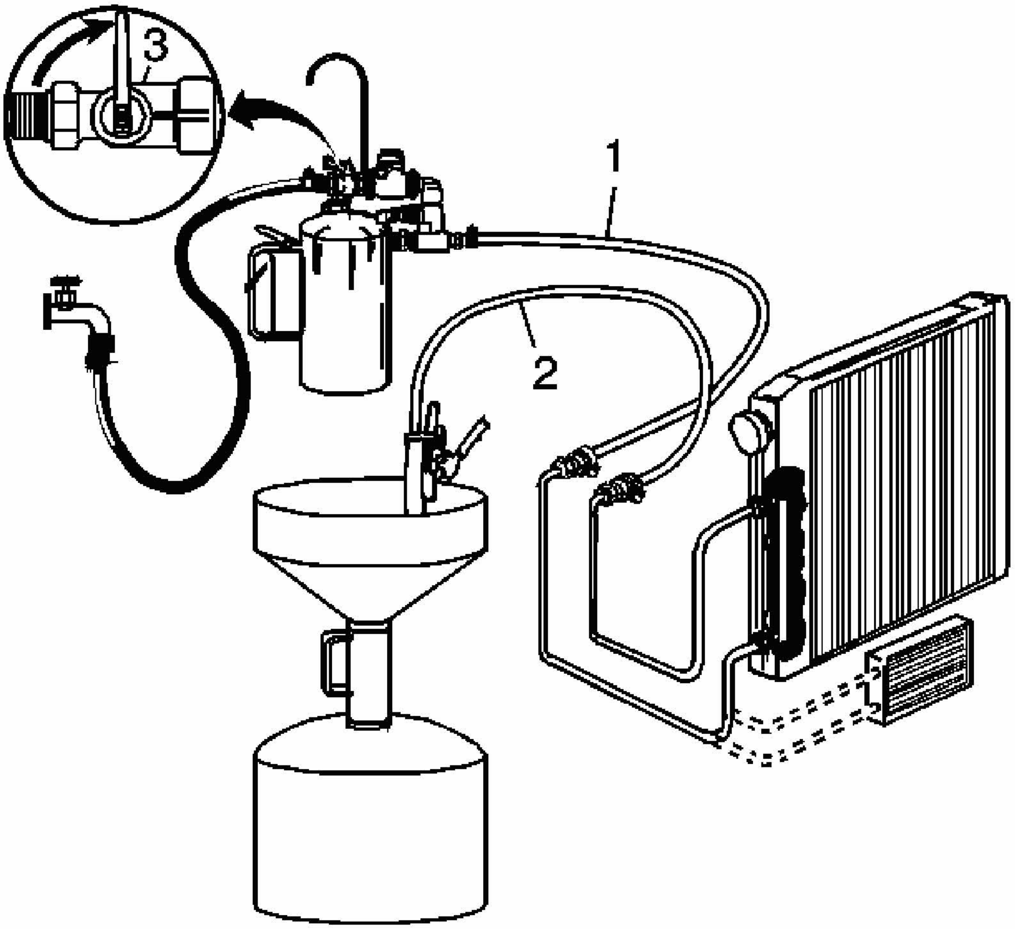


Fig. 8: Connecting J 35944 To Oil Cooler
Courtesy of GENERAL MOTORS CORP.

2. Connect the **J 35944-A** to the oil cooler feed top connector. See **Special Tools** .
3. Clip the discharge hose (2) onto the oil drain container.
4. Attach the **J 35944-A** to the undercarriage of the vehicle with the hook provided and connect the flushing system feed supply hose (1) from the **J 35944-A** to the bottom connector oil cooler return pipe. See **Special Tools** .
5. Turn the **J 35944-A** water supply valve (3) to the ON position and allow water to flow through the oil cooler and pipes for 10 seconds to remove any remaining transmission fluid. See **Special Tools** . If water does not flow through the oil cooler and pipes, the cause of the blockage must be diagnosed and the plugged component must be repaired or replaced. Continue with the cooler flushing and flow check procedure once the blockage is corrected.
6. Turn the **J 35944-A** water supply valve (3) to the OFF position and clip the discharge

hose onto a 19 liter (5 gallon) pail with a lid, to avoid splashing. See **Special Tools** .

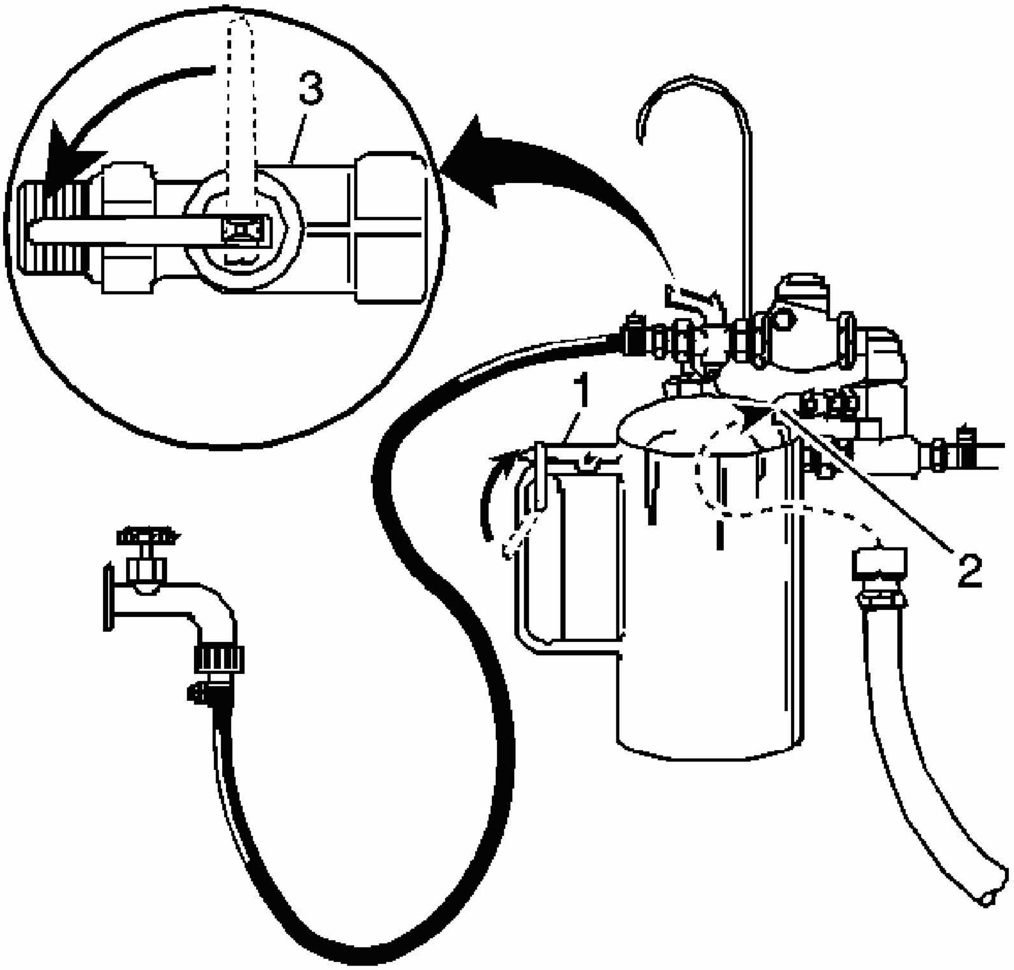


Fig. 9: J 35944-A Water Supply Valve ON/OFF Positions
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Flushing for approximately 2 minutes in each cooler line direction will result in a total of about 8-10 gallons of waste fluid. This mixture of water and flushing fluid is to be captured in a bucket or similar container.

7. Turn the **J 35944-A** water supply valve (3) to the ON position and depress the trigger (1) to mix cooler flushing solution into the water flow. See **Special Tools** . Use the clip provided on the handle to hold the trigger (1) down. The discharge will foam vigorously when the solution is introduced into the water stream.

8. Flush the oil cooler and pipes with water and solution for 2 minutes. During this flush, attach the shop air supply 825 kPa (120 psi) to the flushing system feed air valve (2) located on the **J 35944-A** , for 3-5 seconds at the end of every 15-20 second interval to create a surging action. See **Special Tools** .
9. Release the trigger (1) and turn the **J 35944-A** water supply valve (3) to the OFF position. See **Special Tools** .

FORWARD FLUSH

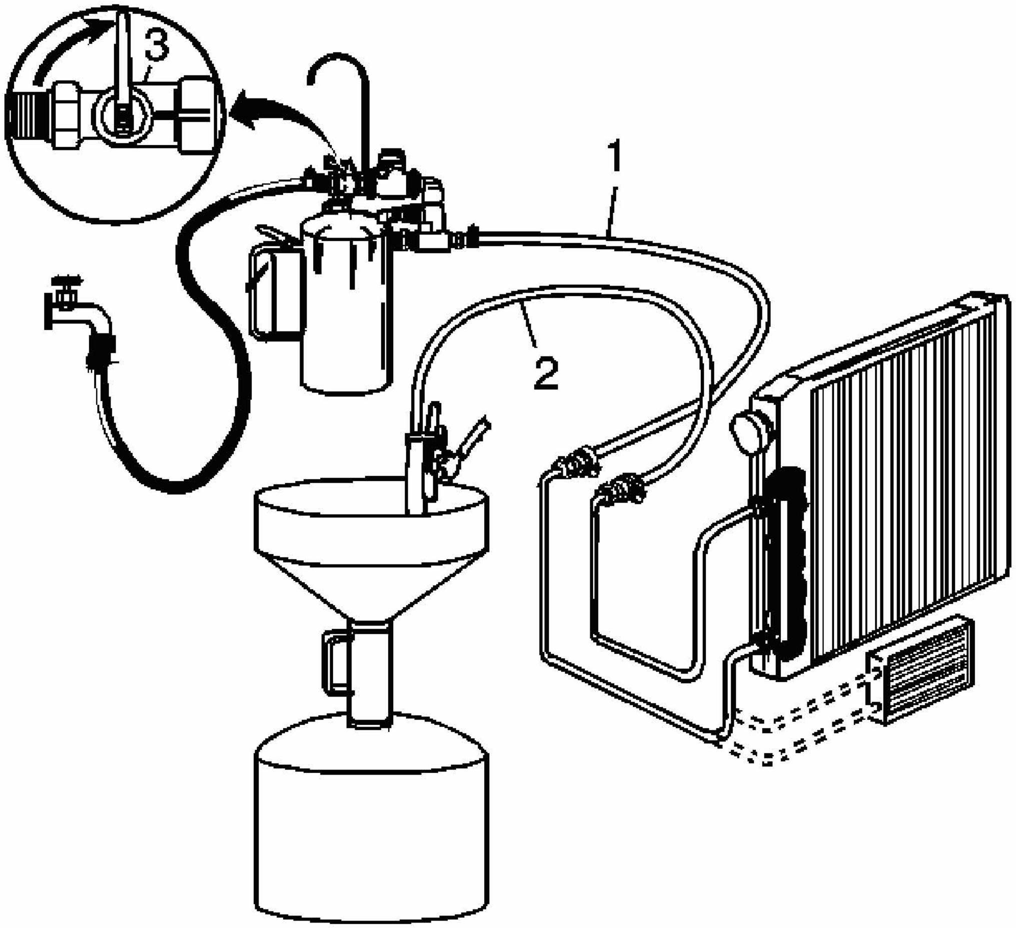


Fig. 10: Connecting J 35944 To Oil Cooler
Courtesy of GENERAL MOTORS CORP.

1. Disconnect both hoses (1 and 2) from the oil cooler pipes and connect them to the opposite oil cooler pipe. This will allow the oil cooler and pipes to be flushed in the normal flow direction.

2. Repeat Step 6 and 7 of the Back Flush.

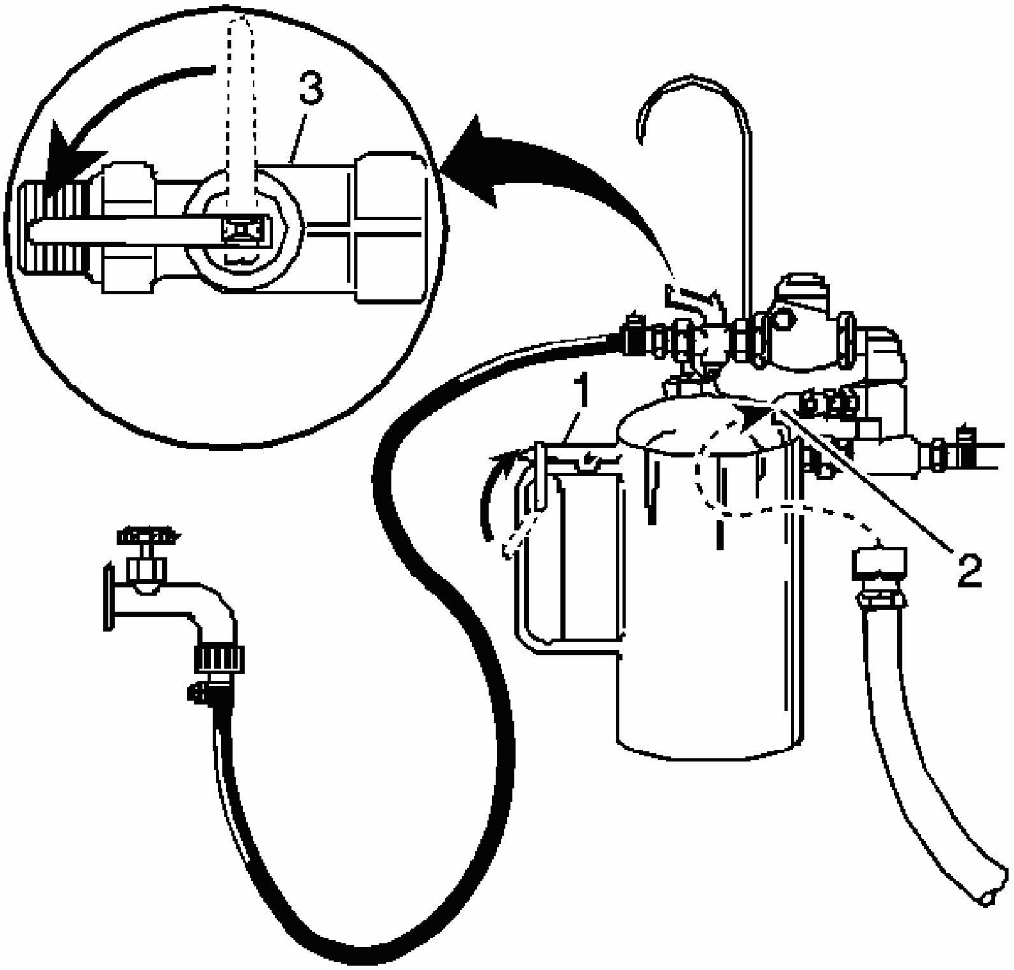


Fig. 11: J 35944-A Water Supply Valve ON/OFF Positions
Courtesy of GENERAL MOTORS CORP.

3. Release the trigger (1) of the **J 35944-A** and allow water only to rinse the oil cooler and pipes for 1 minute. See **Special Tools** .
4. Turn the **J 35944-A** water supply valve (3) to the OFF position and turn OFF the water supply at the faucet. See **Special Tools** .
5. Attach the shop air supply to the flushing system feed air valve (2) on the and **J 35944-A** blow out the water from the oil cooler and pipes. See **Special Tools** . Continue, until no water comes out of the discharge hose.

FLOW TEST

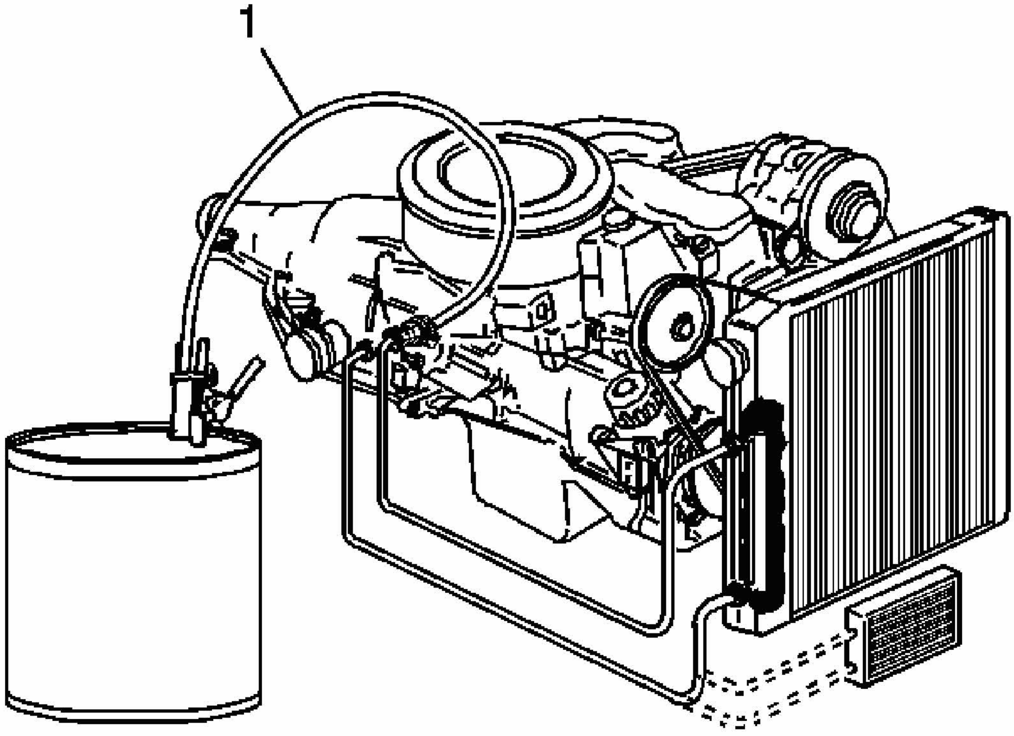


Fig. 12: Clipping The Discharge Hose To An Empty Oil Container
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The Flow Test must be performed after the flush to ensure that all flushing solution and water is removed from the oil cooling system.

1. Disconnect the hose from the oil cooler pipe. Connect the oil cooler feed pipe, top connector, to the transmission for normal flow.
2. Clip the discharge hose (1) to an empty oil container.
3. Confirm the transmission is filled with automatic transmission fluid. Refer to **Fluid Capacity Specifications** for the correct automatic transmission fluid capacity.
4. Start the engine with the transmission in PARK range and run for 30 seconds after fluid begins to flow from the discharge hose (1). A minimum of 1.9 L (2 quarts) must be discharged during this 30 second run time.
5. If the fluid flow meets or exceeds 1.9 L (2 quarts) in 30 seconds, connect the oil cooler feed pipe to the front connector on the transmission.
6. If fluid flow is less than 1.9 L (2 qt) in 30 seconds, perform the following diagnosis:
    1. Disconnect the **J 35944-A** discharge hose (1) from the oil cooler return pipe. See

   Special Tools .
   2. Disconnect the oil cooler feed pipe at the radiator.
   3. Connect the **J 35944-A** discharge hose (1) to the oil cooler feed pipe, radiator end. See **Special Tools** .
   4. Clip the discharge hose (1) onto the oil drain container.
   5. Start the engine with the transmission in PARK range and run for 30 seconds after fluid begins to flow from the discharge hose (1). A minimum of 1.9 L (2 qt) must be discharged during this 30 second run time.
7. If the amount of transmission fluid flow remains less than 1.9 L (2 qt) in 30 seconds, inspect the oil cooler feed pipe, top connector, for restrictions or damage. If no condition is found with the feed pipe, inspect the transmission.

CLEAN-UP

1. Disconnect the water supply hose from the **J 35944-A** and bleed any remaining air pressure from the flusher tank. See **Special Tools** .
2. Remove the fill cap from the **J 35944-A** and return any unused flushing solution to its container. See **Special Tools** . Rinse the **J 35944-A** with water. See **Special Tools** . Do not store the **J 35944-A** with flushing solution in it. See **Special Tools** .
3. After every third use, clean the **J 35944-A** as described in the instructions included with the tool. See **Special Tools** .
4. Dispose of any waste water/solution and transmission fluid in accordance with local regulations.

AUTOMATIC TRANSMISSION OIL COOLER FLUSHING AND FLOW TEST (J45096)

GM studies indicate that plugged or restricted transmission oil coolers and pipes cause insufficient transmission lubrication and elevated operating temperatures which can lead to premature transmission failure. Many repeat repair cases could have been prevented by following published procedures for transmission oil cooler flushing and flow checking. This procedure includes flow checking and flushing the auxiliary transmission oil cooler, if equipped.

IMPORTANT: Use the J 45096 or equivalent to flush and flow test the transmission oil cooler and the oil cooler pipes after the transaxle is removed for repairs. See Special Tools .

Only GM Goodwrench DEXRON®VI automatic transmission fluid should be used when doing a repair on a GM transmission.

Time allowance for performing the cooler flow checking and flushing procedure has been included in the appropriate labor time guide operations since the 1987 model year. The service procedure steps for oil cooler flushing and flow testing are as follows:

COOLER FLOW CHECK AND FLUSHING STEPS

1. Machine Set-up
2. Determine Minimum Flow Rate
3. Back Flush
4. Forward Flush
5. Flow Test
6. Code Recording Procedure
7. Clean-up

Tools Required

- **J 45096** Transmission Oil Cooling System Flush and Flow Test Tool. See **Special Tools** .
- Shop air supply with water/oil filters, regulator and pressure gage - minimum 90 psi
- Eye protection
- Rubber gloves

MACHINE SET-UP

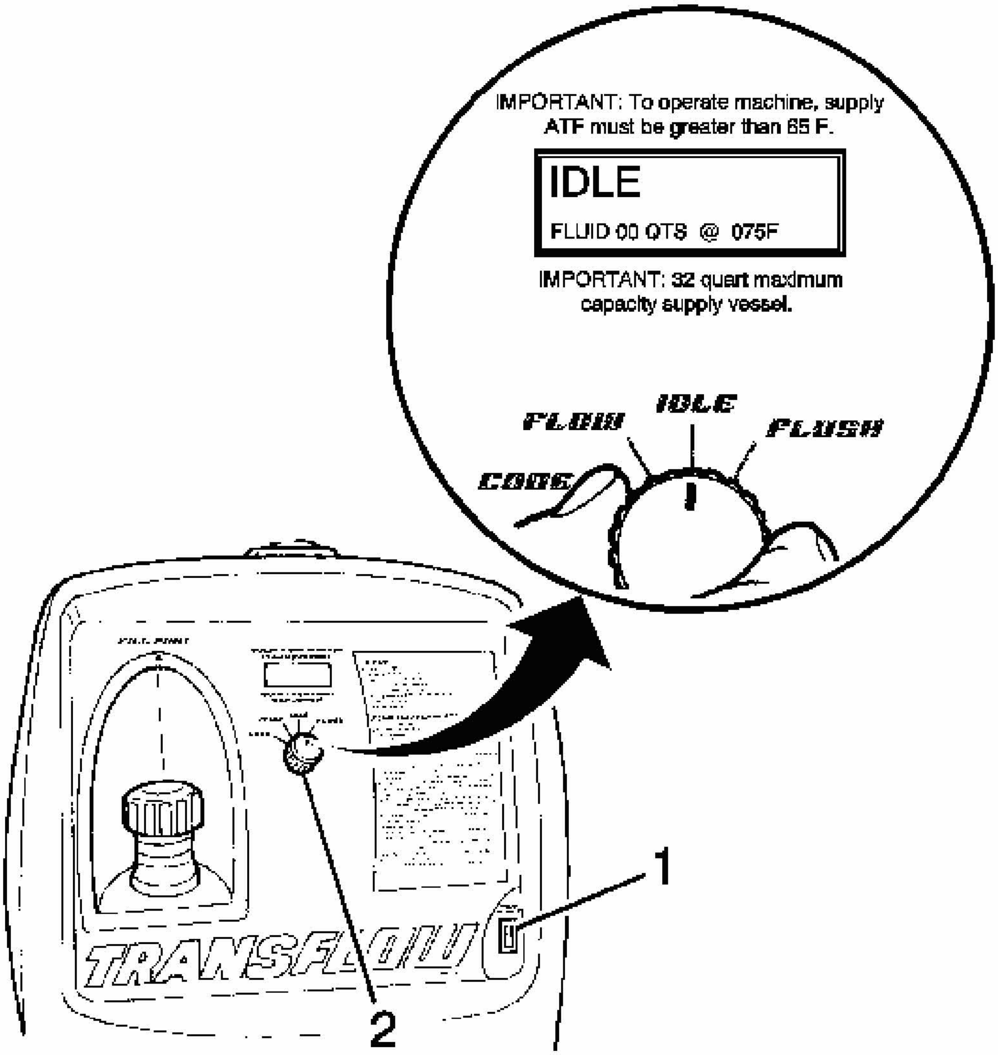

IMPORTANT: To operate machine, supply ATF must be greater than 65 F.
IDLE
FLUID 00 QTS @ 075F
IMPORTANT: 32 quart maximum capacity supply vessel.
FLOW
IDLE
FLUSH
CODE
1
TRANSFLOW
2

Fig. 13: View Of Main Power Switch & Main Function Switch
Courtesy of GENERAL MOTORS CORP.

1. Verify that the main power switch (1) is in the OFF position.
2. Place the main function switch (2) in the IDLE position.

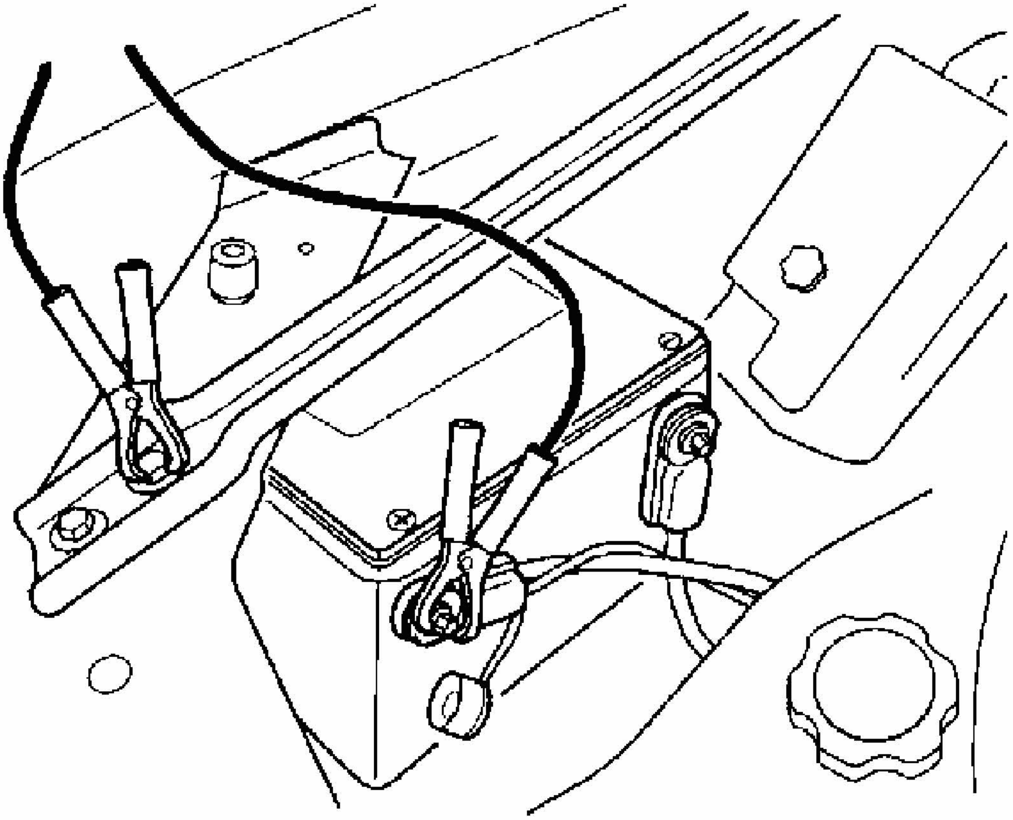


Fig. 14: Connecting To 12V DC Power Source
Courtesy of GENERAL MOTORS CORP.

3. Connect **J 45096** to the vehicle 12V DC power source by connecting the red battery clip to the positive, +, battery post on the vehicle and connect the negative lead to a known good chassis ground. See **Special Tools** .
4. Turn the main power switch to the ON position.

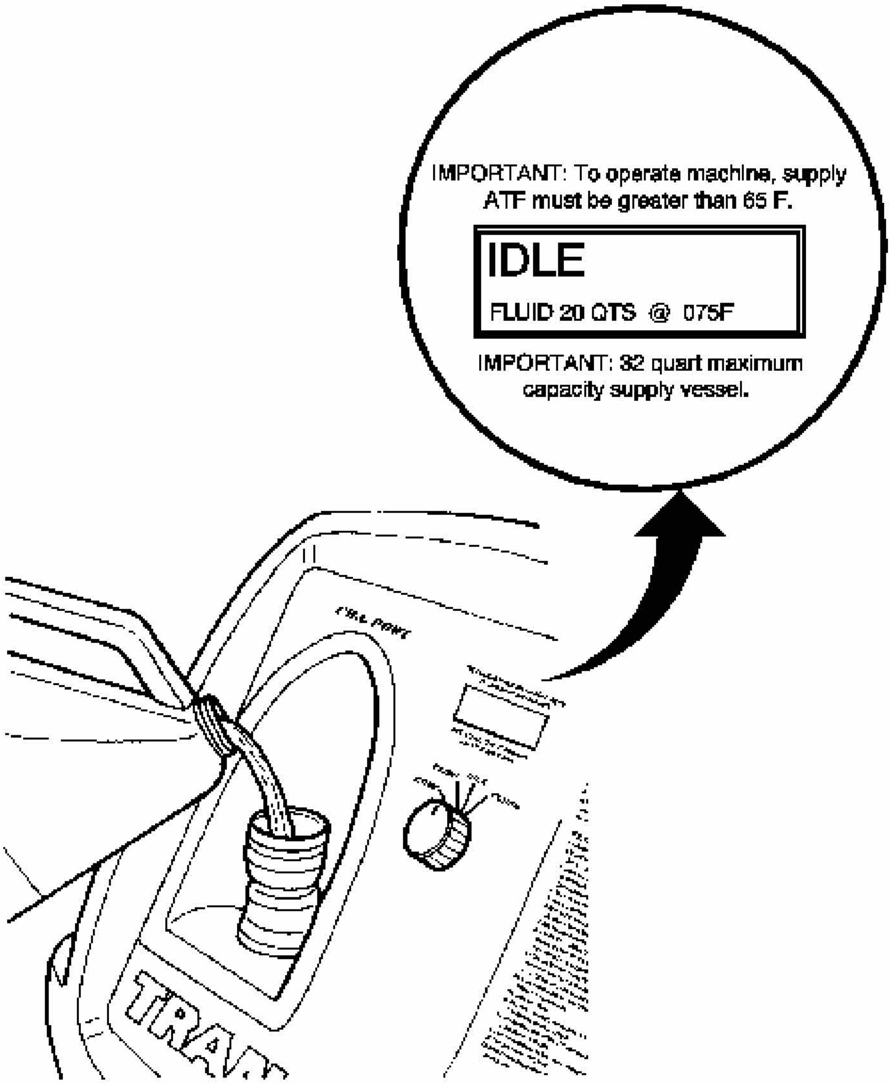

IMPORTANT: To operate machine, supply ATF must be greater than 65 F.
IDLE
FLUID 20 QTS @ 075F
IMPORTANT: 32 quart maximum capacity supply vessel.
FILL PORT

Fig. 15: Filling Supply Tank With Transmission Fluid
Courtesy of GENERAL MOTORS CORP.

NOTE: **Do not overfill the supply vessel. Damage to the unit may result. To verify the fluid level, view the LCD screen display while filling the unit, to ensure the fluid level does not exceed 30 L (32 qt).**

5. Fill the supply tank with Dexron®VI/Mercon®, or equivalent, through the fill port.
6. Reinstall and tighten the fill cap.

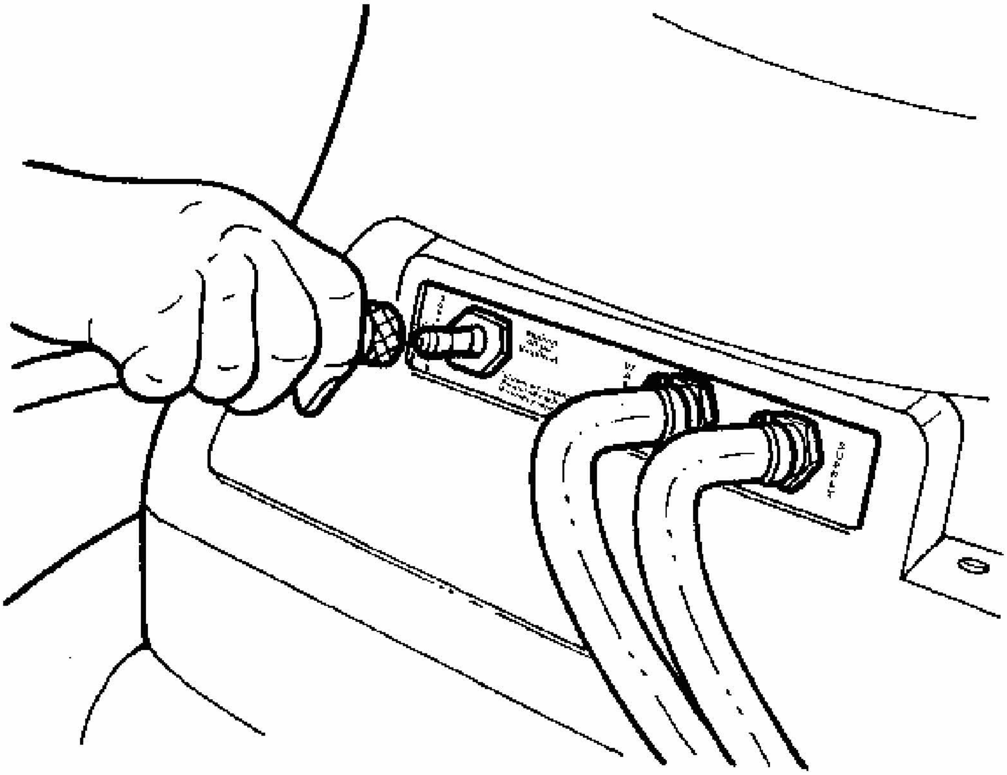


Fig. 16: Applying Shop Air Supply Hose To Quick-Disconnect
Courtesy of GENERAL MOTORS CORP.

7. Connect a shop air supply hose to the quick-disconnect on the rear panel marked SUPPLY AIR.

DETERMINE MINIMUM FLOW RATE

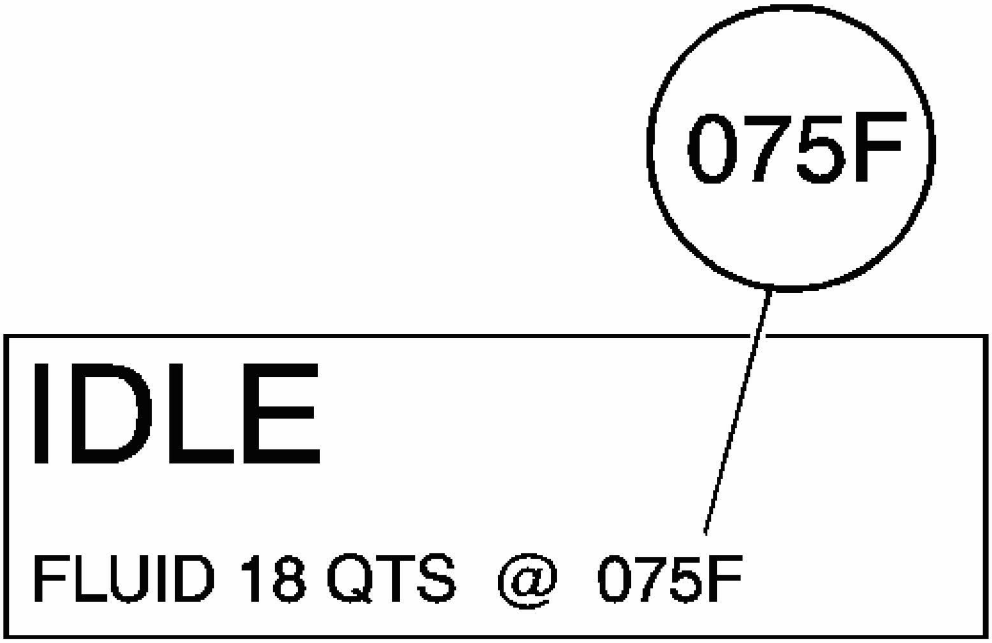


Fig. 17: Identifying Machine Display Of Automatic Transmission Fluid Temperature
Courtesy of GENERAL MOTORS CORP.

1. From the machine display, identify the temperature of the automatic transmission fluid that is stored in the supply vessel of **J 45096** . See **Special Tools** .

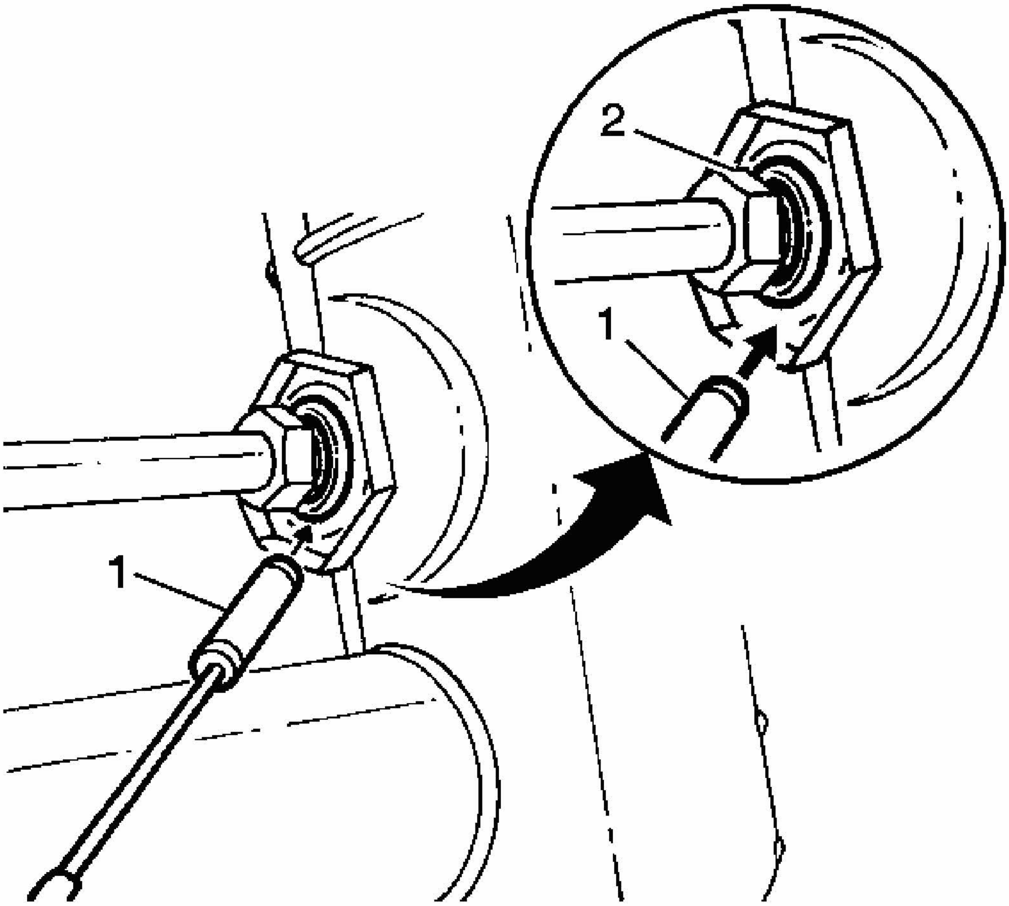


Fig. 18: Identifying Transmission Oil Cooler Metal Composition
Courtesy of GENERAL MOTORS CORP.

2. Determine whether the transmission oil cooler is steel or aluminum by using a magnet (1) at the cooler flange (2) at the radiator.
3. Refer to the table below. Using the temperature from step 1, locate on either the Steel MINIMUM Flow Rate table or the Aluminum MINIMUM Flow Rate table the minimum flow rate in gallons per minutes (GPM). Record the minimum flow rate in GPMs and the supply fluid temperature for further reference.

Example:

- Fluid temperature: 75°F
- Cooler type: Steel

The MINIMUM flow rate for this example would be 0.8 GPM.

4. Inspect transmission oil cooler lines for damage or kinks that could cause restricted oil flow.

Minimum Flow Rate in Gallons Per Minute (GPM)

Temperature Range	Steel	Aluminum
65 - 66°F	0.6 gpm	0.5 gpm
67 - 70°F	0.7 gpm	0.6 gpm
71 - 75°F	0.8 gpm	0.7 gpm
76 - 80°F	0.9 gpm	0.8 gpm
81 - 84°F	1.0 gpm	0.9 gpm
85 - 89°F	1.1 gpm	1.0 gpm
90 - 94°F	1.2 gpm	1.1 gpm
95 - 98°F	1.3 gpm	1.2 gpm
99 - 103°F	1.4 gpm	1.3 gpm
104 - 108°F	1.5 gpm	1.4 gpm
109 - 112°F	1.6 gpm	1.5 gpm
113 - 117°F	1.7 gpm	1.6 gpm
118 - 120°F	1.8 gpm	1.7 gpm

BACK FLUSH PROCEDURE

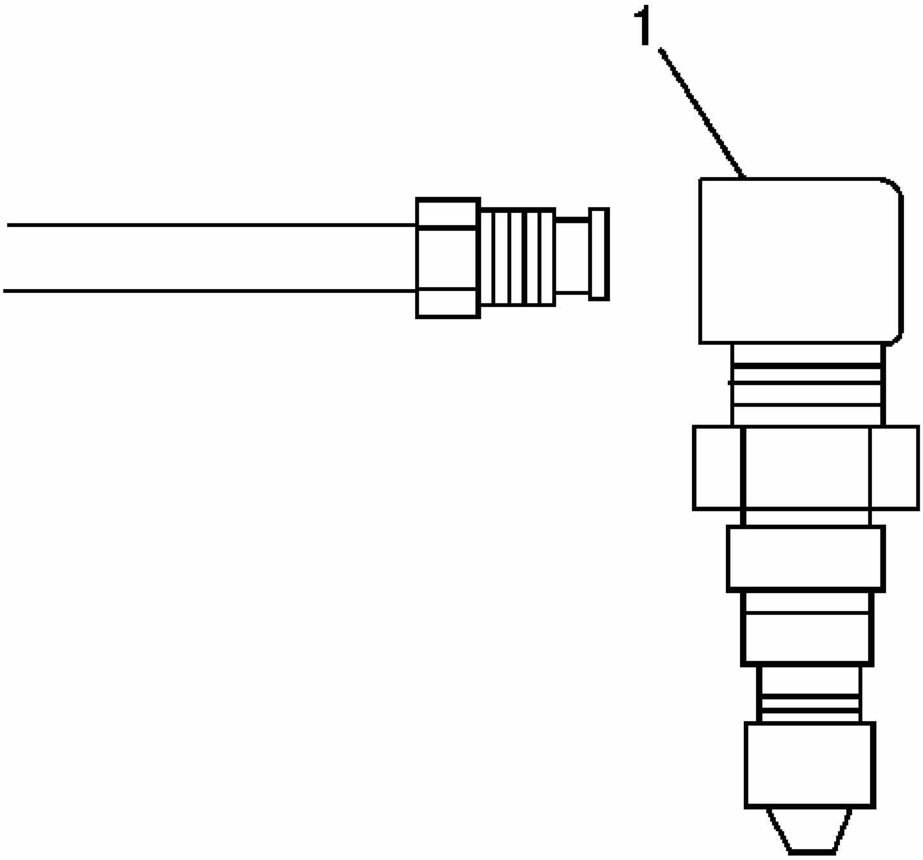


Fig. 19: Connecting J 45096 Adapters To Oil Cooler Supply And Return Lines
Courtesy of GENERAL MOTORS CORP.

1. Connect the **J 45096** adapters (1) to the vehicles transmission oil cooler supply and return lines at the transmission. See **Special Tools** .

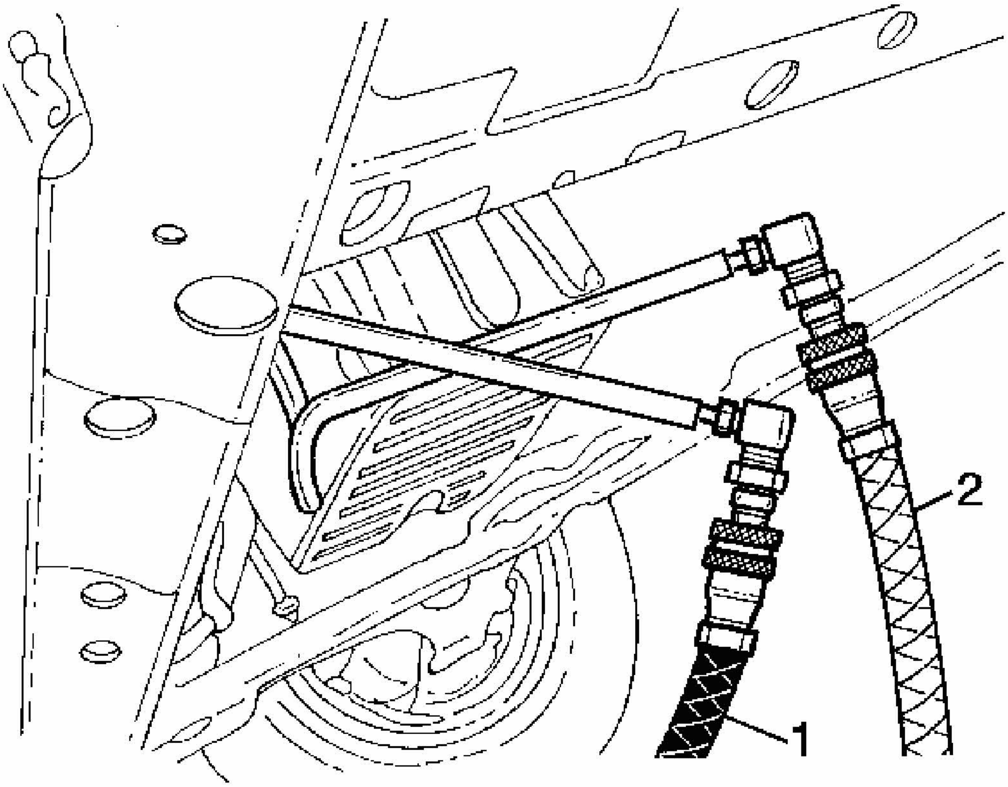


Fig. 20: Identifying Black Supply Hose And Clear Waste Hose
Courtesy of GENERAL MOTORS CORP.

2. Connect the black supply hose (1) to the return line, top connector of the transmission, and the clear waste hose (2) to the feed line, bottom connector of the transmission, to the vehicle cooler lines. This is the reverse flow - backflush direction.

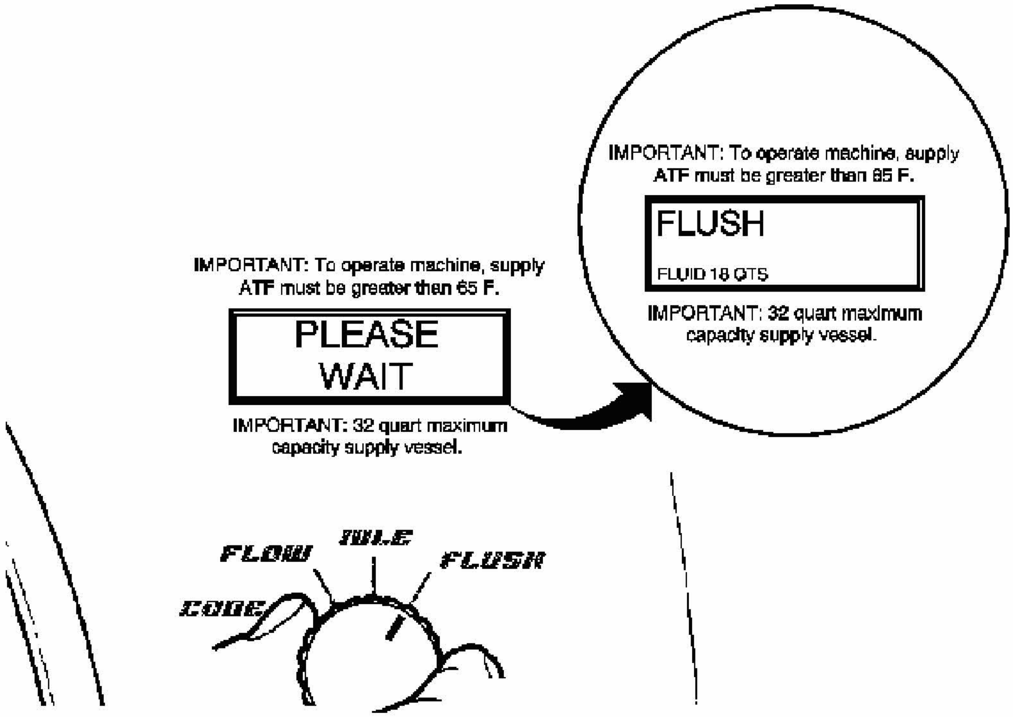

IMPORTANT: To operate machine, supply ATF must be greater than 65 F.
PLEASE WAIT
IMPORTANT: 32 quart maximum capacity supply vessel.
IMPORTANT: To operate machine, supply ATF must be greater than 65 F.
FLUSH
FLUID 18 QTS
IMPORTANT: 32 quart maximum capacity supply vessel.
FLOW
IDLE
FLUSH
CODE

Fig. 21: Setting Main Function Switch To FLUSH Position
Courtesy of GENERAL MOTORS CORP.

3. Turn the main function switch to the FLUSH position. Allow the machine to operate for 30 seconds.

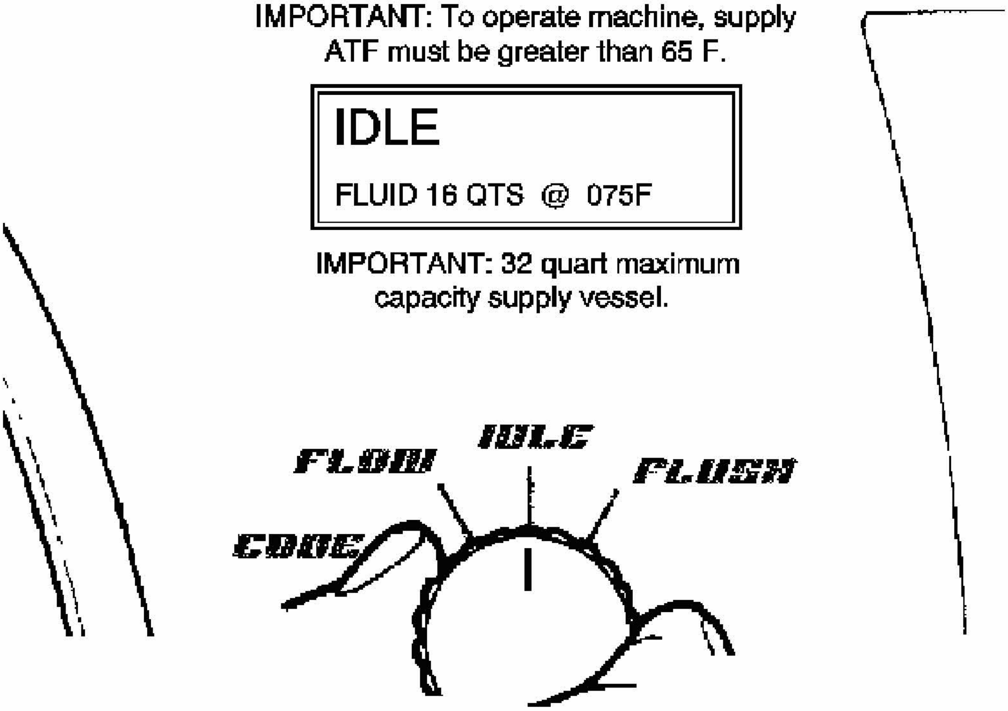

IMPORTANT: To operate machine, supply ATF must be greater than 65 F.
IDLE
FLUID 16 QTS @ 075F
IMPORTANT: 32 quart maximum capacity supply vessel.
FLOW
IDLE
FLUSH
CODE

Fig. 22: Setting Main Function Switch To IDLE Position
Courtesy of GENERAL MOTORS CORP.

4. Turn the main function switch to the IDLE position and allow the supply vessel pressure to dissipate.

FORWARD FLUSH

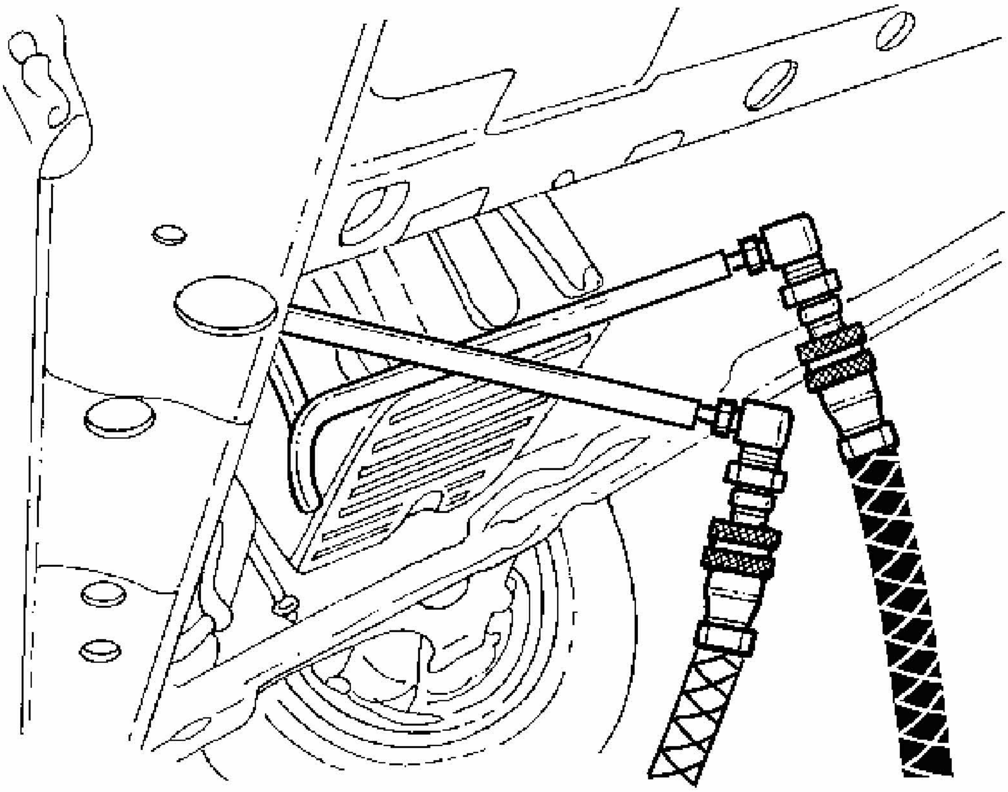


Fig. 23: Identifying Black Supply Hose And Clear Waste Hose
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the supply and waste hoses from the vehicle cooler lines. Reverse the supply and waste hoses to provide a normal flow direction.

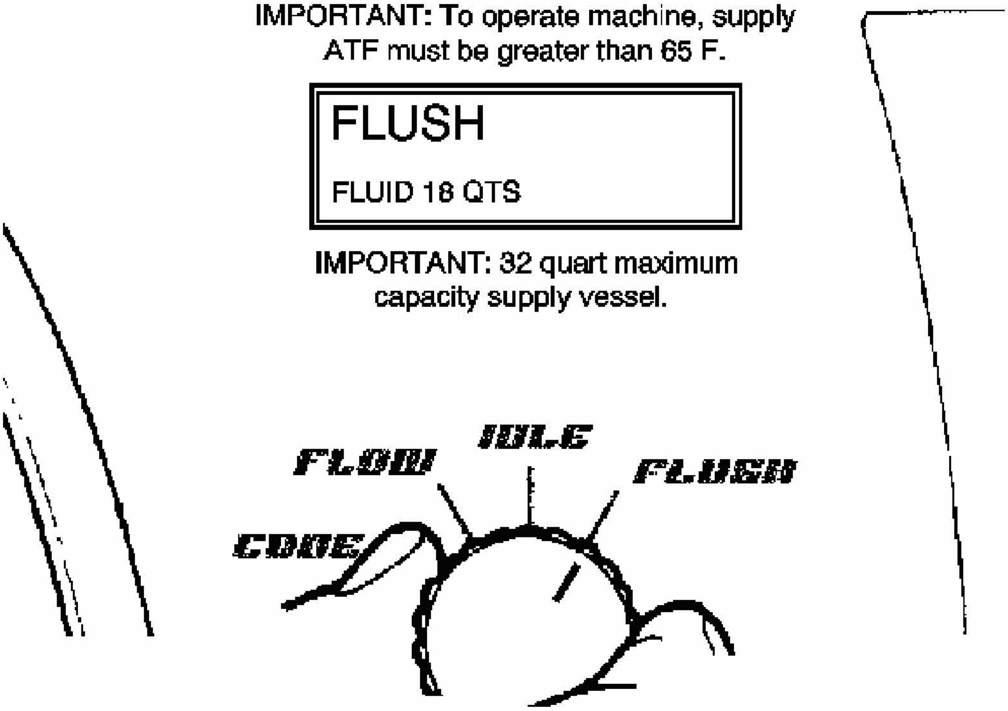

IMPORTANT: To operate machine, supply ATF must be greater than 65 F.
FLUSH
FLUID 18 QTS
IMPORTANT: 32 quart maximum capacity supply vessel.
FLOW
IDLE
FLUSH
CODE

Fig. 24: Setting Main Function Switch To FLUSH Position
Courtesy of GENERAL MOTORS CORP.

2. Turn the main function switch to the FLUSH position and allow machine to operate for 30 seconds.

FLOW TEST

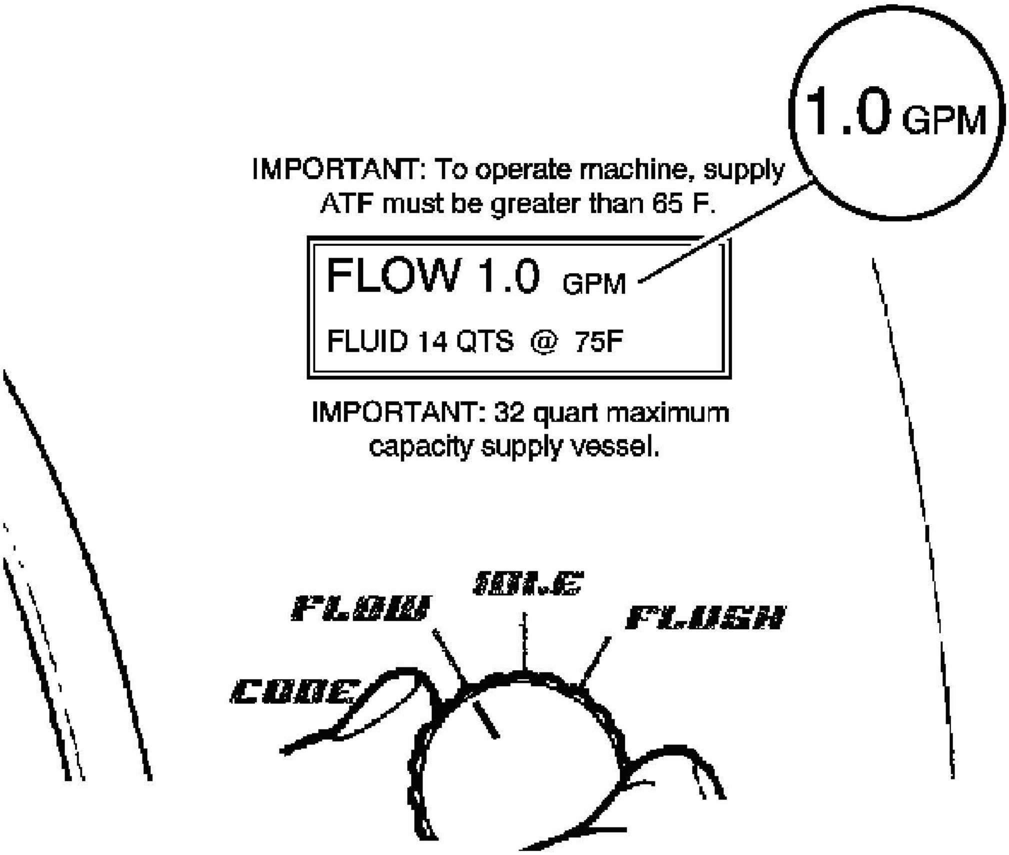

1.0 GPM
IMPORTANT: To operate machine, supply ATF must be greater than 65 F.
FLOW 1.0 GPM
FLUID 14 QTS @ 75F
IMPORTANT: 32 quart maximum capacity supply vessel.
FLOW
IDLE
FLUSH
CODE

Fig. 25: Setting Main Function Switch To FLOW Position
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If the flow rate is less than 0.5 gpm, the LCD displays an error message. Refer to the Troubleshooting section of the operation manual.

1. Turn the main function switch to the FLOW position and allow the oil to flow for 15 seconds. Observe and note the flow rate; this is the TESTED flow rate.
2. Compare the TESTED flow rate to the MINIMUM flow rate information previously recorded.
   - If the TESTED flow rate is equal to or greater than the MINIMUM flow rate recorded, the oil cooling system is functioning properly. Perform Code Recording Procedure.
   - If the TESTED flow rate is less than the MINIMUM flow rate previously recorded, repeat the back flush and forward flush procedures.

3. If the TESTED flow rate is less than the MINIMUM flow rate after the second test, perform Code Recording Procedure.
    1. Replace the transmission oil cooler.
    2. Reconnect supply and waste hoses to the cooler lines in the normal flow direction. Perform Flow Test.
    3. Perform Code Recording Procedure.

CODE RECORDING PROCEDURE

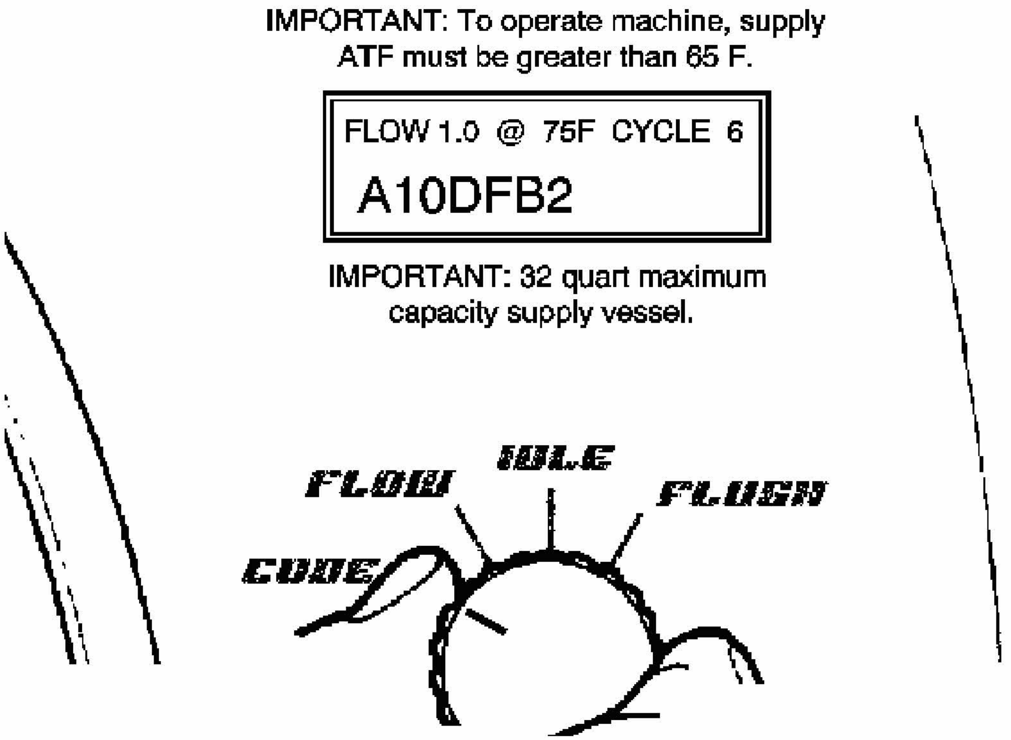

IMPORTANT: To operate machine, supply ATF must be greater than 65 F.
FLOW 1.0 @ 75F CYCLE 6
A10DFB2
IMPORTANT: 32 quart maximum capacity supply vessel.
FLOW
IDLE
FLUSH
CODE

Fig. 26: Setting Main Function Switch To CODE Position
Courtesy of GENERAL MOTORS CORP.

1. Turn the main function switch to the CODE position.

IMPORTANT:

- **If power is interrupted prior to the recording of the seven-character code, the code will be lost and the flow rate test will need to be repeated.**
- **The flow test must run for a minimum of 8-10 seconds**

and be above 0.5 gpm for a code to be generated.

2. Record TESTED flow rate, temperature, cycle and seven-character flow code information on repair order.

CLEAN-UP

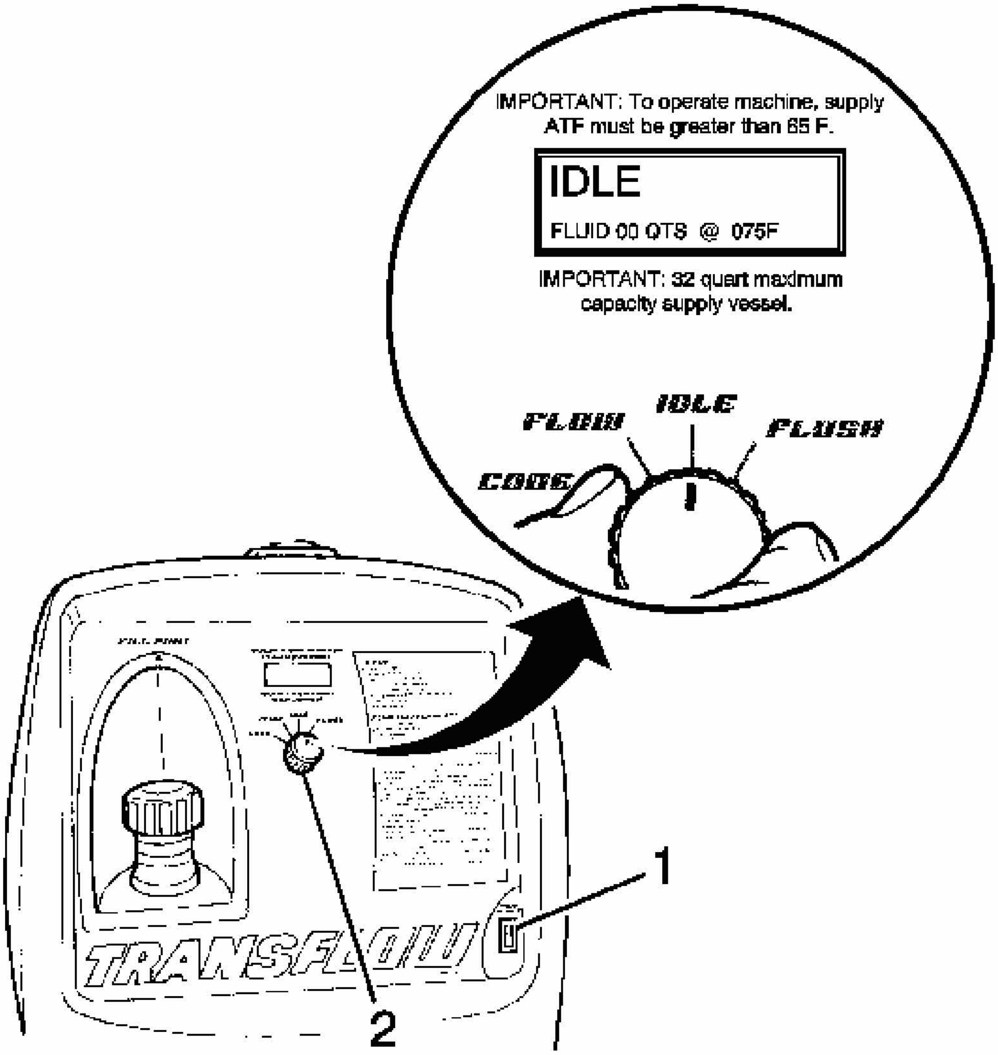

IMPORTANT: To operate machine, supply ATF must be greater than 65 F.
IDLE
FLUID 00 QTS @ 075F
IMPORTANT: 32 quart maximum capacity supply vessel.
FLOW
IDLE
FLUSH
CODE
TRANSFLOW
1
2

Fig. 27: View Of Main Power Switch & Main Function Switch
Courtesy of GENERAL MOTORS CORP.

1. Turn the main function switch (2) to the IDLE position and allow the supply vessel pressure to dissipate.

2. Turn the main power switch (1) to the OFF position.
3. Disconnect the supply and waste hoses and the 12-volt power source from the vehicle.

   Note: A small amount of water may drain from the bottom of the unit when the air supply is disconnected. This is a normal operation of the built-in water separator.

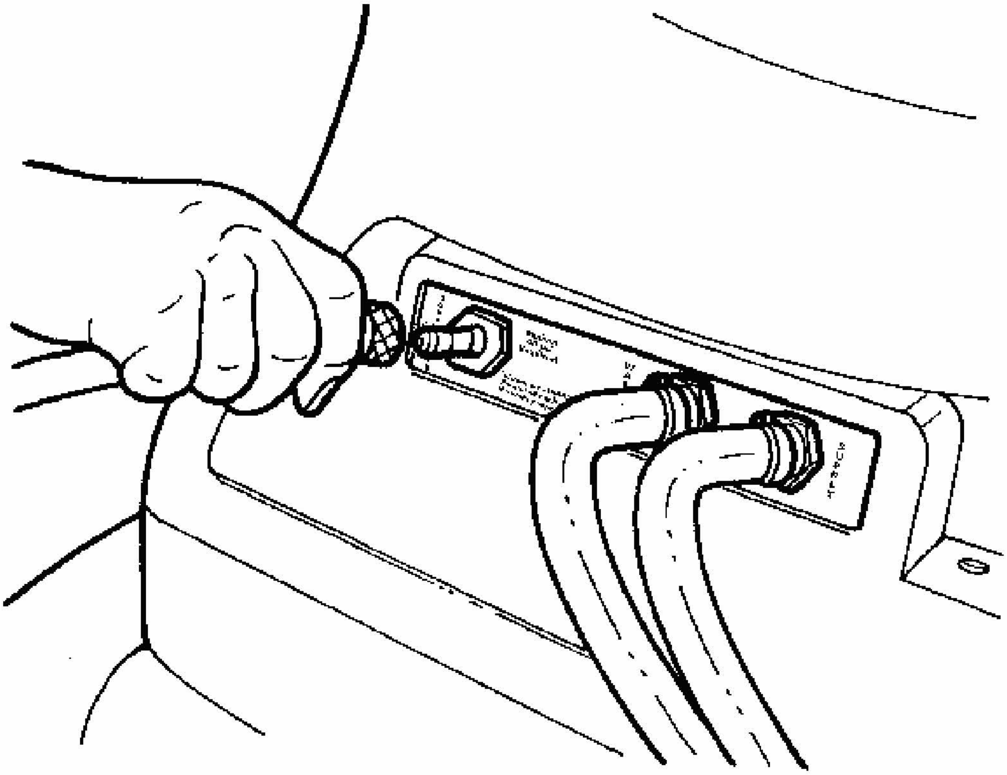


Fig. 28: Applying Shop Air Supply Hose To Quick-Disconnect
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the air supply hose from **J 45096** . See **Special Tools** .
5. Dispose of the waste ATF in accordance with all applicable federal, state, and local requirements.

AUTOMATIC TRANSMISSION FLUID LEAKS

Automatic Transmission Fluid Leaks

Checks	Cause
DEFINITION: Automatic transmission fluid leaks that occur on the transmission.	

Automatic Transmission Fluid Level	High fluid level - causing an oil leak at the vent assembly (37).
Automatic Transmission Fluid Condition	• Contaminated with engine coolant, engine oil, brake fluid, etc. • Oxidized and degraded - causing oil foaming and an oil leak at the vent assembly
Vent Assembly	• The vent assembly (37) is plugged or damaged - causing high internal pressure inside the transmission and causing oil leakage at another component. • Channel plate gasket (430) improperly torqued.
Oil Pan Assembly	• The oil pan bolts and screws are loose, cross-threaded, or missing. • The oil pan (24) is damaged. • The oil pan gasket (25) is out of position or damaged.
Oil Filter and Seal Assembly	• The oil filter assembly (100) is damaged. • The oil filter seal assembly (101) is missing or damaged - causing oil foaming and an oil leak at the vent assembly.
Thermo Element Assembly	• The thermo element plate pins (120, 123) are misadjusted. • The thermo element (121) or thermo element plate (122) is out of position, missing, or damaged - causing a high fluid level in the oil pan, oil foaming, and an oil leak at the vent assembly (37).
Control Valve Body Cover Assembly	• The control valve body cover bolts and screws (56, 57, 58) are loose, cross-threaded, or missing. • The control valve body cover (53) is porous or damaged. • The control valve body cover gaskets (54, 59) are out of position or damaged. • The wiring harness assembly (224) is damaged or is leaking at the electrical connector terminals.
Front Wheel Drive Shaft Oil Seal Assemblies	The front wheel drive shaft oil seal assemblies (4, 409) are loose or damaged.
Forward Band Servo Assembly	• The forward band servo cover bolts and screws (12) are loose, cross-threaded, or missing. • The forward band servo cover (13) is porous or

	damaged. - The forward band servo cover seal (14) is out of position or is damaged.
Reverse Band Servo Assembly	- The reverse band servo cover retaining ring (39) is out of position or is damaged. - The reverse band servo cover (40) is porous or is damaged. - The forward band servo cover seal (14) is out of position or is damaged.
Oil Cooler Pipe Fitting Assemblies	The oil cooler pipe fitting assemblies (28, 29) are loose, cross-threaded, damaged, or are missing a sealer.
Case Extension Assembly	- The case extension bolts and screws (5) are loose, cross-threaded, or are missing. - The case extension assembly (6) is porous or damaged. - The case extension seal (8) is out of position or is damaged. - The front differential carrier bushing (7A) or the output shaft bearing assembly (7B) is worn or damaged. - The case extension assembly (6) oil drain back holes are plugged or missing - causing repeat leaks at the right side front wheel drive shaft oil seal assembly (4).
Vehicle Speed Sensor Assembly	- The vehicle speed sensor bolt or screw (9) is loose, cross-threaded, or missing. - The vehicle speed sensor O-ring seal (11) is out of position or is damaged.
Oil Pressure Test Hole Plug	The oil pressure test hole plug (38) is loose, cross-threaded, damaged, or is missing a sealer.
Manual Shift Shaft Assembly	- The manual shift shaft seal assembly (806) is out of position or is damaged. - The manual shift shaft (807) sealing surface is damaged.
Park Pawl Actuator Guide Assembly	- The park pawl actuator pin (808) is loose or missing. - The park pawl actuator guide (809) is damaged. - The park pawl actuator guide O-ring seal (810) is out of position, missing, or damaged.
Torque Converter Oil Seal	The torque converter oil seal assembly (525) is loose or

Assembly	damaged.
Drive Sprocket Support Assembly	The drive sprocket support (522) oil drain back holes are plugged or missing - causing repeat leaks at the torque converter oil seal assembly (525).
Case Assembly	The case assembly (3) is porous or damaged.

INCORRECT LINE PRESSURE

Incorrect Line Pressure

Checks	Cause
DEFINITION: Transmission main line pressure that is determined to be high or low. Refer to **Line Pressure Check Procedure**.	
Automatic Transmission Fluid Level - low pressure only	Low fluid level
Thermo Element Assembly - low pressure only	• The thermo element plate pins (120, 123) are misadjusted. • The thermo element (121) or the thermo element plate (122) is out of position, missing, or damaged - causing low fluid level in the oil pan.
Oil Filter and Seal Assembly	• The oil filter assembly (100) is missing or damaged. • The oil filter seal assembly (101) is missing or damaged, low pressure only.
Wiring Harness Assembly	The wiring harness assembly (224) is disconnected or damaged.
Oil Pump Assembly	• The following components are worn or damaged - low pressure only: ○ The oil pump cover (201) ○ The oil pump body (202) ○ The oil pump vane ring (209) ○ The oil pump rotor (210) ○ The oil pump vanes (211) ○ The oil pump slide oil seal ring (212) ○ The oil pump slide O-ring seal (213) ○ The oil pump slide (214) • The oil pump slide (214) is binding, high pressure only. • The oil pump prime springs (222, 223) or the oil pump slide pivot pin (215) is missing or damaged,

	low pressure only. - The oil pump slide seal (220) or the oil pump slide seal support (221) is missing or damaged, high pressure only.
Pressure Control Solenoid Valve Assembly	- The pressure control solenoid valve assembly (322) is damaged. - The solenoid valve O-ring seals (305, 316) are missing or damaged. - The valve retainer (314) is missing or damaged.
Torque Signal Regulator Valve Assembly	- The torque signal regulator valve (321) is binding or damaged. - The valve retainer (314) is missing or damaged.
Pressure Regulator Valve Assembly	- The pressure regulator valve (313) is binding or is damaged. - The pressure regulator valve springs (311, 312) is missing or damaged. - The reverse boost valve (310) is binding or is damaged, high pressure only. - The line boost valve (304) is binding or is damaged, high pressure only. - The valve retainer (302) is missing or is damaged.
Actuator Feed Limit Valve Assembly - low pressure only	- The actuator feed limit valve (414) is binding or is damaged. - The actuator feed limit valve spring (415) is missing or is damaged. - The actuator feed limit valve spring retainer (416) is missing or damaged.
Low Blow Off Valve Assembly - low pressure only	- The low blow off valve spring (323) is missing or is damaged. - The low blow off ball valve (324) is missing, binding, or is damaged. - The low blow off valve spring retainer (325) is missing or is damaged.

DELAYED PARK TO REVERSE/DRIVE ENGAGEMENT

Delayed Park to Reverse/Drive Engagement

Checks	Cause
DEFINITION: Gear engagement that takes longer than 3 seconds when the engine is	

idling in Park or Neutral, and the gear selector is moved to Drive or Reverse range.	
Automatic Transmission Fluid Level	Low fluid level
Transmission Main Line Pressure	Low transmission main line pressure
Reverse Band Servo Assembly - Reverse engagement only	The reverse band servo piston oil seal ring (43) is damaged or rolled.
Forward Band Servo Assembly - Drive engagement only	The forward band servo piston oil seal ring (18) is damaged or rolled.
Control Valve Body Assembly - Reverse engagement only	The reverse servo boost valve (367A) is binding or is damaged.
Control Valve Body Assembly - Drive engagement only	The forward servo boost valve (367B) is binding or is damaged.
Control Valve Body Spacer Plate Assembly - Drive engagement only	The thermal element is damaged or is not functioning properly.
TCC Blowoff Ball Valve Assembly	The TCC blowoff ball valve (420) is not seating - causing torque converter drain back.
Input Clutch Assembly	• The input clutch housing oil seal rings (628) are damaged or rolled. • The input clutch housing assembly (632) sealing surfaces are damaged. • The input clutch housing ball check valve assembly (633) is plugged or damaged. • The input clutch inner piston seal (634) is damaged or rolled. • The input clutch outer piston seal (635) is damaged or rolled. • The input clutch piston assembly (636) sealing surfaces are damaged.

HARSH PARK TO REVERSE/DRIVE ENGAGEMENT

Harsh Park to Reverse/Drive Engagement

Checks	Cause
DEFINITION: Gear engagement that is harsh when the engine is idling in Park or Neutral, and the gear selector is moved to Drive or Reverse range.	

Transmission Main Line Pressure	High transmission main line pressure
Reverse Band Servo Assembly - Reverse engagement only	The reverse band servo piston cushion spring (45) is broken or is missing.
Forward Band Servo Assembly - Drive engagement only	The forward band servo piston cushion spring (19) is broken or is missing.
Transmission Case Cover Ball Check Valve - Reverse engagement only	The #5 Ball check valve (372) is mislocated or is missing.
Transmission Case Cover Ball Check Valve - Drive engagement only	The #6 Ball check valve (372) is mislocated or is missing.
Control Valve Body Assembly - Reverse engagement only	The reverse servo boost valve (367A) is binding or is damaged.
Control Valve Body Assembly - Drive engagement only	The forward servo boost valve (367B) is binding or is damaged.
Control Valve Body Spacer Plate Assembly - Drive engagement only	The thermal element is damaged or is not functioning properly.

SLIPS IN DRIVE OR NO DRIVE

Slips in Drive or No Drive

Checks	Cause
DEFINITION: A large engine RPM increase is noted with little or no vehicle forward speed increase during the following conditions: • The engine is running. • The transmission is in Drive range. • The vehicle is stopped or moving slowly. • The vehicle brakes are not applied. • The throttle is opened 25 percent or greater.	
Automatic Transmission Fluid Level	Low fluid level
Transmission Main Line Pressure	Low transmission main line pressure
Manual Linkage	Misadjusted

Oil Filter Assembly	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or damaged.
Accumulator and Manual 2-1 Band Servo Assembly	• A loose or damaged forward band servo oil pipe (124). • Loose manual 2-1 band servo cover or accumulator cover bolts (103, 131). • Missing or damaged manual 2-1 servo cover gasket (105). • A damaged accumulator cover spacer plate assembly (134).
Forward Band Servo Assembly	• A servo piston oil seal ring (18) is missing or is damaged. • A servo piston (16) is damaged or is stuck in the servo cover (13). • The servo piston cushion spring (19) or the retainer (20) is missing or damaged. • The servo piston pin (21) is not engaged to the forward band assembly (688). • The forward band assembly (688) is worn or burned. • The forward band assembly (688) is disengaged from the anchor pin (117A). • The anchor pin (117A) is loose or missing.
Control Valve Body Assembly	The #3 Ball check valve (372) is missing.
Torque Converter Assembly	• The torque converter assembly (1) stator clutch is not holding • The torque converter assembly (1) blades are broken or damaged
Drive Link Assembly	• The drive link assembly (507) is broken. • The drive/driven sprockets (516/506) are damaged.
Input Clutch Assembly	• The input clutch sprag assembly (722) is damaged or misassembled. • The input clutch housing oil seal rings (628) are missing or are damaged. • The input clutch housing ball check valve assembly (633) is missing or is damaged.

	• The input clutch piston inner/outer seals (634/635) are missing or are damaged. • The input clutch piston (636) is damaged. • The input clutch plates (654-658) are worn.
1-2 Clutch Roller Assembly	The 1-2 clutch roller assembly (683) is damaged.
Input and Reaction Carrier Assemblies	The input carrier assembly (672) or the reaction carrier assembly (675) components are damaged.
Differential Carrier Assembly	• The park pawl assembly (694) is broken or damaged. • The sun gear shaft (689), the internal gear assembly (693), or the carrier assembly (700) components are damaged.
Forward Band Servo	Forward band servo piston apply pin (21) nicked or scratched

SLIPS IN REVERSE OR NO REVERSE

Slips in Reverse or No Reverse

Checks	Cause
DEFINITION: A large engine RPM increase is noted with little or no vehicle rearward speed increase during the following conditions: • The engine is running. • The transmission is in Reverse range. • The vehicle is stopped or moving slowly. • The vehicle brakes are not applied. • The throttle is opened 25 percent or greater.	
Automatic Transmission Fluid Level	Low fluid level
Transmission Main Line Pressure	Low transmission main line pressure
Manual Linkage	Misadjusted
Oil Filter Assembly	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or damaged.
Reverse Band Servo Assembly	• A servo piston oil seal ring (43) is missing or is damaged. • A servo piston (44) is damaged or is stuck in the case

	bore. • The servo piston cushion springs (45, 47) or the retainer (46) is missing or damaged. • The servo piston pin (48) is not engaged to the reverse band assembly (615). • The reverse band assembly (615) is worn or burned. • The reverse band assembly (615) is disengaged from the anchor pin (117B) band. • The anchor pin (117B) is loose or missing.
Torque Converter Assembly	The torque converter assembly (1) stator clutch is not holding.
Drive Link Assembly	• The drive link assembly (507) is broken. • The drive/driven sprockets (516/506) are damaged.
Input Clutch Assembly	• The input clutch sprag assembly (722) is damaged or misassembled. • The input clutch housing oil seal rings (628) are missing or are damaged. • The input clutch housing ball check valve assembly (633) is missing or is damaged. • The input clutch piston inner/outer seals (634/635) are missing or are damaged. • The input clutch piston (636) is damaged. • The input clutch plates (654-658) are worn.
Reverse Reaction Drum	The reverse reaction drum (669) splines are damaged.
Input and Reaction Carrier Assemblies	The input carrier assembly (672) or the reaction carrier assembly (675) components are damaged.
Differential Carrier Assembly	• The park pawl assembly (694) is broken or damaged. • The sun gear shaft (689), the internal gear assembly (693), or the carrier assembly (700) components are damaged.

LOCKED UP IN DRIVE/REVERSE

Locked up in Drive/Reverse

Checks	Cause
DEFINITION: The vehicle cannot be moved forward or backward during the following conditions: • The engine is running.	

• The transmission is in Drive or Reverse range. • The vehicle brakes are not applied. • The throttle is closed (idling).	
Manual Linkage	Misadjusted
Input and Reaction Carrier Assemblies	The input carrier assembly (672) or the reaction carrier assembly (675) components are damaged.
Differential Carrier Assembly	• The park pawl assembly (694) is broken or damaged. • The sun gear shaft (689), the internal gear assembly (693), or the carrier assembly (700) components are damaged.

NO PARK RANGE

No Park Range

Checks	Cause
DEFINITION: One of the two following conditions occur: • The transmission range selector cannot be moved into Park. • The vehicle can move forward or backward more than 1 meter (3 ft) after the transmission range selector is moved into Park.	
Manual Linkage	Misadjusted
Differential Carrier Assembly	The park pawl assembly (694) is broken or damaged.
Park Pawl Actuator Assembly	• The actuator assembly (800) is damaged. • The actuator guide (809) is damaged or debris is present.

HARSH OR SOFT 1-2 SHIFT FEEL

Harsh or Soft 1-2 Shift Feel

Checks	Cause
DEFINITION: One of the two following conditions occurs during a first to second gear steady throttle upshift, or a second to first gear coast, or a light to moderate throttle detent downshift: • Harsh shift feel - an unacceptable quick gear change occurs. • Soft shift feel - an unacceptable long gear change occurs.	
Automatic Transmission Fluid Level - soft shift only	Low fluid level
Transmission Main Line	Low or high transmission main line pressure

pressure	
Oil Filter Assembly - soft shift only	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or damaged.
1-2 Accumulator Assembly	• Misassembled or upside down 1-2 accumulator assembly • Damaged or missing 1-2 accumulator piston oil seal ring (137A) • A damaged or missing 1-2 accumulator piston cushion spring (139) or outer spring (142) • A stuck or binding 1-2 accumulator piston (136A) • Debris in the passages of the accumulator cover spacer plate (134)
Control Valve Body Assembly	• Debris in the passages of the control valve body (301) or spacer plate assembly (370) • Missing or mislocated #2 ball check valve (372) • Misassembled 1-2 accumulator valve (340-345) line-up • Stuck or binding 1-2 accumulator valve (341) • Damaged or missing 1-2 accumulator valve spring (340) • Missing, damaged, or misassembled 2-3 accumulator valve bushing (345), bore plug (343), or retainers (342, 385)
Driven Sprocket Support Assembly - soft shift only	• A damaged second clutch housing oil seal rings (613) or the four lobe oil seal ring seals (612) • Worn or damaged second clutch housing bushings (616, 619)
Second Clutch Assembly	• Missing or not seated second clutch basking plate retaining ring (627) • Missing or misassembled second clutch backing plate (626) • Worn, damaged or misassembled clutch plates (623-625) • Missing or not seated second clutch spring retaining ring (622) • A damaged spring assembly (621) or piston (620)

	• A missing or damaged second clutch housing ball check valve assembly (618) • A damaged second clutch housing assembly (617)

HARSH OR SOFT 2-3/3-2 SHIFT FEEL

Harsh or Soft 2-3/3-2 Shift Feel

Checks	Cause
DEFINITION: One of the two following conditions occurs during a second to third gear steady throttle upshift, or a third to second gear coast, or a light to moderate throttle detent downshift: • Harsh shift feel - an unacceptable quick gear change occurs. • Soft shift feel - an unacceptable long gear change occurs.	
Automatic Transmission Fluid Level, soft shift only	Low fluid level
Transmission Main Line Pressure	Low or high transmission main line pressure
Oil Filter Assembly, soft shift only	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or damaged.
2-3 Accumulator Assembly	• Misassembled upside down 2-3 accumulator assembly • Damaged or missing 2-3 accumulator piston oil seal ring (137B) • A damaged or missing 2-3 accumulator piston cushion spring (143) or outer spring (138) • A stuck or binding 2-3 accumulator piston (136B) • Debris in the passages of the accumulator cover spacer plate (134)
Control Valve Body Assembly	• Debris in the passages of the control valve body (301) or control valve body spacer plate assembly and gasket assembly (396) • Missing or mislocated #4 or #9 ball check valves (372) • Misassembled 2-3 accumulator valve (340-345) line-up • Stuck or binding 2-3 accumulator valve (344)

	- Missing, damaged, or misassembled 2-3 accumulator valve bushing (345), bore plug (343), or retainers (342, 385)
Driven Sprocket Support Assembly, soft shift only	A plugged third clutch oil passage in the driven sprocket support assembly (609)
Third Clutch Assembly	- The input clutch housing oil seal rings (628) are missing or are damaged. - The third clutch ball check valve assembly (724) is missing or is damaged. - The third clutch piston (642) is damaged. - The third clutch piston inner seal (641) is missing or damage. - The third clutch plates (645-648) are worn or misassembled.

HARSH OR SOFT 3-4/4-3 SHIFT FEEL

Harsh or Soft 3-4/4-3 Shift Feel

Checks	Cause
DEFINITION: One of the two following conditions occurs during a third to fourth gear steady throttle upshift, or a fourth to third gear coast, or a light to moderate throttle detent downshift: - Harsh shift feel - an unacceptable quick gear change occurs. - Soft shift feel - an unacceptable long gear change occurs.	
Automatic Transmission Fluid Level, soft shift only	Low fluid level
Transmission Main Line Pressure	Low or high transmission main line pressure
Oil Filter Assembly, soft shift only	- The oil filter assembly (100) is missing, plugged, or damaged. - The oil filter seal assembly (101) is missing or damaged.
3-4 Accumulator Assembly	- Misassembled upside down 3-4 accumulator assembly - Damaged or missing 3-4 accumulator piston oil seal ring (427) - A damaged or missing 3-4 accumulator piston outer spring (423) - A stuck or binding 3-4 accumulator piston (428)

	• A damaged 3-4 accumulator piston cylinder (421) or O-ring seal (422)
Control Valve Body Assembly	• Debris in the passages of the control valve body (301) or spacer plate and gasket assembly (396). • Misassembled 3-4 accumulator valve (339, 350, 351) line-up • Stuck or binding 3-4 accumulator valve (350) • Missing, damaged, or misassembled 3-4 accumulator valve spring (351) or retainer (314A)
Driven Sprocket Support Assembly, soft shift only	• A missing or damaged fourth clutch orifice (607) • A damaged driven sprocket support assembly (609)
Fourth Clutch Assembly	• Worn, damaged, or misassembled clutch plates (500-502) • A missing or not seated fourth clutch spring retaining ring (601) • A damaged spring assembly (602) or piston (603) • Worn or damaged fourth clutch piston seals (604, 605)

HIGH OR LOW UPSHIFT OR DOWNSHIFT SPEED

High or Low Upshift or Downshift Speed

Checks	Cause
DEFINITION: An upshift or a downshift, or TCC apply, that occurs at a speed outside of the calibrated range. Refer to **Shift Speed** .	
ECM/PCM Calibration Information	Incorrect calibration in the ECM/PCM.
Throttle Position (TP) Sensor	Misadjusted or faulty TP sensor.

FIRST AND SECOND GEAR ONLY (2-3 SOLENOID STUCK ON)

First and Second Gear Only (2-3 Solenoid Stuck On)

Checks	Cause
DEFINITION: The transmission only provides first and second gear in Drive range. The shift pattern as the vehicle accelerates from a stop is 1-2-2-1. First gear ratio is 2.921:1 and second gear ratio is 1.568:1.	
Control Valve Body Assembly	• A faulty 2-3 shift solenoid valve assembly (315B) is stuck On.

	• Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396)

FIRST AND FOURTH GEAR ONLY (1-2 SOLENOID STUCK ON)

First and Fourth Gear Only (1-2 Solenoid Stuck On)

Checks	Cause
DEFINITION: The transmission only provides first and fourth gear in Drive range. The shift pattern as the vehicle accelerates from a stop is 1-1-4-4. First gear ratio is 2.921:1 and fourth gear ratio is 0.705:1.	
Control Valve Body Assembly	• A faulty 1-2, 3-4 shift solenoid valve assembly (315A) is stuck On. • Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396)

SECOND AND THIRD GEAR ONLY (1-2 SOLENOID STUCK OFF)

Second and Third Gear Only (1-2 Solenoid Stuck Off)

Checks	Cause
DEFINITION: The transmission only provides second and third gear in Drive range. The shift pattern as the vehicle accelerates from a stop is 2-2-3-3. Second gear ratio is 1.568:1 and third gear ratio is 1.000:1.	
Control Valve Body Assembly	• A faulty 1-2, 3-4 shift solenoid valve assembly (315A) is stuck Off. • A missing or damaged shift solenoid valve O-ring seal (316) • Plugged or damaged solenoid valve screen/seal assembly (382) • Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396)
Case Cover Assembly	A stuck, binding, or missing actuator feed limit valve line-up (414-416)

THIRD AND FOURTH GEAR ONLY (2-3 SOLENOID STUCK OFF)

Third and Fourth Gear Only (2-3 Solenoid Stuck Off)

Checks	Cause
DEFINITION: The transmission only provides third and fourth gear in Drive range.	

The shift pattern as the vehicle accelerates from a stop is 4-3-3-4. Third gear ratio is 1.000:1 and fourth gear ratio is 0.705:1.	
Control Valve Body Assembly	• A faulty 2-3 shift solenoid valve assembly (315B) is stuck Off. • A missing or mislocated 2-3 shift solenoid valve (315B) and retainer (314C) • A missing or damaged shift solenoid valve O-ring seal (316) • Plugged or damaged solenoid valve screen/seal assembly (382) • Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396)

FIRST GEAR ONLY

First Gear Only

Checks	Cause
DEFINITION: The transmission only provides first gear in Drive range. The vehicle accelerates from a stop in first gear and does not upshift. First gear ratio is 2.921:1.	
Control Valve Body Assembly	• The 1-2 shift valve (318) is stuck or binding. • Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396) • The spacer plate and gaskets (369-371) are misassembled.
Second Clutch Assembly	• A missing or not seated second clutch backing plate retaining ring (627) • A missing or misassembled second clutch backing plate (626) • Worn, damaged, or misassembled clutch plates (623-625) • A missing or not seated second clutch spring retaining ring (622) • A damaged spring assembly (621) or piston (620) • A missing or damaged second clutch housing ball check valve assembly (618) • A damaged second clutch housing assembly (617)
Reverse Reaction Drum	Damaged splines of the reverse reaction drum (669)

SECOND GEAR ONLY

Second Gear Only

Checks	Cause
DEFINITION: The transmission only provides second gear in Drive range. The vehicle accelerates from a stop in second gear and does not upshift. Second gear ratio is 1.568:1.	
Control Valve Body Assembly	• The 1-2 shift valve (318) is stuck or binding. • Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396)
Input Carrier Assembly	• A damaged input sun gear (668) • Damaged input carrier (672) planetary pinions

THIRD GEAR ONLY

Third Gear Only

Checks	Cause
DEFINITION: The transmission only provides third gear in Drive range. The vehicle accelerates from a stop in third gear and does not upshift. Third gear ratio is 1.000:1.	
Control Valve Body Assembly	Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396).

FOURTH GEAR ONLY

Fourth Gear Only

Checks	Cause
DEFINITION: The transmission only provides fourth gear in Drive range. The vehicle accelerates from a stop in fourth gear and does not upshift. Fourth gear ratio is 0.705:1.	
Control Valve Body Assembly	Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396)

SLIPPING OR NO FIRST GEAR

Slipping or No First Gear

Checks	Cause
DEFINITION: A large engine RPM increase is noted in first gear, Drive range, with little or no vehicle forward speed increase. Second, third, and fourth gear operation are normal. Shifts into first gear are soft or do not occur. First gear ratio is 2.921:1.	
Automatic Transmission	Low fluid level

Fluid Level	
Transmission Main Line Pressure	Low transmission main line pressure
Oil Filter Assembly	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or is damaged.
Accumulator and Manual 2-1 Band Servo Assembly	• A loose or damaged forward band servo oil pipe (124) • Loose manual 2-1 band servo cover of accumulator cover bolts (103, 131) • A missing or a damaged manual 2-1 servo cover gasket (105) • A damaged accumulator cover spacer plate assembly (134)
Forward Band Servo Assembly	• The servo piston oil seal ring (18) is missing or damaged. • The servo piston (16) is damaged or stuck in the servo cover (13). • The servo piston cushion spring (19) or the retainer (20) is missing or damaged. • The servo piston pin (21) is not engaged to the forward band assembly (688). • The forward band assembly (688) is worn or burned. • The forward band assembly (688) is disengaged from the anchor pin (117A). • The band anchor pin (117A) is loose or missing.
Control Valve Body Assembly	• The 1-2 shift valve (318) is stuck or binding. • The #3 ball check valve (372) is missing.
Input Clutch Assembly	• The input clutch sprag assembly (722) is damaged or misassembled. • The input clutch housing oil seal rings (628) are missing or damaged. • The input clutch housing ball check valve assembly (633) is missing or damaged. • The input clutch piston inner/outer seals (634/635) are missing or damaged. • The input clutch piston (636) is damaged.

	- The input clutch plates (645-658) are worn.
1-2 Clutch Roller Assembly	The 1-2 clutch roller assembly (683) is damaged.

SLIPPING OR NO SECOND GEAR

Slipping or No Second Gear

Checks	Cause
DEFINITION: A large engine RPM increase is noted in second gear, Drive range, with little or no vehicle forward speed increase. First, third, and fourth gear operation are normal. Shifts into second gear are soft or do not occur. Second gear ratio is 1.568:1.	
Automatic Transmission Fluid Level	Low fluid level
Transmission Main Line Pressure	Low transmission main line pressure
Oil Filter Assembly	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or is damaged.
Control Valve Body Assembly	• The 1-2 shift valve (318) is stuck or binding. • Debris is found in the passages of the control valve body (301) or of the control valve body spacer plate and gasket assembly (396)
Driven Sprocket Support Assembly	• Damaged second clutch housing oil seal rings (613) • Damaged four lobe oil seal ring seals (612) • Worn or damaged second clutch housing bushings (616, 619)
Second Clutch Assembly	• Missing or not seated second clutch backing plate retaining ring (627) • Missing or misassembled second clutch backing plate (626) • Worn, damaged, or misassembled clutch plates (623-625) • Missing or not seated second clutch spring retaining ring (622) • Damaged spring assembly (621) or piston (620) • Missing or damaged second clutch housing ball check valve assembly (618) • Damaged second clutch housing assembly (617)

SLIPPING OR NO THIRD GEAR

Slipping or No Third Gear

Checks	Cause
DEFINITION: A large engine RPM increase is noted in third gear, Drive range, with little or no vehicle forward speed increase. First, second, and fourth gear operation are normal. Shifts into third gear are soft or do not occur. Third gear ratio is 1.000:1.	
Automatic Transmission Fluid Level	Low fluid level
Transmission Main Line Pressure	Low transmission main line pressure
Oil Filter Assembly	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or is damaged.
Control Valve Body Assembly	• The 2-3 shift valve (357) or the 3-2 manual downshift valve (356) is stuck or binding. • Debris is found in the passages of the control valve body (301) or of the control valve body spacer plate and gasket assembly (396) • The #4 or the #9 ball check valve is missing or mislocated.
Driven Sprocket Support Assembly	A plugged third clutch oil passage in the driven sprocket support assembly (609)
Third Clutch Assembly	• Input clutch housing oil seal rings (628) are missing or damaged. • The third clutch ball check valve assembly (724) is missing or damaged. • The third clutch piston (642) is damaged. • The third clutch piston inner seal (641) is missing or damaged. • The third clutch plates (645-648) are worn or misassembled.
Third Clutch Sprag Assembly	• The sprag (720) was misassembled or backwards on the inner race (661). • A damaged third clutch sprag assembly (653, 661, 719-721)

SLIPPING OR NO FOURTH GEAR

Slipping or No Fourth Gear

Checks	Cause
DEFINITION: A large engine RPM increase is noted in fourth gear, Drive range, with little or no vehicle forward speed increase. First, second, and third gear operation are normal. Shifts into fourth gear are soft or do not occur. Fourth gear ratio is 0.705:1.	
Automatic Transmission Fluid Level	Low fluid level
Transmission Main Line Pressure	Low transmission main line pressure
Oil Filter Assembly	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or is damaged.
Control Valve Body Assembly	• The 3-4 shift valve (362) or the 4-3 manual downshift valve (360) is stuck or binding. • Debris is found in the passages of the control valve body (301) or of the control valve body spacer plate and gasket assembly (396)
Case Cover Assembly	Distortion or damage occurs at the manual valve (404) or at the case cover (401), causing PRN oil leak.
Driven Sprocket Support Assembly	A plugged third clutch oil passage in the driven sprocket support assembly (609)
Fourth Clutch Assembly	• The clutch plates (500-502) are worn, damaged, or misassembled. • A missing or not seated fourth clutch spring retaining ring (601) • A damaged spring assembly (602) or piston (603) • Worn or damaged fourth clutch piston seals (604, 605)
Third Clutch Sprag Assembly	• The sprag (720) was misassembled or backwards on the inner race (661). • A damaged third clutch sprag assembly (653, 661, 719-721)

NO ENGINE BRAKING IN MANUAL SECOND OR LOW RANGE

No Engine Braking in Manual Second or Low Range

Checks	Cause
DEFINITION: A large engine RPM increase and forward vehicle speed decrease do not immediately occur when the transmission is shifted from third or fourth gear in	

Drive or Manual Third range to either first or second gear, Manual Second, or Low range.	
Accumulator and Manual 2-1 Band Servo Assembly	• A loose or damaged manual 2-1 band servo oil pipe (125) • Loose manual 2-1 band servo cover or accumulator cover bolts (103, 131) • A damaged accumulator cover spacer plate assembly (134) • A damaged or missing servo piston seal (107) or a servo piston cylinder O-ring seal (113) • A missing servo exhaust screen assembly (115), allowing debris into the cylinder • A misassembled manual 2-1 servo assembly (103-115)
Manual 2-1 Band Assembly	• A band assembly (680) that is worn or burned • A band assembly (680) that is disengaged from the anchor pin (102) • A band anchor pin (102) that is loose or missing

WHINE NOISE VARYING WITH RPM OR FLUID PRESSURE

Whine Noise Varying with RPM or Fluid Pressure

Checks	Action
DEFINITION: In all ranges, a whine which may be sensitive to RPM load, or which ceases when the TCC engages, or which is sensitive to the oil pressure	
Torque Converter (1)	Verify that the noise is internal to the torque converter by placing your left foot on the brake with the gear or selector in Drive. Momentarily stall the engine. Torque Converter noise increases under load.
Oil Pump System	Verify that the noise is internal to the oil pump during a preliminary oil pressure check. An increase in line pressure will vary an oil pump noise.

POPPING NOISE

Popping Noise

Checks	Action
DEFINITION: A popping noise, similar to popcorn popping	
Oil Pump System	• Check fluid level. • Inspect for pump cavitation, indicated by bubbles

	in fluid. • Inspect the transmission fluid filter for a leaky seam. • Inspect the transmission fluid filter seal for improper positioning or for a cut seal.

BUZZ NOISE OR HIGH FREQUENCY RATTLE SOUND

Buzz Noise or High Frequency Rattle Sound

Checks	Action
DEFINITION: A buzz or high frequency rattle	
• Trace Cooler Pipes • Check for binding or contact at the Radiator, other than at the Cooler Pipe connectors	Verify a pressure buzz by watching for a needle vibration of the pressure gage. A road test may be necessary. Refer to **Road Test Procedure**.

WHINE/GROWL NOISE THAT CHANGES WITH VEHICLE SPEED

Whine/Growl Noise That Changes with Vehicle Speed

Checks	Action
DEFINITION: A whine or growl that increases and fades with vehicle speed and is most noticeable under light acceleration	
Drive Link Assembly System	Verify that the noise comes from the sprockets or the from the drive link assembly chain by placing your left foot on the brake and by moving the gear selector from Park or Reverse. If the noise stops, check the following items.
Drive Sprocket Support (522) and Driven Sprocket Support (609)	The bearing outer race support is rough or nicked.
Drive Sprocket (516) and Driven Sprocket (506)	• Broken or sheared teeth • Nicked or scored bearing surfaces • The bearing race or roller bearing surfaces on the gear support inner bearing are rough or pitted • A damaged bearing
Drive Chain (507)	Stretched

FINAL DRIVE NOISE OR HUM NOISE

Final Drive Noise or Hum Noise

Checks	Cause
DEFINITION: A final drive noise or hum is most noticeable under light throttle acceleration or turns	
• Final Drive Gear Set (700) • Final Drive Internal Gear (693)	• Worn planet pinions • Worn washers • Worn or damaged teeth
• Differential Carrier (700) • Differential Side Gears (705)	• Worn or pitted gears • A damaged thrust washer

NOISE IN FIRST, SECOND, THIRD, OR FOURTH

Noise in First, Second, Third or Fourth

Checks	Cause
• Final Drive Sun Gear (697) • Final Drive Pinions (711)	Worn or damaged gears

NOISE IN RANDOM RANGES

Noise in Random Ranges

Checks	Action
DEFINITION: Noise only in certain gear ranges	
Refer to **Range Reference** . Determine the power flow and the applicable components that may be causing this noise.	

ABNORMAL NOISE IN PARK OR NEUTRAL RANGE

Abnormal Noise in Park or Neutral Range

Checks	Cause
DEFINITION: Noise only in Park or Neutral	
Drive Sprocket Support (522) and Driven Sprocket Support (609)	• Nicked or scored bearing surfaces • The bearing race or roller bearing on the gear support inner bearing are rough or pitted. • The bearing outer race support is rough or nicked. • A damaged bearing
Forth Clutch Assembly	Clutch plates (501) damaged or worn

CONVERTER CLUTCH STUCK ON IN ALL GEARS

TCC Stuck On in All Gears

Checks	Cause
DEFINITION: No difference in RPM is noted between the engine speed and the transmission input, turbine, speed in any transmission range. This condition may also cause the engine to stall when the vehicle is slowed to a stop or when the transmission is shifted from Park or Neutral range into Reverse or Drive range.	
Control Valve Body Assembly	• The TCC control valve (335) or the TCC regulator apply valve (327) is stuck or binding. • The spacer plate and gaskets (369-371) are misassembled or contain incorrect parts.

CONVERTER CLUTCH STUCK ON IN SECOND, THIRD AND FOURTH GEAR

Converter Clutch Stuck On in 2nd, 3rd and 4th Gear

Checks	Cause
DEFINITION: No difference in RPM is noted between the engine speed and the transaxle input (turbine) shaft speed in second, third and fourth gear, DRIVE range. TCC is not ON in first gear and the engine does not stall when the vehicle slows to a stop or is shifted from PARK or NEUTRAL range to REVERSE or DRIVE range.	
Control Valve Body Assembly	• The TCC PWM solenoid valve assembly (334) is faulty (stuck ON). • The control valve body spacer plate gaskets assembly (396) are misassembled or contain incorrect parts. • The PWM internal O-ring is missing or damaged.

HARSH TORQUE CONVERTER CLUTCH (TCC) APPLY OR RELEASE

Harsh TCC Apply or Release

Checks	Cause
DEFINITION: An unacceptably quick TCC apply or release occurs in third or fourth gear, Drive or Manual third range, with the throttle held steady.	
Control Valve Body Assembly	• The TCC regulator apply valve (327) is stuck or binding. • The TCC regulator apply valve spring (326) is missing or damaged. • The TCC control valve spring (336) is missing or damaged. • The control valve body spacer plate gaskets assembly (396) are misassembled or contain incorrect parts.

	• TCC PWM Solenoid faulty.

CONVERTER CLUTCH APPLY ROUGH, SLIPS, OR SHUDDERS

Soft TCC Apply (Shudder)

Checks	Cause
DEFINITION: An unacceptably long TCC apply occurs in third or fourth gear, Drive or Manual Third range, with the throttle held steady. This can cause a momentary rapid jerking sensation in the vehicle during the TCC apply.	
Control Valve Body Assembly	• The TCC regulator apply valve (327) is stuck or binding. • The TCC regulator apply valve spring (326) is missing or damaged. • The control valve body spacer plate gaskets assembly (396) are misassembled or contain incorrect parts. • TCC control valve stuck or binding. • TCC control valve spring is missing or damaged. • TCC PWM solenoid faulty.
Case Cover Assembly	The TCC blowoff ball valve (420B) or the spring (418) is damaged or is not seating.
Turbine Shaft Assembly	• The turbine shaft O-ring seal (520) is damaged or is missing. • The turbine shaft oil seal rings (513, 519) are damaged or missing. • The turbine shaft (518) is damaged.
Drive Sprocket Support Assembly	The turbine shaft bushing (523) is worn or damaged.
Torque Converter Assembly	• The torque converter bushing is worn or damaged • The torque converter cover surface is damaged under lug thread(s) due to the flexplate bolt bottoms out. • The torque converter is damaged internally ○ The TCC friction material is missing or damaged ○ The TCC plate is distorted or damaged ○ The torque converter internal O-ring seal is missing or damaged

NO TORQUE CONVERTER CLUTCH (TCC) APPLY

No TCC Apply

Checks	Cause
DEFINITION: A large difference in RPM is noted between the engine speed and the transmission input, turbine, speed in third or fourth gear, Drive or Manual Third range when the TCC is commanded On by the PCM.	
Control Valve Body Assembly	• The TCC PWM solenoid valve assembly (334) is stuck Off. • The TCC control valve (335) or the TCC regulator apply valve (327) is stuck or binding. • The #10 ball check valve (372) is missing or is mislocated. • The control valve body spacer plate gaskets assembly (396) are misassembled or contain incorrect parts.
Case Cover Assembly	The TCC blowoff ball valve (420B) or the spring (418) is damaged or is not seating.
Turbine Shaft Assembly	• The turbine shaft O-ring seal (520) is damaged or is missing. • The turbine shaft oil seal rings (513, 519) are damaged or missing. • The turbine shaft (518) is damaged.
Drive Sprocket Support Assembly	• The turbine shaft bushing (523) is worn or damaged. • Bearing damage
Torque Converter Assembly	• The torque converter bushing is worn or damaged • The torque converter cover surface is damaged under lug thread(s) due to the flexplate bolt bottoms out • The torque converter is damaged internally ○ The TCC friction material is missing or damaged ○ The TCC plate is distorted or damaged ○ The torque converter internal O-ring seal is missing or damaged

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Antenna Amplifier Fastener	3 N·m	27 lb in
Antenna Module Ground Bolt	10 N·m	89 lb in
Audio Amplifier Fasteners	2.5 N·m	22 lb in
Cellular Communication Antenna Base Fastener	9 N·m	80 lb in
Communication Interface Module Battery Fastener	2.5 N·m	22 lb in
Communication Interface Module Bracket to Body Fastener	3.5 N·m	27 lb in
Communication Interface Module to Mounting Bracket Fastener	5 N·m	44 lb in
Digital Radio Receiver Mounting Bracket to Body Fasteners	5 N·m	44 lb in
Digital Radio Receiver to Mounting Bracket Fasteners	5 N·m	44 lb in
Radio Fasteners	2 N·m	18 lb in
Speaker Grille Fasteners	2 N·m	18 lb in

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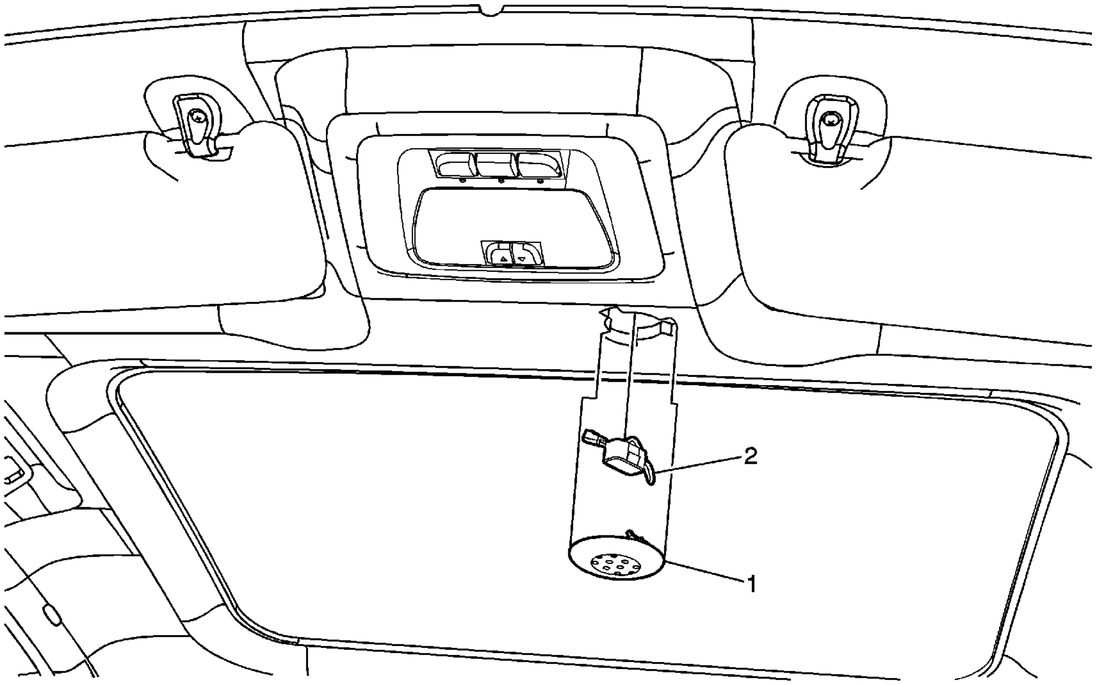
Mobile Telephone Microphone Replacement



Callout	Component Name
1	Mobile Telephone Microphone Bezel **Procedure** Snap the bezel out of the headliner.
2	Mobile Telephone Microphone **Procedure** Disconnect the electrical connector.

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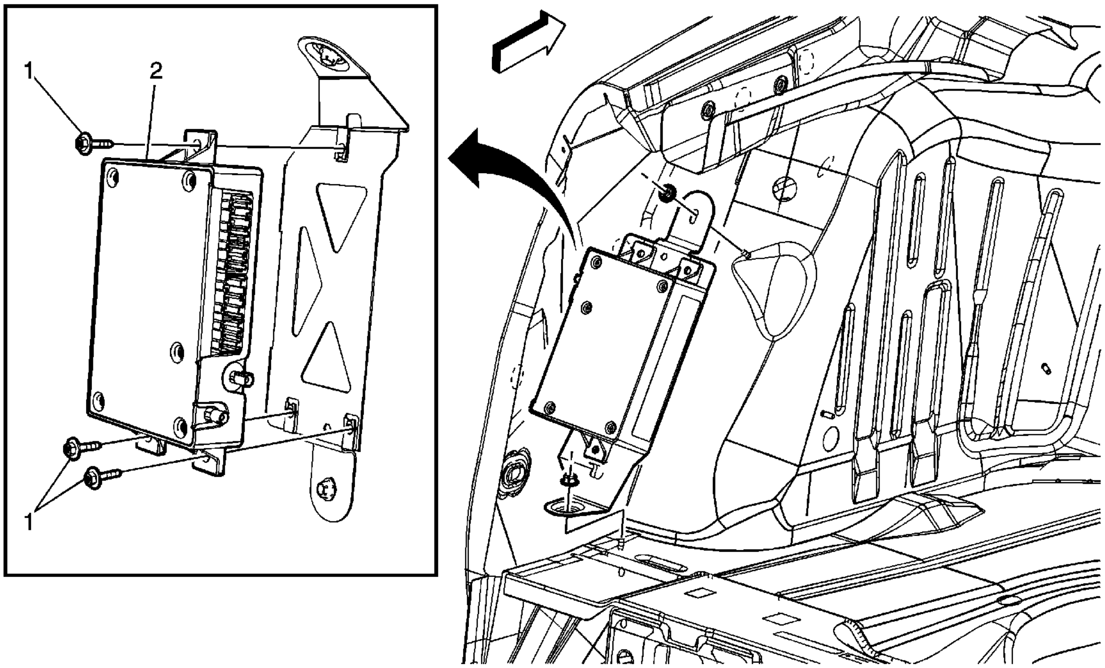
Communication Interface Module Replacement



Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection. 2. Pull back the left rear compartment trim panel in order to expose the communication interface module. 3. For programming and set up, Refer to Control Module References.	
1	Communication Interface Bolt/Screw (Qty: 3) **Caution:** Refer to Fastener Caution in the Preface section. **Tip** - The vehicle communication interface module (VCIM) has a specific set of unique numbers that tie the module to each vehicle. These numbers, the 10-digit station identification and the 11-digit electronic serial number, are used by the National Cellular Network and OnStar® to identify the specific vehicle. Because these numbers are tied to the vehicle identification number of the vehicle, you must never exchange these parts with those of another vehicle. - After replacing the vehicle communication interface module, you must

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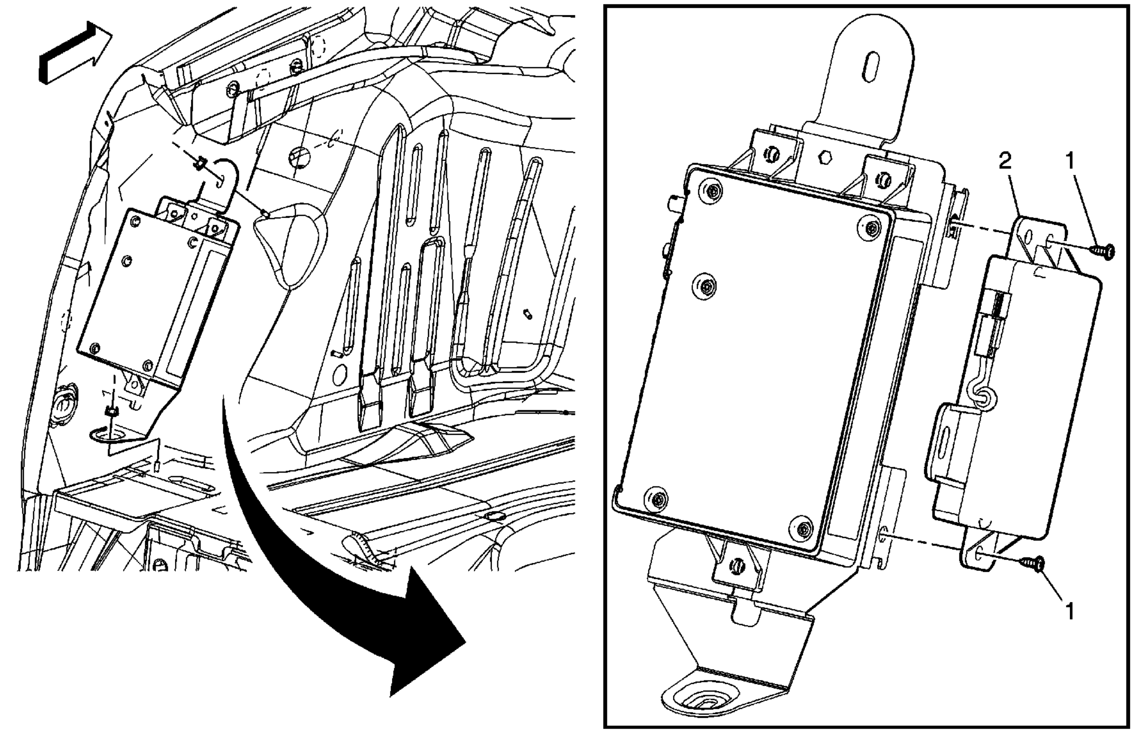
	reconfigure the OnStar® system. Failure to reconfigure the system will result in an additional customer visit for repair. In addition, pressing and holding the white dot button on the keypad will NOT reset this version of the OnStar® system. This action will cause a DTC to set. - When replacing the VCIM be sure to transfer Bluetooth Antenna, if equipped. **Tighten** 5 N·m (44 lb in)
2	Communication Interface Module **Procedure** For programming and set up information, refer to Control Module References.

Communication Interface Module Battery Replacement



Callout	Component Name
Preliminary Procedures 1. Remove the left side rear compartment trim. 2. Program the communication interface module (OnStar®) after replacement. Refer to Control Module References.	
1	Communication Interface Module Battery Screw (Qty: 2) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2.5 N·m (22 lb in)
	Communication Interface Module Battery **Tip** • The vehicle communication interface module (VCIM) has a specific set of unique numbers that tie the module to each vehicle. These numbers, the 10-digit station identification and the 11-digit electronic serial number, are used by the National Cellular Network and OnStar® to identify the specific vehicle. Because these numbers are tied to the vehicle identification number of the

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2	vehicle, you must never exchange these parts with those of another vehicle. • Replacement of the back-up battery (BUB) does not require reconfiguration of the VCIM. If a trouble code is indicated before the battery is replaced, the DTC must be cleared following the installation of the new battery. The OnStar® system does not need to be reconfigured unless the VCIM is replaced. • When the VCIM is replaced, the OnStar® system must be reconfigured. Failure to reconfigure the system will result in an additional customer visit for repair. In addition, pressing and holding the white dot button on the keypad will NOT reset this version of the OnStar® system. This action will cause a DTC to set.

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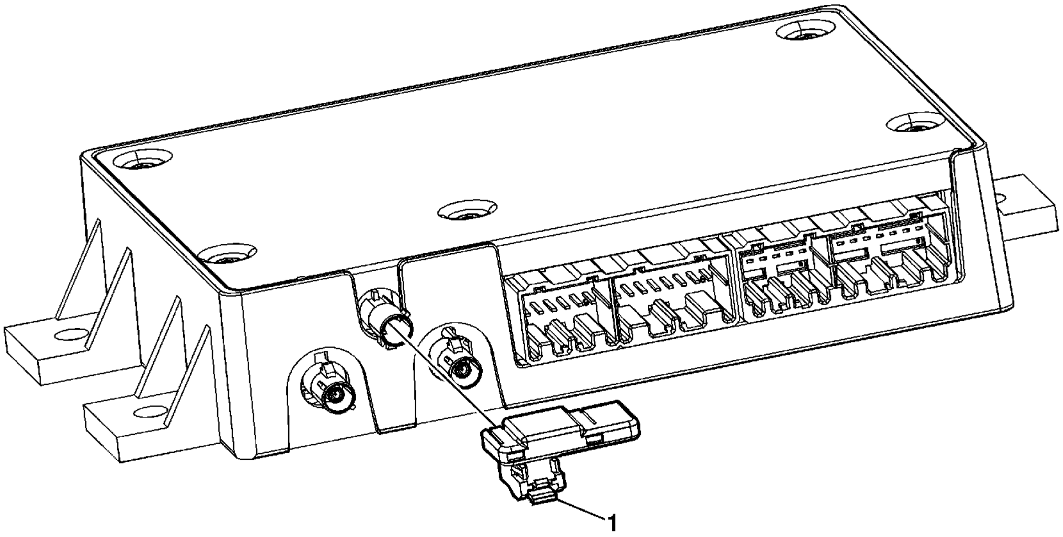
Wireless Communication Interface Antenna Replacement



Callout	Component Name
Preliminary Procedure Remove the communication interface module. Refer to Communication Interface Module Replacement	
1	Wireless Communication Interface Antenna Bluetooth Module **Procedure** Unsnap the Antenna from Communication Module.

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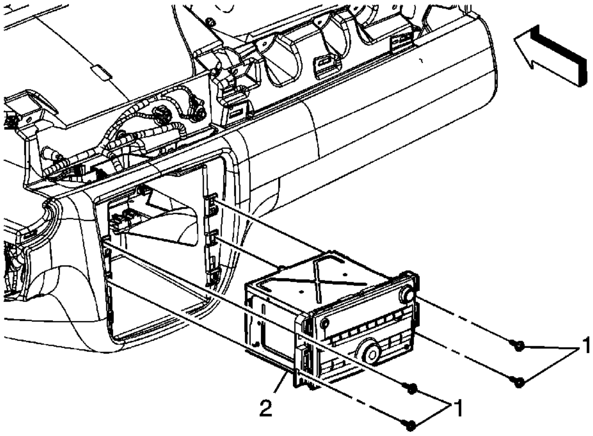
Radio Replacement



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">**Preliminary Procedure**
1. Remove the instrument panel accessory trim plate. Refer to Instrument Panel Accessory Trim Plate Replacement
2. Remove the heating and air conditioning control module. Refer to Heater and Air Conditioning Control Replacement
3. Slightly push the antenna lead toward the radio to relieve tension on the internal fingers. Pull back on the spring-loaded locking ring and remove the connector from the radio.
4. To install the antenna lead, plug the antenna lead into the socket until it clicks.
5. Program the radio after replacement. Refer to Control Module References</td></tr>
<tr><td>1</td><td>Radio Bolt/Screw (Qty: 4)
Caution: Refer to Fastener Caution in the Preface section.
Tighten
2 N·m (18 lb in)</td></tr>
<tr><td>2</td><td>AM/FM Stereo Radio</td></tr>
</table>

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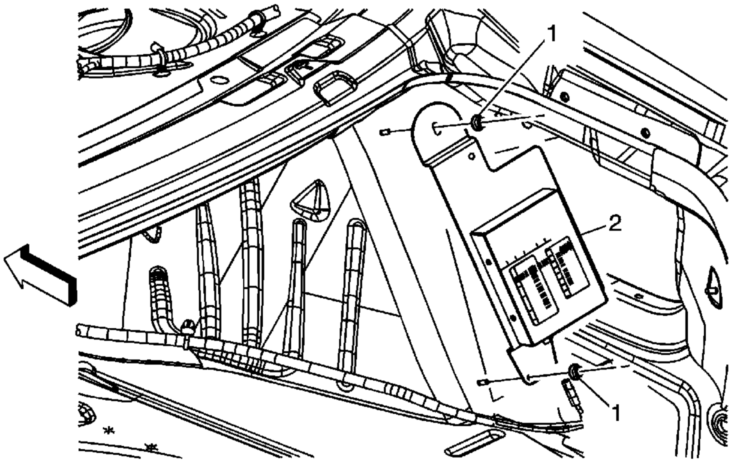
Digital Radio Receiver Replacement



Callout	Component Name
Note: Do not swap digital radio receivers between vehicles. Swapping digital receivers between vehicles will activate the digital radio Theftlock. "XM Theftlock" will be displayed. **Preliminary Procedure** Remove the right rear compartment trim. Refer to Rear Compartment Side Trim Replacement - Right Side.	
1	Digital Radio Receiver Bracket Nut (Qty: 2) **Caution:** Refer to Fastener Caution in the Preface section. **Tip** Disconnect the antenna and electrical connectors from the module. **Tighten** 3.5 N·m (31 lb in)
2	Digital Radio Receiver Assembly **Tip** • Remove the nuts that retain the receiver to the bracket. • If a replacement receiver is installed, perform the Digital Radio Receiver Setup. Refer to Control Module References. **Tighten** 5 N·m (44 lb in)

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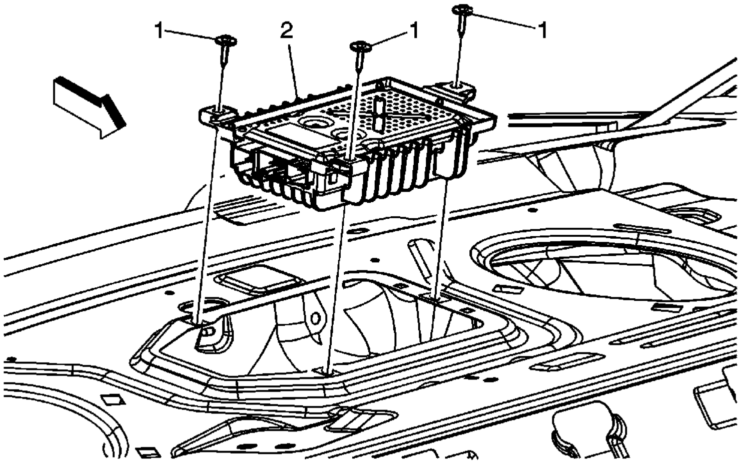
Radio Speaker Amplifier Replacement



Callout	Component Name
Preliminary Procedure Remove the rear window shelf trim panel. Refer to Rear Window Shelf Trim Panel Replacement.	
1	Low Frequency Audio Amplifier Bolt (Qty: 3) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2.5 N·m (22 lb in)
2	Low Frequency Audio Amplifier Assembly Refer to Control Module References for programming and setup information.

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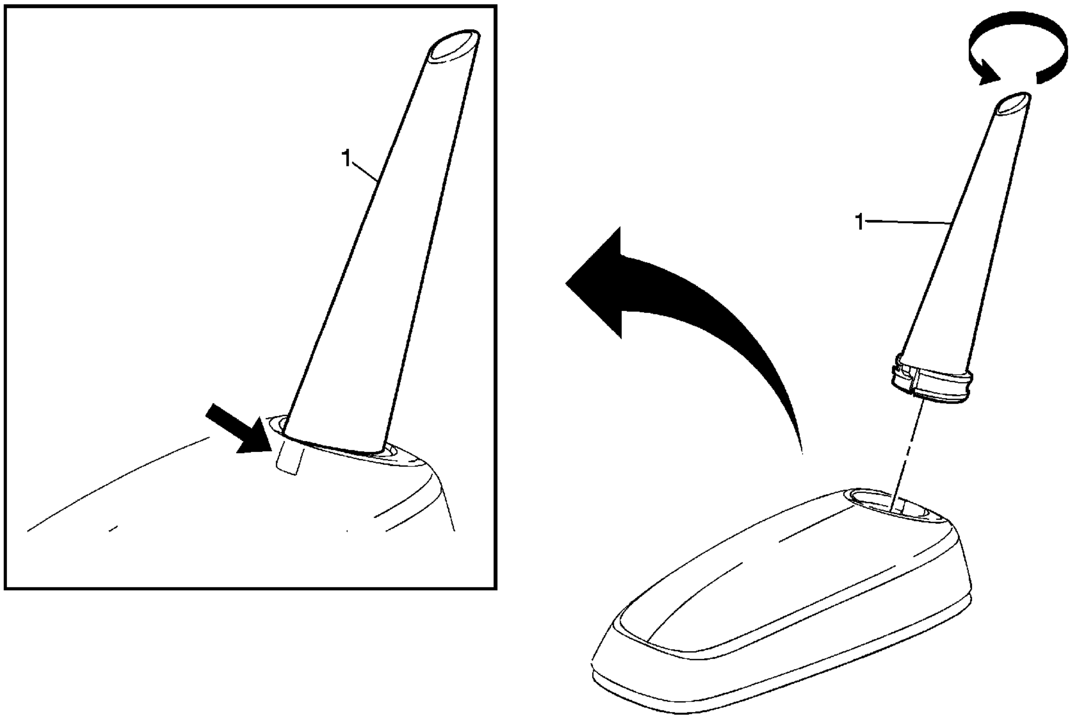
Mobile Telephone Digital Antenna Replacement (Convertible)



Callout	Component Name
1	Mobile Telephone Digital Antenna Assembly **Tip** • The release tab is not visible with the mast assembled to the antenna base. • Using a small flat-bladed tool, push in and hold the release tab, then rotate the mast counterclockwise in order to release the mast from the antenna base.

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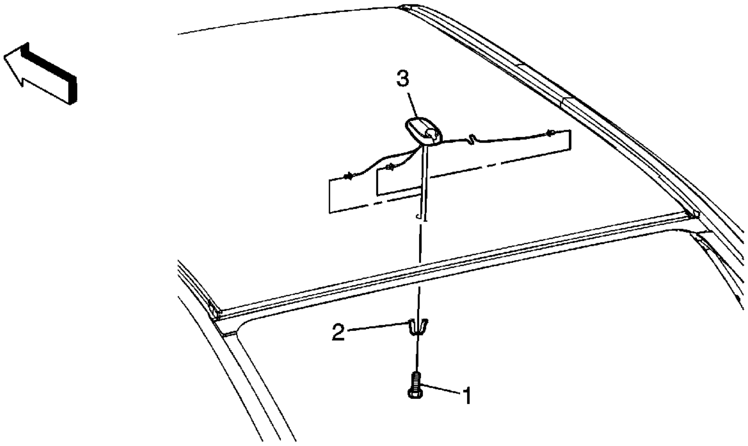
Cellular Communications/Digital Radio Antenna Replacement



Callout	Component Name
Preliminary Procedure Lower the rear of the headliner. Refer to Headlining Trim Panel Replacement.	
1	Mobile Telephone and Vehicle Location Antenna Base Bolt **Caution:** Refer to Fastener Caution in the Preface section. **Tip** Disconnect the electrical connections. **Tighten** 9 N·m (80 lb in)
2	Mobile Telephone and Vehicle Location Antenna Base Expansion Sleeve
3	Mobile Telephone and Vehicle Location Antenna Base Assembly

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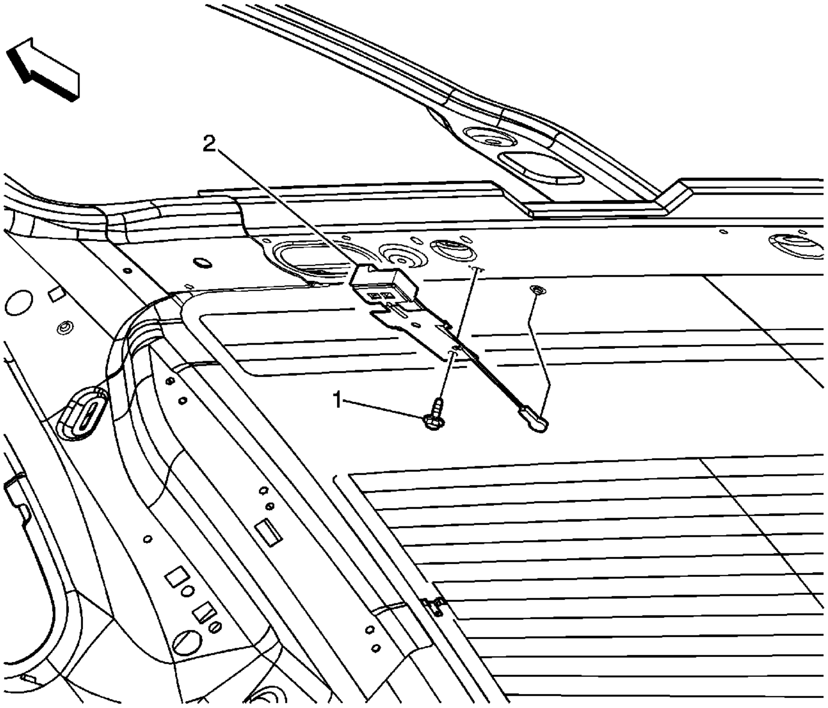
Radio Antenna Module Replacement



Callout	Component Name
Preliminary Procedure Lower the rear of the headliner. Refer to Headlining Trim Panel Replacement.	
1	Radio Antenna Module Bolt (Qty: 3) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 10 N·m (89 lb in)
2	Radio Antenna Module Assembly **Tip** • Disconnect the antenna lead from the rear window. • Disconnect the electrical connector.

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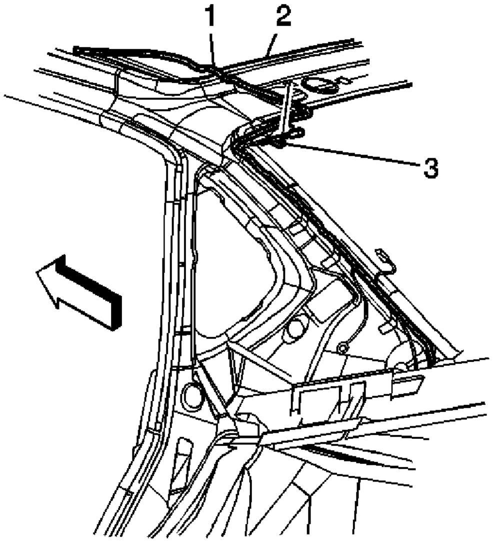
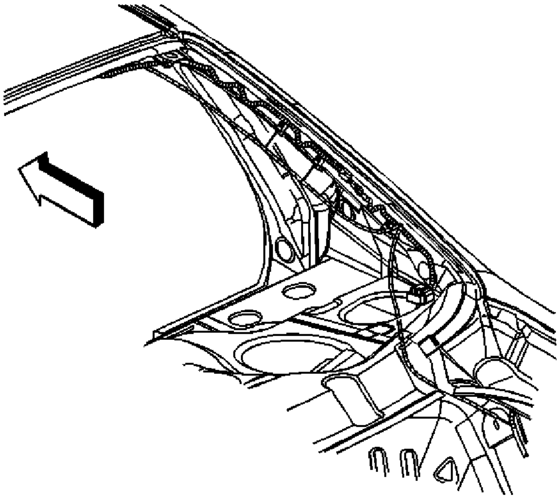
Digital Radio Antenna Cable Replacement

Removal Procedure



1. Remove the right rear upper quarter trim panel. Refer to Quarter Upper Trim Panel Replacement.
2. Lower the rear of the headliner for access to the antenna/cable attachment. Refer to Headlining Trim Panel Replacement.
3. Adjust the antenna cable mastic patch/tape at the roof.
4. Disconnect the antenna cable from the antenna base cable connector.
5. Remove the antenna cable retainer (3) from the rear header (2).



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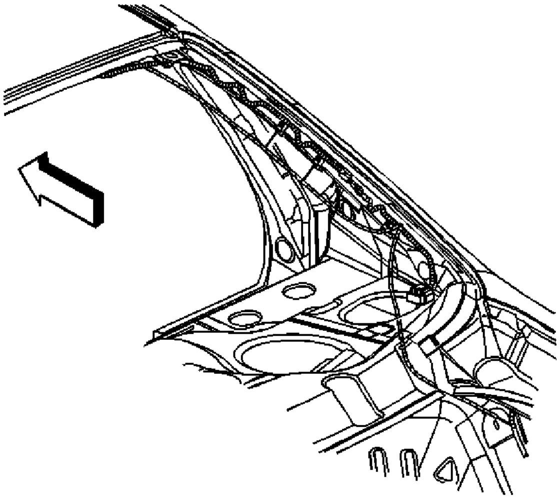
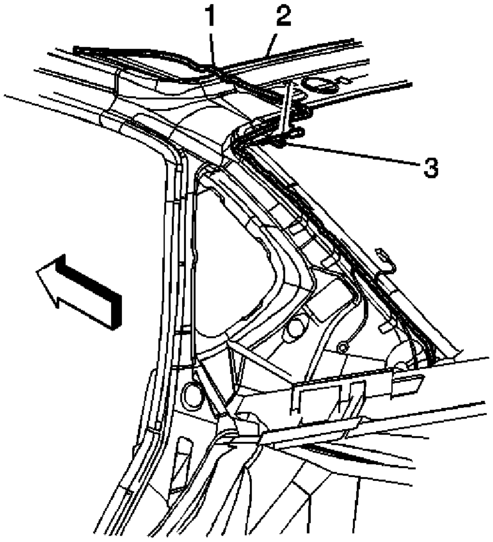
6. Remove the antenna cable from the dome lamp harness clips.
7. Remove the antenna cable from between the dome lamp harness and the upper quarter panel.
8. Attach a piece of wire or string to the end of the antenna cable.
9. Route the antenna cable through the rear shelf and along the rear wheel house.
10. Adjust the right rear compartment trim panel.
11. Disconnect the antenna cable from the digital radio receiver.
12. Remove the antenna cable retainers from the receiver bracket.
13. Remove the wire or string from the antenna cable.
14. Remove the antenna cable.

Installation Procedure



1. Install the antenna cable retainers to the receiver bracket.
2. Connect the antenna cable to the digital radio receiver.
3. Attach the wire or string used in the removal procedure to the cable being installed.
4. Carefully pull the antenna cable through the rear shelf into the passenger compartment.
5. Install the right rear compartment trim panel.
6. Remove the wire or string from the antenna cable.
7. Route the antenna cable between the dome lamp harness and the upper quarter panel.
8. Install the antenna cable to the dome lamp harness clips.



9. Install the antenna cable retainer (3) to the rear header (2).
10. Connect the antenna cable to the antenna base cable connector.
11. Install the antenna cable mastic patch/tape at the roof.
12. Install the rear of the headliner. Refer to Headlining Trim Panel Replacement.
13. Install the right rear upper quarter trim panel. Refer to Quarter Upper Trim Panel Replacement.

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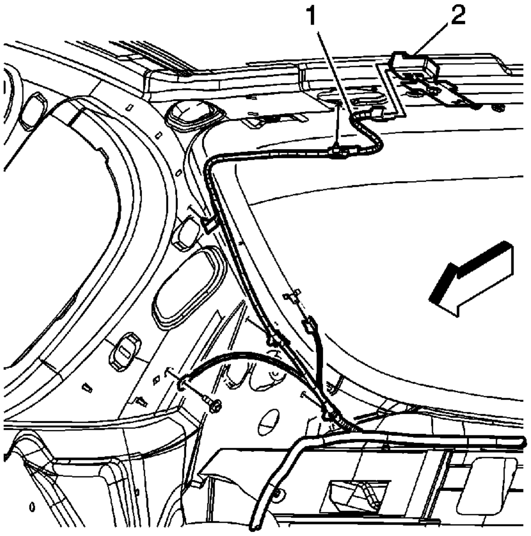
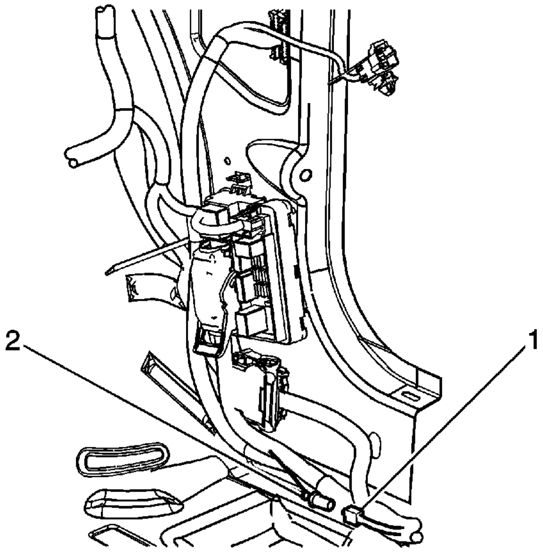
Antenna Cable Replacement

Removal Procedure

1. Remove the rear upper quarter trim panel. Refer to Quarter Upper Trim Panel Replacement.



2. Disconnect the antenna cable (1) from the radio antenna module (2).
3. Remove the rear seat cushion. Refer to Rear Seat Cushion Replacement .
4. Remove the rear seat back. Refer to Rear Seat Back Replacement .



5. Remove the right carpet retainers. Refer to Front Carpet Retainer Replacement .
6. Remove the right lower center pillar trim panel. Refer to Center Pillar Lower Trim Panel

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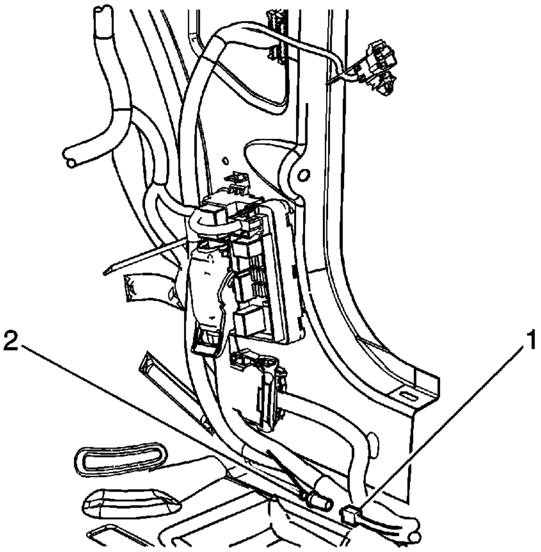
Replacement .

7. Adjust the carpet for access to the antenna cable as required.
8. Disconnect the antenna cable (1) from the antenna extension cable (2).
9. Cut off the visible end of the antenna cable from the wiring harness in the following locations:
   - The kick panel area
   - The rear shelf area

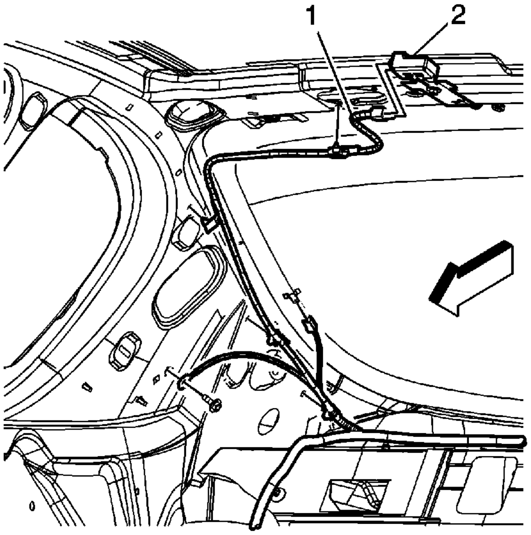
Installation Procedure

1. Install the antenna cable to the vehicle. Use electrical tape in order to secure the antenna extension cable to the top of the wiring harness. Secure the cable to the harness at least every 150 mm (6 in).



Important: The antenna cable uses a sliding snap-lock. Holding the sliding lock feature will prevent installation.

2. Connect the antenna extension cable (2) from the radio to the antenna cable (1) near the kick panel:
   2.1. Position the antenna extension cable behind the sliding lock feature.
   2.2. Install the antenna extension cable to the sliding lock feature.
3. Install the carpet.
4. Install the right lower center pillar trim panel. Refer to Center Pillar Lower Trim Panel Replacement .
5. Install the right carpet retainers. Refer to Front Carpet Retainer Replacement .



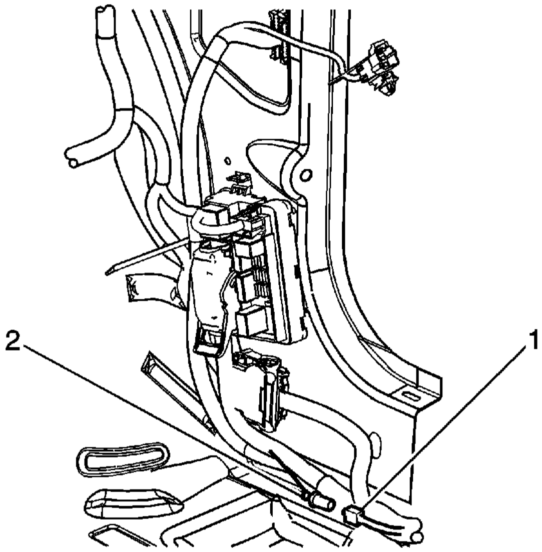
6. Install the rear seat back. Refer to Rear Seat Back Replacement .
7. Install the rear seat cushion. Refer to Rear Seat Cushion Replacement.

Important: The antenna cable uses a sliding snap-lock. Holding the sliding lock feature will prevent installation.

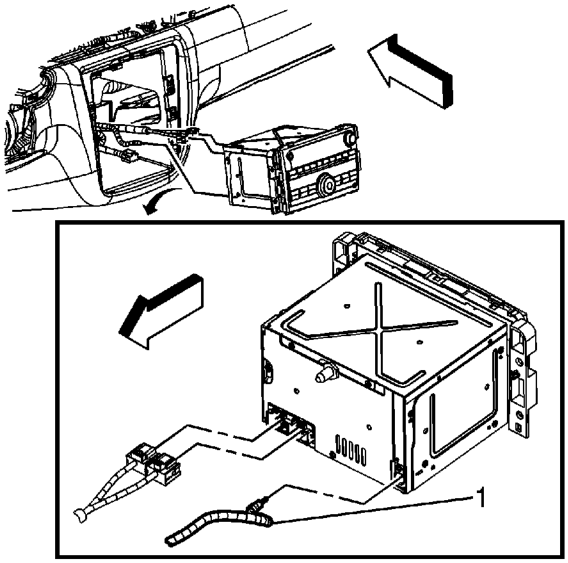
8. Connect the antenna cable (1) to the radio antenna module (2):
   - 8.1. Position the antenna cable behind the sliding lock feature.
   - 8.2. Install the antenna cable to the sliding lock feature.
9. Install the rear upper quarter trim panel. Refer to Quarter Upper Trim Panel Replacement.

Radio Antenna Cable Extension Cable Replacement

Removal Procedure



1. Remove the right carpet retainer. Refer to Front Carpet Retainer Replacement .
2. Adjust the carpet for access.
3. Disconnect the antenna extension cable (2) from the antenna cable (1).
4. Remove the right instrument panel insulator. Refer to Instrument Panel Insulator Panel Replacement - Right Side .



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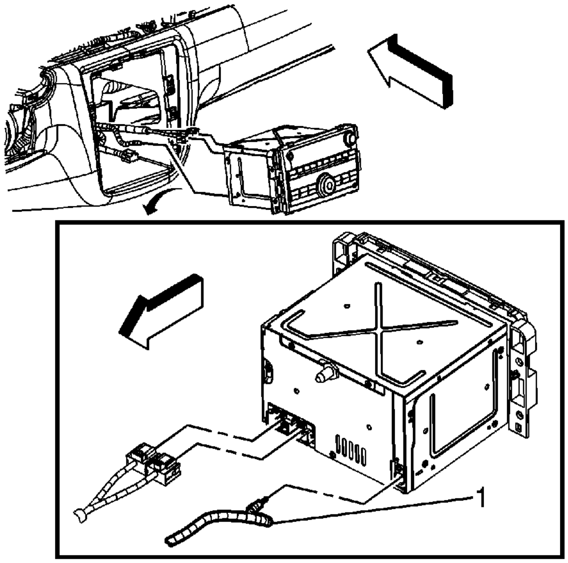
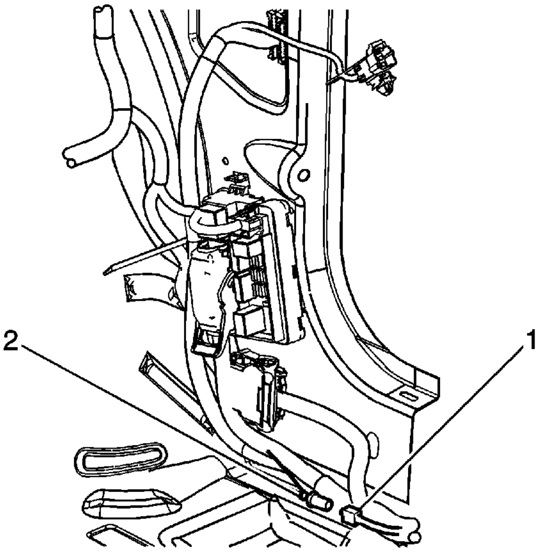
5. Adjust the radio for access. Disconnect the antenna extension cable (1) from the radio. Refer to Radio Replacement .
6. Cut off the visible ends of the antenna extension cable.

Installation Procedure



1. Route the antenna extension cable. Secure the cable.
2. Connect the antenna extension cable (1) to the radio. Install the radio. Refer to Radio Replacement .



Important: The antenna cable uses a sliding snap-lock. Holding the sliding lock feature will prevent installation.

3. Connect the antenna extension cable (2) from the radio to the antenna cable (1) near the kick panel:
    1. 3.1. Position the antenna extension cable behind the sliding lock feature.
    2. 3.2. Install the antenna extension cable to the sliding lock feature.
4. Install the right instrument panel insulator. Refer to Instrument Panel Insulator Panel Replacement - Right Side .
5. Install the carpet.
6. Install the right carpet retainer. Refer to Front Carpet Retainer Replacement .

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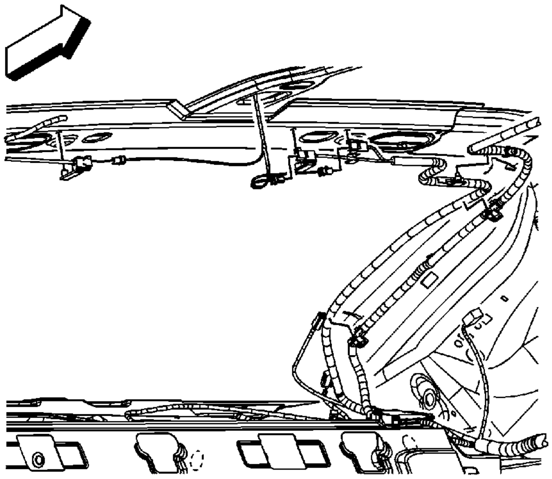
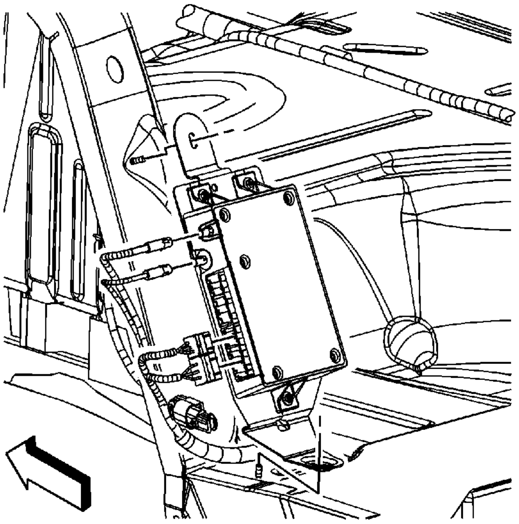
Mobile Telephone and Navigation Antenna Coaxial Cable Replacement (Impala)

Removal Procedure



1. Lower the rear of the headliner to access the digital antenna connection. Refer to Headlining Trim Panel Replacement .
2. Disconnect the digital antenna connection and cut the connector on the harness side off.
3. Remove the left rear compartment side trim. Refer to Rear Compartment Side Trim Replacement - Left Side .



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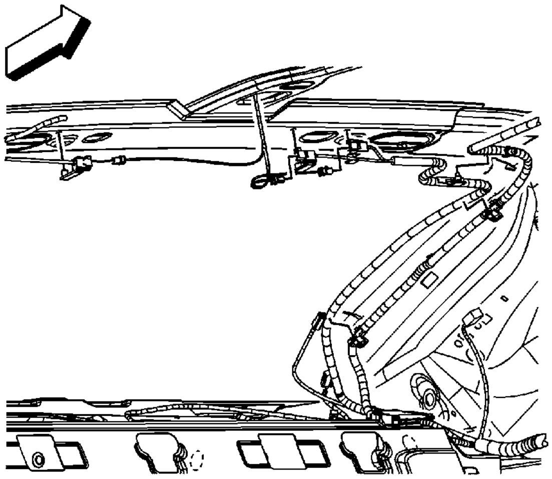
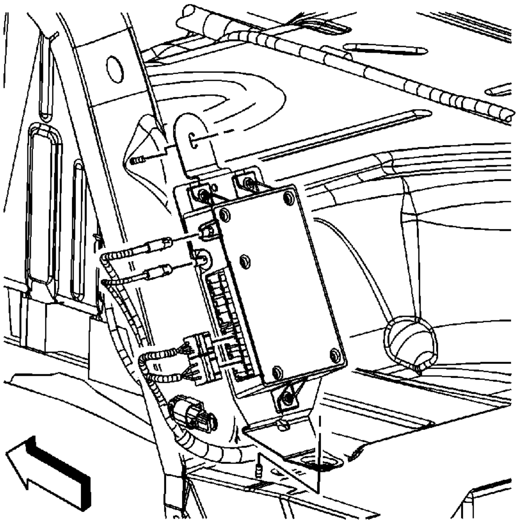
4. Disconnect the antenna cable connector and cut the end off on the harness side.

Installation Procedure



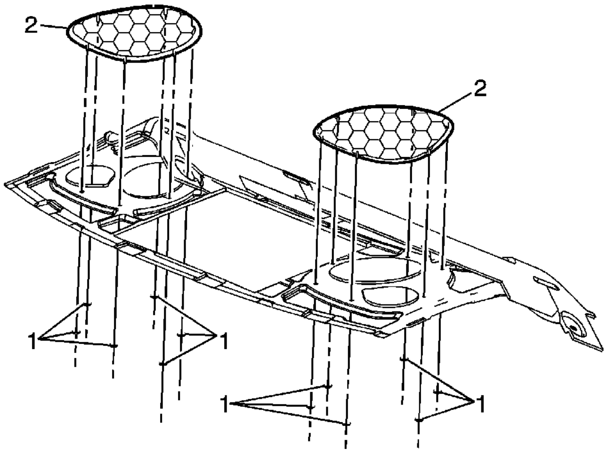
1. Route the new cellular antenna cable from the interior of the vehicle to the rear compartment area following the same path as the old cable. A piece of mechnic's wire may be used as needed to assist in the procedure. Secure the new cable as needed with tie straps.



2. Connect the new cable to the ONSTAR module and install the left rear compartment side trim. Refer to Rear Compartment Side Trim Replacement - Left Side .

3. Connect the new cable to the digital antenna and secure the headliner. Refer to Headlining Trim Panel Replacement .

Radio Rear Speaker Grille Replacement



Callout	Component Name
Preliminary Procedure Remove the rear window shelf trim panel. Refer to Rear Window Shelf Trim Panel Replacement.	
1	Radio Rear Speaker Grille Nut **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Radio Rear Speaker Grille

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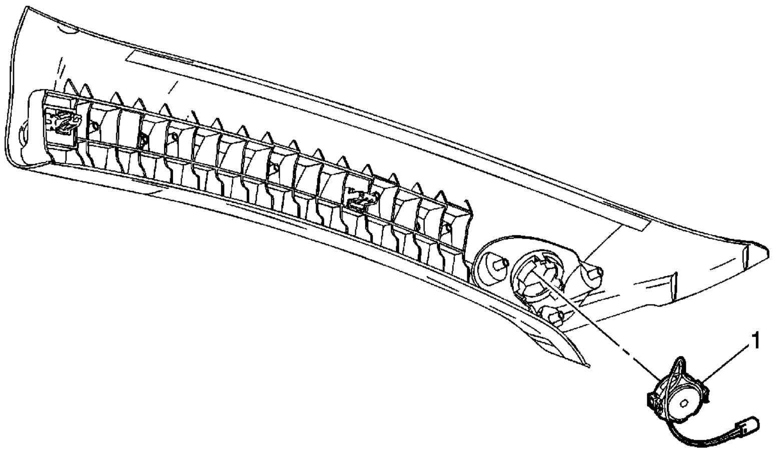
Front Upper Speaker Replacement



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedure
1. Remove the instrument panel (I/P) outer trim cover. Refer to Instrument Panel Outer Trim Cover Replacement - Right Side or Instrument Panel Outer Trim Cover Replacement - Left Side.
2. Remove the windshield pillar garnish molding. Refer to Windshield Pillar Garnish Molding Replacement.</td></tr>
<tr><td>1</td><td>Radio Windshield Side Garnish Molding Speaker Assembly
Tip
Release the tabs on the windshield pillar speaker carrier to remove the speaker from the molding.</td></tr>
</table>

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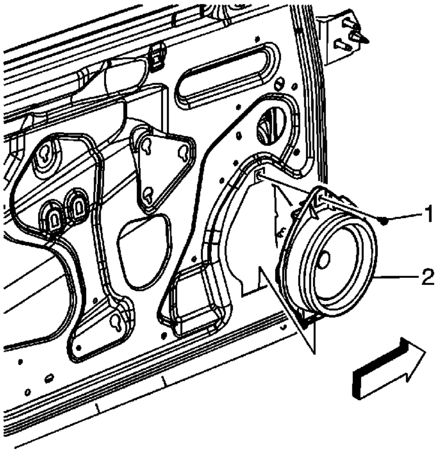
2009 Chevrolet Impala | Impala (VIN W) Service Manual | Driver Information and Entertainment | Cellular, Entertainment, and Navigation | Repair Instructions | **Document ID: 2152223**

Radio Front Side Door Speaker Replacement



Callout	Component Name
Preliminary Procedure Remove the front door trim panel. Refer to Front Side Door Trim Panel Replacement	
1	Radio Front Side Door Speaker Housing Bolt/Screw **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Radio Front Side Door Speaker Assembly

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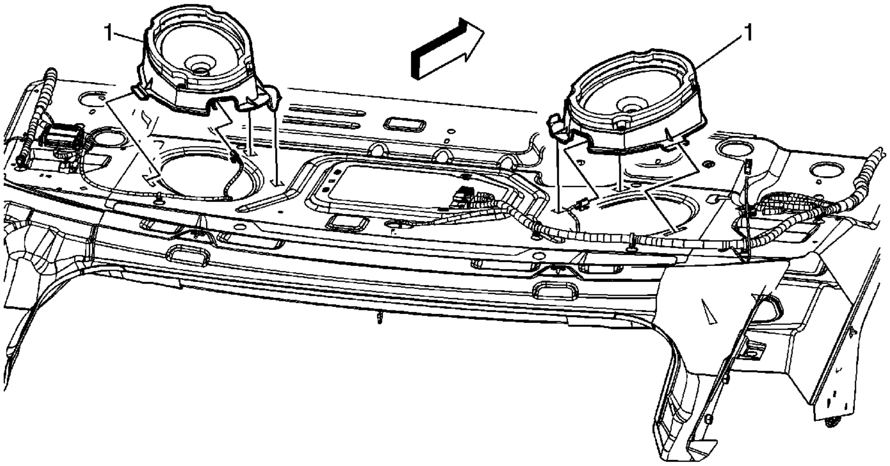
Radio Rear Speaker Replacement (Impala w/UW6)



Callout	Component Name
Preliminary Procedure Remove the rear window shelf trim panel. Refer to Rear Window Shelf Trim Panel Replacement.	
1	Radio Rear Speaker Assembly (Qty: 2) **Tip** • Push in on the tabs on the speaker in order to release. • Disconnect the electrical connector.

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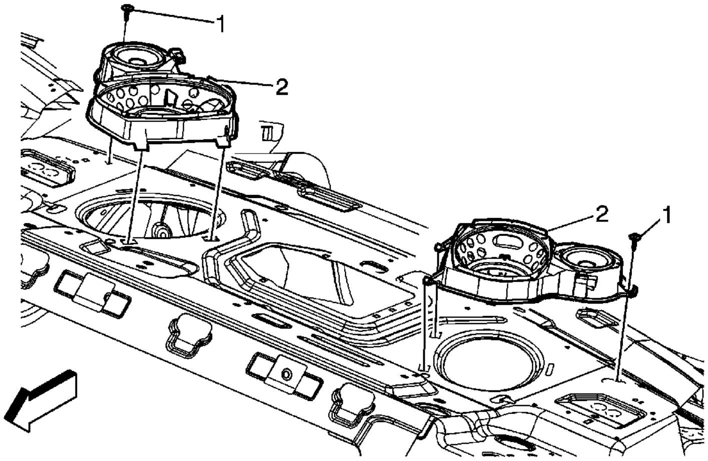
2009 Chevrolet Impala | Impala (VIN W) Service Manual | Driver Information and Entertainment | Cellular, Entertainment, and Navigation | Repair Instructions | Document ID: 2152226

Radio Rear Speaker Replacement (Impala w/UQ3)



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedure
Remove the rear window shelf trim panel. Refer to Rear Window Shelf Trim Panel Replacement.</td></tr>
<tr><td>1</td><td>Radio Rear Speaker Bolt/Screw
Caution: Refer to Fastener Caution in the Preface section.
Tip
Disconnect the electrical connector.
Tighten
2.5 N·m (22 lb in)</td></tr>
<tr><td>2</td><td>Radio Rear Speaker Assembly</td></tr>
</table>

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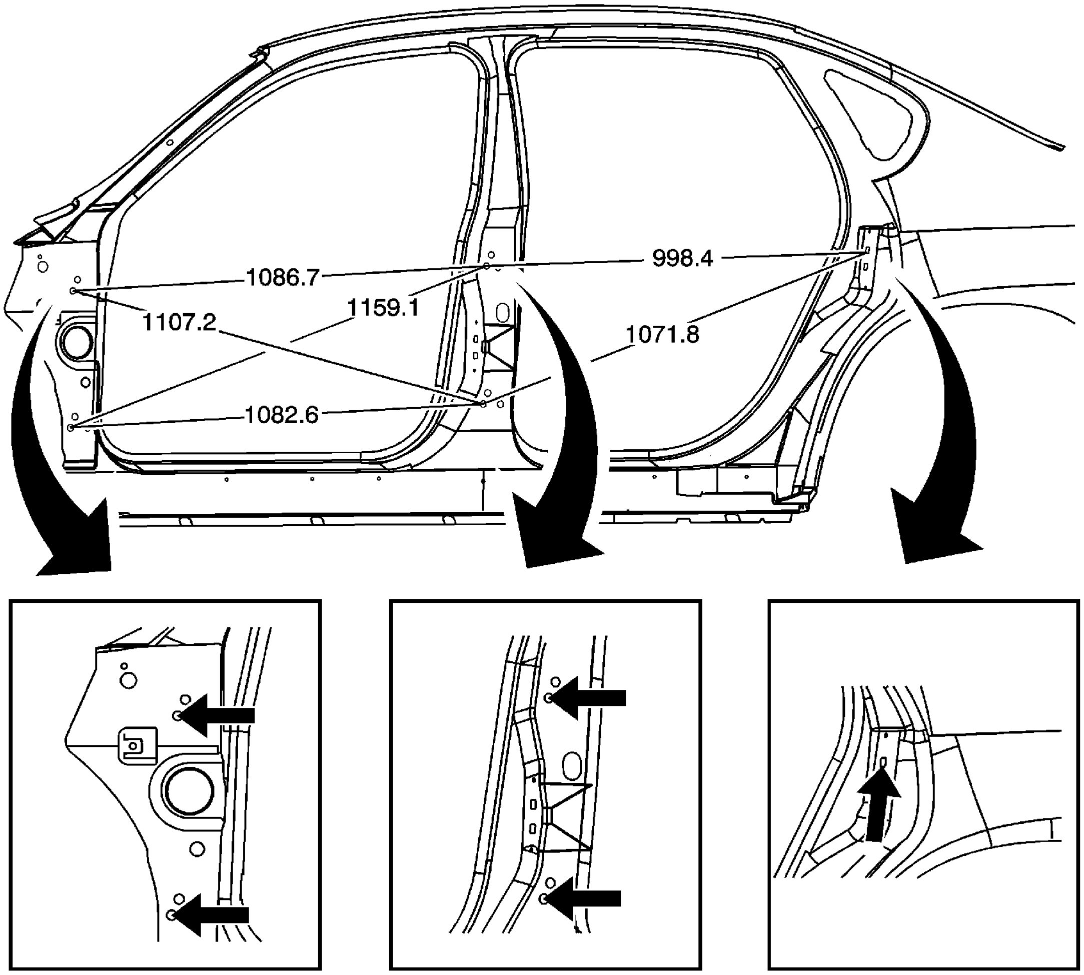
Dimensions - Body

Point to Point Measurements

Point-to-point measurements are for reference only. All Measurements are given in millimeters. Use these measurements for diagnosing and estimating. Point-to-point measurements are duplicated with tram bar pointers set at equal lengths. All die marks, holes, slots, and fasteners are measured to the center. All dimensions are symmetrical unless otherwise specified.

Side



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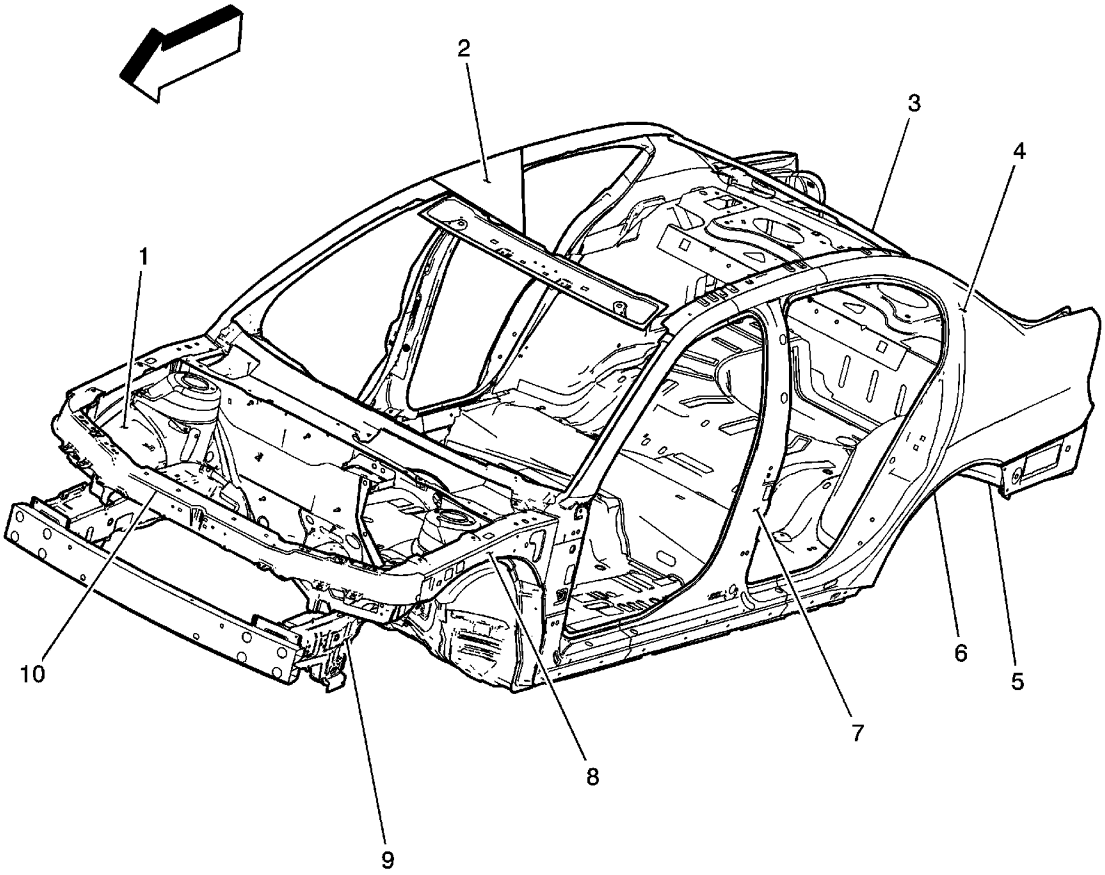
Structure Identification (Sedan)



Number	Description	Material	Procedure
1	Front Wheelhouse	Mild Steel	- Front Wheelhouse Replacement - Front Wheelhouse Extension Replacement
2	Roof Outer Panel	Mild Steel	Roof Outer Replacement
3	Rear Floor Panel	Mild Steel	Floor Panel Replacement
4	Body Side Outer	Mild Steel	- General Door Frame Opening Sectioning - Quarter Panel Replacement
5	Rear Rail	High Strength Low Alloy Steel	- Rear Rail Replacement - Rear Rail Sectioning

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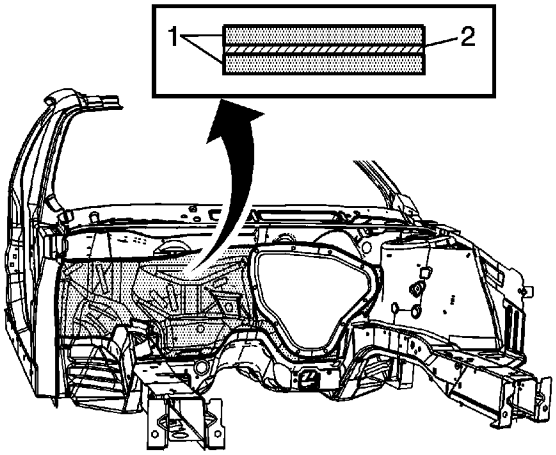
6	Rear Outer Wheelhouse	Mild Steel	Rear Outer Wheelhouse Replacement
7	Center Pillar	Mild Steel	• Door Frame Reinforce Sectioning - Center Pillar • Center Pillar Replacement
8	Upper Rail	Mild Steel	Upper Rail Replacement
9	Lower Rail	High Strength Low Alloy Steel	• Lower Rail Sectioning • Lower Rail Replacement
10	Radiator Support	High Strength Low Alloy Steel	Radiator Support Replacement

Front Wheelhouse Replacement

Removal Procedure



Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.

Warning: Refer to Foam Sound Deadeners Warning in the Preface section.

Note:

- Model year 2004 and prior vehicles are not manufactured with laminated steel in front of the dashes. Therefore, the front wheelhouse assembly can be metal inert gas (MIG) welded instead of the rivet and bonding process, as stated in these instructions.

  The front of the dash panel is formed from laminated steel. This steel is constructed by bonding 2 pieces of cold rolled steel (1) with a viscoelastic layer of adhesive (2). MIG welding laminated steel does not meet GM Corporate standards for structural integrity. As an alternative, all factory welds will be replaced by using the rivet and adhesive bond method described in the installation portion of this procedure. The rivet and adhesive bond method must only be used in the areas, as described in this procedure.
- Failure to follow this procedure will compromise the structural integrity of the vehicle.

1. Disable the SIR system. Refer to SIR Disabling and Enabling.
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.

Warning: Refer to Collision Sectioning Warning in the Preface section.

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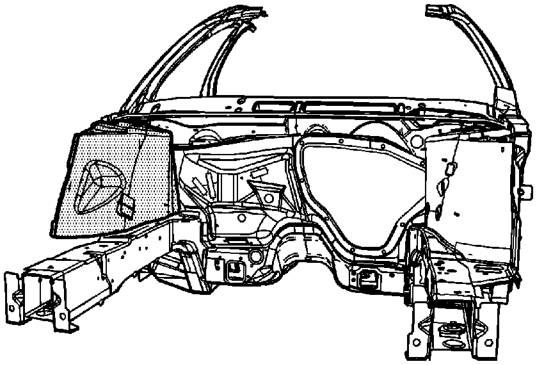
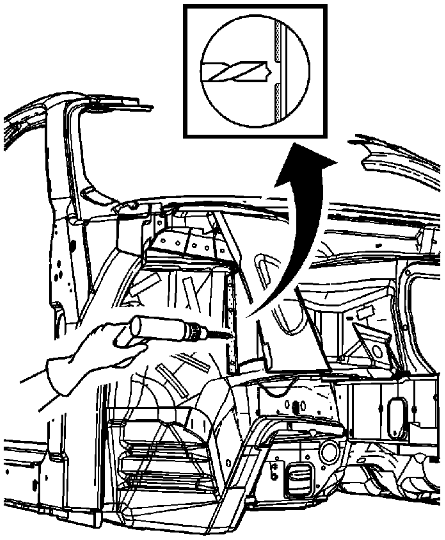
3. Remove all related panels and components.
4. Repair as much of the damage as possible.
5. Remove the sealers and the anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair.



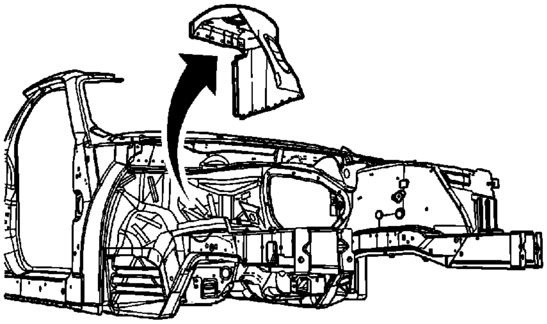
Note: Note the number and location of the factory welds for installation of the full wheelhouse service part.

6. Remove the radiator support assembly. Refer to Radiator Support Replacement.
7. Remove the upper fender rail. Refer to Upper Rail Replacement.



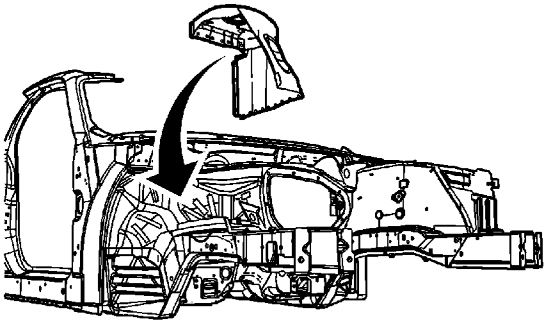
Note: Drill through the wheelhouse flange only. Do NOT drill into the dash panel or the inner reinforcements.

8. Using an 8-mm (5/16-in) spot weld remover, locate and drill out the factory welds on the weld flange connecting the wheelhouse to the dash panel.

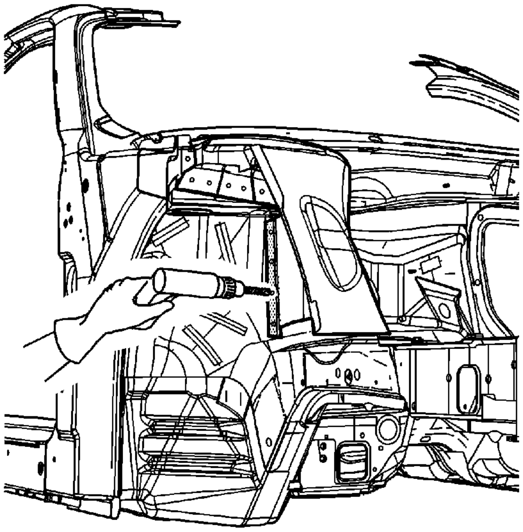


9. Remove the wheelhouse.

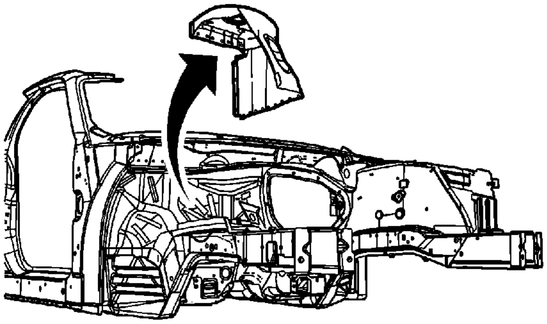
Installation Procedure



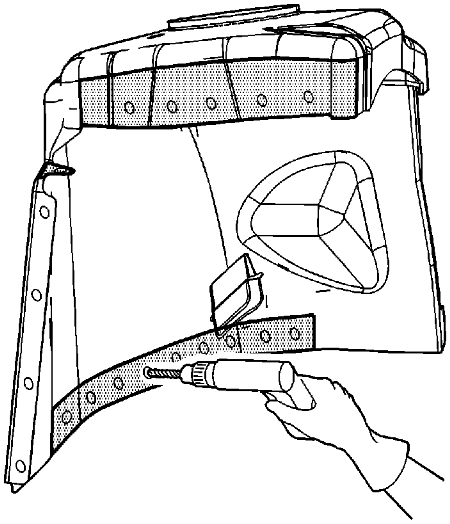
1. Position the service wheelhouse to the vehicle using 3-dimensional measuring equipment.
2. Clamp the wheelhouse in place.



3. Using a 7-mm (17/64-in) bit, drill the rivet attachment holes through the service wheelhouse and the dash panel, in the exact locations as noted from the factory wheelhouse.

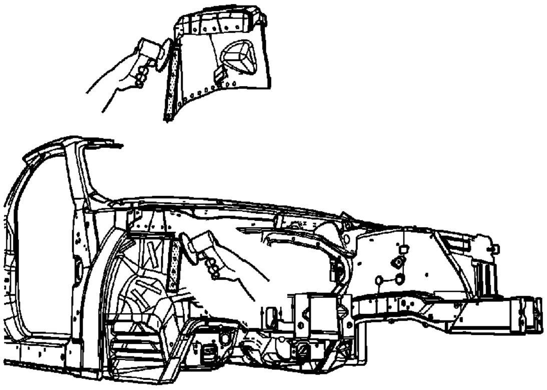


4. Remove the service wheelhouse.

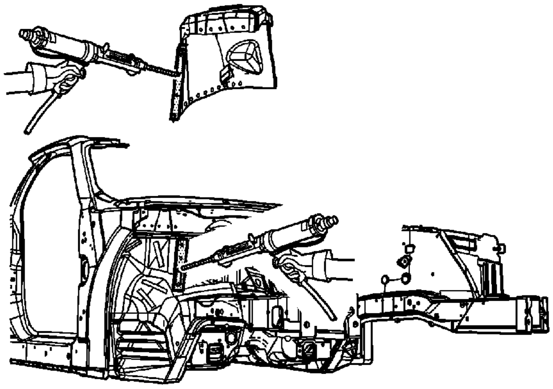


Note: If the location of the original plug weld holes cannot be determined, space the plug weld holes every 40 mm (1.5 in) apart.

5. Drill 8-mm (5/16-in) plug weld holes in the service wheelhouse, as necessary, in the remaining locations noted from the original wheelhouse.
6. Prepare the plug weld mating surfaces, as necessary.
7. Apply 3M® Weld-Thru Coating P/N 05913 or equivalent to the plug weld mating surfaces.

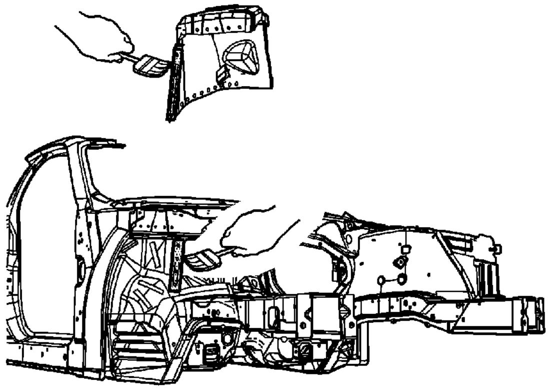


8. Prepare the bond mating areas by grinding the body mating and the service part flanges to bare steel. Do NOT damage the corners or thin the metal during the grinding process.
9. Clean the mating surfaces.



Note: The adhesive has a 40-50 minute working time. Do NOT allow the adhesive to cure prior to installing the service wheelhouse.

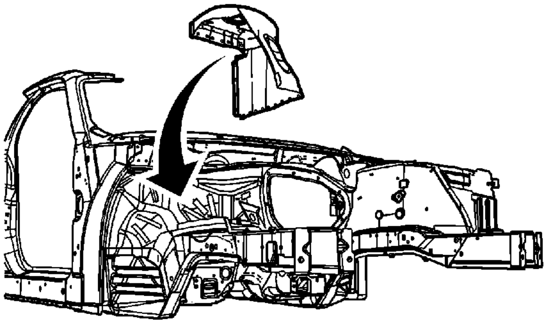
10. Apply a 3-6 mm (1/8 to 1/4 in) bead of metal panel bonding adhesive GM P/N 12378567 (Canadian P/N 88901675) or equivalent to both of the mating surfaces.



11. Using a small acid brush, spread a coat of adhesive to both of the mating surfaces. Cover all of the bare metal to ensure corrosion protection.

Object Number: 1546585 Size: SH

12. Apply a 3-6 mm (1/8 to 1/4 in) bead of metal panel bonding adhesive GM P/N 12378567 (Canadian P/N 88901675) or equivalent to the mating surface of the service wheelhouse.



Note: Do NOT pull the wheelhouse off of the dash after adhesion. To align the parts, slide the wheelhouse against the front of the dash.

13. Position the service wheelhouse to the vehicle using 3-dimensional measuring equipment.
14. Clamp the wheelhouse in place.

Object Number: 1546586 Size: SH

Note: Verify proper positioning of the service wheelhouse prior to riveting and welding.

15. Install the 9 mm (11/32 in) long rivets so that the rivet head contacts the passenger compartment side of the dash.
16. Remove the excess adhesive from the wheelhouse area.

Object Number: 1546587 Size: SH

17. Plug weld the remaining holes accordingly.
18. Clean and prepare all of the welded surfaces.
19. Install the radiator support assembly. Refer to Radiator Support Replacement.
20. Install the upper fender rail. Refer to Upper Rail Replacement.
21. Apply the sealers and anti-corrosion materials to the repaired area, as necessary. Refer to Anti-Corrosion Treatment and Repair.
22. Paint the repaired area. Refer to Basecoat/Clearcoat Paint Systems.

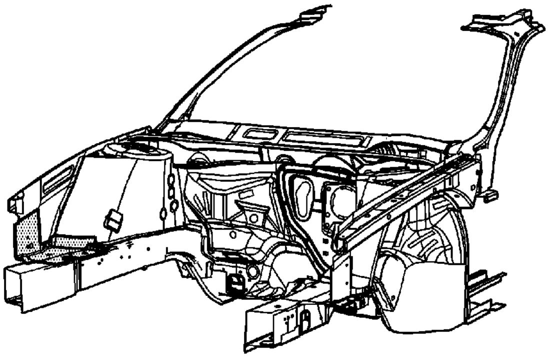
23. Install all of the related panels and components.
24. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
25. Enable the SIR system. Refer to SIR Disabling and Enabling.

Front Wheelhouse Extension Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.

1. Disable the SIR system. Refer to SIR Disabling and Enabling.
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.



3. Remove all related panels and components.
4. Repair as much of the damage as possible to factory specifications. Refer to Dimensions - Body.

Warning: Refer to Foam Sound Deadeners Warning in the Preface section.

5. Note the location and remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair.
6. Remove the radiator support. Refer to Radiator Support Replacement.

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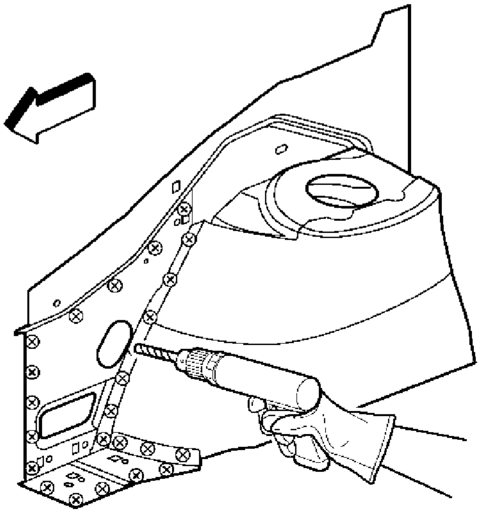
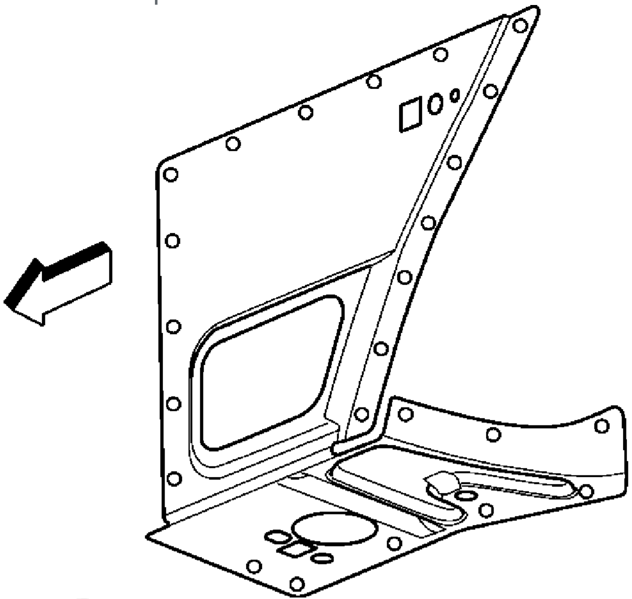


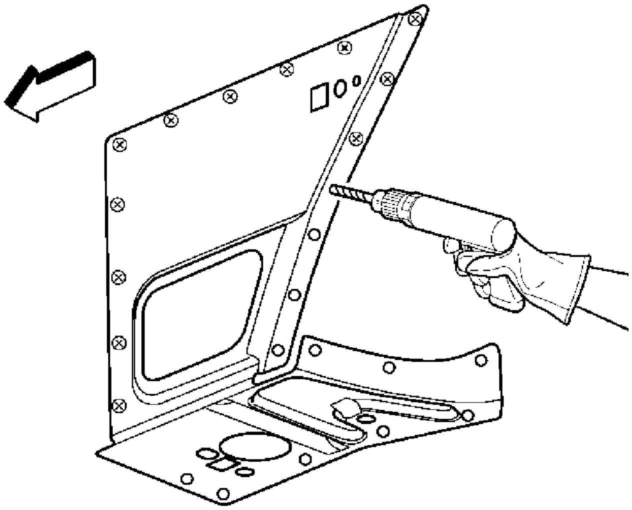
Note: Do not damage any inner panels or reinforcements.

7. Locate and drill out all factory welds. Note the number and location of welds for installation of the service part.



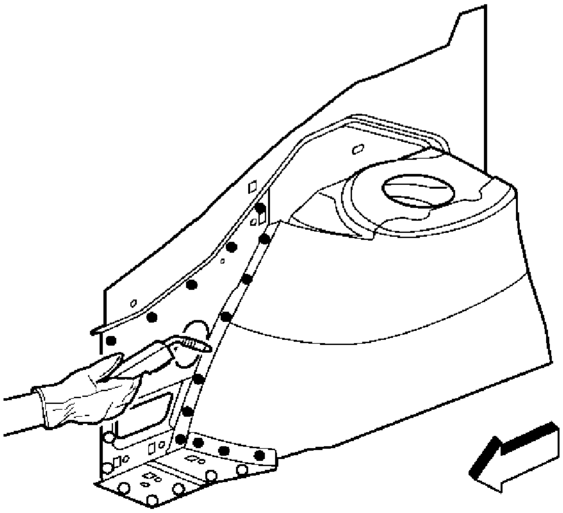
8. Remove the damaged apron extension.

Installation Procedure



Note: If the location of the original plug weld holes can not be determined, or if structural weld-thru adhesive is present, space the plug weld holes every 40 mm (1½ in) apart.

1. Drill 8 mm (5/16 in) plug weld holes in the service part as necessary in the locations noted from the original panel and along the sectioning cut.
2. Prepare all mating surfaces as necessary.
3. Apply 3M® Weld-Thru coating P/N 05916 or equivalent to all mating surfaces



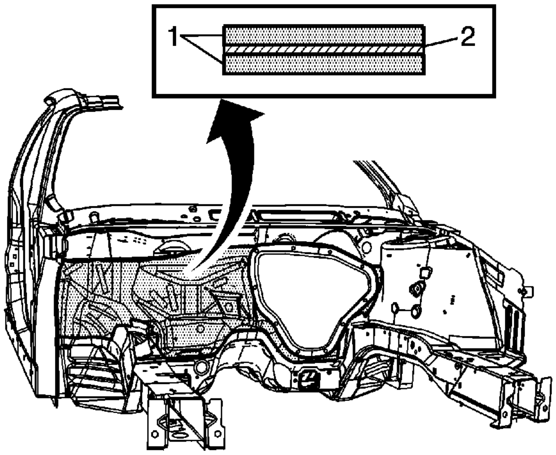
4. Position the apron extension.
5. Plug weld accordingly.
6. Replace the radiator support. Refer to Radiator Support Replacement.
7. Clean and prepare all welded surfaces.
8. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to Anti-

Corrosion Treatment and Repair.

9. Paint and repair the area. Refer to Basecoat/Clearcoat Paint Systems.
10. Install all related panels and components.
11. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
12. Enable the SIR system. Refer to SIR Disabling and Enabling.

Front Compartment Side Rail Rear Extension Replacement

Removal Procedure



Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.

Warning: Refer to Foam Sound Deadeners Warning in the Preface section.

Note:

- Model year 2004 and prior vehicles are not manufactured with laminated steel in front of the dashes. Therefore, the front lower rail extension can be metal inert gas (MIG) welded instead of the rivet and bonding process, as stated in these instructions.

  The front of the dash panel is formed from laminated steel. This steel is constructed by bonding 2 pieces of cold rolled steel (1) with a viscoelastic layer of adhesive (2). MIG welding laminated steel does not meet GM Corporate standards for structural integrity. As an alternative, all factory welds will be replaced by using the rivet and adhesive bond method, described in the installation portion of this procedure. The rivet and adhesive bond method must only be used in the areas as described in this procedure.
- Failure to follow this procedure will compromise the structural integrity of the vehicle.

1. Disable the SIR system. Refer to SIR Disabling and Enabling.
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.

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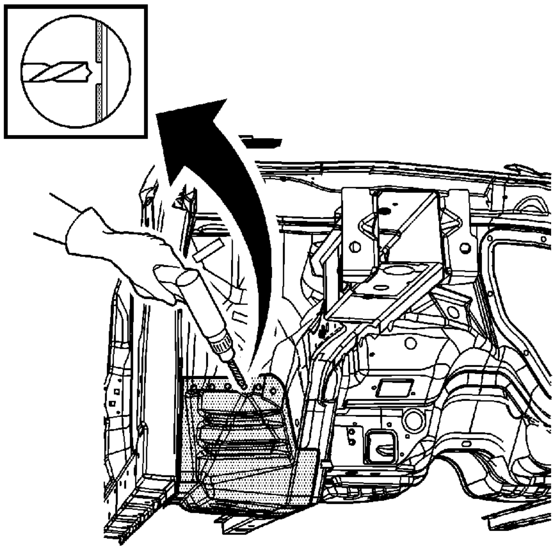
Warning: Refer to Collision Sectioning Warning in the Preface section.

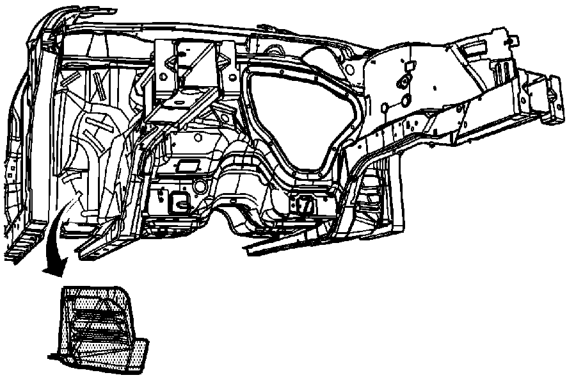
3. Remove all related panels and components.
4. Repair as much of the damage as possible.
5. Remove the sealers and the anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair.



Note:

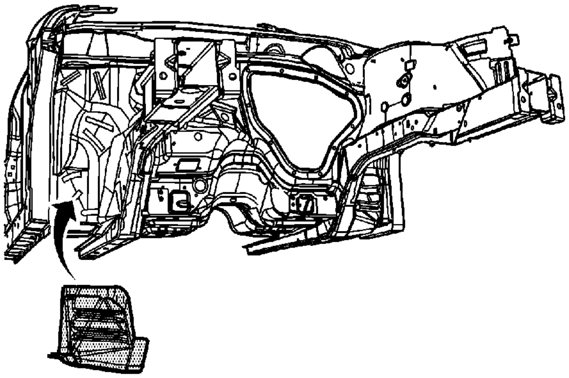
- Note the number and location of the factory welds, for installation of the rail side extension service part.
- Drill through the rail side extension flange only. Do NOT drill into the dash panel or the inner reinforcements.

6. Using an 8-mm (5/16-in) spot weld remover, locate and drill out the factory welds on the weld flange connecting the lower rail side extension to the vehicle structure.

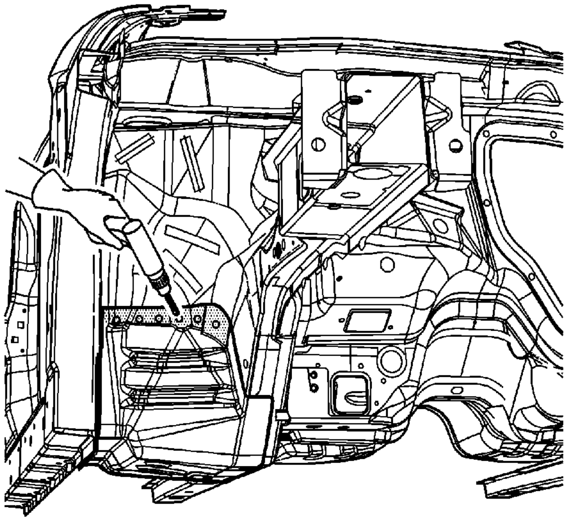


7. Remove the rail side extension.

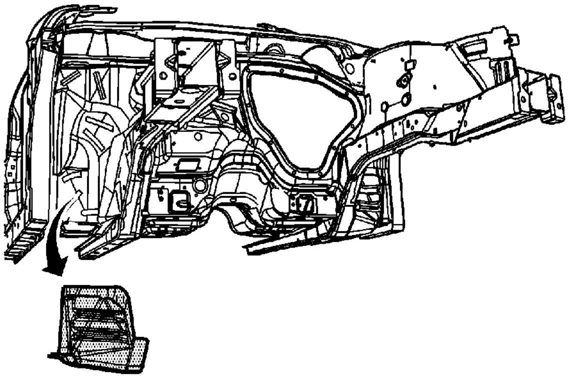
Installation Procedure



1. Position the service rail side extension to the vehicle.
2. Clamp the rail in place.



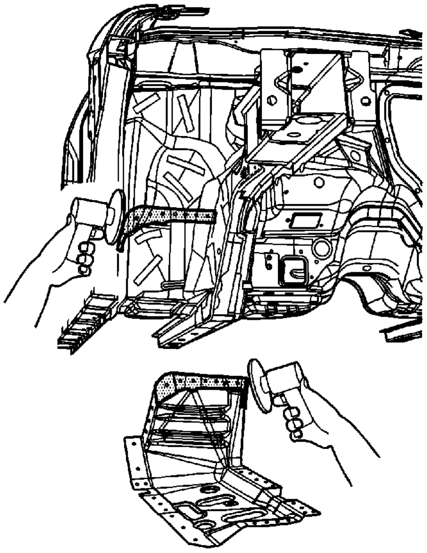
3. Using a 7-mm (17/64-in) bit, drill the rivet attachment holes through the service rail side extension and the dash panel, in the exact locations, as noted from the factory rail side extension.



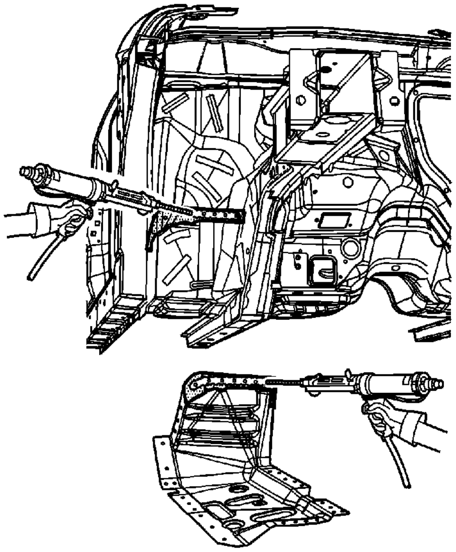
4. Remove the service rail side extension.

   Note: If the location of the original plug weld holes cannot be determined, space the plug weld holes every 40 mm (1.5 in) apart.

5. Drill 8-mm (5/16-in) plug weld holes in the service rail side extension as necessary, in the remaining locations noted from the original rail side extension.
6. Prepare the plug weld mating surfaces, as necessary.
7. Apply 3M® Weld-Thru Coating P/N 05913 or equivalent to the plug weld mating surfaces.

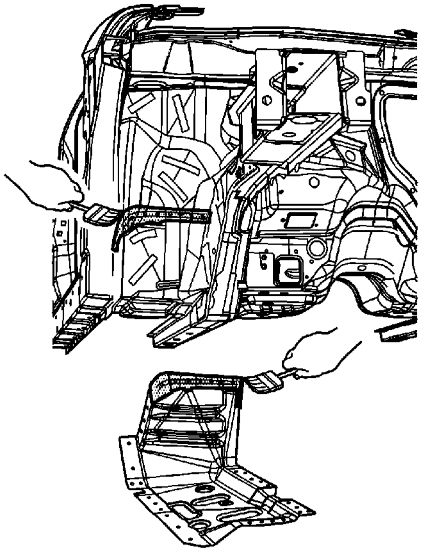


8. Prepare the bond mating areas by grinding the body mating and the service part flanges to bare steel. Do NOT damage the corners or thin the metal during the grinding process.
9. Clean the mating surfaces.

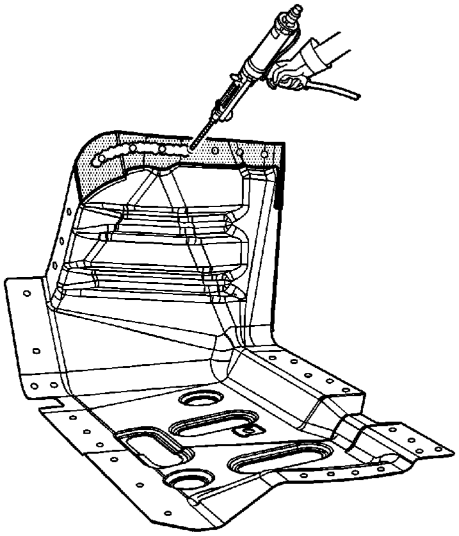


Note: The adhesive has a 40-50 minute working time. Do NOT allow the adhesive to cure prior to installing the service rail side extension.

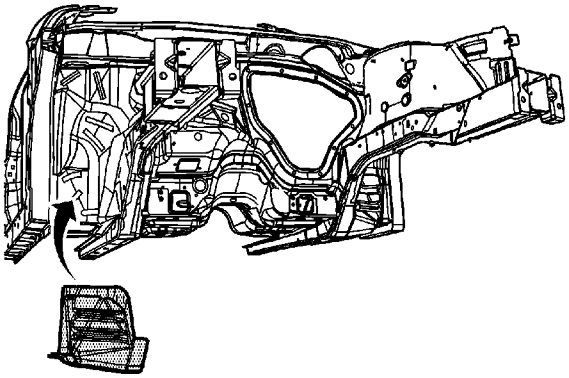
10. Apply a 3-6 mm (1/8 to 1/4 in) bead of metal panel bonding adhesive GM P/N 12378567 (Canadian P/N 88901675) or equivalent to both of the mating surfaces.



11. Using a small acid brush, spread a coat of adhesive to both of the mating surfaces. Cover all of the bare metal to ensure corrosion protection.

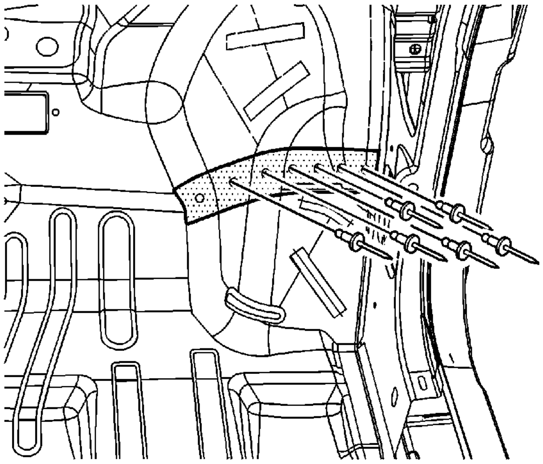


12. Apply a 3-6 mm (1/8 to 1/4 in) bead of metal panel bonding adhesive GM P/N 12378567 (Canadian P/N 88901675) or equivalent to the mating surface of the service rail side extension.



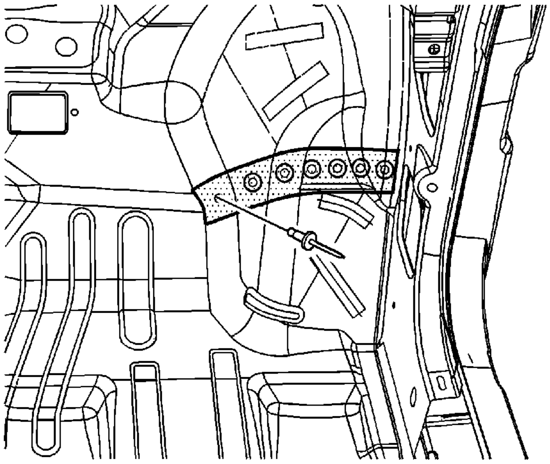
Note: Do NOT pull the service rail side extension off of the dash after adhesion. To align the parts, slide the service rail side extension against the front of the dash.

13. Position the service rail side extension to the vehicle using 3-dimensional measuring equipment.
14. Clamp the service rail side extension in place.

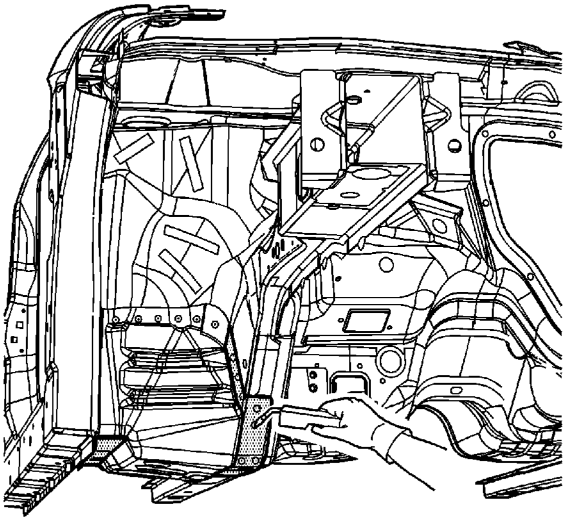


Note: Verify proper positioning of the service rail side extension prior to riveting and welding.

15. Install the 9-mm (11/32-in) long rivets so that the rivet head contacts the passenger compartment side of the dash.



16. Install the 14-mm (17/32-in) long rivets so that the rivet head contacts the passenger compartment side of the dash.
17. Remove the excess adhesive from the service rail side extension area.



18. Plug weld the remaining holes accordingly.
19. Clean and prepare all of the welded surfaces.
20. Apply the sealers and anti-corrosion materials to the repaired area, as necessary. Refer to Anti-Corrosion Treatment and Repair.
21. Paint the repaired area. Refer to Basecoat/Clearcoat Paint Systems.
22. Install all of the related panels and components.
23. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
24. Enable the SIR system. Refer to SIR Disabling and Enabling.

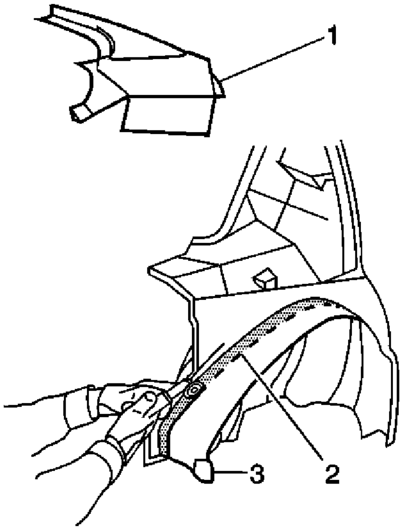
Rear Outer Wheelhouse Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.

Note: Although full replacement of the rear outer wheelhouse can be performed, sectioning procedures have been developed for use when damage permits.

1. Remove all of the related panels and components including the quarter panel.
2. Visually inspect and restore as much of the damage as possible.
3. Remove the following materials as necessary:
   - The sealers
   - The sound deadeners
   - The anti-corrosion materials
4. After removing the quarter panel, locate, mark and drill out the welds attaching the reinforcement panel (1) to the outer wheelhouse and the quarter panel.



5. Apply a strip of 25 mm (1 in) masking tape along the horizontal surface of the bend in the wheelhouse (2).
6. Cut along the outboard side of the masking tape to create a 25 mm (1 in) flange (2).
7. Remove the damaged section of the wheelhouse (3).

Installation Procedure

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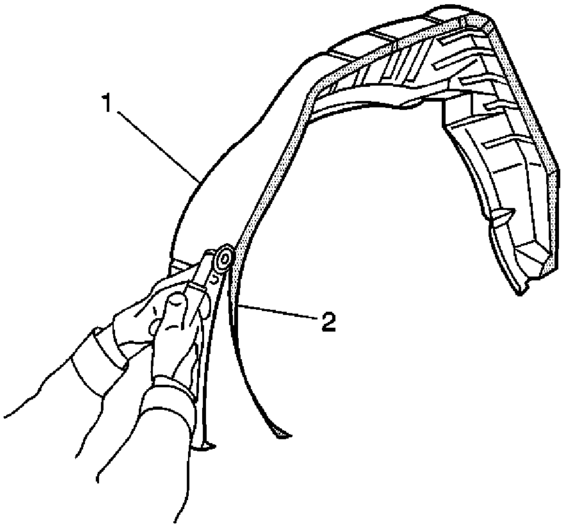
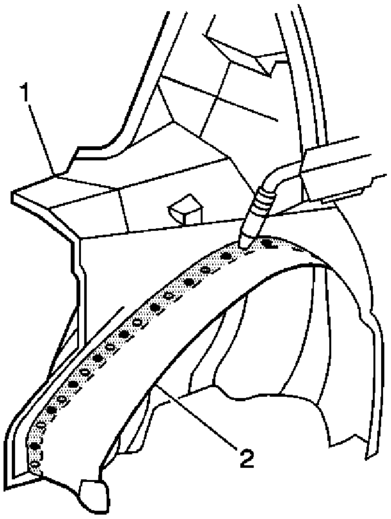


1. Cut the wheelhouse service part (1) along the corner of the bend (2).
2. Remove and discard the unused section of the wheelhouse.
3. On the service part, drill 8 mm (5/16 in) plug weld holes every 40 mm (1½ in) along the cut.



4. Prepare the mating surfaces as necessary. Inspect for proper fit of the service part.
5. Apply 3M Weld-Thru Coating P/N 05916 or equivalent to all mating surfaces.
6. Check for proper fit and plug weld accordingly (2). Take care not to warp or distort the metal.
7. Repair or replace the outer wheelhouse reinforcement as necessary.
8. Position the reinforcement panel as noted from the original panel location.
9. Plug weld accordingly.
10. Clean and prepare welded surfaces.

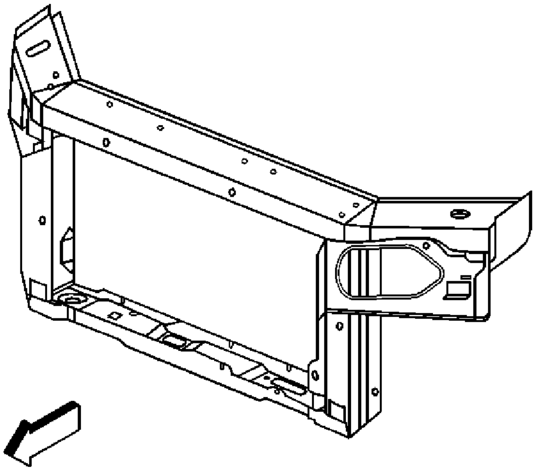
Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

11. Prime with 2-part catalyzed primer.
12. Apply the sealers and the anti-corrosion materials as necessary.
13. Install all of the related panels and components.

Radiator Support Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.



1. Remove all related panels and components.
2. Visually inspect and restore as much of the damage as possible to factory specifications.
3. Locate, mark, and drill out all factory welds. Note the number and location of welds for installation of the service assembly.
4. Remove the damaged radiator support assembly.

Installation Procedure

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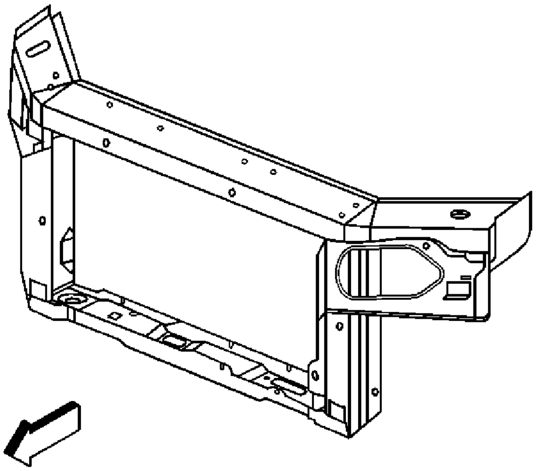


1. Prepare the mating surfaces as necessary. Inspect for proper fit of the service part.
2. Check for proper fit of the service assembly.
3. Drill 8 mm (5/16 in) plug weld holes as necessary in the locations noted from the original assembly.
4. Apply 3M Weld-Thru Coating P/N 05916 or equivalent to all mating surfaces.
5. Position the service assembly using 3-dimensional measuring equipment.
6. Plug weld accordingly with frequent measurements to ensure proper fit and alignment.
7. Clean and prepare all welded surfaces.
8. Prime with 2-part catalyzed primer.
9. Apply sealers and anti-corrosion materials as necessary.

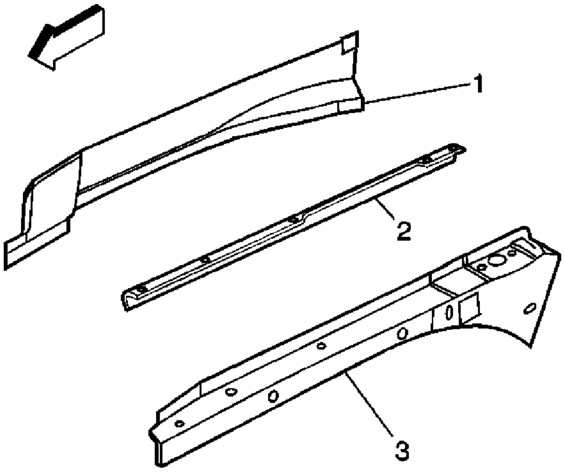
   Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

10. Install all related panels and components.

Upper Rail Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.



Note: The front upper rail is serviced as 2 components: inner (1) and outer (3) panels. The outer panel is serviced as a sub-assembly and includes an inner reinforcement (2). After the outer rail has been removed, the inner rail is completely accessible and can be serviced at the factory seams.

Note: Sectioning of the front upper rails is not recommended.

1. Remove all related panels and components.
2. Remove sealers and anti-corrosion materials as necessary.
3. Locate, mark, and drill out all factory welds attaching the outer rail.
4. Remove the damaged outer rail (3).
5. Locate, mark, and drill out the welds attaching the inner rail (1).
6. Remove the damaged inner rail.

Installation Procedure

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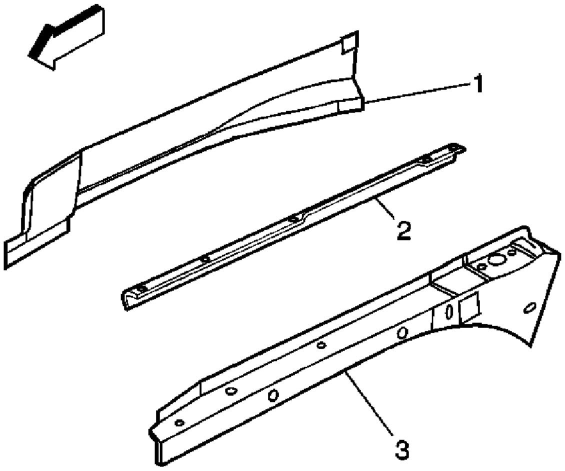
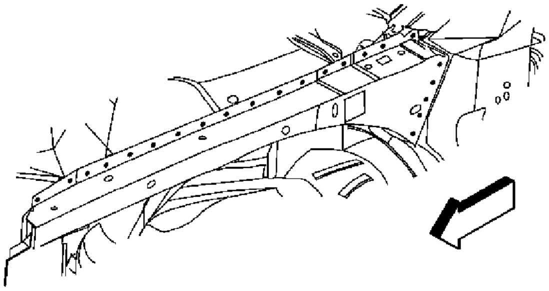


1. Prepare the mating surfaces as necessary. Inspect for proper fit of the service part.
2. Drill 8 mm (5/16 in) plug weld holes as necessary in the locations noted from the original panels.

   Note: If the original plug weld locations can not be determined, locate the holes for plug welding 40 mm (1½ in) apart.

3. Apply 3M Weld-Thru Coating P/N 05916 or equivalent to all mating surfaces.
4. Temporarily position the inner (1) and outer (3) rails on the vehicle.
5. Use 3-dimensional measuring to locate and mark front fender mounting-bolt holes in the outer rail (2).
6. Drill 5.5 mm (7/32 in) holes for self-tapping bolts as marked.



7. When the service panels are correctly positioned, remove the outer panel and plug weld the

inner panel as necessary.

8. Reposition the outer rail with frequent measurements to ensure proper fit and alignment.
9. Plug weld accordingly.
10. Clean and prepare all of the welded surfaces.

Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

11. Prime with 2-part catalyzed primer.
12. Apply the sealers and the anti-corrosion materials as necessary.
13. Install all of the related panels and components.

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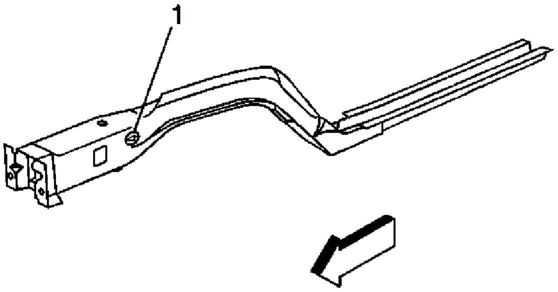
Document ID: 2102046

Lower Rail Sectioning

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.



Note: Sectioning procedures have been developed to simplify repair of the lower rails, providing the majority of the damage can be returned to factory specifications. This allows the damaged front section to be replaced without performing a full rail replacement. The rails are manufactured with diemarks (1) inboard and outboard to indicate the location for the sectioning joint.

Caution: Sectioning should take place only in the locations recommended in the service instructions. Failure to follow these instructions may compromise the structural integrity of the vehicle.

Note: If the damage exceeds the recommended area for sectioning and the rail cannot be straightened, the complete rail must be replaced.

1. Support the powertrain assembly.
2. Remove 4 engine cradle bolts.
3. Position the cradle away from the rail.

   Note: It is not necessary to completely remove the powertrain or engine cradle for rail sectioning.

4. Remove all panels and components necessary for access, including the strut and axle assemblies.
5. Remove sealers and anti-corrosion materials as necessary.

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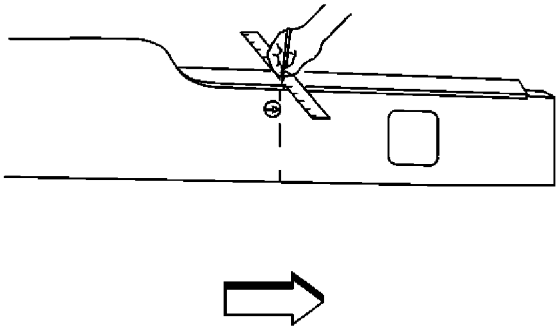
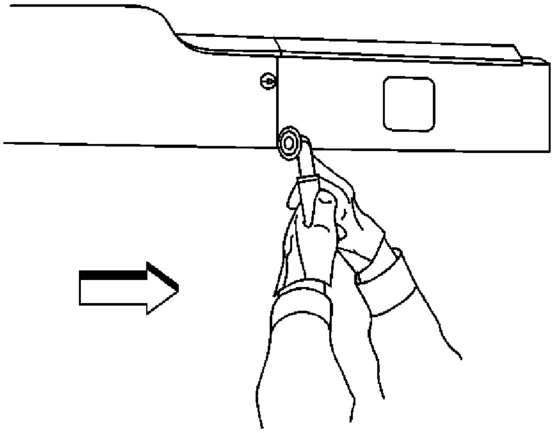
6. Locate the diemarks in the rail.

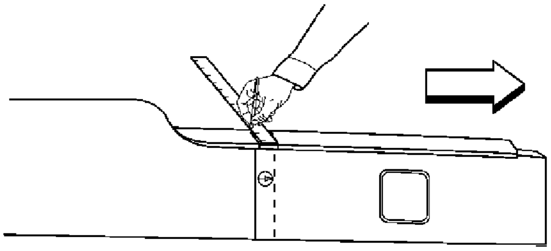


7. Use a straight edge to scribe lines around the rail.

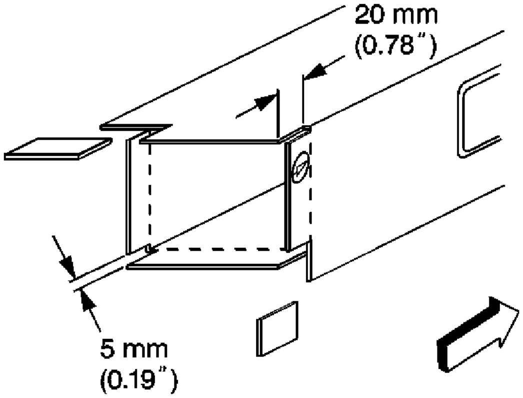


8. Mark and cut the damaged rail at the diemarks.
9. Remove the damaged section of the rail.

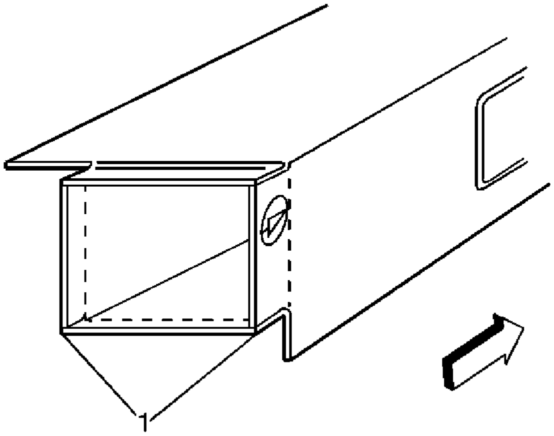
Installation Procedure



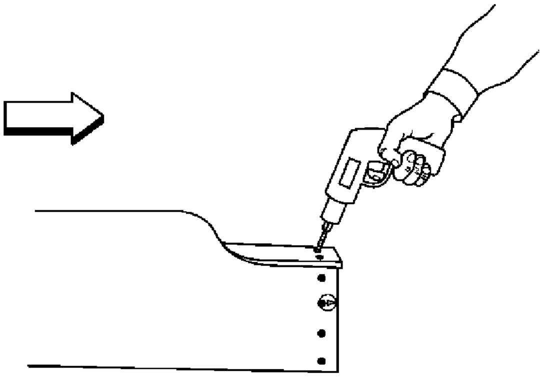
1. Measure from the diemarks to add 20 mm (3/4 in) in length to the service part.
2. Align marks with a straight edge and scribe line for sectioning cut.
3. Cut the service part along the marked lines.
4. Leave 20 mm (3/4 in) added lengths to the service part for sectioning overlap.
5. Cut and remove approximately 20 mm (3/4 in) of the outboard and downward turned flanges of the service part.



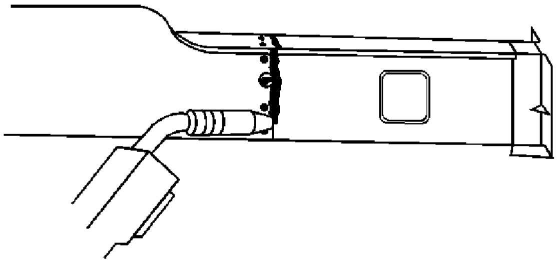
6. Cut 5 mm (3/16 in) wide and 20 mm (3/4 in) long slots along the corners of the service part to create tabs on the four sides of the rail.



7. Step the top, bottom and side tabs inward to allow the service part to fit inside the original rail.
8. Apply 3M Weld-Thru Coating P/N 05916 or equivalent to all mating surfaces.
9. Welds the tabs (1) together along the corners of the service part.



10. Drill 8 mm (5/16 in) plug weld holes in the top, bottom and sides of the original approximately 10 mm (3/8 in) from the sectioning cut.
11. Clean and prepare the mating surfaces as necessary.
12. Position the stepped tabs of the modified service part inside the original rail. Allow 20 mm (¾ in) of overlap.
13. Align and check fit using three dimensional measuring equipment.
14. Plug weld accordingly.
15. Check measurements frequently to ensure proper fit and alignment.
16. Stitch weld along the entire sectioning joint.



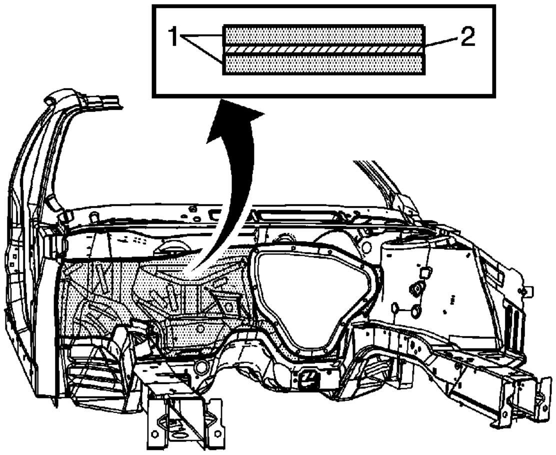
17. Make 25 mm (1 in) welds along the seam with 25 mm (1 in) gaps between them.
18. Go back and complete the stitch weld. This will create a solid joint with minimal heat distortion.
19. Clean and prepare welded surfaces.

Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

20. Prime with 2-part catalyzed primer.
21. Apply sealers and anti-corrosion materials as necessary.
22. Install all related panels and components.

Lower Rail Replacement

Removal Procedure



Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.

Warning: Refer to Foam Sound Deadeners Warning in the Preface section.

Note:

- Model year 2004 and prior vehicles are not manufactured with laminated steel in front of the dashes. Therefore, the front lower rail can be metal inert gas (MIG) welded instead of the rivet and bonding process, as stated in these instructions.
- Failure to follow this procedure will compromise the structural integrity of the vehicle.

  The front of the dash panel is formed from laminated steel. This steel is constructed by bonding 2 pieces of cold rolled steel (1) with a viscoelastic layer of adhesive (2). MIG welding laminated steel does not meet GM Corporate standards for structural integrity. As an alternative, all factory welds will be replaced by using the rivet and adhesive bond method described in the installation portion of this procedure. The rivet and adhesive bond method must only be used in the areas as described in this procedure.

1. Disable the SIR system. Refer to SIR Disabling and Enabling.
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.

   Warning: Refer to Collision Sectioning Warning in the Preface section.

3. Remove all related panels and components.

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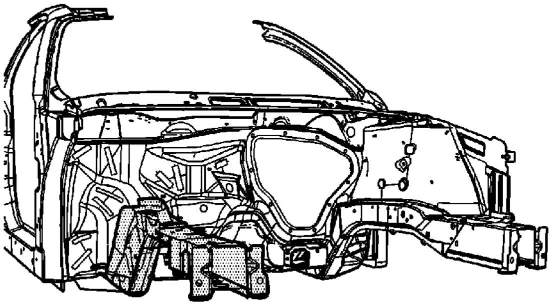
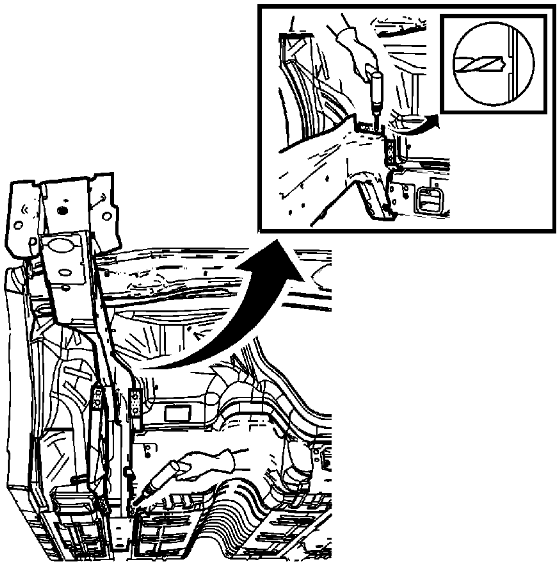
4. Repair as much of the damage as possible.
5. Remove the sealers and the anti-corrosion materials from the repair area, as necessary. Refer to Anti-Corrosion Treatment and Repair.



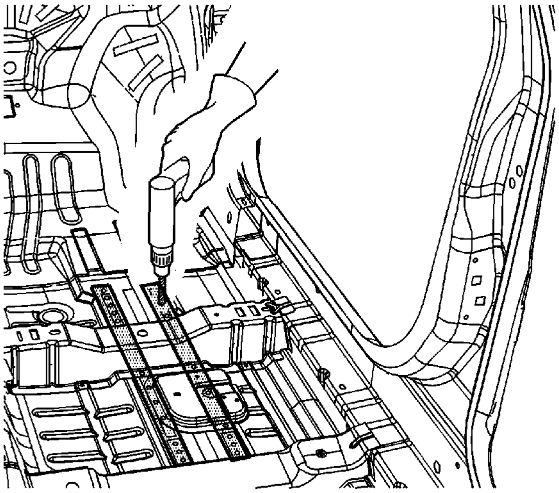
Note: Note the number and location of the factory welds for installation of the full rail service part.

6. Remove the front wheelhouse assembly. Refer to Front Wheelhouse Replacement.
7. Remove the radiator support assembly. Refer to Upper Rail Replacement.
8. Remove the front rail side extension. Refer to Front Compartment Side Rail Rear Extension Replacement.

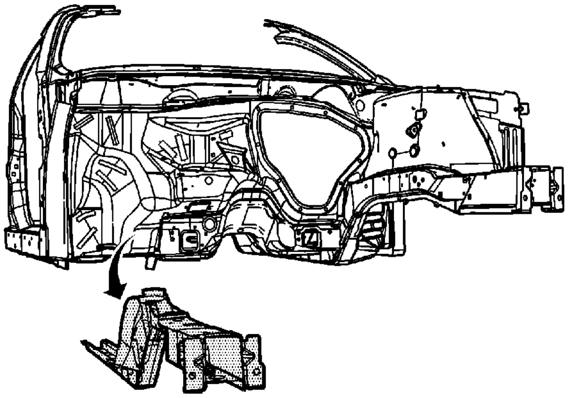


Note: Drill through the rail flange only. Do NOT drill into the dash panel or the inner reinforcements.

9. Using an 8-mm (5/16-in) spot weld remover, locate and drill out the factory welds on the weld flange connecting the lower rail to the dash panel.

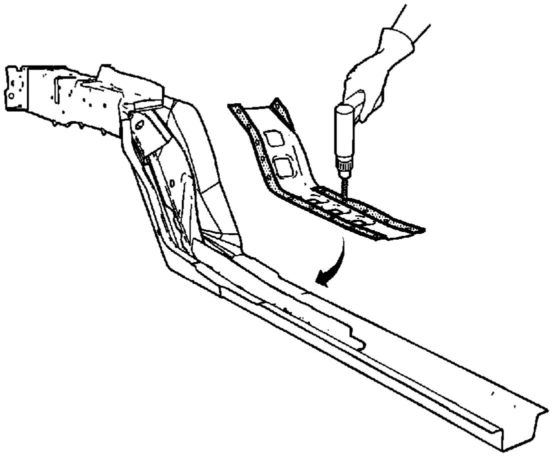


10. From the passenger compartment, locate and drill out the remaining factory weld.



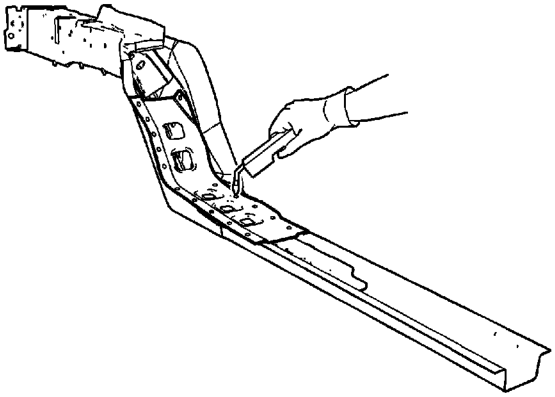
11. Remove the full rail.

Installation Procedure

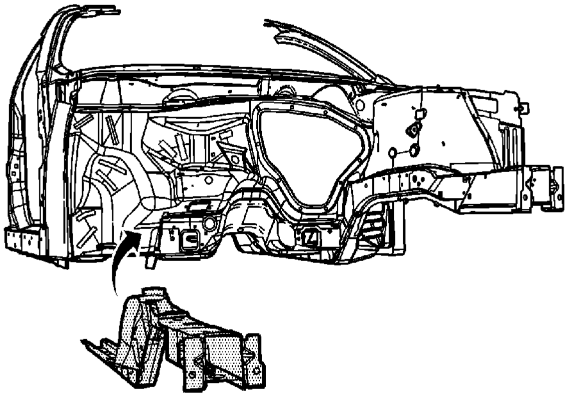


Note: Failure to install the front compartment lower rail reinforcement to the front compartment lower rail will compromise the structural integrity of the vehicle.

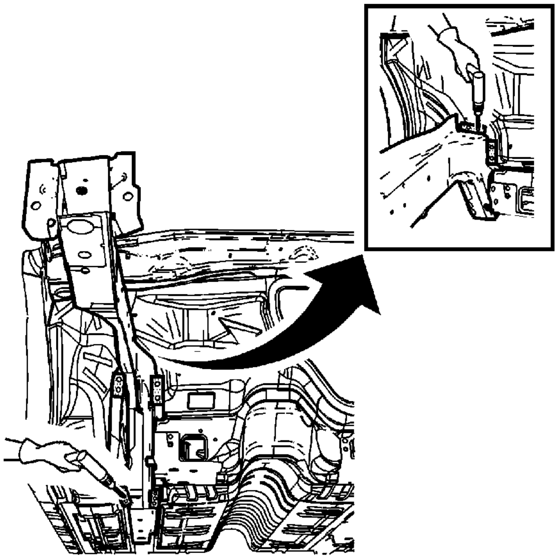
1. Drill 8-mm (5/16-in) plug weld holes in the service front lower rail reinforcement in the location noted from the original rail.
2. Prepare the plug weld mating surfaces, as necessary.
3. Apply 3M® Weld-Thru Coating P/N 05913 or equivalent to the plug weld mating surfaces.
4. Position the front lower rail reinforcement.



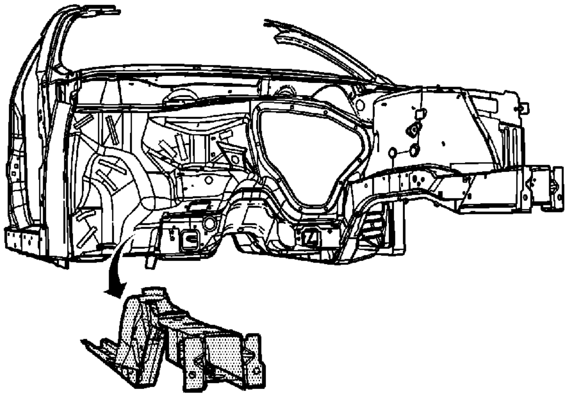
5. Plug weld the holes accordingly.



6. Position the service rail to the vehicle using 3-dimensional measuring equipment.
7. Clamp the rail in place.

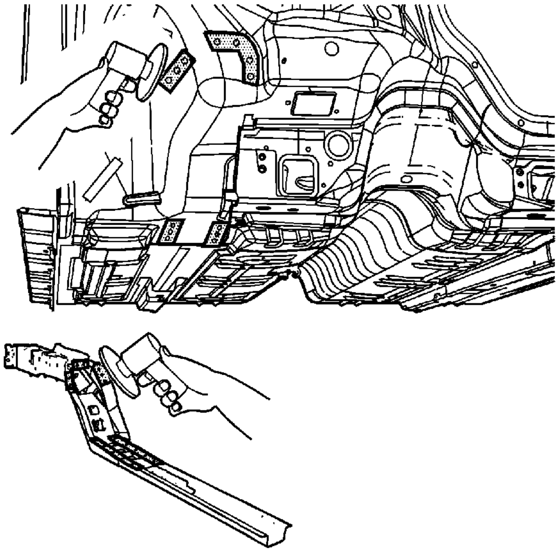


8. Using a 7-mm (17/64-in) bit, drill the rivet attachment holes through the service rail and the dash panel in the exact locations, as noted from the factory rail.

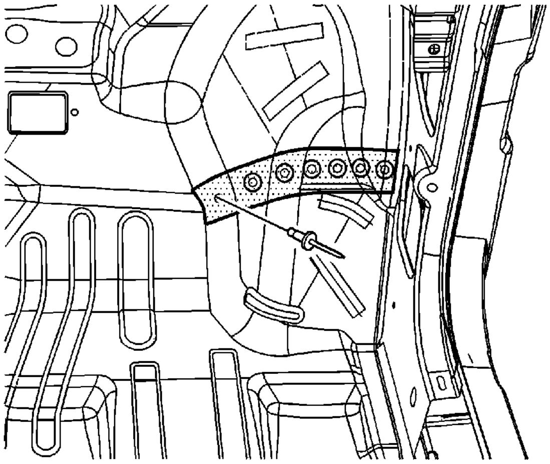


Note: If the location of the original plug weld holes cannot be determined, space the plug weld holes every 40 mm (1.5 in) apart.

9. Remove the service rail.
10. Prepare the plug weld mating surfaces, as necessary.
11. Apply 3M® Weld-Thru Coating P/N 05913 or equivalent to the plug weld mating surfaces.



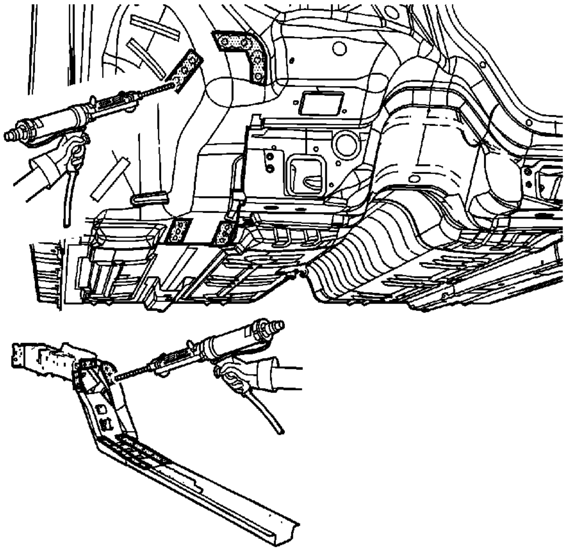
12. Prepare the bond mating areas by grinding the body mating and the service part flanges to bare steel. Do NOT damage the corners or thin the metal during the grinding process.



Note:

- Do NOT allow the adhesive to cure prior to installation of the front rail side extension. Refer to Front Compartment Side Rail Rear Extension Replacement.
- Note the necessary location for installation of a 14-mm (17/32-in) long rivet.

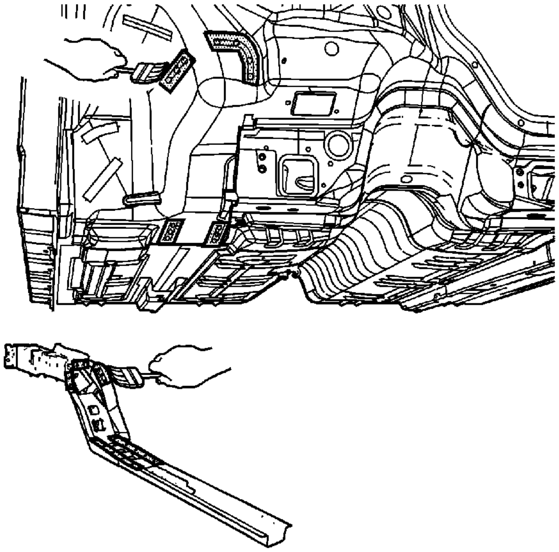
13. Clean the mating surfaces.



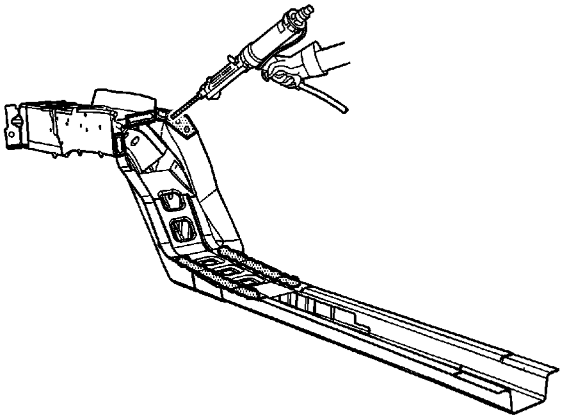
Note: The adhesive has a 40-50 minute working time. Do NOT allow the adhesive to cure prior to installing the service rail.

14. Apply a 3-6 mm (1/8 to 1/4 in) bead of metal panel bonding adhesive GM P/N 12378567

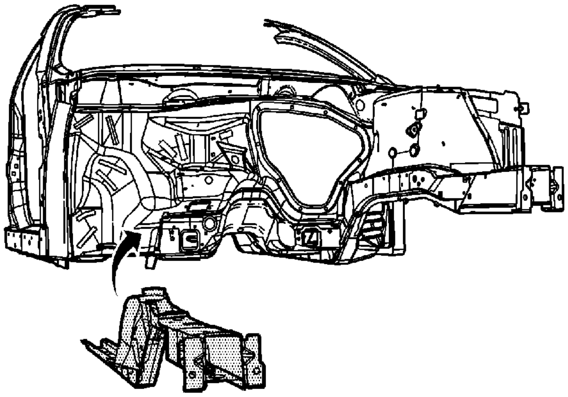
(Canadian P/N 88901675) or equivalent to both of the mating surfaces.



15. Using a small acid brush, spread a coat of adhesive to both of the mating surfaces. Cover all of the bare metal to ensure corrosion protection.

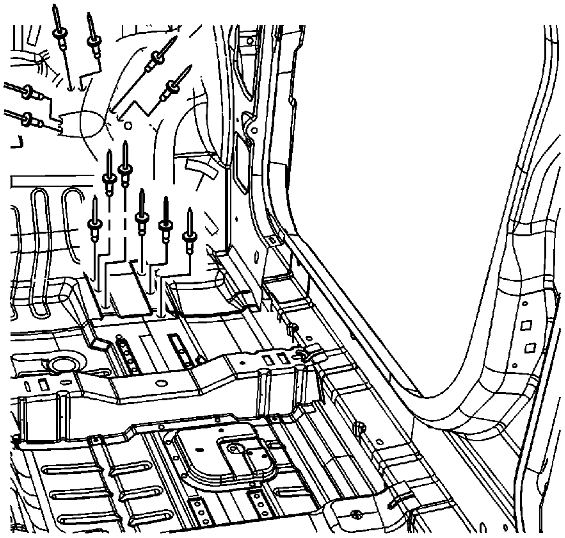


16. Apply a 3-6 mm (1/8 to 1/4 in) bead of metal panel bonding adhesive GM P/N 12378567 (Canadian P/N 88901675) or equivalent to the mating surface of the service rail.



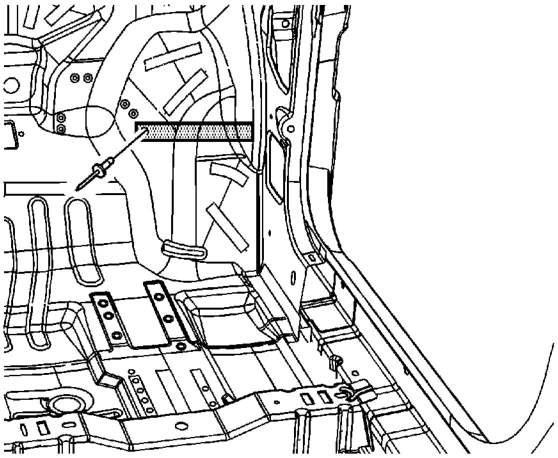
Note: Do NOT pull the rail off of the dash after adhesion. To align the parts, slide the rail against the front of the dash.

17. Position the service rail to the vehicle using 3-dimensional measuring equipment.
18. Clamp the rail in place.

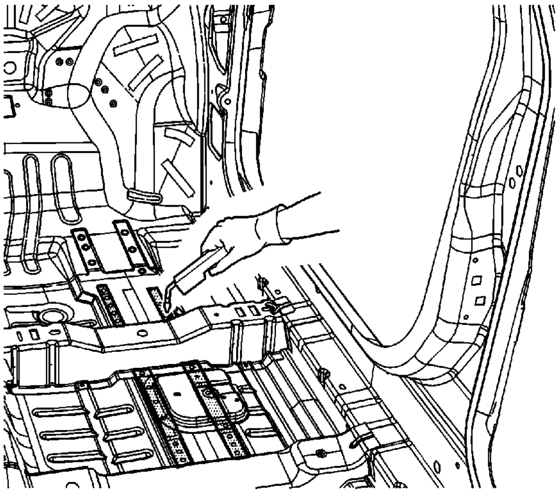


Note: Verify proper positioning of the service rail prior to riveting and welding.

19. Install the 9-mm (11/32-in) long rivets, so that the rivet head contacts the passenger compartment side of the dash.



20. Install the 14-mm (17/32-in) long rivet, so that the rivet head contacts the passenger compartment side of the dash, extending through the front rail and through the rail side extension.
21. Remove the excess adhesive from the rail area.



22. Plug weld the remaining holes, accordingly.
23. Clean and prepare all of the welded surfaces.
24. Install the front wheelhouse assembly. Refer to Front Wheelhouse Replacement.
25. Install the front rail side extension. Refer to Front Compartment Side Rail Rear Extension Replacement.
26. Install the radiator support assembly. Refer to Upper Rail Replacement.
27. Apply the sealers and anti-corrosion materials to the repaired area, as necessary. Refer to Anti-Corrosion Treatment and Repair.
28. Paint the repaired area. Refer to Basecoat/Clearcoat Paint Systems.
29. Install all of the related panels and components.

30. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
31. Enable the SIR system. Refer to SIR Disabling and Enabling.

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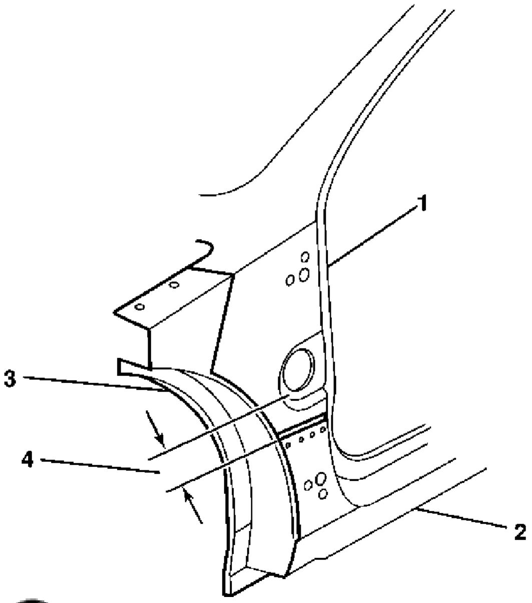
Front Hinge Pillar Sectioning

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.

Note: Do not cut adjacent panels.

Note: Follow general sectioning for the outer rocker panel. Sectioning should take place in shaded areas only. There are key structural areas on the outer rocker panel where sectioning should not be performed. Sectioning in these areas may compromise the structural integrity of the vehicle.



1. Visually inspect and restore as much of the damage as possible to factory specifications.
2. Remove all related panels and components.
3. Position all wiring out of the way to prevent damage and for best access to vehicle.
4. Remove all sealers and anti-corrosion materials as necessary.
5. On the original outer door frame (1) measure down 35 mm (1 3/8 in) from the large wiring harness hole in the pillar and mark a horizontal line (4).
6. Cut the outer door frame along this line for sectioning.
7. Perform additional sectioning procedures as necessary to remove damaged areas of the door frame opening.
8. Locate and mark all factory welds. Note the number and location of welds for installation of the service part.
9. Drill out all factory welds as necessary.

   Note: Note the location of the sound deadening foam for installation.

10. Remove the damaged section of the outer door frame opening (2).

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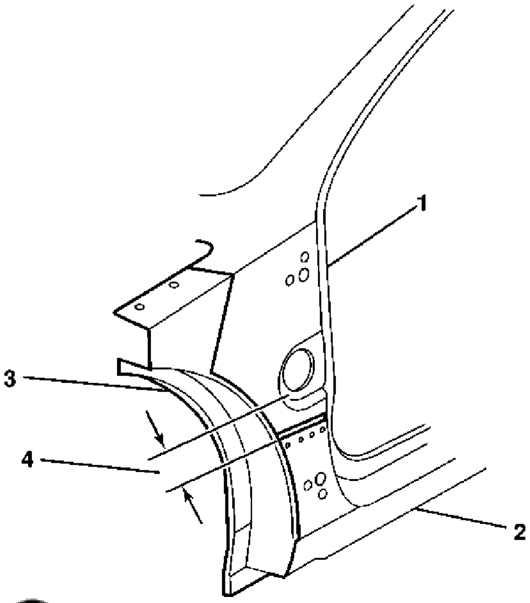
Installation Procedure



1. On the service part (2), mark a horizontal line to leave a gap of 1 ½ times the thickness of the metal at the section joint.
2. Cut the service panel along this line.
3. Drill 8 mm (5/16 mm) holes for plug welding in the service part in the locations noted from the original panel.
4. Drill holes for plug welding along the sectioning cut on the service part. Locate these holes approximately 13 mm (½ in) from the edge of the sectioning cut.
5. Apply 3M Weld-Thru Coating P/N 05916 or equivalent to all mating surfaces.
6. Use the inner reinforcement (3) as a backing plate.
7. Stitch weld along the entire joint with 25 mm (1 in) welds along the seams with 25 mm (1 in) gaps between.
8. Go back and complete the stitch weld. This will create a solid joint with minimal heat distortion.
9. Complete all other welds and sectioning procedures as necessary.
10. Clean and prepare welded surfaces.

    Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

11. Prime with two-part catalyzed primer.

    Note: It is necessary to apply the sound-deadening foam in the locations as noted from removal.

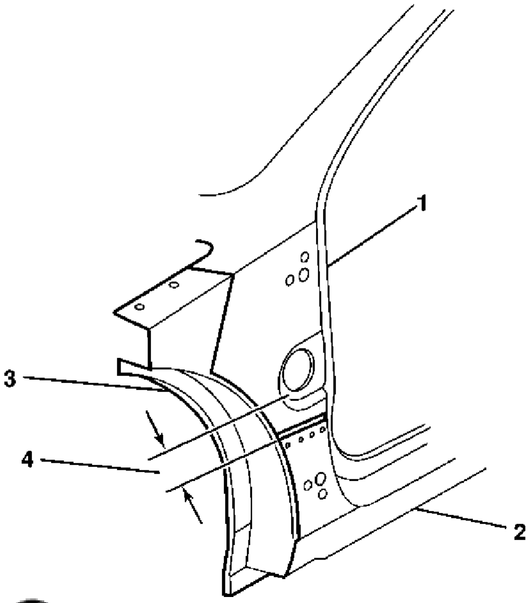
12. Apply sealers and anti-corrosion materials as necessary.
13. Install all related panels and components.

Front Inner Hinge Pillar Reinforcement Sectioning

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.

Note: Sectioning of the inner reinforcement panel (3) can only take place with outer door frame replacement or sectioning procedures. Sectioning the outer door (1) frame at the front hinge pillar requires a 25 mm (1 in) offset from the inner reinforcement sectioning joint. The inner reinforcement can serve as a backing plate for the outer panel sectioning.



1. Visually inspect and restore as much of the damage as possible to factory specifications.
2. Remove all related panels and components.
3. Position all wiring out of the way to prevent damage and for best access to vehicle.
4. Remove all sealers and anti-corrosion materials as necessary.

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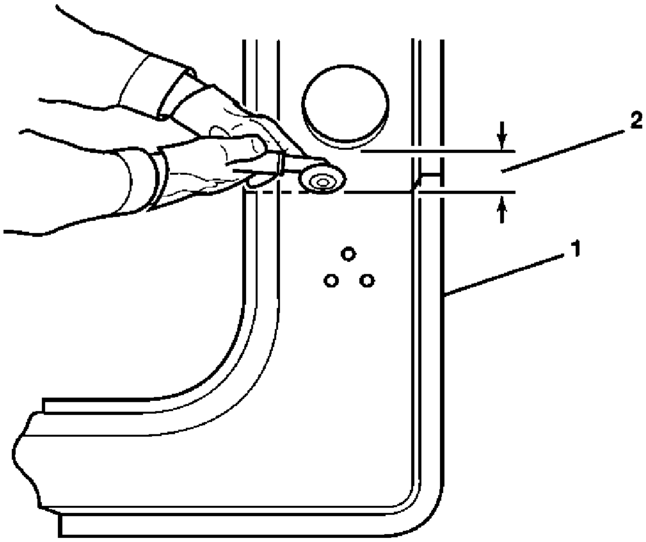
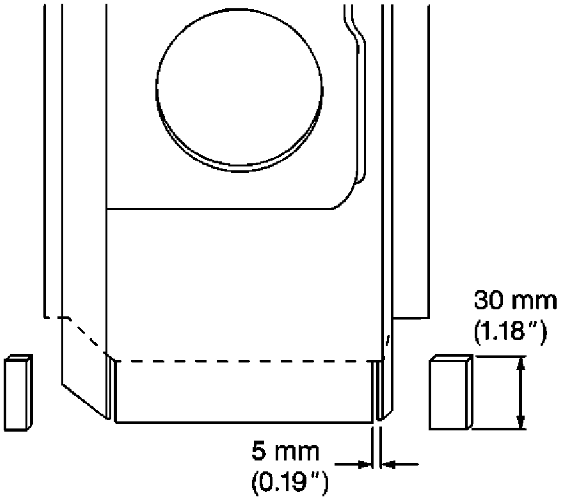


5. On the original reinforcement panels (1) measure down 90 mm (3 9/16 in) from the large wiring harness hole in the pillar and mark a horizontal line.
6. Cut the inner reinforcement along this line for sectioning.
7. Locate and mark all factory welds. Note the number and location of welds for installation of the service part.
8. Drill out all factory welds as necessary.

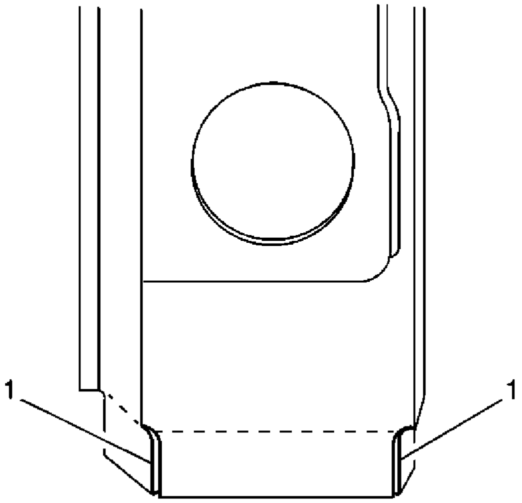
Note: Note the locations of the sound-deadening foam for installation.

9. Remove the damaged section of the inner reinforcement (2).

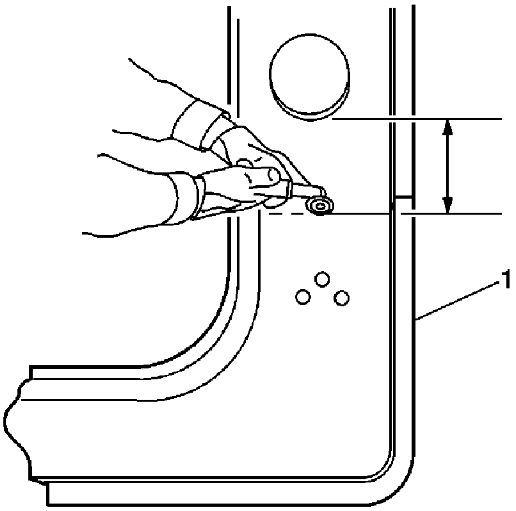
Installation Procedure



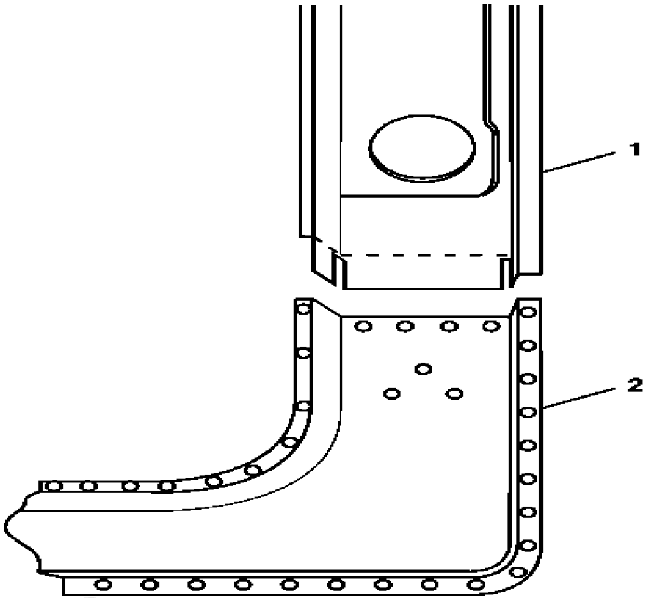
1. Cut and remove 30 mm (1 3/16 in) from the flanges on either side of the remaining section of the original hinge pillar to create a 30 mm (1 3/16 in) flange.
2. Cut 5 mm (3/16 in) wide gaps in the bottom corners.
3. Step the tabs inward to allow the door frame inner reinforcement service section to fit over the original inner reinforcement.
4. Apply 3M Weld-Thru Coating P/N 05916 or equivalent to all mating surfaces.



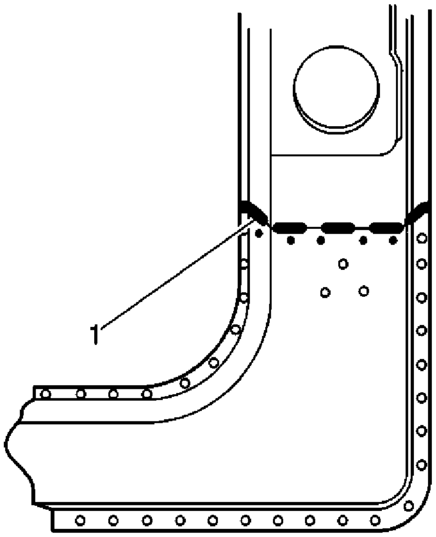
5. Weld the tabs together along the edges (1).



6. On the service part (1) measure 60 mm (2 3/8 in) down from the large wiring harness hole in the hinge pillar and mark a horizontal line.
7. Cut the hinge pillar along this line.



8. Drill 8 mm (5/16 in) plug weld holes as necessary in the locations noted from the original panel.
9. Drill plug weld holes along the sectioning cut of the service part (2).
10. Prepare the mating surfaces as necessary. Position the service section (2) over the stepped tab on the original inner reinforcement (1).
11. Check and make sure the door hinge bolt holes are properly located.



12. Plug weld accordingly.
13. Stitch weld along the entire joint (1).
14. Make 25 mm (1 in) welds along the seam with 25 mm (1 in) gaps between.
15. Go back and complete the stitch weld. This will create a solid joint with minimal heat distortion.
16. Clean and prepare welded surfaces.

Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

17. Prime with 2-part catalyzed primer.

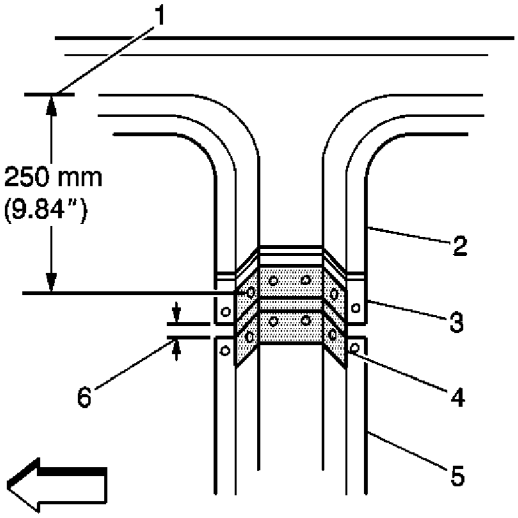
    Note: It is important to re-apply the sound-deadening foam in the locations noted from the removal process.

18. Apply sealers and anti-corrosion materials as necessary.
19. Install all related panels and components.

Door Frame Reinforce Sectioning - Center Pillar

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.



Note: The striker plate is mounted in a cage that allows some degree of adjustment independent of the outer panels position. Use body dimensions to ensure that the striker mounting location falls within the plates range of adjustment.

1. Remove all related panels and components.
2. Visually inspect and restore as much of the damage as possible.
3. Remove sealers and anti-corrosion materials as necessary.

Note: When sectioning both the inner (3) and the outer panels (2) this should result in a 100 mm (4 in) offset in the sectioning joints. Use care not to cut the inner door opening frame when cutting the center pillar reinforcement.

Note: Sectioning of the center pillar reinforcement should be performed only in the specified sectioning locations.

4. Cut the reinforcement (3) panel 250 mm (13 3/4 in) from the lower edge of the door opening (1).
5. Locate and mark all factory welds. Note the number and location of welds for installation of the service assembly.
6. Drill out all factory welds.

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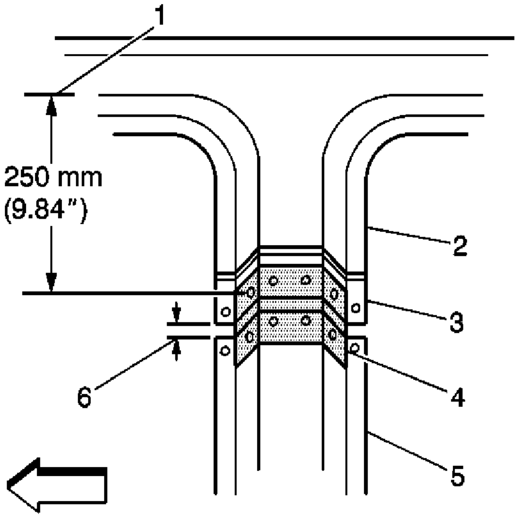
Installation Procedure



1. On the service part (5) mark a horizontal line to leave a gap of 1 ½ times the thickness of the metal (6) at the sectioning joint.
2. Cut the service reinforcement panel along this line.
3. Cut a 50 mm (2 in) piece from the unused portion of the service part (5) for a backing plate.
4. Remove the flange on each side of the backing plate (4) so that it will fit behind the sectioning joint (6).
5. Drill 8 mm (5/16 in) holes for plug welding in the service part in the location noted from the original panel.
6. Drill holes for plug welding along the sectioning cuts on both the service part (5) and the original panel (3).
7. Locate these holes approximately 13 mm (1/2 in) from the edge of the sectioning cuts.
8. Prepare the mating surfaces as necessary. Position the backing plate with 25 mm (1 in) of the backing plate exposed. Position the service part (5) to overlap the exposed backing plate.
9. Apply 3M Weld-Thru Coating P/N 05916 or equivalent to all mating surfaces.
10. Make 25 mm (1 in) welds along the seams with 25 mm (1 in) gaps between.
11. Go back and complete the stitch weld. This will create solid joint with minimal heat distortion.
12. Complete all other welds as necessary.
13. Clean and prepare welded surfaces.

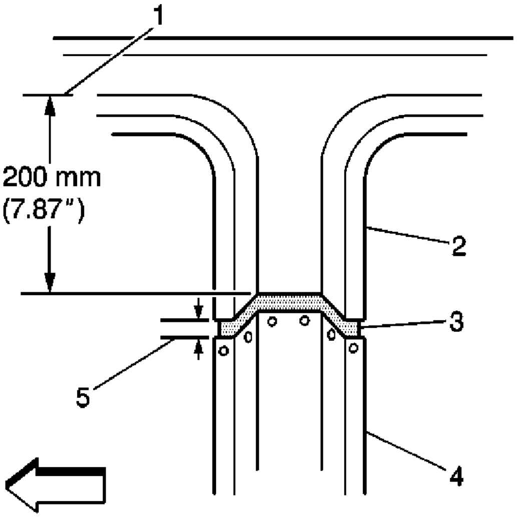
Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

14. Prime with 2 part catalyzed primer.
15. Apply sealers and anti-corrosion materials as necessary.

Center Pillar Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.



1. Visually inspect and restore as much of the damage as possible to factory specifications.
2. Remove all related panels and components.
3. Position all wiring out of the way to prevent damage.
4. Remove sealers and anti-corrosion materials as necessary.
5. On the original outer door frame (2) measure down from the lower edge (1) of the door opening 200 mm (8 in) and mark a horizontal line.
6. Cut the outer door frame along this line for sectioning. Do not cut into the inner reinforcement.
7. Locate and mark all factory welds. Note the number and location of welds for installation of the service section.
8. Drill out all factory welds as necessary.
9. Perform additional sectioning procedures as necessary to remove the center lock pillar.
10. Remove the damaged section of the door frame opening (4).

Installation Procedure

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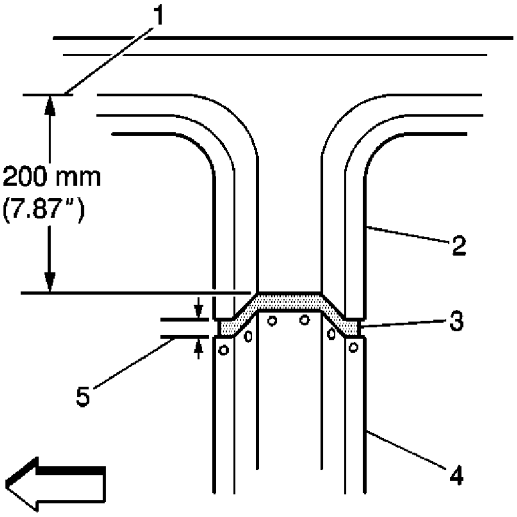


1. On the service part (4), mark a horizontal line to leave a gap of 1½ times the thickness of the metal (5) at the sectioning joint.
2. Cut the service panel along this line.
3. Drill 8 mm (5/16 in) holes for plug welding in the service part (4) in the locations noted from the original panel.
4. Drill holes for plug welding long the sectioning cuts on the services part.
5. Locate these holes approximately 13 mm (17/32 in) from the edge of the sectioning cuts.
6. Prepare the mating surfaces as necessary. Position the service part using three-dimensional measuring equipment.
7. Apply 3M Weld-Thru Coating P/N 05916 or equivalent to all mating surfaces.
8. Plug weld accordingly.
9. Use the inner reinforcement (3) as a backing plate and stitch weld along the entire sectioning joint.
10. Make 25 mm (1 in) welds along the seam with 25 mm (1 in) gaps between.
11. Go back and complete the stitch weld. This will create a solid joint with minimal heat distortion.
12. Complete all other welds and sectioning procedures as necessary.
13. Clean and prepare welded surfaces.

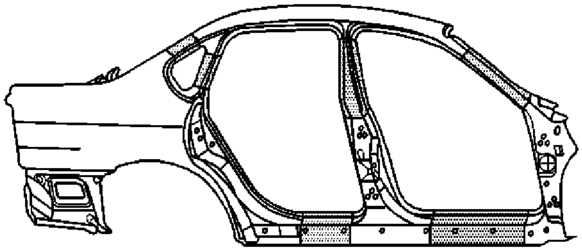
Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

14. Prime with 2-part catalyzed primer.
15. Apply sealers and anti-corrosion materials as necessary.
16. Install all related panels and components.

General Door Frame Opening Sectioning

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.



1. Visually inspect and restore as much of the damage as possible.
2. Remove all related panels and components.
3. Remove sealers and anti-corrosion materials as necessary.
4. Cut the panel in the areas where the sectioning is to take place. Sectioning should take place in shaded areas only.

   Note: Use care not to cut the inner reinforcements when cutting the outer door opening frame.

5. Locate and mark all factory welds. Note the number and location of welds for installation of the service assembly.
6. Drill out all factory welds.

   Note: Note the location of the sound deadening foam for installation.

7. Remove the damaged outer door opening frame.

Installation Procedure

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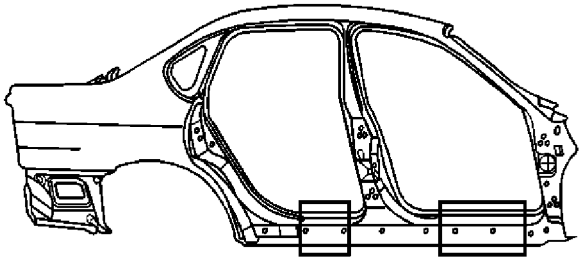
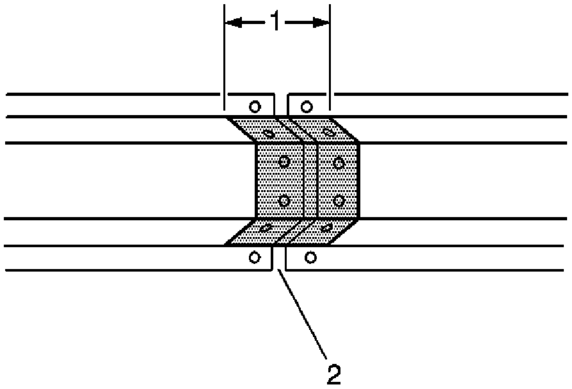
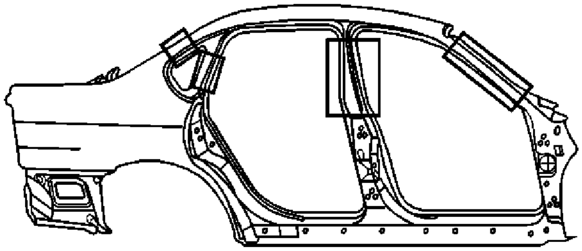


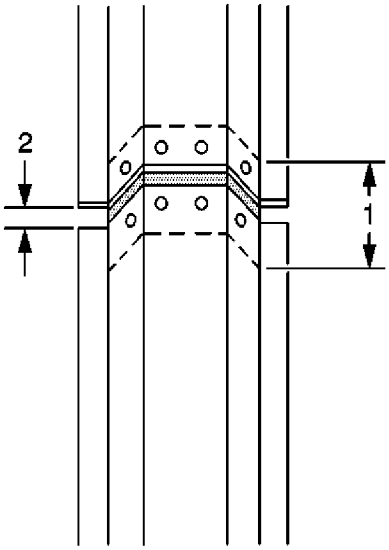
Note: Sectioning in the rocker locations requires the use of a 100 mm (4 in) backing plate.



1. On the service part, mark a line to leave a gap of one and one-half times the thickness of the metal at the sectioning joint (2).
2. Cut the outer door frame opening service part along this line.
3. Cut a 100 mm (4 in) piece (1) from the unused portion of the service part for a backing plate when sectioning in the rocker areas of the door frame opening.



4. Sectioning in the A, B, or C pillars of the outer door frame opening requires the use of a 50 mm (2 in) backing plate.



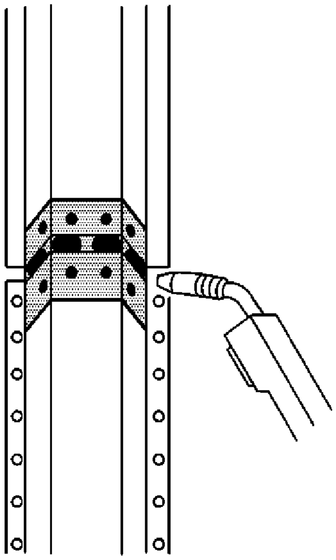
5. Cut a 50 mm (2 in) piece (1) from the unused portion of the service part for a backing plate, leaving a gap of 1½ times the thickness of the metal (2).

   Note: When sectioning the outer door frame at the lower front hinge pillar of at the center lock pillar, the inner reinforcement panel can be used as a backing plate.

6. Drill 8 mm (5/16 in) holes for plug welding in the service part in the locations noted from the original panel.
7. Drill holes for plug welding along the sectioning cuts on both the service part and the original panel.
8. Prepare the mating surfaces as necessary. Position the backing plates on the body with 50

percent of the backing plate exposed.

9. Apply 3M Weld-Thru Coating P/N 05916 or equivalent to all mating surfaces.
10. Plug weld accordingly.
11. Position the service part to overlap the exposed 50 percent of the backing plate.
12. Check the fit using 3-dimensional measuring equipment.
13. Plug weld accordingly.



14. Stitch weld along the entire sectioning joint.
15. Make 25 mm (1 in) welds along the seam with 25 mm (1 in) gaps between.
16. Go back and complete the stitch weld. This will create a solid joint with minimal heat distortion.
17. Complete all other welds and sectioning procedures as necessary.
18. Clean and prepare welded surfaces.

Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

Note: Apply the sound deadening foam in the locations noted from the removal process.

19. Prime with 2-part catalyzed primer.
20. Apply sealers and anti-corrosion materials as necessary.
21. Install all related panels and components.

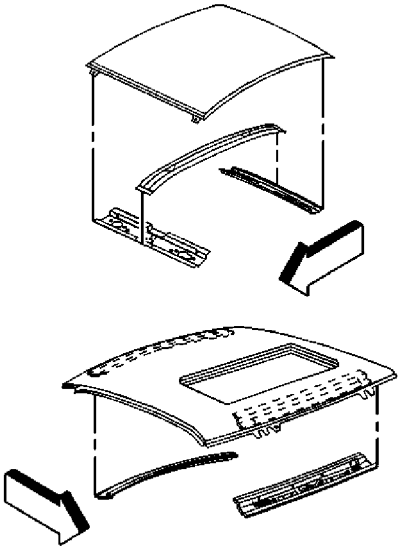
2009 Chevrolet Impala | Impala (VIN W) Service Manual | Body Repair | Collision Repair | Repair Instructions |
Document ID: 2102053

Roof Panel Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.

> **Note:** The roof panel is serviced as a complete assembly, including the outer panel and the inner reinforcements. The roof panel is attached by a number of welds which must be drilled to remove the outer panel and inner reinforcements for servicing.



1. Remove all related panels and components necessary to access the welds attaching the roof assembly to the vehicle.
2. Visually inspect and restore as much of the damage as possible.
3. Remove sealers and anti-corrosion materials as necessary.
4. Locate, mark, and drill out all factory welds. Note the number and location of welds for installation of the service assembly.

> **Note:** A second person may be needed to safely remove the roof assembly and prevent damage to the vehicle.

5. Remove the damaged roof panel assembly.

Installation Procedure

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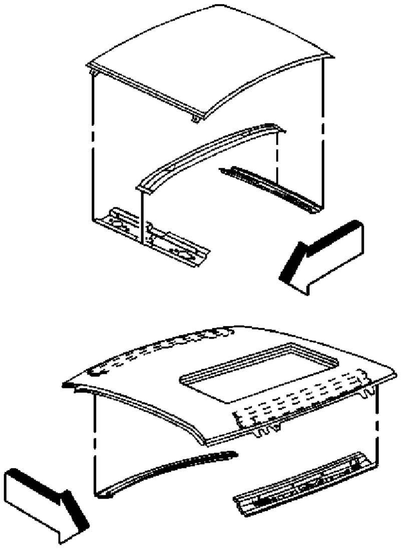

1. Clean and prepare the mating surfaces as necessary.
2. Position the roof panel on the vehicle.
3. Check fit and alignment.
4. Correctly position the service assembly and plug weld accordingly.
5. Clean and prepare all welded surfaces.
6. Prime with 2-part catalyzed primer.
7. Apply sealers and anti-corrosion materials as necessary.

Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

8. Install all related panels and components.

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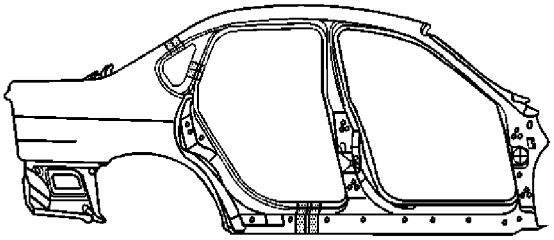
Quarter Panel Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.

Note: The quarter panel is serviced as a body side service assembly which includes the outer door frame opening, and the lower rear quarter close-out panel. Replacement of the quarter panel requires removal of the quarter glass and the back glass. A special sectioning procedure has been developed for improved serviceability.



1. Visually inspect and restore as much of the damage as possible to factory specifications.
2. Remove all related panels and components.
3. Remove sealers and anti-corrosion materials as necessary.
4. Scribe a cut line in upper quarter area.
5. Scribe a cut line in the rocker panel area.
6. Cut damaged section at marked locations.
7. Locate and mark all factory welds. Note the number and location of welds for installation of the service assembly.
8. Drill out all factory welds.

   Note: Note the location of the sound deadening foam for installation.

9. Remove the damaged quarter panel.

Installation Procedure

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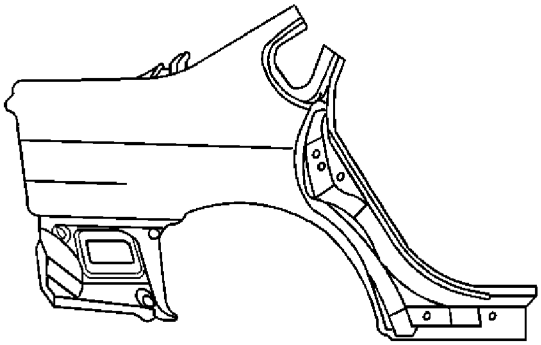


1. Prepare the mating surfaces as necessary.
2. On the service part, locate where to cut the upper quarter and rocker areas. Leave extra length in these areas for trimming.
3. Refer to general sectioning for appropriate usage of backing plates.
4. Trim the quarter panel to leave a gap of one and one-half times the thickness of the metal at the sectioning joints.
5. Check for proper fit and alignment.
6. Plug weld accordingly.

   Note: The glass bonding area should be a primer surface ONLY, and NOT an after-market top-coated (paint, or color coated) surface. Materials such as BASF DE17, Dupont 2610, or PPG DP40, or equivalent, are appropriate for this application. Refer to Service Bulletin #43-10-48 for more detailed information.

7. Clean and prepare all welded surfaces.

   Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendation.

8. Prime with 2-part catalyzed primer.

   Note: It is important to apply the sound deadening foam in the locations noted from removal.

9. Apply sealers and anti-corrosion materials as necessary.
10. Install all related panels and components.

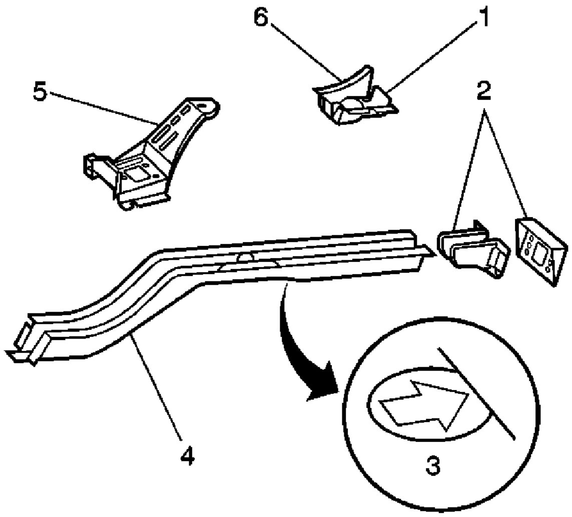
Rear Rail Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.

Note: Full rail replacement will require the removal of either the crossbar or an inner wheelhouse assembly. If sectioning is permitted, locate the diemark (3) on the lower surface of rail.

1. Remove all related panels and components including the rear suspension and seat.
2. Visually inspect and restore as much of the damage as possible to factory specifications.
3. Remove the following as necessary:
   - Sealers
   - Sound deadeners
   - Anti-corrosion materials



4. Locate, mark, and drill out all factory welds attaching the control arm mounting bracket (1) and the rear rail (4) to the vehicle.
5. The factory welds attaching the control arm mounting bracket weld flange (6) to the inner rocker panel must be drilled out from inside the vehicle.

   Note: The corner of the floor panel above this area will need to be positioned out of the way (6).

6. Locate, mark and drill out all factory welds. Note the number and location of welds for installation of the service assembly.
7. Remove the damaged rear rail assembly.

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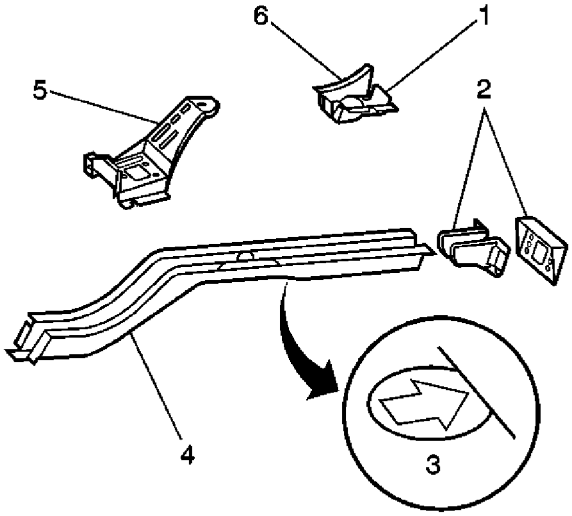
Installation Procedure



1. Clean and prepare the mating surfaces.
2. Check for proper fit of the rear rail service assembly.
3. Drill 8 mm (5/16 in) plug weld holes on the service assembly as necessary in the locations noted from the original assembly.
4. Position the service assembly.
5. Check fit with 3-dimensional measuring equipment.
6. Apply 3M Weld-Thru Coating P/N 05916 or equivalent to all mating surfaces.
7. Plug weld accordingly with frequent measurements to ensure proper fit.
8. Plug weld the control arm mounting bracket weld flange (6) to the inner rocker.
9. Reposition the floor panel into its original location.
10. Weld as necessary.

    Note: The bumper mounting bracket (2) holes must be properly located and drilled. Use 3-dimensional measuring equipment.

11. Clean and prepare all welded surfaces.

    Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

12. Prime with 2-part catalyzed primer.
13. Apply sealers and anti-corrosion materials as necessary.
14. Apply sound deadening materials to restore sound deadening quality as manufactured.
15. Install all related panels and components.

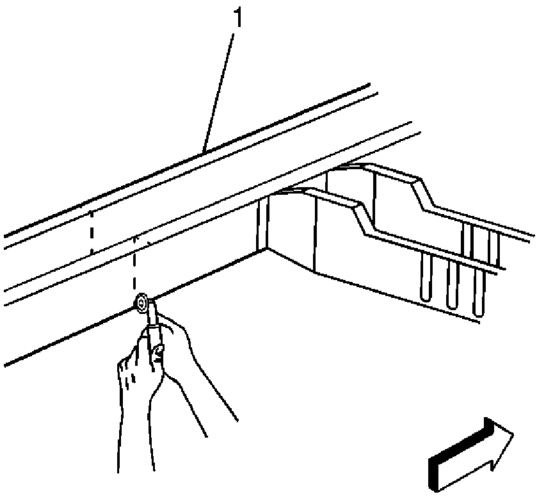
Rear Rail Sectioning

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.

Sectioning procedures can be used to repair the rear rail if just the portion rearward of the crossbar is damaged. Unique service parts are available for sectioning. The sub-assembly consists of the outer rail panel with the bumper mounting brackets attached.

Note: If damage exceeds the recommended area for sectioning and the rail cannot be straightened, the complete rail must be replaced.



1. Remove all related panels and components.
2. Visually inspect and restore as much of the damage as possible to factory specifications.
3. Remove sealers and anti-corrosion materials as necessary.
4. Locate, mark, and drill out all factory welds. Note the number and location of welds for installation of the service assembly.
5. Use a straight edge to scribe a line around the rail.
6. Cut the damaged rail (1).
7. Remove the damaged section of the rail.

Installation Procedure

Note: Note the size and the location of the precut service part.

1. Measure 30 mm (1 3/16 in) on the service part and mark cut lines.

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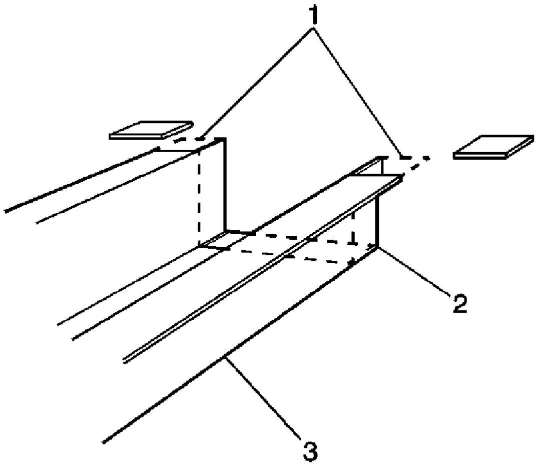
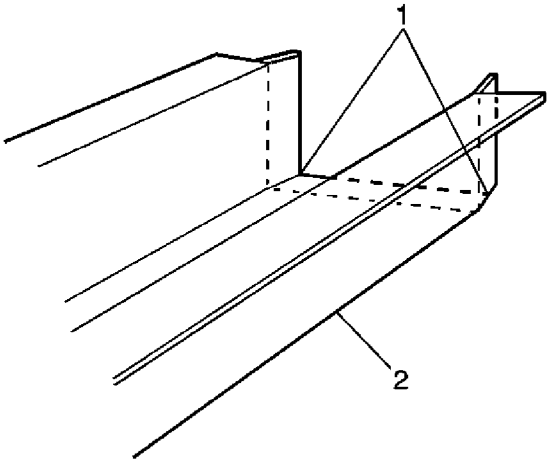
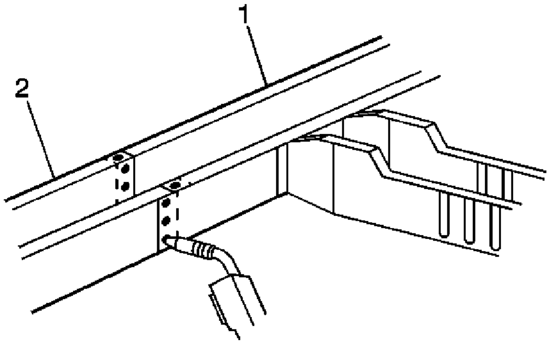


2. Cut and remove 30 mm (1 3/16 in) from the flanges on either side (1) of the service rail (3) to create 30 mm (1 3/16 in) tabs.
3. Cut 5 mm (3/16 in) wide gaps in the bottom corners (2).



4. Step the tabs inward (1) to allow the service part (2) to fit inside of the original rail.
5. Apply 3M Weld-Thru Coating P/N 05916 or equivalent to all mating surfaces.
6. Weld the tabs together along the edges (1).
7. Clean and prepare the mating surfaces.
8. Position the service part.
9. Check fit with 3-dimensional measuring equipment.
10. Plug weld accordingly.



11. Stitch weld along the entire joint (2).
12. Make 25 mm (1 in) welds along the seam with 25 mm (1 in) gaps between.
13. Go back and complete the stitch weld. This will create a solid joint with minimal heat distortion.

Note: The bumper mounting holes must be properly located and drilled. Use 3-dimensional measuring equipment.

14. Clean and prepare welded surfaces.

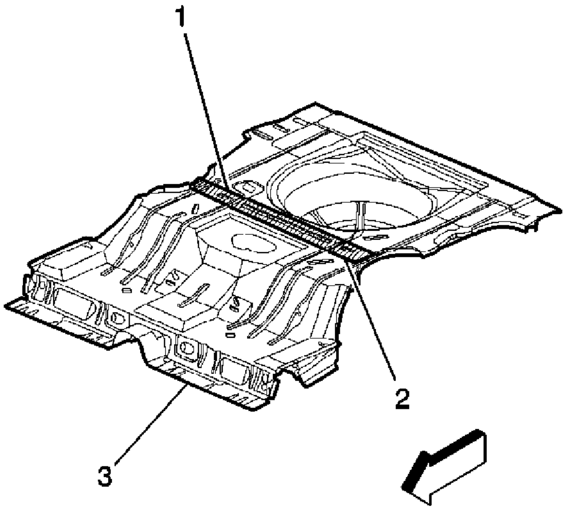
Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

15. Prime with 2-part catalyzed primer.
16. Apply sealers and anti-corrosion materials as necessary.
17. Install all related panels and components.

Floor Panel Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.



Note: The damaged rear floor should be cut along the rearward edge of the rear crossbar (1), and the service part should be cut so that the new floor section extends to the forward edge of the rear crossbar (2). This allows the two sections to overlap where the crossbar is attached (2). The cut to the damaged floor will be about 790 mm (31 1/8 in) from the rear edge of the floor panel.

1. Remove all related panels and components as necessary, including the following:
    - The rear end panel
    - The quarter panels
    - The quarter panel extensions
2. Visually inspect and restore as much of the damage as possible.
3. Remove the following as necessary:
    - The sealers
    - The sound deadeners
    - The anti-corrosion materials
4. Locate and mark all factory welds rearward of the rear crossbar including those along the lower edge of the wheelhouse.
5. Note the number and location of welds for installation of the floor service assembly.
6. Drill out all factory welds.

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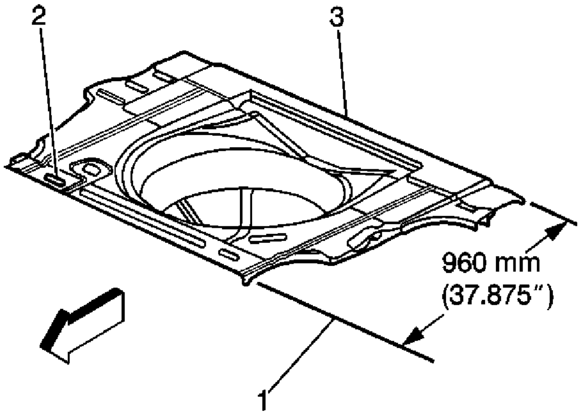
Note: Drill out the factory welds rearward of the crossbar only. Do not drill out the welds attaching the floor to the crossbar.

7. Cut the damaged floor along the rear edge of the crossbar.
8. Do not damage the following:
    - The rear rails
    - The crossbar
    - The wheelhouse
9. Remove the damaged floor section.

Installation Procedure



Note: The service part is supplied as a rear floor assembly.

1. Measure 960 mm (37 ¾ in) forward from the rear edge of the rear floor service assembly, mark the location, and cut accordingly.
2. Prepare the mating surfaces as necessary.
3. Check for proper fit.
4. Allow the floor service assembly (3) to overlap the original floor on top of the rear crossbar (2).
5. Mark the location of the rear rail and crossbar flanges on the bottom of the floor service assembly.
6. Drill 8 mm (5/16 in) plug weld holes as necessary in the locations noted from the original floor assembly (3).
7. Drill holes approximately 40 mm (1 in) apart where the new floor section attaches to the rear rail and crossbar flanges.
8. Position the service assembly and check for proper fit.
9. Apply 3M Weld-Thru Coating P/N 05916 or equivalent to all mating surfaces.
10. Plug weld accordingly (1).
11. Clean and prepare all welded surfaces.

Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

12. Apply 2-part catalyzed primer.

Note: The rear crossbar areas must be properly sealed from moisture and dirt to seal both the front and rear edges of the crossbar as well as the inner seams.

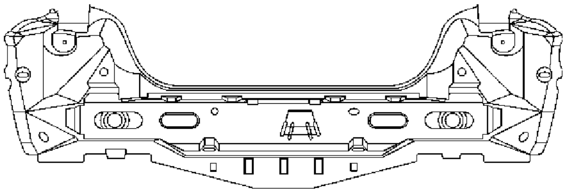
13. Apply the following materials as necessary:
    - The sealers
    - The sound deadeners
    - The anti-corrosion materials
14. Install all related panels and components.

Rear End Panel Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning in the Preface section.

> **Note:** The rear end panels is supplied as a complete assembly. Quarter panels extensions attach to the outside corners of the rear end panel. Service for this panel is performed at factory seams.



1. Remove all related panels and components
2. Visually inspect and restore as much of the damage as possible to factory specifications.
3. Remove sealers and anti-corrosion materials as necessary.
4. Locate, mark, and drill out all factory welds. Note the number and location of welds for installation of the service panel.
5. Remove the damaged rear panel.

Installation Procedure

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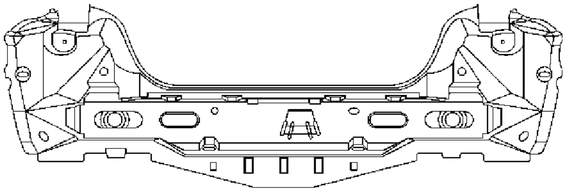


1. Prepare the mating surfaces as necessary. Inspect or proper fit of the service panel.
2. On the new panel, drill 8 mm (5/16 in) plug weld holes as necessary in the locations noted from the original panel.
3. Position the service panel, check with 3-dimensional measuring equipment.
4. Plug weld accordingly.
5. Clean and prepare welded surfaces.

Note: Prior to refinishing, refer to GM 4901MD-99 Refinish Manual for recommended products. Do not combine paint systems. Refer to paint manufacturer's recommendations.

6. Prime with 2-part catalyzed primer.
7. Apply the following as necessary:
8. Apply sealers and anti-corrosion materials as necessary.
9. Install all related panels and components.

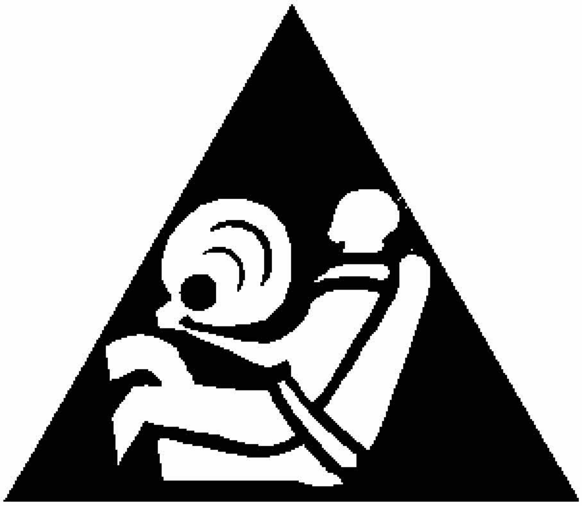
2006 ACCESSORIES & EQUIPMENT

Cruise Control - Impala

SCHEMATIC AND ROUTING DIAGRAMS

CRUISE CONTROL SCHEMATIC ICONS

Cruise Control Schematic Icons

Icon	Icon Definition
	**CAUTION:** **When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Refer to SIR DISABLING AND ENABLING ZONES . Failure to observe the correct procedure could cause deployment of the SIR components, personal injury, or unnecessary SIR system repairs.**

CRUISE CONTROL SCHEMATICS

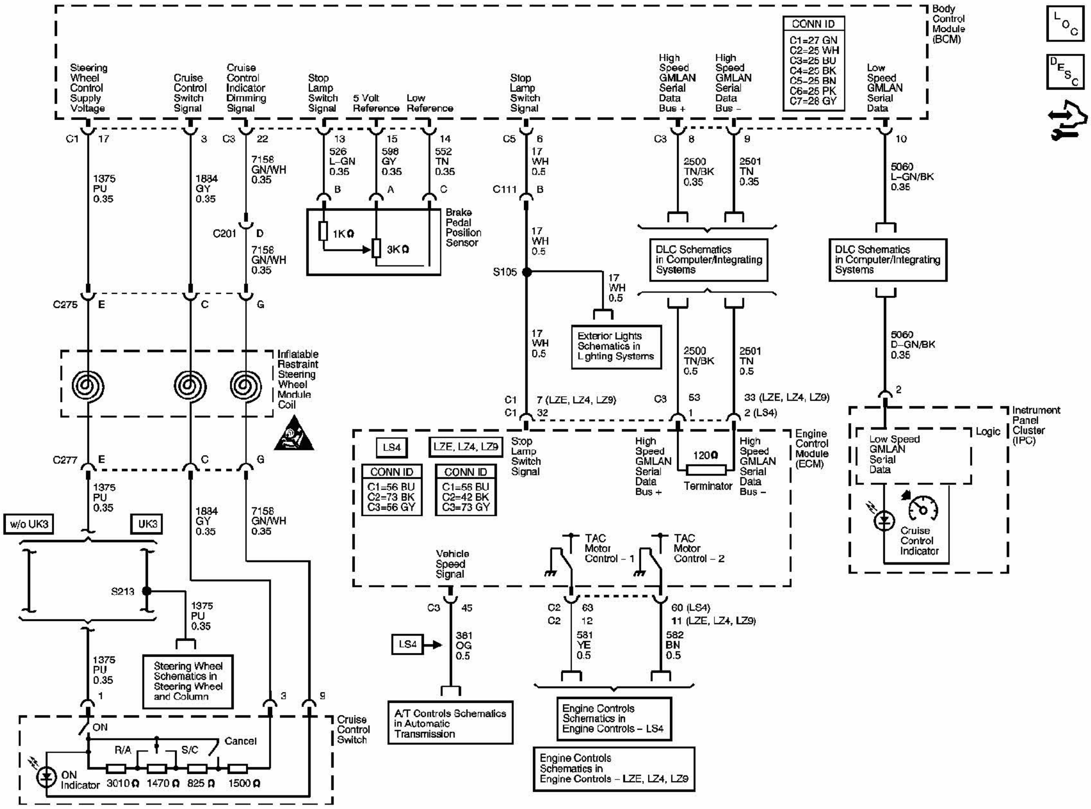

Body Control Module (BCM)
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Steering Wheel Control Supply Voltage
Cruise Control Switch Signal
Cruise Control Indicator Dimming Signal
Stop Lamp Switch Signal
5 Volt Reference
Low Reference
Stop Lamp Switch Signal
High Speed GMLAN Serial Data Bus +
High Speed GMLAN Serial Data Bus –
Low Speed GMLAN Serial Data
1375 PU 0.35
1884 GY 0.35
7158 GN/WH 0.35
526 L-GN 0.35
598 GY 0.35
552 TN 0.35
17 WH 0.5
2500 TN/BK 0.35
2501 TN 0.35
5060 L-GN/BK 0.35
Brake Pedal Position Sensor
1KΩ
3KΩ
C111
C201
S105
C275
C277
Exterior Lights Schematics in Lighting Systems
DLC Schematics in Computer/Integrating Systems
Inflatable Restraint Steering Wheel Module Coil
5060 D-GN/BK 0.35
Instrument Panel Cluster (IPC)
Logic
Low Speed GMLAN Serial Data
Cruise Control Indicator
7 (LZE, LZ4, LZ9)
32
53
33 (LZE, LZ4, LZ9)
2 (LS4)
LS4
LZE, LZ4, LZ9
CONN ID
C1=56 BU
C2=73 BK
C3=56 GY
CONN ID
C1=58 BU
C2=42 BK
C3=73 GY
Stop Lamp Switch Signal
High Speed GMLAN Serial Data Bus +
120Ω
Terminator
High Speed GMLAN Serial Data Bus –
Engine Control Module (ECM)
2500 TN/BK 0.5
2501 TN 0.5
Vehicle Speed Signal
TAC Motor Control – 1
TAC Motor Control – 2
w/o UK3
UK3
S213
Steering Wheel Schematics in Steering Wheel and Column
381 OG 0.5
581 YE 0.5
582 BN 0.5
60 (LS4)
11 (LZE, LZ4, LZ9)
A/T Controls Schematics in Automatic Transmission
Engine Controls Schematics in Engine Controls – LS4
Engine Controls Schematics in Engine Controls – LZE, LZ4, LZ9
Cruise Control Switch
ON
R/A
S/C
Cancel
ON Indicator
3010Ω
1470Ω
825Ω
1500Ω

Fig. 1: Cruise Control Schematics - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

CRUISE CONTROL COMPONENT VIEWS

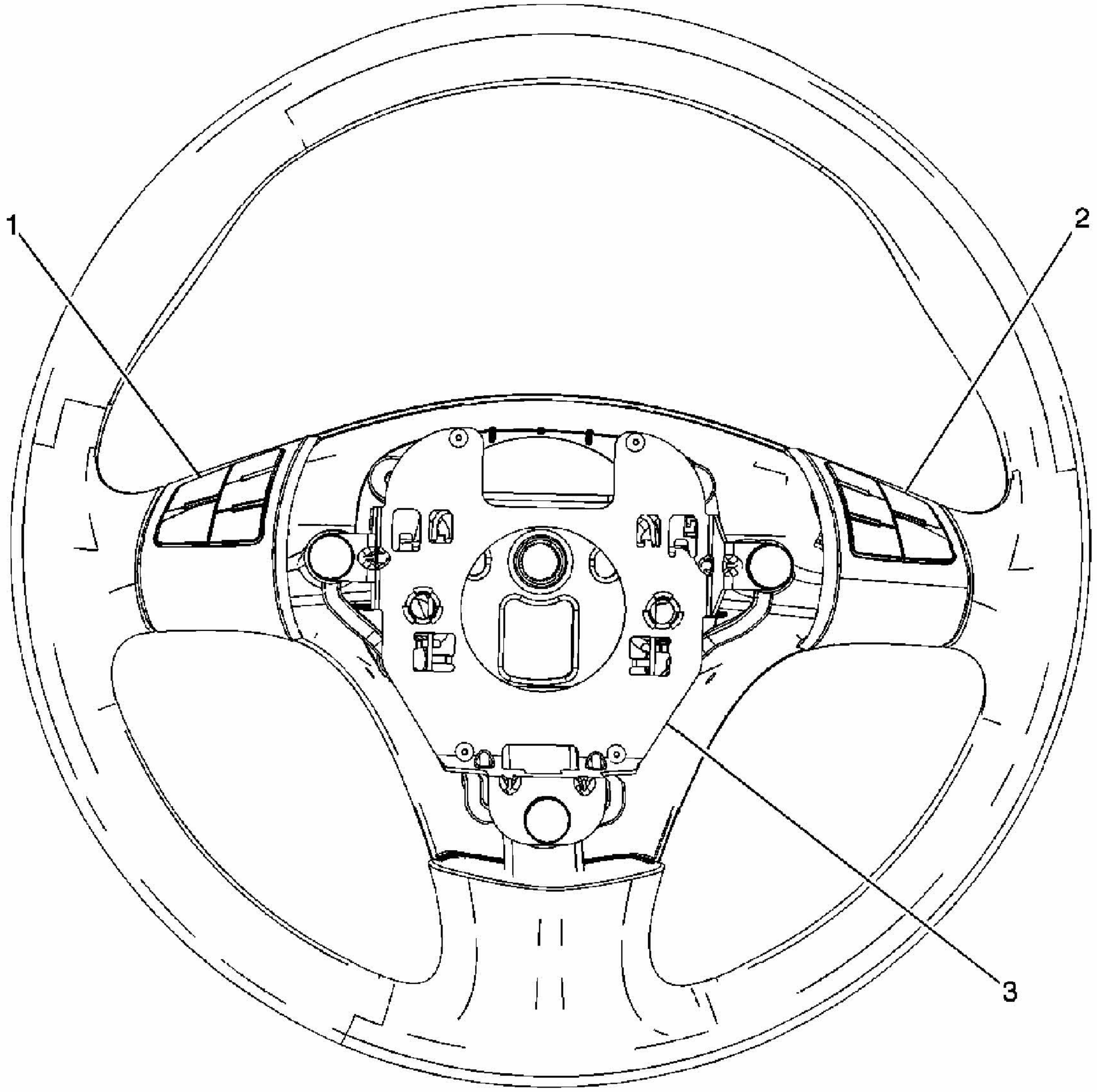


Fig. 2: Steering Wheel Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	Steering Wheel Controls - Left
2	Steering Wheel Controls - Right
3	Horn Switch

CRUISE CONTROL CONNECTOR END VIEWS

Cruise Control Switch

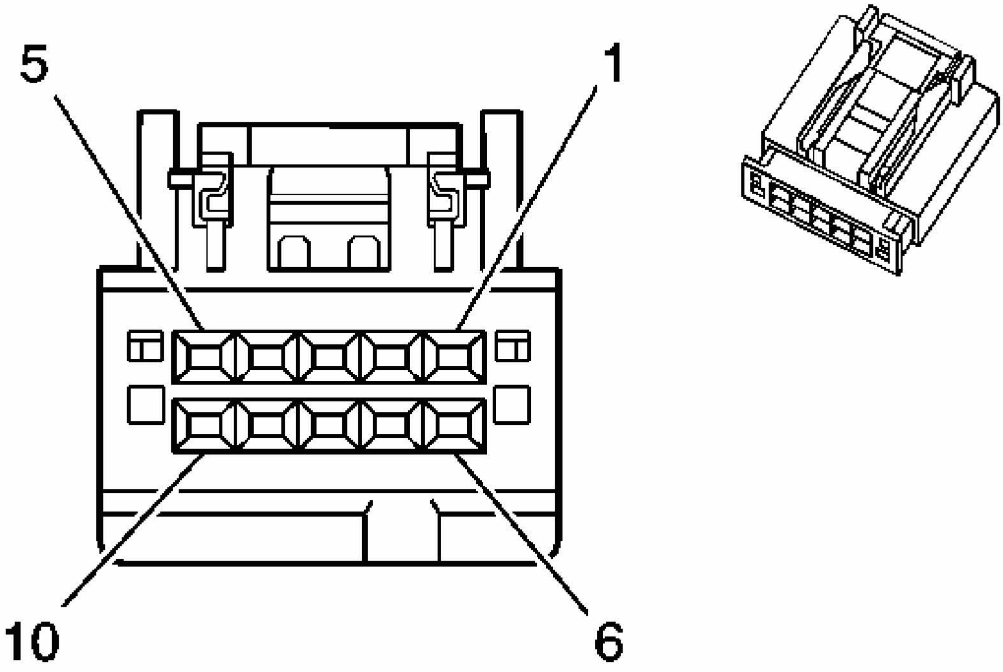


Fig. 3: Cruise Control Switch Connector End View
Courtesy of GENERAL MOTORS CORP.

Cruise Control Connector End Views

Connector Part Information

- 30700-1100
- Service:
- 10-Way F Molex 30700 Series (GY)

Terminal Part Information

- Terminal/Tray:
- Core/Insulation Crimp:
- Release Tool/Test Probe:

Cruise Control Switch

Pin	Wire Color	Circuit No.	Function
1	PU	1375	Steering Wheel Control Supply Voltage
2	-	-	Not Used

3	GY	1884	Cruise Control Switch Signal
4-5	-	-	Not Used
6	PU/WH	7005	LED Dimming Supply
7	-	-	Not Used
8	BK	1450	Ground
9	GN/WH	7158	Cruise Control Indicator Dimming Signal
10	-	-	Not Used

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B3794	Cruise Control Function Request Circuit
DTC P0575	Cruise Control Switch Signal Circuit
DTC P0703	Brake Switch Circuit 2

DIAGNOSTIC STARTING POINT - CRUISE CONTROL

Begin the system diagnosis with the **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL DATA LIST

The scan tool data lists contain all of the cruise control related parameters that are available on the scan tool. The parameters in the list are arranged in alphabetical order. The data list column indicates the location of the parameter within the scan tool menu selections.

Use the scan tool data lists as directed by a diagnostic table or in order to supplement the diagnostic procedures. Begin all of the diagnostic procedures with **Diagnostic System Check - Vehicle** .

Use the scan tool data lists only after the following is determined:

- There is no published DTC procedure nor published symptom procedure for the customer concern.
- The DTC or symptom procedure indicated by the Diagnostic System Check does not resolve the customer concern.

The typical data values are obtained from a properly operating vehicle under the conditions specified in the first row of the scan tool data list table. Comparison of the parameter values from the suspect vehicle with the typical data values may reveal the source of the customer concern.

Engine Control Module (ECM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine Idling at Normal Operating Temperature/Vehicle is in Park or Neutral/Cruise On/Off Switch is Turned Off			
APP Indicated Angle	Cruise Control Data	Percent	0
Cruise Cancel Switch	Cruise Control Data	On/Off	Off
Cruise Control Active	Cruise Control Data	Yes/No	No
Cruise Disengage (1 - 8) History	Cruise Control Data	Last reason for cruise control disengagement	Varies
Cruise On/Off Switch	Cruise Control Data	On/Off	Off
Cruise Resume/Accel. Switch	Cruise Control Data	On/Off	Off
Cruise Set/Coast Switch	Cruise Control Data	On/Off	Off
Engine Load	Cruise Control Data	Percent	0
Engine Run Time	Cruise Control Data	Hr: Min: Sec	Varies
Engine Speed	Cruise Control Data	RPM	Varies
Ignition 1 Signal	Cruise Control Data	Volts	12 to 16 Volts
Reduced Engine Power (5.3L)	Cruise Control Data	Active/Inactive	Inactive
TP Desired Angle	Cruise Control	Percent	Varies

	Data		
TP Indicated Angle	Cruise Control Data	Percent	%
Vehicle Speed Sensor	Cruise Control Data	km/h (mph)	0 km/h (0 mph)

SCAN TOOL DATA DEFINITIONS (DISENGAGE HISTORY)

One of the following conditions must be present in order for a disengagement parameter to appear:

- The Cruise Control System is active and disengagement is requested.
- The engagement of the Cruise Control System is requested while a fault is present.

Accel Rate

The engine control module (ECM) detects that the vehicle acceleration is greater than the calibrated cruise control threshold.

APP Override

The ECM detects that the accelerator pedal overrides the set vehicle speed for approximately 60 seconds.

Brake

The ECM detects that the stop lamps have been activated according to the brake pedal position (BPP) sensor / stop lamp switch input from the platform module. Also, the brake pedal being applied according to the brake fluid pressure sensor input can also set this disengagement reason with vehicles equipped with the vehicle stability enhancement system (VSES).

BPP Data

The ECM detects an invalid brake pedal apply serial data message from the platform module.

BPP DTC

The ECM detects that DTC P0703 is active.

Cancel

The ECM detects that the cruise control cancel switch has been activated.

Clutch

The ECM detects that the clutch pedal switch has been activated.

Coast Disengage

When the ECM detects that the cruise set/coast signal is active and the throttle blade fully closes the cruise control system will disengage until the ECM detects that the set/coast signal is inactive. The cruise control system will then engage and set with the new vehicle speed.

Coast Speed Low

The ECM detects that the Set/Coast switch is activated until the vehicle speed is below 37 km/h (23 mph).

Cruise S/W

The ECM detects that a cruise control software execution error is present.

Cruise Sw Data

A fault in the serial data circuit from the cruise control switch to the platform module is detected.

Cruise Sw. Off

The ECM detects that the cruise On/Off switch was turned to OFF when the cruise control system was enabled.

D WHL Spd Low

The ECM detects the driven wheels are at a slower speed than the non-driven wheels.

D WHL Spd Hi

The ECM detects the driven wheels are at a faster speed than the non-driven wheels.

Decel Rate

The ECM detects that the vehicle deceleration is greater than the calibrated cruise control threshold.

DLC Override

The ECM detects that a DLC override has occurred.

DTC Set

The ECM detects that a DTC has been set which affects the cruise control operation.

ECM Inhibit

The ECM detects a RAM corruption associated to the cruise control system.

ECT Overtemp

The ECM detects the engine temperature is above the calibrated threshold.

Engine Run Time

The ECM detects that the cruise control system has been requested and the engine run time counter is not active.

Engine Speed

The ECM detects that the engine speed is less than or greater than a calibrated RPM.

First Gear

While the cruise control system is active, the ECM detects that the transmission is in Drive 1.

High Speed

The ECM detects that the vehicle speed is greater than the calibrated amount.

High Voltage

The ECM detects that the ignition voltage is above 16 volts.

Illegal Mode

The ECM detects that the acceleration mode is active without the activation of the Accel. switch.

Lost Fwd Gear

The ECM detects that transmission is in Neutral, Reverse or Park.

Low Speed

The ECM detects that the vehicle speed is less than 37 km/h (23 mph) while the cruise control system was enabled.

Low Voltage

The ECM detects that the ignition voltage is below 9 volts.

Memory DTC

The ECM detects an internal memory fault.

MPH Limit

The ECM detects the vehicle is over speed and that the fuel shutoff has been activated.

None

This parameter is displayed when a new ECM has been installed.

Over Set Speed

The ECM detects the current vehicle speed is greater than the set vehicle speed by more than a calibrated amount.

Park Brake

ECM detects the park brake switch is active.

Pedal Initialize

The ECM detects that a stop lamp pedal activation had not occurred before the cruise control system was requested.

PTO Active

The ECM detects power take off is active.

RPM Limit

The ECM detects the engine is over speed and that the fuel shutoff has been activated.

S/C On - Speed High

The ECM detects the Set/Coast switch is briefly applied while the current vehicle speed is greater than the set vehicle speed by more than a calibrated amount.

Simul SC/RA Sw

The ECM detects that the Set/Coast switch and the Resume/Accel switch are active at the same time.

Sw Invalid

The ECM detects the analog cruise control switch input is out of the normal voltage range.

TAC Inhibit

The ECM detects a fault within the throttle actuator control (TAC) system.

TCS

The ECM detects that the traction control system had been activated. It is also possible that a tire with low air pressure can also set this disengagement reason.

Trans. DTC

The ECM detects a transmission gear fault.

Under Set Speed

The ECM detects that the vehicle speed is less than the cruise memory speed by more than a calibrated amount.

VSES

The ECM detects that the vehicle stability enhancement system had been activated.

SCAN TOOL DATA DEFINITIONS (CRUISE CONTROL)

The Scan Tool Data Definitions contains a brief description of all cruise control related parameters available on the scan tool.

APP Indicated Angle

This parameter displays the angle of the accelerator pedal as calculated by the control module using the signals from the accelerator pedal position sensors. The accelerator pedal position (APP) indicated angle is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.

Cruise Cancel Switch

The scan tool displays On or Off. This is the state of the cruise cancel switch as detected by the ECM.

Cruise Control Active

The scan tool displays Yes or No. The engine control module (ECM) determines the current status of cruise control operation. An active cruise control system is displayed as Yes.

Cruise Disengage (1-8) History

The scan tool displays the last 8 reasons why the cruise control system was disengaged. Refer to the Scan Tool Data Definitions (Disengaged History) for descriptions.

Cruise On/Off Switch

The scan tool displays On or Off. The ECM monitors the cruise control set/coast and resume/accelerate switch signal circuit. A closed switch is displayed as On.

Cruise Resume/Accel. Switch

The scan tool displays On or Off. The ECM monitors the cruise control set/coast and resume/accelerate switch signal circuit. A closed switch is displayed as On. The cruise control On/Off switch must be switched On in order to correctly view the Cruise Resume/Accel. Switch parameter.

Cruise Set/Coast Switch

The scan tool displays On or Off. The ECM monitors the cruise control set/coast and resume/accelerate switch signal circuit. A closed switch is displayed as On. The cruise control On/Off switch must be switched On in order to correctly view the Cruise Set/Coast Switch parameter.

Engine Load

Scan tool range 0-100 percent. Engine load is calculated by the ECM from the engine speed and mass air flow (MAF) sensor readings. Engine load should increase with an increase in RPM or air flow.

Engine Run Time

Scan tool range 00:00:00-99:99:99 Hrs:Min:Sec. Indicates the time elapsed since the engine was started. If the engine is stopped, ENGINE RUN TIME will be reset to 00:00:00.

Engine Speed

The scan tool displays 0 to 9,999 RPM. The ECM monitors the CKP signal circuit in order to determine the engine RPM.

Ignition 1 Signal

The scan tool displays 6 volts to 18 volts. The ECM monitors the Ignition 1 signal circuit in order to determine the system voltage.

Reduced Engine Power

The scan tool displays Active or Inactive. When the ECM detects that malfunction in the TAC System exists, the scan tool displays Active.

TP Desired Angle

This parameter indicates the TP angle commanded by the control module. The scan tool will display a low value at idle, and a high value at wide open throttle (WOT).

TP Indicated Angle

This parameter displays the angel of the throttle position (TP) in percent. This information is calculated by the control module using the signals from the throttle position sensors. The scan tool will display a low percentage when the throttle plates are closed. The scan tool will display a high percentage when the throttle plates are fully open.

Vehicle Speed Sensor

The scan tool displays 0 to 150 km/h (93.2 mph). The ECM monitors the vehicle speed sensor signal circuit in order to calculate the vehicle speed for display.

DTC B3794

Circuit Description

The cruise control switch is an input to the body control module (BCM). The BCM monitors the cruise control set/coast and resume/accelerate switch signal circuit in order to detect when the driver has requested to perform a cruise control function. The BCM detects a specific voltage signal on the cruise control set/coast and resume/accelerate switch signal circuit when a switch is applied.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B3794

Cruise Control Function Request Circuit

This vehicle has DTCs which include DTC Symptoms. For more information on DTC Symptoms, refer to.

DTC B3794

DTC Symptom	DTC Symptom Descriptor
08	Signal Invalid
61	Actuator Stuck

Conditions for Running the DTC

- The cruise switch is ON.
- The ignition is ON.

Conditions for Setting the DTC

- The BCM detects an invalid voltage signal on the cruise control + RES switch and - SET switch signal circuit.
- The above condition is present for 0.5 second.

Action Taken When the DTC Sets

- The BCM stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The Cruise Control System is disabled.

Conditions for Clearing the DTC

- The DTC becomes history when the fault is no longer present.
- A History DTC clears after 100 malfunction-free ignition cycles.
- The BCM receives a clear code command from the scan tool.

Diagnostic Aids

For an intermittent, refer to **Testing for Intermittent Conditions and Poor Connections** .

DTC B3794

Step	Action	Values	Yes	No
Schematic Reference: Cruise Control Schematics **Connector End View Reference: Master Electrical Component List**				
1	Did you perform the Diagnostic System Check - Vehicle?	-		Go to **Diagnostic System**

			Go to **Step 2**	**Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With the scan tool, observe the Cruise Control Switch parameter in the Body and Accessories body control module (BCM) Data list. Does the Cruise Control Switch parameter display Error?	-	Go to **Step 3**	Go to **Step 4**
3	1. Turn OFF the ignition. 2. Disconnect C1 of the multifunction switch. 3. Turn ON the ignition, with the engine OFF. 4. With the scan tool, observe the Cruise Control Switch parameter in the Body and Accessories BCM Data list. Does the Cruise Control Switch parameter display Error?	-	Go to **Step 9**	Go to **Step 11**
4	1. Turn the cruise control On/Off control switch ON. 2. With the scan tool, observe the Cruise Control Switch parameter in the Body and Accessories BCM Data list. Does the Cruise Control Switch parameter display Error?	-	Go to **Step 7**	Go to **Step 5**
5	1. Activate the cruise control set/coast switch. 2. With the scan tool, observe the Cruise Control Switch parameter in the Body and Accessories BCM Data list. Does the Cruise Control Switch	-	Go to **Step**	

	parameter display Error?		**7**	Go to **Step 6**
6	1. Activate the cruise control resume/accel switch. 2. With the scan tool, observe the Cruise Control Switch parameter in the Body and Accessories BCM Data list. Does the Cruise Control Switch parameter display Error?	-	Go to **Step 7**	Go to Diagnostic Aids
7	**IMPORTANT:** **The cruise control on/off switch must be turned ON in order to correctly view the set/coast switch resistance values with the DMM.** 1. Turn OFF the ignition. 2. With a DMM, measure the resistance of the cruise control switch between the ignition 1 voltage circuit and the cruise control set/coast and resume/accelerate switch signal circuit. 3. Individually activate and hold the cruise control function switches while measuring the resistance value of each cruise control function switch. Do the cruise control function switch resistance values measure between the specified values?	Off = O.L. On = 7.8 K-8.6 K Resume = 2.7 K-3.0 K Set = 1.2 K-1.3 K	Go to **Step 8**	Go to **Step 11**
8	Test the ignition 1 voltage circuit for a high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 10**
9	Test the cruise control set/coast and resume/accel switch signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
	Test the cruise control set/coast and			

10	resume/accel switch signal circuit for a high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you complete the repair?	-	Go to **Step 15**	Go to **Step 12**
11	Inspect for poor connections at C1 of the multifunction switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
12	Inspect for poor connections at the harness connector of the BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
13	Replace the cruise control switch. Refer to **Multifunction, Turn Signal Switch Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC. Does the DTC reset?	-	Go to **Step 2**	System OK

DTC P0575

Circuit Description

When a cruise control function switch is activated, the body control module (BCM) detects a predetermined voltage signal. The BCM sends a GMLAN serial data message to the engine control module (ECM) indicating the function that has been requested.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0575 Cruise Control Switch Signal Circuit

Conditions for Running the DTC

The engine is ON.

Conditions for Setting the DTC

- The ECM receives an invalid cruise control switch status GMLAN serial data message from the BCM.
- This diagnostic runs continuously.

Action Taken When the DTC Sets

- The Cruise Control System is disabled.
- The ECM stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The ECM records the operating conditions at the time the diagnostic fails. The ECM stores this information in the Failure Records.
- All cruise control function switches are set to OFF.

Conditions for Clearing the DTC

- A last test failed, or the current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if failures are not reported by this or any other emission related diagnostic.
- Use the scan tool in order to clear the DTC.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the BCM. If stored only as a history DTC and not retrieved as a current DTC, do not replace the BCM.
- If this DTC is retrieved as both a current and history DTC, replace the BCM.

DTC P0575

Step	Action	Yes	No
Schematic Reference: Cruise Control Schematics **Connector End View Reference: Computer/Integrating Systems Connector End Views** in Computer/Integrating Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Is DTC P0575 current in the engine control module (ECM)?	Go to **Step 3**	Go to Diagnostic Aids

3	Replace the body control module (BCM). Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 4**	-
4	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC. Does the DTC reset?	Go to **Step 2**	System OK

DTC P0703

Circuit Description

The body control module (BCM) monitors the brake pedal position sensor. When the brake pedal is applied, the BCM detects a predetermined voltage signal. The BCM sends a GMLAN serial data message to the engine control module (ECM) indicating the status of the stop lamps.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0703 Brake Switch Circuit 2

Conditions for Running the DTC

The engine is ON.

Conditions for Setting the DTC

- The ECM receives an invalid brake pedal status GMLAN serial data message from the BCM.
- This diagnostic runs continuously.

Action Taken When the DTC Sets

- The Cruise Control System is disabled.
- The ECM stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The ECM records the operating conditions at the time the diagnostic fails. The ECM stores this information in the Failure Records.

Conditions for Clearing the DTC

- A last test failed, or the current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if failures are not reported by this or any other emission related diagnostic.
- Use the scan tool in order to clear the DTC.

Diagnostic Aids

- Repair any brake system related DTCs before performing this diagnostic.
- If an BCM has been replaced, the brake pedal position (BPP) sensor must be calibrated. Refer to **Brake Pedal Position Sensor Calibration** .
- This DTC may be stored as a history DTC without affecting the operation of the BCM. If stored only as a history DTC and not retrieved as a current DTC, do not replace the BCM.
- If this DTC is retrieved as both a current and a history DTC, replace the BCM.
- For an intermittent condition, refer to **Testing for Intermittent Conditions and Poor Connections** .

Test Description

The numbers below refer to the step numbers located in the diagnostic table.

2: This step is performed in order to confirm that DTC P0703 is current within the ECM.

3: This step is performed in order to correct a BPP sensor that must be calibrated, possibly due to a BCM replacement or for a BPP sensor that is out of adjustment.

DTC P0703

Step	Action	Yes	No
Schematic Reference: Cruise Control Schematics **Connector End View Reference: Cruise Control Connector End Views** or **Computer/Integrating Systems Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Is DTC P0703 current in the engine control module (ECM)?	Go to **Step 3**	Go to Diagnostic Aids
3	1. Perform the brake pedal position (BPP) sensor calibration procedure. Refer to **Brake Pedal Position Sensor Calibration** . 2. Use the scan tool in order to clear the		

	DTCs. 3. Operate the vehicle within the Conditions for Running the DTC. Does the DTC reset?	Go to **Step 4**	System OK
4	Inspect for poor connections at the harness connector of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 6**	Go to **Step 5**
5	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 6**	-
6	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC. Does the DTC reset?	Go to **Step 2**	System OK

SYMPTOMS - CRUISE CONTROL

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** in Vehicle DTC Information, before using the Symptom Tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Cruise Control Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Cruise Control System. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Symptom List

Refer to **Cruise Control Inoperative/Malfunctioning**.

CRUISE CONTROL SWITCH INDICATOR INOPERATIVE

Diagnostic Aids

- Repair any brake system related DTCs before performing this diagnostic.
- If a BCM has been replaced, the brake pedal position (BPP) sensor must be calibrated. Refer to **Brake Pedal Position Sensor Calibration** .
- For an intermittent condition, refer to **Testing for Intermittent Conditions and Poor Connections** .

Cruise Control Switch Indicator Inoperative

Step	Action	Yes	No
Schematic Reference: Cruise Control Schematics **Connector End View Reference: Cruise Control Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn the ignition OFF. 2. Disconnect the cruise control switch. 3. Connect a fused jumper between the voltage signal circuit and the low reference circuit. 4. Turn the ignition ON. 5. With the scan tool, observe the Cruise On/Off Switch parameter in the Engine Control Module Data. Does the Cruise On/Off Switch parameter display On?	Go to **Step 5**	Go to **Step 3**
3	Test the voltage signal circuit and the low reference circuit for an open, or for a high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 7**	Go to **Step 4**
	Inspect for poor connections at the harness		

4	connector of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** . Did you find and correct the condition?	Go to **Step 7**	Go to **Step 6**
5	Replace the cruise control switch. Refer to **Multifunction, Turn Signal Switch Replacement** . Did you complete the replacement?	Go to **Step 7**	-
6	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 7**	-
7	Operate the system in order to verify the repair. Does the system operate properly?	System OK	Go to **Step 2**

CRUISE CONTROL INOPERATIVE/MALFUNCTIONING

Diagnostic Aids

In order to avoid misdiagnosis, inspect for the following:

- Ensure that the following cruise control switches are not stuck in the engaged position:
    - On/Off switch
    - Set/Coast switch
    - Resume/Accel switch
- Proper operation of the brake lamps - Refer to **Exterior Lighting Systems Description and Operation** .

For an intermittent condition, refer to **Testing for Intermittent Conditions and Poor Connections** .

Conditions for Enabling Cruise Control

- The vehicle speed is greater than 40 km/h (25 mph).
- The vehicle is not in PARK, REVERSE, NEUTRAL, or 1st gear.
- The system voltage is within 9-16 volts.
- The park brake is not applied.

Test Description

The number below refers to the step number on the diagnostic table.

6: This step tests the ignition 1 voltage circuit for an open, for a short to ground, or for a high resistance.

Cruise Control Inoperative/Malfunctioning

Step	Action	Values	Yes	No
Schematic Reference: Cruise Control Schematics **Connector End View Reference: Master Electrical Component List**				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With the scan tool, observe the Cruise Control Switch parameter in the Body and Accessories body control module (BCM) Data list. Does the Cruise Control Switch parameter display Off?	-	Go to **Step 3**	Go to **Step 7**
3	1. Turn the cruise control On/Off switch ON. 2. With the scan tool, observe the Cruise Control Switch parameter. Does the Cruise Control Switch parameter display On?	-	Go to **Step 4**	Go to **Step 6**
4	1. Turn the cruise control on/off switch ON. 2. With the scan tool, observe the Cruise Control Switch parameter. 3. Press and hold the cruise control set/coast button. Does the Cruise Control Switch parameter display Set?	-	Go to **Step 5**	Go to **Step 8**
	1. With the scan tool, observe the Cruise Control Switch parameter.			

5	2. Press and hold the resume/accel switch. Does the Cruise Control Switch parameter Display Resume?	-	Go to Diagnostic Aids	Go to **Step 8**
6	1. Turn OFF the ignition. 2. Disconnect C1. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition 1 voltage circuit and a good ground. Does the test lamp illuminate?	-	Go to **Step 8**	Go to **Step 13**
7	**IMPORTANT:** **The cruise control on/off switch must be turned ON in order to correctly view the set/coast switch resistance values with the DMM.** 1. Turn OFF the ignition. 2. Disconnect C1. 3. With a DMM, measure the resistance of the cruise control switch between the ignition 1 voltage circuit and the cruise control set/coast and resume/accelerate switch signal circuit. 4. Individually activate and hold the cruise control function switches while measuring the resistance value of each cruise control function switch. Do the cruise control function switch resistance values measure between the specified values?	Off = O.L. On = 7.8 K-8.6 K Resume = 2.7 K-3.0 K Set = 1.2 K-1.3 K	Go to **Step 10**	Go to **Step 11**
	IMPORTANT: **The cruise control on/off switch must be turned ON in order to correctly view the set/coast switch resistance values with the DMM.**			

8	1. Turn OFF the ignition. 2. Disconnect C1. 3. With a DMM, measure the resistance of the cruise control switch between the ignition 1 voltage circuit and the cruise control set/coast and resume/accelerate switch signal circuit. 4. Individually activate and hold the cruise control function switches while measuring the resistance value of each cruise control function switch. Do the cruise control function switch resistance values measure between the specified values?	Off = O.L. On = 7.8 K-8.6 K Resume = 2.7 K-3.0 K Set = 1.2 K-1.3 K	Go to **Step 9**	Go to **Step 11**
9	Test the cruise control set/coast and resume/accel switch signal circuit for the following: - High resistance - Open - Short to ground - Short to voltage Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 12**
10	Test the cruise control set/coast and resume/accel switch signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 12**
	Inspect for poor connections at the harness connector of the cruise control switch. Refer to **Testing for Intermittent Conditions and Poor**			

11	**Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 14**
12	Inspect for poor connections at the harness connector of the BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 15**
13	Repair the following in the ignition 1 voltage circuit: • An open • A high resistance • A short to ground Refer to **Circuit Testing** and **Wiring Repairs** . Did you complete the repair?	-	Go to **Step 16**	-
14	Replace the cruise control switch. Refer to **Multifunction, Turn Signal Switch Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
15	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 16**	-
16	Operate the vehicle within the conditions for cruise control operation. Does the cruise control system operate properly?	-	System OK	Go to **Step 2**

DESCRIPTION AND OPERATION

CRUISE CONTROL DESCRIPTION AND OPERATION

Cruise control is a speed control system that maintains a desired vehicle speed under normal driving conditions at speeds above 40 km/h (25 mph). Steep grades may cause variations in the selected vehicle speeds.

The following are the main components of the Cruise Control System:

- The accelerator pedal
- The brake pedal position (BPP) sensor
- The body control module (BCM)
- The cruise control switches
- The engine control module (ECM)
- The throttle actuator control (TAC) motor
- The vehicle speed sensor (VSS)

Cruise Control Engaged

The Cruise Control System will engage and adjust vehicle speeds, based on the activation of the following cruise control switches, which are located on the steering wheel:

- The on/off switch
- The + RES switch
- The - SET switch

The body control module (BCM) monitors the signal circuit of the cruise control switches. The BCM relays the cruise control switch status to the engine control module (ECM) via the GMLAN serial data circuit. The ECM uses the status of the cruise control switch to determine when to capture and maintain the vehicle speed. The ECM monitors the vehicle speed signal circuit in order to determine the desired vehicle speed. The ECM uses the TAC motor in order to maintain the vehicle speed. For further information on the TAC System, refer to **Throttle Actuator Control (TAC) System Description** for the 3.5L engine, to **Throttle Actuator Control (TAC) System Description** for the 3.9L engine, or to **Throttle Actuator Control (TAC) System Description** for the 5.3L engine.

Voltage is supplied to the cruise control switch from the steering wheel control switch reference voltage circuit supplied by the BCM. The cruise control switches are arranged in a resistive ladder design, with each cruise control function switch having a different resistance value. The BCM detects a specific voltage value that is associated with the cruise control function switch being activated. When the normally open cruise control On/Off switch is turned ON, the switch closes and the BCM supplies a ground to the cruise control switch ON indicator circuit as it becomes illuminated. The BCM sends a GMLAN serial data message to the ECM indicating that the On/Off switch is active. Similarly, when the normally open + RES switch or the normally open - SET switch are pressed, the switch closes and the BCM detects the predetermined voltage signal on the - SET switch and the + RES switch signal circuit. The BCM sends a GMLAN serial data message to the ECM indicating that the + RES switch or the - SET switch is active. To engage the Cruise Control System, ensure that the vehicle speed is above 40.2 km/h (25 mph), and then turn the On/Off switch ON and momentarily press the - SET switch. The ECM will engage the Cruise Control System and record the vehicle speed. The ECM sends a GMLAN serial data message to the driver information center (DIC) in order to illuminate the CRUISE SET TO ### message. The ECM sends a GMLAN serial data message to the instrument panel cluster (IPC) in order to illuminate the Cruise Engaged indicator in the IPC. The - SET switch and the + RES switch will remain inactive when the BCM has not received the predetermined voltage signal from the On/Off switch. Pressing the accelerator pedal, while the Cruise Control System is engaged, will allow the driver to override the Cruise Control System in order to accelerate the vehicle beyond the current set vehicle speed. When the accelerator pedal is released, the vehicle will decelerate and resume the current set vehicle speed. The driver can also override the current set vehicle speed via the - SET switch and the + RES switch. When the Cruise Control System is engaged, pressing and holding the - SET switch will allow the vehicle to decelerate from the current set vehicle speed without deactivating the Cruise Control System. When the - SET switch is released, the ECM will record the vehicle speed and maintain the vehicle speed as the new set vehicle speed. When the Cruise Control System is engaged, momentarily pressing - SET switch will allow the vehicle to decelerate at 1.6 km/h (1 mph) increments for each time that the - SET switch is momentarily pressed, with a minimum vehicle speed of 37 km/h (23 mph). Pressing and holding the + RES switch, when the Cruise Control System is engaged, will allow the vehicle to accelerate to a greater vehicle speed than the current set vehicle speed. When the + RES switch is released, the ECM will record the vehicle speed and maintain the vehicle speed as the new set vehicle speed. When the Cruise Control System is engaged, momentarily pressing the + RES switch will allow the vehicle to accelerate at 1.6 km/h (1 mph) increments for each time that the + RES switch is momentarily pressed, with the maximum acceleration total of 16 km/h (10 mph) over the current set vehicle speed. Momentarily activating the + RES switch will recall the previous vehicle speed, after the Cruise Control System is disengaged by pressing the brake pedal or by activating the CANCEL switch.

Cruise Control Disengaged

The engine control module (ECM) disengages the cruise control operation based on the signals from the following switches:

- The brake pedal position (BPP) sensor
- The cruise control On/Off switch
- The cruise control cancel switch

The body control module (BCM) determines when the cruise control cancel switch is activated. When the normally open cancel switch is closed, the BCM detects the predetermined voltage signal on the cruise control function switch circuit. The BCM sends a GMLAN serial data message to the ECM in order to disengage the cruise control system.

The BPP sensor is mounted on the brake pedal bracket. Pressing the brake pedal while the cruise control is engaged will disengage the Cruise Control system. The BCM monitors the BPP sensor signal circuit as the voltage signal increases, while the pedal reaches the fully applied position. The BCM sends a GMLAN serial data message to the ECM indicating the position of the brake pedal. For more information on the BPP sensor, refer to **Exterior Lighting Systems Description and Operation** and to **Brake Pedal Position Sensor Calibration** .

The Cruise Control System will also disengage when one of the following conditions exist:

- The cruise control On/Off switch is switched OFF.
- The ECM detects that a drive override function has been active for approximately 60 seconds.

When the Cruise Control System has been disengaged, the ECM sends a GMLAN serial data message to the instrument panel cluster (IPC) in order to turn OFF the Cruise Engaged indicator, and to the drive information center (DIC) in order to turn OFF the CRUISE SET TO ### message. The vehicle speed stored in the memory of the ECM will be erased when the cruise control On/Off button is turned OFF, or the ignition switch is turned OFF.

Cruise Control Inhibited

The engine control module (ECM) inhibits the cruise control operation when any of the following conditions exist:

- The ECM has not detected a brake pedal activation from the body control module (BCM).
- A Cruise Control System DTC has been set.
- The vehicle speed is less than 40.2 km/h (25 mph).
- The vehicle is in PARK, REVERSE, NEUTRAL, or 1st gear.
- The engine RPM is too low.
- The engine RPM is too high.
- The vehicle speed is too high.
- The system voltage is not between 9-16 volts.
- The Antilock Brake System (ABS)/Traction Control System (TCS) is active for more than 2 seconds.

2006 BRAKES

Disc Brakes - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Brakes		
• Brake Hose Bolt	54 N.m	40 lb ft
• Brake Rotor Retension Screw	14 N.m	10 lb ft
• Front Caliper Bolts	36 N.m	26 lb ft
• Front Caliper Bracket Bolts	180 N.m	133 lb ft
Rear Brakes		
• Brake Hose Bolt	54 N.m	40 lb ft
• Brake Rotor Retension Screw	14 N.m	10 lb ft
• Rear Caliper Bolts	44 N.m	32 lb ft
• Rear Caliper Bracket Bolts	120 N.m	88 lb ft

DISC BRAKE COMPONENT SPECIFICATIONS

Disc Brake Component Specifications

Application	Specification	
	Metric	English
Front Brake Pads (16 in and 17 in)		
• Taper	0.15 mm	0.006 in
Front Brake Rotor (16 in)		
• Rotor Diameter	303 mm	11.93 in
• Rotor Discard Thickness	28.6 mm	1.126 in
• Rotor Maximum Allowable Assembled Lateral Runout	0.06 mm	0.002 in
• Rotor Maximum Allowable Scoring	1.50 mm	0.059 in
• Rotor Maximum Thickness Variation	0.025 mm	0.001 in
• Rotor Minimum Allowable Thickness after Refinishing	XX mm	XX in

- Rotor Thickness (New)	30 mm	1.181 in
Front Brake Rotors (17 in)		
- Rotor Diameter	323 mm	12.72 in
- Rotor Discard Thickness	28.6 mm	1.126 in
- Rotor Maximum Allowable Assembled Lateral Runout	0.06 mm	0.002 in
- Rotor Maximum Allowable Scoring	1.50 mm	0.059 in
- Rotor Maximum Thickness Variation	0.025 mm	0.001 in
- Rotor Minimum Allowable Thickness after Refinishing	29.6 mm	1.165 in
- Rotor Thickness (New)	30 mm	1.181 in
Rear Brake Pads		
- Taper	0.15 mm	0.006 in
Rear Brake Rotor		
- Rotor Diameter	292 mm	11.50 in
- Rotor Discard Thickness	10.5 mm	0.413 in
- Rotor Maximum Allowable Assembled Lateral Runout	0.06 mm	0.002 in
- Rotor Maximum Allowable Scoring	1.50 mm	0.059 in
- Rotor Maximum Thickness Variation	0.025 mm	0.001 in
- Rotor Minimum Allowable Thickness after Refinishing	10.5 mm	0.413 in
- Rotor Thickness (New)	12 mm	0.472 in

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - DISC BRAKES

Begin the disc brake system diagnosis with **Diagnostic Starting Point - Hydraulic Brakes** in Hydraulic Brakes. The use of the Diagnostic Starting Point will lead to the identification of the correct procedure for diagnosing the system and where the procedure is located.

BRAKE ROTOR THICKNESS MEASUREMENT

CAUTION: Two different designs of the front brake rotors and front brake pads are used on this vehicle. Do NOT interchange first design and second design parts, or a loss of braking and personal injury could occur.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to **Brake Pads Replacement - Front** and/or **Brake Pads Replacement - Rear**.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

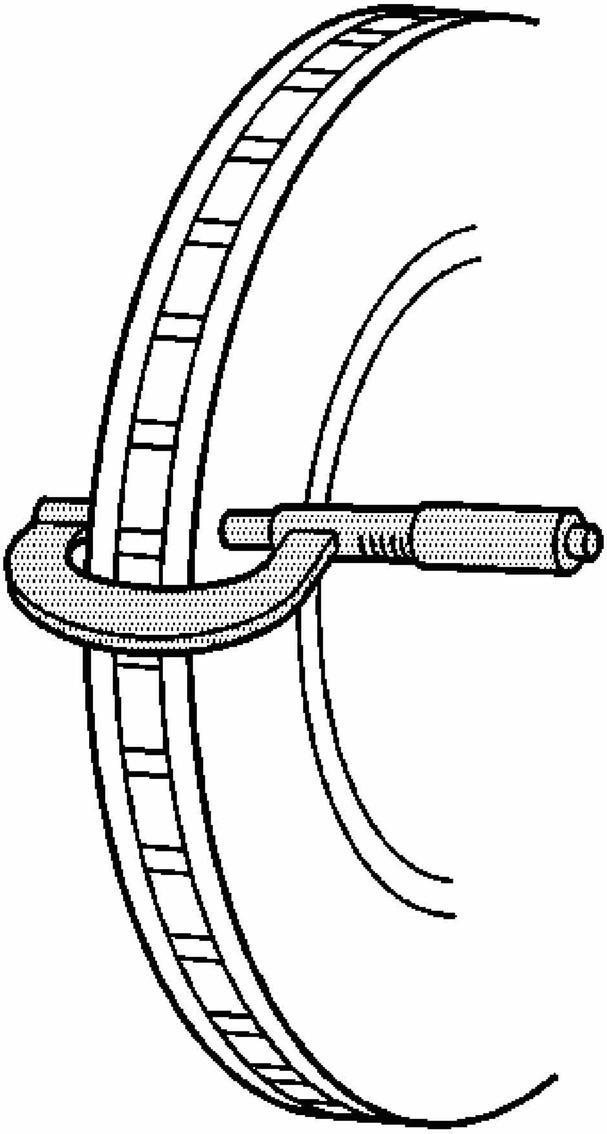


Fig. 1: Measuring Brake Rotor Thickness
Courtesy of GENERAL MOTORS CORP.

3. Using a micrometer calibrated in thousanths-of-a-millimeter, or ten-thousanths-of-an-inch, measure and record the thickness of the brake rotor at four or more points, evenly spaced around the rotor.

   Ensure that the measurements are only taken within the friction surfaces and that the micrometer is positioned the same distance from the outer edge of the rotor, about 13 mm (1/2 in), for each measurement.

4. Compare the lowest thickness measurement recorded to the specifications listed in **Disc Brake Component Specifications**.
5. If the lowest thickness measurement of the brake rotor is above the minimum allowable thickness after refinishing specification, the rotor may be able to be refinished, depending upon surface and wear conditions which may be present.
6. If the lowest thickness measurement of the brake rotor is at or below the minimum allowable thickness after refinishing specification, the rotor may not be refinished.
7. If the lowest thickness measurement of the brake rotor is at or below the discard thickness specification, the rotor requires replacement.

BRAKE ROTOR THICKNESS VARIATION MEASUREMENT

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

IMPORTANT: Any disc brake rotor that exhibits thickness variation exceeding the maximum acceptable level must be refinished or replaced. Thickness variation exceeding the maximum acceptable level can cause brake pulsation.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to **Brake Pads Replacement - Front** and/or **Brake Pads Replacement - Rear**.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

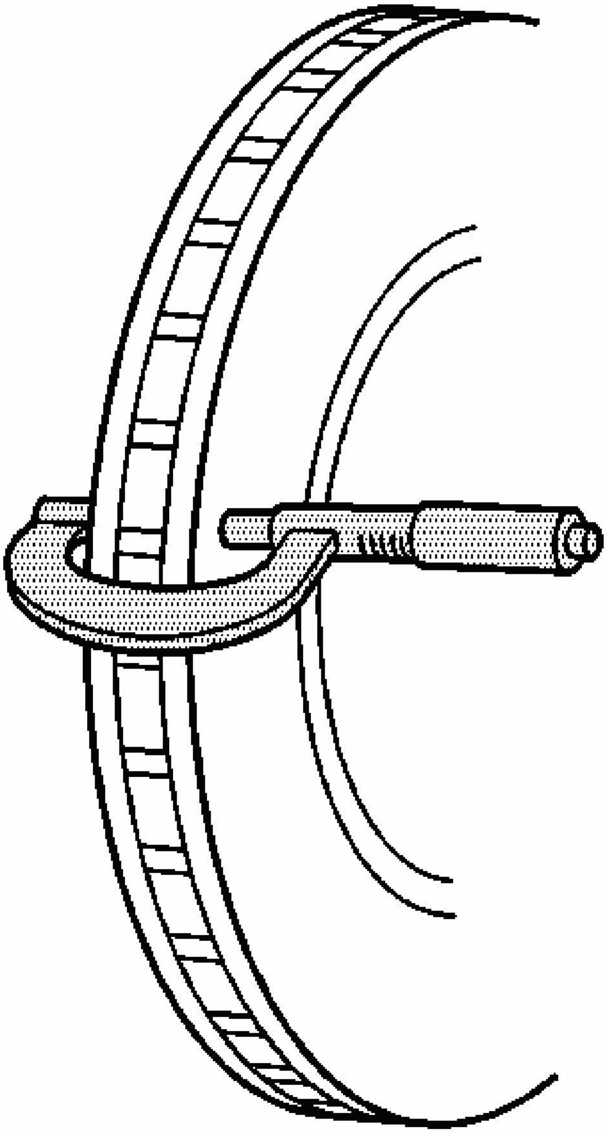


Fig. 2: Measuring Brake Rotor Thickness
Courtesy of GENERAL MOTORS CORP.

3. Using a micrometer calibrated in thousanths-of-a-millimeter, or ten-thousanths-of-an-inch, measure and record the thickness of the brake rotor at four or more points, evenly spaced around the rotor.

   Ensure that the measurements are only taken within the friction surfaces and that the micrometer is positioned the same distance from the outer edge of the rotor, about 13 mm (1/2 in), for each measurement.

4. Calculate the difference between the highest and lowest thickness measurements recorded to obtain the amount of thickness variation.
5. Compare the thickness variation measurement to the following specification:

   Specification: Brake rotor maximum allowable thickness variation: 0.02 mm (0.001 in)

   IMPORTANT: Whenever a brake rotor is refinished or replaced, the assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes.

6. If the brake rotor thickness variation measurement exceeds the specification, the rotor requires refinishing or replacement.

BRAKE ROTOR SURFACE AND WEAR INSPECTION

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to **Brake Pads Replacement - Front** and/or **Brake Pads Replacement - Rear**.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
3. Inspect the friction surfaces of the brake rotor for the following Braking Surface Conditions:
   - Heavy rust and/or pitting

     Light surface rust can be removed with an abrasive disc. Heavy surface rust and/or pitting must be removed by refinishing the rotor.

   - Cracks and/or heat spots
   - Excessive blueing discoloration
4. If the friction surfaces of the brake rotor exhibit one or more of the Braking Surface Conditions, the rotor requires refinishing or replacement.

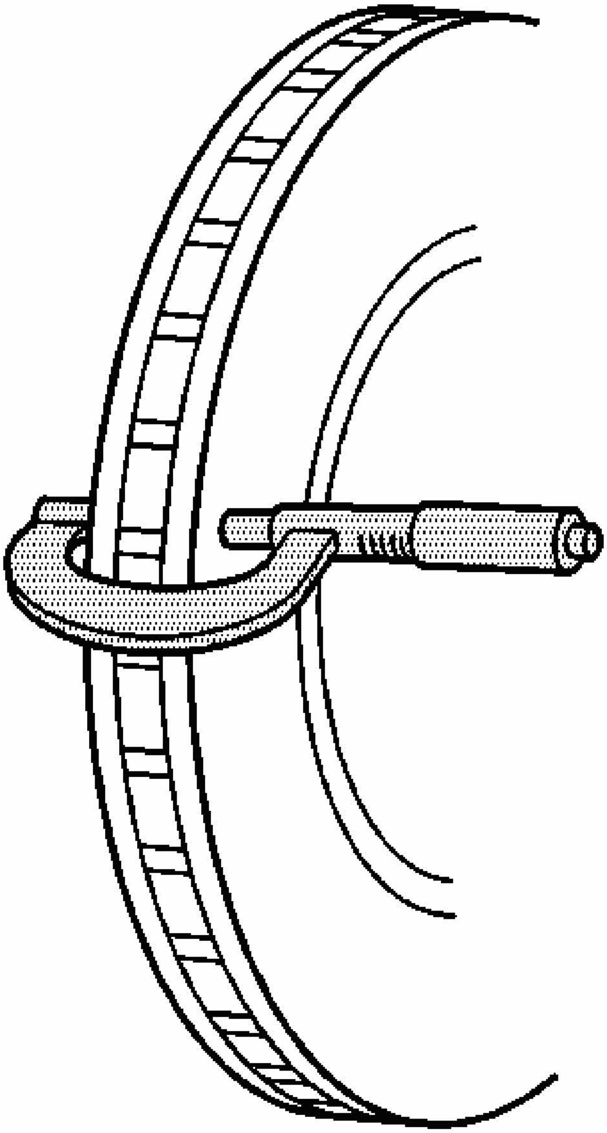


Fig. 3: Measuring Brake Rotor Thickness
Courtesy of GENERAL MOTORS CORP.

5. Using a micrometer calibrated in thousanths-of-a-millimeter, or ten-thousanths-of-an-inch, measure and record the scoring depth of any grooves present on the rotor friction surfaces.
6. Compare the groove scoring depth recorded to the following specification:

   Specification: Brake rotor maximum allowable scoring: 1.50 mm (0.059 in)

7. If the brake rotor scoring depth exceeds the specification, or if an excessive amount of scoring is present, the rotor requires refinishing or replacement.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT (LRO) MEASUREMENT

Tools Required

- **J 39544-KIT** Torque-Limiting Socket Set, or equivalent. See **Special Tools**.
- **J 41013** Rotor Resurfacing Kit. See **Special Tools**.
- **J 42450-A** Wheel Hub Resurfacing Kit. See **Special Tools**.
- **J 45101** Hub and Wheel Runout Gage. See **Special Tools**.
- **J 45101-100** Conical Brake Rotor Washers. See **Special Tools**.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

IMPORTANT:

- **Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800-11 300 km (3,000-7,000 mi).**
- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement.**

1. Matchmark the position of the brake rotor to the wheel studs if this has not been done already.

   IMPORTANT: Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

2. Inspect the mating surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles, corrosion, rust, or debris remaining. If the wheel hub/axle flange and/or if the brake rotor mating surfaces exhibit these conditions, perform the following steps:
   1. Remove the brake rotor from the vehicle. Refer to **Brake Rotor Replacement - Front** and/or **Brake Rotor Replacement - Rear** .

2. Using the **J 42450-A** , thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange. See **Special Tools**.
3. Using the **J 41013** , thoroughly clean any rust or corrosion from the mating surface of the brake rotor. See **Special Tools**.
4. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

3. Install the rotor to the hub/axle flange using the matchmark made prior to removal.

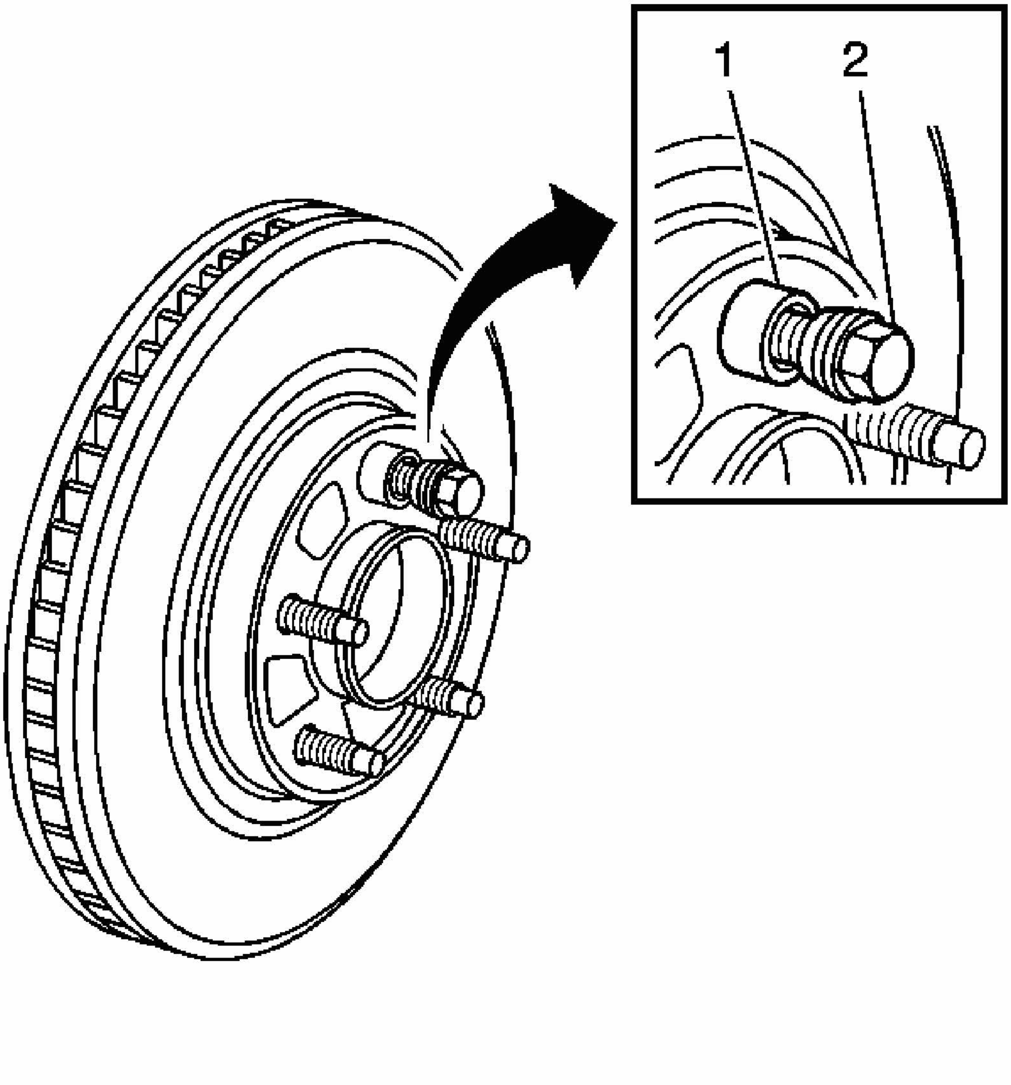


Fig. 4: Identifying J 45101-100 & Lug Nut
Courtesy of GENERAL MOTORS CORP.

4. Hold the rotor firmly in place against the hub/axle flange and install one of the **J 45101-100** (1), and one lug nut (2) onto the upper-most wheel stud. See **Special Tools**.
5. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

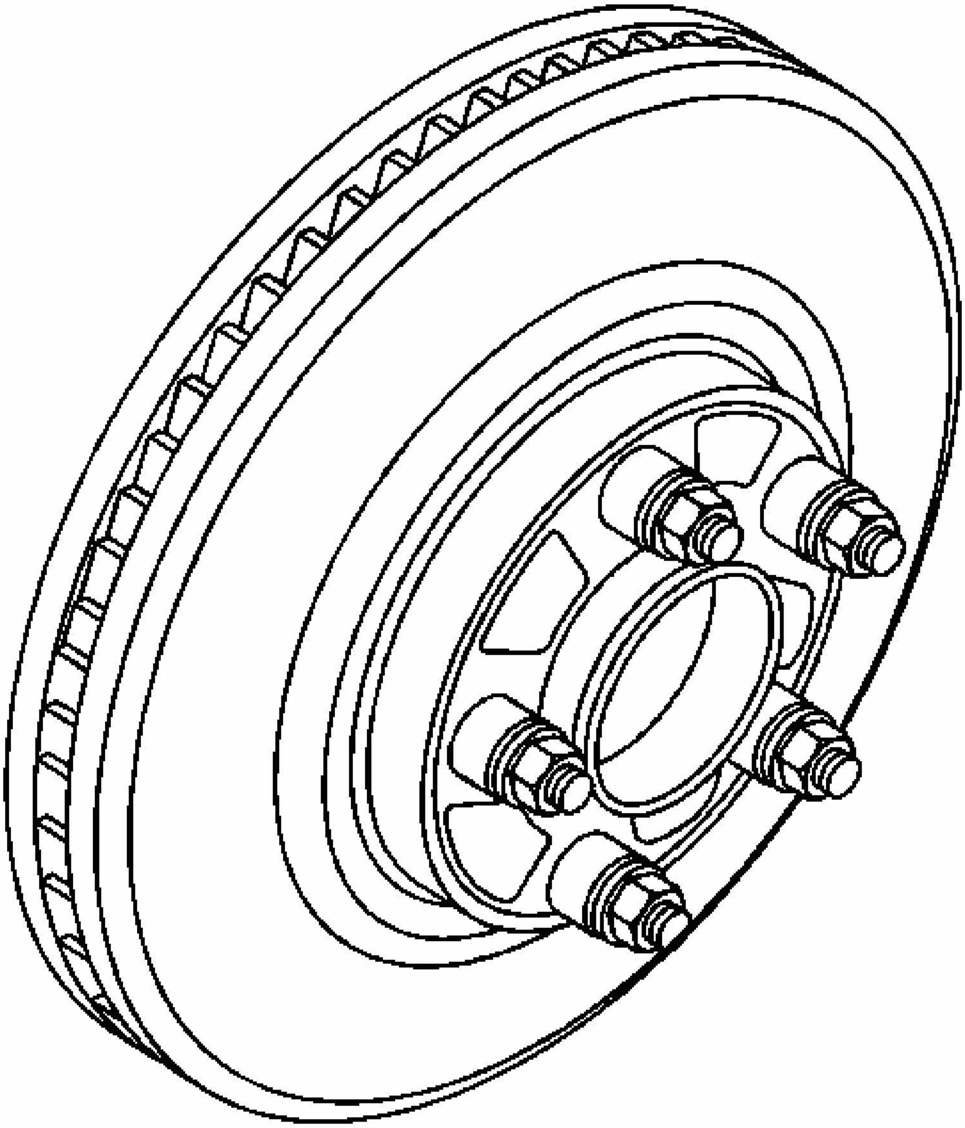


Fig. 5: Installing All J 45101-100s & Lug Nuts
Courtesy of GENERAL MOTORS CORP.

6. Install the remaining **J 45101-100** and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern. See **Special Tools**.
7. Using the **J 39544-KIT** , or equivalent, tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. See **Special Tools**. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
8. If the brake rotor has been REFINISHED or REPLACED with a new rotor, proceed to

step 14.

9. If the brake rotor meets the following criteria, proceed to step 10.
    - The rotor is within specifications and is being REUSED
    - The rotor has NOT been refinished
    - The rotor does NOT exhibit thickness variation exceeding the maximum allowable level

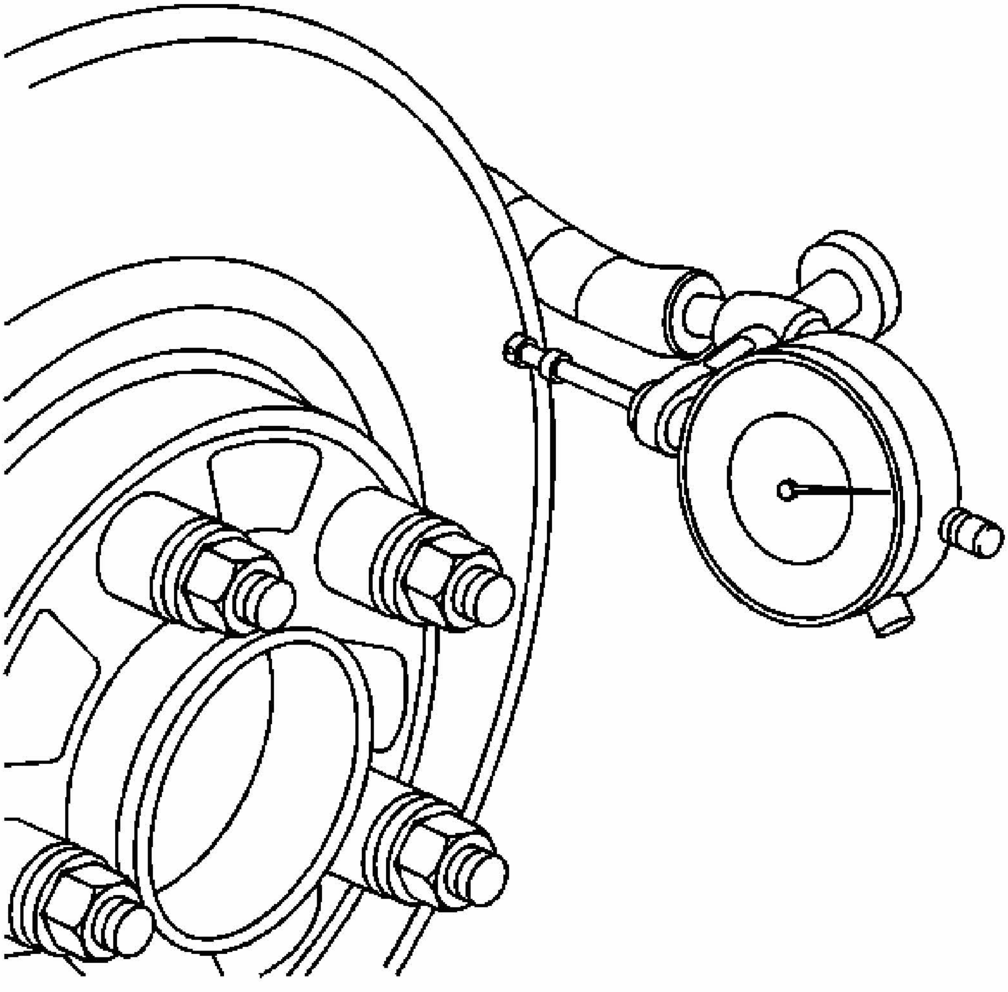


Fig. 6: Mounting Dial Indicator To Measure Lateral Runout
Courtesy of GENERAL MOTORS CORP.

10. Mount a dial indicator, **J 45101** , or equivalent, to the steering knuckle and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0. See **Special Tools**.5 in) from the outer edge of the rotor.

11. Measure and record the assembled LRO of the brake rotor.
    1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
    2. Rotate the rotor until the highest reading is displayed on the dial.
    3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
    4. Measure and record the amount of LRO.
12. Compare the brake rotor assembled LRO to the following specification:

    Specification:
    - Front brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in)
    - Rear brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in)

13. If the brake rotor assembled LRO is within specifications, proceed to step 18.

    If the brake rotor assembled LRO exceeds the specification, refinish the rotor to ensure true parallelism, refer to **Brake Rotor Refinishing**. After refinishing the rotor, proceed to step 14.

14. Mount a dial indicator, **J 45101** , or equivalent, to the steering knuckle and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0. See **Special Tools**.5 in) from the outer edge of the rotor.
15. Measure and record the assembled LRO of the brake rotor.
    1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
    2. Rotate the rotor until the highest reading is displayed on the dial.
    3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
    4. Measure and record the amount of LRO.
16. Compare the brake rotor assembled LRO to the following specification:

    Specification:
    - Front brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in)
    - Rear brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in)

17. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction**.
18. If the brake rotor assembled LRO measurement is within specification, install the brake

caliper and depress the brake pedal several times to secure the rotor in place before removing the **J 45101-100** and the lug nuts. See **Special Tools**.

BRAKE PAD INSPECTION

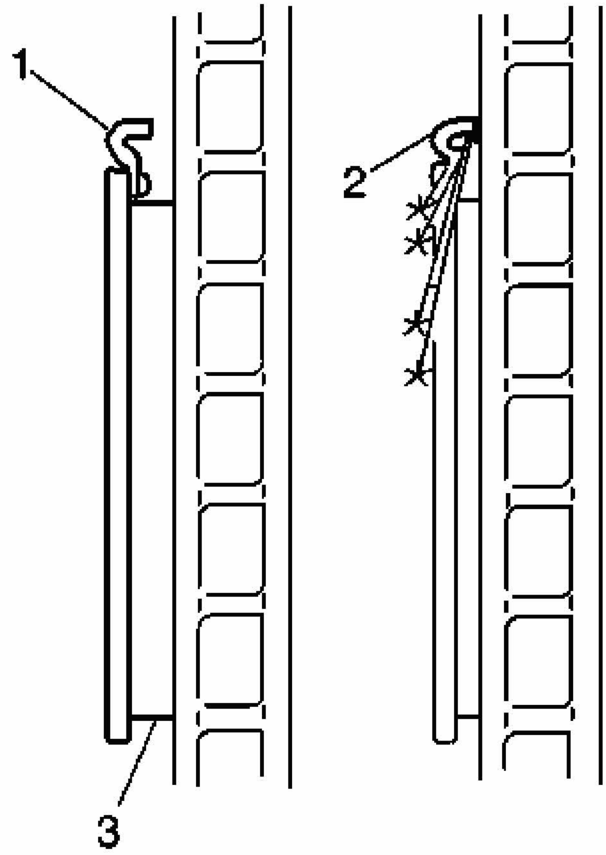


Fig. 7: View Of Brake Pads & Audible Wear Sensors
Courtesy of GENERAL MOTORS CORP.

- Inspect the disc brake pads at regular intervals, or whenever the tire and wheel assemblies are removed from the vehicle.
- If replacement is necessary, always replace disc brake pads in axle sets.
- Inspect both edges of the disc brake pad friction surfaces (3). The highest rate of wear normally occurs at the trailing edge of the disc brake pads.
- Inspect the thickness of the disc brake pads (3) in order to ensure that they have not worn prematurely. The disc brake pad wear should be approximately even per axle set.
- Both front and rear disc brake pads have integral, audible wear sensors (1). When the

disc brake pad wear reaches the minimum allowable thickness, the wear sensor contacts the disc brake rotor (2). The wear indicator will then produce an audible, high-pitched warning noise during wheel rotation.

- Replace the disc brake pads when the friction surface (3) is worn to within 0.76 mm (0.030 in) of the mounting plates.
- Remove the brake calipers and inspect the friction surfaces of the inner and outer disc brake pads to ensure that they are level. Place the disc brake pad friction surfaces together and measure the gap between the surfaces. If more than 0.13 mm (0.005 in) gap exists midway between the length of the disc brake pads, replace the disc brake pads.
- Verify that any disc brake pad shims that may be required are in place and not damaged or excessively corroded. Replace any missing or damaged shims in order to preserve proper disc brake performance.
- Replace the disc brake pads if any have separated from the mounting plates.
- Inspect the disc brake pads friction surfaces for cracks, fractures, or damage which may cause noise or otherwise impair disc brake performance.

BRAKE CALIPER INSPECTION

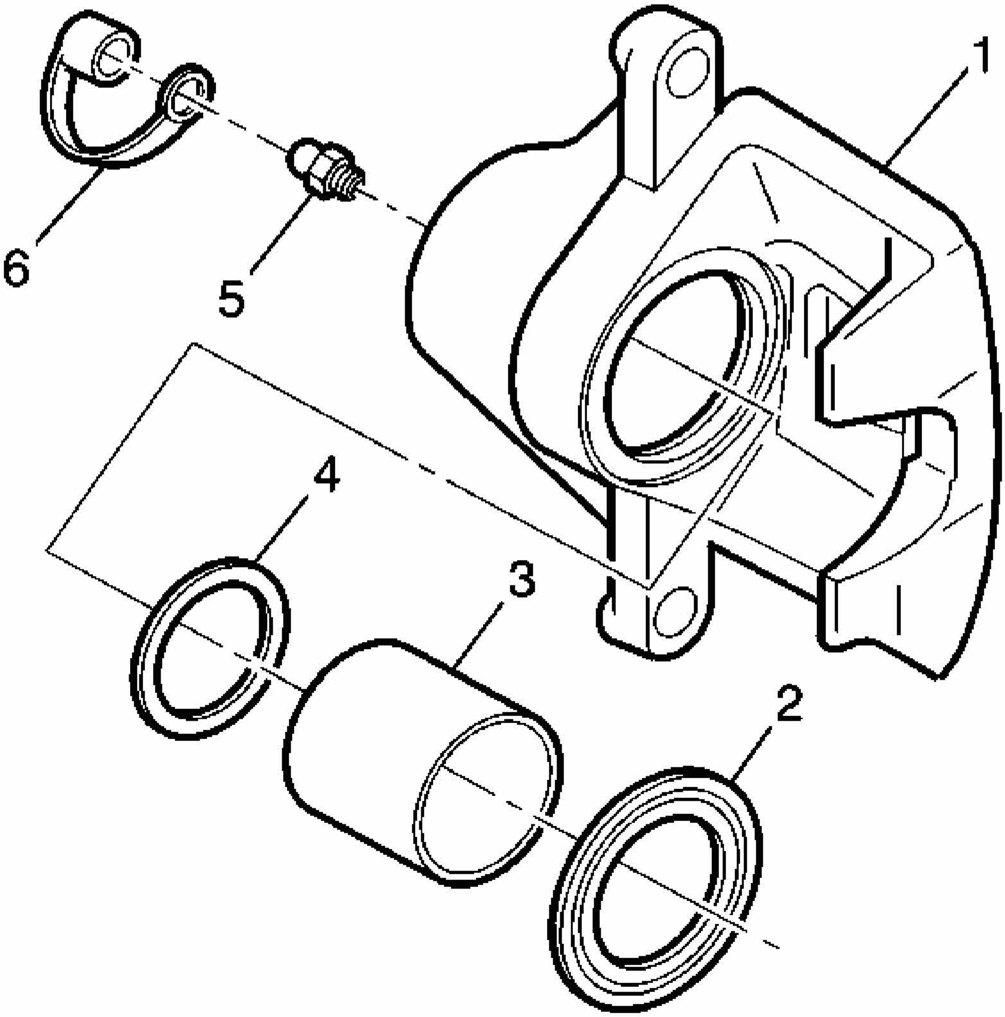


Fig. 8: Exploded View Of Brake Caliper
Courtesy of GENERAL MOTORS CORP.

1. Inspect the brake caliper housing (1) for cracks, excess wear, and/or damage. If any of these conditions are present, the brake caliper requires replacement.
2. Inspect the caliper piston dust boot seal (2) for cracks, tears, cuts, deterioration and/or improper seating in the caliper body. If any of these conditions are present, the brake caliper requires overhaul or replacement.
3. Inspect for brake fluid leakage around the caliper piston dust boot seal (2) and on the disc brake pads. If there is any evidence of brake fluid leakage, the brake caliper requires overhaul or replacement.

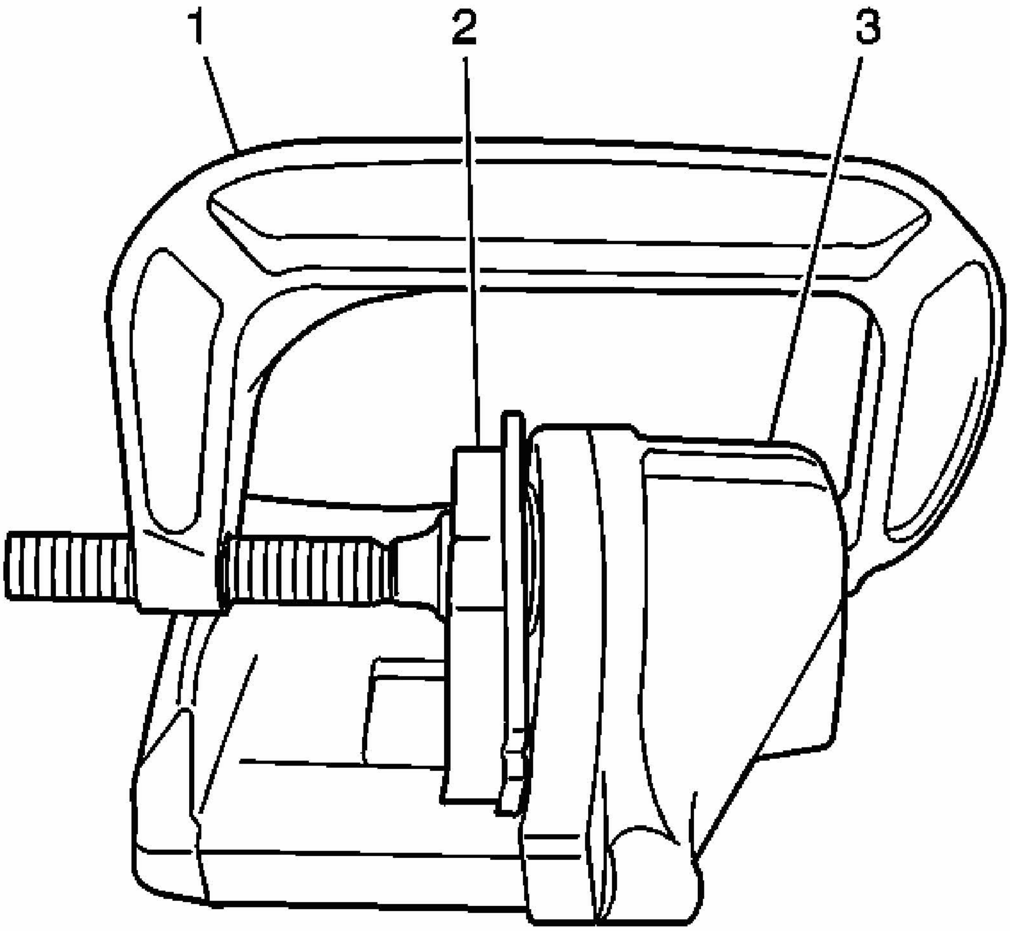


Fig. 9: Compressing Caliper Piston
Courtesy of GENERAL MOTORS CORP.

4. Inspect for smooth and complete travel of the caliper pistons into the caliper bores:

   The movement of the caliper pistons into the caliper bores should be smooth and even. If the caliper piston is frozen or difficult to bottom, the caliper requires overhaul or replacement.

   - For single piston caliper applications, insert a discarded inner brake pad (2) or block of wood in front of the piston. Using a large C-clamp (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly bottom the piston in the bore.
   - For dual piston caliper applications, insert a discarded inner brake pad (2) or block of wood in front of the pistons. Using 2 large C-clamps (1) installed over the body

of the caliper (3) and against the brake pad or block of wood, slowly bottom the pistons evenly into the bores.

DISC BRAKE MOUNTING AND HARDWARE INSPECTION - FRONT

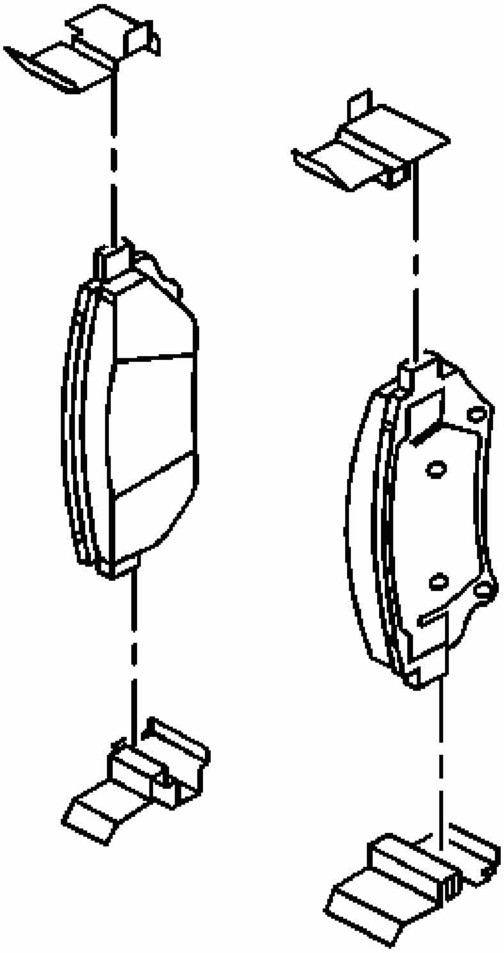


Fig. 10: Disc Brake Pad Mounting Hardware
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. Remove the disc brake caliper from the caliper mounting bracket.
2. Remove the disc brake pads from the caliper mounting bracket.

3. Inspect the disc brake pad mounting hardware for the following:
    - Missing mounting hardware
    - Excessive corrosion
    - Bent mounting tabs
    - Looseness at the caliper mounting bracket
    - Looseness at the disc brake pads
4. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
5. Ensure the disc brake pads are held firmly in place on the caliper mounting bracket, yet slide easily on the mounting hardware without binding.

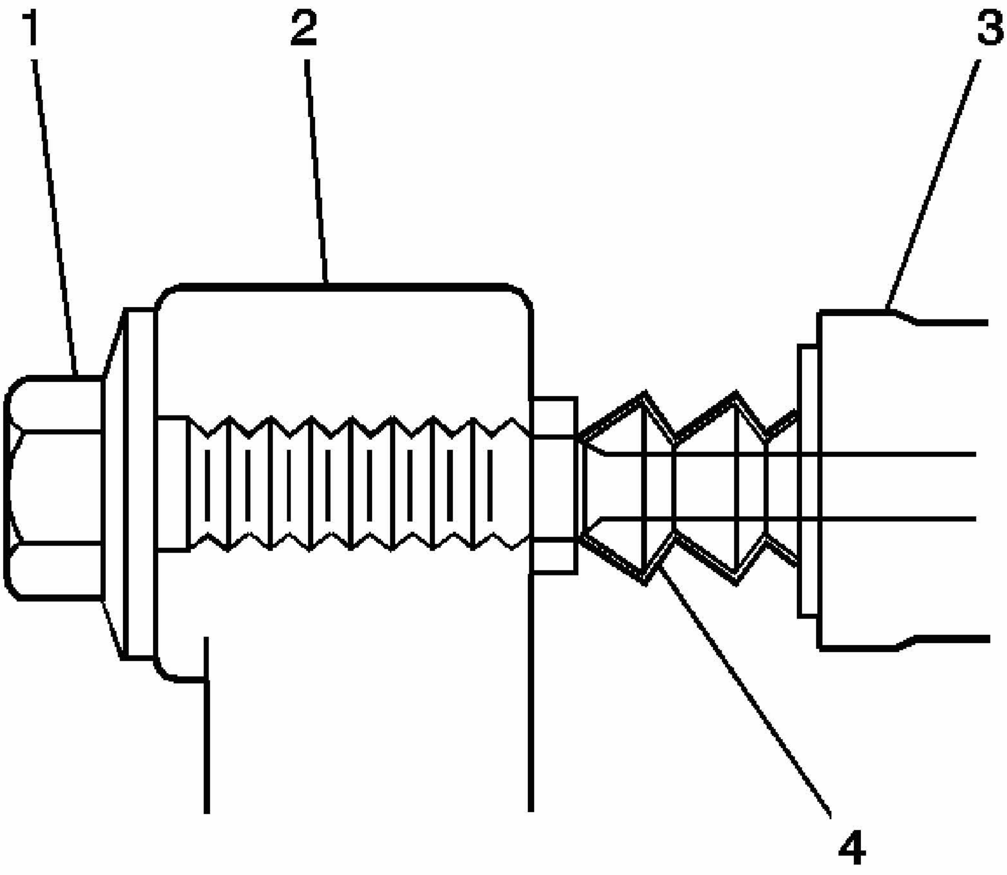


Fig. 11: Inspecting Caliper Bolt
Courtesy of GENERAL MOTORS CORP.

6. Inspect the caliper bolts (1) for the following:

- Binding
- Seizing
- Looseness in the caliper mounting bracket (3)
- Bent or damaged caliper bolts
- Cracked or torn boots (4)
- Missing boots
- Bent or damaged caliper mounting bracket (3)

7. If any of the conditions listed are found, the caliper mounting hardware requires replacement.
8. Install the disc brake pads to the caliper mounting bracket.
9. Install the disc brake caliper to the mounting bracket.

REAR DISC BRAKE MOUNTING AND HARDWARE INSPECTION

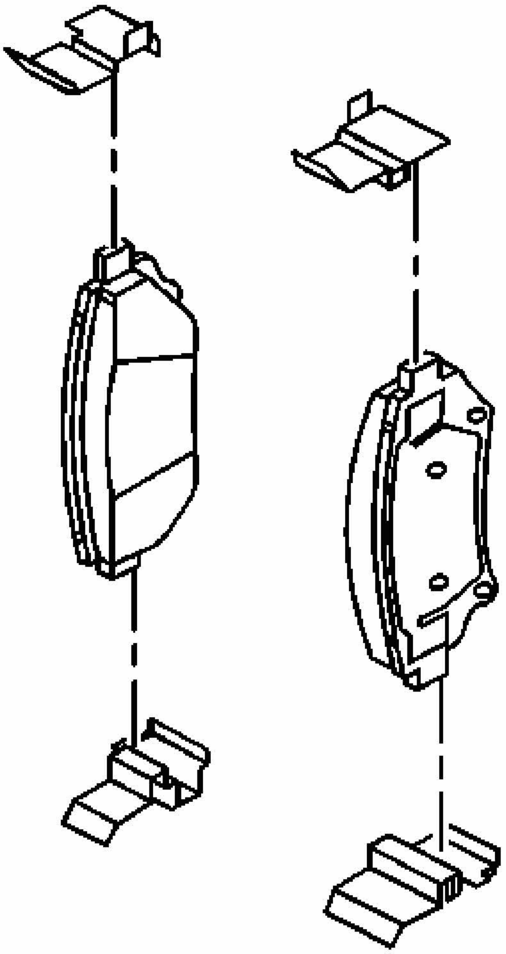


Fig. 12: Disc Brake Pad Mounting Hardware
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. Inspect the disc brake pad mounting hardware for the following:
   - Missing mounting hardware
   - Excessive corrosion
   - Bent mounting tabs
   - Looseness at the caliper mounting bracket
   - Looseness at the disc brake pads

2. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
3. Ensure the disc brake pads are held firmly in place on the caliper mounting bracket, yet slide easily on the mounting hardware without binding.

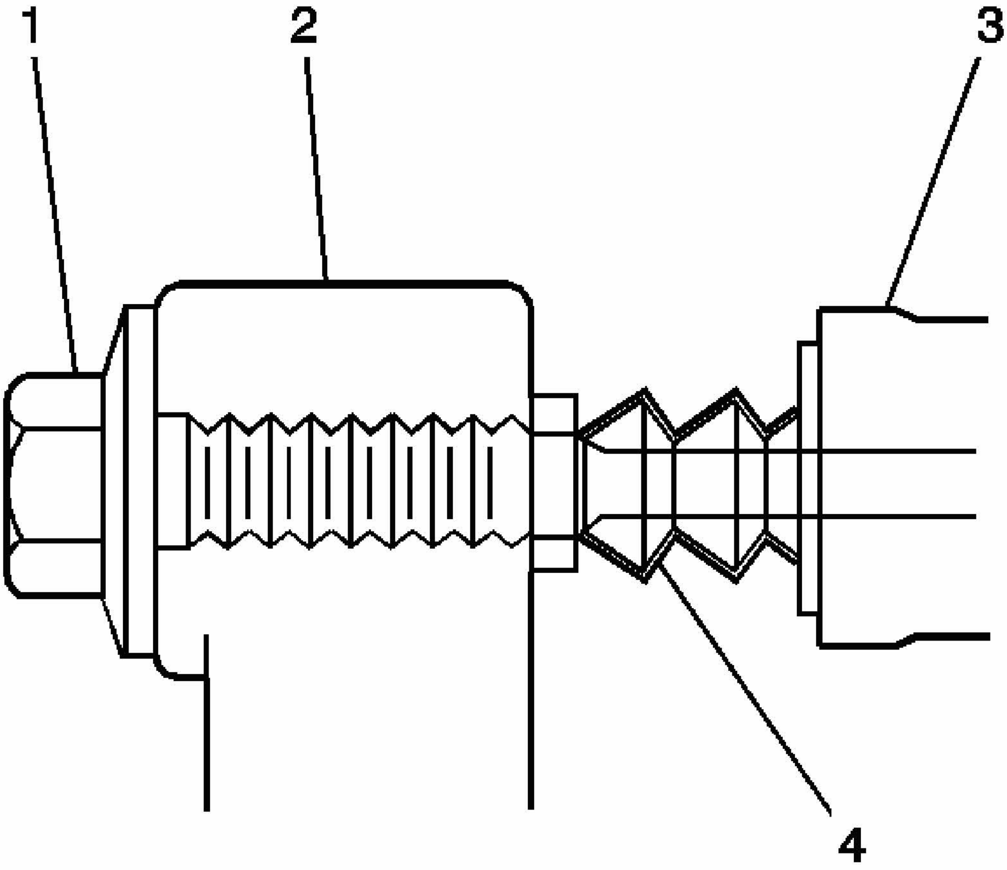


Fig. 13: Inspecting Caliper Bolt
Courtesy of GENERAL MOTORS CORP.

4. Inspect the caliper bolts (1) for the following:
    - Binding
    - Seizing
    - Looseness in the caliper mounting bracket (3)
    - Bent or damaged caliper bolts
    - Cracked or torn boots (4)
    - Missing boots

- Bent or damaged caliper mounting bracket (3)

5. If any of the conditions listed are found, the caliper mounting hardware requires replacement.

REPAIR INSTRUCTIONS

FRONT BRAKE PADS REPLACEMENT

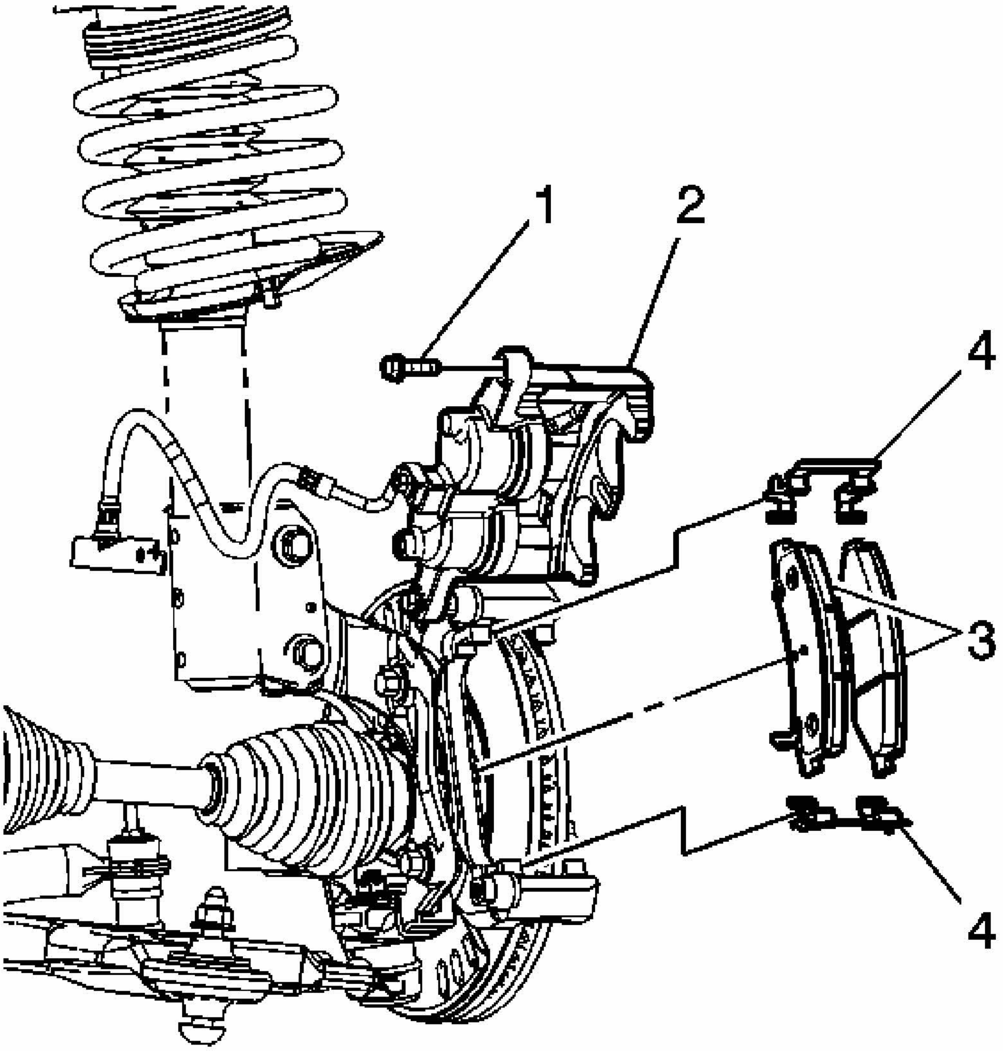


Fig. 14: Replacing Front Brake Pads
Courtesy of GENERAL MOTORS CORP.

Brake Pads Replacement - Front

Callout	Component Name
CAUTION: **Refer to Brake Dust Caution .** **NOTE:** **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** 2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .	
1	Bolt **Tightening Specification:** Tighten to 36 N.m (26 lb ft).
2	Brake Caliper **Tip:** 1. Rotate the caliper up and to the rear until it reaches the 12 o'clock position. 2. Use a mechanics wire or equivalent to hold the brake caliper in the upright position. 3. Using a piece of wood or an old brake pad and a pair of channel locks, gently apply pressure until the pistons are fully seated. BE SURE that the channel locks are CENTERED before applying pressure to seat the pistons.
3	Brake Pads **Tip:** - If removing the brake pads to service the brake system, please note the position of the brake pads for proper installation. - When replacing the brake pads, ensure that the pad with the wear indicator in positioned on the inside and the wear indicator is pointing down. - Use denatured alcohol and clean, filtered compressed air to clean the brake Pad area.
	Brake Pad Springs **Tip:**

4	• If removing the Brake Pad Spring to service the brake system, mark the relationship of the Springs to the Mounting Bracket for proper installation. • Use NEW Brake Pad Springs ONLY when replacing the Brake Pads.

REAR BRAKE PADS REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, then no brake fluid needs to be removed from the reservoir before proceeding. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, then remove brake fluid to the midway point before proceeding.
3. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Remove the rear tire and the wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
5. Install a hand tightened lug nut to retain the rotor to the hub.

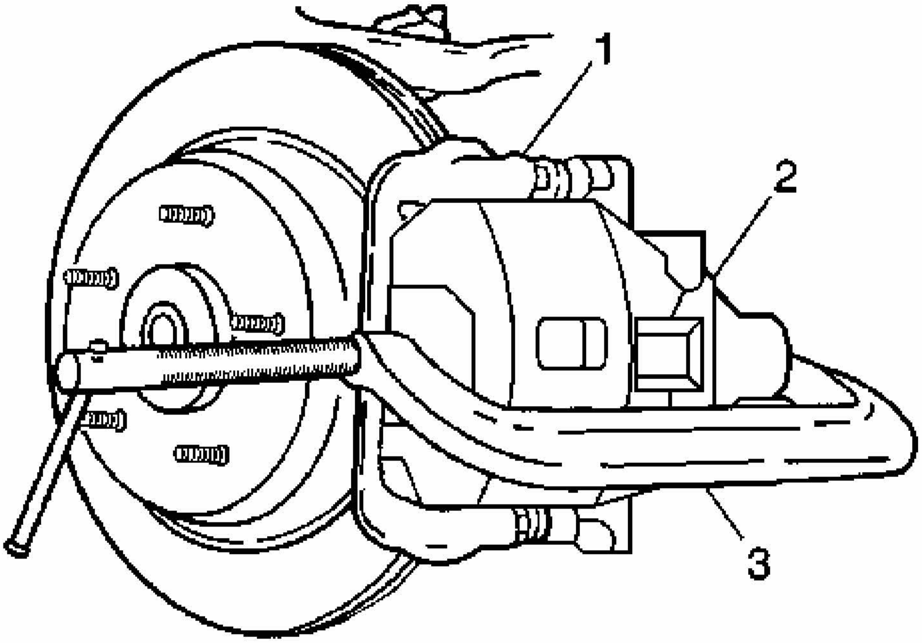


Fig. 15: Pushing In Brake Caliper Piston
Courtesy of GENERAL MOTORS CORP.

6. Compress the caliper piston enough for clearance. Use a C-clamp (3).

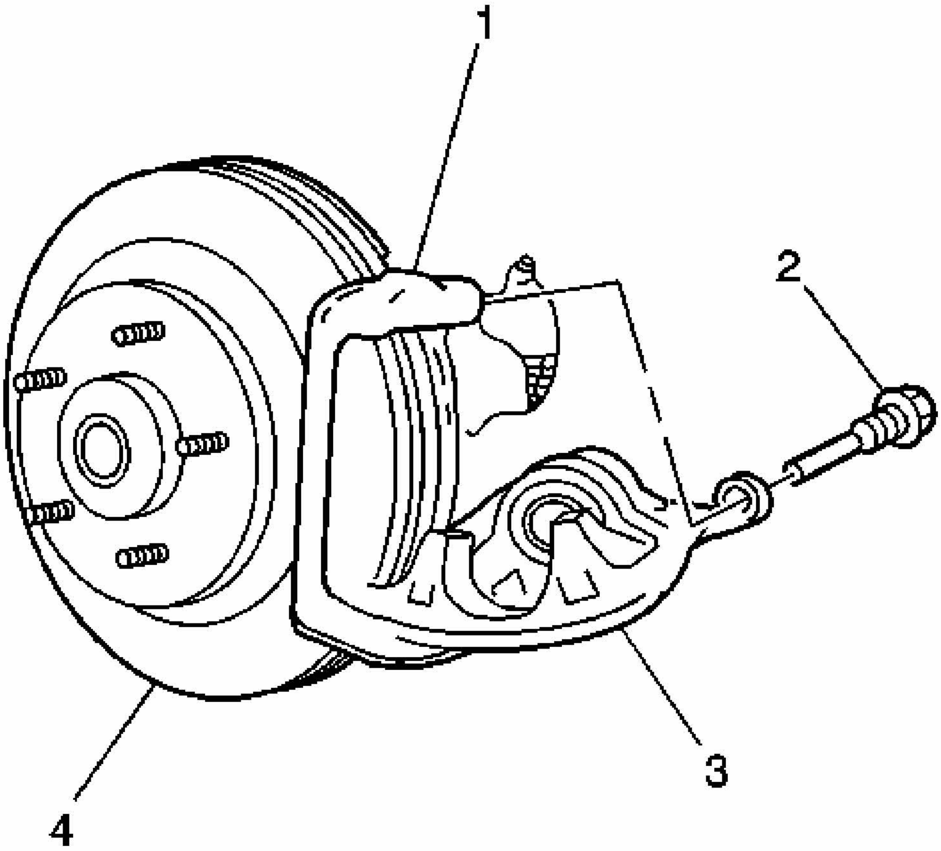


Fig. 16: View Of Upper Caliper Bolt - Rear
Courtesy of GENERAL MOTORS CORP.

7. Remove the upper caliper bolt (2).

NOTE: **Use care to avoid damaging pin boot when rotating caliper.**

NOTE: **Support the brake caliper with heavy mechanic's wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.**

8. Pivot the caliper down in order to access the pads. It is not necessary to remove the caliper.

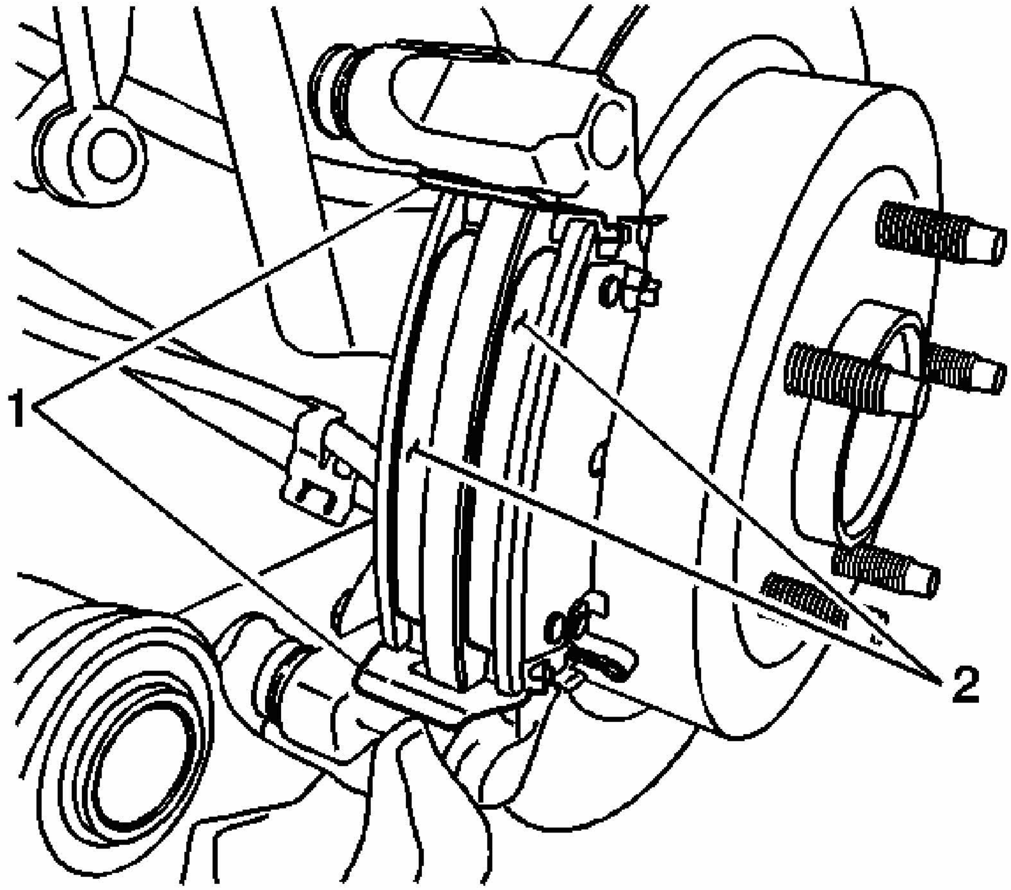


Fig. 17: Rear Brake Pads & Clips
Courtesy of GENERAL MOTORS CORP.

9. Remove the brake pads (2) from the caliper bracket.
10. Remove the 2 pad clips (1) from the caliper bracket.
11. Inspect the caliper mounting hardware for the following conditions:
    - Cuts
    - Tears
    - Deterioration

    Replace any hardware if damage exists. Refer to **Disc Brake Mounting and Hardware Inspection - Rear**.

12. Inspect the caliper dust boot for the following conditions:
    - Cuts
    - Tears
    - Deterioration

    Replace the caliper dust boot if damage exists. Refer to **Brake Caliper Inspection**.

13. Inspect the caliper bolts for corrosion or damage. If corrosion exists, use new caliper bolts when installing the caliper.

Installation Procedure

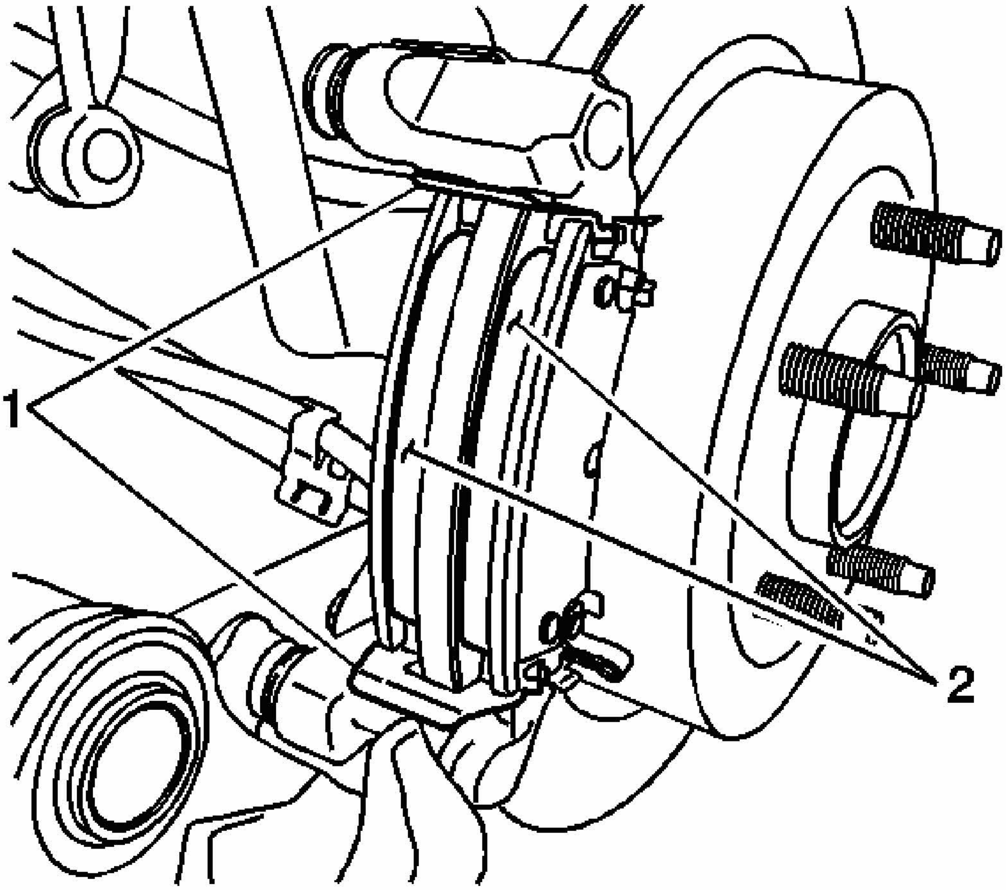


Fig. 18: Rear Brake Pads & Clips
Courtesy of GENERAL MOTORS CORP.

1. Bottom the piston into the caliper bore.

   Use a C-clamp before installing new brake pads in order to compress the piston. Use an old brake pad or wooden block across the face of the piston to avoid damage to the piston or the caliper boot.

2. Install the 2 retainers (1) to the caliper bracket.

   IMPORTANT: The wear sensor is on the outside pad. The sensor is positioned at the trailing or downward edge of the pad during forward wheel rotation.

3. Install the pads (2) to the caliper bracket.

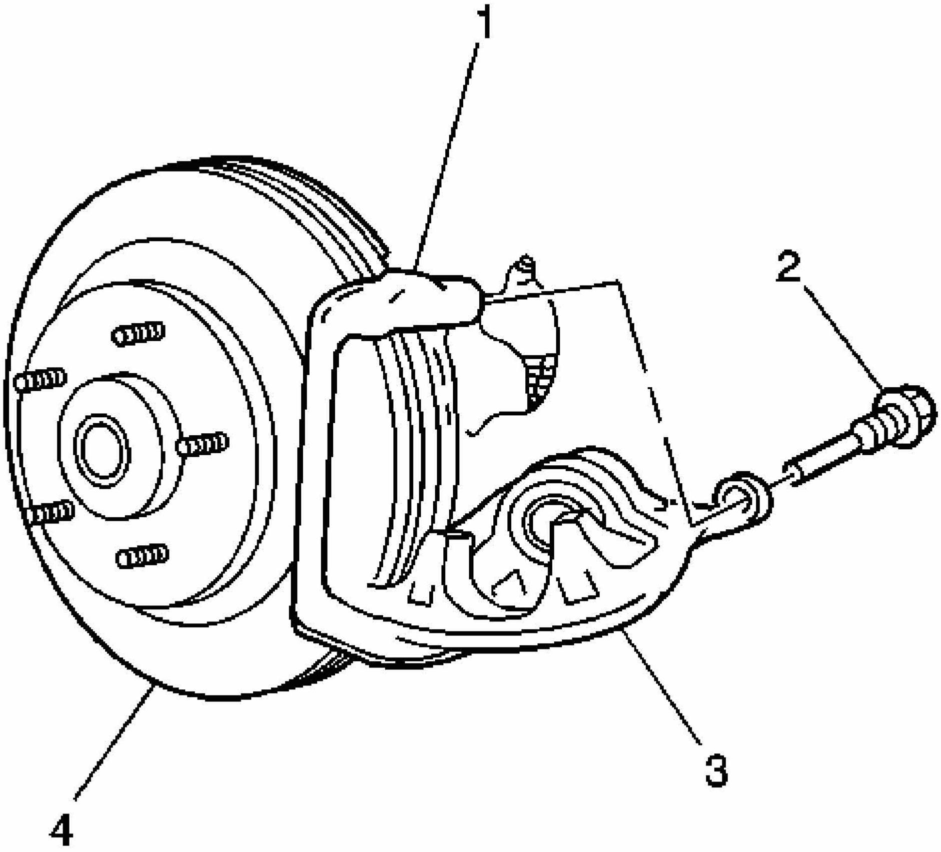


Fig. 19: View Of Upper Caliper Bolt - Rear
Courtesy of GENERAL MOTORS CORP.

NOTE: Use care to avoid damaging pin boot when rotating caliper.

4. Swing the caliper (3) upward in position around the pads.
5. Lubricate the bolt and the bolt boot. Use silicone grease.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

6. Install the upper caliper bolt (2).

   Tighten: Tighten the caliper bolt to 44 N.m (32 lb ft).

7. Remove the wheel lug nut retaining the rotor to the hub.
8. Install the rear tire and the wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels. Align the previous marks on the wheel, hub and bearing.
9. Lower the vehicle.
10. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
11. Slowly release the brake pedal.
12. Wait 15 seconds, then repeat steps 10 and 11 until a firm brake pedal is obtained. This will properly seat the brake caliper pistons and brake pads.
13. Fill the brake master cylinder reservoir to the proper level. Refer to **Master Cylinder Reservoir Filling** in Hydraulic Brakes.
14. Burnish the pads and rotors. Refer to **Burnishing Pads and Rotors**.

BURNISHING PADS AND ROTORS

CAUTION: Refer to ROAD TEST CAUTION in Cautions and Notices.

Burnishing the brake pads and brake rotors is necessary in order to ensure that the braking surfaces are properly prepared after service has been performed on the disc brake system.

This procedure should be performed whenever the disc brake rotors have been refinished or replaced, and/or whenever the disc brake pads have been replaced.

1. Select a smooth road with little or no traffic.
2. Accelerate the vehicle to 48 km/h (30 mph).

IMPORTANT: Use care to avoid overheating the brakes while performing

this step.

3. Using moderate to firm pressure, apply the brakes to bring the vehicle to a stop. Do not allow the brakes to lock.
4. Repeat steps 2 and 3 until approximately 20 stops have been completed. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

FRONT BRAKE CALIPER REPLACEMENT

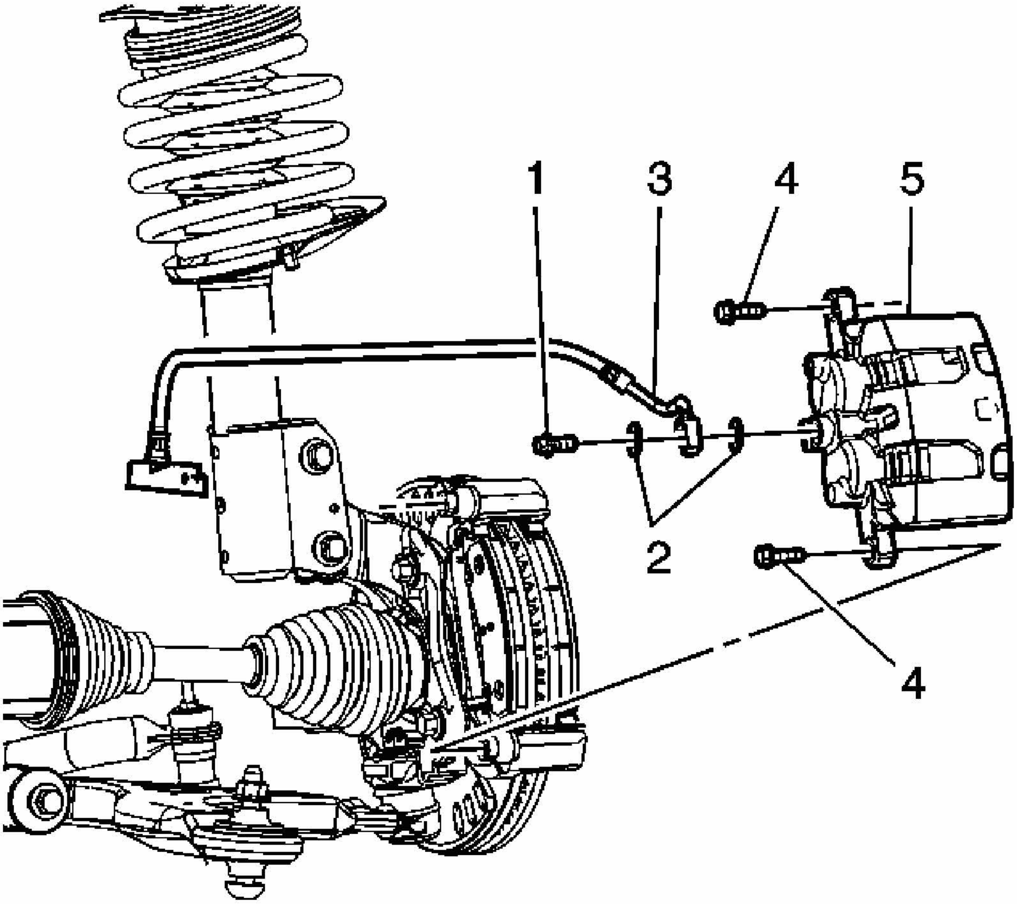


Fig. 20: Replacing Front Brake Caliper
Courtesy of GENERAL MOTORS CORP.

Brake Caliper Replacement - Front

Callout	Component Name
CAUTION:	

Refer to Brake Dust Caution .

CAUTION:

Refer to Brake Fluid Irritant Caution .

CAUTION:

Refer to Brake Fluid Effects on Paint and Electrical Components Notice .

NOTE:

Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .

1	Brake Hose Bolt **Tightening Specification:** Tighten to 54 N.m (40 lb ft).
2	Brake Hose Washer (Qty: 2) **Tip:** DO NOT reuse the brake hose washers, Use NEW ONLY.
3	Brake Hose **Tip:** • Cap or plug the brake hose to ensure that the Brake System DOES NOT become contaminated and to prevent leaks. • Relocate the brake hose to the side. Secure the brake Hose with the fitting facing UP at the highest point without damaging the brake hose.
4	Brake Caliper Bolts (Qty: 2) **Tightening Specifications:** Tighten to 36 N.m (40 lb ft).
5	Brake Caliper **Tip:** • If removing the brake caliper to service the brake system, it is NOT necessary to remove the brake hose from the brake caliper. Reposition the brake caliper to the side and support the caliper

	mechanics wire or equivalent. - Bleed the brakes. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .

REAR BRAKE CALIPER REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, then no brake fluid needs to be removed from the reservoir before proceeding. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, then remove brake fluid to the midway point before proceeding.
3. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Remove the rear tire and the wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
5. Hand tighten 2 wheel lug nuts to retain the rotor to the hub.

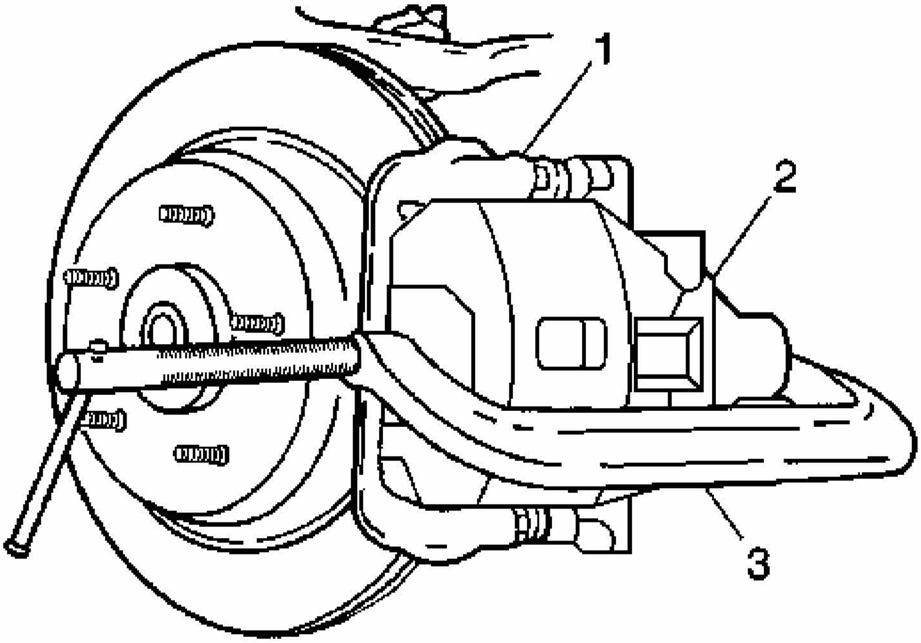


Fig. 21: Pushing In Brake Caliper Piston
Courtesy of GENERAL MOTORS CORP.

6. Install a large C-clamp (3) over the top of the brake caliper (2) and against the back of the outboard brake pad.
7. Tighten the C-clamp (3) until the caliper piston is pushed into the caliper bore enough to slide the caliper off the rotor.
8. Remove the C-clamp (3) from the caliper.

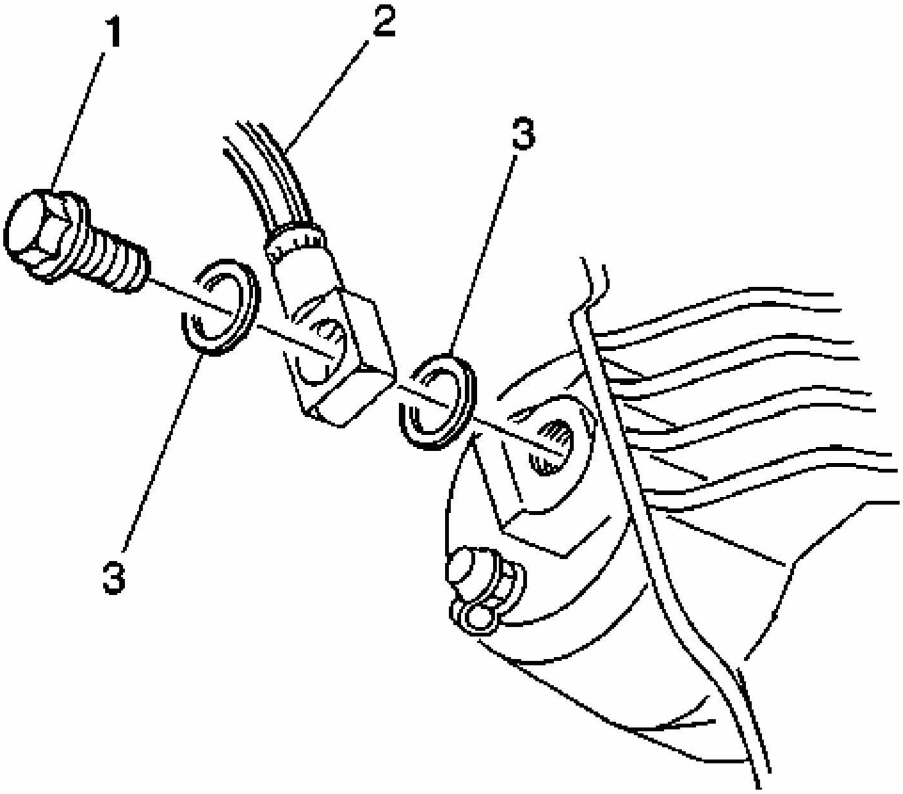


Fig. 22: Identifying Brake Hose & Components
Courtesy of GENERAL MOTORS CORP.

9. Remove the brake hose-to-caliper bolt (1) from the caliper.

   Discard the 2 copper brake hose gaskets (3). These gaskets may be stuck to the brake caliper and/or the brake hose end.

10. Plug the opening in the rear brake hose (2) to prevent excessive brake fluid loss and contamination.

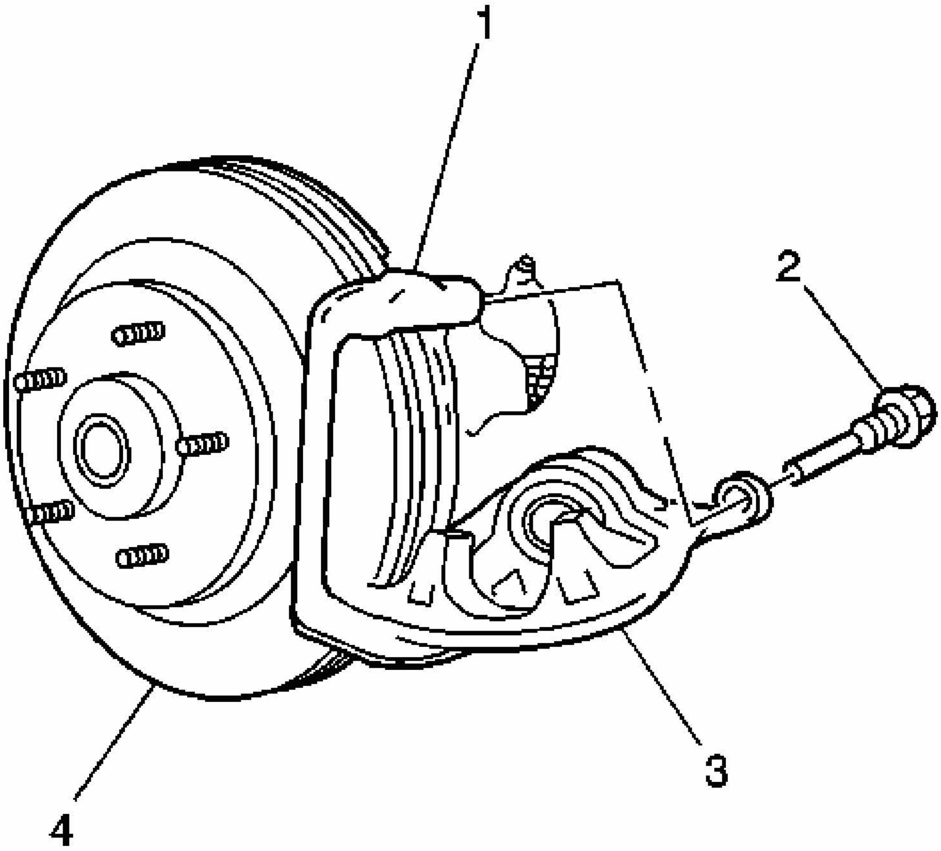


Fig. 23: View Of Upper Caliper Bolt - Rear
Courtesy of GENERAL MOTORS CORP.

11. Remove the caliper bolts (1 and 3).
12. Remove the caliper (3) from the rotor (4) and the caliper bracket (1).
13. Inspect the caliper bracket bolt boots on the caliper bracket for the following conditions:
    - Cuts
    - Tears
    - Deterioration

    Replace any damaged caliper bracket bolt boots. Refer to **Disc Brake Hardware Replacement - Rear**.

14. Inspect the caliper bolts (2) for corrosion or damage. If corrosion is found, use new

caliper bolts, including bushings, when installing caliper.

Installation Procedure

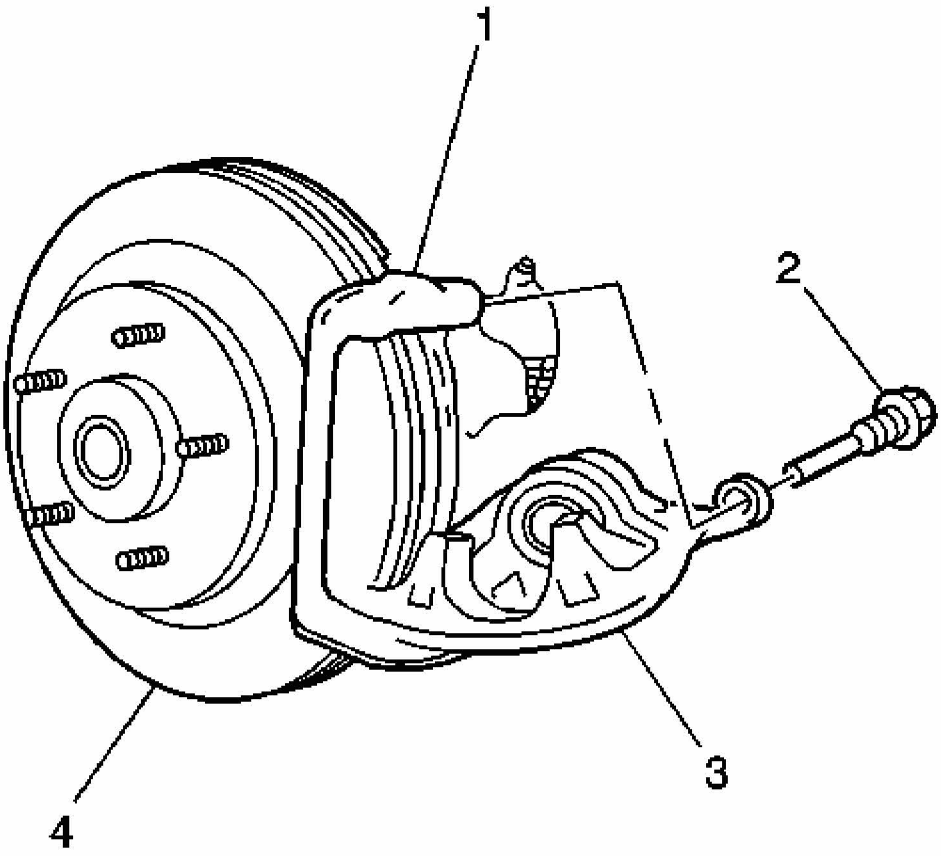


Fig. 24: View Of Upper Caliper Bolt - Rear
Courtesy of GENERAL MOTORS CORP.

1. Install the caliper (3) over the rotor (4) and the caliper bracket (1). Ensure that the bushings are in place.

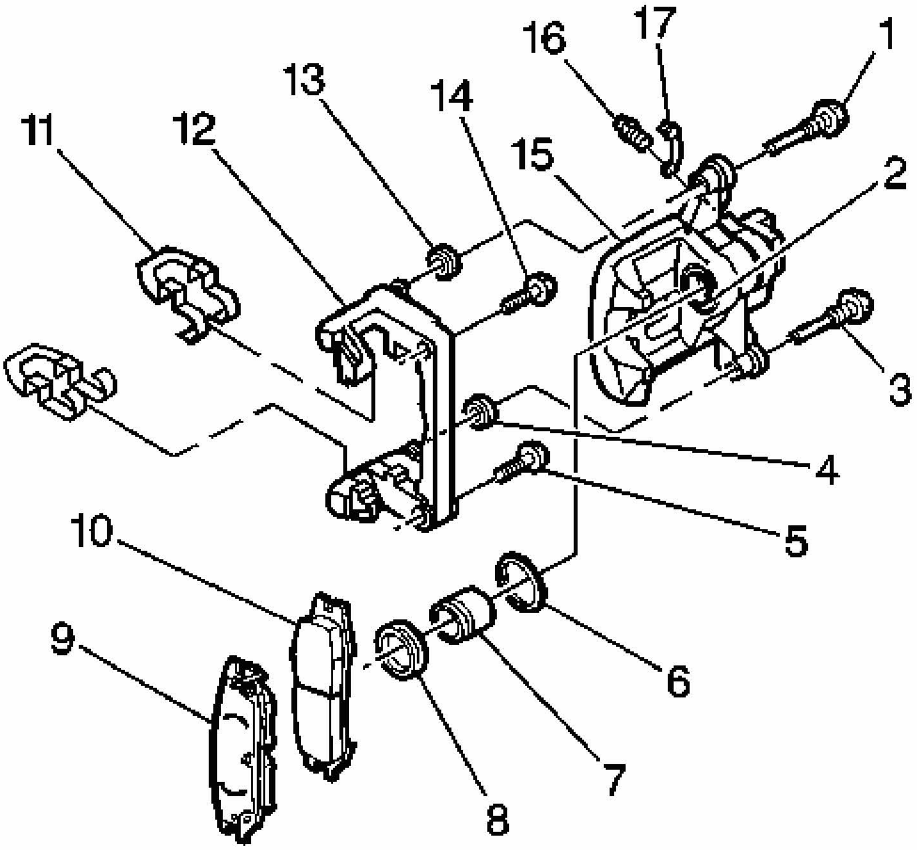


Fig. 25: Exploded View Of Rear Brake Caliper Components
Courtesy of GENERAL MOTORS CORP.

2. Lubricate the caliper bolts (1 and 3). Use silicone grease. Do not lubricate the threads.
3. Lubricate the 2 bolt boots (13 and 4) in the caliper bracket (12). Use silicone grease.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

4. Install the caliper bolts (1 and 3). Ensure that the bolt boots fit securely in the groove of the caliper bolts. Be sure not to pinch or tear the boots. If the boots are damaged, they must be replaced.

   Tighten: Tighten the bolts to 44 N.m (32 lb ft).

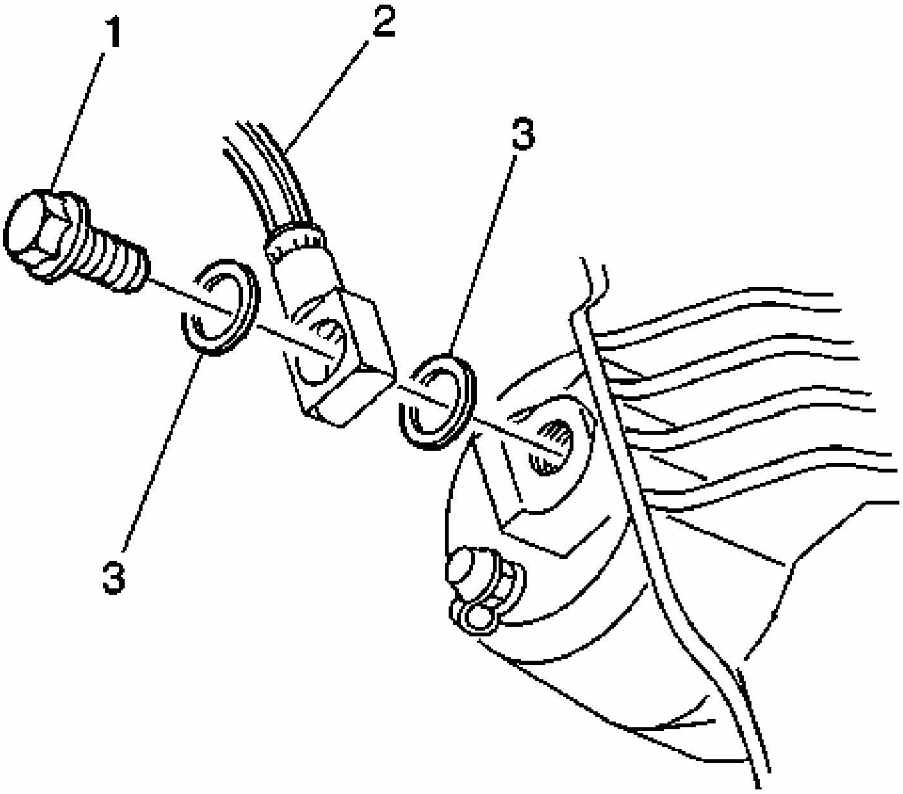


Fig. 26: Identifying Brake Hose & Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Install NEW copper gaskets.

5. Assemble the brake hose bolt (1) and the NEW copper brake hose gaskets (3) to the brake hose (2).
6. Install the brake hose-to-caliper bolt to the brake caliper.

   Tighten: Tighten the bolt to 54 N.m (40 lb ft).

7. Remove the 2 wheel lug nuts retaining the rotor to the hub.
8. Install the rear tire and the wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
9. Lower the vehicle.
10. Fill the master cylinder to the proper level with clean brake fluid. Refer to **Master**

Cylinder Reservoir Filling in Hydraulic Brakes.

11. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** in Hydraulic Brakes.
12. Inspect the hydraulic brake system for brake fluid leaks.

FRONT BRAKE CALIPER OVERHAUL

Tools Required

- **J 8092** Universal Driver Handle 3/4 inch-10
- **J 45863** Boot Seal Installer

CAUTION: Refer to Brake Fluid Irritant Caution .

Disassembly Procedure

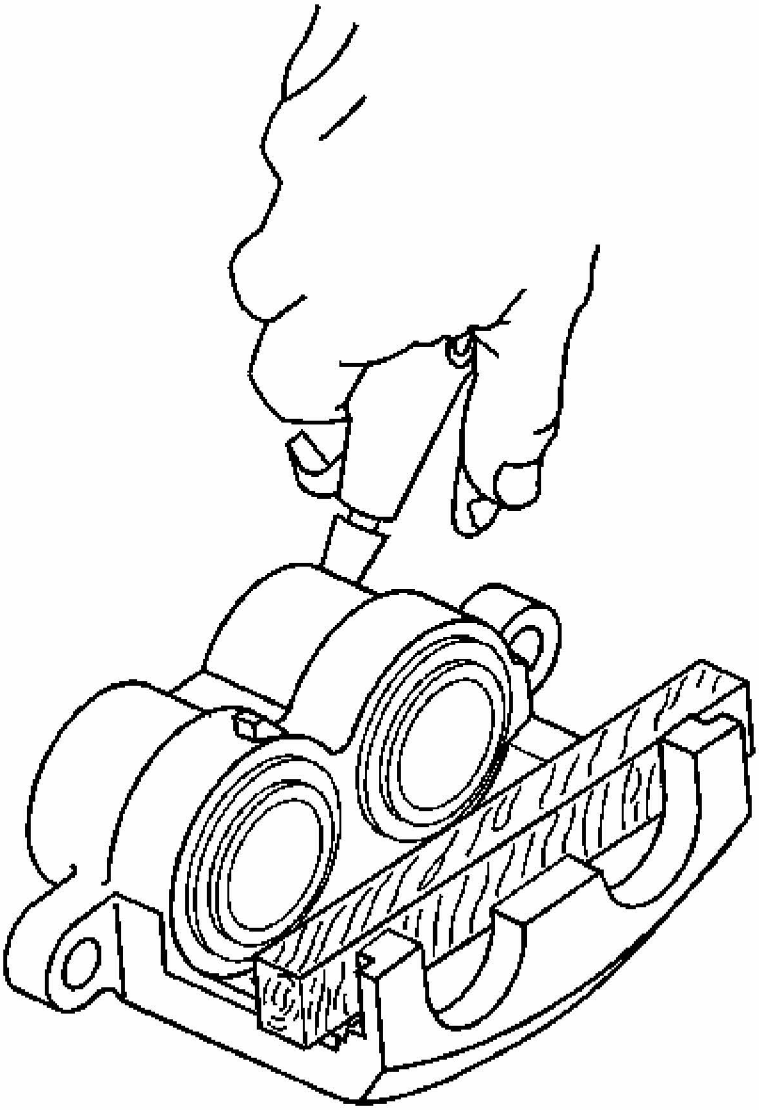


Fig. 27: Applying Air To Brake Caliper
Courtesy of GENERAL MOTORS CORP.

1. Drain all the brake fluid from the caliper.

CAUTION: Do not place your fingers in front of the piston in order to catch or protect the piston while applying compressed air. This could result in serious injury.

IMPORTANT: In the following service procedure, the caliper piston may

become damage when it is removed from the brake caliper assembly. If this happens, DO NOT reuse the piston. Discard and replaced with new.

2. Install the brake caliper in a suitable holding devise.
3. Insert a piece of wood in the brake caliper.
4. Cover the brake caliper with a shop towel.
5. Using compressed filtered, non-lubricated air, apply the air to the remove the pistons from the brake caliper.

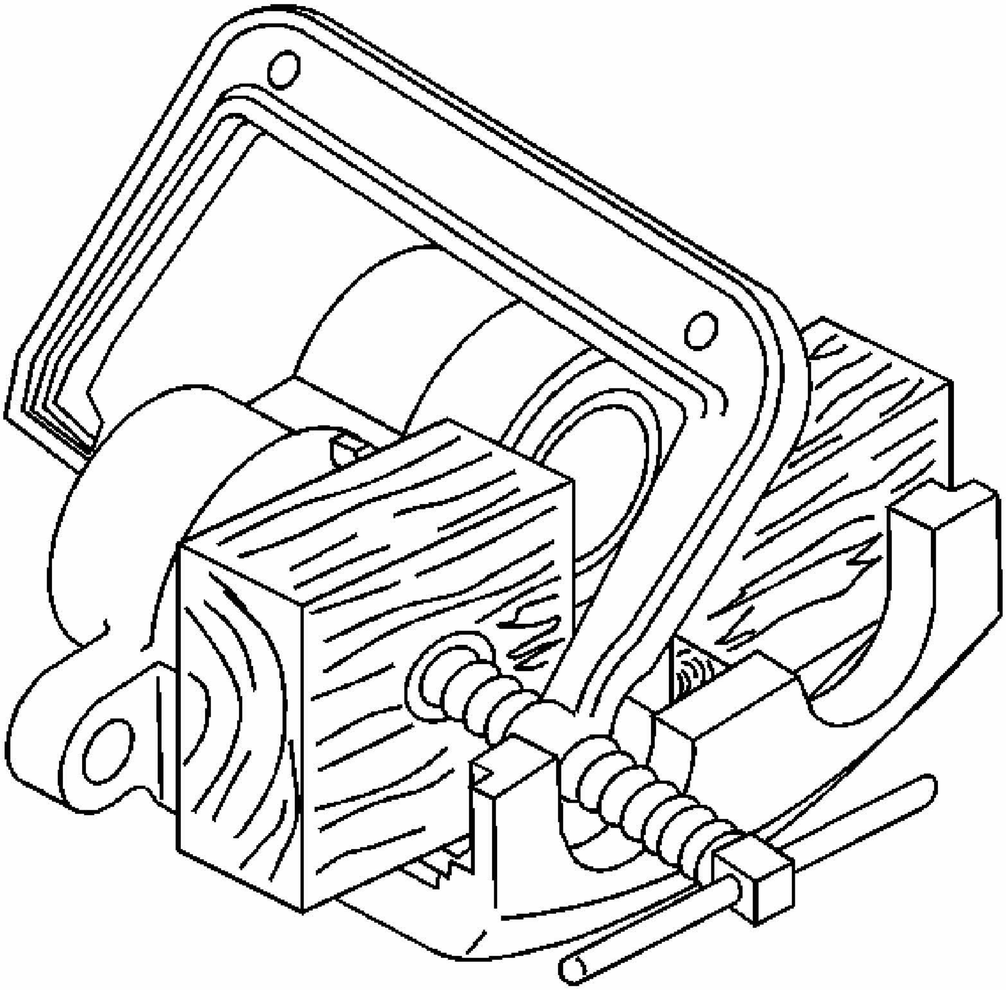


Fig. 28: Clamping Brake Caliper
Courtesy of GENERAL MOTORS CORP.

6. If one of the pistons fails to be removed from the brake caliper, perform the following steps.
    1. Reposition the piston that has been removed back in the brake caliper.
    2. Using a small block of wood and a C-clamp, slowly tighten the C-clamp until the piston it is half way in the brake caliper. It does not have to be fully seated.
    3. Position a second block of wood in front of the piston that remains in the brake caliper.
    4. Cover the brake caliper with a shop towel.
    5. Using compress filtered, non lubricated air, apply the air to the remove the pistons from the brake caliper.

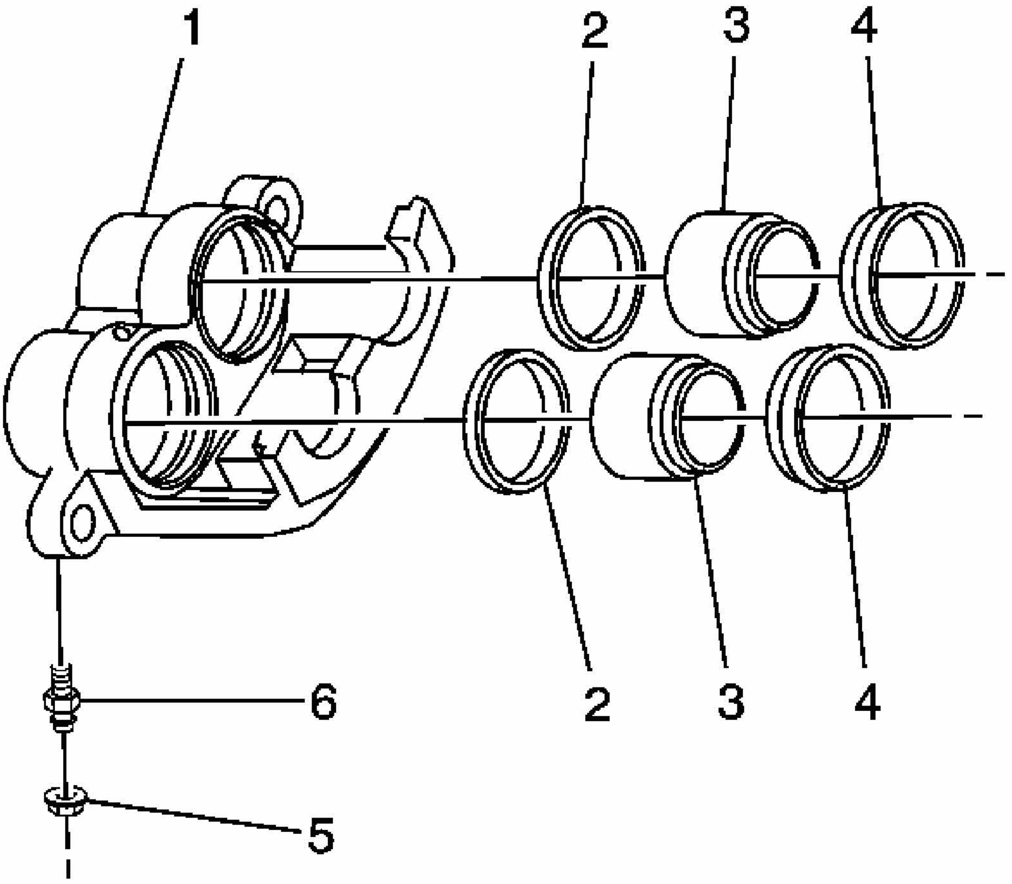


Fig. 29: Exploded View Of Brake Caliper
Courtesy of GENERAL MOTORS CORP.

7. Remove the pistons (3) from the caliper bores.

8. Remove the piston seals (2) from the caliper bores. Do not use a metal tool.
9. Remove the bleeder valve cap (5).
10. Remove the bleeder valve (6) from the caliper housing (1).
11. Clean the bleeder valve, the caliper bores, the caliper passages and the pistons with denatured alcohol. Dry the parts and blow out the brake fluid passages. Use dry and filtered compressed air.

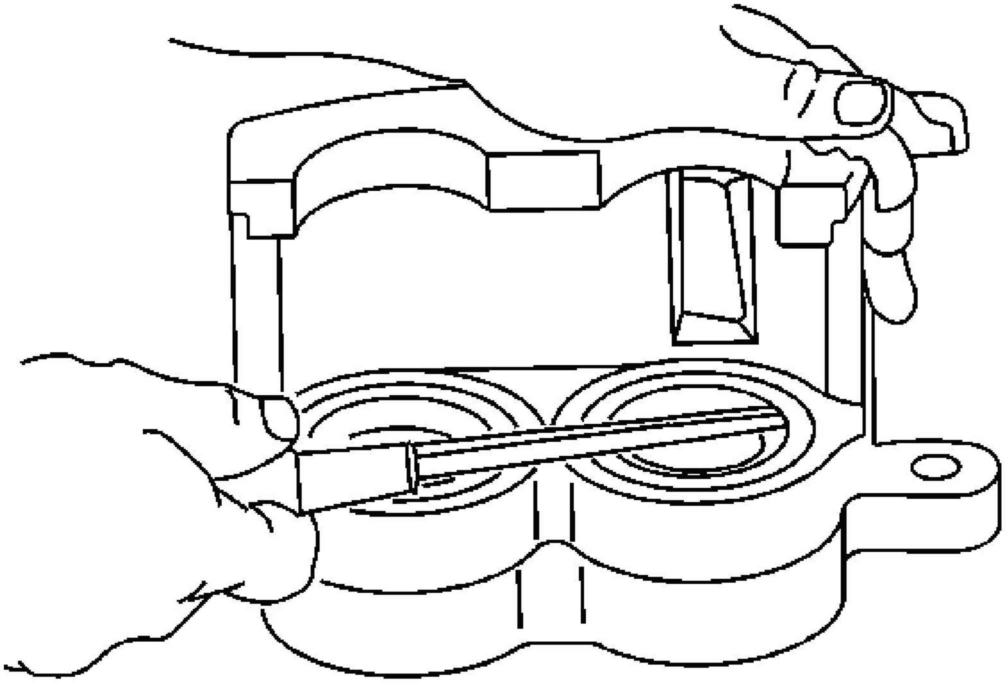


Fig. 30: Removing Caliper Boots
Courtesy of GENERAL MOTORS CORP.

12. Remove the boots from the caliper bores. Do not scratch the caliper bores.
13. Replace the pistons or the caliper if any of the following conditions exist:
    - Scoring in the caliper bores
    - Corrosion in the caliper bores
    - Pitting in the caliper bores
    - Damage to the pistons (phenolic)
14. Clean the brake caliper assembly with denatured alcohol.
15. Dry with filtered, lubricated compressed air.

Assembly Procedure

IMPORTANT: When applying the clean brake fluid to the piston bores and pistons, only apply the brake fluid to one bore at a time. This is done to ensure that the brake caliper, seals and pistons DO NOT become contaminated with dirt or other foreign material.

1. Apply a small amount of clean DOT-3 brake fluid to the piston, piston seal, and piston bore.

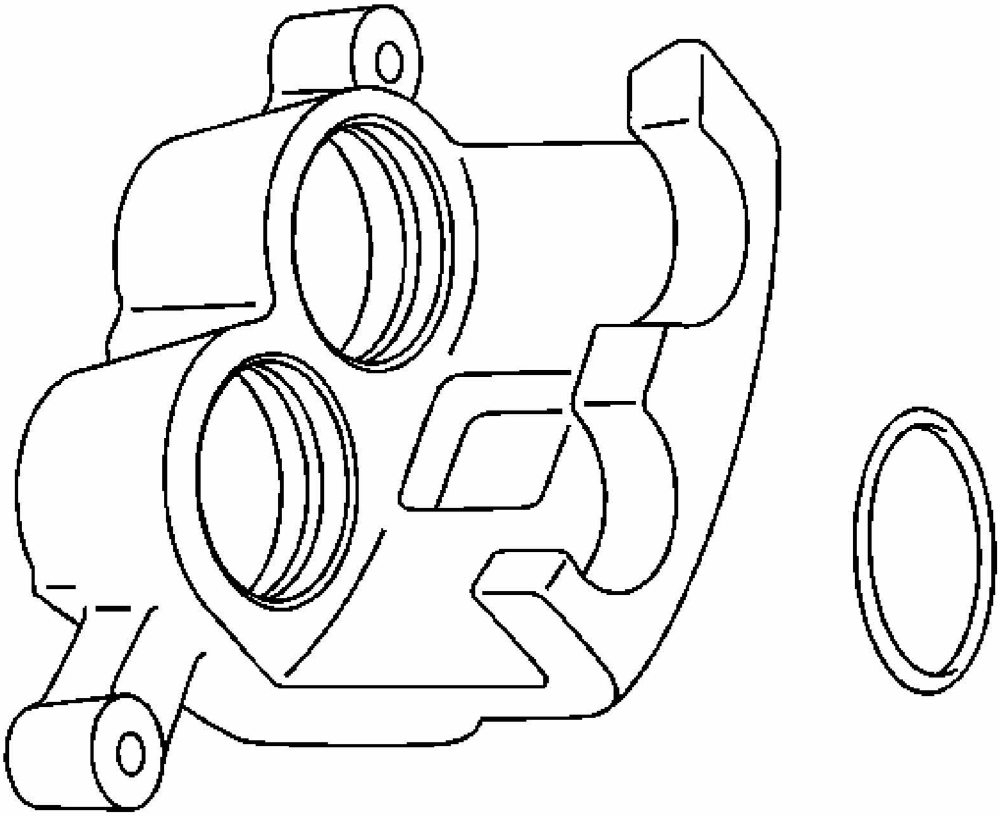


Fig. 31: View Of Brake Caliper Piston Seal
Courtesy of GENERAL MOTORS CORP.

2. Install the piston seal in the brake caliper.

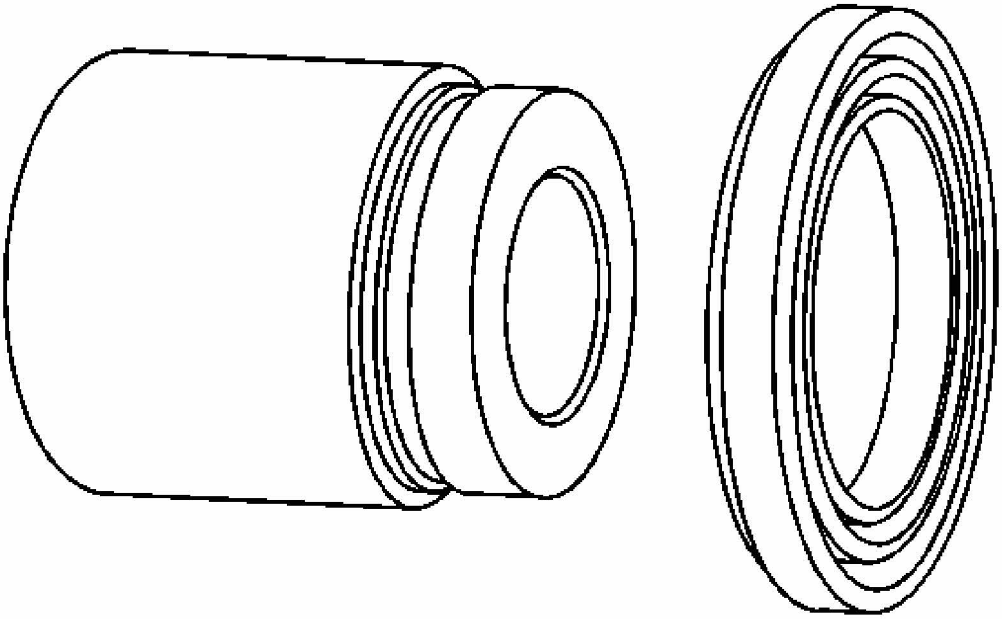


Fig. 32: View Of Piston Dust Seal
Courtesy of GENERAL MOTORS CORP.

3. Install the dust seal on the piston.

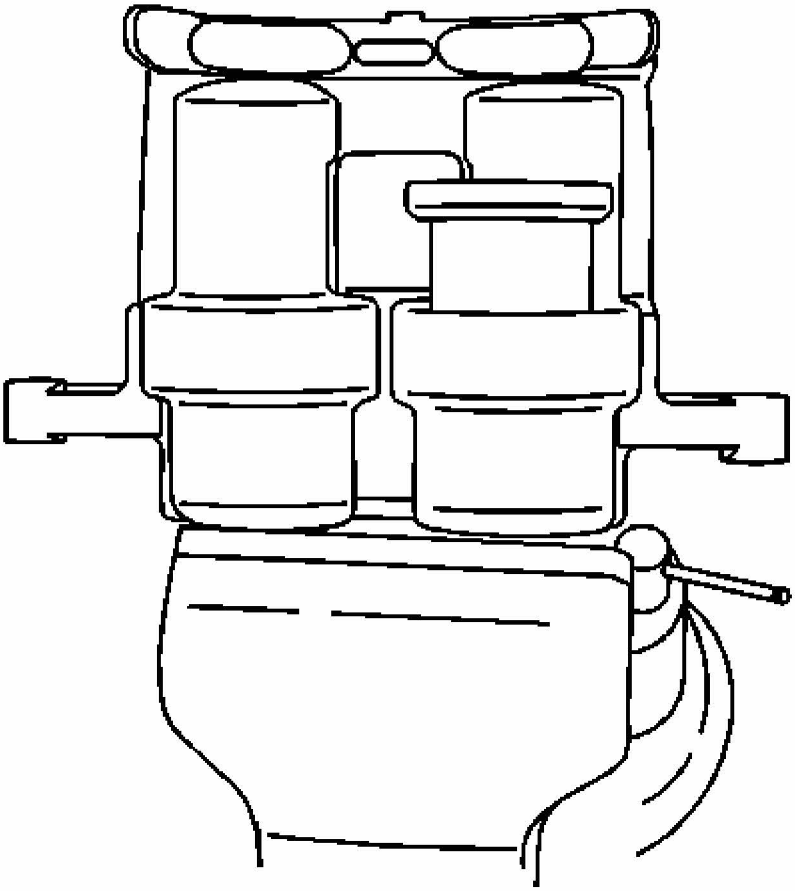


Fig. 33: Installing Piston To Brake Caliper
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Position the piston in the bore so that it is straight and level.

4. Install the piston in the brake caliper.

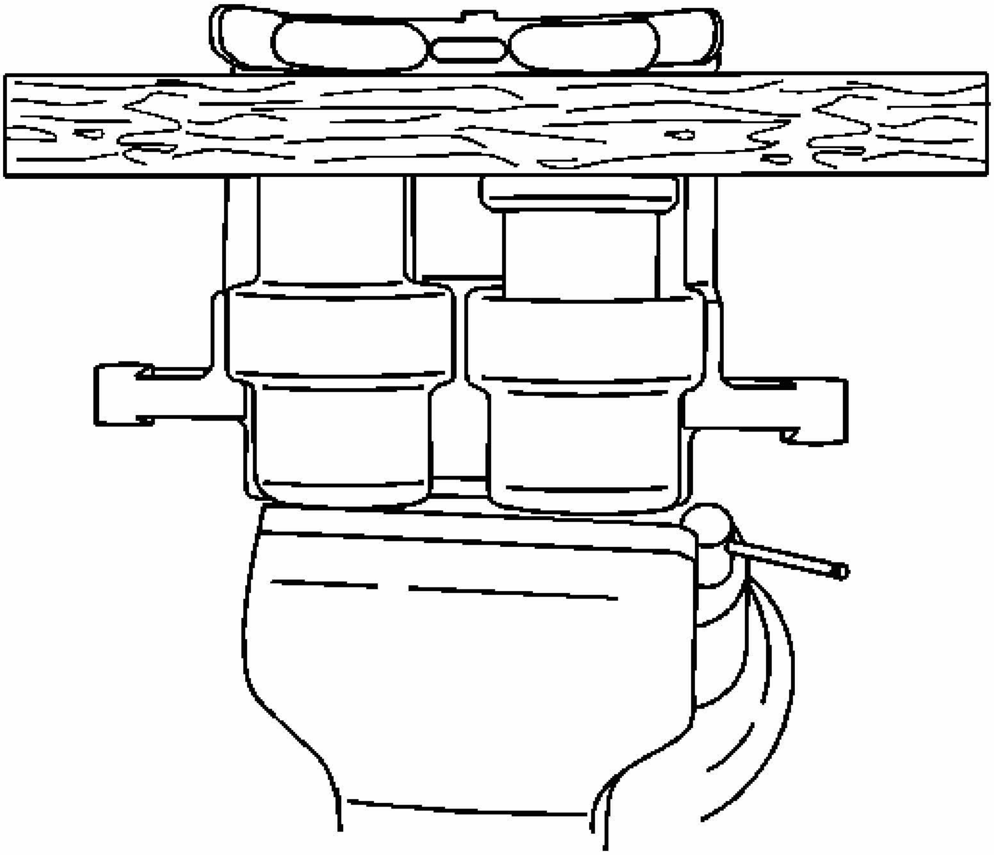


Fig. 34: Installing Piston Into Bore
Courtesy of GENERAL MOTORS CORP.

5. Position a piece of wood across the piston to be installed.
6. Applying equal pressure by hand while pushing down, install the piston in the bore.
7. Remove the piece of wood.

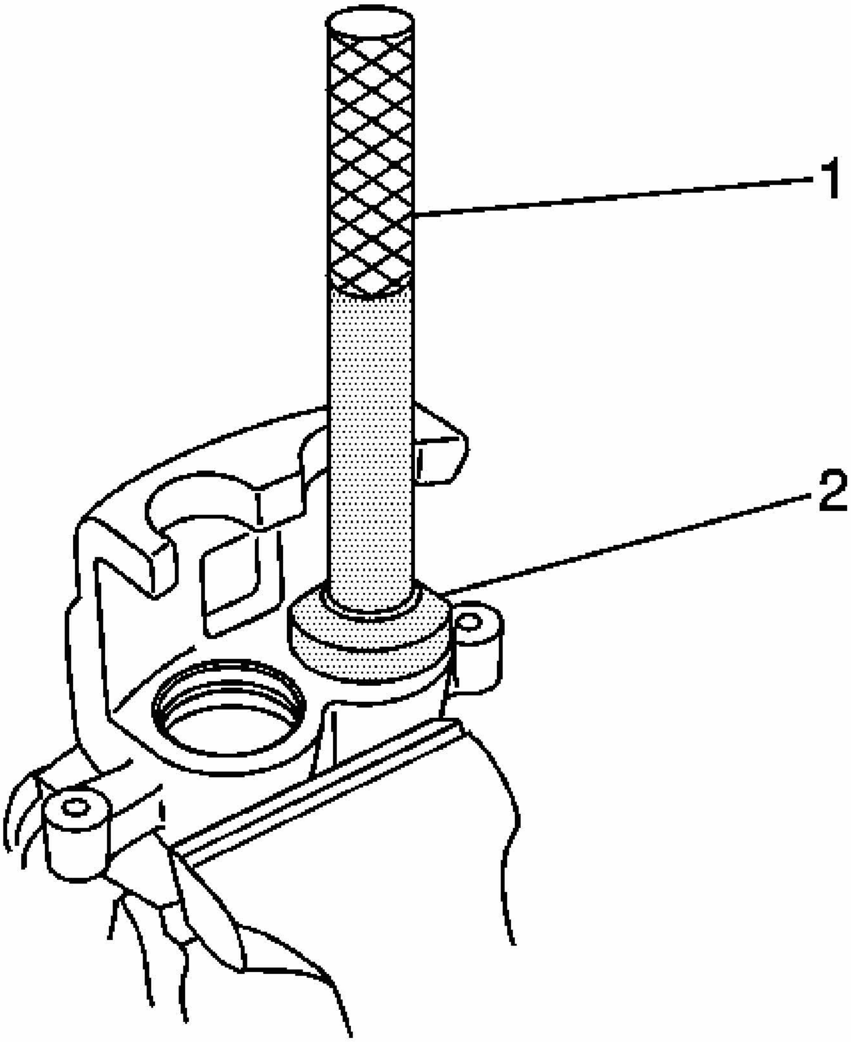


Fig. 35: Installing Piston Dust Seal
Courtesy of GENERAL MOTORS CORP.

8. Using the **J 8092** (1) and the **J 45863** (2), install the piston dust seal in the brake caliper.

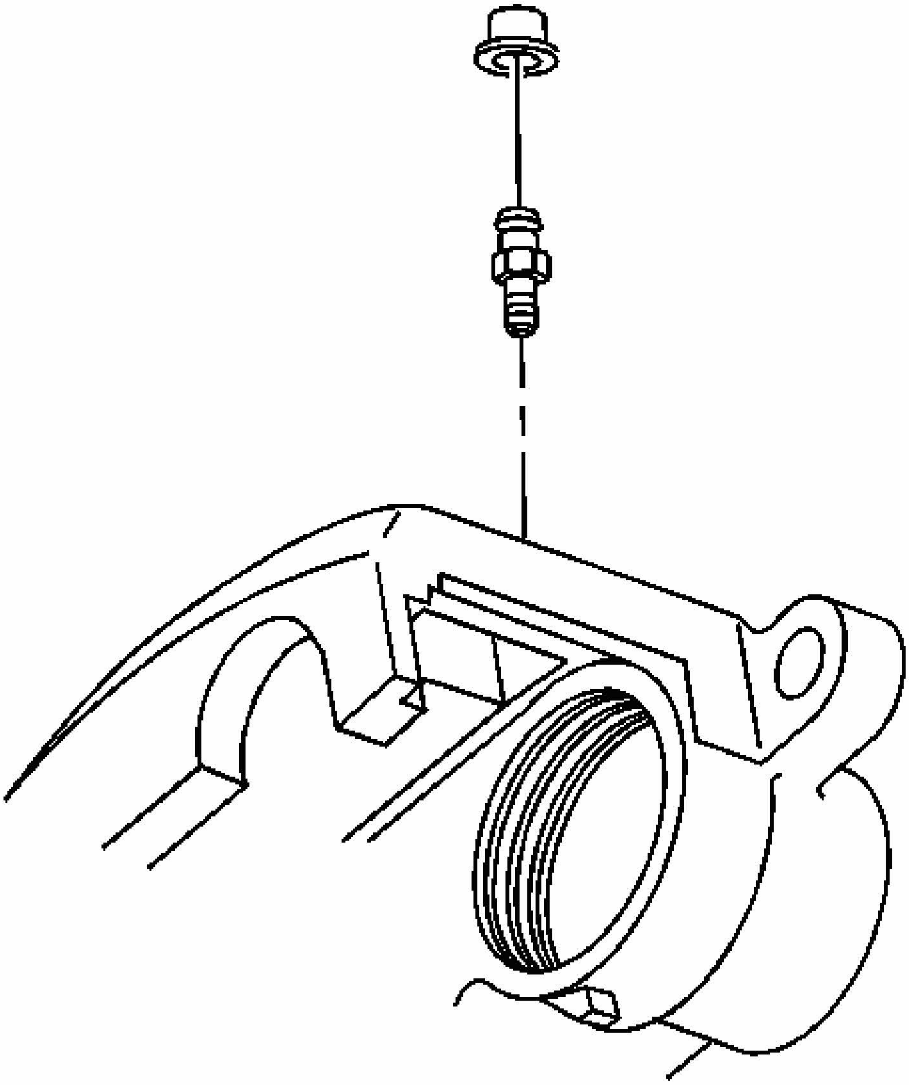


Fig. 36: View Of Bleeder Valve Cap
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

9. Install the bleeder valve in the brake caliper housing.

   Tighten: Tighten the bleeder valve to 19 N.m (14 lb ft).

10. Install bleeder valve cap.

BRAKE CALIPER OVERHAUL - REAR

Removal Procedure

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Remove the rear brake caliper from the vehicle. Refer to **Brake Caliper Replacement - Rear**.

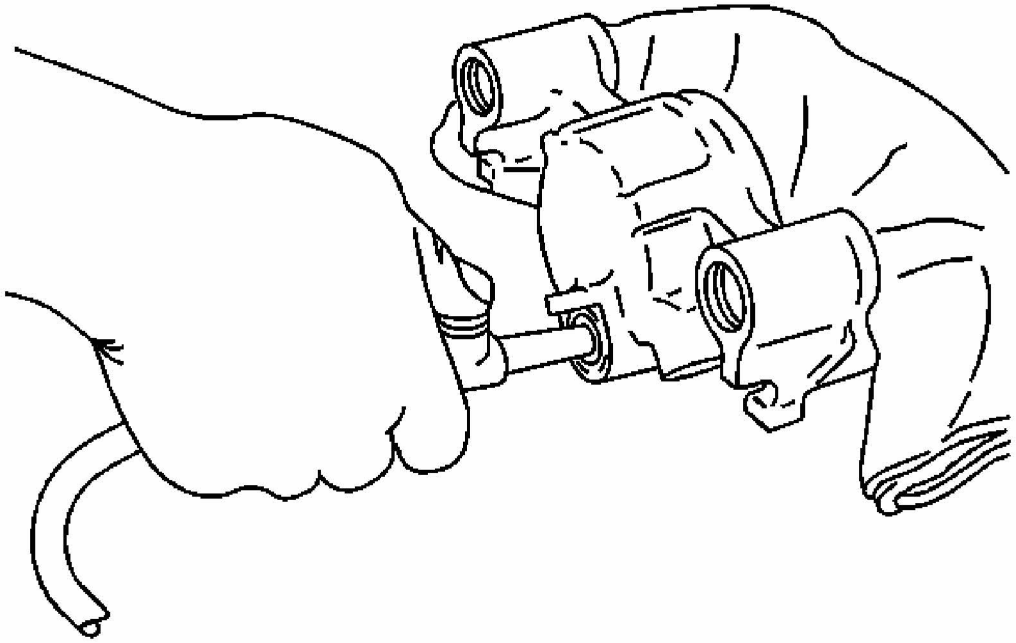


Fig. 37: Removing Brake Caliper Piston Using Low Pressure Compressed Air
Courtesy of GENERAL MOTORS CORP.

CAUTION: Do not place fingers in front of the caliper piston(s) in an attempt to catch or protect it when applying compressed air. The piston(s) can fly out with force

and could result in serious bodily injury.

NOTE: **Use clean cloths to pad interior of caliper housing during piston removal. Use just enough air to ease the pistons out of the bores. If the pistons are blown out, even with the padding provided, it may be damaged.**

2. Remove the brake caliper piston from the caliper bore by directing low pressure compressed air into the caliper bore through the fluid inlet hole.

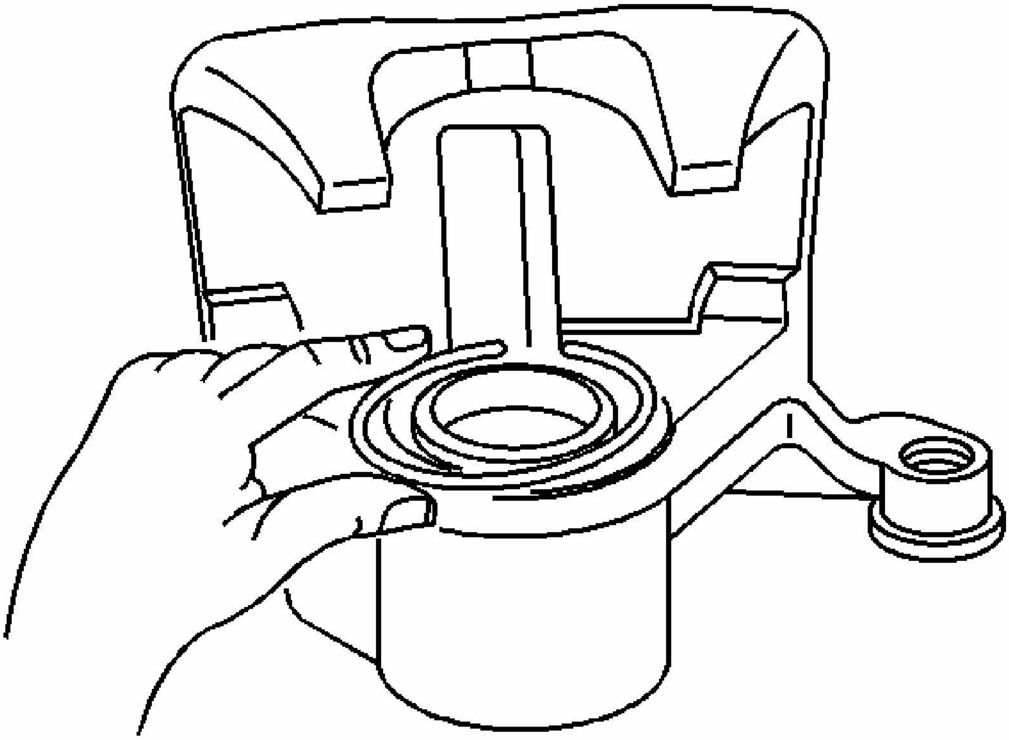


Fig. 38: View Of Dust Boot Retaining Ring
Courtesy of GENERAL MOTORS CORP.

3. Remove the retaining ring that secures the dust boot to the caliper housing.

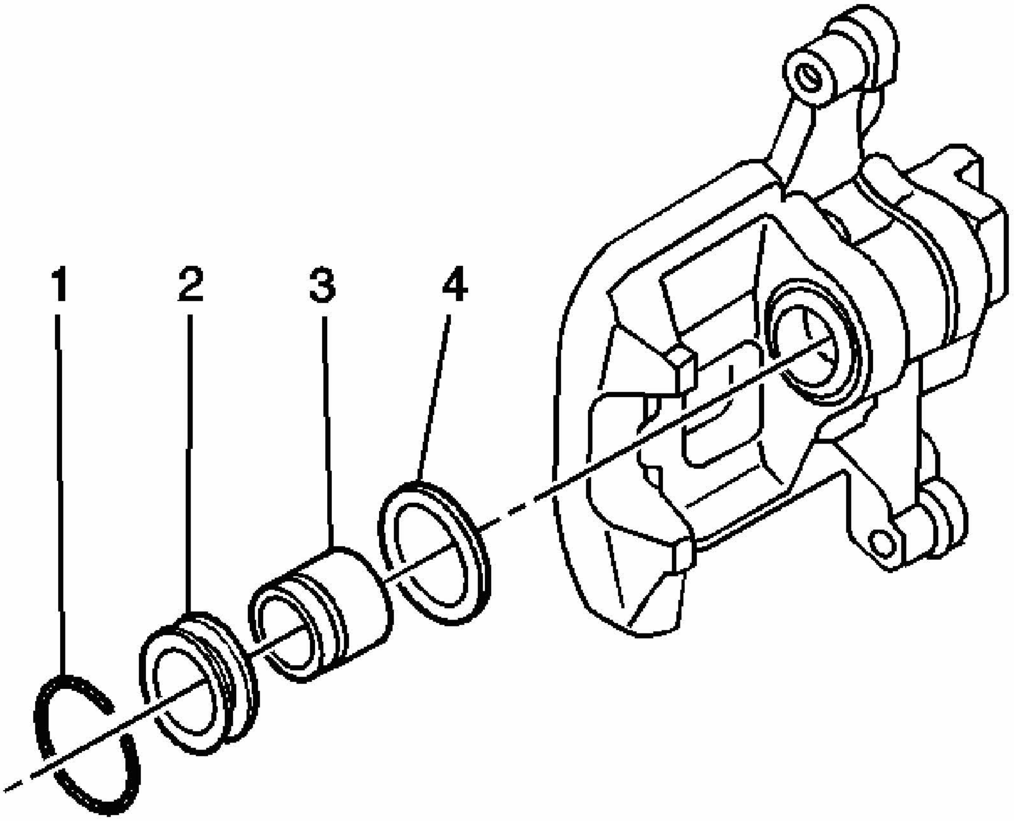


Fig. 39: Exploded View Of Brake Caliper
Courtesy of GENERAL MOTORS CORP.

4. Remove the piston dust boot seal (2) from the seal counterbore in the caliper. Discard the boot seal.
5. Using a small wooden or plastic tool, remove the piston seal (4) from the caliper bore. Discard the piston seal.

IMPORTANT: Do not use abrasives to clean the brake caliper piston.

6. Clean the brake caliper piston bore and seal counterbore, and the caliper piston with denatured alcohol, or equivalent.
7. Dry the caliper piston bore and counterbore, and the piston with non-lubricated, filtered air.
8. Inspect the caliper bore for cracks, scoring, pitting, excessive rust, and/or excessive corrosion.

9. If light rust or light corrosion are present in the caliper bore, attempt to remove the imperfection with a fine emery paper. If the imperfection cannot be removed, replace the caliper assembly.
10. If cracks, scoring, pitting, excessive rust, and/or excessive corrosion are present in the caliper bore, replace the caliper assembly.
11. Inspect the caliper piston for cracks, scoring, and/or damage to the chrome plating. Replace the caliper piston if any of these conditions exist.

Installation Procedure

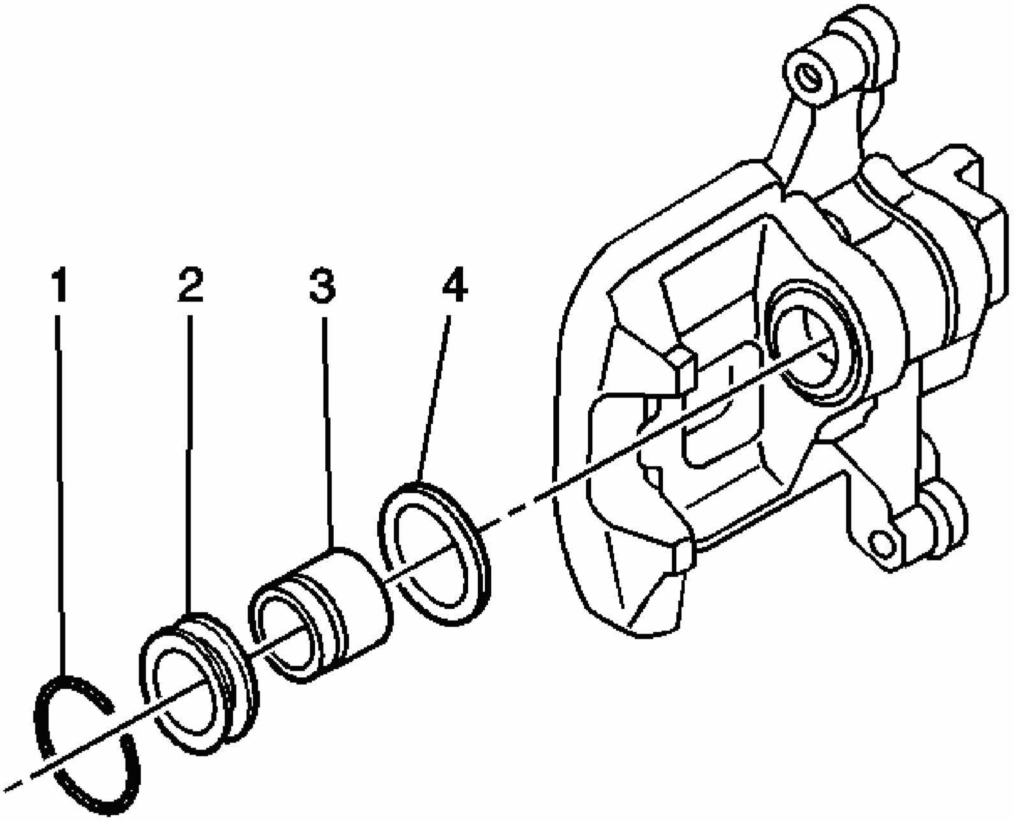


Fig. 40: Exploded View Of Brake Caliper
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the new piston seal (4) with Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
2. Install the lubricated, new piston seal (4) into the caliper bore.

3. Apply a thin coat of Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667) or equivalent, DOT-3 brake fluid from a clean, sealed brake fluid container onto the outer surface area of the caliper piston (3).

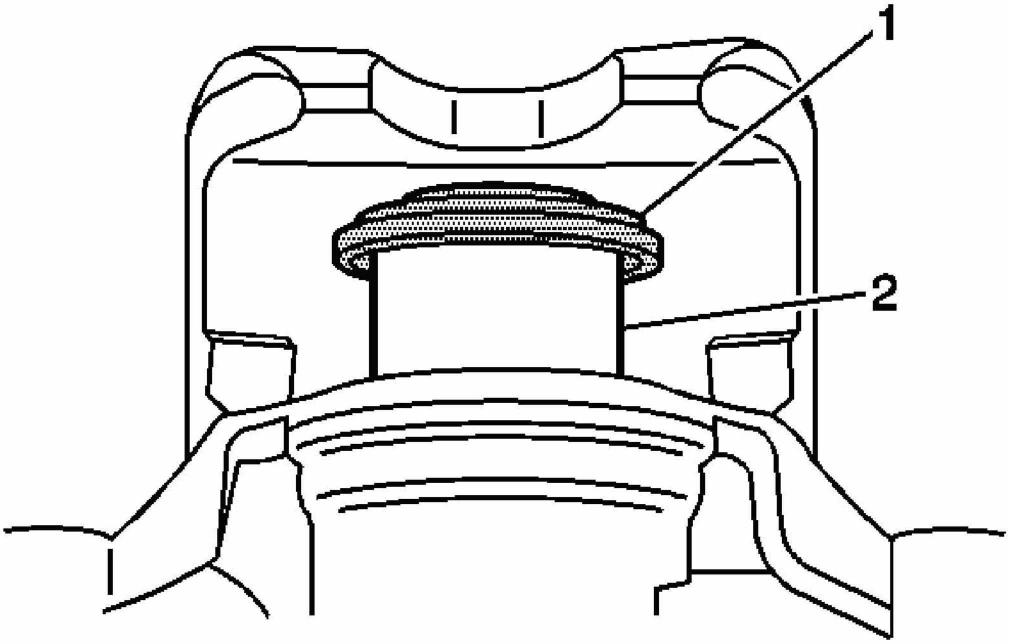


Fig. 41: Identifying Caliper Piston & Piston Dust Boot Seal
Courtesy of GENERAL MOTORS CORP.

4. Install the bottom half of the caliper piston (2) into the caliper bore.
5. Install the new piston dust boot seal (1) over the caliper piston (2).
6. Compress the caliper piston (2) to the bottom of the caliper bore.
7. Fully seat the piston dust boot seal (1) into caliper counterbore.

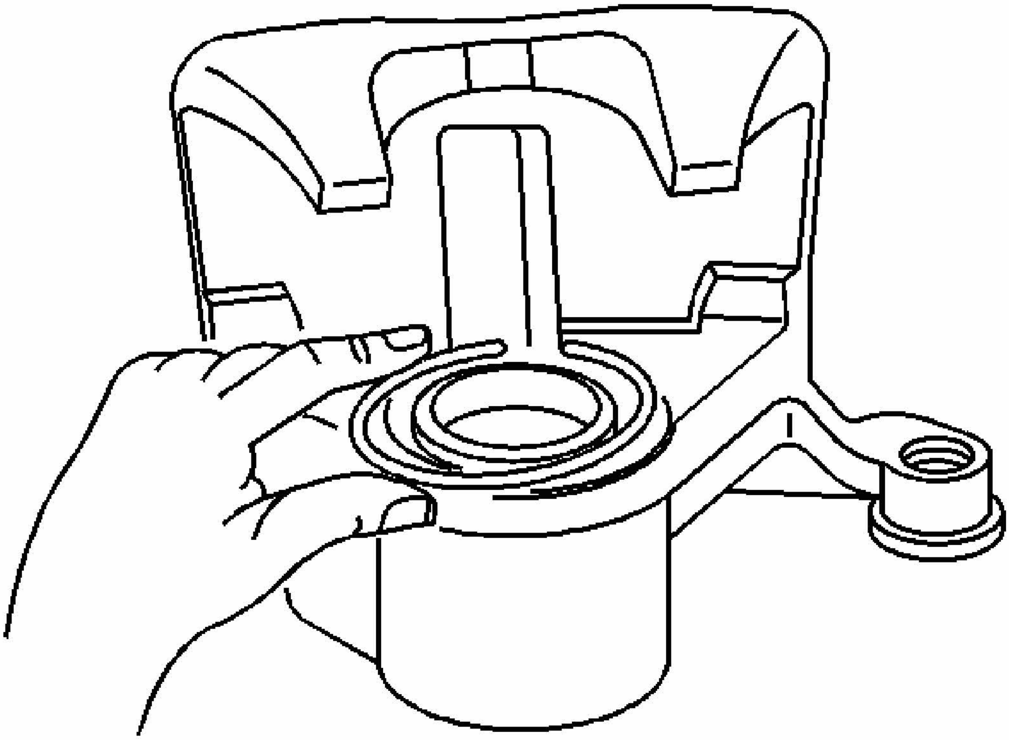


Fig. 42: View Of Dust Boot Retaining Ring
Courtesy of GENERAL MOTORS CORP.

8. Install the retaining ring that secures the dust boot to the caliper housing.
9. Install the bleeder valve and cap to the caliper and tighten the valve securely.
10. Install the rear brake caliper to the vehicle. Refer to **Brake Caliper Replacement - Rear**.

FRONT DISC BRAKE HARDWARE REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

NOTE: Support the brake caliper with heavy mechanic's wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the

brake hose and in turn may cause a brake fluid leak.

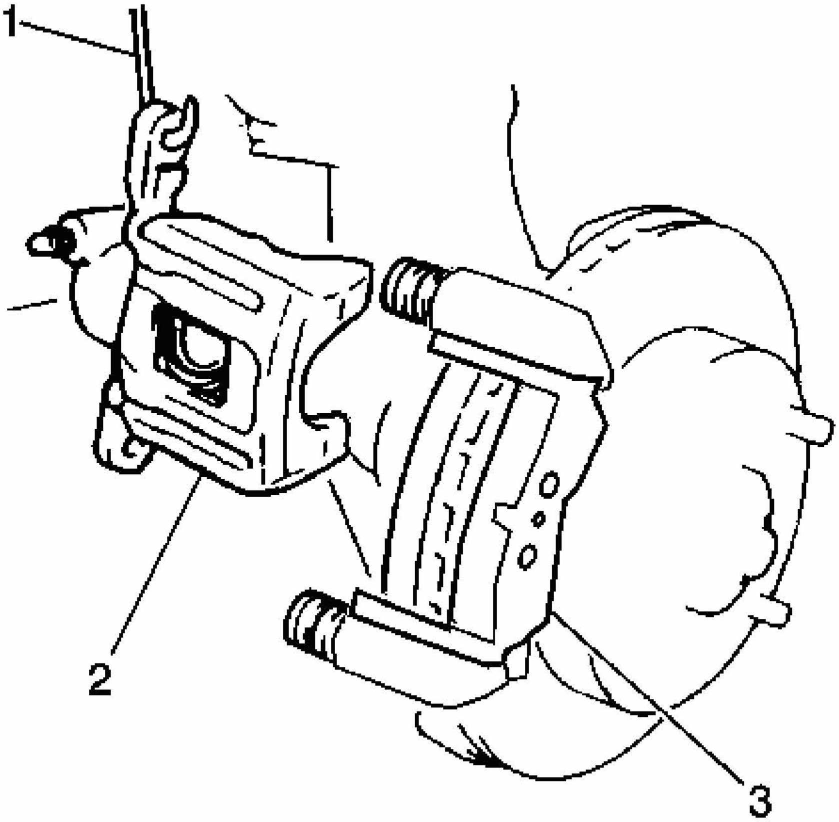


Fig. 43: View Of Brake Caliper And Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

1. Remove the brake caliper from the mounting bracket and support the brake caliper (2) with heavy mechanic's wire (1), or equivalent. Discard the old caliper pin bolts, new bolts are supplied in the hardware kit. It is not necessary to disconnect the hydraulic brake flexible hose from the caliper. Refer to **Brake Caliper Replacement - Front**.

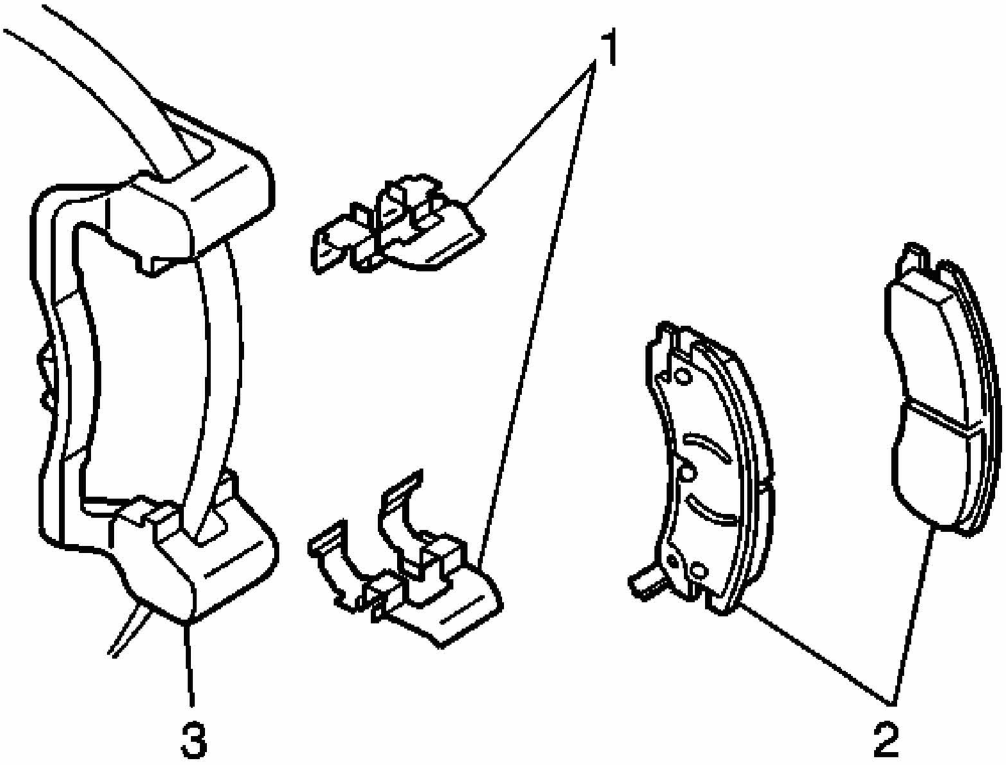


Fig. 44: View Of Brake Pads, Brake Pad Retainers, & Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

2. Remove the brake pads (2) from the brake caliper bracket.
3. Remove the brake pad retainers (1) from the brake caliper bracket.

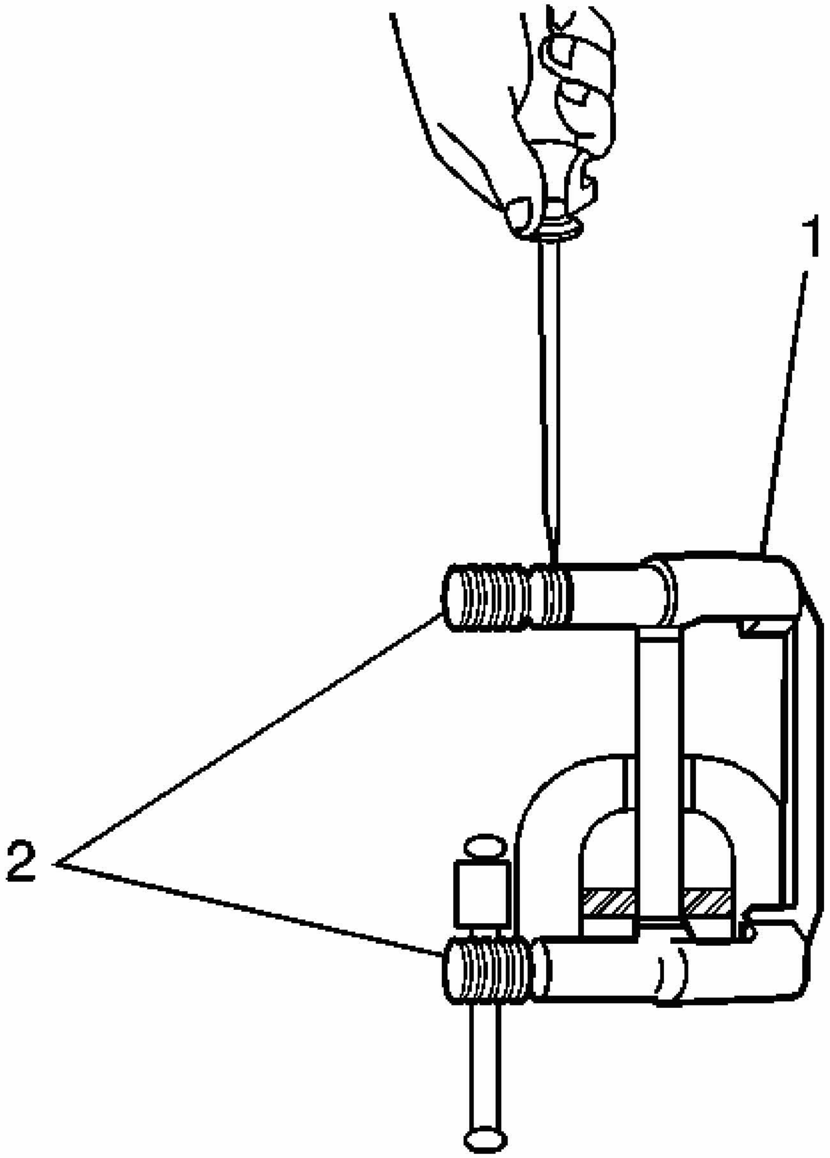


Fig. 45: Removing Front Caliper Pin Boots From Bracket
Courtesy of GENERAL MOTORS CORP.

4. Remove the brake caliper bracket. Refer to **Brake Caliper Bracket Replacement - Front**.
5. Mount the brake caliper bracket (1) in a vise.
6. Using a flat bladed tool or punch carefully remove the caliper pin boots (2) from brake caliper bracket (1).

IMPORTANT:

- **Clean the caliper bracket with denatured alcohol.**
- **Dry with low pressure, non-lubricated, filtered air.**
- **Inspect the brake caliper bracket for damage. If damaged, replace the bracket.**

7. Thoroughly clean the caliper bracket bores of all lubricant.

Installation Procedure

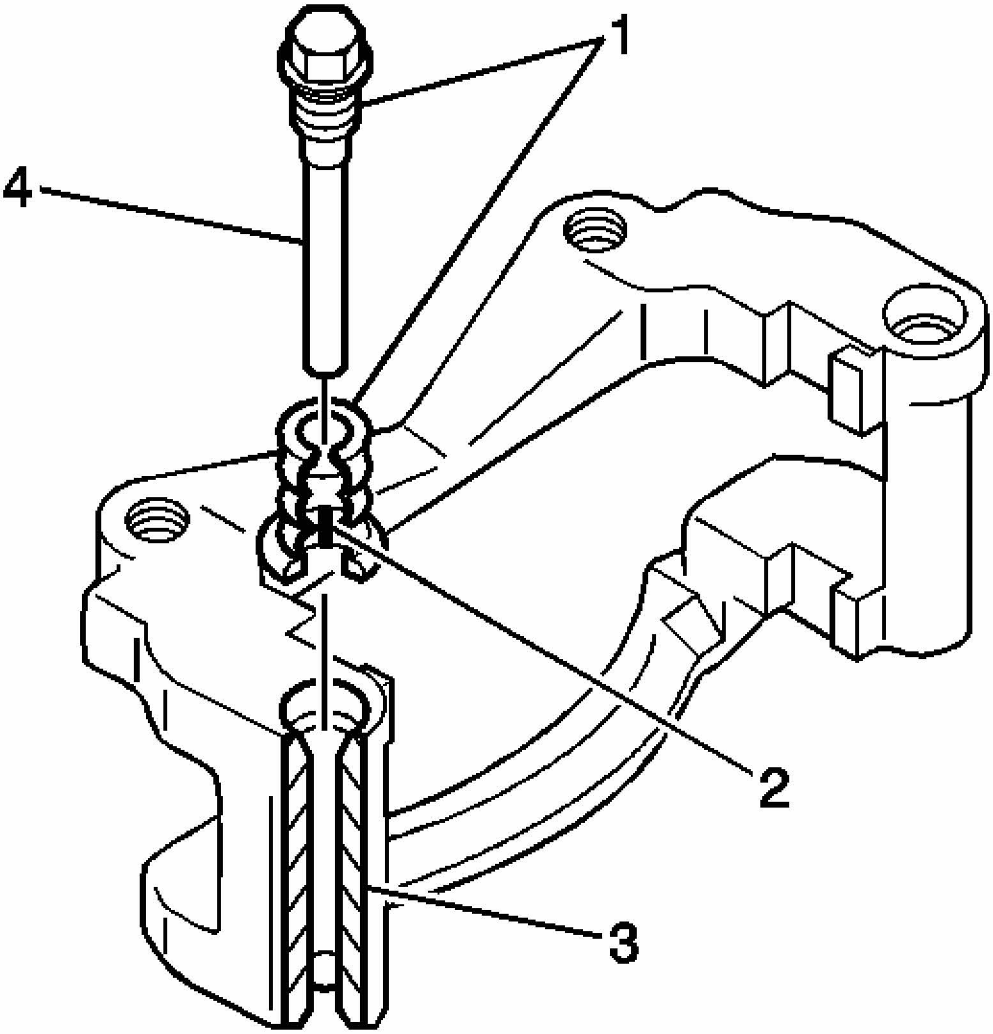


Fig. 46: Installing Pin Bolts & Boots
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the bores (3), the inside part of the bolt boot (2) and the caliper pin bolts (4) with GM P/N 18047666, or equivalent.
2. Press the new caliper pin bolt boots into the caliper pin bores.
3. Install the brake caliper bracket. Refer to **Brake Caliper Bracket Replacement - Front**.

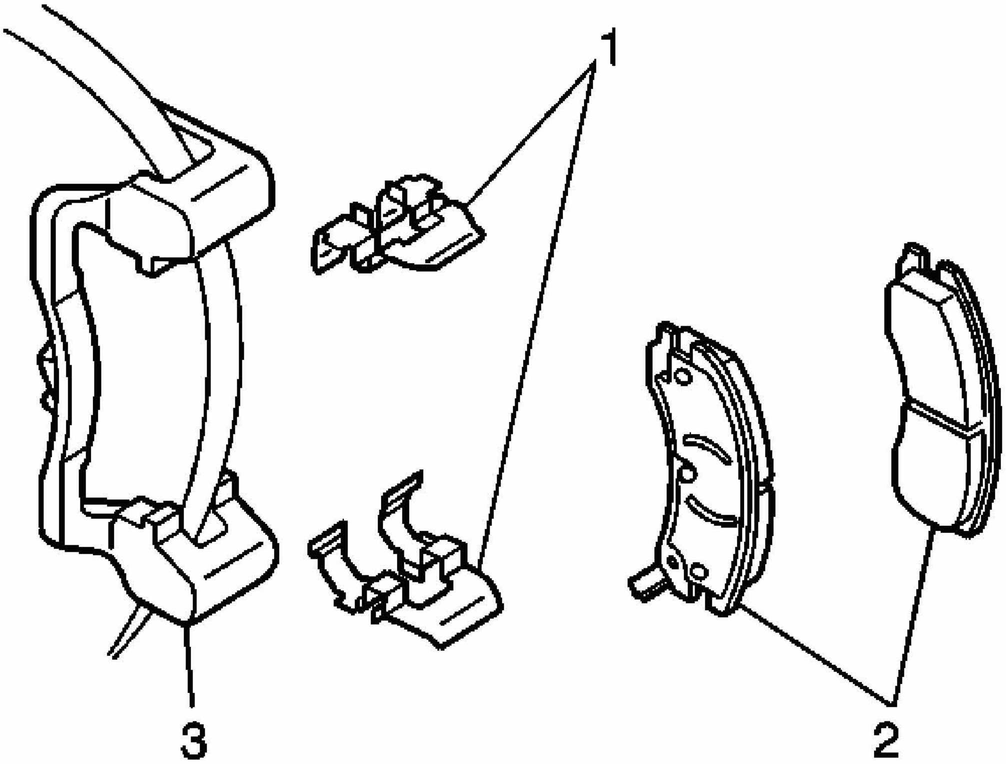


Fig. 47: View Of Brake Pads, Brake Pad Retainers, & Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

4. Install the brake pad retainers (1) to the caliper bracket.
5. Install the brake pads (2) to the caliper bracket.

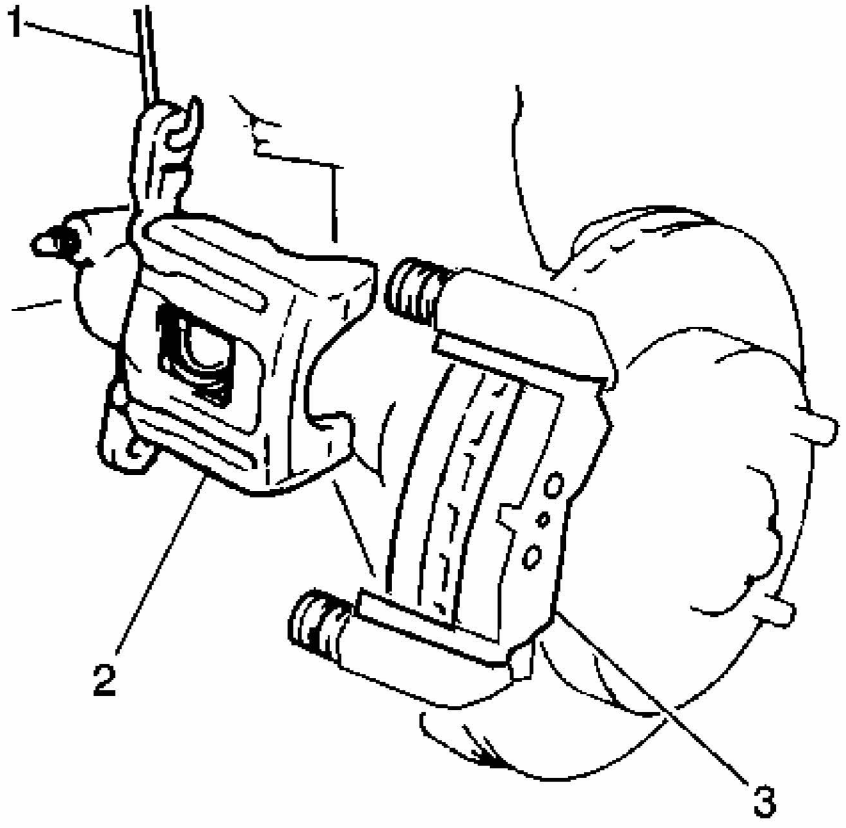


Fig. 48: View Of Brake Caliper And Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

6. Remove the heavy mechanics wire (1) and install the brake caliper. Refer to **Brake Caliper Replacement - Front**.

REAR DISC BRAKE HARDWARE REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

NOTE: Support the brake caliper with heavy mechanic's wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to

bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

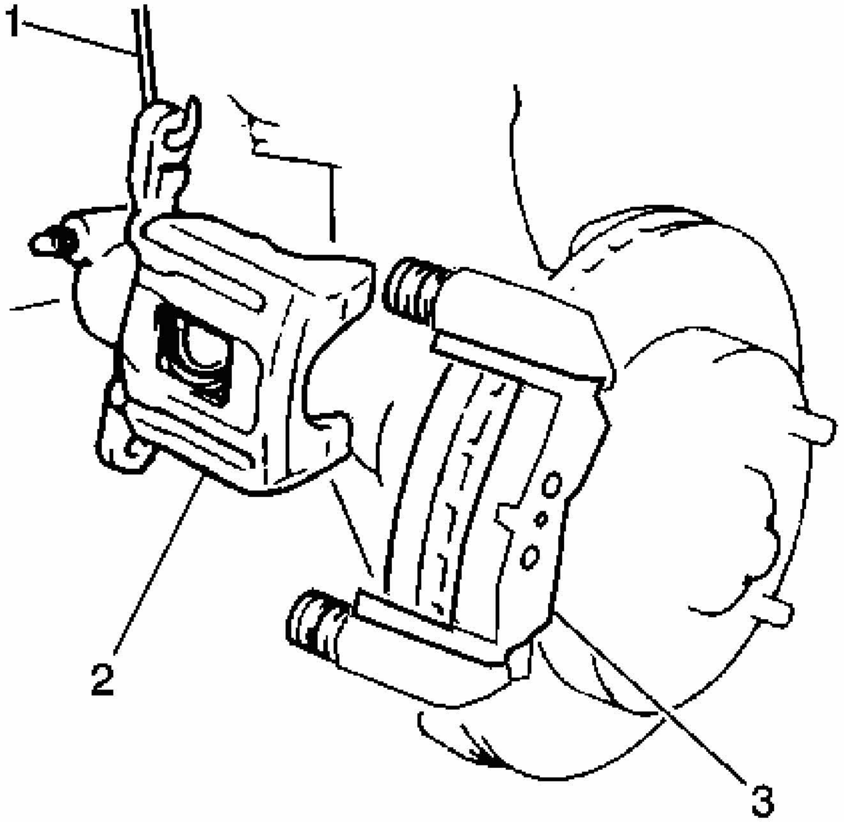


Fig. 49: View Of Brake Caliper And Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

1. Remove the brake caliper from the mounting bracket and support the brake caliper (2) with heavy mechanic's wire (1), or equivalent. It is not necessary to disconnect the hydraulic brake flexible hose from the caliper. Refer to **Brake Caliper Replacement - Rear**.

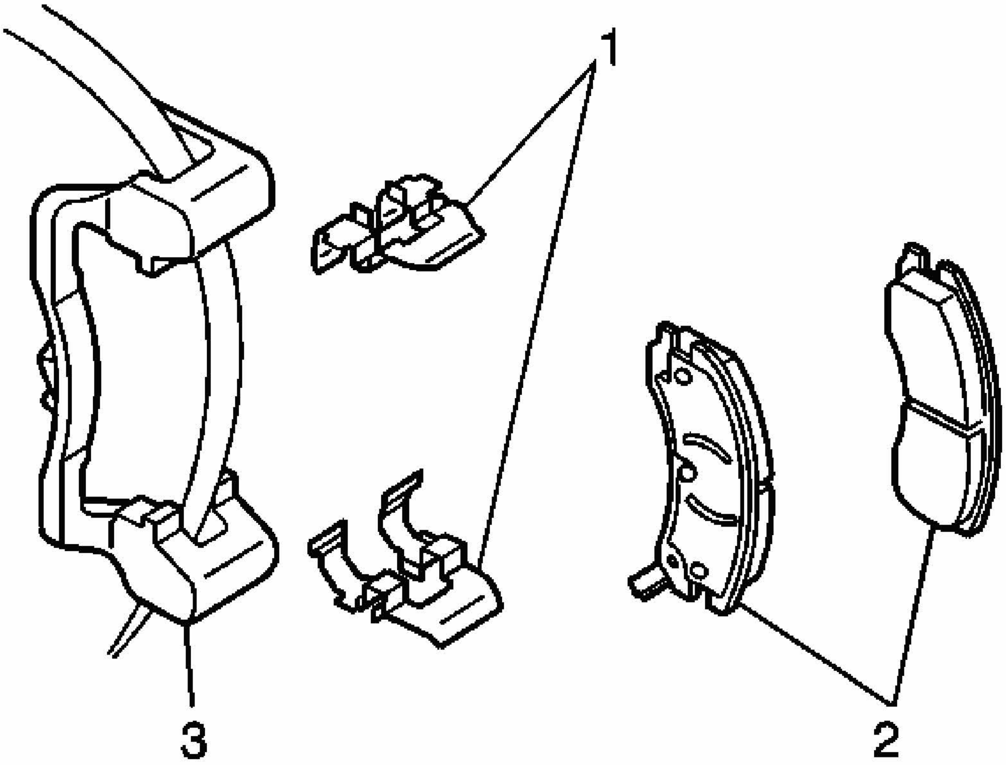


Fig. 50: View Of Brake Pads, Brake Pad Retainers, & Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

2. Remove the brake pads (2) from the brake caliper bracket (1).
3. Remove the brake pad retainers (1) from the brake caliper bracket (3).
4. Remove the brake caliper bracket (3). Refer to **Brake Caliper Bracket Replacement - Rear**.
5. Mount the brake caliper bracket (3) in a vise.

Installation Procedure

1. Clean all parts in clean, denatured alcohol.
2. Dry with low pressure, non-lubricated, filtered air.
3. Inspect the brake caliper bracket for cracks. If cracked, replace bracket.
4. Lubricate the brake caliper pin bolt sleeves with high temperature silicone lubricant.
5. Install the brake caliper bracket. Refer to **Brake Caliper Bracket Replacement - Rear**.

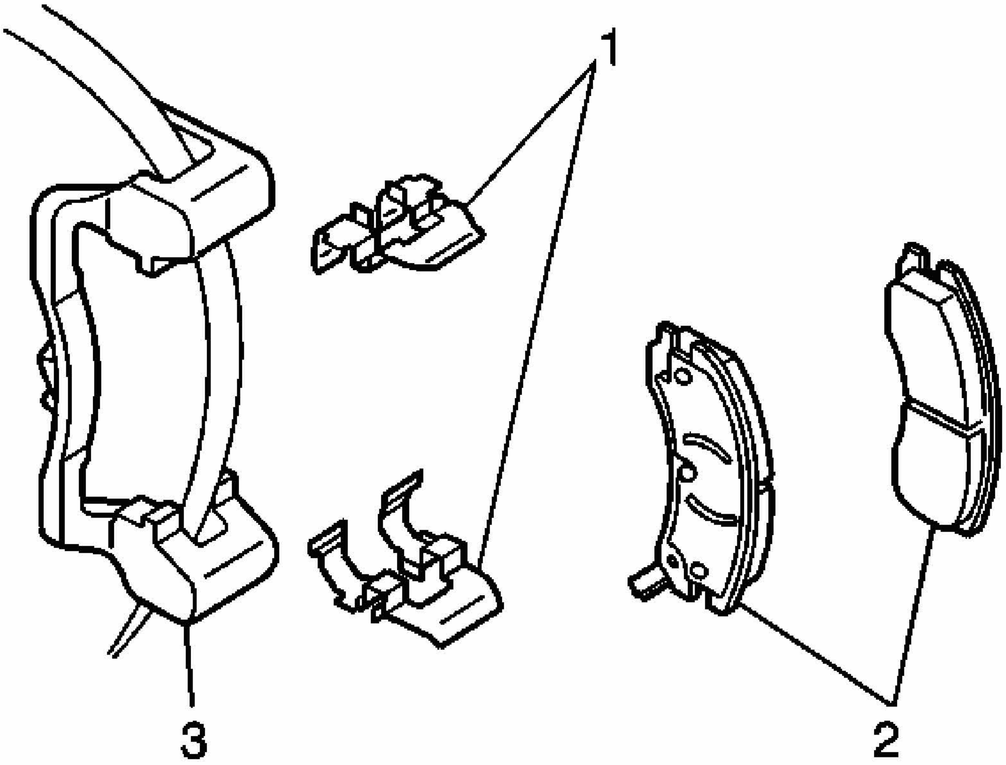


Fig. 51: View Of Brake Pads, Brake Pad Retainers, & Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

6. Install the brake pad retainers (1) to the bracket caliper bracket (3).
7. Install the brake pads (2) to the bracket caliper bracket (3).
8. Install the brake caliper to the brake caliper bracket. Refer to **Brake Caliper Replacement - Rear**.

FRONT BRAKE CALIPER BRACKET REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

NOTE: Support the brake caliper with heavy mechanic's wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to

bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

1. Remove the caliper from the mounting bracket and support the caliper with heavy mechanics wire or equivalent. It is not necessary to disconnect the hydraulic brake flexible hose from the caliper. Refer to **Brake Caliper Replacement - Front**.
2. Remove the front brake pads.

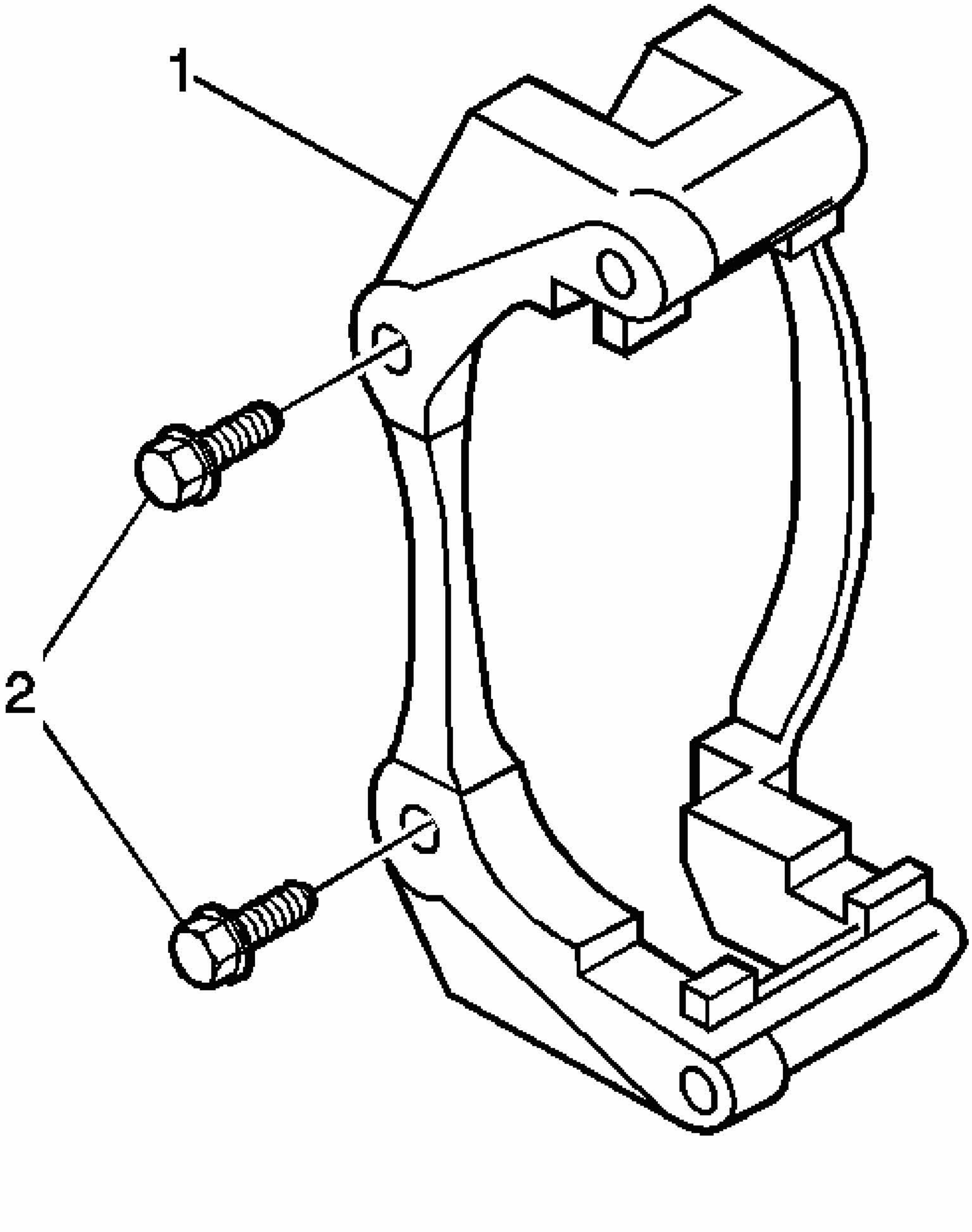


Fig. 52: Removing/Installing Brake Caliper Bracket & Bolts

Courtesy of GENERAL MOTORS CORP.

3. Remove the caliper bracket bolts (2).
4. Remove the caliper bracket (1).

Installation Procedure

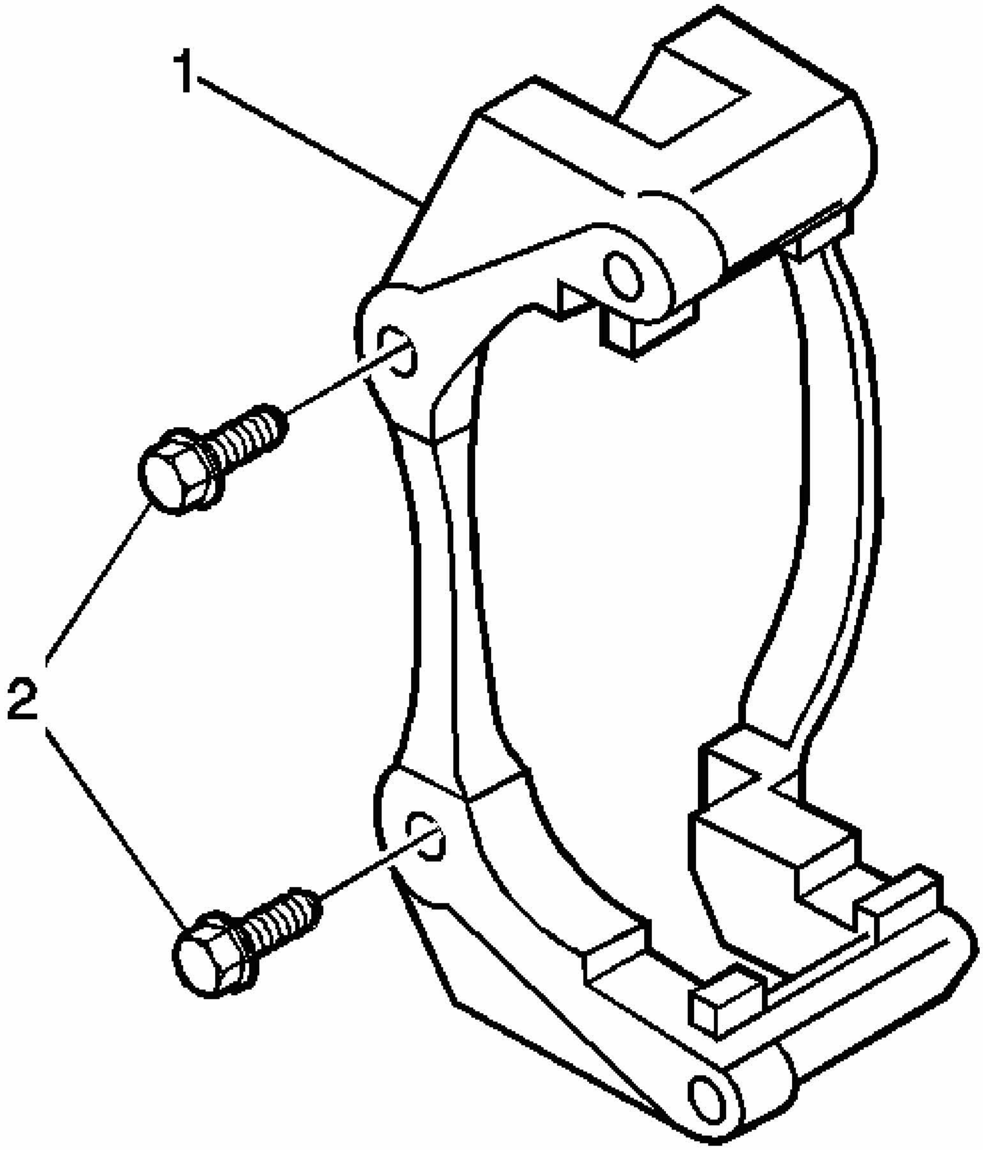


Fig. 53: Removing/Installing Brake Caliper Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: To ensure that the proper clamp load will be present when installed. It is imperative that the threads on the caliper bracket bolts, as well as the mounting holes in the knuckle, be cleaned of all debris and inspected before proceeding with installation.

1. Clean and visually inspect threads of the caliper bracket bolts (2) and mounting holes in the knuckle.
2. Apply THREADLOCKER, GM P/N 12345493 (Canadian P/N 10953488) or equivalent, to the threads of the brake caliper bracket bolts (2).

   NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

3. Install the caliper bracket (1) with the bracket bolts (2).

   Tighten: Tighten the caliper bracket bolts to 180 N.m (133 lb ft).

4. Install the front brake pads.
5. Install the caliper. Refer to **Brake Caliper Replacement - Front**.

REAR BRAKE CALIPER BRACKET REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

NOTE: Support the brake caliper with heavy mechanic's wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

1. Remove the caliper from the mounting bracket and support the caliper with heavy mechanics wire or equivalent. It is not necessary to disconnect the hydraulic brake flexible hose from the caliper. Refer to **Brake Caliper Replacement - Rear**.
2. Remove the rear brake pads.

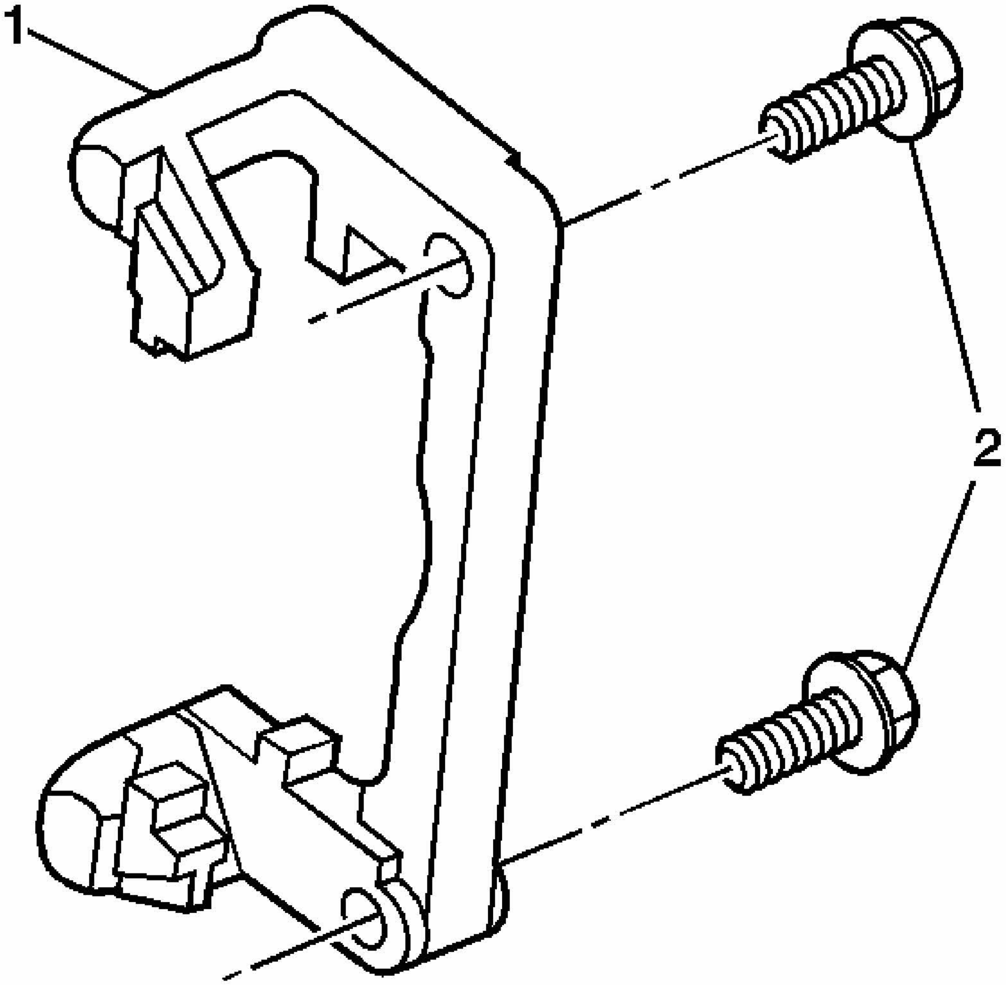


Fig. 54: View Of Caliper Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the caliper bracket bolts (2).
4. Remove the caliper bracket (1).

Installation Procedure

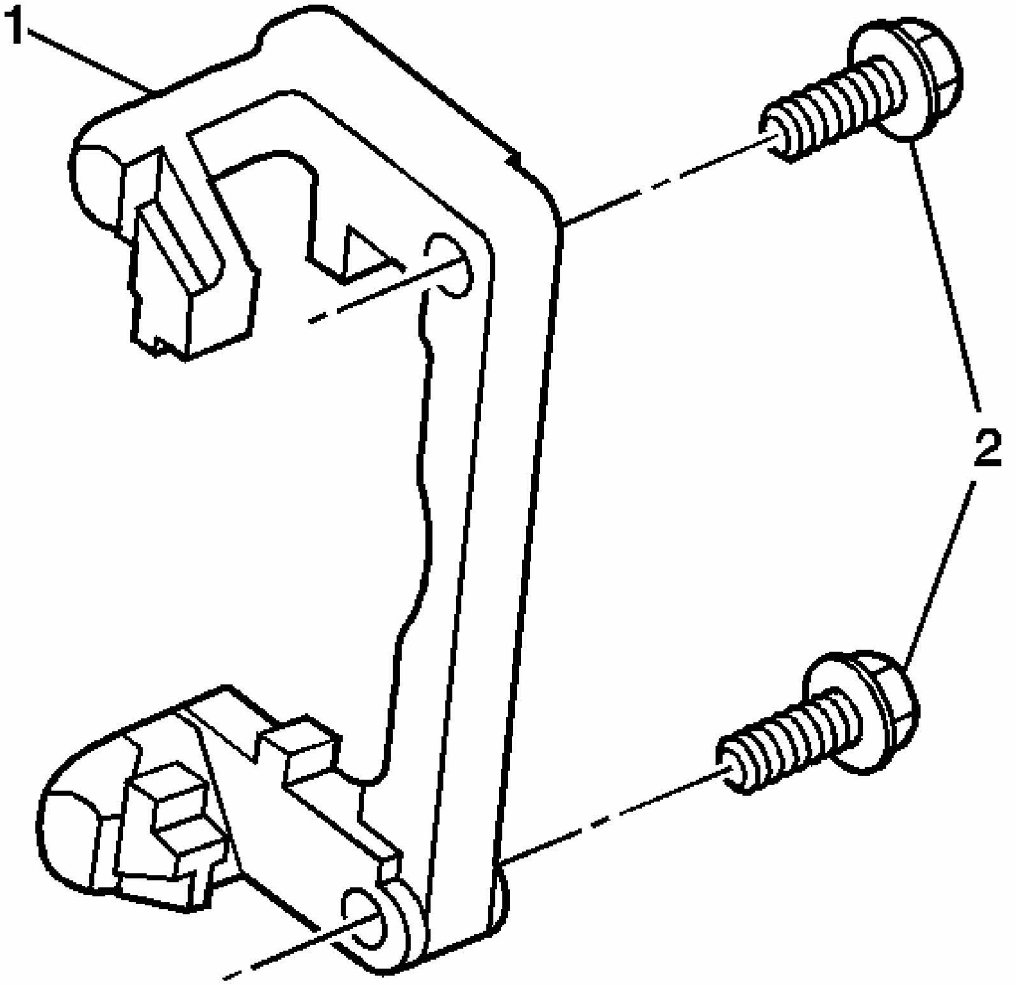


Fig. 55: View Of Caliper Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: To ensure that the proper clamp load will be present when installed. It is imperative that the threads on the caliper bracket bolts, as well as the mounting holes in the knuckle, be cleaned of all debris and inspected before proceeding with installation.

1. Clean and visually inspect threads of the caliper bracket bolts (2) and mounting holes in the knuckle.
2. Apply THREADLOCKER, GM P/N 12345493 (Canadian P/N 10953488), or equivalent to the threads of the brake caliper bracket bolts (2).

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

3. Install the caliper bracket (1) with the bracket bolts (2).

   Tighten: Tighten the caliper bracket bolts to 115 N.m (85 lb ft).

4. Install the rear brake pads.
5. Install the caliper. Refer to **Brake Caliper Replacement - Rear**.

FRONT BRAKE ROTOR REPLACEMENT

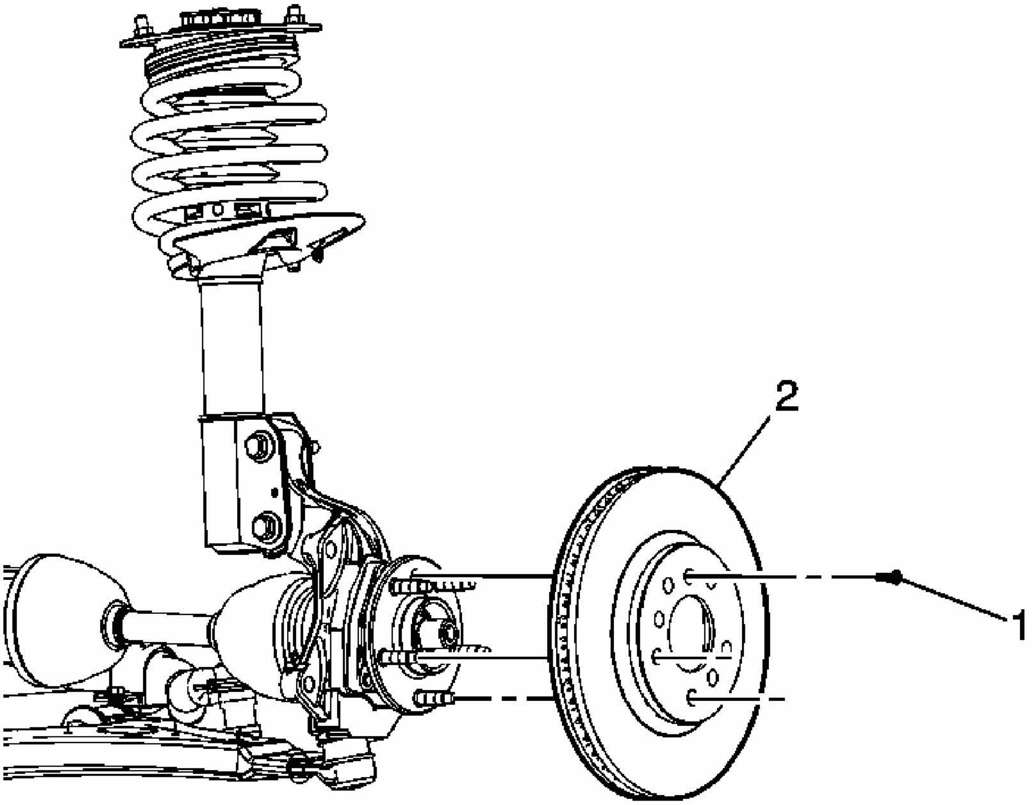


Fig. 56: Replacing Front Brake Rotor
Courtesy of GENERAL MOTORS CORP.

Brake Rotor Replacement - Front

Callout	Component Name
CAUTION: **Refer to Brake Dust**	

Caution .

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
2. Remove the brake caliper mounting bracket. Refer to **Brake Caliper Bracket Replacement - Front**

1	Retaining Screw **Tightening Specifications:** Tighten to 10 N.m (89 lb in)
2	Brake Rotor **Tip:** • If removing the rotor to service the brake system, mark the relationship of the rotor to the wheel stud for proper installation. • Using the **J 41013** , clean the contact area of the brake rotor and the wheel bearing if the rotor is to be reused. See **Special Tools**. • Using the **J 42450-A** , remove the rust and dirt from the contact area of the wheel bearing if replacing the rotor. See **Special Tools**. • Check for Lateral Runout (LRO), refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction**

REAR BRAKE ROTOR REPLACEMENT

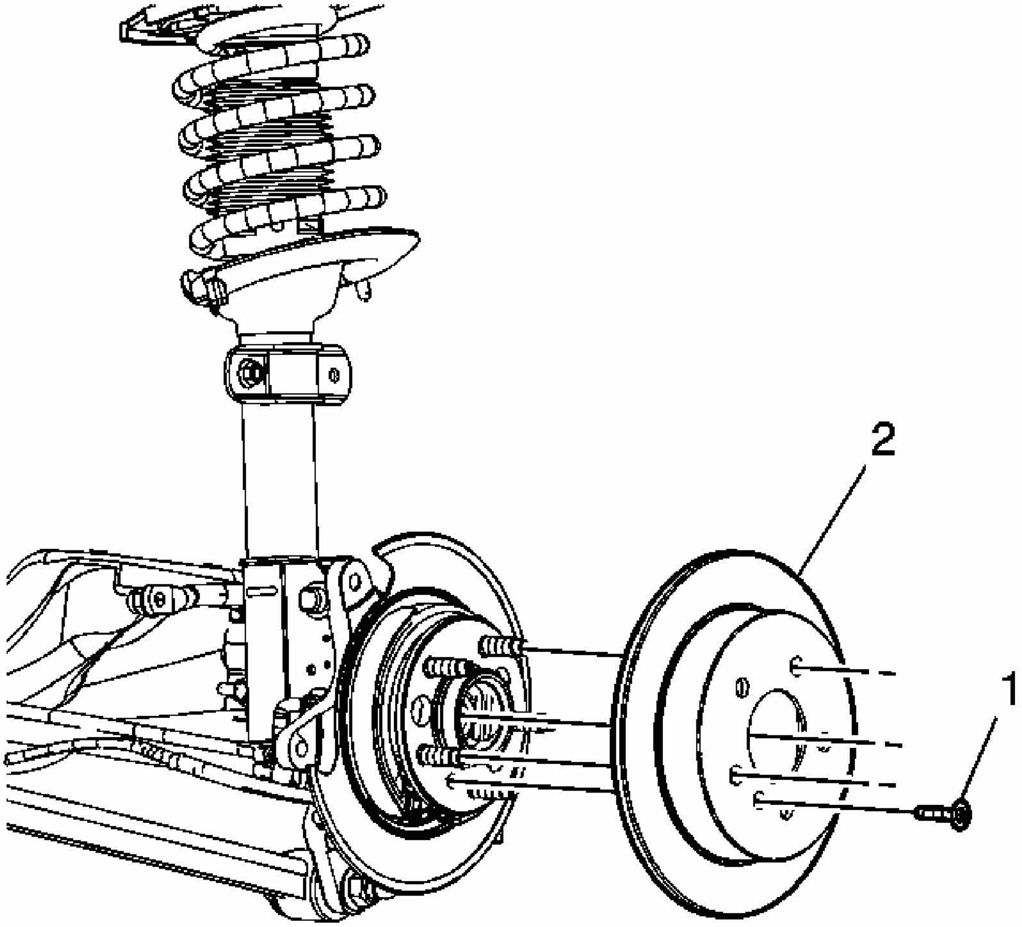


Fig. 57: Replacing Rear Brake Rotor
Courtesy of GENERAL MOTORS CORP.

Brake Rotor Replacement - Rear

Callout	Component Name
CAUTION: Refer to Brake Dust Caution . NOTE: Refer to Fastener Notice .	
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.	
Preliminary Procedure	

<table>
<tr><td colspan="2">1. Raise the vehicle. Refer to Lifting and Jacking the Vehicle
2. Remove the tire and wheel. Refer to Tire and Wheel Removal and Installation
3. Remove the rear brake caliper mounting bracket. Refer to Brake Caliper Bracket Replacement - Rear.</td></tr>
<tr><td>1</td><td>Rotor Retention Screw
Tightening Specifications: Tighten to 14 N.m (10 lb ft).</td></tr>
<tr><td>2</td><td>Brake Rotor
Tip:
• If removing the rotor to service the brake system, mark the relationship of the rotor to the wheel stud for proper installation.
• Using the J 41013 , clean the contact area of the brake rotor and the wheel bearing/hub if the rotor is to be reused. See Special Tools.
• Using the J 42450-A , remove the rust and dirt from the contact area of the wheel bearing/hub if replacing the rotor. See Special Tools.
• Check for Lateral Runout (LRO), refer to Brake Rotor Assembled Lateral Runout (LRO) Correction</td></tr>
</table>

REAR DISC BRAKE BACKING PLATE REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the rear wheels and tires. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

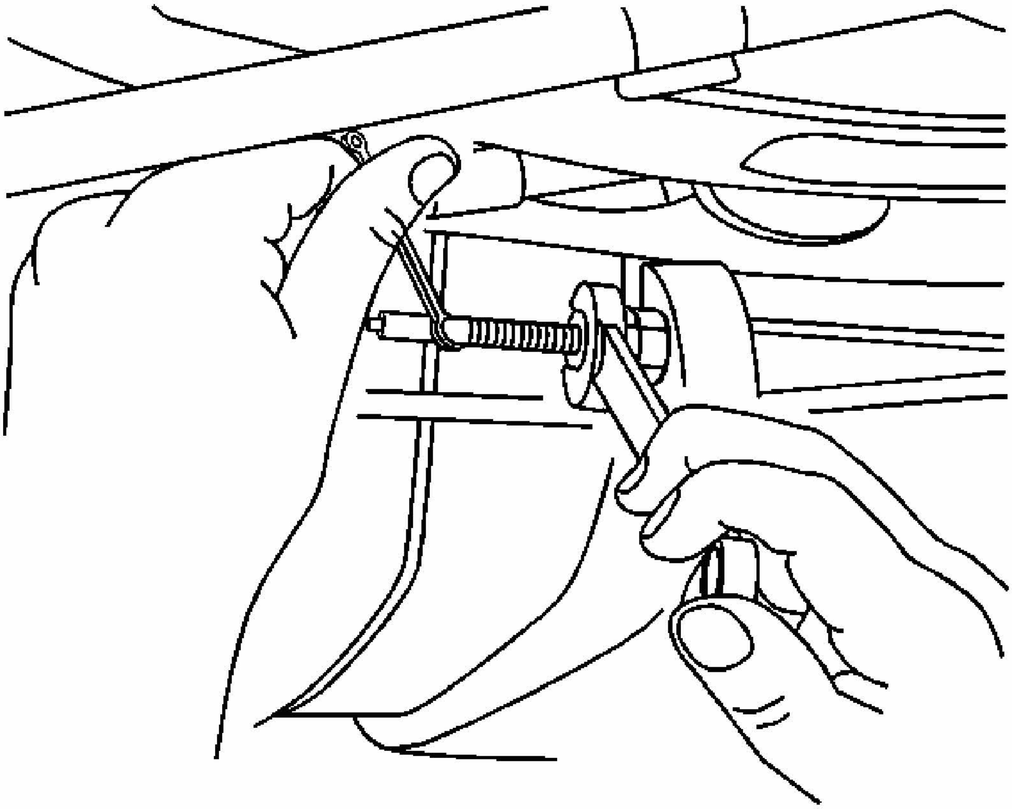


Fig. 58: Adjusting Park Brake Tension At Equalizer Assembly
Courtesy of GENERAL MOTORS CORP.

3. Relieve the park brake system tension at the equalizer assembly.
4. Remove the rear caliper bracket. Refer to **Brake Caliper Bracket Replacement - Rear**.
5. Remove the rear rotor. Refer to **Brake Rotor Replacement - Rear**.

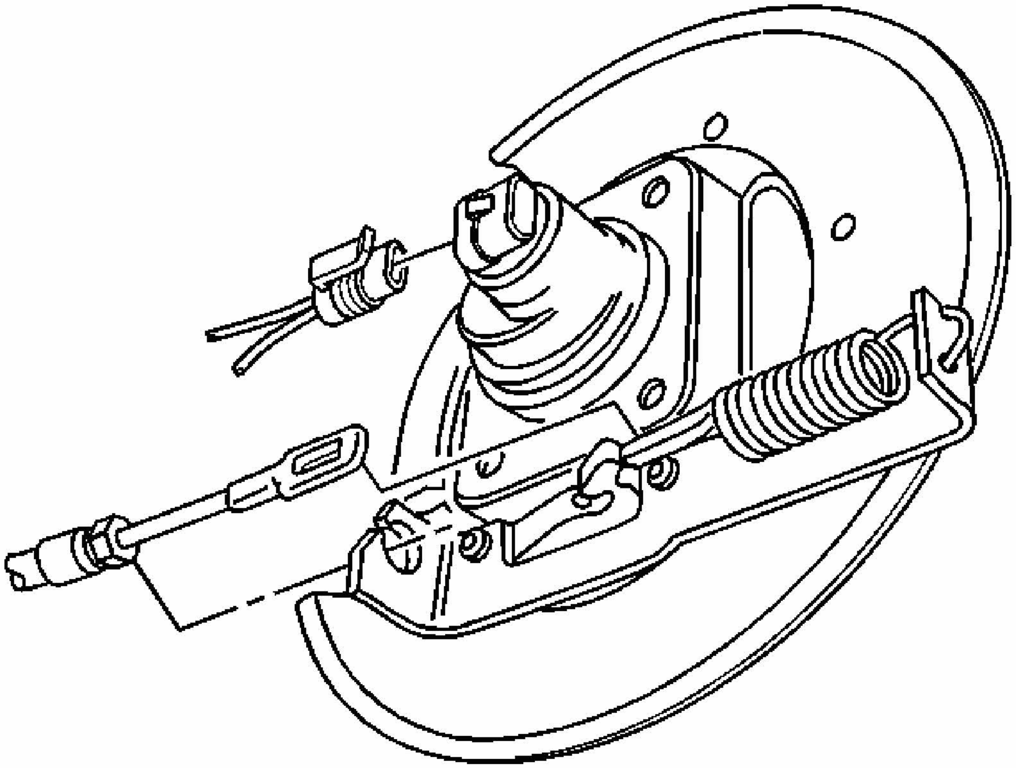


Fig. 59: View Of Rear Park Brake Cable & Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Disconnect and remove the rear park brake cable from the bracket at the rear wheel. Refer to **Park Brake Cable Replacement - Rear (Z7U)** in Park Brake.
7. Disconnect the park brake cable return spring from the park brake actuator and bracket at the rear wheel.
8. Remove the rear hub. Refer to **Wheel Bearing/Hub Replacement - Rear** in Rear Suspension.

   The rear hub, backing plate, park brake cable bracket, and park brake actuator will be removed as an assembly.

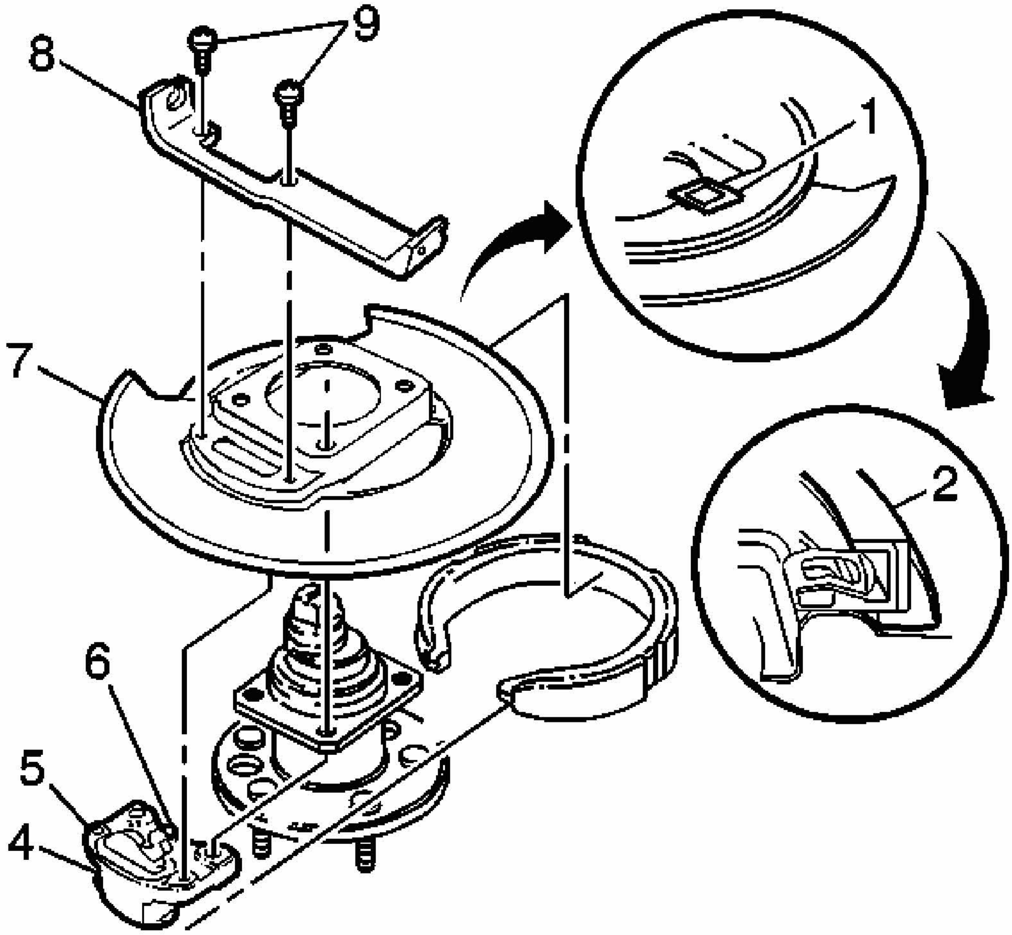


Fig. 60: Identifying Parking Brake Components
Courtesy of GENERAL MOTORS CORP.

9. Remove the 2 retainers (9) and the park brake cable bracket (8) from the park brake actuator (4). Position aside the rear hub.
10. Remove the park brake shoe and actuator (4) from the backing plate (7).

Installation Procedure

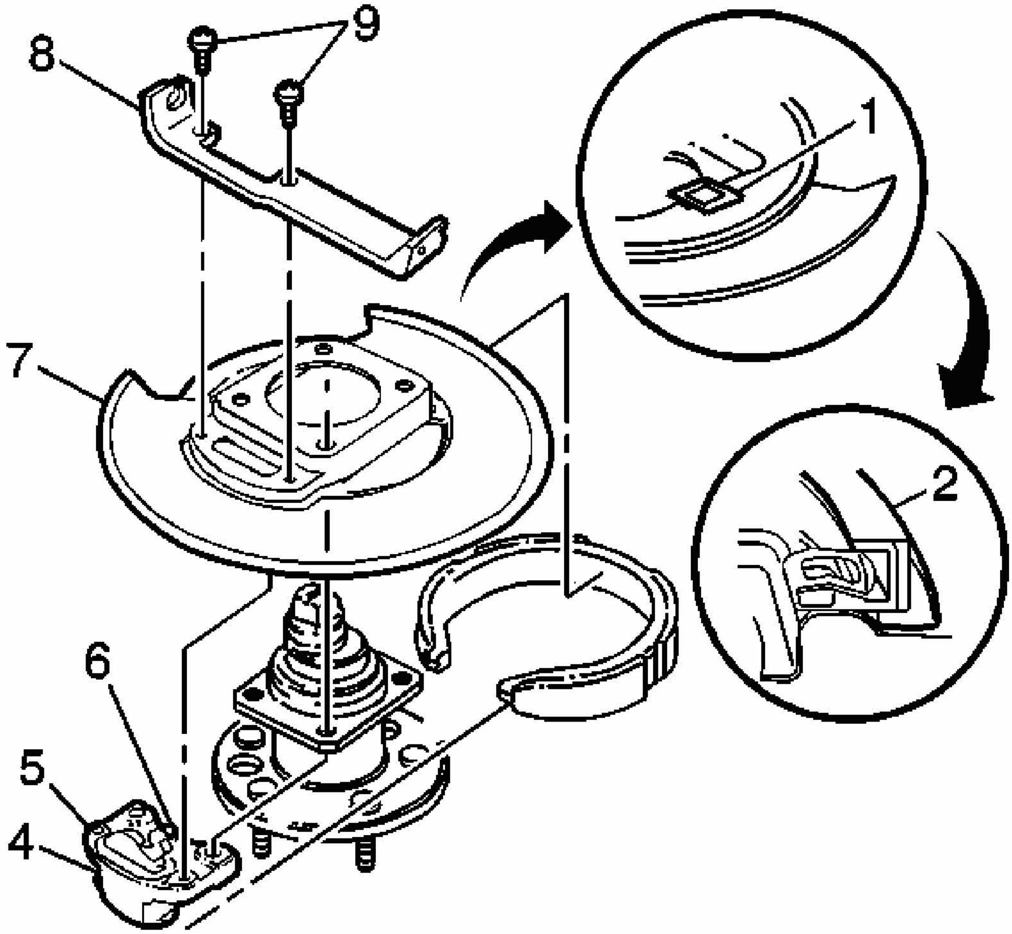


Fig. 61: Identifying Parking Brake Components
Courtesy of GENERAL MOTORS CORP.

1. Install the park brake shoe and actuator (4) onto the backing plate (7).
2. Position the park brake shoe, actuator (4), and backing plate (7) over the rear hub.
3. Install the park brake cable bracket (8) and the two retainers (9).
4. Install the rear hub. Refer to **Wheel Bearing/Hub Replacement - Rear** in Rear Suspension.

   The rear hub, backing plate, park brake cable bracket, and park brake actuator will be installed as an assembly.

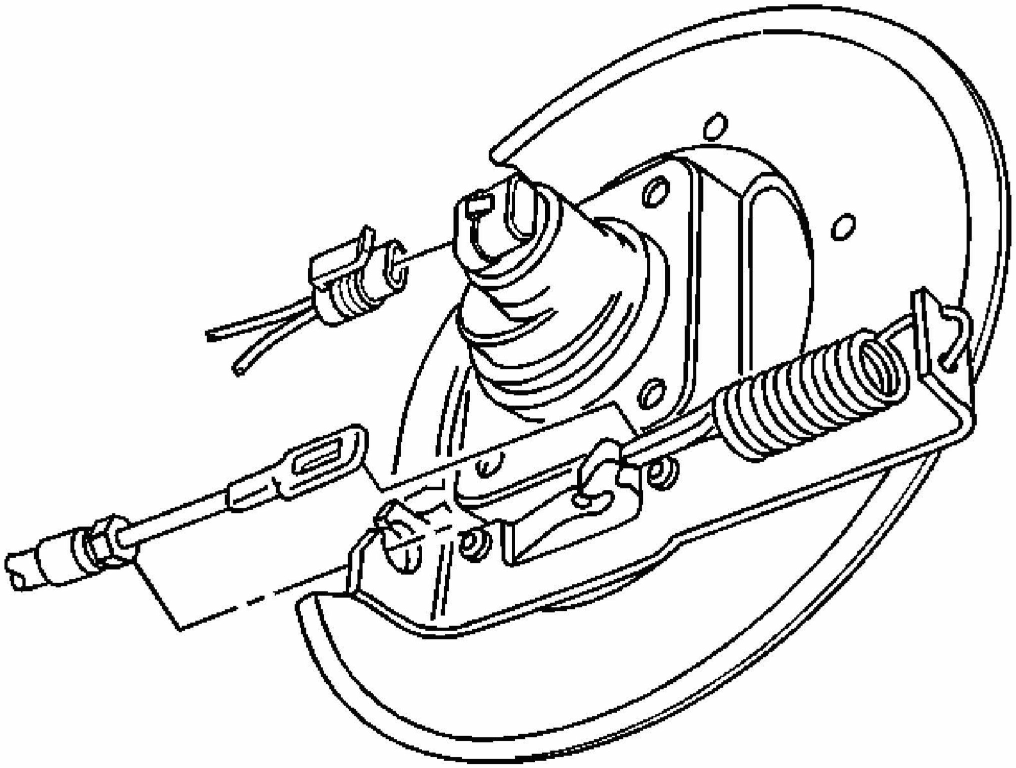


Fig. 62: View Of Rear Park Brake Cable & Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

5. Install and connect the rear park brake cable to the bracket at the rear wheel. Refer to **Park Brake Cable Replacement - Rear (Z7U)** in Park Brake.
6. Connect the park brake cable return spring to the park brake actuator and bracket at the rear wheel.
7. Install the rear rotor. Refer to **Brake Rotor Replacement - Rear**.
8. Install the rear caliper bracket. Refer to **Brake Caliper Bracket Replacement - Rear**.
9. Install the rear wheels and tires. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
10. Adjust the park brake at the equalizer. Refer to **Park Brake Adjustment** in Park Brake.
11. Lower the vehicle.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT (LRO) CORRECTION

IMPORTANT:

- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement.**
- **Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800-11 300 km (3,000-7,000 mi). Refer to Brake Rotor Assembled Lateral Runout (LRO) Measurement.**

Review the following acceptable methods for bringing the brake rotor assembled LRO to within specifications. Determine which method to use for the specific vehicle being repaired.

- The indexing method of correcting assembled LRO is most effective when the LRO specification is only exceeded by a relatively small amount: 0.025-0.127 mm (0.001-0.005 in). Indexing is used to achieve the best possible match of high spots to low spots between related components. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction - Indexing**.
- The correction plate method of correcting assembled LRO involves the addition of a tapered plate between the brake rotor and the hub/axle flange. The correction plate method can be used to correct LRO that exceeds the specification by up to 0.23 mm (0.009 in). Refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction - Correction Plates**.
- The on-vehicle brake lathe method is used to bring the LRO to within specifications through compensating for LRO while refinishing the brake rotor. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction - On-Vehicle Lathe**.

If the assembled LRO cannot be corrected using these methods, then other components must be suspected as causing and/or contributing to the LRO concern.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT (LRO) CORRECTION - INDEXING

Tools Required

- **J 39544-KIT** Torque-Limiting Socket Set, or equivalent. See **Special Tools**.
- **J 45101-100** Conical Brake Rotor Washers. See **Special Tools**.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

IMPORTANT:

- **Brake rotor thickness variation MUST be checked BEFORE**

checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement.

- **Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800-11 300 km (3,000-7,000 mi). Refer to Brake Rotor Assembled Lateral Runout (LRO) Measurement.**

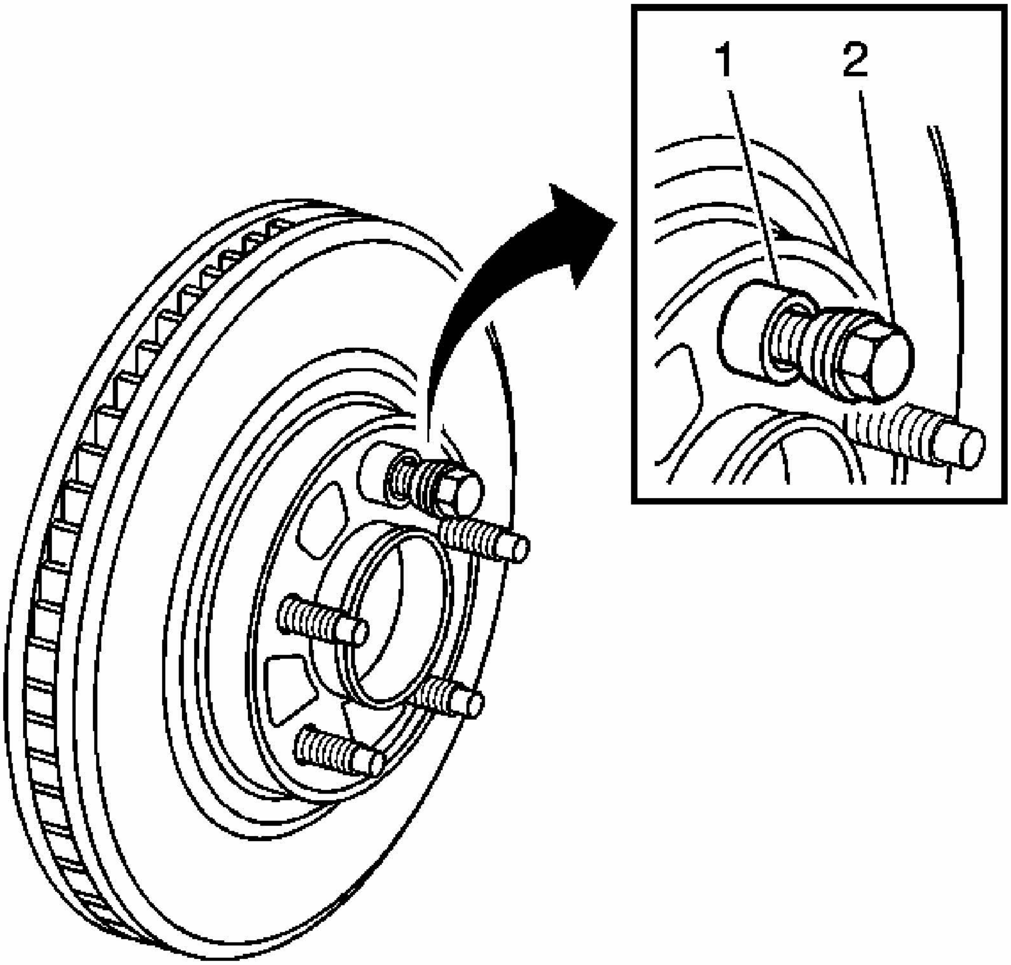


Fig. 63: Identifying J 45101-100 & Lug Nut
Courtesy of GENERAL MOTORS CORP.

1. Remove the **J 45101-100** and the lug nuts that were installed during the assembled

LRO measurement procedure. See **Special Tools**.

2. Inspect the mating surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
3. Index the brake rotor in a different orientation to the hub/axle flange.
4. Hold the rotor firmly in place against the hub/axle flange and install one of the**J 45101-100** (1) and one lug nut (2) onto the upper-most wheel stud. See **Special Tools**.
5. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

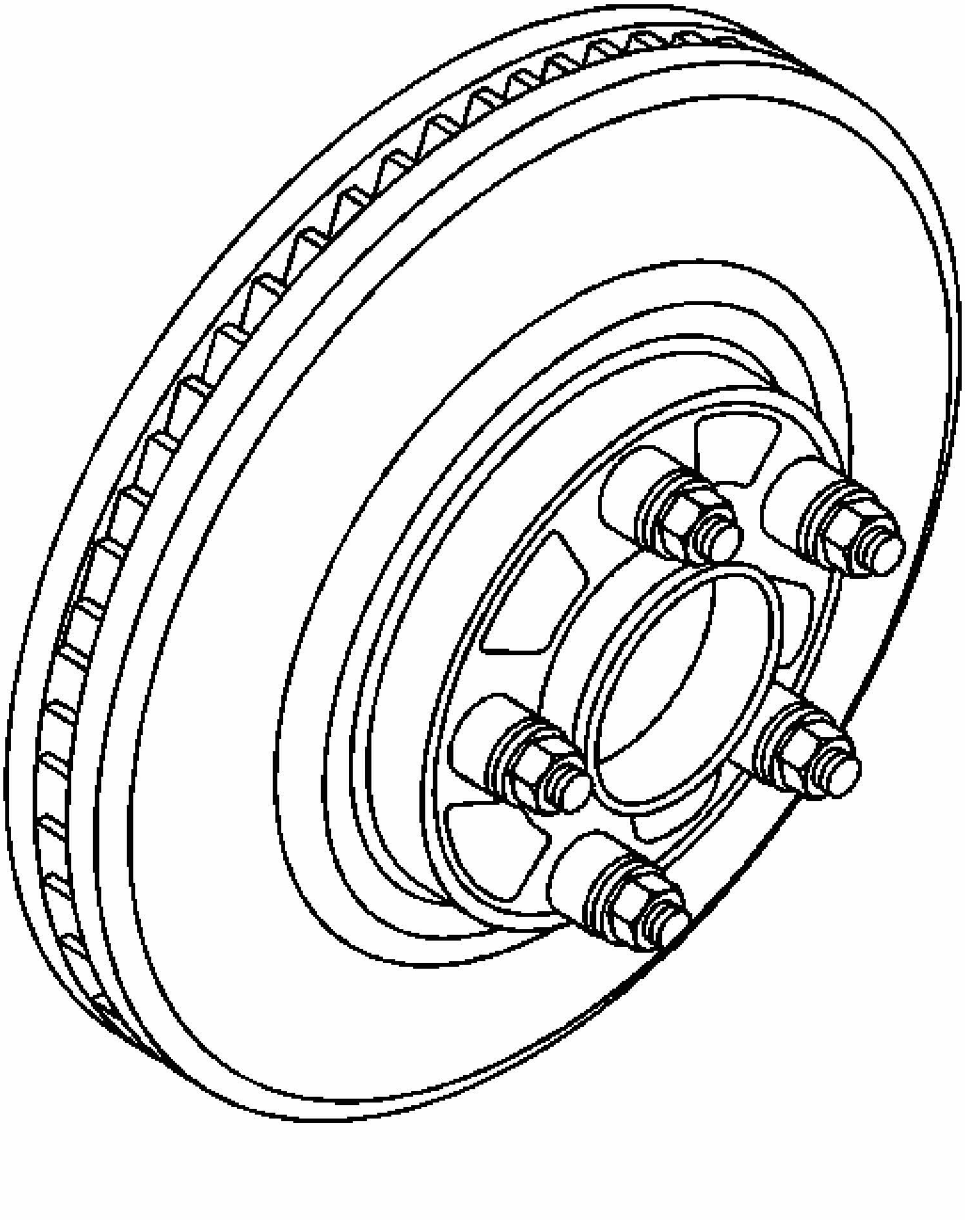


Fig. 64: Installing All J 45101-100s & Lug Nuts

Courtesy of GENERAL MOTORS CORP.

6. Install the remaining**J 45101-100** and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern. See **Special Tools**.
7. Using the **J 39544-KIT** , or equivalent, tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. See **Special Tools**. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
8. Measure the assembled LRO of the brake rotor. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Measurement**.
9. Compare the amount of change between this measurement and the original measurement.
10. If this measurement is within specifications, proceed to step 14.
11. If this measurement still exceeds specifications, repeat steps 1-9 until the best assembled LRO measurement is obtained.
12. Matchmark the final location of the rotor to the wheel studs if the orientation is different than it was originally.
13. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction**.
14. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **J 45101-100** and the lug nuts. See **Special Tools**.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT (LRO) CORRECTION - CORRECTION PLATES

Tools Required

- **J 39544-KIT** Torque-Limiting Socket Set, or equivalent. See **Special Tools**.
- **J 45101-100** Conical Brake Rotor Washers. See **Special Tools**.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

IMPORTANT:

- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement.**
- **Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800-11 300 km (3,000-7,000 mi). Refer to Brake**

Rotor Assembled Lateral Runout (LRO) Measurement.

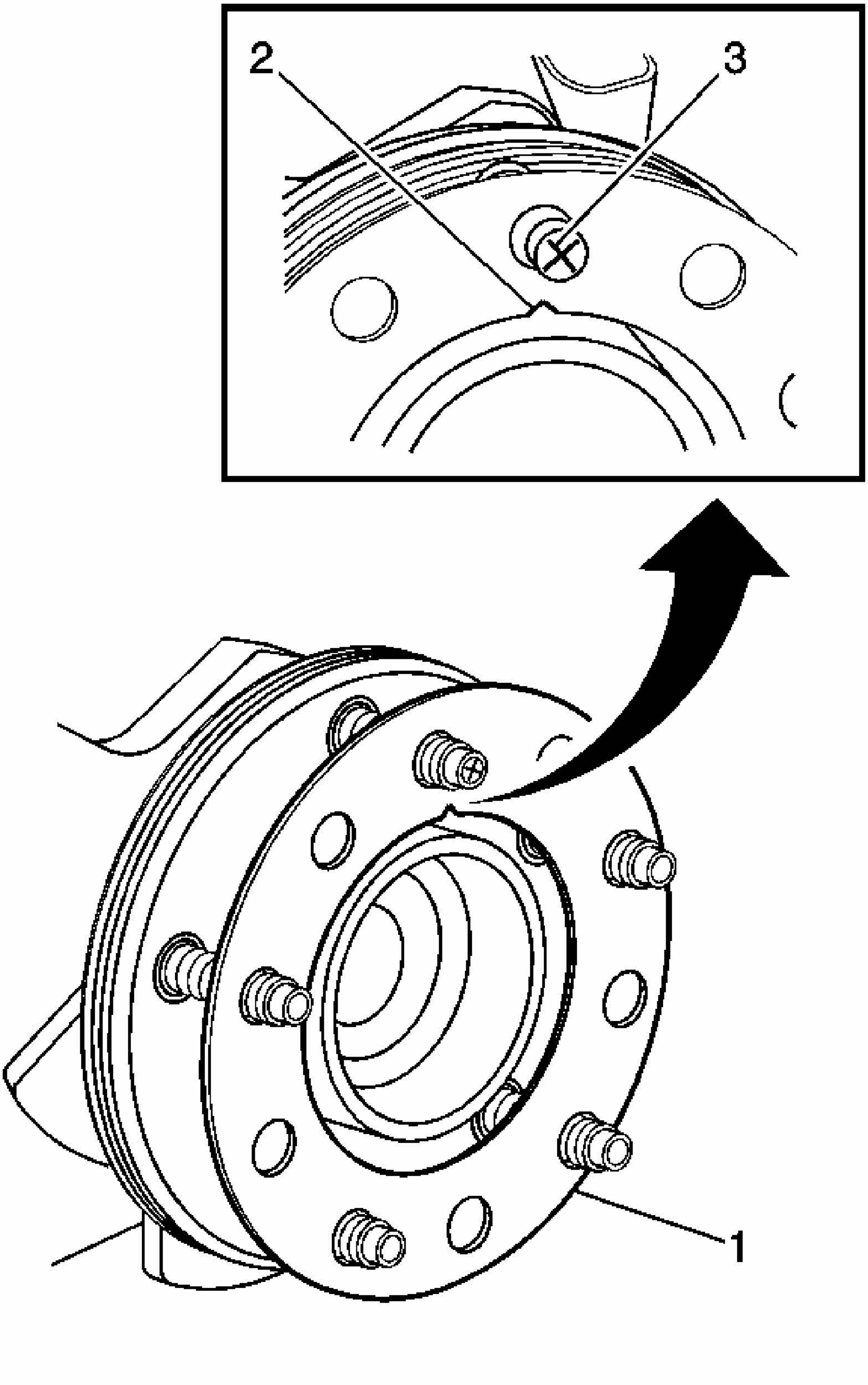


Fig. 65: Identifying Correction Plate, High Spot Mark & V-Shaped Notch

Courtesy of GENERAL MOTORS CORP.

1. Rotate the brake rotor to position the high spot, identified and marked during the brake rotor assembled LRO measurement procedure, to face upward.
2. Remove the**J 45101-100** and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure. See **Special Tools**.
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Select the correction plate, following the manufacturer's instructions, which has a specification closest to the assembled LRO measurement.

   For example: If the assembled LRO measurement was 0.076 mm (0.003 in), the 0.076 mm (0.003 in) correction plate would be used. If the measurement was 0.127 mm (0.005 in), the 0.152 mm (0.006 in) correction plate would be used.

5. Determine the positioning for the correction plate (1) using the high spot mark (3) made during the brake rotor assembled LRO measurement procedure.

IMPORTANT:

- **Do NOT install used correction plates in an attempt to correct brake rotor assembled lateral runout (LRO).**
- **Do NOT stack up, or install more than one correction plate onto one hub/axle flange location, in an attempt to correct brake rotor assembled LRO.**

6. Install the correction plate (1) onto the hub/axle flange, with the V-shaped notch (2) orientated to align with the high spot mark (3), that was positioned to face upward.

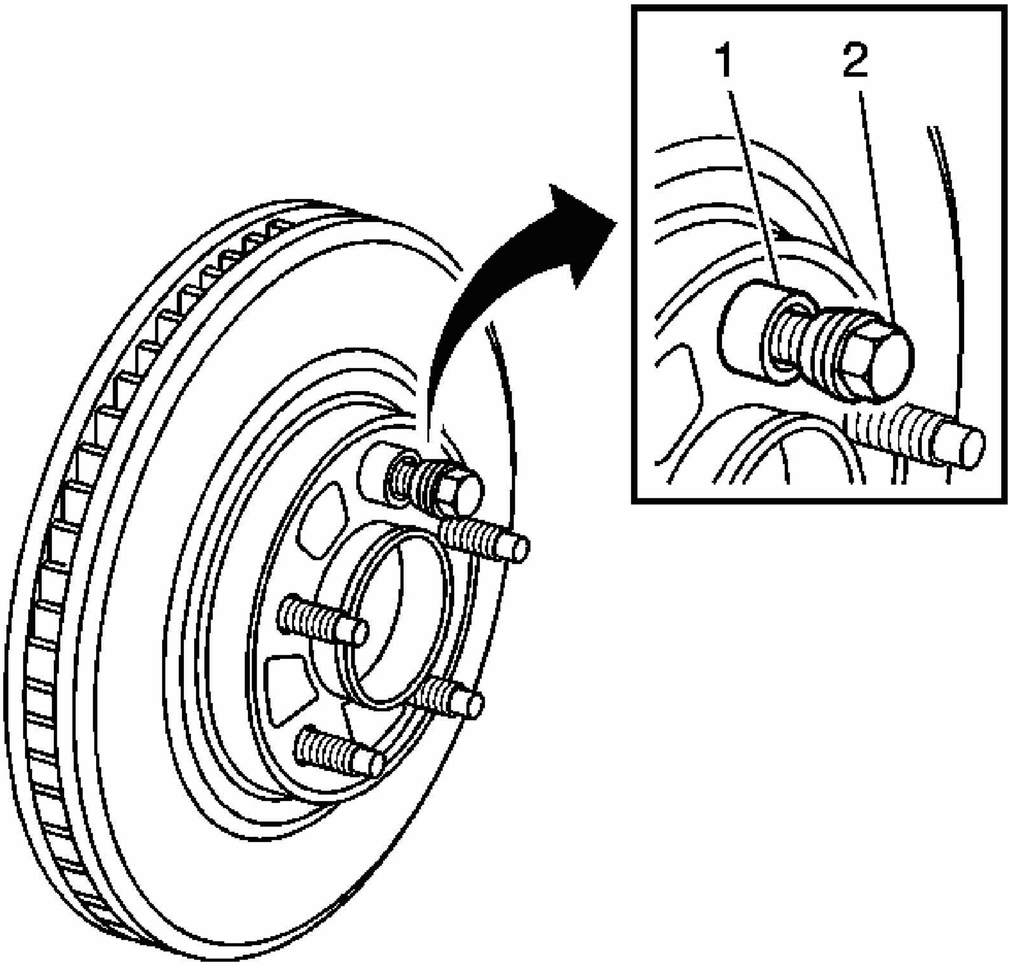


Fig. 66: Identifying J 45101-100 & Lug Nut
Courtesy of GENERAL MOTORS CORP.

7. Install the brake rotor to the hub/axle flange. Use the matchmark made prior to removal for proper orientation to the flange.
8. Hold the rotor firmly in place against the hub/axle flange and install one of the**J 45101-100** (1) and one lug nut (2) onto the upper-most wheel stud. See **Special Tools**.
9. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

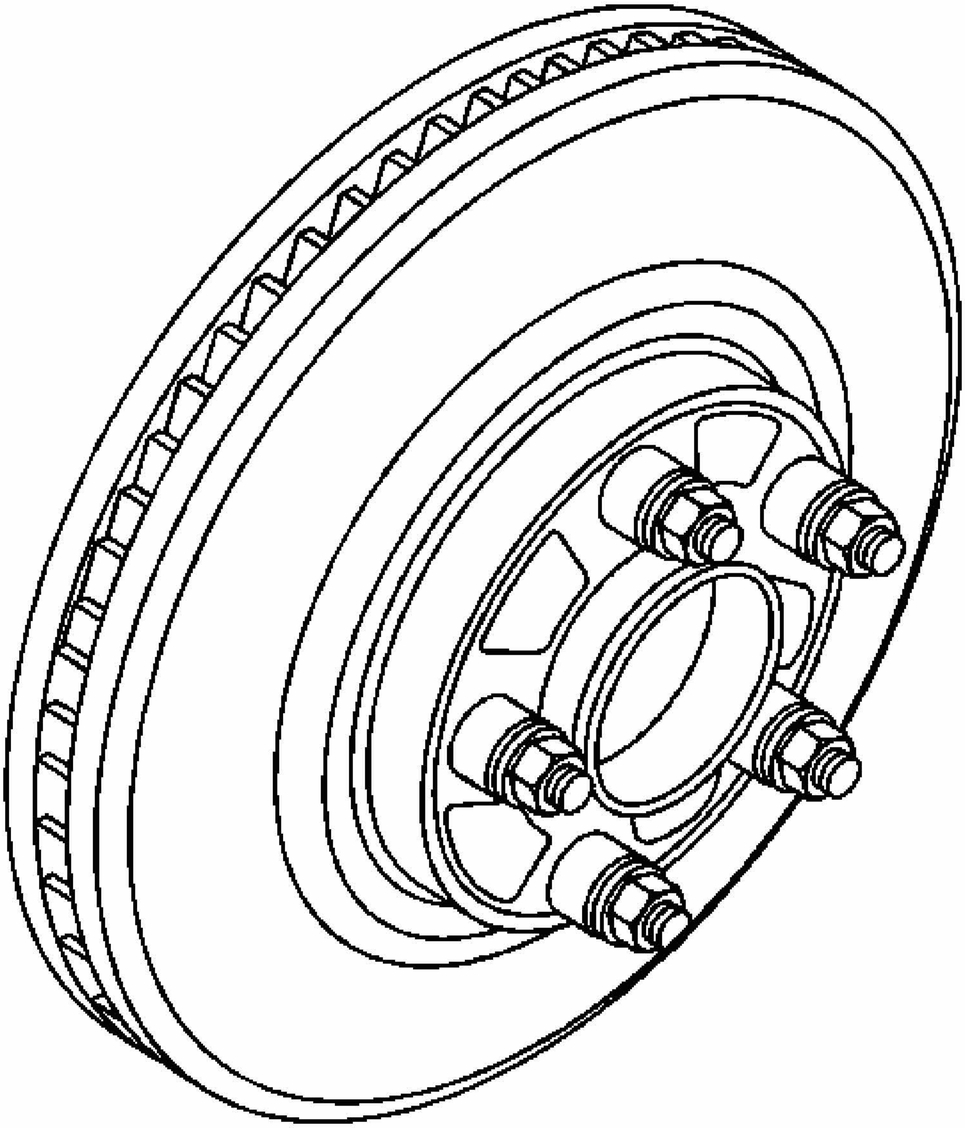


Fig. 67: Installing All J 45101-100s & Lug Nuts
Courtesy of GENERAL MOTORS CORP.

10. Install the remaining **J 45101-100** and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern. See **Special Tools**.
11. Using the **J 39544-KIT** , or equivalent, tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. See **Special Tools**. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
12. Measure the assembled LRO of the brake rotor. Refer to **Brake Rotor Assembled**

Lateral Runout (LRO) Measurement.

13. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction**.
14. If the brake rotor assembled LRO measurement is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **J 45101-100** and the lug nuts. See **Special Tools**.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT (LRO) CORRECTION - ON-VEHICLE LATHE

Tools Required

J 45101-100 Conical Brake Rotor Washers. See **Special Tools**.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

IMPORTANT:

- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement.**
- **Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800-11 300 km (3,000-7,000 mi). Refer to Brake Rotor Assembled Lateral Runout (LRO) Measurement.**

1. Ensure that the caliper and caliper bracket that are already being supported, are clear from contacting any rotating components, such as the brake rotor.
2. Remove the **J 45101-100** and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure. See **Special Tools**.
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Set up the lathe, following the manufacturer's instructions.
5. Refinish the brake rotor, following the brake lathe manufacturer's instructions.
6. After each successive cut, inspect the brake rotor thickness. Refer to **Brake Rotor Thickness Measurement**.
7. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced. After replacing the rotor, proceed to step 10.

8. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
    1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional finish
    2. Using moderate pressure, apply the non-directional finish:
        - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120 grit aluminum oxide sandpaper
        - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150 grit aluminum oxide sandpaper
    3. After applying a non-directional finish, clean each friction surface of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner
9. Remove the lathe from the vehicle.
10. Measure the assembled LRO of the brake rotor. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Measurement**.
11. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction**.
12. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **J 45101-100** and the lug nuts. See **Special Tools**.

BRAKE ROTOR REFINISHING

Tools Required

- **J 41013** Rotor Resurfacing Kit. See **Special Tools**.
- **J 42450-A** Wheel Hub Resurfacing Kit. See **Special Tools**.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

IMPORTANT:

- **The disc brake rotors do not require refinishing as part of routine brake system service. New disc brake rotors do not require refinishing.**

  Do not refinish disc brake rotors in an attempt to correct the following conditions:

    - **Brake system noise - squeal, growl, groan**
    - **Uneven and/or premature disc brake pad wear**
    - **Superficial or cosmetic corrosion/rust of the disc brake rotor friction surface**

  - **Scoring of the disc brake rotor friction surface less than the maximum allowable specification**
- **Before refinishing a brake rotor, the rotor MUST first be checked for adequate thickness to allow the rotor to be refinished and remain above the minimum allowable thickness after refinish specification. Refer to Brake Rotor Thickness Measurement.**

  Disc brake rotors should only be refinished if they have adequate thickness to be refinished and if one or more of the following conditions exist:

  - **Thickness variation in excess of the maximum allowable specification**
  - **Excessive corrosion/rust and/or pitting**
  - **Cracks and/or heat spots**
  - **Excessive blueing discoloration**
  - **Scoring of the disc brake rotor surface in excess of the maximum allowable specification**
- **Disc brake rotors may need to be refinished as part of the process for correcting brake rotor assembled lateral runout (LRO) that exceeds the maximum allowable specification.**

IMPORTANT: Whenever the brake rotor has been separated from the hub/axle flange, clean any rust or contaminants from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in increased assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Using the **J 42450-A** , thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange. See **Special Tools**.
2. Using the **J 41013** , thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor. See **Special Tools**.
3. Inspect the mating surfaces of the hub/axle flange and the rotor to ensure that there are no foreign particles or debris remaining.
4. Mount the brake rotor to the brake lathe according to the lathe manufacturer's instructions, ensuring that all mounting attachments and adapters are clean and free of debris.
5. Ensure that any vibration dampening attachments are securely in place.
6. With the brake lathe running, slowly bring in the cutting tools until they just contact the

brake rotor friction surfaces.

7. Observe the witness mark on the brake rotor. If the witness mark extends approximately three-quarters or more of the way around the brake rotor friction surface on each side, the brake rotor is properly mounted to the lathe.
8. If the witness mark does not extend three-quarters or more of the way around the brake rotor, re-mount the rotor to the lathe.
9. Following the brake lathe manufacturer's instructions, refinish the brake rotor.
10. After each successive cut, inspect the brake rotor thickness. Refer to **Brake Rotor Thickness Measurement**.
11. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced.
12. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
    1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional finish
    2. Using moderate pressure, apply the non-directional finish:
        - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120 grit aluminum oxide sandpaper
        - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150 grit aluminum oxide sandpaper
    3. After applying a non-directional finish, clean each friction surface of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner
13. Remove the brake rotor from the brake lathe.
14. Measure the assembled lateral runout (LRO) of the brake rotor to ensure optimum performance of the disc brakes. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Measurement**.
15. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction**.

DESCRIPTION AND OPERATION

DISC BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The disc brake system consists of the following components:

Disc Brake Pads

Applies mechanical output force from the hydraulic brake calipers to friction surfaces of brake rotors.

Disc Brake Rotors

Uses mechanical output force applied to friction surfaces from the disc brake pads to slow speed of tire and wheel assembly rotation.

Disc Brake Pad Hardware

Secures disc brake pads firmly in proper relationship to the hydraulic brake calipers. Enables a sliding motion of brake pads when mechanical output force is applied.

Disc Brake Caliper Hardware

Provides mounting for hydraulic brake caliper and secures the caliper firmly in proper relationship to caliper bracket. Enables a sliding motion of the brake caliper to the brake pads when mechanical output force is applied.

System Operation

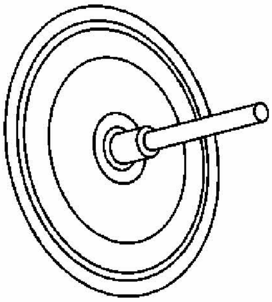
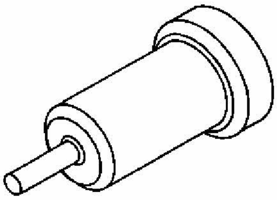
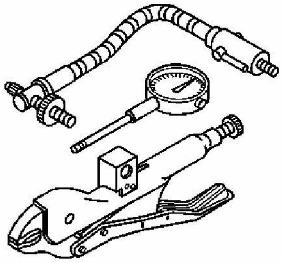
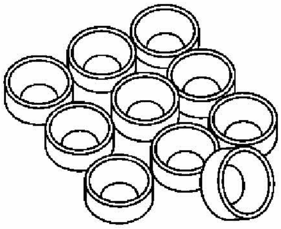
Mechanical output force is applied from the hydraulic brake caliper pistons to the inner brake pads. As the pistons press the inner brake pads outward, the caliper housings draw the outer brake pads inward. This allows the output force to be equally distributed. The brake pads apply the output force to the friction surfaces on both sides of the brake rotors, which slows the rotation of the tire and wheel assemblies. The correct function of both the brake pad and brake caliper hardware is essential for even distribution of braking force.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description
	J 39544-KIT Complete Torque Socket Set - 10 Pieces

	J 41013 Rotor Resurfacing Kit
	J 42450-A Wheel Hub Resurfacing Kit
	J 45101 Hub and Wheel Runout Gage
	J 45101-100 Conical Brake Rotor Washers

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Instrument Panel Cluster Assembly Screws	2 N·m	18 lb in

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2009 Chevrolet Impala | Impala (VIN W) Service Manual | Driver Information and Entertainment | Displays and Gages | Repair Instructions | Document ID: 1623739

Electronic Compass Calibration

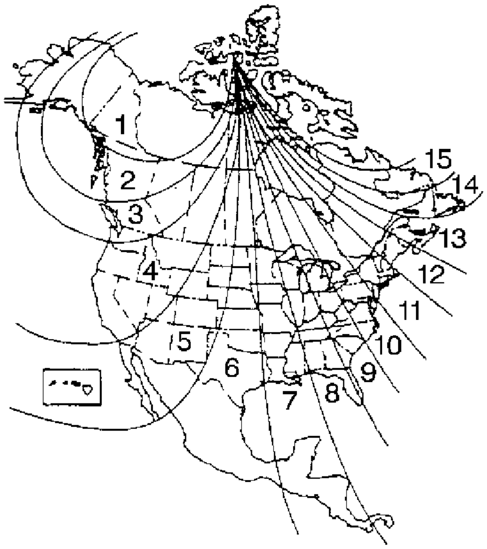
Compass Calibration

The compass direction will show CAL if it needs to be calibrated. Before calibrating the compass, drive the vehicle to an area that is magnetically clean (free of large metallic objects).

1. Turn ON the ignition.
2. Before calibrating the compass, make sure the compass is set to the variance zone in which the vehicle is travelling. See Compass Magnetic Variation Adjustment below.
3. Press the vehicle information button until the PRESS TO CALIBRATE COMPASS screen is displayed.
4. Press the set/reset button to start the compass calibration.
5. The DIC will display CALIBRATING: DRIVE IN CIRCLES. Drive the vehicle in circles at less than 8 km/h (5 mph) to complete the calibration. The DIC will display CALIBRATION COMPLETE when the calibration is complete.

Compass Magnetic Variation Adjustment

Compass variance is the difference between the earth's magnetic north and true geographic north. If not adjusted to account for compass variance, the compass in the vehicle could give false readings. Under certain circumstances, such as during a long distance cross-country trip, it will be necessary to compensate for compass variance and reset the zone through the DIC.



1. Locate your geographic location. Refer to the variation zone map.
2. Turn ON the ignition with the engine OFF.
3. Press the vehicle information button until PRESS TO CHANGE COMPASS ZONE displays on the DIC.
4. Press the set/reset button to scroll through and select the appropriate variance zone.

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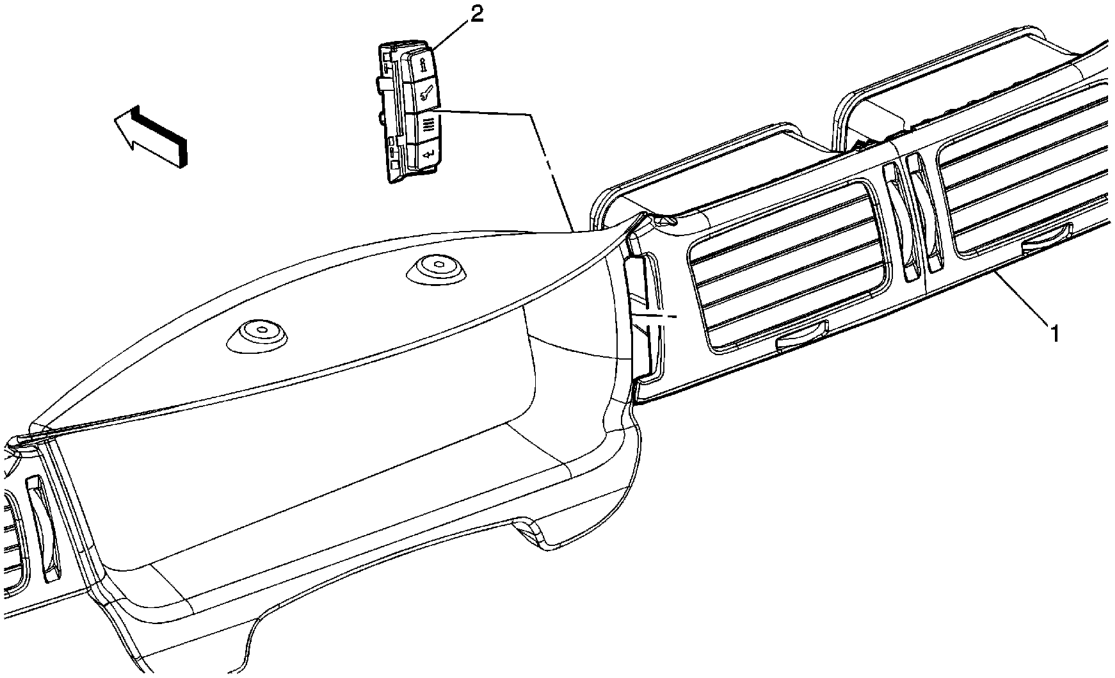
5. Navigate to one of the trip/fuel menu screens to view the direction the vehicle is moving. This will be shown in the top right corner of the DIC display.

If the compass needs to be calibrated, use the compass calibration procedure above.

Driver Information Display Switch Replacement



Callout	Component Name
1	Instrument Panel Trim Plate Assembly Refer to Instrument Panel Trim Plate Replacement.
2	Driver Information Center Switch Assembly

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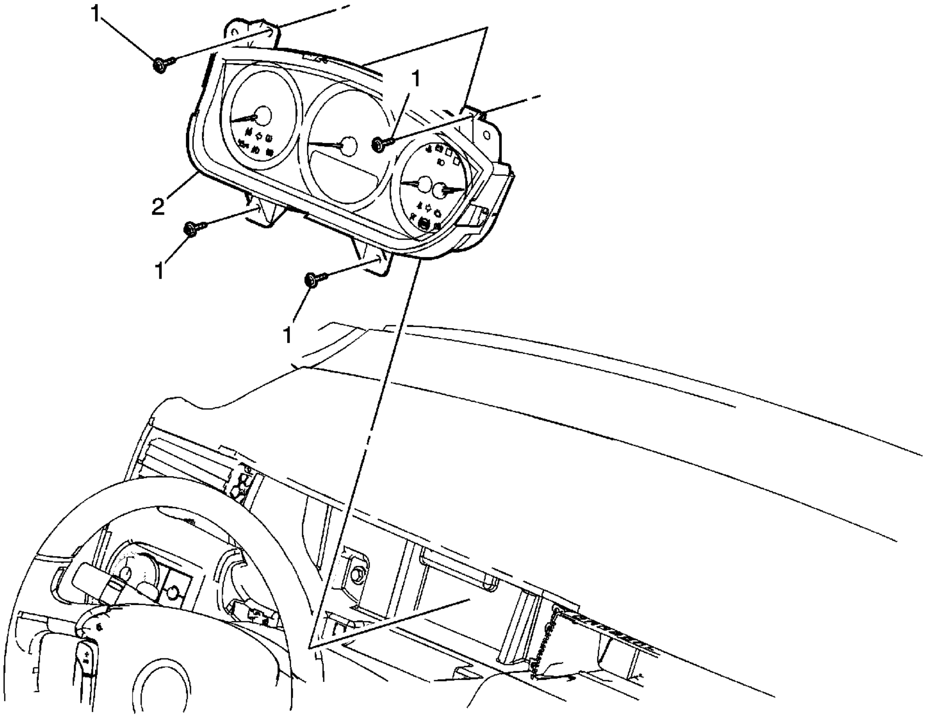
Instrument Cluster Replacement



Callout	Component Name
Preliminary Procedure Remove the instrument panel (I/P) trim plate. Refer to Instrument Panel Trim Plate Replacement.	
1	Instrument Panel Cluster Screw (Qty: 4) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Instrument Panel Cluster Assembly **Procedure** 1. Disconnect the electrical connector. 2. Refer to Control Module References for programming and setup information.

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2006 ACCESSORIES & EQUIPMENT

Doors - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Armrest Pull Cup Screws (Impala)	6 N.m	53 lb in
Cone Adjuster Hinge Bolts (Monte Carlo)	10 N.m	89 lb in
Door Armrest Bracket Screws (All)	10 N.m	89 lb in
Door Check Link (All)	25 N.m	18 lb ft
Door Front Pull Handle Screws (Monte Carlo)	4 N.m	36 lb ft
Door Front Trim Panel Upper Screw (Impala)	2 N.m	18 lb in
Door Front Trim Panel Upper Screw (Monte Carlo)	2 N.m	18 lb in
Door Hinge Bolts (All)	33 N.m	24 lb ft
Door Hinge Keeper Strap Bolts	33 N.m	24 lb ft
Door Inside Handle Bezel Screw (Impala)	2 N.m	18 lb in
Door Inside Handle Bezel Screw (Monte Carlo)	2 N.m	18 lb in
Door Lock Striker Screws (All)	25 N.m	18 lb ft
Door Rear Energy Absorbers Pad Screw (Impala)	2 N.m	18 lb in
Front Door Lock Actuator Screws	2 N.m	18 lb in
Intermediate Door Hinge Bolts	33 N.m	24 lb ft
Lock Screws, Front Door (Impala)	10 N.m	89 lb in
Lock Screws, Front Door (Monte Carlo)	10 N.m	89 lb in
Lock Screws, Rear Door (Impala)	10 N.m	89 lb in
Outer Belt Sealing Strip Machine Screw, Front Door (Monte Carlo)	5 N.m	9 lb in
Outer Belt Sealing Strip Screw, Front Door (Impala)	2 N.m	18 lb in
Outer Belt Sealing Strip Screw, Front Door (Monte Carlo)	2 N.m	18 lb in
Outer Belt Sealing Strip Screw, Rear Door (Impala)	2 N.m	18 lb in
Outside Handle Bolts, Front Door (Impala)	10 N.m	89 lb in
Outside Handle Bolts, Front Door (Monte Carlo)	10 N.m	89 lb in

Outside Handle Bolts, Rear Door (Impala)	10 N.m	89 lb in
Outside Mirror Nuts (All)	10 N.m	89 lb in
Rear Door Lock Actuator Screws	2 N.m	18 lb in
TORX® Body Side Hinge Bolts (Monte Carlo)	10 N.m	89 lb in
Weatherstrip Channel Screws, Front Door (Impala)	10 N.m	89 lb in
Weatherstrip Channel Screws, Front Door (Monte Carlo)	10 N.m	89 lb in
Window Regulator Bolts, Front Door (Impala)	10 N.m	89 lb in
Window Regulator Bolts, Front Door (Monte Carlo)	10 N.m	89 lb in
Window Regulator Bolts, Rear Door (Impala)	10 N.m	89 lb in
Window to Regulator Bolts, Front Door (Impala)	10 N.m	89 lb in
Window to Regulator Bolts, Front Door (Monte Carlo)	10 N.m	89 lb in
Window to Regulator Bolts, Rear Door (Impala)	10 N.m	89 lb in
Window Channel Retainer Screws, Front Door (Impala)	2 N.m	18 lb in
Window Channel Retainer Screws, Front Door (Monte Carlo)	2 N.m	18 lb in
Window Channel Retainer Screws, Rear Door (Impala)	2 N.m	18 lb in
Window Rear Channel Screws, Front Door	10 N.m	89 lb in
Window Regulator Motor	4.6 N.m	41 lb in

SCHEMATIC AND ROUTING DIAGRAMS

POWER WINDOW SCHEMATICS

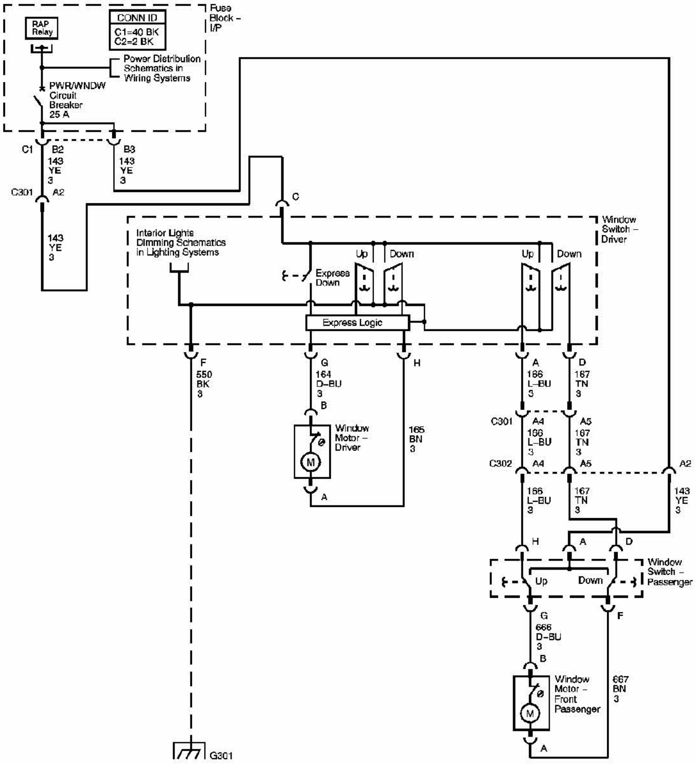

Fuse Block - I/P
RAP Relay
CONN ID
C1=40 BK
C2=2 BK
Power Distribution Schematics in Wiring Systems
PWR/WNDW Circuit Breaker 25 A
C1
B2
B3
143 YE 3
C301
A2
C
Window Switch - Driver
Interior Lights Dimming Schematics in Lighting Systems
Express Down
Up
Down
Express Logic
F
550 BK 3
G
164 D-BU 3
H
A
166 L-BU 3
D
167 TN 3
B
Window Motor - Driver
165 BN 3
C301
A4
A5
C302
Window Switch - Passenger
666 D-BU 3
667 BN 3
Window Motor - Front Passenger
G301

Fig. 1: Coupe - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

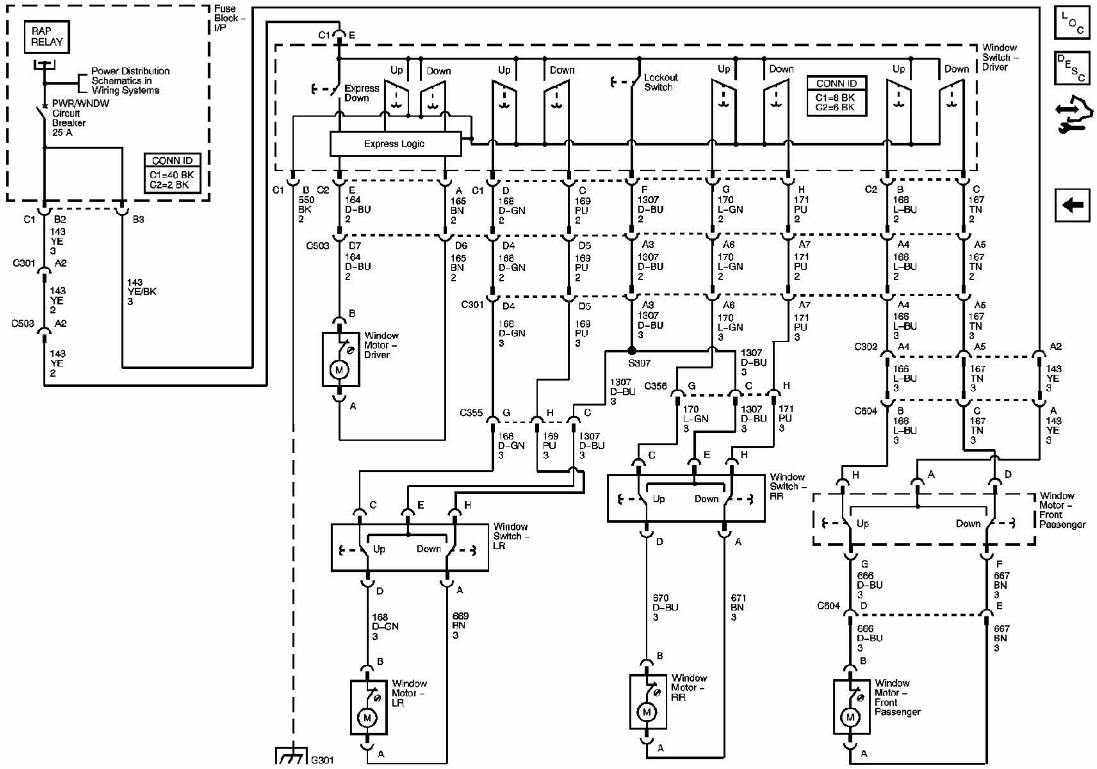

Fuse Block - I/P
RAP RELAY
Power Distribution Schematics in Wiring Systems
PWR/WNDW Circuit Breaker 25 A
CONN ID
C1=40 BK
C2=2 BK
C1
B2
B3
143 YE 3
C301
A2
143 YE 2
C503
143 YE/BK 3
C1 E
Window Switch - Driver
Express Down
Up
Down
Lockout Switch
CONN ID
C1=8 BK
C2=6 BK
Express Logic
C1
B
550 BK 2
C2
E
164 D-BU 2
A
165 BN 2
D
168 D-GN 2
C
169 PU 2
F
1307 D-BU 2
G
170 L-GN 2
H
171 PU 2
166 L-BU 2
167 TN 2
C503
D7
D6
D4
D5
A3
A6
A7
A4
A5
C301
168 D-GN 3
169 PU 3
1307 D-BU 3
170 L-GN 3
171 PU 3
166 L-BU 3
167 TN 3
S307
C302
A1
143 YE 3
C356
C355
C604
Window Motor - Driver
Window Switch - LR
Window Switch - RR
Window Motor - Front Passenger
168 D-GN 3
669 BN 3
670 D-BU 3
671 BN 3
666 D-BU 3
667 BN 3
Window Motor - LR
Window Motor - RR
Window Motor - Front Passenger
G301

Fig. 2: Sedan - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

DOOR LOCK/INDICATOR SCHEMATICS

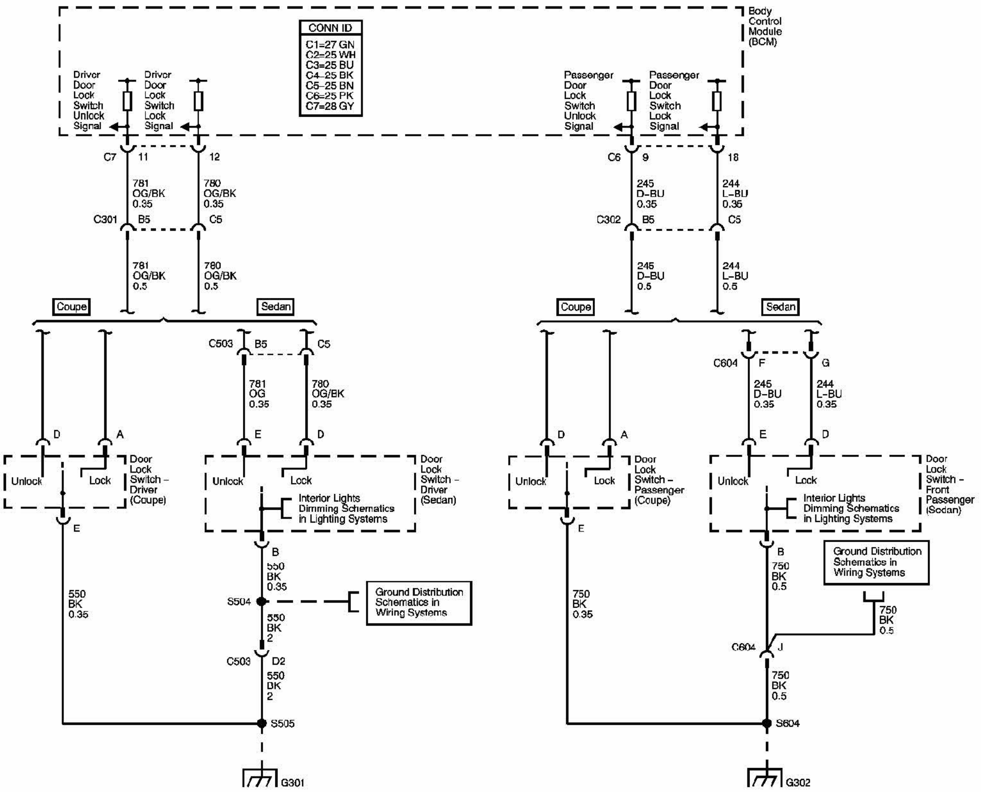

Body Control Module (BCM)
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4-25 BK
C5-25 BN
C6=25 PK
C7=28 GY
Driver Door Lock Switch Unlock Signal
Driver Door Lock Switch Lock Signal
Passenger Door Lock Switch Unlock Signal
Passenger Door Lock Switch Lock Signal
C7 11 12
781 OG/BK 0.35
780 OG/BK 0.35
C301 B5 C5
781 OG/BK 0.5
780 OG/BK 0.5
C6 9 18
245 D-BU 0.35
244 L-BU 0.35
C302 B5 C5
245 D-BU 0.5
244 L-BU 0.5
Coupe
Sedan
C503 B5 C5
781 OG 0.35
780 OG/BK 0.35
C604 F G
245 D-BU 0.35
244 L-BU 0.35
D A E D
Unlock
Lock
Door Lock Switch - Driver (Coupe)
Door Lock Switch - Driver (Sedan)
Door Lock Switch - Passenger (Coupe)
Door Lock Switch - Front Passenger (Sedan)
Interior Lights Dimming Schematics in Lighting Systems
E
B
550 BK 0.35
550 BK 0.35
S504
Ground Distribution Schematics in Wiring Systems
550 BK 2
C503 D2
550 BK 2
S505
G301
750 BK 0.35
750 BK 0.5
750 BK 0.5
C604 J
750 BK 0.5
S604
G302

Fig. 3: Door Lock Switches - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

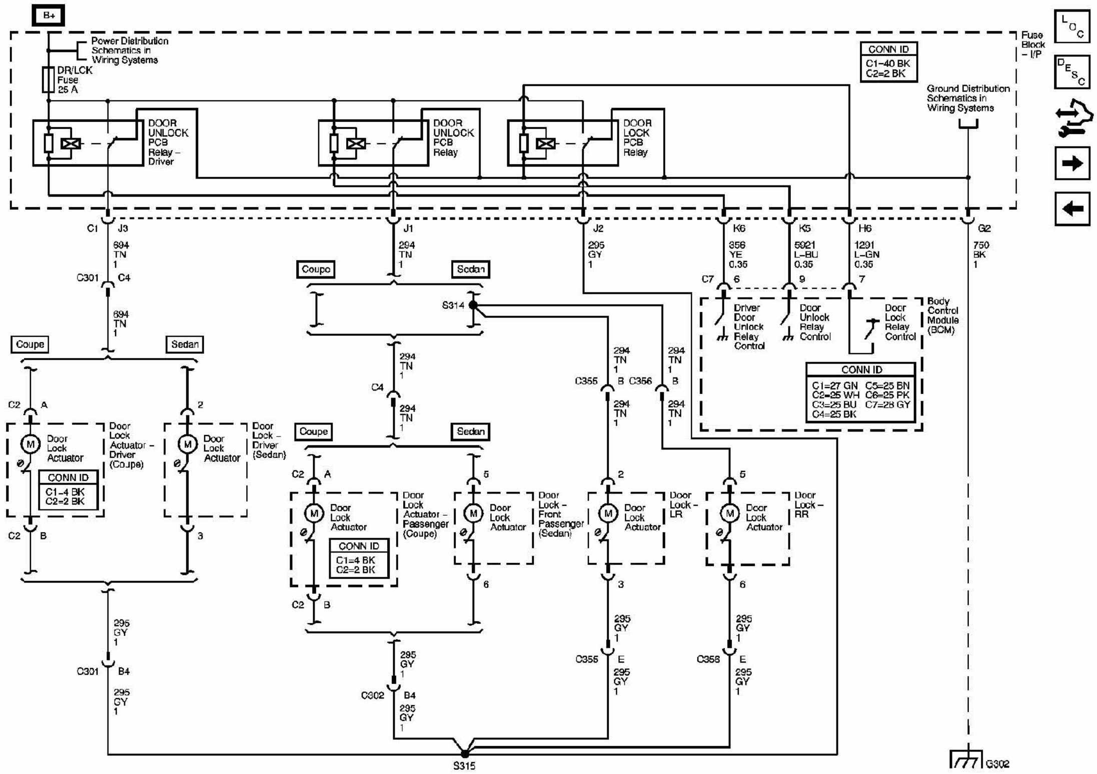

B+
Power Distribution Schematics in Wiring Systems
DR/LCK Fuse 25 A
DOOR UNLOCK PCB Relay – Driver
DOOR UNLOCK PCB Relay
DOOR LOCK PCB Relay
CONN ID
C1=40 BK
C2=2 BK
Fuse Block – I/P
Ground Distribution Schematics in Wiring Systems
C1 J3
694 TN 1
J1
294 TN 1
J2
295 GY 1
K6
356 YE 0.35
K5
5921 L–BU 0.35
H6
1291 L–GN 0.35
G2
750 BK 1
C301 C4
C7 6 9 7
Coupe
Sedan
S314
Driver Door Unlock Relay Control
Door Unlock Relay Control
Door Lock Relay Control
Body Control Module (BCM)
CONN ID
C1=27 GN C5=25 BN
C2=25 WH C6=25 PK
C3=25 BU C7=28 GY
C4=25 BK
C355 B C356 B
C4
C2 A
2
5
Door Lock Actuator
Door Lock Actuator – Driver (Coupe)
Door Lock – Driver (Sedan)
Door Lock Actuator – Passenger (Coupe)
Door Lock – Front Passenger (Sedan)
Door Lock – LR
Door Lock – RR
CONN ID
C1–4 BK
C2=2 BK
C1=4 BK
C2=2 BK
M
C2 B
3
6
295 GY 1
C301 B4
C302 B4
C355 E
C356 E
S315
G302

Fig. 4: Door Lock Actuators - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

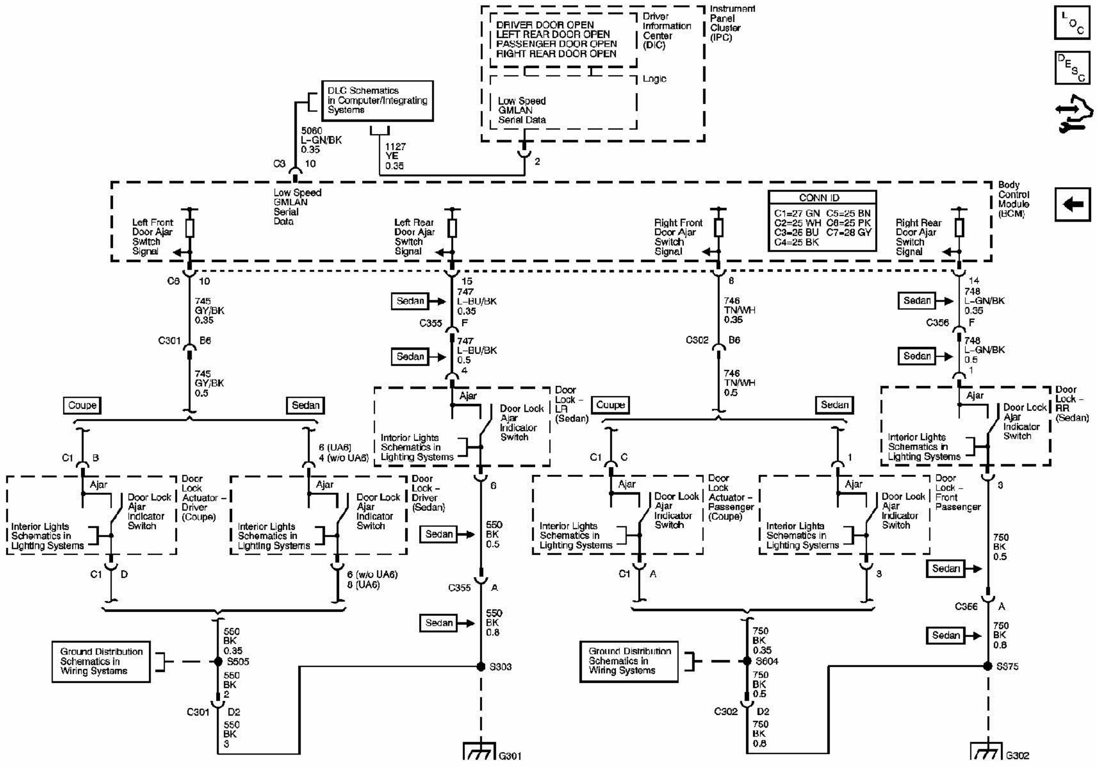

DRIVER DOOR OPEN
LEFT REAR DOOR OPEN
PASSENGER DOOR OPEN
RIGHT REAR DOOR OPEN
Driver Information Center (DIC)
Instrument Panel Cluster (IPC)
Logic
Low Speed GMLAN Serial Data
DLC Schematics in Computer/Integrating Systems
5060 L–GN/BK 0.35
1127 YE 0.35
C3 10
2
Low Speed GMLAN Serial Data
Left Front Door Ajar Switch Signal
Left Rear Door Ajar Switch Signal
Right Front Door Ajar Switch Signal
Right Rear Door Ajar Switch Signal
CONN ID
C1=27 GN C5=25 BN
C2=25 WH C6=25 PK
C3=25 BU C7=28 GY
C4=25 BK
Body Control Module (BCM)
C6 10
15
8
14
745 GY/BK 0.35
747 L–BU/BK 0.35
746 TN/WH 0.35
748 L–GN/BK 0.35
Sedan
C301 B6
C355 F
C302 B6
C356 F
745 GY/BK 0.5
747 L–BU/BK 0.5
746 TN/WH 0.5
748 L–GN/BK 0.5
4
1
Coupe
Sedan
Ajar
Door Lock Ajar Indicator Switch
Interior Lights Schematics in Lighting Systems
Door Lock – LR (Sedan)
Door Lock – RR (Sedan)
C1 B
6 (UA6)
4 (w/o UA6)
C1 C
1
Door Lock Actuator – Driver (Coupe)
Door Lock – Driver (Sedan)
Door Lock Actuator – Passenger (Coupe)
Door Lock – Front Passenger
6
3
C1 D
6 (w/o UA6)
8 (UA6)
C1 A
3
550 BK 0.5
750 BK 0.5
C355 A
C356 A
550 BK 0.8
750 BK 0.8
550 BK 0.35
750 BK 0.35
Ground Distribution Schematics in Wiring Systems
S505
S303
S604
S375
550 BK 2
750 BK 0.5
C301 D2
C302 D2
550 BK 3
750 BK 0.8
G301
G302

Fig. 5: Door Ajar Indicators - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

OUTSIDE MIRROR SCHEMATICS

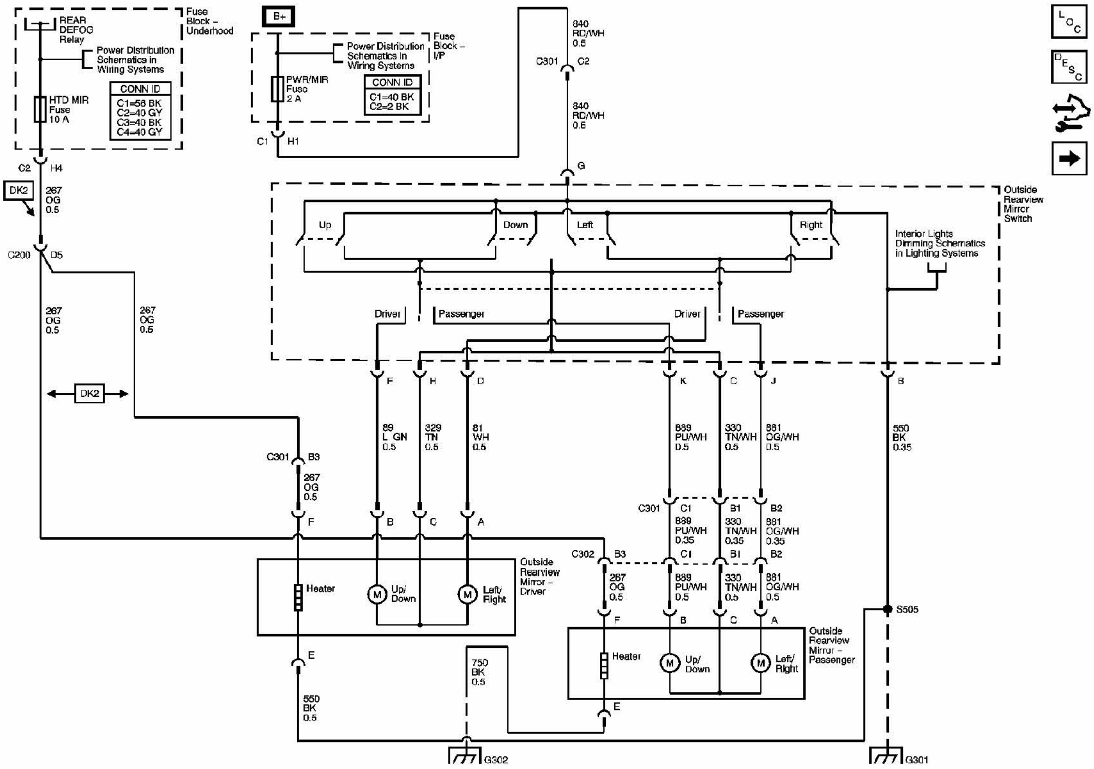

REAR DEFOG Relay
Power Distribution Schematics in Wiring Systems
Fuse Block – Underhood
HTD MIR Fuse 10 A
CONN ID
C1=58 BK
C2=40 GY
C3=40 BK
C4=40 GY
C2
H4
DK2
267 OG 0.5
C200
D5
267 OG 0.5
267 OG 0.5
DK2
B+
Power Distribution Schematics in Wiring Systems
Fuse Block – I/P
PWR/MIR Fuse 2 A
CONN ID
C1=40 BK
C2=2 BK
C1
H1
840 RD/WH 0.5
C301
C2
840 RD/WH 0.5
G
Up
Down
Left
Right
Outside Rearview Mirror Switch
Interior Lights Dimming Schematics in Lighting Systems
Driver
Passenger
Driver
Passenger
F
H
D
K
C
J
B
89 L GN 0.5
329 TN 0.5
81 WH 0.5
889 PU/WH 0.5
330 TN/WH 0.5
881 OG/WH 0.5
550 BK 0.35
C301
B3
267 OG 0.5
F
B
C
A
C301
C1
B1
B2
889 PU/WH 0.35
330 TN/WH 0.35
881 OG/WH 0.35
C302
B3
C1
B1
B2
267 OG 0.5
889 PU/WH 0.5
330 TN/WH 0.5
881 OG/WH 0.5
Heater
Up/ Down
Left/ Right
Outside Rearview Mirror – Driver
F
B
C
A
S505
Heater
Up/ Down
Left/ Right
Outside Rearview Mirror – Passenger
E
550 BK 0.5
750 BK 0.5
E
G302
G301
LOC
DESC

Fig. 6: Coupe - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

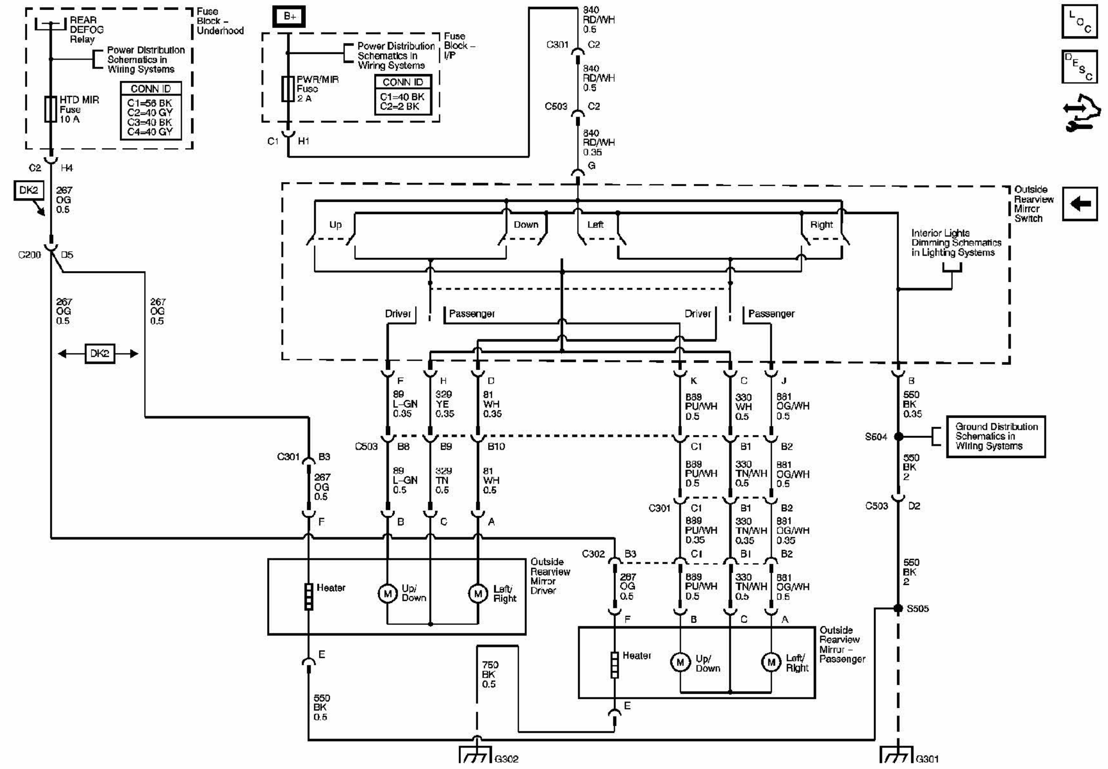

REAR DEFOG Relay
Fuse Block - Underhood
Power Distribution Schematics in Wiring Systems
HTD MIR Fuse 10 A
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
C2
H4
DK2
267 OG 0.5
C200
D5
267 OG 0.5
267 OG 0.5
DK2
B+
Power Distribution Schematics in Wiring Systems
Fuse Block - I/P
PWR/MIR Fuse 2 A
CONN ID
C1=40 BK
C2=2 BK
C1
H1
840 RD/WH 0.5
C301
C2
840 RD/WH 0.5
C503
C2
840 RD/WH 0.35
G
Up
Down
Left
Right
Outside Rearview Mirror Switch
Interior Lights Dimming Schematics in Lighting Systems
Driver
Passenger
Driver
Passenger
F
89 L-GN 0.35
H
329 YE 0.35
D
81 WH 0.35
K
B89 PU/WH 0.5
C
330 WH 0.5
J
881 OG/WH 0.5
B
550 BK 0.35
S504
Ground Distribution Schematics in Wiring Systems
550 BK 2
C503
B8
B9
B10
C1
B1
B2
89 L-GN 0.5
329 TN 0.5
81 WH 0.5
B89 PU/WH 0.5
330 TN/WH 0.5
881 OG/WH 0.5
C301
B3
267 OG 0.5
F
B
C
A
C301
C1
B1
B2
B89 PU/WH 0.35
330 TN/WH 0.35
881 OG/WH 0.35
C503
D2
550 BK 2
C302
B3
C1
B1
B2
267 OG 0.5
B89 PU/WH 0.5
330 TN/WH 0.5
881 OG/WH 0.5
S505
Heater
Up/ Down
Left/ Right
Outside Rearview Mirror Driver
E
550 BK 0.5
750 BK 0.5
F
B
C
A
Heater
Up/ Down
Left/ Right
Outside Rearview Mirror - Passenger
E
G302
G301

Fig. 7: Sedan - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

POWER DOOR SYSTEMS COMPONENT VIEWS

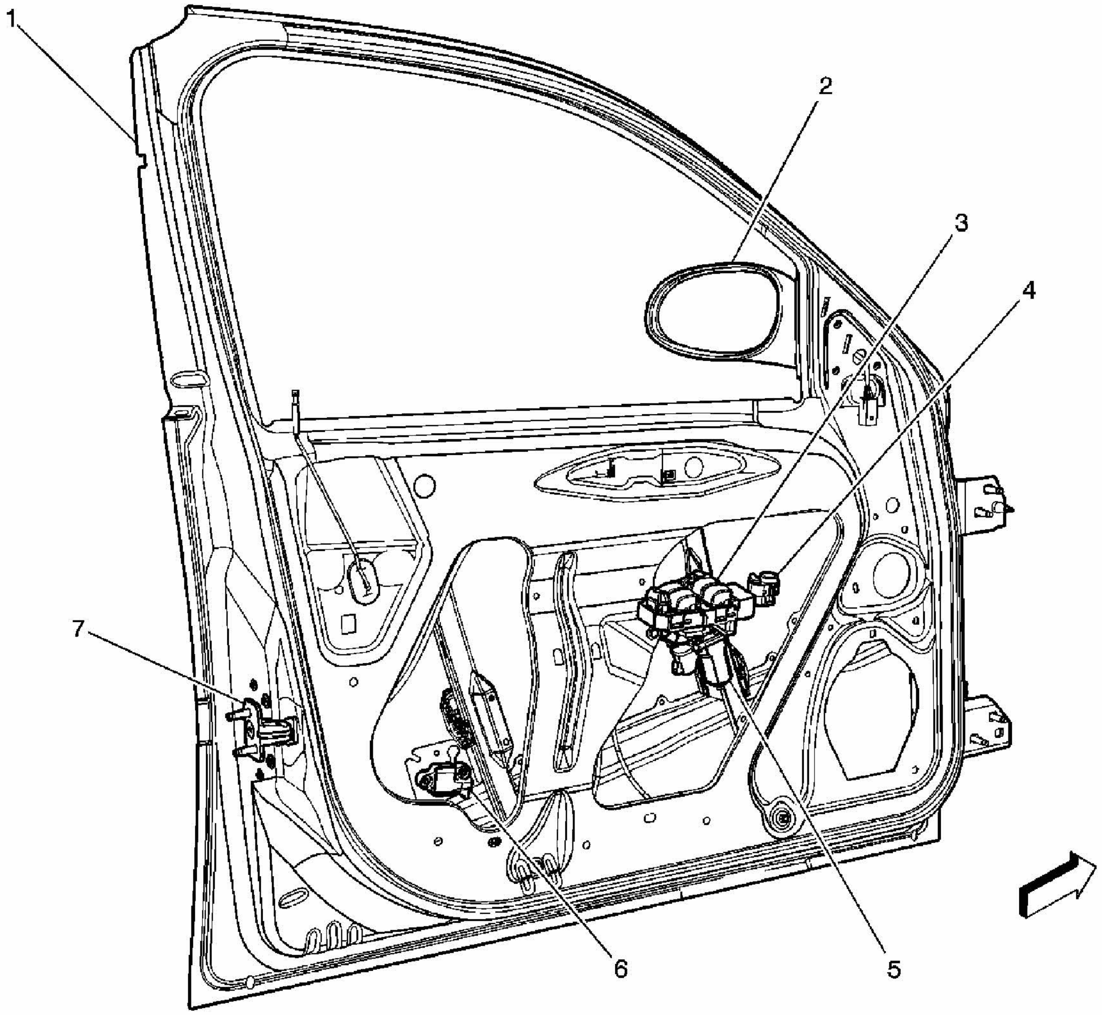


Fig. 8: Driver Door
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 8

Callout	Component Name
1	Door Frame
2	Outside Rearview Mirror - Driver
3	Door Lock / Window Switch - Driver
4	Outside Rearview Mirror Switch
5	Window Motor - Driver
6	Inflatable Restraint Side Impact Sensor - Left (AY1)
7	Door Lock - Driver

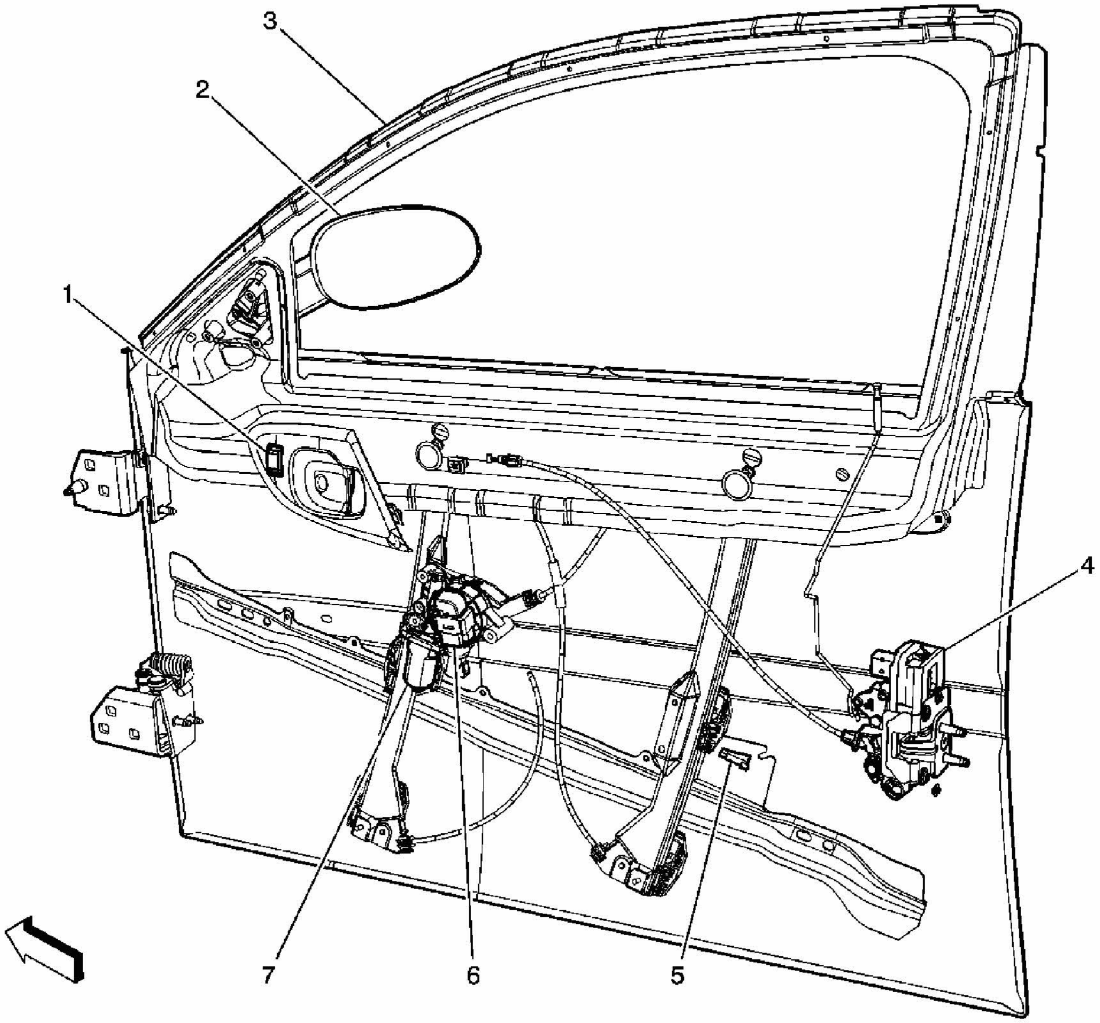


Fig. 9: Passenger Door
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 9

Callout	Component Name
1	Outside Rearview Mirror - Front Passenger
2	Door Frame
3	Door Lock - Front Passenger
4	Inflatable Restraint Side Impact Sensor - Right (AY1)
5	Door Lock Switch - Front Passenger
6	Window Switch - Front Passenger
7	Window Motor - Front Passenger

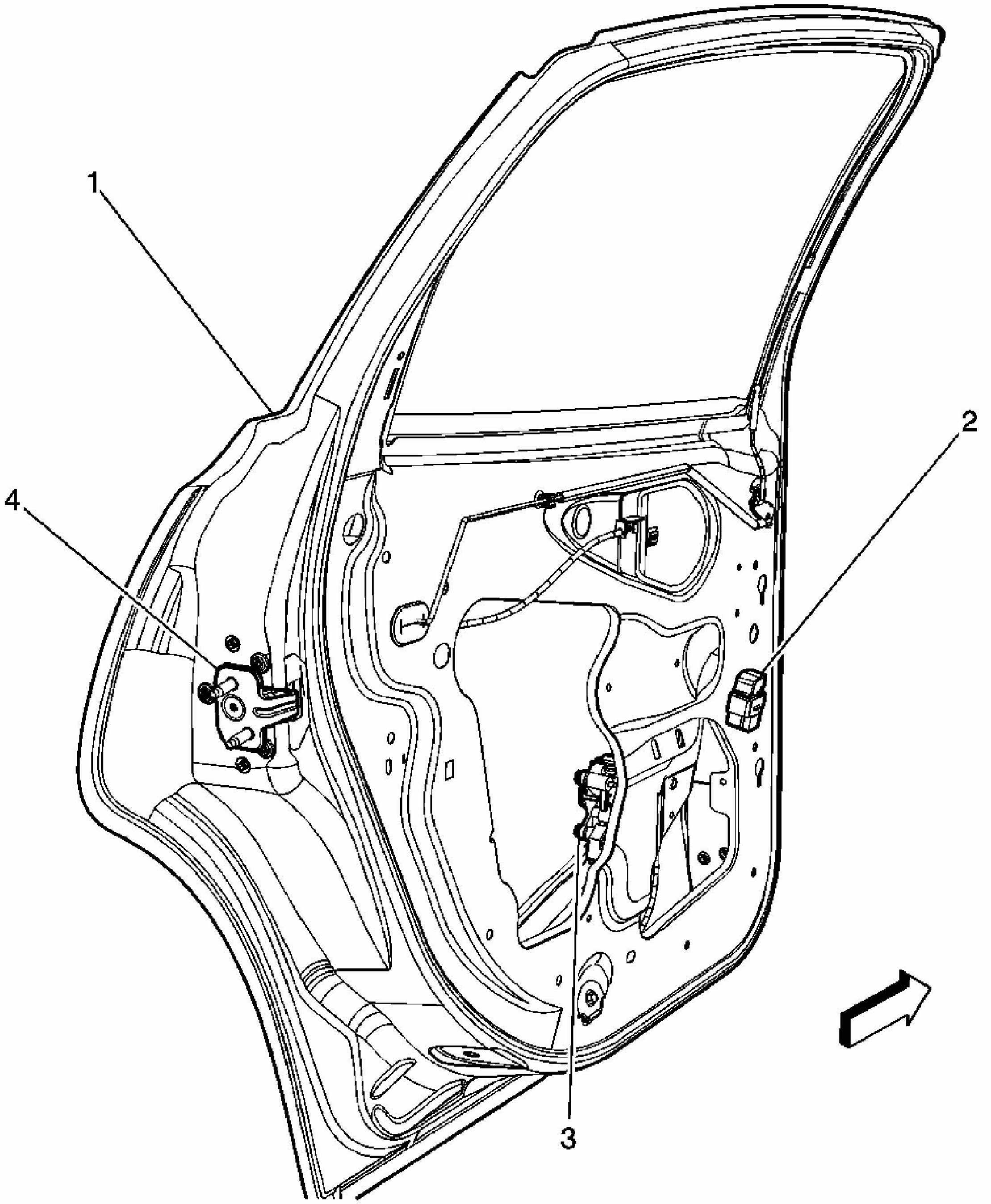


Fig. 10: LR Door
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 10

Callout	Component Name
1	Door Frame
2	Window Switch - LR
3	Window Motor - LR
4	Door Lock - LR

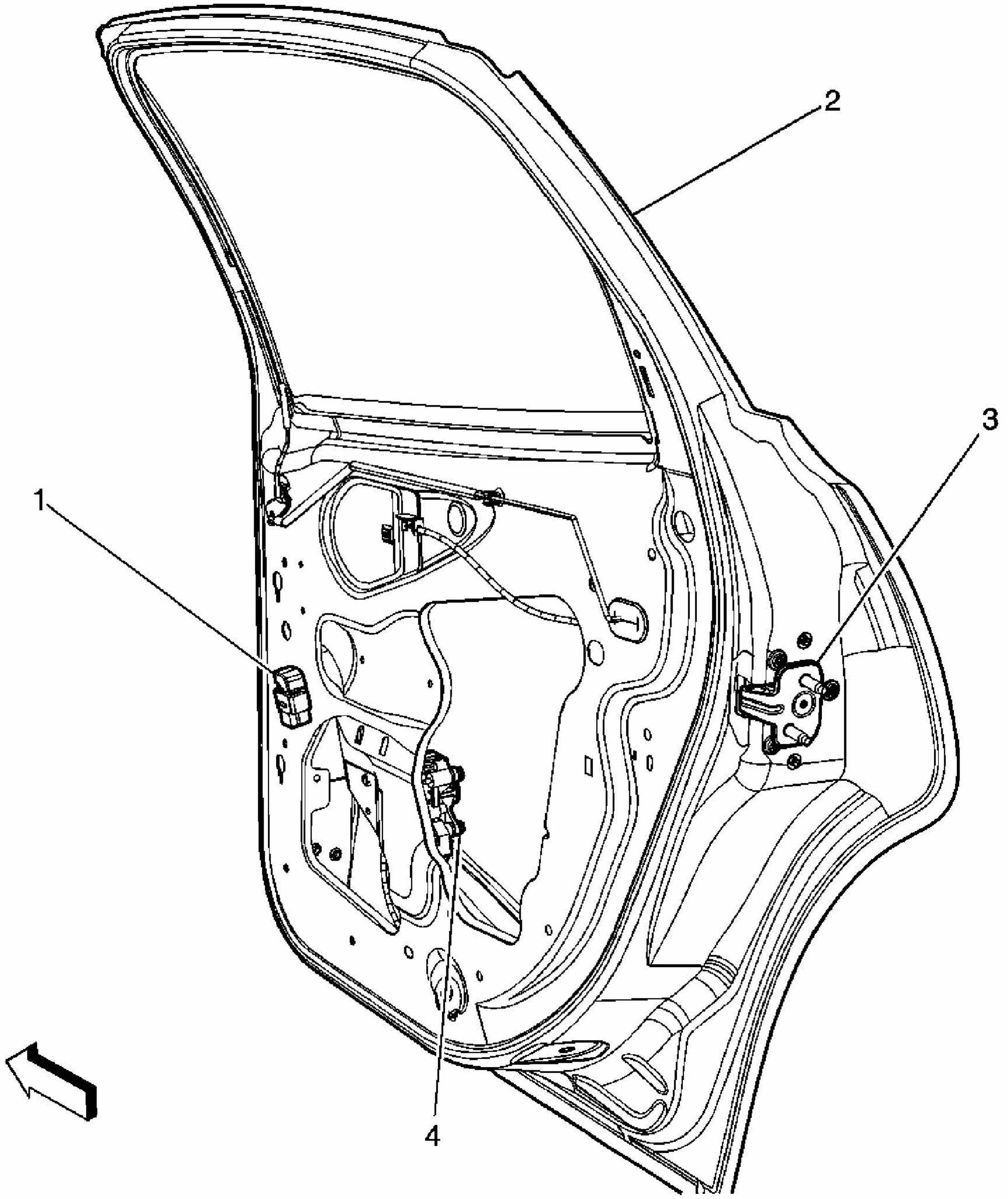


Fig. 11: RR Door
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 11

Callout	Component Name
1	Window Switch - RR
2	Door Frame
3	Door Lock - RR
4	Window Motor - RR

POWER DOOR SYSTEMS CONNECTOR END VIEWS

Door Lock - Driver (UA6)

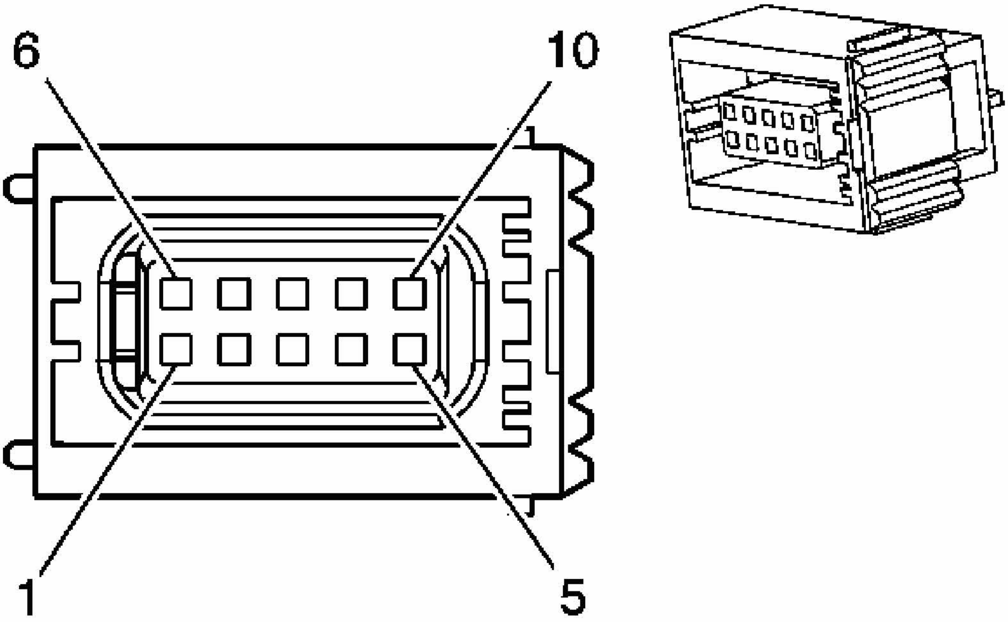


Fig. 12: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 10768367
- Service: 88952463
- Description: 10-Way F Timer Micro III Sealed (BK)

Terminal Part Information

- Pins: 2, 3, 6, 7, 8, 9
- Terminal/Tray: 964274-2/16
- Core/Insulation Crimp: E/1
- Release Tool/Test Probe: J-38125-560/J-35616-33 (YE)

Door Lock - Driver (UA6)

Pin	Wire Color	Circuit No.	Function

1	-	-	Not Used
2	TN	694	Driver Door Lock Actuator Unlock Control
3	GY	295	Door Lock Actuator Lock Control
4-5	-	-	Not Used
6	GY/BK	745	Left Front Door Ajar Switch Signal
7	TN	126	Left Front Door Open Switch Signal
8	BK	550	Ground
9	PU	1124	Door Lock Key Switch Unlock Signal
10	-	-	Not Used

Door Lock - Driver (w/o UA6)

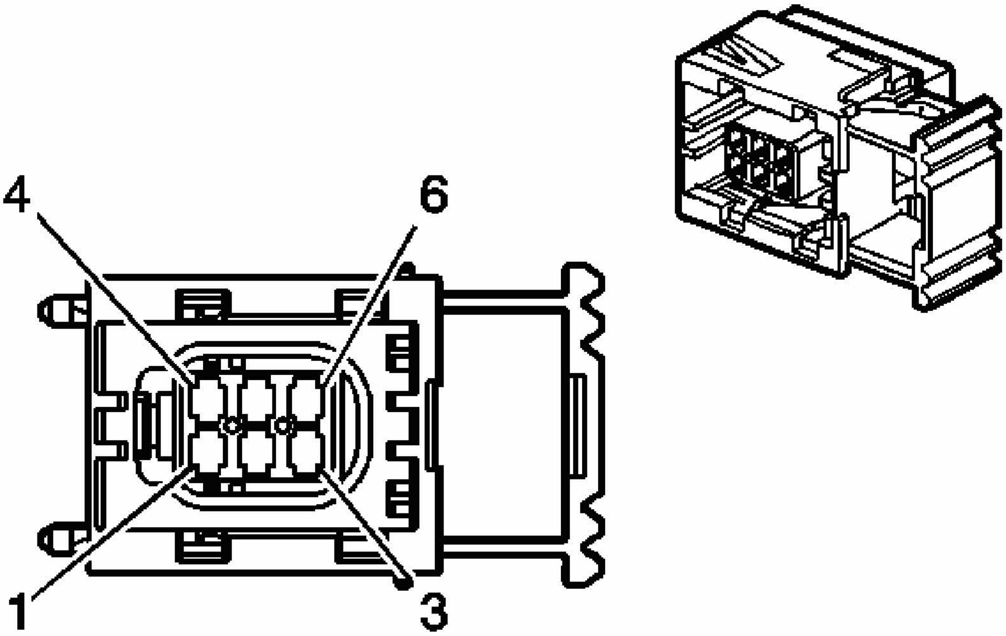


Fig. 13: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information • OEM: 10768369

- Service: 88986251
- Description: 6-Way F TIMER Micro III Sealed (BK)

Terminal Part Information

- Pins: 2, 3, 4, 5, 6
- Terminal/Tray: 4-969005-1/16
- Core/Insulation Crimp: E/1
- Release Tool/Test Probe: J-38125-560/J-35616-33 (YE)

Door Lock - Driver (w/o UA6)

Pin	Wire Color	Circuit No.	Function
1	-	-	Not Used
2	TN	694	Driver Door Lock Actuator Unlock Control
3	GY	295	Door Lock Actuator Lock Control
4	GY/BK	745	Left Front Door Ajar Switch Signal
5	TN	126	Left Front Door Open Switch Signal
6	BK	550	Ground

Door Lock - Front Passenger

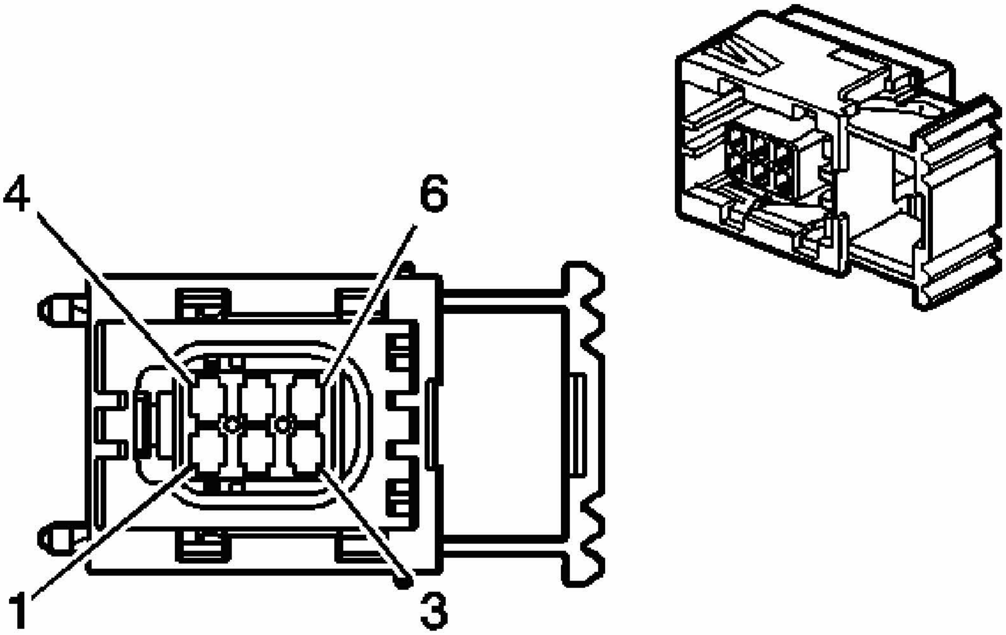


Fig. 14: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 10768369
- Service: 88986251
- Description: 6-Way F TIMER Micro III Sealed (BK)

Terminal Part Information

- Pins: 1, 2, 3, 5, 6
- Terminal/Tray: 964274-2/16
- Core/Insulation Crimp: E/1
- Release Tool/Test Probe: J-38125-560/J-35616-33 (YE)

Door Lock - Front Passenger

Pin	Wire Color	Circuit No.	Function
1	TN/WH	746	Right Front Door Ajar Switch Signal
2	OG	5922	Passenger Door Open Switch Signal

3	BK	750	Ground
4	-	-	Not Used
5	TN	294	Door Lock Actuator Unlock Control
6	GY	295	Door Lock Actuator Lock Control

Door Lock - LR

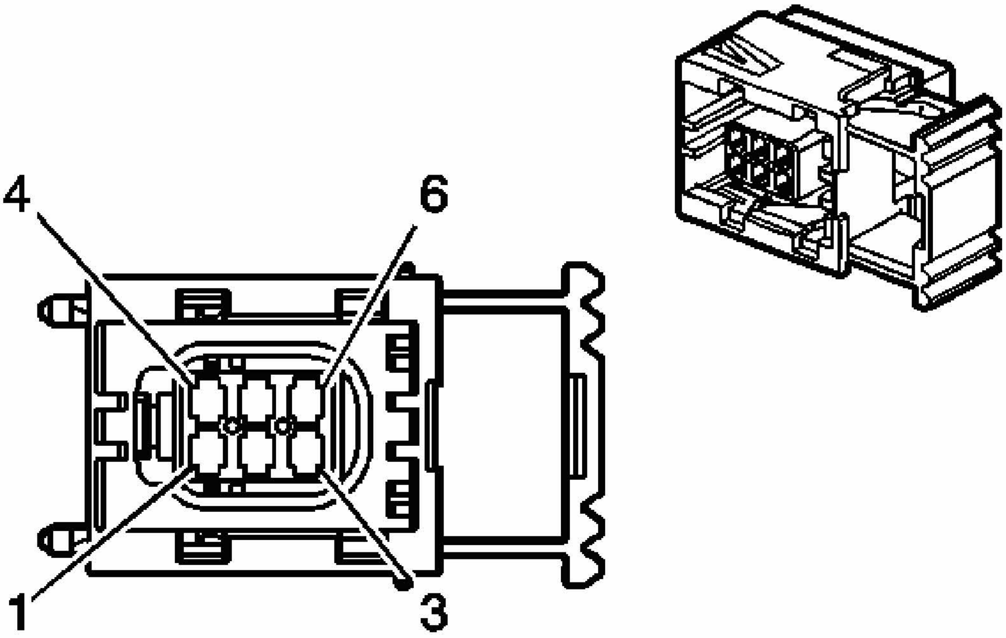


Fig. 15: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 10768369
- Service: 88986251
- Description: 6-Way F TIMER Micro III Sealed (BK)

Terminal Part Information

- Pins: 2, 3, 4, 5, 6
- Terminal/Tray: 964274-2/16
- Core/Insulation Crimp: E/1

- Release Tool/Test Probe: J-38125-560/J-35616-33 (YE)

Door Lock - LR

Pin	Wire Color	Circuit No.	Function
1	-	-	Not Used
2	TN	294	Door Lock Actuator Unlock Control
3	GY	295	Door Lock Actuator Lock Control
4	L-BU/BK	747	Left Rear Door Ajar Switch Signal
5	OG	5922	Passenger Door Open Switch Signal
6	BK	550	Ground

Door Lock - RR

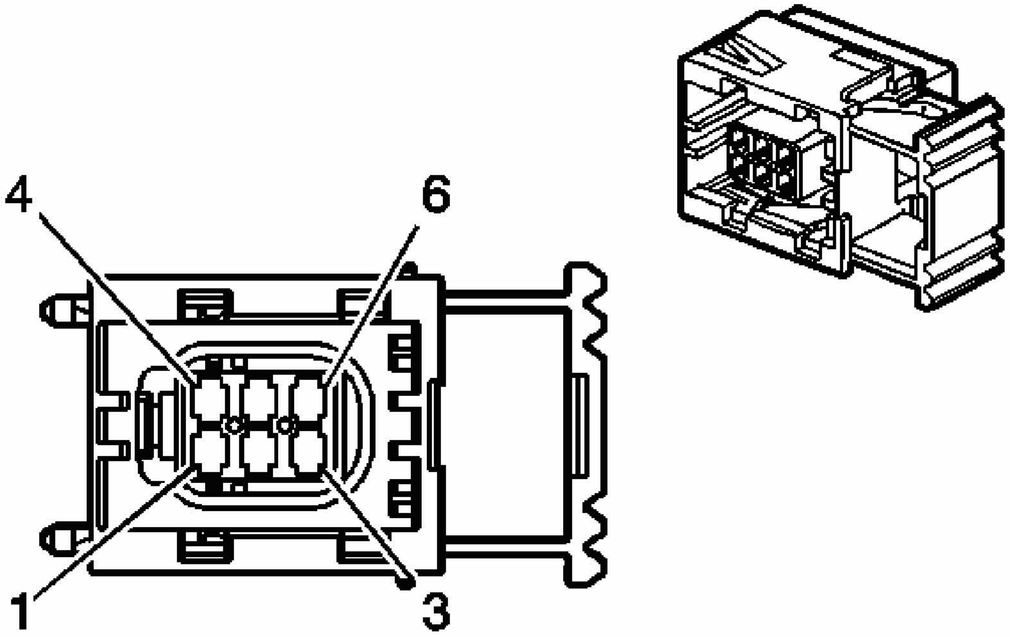


Fig. 16: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 10768369
- Service: 88986251

- Description: 6-Way F TIMER Micro III Sealed (BK)

Terminal Part Information

- Pins: 1, 2, 3, 5, 6
- Terminal/Tray: 964274-2/16
- Core/Insulation Crimp: E/1
- Release Tool/Test Probe: J-38125-560/J-35616-33 (YE)

Door Lock - RR

Pin	Wire Color	Circuit No.	Function
1	L-GN/BK	748	Right Rear Door Ajar Switch Signal
2	OG	5922	Passenger Door Open Switch Signal
3	BK	750	Ground
4	-	-	Not Used
5	TN	294	Door Lock Actuator Unlock Control
6	GY	295	Door Lock Actuator Lock Control

Door Lock Actuator - Driver C1

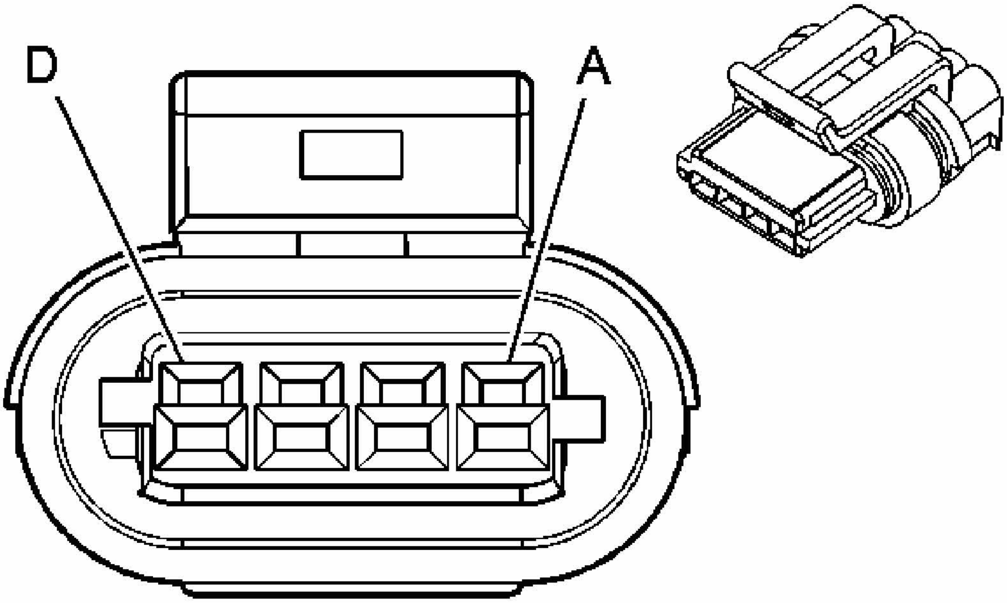


Fig. 17: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 15410728
- Service: 88986450
- Description: 4-Way F GT 150 Sealed (BK)

Terminal Part Information

- Pins: B, C, D
- Terminal/Tray: 15326267/19
- Core/Insulation Crimp: Pins B, C - E/4
- Core/Insulation Crimp: Pins D - See Terminal Repair Kit
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Door Lock Actuator - Driver C1

Pin	Wire Color	Circuit No.	Function
A	-	-	Not Used
B	GY/BK	745	Left Front Door Ajar Switch Signal
C	TN	126	Left Front Door Open Switch Signal
D	BK	550	Ground

Door Lock Actuator - Driver C2

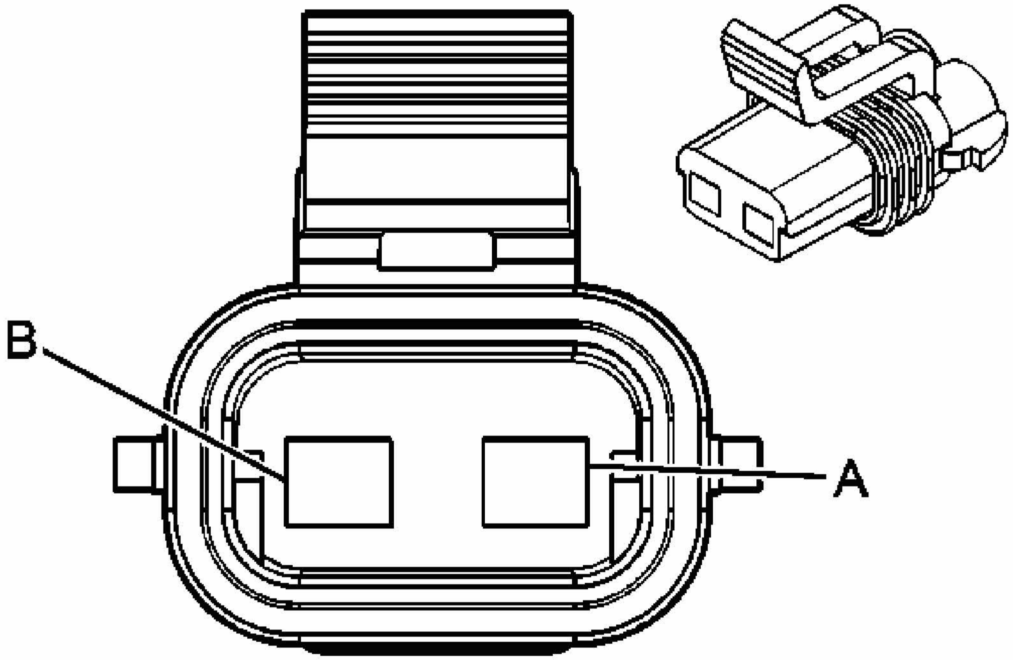


Fig. 18: Door Connectors - End Views
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 15300027
- Service: 12101855
- Description: 2-Way F Metri-Pack 280 Sealed (BK)

Terminal Part Information

- Terminal/Tray: 12077411/2
- Core/Insulation Crimp: 2/5
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Door Lock Actuator - Driver C2

Pin	Wire Color	Circuit No.	Function
A	TN	694	Driver Door Lock Actuator Unlock Control
B	GY	295	Door Lock Actuator Lock Control

Door Lock Actuator - Passenger C1

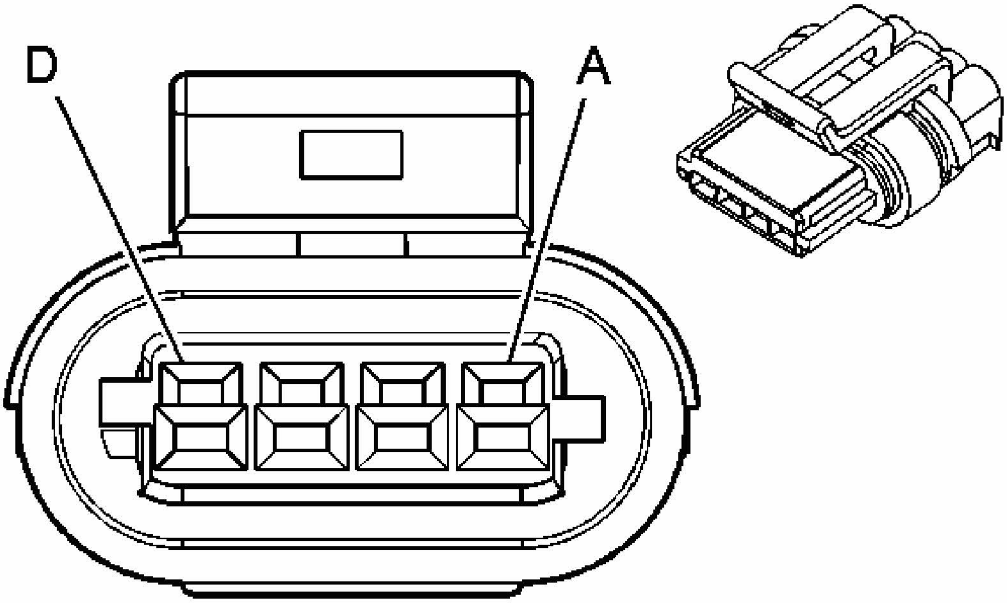


Fig. 19: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 15410728
- Service: 88986450
- Description: 4-Way F GT 150 Sealed (BK)

Terminal Part Information

- Pins: A, B, C
- Terminal/Tray: 15326267/19
- Core/Insulation Crimp: Pins A - See Terminal Repair Kit
- Core/Insulation Crimp: Pins B, C - E/4
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Door Lock Actuator - Passenger C1

Pin	Wire Color	Circuit No.	Function
A	BK	750	Ground

B	OG	5922	Passenger Door Open Switch Signal
C	TN/WH	746	Right Front Door Ajar Switch Signal
D	-	-	Not Used

Door Lock Actuator - Passenger C2

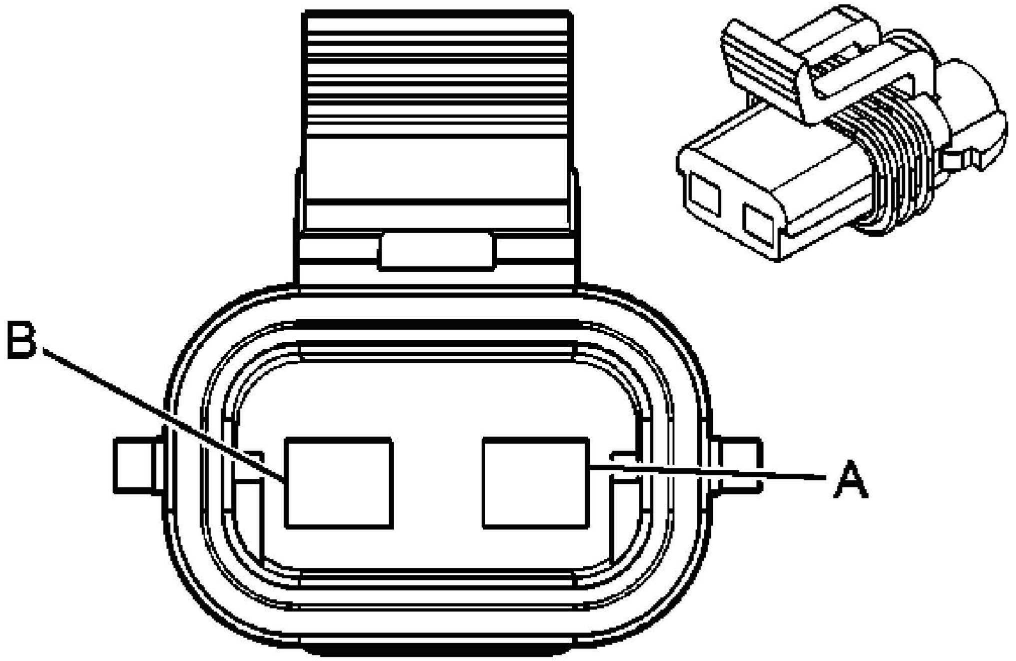


Fig. 20: Door Connectors - End Views
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 15300027
- Service: 12101855
- Description: 2-Way F Metri-Pack 280 Sealed (BK)

Terminal Part Information

- Terminal/Tray: 12077411/2
- Core/Insulation Crimp: 2/5
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Door Lock Actuator - Passenger C2

Pin	Wire Color	Circuit No.	Function
A	TN	294	Door Lock Actuator Unlock Control
B	GY	295	Door Lock Actuator Lock Control

Door Lock Cylinder Switch - Driver

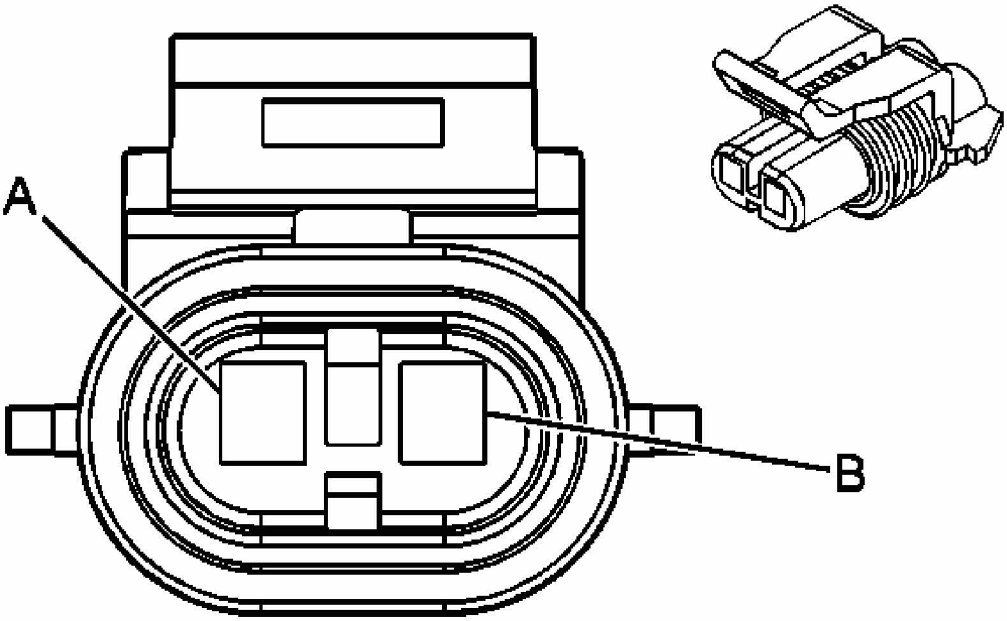


Fig. 21: Sliding Door Detent Switch - (E58/E59) Connector End Views
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12052642
- Service: 12101856
- Description: 2-Way F Metri-Pack 150 Sealed (GN)

Terminal Part Information

- Pins: A, B
- Terminal/Tray: 12048074/2
- Core/Insulation Crimp: Pins A - E/1

- Core/Insulation Crimp: Pins B - See Terminal Repair Kit
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Door Lock Cylinder Switch - Driver

Pin	Wire Color	Circuit No.	Function
A	PU	1124	Door Lock Key Switch Unlock Signal
B	BK	550	Ground

Door Lock Switch - Driver (Impala)

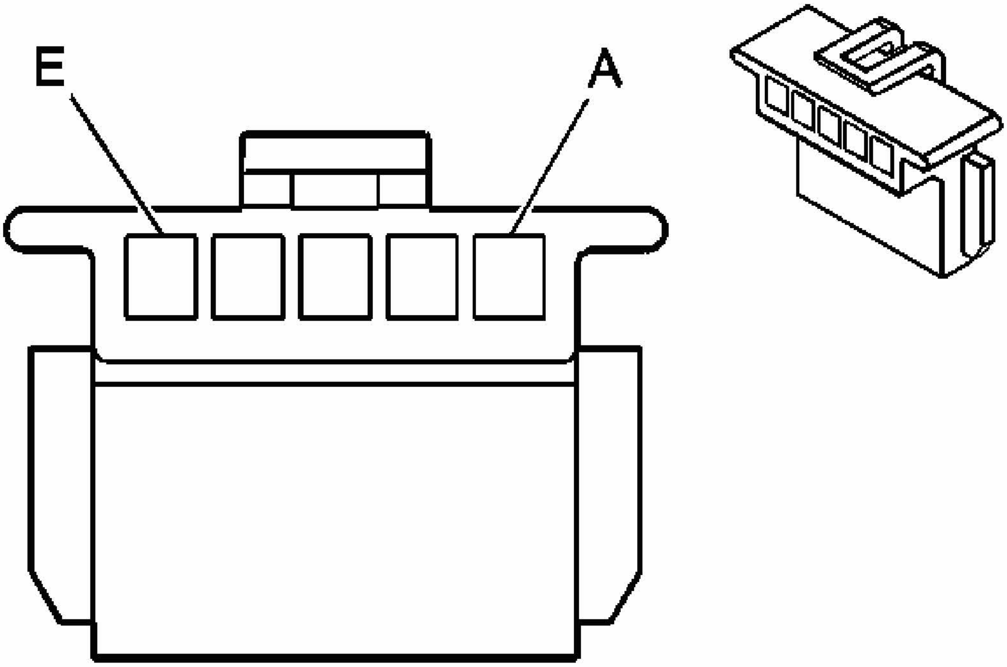


Fig. 22: Door Lock Switch Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12124997
- Service: 12167130
- Description: 5-Way F Metri-Pack 150RT Angled (BK)

Terminal Part Information

- Pins: A, B, D, E
- Terminal/Tray: 12103359/18
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Door Lock Switch - Driver (Impala)

Pin	Wire Color	Circuit No.	Function
A	GY	8	Instrument Panel Lamp Supply Voltage
B	BK	550	Ground
C	-	-	Not Used
D	OG/BK	780	Driver Door Lock Switch Lock Signal
E	OG	781	Driver Door Lock Switch Unlock Signal

Door Lock Switch - Driver (Monte Carlo)

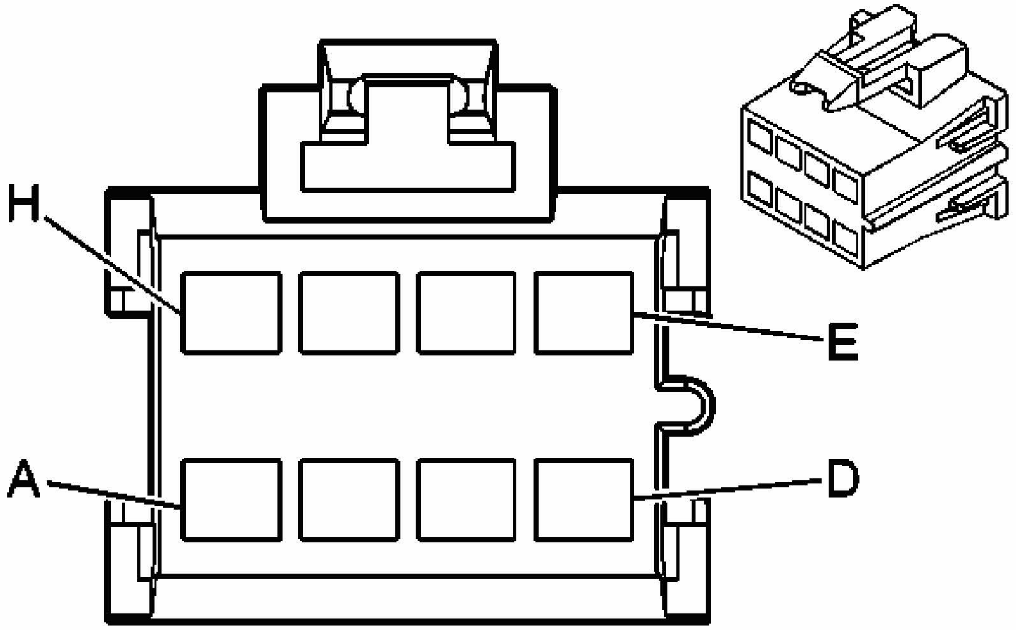


Fig. 23: Connector End View

Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12064998
- Service: 15306189
- Description: 8-Way F Metri-Pack 280 (BK)

Terminal Part Information

- Pins: A, D, E, F, G
- Terminal/Tray: 12034046/2
- Core/Insulation Crimp: Pins A, D - E/A
- Core/Insulation Crimp: Pins E, F, G - See Terminal Repair Kit
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Door Lock Switch - Driver (Monte Carlo)

Pin	Wire Color	Circuit No.	Function
A	OG/BK	780	Driver Door Lock Switch Lock Signal
B-C	-	-	Not Used
D	OG/BK	781	Driver Door Lock Switch Unlock Signal
E	BK	550	Ground
F	BK	550	Ground
G	GY	8	Instrument Panel Lamp Supply Voltage
H	-	-	Not Used

Door Lock Switch - Front Passenger (Impala)

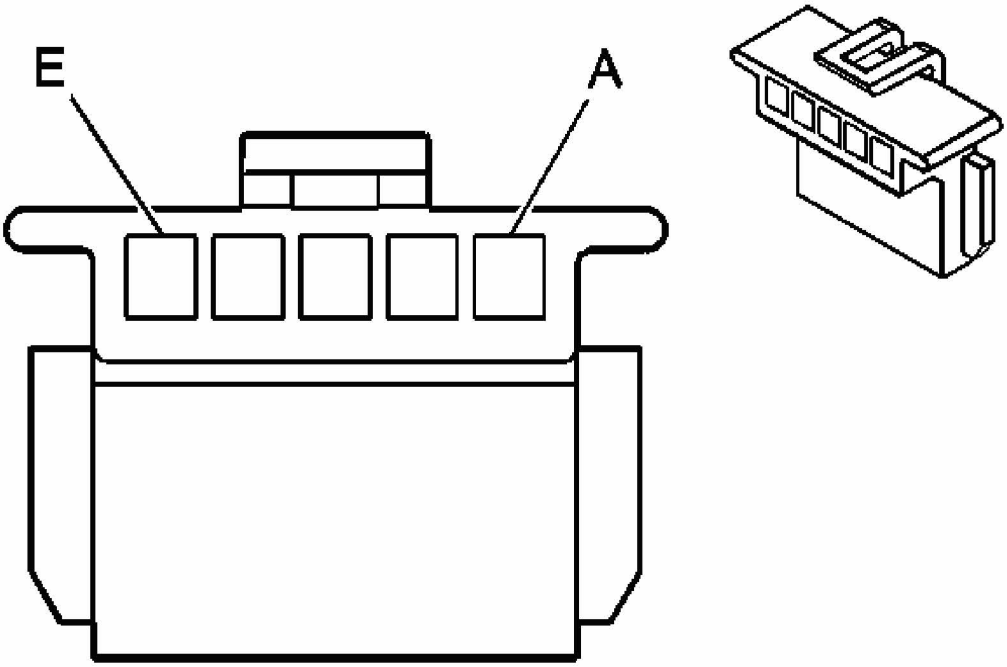


Fig. 24: Door Lock Switch Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12124997
- Service: 12167130
- Description: 5-Way F Metri-Pack 150RT Angled (BK)

Terminal Part Information

- Pins: A, B, D, E
- Terminal/Tray: 12103359/18
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Door Lock Switch - Front Passenger (Impala)

Pin	Wire Color	Circuit No.	Function
A	GY	8	Instrument Panel Lamp Supply Voltage

B	BK	750	Ground
C	-	-	Not Used
D	L-BU	244	Passenger Door Lock Switch Lock [Control or Supply Voltage]
E	D-BU	245	Passenger Door Lock Switch Unlock [Control or Supply Voltage]

Door Lock Switch - Passenger (Monte Carlo)

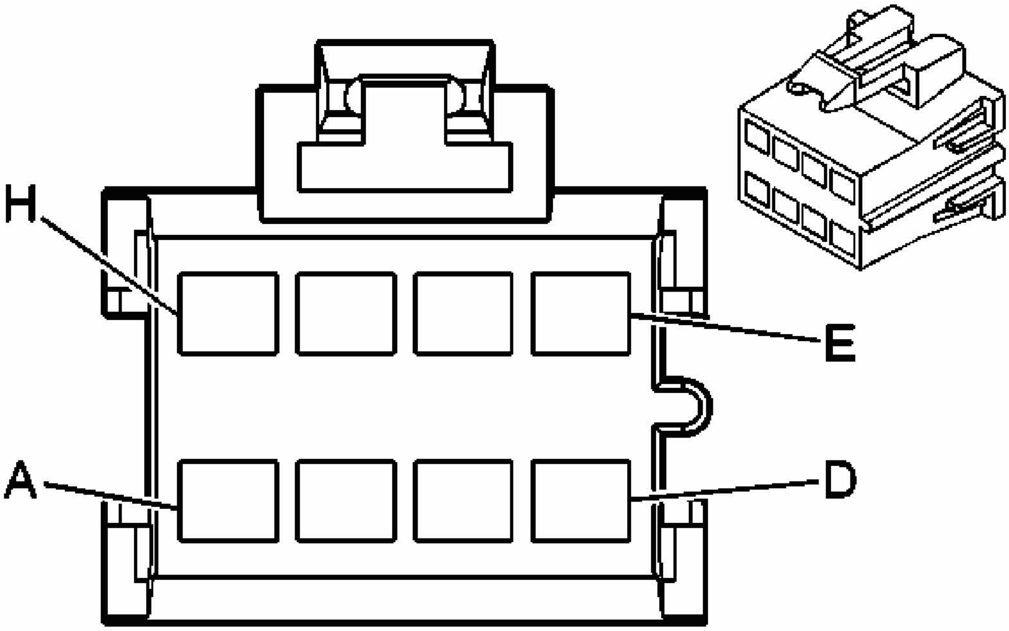


Fig. 25: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12064998
- Service: 15306189
- Description: 8-Way F Metri-Pack 280 (BK)

Terminal Part Information

- Pins: A, D, E, F, G

- Terminal/Tray: 12034046/2
- Core/Insulation Crimp: Pins A, D - E/A
- Core/Insulation Crimp: Pins E, F, G - See Terminal Repair Kit
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Door Lock Switch - Passenger (Monte Carlo)

Pin	Wire Color	Circuit No.	Function
A	L-BU	244	Passenger Door Lock Switch Lock [Control or Supply Voltage]
B-C	-	-	Not Used
D	D-BU	245	Passenger Door Lock Switch Unlock [Control or Supply Voltage]
E	BK	750	Ground
F	BK	550	Ground
G	GY	8	Instrument Panel Lamp Supply Voltage

Outside Rearview Mirror - Driver

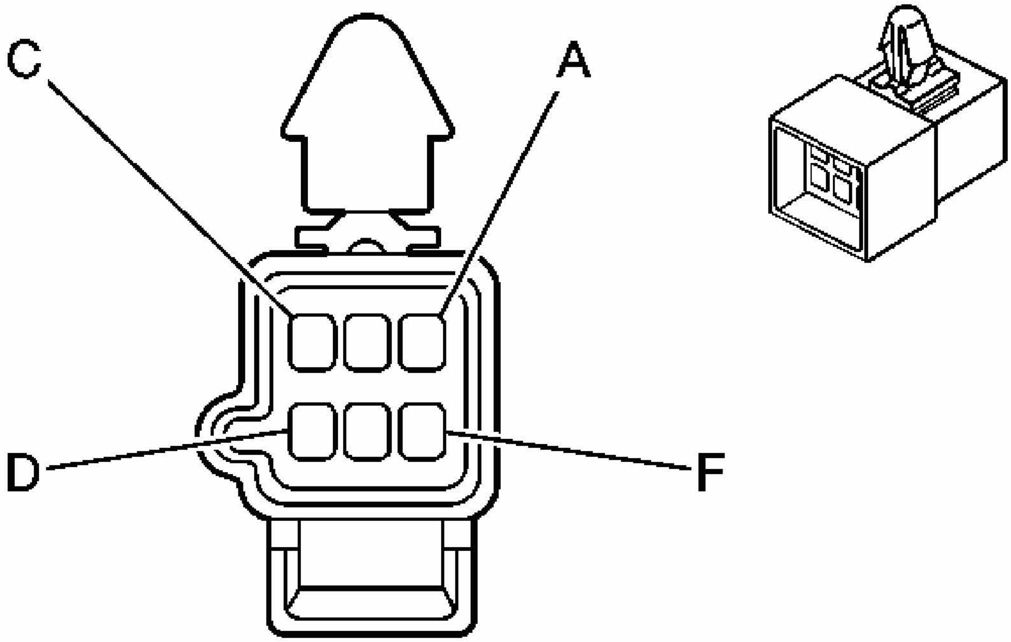


Fig. 26: Outside Rearview Mirror Connector End View

Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12065781
- Service: See Catalog
- Description: 6-Way M Metri-Pack 150 (GY)

Terminal Part Information

- Pins: A, B, C, E, F
- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Outside Rearview Mirror - Driver

Pin	Wire Color	Circuit No.	Function
A	WH	81	Driver Mirror Motor Right Control
B	L-GN	89	Driver Mirror Motor Down Control
C	TN	329	Left Mirror Motor Supply Voltage
D	-	-	Not Used
E	BK	550	Ground
F	OG	267	Heated Mirror/Rear Defog Relay Coil Supply Voltage

Outside Rearview Mirror - Passenger

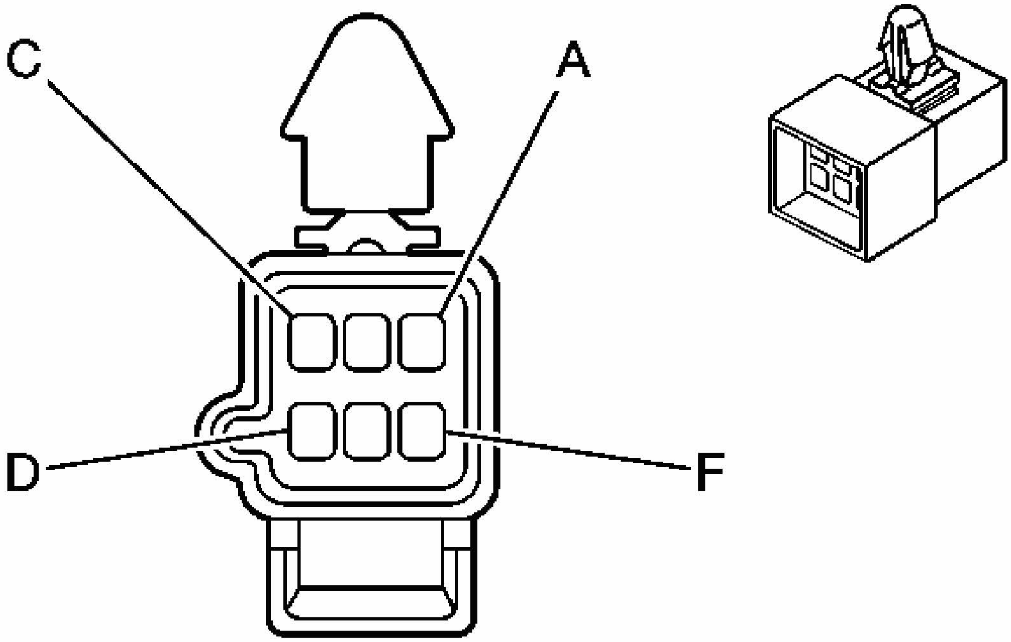


Fig. 27: Outside Rearview Mirror Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12065781
- Service: See Catalog
- Description: 6-Way M Metri-Pack 150 (GY)

Terminal Part Information

- Pins: A, B, C, E, F
- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Outside Rearview Mirror - Passenger

Pin	Wire Color	Circuit No.	Function
A	OG/WH	881	Passenger Mirror Motor Right Control

B	PU/WH	889	Passenger Mirror Motor Down Control
C	TN/WH	330	Right Mirror Motor Supply Voltage
D	-	-	Not Used
E	BK	750	Ground
F	OG	267	Heated Mirror/Rear Defog Relay Coil Supply Voltage

Outside Rearview Mirror Switch

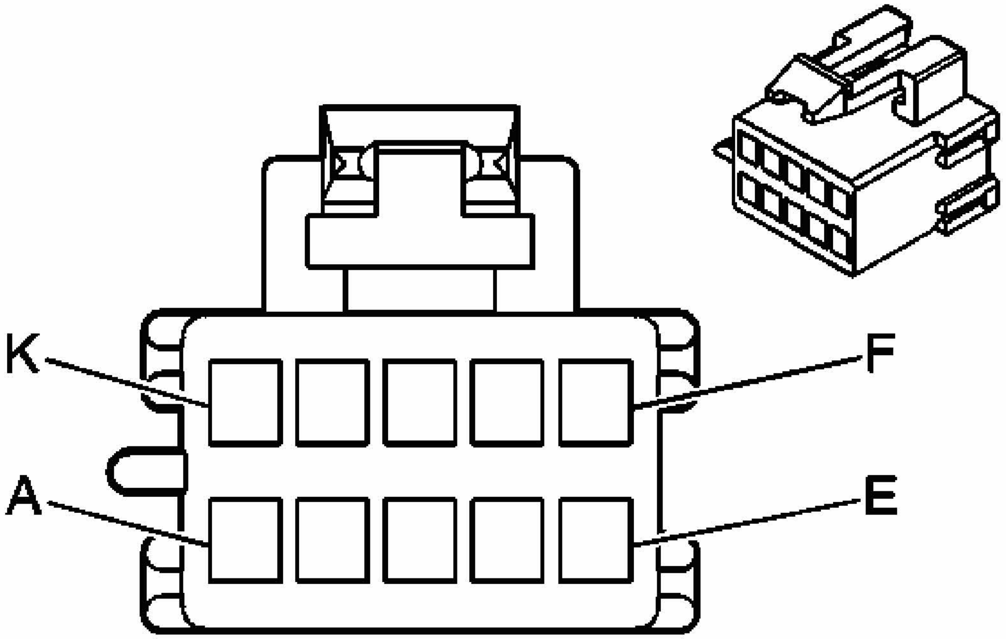


Fig. 28: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12064769
- Service: 12101762
- Description: 10-Way F Metri-Pack 150 (NA)

Terminal Part Information

- Pins: B, C, D, E, F, G, H, J, K
- Terminal/Tray: 12064971/5
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Outside Rearview Mirror Switch

Pin	Wire Color	Circuit No.	Function
A	-	-	Not Used
B	BK	550	Ground
C	TN/WH	330	Right Mirror Motor Supply Voltage
D	WH	81	Driver Mirror Motor Right Control
E	GY	8	Instrument Panel Lamp Supply Voltage
F	L-GN	89	Driver Mirror Motor Down Control
G	RD/WH	840	Battery Positive Voltage
H	TN	329	Left Mirror Motor Supply Voltage
J	OG/WH	881	Passenger Mirror Motor Right Control
K	PU/WH	889	Passenger Mirror Motor Down Control

Window Motor - Driver (Impala)

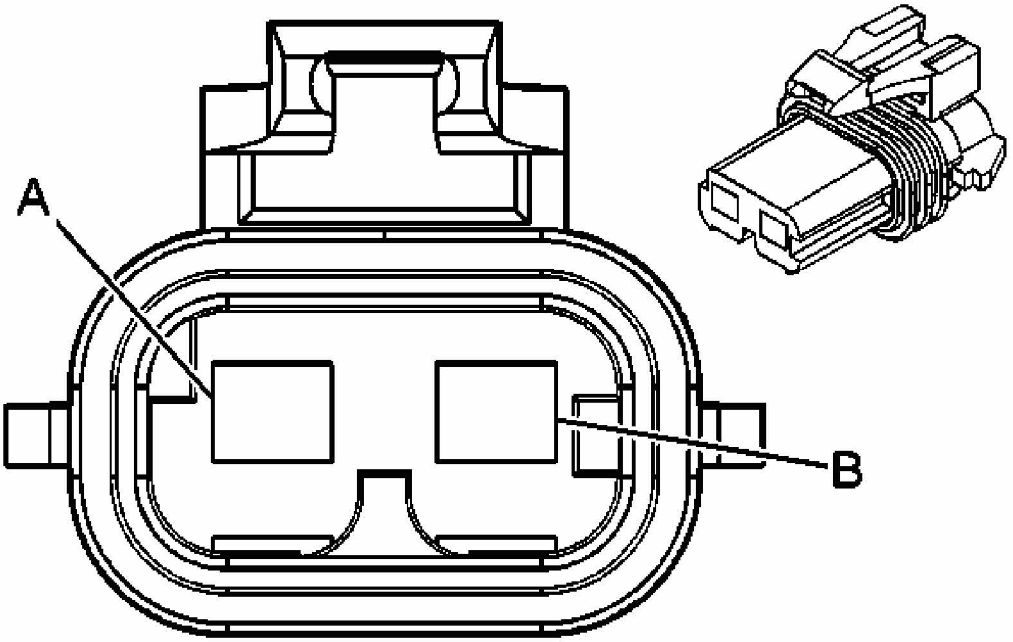


Fig. 29: Window Motor Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12129487
- Service: See Catalog
- Description: 2-Way F Metri-Pack 280 Sealed (GY)

Terminal Part Information

- Terminal/Tray: 12110845/4
- Core/Insulation Crimp: A/5
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Window Motor - Driver (Impala)

Pin	Wire Color	Circuit No.	Function
A	BN	165	Power Window Motor Left Front Down Control
B	D-BU	164	Power Window Motor Left Front Up Control

Window Motor - Driver (Monte Carlo)

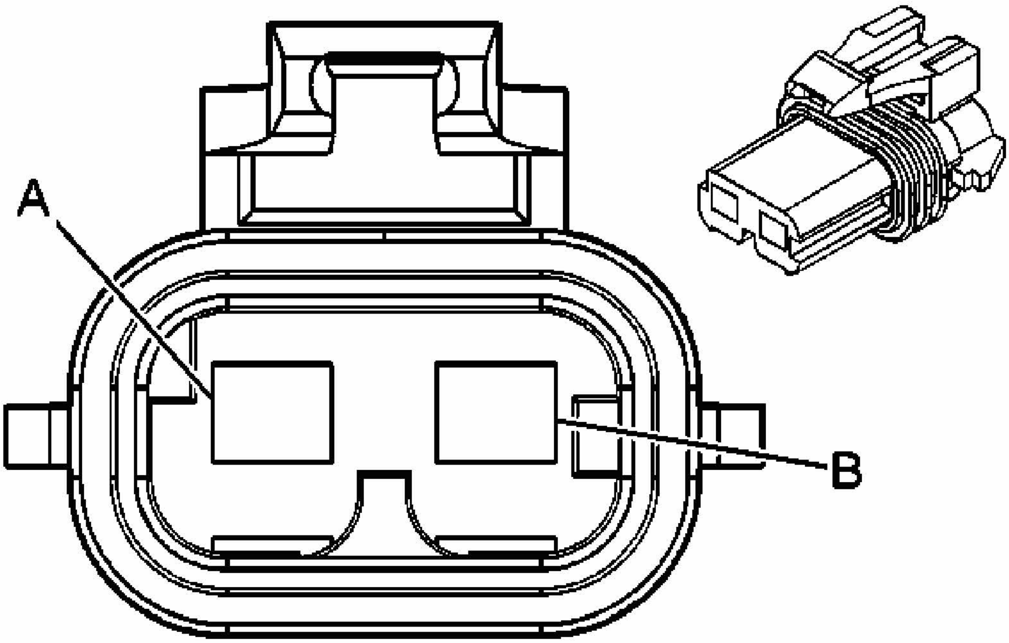


Fig. 30: Window Motor Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12129487
- Service: See Catalog
- Description: 2-Way F Metri-Pack 280 Sealed (GY)

Terminal Part Information

- Terminal/Tray: 12110845/4
- Core/Insulation Crimp: F/5
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Window Motor - Driver (Monte Carlo)

Pin	Wire Color	Circuit No.	Function
A	BN	165	Power Window Motor Left Front Down Control

B	D-BU	164	Power Window Motor Left Front Up Control

Window Motor - Front Passenger

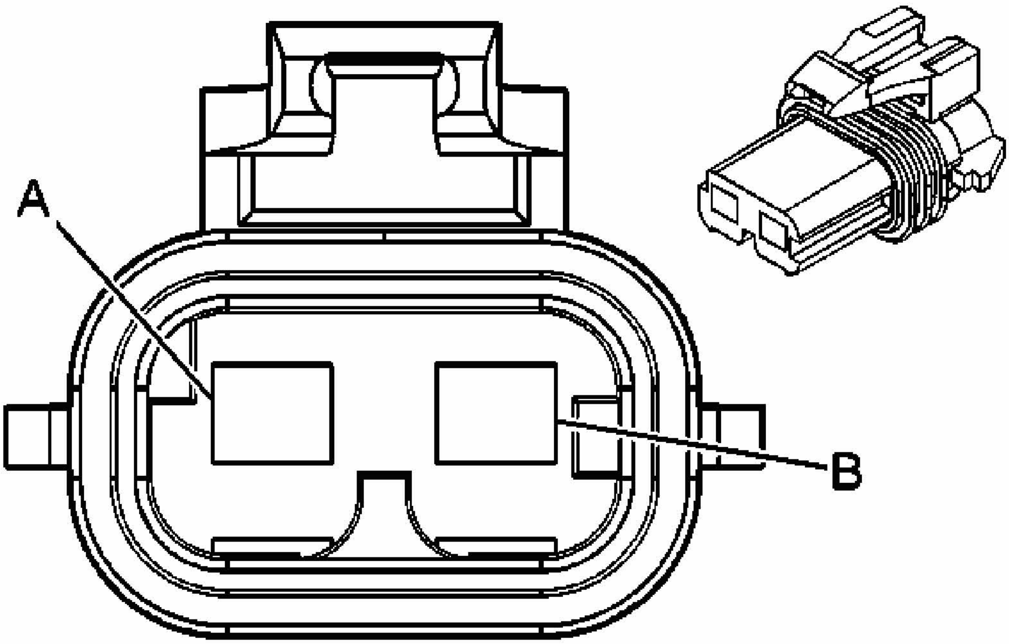


Fig. 31: Window Motor Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12129487
- Service: See Catalog
- Description: 2-Way F Metri-Pack 280 Sealed (GY)

Terminal Part Information

- Terminal/Tray: 12110845/4
- Core/Insulation Crimp: F/5
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Window Motor - Front Passenger

Pin	Wire Color	Circuit No.	Function
A	BN	667	Power Window Motor Right Front Down Control
B	D-BU	666	Power Window Motor Right Front Up Control

Window Motor - LR (Impala)

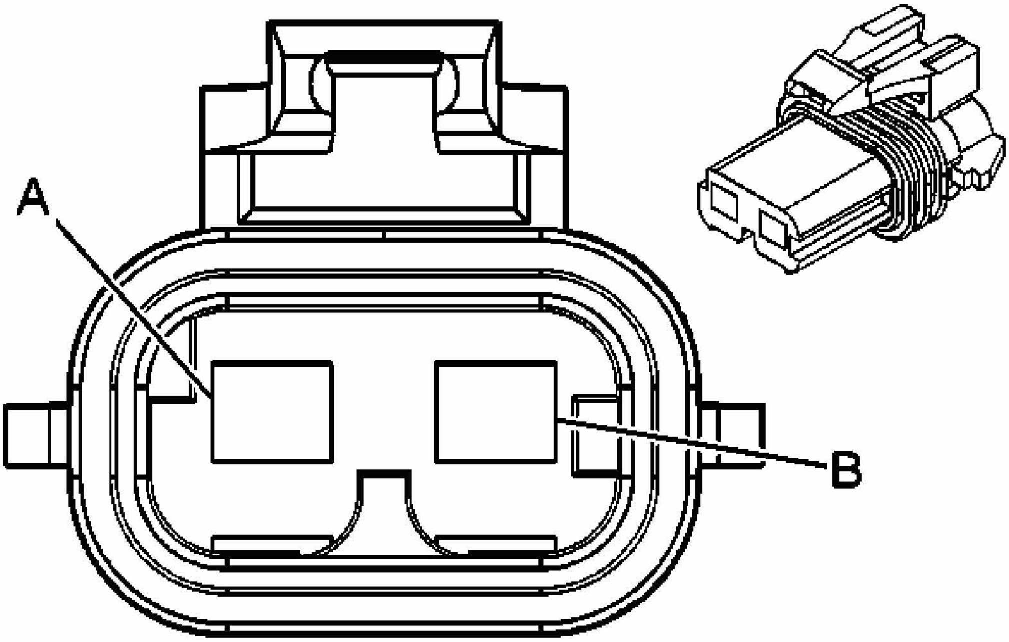


Fig. 32: Window Motor Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12129487
- Service: See Catalog
- Description: 2-Way F Metri-Pack 280 Sealed (GY)

Terminal Part Information

- Terminal/Tray: 12110845/4
- Core/Insulation Crimp: F/5

- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Window Motor - LR (Impala)

Pin	Wire Color	Circuit No.	Function
A	BN	669	Power Window Motor Left Rear Down Control
B	D-BU	668	Power Window Motor Left Rear Up Control

Window Motor - RR (Impala)

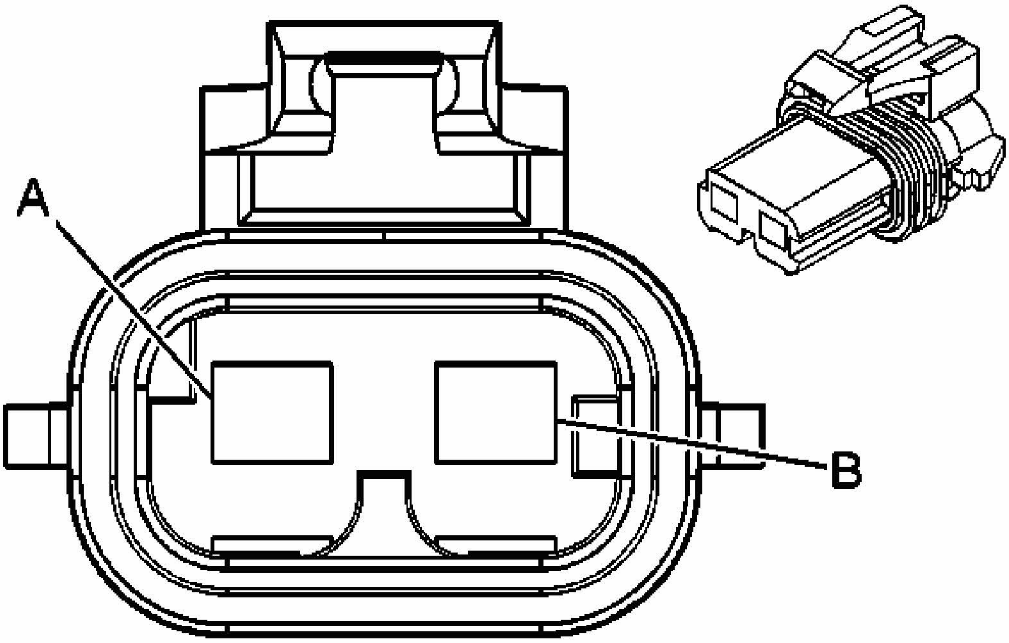


Fig. 33: Window Motor Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12129487
- Service: See Catalog
- Description: 2-Way F Metri-Pack 280 Sealed (GY)

Terminal Part Information

- Terminal/Tray: 12110845/4
- Core/Insulation Crimp: F/5
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Window Motor - RR (Impala)

Pin	Wire Color	Circuit No.	Function
A	BN	671	Power Window Motor Right Rear Down Control
B	D-BU	670	Power Window Motor Right Rear Up Control

Window Switch - Driver (Monte Carlo)

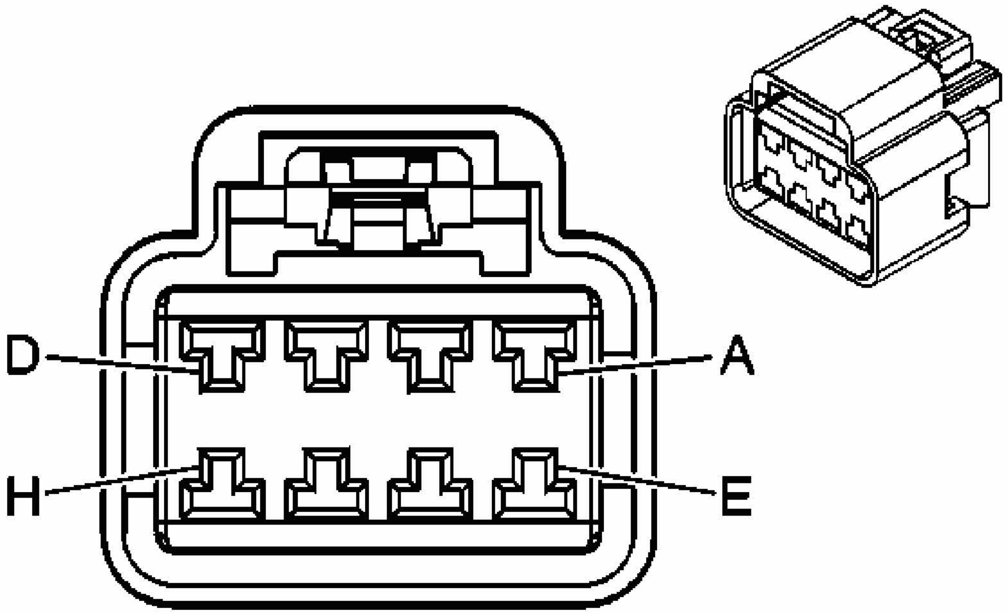


Fig. 34: Window Switch Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 15326924
- Service: 15306174

- Description: 8-Way F GT 280 (BK)

Terminal Part Information

- Pins: A, C, D, F, G, H
- Terminal/Tray: 15304713/19
- Core/Insulation Crimp: F/D
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

- Pins: B
- Terminal/Tray: 15304711/8
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Window Switch - Driver (Monte Carlo)

Pin	Wire Color	Circuit No.	Function
A	L-BU	166	Power Window Master Switch Right Front Up Signal
B	GY	8	Instrument Panel Lamp Supply Voltage
C	YE	143	Accessory Voltage
D	TN	167	Power Window Master Switch Right Front Down Signal
E	-	-	Not Used
F	BK	550	Ground
G	D-BU	164	Power Window Motor Left Front Up Control
H	BN	165	Power Window Motor Left Front Down Control

Window Switch - Driver C1 (Impala)

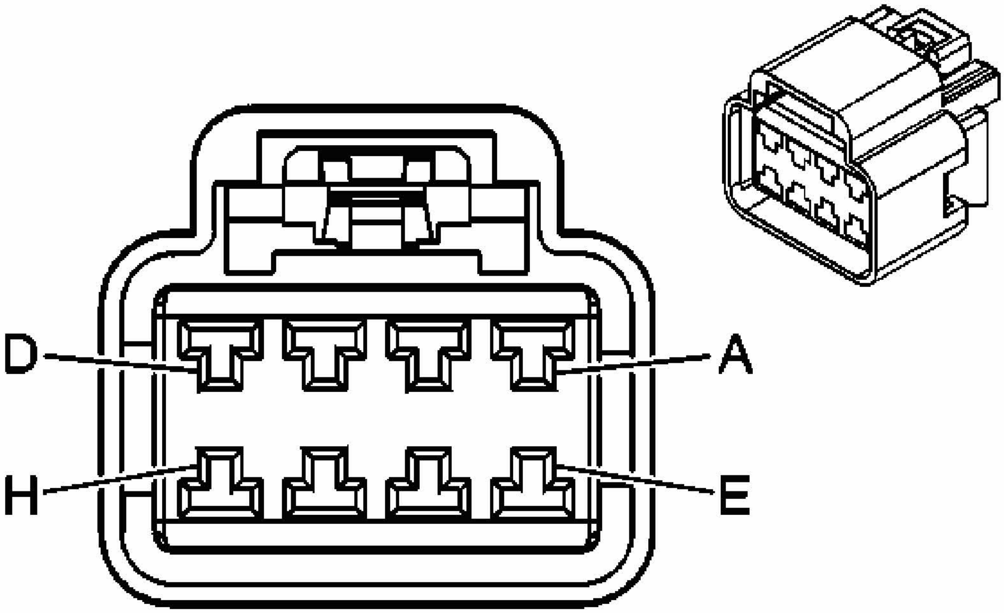


Fig. 35: Window Switch Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 15326924
- Service: 15306174
- Description: 8-Way F GT 280 (BK)

Terminal Part Information

- Pins: B, C, D, E, F, G, H
- Terminal/Tray: 15304713/19
- Core/Insulation Crimp: 4/4
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Window Switch - Driver C1 (Impala)

Pin	Wire Color	Circuit No.	Function
A	-	-	Not Used
B	BK	550	Ground
			Power Window Master Switch Left

C	PU	169	Rear Down Signal
D	D-GN	168	Power Window Master Switch Left Rear Up Signal
E	YE	143	Accessory Voltage
F	D-BU	1307	Power Window Master Switch Lockout Signal
G	L-GN	170	Power Window Master Switch Right Rear Up Signal
H	PU	171	Power Window Master Switch Right Rear Down Signal

Window Switch - Driver C2 (Impala)

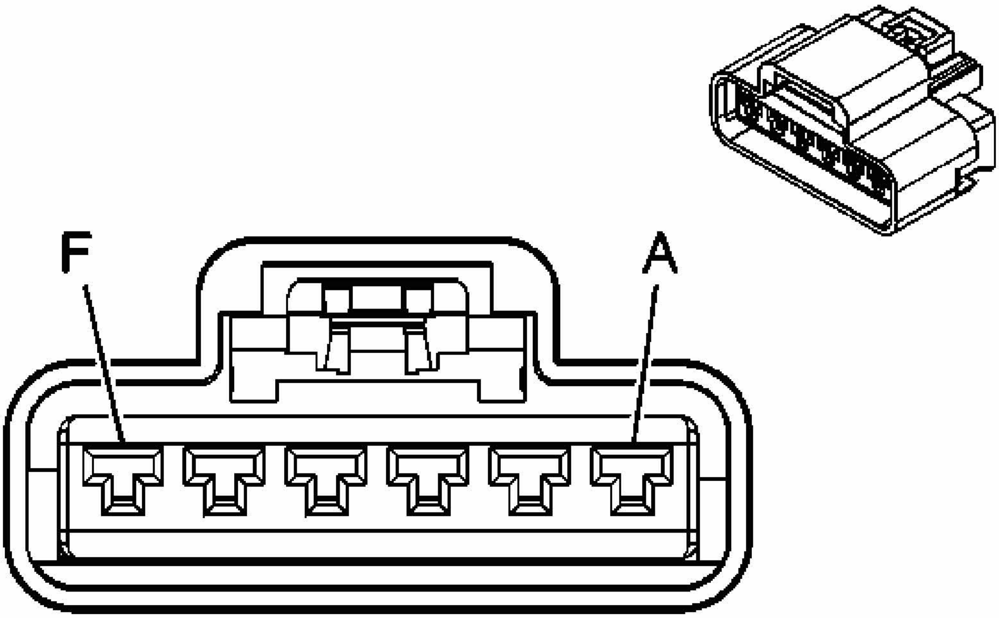


Fig. 36: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 15326900
- Service: 15306380

- Description: 6-Way F GT 280 (BK)

Terminal Part Information

- Pins: A, B, C, E
- Terminal/Tray: 15304713/19
- Core/Insulation Crimp: 4/4
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

- Pins: F
- Terminal/Tray: 15304711/8
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Window Switch - Driver C2 (Impala)

Pin	Wire Color	Circuit No.	Function
A	BN	165	Power Window Motor Left Front Down Control
B	L-BU	166	Power Window Master Switch Right Front Up Signal
C	TN	167	Power Window Master Switch Right Front Down Signal
D	-	-	Not Used
E	D-BU	164	Power Window Motor Left Front Up Control
F	GY	8	Instrument Panel Lamp Supply Voltage

Window Switch - Front Passenger (Impala)

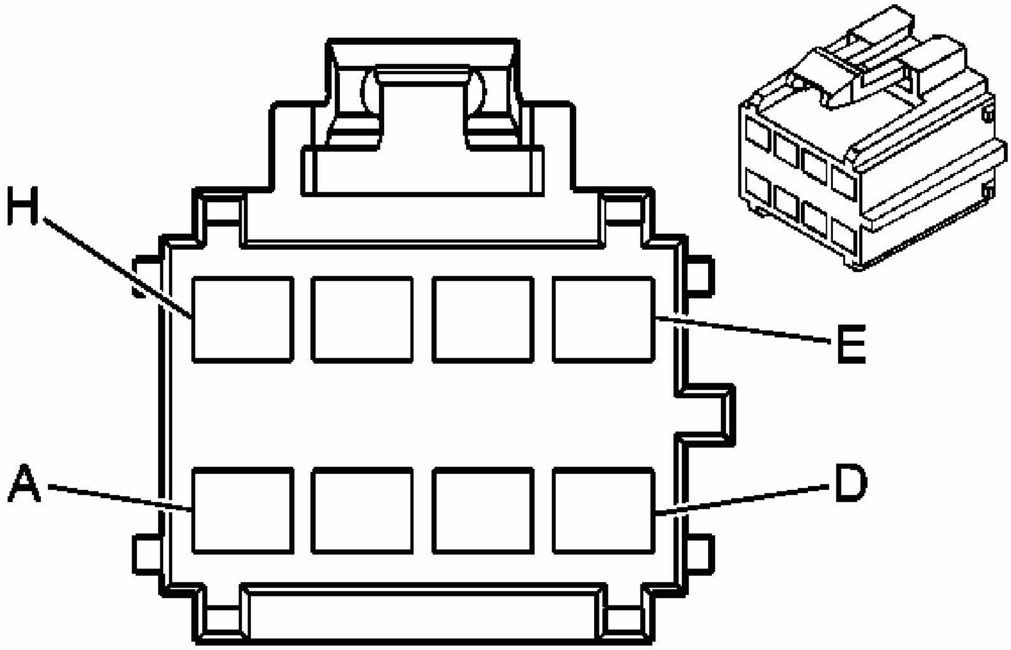


Fig. 37: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12191825
- Service: 15306048
- Description: 8-Way F GT 280 (BN)

Terminal Part Information

- Pins: A, D, F, G, H
- Terminal/Tray: 15304713/19
- Core/Insulation Crimp: F/D
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

- Pins: B, C
- Terminal/Tray: 15304711/8
- Core/Insulation Crimp: Pins B - See Terminal Repair Kit
- Core/Insulation Crimp: Pins C - E/A

- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Window Switch - Front Passenger (Impala)

Pin	Wire Color	Circuit No.	Function
A	YE	143	Accessory Voltage
B	GY	8	Instrument Panel Lamp Supply Voltage
C	BK	750	Ground
D	TN	167	Power Window Master Switch Right Front Down Signal
E	-	-	Not Used
F	BN	667	Power Window Motor Right Front Down Control
G	D-BU	666	Power Window Motor Right Front Up Control
H	L-BU	166	Power Window Master Switch Right Front Up Signal

Window Switch - LR (Impala)

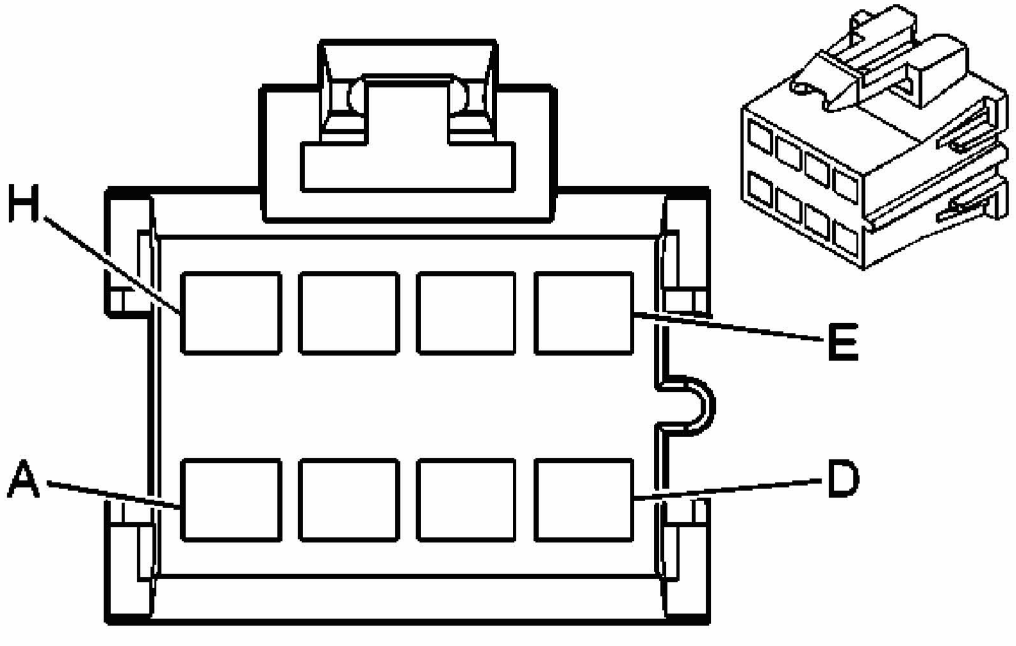


Fig. 38: Connector End View

Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12064998
- Service: 15306189
- Description: 8-Way F Metri-Pack 280 (BK)

Terminal Part Information

- Pins: A, C, D, E, H
- Terminal/Tray: 12015858/4
- Core/Insulation Crimp: F/G
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Window Switch - LR (Impala)

Pin	Wire Color	Circuit No.	Function
A	BN	669	Power Window Motor Left Rear Down Control
B	-	-	Not Used
C	D-GN	168	Power Window Master Switch Left Rear Up Signal
D	D-BU	668	Power Window Motor Left Rear Up Control
E	D-BU	1307	Power Window Master Switch Lockout Signal
F-G	-	-	Not Used
H	PU	169	Power Window Master Switch Left Rear Down Signal
J	-	-	Not Used

Window Switch - Passenger (Monte Carlo)

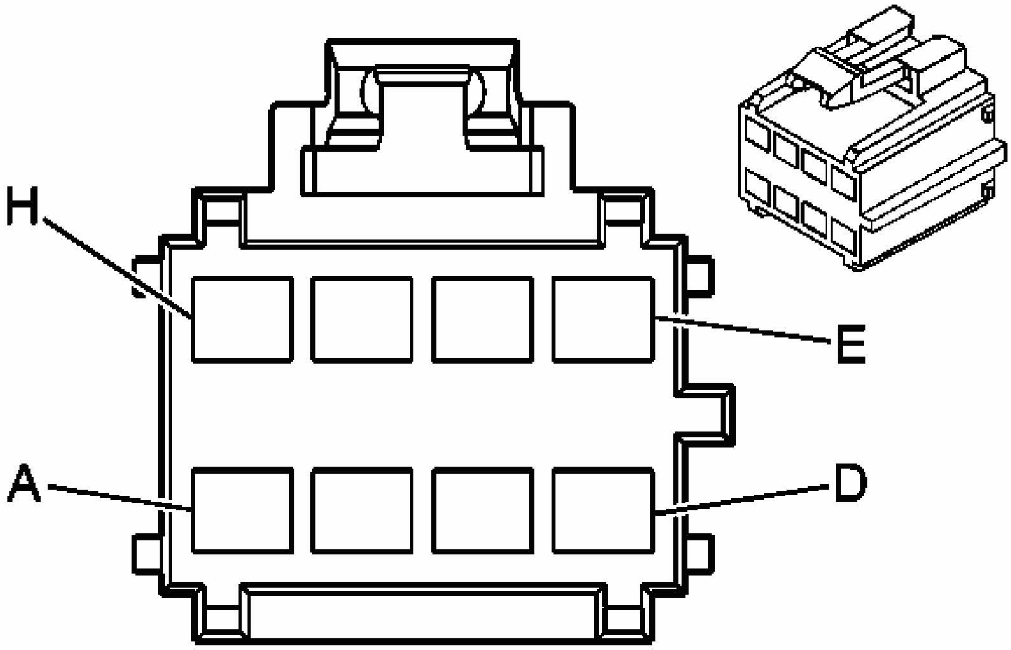


Fig. 39: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12191825
- Service: 15306048
- Description: 8-Way F GT 280 (BN)

Terminal Part Information

- Pins: A, D, F, G, H
- Terminal/Tray: 15304713/19
- Core/Insulation Crimp: F/D
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

- Pins: B, C
- Terminal/Tray: 15304711/8
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Window Switch - Passenger (Monte Carlo)

Pin	Wire Color	Circuit No.	Function
A	YE	143	Accessory Voltage
B	GY	8	Instrument Panel Lamp Supply Voltage
C	BK	750	Ground
D	TN	167	Power Window Master Switch Right Front Down Signal
E	-	-	Not Used
F	BN	667	Power Window Motor Right Front Down Control
G	D-BU	666	Power Window Motor Right Front Up Control
H	L-BU	166	Power Window Master Switch Right Front Up Signal

Window Switch - RR (Impala)

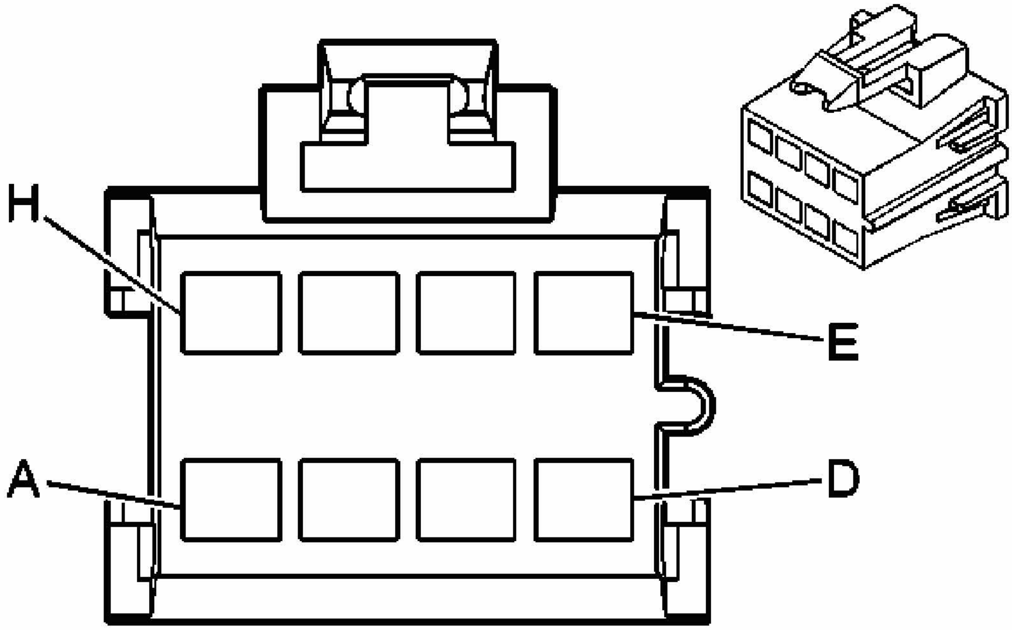


Fig. 40: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Door Systems Connector End Views

Connector Part Information

- OEM: 12064998
- Service: 15306189
- Description: 8-Way F Metri-Pack 280 (BK)

Terminal Part Information

- Pins: A, C, D, E, H
- Terminal/Tray: 12015858/4
- Core/Insulation Crimp: F/G
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Window Switch - RR (Impala)

Pin	Wire Color	Circuit No.	Function
A	BN	671	Power Window Motor Right Rear Down Control
B	-	-	Not Used
C	L-GN	170	Power Window Master Switch Right Rear Up Signal
D	D-BU	670	Power Window Motor Right Rear Up Control
E	D-BU	1307	Power Window Master Switch Lockout Signal
F-G	-	-	Not Used
H	PU	171	Power Window Master Switch Right Rear Down Signal
J	-	-	Not Used

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B2976	Driver Door Ajar Circuit
DTC B3125	All Door Lock Circuit
DTC B3130	Passenger Door Unlock Circuit
DTC B3135	All Door Lock Circuit

DIAGNOSTIC STARTING POINT - DOORS

Begin the system diagnosis with **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the Serial Data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL OUTPUT CONTROLS

Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection(s)	Description
Lock All Doors	Door Lock Test	The BCM momentarily pulses all of the door lock motors. All doors should lock when ON is selected.
Driver Door Unlock	Door Lock Test	The BCM momentarily pulses only the driver door lock motor. The driver door should unlock when ON is selected.
Passenger Door Unlock	Door Lock Test	The BCM momentarily pulses all of the passenger door lock motors. All passenger doors should unlock when ON is selected.

SCAN TOOL DATA LIST

Body Control Module (BCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Battery power is the only requirement for Data, Inputs, Module Information and Lock Outputs.			
Base Model Part Number	Module Information 1	Number	varies
All Door Lock Motors	Outputs	OFF/ON	OFF
Battery Voltage	Data	9.0 -16.0 Volts	12.8 Volts
Driver Door Unlock Motors	Outputs	OFF/ON	OFF
Left Rear Door Ajar Sw.	Inputs	Closed/Ajar	Closed
LF Door Ajar Switch	Inputs	Door Closed/Ajar	Door Closed
LF Door Lock Switch	Inputs	Idle/Lock/Unlock/Invalid	Idle
LF Door Open Switch	Inputs	Closed/Open	Closed

LF Key Cylinder Lock Switch	Inputs	Idle/Lock/Unlock/Invalid	Idle
LR Door Open Switch	Inputs	Closed/Open	Closed
Passenger Door Unlock Motors	Outputs	OFF/ON	OFF
RF Door Ajar Switch	Inputs	Door Closed/Ajar	Door Closed
RF Door Lock Switch	Inputs	Idle/Lock/Unlock/Invalid	Idle
RF Door Open Switch	Inputs	Closed/Open	Closed
RF Key Cylinder Lock Switch	Inputs	Idle/Lock/Unlock/Invalid	Idle
Right Rear Door Ajar Sw.	Inputs	Closed/Ajar	Closed
RR Door Open Sw.	Inputs	Closed/Open	Closed

SCAN TOOL DATA DEFINITIONS

Base Model Part Number

The scan tool displays the part number of the module.

All Door Lock Motors

The scan tool displays OFF/ON. This is the Lock output from the body control module (BCM) to all door lock actuators. When either door lock switch is operated to the Lock position the parameter is displayed as ON.

Battery Voltage

The scan tool displays 9.0-16.0 volts. This is the state of charge of the vehicles battery.

Driver Door Unlock Motor

The scan tool displays OFF/ON. This is the Unlock output from the body control module (BCM) to the driver door lock actuator. When either door lock switch is operated to the Unlock position the parameter is displayed as ON.

Left Rear Door Ajar Sw.

The scan tool displays Closed/Ajar, the left rear door ajar switch input to the body control module (BCM), where an open door is displayed as Ajar.

LF Door Ajar Switch

The scan tool displays Door Closed/Ajar, the driver door ajar switch input to the body control module (BCM), where an open door is displayed as Ajar.

LF Door Lock Switch

The scan tool displays Idle/Lock/Unlock/Invalid. This is the driver door lock switch input to the body control module (BCM). Switch transitions to the lock and unlock positions are displayed as Lock and Unlock. If the switch is stuck, or if the switch circuit has shorted to ground, the scan tool will display that function as active. If the switch is then activated to the opposite function, the scan tool displays Invalid.

LF Door Open Switch

The scan tool displays Closed/Open, the driver door open switch input to the body control module (BCM), where an open door is displayed as Open.

LF Key Cylinder Lock Switch

The scan tool displays Idle/Lock/Unlock/Invalid, the driver door key cylinder switch input to the body control module (BCM), where the switch transitions to the lock and unlock positions are displayed as Lock and Unlock. If the switch is stuck, or if the switch circuit has shorted to ground, the scan tool will display that function as active. If the switch is then activated to the opposite function, the scan tool displays Invalid.

LR Door Open Switch

The scan tool displays Closed/Open, the left rear door open switch input to the body control module (BCM), where an open door is displayed as Open.

Passenger Door Unlock Motors

The scan tool displays OFF/ON. This is the Unlock output from the body control module (BCM) to all passenger door lock actuators. When either door lock switch is operated to the Unlock position the parameter is displayed as ON.

RF Door Ajar Switch

The scan tool displays Door Closed/Ajar, the front passenger door ajar switch input to the body control module (BCM), where an open door is displayed as Ajar.

RF Door Lock Switch

The scan tool displays Idle/Lock/Unlock/Invalid. This is the front passenger door lock switch input to the body control module (BCM). Switch transitions to the lock and unlock positions are displayed as Lock and Unlock. If the switch is stuck, or if the switch circuit has shorted to ground, the scan tool will display that function as active. If the switch is then activated to the opposite function, the scan tool displays Invalid.

RF Door Open Sw.

The scan tool displays Closed/Open, the front passenger door open switch input to the body control module (BCM), where an open door is displayed as Open.

RF Key Cylinder Lock Switch

If the vehicle is equipped with this feature, the scan tool displays Idle/Lock/Unlock/Invalid, the front passenger door key cylinder switch input to the body control module (BCM), where the switch transitions to the lock and unlock positions are displayed as Lock and Unlock. If the switch is stuck, or if the switch circuit has shorted to ground, the scan tool will display that function as active. If the switch is then activated to the opposite function, the scan tool displays Invalid.

Right Rear Door Ajar Sw.

The scan tool displays Closed/Ajar, the right rear door ajar switch input to the body control module (BCM), where an open door is displayed as Ajar.

RR Door Open Switch

The scan tool displays Closed/Open, the right rear door open switch input to the body control module (BCM), where an open door is displayed as Open.

DTC B2976

DTC Descriptor

DTC B2976 00

Driver Door Ajar Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC B2976

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Door Ajar	B2976 00	1	1	-
1. Door Ajar Malfunction				

Circuit/System Description

When the driver door lock is in to the AJAR position, ground is applied through the switch to the body control module (BCM). The BCM then sends a class 2 message to the instrument panel cluster to illuminate the ajar indicator.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The BCM receives a voltage signal on the driver door ajar circuit.

Action Taken When the DTC Sets

The Ajar indicator is ON at all times.

Conditions for Clearing the DTC

The BCM clears this code from current when the fault is removed from the system.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

Power Door Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, open the driver side door. The driver door ajar indicator should illuminate. Close the driver door. The ajar indicator should turn OFF.

Circuit/System Testing

1. Disconnect the driver door lock connector. Verify the DTC resets.
2. If the DTC does not reset, replace the driver door lock assembly.
3. Test for a short to ground in the driver door ajar circuit.
4. If all circuits/connections test normal, replace the BCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Lock Replacement - Front Door (Monte Carlo)** or **Lock Replacement - Front Door (Impala)**
- **Door Handle Replacement - Front Inside**
- **Door Handle Replacement - Rear Inside**
- **Control Module References** for BCM replacement, setup, and programming

DTC B3125

DTC Descriptor

DTC B3135 00

All Door Lock Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC B3125

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Door Lock Relay Control	B3135 00	1	1	-
1. Power Door Locks Inoperative - All Doors				

Circuit/System Description

When the door lock switch is place in to the LOCK position, ground is applied through the switch to the body control module (BCM). The BCM then applies a voltage through the door lock relay control circuit to the coil side of the lock relay in the body electrical center (BEC). The relay then engages and applies voltage to all the door lock assemblies.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The BCM receives a ground signal on the door lock relay control circuit

Action Taken When the DTC Sets

The BCM cease attempt to lock the doors.

Conditions for Clearing the DTC

The BCM clears this code from current when the fault is removed from the system.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

Power Door Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, place the door lock switch to the LOCK position. All doors should lock.

Circuit/System Testing

1. Disconnect the Lock relay in the BEC. Verify the DTC resets.
    - If the DTC does not reset, replace the relay.

2. Disconnect the BEC connector C1. Verify the DTC resets.
    - If the DTC does not reset, replace the BEC.
3. Test for a short to ground in the door lock relay control circuit.
    - If all circuits/connections test normal, replace the BCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Control Module References** for BCM replacement, setup, and programming
- **Junction Block Replacement - Accessory Wiring**

DTC B3130

DTC Descriptor

DTC B3130 00

Passenger Door Unlock Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC B3130

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Door Unlock Relay Control	B3130 00	1	1	-
1. Power Door Locks Inoperative - Passenger Door				

Circuit/System Description

When the passenger door lock switch is place in to the UNLOCK position, ground is applied through the switch to the body control module (BCM). The BCM then applies ground through the passenger door unlock relay control circuit to the coil side of the passenger unlock relay in the body electrical center (BEC). The relay then engages and applies voltage to all of the passenger door lock assemblies.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The BCM receives a voltage signal on the passenger door unlock relay control circuit.

Action Taken When the DTC Sets

The BCM cease attempt to unlock the doors.

Conditions for Clearing the DTC

The BCM clears this code from current when the fault is removed from the system.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

Power Door Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, place the driver door lock switch to the UNLOCK position. The driver door should unlock.

Circuit/System Testing

1. Disconnect the BEC connector C1. Verify the DTC resets.
    - If the DTC does not reset, replace the BEC.
2. Test for a short to voltage in the passenger door unlock relay control circuit.
    - If all circuits/connections test normal, replace the BCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Control Module References** for BCM replacement, setup, and programming
- **Junction Block Replacement - Accessory Wiring**

DTC B3135

DTC Descriptor

DTC B3135 00

All Door Lock Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC B3135

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Door Lock Relay Control	B3135 00	1	1	-
1. Power Door Locks Inoperative - All Doors				

Circuit/System Description

When the door lock switch is place in to the LOCK position, ground is applied through the switch to the body control module (BCM). The BCM then applies a voltage through the door lock relay control circuit to the coil side of the lock relay in the body electrical center (BEC). The relay then engages and applies voltage to all the door lock assemblies.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The BCM receives a ground signal on the door lock relay control circuit.

Action Taken When the DTC Sets

The BCM cease attempt to lock the doors.

Conditions for Clearing the DTC

The BCM clears this code from current when the fault is removed from the system.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

Power Door Systems Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

- Scan Tool Output Controls
- Scan Tool Data List
- Scan Tool Data Definitions

Circuit/System Verification

Ignition ON, place the door lock switch to the LOCK position. All doors should lock.

Circuit/System Testing

1. Disconnect the Lock relay in the BEC. Verify the DTC resets.
    - If the DTC does not reset, replace the Relay.
2. Disconnect the BEC connector C1. Verify the DTC resets.
    - If the DTC does not reset, replace the BEC.
3. Test for a short to ground in the door lock relay control circuit.
    - If all circuits/connections test normal, replace the BCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Control Module References** for BCM replacement, setup, and programming
- **Junction Block Replacement - Accessory Wiring**
- **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)**

SYMPTOMS - DOORS

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions:

   Power Windows Description and Operation

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the door systems. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Power Windows Inoperative - All**
- **Power Windows Inoperative - Express Down Function**
- **Power Windows Inoperative - Lockout Function**
- **Power Window Inoperative - Driver Door**
- **Power Window Inoperative - Passenger Door**
- **Door Ajar Indicator Malfunction**
- **Power Door Locks Inoperative - Key Cylinder Switches**

- **Automatic Door Locks Inoperative**
- **Power Mirrors Inoperative**
- **Heated Mirrors Inoperative**

POWER WINDOWS INOPERATIVE - ALL

Test Description

The number below refers to the step number on the diagnostic table.

> **6:** This step ensures that the power window master switch lockout signal circuit is not the cause of the malfunction. This circuit supplies battery positive voltage, through the rear window lockout switch, to the rear window switches, and is used to enable or disable the rear window lockout feature. When the rear window lockout feature is enabled, the circuit is open and no voltage is supplied to the rear window switches. When the feature is not enabled, the circuit is connected to battery positive voltage. If this circuit is shorted to ground when the lockout feature is not enabled, the PWR WDO circuit breaker may cycle continuously OFF/ON until, either the lockout switch is pressed to open the circuit, or the circuit breaker is permanently damaged. All windows may be partially or totally inoperative while the fault is present.

Power Windows Inoperative - All

Step	Action	Yes	No
Schematic Reference: Power Window Schematics **Connector End View Reference: Power Door Systems Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Are all the power windows inoperative?	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems
3	1. Disconnect the driver window switch C2 harness connector. 2. Turn ON the ignition, with the engine OFF. 3. Probe the power window switch voltage supply circuit of the harness connector with a test lamp that is		

	connected to ground. Does the test lamp illuminate?	Go to **Step 4**	Go to **Step 5**
4	Connect the test lamp between the power window switch voltage supply circuit and the ground circuit of the harness connector. Does the test lamp illuminate?	Go to **Step 6**	Go to **Step 8**
5	Test for an open or a short to ground in the power window switch voltage supply circuits of the driver window and front passenger window switches. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 10**
6	Test the power window master switch lockout signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 7**
7	Inspect for poor connections at the harness connector of the driver window switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 9**
8	Repair the open in the ground circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 11**	-
9	Replace the driver window switch. Refer to **Power Window Switch Replacement (Impala)**. Did you complete the replacement?	Go to **Step 11**	-
10	Replace the PWR WDO circuit breaker. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the repair?	Go to **Step 11**	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

POWER WINDOWS INOPERATIVE - EXPRESS DOWN FUNCTION

Power Windows Inoperative - Express Down Function

Step	Action	Yes	No
Schematic Reference: Power Window Schematics **Connector End View Reference: Power Door Systems Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Verify that the inoperative power windows express down function fault is present. Does the power window express down function operate normally?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	Inspect for poor connections at the harness connector of the driver window switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 5**	Go to **Step 4**
4	Replace the driver window switch. Refer to **Power Window Switch Replacement (Impala)**. Did you complete the replacement?	Go to **Step 5**	-
5	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

POWER WINDOWS INOPERATIVE - LOCKOUT FUNCTION

Test Description

The number below refers to the step number on the diagnostic table.

> **3:** This step determines if the power window master switch lockout signal circuit may be shorted to battery positive voltage. Normally, with rear window lockout not enabled, this circuit is closed within the master window switch and rear windows are operational from their respective switches. When the lockout feature is enabled, the circuit is open and no voltage is available at the rear window switches. A short to battery positive voltage on this circuit would cause power to be supplied to the rear window switches regardless of the lockout switch status.

Power Windows Inoperative - Lockout Function

Step	Action	Yes	No
Schematic Reference: Power Window Schematics **Connector End View Reference: Power Door Systems Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Verify that the inoperative power windows lockout function fault is present. Does the power windows lockout function operate normally?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	1. Disconnect the driver window switch. 2. Turn ON the ignition, with the engine OFF. 3. Probe the power window master switch lockout signal circuit of the driver window switch with a test lamp that is connected to ground. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 4**
4	Inspect for poor connections at the harness connector of the driver window switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 7**	Go to **Step 6**
5	Repair the short to battery positive voltage in the power window master switch lockout signal circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 7**	-
6	Replace the driver window switch. Refer to **Power Window Switch Replacement (Impala)**. Did you complete the replacement?	Go to **Step 7**	-
	Operate the system in order to verify the		

7	repair. Did you correct the condition?	System OK	Go to **Step 2**

POWER WINDOW INOPERATIVE - DRIVER DOOR

Power Window Inoperative - Driver Door

Step	Action	Yes	No
Schematic Reference: Power Window Schematics **Connector End View Reference: Power Door Systems Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Verify that the inoperative driver door power window fault is present. Does the driver door power window operate normally?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	Are the driver door, left rear (LR) and right rear (RR) windows all inoperative?	Go to **Power Windows Inoperative - All**	Go to **Step 4**
4	1. Disconnect the driver window motor harness connector. 2. Turn ON the ignition, with the engine OFF. 3. Probe the power window motor left front up control circuit of the harness with a test lamp that is connected to ground. 4. Operate the driver window switch to the UP position. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 6**
	1. Connect a test lamp between the power window motor left front up control circuit of the harness connector and the power window motor left front down		

5	control circuit of the harness connector. 2. Operate the driver window switch to the DOWN position. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 7**
6	Test the power window motor left front up control circuit of the driver window motor for an open or a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 9**
7	Test the power window motor left front down control circuit of the driver window motor for an open or a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 9**
8	Inspect for poor connections at the harness connector of the driver window motor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 10**
9	Inspect for poor connections at the harness connector of the driver window switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 11**
10	Replace the driver window motor. Refer to **Window Regulator Motor Replacement - Front Door**. Did you complete the repair?	Go to **Step 12**	-
11	Replace the driver window switch. Refer to **Power Window Switch Replacement (Impala)**. Did you complete the repair?	Go to **Step 12**	-
12	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

POWER WINDOW INOPERATIVE - PASSENGER DOOR

Power Window Inoperative - Passenger Door

Step	Action	Yes	No
Schematic Reference: Power Window Schematics **Connector End View Reference: Power Door Systems Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Verify that the inoperative passenger door power window fault is present. Do all the passenger door power windows operate normally?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 6**
3	Is this vehicle an Impala?	Go to **Step 4**	Go to **Step 6**
4	Are all of the passenger windows inoperative?	Go to **Step 5**	Go to **Step 7**
5	Test for an open in the window lockout switch circuit of the driver window switch. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 18**
6	1. Disconnect the inoperative passenger window switch. 2. Turn ON the ignition, with the engine OFF. 3. Probe the power window master switch lockout signal circuit of the inoperative passenger window switch with a test lamp that is connected to ground. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 10**
7	1. Disconnect the passenger window switch. 2. Turn the ignition to the ON position. 3. Using a test lamp connected to ground, probe the accessory voltage supply circuit.		

	Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 16**
8	1. Using a test lamp, probe between the master window switch up circuit and the master window switch down circuit. 2. Activate the driver window switch to the UP and DOWN positions. Does the test lamp illuminate?	Go to **Step 9**	Go to **Step 11**
9	1. Connect the inoperative passenger window switch. 2. Disconnect the inoperative passenger window motor. 3. Connect a test lamp between the power window motor up control circuit and the power window motor down control circuit. 4. Activate the inoperative passenger window switch to the UP and DOWN positions. Does the test lamp illuminate?	Go to **Step 13**	Go to **Step 12**
10	Test the power window master switch lockout signal circuit of the inoperative passenger window switch for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 14**
11	Test the power window master switch signal circuits of the inoperative passenger window switch for a short to battery positive voltage or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 14**
12	Test the power window motor circuits of the inoperative passenger window motor for a short to battery positive voltage or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 15**
	Inspect for poor connections at the		

13	inoperative passenger window motor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 17**
14	Inspect for poor connections at the driver window switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 18**
15	Inspect for poor connections at the inoperative passenger window switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 19**
16	Repair a poor connection or an open in the accessory voltage supply circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 20**	-
17	Replace the inoperative passenger window motor. Refer to **Window Regulator Replacement - Front Door (Impala)** or **Window Regulator Replacement - Front Door (Monte Carlo)** or **Window Regulator Replacement - Rear Door**. Did you complete the replacement?	Go to **Step 20**	-
18	Replace the driver window switch. Refer to **Power Window Switch Replacement (Impala)**. Did you complete the replacement?	Go to **Step 20**	-
19	Replace the inoperative passenger window switch. Refer to **Power Window Switch Replacement (Impala)**. Did you complete the replacement?	Go to **Step 20**	-
20	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

DOOR AJAR INDICATOR MALFUNCTION

Door Ajar Indicator Malfunction

Step	Action	Yes	No
Schematic Reference: Door Lock/Indicator Schematics **Connector End View Reference: Power Door Systems Connector End Views** DEFINITION: One of the door ajar messages does not display Ajar when the corresponding door is ajar, or, one of the door ajar messages displays Ajar when the corresponding door is closed			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Verify that the Door Ajar Indicator Malfunction complaint is present. Does the Door Ajar Indicator System operate as described in the system description and operation?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Close all doors. 4. With a scan tool, navigate to the input list by selecting: • Lighting Systems • Data display • Body control module (BCM) • Input list Observe the parameter of each door ajar switch: • Left front (LF) Door Ajar Switch • Right front (RF) Door Ajar Switch • Left rear (LR) Door Ajar Sw. • Right rear (RR) Door Ajar Sw. Does the scan tool indicate that the Door Ajar Switch parameter is in the Door Closed state for all doors?	Go to **Step 4**	Go to **Step 5**
	1. Open all of the vehicle doors. 2. With the scan tool, observe the		

4	parameter of each door ajar switch in the Data Display, Inputs list of the BCM: - LF Door Ajar Switch - RF Door Ajar Switch - LR Door Ajar Sw. - RR Door Ajar Sw. Does the scan tool indicate that the Door Ajar Switch is in the Door Open state for all doors?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 6**
5	1. Turn OFF the ignition. 2. Disconnect the harness connector of the malfunctioning door lock. 3. Turn ON the ignition, with the engine OFF. 4. With the scan tool, observe the inoperative Door Ajar Switch parameter. Does the scan tool display Door Closed?	Go to **Step 11**	Go to **Step 9**
6	1. Turn OFF the ignition. 2. Disconnect the harness connector of the malfunctioning door lock. 3. Connect a 3-amp fused jumper wire between the door ajar switch signal circuit of the harness connector and ground. 4. Turn ON the ignition, with the engine OFF. 5. With the scan tool, observe the appropriate Door Ajar Switch parameter. Does the scan tool display ON?	Go to **Step 7**	Go to **Step 8**
	1. Turn OFF the ignition. 2. Connect the 3-amp fused jumper wire between the door ajar switch signal circuit and the ground circuit of the harness connector.		

7	3. Turn ON the ignition, with the engine OFF. 4. With the scan tool, observe the appropriate Door Ajar Switch parameter. Does the scan tool display Door Open?	Go to **Step 11**	Go to **Step 12**
8	Test the door ajar switch signal circuit of the door lock for an open or a short to battery positive voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 15**	Go to **Step 10**
9	Test the door ajar switch signal circuit of the door lock for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 15**	Go to **Step 10**
10	Inspect for poor connections at the harness connector of the suspect BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and to **Connector Repairs** . Did you find and correct the condition?	Go to **Step 15**	Go to **Step 13**
11	Inspect for poor connections at the harness connector of the malfunctioning door lock. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 15**	Go to **Step 14**
12	Repair the high resistance or open in the ground circuit of the door lock. Refer to **Circuit Testing** and **Wiring Repairs** . Did you complete the repair?	Go to **Step 15**	-
13	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 15**	-
14	Replace the door lock. Refer to **Lock Actuator Replacement - Front Door** or **Lock Actuator Replacement - Rear Door**. Did you complete the replacement?	Go to **Step 15**	-
	Operate the system in order to verify the		

15	repair. Did you correct the condition?	System OK	Go to **Step 2**

POWER DOOR LOCKS INOPERATIVE - ALL DOORS AND SWITCHES

Diagnostic Aids

A short to ground in any door lock or unlock control circuit will most likely open the 15-amp DR LK/TRUNK fuse located in the instrument panel (I/P) fuse block and cause all door lock functions to become inoperative. However, if the lock or unlock control circuit is shorted to ground and the DR LK/TRUNK fuse does not open, the most likely affect will be that all door locks will be inoperative in one direction, i.e. if the unlock control circuit is shorted to ground, all doors may lock, but will not unlock, or, if the lock control circuit is shorted to ground, all doors may unlock, but will not lock.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

> **4:** This step determines if the malfunction may be caused by a short to ground in the battery positive voltage circuit of the body control module (BCM). The BCM provides the voltage needed to power all door lock actuator control circuits. A short to ground in the battery positive voltage circuit of the BCM will open the DR LK/TRUNK 15-amp fuse in the I/P fuse block and cause all door lock functions to become inoperative. While following the steps of this procedure, be sure you are testing the battery voltage circuit of the BCM that is associated with the door lock system. Use **Door Lock/Indicator Schematics** in order to correctly identify the appropriate circuit.
>
> **6:** This step determines if the malfunction may be caused by an open in the battery positive voltage circuit of the BCM. The BCM provides the voltage needed to power all door lock actuator control circuits. An open in the BCM battery positive voltage circuit of the BCM will cause all door lock functions to be inoperative. While following the steps of this procedure, be sure you are testing the battery voltage circuit of the BCM that is associated with the door lock system. Use **Door Lock/Indicator Schematics** in order to correctly identify the appropriate circuit.
>
> **7:** This step determines if the malfunction may be caused by an open in the ground circuit of the BCM. The BCM provides the ground path for all door lock actuator control circuits. While following the steps of this procedure, be sure you are testing the ground circuit of the BCM that is associated with the door lock system. Use **Door Lock/Indicator Schematics** in order to correctly identify the appropriate circuit.

Power Door Locks Inoperative - All Doors and Switches

Step	Action	Yes	No
Schematic Reference: Door Lock/Indicator Schematics **Connector End View Reference: Power Door Systems Connector End Views**			

DEFINITION: All door lock functions are inoperative from any switch or key FOB.

1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Verify that the all doors and switches power door locks inoperative fault is present. Does the power door locks system operate normally?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	Is the DR LK/TRUNK fuse open?	Go to **Step 4**	Go to **Step 5**
4	Test the battery positive voltage circuit of the body control module (BCM) for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 8**
5	Test the door lock and unlock control circuits for a short to ground or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 6**
6	Test the battery positive voltage circuit of the BCM for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 7**
7	Test the ground circuit of the BCM for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
8	Test the door lock actuator lock control circuits for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 9**
9	Test the door lock actuator unlock control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.		

	Did you find and correct the condition?	Go to **Step 14**	Go to **Step 11**
10	Test the door lock actuator lock control circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
11	Test the driver door lock actuator unlock control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
12	Inspect for poor connections at the harness connector of the BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
13	Replace the BCM. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 14**	-
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

POWER DOOR LOCKS INOPERATIVE - KEY CYLINDER SWITCHES

Power Door Locks Inoperative - Key Cylinder Switches

Step	Action	Yes	No
Schematic Reference: Door Lock/Indicator Schematics **Connector End View Reference: Power Door Systems Connector End Views** DEFINITION: The key cylinder Lock/Unlock function is inoperative.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Verify that the power door locks key cylinder switches inoperative fault is present. Does the power door locks key cylinder switches system operate normally?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**

3	Does the power door locks system operate normally?	Go to **Step 4**	Go to **Symptoms - Doors**
4	1. Close all of the doors. 2. Install a scan tool. 3. With the scan tool, observe the appropriate Left Front (LF) or Right Front (RF) Key Cylinder Lock Switch parameter in the Data Display Inputs list of the body control module (BCM). Does the Key Cylinder Lock Switch parameter display the Idle state?	Go to **Step 5**	Go to **Step 6**
5	1. Insert the door key into the inoperative door lock cylinder switch. 2. With the scan tool, observe the appropriate LF or RF Key Cylinder Lock Switch parameter in the Data Display Inputs list of the BCM. 3. Turn the door key cylinder first to the LOCK position, and then to the UNLOCK position. Did the Key Cylinder LOCK Switch parameter change from the Idle state to the Lock and UNLOCK states as expected?	Go to **Step 12**	Go to **Step 7**
6	Disconnect the harness connector of the inoperative door lock cylinder switch. Does the Key Cylinder Lock Switch parameter display the Idle state?	Go to **Step 11**	Go to **Step 9**
7	1. Disconnect the harness connector of the inoperative door lock cylinder switch. 2. Connect a 3-amp fused jumper wire between the appropriate key switch lock or unlock signal circuit of the harness connector and a ground. 3. With the scan tool, observe the appropriate Key Cylinder Lock Switch parameter.		

	Did the Key Cylinder Lock Switch parameter display the appropriate state?	Go to **Step 8**	Go to **Step 10**
8	1. Connect the 3-amp fused jumper wire between the inoperative key switch lock or unlock signal circuit and the ground circuit of the harness connector. 2. With the scan tool, observe the inoperative Key Cylinder Lock Switch parameter. Did the Key Cylinder Lock Switch parameter display the appropriate state?	Go to **Step 11**	Go to **Step 13**
9	Test the inoperative door lock cylinder switch signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 16**	Go to **Step 12**
10	Test the inoperative door lock cylinder switch signal circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 16**	Go to **Step 12**
11	Inspect for poor connections at the harness connector of the inoperative door lock cylinder switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 16**	Go to **Step 14**
12	Inspect for poor connections at the harness connector of the BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 16**	Go to **Step 15**
13	Repair the open ground circuit of the door lock cylinder switch. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 16**	-
14	Replace the inoperative door lock cylinder switch. Refer to **Lock Cylinder Replacement - Door (Impala)** or **Lock Cylinder Replacement - Door (Monte Carlo)**.		

	Did you complete the replacement?	Go to **Step 16**	-
15	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 16**	-
16	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

POWER DOOR LOCK INOPERATIVE - DRIVER DOOR

Power Door Lock Inoperative - Driver Door

Step	Action	Yes	No
Schematic Reference: Door Lock/Indicator Schematics **Connector End View Reference: Power Door Systems Connector End Views** DEFINITION: The driver door lock actuator or lock switch does not operate.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Verify that the Power Door Lock Inoperative - Driver Door fault is present. Do the door locks operate as described in the Power Door Locks Description and Operation?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	1. Install a scan tool. 2. Close all of the vehicle doors. 3. With the scan tool, observe the Left Front (LF) Door Lock Switch parameter in the Data Display, Inputs list of the body control module (BCM). 4. Operate the driver door lock switch to both the LOCK and UNLOCK positions. Did the parameter change to both the LOCK and UNLOCK states?	Go to **Step 6**	Go to **Step 4**
	IMPORTANT: **If the 3-amp fuse of the jumper wire opens when the jumper wire is connected, test the appropriate signal circuit for a short to battery positive voltage.**		

4	1. Disconnect the harness connector of the driver door lock switch. 2. Connect a 3-amp fused jumper wire between the lock switch lock signal circuit of the harness connector and a ground. 3. Observe the LF Door Lock Switch parameter. 4. Connect the 3-amp fused jumper wire between the lock switch unlock signal circuit of the harness connector and a ground. 5. Observe the LF Door Lock Switch parameter. Did the Scan Tool parameter change to the both the LOCK and UNLOCK states?	Go to **Step 5**	Go to **Step 7**
5	Connect the 3-amp fused jumper wire between the lock switch lock signal circuit and the ground circuit of the harness connector while observing the appropriate scan tool parameter. Did the Scan Tool parameter change to the LOCK state?	Go to **Step 10**	Go to **Step 13**
6	1. Disconnect the harness connector of the driver door lock actuator. 2. Connect a test lamp between the door lock actuator lock control circuit and the door lock actuator unlock control circuit of the harness connector. 3. Operate the driver door lock switch to the LOCK and UNLOCK positions. Did the test lamp illuminate in both positions?	Go to **Step 12**	Go to **Step 8**
7	Test the signal circuits of the driver door lock switch for the following: • An open • A short to ground • A short to battery positive voltage		

	Refer to **Circuit Testing** and**Wiring Repairs** . Did you find and correct the condition?	Go to **Step 17**	Go to **Step 11**
8	Test the lock control circuit of the driver door lock actuator for an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 17**	Go to **Step 9**
9	Test the unlock control circuit of the driver door lock actuator for an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 17**	Go to **Step 11**
10	Inspect for poor connections at the harness connector of the driver door lock switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 17**	Go to **Step 14**
11	Inspect for poor connections at the harness connector of the BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** . Did you find and correct the condition?	Go to **Step 17**	Go to **Step 15**
12	Inspect for poor connections at the harness connector of the driver door lock actuator. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 17**	Go to **Step 16**
13	Repair the open ground circuit of the driver door lock switch. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 17**	-
14	Replace the driver door lock switch. Refer to **Power Door Lock Switch Replacement (Impala)** or **Power Door Lock Switch Replacement (Monte Carlo)**. Did you complete the replacement?	Go to **Step 17**	-
15	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming.		

	Did you complete the replacement?	Go to **Step 17**	-
16	Replace the driver door lock actuator. Refer to **Lock Actuator Replacement - Front Door**. Did you complete the replacement?	Go to **Step 17**	-
17	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

POWER DOOR LOCKS INOPERATIVE - PASSENGER DOOR

Power Door Locks Inoperative - Passenger Door

Step	Action	Yes	No
Schematic Reference: Door Lock/Indicator Schematics **Connector End View Reference: Power Door Systems Connector End Views** DEFINITION: One or all 3 of the passenger door lock actuators do not operate, or, the front passenger door lock switch does not operate.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Verify that the Power Door Locks Inoperative - Passenger Door fault is present. Do the door locks operate as described in the Power Door Locks Description and Operation?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	If the vehicle is a 4-door model, are all 3 of the passenger doors locks inoperative from both door lock switches?	Go to **Step 10**	Go to **Step 4**
4	1. Install a scan tool. 2. Close all of the vehicle doors. 3. With the scan tool, observe the Right Front (RF) Door Lock Switch parameter in the Data Display, Inputs list of the body control module (BCM). 4. Operate the front passenger door lock switch to both the LOCK and UNLOCK positions.		

	Did the parameter change to both the LOCK and UNLOCK states?	Go to **Step 7**	Go to **Step 5**
5	**IMPORTANT:** **If the 3-amp fuse of the jumper wire opens when the jumper wire is connected, test the appropriate signal circuit for a short to battery positive voltage.** 1. Disconnect the harness connector of the front passenger door lock switch. 2. Connect a 3-amp fused jumper wire between the lock switch lock signal circuit of the harness connector and a ground. 3. Observe the RF Door Lock Switch parameter. 4. Connect the 3-amp fused jumper wire between the lock switch unlock signal circuit of the harness connector and a ground. 5. Observe the RF Door Lock Switch parameter. Did the Scan Tool parameter change to the both the LOCK and UNLOCK states?	Go to **Step 6**	Go to **Step 8**
6	Connect the 3-amp fused jumper wire between the lock switch lock signal circuit and the ground circuit of the harness connector while observing the appropriate Scan Tool parameter. Did the Scan Tool parameter change to the LOCK state?	Go to **Step 11**	Go to **Step 14**
7	1. Disconnect the harness connector of the inoperative door lock actuator. 2. Connect a test lamp between the door lock actuator lock control circuit and the door lock actuator unlock control circuit of the harness connector. 3. Operate the front passenger door lock switch to the LOCK and UNLOCK positions.		

	Did the test lamp illuminate in both positions?	Go to **Step 13**	Go to **Step 9**
8	Test the signal circuits of the front passenger door lock switch for a short to ground or an open. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 12**
9	Test the lock control circuit of the inoperative door lock actuator for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 10**
10	**IMPORTANT:** **If all 3 passenger door locks are inoperative from both door lock switches, test the unlock control circuit between the splice and the BCM for an open.** Test the unlock control circuit of the inoperative door lock actuator for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	Go to **Step 18**	Go to **Step 12**
11	Inspect for poor connections at the harness connector of the front passenger door lock switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 15**
12	Inspect for poor connections at the harness connector of the BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 16**
13	Inspect for poor connections at the harness connector of the inoperative door lock actuator. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 17**
	Repair the open ground circuit of the front passenger door lock switch. Refer to		

14	**Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 18**	-
15	Replace the front passenger door lock switch. Refer to **Power Door Lock Switch Replacement (Impala)** or **Power Door Lock Switch Replacement (Monte Carlo)**. Did you complete the replacement?	Go to **Step 18**	-
16	Replace the BCM. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 18**	-
17	Replace the inoperative door lock actuator. Refer to **Lock Actuator Replacement - Front Door** or **Lock Actuator Replacement - Rear Door**. Did you complete the replacement?	Go to **Step 18**	-
18	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

AUTOMATIC DOOR LOCKS INOPERATIVE

Diagnostic Aids

The door open switches are an integral part of each door lock and are not serviced separately.

Automatic Door Locks Inoperative

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Power Door Systems Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Verify that the automatic door locks are inoperative. Do the automatic door locks operate normally?	Go to **Testing for Intermittent Conditions and Poor**	

		Connections in Wiring Systems	Go to **Step 3**
3	Verify that the automatic door locks feature is enabled. Refer to **Vehicle Personalization** in Personalization. Are the automatic door locks enabled?	Go to **Step 4**	Go to **Vehicle Personalization** in Personalization
4	Do the power door locks operate normally?	Go to **Step 5**	Go to **Symptoms - Doors**
5	1. Close all of the doors. 2. With a scan tool, observe the parameter of each door open switch in the body control module (BCM), Data Display, Inputs List: • Left front (LF) Door Open Switch • Left rear (LR) Door Open Switch • Right front (RF) Door Open Switch • Right rear (RR) Door Open Switch Does the scan tool display Closed for all doors?	Go to **Step 9**	Go to **Step 6**
6	**IMPORTANT:** **The door open switch is an integral part of the door lock.** 1. Disconnect the harness connector of the inoperative door open switch. 2. With a scan tool, observe the inoperative Door Open Switch parameter in the Data Display, Inputs list of the BCM. Does the scan tool display Closed?	Go to **Step 8**	Go to **Step 7**
7	Test the door open switch signal circuit of the harness connector for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 9**
	Inspect for poor connections at the harness		

8	connectors of the inoperative door lock. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 10**
9	Inspect for poor connections at the harness connector of the BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 11**
10	Replace the inoperative door lock. Refer to **Lock Replacement - Front Door (Monte Carlo)** or **Lock Replacement - Front Door (Impala)** and **Lock Replacement - Rear Door**. Did you complete the replacement?	Go to **Step 12**	-
11	Replace the BCM. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the repair?	Go to **Step 12**	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

POWER MIRRORS INOPERATIVE

Diagnostic Aids

- If the power mirror system fuse is open and a short to ground in the battery positive voltage circuit is not detected, the fault could be a short to ground in one of the power mirror control circuits. This would open the power mirror system fuse when the mirror switch is pressed.
- If both power mirrors are inoperative on one or more axis, the most probable cause is a power mirror switch failure. However, the fault could be an open circuit on 2 or more of the power mirror control circuits.
- The power mirror assembly is equipped with a pigtail harness and is not serviceable. If an internal open or short is detected in the power mirror assembly, replace the power mirror assembly.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

6: This step tests the integrity of both the mirror control circuits and the power mirror switch. If both power mirrors are inoperative on one or more axis, begin testing by disconnecting one of the power mirrors, if an open circuit is detected and repaired for that power mirror, repeat step 6 for the other power mirror.

7: This step tests the integrity of the battery positive voltage circuit, not the fuse.

Power Mirrors Inoperative

Step	Action	Yes	No
Schematic Reference: Outside Mirror Schematics **Connector End View Reference: Power Door Systems Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Place the mirror selector switch in the LEFT mirror position. 2. Activate the mirror position switch in the UP, DOWN, LEFT, and RIGHT directions and note the operation. 3. Place the mirror selector switch in the RIGHT mirror position. 4. Activate the mirror position switch in the UP, DOWN, LEFT, and RIGHT directions and note the operation. Do both power mirrors operate properly?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	Are both the left and right power mirrors completely inoperative?	Go to **Step 4**	Go to **Step 6**
4	1. Disconnect the power mirror switch. 2. Probe the battery positive voltage circuit of the power mirror switch harness connector with a test lamp that is connected to ground. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 7**
5	Connect a test lamp between the battery positive voltage circuit of the power mirror switch harness connector and the ground circuit of the power mirror switch harness connector.		

	Does the test lamp illuminate?	Go to **Step 9**	Go to **Step 15**
6	1. Disconnect the inoperative power mirror. 2. Connect a test lamp between the inoperative mirror motor control circuits of the power mirror harness connector. 3. Place the mirror selector switch to the mirror to be tested. 4. Activate the power mirror switch in both directions for the functions being tested. Does the test lamp illuminate in both directions?	Go to **Step 12**	Go to **Step 8**
7	Repair the battery positive voltage circuit of the power mirror switch for a short to ground or an open. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 18**	Go to **Step 9**
8	Test the mirror motor control circuits for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 9**
9	Probe each of the power mirror motor control circuits of the power mirror switch harness connector with a test lamp that is connected to battery positive voltage. Did the test lamp illuminate at any of the power mirror motor control circuits?	Go to **Step 13**	Go to **Step 10**
10	Probe each of the power mirror motor control circuits of the power mirror switch harness connector with a test lamp that is connected to ground. Did the test lamp illuminate at any of the power mirror motor control circuits?	Go to **Step 14**	Go to **Step 11**
11	Inspect for poor connections at the harness connector of the power mirror switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.		

	Did you find and correct the condition?	Go to **Step 18**	Go to **Step 16**
12	Inspect for poor connections at the harness connector of the inoperative power mirror. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 17**
13	Repair the short to ground in the power mirror motor control circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 18**	-
14	Repair the short to battery positive voltage in the power mirror motor control circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 18**	-
15	Repair the open in the power mirror switch ground circuit. Refer **Wiring Repairs** to in Wiring Systems. Did you complete the repair?	Go to **Step 18**	-
16	Replace the power mirror switch. Refer to **Power Mirror Switch Replacement (Impala)** or **Power Mirror Switch Replacement (Monte Carlo)**. Did you complete the replacement?	Go to **Step 18**	-
17	Replace the power mirror motor. Refer to **Motor Replacement - Power Mirror**. Did you complete the replacement?	Go to **Step 18**	-
18	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

HEATED MIRRORS INOPERATIVE

Heated Mirrors Inoperative

Step	Action	Yes	No
Schematic Reference: Outside Mirror Schematics **Connector End View Reference: Power Door Systems Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?		Go to **Diagnostic System Check - Vehicle** in Vehicle DTC

		Go to **Step 2**	Information
2	Verify that the Heated Mirrors Inoperative complaint is present. Does the Heated Mirrors System operate as described in the Description and Operation?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	Is the rear defogger inoperative also?	Go to **Defogger Inoperative - Rear Window** in Stationary Windows	Go to **Step 4**
4	1. Disconnect the inoperative mirror. 2. Using a test lamp connected to ground, probe the heated mirror element supply voltage circuit. 3. Turn ON the ignition. 4. Place the rear defogger switch to the ON position. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 6**
5	1. Turn OFF the ignition. 2. Using a test lamp, probe between the heated mirror element supply voltage circuit and the heated mirror element ground circuit. 3. Turn ON the ignition. 4. Place the rear defogger switch to the ON position. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 7**
6	Repair the poor connection or an open in the heated mirror element supply voltage circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 9**	-
7	Repair the poor connection or an open in the heated mirror ground circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 9**	-

8	Replace the mirror face. Refer to **Mirror Face Replacement**. Did you complete the repair?	Go to **Step 9**	-
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

REPAIR INSTRUCTIONS

FRONT DOOR SWITCH BEZEL REPLACEMENT - (IMPALA)

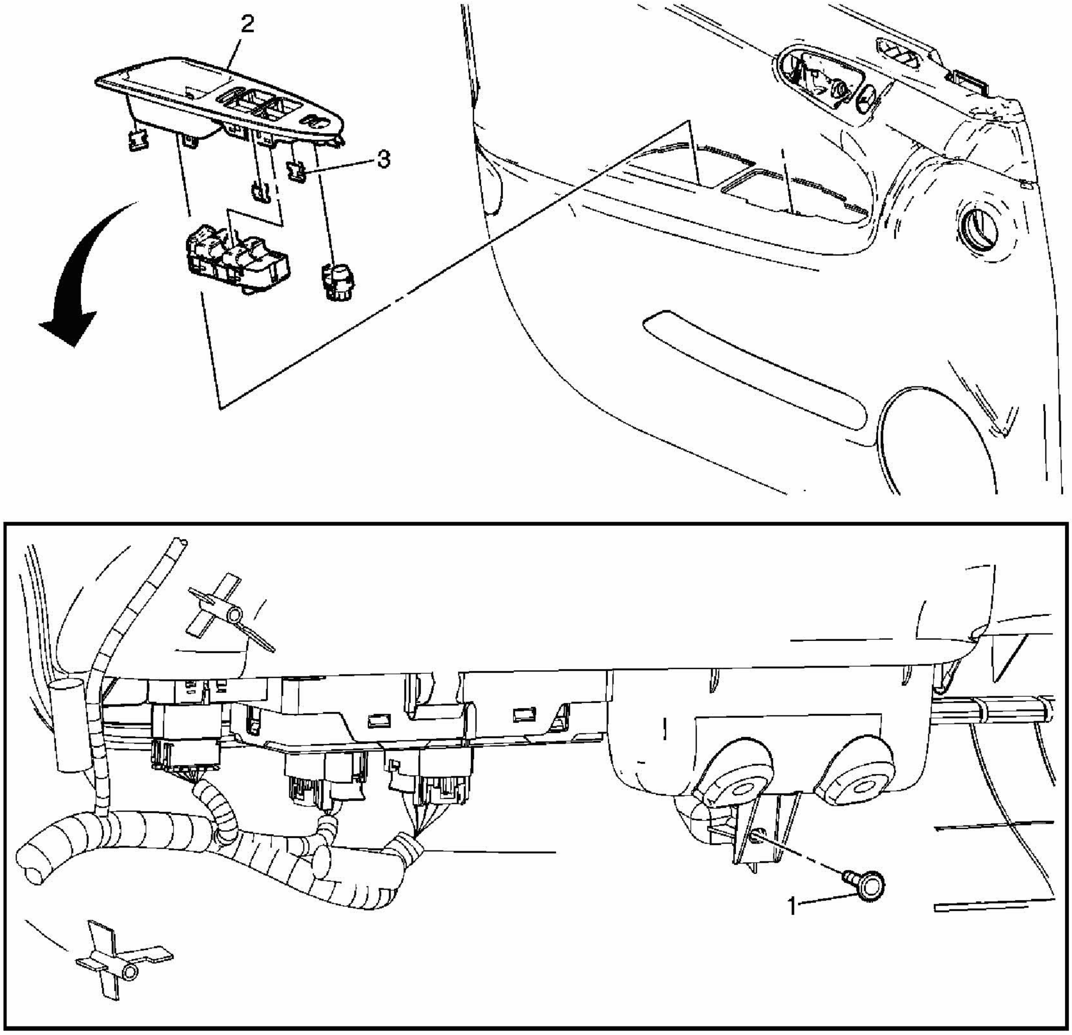


Fig. 41: Replacing Front Door Switch Bezel
Courtesy of GENERAL MOTORS CORP.

Bezel Replacement - Front Door Switch (Impala)

Callout	Component Name

NOTE: **Refer to Fastener Notice .**	
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the door panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.	
1	Screw, Side Door Pull Handle **Tighten:** 2 N.m (18 lb in)
2	Plate Assembly, Side Door Armrest Switch Mount
3	Clip, Side Door Arm Rest Switch Mount Plate

FRONT DOOR SWITCH BEZEL REPLACEMENT - (MONTE CARLO)

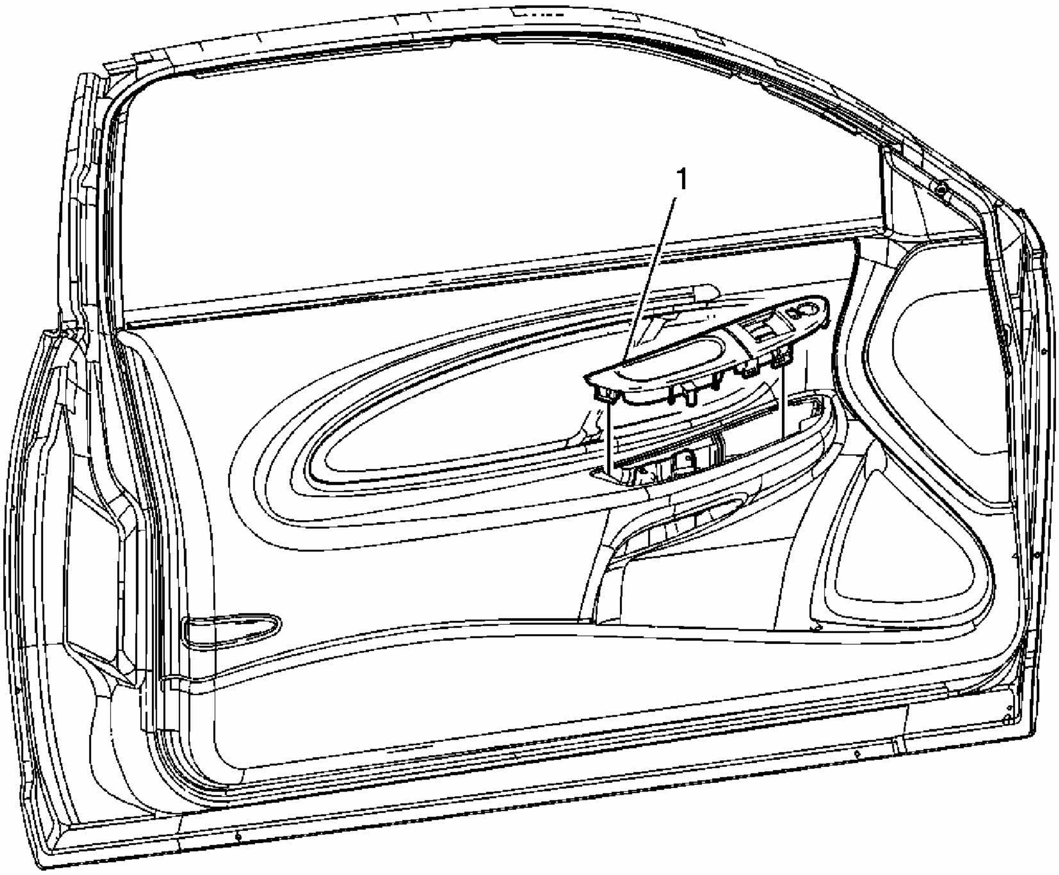


Fig. 42: Replacing Front Door Switch Bezel
Courtesy of GENERAL MOTORS CORP.

Bezel Replacement - Front Door Switch (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .**	
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .**Preliminary Procedure:** Remove the door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.	
1	Front Side Door Armrest Switch Plate **Tip:** 1. Remove the two pull cup to switch plate screws. **Tighten:** 2 N.m (18 lb in) 2. Pull up to disengage the retainers. 3. Disconnect the electrical connectors. 4. If replacing the switch plate transfer the switches.

LEFT FRONT POWER WINDOW SWITCH REPLACEMENT - (MONTE CARLO)

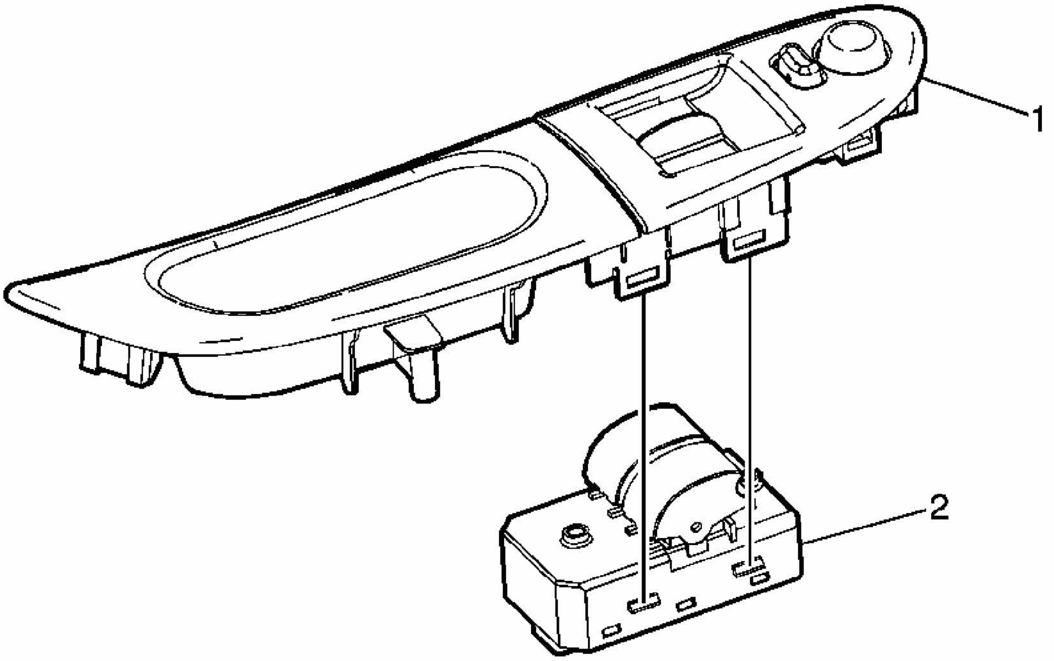


Fig. 43: Replacing Left Front Power Window Switch
Courtesy of GENERAL MOTORS CORP.

Power Window Switch Replacement - Left Front (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .	
1	Front Side Door Armrest Switch Plate **Tip:** 1. Pull up to disengage the retainers. 2. Disconnect the electrical connectors.
2	Side Window Switch Assembly

RIGHT FRONT POWER WINDOW SWITCH REPLACEMENT - (MONTE CARLO)

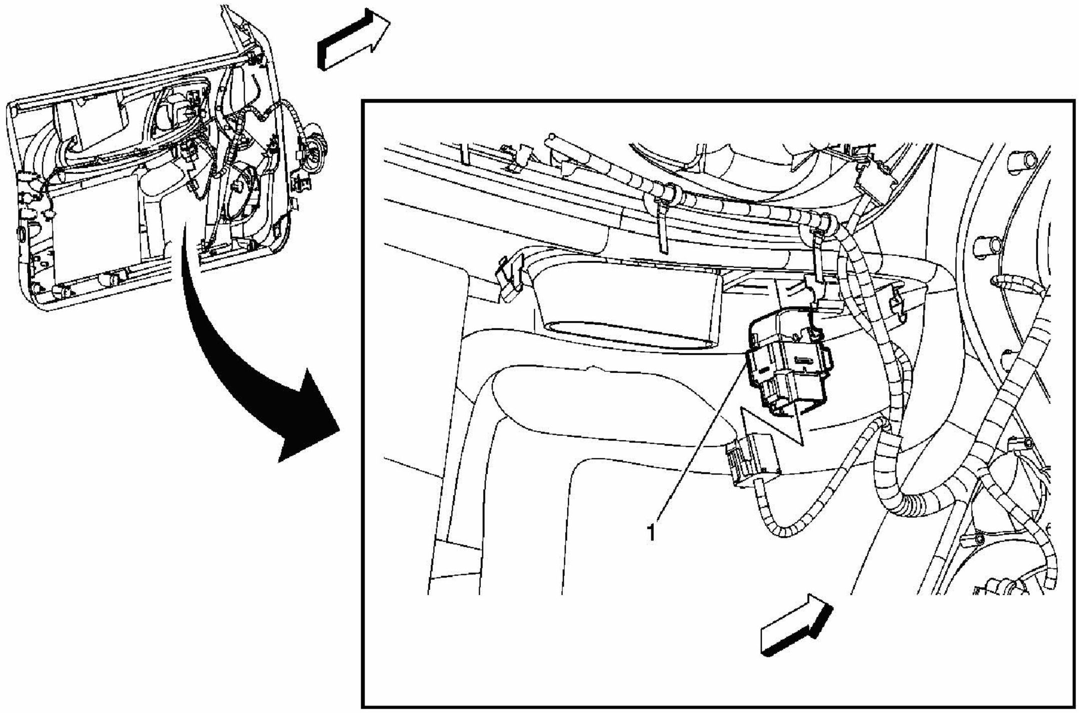


Fig. 44: Replacing Right Front Power Window Switch
Courtesy of GENERAL MOTORS CORP.

Power Window Switch Replacement - Right Front (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** . **Preliminary Procedure:** Remove the door trim panel. Refer to **Trim Panel Replacement - Door (Monte Carlo)**.	
1	Front Side Door Window Switch Assembly **Tip:** Disconnect the electrical connector and remove from the back side of

	the door trim panel.

POWER WINDOW SWITCH REPLACEMENT (IMPALA)

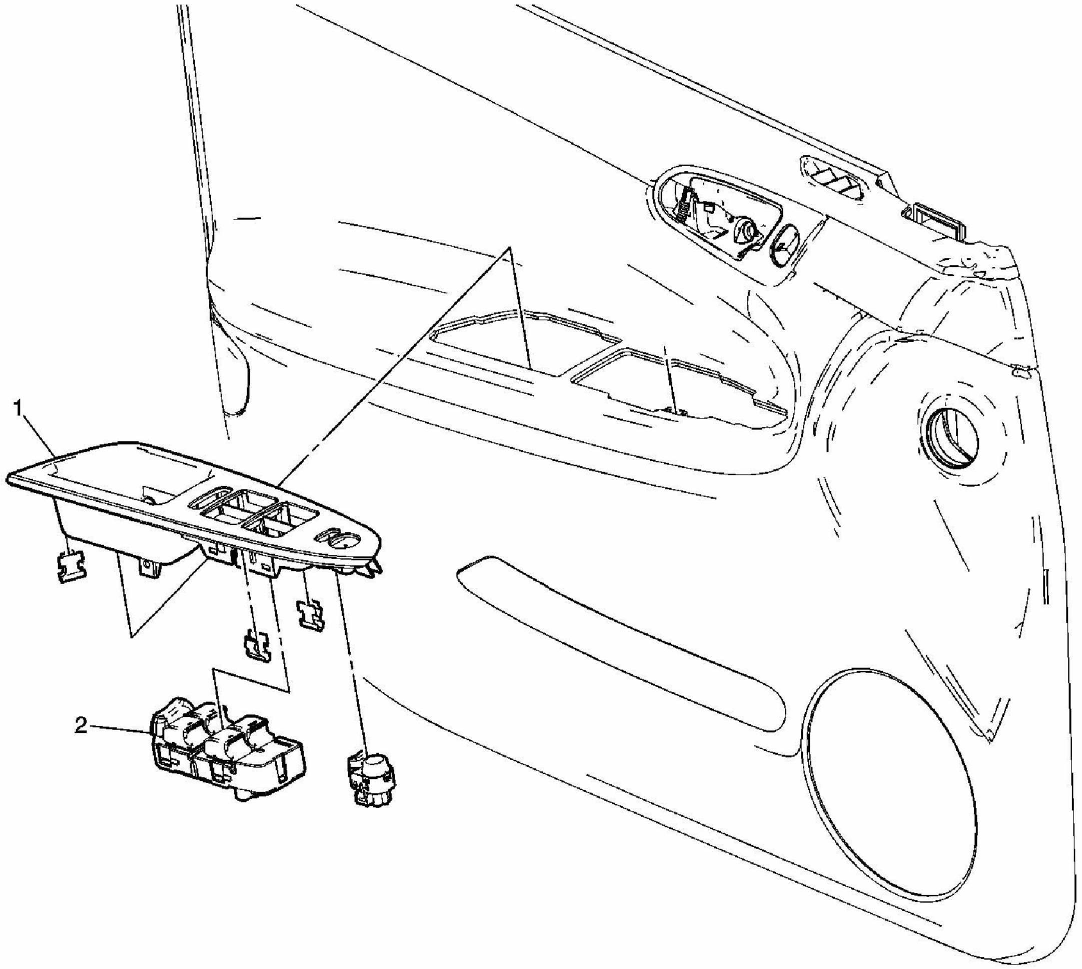


Fig. 45: Replacing Power Window Switch
Courtesy of GENERAL MOTORS CORP.

Power Window Switch Replacement (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .**	
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
Preliminary Procedure	
1. Remove the door panel. Refer to **Trim Panel Replacement - Side Front Door**	

(Impala). 2. Remove the front door switch bezel. Refer to **Bezel Replacement - Front Door Switch (Impala)** or **Bezel Replacement - Front Door Switch (Monte Carlo)**.	
1	Plate Assembly, Side Door Armrest Switch Mount
2	Switch, Power Window

REAR DOOR POWER WINDOW SWITCH REPLACEMENT

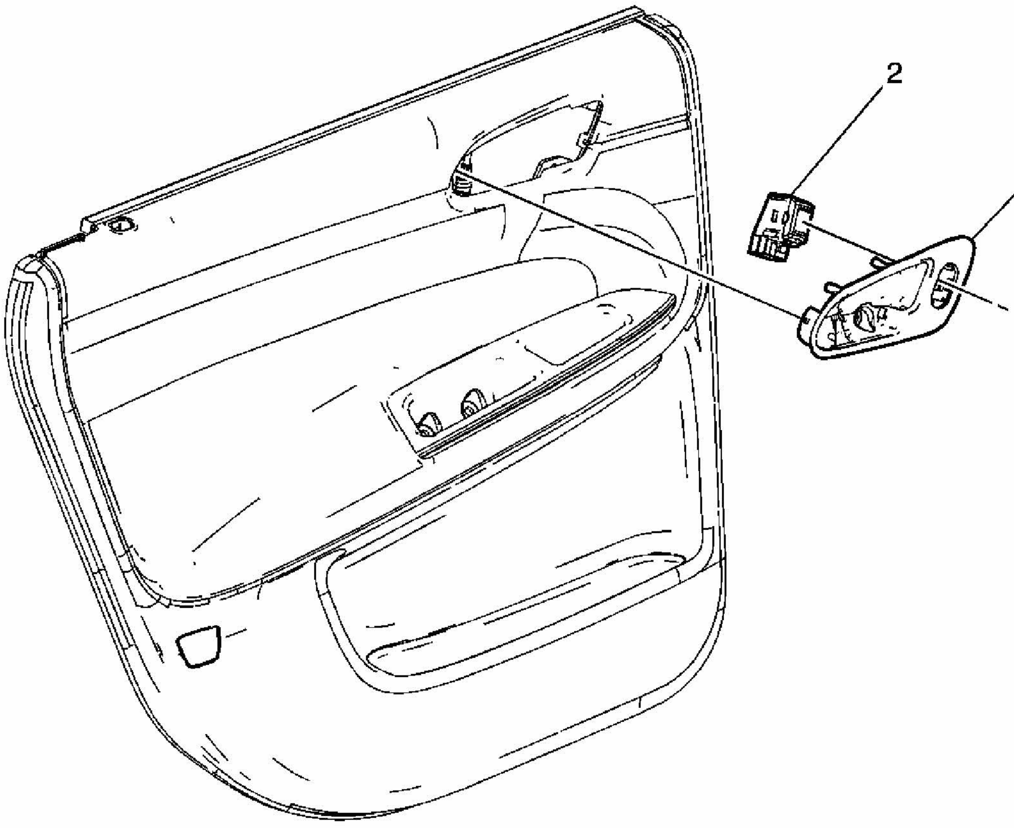


Fig. 46: Replacing Rear Door Power Window Switch
Courtesy of GENERAL MOTORS CORP.

Power Window Switch Replacement - Rear Door

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .	
1	Rear Side Door Inside Handle Bezel **Tip:** 1. Pull out at the front edge of the bezel to disengage the retainer 2. Disconnect the power window switch electrical connector.

2	Rear Side Door Window Switch Assembly

POWER DOOR LOCK SWITCH REPLACEMENT (IMPALA)

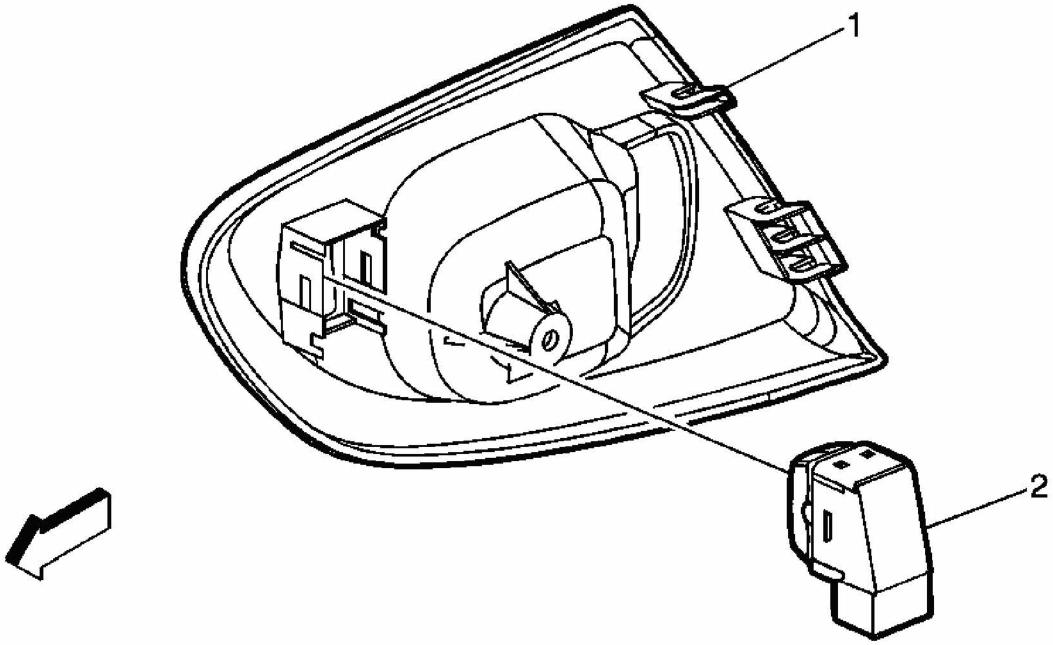


Fig. 47: Replacing Power Door Lock Switch
Courtesy of GENERAL MOTORS CORP.

Power Door Lock Switch Replacement (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .	
1	Front Door Inside Handle Bezel Refer to **Handle Bezel Replacement - Inside - Front (Impala)** or **Handle Bezel Replacement - Inside - Front (Monte Carlo)**.
2	Front Side Door Lock Switch Assembly **Tip:** Disconnect the electrical connector and remove from the back side of the door trim panel.

POWER DOOR LOCK SWITCH REPLACEMENT (MONTE CARLO)

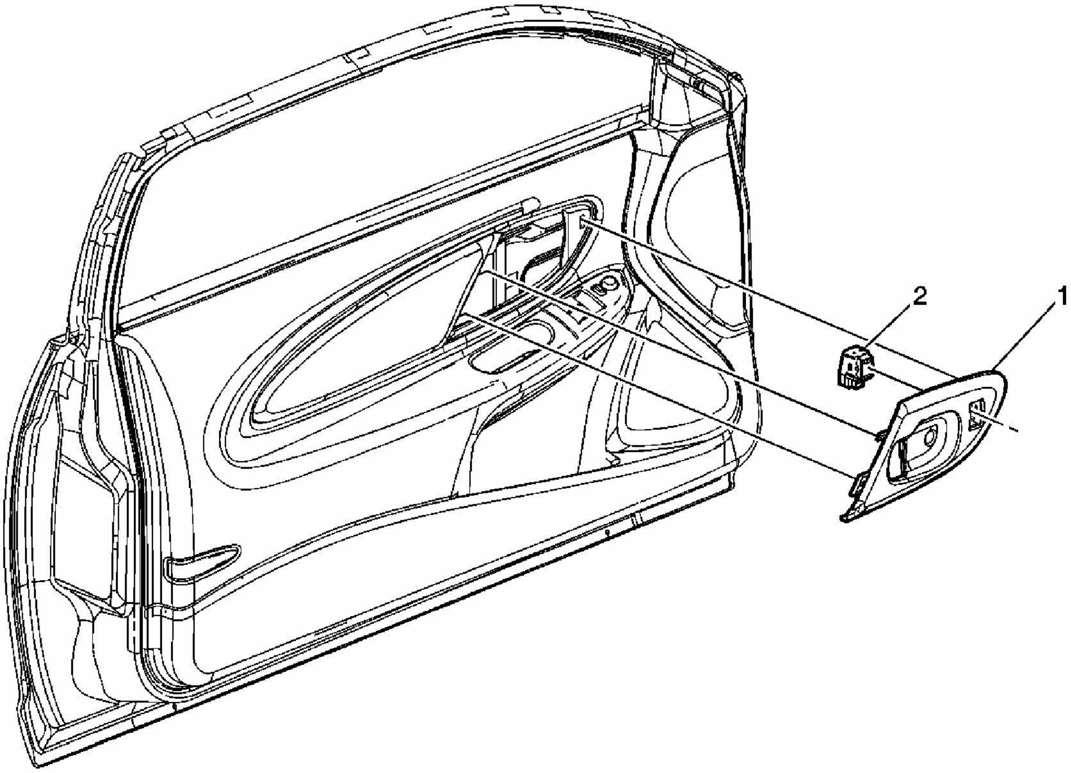


Fig. 48: Replacing Power Door Lock Switch
Courtesy of GENERAL MOTORS CORP.

Power Door Lock Switch Replacement (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .	
1	Front Side Door Inside Handle Bezel **Tip:** 1. Pull out at the front edge of the bezel to disengage the retainer 2. Disconnect the door lock switch electrical connector.
2	Door Lock Switch Assembly

POWER MIRROR SWITCH REPLACEMENT (IMPALA)

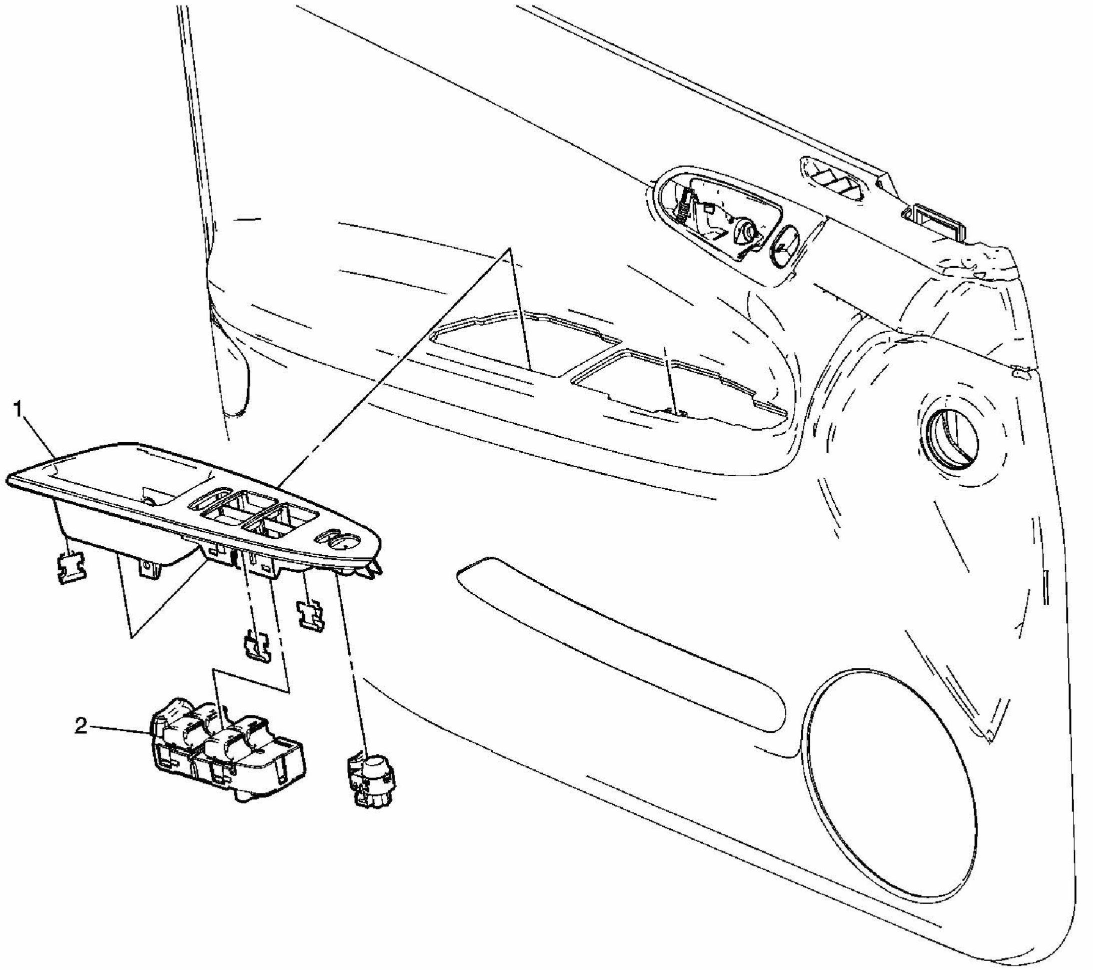


Fig. 49: Replacing Power Mirror Switch
Courtesy of GENERAL MOTORS CORP.

Power Mirror Switch Replacement (Impala)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">NOTE:
Refer to Fastener Notice .
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.
Preliminary Procedure
1. Remove the door panel. Refer to Trim Panel Replacement - Side Front Door (Impala).
2. Remove the front door switch bezel. Refer to Bezel Replacement - Front Door Switch (Impala) or Bezel Replacement - Front Door Switch (Monte Carlo).</td></tr>
<tr><td>1</td><td>Plate Assembly, Side Door Armrest Switch Mount</td></tr>
</table>

2	Switch, Power Mirror

POWER MIRROR SWITCH REPLACEMENT (MONTE CARLO)

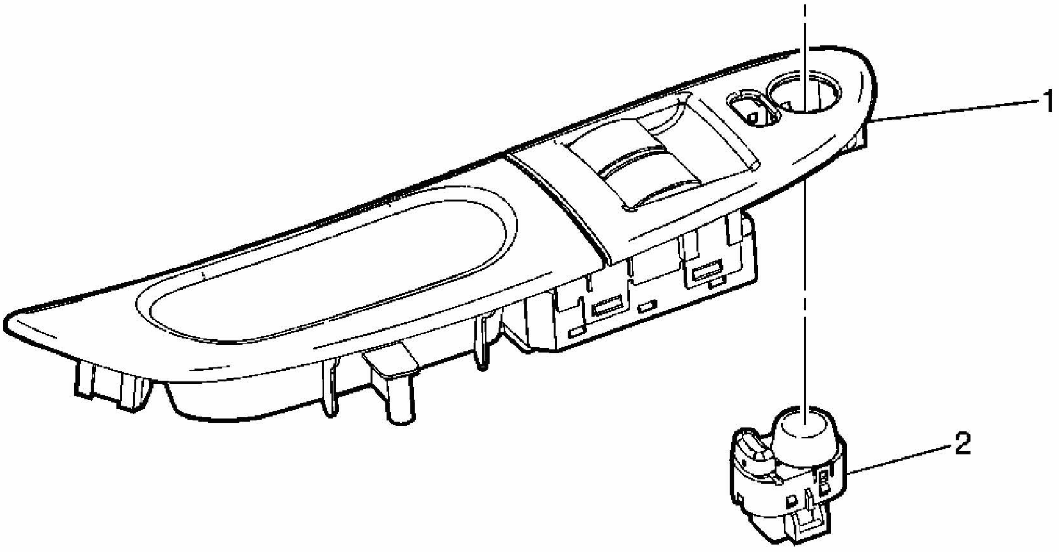


Fig. 50: Replacing Power Mirror Switch
Courtesy of GENERAL MOTORS CORP.

Power Mirror Switch Replacement (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .	
1	Front Side Door Armrest Switch Plate **Tip:** 1. Pull up to disengage the retainers. 2. Disconnect the electrical connectors.
2	Outside Rear View Mirror Switch Assembly

FRONT INSIDE HANDLE BEZEL REPLACEMENT - (IMPALA)

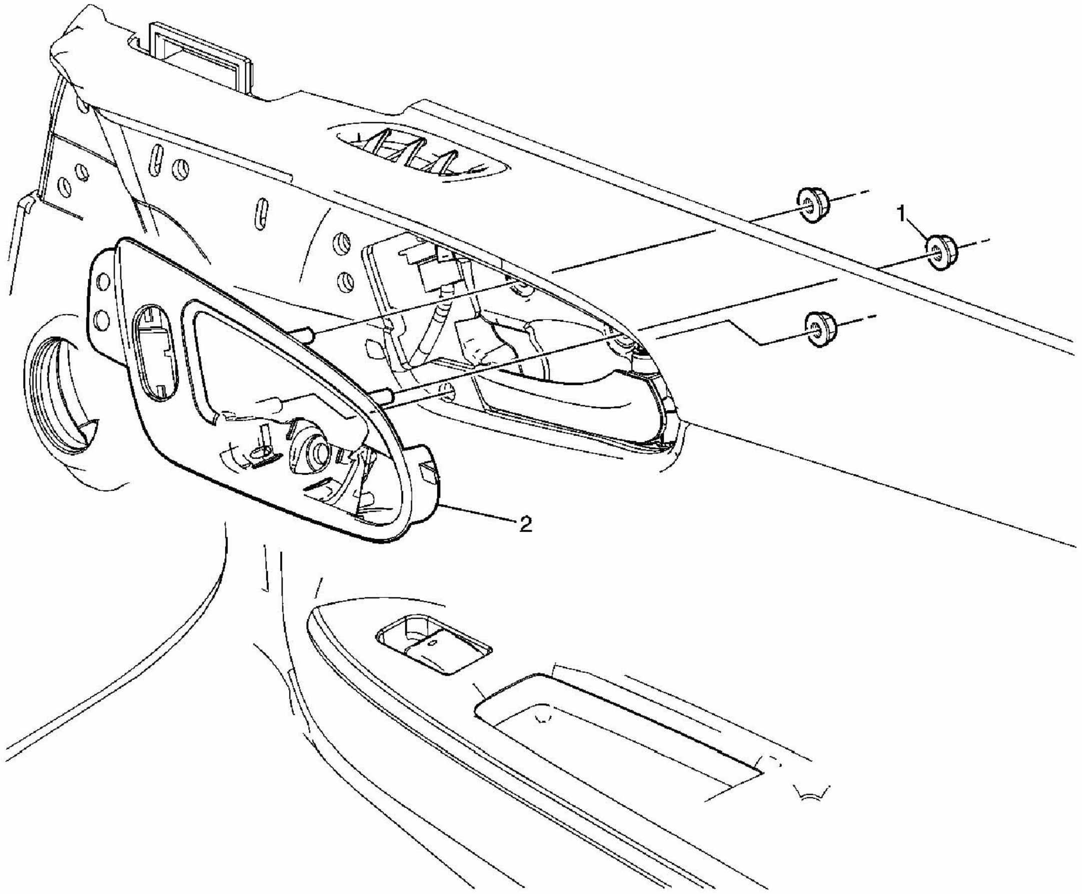


Fig. 51: Replacing Front Inside Handle Bezel
Courtesy of GENERAL MOTORS CORP.

Handle Bezel Replacement - Inside - Front (Impala)

Callout	Component Name
NOTE: Refer to Fastener Notice . **Fastener Tightening Specifications:** Refer to Fastener Tightening Specifications. **Preliminary Procedure** 1. Remove the door panel. Refer to Trim Panel Replacement - Side Front Door (Impala). 2. Remove the trim panel applique. Refer to Trim Panel Replacement - Applique (Impala).	
1	Nut, Side Door Handle Bezel (Qty: 3)

	Tighten: 2 N.m (18 lb in)
2	Bezel, Side Door Handle

FRONT INSIDE HANDLE BEZEL REPLACEMENT - (MONTE CARLO)

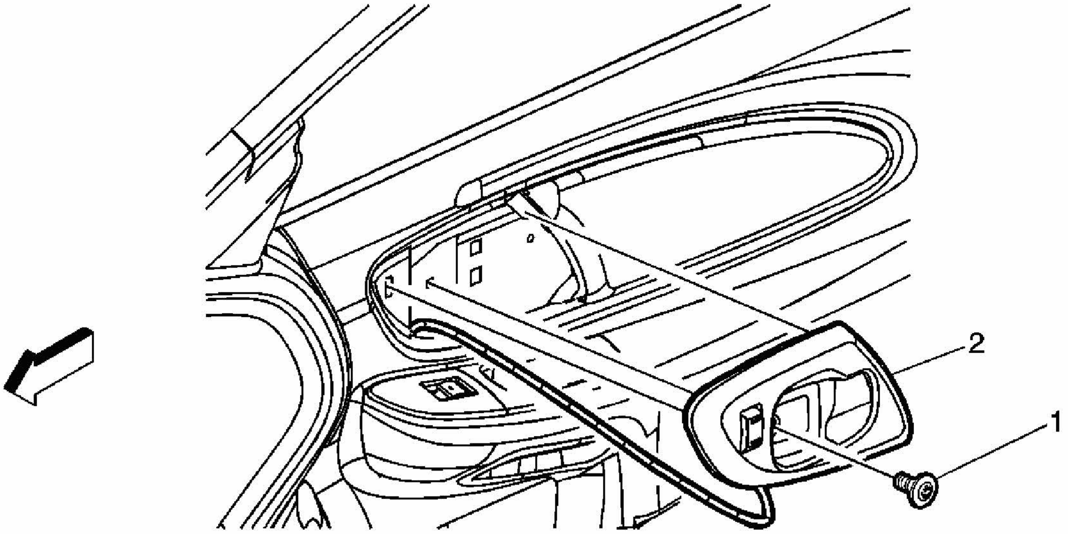


Fig. 52: Replacing Front Inside Handle Bezel
Courtesy of GENERAL MOTORS CORP.

Handle Bezel Replacement - Inside - Front (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications** .	
1	Front Side Door Inside Handle Screw **Tighten:** 3 N.m (25 lb in)
2	Front Door Inside Handle Bezel **Tip:** Disconnect the electrical connector.

REAR INSIDE HANDLE BEZEL REPLACEMENT - (IMPALA)

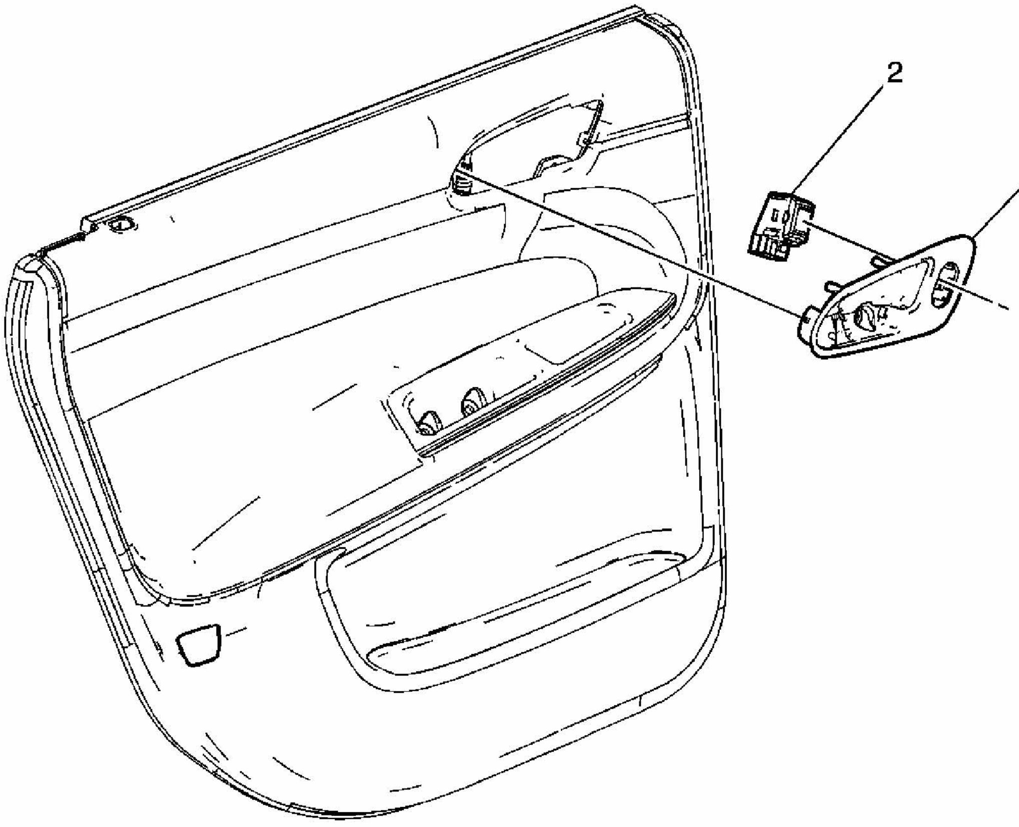


Fig. 53: Replacing Rear Inside Handle Bezel
Courtesy of GENERAL MOTORS CORP.

Handle Bezel Replacement - Inside - Rear (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .	
1	Rear Side Door Inside Handle Bezel **Tip:** 1. Pull out at the front edge of the bezel to disengage the retainer 2. Disconnect the power window switch electrical connector.
2	Rear Side Door Window Switch Assembly **Tip:** The switch only needs to be removed and transferred if replacing the door inside handle bezel.

APPLIQUE TRIM PANEL REPLACEMENT - (IMPALA)

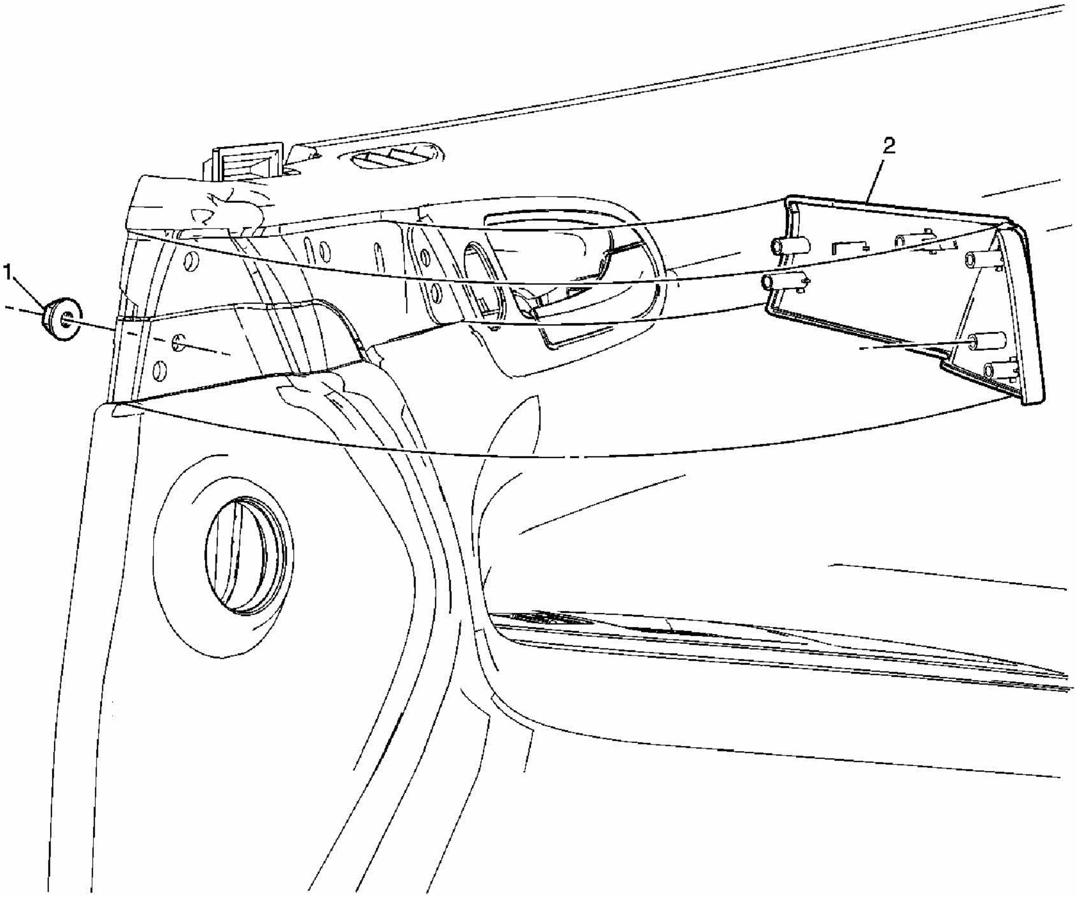


Fig. 54: Replacing Applique Trim Panel
Courtesy of GENERAL MOTORS CORP.

Trim Panel Replacement - Applique (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the door panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.	
1	Nut, Escutcheon Side Door Handle (Qty: 3) **Tighten:** 2 N.m (18 lb in)
2	Escutcheon, Side Door Handle

DOOR TRIM PANEL REPLACEMENT - (MONTE CARLO)

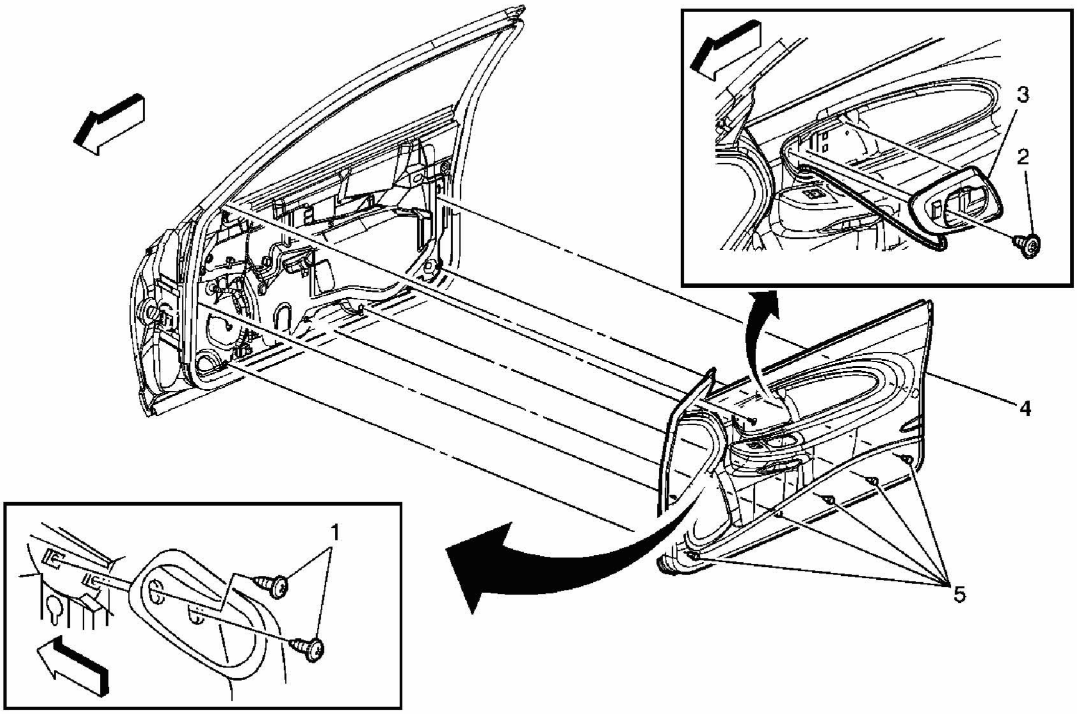


Fig. 55: Replacing Door Trim Panel
Courtesy of GENERAL MOTORS CORP.

Trim Panel Replacement - Door (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications** .	
1	Front Side Door Armrest Screw (Qty: 2) **Tip:** Remove the pull cup liner to access the screws. **Tighten:** 10 N.m (89 lb in)
2	Front Side Door Inside Handle Screw **Tighten:** 2 N.m (18 lb in)
3	Front Door Inside Handle Bezel **Tip:** Disconnect the electrical connector.
4	Front Side Door Trim Panel **Tip:** Use a **J 38778** Door Trim Pad Clip Remover to aid in the removal of the side door trim panel. See **Special Tools**.
5	Door Trim Panel Retainer Clip (Qty: 5)

SIDE FRONT DOOR TRIM PANEL REPLACEMENT - (IMPALA)

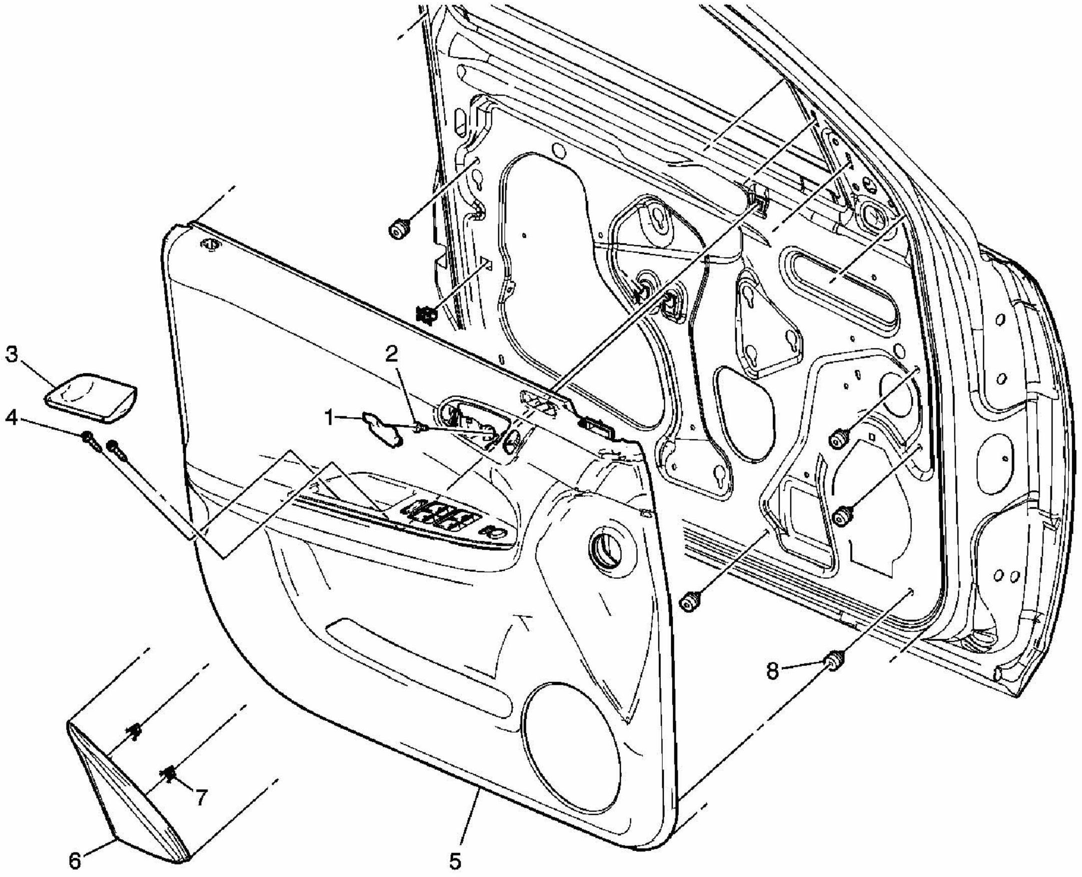


Fig. 56: Replacing Side Front Door Trim Panel
Courtesy of GENERAL MOTORS CORP.

Trim Panel Replacement - Side Front Door (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Cover, Front Side Door Inside Handle Bezel
2	Screw, Front Side Door Inside Handle Bezel **Tighten:** 2 N.m (18 lb in)
3	Cover, Armrest Finish
4	Screw, Front Side Door Pull Handle **Tighten:** 2 N.m (18 lb in)

5	Trim Assembly, Front Side Door
6	Panel Assembly, Side Door Upper Trim **Tip:** • Release the inside door handle cable. • Disconnect the electrical connectors.
7	Clip, Side Door Upper Trim
8	Retainer, Side Door Trim

SIDE REAR DOOR TRIM PANEL REPLACEMENT - (IMPALA)

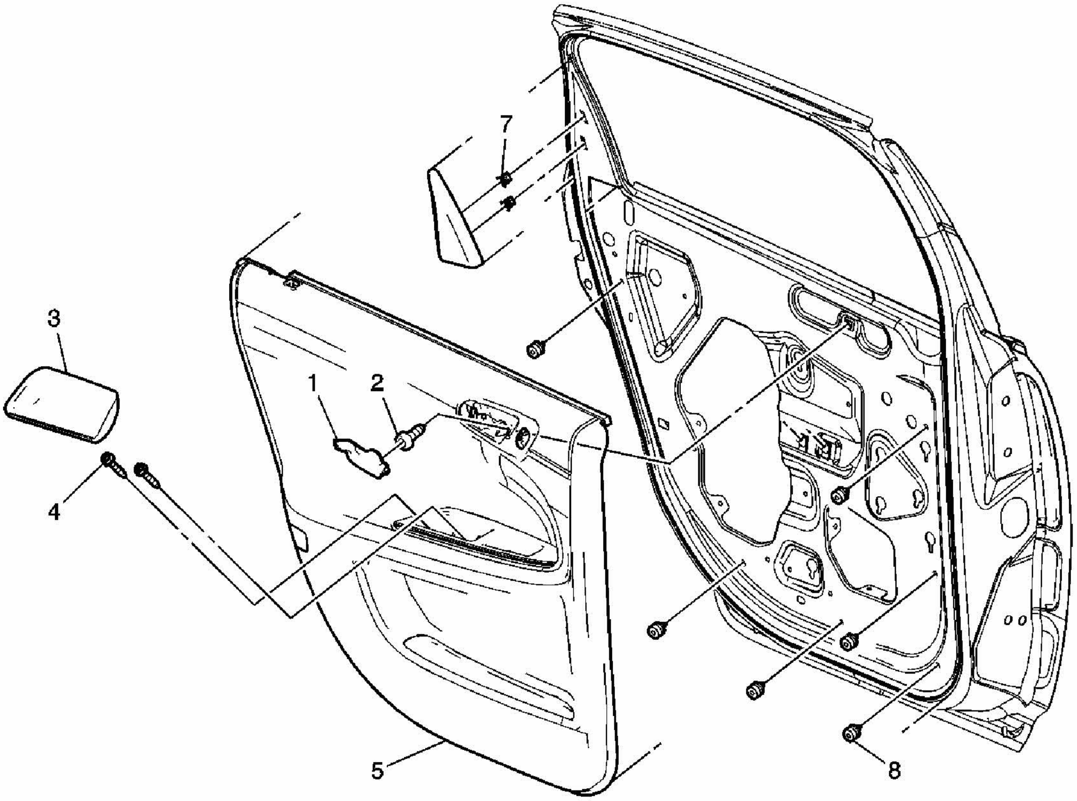


Fig. 57: Replacing Side Rear Door Trim Panel
Courtesy of GENERAL MOTORS CORP.

Trim Panel Replacement - Side Rear Door (Impala)

Callout	Component Name
NOTE: Refer to Fastener Notice .	
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	

1	Cover, Rear Side Door Inside Handle Bezel
2	Screw, Rear Side Door Inside Handle Bezel **Tighten:** 2 N.m (18 lb in)
3	Cover, Armrest Finish
4	Screw, Rear Side Door Pull Handle **Tighten:** 2 N.m (18 lb in)
5	Trim Assembly, Rear Side Door
6	Panel Assembly, Side Door Upper Trim **Tip:** • Release the inside door handle cable. • Disconnect the electrical connectors.
7	Clip, Side Door Upper Trim
8	Retainer, Side Door Trim

INNER REAR ENERGY ABSORBER PAD REPLACEMENT

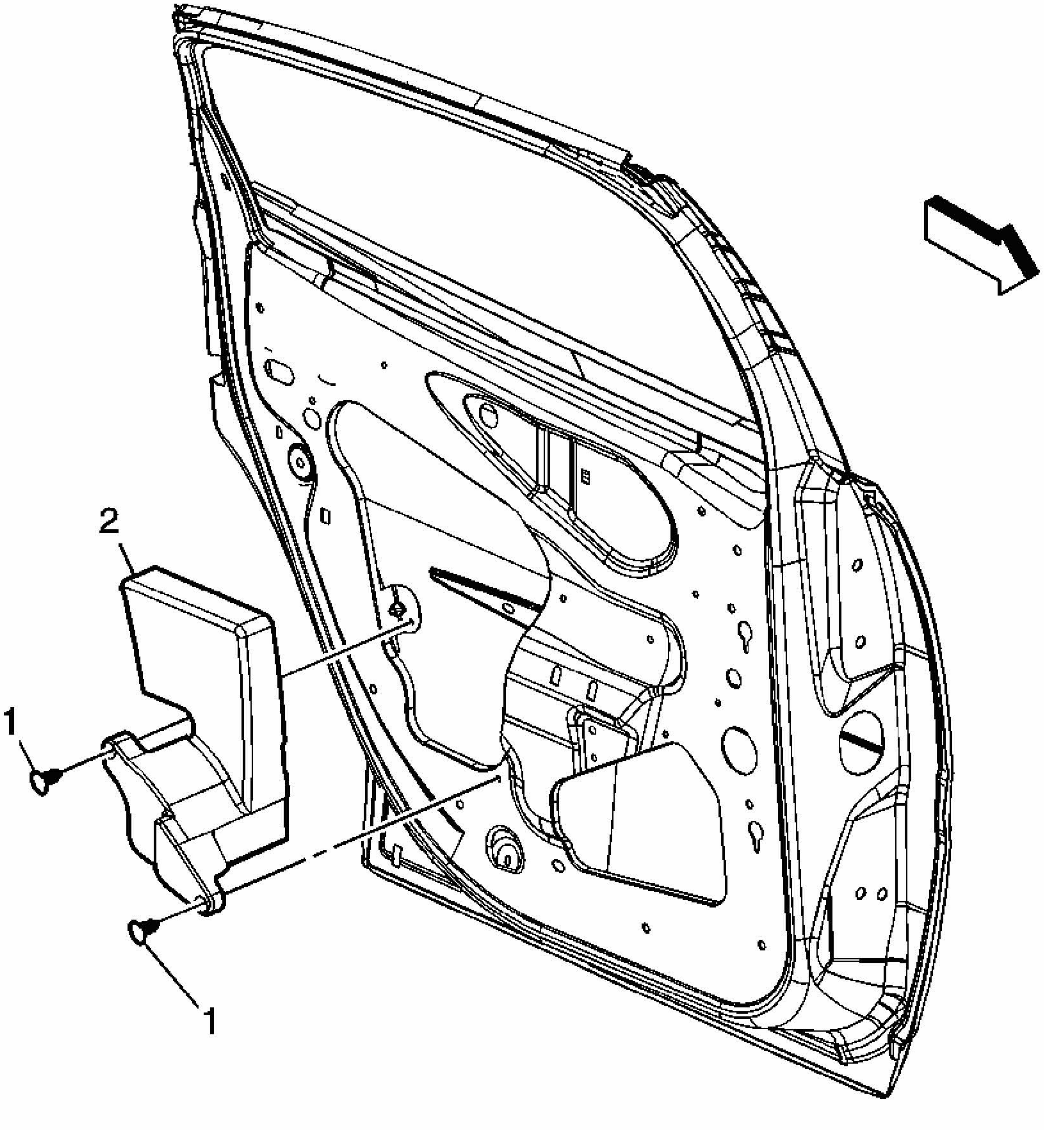


Fig. 58: Replacing Inner Rear Energy Absorber Pad
Courtesy of GENERAL MOTORS CORP.

Energy Absorber Pad Replacement - Inner Rear

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**. 2. Remove the water deflector. Refer to **Water Deflector Replacement - Rear**	

Door (Impala).	
1	Retainer, Push Pin (Qty: 2)
2	Absorber, Rear Side Door Energy **Tip:** Pull the absorber from the door to release the retainers and adhesive.

INNER FRONT ENERGY ABSORBER PAD REPLACEMENT

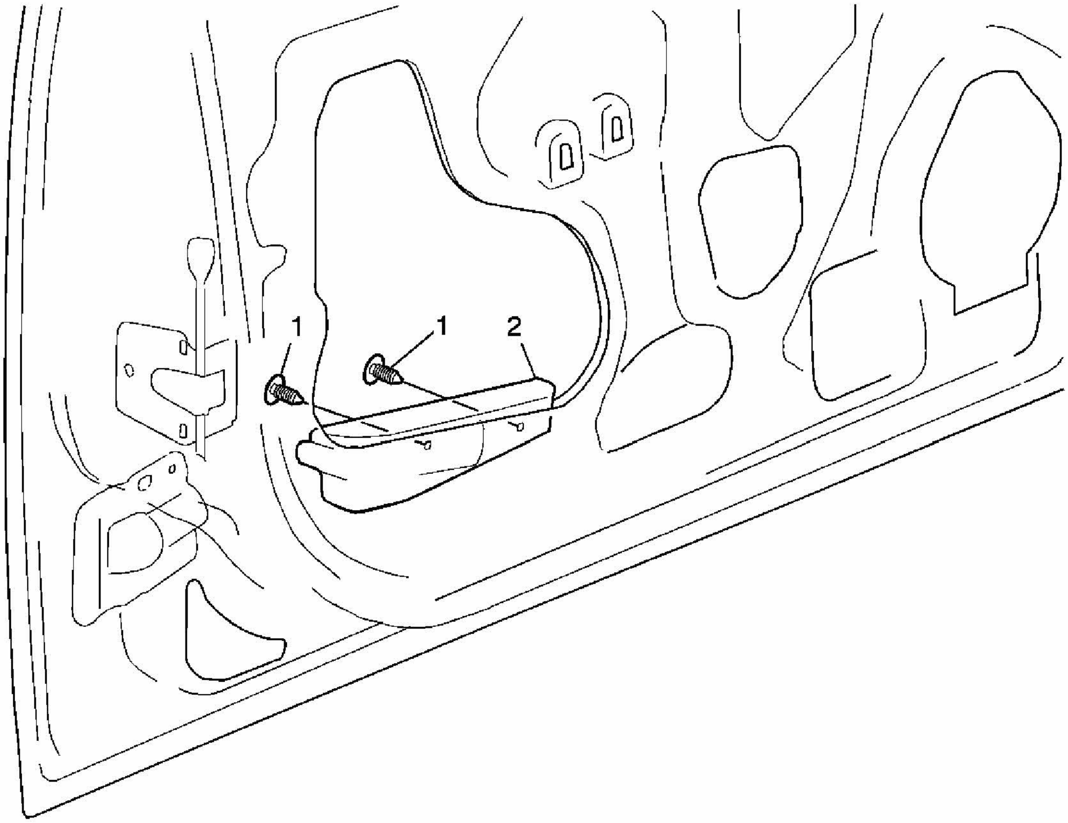


Fig. 59: Replacing Inner Front Energy Absorber Pad
Courtesy of GENERAL MOTORS CORP.

Energy Absorber Pad Replacement - Inner Front

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**. 2. Remove the water deflector. Refer to **Water Deflector Replacement - Rear Door (Impala)**.	

1	Retainer, Push Pin (Qty: 2)
2	Absorber, Front Side Door Energy **Tip:** Pull the absorber from the door to release the retainers and adhesive.

FRONT DOOR WATER DEFLECTOR REPLACEMENT - (IMPALA)

Removal Procedure

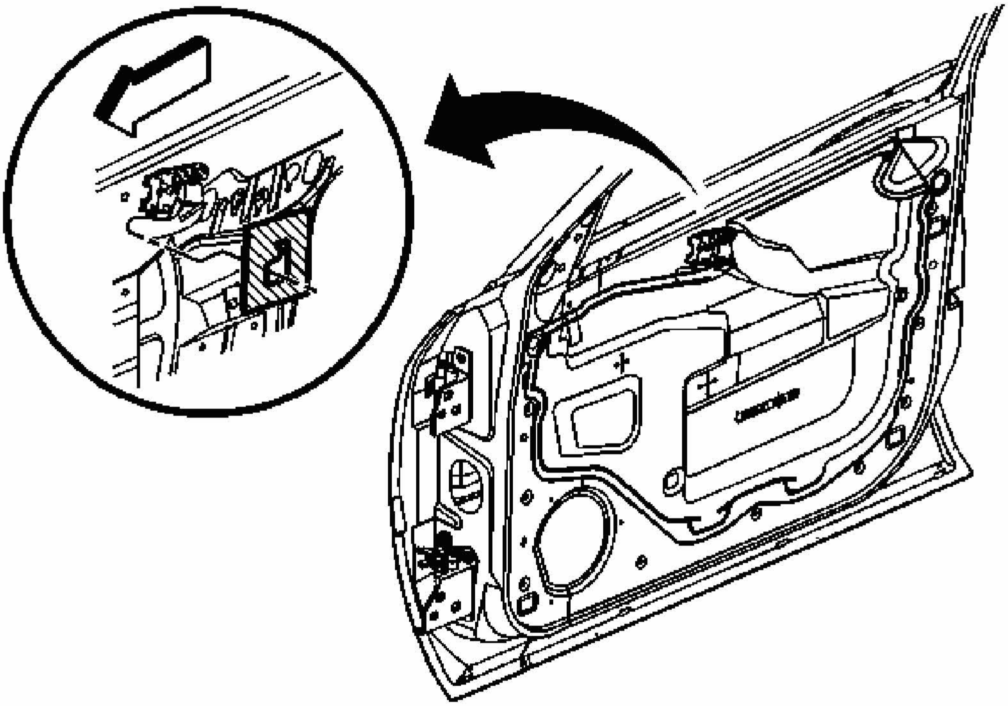


Fig. 60: Front Door Water Deflector (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Remove the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.
2. Remove the front door pull handle bracket from the front door inner panel.
3. Disconnect all of the required electrical connectors.
4. Remove the inside door handle gasket.
5. Remove the front door water deflector from the front door inner panel.

Installation Procedure

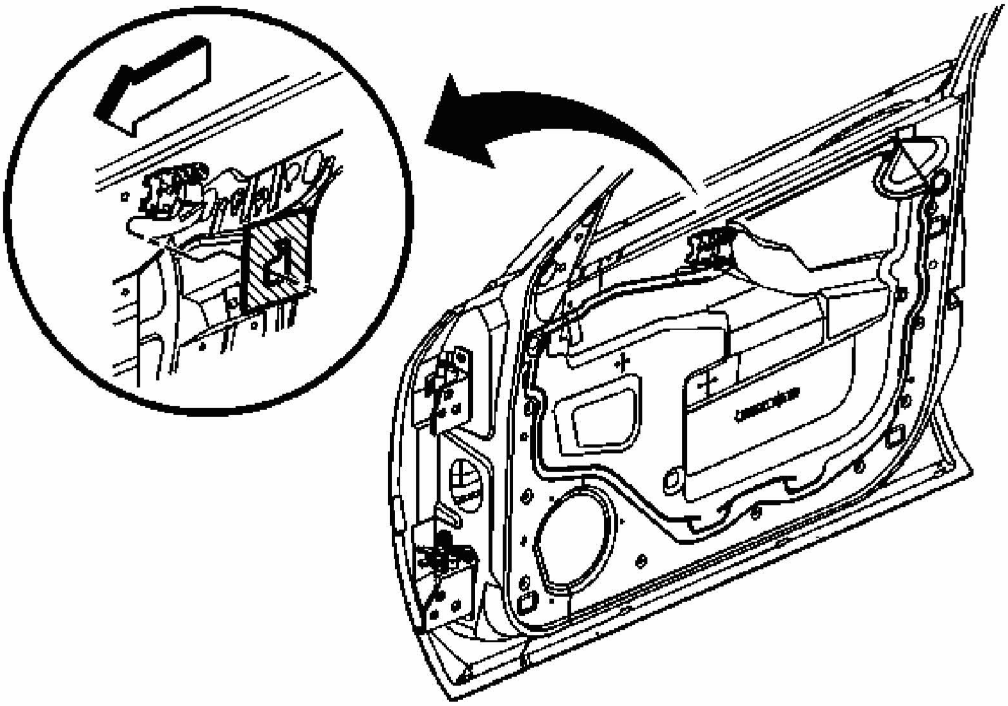


Fig. 61: Front Door Water Deflector (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Align the front door water deflector to the front door inner panel. Secure the water deflector at the corners.
2. Pull the front door wiring harness leads through the slits in the front door water deflector.
3. Install the front door water deflector, start pressing the adhesive pattern at the bottom center and working outward and upward in order to prevent puckering.
4. Install the inside door handle gasket.
5. Connect all of the required electrical connectors.
6. Install the front door pull handle bracket to the front door inner panel.
7. Install the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.

WATER DEFLECTOR REPLACEMENT - FRONT DOOR (MONTE CARLO)

Removal Procedure

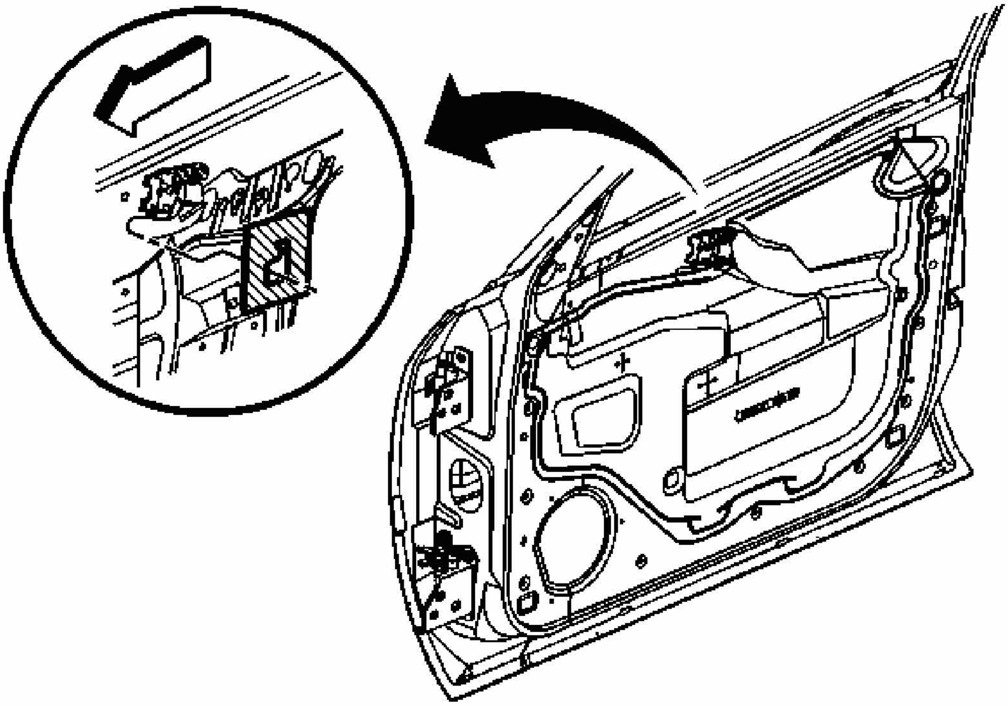


Fig. 62: Front Door Water Deflector (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Remove the front door trim panel. Refer to **Trim Panel Replacement - Door (Monte Carlo)**.
2. Disconnect all of the required electrical connectors.
3. Remove the inside door handle gasket.
4. Remove the front door water deflector from the front door inner panel.

Installation Procedure

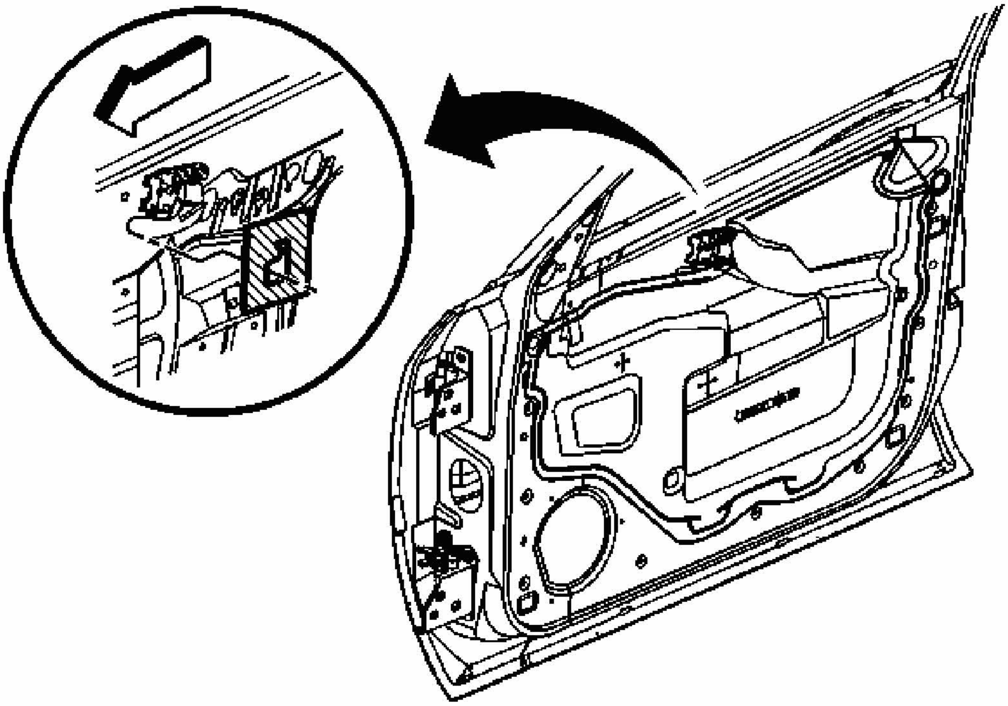


Fig. 63: Front Door Water Deflector (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Align the front door water deflector to the front door inner panel. Secure the water deflector at the corners.
2. Pull the front door wiring harness leads through the slits in the front door water deflector.
3. Install the front door water deflector, start pressing the adhesive pattern at the bottom center and working outward and upward in order to prevent puckering.
4. Install the inside door handle gasket.
5. Connect all of the required electrical connectors.
6. Install the front door pull handle bracket to the front door inner panel.
7. Install the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.

REAR DOOR WATER DEFLECTOR REPLACEMENT - (IMPALA)

Removal Procedure

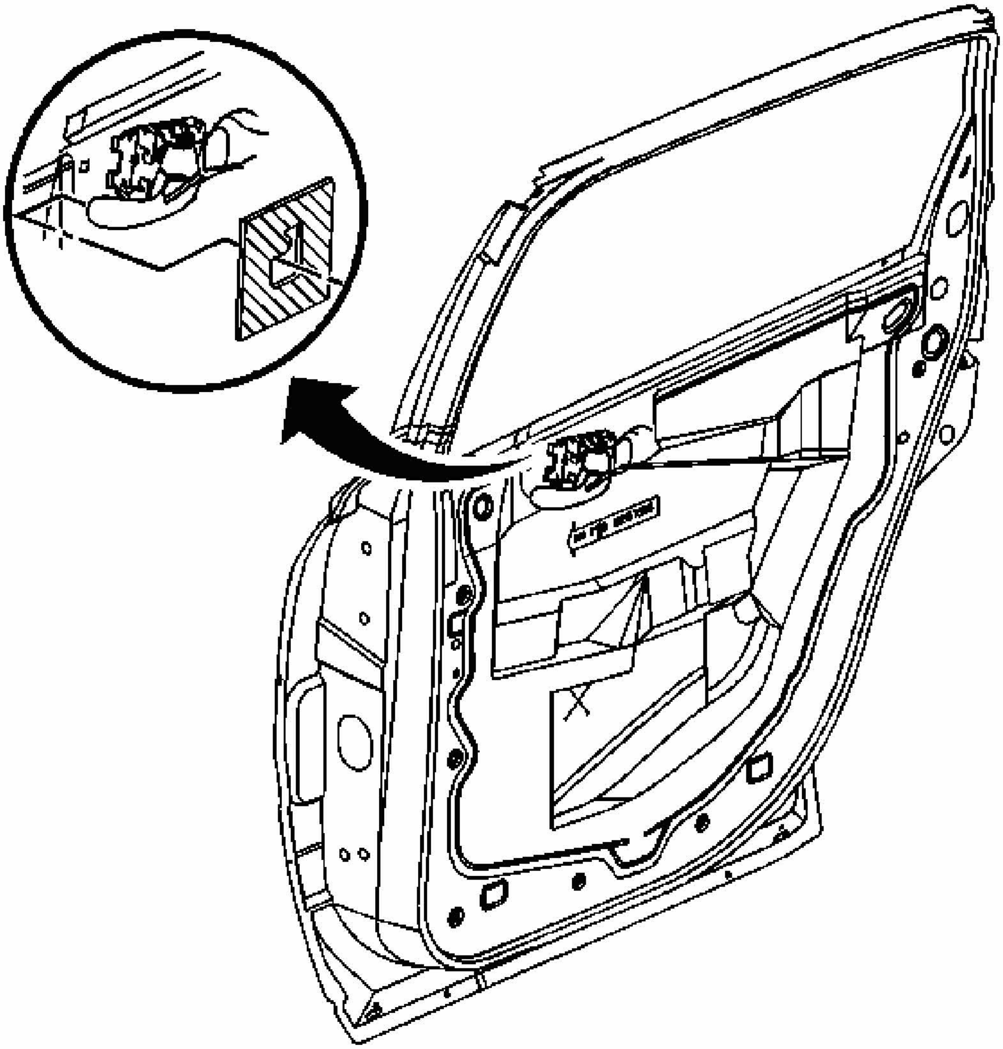


Fig. 64: Rear Door Water Deflector (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Remove the rear door trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**.
2. Remove the rear door pull handle bracket from the rear door inner panel.
3. Disconnect all of the required electrical connectors.
4. Remove the inside door handle gasket.
5. Remove the rear door water deflector from the rear door inner panel.

Installation Procedure

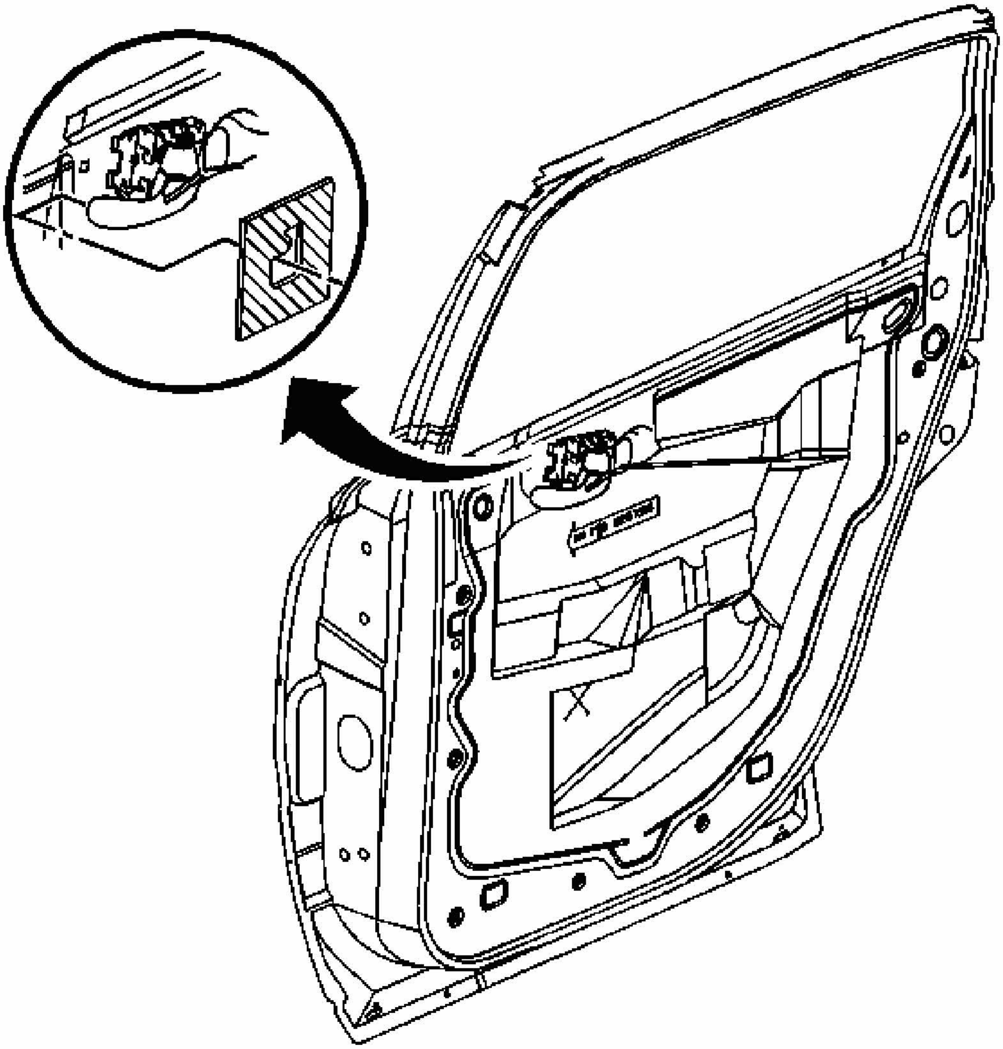


Fig. 65: Rear Door Water Deflector (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Align the rear door water deflector to the rear door inner panel. Secure the water deflector at the corners.
2. Pull the rear door wiring harness leads through the slits in the rear door water deflector.
3. Install the rear door water deflector, start pressing the adhesive pattern at the bottom center and working outward and upward in order to prevent puckering.
4. Install the inside door handle gasket.
5. Connect all of the required electrical connectors.
6. Install the rear door pull handle bracket to the rear door inner panel.

7. Install the rear door trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**.

FRONT DOOR ADJUSTMENT

Up/Down or In/Out Adjustment

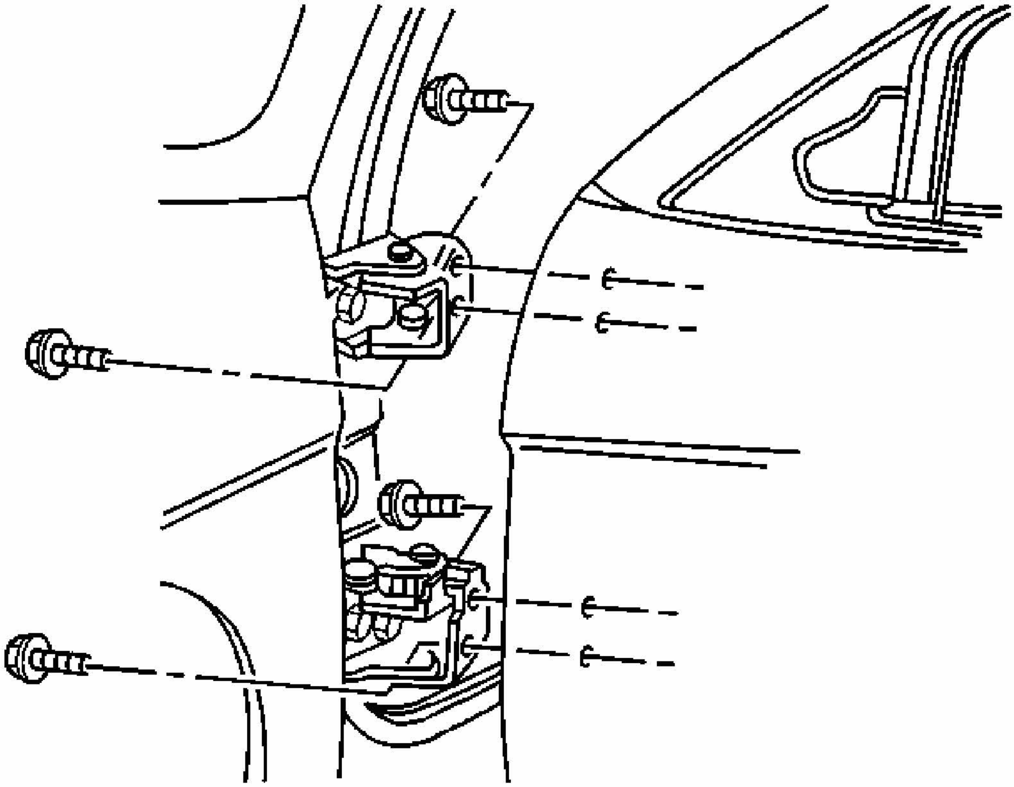


Fig. 66: Front Door Hinges
Courtesy of GENERAL MOTORS CORP.

1. Open the font door to access the front door hinge bolts.

IMPORTANT: Do not remove the front door hinge bolts.

2. Loosen the front door side hinge bolts.

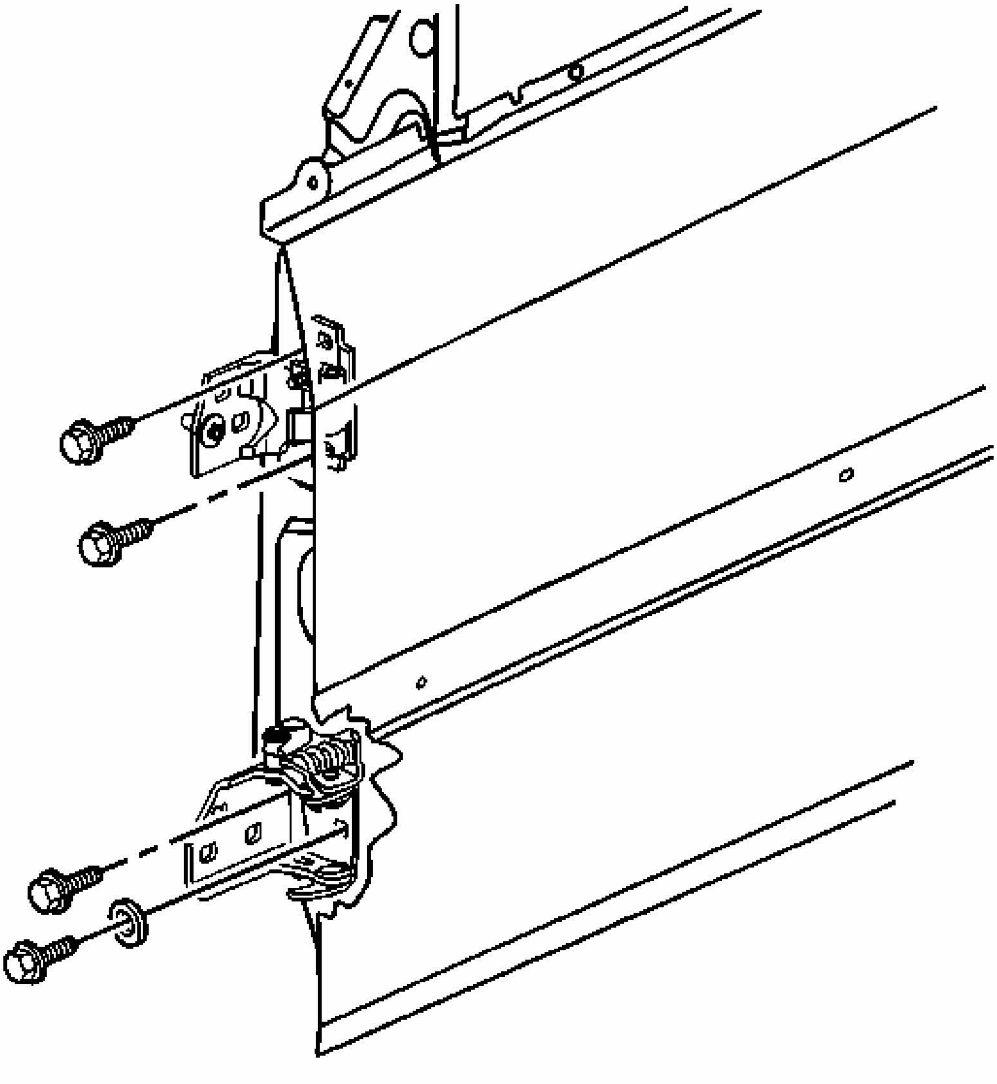


Fig. 67: Front Door Bolts
Courtesy of GENERAL MOTORS CORP.

3. Pry off the washer from the lower bolt on the lower hinge (Impala only).

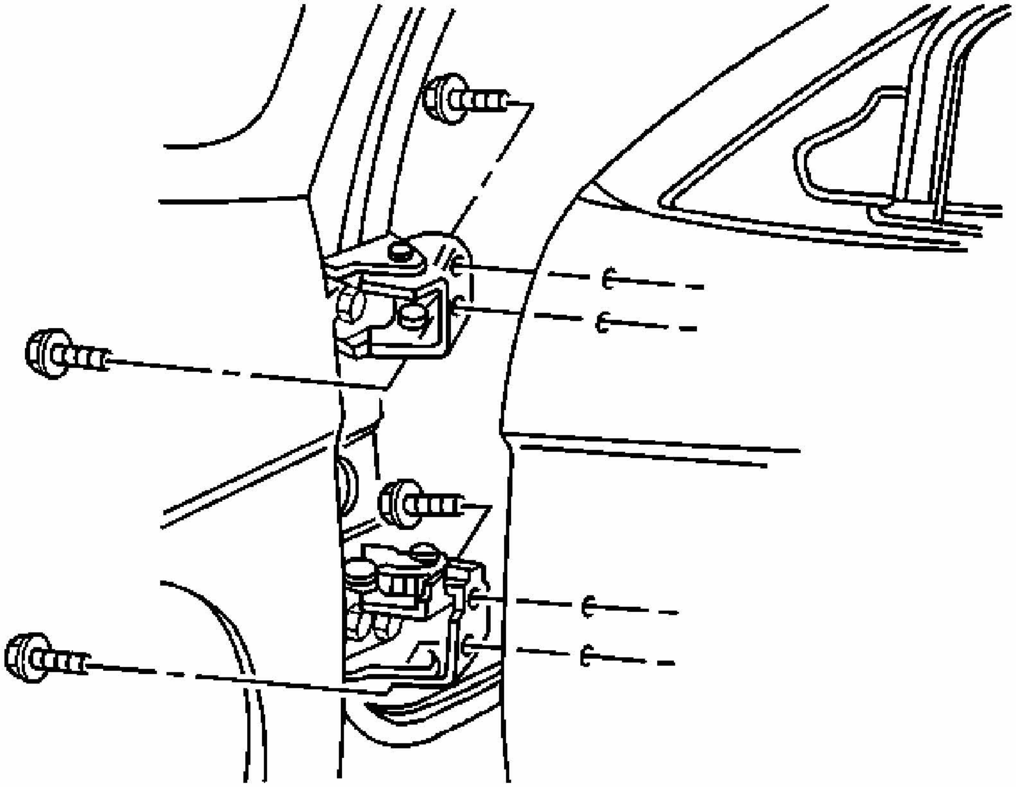


Fig. 68: Front Door Hinges
Courtesy of GENERAL MOTORS CORP.

4. Adjust the front door up or down and in and out as required.

NOTE: **Refer to FASTENER NOTICE .**

5. Tighten the door side hinge bolts.

Tighten: Tighten the front door hinge to door bolts to 33 N.m (24 lb ft).

Fore/Aft Adjustment

IMPORTANT: Do not remove the bolts.

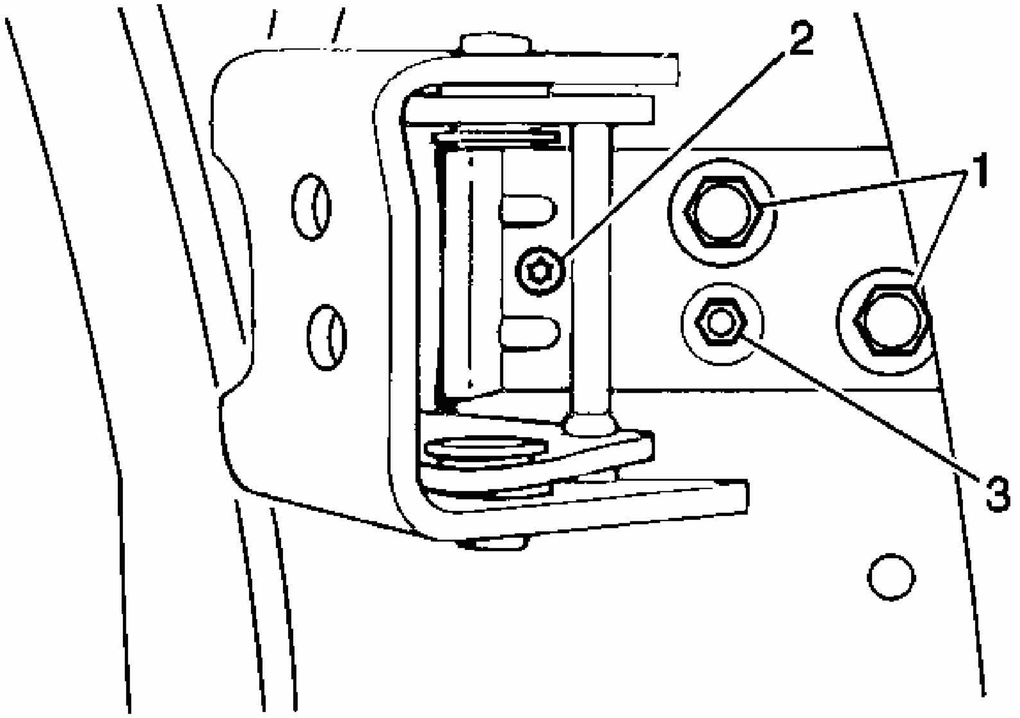


Fig. 69: Front Door Hinge & Components
Courtesy of GENERAL MOTORS CORP.

1. Loosen the body side hinge bolts (1).

   IMPORTANT: Do not remove the cone adjuster bolt.

2. Loosen the body side hinge cone adjuster bolt (3) (Monte Carlo Lower Hinge Only).

   IMPORTANT: Do not remove the TORX® bolt (2).

3. Loosen the TORX® body side hinge bolt (Monte Carlo Lower Hinge Only).
4. Adjust the door fore and aft as required.

   NOTE: Refer to FASTENER NOTICE .

5. Tighten the TORX® body side hinge bolt (2) (Monte Carlo Lower Hinge Only).

Tighten: Tighten the TORX® body side hinge bolt to 10 N.m (89 lb in).

6. Tighten the cone adjuster side hinge bolt (3) (Monte Carlo Lower Hinge Only).

   Tighten: Tighten the cone adjuster side hinge bolt to 10 N.m (89 lb in).

7. Tighten the body side hinge bolts (1).

   Tighten: Tighten the door hinge to body bolts to 33 N.m (24 lb ft).

SIDE FRONT DOOR REPLACEMENT

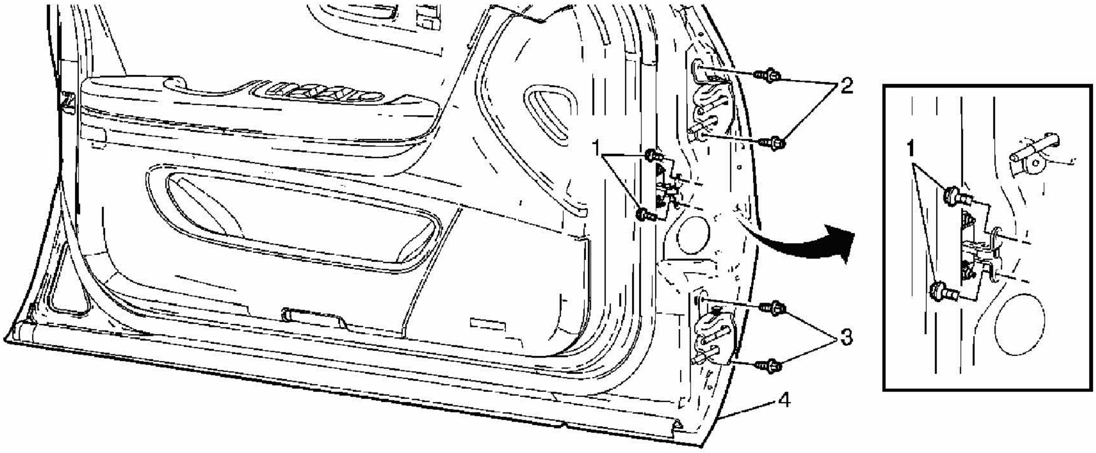


Fig. 70: Replacing Side Front Door
Courtesy of GENERAL MOTORS CORP.

Door Replacement - Side Front

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Bolt, Front Side Door Check Link (Qty: 2) **Tighten:** 25 N.m (18 lb ft)
2	Bolt, Front Side Door Upper Hinge (Qty: 2) **Tip:** • Support the door before removing the hinge bolts. • Disconnect the door electrical connector. **Tighten:** 33 N.m (24 lb ft)

3	Bolt, Front Side Door Lower Hinge (Qty: 2) **Tighten:** 33 N.m (24 lb ft)
4	Door Assembly, Front Side **Tip:** When replacing the door it is necessary to transfer all of the internal components.

SIDE REAR DOOR REPLACEMENT

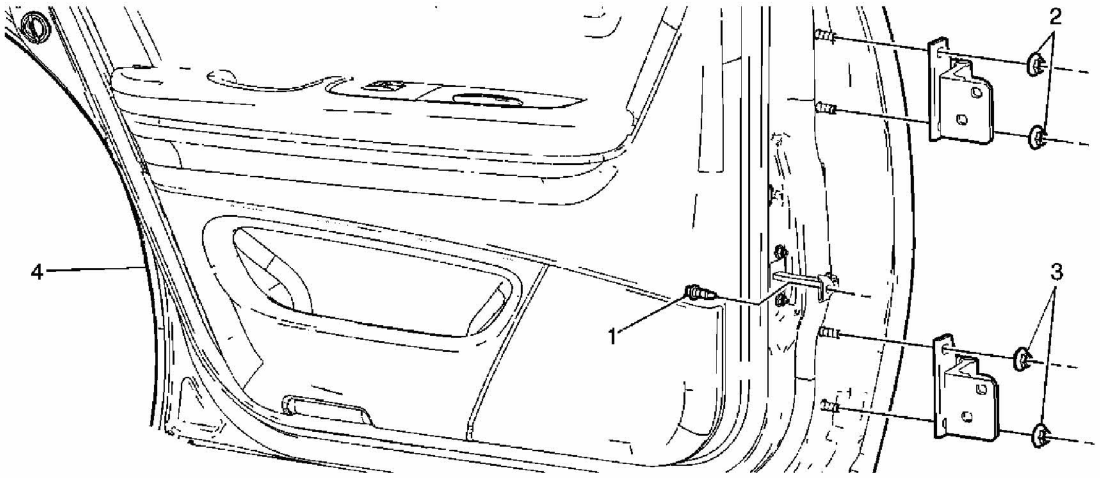


Fig. 71: Replacing Side Rear Door
Courtesy of GENERAL MOTORS CORP.

Door Replacement - Side Rear

Callout	Component Name
NOTE: Refer to Fastener Notice . **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Bolt, Rear Side Door Check Link **Tighten:** 25 N.m (18 lb ft)
2	Nut, Rear Side Door Upper Hinge (Qty: 2) **Tip:** • Support the door before removing the hinge nuts. • Disconnect the door electrical connector. **Tighten:** 26 N.m (19 lb ft)
	Nut, Rear Side Door Lower Hinge (Qty: 2)

3	**Tighten:** 26 N.m (19 lb ft)
4	Door Assembly, Rear Side **Tip:** When replacing the door it is necessary to transfer all of the internal components.

REAR DOOR ADJUSTMENT

Up/Down or In/Out Adjustment

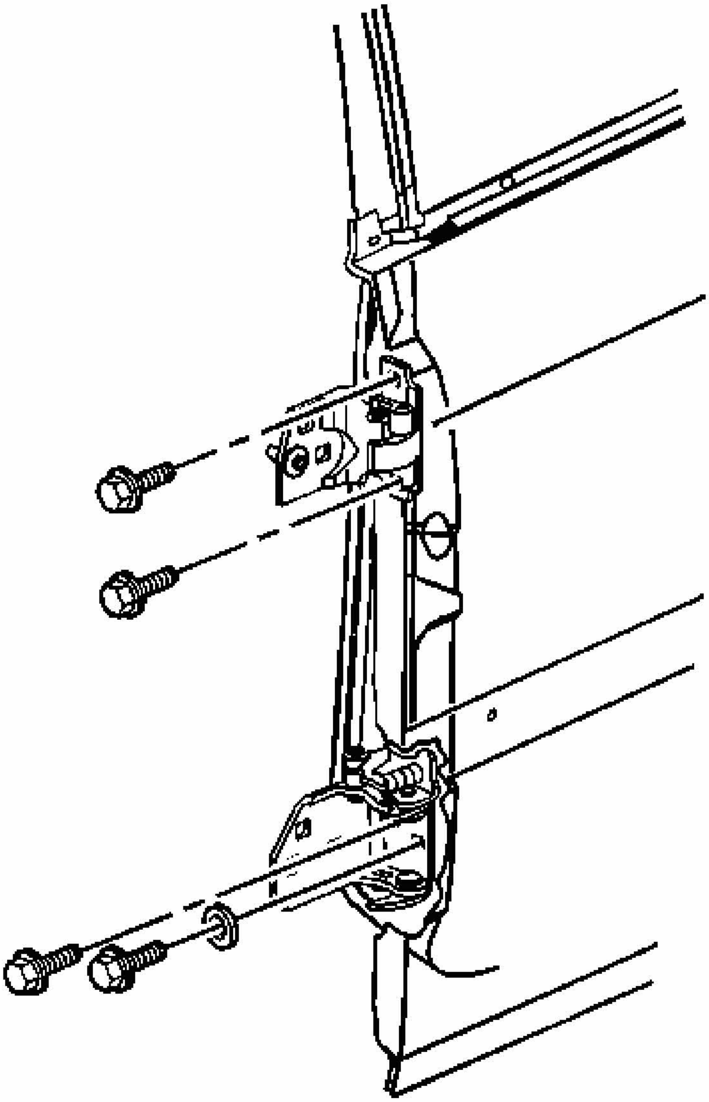


Fig. 72: Locating Door Hinge Bolts

Courtesy of GENERAL MOTORS CORP.

1. Open the front door to access the rear door hinge bolts.

IMPORTANT: Do not remove the rear door hinge bolts.

2. Loosen the rear door side hinge bolts.
3. Pry off the washer from the lower bolt on the lower hinge.
4. Adjust the rear door up or down and in and out as required.

NOTE: Refer to FASTENER NOTICE .

5. Tighten the door side hinge bolts.

Tighten: Tighten the rear door hinge to door bolts to 33 N.m (24 lb ft).

FRONT DOOR HINGE SPRING REPLACEMENT

Tools Required

J 36604 Door Hinge Spring Compressor. See **Special Tools**.

Removal Procedure

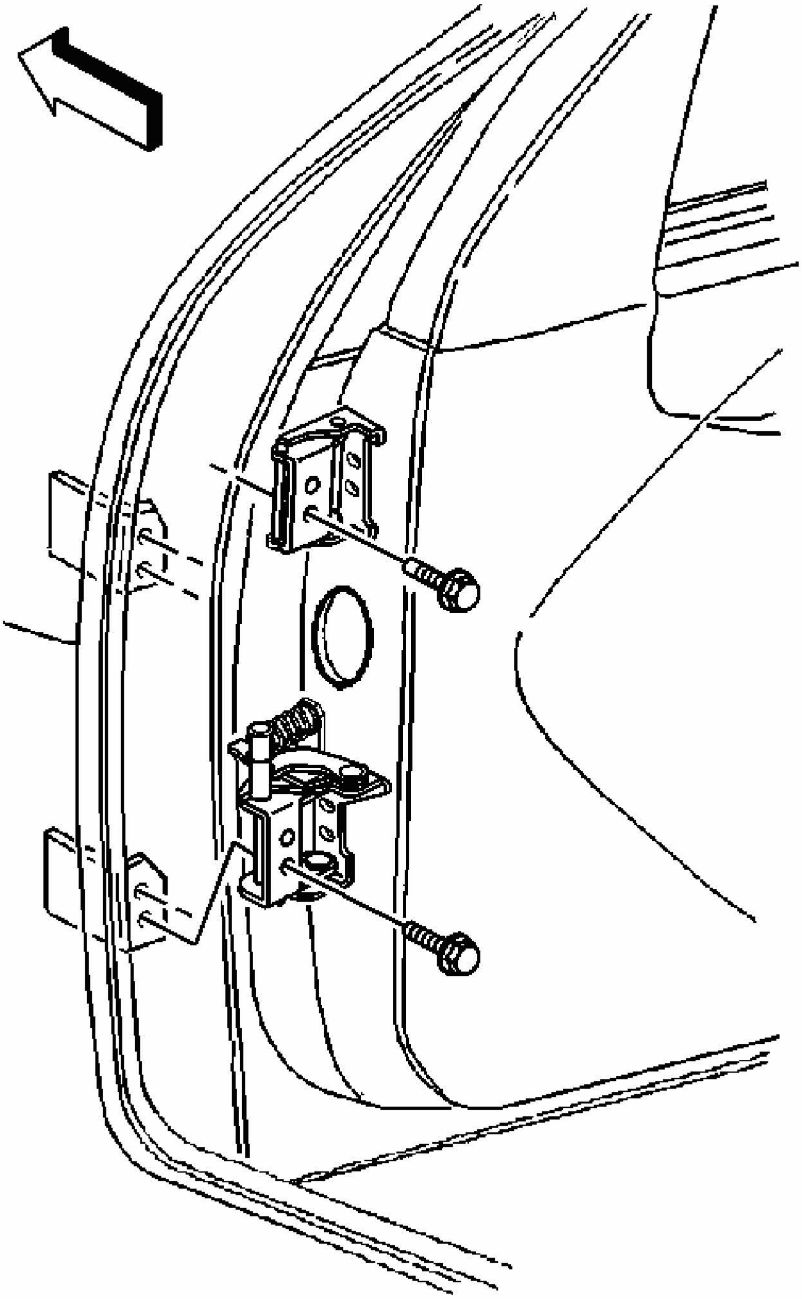


Fig. 73: Front Door Hinge
Courtesy of GENERAL MOTORS CORP.

1. Open the door.
2. Using **J 36604** , remove the door hinge spring from the door hinge. See **Special Tools**.
3. Remove the door hinge spring from the vehicle.

Installation Procedure

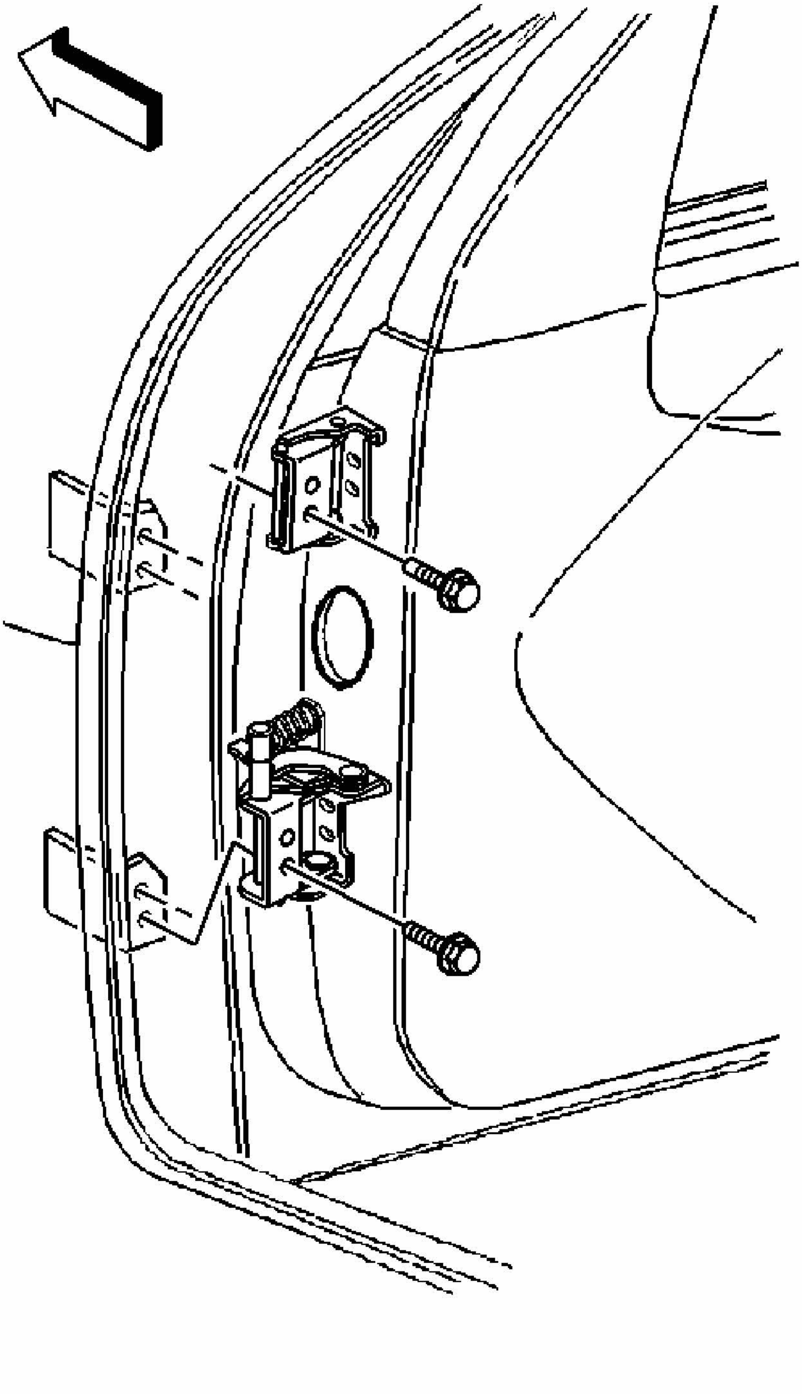


Fig. 74: Front Door Hinge
Courtesy of GENERAL MOTORS CORP.

1. Using **J 36604** , install the door hinge spring to the door hinge. See **Special Tools**.
2. Close the door.

FRONT DOOR HINGE REPLACEMENT

Removal Procedure

IMPORTANT: In order to minimize door realignment, do not remove both door hinges at the same time. Do each door hinge separately, and replace the broken door hinge first.

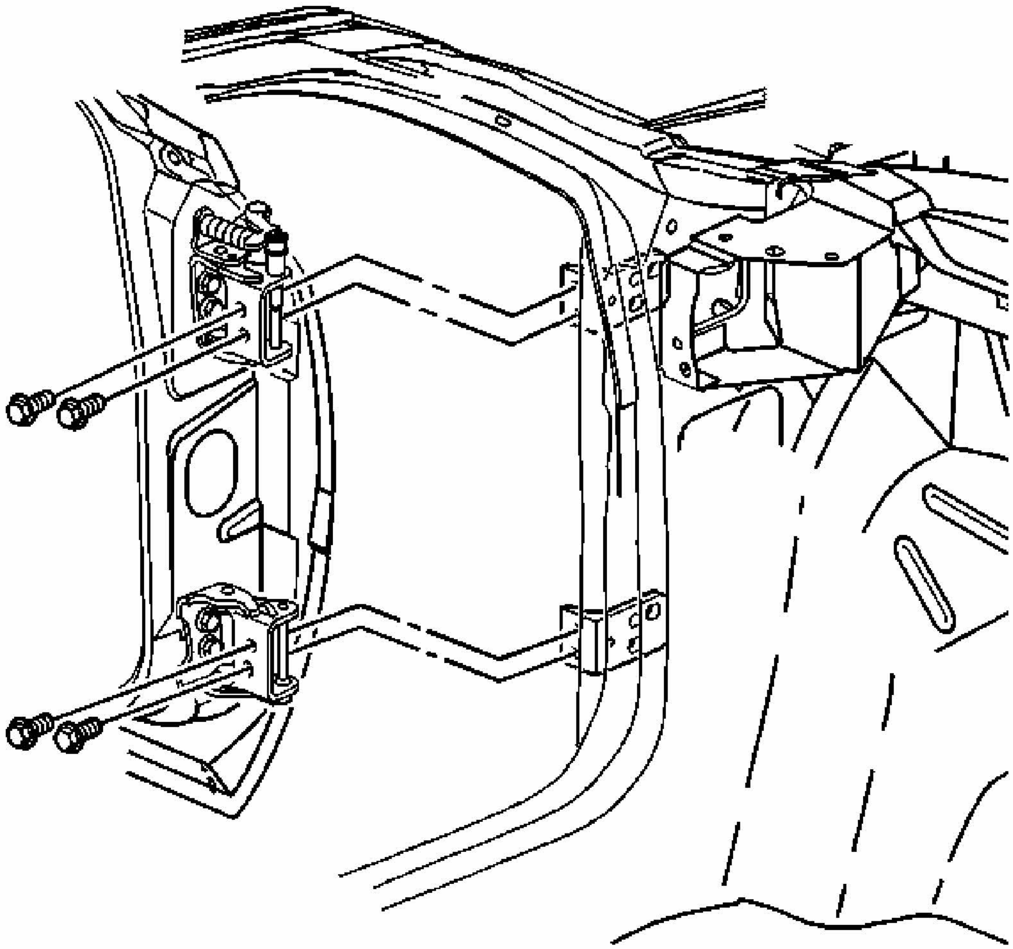


Fig. 75: Removing Front Door Hinges (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

1. Open the front door.
2. Support the front door.
3. Remove the intermediate hinge bolts from the front door hinge.
4. Move the door as far as the rubber conduit will allow.

5. Clean the mounting surfaces of the hinges with a clean rag and mark the front door hinge locations on each surface with a grease pencil or other suitable marker.
6. Remove the bolts from the front door side hinge.
7. Remove the door side hinge.
8. Remove the bolts from the bodyside hinge.
9. Remove the bodyside hinge.

Installation Procedure

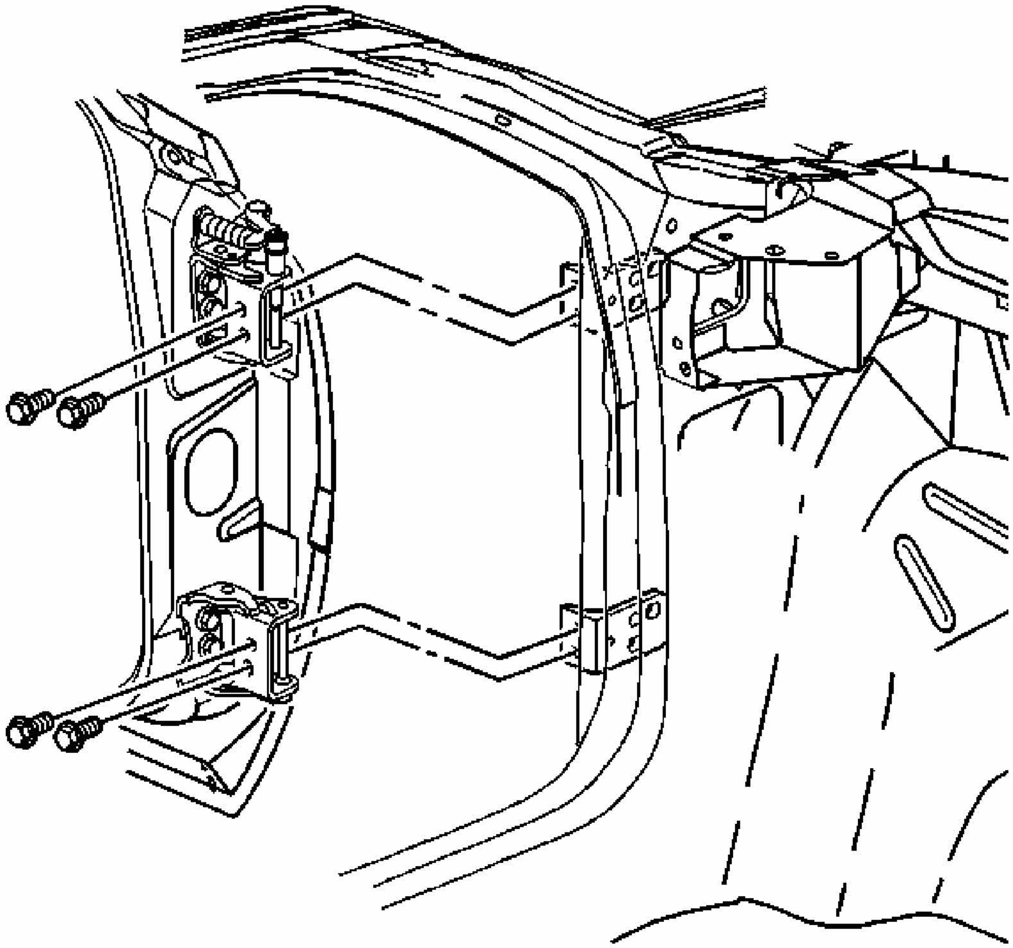


Fig. 76: Removing Front Door Hinges (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

1. Position the bodyside hinge to the alignment marks.

NOTE: Refer to FASTENER NOTICE .

2. Install the bolts to the bodyside hinge.

   Tighten: Tighten the bolts to the bodyside hinge to 33 N.m (24 lb ft).

3. Position the door side hinge to the bodyside hinge.
4. Install the intermediate hinge bolts to the front door hinge.

   Tighten: Tighten the bolts to the intermediate hinge to 33 N.m (24 lb ft).

5. Install the door side hinge bolts.

   Tighten: Tighten the bolts to the door side hinge to 33 N.m (24 lb ft).

6. Remove the door support.
7. Inspect the door for proper operation and alignment. Refer to **Door Adjustment - Front** or **Door Adjustment - Rear**.

REAR DOOR HINGE REPLACEMENT

Removal Procedure

IMPORTANT: This procedure is completed with the rear door closed at all times. Do each door hinge separately, and replace the broken door hinge first.

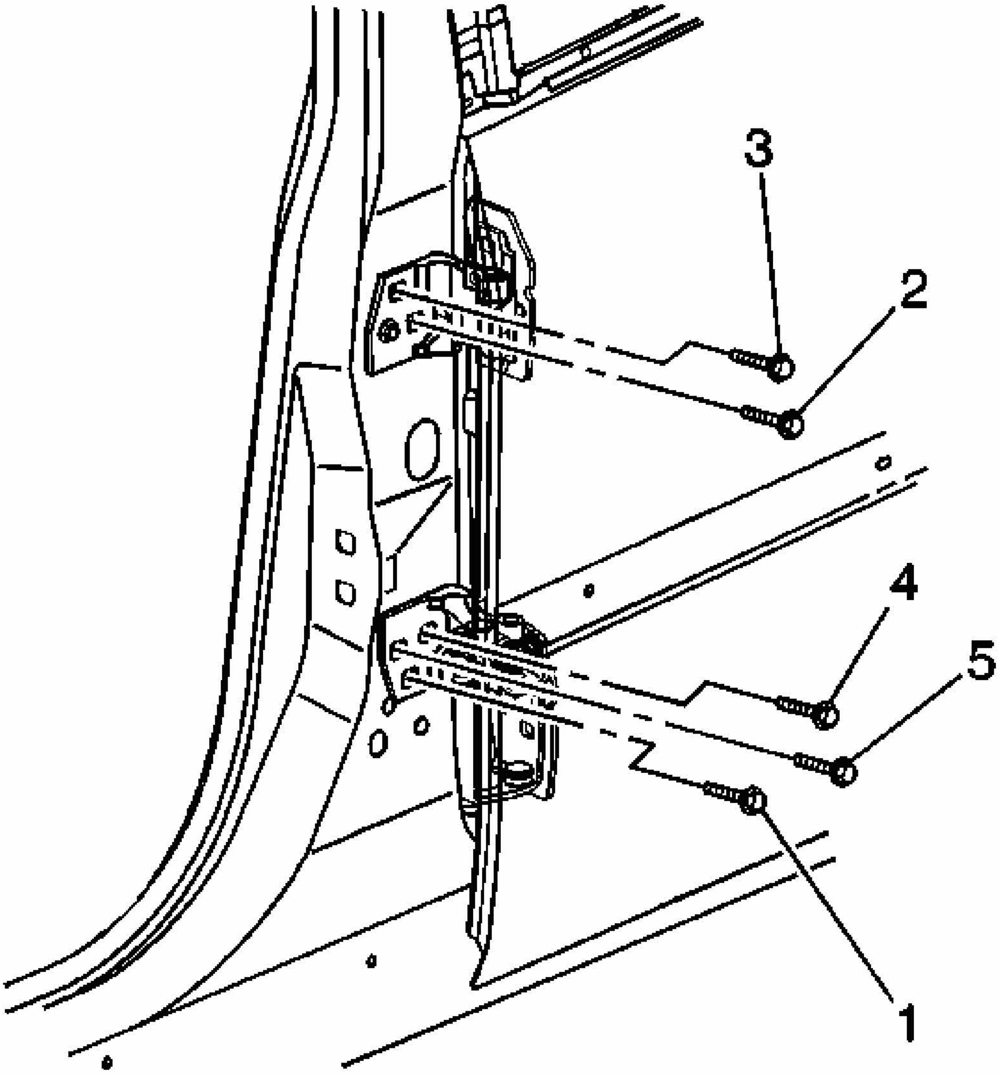


Fig. 77: Removing Body Side Rear Door Hinge Bolts
Courtesy of GENERAL MOTORS CORP.

1. Open the front door in order to remove the rear door hinges.
2. Clean the mounting surfaces with clean a rag and mark the rear door hinge locations on each surface with a grease pencil or other suitable marker.
3. Remove the bolts from the doorside rear door hinge.
4. Remove the bolts (1-5) from the bodyside rear door hinge.
5. Remove the rear door hinge from the vehicle.

Installation Procedure

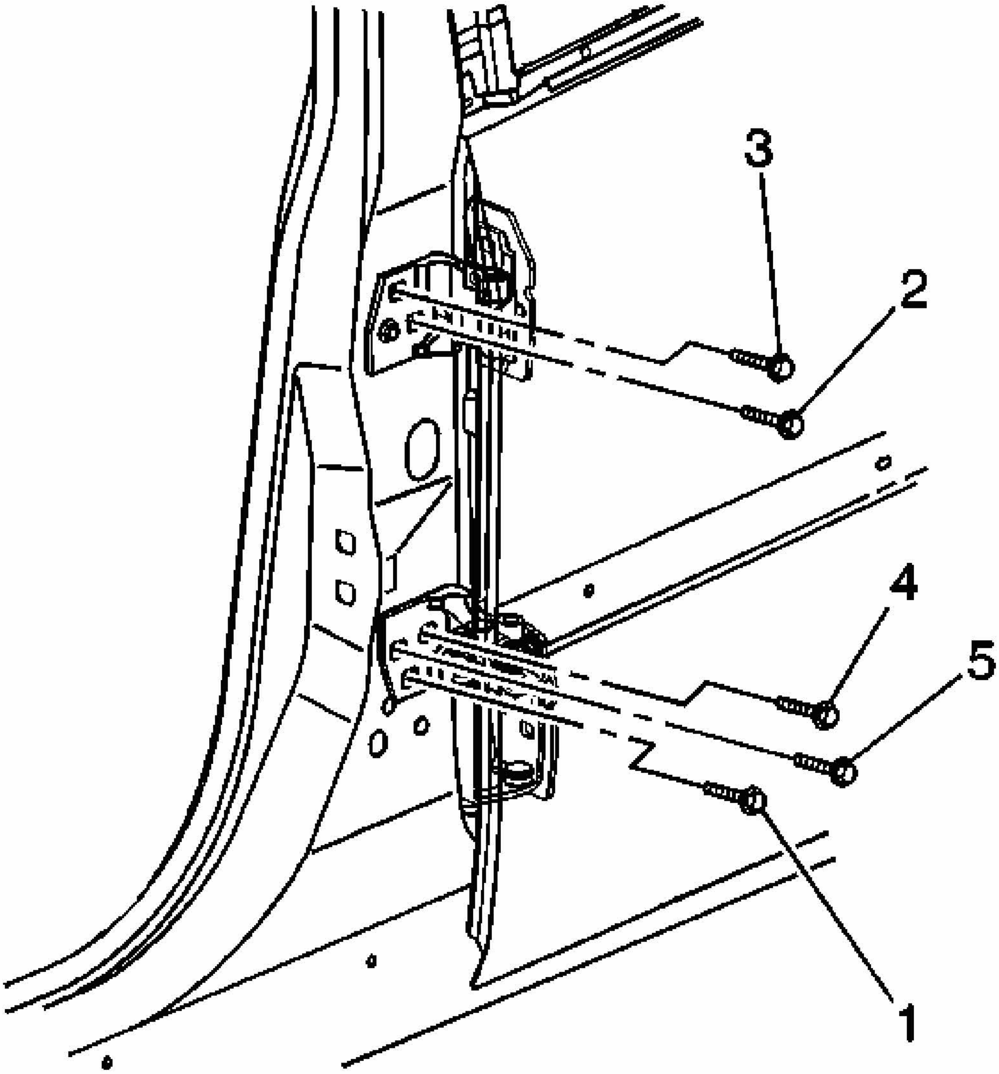


Fig. 78: Removing Body Side Rear Door Hinge Bolts
Courtesy of GENERAL MOTORS CORP.

1. Position the rear door hinge to the alignment marks.

NOTE: Refer to FASTENER NOTICE .

2. Install the bolts (1-5) to the bodyside rear door hinge.

Tighten: Tighten the bodyside rear door hinge bolts to 33 N.m (24 lb ft).

3. Install the bolts to the doorside rear door hinge.

   Tighten: Tighten the doorside rear door hinge bolts to 33 N.m (24 lb ft).

4. Close the rear door.
5. Inspect the rear door for proper operation and alignment. Refer to **Door Adjustment - Rear**.

FRONT OUTSIDE DOOR HANDLE REPLACEMENT - (IMPALA)

Removal Procedure

IMPORTANT: The outside handles have adjustable outside handle lock rods. This allows for adjustment of the amount of travel needed in order to operate the outside handle.

When servicing a vehicle with adjustable outside handle lock rods, remove all free play between the outside handle and the lock. Also, do not operate the outside handle before these connections are made.

1. Raise the window to the full up position.
2. Remove the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.
3. Remove the front water deflector, as necessary. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**.

   NOTE: Refer to PAINT DAMAGE NOTICE .

4. Apply masking tape around the outside handle.

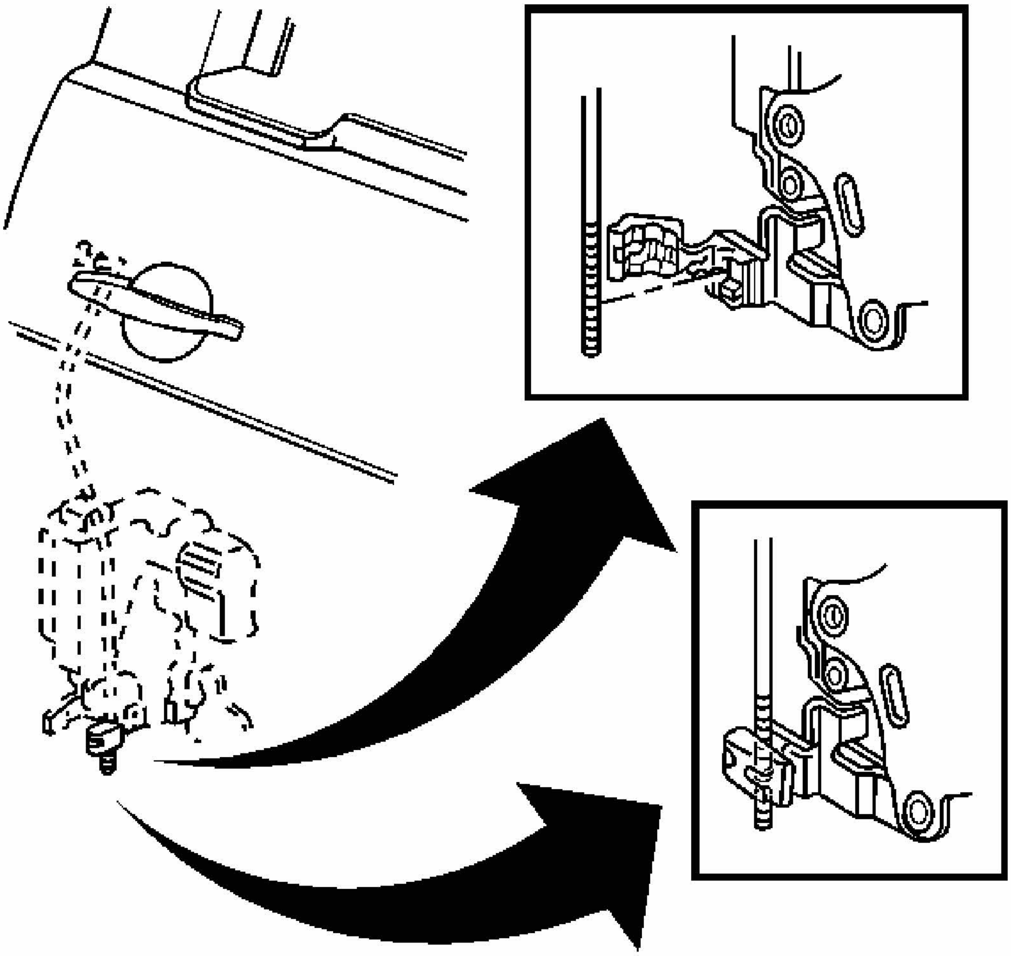


Fig. 79: View Of Handle Rod To Lock Clip
Courtesy of GENERAL MOTORS CORP.

5. Open the outside door handle rod to lock clip located on the door lock.
6. Remove the lock cylinder rod from the outside door handle. Refer to **Lock Cylinder Replacement - Door (Impala)** or **Lock Cylinder Replacement - Door (Monte Carlo)**.

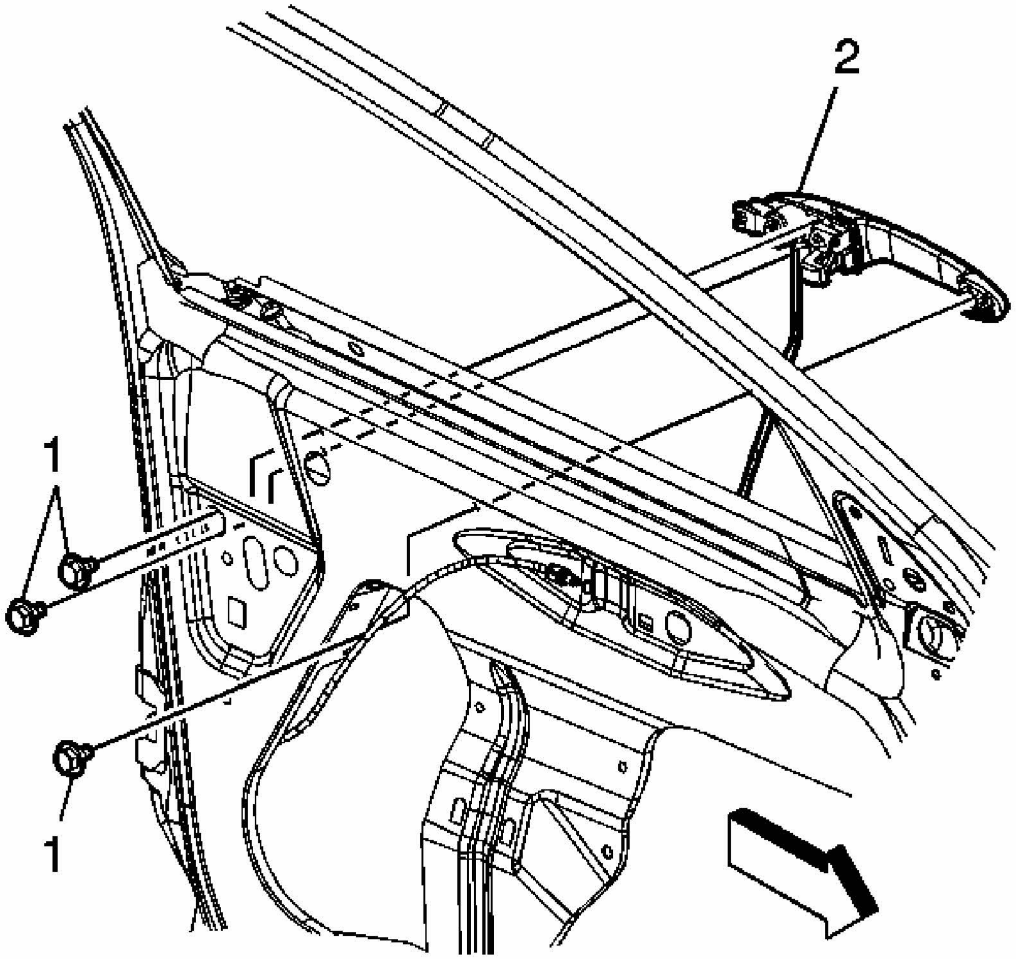


Fig. 80: Remove The Bolts From The Outside Handle
Courtesy of GENERAL MOTORS CORP.

7. Remove the door handle bolt access tape from the inner door panel.
8. Remove the bolts (1) from the outside handle.

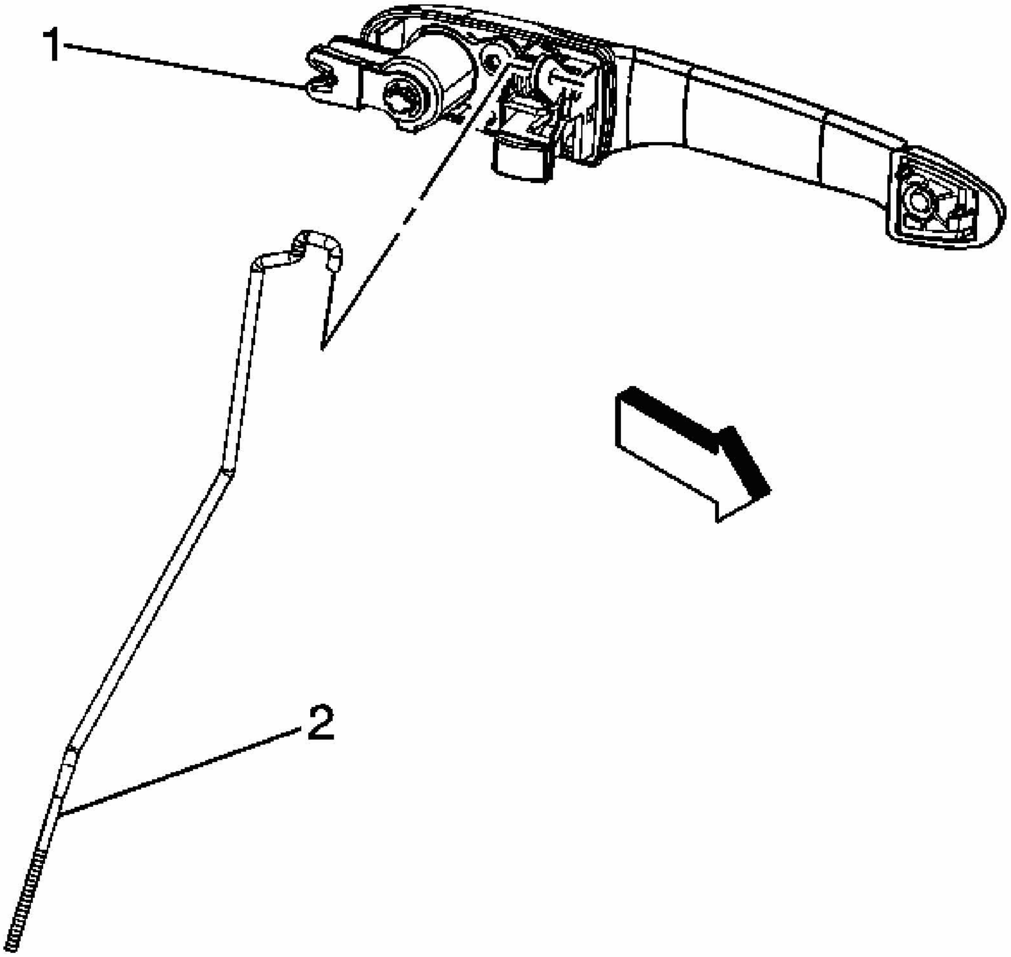


Fig. 81: Remove The Outside Handle And The Rod From The Door
Courtesy of GENERAL MOTORS CORP.

9. Remove the outside handle (1) and the rod (2) from the door.

Installation Procedure

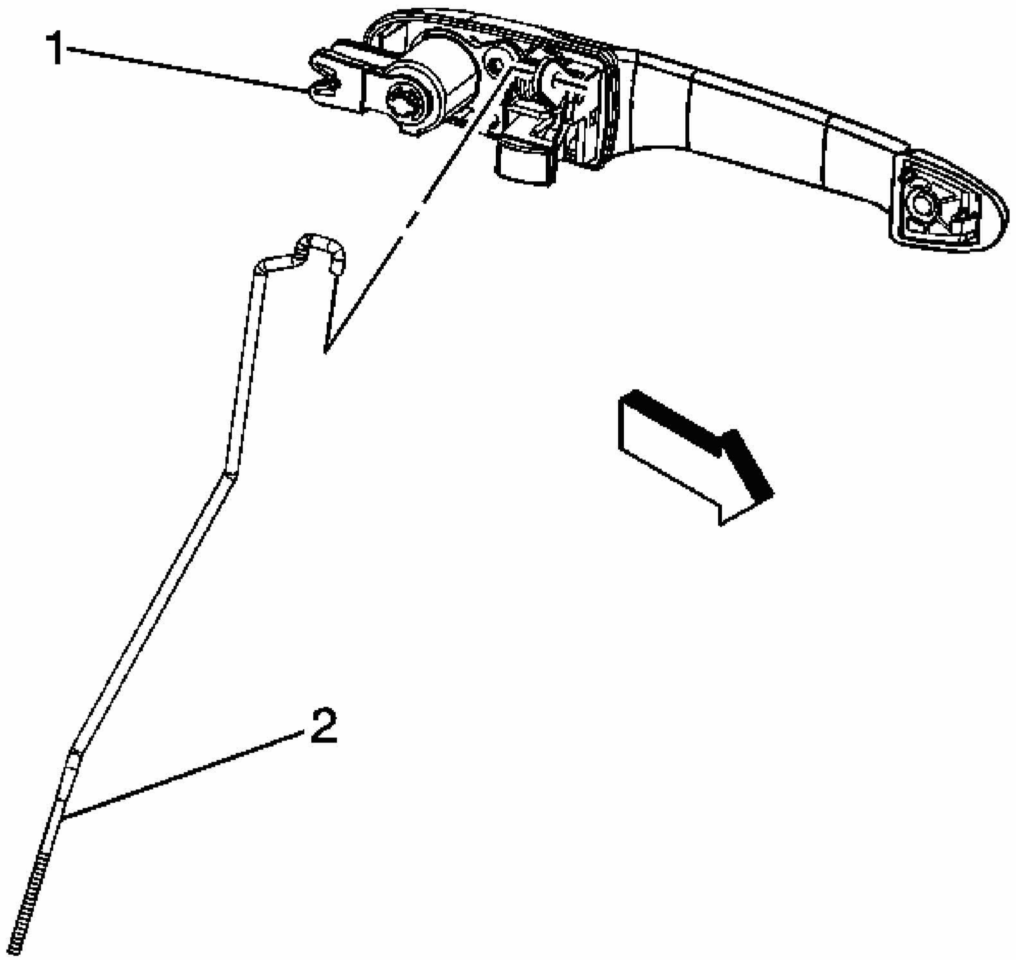


Fig. 82: Install The Outside Handle And The Rod To The Door
Courtesy of GENERAL MOTORS CORP.

1. Install the outside handle (1) and the rod (2) to the door.

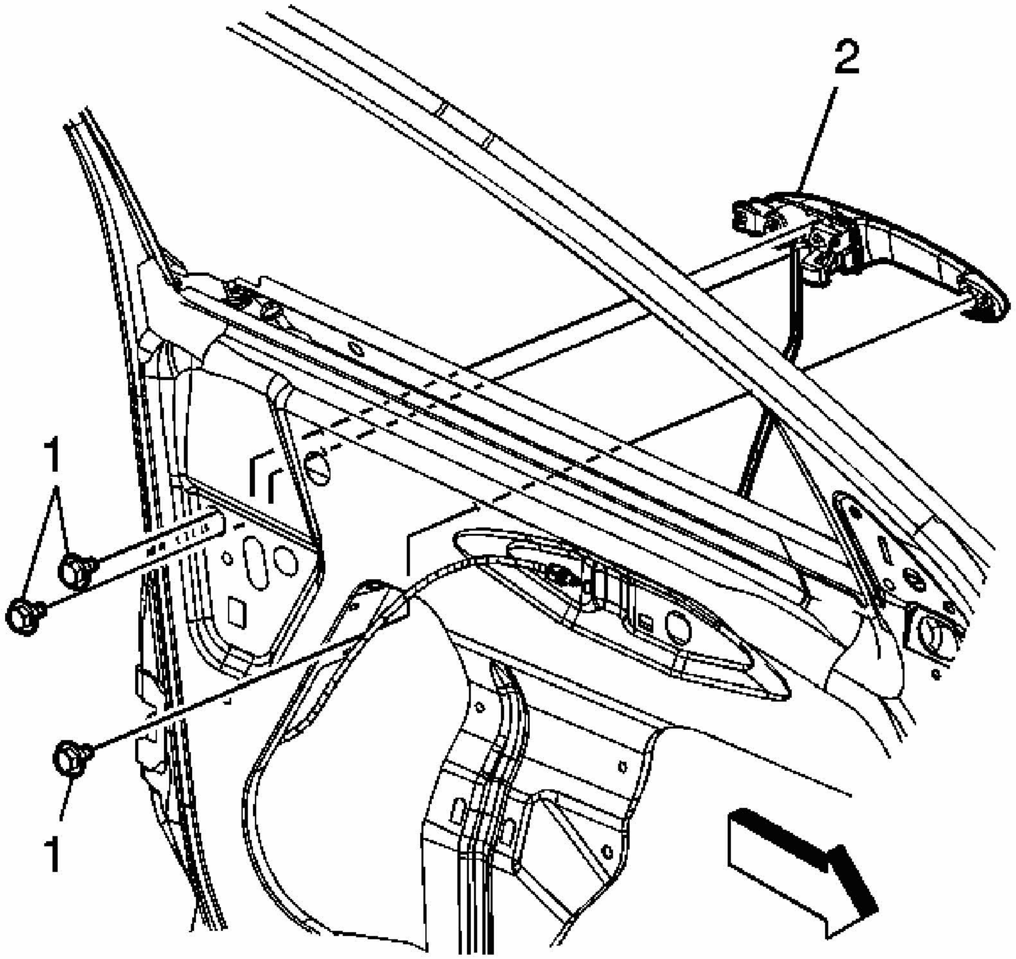


Fig. 83: Install The Outside Handle Bolts To The Door
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

2. Install the outside handle bolts (1) to the door.

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

3. Install the outside handle bolt access tape to the inner door panel.
4. Install the lock cylinder rod to the outside door handle. Refer to **Lock Cylinder Replacement - Door (Impala)** or **Lock Cylinder Replacement - Door (Monte Carlo)**.

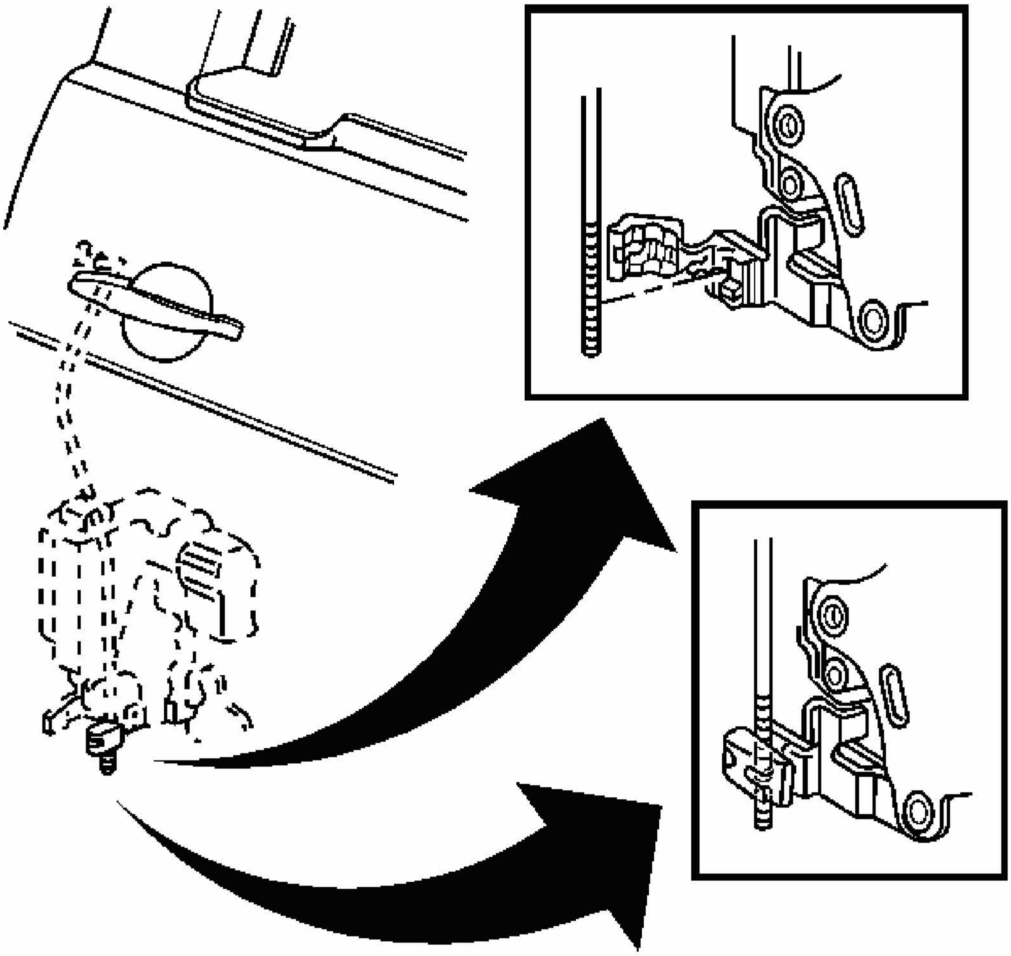


Fig. 84: View Of Handle Rod To Lock Clip
Courtesy of GENERAL MOTORS CORP.

5. Install the outside handle rod into the clip
6. Close the clip cover over the outside handle rod.
7. Inspect the outside handle for proper operation.
8. Remove the masking tape.
9. Install the front door water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**.
10. Install the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.

DOOR HANDLE REPLACEMENT - FRONT OUTSIDE (MONTE CARLO)

Removal Procedure

IMPORTANT: The outside handles have adjustable lock rod. This allows for adjustment of the amount of travel needed to operate the outside handle.

When servicing a vehicle with adjustable outside handle-to-lock rods, it is important that all free play between the outside handle and the lock be removed. Do not operate the outside handle before these adjustments are made.

Before removing the door handle, apply a double layer of masking tape around the perimeter of the painted surfaces.

1. Position the window completely up.
2. Remove the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.
3. Remove the front door water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**.

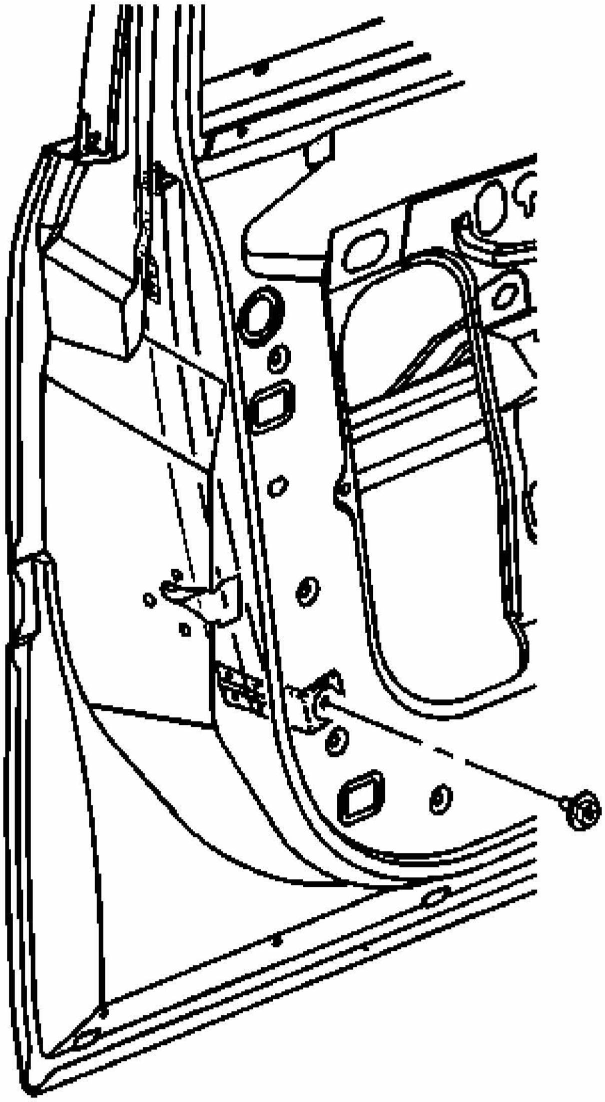


Fig. 85: Front Door Rear Window Channel Bolt (Impala)
Courtesy of GENERAL MOTORS CORP.

4. Remove the front door rear window channel bolt.

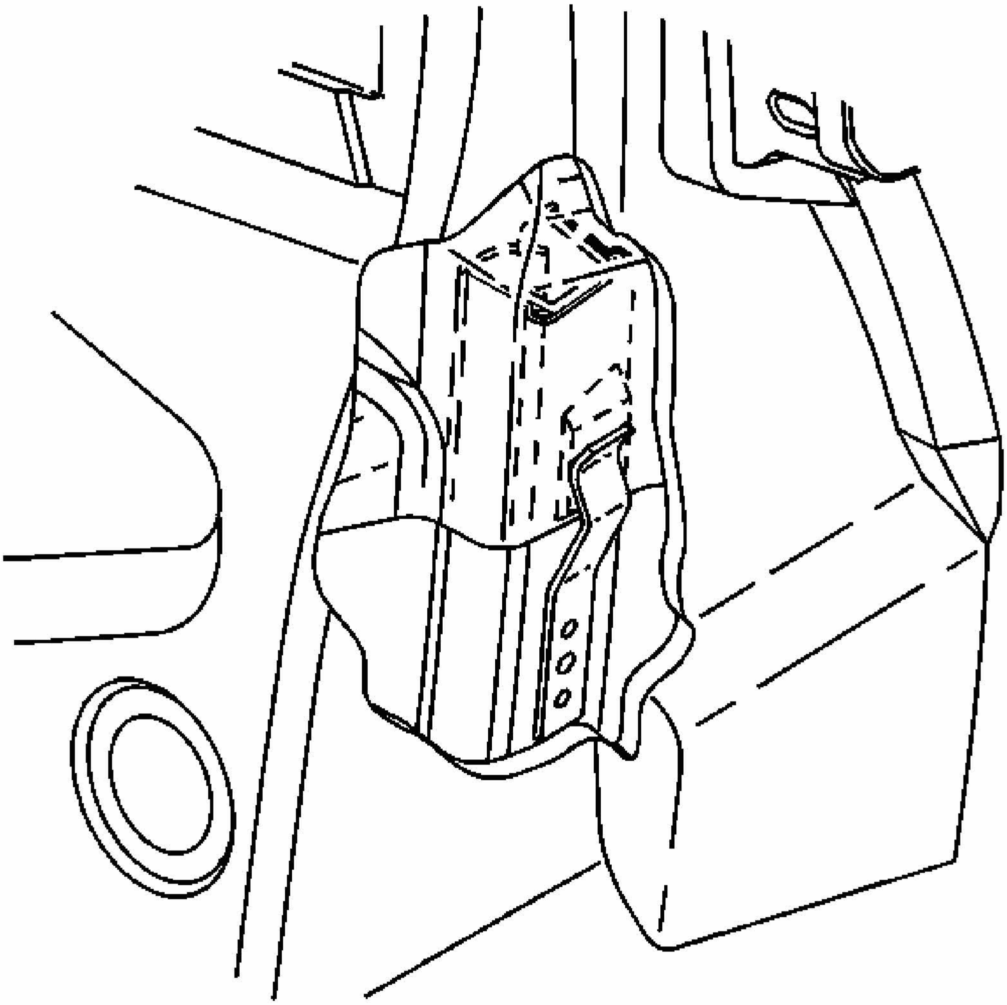


Fig. 86: Front Door Rear Window Channel (Impala)
Courtesy of GENERAL MOTORS CORP.

5. Remove the front door rear window channel from the front door slot by pulling downward to disengage the retainer clip.

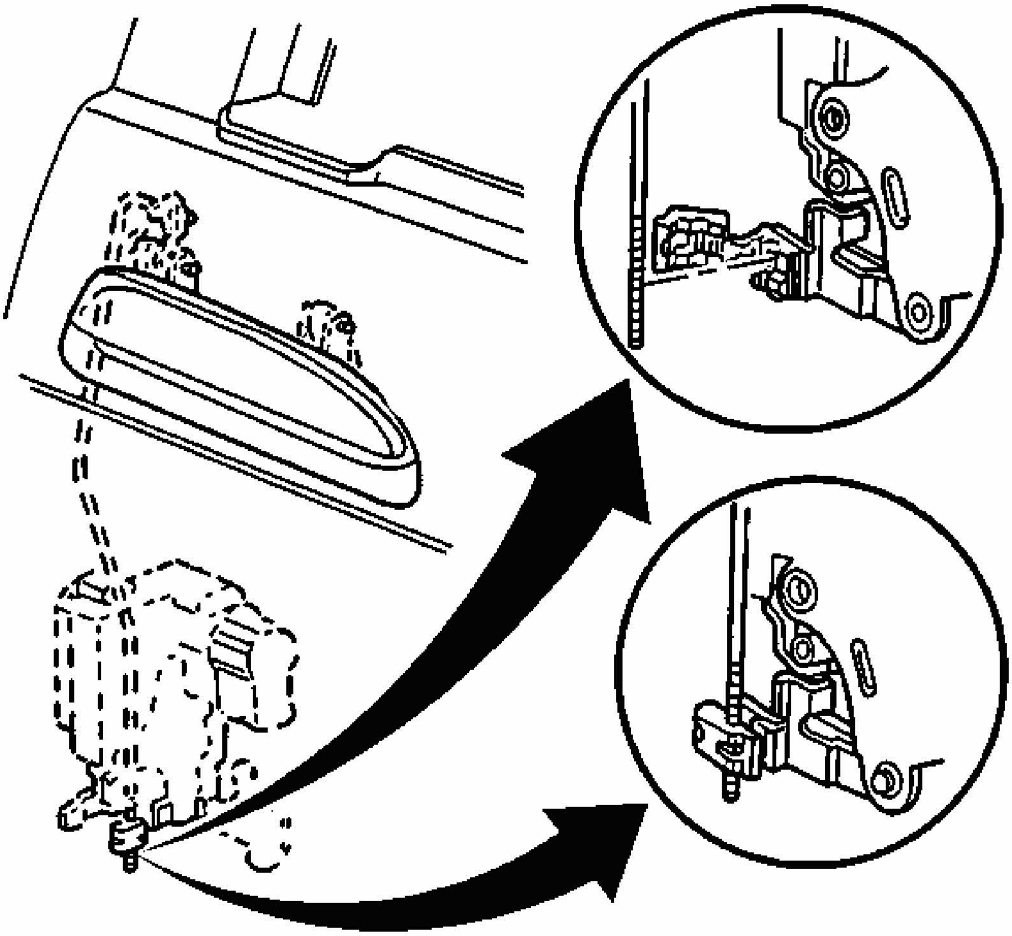


Fig. 87: Removing Outside Door Hand Rod-To-Lock Clip From Lock (Impala)
Courtesy of GENERAL MOTORS CORP.

6. Remove the outside door handle rod-to-lock clip from the lock.
7. Remove the front door outside handle lockcylinder. Refer to **Lock Cylinder Replacement - Door (Impala)** or **Lock Cylinder Replacement - Door (Monte Carlo)**.

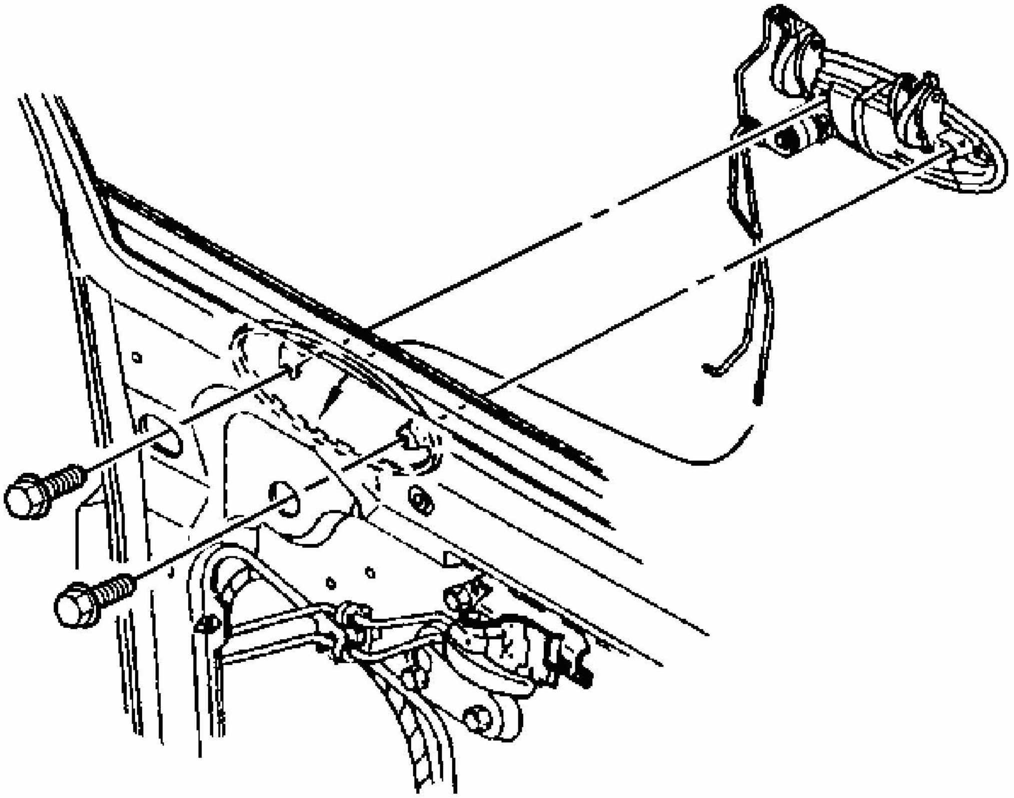


Fig. 88: Front Outside Handle & Bolts
Courtesy of GENERAL MOTORS CORP.

8. Remove the hole plug to access to one of the two bolts that attach the outer door handle.
9. Remove the front door outside door handle from the door.

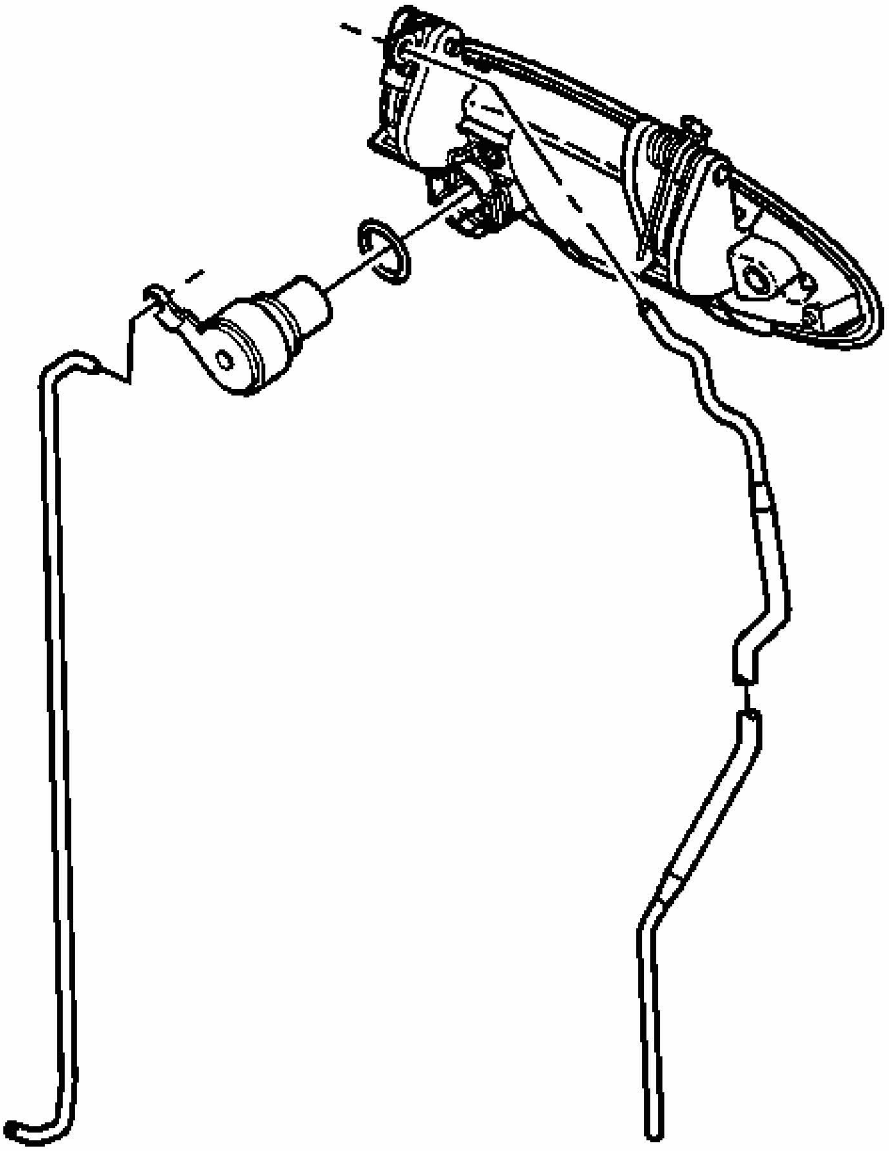


Fig. 89: Outside Door Handle Rod & Handle (Impala)
Courtesy of GENERAL MOTORS CORP.

10. Remove the front door outside door handle rod from the handle.

Installation Procedure

1. Install the lockcylinder retainer clip to door handle.

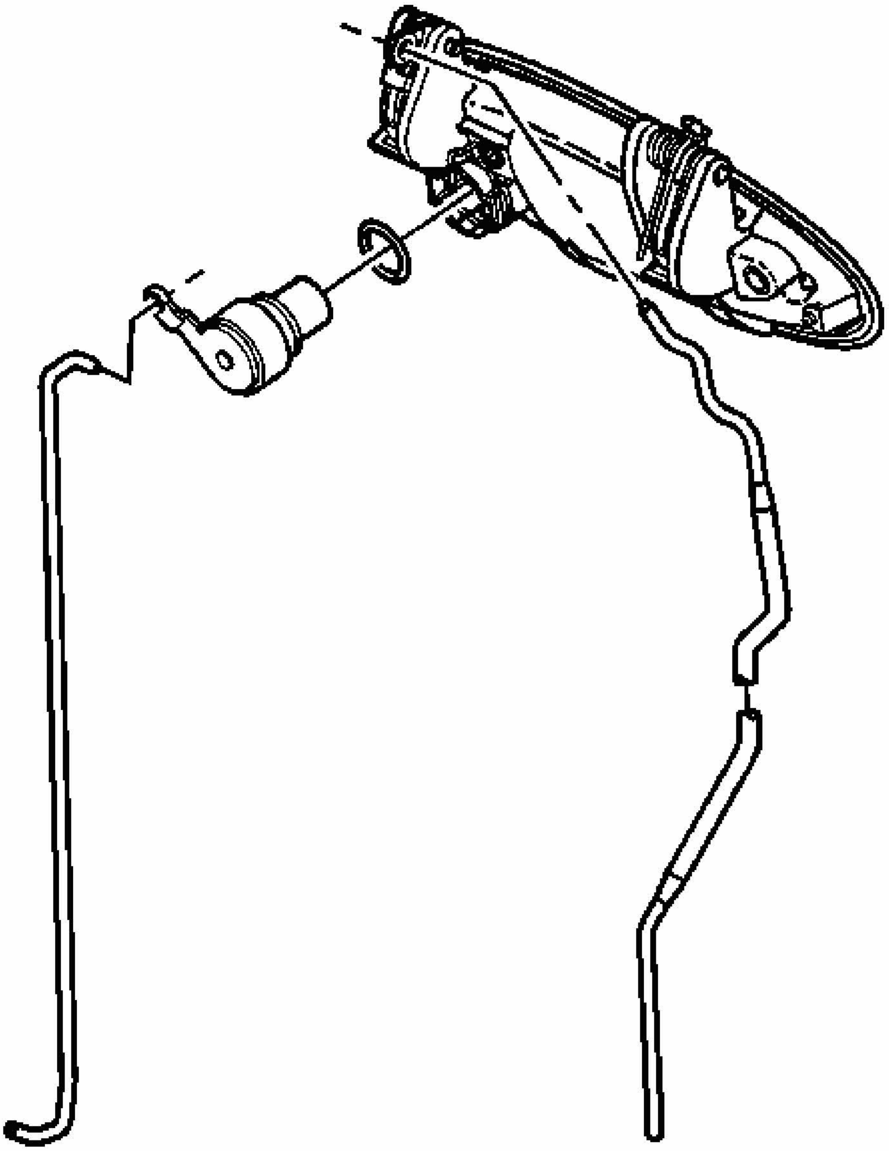


Fig. 90: Outside Door Handle Rod & Handle (Impala)
Courtesy of GENERAL MOTORS CORP.

2. Install the front door handle rod to the door handle.

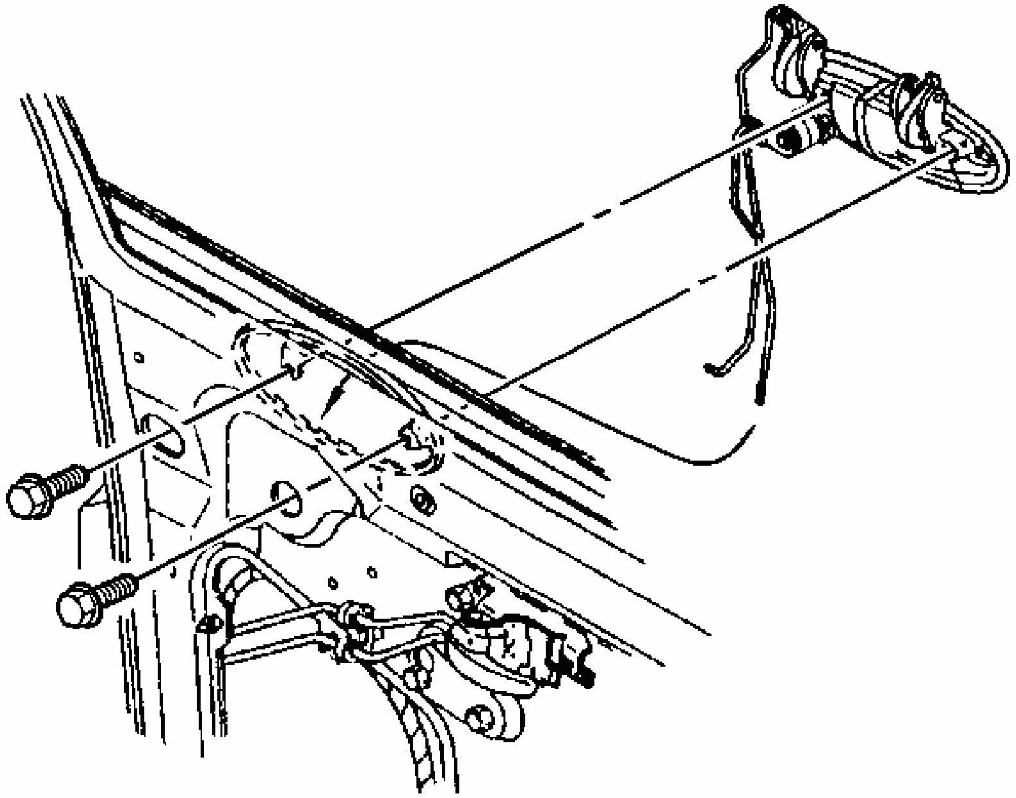


Fig. 91: Front Outside Handle & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the front outside door handle to the door.

NOTE: **Refer to FASTENER NOTICE Fastener Notice in Cautions and Notices.**

4. Install the front door outside door handle bolts.

   Tighten: Tighten the front door outside door handle bolts to 10 N.m (89 lb in).

5. Install the front door outside handle lockcylinder. Refer to **Lock Cylinder Replacement - Door (Impala)** or **Lock Cylinder Replacement - Door (Monte Carlo)**.
6. Install a NEW outside handle rod-to-lock clip onto the door lock lever.
   - Position the outside door handle rod in the clip to eliminate any free play in the outside door handle.

- Install the clip cover over the threaded outside door handle rod.

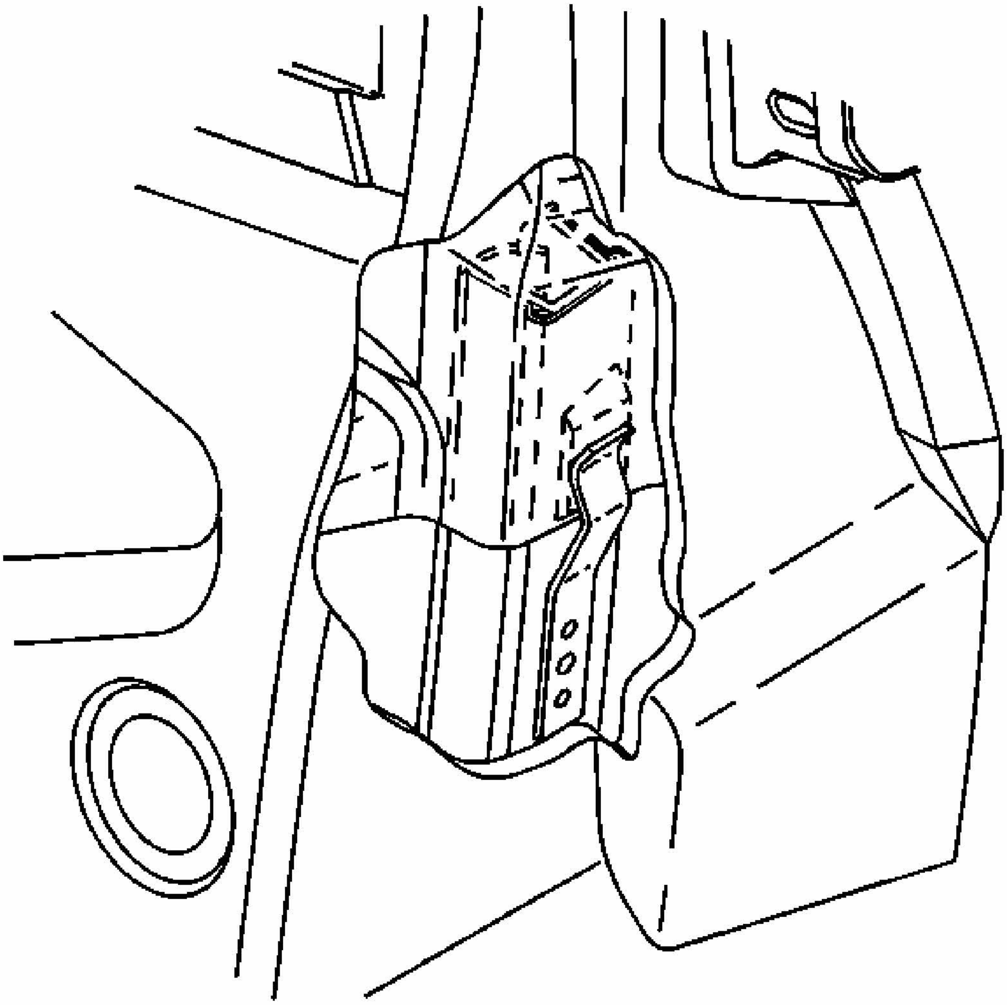


Fig. 92: Front Door Rear Window Channel (Impala)
Courtesy of GENERAL MOTORS CORP.

7. Install the front door rear window channel to the front door, ensuring that the up clip is engaged to the upper channel.

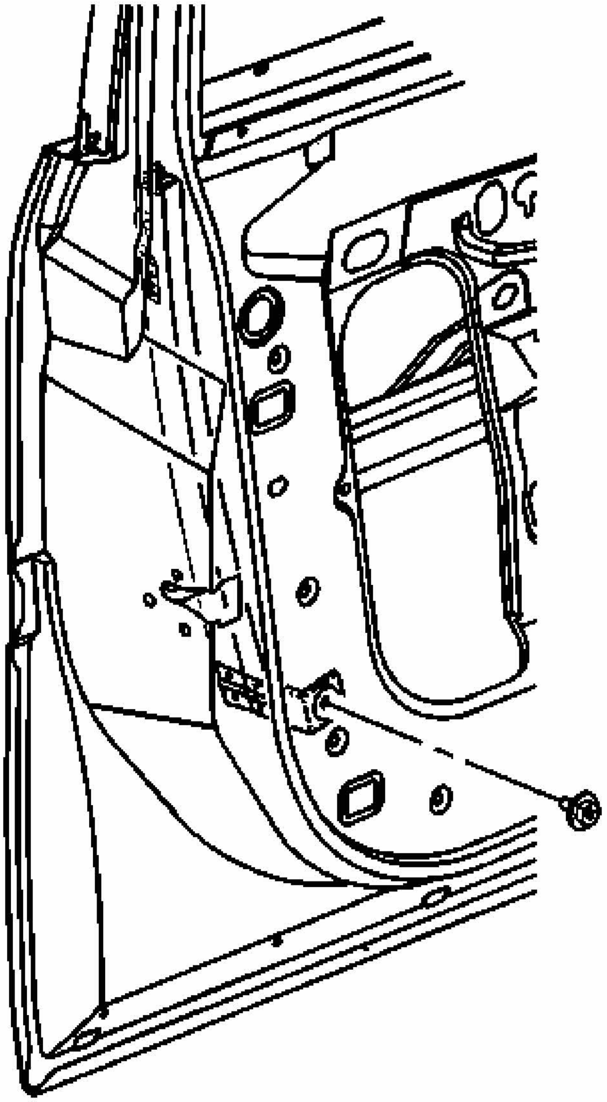


Fig. 93: Front Door Rear Window Channel Bolt (Impala)
Courtesy of GENERAL MOTORS CORP.

8. Install the front door rear window channel bolt.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

Install the front door rear window channel bolt.

Tighten: Tighten the front door rear window channel bolt to 10 N.m (89 lb in).

9. Install the access hole plug.
10. Install the front door water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**.
11. Install the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.

REAR OUTSIDE DOOR HANDLE REPLACEMENT

Removal Procedure

IMPORTANT: The outside handles have adjustable outside handle lock rods. This allows for adjustment of the amount of travel needed in order to operate the outside handle.

When servicing a vehicle with adjustable outside handle lock rods, remove all free play between the outside handle and the lock. Also, do not operate the outside handle before these connections are made.

1. Remove the rear door trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**.
2. Remove the rear door water deflector. Refer to **Water Deflector Replacement - Rear Door (Impala)**.
3. Raise the window to the full up position.

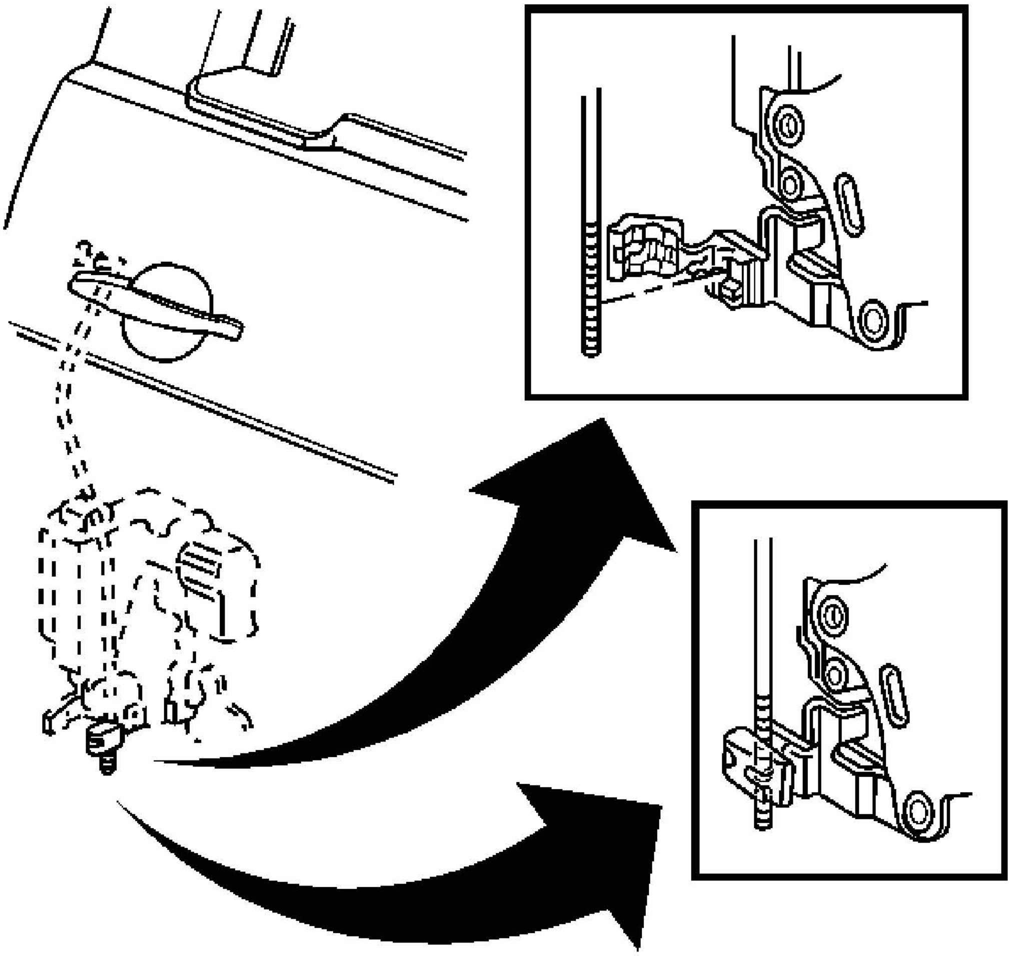


Fig. 94: View Of Handle Rod To Lock Clip
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to PAINT DAMAGE NOTICE .**

4. Apply masking tape around the outside handle.
5. Open the outside handle rod to lock clip located on the door lock.
6. Remove the rear door lock. Refer to **Lock Replacement - Rear Door**.

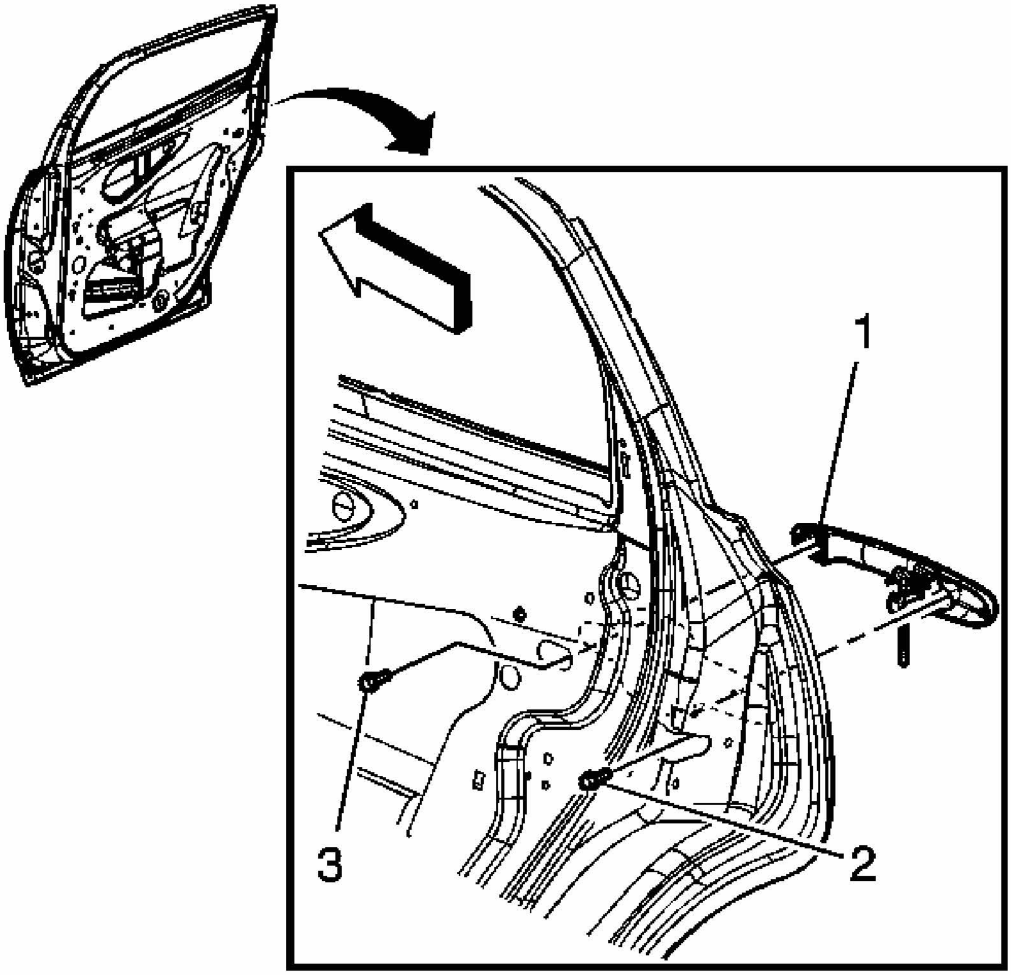


Fig. 95: Removing The Bolts From The Rear Door Handle
Courtesy of GENERAL MOTORS CORP.

7. Remove the outside door handle bolt access tape.
8. Remove the bolts (3) from the rear door handle.
9. Remove the outside handle bolt (2) through the latch hole.

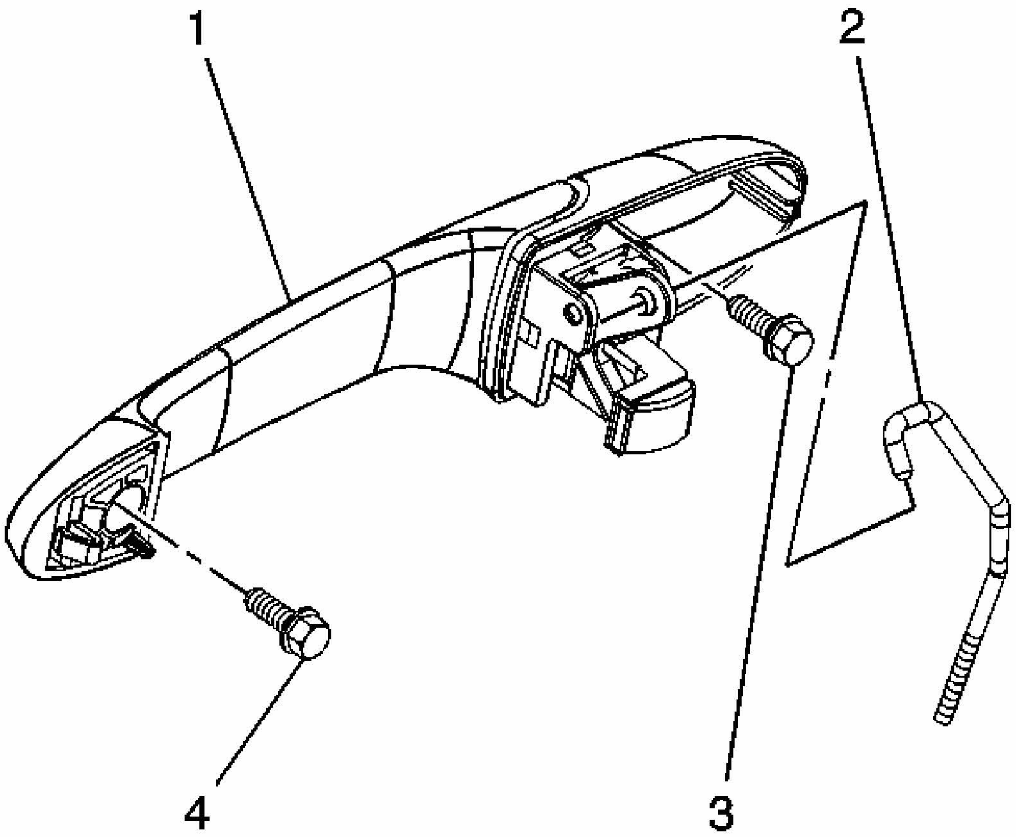


Fig. 96: Outside Door Handle and Rod
Courtesy of GENERAL MOTORS CORP.

10. Remove the outside handle (1) and the rod (2) from the door.

Installation Procedure

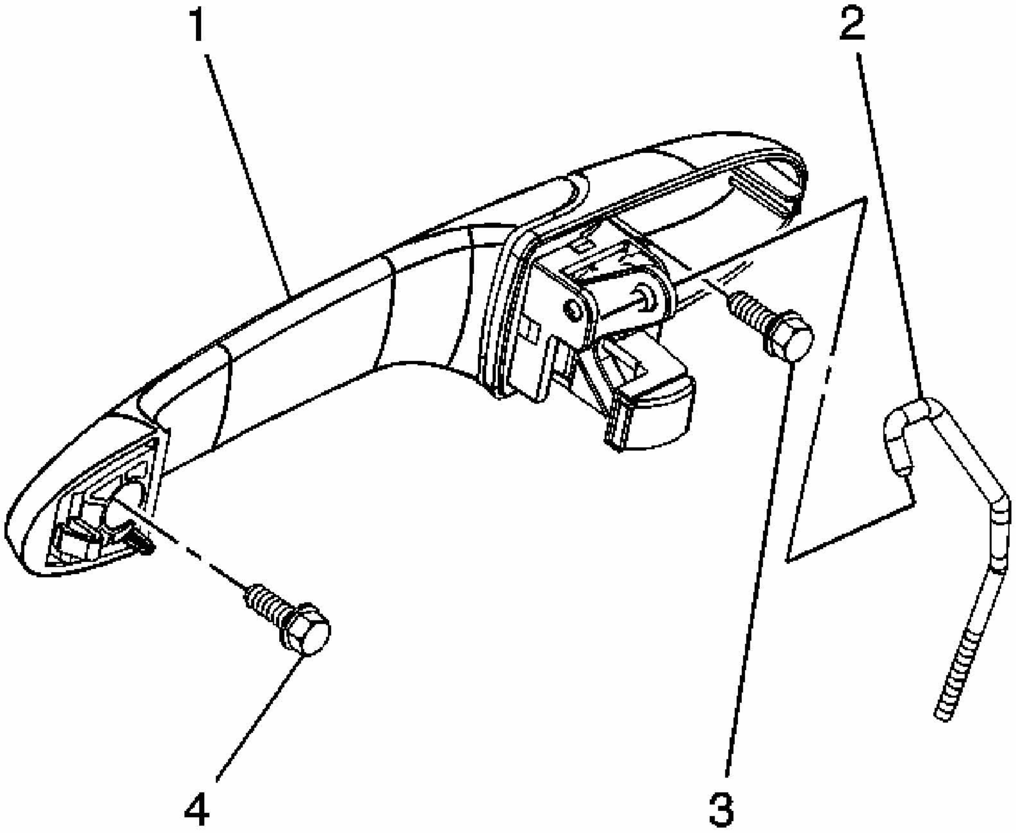


Fig. 97: Outside Door Handle and Rod
Courtesy of GENERAL MOTORS CORP.

1. Install the outside door handle (1) and the rod (2) to the door.

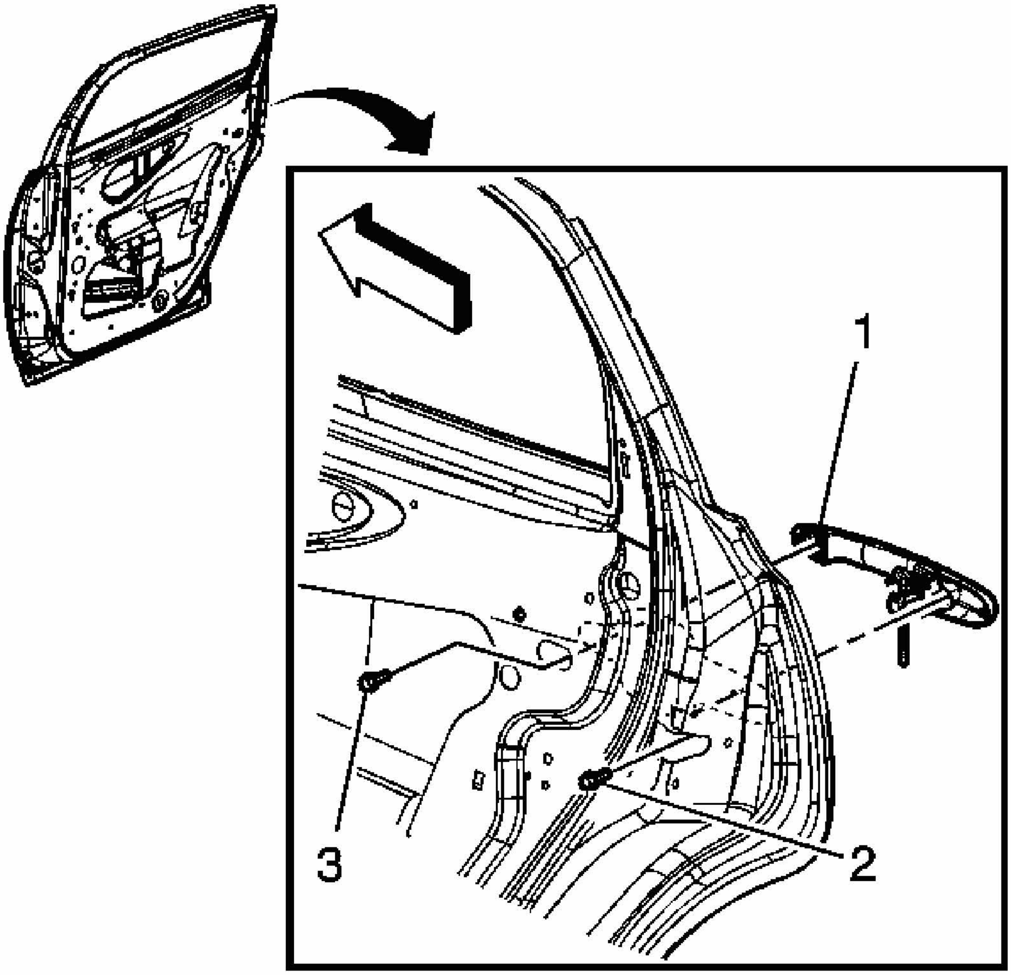


Fig. 98: Install The Outside Handle Bolt Through The Latch Hole
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

2. Install the outside handle bolt (2) through the latch hole.

   Tighten: Tighten the bolt to 10 N.m (89 lb in).

3. Install the bolts (3) to the rear door handle.

   Tighten: Tighten the bolt to 10 N.m (89 lb in).

4. Install the rear door lock. Refer to **Lock Replacement - Rear Door**.

5. Install the outside door handle bolt access tape.

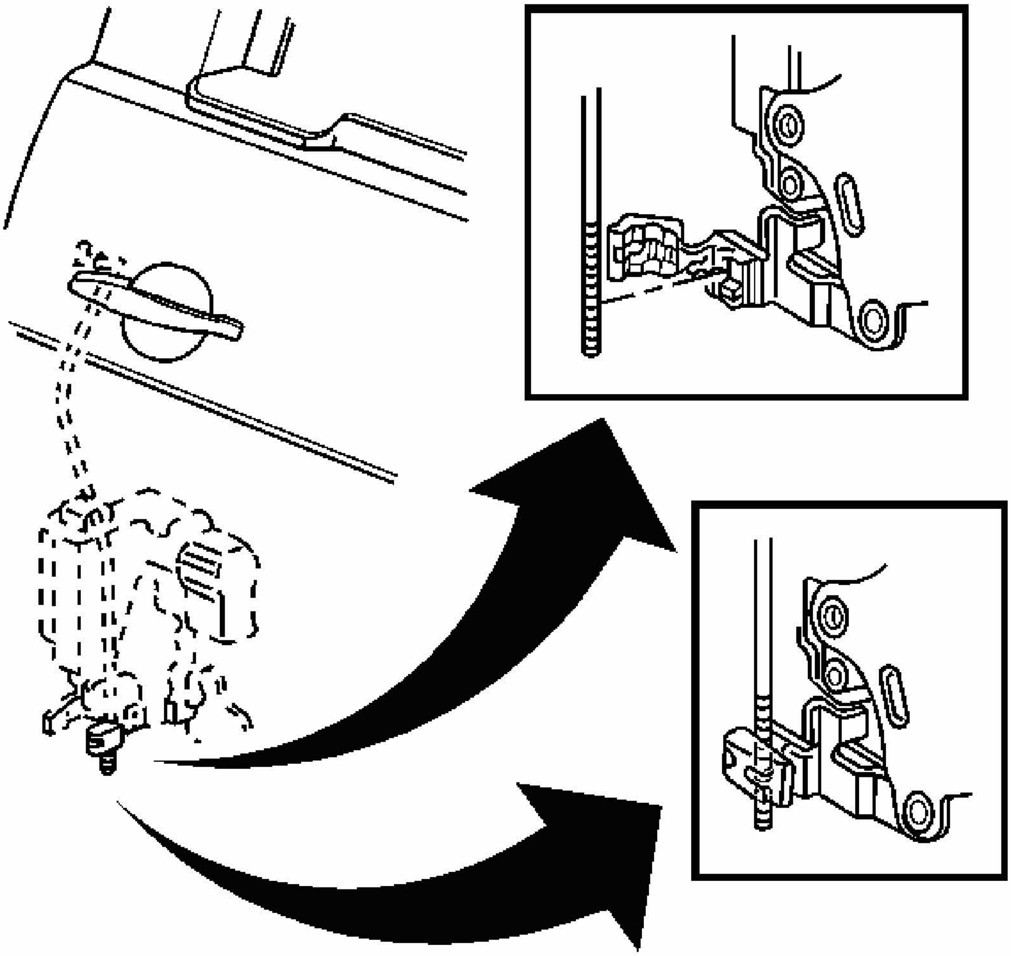


Fig. 99: View Of Handle Rod To Lock Clip
Courtesy of GENERAL MOTORS CORP.

6. Install the outside handle rod into the clip.
7. Close the clip cover over the outside door handle rod.
8. Inspect the outside door handle for proper operation.
9. Remove the masking tape.
10. Install the rear door water deflector. Refer to **Water Deflector Replacement - Rear Door (Impala)**.
11. Install the rear door trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**.

FRONT OUTSIDE DOOR HANDLE ROD ADJUSTMENT

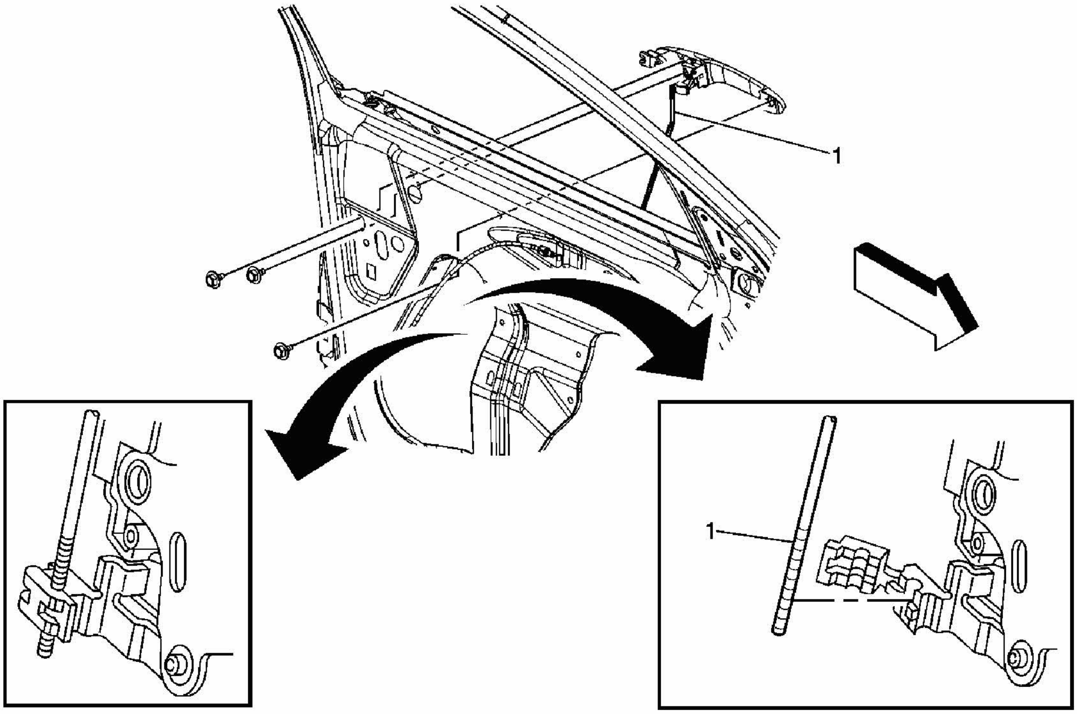


Fig. 100: Adjusting Front Outside Door Handle Rod
Courtesy of GENERAL MOTORS CORP.

Door Handle Rod Adjustment - Front Outside

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**. 2. Remove the water deflector as needed. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**.	
1	Rod, Outside Door Handle **Tip:** 1. Use a flat-bladed tool to release the threaded rod (1) from the clip (2).

	2. Position the rod in the clip in order to eliminate any free play in the outside door handle. 3. Inspect the door lock system for proper operation.

FRONT OUTSIDE DOOR HANDLE ROD REPLACEMENT

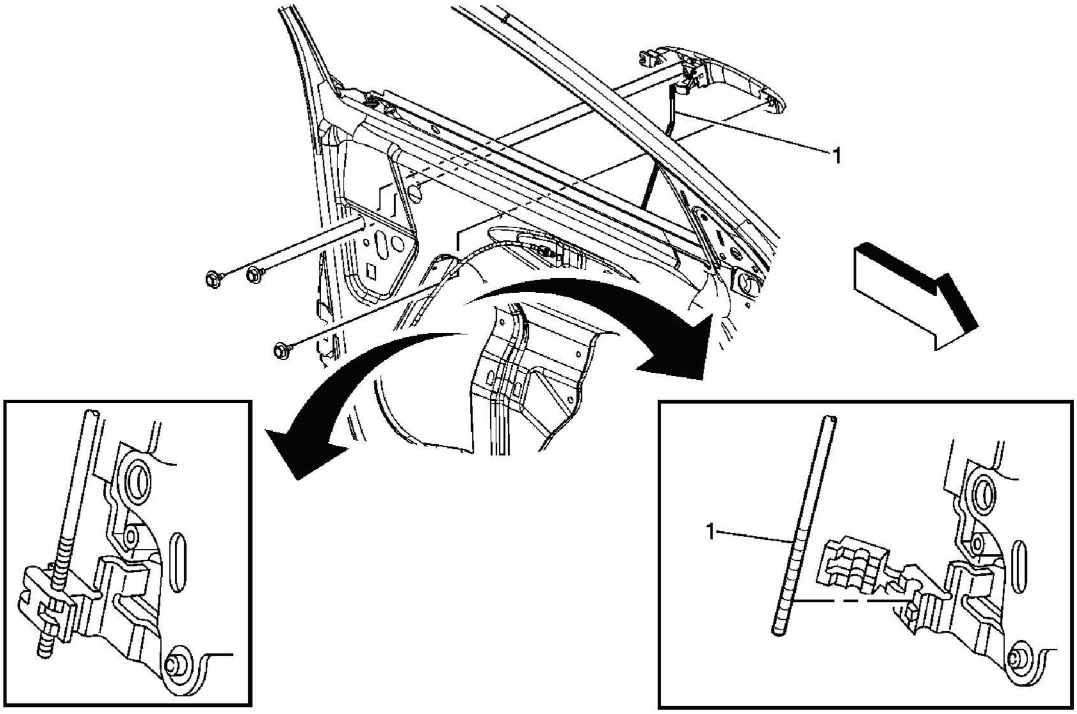


Fig. 101: Replacing Front Outside Door Handle Rod
Courtesy of GENERAL MOTORS CORP.

Door Handle Rod Replacement - Front Outside

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**. 2. Remove the water deflector as needed. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte**	

	Carlo). 3. Remove the door lock. Refer to **Lock Replacement - Front Door (Monte Carlo)** or **Lock Replacement - Front Door (Impala)**.
1	Rod, Outside Door Handle **Tip:** 1. Use a flat-bladed tool to release the threaded rod from the clip. 2. Position the rod in the clip in order to eliminate any free play in the outside door handle. 3. Inspect the door lock system for proper operation.

REAR OUTSIDE DOOR HANDLE ROD ADJUSTMENT

Removal Procedure

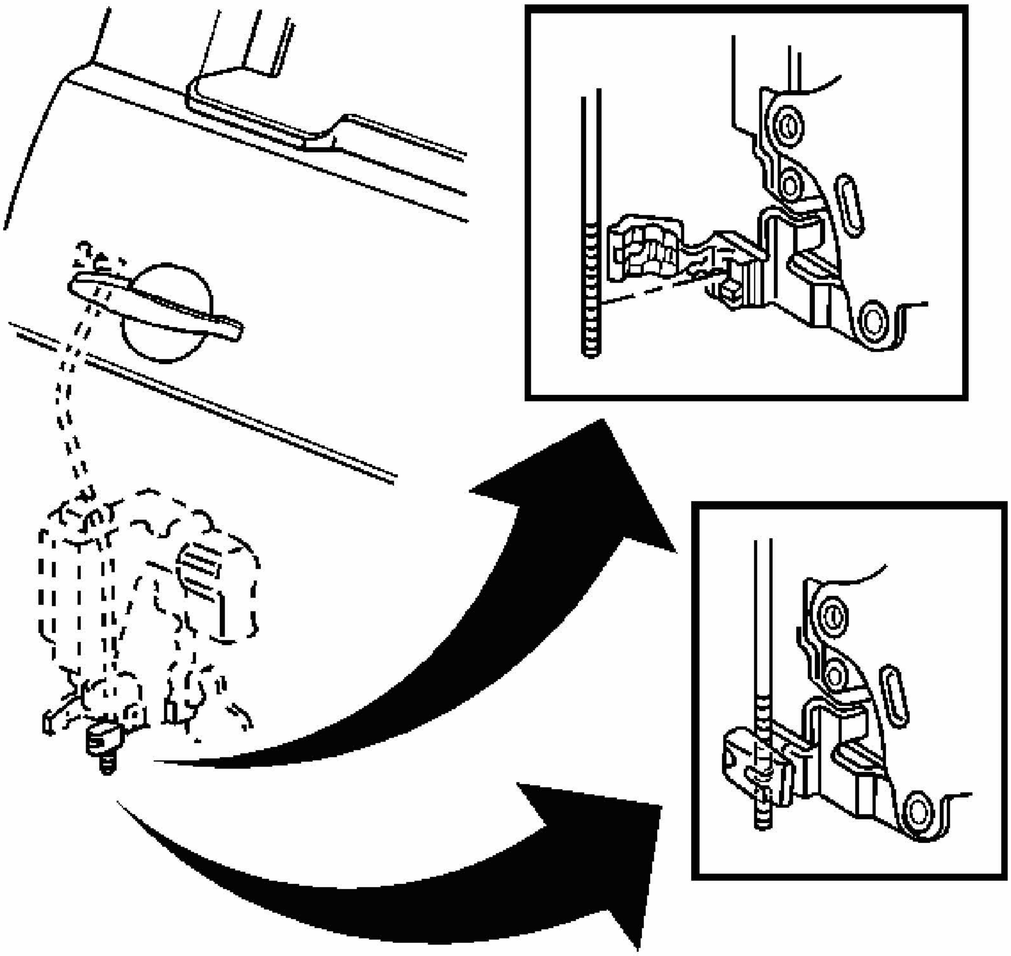


Fig. 102: View Of Handle Rod To Lock Clip
Courtesy of GENERAL MOTORS CORP.

1. Remove the rear door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.
2. Remove the rear door water deflector as needed. Refer to **Water Deflector Replacement - Rear Door (Impala)**.
3. Use a flat-head tool to open the clip from the threaded rod connecting the lock to the outside handle.
4. Adjust the travel of the handle by removing the threaded rod from the clip.

Installation Procedure

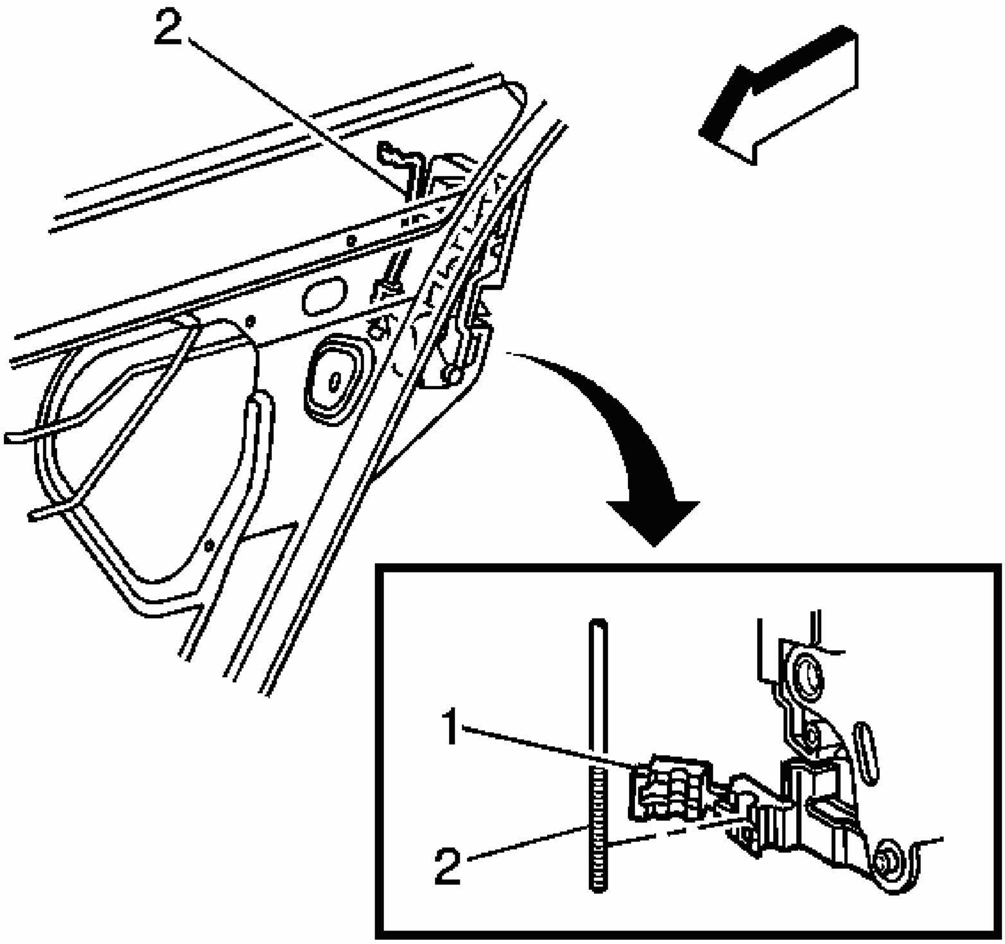


Fig. 103: Positioning Outside Door Handle Rod In Clip (1)
Courtesy of GENERAL MOTORS CORP.

1. Position the outside door handle rod (2) in the clip (1) in order to eliminate any free play in the outside door handle.
2. Install the clip cover closed over the threaded outside door handle rod.
3. Inspect the door lock system for proper operation.
4. Install the rear door water deflector as needed. Refer to **Water Deflector Replacement - Rear Door (Impala)**.
5. Install the rear door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.

FRONT INSIDE DOOR HANDLE REPLACEMENT

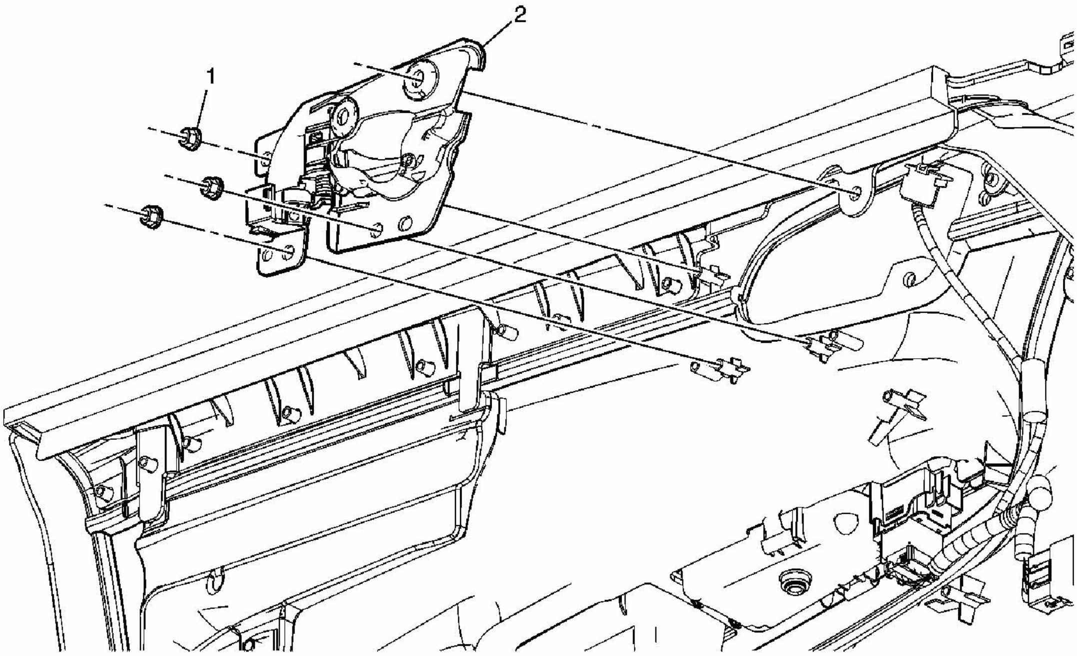


Fig. 104: Replacing Front Inside Door Handle
Courtesy of GENERAL MOTORS CORP.

Door Handle Replacement - Front Inside

Callout	Component Name
NOTE: Refer to Fastener Notice **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications** **Preliminary Procedure:** Remove the door panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**	
	Nut, Side Door Handle (Qty: 3)

1	**Tighten:** 2 N.m (18 lb in)
2	Handle Assembly, Inside Door

REAR INSIDE DOOR HANDLE REPLACEMENT

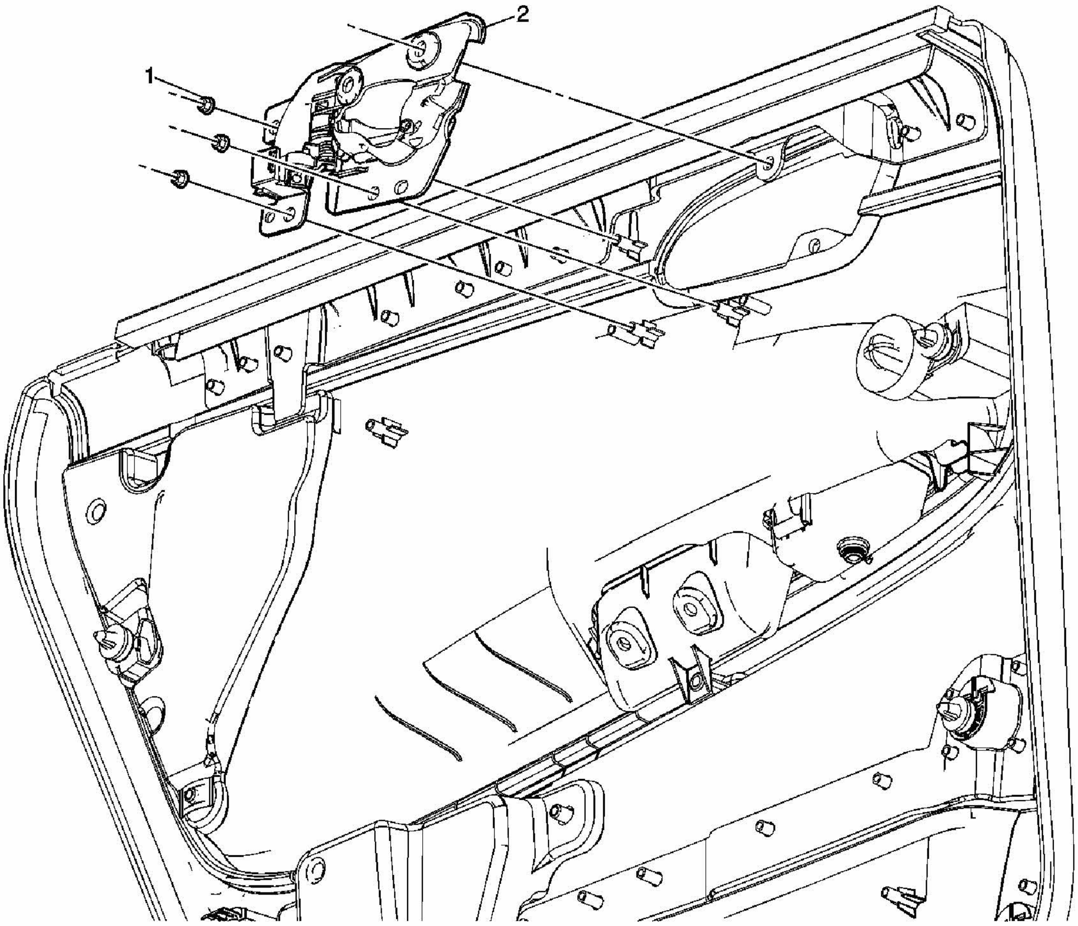


Fig. 105: Replacing Rear Inside Door Handle
Courtesy of GENERAL MOTORS CORP.

Door Handle Replacement - Rear Inside

Callout	Component Name
NOTE: **Refer to Fastener Notice** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications** **Preliminary Procedure:** Remove the door panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**	
1	Nut, Side Door Handle (Qty: 3)

	Tighten: 2 N.m (18 lb in)
2	Handle Assembly, Inside Door

FRONT INSIDE DOOR HANDLE CABLE REPLACEMENT - (MONTE CARLO)

Removal Procedure

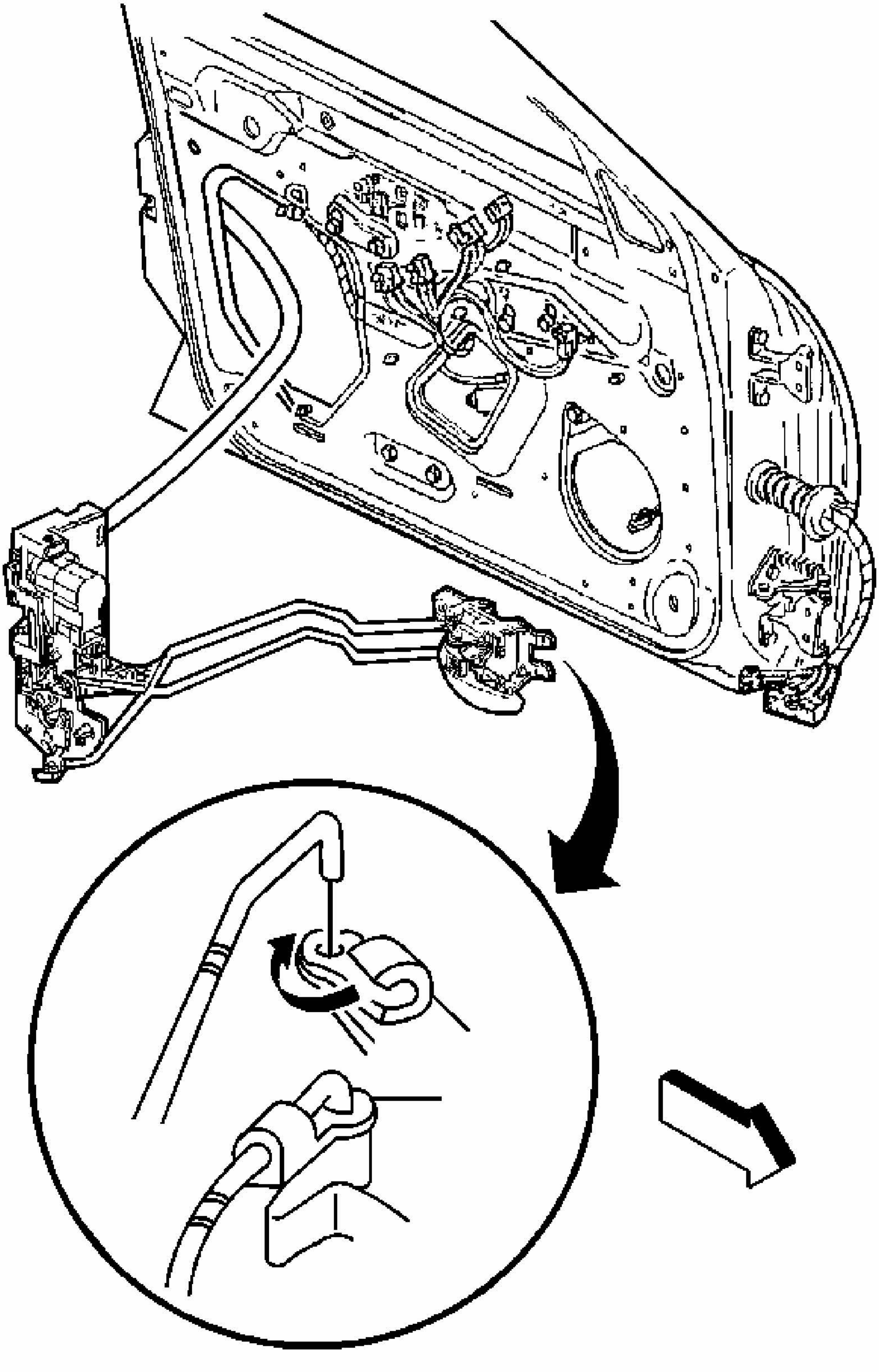


Fig. 106: View Of Front Door Inside Handle Rod - Front Door Lock
Courtesy of GENERAL MOTORS CORP.

1. Remove the front door lock. Refer to **Lock Replacement - Front Door (Monte Carlo)** or **Lock Replacement - Front Door (Impala)**.
2. Remove the front door inside handle rod from the front door lock.

Installation Procedure

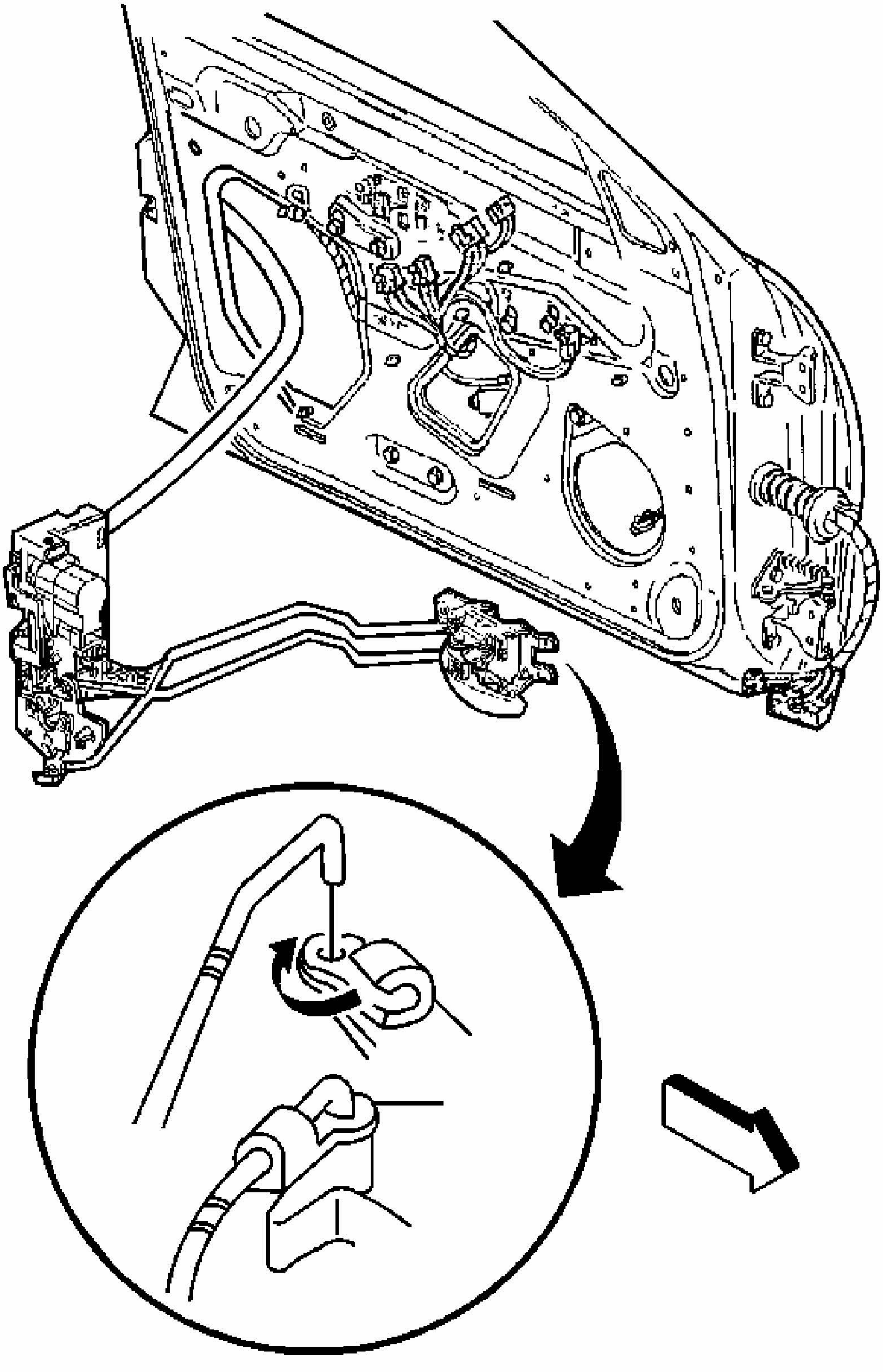


Fig. 107: View Of Front Door Inside Handle Rod - Front Door Lock
Courtesy of GENERAL MOTORS CORP.

1. Install the front door inside handle rod to the front door lock.

   Push in and rotate the rod through the clip in order to secure the rod.

2. Install the front door lock. Refer to **Lock Replacement - Front Door (Monte Carlo)** or **Lock Replacement - Front Door (Impala)**.

FRONT INSIDE DOOR HANDLE CABLE REPLACEMENT - (IMPALA)

Removal Procedure

1. Raise the door window to the full up position.

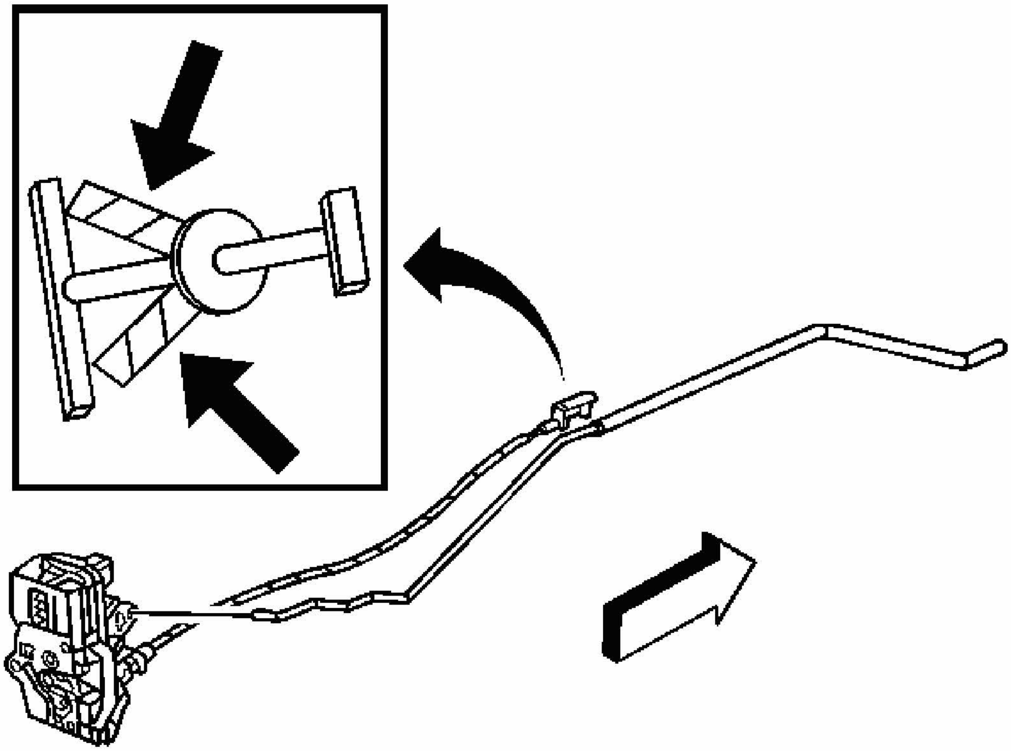


Fig. 108: View Of Inside Door Handle Cable
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The latch or cable is not serviceable separately. It must be replaced as an assembly.

2. Remove the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.
3. Remove the front door water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**.
4. Remove the front door lock. Refer to **Lock Replacement - Front Door (Monte Carlo)** or **Lock Replacement - Front Door (Impala)**.
5. Remove the lock and cable through the opening in the inner door panel.

Installation Procedure

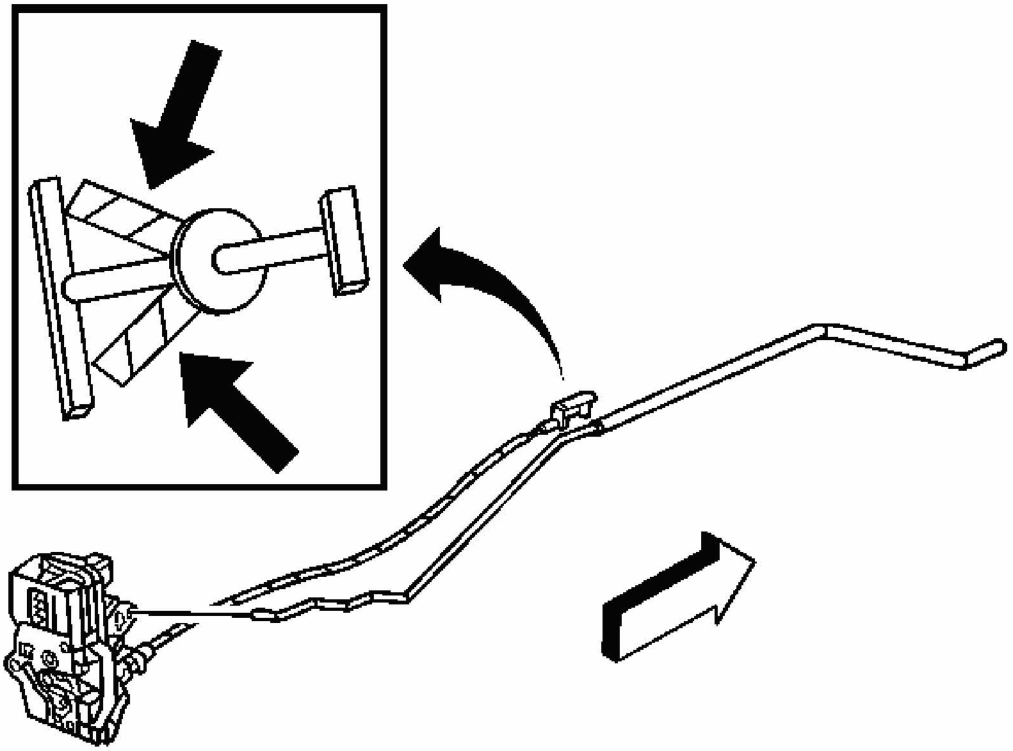


Fig. 109: View Of Inside Door Handle Cable
Courtesy of GENERAL MOTORS CORP.

1. Install the lock and cable through the opening in the inner door panel.
2. Install the front door lock. Refer to **Lock Replacement - Front Door (Monte Carlo)** or **Lock Replacement - Front Door (Impala)**.
3. Inspect the door for proper operation.
4. Install the front door water deflector. Refer to **Water Deflector Replacement - Front**

Door (Impala) or **Water Deflector Replacement - Front Door (Monte Carlo)**.

5. Install the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.

REAR INSIDE DOOR HANDLE CABLE REPLACEMENT

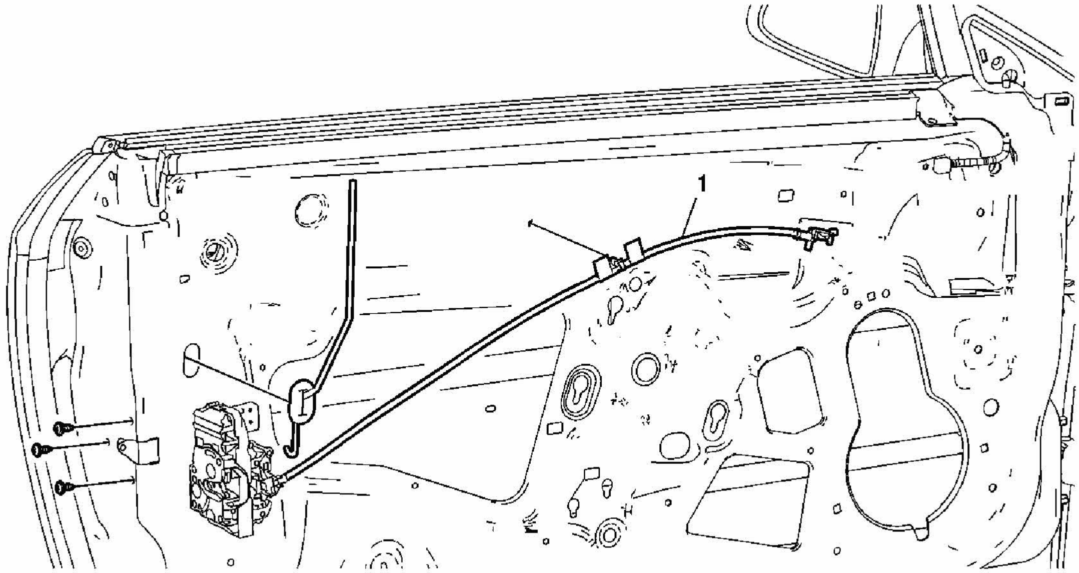


Fig. 110: Replacing Rear Inside Door Handle Cable
Courtesy of GENERAL MOTORS CORP.

Door Handle Cable Replacement - Rear Inside

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">NOTE:
Refer to Fastener Notice .
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.
Preliminary Procedures
1. Remove the interior trim panel. Refer to Trim Panel Replacement - Side Rear Door (Impala).
2. Remove the water deflector. Refer to Water Deflector Replacement - Rear Door (Impala).
3. Remove the rear side door lock. Refer to Lock Replacement - Rear Door.</td></tr>
<tr><td>1</td><td>Rear Door Lock Cable
Tip: Use a flat-bladed screwdriver to release the inside door handle from the trim panel.</td></tr>
</table>

FRONT DOOR LOCKING ROD REPLACEMENT - (IMPALA)

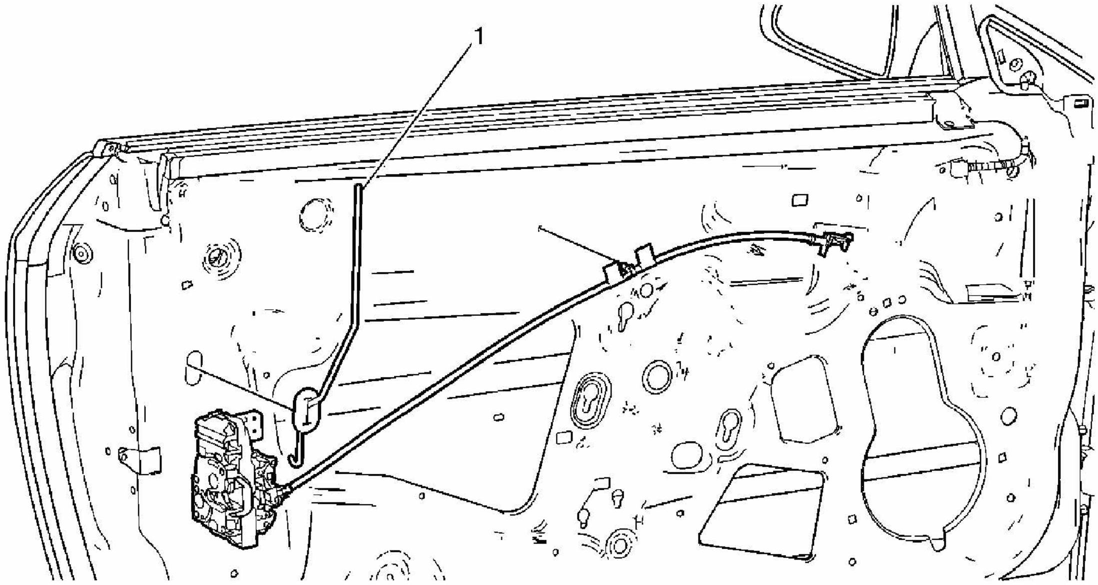


Fig. 111: Replacing Front Door Locking Rod
Courtesy of GENERAL MOTORS CORP.

Locking Rod Replacement - Front Door (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**. 2. Remove the water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**. 3. Remove the front side door lock. Refer to **Lock Replacement - Front Door (Monte Carlo)** or **Lock Replacement - Front Door (Impala)**.	
1	Rod, Front Side Door Lock

FRONT DOOR LOCKING ROD REPLACEMENT - (MONTE CARLO)

Removal Procedure

1. Remove the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.
2. Remove the front door water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**.

3. Remove the front door inner energy absorber panel. Refer to **Energy Absorber Pad Replacement - Inner Front**.

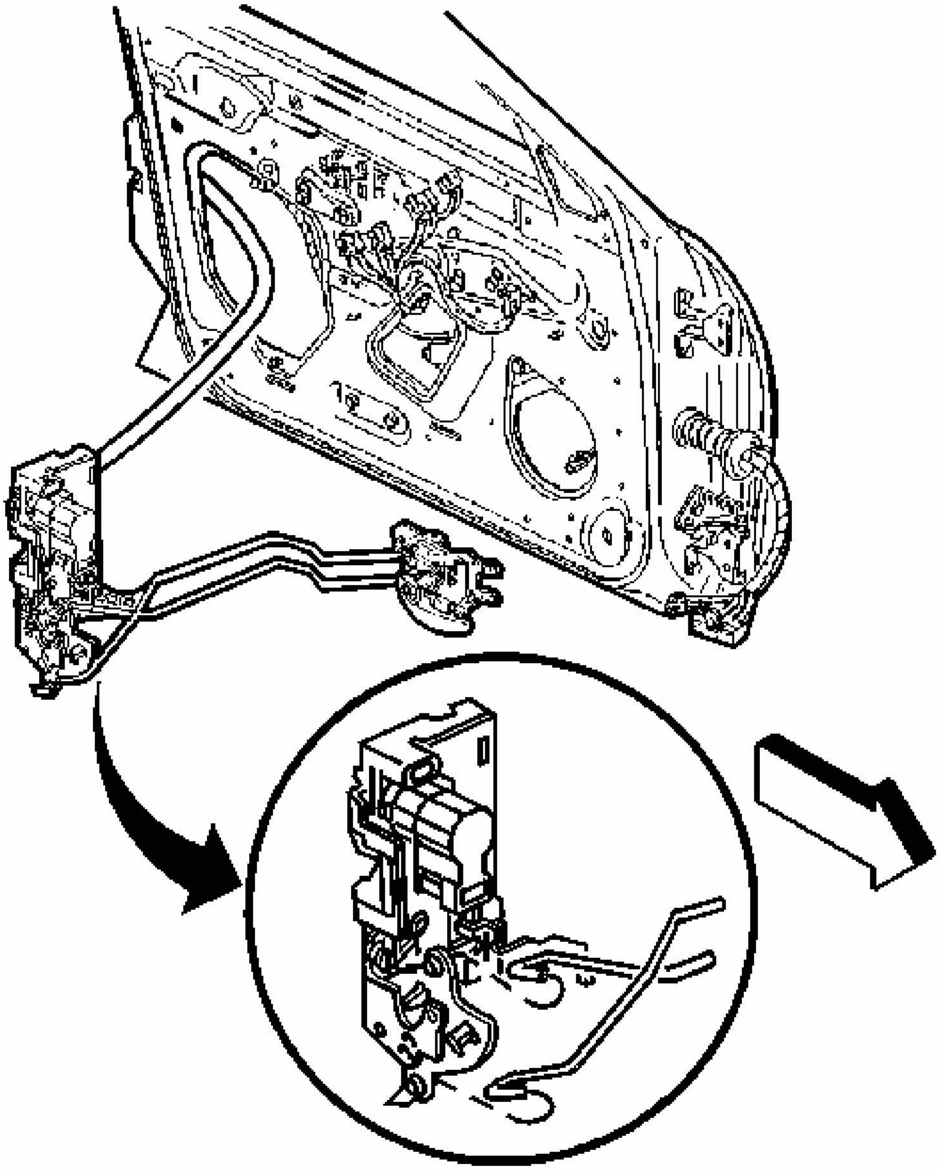


Fig. 112: Door Lock & Locking Rod (Impala)
Courtesy of GENERAL MOTORS CORP.

4. Remove the front door lock rod from the inside door handle.
5. Remove the lock rod from the locking clip.

6. Rotate and remove the front door inside locking rod from the front door lock.
7. Remove the front door inside locking rod from the front door.

Installation Procedure

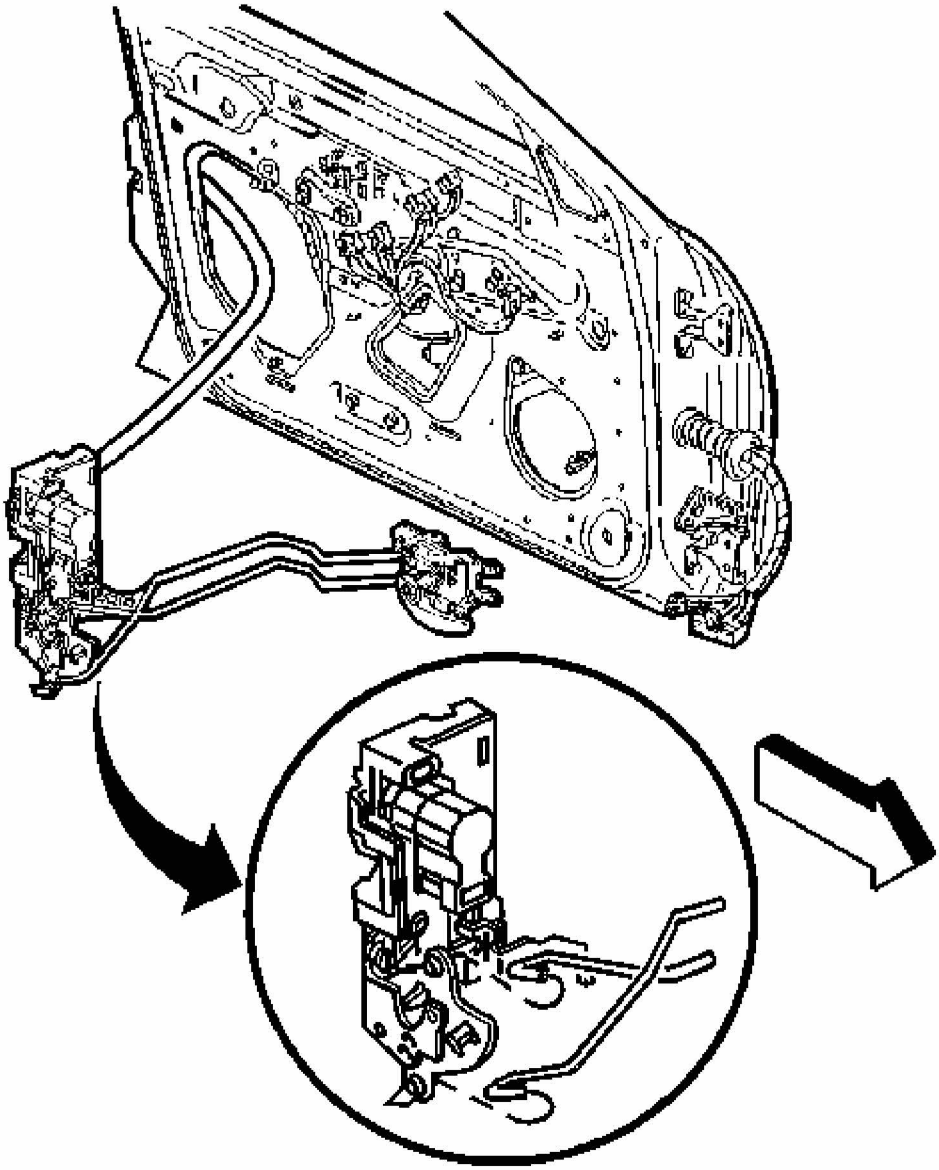


Fig. 113: Door Lock & Locking Rod (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Install the front door inside locking rod to the front door lock.

2. Install the lock rod into the locking clip.
3. Install the front door lock rod in the inside door handle.
4. Install the front door inner energy absorber panel. Refer to **Energy Absorber Pad Replacement - Inner Front**.
5. Install the front door water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**.
6. Install the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.

FRONT DOOR LOCK REPLACEMENT - (MONTE CARLO)

Removal Procedure

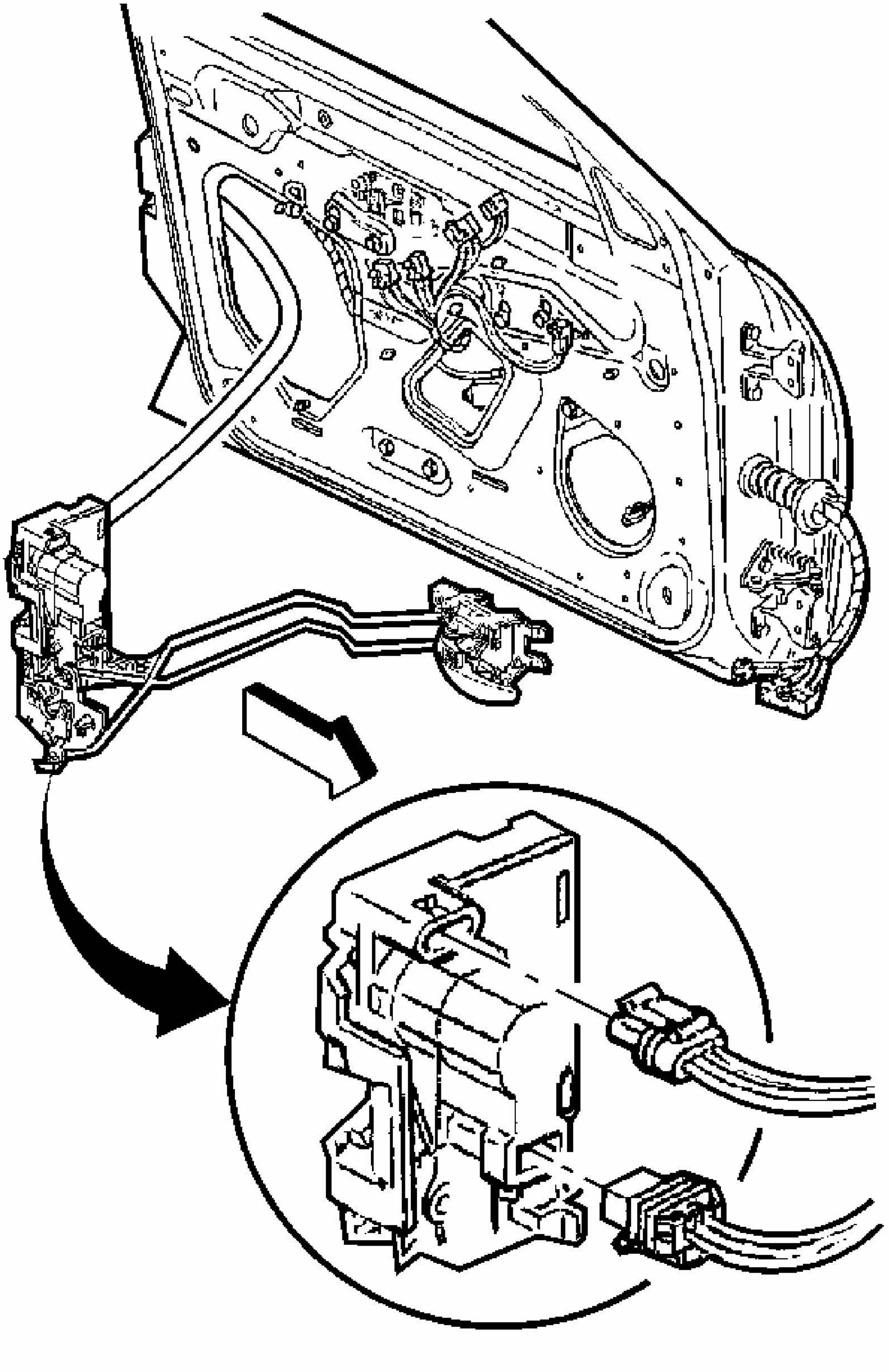


Fig. 114: Front Door Lock & Electrical Connectors (Impala)

Courtesy of GENERAL MOTORS CORP.

1. Remove the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**
2. Remove the front door water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**
3. Remove the front door inside handle rods from the front door inside handle.
4. Remove the clip securing the front door inside handle rods to the front door.
5. Remove the outside handle rod-to-lock clip from the lock.

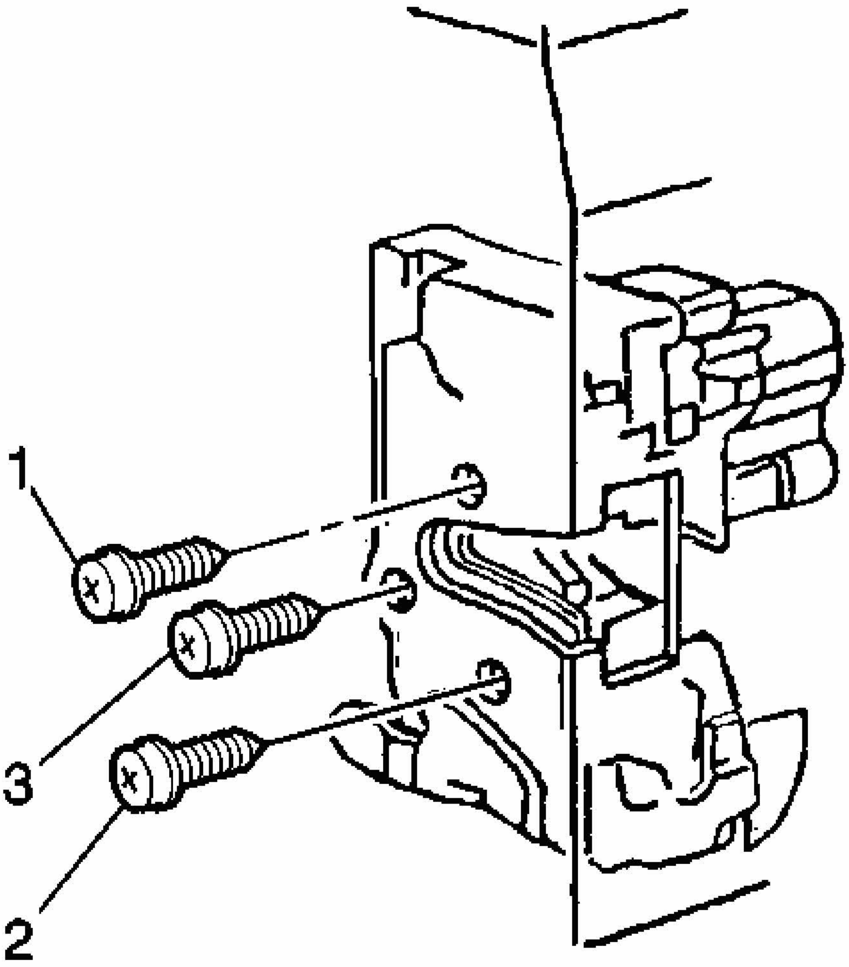


Fig. 115: Removing Lock To Front Door Screws (Impala)
Courtesy of GENERAL MOTORS CORP.

6. Remove the screws (1) securing the lock to the front door.
7. Remove the lock from the front door with the inside handle rods attached to the lock.
8. Disconnect the electrical connectors.
9. Remove the front door inside handle rods from the lock.

Installation Procedure

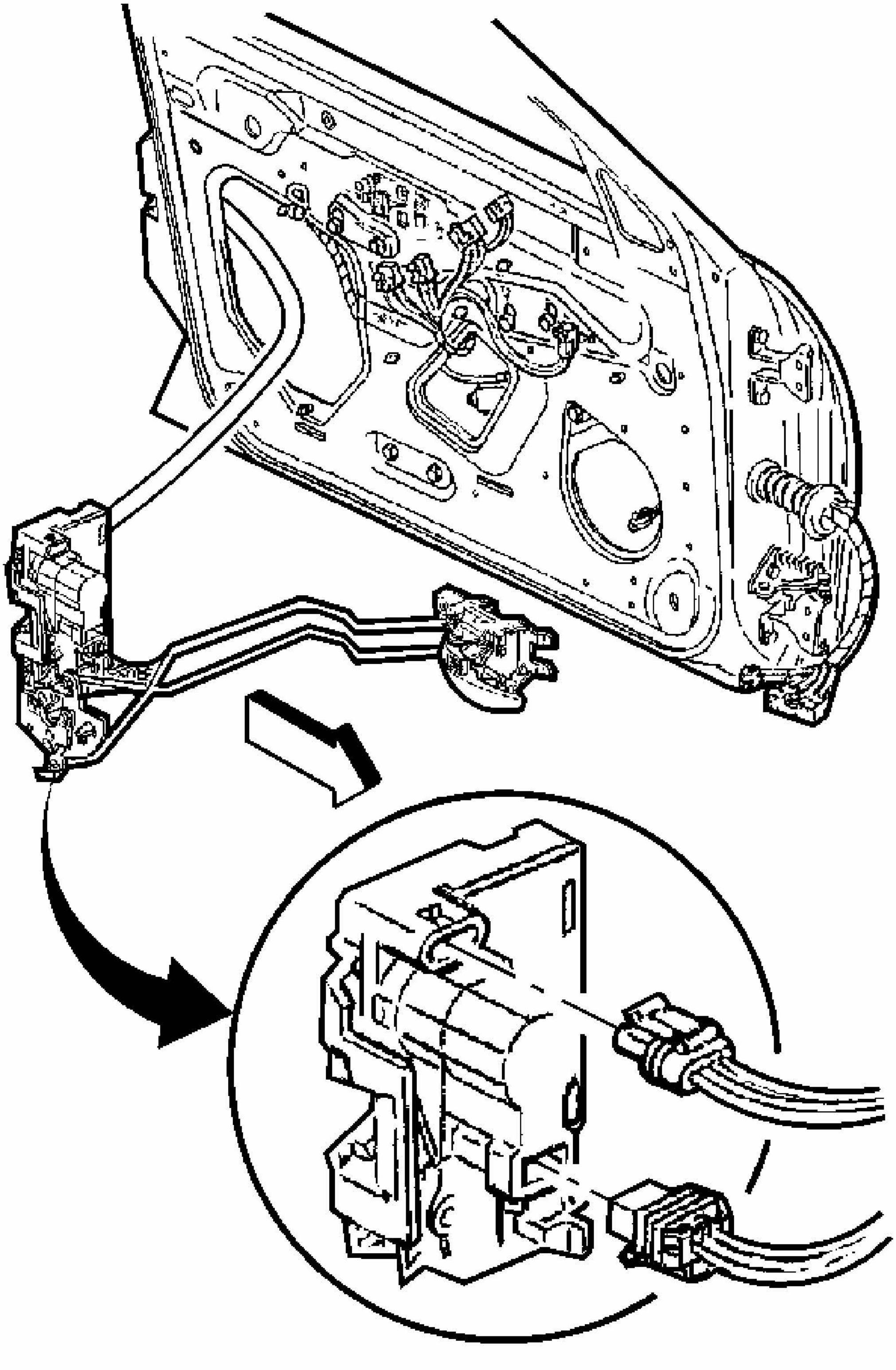


Fig. 116: Front Door Lock & Electrical Connectors (Impala)

Courtesy of GENERAL MOTORS CORP.

1. Install the front door inside handle rods to the lock.
2. Install the front door lock in the position through the access hole in the front door inner panel.
3. Connect the electrical connectors.

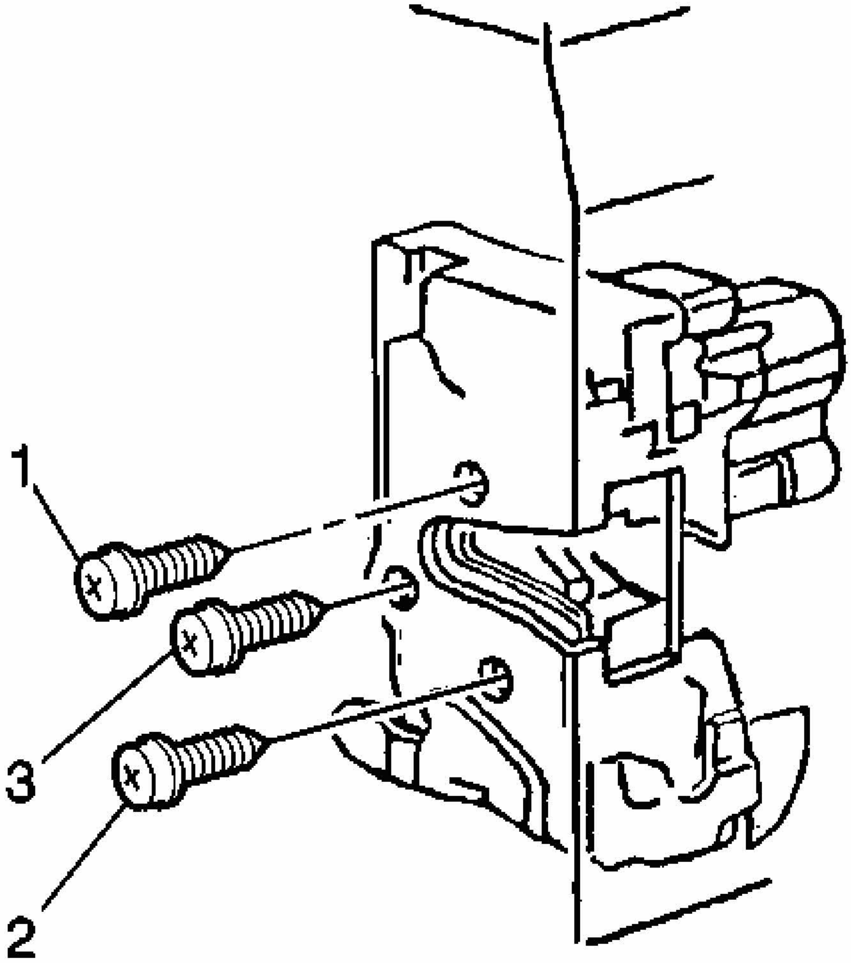


Fig. 117: Removing Lock To Front Door Screws (Impala)
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE .**

4. Install the front door lock screws in the proper fastener tightening sequence: top (1), bottom (2), middle (3).

   Tighten: Tighten the front door lock screws to 10 N.m (89 lb in).

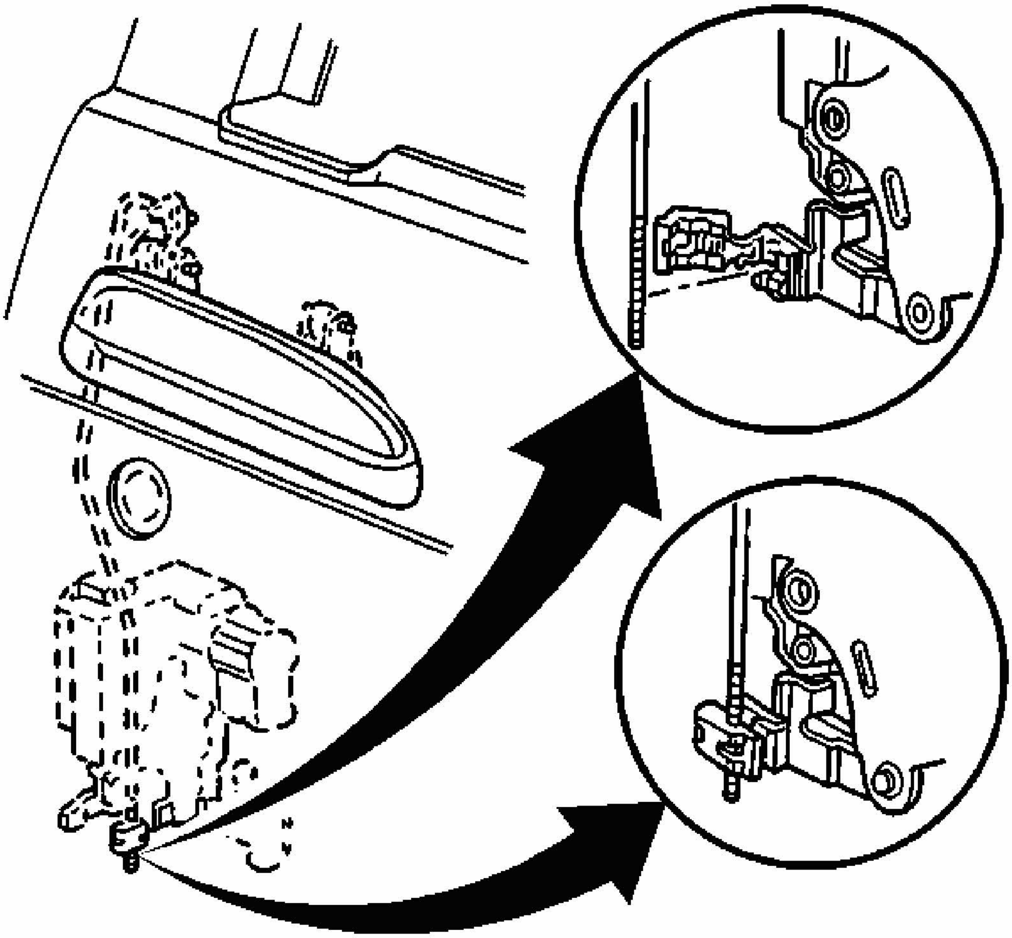


Fig. 118: Installing Outside Handle Rod-To-Lock Clip (Impala)
Courtesy of GENERAL MOTORS CORP.

5. Install a NEW outside handle rod-to-lock clip onto the front door lock lever.
   1. Position the front door outside door handle rod in the clip to eliminate any free play in the front door outside door handle.
   2. Install the clip cover closed over the threaded front door outside door handle rod.
6. Install the clip to the front door inside handle rods.
7. Install the front door handle rods to the handle.

8. Install the front door water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**
9. Install the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**
10. Inspect the door lock system for the proper operation.

FRONT DOOR LOCK REPLACEMENT - (IMPALA)

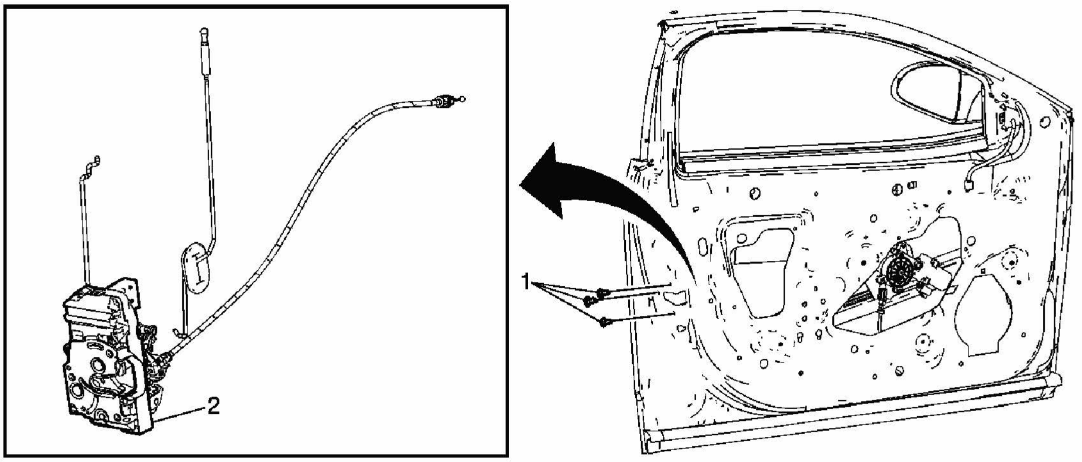


Fig. 119: Replacing Front Door Lock
Courtesy of GENERAL MOTORS CORP.

Lock Replacement - Front Door (Impala)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.

Preliminary Procedures

1. Remove the interior trim panel. Refer to Trim Panel Replacement - Side Front Door (Impala).
2. Remove the water deflector. Refer to Water Deflector Replacement - Front Door (Impala) or Water Deflector Replacement - Front Door (Monte Carlo).
3. Remove the outside door handle. Refer to Door Handle Replacement - Front Outside (Impala) or Door Handle Replacement - Front Outside (Monte Carlo).</td></tr>
<tr><td></td><td>Screw, Front Side Door Lock (Qty: 3)</td></tr>
</table>

1	**Tighten:** 10 N.m (89 lb in)
2	Lock Assembly, Front Side Door **Tip:** 1. Release the door lock cable retainers from the door. 2. Disconnect the door lock electrical connector. 3. Remove the door lock with the handle housing. 4. Remove the handle and lock rods from the lock.

REAR DOOR LOCK REPLACEMENT

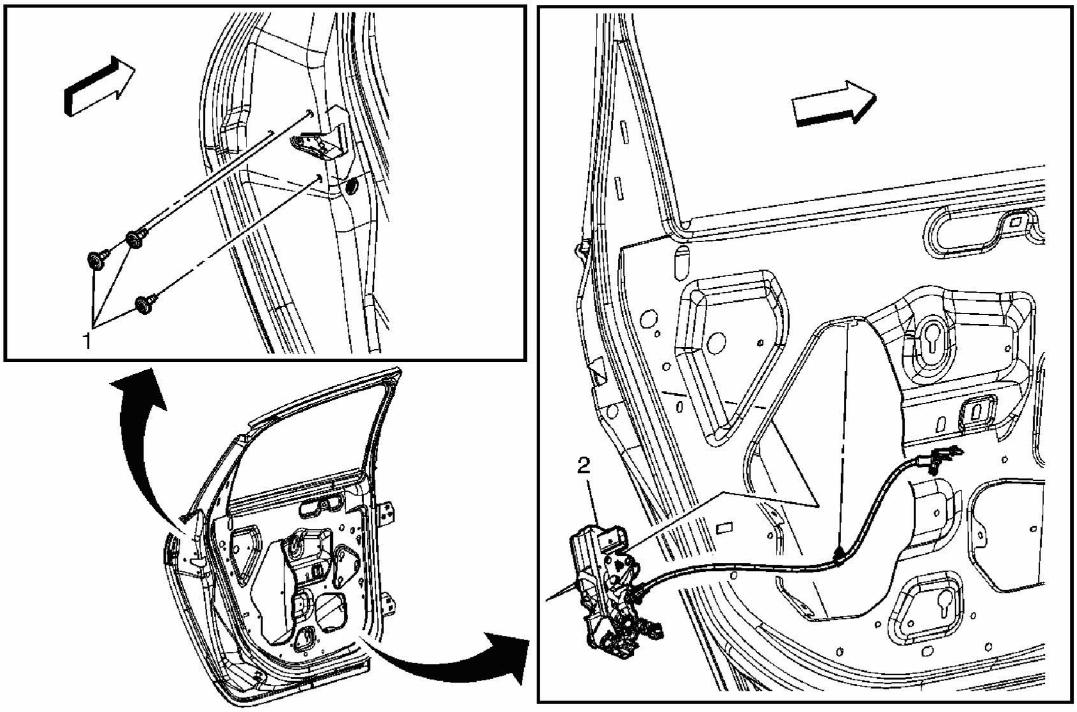


Fig. 120: Replacing Rear Door Lock
Courtesy of GENERAL MOTORS CORP.

Lock Replacement - Rear Door

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures**	

1. Remove the rear door outside handle. Refer to **Door Handle Replacement - Rear Outside**. 2. Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**. 3. Remove the water deflector. Refer to **Water Deflector Replacement - Rear Door (Impala)**.	
1	Bolt, Rear Side Door Lock (Qty: 3) **Tighten:** 10 N.m (89 lb in)
2	Lock Assembly, Rear Side Door **Tip:** 1. Release the inside handle cable retainers before removing the door lock. 2. Disconnect the door lock electrical connector. 3. Remove the door lock with the outside handle housing. 4. Transfer the handle and lock rods to the new door lock.

FRONT DOOR LOCK ACTUATOR REPLACEMENT

Removal Procedure

1. Remove the front door lock. Refer to **Lock Replacement - Front Door (Monte Carlo)** or **Lock Replacement - Front Door (Impala)**

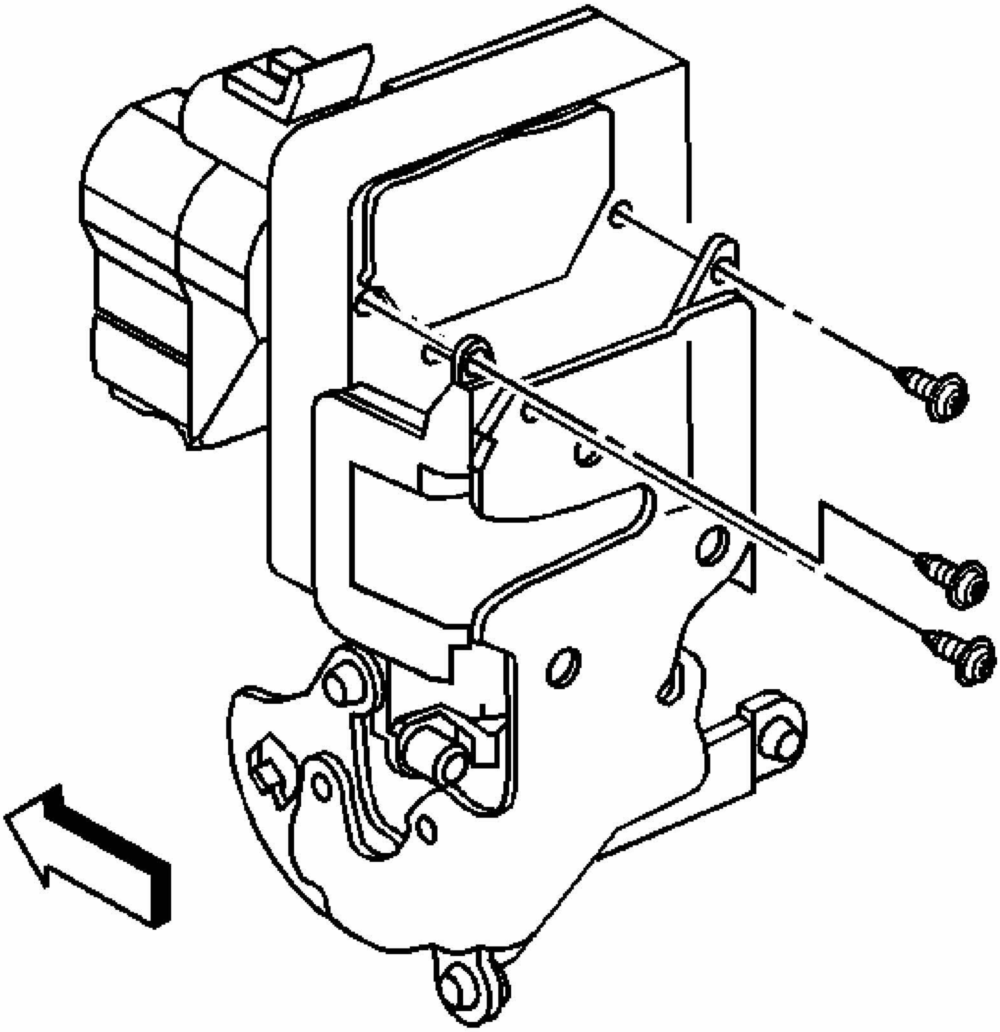


Fig. 121: Door Lock, Actuator & Screws
Courtesy of GENERAL MOTORS CORP.

2. Remove the front door lock to front door lock actuator screws.
3. Remove the front door actuator from the front door lock.

Installation Procedure

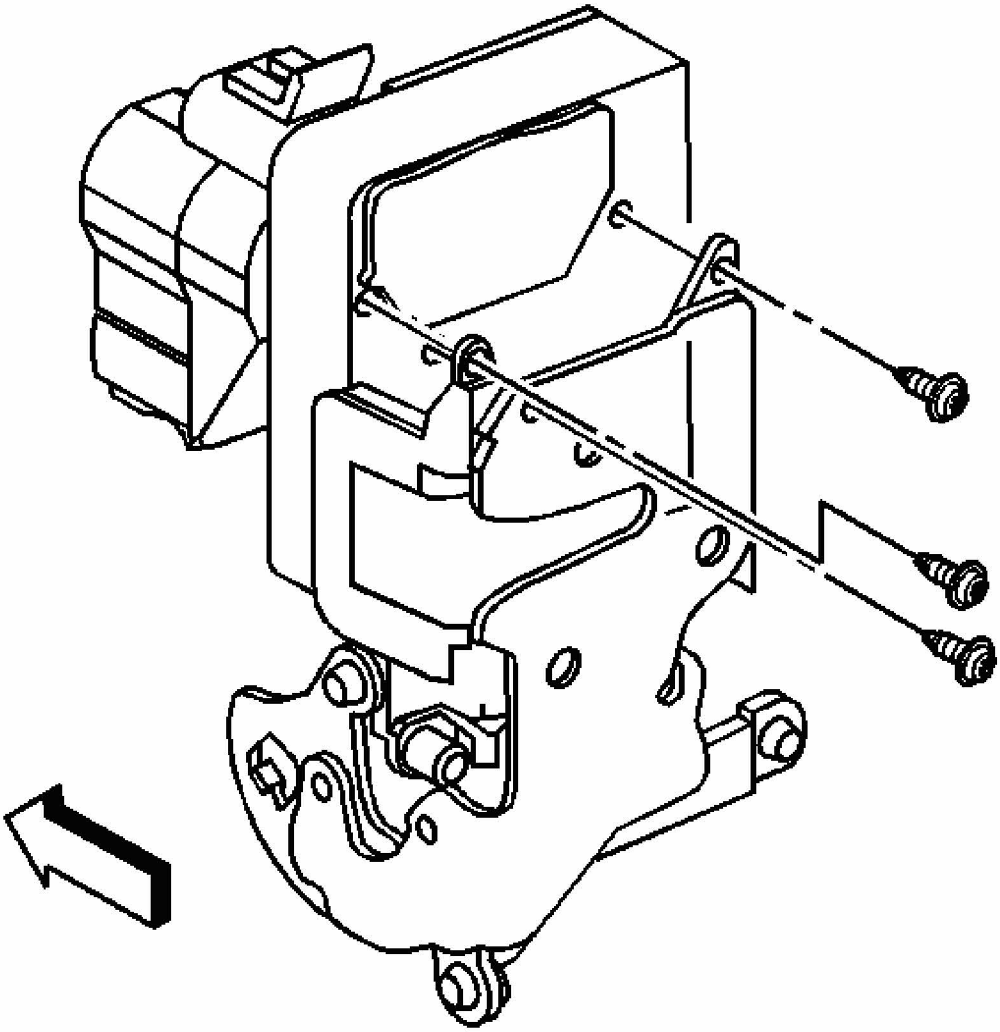


Fig. 122: Door Lock, Actuator & Screws
Courtesy of GENERAL MOTORS CORP.

1. Align the front door actuator to the front door lock.

   NOTE: **Refer to FASTENER NOTICE .**

2. Install the front door lock to front door actuator screws.

   Tighten: Tighten the front door actuator screws to 2 N.m (18 lb in).

3. Install the front door lock. Refer to **Lock Replacement - Front Door (Monte Carlo)**

or **Lock Replacement - Front Door (Impala)**

REAR DOOR LOCK ACTUATOR REPLACEMENT

Removal Procedure

1. Remove the rear door lock. Refer to **Lock Replacement - Rear Door**

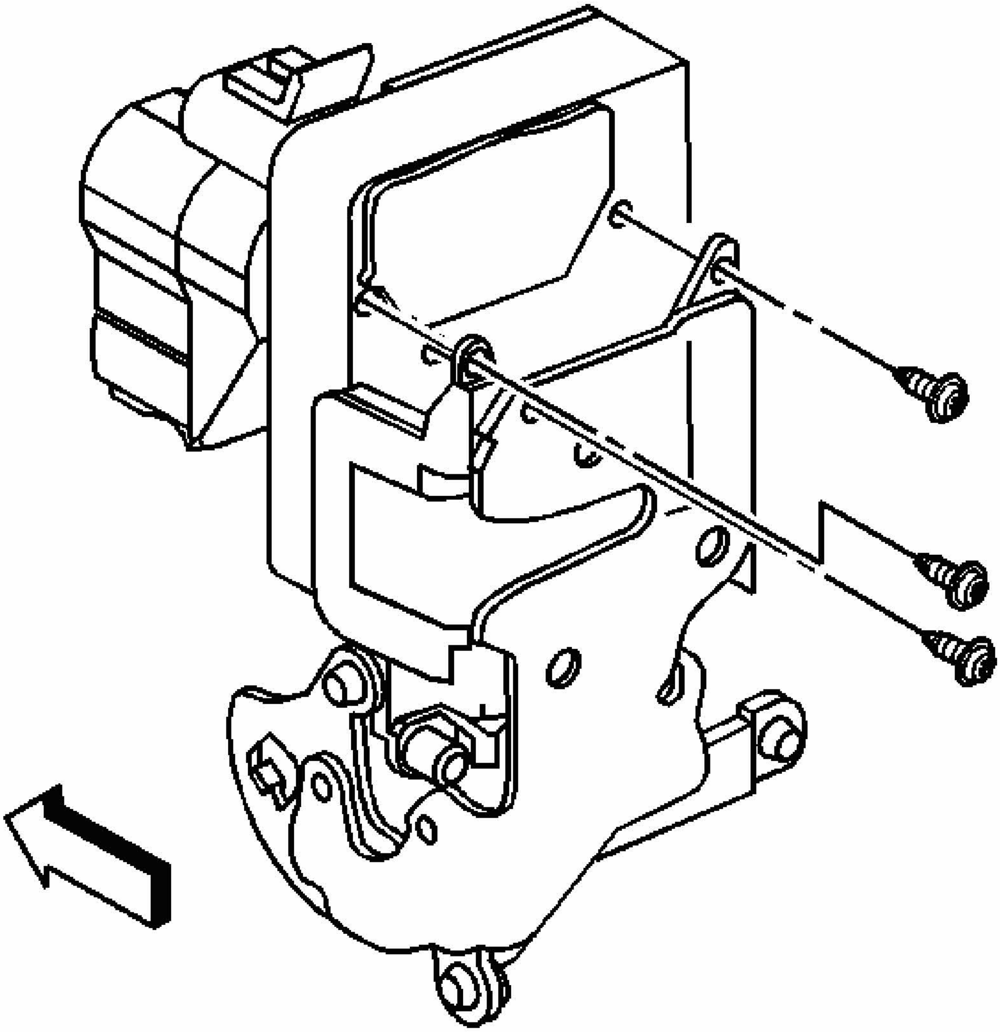


Fig. 123: Door Lock, Actuator & Screws
Courtesy of GENERAL MOTORS CORP.

2. Remove the rear door lock to rear door lock actuator screws.
3. Remove the rear door actuator from the rear door lock.

Installation Procedure

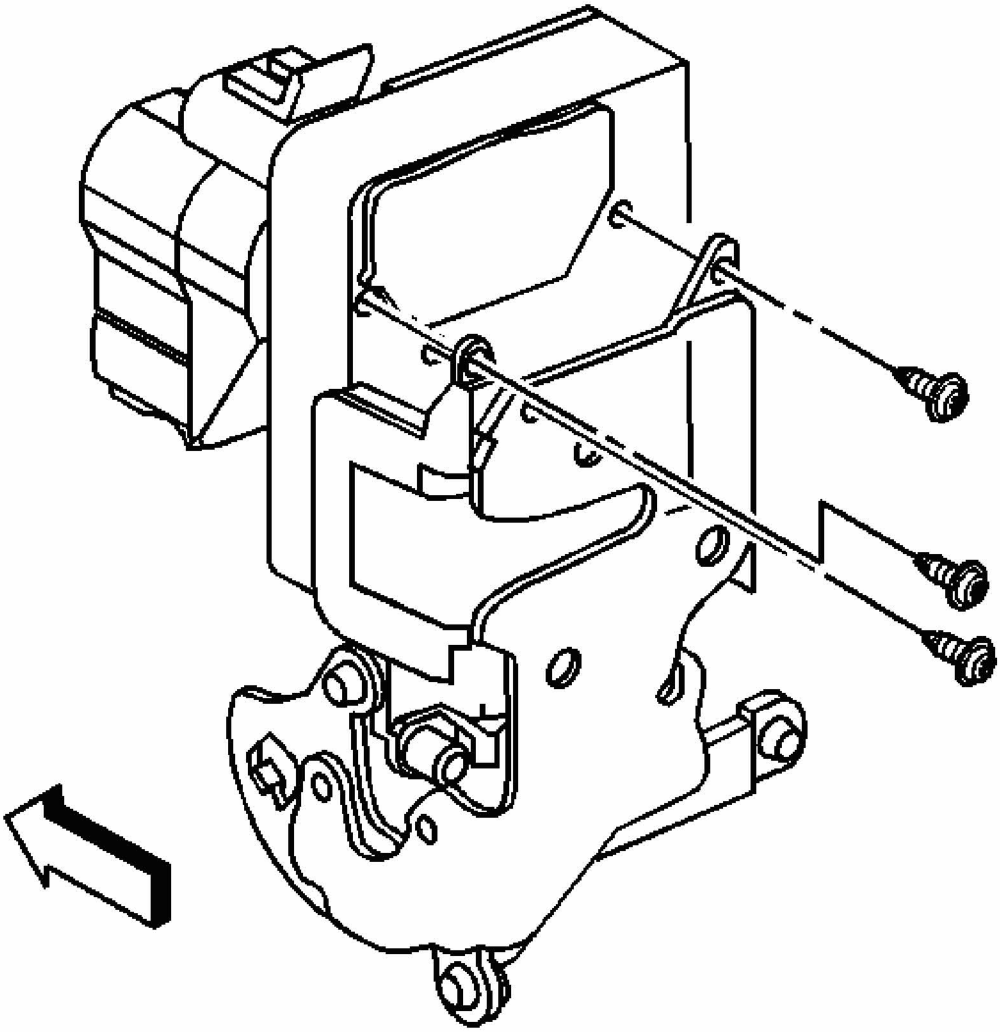


Fig. 124: Door Lock, Actuator & Screws
Courtesy of GENERAL MOTORS CORP.

1. Align the rear door actuator to the rear door lock.

NOTE: Refer to FASTENER NOTICE .

2. Install the rear door lock to rear door actuator screws.

Tighten: Tighten the rear door actuator screws to 2 N.m (18 lb in).

3. Install the rear door lock. Refer to **Lock Replacement - Rear Door**

DOOR LOCK CYLINDER REPLACEMENT - (IMPALA)

Removal Procedure

IMPORTANT: Do not attempt repairs in order to correct lock cylinder discrepancies. Replace the lock cylinder.

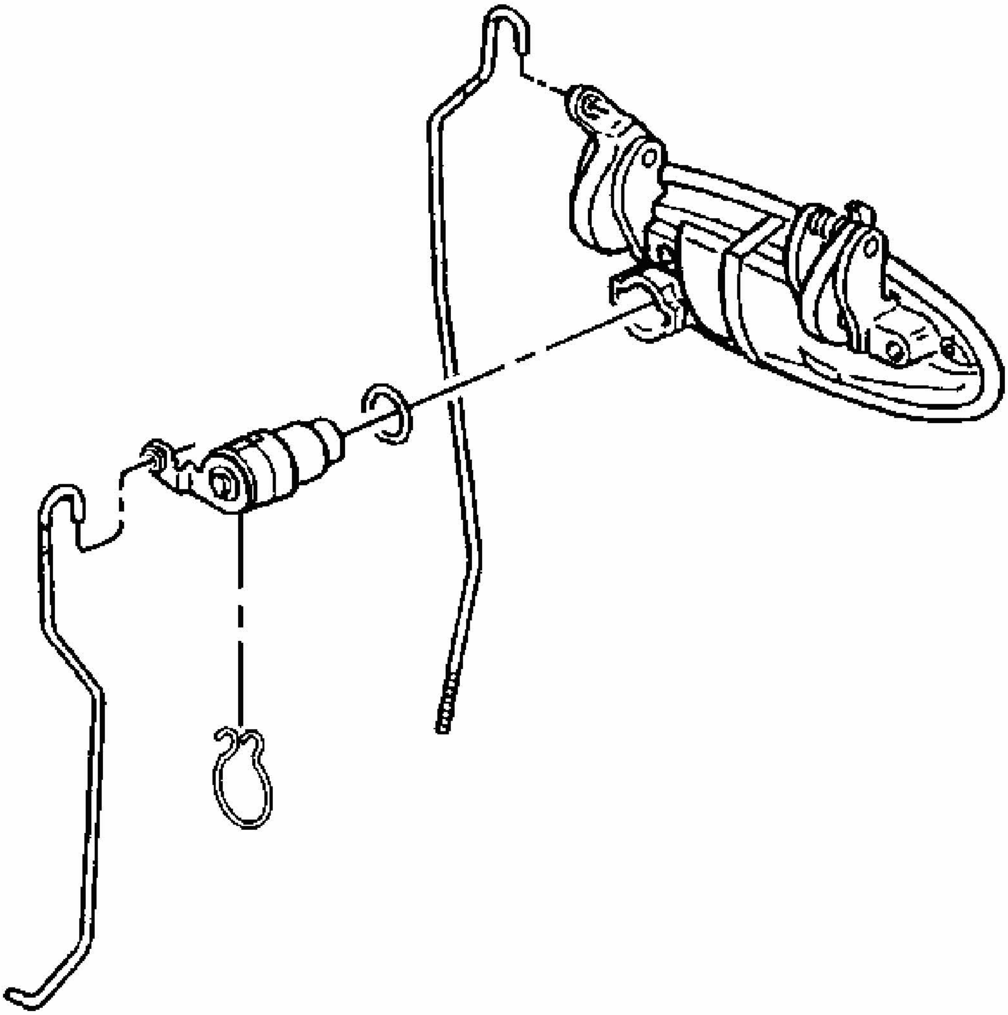


Fig. 125: Door Handle & Lock Cylinder
Courtesy of GENERAL MOTORS CORP.

1. Remove the front door outside handle. Refer to **Door Handle Replacement - Front Outside (Impala)** or **Door Handle Replacement - Front Outside (Monte Carlo)**.

2. Remove the lock cylinder retainer clip.
3. Remove the lock cylinder from the front door outside door handle.

Installation Procedure

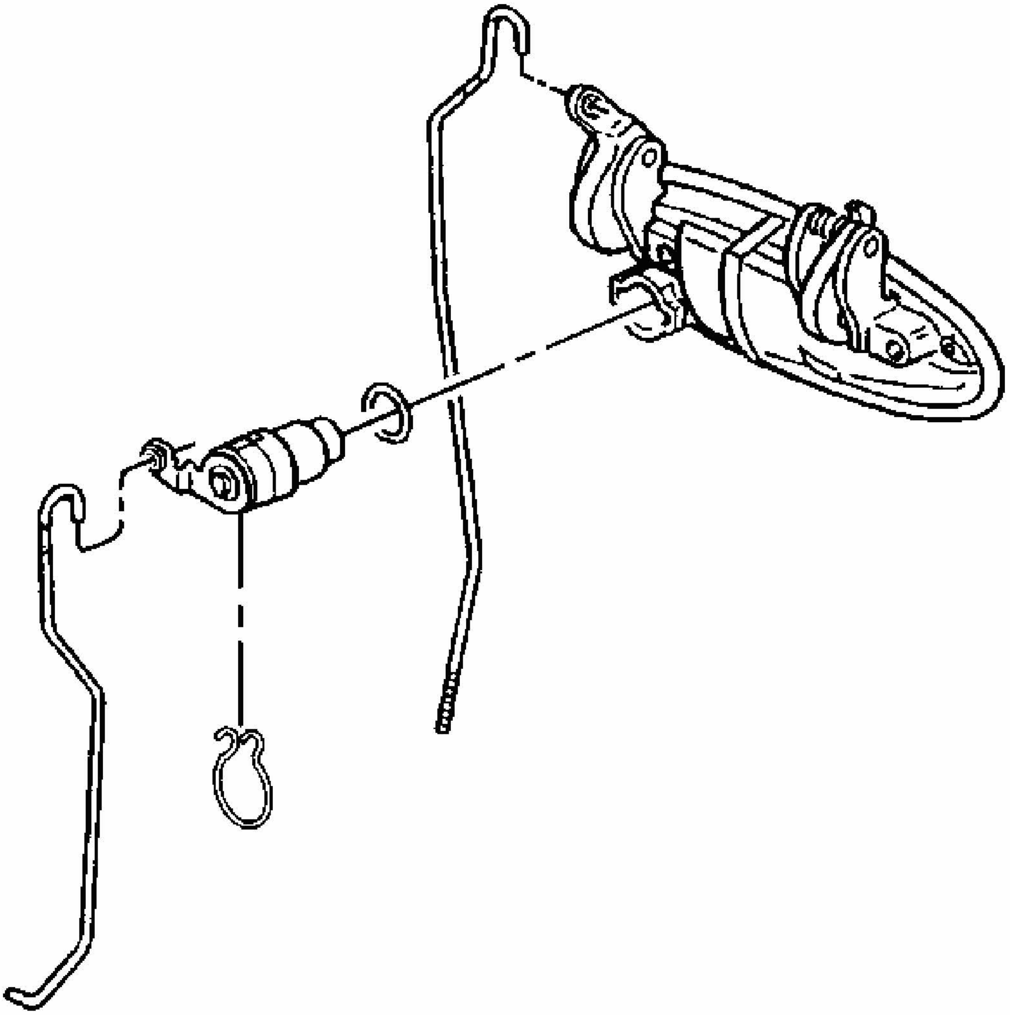


Fig. 126: Door Handle & Lock Cylinder
Courtesy of GENERAL MOTORS CORP.

1. Install the lock cylinder to the front door outside door handle.
2. Install the lock cylinder retainer clip.
3. Install the front door outside handle. Refer to **Door Handle Replacement - Front Outside (Impala)** or **Door Handle Replacement - Front Outside (Monte Carlo)**.

DOOR LOCK CYLINDER REPLACEMENT - (MONTE CARLO)

Removal Procedure

IMPORTANT: Do not attempt repairs in order to correct lock cylinder discrepancies. Replace the lock cylinder.

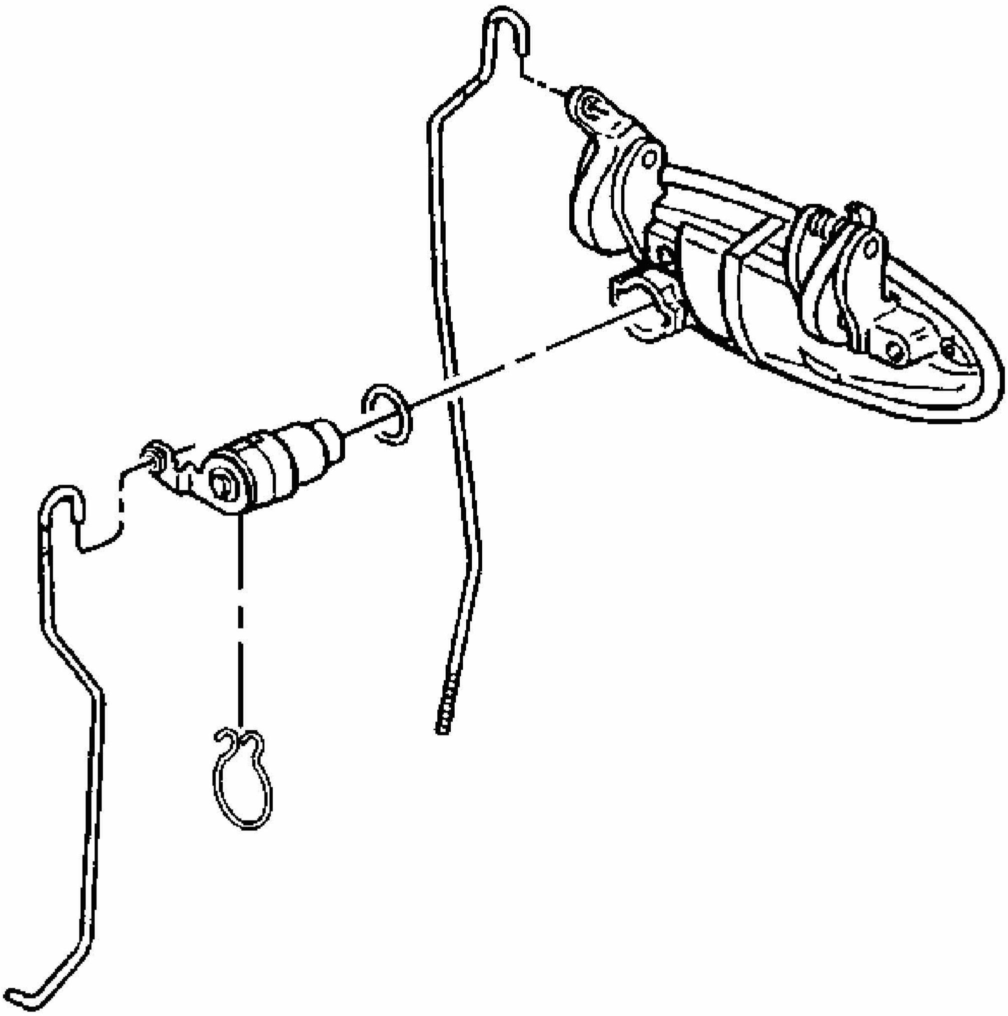


Fig. 127: Door Handle & Lock Cylinder
Courtesy of GENERAL MOTORS CORP.

1. Remove the front door outside door handle. Refer to **Door Handle Replacement - Front Outside (Impala)** or **Door Handle Replacement - Front Outside (Monte Carlo)**.

2. Remove the lock cylinder retainer clip.
3. Remove the lock cylinder from the front door outside door handle.

Installation Procedure

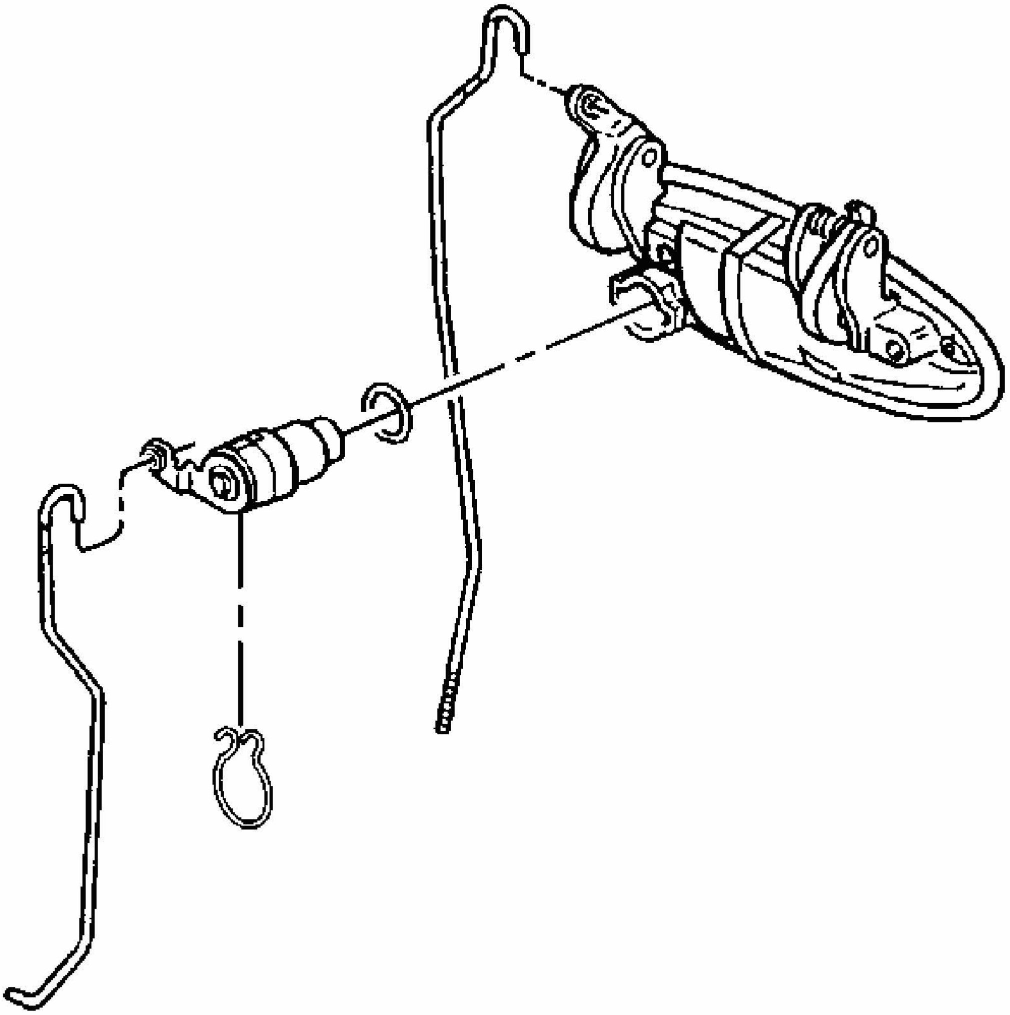


Fig. 128: Door Handle & Lock Cylinder
Courtesy of GENERAL MOTORS CORP.

1. Install the lock cylinder to the front door outside door handle.
2. Install the lock cylinder retainer clip.
3. Install the front door outside door handle. Refer to **Door Handle Replacement - Front Outside (Impala)** or **Door Handle Replacement - Front Outside (Monte Carlo)**.

FROZEN LOCK CYLINDER REPAIR

The frozen lock cylinders due to the cold weather may be repaired using the following procedure:

1. Apply heat to the cylinder area with a heat gun.
2. Hold the shutter door open with a paper clip or similar item and force air into the cylinder using compressed air and a blow gun attachment.
3. While holding the shutter door open inject a small amount of multi-purpose lubricant GM P/N 12346241 or equivalent.
4. Work the key into the cylinder several times and wipe any excess lubrication residue from the key.

DOOR LOCK STRIKER ADJUSTMENT - (IMPALA)

Tools Required

J 39346-A . See **Special Tools**.

IMPORTANT: Properly align the door before adjusting the striker.

1. Open the door.

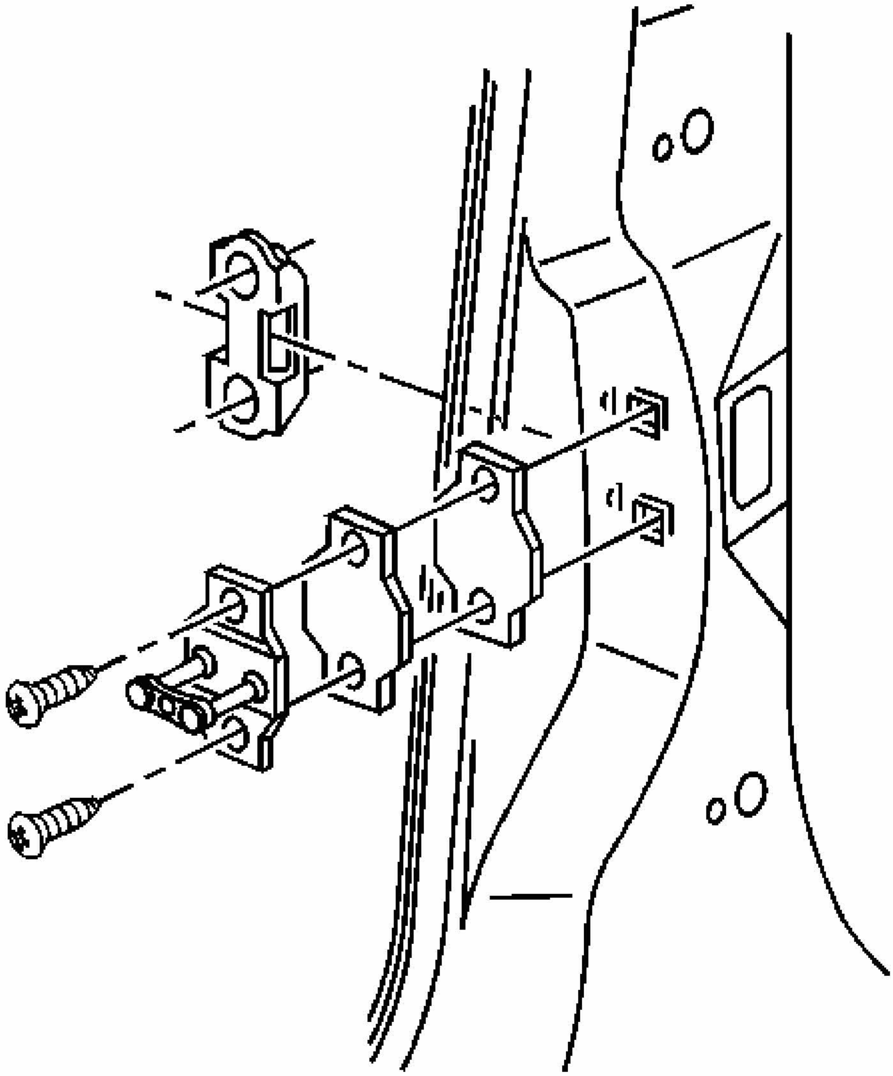


Fig. 129: View Of Lock Striker Components
Courtesy of GENERAL MOTORS CORP.

2. Loosen the door striker screws just enough to allow movement of the door striker.
3. Install the **J 39346-A** . See Special Tools.

IMPORTANT: Do not slam the door.

4. Close the door while holding the outside handle in the open position.

5. Open the door.

NOTE: Refer to Fastener Notice .

6. Tighten the door lock striker screws.

   Tighten: Tighten the door striker screws to 25 N.m (18 lb ft).

7. Remove the **J 39346-A** . See **Special Tools**.
8. Close the door.

DOOR LOCK STRIKER ADJUSTMENT - (MONTE CARLO)

IMPORTANT: Properly align the door before adjusting the striker.

1. Open the door.

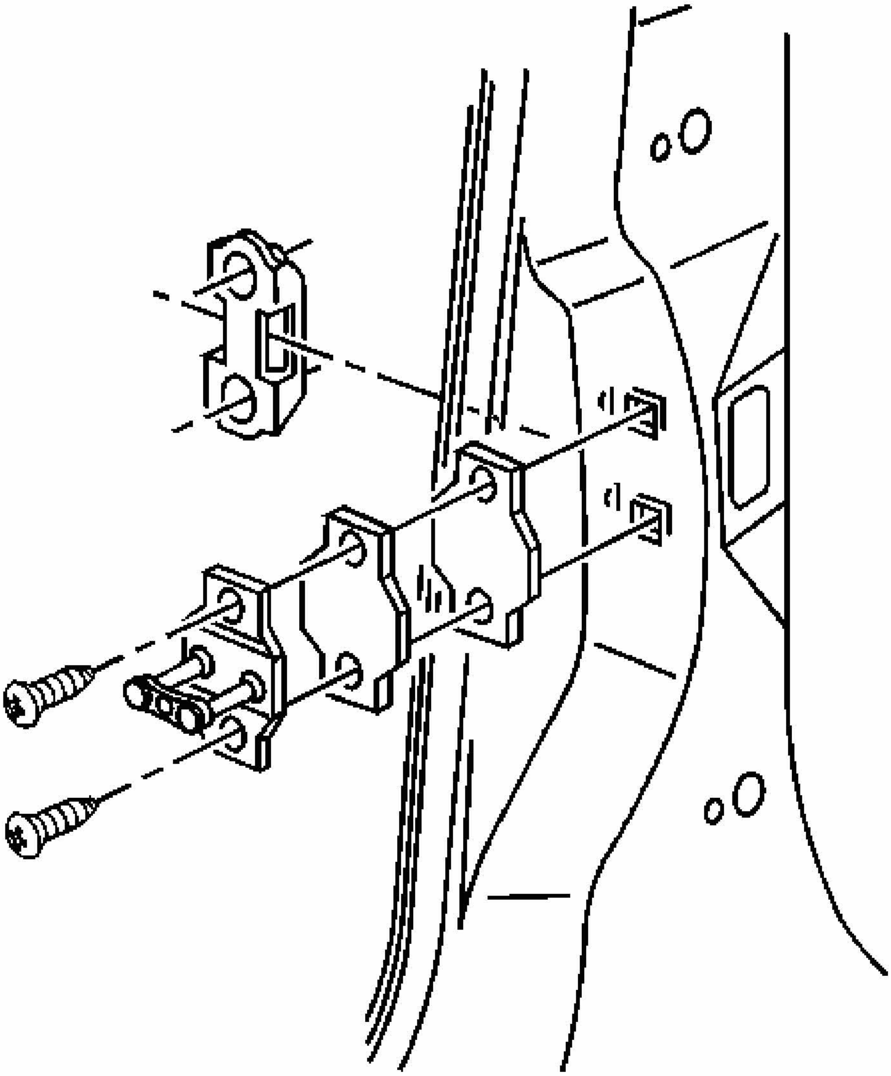


Fig. 130: View Of Lock Striker Components
Courtesy of GENERAL MOTORS CORP.

2. Loosen the door striker screws just enough to allow movement of the door striker.
3. Adjust the door striker up or down and inboard or outboard as required.
4. Apply modeling clay or body caulking compound to the door lock opening.

IMPORTANT: Do not close the door all the way.

5. Close the door far enough for the striker to make an impression into the modeling clay or body caulking compound.
6. Open the door and check the door striker impression in the modeling clay or body caulking compound.

NOTE: **Refer to FASTENER NOTICE .**

7. Readjust door striker as required.

   Add or remove spacers as needed.

   Tighten: Tighten the door striker screws to 25 N.m (18 lb ft).

8. Close the door.

DOOR STRIKER ANCHOR PLATE REPLACEMENT

Removal Procedure

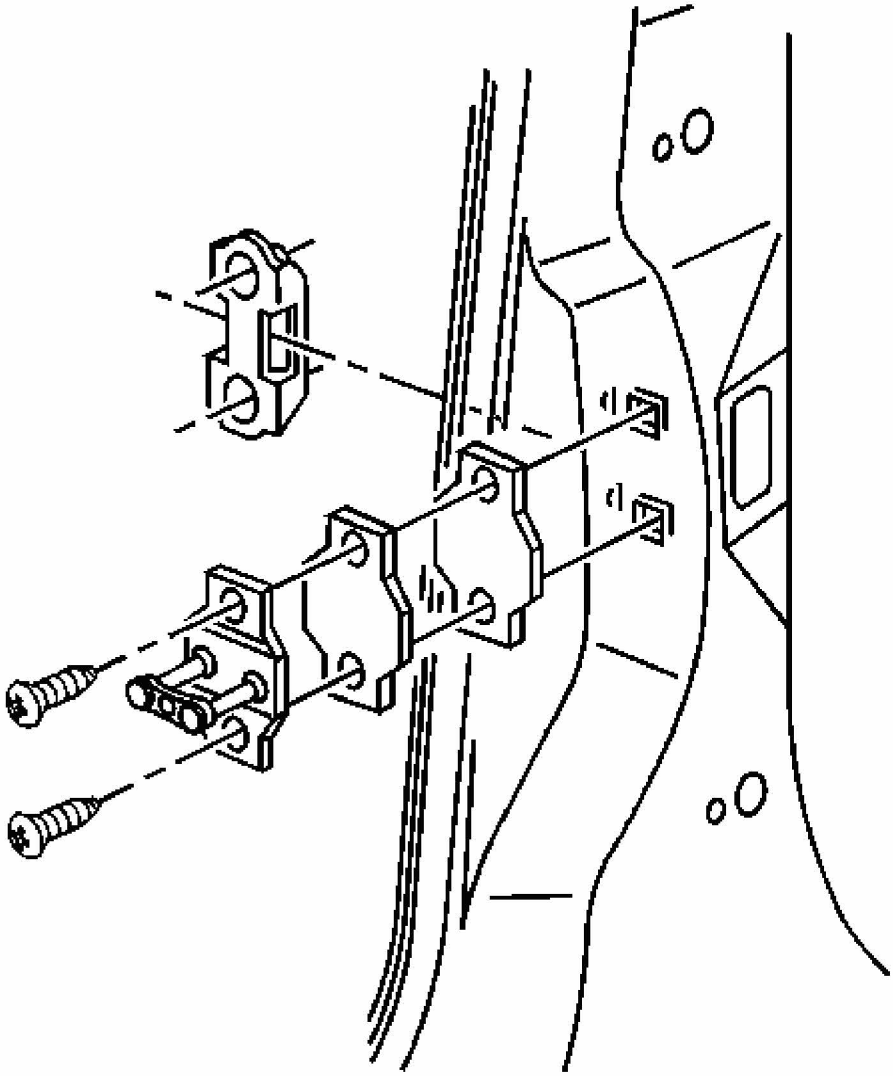


Fig. 131: View Of Lock Striker Components
Courtesy of GENERAL MOTORS CORP.

1. Remove the front or rear door lock pillar trim to gain access to the anchor plate.
    1. Remove the center pillar upper trim panel. (Front Striker) Refer to **Trim Panel Replacement - Upper Center Pillar**
    2. Remove the center pillar lower trim panel. (Front Striker) Refer to **Trim Panel Replacement - Lower Center Pillar**
    3. Remove the quarter lower trim panel. (Rear Striker). Refer to **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement -**

Rear Quarter Lower (Monte Carlo)

2. Mark the position of the striker with a grease pencil.
3. Remove the screws from the front door lock striker.
4. Remove the striker and the shims.
5. Remove the anchor plate.

Installation Procedure

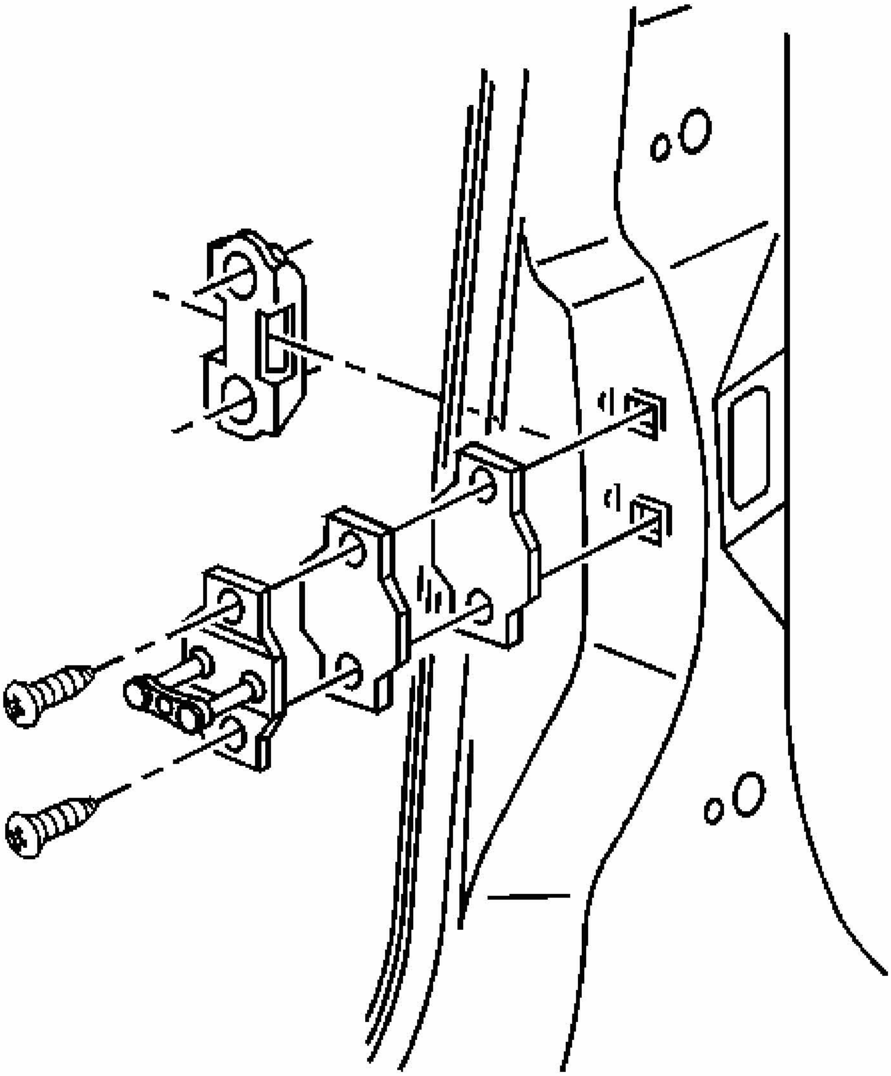


Fig. 132: View Of Lock Striker Components
Courtesy of GENERAL MOTORS CORP.

1. Install the anchor plate.
2. Install the door lock shims and striker.
3. Install the striker screws.
4. Align the door lock striker to the alignment marks.

NOTE: Refer to FASTENER NOTICE .

5. Tighten the door lock striker screws.

   Tighten: Tighten the striker screws to 25 N.m (18 lb ft).

6. Adjust door lock striker if required. Refer to **Lock Striker Adjustment - Door (Impala)** or **Lock Striker Adjustment - Door (Monte Carlo)**
7. Install the front and/or rear trim.
   1. Install the center pillar upper trim panel. (Front Striker) Refer to **Trim Panel Replacement - Upper Center Pillar**
   2. Install the center pillar lower trim panel. (Front Striker) Refer to **Trim Panel Replacement - Lower Center Pillar**
   3. Install the quarter lower trim panel. (Rear Striker). Refer to **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)**

FRONT DOOR WINDOW REGULATOR REPLACEMENT - (IMPALA)

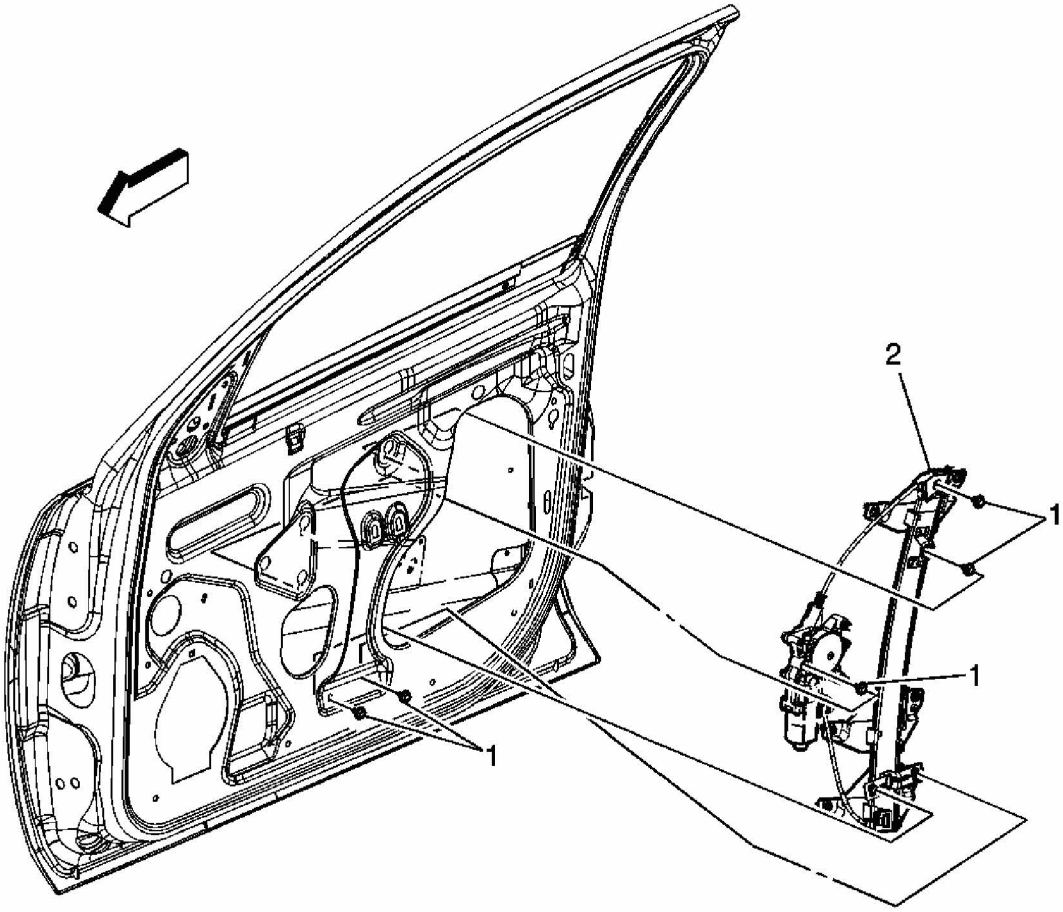


Fig. 133: Replacing Front Door Window Regulator
Courtesy of GENERAL MOTORS CORP.

Window Regulator Replacement - Front Door (Impala)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedures

1. Position window approximately half way down in the door.
2. Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.
3. Remove the water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**.</td></tr>
</table>

4. Tape the window to door frame to prevent it from moving.	
1	Screw, Front Side Door Window Regulator (Qty: 5) **Tighten:** 10 N.m (89 lb in)
2	Front Side Door Window Regulator **Tip:** 1. Disconnect the electrical connector from the window regulator motor. 2. Transfer parts as necessary.

FRONT DOOR WINDOW REGULATOR REPLACEMENT - (MONTE CARLO)

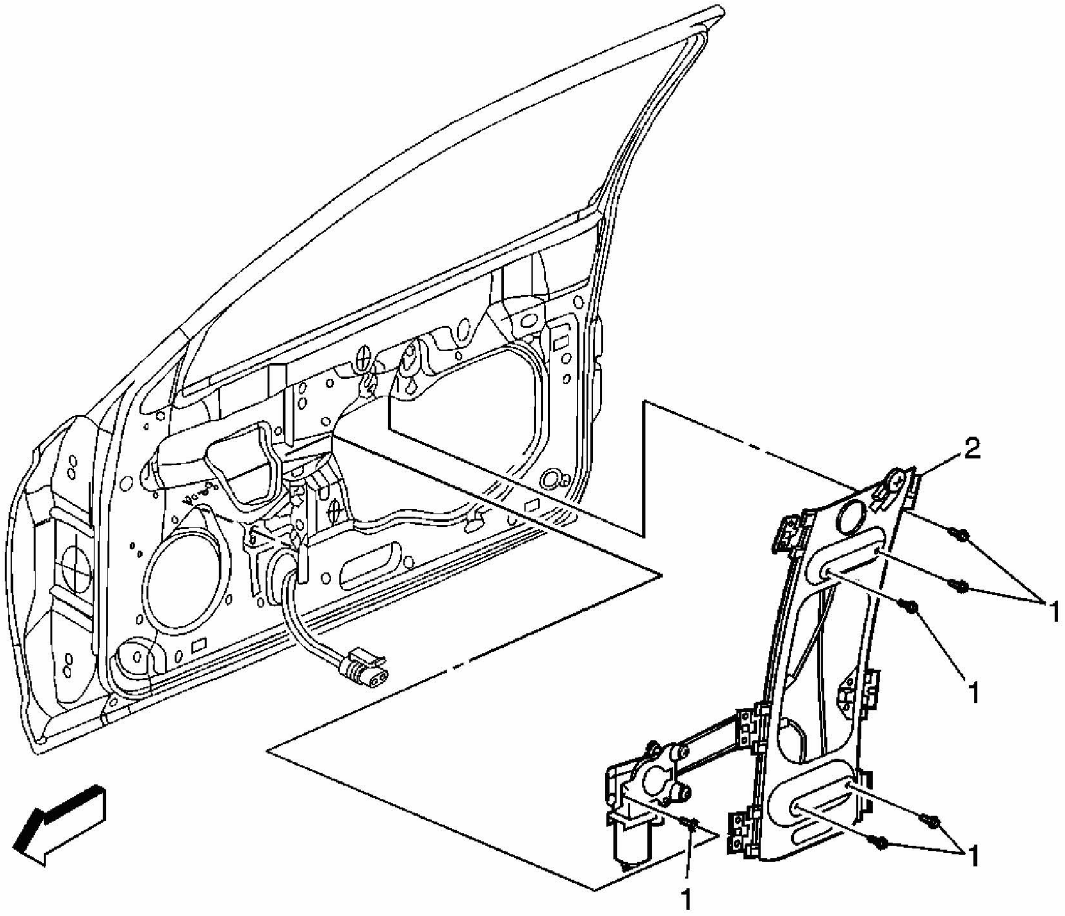


Fig. 134: Replacing Front Door Window Regulator
Courtesy of GENERAL MOTORS CORP.

Window Regulator Replacement - Front Door (Monte Carlo)

Callout	Component Name

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedures

1. Position window approximately half way down in the door.
2. Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.
3. Remove the water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**.
4. Tape the window to door frame to prevent it from moving.

1	Front Side Door Window Regulator Bolts (Qty: 5) **Tighten:** 10 N.m (89 lb in)
2	Front Side Door Window Regulator **Tip:** 1. Disconnect the electrical connector from the window regulator motor. 2. Transfer parts as necessary.

REAR DOOR WINDOW REGULATOR REPLACEMENT

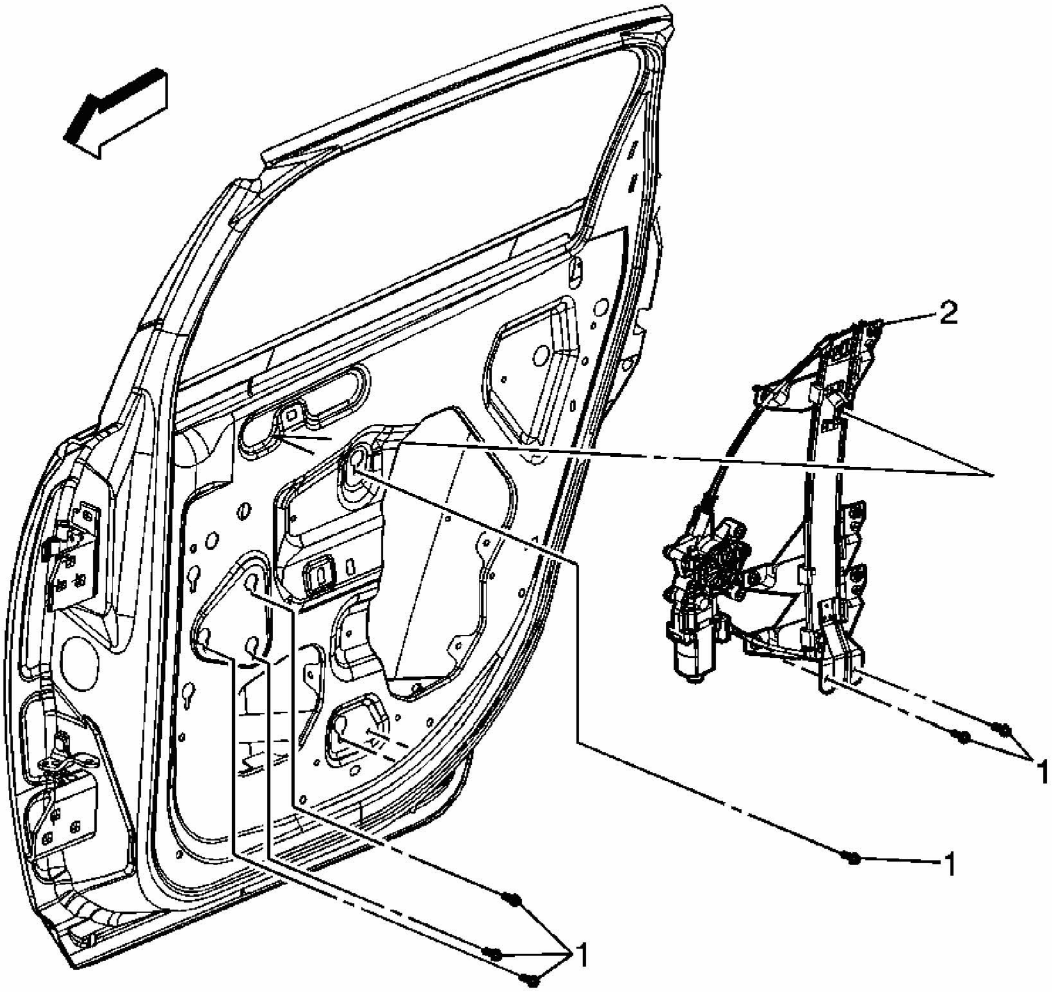


Fig. 135: Replacing Rear Door Window Regulator
Courtesy of GENERAL MOTORS CORP.

Window Regulator Replacement - Rear Door

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Position window approximately half way down in the door. 2. Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**.	

3. Remove the water deflector. Refer to **Water Deflector Replacement - Rear Door (Impala)**. 4. Tape the window to door frame to prevent it from moving.	
1	Rear Side Door Window Regulator Bolts (Qty: 6) **Tighten:** 10 N.m (89 lb in)
2	Rear Side Door Window Regulator **Tip:** 1. Disconnect the electrical connector from the window regulator motor. 2. Transfer parts as necessary.

FRONT DOOR WINDOW REGULATOR MOTOR REPLACEMENT

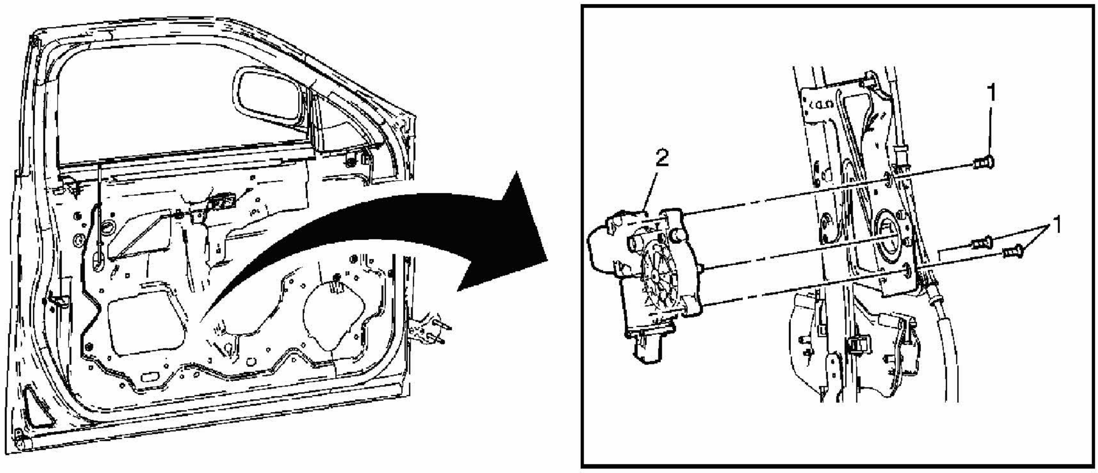


Fig. 136: Replacing Front Door Window Regulator Motor
Courtesy of GENERAL MOTORS CORP.

Window Regulator Motor Replacement - Front Door

Callout	Component Name
NOTE: Refer to Fastener Notice . **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Position window approximately half way down in the door. 2. Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.	

3. Remove the water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**.
4. Tape the window to door frame to prevent it from moving.
5. Remove the front door window regulator. Refer to **Window Replacement - Front Door (Impala)** or **Window Replacement - Front Door (Monte Carlo)**.

1	Screw, Front Side Door Window Regulator Motor (Qty: 3) **Tighten:** 4.6 N.m (41 lb in)
2	Motor, Front Side Door Window Regulator **Tip:** Disconnect the electrical connector from the window regulator motor.

REAR DOOR WINDOW REGULATOR MOTOR REPLACEMENT

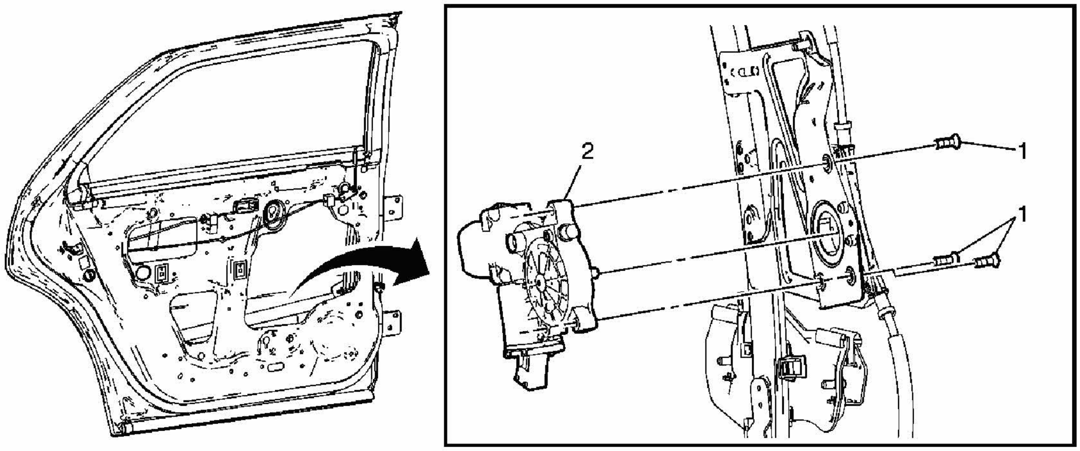


Fig. 137: Replacing Rear Door Window Regulator Motor
Courtesy of GENERAL MOTORS CORP.

Window Regulator Motor Replacement - Rear Door

Callout	Component Name

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedures

1. Position the rear door window approximately half way down in the door.
2. Remove the rear door trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**.

<table>
<tr><td colspan="2">3. Remove the rear door water deflector. Refer to Water Deflector Replacement - Rear Door (Impala).
4. Tape the window to the door frame to prevent it from moving.
5. Remove the rear door window regulator. Refer to Window Regulator Replacement - Rear Door.</td></tr>
<tr><td>1</td><td>Screw, Rear Door Window Regulator Motor (Qty: 3)

Tighten: 4.6 N.m (41 lb in)</td></tr>
<tr><td>2</td><td>Motor, Rear Door Window Regulator
Tip: Disconnect the electrical connector from the window regulator motor.</td></tr>
</table>

FRONT DOOR WINDOW REPLACEMENT - (IMPALA)

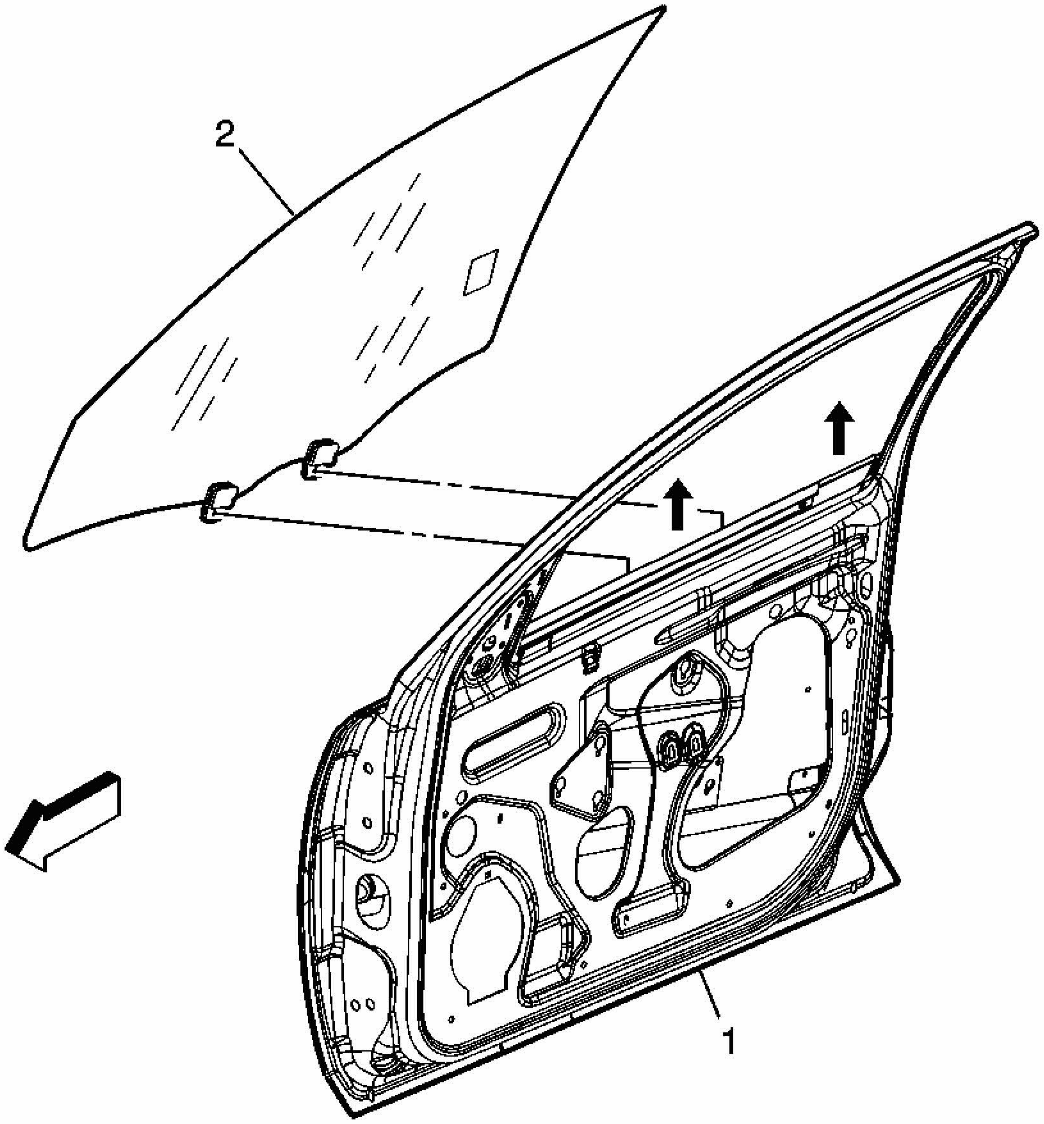


Fig. 138: Replacing Front Door Window
Courtesy of GENERAL MOTORS CORP.

Window Replacement - Front Door (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .**	
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
Preliminary Procedures	

1. Position window approximately half way down in the door. 2. Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**. 3. Remove the water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**. 4. Tape the window to door frame to prevent it from moving. 5. Remove the inside sealing strip. Refer to **Sealing Strip Replacement - Front Door Window Belt Inner**.	
1	Front Side Door Window to Regulator Bolts (Qty: 2) **Tighten:** 10 N.m (89 lb in)
2	Front Side Door Window **Tip:** Remove the window from the outside of the door, tape the frame as needed.

FRONT DOOR WINDOW REPLACEMENT - (MONTE CARLO)

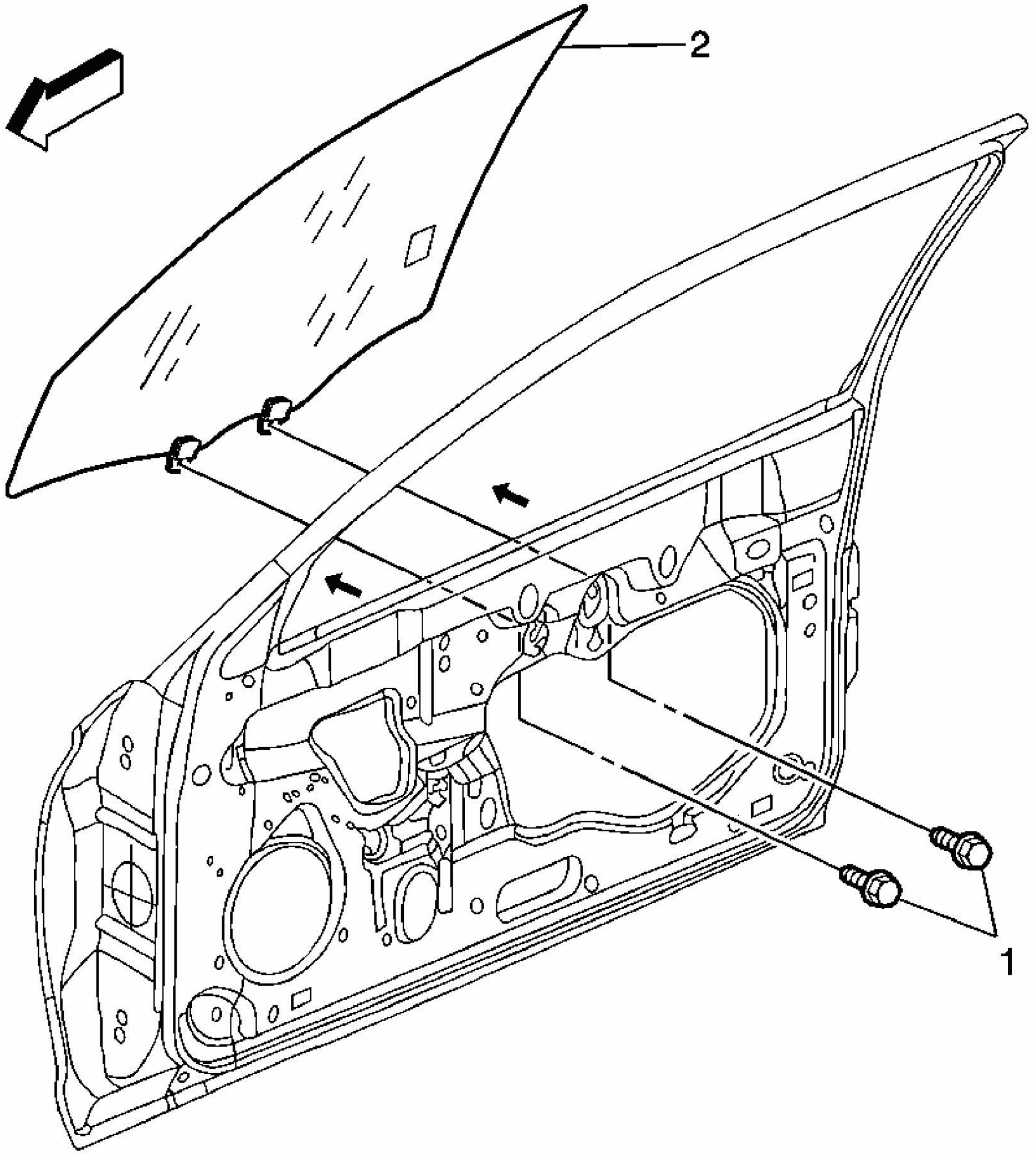


Fig. 139: Replacing Front Door Window
Courtesy of GENERAL MOTORS CORP.

Window Replacement - Front Door (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .**	
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	

Preliminary Procedures 1. Position window approximately half way down in the door. 2. Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**. 3. Remove the water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**. 4. Tape the window to door frame to prevent it from moving. 5. Remove the inside sealing strip. Refer to **Sealing Strip Replacement - Front Door Window Belt Inner**.	
1	Front Side Door Window to Regulator Bolts (Qty: 2) **Tighten:** 10 N.m (89 lb in)
2	Front Side Door Window **Tip:** Remove the window from the outside of the door, tape the frame as needed.

REAR DOOR WINDOW REPLACEMENT

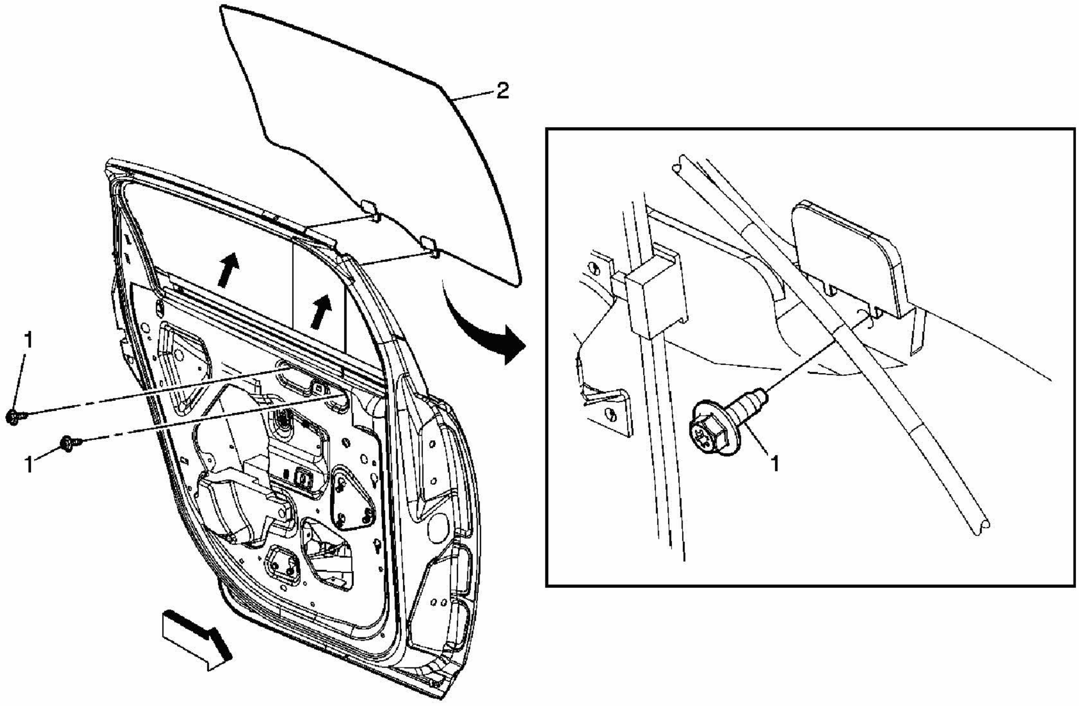


Fig. 140: Replacing Rear Door Window
Courtesy of GENERAL MOTORS CORP.

Window Replacement - Rear Door

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">**NOTE:**
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedures

1. Position window approximately half way down in the door.
2. Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**.
3. Remove the water deflector. Refer to **Water Deflector Replacement - Rear Door (Impala)**.
4. Tape the window to door frame to prevent it from moving.
5. Remove the inside sealing strip. Refer to **Sealing Strip Replacement - Rear Door Window Belt Inner**.
6. Remove the rear door window weatherstrip. Refer to **Window Run Channel Replacement - Rear Door**.</td></tr>
<tr><td>1</td><td>Rear Side Door Window to Regulator Bolts (Qty: 2)

Tighten: 10 N.m (89 lb in)</td></tr>
<tr><td>2</td><td>Rear Side Door Window
Tip:

1. Slide the window up and install the two bolts which hold the rear door window to the window regulator.
2. Remove the tape.</td></tr>
</table>

FRONT DOOR WINDOW CHANNEL RETAINER REPLACEMENT - (MONTE CARLO)

Removal Procedure

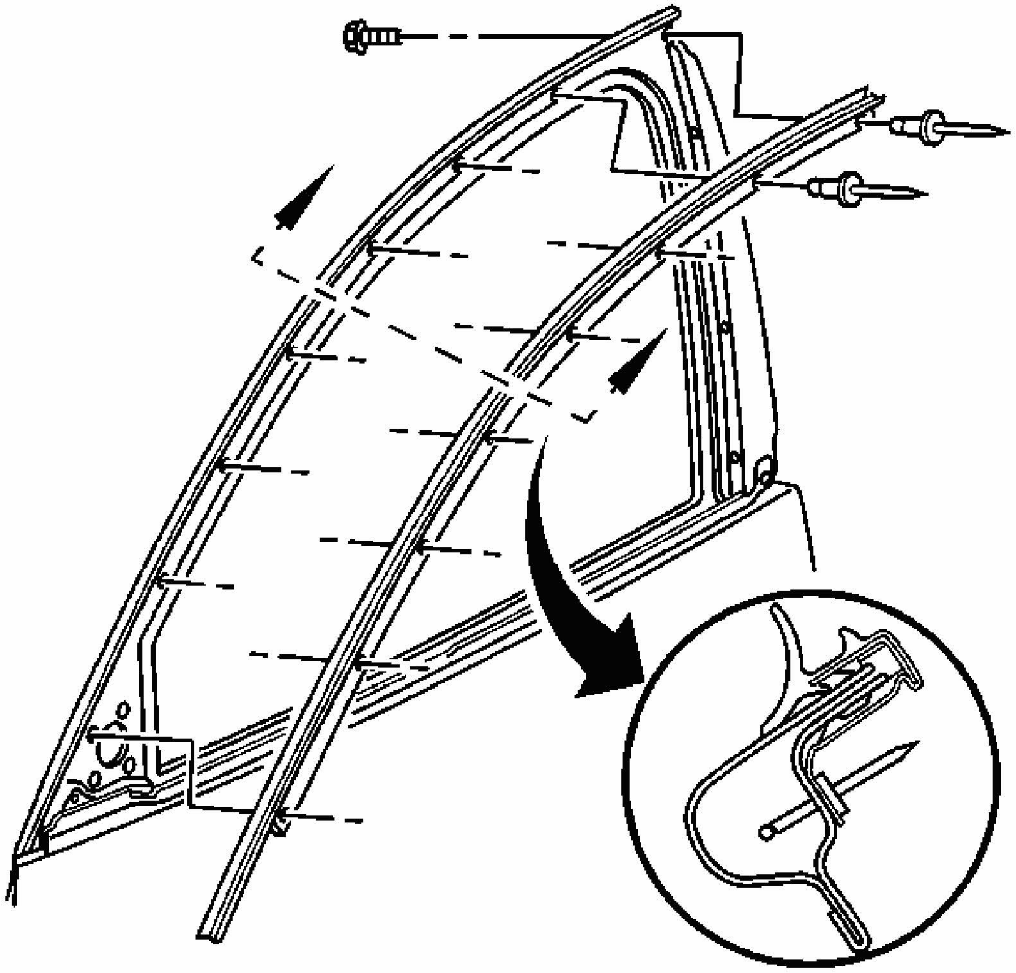


Fig. 141: Front Door Window Channel Retainer & Components (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Remove the outside rearview mirror. Refer to **Mirror Replacement - Power**.
2. Pull down the door window channel in order to gain access to the rivets.
3. Loosen the front door frame applique screws. Refer to **Door Frame Applique/Runchannel Replacement - Front (Impala)** or **Door Frame Applique/Runchannel Replacement - Front (Monte Carlo)**.
4. Remove the front door window channel retainer screw.
5. Remove the front door window channel retainer from the front door.

Installation Procedure

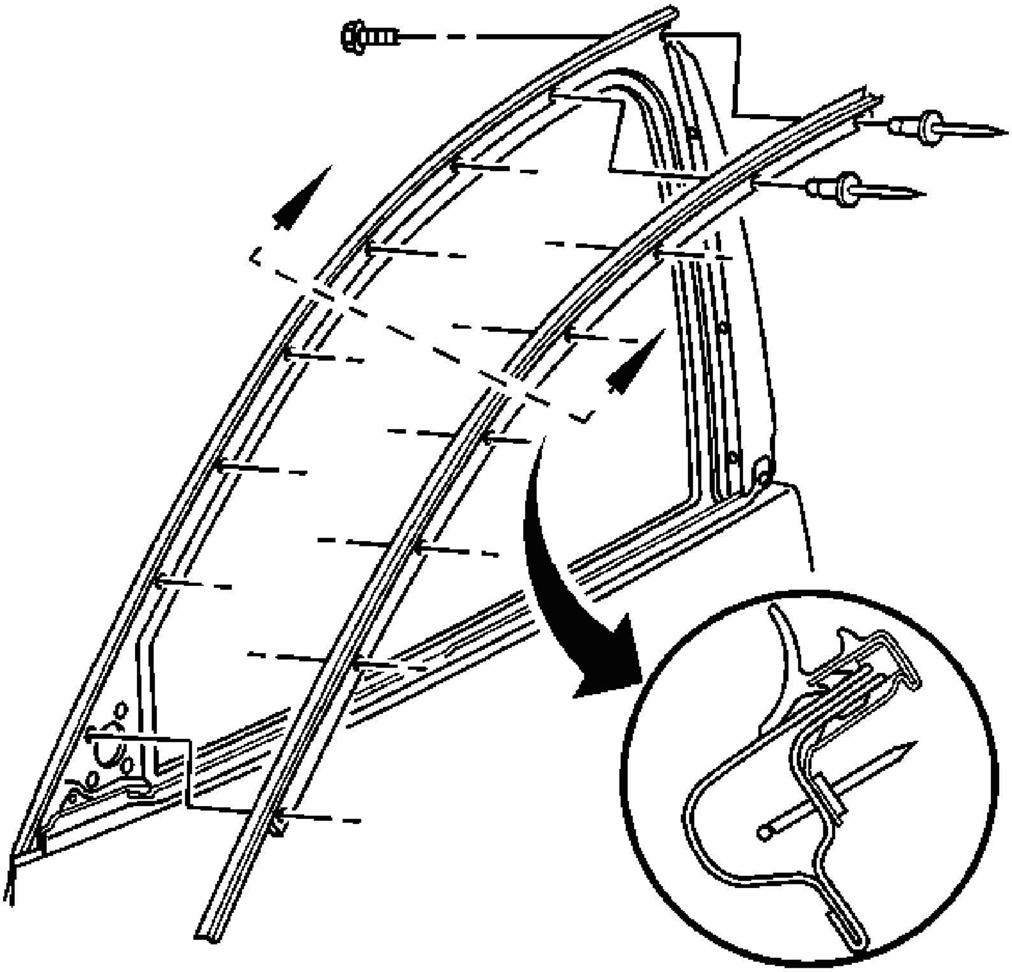


Fig. 142: Front Door Window Channel Retainer & Components (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Position the front door window channel retainer to the front door.
2. Install the front door window channel retainer rivets.
3. Tighten the front door frame applique screws. Refer to **Door Frame Applique/Runchannel Replacement - Front (Impala)** or **Door Frame Applique/Runchannel Replacement - Front (Monte Carlo)**.
4. Install the front door window weather-strip in position.
5. Install the outside mirror. Refer to **Mirror Replacement - Power**.

FRONT DOOR WINDOW CHANNEL RETAINER REPLACEMENT - (IMPALA)

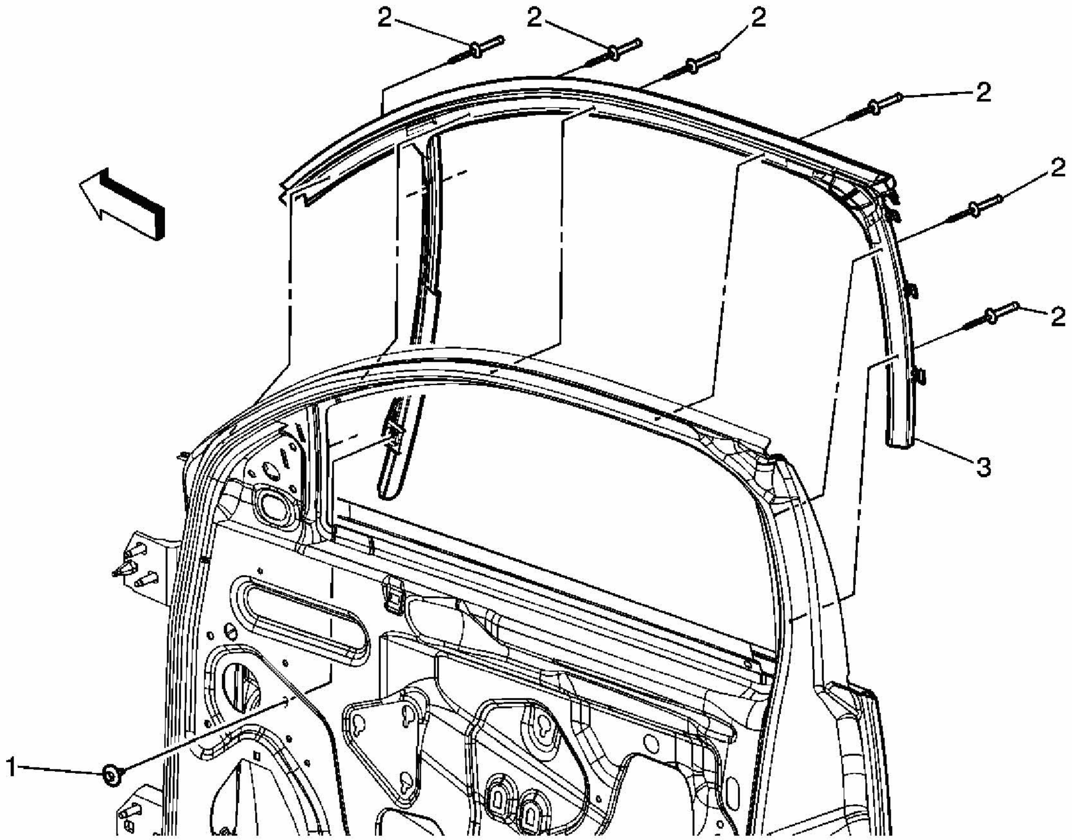


Fig. 143: Replacing Front Door Window Channel Retainer
Courtesy of GENERAL MOTORS CORP.

Window Channel Retainer Replacement - Front Door (Impala)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications Refer to Fastener Tightening Specifications.

Preliminary Procedures

1. Remove the interior trim panel. Refer to Trim Panel Replacement - Side Front Door (Impala).
2. Remove the water deflector. Refer to Water Deflector Replacement - Front Door (Impala) or Water Deflector Replacement - Front Door (Monte Carlo).
3. Remove the inside sealing strip. Refer to Sealing Strip Replacement - Front Door Window Belt Inner.</td></tr>
<tr><td></td><td>Front Door Weatherstrip Seal Retainer Bolt</td></tr>
</table>

1	**Tighten:** 10 N.m (89 lb in)
2	Front Door Weatherstrip Seal Retainer Rivets (Qty: 7) **Tip:** Drill out the rivets from around the upper door frame.
3	Front Door Weatherstrip Seal Retainer **Tip:** Pull the weatherstrip retainer upward, slightly twisting weatherstrip retainer to clear the outer sealing strip.

REAR DOOR WINDOW CHANNEL RETAINER REPLACEMENT

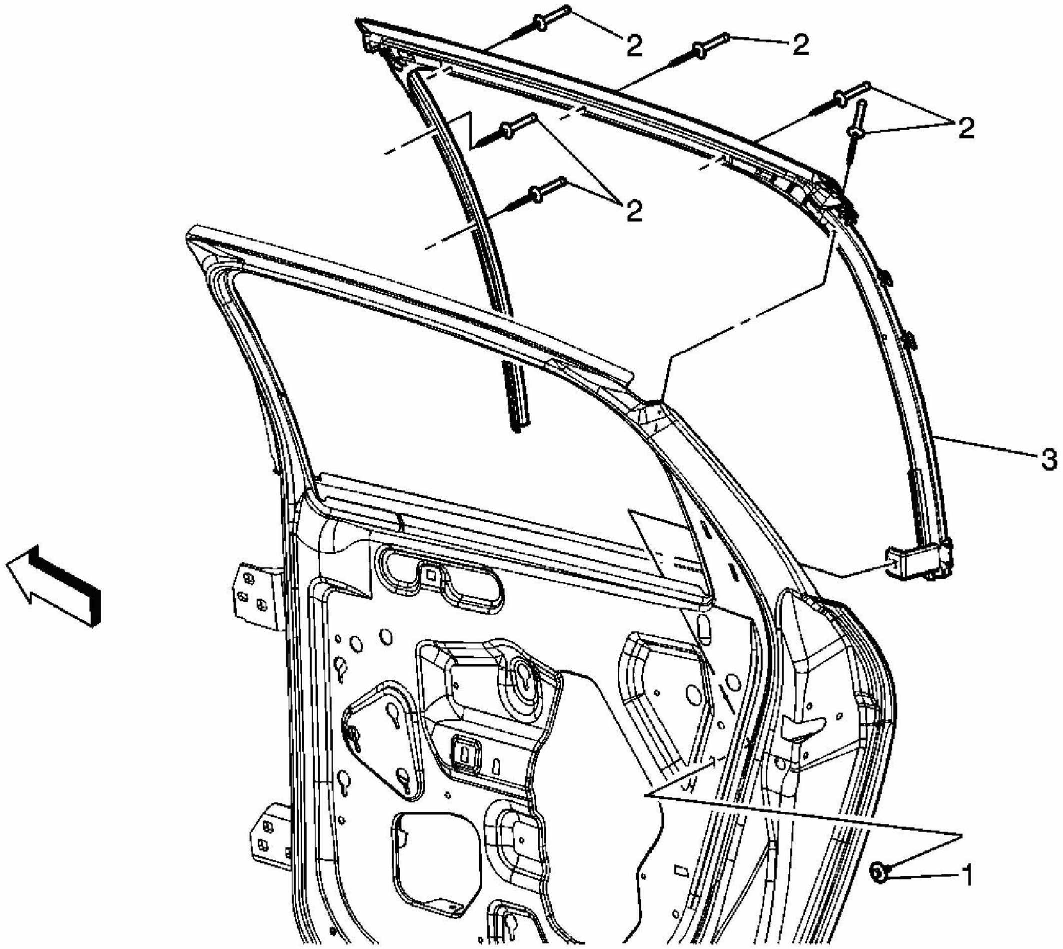


Fig. 144: Replacing Rear Door Window Channel Retainer
Courtesy of GENERAL MOTORS CORP.

Window Channel Retainer Replacement - Rear Door

Callout	Component Name
NOTE: Refer to Fastener Notice .	

<table>
<tr><td colspan="2">Fastener Tightening Specifications Refer to Fastener Tightening Specifications.

Preliminary Procedures
1. Remove the interior trim panel. Refer to Trim Panel Replacement - Side Rear Door (Impala).
2. Remove the water deflector. Refer to Water Deflector Replacement - Rear Door (Impala).
3. Remove the inside sealing strip. Refer to Sealing Strip Replacement - Rear Door Window Belt Inner.</td></tr>
<tr><td>1</td><td>Rear Door Weatherstrip Seal Retainer Bolt

Tighten: 10 N.m (89 lb in)</td></tr>
<tr><td>2</td><td>Rear Door Weatherstrip Seal Retainer Rivets (Qty: 6)
Tip: Drill out the rivets from around the upper door frame.</td></tr>
<tr><td>3</td><td>Rear Door Weatherstrip Seal Retainer
Tip: Pull the weatherstrip retainer upward, slightly twisting weatherstrip retainer to clear the outer sealing strip.</td></tr>
</table>

REAR DOOR WINDOW RUN CHANNEL REPLACEMENT

Removal Procedure

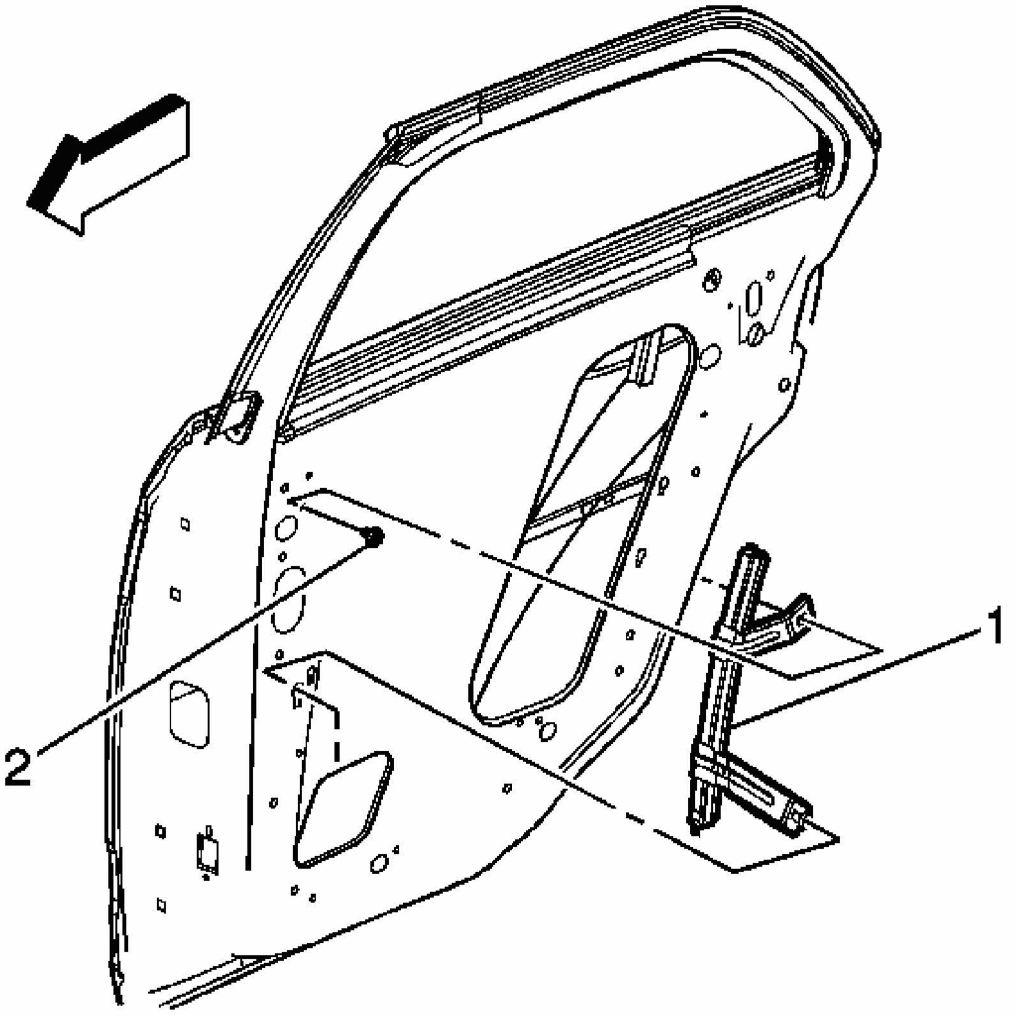


Fig. 145: Replacing Rear Door Window Run Channel
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to PAINT DAMAGE NOTICE .**

1. Apply masking tape to the door frame and applique.
2. Remove the rear door trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**.
3. Remove the rear door water deflector. Refer to **Water Deflector Replacement - Rear Door (Impala)**.
4. Position the window in the full down position.

5. Remove the window channel bolt (2).
6. Remove the window channel from the door.

Installation Procedure

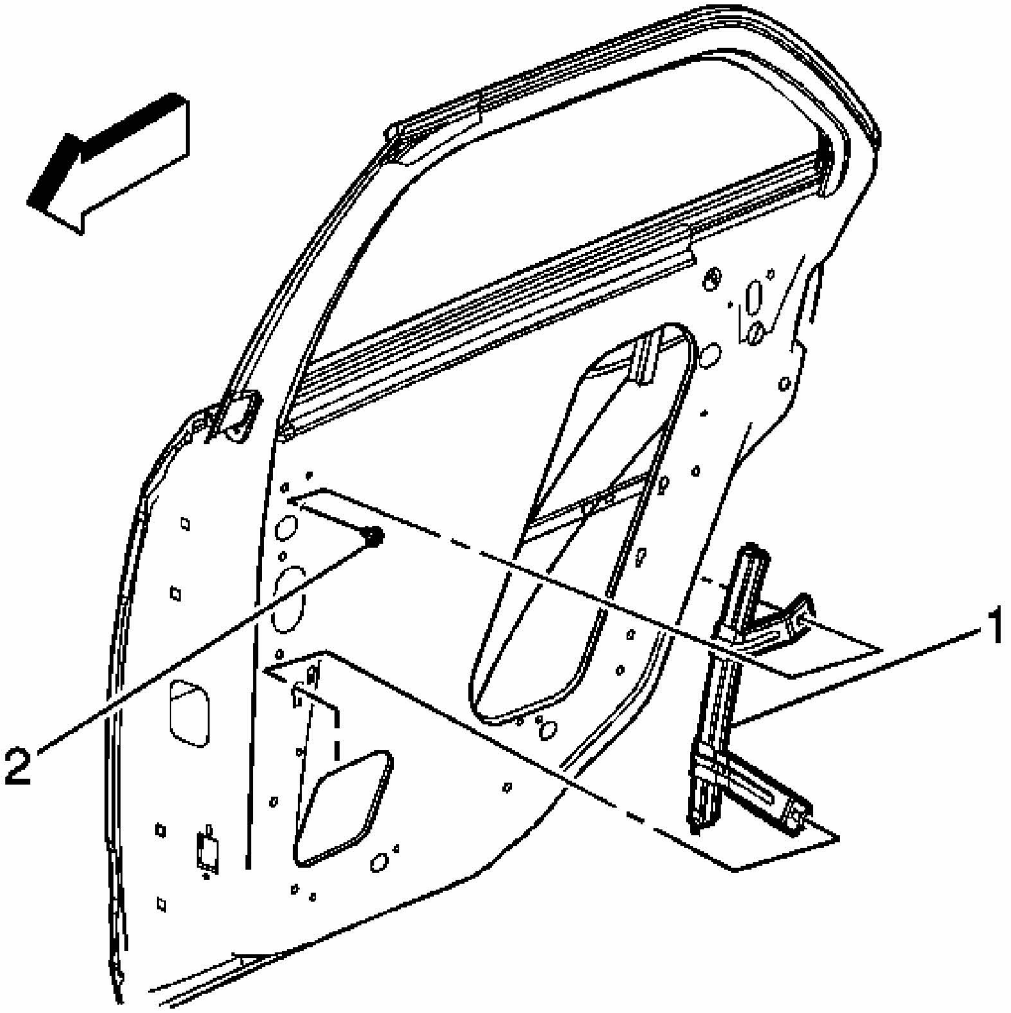


Fig. 146: Installing The Window Channel
Courtesy of GENERAL MOTORS CORP.

1. Install the window channel (1) in the door.

NOTE: **Refer to FASTENER NOTICE .**

2. Install the window run channel bolts (2).

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

3. Inspect the window for proper operation.
4. Remove the masking tape from the frame and applique.
5. Install the rear door water deflector. Refer to **Water Deflector Replacement - Rear Door (Impala)**.
6. Install the rear door trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**.

FRONT DOOR FRAME APPLIQUE/RUNCHANNEL REPLACEMENT - (IMPALA)

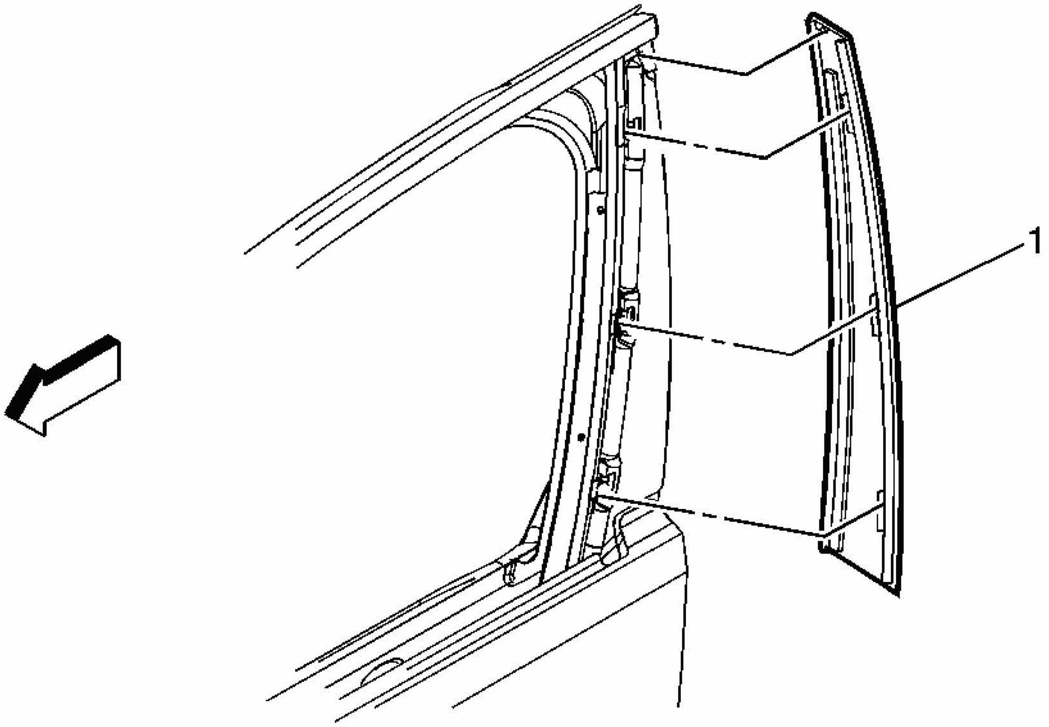


Fig. 147: Replacing Front Door Frame Applique/Runchannel
Courtesy of GENERAL MOTORS CORP.

Door Frame Applique/Runchannel Replacement - Front (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Front Side Door Window Frame Applique **Tip:** The applique is secured with 3 metal clips located in the glass run

	channel.

FRONT DOOR FRAME APPLIQUE/RUNCHANNEL REPLACEMENT - (MONTE CARLO)

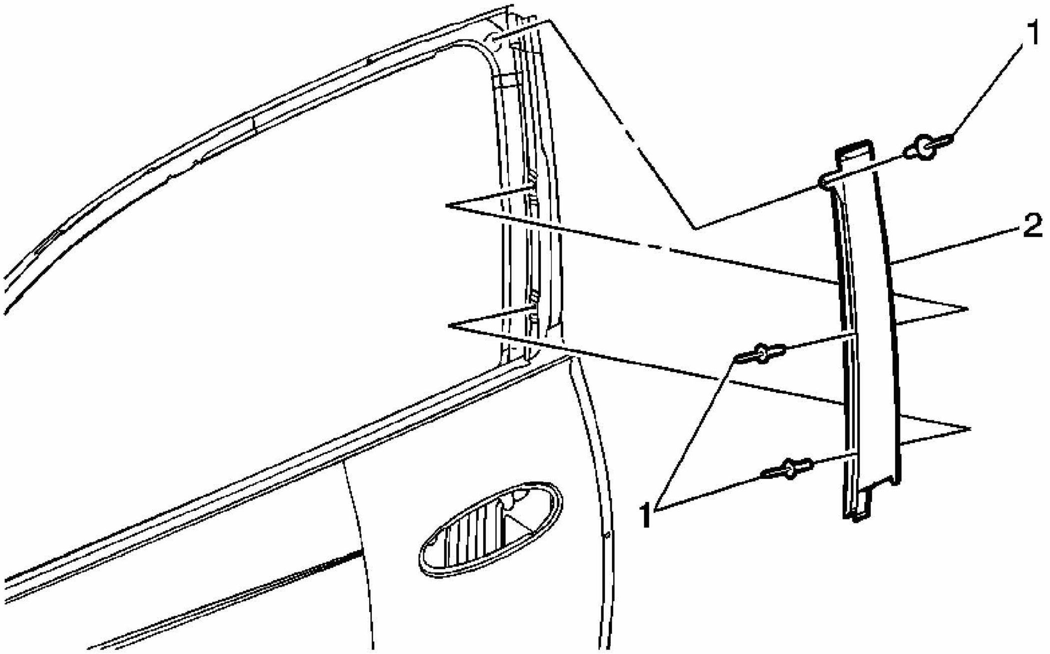


Fig. 148: Replacing Front Door Frame Applique/Runchannel
Courtesy of GENERAL MOTORS CORP.

Door Frame Applique/Runchannel Replacement - Front (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Front Side Door Applique Rivet (Qty: 3) **Tip:** Drill out the 4 mm (5/32 in) rivets along the inside edge of the door window channel retainer.
2	Front Side Door Window Frame Applique **Tip:** Pull upward to release the applique from the door frame.

REAR DOOR FRAME APPLIQUE/RUNCHANNEL REPLACEMENT

Removal Procedure

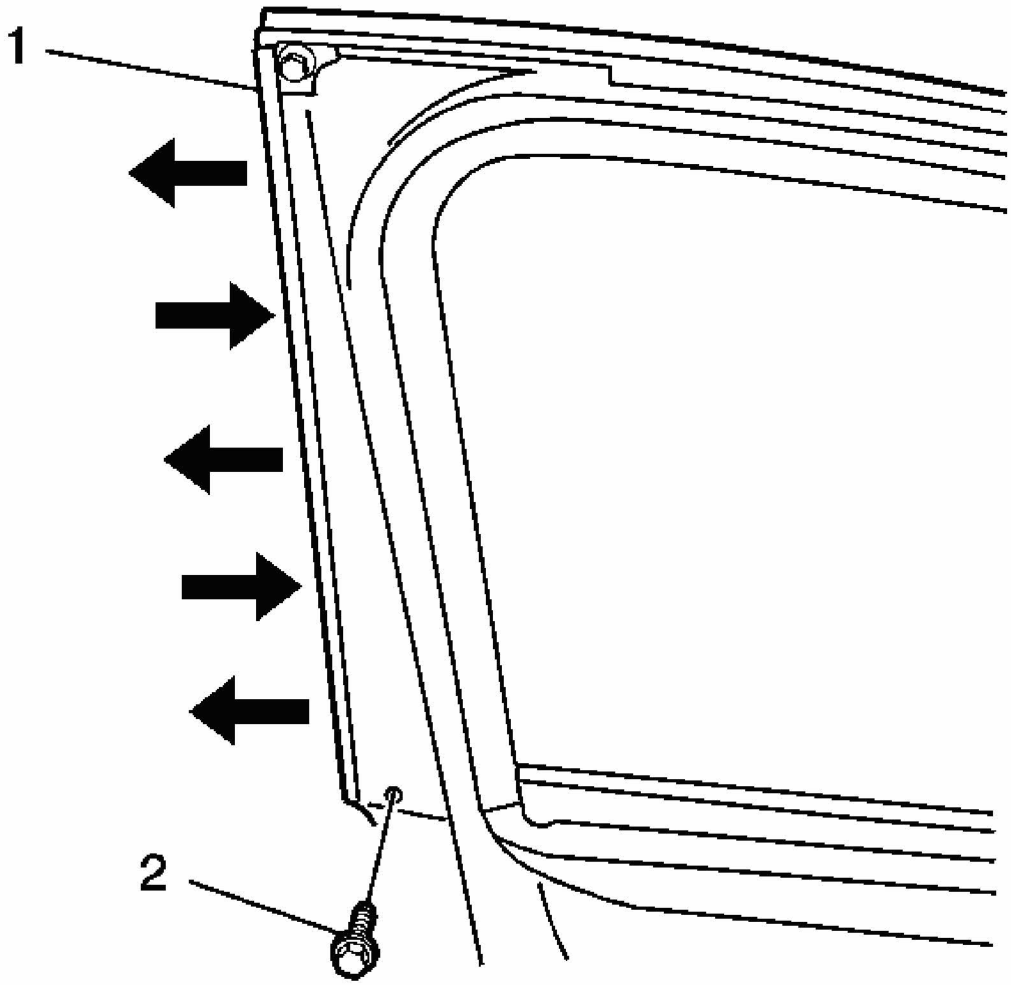


Fig. 149: Inside Door Frame Screws & Weatherstrip (Front Door)
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to PAINT DAMAGE NOTICE .**

1. Apply masking tape to the door frame and applique.
2. Lower the window to the full down position.
3. Remove the window channel retainer. Refer to **Window Channel Retainer Replacement - Rear Door**.
4. Remove the screws (1, 2) from the upper and lower corners of the inside door frame.
5. Pull the window run channel weatherstrip out of the retainer and reposition it in order to access to the applique rivets.

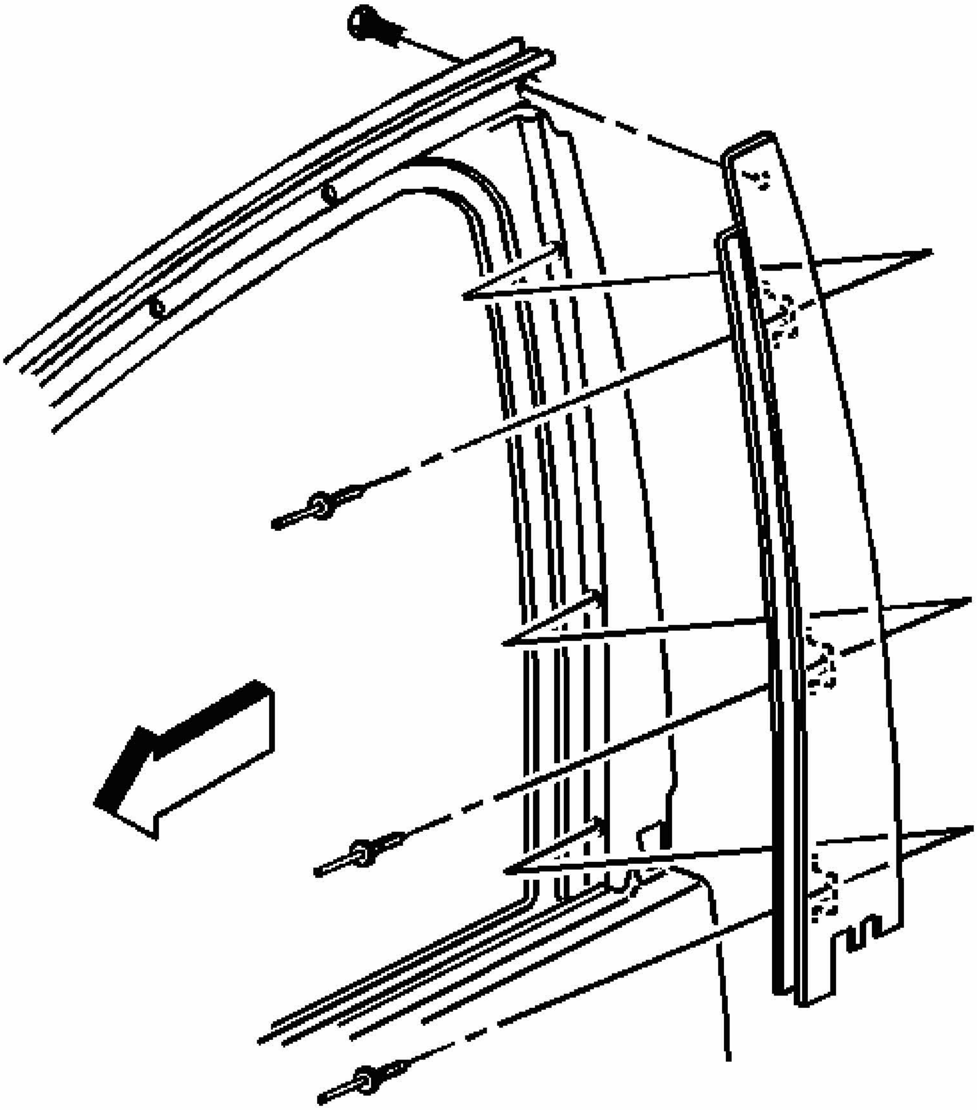


Fig. 150: Window Channel Retainer Rivets & Door Frame Applique/Run Channel (Front Door)
Courtesy of GENERAL MOTORS CORP.

6. Drill out the 4 mm (5/32 in) rivets along the inside edge of the window channel retainer.
7. Pull upward to release the applique from the door frame.

Installation Procedure

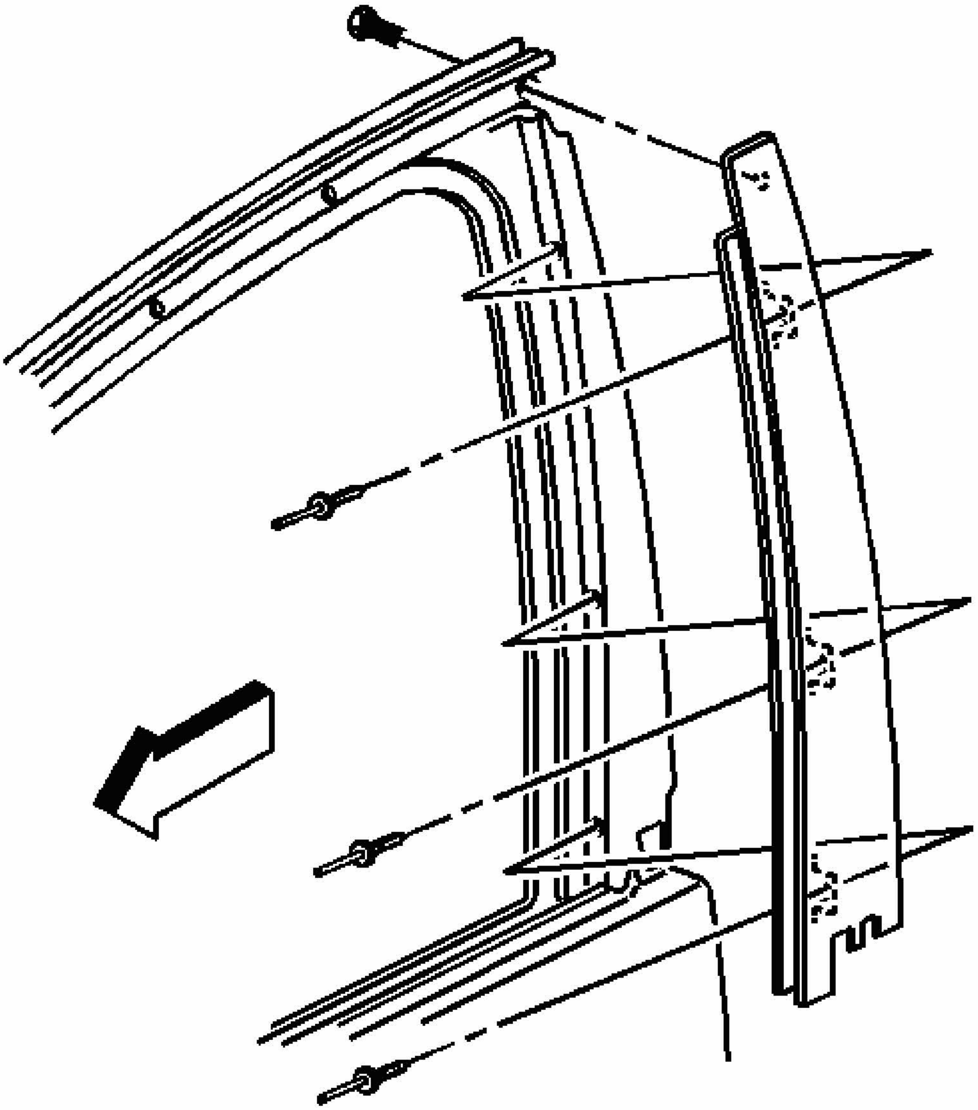


Fig. 151: Window Channel Retainer Rivets & Door Frame Applique/Run Channel (Front Door)
Courtesy of GENERAL MOTORS CORP.

1. Install the applique to the door frame.
2. Install the new 4 mm (5/32 in) rivets along the inside edge of the window channel retainer to secure the applique to the door frame.

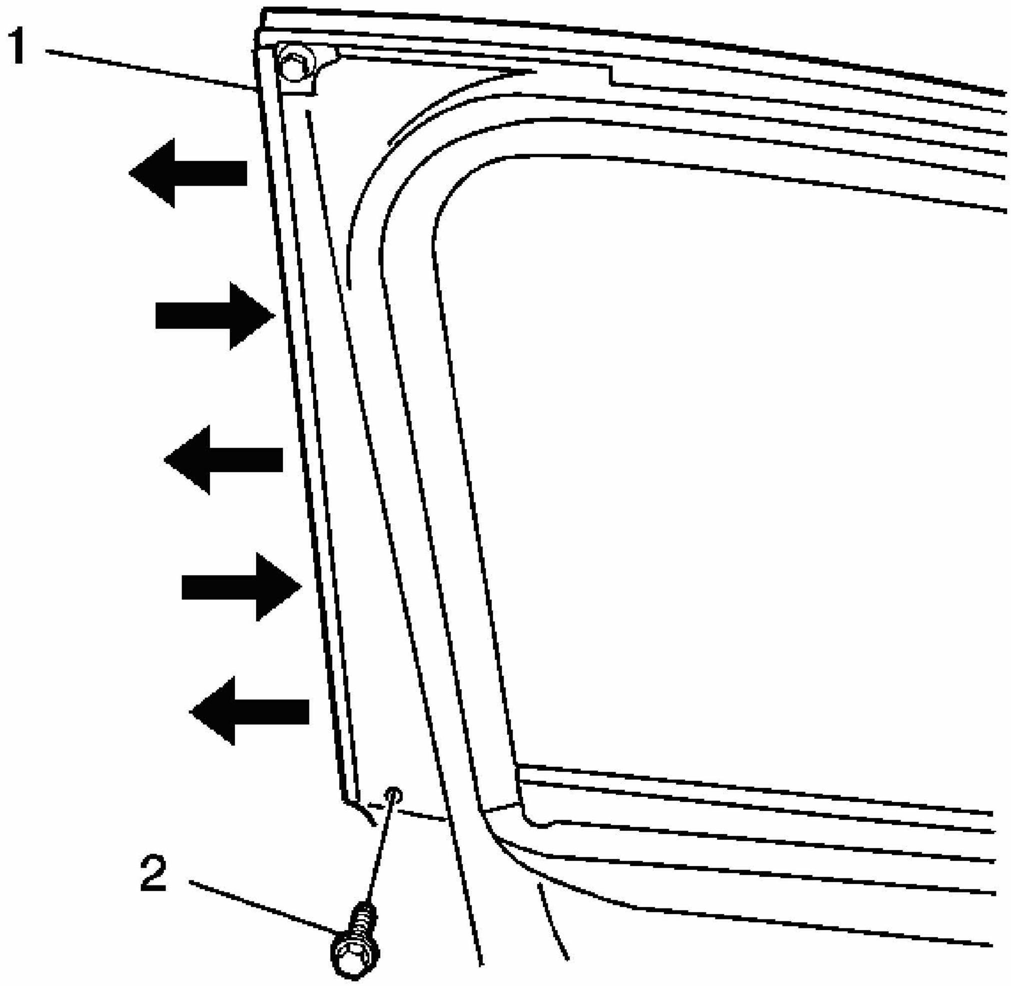


Fig. 152: Inside Door Frame Screws & Weatherstrip (Front Door)
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE .**

3. Install the screws (1, 2) to the upper and lower corners of the inside door frame.

   Tighten: Tighten the screws to 2 N.m (18 lb in).

4. Install the window channel retainer. Refer to **Window Channel Retainer Replacement - Rear Door**.
5. Install the window weatherstrip.

6. Remove masking tape.
7. Inspect the window for proper operation.

FRONT DOOR RUBBER CONDUIT REPLACEMENT - (IMPALA)

Removal Procedure

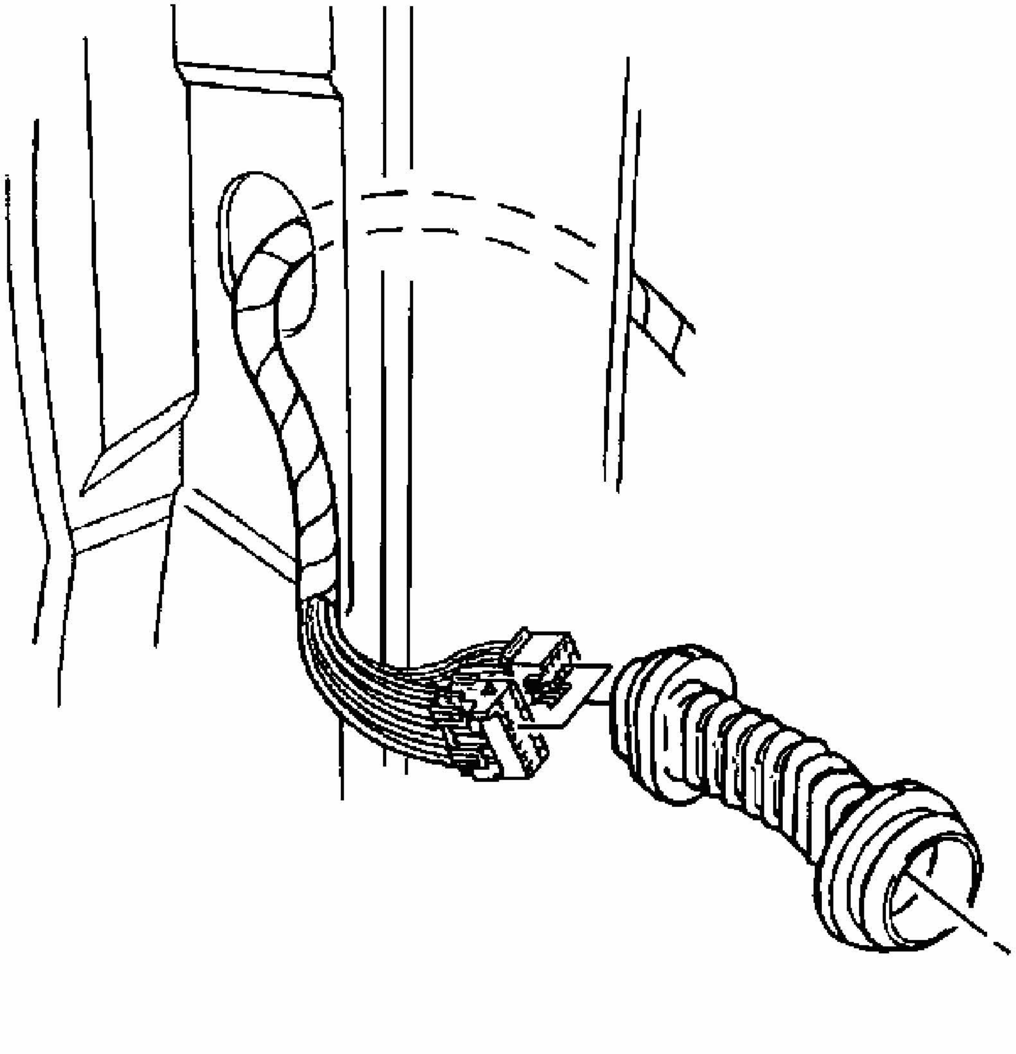


Fig. 153: Front Door Rubber Conduit
Courtesy of GENERAL MOTORS CORP.

1. Remove the right instrument panel insulator if removing the right conduit. Refer to **Closeout/Insulator Panel Replacement - Right** .
2. Remove the door rubber conduit from where it attaches at the windshield pillar.
3. Disconnect the body harness electrical connector from the front door wiring harness.

4. Remove the conduit from the front door.
5. Remove the front door wiring harness out from the rubber conduit.

Installation Procedure

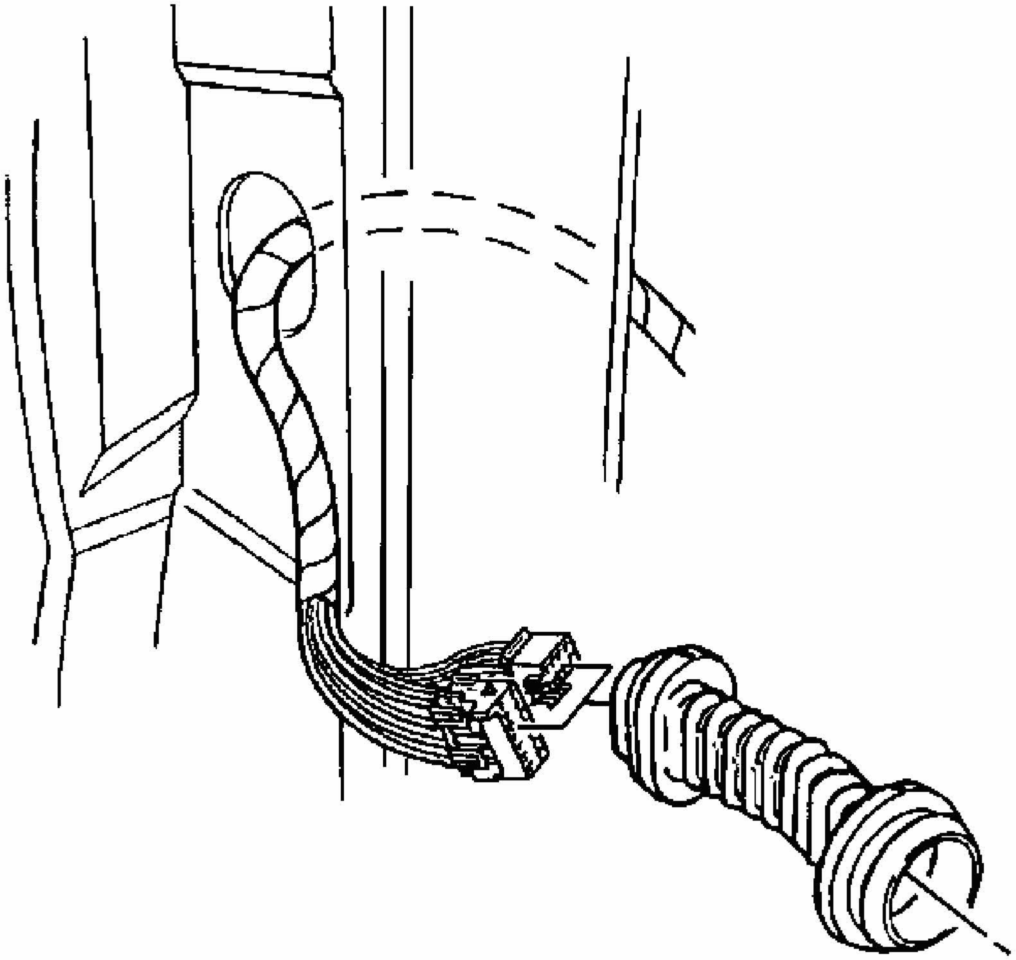


Fig. 154: Front Door Rubber Conduit
Courtesy of GENERAL MOTORS CORP.

1. Install the wiring harness to the front door through the rubber conduit.
2. Install the rubber conduit to the front door.
3. Install the rubber conduit to the windshield pillar.
4. Connect the front door wiring harness electrical connector to the body harness.
5. Install the right instrument panel insulator if required. Refer to **Closeout/Insulator Panel Replacement - Right** .

FRONT DOOR RUBBER CONDUIT REPLACEMENT - (MONTE CARLO)

Removal Procedure

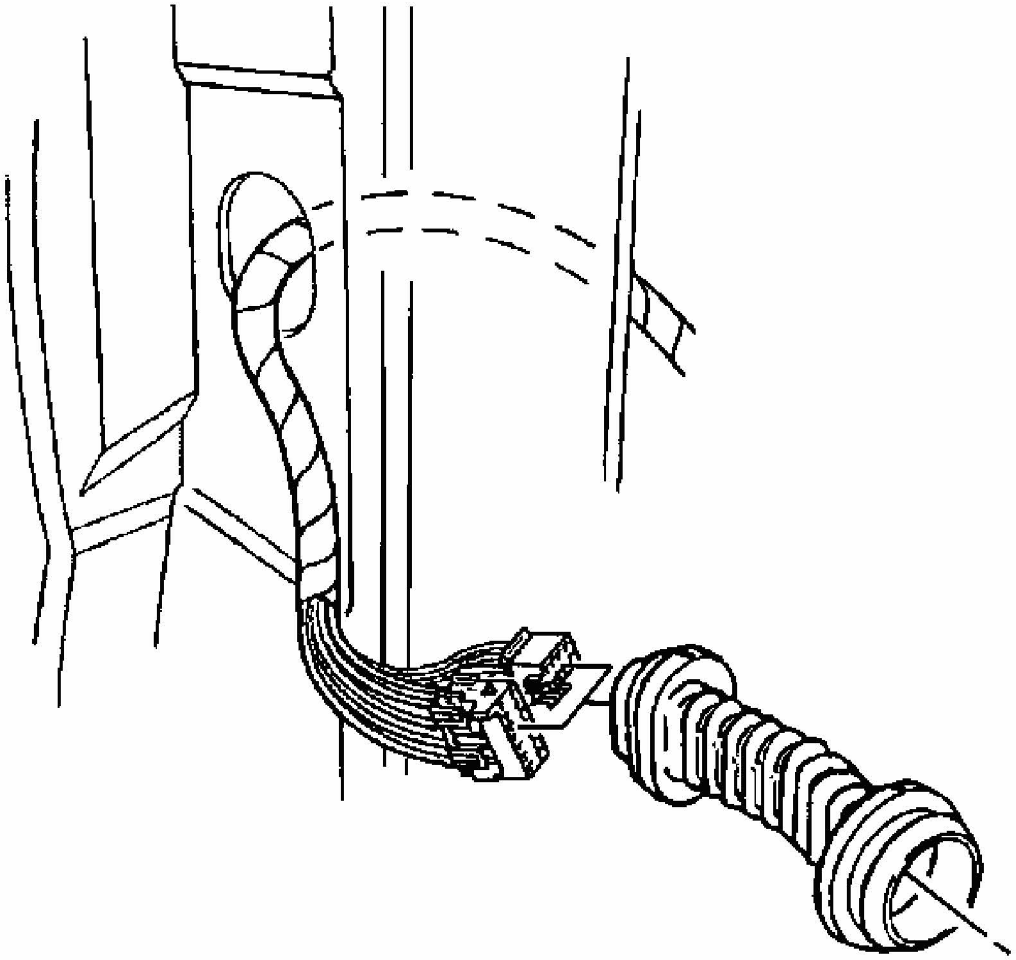


Fig. 155: Front Door Rubber Conduit
Courtesy of GENERAL MOTORS CORP.

1. Remove the right instrument panel insulator if removing the right conduit. Refer to **Closeout/Insulator Panel Replacement - Right** .
2. Remove the door rubber conduit from where it attaches at the windshield pillar.
3. Disconnect the body harness electrical connector from the front door wiring harness.
4. Remove the conduit from the front door.
5. Remove the front door wiring harness out from the rubber conduit.

Installation Procedure

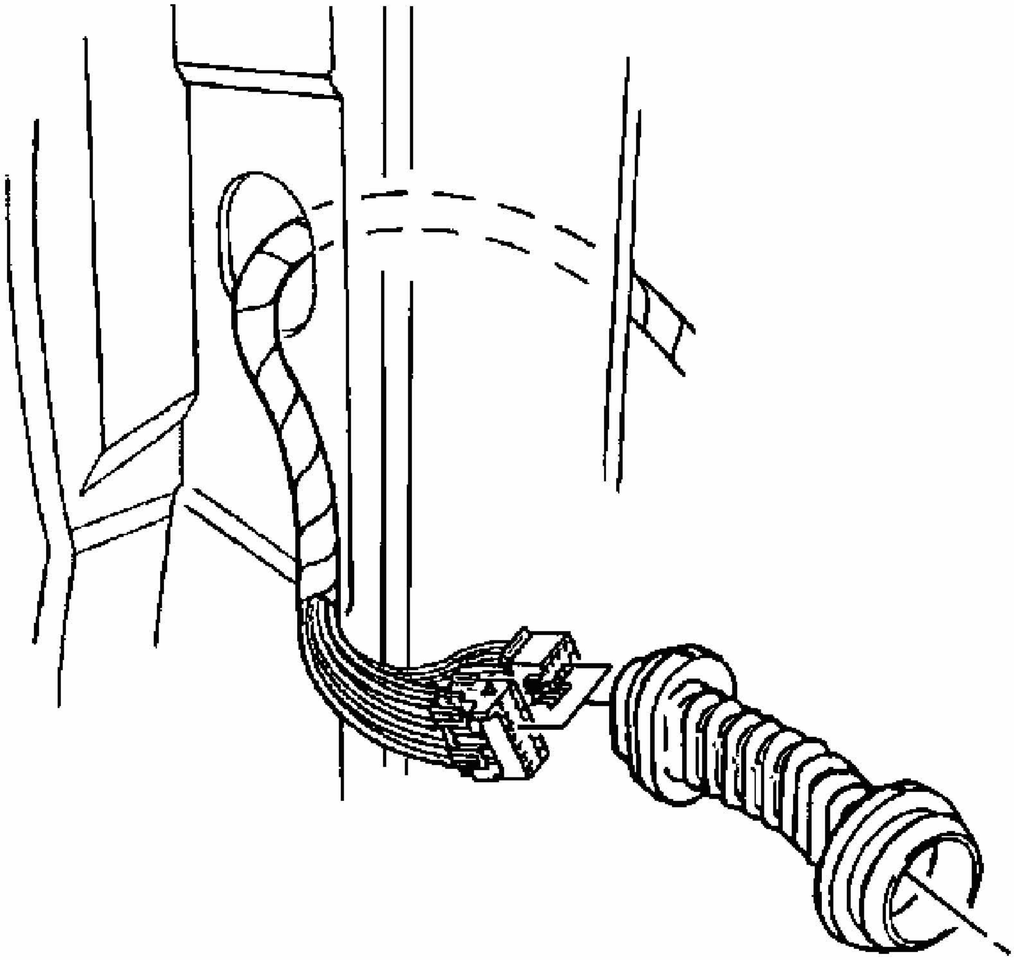


Fig. 156: Front Door Rubber Conduit
Courtesy of GENERAL MOTORS CORP.

1. Install the wiring harness to the front door through the rubber conduit.
2. Install the rubber conduit to the front door.
3. Install the rubber conduit to the windshield pillar.
4. Connect the front door wiring harness to the body harness electrical connector.
5. Install the right instrument panel insulator if required. Refer to **Closeout/Insulator Panel Replacement - Right** .

REAR DOOR RUBBER CONDUIT REPLACEMENT

Removal Procedure

IMPORTANT: Mark the location and the color of the wires to the electrical socket before removing the wires.

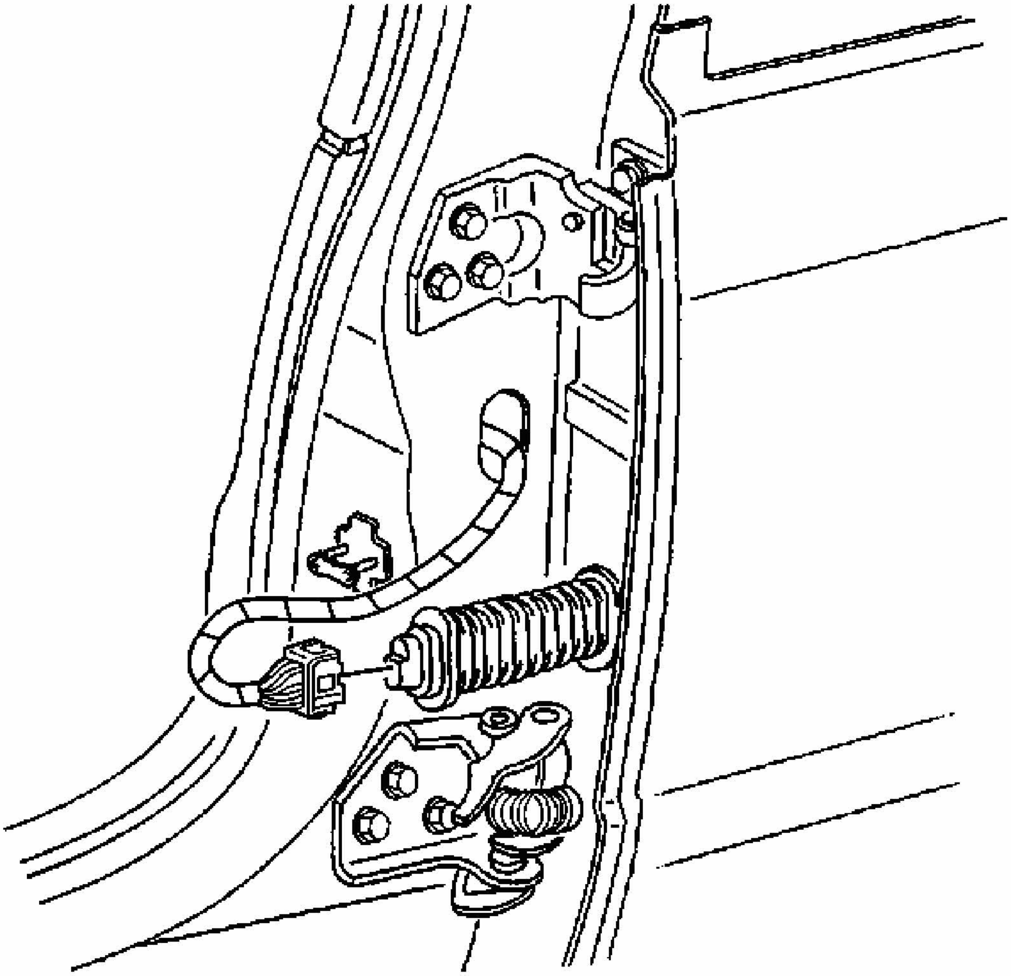


Fig. 157: View Of Rear Door Wiring Harness
Courtesy of GENERAL MOTORS CORP.

1. Remove the conduit from the center pillar.
2. Disconnect the rear door wiring harness electrical connector from the body harness.
3. Disconnect the wire harness retainer from the wiring harness socket.
4. Remove the wiring harness wiring one at a time from the socket.
5. Remove the rubber conduit from the rear door.
6. Remove the wiring harness wiring from the rubber conduit.

Installation Procedure

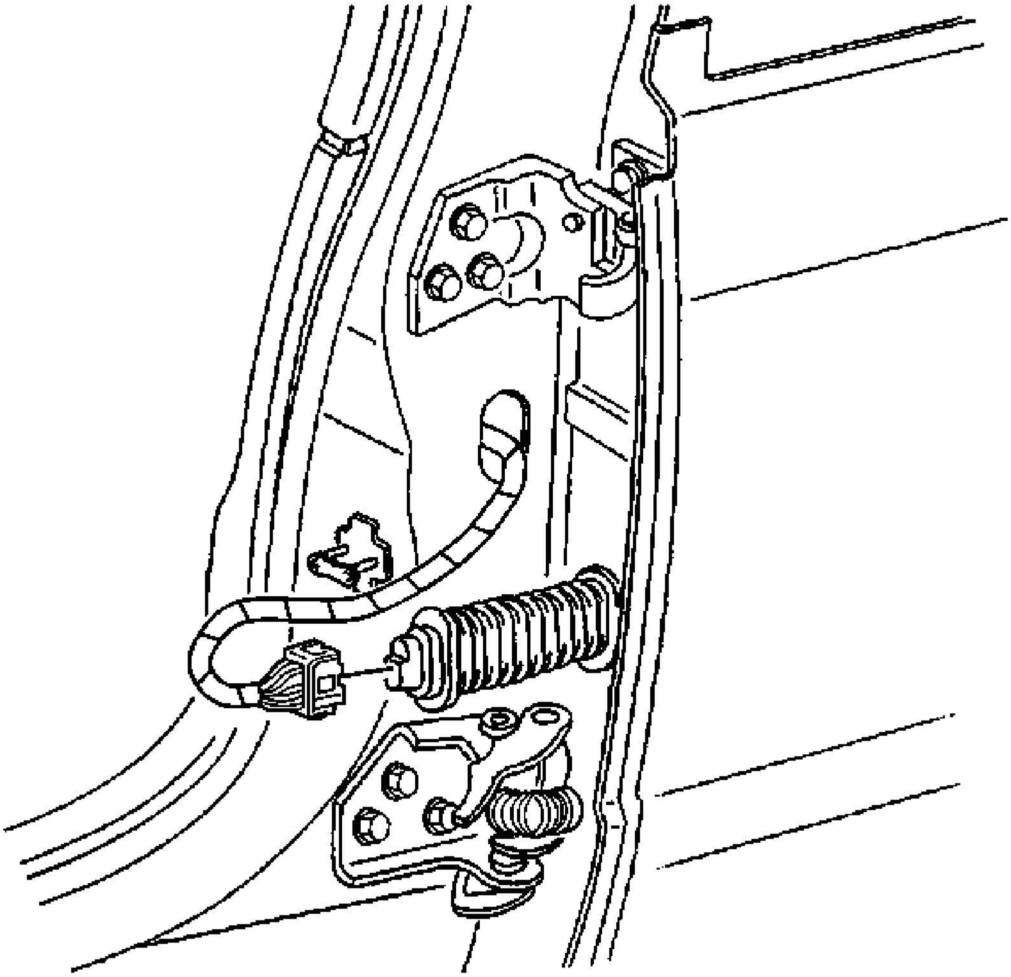


Fig. 158: View Of Rear Door Wiring Harness
Courtesy of GENERAL MOTORS CORP.

1. Install the rear door electrical harness through the rubber conduit.
2. Install the rear door wiring harness wires to the electrical socket.
3. Connect the rear door wiring harness electrical connector.

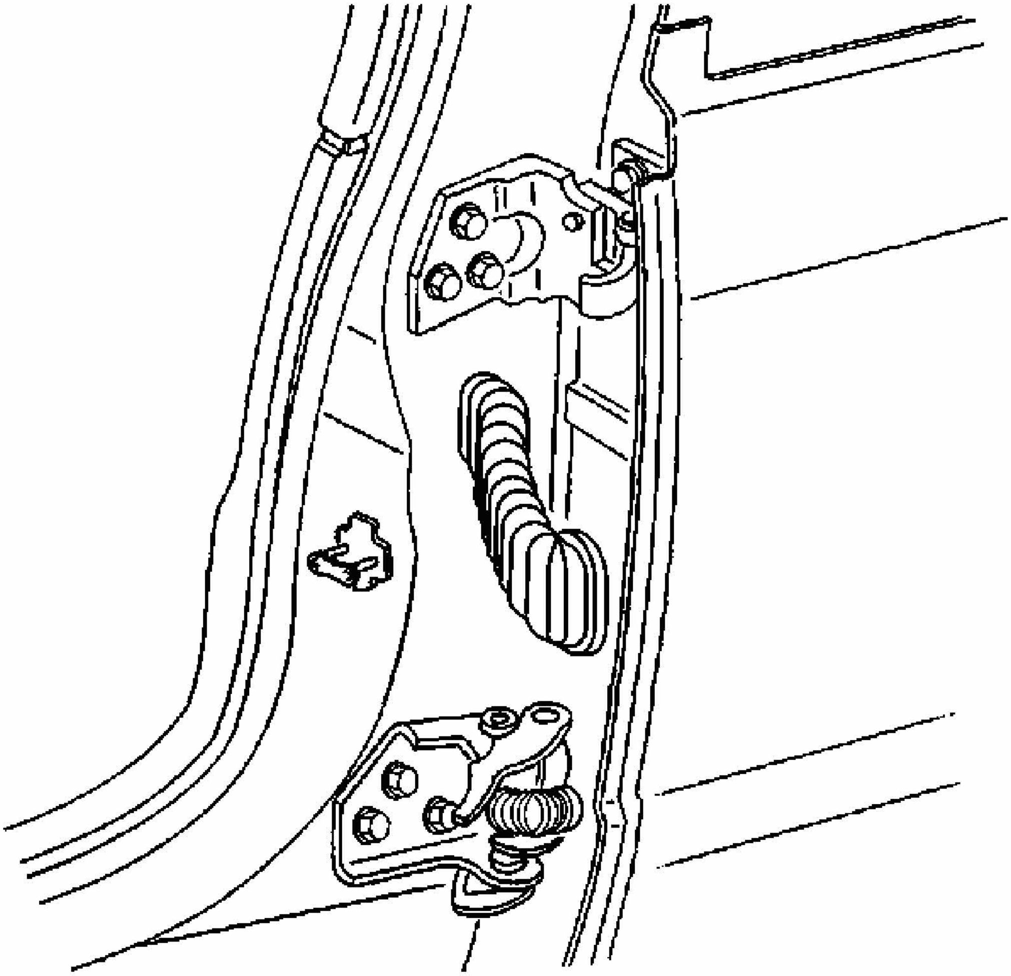


Fig. 159: Identifying Rear Door Rubber Conduit
Courtesy of GENERAL MOTORS CORP.

4. Install the rubber conduit to the rear door.
5. Install the rubber conduit to the center pillar.

FRONT DOOR WINDOW BELT OUTER SEALING STRIP REPLACEMENT - (IMPALA)

Removal Procedure

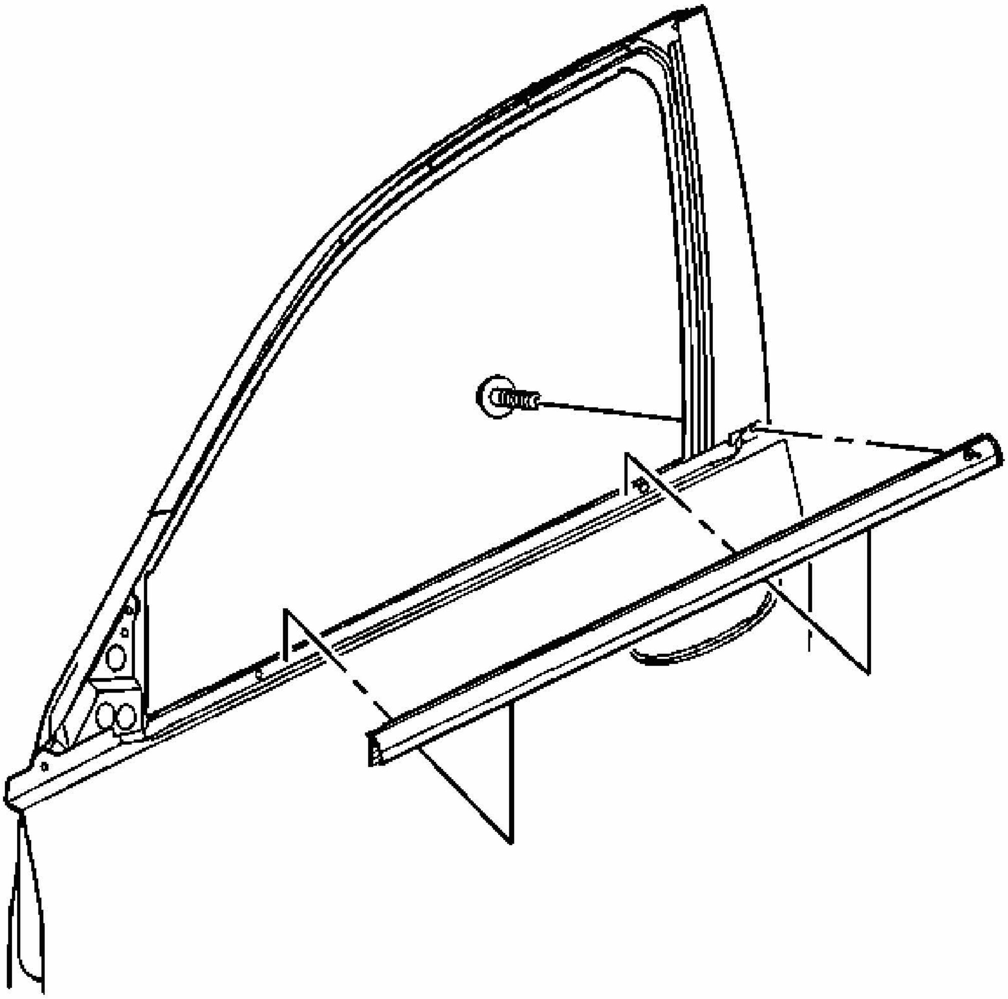


Fig. 160: Front Door Sealing Strip (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Remove the outside rearview mirror. Refer to **Mirror Replacement - Power**.
2. Remove the rear screw from the front door outer belt sealing strip.
3. Remove the front door outer belt sealing strip.

Installation Procedure

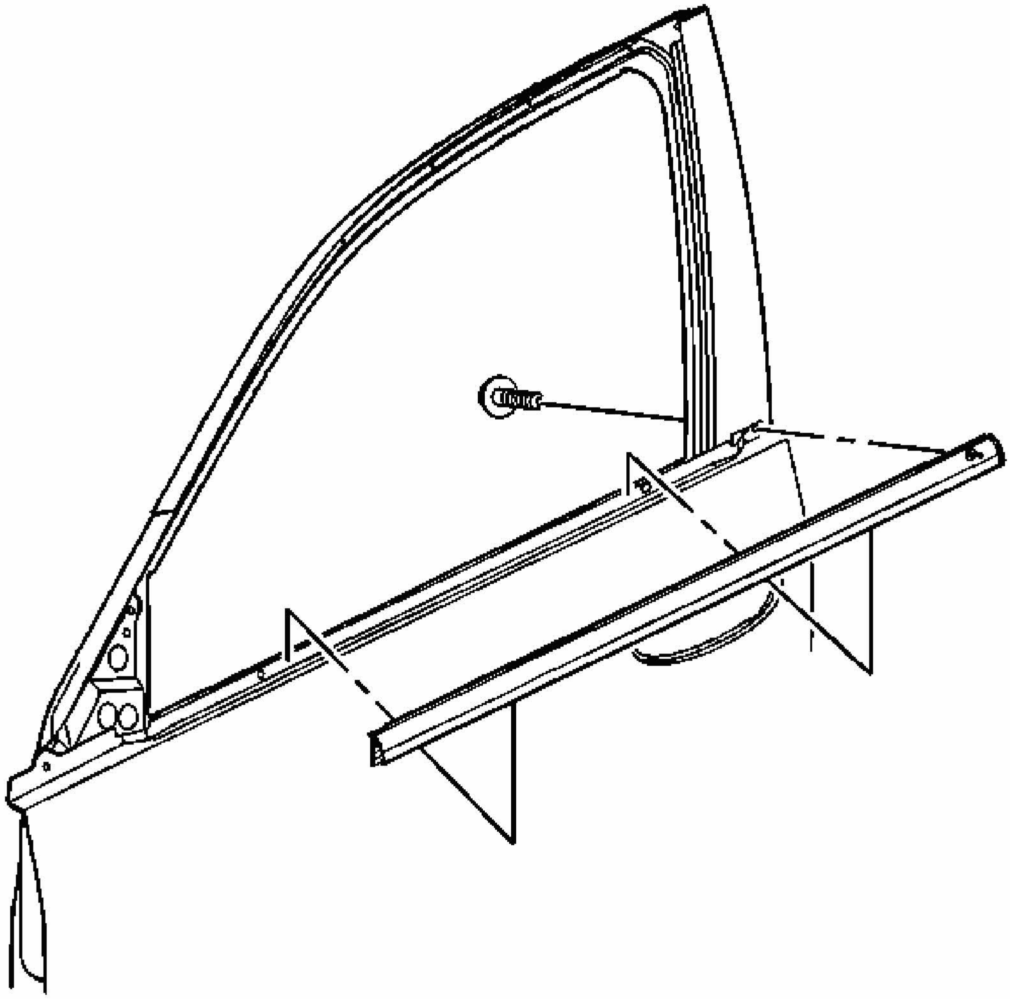


Fig. 161: Front Door Sealing Strip (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Position the front door outer belt sealing strip to the front door pinch-weld flange.
2. Install the front door outer belt sealing strip to the front door pinch-weld flange pressing into place until fully seated.

NOTE: Refer to FASTENER NOTICE .

3. Install the screw to the rear of the front door outer belt sealing strip.

Tighten: Tighten the outer belt sealing strip screw to 2 N.m (18 lb in).

4. Install the outside rearview mirror. Refer to **Mirror Replacement - Power**.

SEALING STRIP REPLACEMENT - FRONT DOOR WINDOW BELT OUTER (MONTE CARLO)

Removal Procedure

1. Remove the outside rearview mirror. Refer to **Mirror Replacement - Power**.
2. Remove the screws from the front door outer belt sealing strip.

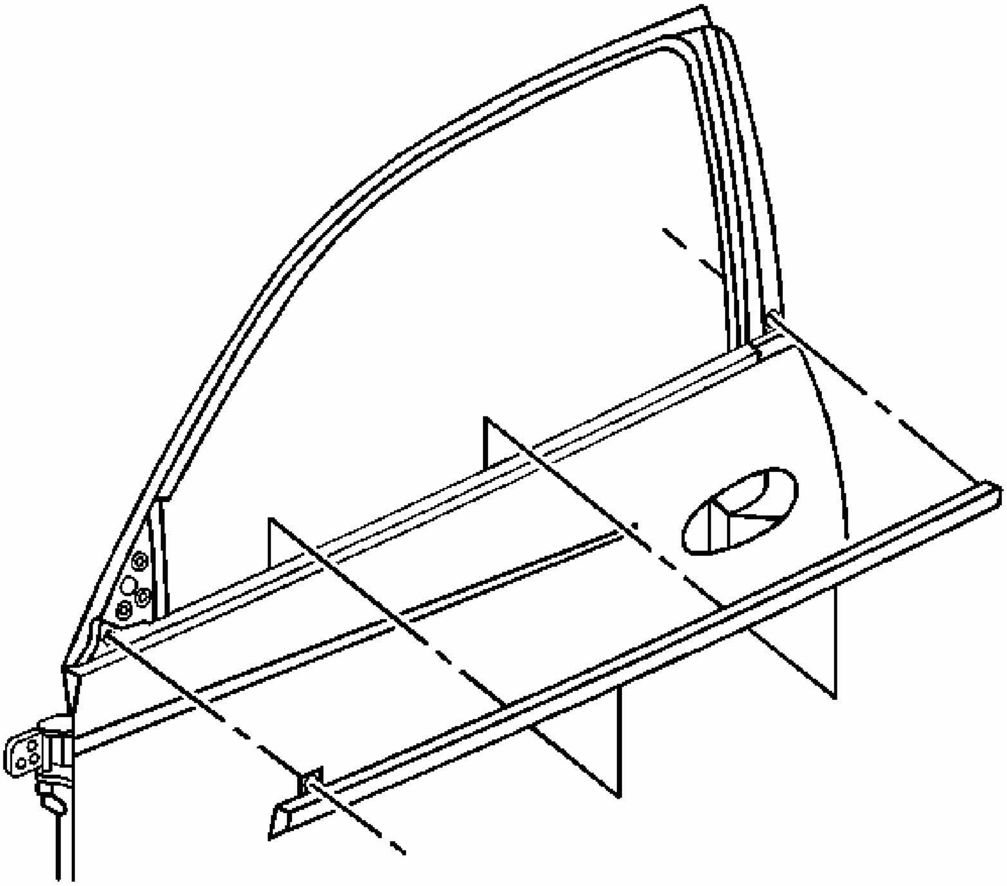


Fig. 162: Front Door Sealing Strip (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

3. Remove the front door outer belt sealing strip.

Installation Procedure

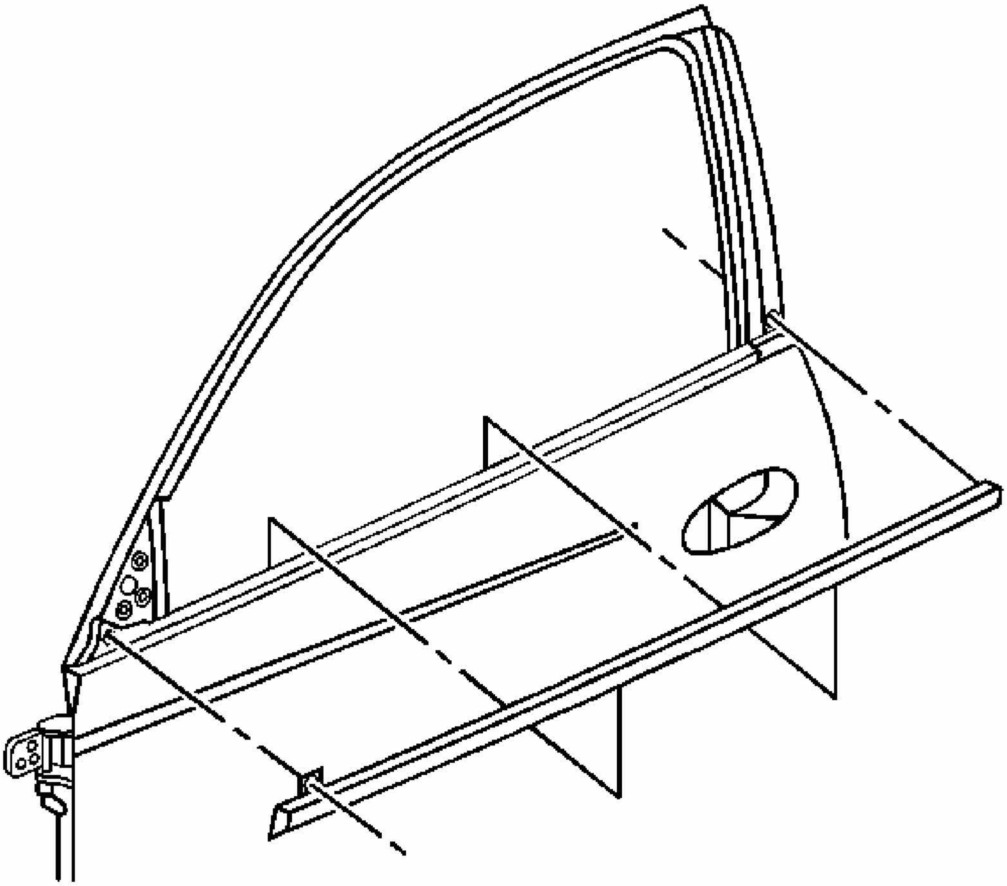


Fig. 163: Front Door Sealing Strip (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

1. Position the front door outer belt sealing strip to the front door pinch-weld flange.

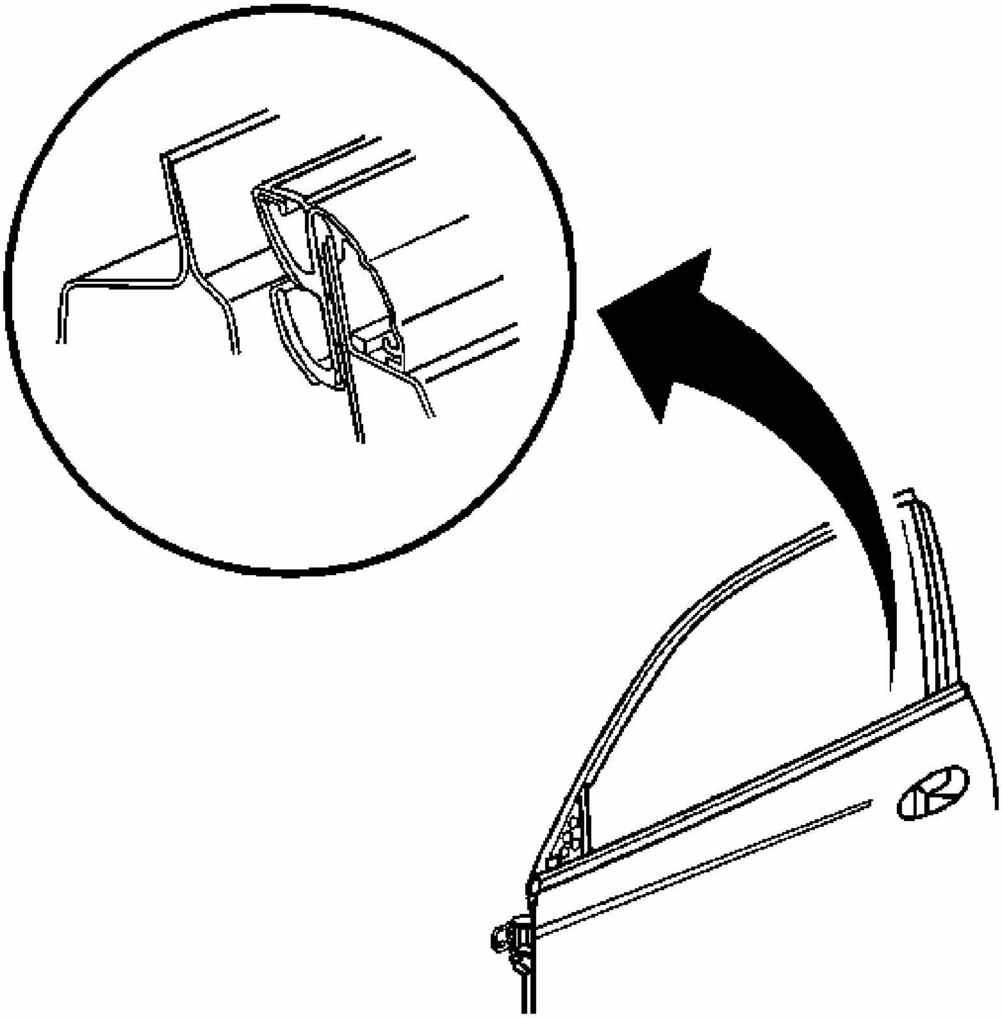


Fig. 164: Front Door Pinch-Weld Flange
Courtesy of GENERAL MOTORS CORP.

2. Install the front door outer belt sealing strip to the front door pinch-weld flange pressing into place until fully seated.

NOTE: **Refer to FASTENER NOTICE .**

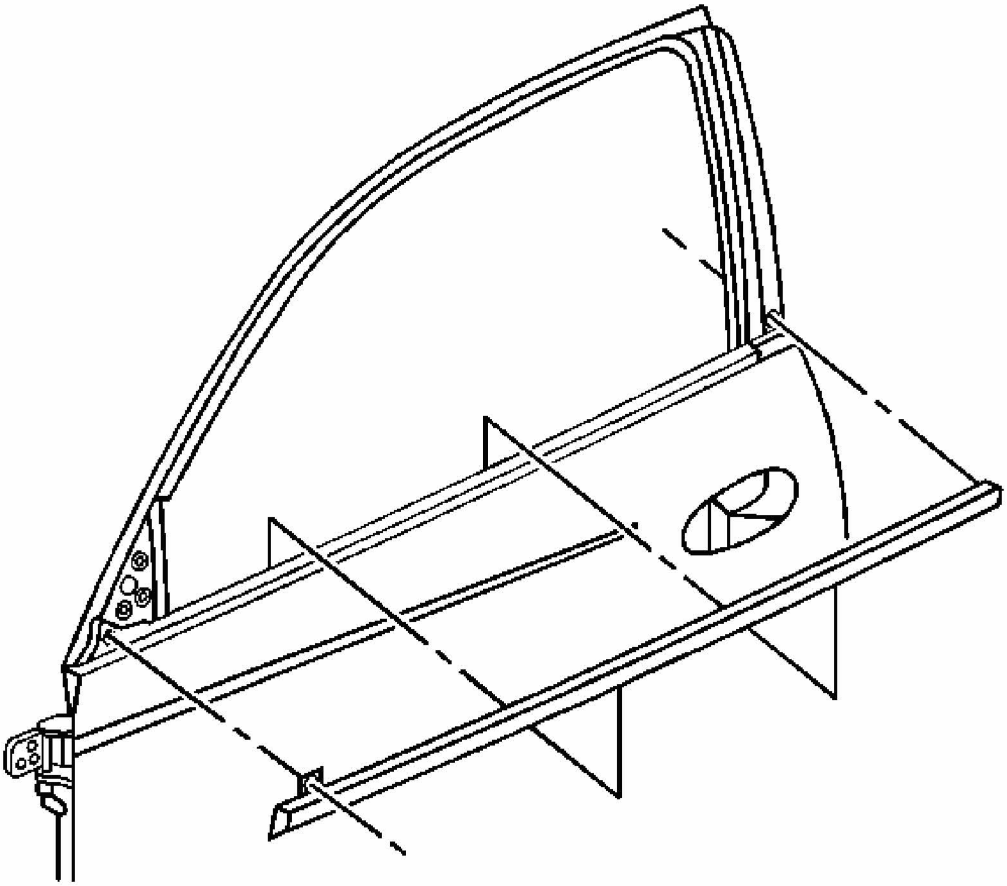


Fig. 165: Front Door Sealing Strip (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

3. Install the front screw to front door outer belt sealing strip.

   Tighten: Tighten the outer belt sealing strip front screw to 2 N.m (18 lb in).

4. Install the screw to the front door outer belt sealing strip.

   Tighten: Tighten the outer belt sealing strip machine rear screw to 5 N.m (9 lb in).

5. Install the outside rearview mirror. Refer to **Mirror Replacement - Power**.

REAR DOOR WINDOW BELT OUTER SEALING STRIP REPLACEMENT

Removal Procedure

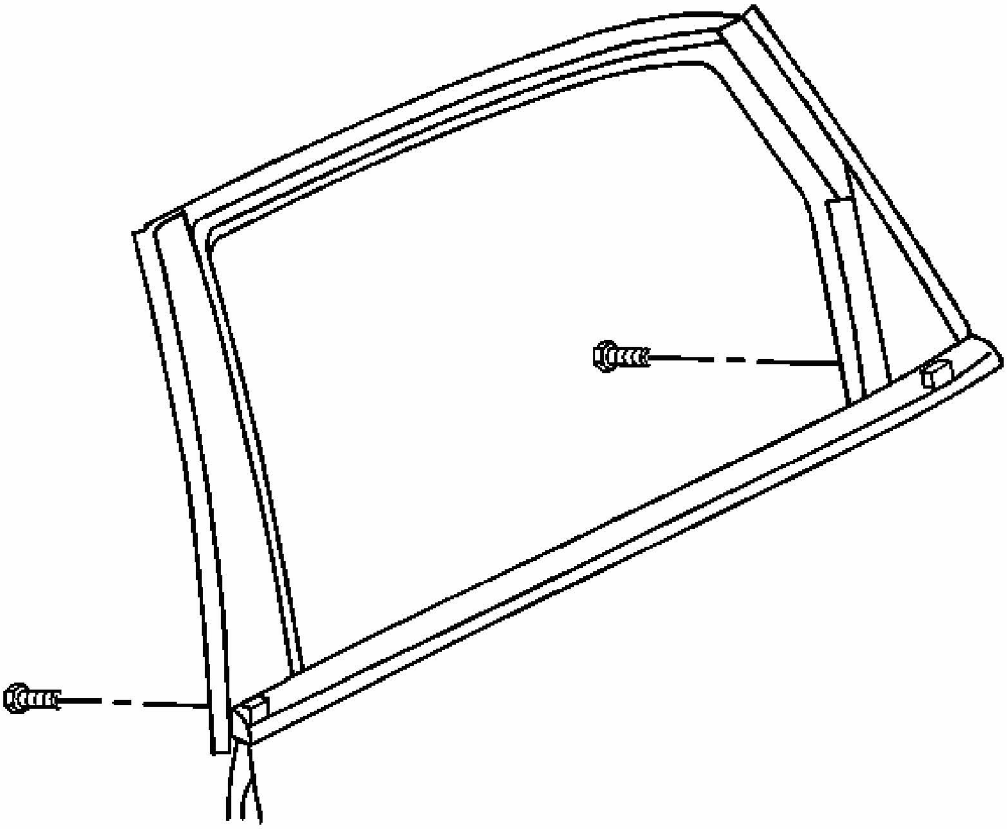


Fig. 166: Rear Door Sealing Strip Screws
Courtesy of GENERAL MOTORS CORP.

1. Position the rear window all the way down.
2. Remove the rear door trim panel to have access to these screws. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**.

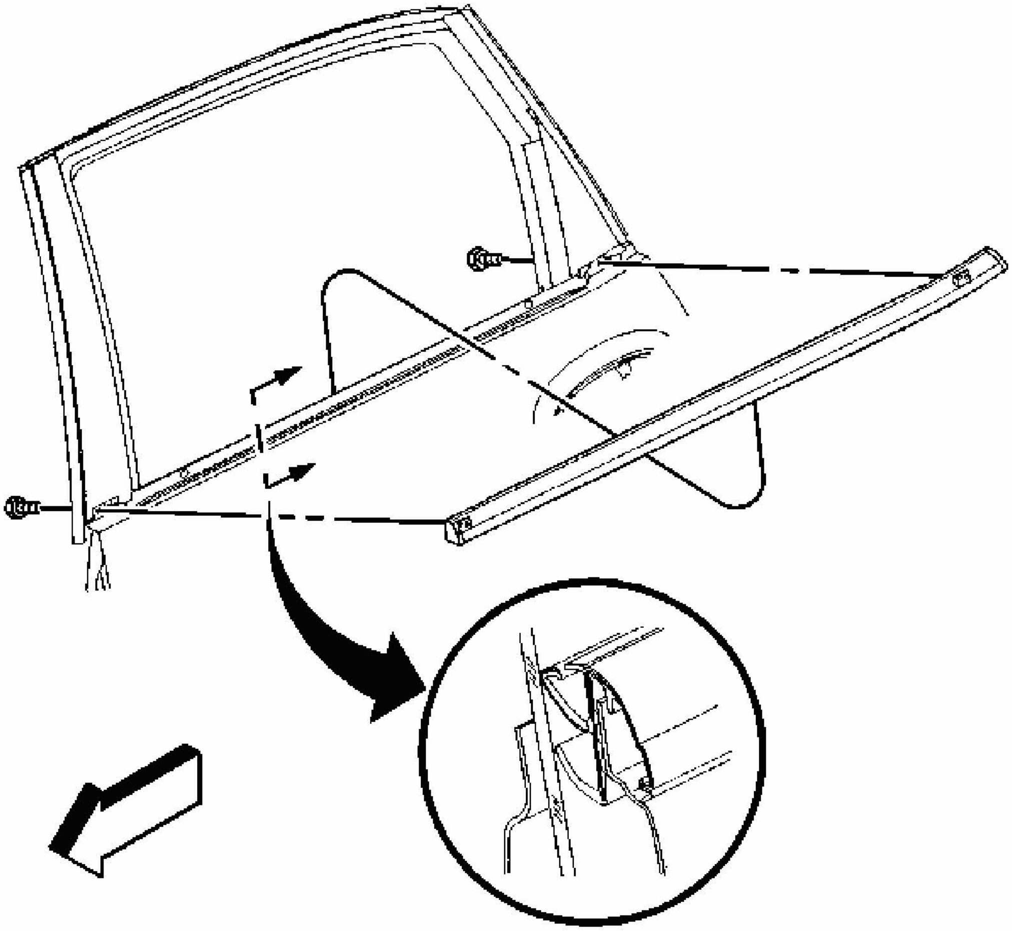


Fig. 167: Rear Door Window Outer Belt Sealing Strip
Courtesy of GENERAL MOTORS CORP.

3. Remove the rear door outer belt sealing strip screws.

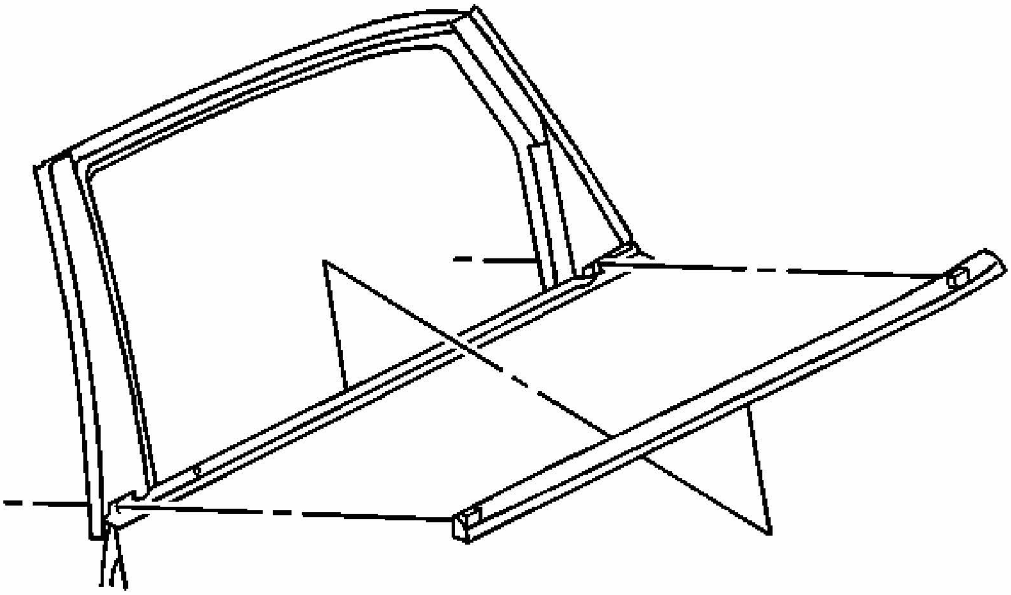


Fig. 168: Rear Door Sealing Strip
Courtesy of GENERAL MOTORS CORP.

4. Remove the rear window outer belt sealing strip by pulling the sealing strip from the rear door pinch-weld flange.

Installation Procedure

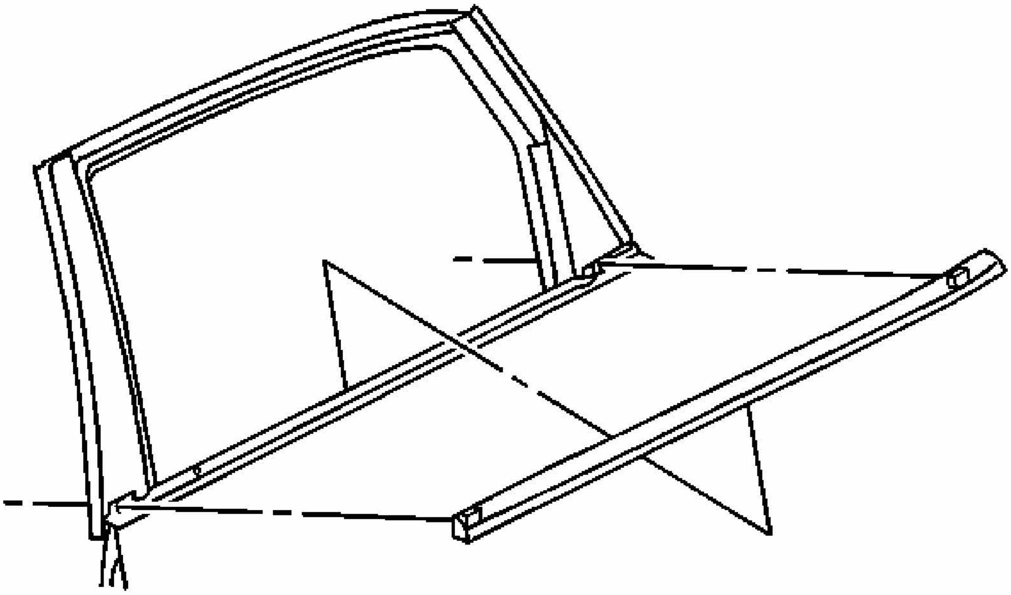


Fig. 169: Rear Door Sealing Strip
Courtesy of GENERAL MOTORS CORP.

1. Position the rear door outer belt sealing strip to the rear door pinch-weld flange.

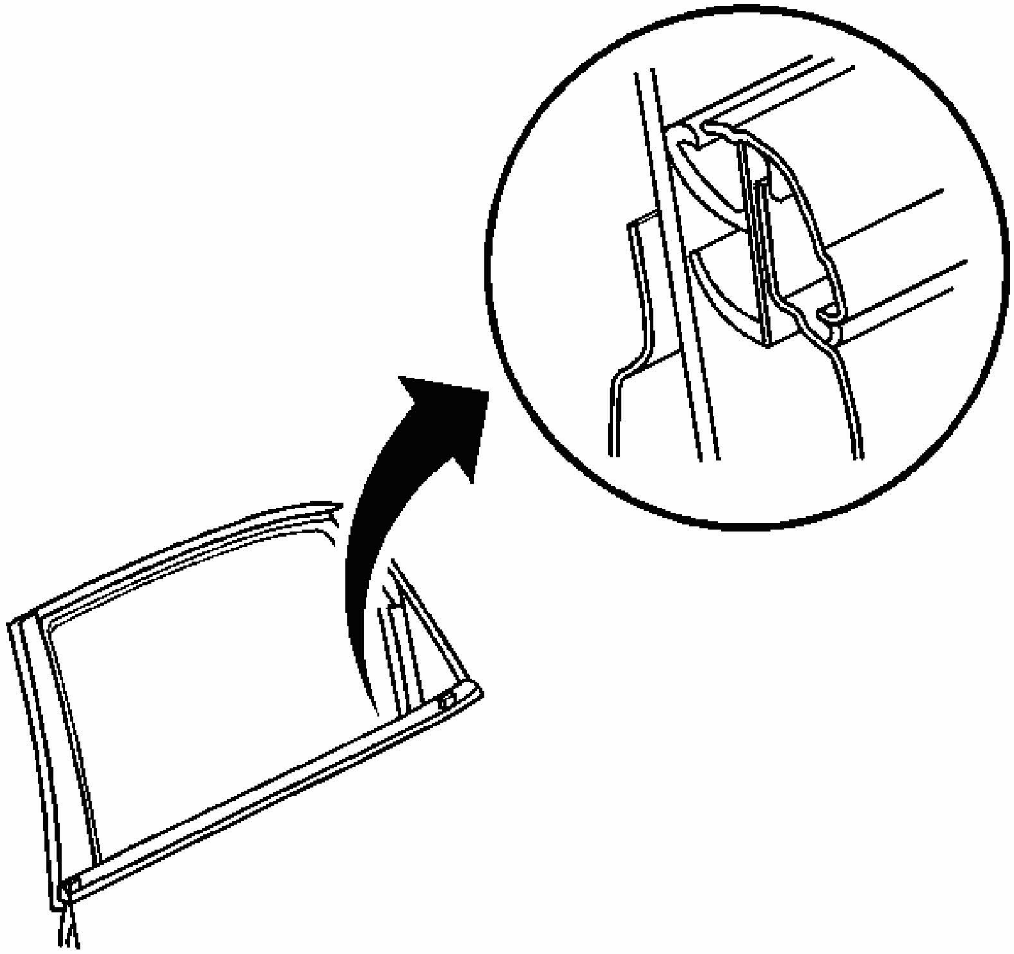


Fig. 170: Rear Door Pinch-Weld Flange
Courtesy of GENERAL MOTORS CORP.

2. Install the rear door outer belt sealing strip to the pinch-weld flange, pressing into place until full seated.

NOTE: **Refer to FASTENER NOTICE .**

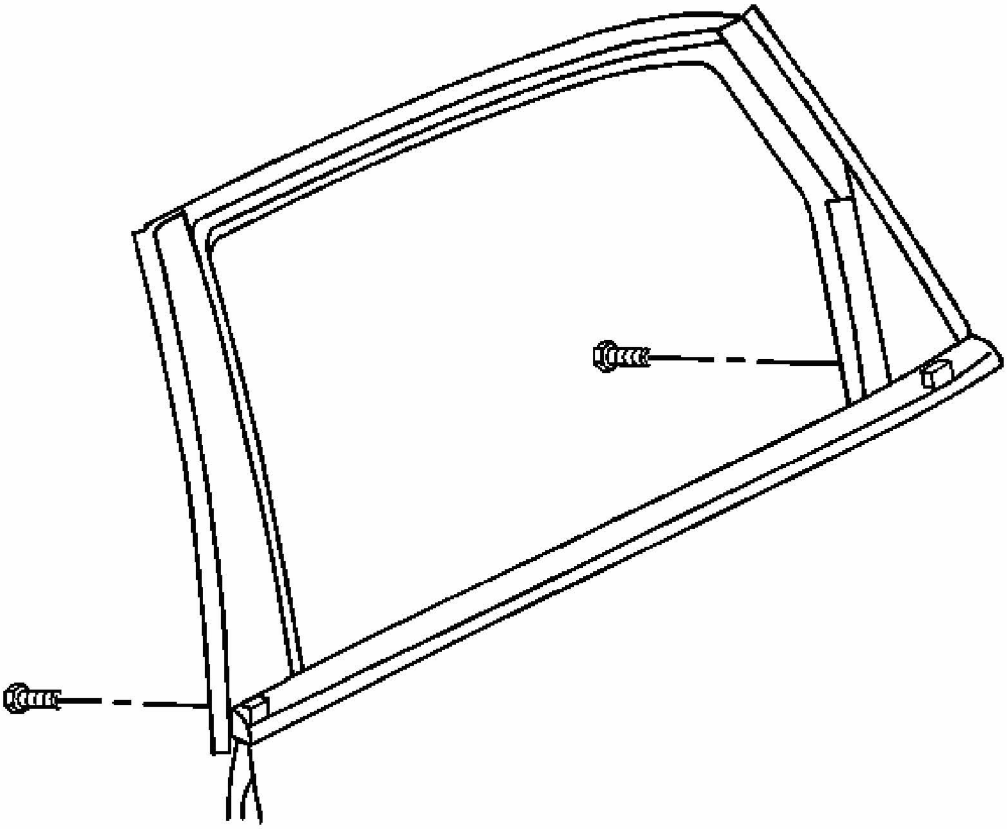


Fig. 171: Rear Door Sealing Strip Screws
Courtesy of GENERAL MOTORS CORP.

3. Install the rear door outer belt sealing strip screws.

   Tighten: Tighten the rear door outer belt sealing strip screws to 2 N.m (18 lb in).

4. Install Rear door trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**.

FRONT DOOR WINDOW BELT INNER SEALING STRIP REPLACEMENT

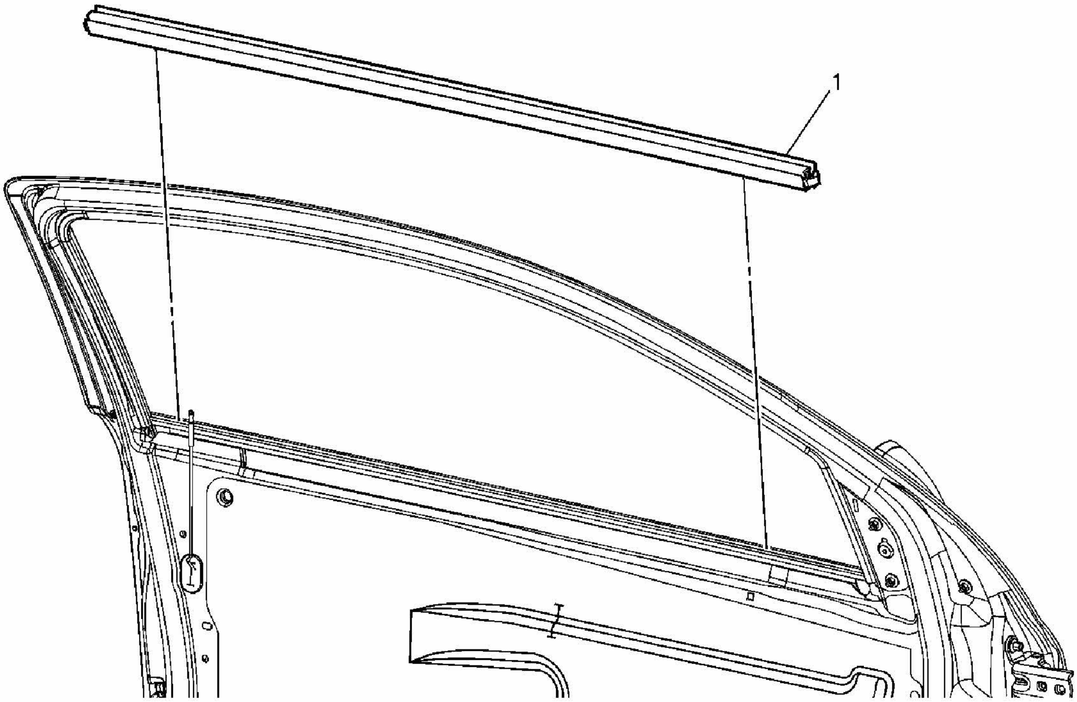


Fig. 172: Replacing Front Door Window Belt Inner Sealing Strip
Courtesy of GENERAL MOTORS CORP.

Sealing Strip Replacement - Front Door Window Belt Inner

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures:** Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**	
1	Sealing Strip, Front Side Door Window Inner **Tip:** Pull up and away from inner panel to remove from the door.

REAR DOOR WINDOW BELT INNER SEALING STRIP REPLACEMENT

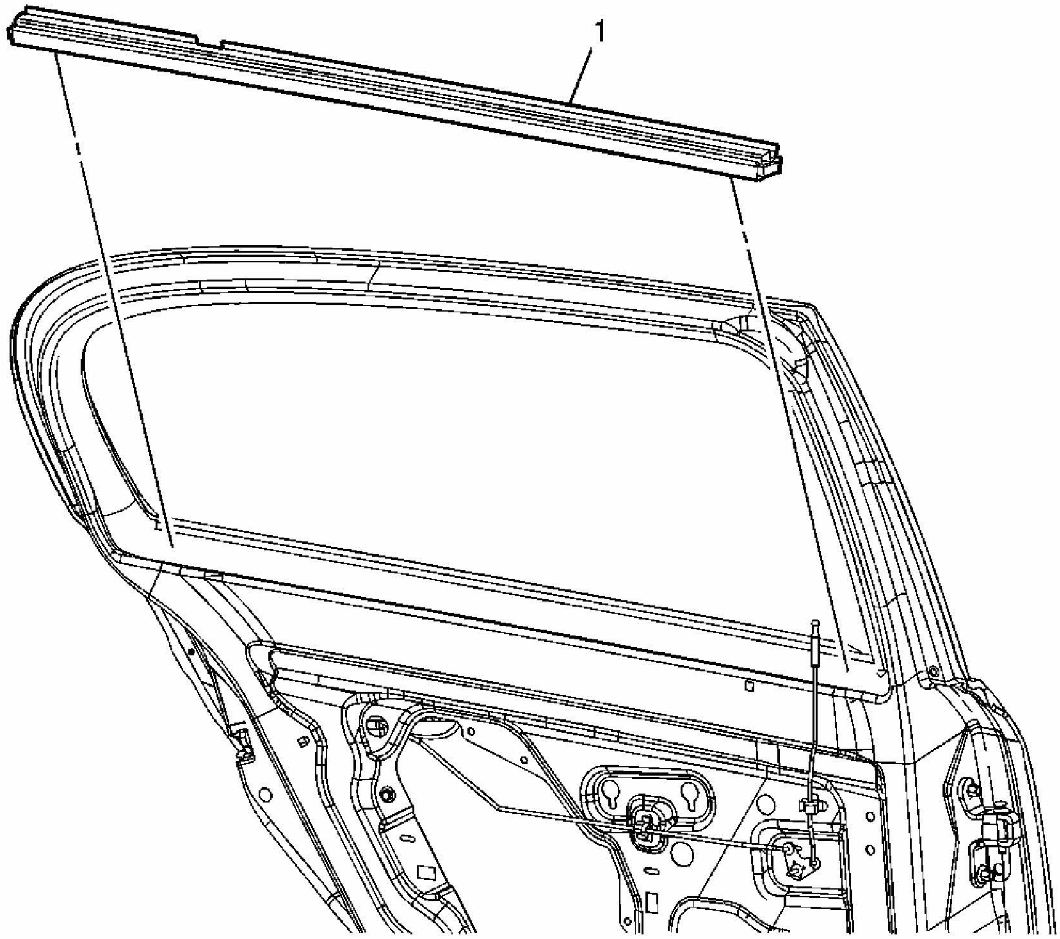


Fig. 173: Replacing Rear Door Window Belt Inner Sealing Strip
Courtesy of GENERAL MOTORS CORP.

Sealing Strip Replacement - Rear Door Window Belt Inner

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures:** Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Rear Door (Impala)**	
1	Sealing Strip, Front Side Door Window Inner **Tip:** Pull up and away from inner panel to remove from the door.

FRONT DOOR WEATHERSTRIP REPLACEMENT - (IMPALA)

Removal Procedure

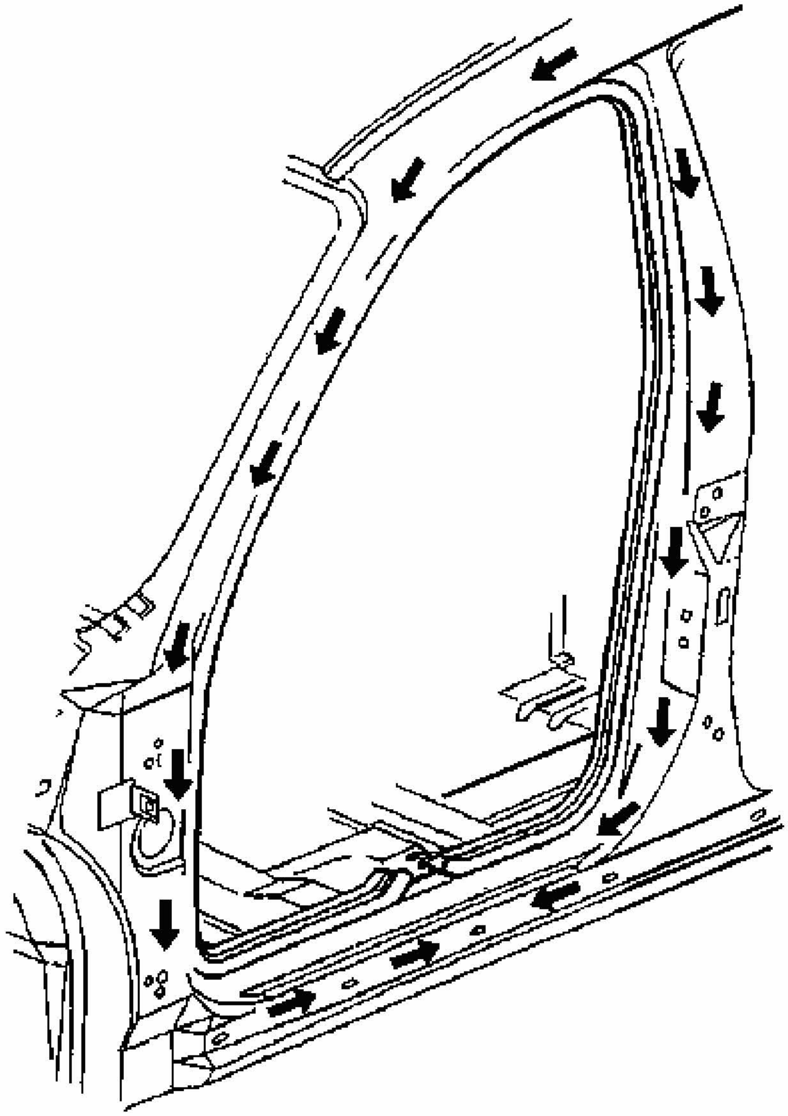


Fig. 174: Front Door Weatherstrip Positioning (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Open the front door.
2. Remove the carpet retainers. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** .
3. Remove the windshield garnish molding. Refer to **Garnish Molding Replacement - Windshield Pillar (Impala)** or **Garnish Molding Replacement - Windshield Pillar (Monte Carlo)** .

4. Remove the upper center pillar trim panel. Refer to **Trim Panel Replacement - Upper Center Pillar** .
5. Remove the center lower trim panel. Refer to **Trim Panel Replacement - Lower Center Pillar** .
6. Remove the front door opening weatherstrip by pulling it off the pinch-weld flange.

Installation Procedure

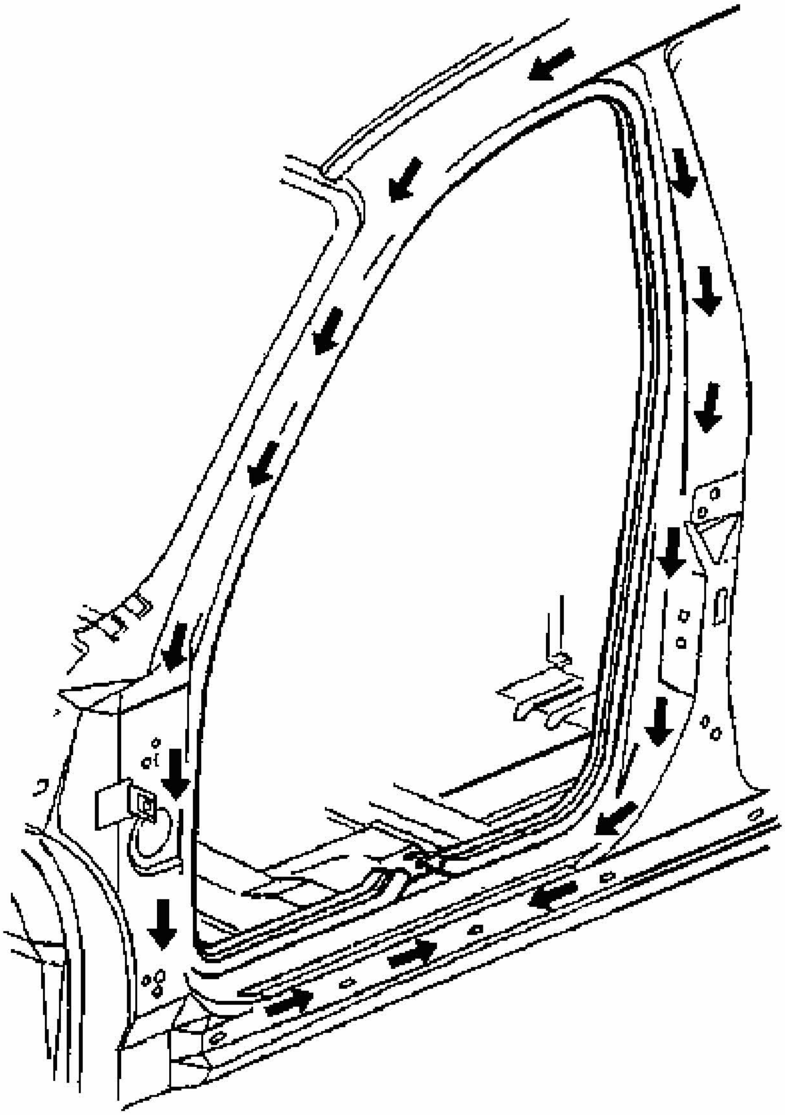


Fig. 175: Front Door Weatherstrip Positioning (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Position the front door opening weatherstrip to the pinch-weld flange.

   Starting at the center of the rocker panel area and moving in a clockwise direction press the front door opening weatherstrip to the pinch-weld flange until fully seated.

   IMPORTANT: The joint butt ends must have no gap and be located in the center of the of the rocker panel area.

2. Install joint butt ends together.
3. Install the carpet retainers. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** .
4. Install the windshield garnish molding. Refer to **Garnish Molding Replacement - Windshield Pillar (Impala)** or **Garnish Molding Replacement - Windshield Pillar (Monte Carlo)** .
5. Install the upper center pillar trim panel. Refer to **Trim Panel Replacement - Upper Center Pillar** .
6. Install the center lower trim panel. Refer to **Trim Panel Replacement - Lower Center Pillar** .
7. Close the front door.

FRONT DOOR WEATHERSTRIP REPLACEMENT - (MONTE CARLO)

Removal Procedure

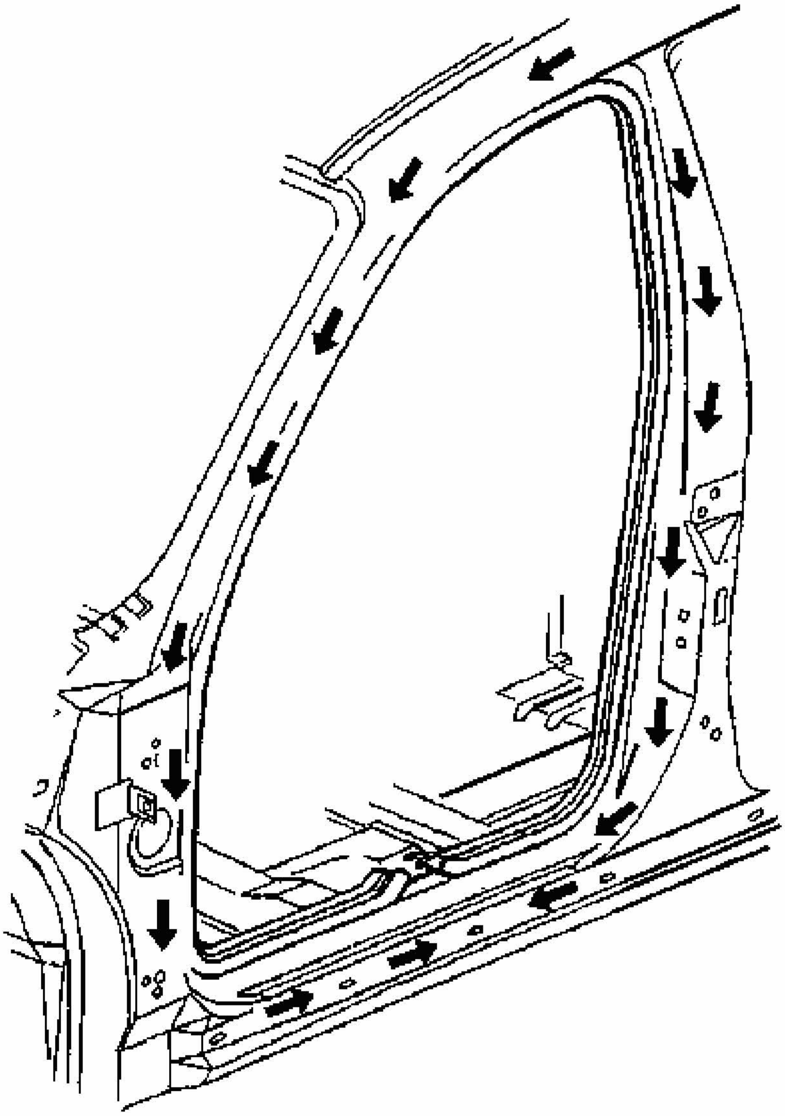


Fig. 176: Front Door Weatherstrip Positioning (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Open the door.
2. Remove the carpet retainers. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** .
3. Remove the windshield garnish molding. Refer to **Garnish Molding Replacement - Windshield Pillar (Impala)** or **Garnish Molding Replacement - Windshield Pillar (Monte Carlo)** .

4. Remove the rear upper quarter trim panel. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .
5. Remove the rear lower quarter trim panel. Refer to **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)** .
6. Remove the door opening weatherstrip by pulling it off the pinch-weld flange.

Installation Procedure

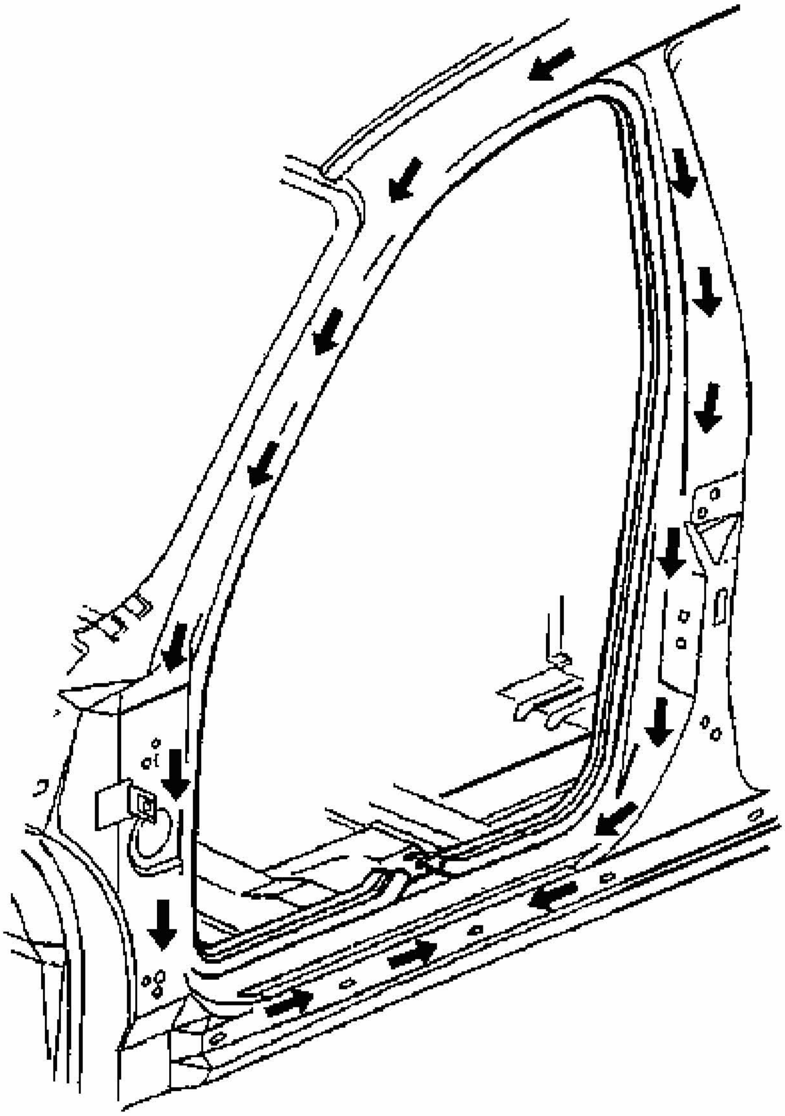


Fig. 177: Front Door Weatherstrip Positioning (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Position the front door opening weatherstrip to the pinch-weld flange.

   Starting at the center of the rocker panel area and moving in a clockwise direction press the front door opening weatherstrip to the pinch-weld flange until fully seated.

   IMPORTANT: The joint butt ends must have no gap and be located in the center of the of the rocker panel area.

2. Install joint butt ends together.
3. Install the carpet retainers. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** .
4. Install the windshield garnish molding. Refer to **Garnish Molding Replacement - Windshield Pillar (Impala)** or **Garnish Molding Replacement - Windshield Pillar (Monte Carlo)** .
5. Install the rear upper quarter trim panel. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .
6. Install the rear lower quarter trim panel. Refer to **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)** .
7. Close the door.

FRONT DOOR WINDOW WEATHERSTRIP REPLACEMENT

Removal Procedure

1. Remove the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.
2. Remove the front door water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**.
3. Remove the front door outer belt sealing strip. Refer to **Sealing Strip Replacement - Front Door Window Belt Outer (Impala)** or **Sealing Strip Replacement - Front Door Window Belt Outer (Monte Carlo)**.
4. Remove the front door window. Refer to **Window Replacement - Front Door (Impala)** or **Window Replacement - Front Door (Monte Carlo)**.

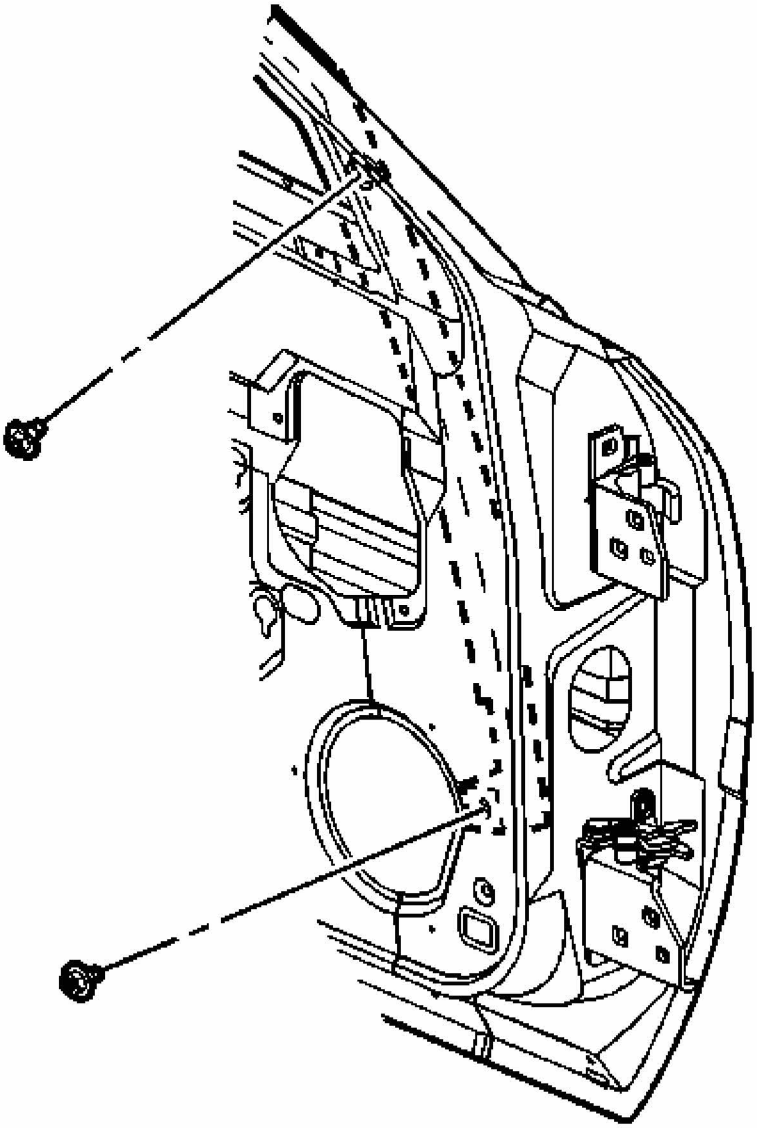


Fig. 178: Front Door Window Channel Screws (Impala)
Courtesy of GENERAL MOTORS CORP.

5. Remove the screws from the front door window channel.

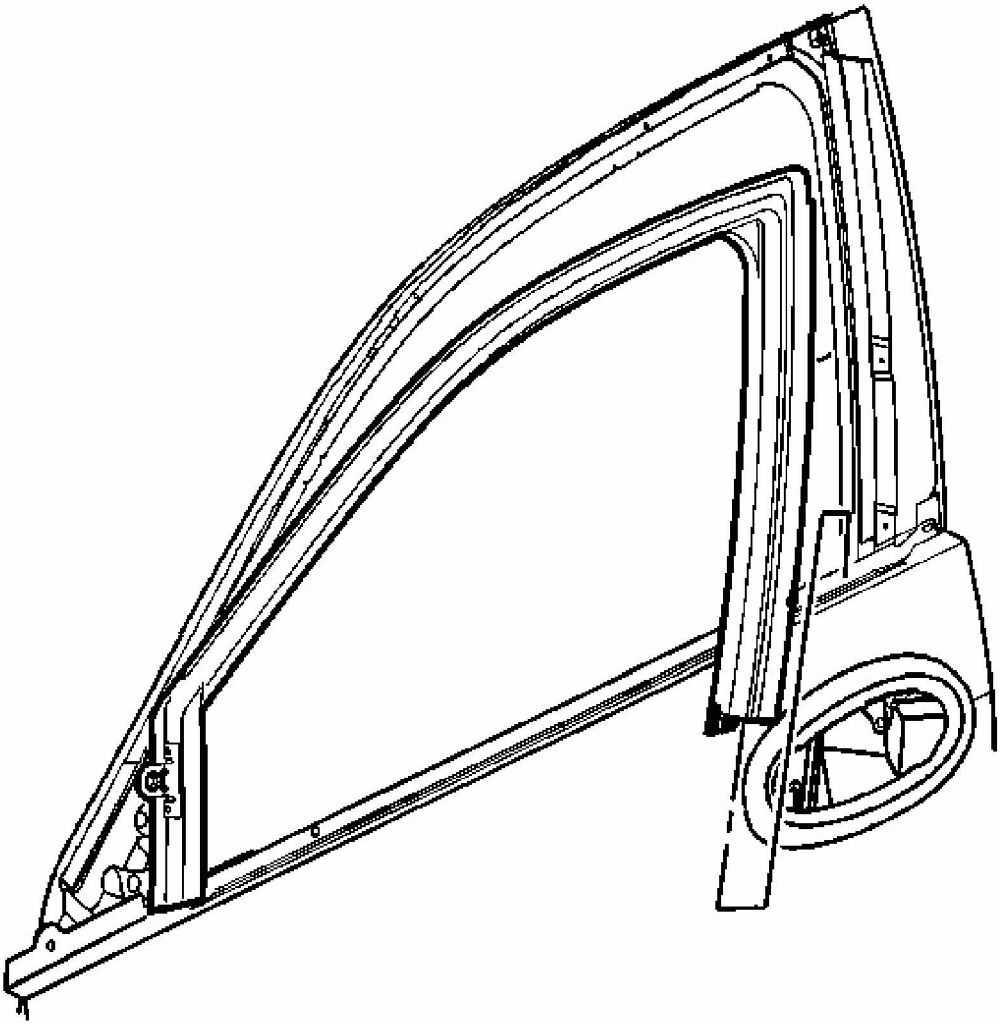


Fig. 179: Removing Front Door Window Channel From Front Door Frame (Impala)
Courtesy of GENERAL MOTORS CORP.

6. Remove the front door window channel from the front door frame.

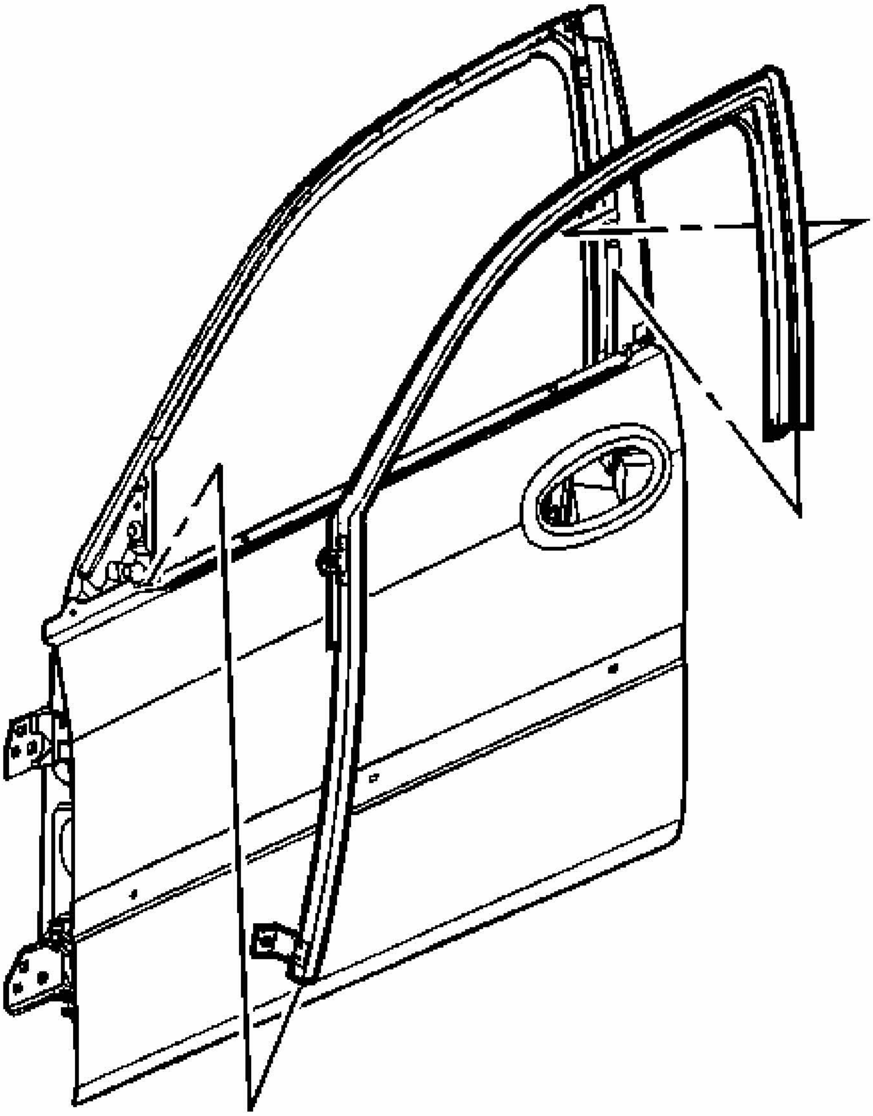


Fig. 180: Front Door Window Channel (Impala)
Courtesy of GENERAL MOTORS CORP.

7. Remove the front door window channel from the front door.

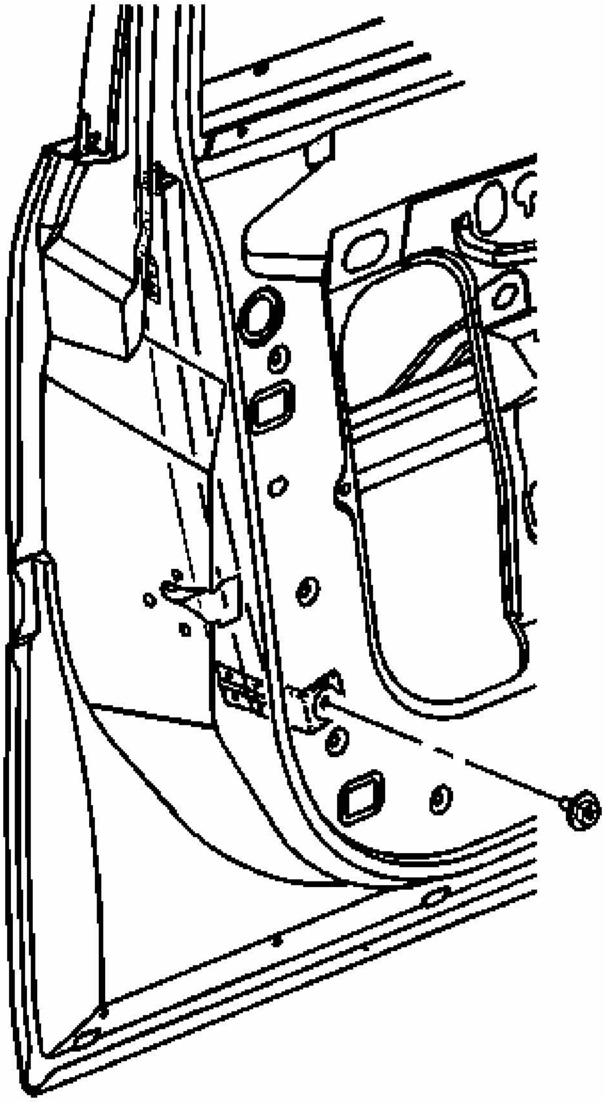


Fig. 181: Front Door Rear Window Channel Bolt (Impala)
Courtesy of GENERAL MOTORS CORP.

8. Remove the screw from the front door rear window channel.

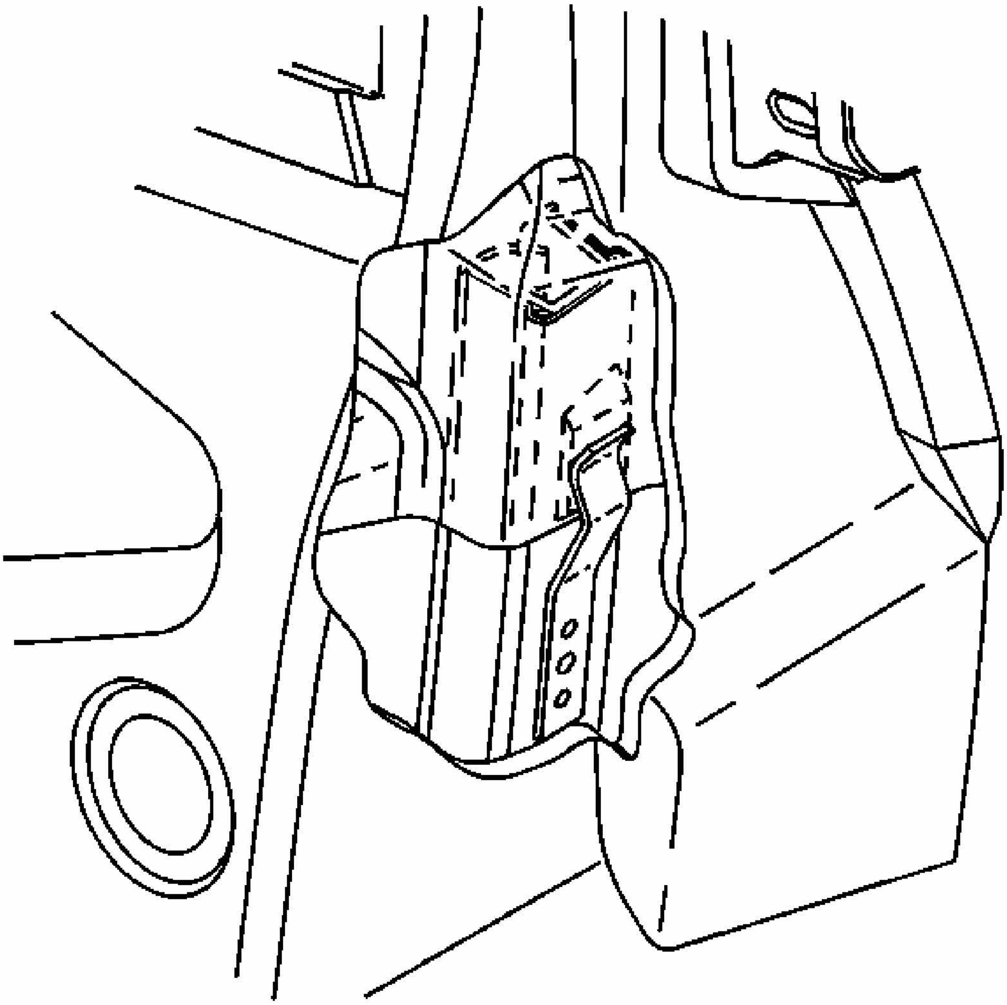


Fig. 182: Front Door Rear Window Channel (Impala)
Courtesy of GENERAL MOTORS CORP.

9. Remove the front door rear window channel from the front door slot by pulling down to disengage the retainer clip.

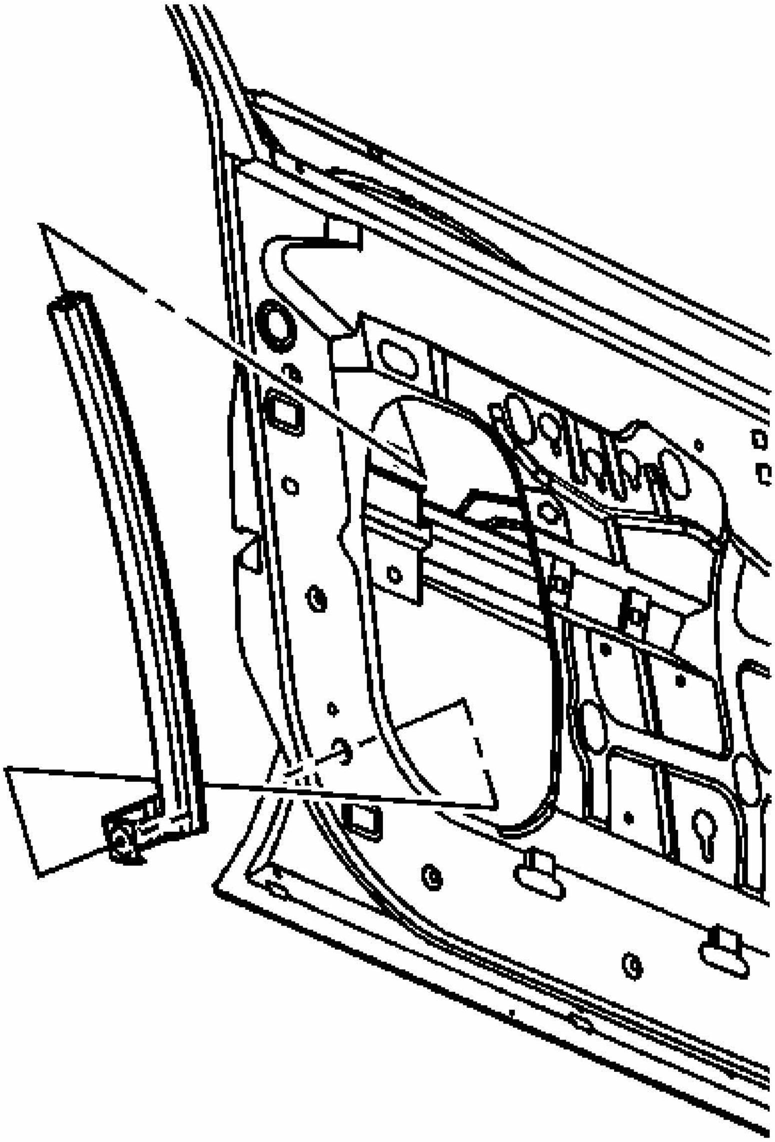


Fig. 183: Removing Front Door Rear Window Channel (Impala)
Courtesy of GENERAL MOTORS CORP.

10. Remove the front door rear window channel from the front door through the access hole in the inner front door panel.

Installation Procedure

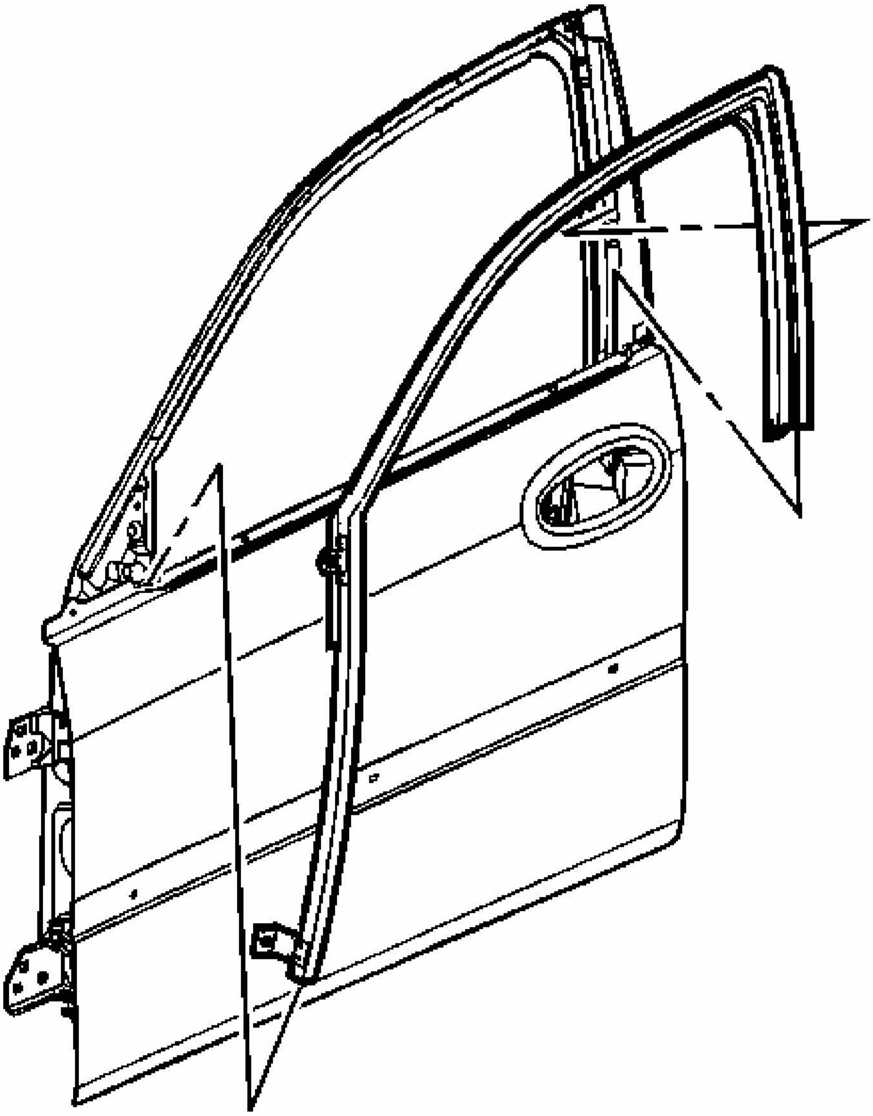


Fig. 184: Front Door Window Channel (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Position the front door window channel front channel into the front door.

NOTE: **Refer to FASTENER NOTICE .**

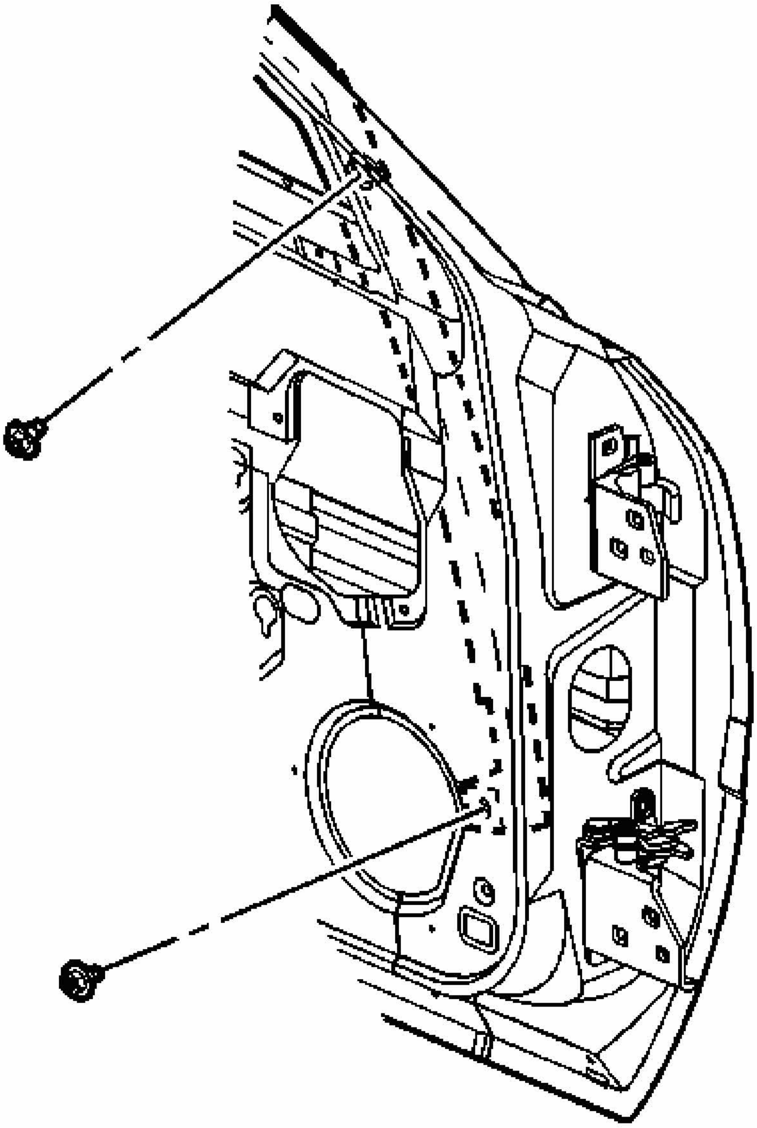


Fig. 185: Front Door Window Channel Screws (Impala)
Courtesy of GENERAL MOTORS CORP.

2. Install the front door window channel screws.

   Tighten: Tighten the front door window channel screws to 10 N.m (89 lb in).

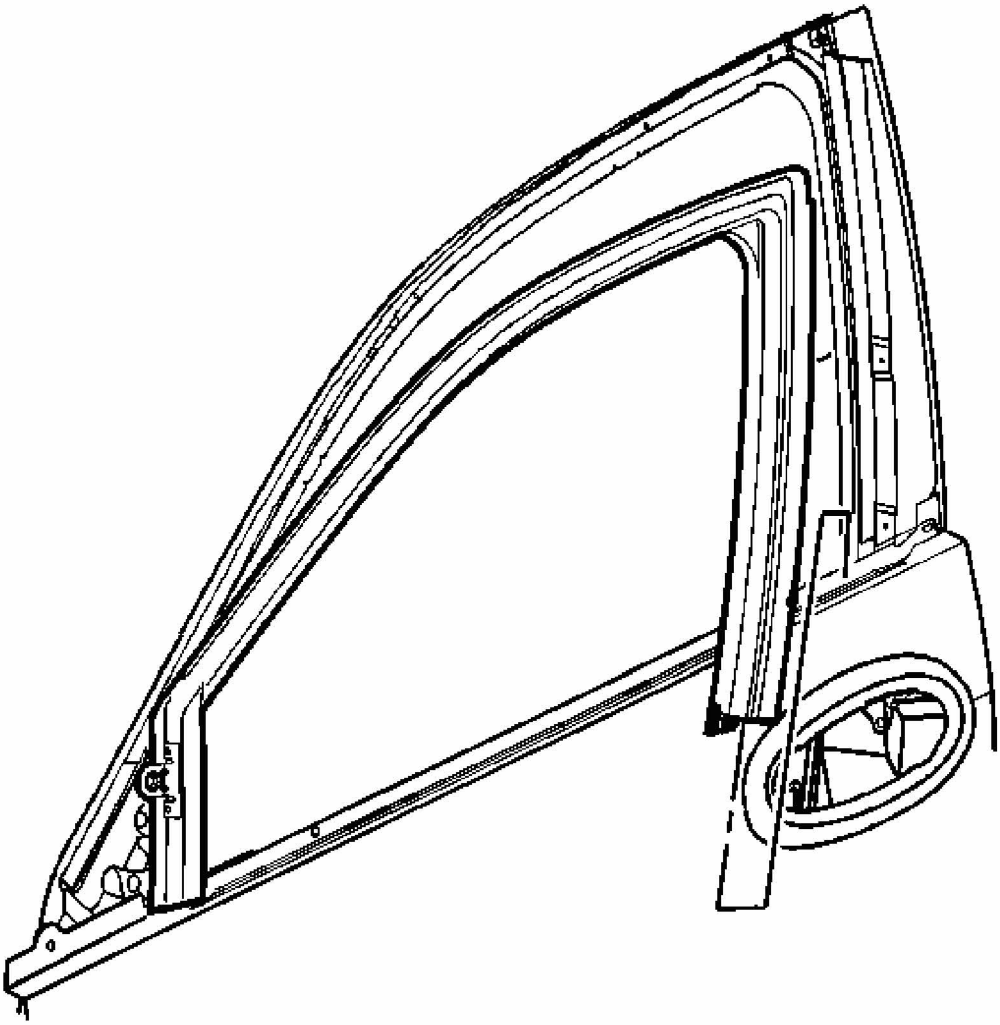


Fig. 186: Removing Front Door Window Channel From Front Door Frame (Impala)
Courtesy of GENERAL MOTORS CORP.

3. Install the front door window channel to the front door starting in the top corner working out in both directions.

   Firmly seat the front door window channel to the front door.

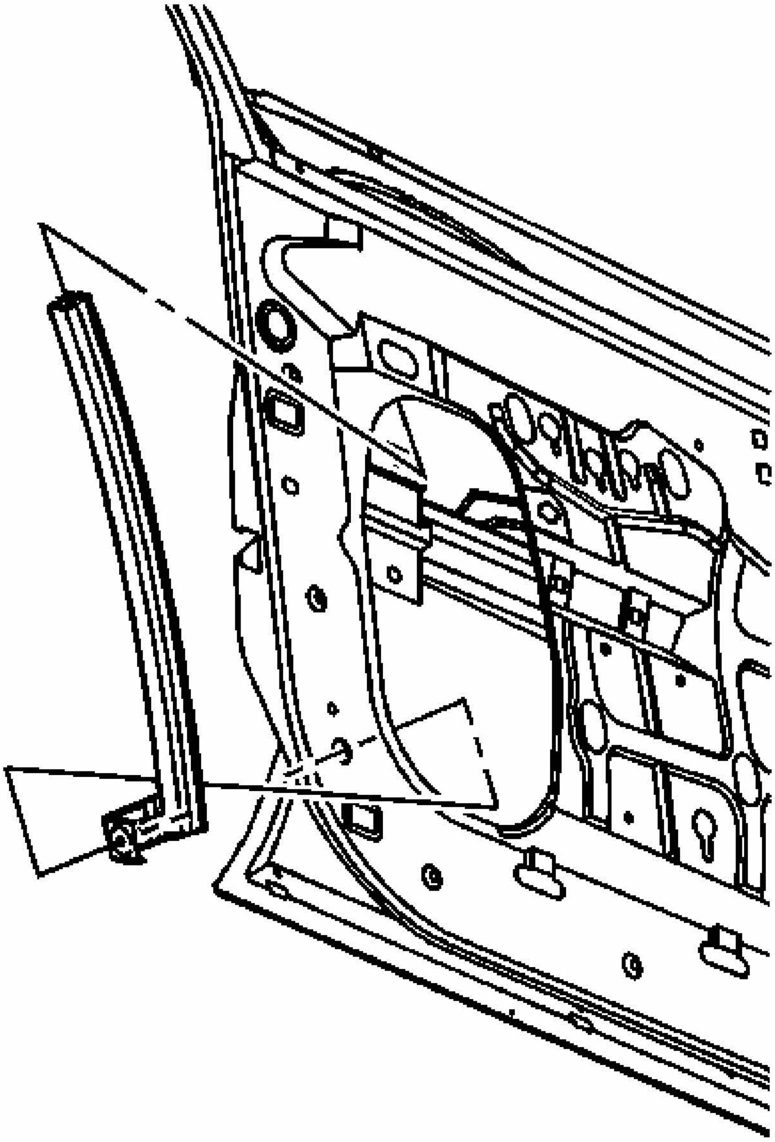


Fig. 187: Removing Front Door Rear Window Channel (Impala)
Courtesy of GENERAL MOTORS CORP.

4. Install the front door rear window channel to the front door through the access hole in the inner front door panel.

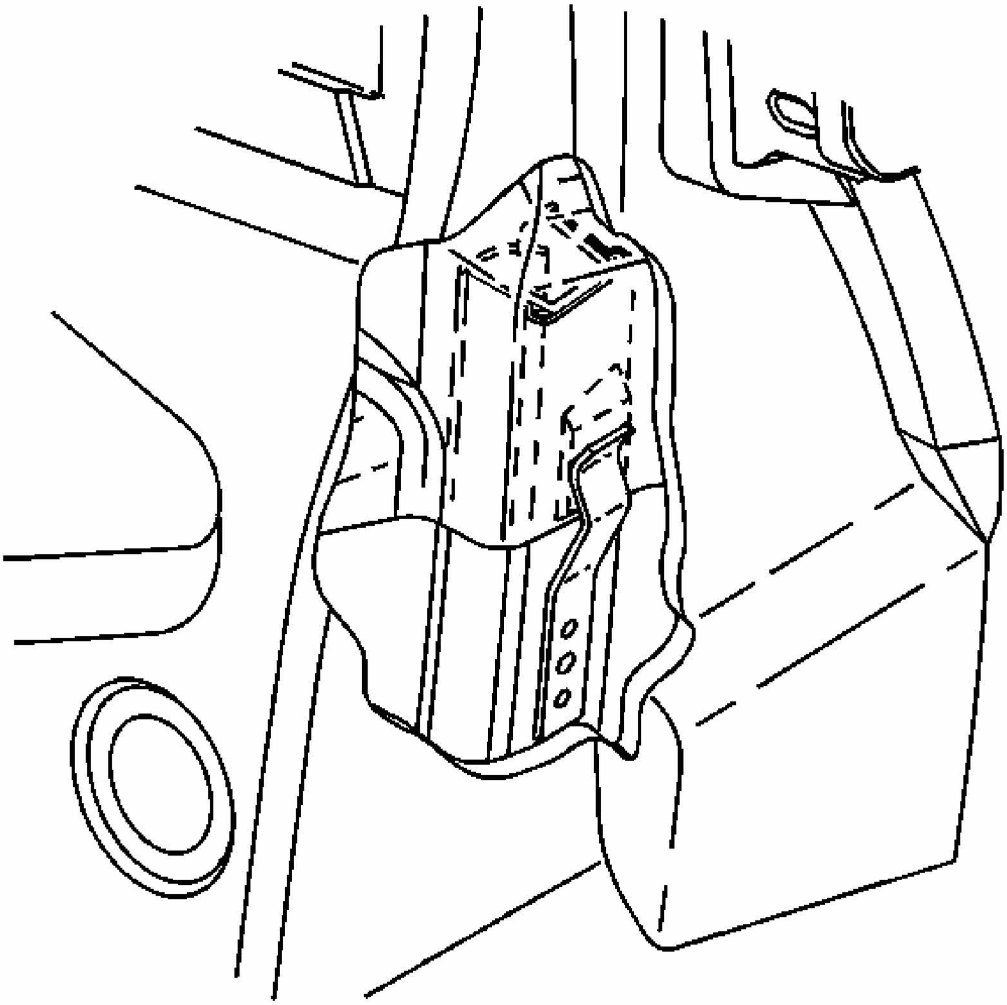


Fig. 188: Front Door Rear Window Channel (Impala)
Courtesy of GENERAL MOTORS CORP.

5. Install the front door rear window channel to the front door slot by pushing up to engage the retainer clip.

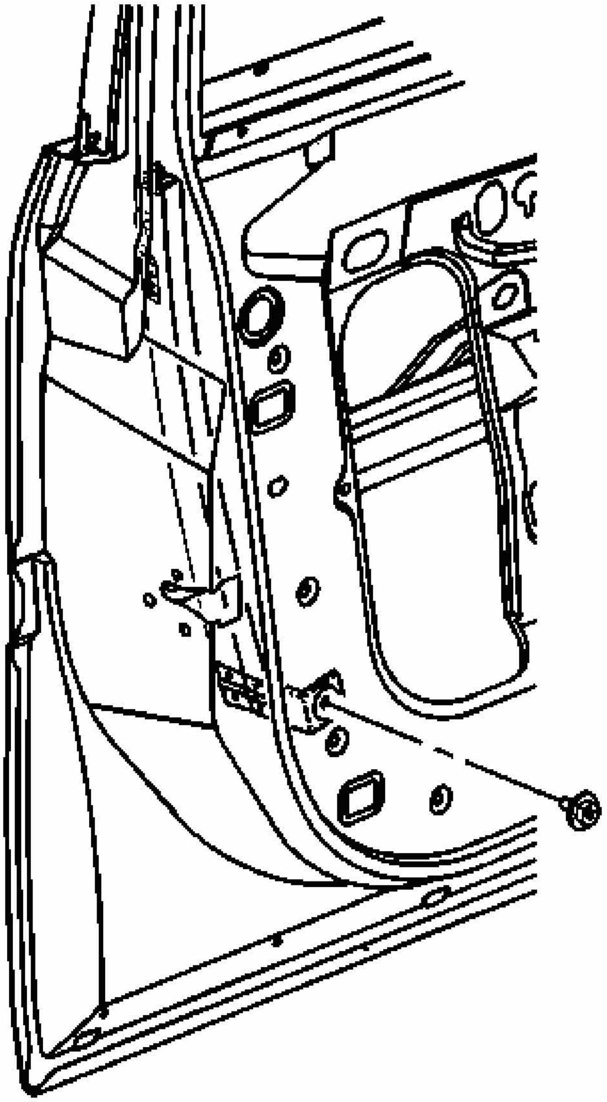


Fig. 189: Front Door Rear Window Channel Bolt (Impala)
Courtesy of GENERAL MOTORS CORP.

6. Install the screw to the front door rear window channel.

   Tighten: Tighten the front door weatherstrip channel screws to 10 N.m (89 lb in).

7. Install the front door window. Refer to **Window Replacement - Front Door (Impala)** or **Window Replacement - Front Door (Monte Carlo)**.
8. Inspect the front door window for proper operation.

9. Install the front door outer belt sealing strip. Refer to **Sealing Strip Replacement - Front Door Window Belt Outer (Impala)** or **Sealing Strip Replacement - Front Door Window Belt Outer (Monte Carlo)**.
10. Install the front door water deflector. Refer to **Water Deflector Replacement - Front Door (Impala)** or **Water Deflector Replacement - Front Door (Monte Carlo)**.
11. Install the front door trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.

REAR DOOR OPENING WEATHERSTRIP REPLACEMENT

Removal Procedure

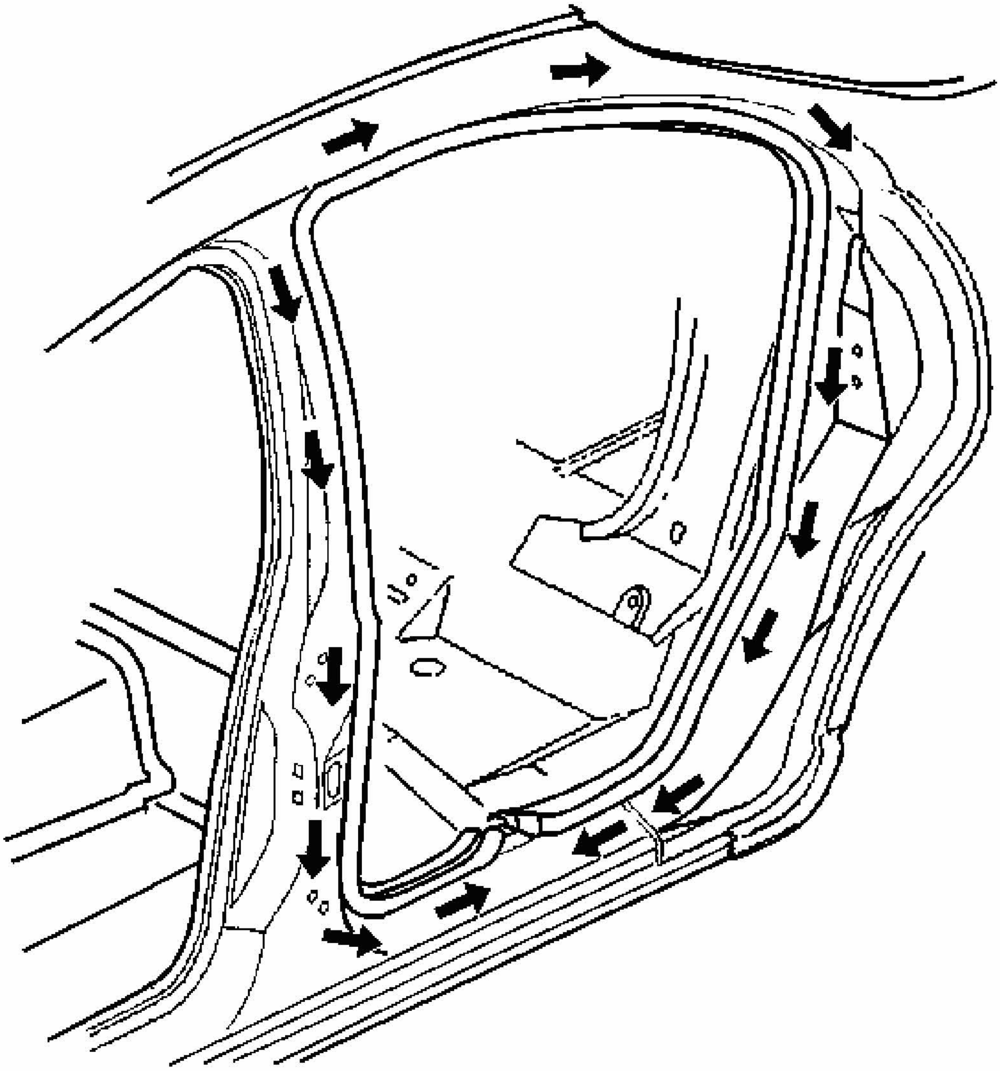


Fig. 190: Rear Door Weatherstrip Positioning
Courtesy of GENERAL MOTORS CORP.

1. Open the rear door.
2. Remove the trim panels. Refer to the following procedures:
   - **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)**
   - **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)**
   - **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)**
   - **Trim Panel Replacement - Upper Center Pillar**
   - **Trim Panel Replacement - Lower Center Pillar**
3. Remove the weatherstrip from the rear door opening by pulling the weatherstrip off the pinchweld flange.

Installation Procedure

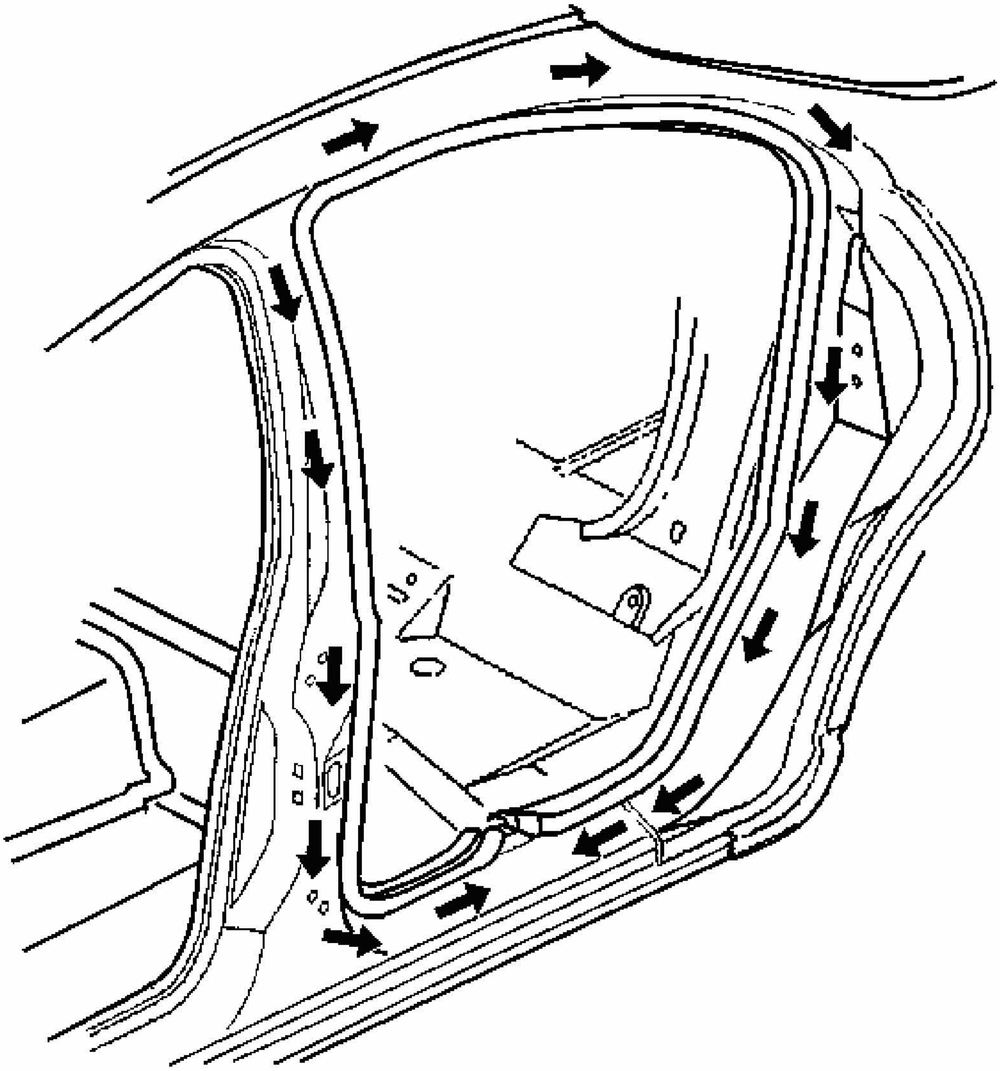


Fig. 191: Rear Door Weatherstrip Positioning
Courtesy of GENERAL MOTORS CORP.

1. Position the rear door opening weatherstrip to the pinchweld flange.

   Starting at the center of the rocker panel area and moving in a clockwise direction, press the weatherstrip to the pinchweld flange until fully seated.

   IMPORTANT: The joint butt ends must have no gap and must be located in the center of the of the rocker panel area.

2. Install the joint butt ends together.

3. Install the trim panels. Refer to the following procedures:
   - **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)**
   - **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)**
   - **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)**
   - **Trim Panel Replacement - Upper Center Pillar**
   - **Trim Panel Replacement - Lower Center Pillar**
4. Close the rear door.

POWER MIRROR REPLACEMENT

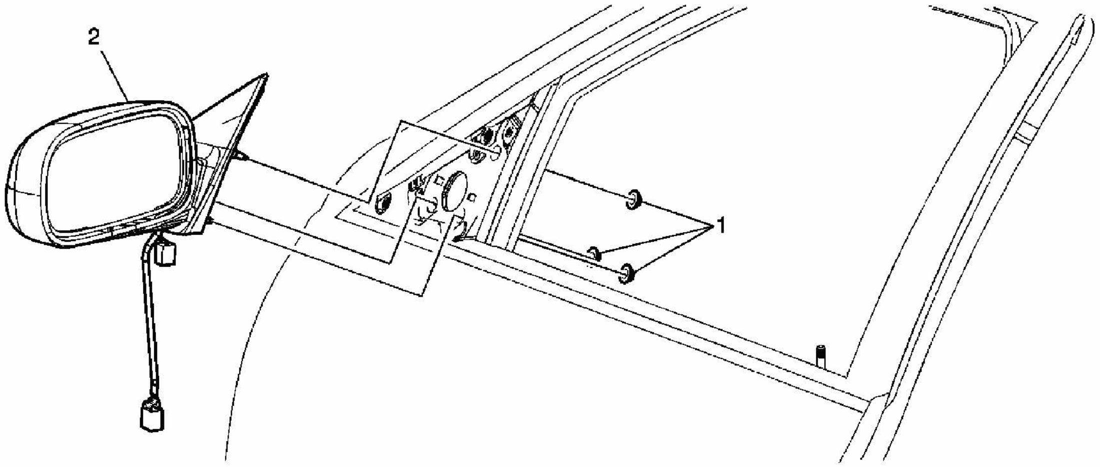


Fig. 192: Replacing Power Mirror
Courtesy of GENERAL MOTORS CORP.

Mirror Replacement - Power

Callout	Component Name
NOTE: Refer to Fastener Notice . **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedures:** Remove the interior trim panel. Refer to **Trim Panel Replacement - Side Front Door (Impala)**.	
1	Nut, Outside Rearview Mirror (Qty: 3) **Tip:** Disconnect the mirror electrical connector. **Tighten:** 10 N.m (89 lb in)

2	Mirror Assembly, Outside Rearview

POWER MIRROR MOTOR REPLACEMENT

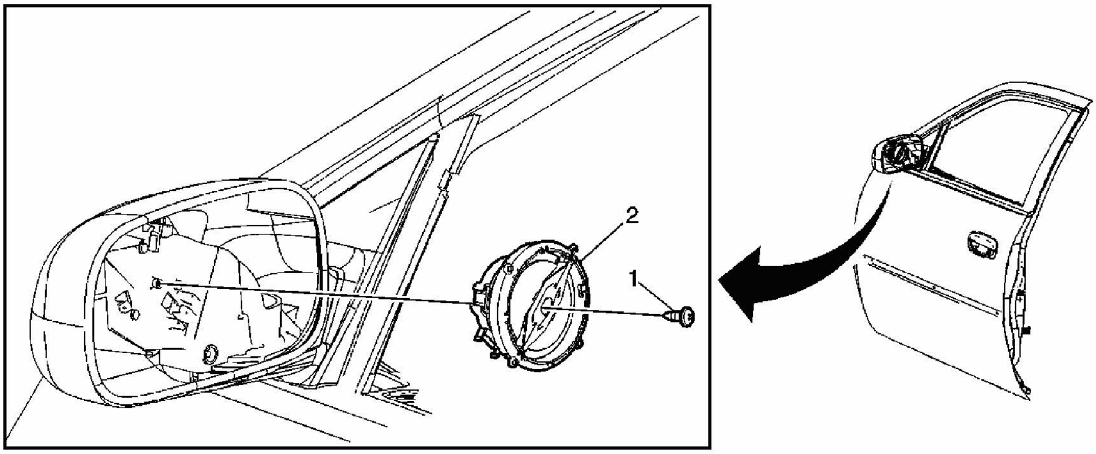


Fig. 193: Replacing Power Mirror Motor
Courtesy of GENERAL MOTORS CORP.

Motor Replacement - Power Mirror

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the door mirror face. Refer to **Mirror Face Replacement**.	
1	Screw, Front Door Mirror Motor **Tighten:** 2 N.m (18 lb in)
2	Motor, Front Door Mirror **Tip:** Disconnect the electrical connector from the mirror motor.

MIRROR FACE REPLACEMENT

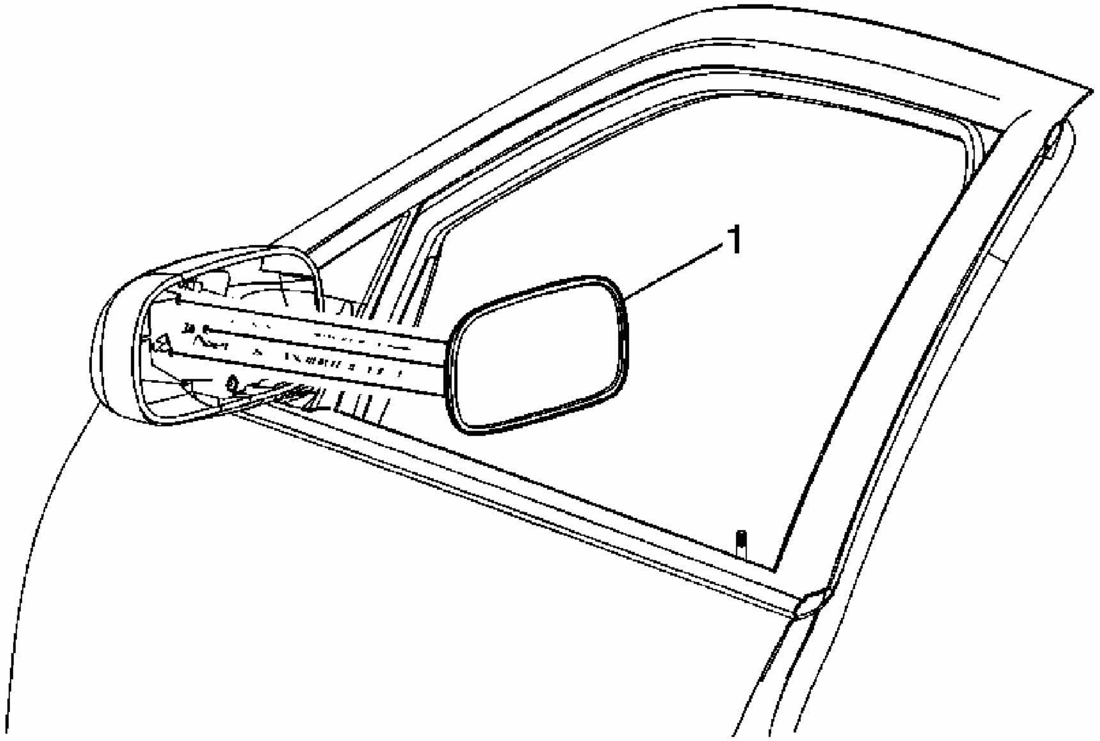


Fig. 194: Replacing Mirror Face
Courtesy of GENERAL MOTORS CORP.

Mirror Face Replacement

Callout	Component Name
CAUTION: **Refer to Glass and Sheet Metal Handling Caution .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Mirror Face, Outside Rearview **Tip:** 1. Release the mirror face backing from the mirror housing by pulling outward. 2. Disconnect electrical connectors from mirror, if equipped.

DESCRIPTION AND OPERATION

POWER WINDOWS DESCRIPTION AND OPERATION

Power Windows System Components

The Power Window System consists of the following components:

- Driver window switch.
- Front passenger window switch.
- Left rear (LR) window switch.
- Right rear (RR) window switch.
- Window regulator motors in each of the doors.
- RETAINED ACCSRY PWR Circuit Breaker 30-amp.

Power Windows System Controls

The Power Windows System can be controlled by a power window up or down switch activation

Driver Window Operation

When the ignition switch is in the RUN or ACCY position, or retained accessory power (RAP) is enabled and the driver window switch is pressed in the down position, battery positive voltage is applied to the window regulator motor causing the window to open. When the driver window switch is pressed in the up position, voltage is applied to the window regulator motor in the opposite direction and the window closes.

The driver window switch also controls the front passenger, left rear (LR), and right rear (RR) windows.

Express Down Feature

The driver window will travel to the fully down position when the driver window switch is pressed past the first detent. Pressing the driver window switch to the up position will cancel the express down feature.

Lockout Switch Feature

On Impala models, the driver window switch has a lockout switch which disconnects the battery positive voltage to the front passenger, left rear (LR) and right rear (RR) window switches, disabling them.

Individual Window Operation

When the ignition switch is in the RUN or ACCY position, or retained accessory power (RAP) is enabled and an individual window switch is pressed in the down position, battery positive voltage is applied to the window regulator motor causing that window to open. When the individual window switch is pressed in the up position, voltage is applied to the window regulator motor in the opposite direction causing that window to close.

POWER DOOR LOCKS DESCRIPTION AND OPERATION

Power Door Locks System Components

The power window system consists of the following components:

- Body control module (BCM).
- Driver door lock cylinder switch.
- Front passenger door lock cylinder switch.
- Driver door lock switch.
- Front passenger door lock switch.
- Door lock actuators in each of the doors.
- DR LK Fuse 20-amp.

Door Lock System Controls

The Power Door Lock System is controlled by the body control module (BCM) and can be activated by any one of the following:

- A door lock switch lock or unlock actuation.
- A door lock cylinder switch unlock actuation.
- A keyless entry transmitter actuation.
- An automatic door lock actuation (Personalization function).
- An automatic door unlock actuation (Personalization function).
- A last door closed locking (LDCL) actuation (Personalization function).

Door Lock Operation

When the body control module (BCM) detects a transition of either of the door lock switches to the lock position, it switches the door lock actuator lock control circuit to voltage. Since the lock actuator unlock control circuits are at ground potential within the BCM, the door lock actuator motors transition to the lock position.

Driver Door Unlock Operation

When the body control module (BCM) detects a transition of either of the door lock switches to the unlock position, it switches the driver door lock actuator unlock control circuit to voltage. Since the door lock actuator lock control circuit is at ground potential within the BCM, the left front (LF) door lock actuator motor transitions to the Unlock position.

The driver door lock actuator unlock control circuit is a dedicated control circuit used only for the driver door lock actuator motor. This is done so that the driver door may be unlocked by itself using a keyless entry transmitter or an automatic door unlock function (if programmed).

Passenger Door Unlock Operation

When the body control module (BCM) detects a transition of either of the door lock switches to the unlock position, it switches the door lock actuator unlock control circuits to voltage. Since the door lock actuator lock control circuit is at ground potential within the BCM, the passenger door lock actuator motors transition to the unlock position.

The door lock actuator unlock control circuits are dedicated control circuits used only for the passenger door lock actuator motors. This is done so that the driver door may be unlocked separate from the passenger doors using a keyless entry transmitter or an automatic door unlock function (if programmed).

Lockout Prevention

This function is intended to prevent the vehicle operator from locking the doors if the key is left in the ignition and any vehicle door is open. The body control module (BCM) will react after locking all the doors by unlocking the driver door. The lockout prevention function can be overridden by manually locking the door.

Key Cylinder Unlock

The body control module (BCM) will provide unlocking of all the doors when either the driver or front passenger key cylinder switch is actuated to the unlock position for longer than one second.

Automatic Door Lock/Unlock

The automatic door lock/unlock function is a Vehicle Personalization feature with the following four programmable modes of operation:

1. The automatic door lock feature is disabled.
2. All of the doors lock when the vehicle is shifted out of Park with the ignition ON.
3. All of the doors lock when the vehicle is shifted out of Park with the ignition ON, and only the driver door Unlocks when the vehicle is shifted into Park.
4. All of the doors lock when the vehicle is shifted out of Park with the ignition ON, and all of the doors Unlock when the vehicle is shifted into Park.

The automatic door lock function can only be enabled by the body control module (BCM) if the driver door open switch and door ajar switches are in the Closed state. For information on programming the automatic door locks, refer to **Vehicle Personalization** in Personalization.

Air Bag Deployment Unlock

The body control module (BCM) will provide unlocking of all the doors 15 seconds after determining the air bags have been deployed.

DOOR AJAR INDICATOR DESCRIPTION AND OPERATION

Door Ajar Indicator

The IPC illuminates the DOOR AJAR indicator in the message center when the body control module (BCM) detects that the driver or passenger door is open. The IPC receives a low speed GM LAN message from the BCM requesting illumination of the door ajar indicator.

OUTSIDE MIRROR DESCRIPTION AND OPERATION

Power Mirror System Components

The power mirror system consists of the following components:

- Outside rearview mirror switch.
- Mirror selector switch.
- Driver outside rearview mirror.
- Passenger outside rearview mirror.
- PWR MIR Fuse 2A.

Each of the outside rearview mirrors contains two motors. The vertical motor operates the mirror in the up and down directions, and the horizontal motor operates the mirror in the left and right directions. Each of the outside rearview mirror motors are circuit breaker protected.

Power Mirror System Controls

The outside rearview mirror switch is a four position directional switch (Up, Down, Left and Right).

The mirror select switch is a three position switch (L, Off and R).

The mirror direction switch is a four position switch that allows the operator to move the selected mirror up, down, left or right.

Power Mirror System Operation

The outside rearview mirror switch receives power through the battery positive voltage circuit from the PWR MIR 2A Fuse. The power mirror switch also receives a constant ground.

The four positions of the direction switch have dual switch contacts. Each of the contacts are connected to opposing sides of the appropriate power mirror motors through the selector switch. The selector switch completes these circuits depending on the position of the selector switch (L or R).

If the selector switch is placed in the L position and the up switch is depressed, battery positive voltage will be supplied to the left outside rearview mirror vertical motor through the left mirror motor down control circuit and ground through the left mirror motor left control circuit. If the down switch is depressed, battery positive voltage will be supplied to the left outside rearview mirror vertical motor through the left mirror motor left control circuit and ground through the left mirror motor down control circuit.

The remainder of the mirror functions operate in the same manner as described above. Placing the power mirror switch in opposing positions (left/right or up/down) will reverse the polarity to the mirror motor.

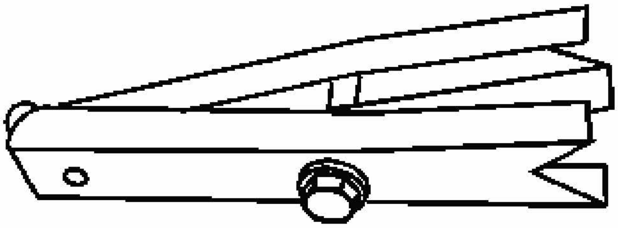
Heated Outside Rearview Mirrors

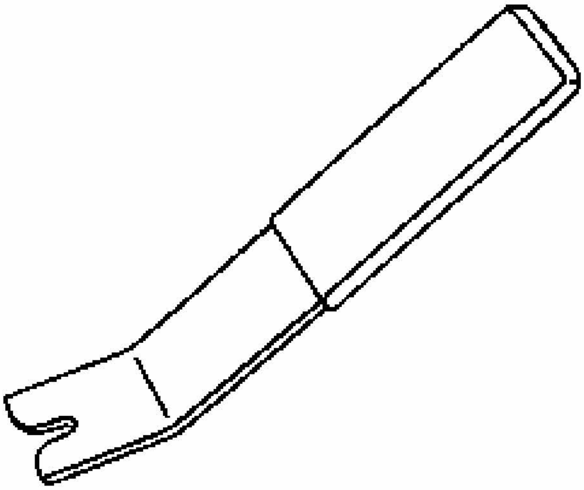
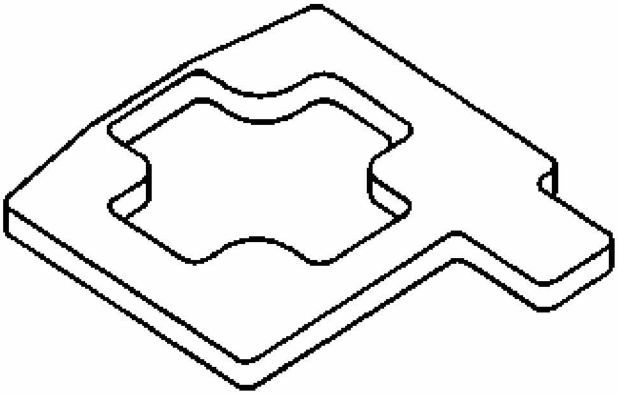
Battery positive voltage is supplied through the REAR DEFOG circuit breaker in the fuse block to the rear window defogger relay switch. With the ignition in the ON position, ignition 3 voltage is supplied through the HVAC fuse in the fuse block to the rear window defogger relay coil. When you depress the rear window defogger switch, the rear window defogger indicator illuminates and grounds the control circuit of the rear window defogger relay. This energizes the rear window defogger relay and allows battery positive voltage to the HTD MIR fuse (10A). The HTD MIR fuse provides battery positive voltage to the heated mirrors.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/Description
	J 36604 Door Hinge Spring Compressor

	J 38778 Door Trim Pad Clip Remover
	J 39346-A Mini-Wedge Door Striker Aligner

2006 GENERAL MOTORS

Impala & Monte Carlo

BUZZERS, RELAYS & TIMERS

BUZZERS, RELAYS & TIMERS LOCATION

Component	Location
A/C CMPRSR Relay	In underhood fuse block. See **Fig. 69** .
FAN 1 Relay	In underhood fuse block. See **Fig. 69** .
FAN 2 Relay	In underhood fuse block. See **Fig. 69** .
FAN 3 Relay	In underhood fuse block. See **Fig. 69** .
FUEL/PUMP Relay	In underhood fuse block. See **Fig. 69** .
PWR/TRN Relay	In underhood fuse block. See **Fig. 69** .
REAR DEFOG Relay	In underhood fuse block. See **Fig. 69** .
STRTR Relay	In underhood fuse block. See **Fig. 69** .

CIRCUIT PROTECTION DEVICES

CIRCUIT PROTECTION DEVICES LOCATION

Component	Location
Emergency Vehicle Rear Compartment Lid Lamps Relay	Right front of rear compartment. See **Fig. 86** .
Fusible Link (Except Police)	Near starter.
Fusible Links (Police)	At underhood battery stud. See **Fig. 63** .
I/P Fuse Block	In right front kick panel. See **Fig. 66** .
Rear Junction Block	In rear compartment, behind right rear wheelhouse. See **Fig. 39** .
SEO Fuse Block	Above accelerator pedal. See **Fig. 64** .
Terminator Resistor (W/ GPS)	In body harness, left side of rear compartment. See **Fig. 8** .
Terminator Resistor (W/O GPS)	In body harness, near connector C203. See **Fig. 11** .
Underhood Fuse Block	Mounted to right strut tower. See **Fig. 34** .

CONTROL UNITS

CONTROL UNITS LOCATION

Component	Location
Blower Motor Control Processor	Lower right side of dash. See **Fig. 41** .
Body Control Module (BCM)	Left of steering column. See **Fig. 9** .

Electronic Brake Control Module (EBCM)	Part of brake pressure modulator valve. See **Fig. 1** .
Engine Control Module (ECM)	Inside air cleaner assembly. See **Fig. 1** .
Headlamp Flasher Module	At left side of right headlamp assembly. See **Fig. 46** .
Heated Seat Control Module	Under driver seat. See **Fig. 56** .
HVAC Control Module	Center of dash. See **Fig. 41** .
Ignition Control Module (ICM)	Top rear center of engine. See **Fig. 20** .
Inflatable Restraint Front Passenger Presence System (PPS) Module	Under front passenger seat. See **Fig. 50** .
Inflatable Restraint I/P Module	Right side of instrument panel, above I/P compartment. See **Fig. 37** .
Inflatable Restraint Sensing & Diagnostic Module (SDM)	Under front passenger seat, under carpet. See **Fig. 51** .
Inflatable Restraint Side Impact Module - Left	On left side of driver seat back. See **Fig. 53** .
Inflatable Restraint Side Impact Module - Right	On right side of front passenger seat back. See **Fig. 53** .
Inflatable Restraint Steering Wheel Module	Center of steering wheel. See **Fig. 9** .
Radio Antenna Module	Left of back window. See **Fig. 38** .
Remote Control Door Lock Receiver (RCDLR)	Under defroster grill panel. See **Fig. 45** .
Roof Rail Module - Left	Mounted on left "C" pillar. See **Fig. 54** .
Roof Rail Module - Right	Mounted on right "C" pillar. See **Fig. 54** .
Theft Deterrent Exciter Module	Around ignition key cylinder housing. See **Fig. 59** .
Transmission Control Module (TCM)	Left side of engine compartment in with air cleaner. See **Fig. 5** .
Vehicle Communication Interface Module (VCIM)	Mounted to rear of left rear wheelhouse. See **Fig. 8** .

MOTORS

MOTORS LOCATION

Component	Location
Air Temperature Actuator	Behind center of I/P on HVAC case. See **Fig. 41** .
Air Temperature Actuator - Left	Right of accelerator pedal. See **Fig. 41** .
Air Temperature Actuator - Right	Behind center of dash, on HVAC case. See **Fig. 41** .

Blower Motor	Above foot area of passenger floor. See **Fig. 41** .
Cooling Fan - Left	Front of engine compartment, mounted to left side of radiator. See **Fig. 31** .
Cooling Fan - Right	Mounted to right side of radiator. See **Fig. 31** .
Door Lock Actuator - Driver	Rear of driver door. See **Fig. 13** .
Door Lock Actuator - Passenger	Rear of passenger door. See **Fig. 15** .
Fuel Pump	In fuel tank assembly. See **Fig. 30** .
Fuel Pump & Sender Assembly	Top of fuel tank. See **Fig. 25** .
Horizontal Motor	In seat back. See **Fig. 50** .
Ignition Lock Cylinder Control Actuator	In steering column. See **Fig. 59** .
Mode Actuator	On HVAC assembly. See **Fig. 41** .
Rear Compartment Lid Release Actuator	Center of deck lid. See **Fig. 6** .
Recirculation Actuator	On right side of HVAC case. See **Fig. 41** .
Seat Adjuster Motor Assembly - Driver	Below driver seat.
Seat Adjuster Motor Assembly - Passenger	Below front passenger seat.
Seat Recline Motor - Driver	Attached to right side of driver seat back. See **Fig. 56** .
Starter	Lower front of engine, at transaxle. See **Fig. 32** .
Sunroof Motor	Front center of sunroof module. See **Fig. 7** .
Vertical Motor (Front)	In seat back. See **Fig. 50** .
Vertical Motor (Rear)	In seat back. See **Fig. 50** .
Window Motor-Driver (Coupe)	Center of door. See **Fig. 13** .
Window Motor - Driver (Sedan)	Center of driver door. See **Fig. 12** .
Window Motor-Front Passenger (Coupe)	Center of front passenger door. See **Fig. 15** .
Window Motor - Front Passenger (Sedan)	Center of front passenger door. See **Fig. 14** .
Window Motor - LR	Center of left rear door. See **Fig. 16** .
Window Motor - RR	Center of right rear door. See **Fig. 17** .
Windshield Washer Fluid Pump	In lower portion of washer fluid container. See **Fig. 34** .
Windshield Wiper Motor	In left side cowl panel, below air inlet screen. See **Fig. 1** .

SENDING UNITS & SENSORS

SENDING UNITS & SENSORS LOCATION

Component	Location
Accelerator Pedal Position (APP) Sensor	Above accelerator pedal. See **Fig. 24** .
A/C Refrigerant Pressure Sensor	Under air cleaner. See **Fig. 1** .
Ambient Air Temperature Sensor	In front of radiator. See **Fig. 43** .
Ambient Light Sensor	Top center of dash. See **Fig. 37** .
Automatic Transmission Fluid Temperature (TFT) Sensor	Inside automatic transaxle.
Automatic Transmission Input Shaft Speed (A/T ISS) Sensor	Inside automatic transaxle. See **Fig. 4** .
Battery Current Sensor	On positive battery cable. See **Fig. 35** .
Brake Booster Vacuum Sensor	At brake booster. See **Fig. 42** .
Brake Pedal Position Sensor	Right side of brake pedal bracket. See **Fig. 24** .
Camshaft Position Actuator Solenoid (3.5L & 3.9L)	At end of camshaft, in timing cover.
Camshaft Position (CMP) Sensor (3.5L & 3.9L)	Center of engine block above timing cover. See **Fig. 22** .
Camshaft Position (CMP) Sensor (5.3L)	In timing cover, to left of water pump pulley. See **Fig. 27** .
Crankshaft Position (CKP) Sensor (3.5L & 3.9L)	Above transaxle.
Crankshaft Position (CKP) Sensor (5.3L)	At end of crankshaft, behind harmonic balancer. See **Fig. 29** .
Engine Coolant Temperature (ECT) Sensor (3.5L & 3.9L)	Left side of front cylinder head. See **Fig. 21** .
Engine Coolant Temperature (ECT) Sensor (5.3L)	Left front of engine at cylinder No. 1. See **Fig. 27** .
Engine Oil Pressure (EOP) Sensor (3.5L, 3.9L)	Right of starter. See **Fig. 19** .
Engine Oil Pressure (EOP) Sensor (5.3L)	Below throttle body. See **Fig. 28** .
Fuel Level Sensor	In fuel pump & sender assembly. See **Fig. 30** .
Fuel Tank Pressure (FTP) Sensor	Inside fuel tank, part of fuel pump/sender assembly. See **Fig. 30** .
Heated Oxygen Sensor (HO2S) 1	Rear of engine, mounted in exhaust manifold. See **Fig. 20** .
Heated Oxygen Sensor (HO2S) 1 (5.3L)	Rear of engine, mounted in exhaust manifold. See **Fig. 29** .
Heated Oxygen Sensor (HO2S) 2	In exhaust system, behind catalytic

	converter. See **Fig. 23** .
Inflatable Restraint Front End Sensor - Left	Front left of car, rear of front fascia, left of hood latch. See **Fig. 1** .
Inflatable Restraint Front End Sensor - Right	Front right of car, rear of front fascia, right of hood latch. See **Fig. 34** .
Inflatable Restraint Front Passenger Presence System (PPS) Sensor	In front passenger seat cushion. See **Fig. 50** .
Inflatable Restraint Side Impact Sensor (SIS) (Left)	In driver door. See **Fig. 12** .
Inflatable Restraint Side Impact Sensor (SIS) (Right)	In front passenger door. See **Fig. 14** .
Knock Sensor (KS) Bank 1 (3.5L & 3.9L)	Front of engine, above starter. See **Fig. 22** .
Knock Sensor (KS) Bank 1 (5.3L)	Lower left rear of engine block. See **Fig. 27** .
Knock Sensor (KS) Bank 2 (3.5L & 3.9L)	Rear of engine, below exhaust manifold. See **Fig. 19** .
Knock Sensor (KS) Bank 2 (5.3L)	Rear of engine, below exhaust manifold. See **Fig. 29** .
Manifold Absolute Pressure (MAP) Sensor (3.5L & 3.9L)	Behind throttle body. See **Fig. 20** .
Manifold Absolute Pressure (MAP) Sensor (5.3L)	On throttle body. See **Fig. 27** .
Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor	In air cleaner duct. See **Fig. 26** .
Seat Belt Tension Sensor - Passenger	Part of buckle assembly. See **Fig. 50** .
Tire Pressure Monitor Sensor - LF	Inside left front tire at valve stem. See **Fig. 60** .
Tire Pressure Monitor Sensor - LR	Inside left rear tire at valve stem. See **Fig. 60** .
Tire Pressure Monitor Sensor - RF	Inside right front tire at valve stem. See **Fig. 60** .
Tire Pressure Monitor Sensor - RR	Inside right rear tire at valve stem. See **Fig. 60** .
Transmission Fluid Temperature (TFT) Sensor	On transmission assembly. See **Fig. 4** .
Vehicle Speed Sensor (VSS)	Right side of transaxle, near right axle shaft. See **Fig. 4** .
Wheel Speed Sensor (WSS) - LF	Inside left front wheel hub.
Wheel Speed Sensor (WSS) - LR	Inside left rear wheel hub.
Wheel Speed Sensor (WSS) - RF	Inside right front wheel hub. See **Fig. 3** .

Wheel Speed Sensor (WSS) - RR	Inside right rear wheel hub. See **Fig. 2** .

SOLENOIDS & SOLENOID VALVES

SOLENOIDS & SOLENOID VALVES LOCATION

Component	Location
A/C Compressor Clutch	Part of A/C compressor, on lower right front of engine. See **Fig. 40** .
A/T Shift Lock Control Solenoid (W/ Floor Shifter)	Under center console. See **Fig. 58** .
A/T Shift Lock Control Solenoid (W/O Floor Shifter)	Attached to right side of steering column. See **Fig. 57** .
Camshaft Position Actuator Solenoid	Top front of engine. See **Fig. 20** .
Evaporative Emission (EVAP) Canister Purge Solenoid Valve (3.5L & 3.9L)	Left front of engine, in front of throttle body. See **Fig. 18** .
Evaporative Emission (EVAP) Canister Purge Solenoid Valve (5.3L)	On intake manifold, near fuel injectors. See **Fig. 28** .
Evaporative Emission (EVAP) Canister Vent Solenoid	Behind left rear wheelhouse. See **Fig. 25** .
Fuel Injector 1 (3.5L & 3.9L)	Top of engine, at number 1 cylinder intake port. See **Fig. 21** .
Fuel Injector 1 (5.3L)	Top of engine, at number 1 cylinder intake port. See **Fig. 21** .
Fuel Injector 2 (3.5L & 3.9L)	Top of engine, at number 2 cylinder intake port. See **Fig. 21** .
Fuel Injector 2 (5.3L)	Top of engine, at number 2 cylinder intake port. See **Fig. 28** .
Fuel Injector 3 (3.5L & 3.9L)	Top of engine, at number 3 cylinder intake port. See **Fig. 21** .
Fuel Injector 3 (5.3L)	Top of engine, at number 3 cylinder intake port. See **Fig. 28** .
Fuel Injector 4 (3.5L & 3.9L)	Top of engine, at number 4 cylinder intake port. See **Fig. 21** .
Fuel Injector 4 (5.3L)	Top of engine, at number 4 cylinder intake port. See **Fig. 28** .
Fuel Injector 5 (3.5L & 3.9L)	Top of engine, at number 5 cylinder intake port. See **Fig. 21** .
Fuel Injector 5 (5.3L)	Top of engine, at number 5 cylinder intake port. See **Fig. 28** .
Fuel Injector 6 (3.5L & 3.9L)	Top of engine, at number 6 cylinder intake port. See **Fig. 21** .

Fuel Injector 6 (5.3L)	Top of engine, at number 6 cylinder intake port. See **Fig. 28** .
Fuel Injector 7 (5.3L)	Top of engine, at number 7 cylinder intake port. See **Fig. 28** .
Fuel Injector 8 (5.3L)	Top of engine, at number 8 cylinder intake port. See **Fig. 28** .
Intake Manifold Tuning (IMT) Valve Solenoid	Right side of engine in intake manifold. See **Fig. 20** .
Pressure Control (PC) Solenoid Valve	Inside automatic transaxle. See **Fig. 4** .
Starter Solenoid	Left rear of engine. See **Fig. 33** .
Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Valve Assembly	Inside automatic transaxle. See **Fig. 4** .
1-2, 3-4 Shift Solenoid (1-2) (SS) Valve	Inside automatic transaxle. See **Fig. 4** .
2-3 Shift Solenoid (2-3) (SS) Valve	Inside automatic transaxle. See **Fig. 4** .

SWITCHES

SWITCHES LOCATION

Component	Location
A/C Pressure Switch	On A/C line, lower left front of engine compartment. See **Fig. 1** .
Automatic Transmission Fluid Pressure (TFP) Manual Valve Position Switch	Inside automatic transaxle.
Brake Fluid Level Switch	Mounted under center of brake fluid reservoir. See **Fig. 42** .
Engine Oil Level Switch (3.5L & 3.9L)	Front lower center of engine oil pan. See **Fig. 22** .
Engine Oil Level Switch (5.3L)	Bottom of oil pan. See **Fig. 29** .
Hood Ajar Switch	Part of hood latch. See **Fig. 43** .
Park Brake Switch	Part of park brake assembly. See **Fig. 24** .
Rear Compartment Lid Ajar Switch	On deck lid. See **Fig. 6** .
Seat Belt Switch - Driver	Inside driver seat belt buckle. See **Fig. 55** .
Seat Belt Switch - Passenger	Inside front passenger seat belt buckle. See **Fig. 50** .
Transmission Fluid Pressure (TFT) Manual Valve Position Switch Assembly	On transmission assembly. See **Fig. 4** .
Transmission Internal Mode Switch (IMS)	Inside automatic transaxle.
Turn Signal/Multifunction Switch	Inside steering column, below inflatable restraint steering wheel module coil. See **Fig. 37** .

Windshield Washer Fluid Level Switch	In lower portion of washer fluid container. See **Fig. 34** .

MISCELLANEOUS

MISCELLANEOUS LOCATION

Component	Location
A/C Compressor Clutch Diode	In wiring harness, 10 cm from A/C compressor clutch.
Audio Amplifier	Center of rear compartment. See **Fig. 47** .
Cellular Navigation & Digital Radio Antenna	Top rear center of roof. See **Fig. 7** .
Data Link Connector (DLC)	Left of steering column. See **Fig. 10** .
Digital Radio Receiver	Mounted to rear of right rear wheelwell. See **Fig. 39** .
Door Lock - Driver (Sedan)	Rear of driver door.
Door Lock - Front Passenger (Sedan)	Rear of passenger door.
Door Lock - LR (Sedan)	Rear of left rear door.
Door Lock - RR (Sedan)	Rear of right rear door.
Generator	Top right rear side of engine. See **Fig. 34** .
Heated Seat Element - Driver (Seat Back)	Under upholstery of driver seat back. See **Fig. 56** .
Heated Seat Element - Driver (Seat Bottom)	Under upholstery of driver seat bottom. See **Fig. 56** .
Heated Seat Element - Passenger (Seat Back)	Under upholstery of passenger seat back.
Heated Seat Element - Passenger (Seat Bottom)	Under upholstery of passenger seat bottom. See **Fig. 50** .
Horn Assembly	Below right headlamp. See **Fig. 34** .
Ignition Coil 1 (3.5L & 3.9L)	Top of engine, at number 1 cylinder. See **Fig. 27** .
Ignition Coil 1 (5.3L)	Top of engine, at number 1 cylinder. See **Fig. 28** .
Ignition Coil 2 (3.5L & 3.9L)	Top of engine, at number 2 cylinder. See **Fig. 27** .
Ignition Coil 2 (5.3L)	Top of engine, at number 2 cylinder. See **Fig. 28** .
Ignition Coil 3 (3.5L & 3.9L)	Top of engine, at number 3 cylinder. See **Fig. 27** .
Ignition Coil 3 (5.3L)	Top of engine, at number 3 cylinder. See **Fig. 28** .

Ignition Coil 4 (3.5L & 3.9L)	Top of engine, at number 4 cylinder. See **Fig. 27** .
Ignition Coil 4 (5.3L)	Top of engine, at number 4 cylinder. See **Fig. 28** .
Ignition Coil 5 (3.5L & 3.9L)	Top of engine, at number 5 cylinder. See **Fig. 27** .
Ignition Coil 5 (5.3L)	Top of engine, at number 5 cylinder. See **Fig. 28** .
Ignition Coil 6 (3.5L & 3.9L)	Top of engine, at number 6 cylinder. See **Fig. 27** .
Ignition Coil 6 (5.3L)	Top of engine, at number 6 cylinder. See **Fig. 28** .
Ignition Coil 7 (5.3L)	Top of engine, at number 7 cylinder. See **Fig. 28** .
Ignition Coil 8 (5.3L)	Top of engine, at number 8 cylinder. See **Fig. 28** .
Inflatable Restraint Steering Wheel Module Coil	In steering column behind steering wheel.
Radio	Center of dash. See **Fig. 36** .
Remote Control Door Lock Receiver Windshield Antenna	Left "A" pillar. See **Fig. 44** .
Seat Belt Pretensioner - Left	At base of "B" pillar. See **Fig. 49** .
Seat Belt Pretensioner - Right	At base of "B" pillar. See **Fig. 52** .
Valve Lifter Oil Manifold Assembly	Under throttle actuator control (TAC) module.

CONNECTORS

CONNECTORS LOCATION

Component	Location
C100 (20 Pin)	In engine wiring harness to automatic transaxle wiring harness, on top of transmission. See **Fig. 33** .
C101 (Black, 10 Pin)	In I/P wiring harness to engine wiring harness, bolted to left strut tower next to C111. See **Fig. 62** .
C102 (Black, 16 Pin)	In engine wiring harness to fuel injector wiring harness, top right side of engine. See **Fig. 75** .
C105 (Black, 2 Pin)	In I/P wiring harness to battery cable harness, forward of right front strut tower.

	See **Fig. 71** .
C107 (Blue/Gray, 8 Pin)	In engine wiring harness to ignition control module wiring harness, on top of engine between fuel injectors 3 / 5. See **Fig. 73** .
C108 (Blue/Gray, 8 Pin)	In engine wiring harness to ignition control module wiring harness, on top of engine between fuel injectors 4 & 6. See **Fig. 62** .
C111 (Black, 14 Pin)	In I/P wiring harness to engine wiring harness, bolted to left strut tower next to C101. See **Fig. 62** .
C116 (Black, 5 Pin)	In engine wiring harness to crank sensor jumper harness, on transmission. See **Fig. 73** .
C120 (Black, 10 Pin)	In I/P wiring harness to forward lamp wiring harness, behind left headlamp assembly on frame. See **Fig. 70** .
C122 (Black, 6 Pin)	In forward lamp wiring harness to forward lamp wiring harness, at left side of right headlamp assembly. See **Fig. 70** .
C123 (Black, 4 Pin)	In I/P wiring harness to grill lamp jumper harness, forward of RF strut tower. See **Fig. 63** .
C141 (Black, 5 Pin)	In forward lamp wiring harness to left headlamp harness, behind left headlamp assembly. See **Fig. 70** .
C142 (Black, 5 Pin)	In forward lamp wiring harness to right headlamp harness, behind right headlamp assembly. See **Fig. 70** .
C200 (Blue/Gray, 40 Pin)	In body wiring harness to I/P wiring harness, below I/P fuse panel. See **Fig. 10** .
C201 (Black, 10 Pin)	In steering column harness to I/P wiring harness, behind knee bolster to right of steering column. See **Fig. 10** .
C203 (Blue/Gray, 22 Pin)	In body wiring harness to I/P wiring harness, near C250. See **Fig. 11** .
C208 (Black, 2 Pin)	In SEO auxiliary wiring harness to body harness, at right front footwell.
C210 (Black, 2 Pin)	In I/P wiring harness to HVAC harness, on right side of HVAC module assembly. See **Fig. 10** .
C223 (Black, 2 Pin)	In body wiring harness, near G301.

C250 (Yellow, 4 Pin)	In inflatable restraint steering wheel module coil wiring harness to body wiring harness, near C203,. See **Fig. 11** .
C266A (Black, 1 Pin)	In I/P wiring harness to C266B, above right front footwell. See **Fig. 10** .
C266B (Black, 1 Pin)	In I/P wiring harness to C266A, above right front footwell. See **Fig. 10** .
C267A (Blue, 8 Pin)	In I/P wiring harness to C267B, above right front footwell. See **Fig. 10** .
C267B (Blue, 8 Pin)	In I/P wiring harness to C267A, above right front footwell. See **Fig. 10** .
C275 (Black, 8 Pin)	In Inflatable restraint steering wheel module coil wiring harness to steering column wiring harness, taped to steering column harness.
C277 (Black, 8 Pin)	In inflatable restraint steering wheel module coil wiring harness to steering wheel wiring harness, behind inflatable restraint steering wheel module. See **Fig. 76** .
C278 (Yellow, 4 Pin)	In inflatable restraint I/P module jumper harness to body harness, behind right I/P access panel.
C297 (Blue/Gray, 6 Pin)	In I/P wiring harness to emergency vehicle front lamps flasher harness, above right front footwell. See **Fig. 10** .
C301 (Gray, 40 Pin)	In body wiring harness to left front door wiring harness, between door hinges. See **Fig. 77** .
C302 (Gray, 40 Pin)	In body wiring harness to right front door wiring harness, between door hinges. See **Fig. 77** .
C303 (1 Pin)	In I/P wiring harness to body wiring harness COAX connector, next to G302. See **Fig. 66** .
C311 (Black, 12 Pin)	In body wiring harness to driver seat wiring harness, below driver seat. See **Fig. 77** .
C312 (Yellow, 2 Pin)	In left inflatable restraint side impact module jumper harness to body harness, below drivers seat. See **Fig. 53** .
	In body wiring harness to front passenger

C313 (Black, 12 Pin)	seat wiring harness, below front passenger seat. See **Fig. 77** .
C314 (Yellow, 2 Pin)	In right inflatable restraint side impact module jumper harness to body harness, below passenger seat. See **Fig. 53** .
C322 (Black, 2 Pin)	In body wiring harness to roof wiring provisions harness, near right "C" pillar. See **Fig. 80** .
C340 (Coupe) (Black, 2 Pin)	In body wiring harness to floor console wiring harness, below center floor console.
C340 (Sedan) (Black, 2 Pin)	In body wiring harness to auxiliary power outlet seat jumper harness, under center of front seat. See **Fig. 77** .
C355 (Black/Gray, 9 Pin)	In body wiring harness to left rear door wiring harness, center of left rear door jamb. See **Fig. 84** .
C356 (Black/Gray, 9 Pin)	In body wiring harness to right rear door wiring harness, center of right rear door jamb. See **Fig. 85** .
C360 (Black, 1 Pin)	In body harness to I/P harness, near C200. See **Fig. 10** .
C362 (Black, 1 Pin)	In body harness to I/P harness, near C200. See **Fig. 10** .
C398 (Black, 6 Pin)	In sunroof wiring harness to roof wiring harness, above sunshade. See **Fig. 67** .
C401 (Gray, 4 Pin)	In rear body harness to left tail lamp harness, near left tail lamp assembly. See **Fig. 88** .
C402 (Gray, 4 Pin)	In rear body harness to right tail lamp harness, near right tail lamp assembly. See **Fig. 88** .
C405 (Gray, 12 Pin)	In rear chassis harness to body harness, forward of right of spare tire well. See **Fig. 81** .
C406 (Black, 8 Pin)	In body harness to rear body harness, clipped on bumper fascia. See **Fig. 81** .
C409 (Black, 2 Pin)	In emergency vehicle rear compartment lid lamps wiring harness to body wiring harness, between center high mounted stop lamp (CHMSL) & rear junction block. See **Fig. 48** .
	In left roof rail module left jumper harness

C412 (Yellow, 2 Pin)	to body harness, behind left "C" pillar trim. See **Fig. 79** .
C414 (Yellow, 2 Pin)	In right roof rail module jumper harness to body harness, behind right "C" pillar trim. See **Fig. 79** .
C430 (Coupe) (Black, 4 Pin)	In rear compartment lid harness to body harness, above right rear wheelhouse. See **Fig. 87** .
C490 (Coupe) (Gray, 18 Pin)	In body wiring harness to roof wiring harness, behind left "C" pillar trim. See **Fig. 67** .
C490 (Sedan) (Black, 18 Pin)	In body wiring harness to roof wiring harness, under left side of rear package shelf trim panel. See **Fig. 81** .
C503 (Sedan) (Gray, 40 Pin)	In driver door wiring harness to driver door trim wiring harness, near left front door speaker. See **Fig. 82** .
C604 (Sedan) (Black, 10 Pin)	In front passenger door trim wiring harness to front passenger door harness, near right front door speaker. See **Fig. 83** .

GROUNDS

GROUNDS LOCATION

Component	Location
G100	Behind right headlamp, on frame. See **Fig. 70** .
G101	Behind left headlamp, on frame. See **Fig. 70** .
G102	Near battery. See **Fig. 34** .
G111 (3.5L & 3.9L)	On transmission to engine bolt, above starter. See **Fig. 61** .
G111 (5.3L)	On transmission to engine bolt, below starter. See **Fig. 62** .
G113	On front of automatic transaxle, left of G111. See **Fig. 62** .
G115 (3.5L & 3.9L)	On transmission case, below brake booster. See **Fig. 75** .
G115 (5.3L)	Lower front of engine, under cylinder #5 exhaust port. See **Fig. 62** .
G200	Front of dash, left of G204. See **Fig. 10** .

G201	Front of dash, above G202. See **Fig. 10** .
G202	On right side of steering column below C201. See **Fig. 10** .
G204	Right side of dash, next to G200. See **Fig. 10** .
G301	Below driver door opening, rear of left A-pillar. See **Fig. 65** .
G302	Below passenger front door opening, rear of right A-pillar. See **Fig. 66** .
G403 (Coupe)	In rear compartment, near left "C" pillar. See **Fig. 67** .
G403 (Sedan)	On left side of package shelf, near "C pillar. See **Fig. 78** .
G404 (Coupe)	On right "C" pillar, near connector C430. See **Fig. 68** .
G404 (Sedan)	On right side of package shelf, near "C" pillar. See **Fig. 78** .

SPLICES

SPLICES LOCATION

Component	**Location**
Splice Pack SP205	Clipped to inner I/P structure, to right of steering column. See **Fig. 10** .
Splice Pack SP206	On I/P harness, near steering column.
Splice Pack SP207	On I/P harness, near steering column.
S101 (3.5L & 3.9L)	In engine wiring harness, approximately 7 cm (2.75 in) from breakout to G113.
S101 (5.3L)	In engine wiring harness, approximately 5 cm (2 in) from breakout to G112. See **Fig. 62** .
S105	In engine wiring harness, approximately 5.5 cm (2.25 in) from breakout to starter. See **Fig. 75** .
S105 (3.5L & 3.9L)	In engine wiring harness, approximately 5 cm (2.0 in) from breakout towards starter. See **Fig. 74** .
S106	On ignition control module wiring harness.
S107	On ignition control module wiring harness.
S108	In engine wiring harness, approximately 5 cm (2 in) from breakout to fuel injector 3.

	See **Fig. 73** .
S109 (3.5L & 3.9L)	On fuel injector wiring harness.
S109 (5.3L)	In engine wiring harness, approximately 5 cm (2 in) from breakout to fuel injector 4. See **Fig. 72** .
S115	In automatic transaxle wiring harness, approximately 9.5 cm (3.8 in) from connector C100.
S124	On forward lamp wiring harness, approximately 8 cm (3.2 in) from breakout to G100. See **Fig. 70** .
S126	On right head lamp assembly wiring harness.
S127	On left head lamp assembly wiring harness.
S128	On right headlamp harness.
S129	On left headlamp harness.
S130	On ignition control module wiring harness.
S131	On ignition control module wiring harness.
S132	On ignition control module wiring harness.
S133	On ignition control module wiring harness.
S203 (Except Police)	On I/P wiring harness, approximately 11.5 cm (4.5 in) from second breakout to brake pedal position sensor. See **Fig. 64** .
S203 (Police)	On I/P wiring harness, approximately 30.5 cm (12.5 in) from third breakout to brake pedal position sensor. See **Fig. 64** .
S204	On steering column harness, between BCM connector C1 & ignition switch.
S212	On steering wheel harness.
S213	On steering wheel harness, behind inflatable restraint steering wheel module.
S214	On steering column harness, between C201 & turn signal/multifunction switch.
S215	In steering wheel harness, behind inflatable restraint steering wheel module.
S218	On I/P wiring harness approximately 20 cm (8 in) from breakout to remote control door lock receiver. See **Fig. 64** .
S228 (Except Police)	On I/P wiring harness approximately 7.5 cm (3 in) from breakout to brake pedal

	position sensor.
S228 (Police)	On I/P wiring harness, approximately 12.5 cm (5 in) from brake pedal position sensor towards C201.
S231 (Sedan)	On floor console wiring harness, approximately 12 cm (4.75 in) from breakout to auxiliary power outlet.
S238 (Sedan)	On floor console wiring harness, approximately 5 cm (2 in) from breakout to C340.
S239	On I/P wiring harness, approximately 5 cm (2 in) from second breakout to brake pedal position sensor. See **Fig. 64** .
S250	In I/P wiring harness, approximately 15.5 cm (6.25 in) from 3rd breakout to brake pedal position sensor. See **Fig. 64** .
S259 (Coupe)	On I/P wiring harness, approximately 5 cm (2 in) from breakout to data link connector (DLC). See **Fig. 64** .
S259 (Sedan)	On I/P wiring harness approximately 4 cm (1.5 in) from breakout to remote control door lock receiver (RCDLR) towards data link connector (DLC). See **Fig. 64** .
S269	On I/P wiring harness, approximately 6.5 cm (2.5 in) from breakout to data link connector. See **Fig. 64** .
S282	In I/P wiring harness, approximately 37.5 cm (15 in) from 3rd breakout to brake pedal position sensor. See **Fig. 64** .
S303 (Coupe)	In body wiring harness, approximately 8.5 cm (3.5 in) from second breakout to C311.
S303 (Sedan)	In body wiring harness, approximately 8.5 cm (3.5 in) from breakout to C311. See **Fig. 77** .
S307 (Sedan)	In body harness, approximately 16.5 cm (6.5 in) from breakout to C301. See **Fig. 77** .
S308 (Coupe)	In Body wiring harness, approximately 24 cm (9.5 in) from second breakout to C311.
S308 (Sedan)	In body wiring harness, approximately 14 cm (5.5 in) from breakout to G301. See **Fig. 77** .

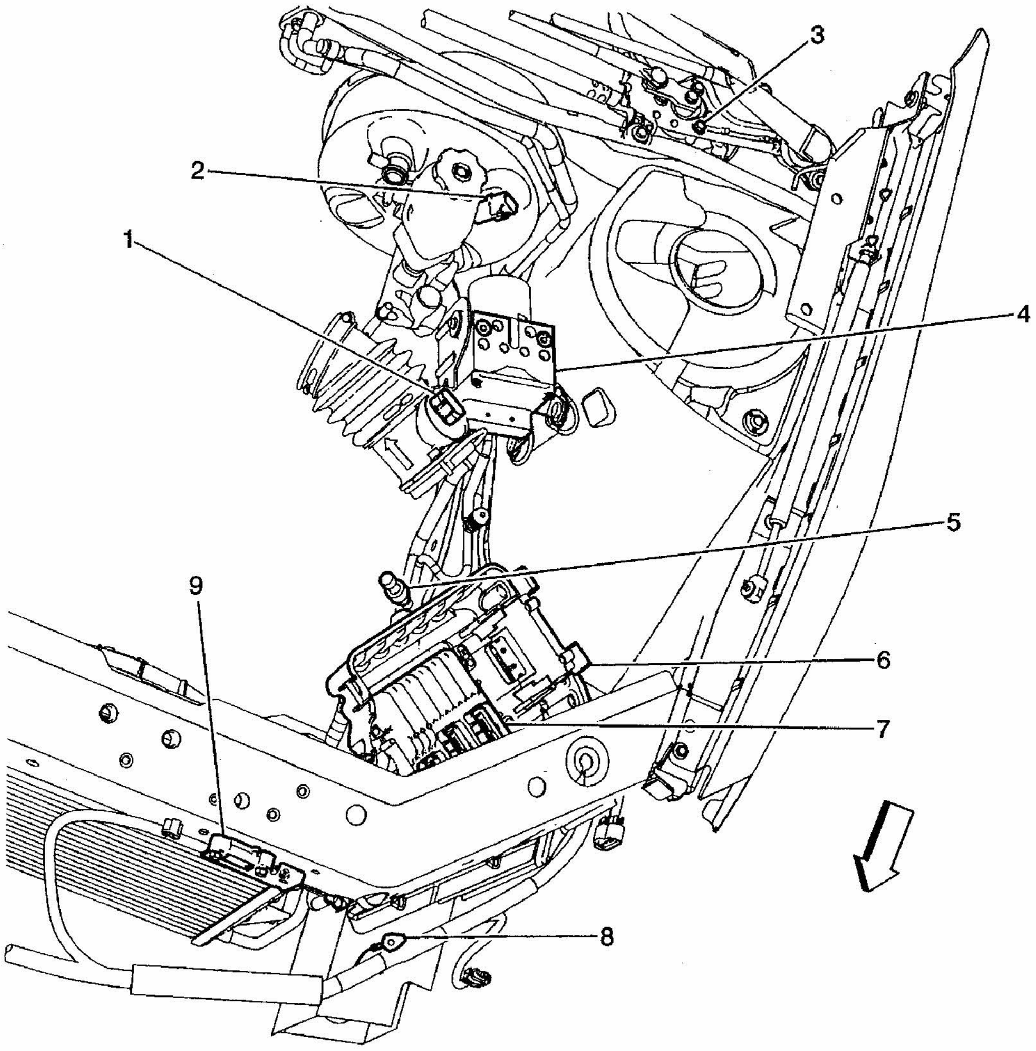
S311 (Coupe)	In body wiring harness, approximately 7 cm (2.75 in) from second breakout to C302.
S311 (Sedan)	In body wiring harness, approximately 10 cm (4 in) from second breakout to C302.
S314 (Sedan)	On body wiring harness, approximately 16 cm (6.5 in) from breakout to C313. See **Fig. 77** .
S315 (Sedan)	On body wiring harness, approximately 5 cm (2 in) from breakout to C313. See **Fig. 77** .
S324 (Coupe)	On body harness, approximately 7 cm (2.75 in) from breakout to C405. See **Fig. 81** .
S324 (Sedan)	On body harness, approximately 24 cm (9.5 in) from breakout to C405. See **Fig. 81** .
S332 (Sedan)	On body harness, approximately 12 cm (4.75 in) from breakout to left seat belt pretensioner. See **Fig. 77** .
S350 (Coupe)	On body harness, approximately 18 cm (7.2 in) from second breakout to C311.
S350 (Sedan)	On body harness, approximately 14.5 cm (5.75 in) from breakout to G302. See **Fig. 77** .
S359 (Sedan)	On body harness, approximately 24 cm (9.5 in) from breakout to C311. See **Fig. 77** .
S364 (Coupe)	On roof harness, approximately 16.5 cm (6.5 in) from second breakout to C398. See **Fig. 67** .
S364 (Sedan)	On roof harness, approximately 10 cm (4 in) from breakout to C398.
S375 (Sedan)	On body harness, approximately 15 cm (6 in) from breakout to inflatable restraint sensing & diagnostic module. See **Fig. 77** .
S376 (Sedan)	On body harness, approximately 22 cm (8.75 in) from breakout to center high mounted stop lamp.
S390 (Coupe)	On roof wiring harness, approximately 34 cm (13.5 in) from breakout to dome lamp. See **Fig. 67** .

S390 (Sedan)	On roof wiring harness, approximately 53 cm (21 in) from breakout to dome lamp.
S393 (Coupe)	On roof wiring harness, approximately 19 cm (7.5 in) from breakout to dome lamp. See **Fig. 67** .
S393 (Sedan)	On roof wiring harness, approximately 38 cm (15.25 in) from breakout to dome lamp.
S394	On body harness, approximately 15 cm (6 in) from breakout to inflatable restraint sensing & diagnostic module.
S417	On body harness, approximately 32 cm (12.75 in) from breakout to left seat belt pretensioner.
S430 (Coupe)	On rear body harness, approximately 10 cm (4 in) from breakout to right backup lamp. See **Fig. 89** .
S430 (Sedan)	On rear body harness, approximately 14 cm (5.5 in) from breakout to right license lamp.
S431	On right tail lamp harness.
S470	On left tail lamp harness.
S474 (Except Police)	On body harness, approximately 17 cm (6.5 in) from breakout to C430.
S474 (Police)	On body harness, approximately 45.5 cm (18 in) from breakout to C409.
S485 (Coupe)	On rear body harness, approximately 10 cm (4 in) from breakout to license lamp. See **Fig. 89** .
S485 (Sedan)	On rear body harness, approximately 24 cm (9.5 in) from breakout to license lamp.
S487	On left tail lamp harness.
S488	On right tail lamp harness.
S504 (Sedan)	On driver door trim wiring harness, approximately 4.5 cm (1.75 in) from breakout to window switch. See **Fig. 82** .
S505 (Coupe)	On driver door wiring harness, approximately 20 cm (8 in) from breakout to driver's door lock switch.
S505 (Sedan)	On driver door wiring harness, approximately 18.5 cm (7.25 in) from

	breakout to left front door speaker. See **Fig. 82** .
S506 (Coupe)	On driver door wiring harness, approximately 3.5 cm (1.5 in) from breakout to driver's outside rearview mirror.
S506 (Sedan)	On driver door trim wiring harness, approximately 11 cm (4.25 in) from breakout to driver's window switch. See **Fig. 82** .
S604 (Coupe)	On front passenger door wiring harness, approximately 20 cm (8 in) from breakout to passenger's door lock switch.
S604 (Sedan)	On front passenger door wiring harness, approximately 6 cm (2.5 in) from breakout to right front speaker. See **Fig. 83** .
S608 (Coupe)	On front passenger door wiring harness, approximately 3.5 cm (1.5 in) from breakout to passengers outside rearview mirror. See **Fig. 83** .
S608 (Sedan)	On front passenger door trim wiring harness, approximately 6.5 cm (2.5 in) from front window switch.
S901 (Coupe)	On rear compartment lid wiring harness, approximately 11 cm (4.25 in) from breakout to center high mounted stop lamp. See **Fig. 87** .
S902	In rear body harness, at decklid. See **Fig. 87** .

COMPONENT LOCATION GRAPHICS

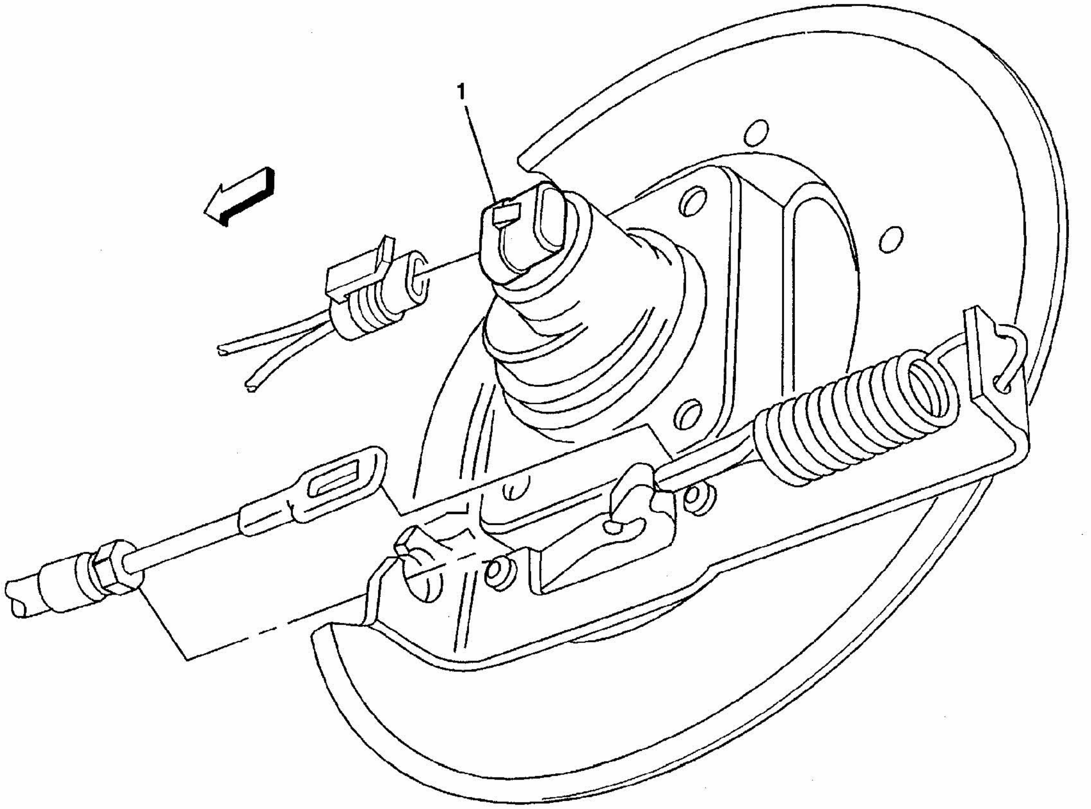
NOTE: **Figures may show multiple component locations. Refer to appropriate table for proper figure references.**



(1) Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor
(2) Brake Booster Vacuum Sensor (LS4)
(3) Windshield Wiper Motor
(4) Electronic Brake Control Module (EBCM)
(5) A/C Refrigerant Pressure Sensor
(6) Transmission Control Module (TCM)
(7) Engine Control Module (ECM)
(8) G101
(9) Inflatable Restraint Front End Sensor - Left

G00421639

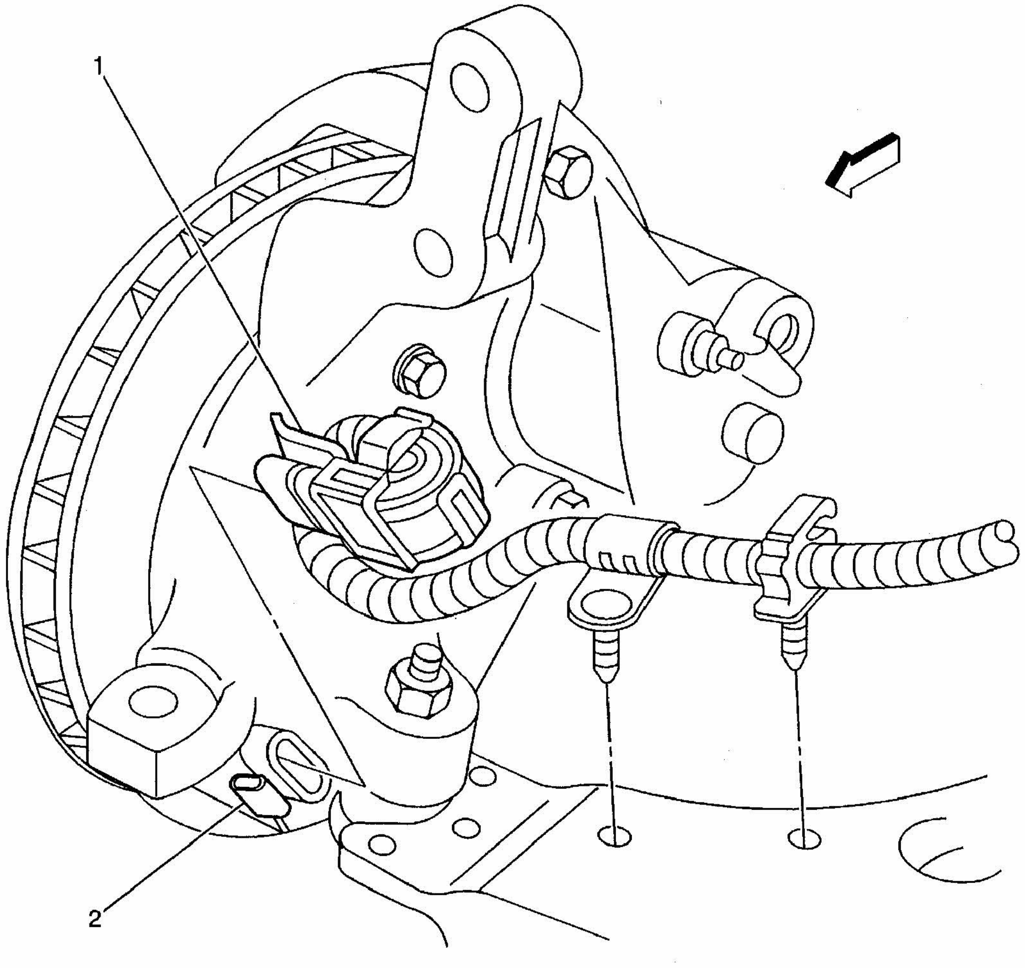
Fig. 1: Left Front Of Engine Compartment
Courtesy of GENERAL MOTORS CORP.



(1) Wheel Speed Sensor (WSS) - RR (Wheel Speed Sensor (WSS) - LR Similar)

G00421640

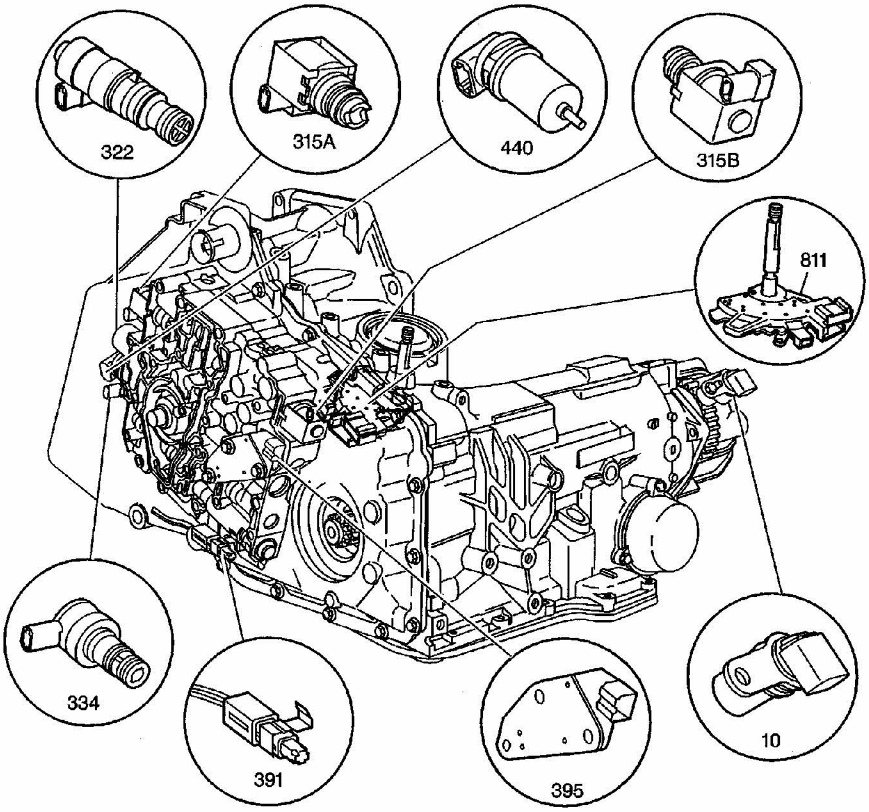
Fig. 2: Right Rear Hub Assembly
Courtesy of GENERAL MOTORS CORP.



(1) Wheel Speed Sensor (WSS) - RF (Wheel Speed Sensor (WSS) - LF Similar)

G00421641

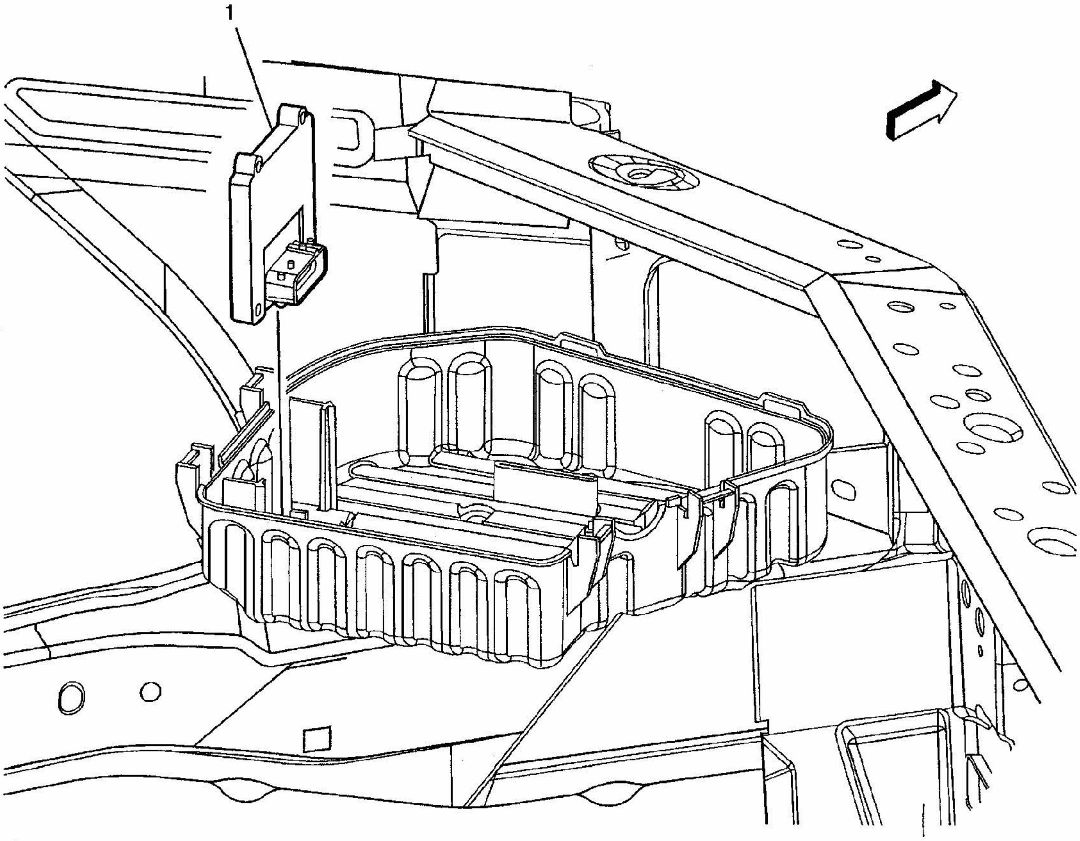
Fig. 3: Right Front Hub Assembly
Courtesy of GENERAL MOTORS CORP.



(10) Vehicle Speed Sensor (VSS) Assembly
(315a) 1-2, 3-4 Shift Solenoid (SS) Valve Assembly
(315b) 2-3 Shift Solenoid (SS) Valve Assembly
(322) Pressure Control (PC) Solenoid Valve Assembly
(334) Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Valve Assembly
(391) Transmission Fluid Temperature (TFT) Sensor
(395) Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly
(440) Automatic Transmission Input Shaft Speed (A/T ISS) Sensor Assembly
(811) Lever Assembly-Manual Shaft Detent with Shift Position Switch - Internal Mode Switch (IMS)

G00421642

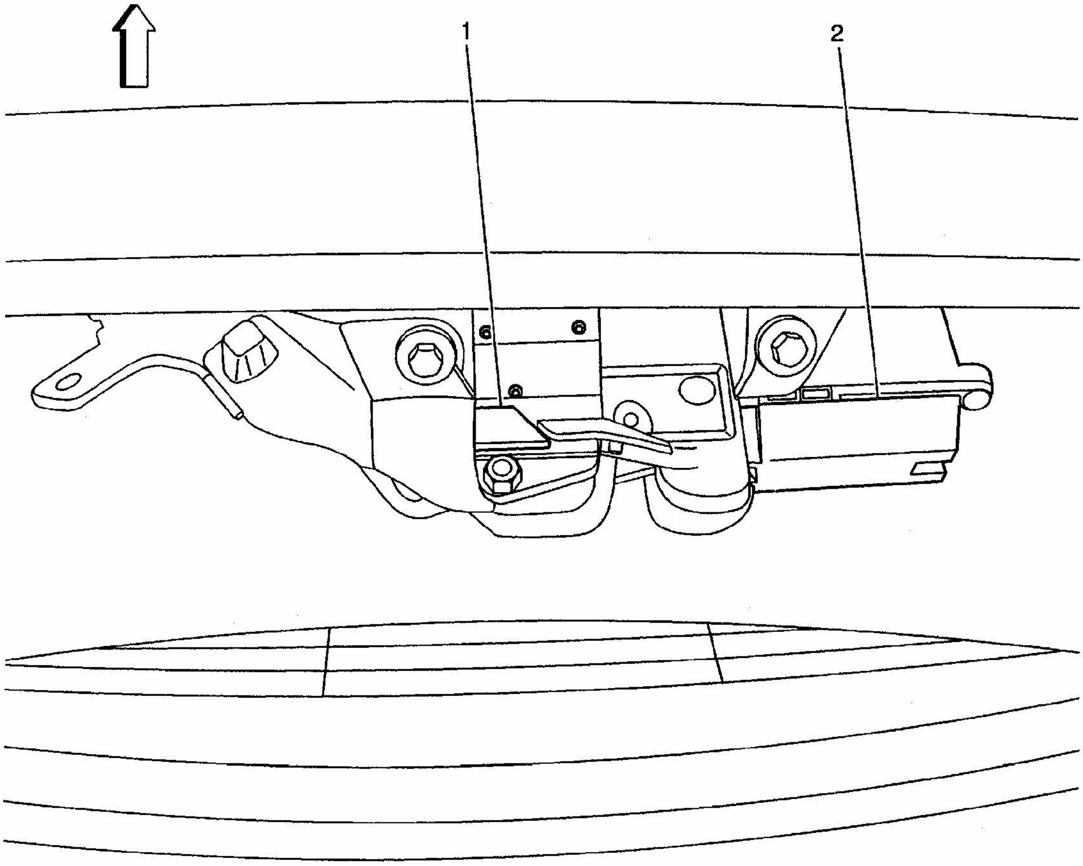
Fig. 4: Transmission Assembly
Courtesy of GENERAL MOTORS CORP.



(1) Transmission Control Module

G00421643

Fig. 5: Left Front Of Engine Compartment
Courtesy of GENERAL MOTORS CORP.

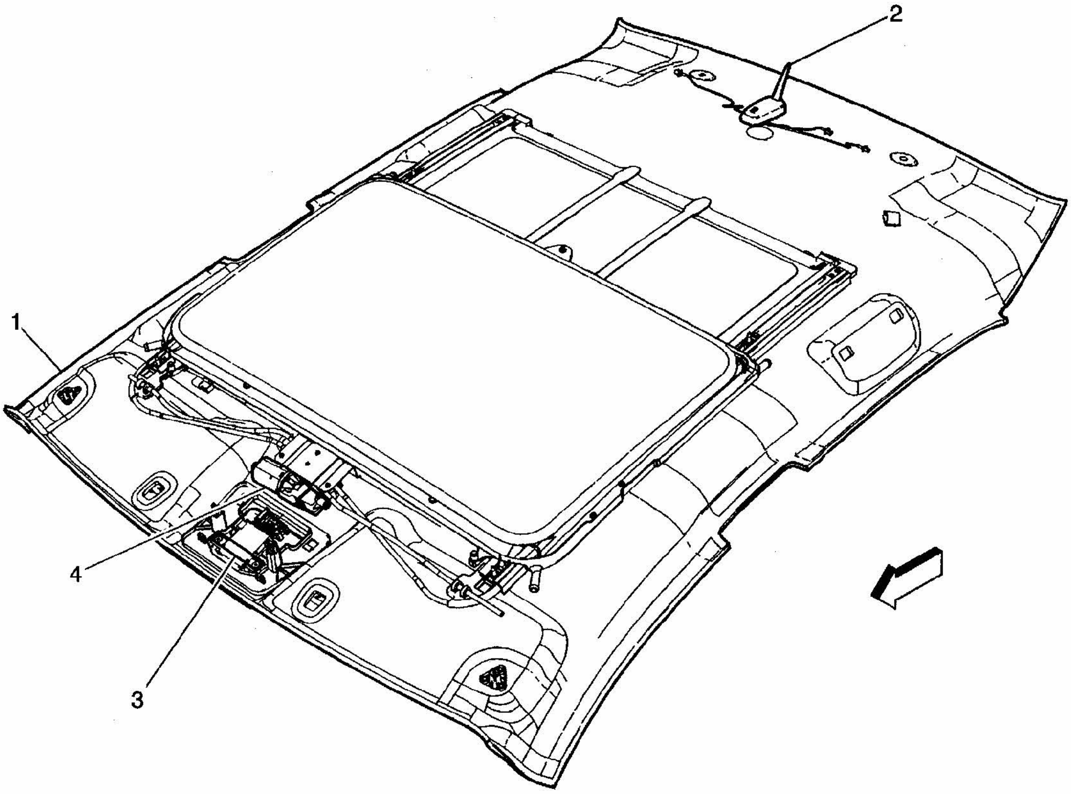


(1) Rear Compartment Lid Ajar Switch (Coupe)

(2) Rear Compartment Lid Release Actuator

G00421644

Fig. 6: Body Rear End Component Views
Courtesy of GENERAL MOTORS CORP.



(1) Headliner

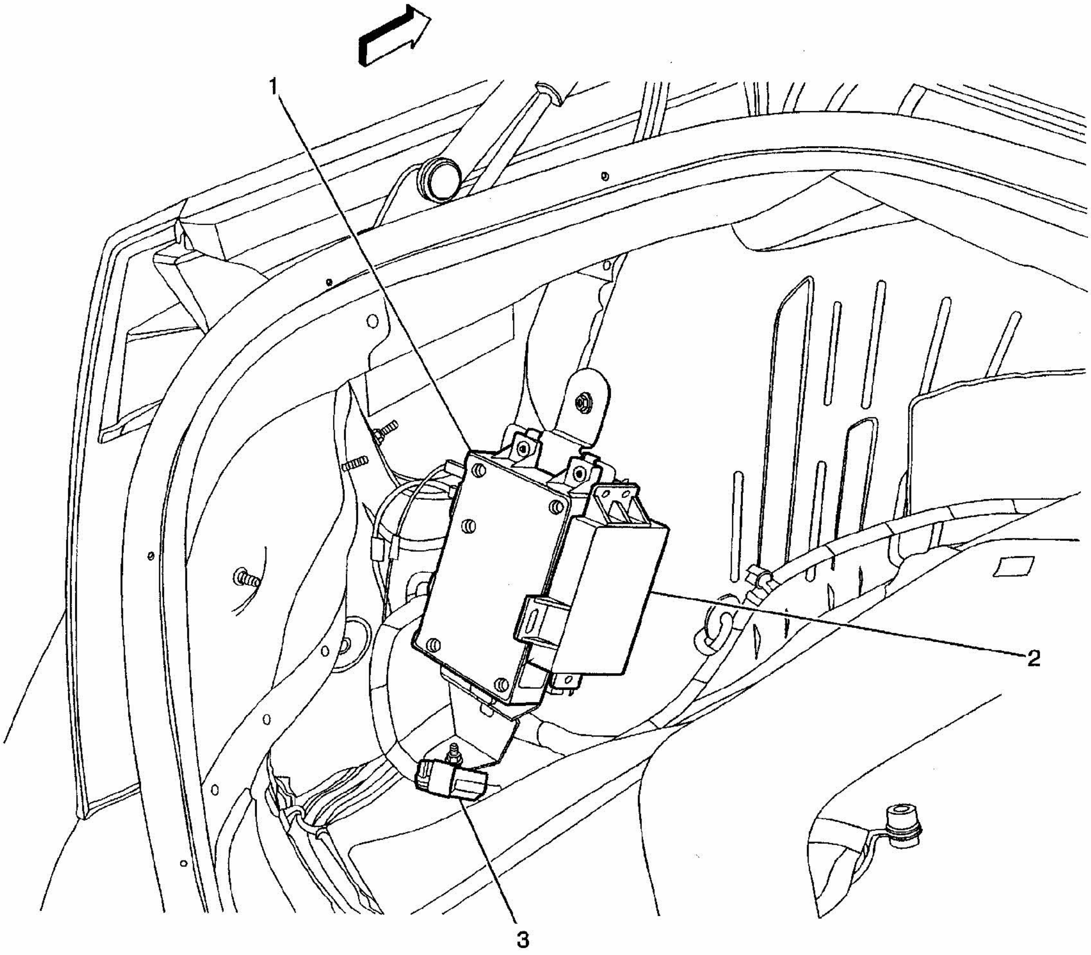
(2) Cellular Navigation and Digital Radio Antenna (UE1, U2K)

(3) Inflatable Restraint Passenger Air Bag On/Off Indicator (Coupe)

(4) Sunroof Motor (CF5)

G00421645

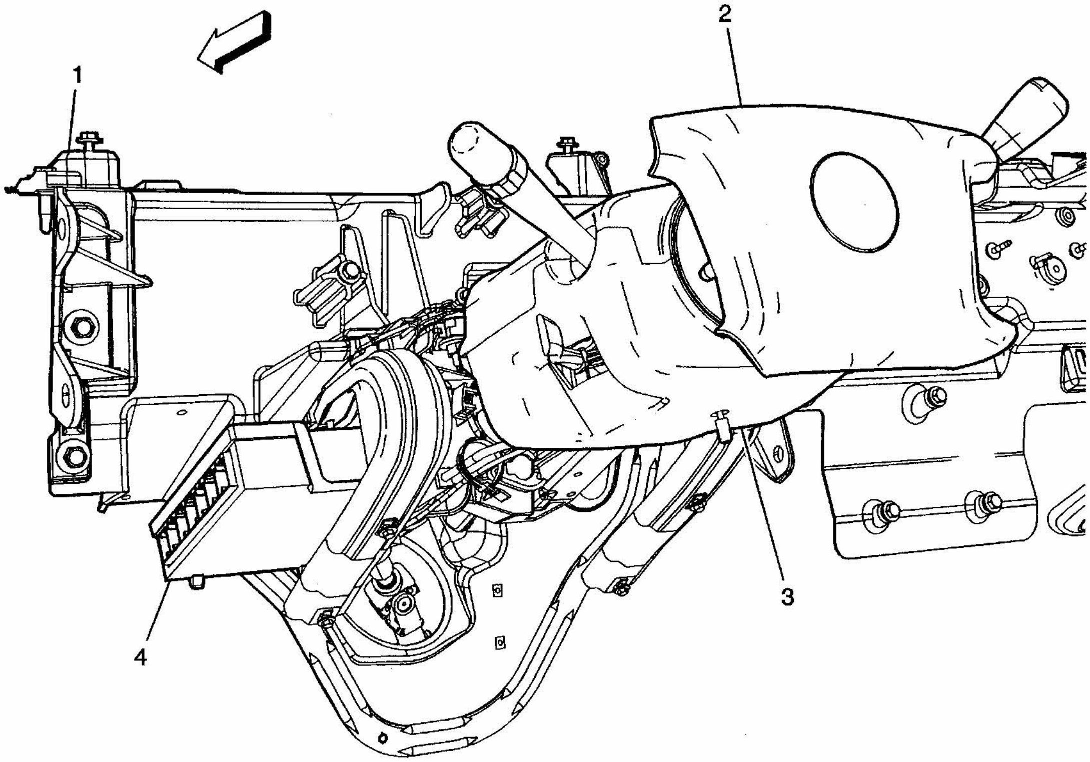
Fig. 7: Headliner Components
Courtesy of GENERAL MOTORS CORP.



(1) Vehicle Communication Interface Module (VCIM) (UE1)
(2) Backup Battery (UE1 Late Production)
(3) Terminator Resistor (w/UE1)

G00421646

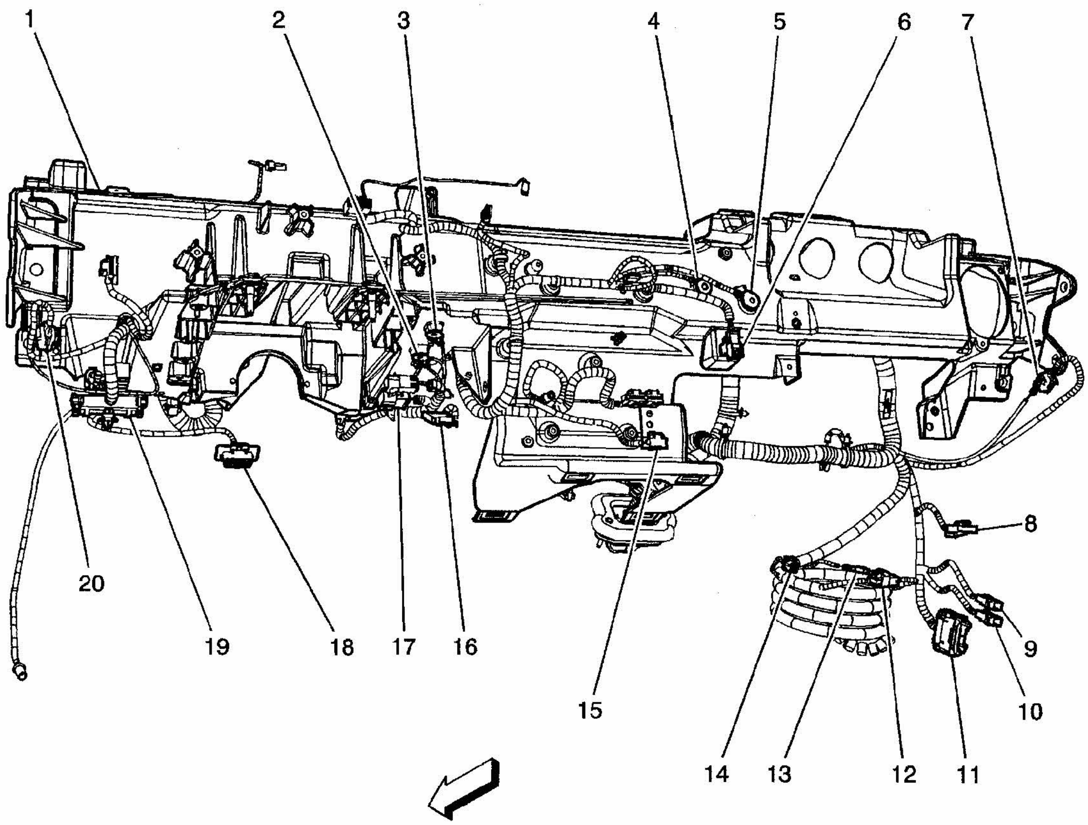
Fig. 8: Left Side Of Rear Compartment
Courtesy of GENERAL MOTORS CORP.



(1) I/P Carrier
(2) Inflatable Restraint Steering Wheel Module
(3) Steering Column
(4) Body Control Module (BCM)

G00421647

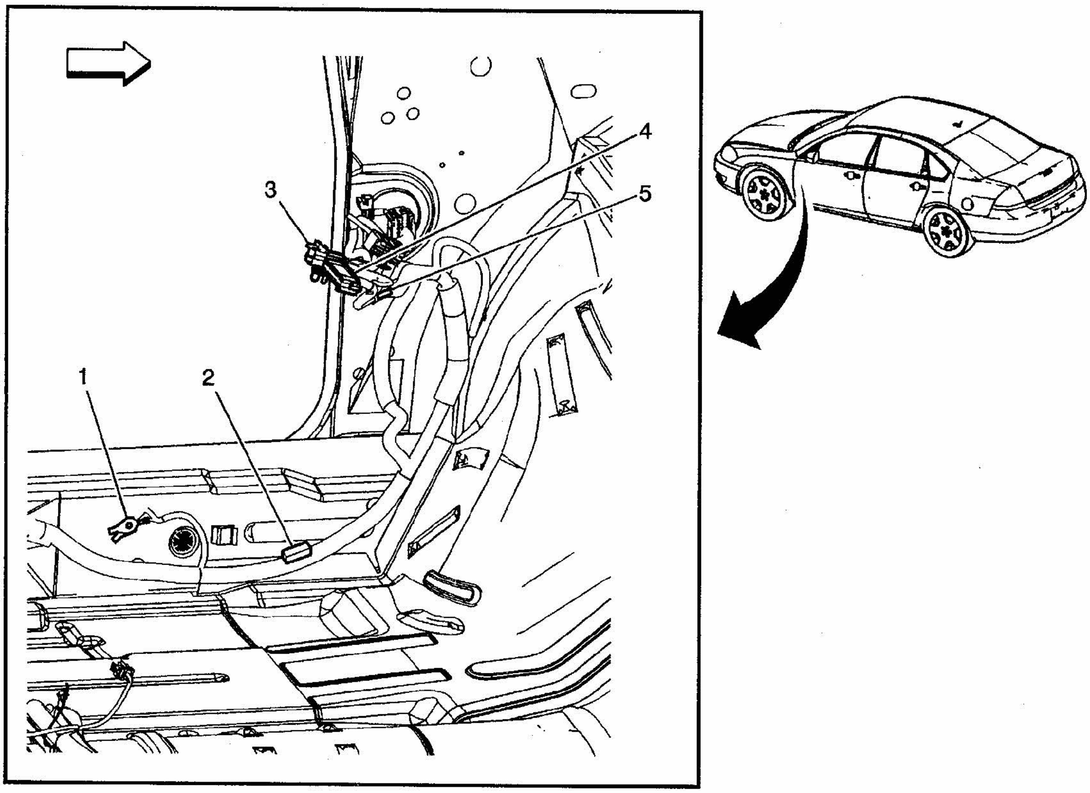
Fig. 9: Steering Column Assembly
Courtesy of GENERAL MOTORS CORP.



(1) I/P Carrier
(2) G202
(3) G201
(4) G200
(5) G204 (9C1, 9C3)
(6) C210
(7) Spot Lamp - Right Connector (9C1, 9C3)
(8) Fuse Block - I/P C2
(9) C360 (9C1 and 9C3)
(10) C362 (9C1 and 9C3)
(11) C200
(12) C267 (9C1 and 9C3)
(13) C266 (9C1 and 9C3)
(14) C297 (9C1 and 9C3)
(15) HVAC Control Module C2
(16) Splice Pack SP205
(17) C201
(18) Data Link Connector (DLC)
(19) C203
(20) C250

G00421648

Fig. 10: Dash Harness
Courtesy of GENERAL MOTORS CORP.



(1) G301

(2) C223 - Taped to Harness (9C1,9C3)

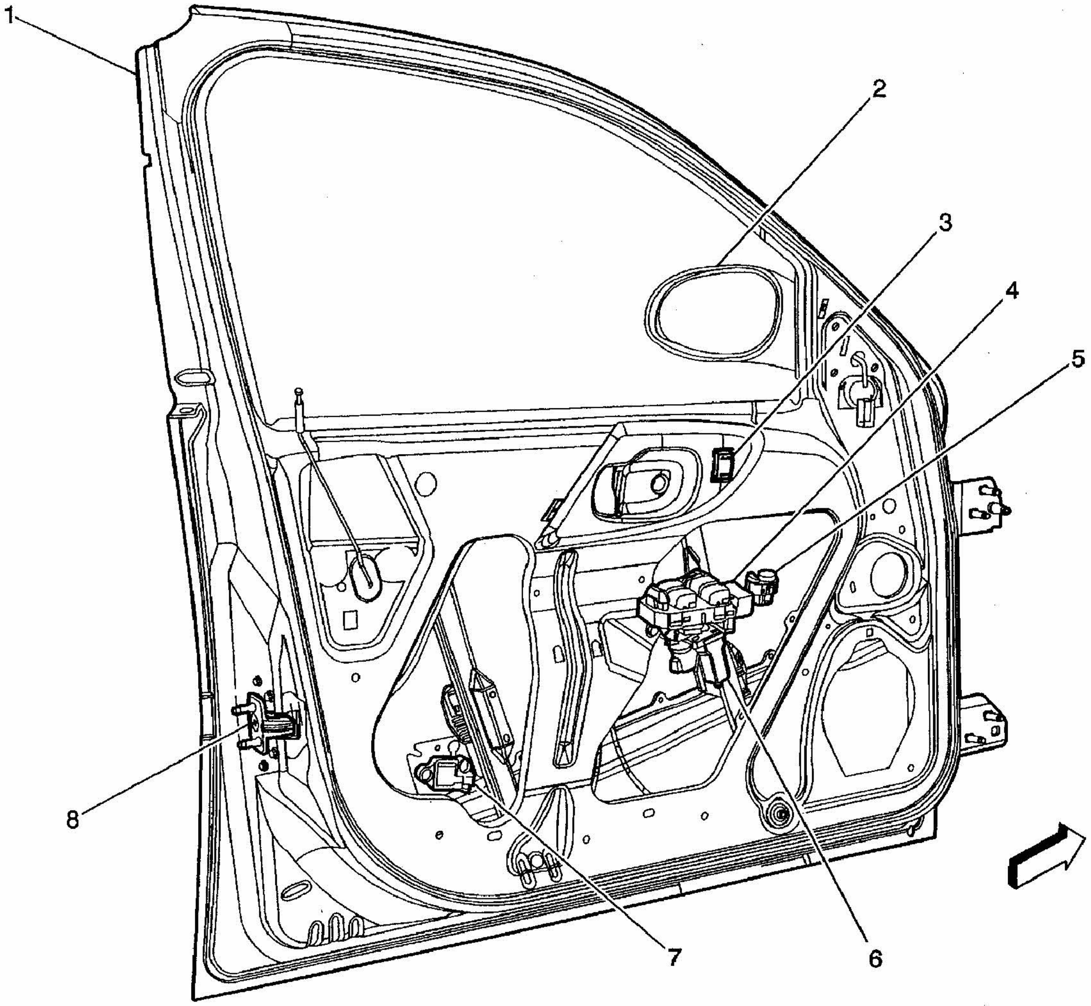
(3) C250

(4) C203

(5) Terminator Resistor--Taped to Harness (w/o UE1)

G00421649

Fig. 11: Lower Left Side Of Dash
Courtesy of GENERAL MOTORS CORP.



(1) Door Frame

(2) Outside Rearview Mirror - Driver

(3) Door Lock Switch - Driver

(4) Window Switch - Driver

(5) Outside Rearview Mirror Switch

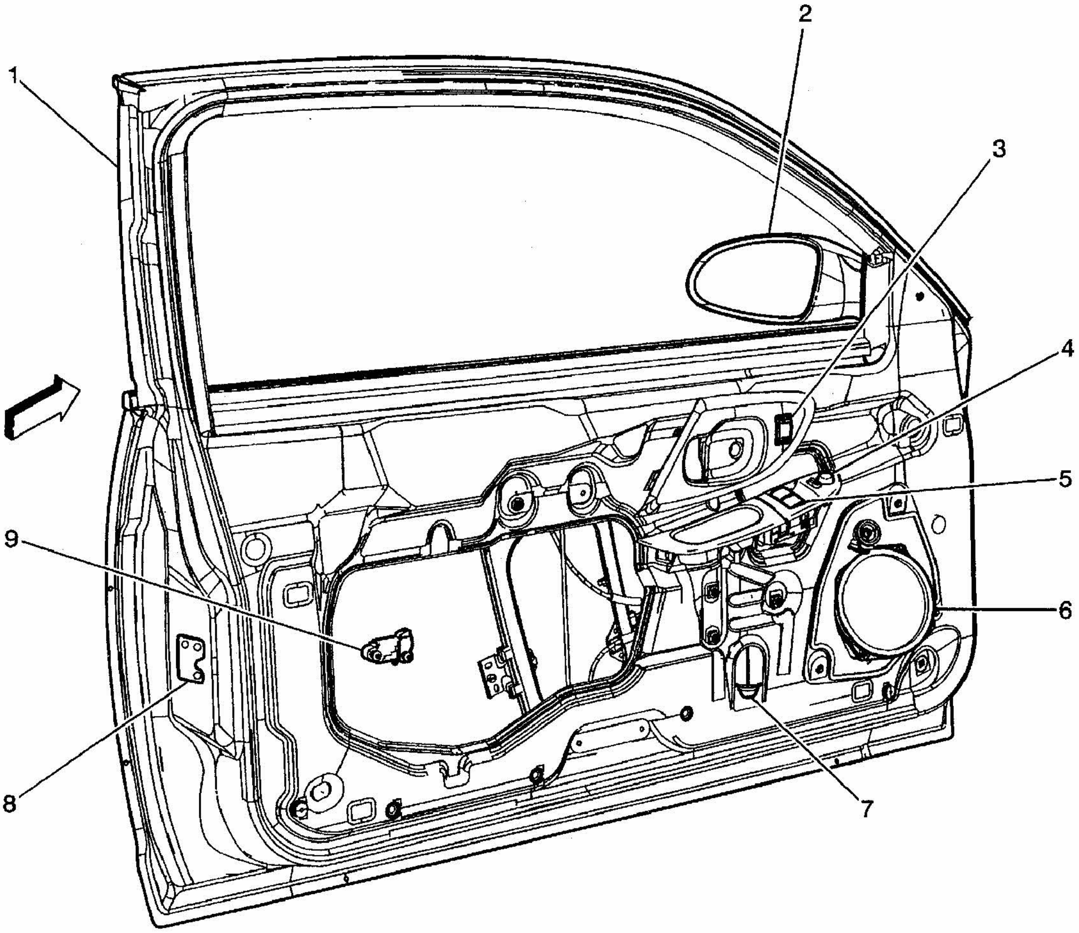
(6) Window Motor - Driver

(7) Inflatable Restraint Side Impact Sensor (SIS) Left (AY1)

(8) Door Lock - Driver

G00421650

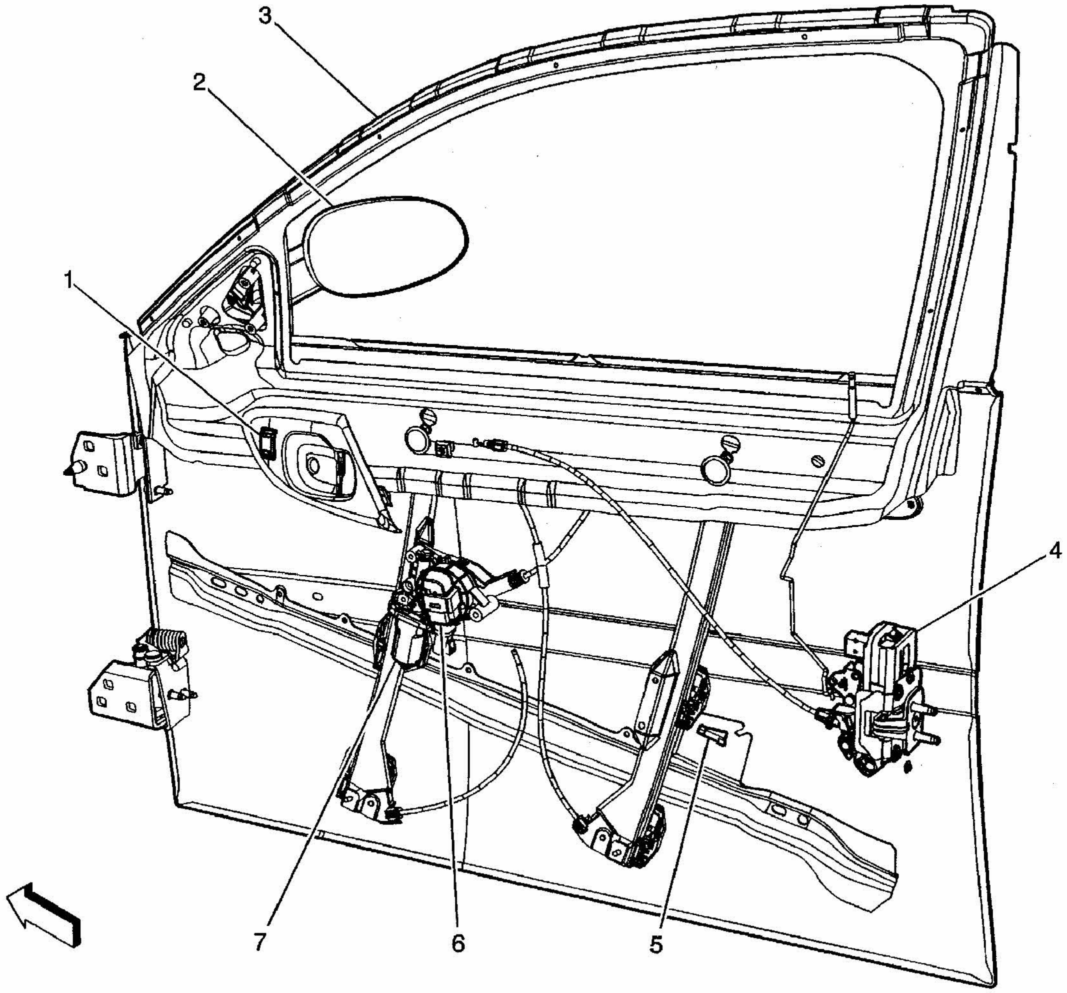
Fig. 12: Driver Door (Sedan)
Courtesy of GENERAL MOTORS CORP.



(1) Door Frame
(2) Outside Rearview Mirror - Driver
(3) Door Lock Switch - Driver
(4) Outside Rearview Mirror Switch
(5) Window Switch - Driver
(6) Speaker - LF Door
(7) Window Motor - Driver
(8) Door Lock Actuator - Driver
(9) Inflatable Restraint Side Impact Sensor (SIS) Left

G00421651

Fig. 13: Left Front Door (Coupe)
Courtesy of GENERAL MOTORS CORP.



(1) Door Lock Switch - Front Passenger

(2) Outside Rearview Mirror - Passenger

(3) Door Frame

(4) Door Lock - Front Passenger

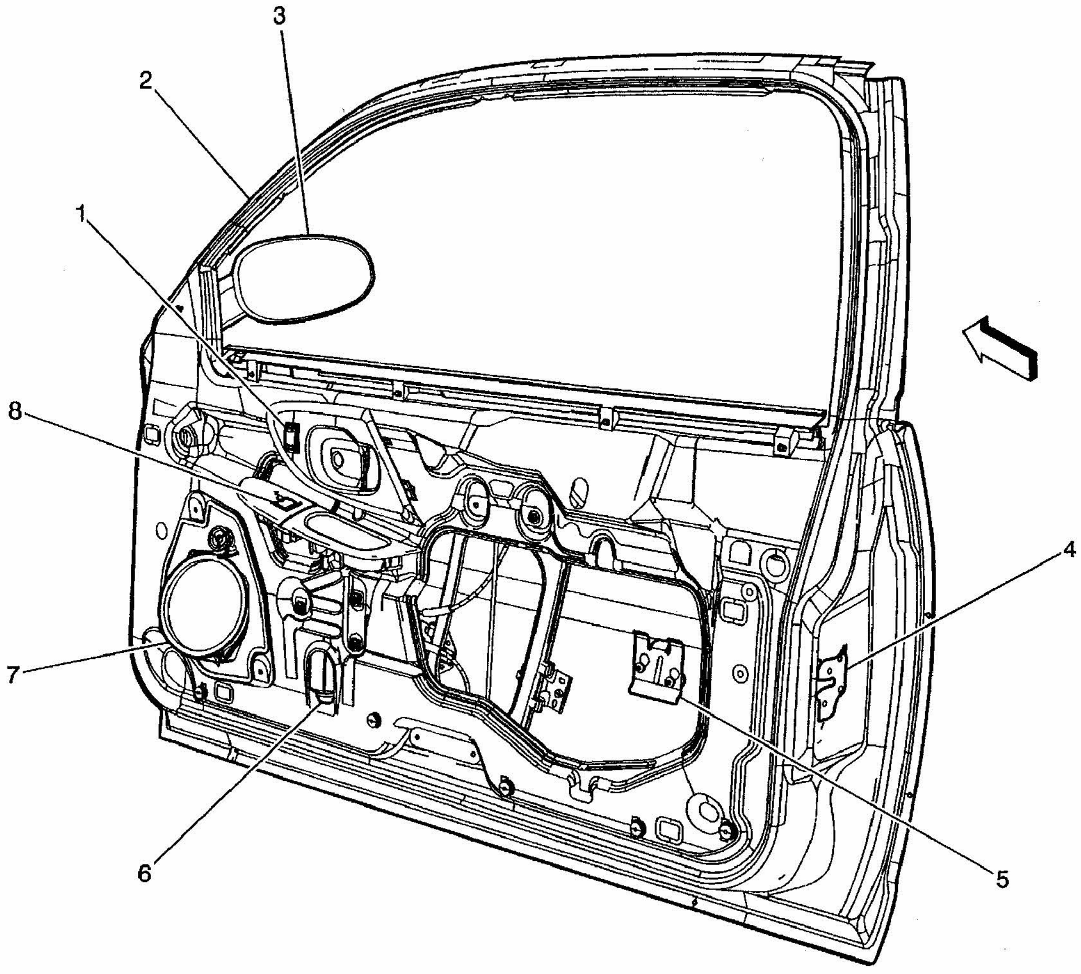
(5) Inflatable Restraint Side Impact Sensor (SIS) Right (AY1)

(6) Window Switch - Front Passenger

(7) Window Motor - Front Passenger

G00421652

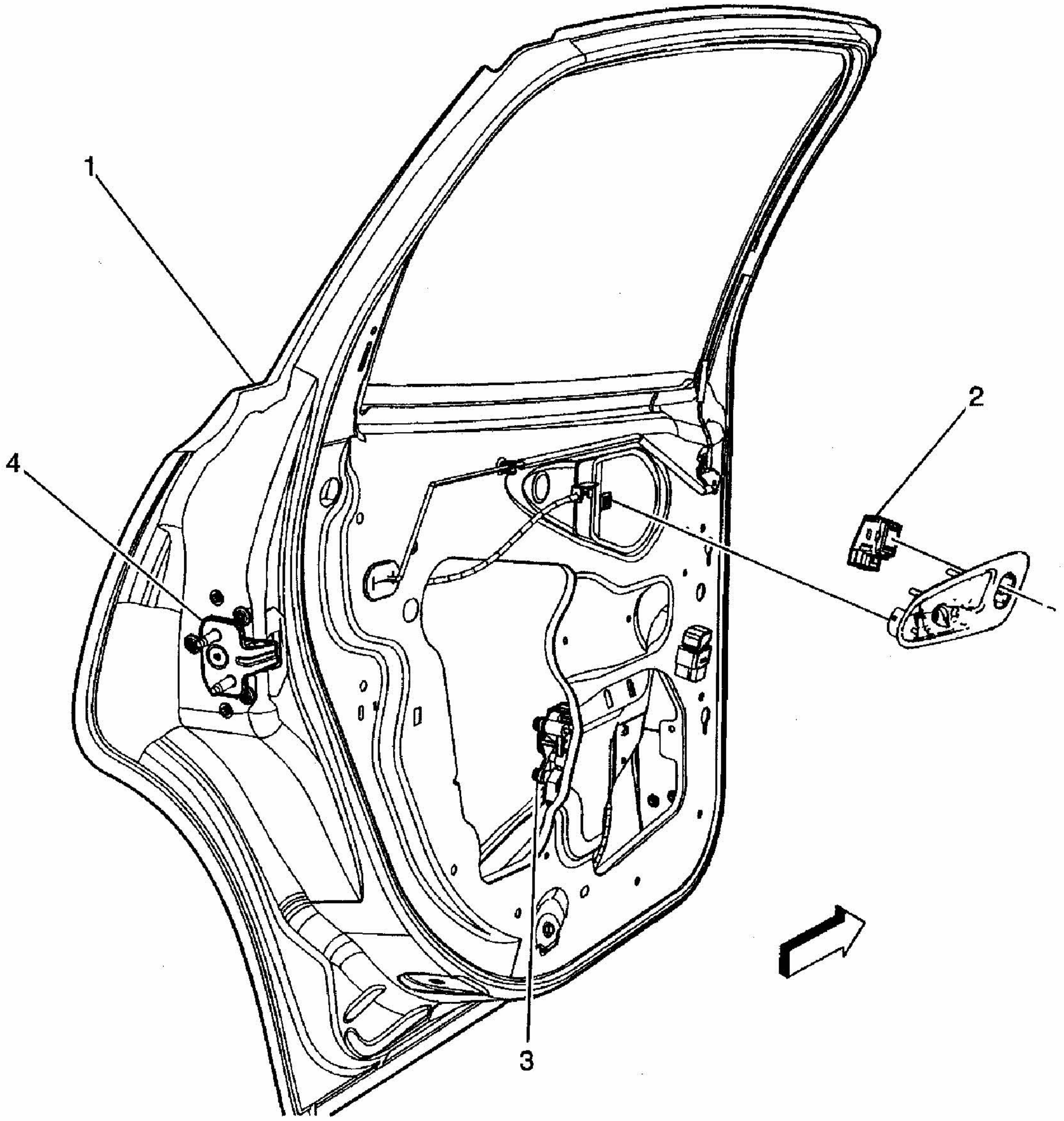
Fig. 14: Front Passenger Door (Sedan)
Courtesy of GENERAL MOTORS CORP.



(1) Door Lock Switch - Passenger
(2) Door Frame
(3) Outside Rearview Mirror - Passenger
(4) Door Lock Actuator - Passenger
(5) Inflatable Restraint Side Impact Sensor (SIS) Right (AJ7)
(6) Window Motor - Front Passenger
(7) Speaker - RF Door
(8) Window Switch - Passenger

G00421653

Fig. 15: Right Front Door Components (Coupe)
Courtesy of GENERAL MOTORS CORP.



(1) Door Frame
(2) Window Switch - LR
(3) Window Motor - LR
(4) Door Lock - LR

G00421654

Fig. 16: Left Rear Door (Sedan)
Courtesy of GENERAL MOTORS CORP.

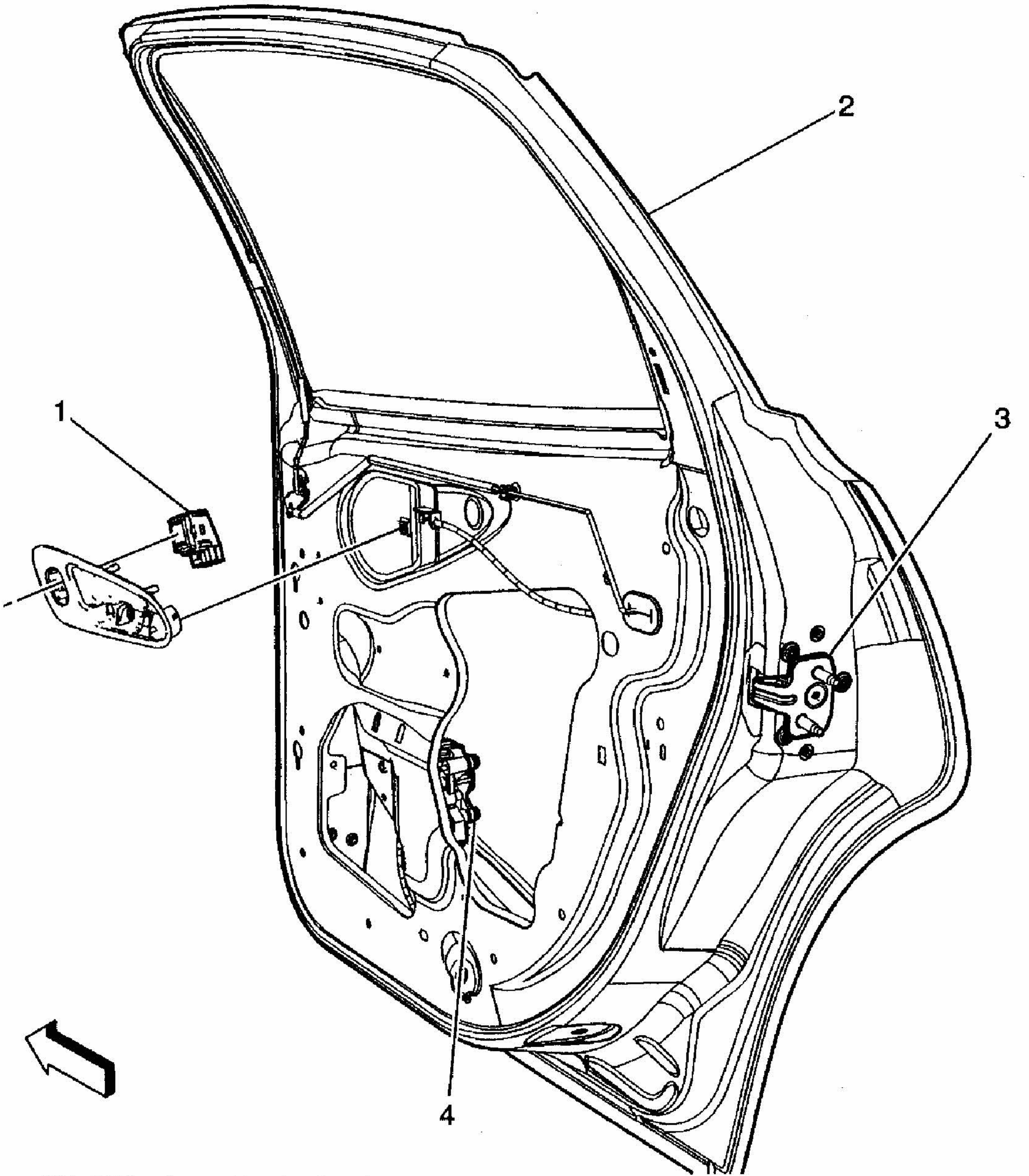
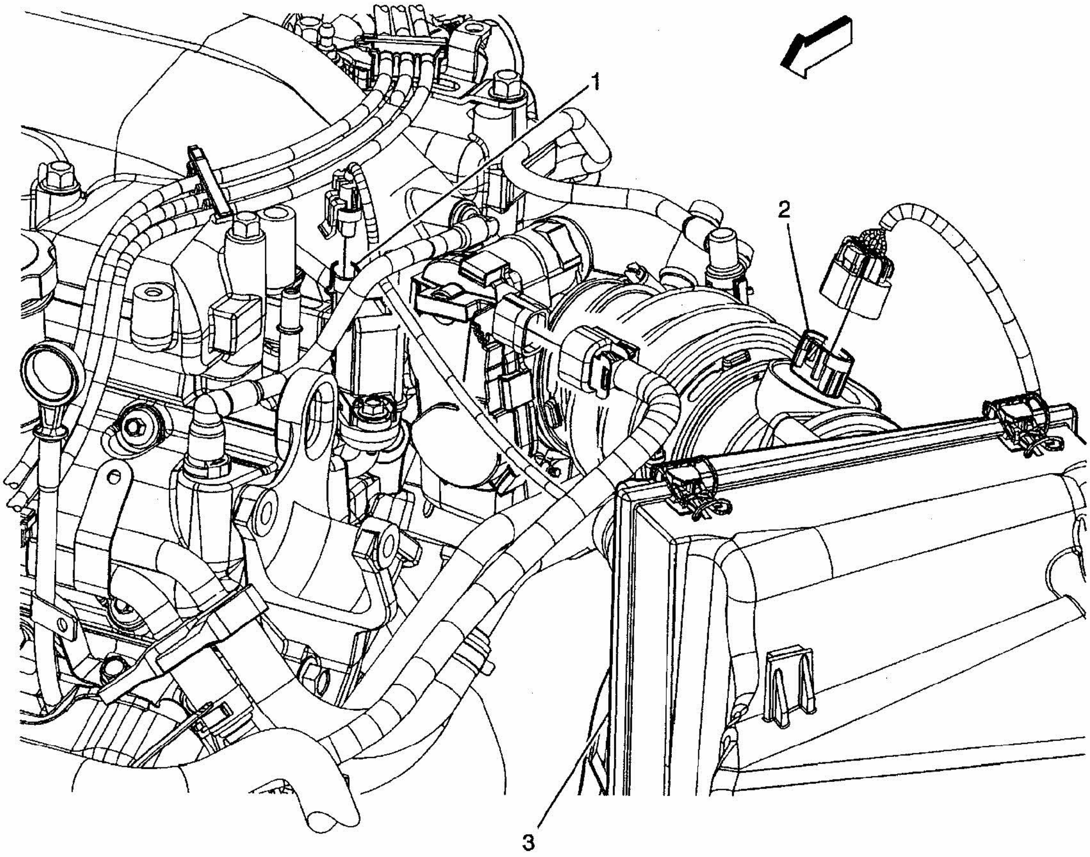

1
2
3
4
(1) Window Switch - RR
(2) Door Frame
(3) Door Lock - RR
(4) Window Motor - RR
G00421655

Fig. 17: Right Rear Door (Sedan)
Courtesy of GENERAL MOTORS CORP.



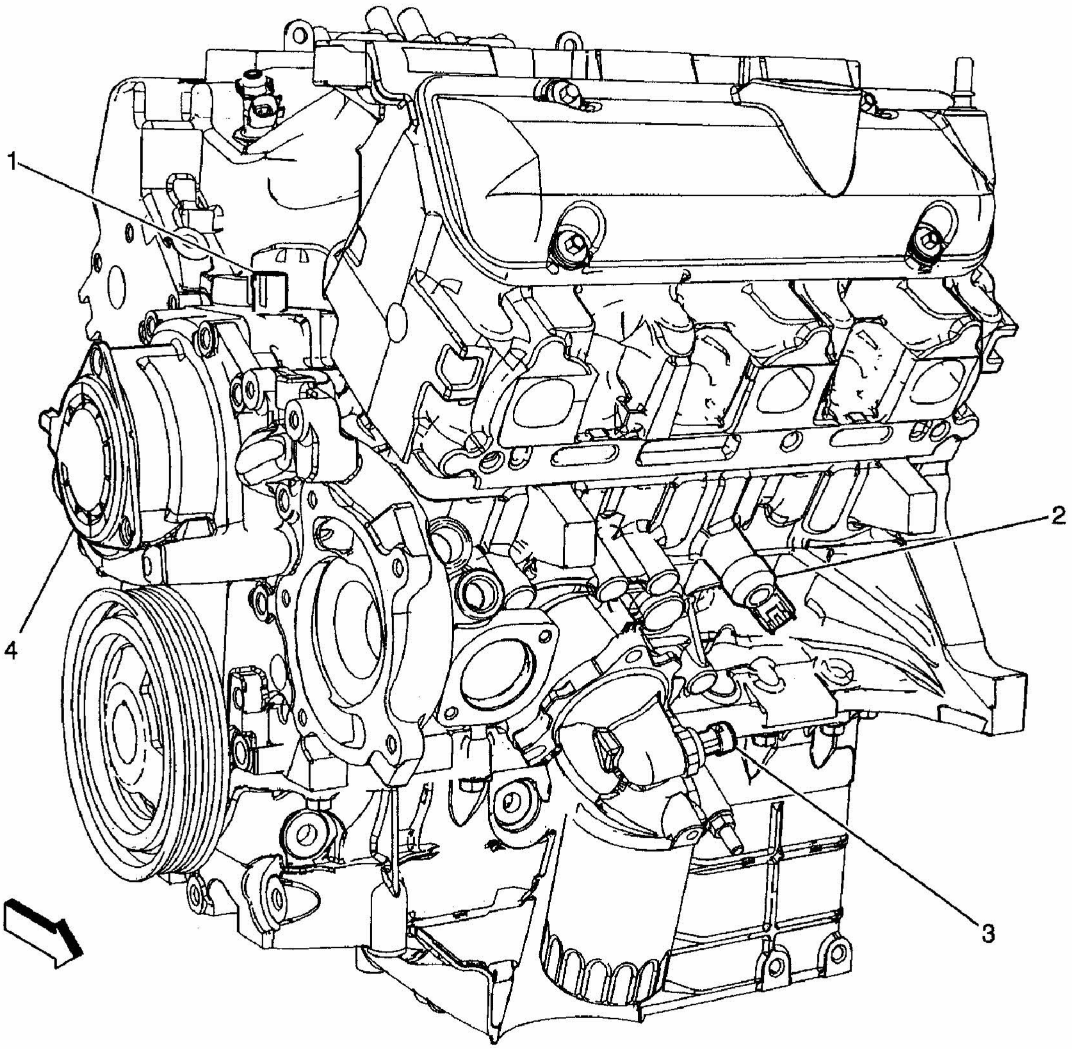
(1) Evaporative Emission (EVAP) Canister Purge Solenoid Valve

(2) Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor

(3) Air Cleaner Housing

G00421656

Fig. 18: Top Of Engine (3.5L & 3.9L)
Courtesy of GENERAL MOTORS CORP.



(1) Camshaft Position (CMP) Sensor

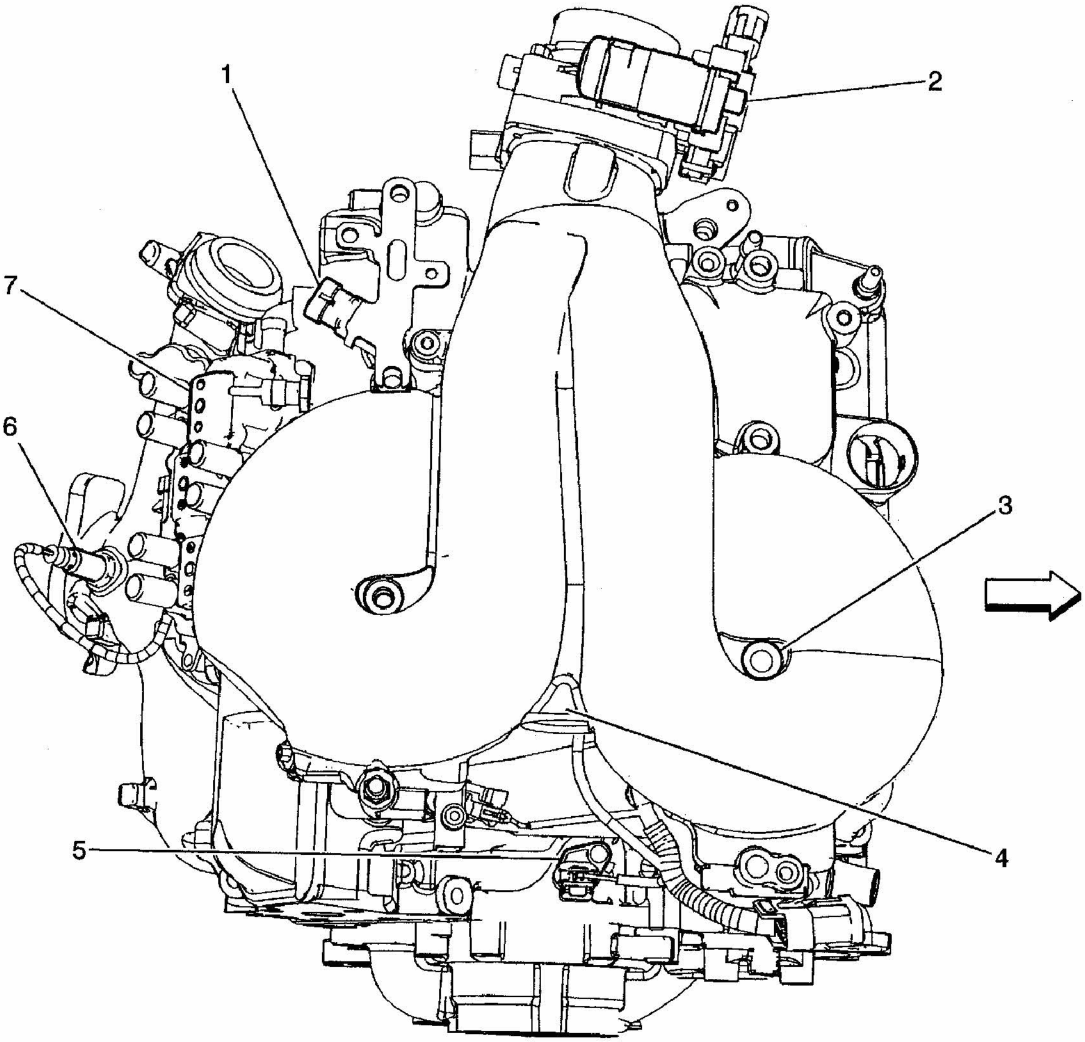
(2) Knock Sensor (KS) Bank 2

(3) Engine Oil Pressure (EOP) Sensor

(4) Camshaft Position Actuator Solenoid

G00421657

Fig. 19: Front Of Engine (3.5L & 3.9L)
Courtesy of GENERAL MOTORS CORP.



(1) Manifold Absolute Pressure (MAP) Sensor

(2) Throttle Body

(3) Intake Manifold

(4) Intake Manifold Tuning (IMT) Valve Solenoid (LZ9)

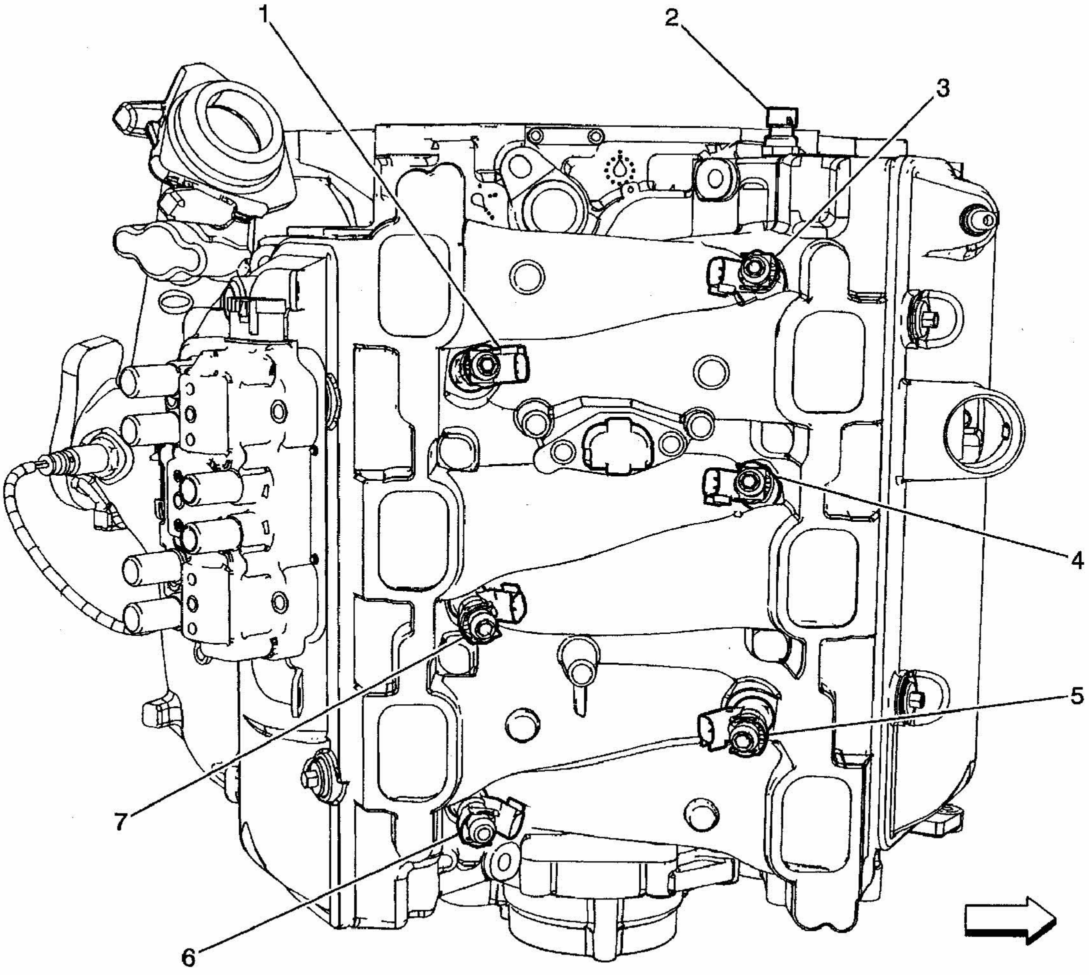
(5) Camshaft Position Actuator Solenoid

(6) Heated Oxygen Sensor (HO2S) 1

(7) Ignition Control Module (ICM)

G00421658

Fig. 20: Top Of Engine (3.5L & 3.9L)
Courtesy of GENERAL MOTORS CORP.



(1) Fuel Injector 5

(2) Engine Coolant Temperature (ECT) Sensor

(3) Fuel Injector 6

(4) Fuel Injector 4

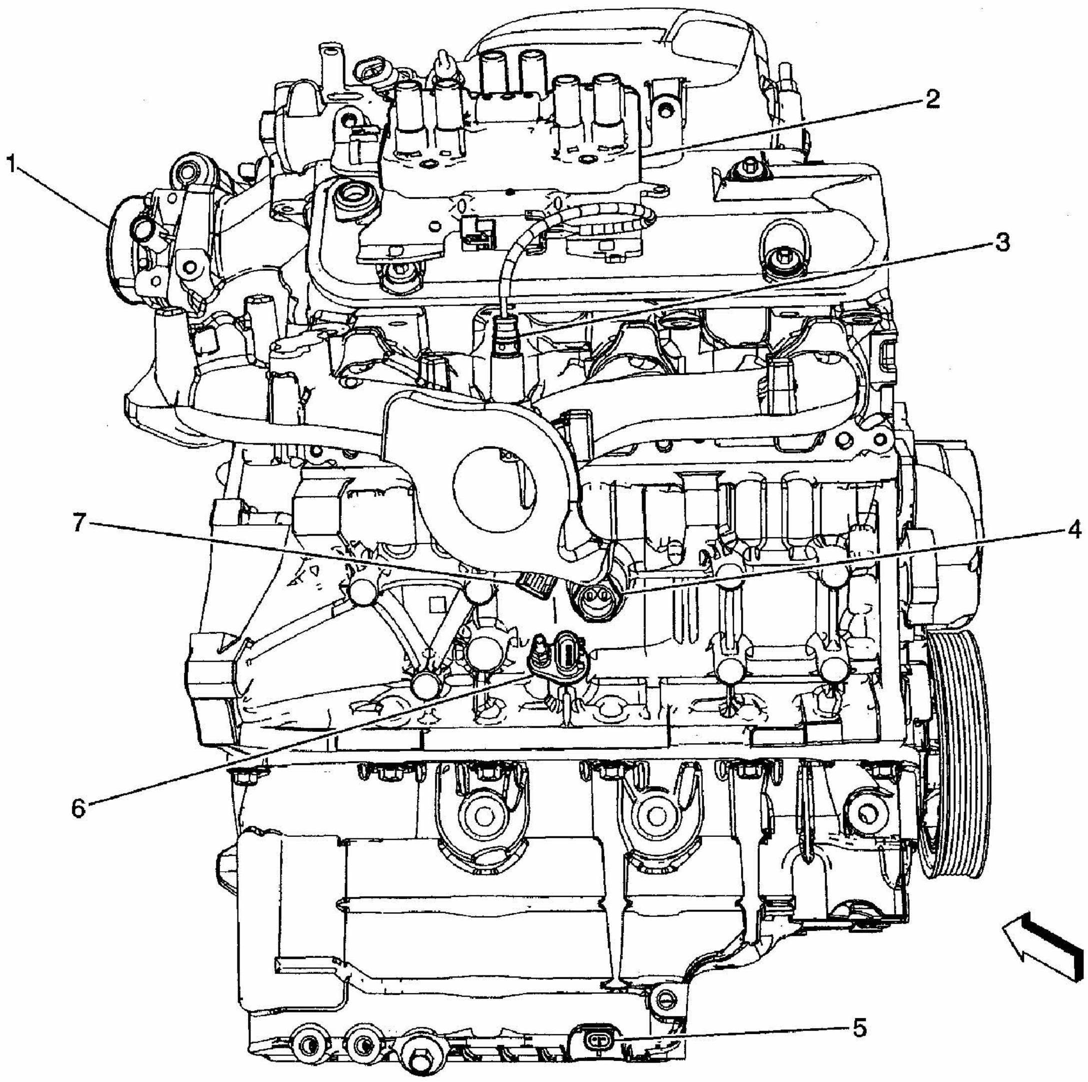
(5) Fuel Injector 2

(6) Fuel Injector 1

(7) Fuel Injector 3

G00421659

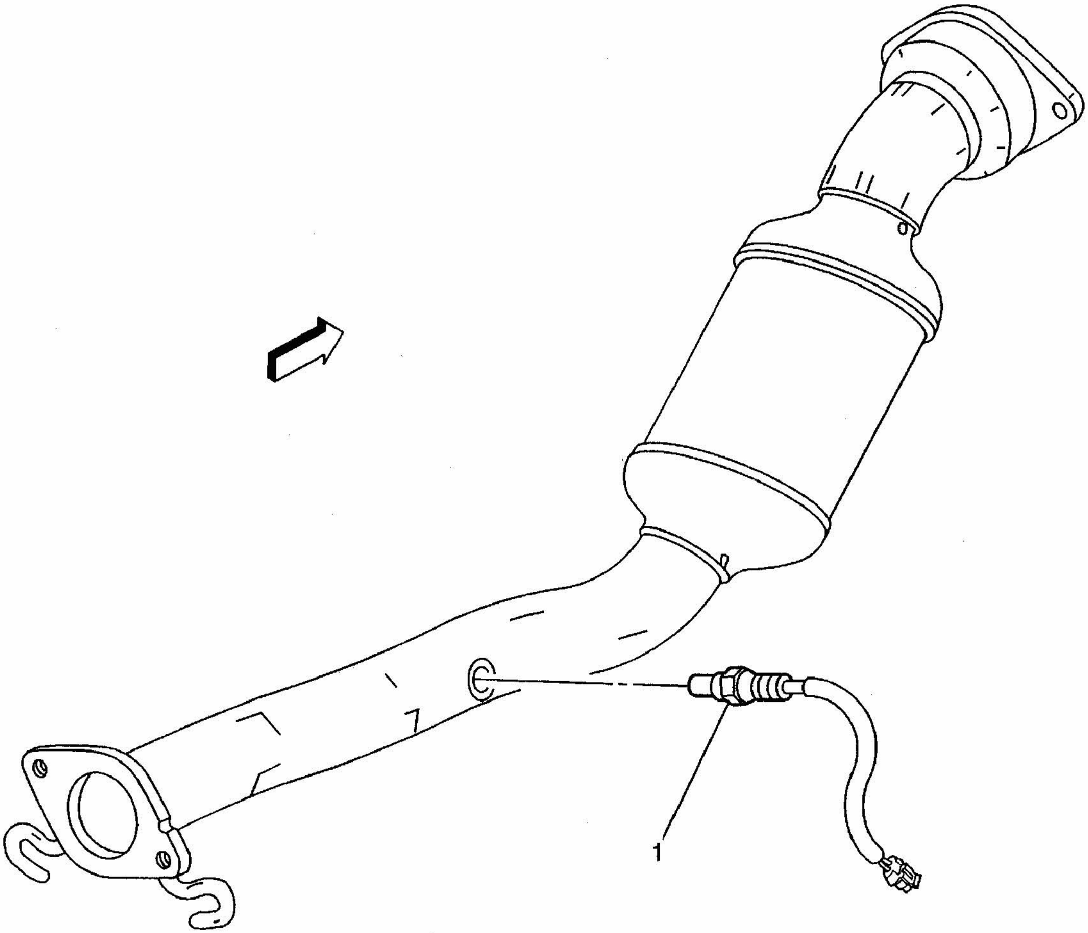
Fig. 21: Top Of Engine (3.5L & 3.9L)
Courtesy of GENERAL MOTORS CORP.



(1) Throttle Body
(2) Ignition Control Module (ICM)
(3) Heated Oxygen Sensor (HO2S) 1
(4) Engine Coolant Heater
(5) Engine Oil Level Switch
(6) Crankshaft Position (CKP) Sensor
(7) Knock Sensor (KS) Bank 1

G00421660

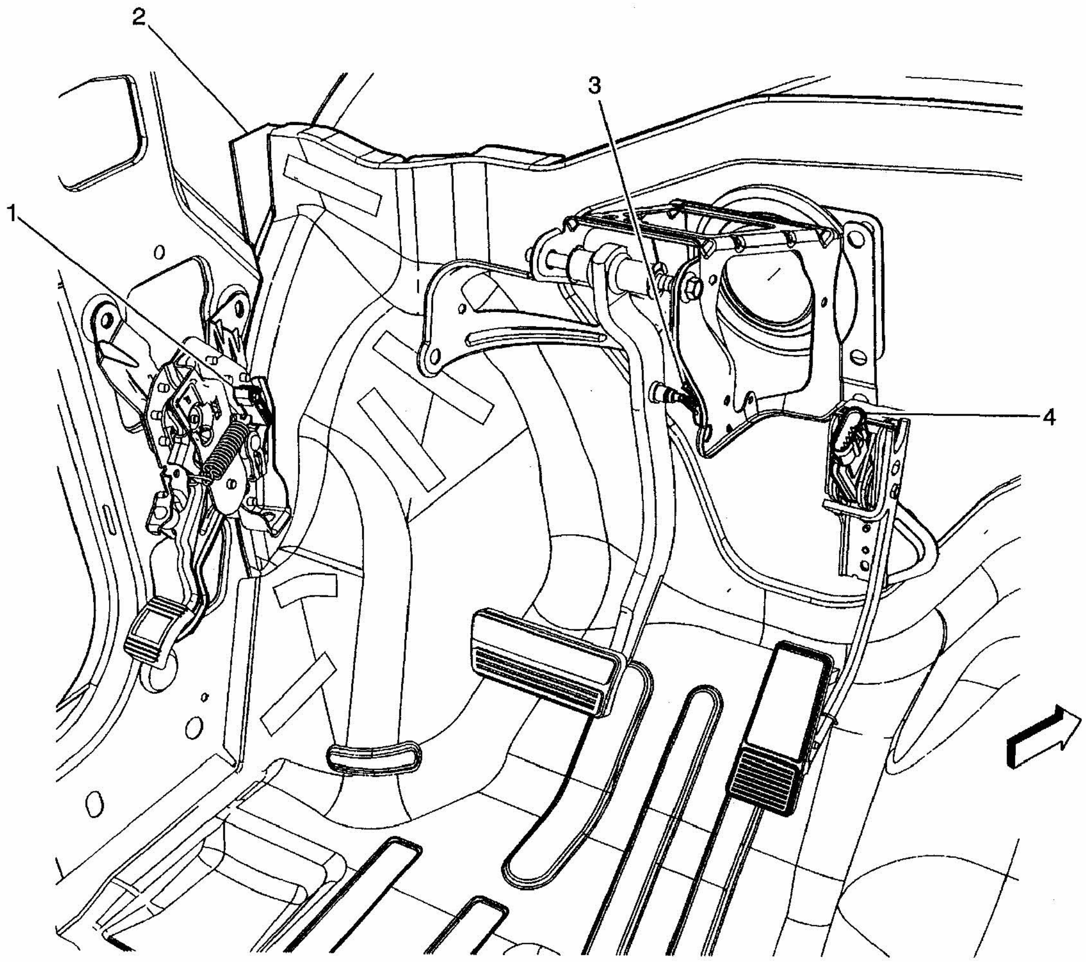
Fig. 22: Right Side Of Engine (3.5L & 3.9L)
Courtesy of GENERAL MOTORS CORP.



(1) Heated Oxygen Sensor (HO2S) 2

G00421661

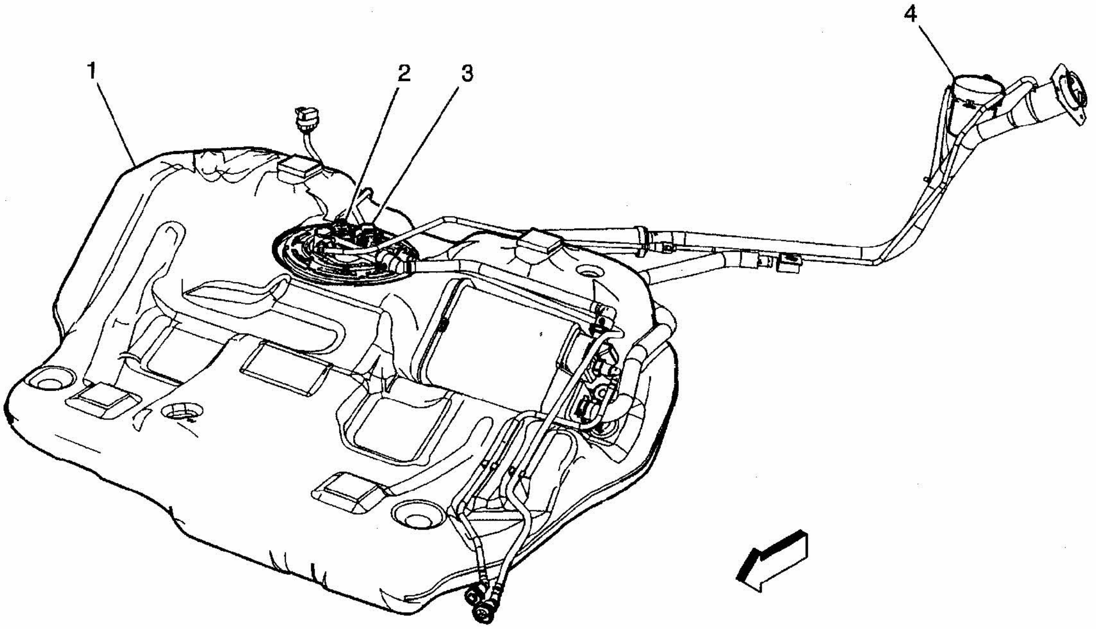
Fig. 23: Exhaust
Courtesy of GENERAL MOTORS CORP.



(1) Park Brake Switch
(2) Dash Panel
(3) Brake Pedal Position Sensor
(4) Accelerator Pedal Position (APP) Sensor

G00421662

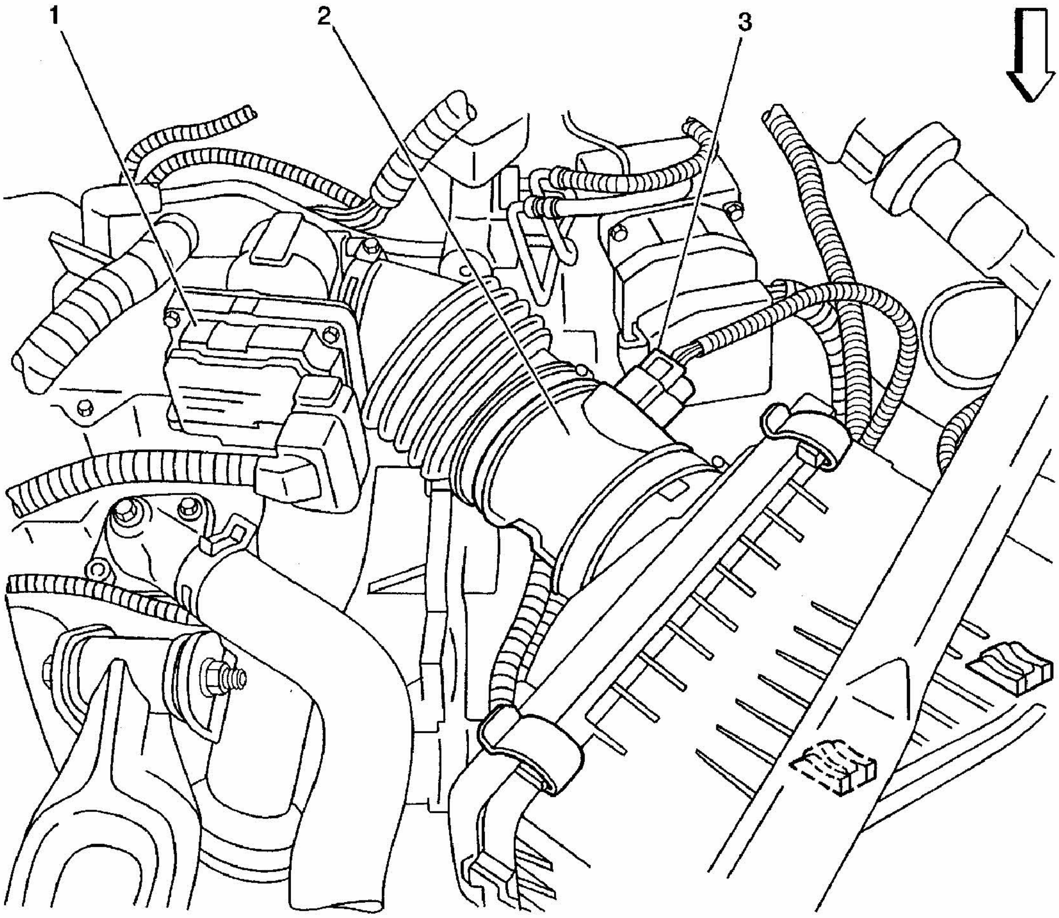
Fig. 24: Pedal Assembly
Courtesy of GENERAL MOTORS CORP.



(1) Fuel Tank
(2) Fuel Pump and Sender Assembly
(3) Fuel Tank Pressure (FTP) Sensor
(4) Evaporative Emission (EVAP) Canister Vent Solenoid

G00421663

Fig. 25: Fuel Tank Assembly
Courtesy of GENERAL MOTORS CORP.



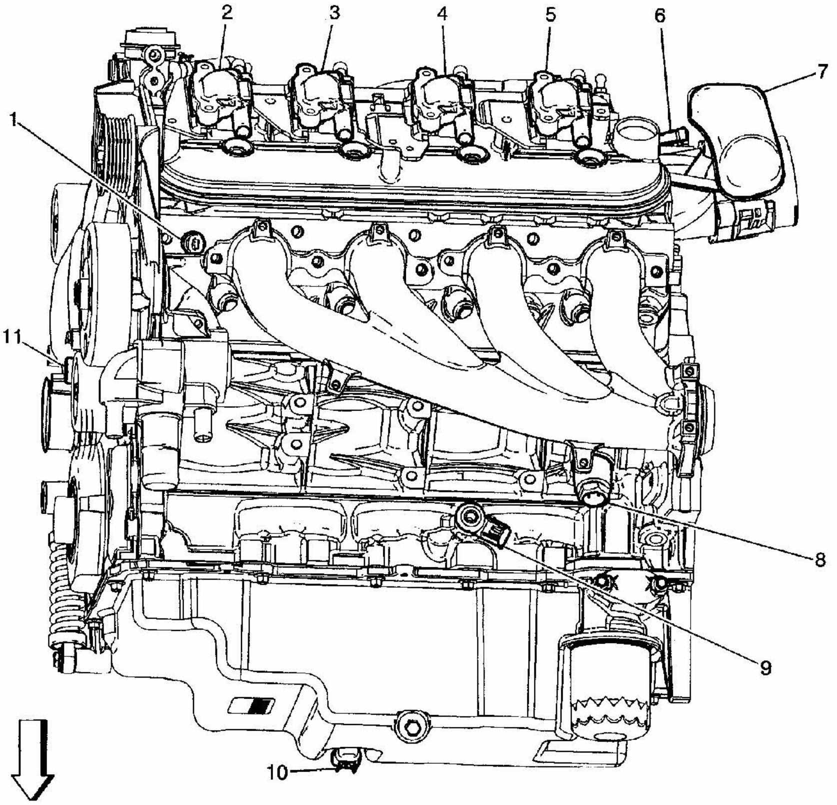
(1) Throttle Body

(2) Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor

(3) Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Connector

G00421664

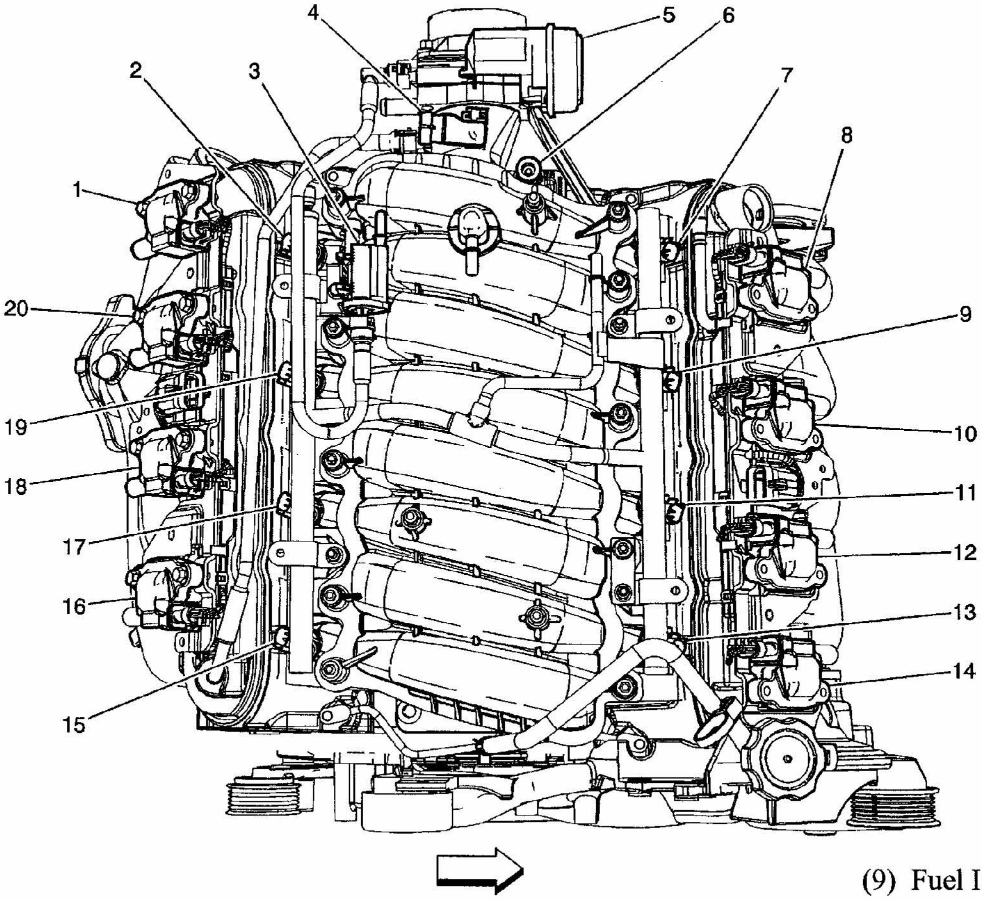
Fig. 26: Top Of Engine
Courtesy of GENERAL MOTORS CORP.



(1) Engine Coolant Temperature (ECT) Sensor
(2) Ignition Coil 1
(3) Ignition Coil 3
(4) Ignition Coil 5
(5) Ignition Coil 7
(6) Manifold Absolute Pressure (MAP) Sensor
(7) Throttle Body
(8) Engine Coolant Heater
(9) Knock Sensor (KS) Bank 1
(10) Engine Oil Level Switch
(11) Camshaft Position (CMP) Sensor

G00421665

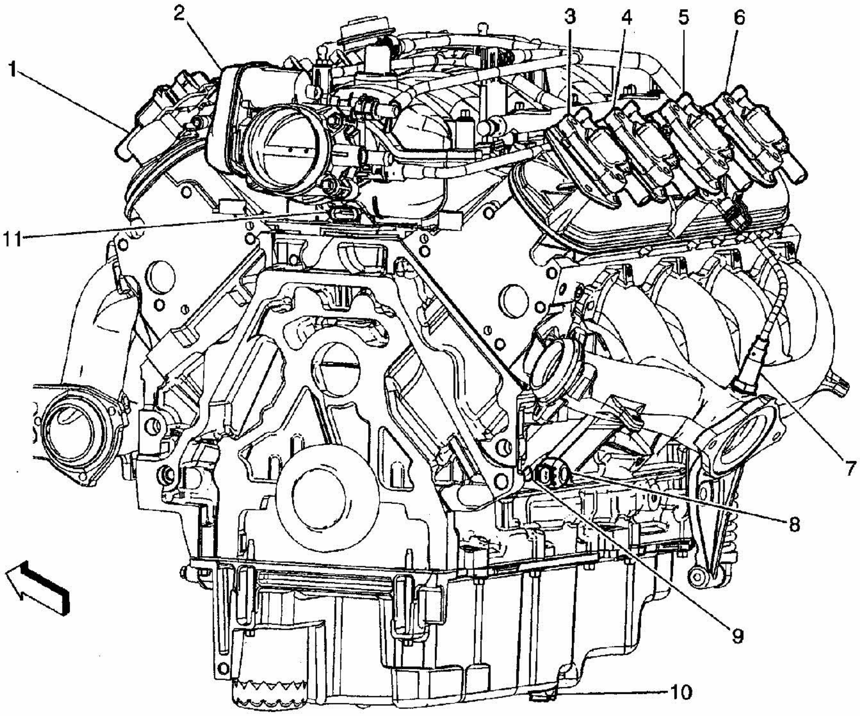
Fig. 27: Left Side Of Engine (5.3L)
Courtesy of GENERAL MOTORS CORP.



(1) Ignition Coil 8
(2) Fuel Injector 8
(3) Evaporative Emission (EVAP) Canister Purge Solenoid Valve
(4) Manifold Absolute Pressure (MAP) Sensor
(5) Throttle Body
(6) Engine Oil Pressure (EOP) Sensor
(7) Fuel Injector 7
(8) Ignition Coil 7
(9) Fuel Injector 5
(10) Ignition Coil 5
(11) Fuel Injector 3
(12) Ignition Coil 3
(13) Fuel Injector 1
(14) Ignition Coil 1
(15) Fuel Injector 2
(16) Ignition Coil 2
(17) Fuel Injector 4
(18) Ignition Coil 4
(19) Fuel Injector 6
(20) Ignition Coil 6

G00421666

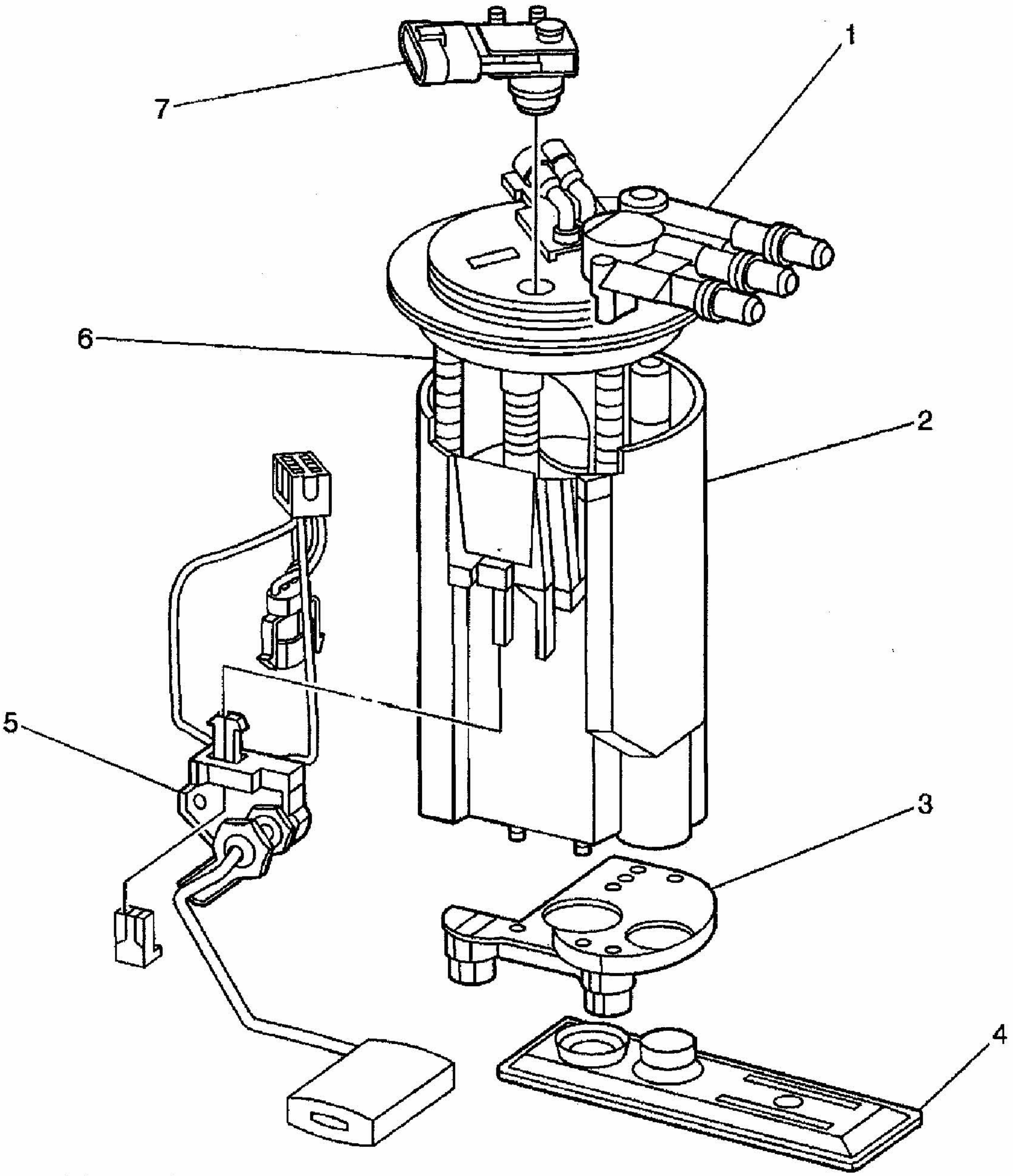
Fig. 28: Top Of Engine (5.3L)
Courtesy of GENERAL MOTORS CORP.



(1) Ignition Coil 7
(2) Throttle Body
(3) Ignition Coil 8
(4) Ignition Coil 6
(5) Ignition Coil 4
(6) Ignition Coil 2
(7) Heated Oxygen Sensor (HO2S) 1
(8) Knock Sensor (KS) Bank 2
(9) Crankshaft Position (CKP) Sensor
(10) Engine Oil Level Switch
(11) Valve Lifter Oil Manifold (VLOM) Assembly

G00421667

Fig. 29: Rear Of Engine (5.3L)
Courtesy of GENERAL MOTORS CORP.

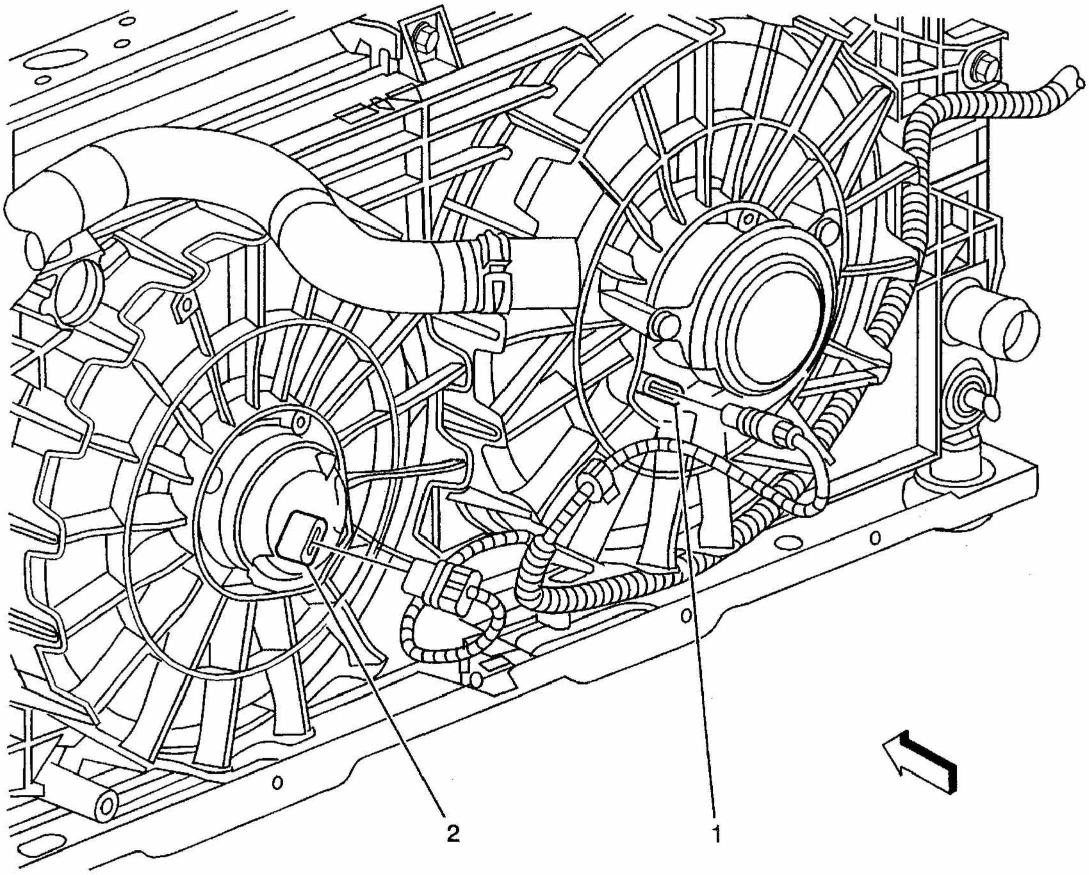


(1) Fuel Line Quick Connector
(2) Fuel Pump
(3) Base Plate
(4) Fuel Strainer
(5) Fuel Level Sensor
(6) Springs
(7) Fuel Tank Pressure (FTP) Sensor

G00421668

Fig. 30: Fuel Pump & Sender Assembly

Courtesy of GENERAL MOTORS CORP.



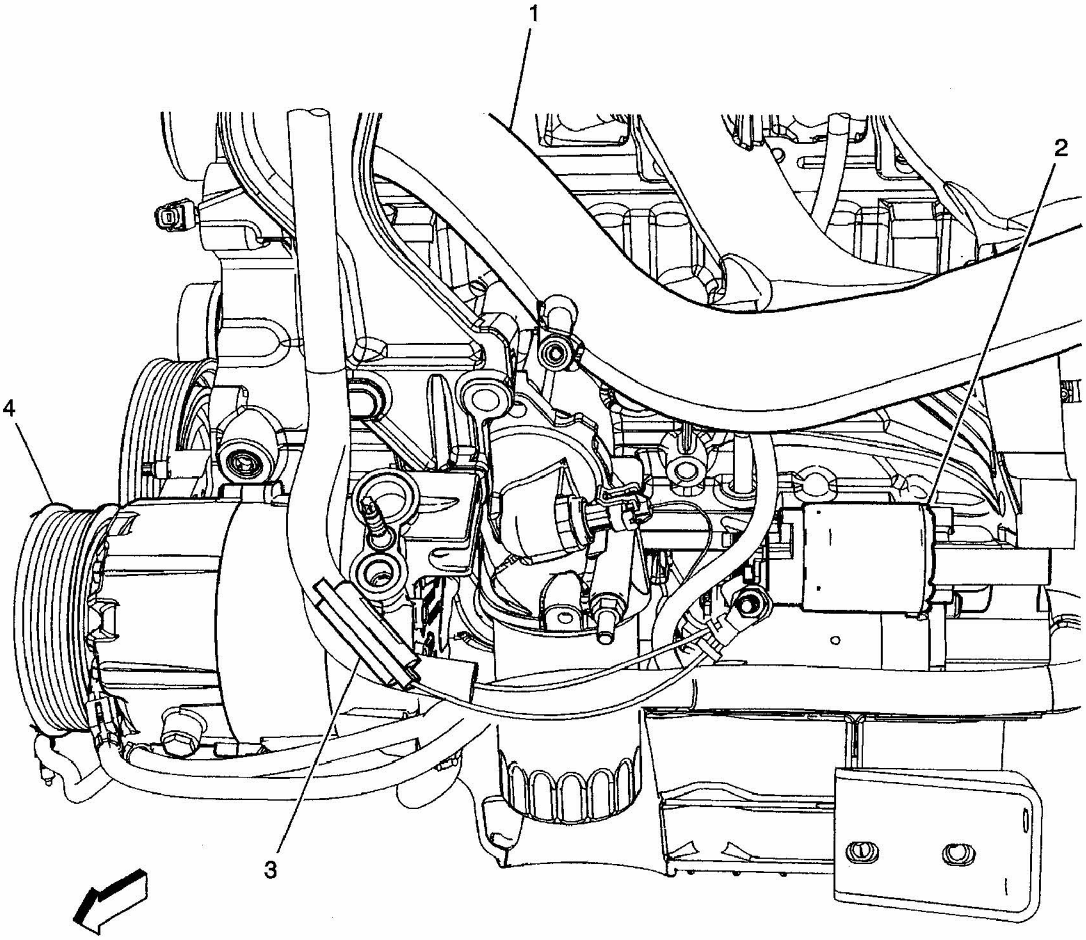
(1) Cooling Fan - Right

(2) Cooling Fan - Left

G00421669

Fig. 31: Cooling System Component Views

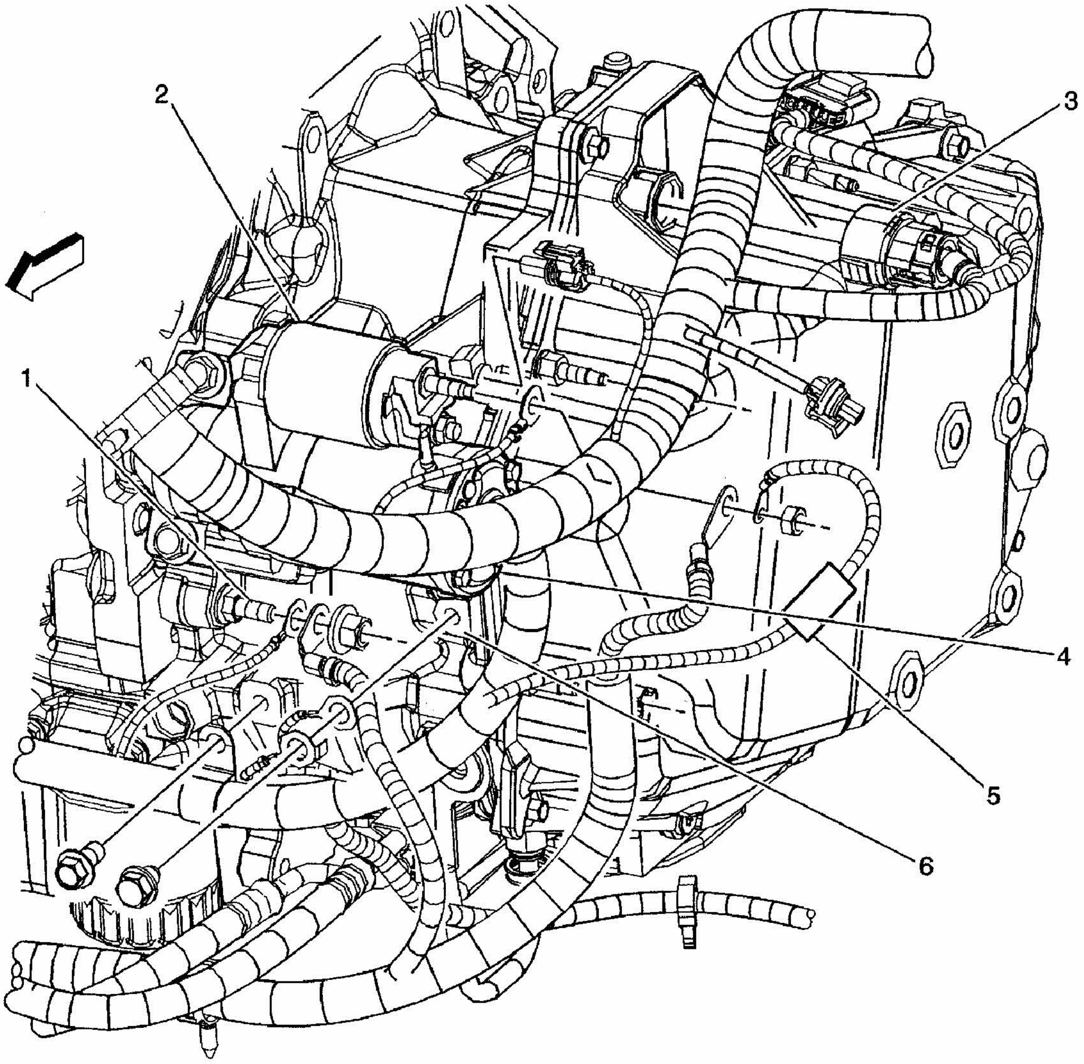
Courtesy of GENERAL MOTORS CORP.



(1) Exhaust Manifold
(2) Starter
(3) Cable Pro Fuse (6J1)
(4) A/C Compressor Clutch

G00421670

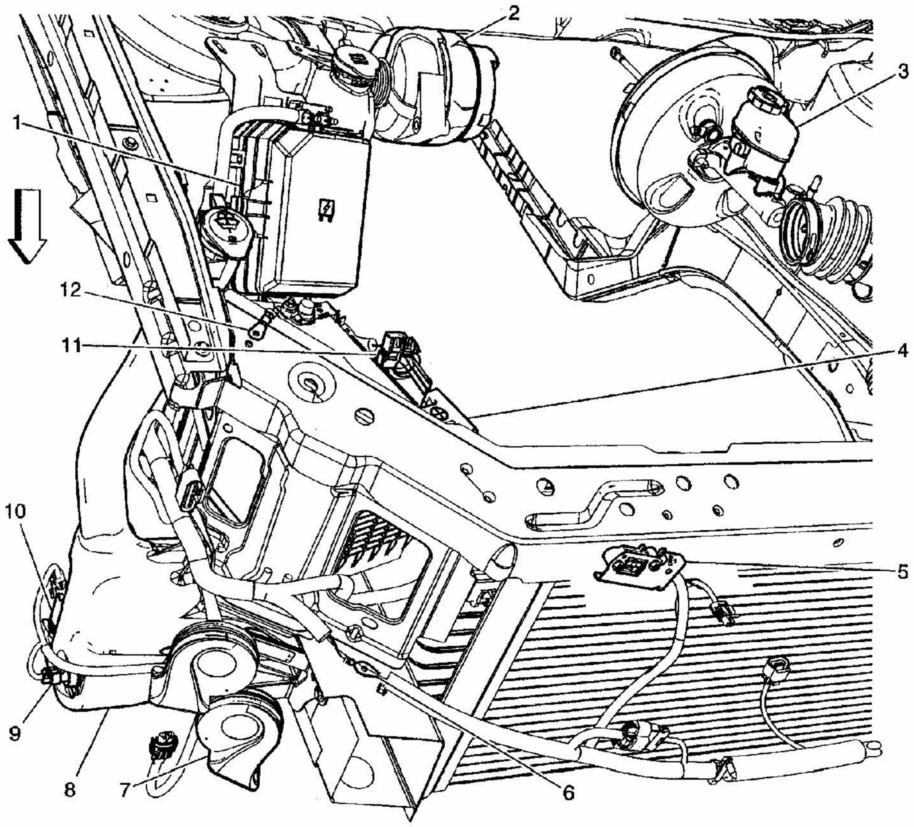
Fig. 32: Lower Front Of Engine (3.5L & 3.9L)
Courtesy of GENERAL MOTORS CORP.



(1) G111
(2) Starter Solenoid
(3) C100
(4) Starter
(5) Cable Pro fuse
(6) G113

G00421671

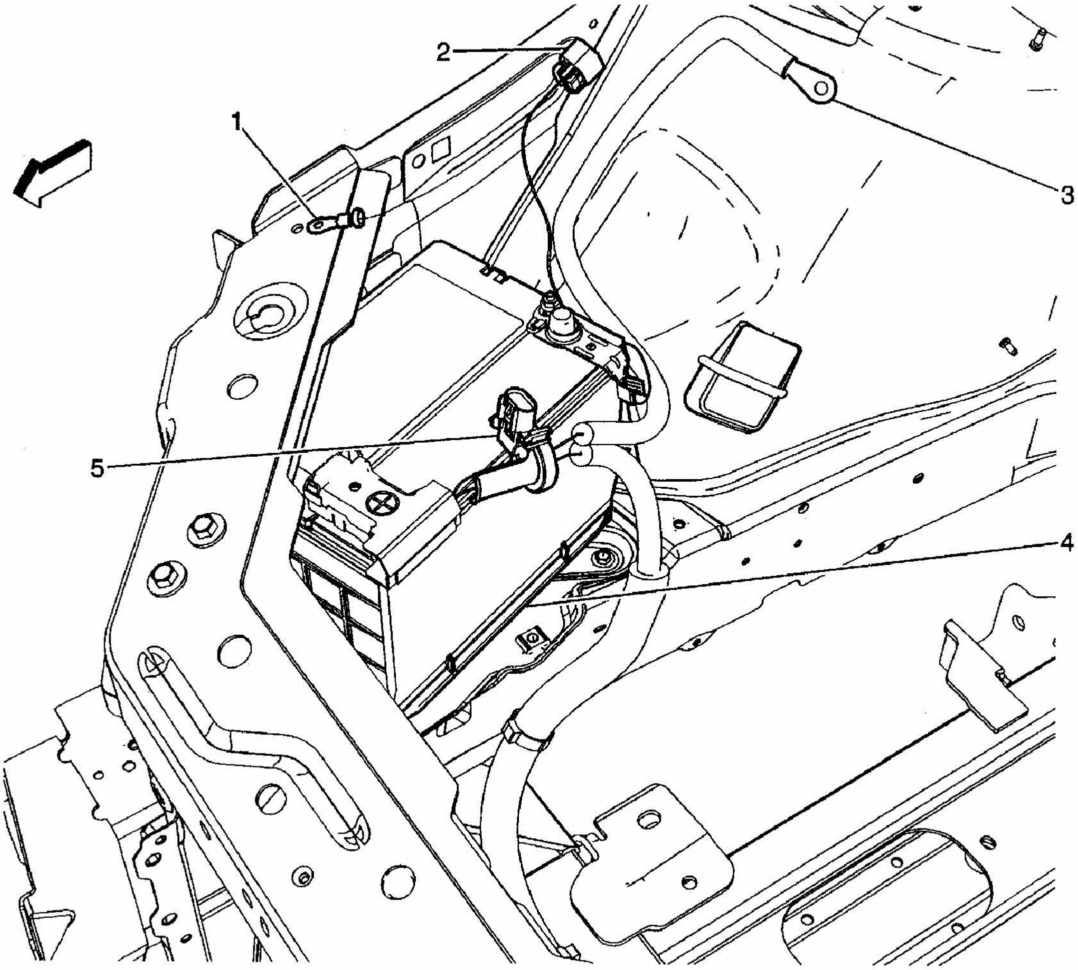
Fig. 33: Rear Of Engine Assembly (5.3L)
Courtesy of GENERAL MOTORS CORP.



(1) Fuse Block - Underhood
(2) Generator
(3) Brake Fluid Level Switch
(4) Battery
(5) Inflatable Restraint Front End Sensor - Right
(6) G100
(7) Horn Assembly
(8) Windshield Washer Fluid Container
(9) Windshield Washer Fluid Level Switch
(10) Windshield Washer Fluid Pump
(11) Battery Current Sensor
(12) G102

G00421672

Fig. 34: Right Front Of Engine Compartment
Courtesy of GENERAL MOTORS CORP.



(1) G102

(2) C105

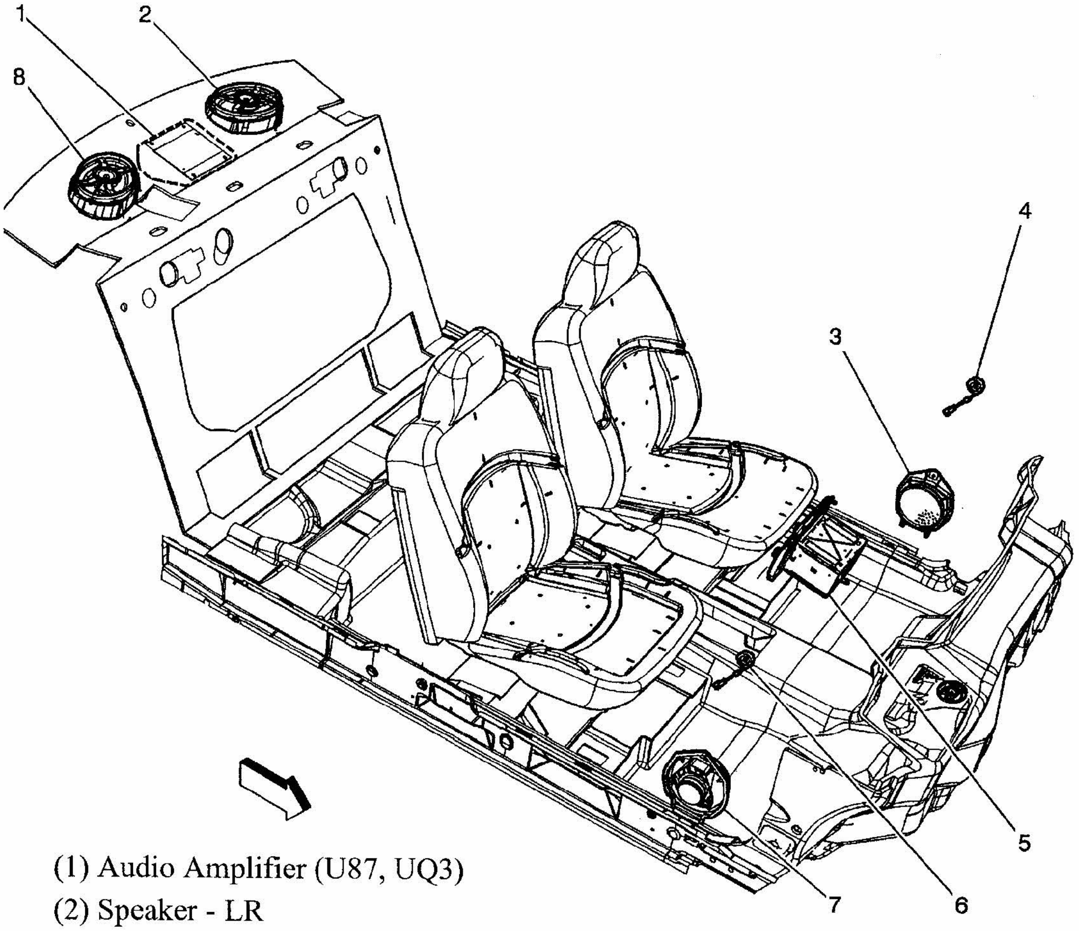
(3) Fuse Block - Underhood Positive Battery Cable Terminal

(4) Battery

(5) Battery Current Sensor

G00421673

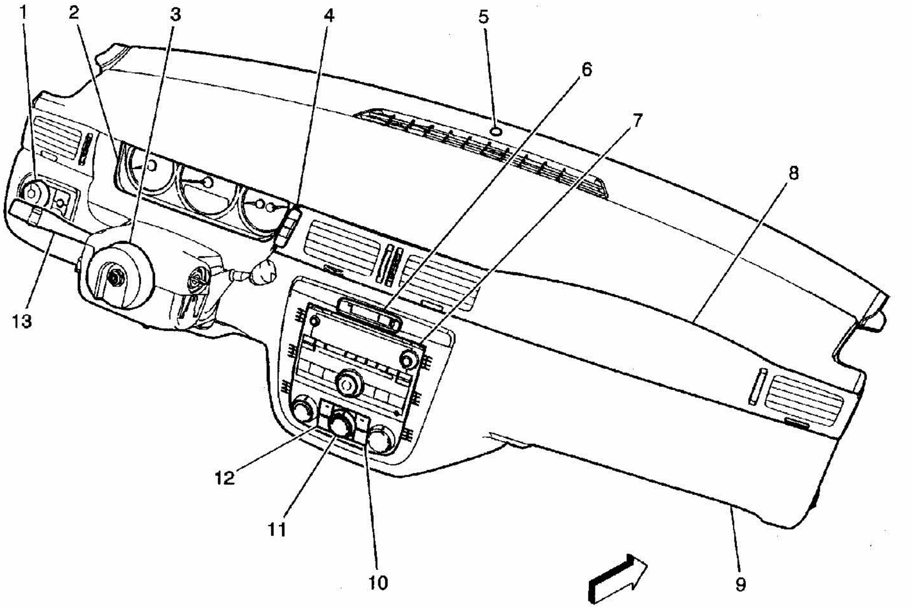
Fig. 35: Right Front Of Vehicle (3.5L & 3.9L)
Courtesy of GENERAL MOTORS CORP.



(1) Audio Amplifier (U87, UQ3)
(2) Speaker - LR
(3) Speaker - LF Door
(4) Speaker - LF Tweeter (UQ3)
(5) Radio
(6) Speaker - RF Tweeter (UQ3)
(7) Speaker - RF Door
(8) Speaker - RR

G00421674

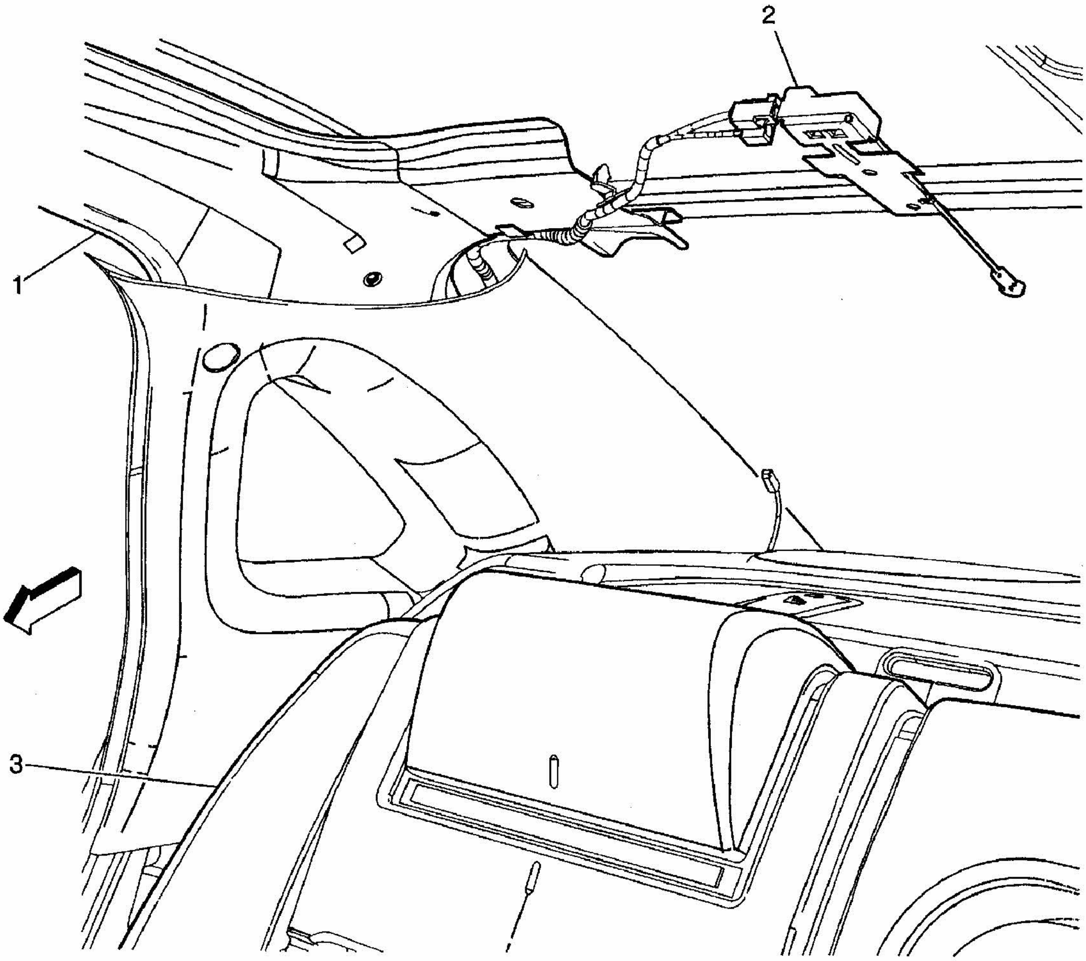
Fig. 36: Interior Overview
Courtesy of GENERAL MOTORS CORP.



(1) Headlamp Switch
(2) Instrument Panel Cluster (IPC)
(3) Inflatable Restraint Steering Wheel Module Coil
(4) Driver Information Center (DIC) Switch
(5) Ambient Light Sensor
(6) Inflatable Restraint Passenger Air Bag On/Off Indicator (Sedan w/o 9C1, 9C3)
(7) Radio
(8) Inflatable Restraint I/P Module
(9) I/P Trim Panel
(10) Heated Seat Switch - Passenger (KA1)
(11) HVAC Control Module
(12) Heated Seat Switch - Driver (KA1)
(13) Turn Signal/Multifunction Switch

G00421675

Fig. 37: Dash Components
Courtesy of GENERAL MOTORS CORP.



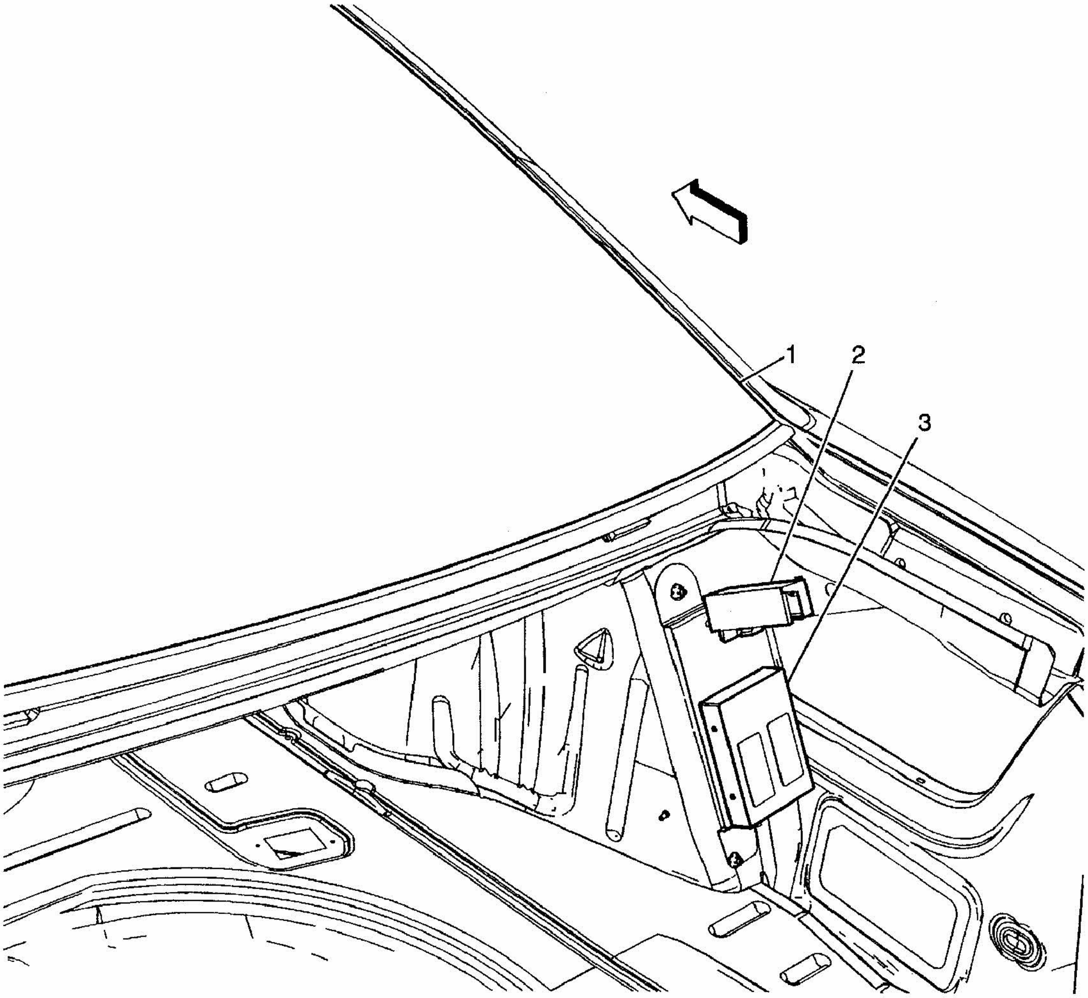
(1) Left Rear C-Pillar

(2) Radio Antenna Module

(3) Rear Seat

G00421676

Fig. 38: Rear Seat
Courtesy of GENERAL MOTORS CORP.



(1) Rear Window

(2) Junction Block - Rear (6J1)

(3) Digital Radio Receiver (U2K)

G00421677

Fig. 39: Right Side Of Luggage Compartment
Courtesy of GENERAL MOTORS CORP.

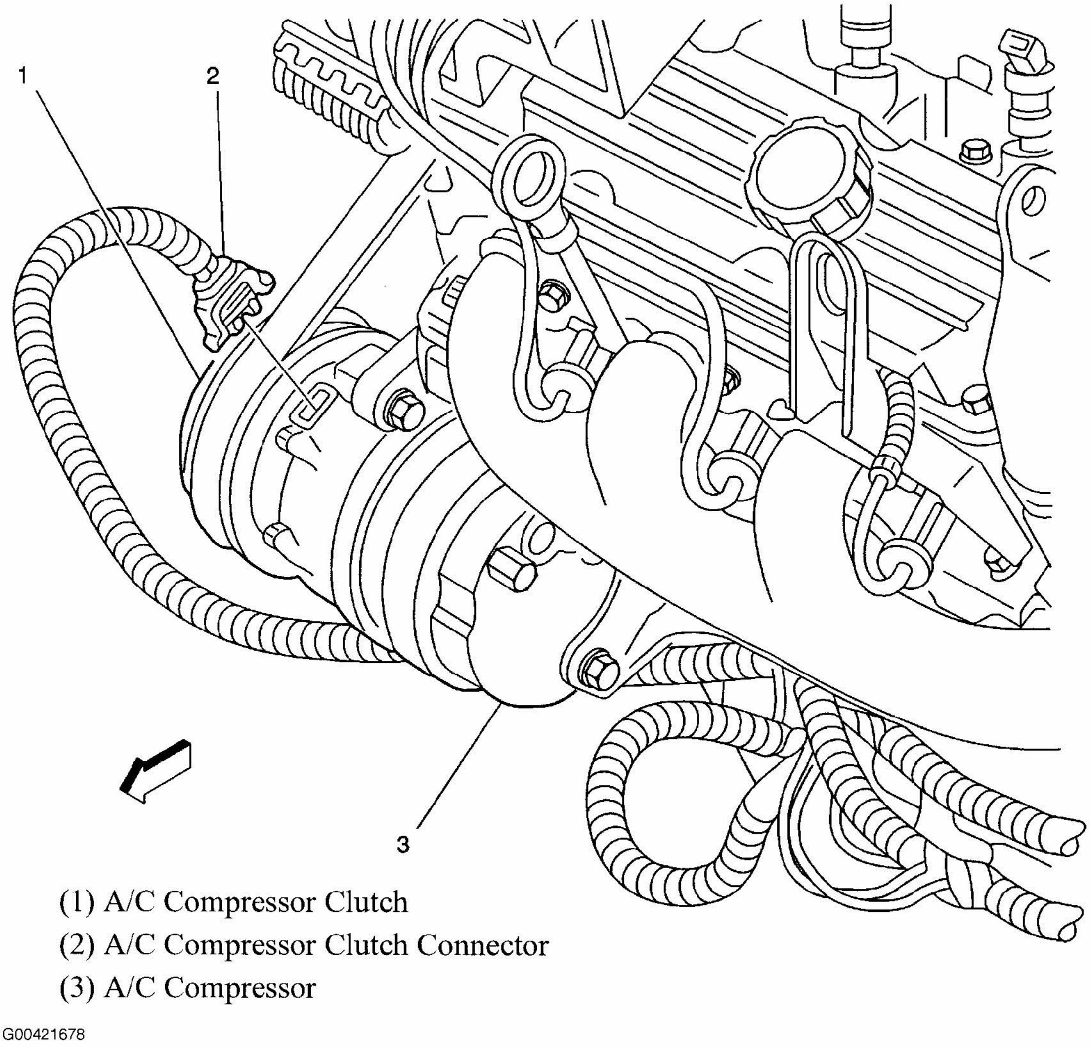
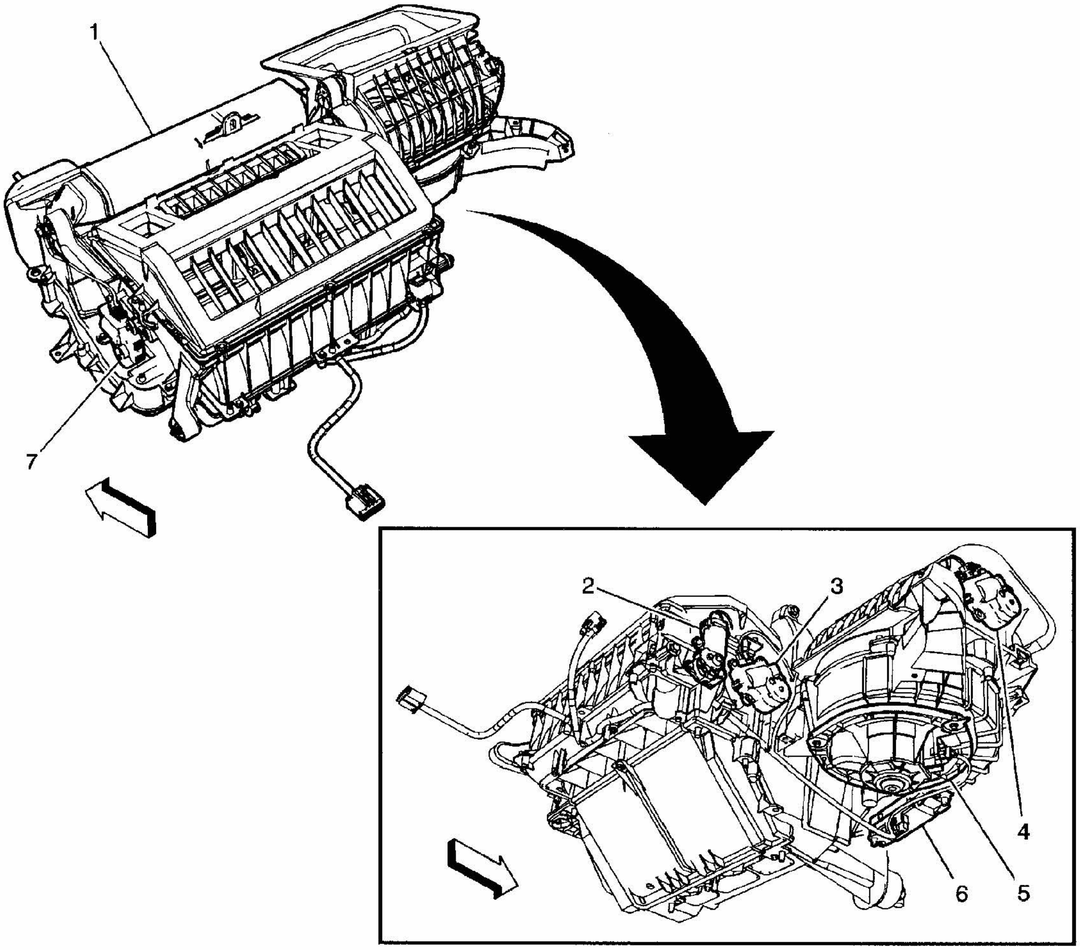

1
2
3
(1) A/C Compressor Clutch
(2) A/C Compressor Clutch Connector
(3) A/C Compressor
G00421678

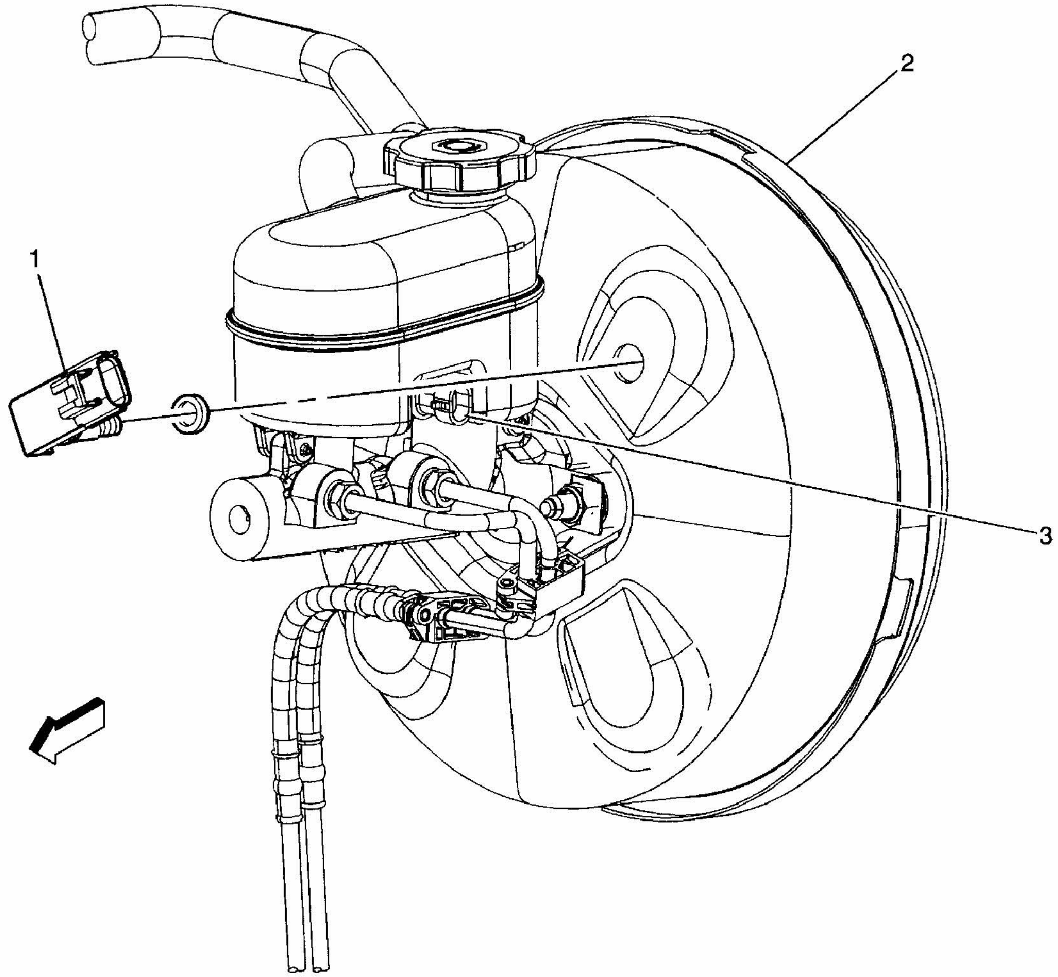
Fig. 40: Lower Left Front Of Engine
Courtesy of GENERAL MOTORS CORP.



(1) HVAC Module
(2) Mode Actuator
(3) Air Temperature Actuator (C67), Air Temperature Actuator - Right (CJ3)
(4) Recirculation Actuator
(5) Blower Motor
(6) Blower Motor Control Processor
(7) Air Temperature Actuator - Left (CJ3)

G00421679

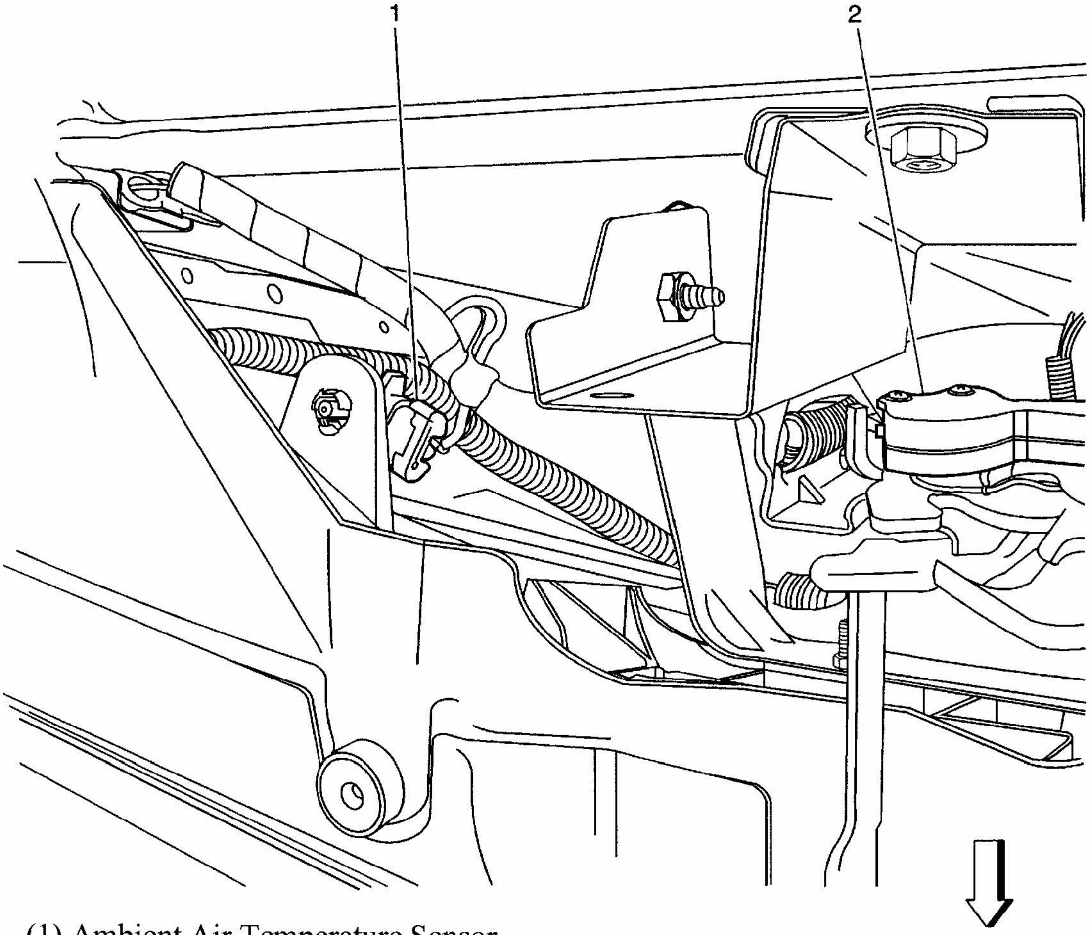
Fig. 41: HVAC Components
Courtesy of GENERAL MOTORS CORP.



(1) Brake Booster Vacuum Sensor (LS4)
(2) Brake Booster
(3) Brake Fluid Level Switch

G00421680

Fig. 42: Left Rear Of Engine Compartment
Courtesy of GENERAL MOTORS CORP.

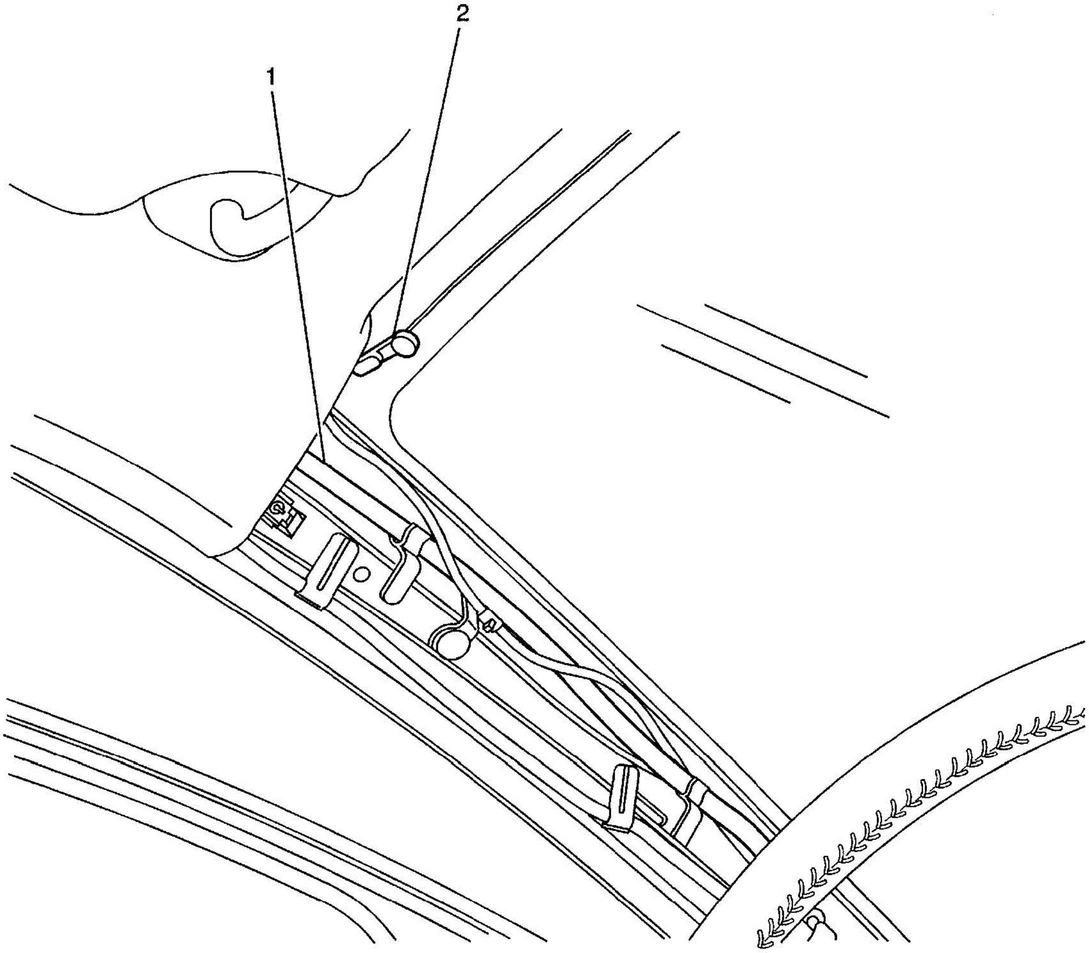


(1) Ambient Air Temperature Sensor

(2) Hood Ajar Switch (AP3, AP8)

G00421681

Fig. 43: Front Of Engine Compartment
Courtesy of GENERAL MOTORS CORP.

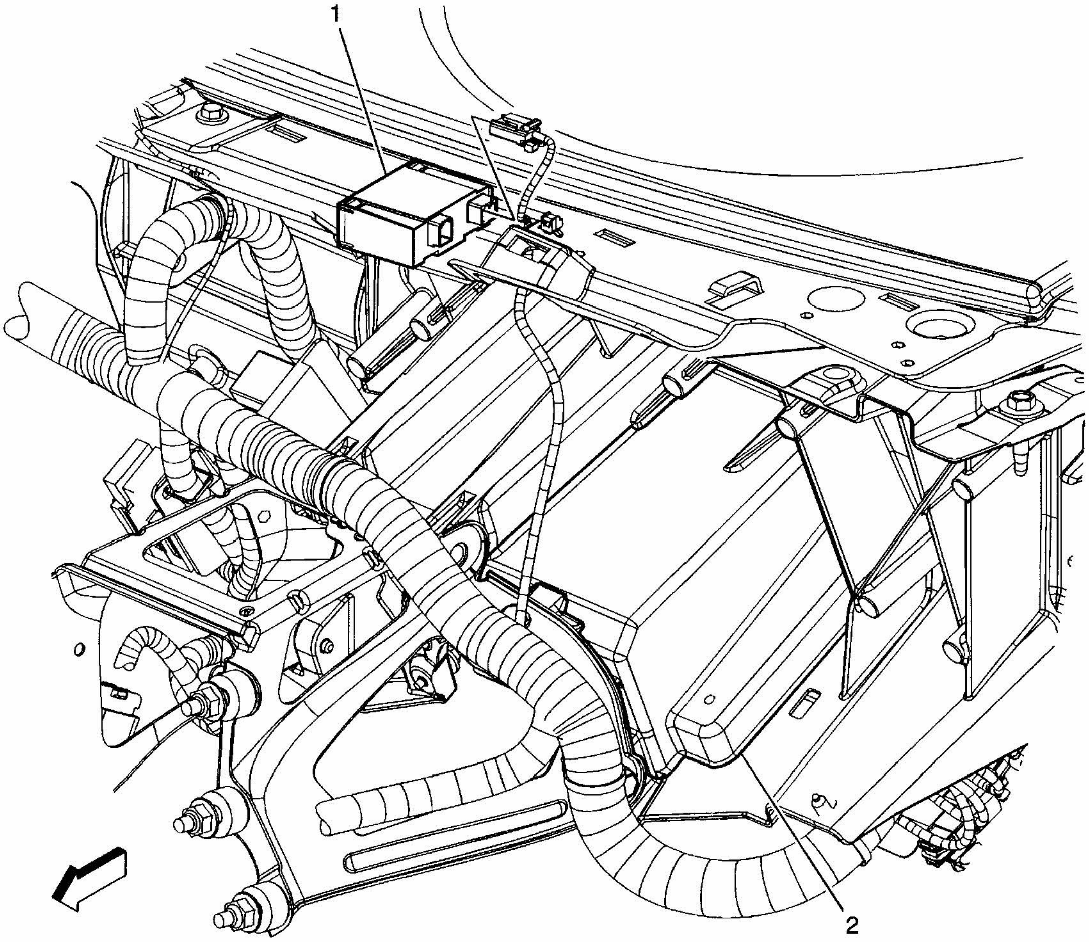


(1) Left A-Pillar

(2) Remote Control Door Lock Receiver Windshield Antenna (AP3, AP8)

G00421682

Fig. 44: Left Side Of Windshield
Courtesy of GENERAL MOTORS CORP.



(1) Remote Control Door Lock Receiver (RCDLR)
(2) I/P Carrier

G00421683

Fig. 45: Upper Center Of Dash
Courtesy of GENERAL MOTORS CORP.

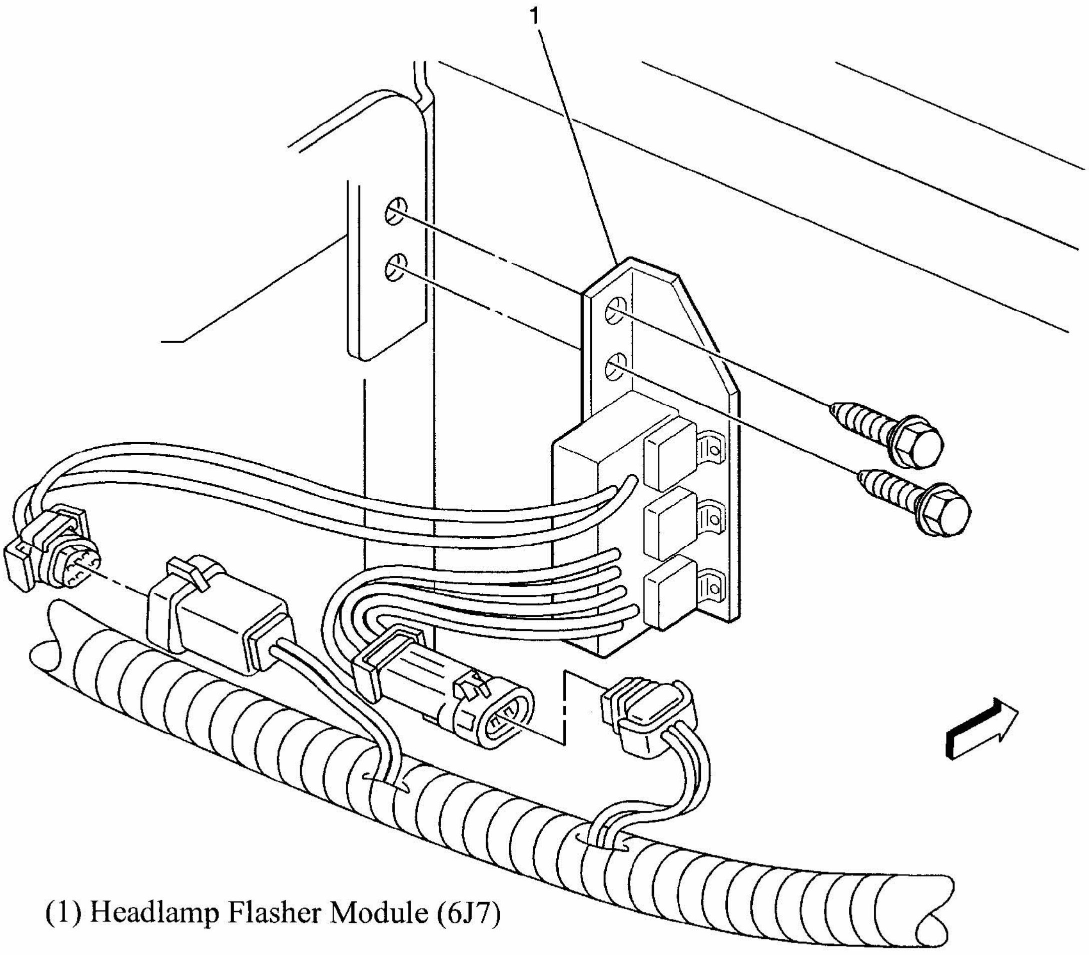
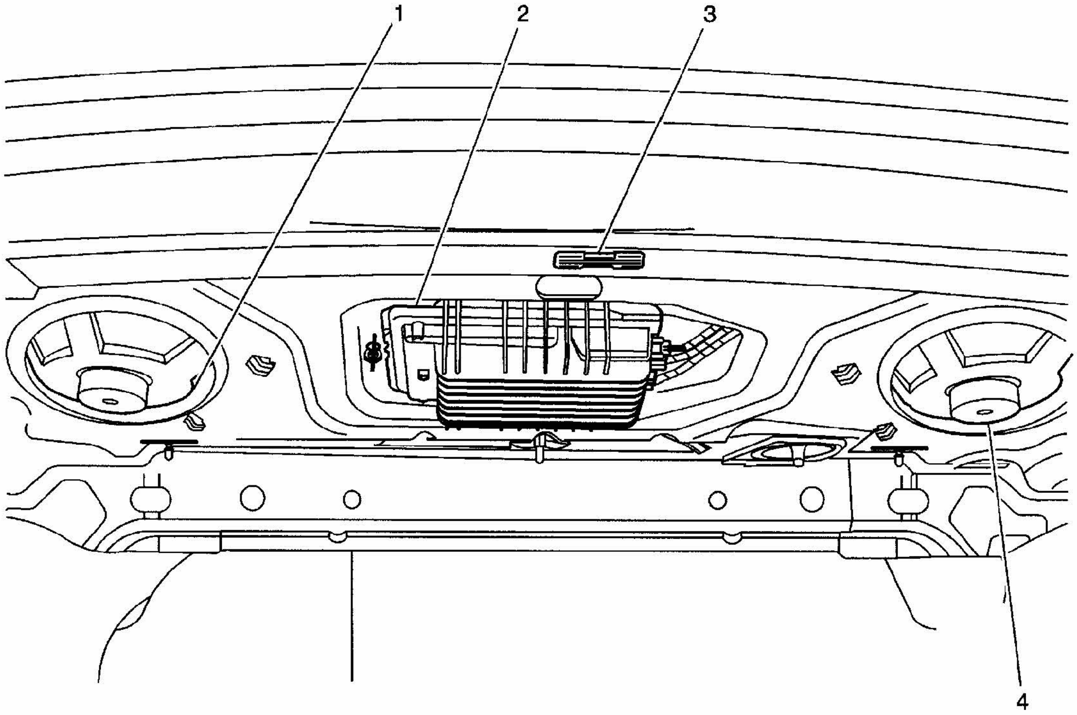

1
(1) Headlamp Flasher Module (6J7)
G00421684

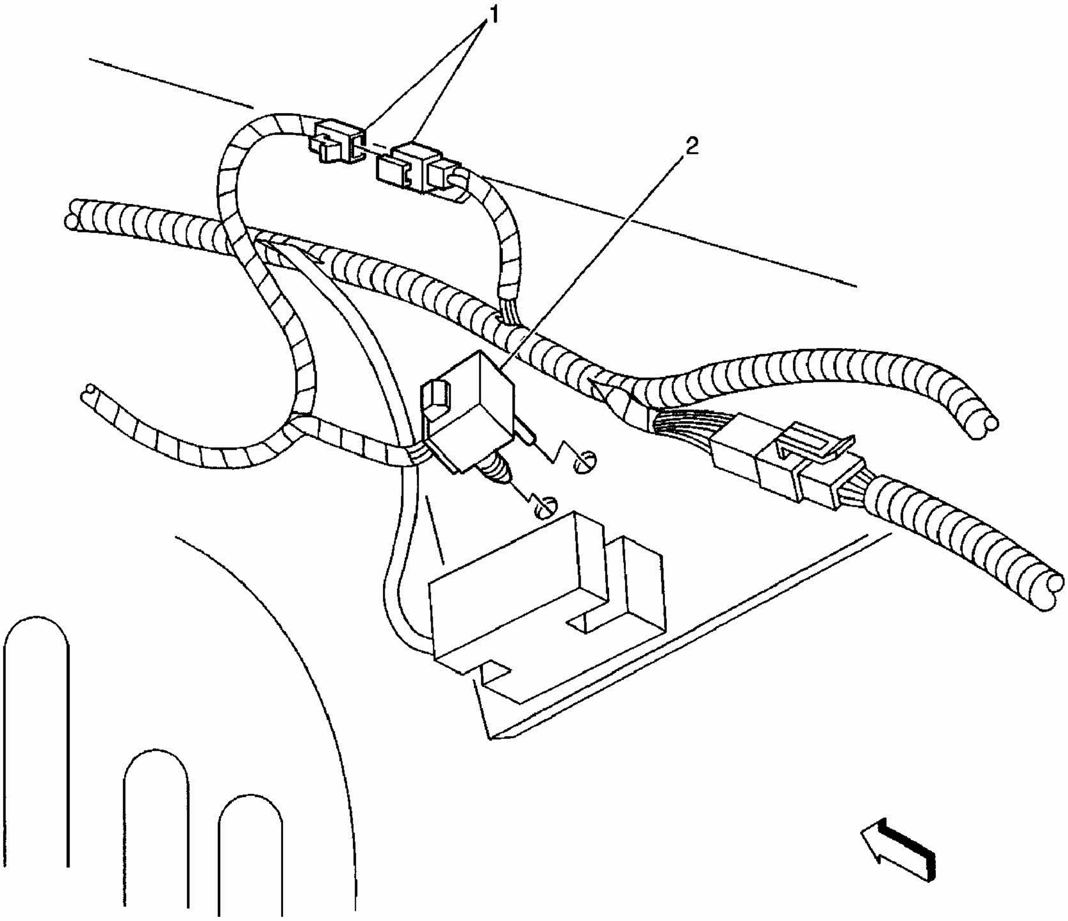
Fig. 46: Right Front Of Engine Compartment
Courtesy of GENERAL MOTORS CORP.



(1) Speaker - LR
(2) Audio Amplifier
(3) Rear Compartment Courtesy Lamp
(4) Speaker - RR

G00421685

Fig. 47: Rear Package Shelf
Courtesy of GENERAL MOTORS CORP.

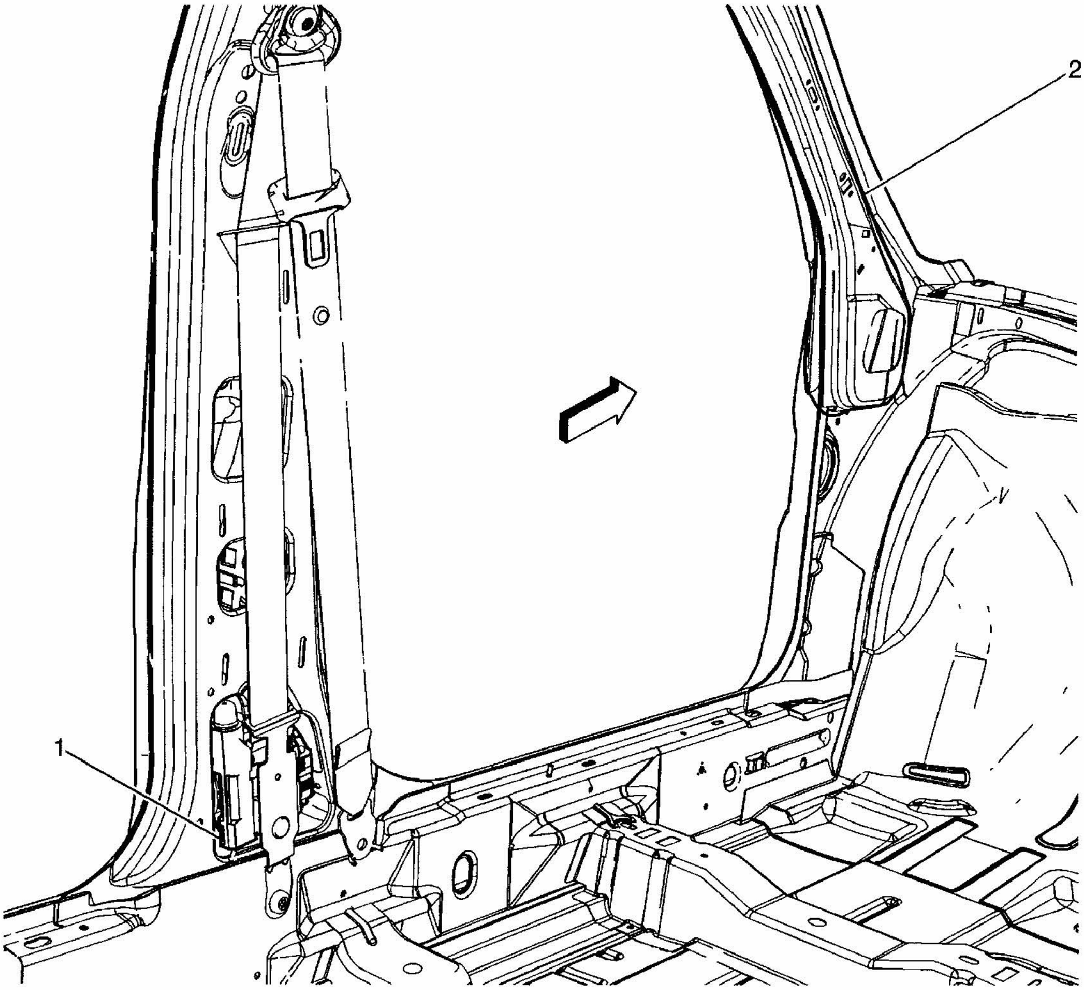


(1) C409

(2) Emergency Vehicle Rear Compartment Lid Lamps Relay

G00421686

Fig. 48: Right Front Of Rear Compartment
Courtesy of GENERAL MOTORS CORP.

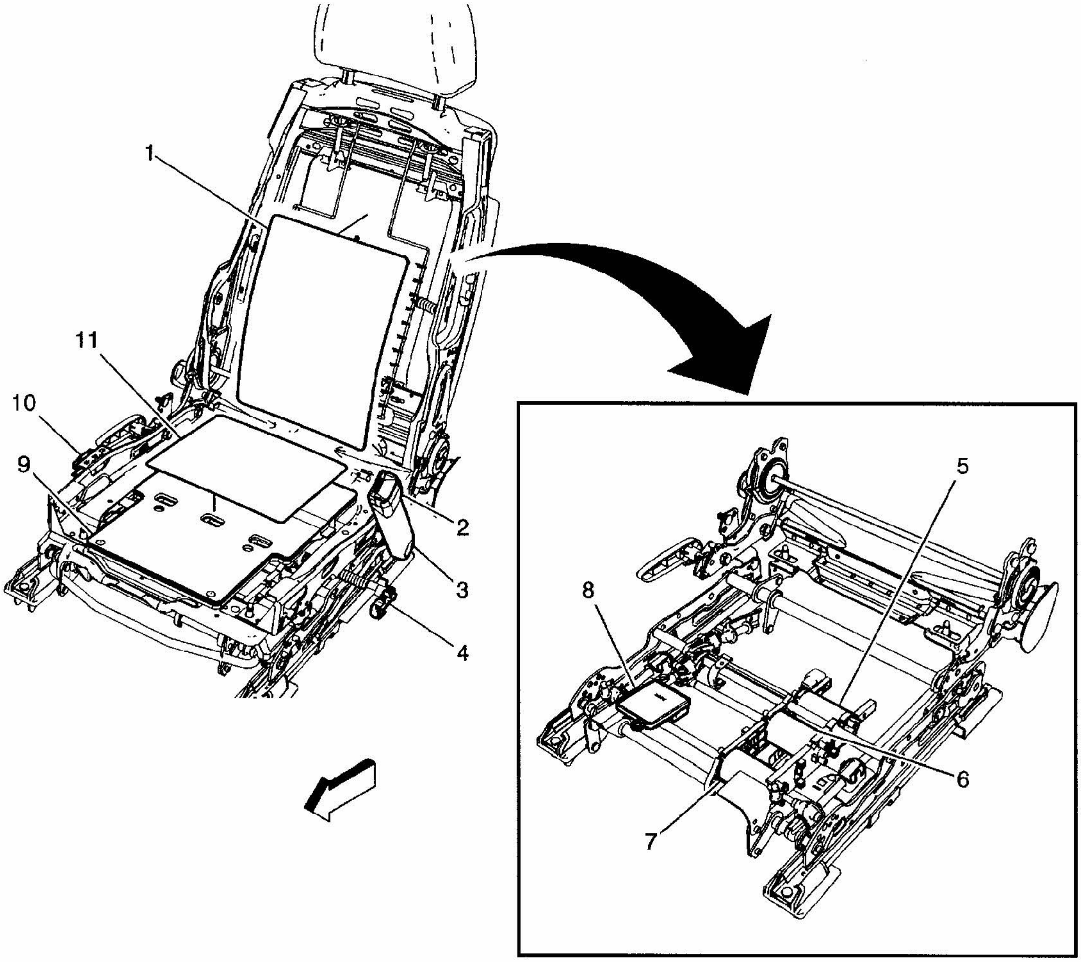


(1) Seat Belt Pretensioner - Left

(2) Left A-Pillar

G00421687

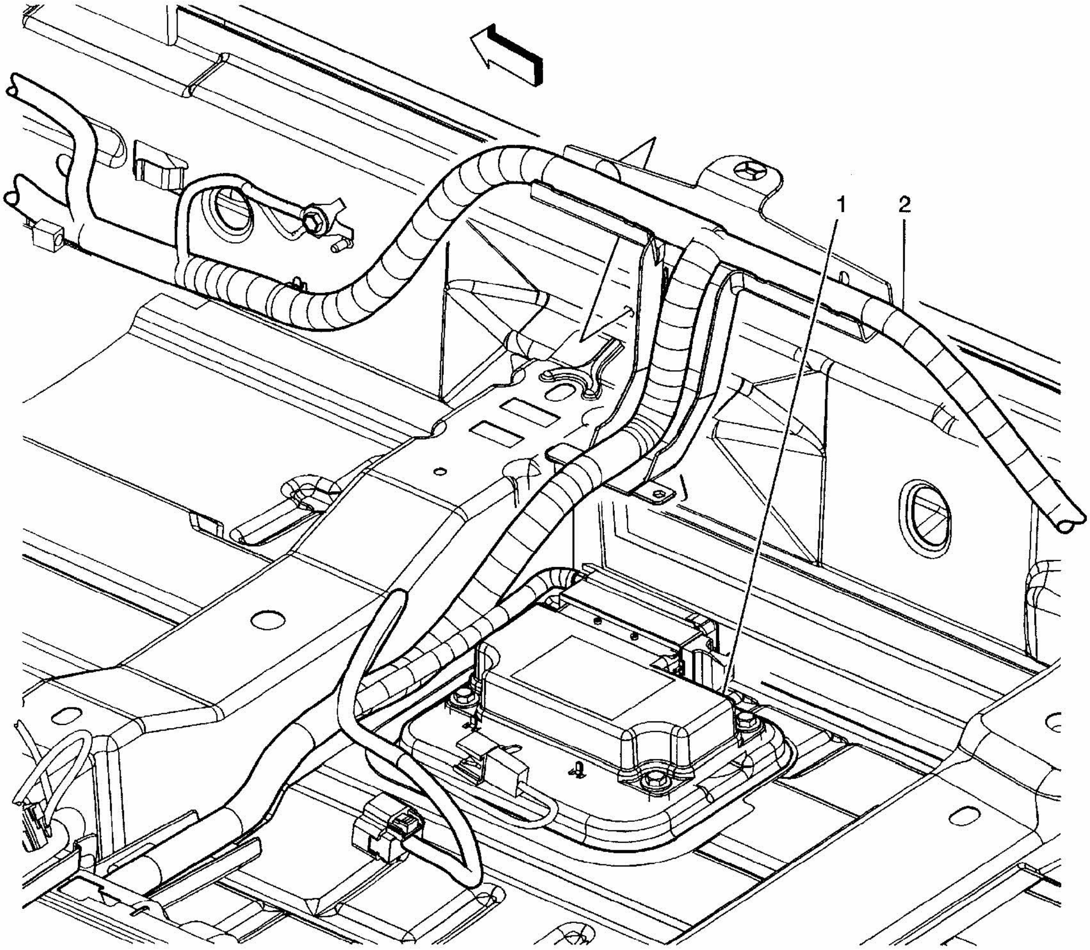
Fig. 49: Left "B" Pillar
Courtesy of GENERAL MOTORS CORP.



(1) Heated Seat Element - Passenger - Back (KA1)
(2) Seat Belt Switch - Passenger
(3) Seat Belt Tension Sensor - Passenger
(4) Seat Belt Tension Sensor - Passenger, Connector
(5) Rear Vertical Motor (Part of the Seat Adjuster Motor Assembly - Passenger)
(6) Front Vertical Motor (Part of the Seat Adjuster Motor Assembly - Passenger)
(7) Horizontal Motor (Part of the Seat Adjuster Motor Assembly - Passenger)
(8) Inflatable Restraint Front Passenger Presence System (PPS) Module
(9) Inflatable Restraint Front Passenger Presence System (PPS) Sensor
(10) Seat Adjuster Switch - Passenger (AG2)
(11) Heated Seat Element - Passenger - Seat (KA1)

G00421688

Fig. 50: Passenger's Seat
Courtesy of GENERAL MOTORS CORP.

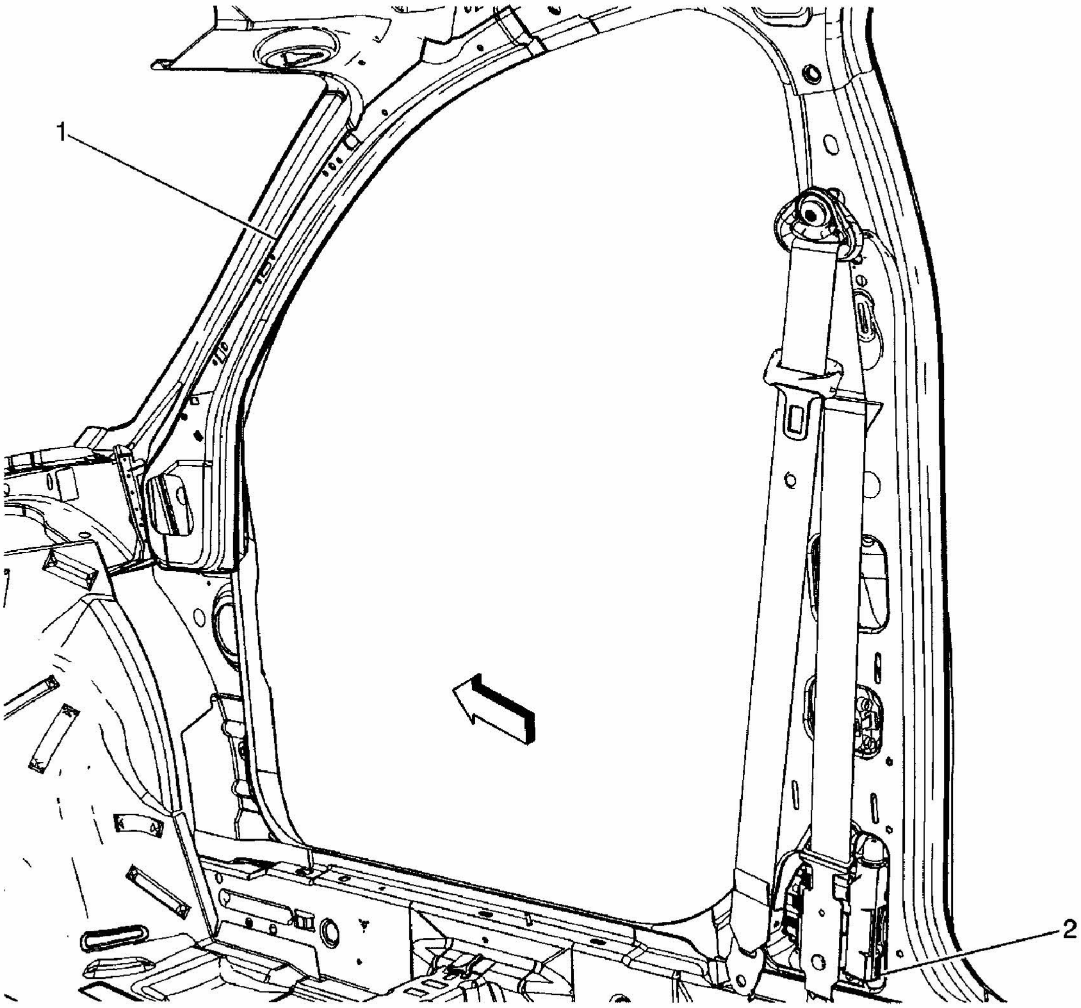


(1) Inflatable Restraint Sensing and Diagnostic Module (SDM)

(2) Front Passenger Floor Panel

G00421689

Fig. 51: Passenger's Floor Pan
Courtesy of GENERAL MOTORS CORP.

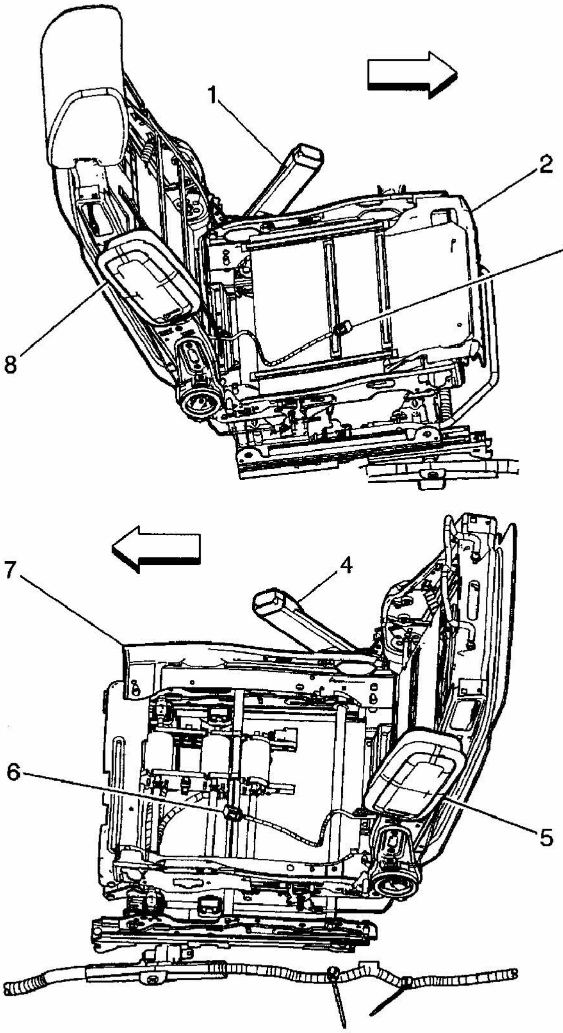


(1) Right A-Pillar

(2) Seat Belt Pretensioner - Right

G00421690

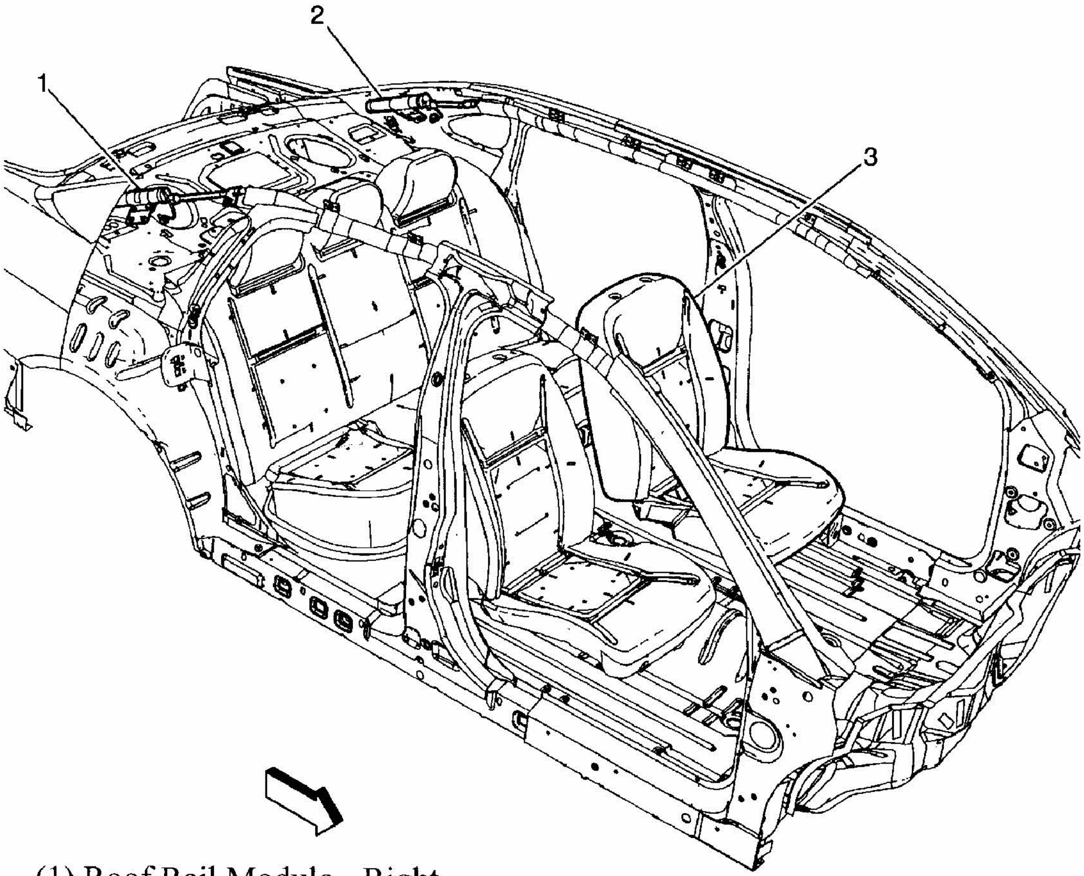
Fig. 52: Right "B" Pillar
Courtesy of GENERAL MOTORS CORP.



(1) Seat Belt Switch-Passenger
(2) Passenger
(3) C314
(4) Seat Belt Switch-Driver
(5) Inflatable Restraint Side Impact Module-Left
(6) C312
(7) Driver Seat
(8) Inflatable Restraint Side Impact Module-Right

G00421691

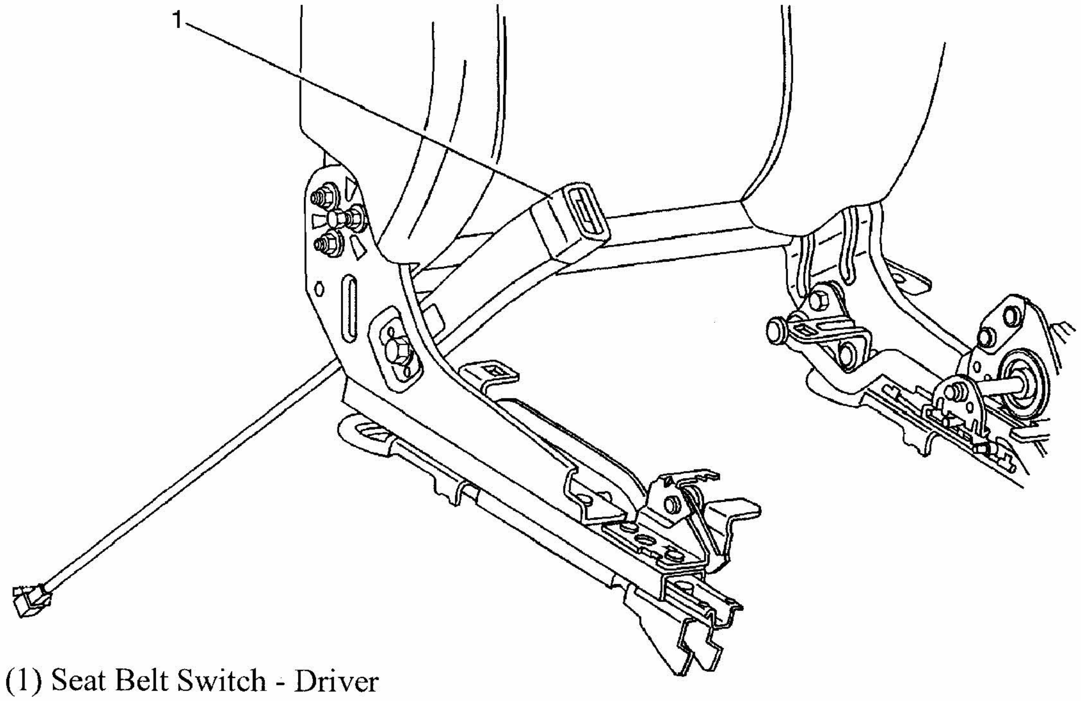
Fig. 53: Front Seats
Courtesy of GENERAL MOTORS CORP.



(1) Roof Rail Module - Right
(2) Roof Rail Module - Left
(3) Drivers Seat

G00421692

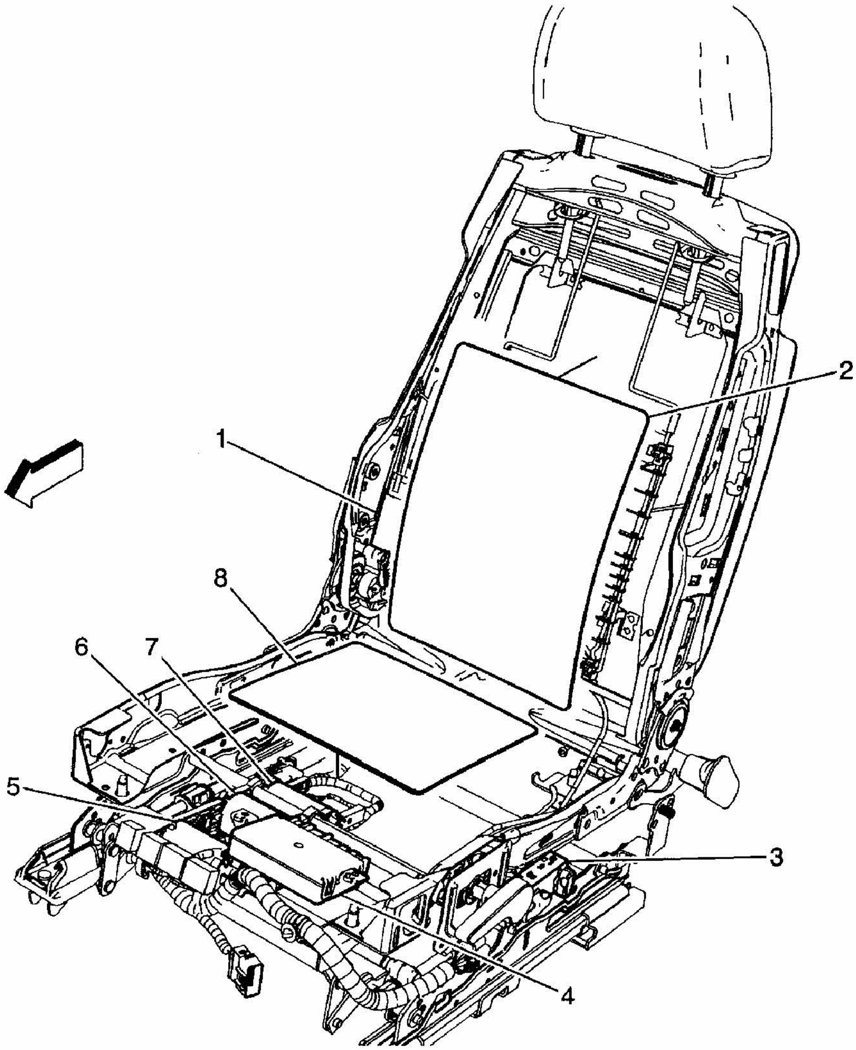
Fig. 54: Vehicle Overview
Courtesy of GENERAL MOTORS CORP.



(1) Seat Belt Switch - Driver

G00421693

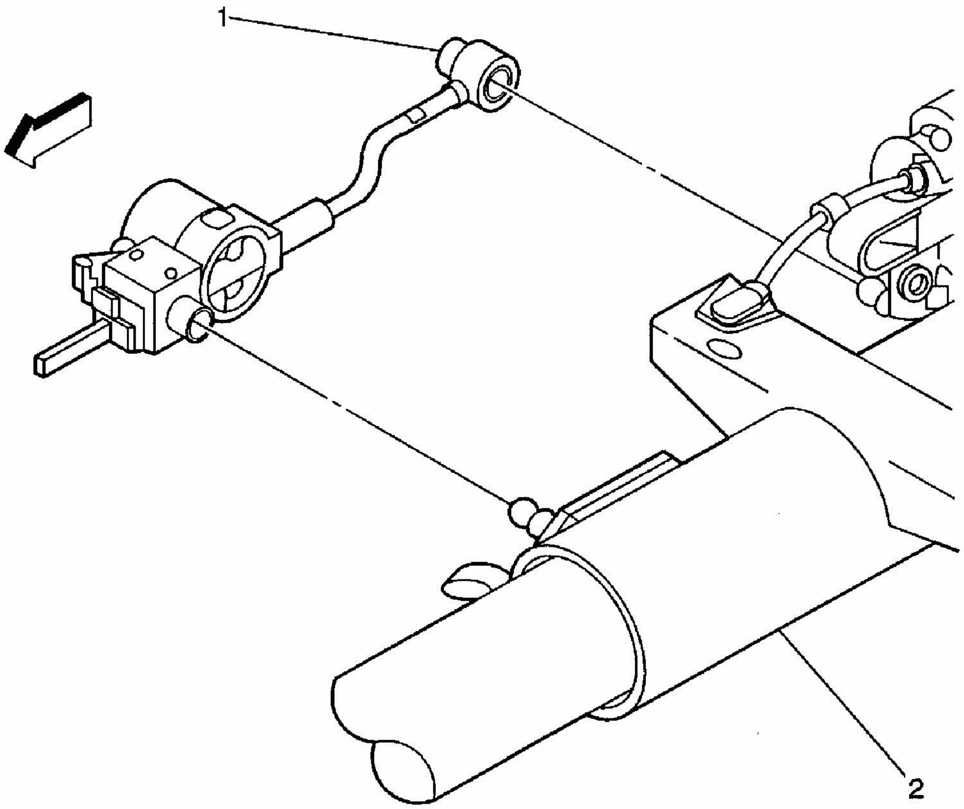
Fig. 55: Left Front Seat
Courtesy of GENERAL MOTORS CORP.



(1) Seat Recline Motor - Driver (AH5)
(2) Heated Seat Element - Driver - Back (KA1)
(3) Seat Adjuster Switch - Driver
(4) Heated Seat Control Module (KA1)
(5) Horizontal Motor (Part of the Seat Adjuster Motor Assembly - Driver)
(6) Front Vertical Motor (Part of the Seat Adjuster Motor Assembly - Driver)
(7) Rear Vertical Motor (Part of the Seat Adjuster Motor Assembly - Driver)
(8) Heated Seat Element - Driver - Seat (KA1)

G00421694

Fig. 56: Driver's Seat Components
Courtesy of GENERAL MOTORS CORP.

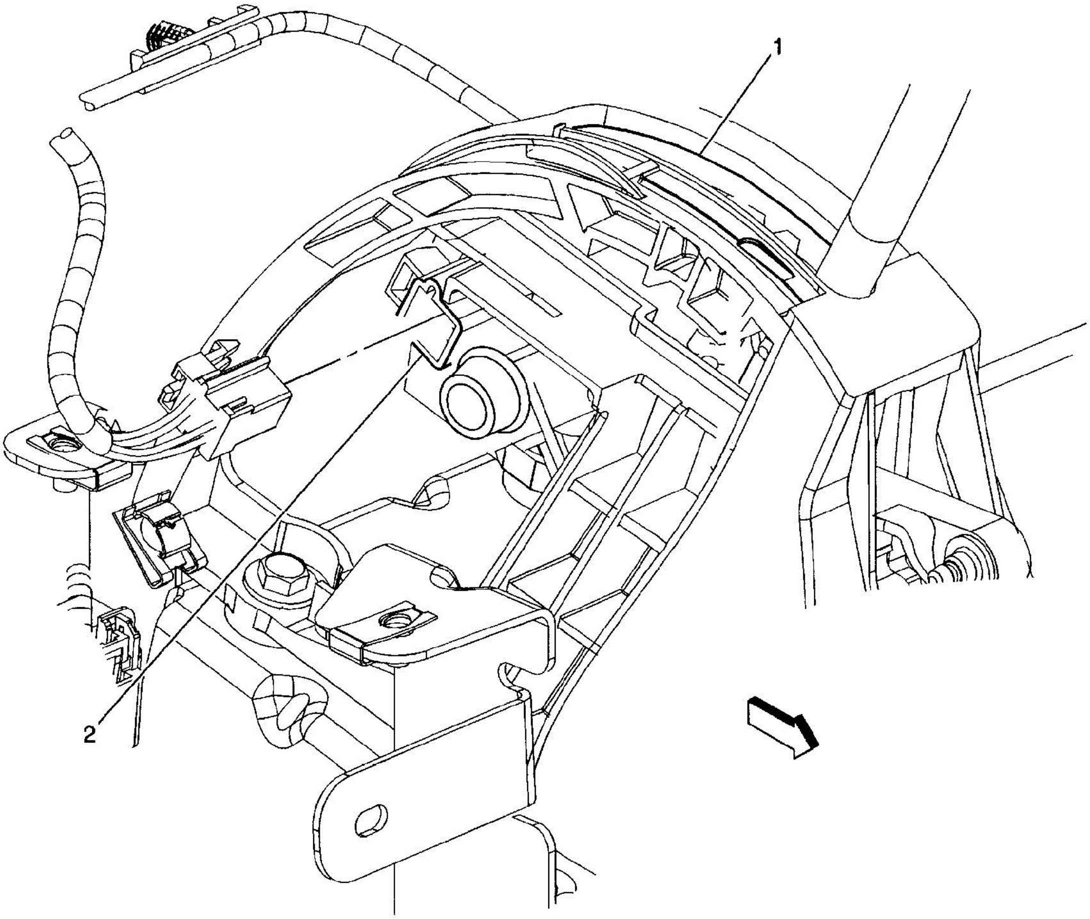


(1) A/T Shift Lock Control Solenoid

(2) Steering Column

G00421695

Fig. 57: Steering Column Components
Courtesy of GENERAL MOTORS CORP.

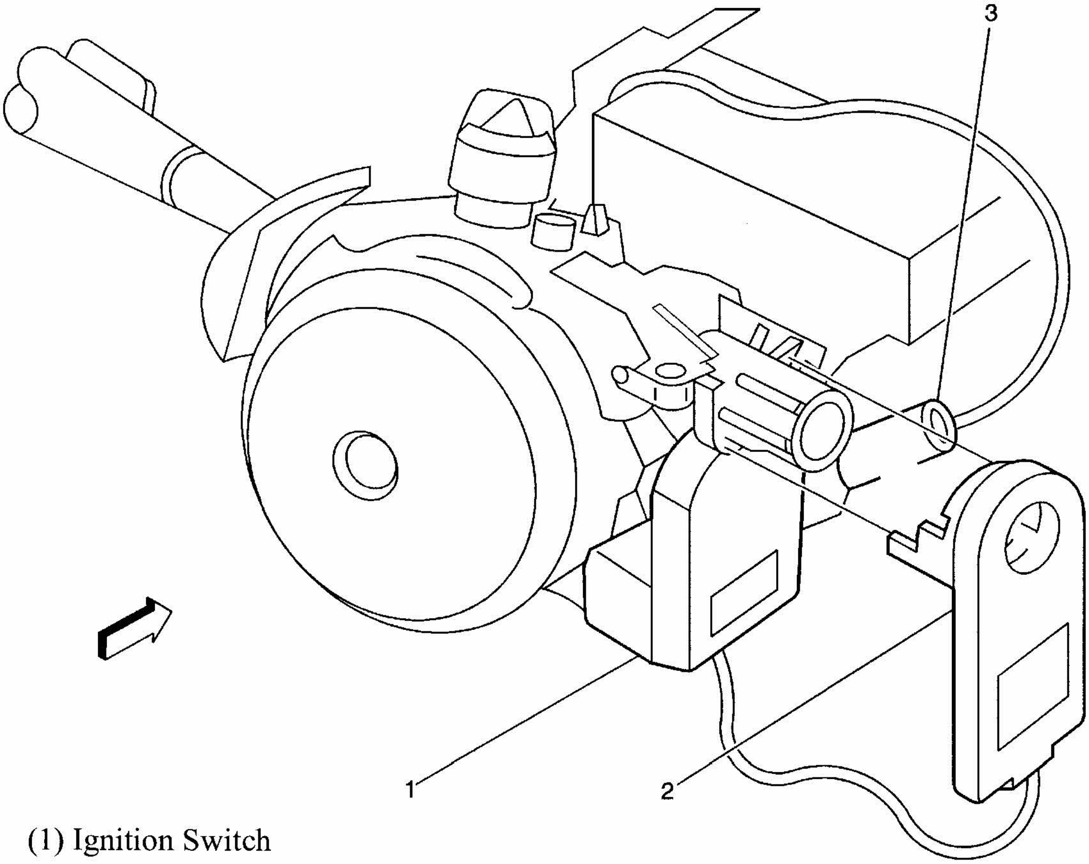


(1) Floor Shifter

(2) A/T Shift Lock Control Solenoid

G00421696

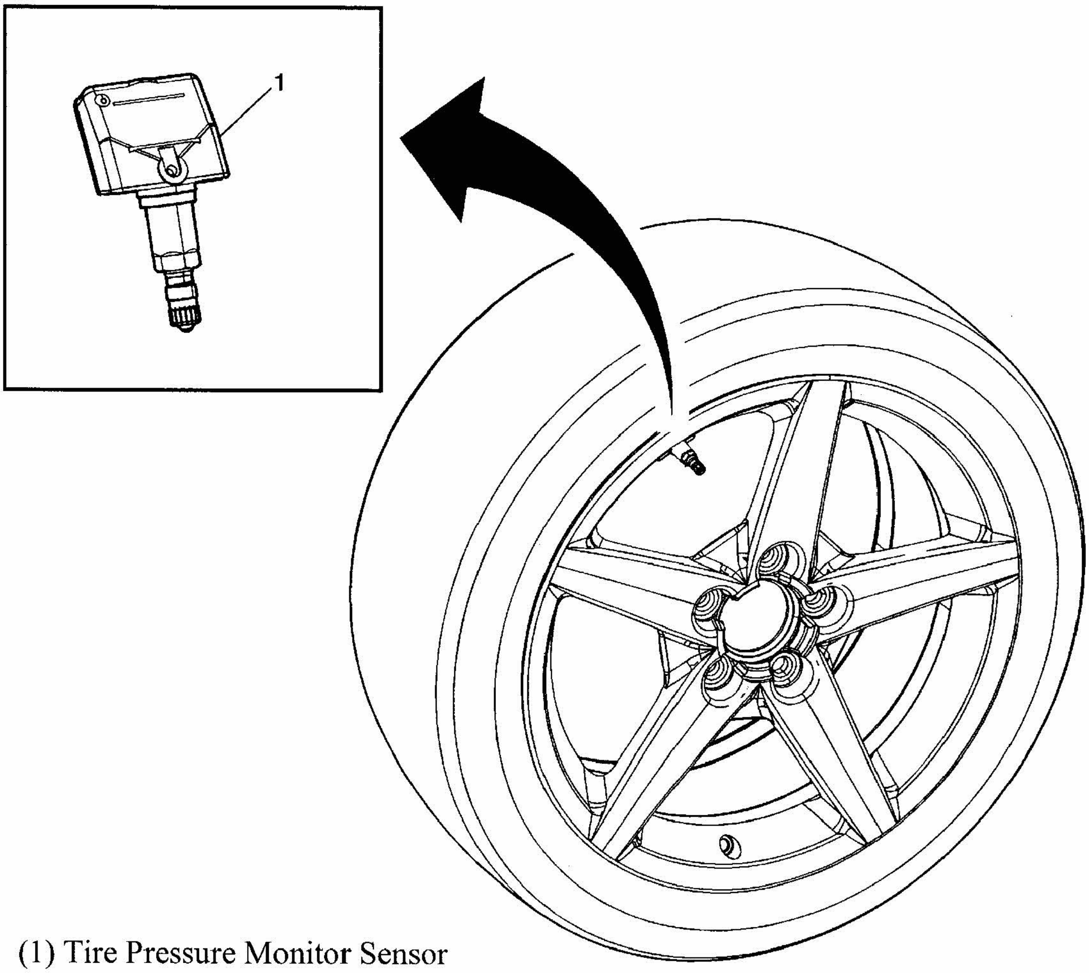
Fig. 58: Center Console
Courtesy of GENERAL MOTORS CORP.



(1) Ignition Switch
(2) Theft Deterrent Exciter Module
(3) Ignition Lock Cylinder Control Actuator

G00421697

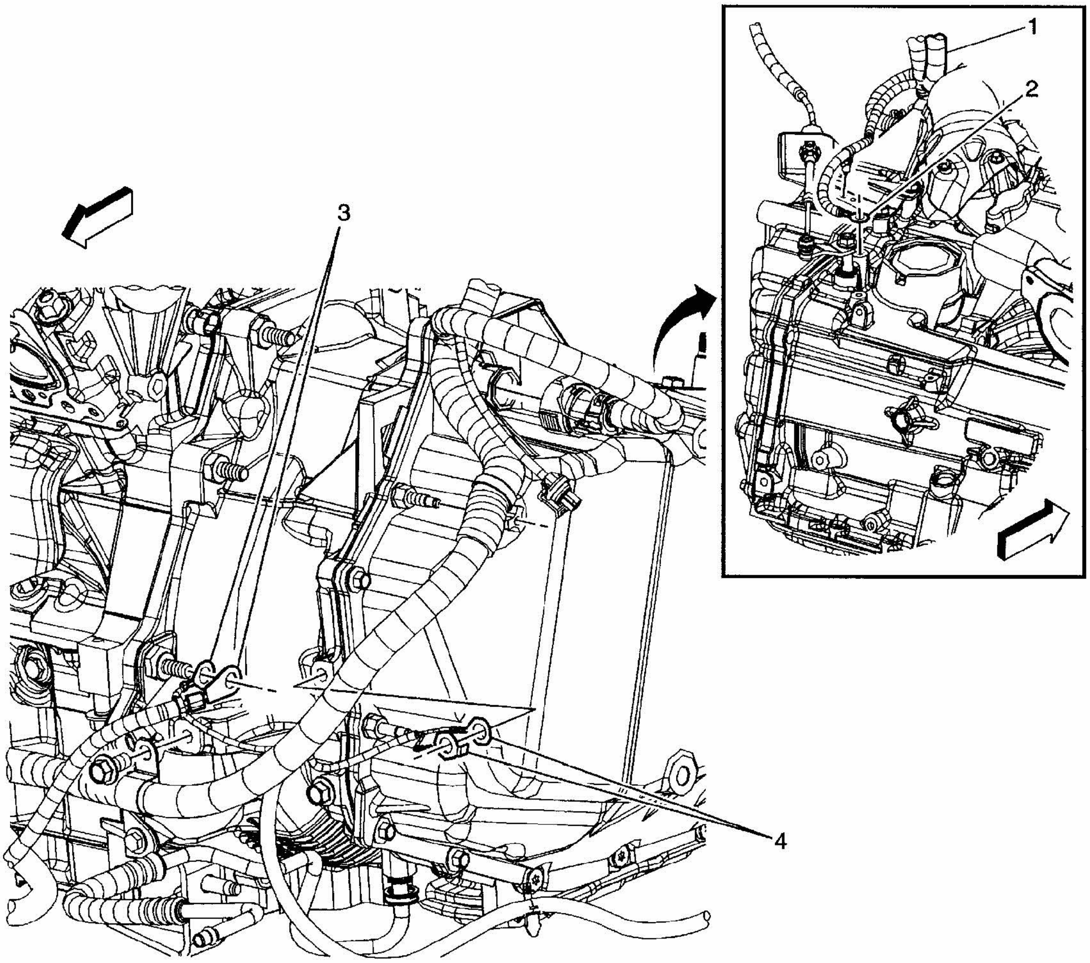
Fig. 59: Steering Column
Courtesy of GENERAL MOTORS CORP.



(1) Tire Pressure Monitor Sensor

G00421698

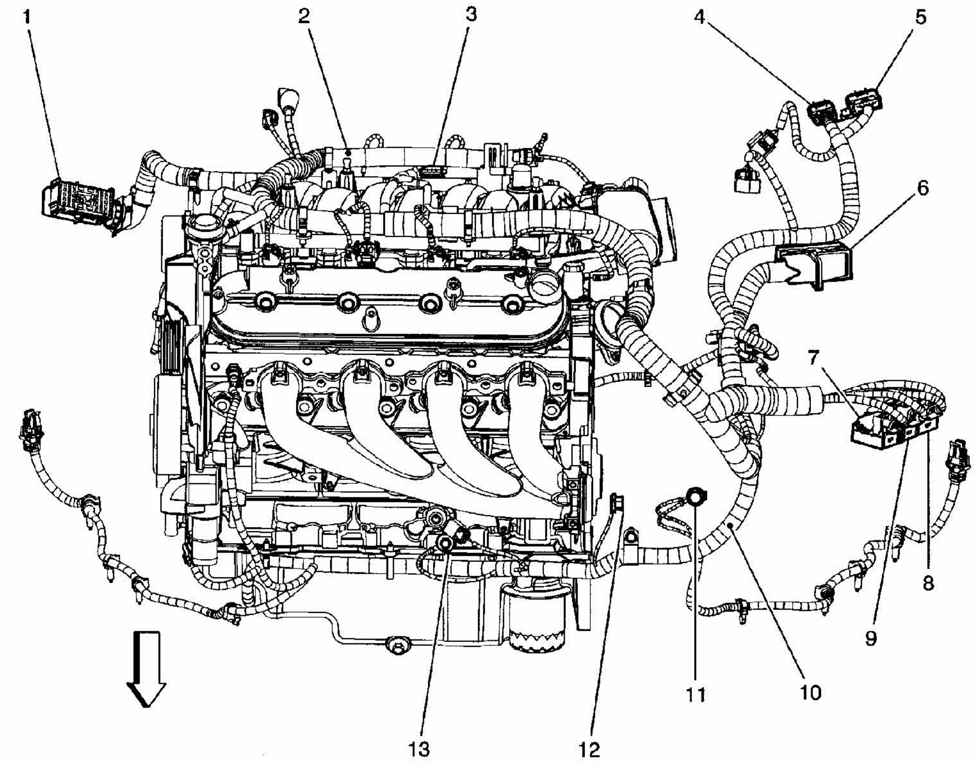
Fig. 60: Wheel Assembly
Courtesy of GENERAL MOTORS CORP.



(1) Engine Harness
(2) G115
(3) G111
(4) G113

G00421699

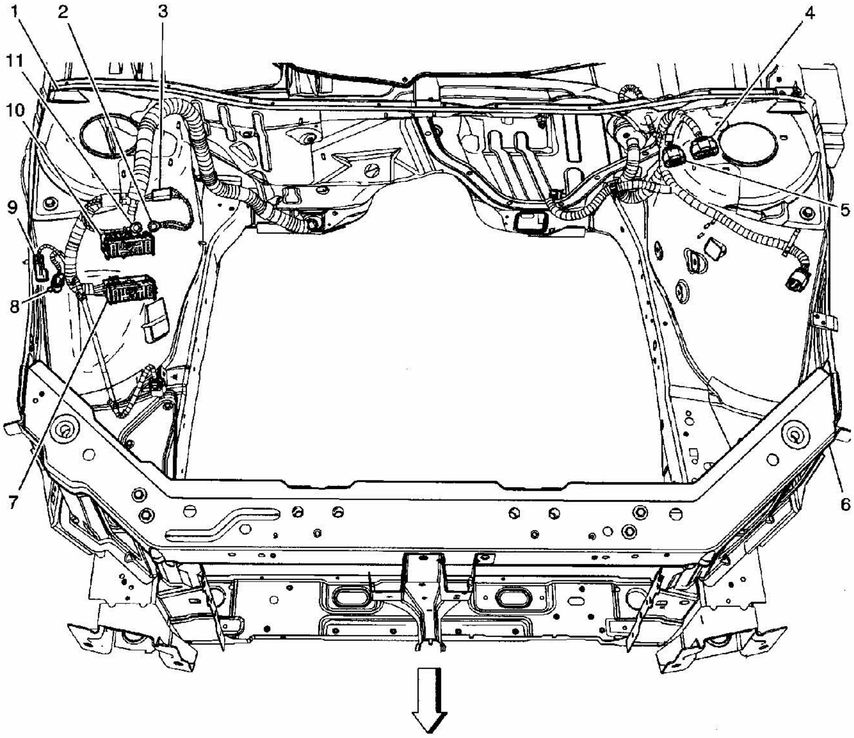
Fig. 61: Left Side Of Transmission (3.5L & 3.9L)
Courtesy of GENERAL MOTORS CORP.



(1) Fuse Block - Underhood C1
(2) S109
(3) C108
(4) C101
(5) C111
(6) Electronic Brake Control Module (EBCM) C1
(7) Engine Control Module (ECM) C3
(8) Engine Control Module (ECM) C2
(9) Engine Control Module (ECM) C1
(10) S101
(11) G113
(12) G111
(13) G115

G00421700

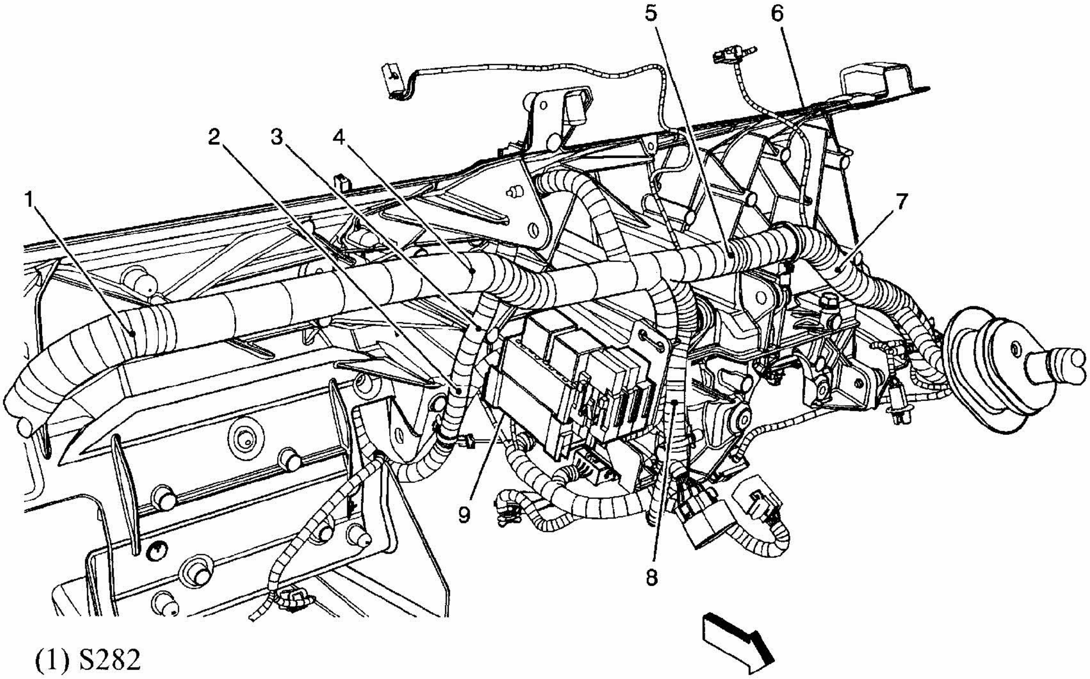
Fig. 62: Left Side Of Engine (5.3L)
Courtesy of GENERAL MOTORS CORP.



(1) RF Strut Tower
(2) Fuse Block - Underhood Positive Battery Terminal (9C1 and 9C3)
(3) Fusible Links (9C1, 9C3)
(4) C111
(5) C101
(6) Radiator Core Support
(7) Fuse Block - Underhood C2
(8) C123 (9C1, 9C3)
(9) C105
(10) Fuse Block - Underhood C1
(11) Fuse Block - Underhood Positive Battery Terminal (9C1 and 9C3)

G00421701

Fig. 63: Engine Compartment
Courtesy of GENERAL MOTORS CORP.



(1) S282

(2) S203

(3) S239

(4) S250

(5) S218

(6) I/P Carrier

(7) S259

(8) S269

(9) Fuse Block - SEO

G00421702

Fig. 64: Rear Of Dash
Courtesy of GENERAL MOTORS CORP.

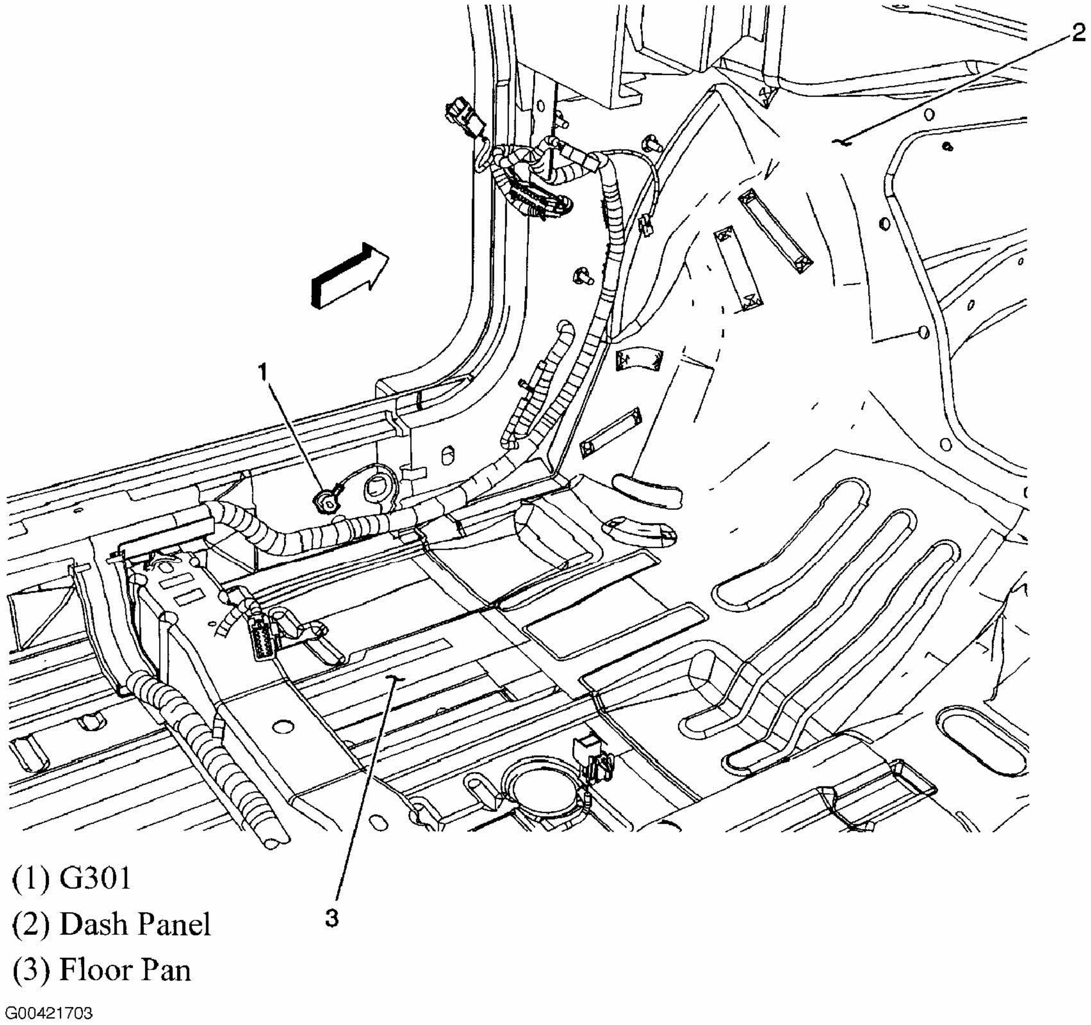
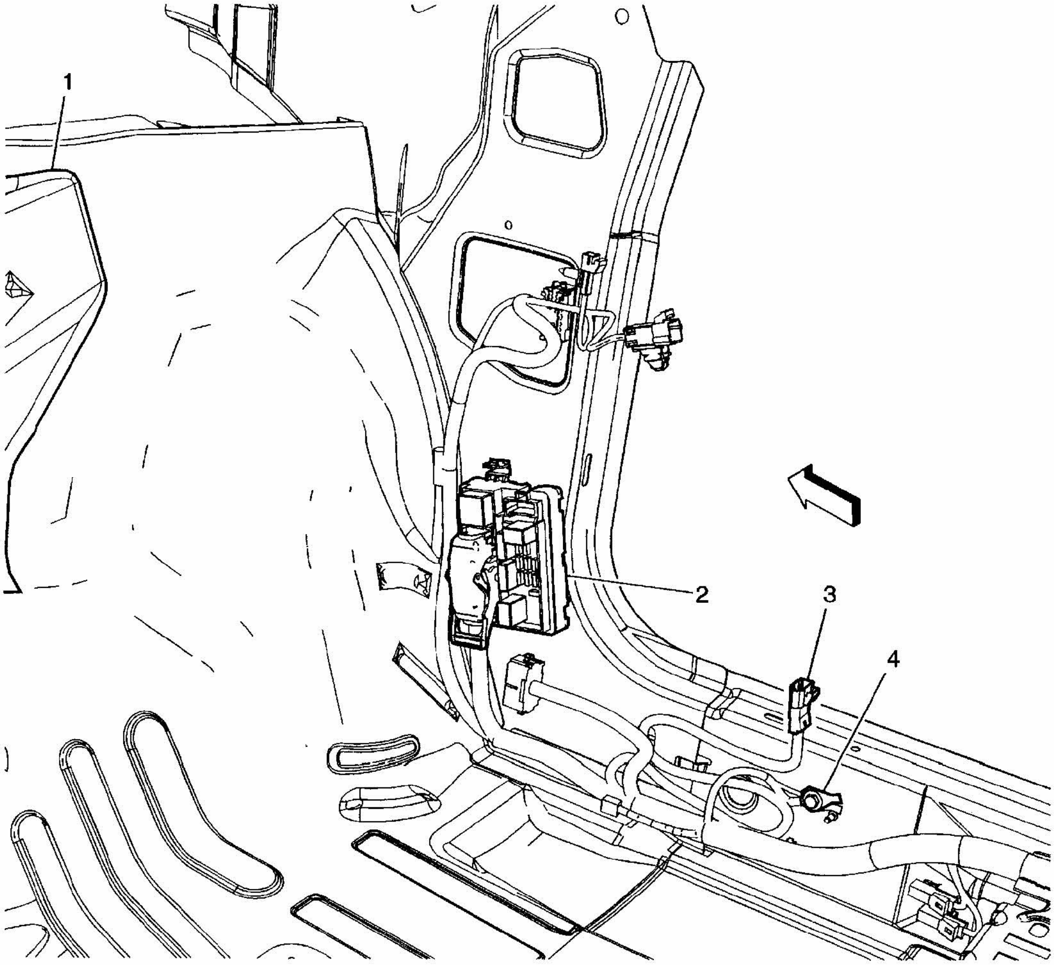

2
1
3
(1) G301
(2) Dash Panel
(3) Floor Pan
G00421703

Fig. 65: Left Kick Panel
Courtesy of GENERAL MOTORS CORP.



(1) Dash Panel

(2) Fuse Block - I/P

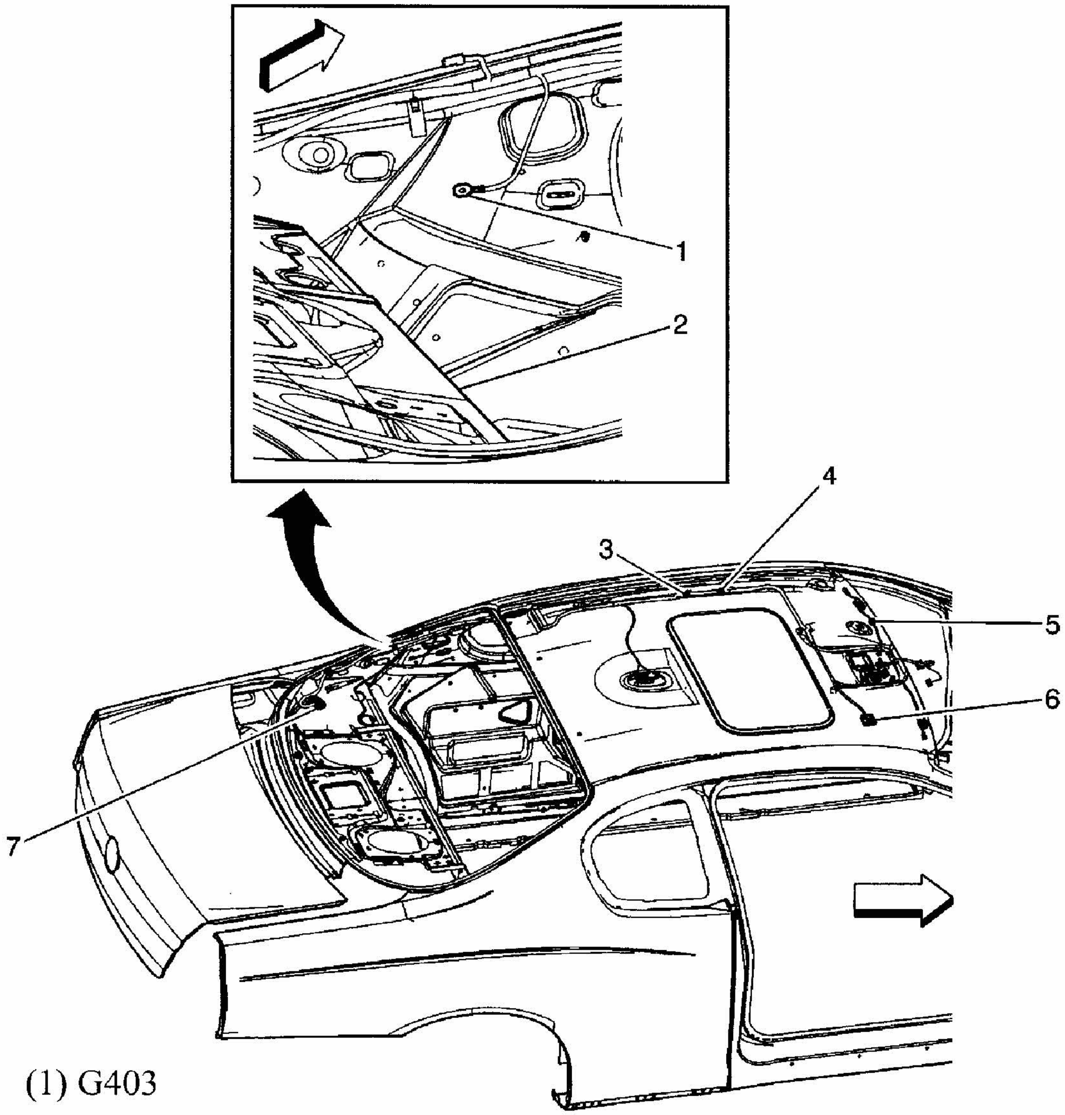
(3) C303

(4) G302

G00421704

Fig. 66: Right Kick Panel

Courtesy of GENERAL MOTORS CORP.



(1) G403

(2) Rear Shelf

(3) S393

(4) S390

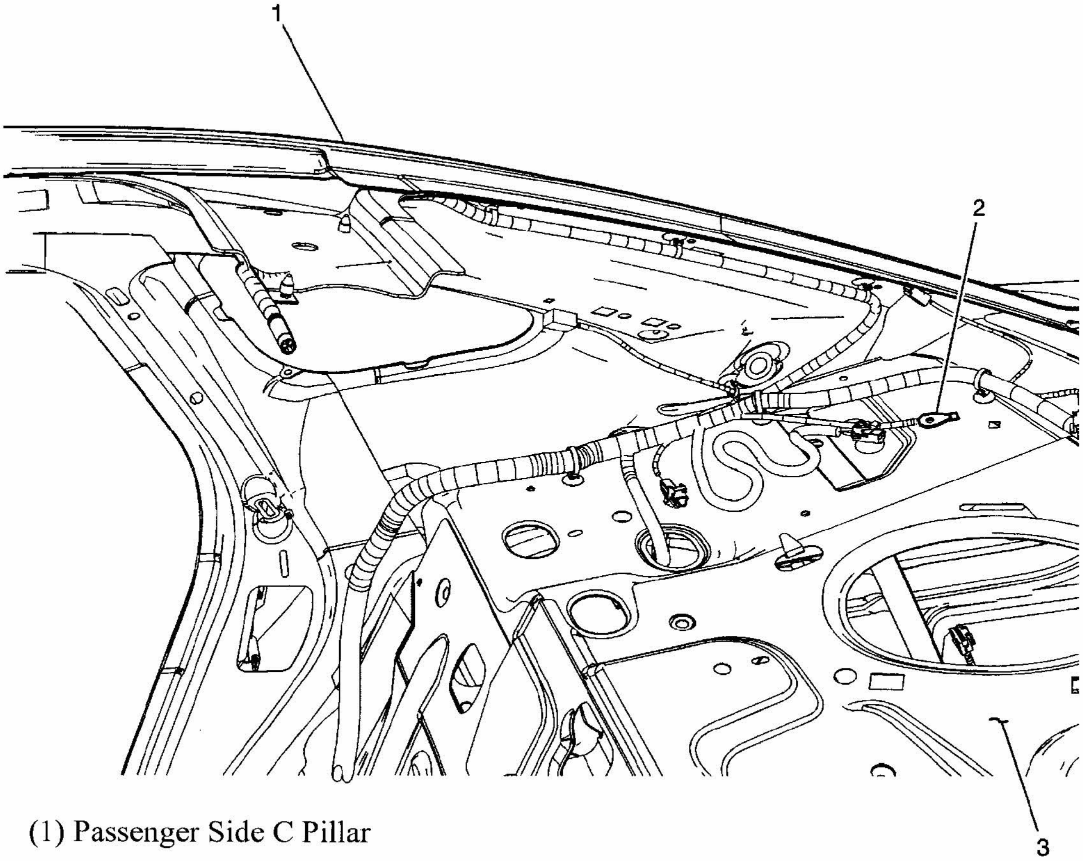
(5) S364

(6) C398 (CF5)

(7) C490

G00421705

Fig. 67: Vehicle Overview
Courtesy of GENERAL MOTORS CORP.



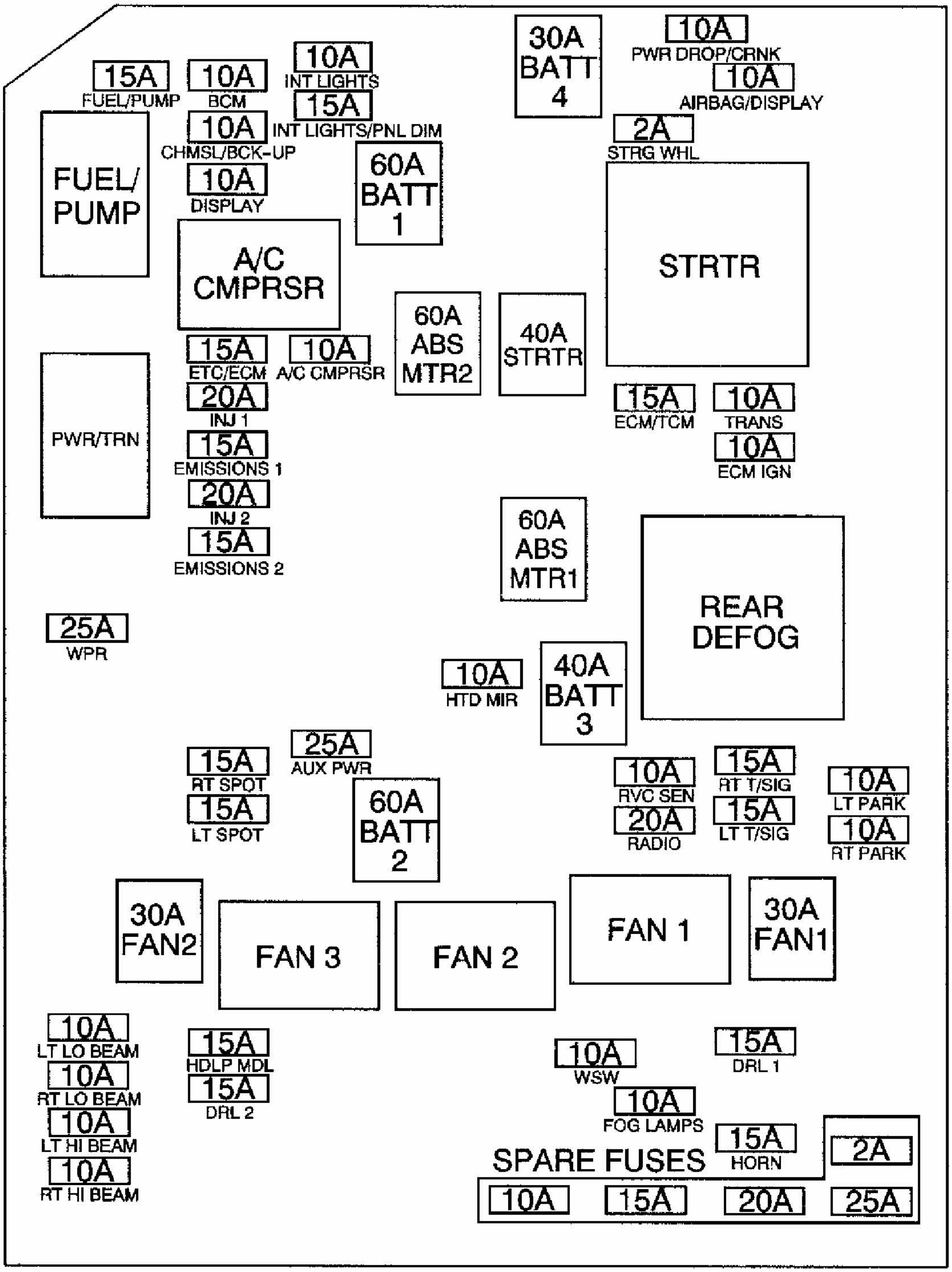
(1) Passenger Side C Pillar

(2) G404

(3) Rear Window Shelf

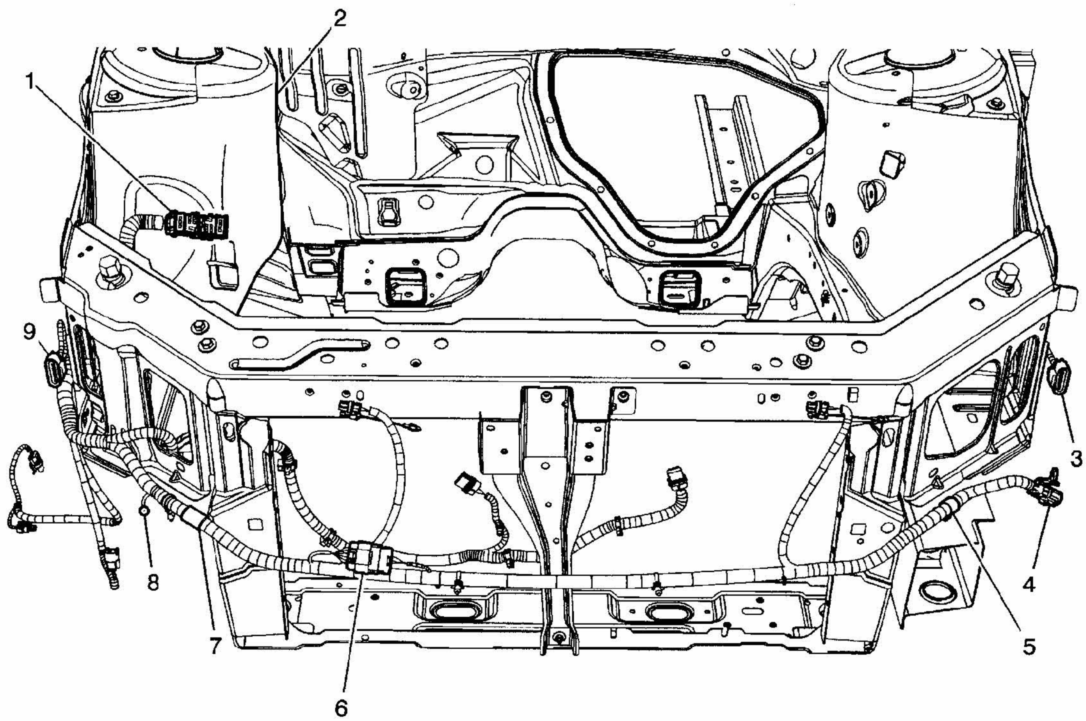
G00421706

Fig. 68: Right "C" Pillar
Courtesy of GENERAL MOTORS CORP.


15A FUEL/PUMP
10A BCM
10A INT LIGHTS
15A INT LIGHTS/PNL DIM
10A CHMSL/BCK-UP
10A DISPLAY
FUEL/ PUMP
60A BATT 1
A/C CMPRSR
30A BATT 4
10A PWR DROP/CRNK
10A AIRBAG/DISPLAY
2A STRG WHL
STRTR
15A ETC/ECM
10A A/C CMPRSR
60A ABS MTR2
40A STRTR
20A INJ 1
PWR/TRN
15A EMISSIONS 1
20A INJ 2
15A EMISSIONS 2
15A ECM/TCM
10A TRANS
10A ECM IGN
60A ABS MTR1
REAR DEFOG
25A WPR
10A HTD MIR
40A BATT 3
25A AUX PWR
15A RT SPOT
15A LT SPOT
60A BATT 2
10A RVC SEN
20A RADIO
15A RT T/SIG
15A LT T/SIG
10A LT PARK
10A RT PARK
30A FAN2
FAN 3
FAN 2
FAN 1
30A FAN1
10A LT LO BEAM
10A RT LO BEAM
10A LT HI BEAM
10A RT HI BEAM
15A HDLP MDL
15A DRL 2
10A WSW
15A DRL 1
10A FOG LAMPS
15A HORN
SPARE FUSES
2A
10A
15A
20A
25A

G00421707

Fig. 69: Underhood Fuse Block
Courtesy of GENERAL MOTORS CORP.



(1) Fuse Block - Underhood C3

(2) RF Strut Tower

(3) C120

(4) C141

(5) G101

(6) C122 (9C1,9C3 w/o 6J7)

(7) S124

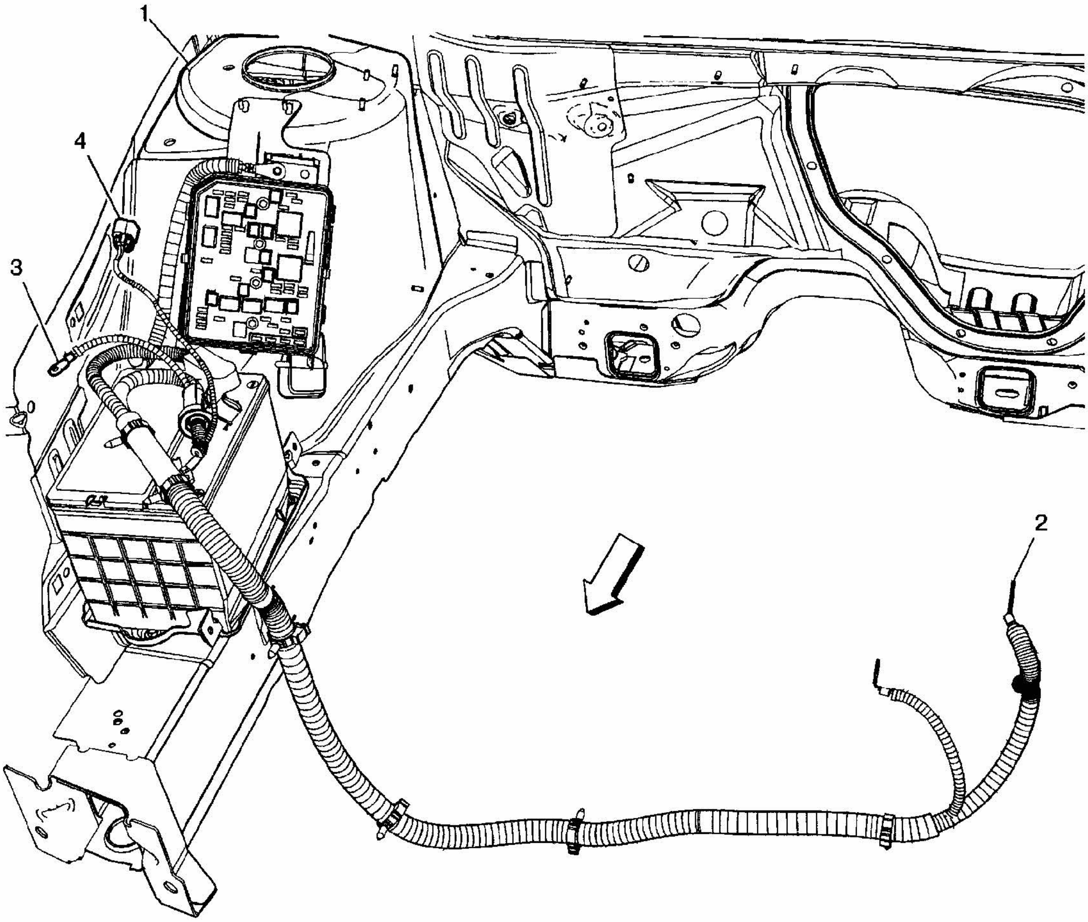
(8) G100

(9) C142

G00421708

Fig. 70: Front Of Vehicle

Courtesy of GENERAL MOTORS CORP.



(1) RF Strut Tower

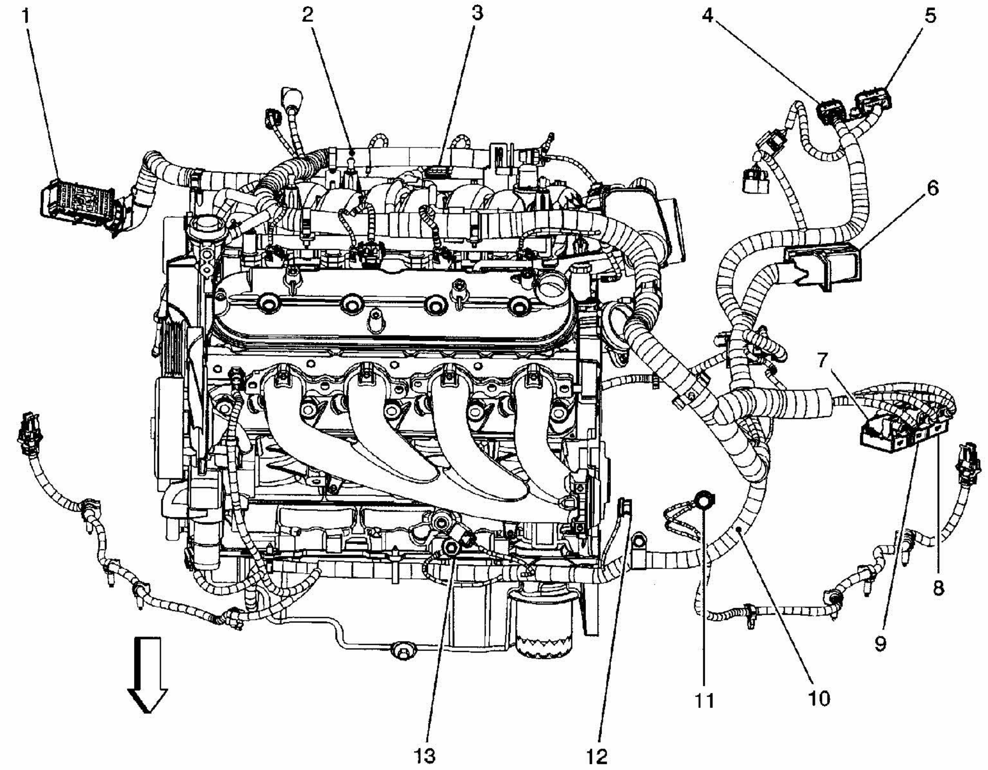
(2) G111

(3) G102

(4) C105

G00421709

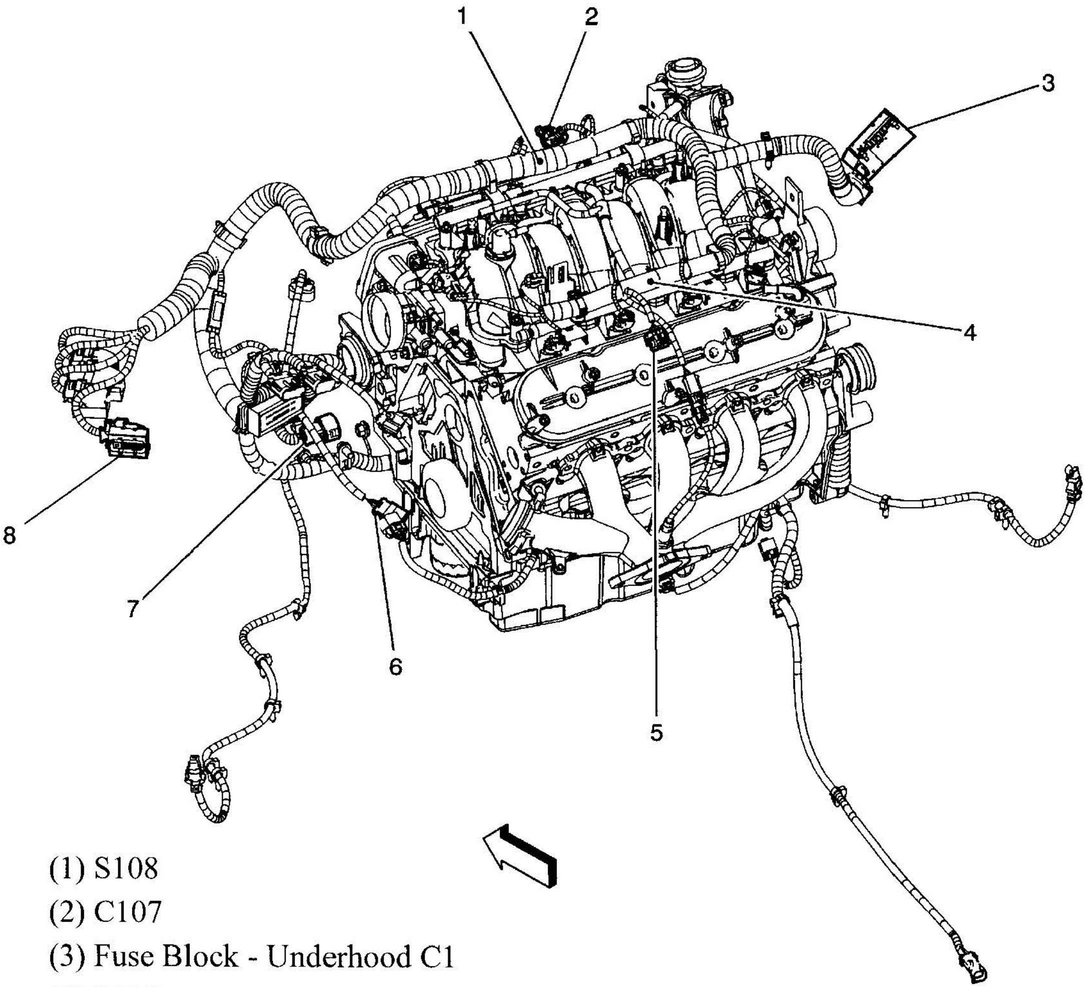
Fig. 71: Right Front Of Engine Compartment
Courtesy of GENERAL MOTORS CORP.



(1) Fuse Block - Underhood C1
(2) S109
(3) C108
(4) C101
(5) C111
(6) Electronic Brake Control Module (EBCM) C1
(7) Engine Control Module (ECM) C3
(8) Engine Control Module (ECM) C2
(9) Engine Control Module (ECM) C1
(10) S101
(11) G113
(12) G111
(13) G115

G00421710

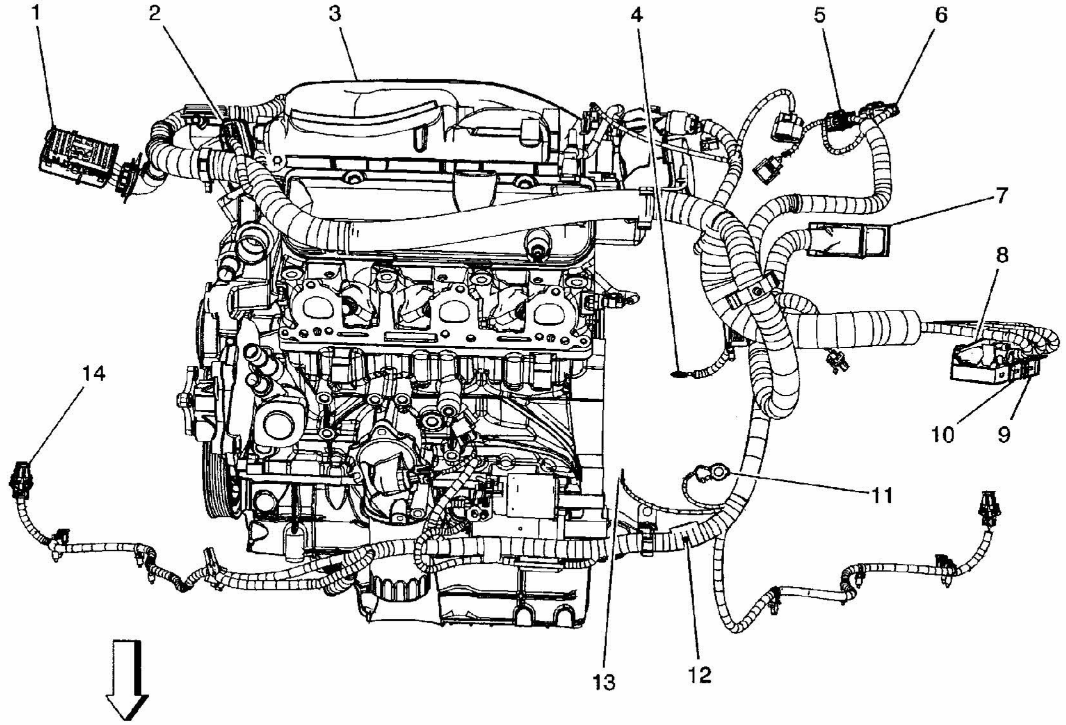
Fig. 72: Left Side Of Engine
Courtesy of GENERAL MOTORS CORP.



(1) S108
(2) C107
(3) Fuse Block - Underhood C1
(4) S109
(5) C108
(6) C116
(7) C100
(8) Transmission Control Module (TCM) Connector

G00421711

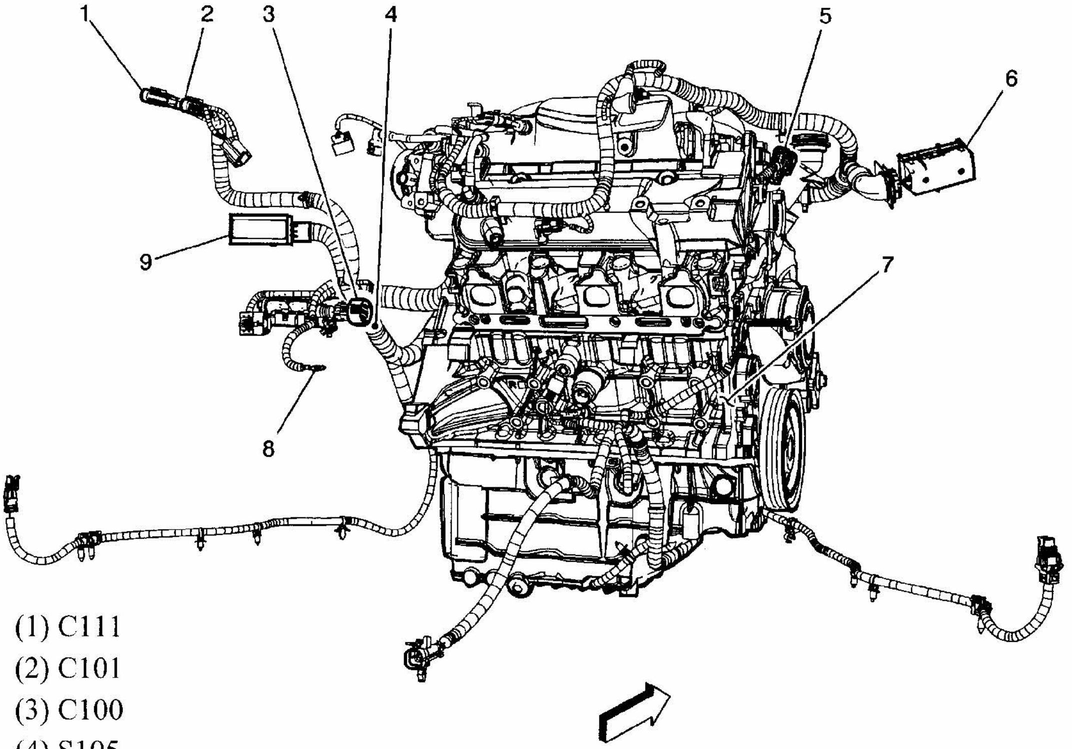
Fig. 73: Right Rear Of Engine (5.3L)
Courtesy of GENERAL MOTORS CORP.



(1) Fuse Block - Underhood C1
(2) C102
(3) Intake Manifold
(4) G115
(5) C101
(6) C111
(7) Electronic Brake Control Module (EBCM)
(8) Engine Control Module (ECM) C1
(9) Engine Control Module (ECM) C3
(10) Engine Control Module (ECM) C2
(11) G113
(12) S101
(13) G111
(14) Wheel Speed Sensor (WSS) - RF

G00421712

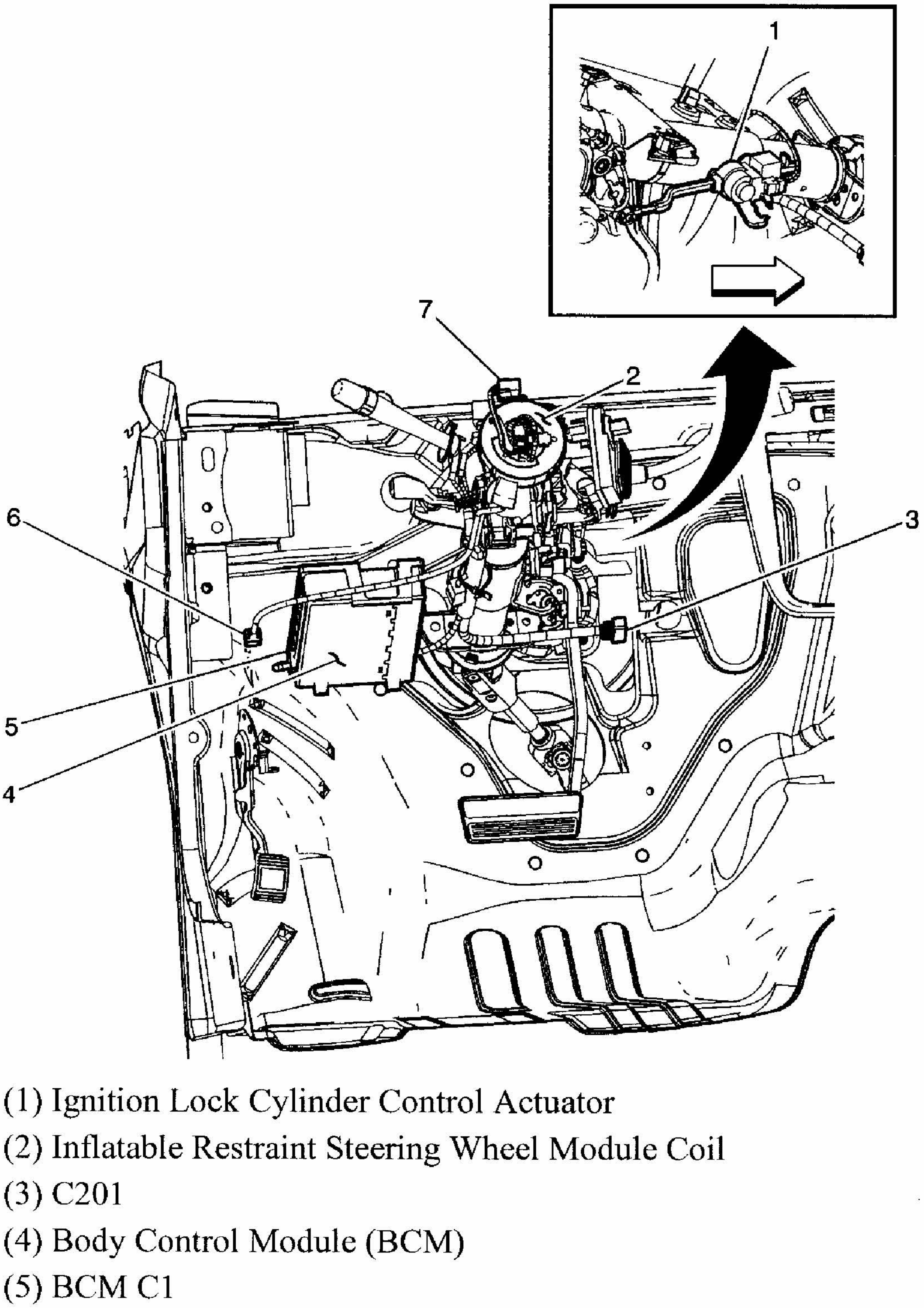
Fig. 74: Left Side Of Engine
Courtesy of GENERAL MOTORS CORP.



(1) C111
(2) C101
(3) C100
(4) S105
(5) C102
(6) Fuse Block - Underhood C1 Connector
(7) Engine Block
(8) G115
(9) Electronic Brake Control Module (EBCM) Connector

G00421713

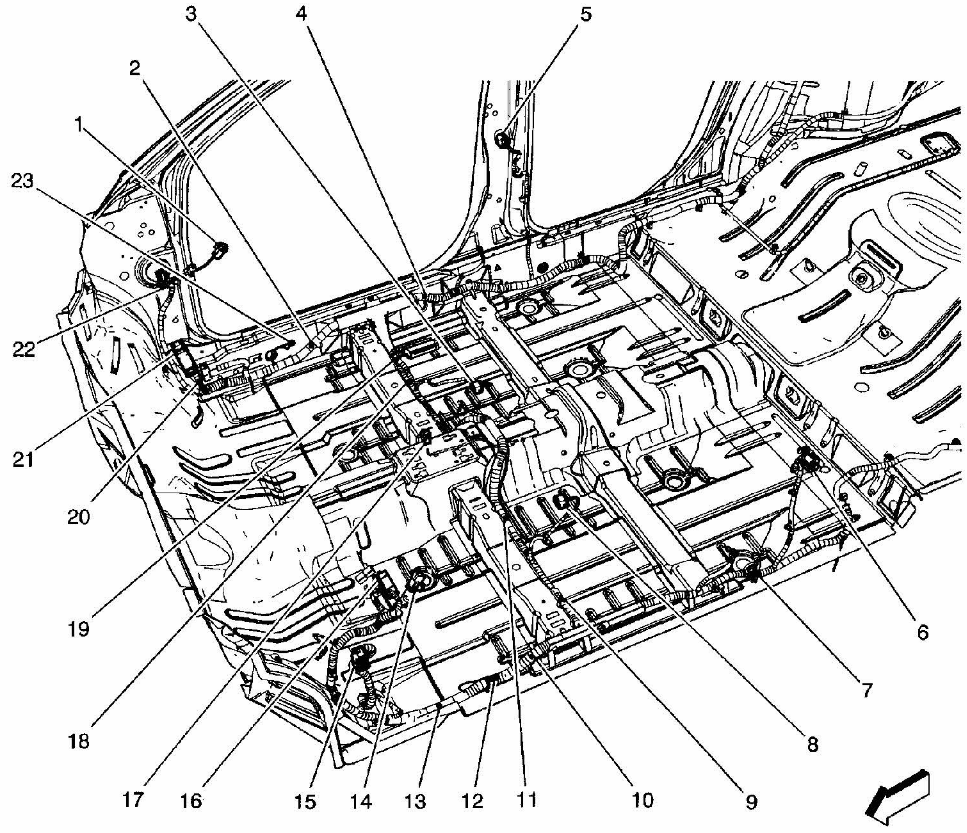
Fig. 75: Right Side Of Engine (3.5L & 3.9L)
Courtesy of GENERAL MOTORS CORP.



(1) Ignition Lock Cylinder Control Actuator
(2) Inflatable Restraint Steering Wheel Module Coil
(3) C201
(4) Body Control Module (BCM)
(5) BCM C1
(6) C250
(7) C277

G00421714

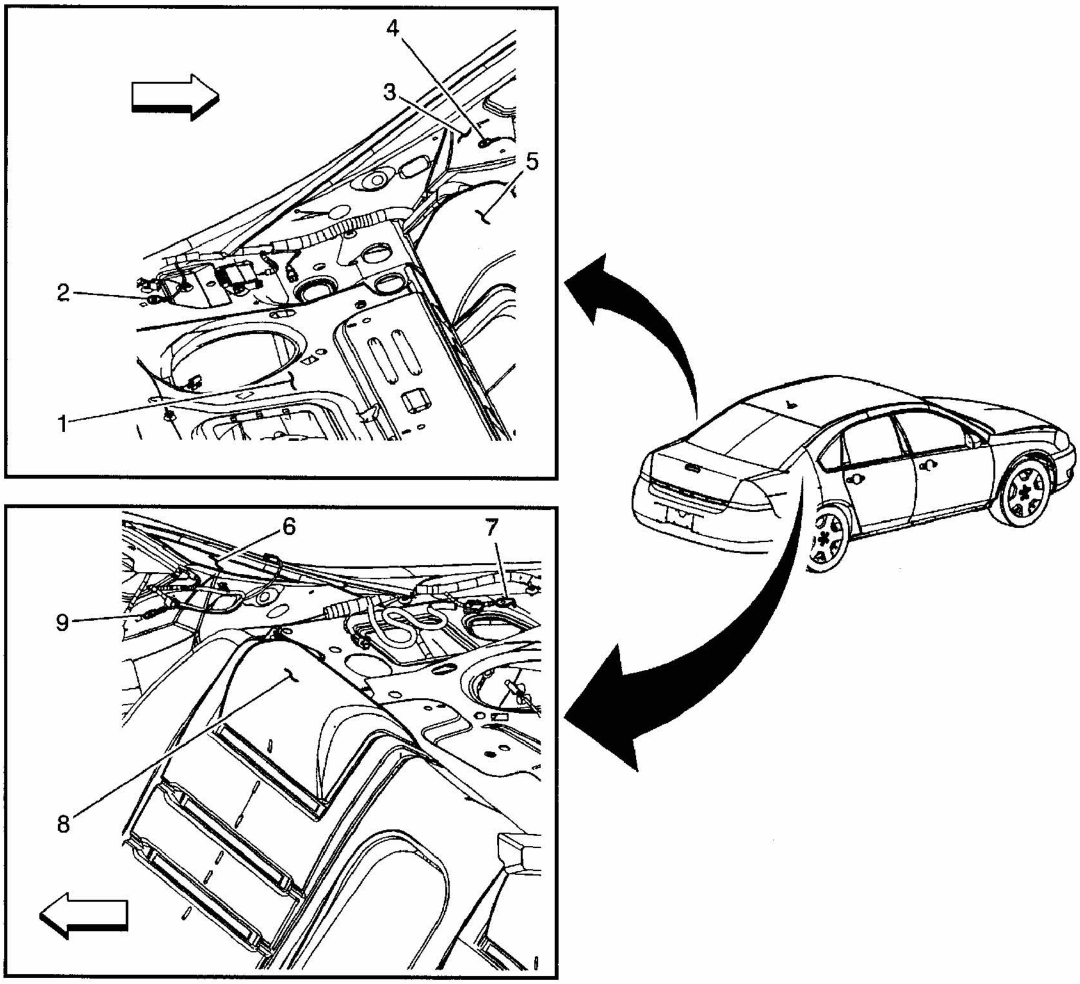
Fig. 76: Left Side Of Dash
Courtesy of GENERAL MOTORS CORP.


3
4
5
2
1
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6

(1) Inflatable Restraint I/P Module Connector
(2) S350
(3) C313
(4) S375
(5) C356 (Sedan)
(6) C355 (Sedan)
(7) S332
(8) C311
(9) S303
(10) S308
(11) S359
(12) G301
(13) S307
(14) C250
(15) C301
(16) C203
(17) C340
(18) S315
(19) S314
(20) C360
(21) C200
(22) C302
(23) G302

G00421715

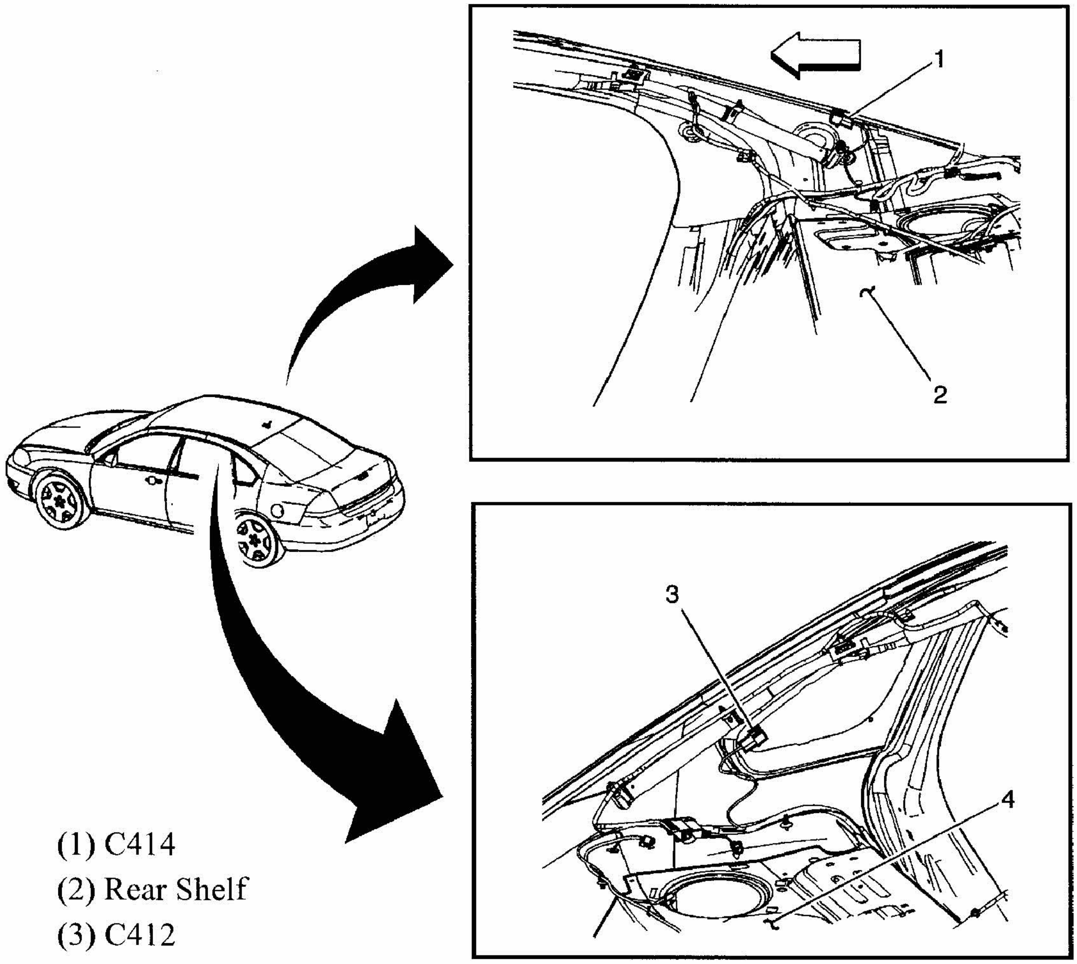
Fig. 77: Floor Pan (Sedan)
Courtesy of GENERAL MOTORS CORP.



(1) Rear Shelf
(2) G403 (Sedan)
(3) Quarter Inner Upper Panel (Coupe)
(4) G403 (Coupe)
(5) Rear Seat Back Cushion
(6) Quarter Inner Upper Panel (Coupe)
(7) G404 (Sedan)
(8) Rear Seat Back Cushion
(9) G404 (Coupe)

G00421716

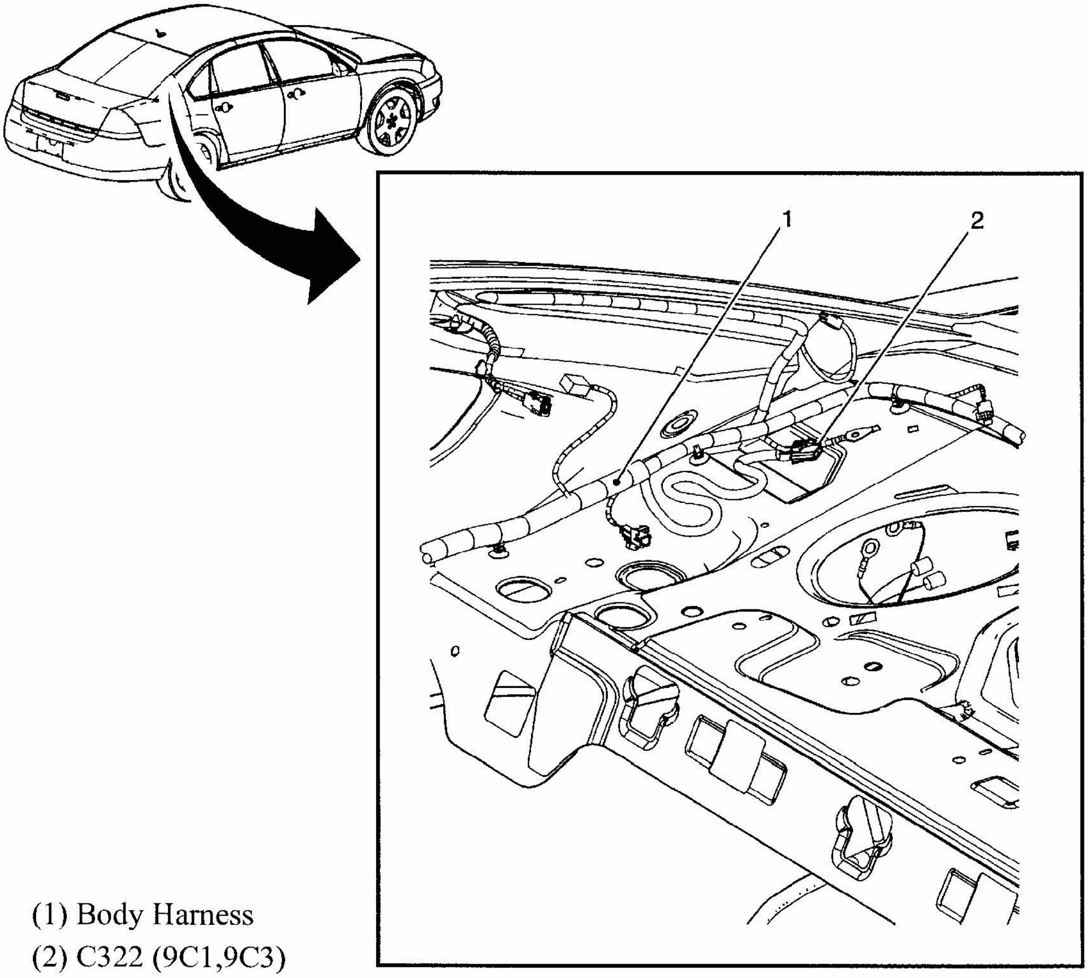
Fig. 78: Rear Of Passenger Compartment
Courtesy of GENERAL MOTORS CORP.



(1) C414
(2) Rear Shelf
(3) C412
(4) Rear Shelf

G00421717

Fig. 79: Rear Of Passenger Compartment
Courtesy of GENERAL MOTORS CORP.

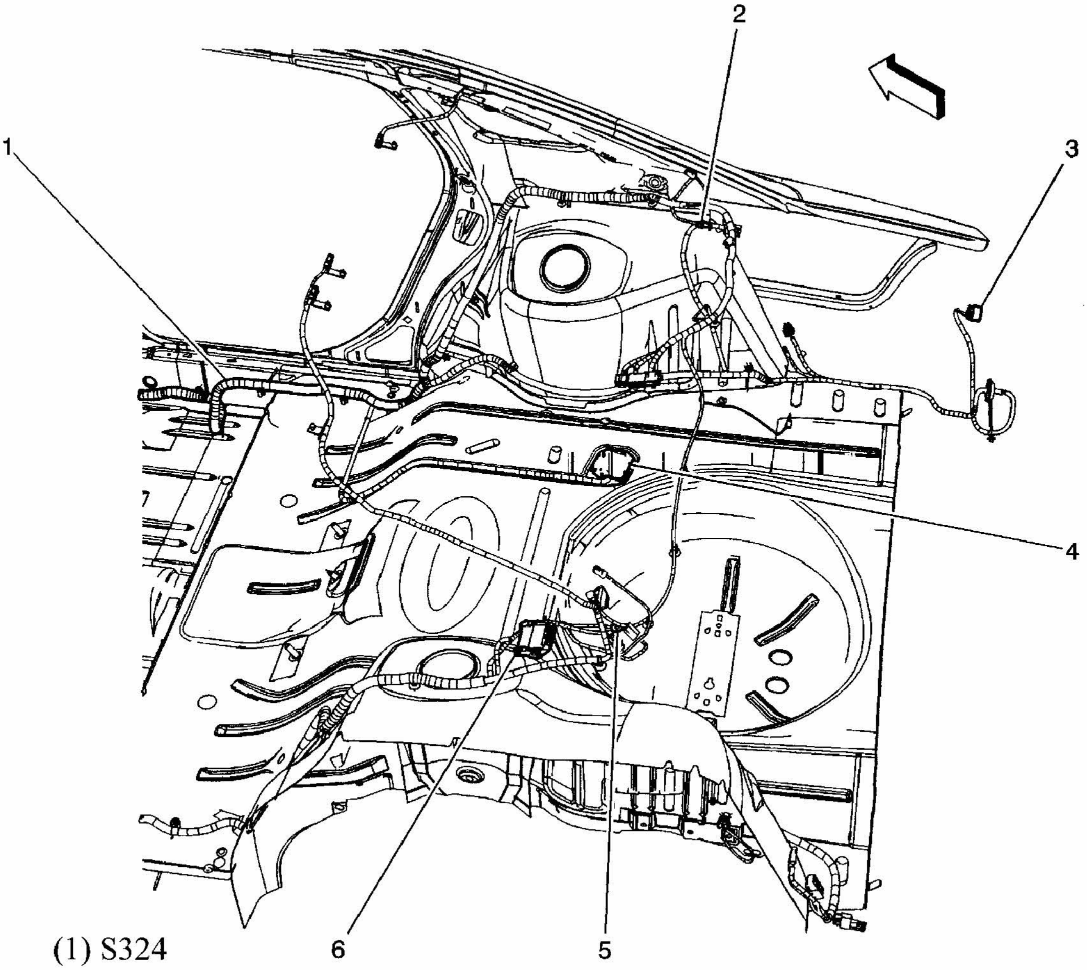


(1) Body Harness

(2) C322 (9C1,9C3)

G00421718

Fig. 80: Rear Shelf
Courtesy of GENERAL MOTORS CORP.



(1) S324

(2) G404

(3) C406

(4) C405

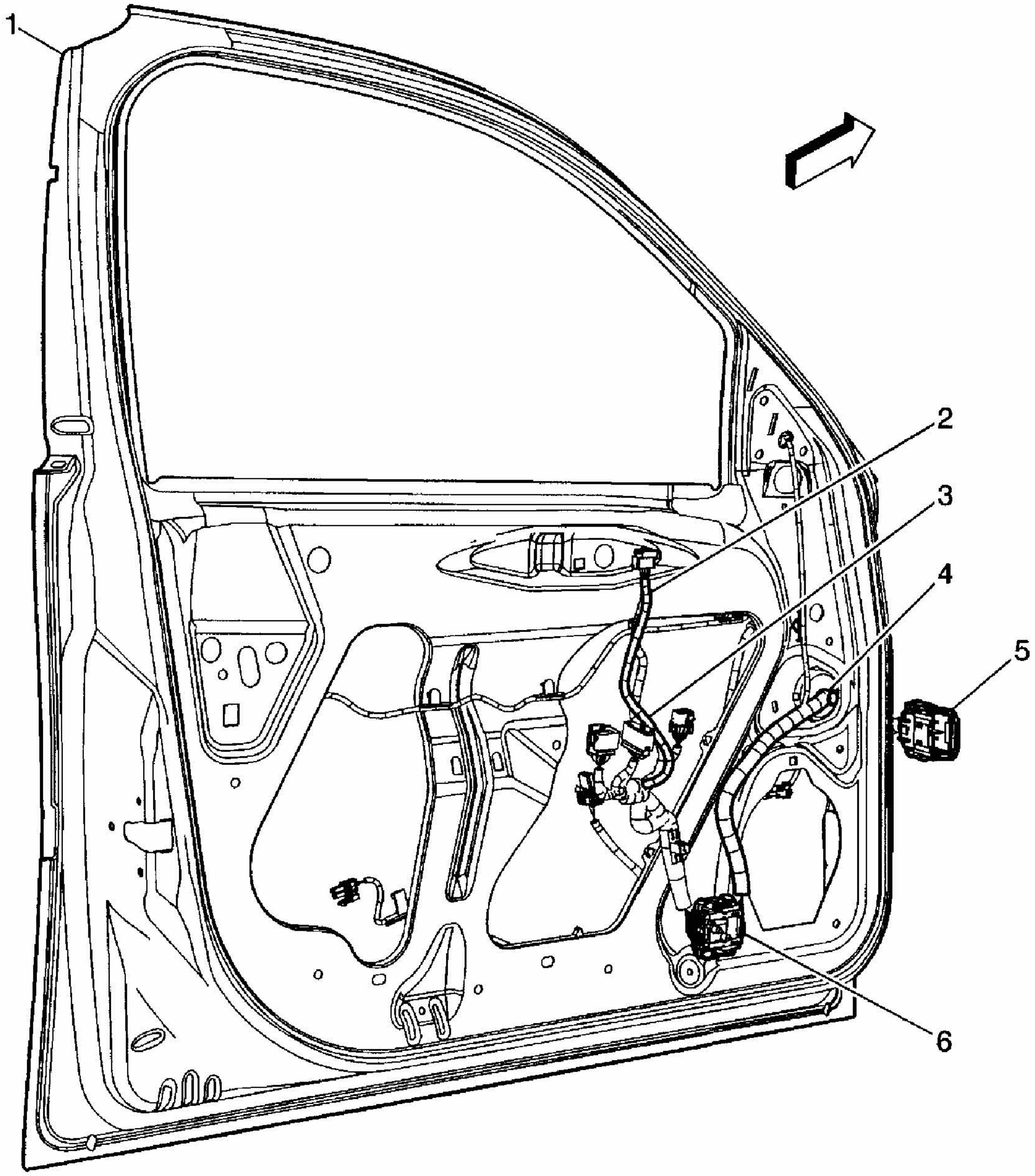
(5) G403

(6) C490

G00421719

Fig. 81: Rear Body Harness

Courtesy of GENERAL MOTORS CORP.



(1) Door Frame

(2) S506

(3) S504

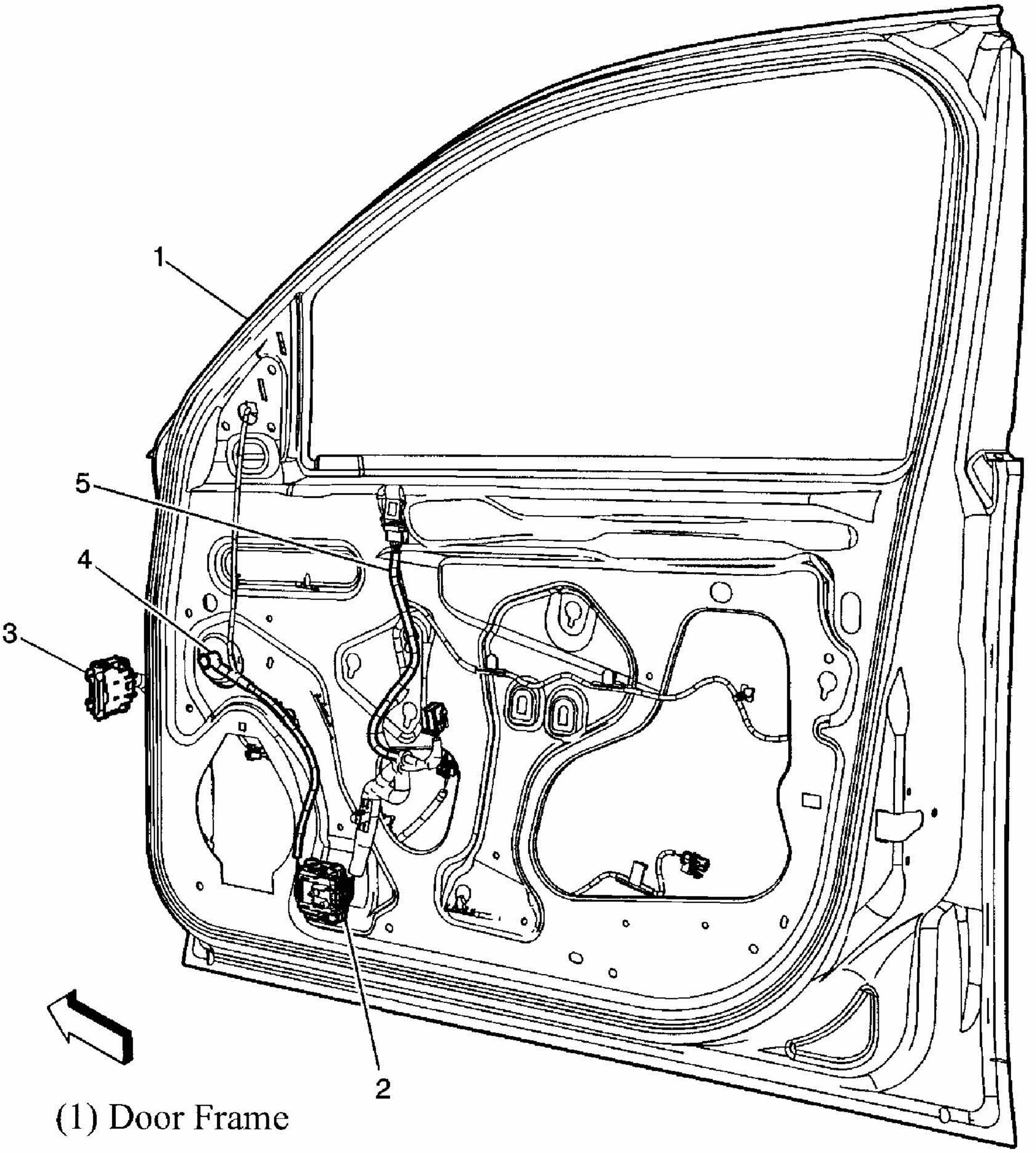
(4) S505

(5) C301

(6) C503

G00421720

Fig. 82: Driver's Door (Sedan)
Courtesy of GENERAL MOTORS CORP.



(1) Door Frame

(2) C604

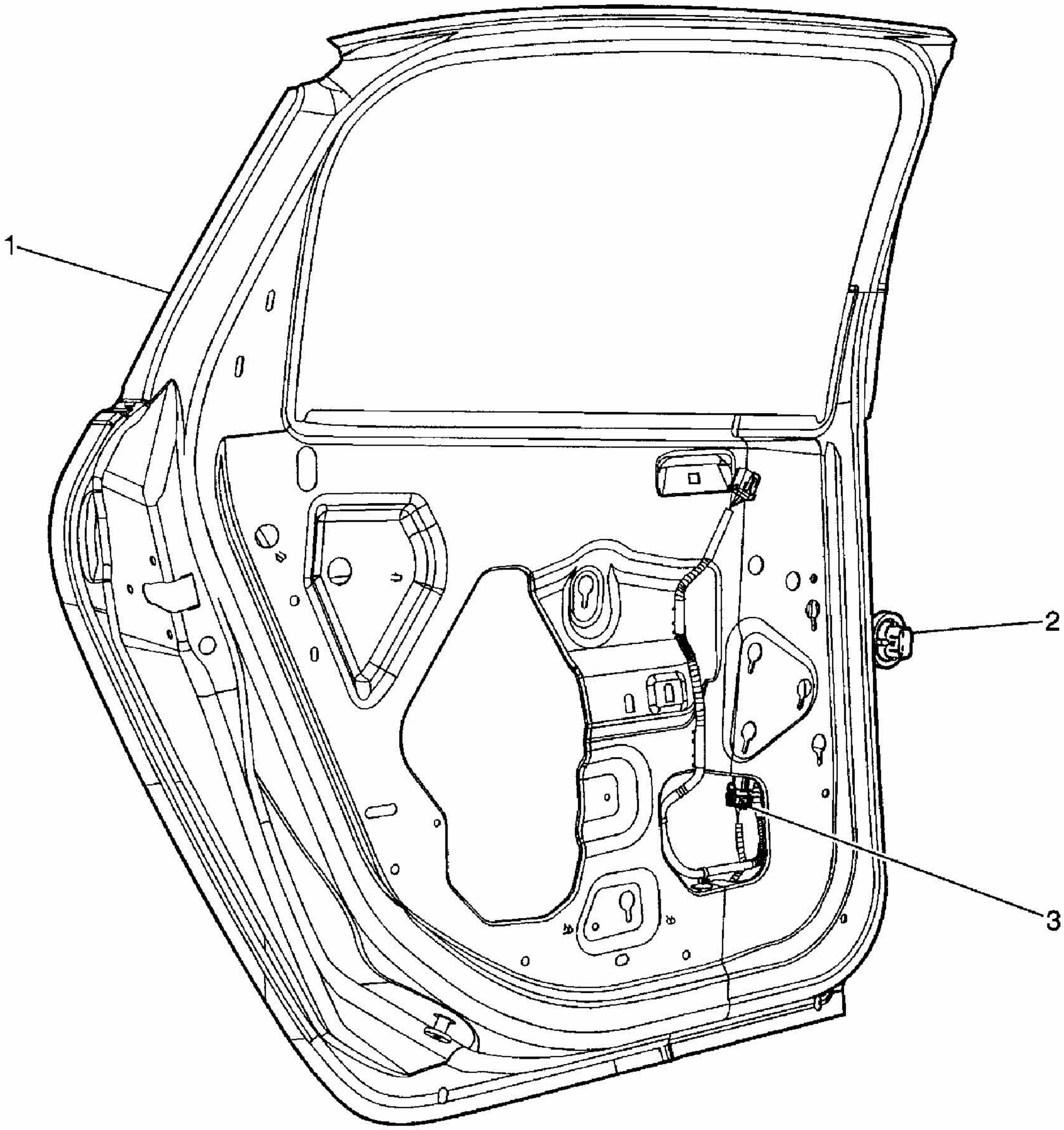
(3) C302

(4) S604

(5) S608

G00421721

Fig. 83: Front Passenger Door Harness (Sedan)
Courtesy of GENERAL MOTORS CORP.



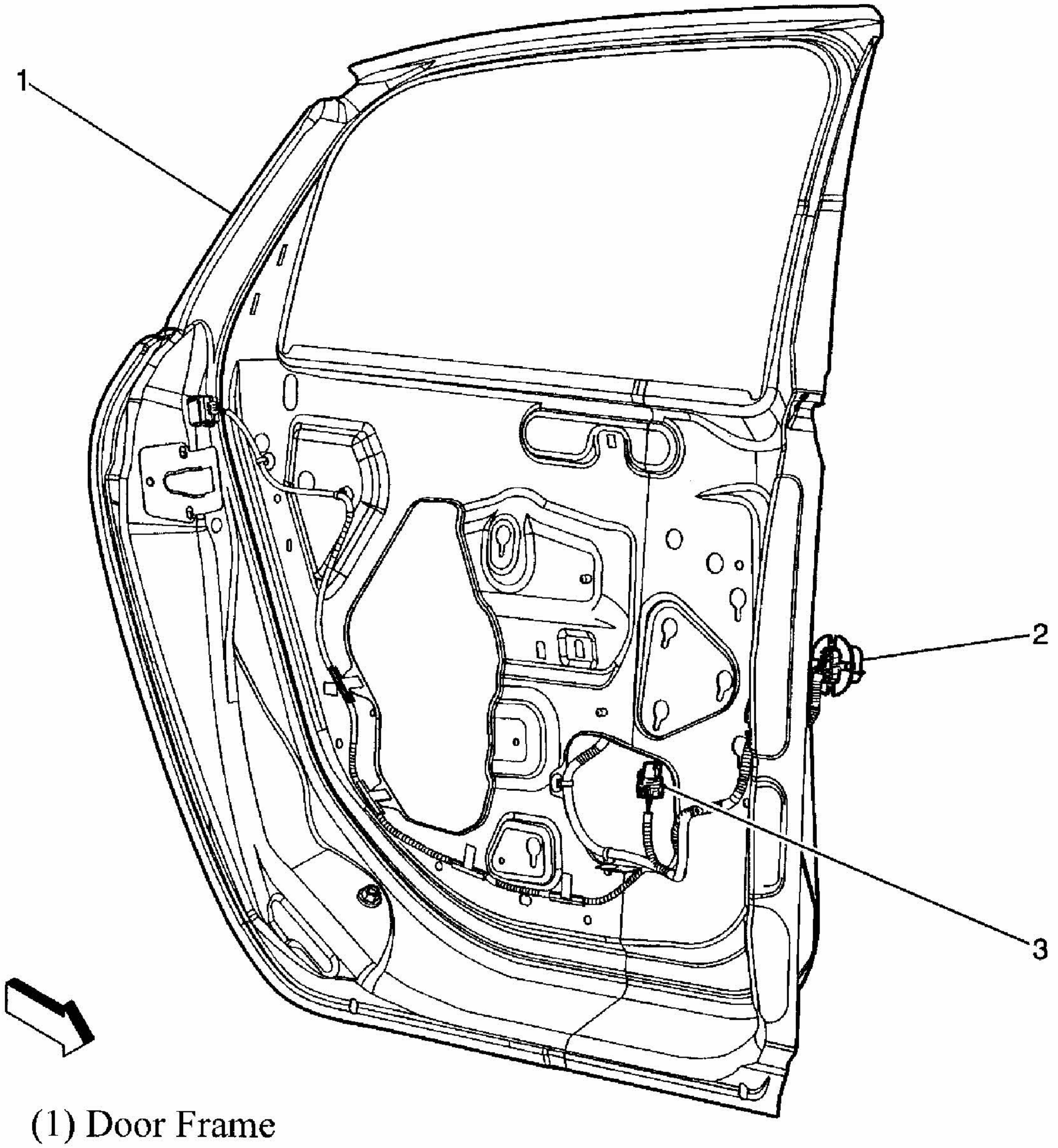
(1) Door Frame

(2) C355

(3) Window Motor - LR Connector

G00421722

Fig. 84: Left Rear Door Harness (Sedan)
Courtesy of GENERAL MOTORS CORP.



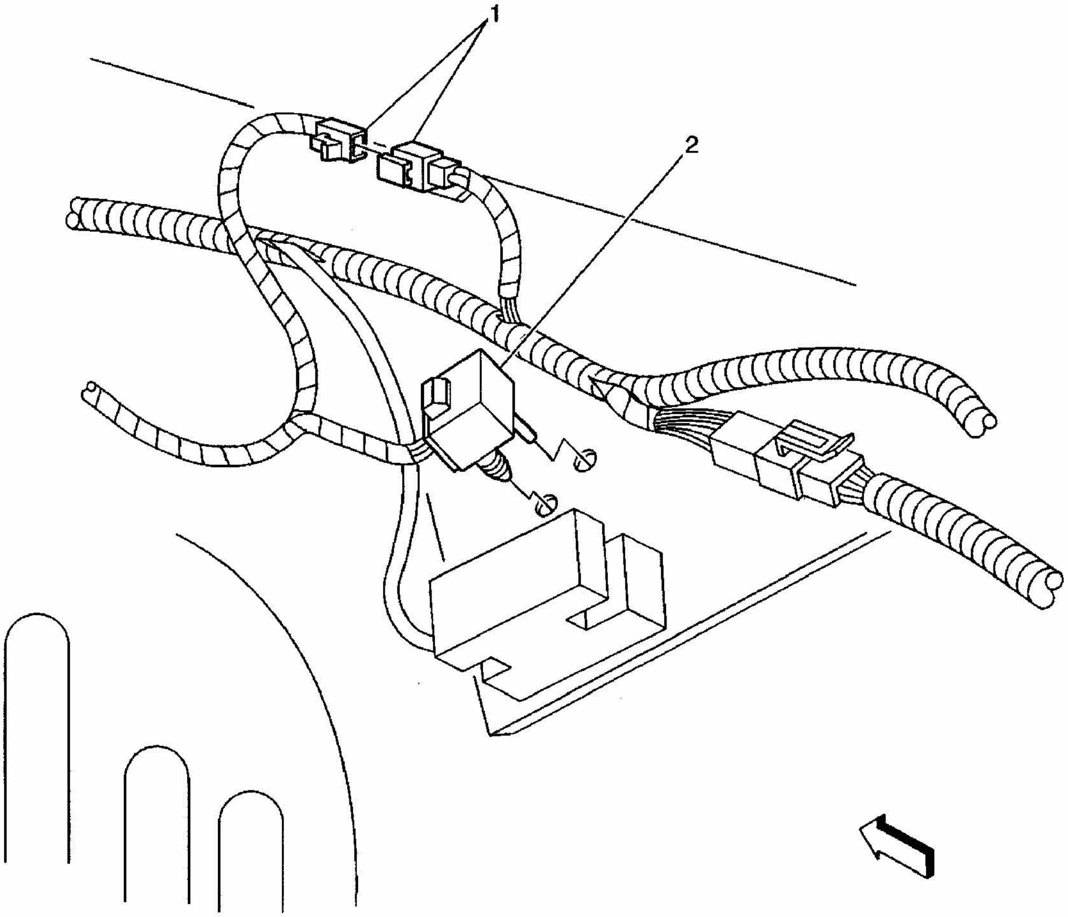
(1) Door Frame

(2) C356

(3) Window Motor - RR Connector

G00421723

Fig. 85: Right Rear Door Harness (Sedan)
Courtesy of GENERAL MOTORS CORP.

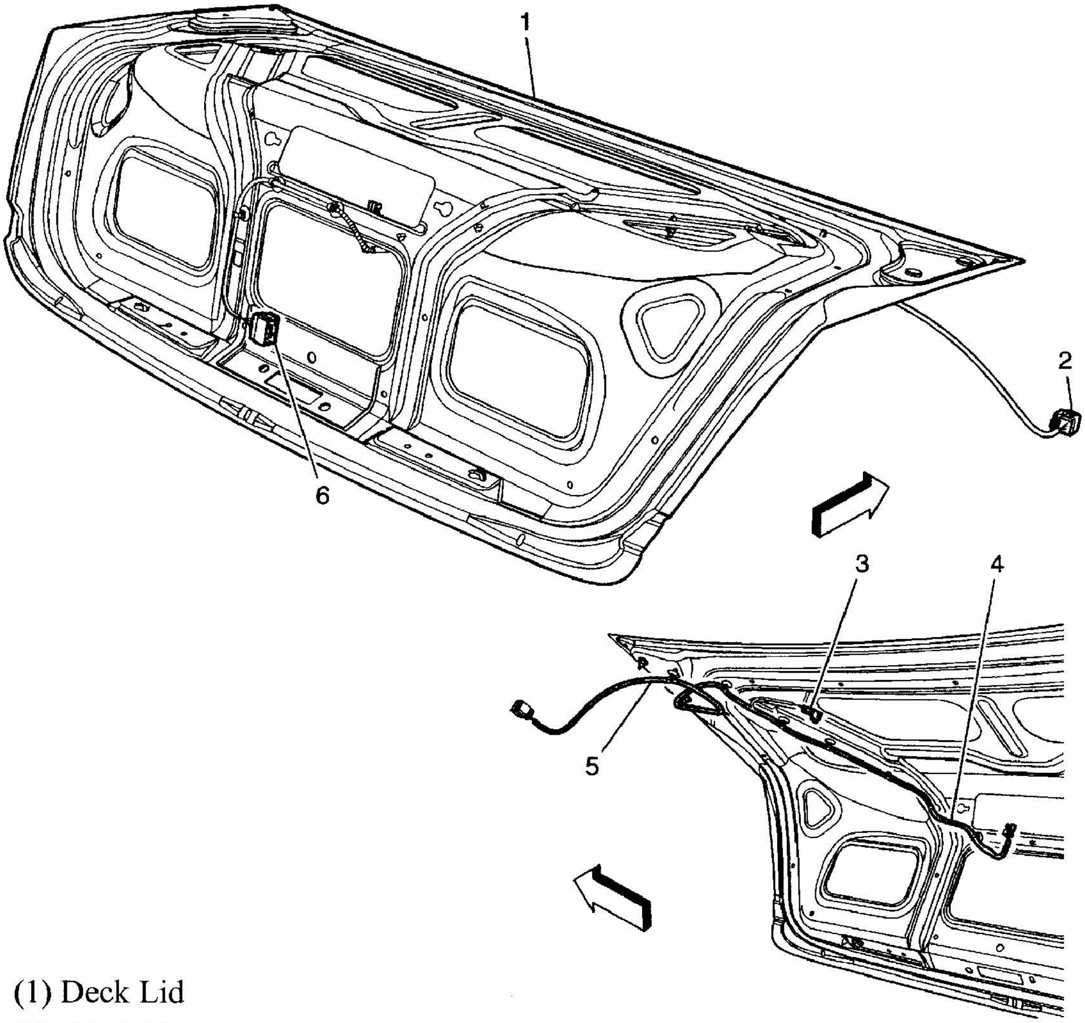


(1) C409

(2) Emergency Vehicle Rear Compartment Lid Lamps Relay

G00421724

Fig. 86: Rear Compartment
Courtesy of GENERAL MOTORS CORP.



(1) Deck Lid

(2) C430 (Coupe)

(3) C432 (9C1 and 9C3)

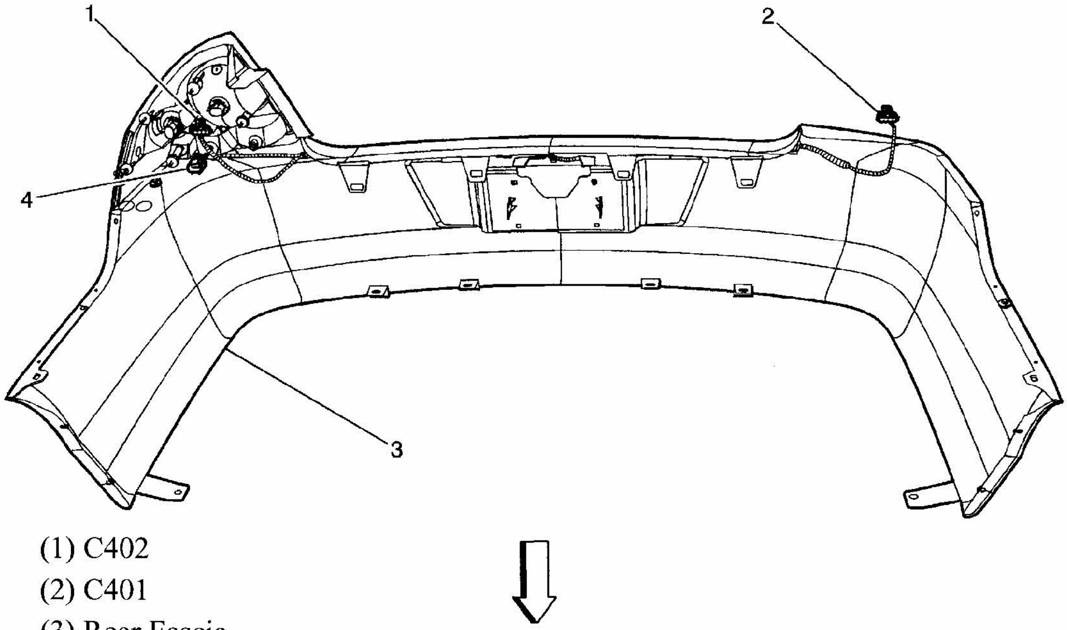
(4) S901

(5) S902

(6) Rear Compartment Lid Release Actuator Connector

G00421725

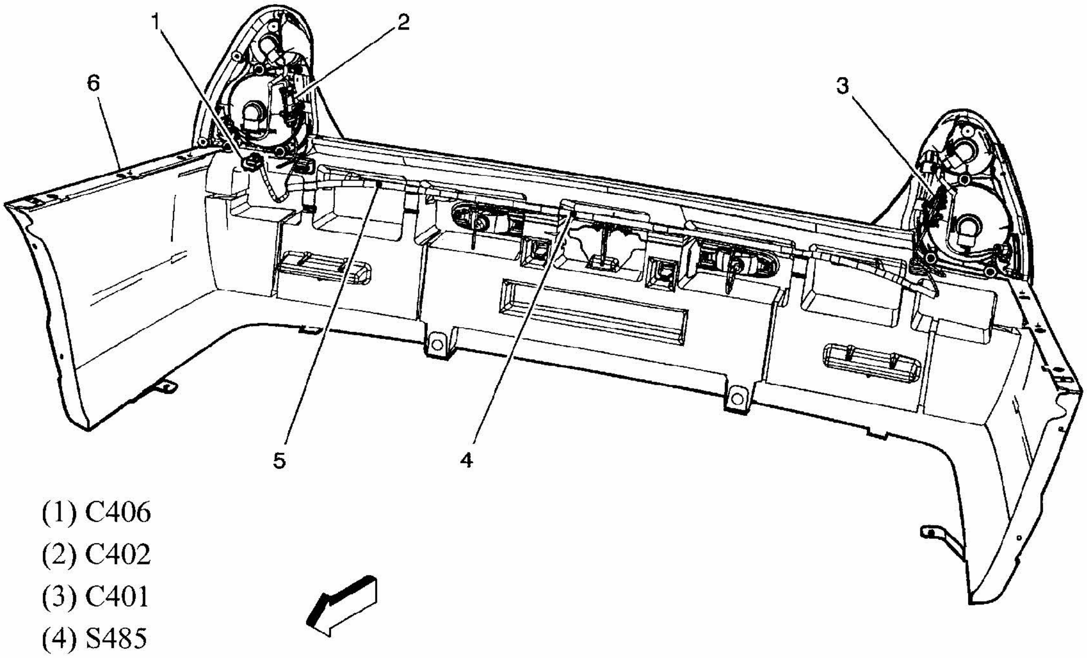
Fig. 87: Deck Lid
Courtesy of GENERAL MOTORS CORP.



(1) C402
(2) C401
(3) Rear Fascia
(4) C406

G00421726

Fig. 88: Rear Bumper (Sedan)
Courtesy of GENERAL MOTORS CORP.



(1) C406
(2) C402
(3) C401
(4) S485
(5) S430
(6) Rear Fascia

G00421727

Fig. 89: Rear Bumper (Coupe)
Courtesy of GENERAL MOTORS CORP.

2006 ENGINE PERFORMANCE

Emission Applications - General Motors - Domestic Cars - Chevrolet Impala

EMISSION APPLICATIONS

IMPALA

Engine & Fuel System	(1) Emission Control Systems & Devices
2006	
3.5L (213") V6 SFI	**PCV, (2) EVAP, TWC, FR, (2) EGR, (2) SPK, (3) HO2S, CEC, (2) MIL,** EVAP-CPCSV, EVAP-CVCSV, EVAP-RV/FTPS, EVAP-VC
3.9L (240") V6 SFI	**PCV, (2) EVAP, TWC, FR, (2) SPK, HO2S, CEC, (2) MIL,** EVAP-CPCSV, EVAP-CVCSV, EVAP-RV/FTPS, EVAP-VC
5.3L (346") V8 SFI	**PCV, (2) EVAP, TWC, FR, (2) SPK, HO2S, CEC, (2) MIL,** EVAP-CPCSV, EVAP-CVCSV, EVAP-RV/FTPS, EVAP-VC

(1) For quick reference, major emission control systems and devices are listed in bold type; components and other related devices are listed in light type.

(2) PCM-controlled.

(3) Equipped with 2.

ABBREVIATIONS

CEC

Computerized Engine Controls

EGR

Exhaust Gas Recirculation System

EVAP

Fuel Evaporative System

EVAP-CPCSV

EVAP Canister Purge Control Solenoid Valve

EVAP-CVCSV

EVAP Canister Vent Control Solenoid Valve

EVAP-FTPS

EVAP Fuel Tank Pressure Sensor

EVAP-ORVR

EVAP On-Board Refueling Vapor Recovery

EVAP-PSSV

EVAP Pressure Switching Solenoid Valve

EVAP-RV/FTPS

EVAP Rollover Valve/Fuel Tank Pressure Sensor

EVAP-VC

EVAP Vapor Canister

EVAP-VCF

EVAP Vapor Canister Filter

EVAP-VSOL

EVAP Ventilation Solenoid

FF-CKV

Fuel Fill Check Valve

FR

Fill Pipe Restrictor

FT-FLVV

Fuel Tank Fill Limit Vent Valve

FT-GVV

Fuel Tank Grade Vent Valve

FTPS

Fuel Tank Pressure Sensor

HO2S

Heated Oxygen Sensor

MIL

Malfunction Indicator Light

PCV

Positive Crankcase Ventilation

SFI

Sequential Fuel Injection

SPK

Spark Controls

TWC

Three-Way Catalytic Converter

WU-TWC

Warm-Up TWC

2006 ENGINE

Engine Mechanical - 3.5L - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
A/C Compressor Bracket Bolt	50 N.m	37 lb ft
Camshaft Position Actuator Assembly Bolt	16 N.m	12 lb ft
Camshaft Position Actuator Magnet Bolt	10 N.m	89 lb in
Camshaft Position Sensor Bolt	10 N.m	89 lb in
Camshaft Thrust Plate Screw	10 N.m	89 lb in
Clutch Pressure Plate Bolt	25 N.m	18 lb ft
Connecting Rod Bearing Cap Bolt		
• First Pass	25 N.m	18 lb ft
• Final Pass	110 degrees	
Coolant Crossover Pipe Bolt - Front	50 N.m	37 lb ft
Coolant Crossover Pipe Bolt - Side	10 N.m	89 lb in
Coolant Drain Plug	19 N.m	14 lb ft
Coolant Temperature Sensor	23 N.m	17 lb ft
Crankshaft Balancer Bolt		
• First Pass	125 N.m	92 lb ft
• Final Pass	130 degrees	
Crankshaft Main Bearing Cap Bolt/Stud		
• First Pass	50 N.m	37 lb ft
• Final Pass	77 degrees	
Crankshaft Oil Deflector Nut	25 N.m	18 lb ft
Crankshaft Position Sensor Shield Nut	11 N.m	98 lb in
Crankshaft Position Sensor Stud	11 N.m	98 lb in
Cylinder Head Bolt		
• First Pass	60 N.m	44 lb ft
• Final Pass	95 degrees	
Drive Belt Idler Pulley Bolt - 13 mm	30 N.m	22 lb ft
Drive Belt Idler Pulley Bolt - 15 mm	50 N.m	37 lb ft

Drive Belt Tensioner Bolt	50 N.m	37 lb ft
Engine Block Heater	50 N.m	37 lb ft
Engine Block Plug	60 N.m	44 lb ft
Engine Front Cover Bolt	25 N.m	18 lb ft
Engine Lift Bracket Bolt -	70 N.m	52 lb ft
Engine Oil Pressure Switch	16 N.m	12 lb ft
Engine Wiring Harness Bracket Bolt	13 N.m	115 lb in
EVAP Purge Valve Bolt	12 N.m	106 lb in
Exhaust Crossover Heat Shield Bolts	10 N.m	89 lb in
Exhaust Crossover Pipe Nuts	25 N.m	18 lb ft
Exhaust Crossover Pipe Studs	25 N.m	18 lb ft
Exhaust Manifold Bolt	20 N.m	15 lb ft
Exhaust Manifold Heat Shield Bolt	10 N.m	89 lb in
Exhaust Manifold Lower Heat Shield Bolt	10 N.m	89 lb in
Engine Mount Strut and Engine Lift Bracket Bolts	50 N.m	37 lb ft
Engine Mount Support and Strut Bracket Bolts	50 N.m	37 lb ft
Flywheel Bolt		
• Automatic Transmission	70 N.m	52 lb ft
• Manual Transmission - First Pass	50 N.m	37 lb ft
• Manual Transmission - Final Pass	70 degrees	
Front Oil Gallery Plug	33 N.m	24 lb ft
Fuel Injector Rail Bolt	10 N.m	89 lb in
Heated Oxygen Sensor	42 N.m	31 lb ft
Heater Inlet and Outlet Pipe Bolt - 10 mm	10 N.m	89 lb in
Heater Inlet and Outlet Pipe Bolt/Nut - 13 mm	25 N.m	18 lb ft
Heater Inlet Pipe Stud	35 N.m	26 lb ft
Ignition Coil Bracket Bolt/Nut/Stud	25 N.m	18 lb ft
Knock Sensor	25 N.m	18 lb ft
Lower Intake Manifold Bolt - Center		
• First Pass	7 N.m	62 lb in
• Final Pass	13 N.m	115 lb in
Lower Intake Manifold Bolt - Corner		
• First Pass	7 N.m	62 lb in
• Final Pass	25 N.m	18 lb ft
Oil Filter	30 N.m	22 lb ft
Oil Filter Adapter Bolt	25 N.m	18 lb ft

Oil Filter Adapter Heat Shield Nuts	25 N.m	18 lb ft
Oil Filter Fitting	39 N.m	29 lb ft
Oil Level Indicator Tube Bolt	25 N.m	18 lb ft
Oil Pan Bolt	25 N.m	18 lb ft
Oil Pan Drain Plug	25 N.m	18 lb ft
Oil Pan Side Bolt	50 N.m	37 lb ft
Oil Pan Support Bracket Bolt	50 N.m	37 lb ft
Oil Pump Cover Bolt	10 N.m	89 lb in
Oil Pump Drive Gear Clamp Bolt	36 N.m	27 lb ft
Oil Pump Mounting Bolt	41 N.m	30 lb ft
Piston Oil Nozzle Bolt	10 N.m	89 lb in
Rear Oil Gallery Plug - 3/8 inch	33 N.m	24 lb ft
Spark Plug	15 N.m	11 lb ft
Throttle Body Bolt/Nut	10 N.m	89 lb in
Throttle Body Stud	6 N.m	53 lb in
Timing Chain Tensioner Bolt	21 N.m	15 lb ft
Upper Intake Manifold Bolt/Stud	25 N.m	18 lb ft
Valve Lifter Guide Bolt	10 N.m	89 lb in
Valve Lifter Oil Manifold Cover Plate Bolt	25 N.m	18 lb ft
Valve Rocker Arm Bolt	34 N.m	25 lb ft
Valve Rocker Arm Cover Bolt	10 N.m	89 lb in
Water Outlet Bolt/Stud	25 N.m	18 lb ft
Water Pump Bolt	10 N.m	89 lb in
Water Pump Pulley Bolt	25 N.m	18 lb ft

ENGINE MECHANICAL SPECIFICATIONS

Engine Mechanical Specifications

Application	Specification	
	Metric	English
General Data		
• Engine Type	60 degree V-6	
• Displacement	3.5L	214 cu in
• RPO	LZ4 (LZE-E85)	
• VIN	N (K-E85)	
• Bore	99 mm	3.90 in
• Stroke	76 mm	2.99 in
	9.8:1	

• Compression Ratio		
• Firing Order	123456	
• Spark Plug Gap	1.00 mm	0.040 in
Block		
• Camshaft Bearing Bore Diameter - Front and Rear	51.03-51.08 mm	2.009-2.011 in
• Camshaft Bearing Bore Diameter - Middle #2, #3	50.77-50.82 mm	1.999-2.001 in
• Crankshaft Main Bearing Bore Diameter	72.1535-72.0695 mm	2.840-2.841 in
• Crankshaft Main Bearing Bore Out-of-Round	0.008 mm	0.00031 in
• Cylinder Bore Diameter	99.000-99.018 mm	3.897-3.898 in
• Cylinder Bore Out-of-Round - Diameter - Production	0.020 mm	0.0008 in
• Cylinder Bore Out-of-Round - Diameter - Service	0.025 mm	0.001 in
• Cylinder Bore Taper - Production	0.020 mm	0.0008 in
• Cylinder Bore Taper - Service	0.025 mm	0.001 in
• Cylinder Head Deck Height	224 mm	8.818 in
• Cylinder Head Deck Surface Flatness	0.05 mm per 152 mm	0.0019 in per 6 in
• Valve Lifter Bore Diameter	21.417-21.455 mm	0.843-0.844 in
Camshaft		
• Camshaft Bearing Inside Diameter	51.500-51.525 mm	2.028-2.029 in
• Camshaft Journal Diameter	51.415-51.440 mm	2.024-2.025 in
• Camshaft Journal Out-of-Round	0.025 mm	0.001 in
• Camshaft Lobe Lift - Exhaust	6.9263 mm	0.2727 in
• Camshaft Lobe Lift - Intake	6.9263 mm	0.2727 in
Cooling System		
• Capacity	12.4 liters	13.1 quarts
• Thermostat Full Open Temperature	195 degrees	

Connecting Rod		
• Connecting Rod Bearing Clearance	0.18-0.062 mm	0.0007-0.017 in
• Connecting Rod Bore Diameter	60.322-60.338 mm	2.375-2.376 in
• Connecting Rod Bore Out-of-Round	0.006 mm	0.00023 in
• Connecting Rod Length - Center to Center	150 mm	5.9 in
• Connecting Rod Side Clearance	0.200-0.241 mm	0.008-0.009 in
Crankshaft		
• Connecting Rod Journal Diameter	57.122-57.138 mm	2.2489-2.2495 in
• Connecting Rod Journal Out-of-Round	0.005 mm	0.0002 in
• Connecting Rod Journal Taper	0.005 mm	0.0002 in
• Connecting Rod Journal Width	21.92-22.08 mm	0.863-0.869 in
• Crankshaft End Play	0.060-0.210 mm	0.0024-0.0083 in
• Crankshaft Main Bearing Journal Width	23.9-24.1 mm	0.941-0.949 in
• Crankshaft Main Bearing Clearance - Except #3	0.019-0.064 mm	0.0008-0.0025 in
• Crankshaft Main Bearing Clearance - #3 Thrust Bearing	0.032-0.077 mm	0.0012-0.0030 in
• Crankshaft Main Journal Diameter	67.239-67.257 mm	2.6473-2.6483 in
• Crankshaft Main Journal Out-of-Round	0.005 mm	0.0002 in
• Crankshaft Main Journal Taper	0.005 mm	0.0002 in
• Crankshaft Rear Flange Runout	0.04 mm	0.0016 in
Cylinder Head		
• Combustion Chamber Depth - at Measurement Point	2.2 mm	0.087 in
• Surface Finish - Maximum	2.8 RA	
• Surface Flatness - Block Deck	0.08 mm Per 152 mm	0.003 in Per 6 in
• Surface Flatness - Exhaust Manifold Deck	0.1 mm	0.004 in
• Surface Flatness - Intake Manifold Deck	0.1 mm	0.004 in
• Valve Guide Bore - Exhaust	8.01 mm	0.315 in
• Valve Guide Bore - Intake	8.01 mm	0.315 in
• Valve Guide Installed Height	16.6 mm	0.654 in

Lubrication System		
• Oil Capacity - with Filter	3.8 liter	4.0 quarts
• Oil Capacity - without Filter	3.3 liter	3.5 quarts
• Oil Pressure - @ 1850 RPM	207-310 kPa	30-45 PSI
Oil Pump		
• Gear Diameter	50.749-50.800 mm	1.997-1.999 in
• Gear Pocket - Depth	26.274-26.332 mm	1.034-1.036 in
• Gear Pocket - Diameter	50.902-50.952 mm	2.004-2.005 in
• Gears Lash	0.094-0.195 mm	0.0037-0.0077 in
• Relief Valve-to-Bore Clearance	0.038-0.089 mm	0.0015-0.0035 in
Piston Ring End Gap		
• First Compression Ring	0.18-0.39 mm	0.007-0.015 in
• Second Compression Ring	0.48-0.74 mm	0.019-0.029 in
• Oil Control Ring	0.25-0.74 mm	0.010-0.029 in
Piston Ring to Groove Clearance		
• First Compression Ring	0.03-0.076 mm	0.001-0.003 in
• Second Compression Ring	0.04-0.078 mm	0.002-0.003 in
• Oil Control Ring	0.09 mm	0.004 in
Piston Ring Thickness		
• First Compression Ring	1.164-1.190 mm	0.046-0.047 in
• Second Compression Ring	1.472-1.490 mm	0.058 in
• Oil Control Ring - Maximum	2.440 mm	0.096 in
Piston		
• Piston Diameter - production	98.970-99.008 mm	3.896-3.897 in
• Piston Diameter - service limit	98.950 mm	3.895 in
• Piston Pin Bore Diameter	24.008-24.013 mm	0.9452-0.9454 in
• Piston Ring Groove Width	1.23-1.255 mm	0.048-0.049 in
• Piston to Bore Clearance - production	-0.029-0.029 mm	-0.0011-0.011 in
• Piston to Bore Clearance - service limit - Maximum	0.080 mm	0.003 in

Pin		
• Piston Pin Clearance to Connecting Rod Bore - Press Fit	-0.022--0.044 mm	-0.0008--0.0017 in
• Piston Pin Clearance to Piston Pin Bore	0.008-0.016 mm	0.0003-0.0006 in
• Piston Pin Diameter	23.997-24.000 mm	0.9447-0.9448 in
• Piston Pin Length	59.87-60.13 mm	2.35-2.36 in
Valves		
• Valve Face Angle	45 degrees	
• Valve Seat Angle	46 degrees	
• Valve Seat Depth - Exhaust - from deck face	8.9-9.1 mm	0.350-0.358 in
• Valve Seat Depth - Intake - from deck face	7.9-8.1 mm	0.311-0.318 in
• Valve Seat Width - Exhaust	1.70-2.0 mm	0.067-0.079 in
• Valve Seat Width - Intake	1.55-1.80 mm	0.061-0.071 in
• Valve Stem-to-Guide Clearance	0.026-0.068 mm	0.0010-0.0027 in
Valve Lifters/Push Rods		
• Push Rod Length - Intake	146.0 mm	5.75 in
• Push Rod Length - Exhaust	152.5 mm	6.0 in
Valve Springs		
• Valve Spring Free Length	48.5 mm	1.89 in
• Valve Spring Installed Height	43.2 mm	1.701 in
• Valve Spring Load - Closed	320 N 43.2 mm	75 lb 1.701 in
• Valve Spring Load - Open	1036 N 32 mm	230 lb 1.260 in
• Valve Spring Total Number of Coils	7.10	

SEALERS, ADHESIVES, AND LUBRICANTS

Sealers, Adhesives, and Lubricants

Application	Type of Material	GM Part Number	
		United States	Canada
Camshaft Rear Bearing Hole Plug	Sealant	12377901	10953504
Coolant Drain Plug	Sealant	12346004	10953480
Coolant Temperature Sensor Threads	Sealant	12346004	10953480
Crankshaft Balancer Keyway	Sealant	12378521	88901148

Crankshaft Position Sensor Bolt/Stud Threads	Threadlock	12345382	10953489
Engine Block Coolant Drain Plug Threads	Sealant	12346004	10953480
Engine Block Oil Gallery Plug Threads	Sealant	12346004	10953480
Engine Front Cover Bolt Threads	Sealant	12346004	10953480
Engine Front Cover Gasket Lower Tabs	Sealant	12346004	10953480
Engine Oil	5W-30 Oil	12345610	993193
Engine Oil Cooler Fitting Threads	Sealant	12346004	10953480
Engine Oil Supplement	Lubricant	1052367	992869
Intake Manifold Bolt Threads - Upper and Lower	Threadlock	12345382	10953489
Intake Manifold Coolant Pipe	Sealant	12345493	10953488
Intake Manifold to Engine Block Mating Surface	Sealant	12378521	88901148
Intake Manifold Tuning Valve	Lubricant	1051344	993037
Oil Filter Bypass Hole Plug Threads	Sealant	12346004	10953480
Oil Pan Surface at Rear Crankshaft Main Bearing Cap	Sealant	12378521	88901148
Oil Pressure Switch Threads	Sealant	12346004	10953480
Oil Pump Suction Pipe	Sealant	12346004	10953480
Piston and Piston Pin	5W-30 Oil	12345610	993193
Rear Crankshaft Main Bearing Cap	Sealant	1052942	10953466
Throttle Body Stud and Bolts	Threadlock	12345382	10953489
Valve Lifter and Camshaft Prelube	Lubricant	12345501	992704
Valve Lifter Guide Bolt Threads	Threadlock	12345382	10953489
Valve Rocker Arm Cover Notch at Cylinder Head and Lower Intake Manifold	Sealant	12378521	88901148

COMPONENT LOCATOR

DISASSEMBLED VIEWS

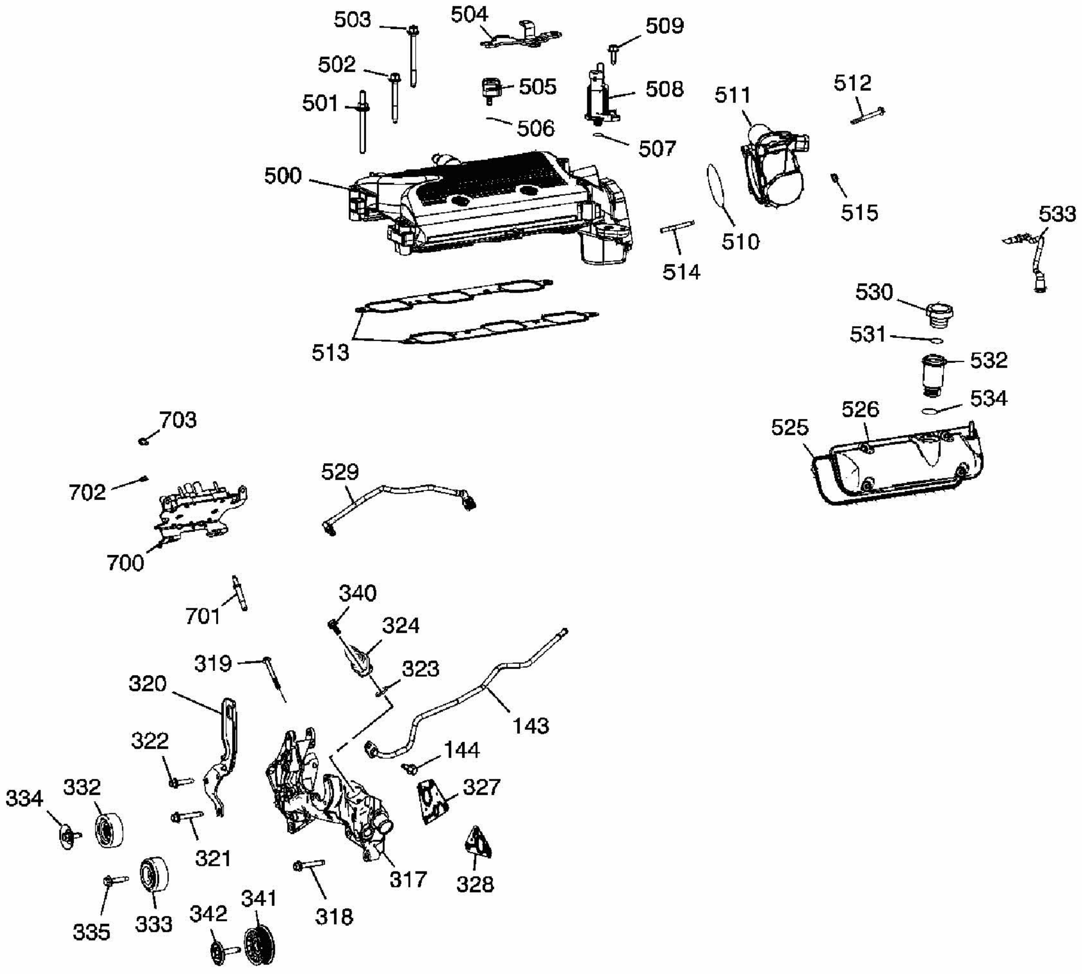

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Fig. 1: Upper Intake Manifold And Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 1

Callout	Component Name
143	Coolant Vent Pipe
144	Coolant Vent Pipe Bolt
317	Coolant Crossover Pipe
318	Coolant Crossover Pipe Bolt - Small
319	Coolant Crossover Pipe Bolt - Large
320	Engine Lift Bracket - Front
321	Engine Lift Bracket Bolt - Small
322	Engine Lift Bracket Bolt - Large
323	Coolant Fill Adapter Seal
324	Coolant Fill Adapter
327	Coolant Crossover Pipe Gasket - Right

328	Coolant Crossover Pipe Gasket - Left
332	Idler Pulley - Upper
333	Idler Pulley - Lower
334	Idler Pulley Bolt - Upper
335	Idler Pulley Bolt - Lower
340	Coolant Fill Adapter Bolt
341	Idler Pulley
342	Idler Pulley Bolt
500	Upper Intake Manifold
501	Upper Intake Manifold Stud
502	Upper Intake Manifold Bolt - Large
503	Upper Intake Manifold Bolt - Small
504	MAP Sensor Bracket
505	MAP Sensor
506	MAP Sensor Seal
507	EVAP Purge Valve Seal
508	EVAP Purge Valve
509	EVAP Purge Valve Bolt
510	Throttle Body Seal
511	Throttle Body
512	Throttle Body Bolt
513	Upper Intake Manifold Gasket
514	Throttle Body Stud
515	Throttle Body Nut
525	Valve Rocker Cover Seal
526	Valve Rocker Cover - LH
529	PCV Tube - Fresh Air
530	Oil Fill Cap
531	Oil Fill Cap Seal
532	Oil Fill Tube
533	PCV Tube - Fool Air
534	Oil Fill Tube Seal
700	Ignition Coil Assembly
701	Ignition Coil Assembly Stud
702	Ignition Coil Assembly Nut
703	Ignition Coil Assembly Bolt

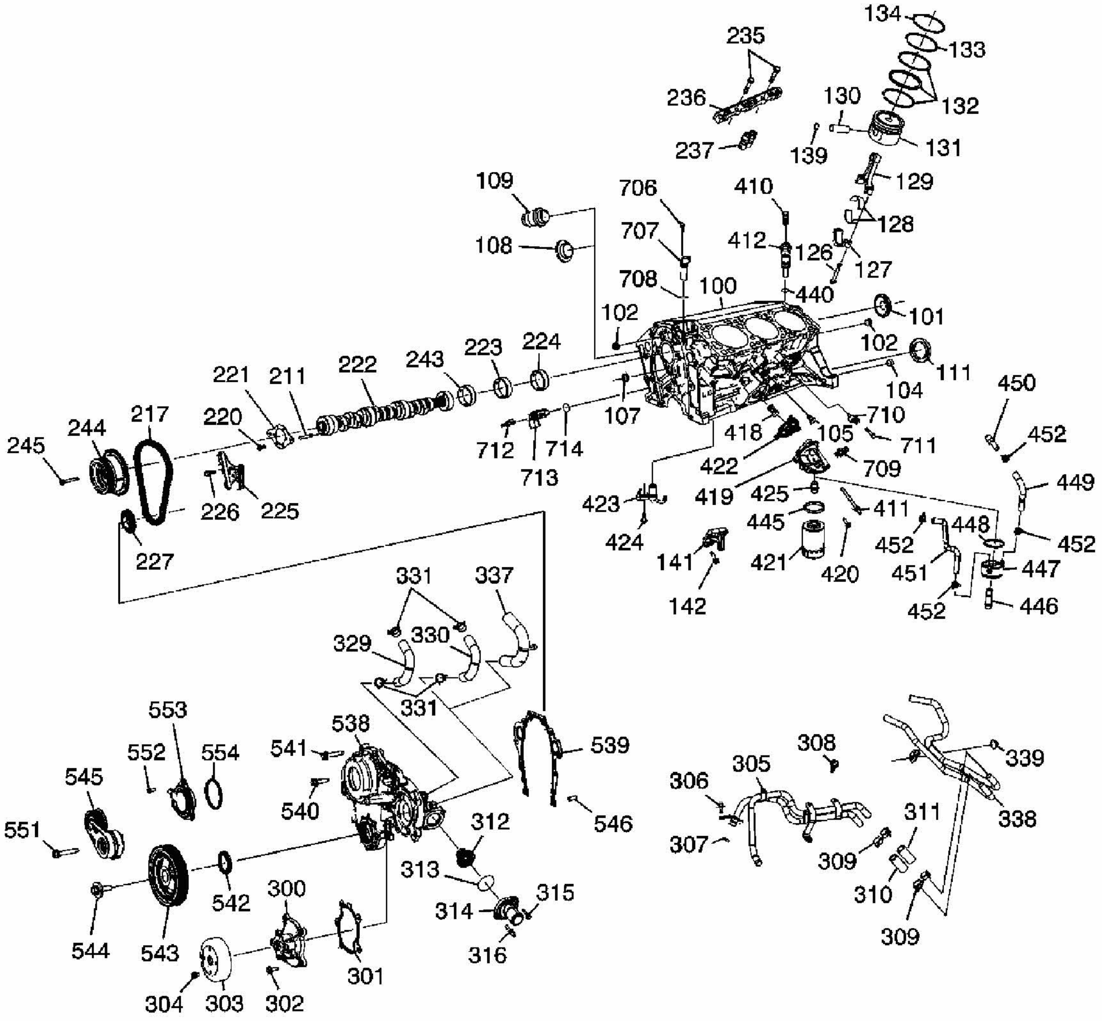
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Fig. 2: Engine Block And Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
100	Engine Block
101	Camshaft Rear Bearing Hole Plug
102	Engine Block Oil Gallery Plug
104	Transmission Locating Pin
105	Engine Block Coolant Drain Hole Plug
107	Engine Block Oil Gallery Plug - Front
108	Engine Block Heater Plug
109	Engine Block Heater
111	Crankshaft Rear Oil Seal
126	Connecting Rod Bearing Cap Bolt
127	Connecting Rod Bearing Cap

128	Connecting Rod Bearing
129	Connecting Rod
130	Piston Pin
131	Piston
132	Piston Ring - Oil Control
133	Piston Ring - Compression - Lower
134	Piston Ring - Compression - Upper
139	Piston Pin Retainer Clip
141	A/C Compressor Bracket
142	A/C Compressor Bracket Bolt
211	Camshaft Position Actuator Filter
217	Timing Chain
220	Camshaft Thrust Plate Bolt
221	Camshaft Thrust Plate
222	Camshaft
223	Camshaft Bearing - 2 and 3
224	Camshaft Bearing - 4
225	Timing Chain Tensioner
226	Timing Chain Tensioner Bolt
227	Crankshaft Sprocket
235	Valve Lifter Guide Bolt
236	Valve Lifter Guide
237	Valve Lifter
243	Camshaft Bearing - 1
244	Camshaft Position Actuator
245	Camshaft Position Actuator Bolt
300	Water Pump
301	Water Pump Gasket
302	Water Pump Bolt
303	Water Pump Pulley
304	Water Pump Pulley Bolt
305	Heater Inlet and Outlet Pipe Assembly - to Coolant Crossover
306	Heater Inlet and Outlet Pipe Assembly Bolt - to Coolant Crossover
307	Heater Inlet and Outlet Pipe Assembly Seal
308	Heater Inlet and Outlet Pipe Assembly Bolt - to Cylinder Head
309	Heater Inlet and Outlet Pipe Assembly Hose Clamp
310	Heater Inlet and Outlet Pipe Assembly Hose - Small
311	Heater Inlet and Outlet Pipe Assembly Hose - Large

	Thermostat
313	Thermostat Seal
314	Thermostat Housing
315	Thermostat Housing Bolt
316	Thermostat Housing Stud
329	Thermal Bypass Hose
330	Thermal Bypass Hose - W/O Oil Cooler
331	Thermal Bypass Hose Clamp
337	Thermal Bypass Hose - W/Oil Cooler
338	Heater Inlet and Outlet Pipe Assembly
339	Heater Inlet and Outlet Pipe Assembly Nut
410	Oil Pump Drive Bolt
411	Oil Filter Adapter Stud
412	Oil Pump Drive
418	Oil Filter Bypass Valve
419	Oil Filter Adapter
420	Oil Filter Adapter Bolt - Small
421	Oil Filter
422	Oil Filter Adapter Gasket
423	Piston Oil Nozzle
424	Piston Oil Nozzle Bolt
425	Oil Filter Fitting
440	Oil Pump Drive Seal
445	Oil Filter Gasket
446	Oil Cooler Connector
447	Oil Cooler Assembly
448	Oil Cooler Assembly Seal
449	Oil Cooler Hose - Inlet
450	Oil Cooler Fitting
451	Oil Cooler Hose - Outlet
452	Oil Cooler Hose Clamp
538	Engine Front Cover
539	Engine Front Cover Gasket
540	Engine Front Cover Bolt - Small
541	Engine Front Cover Bolt - Large
542	Crankshaft Front Oil Seal
543	Crankshaft Balancer
544	Crankshaft Balancer Bolt

	Belt Tensioner
546	Engine Front Cover Locating Pin
551	Belt Tensioner Bolt
552	Camshaft Position Actuator Magnet Bolt
553	Camshaft Position Actuator Magnet
554	Camshaft Position Actuator Magnet Seal
706	Camshaft Sensor Bolt
707	Camshaft Sensor
708	Camshaft Sensor Seal
709	Engine Oil Pressure Sensor
710	Knock Sensor
711	Knock Sensor Bolt
712	Crankshaft Position Sensor Stud
713	Crankshaft Position Sensor
714	Crankshaft Position Sensor Seal

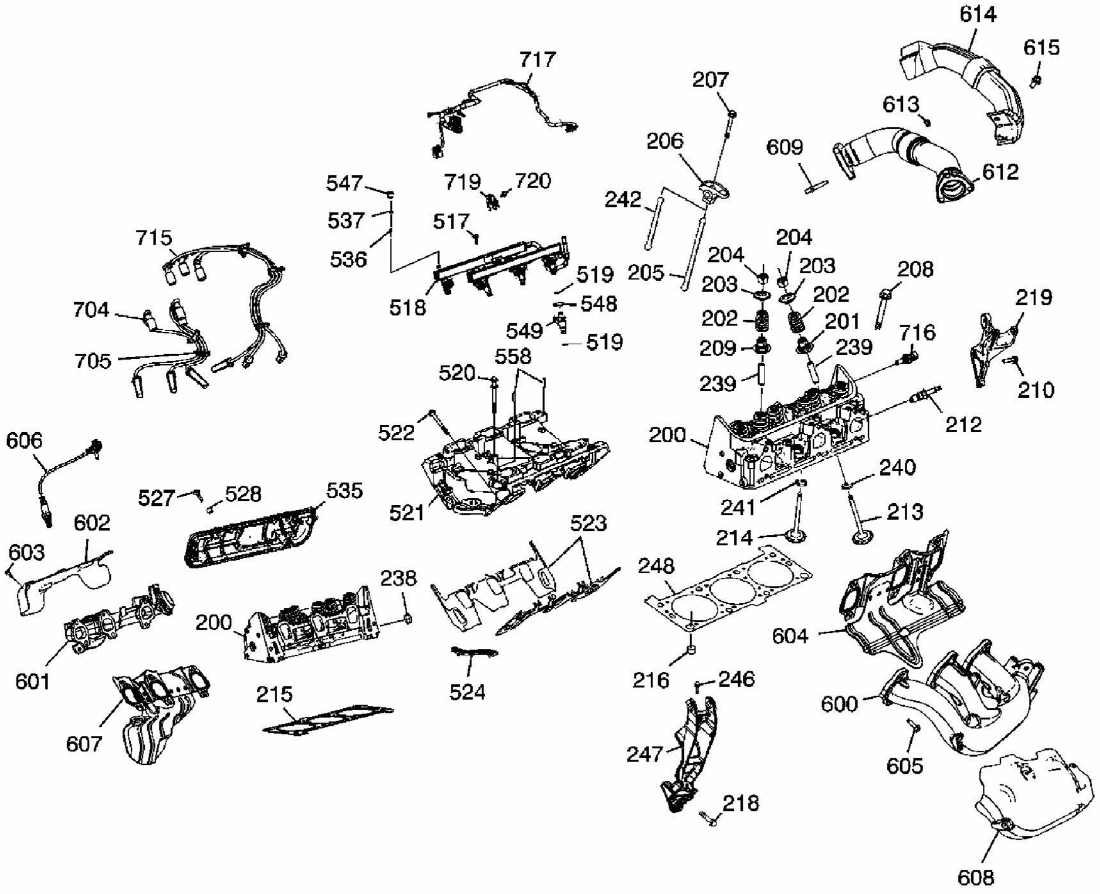
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Fig. 3: Lower Intake Manifold, Cylinder Head, And Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
200	Cylinder Head
201	Valve Seal - Exhaust
202	Valve Spring
203	Valve Spring Cap
204	Valve Stem Key
205	Valve Pushrod - Exhaust
206	Valve Rocker Arm
207	Valve Rocker Arm Bolt
208	Cylinder Head Bolt
209	Valve Seal - Intake
210	Engine Mount Strut Bracket Bolt
212	Spark Plug
213	Exhaust Valve
214	Intake Valve
215	Cylinder Head Gasket - RH
216	Cylinder Head Locating Pin
218	Engine Mount Strut and A/C Compressor Bracket Bolt - Long
219	Engine Mount Strut Bracket
238	Cylinder Head Expansion Plug
239	Valve Guide
240	Valve Seat - Exhaust
241	Valve Seat - Intake
242	Valve Pushrod - Intake
246	Engine Mount Strut and A/C Compressor Bracket Bolt - Short
247	Engine Mount Strut and A/C Compressor Bracket
248	Cylinder Head Gasket - LH
517	Fuel Rail Bolt
518	Fuel Rail
519	Fuel Injector Seal
520	Lower Intake Manifold Bolt - Long
521	Lower Intake Manifold
522	Lower Intake Manifold Bolt - Short
523	Lower Intake Manifold Gasket
524	Lower Intake Manifold Seal
527	Valve Rocker Cover Bolt
528	Valve Rocker Cover Bolt Grommet

535	Valve Rocker Cover - RH
536	Fuel Schrader Valve
537	Fuel Service Port Cap Seal
547	Fuel Service Port Cap
548	Fuel Injector Retaining Clip
549	Fuel Injector
558	Lower Intake Manifold Locating Pin
600	Exhaust Manifold - Left
601	Exhaust Manifold - Right
602	Exhaust Manifold Heat Shield - Right - Upper
603	Exhaust Manifold Heat Shield Bolt
604	Exhaust Manifold Gasket - LH
605	Exhaust Manifold Bolt
606	Heated Oxygen Sensor
607	Exhaust Manifold Gasket - RH
608	Exhaust Manifold Heat Shield - Left - Upper
609	Exhaust Crossover Stud
612	Exhaust Crossover
613	Exhaust Crossover Nut
614	Exhaust Crossover Heat Shield
615	Exhaust Crossover Heat Shield Bolt
704	Spark Plug Wire Harness - Front
705	Spark Plug Wire Support Clip
715	Spark Plug Wire Harness - Rear
716	Coolant Temperature Sensor
717	Wiring Harness
719	Wiring Connector Bracket
720	Wiring Connector Bracket Bolt

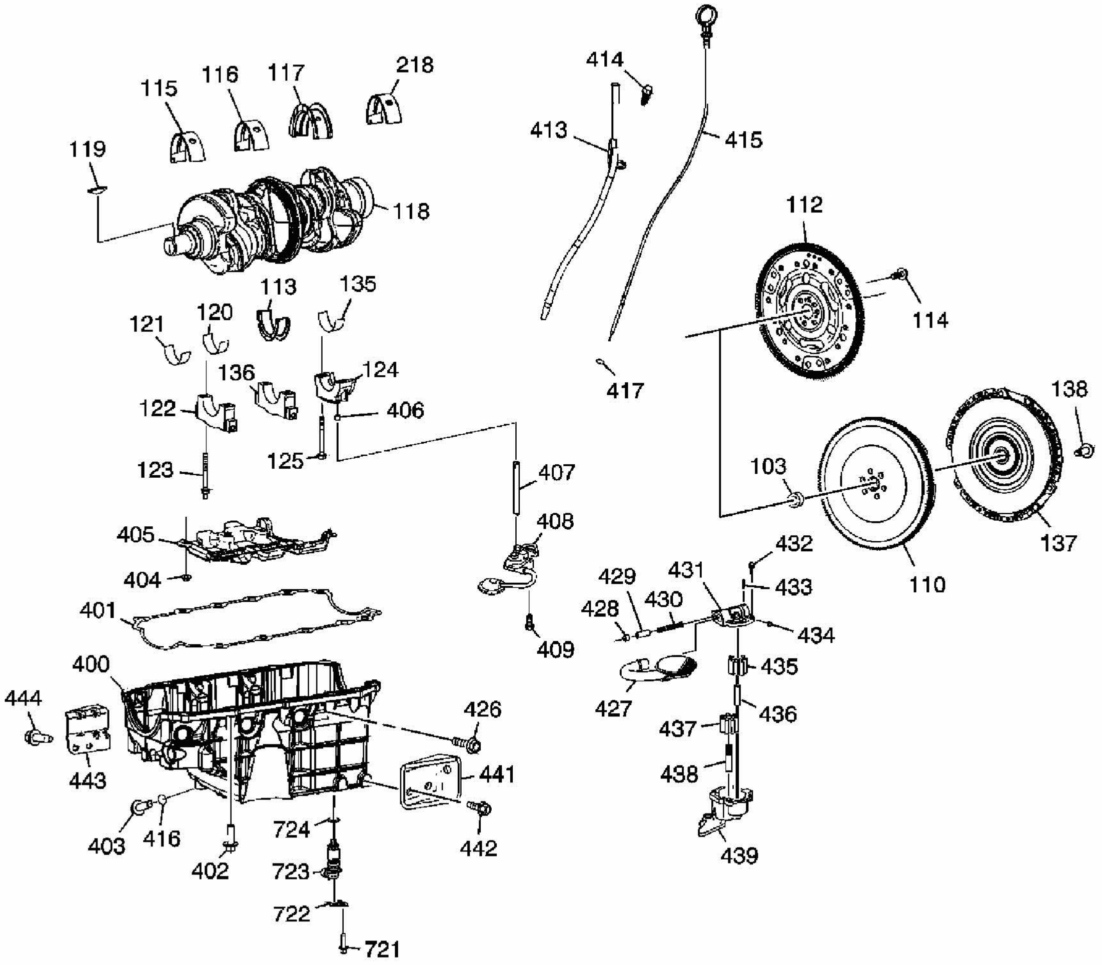
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Fig. 4: Crankshaft And Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
103	Clutch Pilot Bearing
110	Flywheel - Manual
112	Flywheel - Automatic
113	Crankshaft Lower Bearing - 3
114	Flywheel Bolt
115	Crankshaft Upper Bearing - 1
116	Crankshaft Upper Bearing - 2
117	Crankshaft Upper Bearing - 3
118	Crankshaft
119	Crankshaft Balancer Key
120	Crankshaft Lower Bearing - 2
121	Crankshaft Lower Bearing - 1

122	Crankshaft Bearing Cap - 1
123	Crankshaft Bearing Cap Stud
124	Crankshaft Bearing Cap - 4
125	Crankshaft Bearing Cap Bolt
135	Crankshaft Lower Bearing - 4
136	Crankshaft Bearing Cap - 2 and 3
137	Clutch Pressure Plate
138	Clutch Pressure Plate Bolt
218	Crankshaft Upper Bearing - 4
400	Oil Pan
401	Oil Pan Gasket
402	Oil Pan Bolt - to Engine Block
403	Oil Pan Drain Plug
404	Crankshaft Oil Deflector Nut
405	Crankshaft Oil Deflector
406	Oil Pump Locating Pin
407	Oil Pump Shaft
408	Oil Pump
409	Oil Pump Bolt
413	Oil Level Indicator Tube
414	Oil Level Indicator Tube Bolt
415	Oil Level Indicator
416	Oil Pan Drain Plug Seal
417	Oil Level Indicator Seal
426	Oil Pan Bolt - Side of Pan
427	Oil Pump Screen
428	Oil Pump Plug
429	Oil Pump Valve
430	Oil Pump Spring
431	Oil Pump Cover
432	Oil Pump Cover Bolt
433	Oil Pump Pin
434	Oil Pressure Relief Valve Bore Plug
435	Oil Pump Driven Gear
436	Oil Pump Driven Shaft
437	Oil Pump Drive Gear
438	Oil Pump Drive Shaft
439	Oil Pump Housing

	Oil Pan Support Bracket - LH
442	Oil Pan Support Bracket Bolt - LH
443	Oil Pan Support Bracket - RH
444	Oil Pan Support Bracket Bolt - RH
721	Engine Oil Level Indicator Switch Bolt
722	Engine Oil Level Indicator Switch Clip
723	Engine Oil Level Indicator Switch
724	Engine Oil Level Indicator Seal

ENGINE IDENTIFICATION

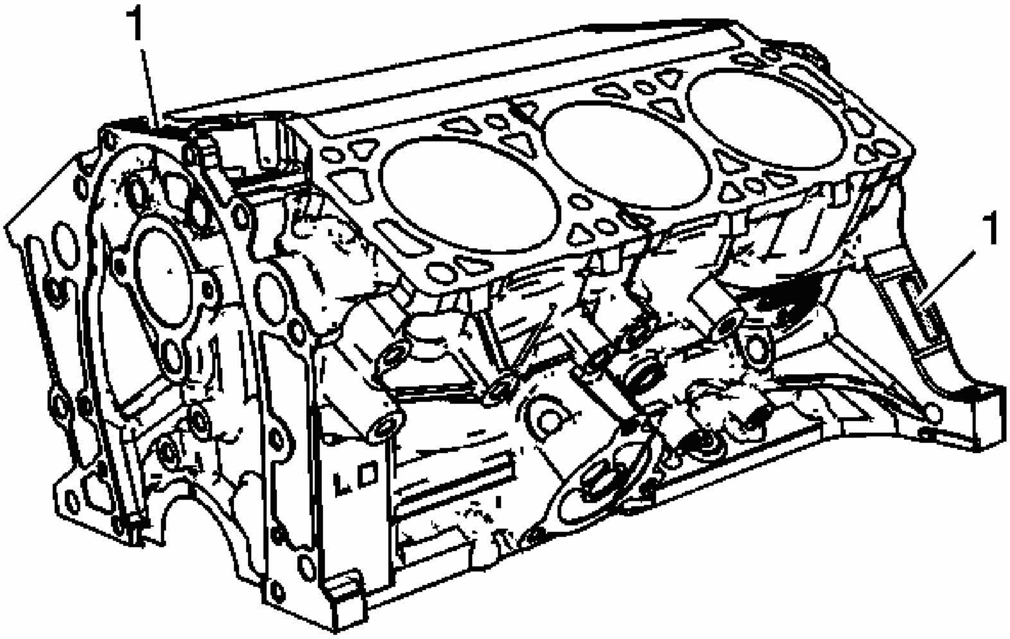


Fig. 5: Locating Engine Identification Tags
Courtesy of GENERAL MOTORS CORP.

The Vehicle Identification Number - VIN derivative (1) for 3400 LZ4 is stamped or laser etched on the front and left side of the engine block. The Vehicle Identification Number - VIN derivative is nine digits long and can be used to determine if a vehicle contains the original engine.

- The first digit identifies the division.
- The second digit identifies the model year.

- The third digit identifies the assembly plant.
- The fourth through ninth digits are the last six digits of the Vehicle Identification Number - VIN.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - ENGINE MECHANICAL

Begin the system diagnosis by reviewing the **Disassembled Views** , **Engine Component Description**, **Drive Belt System Description** and **Lubrication Description** in Engine Mechanical. Reviewing the description and operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the description and operation information will also help you determine if the condition described by the customer is normal operation. Refer to **Symptoms - Engine Mechanical** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

SYMPTOMS - ENGINE MECHANICAL

Strategy Based Diagnostics

1. Perform A **DIAGNOSTIC STARTING POINT - ENGINE CONTROLS** in Engine Controls before using the symptom tables - if applicable.
2. Review the system operations in order to familiarize yourself with the system functions. Refer to **Disassembled Views** , **Engine Component Description**, **Drive Belt System Description** and **Lubrication Description** in Engine Mechanical.

All diagnosis on a vehicle should follow a logical process. Strategy based diagnostics is a uniform approach for repairing all systems. The diagnostic flow may always be used in order to resolve a system problem. The diagnostic flow is the place to start when repairs are necessary. For a detailed explanation, refer to **Strategy Based Diagnosis** in General Information.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Engine. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Check for the correct oil level, proper oil viscosity, and correct filter application.
- Verify the exact operating conditions under which the concern exists. Note factors such as engine RPM, ambient temperature, engine temperature, amount of engine warm-up time, and other specifics.
- Compare the engine sounds - if applicable to a known good engine and make sure you are not trying to correct a normal condition.

Intermittent

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating properly.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Base Engine Misfire without Internal Engine Noises**
- **Base Engine Misfire with Abnormal Internal Lower Engine Noises**
- **Base Engine Misfire with Abnormal Valve Train Noise**
- **Base Engine Misfire with Coolant Consumption**
- **Base Engine Misfire with Excessive Oil Consumption**
- **Upper Engine Noise, Regardless of Engine Speed**
- **Lower Engine Noise, Regardless of Engine Speed**
- **Engine Noise Under Load**
- **Engine Will Not Crank - Crankshaft Will Not Rotate**
- **Engine Compression Test**
- **Engine Noise on Start-Up, but Only Lasting a Few Seconds**
- **Oil Consumption Diagnosis**
- **Oil Pressure Diagnosis and Testing**
- **Oil Leak Diagnosis**
- **Drive Belt Chirping Diagnosis**
- **Drive Belt Squeal Diagnosis**
- **Drive Belt Whine Diagnosis**
- **Drive Belt Rumbling Diagnosis**
- **Drive Belt Vibration Diagnosis**
- **Drive Belt Falls Off Diagnosis**
- **Drive Belt Tensioner Diagnosis**
- **Valve Rocker Arm Cover Replacement - Left**

BASE ENGINE MISFIRE WITHOUT INTERNAL ENGINE NOISES

Base Engine Misfire without Internal Engine Noises

Cause	Correction
Engine oil level overfull, causing aeration	Drain excess oil and adjust oil level to proper specification.
Abnormalities - severe cracking, bumps,	Replace the drive belt. Refer to **Drive Belt**

or missing areas in the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine RPM variations and lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	**Tensioner Replacement** .
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout may lead to a misfire DTC A misfire code may be present without an actual misfire condition.	Inspect the components, and repair or replace as required.
Loose or improperly installed engine flywheel or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer as required. Refer to **Engine Flywheel Replacement** or **Crankshaft Balancer Replacement** .
Restricted exhaust system A severe restriction in the exhaust flow can cause significant loss of engine performance and may set a DTC. Possible causes of restrictions include collapsed or dented pipes or plugged mufflers and/or catalytic converters.	Repair or replace as required.
Improperly installed or damaged vacuum hoses	Repair or replace as required.
Improper sealing between the intake manifold and cylinder heads or throttle body.	Replace the intake manifold, gaskets, cylinder heads, and/or throttle body as required.
Worn or loose rocker arms (The rocker arm bearing end caps and/or needle bearings should be intact and in the proper position.	Replace the valve rocker arms as required.
Worn or bent pushrods	Replace the pushrods.
Stuck valves Carbon buildup on the valve stem can cause the valve not to close properly.	Repair or replace as required.
Excessively worn or out of time timing chain	Replace the timing chain and sprockets as required.
Worn camshaft lobes	Replace the camshaft and valve lifters.
Excessive oil pressure A lubrication system with excessive oil	• Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing**.

pressure may lead to excessive valve lifter pump-up and loss of compression.	• Repair or replace the oil pump as required.
Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages. Refer to **Diagnostic Starting Point - Engine Cooling** . Coolant consumption may or may not cause the engine to overheat.	• Inspect for spark plugs saturated by coolant. Refer to **Spark Plug Inspection** in Engine Controls. • Inspect the cylinder heads, engine block, and/or head gaskets. • Repair or replace as required.
Worn Piston Rings Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs for oil deposits. Refer to **Spark Plug Inspection** in Engine Controls. • Inspect the cylinders for a loss of compression. Refer to **Engine Compression Test**. • Perform cylinder leak down and compression testing to identify the cause. • Repair or replace as required.

BASE ENGINE MISFIRE WITH ABNORMAL INTERNAL LOWER ENGINE NOISES

Base Engine Misfire with Abnormal Internal Lower Engine Noises

Cause	Correction
Abnormalities - severe cracking, bumps or missing areas in the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine RPM variations, noises similar to a faulty lower engine and also lead to a misfire condition. A misfire code may be present without an actual misfire condition.	Replace the drive belt. Refer to **Drive Belt Tensioner Replacement** .
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout A misfire code may be present without an actual misfire condition.	Inspect the components, repair or replace as required.
Loose or improperly installed engine flywheel or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer as required. Refer to **Engine Flywheel Replacement** or **Crankshaft Balancer Replacement** .

Worn Piston Rings - Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs for oil deposits. Refer to **Spark Plug Inspection** in Engine Controls. • Inspect the cylinders for a loss of compression. Refer to **Engine Compression Test**. • Perform cylinder leak down and compression testing to determine the cause. • Repair or replace as required.
Worn Crankshaft Thrust Bearings Severely worn thrust surfaces on the crankshaft and/or thrust bearing may permit fore and aft movement of the crankshaft and create a DTC without an actual misfire condition.	Replace the crankshaft and bearings as required.

BASE ENGINE MISFIRE WITH ABNORMAL VALVE TRAIN NOISE

Base Engine Misfire with Abnormal Valve Train Noise

Cause	Correction
Engine oil level overfull, causing aeration	Drain excess oil and adjust oil level to proper specification.
Worn or loose rocker arms The rocker arm bearing end caps and/or needle bearings should intact within the rocker arm assembly.	Replace the valve rocker arms as required.
Worn or bent pushrods	Replace the pushrods.
Stuck valves Carbon buildup on the valve stem can cause the valve not to close properly.	Repair or replace as required.
Excessively worn or mis-aligned timing chain	Replace the timing chain and sprockets as required.
Worn camshaft lobes	Replace the camshaft and valve lifters.
Sticking lifters	Replace as required.
Malfunctioning camshaft position actuator. Improper viscosity oil, contaminated oil, or a plugged or missing camshaft position actuator filter can cause the camshaft position actuator locking pin to malfunction.	• Verify correct oil viscosity by changing the engine oil and oil filter and re-evaluating the concern. • Inspect for a missing or plugged camshaft position actuator filter. • If filter is missing, replace the filter,

	replace the camshaft position actuator, and change the engine oil and oil filter. • If filter is plugged, replace the filter, and change the engine oil and oil filter. • If no problem is found with the camshaft position actuator filter, replace the camshaft position actuator and change the engine oil and oil filter.

BASE ENGINE MISFIRE WITH COOLANT CONSUMPTION

Base Engine Misfire with Coolant Consumption

Cause	Correction
Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages. Refer to **Diagnostic Starting Point - Engine Cooling** in Engine Cooling. Coolant consumption may or may not cause the engine to overheat.	• Inspect for spark plugs saturated by coolant. Refer to **Spark Plug Inspection** in Engine Controls. • Perform a cylinder leak down test. • Inspect the cylinder heads and engine block for damage to the coolant passages and/or a faulty head gasket. • Repair or replace as required.

BASE ENGINE MISFIRE WITH EXCESSIVE OIL CONSUMPTION

Base Engine Misfire with Excessive Oil Consumption

Cause	Correction
Worn valves, valve guides and/or valve stem oil seals	• Inspect the spark plugs for oil deposits. Refer to **Spark Plug Inspection** in Engine Controls. • Repair or replace as required.
Worn Piston Rings Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs for oil deposits. Refer to **Spark Plug Inspection** in Engine Controls. • Inspect the cylinders for a loss of compression. Refer to **Engine Compression Test**. • Perform cylinder leak down and compression testing to determine the

	cause. • Repair or replace as required.

ENGINE NOISE ON START-UP, BUT ONLY LASTING A FEW SECONDS

Engine Noise on Start-Up, but Only Lasting a Few Seconds

Cause	Correction
IMPORTANT: **The camshaft position actuator may make a slight tapping noise upon cold startup. This is due to the viscosity of the oil that has not yet warmed to proper operating temperatures, and should be considered normal for the first 3.5 minutes of cold engine operation.**	
Incorrect oil filter without anti-drainback feature	Install the correct oil filter.
Incorrect oil viscosity	1. Drain the oil. 2. Install the correct viscosity oil.
Worn crankshaft thrust bearing	1. Inspect the thrust bearing and crankshaft. 2. Repair or replace as required.
High valve lifter leak down rate	Replace the lifters as required.
Excessive crank/rod bearing clearances	1. Inspect the crankshaft and rod bearings. 2. Repair or replace as required.

UPPER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Upper Engine Noise, Regardless of Engine Speed

Cause	Correction
IMPORTANT: **The camshaft position actuator may make a slight tapping noise upon cold startup. This is due to the viscosity of the oil that has not yet warmed to proper operating temperatures, and should be considered normal for the first 3.5 minutes of cold engine operation.**	
Engine oil level overfull, causing aeration	Drain excess oil and adjust oil level to proper specification.
Low oil pressure	1. Perform an oil pressure test. Refer **Oil Pressure Diagnosis and Testing**. 2. Repair or replace as required.
Loose and/or worn valve rocker arm attachments	1. Inspect the valve rocker arm stud, nut, or bolt. 2. Repair or replace as required.
Worn valve rocker arm	Replace the valve rocker arm.

Bent or damaged push rod	Inspect the following components, and replace as required: • The valve rocker arm • The valve push rod • The valve lifter
Improper lubrication to the valve rocker arms	Inspect the following components, and repair or replace as required: • The valve rocker arm • The valve push rod • The valve lifter • The oil filter bypass valve • The oil pump and pump screen • The engine block oil galleries
Broken valve spring	Replace the valve spring.
Worn and/or damaged valve rotators	Replace the valve rotators as required.
Worn or dirty valve lifters	Replace the valve lifters.
Stretched or broken timing chain and/or damaged sprocket teeth	Replace the timing chain and sprockets.
Worn timing chain tensioner (if applicable)	Replace the timing chain tensioners as required.
Worn engine camshaft lobes	1. Inspect the engine camshaft lobes. 2. Replace the camshaft and valve lifters as required.
Damaged, broken, or dirty, balance shaft sprocket teeth (if applicable)	Inspect the following components, and repair as required: • The balance shaft gear • The camshaft gear • The balance shaft rear bushing
Worn valve guides or valve stems	Inspect the following components, and repair as required: • The valves • The valve guides
Stuck Valves (Carbon on the valve stem or valve seat may cause the valve to stay open)	Inspect the following components, and repair as required: • The valves

	- The valve guides
Malfunctioning camshaft position actuator. Improper viscosity oil, contaminated oil, or a plugged or missing camshaft position actuator filter can cause the camshaft position actuator locking pin to malfunction.	- Verify correct oil viscosity by changing the engine oil and oil filter and reevaluating the concern. - Inspect for a missing or plugged camshaft position actuator filter. - If filter is missing, replace the filter, replace the camshaft position actuator, and change the engine oil and oil filter. - If filter is plugged, replace the filter, and change the engine oil and oil filter. - If no problem is found with the camshaft position actuator filter, replace the camshaft position actuator and change the engine oil and oil filter.

LOWER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Lower Engine Noise, Regardless of Engine Speed

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing**. 2. Repair or replace damaged components as required.
Worn accessory drive components Abnormalities such as severe cracking, bumps or missing areas in the accessory drive belt and/or misalignment of system components.	1. Inspect the accessory drive system. 2. Repair or replace as required.
Loose or damaged crankshaft balancer	1. Inspect the crankshaft balancer. 2. Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the knock sensor system. Refer to **Electronic Ignition (EI) System Diagnosis** in Engine Controls.
Loose torque converter bolts	1. Inspect the torque converter bolts and flywheel.

	2. Repair or replace as required.
Loose or damaged flywheel	Repair or replace the flywheel.
Damaged oil pan, contacting the oil pump screen An oil pan that has been damaged may improperly position the oil pump screen, preventing proper oil flow to the oil pump.	1. Inspect the oil pan. 2. Inspect the oil pump screen 3. Repair or replace as required.
Oil pump screen loose, damaged or restricted	1. Inspect the oil pump screen. 2. Repair or replace as required.
Excessive piston-to-cylinder bore clearance	1. Inspect the piston and cylinder bore. 2. Repair as required.
Excessive piston pin-to-bore clearance	1. Inspect the piston, piston pin, and the connecting rod. 2. Repair or replace as required.
Excessive connecting rod bearing clearance	Inspect the following components, and repair as required: • The connecting rod bearings • The connecting rods • The crankshaft • The crankshaft journals
Excessive crankshaft bearing clearance	Inspect the following components, and repair as required: • The crankshaft bearings • The crankshaft journals
Incorrect piston, piston pin and connecting rod installation Pistons must be installed with the mark or dimple on the top of the piston facing the front of the engine. Piston pins must be centered in the connecting rod pin bore.	1. Verify the pistons, piston pins and connecting rods are installed correctly. 2. Repair as required.

ENGINE NOISE UNDER LOAD

Engine Noise Under Load

Cause	Correction
IMPORTANT: **The camshaft position actuator may make a slight tapping noise upon cold startup. This is due to the viscosity of the oil that has not yet warmed to proper operating temperatures, and should be considered normal for the first 3.5 minutes of cold engine operation.**	

Low oil pressure	1. Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing**. 2. Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the knock sensor system. Refer to **Electronic Ignition (EI) System Diagnosis** in Engine Controls.
Loose torque converter bolts	1. Inspect the torque converter bolts and flywheel. 2. Repair as required.
Cracked flywheel - automatic transmission	1. Inspect the flywheel bolts and flywheel. 2. Repair as required.
Excessive connecting rod bearing clearance	Inspect the following components, and repair as required: • The connecting rod bearings • The connecting rods • The crankshaft
Excessive crankshaft bearing clearance	Inspect the following components, and repair as required: • The crankshaft bearings • The crankshaft journals • The cylinder block crankshaft bearing bore
Malfunctioning camshaft position actuator. Improper viscosity oil, contaminated oil, or a plugged or missing camshaft position actuator filter can cause the camshaft position actuator locking pin to malfunction.	• Verify correct oil viscosity by changing the engine oil and oil filter and reevaluating the concern. • Inspect for a missing or plugged camshaft position actuator filter. • If filter is missing, replace the filter, replace the camshaft position actuator, and change the engine oil and oil filter. • If filter is plugged, replace the filter, and change the engine oil and oil filter. • If no problem is found with the

	camshaft position actuator filter, replace the camshaft position actuator and change the engine oil and oil filter.

ENGINE WILL NOT CRANK - CRANKSHAFT WILL NOT ROTATE

Engine Will Not Crank - Crankshaft Will Not Rotate

Cause	Correction
Seized accessory drive system component	1. Remove accessory drive belt or belts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Hydraulically locked cylinder • Coolant/antifreeze in cylinder • Oil in cylinder • Fuel in cylinder	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket or gaskets. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
Seized automatic transmission torque converter	1. Remove the torque converter bolts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Broken timing chain and/or timing chain gears	1. Inspect timing chain and gears. 2. Repair as required.
Material in cylinder • Broken valve • Piston material • Foreign material	1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
Seized crankshaft or connecting rod bearings	1. Inspect crankshaft and connecting rod bearings. 2. Repair as required.
Bent or broken connecting rod	1. Inspect connecting rods. 2. Repair as required.
Broken crankshaft	1. Inspect crankshaft. 2. Repair as required.

COOLANT IN COMBUSTION CHAMBER

Coolant in Combustion Chamber

<table>
<tr><th>Cause</th><th>Correction</th></tr>
<tr><td colspan="2">DEFINITION: Excessive white smoke and/or coolant type odor coming from the exhaust pipe may indicate coolant in the combustion chamber. Low coolant levels, an inoperative cooling fan, or a faulty thermostat may lead to an "overtemperature" condition which may cause engine component damage.
1. A slower than normal cranking speed may indicate coolant entering the combustion chamber. Refer to Engine Will Not Crank - Crankshaft Will Not Rotate.
2. Remove the spark plugs and inspect for spark plugs saturated by coolant or coolant in the cylinder bore.
3. Inspect by performing a Cylinder Leakage Test. During this test, excessive air bubbles within the coolant may indicate a faulty gasket or damaged component.
4. Inspect by performing a cylinder compression test. Two cylinders "side-by-side" on the engine block, with low compression, may indicate a failed cylinder head gasket. Refer to Engine Compression Test.</td></tr>
<tr><td>Cracked intake manifold or failed gasket</td><td>Replace the components as required.</td></tr>
<tr><td>Warped cylinder head</td><td>Machine the cylinder head to the proper flatness, if applicable and replace the cylinder head gasket. Refer to Cylinder Head Replacement - Left or Cylinder Head Replacement - Right .</td></tr>
<tr><td>Cracked cylinder head</td><td>Replace the cylinder head and gasket.</td></tr>
<tr><td>Cracked cylinder liner or engine block</td><td>Replace the components as required.</td></tr>
<tr><td>Cylinder head or engine block porosity</td><td>Replace the components as required.</td></tr>
</table>

COOLANT IN ENGINE OIL

Coolant in Engine Oil

<table>
<tr><th>Cause</th><th>Correction</th></tr>
<tr><td colspan="2">DEFINITION: Foamy or discolored oil or an engine oil "overfill" condition may indicate coolant entering the engine crankcase. Low coolant levels, an inoperative cooling fan, or a faulty thermostat may lead to an "overtemperature" condition which may cause engine component damage. Contaminated engine oil and oil filter should be changed.
1. Inspect the oil for excessive foaming or an overfill condition. Oil diluted by coolant may not properly lubricate the crankshaft bearings and may lead to component damage. Refer to Lower Engine Noise, Regardless of Engine</td></tr>
</table>

Speed. 2. Inspect by performing a **Cylinder Leakage Test**. During this test, excessive air bubbles within the cooling system may indicate a faulty gasket or damaged component. 3. Inspect by performing a cylinder compression test. Two cylinders "side-by-side" on the engine block with low compression may indicate a failed cylinder head gasket. Refer to **Engine Compression Test**.	
Faulty external engine oil cooler	Replace the components as required.
Warped cylinder head	Machine the cylinder head to proper flatness, if applicable, and replace the cylinder head gasket. Refer to **Cylinder Head Replacement - Left** or **Cylinder Head Replacement - Right** .
Cracked cylinder head	Replace the cylinder head and gasket.
Cracked cylinder liner or engine block	Replace the components as required.
Cylinder head, or block, porosity	Replace the components as required.

ENGINE COMPRESSION TEST

A compression pressure test of the engine cylinders determines the condition of the rings, the valves, and the head gasket.

IMPORTANT: Remove the Powertrain Control Module (PCM) and the ignition fuses from the I/P fuse block. Refer to Engine Electrical Component Views in Wiring Systems.

1. Disable the ignition.
2. Disable the fuel systems.
3. Remove the spark plugs from all the cylinders.
4. Remove the air duct from the throttle body.
5. Block the throttle plate in the open position.
6. Measure the engine compression, using the following procedure:
    1. Firmly install the compression gauge to the spark plug hole.
    2. Have an assistant crank the engine through at least 4 compression strokes in the testing cylinder.
    3. Record the readings on the gauge at each stroke.
    4. Disconnect the gauge.
    5. Repeat the compression test for each cylinder.
7. Record the compression readings from all of the cylinders.
    - The lowest reading should not be less than 70 percent of the highest reading.

  - No cylinder reading should be less than 689 kPa (100 psi).

8. The following list contains examples of the possible measurements:
    - When the compression measurement is normal, the compression builds up quickly and evenly to the specified compression on each cylinder.
    - When the compression is low on the first stroke and tends to build up on the following strokes, but does not reach the normal compression, the piston rings may be the cause.
    - If the compression improves considerably with the addition of three squirts of oil, the piston rings may be the cause.
    - When the compression is low on the first stroke and does not build up in the following strokes, the valves may be the cause.
    - The addition of oil does not affect the compression, the valves may be the cause.
    - When the compression is low on two adjacent cylinders, or coolant is present in the crankcase, the head gasket may be the cause.
9. Remove the block from the throttle plate.
10. Install the air duct to the throttle body.
11. Install the spark plugs.
12. Install the Powertrain Control Module (PCM) fuse.
13. Install the ignition fuse to the I/P fuse block.

CYLINDER LEAKAGE TEST

Tools Required

J 35667-A Cylinder Leakdown Tester. See **Special Tools**.

With the use of air pressure, a cylinder leakage test will aid in the diagnosis. Use the cylinder leakage test in conjunction with the engine compression test in order to isolate the cause of leaking cylinders.

CAUTION: Refer to BATTERY DISCONNECT CAUTION in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Remove the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls.
3. Install the **J 35667-A** . See **Special Tools**.
4. Measure each cylinder on the compression stroke, with both valves closed.

IMPORTANT: Hold the crankshaft balancer bolt in order to prevent piston movement.

5. Apply air pressure, using the **J 35667-A** . See **Special Tools**. Refer to the manufacturer's instructions.
6. Record the cylinder leakage readings for each cylinder.

IMPORTANT:

- **Normal cylinder leakage is from 12 to 18 percent.**
- **Make a note of any cylinder with more leakage than the other cylinders.**
- **Any cylinder with 30 percent leakage or more requires service.**

7. Inspect the 4 primary areas in order to properly diagnose a leaking cylinder.
8. If air is heard from the intake or exhaust system, perform the following procedure:
   - Remove the valve rocker arm cover of the suspect cylinder head.
     - Ensure that both valves are closed.
     - Inspect the cylinder head for a broken valve spring.
   - Remove and inspect the suspect cylinder head. Refer to **Cylinder Head Cleaning and Inspection** .
9. If air is heard from the crankcase system at the crankcase - oil filler tube, perform the following procedure:
   1. Remove the piston from the suspect cylinder.
   2. Inspect the piston and connecting rod assembly. Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** .
   3. Inspect the engine block. Refer to **Engine Block Cleaning and Inspection** .
10. If bubbles are found in the radiator, perform the following procedure:
    - Remove and inspect both cylinder heads. Refer to **Cylinder Head Cleaning and Inspection** .
    - Inspect the engine block. Refer to **Engine Block Cleaning and Inspection** .
11. Remove the **J 35667-A** . See **Special Tools**.
12. Install the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls.
13. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** in Engine Electrical.

OIL CONSUMPTION DIAGNOSIS

An engine that has excessive oil consumption uses 0.9 L (1 qt) of oil, or more, within 3 200 km (2,000 mi). The following list indicates the conditions and corrections of excessive oil consumption:

- An improperly read oil level indicator dipstick
    - Inspect the oil level while the vehicle is parked on a level surface.
    - Allow adequate drain-down time.
- Improper oil viscosity

  Use the recommended SAE viscosity for prevailing temperatures.

- Continuous high-speed driving
- Severe hauling, such as a trailer. This causes decreased oil mileage.
- A malfunctioning crankcase ventilation system
- External oil leaks
    - Tighten the bolts, as needed.
    - Replace the gaskets and seals, as needed.
- Worn or omitted valve guides and/or valve stem seals
    - Ream the guides.
    - Install oversized service valves and/or new valve stem seals.
- Broken or worn piston rings
- Improperly installed or unseated piston rings
- Improperly installed or improperly fitted piston
- Plugged cylinder head gasket oil drain holes
- Damaged intake gaskets

OIL PRESSURE DIAGNOSIS AND TESTING

Low or No Oil Pressure

The following conditions may cause low or no oil pressure:

- Low oil level

  Fill to the full mark on the oil level indicator.

- Incorrect or malfunctioning oil pressure switch

  Replace the oil pressure switch.

- Incorrect or malfunctioning oil pressure gauge

  Replace the oil pressure gauge.

- Improper oil viscosity or diluted oil

  - Install oil of proper viscosity for expected temperature.
  - Install new oil if the oil is diluted.
- A worn or dirty oil pump

  Clean or replace the oil pump.

- A plugged oil filter

  Replace the oil filter.

- A loose or plugged oil pickup screen

  Replace the oil pickup screen.

- A hole in the oil pickup tube

  Replace the oil pickup tube.

- Excessive rod, main, or cam bearing clearance

  Replace the bearings.

- Cracked, porous, or plugged oil gallery

  Repair or replace the engine block.

- Missing or improperly installed gallery plugs

  Install or repair the plugs as needed.

- A stuck pressure regulator valve
  - Inspect the pressure regulator valve for sticking in the bore.
  - Inspect the bore for scoring and burrs.
- A worn or poorly machined camshaft

  Replace the camshaft.

- Worn valve guides

  Repair the valve guides as needed.

Oil Pressure Testing

Tools Required

- **J-21867-6** Oil Pressure Adapter Fitting. See **Special Tools**.
- **J 25087-C** Oil Pressure Tester. See **Special Tools**.

If the vehicle has low oil pressure complete the following steps:

1. Inspect the oil level.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Remove the oil filter.
4. Assemble the plunger valve in the large hole of the **J 25087-C** base. See **Special Tools**. Insert the hose in the small hole of the **J 25087-C** base. See **Special Tools**. Connect the gauge to the end of the hose.
5. Insert the flat side of the rubber plug in the bypass valve without depressing the bypass valve.
6. Install the **J 25087-C** and **J-21867-6** on the filter mounting pad. See **Special Tools**.
7. Start the engine.
8. Inspect the overall oil pressure, the oil pressure switch, and for noisy lifters. Ensure that the engine is at operating temperature before inspecting the oil pressure. The oil pressure should be approximately 414 kPa (60 psi) at 1,850 RPM using 5W-30 engine oil.
9. If adequate oil pressure is indicated, test the oil pressure switch.
10. If a low reading is indicated, press the valve on the tester base in order to isolate the oil pump and/or its components from the lubricating system. An adequate reading at this time indicates a good pump and the previous low pressure was due to worn bearings, etc. A low reading while pressing the valve indicates a faulty pump.

OIL LEAK DIAGNOSIS

Tools Required

J 28428-E High Intensity Black Light Kit. See **Special Tools**.

You may repair most fluid leaks by first visually locating the leak, repairing or replacing the component, or by resealing the gasket surface. Once the leak is identified, determine the cause of the leak. Repair the leak and the cause of leak.

Locating and Identifying the Leak

Use the visual inspection method in order to determine if the leaking fluid is one of the following items:

- Engine oil
- Transmission fluid

- Power steering fluid
- Brake fluid
- Some other fluid

Visual Inspection Method

Complete the following steps in order to perform the visual inspection method:

1. Bring the vehicle to normal operating temperature.
2. Park the vehicle over a large sheet of paper, or other clean surface.
3. Wait several minutes, then inspect for dripping fluids.
4. Identify the type of fluid, and the approximate location of the leak.
5. Visually inspect the suspected area. Use a small mirror if necessary.
6. Inspect for leaks at sealing surfaces, fittings, or from cracked or damaged components.
7. If you cannot locate the leak, perform the following steps:
    1. Completely clean the entire engine and surrounding components.
    2. Operate the vehicle for several miles at normal operation temperature and at varying speeds.
    3. Park the vehicle over a large sheet of paper, or other clean surface.
    4. Wait several minutes, then inspect for dripping fluids.
    5. Identify the type of fluid, and the approximate location of the leak.
    6. Visually inspect the suspected area. Use a small mirror if necessary.
8. If you still cannot locate the leak, use the powder method or the black light and dye method.

Powder Method

1. Completely clean the entire engine and surrounding components.
2. Apply an aerosol-type powder, baby powder, foot powder, etc., to the suspected area.
3. Operate the vehicle for several miles at normal operation temperature and at varying speeds.
4. Identify the type of fluid, and the approximate location of the leak, from the discolorations in the powder surface.
5. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas.

    Refer to **Possible Causes for Leaks** if necessary.

Black Light and Dye Method

A dye and light kit is available for finding leaks.

1. Use the **J 28428-E** or the equivalent. See **Special Tools**. Refer to the manufacturer's instructions when using the tool.
2. Visually inspect the suspected area. Use a small mirror if necessary

   Refer to **Possible Causes for Leaks** if necessary.

Possible Causes for Leaks

Inspect the vehicle for the following conditions:

- Higher than recommended fluid levels
- Higher than recommended fluid pressures
- Plugged or malfunctioning fluid filters or pressure bypass valves
- Plugged or malfunctioning engine ventilation system
- Improperly tightened or damaged fasteners
- Cracked or porous components
- Improper sealants or gaskets where required
- Improper sealant or gasket installation
- Damaged or worn gaskets or seals
- Damaged or worn sealing surfaces

CRANKCASE VENTILATION SYSTEM INSPECTION/DIAGNOSIS

Results Of Incorrect Operation

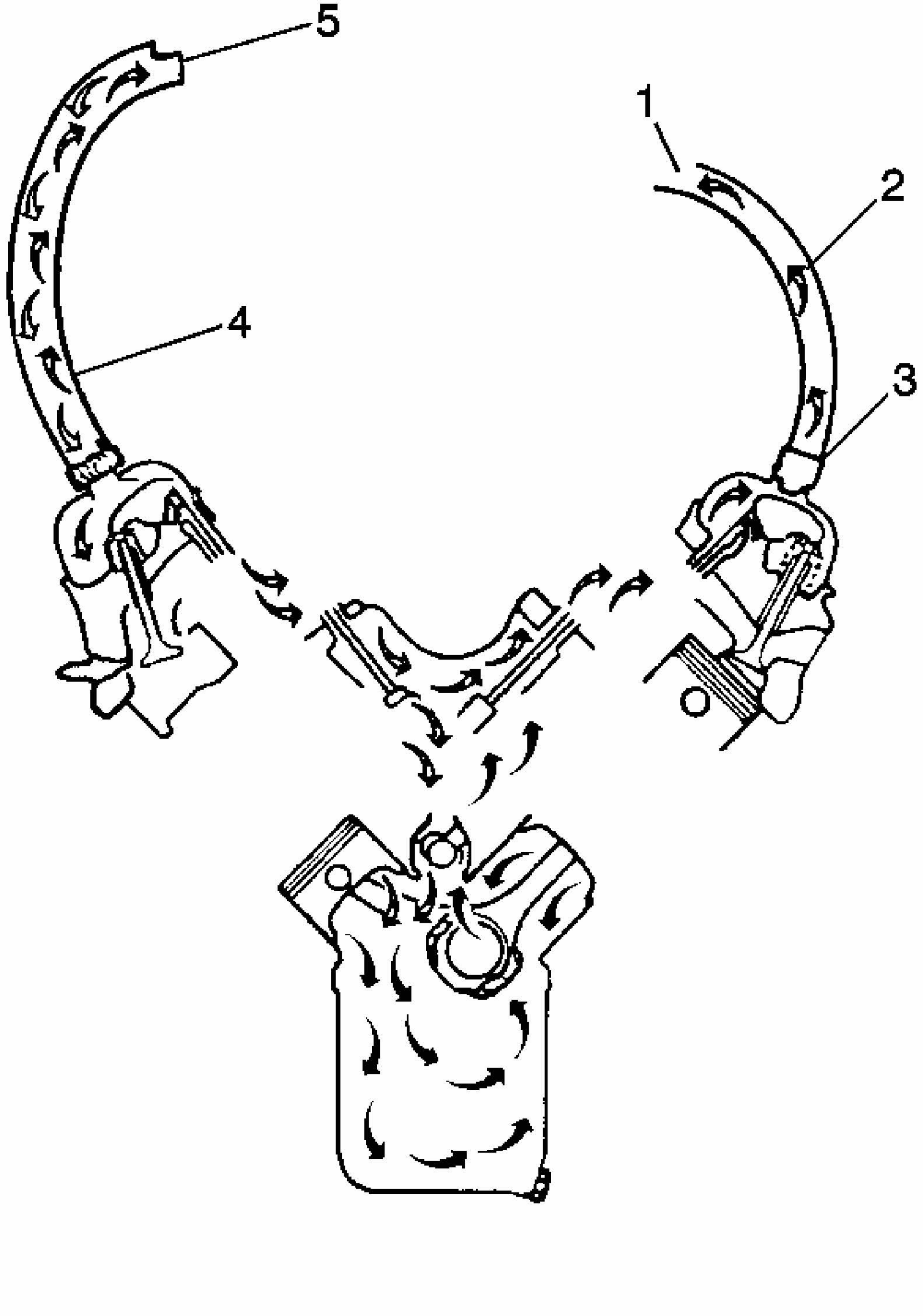


Fig. 6: Crankcase Ventilation System Flow Diagram
Courtesy of GENERAL MOTORS CORP.

- A plugged valve (3) or hose (2 and 4) may cause the following conditions:
  - Rough idle

  - Stalling or a low idle speed
  - Oil leaks
  - Oil in the air cleaner
  - Sludge in the engine
- A leaking crankcase ventilation valve (3) or hose (2 and 4) may cause the following conditions:
  - Rough idle
  - Stalling
  - High idle speed

Functional Test

With these systems, any blow-by in excess of the system capacity, from a badly worn engine, sustained heavy load, etc. is exhausted into the air intake passages and is drawn into the engine.

Proper operation of the crankcase ventilation system depends upon a sealed engine. If oil sludging or dilution is noted and the crankcase ventilation system is functioning properly, inspect the engine for a possible cause. Correct any problems.

If an engine is idling rough, inspect for a clogged crankcase ventilation valve, a dirty vent filter or air cleaner element, or a plugged hose. Replace any components as required. Refer to the following procedure:

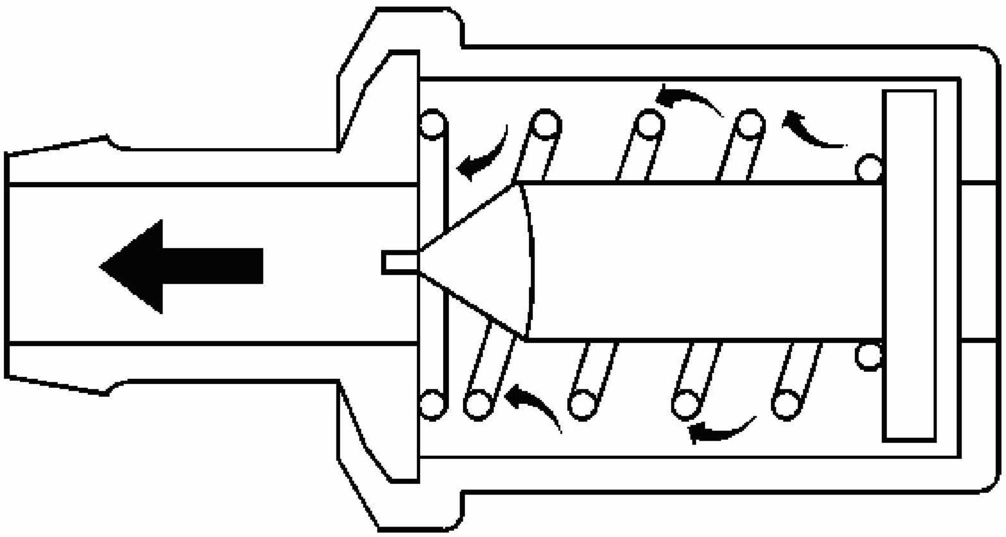


Fig. 7: Crankcase Ventilation System Flow Diagram
Courtesy of GENERAL MOTORS CORP.

1. Remove the crankcase ventilation valve from the rocker arm cover.
2. Operate the engine at idle.
3. Place your thumb over the end of the valve in order to check for a vacuum. If there is no vacuum at the valve, check for the following items:
    - Any plugged hoses
    - The manifold port
    - The crankcase ventilation valve
4. Turn OFF the engine. Remove the crankcase ventilation valve. Shake the valve. Listen for the rattle of the check needle inside of the valve. If valve does not rattle, replace the valve.

DRIVE BELT CHIRPING DIAGNOSIS

Drive Belt Chirping Diagnosis

Step	Action	Yes	No
DEFINITION: The following items are indications of chirping: • A high pitched noise is heard once per revolution of the drive belt or a pulley. • It usually occurs on cold damp mornings. • Verify the condition by spraying water on the belt. The noise should stop momentarily.			
1	Check for misalignment of the pulleys. Are any of the pulleys misaligned?	Go to **Step 2**	Go to **Step 3**
2	Replace any misaligned pulleys. Is the chirp still present?	Go to **Step 3**	System OK
3	Check for bent or cracked brackets. Are there any bent or cracked brackets?	Go to **Step 4**	Go to **Step 5**
4	Replace any bent or cracked brackets. Is the chirp still present?	Go to **Step 5**	System OK
5	Check for any loose or missing fasteners. Are there any loose or missing fasteners?	Go to **Step 6**	Go to **Step 7**
6	1. Tighten any loose fasteners. 2. Replace any missing fasteners. Refer to **Fastener Tightening Specifications**. Is the chirp still present?	Go to **Step 7**	System OK
7	Check for a bent pulley flange. Is there a bent pulley flange?	Go to **Step 8**	Go to **Step 9**

8	Replace the pulley. Is the chirp still present?	Go to **Step 9**	System OK
9	Check for severe pilling, exceeding 1/3 of the belt groove depth. Is there severe pilling?	Go to **Step 10**	-
10	Replace the drive belt. Refer to **Drive Belt Replacement**. Is the repair complete?	-	System OK

DRIVE BELT SQUEAL DIAGNOSIS

Drive Belt Squeal Diagnosis

Step	Action	Yes	No
DEFINITION: The following items are indications of squeal: • A loud screeching noise that is caused by a slipping drive belt (this is unusual for a drive belt with multiple ribs) • The noise occurs when a heavy load is applied to the drive belt, such as an air conditioning compressor engagement snapping the throttle, or slipping on a seized pulley.			
1	Check for a misaligned pulley. Is there a pulley misaligned?	Go to **Step 3**	Go to **Step 2**
2	Check for correct drive belt length. Is the drive belt the correct length?	Go to **Step 4**	Go to **Step 5**
3	Repair or replace with new parts as necessary. Is the repair complete?	System OK	-
4	Check the drive belt tensioner for proper operation. Is the drive belt tensioner operating correctly?	Go to **Step 3**	Go to **Step 5**
5	Check for correct pulley size. Are the pulleys the correct size?	Go to **Step 6**	Go to **Step 3**
6	Check for seized bearings. Is there a seized bearing?	Go to **Step 3**	System OK

DRIVE BELT WHINE DIAGNOSIS

Drive Belt Whine Diagnosis

Step	Action	Yes	No
DEFINITION: A high pitched continuous noise that may be caused by a failed bearing.			
1	Check for a worn accessory component bearing.		

	Is a bearing making the noise?	Go to **Step 2**	System OK
2	Install new part as necessary. Is the repair complete?	System OK	-

DRIVE BELT RUMBLING DIAGNOSIS

Drive Belt Rumbling Diagnosis

Step	Action	Yes	No
DEFINITION: • A low pitch tapping noise caused by drive belt misalignment • This noise occurs on cold start-up at idle. • A low frequency noise heard once per revolution of the drive belt			
1	Check for severe pilling. Is there severe pilling of more than 1/3 of the rib depth?	Go to **Step 2**	System OK
2	Clean the drive belt pulleys. Is the repair complete?	System OK	Go to **Step 3**
3	Install a new drive belt. Refer to **Drive Belt Replacement**. Is the repair complete?	System OK	-

DRIVE BELT VIBRATION DIAGNOSIS

Diagnostic Aids

The accessory drive components can have an affect on engine vibration, such as, but not limited to, the A/C system over charged, or an extra load on the generator. To help identify an intermittent or an improper condition, vary the loads on the accessory drive components.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This test is to verify that the symptom is present during diagnosing. Other vehicle components may cause a similar symptom, such as the exhaust system, or the drivetrain.

3: This test is to verify that the drive belts or accessory drive components may be causing the vibration. When removing the drive belt, the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belt removed.

4: The drive belts may cause a vibration. While the drive belts are removed, this is the best time to inspect the condition of the belt.

6: Inspecting of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer, or washer was installed.

8: This step should only be performed if the fan is driven by the drive belt. Inspect the engine cooling fan for bent, twisted, loose, or cracked blades. Inspect the fan clutch for smoothness, ease of turning. Inspect for a bent fan shaft or bent mounting flange.

9: This step should only be performed if the water pump is driven by the drive belt. Inspect the water pump shaft for being bent. Also inspect the water pump bearings for smoothness and excessive play. Compare the water pump with a known good water pump.

10: Accessory drive component brackets that are bent, cracked, or loose may put extra strain on that accessory component causing it to vibrate.

Drive Belt Vibration Diagnosis

Step	Action	Yes	No
NOTE: **Refer to Belt Dressing Notice .** DEFINITION: The following items are indications of drive belt vibration: • The vibration is engine-speed related. • The vibration may be sensitive to accessory load.			
1	Did you review the Symptoms - Engine Mechanical operation and perform the necessary inspections?	Go to **Step 2**	Go to **Vibration Analysis - Engine**
2	Verify that the vibration is engine related. Does the engine make the vibration?	Go to **Step 3**	Go to **Diagnostic Aids**
3	1. Remove the drive belt. Refer to **Drive Belt Replacement**. 2. Operate the engine for no longer than 30-40 seconds. Does the engine still make the vibration?	Go to **Diagnostic Starting Point - Vibration Diagnosis and Correction**	Go to **Step 4**
4	Inspect the drive belt for wear, damage, debris build-up, and missing drive belt ribs. Did you find any of these conditions?	Go to **Step 5**	Go to **Step 6**
5	Install a new drive belt. Refer to **Drive Belt Replacement**. Did you complete the replacement?	Go to **Step 11**	-
6	Inspect for improper, loose, or missing fasteners. Did you find any of these conditions?	Go to **Step 7**	Go to **Step 8**

7	1. Tighten any loose fasteners. 2. Replace improper or missing fasteners. Refer to **Fasteners** . Did you complete the repair?	Go to **Step 11**	-
8	Inspect for damaged fan blades or bent fan clutch shaft, if the fan is belt driven. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 9**
9	Inspect for a bent water pump shaft, if the water pump is belt driven. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 10**
10	Inspect for bent or cracked brackets. Did you find and correct the condition?	Go to **Step 11**	Go to **Diagnostic Aids**
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

DRIVE BELT FALLS OFF DIAGNOSIS

Diagnostic Aids

- If the drive belts repeatedly falls off the drive belt pulleys, this is because of pulley misalignment.
- An extra load that is quickly applied on released by an accessory drive component may cause the drive belt to fall off the pulleys. Verify the accessory drive components operate properly.
- If the drive belt is the incorrect length, the drive belt tensioner may not keep the proper tension on the drive belt.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This inspection is to verify the condition of the drive belt. Damage to the belt may have occurred when it came off of the pulleys. The drive belt may have been damaged, which caused the drive belt to fall off. Inspect the belt for cuts, tears, sections of ribs missing, or damaged belt plys.

4: Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley, or the pulley bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across 2 or 3 pulleys. If a misaligned pulley is found, refer to that accessory drive component for the proper installation procedure for that pulley.

5: Inspecting the pulleys for being bent should include inspecting for a dent or other damage to the pulleys that would prevent the drive belt from not seating properly in all of the pulley grooves or on the smooth surface of a pulley when the back side of the belt is used to drive the pulley.

6: Accessory drive component brackets that are bent or cracked will let the drive belt fall off.

7: Inspecting of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer, or washer was installed. Missing, loose, or the wrong fasteners may cause pulley misalignment from the bracket moving under load. Over tightening of the fasteners may cause misalignment of the accessory component bracket.

Drive Belt Falls Off Diagnosis

Step	Action	Yes	No
NOTE: **Refer to Belt Dressing Notice .** DEFINITION: The drive belt falls off the pulleys or may not ride correctly on the pulleys.			
1	Did you review the Symptoms - Engine Mechanical operation and perform the necessary inspections?	Go to **Step 2**	Go to **Drive Belt System Description**
2	Inspect for a damaged drive belt. Did you find the condition?	Go to **Step 3**	Go to **Step 4**
3	Install a new drive belt. Refer to **Drive Belt Replacement**. Does the drive belt continue to fall off?	Go to **Step 4**	System OK
4	Inspect for misalignment of the pulleys. Did you find and repair the condition?	Go to **Step 12**	Go to **Step 5**
5	Inspect for a bent or dented pulley. Did you find and repair the condition?	Go to **Step 12**	Go to **Step 6**
6	Inspect for a bent or a cracked bracket. Did you find and repair the condition?	Go to **Step 12**	Go to **Step 7**
7	Inspect for improper, loose, or missing fasteners. Did you find loose or missing fasteners?	Go to **Step 8**	Go to **Step 9**
8	1. Tighten any loose fasteners. 2. Replace improper or missing fasteners. Refer to **Fasteners** . Does the drive belt continue to fall off?	Go to **Step 9**	System OK
	Test the drive belt tensioner for operating		

9	correctly. Refer to **Drive Belt Tensioner Diagnosis**. Does the drive belt tensioner operate correctly?	Go to **Step 11**	Go to **Step 10**
10	Replace the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**. Does the drive belt continue to fall off?	Go to **Step 11**	System OK
11	Inspect for failed drive belt idler and drive belt tensioner pulley bearings. Did you find and repair the condition?	Go to **Step 12**	Go to **Diagnostic Aids**
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

DRIVE BELT EXCESSIVE WEAR DIAGNOSIS

Diagnostic Aids

Excessive wear on a drive belt is usually caused by an incorrect installation or the wrong drive belt for the application.

Minor misalignment of the drive belt pulleys will not cause excessive wear, but will probably cause the drive belt to make a noise or to fall off.

Excessive misalignment of the drive belt pulleys will cause excessive wear but may also make the drive belt fall off.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: The inspection is to verify the drive belt is correctly installed on all of the drive belt pulleys. Wear on the drive belt may be caused by mispositioning the drive belt by one groove on a pulley.

3: The installation of a drive belt that is too wide or too narrow will cause wear on the drive belt. The drive belt ribs should match all of the grooves on all of the pulleys.

4: This inspection is to verify the drive belt is not contacting any parts of the engine or body while the engine is operating. There should be sufficient clearance when the drive belt accessory drive components load varies. The drive belt should not come in contact with an engine or a body component when snapping the throttle.

Drive Belt Excessive Wear Diagnosis

Step	Action	Yes	No
NOTE:			

Refer to Belt Dressing Notice .

DEFINITION: Wear at the outside ribs of the drive belt due to an incorrectly installed drive belt.

1	Did you review the Symptoms - Engine Mechanical operation and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Mechanical**
2	Inspect the drive belt for the proper installation. Refer to **Drive Belt Replacement**. Did you find this condition?	Go to **Step 5**	Go to **Step 3**
3	Inspect for the proper drive belt. Did you find this condition?	Go to **Step 5**	Go to **Step 4**
4	Inspect for the drive belt rubbing against a bracket, hose, or wiring harness. Did you find and repair the condition?	Go to **Step 6**	Go to **Diagnostic Aids**
5	Replace the drive belt. Refer to **Drive Belt Replacement**. Did you complete the replacement?	Go to **Step 6**	-
6	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

DRIVE BELT TENSIONER DIAGNOSIS

Drive Belt Tensioner Diagnosis

Step	Action	Yes	No
1	Remove the drive belt. Inspect the drive belt tensioner pulley. Is the drive belt tensioner pulley loose or misaligned?	Go to **Step 4**	Go to **Step 2**
2	Rotate the drive belt tensioner. Does the tensioner rotate without any unusual resistance or binding?	Go to **Step 3**	Go to **Step 4**
3	1. Use a torque wrench in order to measure the torque required to move the tensioner off of the stop. 2. Use a torque wrench on a known good tensioner in order to measure the torque required to move the tensioner off of the stop.		

	Is the first torque reading within 10 percent of the second torque reading?	System OK	Go to **Step 4**
4	Replace the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**. Is the repair complete?	System OK	-

REPAIR INSTRUCTIONS - ON VEHICLE

INTAKE MANIFOLD COVER REPLACEMENT

Removal Procedure

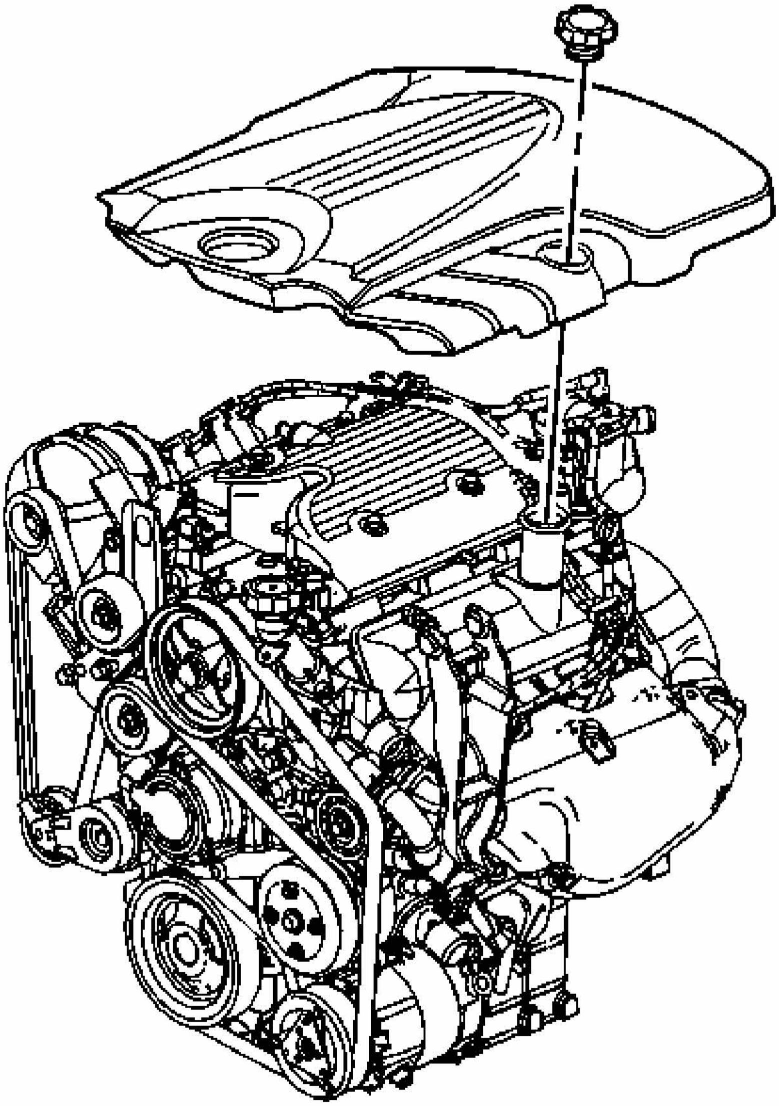


Fig. 8: Locating Engine Oil Fill Cap
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine oil fill cap.
2. Pull up on the cover in order to disengage the cover from the studs.

Installation Procedure

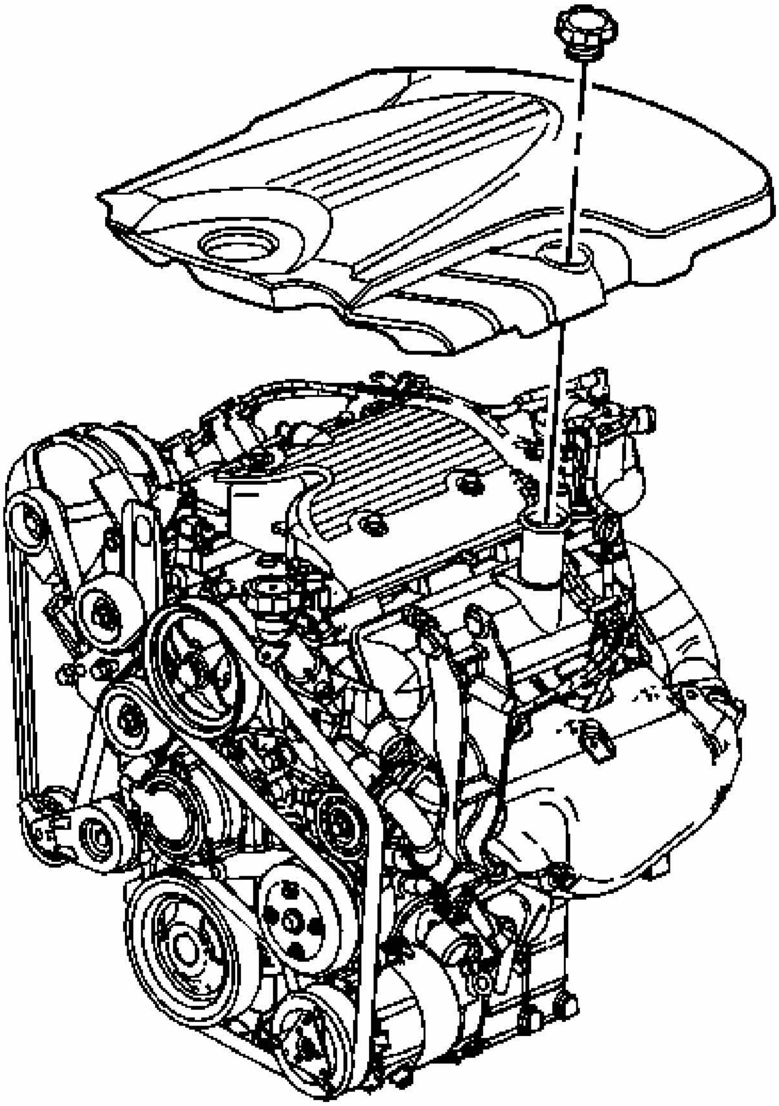


Fig. 9: Locating Engine Oil Fill Cap
Courtesy of GENERAL MOTORS CORP.

1. Align the cover to the studs on the engine, push down on the cover above the studs in order to engage the cover to the studs.
2. Install the engine oil fill cap.

DRIVE BELT REPLACEMENT

Removal Procedure

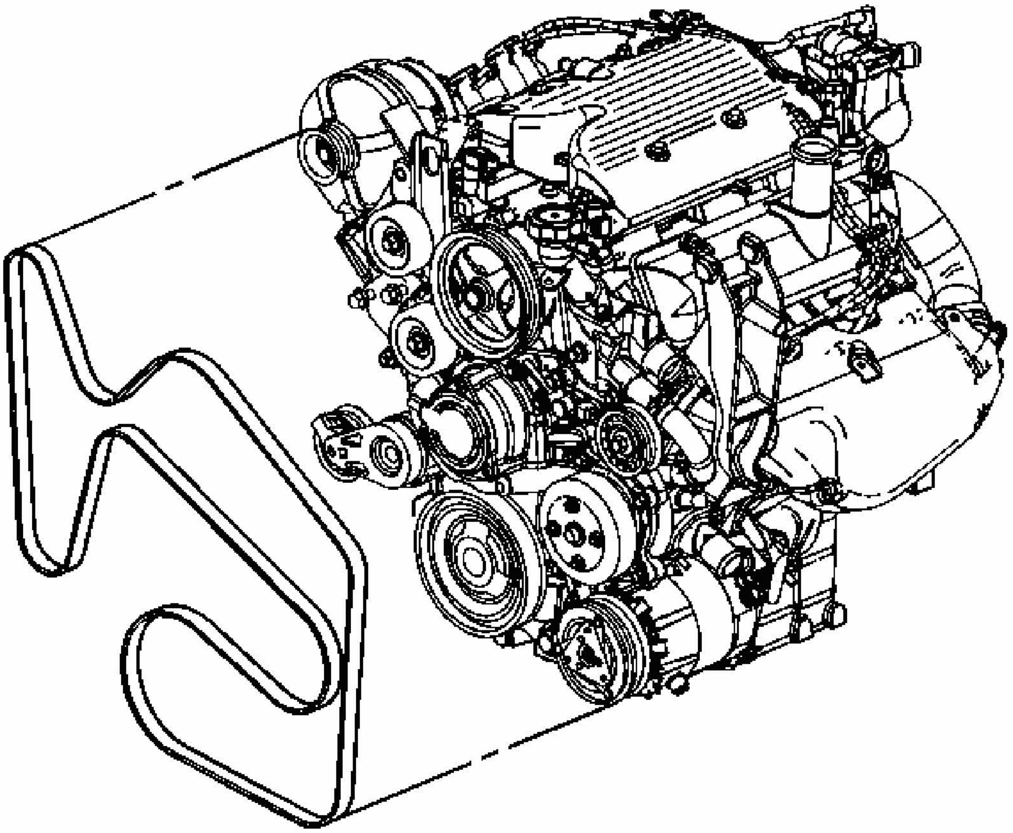


Fig. 10: View Of Drive Belt
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Remove the air cleaner. Refer to **Air Cleaner Assembly Replacement** .
3. Rotate the drive belt tensioner clockwise in order to release the spring tension.
4. Remove the drive belt from around the tensioner pulley.
5. Remove the drive belt from around all the other pulleys.
6. Remove the drive belt from the vehicle.

Installation Procedure

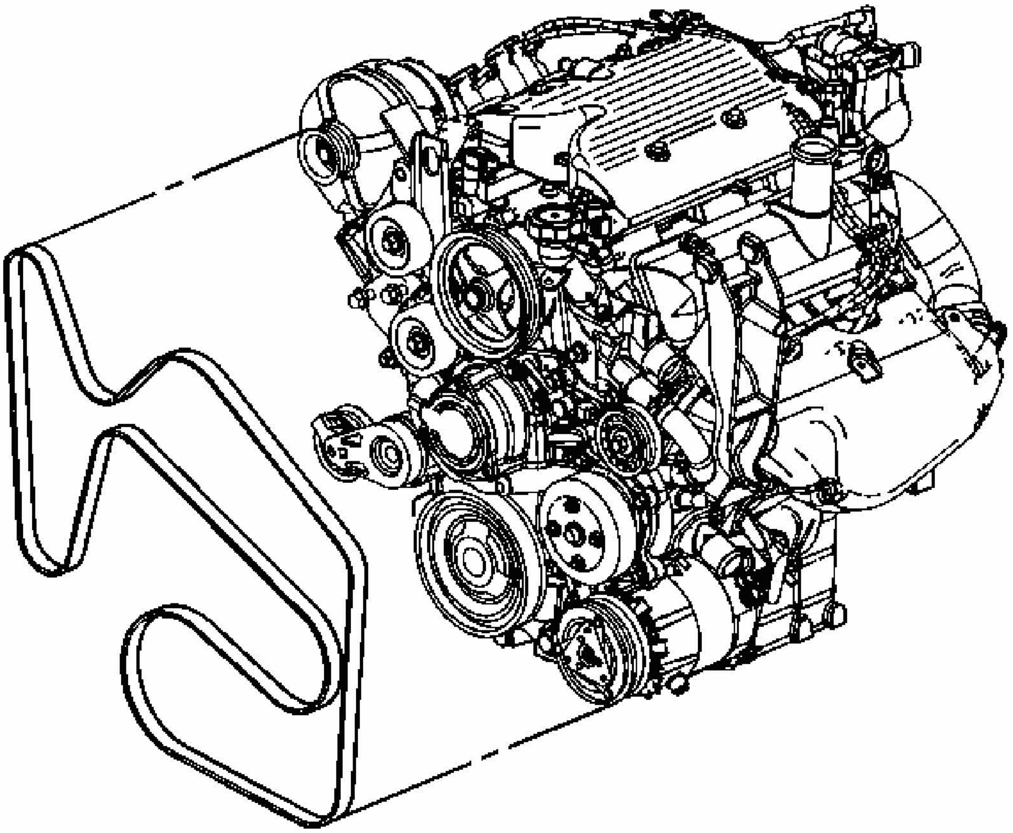


Fig. 11: View Of Drive Belt
Courtesy of GENERAL MOTORS CORP.

1. Install the drive belt to the vehicle.
2. Starting at the generator, route the drive belt around all of the pulleys, except for tensioner.
3. Rotate the drive belt tensioner clockwise in order to release the spring tension.
4. Install the drive belt around the tensioner.
5. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
6. Install the air cleaner. Refer to **Air Cleaner Assembly Replacement** .

DRIVE BELT IDLER PULLEY REPLACEMENT

Removal Procedure

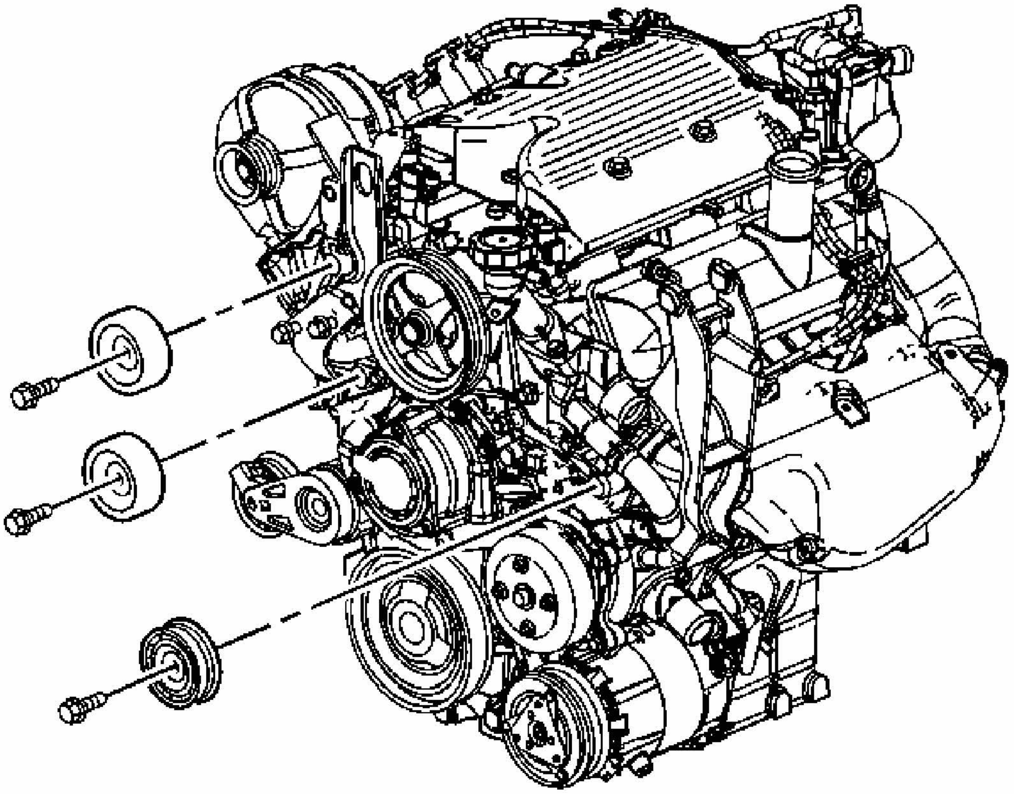


Fig. 12: Locating Drive Belt Idler Pulleys
Courtesy of GENERAL MOTORS CORP.

1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Loosen the required drive belt idler pulley bolt.
3. Remove the required drive belt idler pulley.

Installation Procedure

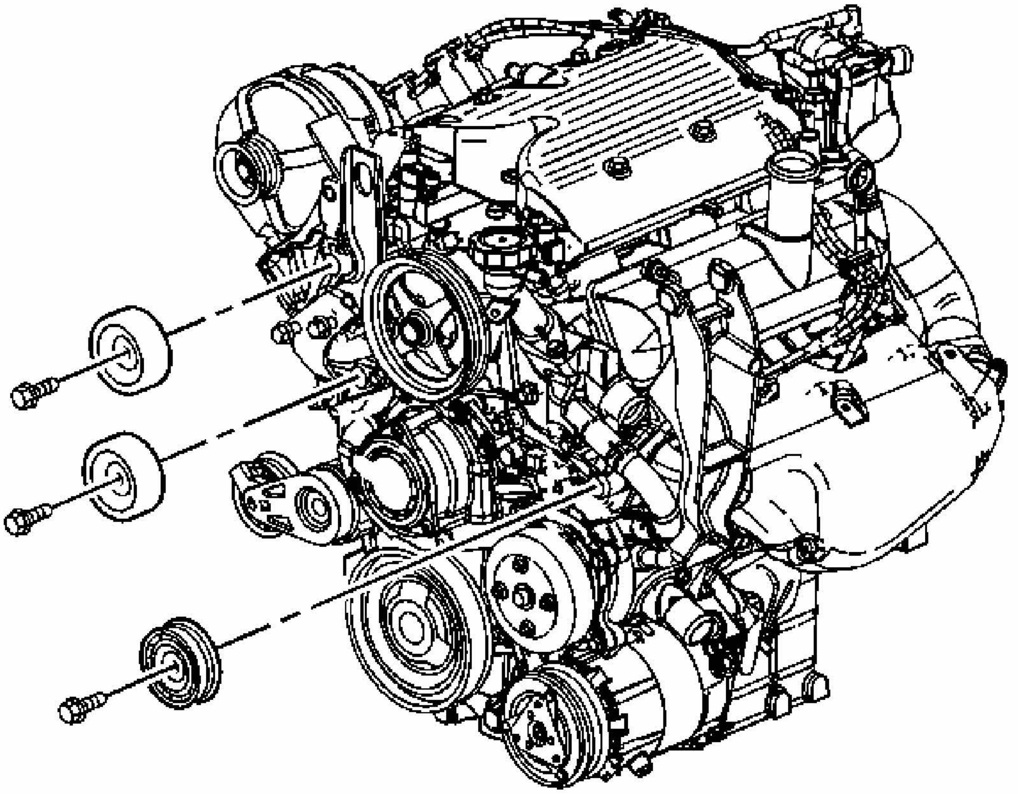


Fig. 13: Locating Drive Belt Idler Pulleys
Courtesy of GENERAL MOTORS CORP.

1. Install the required drive belt idler pulley.

   NOTE: **Refer to Fastener Notice .**

2. Tighten the required drive belt idler pulley bolt.

   Tighten: Tighten the bolt to 50 N.m (37 lb ft).

3. Install the drive belt. Refer to **Drive Belt Replacement**.

DRIVE BELT TENSIONER REPLACEMENT

Removal Procedure

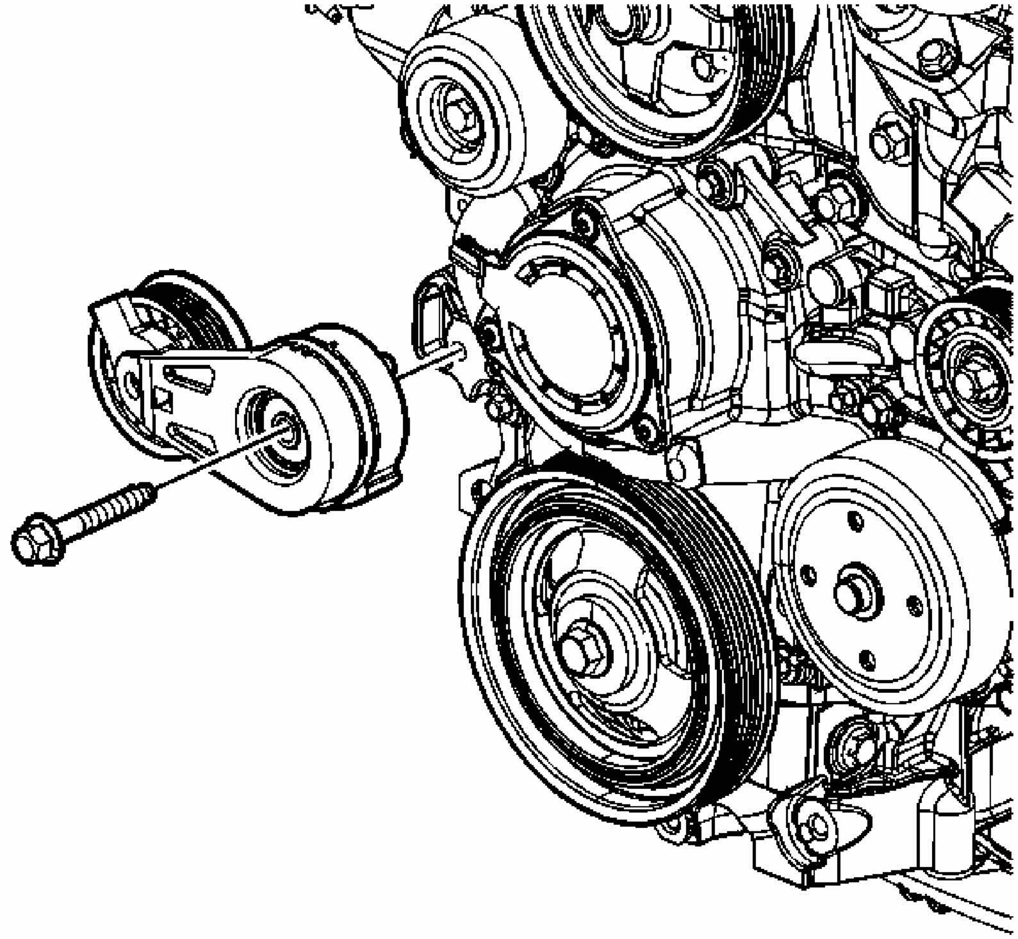


Fig. 14: View Of Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Remove the drive belt tensioner bolt.
3. Remove the drive belt tensioner.

Installation Procedure

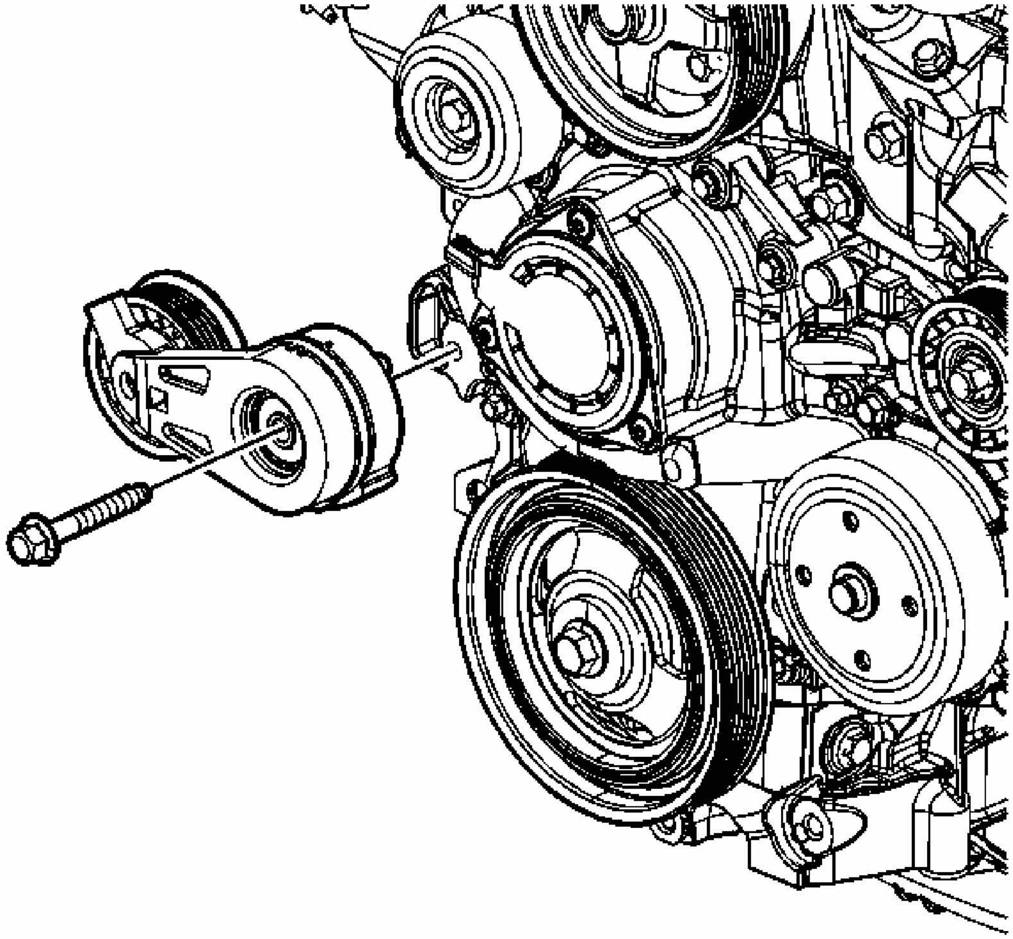


Fig. 15: View Of Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Install the drive belt tensioner.

   NOTE: **Refer to Fastener Notice .**

2. Install the drive belt tensioner bolt.

   Tighten: Tighten the bolt to 50 N.m (37 lb ft).

3. Install the drive belt. Refer to **Drive Belt Replacement**.

ENGINE SUPPORT FIXTURE

Tools Required

- **J 28467-B** Engine Support Fixture. See **Special Tools**.
- **J 36462** Engine Support Adapter Leg. See **Special Tools**.

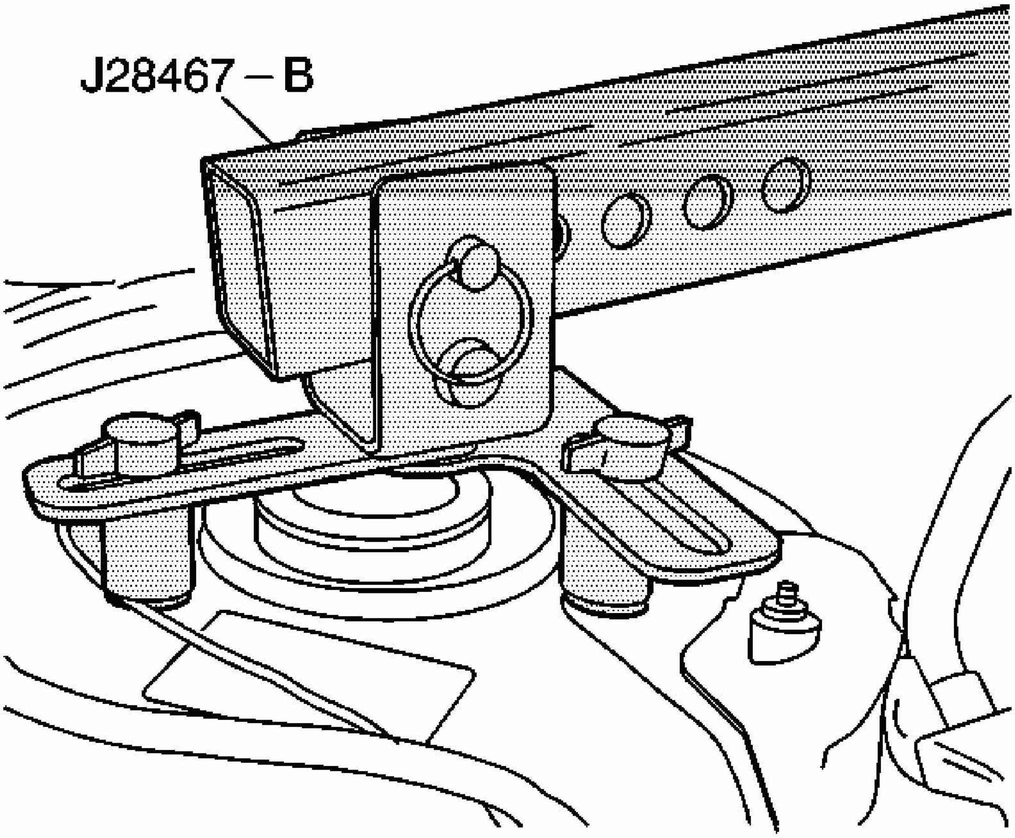


Fig. 16: Identifying Thread Support Nuts (J 28467-33A)
Courtesy of GENERAL MOTORS CORP.

1. Raise the hood.
2. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
3. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .
4. Install the thread support nuts J 28467-33A onto the strut attaching studs.
5. Install the strut tower support assemblies J 28467-5A over the thread support nuts J 28467-33A.
6. Install the T-bolts J 28467-5 with 5/16 inch washers through the strut tower support

assemblies J 28467-5A into the thread support nuts J 28467-33A. Hand tighten the bolts.

7. Install the 2 cross bracket assemblies J 28467-1A over the strut tower tube J 28467-3.
8. Install the strut tower tube J 28467-3 into the strut tower support assemblies J 28467-5A.
9. Install the 1/2 inch x 2.5 inch quick release pin J 28467-10 through the strut tower support assemblies J 28467-5A and the strut tower tube J 28467-3 on one side only.

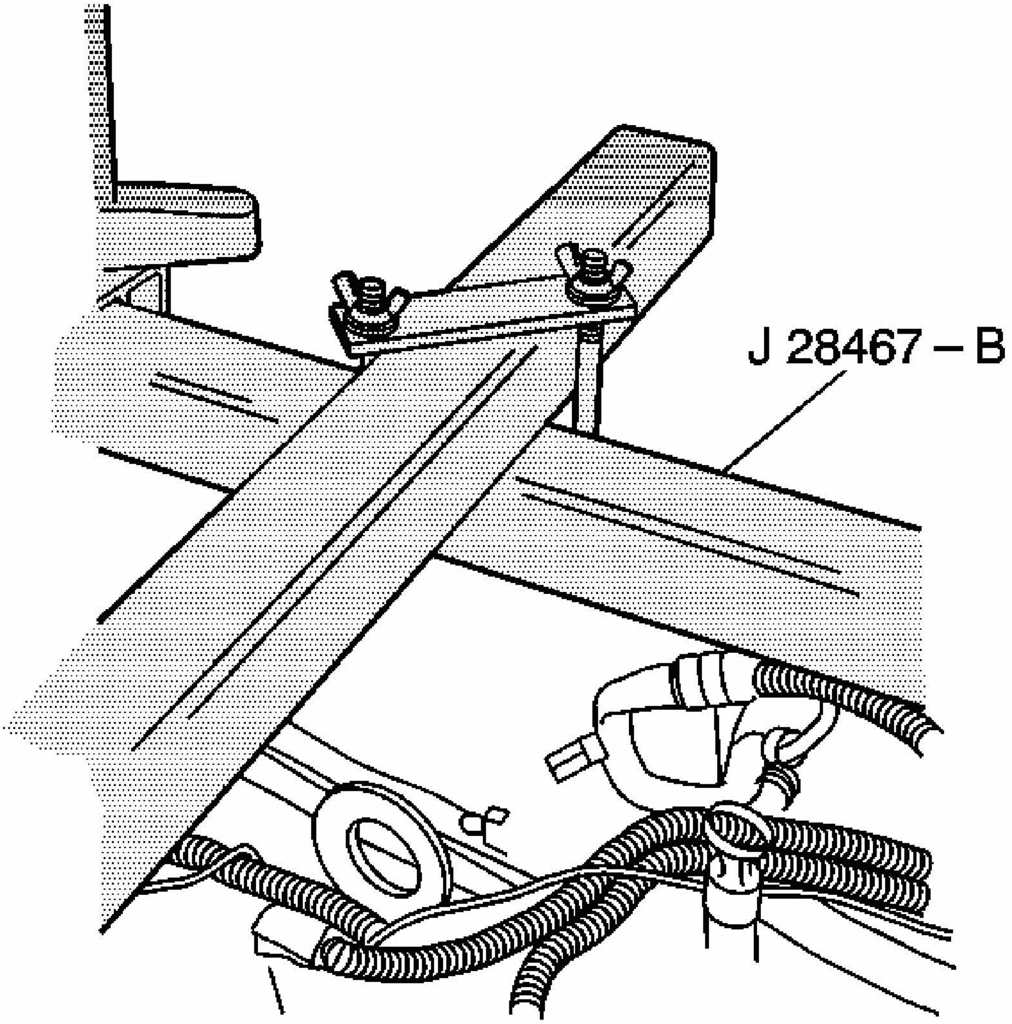


Fig. 17: Identifying Radiator Shelf Tube (J 28467-2A)
Courtesy of GENERAL MOTORS CORP.

10. Install the radiator shelf tube J 28467-2A through the driver side cross bracket

assembly J 28467-1A on the top of the strut tower tube J 28467-3.

11. Place the rubber padded foot of the front support assembly J 28467-4A on the vehicle radiator shelf. The foot position used in the front support assembly J 28467-4A depends on the vehicle application.
12. Install the 7/16 inch x 2.0 inch quick release pin J 28467-9 through the hole in the front support assembly J 28467-4A in order to level the radiator shelf tube J 28467-2A. The hole used in the front support assembly J 28467-4A depends on the vehicle application.
13. Install the lift hook J 28467-7A through the lift hook bracket J 28467-6A.
14. Install the 1/2 inch lift hook washer and lift hook wing nut J 28467-34 onto the lift hook J 28467-7A.
15. Install the assembled lift hook bracket J 28467-6A over the radiator shelf tube J 28467-2A.
16. Adjust the radiator shelf tube J 28467-2A and the assemblage lift hook bracket J 28467-6A in order to align the hook with the left (front), rear of engine, lift hook bracket part of the left engine mount strut bracket.
17. Hand tighten the driver side cross bracket assembly J 28467-1A wing nuts.
18. Install the second radiator shelf tube J 28467-2A through the passenger side cross bracket assembly (J 28467-1A) on the top of the strut tower tube J 28467-3.
19. Place the rubber padded foot of the front support assembly J 28467-4A on the vehicle radiator shelf. The foot position used in the front support assembly J 28467-4A depends on the vehicle application.
20. Install the 7/16 inch x 2.0 inch quick release pin J 28467-9 through the hole in the front support assembly J 28467-4A in order to level the radiator shelf tube J 28467-2A. The hole used in the front support assembly J 28467-4A depends on the vehicle application.
21. Install the lift hook J 28467-7A through the lift hook bracket J 28467-6A.
22. Install the 1/2 inch lift hook washer and lift hook wing nut J 28467-34 onto the lift hook J 28467-7A.
23. Install the assemblage lift hook bracket J 28467-6A over the radiator shelf tube J 28467-2A.
24. Adjust the radiator shelf tube J 28467-2A and the assemblage lift hook bracket J 28467-6A in order to align the hook with the right rear, front of engine, lift hook bracket located next to the generator.
25. Hand tighten the passenger side cross bracket assembly J 28467-1A wing nuts.
26. Hand tighten the lift hook wing nuts J 28467-34 securely in order to remove all slack from the engine support fixture assembly.

ENGINE MOUNT INSPECTION

IMPORTANT: Before replacing any engine mount due to suspected fluid loss, verify that the source of the fluid is the engine mount, not the

engine or accessories.

1. Install the engine support fixture. Refer to **Engine Support Fixture**.
2. Observe the engine mount while raising the engine. Raising the engine removes the weight from the engine mount and creates slight tension on the rubber.
3. Replace the engine mount if the engine mount exhibits any of the following conditions:
    - The hard rubber is covered with heat check cracks.
    - The rubber is separated from the metal plate of the engine mount.
    - The rubber is split through the center of the engine mount.
    - The engine mount itself is leaking fluid.
4. For engine mount replacement. Refer to **Engine Mount Replacement**.

ENGINE MOUNT REPLACEMENT

Removal Procedure

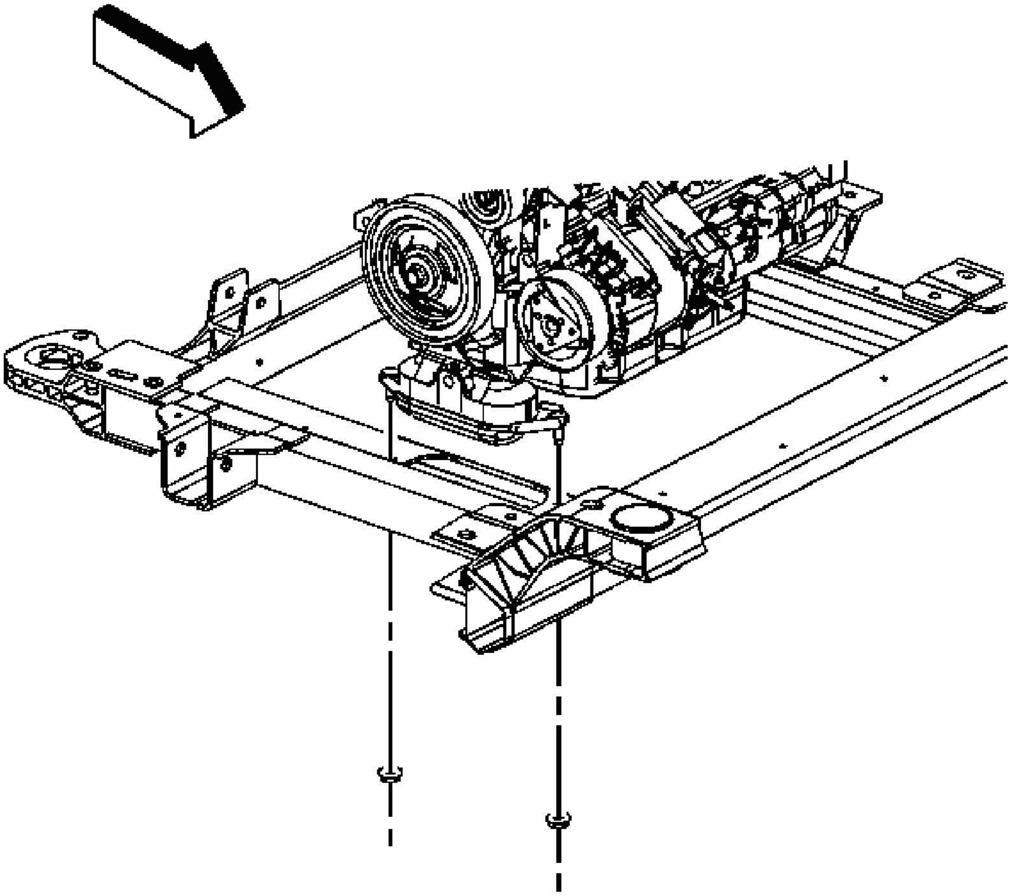


Fig. 18: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

1. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
2. Remove the engine splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
3. Remove the engine mount to frame nuts.

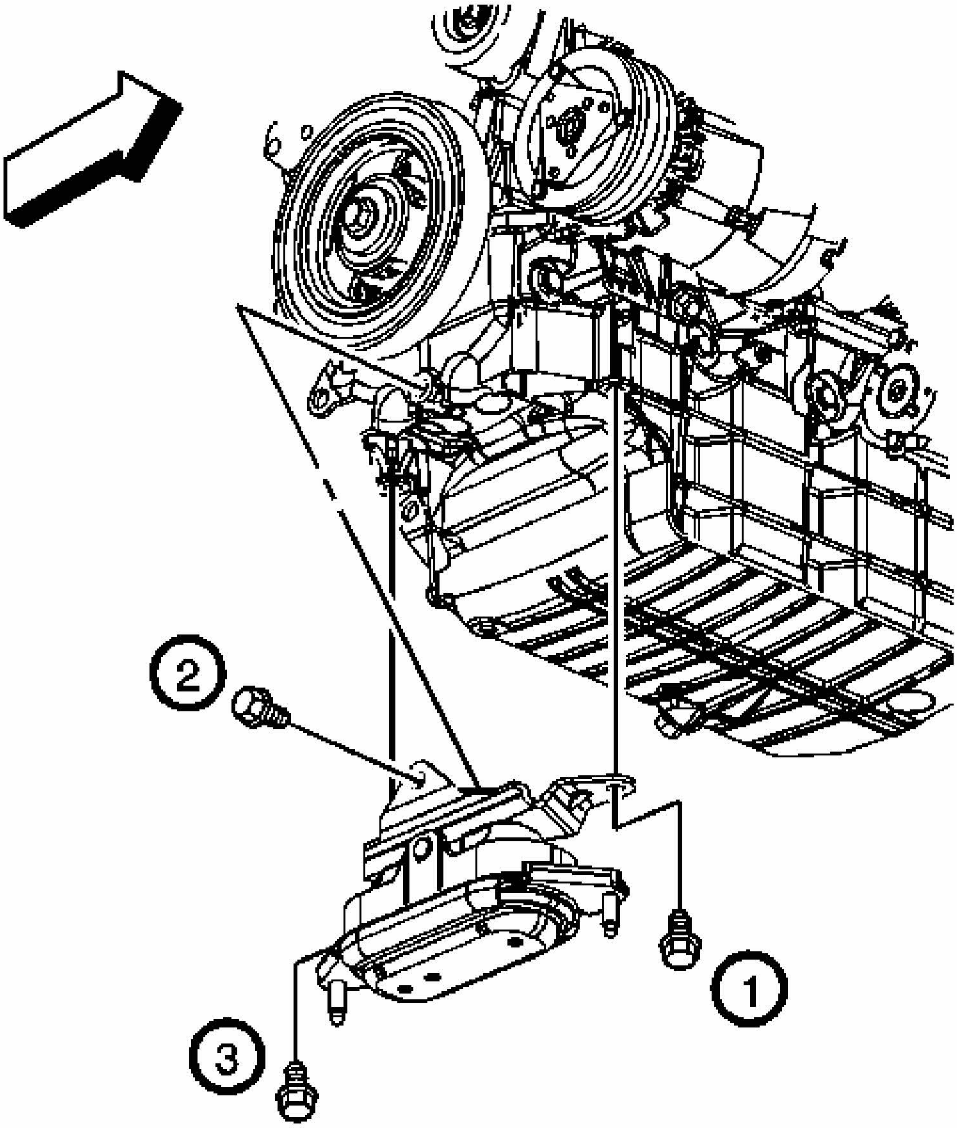


Fig. 19: Locating Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

4. Place an adjustable jack and a block of wood under the oil pan.
5. Remove the engine mount bracket bolts.
6. Using the adjustable jack and block of wood, raise the engine until the engine mount/bracket can be removed.
7. Remove the engine mount/bracket from the vehicle.

Installation Procedure

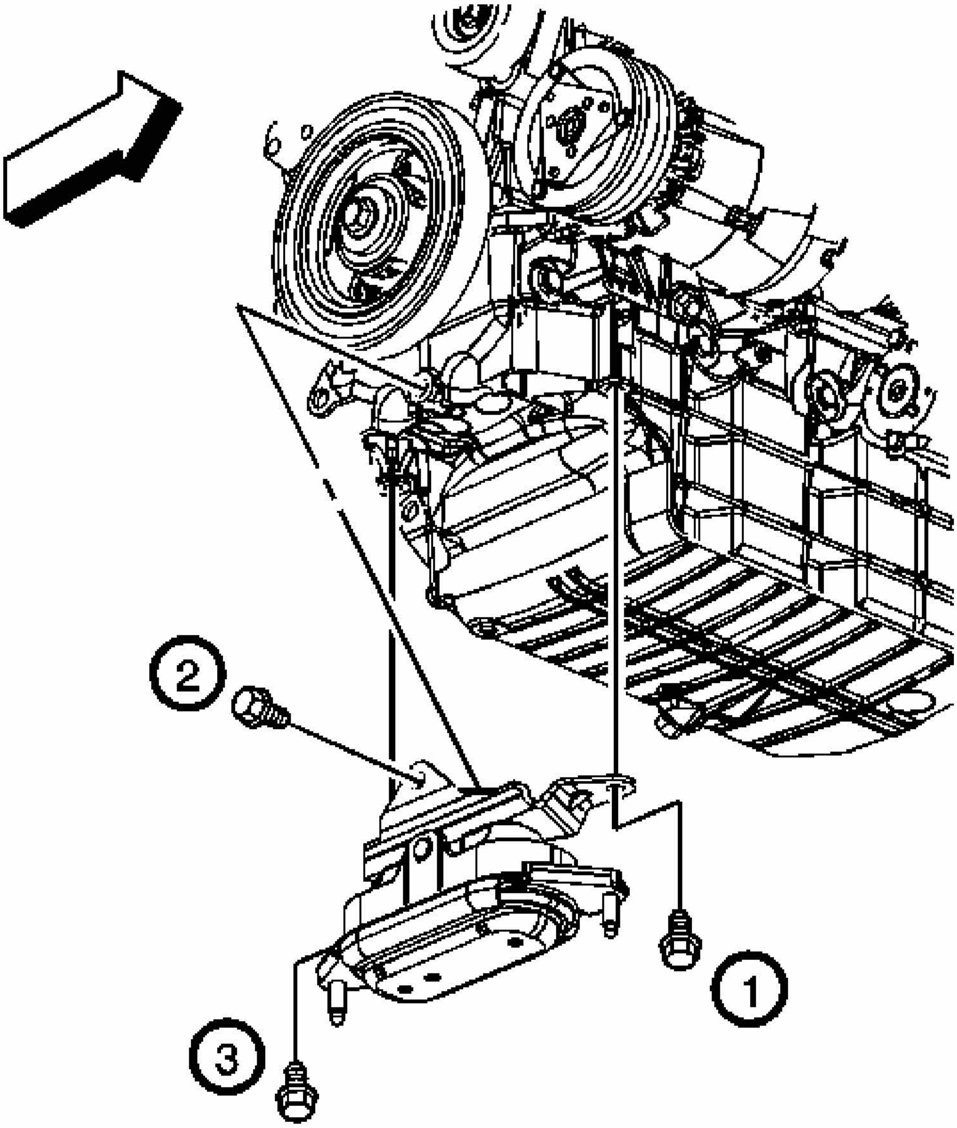


Fig. 20: Locating Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

1. Position the engine mount/bracket to the engine.
2. Install the engine mount bracket bolts.

NOTE: **Refer to Fastener Notice .**

3. Tighten the engine mount bracket bolts.

   Tighten: Tighten the bolts in the sequence shown to 50 N.m (37 lb ft).

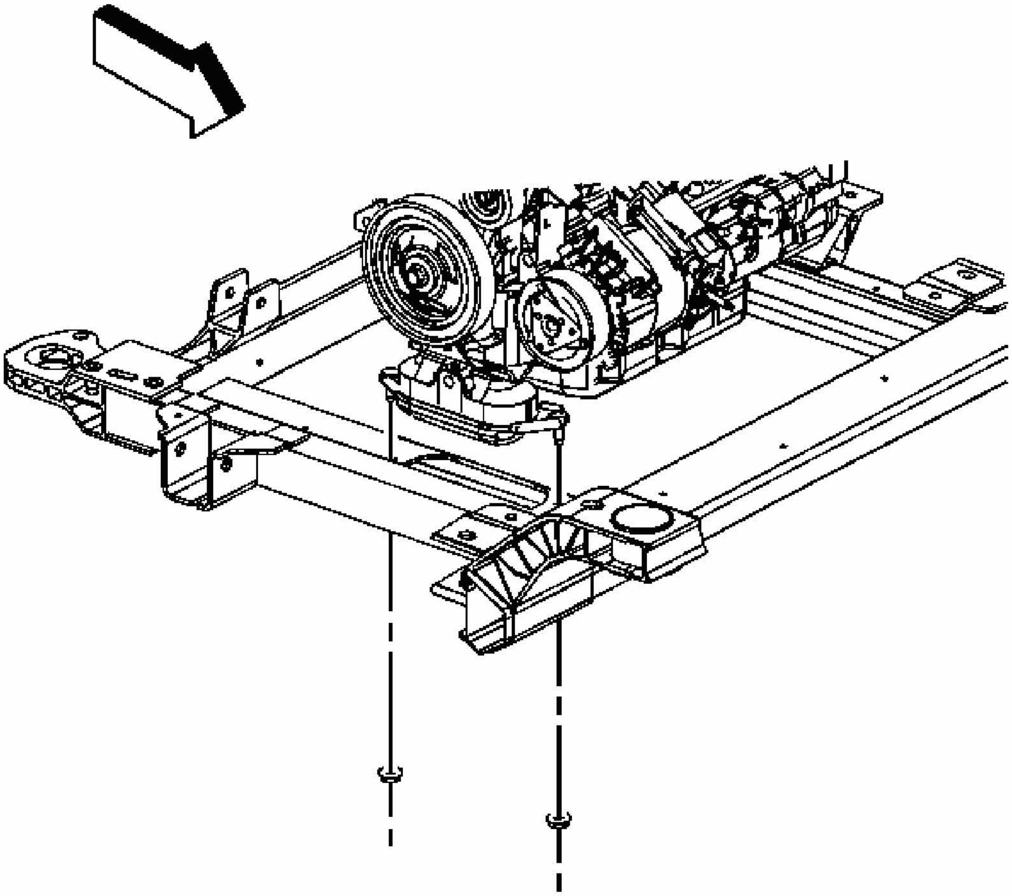


Fig. 21: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

4. Lower the engine using the adjustable jack until the engine mount rests on the frame.
5. Remove the adjustable jack and block of wood from under the vehicle.
6. Install the engine mount to frame nuts.

   Tighten: Tighten the nuts to 50 N.m (37 lb ft).

7. Install the engine splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
8. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .

ENGINE MOUNT BRACKET REPLACEMENT

Removal Procedure

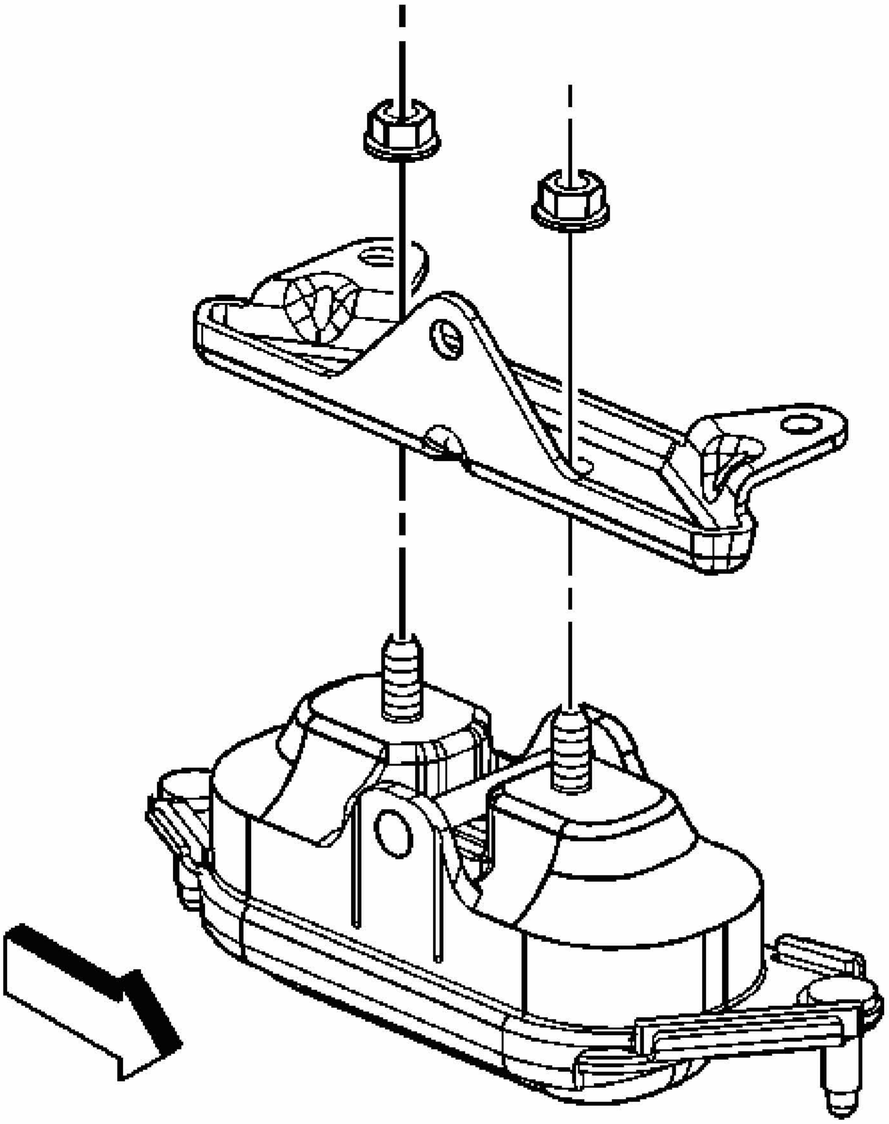


Fig. 22: View Of Engine Mount & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount. Refer to **Engine Mount Replacement**.
2. Remove the engine mount bracket to mount nuts.
3. Remove the engine mount bracket.

Installation Procedure

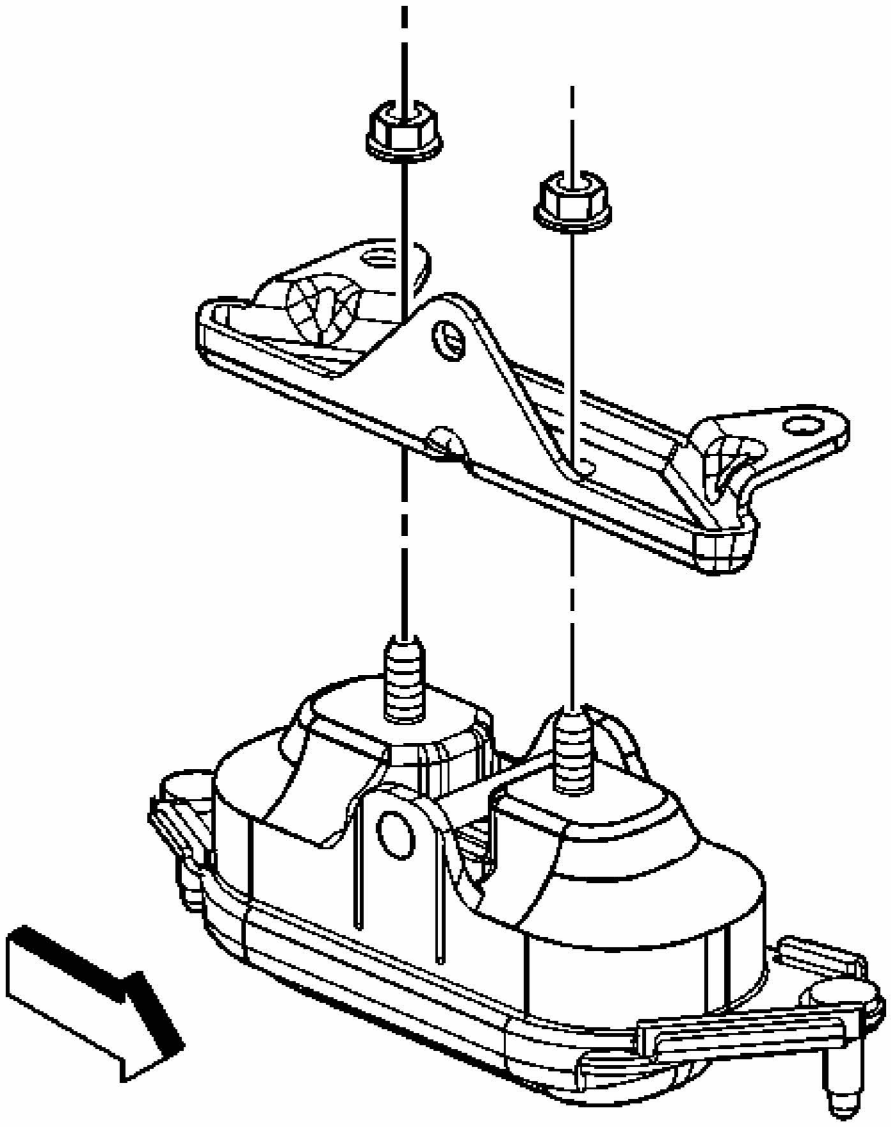


Fig. 23: View Of Engine Mount Bracket & Mount
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount bracket to the mount.

NOTE: **Refer to Fastener Notice .**

2. Install the engine mount bracket to mount nuts.

   Tighten: Tighten the nuts to 50 N.m (37 lb ft).

3. Install the engine mount. Refer to **Engine Mount Replacement**.

ENGINE MOUNT STRUT REPLACEMENT

Removal Procedure

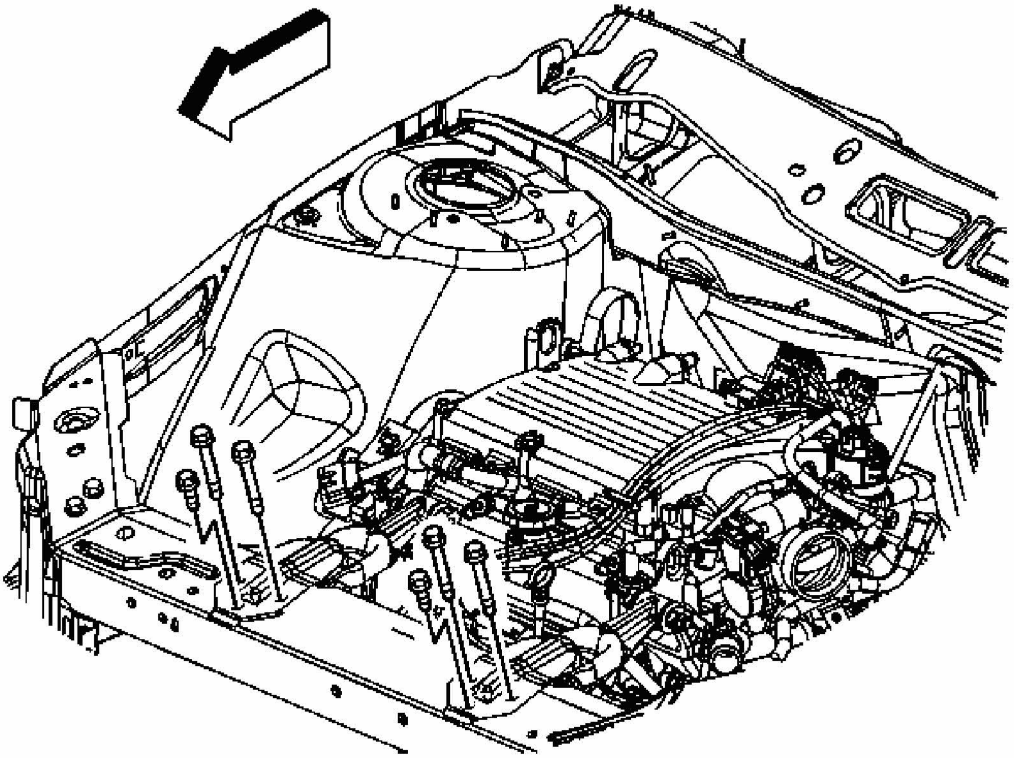


Fig. 24: View Of Engine Mount Strut & Radiator Support Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount strut to radiator support bolts.

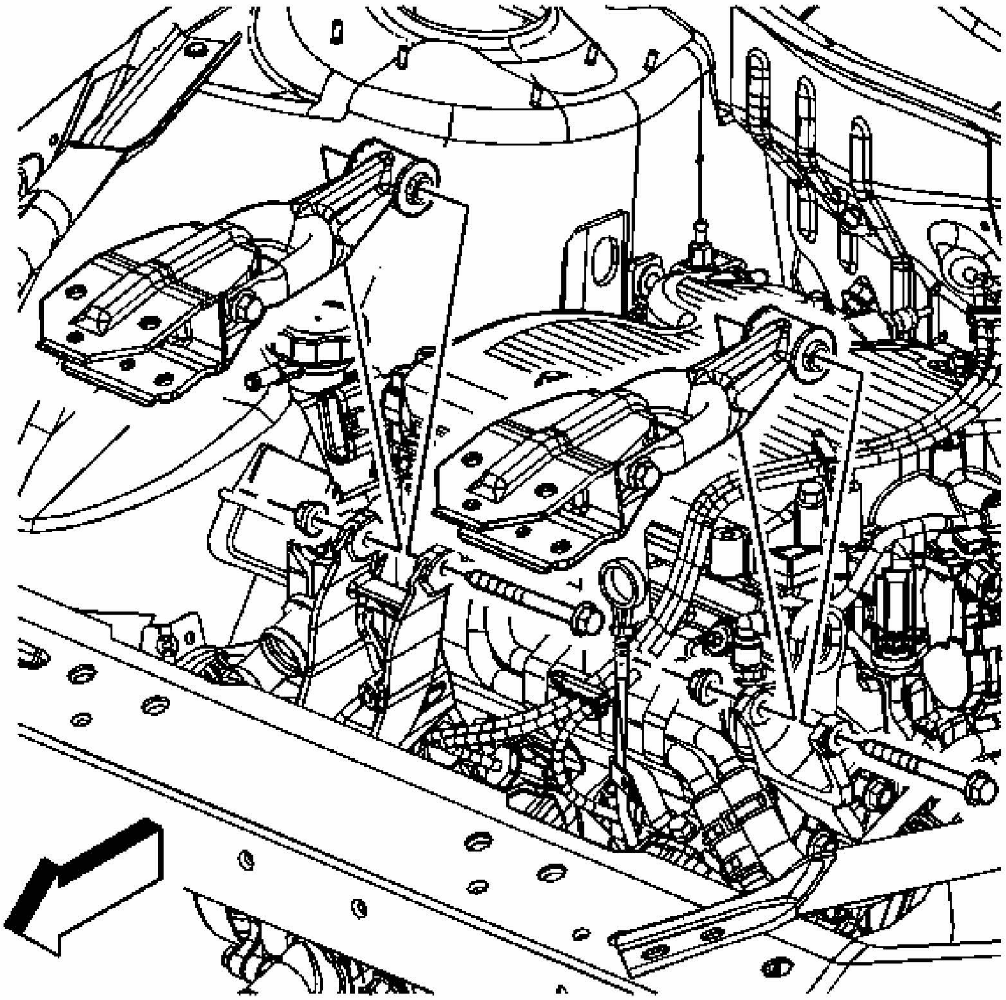


Fig. 25: View Of Engine Mount Struts
Courtesy of GENERAL MOTORS CORP.

2. Remove the engine mount strut to engine mount strut bracket bolts/nuts.
3. Remove the engine mount strut(s).

Installation Procedure

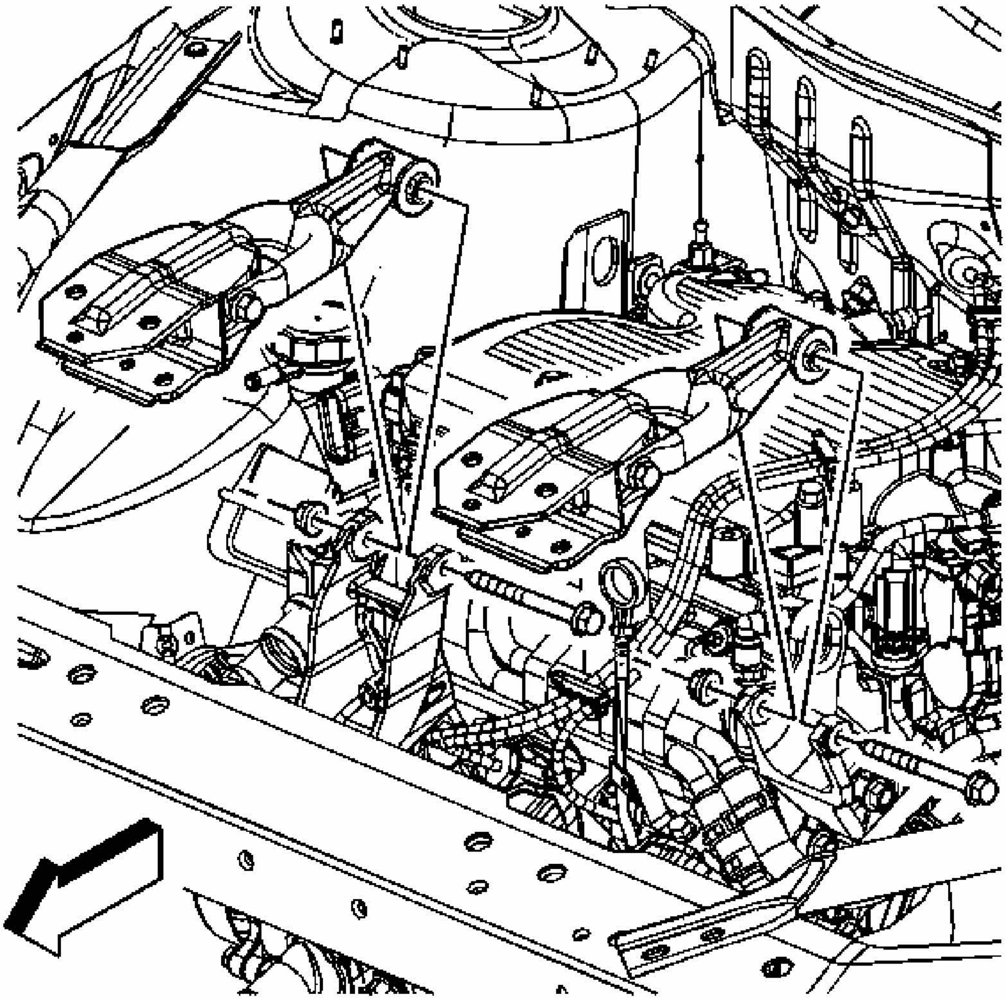


Fig. 26: View Of Engine Mount Struts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount strut(s).
2. Install the engine mount strut to engine mount strut bracket bolts/nuts.

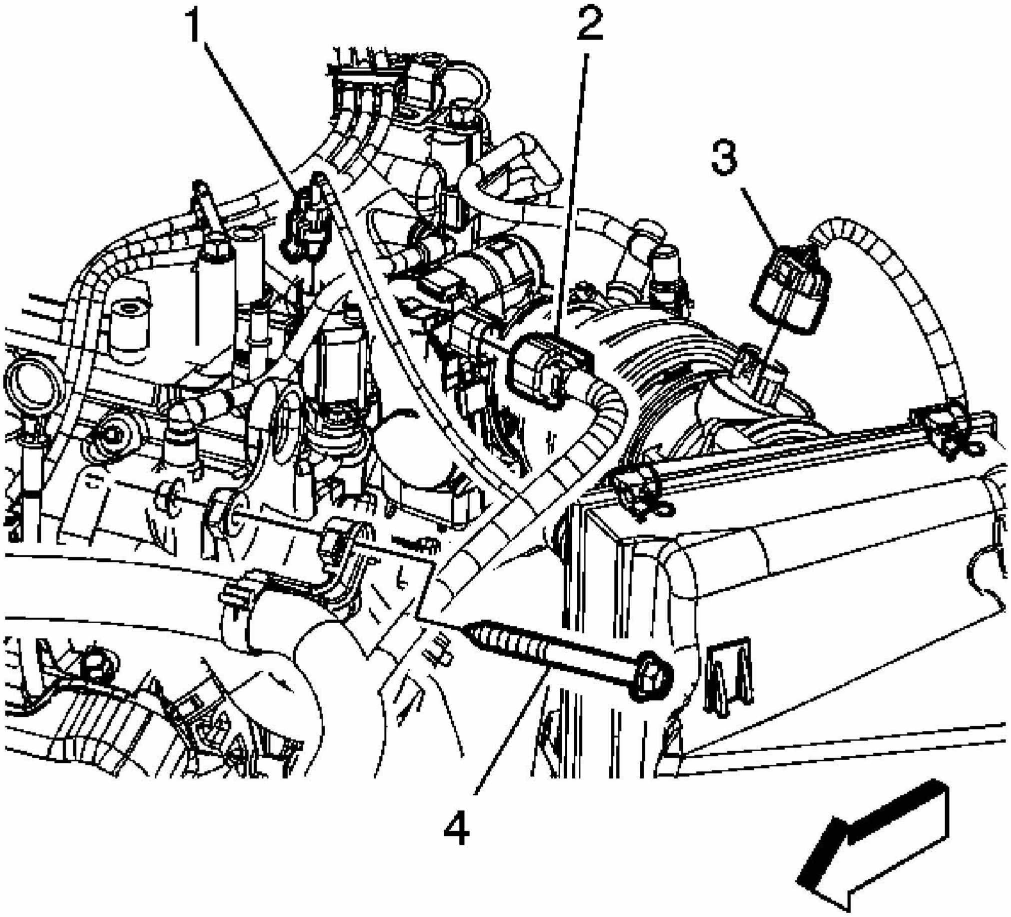


Fig. 27: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. On the right side, ensure that the engine harness clamp is sandwiched between the bolt (4) and the strut bracket.

NOTE:	**Refer to Fastener Notice .**

4. Tighten the engine mount strut to engine mount strut bracket bolts/nuts.

   Tighten: Tighten the bolts/nuts to 50 N.m (37 lb ft).

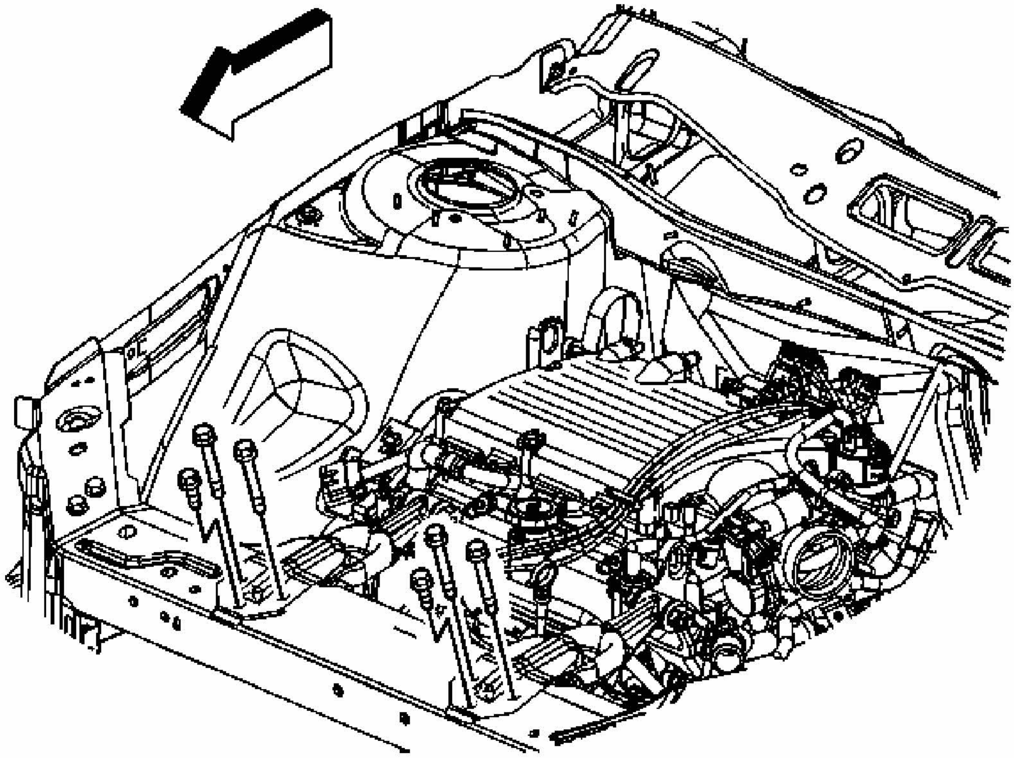


Fig. 28: View Of Engine Mount Strut & Radiator Support Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the engine mount strut to radiator support bolts.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

ENGINE MOUNT STRUT BRACKET REPLACEMENT - LEFT

Removal Procedure

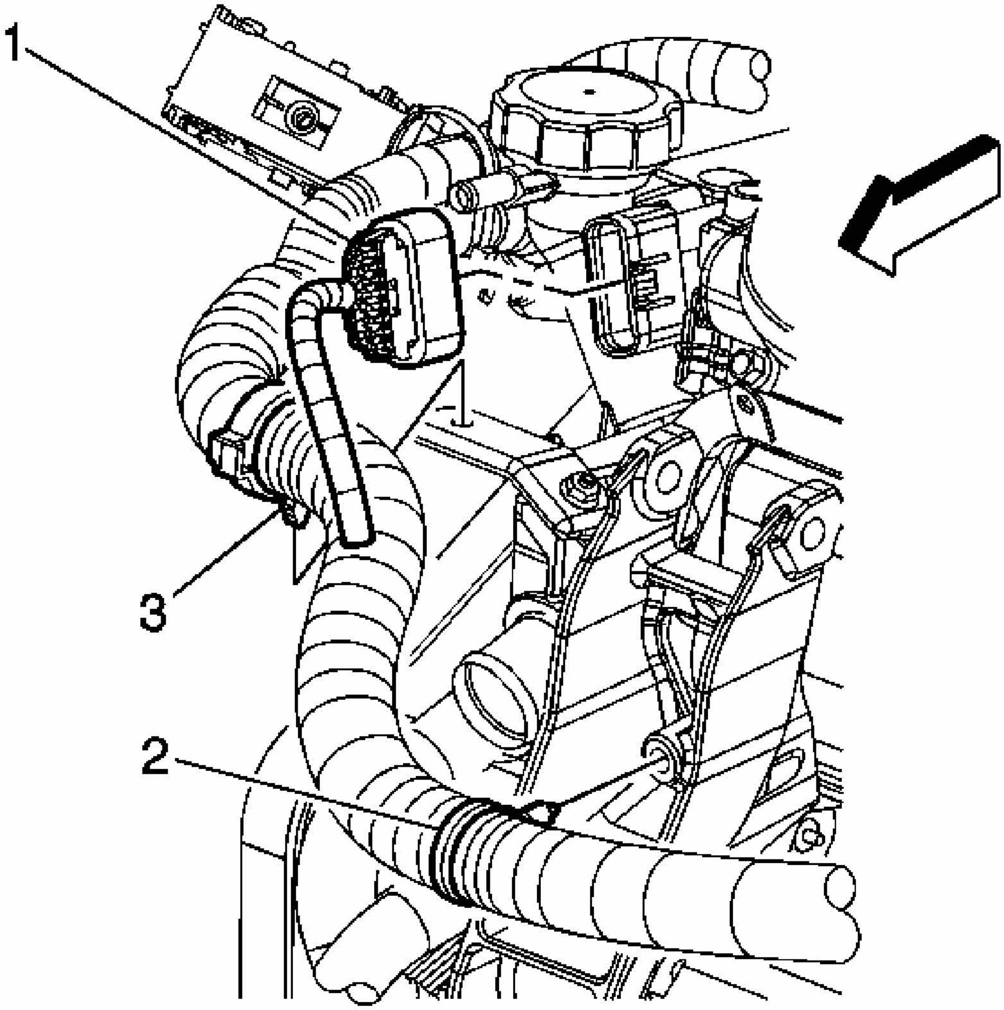


Fig. 29: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount strut. Refer to **Engine Mount Strut Replacement**.
2. Remove the engine harness clip (2) from the strut bracket.

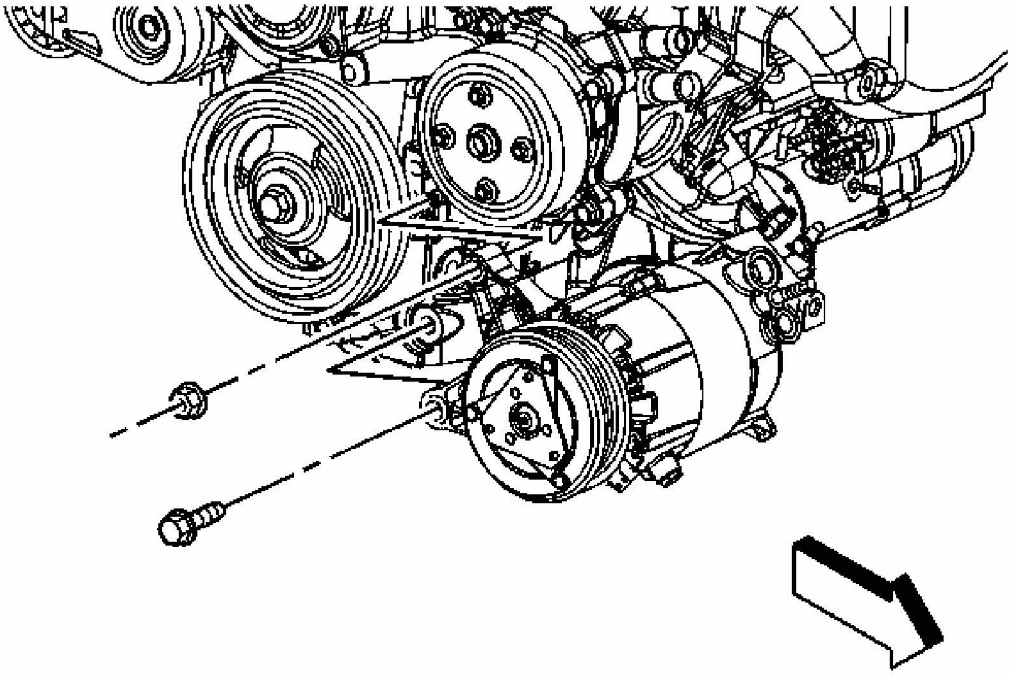


Fig. 30: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Remove the air conditioning (A/C) compressor front bolt/nut.

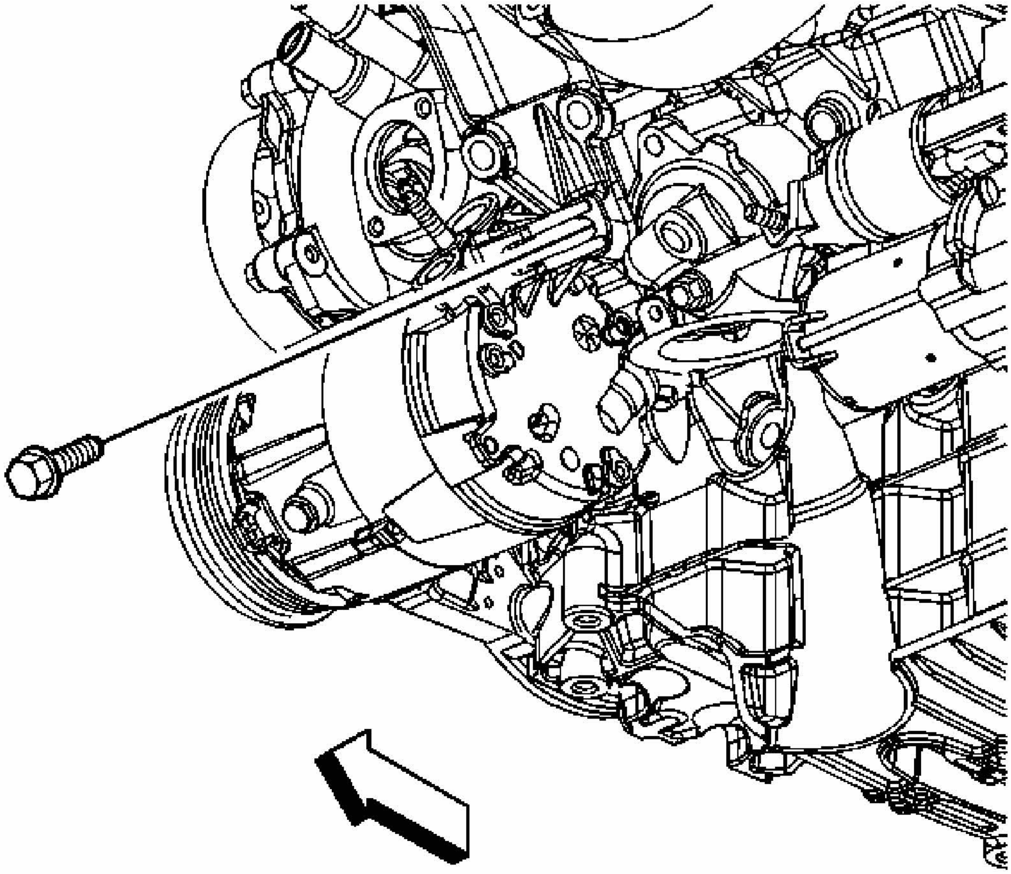


Fig. 31: Locating A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the A/C compressor rear bolt.
6. Reposition the A/C compressor.

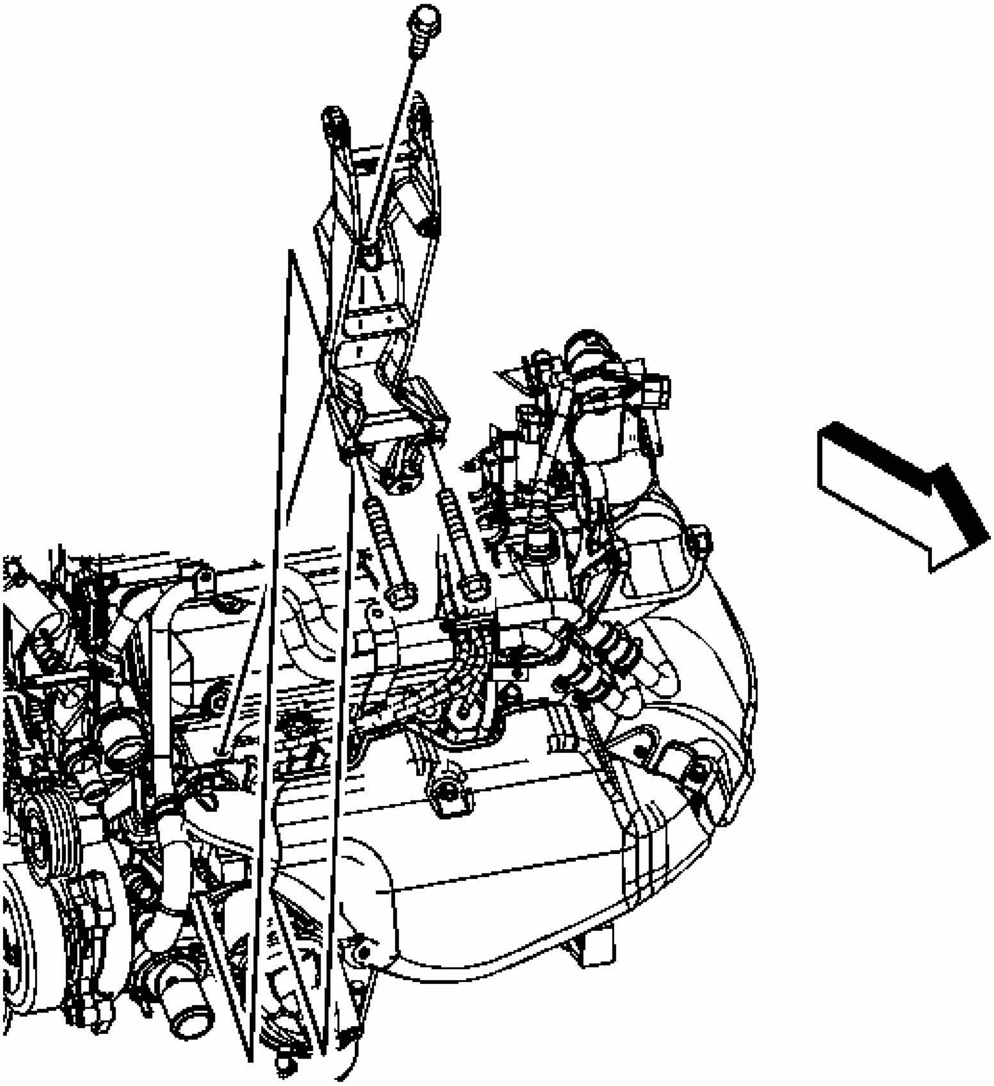


Fig. 32: Locating Engine Mount Strut Bracket & Lower Engine Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the engine mount strut bracket to engine lower bolts.
8. Lower the vehicle.
9. Remove the engine mount strut bracket to engine upper bolt.
10. Remove the engine mount strut bracket.

Installation Procedure

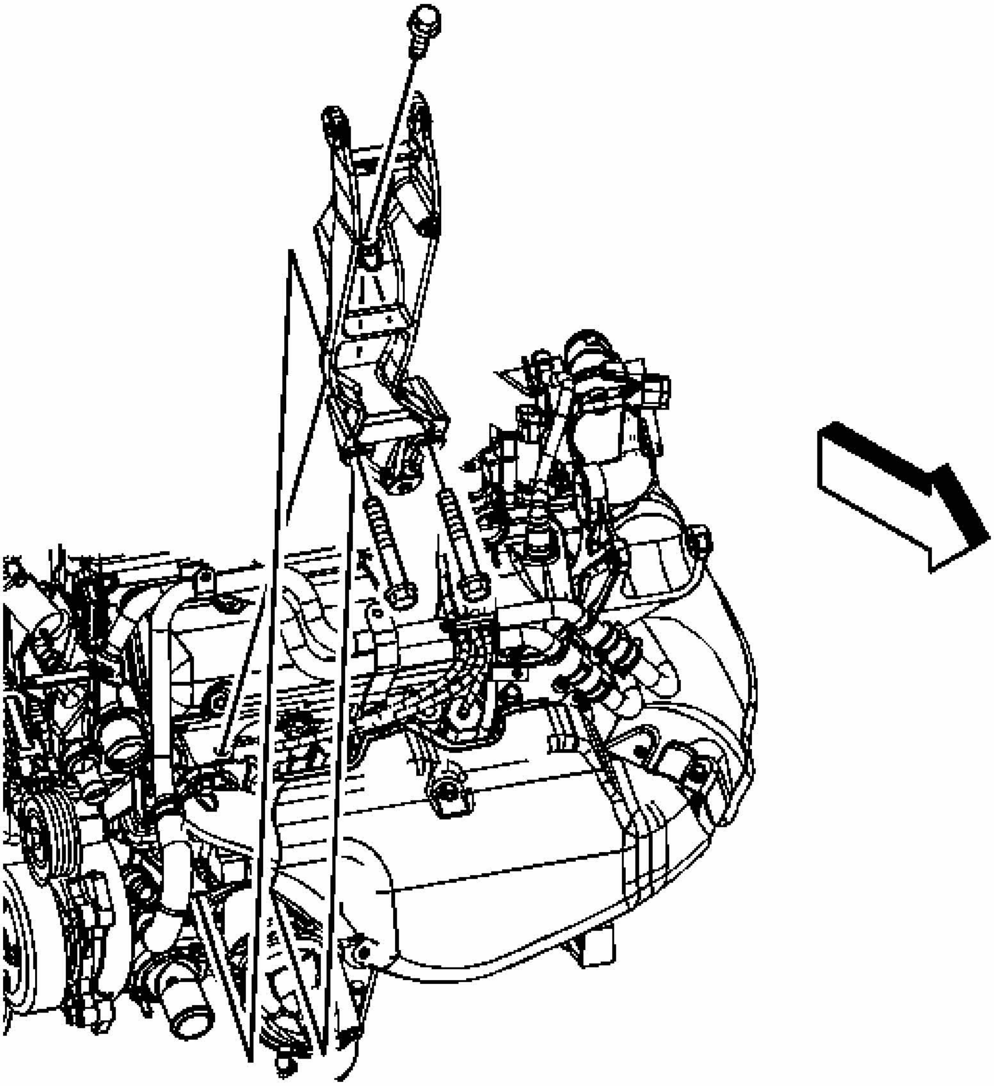


Fig. 33: Locating Engine Mount Strut Bracket & Lower Engine Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount strut bracket.
2. Loosely install the engine mount strut bracket to engine upper bolt.
3. Raise and support the vehicle.

NOTE: **Refer to Fastener Notice .**

4. Install the engine mount strut bracket to engine lower bolts.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

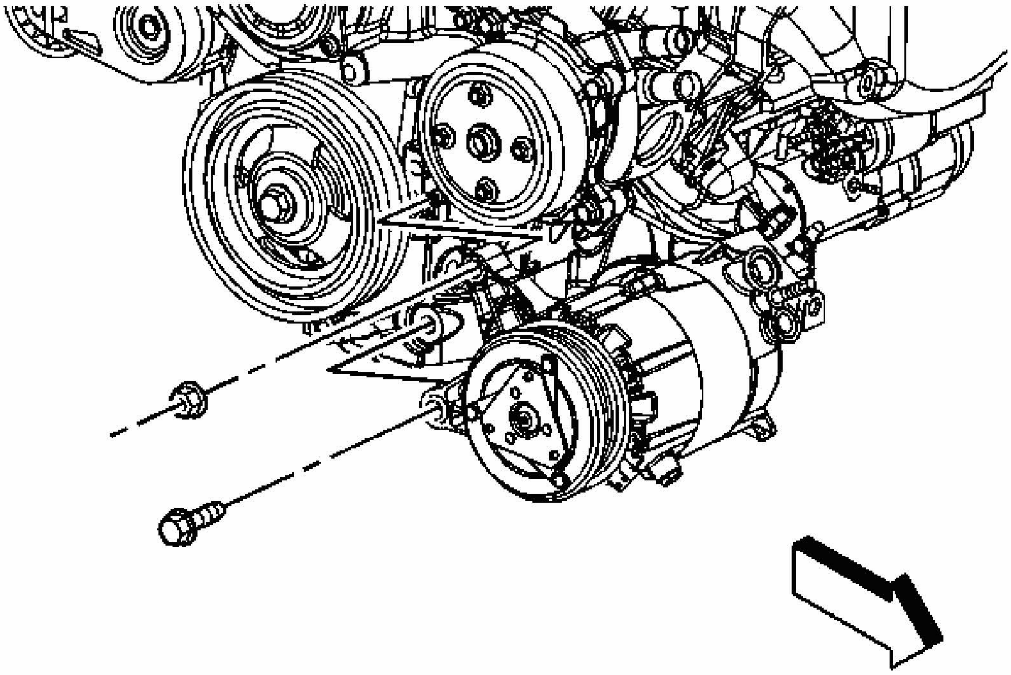


Fig. 34: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

5. Position the A/C compressor to the engine block.
6. Install until snug, the A/C compressor front nut and bolt.

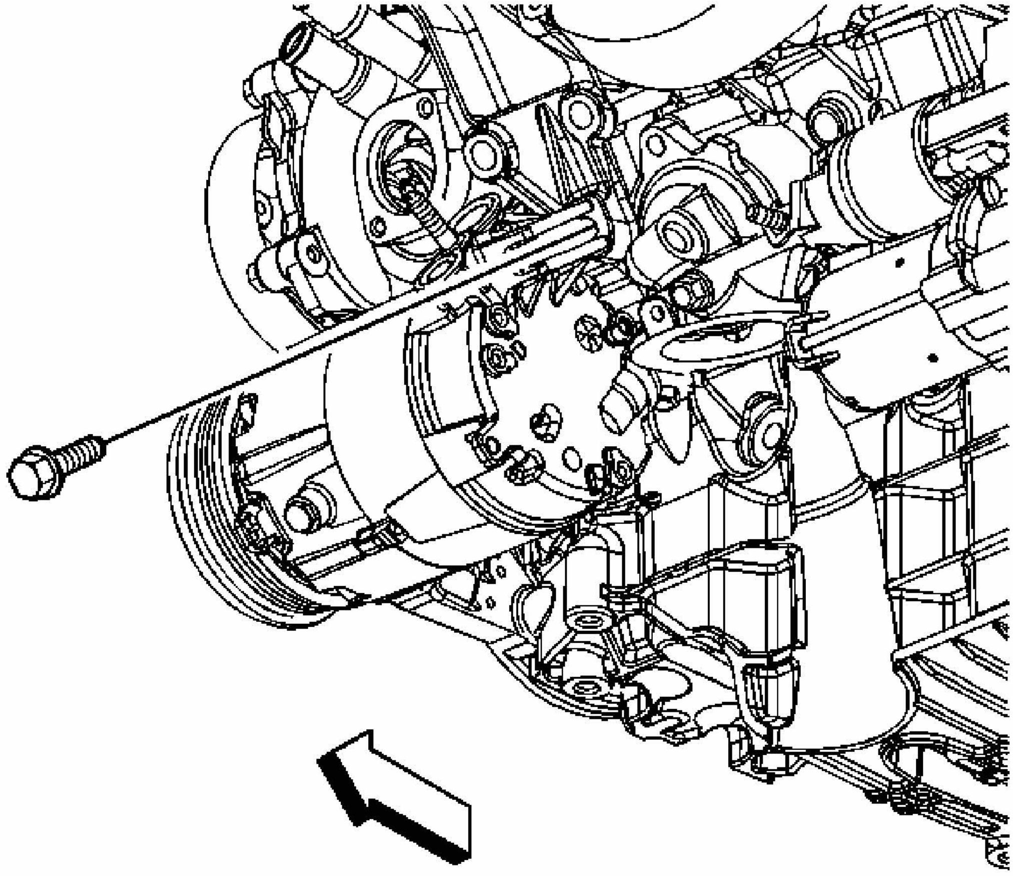


Fig. 35: Locating A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

7. Install until snug, the A/C compressor rear bolt.
8. Tighten the A/C compressor nut first, then the rear bolt and finally the front bolt.

   Tighten: Tighten the bolts/nut to 50 N.m (37 lb ft).

9. Lower the vehicle.

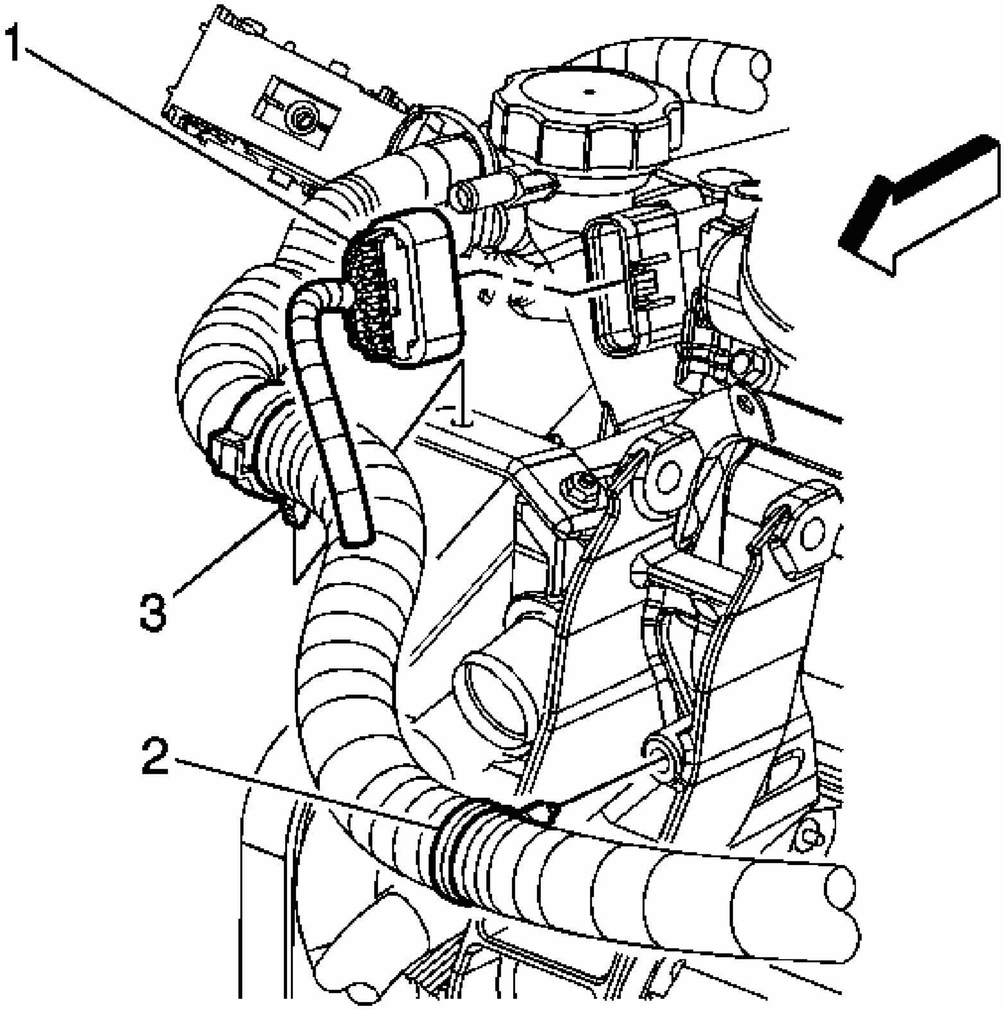


Fig. 36: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

10. Tighten the engine mount strut bracket to engine upper bolt.

    Tighten: Tighten the bolts to 25 N.m (18 lb ft).

11. Install the engine harness clip (2) to the strut bracket.
12. Install the engine mount strut. Refer to **Engine Mount Strut Replacement**.

ENGINE MOUNT STRUT BRACKET REPLACEMENT - RIGHT

Removal Procedure

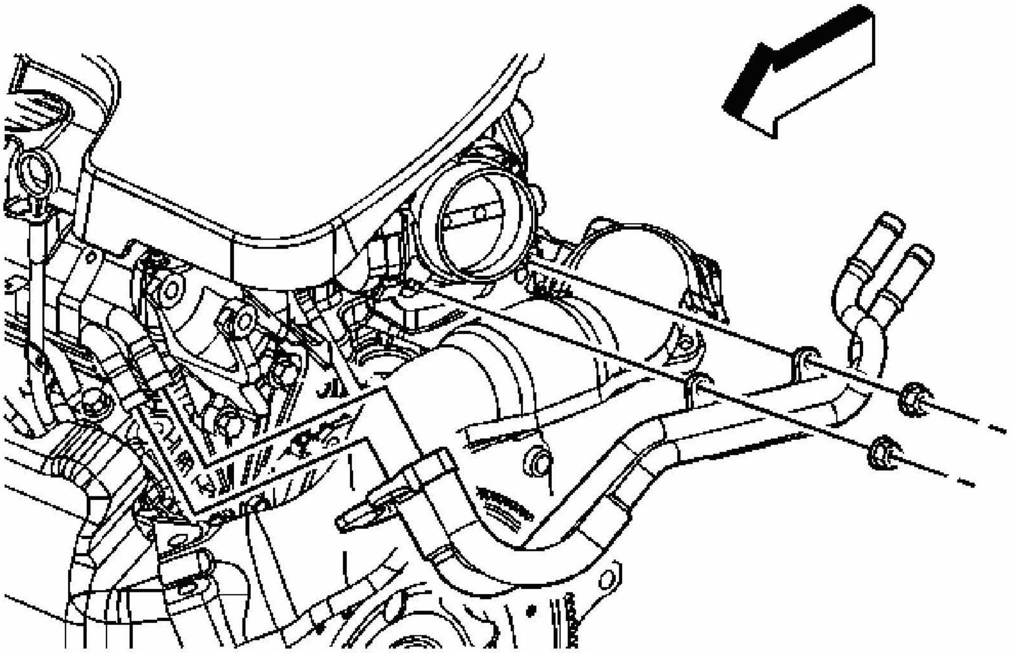


Fig. 37: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
2. Remove the engine mount strut. Refer to **Engine Mount Strut Replacement**.
3. Remove the heater inlet and outlet hose clamp nuts from the throttle body studs.
4. Reposition the heater inlet and outlet hose clamps at the pipes.
5. Remove the heater inlet and outlet hoses from the engine pipes.
6. Remove the heater inlet and outlet hose clamp from the throttle body studs.
7. Reposition the inlet and outlet hoses.

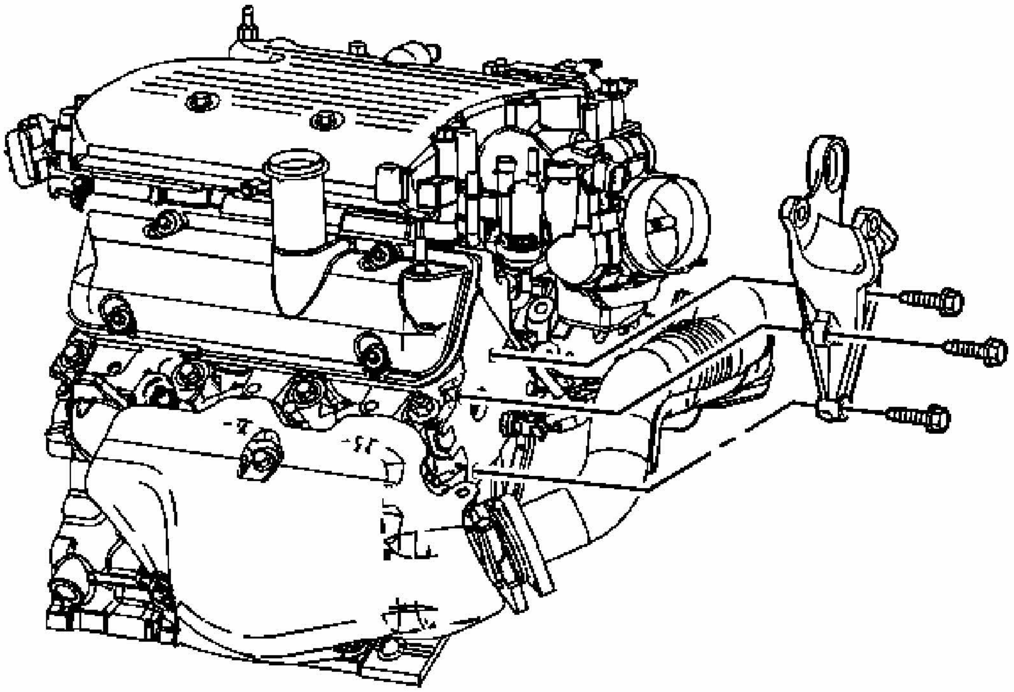


Fig. 38: View Of Engine Mount Strut Bracket
Courtesy of GENERAL MOTORS CORP.

8. Remove the engine mount strut bracket to cylinder head bolts.
9. Remove the engine mount strut bracket.

Installation Procedure

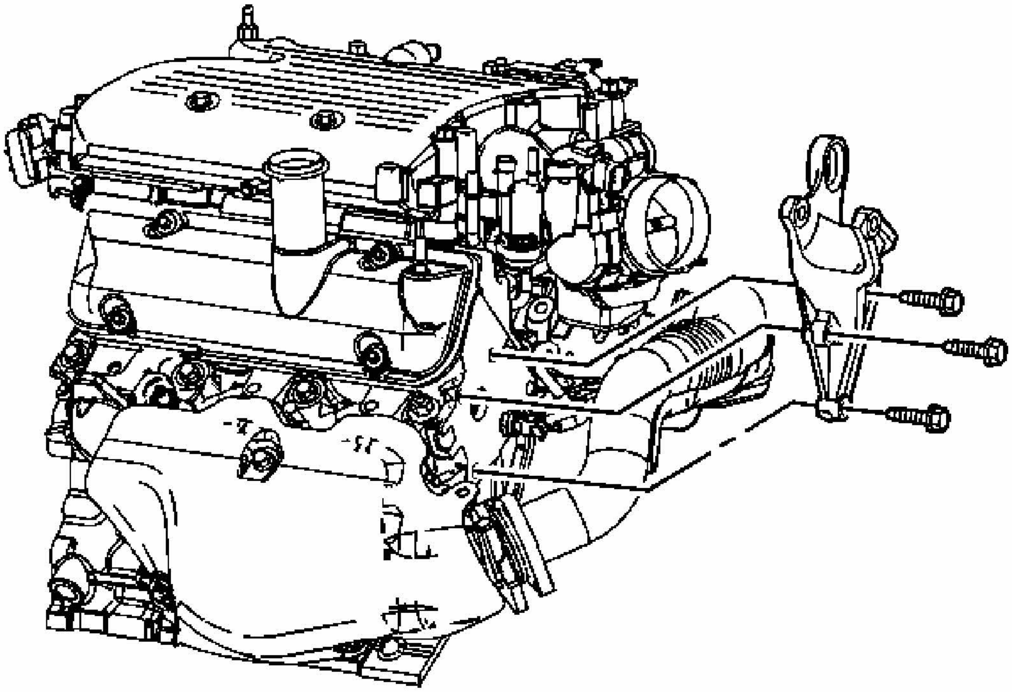


Fig. 39: View Of Engine Mount Strut Bracket & Cylinder Head
Courtesy of GENERAL MOTORS CORP.

1. Position the engine mount strut bracket to the cylinder head.

NOTE: **Refer to Fastener Notice .**

2. Install the engine mount strut bracket to cylinder head bolts.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

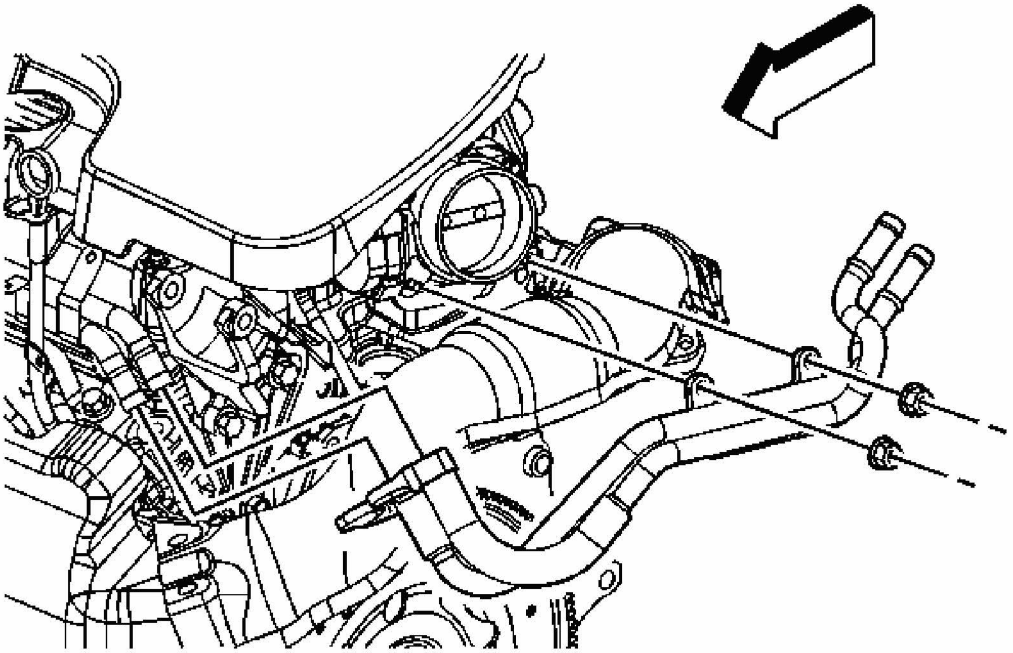


Fig. 40: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

3. Position and install the heater inlet and outlet hoses to the engine pipes.
4. Install the heater inlet and outlet hose clamp to the throttle body studs.
5. Position the heater inlet and outlet hose clamps at the pipes.
6. Install the heater inlet and outlet hose clamp nuts to the throttle body studs.

   Tighten: Tighten the nuts to 10 N.m (89 lb ft).

7. Install the engine mount strut. Refer to **Engine Mount Strut Replacement**.
8. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

OIL FILTER ADAPTER AND BYPASS VALVE ASSEMBLY REPLACEMENT

Removal Procedure

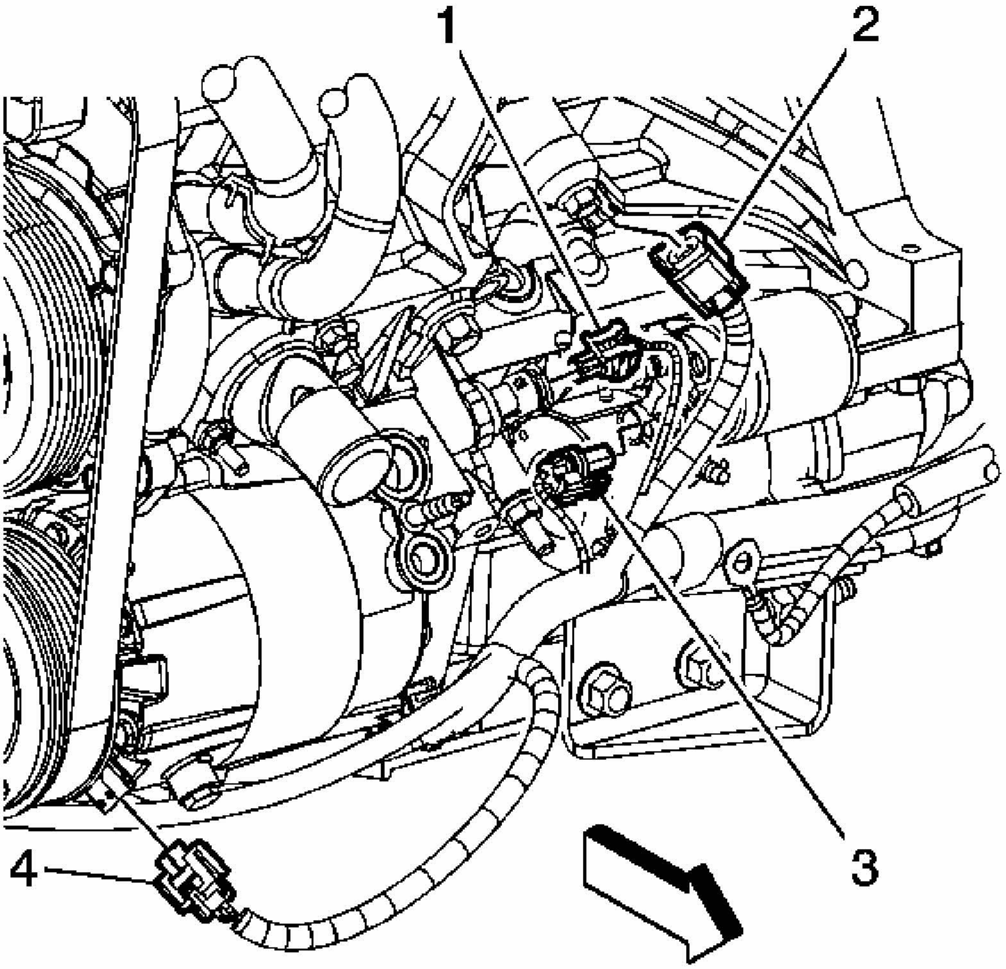


Fig. 41: Locating Starter Motor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Disconnect the oil pressure sensor electrical connector (1).

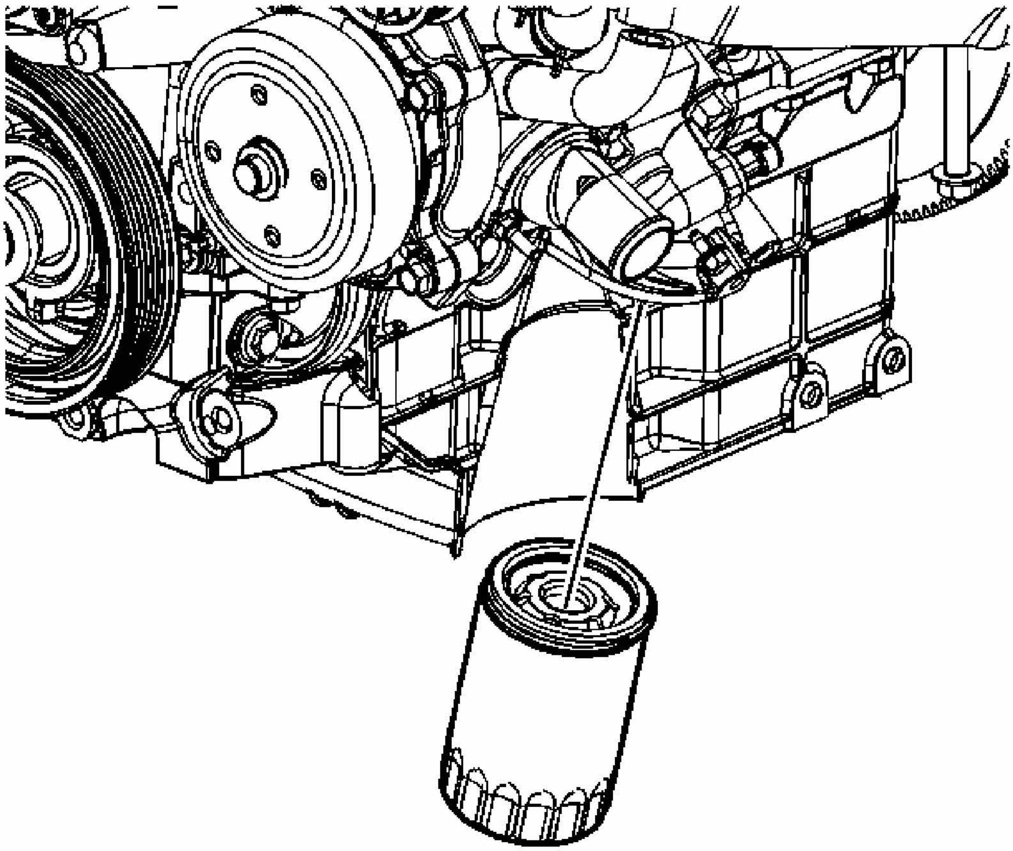


Fig. 42: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil filter.

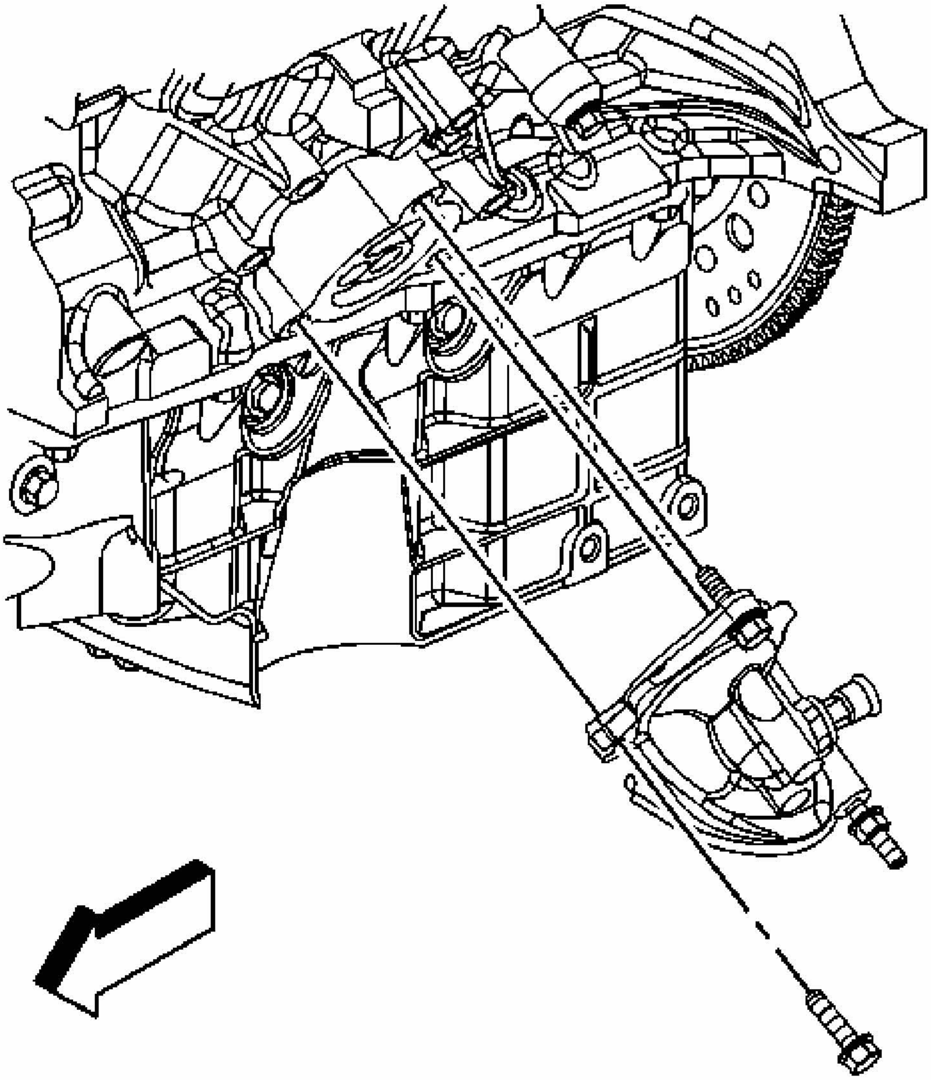


Fig. 43: Identifying Oil Filter Adapter Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

4. Remove the oil filter adapter bolts and stud.
5. Remove the oil filter adapter and gasket.

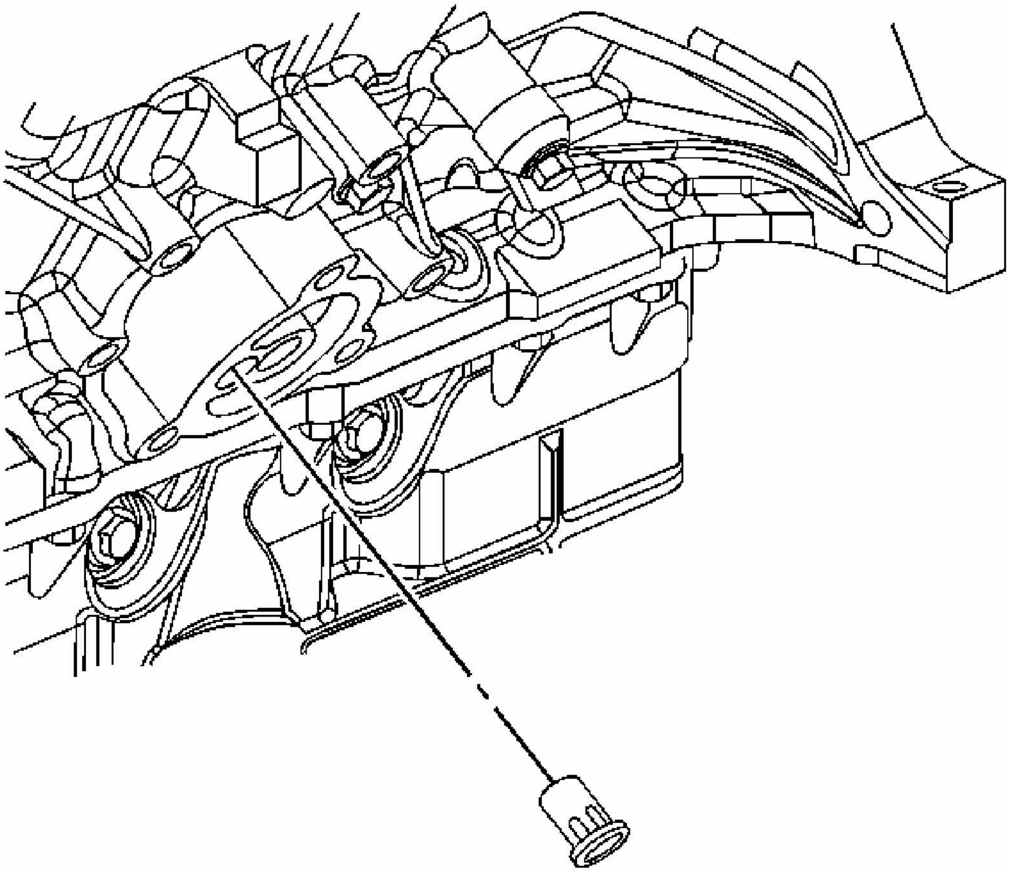


Fig. 44: Locating Oil Filter Bypass Hole & Bypass Valve
Courtesy of GENERAL MOTORS CORP.

6. Insert a flat-bladed tool into the oil filter bypass hole and remove the oil filter bypass valve.

Installation Procedure

NOTE: **Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.**

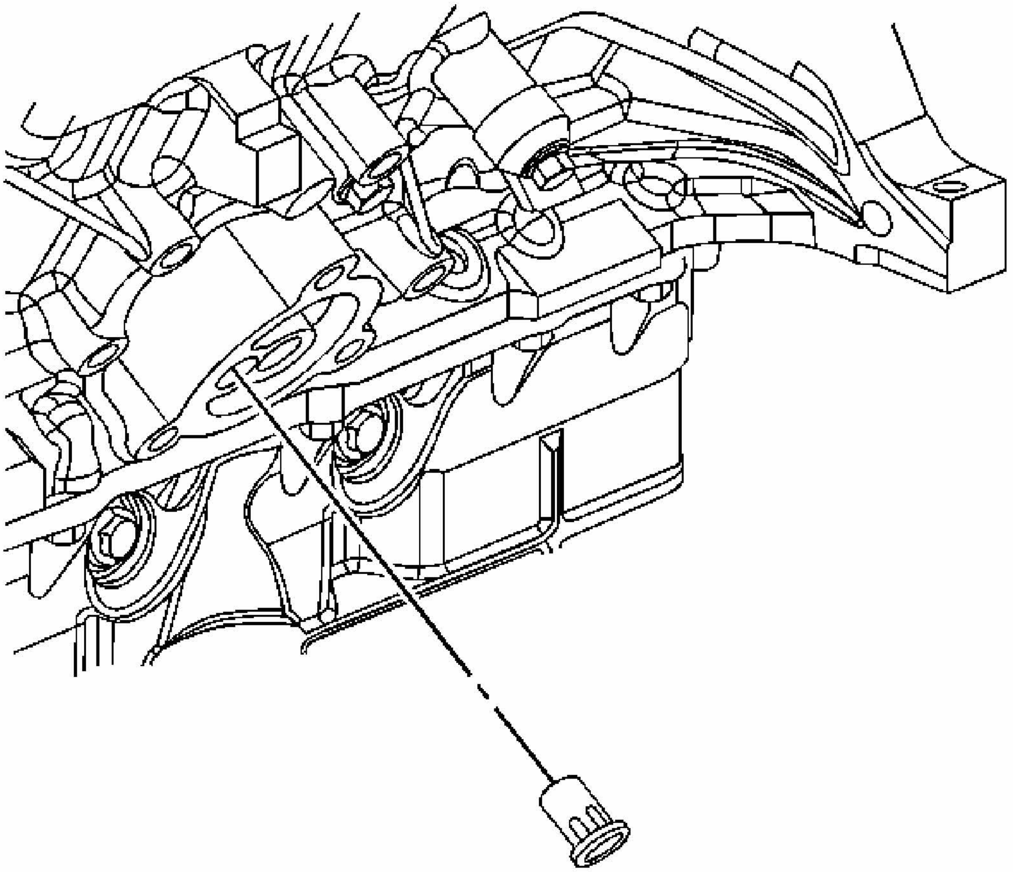


Fig. 45: Locating Oil Filter Bypass Hole & Bypass Valve
Courtesy of GENERAL MOTORS CORP.

1. Install the oil filter bypass valve. Seat the valve fully below the bypass valve hole chamfer.

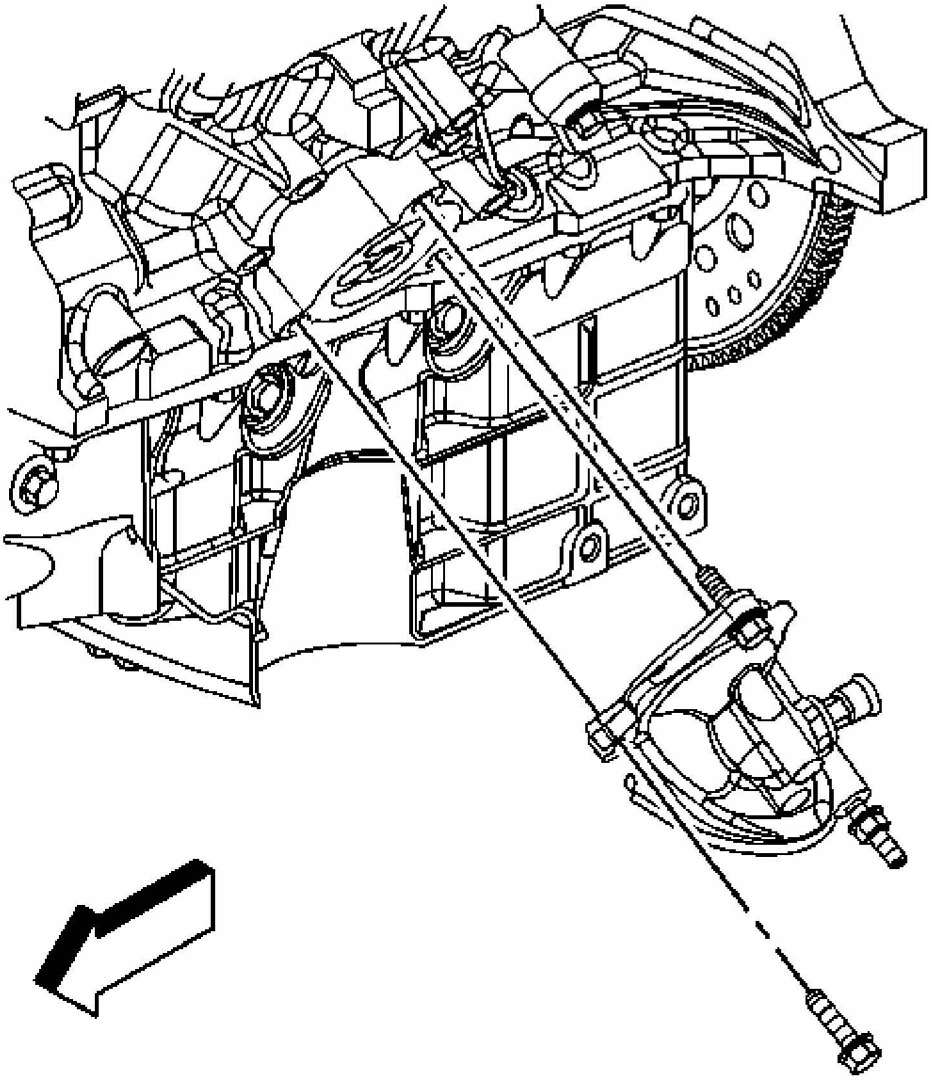


Fig. 46: Identifying Oil Filter Adapter Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

2. Position the oil filter adapter and gasket to the engine.
3. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent to the bolt/stud threads, if required.

NOTE: **Refer to Fastener Notice .**

4. Install the oil filter adapter bolts and stud.

   Tighten: Tighten the bolts and stud to 25 N.m (18 lb ft).

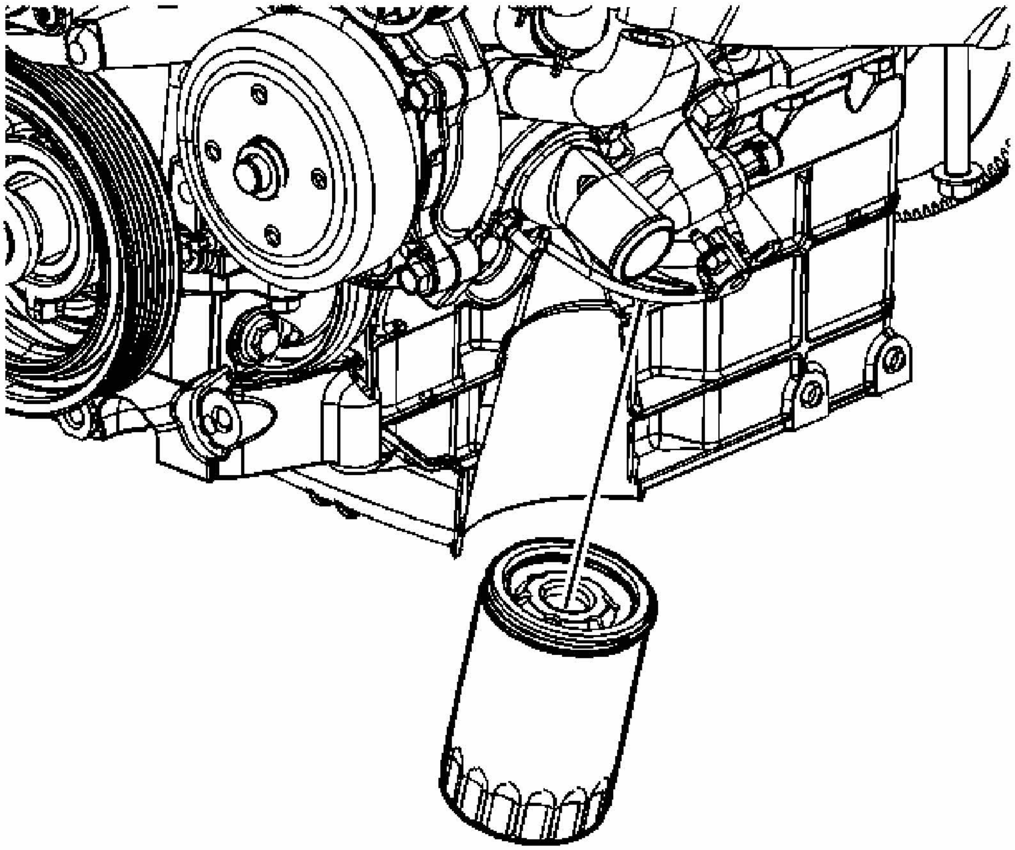


Fig. 47: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

5. Install the oil filter.

   Tighten: Tighten the filter to 30 N.m (22 lb ft).

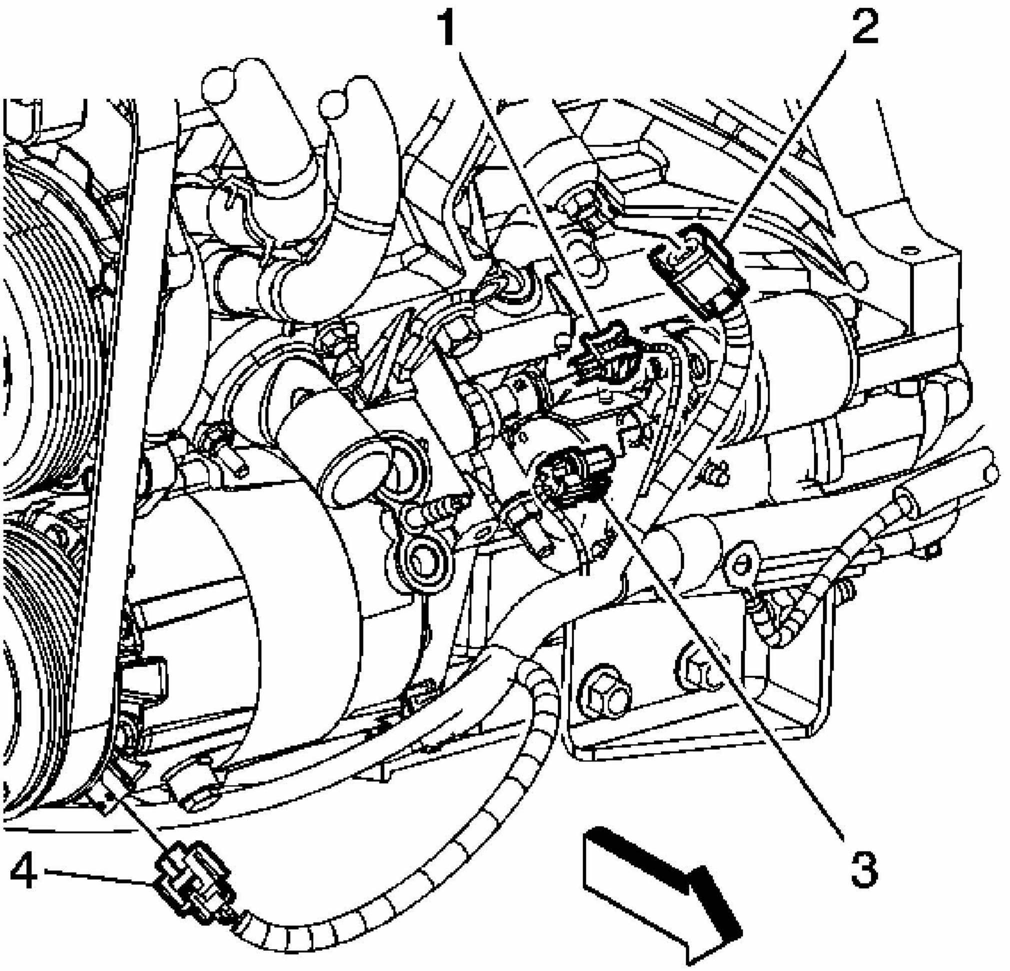


Fig. 48: Locating Starter Motor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Connect the oil pressure sensor electrical connector (1).
7. Lower the vehicle.
8. Check and fill the crankcase, if necessary.

OIL LEVEL INDICATOR AND TUBE REPLACEMENT

Removal Procedure

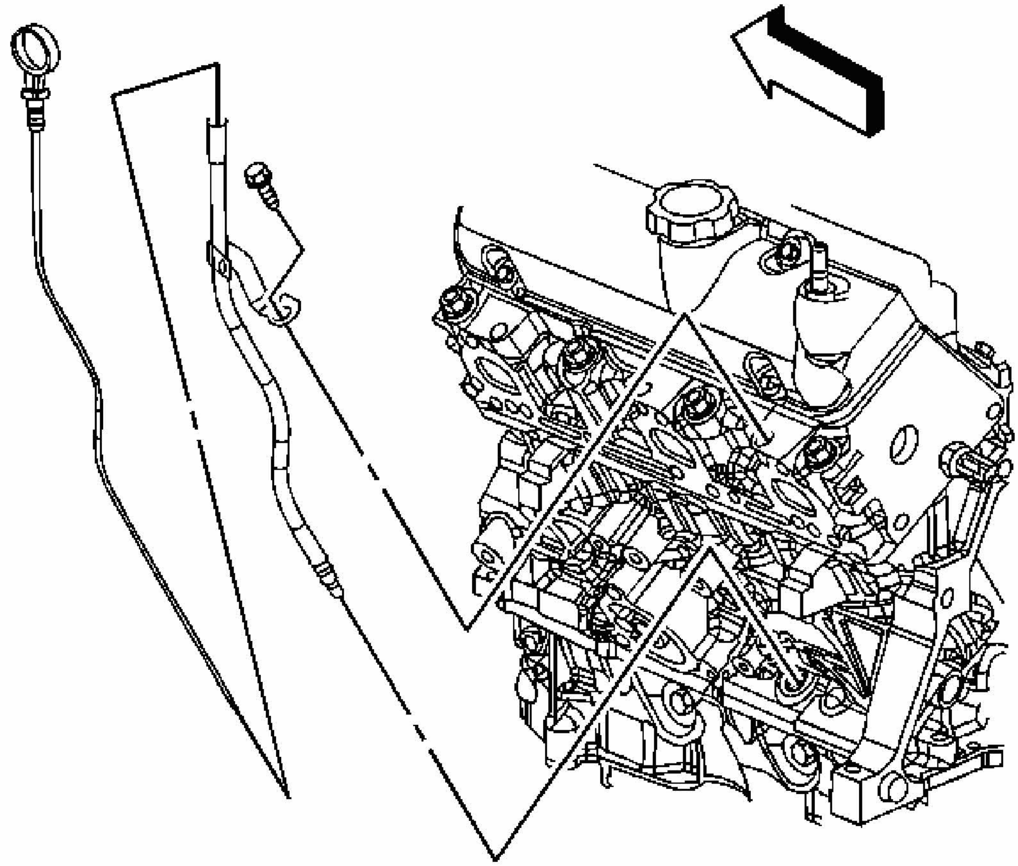


Fig. 49: Identifying Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil level indicator.
2. Remove the oil level indicator tube bracket bolt.
3. Remove the oil level indicator tube.
4. Inspect the oil level indicator tube O-ring seal, for damage, replace as necessary.

Installation Procedure

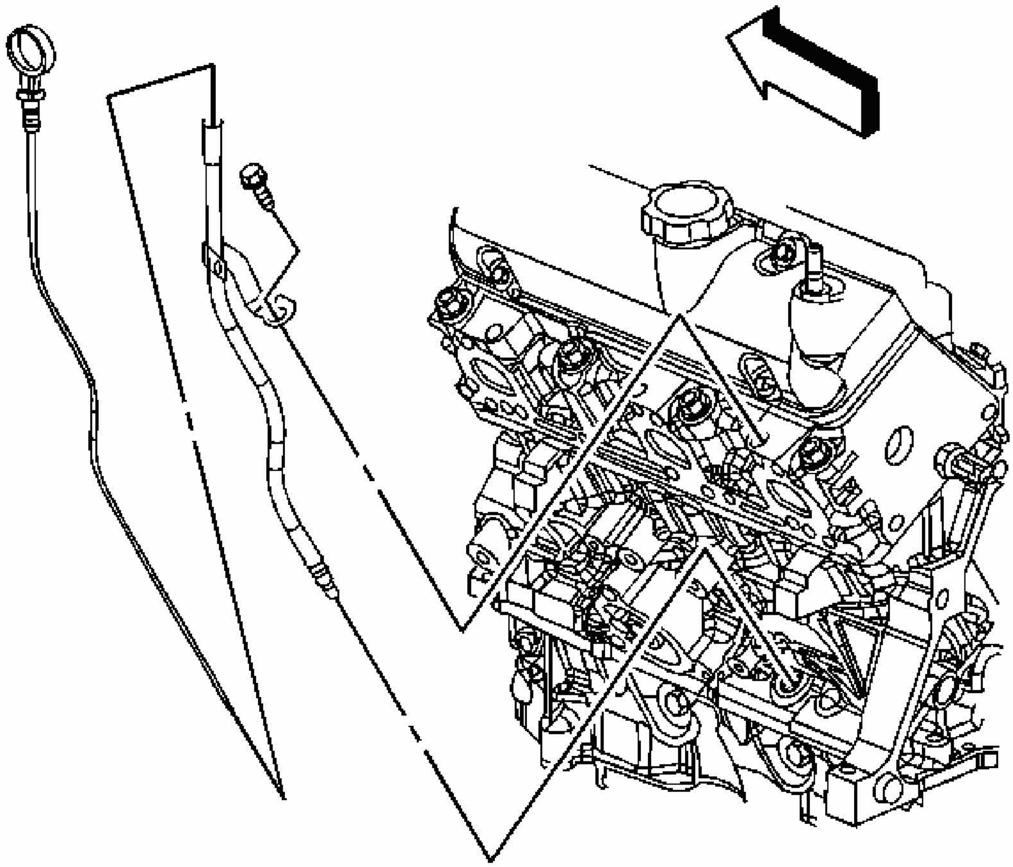


Fig. 50: Identifying Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the oil level indicator tube O-ring seal with clean engine oil.
2. Install the oil level indicator tube into the engine block.

NOTE: **Refer to FASTENER NOTICE .**

3. Install the oil level indicator tube bracket bolt.

   Tighten: Tighten the bolt to 25 N.m (18 lb ft).

4. Install the oil level indicator.

INTAKE MANIFOLD REPLACEMENT - UPPER

Removal Procedure

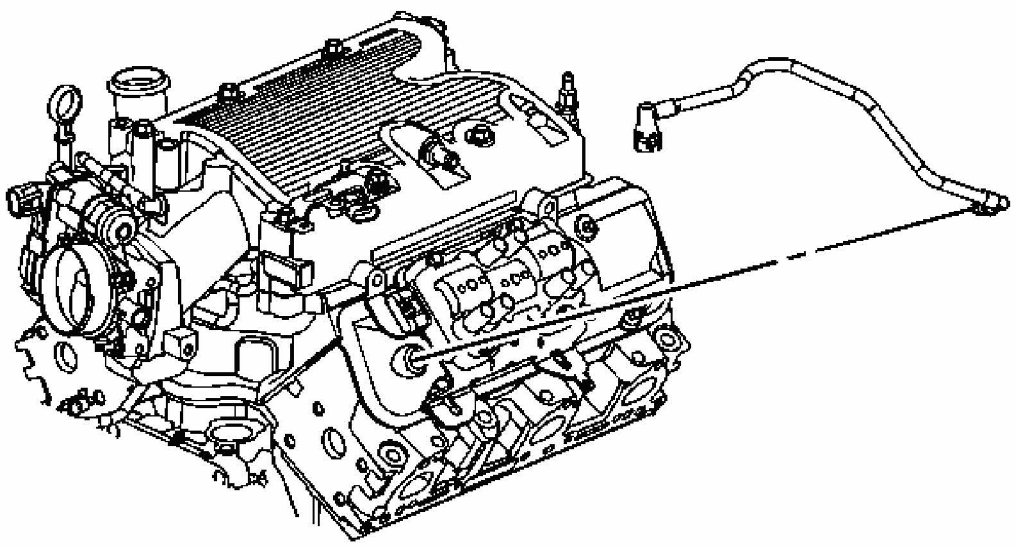


Fig. 51: View Of PCV Tube & Air Inlet Duct
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .
2. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
3. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
4. Remove the positive crankcase ventilation (PCV) fresh air tube. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

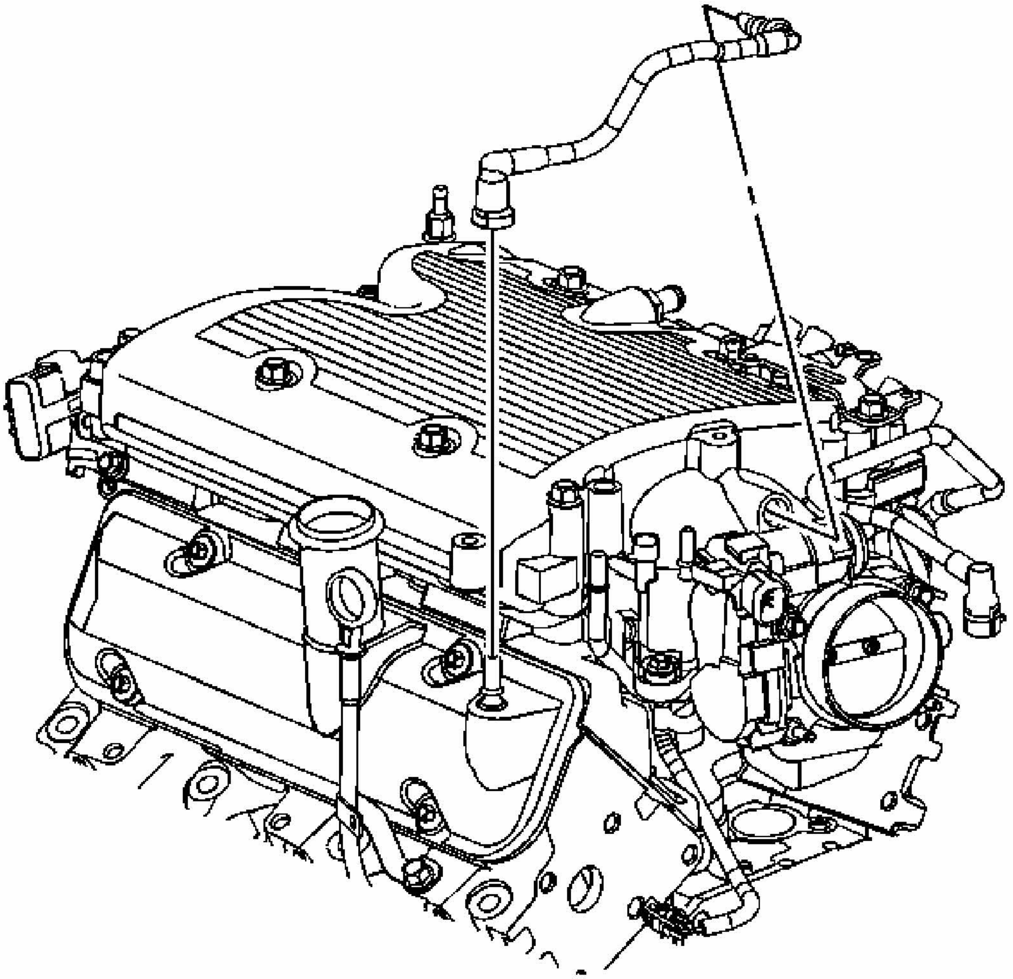


Fig. 52: Locating PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Remove the PCV foul air tube. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

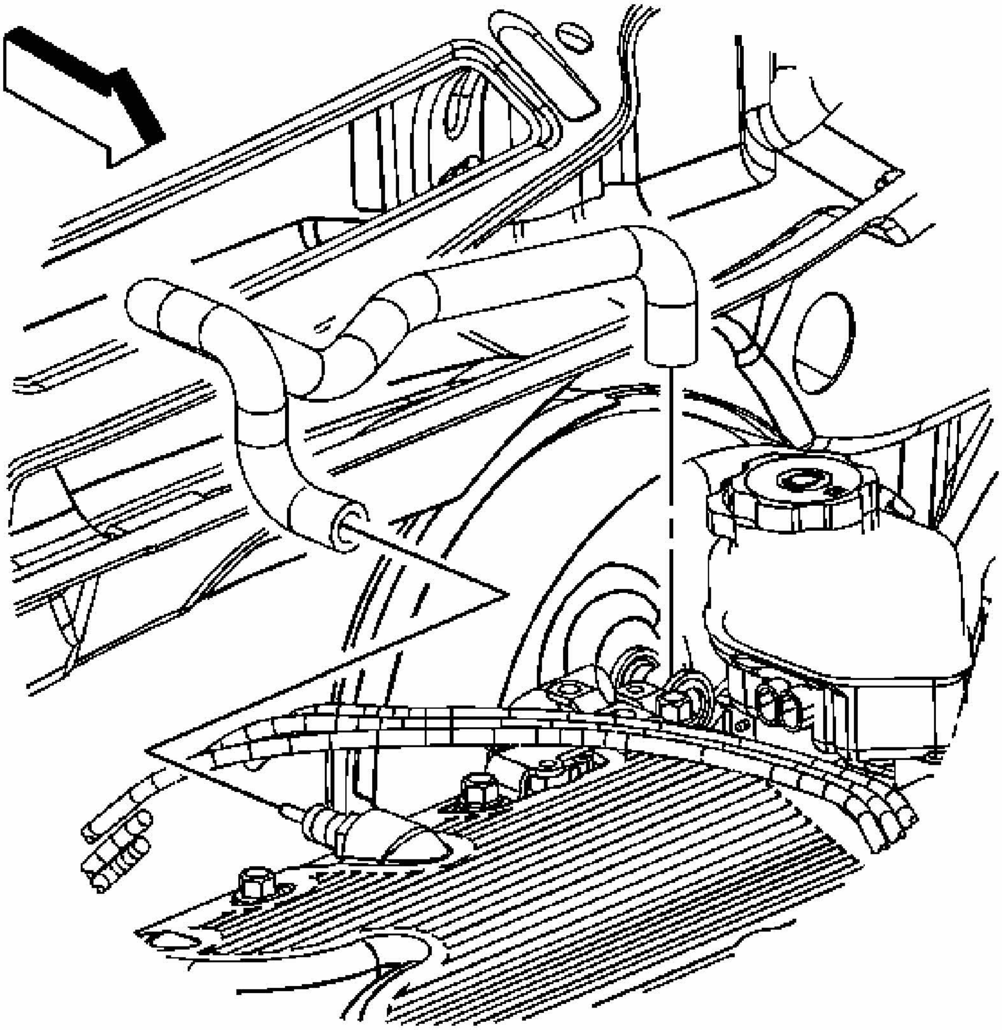


Fig. 53: View Of Brake Booster Vacuum Hose & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

6. Remove the vacuum hose from the intake manifold.

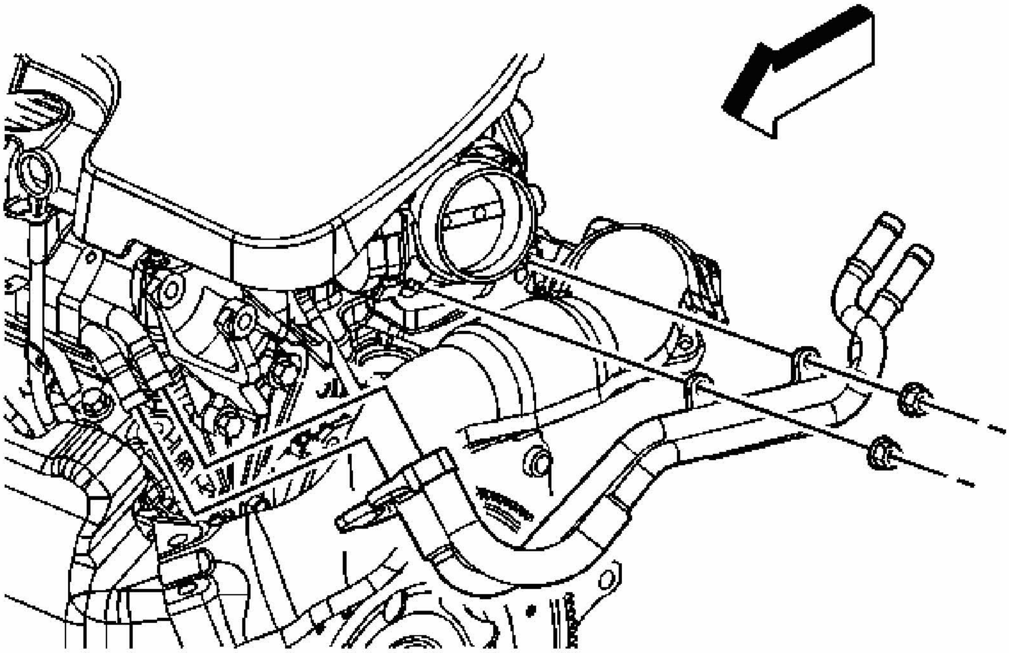


Fig. 54: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

7. Reposition the heater inlet and outlet hose/pipe clamps at the engine pipes.
8. Remove the heater inlet and outlet hose/pipe clamp nuts from the throttle body studs.
9. Remove the heater inlet and outlet hoses/pipes from the engine pipes and the throttle body studs.
10. Reposition the hoses/pipes out of the way.

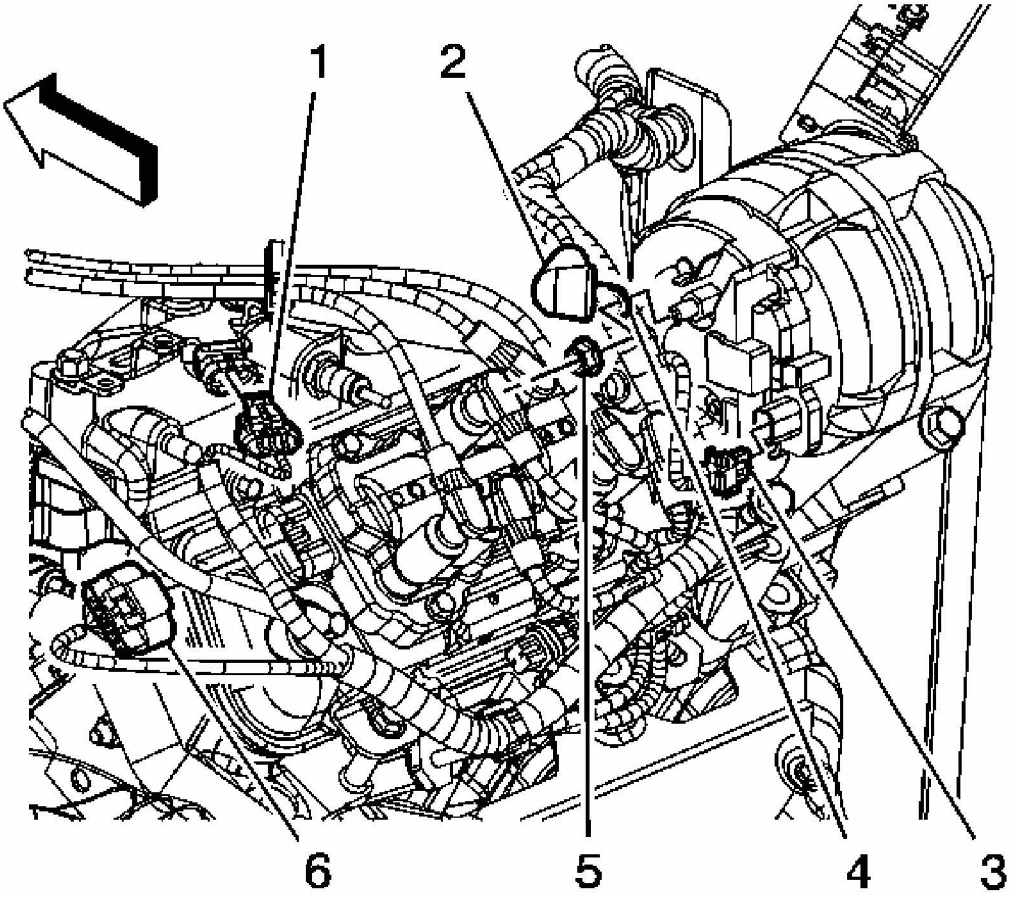


Fig. 55: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

11. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).

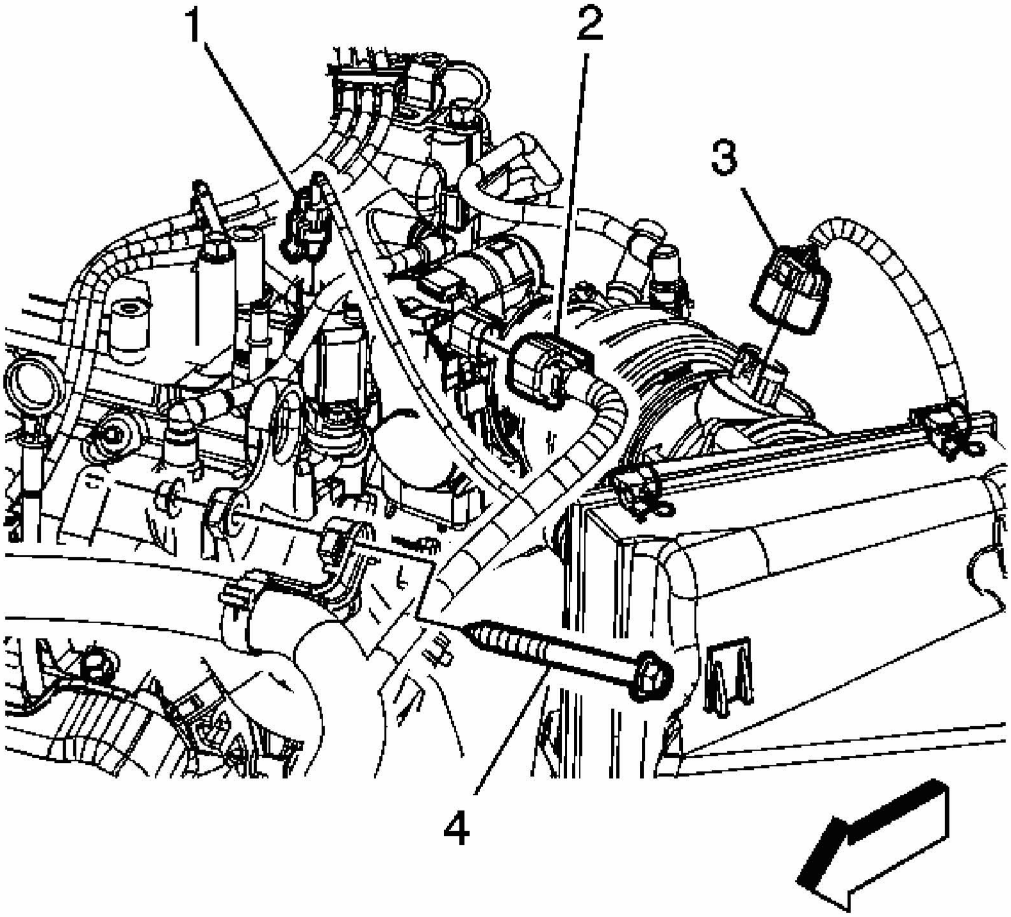


Fig. 56: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

12. Disconnect the evaporative emission (EVAP) canister purge solenoid electrical connector (1).
13. Disconnect the chassis EVAP line quick connect fitting from the purge solenoid. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
14. Disconnect the electronic throttle control (ETC) electrical connector (2).

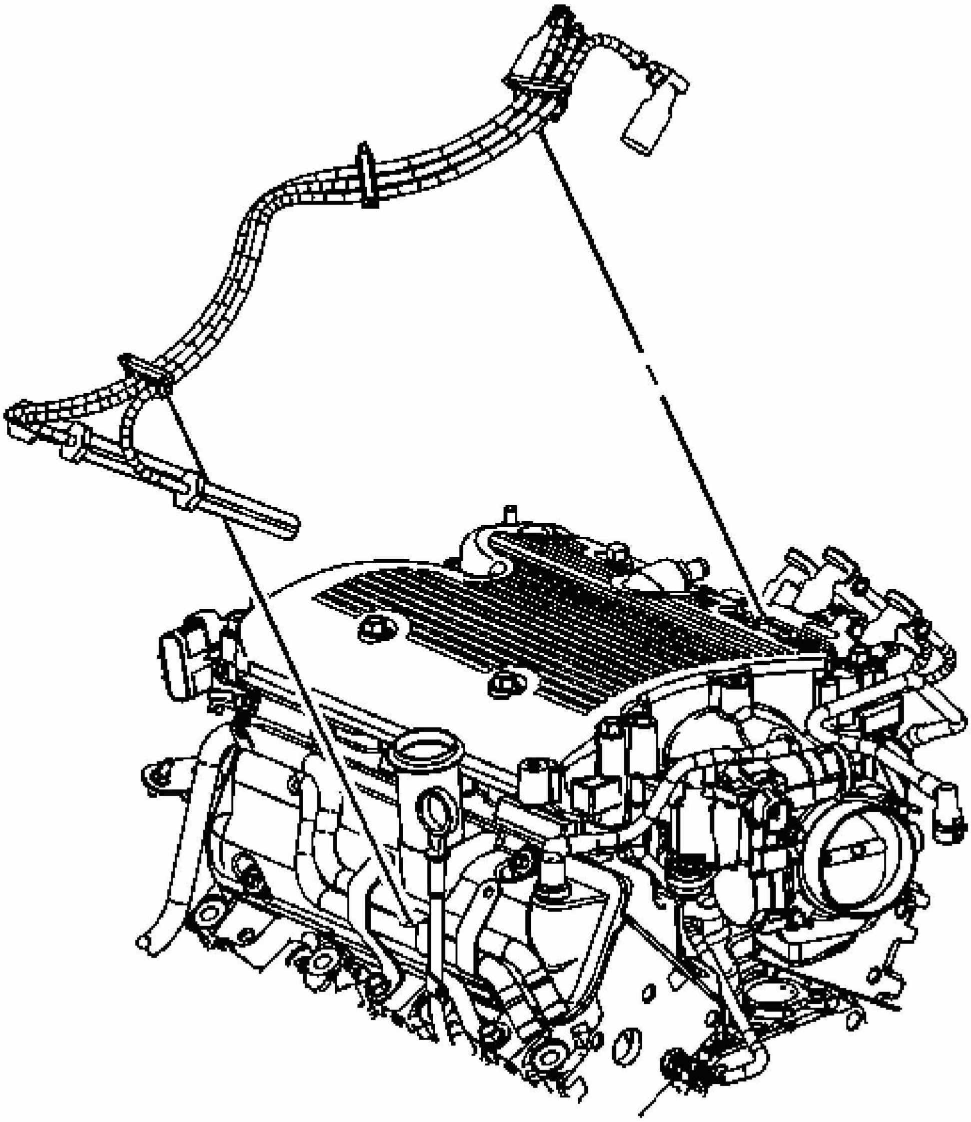


Fig. 57: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

15. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
16. Disconnect the left side spark plug wires from the spark plugs.
17. Disconnect the left side spark plug wires from the ignition coil.
18. Disengage the spark plug wire retainer clips from the intake manifold bracket and the heater inlet/outlet hose/pipe bracket.
19. Remove the left side spark plug wires.

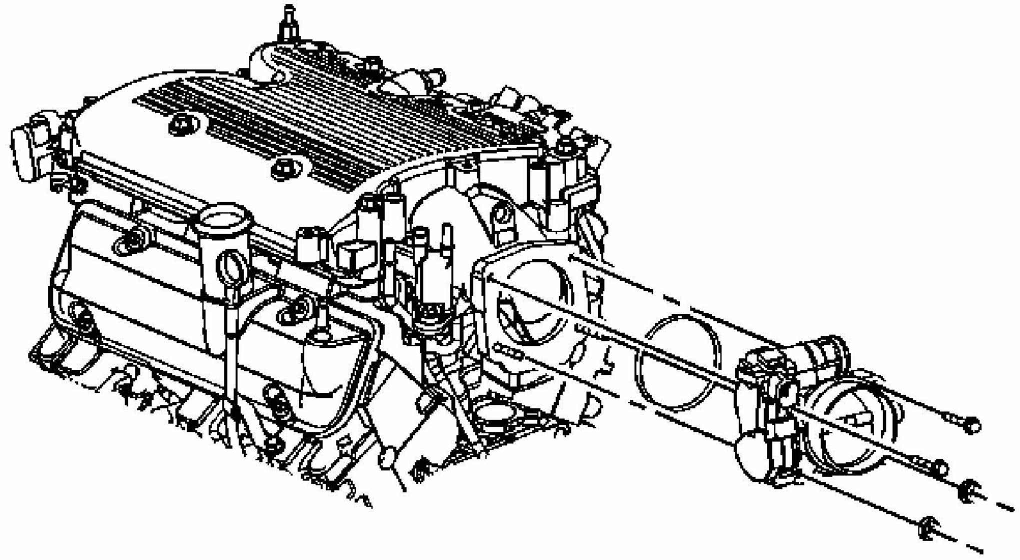


Fig. 58: View Of Throttle Body Bolts/Studs
Courtesy of GENERAL MOTORS CORP.

20. Remove the throttle body bolts and nuts.
21. Remove the throttle body and gasket.

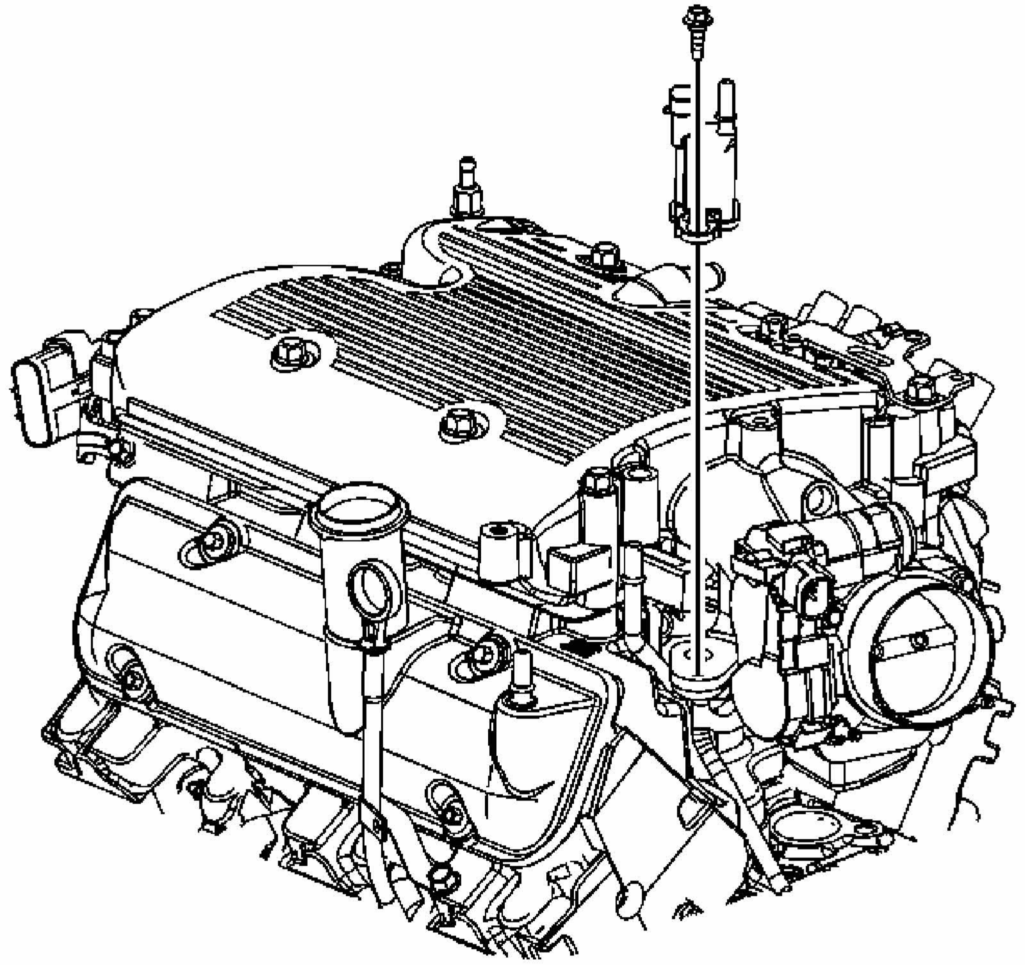


Fig. 59: View Of EVAP Canister Purge Valve Bolt
Courtesy of GENERAL MOTORS CORP.

22. Remove the EVAP canister purge solenoid valve bolt.
23. Remove the EVAP canister purge solenoid valve.

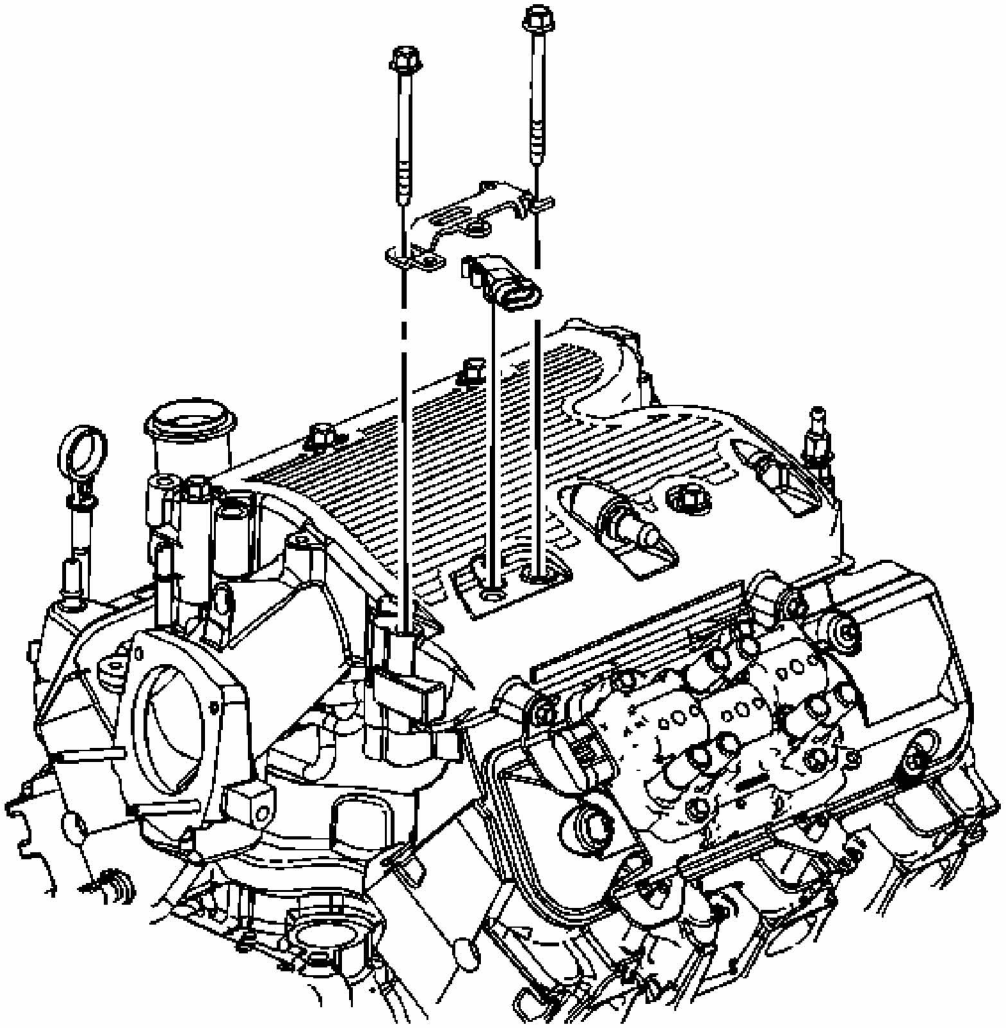


Fig. 60: Locating MAP Sensor And Bracket
Courtesy of GENERAL MOTORS CORP.

24. Remove the MAP sensor bracket bolts.
25. Remove the MAP sensor bracket and sensor.

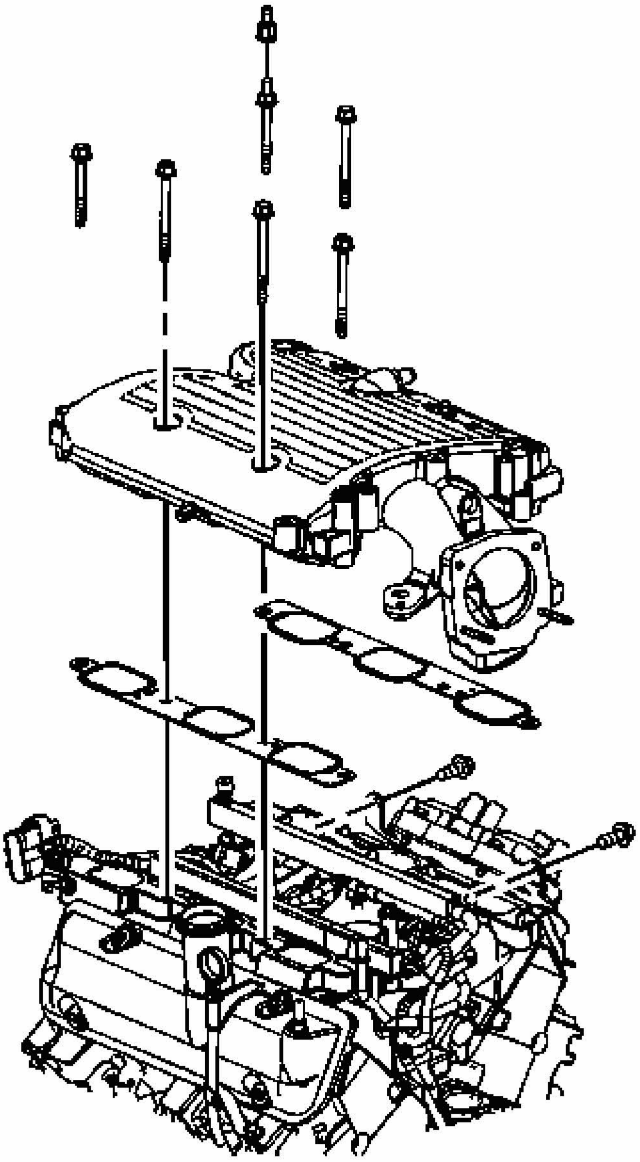


Fig. 61: View Of Upper Intake Manifold Bolts And Stud
Courtesy of GENERAL MOTORS CORP.

26. Remove the ignition coil bracket (to intake manifold) bolts.
27. Remove the intake manifold cover ball stud nut from the intake manifold stud.
28. Remove the upper intake manifold bolts and stud.
29. Separate and remove the upper intake manifold from the lower intake manifold.
30. Remove the upper to lower intake manifold gaskets.

31. Clean the upper intake to lower intake gasket mating surfaces.

Installation Procedure

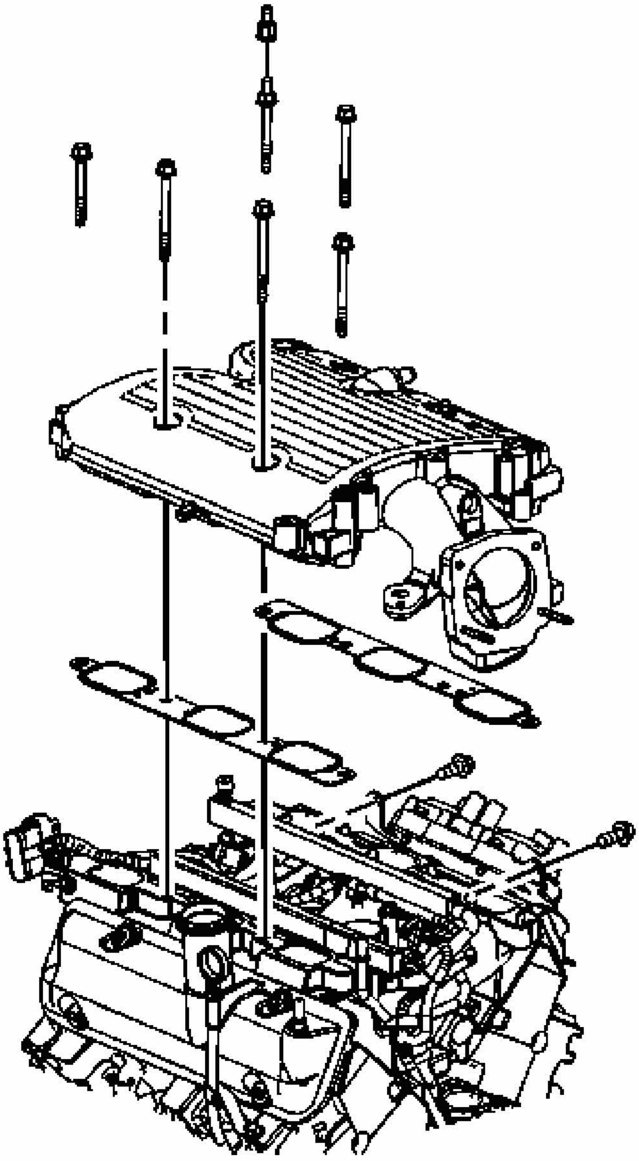


Fig. 62: View Of Upper Intake Manifold & Lower Intake Manifold
Courtesy of GENERAL MOTORS CORP.

1. Install NEW upper to lower intake manifold gaskets.
2. Install the upper intake manifold onto the lower intake manifold.

3. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or equivalent, to the upper intake manifold bolts/stud threads.

   NOTE: **Refer to Fastener Notice .**

4. Install the upper intake manifold bolts and stud.

   Tighten: Tighten the bolts and stud to 25 N.m (18 lb ft).

5. Install the intake manifold cover ball stud nut to the intake manifold stud.

   Tighten: Tighten the nut to 5 N.m (44 lb in).

6. Install the ignition coil bracket (to intake manifold) bolts.

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

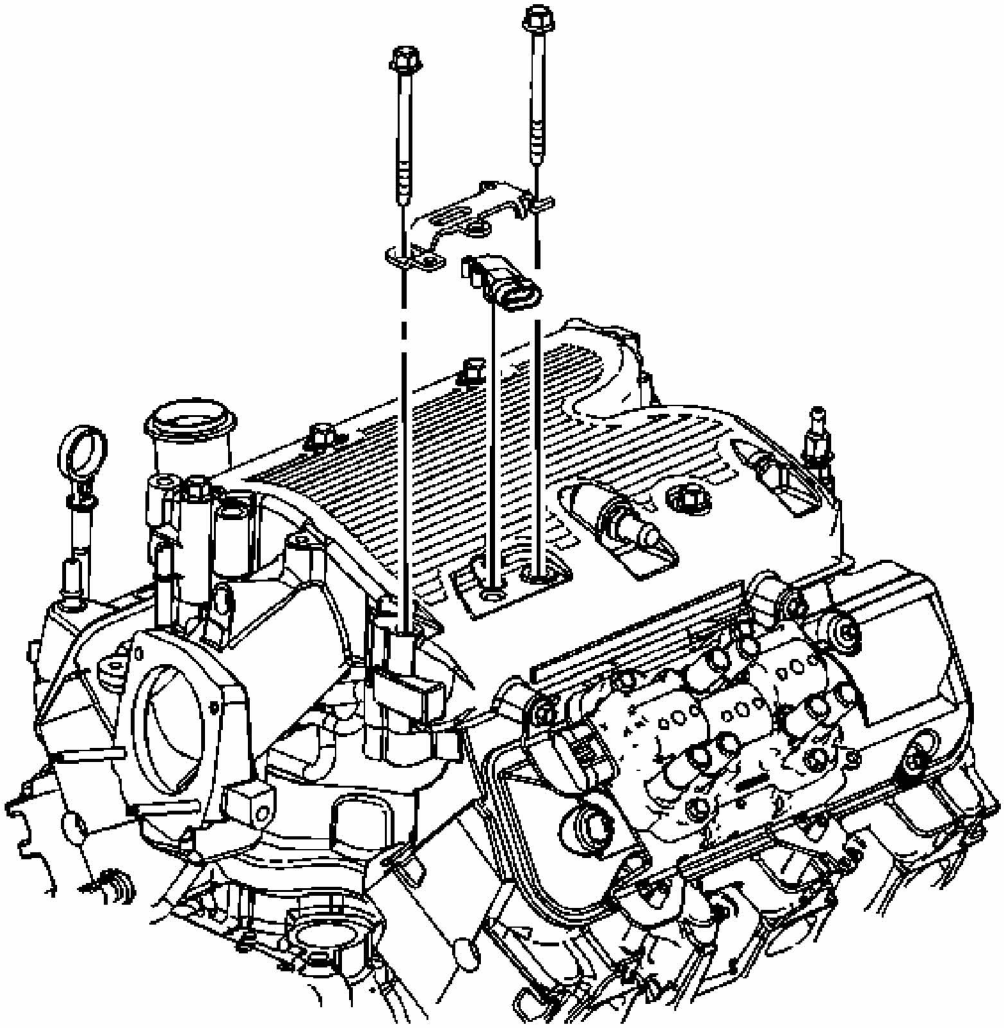


Fig. 63: View Of MAP Sensor Seal & Upper Intake Manifold
Courtesy of GENERAL MOTORS CORP.

7. Install the MAP sensor and bracket.
8. Install the MAP sensor bracket bolts.

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

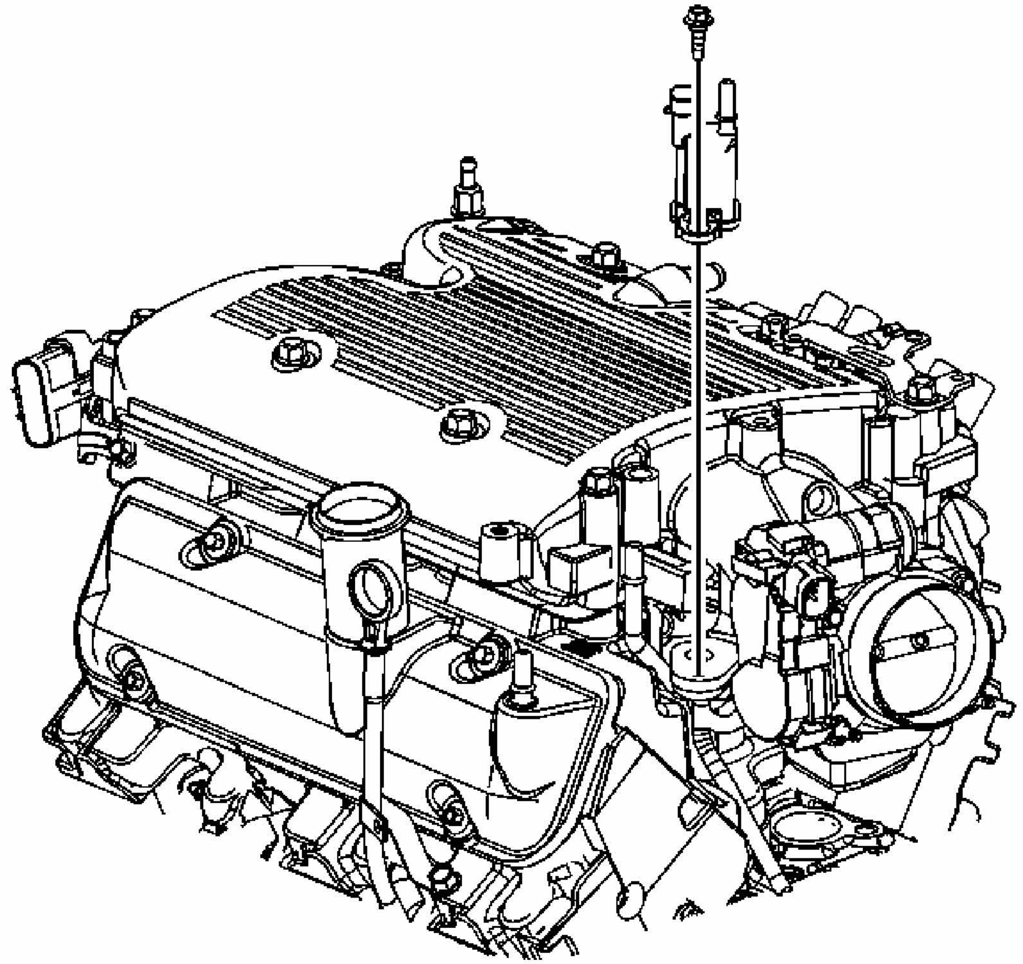


Fig. 64: Identifying EVAP Canister Purge Valve
Courtesy of GENERAL MOTORS CORP.

9. Install the EVAP canister purge solenoid valve.
10. Install the EVAP canister purge solenoid valve bolt.

Tighten: Tighten the bolts to 16 N.m (12 lb ft).

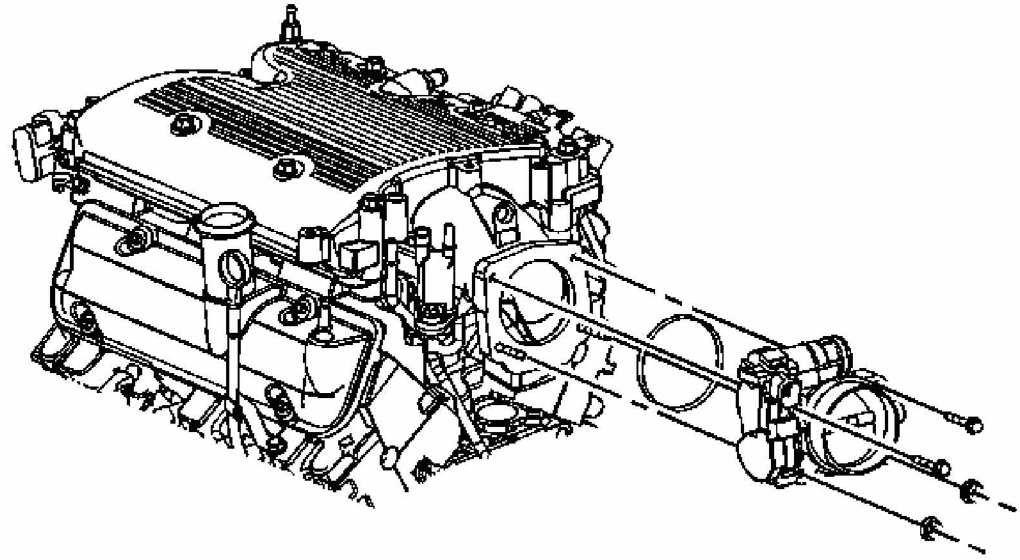


Fig. 65: Identifying Throttle Body, Throttle Body Seal & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

11. Inspect the throttle body seal for damage, replace as necessary.
12. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or equivalent, to the throttle body bolts/studs threads.
13. Position the throttle body gasket and throttle body to the intake.
14. Install the throttle body bolts and nuts.

    Tighten: Tighten the bolts/studs to 10 N.m (89 lb in).

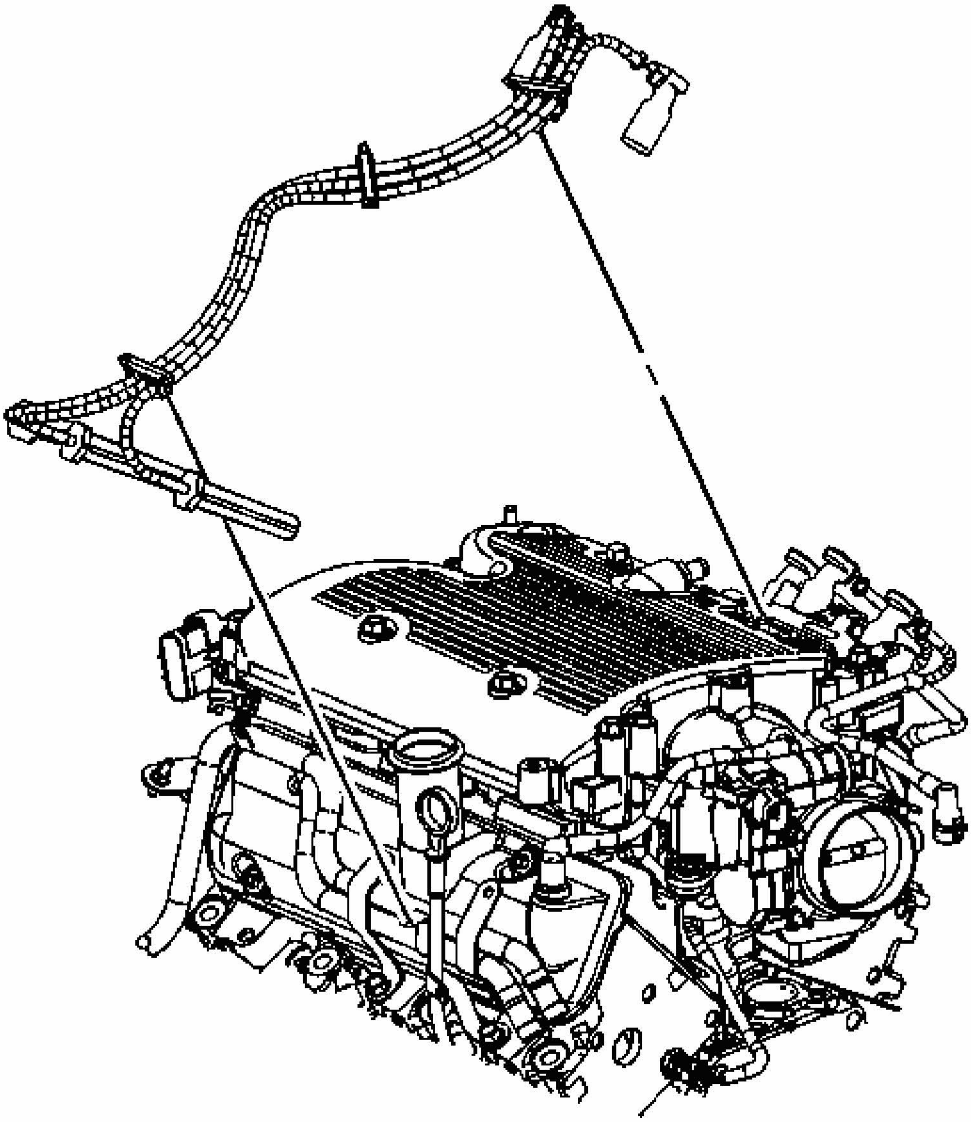


Fig. 66: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

15. Install the left side spark plug wires.
16. Engage the spark plug wire retainer clips to the intake manifold bracket and the heater inlet/outlet hose/pipe bracket.
17. Connect the left side spark plug wires to the ignition coil.
18. Connect the left side spark plug wires to the spark plugs.
19. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .

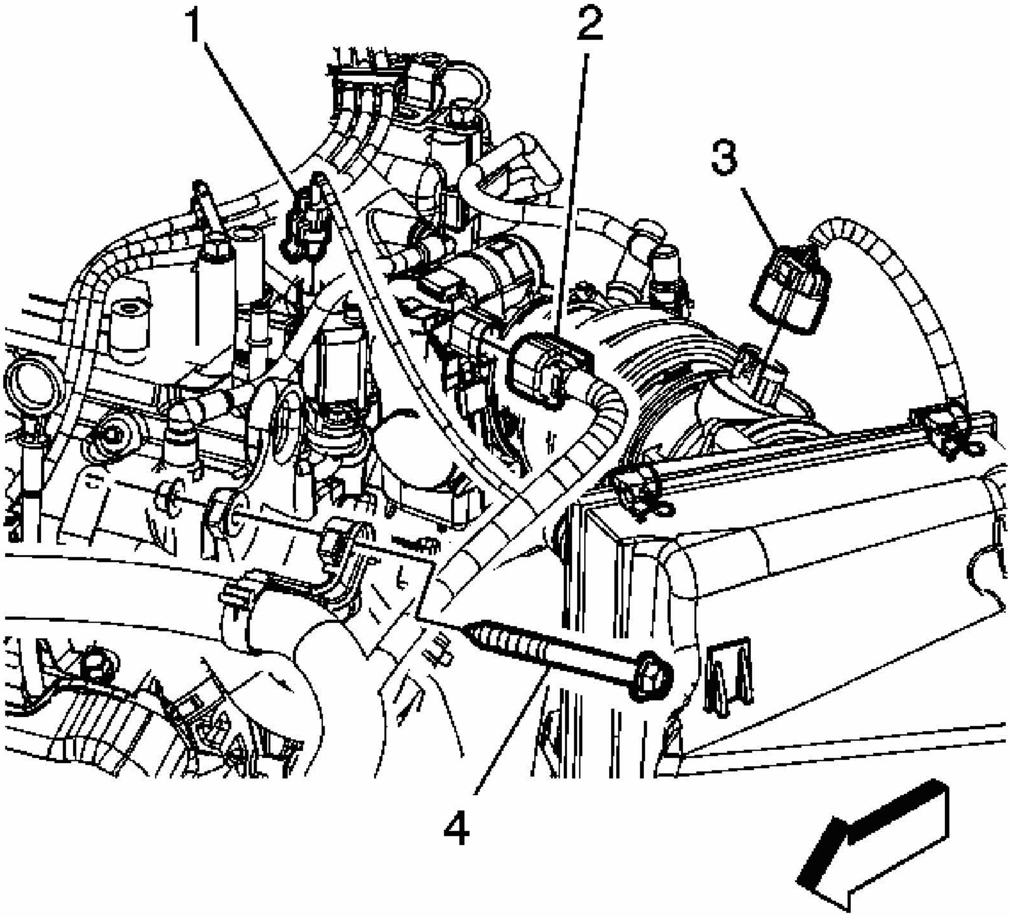


Fig. 67: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

20. Connect the EVAP canister purge solenoid electrical connector (1).
21. Connect the chassis EVAP line quick connect fitting to the purge solenoid. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
22. Connect the ETC electrical connector (2).

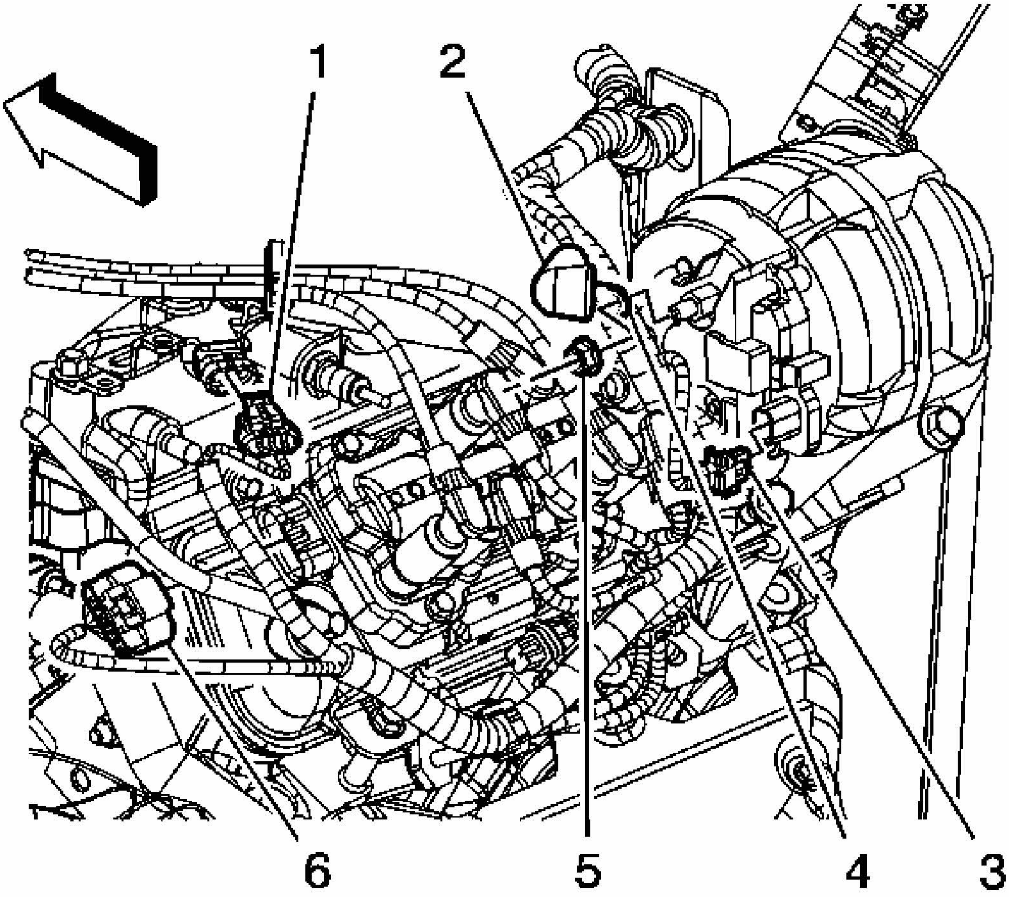


Fig. 68: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

23. Connect the MAP sensor electrical connector (1).

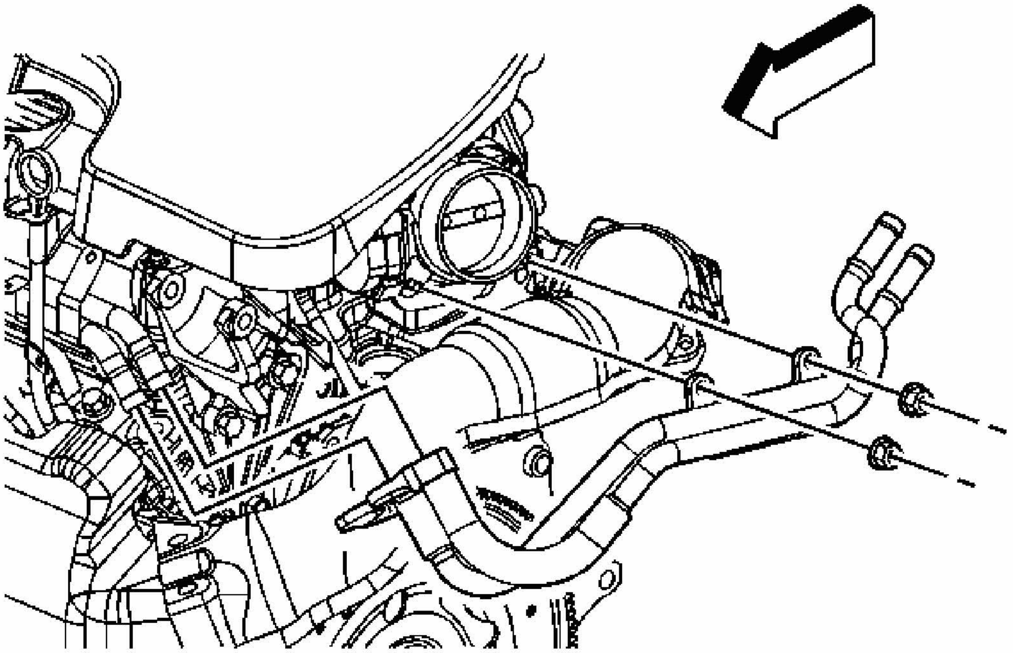


Fig. 69: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

24. Position the hoses/pipes.
25. Install the heater inlet and outlet hoses/pipes to the engine pipes and the throttle body studs.
26. Install the heater inlet and outlet hose/pipe clamp nuts to the throttle body studs.

    Tighten: Tighten the nuts to 10 N.m (89 lb in).

27. Position the heater inlet and outlet hose/pipe clamps at the engine pipes.

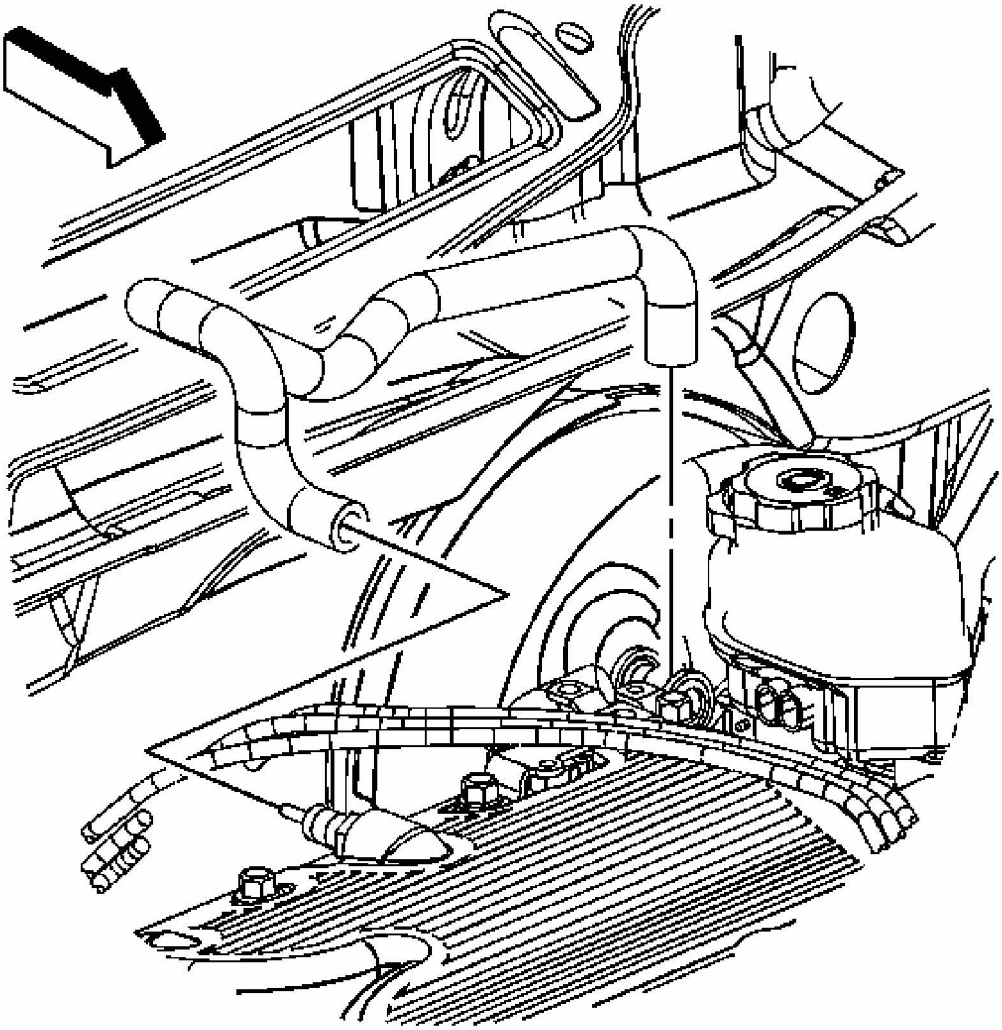


Fig. 70: View Of Brake Booster Vacuum Hose & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

28. Install the vacuum hose to the intake manifold.

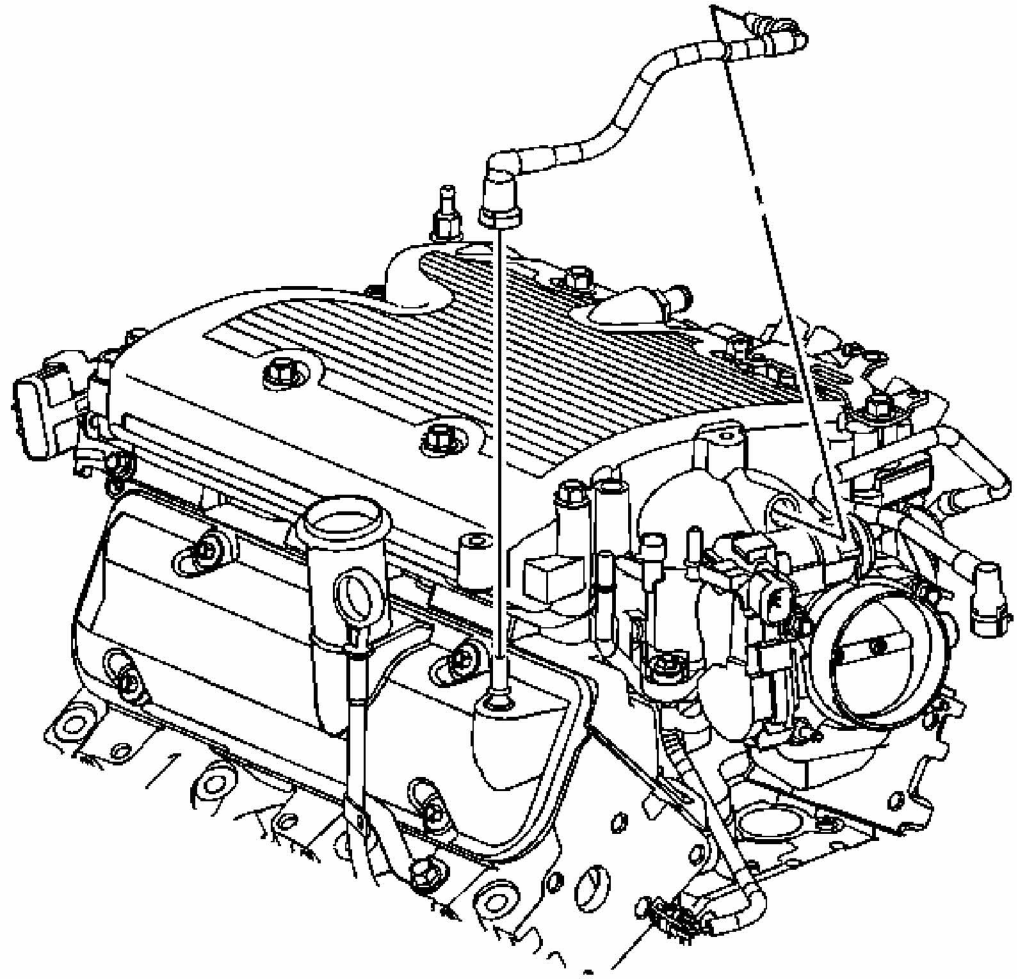


Fig. 71: Locating PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

29. Install the PCV foul air tube. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

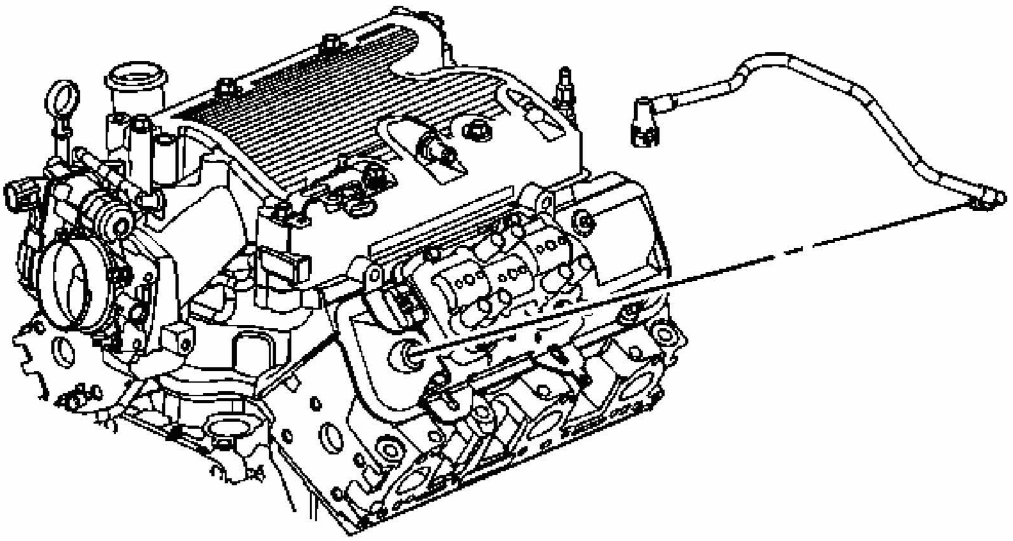


Fig. 72: View Of PCV Tube & Air Inlet Duct
Courtesy of GENERAL MOTORS CORP.

30. Install the PCV fresh air tube. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
31. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
32. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .
33. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

INTAKE MANIFOLD REPLACEMENT - LOWER

Removal Procedure

IMPORTANT: This engine uses a sequential multiport fuel injection system. Injector wiring harness connectors must be connected to their appropriate fuel injector or exhaust emissions and engine performance may be seriously affected.

1. Disconnect the battery ground negative cable. Refer to **Battery Negative Cable**

Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9) or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .

2. Remove the upper intake manifold. Refer to **Intake Manifold Replacement - Upper**.
3. Remove the left valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Left**.
4. Remove the right valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Right**.
5. Disconnect the fuel feed line from the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .

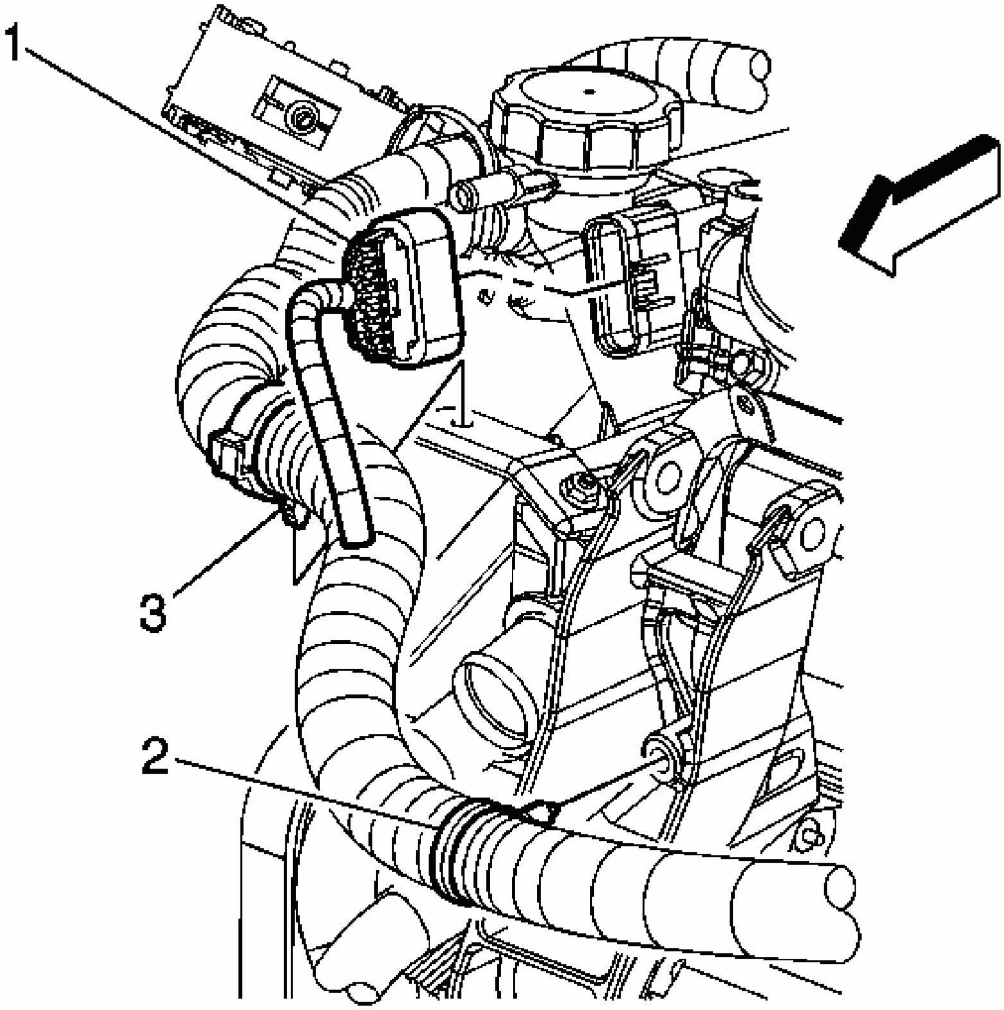


Fig. 73: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

6. Disconnect fuel injector inline connector.

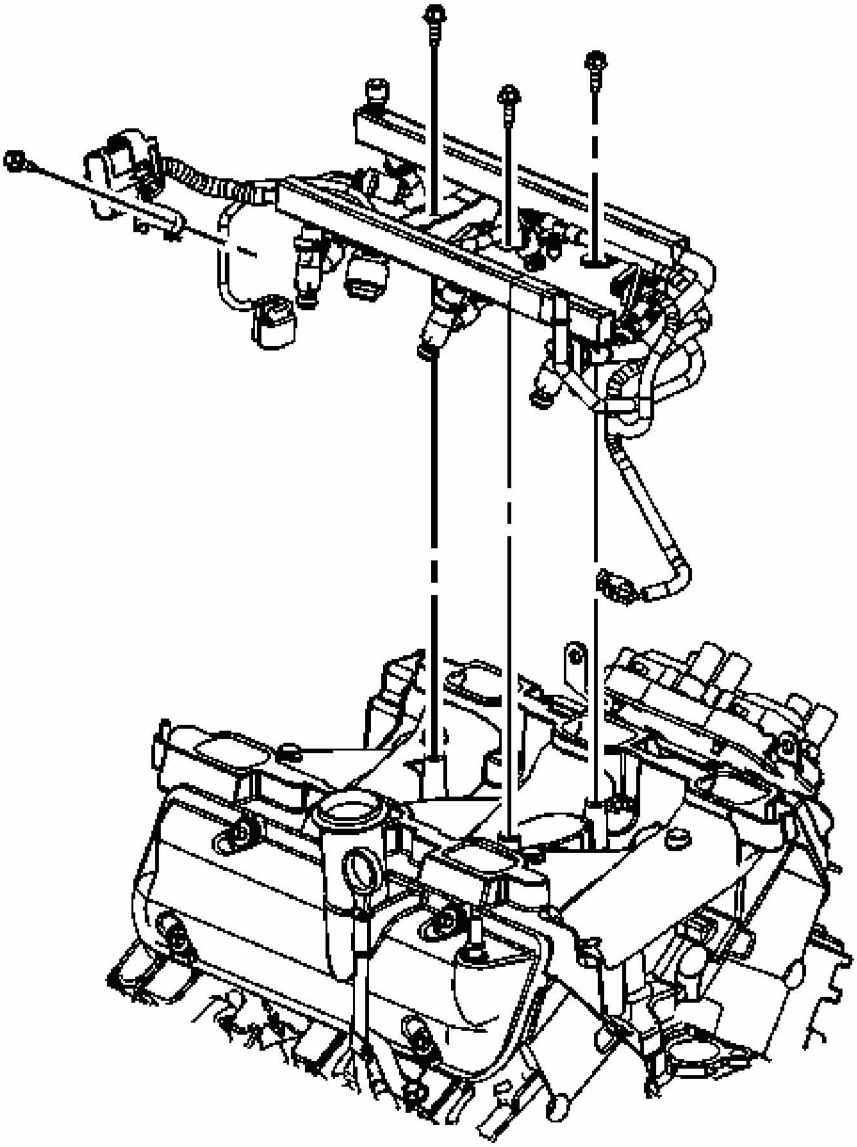


Fig. 74: Locating Fuel Injector Harness Connector Bracket Bolt & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

7. Remove the fuel injector harness connector bracket bolt from the intake manifold.
8. Disconnect the engine coolant temperature (ECT) electrical connector.
9. Disconnect the camshaft position (CMP) sensor electrical connector.

10. Remove the fuel injector rail bolts.
11. Remove the fuel rail.

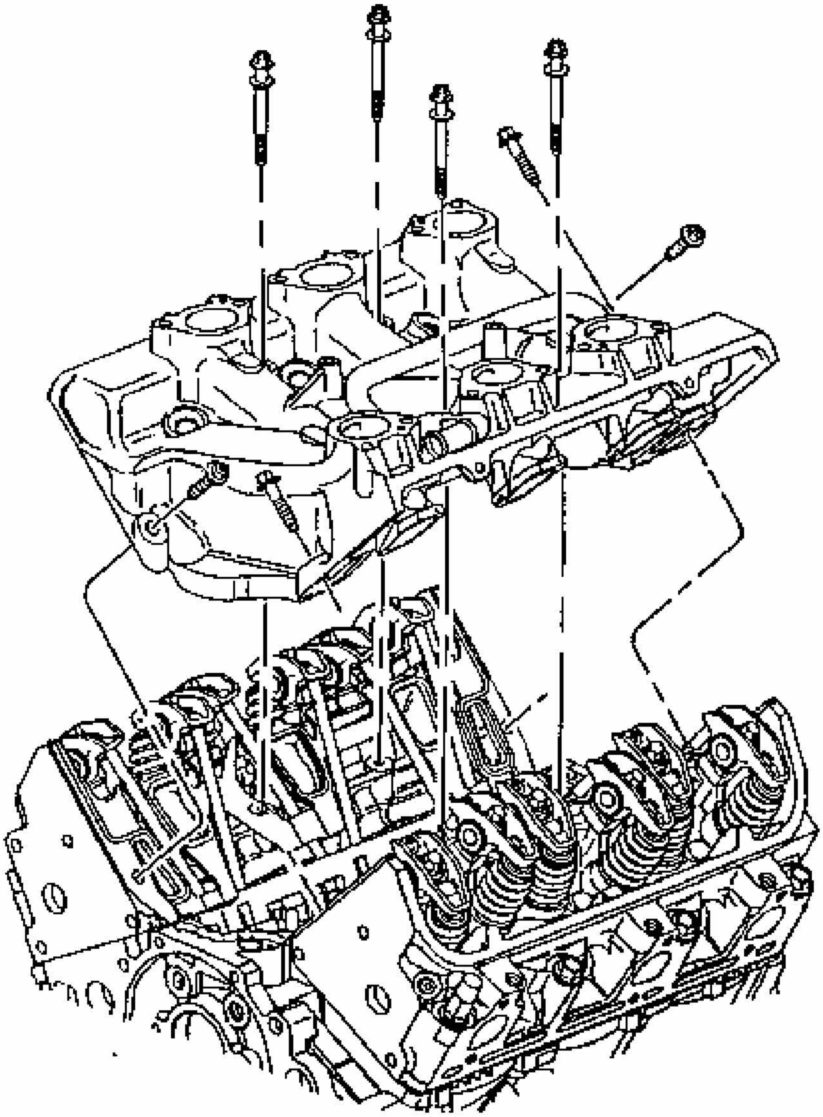


Fig. 75: View Of Lower Intake Manifold & Bolts
Courtesy of GENERAL MOTORS CORP.

12. Remove the lower intake manifold bolts.
13. Remove the lower intake manifold.

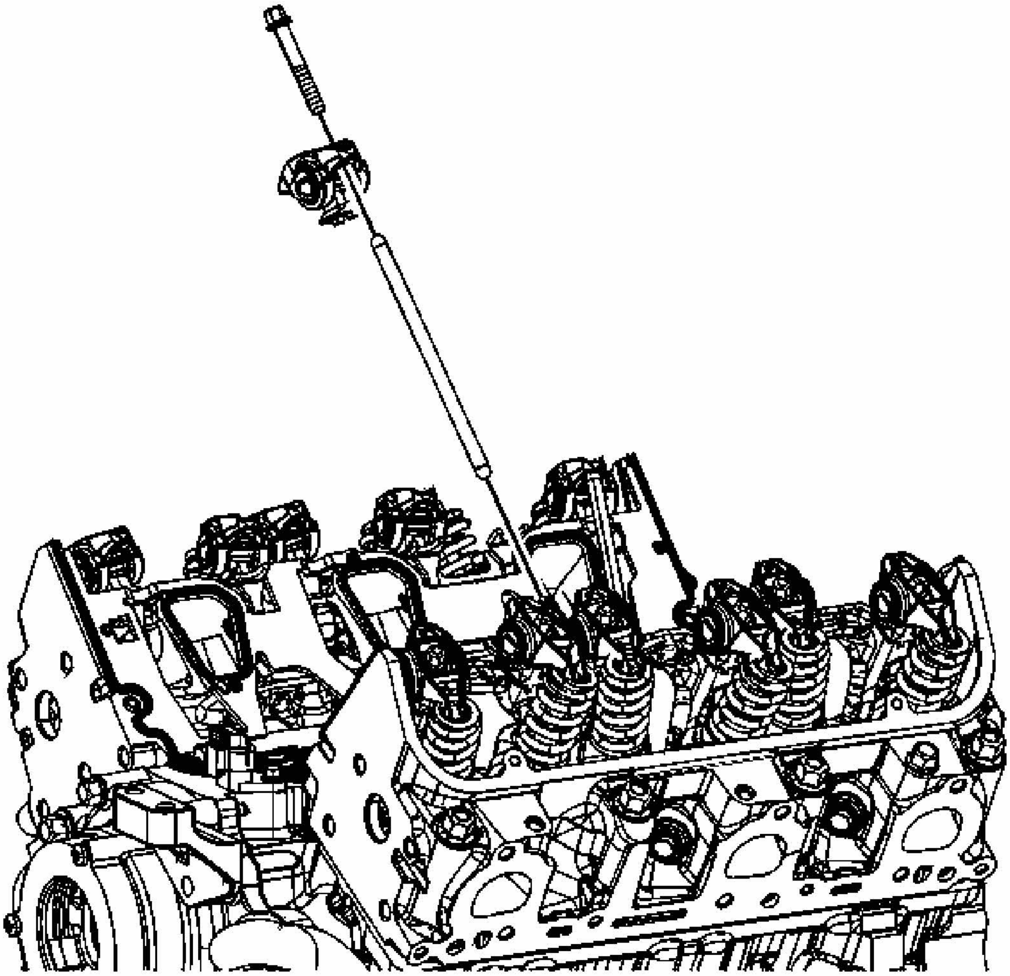


Fig. 76: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

14. Loosen the valve rocker arm bolts.

IMPORTANT: Place the valve train components in a rack in order to ensure that the components are installed in the same location from which they where removed.

15. Remove the valve rocker arms.
16. Remove the push rods.
    - The intake push rods measure 147.51 mm (5.81 in).
    - The exhaust push rods measure 154.87 mm (6.1 in).

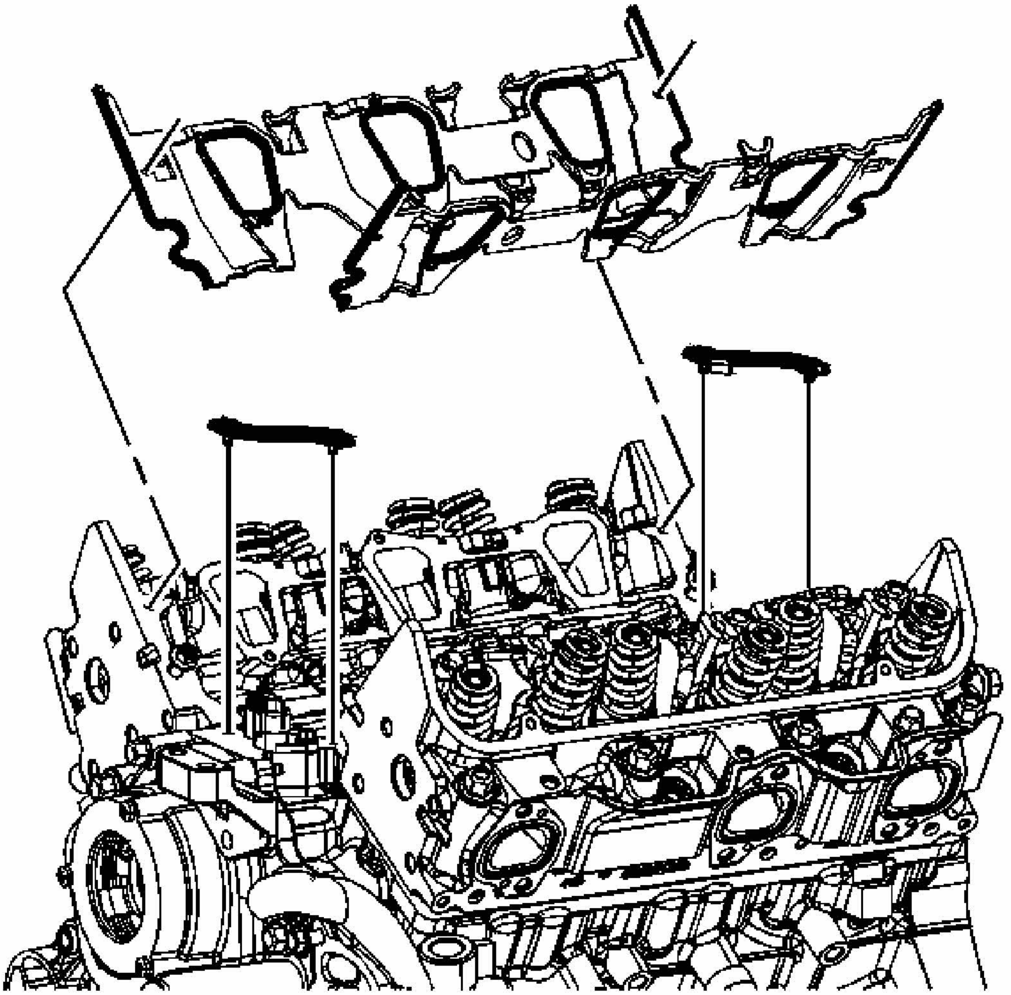


Fig. 77: Identifying Intake Manifold Gaskets & Seals
Courtesy of GENERAL MOTORS CORP.

17. Remove the lower intake manifold gaskets and seals.
18. Clean the lower intake manifold gasket and seal surfaces on the cylinder heads and the engine block.
19. Clean the gasket and seal surfaces on the lower intake manifold with degreaser.
20. Remove all the loose room temperature vulcanizing (RTV) sealer (1).

Installation Procedure

IMPORTANT: All gasket mating surfaces need to be free of oil and foreign material. Use GM P/N 12346139 (Canadian P/N 10953463) or

equivalent, to clean the surfaces.

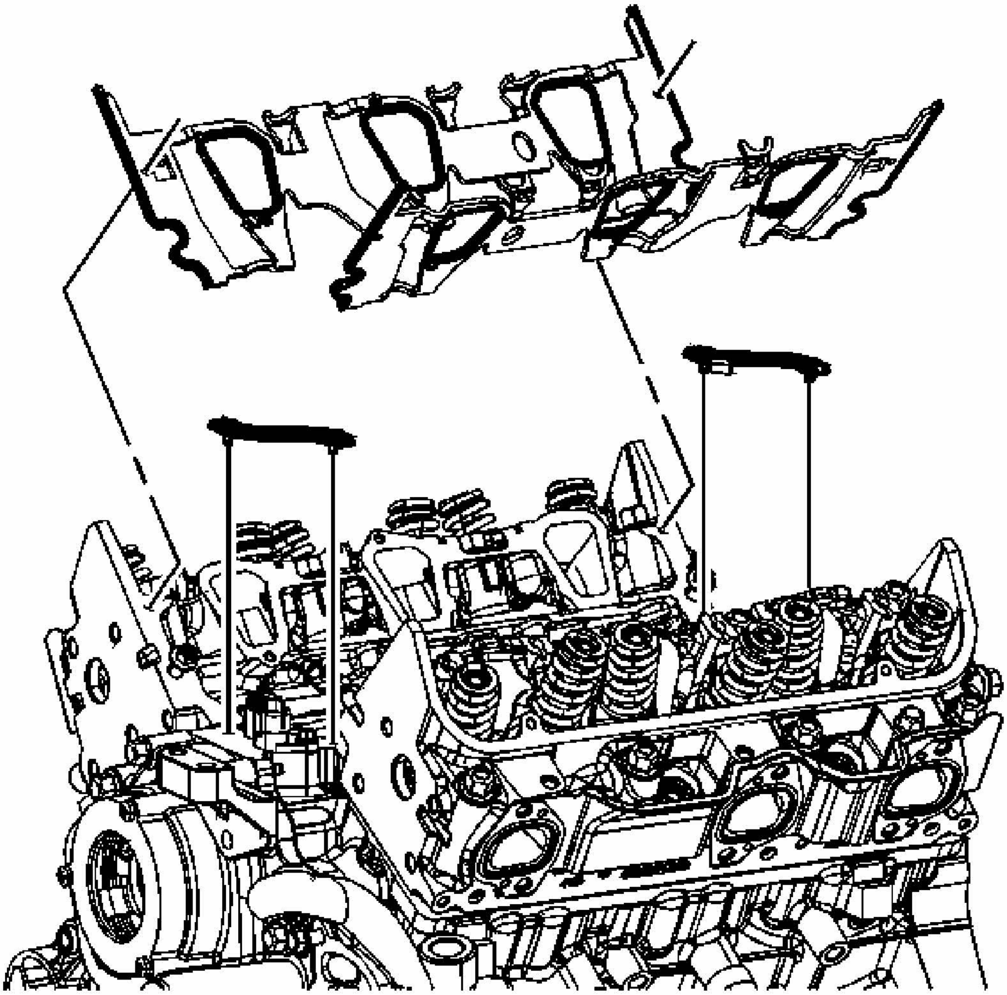


Fig. 78: Identifying Intake Manifold Gaskets & Seals
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: RTV sealer is NOT to be placed under the lower intake manifold gaskets.

1. Install the lower intake manifold gaskets and seals.

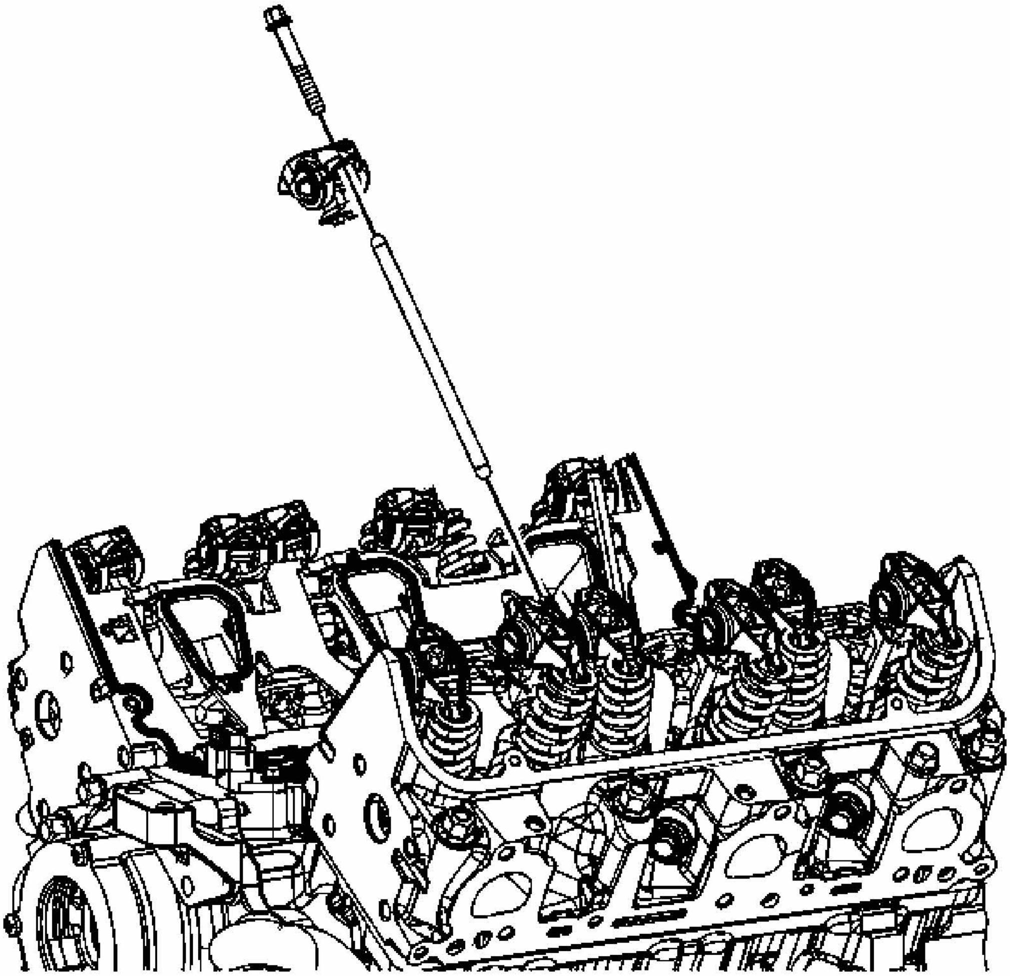


Fig. 79: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

2. Coat the ends of the push rods using prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent.

IMPORTANT: The intake valve push rods measure 146.0 mm (5.75 in) and the exhaust valve push rods measure 152.5 mm (6.0 in).

3. Install the push rods in their original location.
4. Coat the rocker arm friction surfaces using prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent.

IMPORTANT: Shims (P/N 88894006) may be required under the valve rocker arm pedestals if reconditioning has been performed on the cylinder head or its components.

5. Install the valve rocker arms in their original positions.

NOTE: Refer to Fastener Notice .

6. Install the valve rocker arm bolts.

Tighten: Tighten the bolts to 34 N.m (25 lb ft).

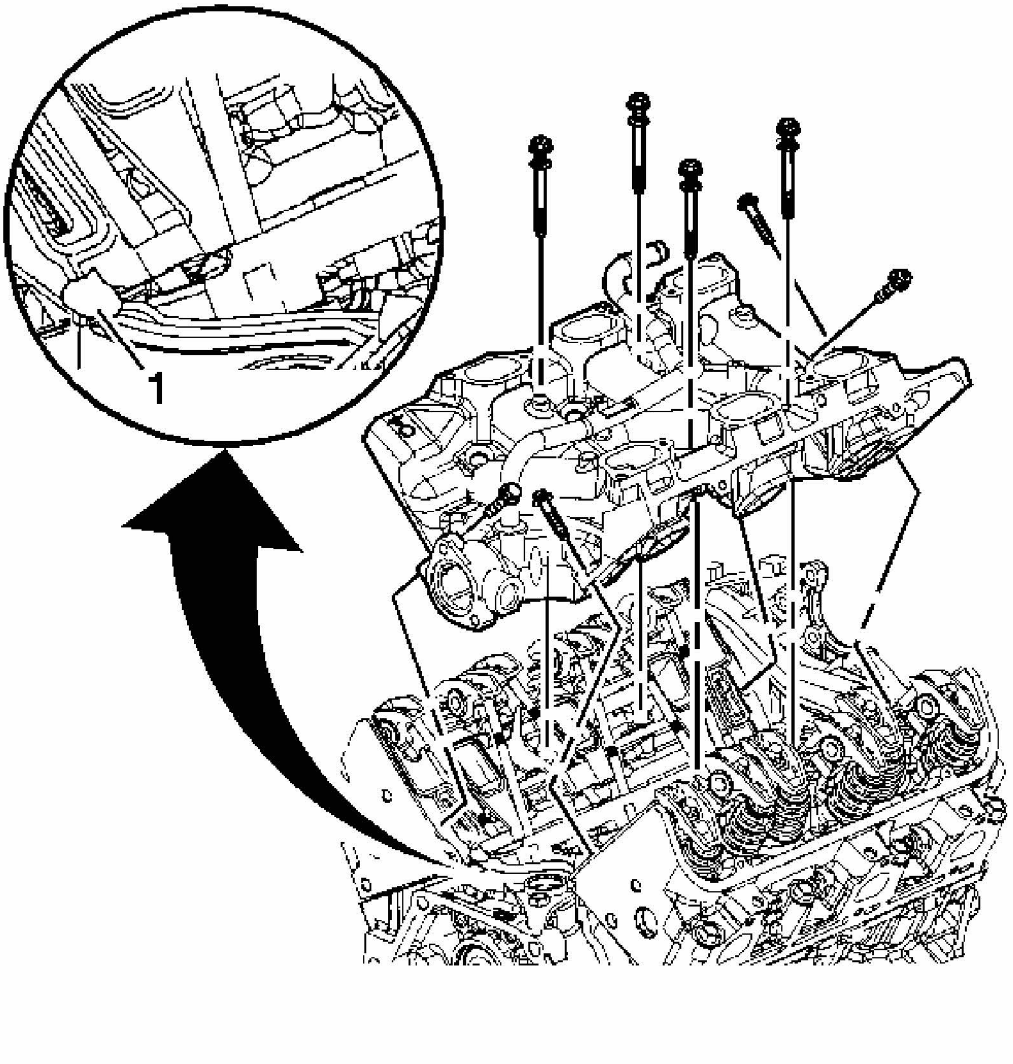


Fig. 80: View Of Lower Intake Manifold

Courtesy of GENERAL MOTORS CORP.

7. With the NEW gaskets and seals in place, apply a small drop, 8-10 mm (.031-0.39 in) of RTV sealer GM P/N 12378521 (Canadian P/N 88901148) or equivalent to the 4 corners of the intake manifold to engine block joints (1).
8. Install the lower intake manifold.

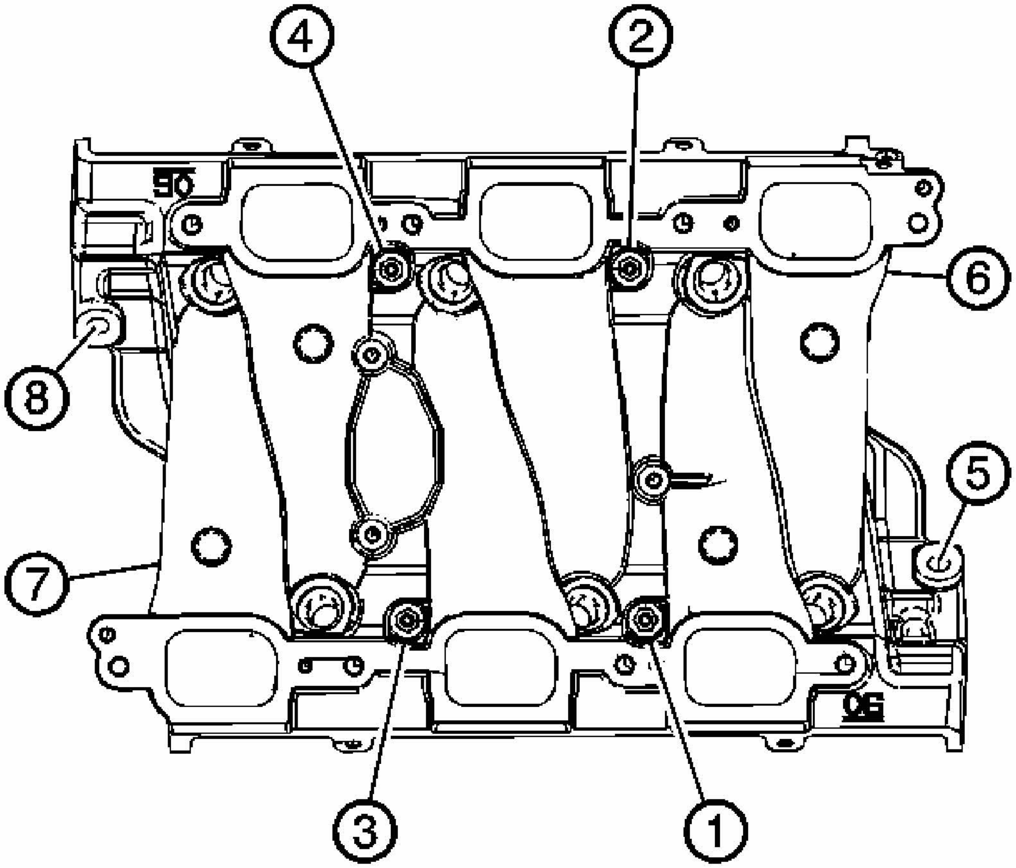


Fig. 81: Identifying Lower Intake Manifold Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.**

NOTE: Failure to tighten vertical bolts before the diagonal bolts may cause an oil leak.

9. Apply sealer GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the lower intake manifold bolt threads.
10. Install the lower intake manifold bolts.
11. Tighten the lower intake manifold bolts in the sequence shown.

    Tighten:

    1. Tighten the bolts (1, 2, 3, 4) in sequence to 16 N.m (12 lb ft).
    2. Tighten the bolts (5, 6, 7, 8) in sequence to 25 N.m (18 lb ft).

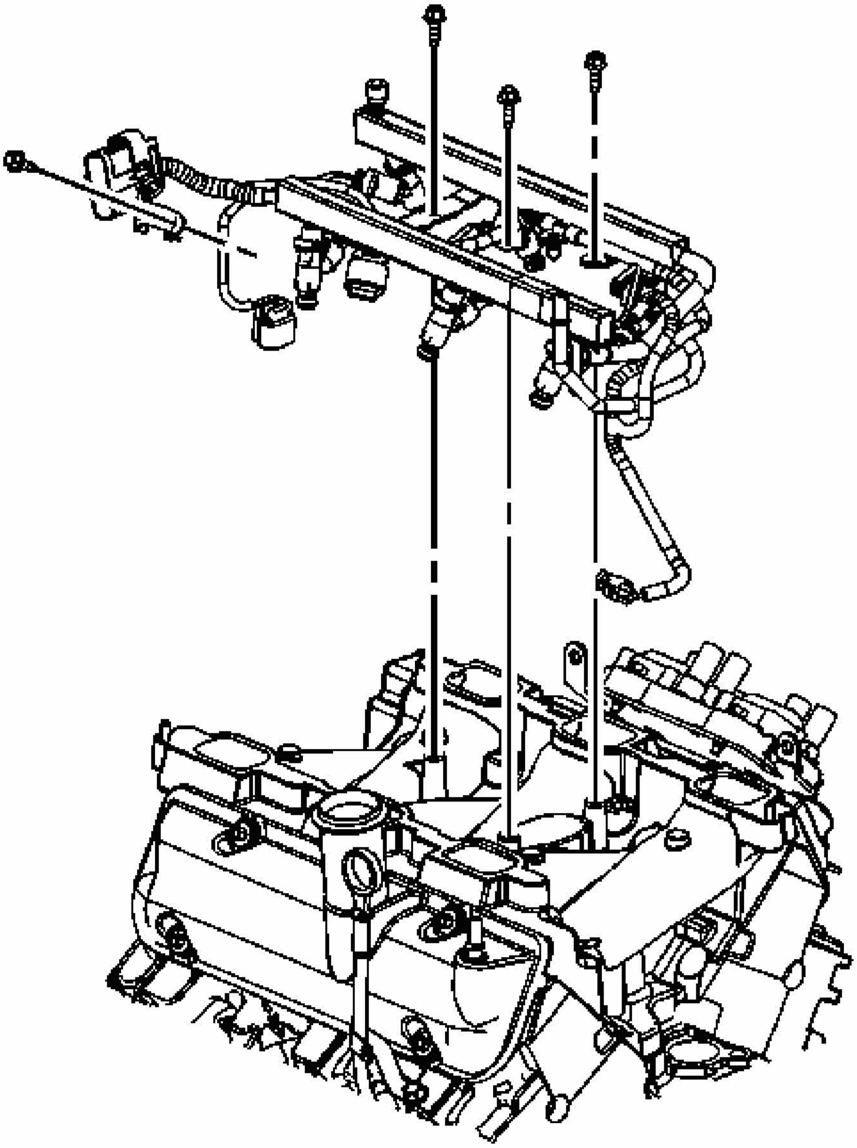


Fig. 82: View Of Fuel Rail Assembly & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

12. Inspect the fuel rail, fuel injectors and fuel injector O-rings for damage and replace, as necessary.
13. Lubricate the fuel injector O-rings using GM P/N 12345616 (Canadian P/N 993182).
14. Install the injector nozzles into the lower intake manifold injector bores.
15. Press on the injector rail using the palms of both hands until the injector are fully

seated.

16. Install the fuel injector rail bolts.

    Tighten: Tighten the bolts to 10 N.m (89 lb in).

17. Connect the CMP sensor electrical connector.
18. Connect the ECT electrical connector.
19. Position the fuel injector harness connector bracket to the intake manifold.
20. Install the fuel injector harness connector bracket bolt.

    Tighten: Tighten the bolt to 8 N.m (71 lb in).

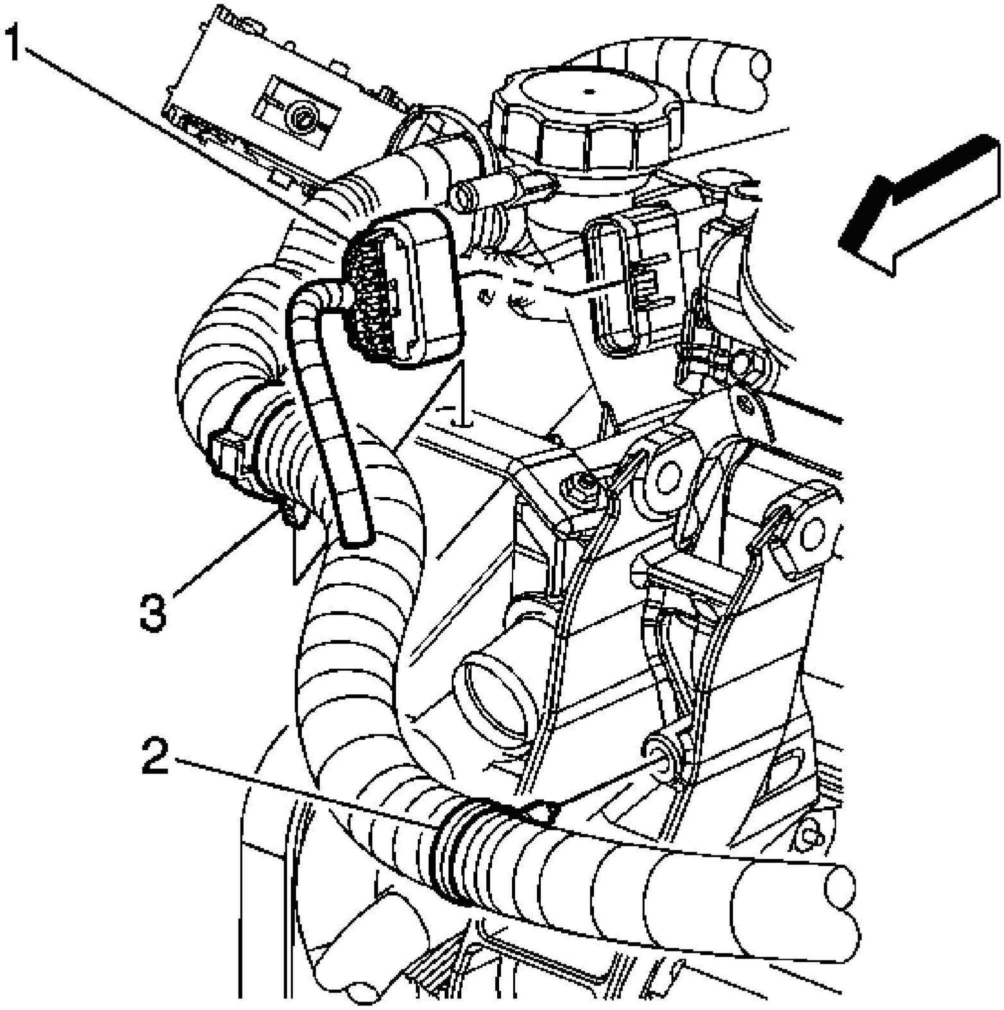


Fig. 83: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

21. Connect fuel injector inline connector.
22. Connect the fuel feed line to the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .
23. Install the right valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Right**.
24. Install the left valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Left**.
25. Install the upper intake manifold. Refer to **Intake Manifold Replacement - Upper**.
26. Connect the battery ground negative cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .

CRANKCASE VENTILATION HOSES/PIPES REPLACEMENT

Removal Procedure

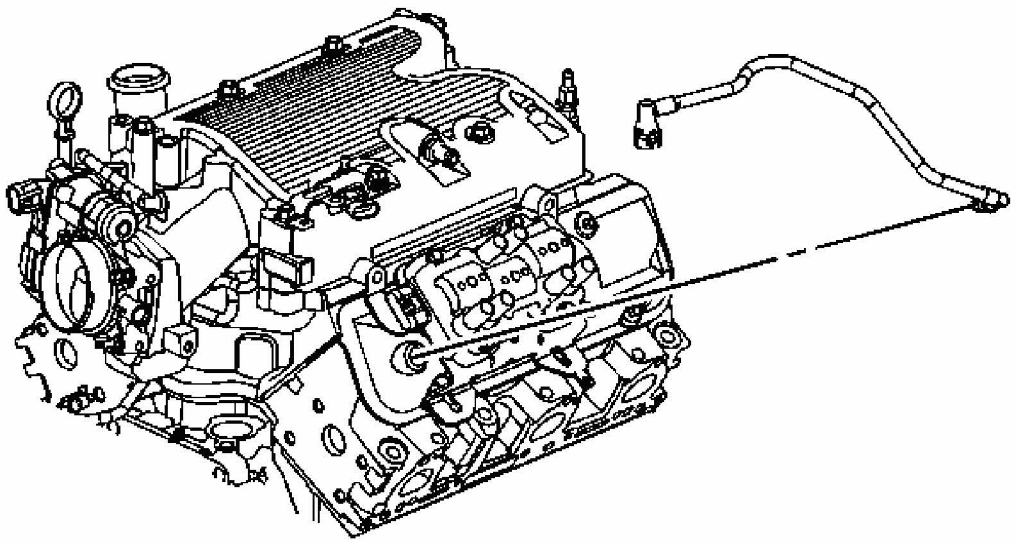


Fig. 84: View Of PCV Tube & Air Inlet Duct
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Disconnect the positive crankcase ventilation (PCV) fresh air tube from the air cleaner

outlet duct. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

3. Remove the PCV fresh air tube from the rocker arm cover.
4. Remove the PCV fresh air tube from the vehicle.

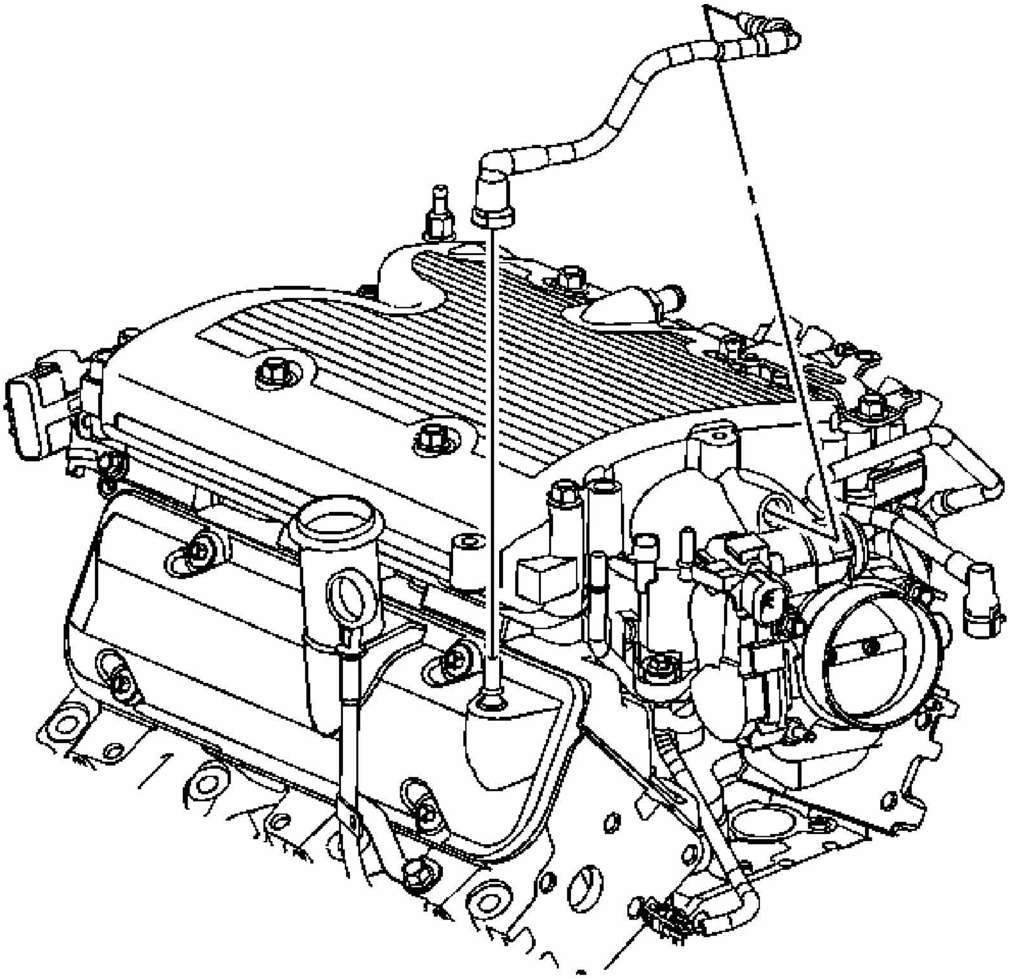


Fig. 85: Locating PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the PCV foul air tube from the PCV valve. Refer to **Quick Connect Fitting (s) Service (Plastic Collar)** .
6. Remove the PCV foul air tube from the intake manifold.
7. Remove the PCV foul air tube from the vehicle.

Installation Procedure

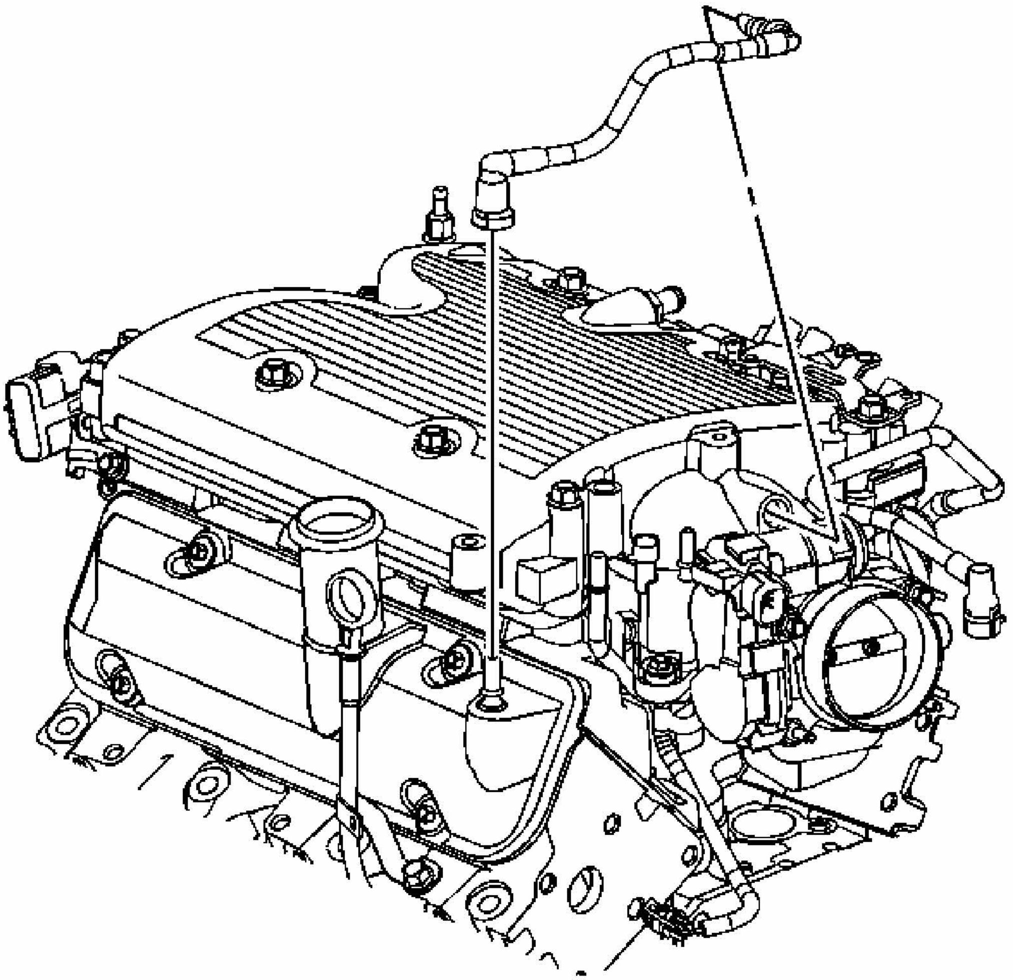


Fig. 86: Locating PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

1. Install the PCV foul air tube to the vehicle.
2. Install the PCV foul air tube to the intake manifold.
3. Connect the PCV foul air tube to the PCV valve. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

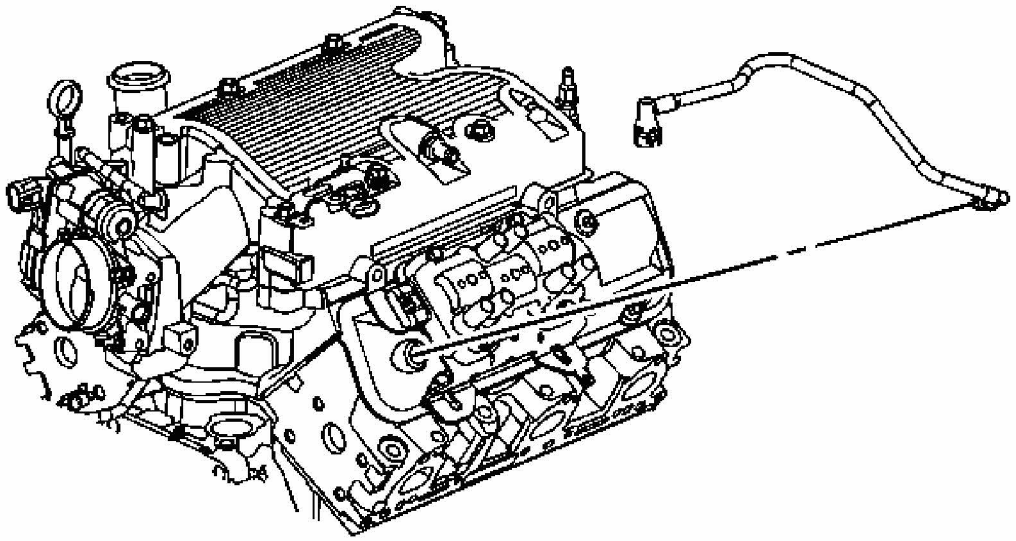


Fig. 87: View Of PCV Tube & Air Inlet Duct
Courtesy of GENERAL MOTORS CORP.

4. Install the PCV fresh air tube to the vehicle.
5. Install the PCV fresh air tube to the rocker arm cover.
6. Connect the PCV fresh air tube to the air cleaner outlet duct. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
7. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

VALVE ROCKER ARM COVER REPLACEMENT - LEFT

Removal Procedure

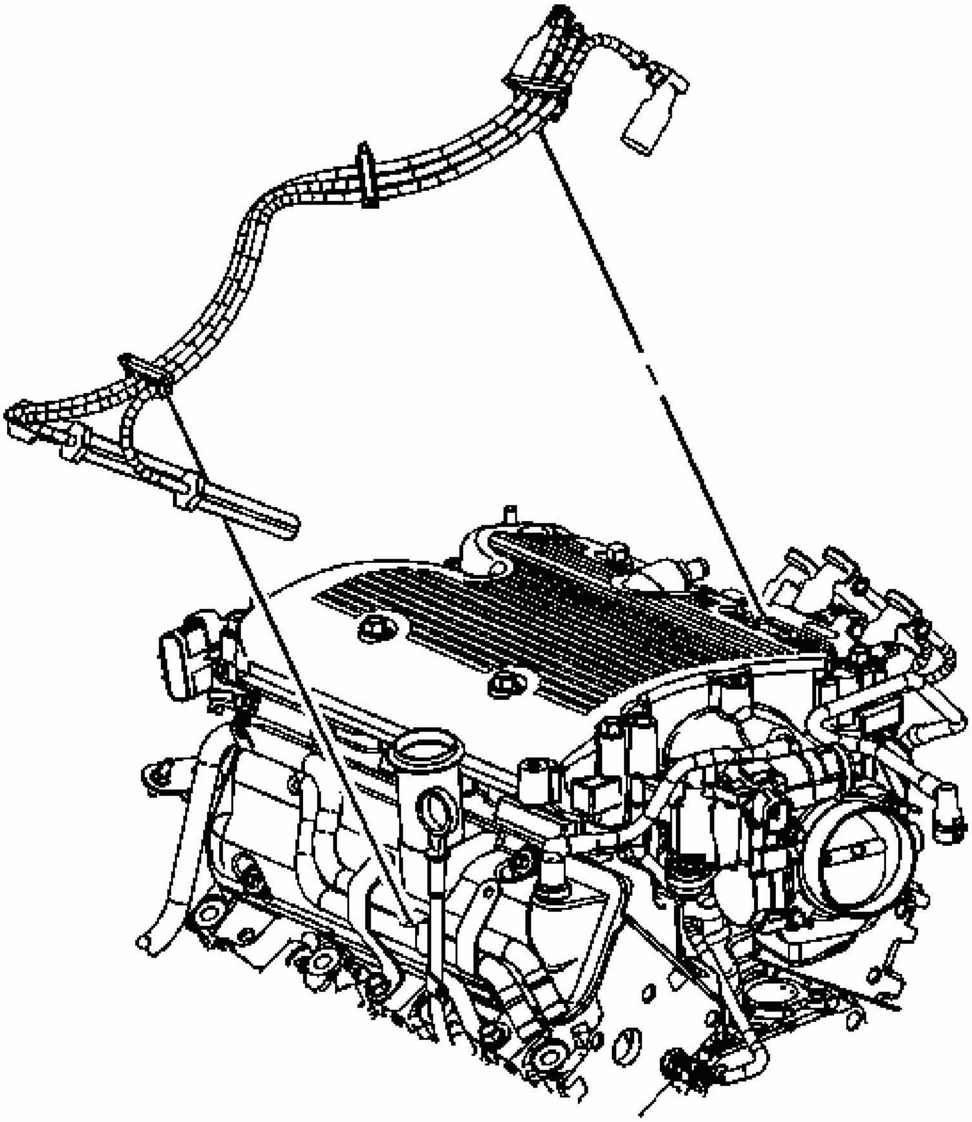


Fig. 88: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
2. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

3. Remove the oil level indicator tube. Refer to **Oil Level Indicator and Tube Replacement**.
4. Disconnect the left spark plug wires from the spark plugs.
5. Remove the spark plug wire harness clip from the heater inlet and outlet front pipe bracket.
6. Reposition the spark plug harness.

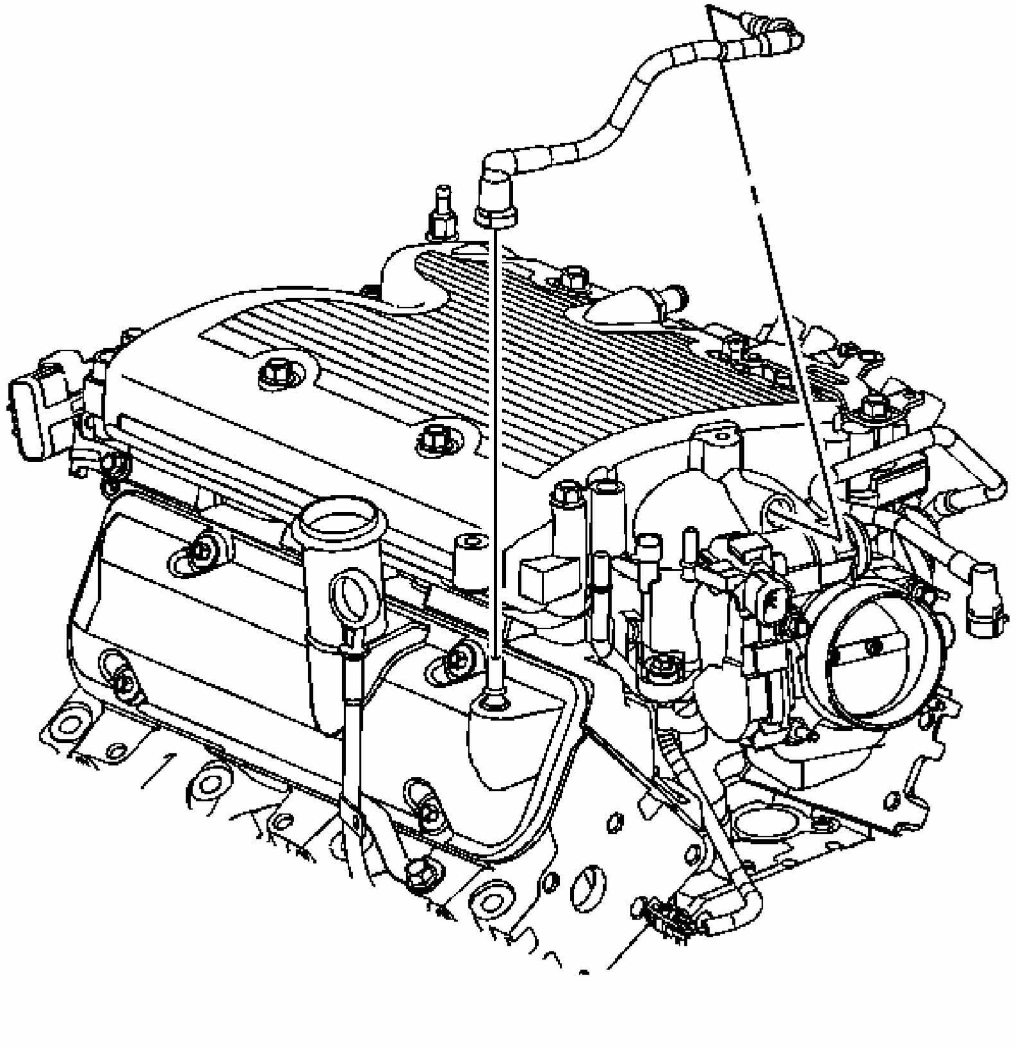


Fig. 89: Locating PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

7. Remove the positive crankcase ventilation (PCV) foul air tube. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
8. Remove the left engine mount strut bracket. Refer to **Engine Mount Strut Bracket**

Replacement - Left.

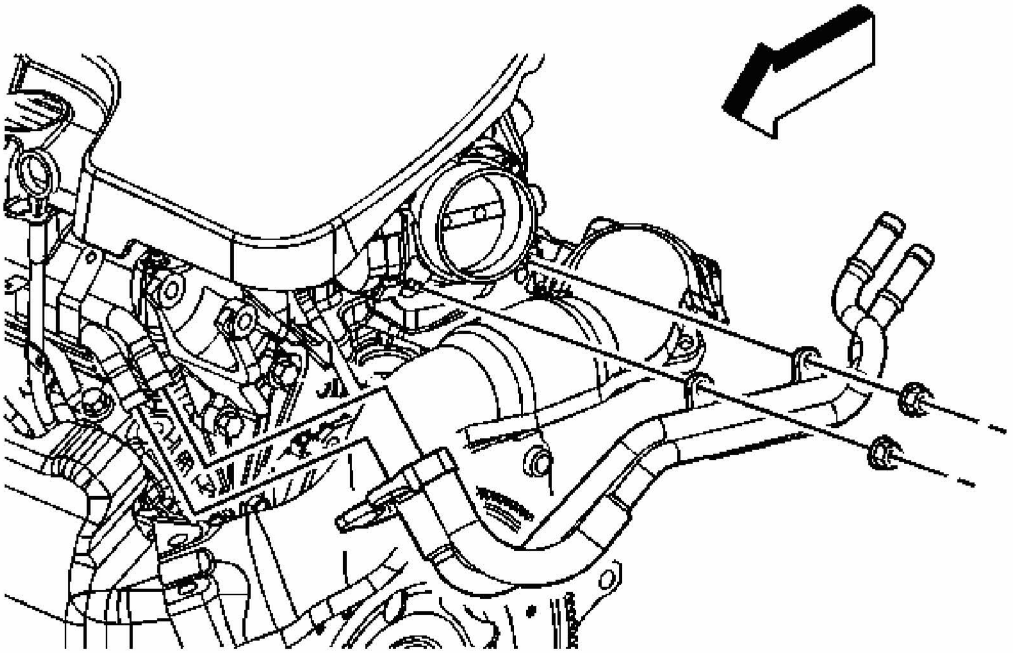


Fig. 90: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

9. Reposition the heater inlet and outlet hose/pipe clamps at the engine inlet and outer pipes.
10. Remove the heater inlet and outlet hose/pipe clip nuts at the throttle body.
11. Remove the heater inlet and outer hoses/pipes from the engine inlet and outlet pipes.
12. Remove the clips from the throttle body studs. Reposition the hose/pipe assembly.

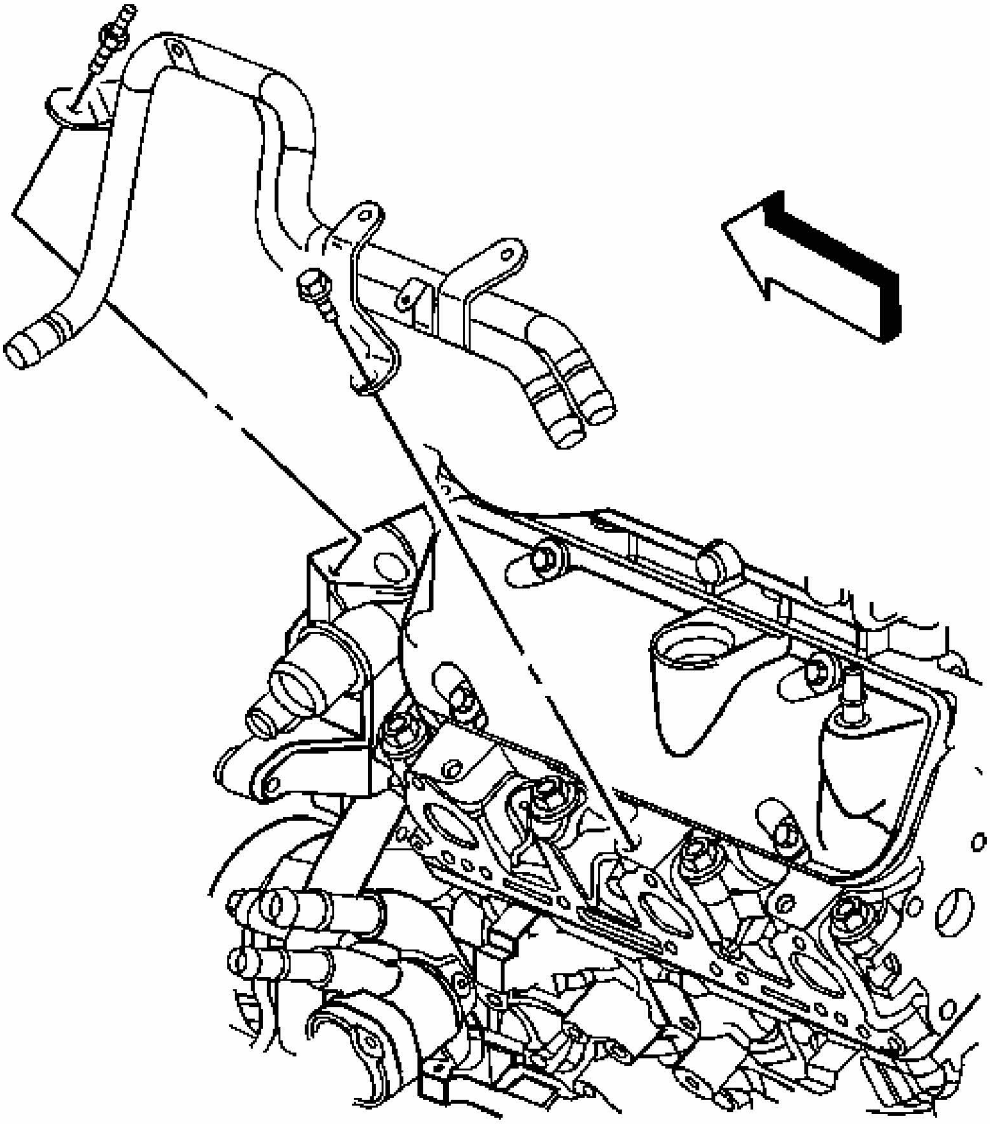


Fig. 91: Front Heater Outlet Hose & Outlet Heater Pipe
Courtesy of GENERAL MOTORS CORP.

13. Remove the front heater outlet hose from the outlet heater pipe.
14. Remove the heater inlet and outlet pipe bolt and stud.
15. Remove the heater inlet and outlet pipe from the vehicle.

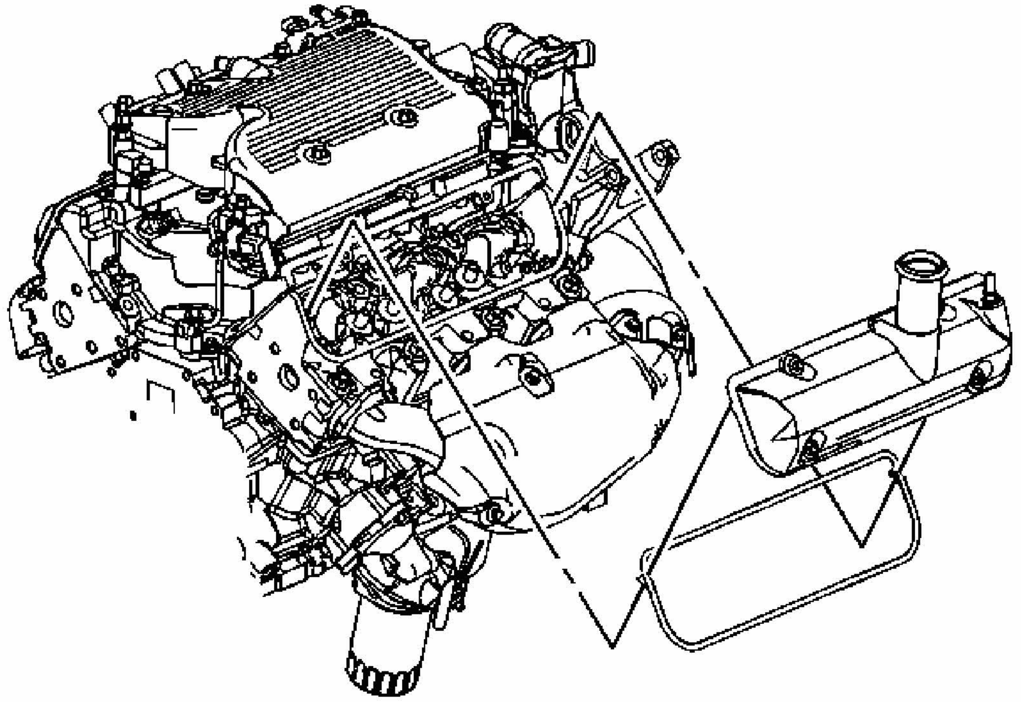


Fig. 92: Locating Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

16. Loosen the valve rocker arm cover bolts.

IMPORTANT: When removing the valve rocker arm cover, ensure the gasket stays in place attached to the cylinder head.

17. Remove the valve rocker arm cover. If necessary, bump the end of the cover with the palm of your hand or a soft rubber mallet if the cover adheres to the cylinder head.
18. Cut the RTV in the channel where the intake, cylinder head and valve rocker arm cover meet with a suitable tool.
19. Remove the valve cover gasket.
20. Clean the sealing surface on the cylinder head with degreaser.

Installation Procedure

IMPORTANT: All gasket mating surfaces need to be free of oil and foreign material. Use GM P/N 12346139 (Canadian P/N 10953463) or equivalent, to clean the surfaces.

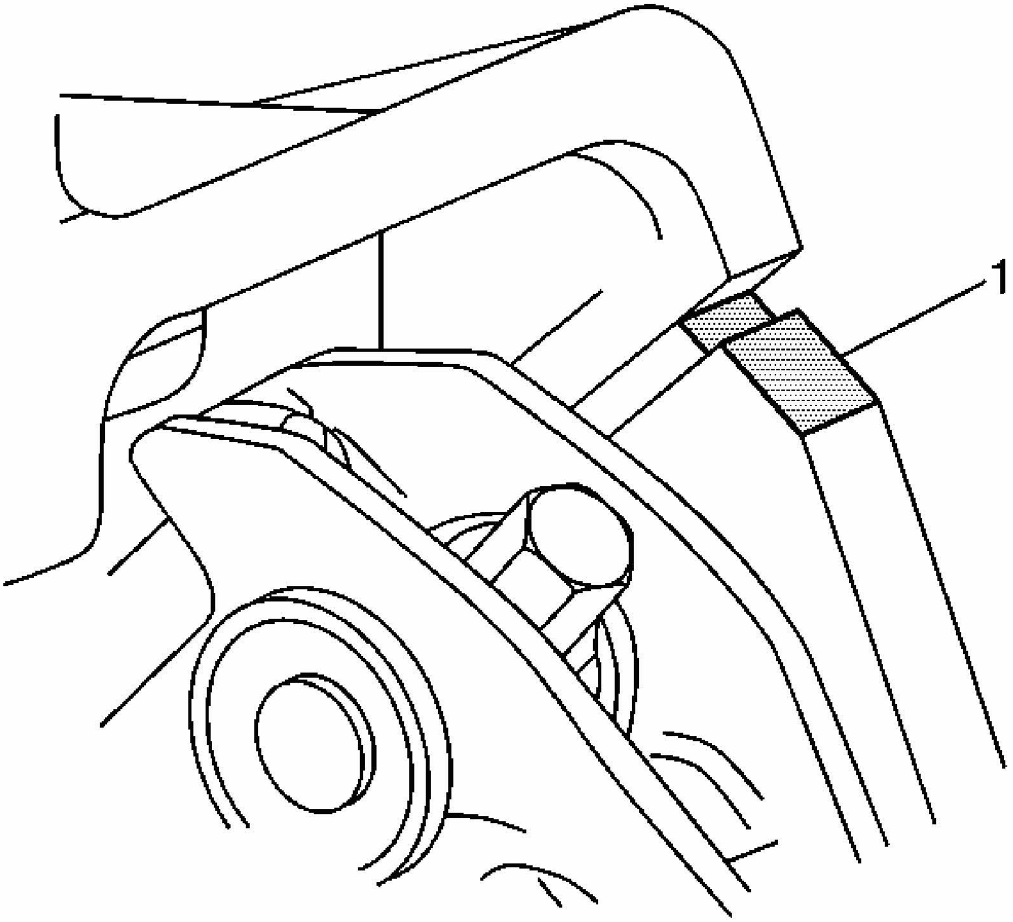


Fig. 93: Identifying Cylinder Head To Lower Intake Manifold Joint
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW valve rocker arm cover gasket into the groove in the valve rocker arm cover. Ensure that the gasket is properly seated in the groove of the valve rocker arm cover.
2. Apply sealant GM P/N 12378521 (Canadian P/N 88901148) or equivalent, at the cylinder head to the surfaces where the cylinder head and intake manifold meet (1).

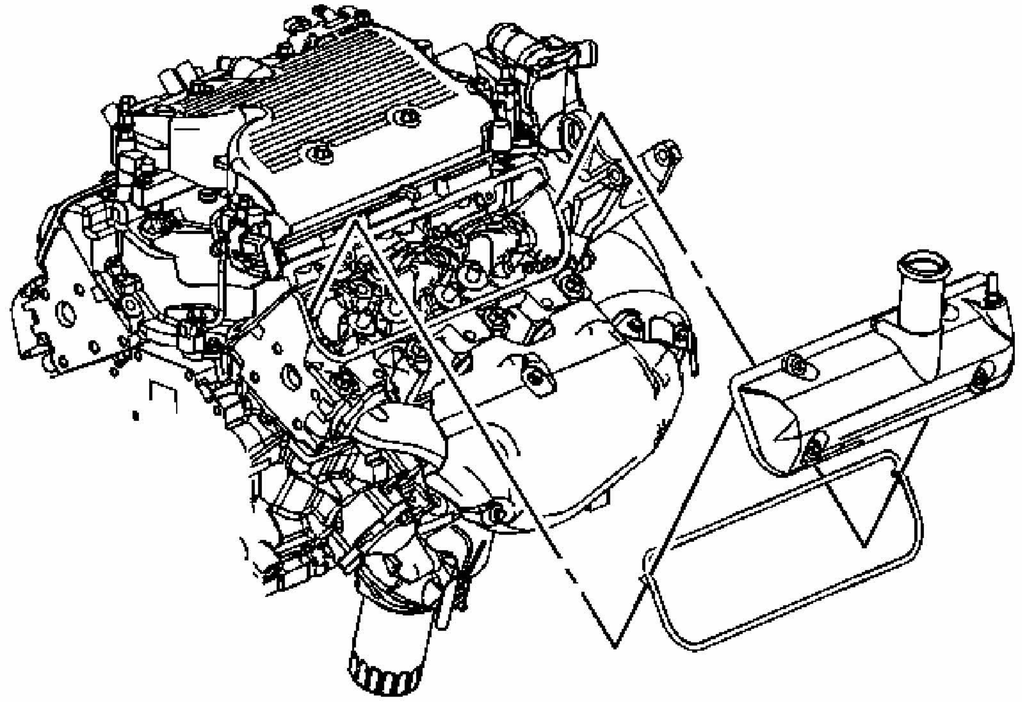


Fig. 94: Locating Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

3. Install the valve rocker arm cover.

NOTE: **Refer to Fastener Notice .**

IMPORTANT: **Use an alternating criss-cross pattern when tightening the valve rocker cover bolts. Failure to do so may result in oil leakage from the valve cover due to improper seating of the gasket.**

4. Tighten the valve rocker arm cover bolts.

Tighten: Tighten the bolts to 10 N.m (89 lb in).

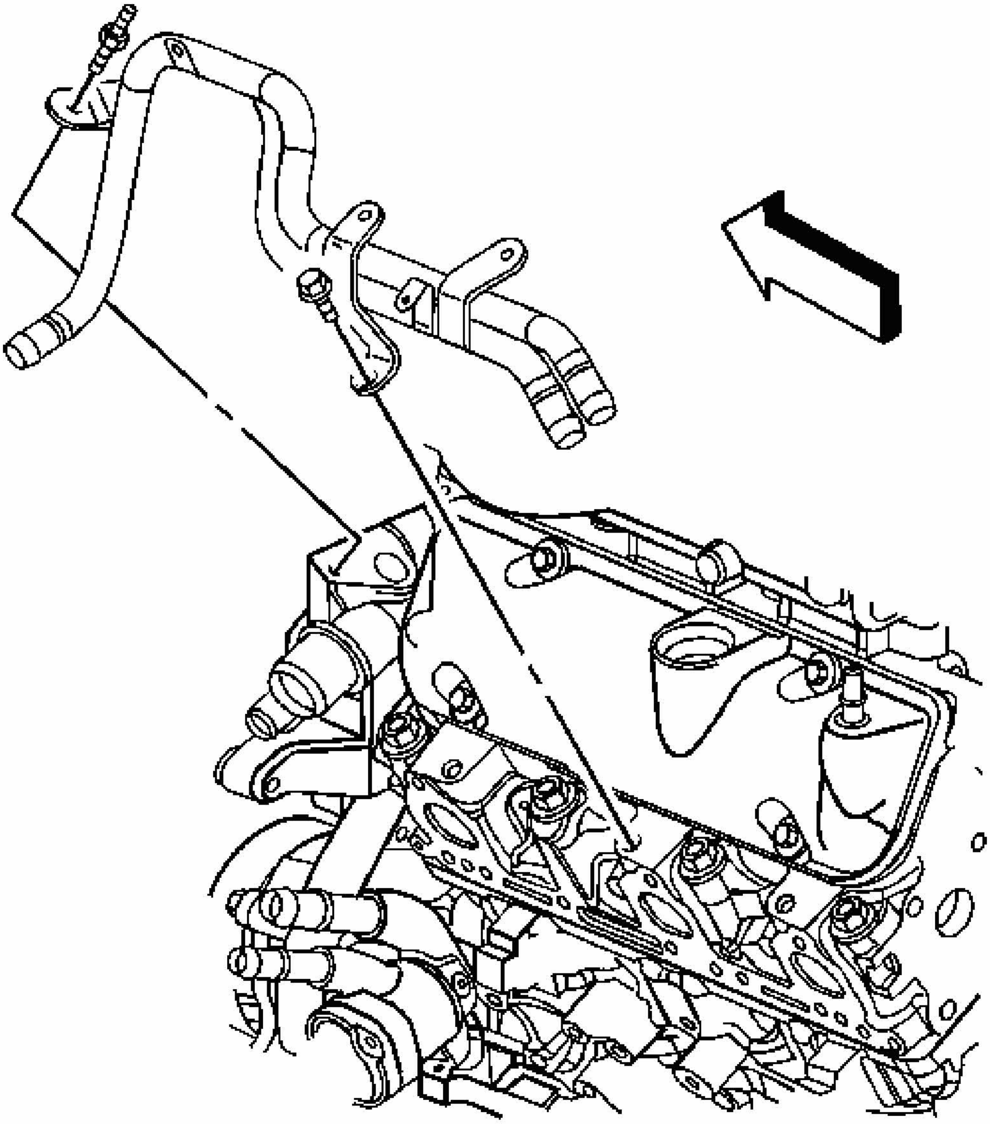


Fig. 95: Locating Heater Inlet And Outlet Pipe To The Vehicle
Courtesy of GENERAL MOTORS CORP.

5. Install the heater inlet and outlet pipe to the vehicle.
6. Install the heater inlet and outlet pipe bolt and stud.

Tighten:

- Tighten the bolt to 25 N.m (18 lb ft).
- Tighten the stud to 10 N.m (89 lb in).

7. Install the front heater outlet hose to the outlet heater pipe.

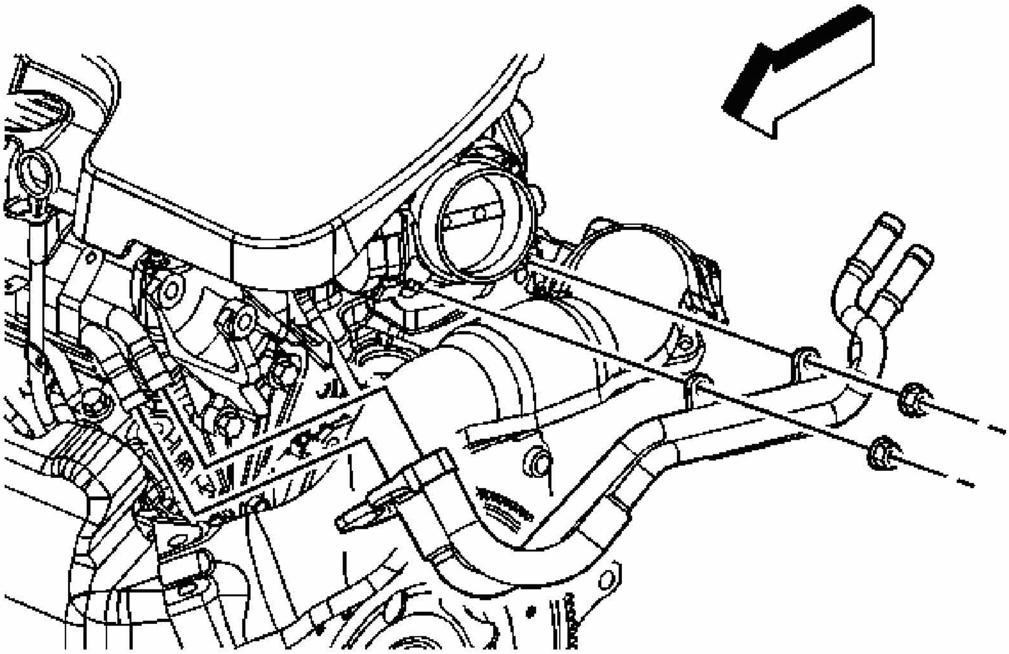


Fig. 96: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

8. Position the hose/pipe assembly. Install the clips to the throttle body studs.
9. Install the heater inlet and outer hoses/pipes to the engine inlet and outlet pipes.
10. Install the heater inlet and outlet hose/pipe clip nuts at the throttle body.

    Tighten: Tighten the nuts to 10 N.m (89 lb in).

11. Position the heater inlet and outlet hose/pipe clamps at the engine inlet and outer pipes.
12. Install the left engine mount strut bracket. Refer to **Engine Mount Strut Bracket Replacement - Left**.

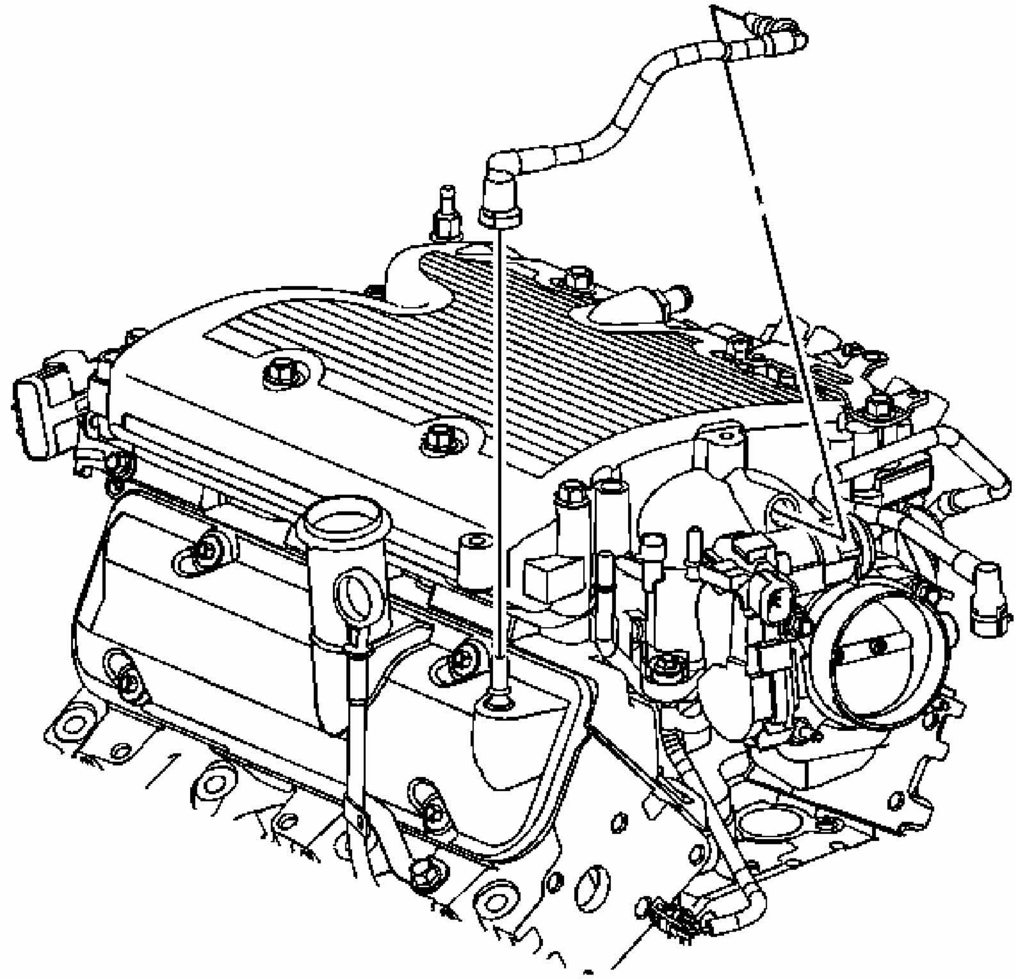


Fig. 97: Locating PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

13. Install the PCV foul air tube. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

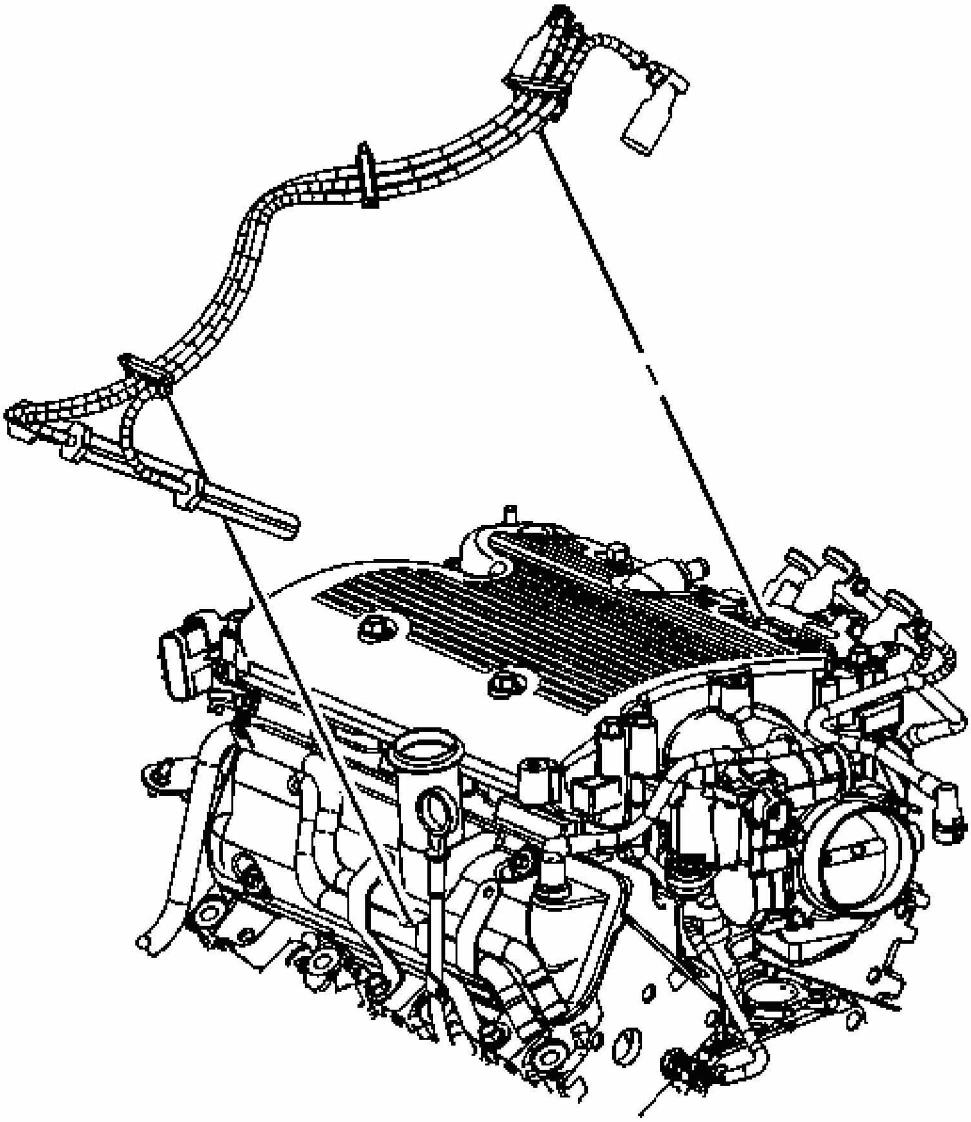


Fig. 98: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

14. Position the spark plug harness.
15. Install the spark plug wire harness clip to the heater inlet and outlet front pipe bracket.
16. Connect the left spark plug wires to the spark plugs.
17. Install the oil level indicator tube. Refer to **Oil Level Indicator and Tube Replacement**.
18. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

19. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

VALVE ROCKER ARM COVER REPLACEMENT - RIGHT

Removal Procedure

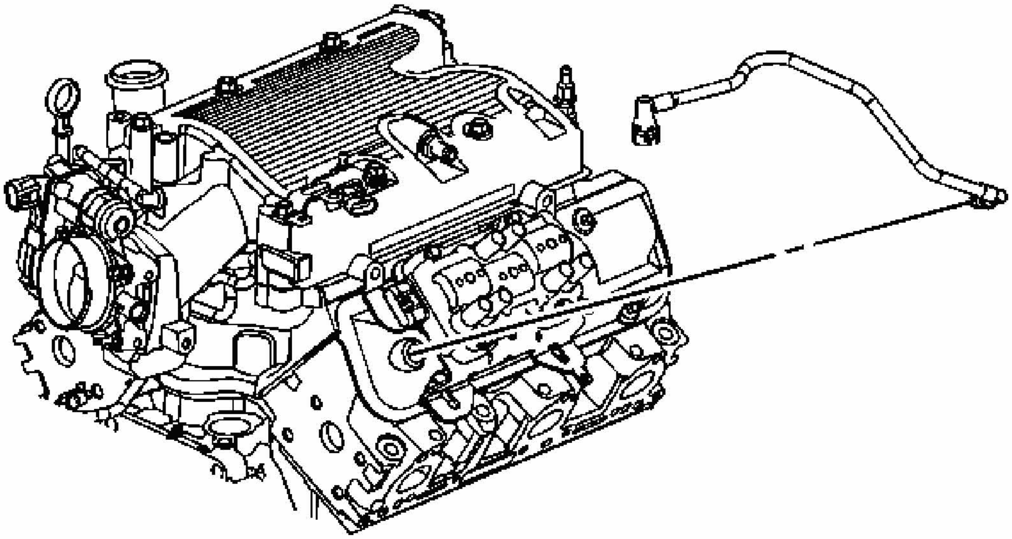


Fig. 99: View Of PCV Tube & Air Inlet Duct
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** .
2. Disconnect the positive crankcase ventilation (PCV) fresh air tube from the air cleaner outlet duct. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
3. Remove the PCV fresh air tube from the right side valve rocker arm cover.

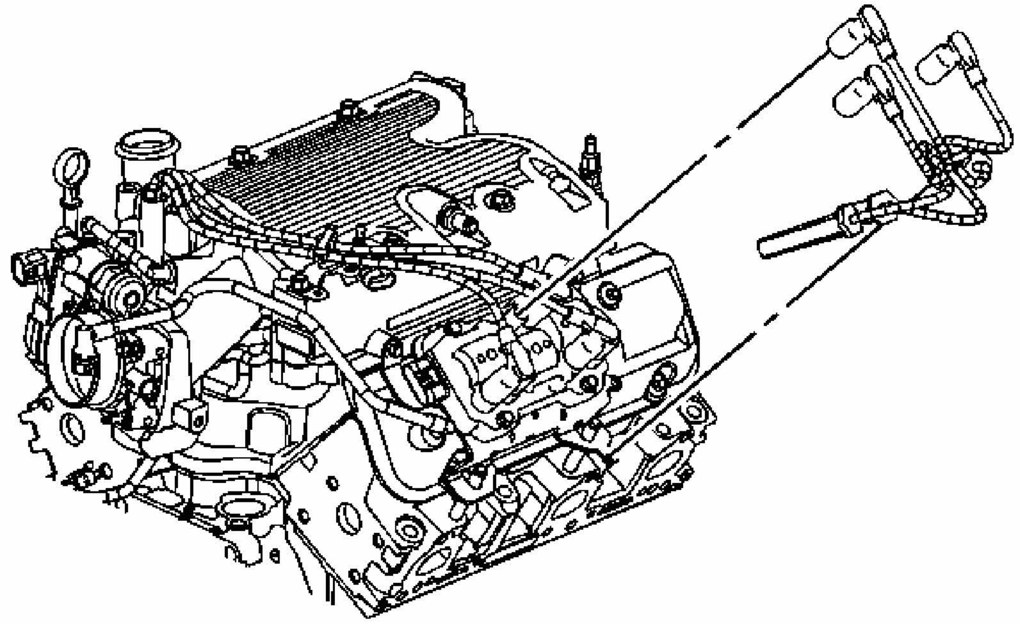


Fig. 100: Locating Right Side Spark Plug Wires & Ignition Coil
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the right side spark plug wires from the spark plugs.
5. Disconnect the right side spark plug wires from the ignition coil.
6. Remove the right side spark plug harness clip from the ignition coil bracket.
7. Remove the spark plug harness.

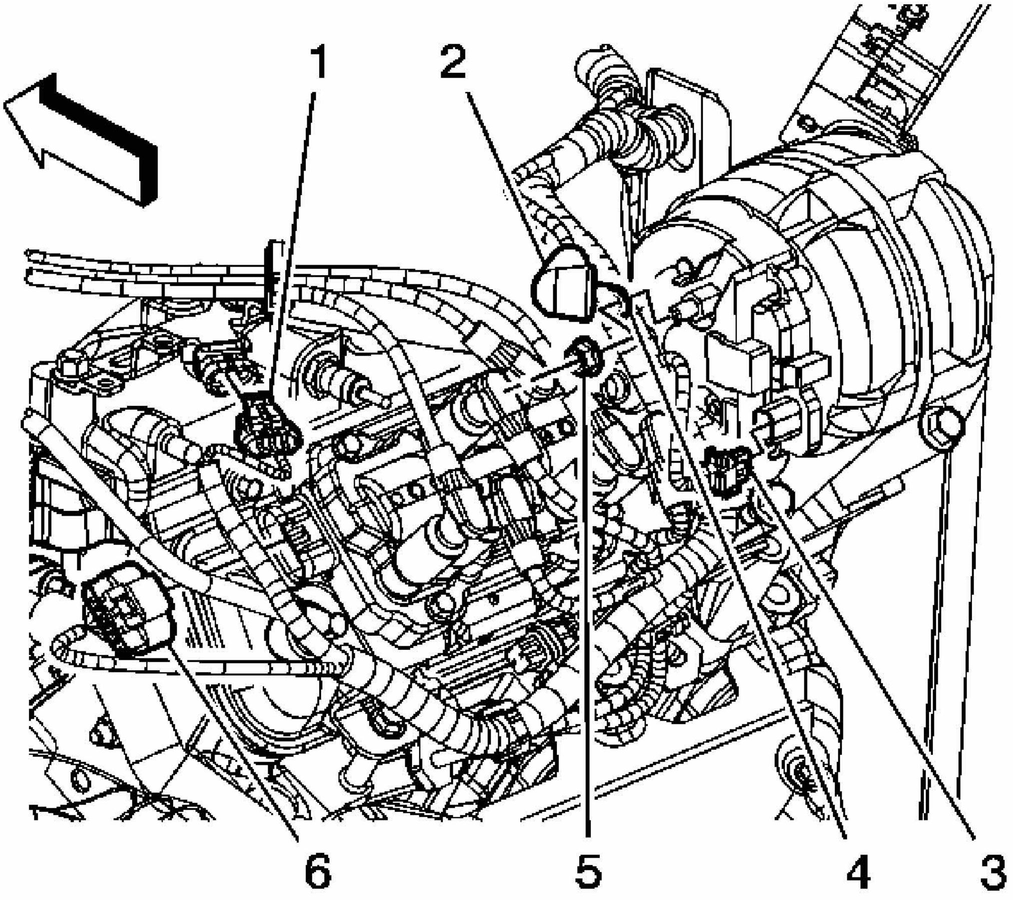


Fig. 101: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).
9. Disconnect the ignition coil electrical connector (6).
10. Remove the engine harness clip from the ignition coil bracket.

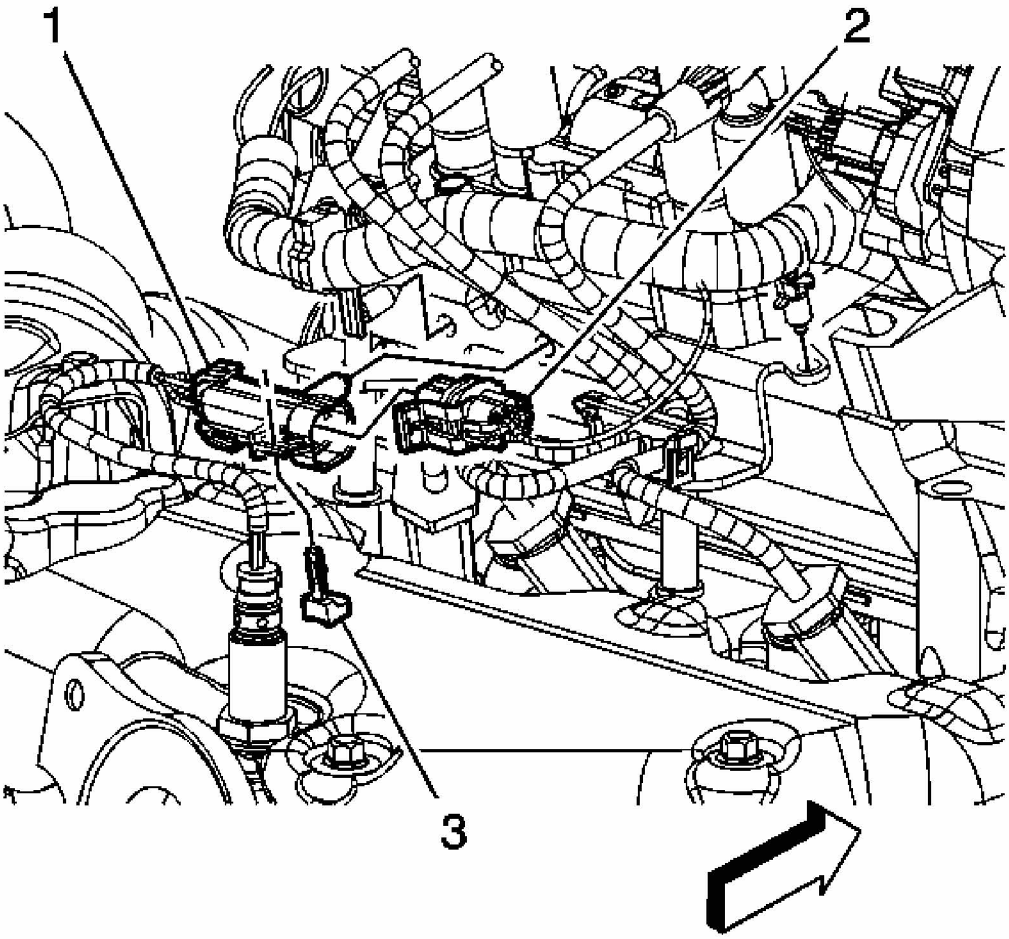


Fig. 102: Locating Heated Oxygen Sensor Electrical Connector Clip (1) & Ignition Coil Bracket
Courtesy of GENERAL MOTORS CORP.

11. Remove the heated oxygen sensor (HO2S) electrical connector clip (1) from the ignition coil bracket.

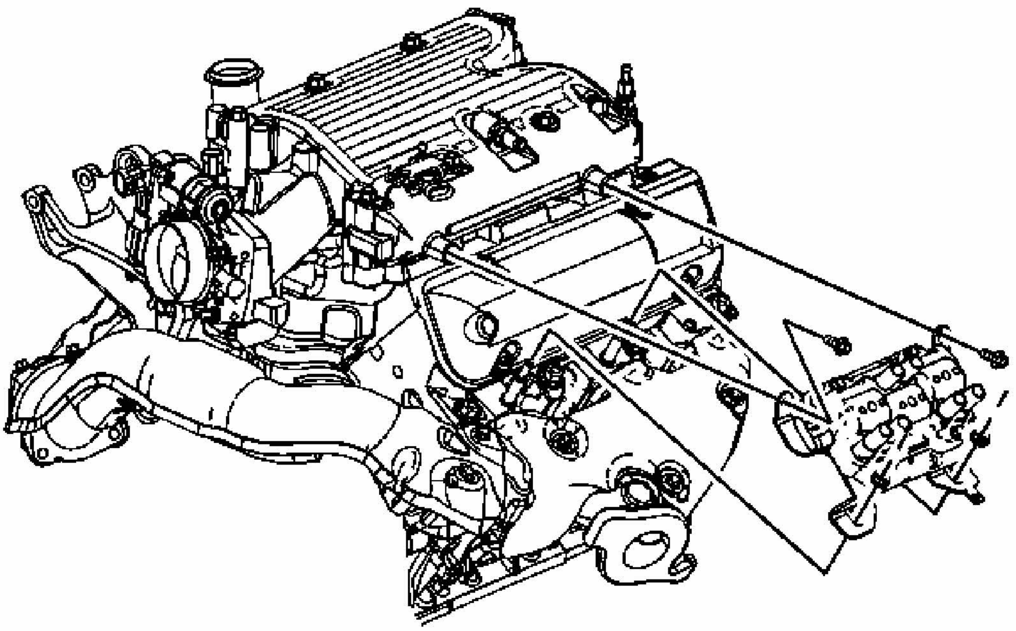


Fig. 103: Ignition Coil Bracket Nuts
Courtesy of GENERAL MOTORS CORP.

12. Remove the ignition coil bracket nuts.
13. Remove the ignition coil bracket bolts.
14. Remove the ignition coil.

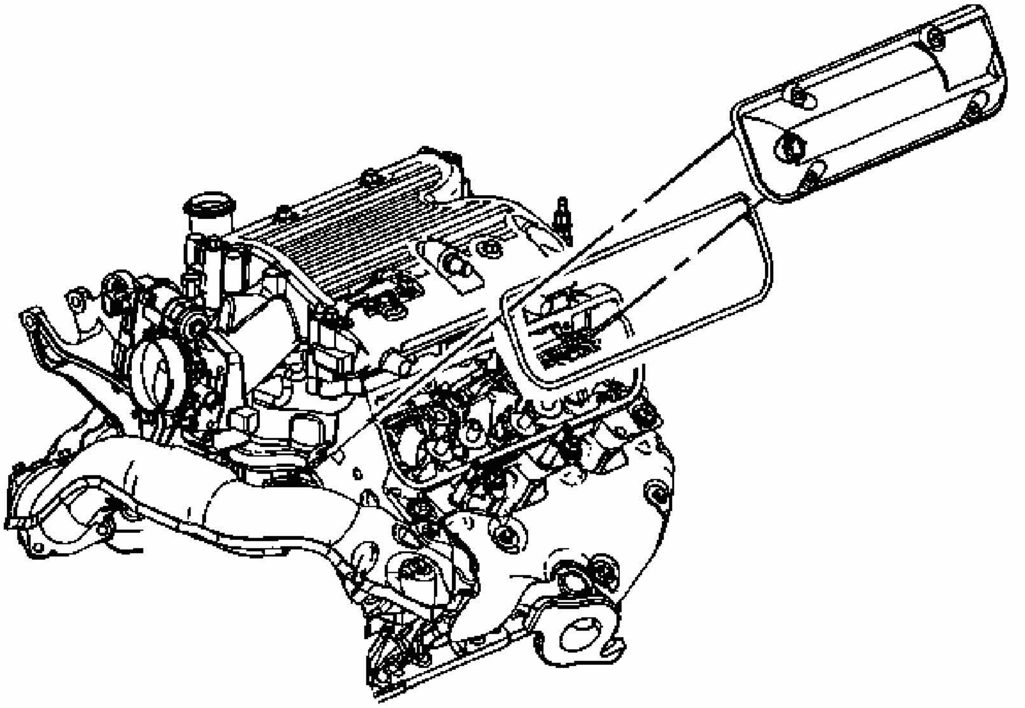


Fig. 104: View Of Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

15. Loosen the valve rocker arm cover bolts.

IMPORTANT: When removing the valve rocker arm cover, ensure the gasket stays in place attached to the cylinder head.

16. Remove the valve rocker arm cover. Bump the end of the cover with the palm of your hand or a soft rubber mallet if the cover adheres to the cylinder head.
17. Cut the room temperature vulcanizing (RTV) sealer in the channel where the intake, cylinder head and valve rocker arm cover meet with a suitable tool.
18. Remove the valve cover gasket.
19. Clean the sealing surface on the cylinder head with degreaser.

Installation Procedure

IMPORTANT: All gasket mating surfaces need to be free of oil and foreign material. Use GM P/N 12346139 (Canadian P/N 10953463) or equivalent, to clean the surfaces.

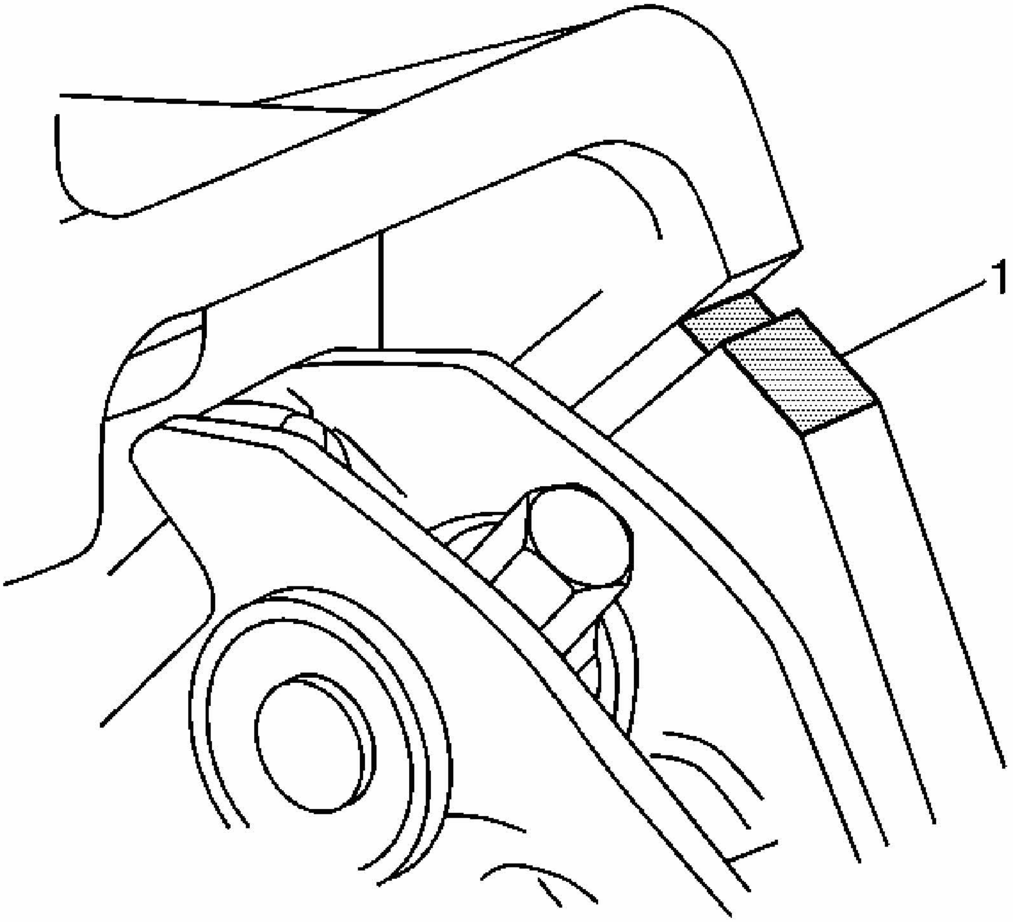


Fig. 105: Identifying Cylinder Head To Lower Intake Manifold Joint
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW valve rocker arm cover gasket into the groove in the valve rocker arm cover. Ensure that the gasket is properly seated in the groove of the valve rocker arm cover.
2. Apply sealant GM P/N 12378521 (Canadian P/N 88901148) or equivalent, at the cylinder head to the surfaces where the cylinder head and intake manifold meet (1).

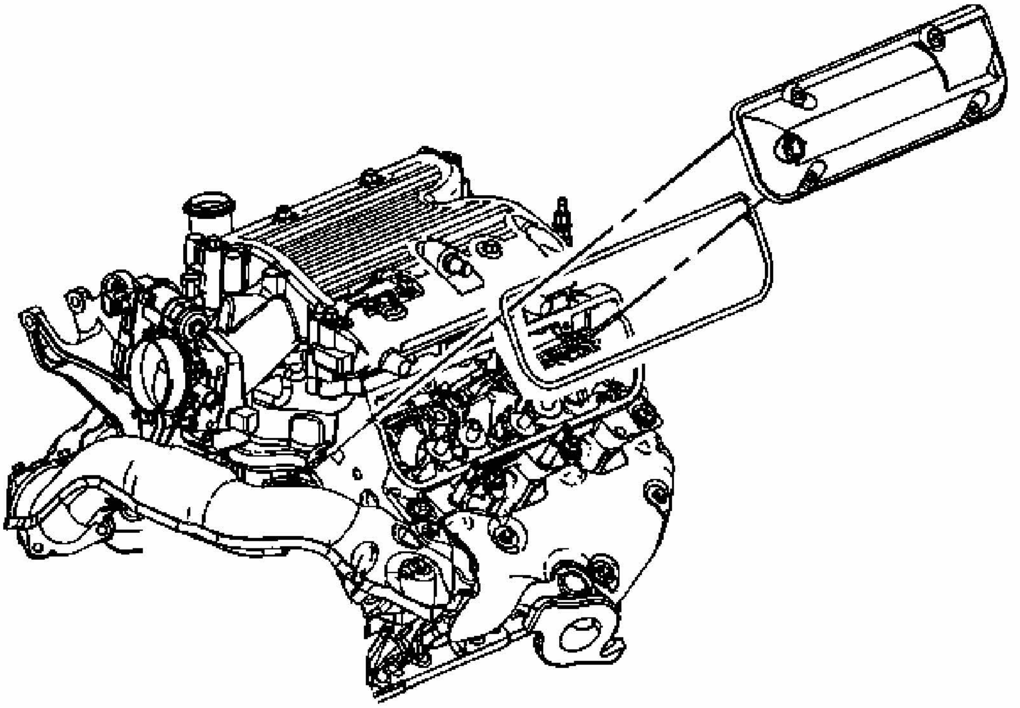


Fig. 106: View Of Valve Rocker Arm Cover & Gasket
Courtesy of GENERAL MOTORS CORP.

3. Install a new gasket to the valve rocker arm cover. Ensure that the gasket is properly seated in the groove of the valve rocker arm cover.
4. Install the right valve rocker arm cover.

NOTE: **Refer to Fastener Notice .**

IMPORTANT: **Use an alternating criss-cross pattern when tightening the valve rocker cover bolts. Failure to do so may result in oil leakage from the valve cover due to improper seating of the gasket.**

5. Tighten the valve rocker arm cover bolts.

Tighten: Tighten the bolts to 10 N.m (89 lb in).

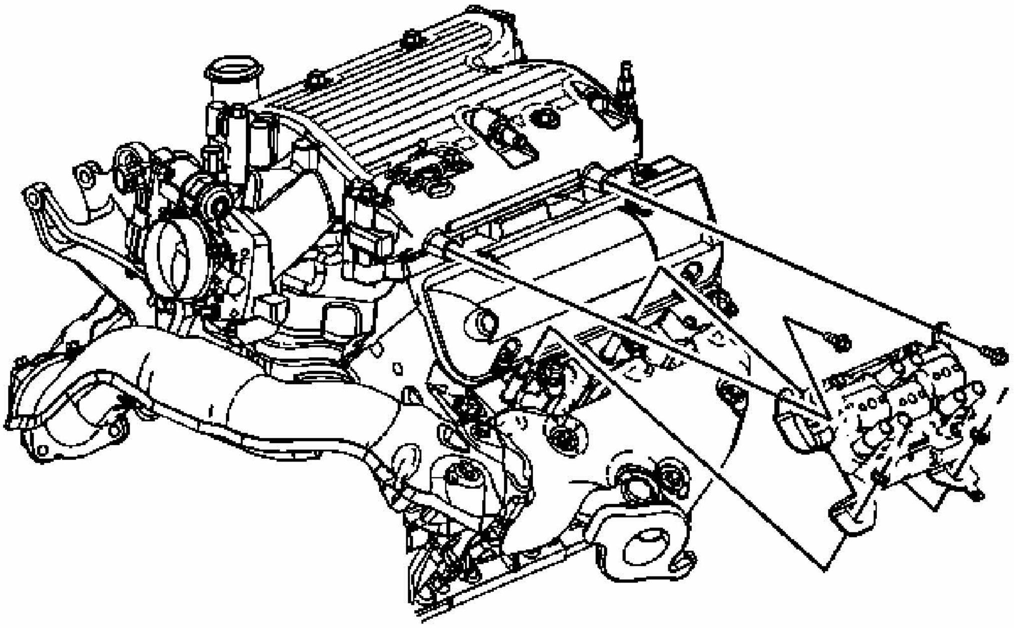


Fig. 107: View Of Ignition Coil
Courtesy of GENERAL MOTORS CORP.

6. Install the ignition coil.
7. Install the ignition coil bracket bolts.
8. Install the ignition coil bracket nuts.

   Tighten: Tighten the bolts/nuts to 25 N.m (18 lb ft).

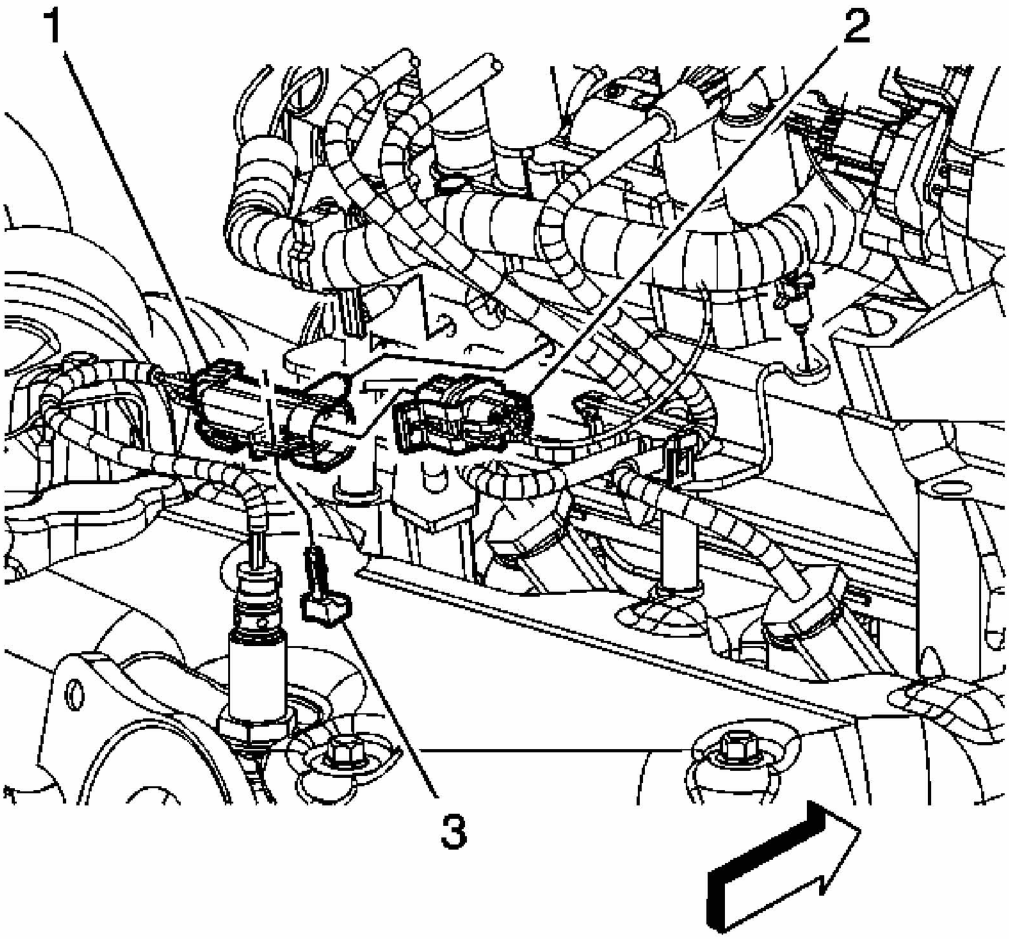


Fig. 108: View Of HO2S Electrical Connector Clip (1) & Ignition Coil Bracket
Courtesy of GENERAL MOTORS CORP.

9. Install the HO2S electrical connector clip (1) to the ignition coil bracket.

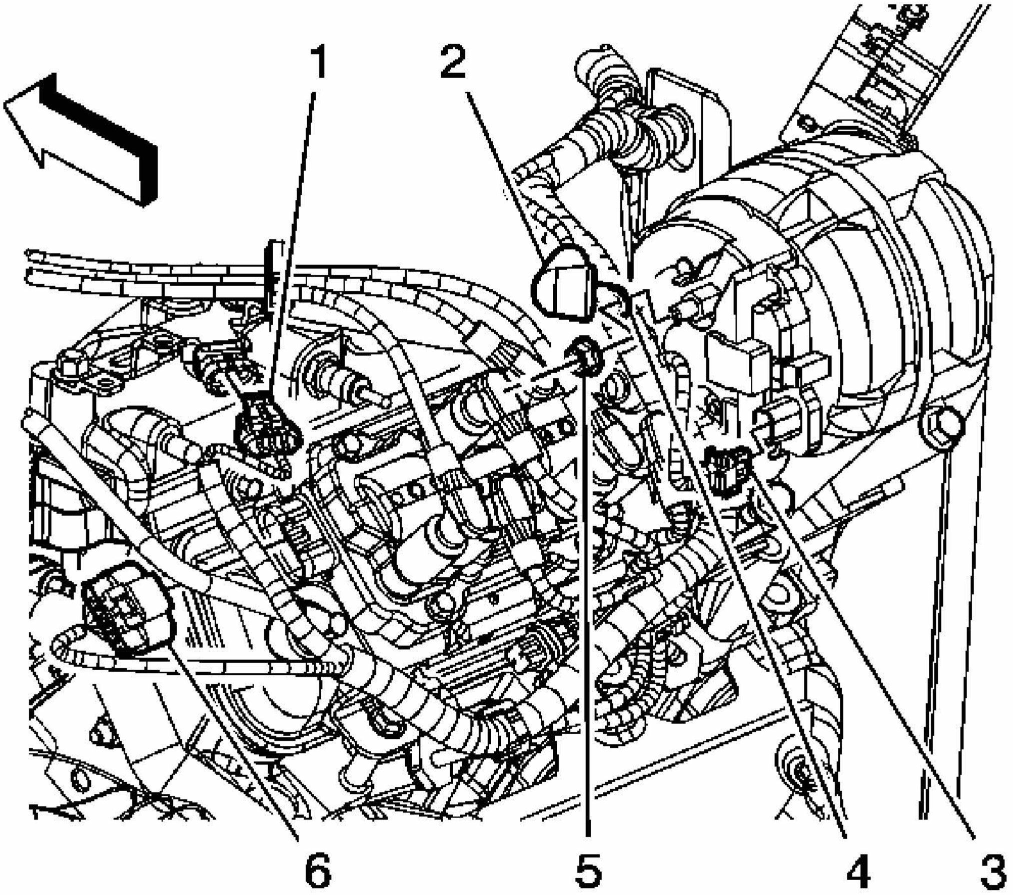


Fig. 109: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

10. Install the engine harness clip to the ignition coil bracket.
11. Connect the ignition coil electrical connector (6).
12. Connect the MAP sensor electrical connector (1).

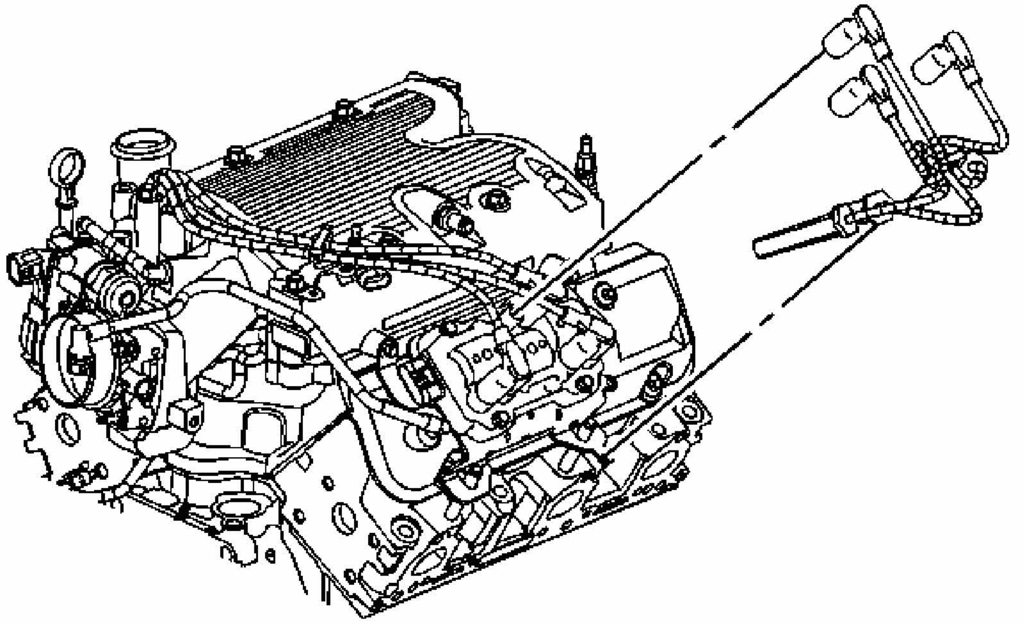


Fig. 110: Locating Right Side Spark Plug Wires & Ignition Coil
Courtesy of GENERAL MOTORS CORP.

13. Install the spark plug harness.
14. Connect the right side spark plug wires to the spark plugs.
15. Connect the right side spark plug wires to the ignition coil.
16. Install the right side spark plug harness clip to the ignition coil bracket.

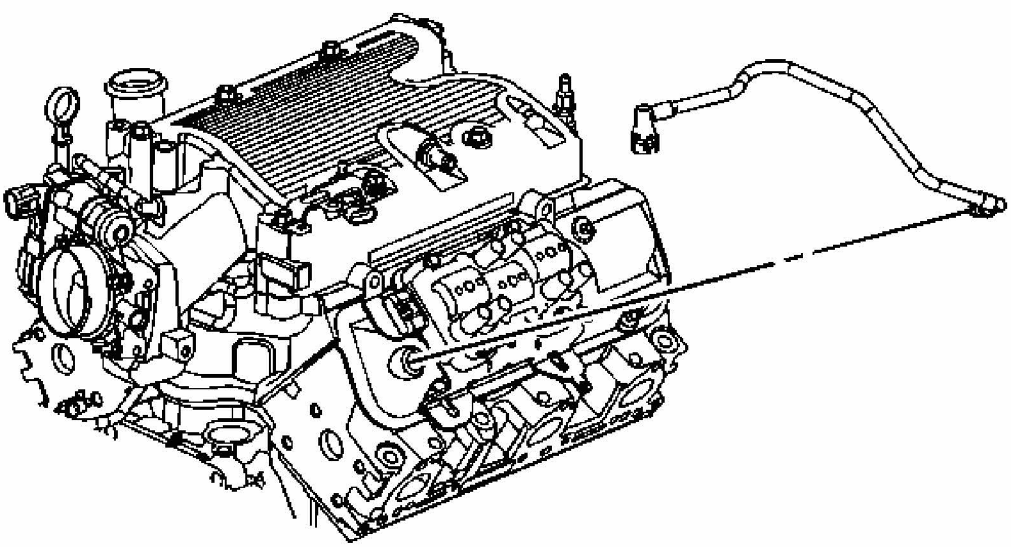


Fig. 111: View Of PCV Tube & Air Inlet Duct
Courtesy of GENERAL MOTORS CORP.

17. Install the PCV fresh air tube to the right side valve rocker arm cover.
18. Connect the PCV fresh air tube to the air cleaner outlet duct. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
19. Install the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** .

VALVE ROCKER ARM AND PUSH ROD REPLACEMENT

Removal Procedure

IMPORTANT: Place the valve train components in a rack in order to ensure that the components are installed in the same location from which they were removed.

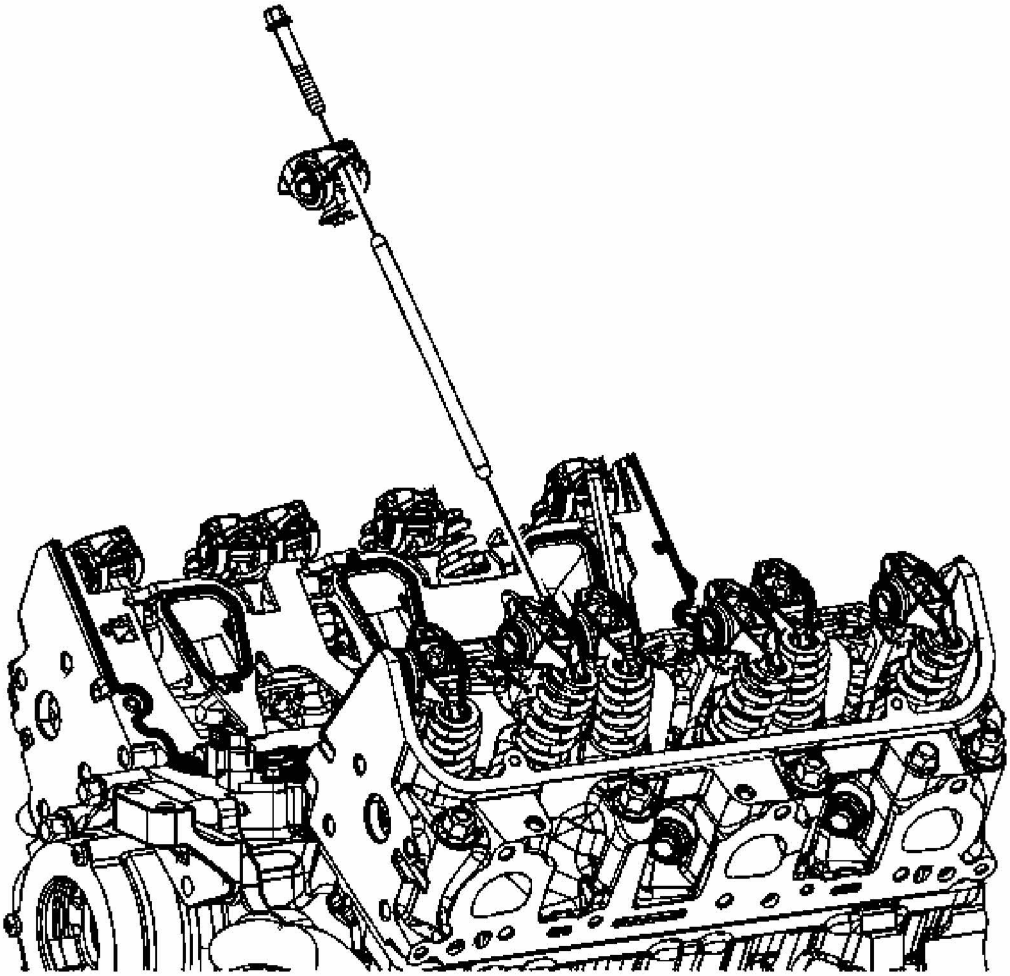


Fig. 112: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the valve rocker arm cover(s). Refer to **Valve Rocker Arm Cover Replacement - Left** or **Valve Rocker Arm Cover Replacement - Right**.
2. Loosen the valve rocker arm bolts.
3. Remove the rocker arms.
4. Remove the pushrods.
    - The intake push rods measure 147.51 mm (5.81 in).
    - The exhaust push rods measure 154.87 mm (6.1 in).

Installation Procedure

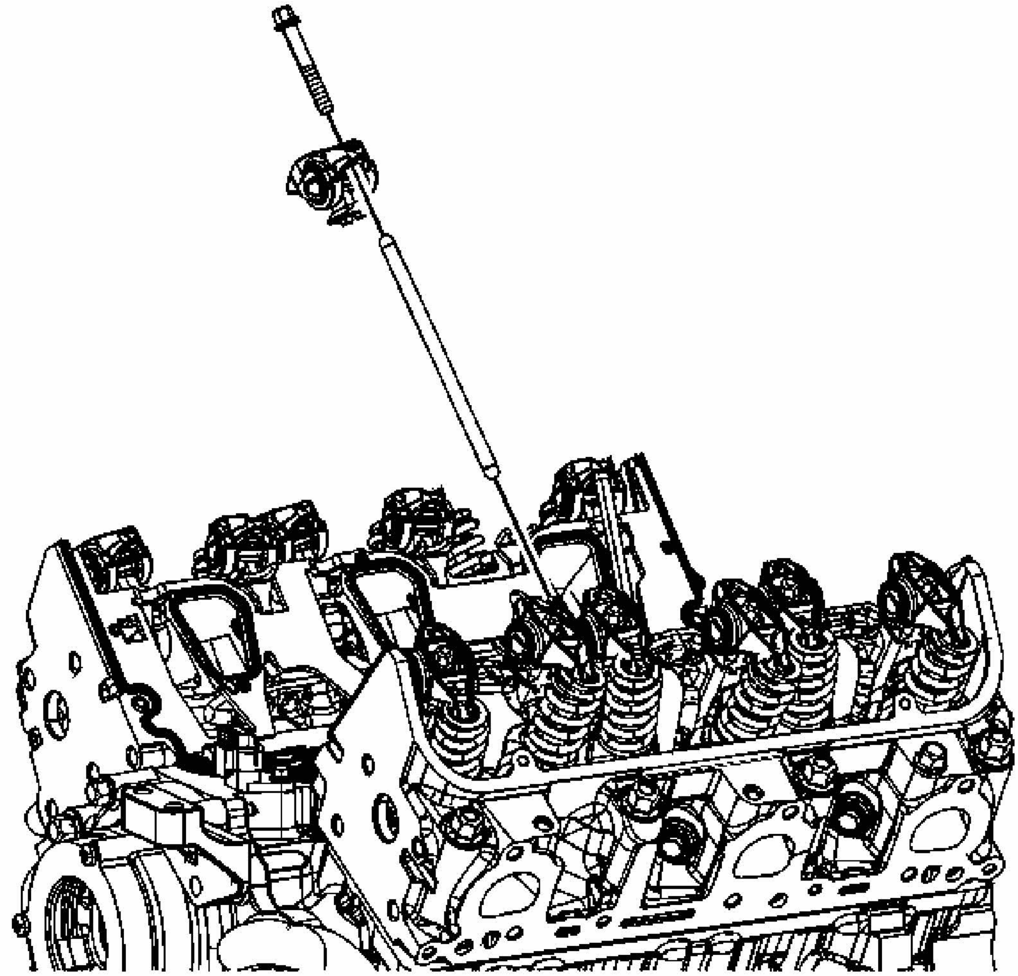


Fig. 113: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Coat the ends of the pushrods using prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent.
2. Install the pushrods.
   - The intake pushrods are identified with yellow stripes.
   - The exhaust pushrods are identified with blue stripes.
3. Ensure that the pushrods seat in the lifter bore.
4. Coat the rocker arm friction surfaces using prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent.

IMPORTANT: Shims (88894006) may be required under the valve rocker

arm pedestals if reconditioning has been performed on the cylinder head or its components.

5. Install the rocker arms.

NOTE: **Refer to Fastener Notice .**

6. Install the rocker arm bolts.

   Tighten: Tighten the bolts to 34 N.m (25 lb ft).

7. Install the valve rocker arm cover(s). Refer to **Valve Rocker Arm Cover Replacement - Left** or **Valve Rocker Arm Cover Replacement - Right**.

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT

Tools Required

- **J 22794** Spark Plug Port Adapter. See **Special Tools**.
- **J 38606** Valve Spring Compressor. See **Special Tools**.

Removal Procedure

IMPORTANT:

- **Before removing the valve locks, rotate the engine so that the piston in the cylinder you are working on is at top dead center (TDC). This will eliminate the possibility of the valve accidentally falling inside the cylinder.**
- **Loosen the spark plug, and clean any dirt and/or debris from the spark plug recess area before removing.**

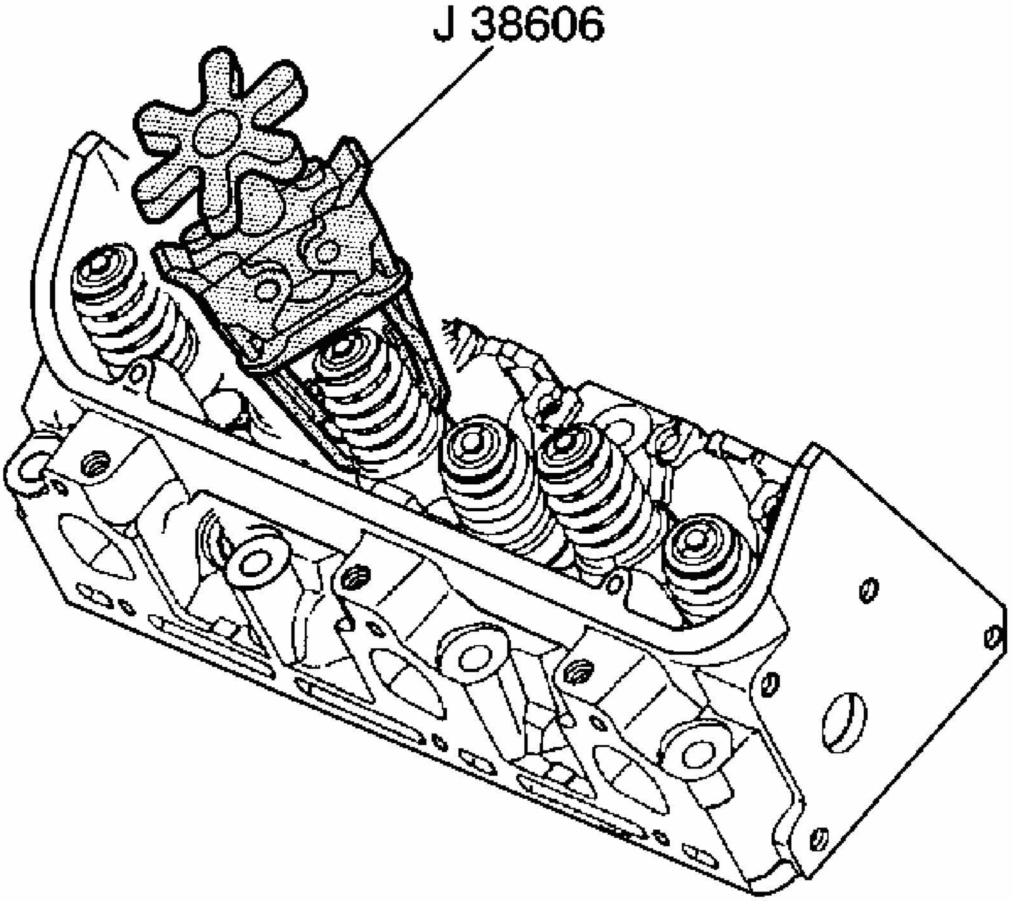


Fig. 114: Compressing Valve Springs
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug. Refer to **Spark Plug Replacement** .
2. Remove the rocker arm. Refer to **Valve Rocker Arm and Push Rod Replacement**.
3. Install the **J 22794** into the spark plug port. See **Special Tools**. Apply compressed air in order to hold the valves in place.
4. Install the **J 38606** onto the valve spring. See **Special Tools**.

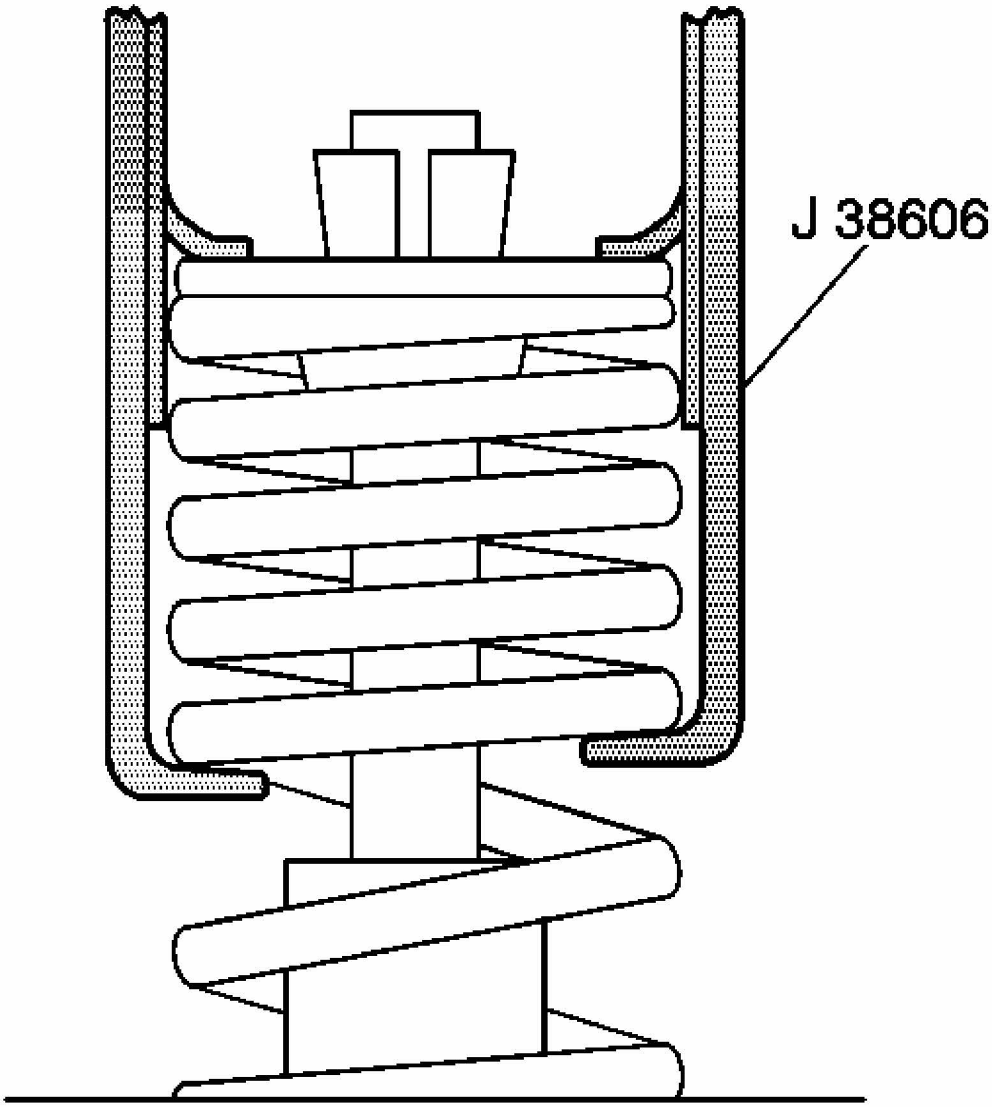


Fig. 115: Compressing Valve Spring
Courtesy of GENERAL MOTORS CORP.

5. Compress the valve spring using the **J 38606** . See **Special Tools**.

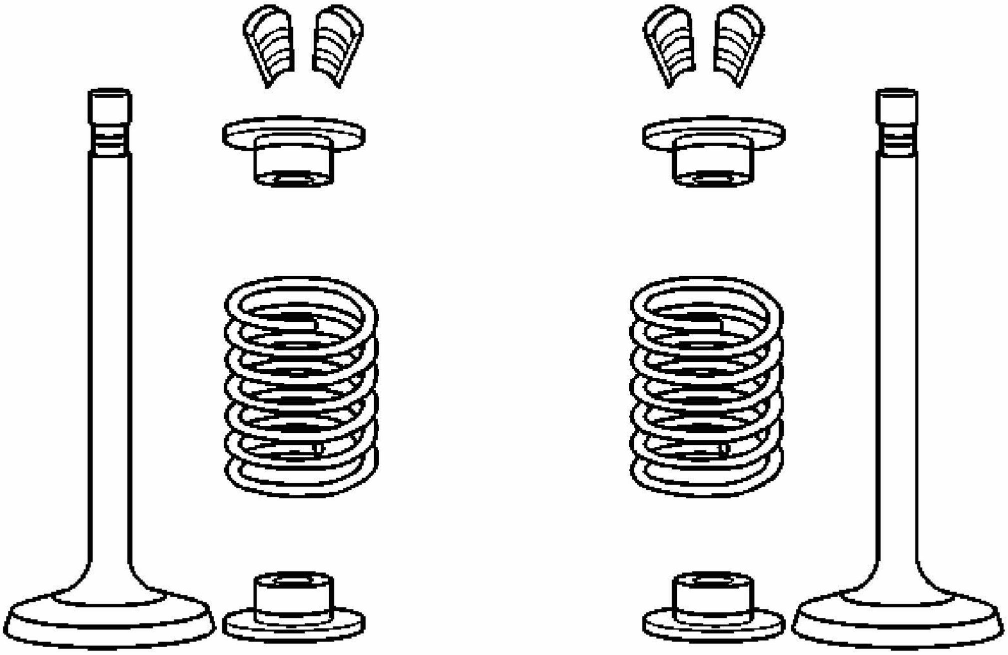


Fig. 116: Valve Locks, Caps, Seats & Spring
Courtesy of GENERAL MOTORS CORP.

6. Remove the valve spring cap keys.
7. Remove the valve cap.
8. Remove the valve spring.
9. Remove the valve stem oil seal.

Installation Procedure

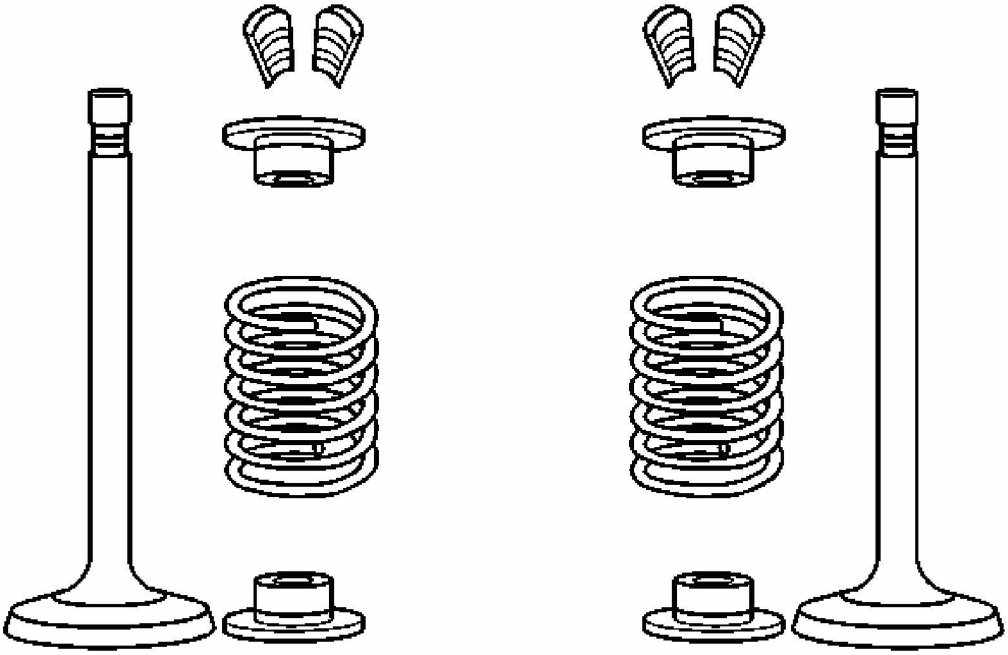


Fig. 117: Valve Locks, Caps, Seats & Spring
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the valve stem with clean engine oil.
2. Install the valve stem oil seal.
3. Install the valve spring.
4. Install the valve cap.

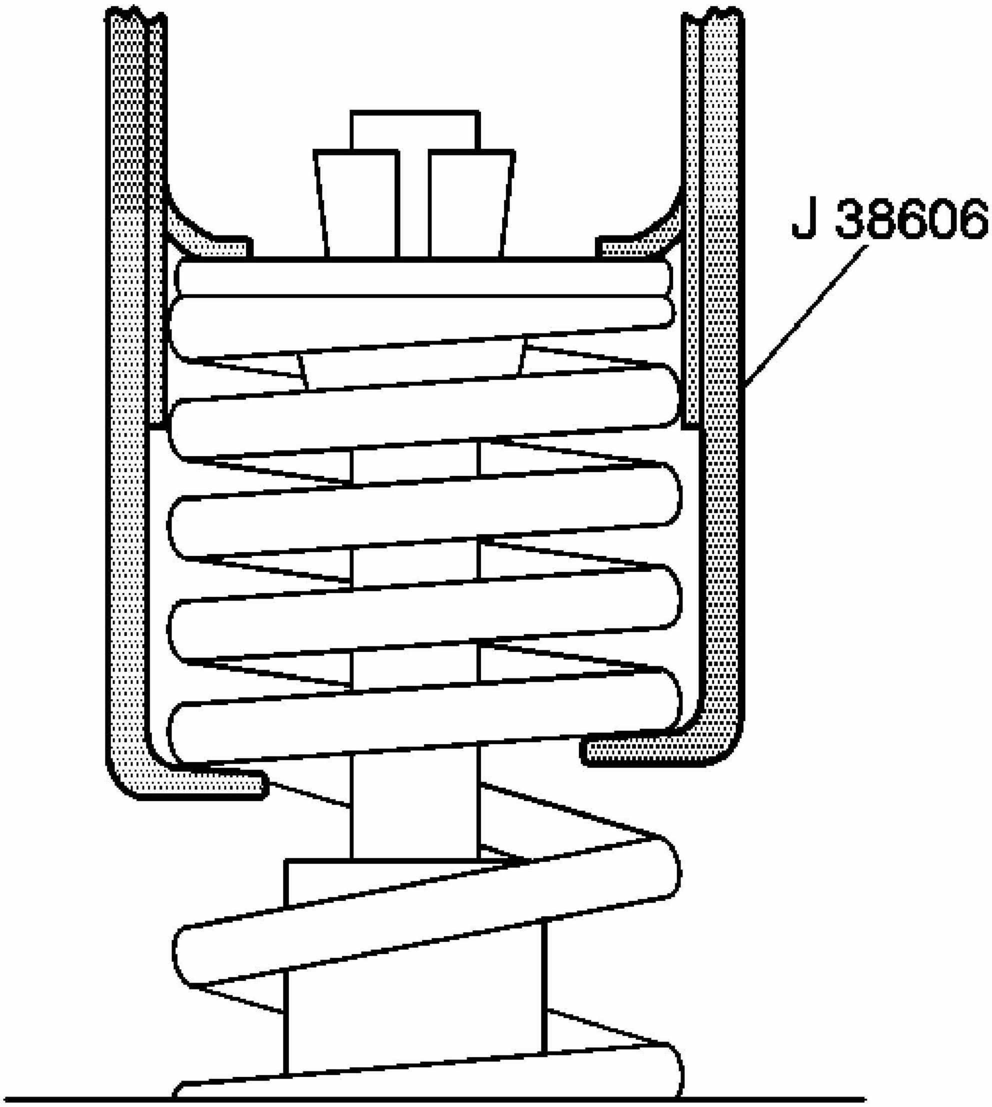


Fig. 118: Compressing Valve Spring
Courtesy of GENERAL MOTORS CORP.

5. Compress the valve spring using the **J 38606** . See **Special Tools**.
6. Install the valve cap keys. If necessary, use grease in order to hold the valve cap keys in place.

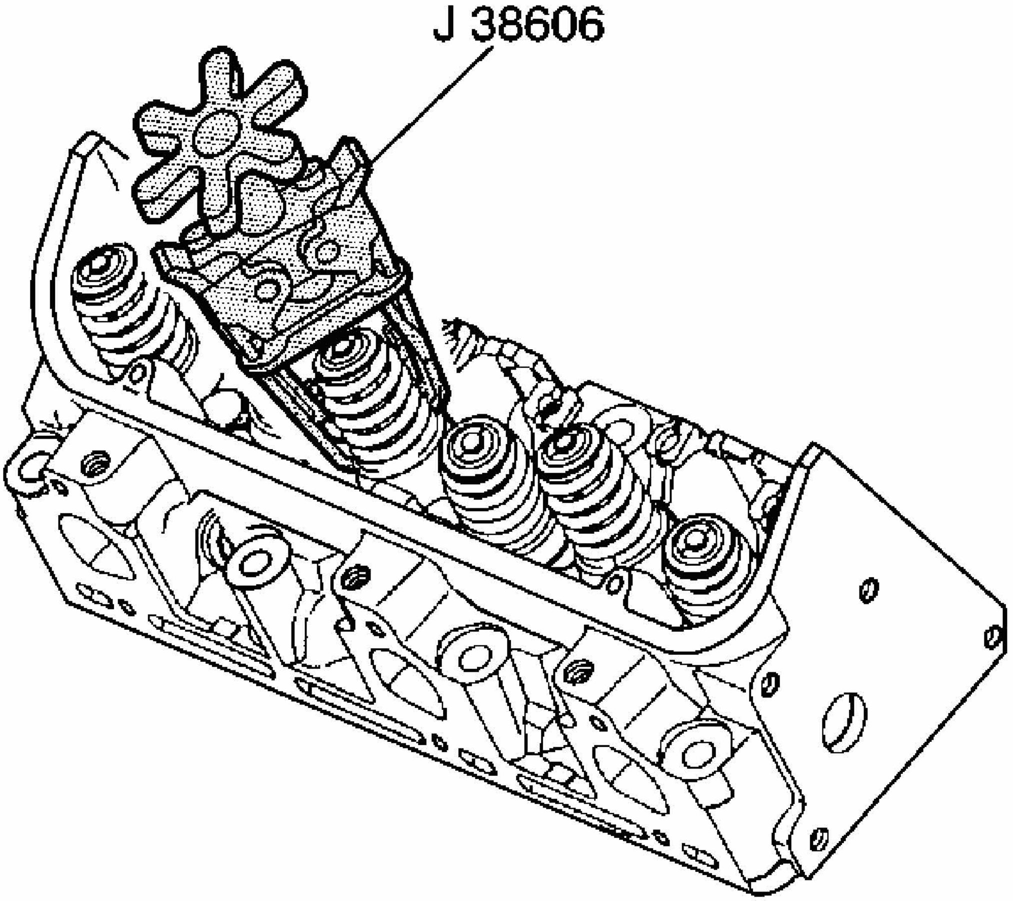


Fig. 119: Compressing Valve Springs
Courtesy of GENERAL MOTORS CORP.

7. Release the valve spring using the **J 38606** . See **Special Tools**.
8. Ensure the valve cap keys are seated.
9. Remove the compressed air and remove the **J 22794** from the spark plug port. See **Special Tools**.
10. Install the rocker arm. Refer to **Valve Rocker Arm and Push Rod Replacement**.
11. Install the spark plug. Refer to **Spark Plug Replacement** .

VALVE LIFTER REPLACEMENT

Removal Procedure

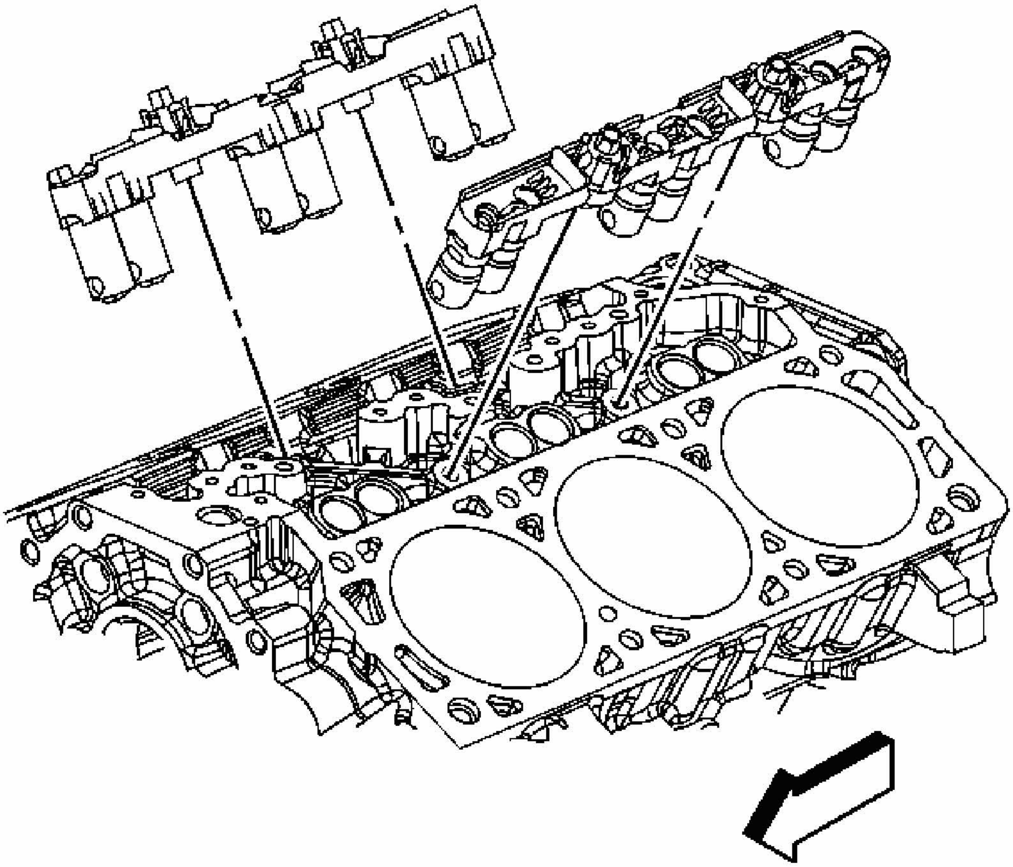


Fig. 120: Identifying Valve Lifter Guides
Courtesy of GENERAL MOTORS CORP.

1. Remove the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
2. Remove the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.

IMPORTANT: The valve lifter guide bolts are not removable.

3. Loosen the valve lifter guide bolts.
4. Remove the valve lifter guides.

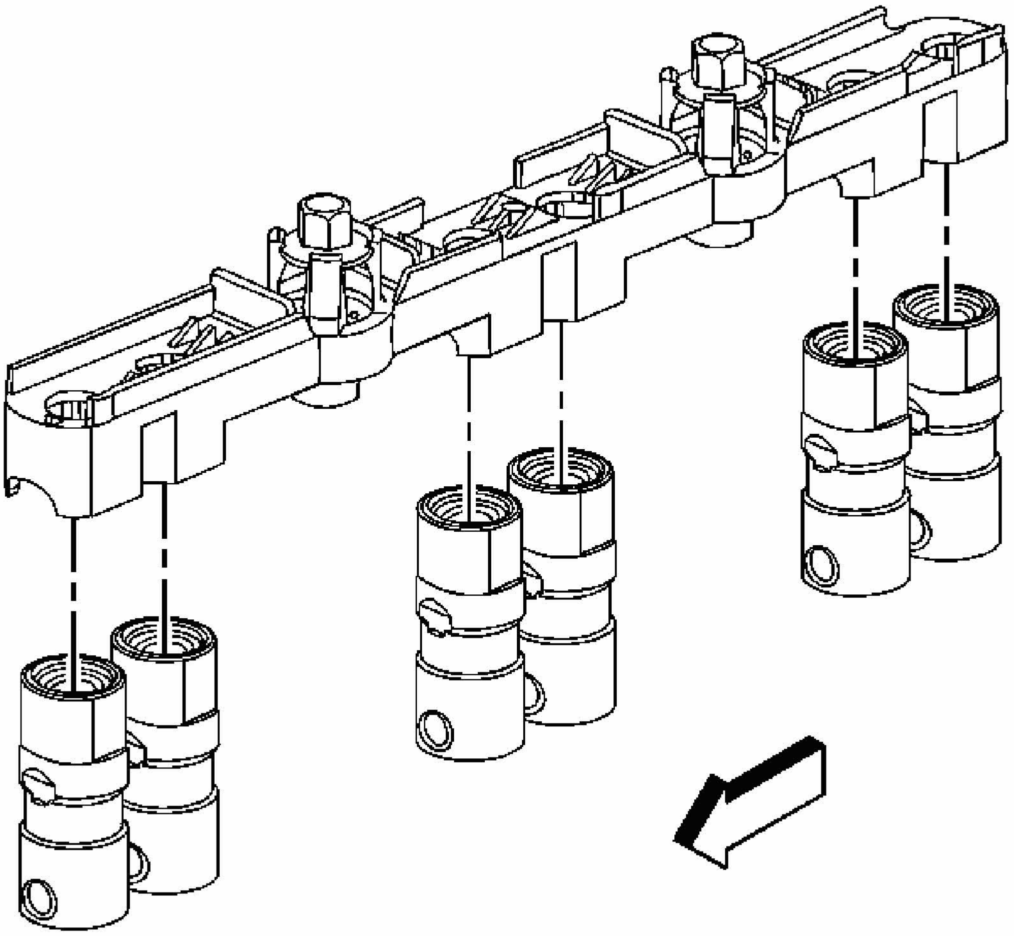


Fig. 121: Identifying Valve Lifters
Courtesy of GENERAL MOTORS CORP.

5. Remove the valve lifters from the valve lifter guides.
6. Clean all gasket surfaces with degreaser.

Installation Procedure

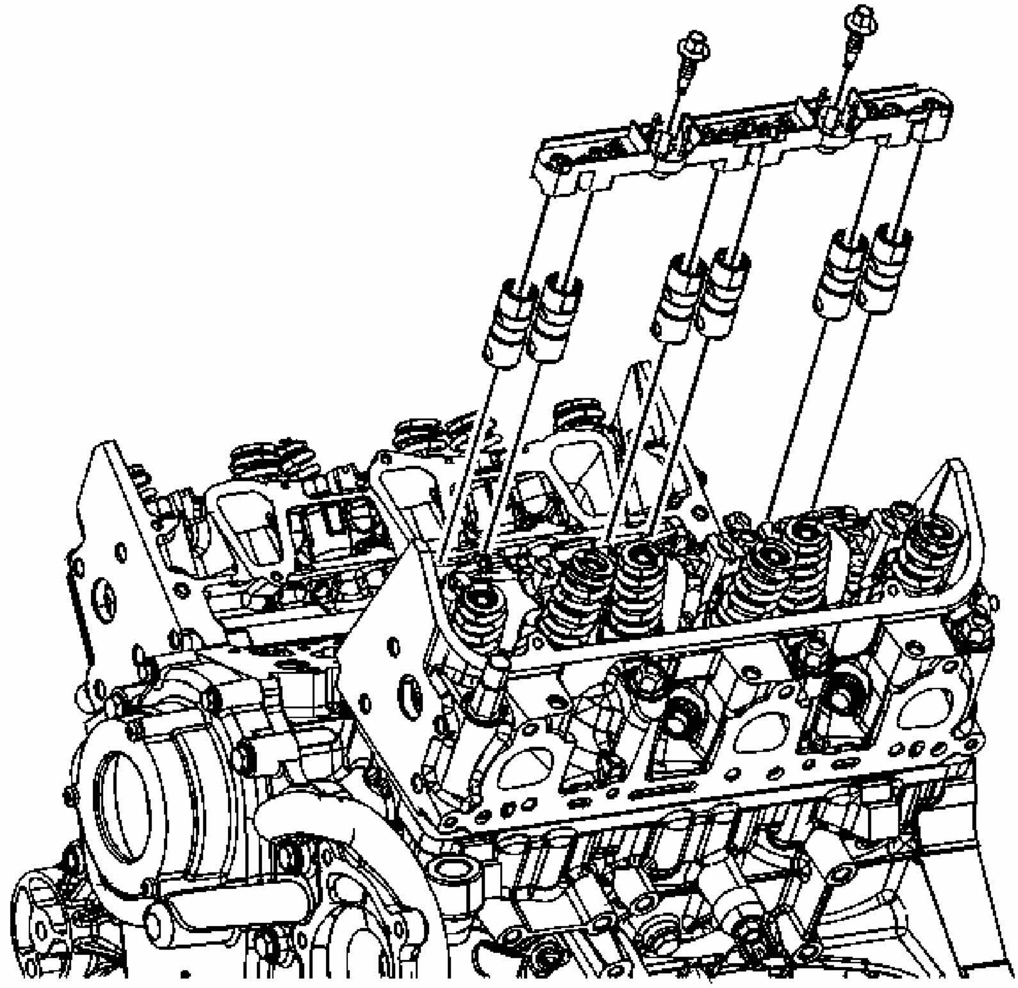


Fig. 122: View Of Valve Lifter Guides
Courtesy of GENERAL MOTORS CORP.

1. Coat the valve lifters using prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent.
2. Install the valve lifters to the cylinder bores.
3. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the valve lifter guide bolt threads.
4. Install the valve lifter guides.

NOTE: **Refer to Fastener Notice .**

5. Tighten the valve lifter guide bolts.

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

6. Install the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
7. Install the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.

CRANKSHAFT BALANCER REPLACEMENT

Tools Required

- **EN 46359** Puller End Protector. See **Special Tools**.
- **J 29113** Balancer and Crank Sprocket Installer. See **Special Tools**.
- **J 37096** Flywheel Holder. See **Special Tools**.
- **J 41816** Harmonic Balancer Remover. See **Special Tools**.
- **J 45059** Angle Meter. See **Special Tools**.

Removal Procedure

NOTE: The inertial weight section of the crankshaft balancer is assembled to the hub with a rubber type material. The correct installation procedures (with the proper tool) must be followed or movement of the inertial weight section of the hub will destroy the tuning of the crankshaft balancer.

1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Remove the right front tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
4. Remove the right engine splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
5. Install adjustable jack stands under the frame.
6. Loosen the left side frame bolts and remove the right side frame bolts.
7. Using the jack stands, lower the right side of the frame in order to access the crankshaft balancer.
8. Remove the torque converter covers.
9. Install the **J 37096** to the flywheel in order to prevent flywheel rotation. See **Special Tools**.

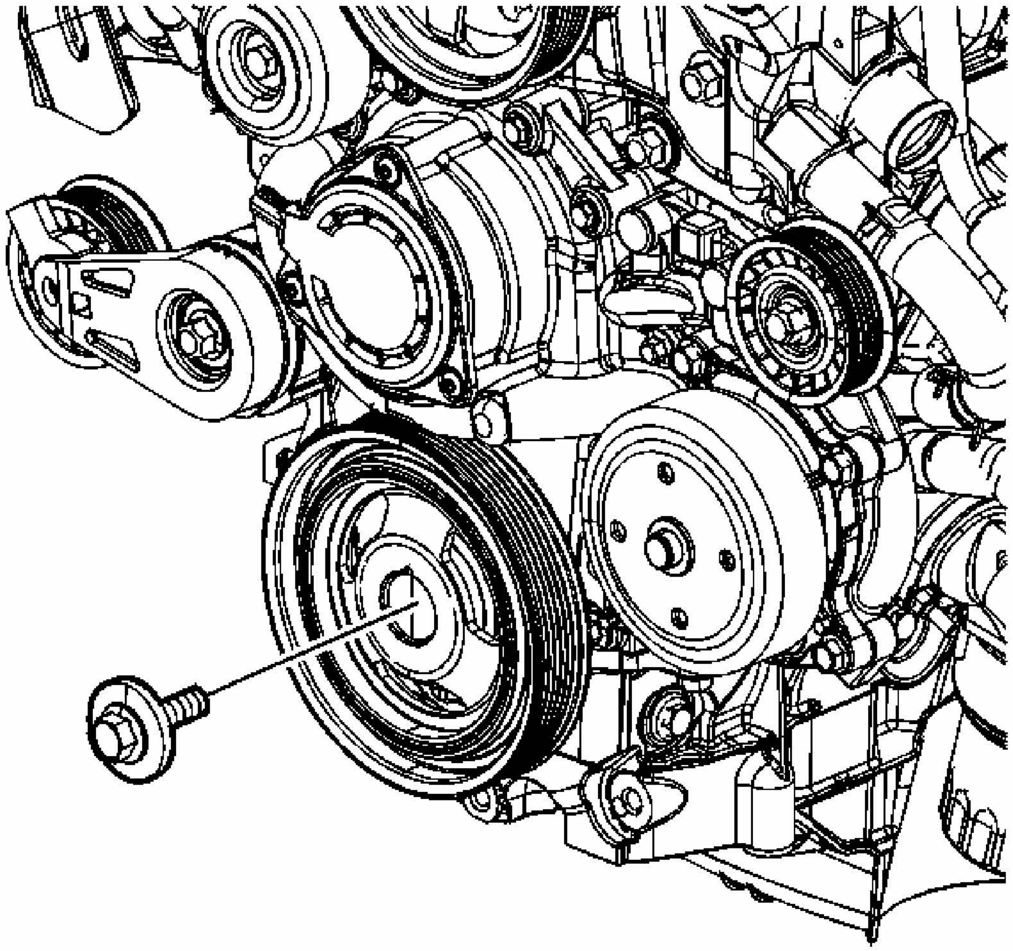


Fig. 123: Identifying Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

10. Remove the crankshaft balancer bolt and the washer.

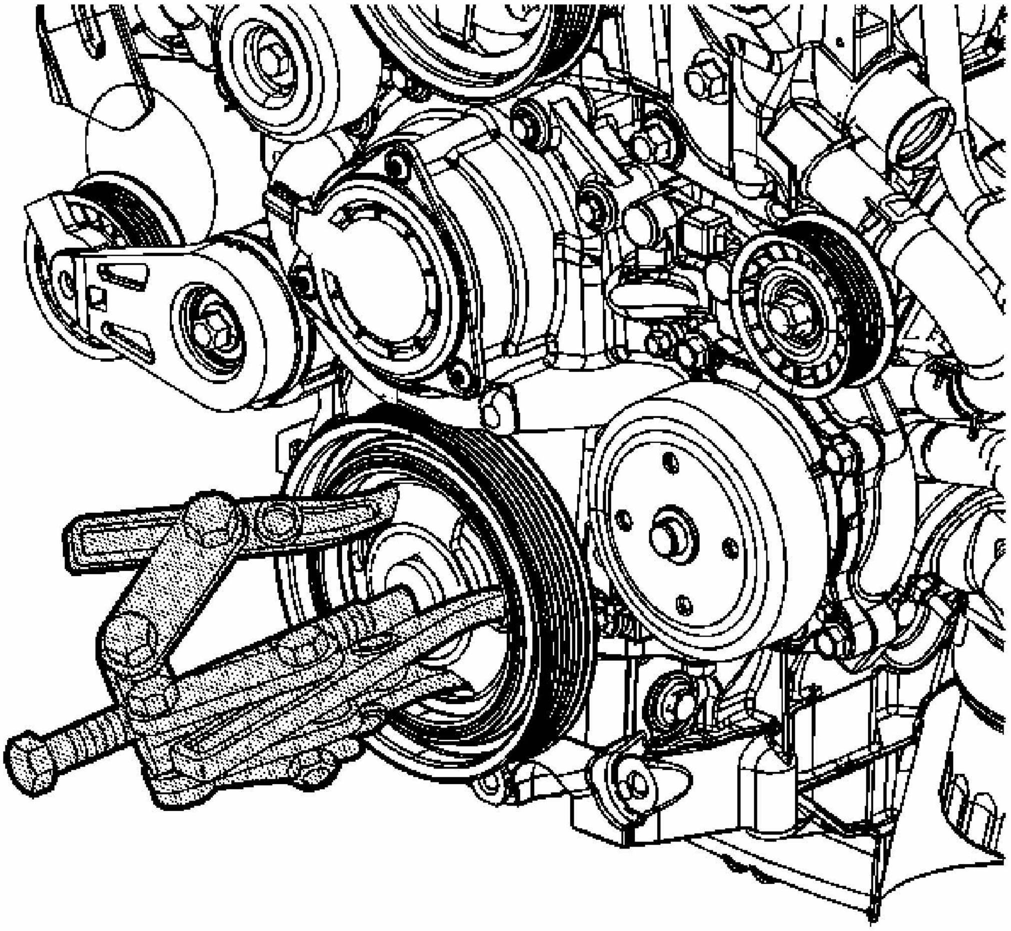


Fig. 124: Removing Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

NOTE: **Do NOT use a power-assisted tool with the special tool in order to remove or install this component. You cannot properly control the alignment of this component using a power-assisted tool, and this can damage the component.**

11. Remove the crankshaft balancer using the **J 41816** and **EN 46359** . See Special Tools.

Installation Procedure

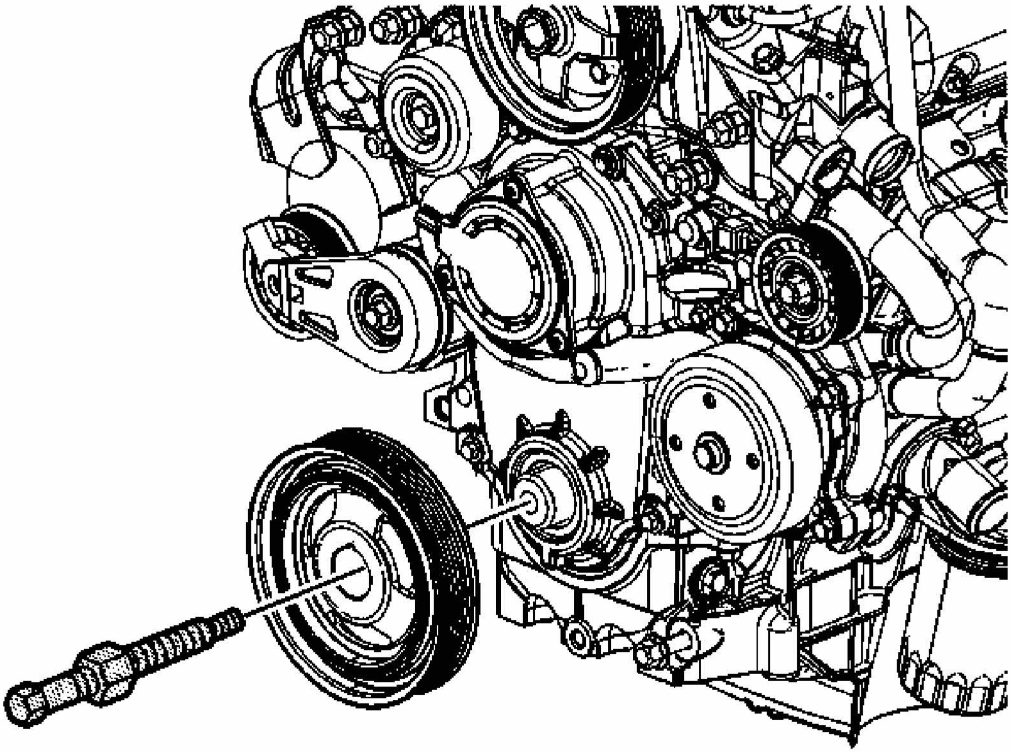


Fig. 125: View Of Balancer & Crank Sprocket Puller (J 29113)
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer GM P/N 12378521 (Canadian P/N 88901148) or equivalent to the keyway of the crankshaft balancer.
2. Place the crankshaft balancer into position over the key in the crankshaft.
3. Thread the **J 29113** into the crankshaft. See **Special Tools**.
4. Rotate the hex nut on the **J 29113** in order to install the crankshaft balancer onto the crankshaft. See **Special Tools**.
5. Remove the **J 29113** from the crankshaft. See **Special Tools**.

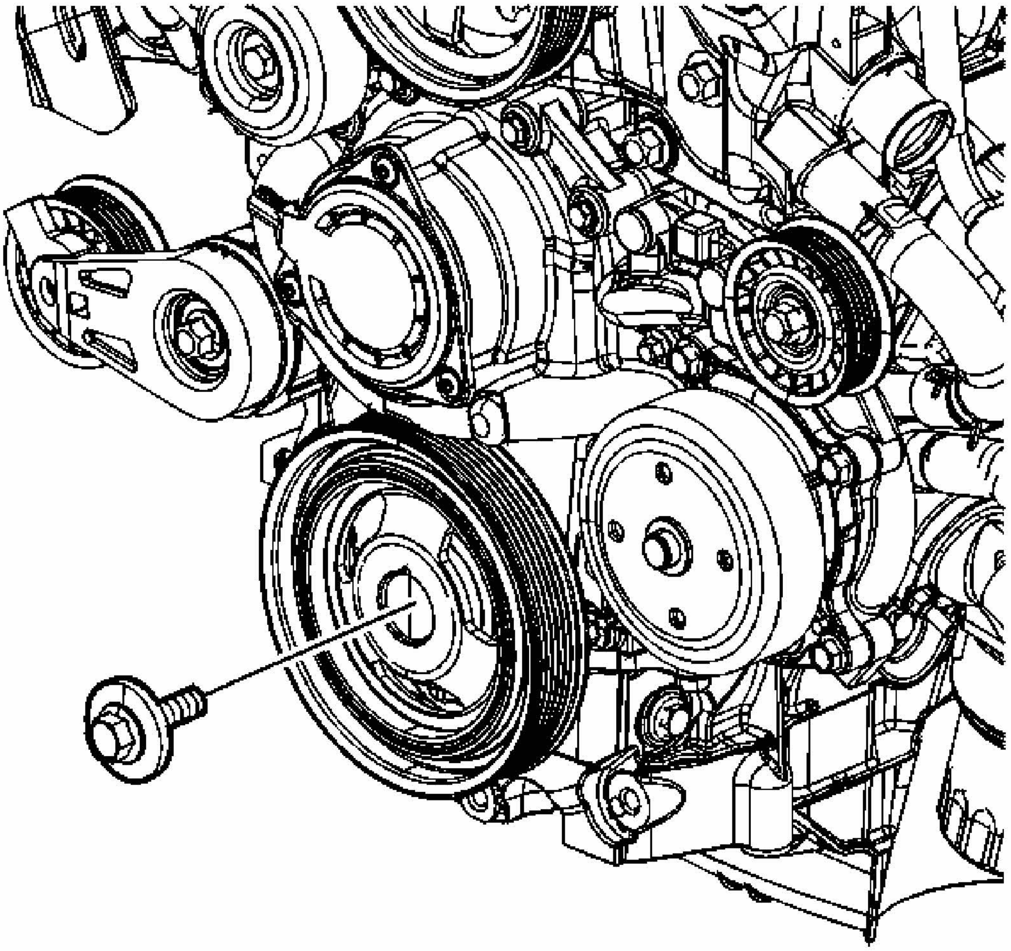


Fig. 126: Identifying Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

6. Install the crankshaft balancer washer and the bolt.

   NOTE: **Refer to Fastener Notice .**

7. Tighten the crankshaft balancer bolt.

   Tighten: Tighten the bolt to 160 N.m (118 lb ft).

8. Remove the **J 37096** from the flywheel. See **Special Tools**.
9. Install the torque converter covers.
10. Raise the frame into the original position.

11. Install and tighten the right and left side frame bolts.

    Tighten: Tighten the bolts to 100 N.m (74 lb ft) plus an additional 90 degrees using the **J 45059** . See **Special Tools**.

12. Install the right engine splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
13. Install the right front tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
14. Lower the vehicle.
15. Install the drive belt. Refer to **Drive Belt Replacement**.

OIL PAN REPLACEMENT

Tools Required

J 39505 Torque Wrench Adapter. See **Special Tools**.

Removal Procedure

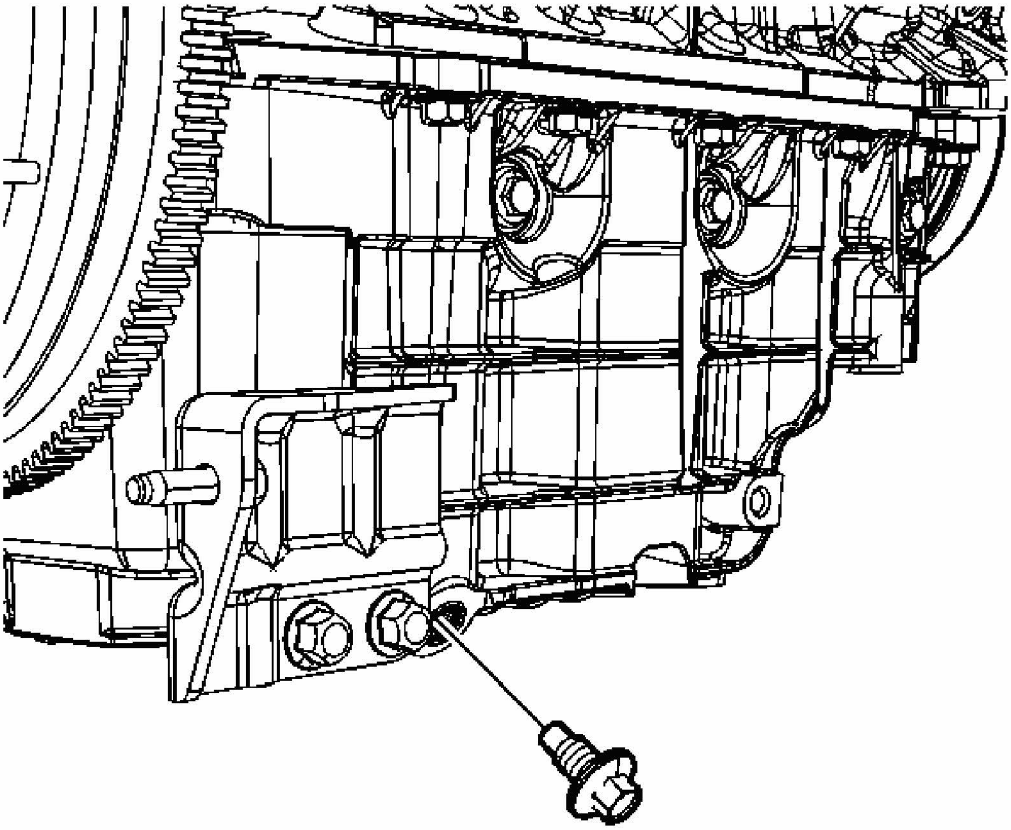


Fig. 127: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .
2. Remove the engine mount struts. Refer to **Engine Mount Strut Replacement**.
3. Install the engine support fixture. Refer to **Engine Support Fixture**.
4. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)** .
5. Remove the oil pan drain plug.
6. Drain the crankcase.
7. Reinstall the oil pan drain plug.

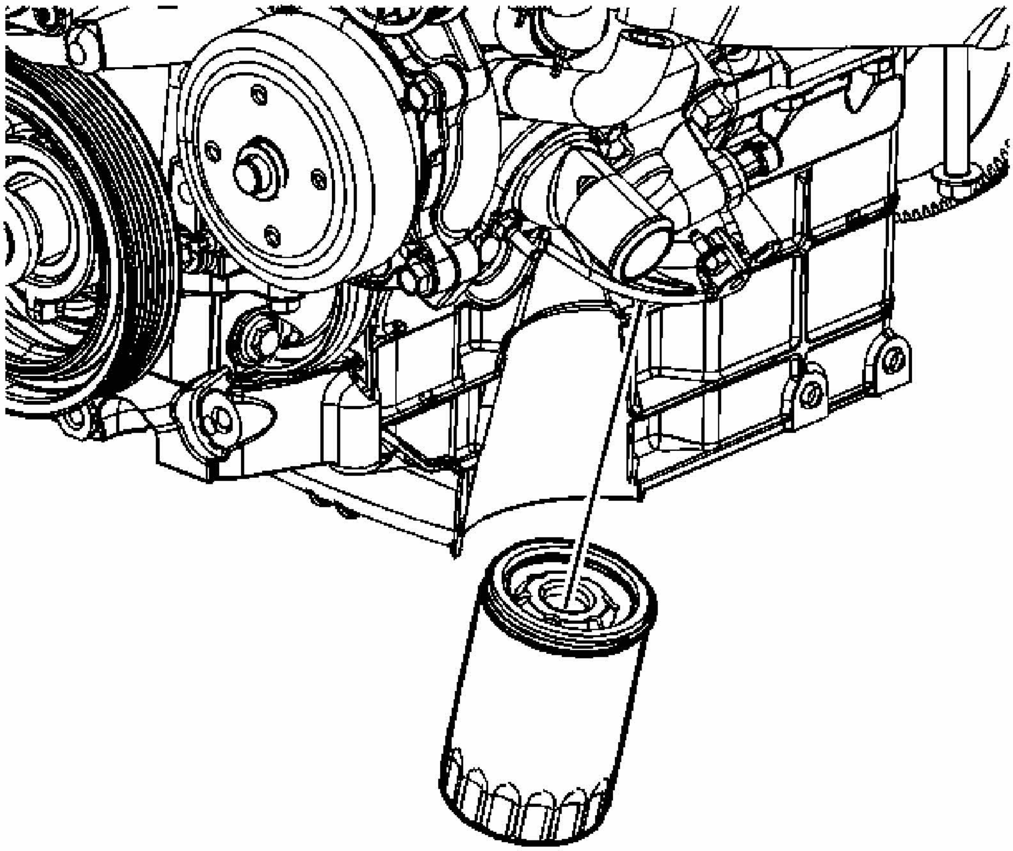


Fig. 128: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

8. Remove the oil filter.
9. Remove the starter. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)** .

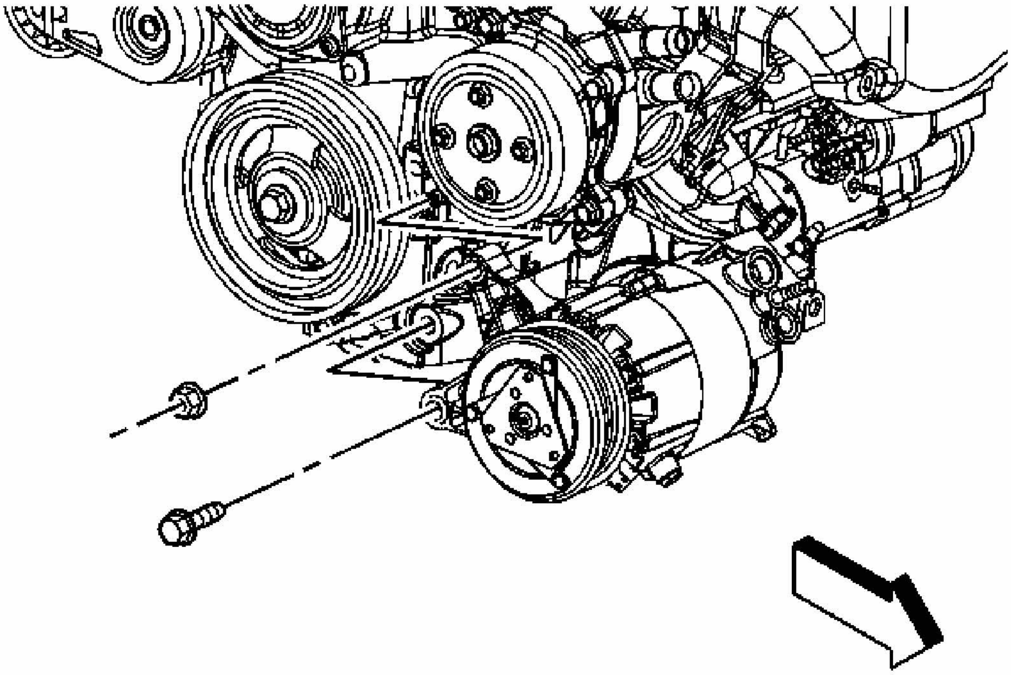


Fig. 129: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

10. Remove the air conditioning (A/C) compressor nut and bolt.

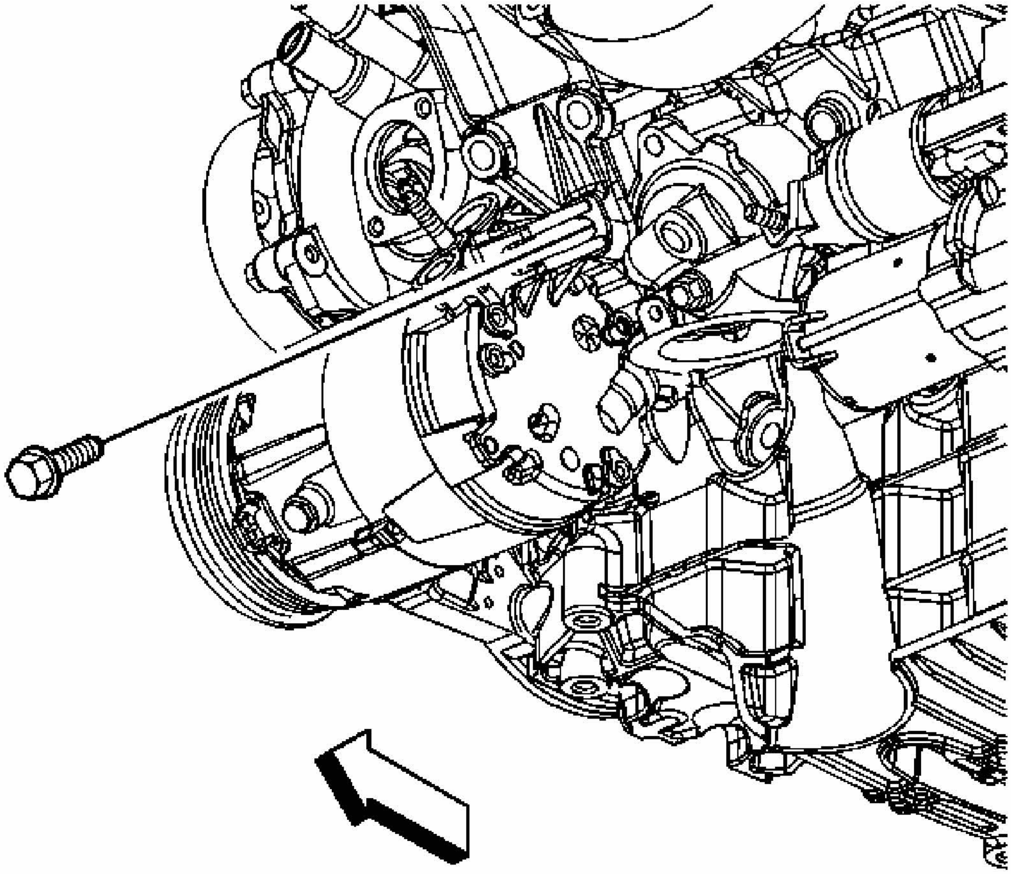


Fig. 130: Locating A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

11. Remove the A/C compressor rear bolt and position the compressor aside.

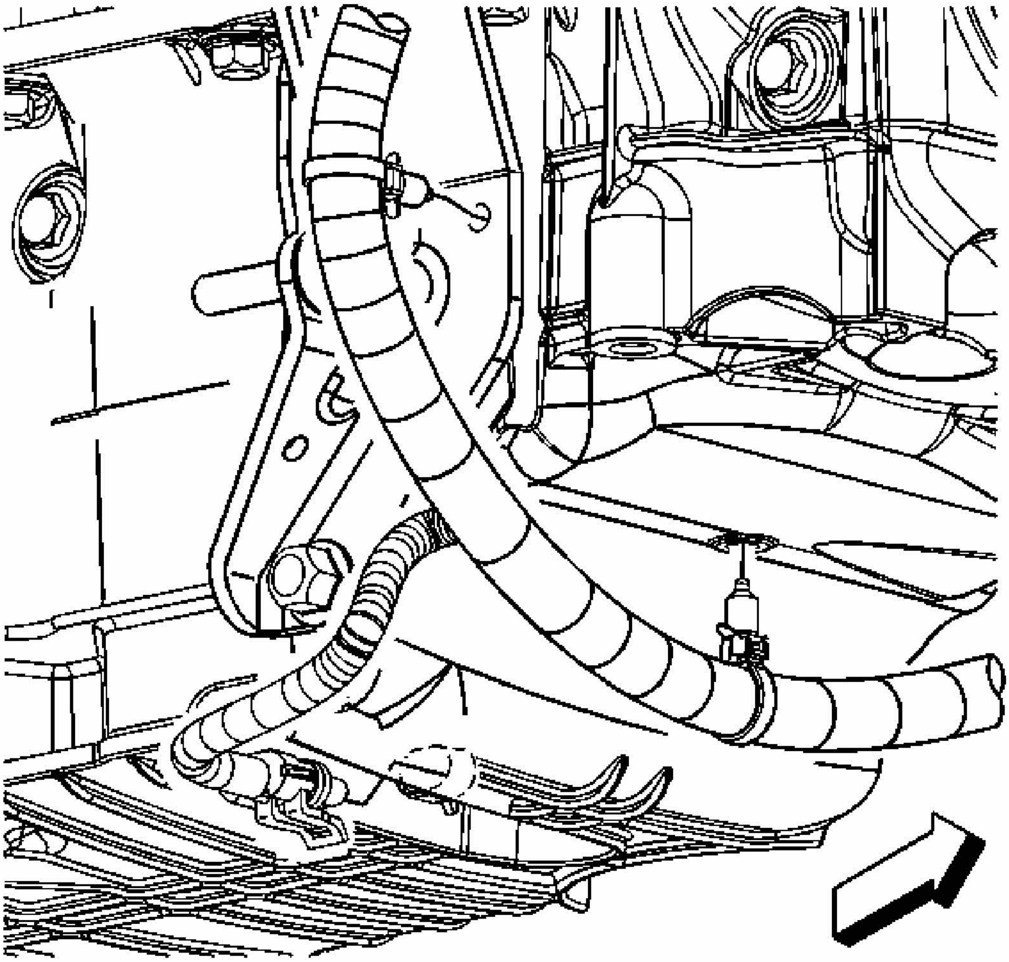


Fig. 131: Locating Engine Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

12. Disconnect the oil level sensor electrical connector.
13. Remove the engine harness clips from the oil pan and the transaxle brace.

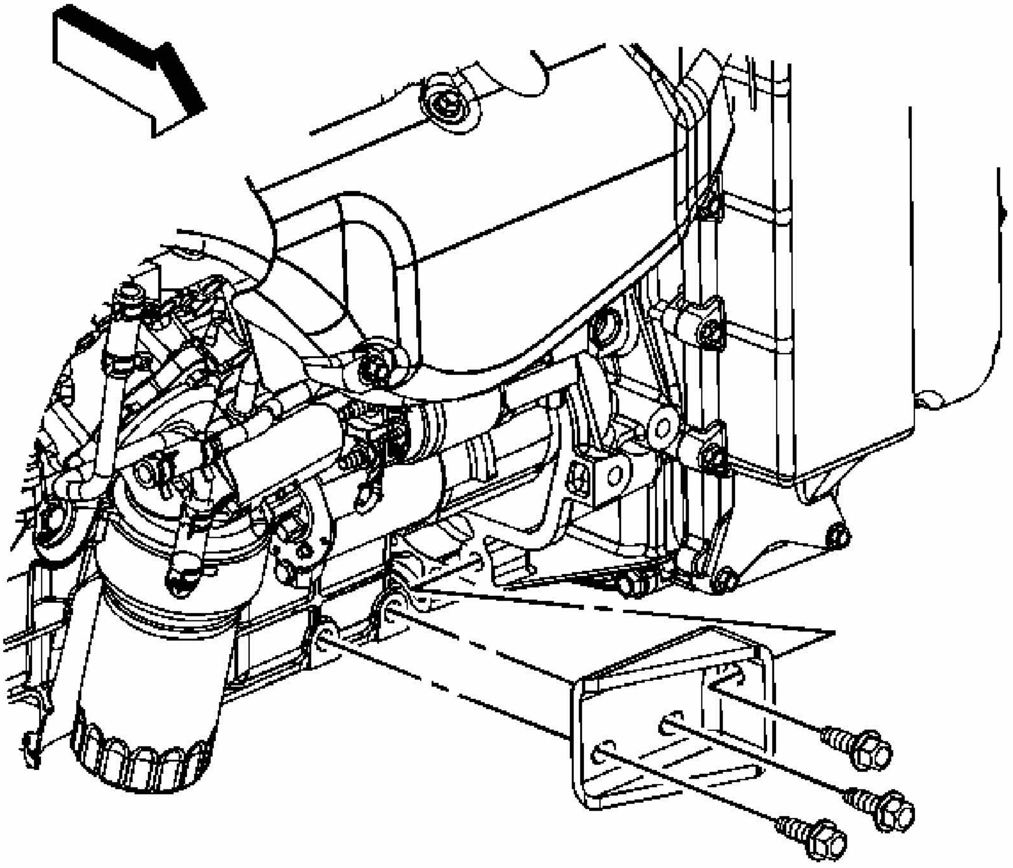


Fig. 132: View Of Front Transaxle Brace & Engine Bolts
Courtesy of GENERAL MOTORS CORP.

14. Remove the front transaxle brace to engine bolts and the brace.

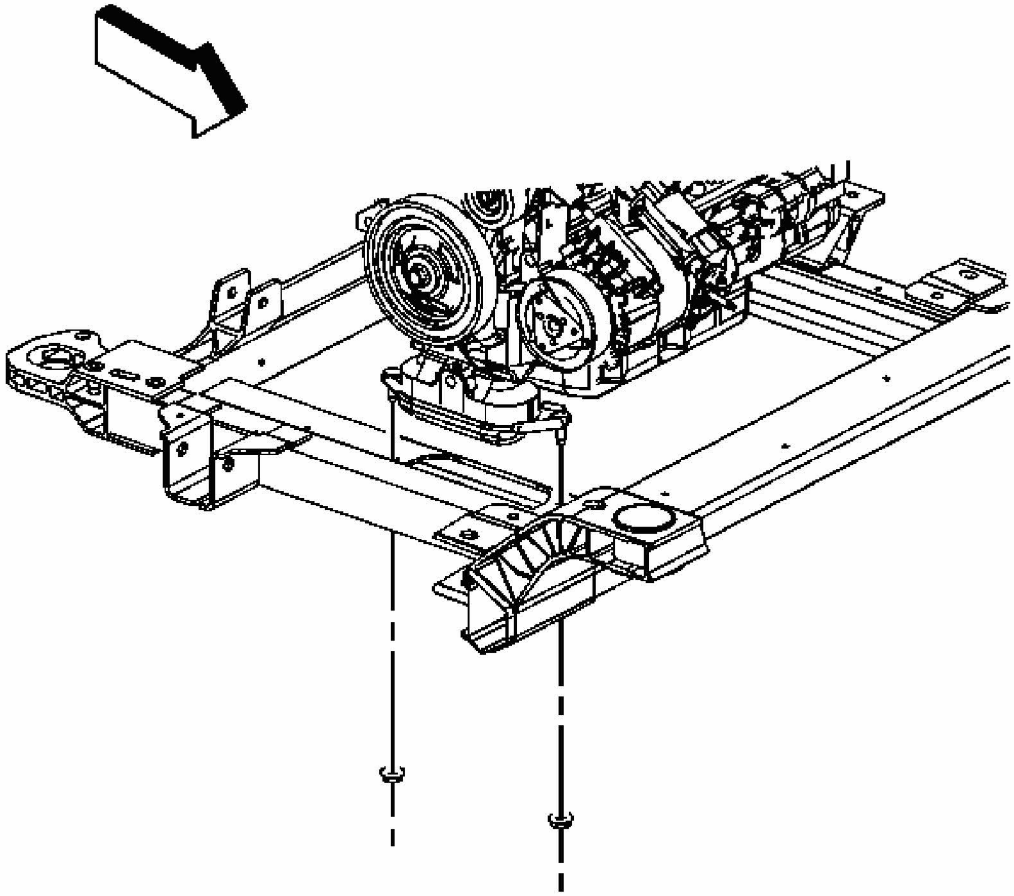


Fig. 133: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

15. Remove the engine mount lower nuts.
16. Loosen the transaxle mount lower nuts. Refer to **Transmission Mount Replacement - Left** .

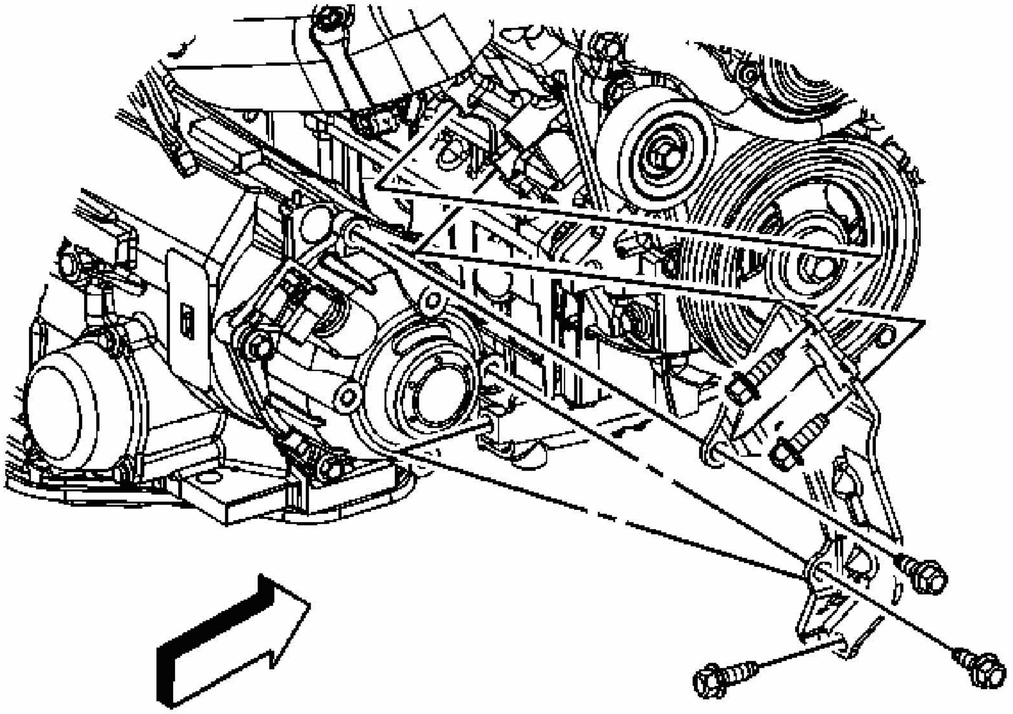


Fig. 134: Locating Rear Transaxle Brace To Engine/Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

17. Remove the rear transaxle brace to engine/oil pan bolts.
18. Lower the vehicle.
19. Using the engine support fixture, raise the engine.
20. Raise the engine.
21. Remove the steering shaft intermediate pinch bolt. Refer to **Intermediate Steering Shaft Replacement** .

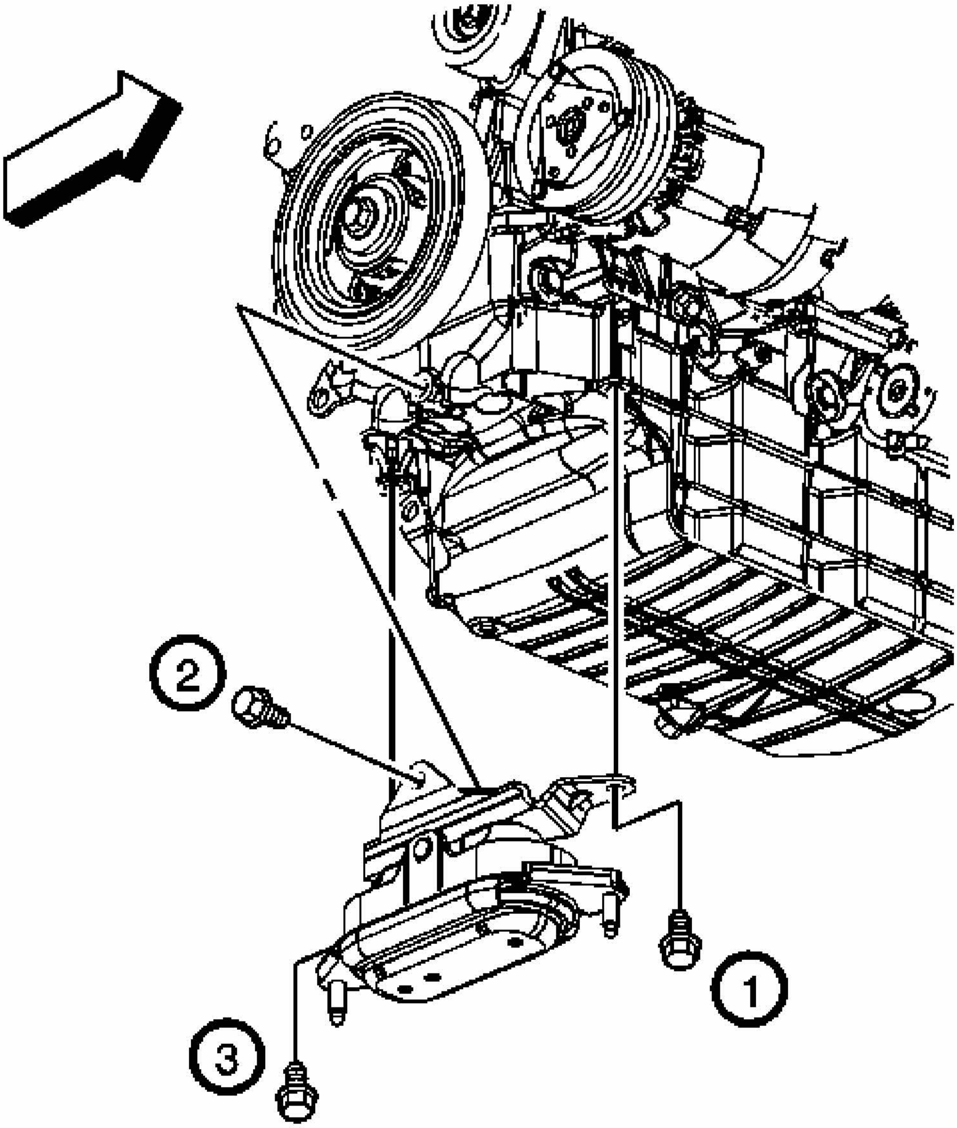


Fig. 135: Locating Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

22. Remove the engine mount bracket bolts.
23. Remove the engine mount and bracket.
24. Remove the right side lower ball joint from the steering knuckle. Refer to **Lower Ball Joint Replacement** .
25. Remove the right side outer tie rod from the steering knuckle. Refer to **Rack and Pinion Outer Tie Rod End Replacement** .

26. Remove the right side stabilizer link. Refer to **Stabilizer Shaft Link Replacement** .
27. Install the jackstands to the frame.
28. Remove the right side frame bolts and loosen the left side frame bolts. Refer to **Frame Replacement** .
29. Using the jackstands lower the right side of the frame.

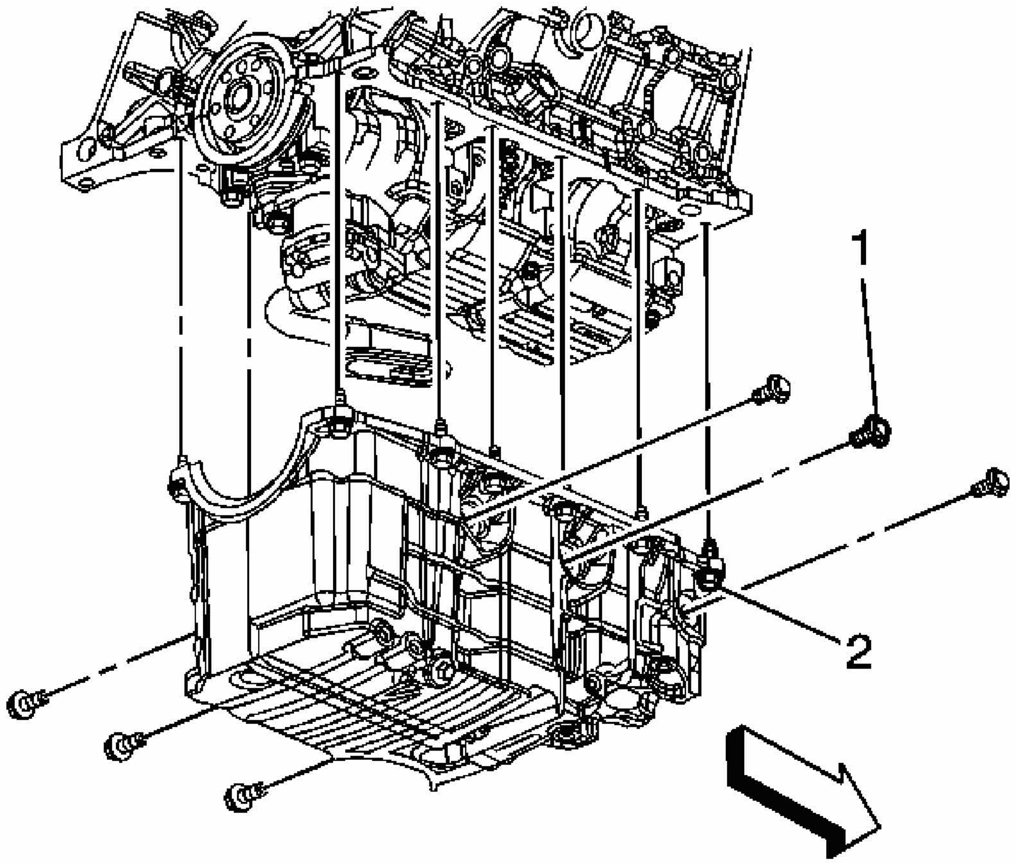


Fig. 136: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

30. Using the **J 39505** , remove the right side oil pan side bolts. See **Special Tools**.
31. Remove the left side oil pan side bolts (1).
32. Remove the oil pan bolts (2).
33. Remove the oil pan.
34. Remove the oil pan gasket.
35. Clean the following items:

- The oil pan flanges
- The oil pan rail
- The front cover
- The rear main bearing cap
- The threaded holes

Installation Procedure

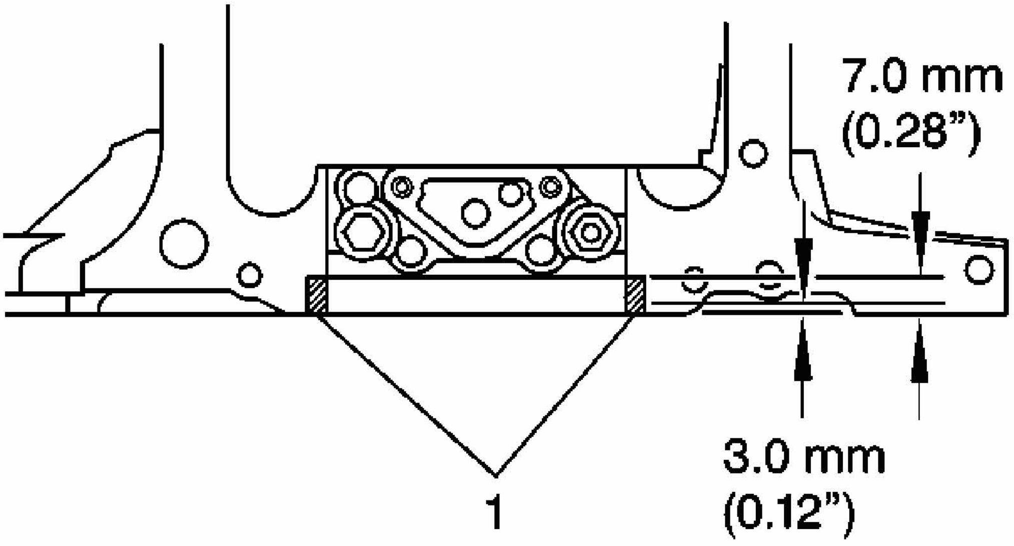


Fig. 137: Illustrating Proper Sealer Application
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer GM P/N 12378521 (Canadian P/N 88901148) or equivalent to both sides of the crankshaft rear main bearing cap (1). Press the sealer into the gap using a putty knife.

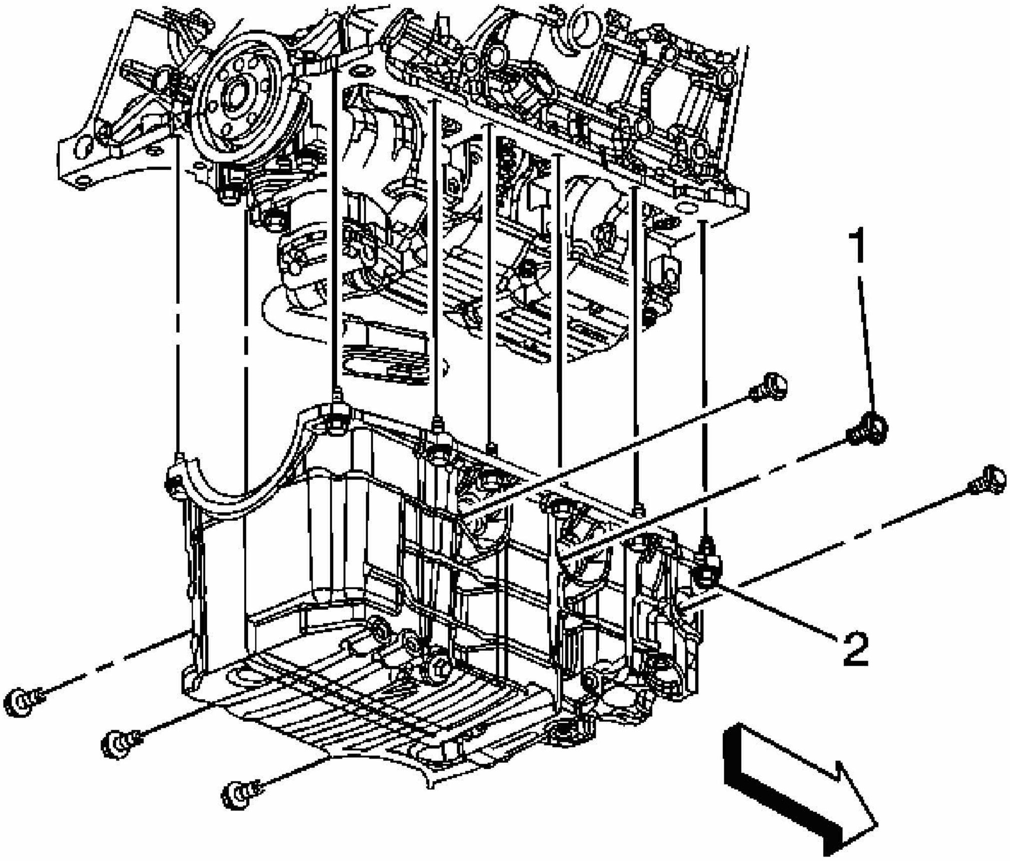


Fig. 138: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW oil pan gasket.
3. Position the oil pan to the engine.

NOTE: **Refer to Fastener Notice .**

4. Install the oil pan bolts (2).

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

5. Install the left side oil pan side bolts (1).
6. Using the **J 39505** , install the right side oil pan side bolts. See **Special Tools**.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

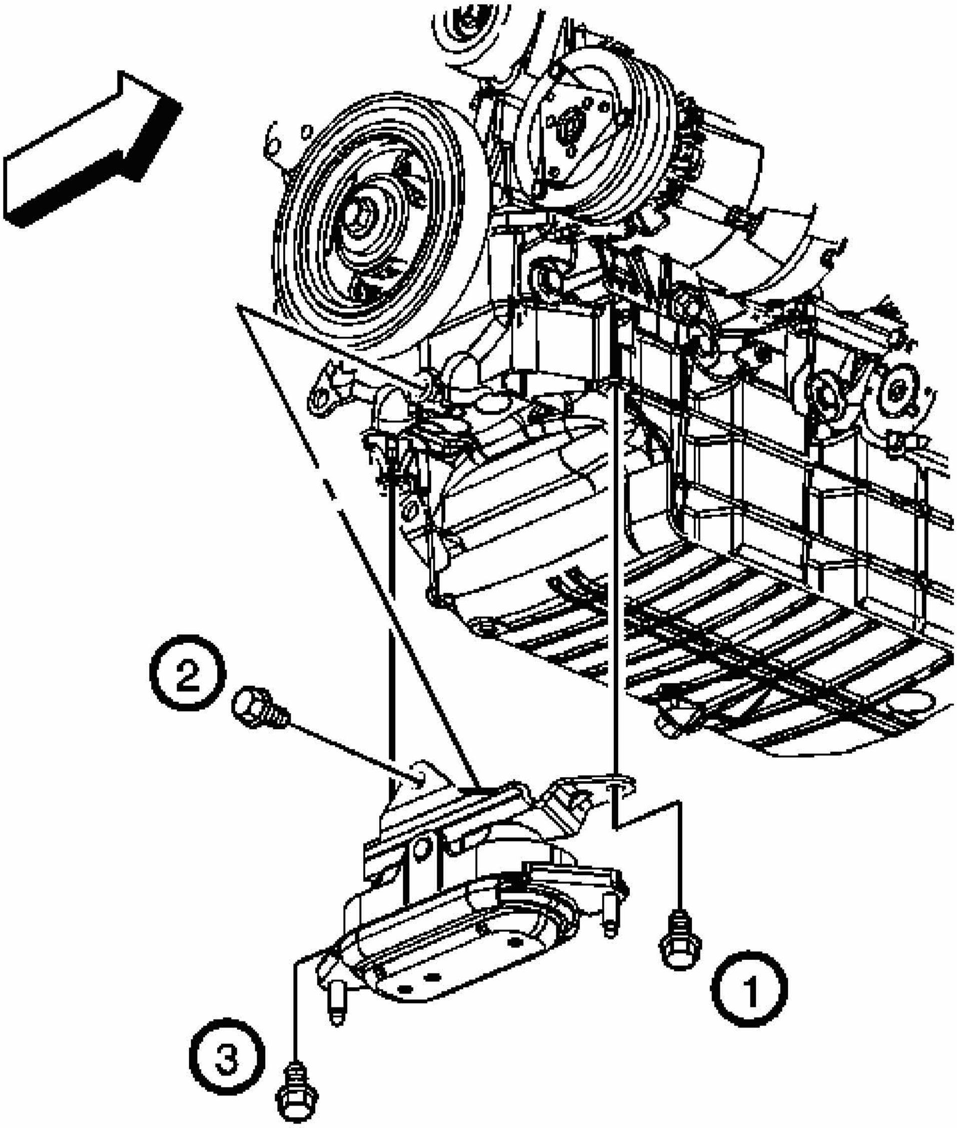


Fig. 139: Locating Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

7. Using the jackstands raise the right side of the frame to the original position.
8. Install the right side frame bolts and tighten the left and right side frame bolts. Refer to **Frame Replacement** .
9. Remove the jackstands from under the frame.
10. Install the right side stabilizer link. Refer to **Stabilizer Shaft Link Replacement** .
11. Install the right side outer tie rod to the steering knuckle. Refer to **Rack and Pinion**

Outer Tie Rod End Replacement .

12. Install the right side lower ball joint to the steering knuckle. Refer to **Lower Ball Joint Replacement** .
13. Position the engine mount and bracket to the oil pan.
14. Install the engine mount bracket bolts.

    Tighten: Tighten the bolts to 50 N.m (37 lb ft).

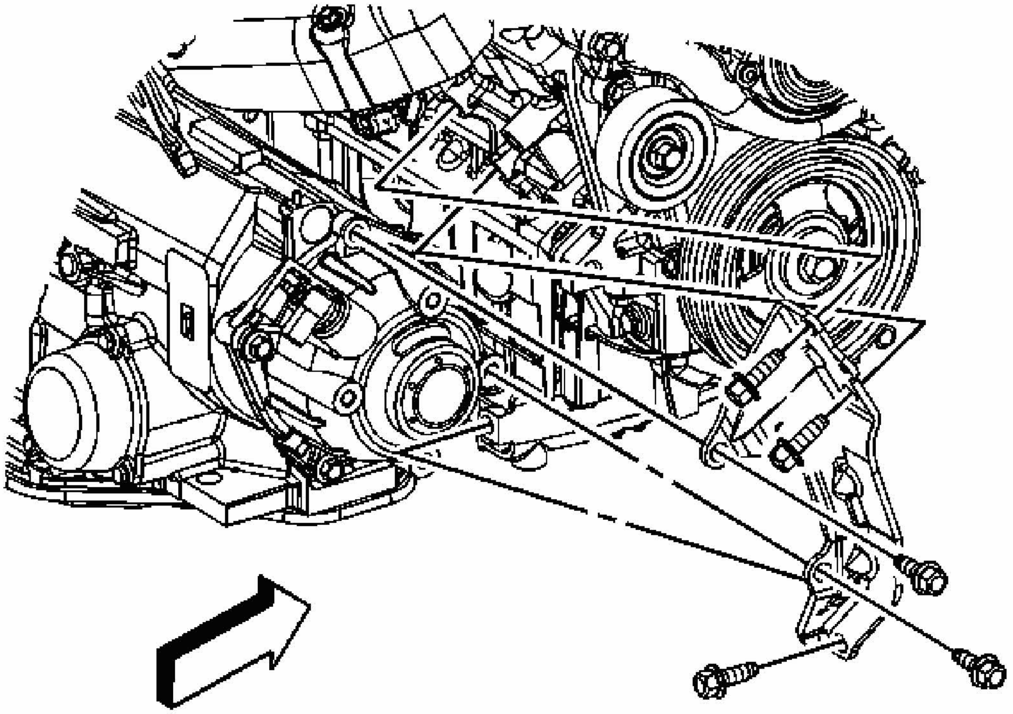


Fig. 140: Locating Rear Transaxle Brace To Engine/Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

15. Install the steering shaft intermediate pinch bolt. Refer to **Intermediate Steering Shaft Replacement** .
16. Lower the vehicle.
17. Using the engine support fixture, lower the engine.
18. Raise the vehicle.
19. Install the rear transaxle brace to engine/oil pan bolts.

    Tighten: Tighten the bolts to 63 N.m (46 lb ft).

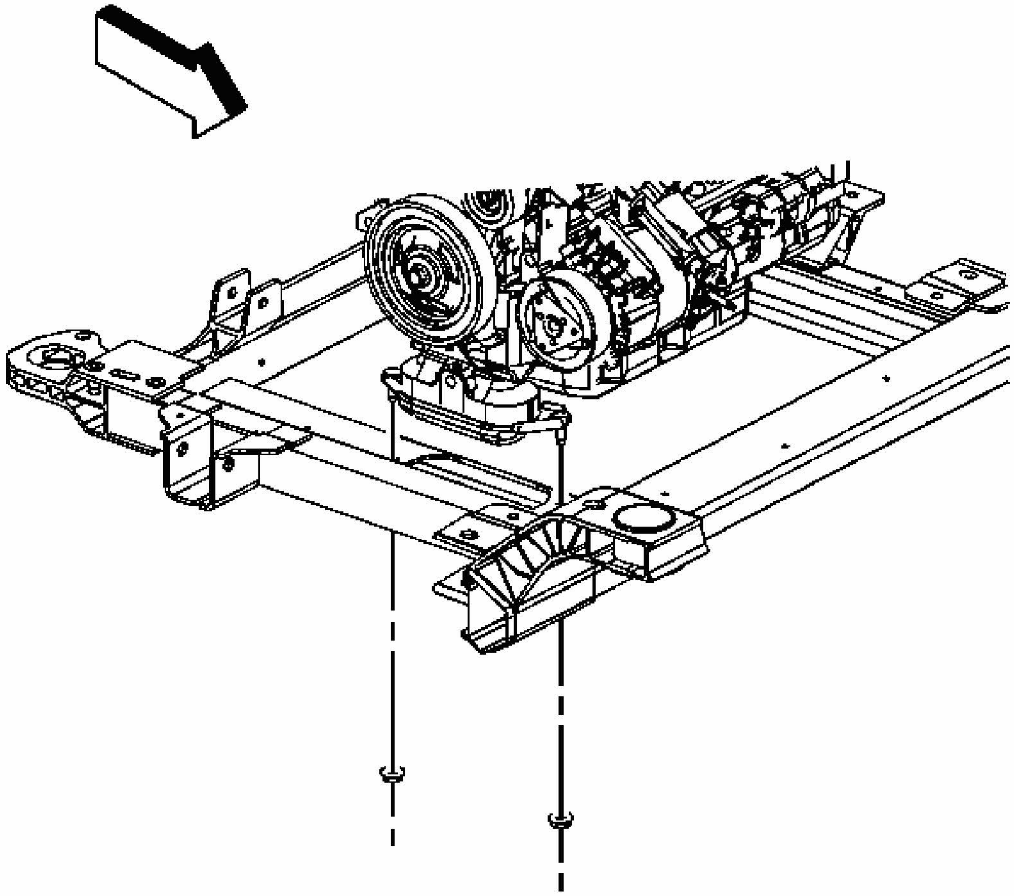


Fig. 141: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

20. Install the engine mount lower nuts.

    Tighten: Tighten the nuts to 50 N.m (37 lb ft).

21. Tighten the transaxle mount lower nuts. Refer to **Transmission Mount Replacement - Left** .

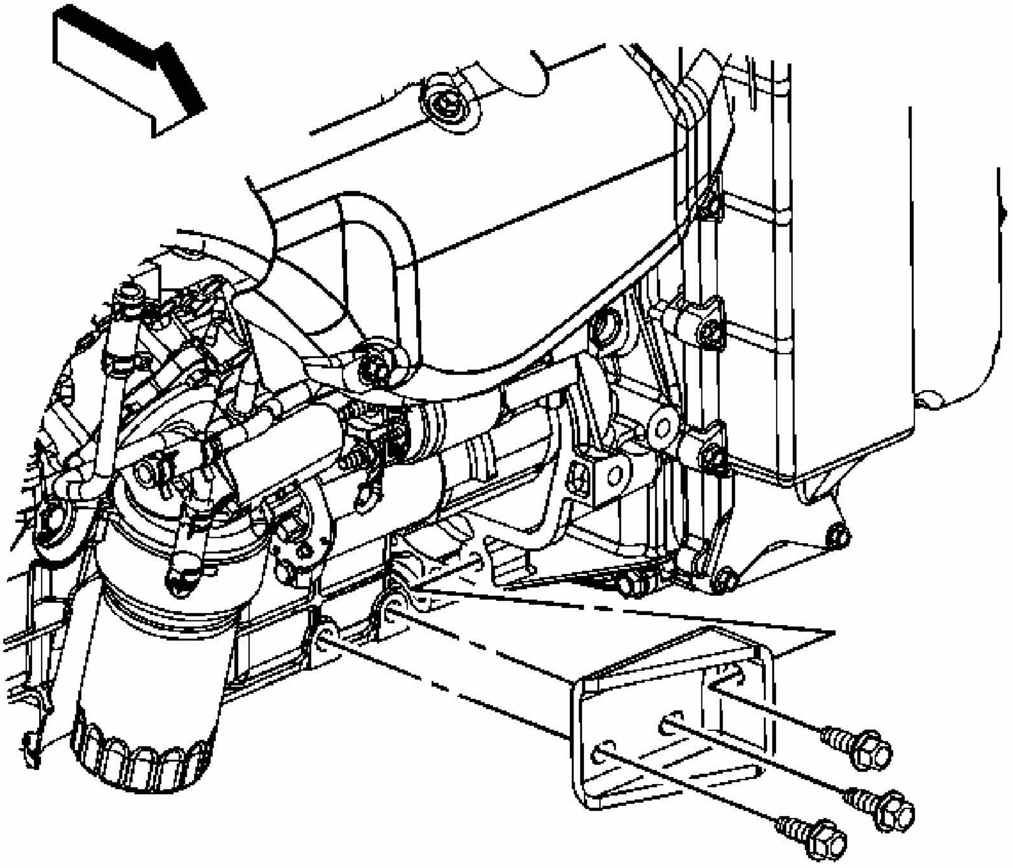


Fig. 142: View Of Front Transaxle Brace & Engine Bolts
Courtesy of GENERAL MOTORS CORP.

22. Install the front transaxle brace and the brace to engine bolts.

    Tighten: Tighten the bolts to 63 N.m (46 lb ft).

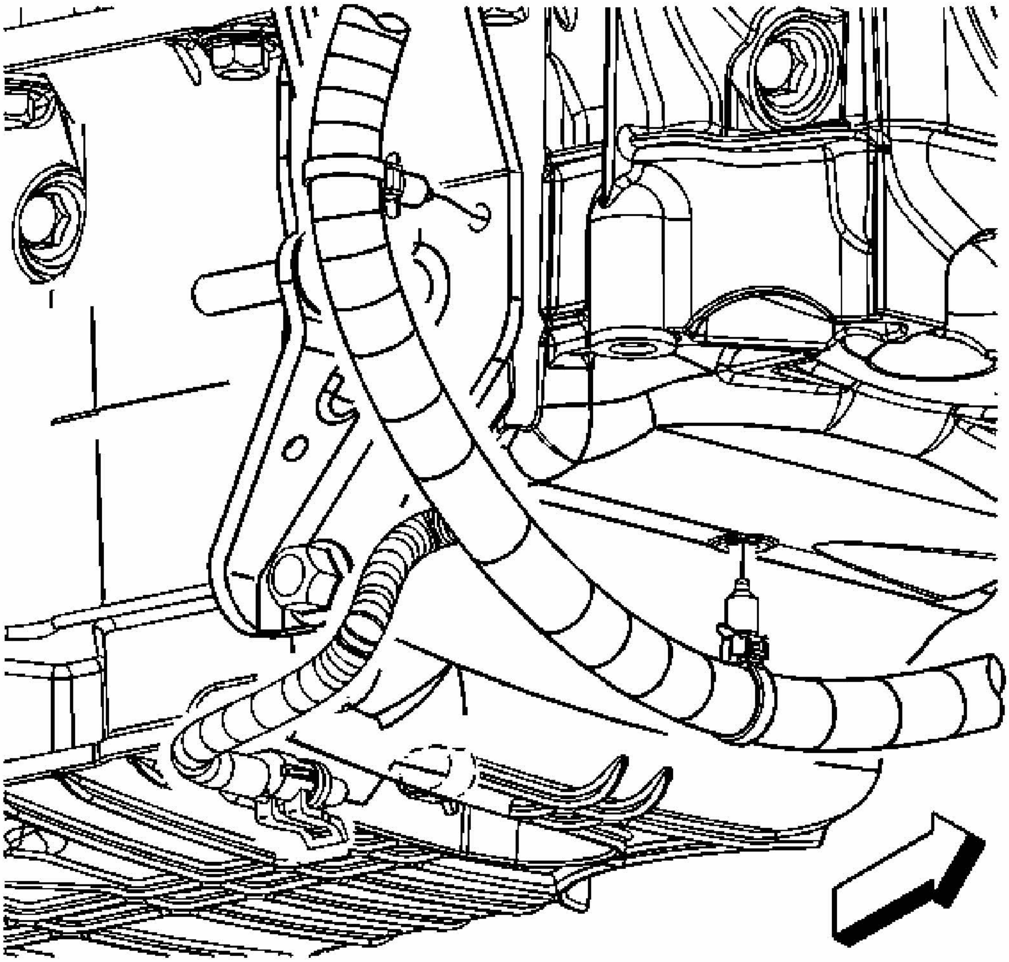


Fig. 143: Locating Engine Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

23. Connect the oil level sensor electrical connector.
24. Install the engine harness clips to the oil pan and the transaxle brace.

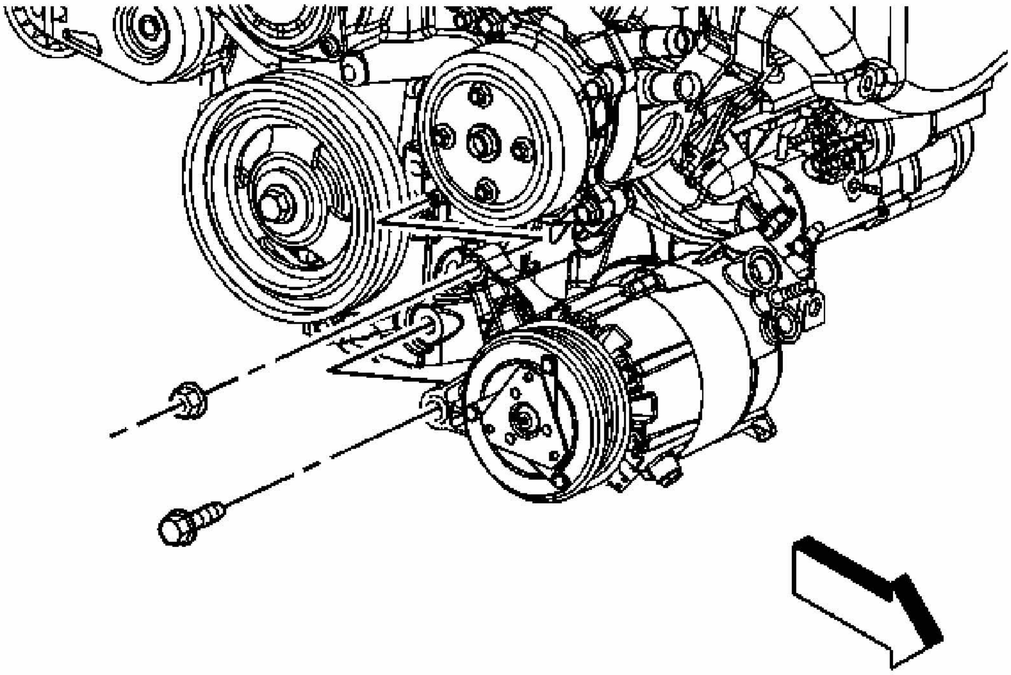


Fig. 144: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

25. Position the A/C compressor, and install the A/C compressor nut and bolt.

    Tighten: Tighten the bolt/nut to 50 N.m (37 lb ft).

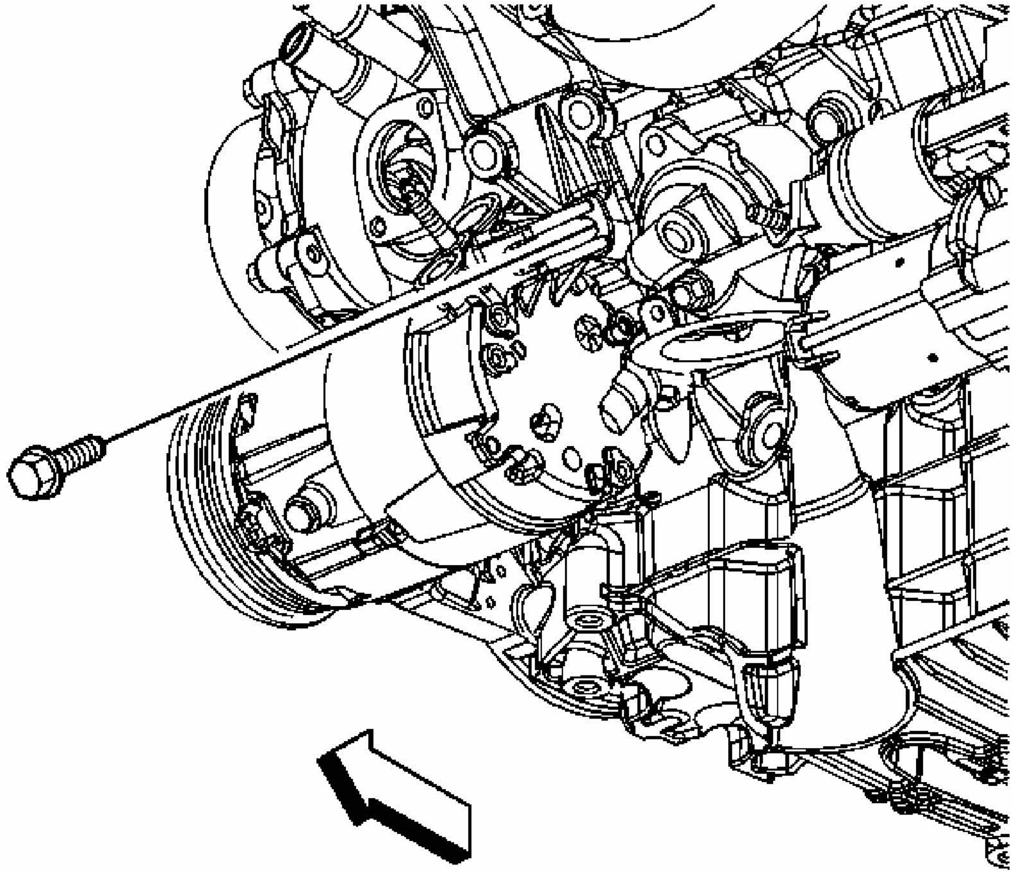


Fig. 145: Locating A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

26. Install the A/C compressor rear bolt.

    Tighten: Tighten the bolt to 50 N.m (37 lb ft).

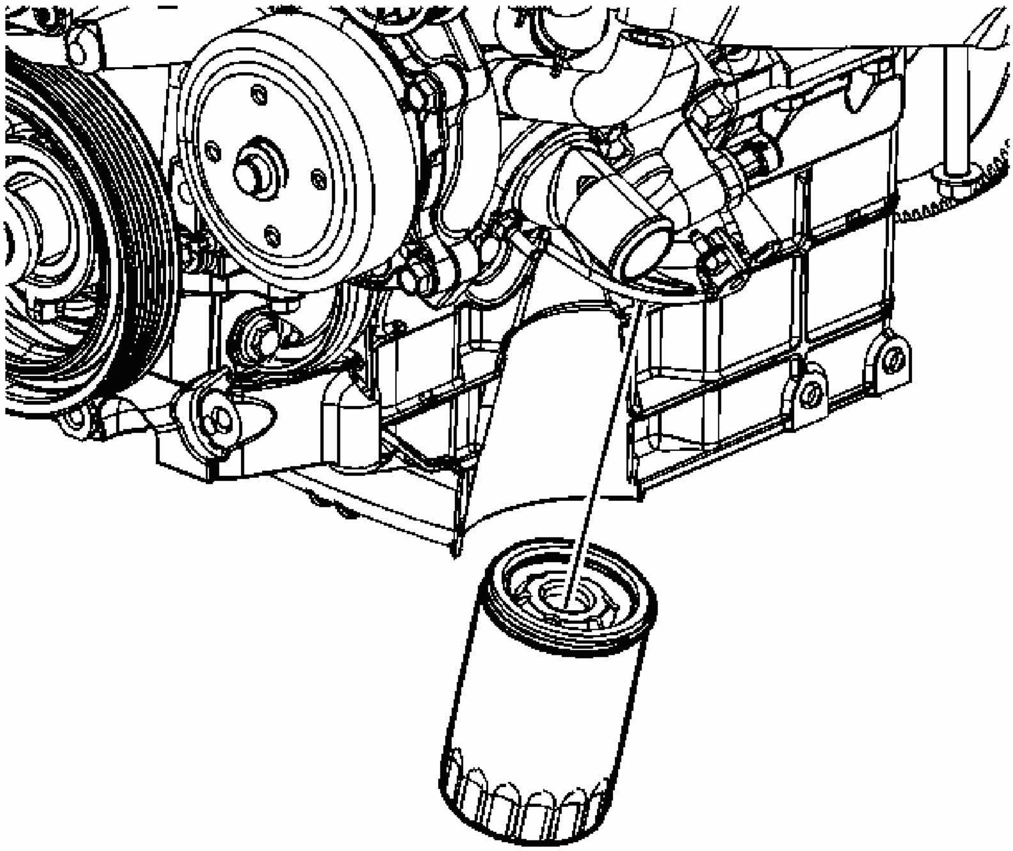


Fig. 146: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

27. Install the starter. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)** .
28. Install the oil filter.
29. Install the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)** .
30. Lower the vehicle.
31. Remove the engine support fixture.
32. Install the engine mount struts. Refer to **Engine Mount Strut Replacement**.
33. Fill the crankcase with new engine oil.
34. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .

ENGINE OIL PRESSURE SENSOR AND/OR SWITCH REPLACEMENT

Removal Procedure

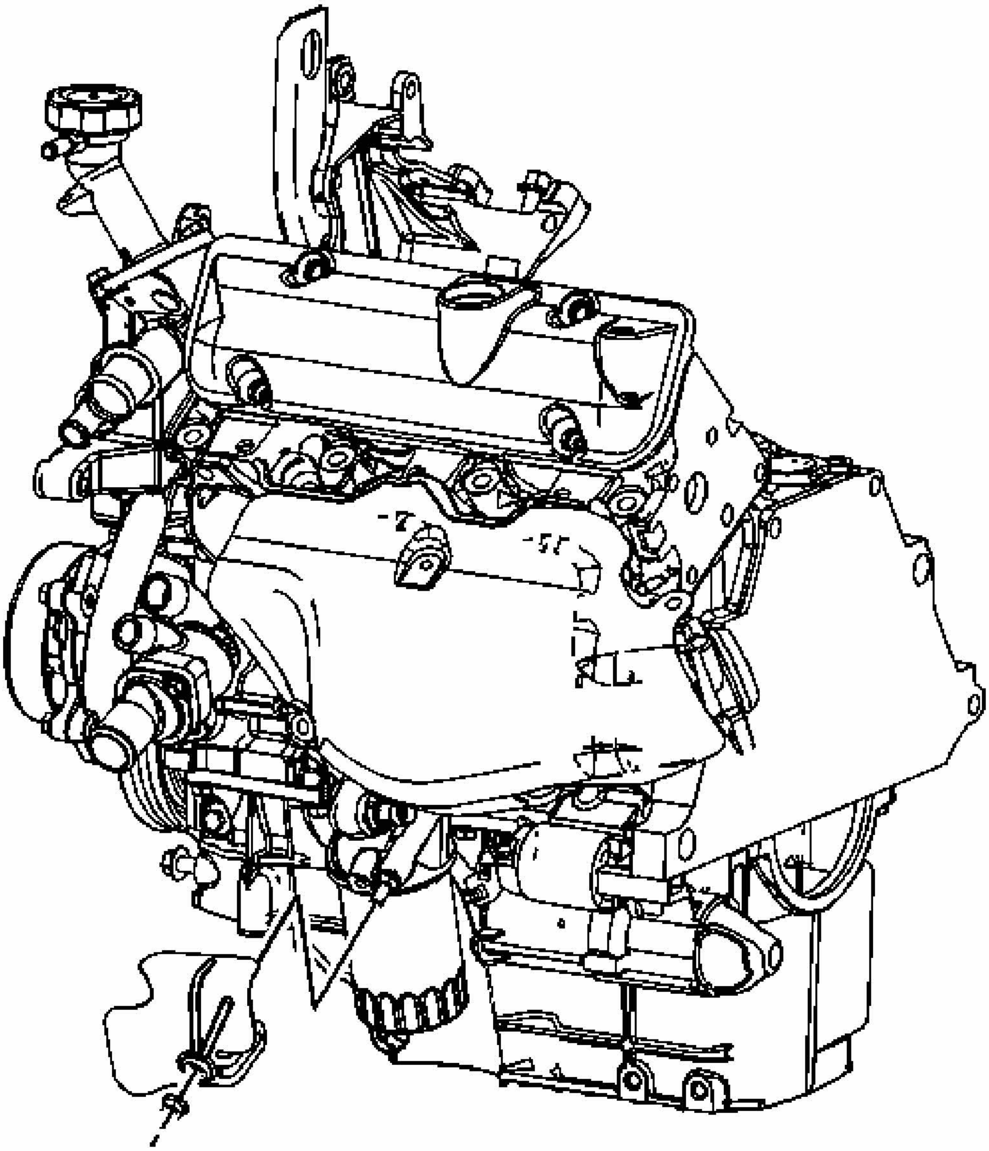


Fig. 147: Locating Oil Pressure Sensor Heat Shield & Nut
Courtesy of GENERAL MOTORS CORP.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the oil pressure sensor heat shield nut and shield.

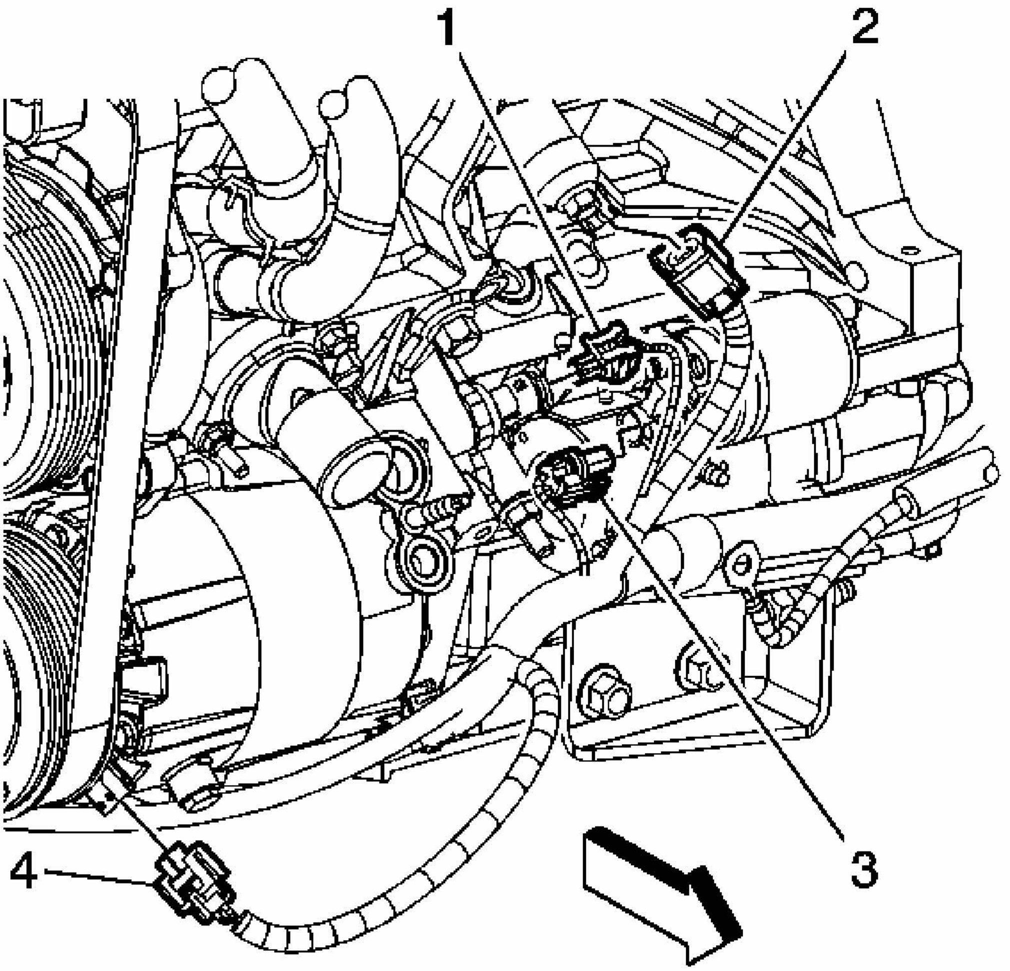


Fig. 148: Locating Starter Motor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the engine oil pressure sensor electrical connector (1).

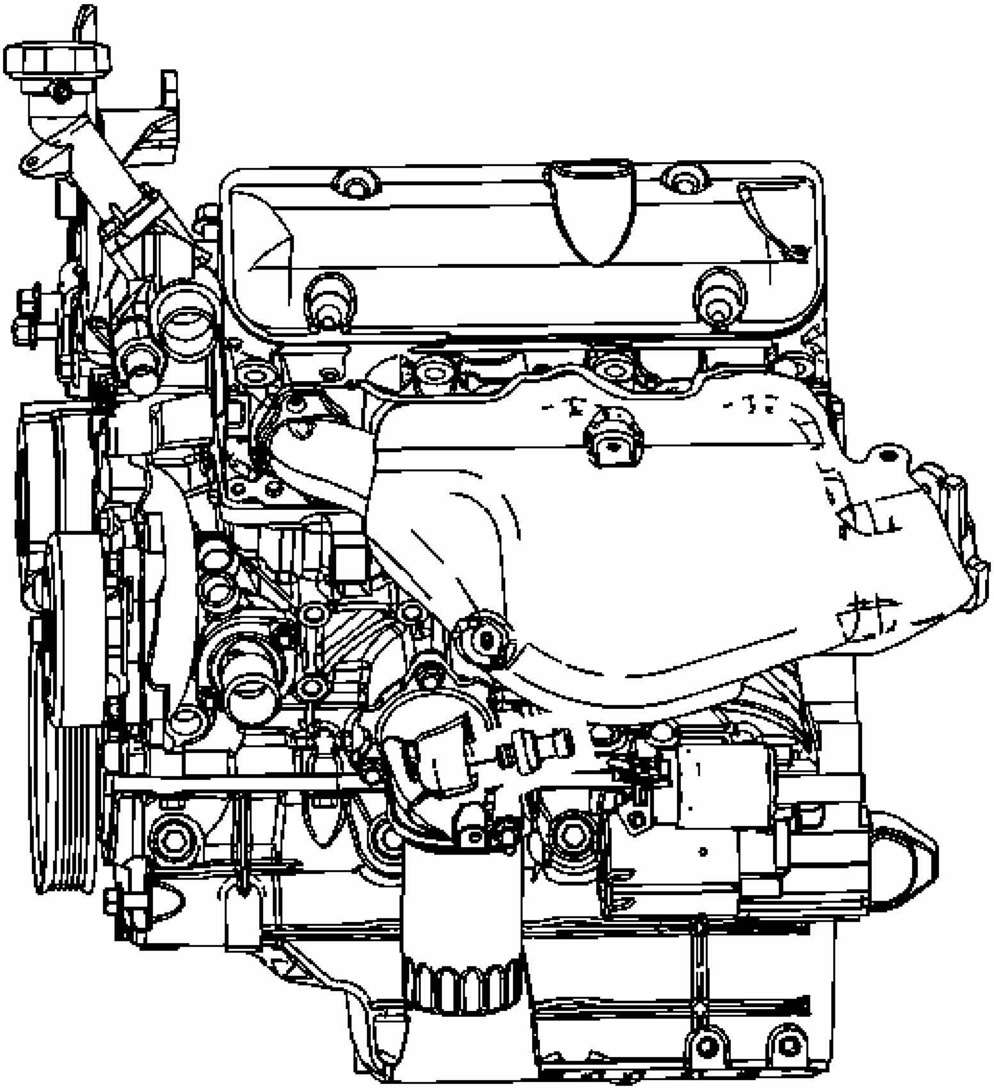


Fig. 149: Locating Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine oil pressure sensor.

Installation Procedure

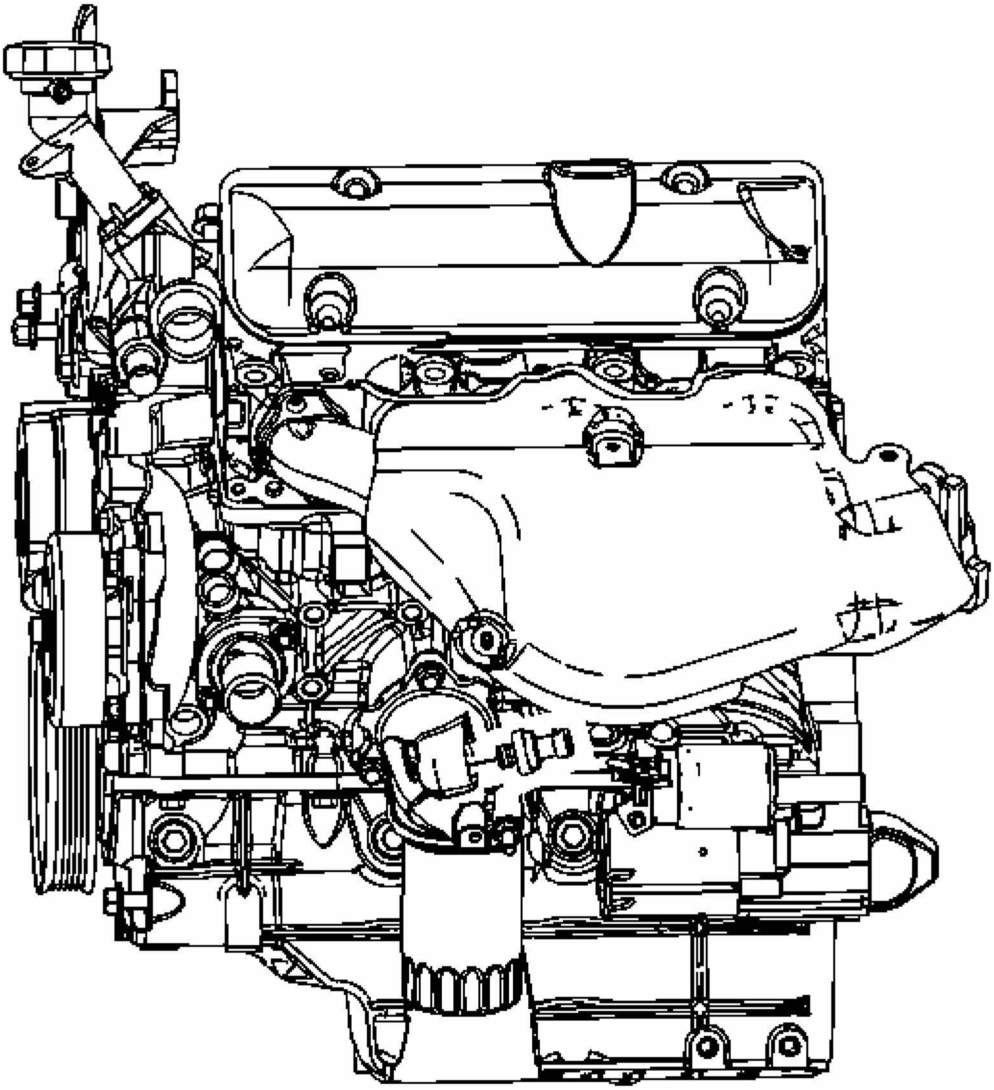


Fig. 150: Locating Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

1. Install the engine oil pressure sensor.

   Tighten: Tighten the sensor to 16 N.m (12 lb ft).

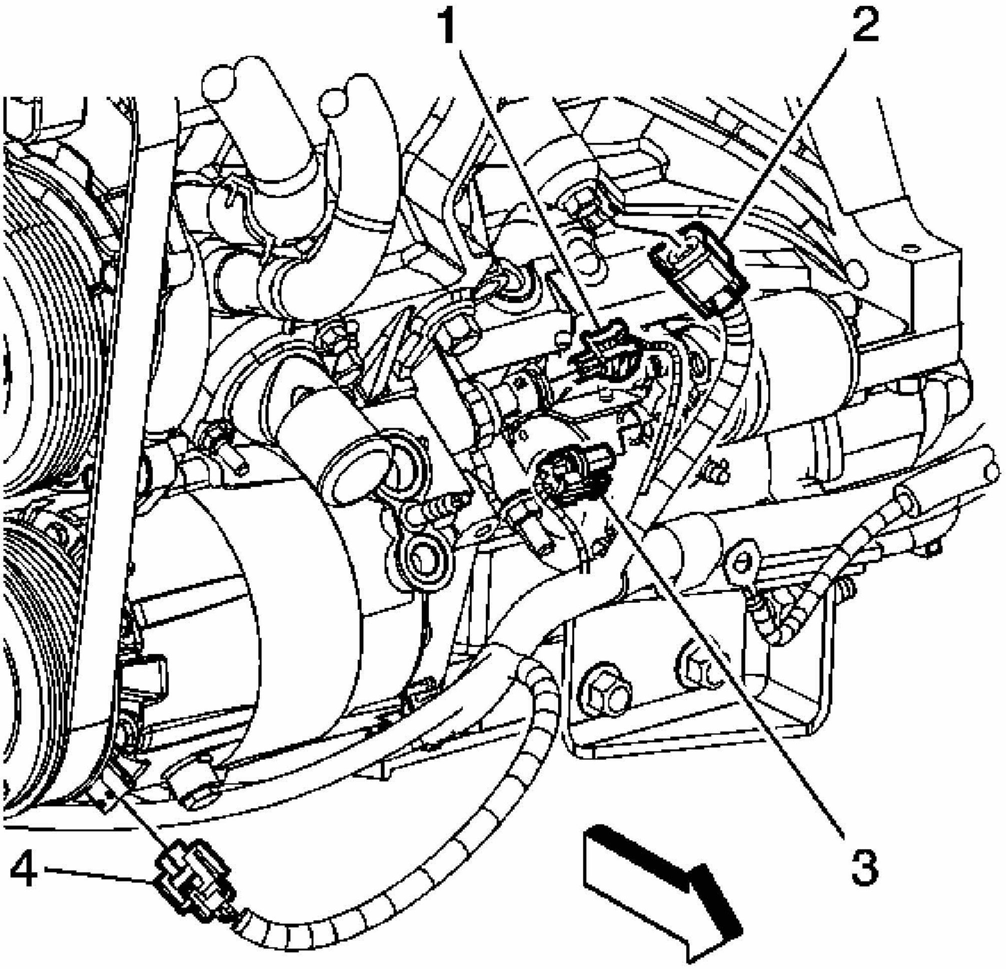


Fig. 151: Locating Starter Motor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Connect the engine oil pressure sensor electrical connector (1).

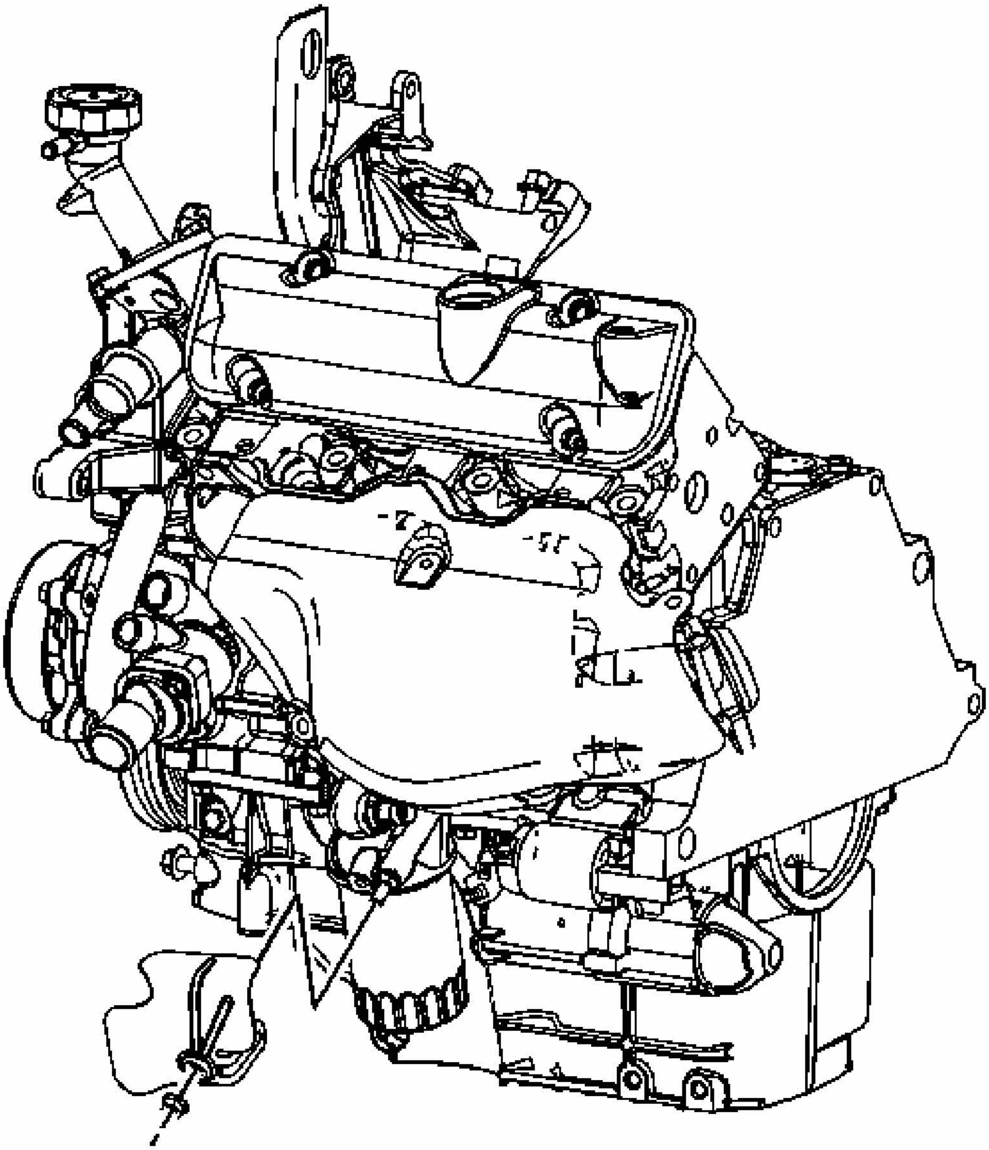


Fig. 152: Locating Oil Pressure Sensor Heat Shield & Nut
Courtesy of GENERAL MOTORS CORP.

3. Install the oil pressure sensor heat shield and nut.

   Tighten: Tighten the nut to 10 N.m (89 lb in).

4. Lower the vehicle.

ENGINE OIL LEVEL SENSOR AND/OR SWITCH REPLACEMENT

Removal Procedure

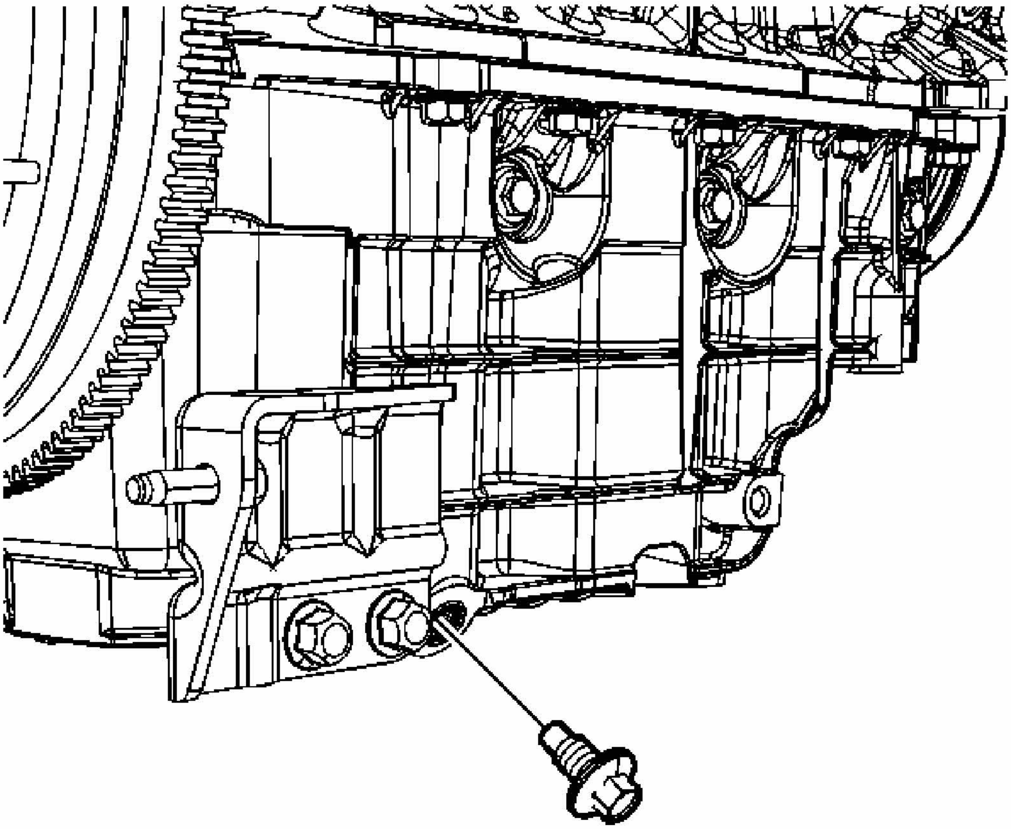


Fig. 153: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the oil pan drain plug.
3. Drain the crankcase.
4. Reinstall the oil pan drain plug.

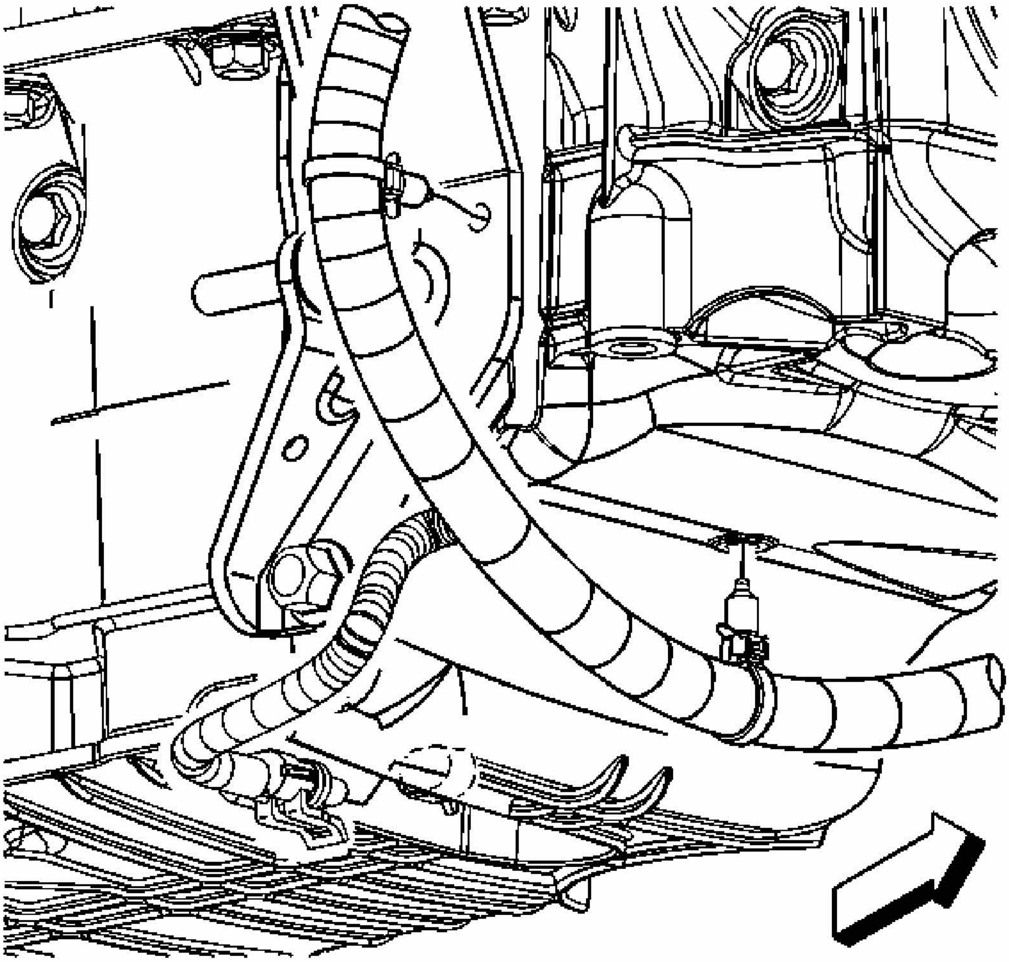


Fig. 154: Locating Engine Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the engine oil level sensor electrical connector.

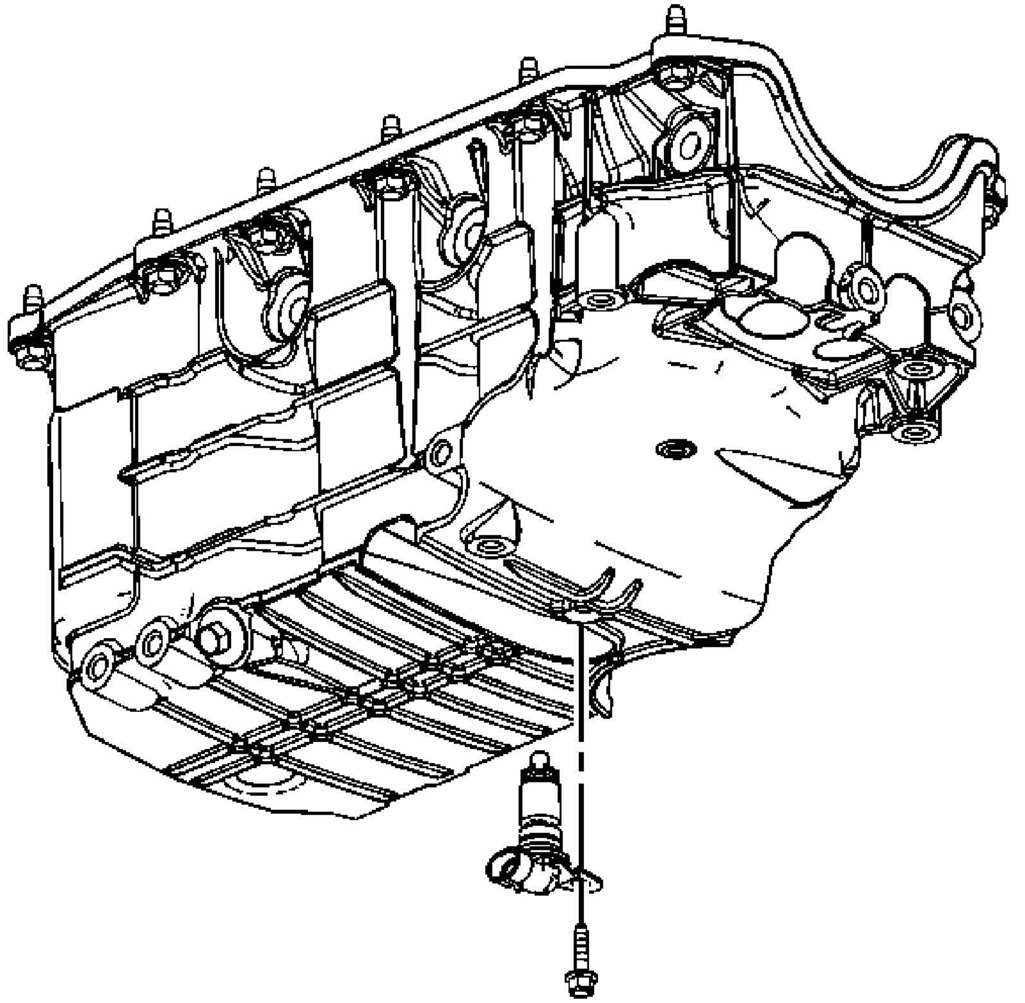


Fig. 155: Identifying Engine Oil Level Sensor Bolt & Sensor
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine oil level sensor bolt and sensor.

Installation Procedure

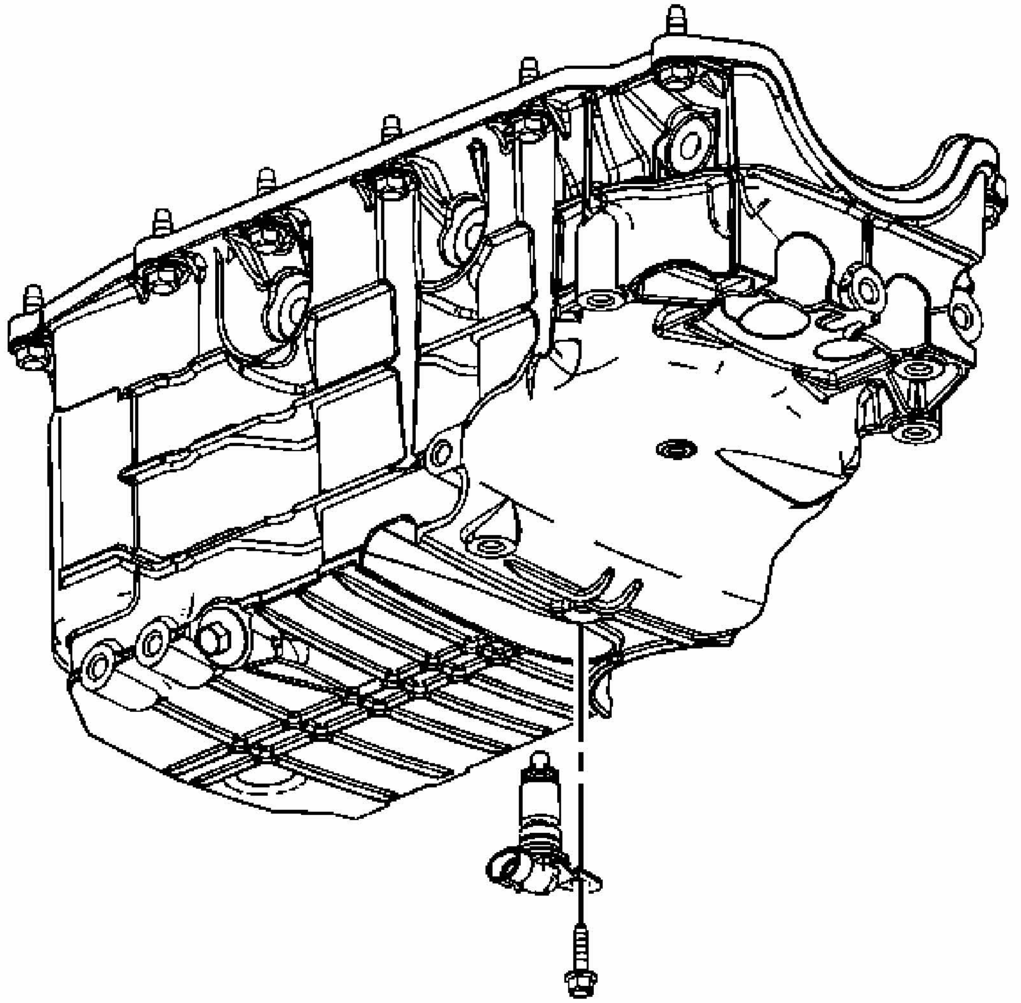


Fig. 156: Identifying Engine Oil Level Sensor Bolt & Sensor
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

1. Install the engine oil level sensor and bolt.

   Tighten: Tighten the bolt to 10 N.m (89 lb in).

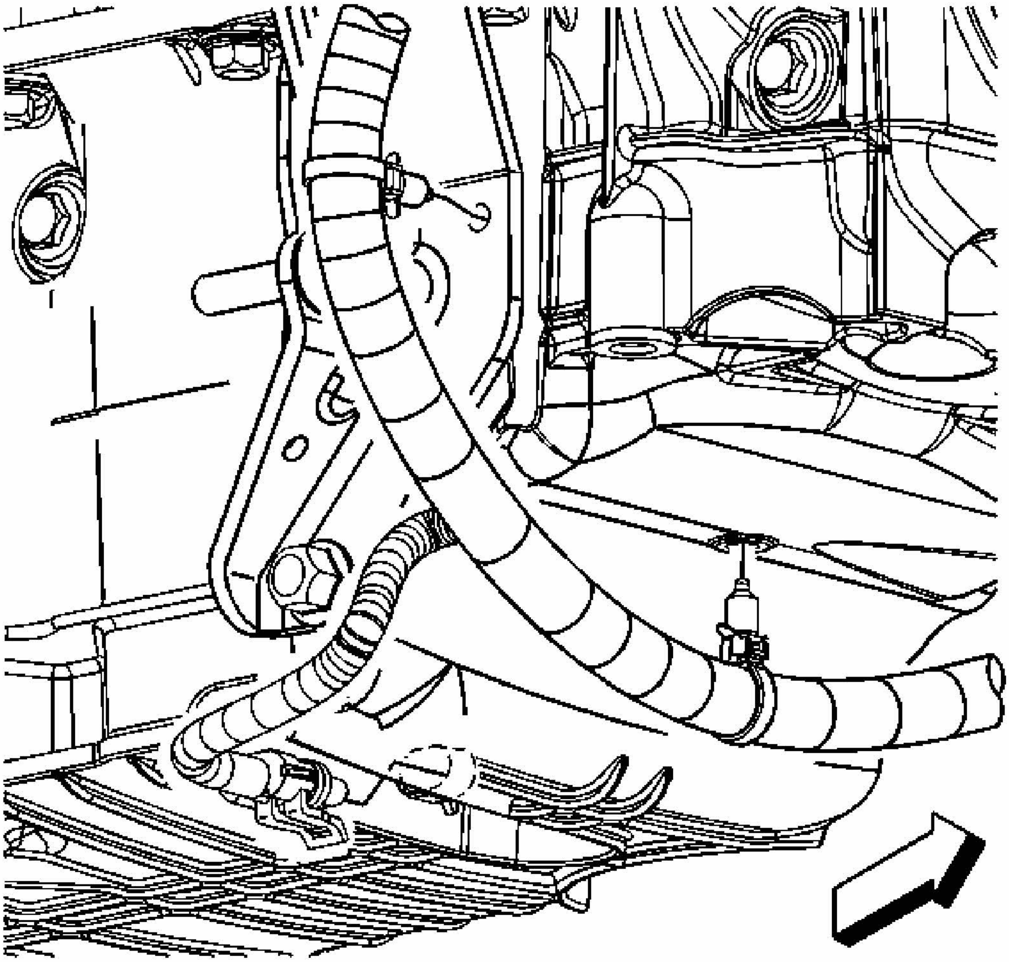


Fig. 157: Locating Engine Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Connect the engine oil level sensor electrical connector.
3. Lower the vehicle.
4. Refill the crankcase with new engine oil.

OIL PUMP REPLACEMENT

Removal Procedure

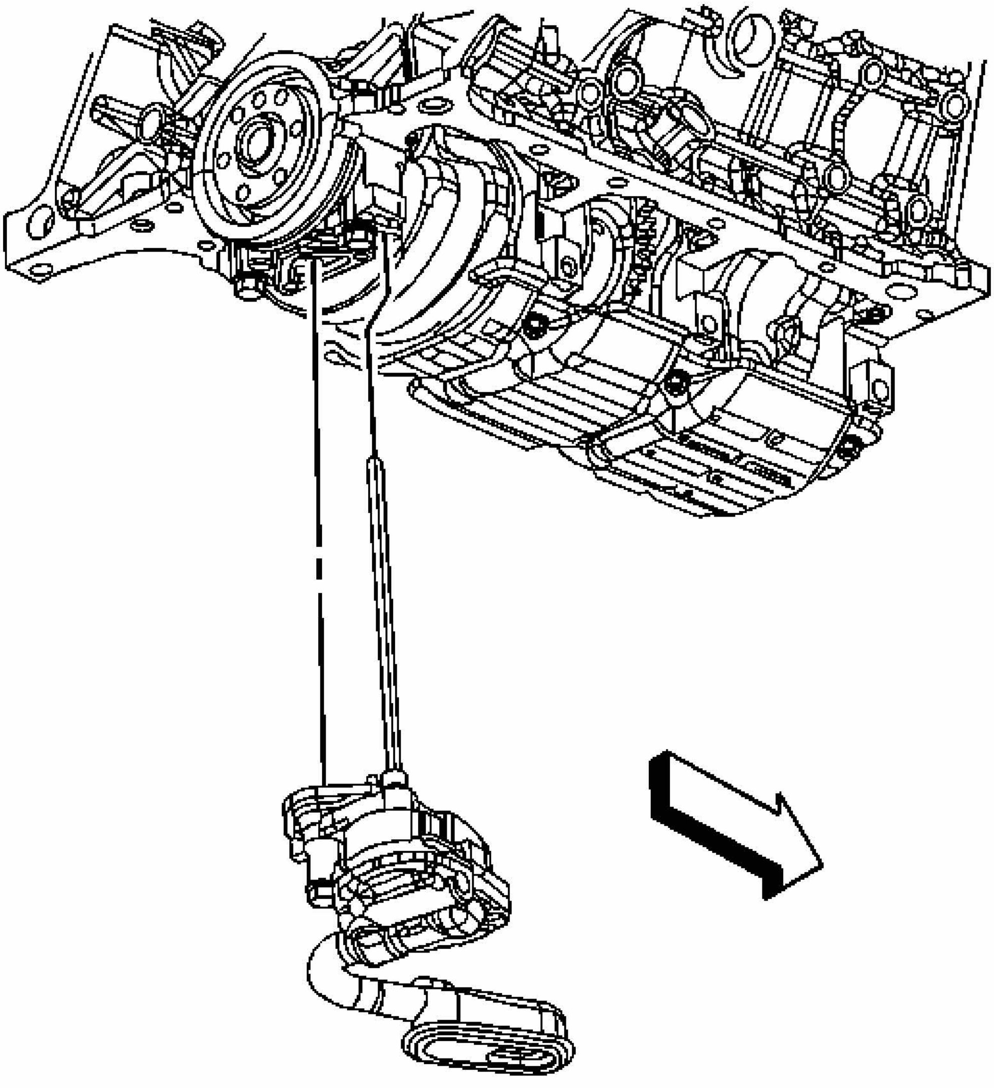


Fig. 158: Identifying Oil Pump & Oil Pump Drive Shaft
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pan. Refer to **Oil Pan Replacement**.
2. Remove the oil pump bolt.
3. Remove the oil pump and the oil pump drive shaft.

Installation Procedure

IMPORTANT: Rotate the oil pump drive shaft as necessary in order to obtain the engagement with the oil pump drive unit.

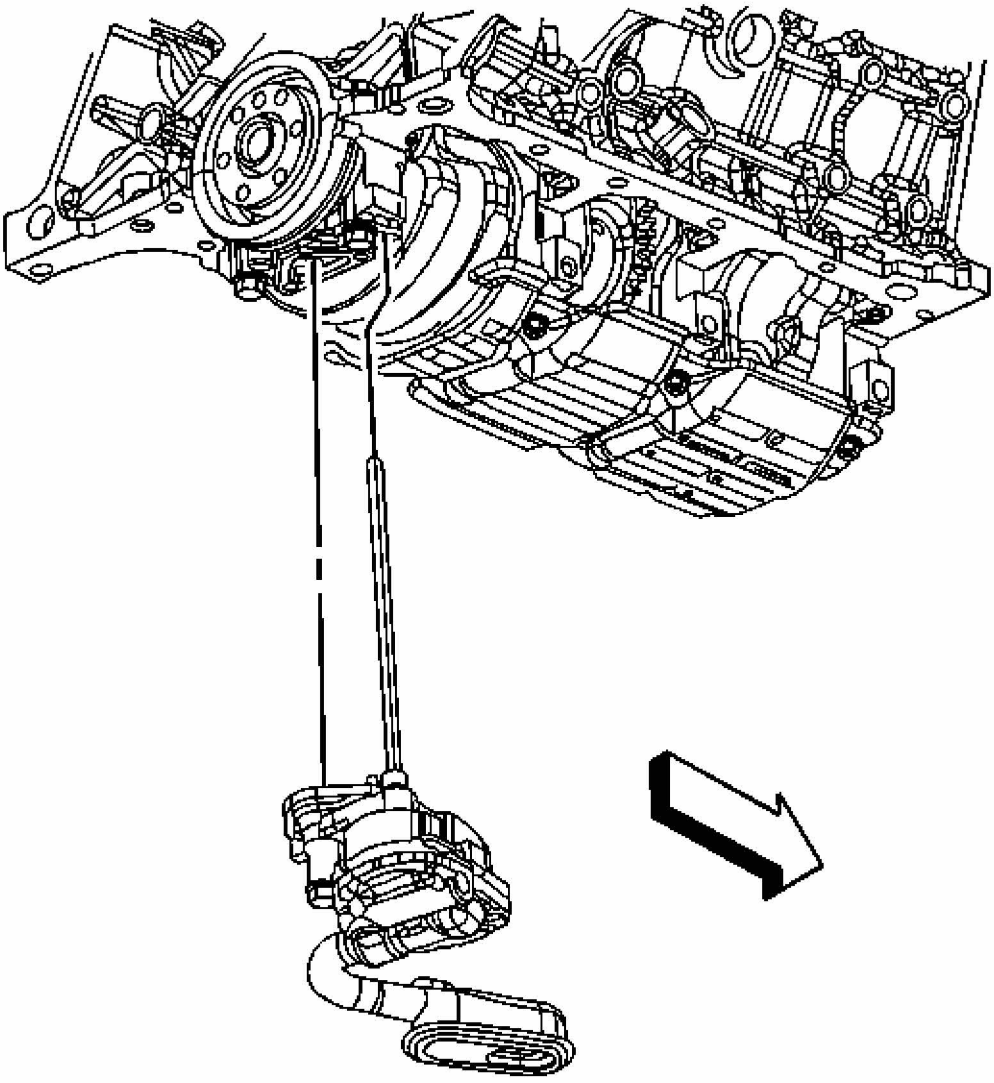


Fig. 159: Identifying Oil Pump & Oil Pump Drive Shaft
Courtesy of GENERAL MOTORS CORP.

1. Install the oil pump drive shaft and the oil pump.

NOTE: **Refer to Fastener Notice .**

2. Install the oil pump bolt.

Tighten: Tighten the bolt to 41 N.m (30 lb ft).

3. Install the oil pan. Refer to **Oil Pan Replacement**.

OIL PUMP DRIVE REPLACEMENT

Removal Procedure

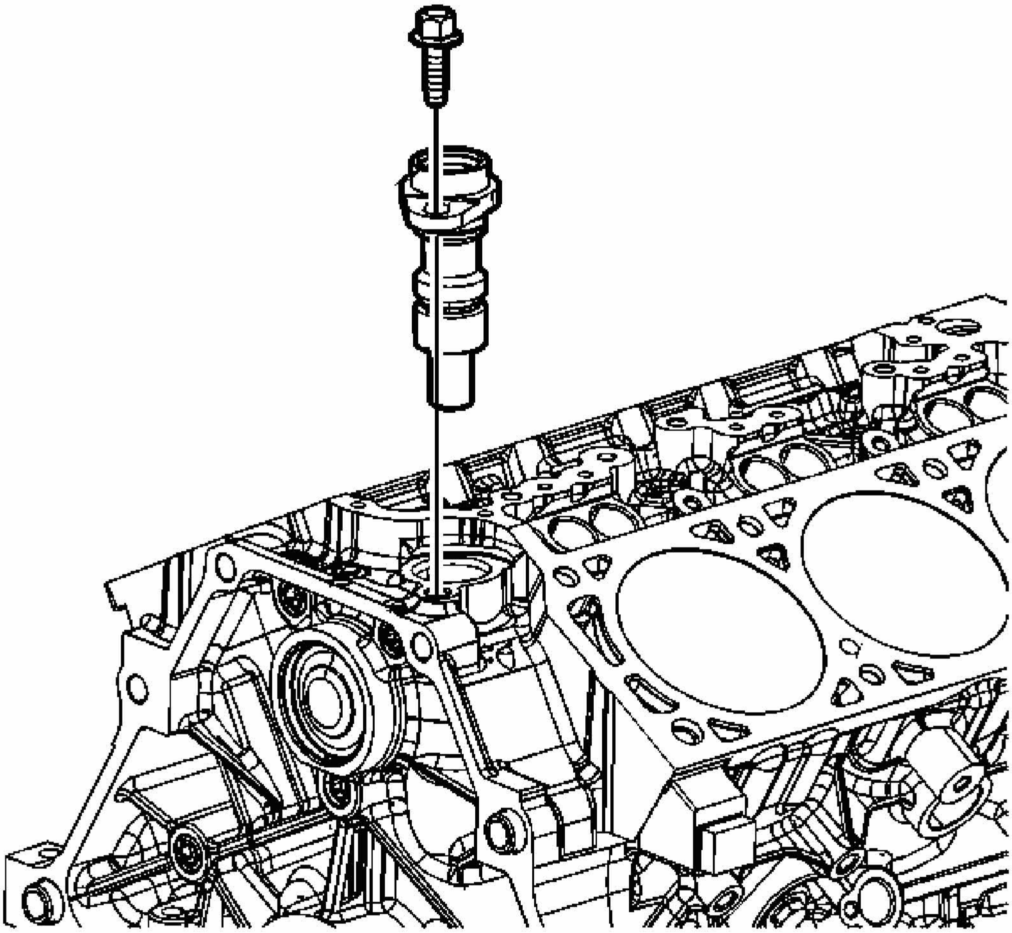


Fig. 160: Identifying Oil Pump Drive
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Remove the oil pump drive bolt.
3. Remove the oil pump drive.
4. Remove the oil pump drive seal.

Installation Procedure

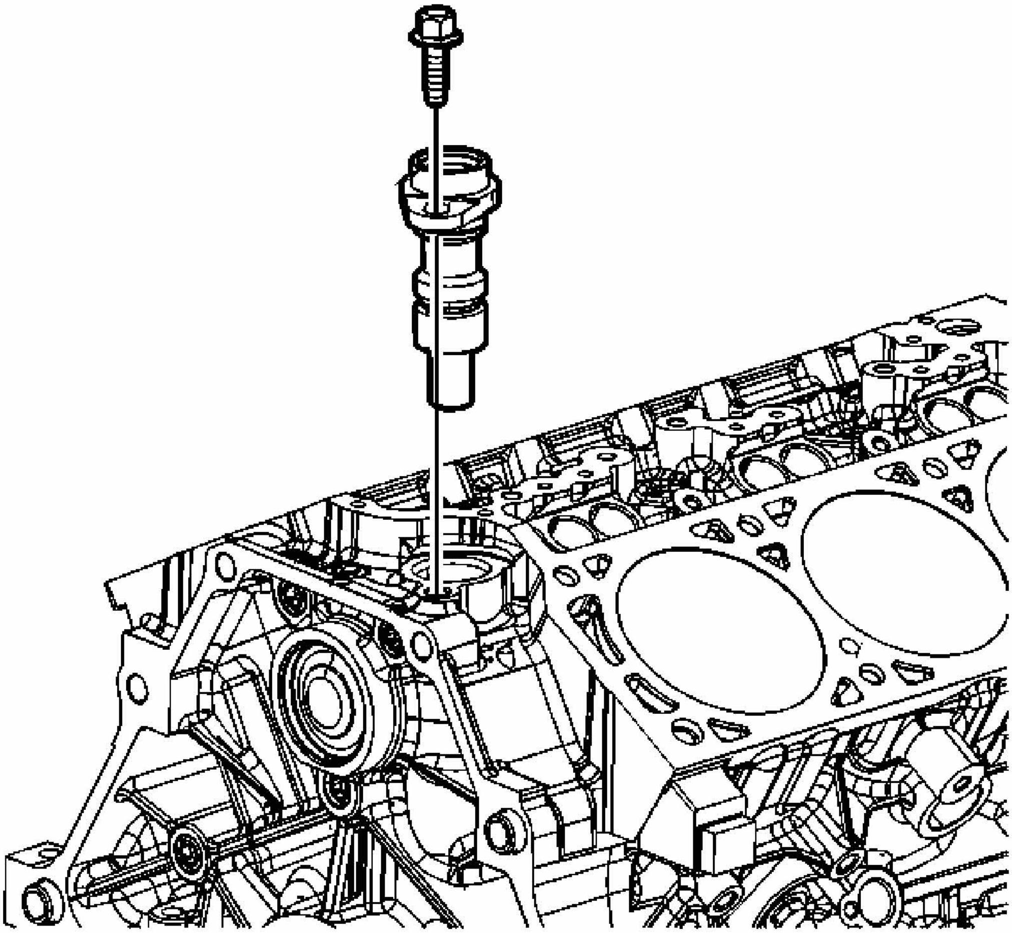


Fig. 161: Identifying Oil Pump Drive
Courtesy of GENERAL MOTORS CORP.

1. Install the oil pump drive seal. Coat the seal or bore in the engine block with clean engine oil.
2. Apply prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent to the oil pump drive gear.
3. Install the oil pump drive.

NOTE: **Refer to Fastener Notice .**

4. Install the oil pump drive bolt.

Tighten: Tighten the bolt to 50 N.m (37 lb ft).

5. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

Tools Required

J 35468 Cover Aligner and Seal Installer. See **Special Tools**.

Removal Procedure

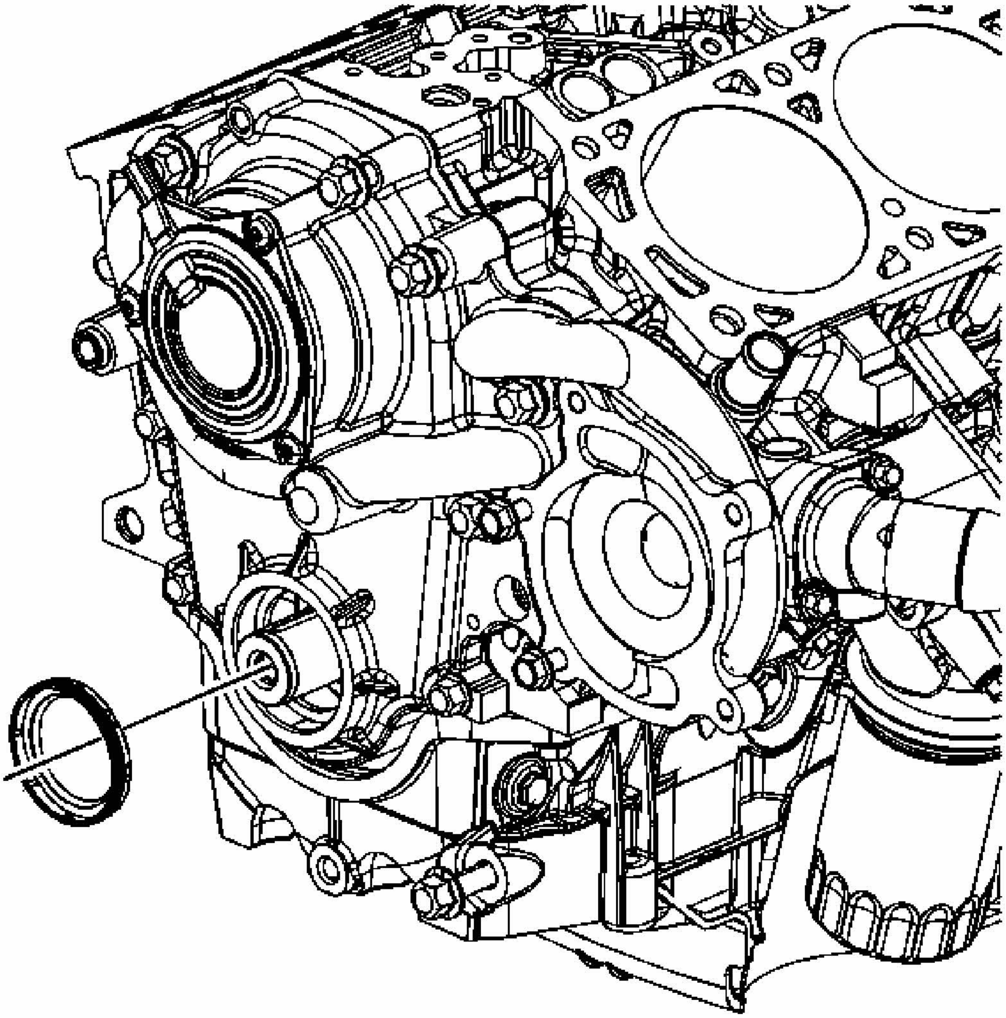


Fig. 162: Identifying Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

2. Remove the crankshaft key from the keyway.
3. Pry out the crankshaft front oil seal using a suitable tool. Use care not to damage the engine front cover or the crankshaft.

Installation Procedure

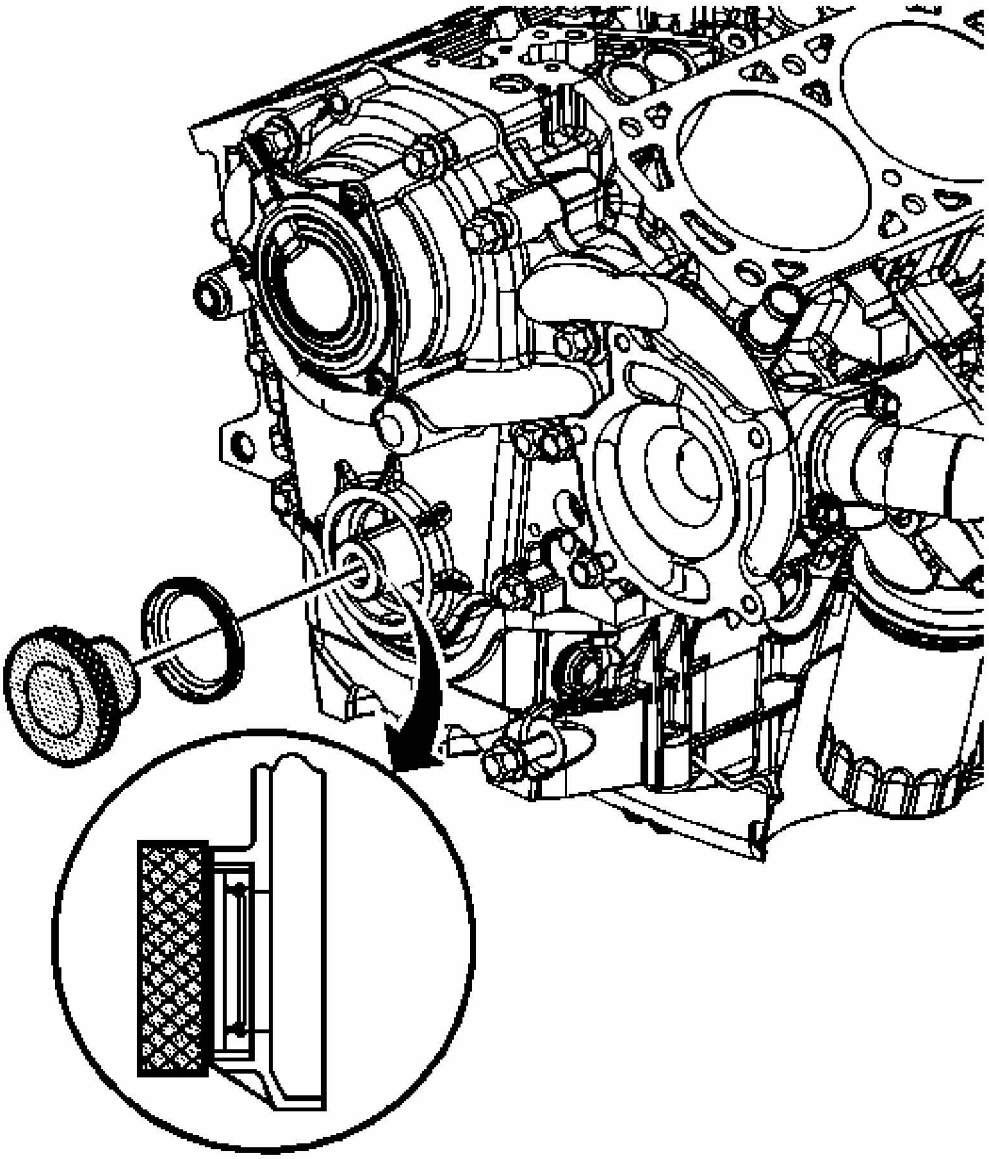


Fig. 163: View Of Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the NEW oil seal with clean engine oil.
2. Align the **J 35468** and the crankshaft front oil seal with the engine front cover and crankshaft. See **Special Tools**.
3. Install the crankshaft front oil seal using **J 35468** and a suitable tool. See **Special Tools**.
4. Install the crankshaft key into the keyway.
5. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

CAMSHAFT POSITION ACTUATOR MAGNET REPLACEMENT

Removal Procedure

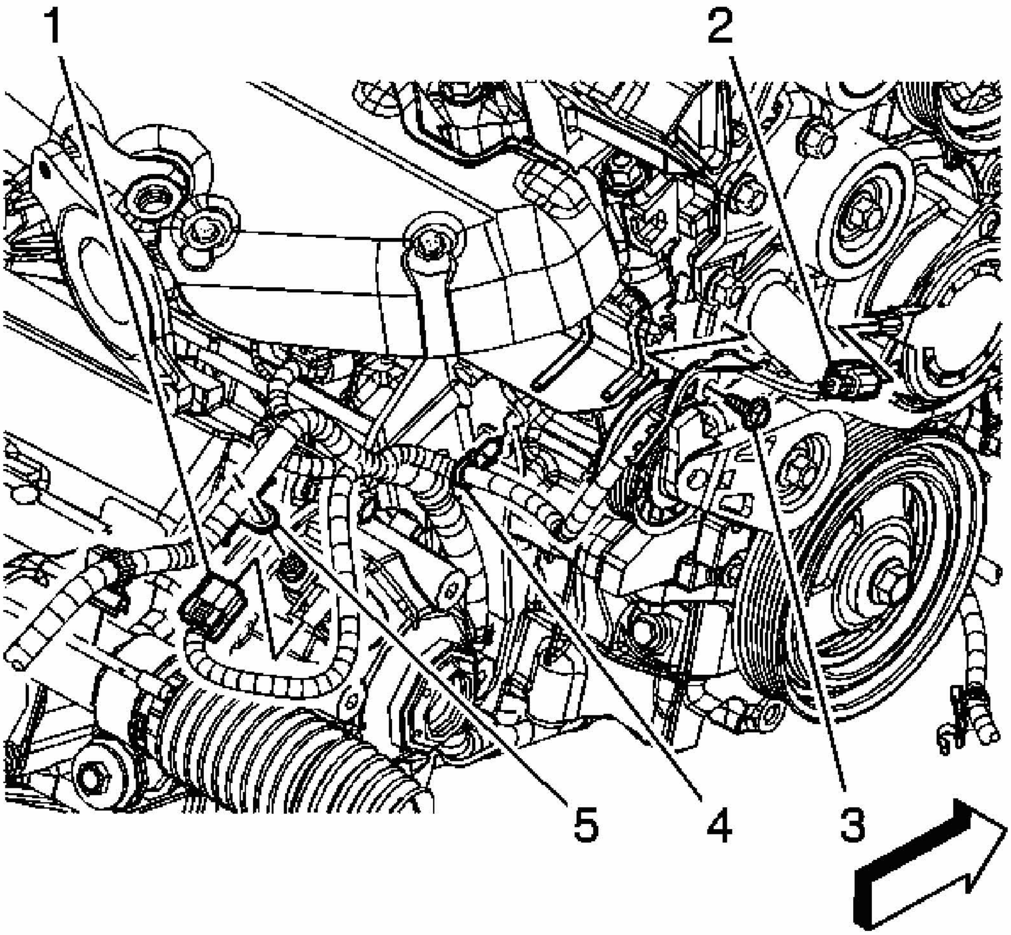


Fig. 164: Locating Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Disconnect the camshaft position actuator magnet electrical connector (2).

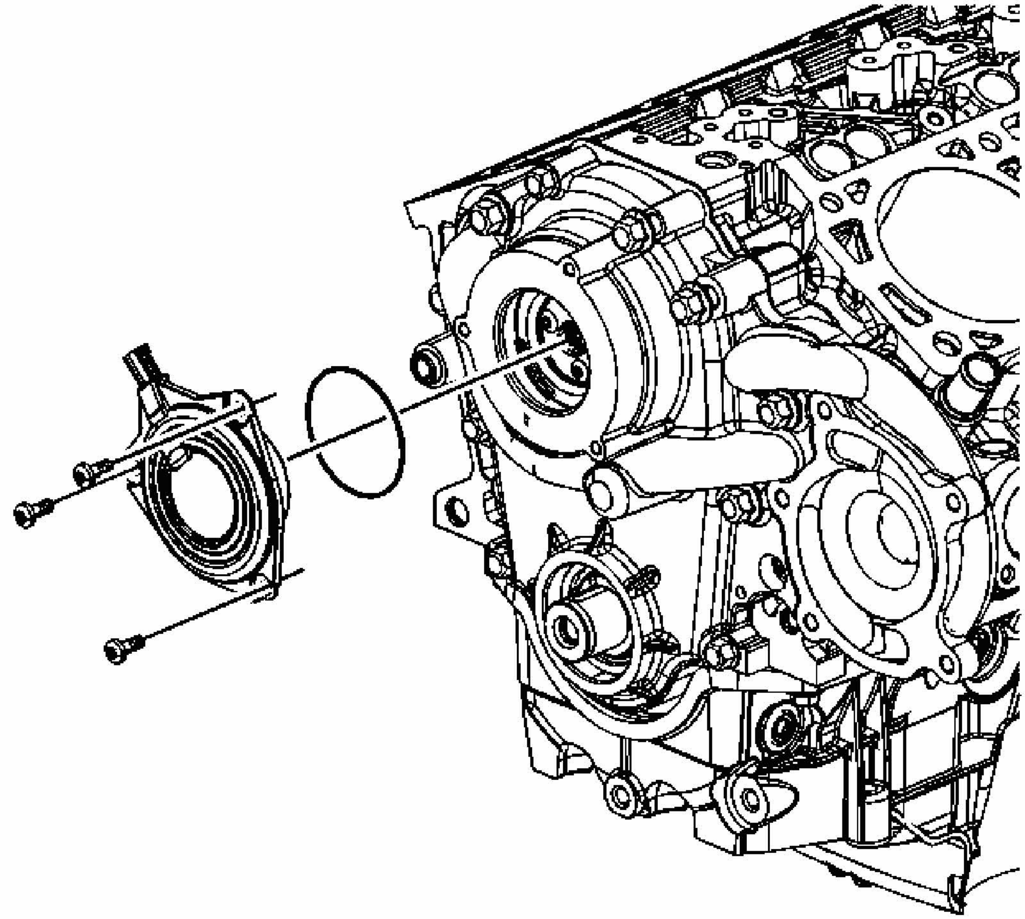


Fig. 165: Identifying Camshaft Position Actuator Magnet
Courtesy of GENERAL MOTORS CORP.

3. Remove the camshaft position actuator magnet bolts.
4. Remove the camshaft position actuator magnet and O-ring seal.

Installation Procedure

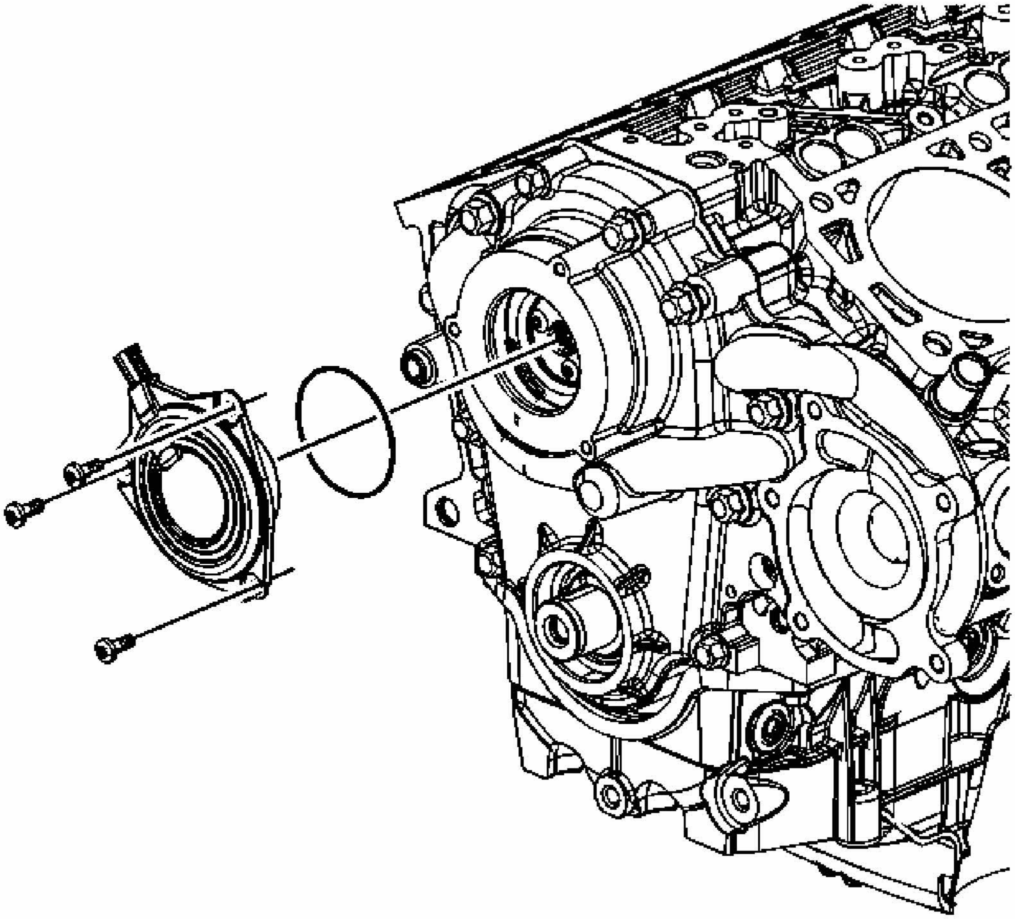


Fig. 166: Identifying Camshaft Position Actuator Magnet
Courtesy of GENERAL MOTORS CORP.

1. Install the camshaft position actuator magnet O-ring seal and magnet.

NOTE: **Refer to Fastener Notice .**

2. Install the camshaft position actuator magnet bolts.

Tighten: Tighten the bolts to 10 N.m (89 lb in).

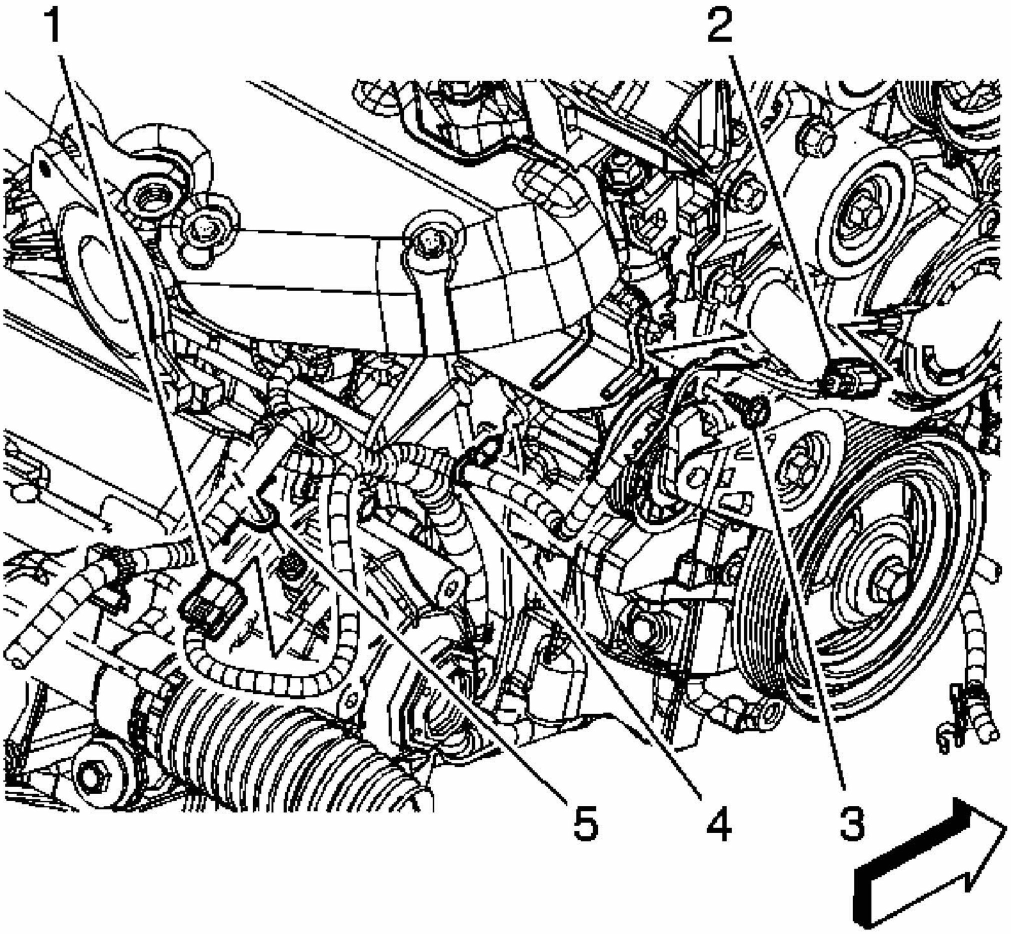


Fig. 167: Locating Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the camshaft position actuator magnet electrical connector (2).
4. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

ENGINE FRONT COVER REPLACEMENT

Removal Procedure

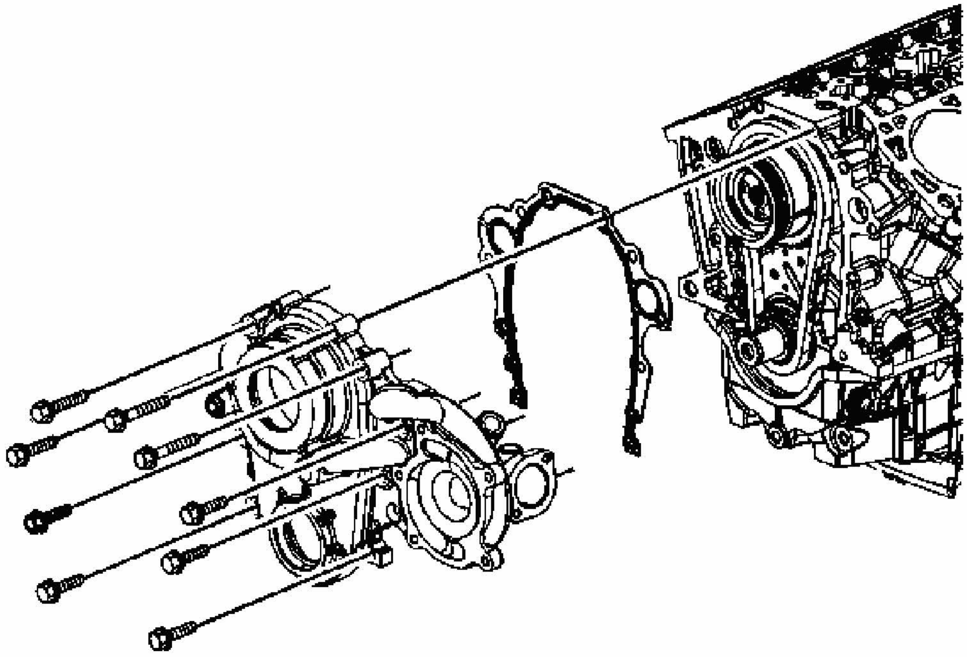


Fig. 168: Identifying Engine Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
2. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
3. Remove the oil pan. Refer to **Oil Pan Replacement**.
4. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
5. Remove the crankshaft position actuator magnet. Refer to **Camshaft Position Actuator Magnet Replacement**.
6. Remove the thermostat housing. Refer to **Thermostat Housing Replacement (RPOs LZE/LZ4/LZ9)** or **Thermostat Housing Replacement (RPO LS4)** .
7. Remove the water pump. Refer to **Water Pump Replacement (RPOs LZE/LZ4/LZ9)**

or **Water Pump Replacement (RPO LS4)** .

8. Remove the engine front cover bolts.
9. Remove the engine front cover.
10. Remove the engine front cover gasket.

Installation Procedure

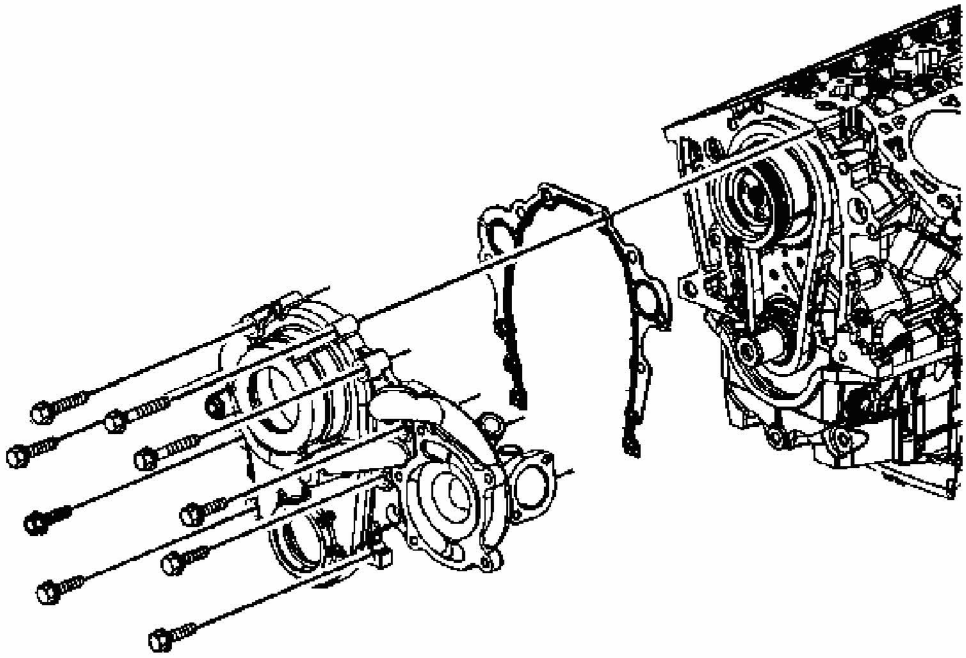


Fig. 169: Identifying Engine Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the engine front cover gasket.
2. Install the engine front cover.

NOTE: **Refer to Fastener Notice .**

3. Install the engine front cover bolts.

Tighten: Tighten the bolts to 257 N.m (18 lb ft).

4. Install the water pump. Refer to **Water Pump Replacement (RPOs LZE/LZ4/LZ9)** or **Water Pump Replacement (RPO LS4)** .
5. Install the thermostat housing. Refer to **Thermostat Housing Replacement (RPOs LZE/LZ4/LZ9)** or **Thermostat Housing Replacement (RPO LS4)** .
6. Install the crankshaft position actuator magnet. Refer to **Camshaft Position Actuator Magnet Replacement**.
7. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
8. Install the oil pan. Refer to **Oil Pan Replacement**.
9. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
10. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

TIMING CHAIN AND SPROCKETS REPLACEMENT

Tools Required

EN-47719 Tensioner Compressor. See **Special Tools**.

Removal Procedure

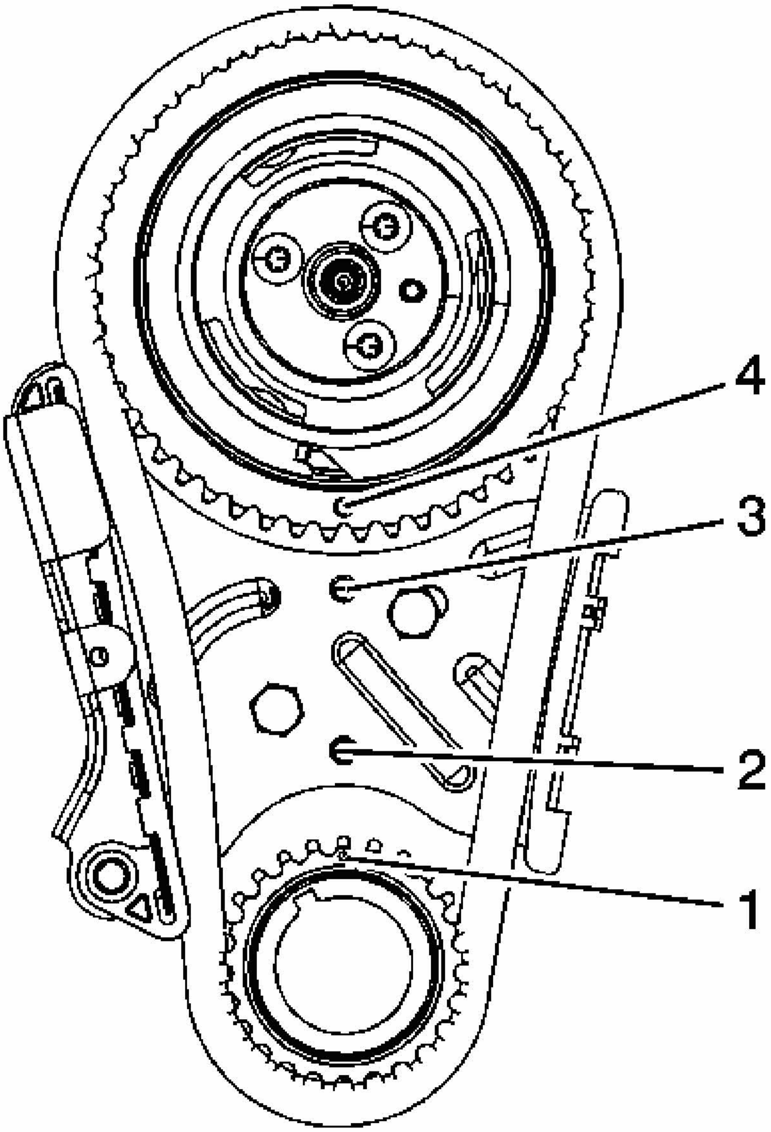


Fig. 170: Identifying Timing Marks & Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Align the crankshaft timing mark (1) to the timing mark on the bottom of the timing chain tensioner (2).
3. Align the timing mark on the camshaft gear (3) with the timing mark on top of the timing chain tensioner (4).

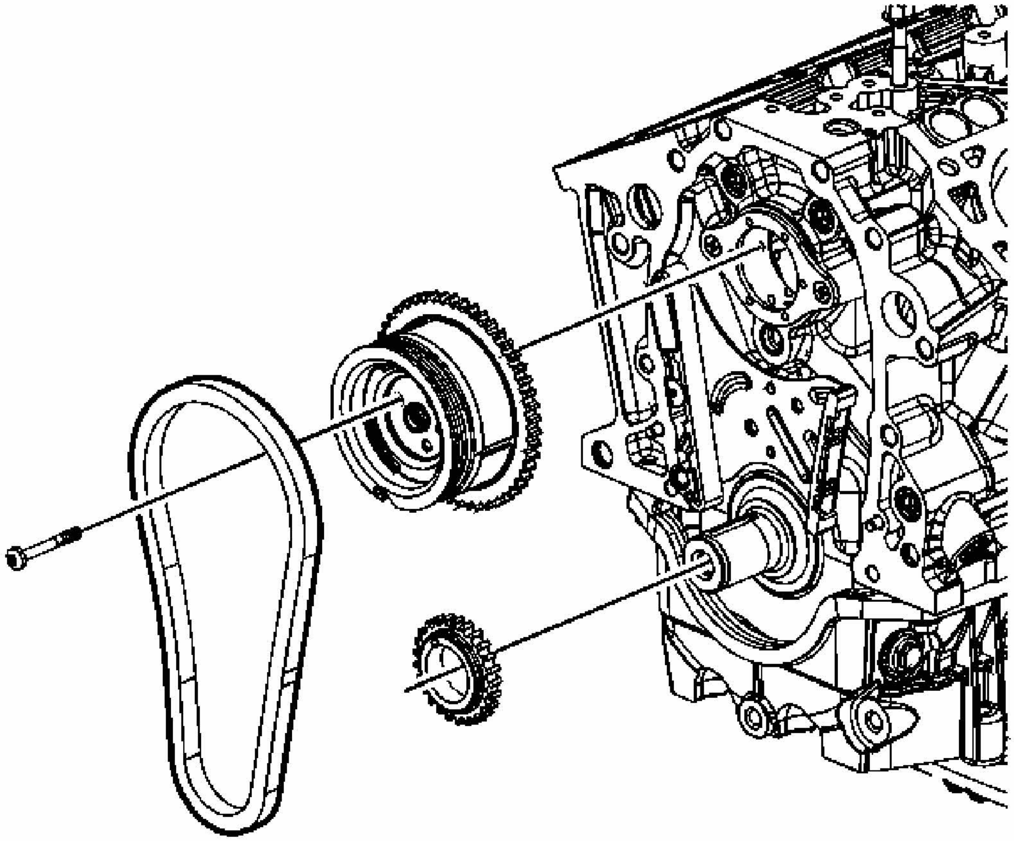


Fig. 171: View Of Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

4. Remove the camshaft sprocket bolts.
5. Remove the timing chain, camshaft, and crankshaft sprockets.

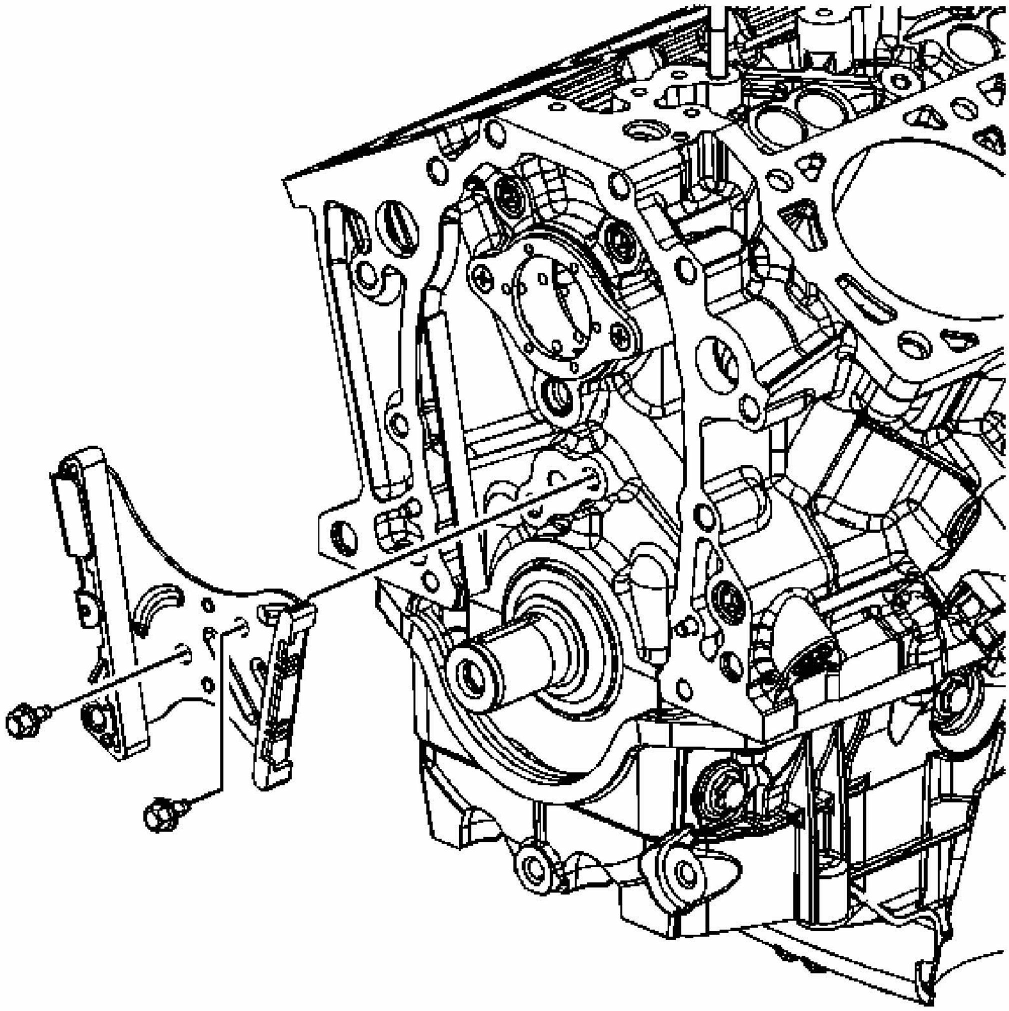


Fig. 172: View Of Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the timing chain tensioner bolts.
7. Remove the timing chain tensioner.

Installation Procedure

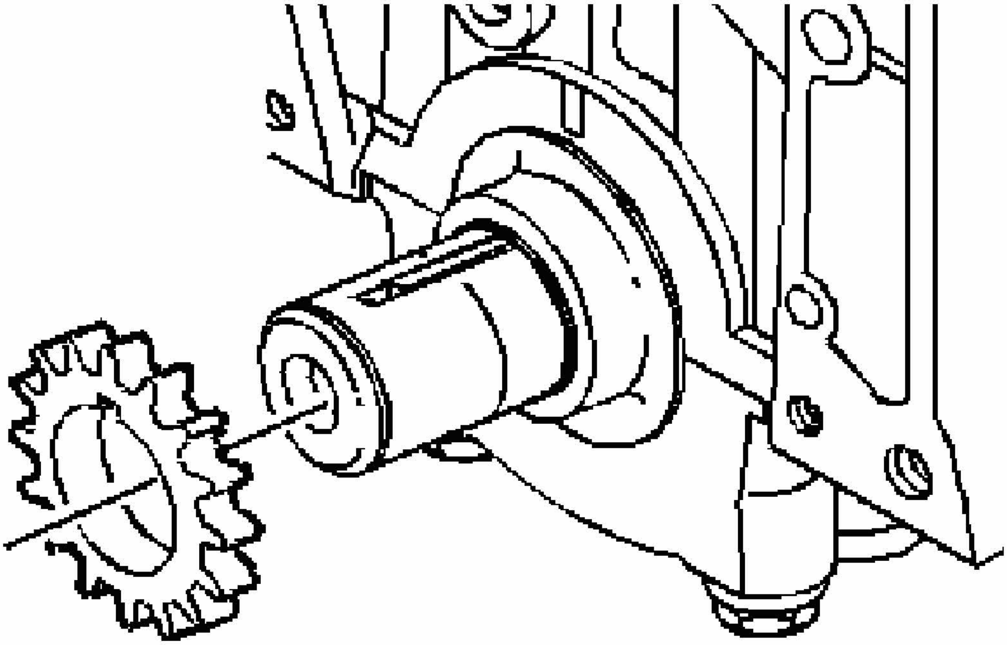


Fig. 173: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

1. Install the crankshaft sprocket.
2. Apply prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent to the crankshaft sprocket thrust surface.

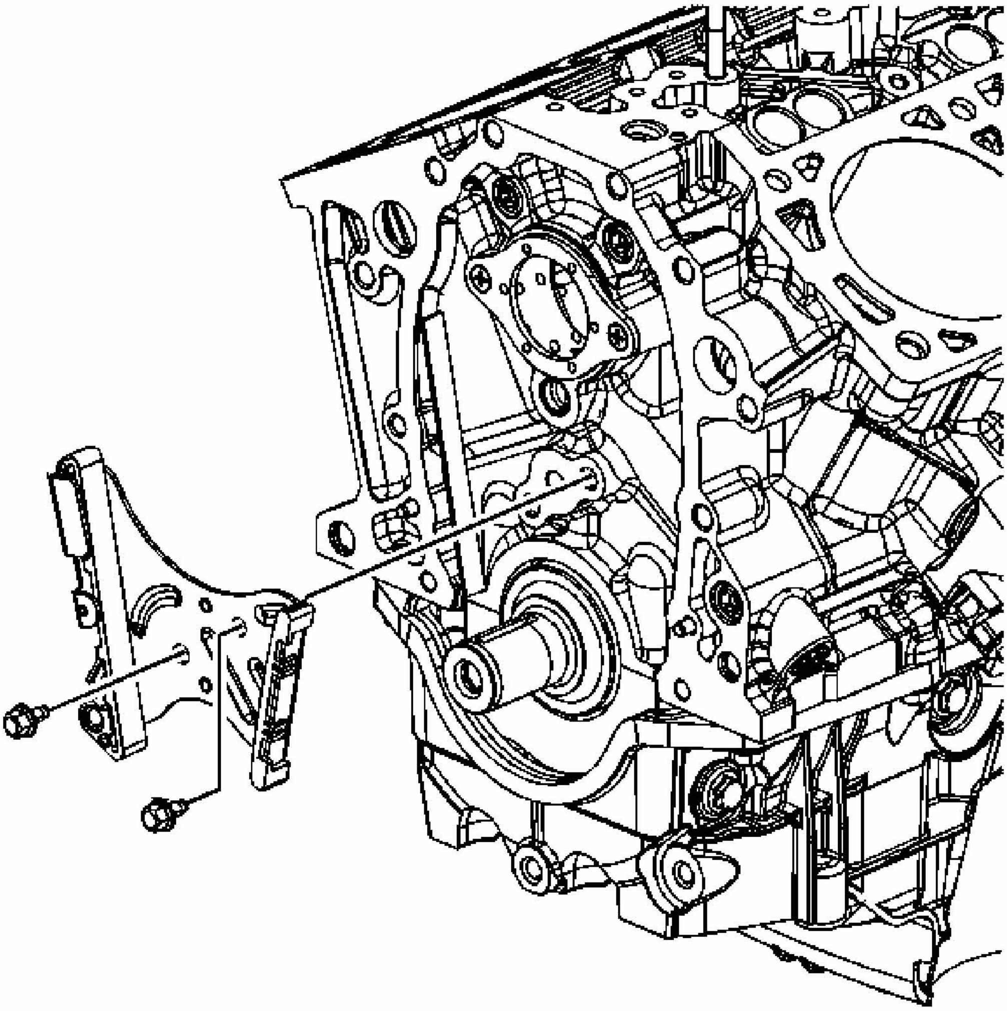


Fig. 174: View Of Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the timing chain tensioner.

NOTE: **Refer to Fastener Notice .**

4. Install the timing chain tensioner bolts.

Tighten: Tighten the bolts 21 N.m (15 lb ft).

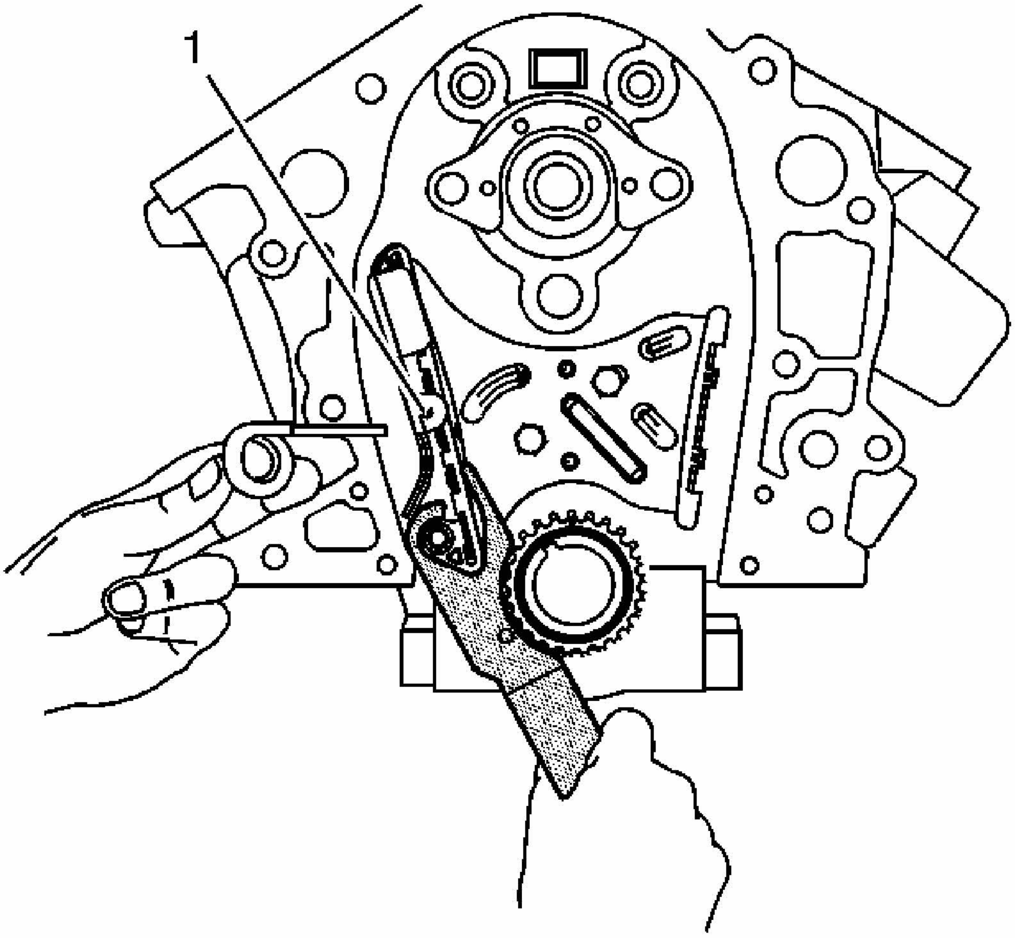


Fig. 175: Collapsing Tensioner
Courtesy of GENERAL MOTORS CORP.

5. Using the **EN-47719** , fully collapse the tensioner, and place the tensioner retaining pin into the retaining hole (1). See **Special Tools**.

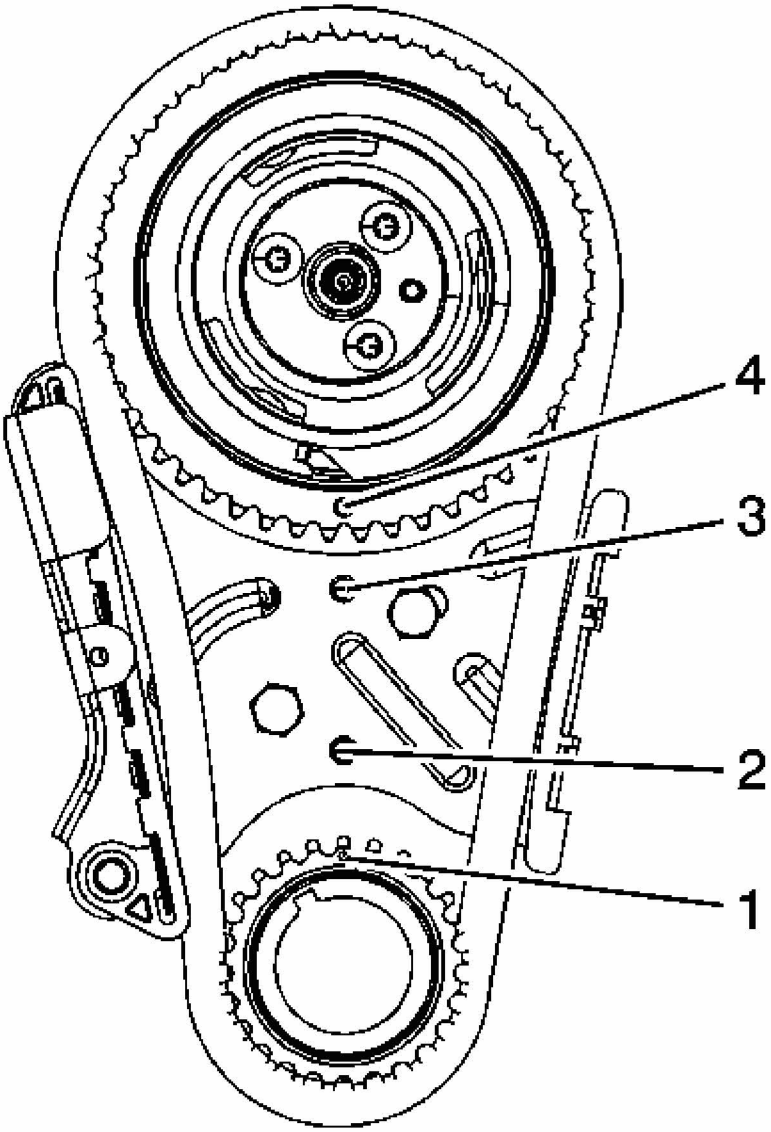


Fig. 176: Identifying Timing Marks & Tensioner
Courtesy of GENERAL MOTORS CORP.

6. Align the crankshaft timing mark (1) to the timing mark on the bottom of the timing chain tensioner (2).
7. Hold the camshaft sprocket with the timing chain hanging down and install the timing chain to the crankshaft gear.
8. Align the timing mark on the camshaft gear (3) with the timing mark on top of the timing chain tensioner (4).

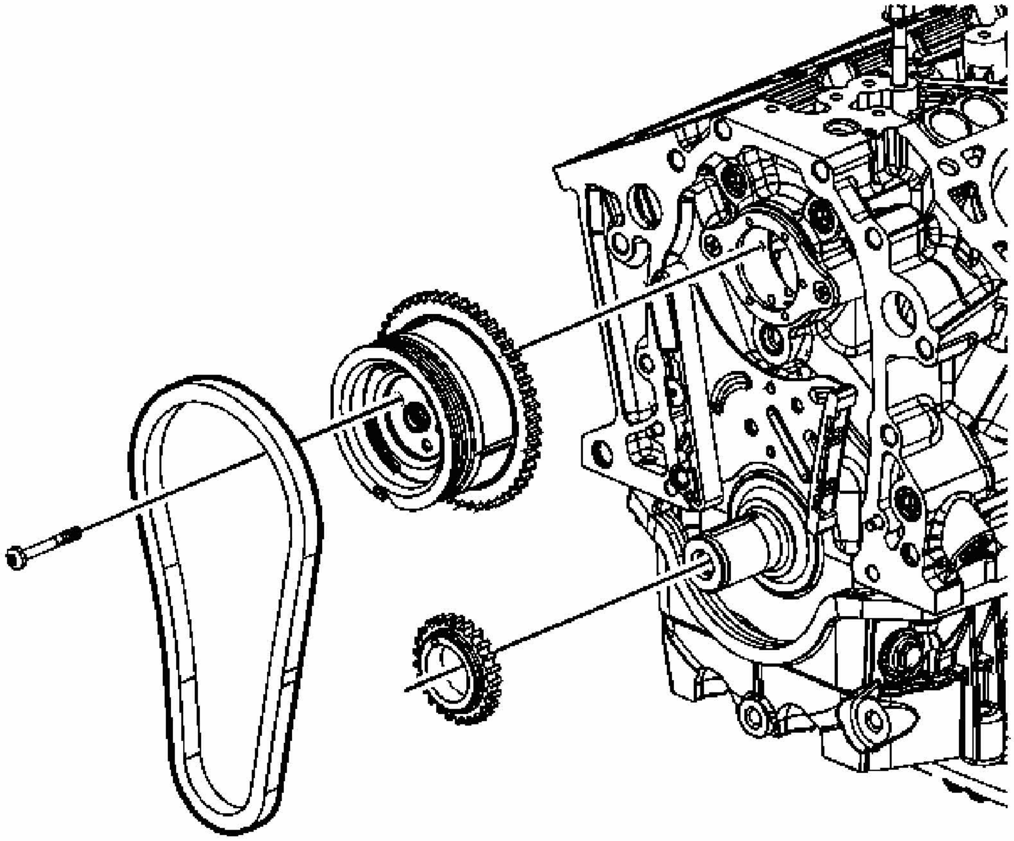


Fig. 177: View Of Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

9. Align the dowel in the camshaft sprocket with the dowel hole in the camshaft.
10. Draw the camshaft sprocket onto the camshaft using the mounting bolts.

    Tighten: Tighten the bolts 16 N.m (12 lb ft).

11. Coat the crankshaft and camshaft sprockets with clean engine oil.
12. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

CYLINDER HEAD REPLACEMENT - LEFT

Tools Required

J 45059 Angle Meter. See **Special Tools**.

Removal Procedure

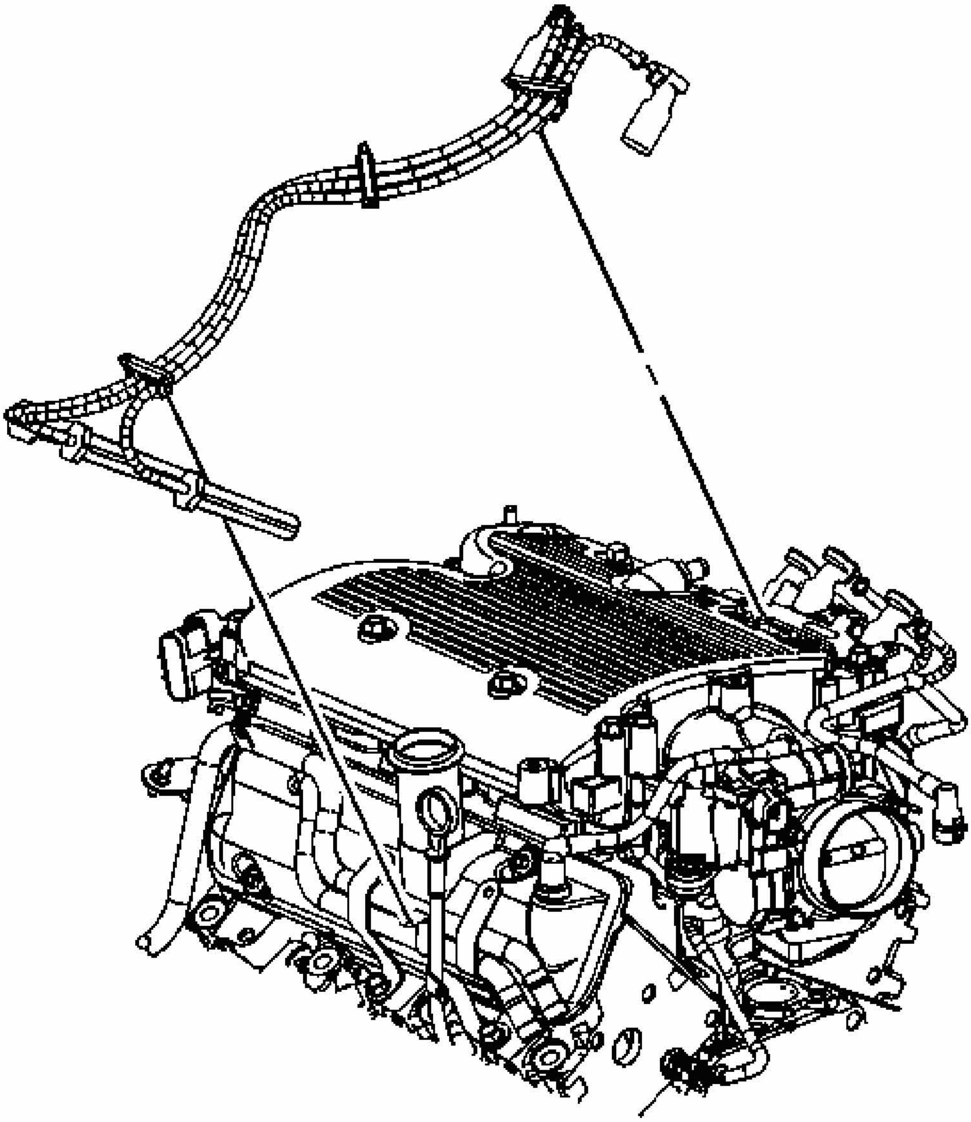


Fig. 178: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
2. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.

3. Lower the vehicle.
4. Remove the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
5. Remove the valve rocker arms and the pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
6. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement - Left (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Left (RPO LS4)** .
7. Remove the oil level indicator tube. Refer to **Oil Level Indicator and Tube Replacement**.
8. Disconnect the left spark plug wires from the spark plugs.
9. Remove the spark plug wire clips from the brackets.
10. Disconnect and remove the left spark plug wires from the ignition coil.

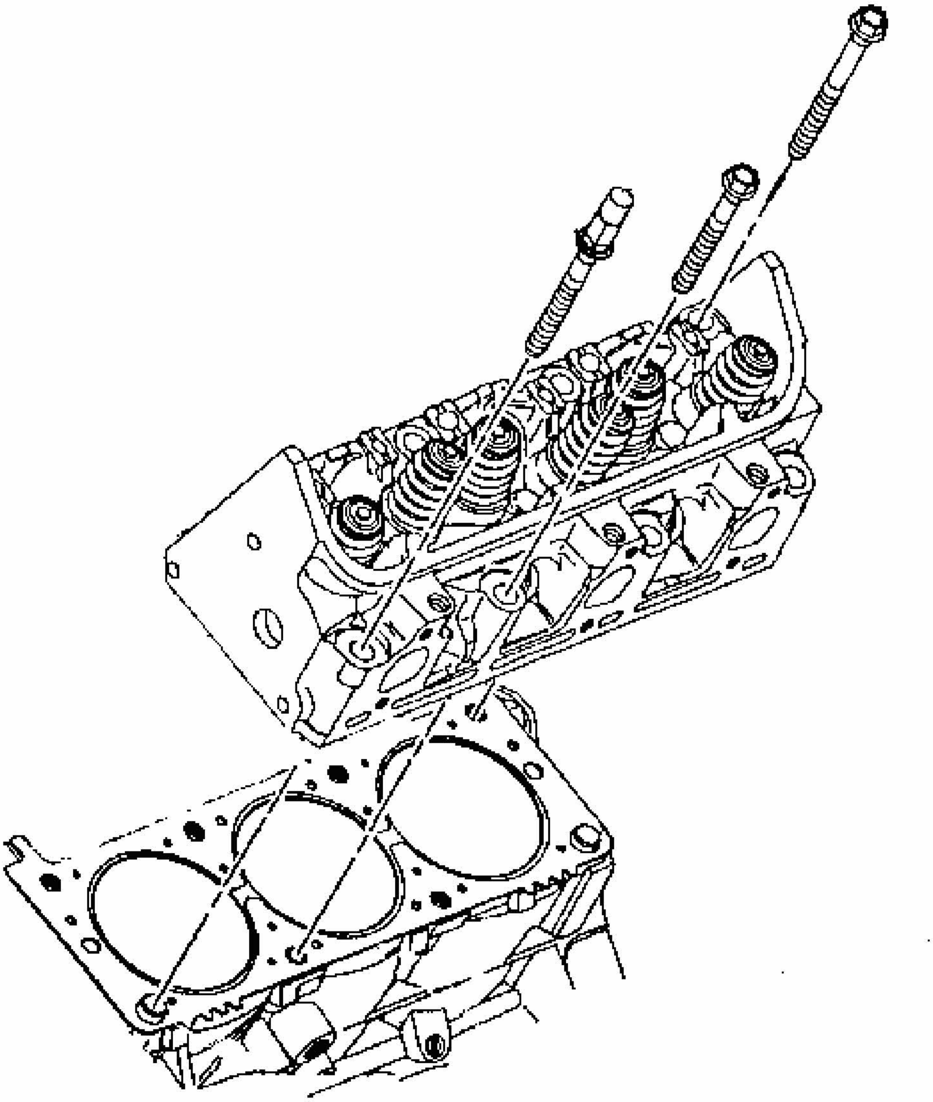


Fig. 179: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

11. Remove the left spark plugs. Refer to **Spark Plug Replacement** .
12. Remove and discard the cylinder head bolts.
13. Remove the cylinder head.

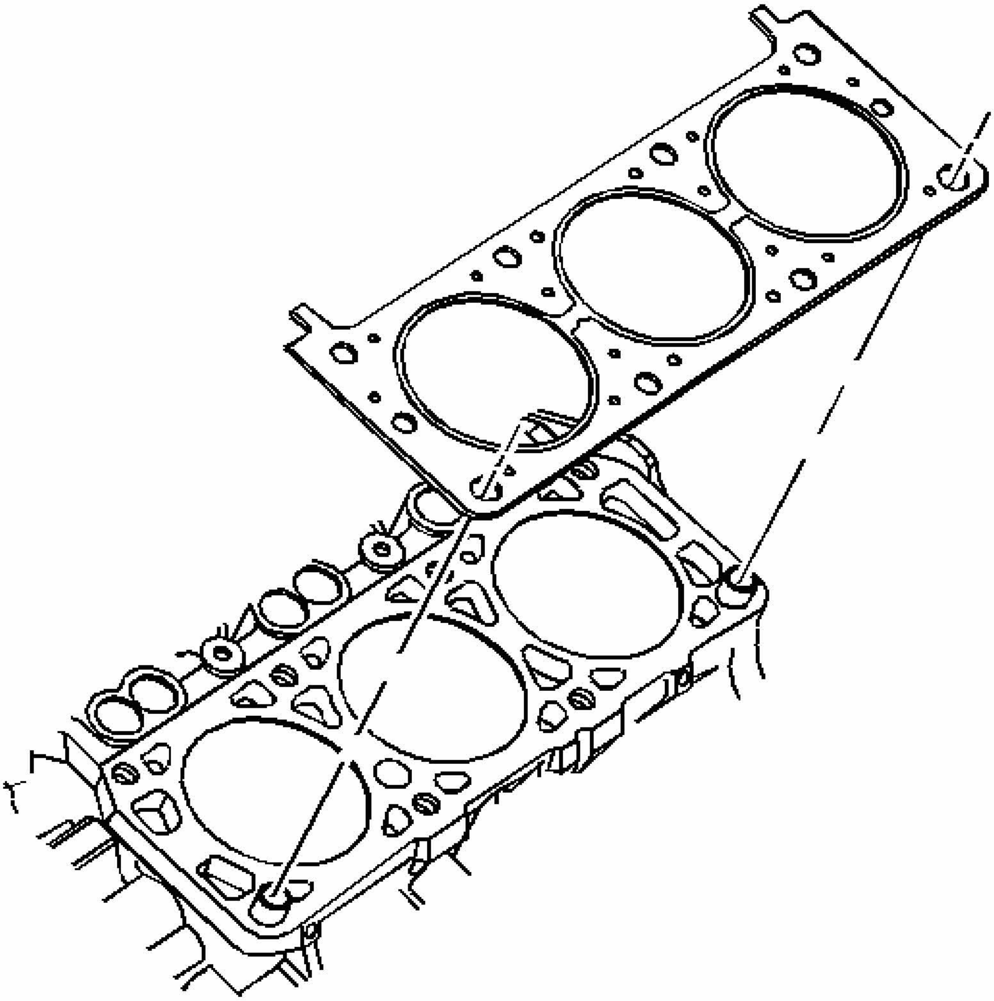


Fig. 180: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

14. Remove and discard the cylinder head gasket.
15. Remove the cylinder head locator dowel pins, if necessary.

Installation Procedure

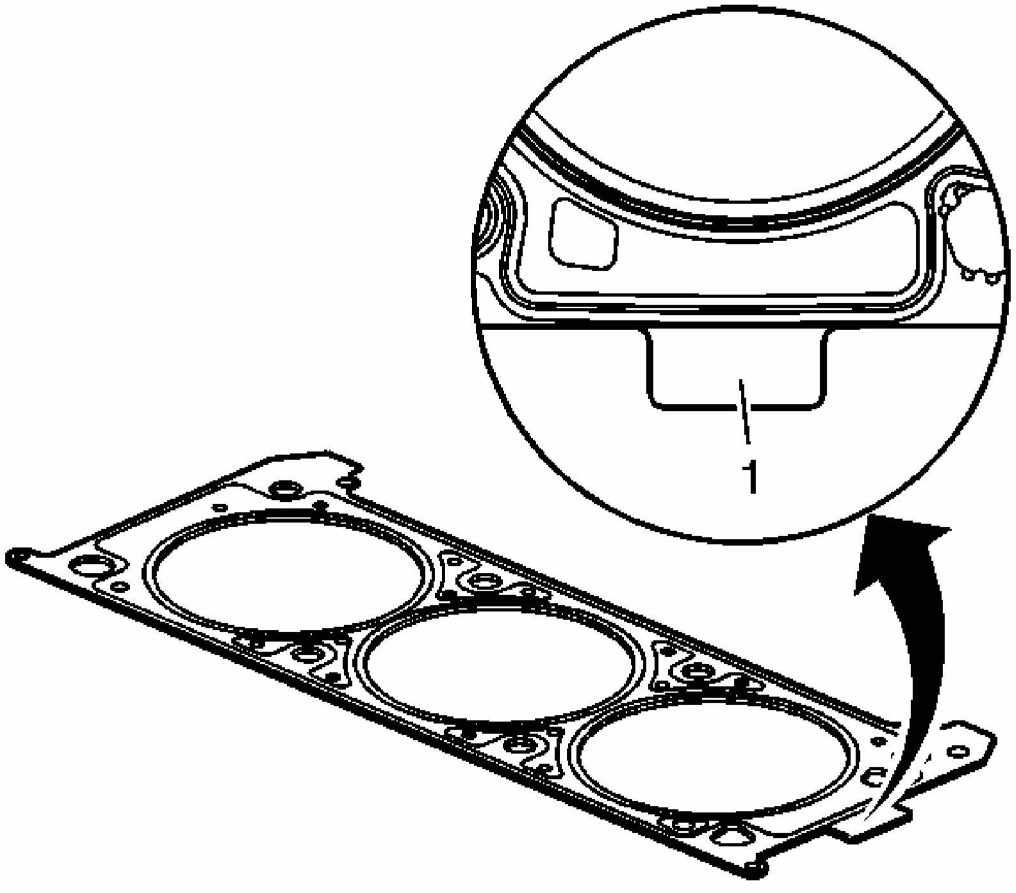


Fig. 181: Identifying Proper Cylinder Head Gasket Installation
Courtesy of GENERAL MOTORS CORP.

NOTE: **Head gaskets are specific for right hand and left hand applications, and also must be installed with the correct side facing up. Note the markings (1) on the head gaskets for proper installation. Failure to do so may lead to engine damage.**

1. Install the cylinder head locator dowel pins, if necessary.
2. Inspect the cylinder head locator dowel pins for proper installation.

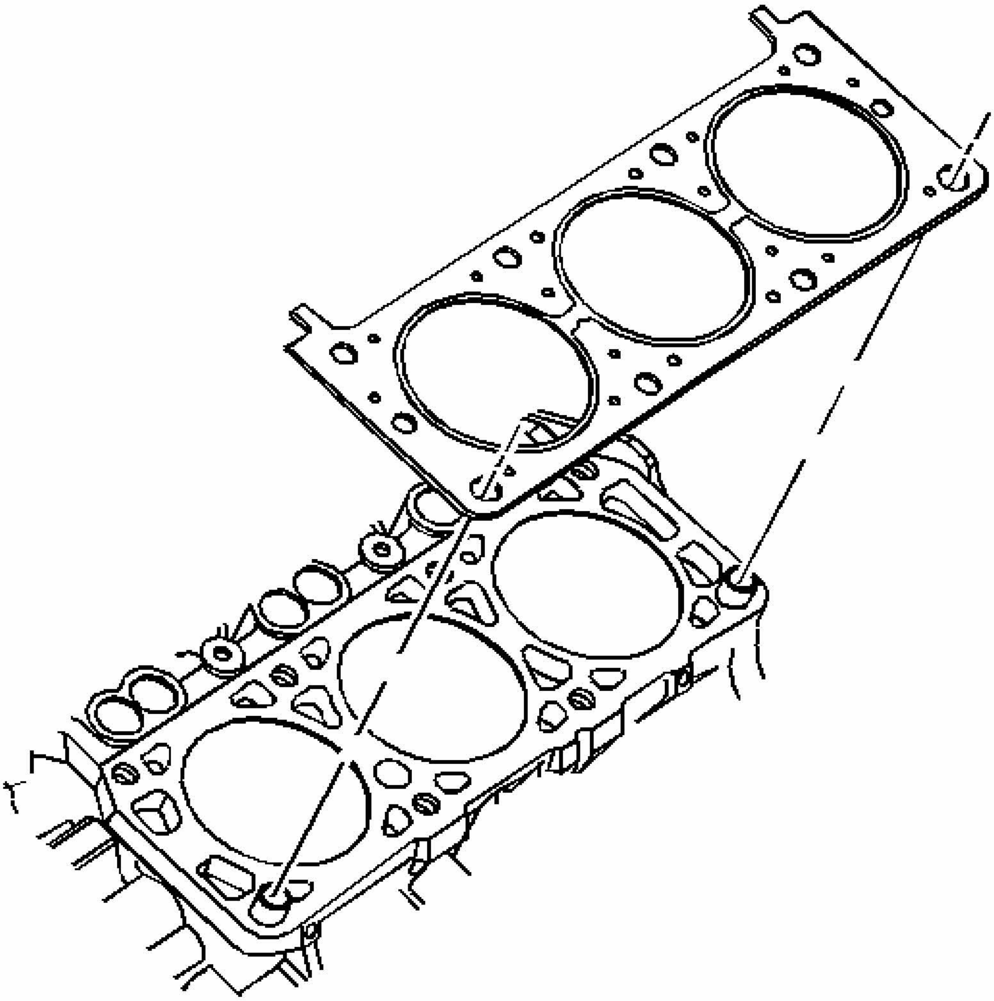


Fig. 182: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install a NEW cylinder head gasket.

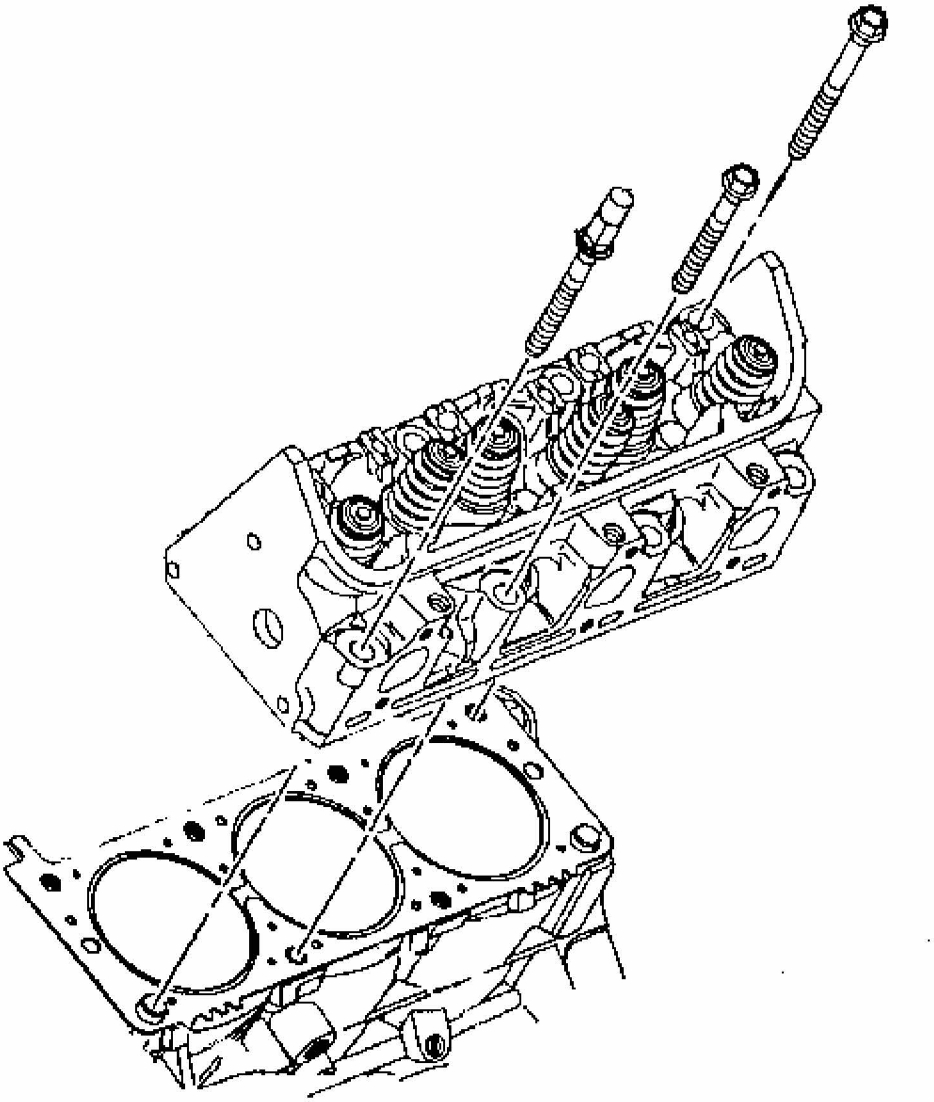


Fig. 183: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Install the cylinder head onto the locator pins and the engine.

NOTE: **This component uses torque-to-yield bolts. When servicing this component do not reuse the bolts, New torque-to-yield bolts must be installed. Reusing used torque-to-yield bolts will not provide proper bolt torque and clamp load. Failure to install NEW torque-to-yield bolts may lead to engine damage.**

5. Install NEW cylinder head bolts finger tight.

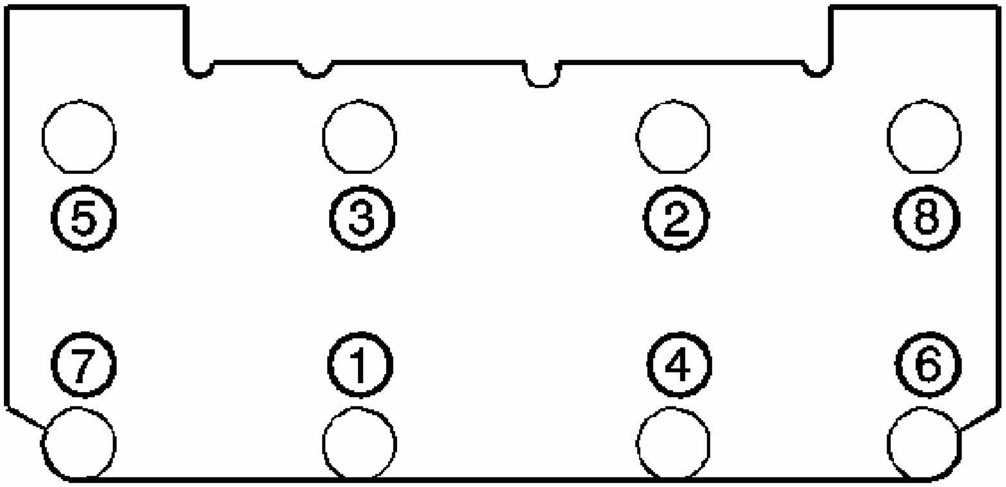


Fig. 184: View Of Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

6. Tighten the cylinder head bolts.

   Tighten: Tighten the bolts in sequence to 60 N.m (44 lb ft) plus an additional 95 degrees using the **J 45059** . See **Special Tools**.

7. Install the left spark plugs. Refer to **Spark Plug Replacement** .

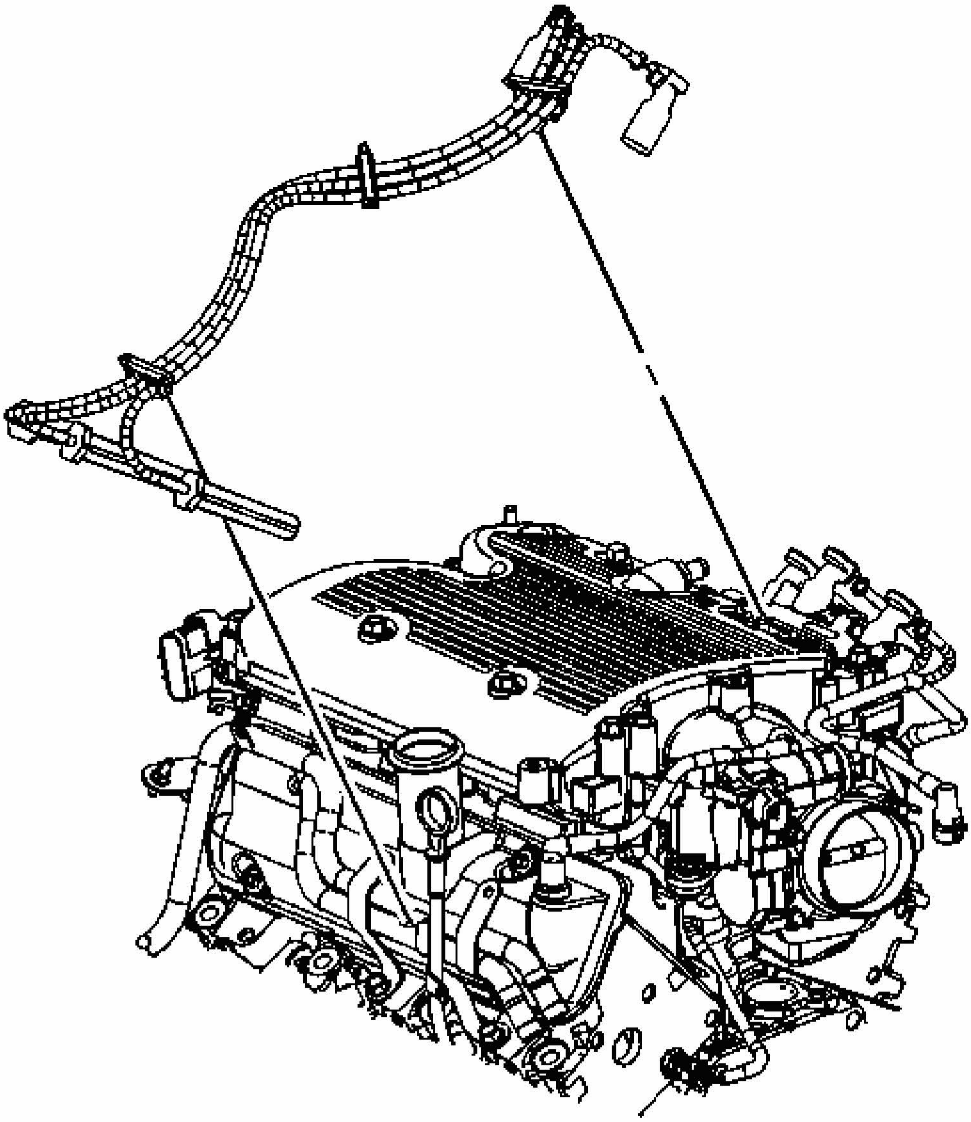


Fig. 185: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

8. Install and connect the left spark plug wires to the ignition coil.
9. Install the spark plug wire clips to the brackets.
10. Connect the left spark plug wires to the spark plugs.
11. Install the oil level indicator tube. Refer to **Oil Level Indicator and Tube Replacement**.
12. Install the exhaust manifold. Refer to **Exhaust Manifold Replacement - Left (RPOs**

LZE/LZ4/LZ9) or **Exhaust Manifold Replacement - Left (RPO LS4)** .

13. Install the valve rocker arms and the pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
14. Install the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
15. Fill the engine with oil. Refer to **Engine Oil and Oil Filter Replacement**.
16. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
17. Inspect for leaks.

CYLINDER HEAD REPLACEMENT - RIGHT

Tools Required

J 45059 Angle Meter. See **Special Tools**.

Removal Procedure

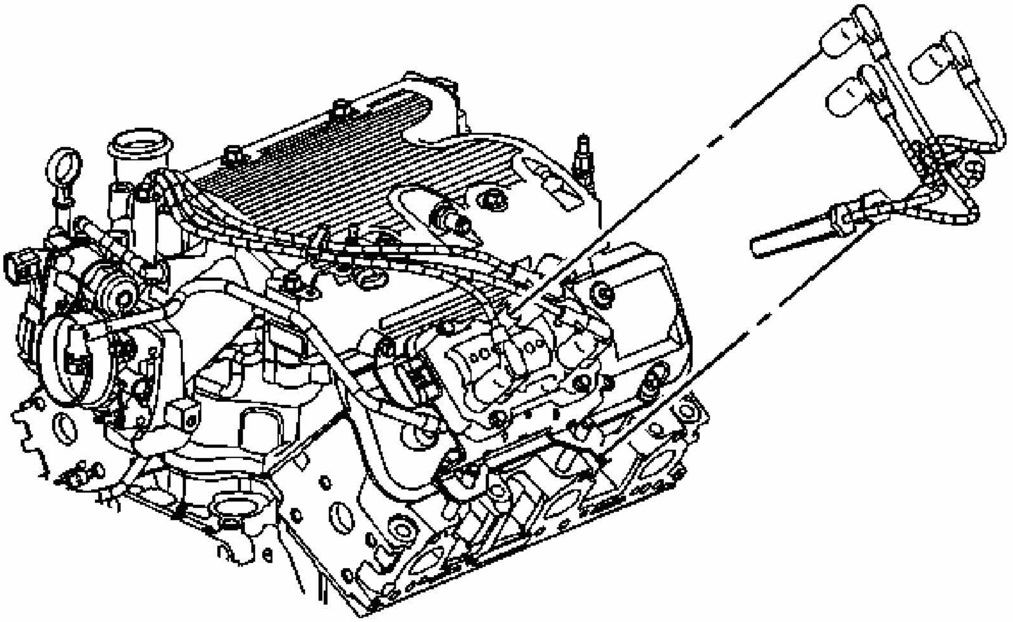


Fig. 186: Locating Right Side Spark Plug Wires & Ignition Coil
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
2. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
3. Lower the vehicle.
4. Remove the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
5. Remove the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
6. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement - Right (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Right (RPO LS4)** .
7. Disconnect the right spark plug wires from the spark plugs.
8. Remove the spark plug wire clip from the bracket.
9. Disconnect and remove the right spark plug wires from the ignition coil.
10. Remove the right spark plugs. Refer to **Spark Plug Replacement** .
11. Remove the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** .

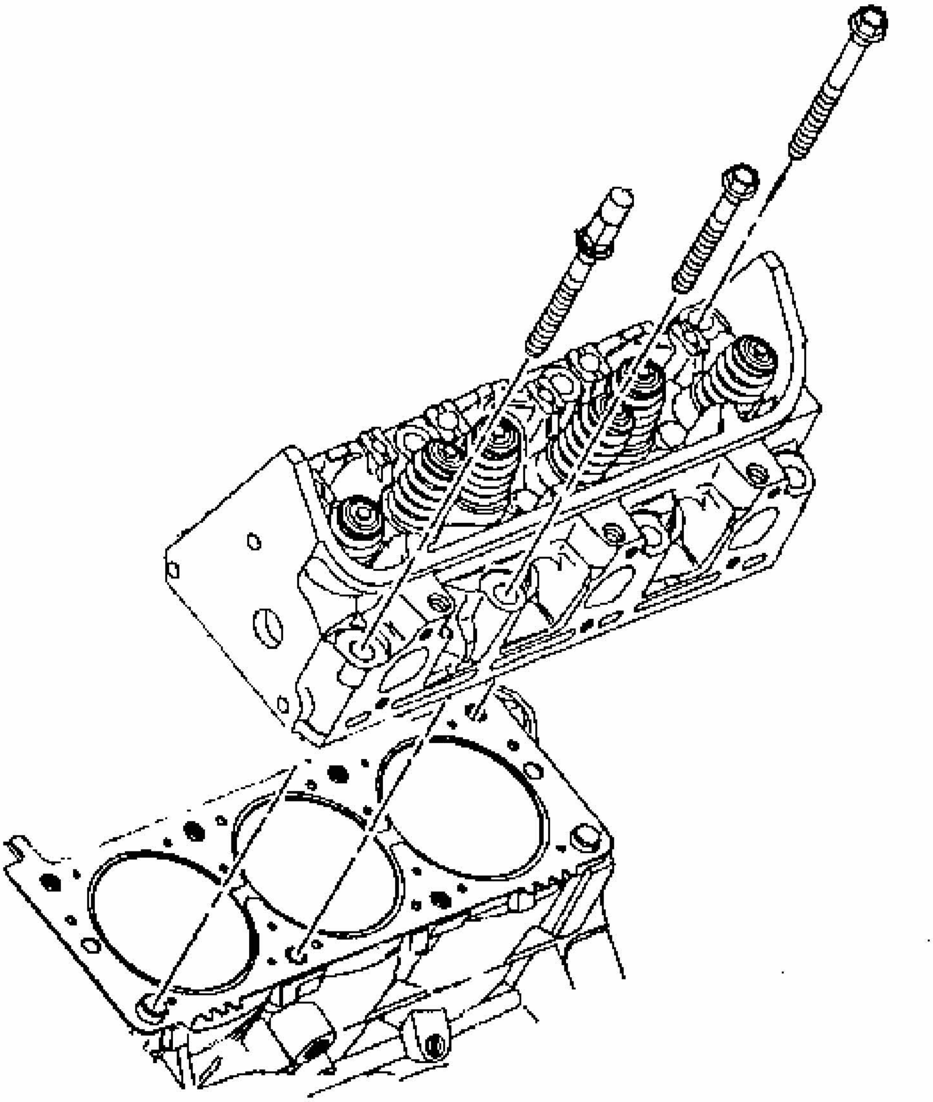


Fig. 187: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

12. Remove and discard the cylinder head bolts.
13. Remove the cylinder head.

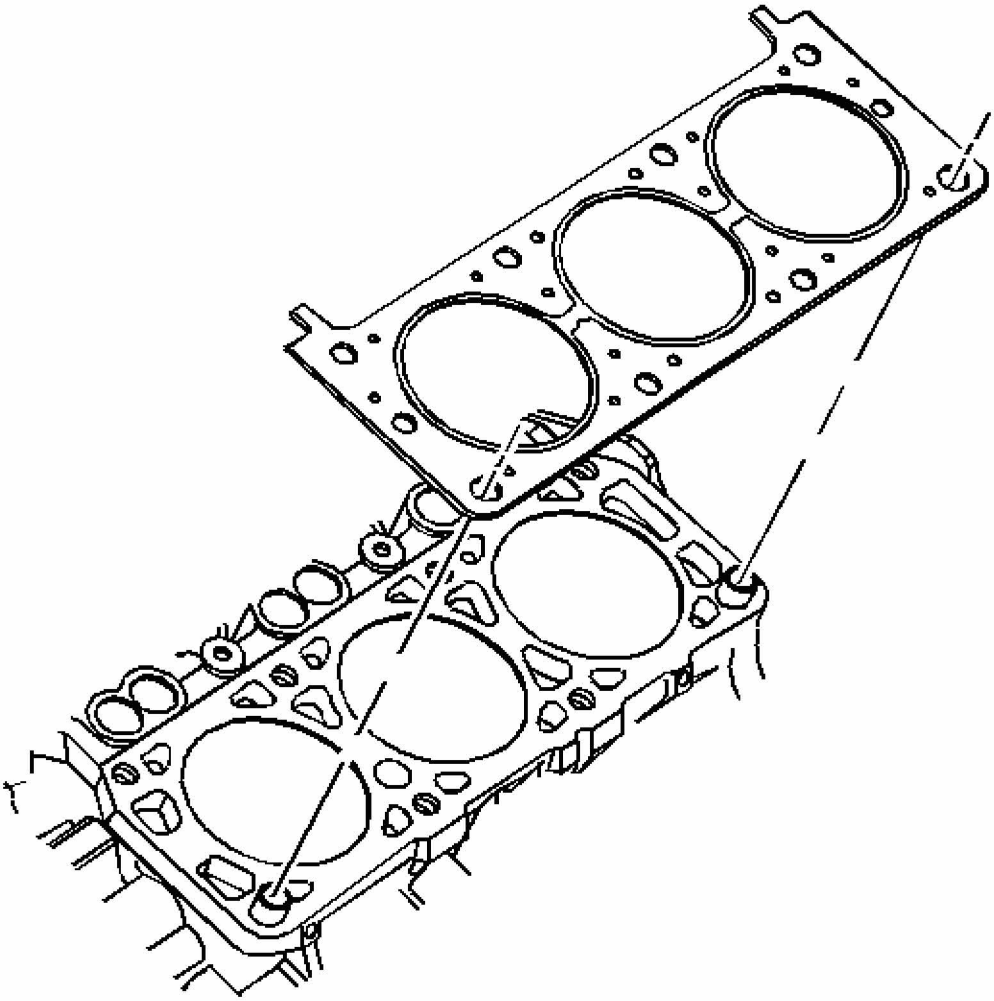


Fig. 188: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

14. Remove and discard the cylinder head gasket.
15. Remove the cylinder head locator dowel pins, if necessary.

Installation Procedure

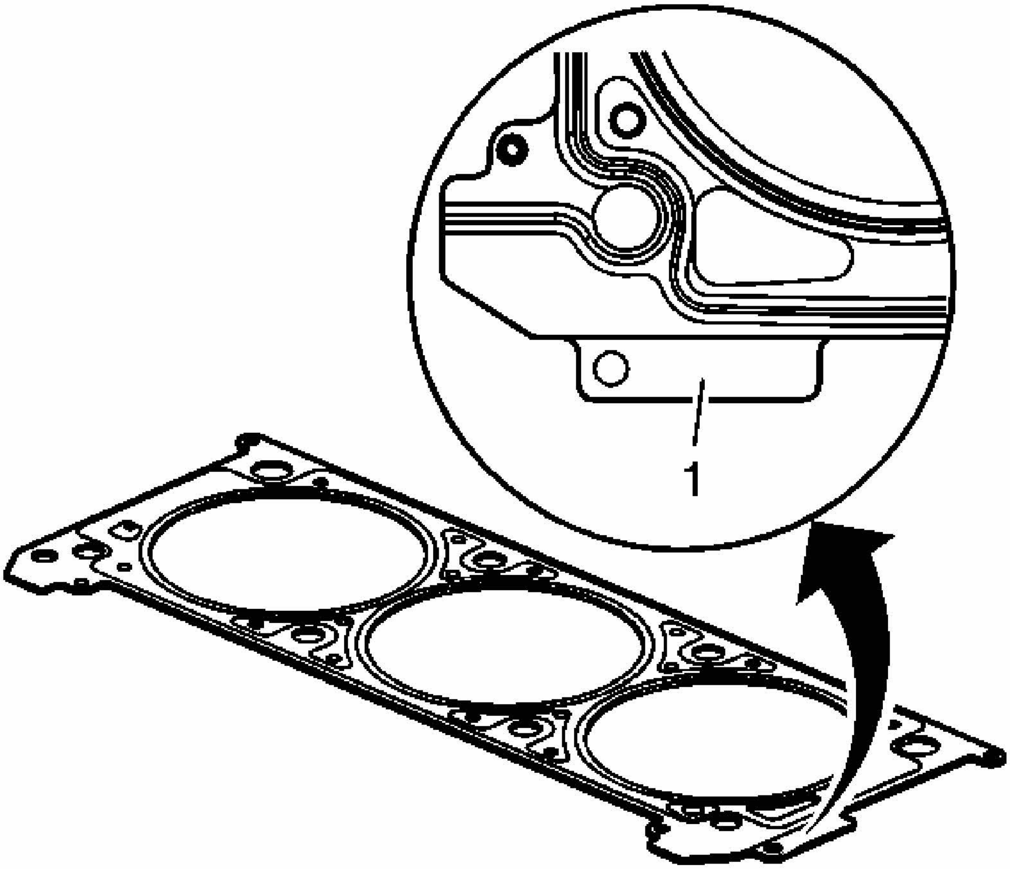


Fig. 189: Identifying Proper Cylinder Head Gasket Installation
Courtesy of GENERAL MOTORS CORP.

NOTE: Head gaskets are specific for right hand and left hand applications, and also must be installed with the correct side facing up. Note the markings (1) on the head gaskets for proper installation. Failure to do so may lead to engine damage.

1. Install the cylinder head locator dowel pins, if necessary.
2. Inspect the cylinder head locator dowel pins for proper installation.

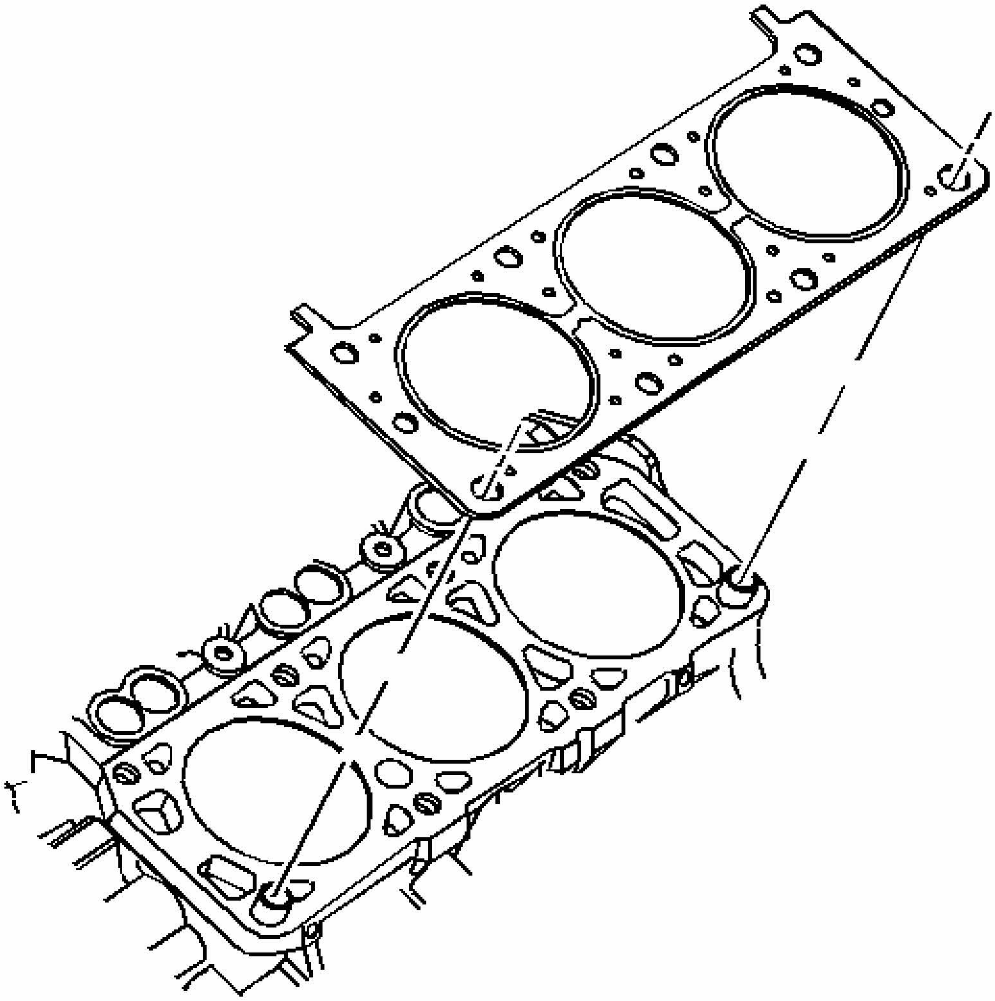


Fig. 190: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install a NEW cylinder head gasket.

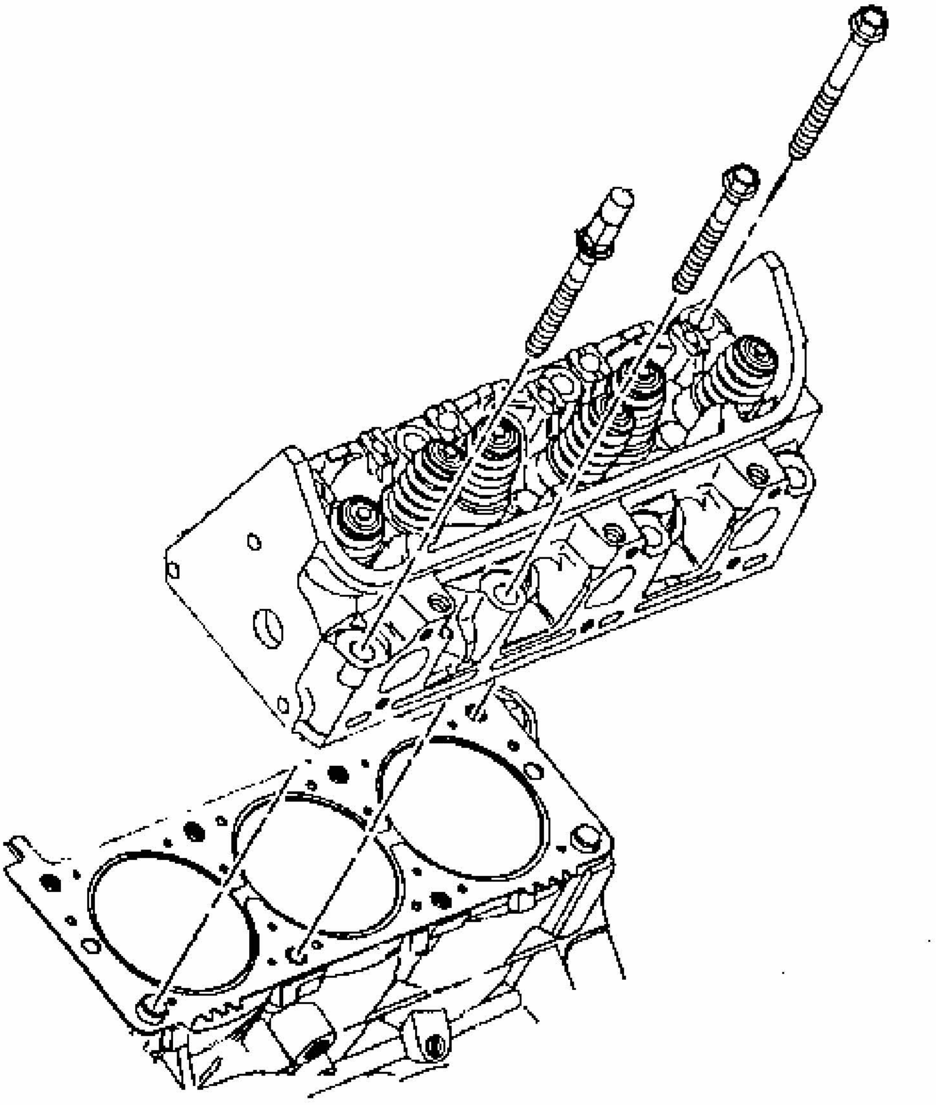


Fig. 191: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Install the cylinder head onto the locator pins and the engine.

NOTE: **This component uses torque-to-yield bolts. When servicing this component do not reuse the bolts, New torque-to-yield bolts must be installed. Reusing used torque-to-yield bolts will not provide proper bolt torque and clamp load. Failure to install NEW torque-to-yield bolts may lead to engine damage.**

5. Install NEW cylinder head bolts finger tight.

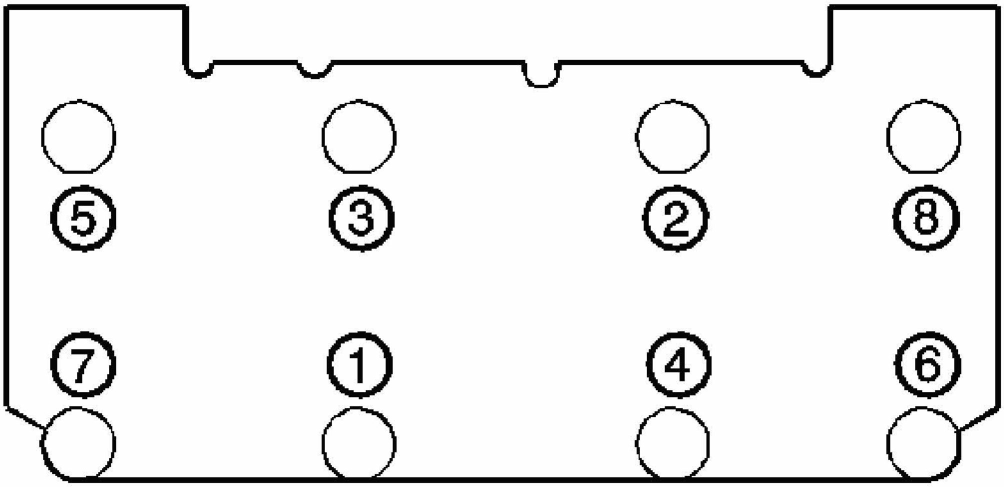


Fig. 192: View Of Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

6. Tighten the cylinder head bolts.

   Tighten: Tighten the bolts in sequence to 60 N.m (44 lb ft) plus an additional 95 degrees using the **J 45059** . See **Special Tools**.

7. Install the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** .
8. Install the right spark plugs. Refer to **Spark Plug Replacement** .

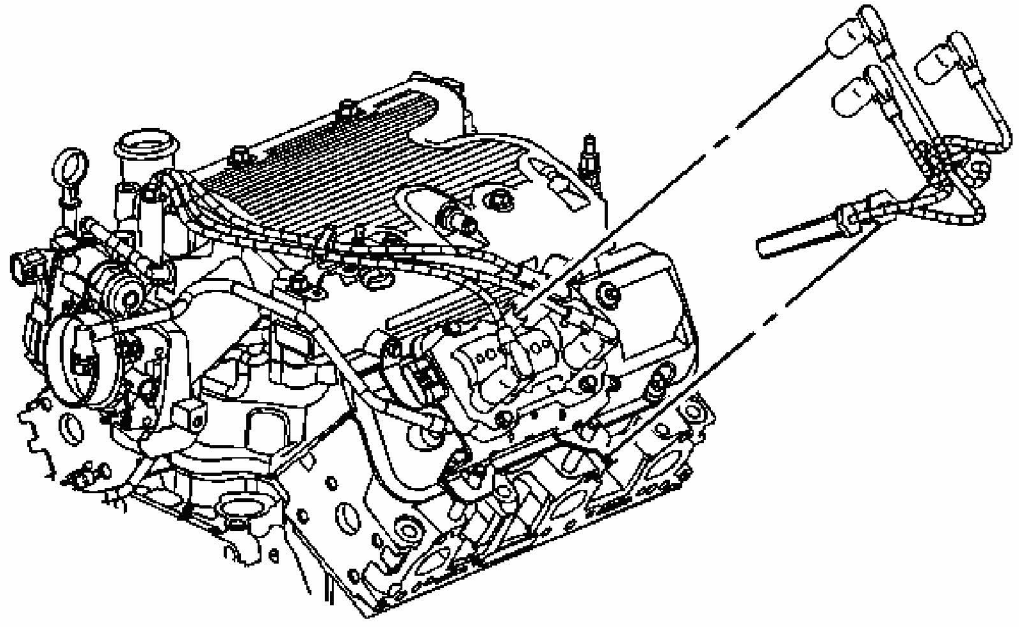


Fig. 193: Locating Right Side Spark Plug Wires & Ignition Coil
Courtesy of GENERAL MOTORS CORP.

9. Install and connect the right spark plug wires to the ignition coil.
10. Install the spark plug wire clip to the bracket.
11. Connect the right spark plug wires to the spark plugs.
12. Install the exhaust manifold. Refer to **Exhaust Manifold Replacement - Right (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Right (RPO LS4)** .
13. Install the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
14. Install the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
15. Fill the engine with oil. Refer to **Engine Oil and Oil Filter Replacement**.
16. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
17. Inspect for leaks.

ENGINE FLYWHEEL REPLACEMENT

Tools Required

J 37096 Flywheel Holder. See **Special Tools**.

Removal Procedure

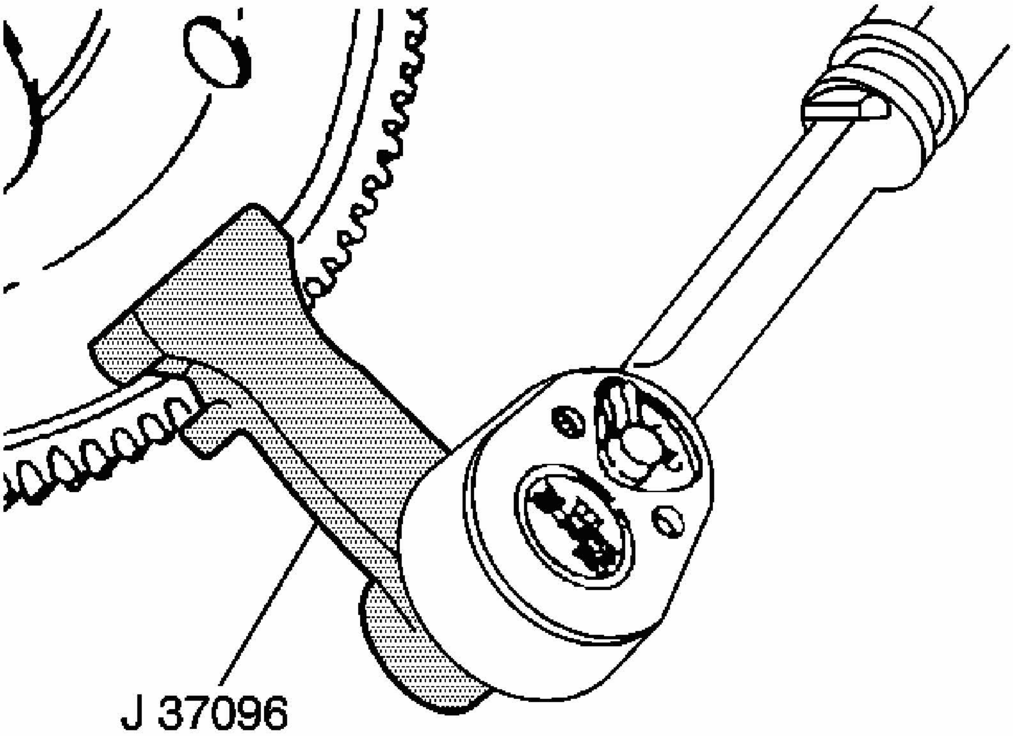


Fig. 194: Holding Flywheel
Courtesy of GENERAL MOTORS CORP.

1. Remove the automatic transaxle, if equipped. Refer to **Transmission Replacement (RPOs LZE/LZ9)** or **Transmission Replacement (RPO LS4)** .
2. Use the **J 37096** to secure the flywheel in order to prevent the crankshaft from rotating. See **Special Tools**.

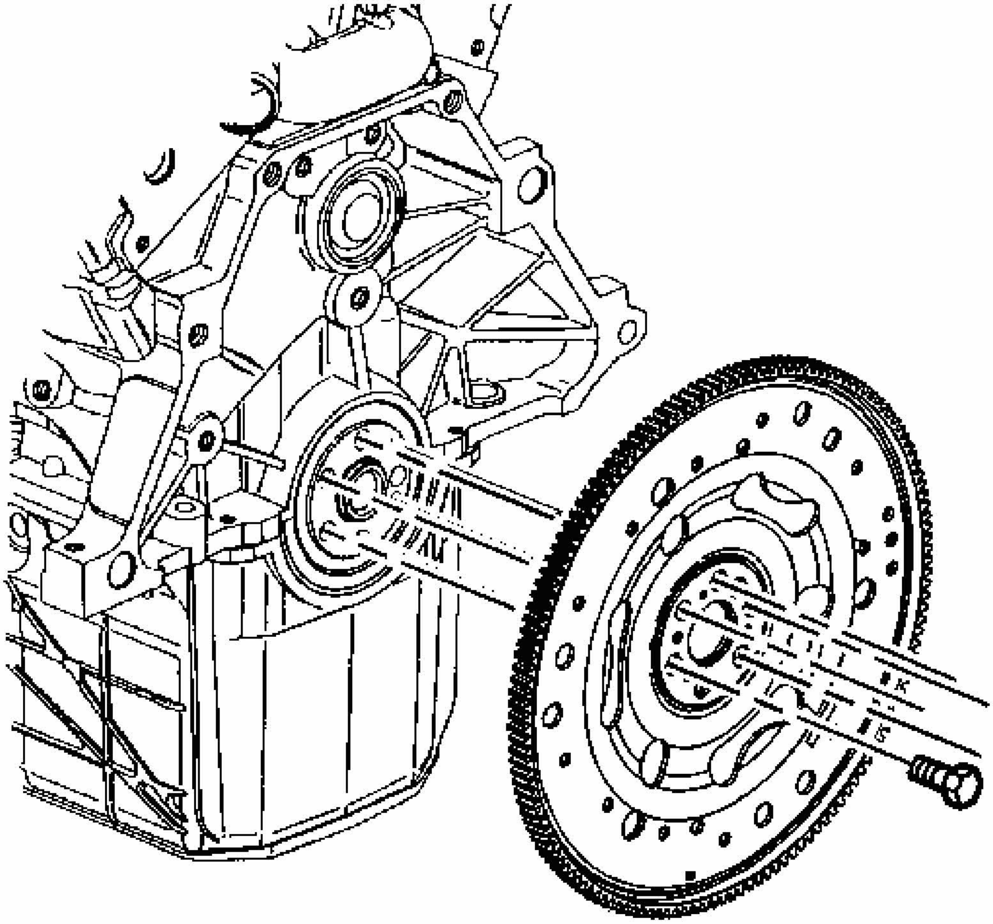


Fig. 195: View Of Flywheel
Courtesy of GENERAL MOTORS CORP.

3. Loosen the flywheel bolts.
4. Remove 5 of the 6 flywheel bolts leaving one bolt at the top of the crankshaft.
5. Grip the flywheel and remove the remaining bolt. Do not drop the flywheel when removing the final bolt.
6. Remove the engine flywheel.
7. Clean the engine flywheel bolt threads and bolt holes.

Installation Procedure

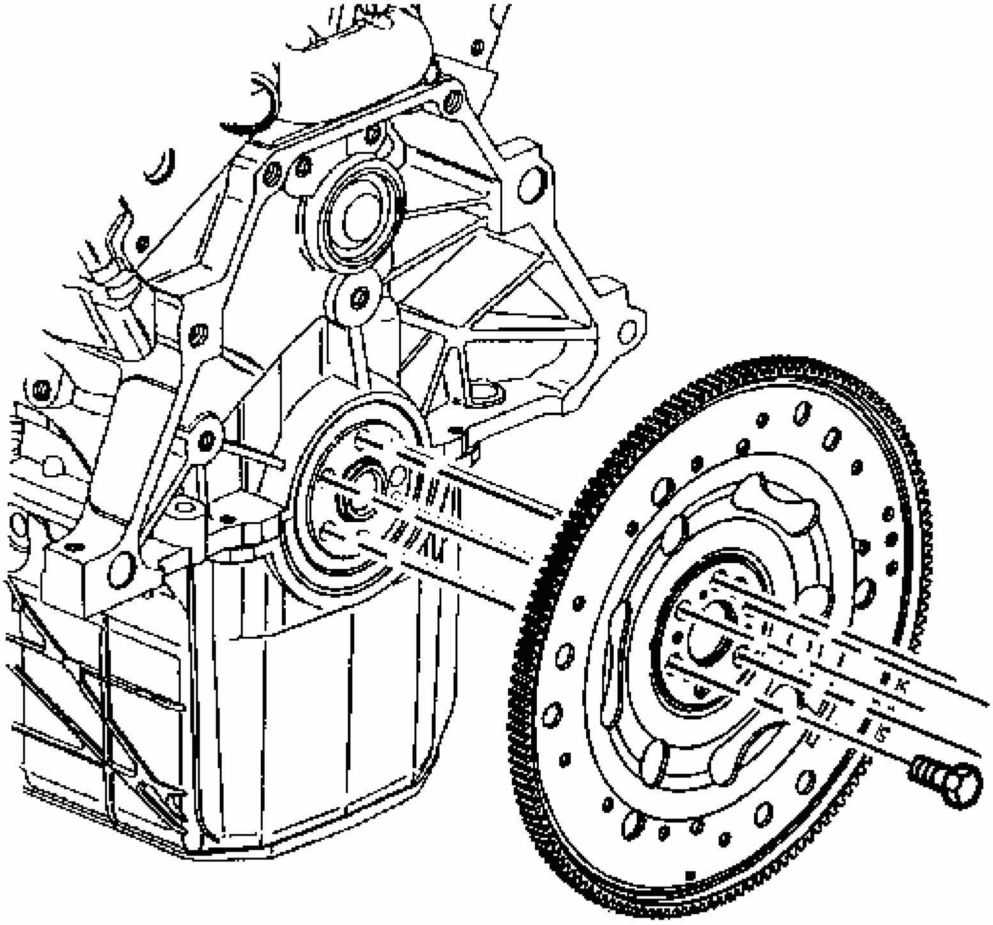


Fig. 196: View Of Flywheel
Courtesy of GENERAL MOTORS CORP.

1. Position the flywheel to the crankshaft.
2. Install the flywheel bolts finger tight.
3. Use the **J 37096** to secure the flywheel in order to prevent the crankshaft from rotating. See Special Tools.

NOTE: **Refer to Fastener Notice .**

4. Tighten the engine flywheel bolts.

Tighten: Tighten the bolts to 70 N.m (52 lb ft).

5. Install the automatic transaxle, if equipped. Refer to **Transmission Replacement (RPOs LZE/LZ9)** or **Transmission Replacement (RPO LS4)** .

CRANKSHAFT REAR OIL SEAL REPLACEMENT

Tools Required

J 34686 Rear Main Seal Installer. See **Special Tools**.

Removal Procedure

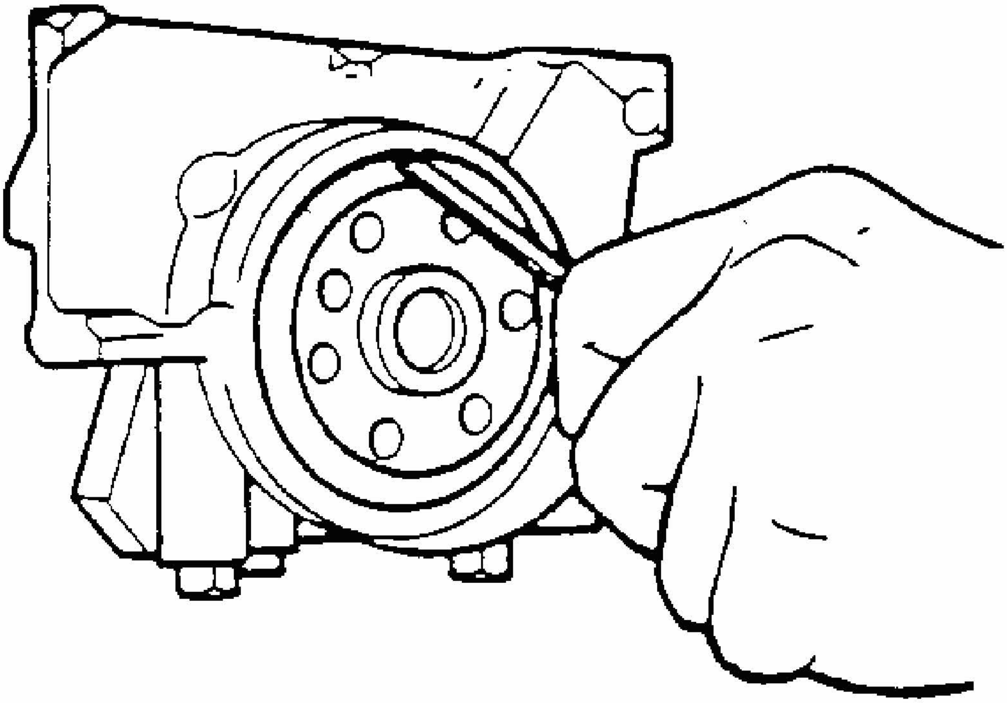


Fig. 197: Removing Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the flywheel. Refer to **Engine Flywheel Replacement**.

IMPORTANT: Do not nick the crankshaft sealing surface when removing the seal.

2. Insert a flat-bladed or similar tool through the dust lip at an angle.
3. Pry the crankshaft rear oil seal out by moving the handle of the tool towards the end of

the crankshaft.

4. Repeat, as necessary around the crankshaft rear oil seal, until the seal is removed.

Installation Procedure

NOTE: Do not apply or use any oil lubrication on the crankshaft rear oil seal, or the seal installer. Do not touch the sealing lip of the oil seal once the protective sleeve is removed. Doing so will damage/deform the seal.

NOTE: Clean the crankshaft sealing surface with a clean, lint free towel. Inspect lead-in edge of crankshaft for burrs/sharp edges that could damage the rear main oil seal. Remove burrs/sharp edges with crocus cloth before proceeding.

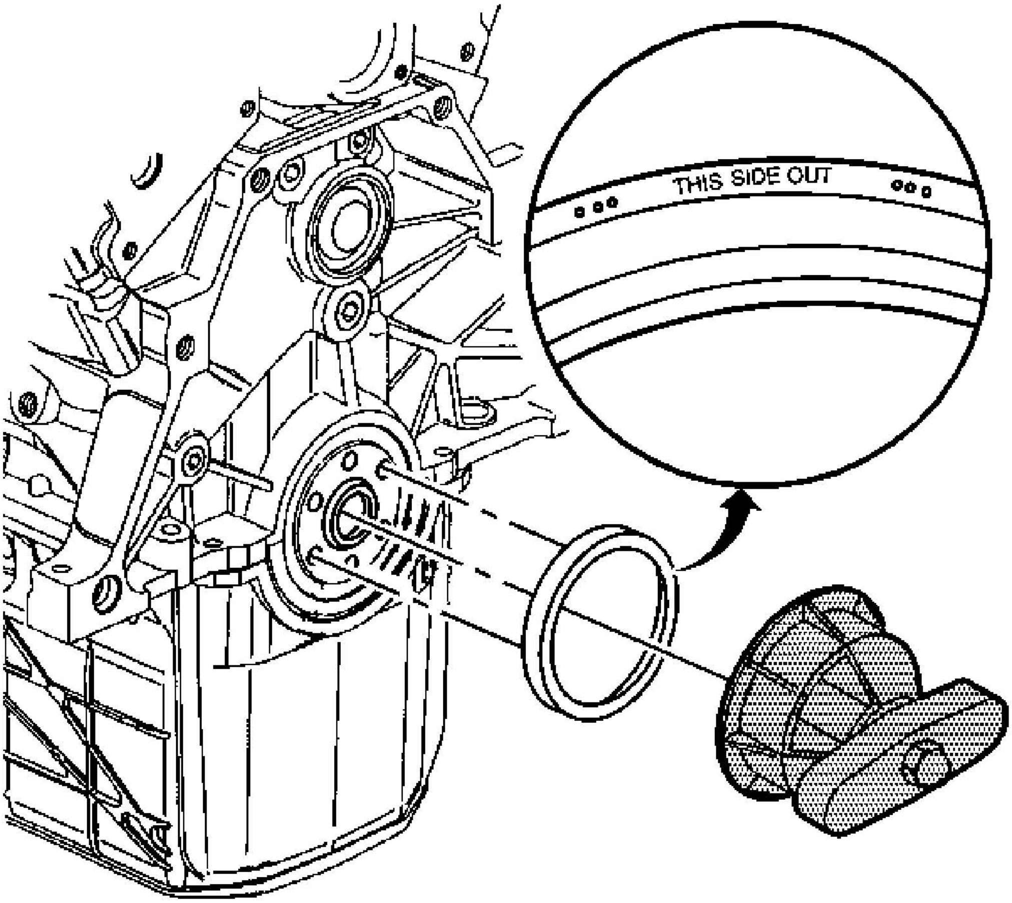


Fig. 198: Installing Crankshaft Rear Oil Seal

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Notice the direction of the rear oil seal. The new design seal is a reverse style as opposed to what has been used in the past. "THIS SIDE OUT" has been stamped into the seal, as shown in the graphic.

1. Carefully remove the protection sleeve from the NEW crankshaft rear oil seal.
2. Install the crankshaft rear oil seal onto the **J 34686** by sliding the crankshaft rear oil seal over the mandrel using a twisting motion until the back of the crankshaft rear oil seal bottoms squarely against the collar of the tool. See **Special Tools**.
3. Perform the following steps in order to install the crankshaft rear oil seal:
    1. Align the dowel pin of the **J 34686** with the dowel pin in the crankshaft. See **Special Tools**.
    2. Attach the **J 34686** to the crankshaft by hand, or tighten the attaching screws to 5 N. See **Special Tools**.m (45 lb in).
    3. Turn the T-handle of the **J 34686** in order to engage and allow the collar to push the seal into the bore. See **Special Tools**. Turn the handle until the collar is tight against the engine block. Ensure that the seal is seated properly.
    4. Loosen the T-handle until the handle comes to a stop.
    5. Remove the attaching screws.
4. Install the engine flywheel. Refer to **Engine Flywheel Replacement**.

CAMSHAFT REAR BEARING HOLE PLUG REPLACEMENT

Removal Procedure

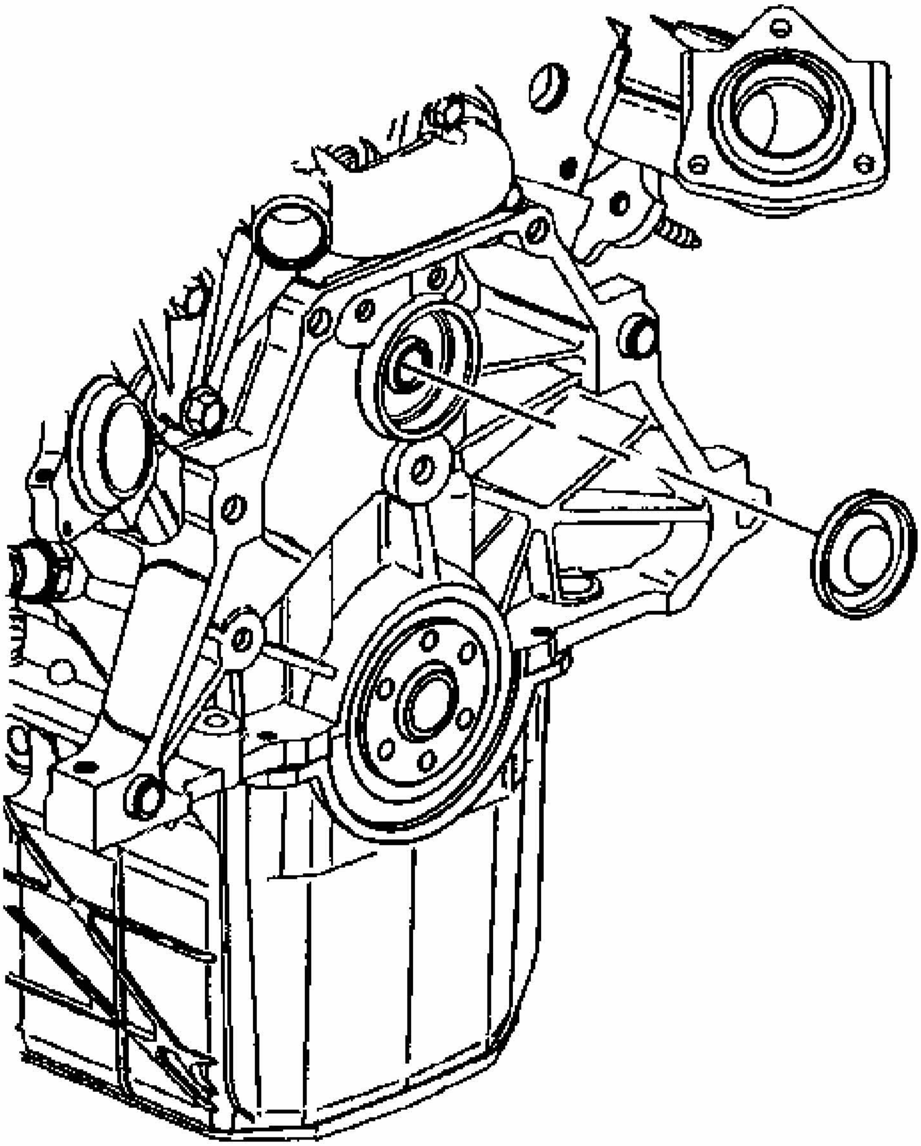


Fig. 199: View Of Camshaft Rear Bearing Hole Plug
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine flywheel. Refer to **Engine Flywheel Replacement**.
2. Remove the camshaft rear bearing hole plug.

Installation Procedure

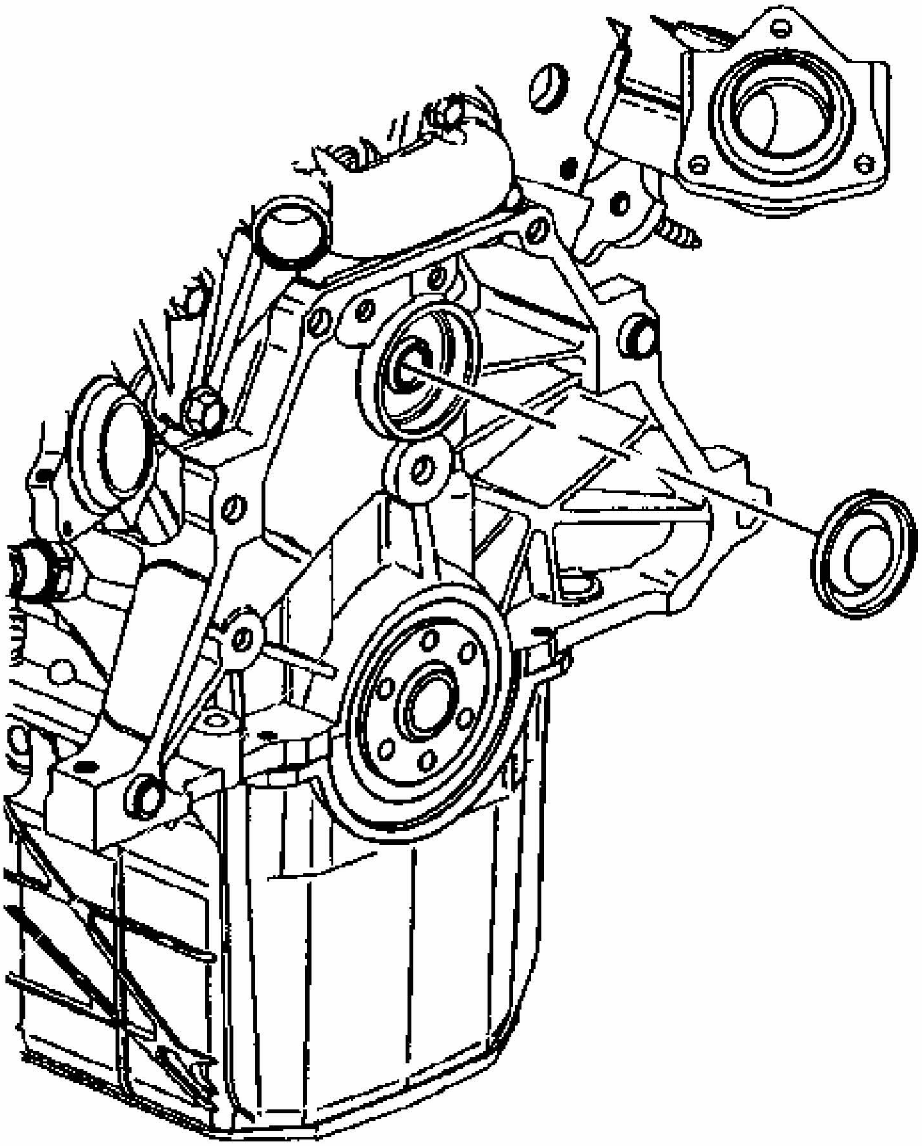


Fig. 200: View Of Camshaft Rear Bearing Hole Plug
Courtesy of GENERAL MOTORS CORP.

1. Coat the camshaft rear bearing hole plug with sealer GM P/N 12377901 (Canadian P/N 10953504) or equivalent.
2. Install the camshaft rear bearing hole plug.

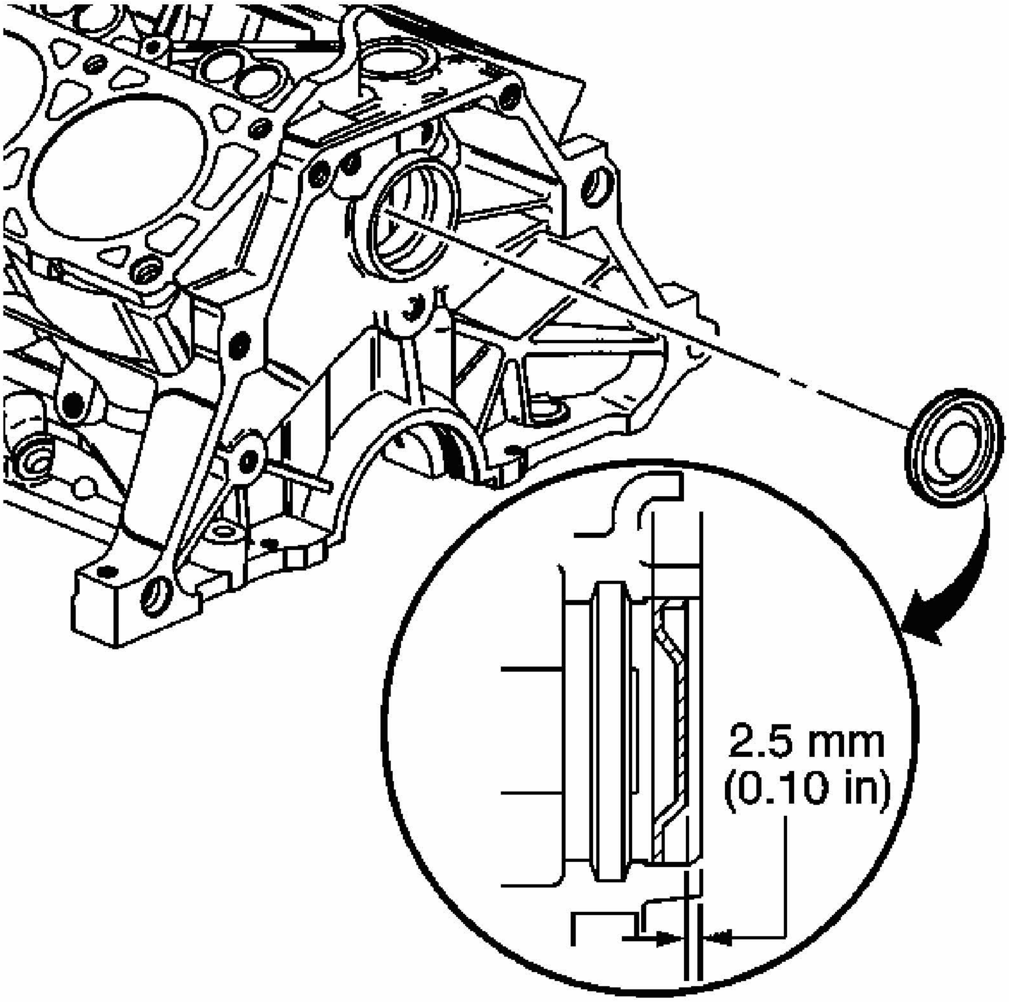


Fig. 201: Identifying Camshaft Rear Bearing Hole Plug Installation Depth
Courtesy of GENERAL MOTORS CORP.

3. Ensure that the camshaft rear bearing plug is installed to specifications.
4. Install the engine flywheel. Refer to **Engine Flywheel Replacement**.

ENGINE REPLACEMENT

Removal Procedure

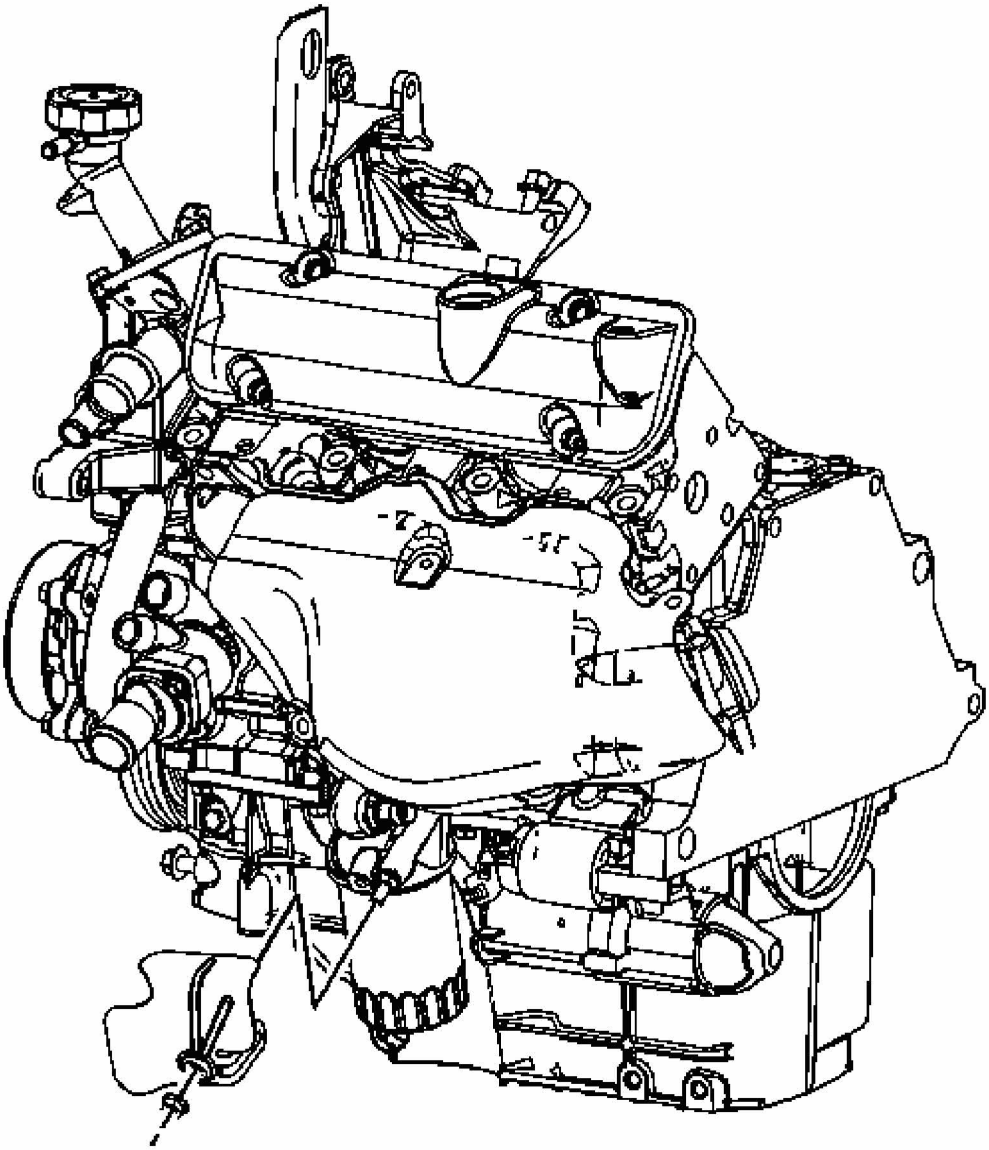


Fig. 202: Locating Oil Pressure Sensor Heat Shield & Nut
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .
2. Remove the hood. Refer to **Hood Replacement** .
3. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

4. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
5. Remove the engine mount struts. Refer to **Engine Mount Strut Replacement**.
6. Remove the drive belt. Refer to **Drive Belt Replacement**.
7. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
8. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
9. Remove the oil pressure sensor heat shield nuts and shield.

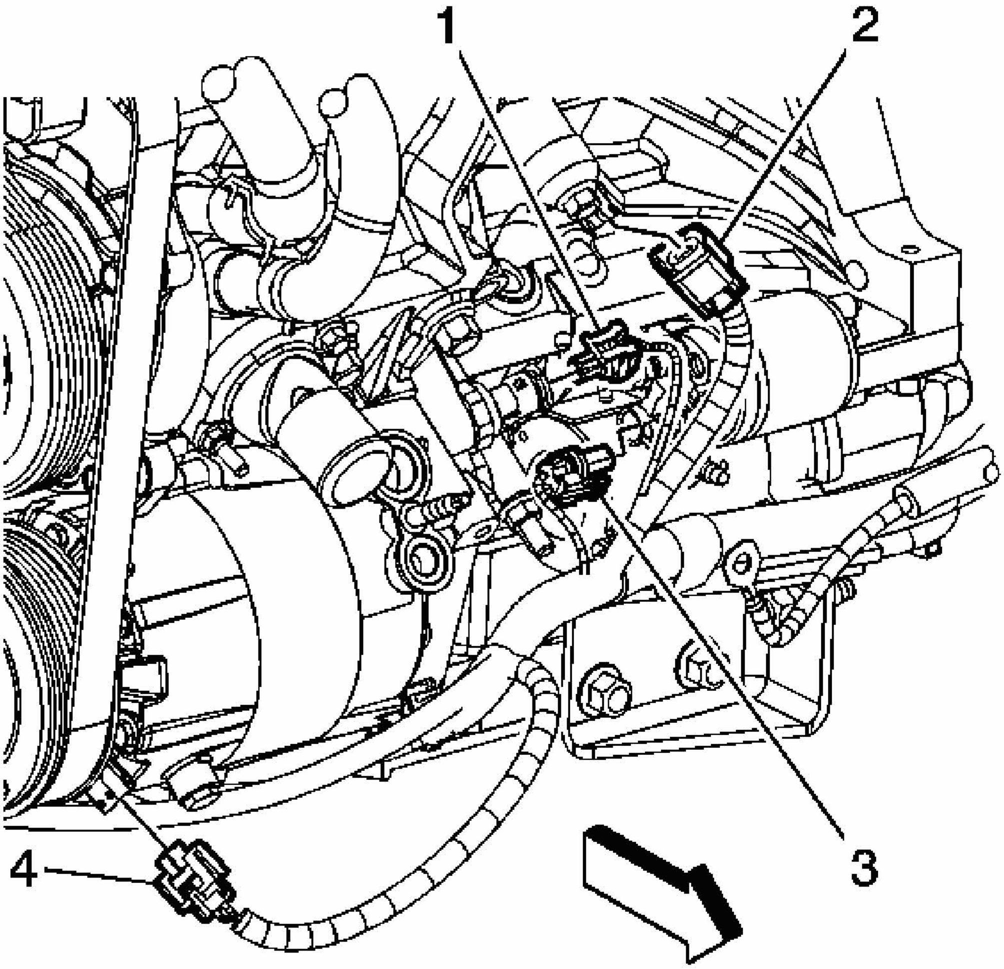


Fig. 203: Locating Starter Motor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

10. Disconnect the oil pressure sensor electrical connector (1).
11. Disconnect the knock sensor electrical connector (2).
12. Disconnect the starter motor electrical connector (3).
13. Disconnect the air conditioning (A/C) compressor electrical connector (4).

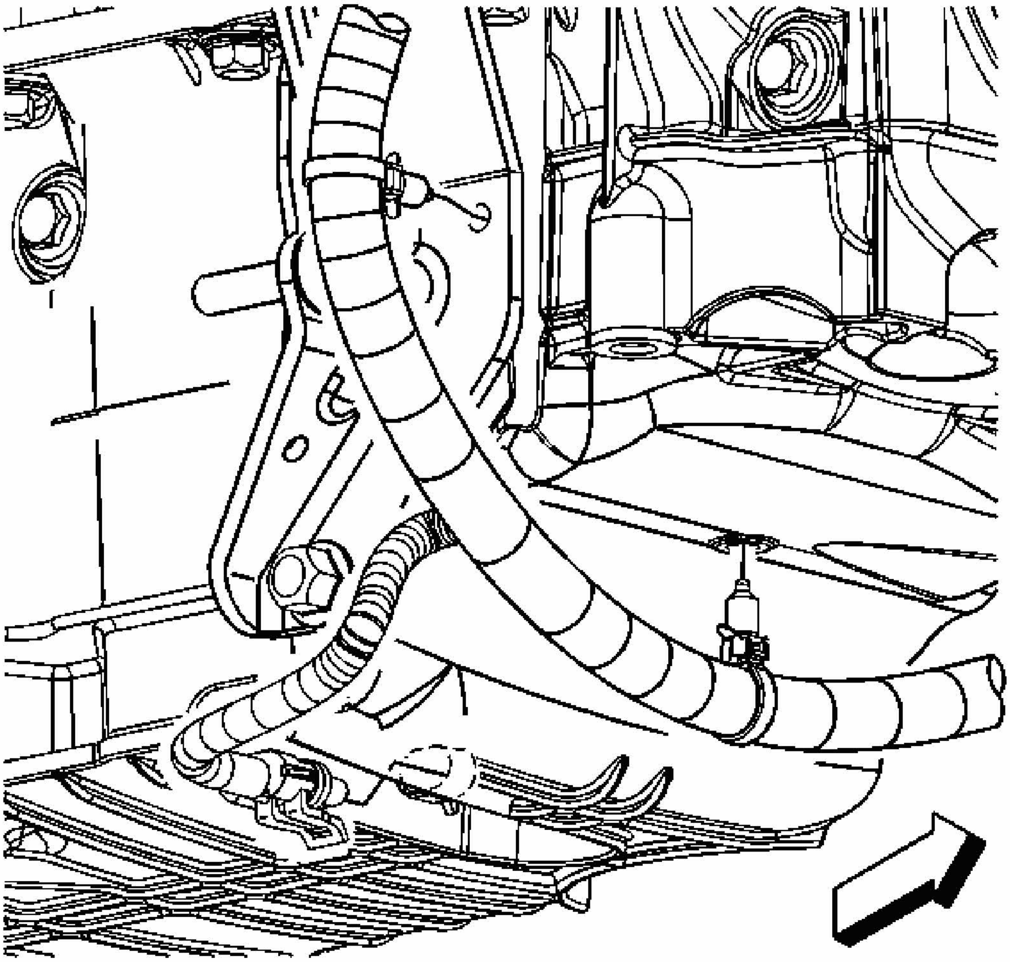


Fig. 204: Locating Engine Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

14. Disconnect the oil level sensor electrical connector.
15. Remove the engine harness clips from the transaxle brace and the oil pan.
16. Lower the vehicle.

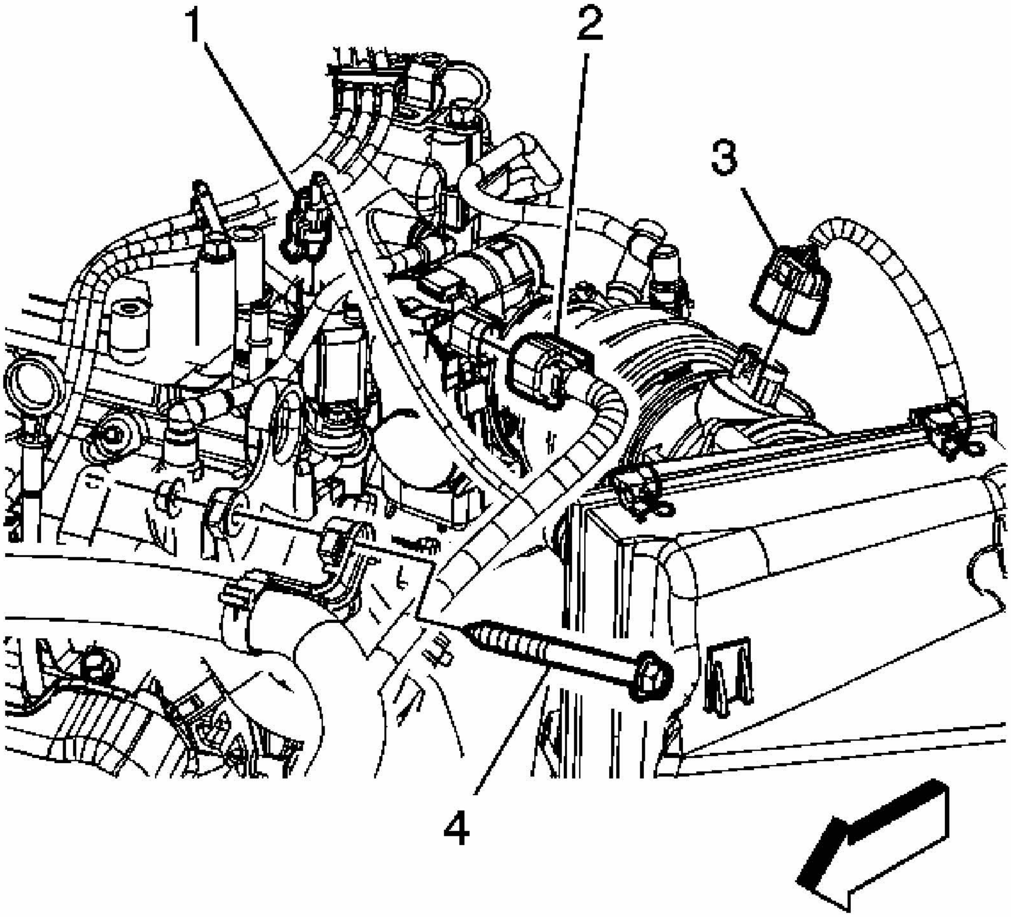


Fig. 205: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

17. Disconnect the evaporative emission (EVAP) canister purge solenoid electrical connector (1).
18. Disconnect the electronic throttle control (ETC) electrical connector (2).

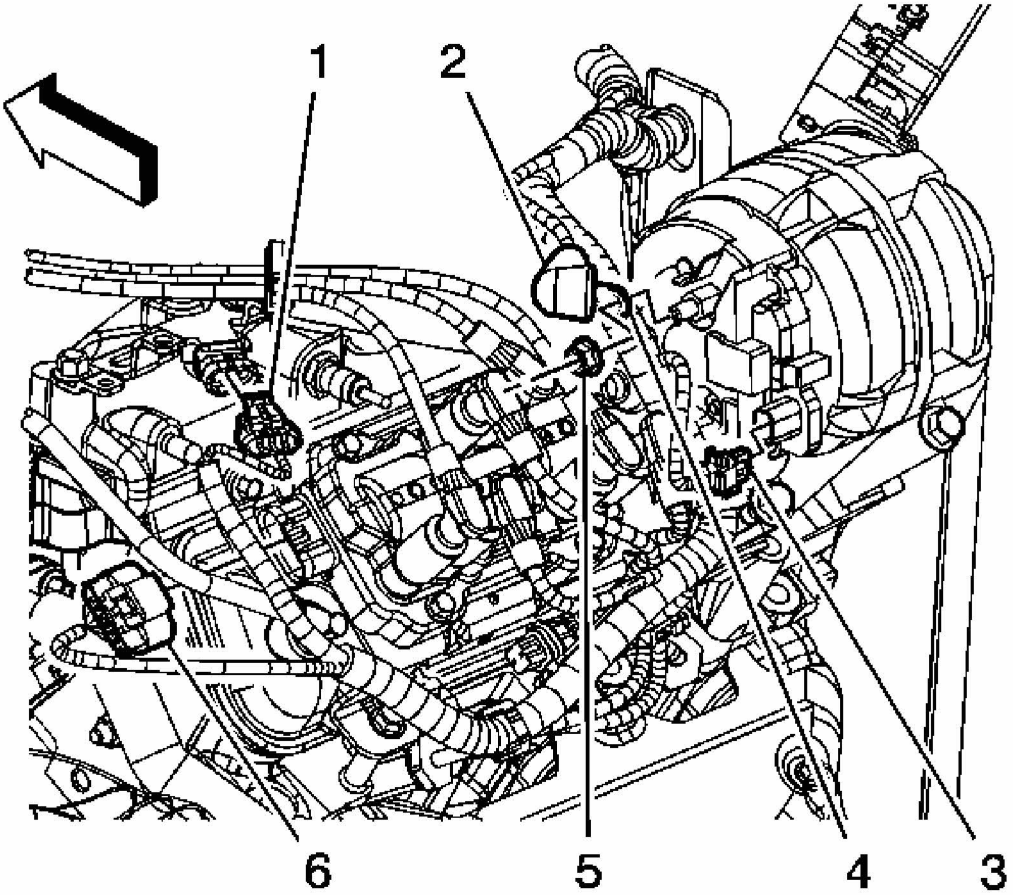


Fig. 206: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

19. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).
20. Reposition the generator terminal boot (2).
21. Remove the generator terminal nut (5).
22. Remove the generator terminal (4) from the stud.
23. Disconnect the generator electrical connector (3).
24. Disconnect the ignition coil electrical connector (6).

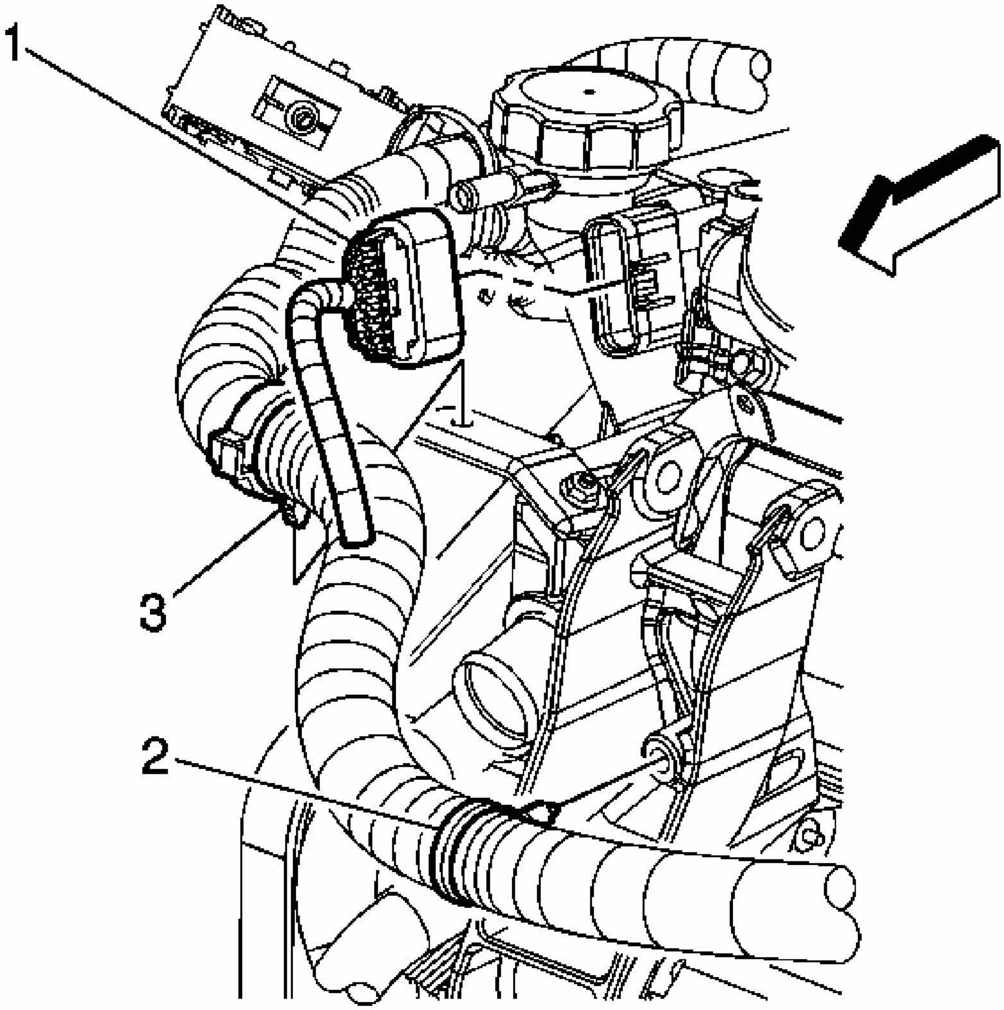


Fig. 207: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

25. Disconnect the fuel injector inline (1) electrical connector.
26. Remove the engine harness clips (2, 3) from the brackets.

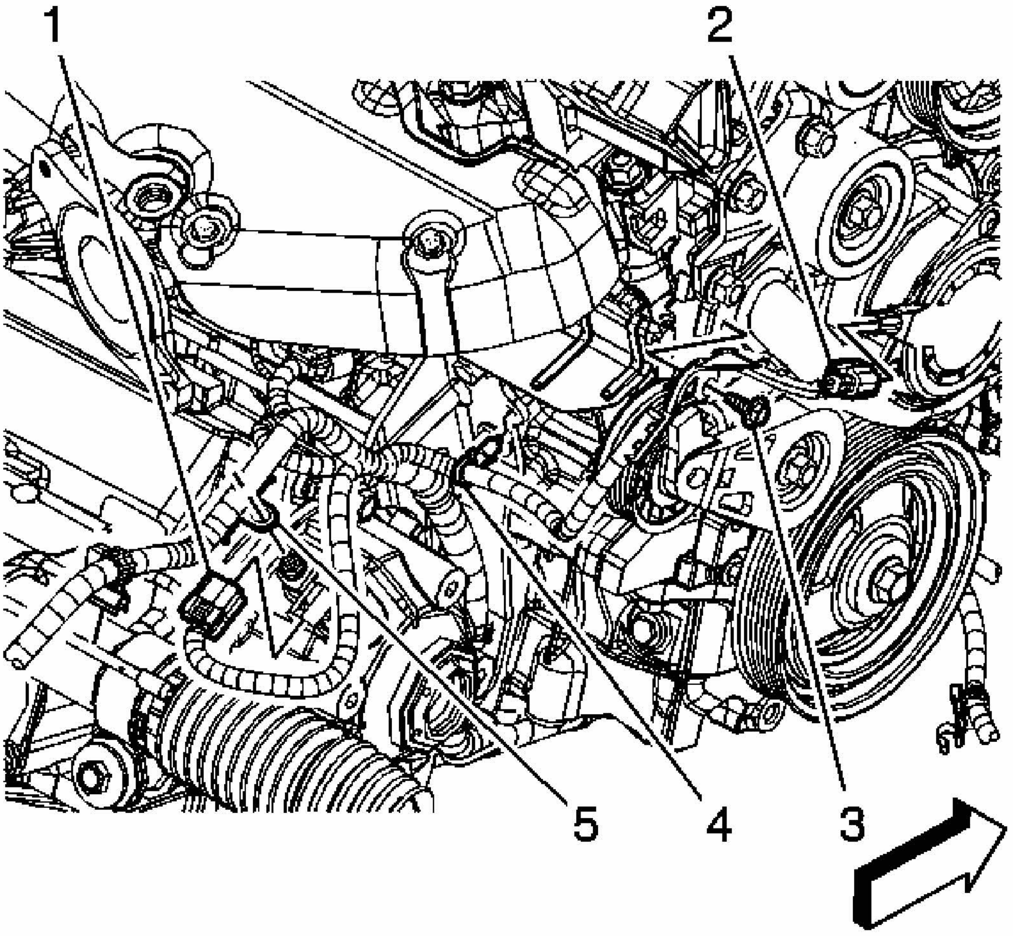


Fig. 208: Locating Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

27. Disconnect the camshaft phasor sensor electrical connector (2).
28. Remove the engine harness clip bolt (3).
29. Remove the engine harness clip (4) from the transaxle bracket.

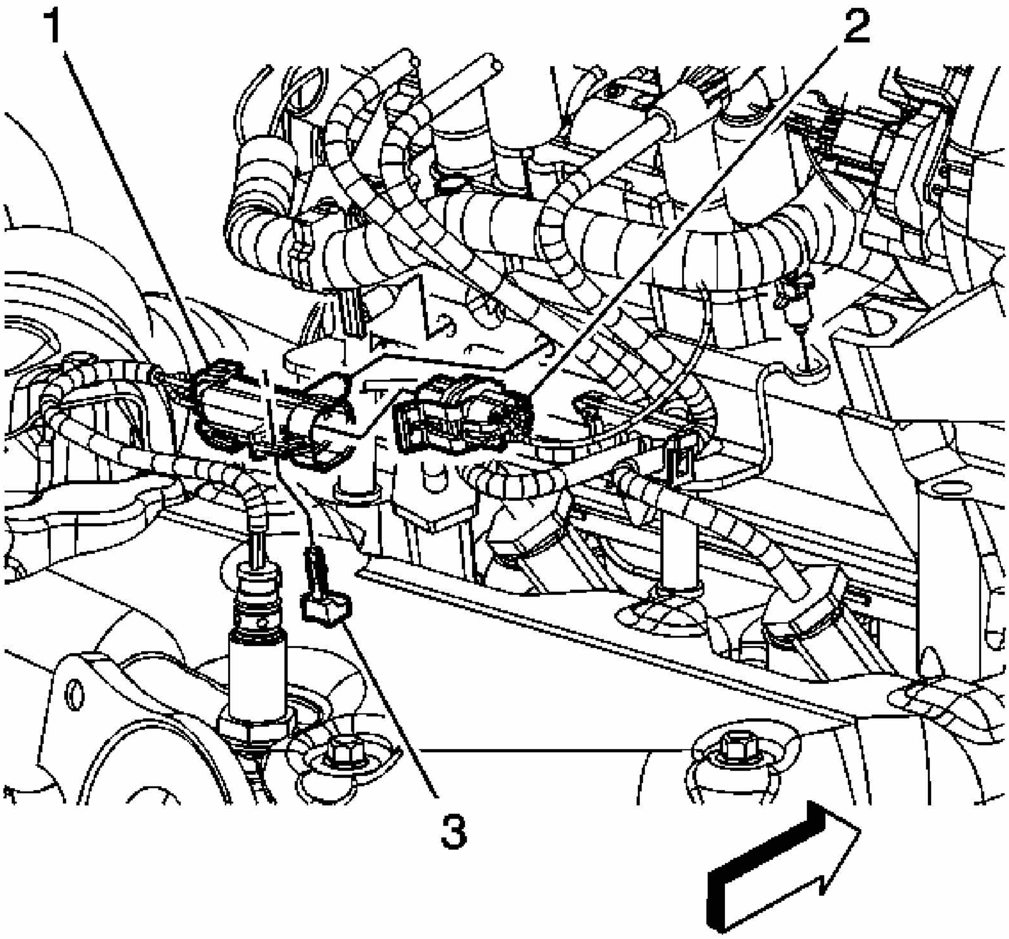


Fig. 209: Locating Connector Position Assurance (CPA) Retainer
Courtesy of GENERAL MOTORS CORP.

30. Remove the connector position assurance (CPA) retainer (3).
31. Disconnect the rear upper heated oxygen sensor (HO2S) electrical connector (2).

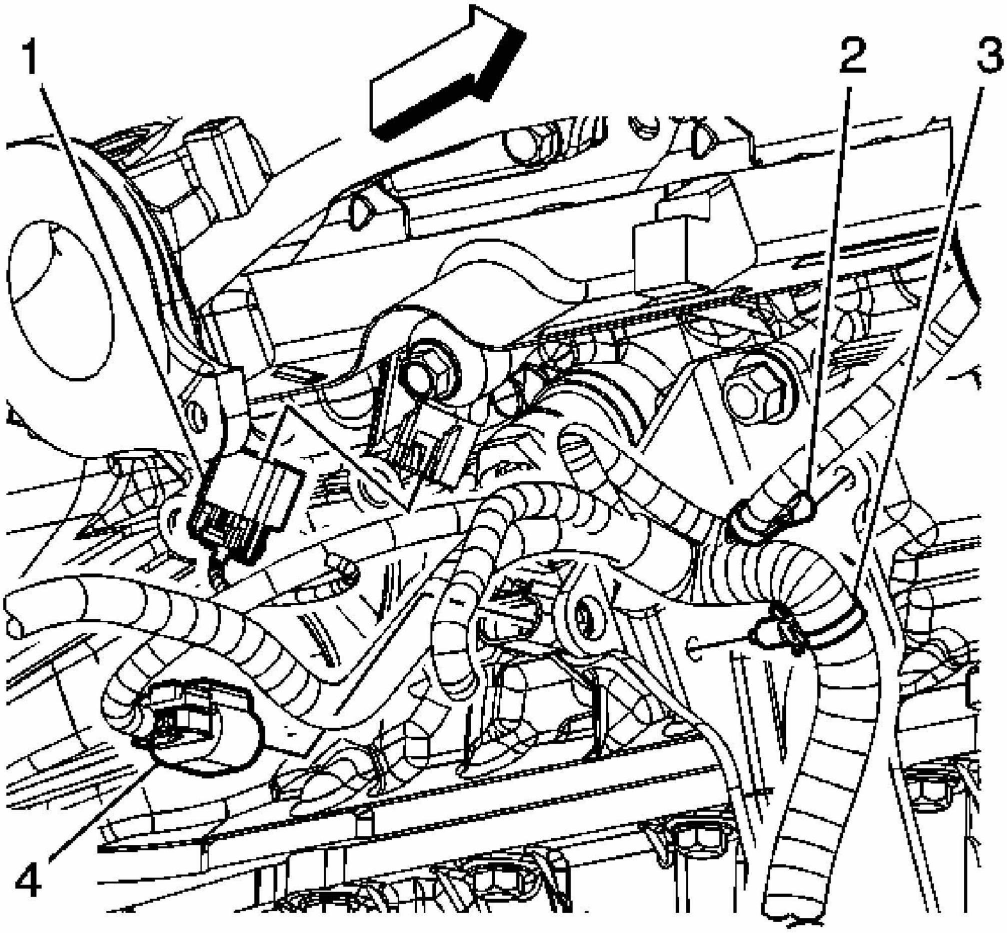


Fig. 210: Identifying Knock Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

32. Disconnect the knock sensor electrical connector (1).
33. Disconnect the crankshaft position (CKP) sensor electrical connector (4).
34. Remove the engine harness clips (2, 3) from the transaxle brace.

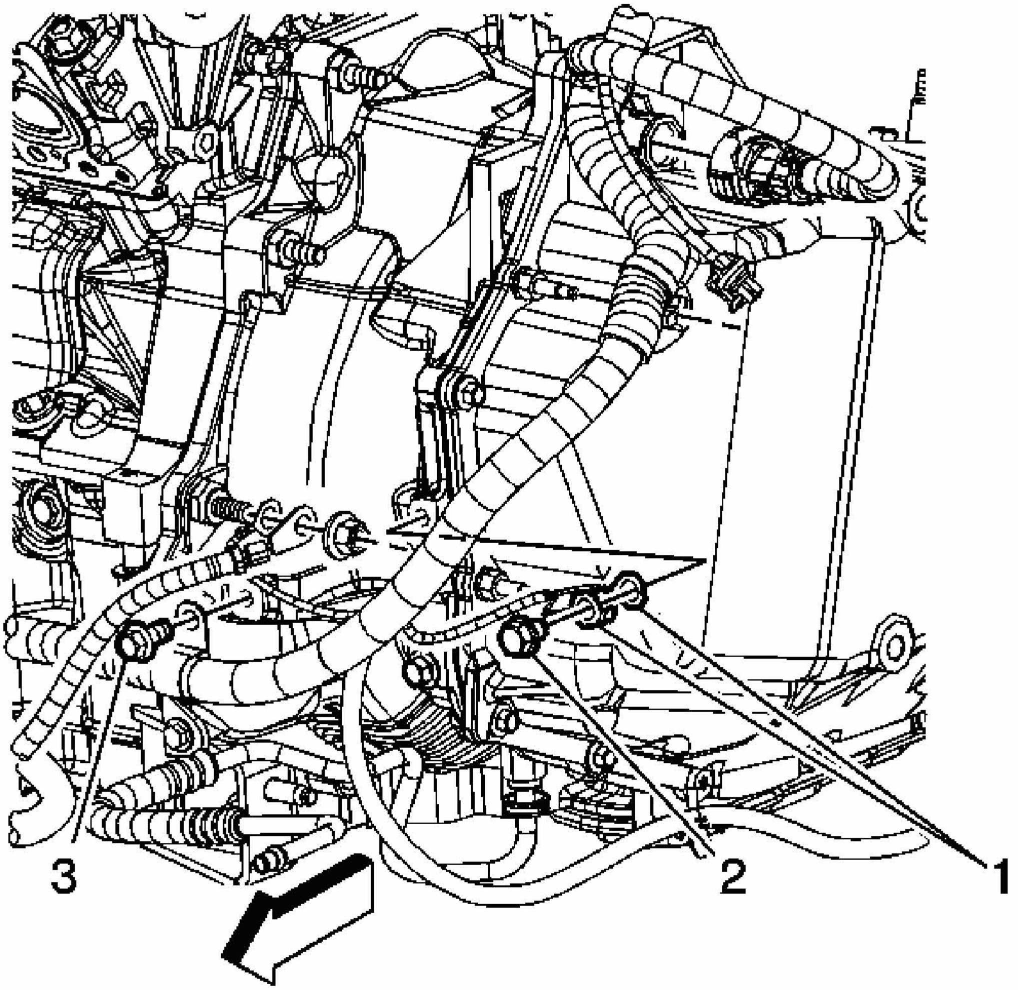


Fig. 211: View Of Engine Harness Ground Bolt
Courtesy of GENERAL MOTORS CORP.

35. Remove the engine harness ground bolt (2).
36. Remove the engine harness ground terminals (1) from the transmission.
37. Remove the engine harness clip bolt (3) from the transmission.
38. Reposition all branches of the engine harness out of the way.
39. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)** .

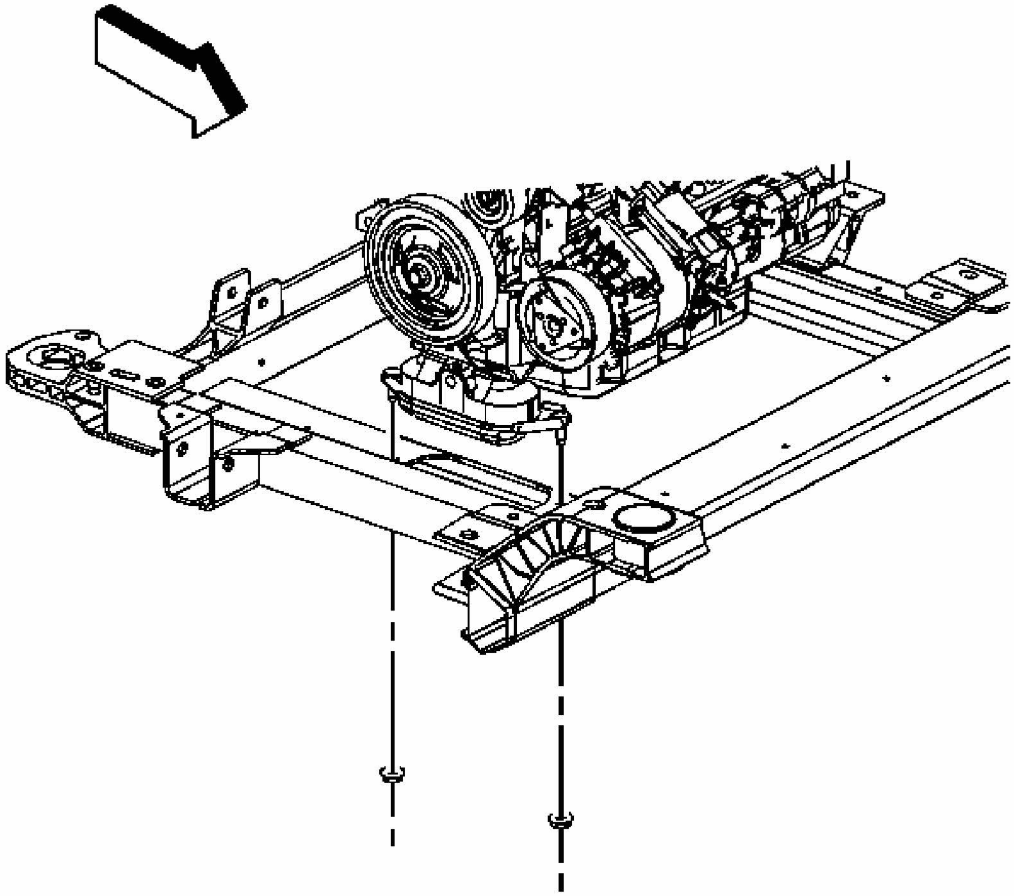


Fig. 212: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

40. Remove the engine mount lower nuts.

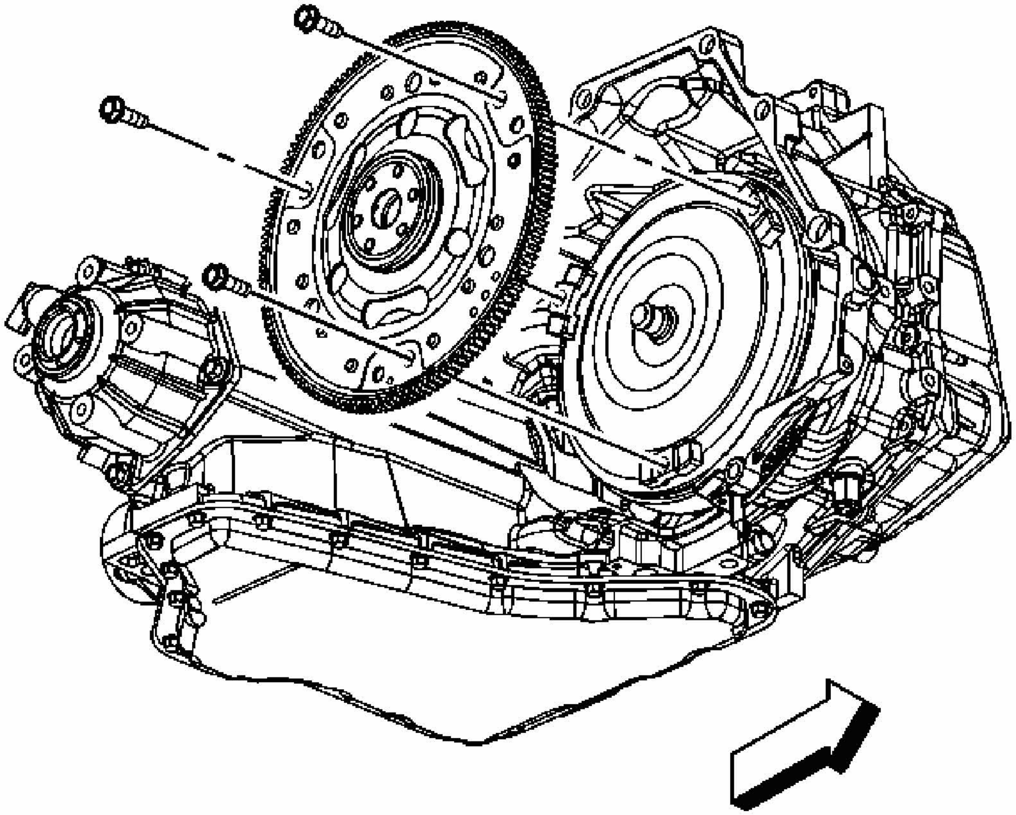


Fig. 213: Locating Torque Converter Bolts
Courtesy of GENERAL MOTORS CORP.

41. Remove the torque converter cover. Refer to **Torque Converter Cover Replacement** .
42. Remove the starter motor. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)** .
43. Remove the torque converter bolts.

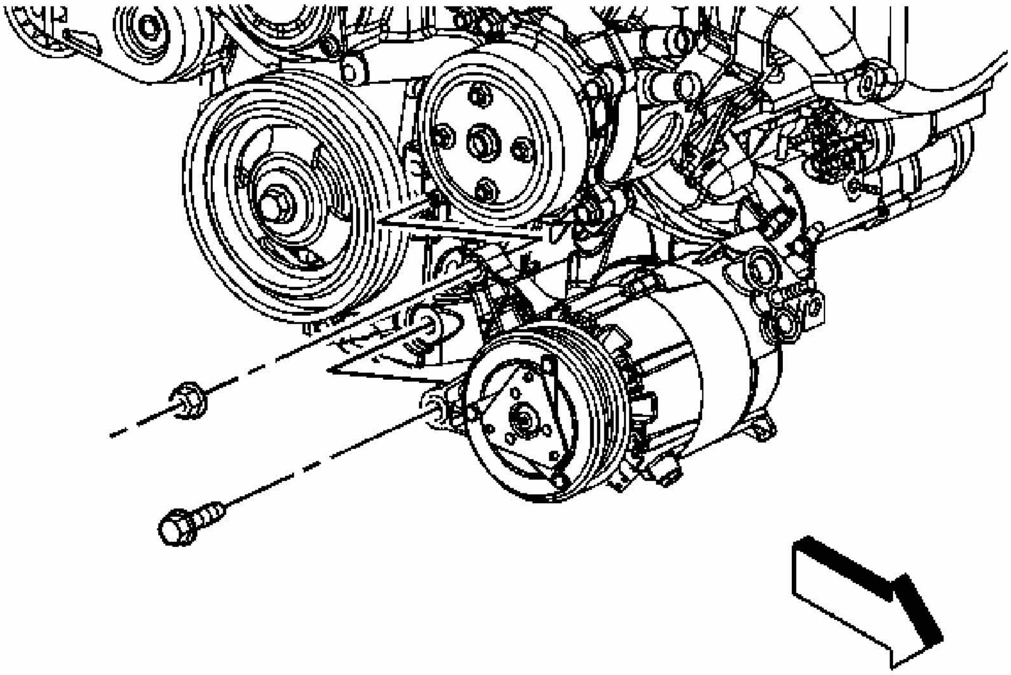


Fig. 214: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

44. Remove the A/C compressor front bolt and nut.

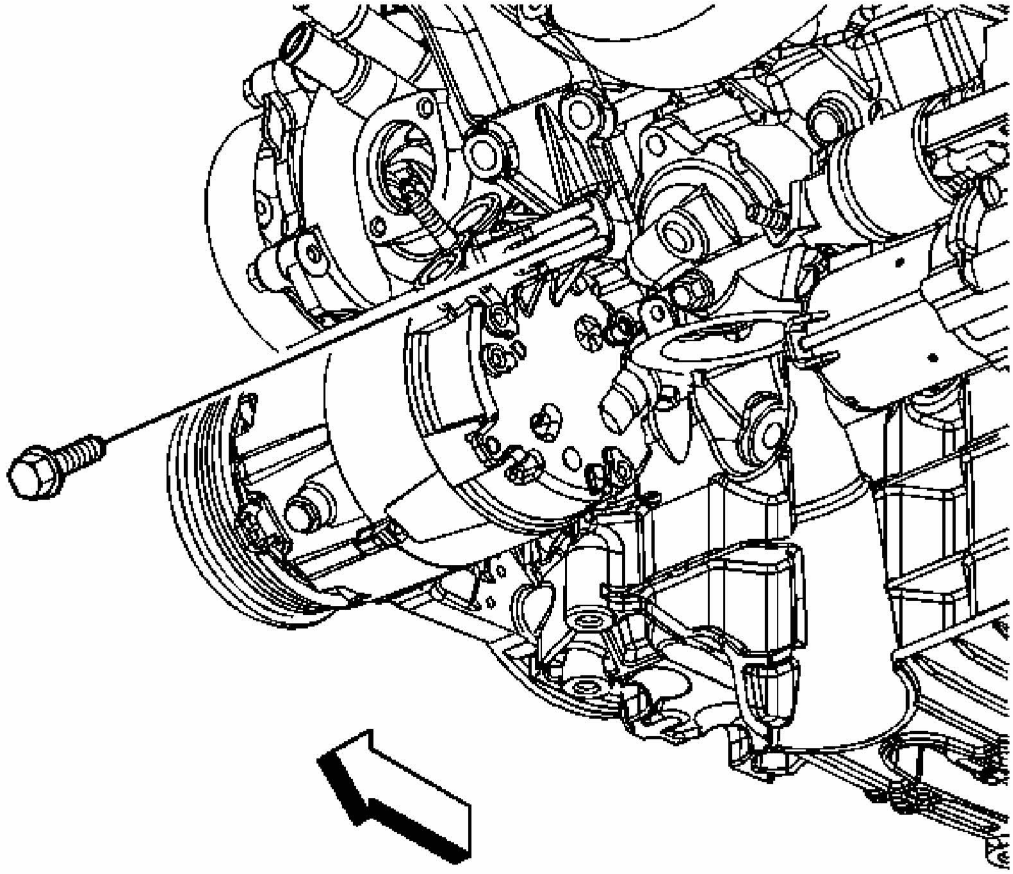


Fig. 215: Locating A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

45. Remove the A/C compressor rear bolt and reposition the compressor off to the side. DO NOT discharge the A/C system.

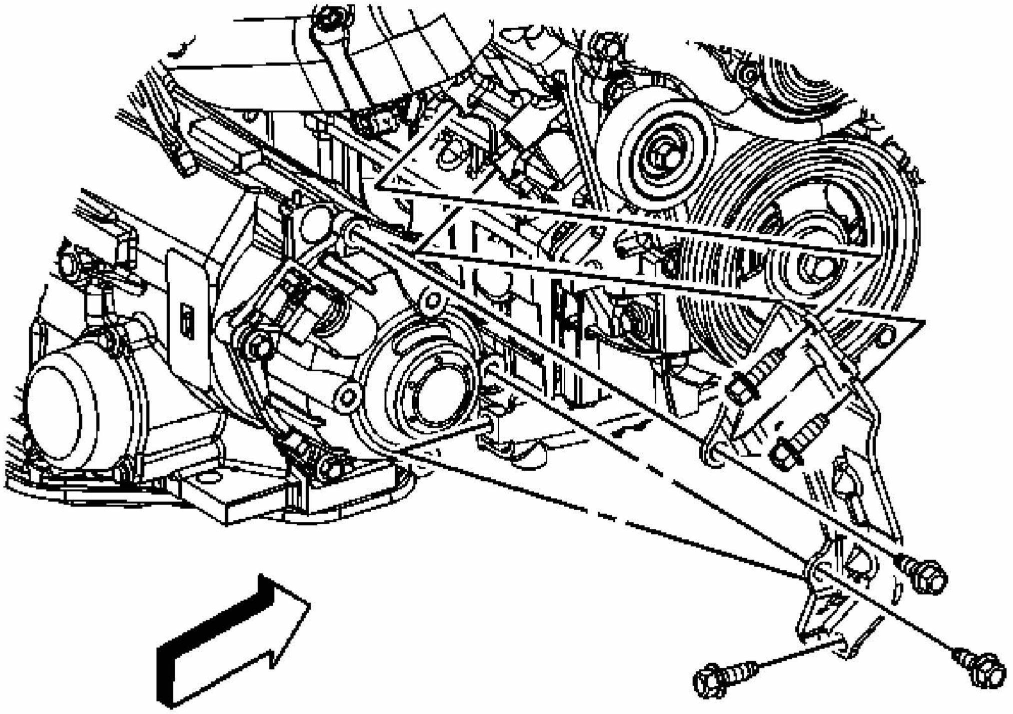


Fig. 216: Locating Rear Transaxle Brace To Engine/Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

46. Remove the transaxle brace to transaxle bolts.
47. Remove the transaxle brace to engine bolts.
48. Remove the transaxle brace.

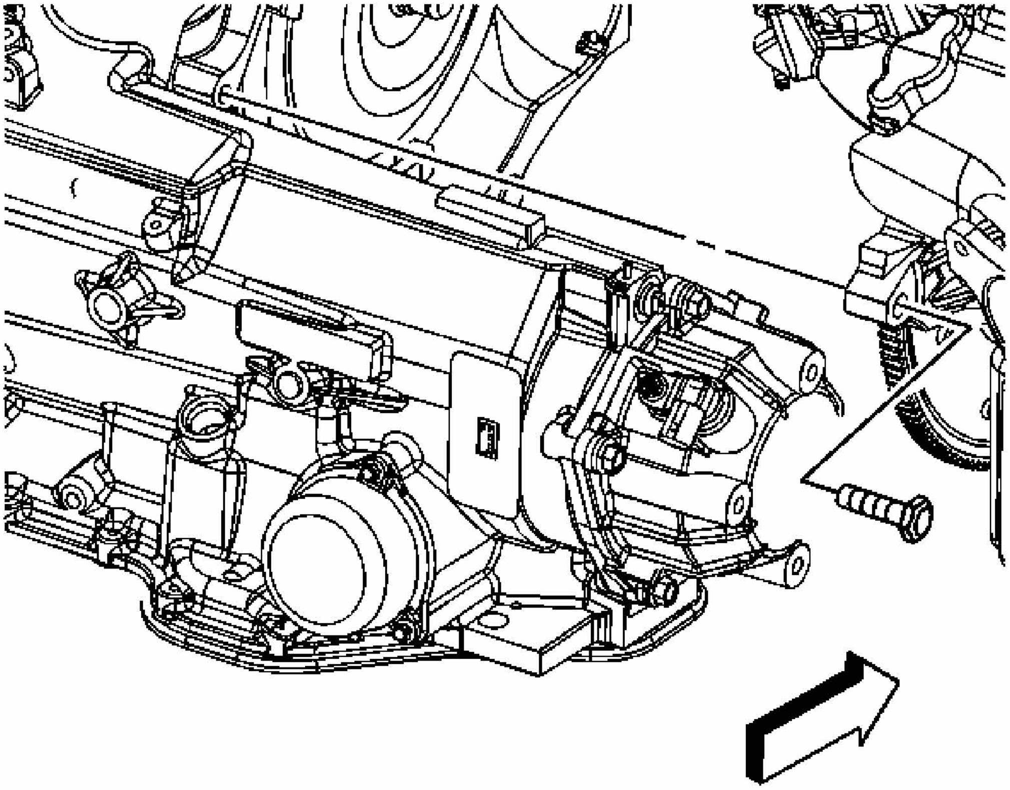


Fig. 217: View Of Transaxle-To-Engine Lower Rear Bolt
Courtesy of GENERAL MOTORS CORP.

49. Remove the transaxle-to-engine lower rear bolt.

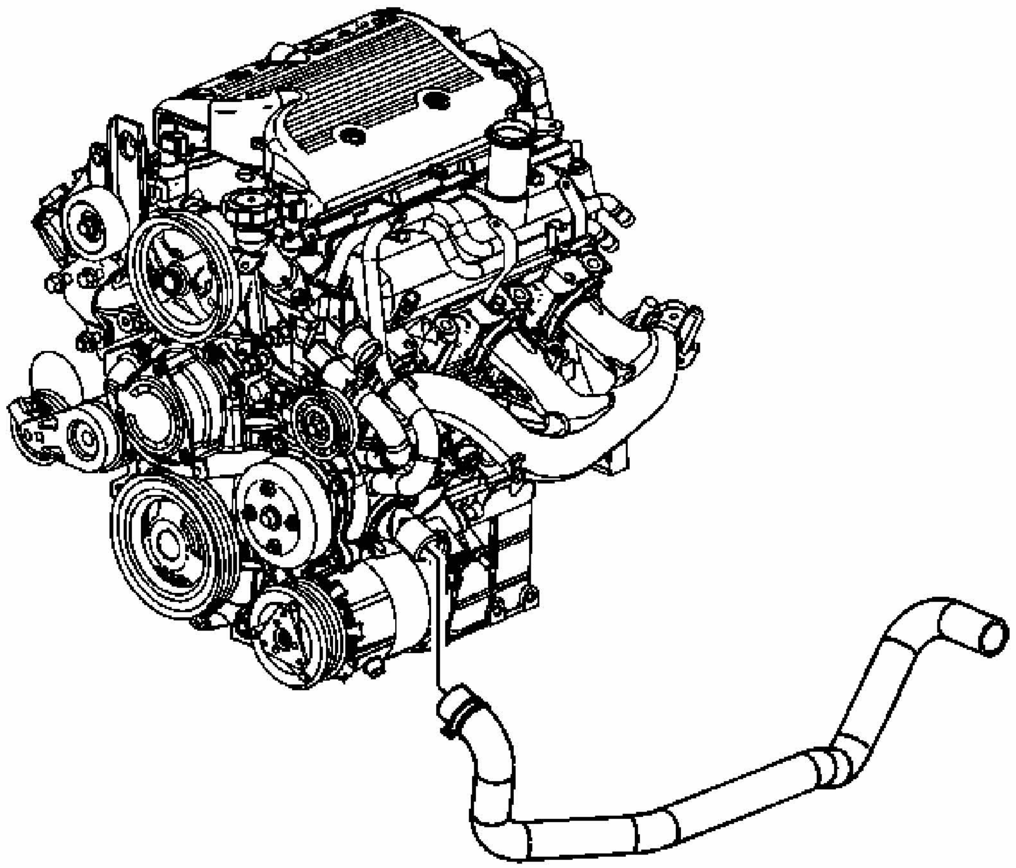


Fig. 218: Identifying Radiator Outlet Hose Clamp & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

50. Reposition the radiator outlet hose clamp at the thermostat housing.
51. Remove the radiator outlet hose from the thermostat housing.
52. Lower the vehicle and support the transaxle.

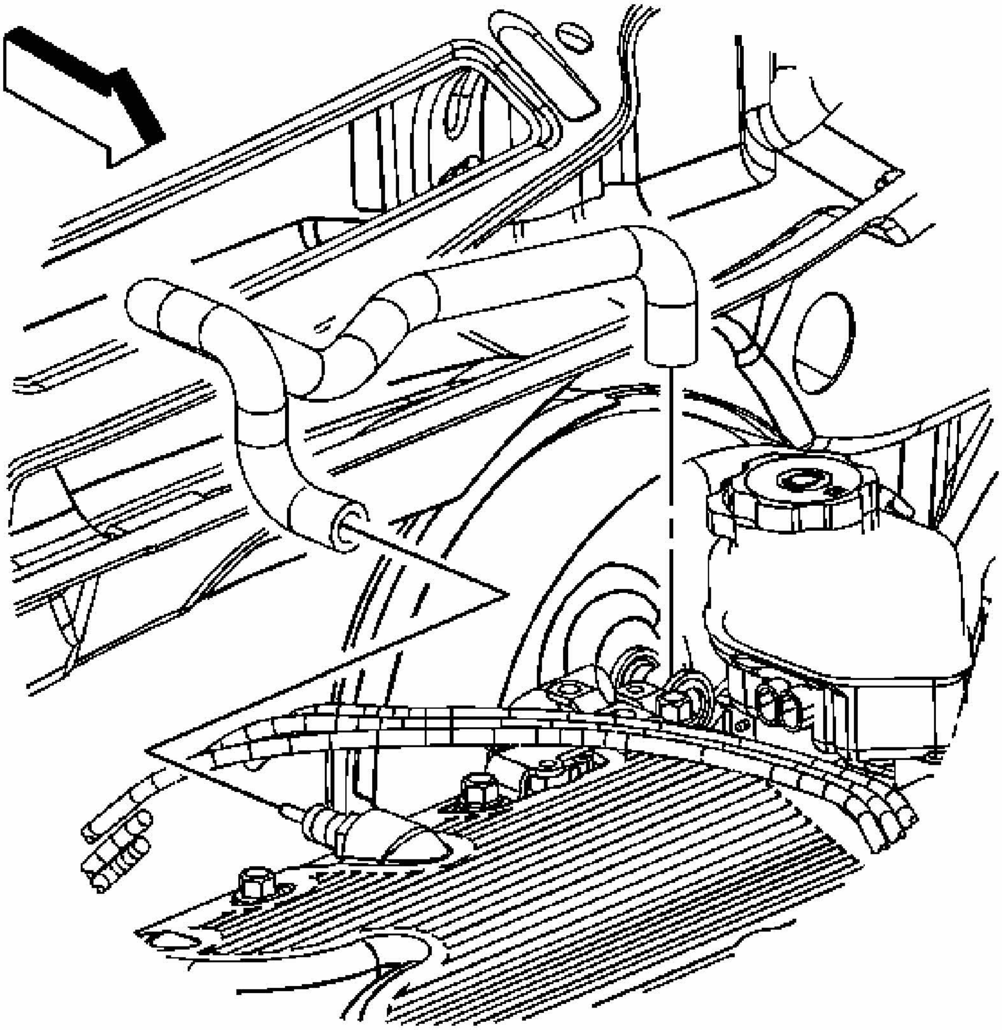


Fig. 219: View Of Brake Booster Vacuum Hose & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

53. Remove the brake booster vacuum hose from the intake manifold.

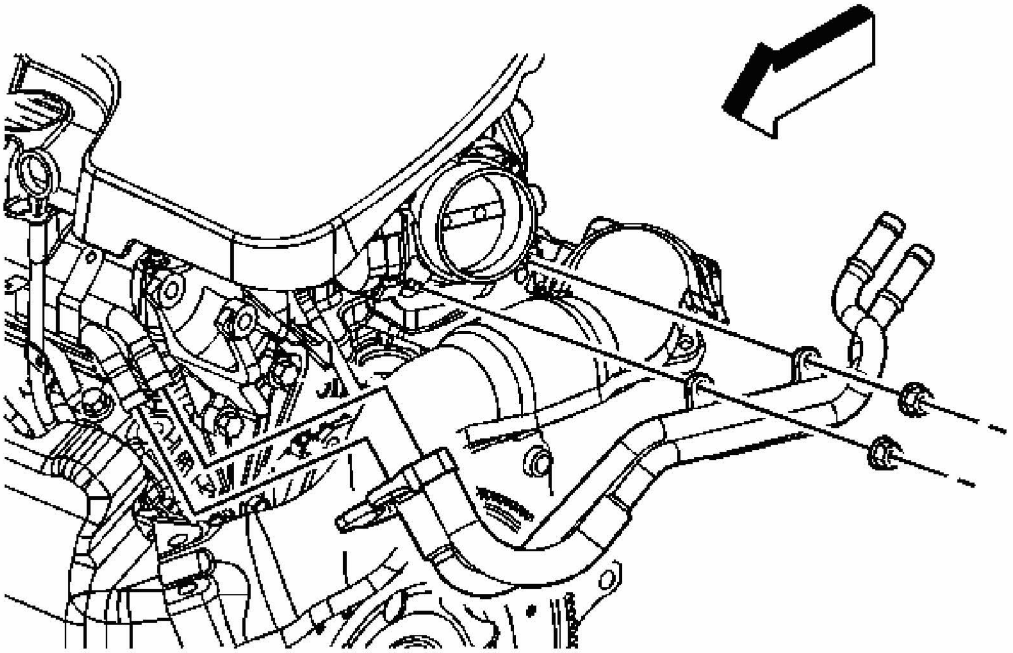


Fig. 220: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

54. Reposition the heater inlet and outlet hose clamps at the engine.
55. Remove the heater inlet and outlet hoses from the engine pipes.
56. Remove the exhaust crossover pipe. Refer to **Exhaust Crossover Pipe Replacement (RPOs LZE/LZ4/LZ9)** or **Exhaust Crossover Pipe Replacement (RPO LS4)** .
57. Disconnect the fuel feed line from the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .
58. Disconnect the EVAP purge line from the canister purge solenoid. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

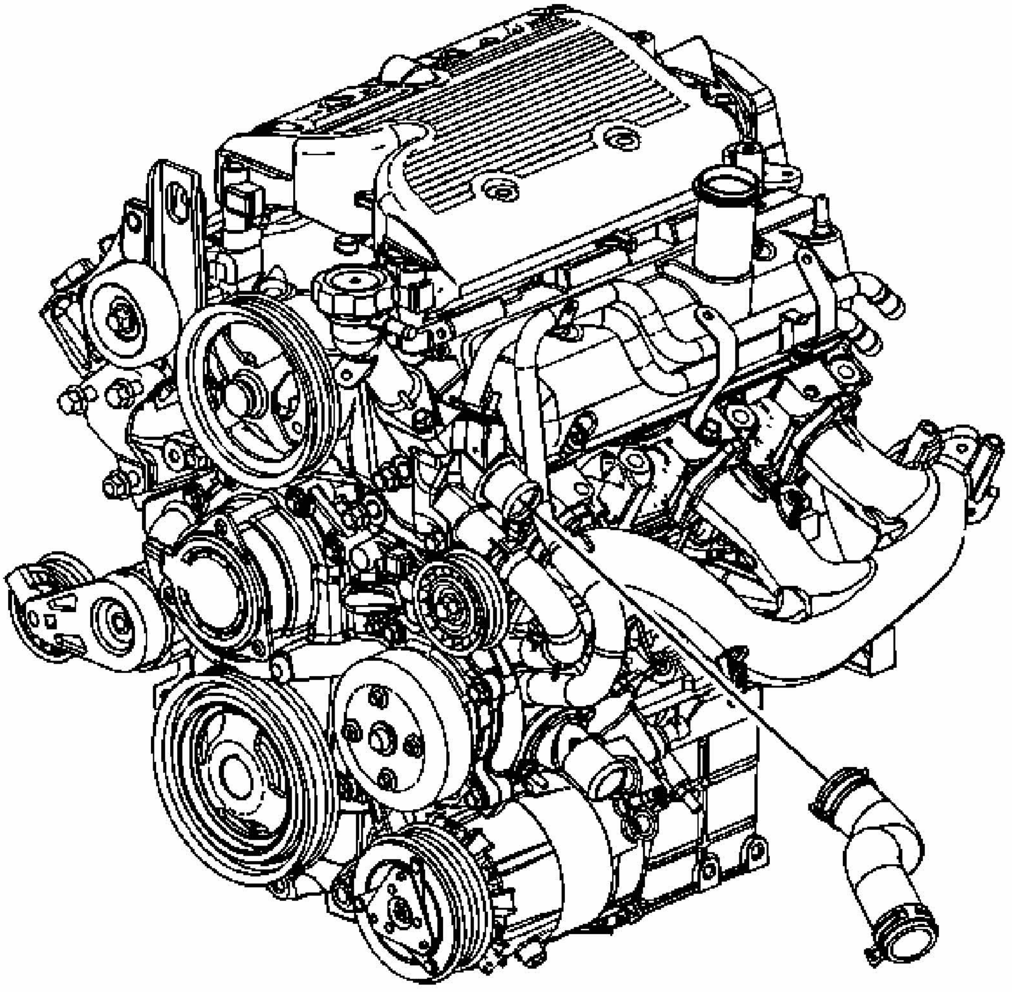


Fig. 221: View Of Radiator Inlet Hose & Crossover Pipe
Courtesy of GENERAL MOTORS CORP.

59. Reposition the radiator inlet hose clamp at the engine.
60. Remove the radiator inlet hose from the engine.

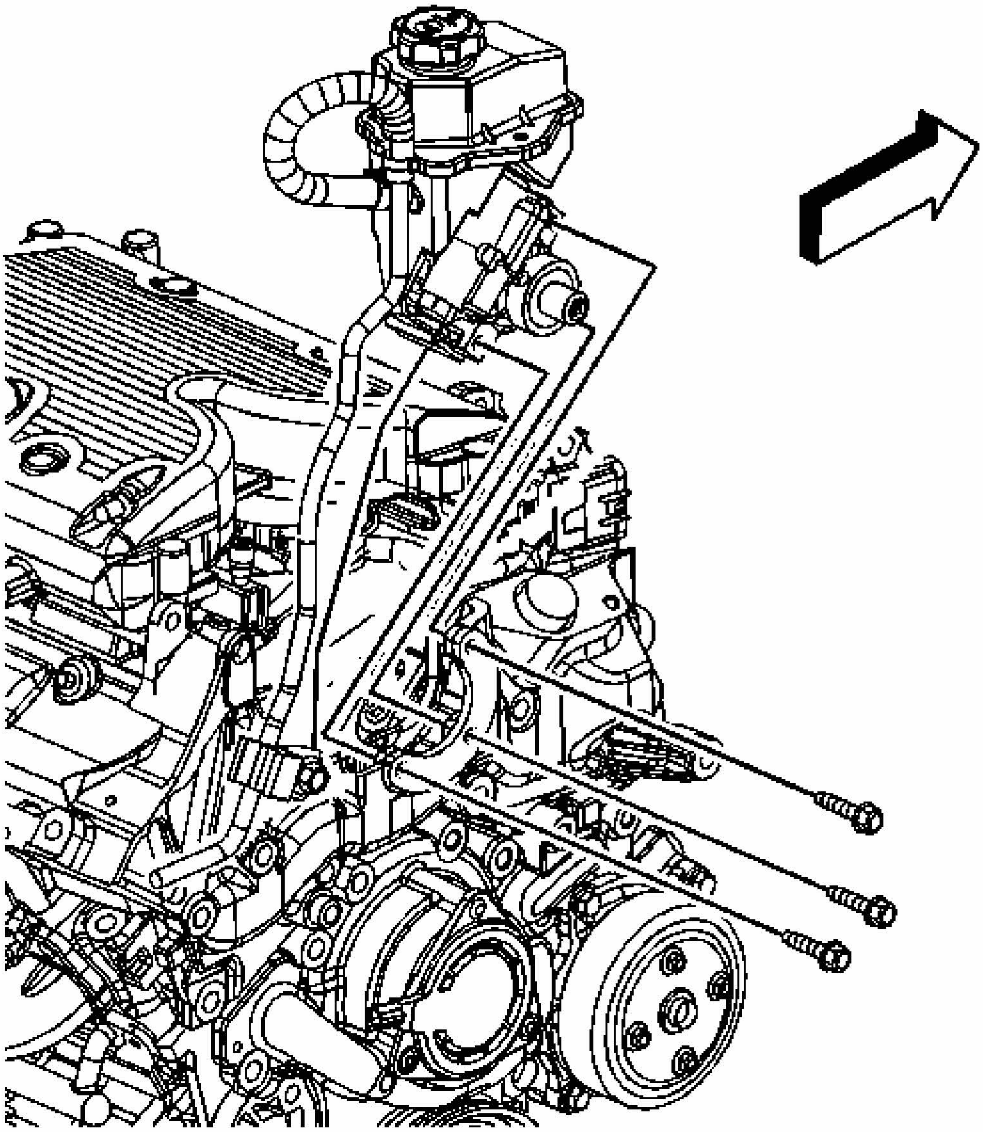


Fig. 222: Power Steering Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

61. Remove the power steering pump bolts and reposition. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)** .
62. Install a engine lifting device to the engine.

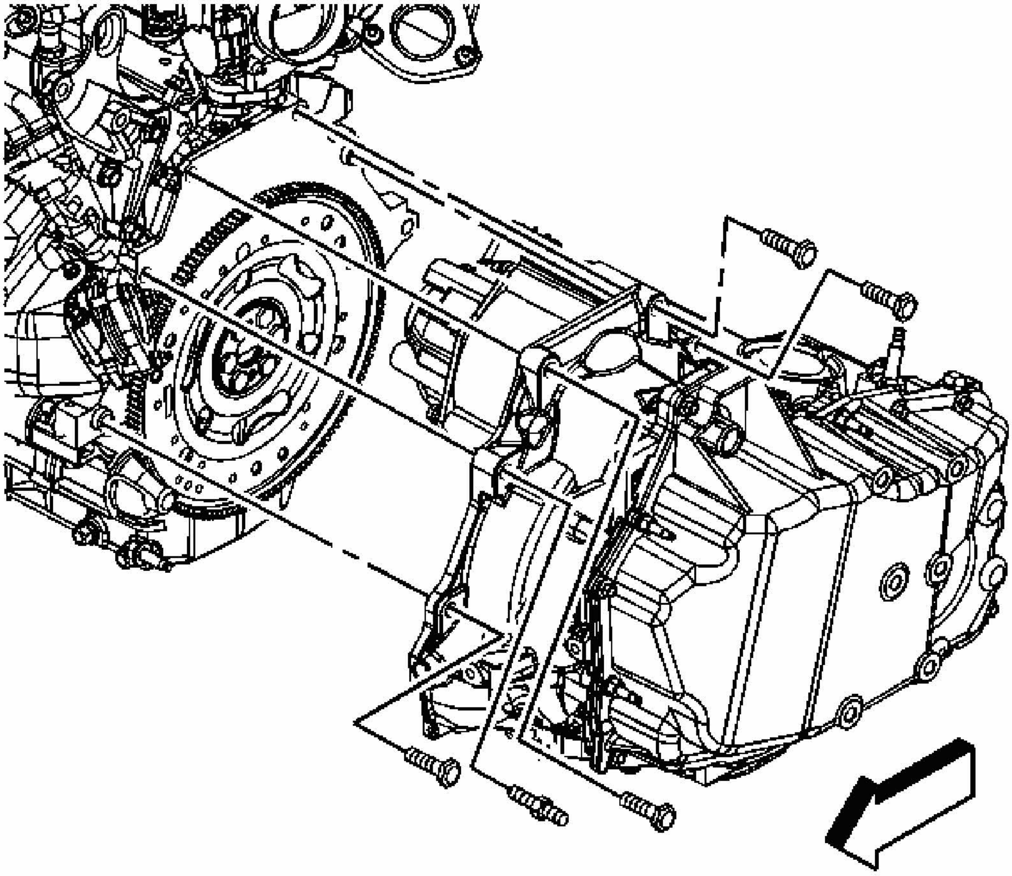


Fig. 223: View Of Transaxle-To-Engine Bolts/Studs
Courtesy of GENERAL MOTORS CORP.

63. Remove the transaxle-to-engine bolts/studs.
64. Remove the engine from the vehicle.
65. Remove the flywheel. Refer to **Engine Flywheel Removal (Automatic Transmission)** or **Engine Flywheel Removal (Manual Transmission)**.
66. Install the engine to a engine stand.

Installation Procedure

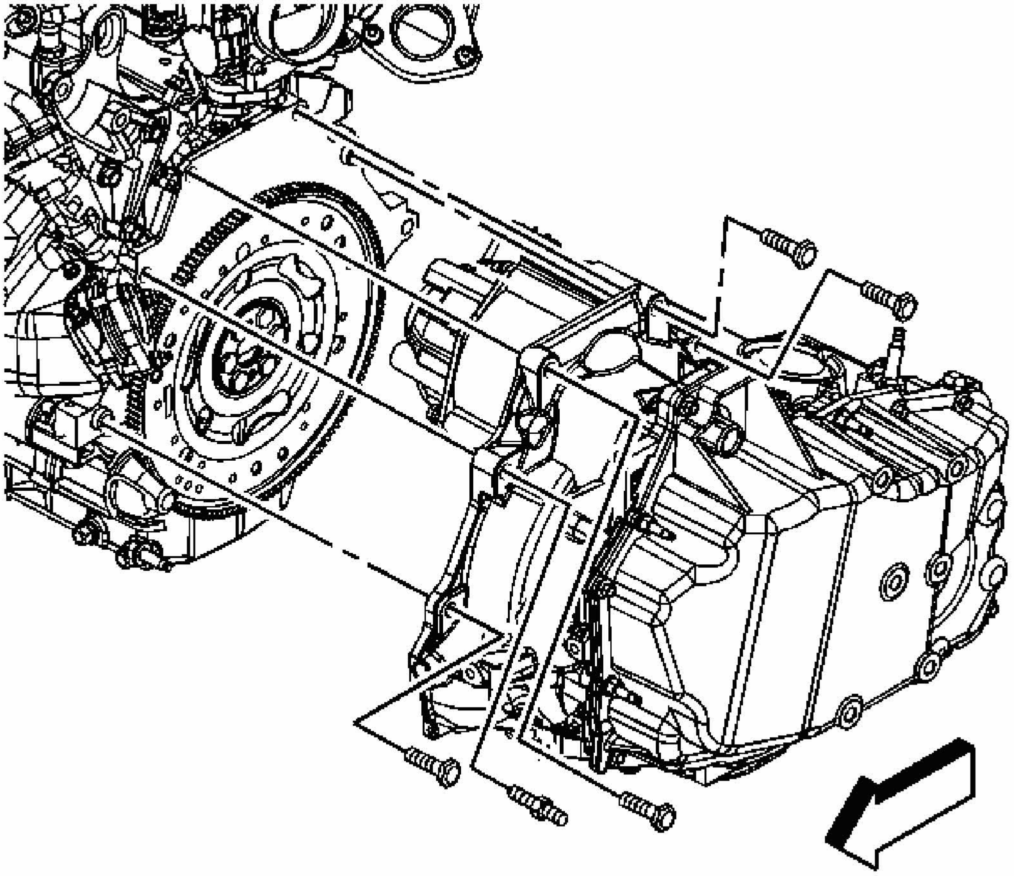


Fig. 224: View Of Transaxle-To-Engine Bolts/Studs
Courtesy of GENERAL MOTORS CORP.

1. Install a engine lifting devise to the engine.
2. Remove the engine from the engine stand.
3. Install the flywheel. Refer to **Engine Flywheel Installation (Automatic Transmission)** or **Engine Flywheel Installation (Manual Transmission)**.
4. Install the engine to the vehicle.

NOTE: **Refer to Fastener Notice .**

5. Install the transaxle-to-engine bolts/studs.

   Tighten: Tighten the bolts/stud to 75 N.m (55 lb ft).

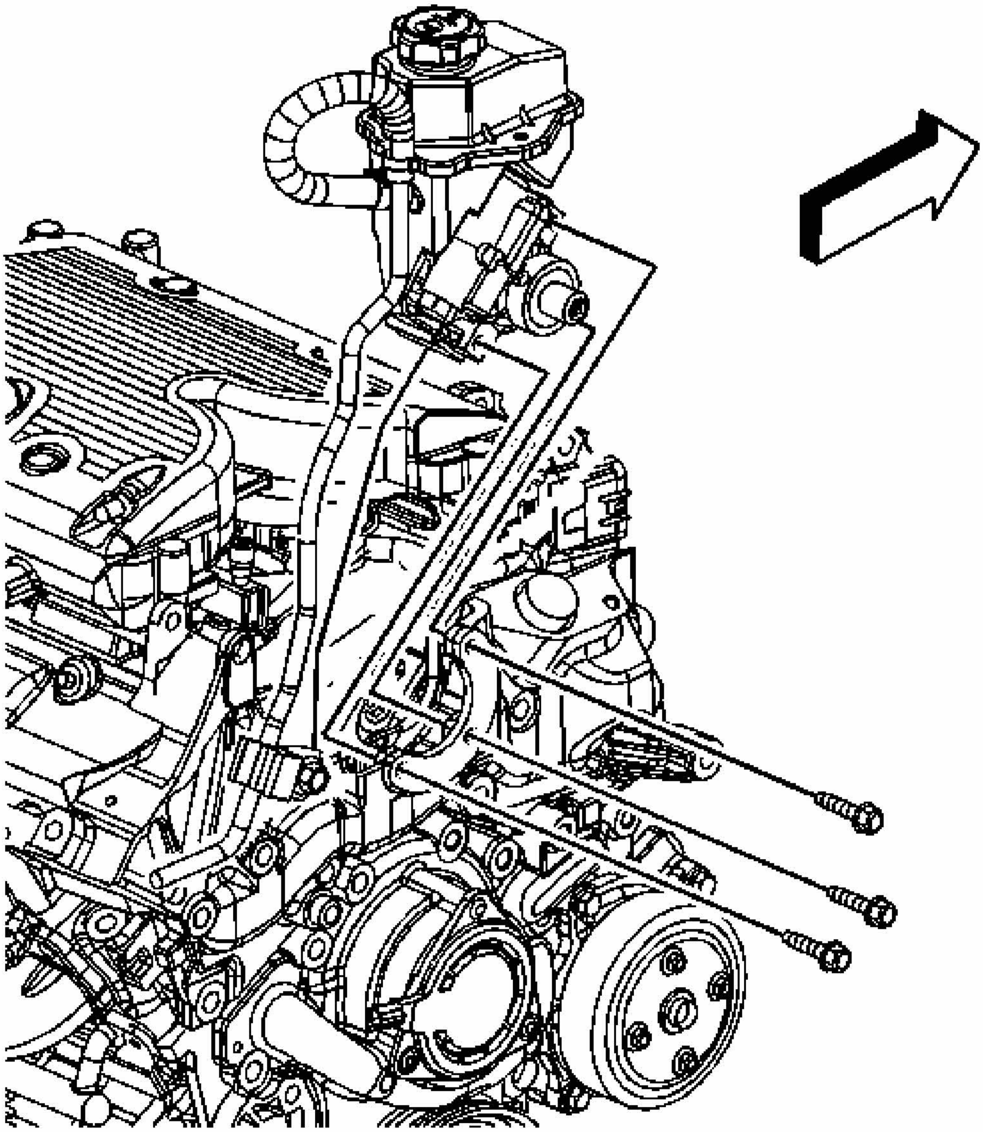


Fig. 225: Power Steering Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine lifting device from the engine.
7. Position and install the power steering pump bolts. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)** .

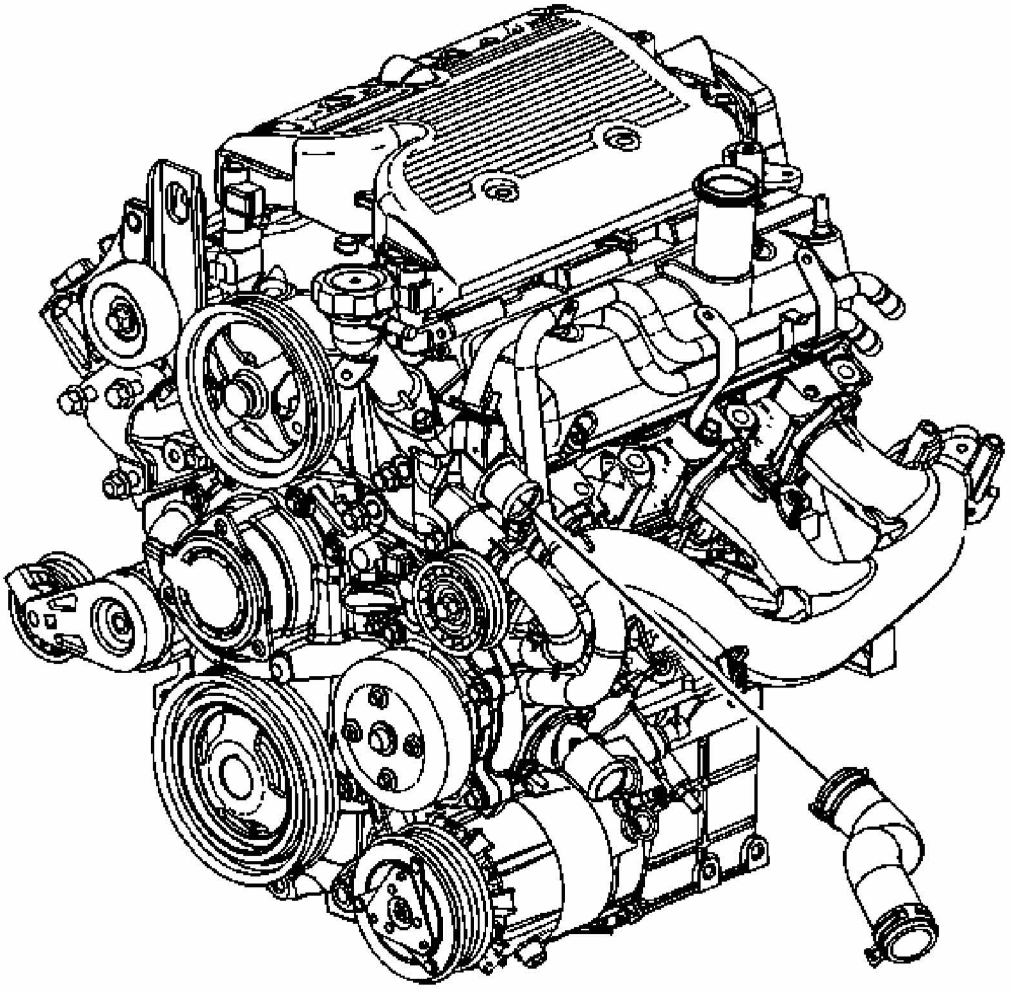


Fig. 226: View Of Radiator Inlet Hose & Crossover Pipe
Courtesy of GENERAL MOTORS CORP.

8. Install the radiator inlet hose to the engine.
9. Position the radiator inlet hose clamp at the engine.

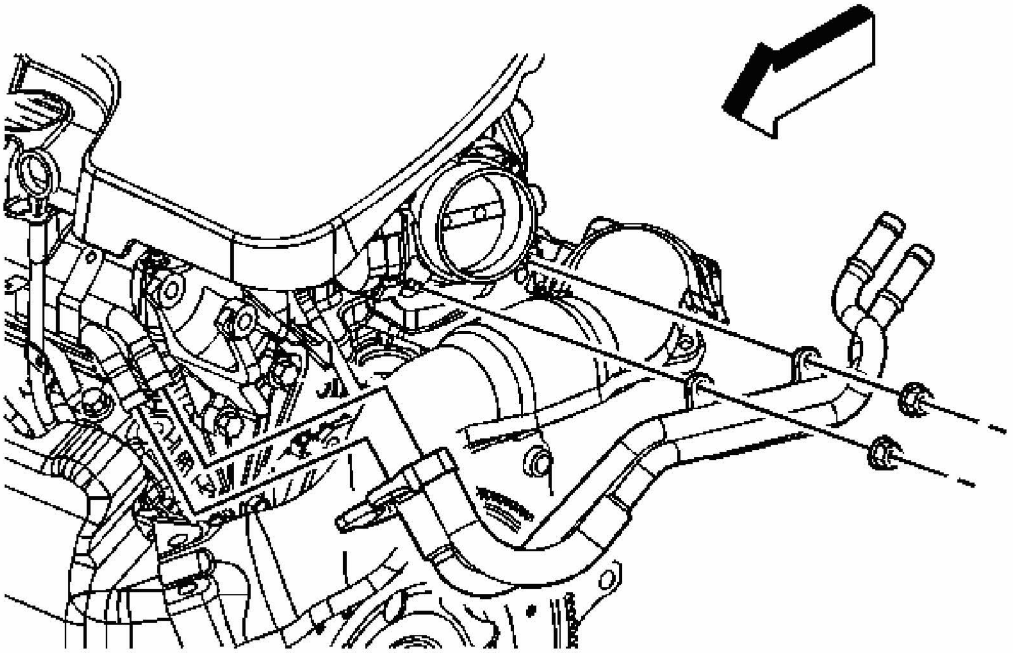


Fig. 227: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

10. Connect the EVAP purge line to the canister purge solenoid. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
11. Connect the fuel feed line to the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .
12. Install the exhaust crossover pipe. Refer to **Exhaust Crossover Pipe Replacement (RPOs LZE/LZ4/LZ9)** or **Exhaust Crossover Pipe Replacement (RPO LS4)** .
13. Install the heater inlet and outlet hoses to the engine pipes.
14. Position the heater inlet and outlet hose clamps at the engine.

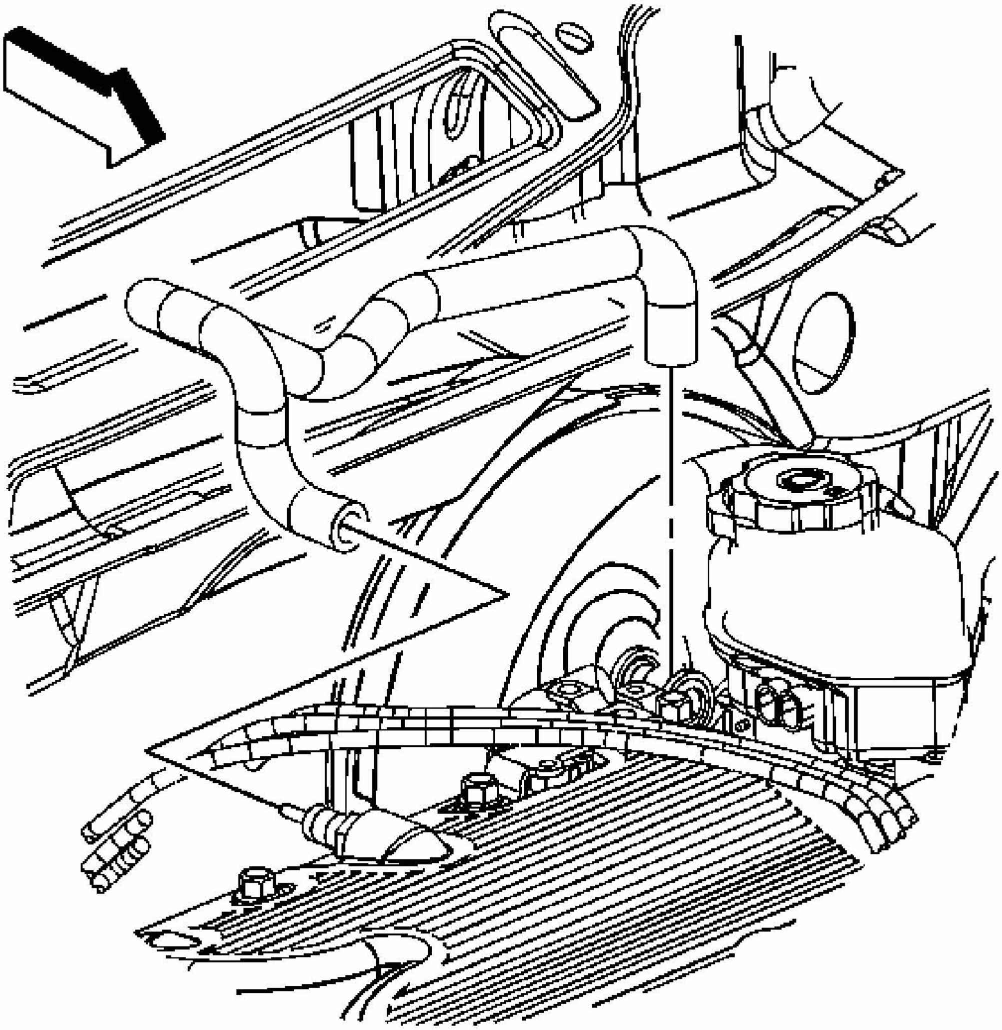


Fig. 228: View Of Brake Booster Vacuum Hose & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

15. Install the brake booster vacuum hose to the intake manifold.

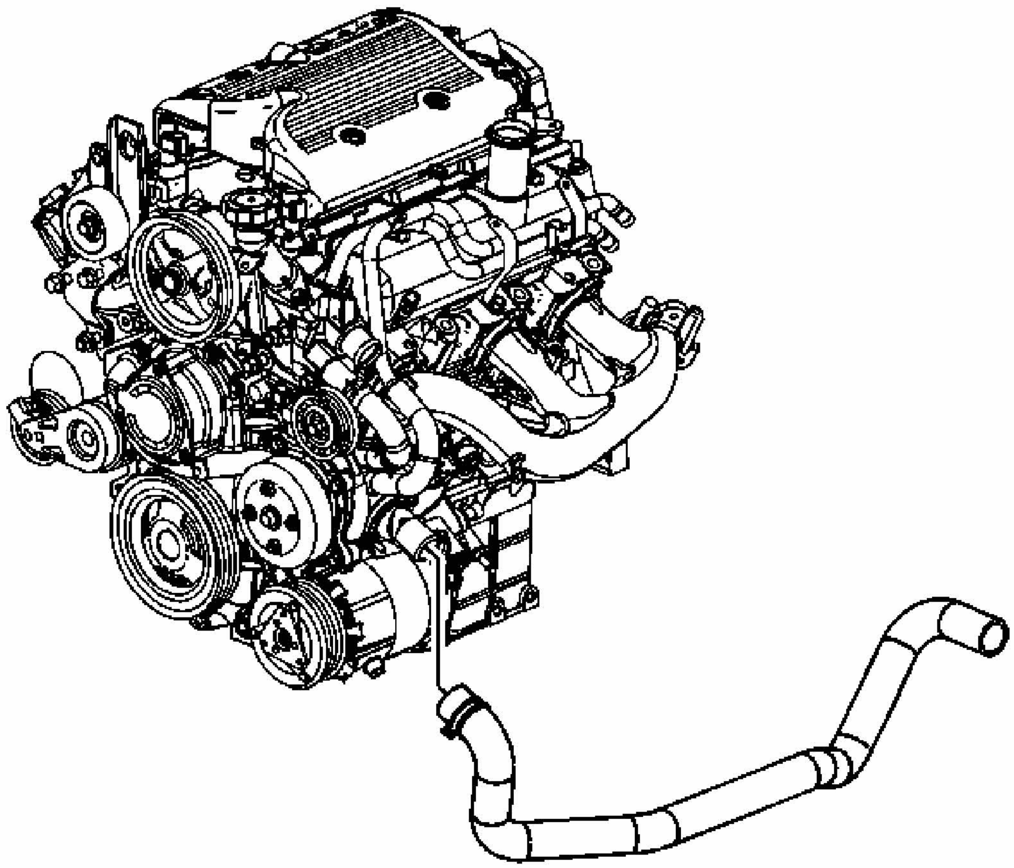


Fig. 229: Identifying Radiator Outlet Hose Clamp & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

16. Install the radiator outlet hose to the thermostat housing.
17. Position the radiator outlet hose clamp at the thermostat housing.
18. Raise and support the vehicle.

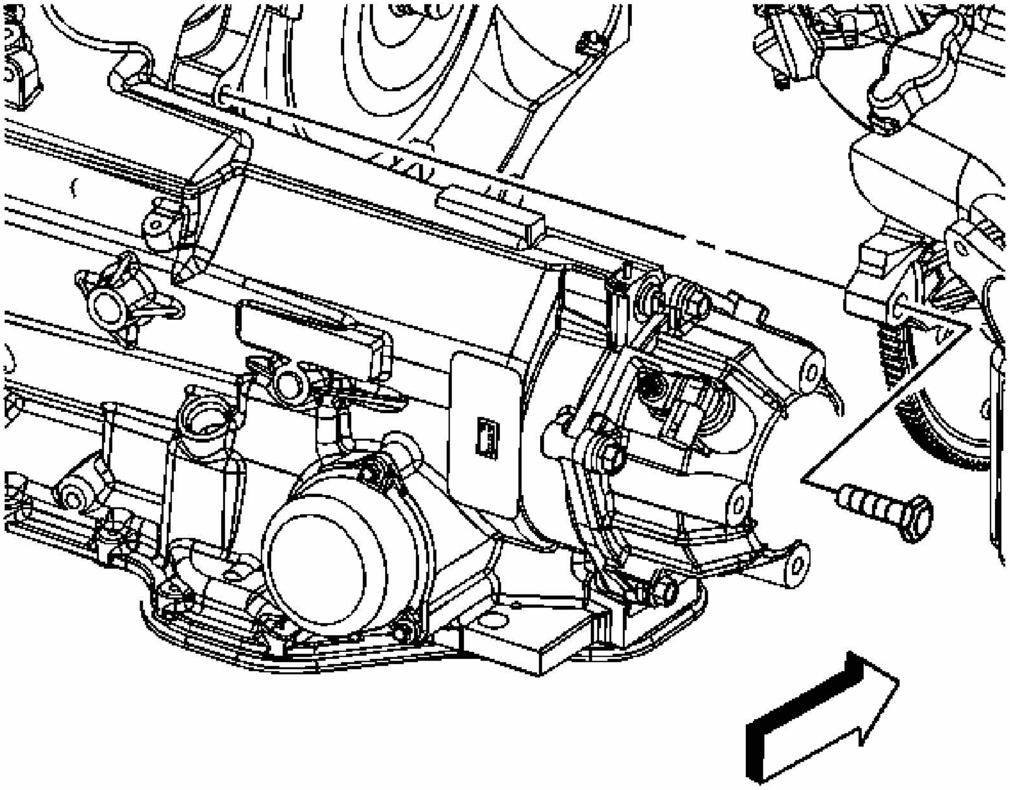


Fig. 230: View Of Transaxle-To-Engine Lower Rear Bolt
Courtesy of GENERAL MOTORS CORP.

19. Install the transaxle-to-engine lower rear bolt.

    Tighten: Tighten the bolt to 75 N.m (55 lb ft).

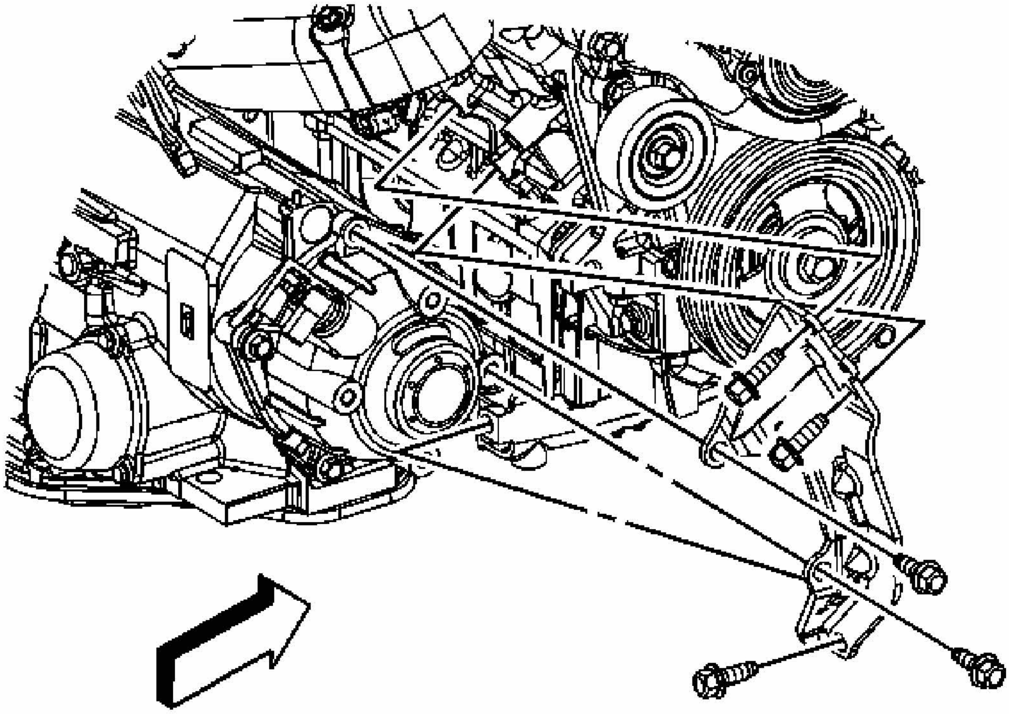


Fig. 231: Locating Rear Transaxle Brace To Engine/Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

20. Install the transaxle brace.
21. Install the transaxle brace to engine bolts.
22. Install the transaxle brace to transaxle bolts.

Tighten: Tighten the bolts to 63 N.m (46 lb ft).

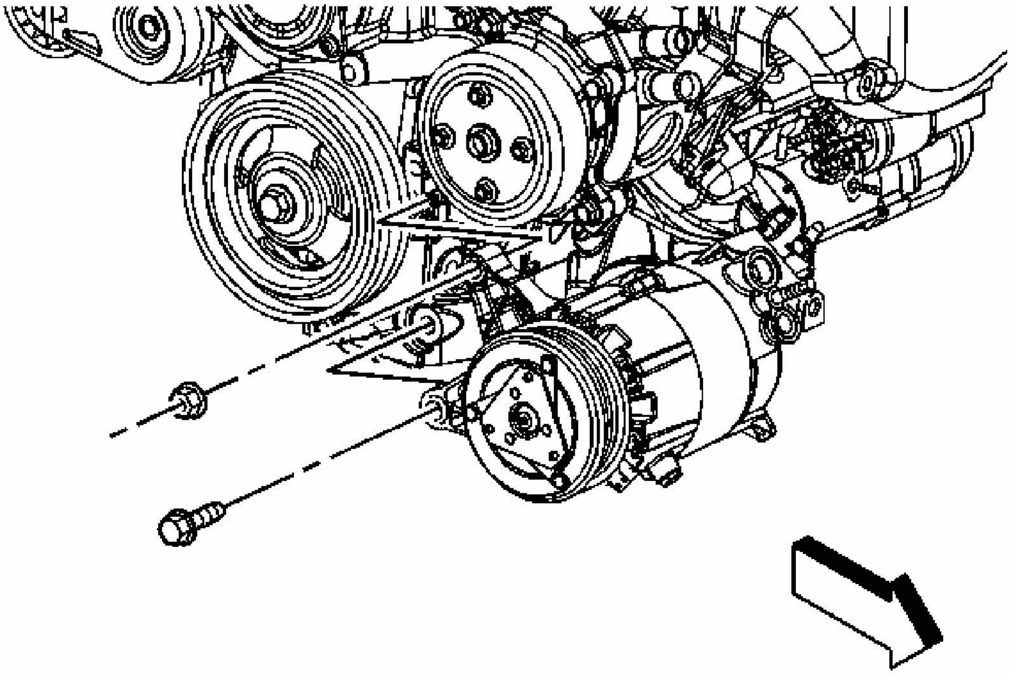


Fig. 232: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

23. Position the A/C compressor and install the compressor front bolt and nut.

Tighten: Tighten the bolt/nut to 50 N.m (37 lb ft).

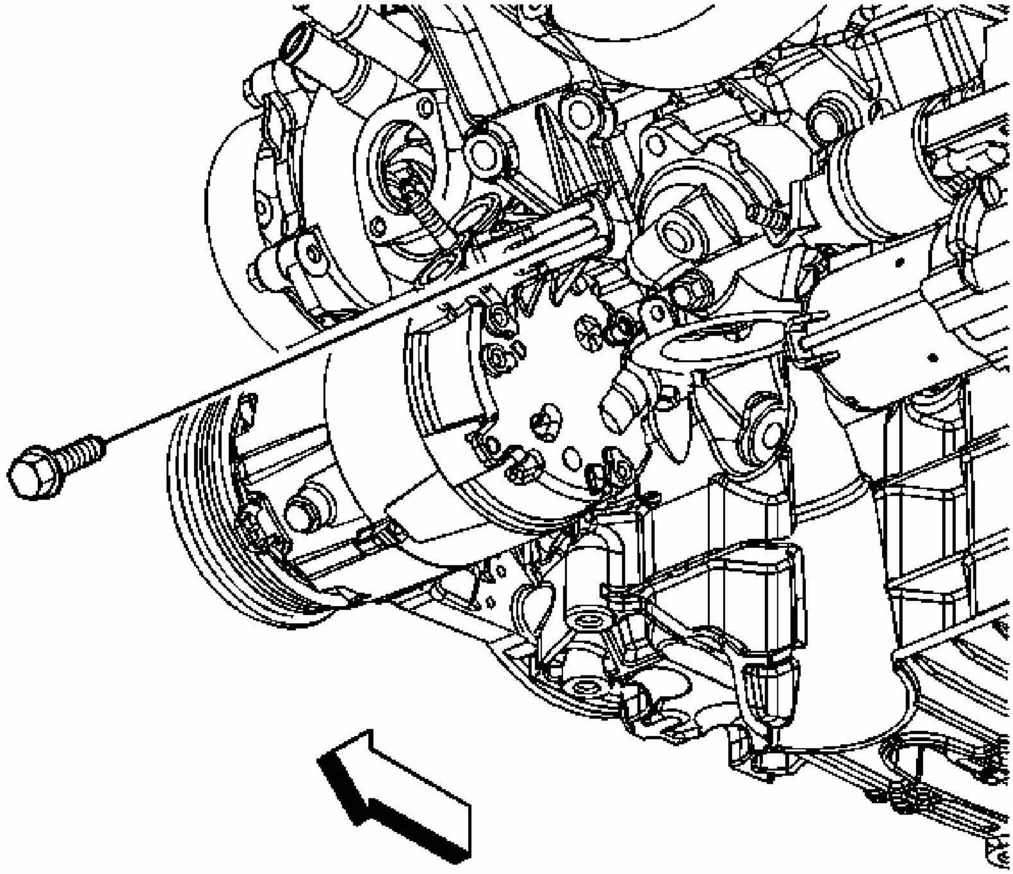


Fig. 233: Locating A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

24. Install the A/C compressor rear bolt.

    Tighten: Tighten the bolt to 50 N.m (37 lb ft).

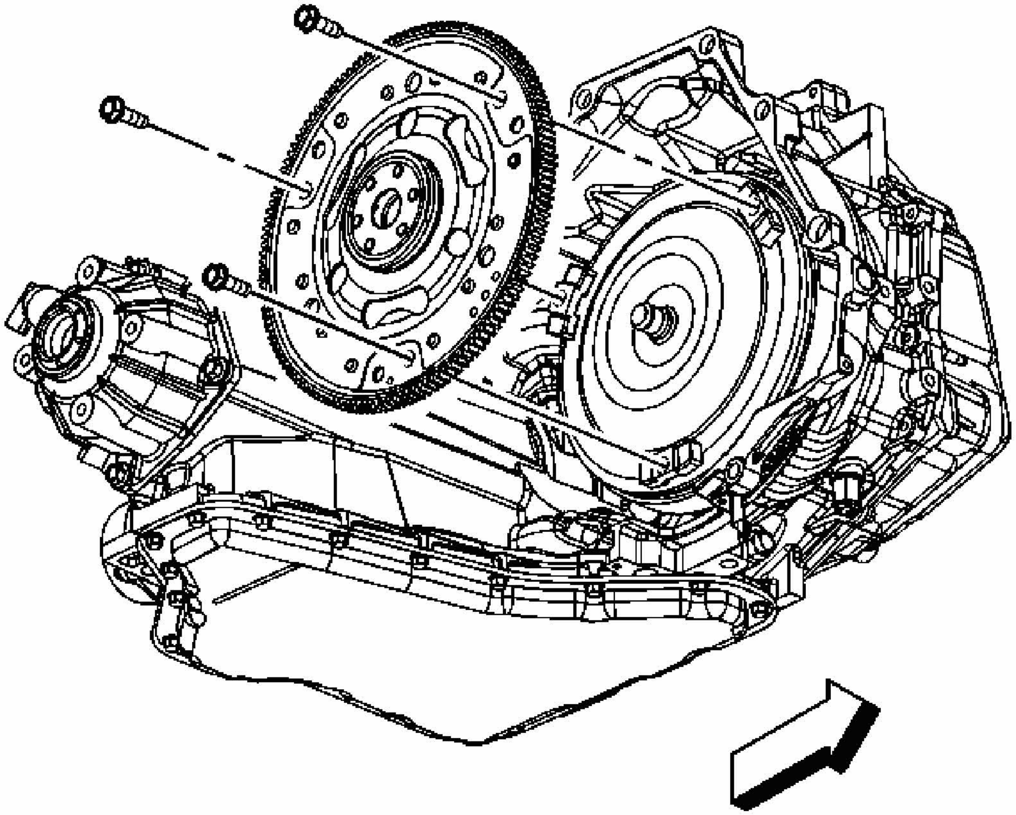


Fig. 234: Locating Torque Converter Bolts
Courtesy of GENERAL MOTORS CORP.

25. Install the torque converter bolts.

    Tighten: Tighten the bolts to 63 N.m (46 lb ft).

26. Install the starter motor. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)** .
27. Install the torque converter cover. Refer to **Torque Converter Cover Replacement** .

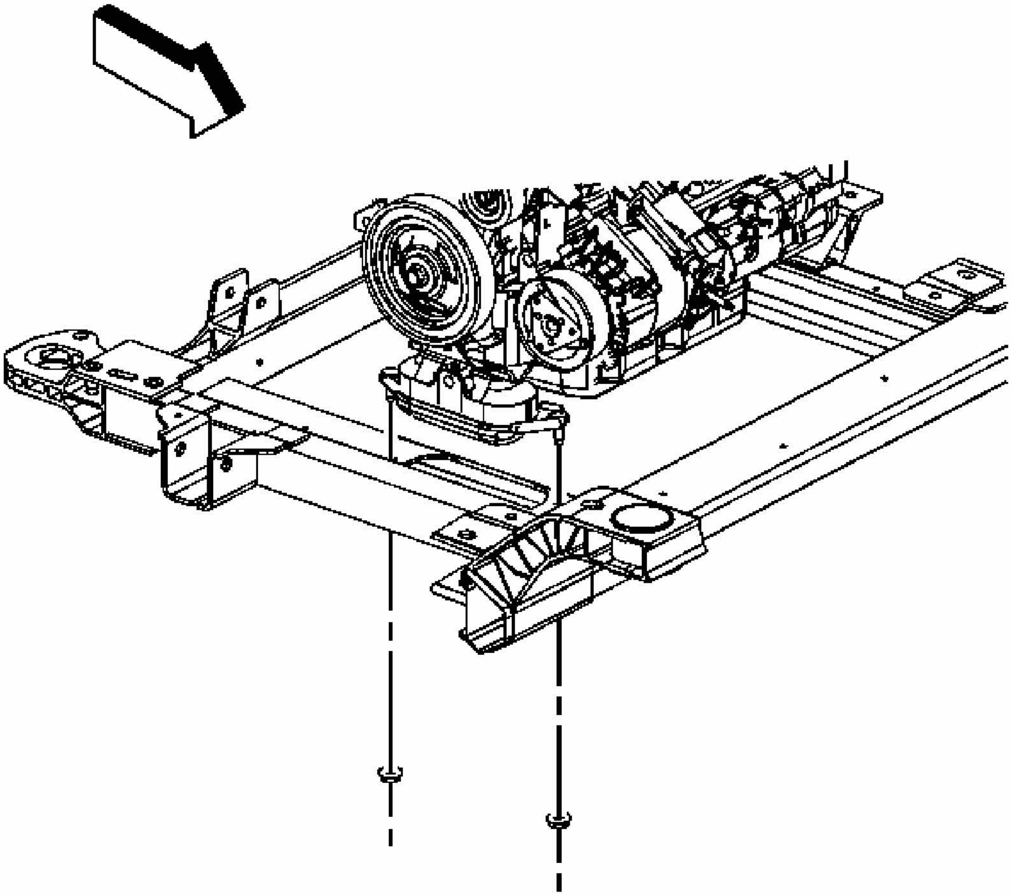


Fig. 235: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

28. Install the engine mount lower nuts.

    Tighten: Tighten the nuts to 50 N.m (37 lb ft).

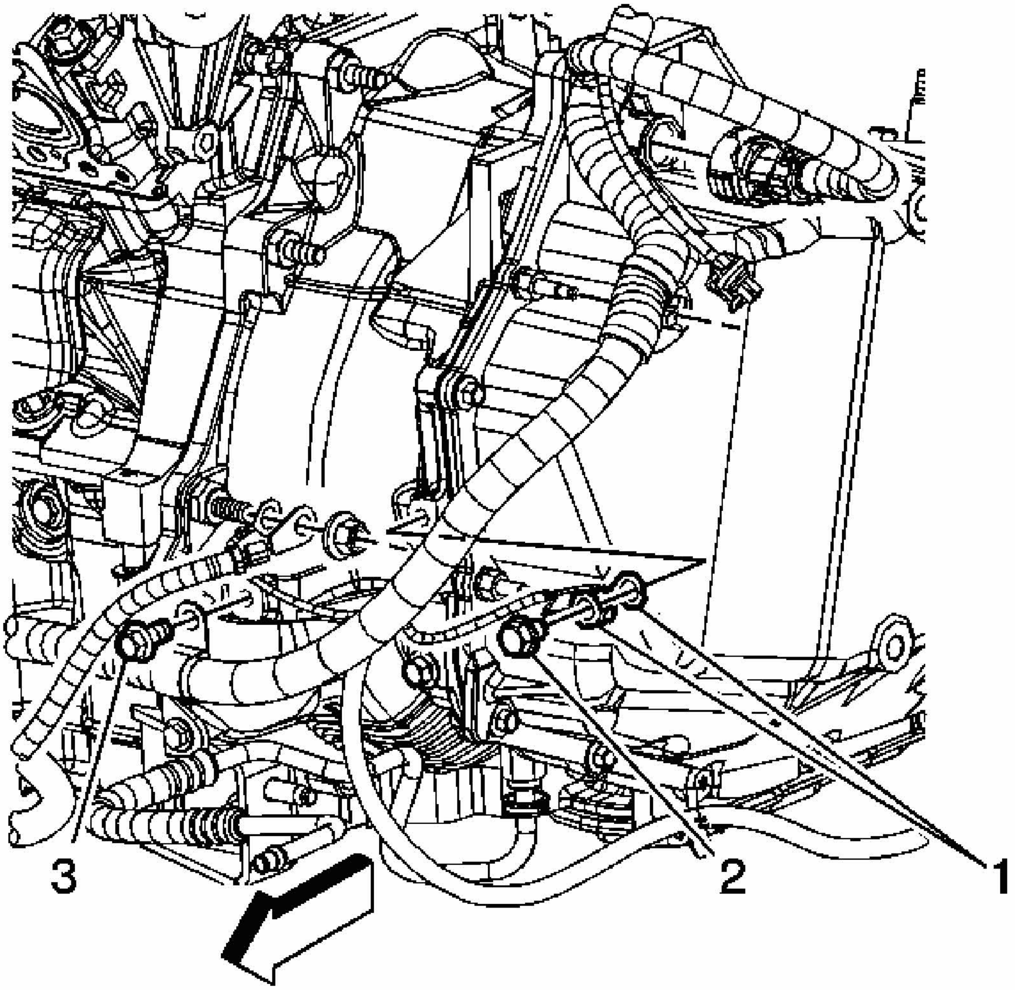


Fig. 236: Positioning The Engine Harness Ground Terminals (1) To The Transmission
Courtesy of GENERAL MOTORS CORP.

29. Install the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)** .
30. Position the engine harness over the engine.
31. Position the engine harness ground terminals (1) to the transmission.
32. Install the engine harness ground bolt (2).

    Tighten: Tighten the bolt to 25 N.m (18 lb ft).

33. Install the engine harness clip bolt (3) to the transmission.

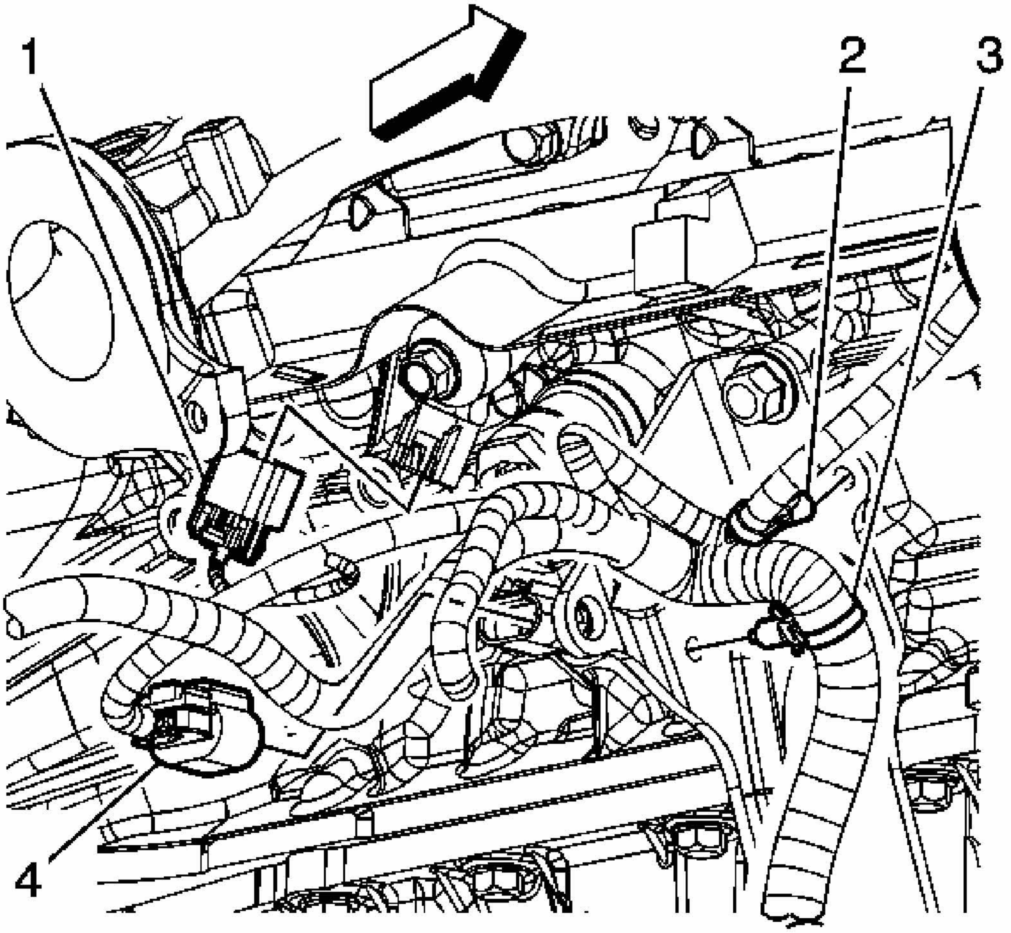


Fig. 237: Locating CKP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

34. Connect the CKP sensor electrical connector (4).
35. Connect the knock sensor electrical connector (1).
36. Install the engine harness clips (2, 3) to the transaxle brace.
37. Lower the vehicle.

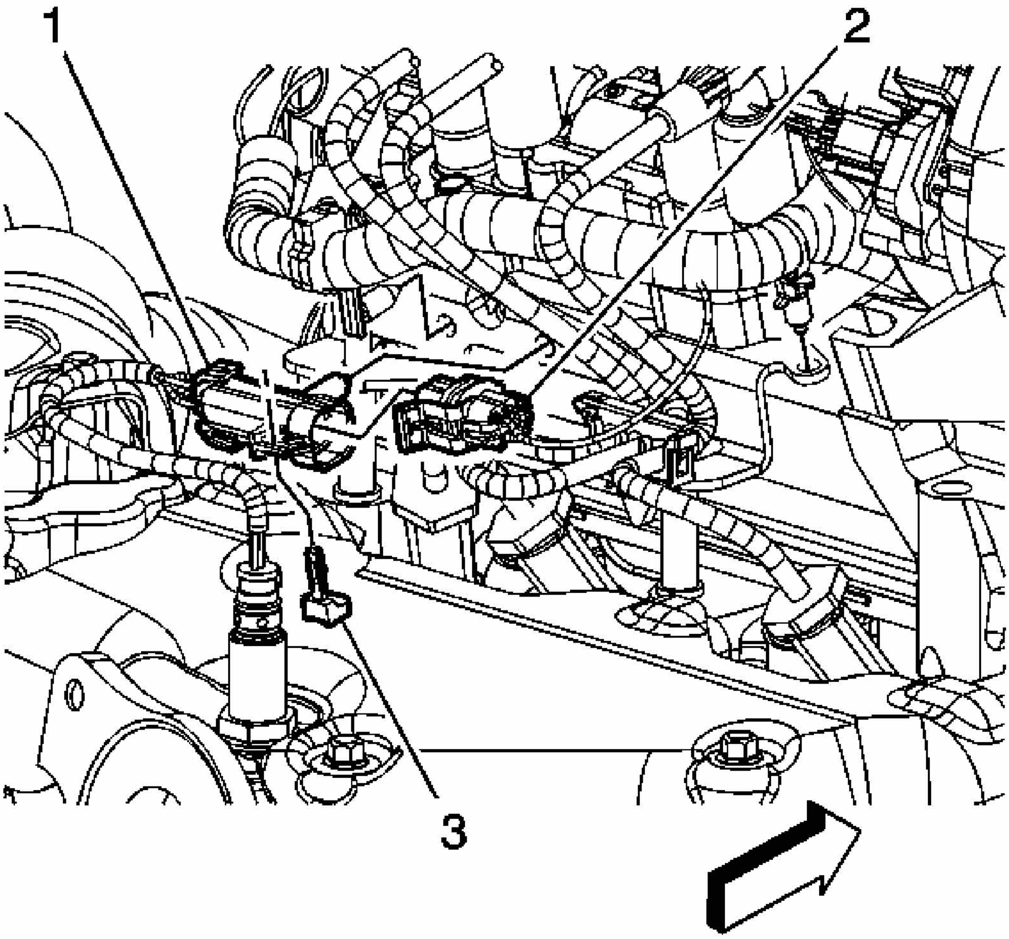


Fig. 238: Identifying The HO2S Electrical Connector
Courtesy of GENERAL MOTORS CORP.

38. Connect the rear upper HO2S electrical connector (2).
39. Install the CPA retainer (3).

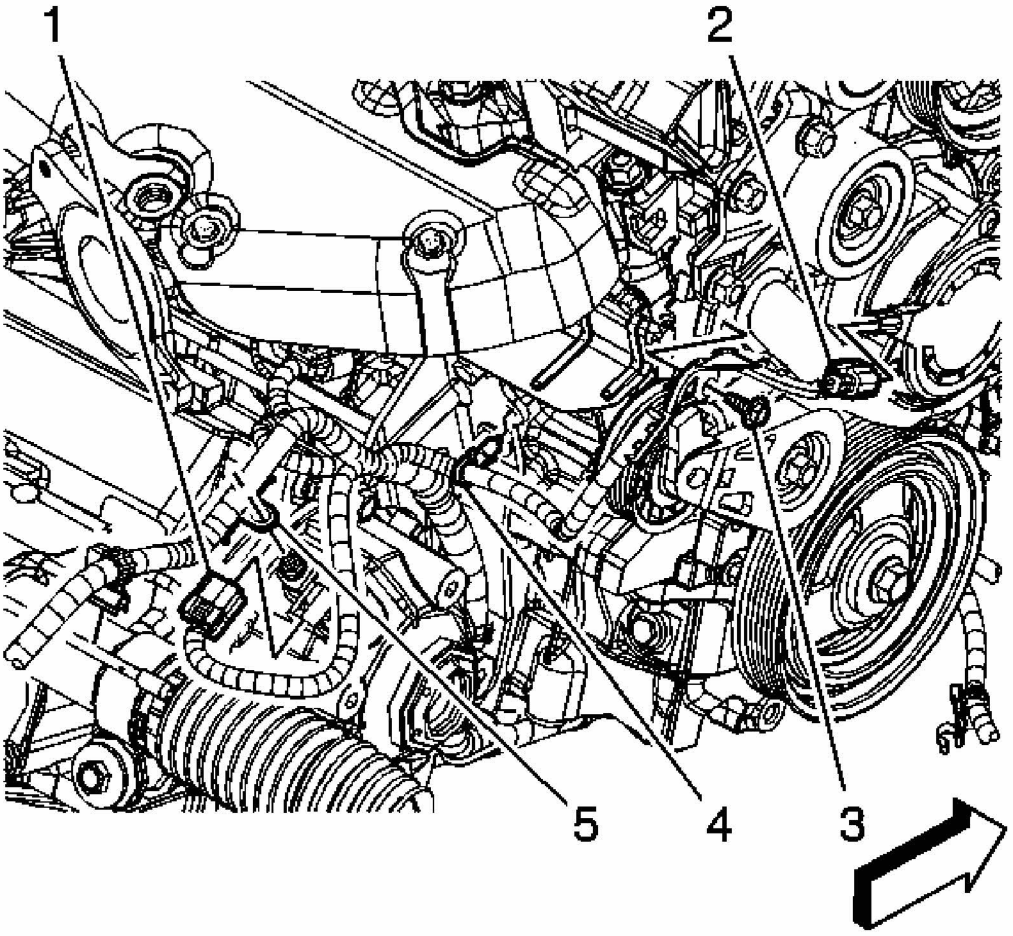


Fig. 239: Locating Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

40. Install the engine harness clip (4) to the transaxle bracket.
41. Install the engine harness clip bolt (3).

    Tighten: Tighten the bolt to 25 N.m (18 lb ft).

42. Connect the camshaft phasor sensor electrical connector (2).

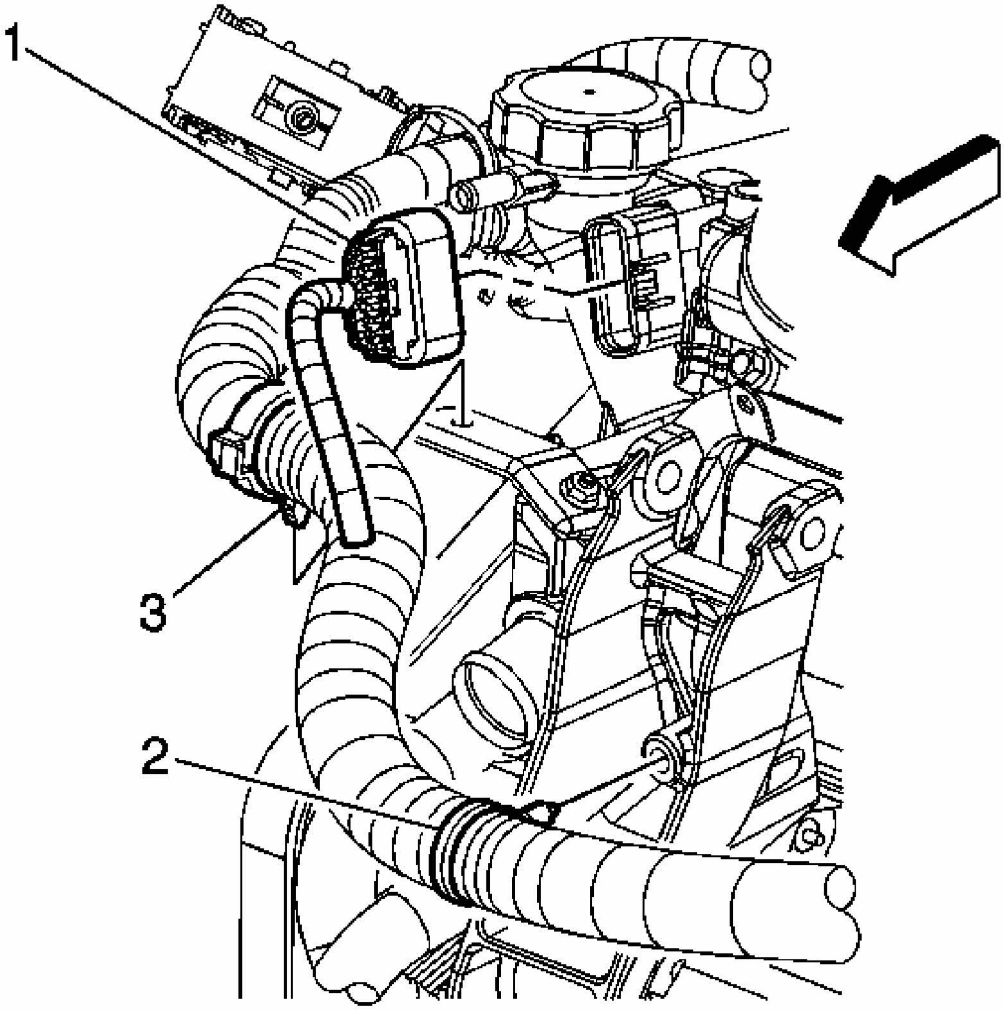


Fig. 240: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

43. Connect the fuel injector inline (1) electrical connector.
44. Install the engine harness clips (2, 3) to the brackets.

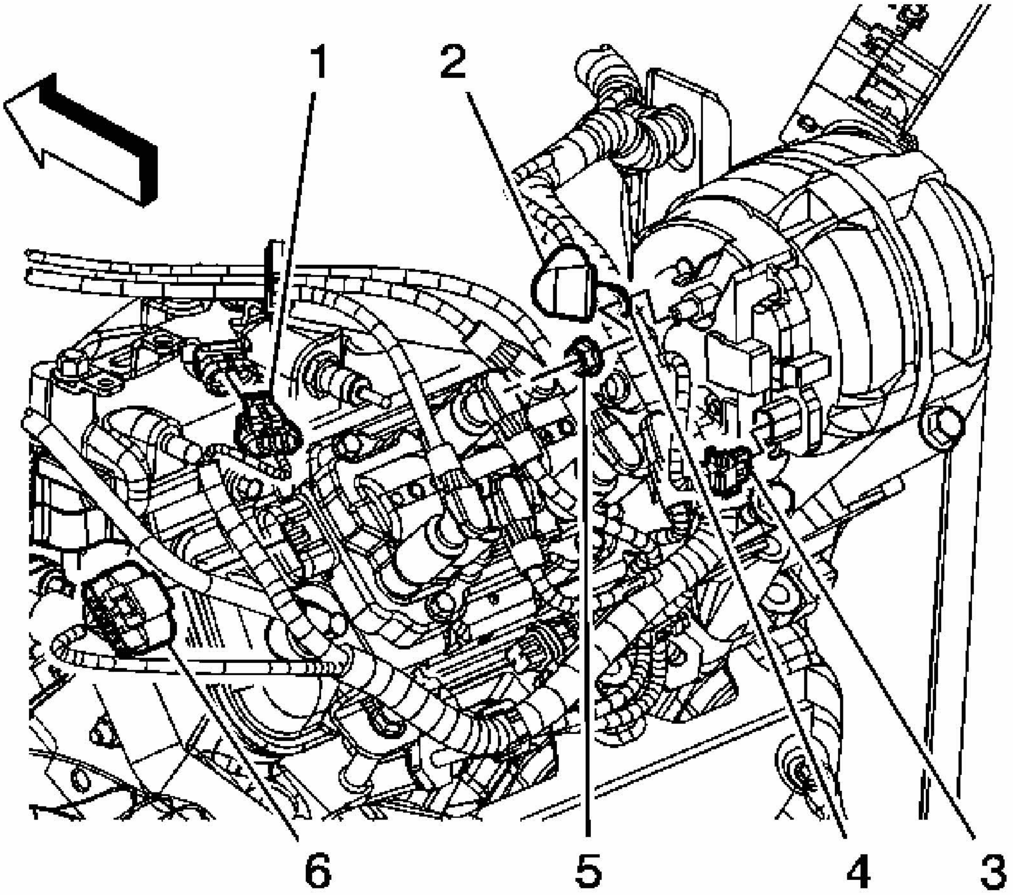


Fig. 241: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

45. Connect the ignition coil electrical connector (6).
46. Connect the generator electrical connector (3).
47. Install the generator terminal (4).
48. Install the generator terminal nut (5).

    Tighten: Tighten the nut to 30 N.m (22 lb ft).

49. Position the generator terminal boot (2).
50. Connect the MAP sensor electrical connector (1).

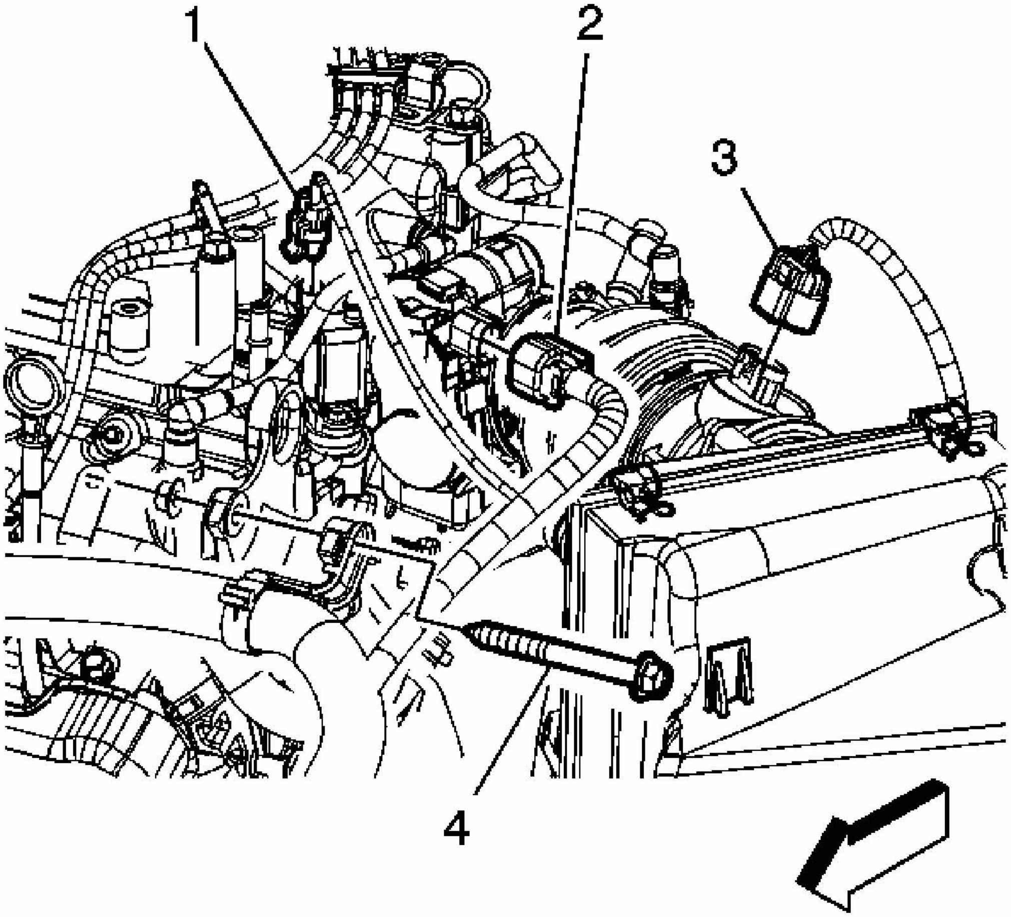


Fig. 242: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

51. Connect the ETC (2) electrical connector.
52. Connect the EVAP canister purge solenoid (1) electrical connector.

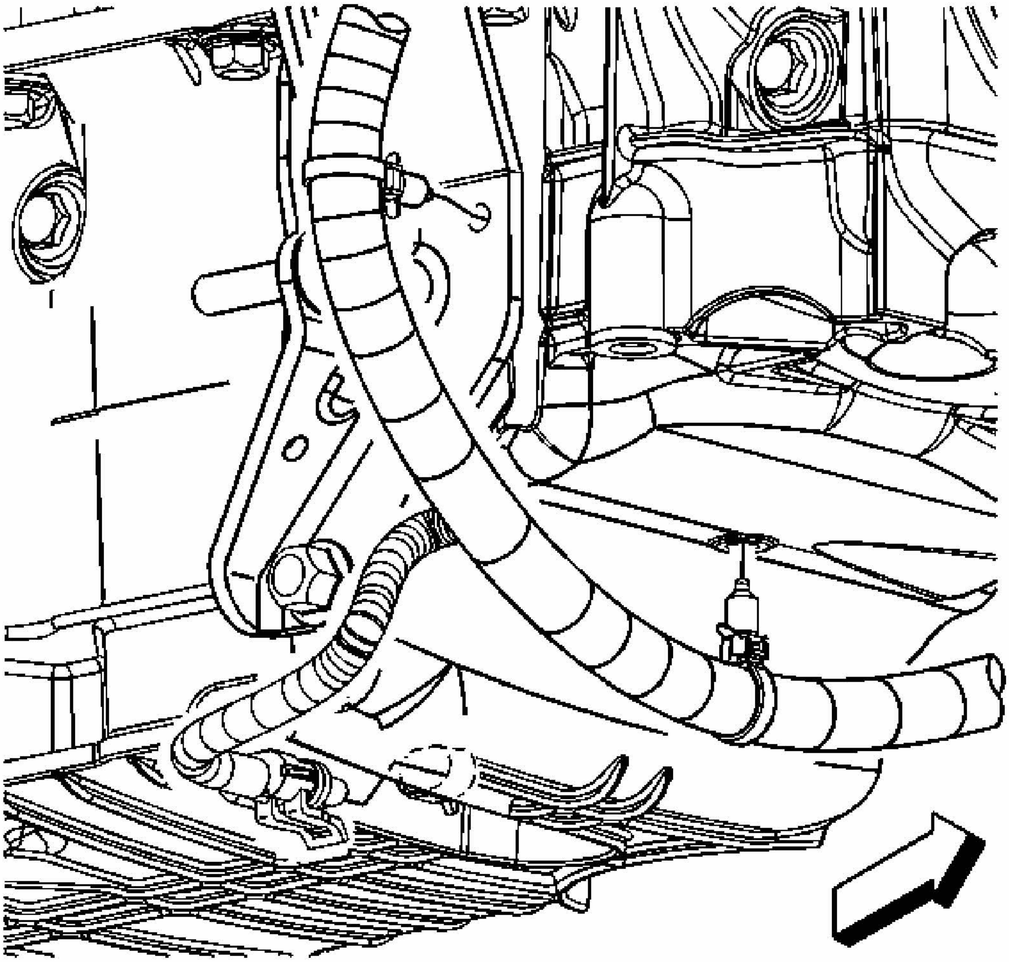


Fig. 243: Locating Engine Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

53. Raise the vehicle.
54. Connect the oil level sensor electrical connector.
55. Install the engine harness clips to the transaxle brace and the oil pan.

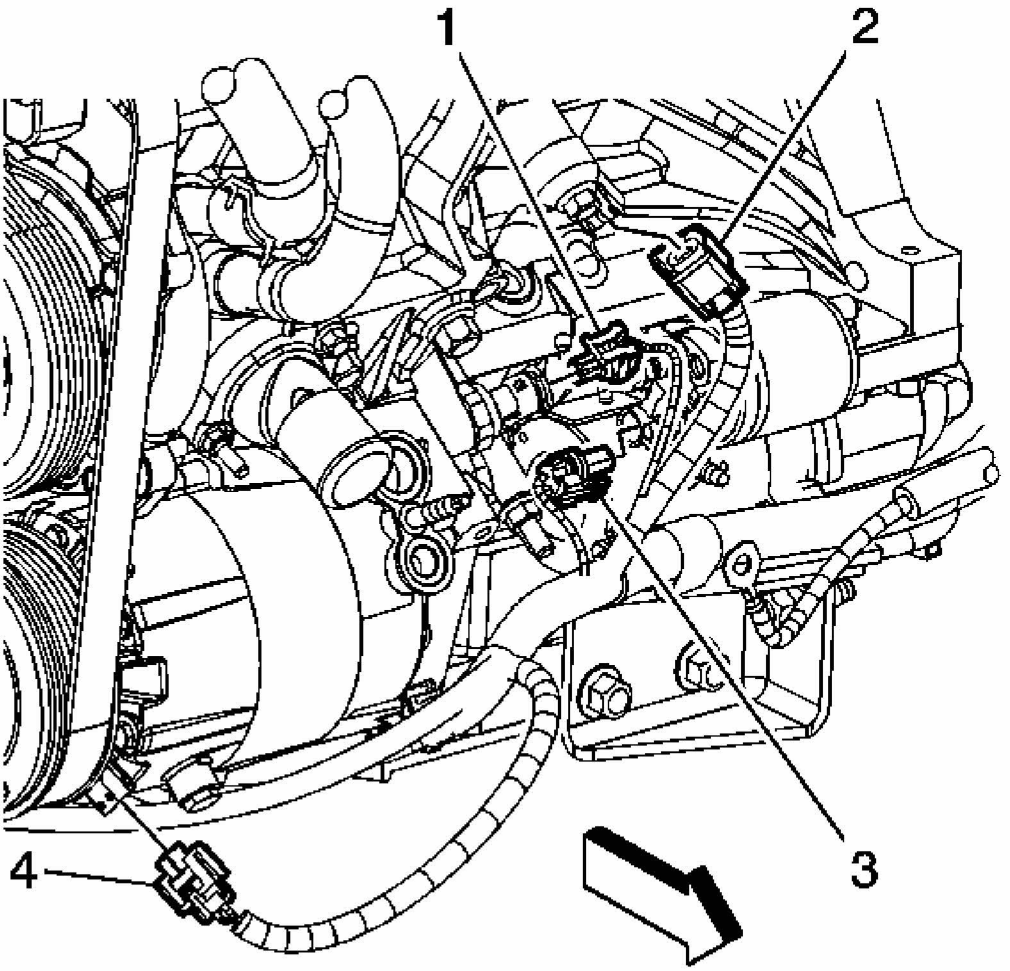


Fig. 244: Locating Starter Motor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

56. Connect the A/C compressor electrical connector (4).
57. Connect the starter motor electrical connector (3)
58. Connect the knock sensor (2) electrical connector.
59. Connect the oil pressure sensor (1) electrical connector.

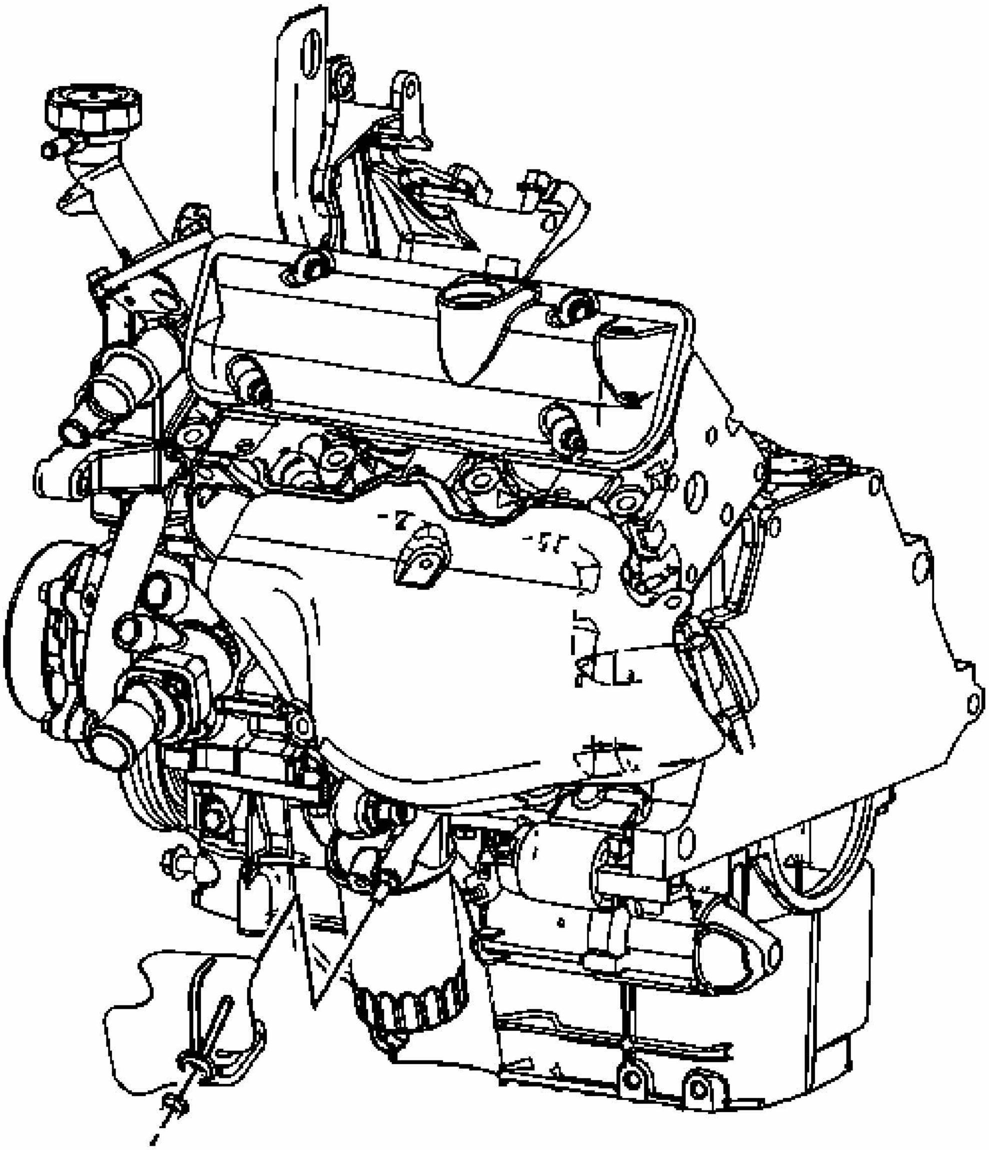


Fig. 245: Locating Oil Pressure Sensor Heat Shield & Nut
Courtesy of GENERAL MOTORS CORP.

60. Install the oil pressure sensor heat shield and nuts.

    Tighten: Tighten the nuts to 10 N.m (89 lb in).

61. Lower the vehicle.
62. Install the engine mount struts. Refer to **Engine Mount Strut Replacement**.

63. Install the drive belt. Refer to **Drive Belt Replacement**.
64. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
65. Install the hood. Refer to **Hood Replacement** .
66. Fill the engine with oil. Refer to **Engine Oil and Oil Filter Replacement**.
67. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
68. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
69. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .

ENGINE OIL AND OIL FILTER REPLACEMENT

Removal Procedure

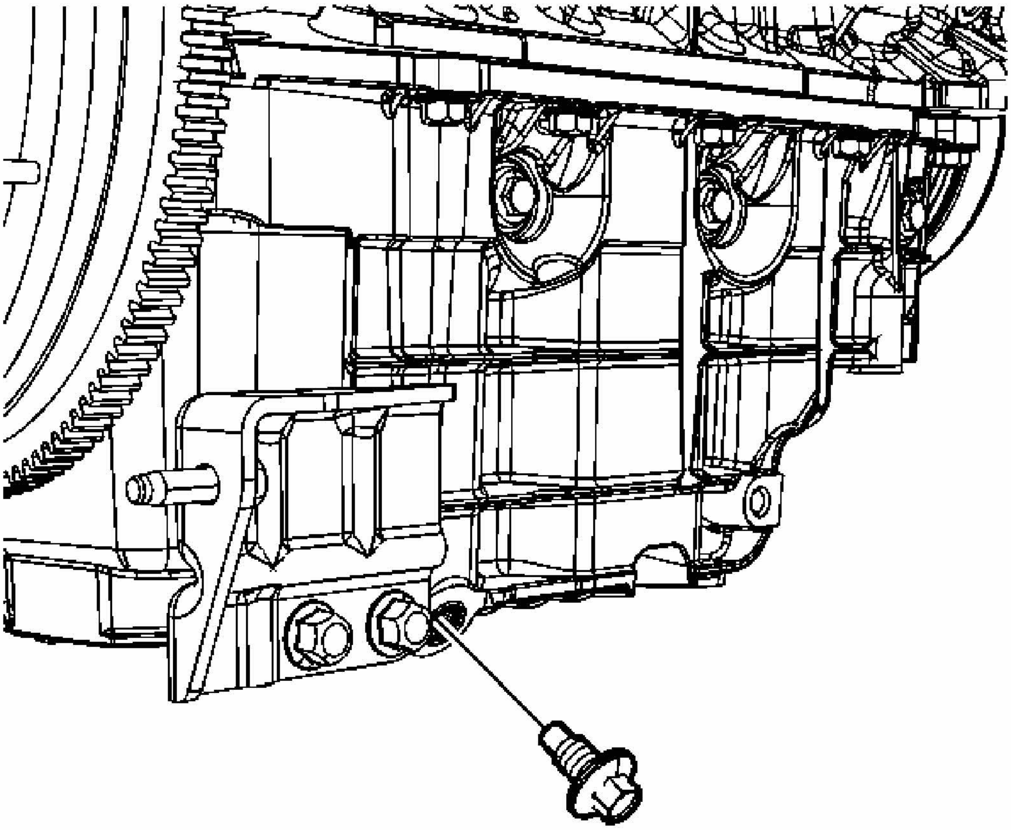


Fig. 246: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the oil pan drain plug.
3. Allow the engine oil to drain completely.

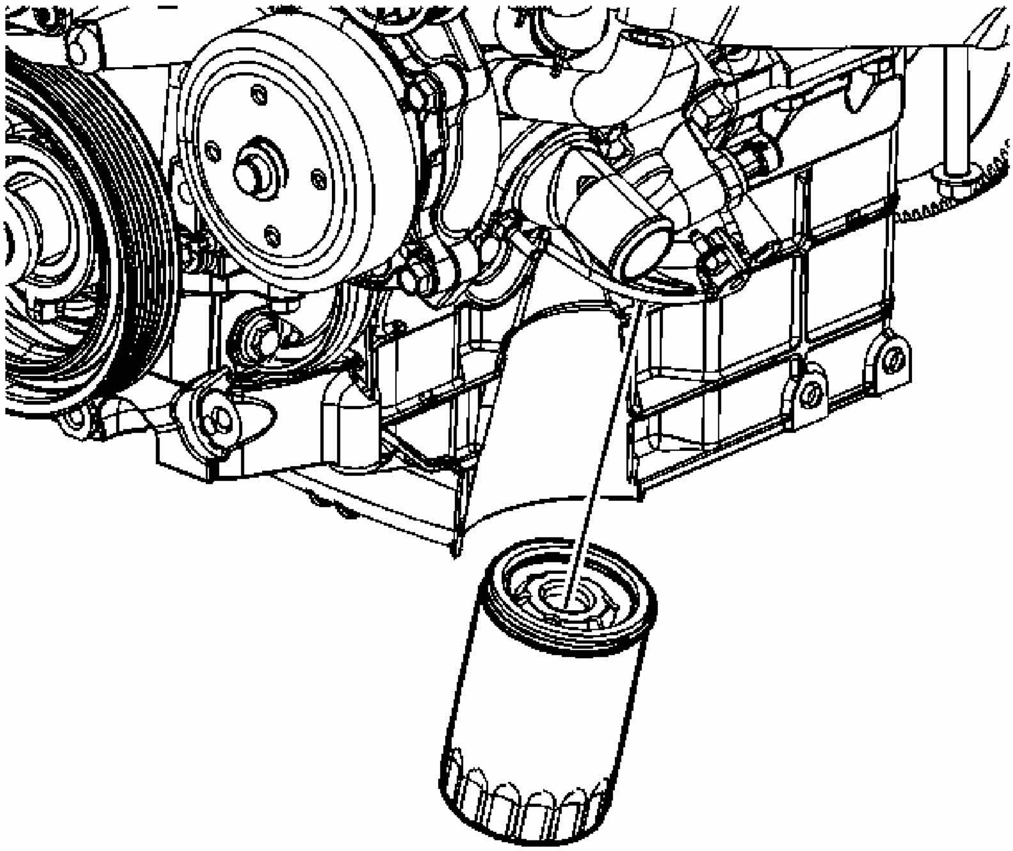


Fig. 247: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

4. Remove the oil filter.

Installation Procedure

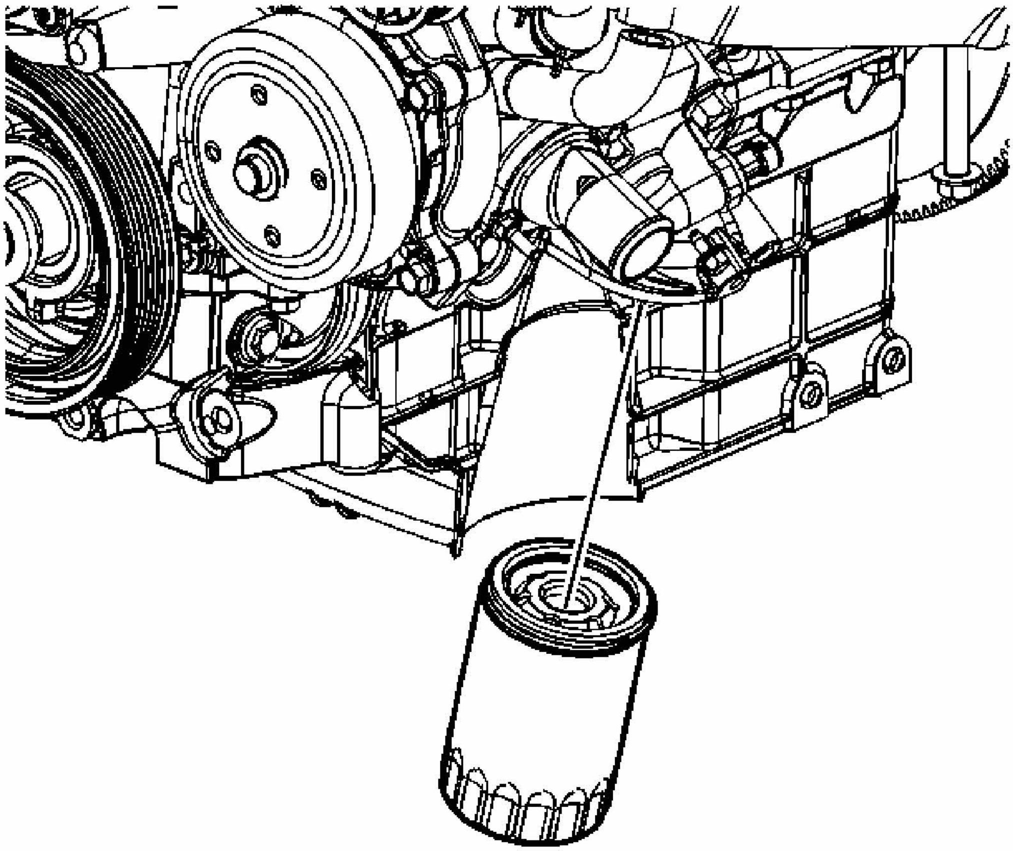


Fig. 248: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

1. Install the oil filter.

NOTE: **Refer to Fastener Notice .**

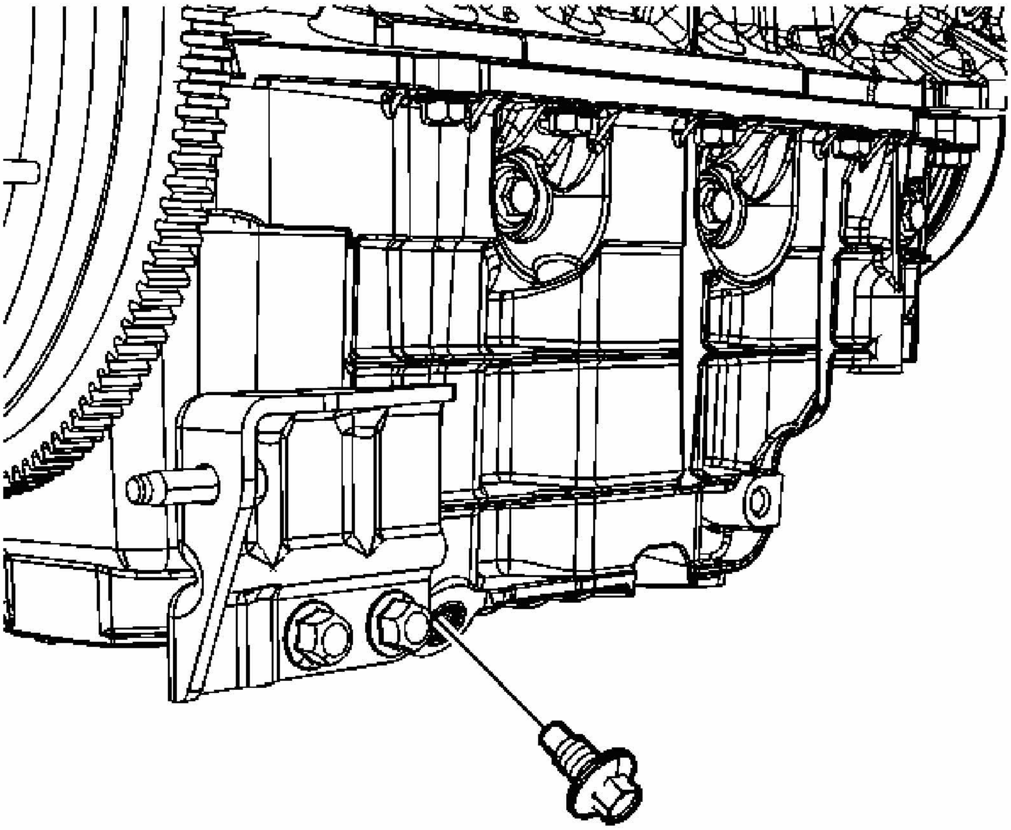


Fig. 249: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

2. Install the oil pan drain bolt.

   Tighten: Tighten the bolt to 26 N.m (19 lb ft).

3. Lower the vehicle.
4. Fill the engine with oil to the appropriate level.
5. Start engine and inspect for leaks.

REPAIR INSTRUCTIONS - OFF VEHICLE

DRAINING FLUIDS AND OIL FILTER REMOVAL

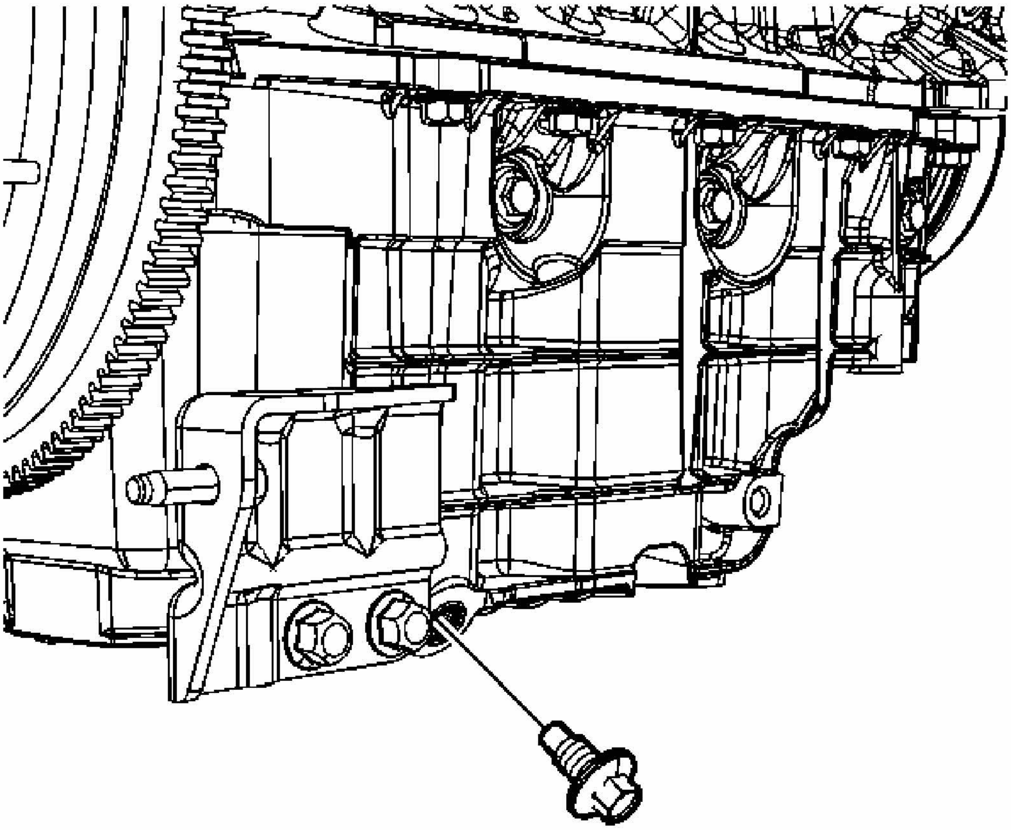


Fig. 250: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pan drain plug.
2. Drain the engine oil.

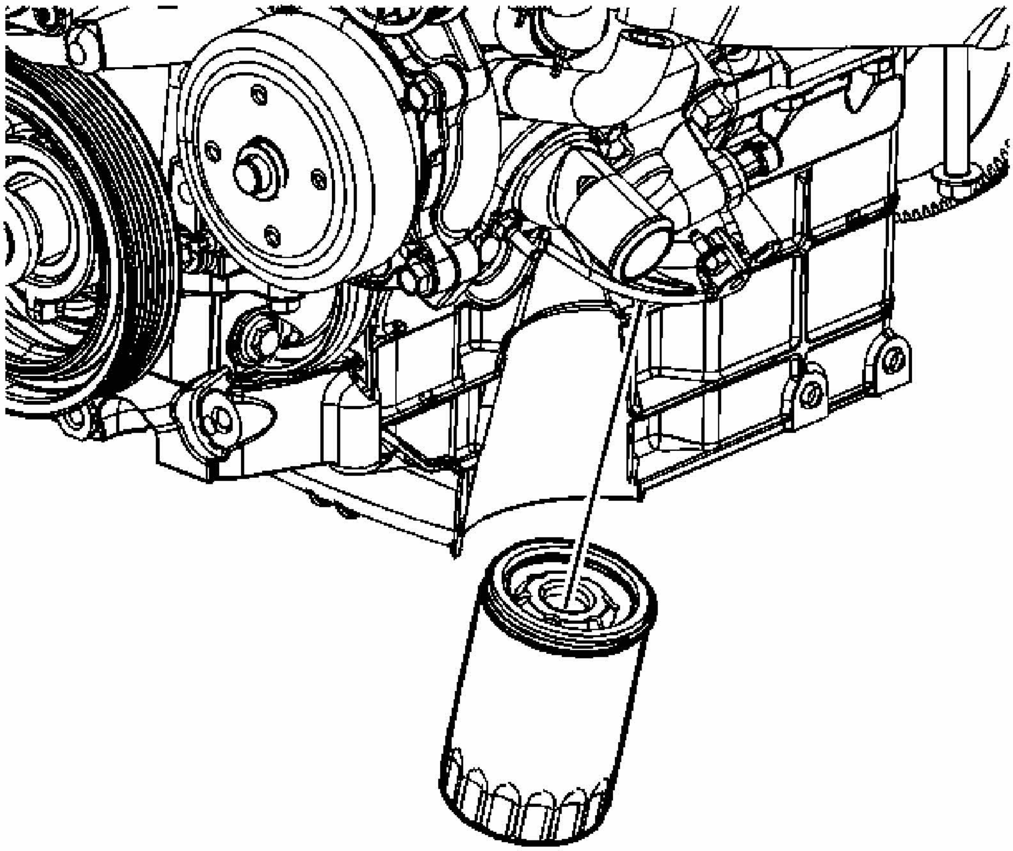


Fig. 251: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil filter.

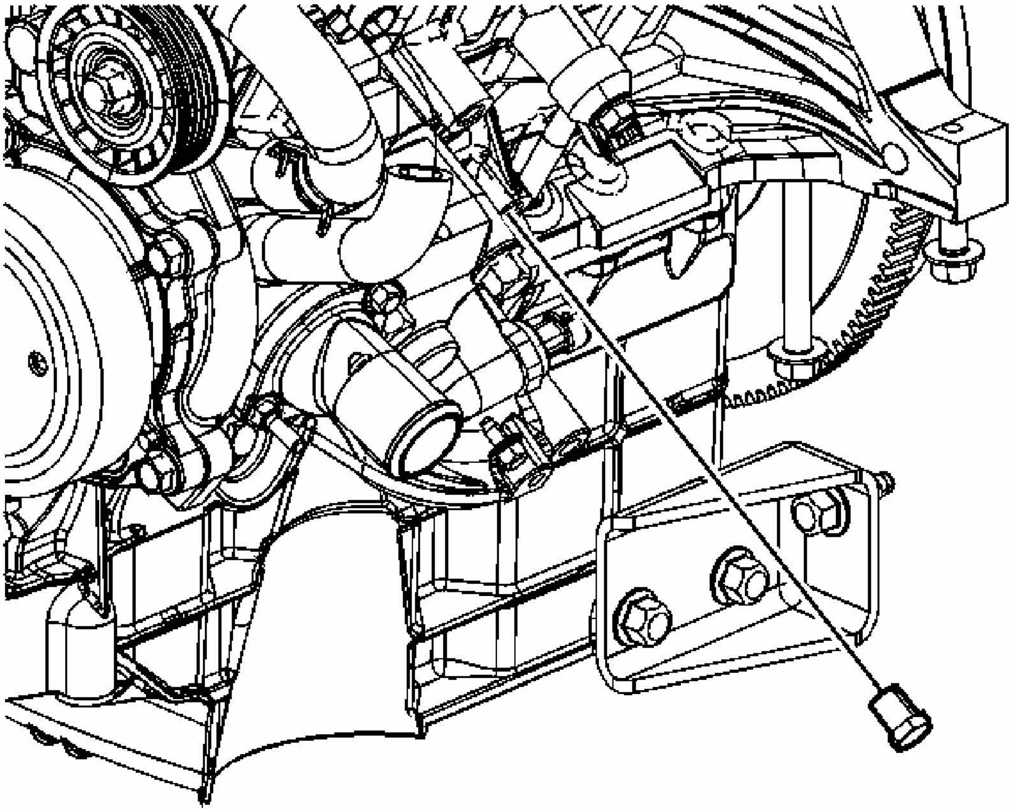


Fig. 252: Identifying Left Side Coolant Drain Plug
Courtesy of GENERAL MOTORS CORP.

4. Remove the coolant drain plug from the left side.

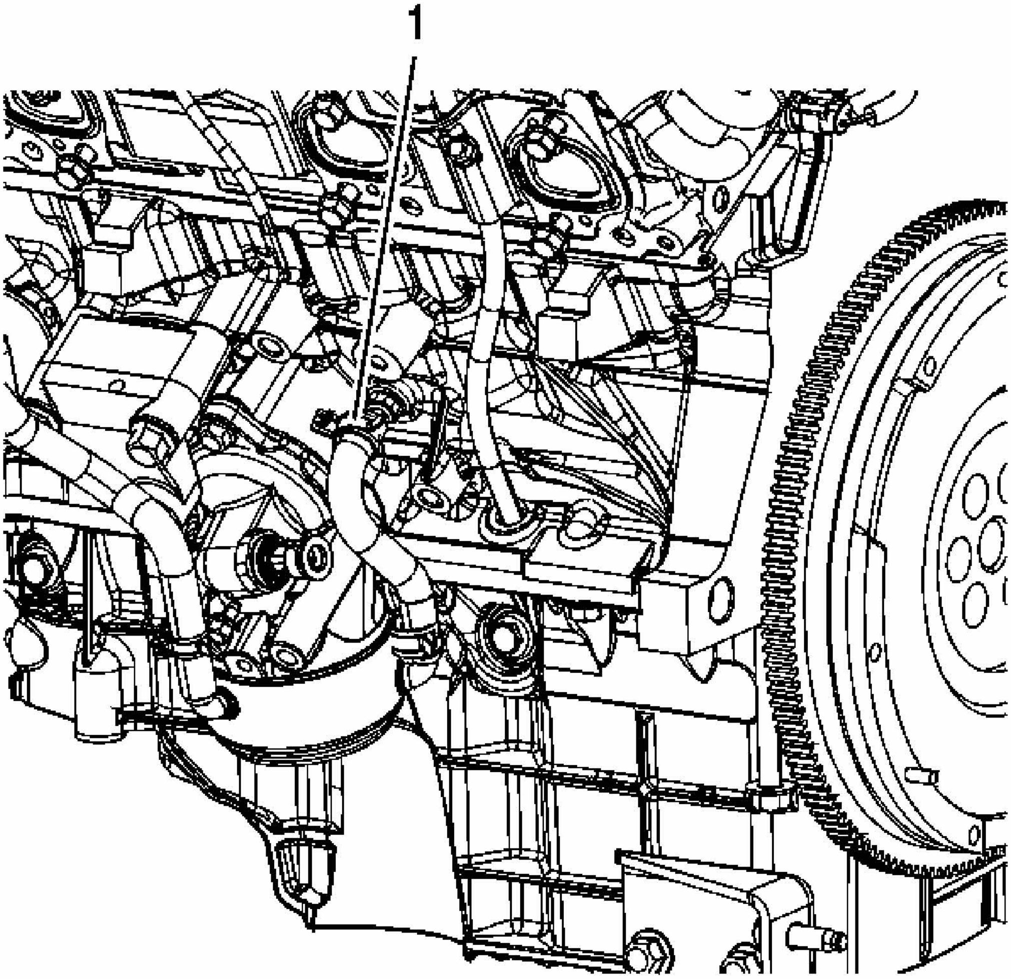


Fig. 253: Locating Upper Inlet Hose Clamp (1)
Courtesy of GENERAL MOTORS CORP.

5. If equipped with an oil cooler (RPO-KC4), reposition the upper inlet hose clamp (1).
6. Remove the oil cooler inlet hose from the block outlet.

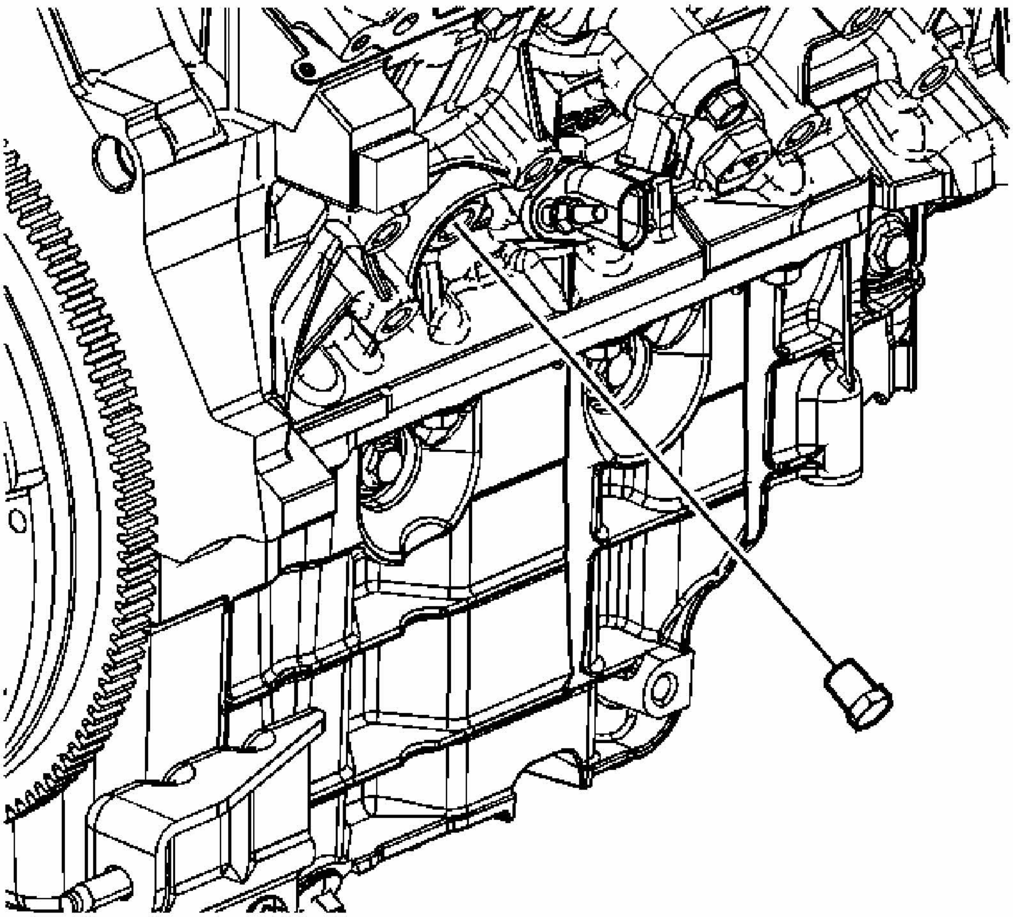


Fig. 254: Identifying Right Side Coolant Drain Plug
Courtesy of GENERAL MOTORS CORP.

7. If not equipped with an oil cooler (RPO-KC4), remove the coolant drain plug from the right side.
8. Drain the coolant.

CRANKSHAFT BALANCER REMOVAL

Tools Required

- **J 41816** Crankshaft Balancer Remover. See **Special Tools**.
- **EN 46359** Puller End Protector. See **Special Tools**.

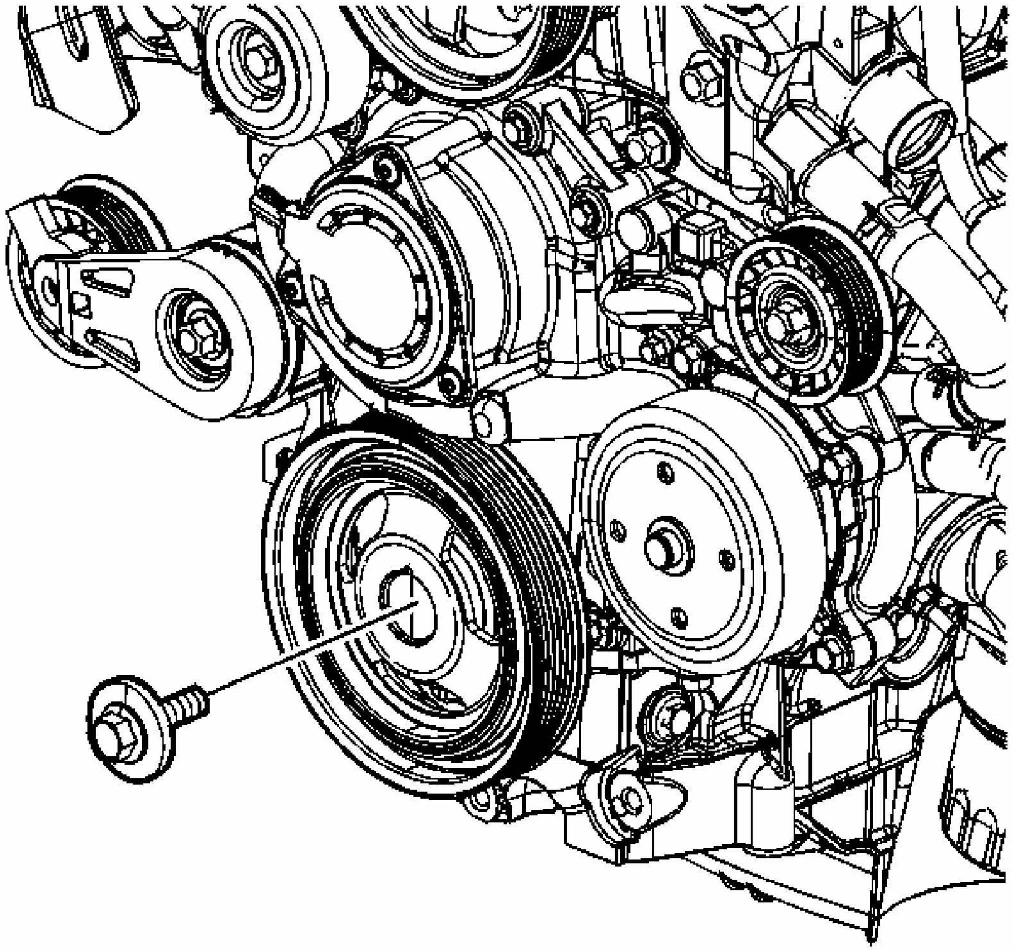


Fig. 255: Identifying Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

1. Remove the crankshaft balancer bolt and washer.

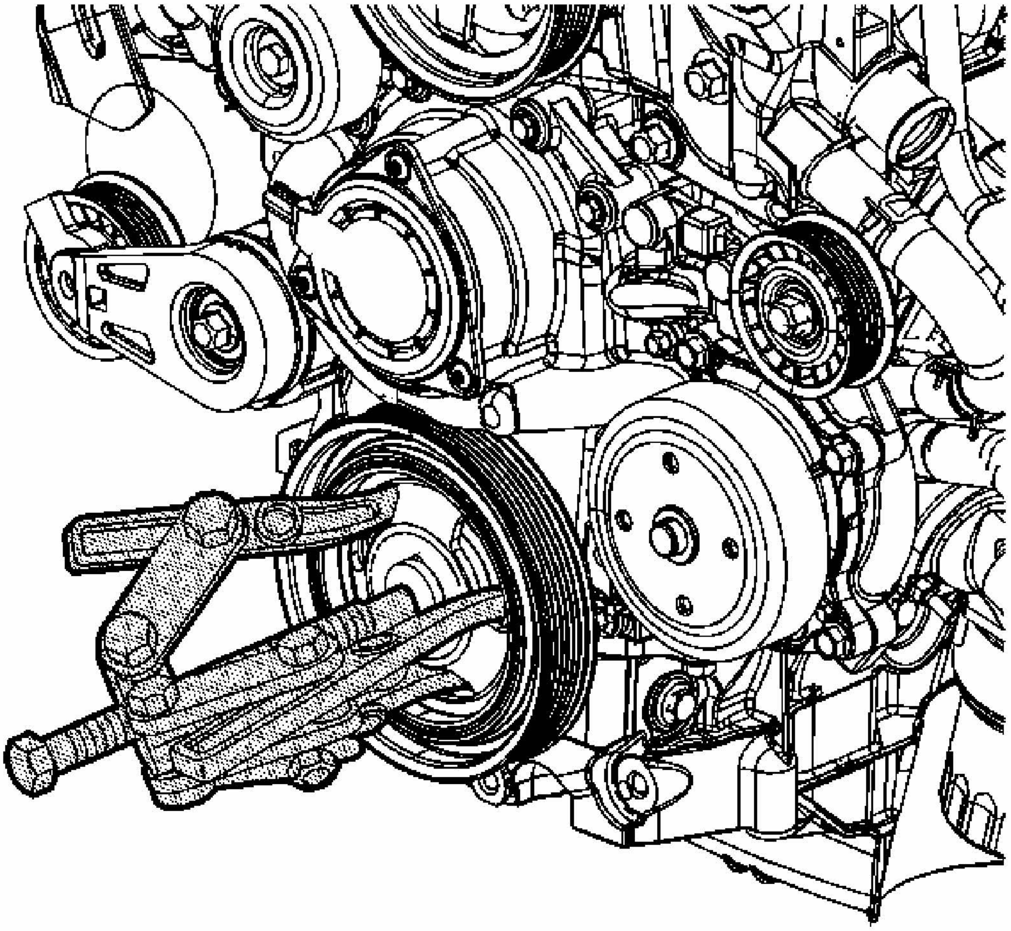


Fig. 256: Removing Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

NOTE: **Do NOT use a power-assisted tool with the special tool in order to remove or install this component. You cannot properly control the alignment of this component using a power-assisted tool, and this can damage the component.**

2. Remove the crankshaft balancer using the **J 41816** along with **EN 46359** . See Special Tools.

ENGINE FLYWHEEL REMOVAL (AUTOMATIC TRANSMISSION)

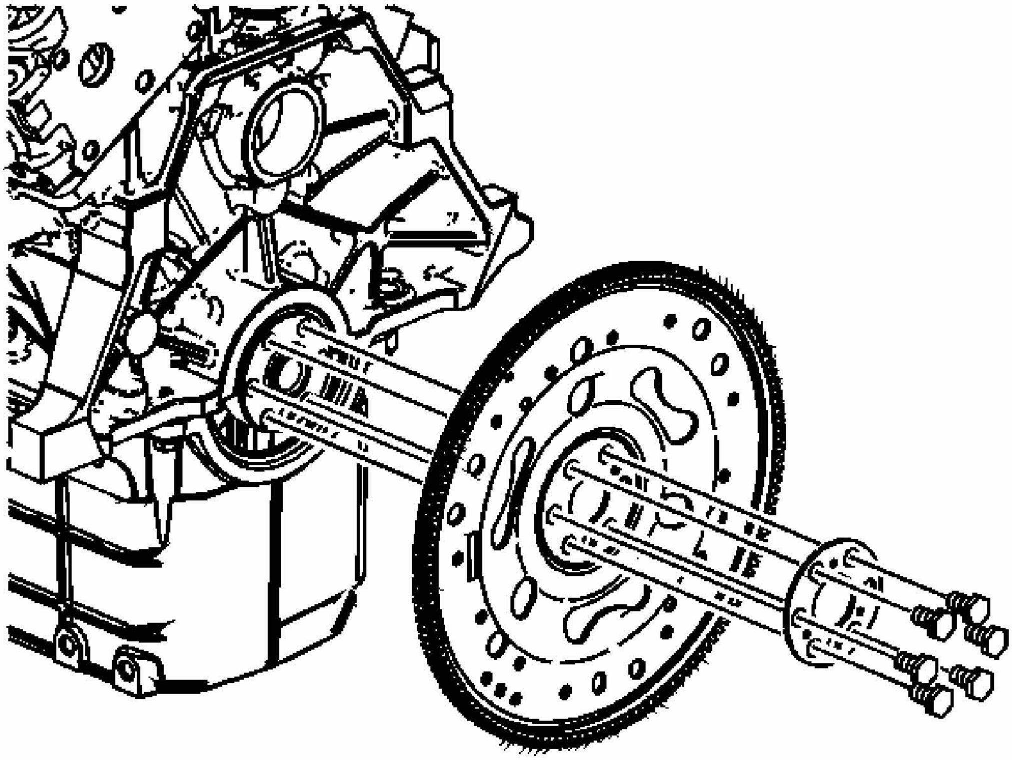


Fig. 257: Identifying Flywheel & Bolts (Automatic Transmission)
Courtesy of GENERAL MOTORS CORP.

1. If equipped with an automatic transmission, remove the flywheel bolts.
2. Remove the flywheel.

ENGINE FLYWHEEL REMOVAL (MANUAL TRANSMISSION)

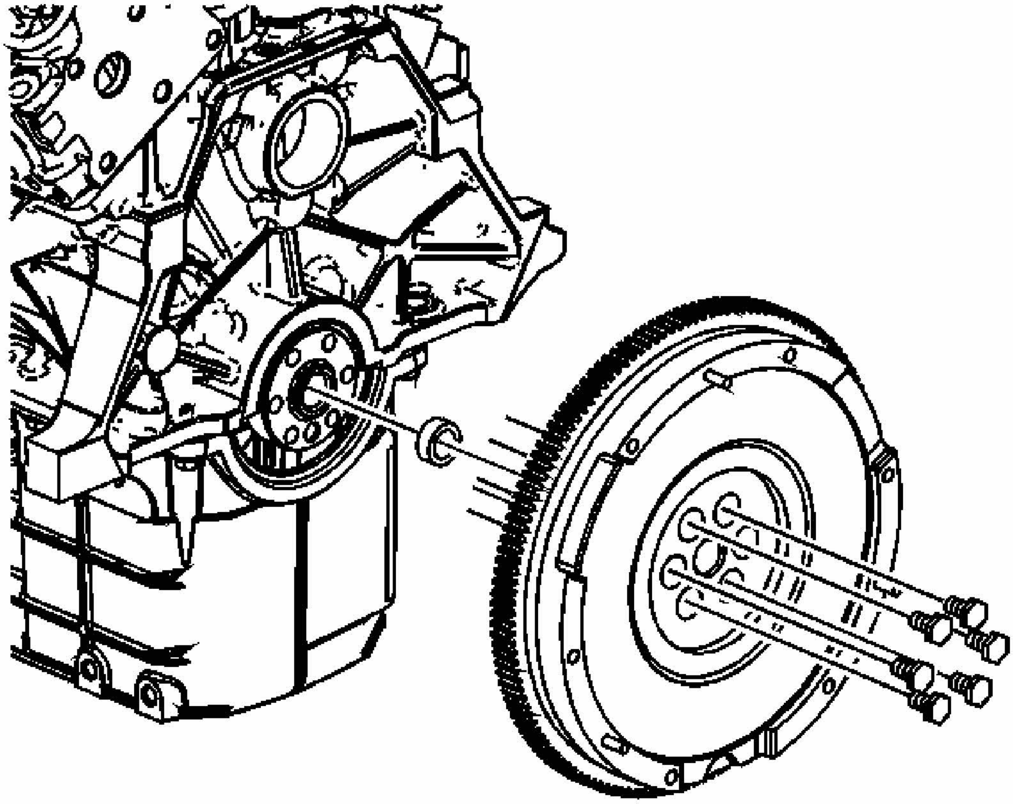


Fig. 258: Identifying Flywheel Bolts (Manual Transmission)
Courtesy of GENERAL MOTORS CORP.

1. Remove the flywheel/pressure plate bolts.
2. Remove the flywheel/pressure plate.
3. Remove the clutch pilot bearing.

DRIVE BELT TENSIONER REMOVAL

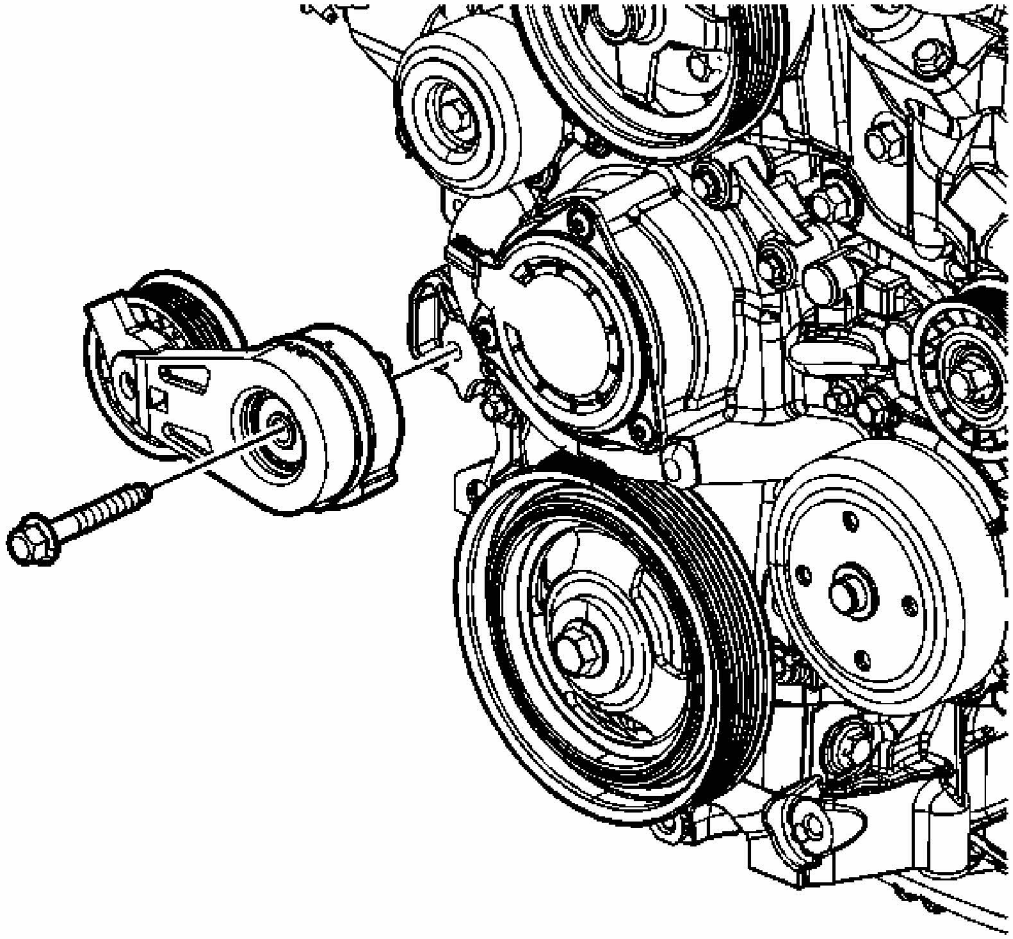


Fig. 259: View Of Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Remove the drive belt tensioner bolt.
2. Remove the drive belt tensioner.

COOLANT CROSSOVER PIPE REMOVAL

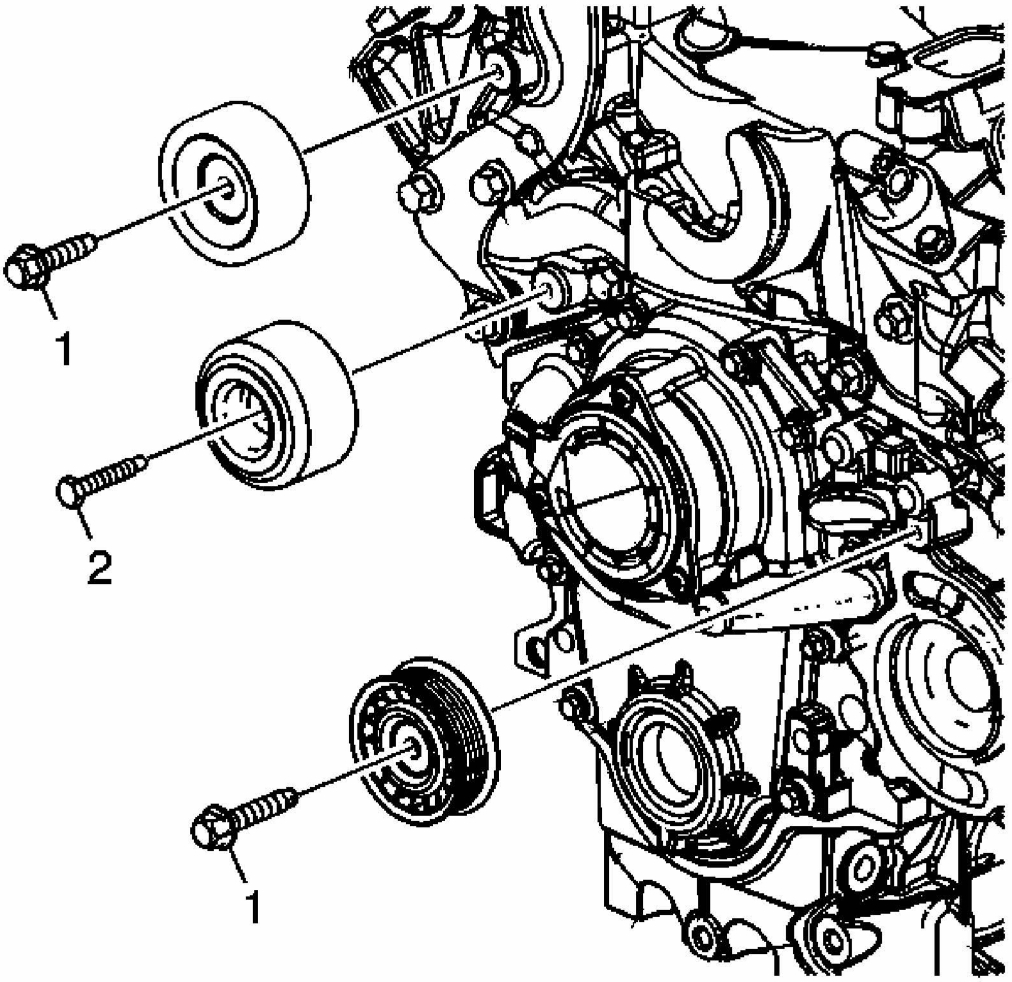


Fig. 260: Identifying Idler Pulley Bolts & Pulleys
Courtesy of GENERAL MOTORS CORP.

1. Remove the idler pulley bolts and pulleys.

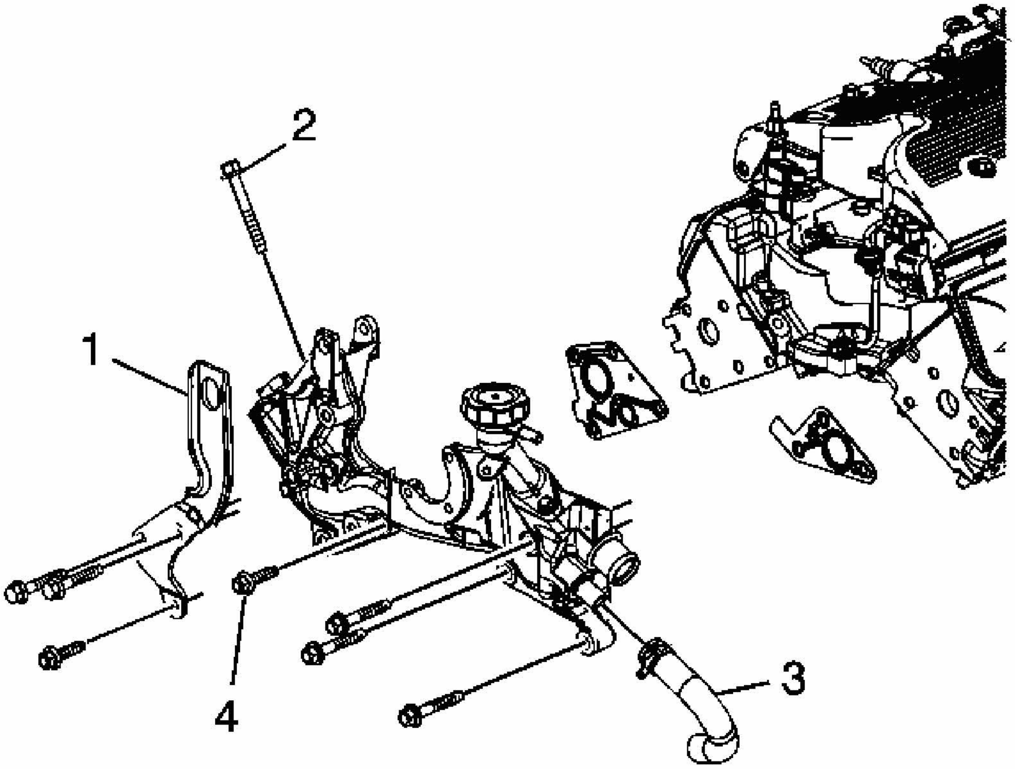


Fig. 261: View Of Coolant Crossover Pipe Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Loosen the thermal bypass hose clamp and remove the hose (3) from the coolant crossover pipe.
3. Remove the coolant crossover pipe bolts (2, 4), engine lift bracket (1), and the coolant crossover pipe assembly.
4. Remove the coolant crossover pipe gaskets.

ENGINE MOUNT SUPPORT AND STRUT BRACKET REMOVAL

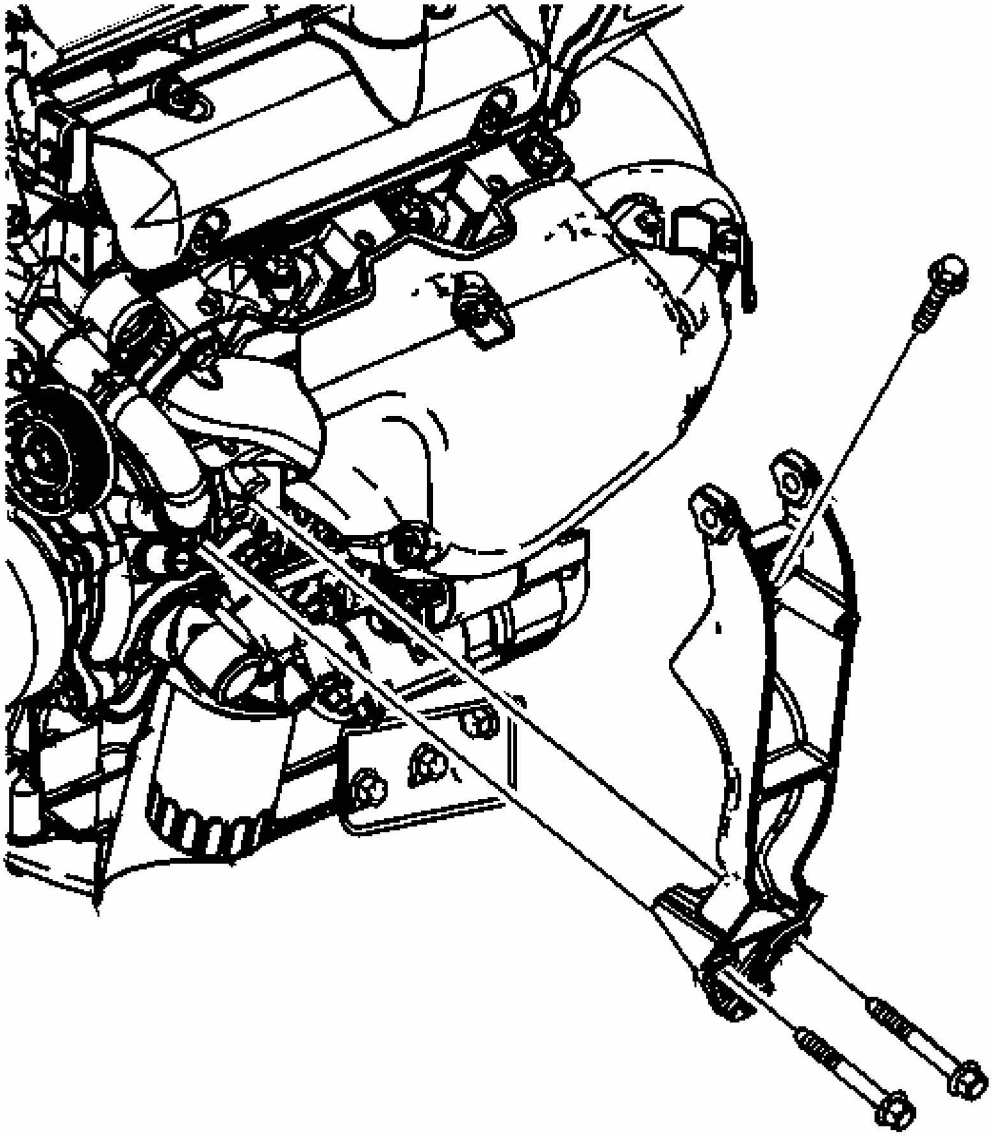


Fig. 262: View Of Engine Mount Support & Strut Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount support and strut bracket bolts.
2. Remove the engine mount support and strut bracket.

ENGINE MOUNT STRUT AND ENGINE LIFT BRACKET REMOVAL

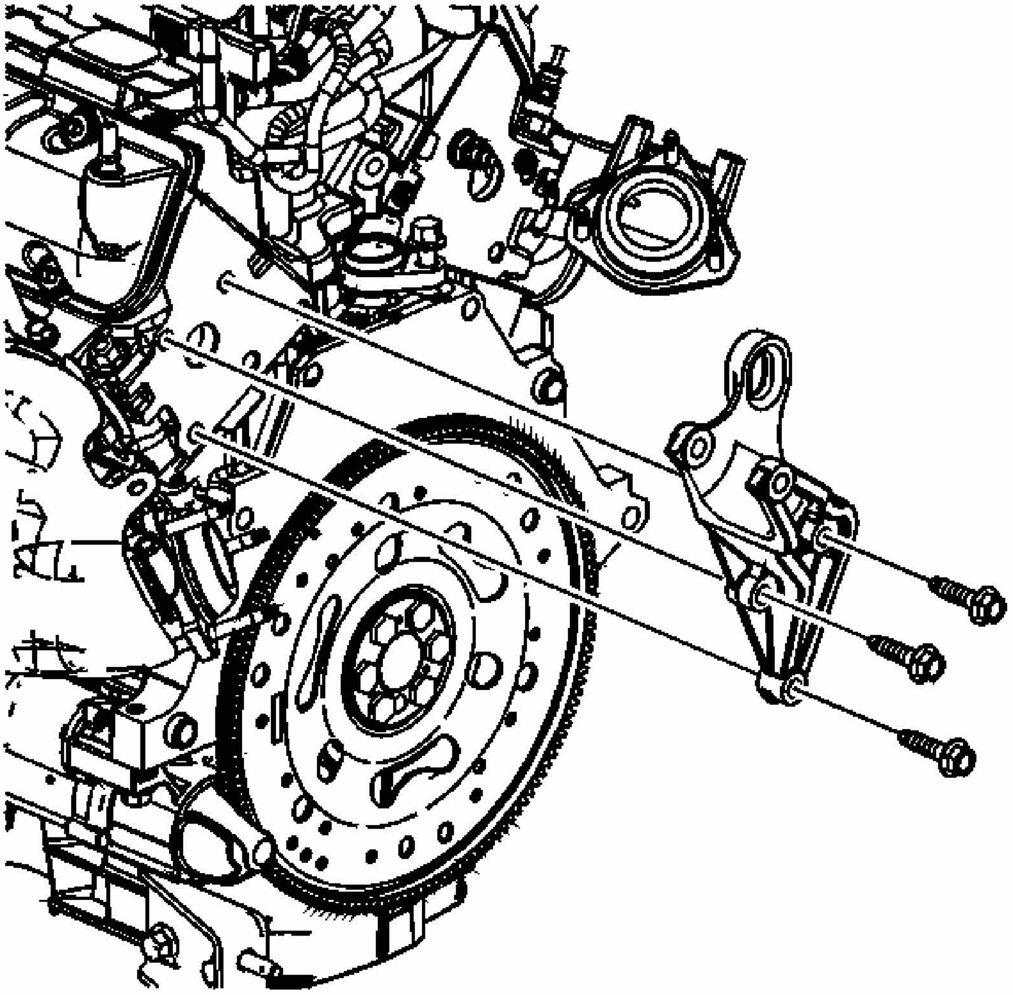


Fig. 263: Identifying Engine Mount Strut & Engine Lift Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount strut and engine lift bracket bolts.
2. Remove the engine mount strut and engine lift bracket.

OIL LEVEL INDICATOR AND TUBE REMOVAL

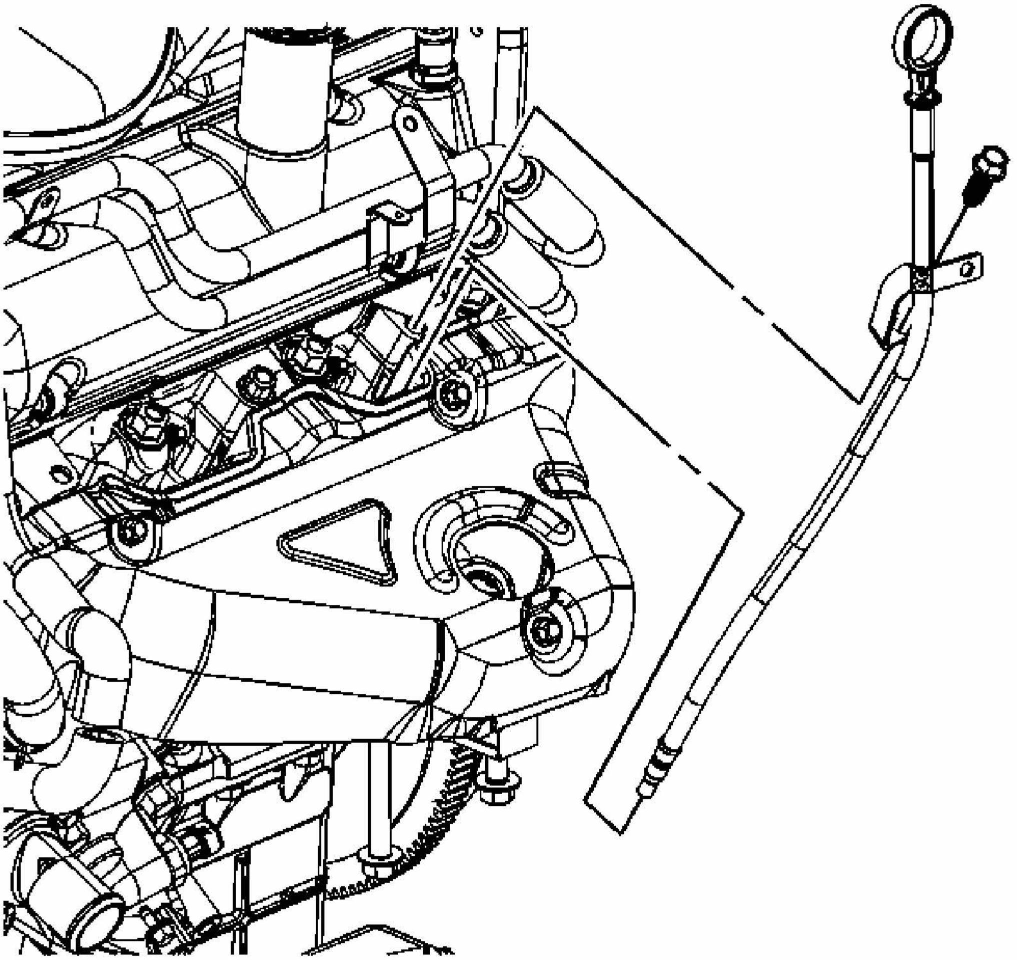


Fig. 264: View Of Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil level indicator tube bolt.
2. Remove the oil level indicator and oil level indicator tube.

OIL FILTER ADAPTER REMOVAL

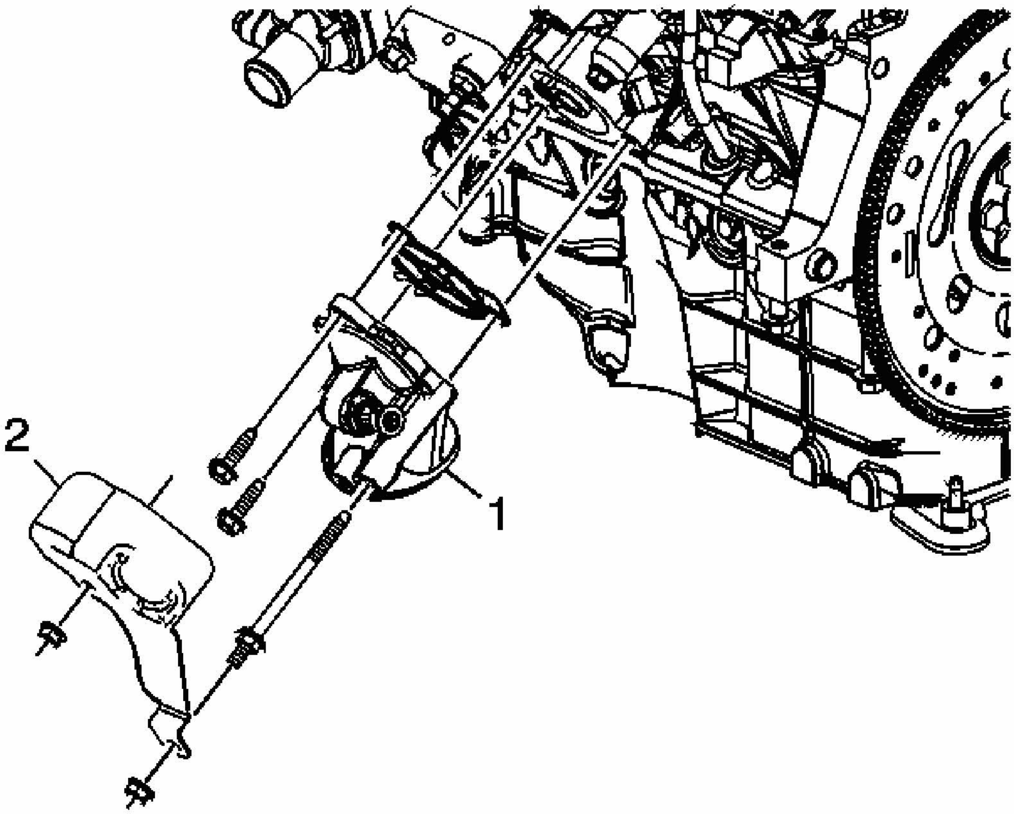


Fig. 265: Identifying Oil Filter Adapter & Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil filter adapter heat shield nuts.
2. Remove the oil filter adapter heat shield (2).
3. Remove the oil filter adapter bolts.
4. Remove the oil filter adapter (1) and gasket.

EXHAUST CROSSOVER PIPE REMOVAL

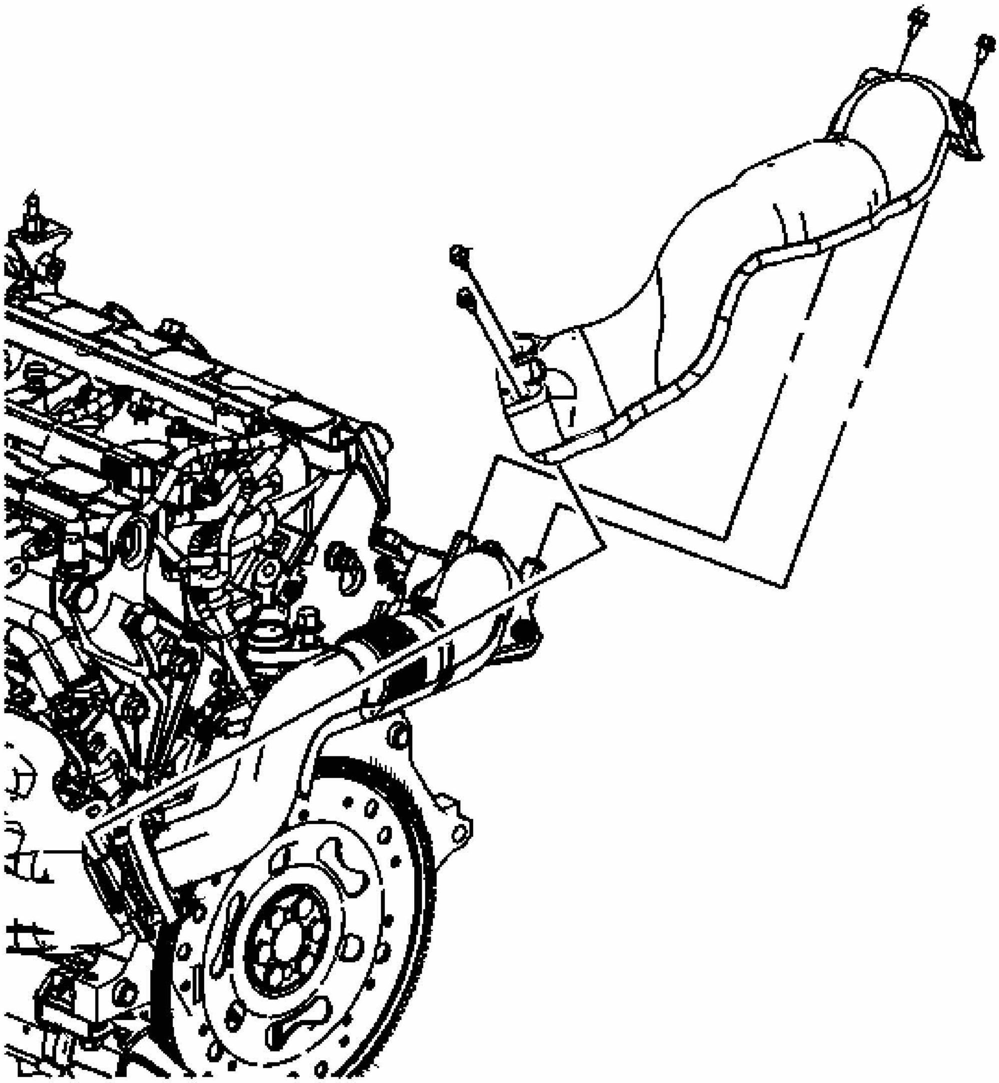


Fig. 266: Identifying Exhaust Crossover Pipe Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the exhaust crossover heat shield pipe bolts.
2. Remove the exhaust crossover heat shield.

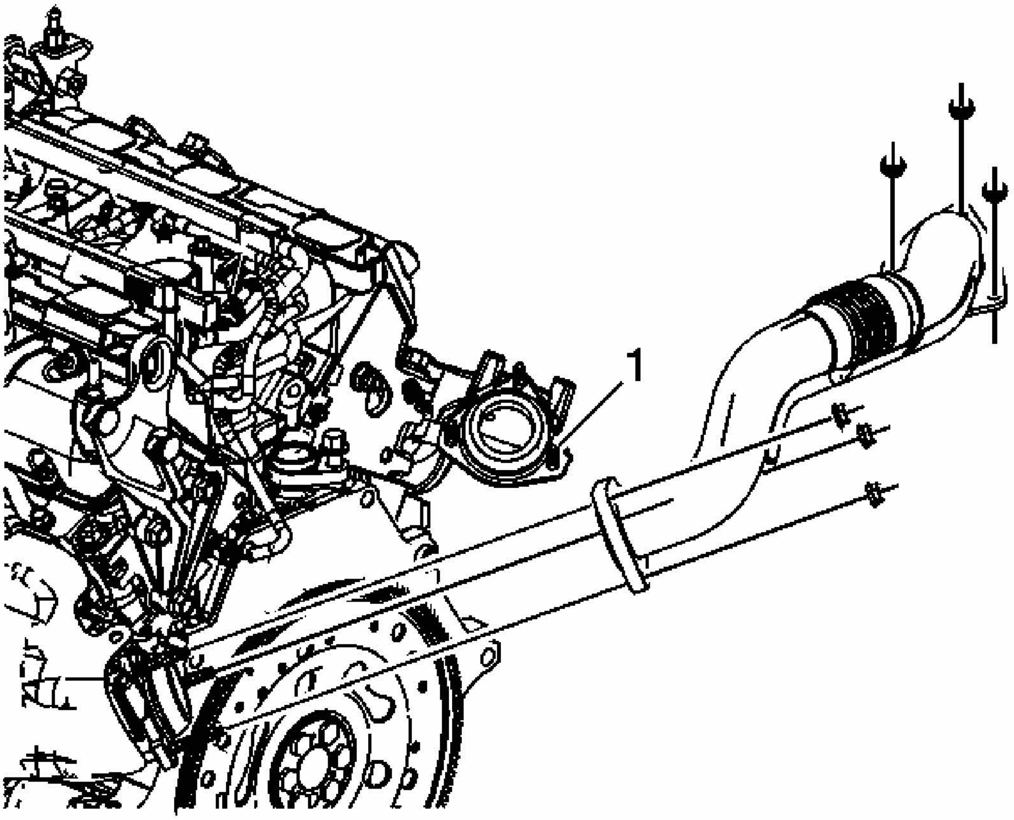


Fig. 267: Identifying Exhaust Crossover Pipe & Nuts
Courtesy of GENERAL MOTORS CORP.

3. Remove the exhaust crossover pipe nuts.
4. Remove the exhaust crossover pipe studs (1) if necessary.
5. Remove the exhaust crossover pipe.

EXHAUST MANIFOLD REMOVAL - LEFT

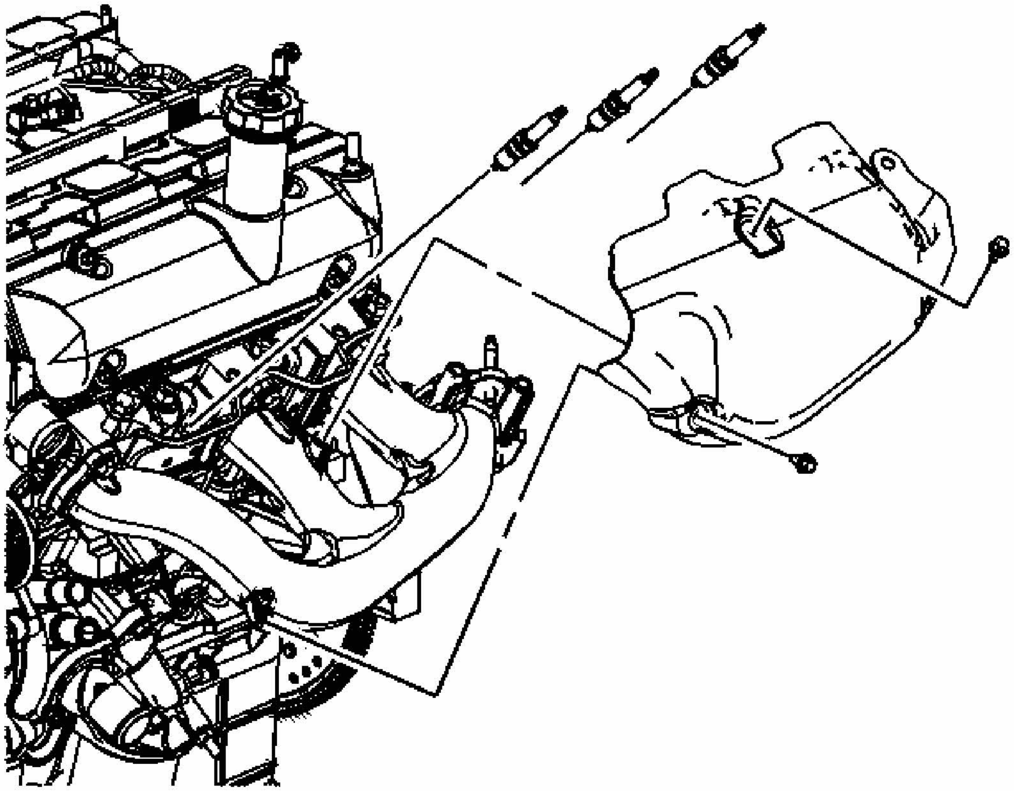


Fig. 268: View Of Spark Plugs & Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug wires and spark plugs.
2. Remove the exhaust manifold heat shield bolts.
3. Remove the exhaust manifold heat shield.

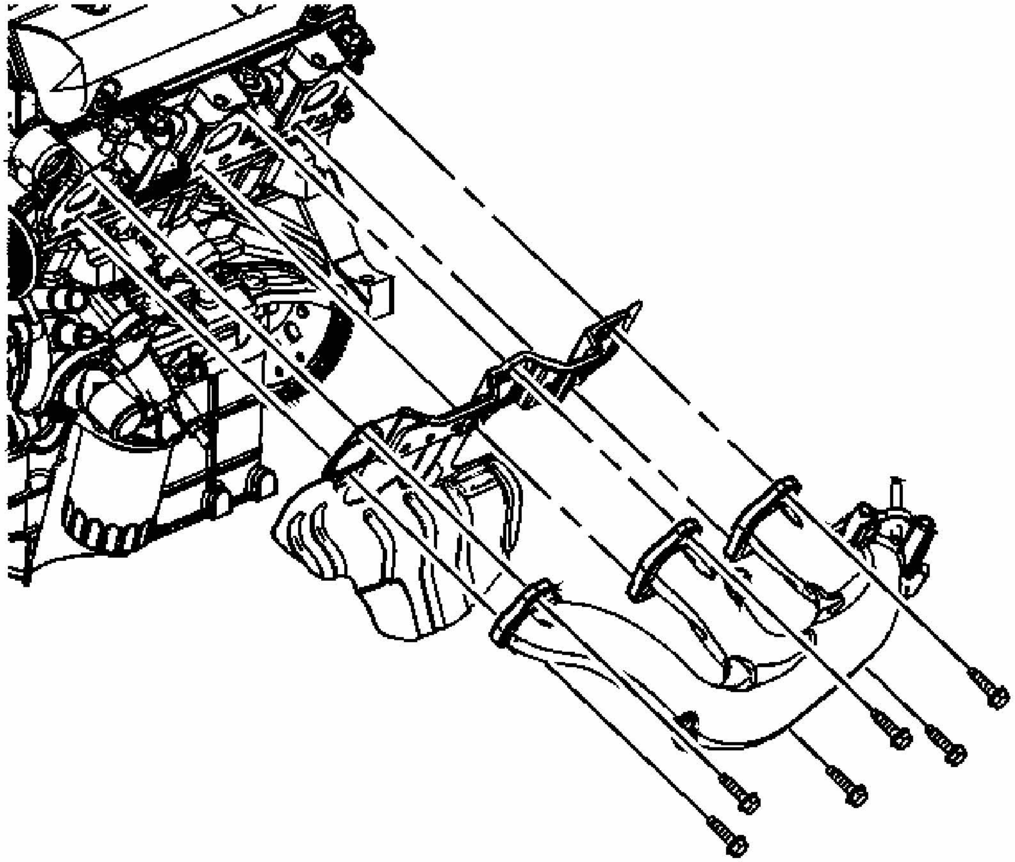


Fig. 269: View Of Left Exhaust Manifold & Gasket
Courtesy of GENERAL MOTORS CORP.

4. Remove the exhaust manifold bolts.
5. Remove the exhaust manifold.
6. Remove the exhaust manifold gasket.

EXHAUST MANIFOLD REMOVAL - RIGHT

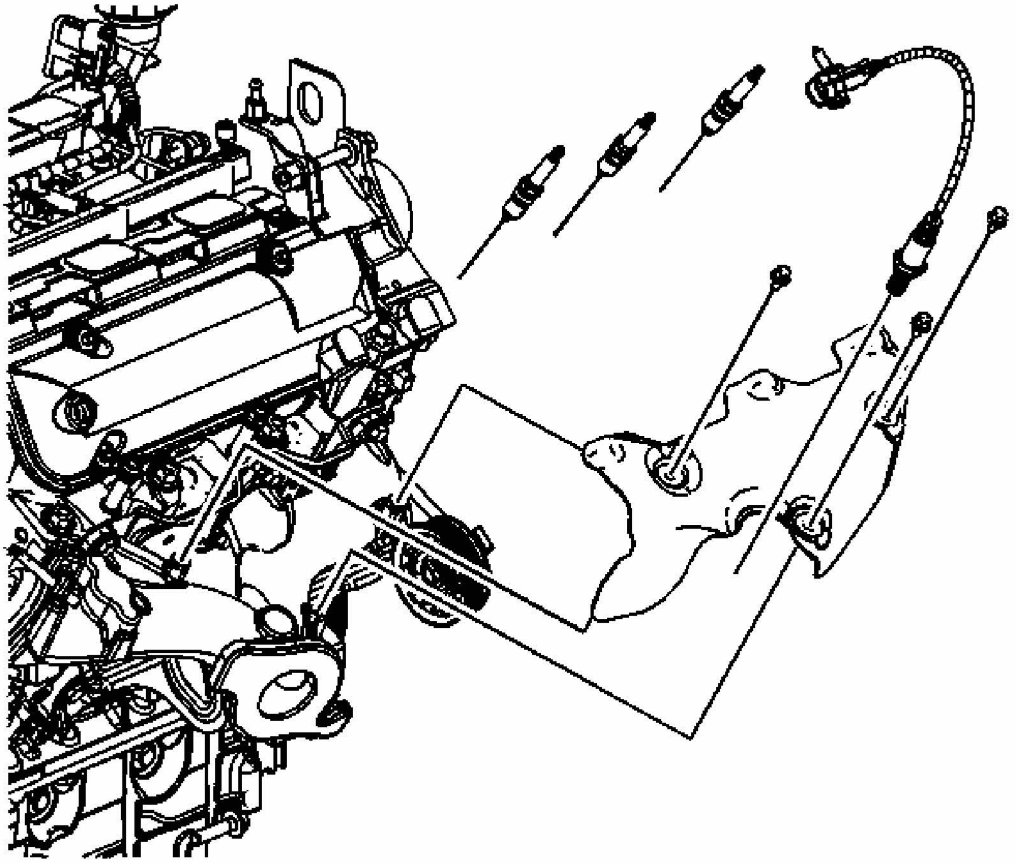


Fig. 270: Identifying Right Side Spark Plugs, HO2S & Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the heated oxygen sensor.
2. Remove the spark plug wires and spark plugs.
3. Remove the exhaust manifold heat shield bolts.
4. Remove the exhaust manifold heat shield.

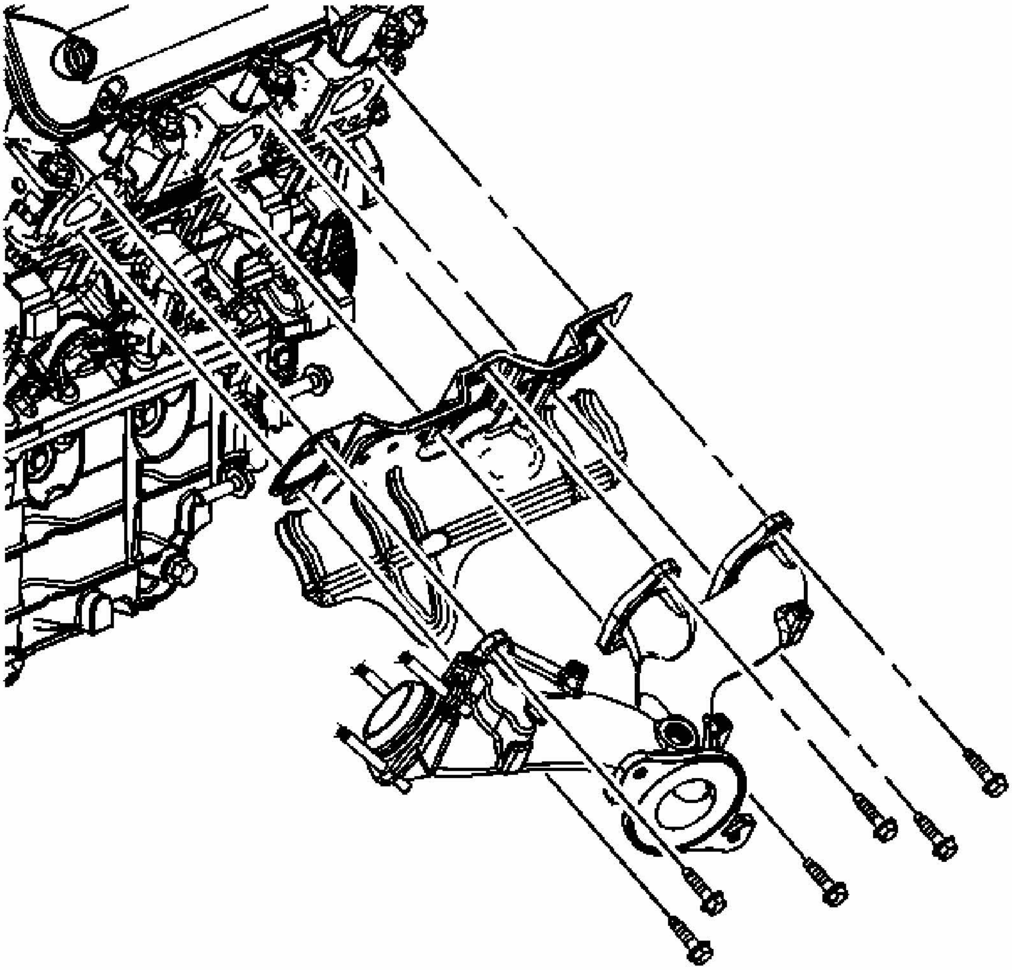


Fig. 271: View Of Right Exhaust Manifold & Gasket
Courtesy of GENERAL MOTORS CORP.

5. Remove the exhaust manifold bolts.
6. Remove the exhaust manifold.
7. Remove the exhaust manifold gasket.

WATER OUTLET AND THERMOSTAT REMOVAL

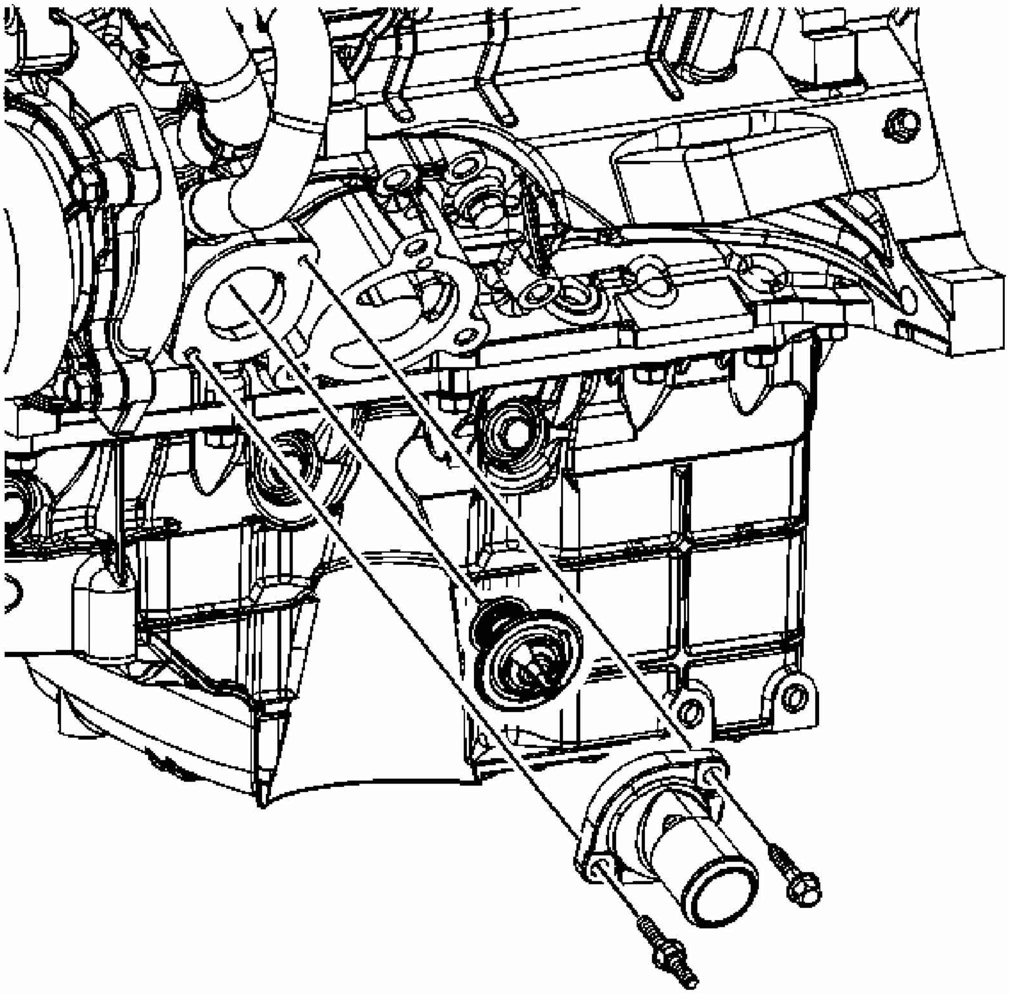


Fig. 272: Identifying Thermostat Housing Bolt/Stud
Courtesy of GENERAL MOTORS CORP.

1. Remove the water outlet bolts.
2. Remove the water outlet.
3. Remove the thermostat.

VALVE ROCKER ARM COVER REMOVAL - LEFT

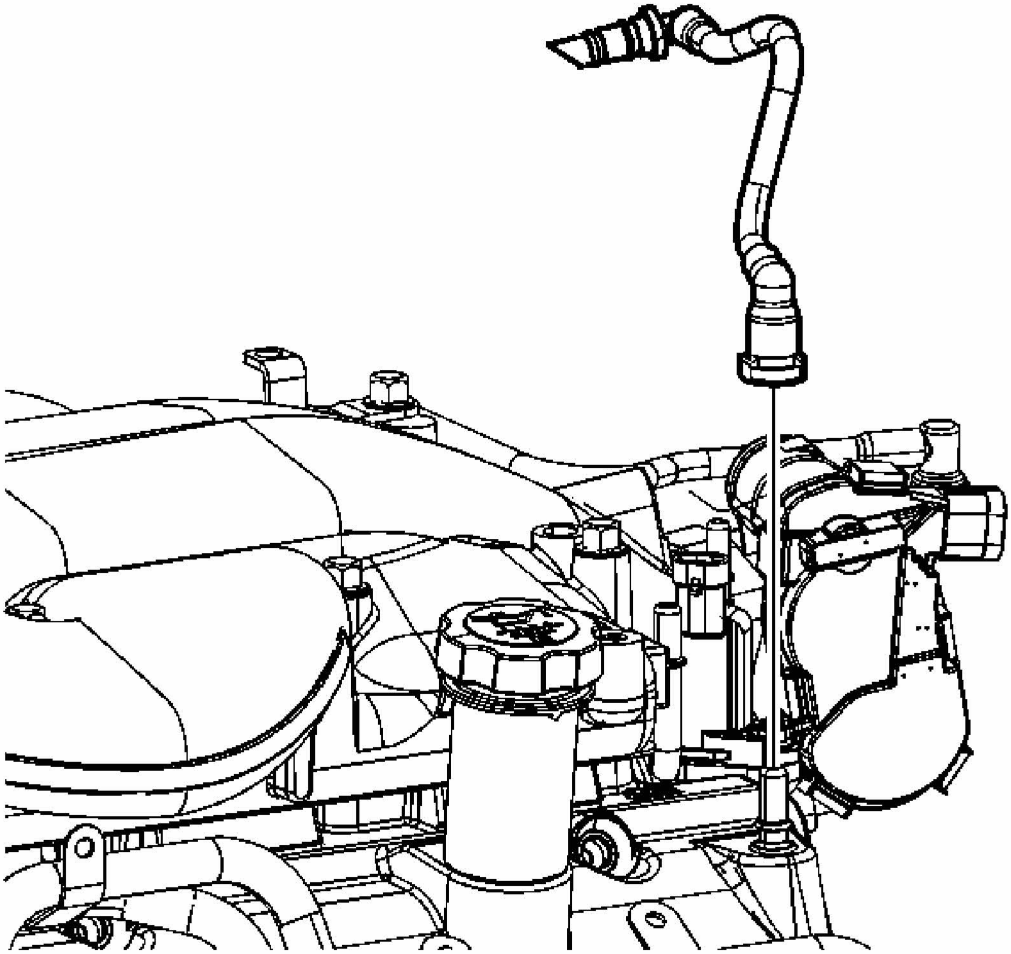


Fig. 273: Locating Positive Crankcase Ventilation Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the positive crankcase ventilation (PCV) tube.

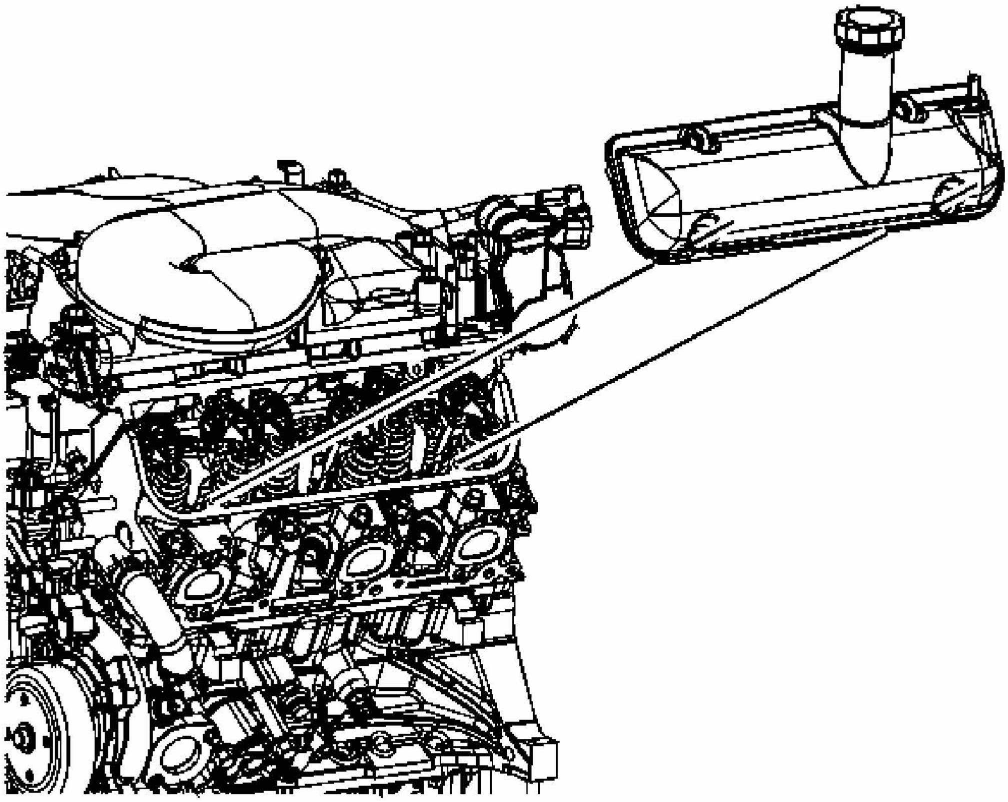


Fig. 274: Identifying Left Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

2. Remove the valve rocker arm cover bolts.

IMPORTANT: When removing the valve rocker arm cover make sure the gasket stays in place attached to the cylinder head.

3. Remove the valve rocker arm cover.
4. Cut the room temperature vulcanizing (RTV) in the channel where the intake, cylinder head and valve rocker arm cover meet with a suitable tool.
5. Remove the valve rocker arm cover gasket.

VALVE ROCKER ARM COVER REMOVAL - RIGHT

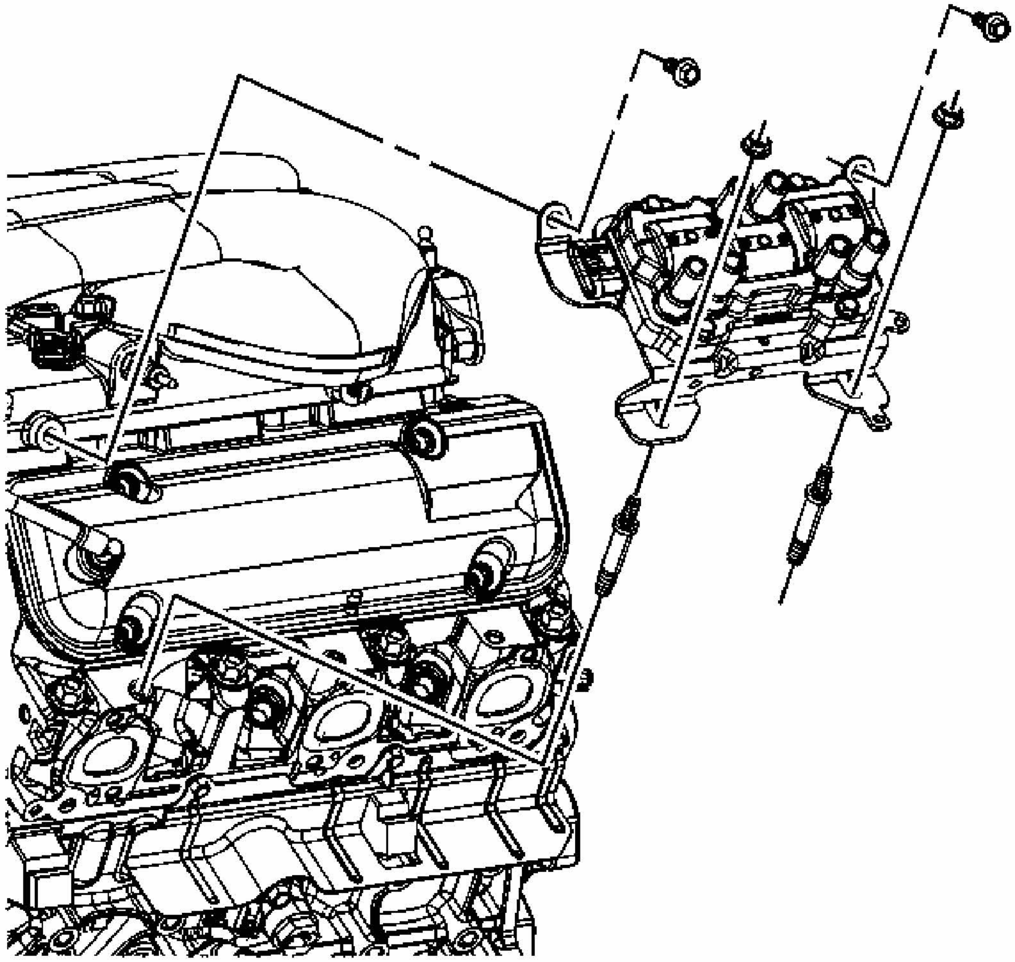


Fig. 275: Identifying Ignition Coil Assembly, Studs & Nuts
Courtesy of GENERAL MOTORS CORP.

1. Remove any remaining spark plug wires from their retainers.
2. Remove the ignition coil assembly bolts and nuts.
3. Remove the ignition coil assembly.
4. Remove the ignition coil assembly studs, if necessary.

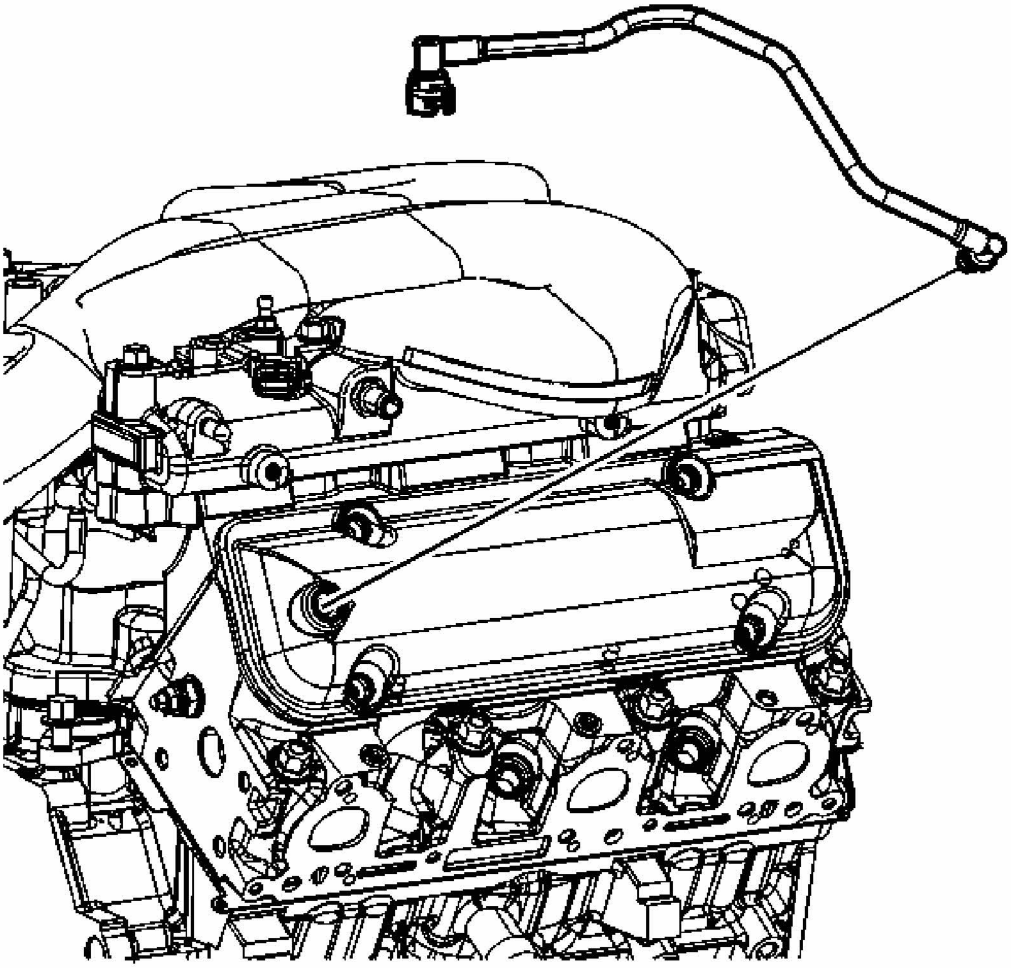


Fig. 276: Identifying Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Remove the fresh air tube from the valve rocker arm cover.

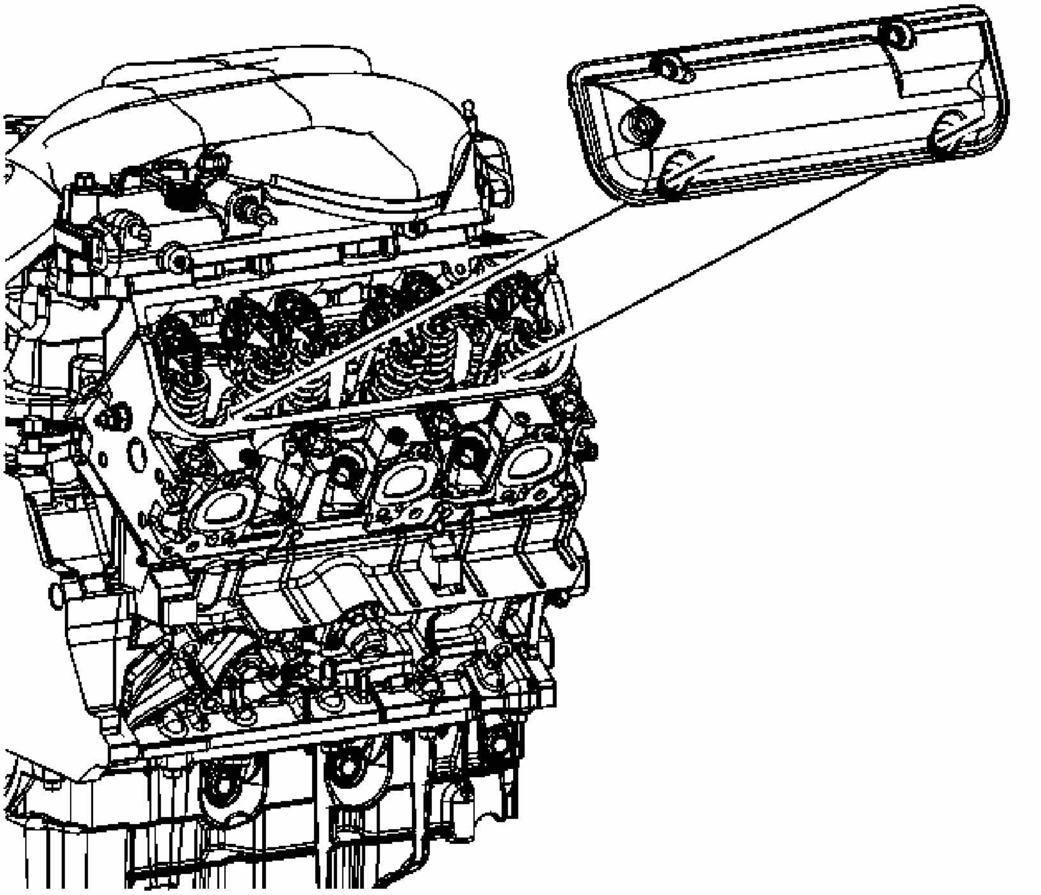


Fig. 277: View Of Right Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

6. Remove the valve rocker arm cover bolts.

IMPORTANT: When removing the valve rocker arm cover make sure the gasket stays in place attached to the cylinder head.

7. Remove the valve rocker arm cover.
8. Cut the room temperature vulcanizing (RTV) in the channel where the intake, cylinder head and valve rocker arm cover meet with a suitable tool.
9. Remove the valve rocker arm cover gasket.

INTAKE MANIFOLD REMOVAL - UPPER

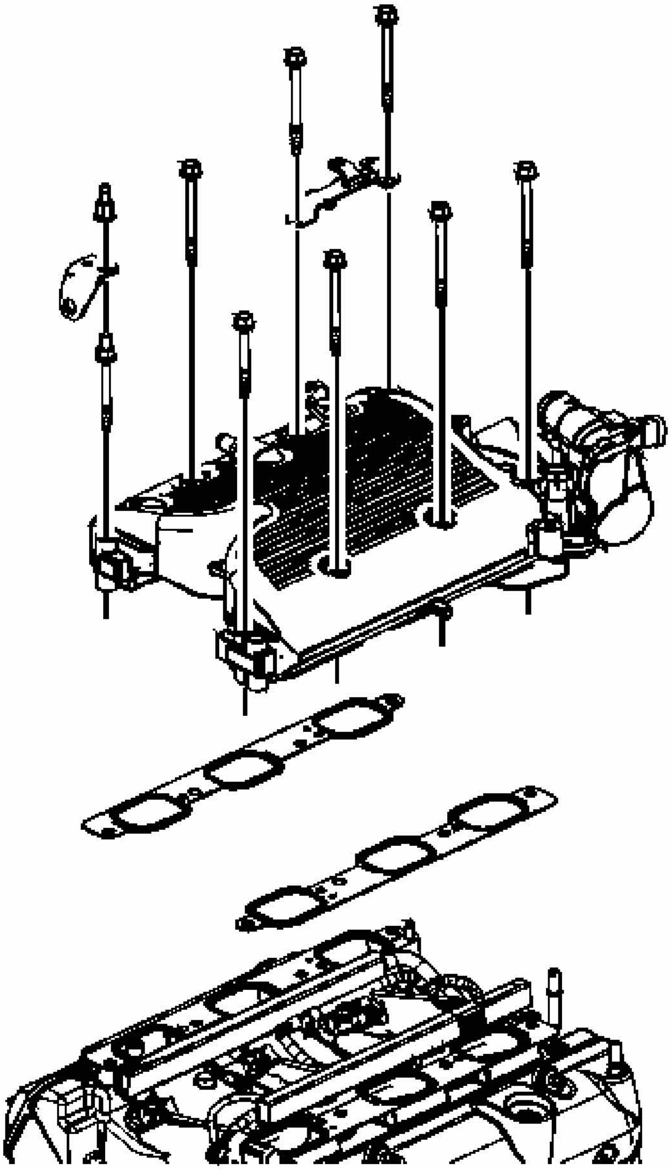


Fig. 278: Locating Upper Intake Manifold Bolts And Stud
Courtesy of GENERAL MOTORS CORP.

1. Remove the upper intake manifold bolts and stud.
2. Remove the manifold absolute pressure (MAP) sensor bracket.
3. Remove the upper intake manifold and gaskets.

INTAKE MANIFOLD REMOVAL - LOWER

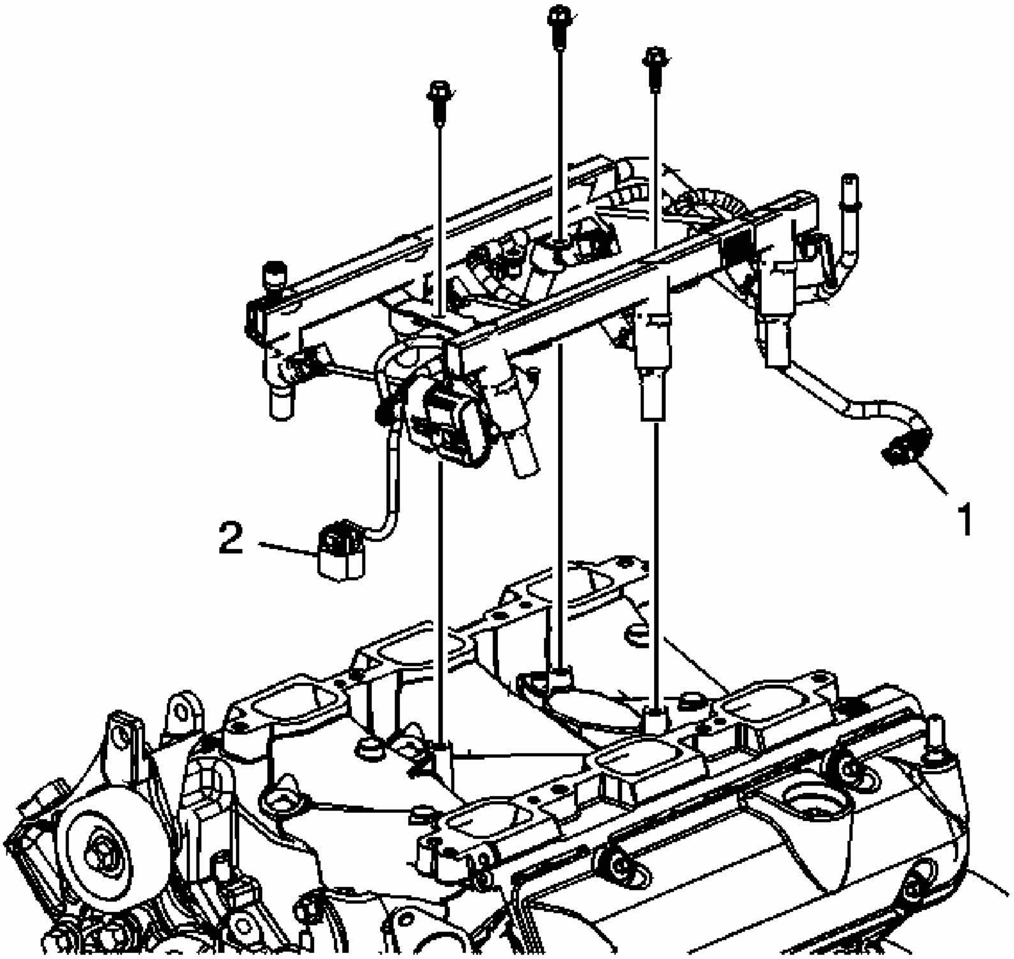


Fig. 279: Identifying Lower Intake Manifold Attachments
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the coolant temperature sensor (1).
2. Disconnect the camshaft position (CMP) sensor (2).
3. Remove the fuel injector rail bolts.
4. Remove the fuel rail assembly.

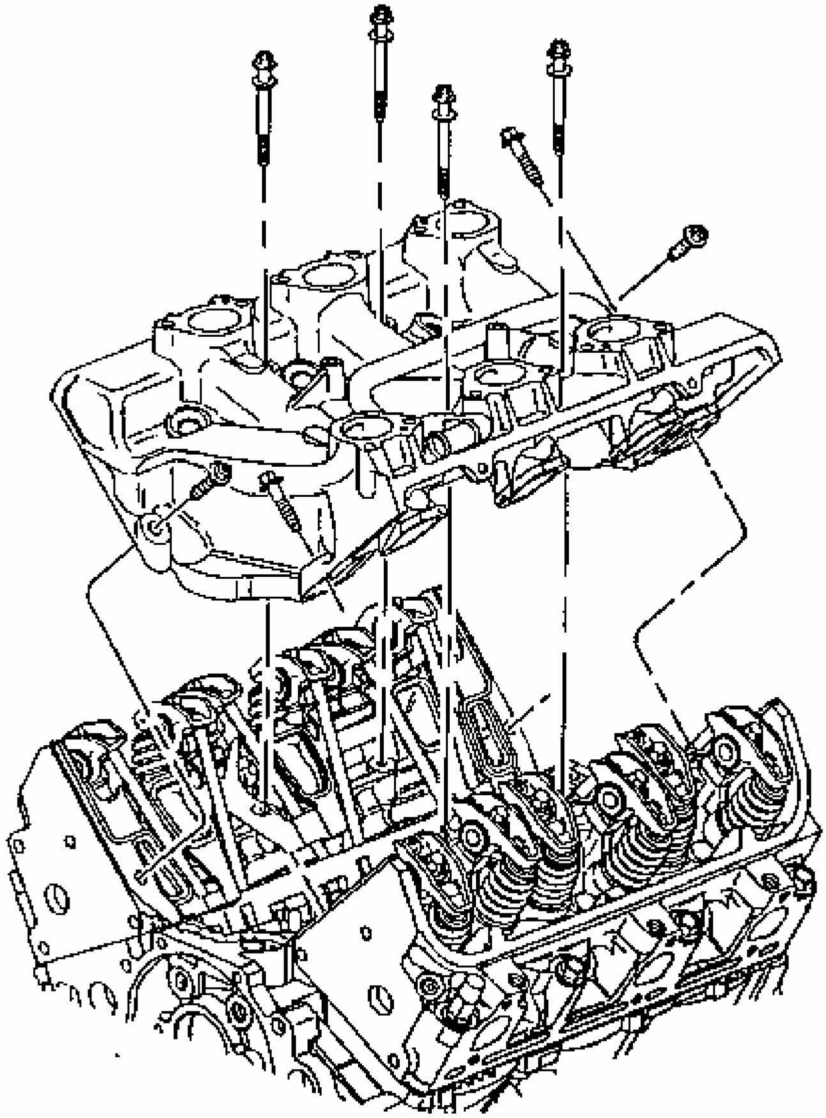


Fig. 280: View Of Lower Intake Manifold & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the lower intake manifold bolts and discard.
6. Remove the lower intake manifold.

VALVE ROCKER ARM AND PUSH ROD REMOVAL

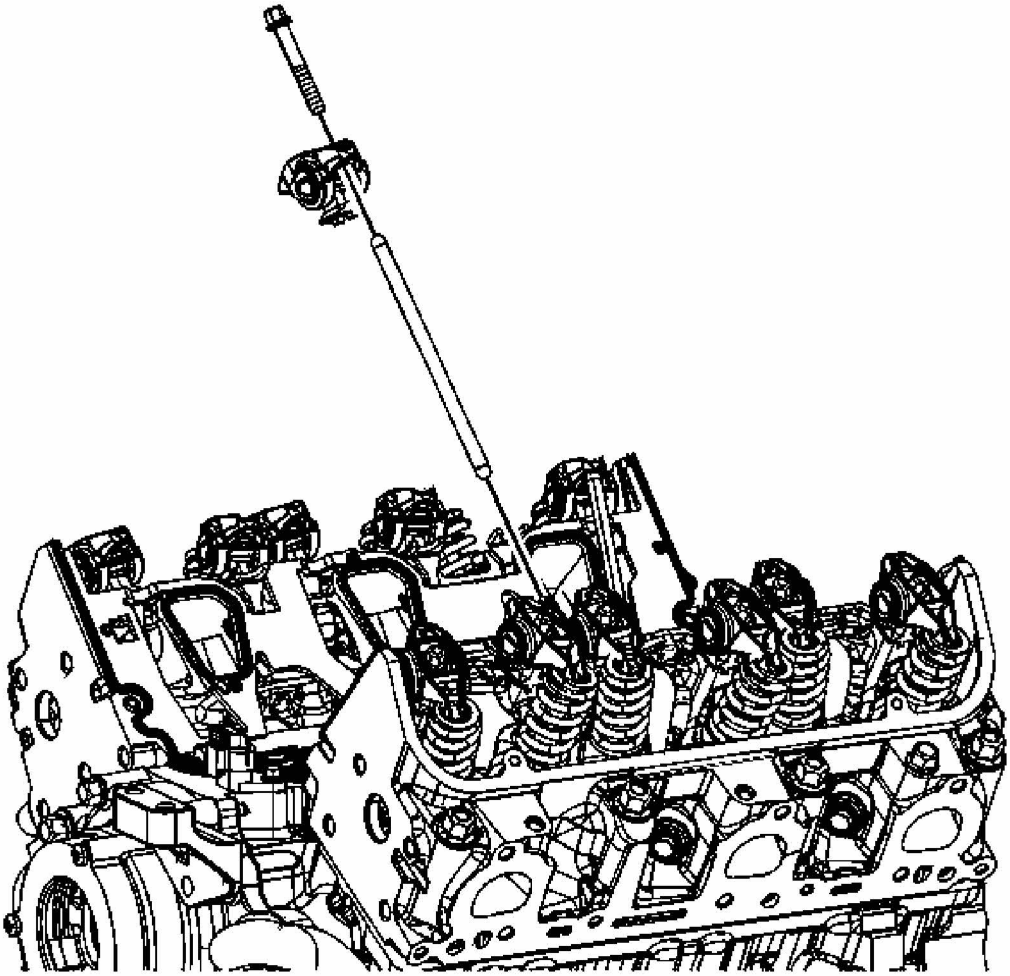


Fig. 281: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Loosen the valve rocker arm bolts.

IMPORTANT: Place the valve train components in a rack in order to ensure that the components are installed in the same location from which they where removed.

2. Remove the valve rocker arms.
3. Remove the push rods.
    - The intake push rods measure 147.51 mm (5.81 in).
    - The exhaust push rods measure 154.87 mm (6.1 in).

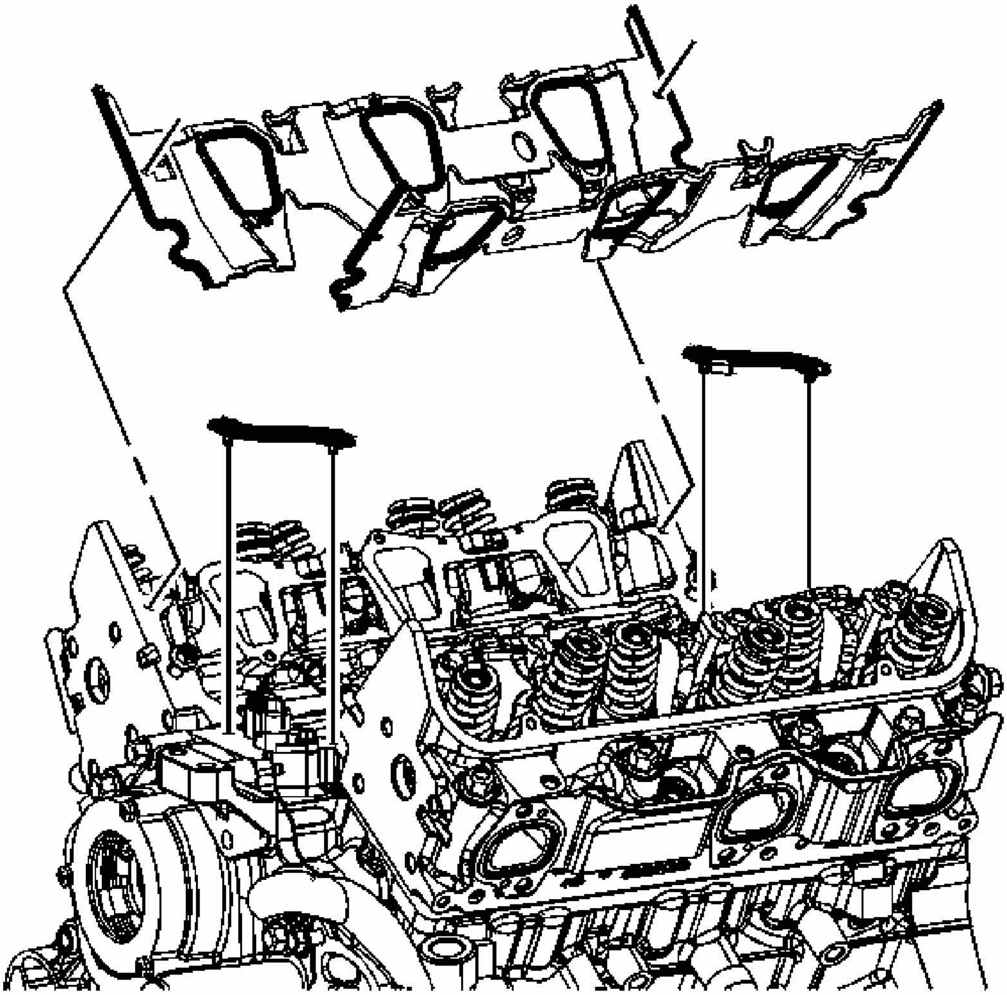


Fig. 282: Identifying Intake Manifold Gaskets & Seals
Courtesy of GENERAL MOTORS CORP.

4. Remove the intake manifold gaskets.

VALVE LIFTER REMOVAL

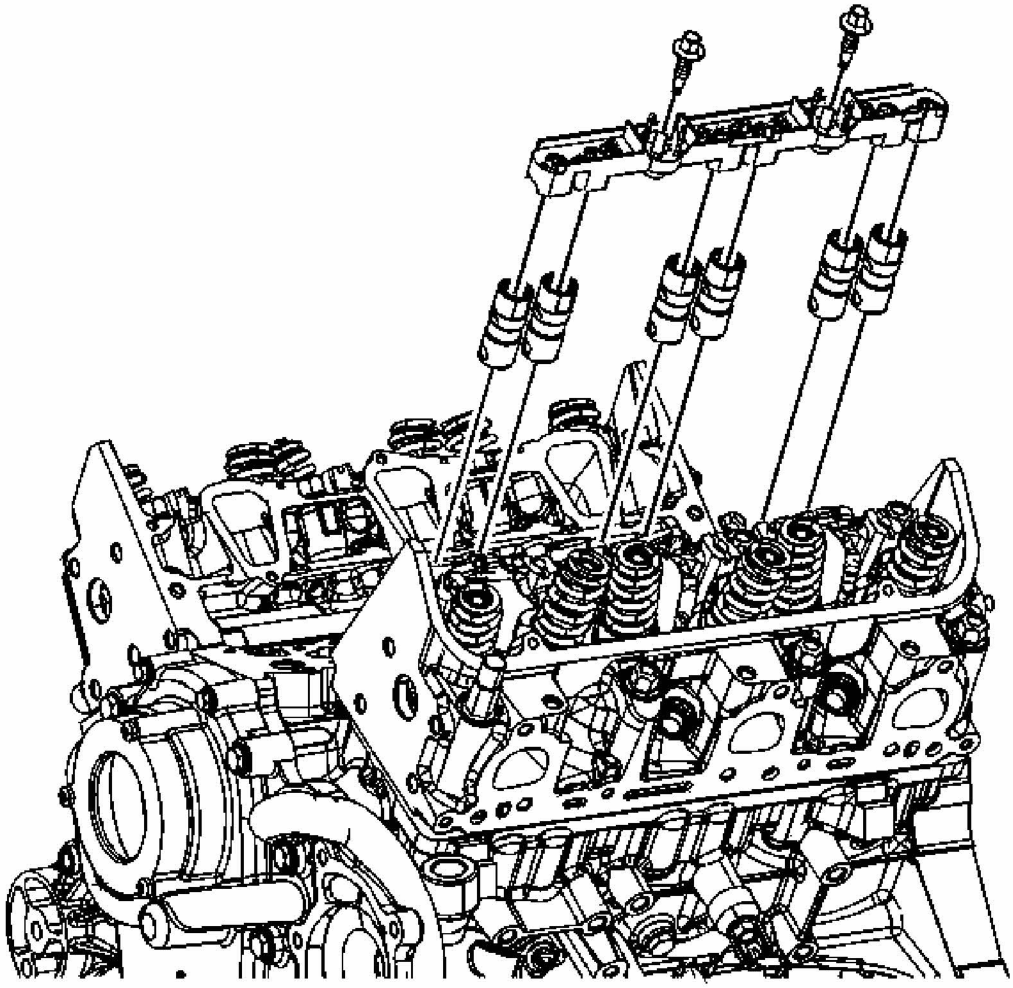


Fig. 283: View Of Valve Lifter Guides
Courtesy of GENERAL MOTORS CORP.

1. Remove the valve lifter guide bolts.
2. Remove the valve lifter guides.

IMPORTANT: Once removed, place the valve lifters in an organized order so the valve lifters can be installed into the original locations.

3. Remove the valve lifters.

WATER PUMP REMOVAL

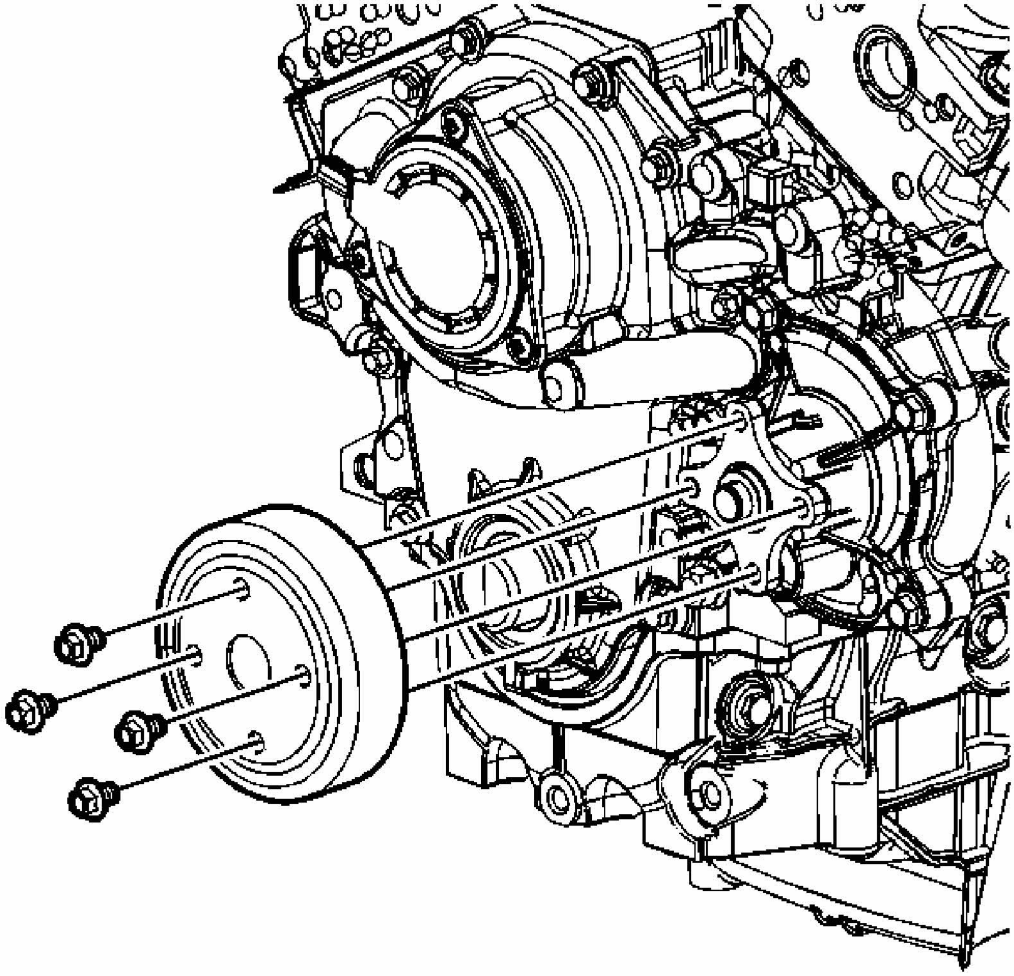


Fig. 284: View Of Water Pump Pulley & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the water pump pulley bolts.
2. Remove the water pump pulley.

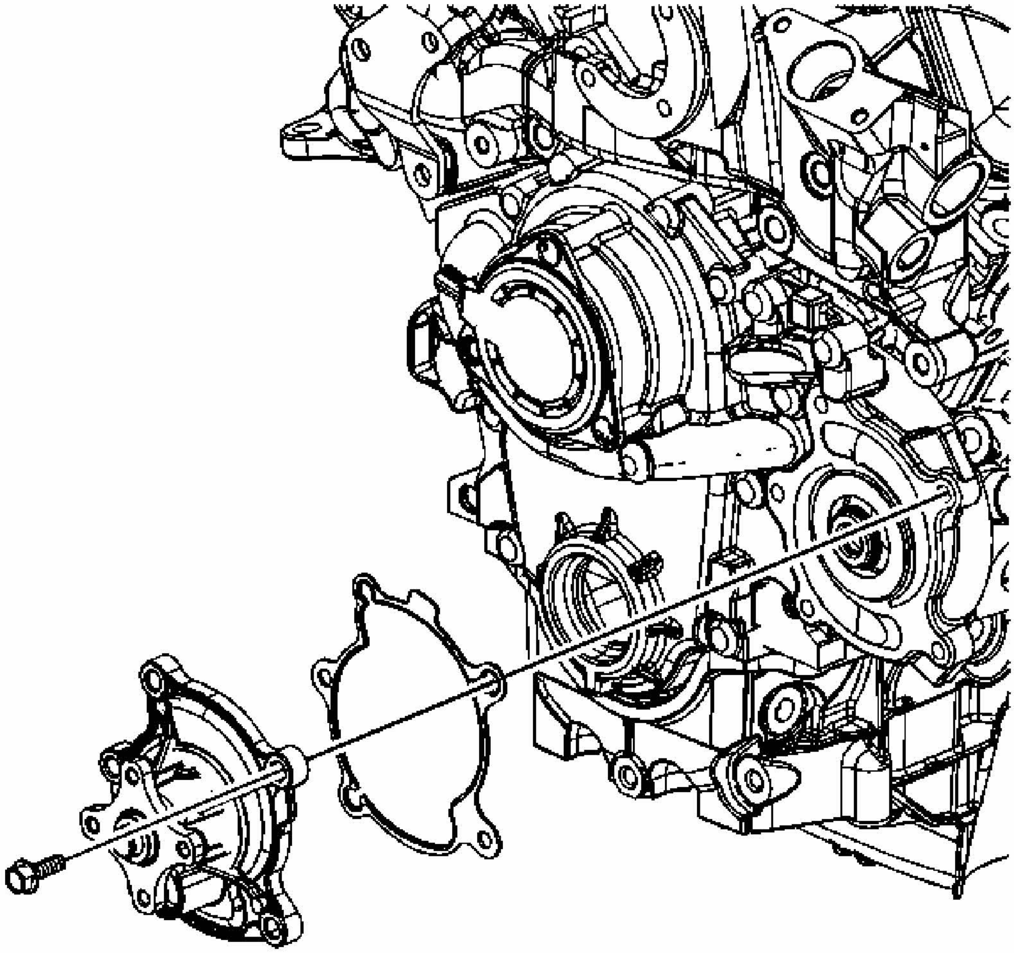


Fig. 285: View Of Water Pump, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

3. Remove the water pump bolts.
4. Remove the water pump.
5. Remove the water pump gasket.

CYLINDER HEAD REMOVAL - LEFT

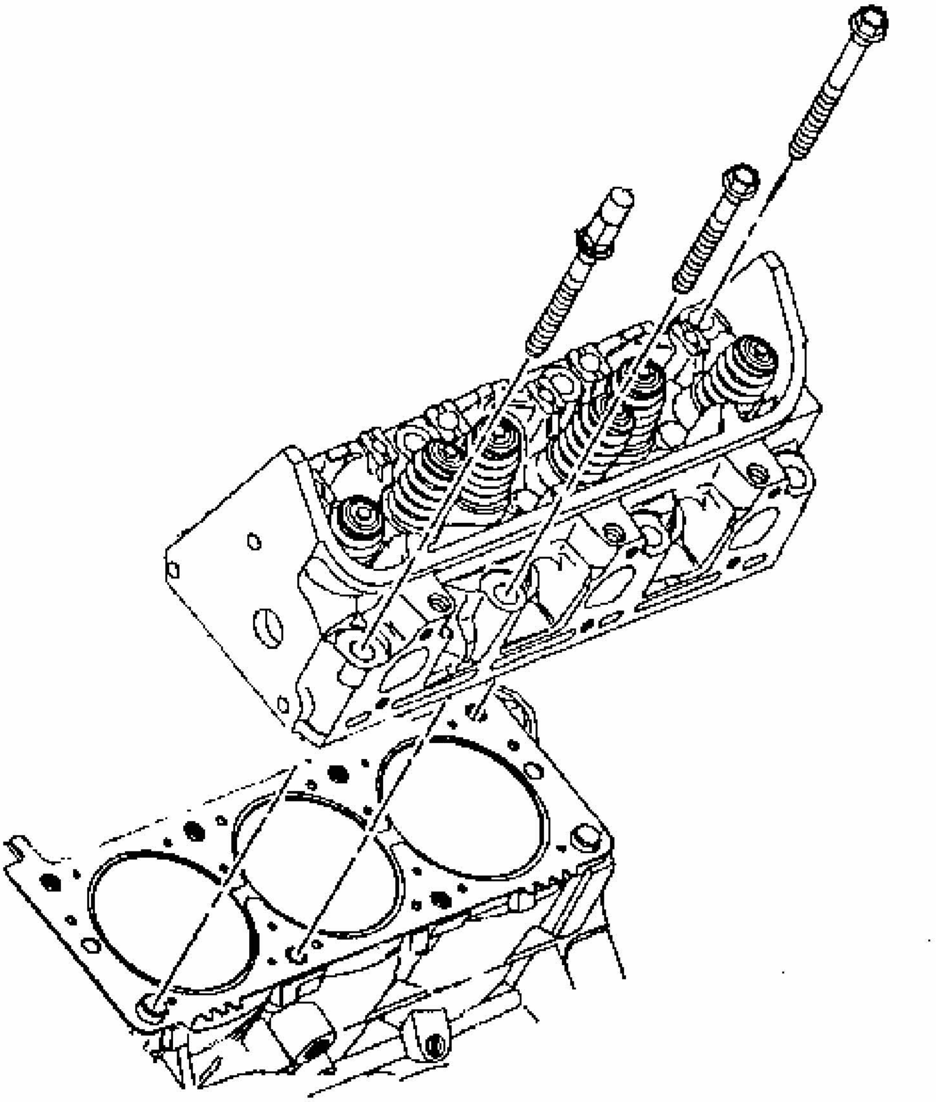


Fig. 286: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

1. Remove the cylinder head bolt and discards.
2. Remove the cylinder head.

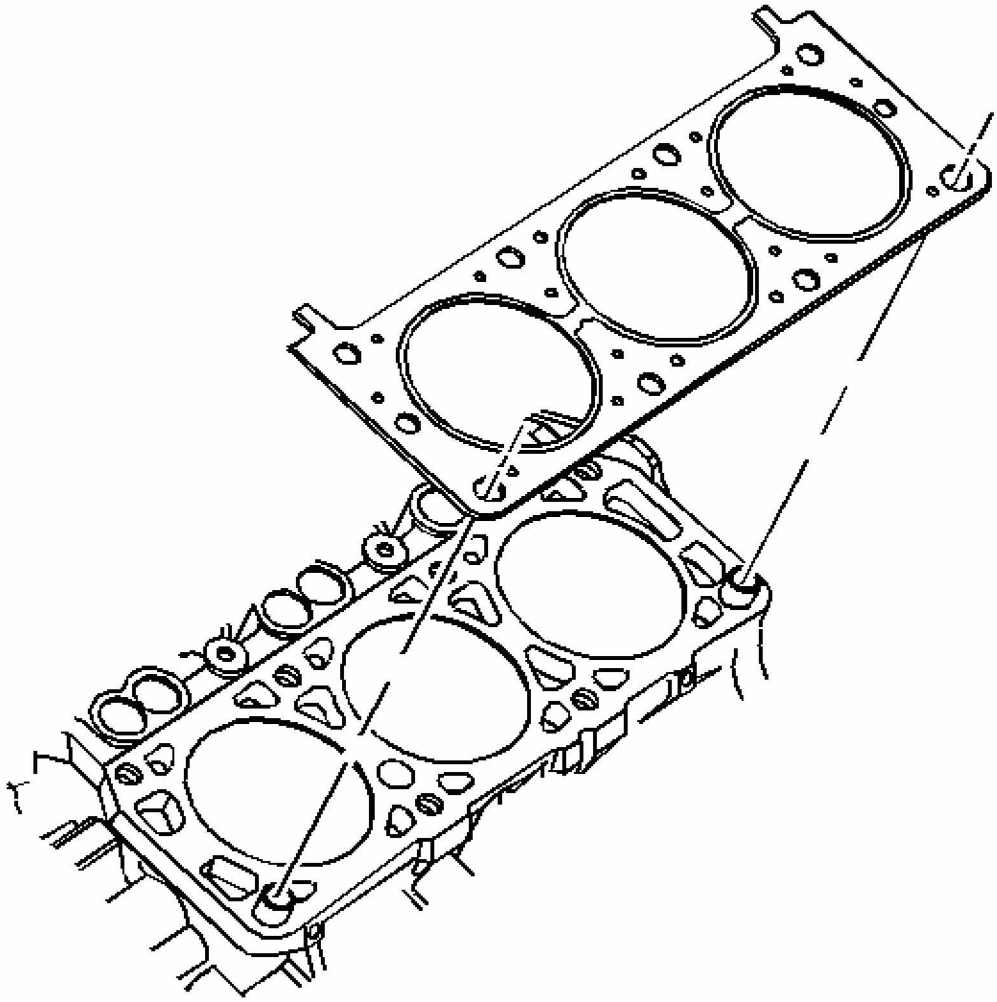


Fig. 287: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Remove the cylinder head gasket.
4. Remove the cylinder head locator dowel pins, if required.

CYLINDER HEAD REMOVAL - RIGHT

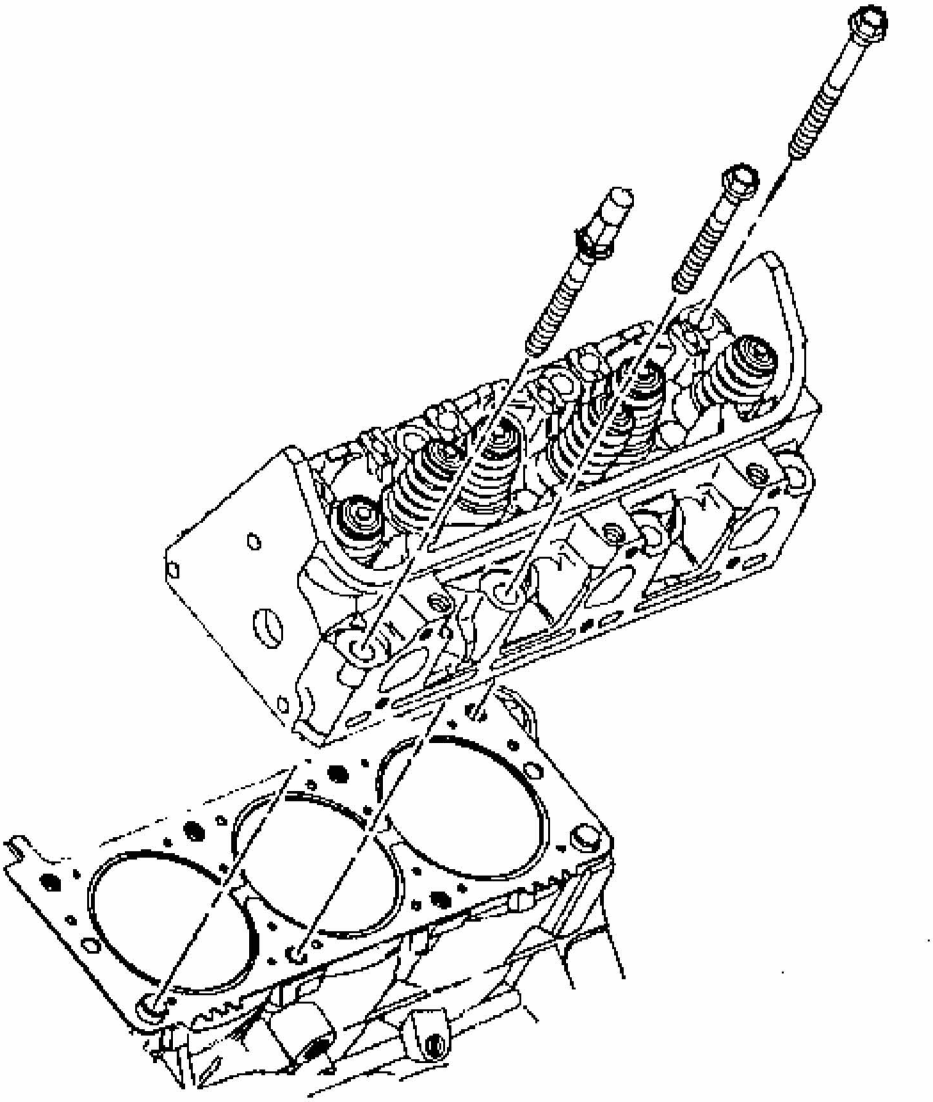


Fig. 288: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

1. Remove the cylinder head bolts and discard.
2. Remove the cylinder head.

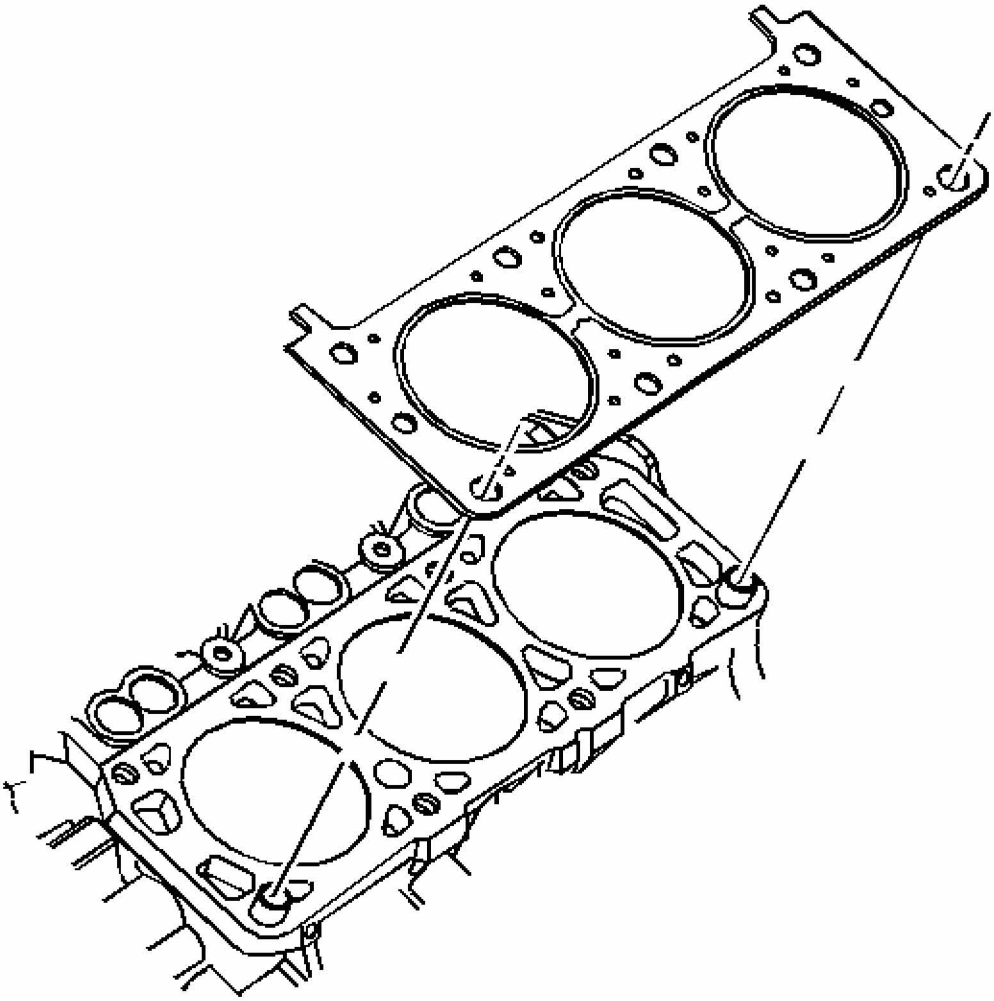


Fig. 289: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Remove the cylinder head gasket.
4. Remove the cylinder head locator dowel pins, if required.

OIL PAN REMOVAL

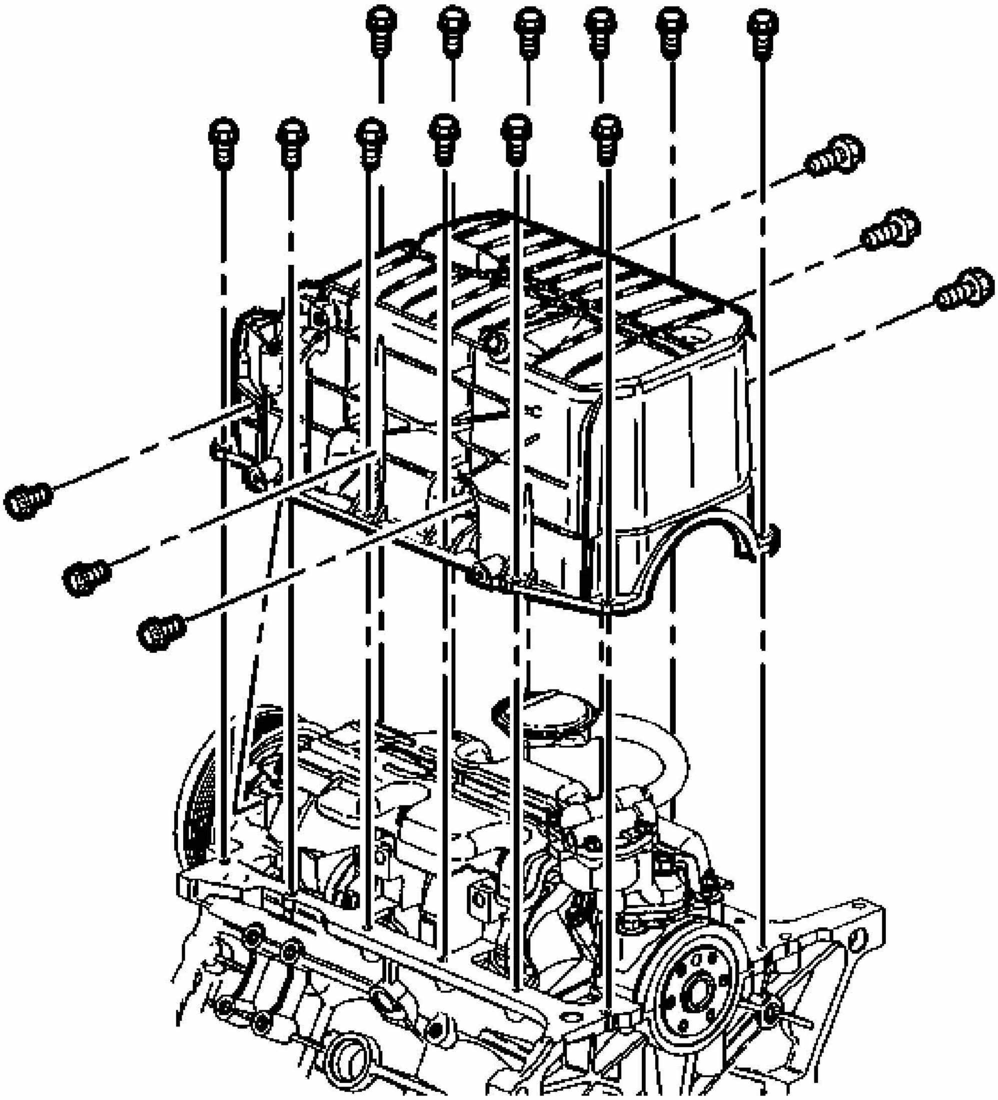


Fig. 290: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pan support bracket bolts and brackets as needed
2. Remove the oil pan side bolts.
3. Remove the oil pan bolts.
4. Remove the oil pan.
5. Remove the oil pan gasket.

OIL PUMP REMOVAL

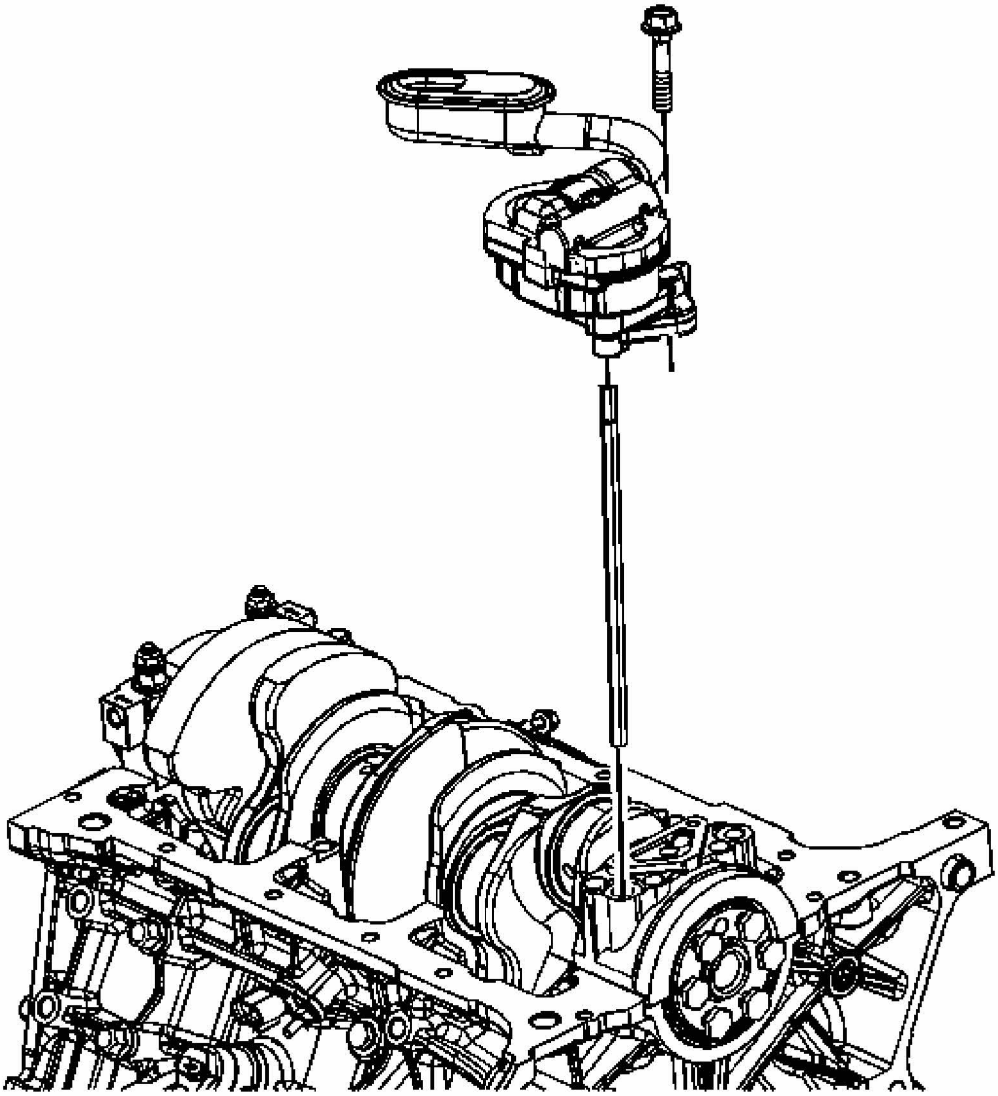


Fig. 291: View Of Oil Pump & Oil Pump Drive Shaft
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pump bolt.
2. Remove the oil pump and oil pump drive shaft.

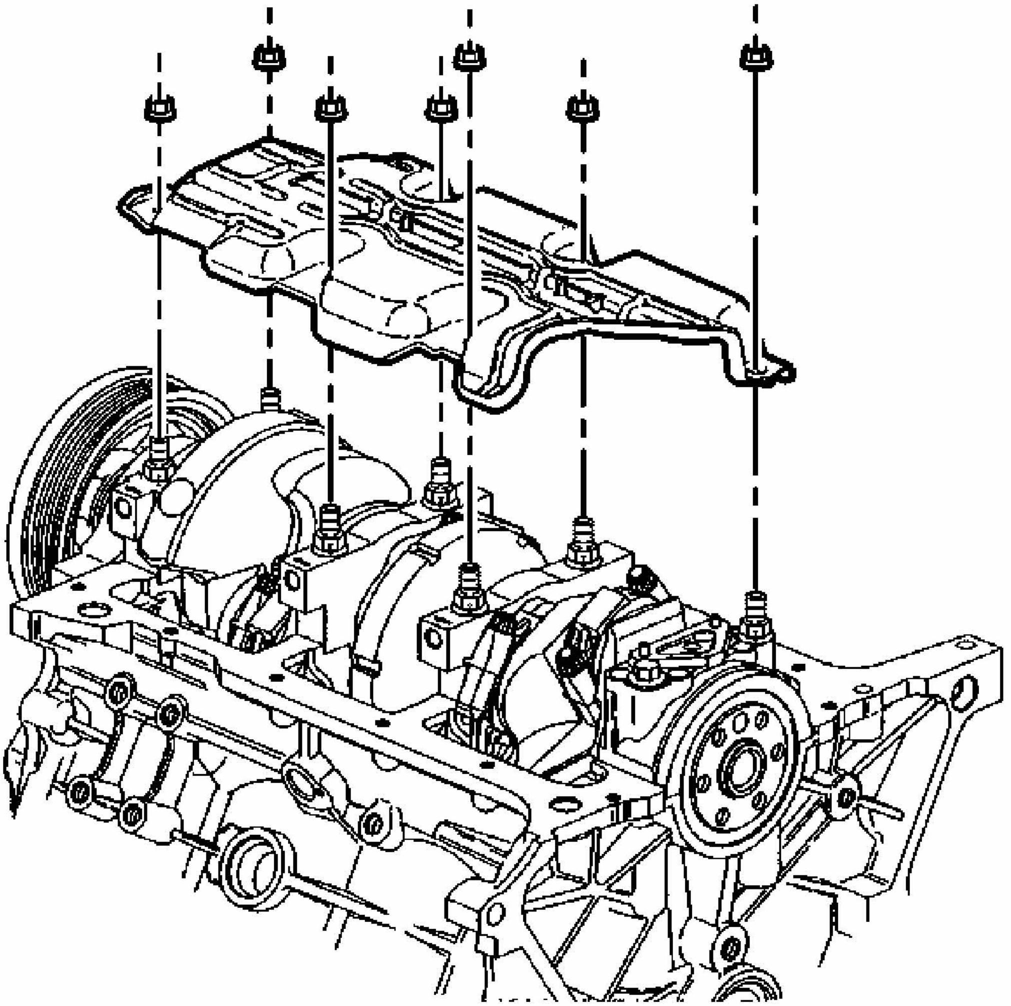


Fig. 292: View Of Crankshaft Oil Deflector & Nuts
Courtesy of GENERAL MOTORS CORP.

3. Remove the crankshaft oil deflector nuts.
4. Remove the crankshaft oil deflector.

CAMSHAFT POSITION ACTUATOR MAGNET REMOVAL

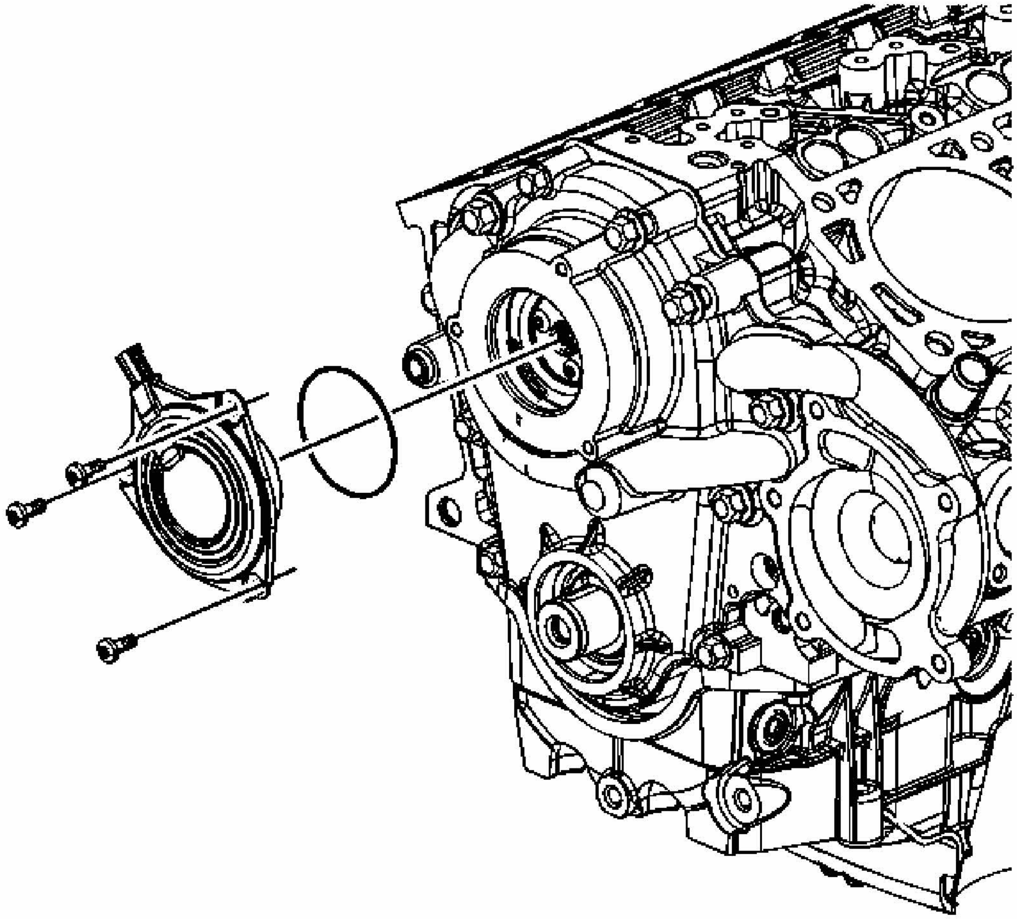


Fig. 293: Identifying Camshaft Position Actuator Magnet
Courtesy of GENERAL MOTORS CORP.

1. Remove the camshaft position actuator magnet bolts.
2. Remove the camshaft position actuator magnet and O-ring seal.

OIL PUMP DRIVE REMOVAL

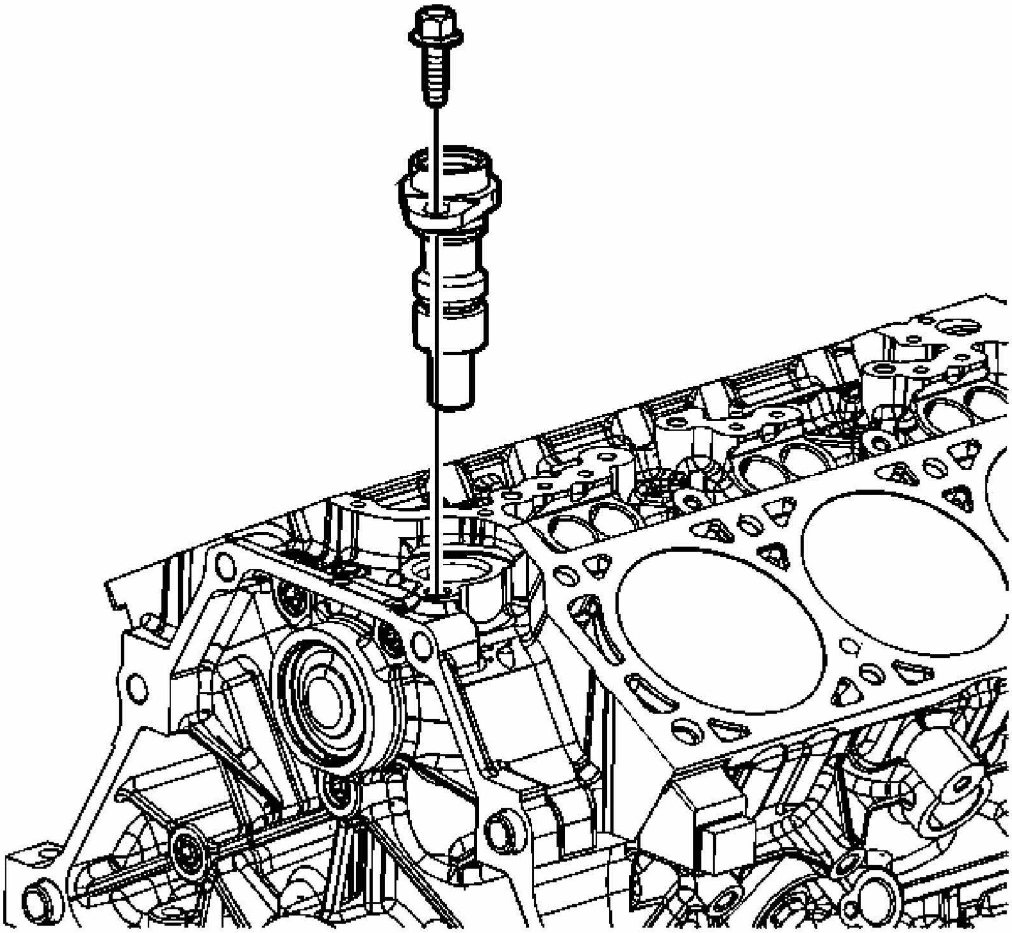


Fig. 294: Identifying Oil Pump Drive
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pump drive clamp bolt.
2. Remove the oil pump drive clamp.
3. Remove the oil pump drive.

CRANKSHAFT FRONT OIL SEAL REMOVAL

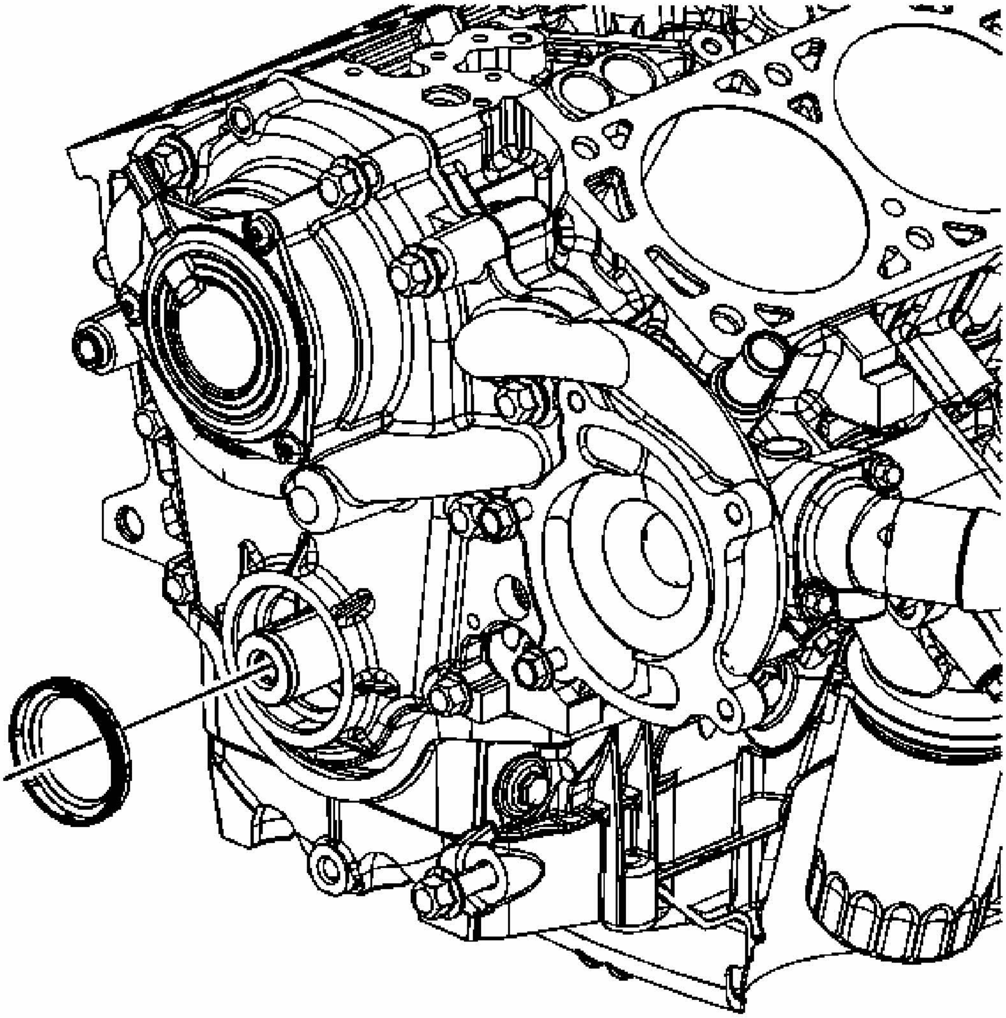


Fig. 295: Identifying Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

Pry out the crankshaft front oil seal using a suitable tool. Use care not to damage the engine front cover or the crankshaft.

ENGINE FRONT COVER REMOVAL

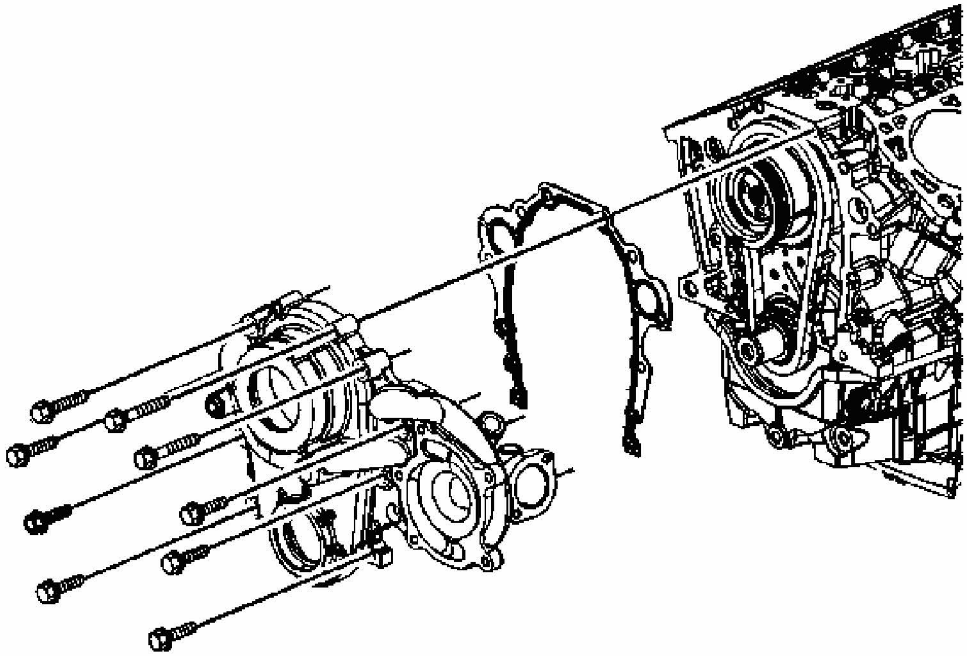


Fig. 296: Identifying Engine Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine front cover bolts.
2. Remove the engine front cover.
3. Remove the engine front cover gasket.

TIMING CHAIN AND SPROCKETS REMOVAL

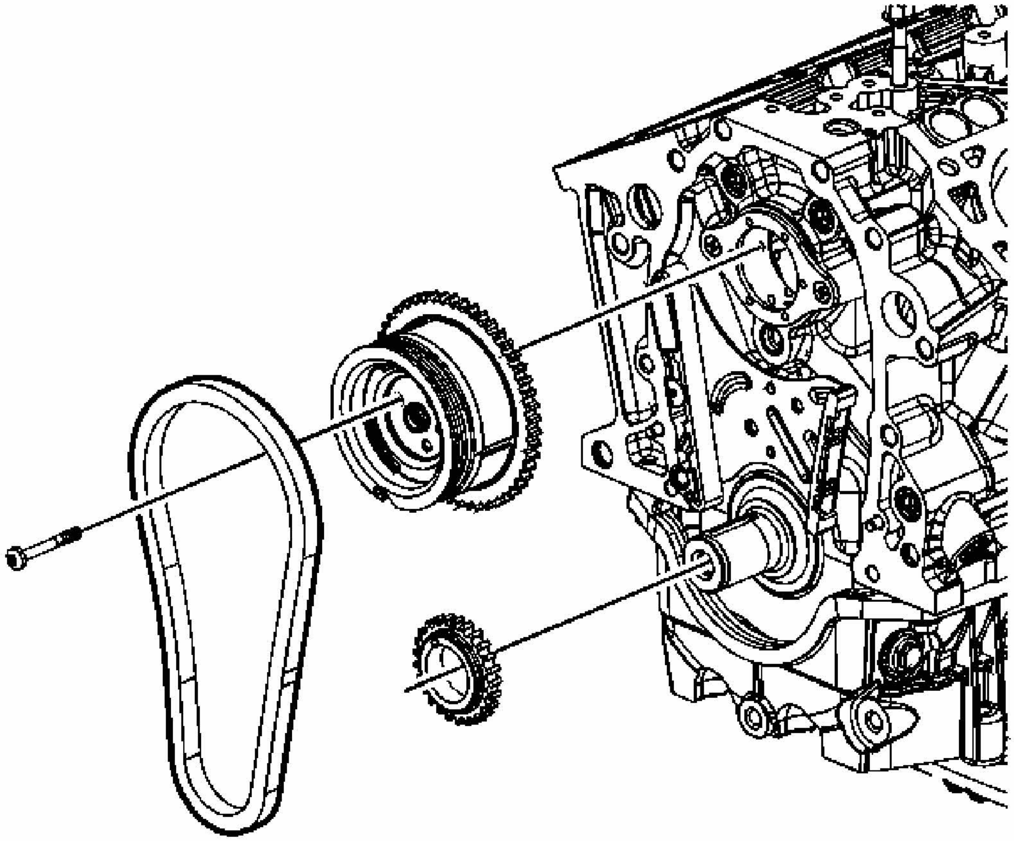


Fig. 297: View Of Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

1. Remove the camshaft sprocket bolts.
2. Remove the timing chain and sprockets.

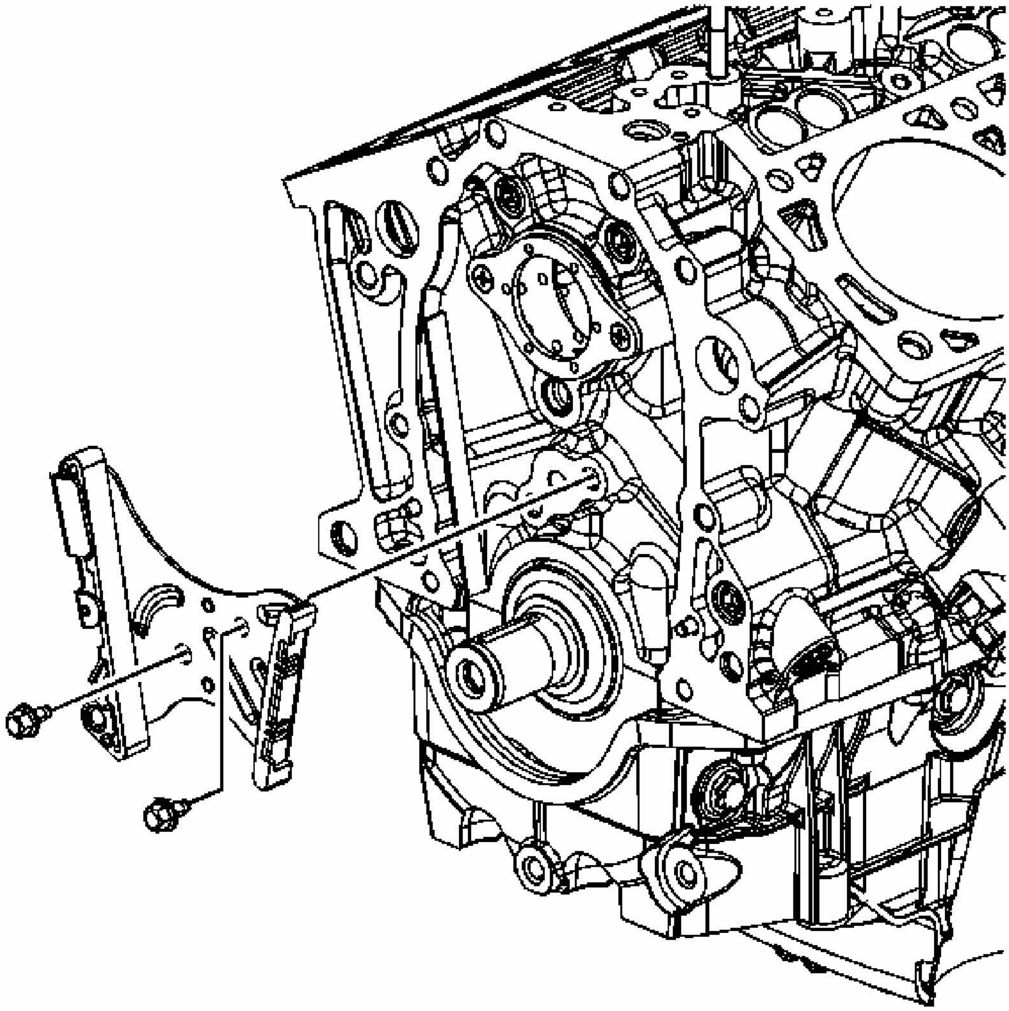


Fig. 298: View Of Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the timing chain tensioner bolts.
4. Remove the timing chain tensioner.

CAMSHAFT REMOVAL

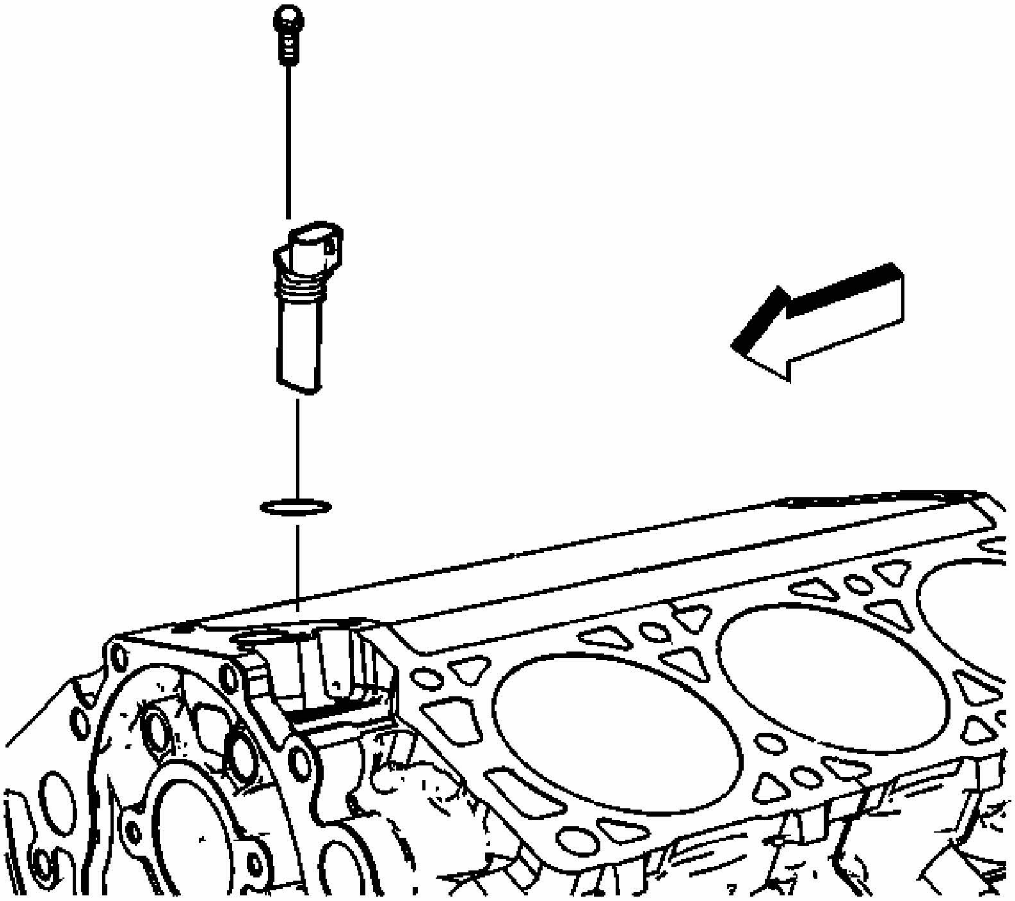


Fig. 299: View Of Camshaft Position Sensor
Courtesy of GENERAL MOTORS CORP.

1. Remove the camshaft position sensor bolt.
2. Remove the camshaft position sensor.

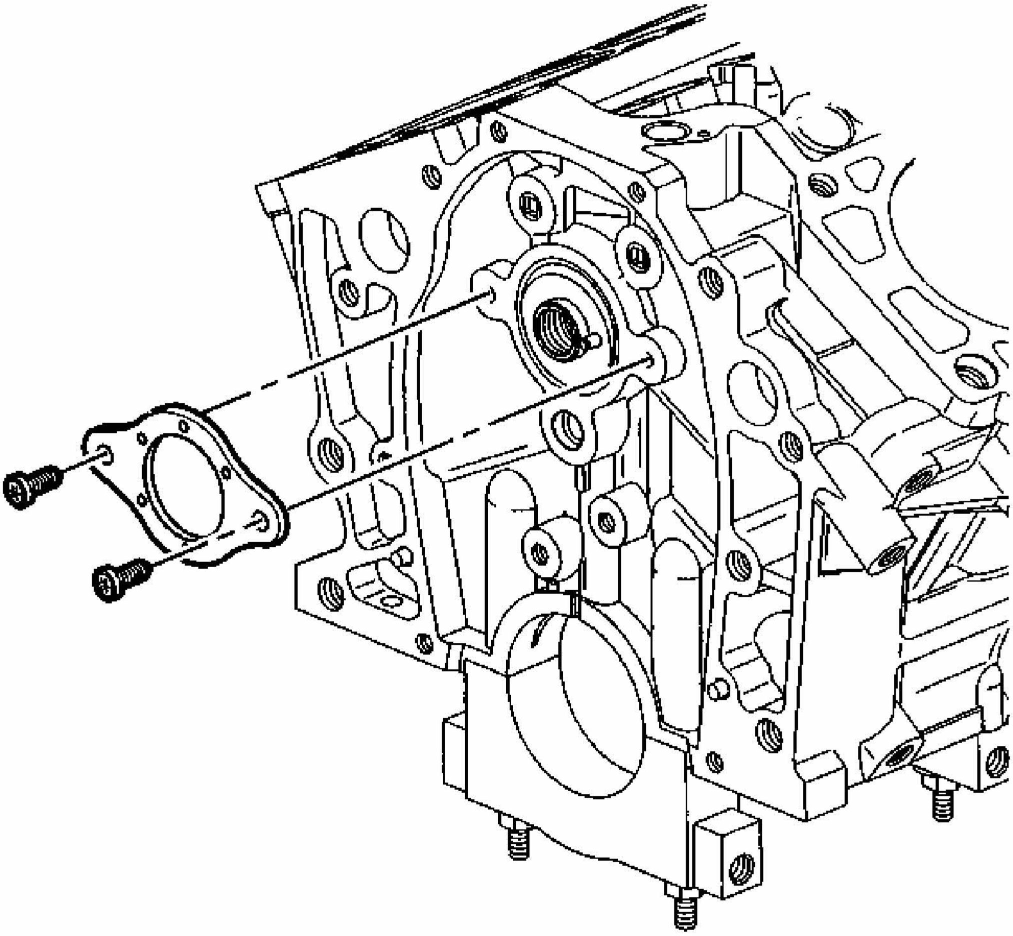


Fig. 300: View Of Camshaft Thrust Plate
Courtesy of GENERAL MOTORS CORP.

3. Remove the camshaft thrust plate screws.
4. Remove the camshaft thrust plate.

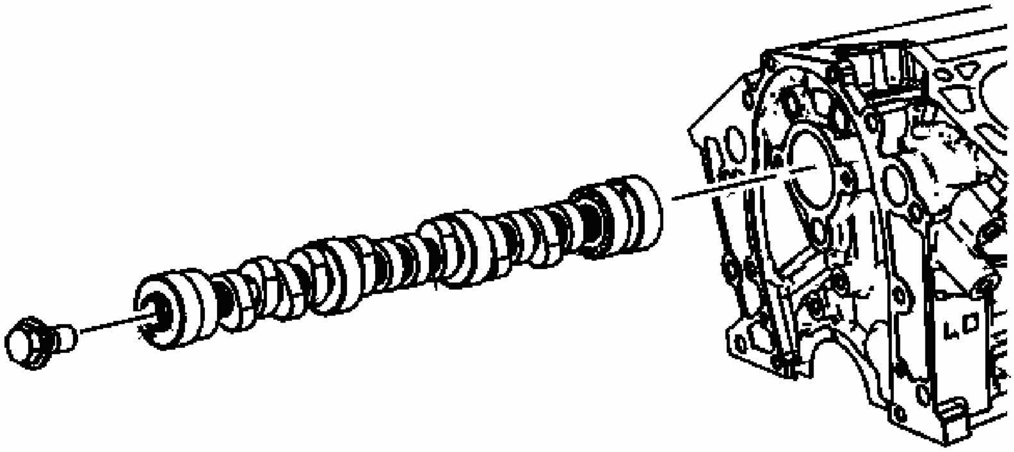


Fig. 301: Inspecting Camshaft Journals
Courtesy of GENERAL MOTORS CORP.

NOTE: All camshaft journals are the same diameter, so care must be used in removing or installing the camshaft to avoid damage to the camshaft bearings.

5. Complete the following steps in order to remove the camshaft.
    1. Install the camshaft sprocket bolt into the camshaft. Tighten finger tight only.
    2. Carefully rotate and remove the camshaft from the engine block.

PISTON, CONNECTING ROD, AND BEARING REMOVAL

Tools Required

- **J 24270** Cylinder Bore Ridge Reamer. See Special Tools.
- **J 41556** Connecting Rod Guide. See Special Tools.

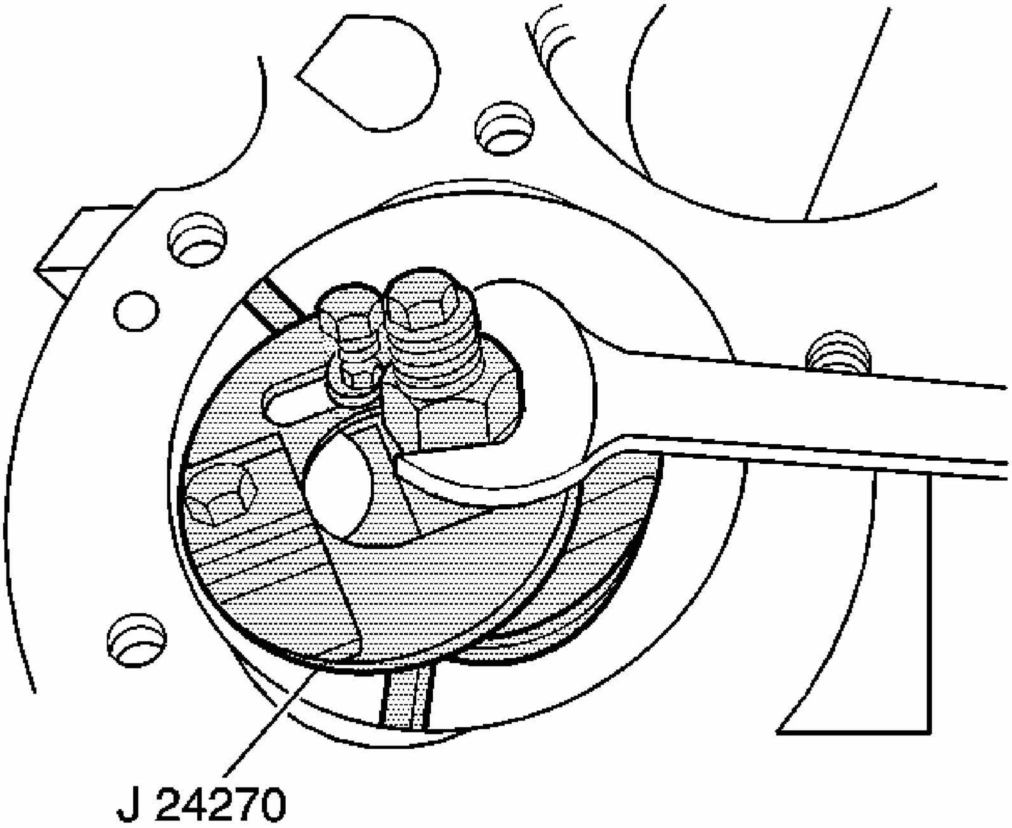


Fig. 302: Removing Cylinder Bore Ring Ridge
Courtesy of GENERAL MOTORS CORP.

1. Mark the piston with the number of the cylinder from which the piston is being removed.
2. Mark the connecting rod and the connecting rod cap in order to ensure correct assembly.

NOTE: **If there is a pronounced ridge at the top of the piston travel, the ridge must be removed with a ridge reamer before the piston and connecting rod assembly are removed. Applying force may break the piston rings or damage the piston.**

3. Use the **J 24270** in order to remove the cylinder bore ring ridge. See **Special Tools**. Complete the following steps:
    1. Turn the crankshaft until the piston is at the bottom of the stroke.
    2. Cover the piston with a cloth.

3. Remove the cylinder ring ridge.
4. Turn the crankshaft until the piston is at the top of the stroke.
5. Remove the cloth.
6. Remove the metal shavings from the cylinder and piston.

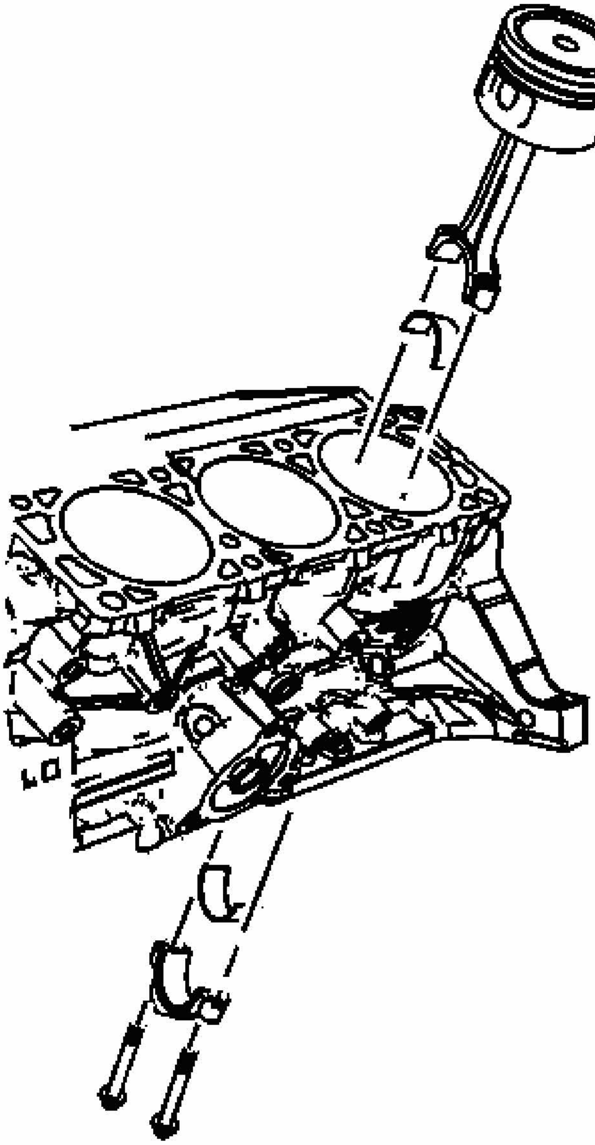


Fig. 303: View Of Connecting Rod & Piston Assembly
Courtesy of GENERAL MOTORS CORP.

4. Remove the connecting rod bolts.
5. Remove the connecting rod cap.
6. Remove the connecting rod bearing half.
7. Install **J 41556** into the connecting rod. See **Special Tools**.
8. Remove the connecting rod and piston assembly from the engine with a suitable tool.

CRANKSHAFT REAR OIL SEAL REMOVAL

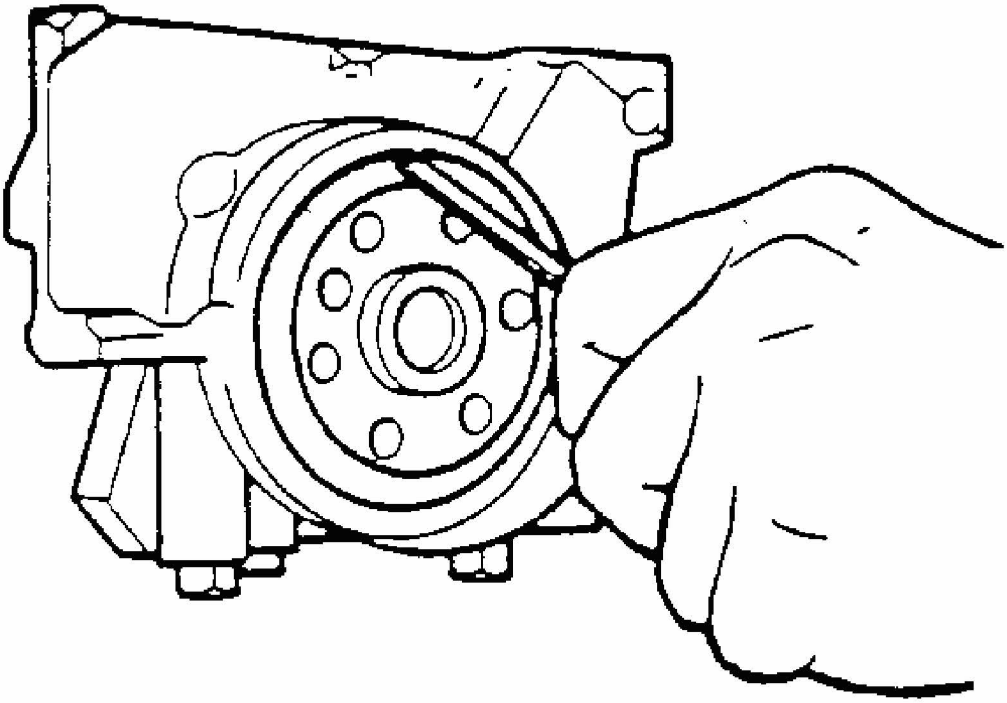


Fig. 304: Removing Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the crankshaft rear oil seal.

IMPORTANT: Do not damage the crankshaft or seal bore.

2. Pry out the crankshaft rear oil seal out using a suitable tool.

CRANKSHAFT AND BEARINGS REMOVAL

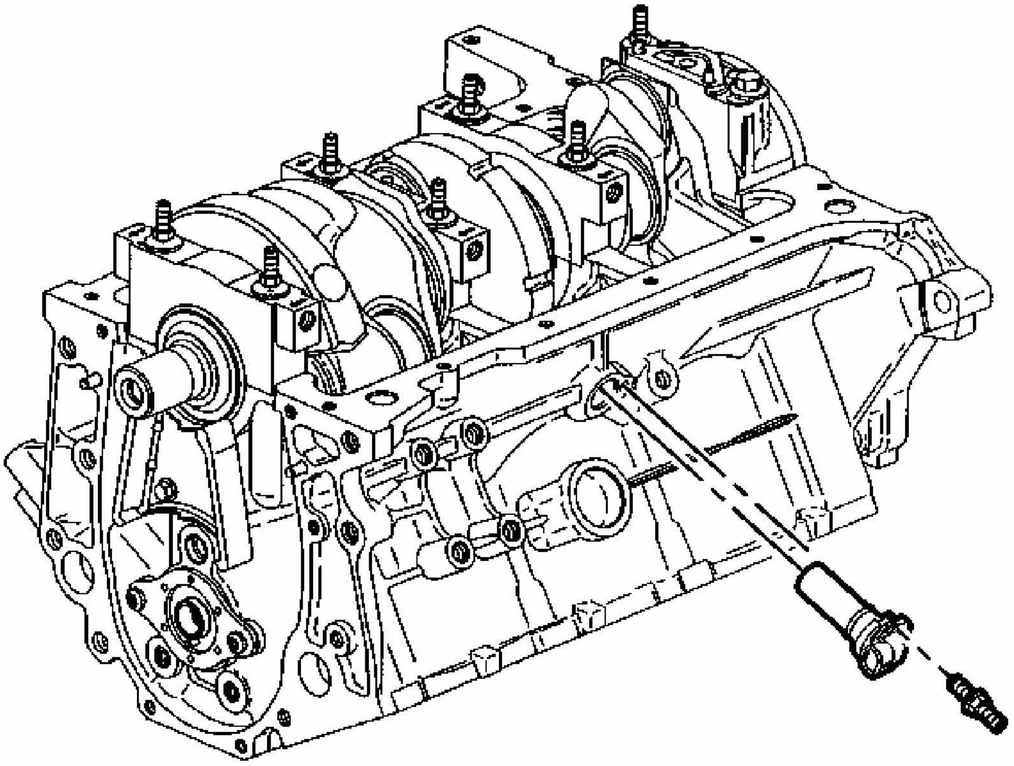


Fig. 305: View Of Crankshaft Position Sensor & Stud
Courtesy of GENERAL MOTORS CORP.

1. Remove the crankshaft position sensor heat shield nut and heat shield.
2. Remove the crankshaft position sensor stud.
3. Remove the crankshaft position sensor from the side of the block.

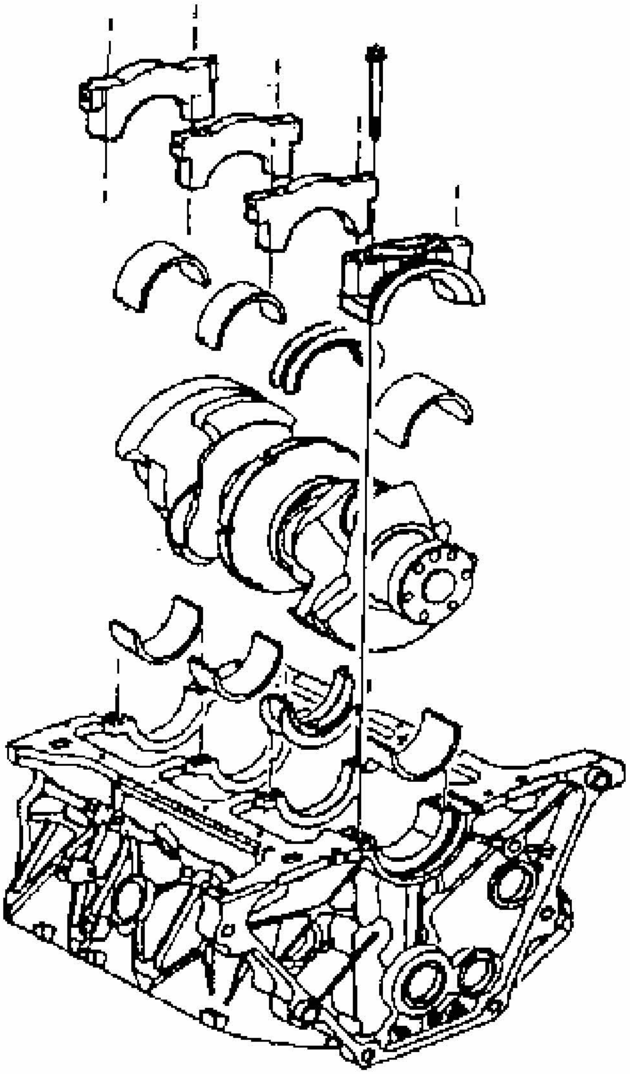


Fig. 306: View Of Crankshaft, Main Bearings And Bearing Caps
Courtesy of GENERAL MOTORS CORP.

4. Remove the crankshaft main bearing cap bolt and studs.
5. Remove the crankshaft main bearing caps and lower crankshaft main bearing halves.

IMPORTANT: Use Care when handling the crankshaft. Avoid damage to the crankshaft position sensor reluctor wheel teeth. Nicks, burrs or other damage to the teeth may effect On-board Diagnostics (OBD) II system performance.

6. Remove the crankshaft.
7. Remove the upper crankshaft main bearing halves.

PISTON OIL NOZZLE REMOVAL

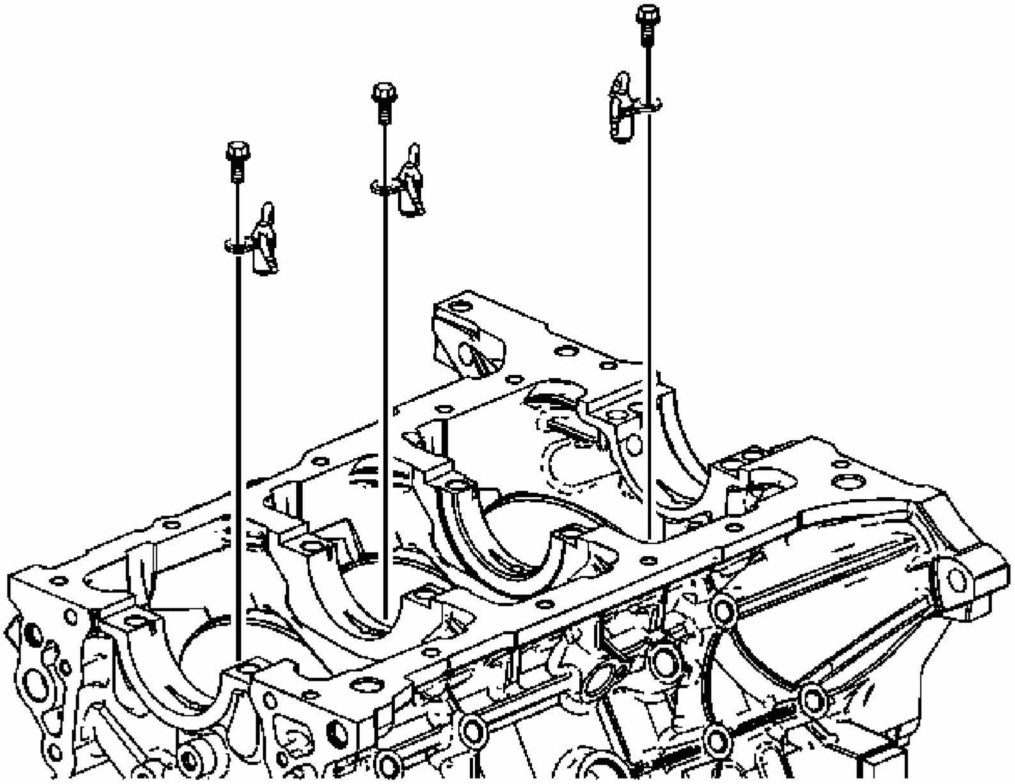


Fig. 307: Identifying Piston Oil Nozzles & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the bolts retaining the piston oil nozzles to the engine block.
2. Remove the piston oil nozzles.

CAMSHAFT BEARING REMOVAL

Tools Required

J 33049 Camshaft Bearing Service Set. See **Special Tools**.

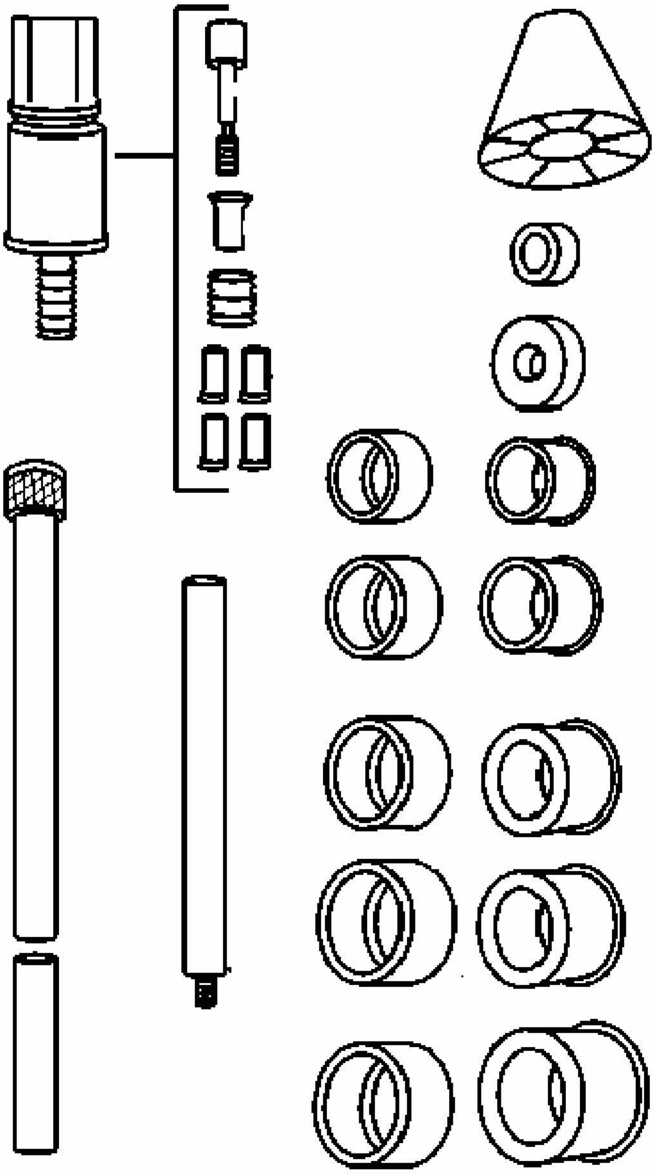


Fig. 308: Camshaft Bearing Service Set
Courtesy of GENERAL MOTORS CORP.

1. Select the expander assembly and driving washer.
2. Assemble the **J 33049** . See **Special Tools**.

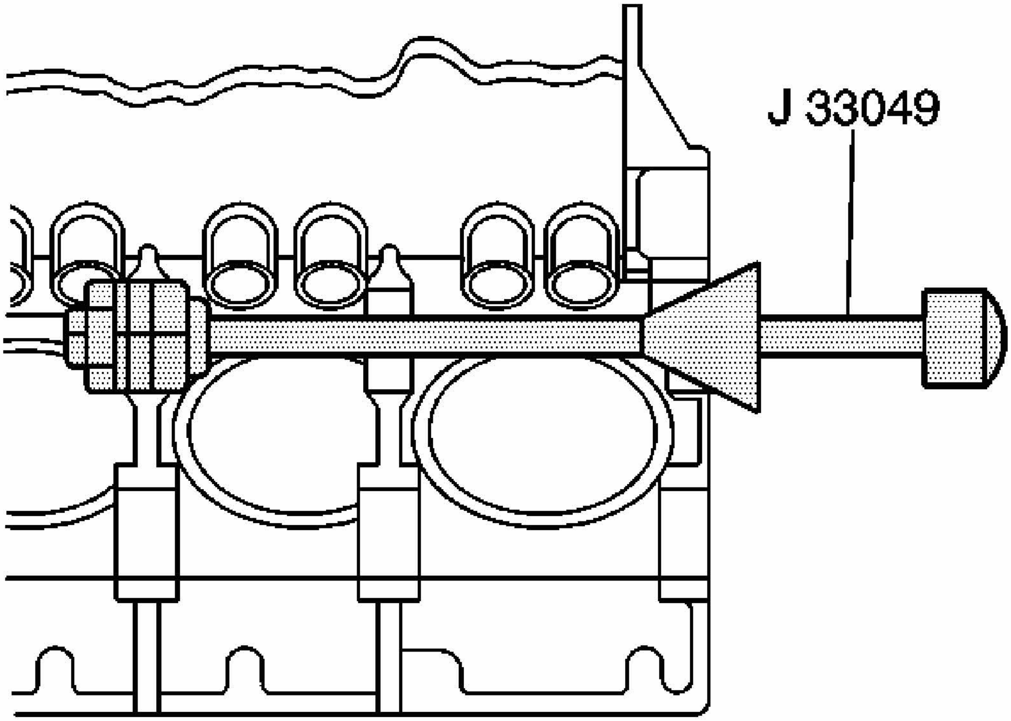


Fig. 309: Removing/Installation Camshaft Inner Bearing Using J 33049
Courtesy of GENERAL MOTORS CORP.

3. Drive out the camshaft bearings. Use the **J 33049** . See **Special Tools**.

ENGINE BLOCK DISASSEMBLE

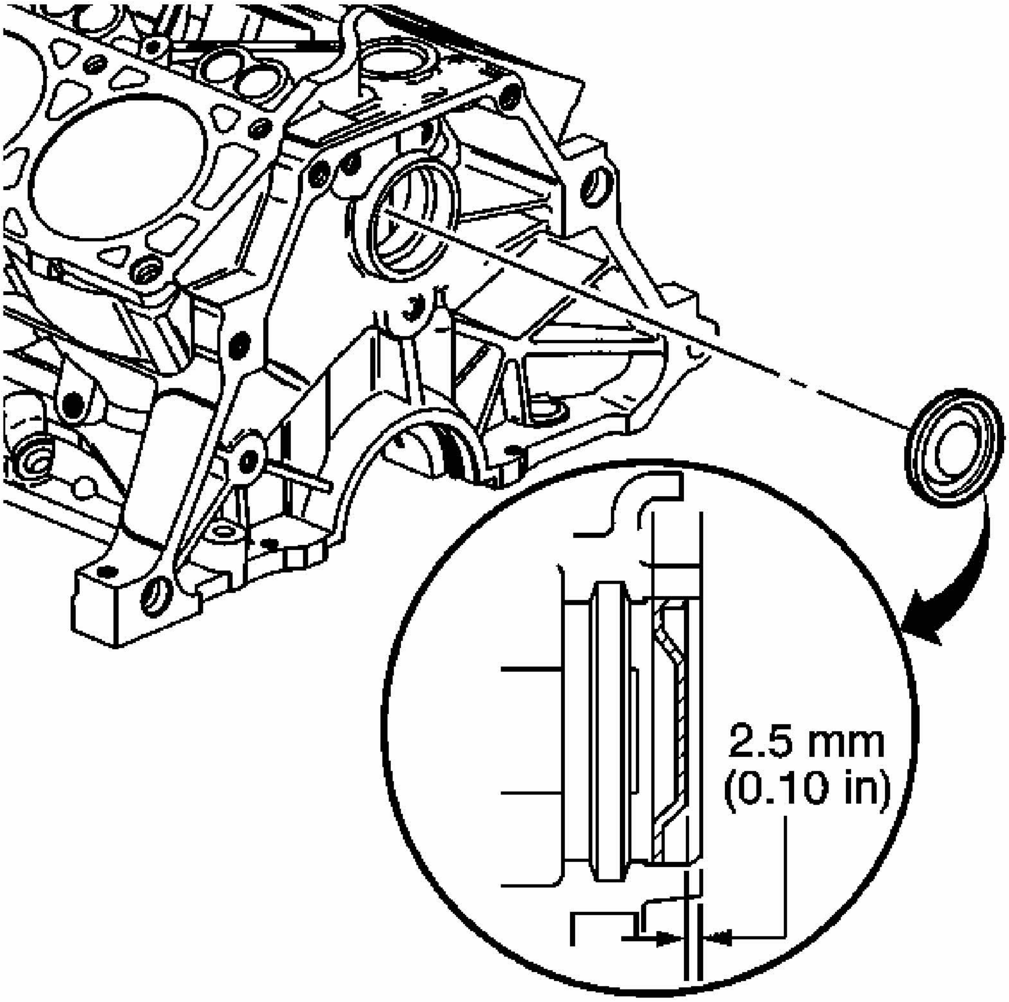


Fig. 310: Identifying Camshaft Rear Bearing Hole Plug Installation Depth
Courtesy of GENERAL MOTORS CORP.

NOTE: **Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.**

1. Remove the camshaft rear bearing hole plug.

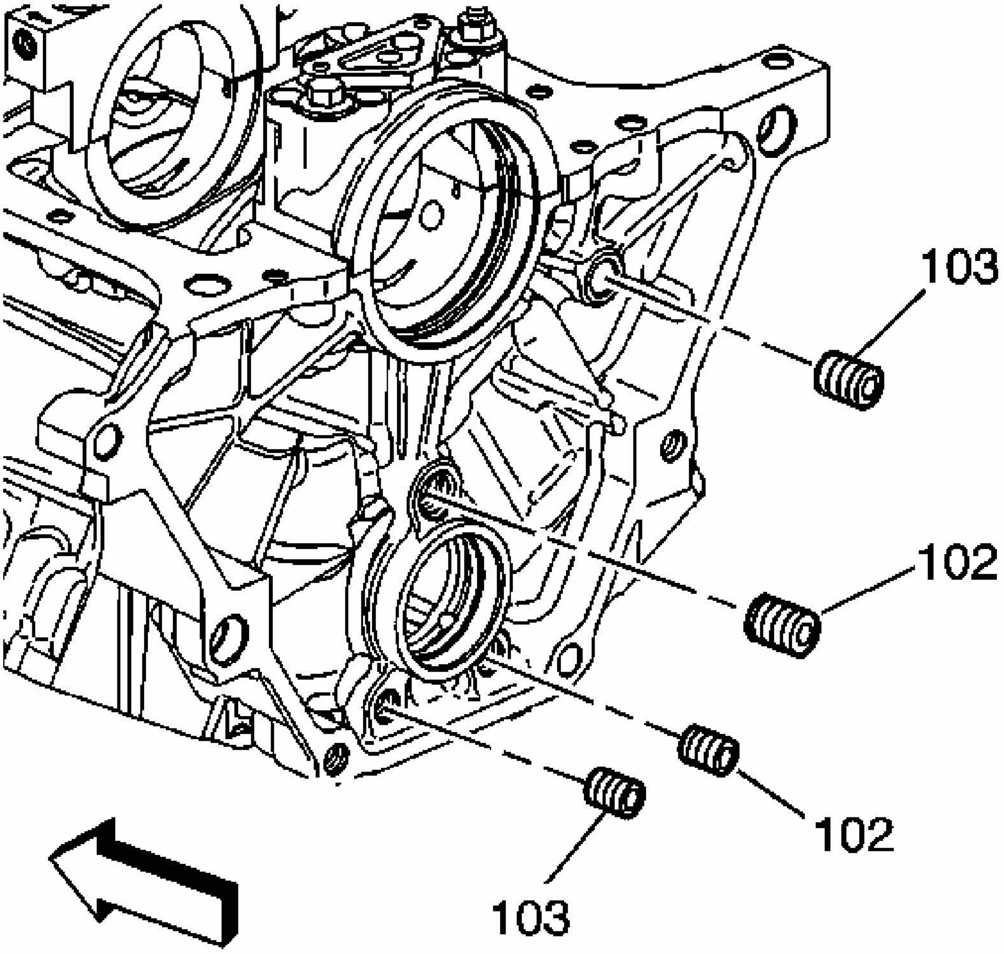


Fig. 311: View Of Rear Oil Gallery Plugs
Courtesy of GENERAL MOTORS CORP.

2. Remove the rear oil gallery plugs (102, 103).

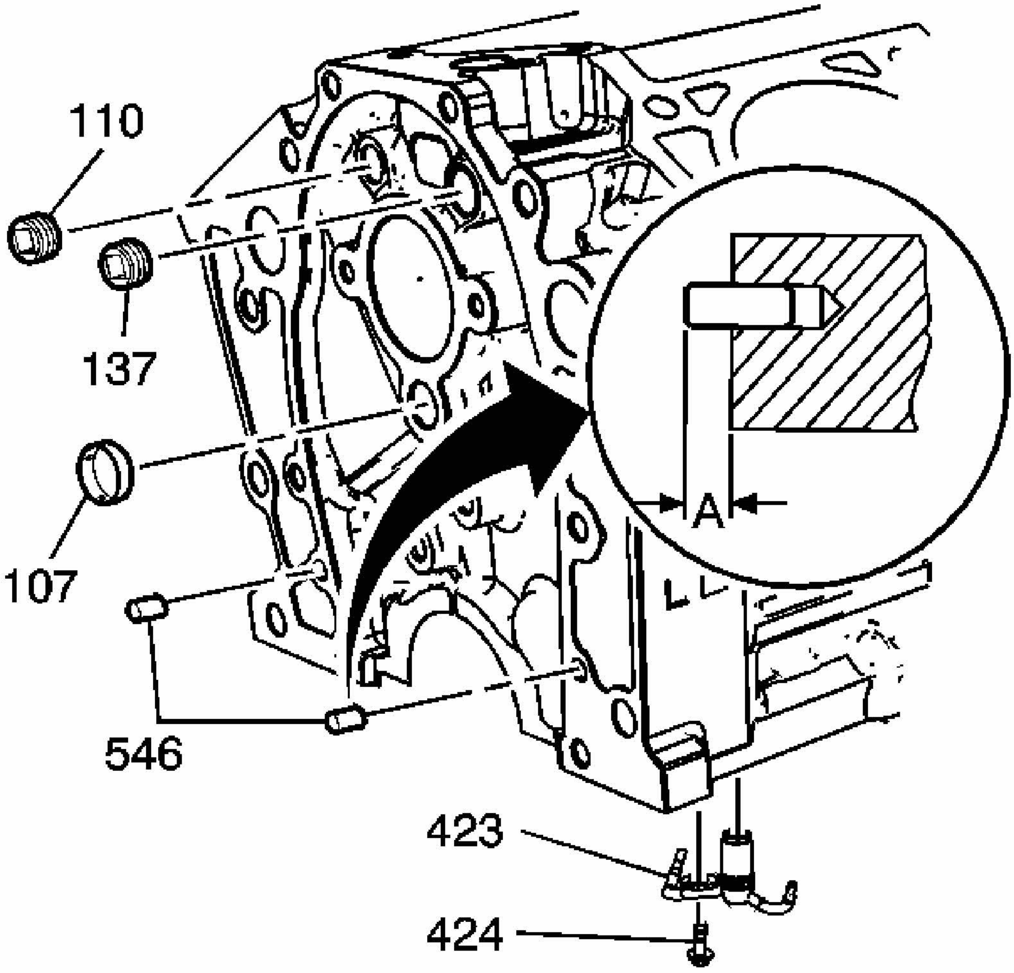


Fig. 312: View Of Front Oil Gallery Plugs (107, 110, 137)
Courtesy of GENERAL MOTORS CORP.

3. Remove the front oil gallery plugs (107, 110, 137).
4. Remove the engine front cover locating pins (546).

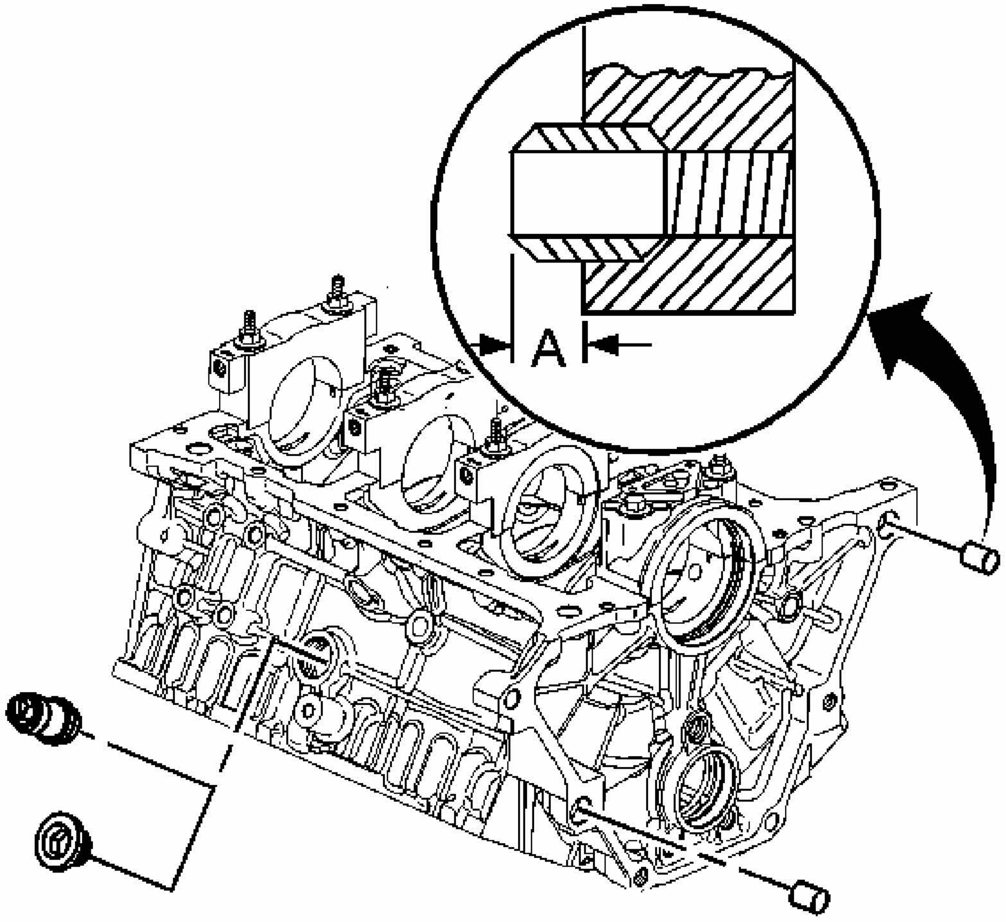


Fig. 313: View Of Engine Block Plug
Courtesy of GENERAL MOTORS CORP.

5. Remove the engine block plug.
6. Remove the transmission locating pins.

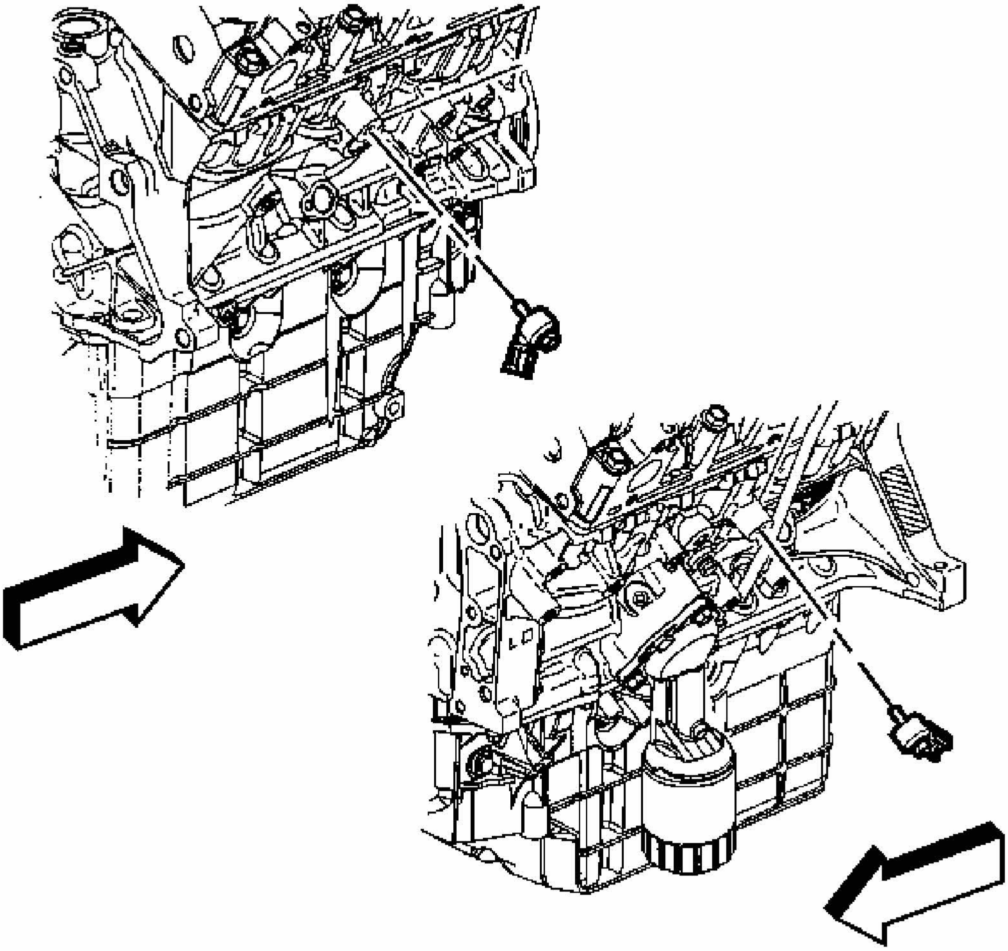


Fig. 314: View Of Knock Sensors
Courtesy of GENERAL MOTORS CORP.

7. Remove the knock sensors.

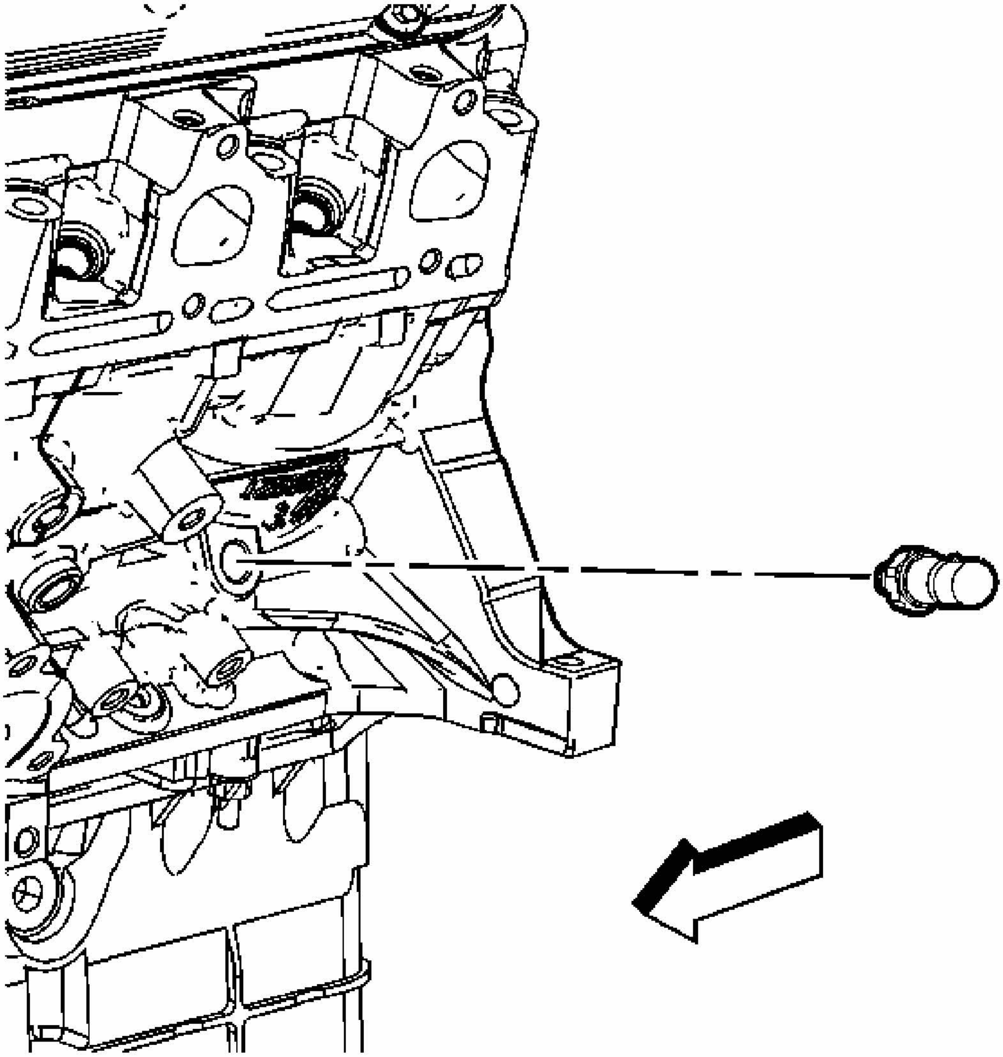


Fig. 315: Locating Engine Oil Pressure Indicator Switch
Courtesy of GENERAL MOTORS CORP.

8. Remove the engine oil pressure indicator switch.

ENGINE BLOCK HEATER REMOVAL

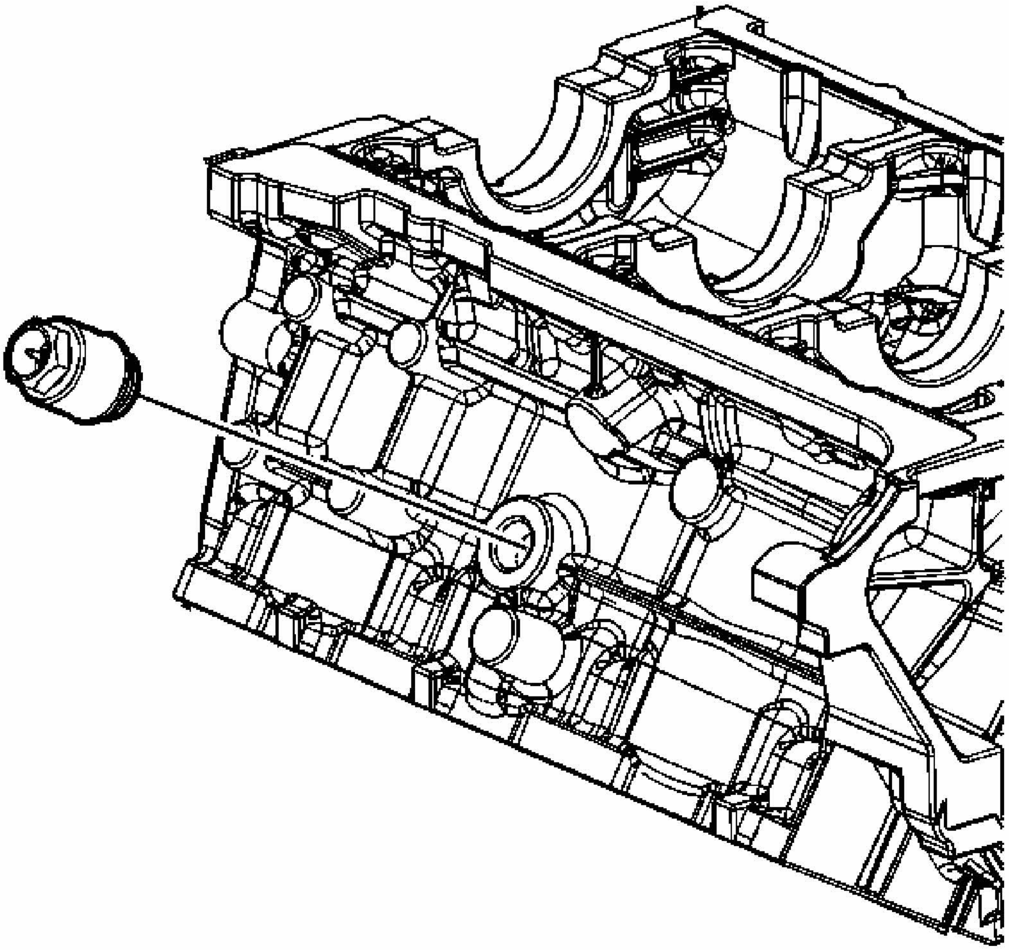


Fig. 316: View Of Engine Block Heater
Courtesy of GENERAL MOTORS CORP.

Remove the engine block heater from engine block.

ENGINE BLOCK CLEANING AND INSPECTION

Tools Required

- **J 8001** Dial Indicator Set. See **Special Tools**.
- **J 8087** Cylinder Bore Gage

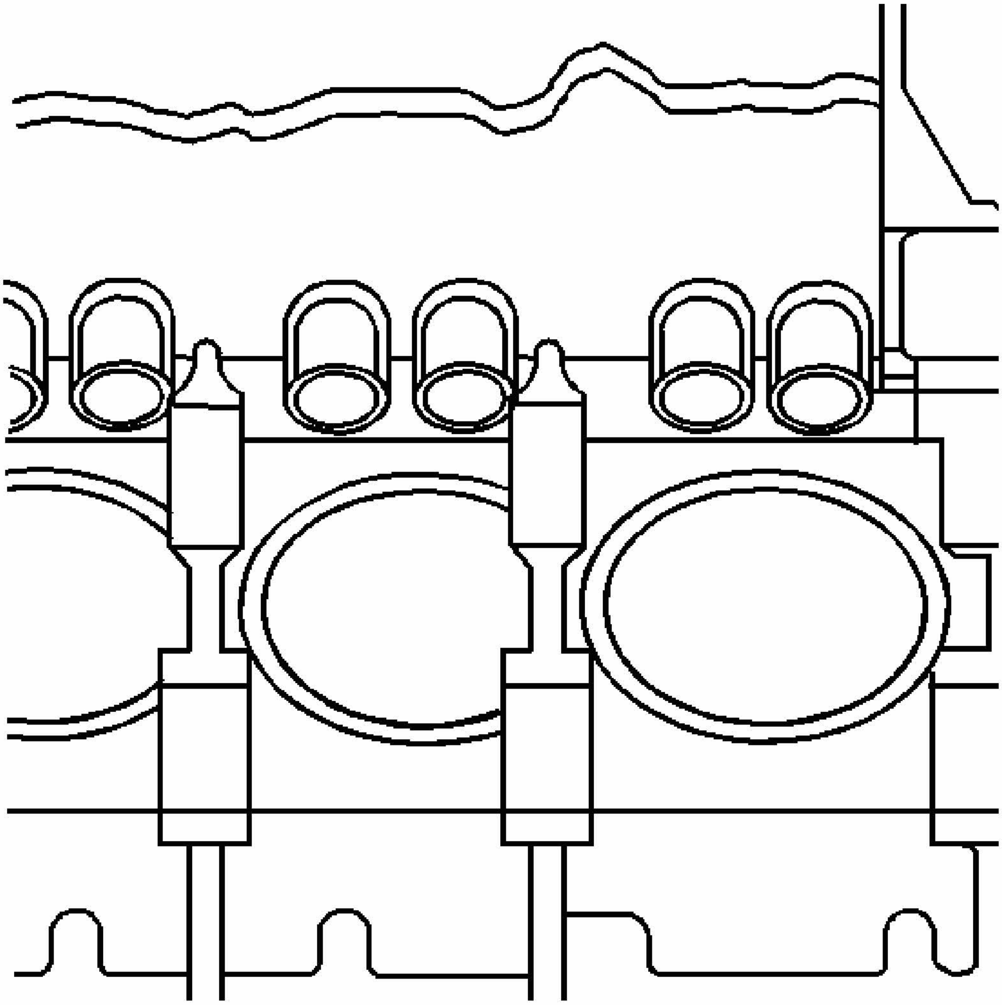


Fig. 317: View Of Gasket Mating Surfaces
Courtesy of GENERAL MOTORS CORP.

1. Clean the sealing material from the gasket mating surfaces.
2. Boil the engine block in caustic solution.
3. Flush the engine block with clean water or steam.
4. Clean the oil passages.
5. Clean the blind holes.
6. Spray the cylinder bores and the machined surfaces with engine oil.
7. Inspect the threaded holes.
8. Clean the holes with a tap. Drill out the holes and install thread inserts, as needed.

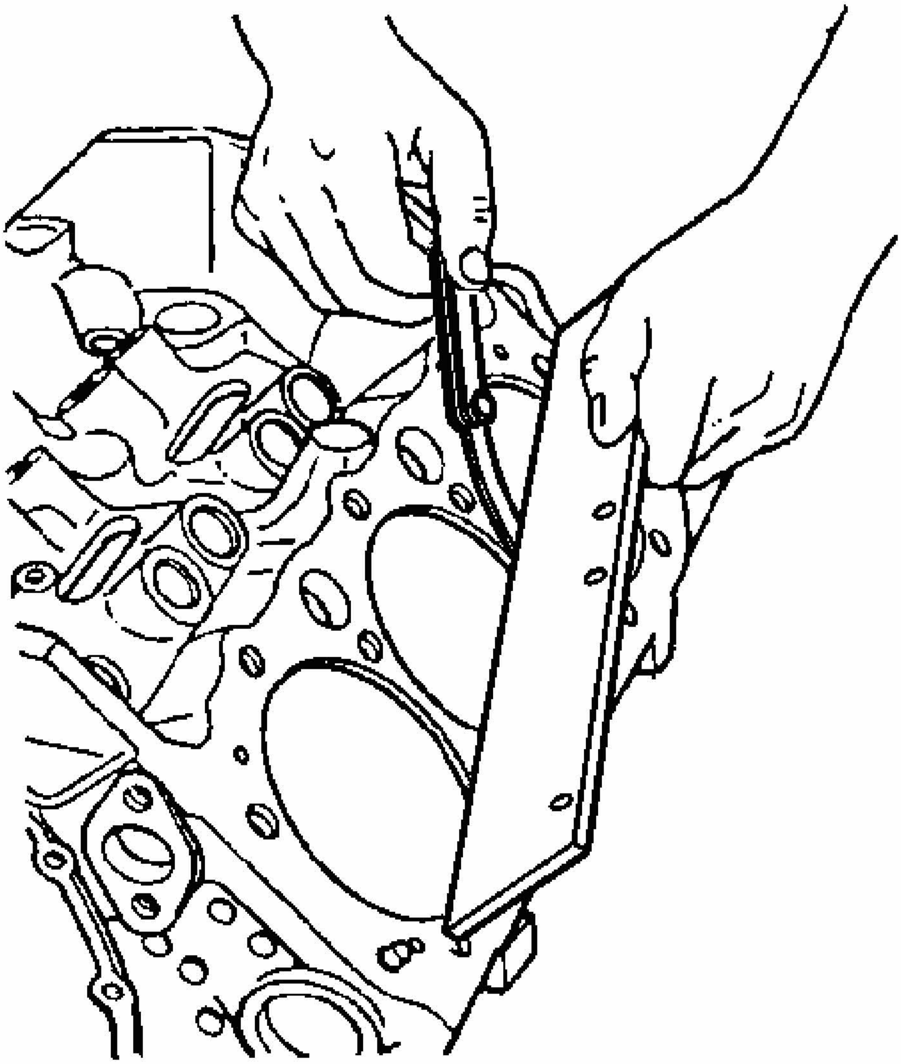


Fig. 318: Testing Block Deck Surface For Flatness
Courtesy of GENERAL MOTORS CORP.

9. Use a straight edge and a feeler gauge in order to test the deck surface for flatness. Replace the block if it is outside of the specification limit.
10. Inspect the oil pan rail for nicks.

    Inspect the front cover attaching area for nicks.

    Use a flat mill file in order to remove any nicks.

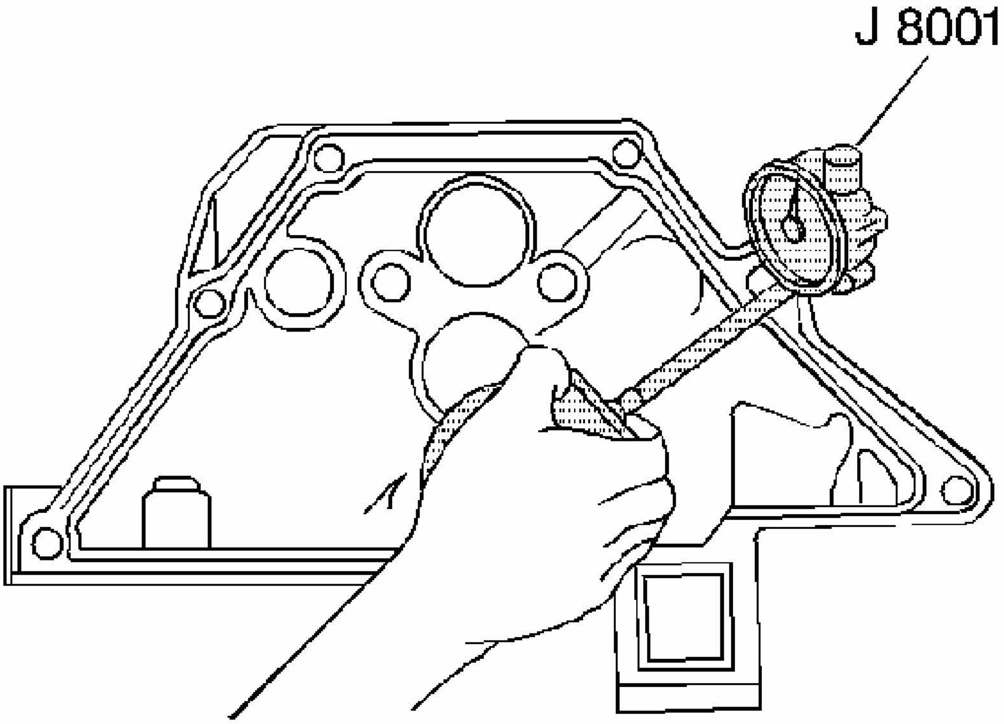


Fig. 319: Inspect Mating Surfaces Of Transmission Case
Courtesy of GENERAL MOTORS CORP.

11. Inspect the mating surfaces of the transmission case.

    NOTE: A broken flywheel may result if the transmission case mating surface is not flat.

12. Use the following procedure in order to measure the engine block flange runout at the 6 mounting bolt hole bosses:
    1. Temporarily install the crankshaft. Measure the crankshaft flange runout.
    2. Hold the **J 8001** gage plate flat against the crankshaft flange. See **Special Tools**.
    3. Place the dial indicator stem on the transmission mounting bolt hole boss. Set the indicator to 0.
    4. Record the readings obtained from all of the bolt hole bosses. The measurements should not vary more than 0.25 mm (0.010 in).
    5. Retest the crankshaft flange runout if the readings vary more than 0.25 mm (0.010 in). If the crankshaft flange runout is not within the specification, replace the engine block.

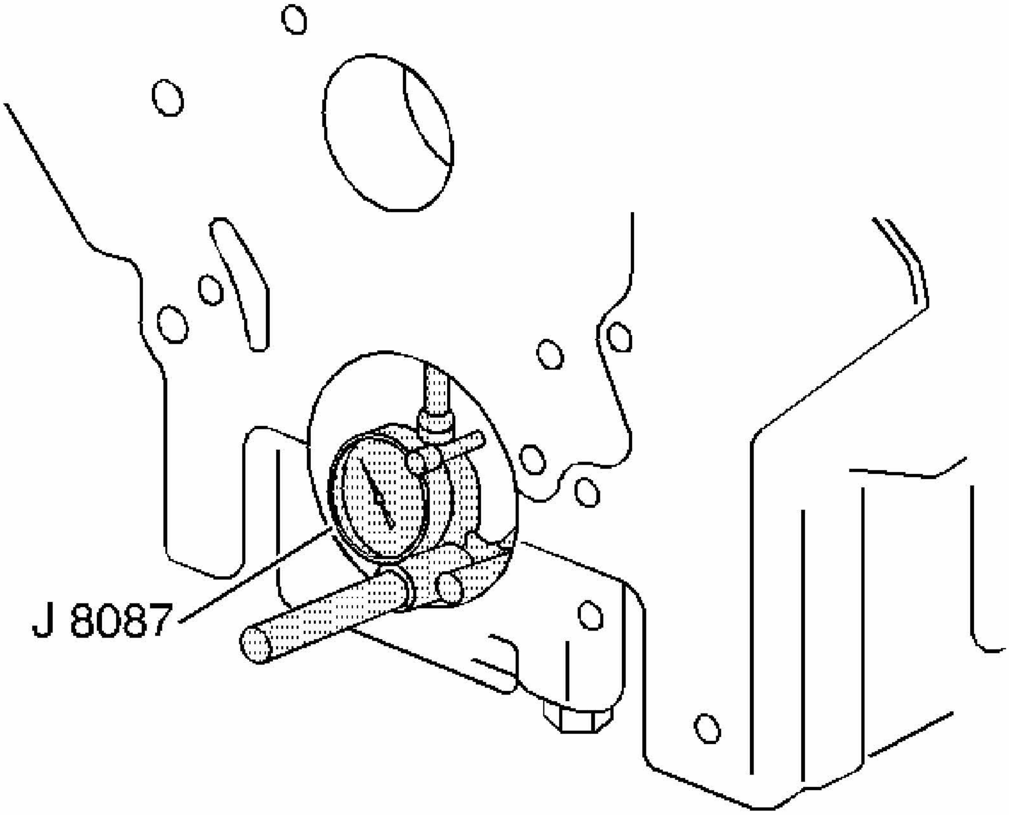


Fig. 320: Inspecting Crankshaft Main Bearing Bores
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Perform the following inspections, and reconditioning if necessary, with the crankshaft main bearing caps installed and tightened to specification.

13. Inspect the crankshaft main bearing bores. Use the **J 8087** in order to measure the bearing bore concentricity and alignment at the following locations:
    - The camshaft
    - The crankshaft
14. Replace the engine block if the bores are out of specification.

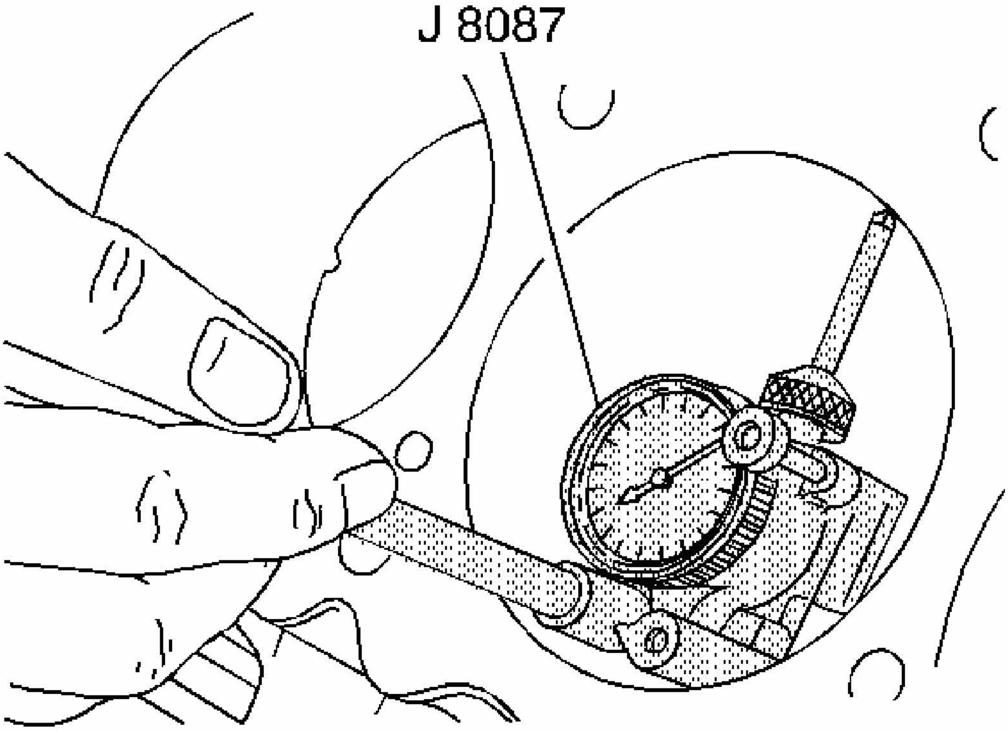


Fig. 321: Inspecting Cylinder Bores Using J 8087
Courtesy of GENERAL MOTORS CORP.

15. Use the **J 8087** in order to inspect the cylinder bores. Inspect the bores for the following conditions:
    - Wear
    - Taper
    - Runout
    - Ridging

IMPORTANT: If the bore is worn beyond the limits, refit the bore with 0.5 mm (0.02 in) oversized pistons.

16. Leave sufficient material in order to allow honing when fitting the piston.

CYLINDER BORING AND HONING

Boring Procedure

1. Before honing or boring, measure all of the new pistons. Select the smallest piston for

the piston fitting. Slightly varied pistons in a set may provide correction, if the first piston is too loosely fitted.

2. Before using any type of boring bar, file the top of the engine block to remove any dirt or burrs. If the cylinder block is not straight, the boring bar may be tilted, causing the bored cylinder wall to have incorrect right angles to the crankshaft.
3. Carefully follow the instructions furnished by the manufacturer regarding use of equipment.
4. Install all crankshaft main bearing caps to specification when boring cylinders. Cover or tape the crankshaft bearings and other internal parts to protect these parts during the boring or honing operation.
5. Leave 0.03 mm (0.001 in) on the diameter for finish honing when performing the final cut with a boring bar. Carefully perform the honing and boring operation to maintain the specified clearances between pistons, rings, and cylinder bores.

Honing Procedure

1. Follow the manufacturer's recommendations for use, cleaning, and lubrication when honing the cylinders. Use only clean, sharp stones of the proper grade for the amount of material to be removed. Dull, dirty stones cut unevenly and generate excessive heat. When using coarse or medium-grade stones, leave sufficient metal so all stone marks may be removed with the fine stones used for finishing to provide the proper clearance.
2. During the honing operation, thoroughly clean the cylinder bore. Check for the correct piston fit.

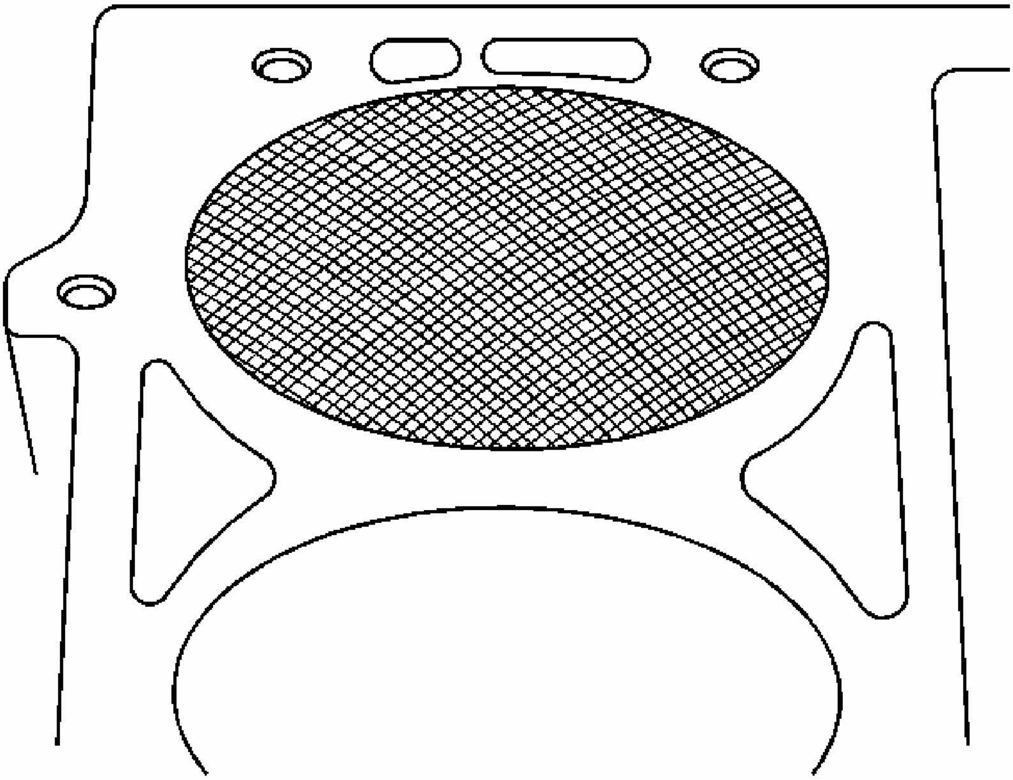


Fig. 322: Identifying Cylinder Bore Cross Hatch Pattern
Courtesy of GENERAL MOTORS CORP.

3. Make full strokes in the cylinder to eliminate taper. Repeatedly check the measurement at the top, the middle, and the bottom of the cylinder bore.

NOTE: Handle the pistons with care. Do not force the pistons through the cylinder until you hone the cylinder to the correct size. The piston can be distorted through careless handling.

4. When finish honing a cylinder bore to fit a piston, move the hone up and down at a sufficient speed to obtain a fine and uniform surface finish in a cross hatch pattern.
5. The finish marks should be clean but not sharp. The finish marks should be free from imbedded particles and torn or folded metal.
6. Determine the finish hone cylinder measurement by measuring the piston to be installed, and by adding the average of the clearance specification. Measure the block and the piston at normal room temperature.

7. True up the refinished cylinder bores. Final hone each cylinder bore to remove all stone or cutter marks.
8. After final honing and before the piston is checked for fit, clean the bores with hot water and detergent. Scrub the bores with a stiff bristle brush and rinse the bores thoroughly with hot water. Do not allow any abrasive material to remain in the cylinder bores. This abrasive material will wear the new rings, the cylinder bores, and the bearings lubricated by the contaminated oil. After washing dry the bore.
9. Permanently mark the piston for the cylinder to which the piston has been fitted.
10. Apply clean engine oil to each bore to prevent rusting.

ENGINE BLOCK ASSEMBLE

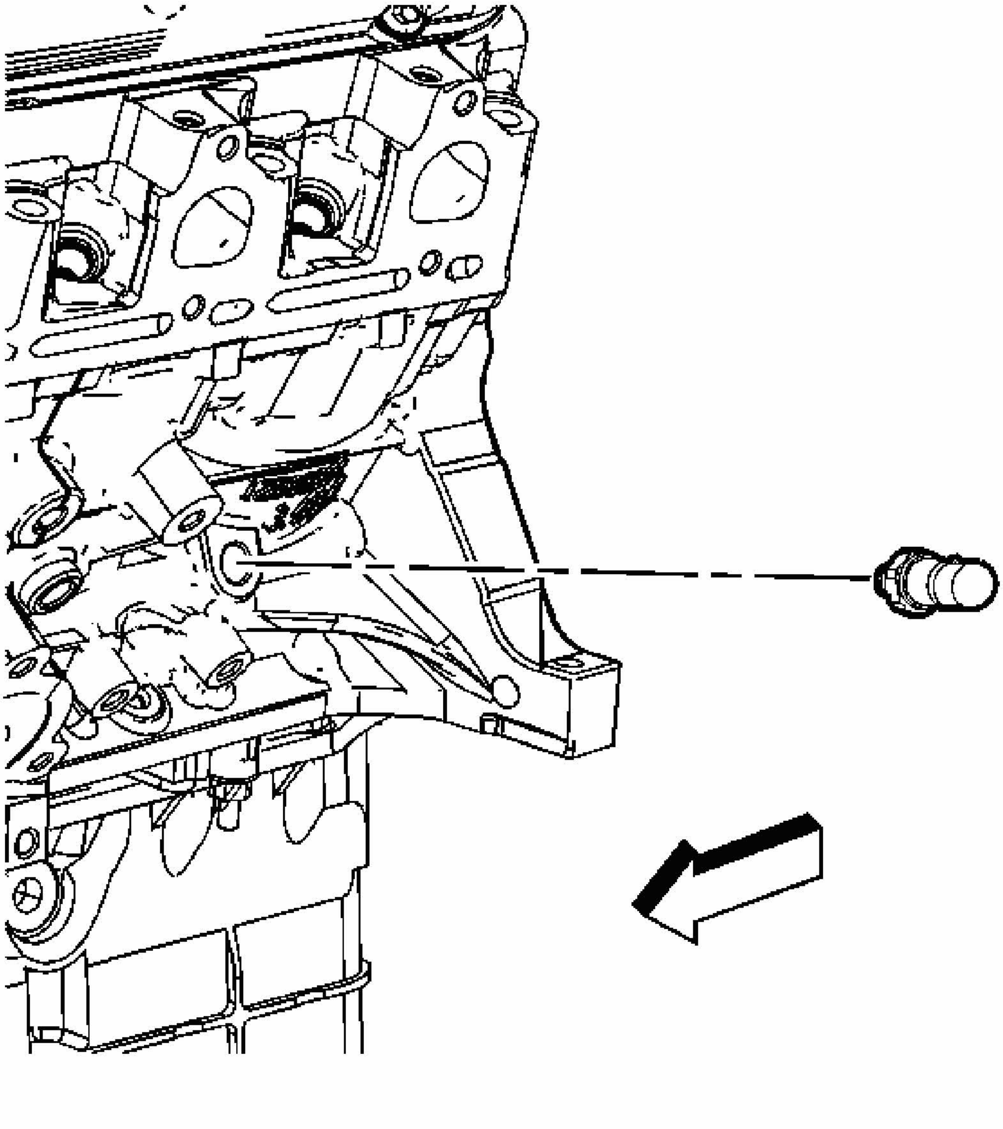


Fig. 323: Locating Engine Oil Pressure Indicator Switch
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the oil pressure switch threads.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the engine oil pressure switch.

Tighten: Tighten the engine oil pressure switch to 16 N.m (12 lb ft).

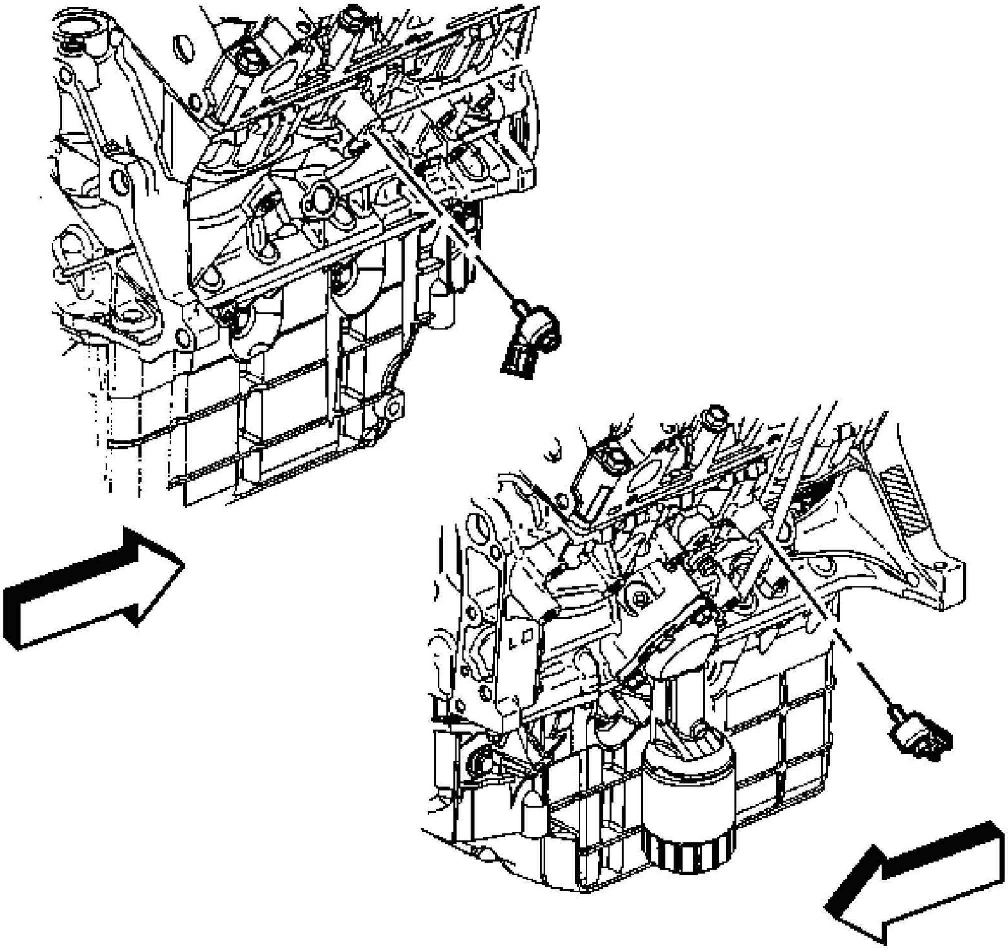


Fig. 324: View Of Knock Sensors
Courtesy of GENERAL MOTORS CORP.

3. Install the knock sensors.

   Tighten: Tighten the knock sensors to 25 N.m (18 lb ft).

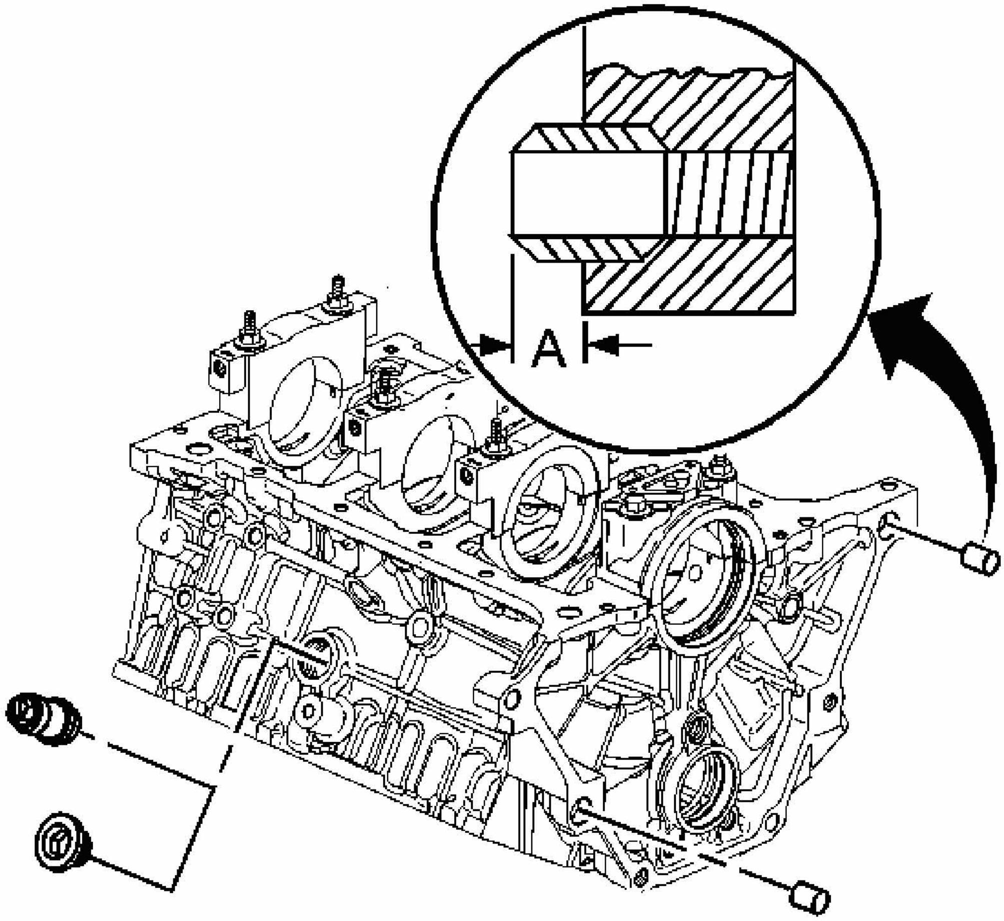


Fig. 325: View Of Engine Block Plug
Courtesy of GENERAL MOTORS CORP.

4. Apply sealer GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the engine block plug.
5. Install a NEW engine block plug.

   Tighten: Tighten the engine block plug to 60 N.m (44 lb ft).

6. Install the transmission locating pins. The installation height should be 8.3-9.3 mm (0.327-0.366 in) (A).

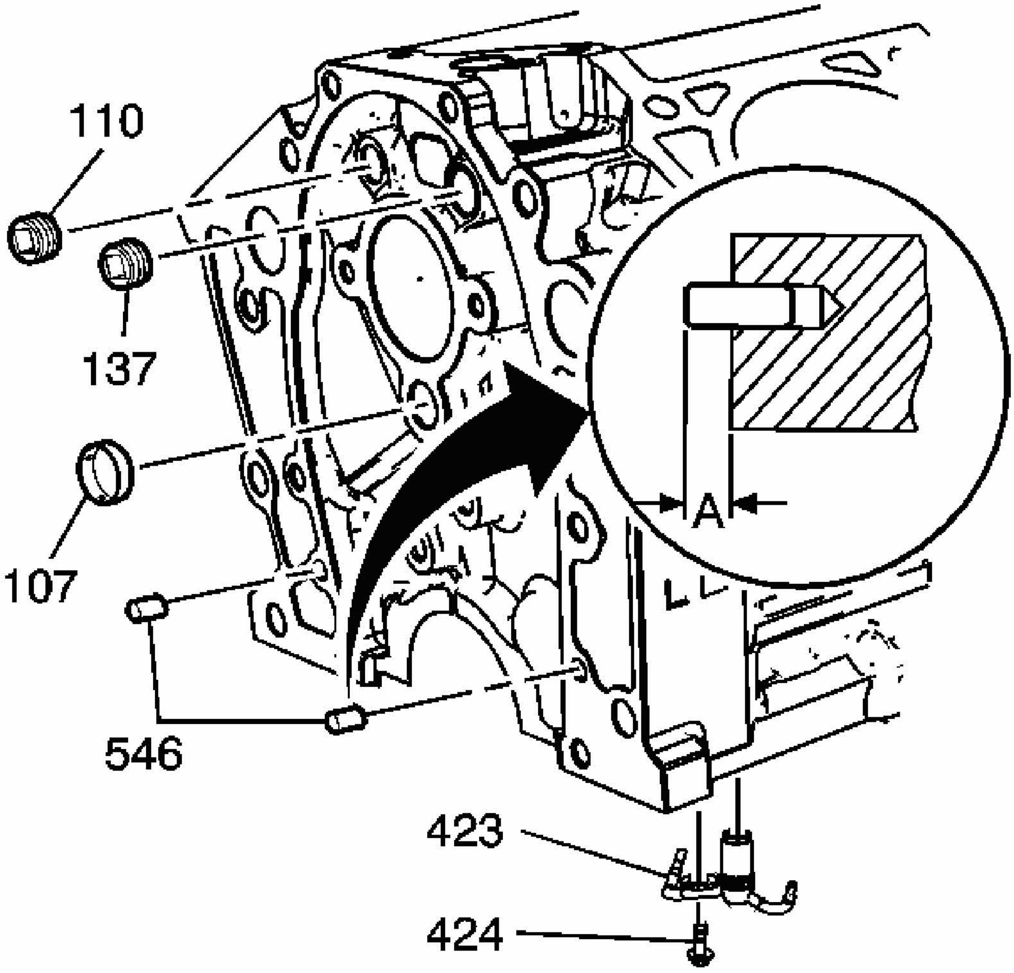


Fig. 326: View Of Front Oil Gallery Plugs (107, 110, 137)
Courtesy of GENERAL MOTORS CORP.

7. Apply sealer GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the front oil gallery plug threads (110, 137).
8. Install the front oil gallery plug (110).

   Tighten: Tighten the front oil gallery plug to 19 N.m (14 lb ft).

9. Install the front oil gallery plug (137).

   Tighten: Tighten the front oil gallery plug to 33 N.m (24 lb ft).

10. Apply sealer GM P/N 12377901 (Canadian P/N 10953504), or equivalent to the front oil gallery plug (107).

11. Install the front oil gallery plug (107) so that it is 1.5 mm (0.06 in) below flush of the engine block.
12. Install the engine front cover locating pins (546). The installation height should be 5.8-8.2 mm (0.228-0.323 in) (A).

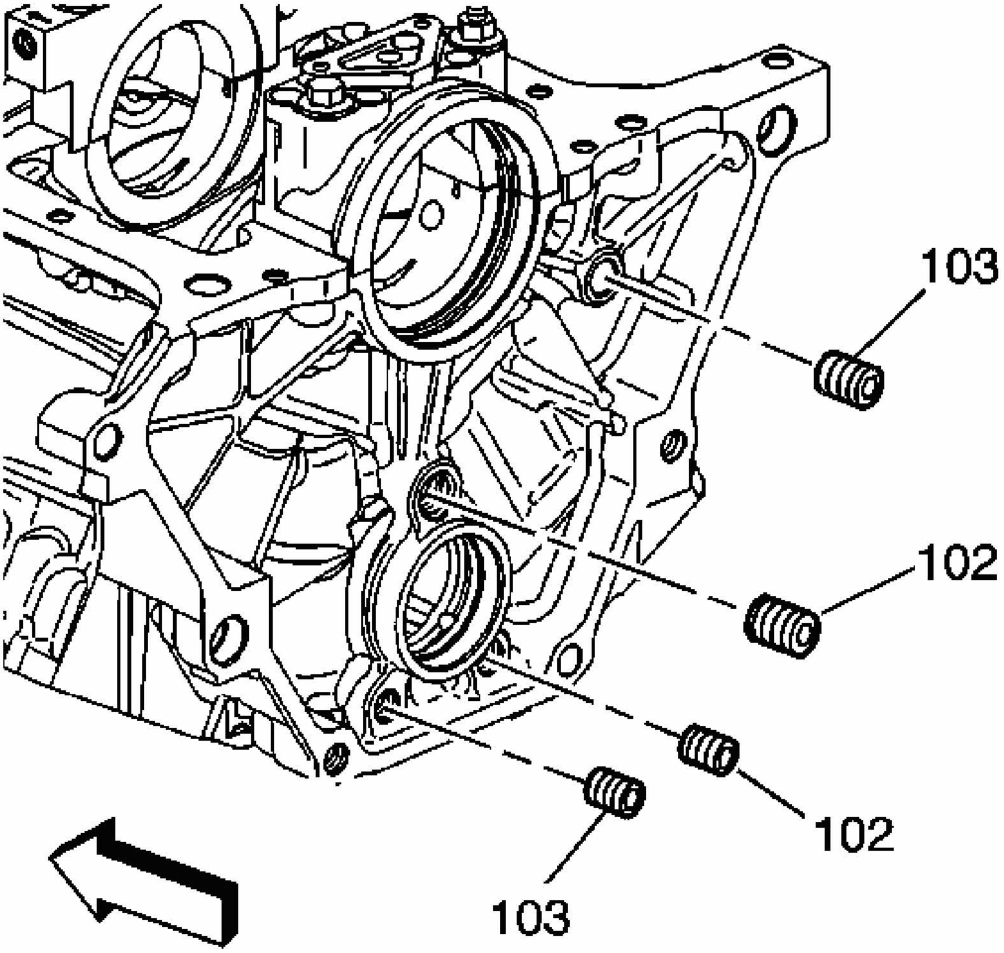


Fig. 327: View Of Rear Oil Gallery Plugs
Courtesy of GENERAL MOTORS CORP.

13. Apply Sealer GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the rear oil gallery plugs.
14. Install the rear oil gallery plugs (103).

    Tighten: Tighten the rear oil gallery plugs to 19 N.m (14 lb ft).

15. Install the rear oil gallery plugs (102).

    Tighten: Tighten the rear oil gallery plugs to 33 N.m (24 lb ft).

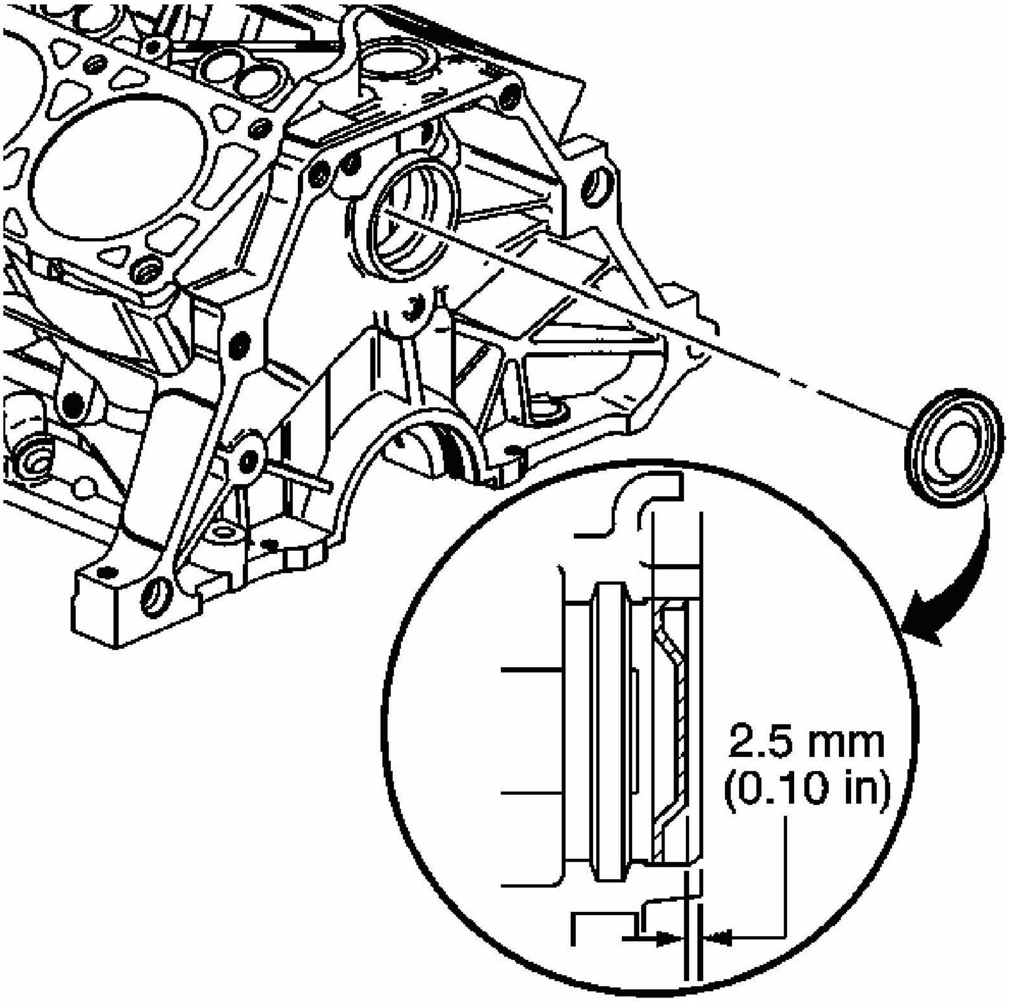


Fig. 328: Identifying Camshaft Rear Bearing Hole Plug Installation Depth
Courtesy of GENERAL MOTORS CORP.

16. Apply sealer GM P/N 12377901 (Canadian P/N 10953504), or equivalent to the camshaft rear bearing hole plug.
17. Install the camshaft rear bearing hole plug.

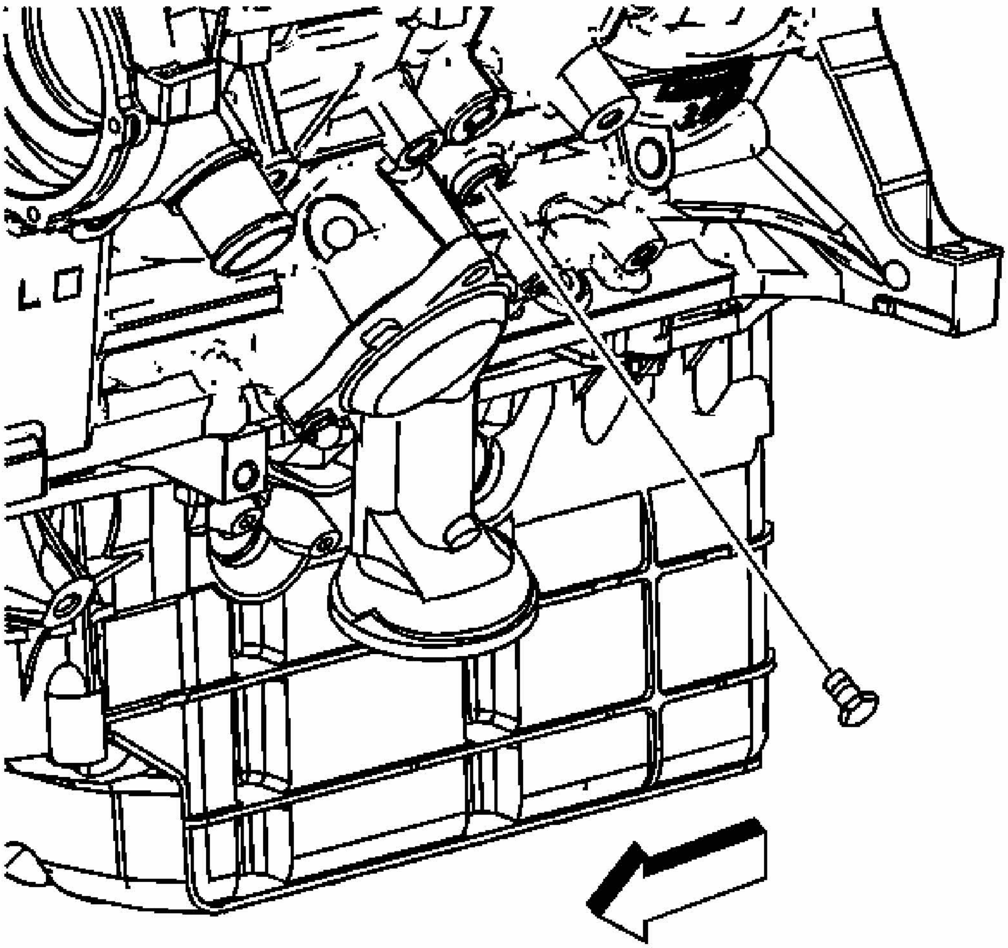


Fig. 329: View Of Left Coolant Drain Plug
Courtesy of GENERAL MOTORS CORP.

> **NOTE:** **Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.**

18. Apply sealer GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the left and right coolant drain plug threads.
19. Install the left coolant drain plug.

    Tighten: Tighten the left coolant drain plug to 19 N.m (14 lb ft).

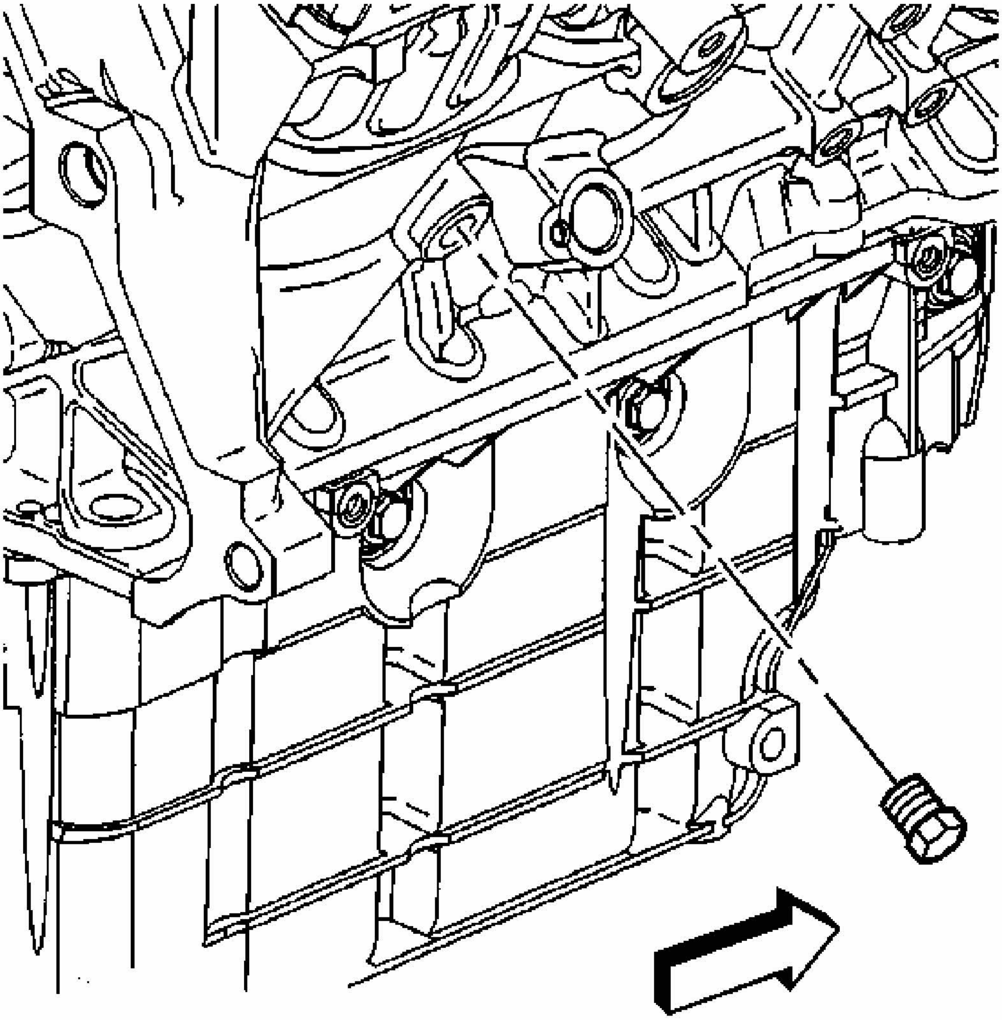


Fig. 330: View Of Right Coolant Drain Plug
Courtesy of GENERAL MOTORS CORP.

20. Install the right coolant drain plug.

    Tighten: Tighten the right coolant drain plug to 19 N.m (14 lb ft).

ENGINE BLOCK HEATER INSTALLATION

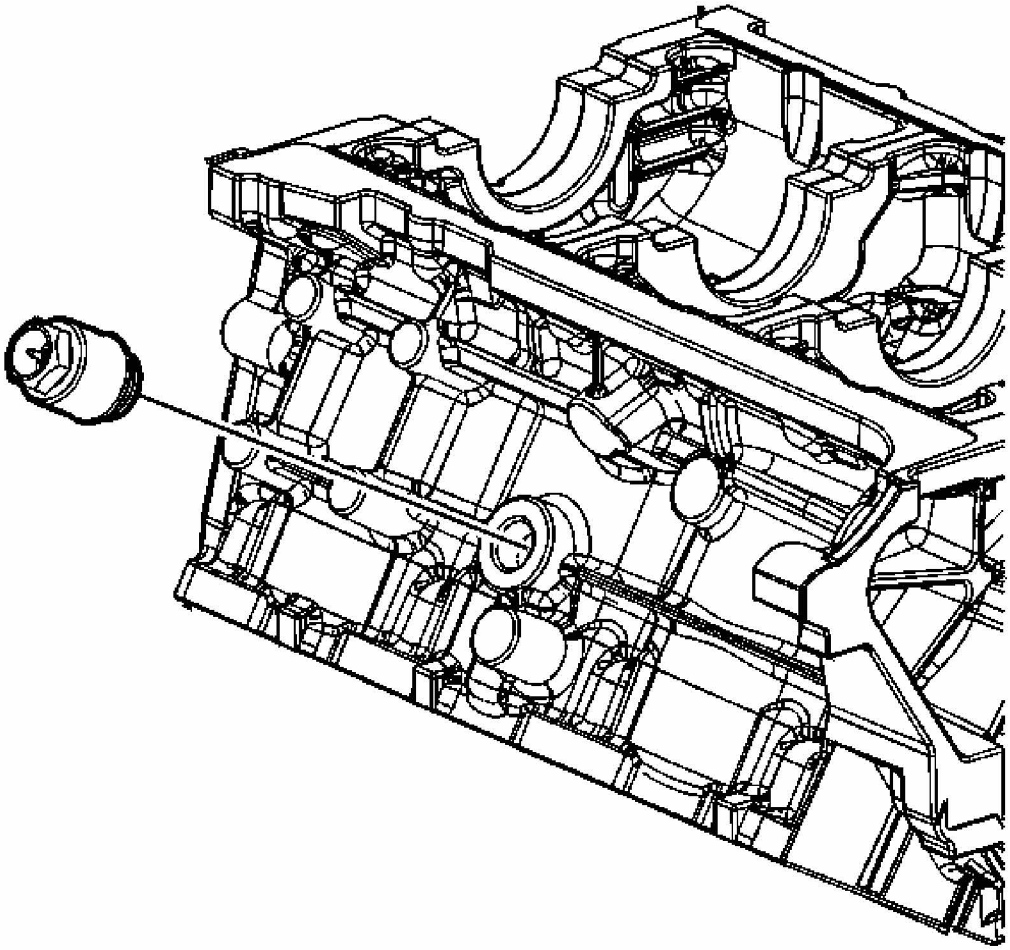


Fig. 331: View Of Engine Block Heater
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer GM P/N 12346004 (Canadian P/N 1095380), or equivalent to the engine block heater.

NOTE: **Refer to Fastener Notice .**

2. Install the engine block heater into the engine block.

Tighten: Tighten engine block heater to 50 N.m (37 lb ft).

PISTON OIL NOZZLE CLEANING AND INSPECTION

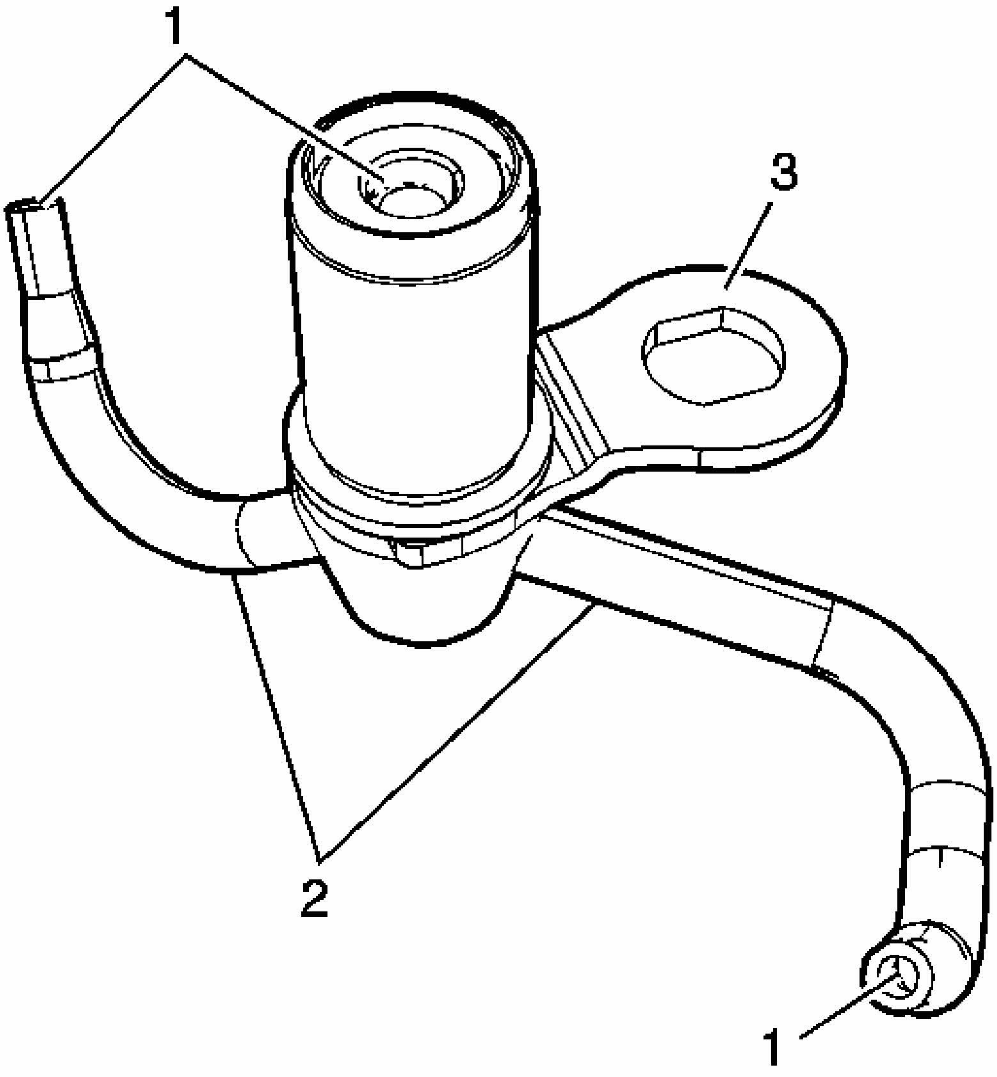


Fig. 332: Inspecting Piston Oil Nozzle
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Cleaning Solvent Caution .

1. Clean the piston oil nozzle in cleaning solvent using GM P/N 10953463 (Canadian P/N 88901148) or equivalent.

CAUTION: Wear safety glasses in order to avoid eye damage.

2. Dry the nozzle with compressed air.
3. Inspect the piston oil nozzle for the following:
    - For cracks or damage
    - Plugged oil passages (1)
    - Bent, misaligned, or cracked oil nozzle tubes (2)
    - Bent or broken clip (3)

CRANKSHAFT AND BEARINGS CLEANING AND INSPECTION

Tools Required

- **J 8087** Cylinder Bore Gage. See **Special Tools**.
- **J 45059** Angle Meter. See **Special Tools**.

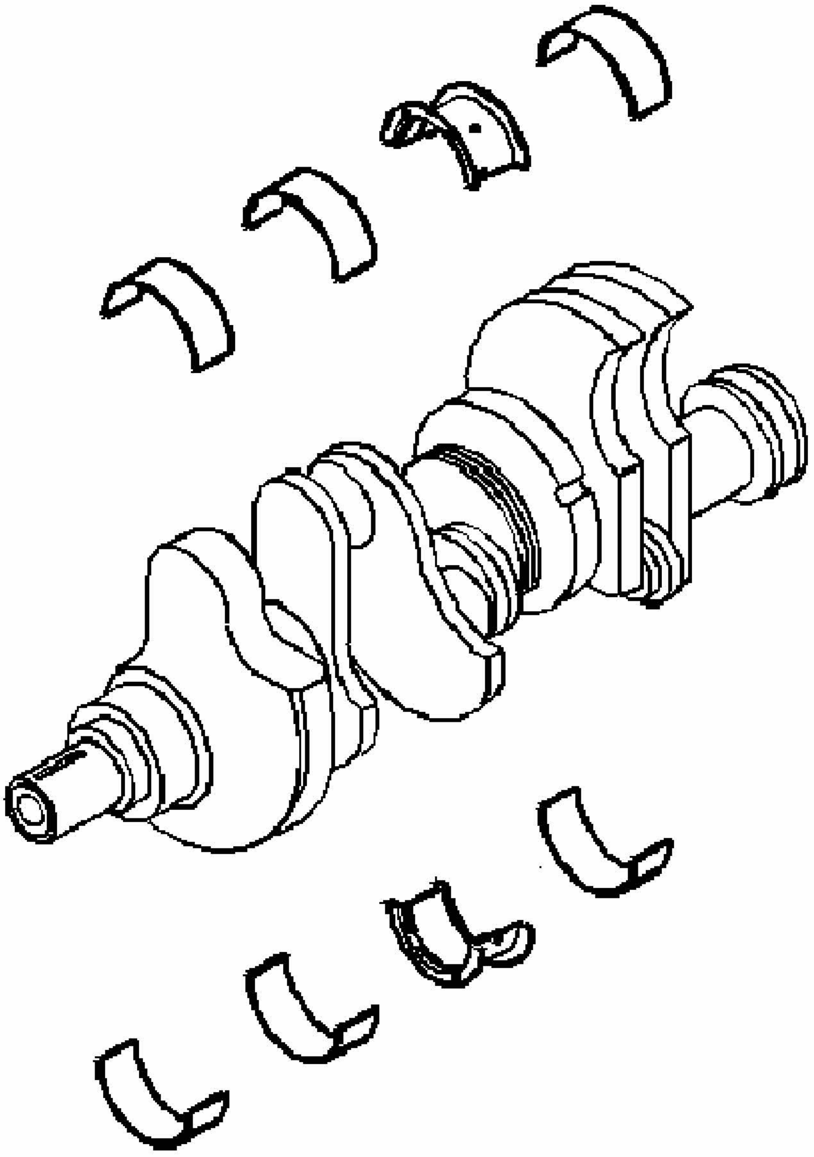


Fig. 333: View Of Crankshaft & Bearings
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **Use Care when handling the crankshaft. Avoid damage to the crankshaft position sensor reluctor wheel teeth. Nicks, burrs or other damage to the teeth may effect on-board diagnostics (OBD) 2 system performance.**

1. Clean the crankshaft of the following elements:

  - Oil
  - Sludge
  - Carbon
2. Inspect the crankshaft oil passages for obstructions.

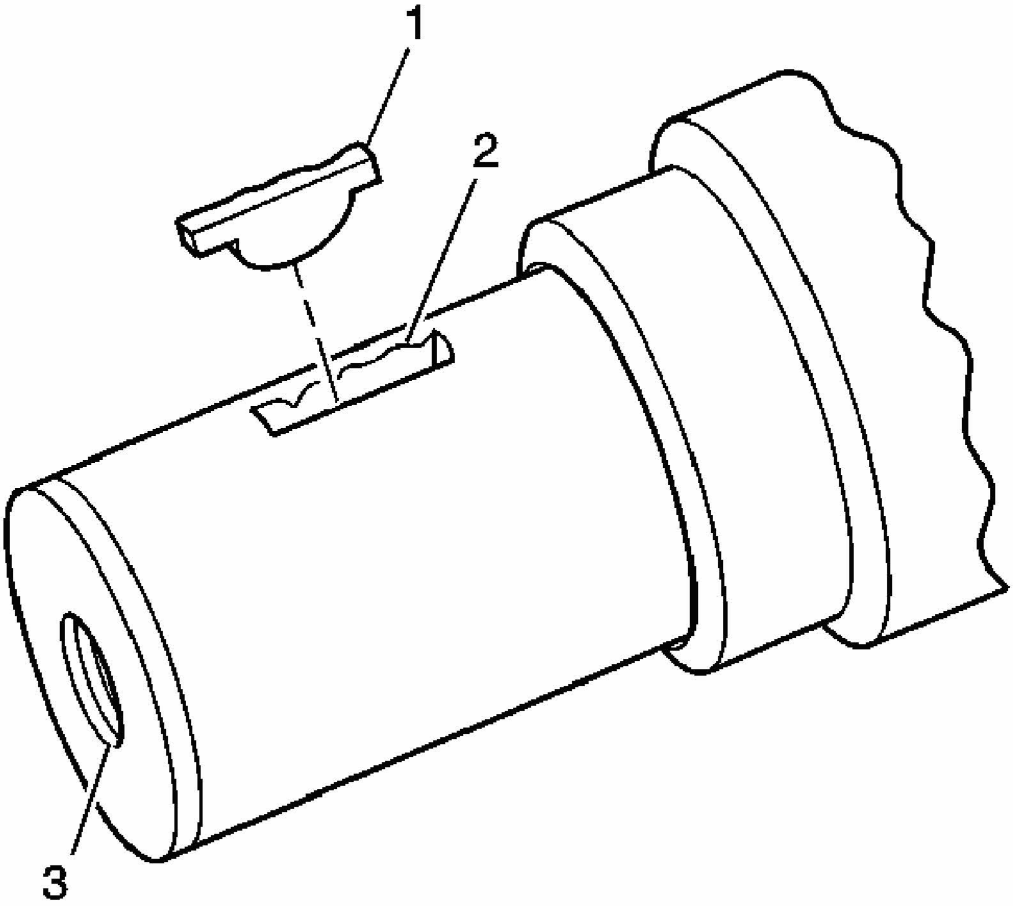


Fig. 334: Inspecting Crankshaft Keyway
Courtesy of GENERAL MOTORS CORP.

3. Inspect the crankshaft keyway for the following conditions:
   - A worn crankshaft key (1)
   - A worn crankshaft keyway (2)
4. Inspect the crankshaft threads (3) for damage.

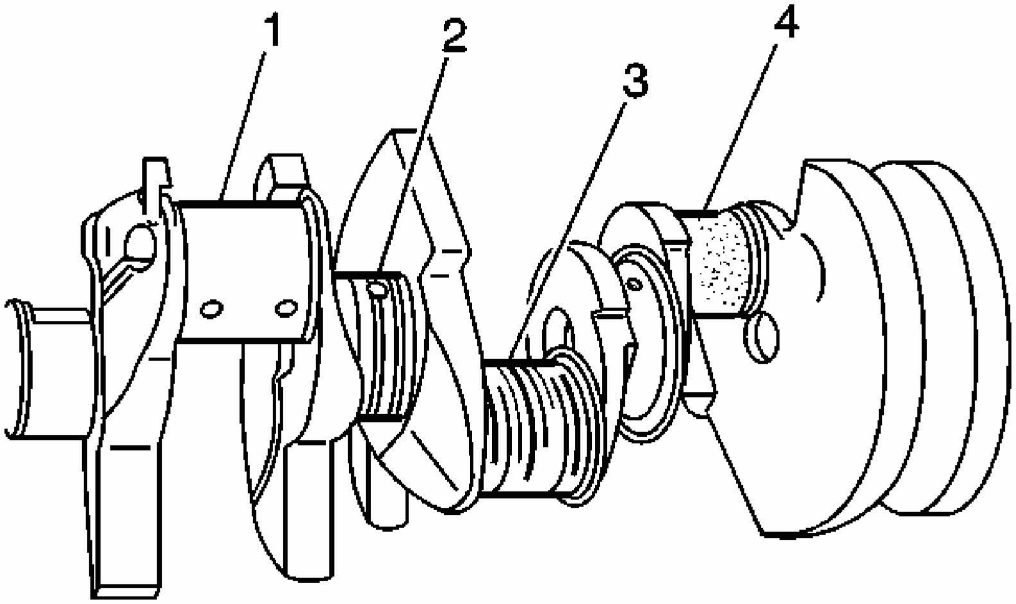


Fig. 335: Identifying Different Crankshaft Journal Wear Patterns
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If cracks, severe gouges or burned spots are found, replace the crankshaft. Remove slight roughness using a fine polishing cloth soaked in clean engine oil. Remove any burrs using a fine oil stone.

5. Inspect the crankshaft bearing journals and the crankshaft thrust surfaces for the following conditions:
   - Wear without any grooves or scratches (1)
   - Grooves or scoring (2)
   - Scratches or excessive wear (3)
   - Pitting or embedded bearing material (4)-Inspect the corresponding crankshaft bearing inserts for embedded material and determine the source of the material.
   - Overheating or discoloration

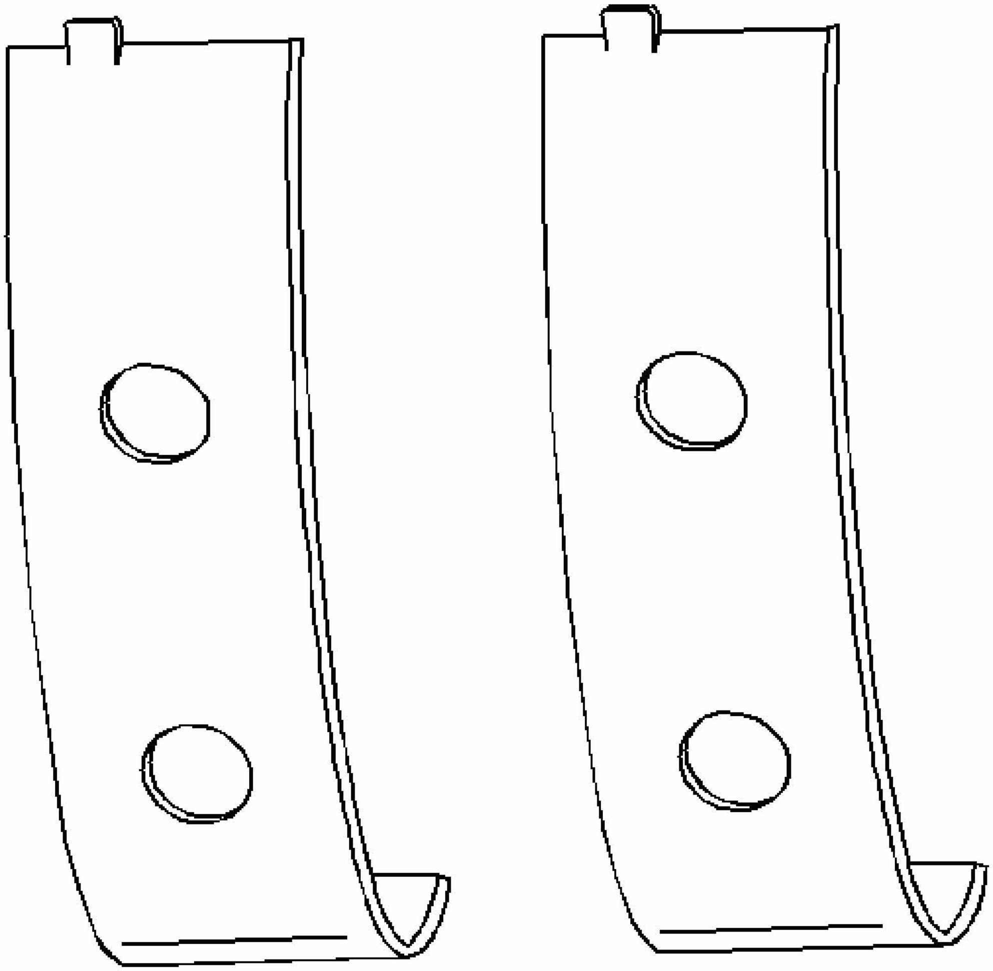


Fig. 336: View Of Crankshaft Bearings
Courtesy of GENERAL MOTORS CORP.

6. The crankshaft bearings are the precision insert type.
7. Inspect the outer surfaces of the crankshaft bearings for the following conditions:
    - Wear-surface wear indicates either movement of the insert, or high spots in the surrounding material - spot wear.
    - Overheating or discoloration
    - Looseness or rotation indicated by flattened tangs and wear grooves

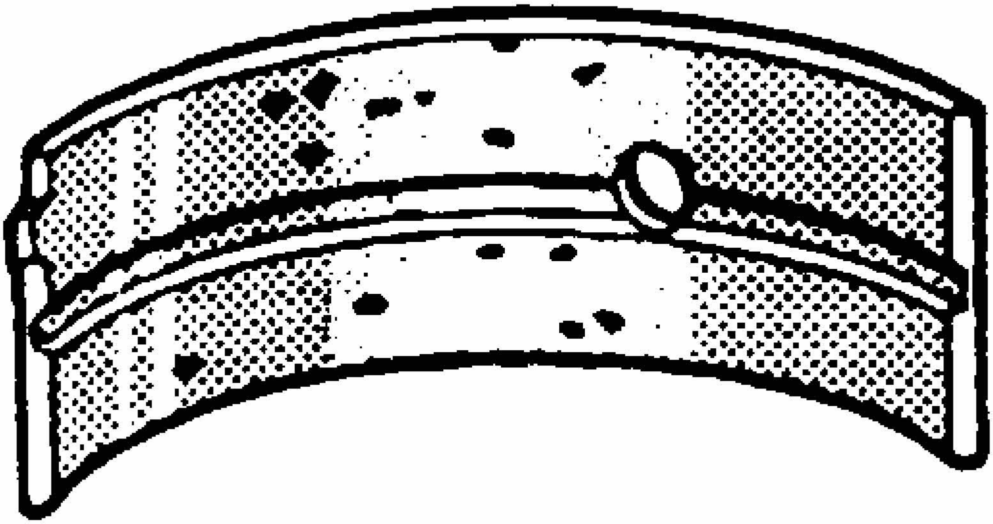


Fig. 337: Identifying Crankshaft Bearing Craters Or Pockets
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Note the location of the crankshaft main bearing high spots. If the spots are not in line, the crankshaft is bent. Replace the crankshaft.

8. Inspect the crankshaft main bearings for craters or pockets. Flattened sections on the crankshaft bearing halves also indicate fatigue.
9. Inspect the thrust surfaces of the main thrust bearing for the following conditions:
    - Wear
    - Grooving-Grooves are caused by irregularities of the crankshaft thrust surface.

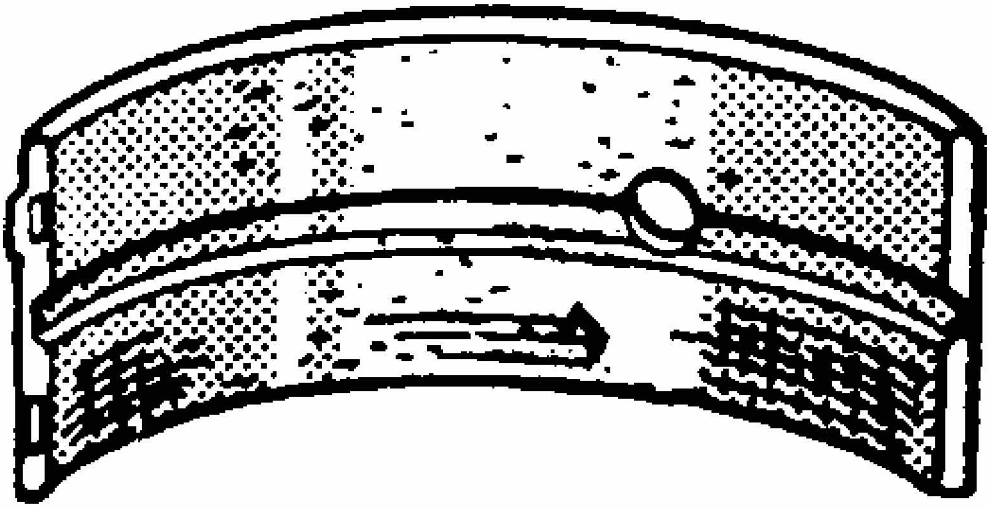


Fig. 338: Identifying Connecting Rod Bearing Scoring Or Discoloration
Courtesy of GENERAL MOTORS CORP.

10. Inspect the crankshaft bearings for excessive scoring or discoloration.
11. Inspect the crankshaft main bearings for dirt or imbedded debris.

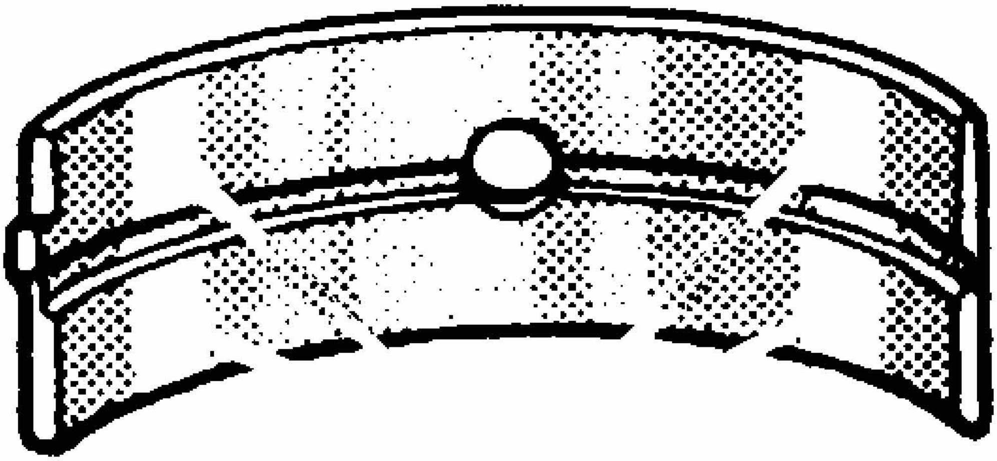


Fig. 339: Crankshaft Bearing Polished Sections (Improper Seating)

Courtesy of GENERAL MOTORS CORP.

12. Inspect the crankshaft main bearings for improper seating indicated by bright, polished sections.
13. Inspect the crankshaft bearings for uneven side-to-side wear. This may indicate a bent crankshaft or a tapered bearing journal.

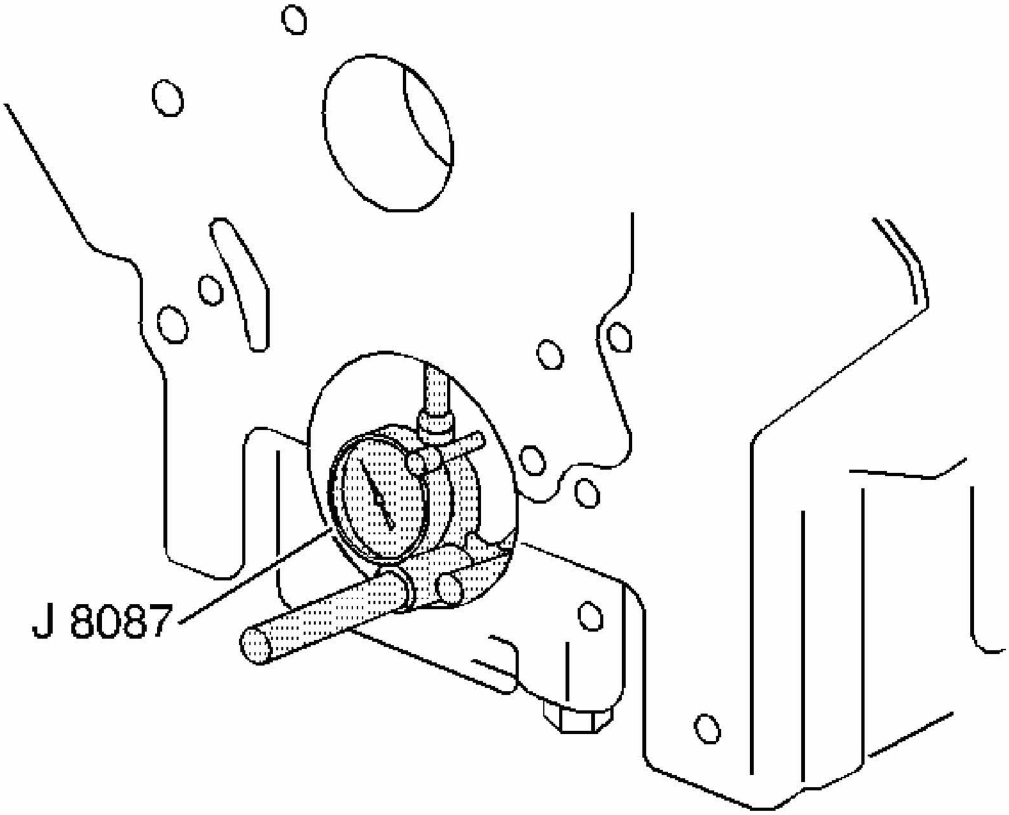


Fig. 340: Inspecting Crankshaft Main Bearing Bores
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If crankshaft bearing failure is due to conditions other than normal wear, investigate the cause of the condition. Inspect the crankshaft or connecting rod bearing bores.

14. Inspect the connecting rod bearing bores or crankshaft main bearing bores using the following procedure:
    1. Tighten the bearing cap to specification.

2. Use the **J 8087** in order to measure the bearing bore for taper and out-of-round. See **Special Tools**. Record the readings for bearing selection.
3. No taper or out-of-round should exist.

Bearing Selection

Measure the bearing clearance to determine the correct replacement bearing insert size. There are two methods to measure bearing clearance. Method A gives more reliable results and is preferred.

- Method A yields measurement from which the bearing clearance can be computed.
- Method B yields the bearing clearance directly. Method B does not give any indication of bearing run-out.

Method A

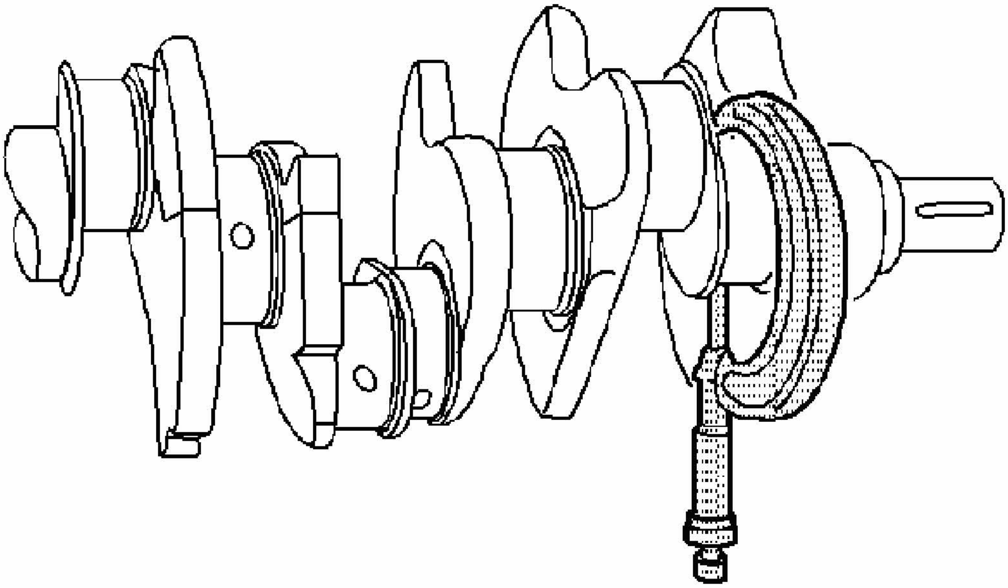


Fig. 341: Measuring Crankshaft Bearing Journal Diameter
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not mix inserts of different nominal size in the same bearing bore.

1. Measure the crankshaft bearing journal diameter with a micrometer in several places,

90 degrees apart. Average the measurements.

2. Measure the crankshaft bearing journal taper and runout.
3. Install the crankshaft bearing inserts. Tighten the bearing cap bolts to specification using **J 45059** . See **Special Tools**.
4. Measure the connecting rod inside diameter in the same direction as the length of the rod with an inside micrometer.
5. Measure the crankshaft main bearing inside diameter with an inside micrometer.
6. Select a set of bearing inserts that will produce the desired clearance.
7. If the specified clearances cannot be met, the crankshaft journals must be reconditioned and undersized bearing inserts installed.

Method B

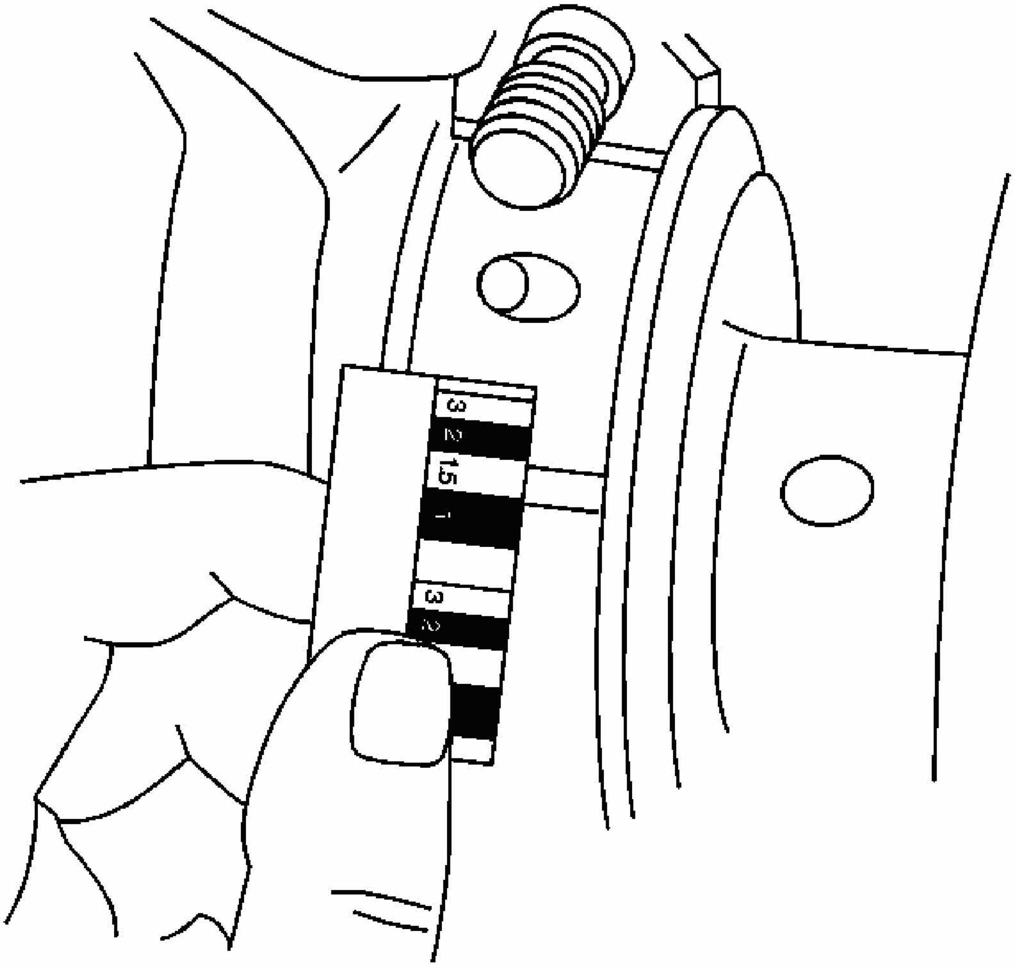


Fig. 342: Measuring Gaging Plastic
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not mix inserts of different nominal size in the same bearing bore.

1. Clean the used bearing inserts.
2. Install the used bearing inserts.
3. Place a piece of gaging plastic across the entire bearing width.
4. Install the bearing caps.

NOTE: In order to prevent the possibility of cylinder block or crankshaft bearing cap damage, the crankshaft bearing caps are tapped into the cylinder block cavity using a brass, lead, or a leather mallet before the attaching bolts are installed. Do not use attaching bolts to pull the crankshaft bearing caps into the seats. Failure to use this process may damage a cylinder block or a bearing cap.

5. Install the bearing cap bolts to specification using **J 45059** . See **Special Tools**.

IMPORTANT: Do not rotate the crankshaft.

6. Remove the bearing cap, leaving the gaging plastic in place. It does not matter whether the gaging plastic adheres to the journal or to the bearing cap.
7. Measure the gaging plastic at its widest point with the scale printed on the gaging plastic package.
8. Remove the gaging plastic.
9. Select a set of bearing inserts that will produce the desired clearance.

CRANKSHAFT BALANCER CLEANING AND INSPECTION

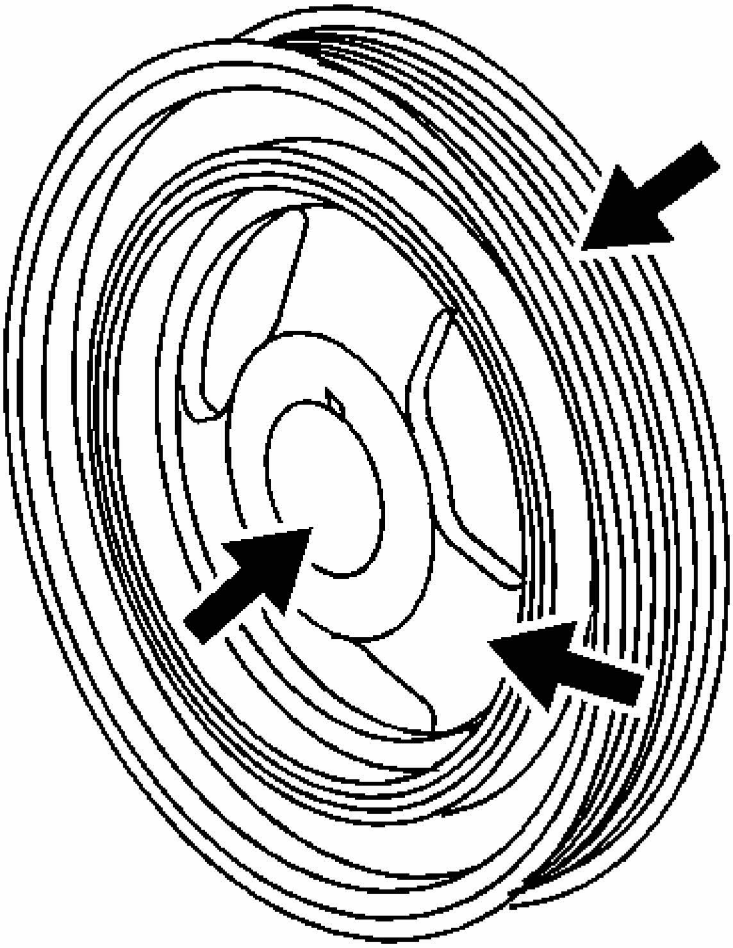


Fig. 343: Cleaning Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

1. Clean the crankshaft balancer in solvent.
2. Clean the belt grooves of all dirt or debris with a wire brush.
3. Inspect the crankshaft balancer for the following:

IMPORTANT: A crankshaft balancer hub seal surface with excessive scoring, grooves, rust or other damage must be replaced. Minor imperfections on the hub seal surface may be

removed with polishing compound or fine grade emery cloth.

- Worn, grooved, or damaged hub seal surface

IMPORTANT: In order for the belt to track properly, the belt grooves should be free of all dirt, debris, nicks, gouges or other damage. Minor imperfections may be removed with a fine file.

- Dirty or damaged belt grooves.
- Worn, chunking or deteriorated rubber between the hub and pulley

ENGINE FLYWHEEL CLEANING AND INSPECTION

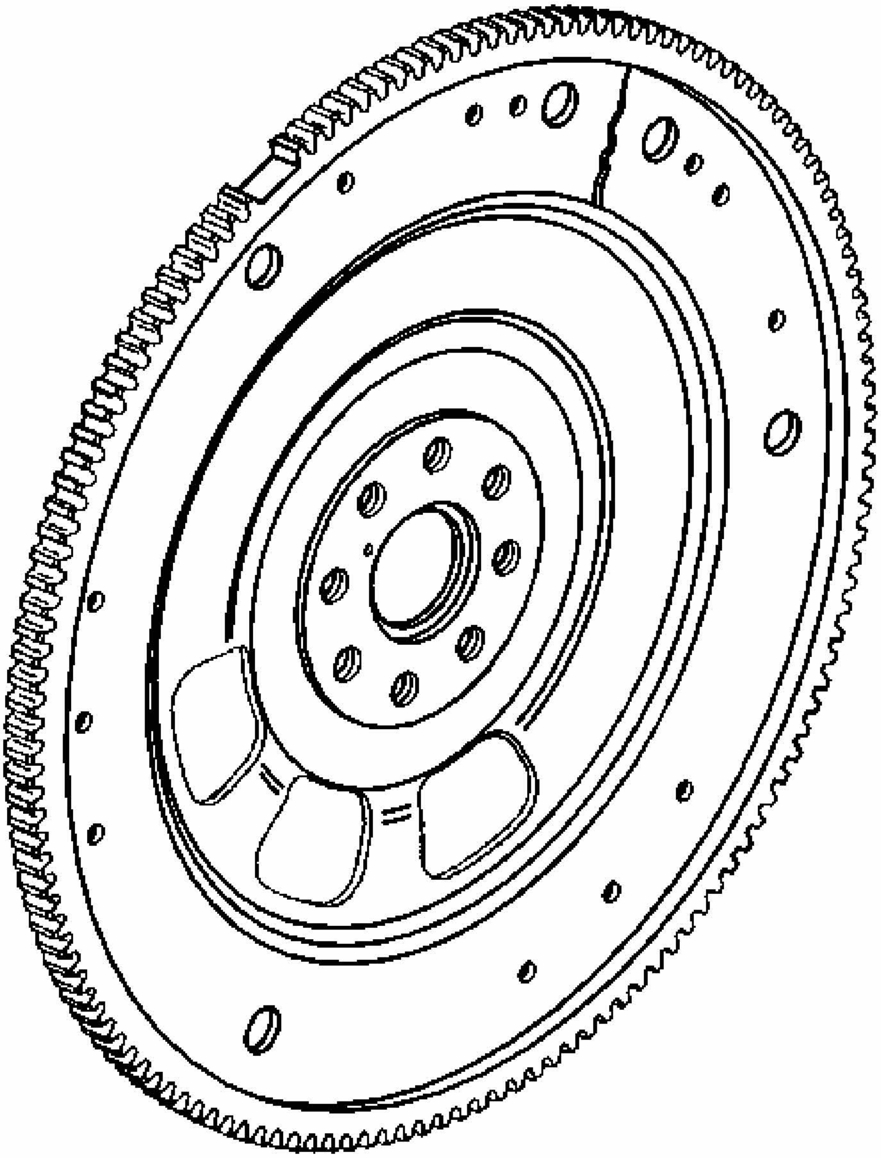


Fig. 344: Inspecting Engine Flywheel
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

1. Clean the engine flywheel with solvent.
2. Dry the engine flywheel with compressed air.

3. Inspect the engine flywheel for the following:
    - Damaged ring gear teeth
    - Stress cracks around the flywheel-to-crankshaft bolt hole locations

PISTON, CONNECTING ROD, AND BEARINGS CLEANING AND INSPECTION

Tools Required

- **J 8087** Cylinder Bore Gage. See **Special Tools**.
- **EN-46745** Piston Pin Retainer Remover and Installer

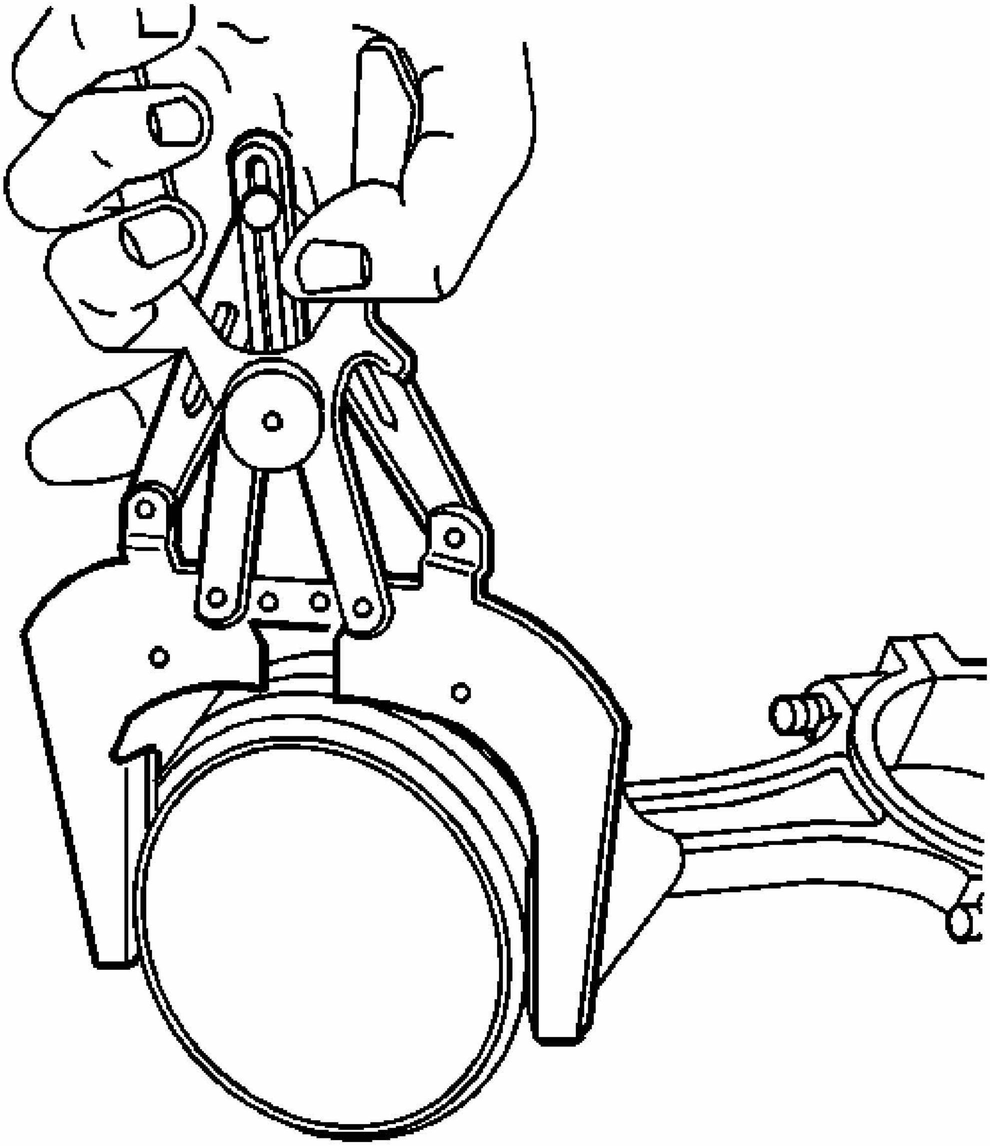


Fig. 345: Cleaning The Piston Ring Grooves With Suitable Ring Groove Cleaning Tool
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

IMPORTANT: Measurement of all components should be taken with the components at room temperature. Do not use a wire brush in order to clean any part of the piston or connecting rod

assembly.

IMPORTANT: Some steps in this procedure may reflect on a disassembled oversized piston. Others will only apply to the standard size pistons that are NOT to be disassembled.

1. Clean the piston and connecting rod in solvent.
2. Dry off the piston and connecting rod with compressed air.
3. Clean the piston ring grooves with a suitable ring groove cleaning tool.
4. Clean the piston oil lubrication holes and slots.

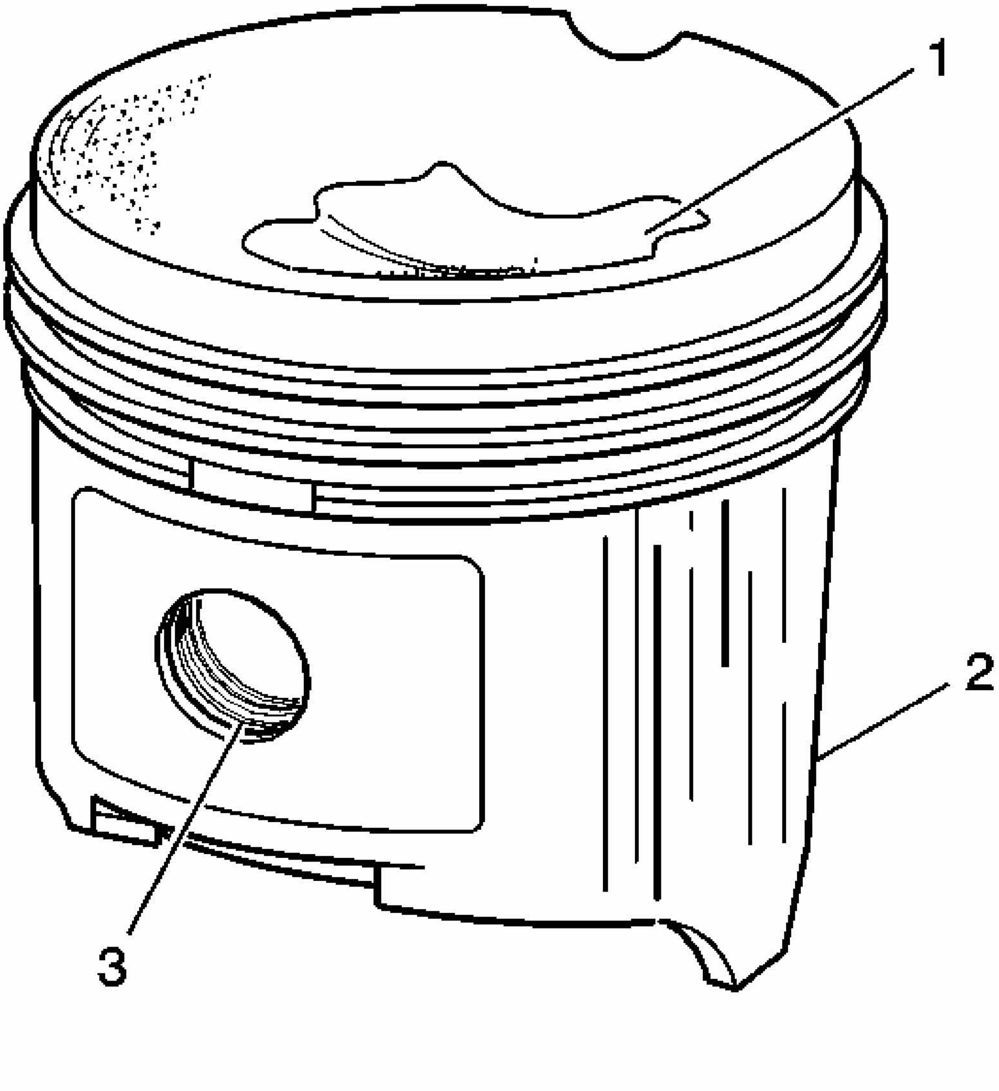


Fig. 346: Identifying Piston Damage Inspection Areas

Courtesy of GENERAL MOTORS CORP.

5. Inspect the piston for the following:
    - Eroded areas (1) on the top of the piston
    - Scuffed or damaged skirt (2)
    - Damage to the pin bore (3)
    - Cracks in the piston ring lands, the piston skirt, or the pin bosses
    - Piston ring grooves for nicks, burrs, or other warpage which may cause the piston ring to bind
6. Inspect the piston pin for scoring, wear or other damage.

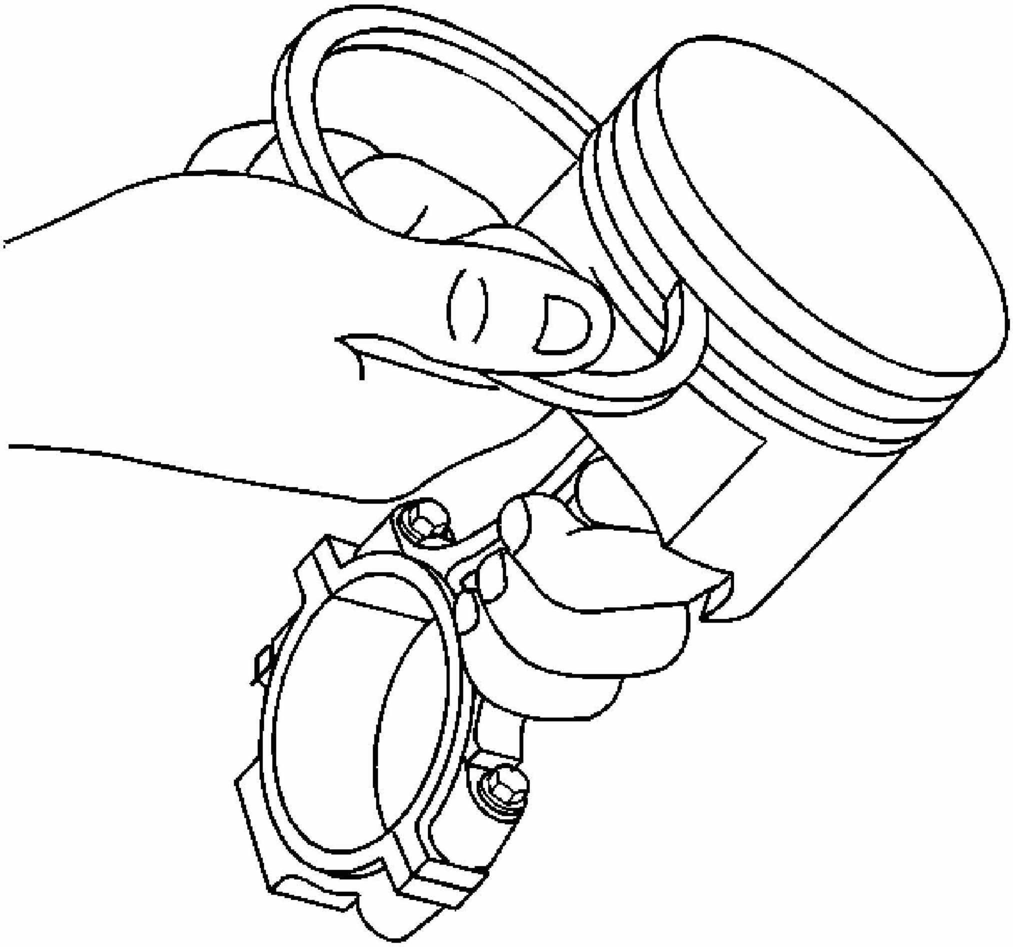


Fig. 347: Inserting Piston Ring Into Ring Groove
Courtesy of GENERAL MOTORS CORP.

7. Measure the piston ring-to-piston ring groove side clearance.
    1. Insert the edge of the piston ring into the piston ring groove.
    2. Roll the piston ring completely around the piston ring groove.
        - If binding is caused by distorted piston ring groove, replace the piston.
        - If binding is caused by a distorted piston ring, replace the piston ring.

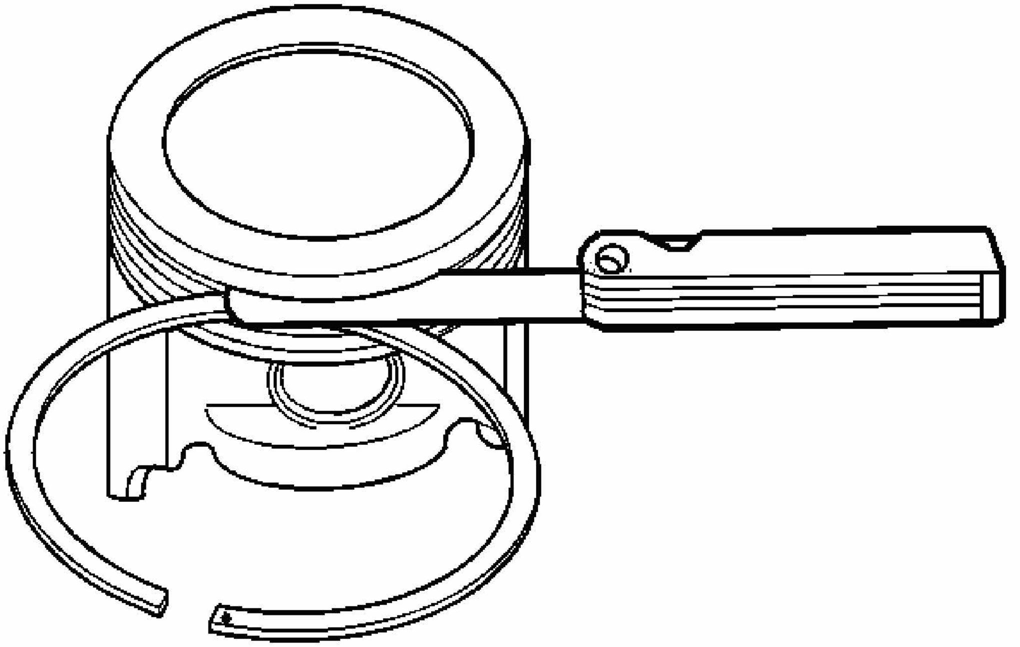


Fig. 348: Measuring Piston Ring Side Clearance
Courtesy of GENERAL MOTORS CORP.

8. Measure the piston ring side clearance with a feeler gage.
9. If the side clearance is too small try another ring set.
10. If the proper piston ring-to-piston ring groove clearance cannot be achieved, replace the piston and pin assembly.
    - Proper ring-to-piston ring groove clearance for the top ring is 0.03-0.065 mm (0.001-0.002 in).
    - Proper ring-to-piston ring groove clearance for the second ring is 0.04-0.078 mm (0.002-0.003 in).

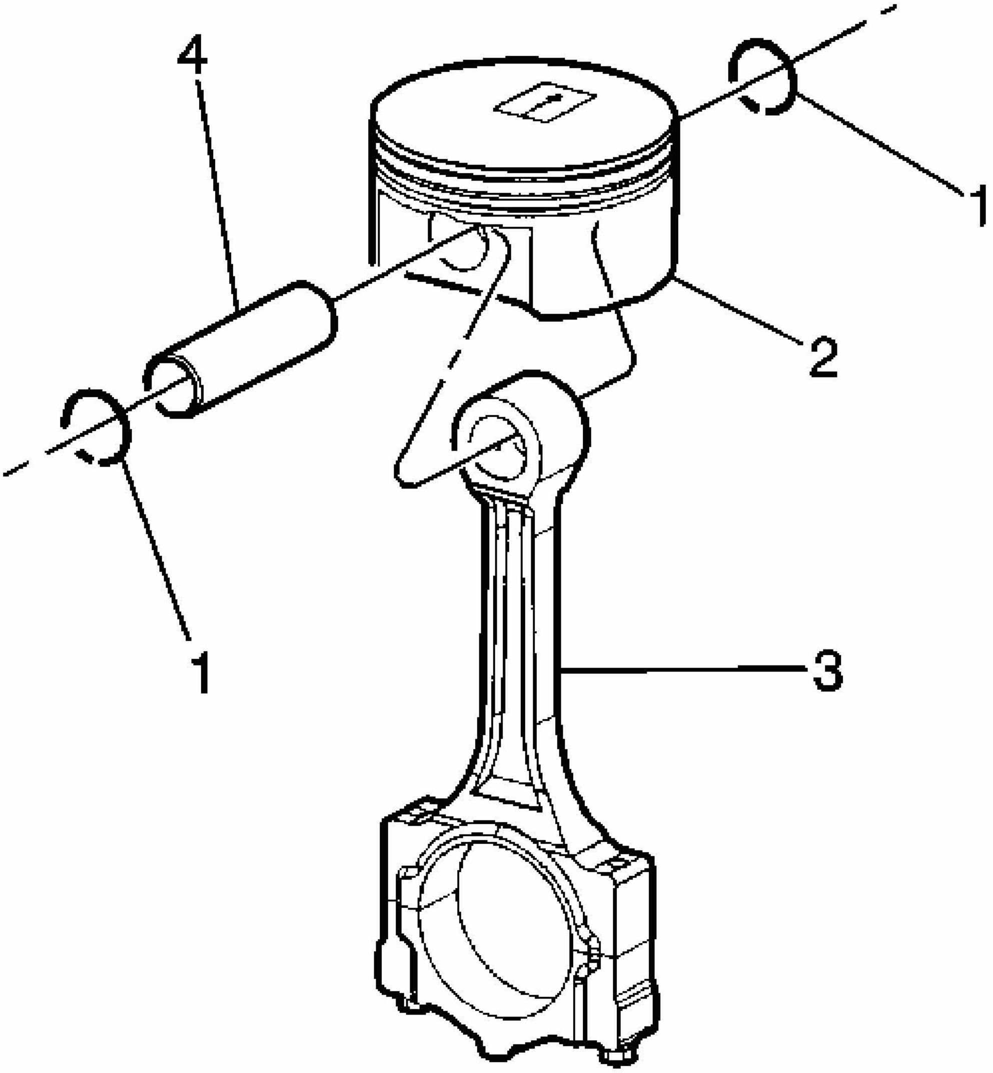


Fig. 349: Exploded View Of Piston & Connecting Rod Assembly
Courtesy of GENERAL MOTORS CORP.

11. Using the **EN-46745** , remove the piston pin retainers (1).
12. Discard the oil piston pin retainers.
13. Slide the piston pin (4) out of the piston (2), disconnecting the piston from the connecting rod (3).

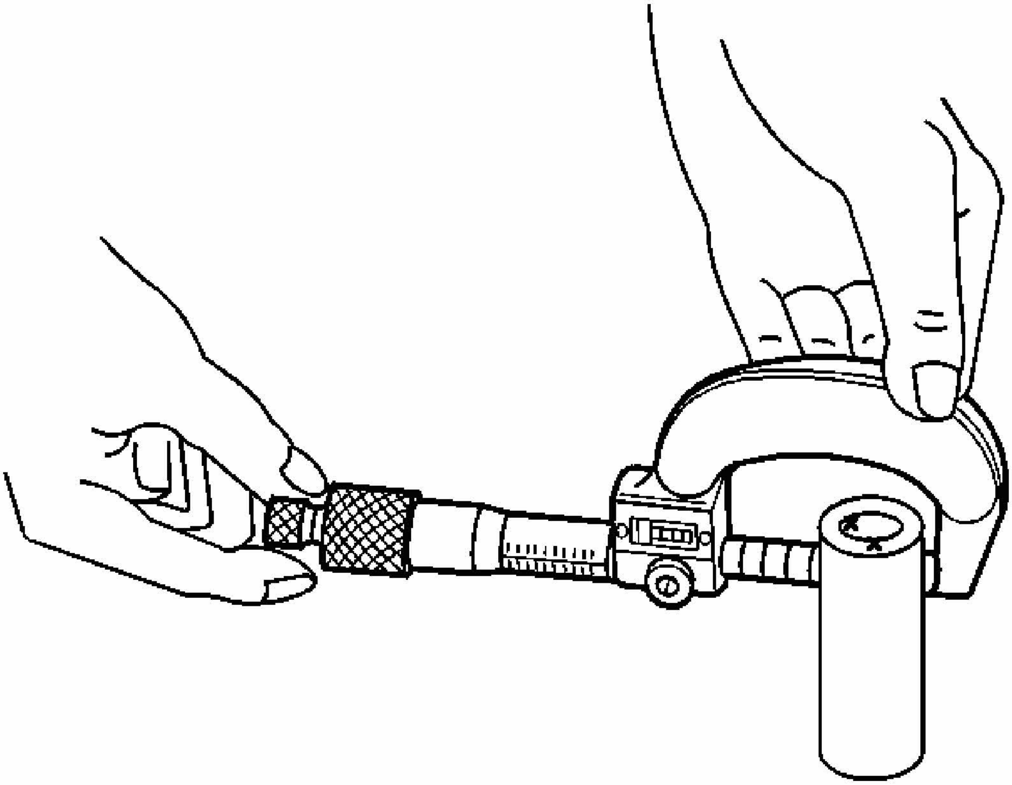


Fig. 350: Measuring Piston Pin Diameter
Courtesy of GENERAL MOTORS CORP.

14. Measure the piston pin diameter using and outside micrometer.

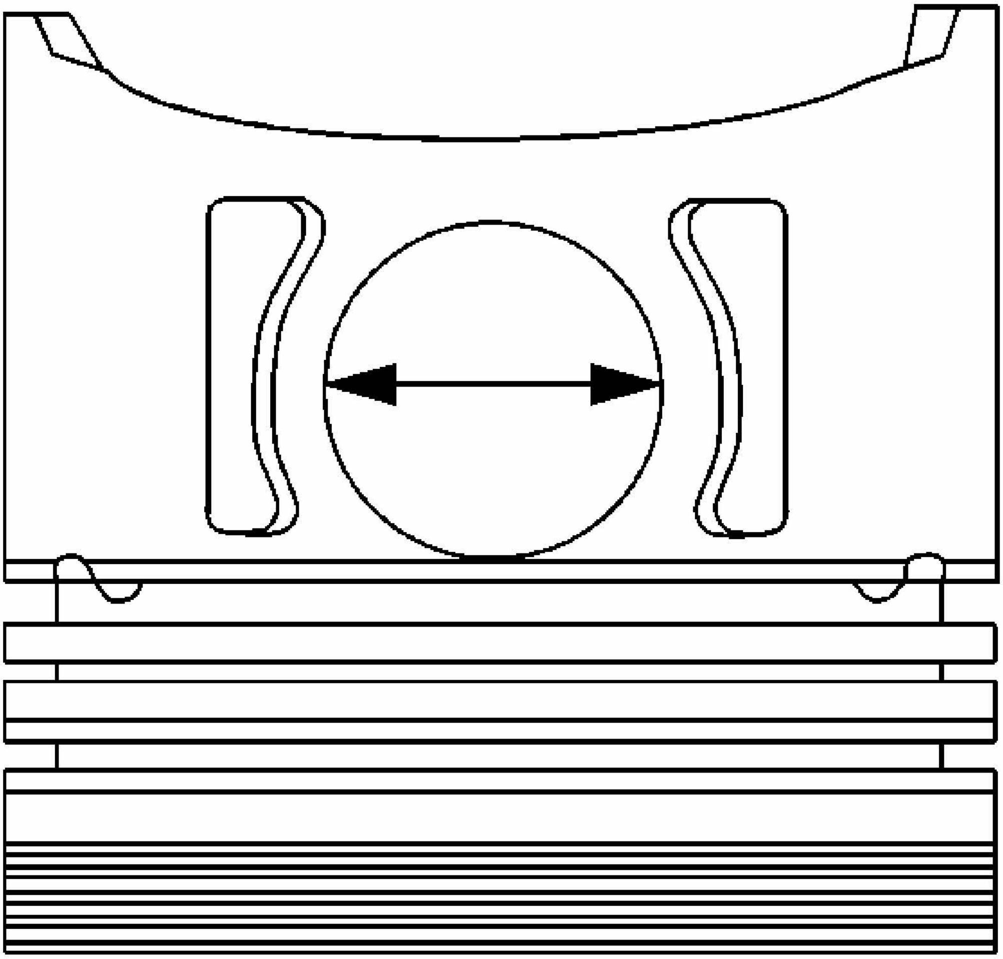


Fig. 351: Measuring The Piston Pin Bore
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When fitting pistons, consider both the pistons and the cylinder bore conditions together. Production and service pistons have the same nominal weight and may be intermixed without affecting engine balance. If necessary, used pistons may be fitted selectively to any cylinder of the engine, providing the pistons are in good condition and the same weight. Do not cut oversize pistons down or the engine balance may be affected. Finish hone when selecting the pistons.

15. Measure the piston pin bore using an inside micrometer.

16. Subtract the piston pin diameter from the piston pin bore diameter in order to determine the piston pin-to-piston pin bore clearance.
17. Piston-to-piston pin bore clearance must measure 0.002-0.010 mm (0.00008-0.0004 in). Replace the piston and the piston pin if the piston and the piston pin are not within specifications.

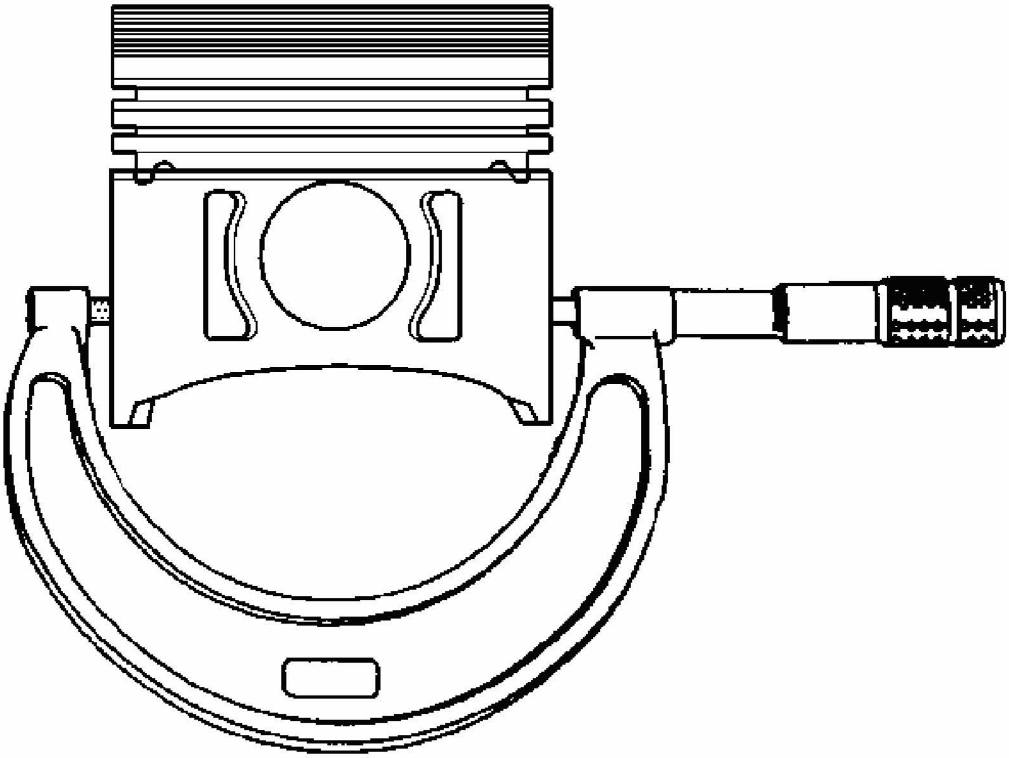


Fig. 352: Measuring Piston Diameter
Courtesy of GENERAL MOTORS CORP.

18. Measure the piston diameter with a micrometer at a right angle to the piston bore with the piston pin removed, and record the measurement. Measure the piston at 43 mm (1.692 in) from dome of piston. Piston diameter must measure no less than 98.950 mm (3.895 in). Replace the piston and the pin as an assembly if the piston is not within specifications.

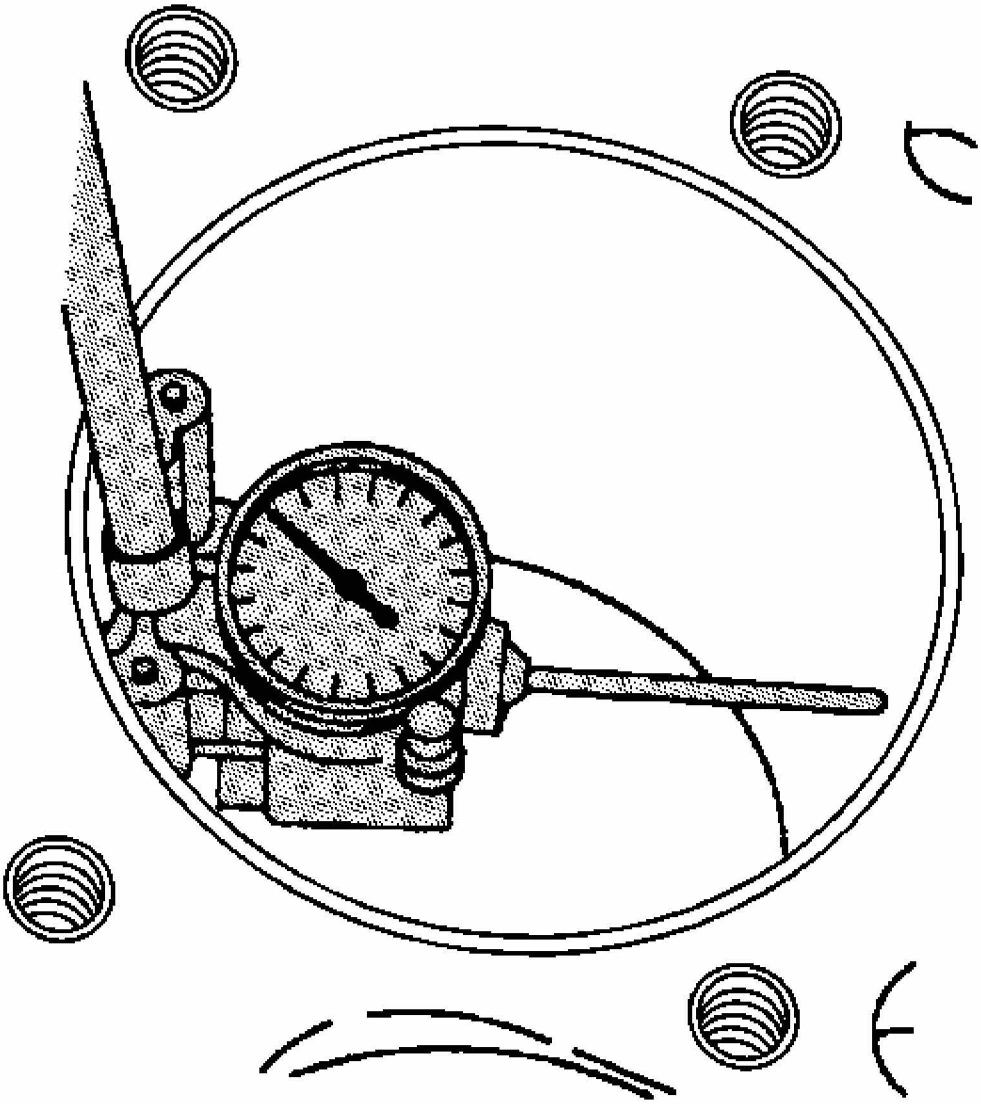


Fig. 353: Measuring Cylinder Bore
Courtesy of GENERAL MOTORS CORP.

19. Measure the cylinder bore, using **J 8087** . See **Special Tools**.

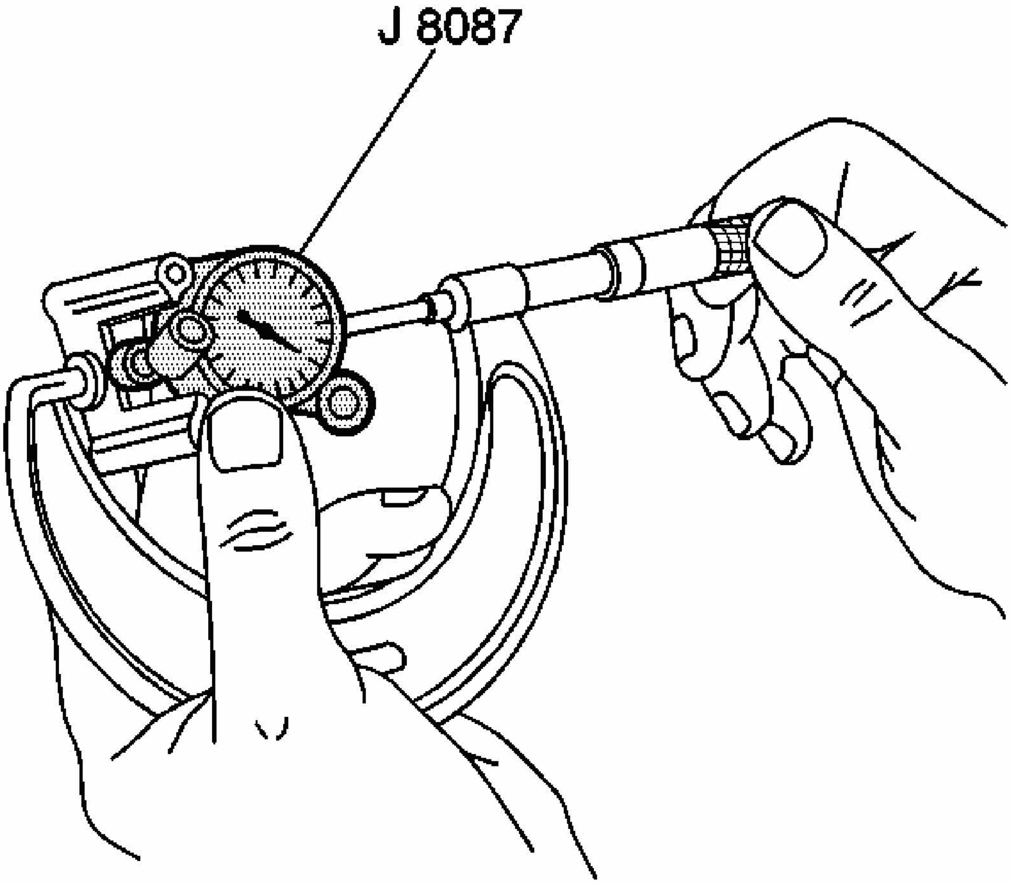


Fig. 354: Measuring Bore Gauge With Micrometer
Courtesy of GENERAL MOTORS CORP.

20. Measure the **J 8087** . See **Special Tools**. Record this reading.
21. Subtract the diameter of the piston from the diameter of the cylinder bore to determine the piston-to-bore clearance. The cylinder bore clearance must be no more than 0.080 mm (0.003 in).
22. If a used piston is not acceptable, inspect the service piston size and determine if a new piston may be selected. Service pistons are available in standard and 0.5 mm (0.012 in) oversize.
23. When a piston has been selected, mark the piston in order to identify the cylinder for which the piston was fitted.

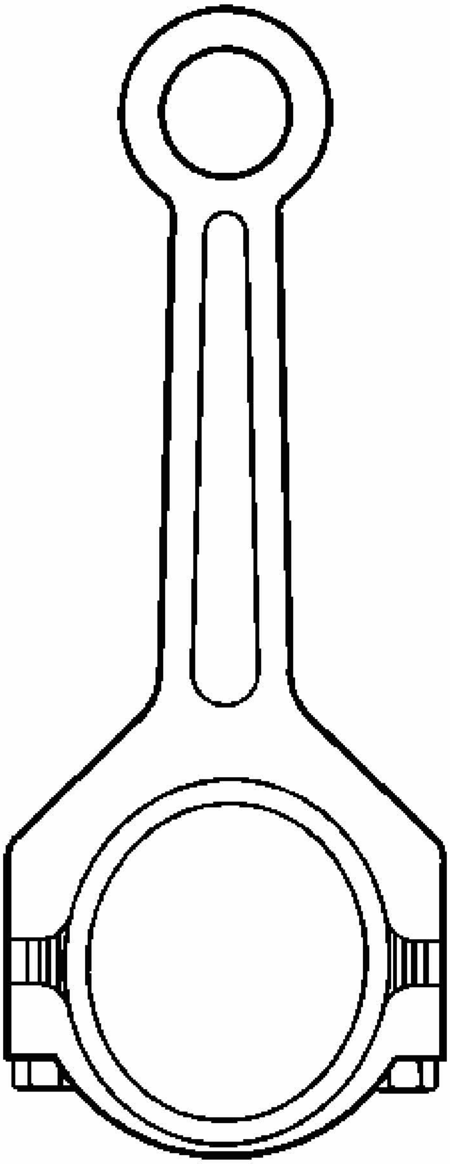


Fig. 355: View Of Connecting Rod
Courtesy of GENERAL MOTORS CORP.

24. Inspect the connecting rod for an out-of-round bearing bore. If the out-of-round measurement exceeds 0.005 mm (0.0002 in) the connecting rod must be replaced.

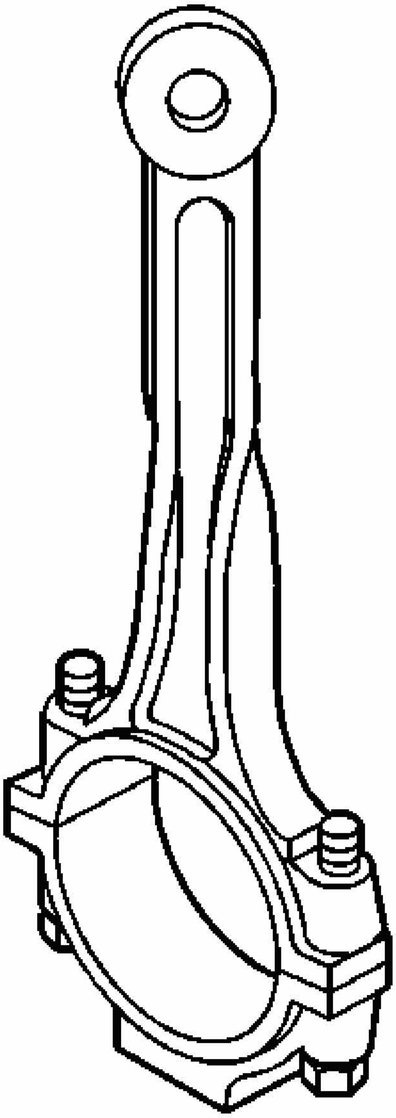


Fig. 356: Identifying Twisted Connecting Rod
Courtesy of GENERAL MOTORS CORP.

25. Inspect the connecting rod for twisting.
    1. Install the connecting rod cap.
    2. Place the connecting rod assembly on a checking fixture. Inspect the assembly for bending or twisting.
    3. Do not attempt to straighten the connecting rod. Ensure that the connecting rod meets the following conditions:

    - The connecting rods are not bent more than 0.18 mm (0.007 in).
    - The connecting rods are not twisted more than 0.38 mm (0.015 in).
  4. Replace any bent or twisted connecting rods.
  5. Inspect the new connecting rods before using the new rods.
26. Inspect the connecting rod for damage to the bearing cap and bolt threads.

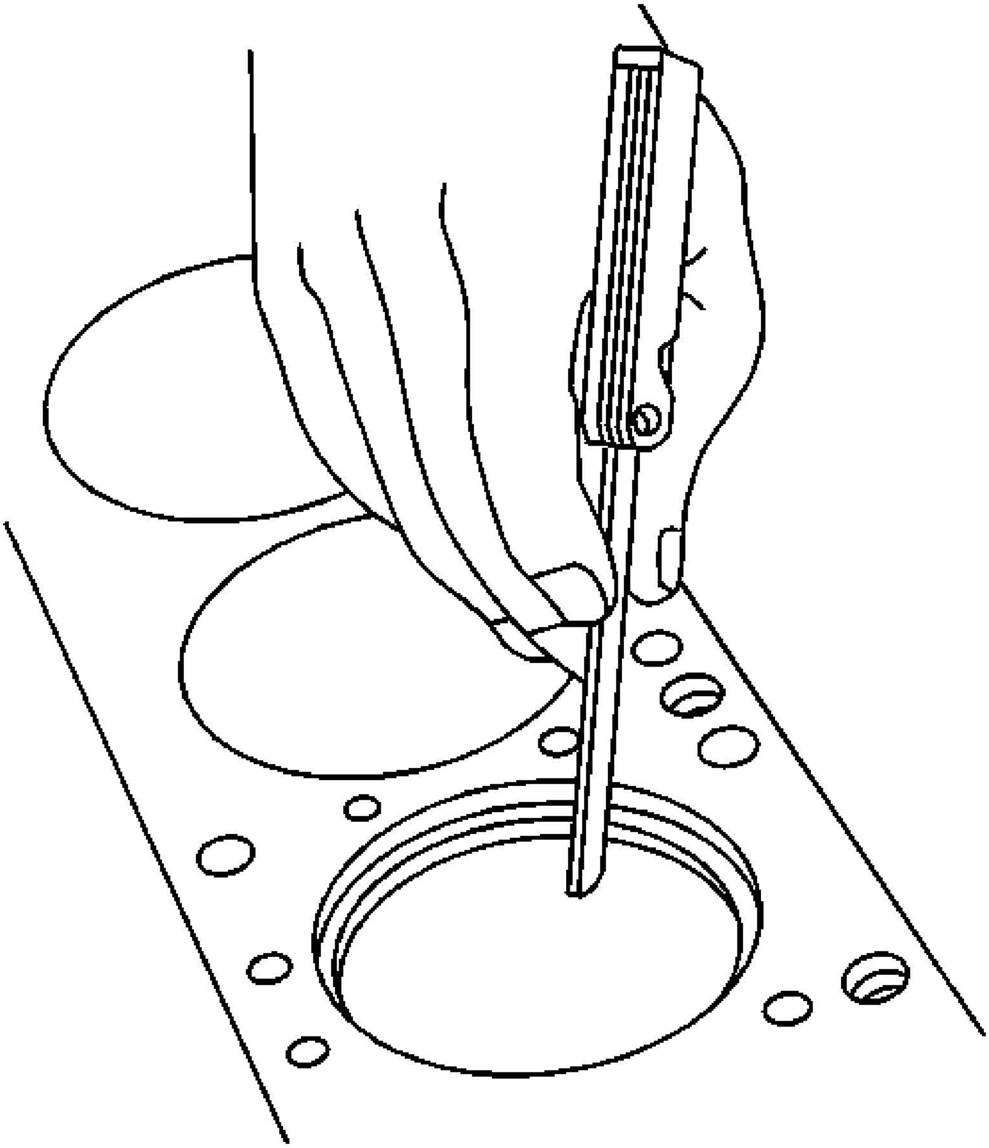


Fig. 357: Measuring Piston Ring End Gap
Courtesy of GENERAL MOTORS CORP.

27. Measure the piston compression ring end gap.

    IMPORTANT: Fit each compression ring to the cylinder in which it will be used.

    1. Place the compression ring into the cylinder bore.
    2. Push the compression ring into the bottom of the cylinder bore to approximately 6.5 mm (0.25 in) above ring travel. The ring must be square to the cylinder wall.
    3. Use a feeler gage in order to measure the end gap. The first compression ring end gap must measure 0.15-0.30 mm (0.006-0.011 in), the second compression ring must measure 0.25-0.45 mm (0.009-0.017 in).
    4. Select another size ring set if the end gap exceeds specifications. If ring gap clearance is below specifications, increase the gap by carefully filing off excess material.

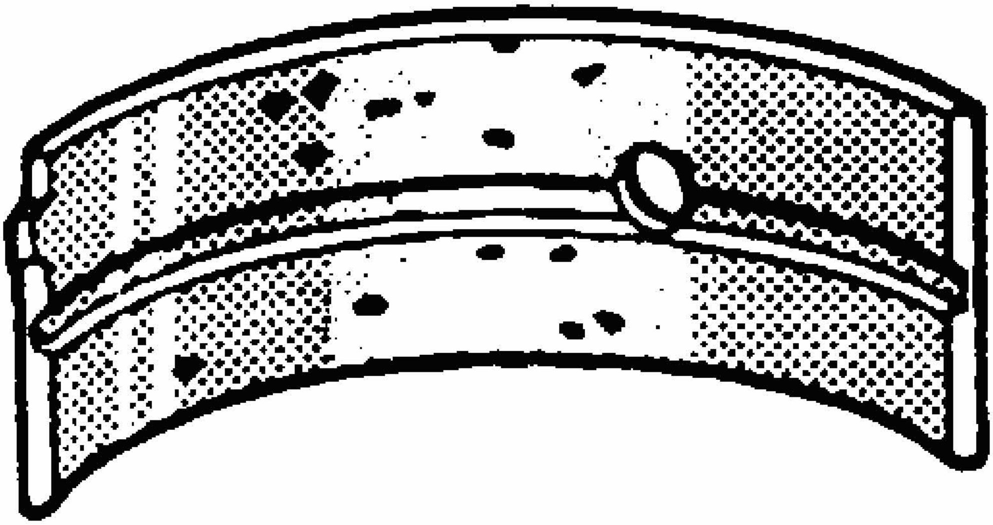


Fig. 358: Identifying Crankshaft Bearing Craters Or Pockets
Courtesy of GENERAL MOTORS CORP.

28. Inspect the connecting rod bearings for craters or pockets. Flattened sections on the connecting rod bearing halves may indicate fatigue.

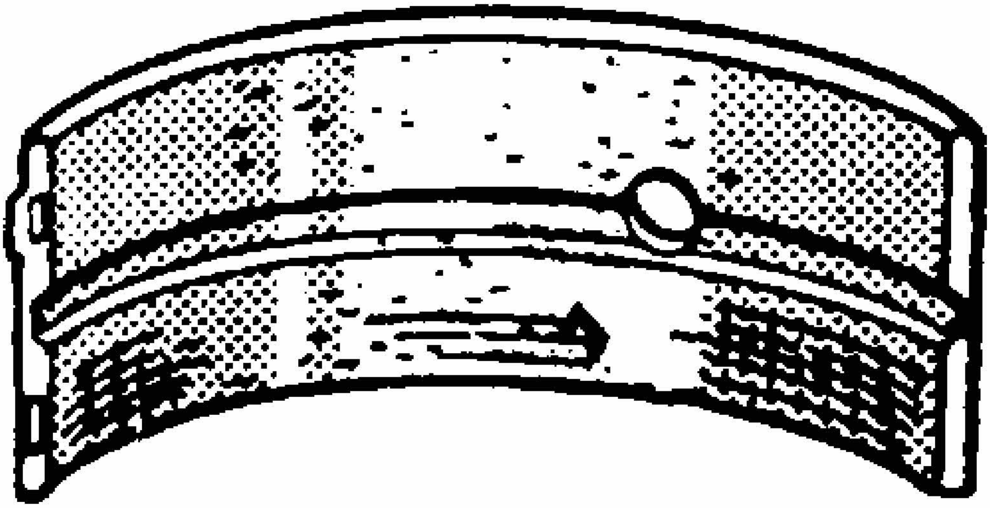


Fig. 359: Identifying Connecting Rod Bearing Scoring Or Discoloration
Courtesy of GENERAL MOTORS CORP.

29. Inspect the connecting rod bearings for excess scoring or discoloration.
30. Inspect the connecting rod bearings for dirt or debris imbedded into the connecting rod bearing halves.

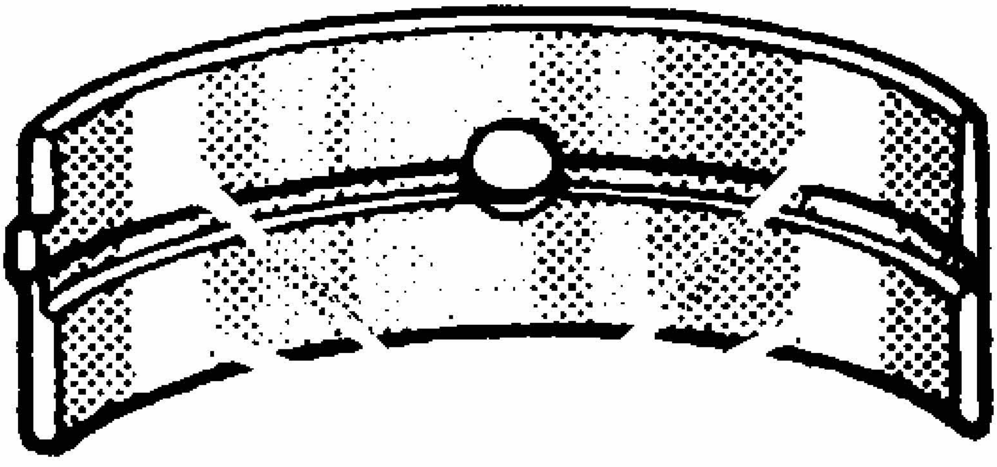


Fig. 360: Crankshaft Bearing Polished Sections (Improper Seating)
Courtesy of GENERAL MOTORS CORP.

31. Inspect the connecting rod bearings for improper seating indicated by bright, polished sections of the bearings.
32. Inspect the inside of the connecting rod bearing and the outside diameter of the connecting rod bearing journal for wear. This indicates high spots.

CAMSHAFT AND BEARINGS CLEANING AND INSPECTION

Tools Required

J 7872 Magnetic Base Dial Indicator Set. See **Special Tools**.

1. Remove and discard the camshaft position actuator filter (1).
2. Clean the camshaft with cleaning solvent.

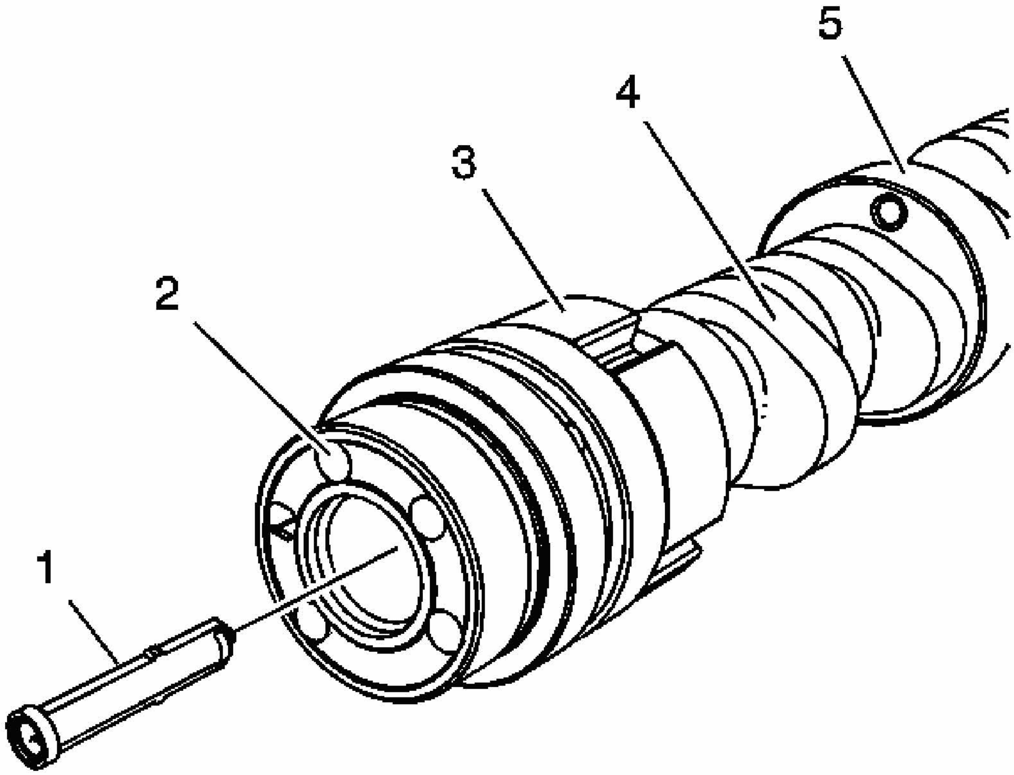


Fig. 361: Identifying Camshaft Inspection Points
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to CLEANING SOLVENT CAUTION in Cautions and Notices.

3. Inspect the camshaft for the following conditions:
   - Scored camshaft bearing journals (5)
   - Damaged camshaft lobes (4)
   - Damaged camshaft position sensor reluctor area (3)
   - Damaged threads (2)

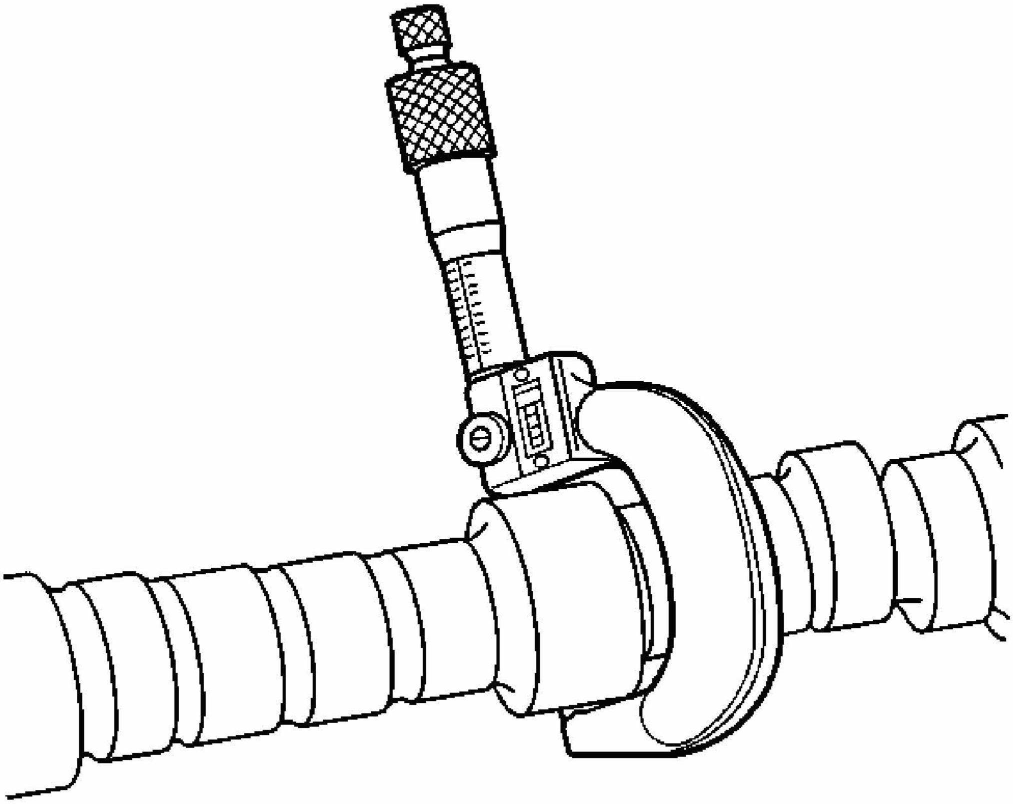


Fig. 362: Measure Camshaft Journals With Micrometer
Courtesy of GENERAL MOTORS CORP.

4. Measure the camshaft journals using a micrometer.

   If the camshaft journals are not within specifications, replace the camshaft.

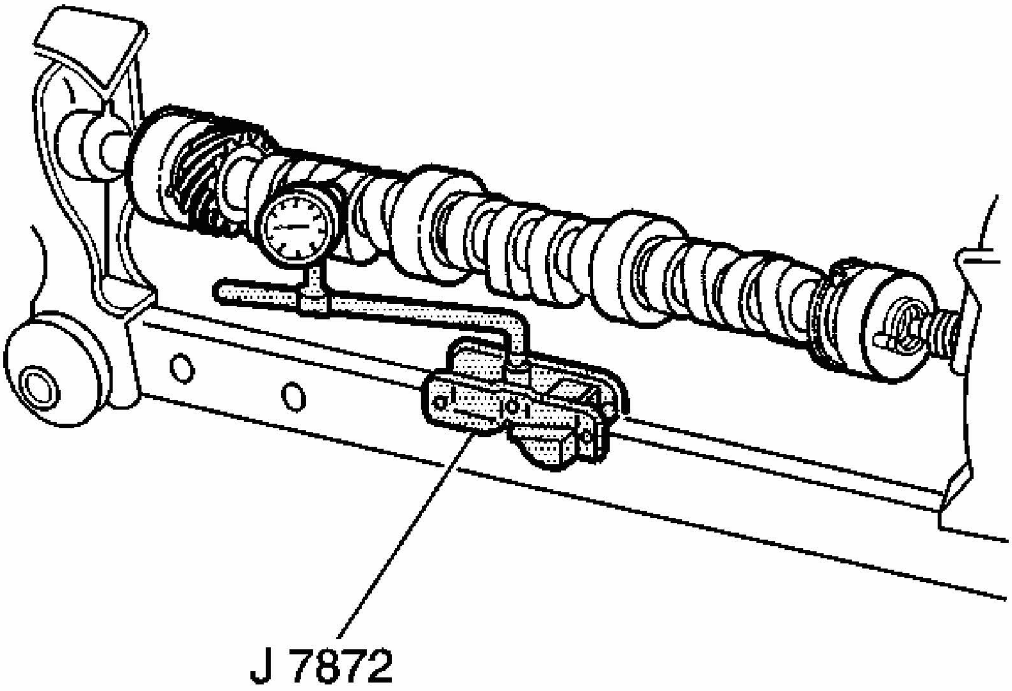


Fig. 363: Measuring Camshaft With J 7872
Courtesy of GENERAL MOTORS CORP.

5. Measure the camshaft runout using the **J 7872** . See **Special Tools**.
    1. Mount the camshaft in V-blocks between the centers.
    2. Use the **J 7872** in order to measure the intermediate camshaft journal. See **Special Tools**.
6. Measure the camshaft lobe lift using the **J 7872** . See **Special Tools**.
    1. Lubricate the camshaft using GM P/N 12345501 (Canadian P/N 992704) or the equivalent.
    2. Set the camshaft on V-blocks.
    3. Use the **J 7872** in order to measure the lobe lift. See **Special Tools**.
7. If the runout or lobe lift is not within specifications, replace the camshaft.

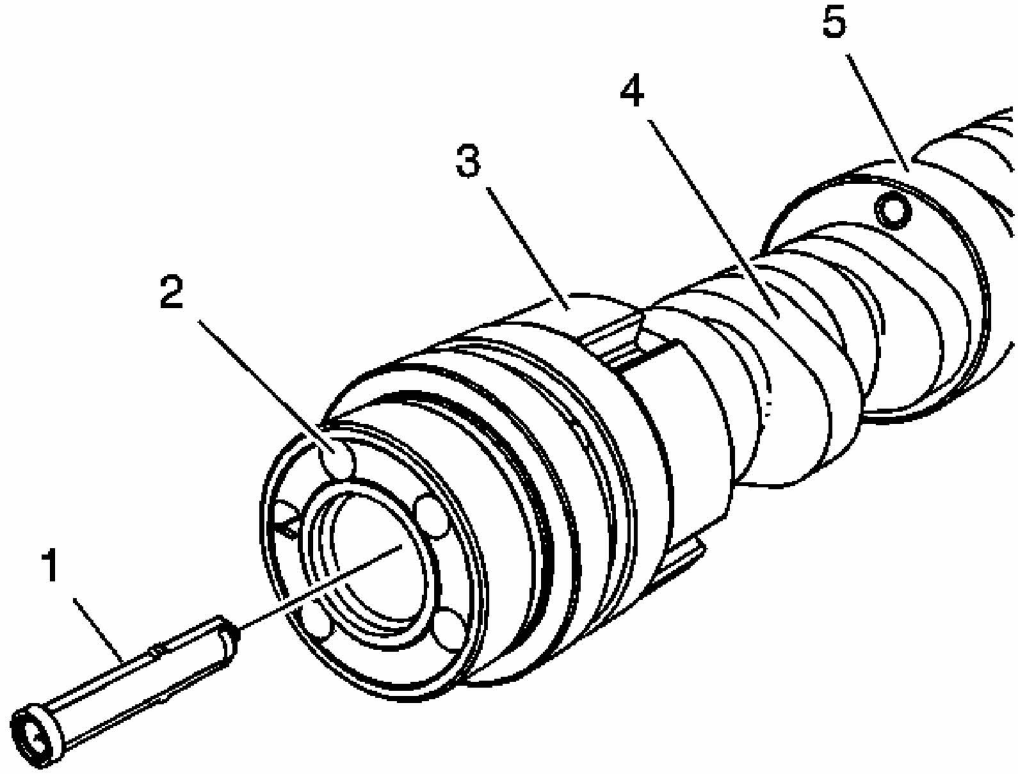


Fig. 364: View Of Camshaft & Actuator Filter
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Always install a NEW camshaft position actuator filter anytime the camshaft position actuator is removed or installed.

8. Install a NEW camshaft position actuator filter (1).

TIMING CHAIN AND SPROCKETS CLEANING AND INSPECTION

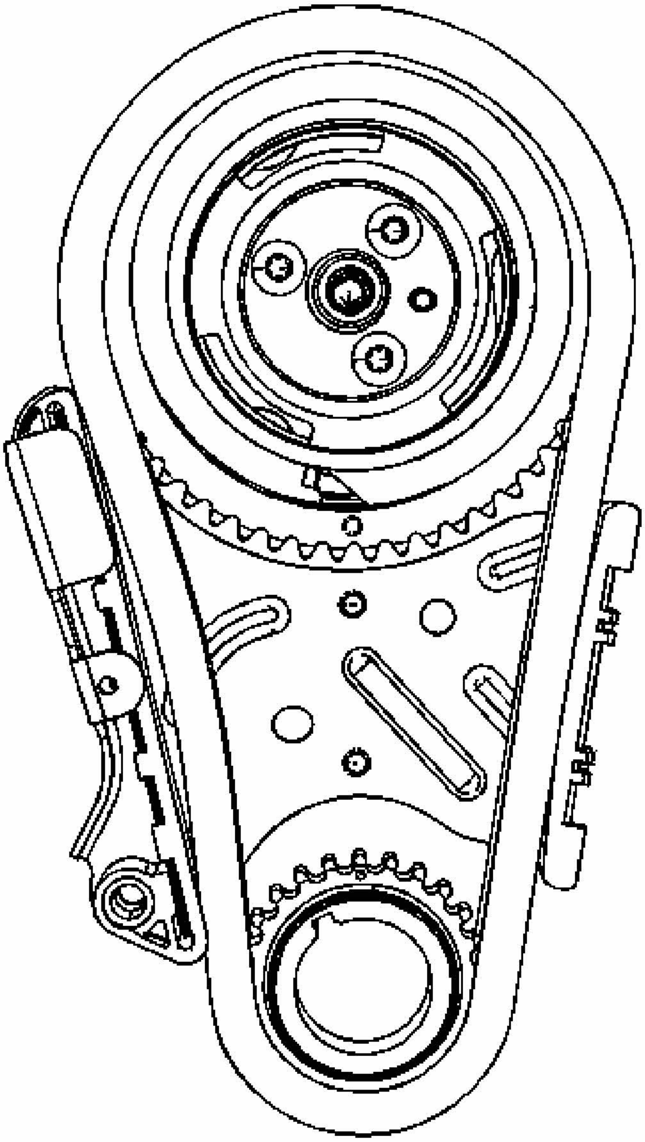


Fig. 365: View Of Timing Chain, Sprockets & Tensioners
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

1. Clean all components with cleaning solvent.
2. Dry the components with compressed air.
3. Inspect the timing chain for binding or wear.

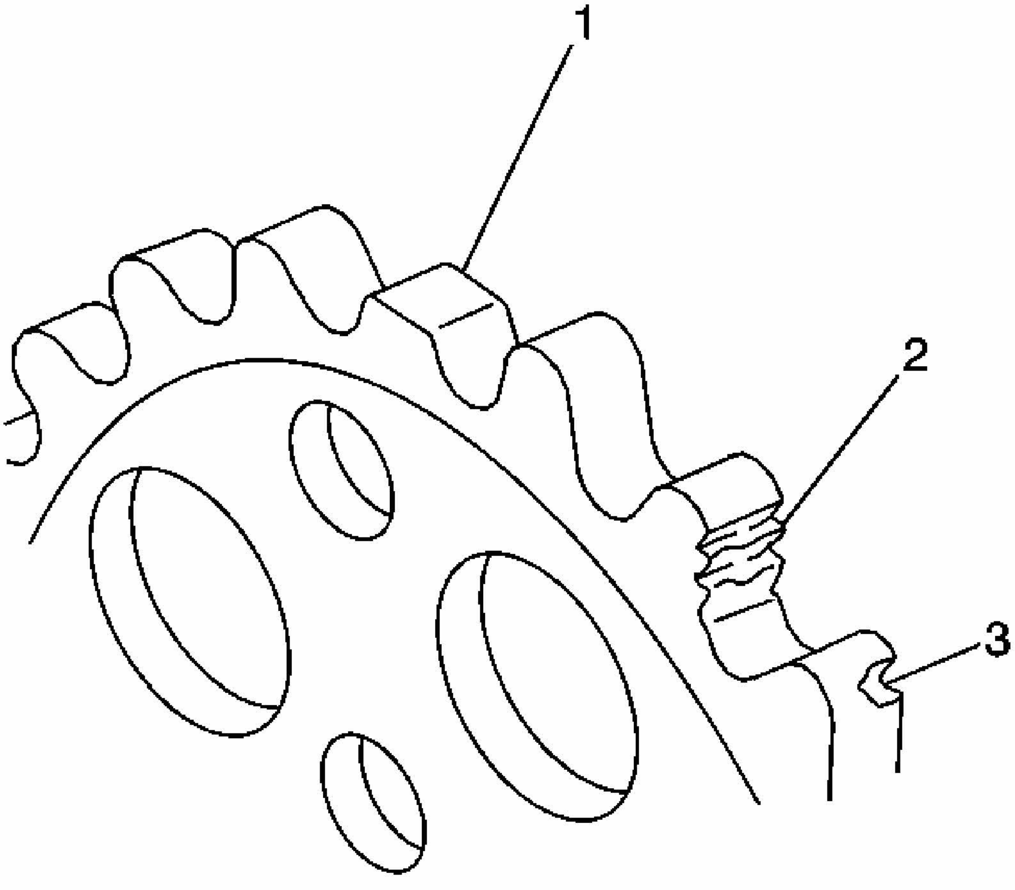


Fig. 366: Identifying Damaged Sprocket Teeth
Courtesy of GENERAL MOTORS CORP.

4. Inspect the camshaft and crankshaft sprockets for:
   - Worn teeth (1)
   - Broken teeth (2)
   - Chipped teeth (3)

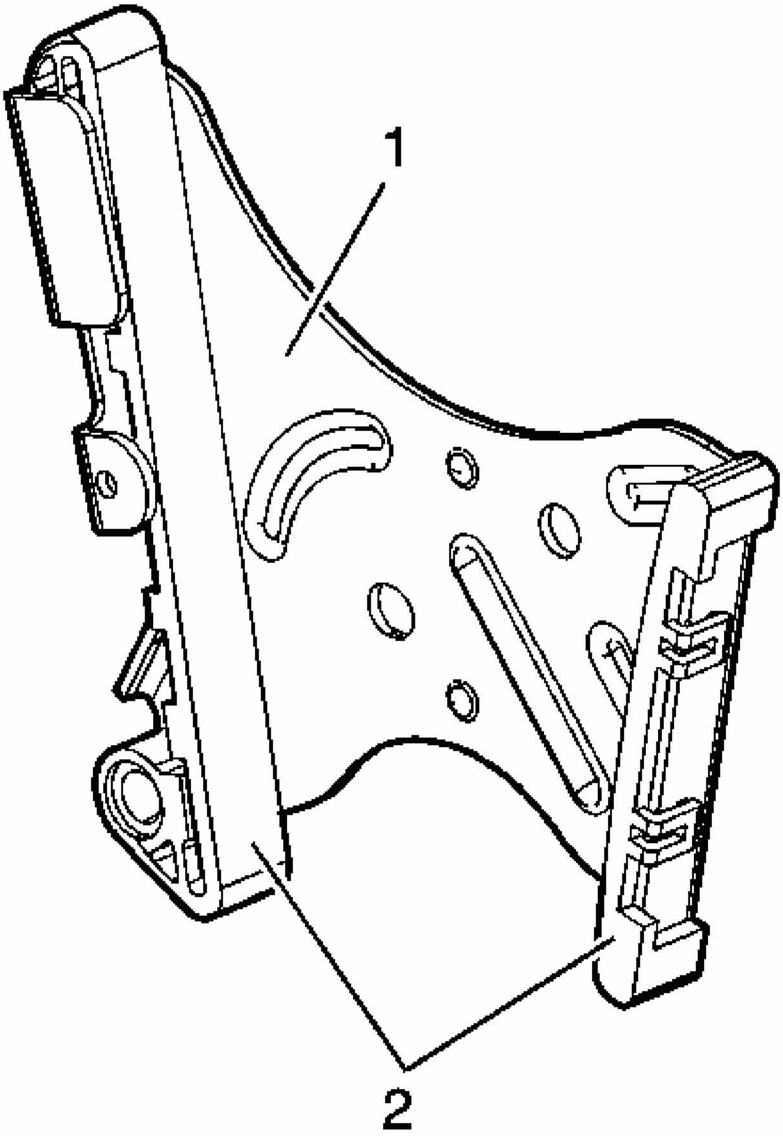


Fig. 367: Identifying Damaged Timing Chain Tensioner & Chain Tensioner Slides
Courtesy of GENERAL MOTORS CORP.

5. Inspect the timing chain tensioner (1) and timing chain tensioner slides (2) for excessive wear or cracks. Repair or replace as required.

CAMSHAFT POSITION ACTUATOR MAGNET CLEANING AND INSPECTION

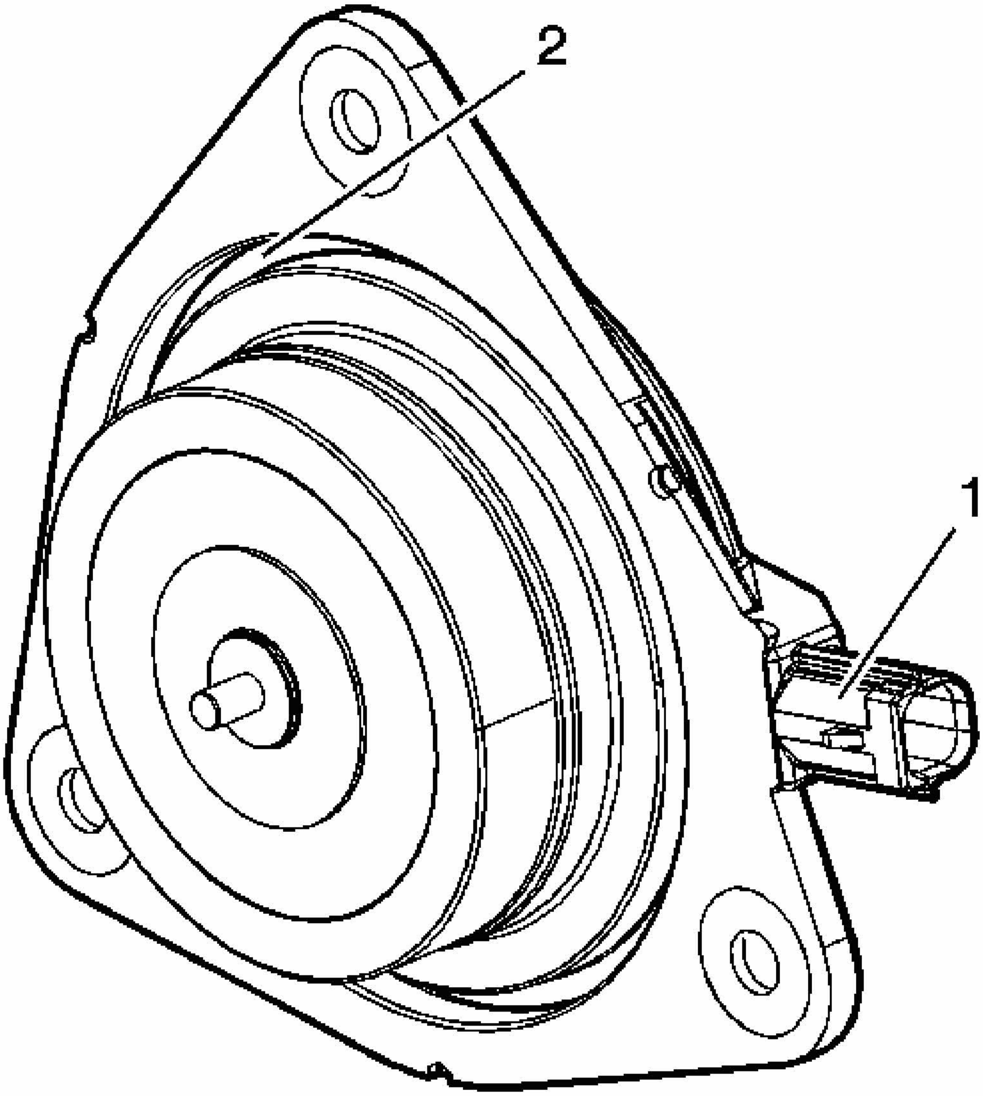


Fig. 368: Identifying Sealing Area & Magnet
Courtesy of GENERAL MOTORS CORP.

1. Inspect the camshaft position actuator magnet for the following conditions:
   - The camshaft position actuator magnet wiring connector (1) for damage.
   - The camshaft position actuator magnet O-ring seal and sealing area (2) for damage.
2. Repair or replace the camshaft position actuator housing and/or components as necessary.

CAMSHAFT POSITION ACTUATOR CLEANING AND INSPECTION

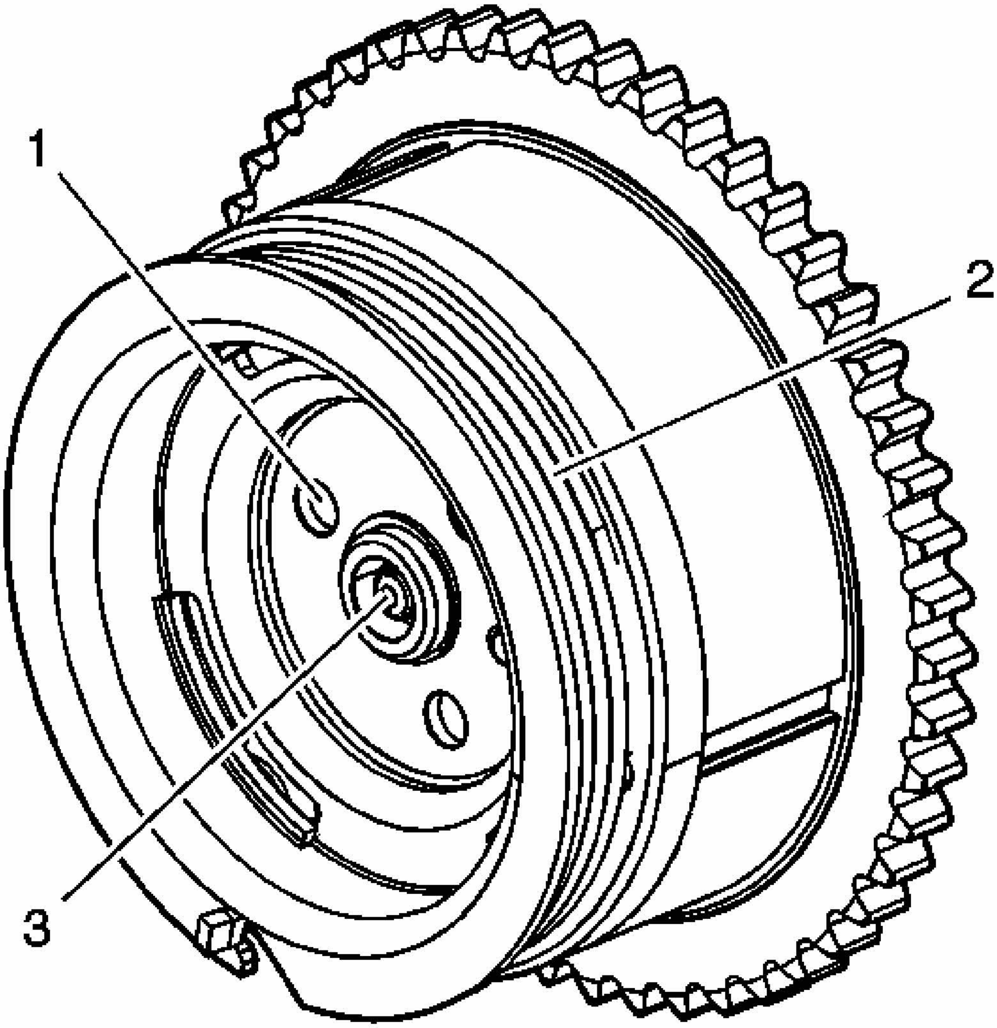


Fig. 369: Identifying Camshaft Position Actuator
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to CLEANING SOLVENT CAUTION in Cautions and Notices.

1. Clean the camshaft position actuator components with solvent.

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.

2. Dry the camshaft position actuator components with compressed air.
3. Inspect the camshaft position actuator for the following conditions:
    - The camshaft position actuator mounting bores (1) for damage.
    - The camshaft position actuator return spring (2) for nicks or damage.
    - The camshaft position actuator valve surface for pitting or damage (3).
4. Repair or replace the camshaft position actuator as necessary.

VALVE LIFTERS CLEANING AND INSPECTION

1. Clean the valve lifters in cleaning solvent.

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.

2. Dry the valve lifters with compressed air.

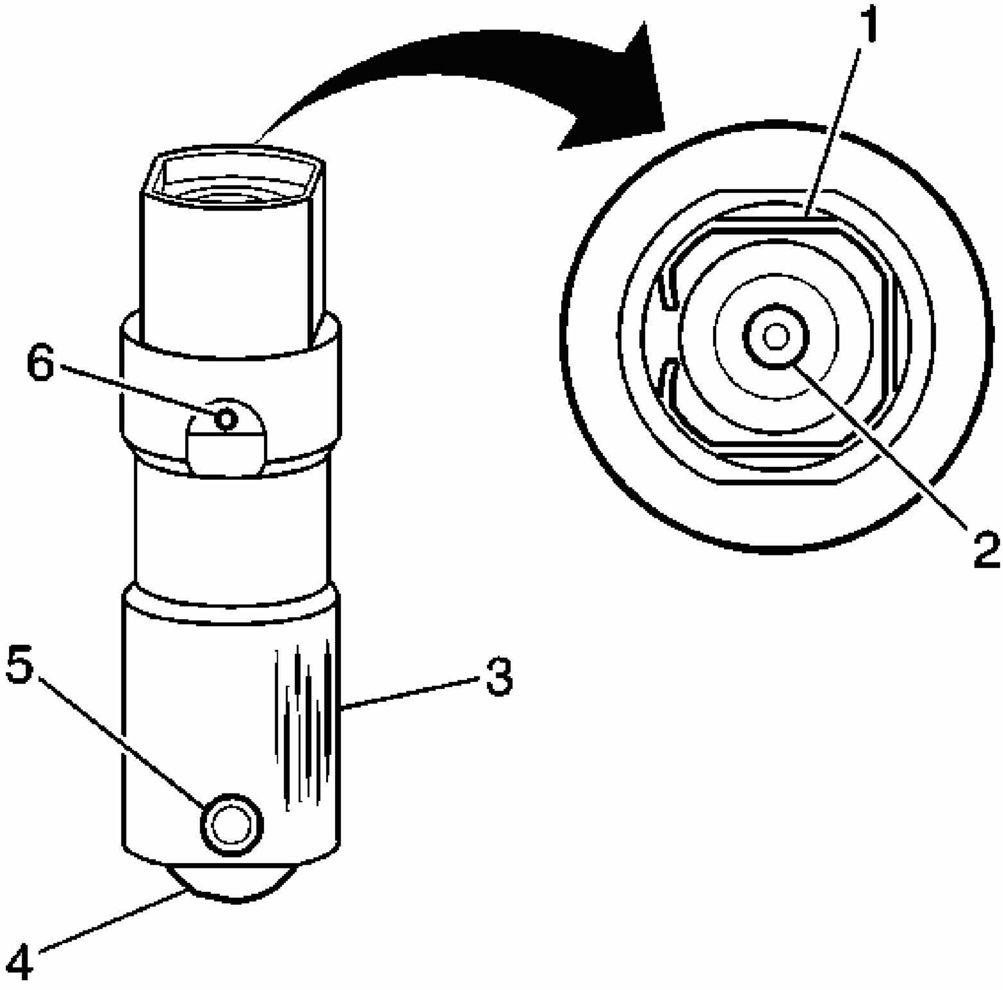


Fig. 370: Inspecting Areas Of Valve Lifters
Courtesy of GENERAL MOTORS CORP.

3. Inspect the valve lifters for the following:
   - Bent or broken clip (1)
   - Worn push rod socket (2)
   - Scuffed or worn sides (3)

     If the valve lifter shows wear, inspect the engine block lifter bores for wear or damage.

   - Flat spots on the roller (4)
   - Loose or damaged pin (5)

- Plugged oil hole (6)
- Worn or damaged roller bearing

  The roller should rotate freely with no binding or roughness.

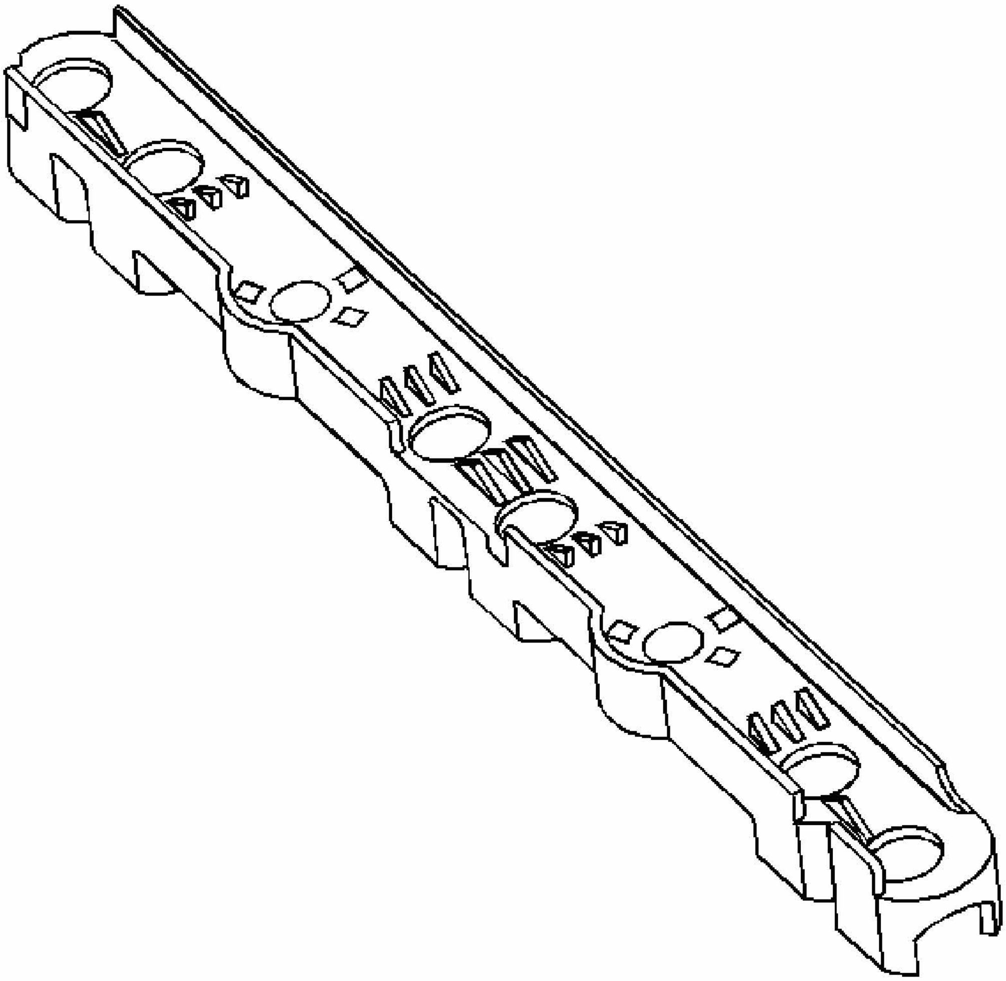


Fig. 371: View Of Valve Lifter Guides
Courtesy of GENERAL MOTORS CORP.

4. Inspect the valve lifter guides for the following:
   - For cracks or damage
   - Excessive wear in the lifter mounting bores

VALVE ROCKER ARM AND PUSH RODS CLEANING AND INSPECTION

CAUTION: Refer to CLEANING SOLVENT CAUTION in Cautions and Notices.

1. Clean the valve rocker arms and push rods in cleaning solvent.

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.

2. Dry the valve rocker arms and push rods with compressed air.

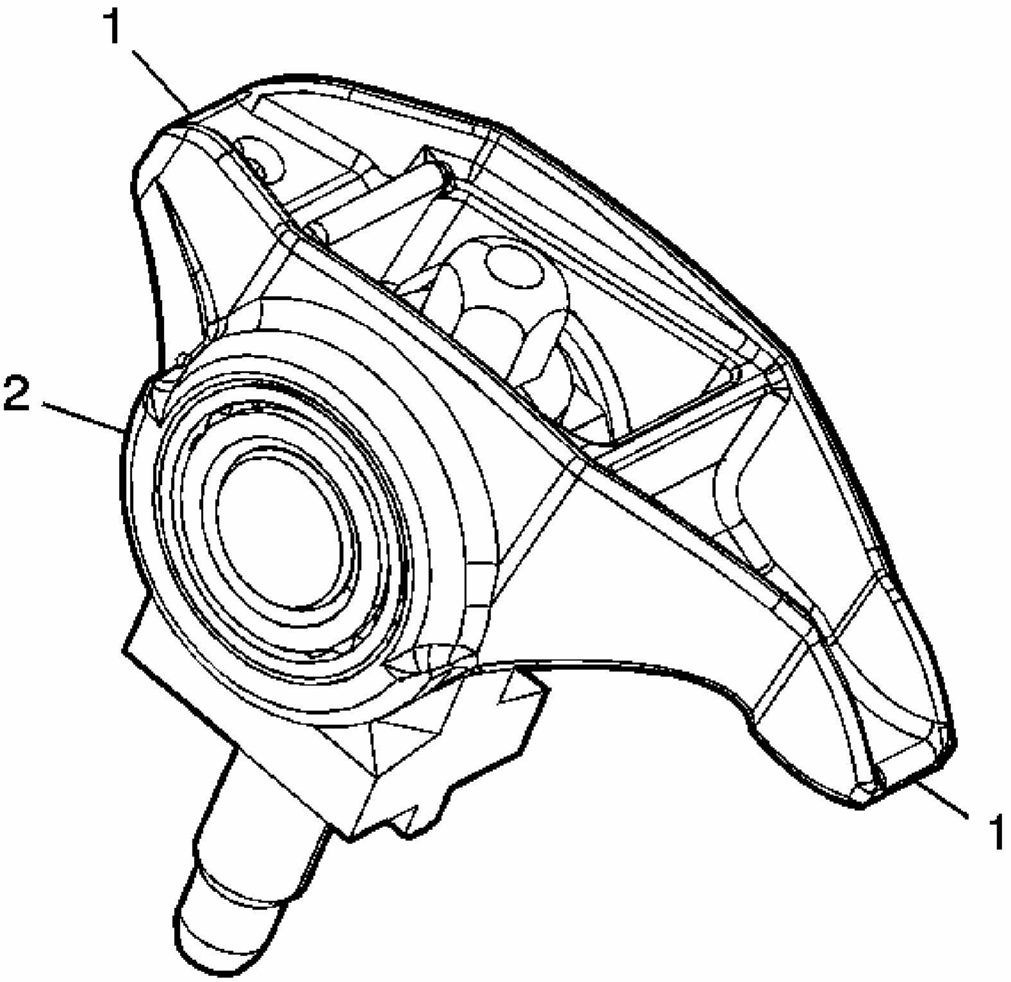


Fig. 372: Inspecting Rocker Arm Assemblies
Courtesy of GENERAL MOTORS CORP.

3. Inspect the valve rocker arms for the following conditions:

- Excessive wear at the valve contact or push rod socket area (1)
- A loose or damaged pin (2)
- A worn or damaged roller bearing (2)

  The roller should rotate freely with no binding or roughness.

- The bolt threads for damage

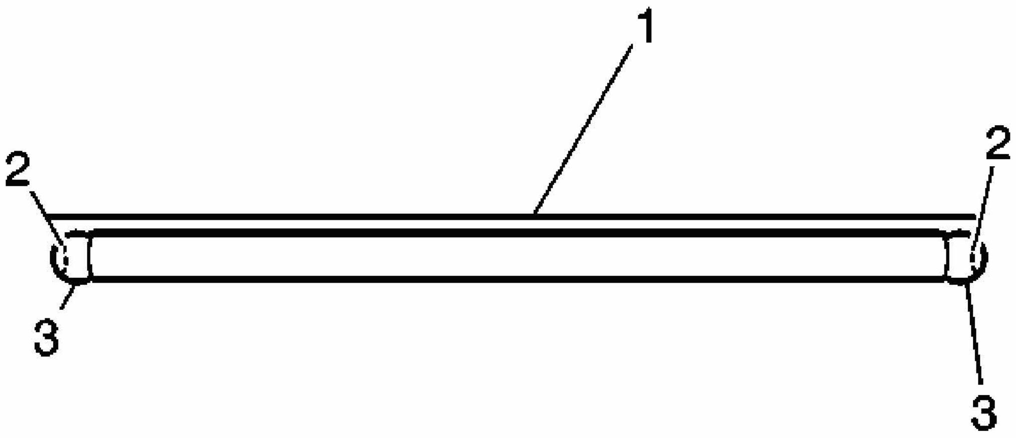


Fig. 373: Inspecting Push Rods
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Keep the push rods in order. The intake and exhaust are different lengths.

4. Inspect the push rods for the following conditions:
   - Straightness using a straight edge (1)
   - Excessive wear on the push rod ends (3)
   - Clogging of the oil passage (2)

CYLINDER HEAD DISASSEMBLE

Tools Required

- **EN-47823** Valve Spring Compressor Adapter. See **Special Tools**.
- **J 5892-D** Valve Spring Compressor. See **Special Tools**.

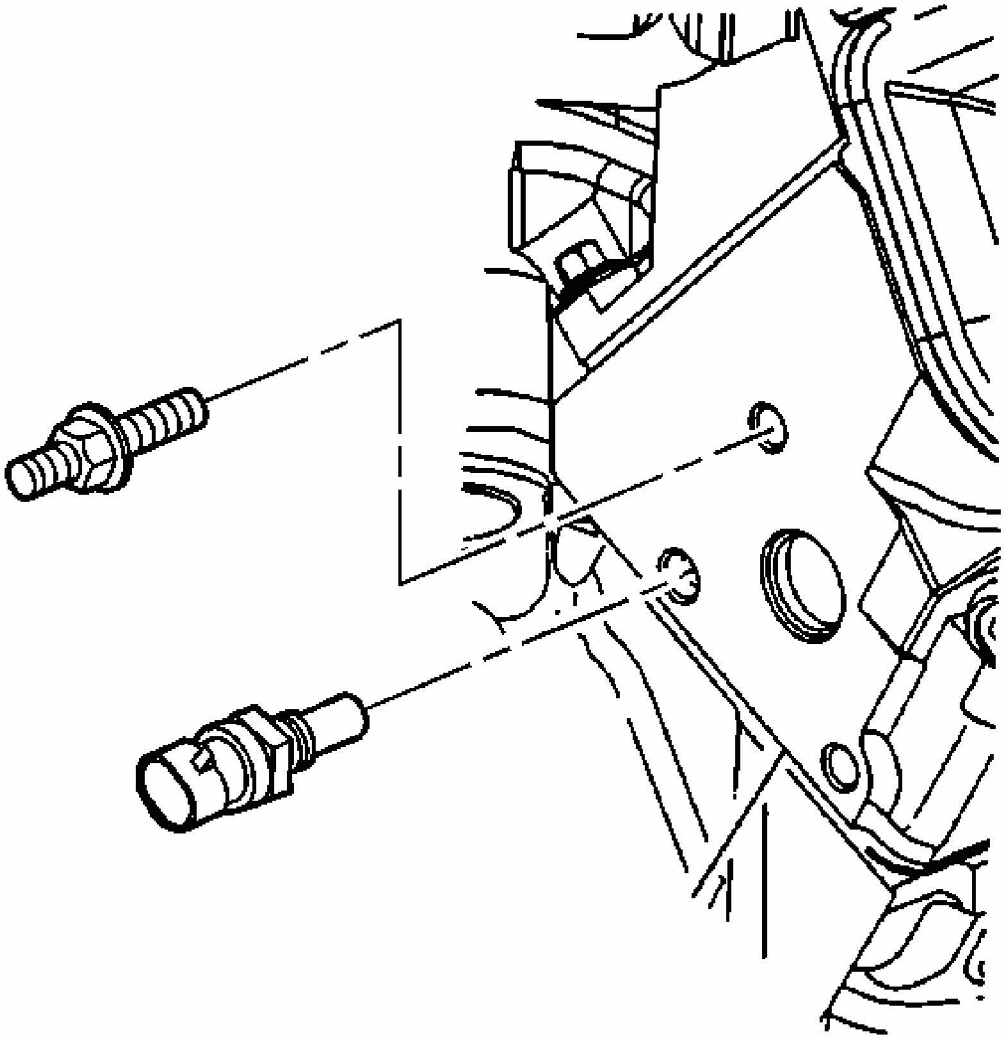


Fig. 374: View Of Heater Inlet Pipe Stud & Coolant Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

1. Remove the heater inlet pipe stud from the right cylinder head, if required.
2. Remove the coolant temperature sensor from the right cylinder head, if required.

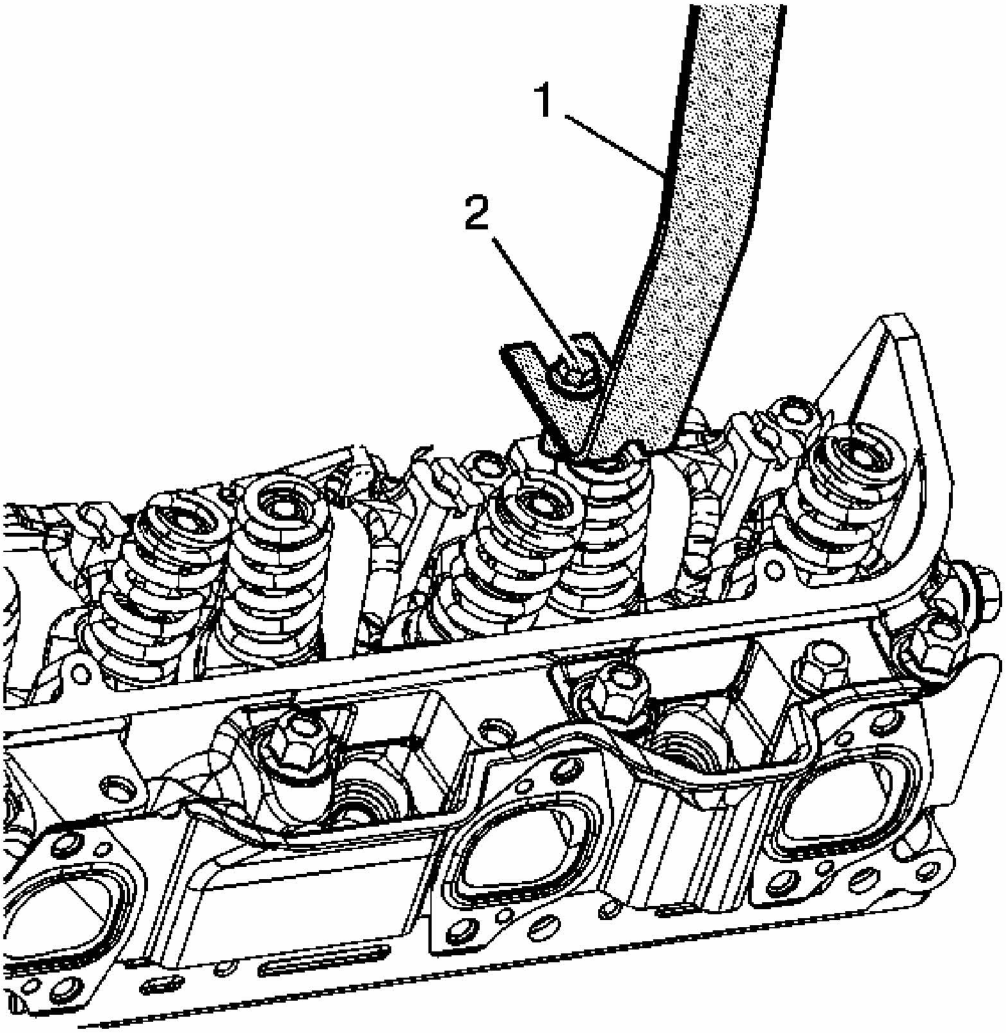


Fig. 375: Compressing Valve Springs
Courtesy of GENERAL MOTORS CORP.

3. Using caution so as not to damage the valve spring or valve spring dampener, compress the valve springs using the **J 5892-D** (1) and the **EN-47823** (2). See **Special Tools**.

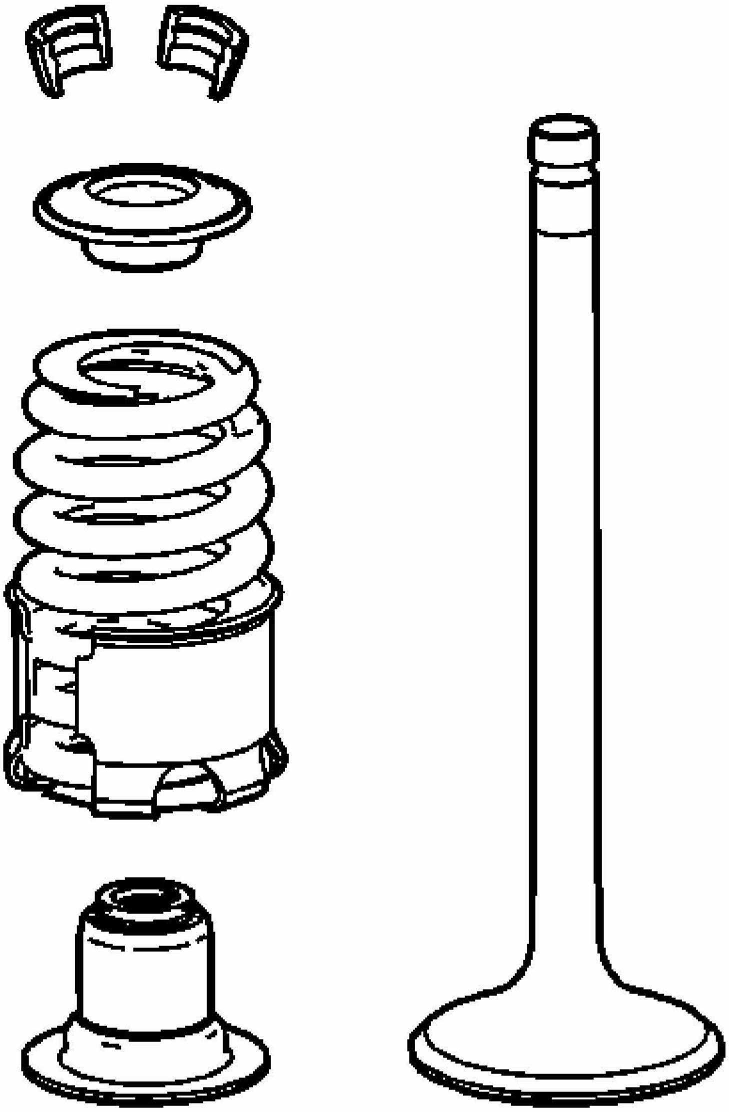


Fig. 376: View Of Valve Components
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not damage the valve guide. Remove any burrs that have formed at the key groove by chamfering the valve stem with an oil stone or a file.

IMPORTANT: Ensure that the valve train components are marked, organized or sorted when disassembling the cylinder

head. Install the valve train components in the original location from which the component were removed.

4. Remove the valve spring cap keys.
5. Remove the valve spring caps.
6. Remove the valve spring assembly.
7. Remove the valves.
8. Remove the valve stem oil seals and spring seats as an assembly.
9. Inspect all valve components for any damage or excess wear. Repair or replace as necessary.

CYLINDER HEAD CLEANING AND INSPECTION

Tools Required

- **J 8089** Carbon Removing Brush. See **Special Tools**.
- **J 9666** Valve Spring Tester

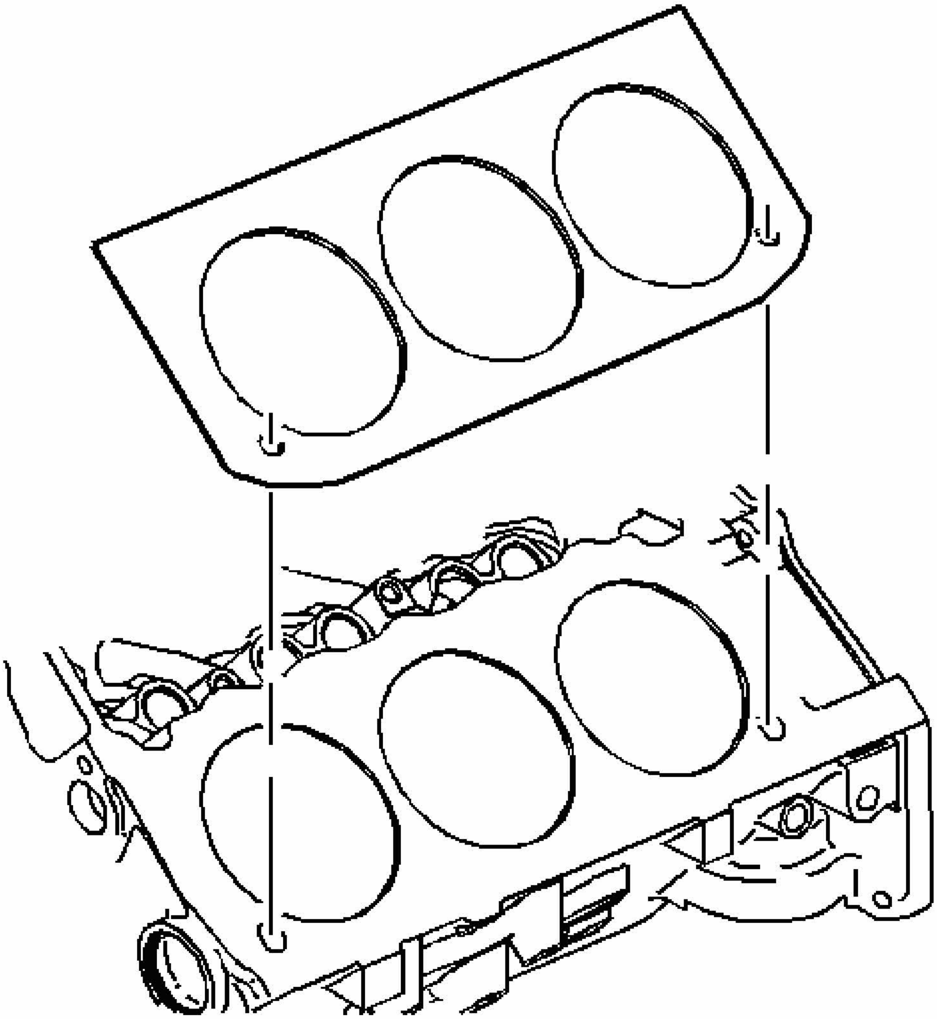


Fig. 377: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

1. Inspect the cylinder head gasket and the mating surfaces. Inspect for leaks, corrosion, and blowby.
2. If the gasket failed, determine the cause. The following conditions may cause gasket failure:
    - Improper installation
    - A loose or warped cylinder head
    - Missing, off location, or not fully seated dowel pins
    - Low torque on the cylinder head bolts

- Cylinder head bolts with the incorrect length
- A warped engine block surface
- Scratched surfaces
- Excessive intake manifold torque
- Cracked engine block threaded holes

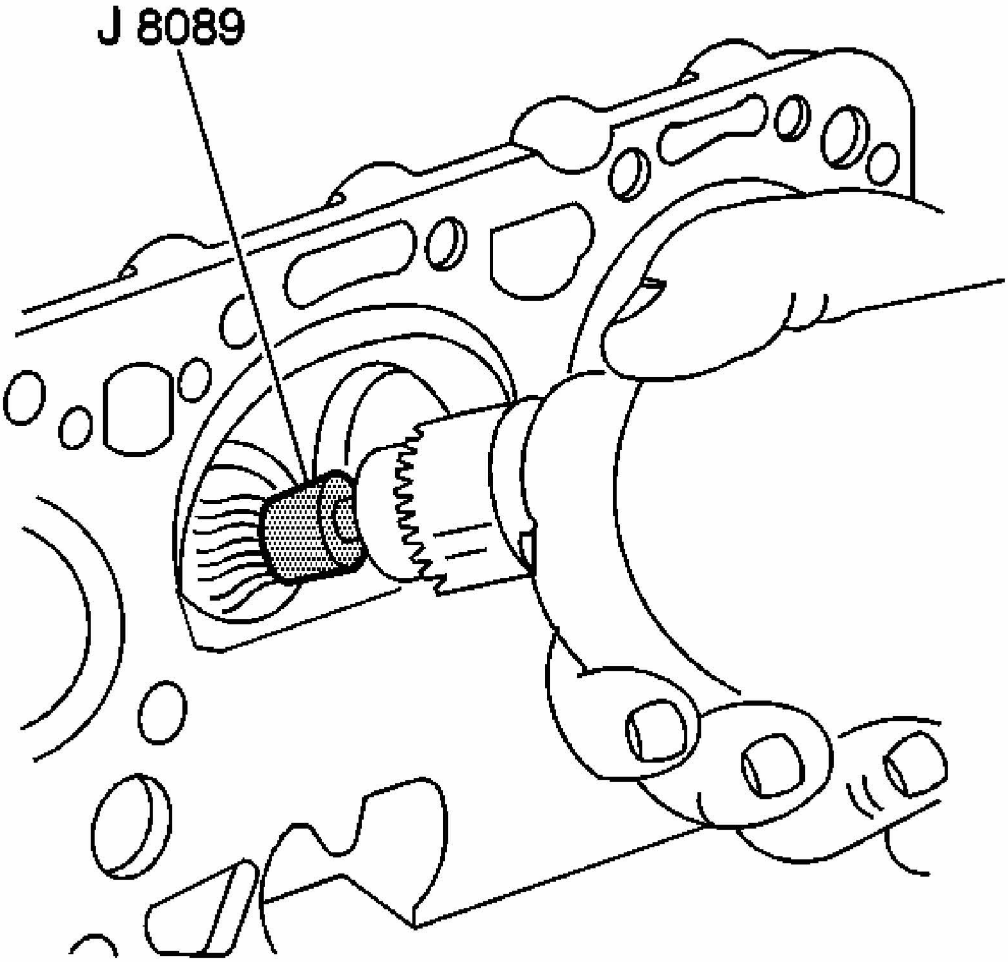


Fig. 378: Removing Carbon From Combustion Chambers
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.

IMPORTANT: Do not scuff the

chamber.

3. Use the **J 8089** in order to remove the carbon from the combustion chambers. See **Special Tools**.
4. Clean the following components:
   - The gasket surfaces

     Do not use a motorized brush on any gasket sealing surface.
   - Valve stems and heads on a buffing wheel
   - The bolt hole threads

     Remove all dirt, debris, or threadlocking material from the bolt holes.

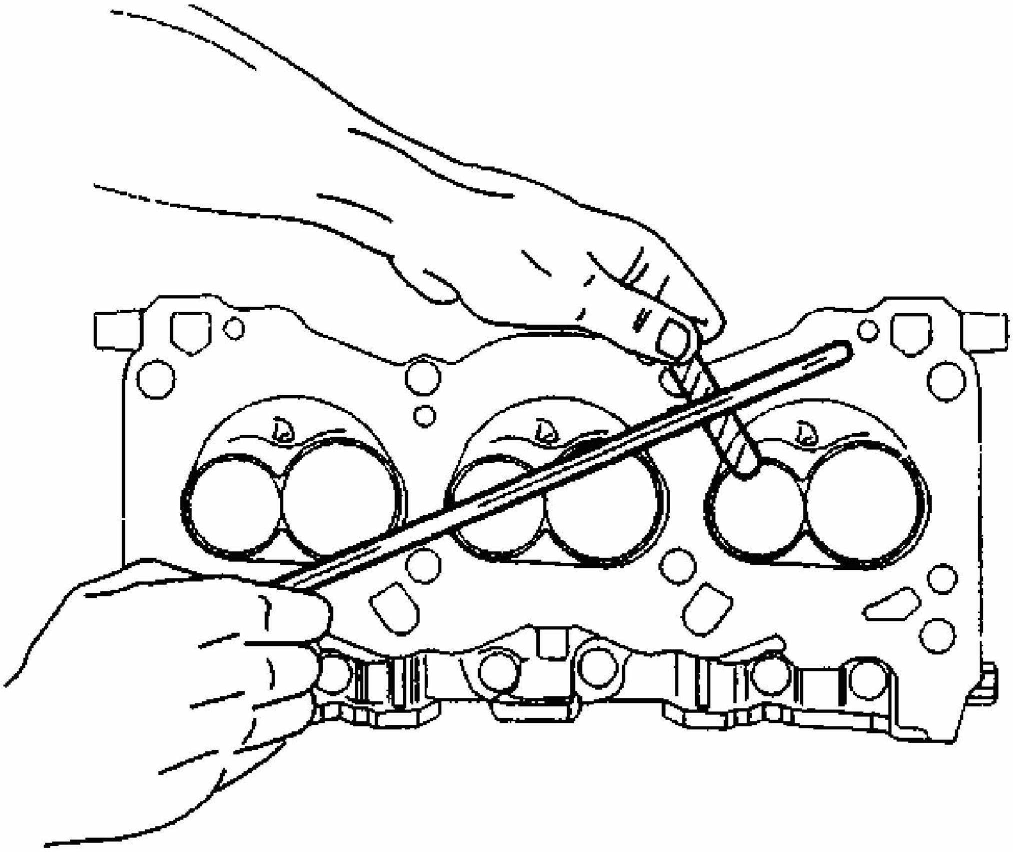


Fig. 379: Inspecting Cylinder Head Mating Surfaces For Flatness
Courtesy of GENERAL MOTORS CORP.

5. Inspect the cylinder head mating surfaces for flatness. Replace the cylinder head if it is outside of the specification limit.
6. Inspect the cylinder head for cracks.
7. Inspect the cylinder head deck for corrosion. Do not attempt to weld the cylinder head. If the cylinder head is damaged, replace the cylinder head.

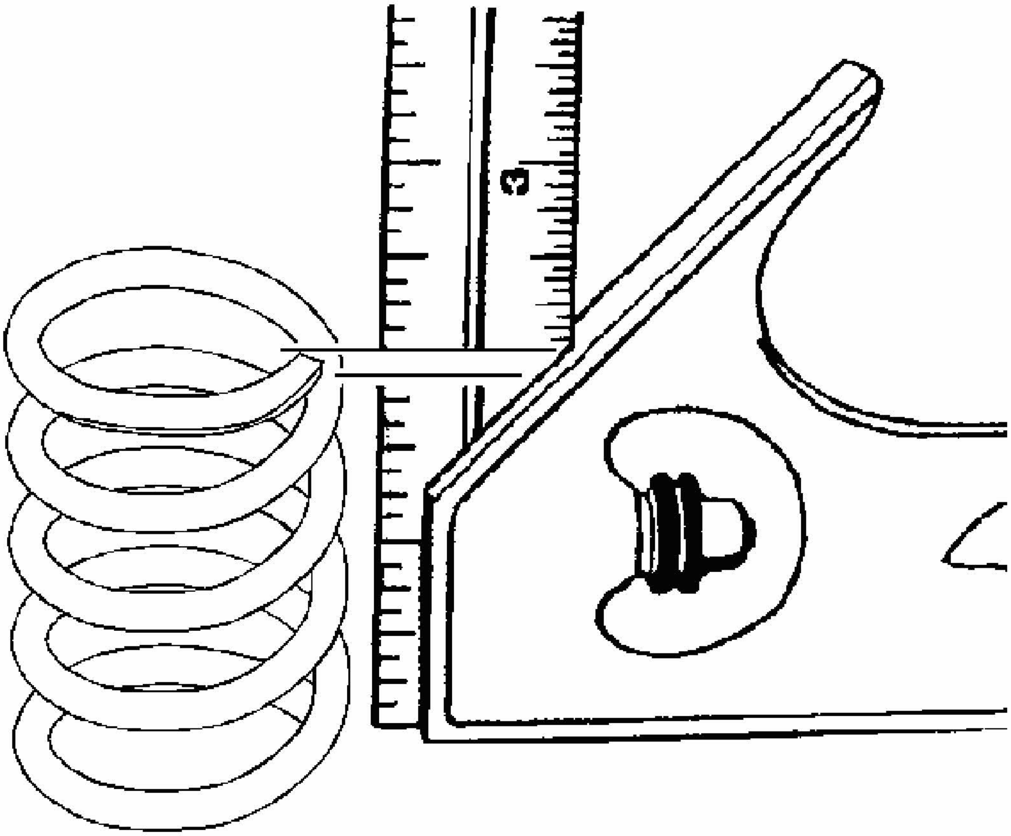


Fig. 380: Inspecting Valve Spring For Squareness
Courtesy of GENERAL MOTORS CORP.

8. Inspect the valve springs for squareness.

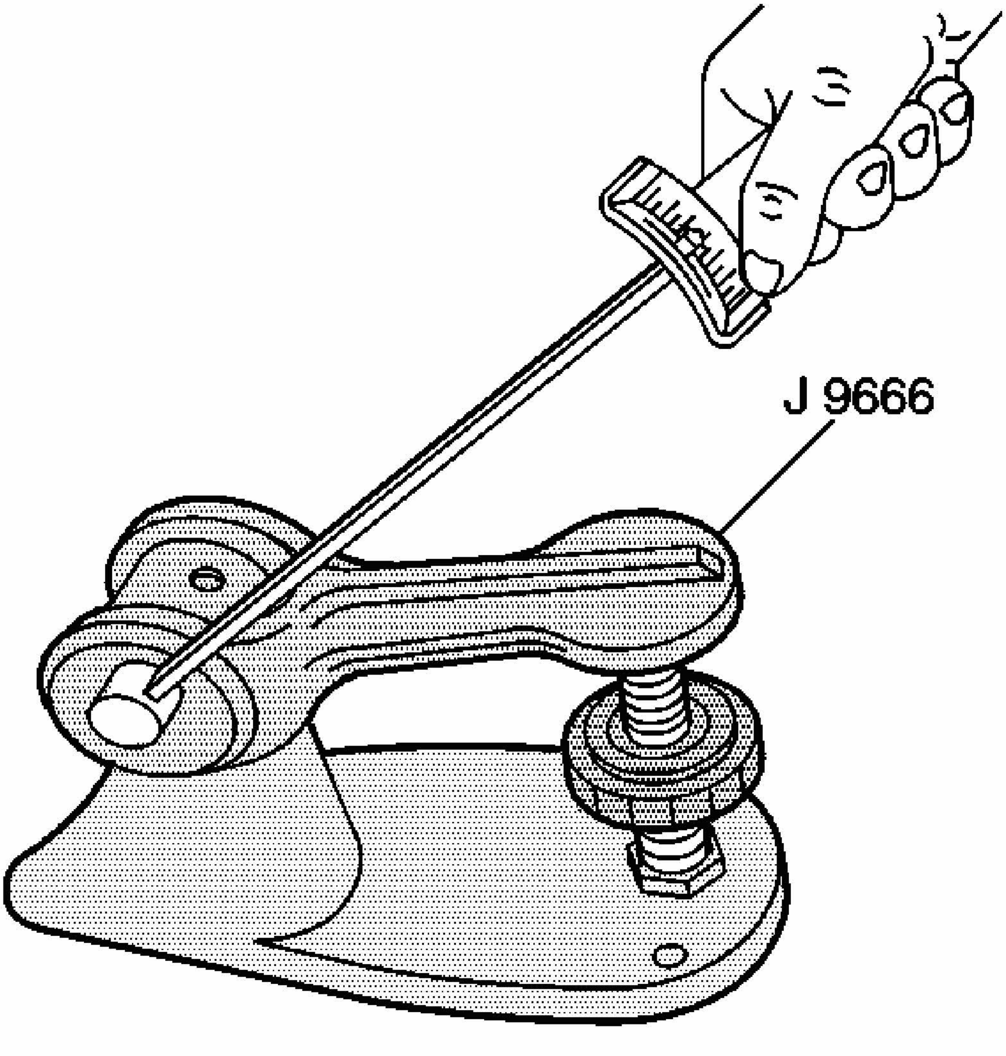


Fig. 381: Measuring Valve Spring Tension
Courtesy of GENERAL MOTORS CORP.

9. Use the **J 9666** in order to measure the valve spring tension.

   Replace the spring if the spring tension is not within specification.

VALVE GUIDE REAMING/VALVE AND SEAT GRINDING

Tools Required

J 8520 Camshaft Lobe Lift Indicator Set. See **Special Tools**.

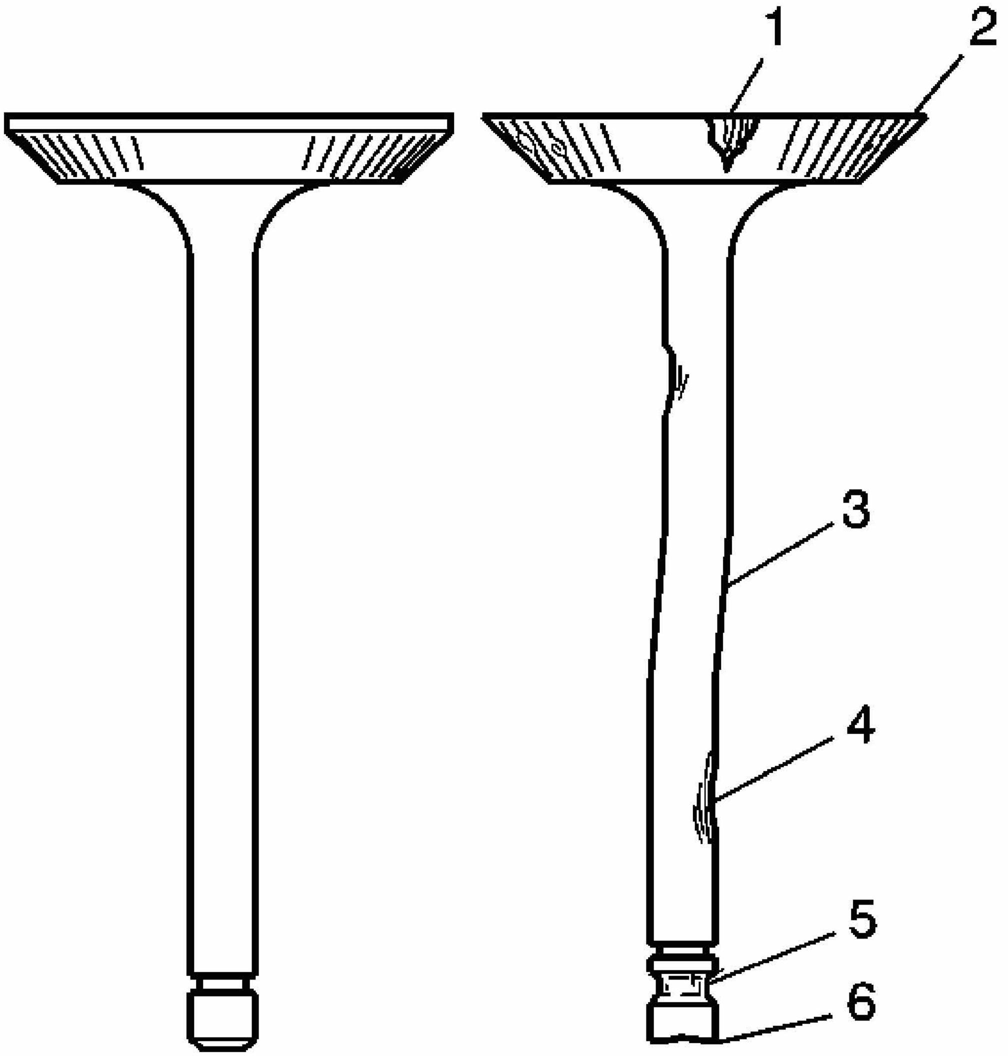


Fig. 382: Identifying Inspection Points For Valves Damage
Courtesy of GENERAL MOTORS CORP.

1. Inspect the valves for the following conditions:
   - Burnt or eroded areas (1)
   - A worn margin (2)
   - A bent stem (3)
   - A worn or scored stem (4)
   - A worn key groove (5)
   - A worn stem tip (6)

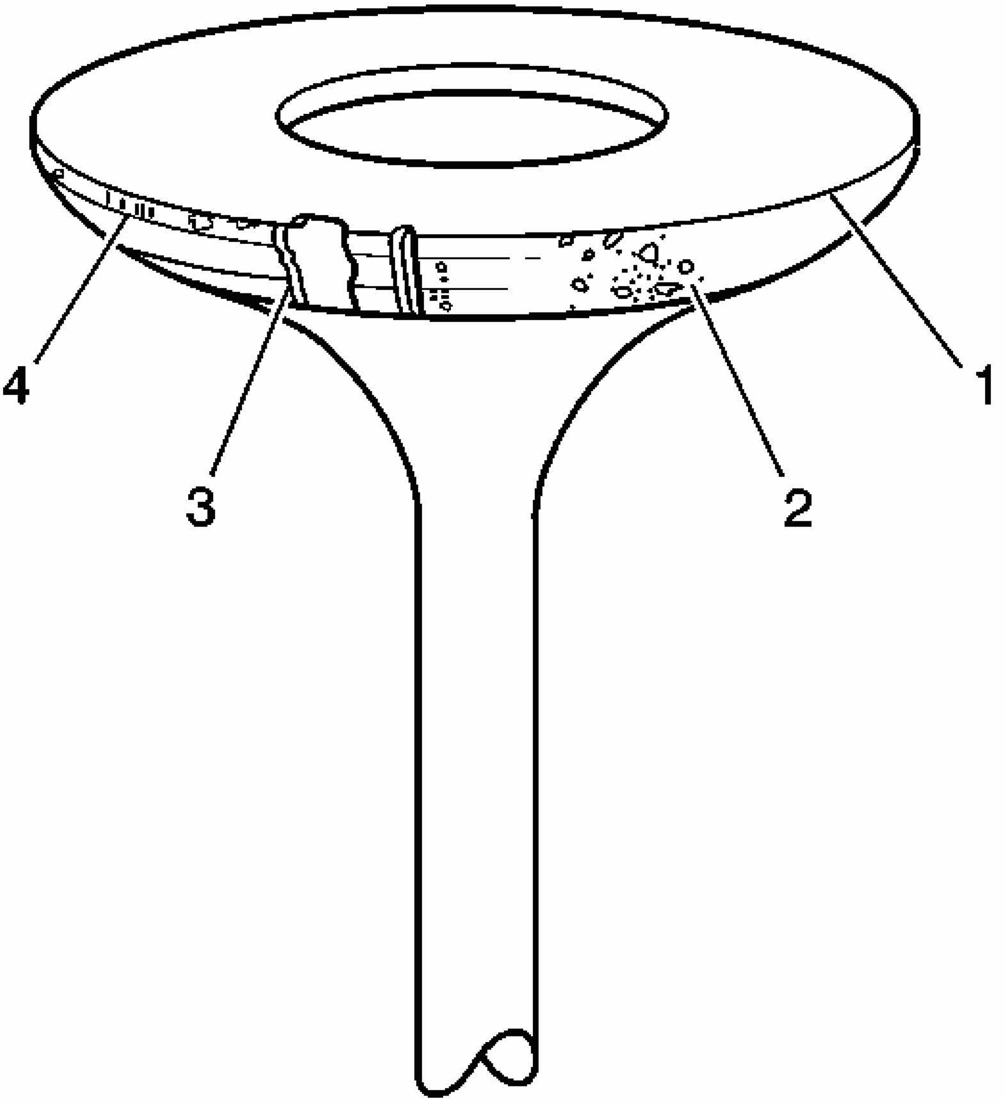


Fig. 383: Inspecting Valve Face For Burning, Pitting & Cracking
Courtesy of GENERAL MOTORS CORP.

2. Inspect the valve face for the following conditions:
   - Worn margin (4)
   - No margin (1)
   - Pitted surfaces (2)
   - Burnt or eroded areas (3)
3. Inspect the valve seats for a loose fit in the cylinder head.

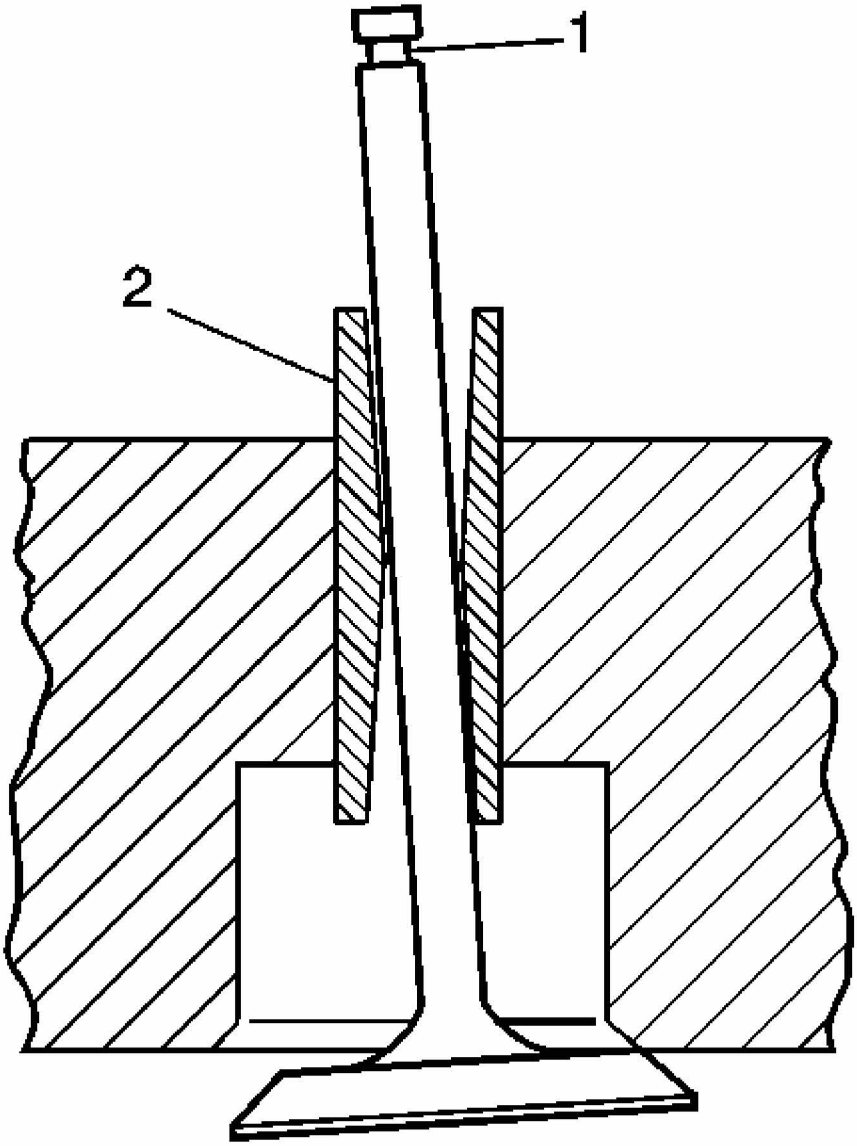


Fig. 384: Inspecting For Excessive Valve Stem To Guide Clearance
Courtesy of GENERAL MOTORS CORP.

NOTE: **Proper valve stem-to-valve guide clearance is necessary for proper engine operation and component life. Excessive clearance may cause a noisy valve train, premature valve stem oil seal failure, excessive oil consumption and related component damage. Insufficient clearance may cause a noisy valve train, rough engine operation or sticking valves**

that may lead to related component damage. Failure to inspect valve stem-to-valve guide clearance and repair or replace necessary components may lead to extensive engine damage.

IMPORTANT: Excessive valve stem-to guide clearance may cause the following conditions:

- **A noisy valve train**
- **Premature valve stem oil seal wear**
- **Component damage**
- **Excessive engine oil consumption**

4. Inspect for excessive valve stem (1) to guide (2) clearance.

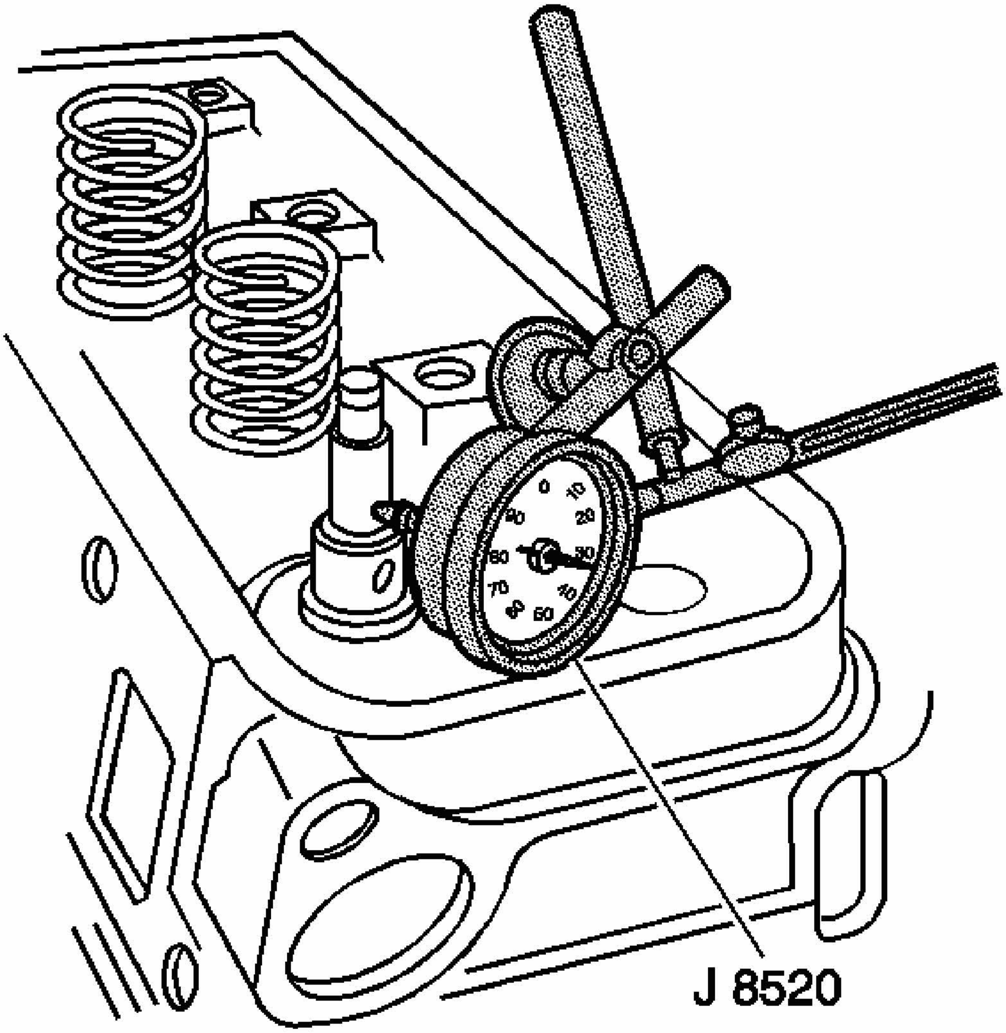


Fig. 385: Identifying J 8520
Courtesy of GENERAL MOTORS CORP.

5. Use a dial indicator in order to measure the valve stem-to-guide clearance. Complete the following steps:
    1. Install the valve into the guide.
    2. Install the **J 8520** onto the cylinder head. See **Special Tools**.
    3. Locate the dial indicator so that the movement of the valve stem from side to side, crosswise to the cylinder head, will cause a direct movement on the indicator stem.
    4. Ensure that the indicator stem contacts the side of the valve stem just above the valve guide.

5. Drop the valve head about 2 mm (1/8 in) off the valve seat.
6. Use light pressure and move the valve stem side to side in order to obtain a clearance reading.
7. If the valve stem to guide clearance is not within specification, replace the valve and/or repair the guide in order to obtain the proper clearances.

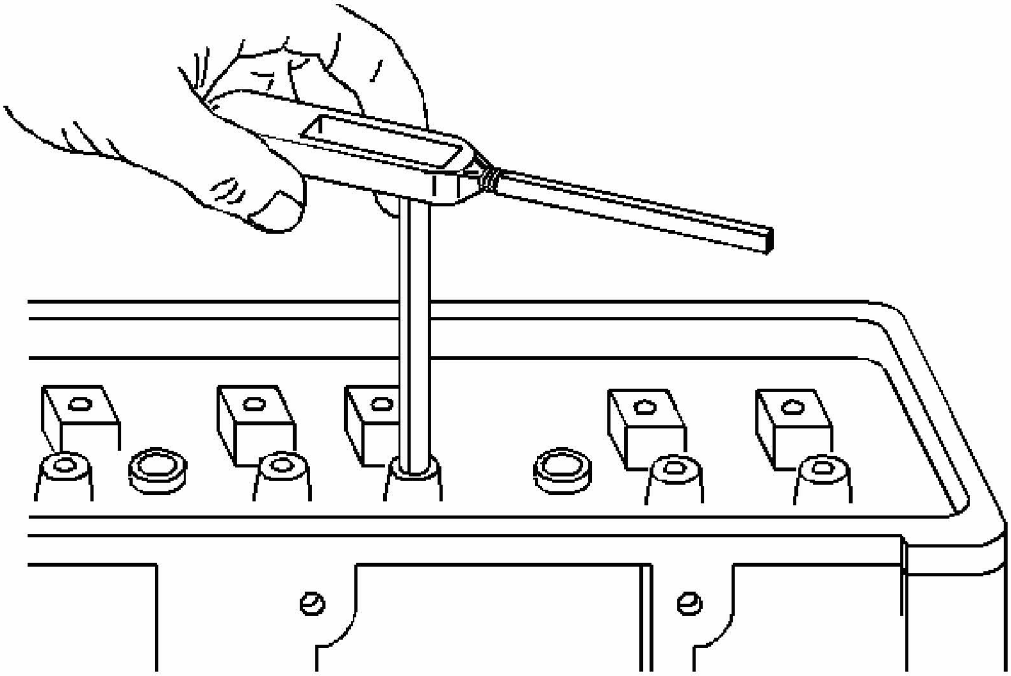


Fig. 386: Reaming Valve Guides For Oversize Valves
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Replace a valve stem that has excessive scoring or wear. A valve guide that is worn and has excessive stem-to-guide clearance may need to be sleeved.

6. Ream the valve guides for oversize valves if the clearance exceeds the specifications.

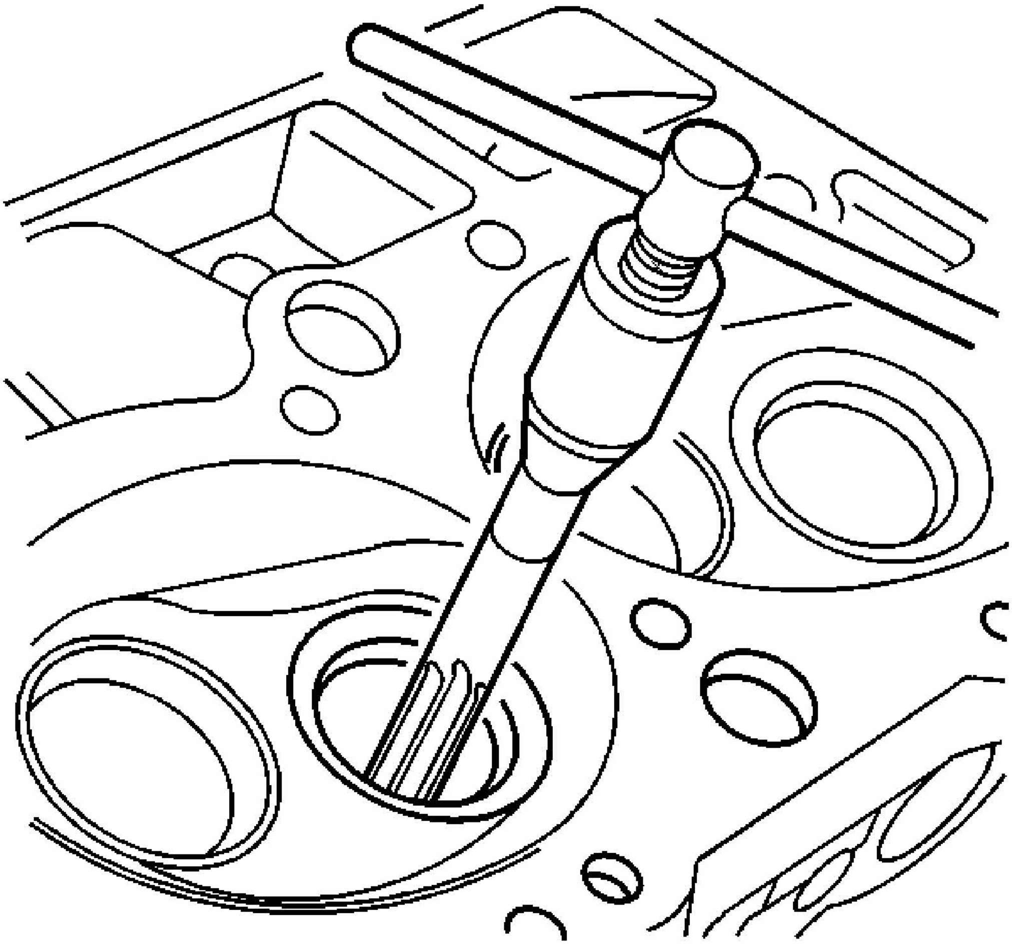


Fig. 387: Reaming Valve Guide
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Follow the manufacturers instructions when using valve guide reamers, sleeves, and installers.

7. Ream the valve guide in order to obtain the proper specification.

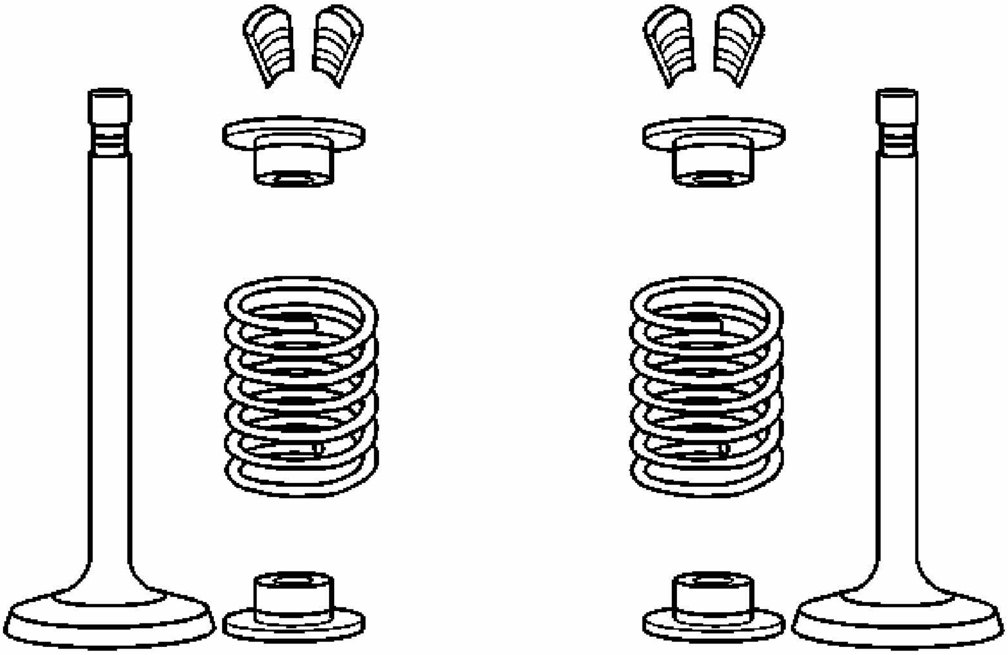


Fig. 388: Valve Locks, Caps, Seats & Spring
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **Valves that are pitted must be refaced to the proper angle. Replace valve stems that show excessive wear, or replace valves that are warped. Several different types of equipment are available for refacing valves and valve seats. Follow the manufacturers recommendations when performing these procedures.**

8. Inspect the valves for excessive scoring.

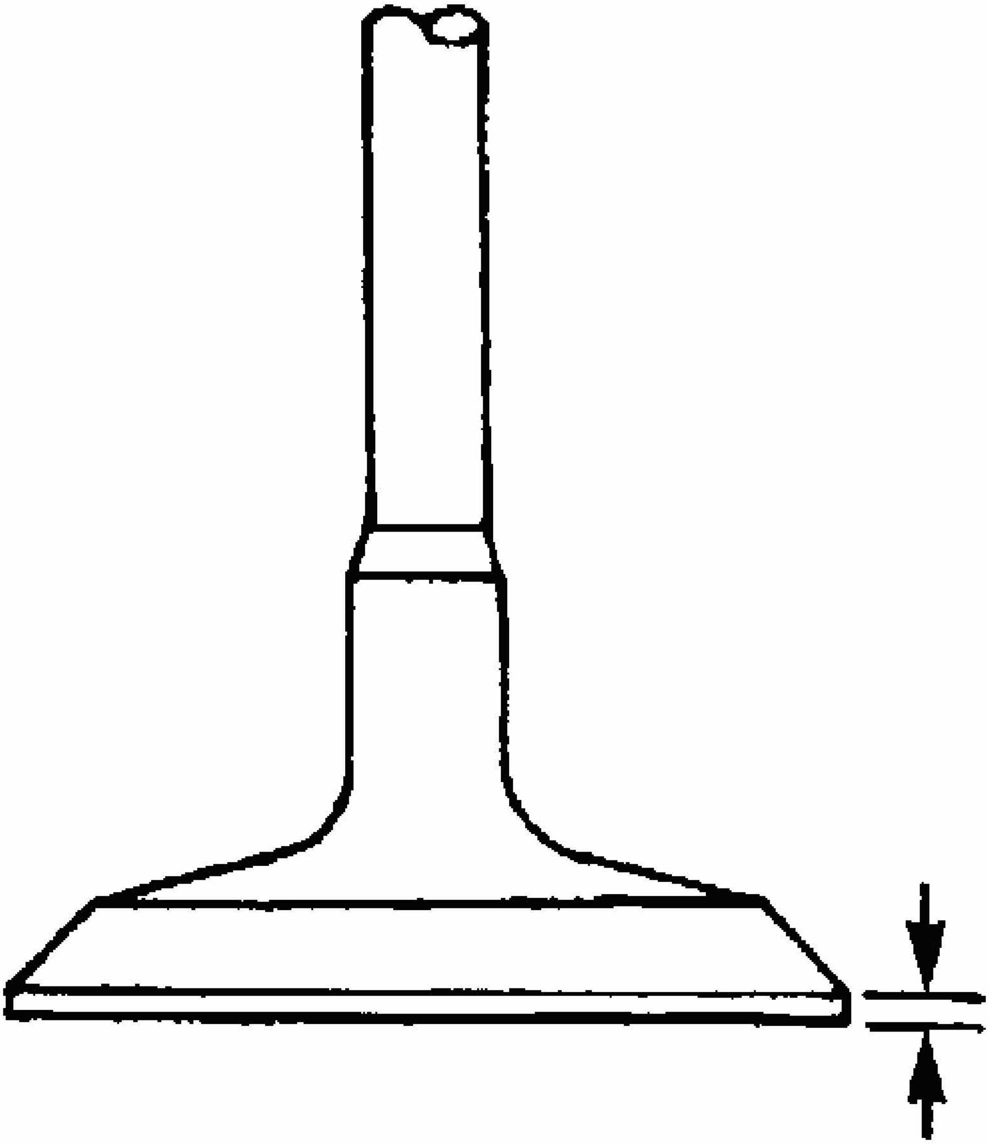


Fig. 389: Inspecting Valve Margin
Courtesy of GENERAL MOTORS CORP.

9. Inspect the valve face.

   Replace the valve if the valve margin is not within specifications after grinding.

10. Reface pitted valves on a valve refacing machine in order to ensure the correct relationship between the head and the stem.

IMPORTANT: Reconditioning the valve seats is very important. Ensure perfect seating of the valves in the engine in order to deliver optimum power and performance. Clean the valve guides of all debris and dirt before grinding the valve seat.

11. Recondition the valve seats after reaming the valve guide bores or installing the new valve guides.
12. The valve seats should be concentric to within 0.05 mm (0.031 in) total indicator reading.

CYLINDER HEAD ASSEMBLE

Tools Required

- **EN-47823** Valve Spring Compressor Adapter. See **Special Tools**.
- **J 5892-D** Valve Spring Compressor. See **Special Tools**.

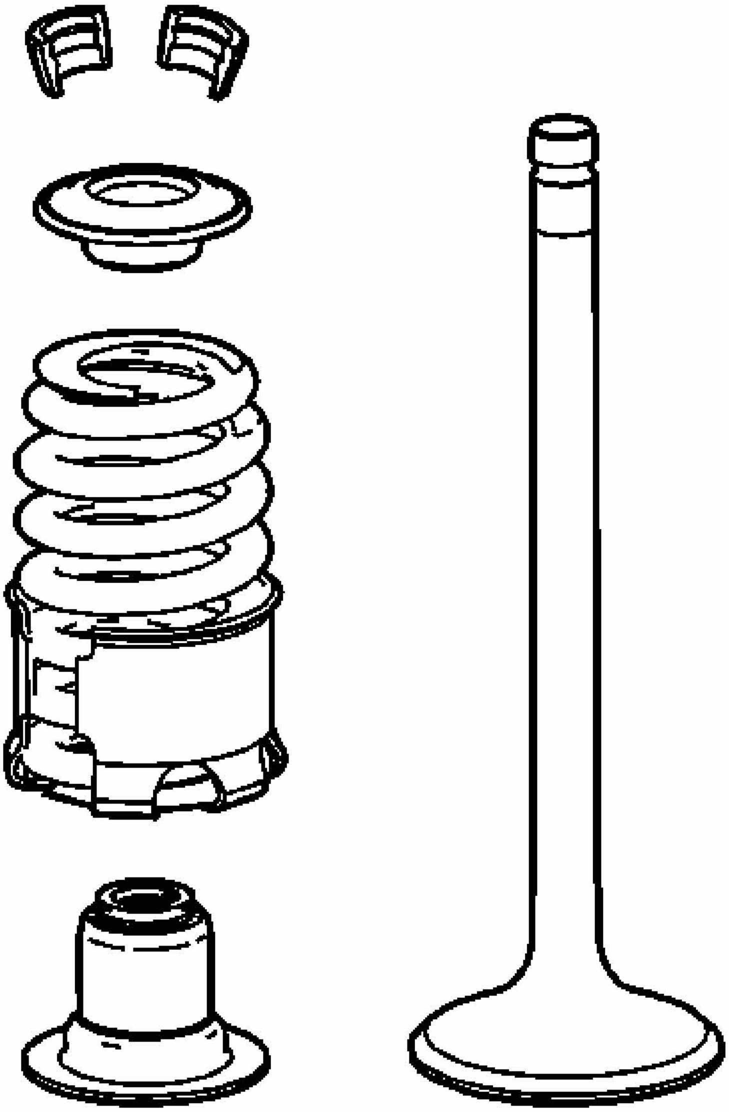


Fig. 390: View Of Valve Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use oversize valve stem seals if you install oversize valves.

1. Lubricate the valve stem with clean engine oil.
2. Install the valves.
3. Lightly tap the new or reconditioned valves into the valve seat.

4. Install the valve stem oil seals, ensuring proper intake - black seal and exhaust - brown seal, seals are installed.
5. Install the valve springs.
6. Install the valve spring caps.

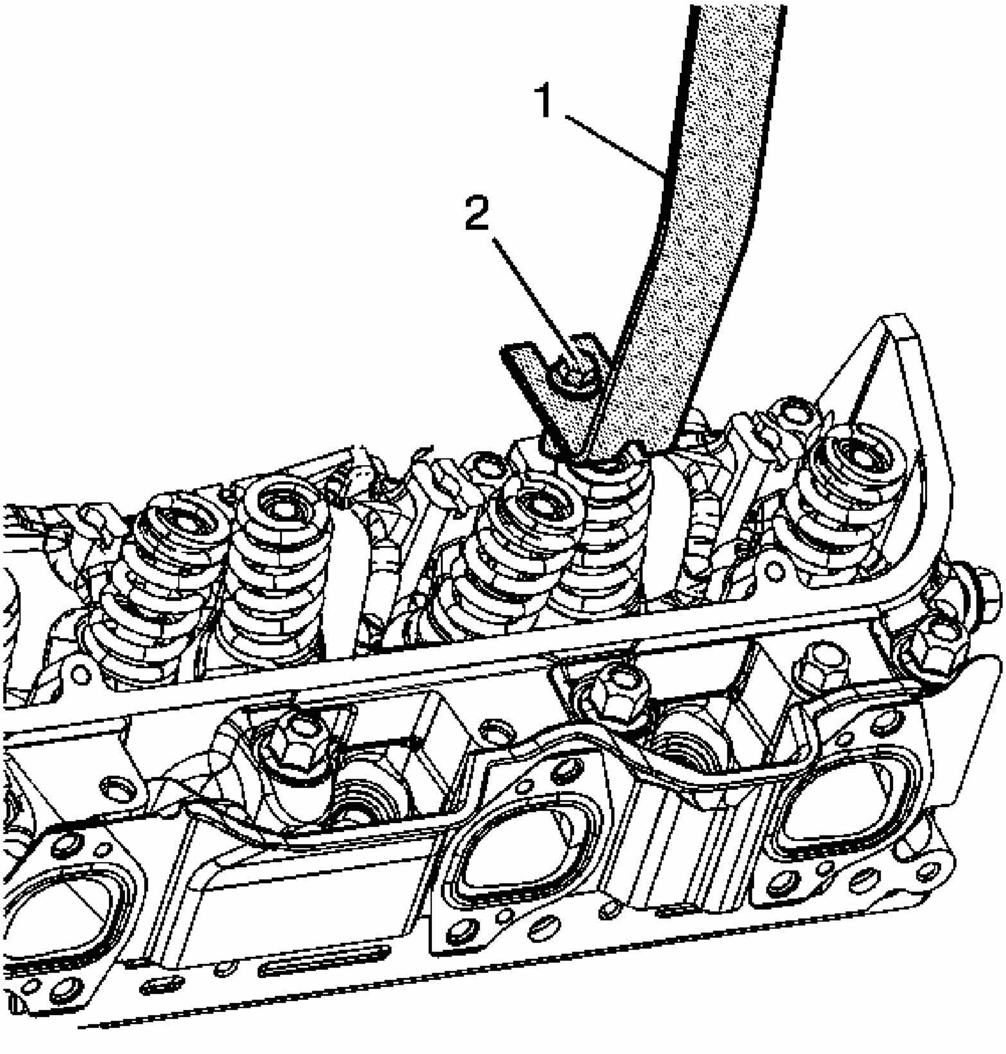


Fig. 391: Compressing Valve Springs
Courtesy of GENERAL MOTORS CORP.

7. Using caution so as not to damage the valve spring or valve spring dampener, compress the valve springs using the **J 5892-D** (1) and the **EN-47823** (2). See **Special Tools**.
8. Install the valve spring cap keys. Hold the valves in place with grease, if necessary.
9. Release the valve springs.

10. Ensure that the valve locks are seated.

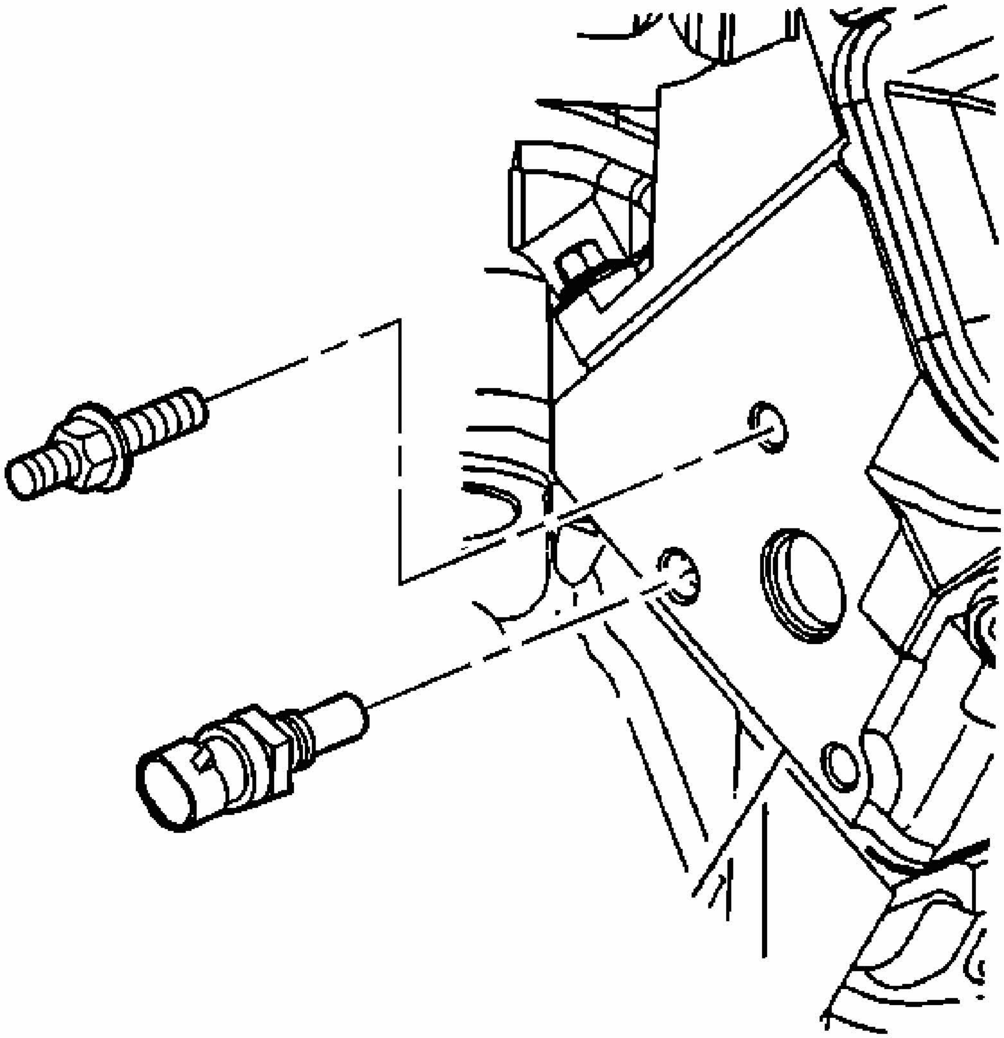


Fig. 392: View Of Heater Inlet Pipe Stud & Coolant Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

11. Apply sealer P/N 21485278 to the coolant temperature sensor.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

12. Install the coolant temperature sensor, if required.

Tighten: Tighten the coolant temperature sensor to 23 N.m (17 lb ft).

13. Install the heater inlet pipe stud, if required.

Tighten: Tighten the heater inlet pipe stud to 35 N.m (26 lb ft).

OIL PUMP DISASSEMBLE

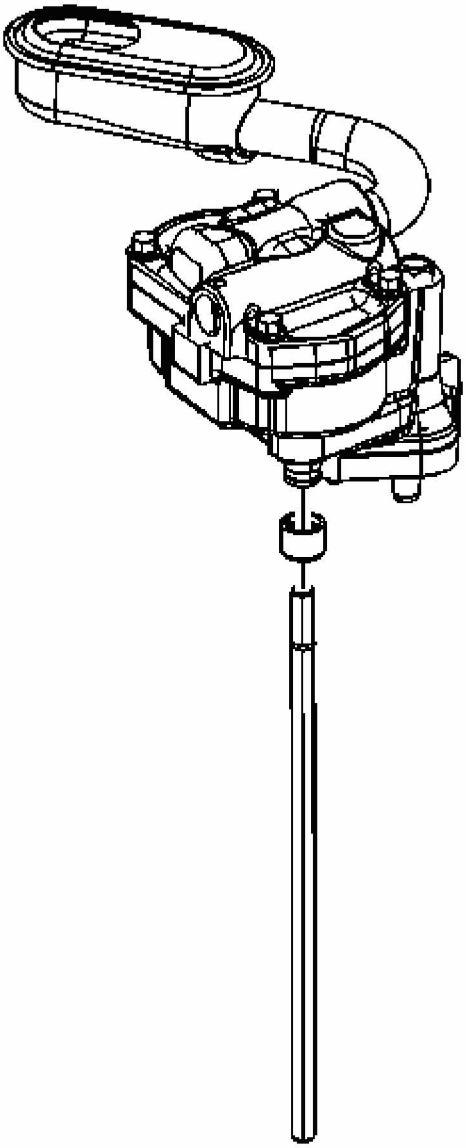


Fig. 393: Identifying Oil Pump Drive Components
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pump driveshaft and oil pump driveshaft retainer.

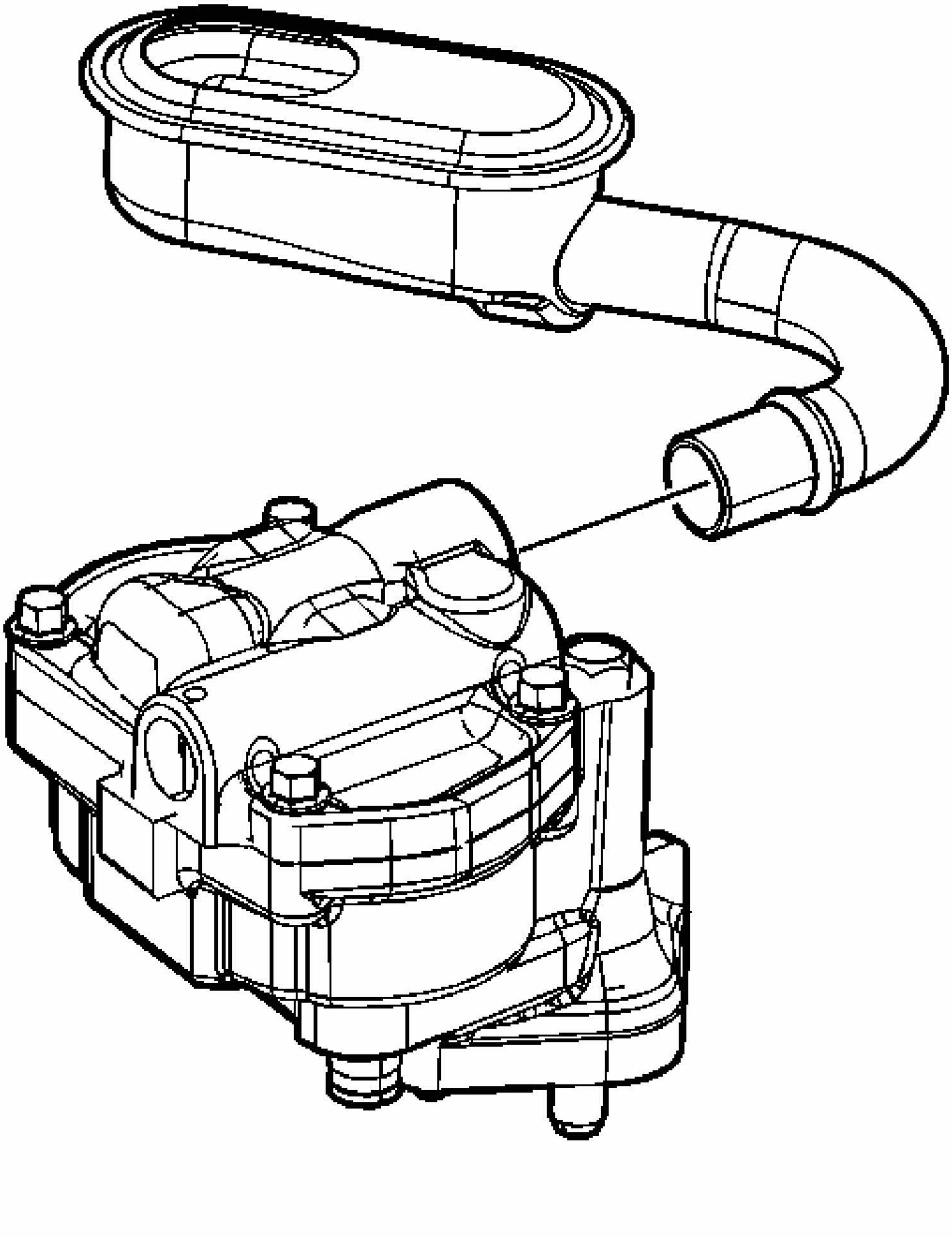


Fig. 394: Identifying Oil Pump & Screen
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **DO NOT remove the oil pump screen from the pipe. The pipe and oil pump screen are serviced as a complete assembly.**

2. Remove the oil pump screen, if necessary.

   The oil pump screen has a press fit into the oil pump cover.

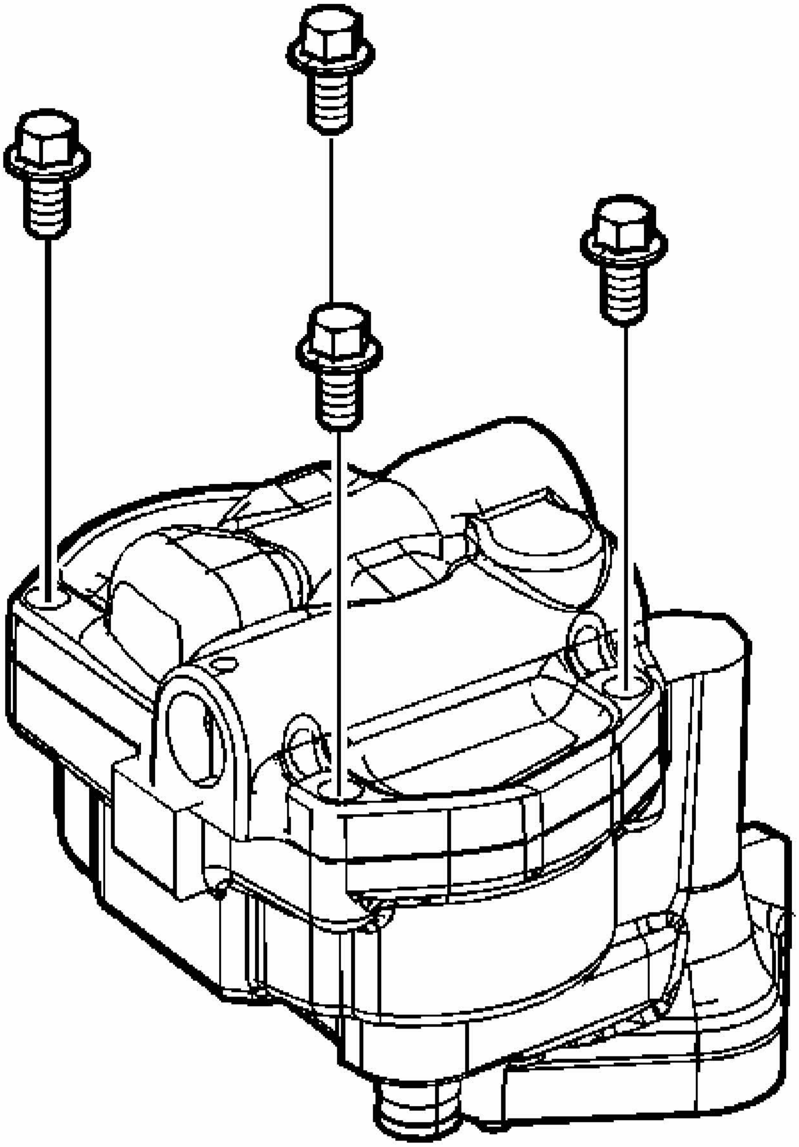


Fig. 395: Identifying Oil Pump Cover Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil pump cover bolts.

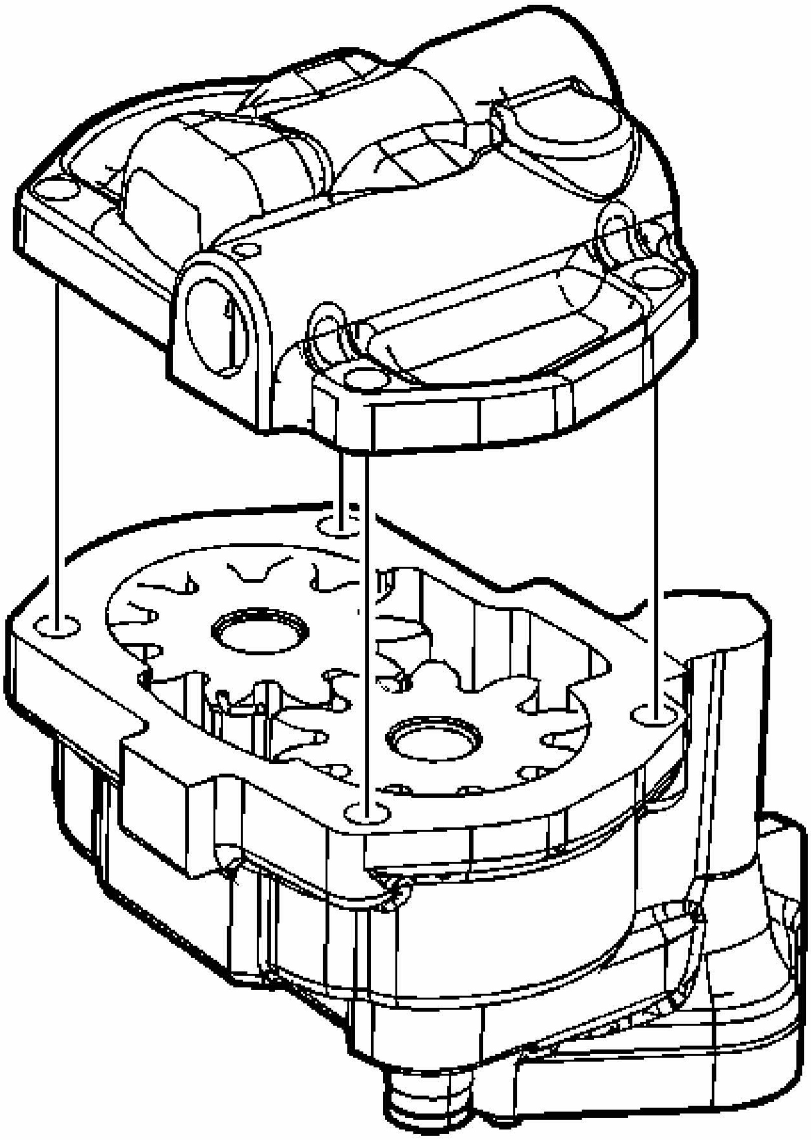


Fig. 396: Identifying Oil Pump Cover
Courtesy of GENERAL MOTORS CORP.

4. Remove the oil pump cover.

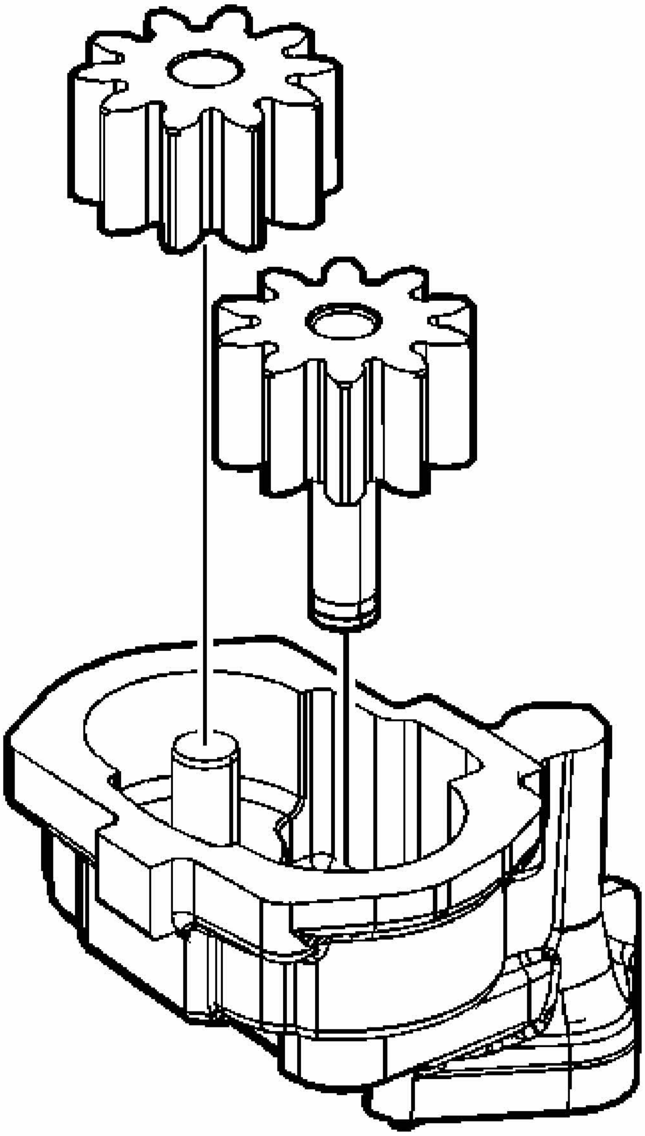


Fig. 397: Identifying Oil Pump Gears
Courtesy of GENERAL MOTORS CORP.

5. Remove the oil pump drive gear and the oil pump driven gear.
6. Matchmark the gear teeth for assembly.

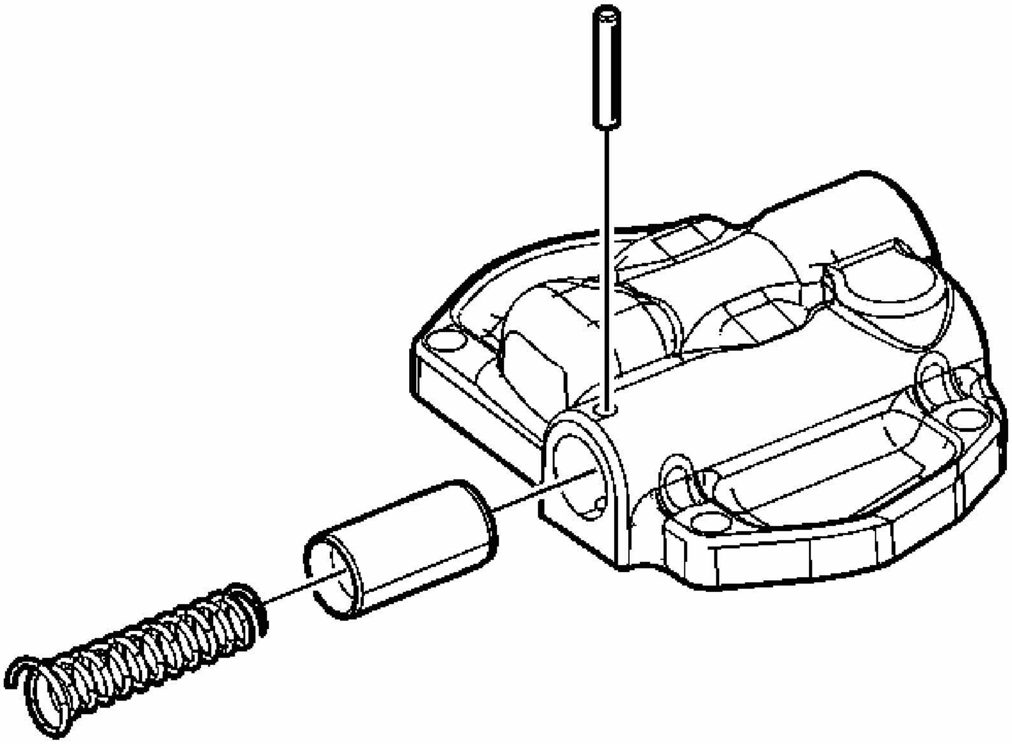


Fig. 398: Identifying Pressure Regulator Valve Spring
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.
In some models, the pressure regulator valve spring is under pressure. Remove the retaining pin carefully in order to avoid bodily injury.

7. Remove the following items:
    1. The oil pump pressure relief valve spring straight pin.
    2. The oil pump pressure relief spring.

    CAUTION: Refer to CLEANING SOLVENT CAUTION in Cautions and Notices.

    3. The oil pump pressure relief valve. If the valve is stuck, soak the pump housing in cleaning solvent.

OIL PUMP CLEANING AND INSPECTION

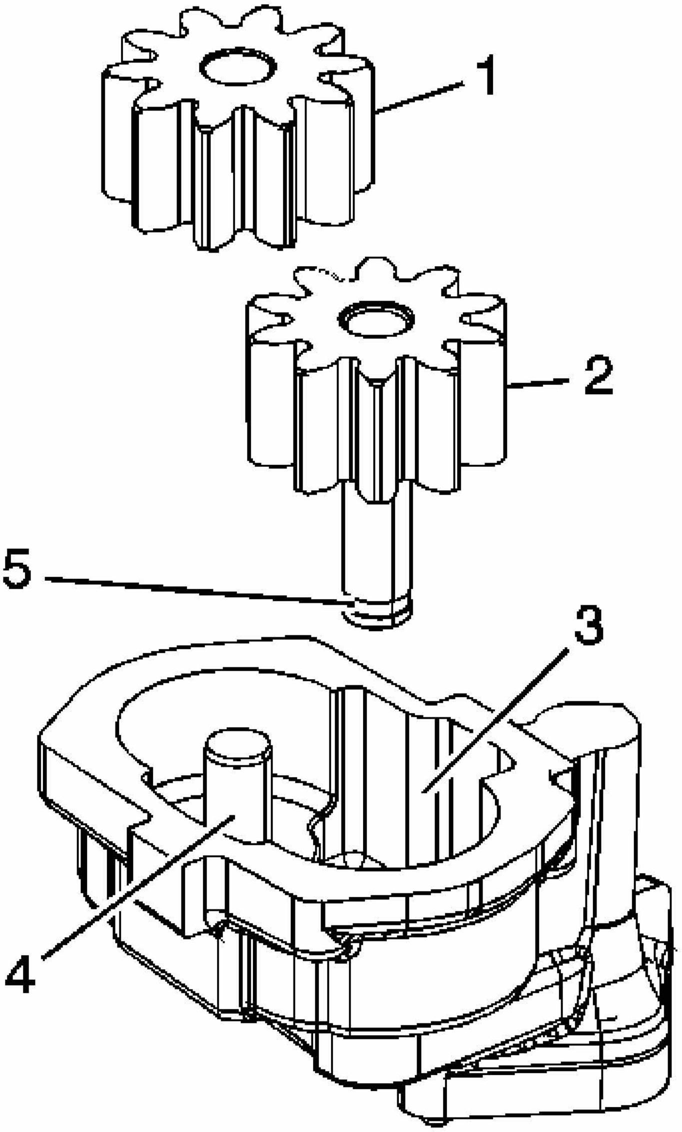


Fig. 399: Identifying Oil Pump Components
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to CLEANING SOLVENT CAUTION in Cautions and Notices.

1. Clean all parts of sludge, oil, and varnish by soaking in cleaning solvent.

2. Inspect for foreign material and determine the source of the foreign material.
3. Inspect the pump housing and cover for the following conditions:
    - Cracks or casting imperfections
    - Scoring (3)
    - Damaged threads
4. Do not attempt to repair the pump housing.

    Replace the pump housing.

5. Inspect the oil pump gears for the following conditions:
    - Scoring (1)
    - Excessive wear (2)
6. Inspect the idler shaft for looseness or scoring (4).

    If loose or damaged, replace the oil pump.

7. Inspect the drive gear shaft for looseness or scoring (5).

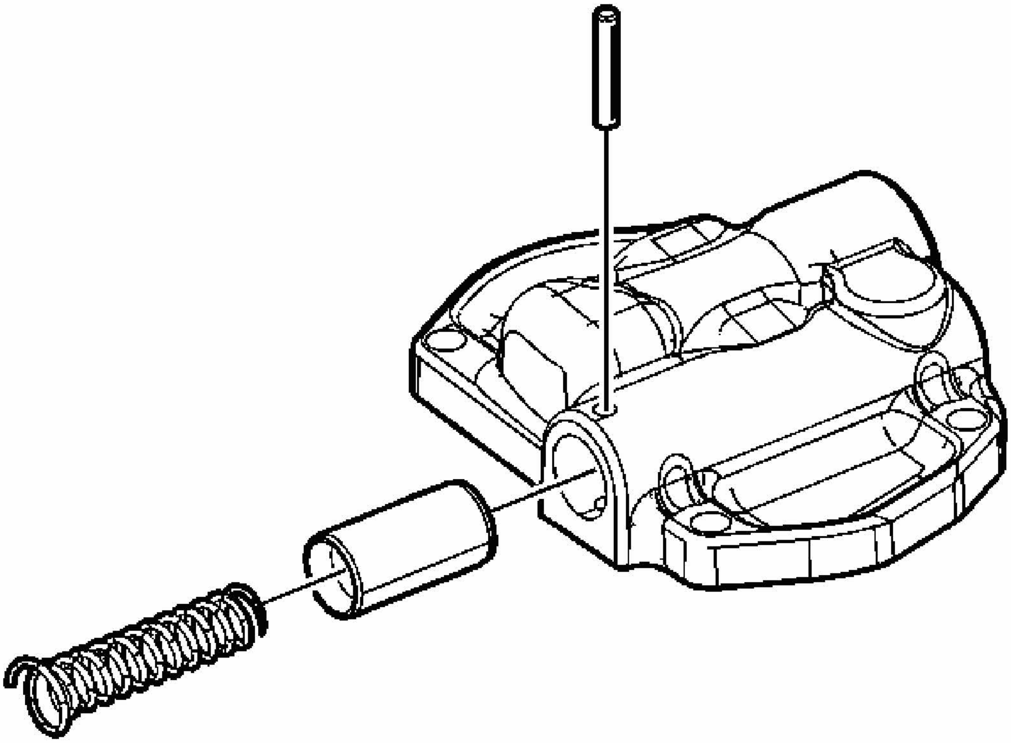


Fig. 400: Identifying Oil Pump Pressure Regulator Valve
Courtesy of GENERAL MOTORS CORP.

8. Inspect the pressure regulator valve for the following conditions:
    - Scoring
    - Sticking

    Burrs may be removed using a fine oil stone.

9. Inspect the pressure regulator valve spring for the following conditions:
    - Loss of tension
    - Bending
10. Inspect the suction pipe and screen assembly for the following conditions:
    - Looseness

      If the suction pipe is loose, bent or has been removed, replace the pump body cover and suction pipe.

    - Broken wire mesh or screen

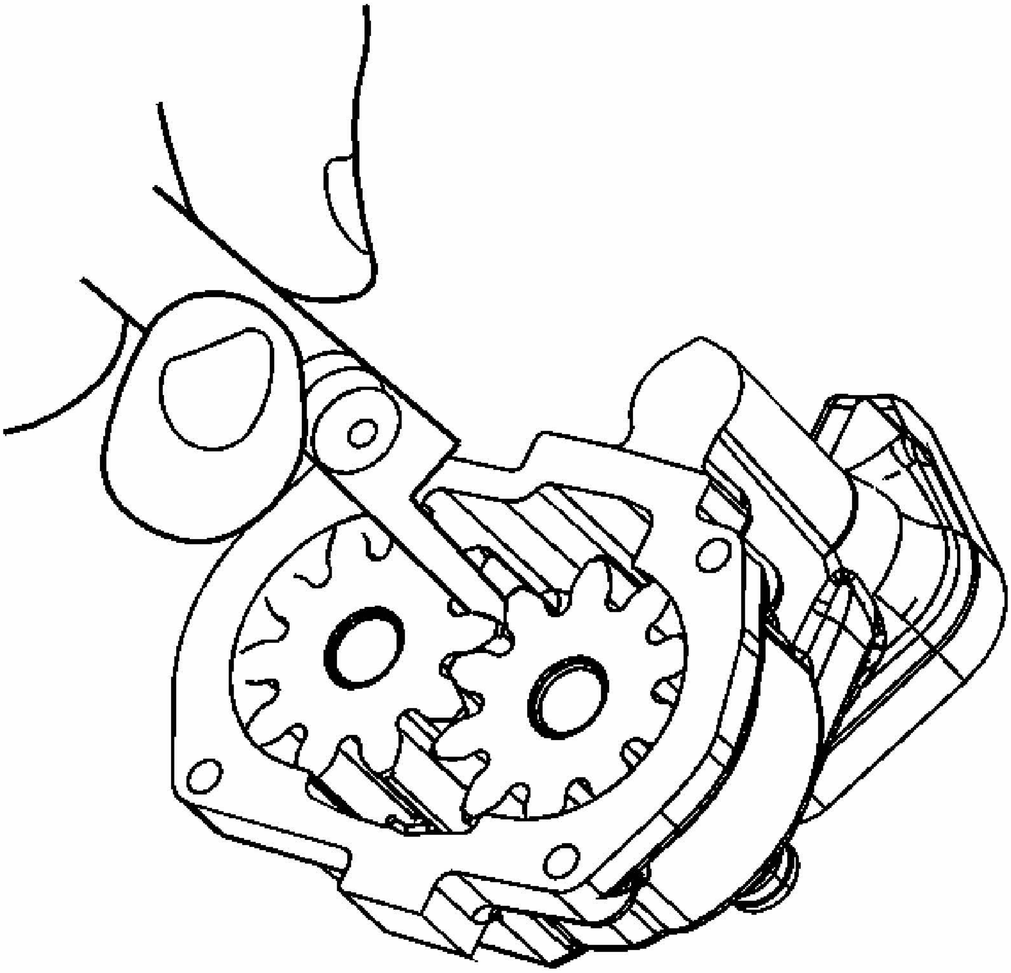


Fig. 401: Measuring Oil Pump Gear Lash
Courtesy of GENERAL MOTORS CORP.

11. Measure the oil pump gear lash. Install the gears, and measure in several places.

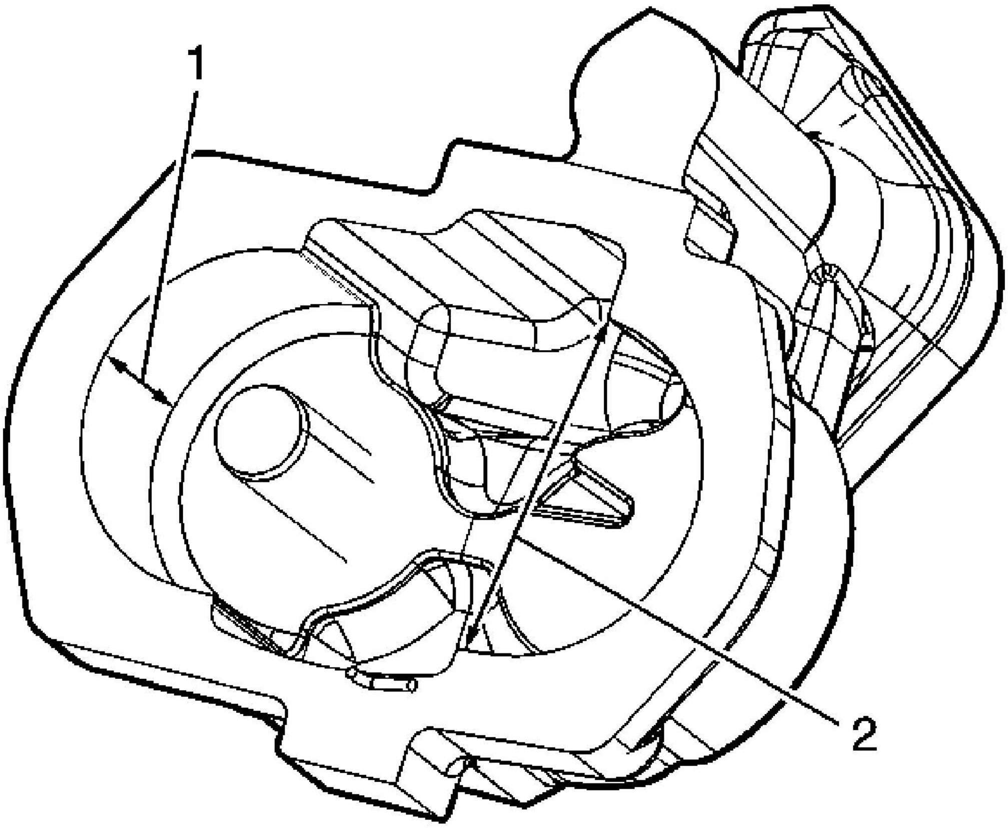


Fig. 402: Measuring Oil Pump Housing Gear Pocket
Courtesy of GENERAL MOTORS CORP.

12. Measure the oil pump housing gear pocket (1, 2).

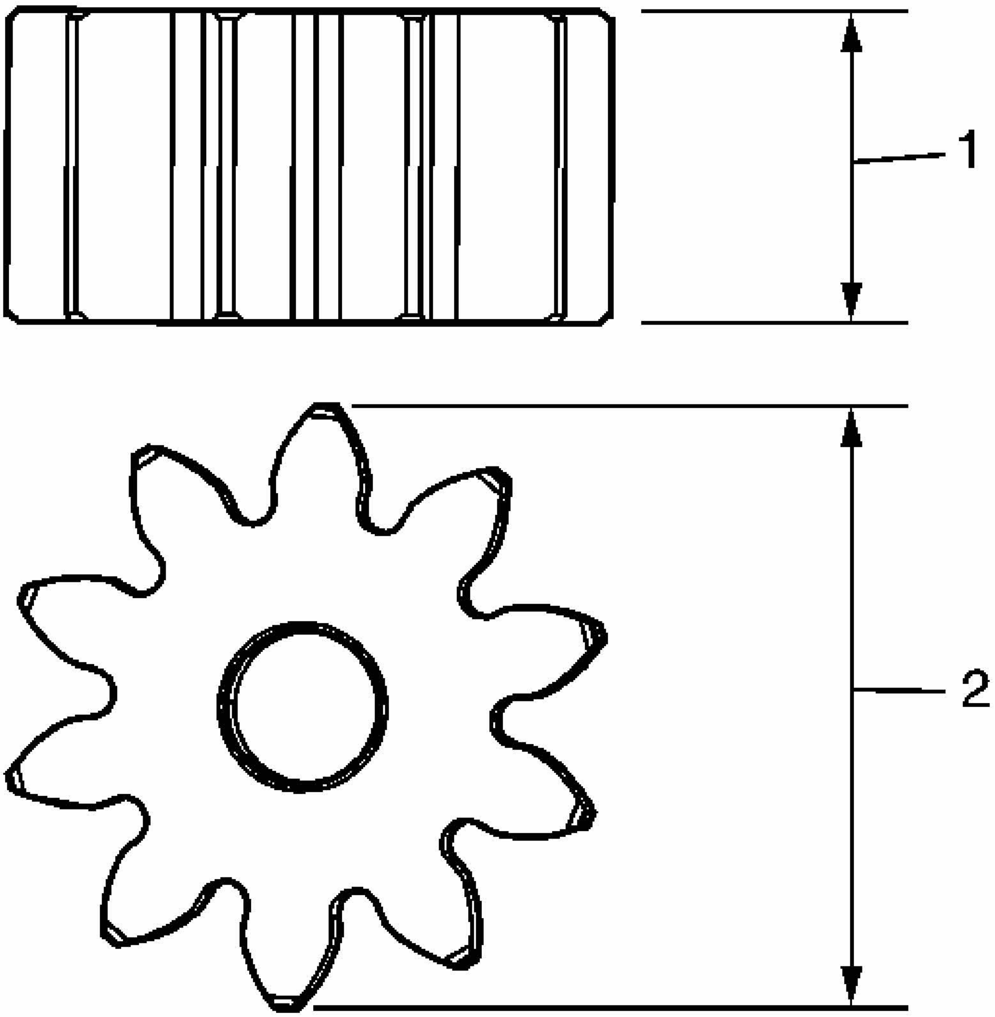


Fig. 403: Measuring Oil Pump Gears
Courtesy of GENERAL MOTORS CORP.

13. Measure the oil pump gears (1, 2).

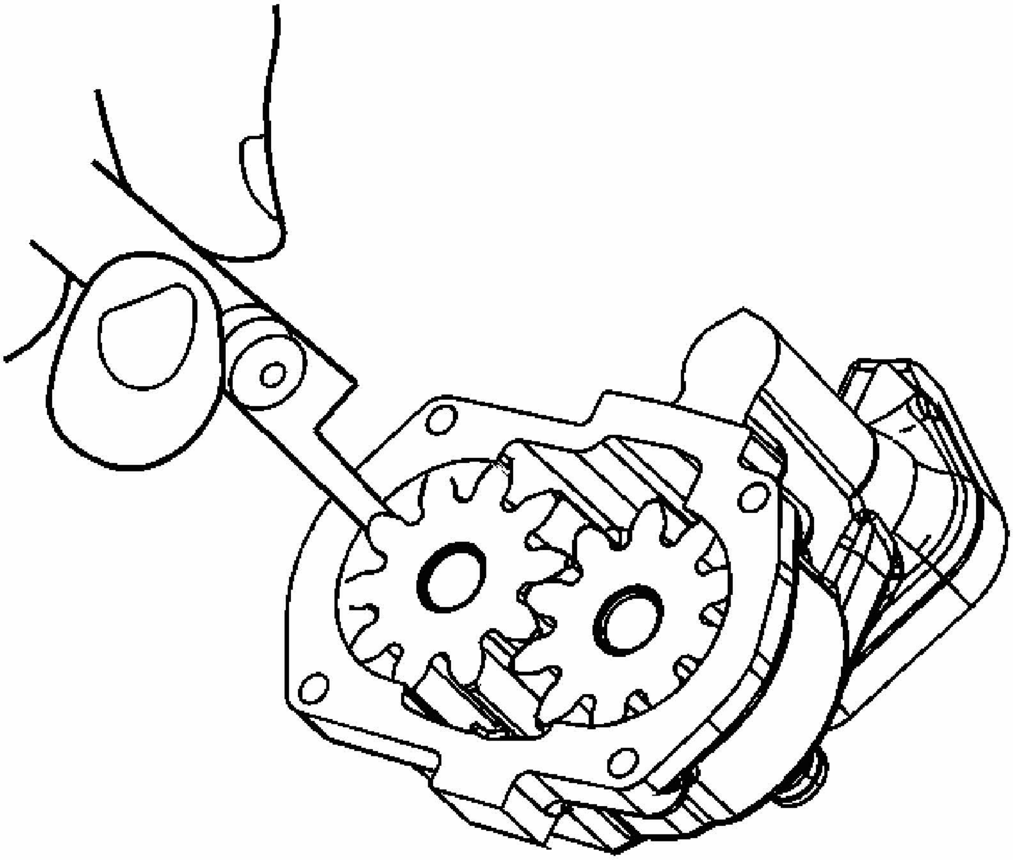


Fig. 404: Measuring Oil Pump Gear Side Clearance
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When deciding pump serviceability based on end clearance, consider depth of the wear pattern in the pump cover.

14. Measure the oil pump gear side clearance.

OIL PUMP ASSEMBLE

Tools Required

J 22144 Oil Suction Pipe Installer. See **Special Tools**.

1. Lubricate all the internal oil pump parts using engine oil during assembly.

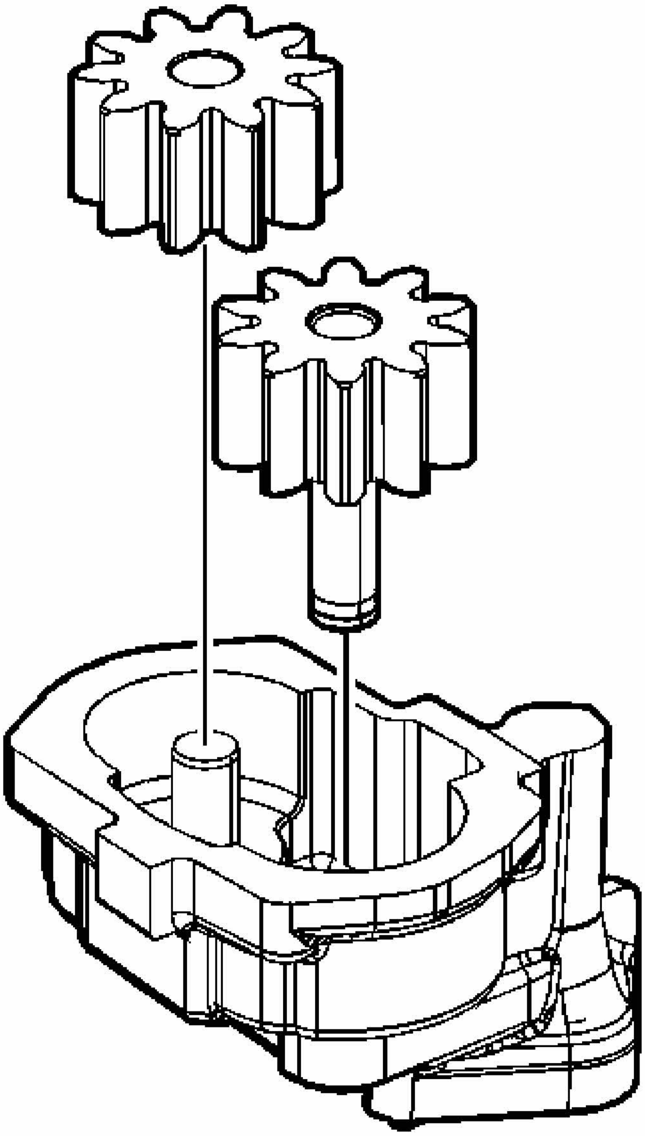


Fig. 405: Identifying Oil Pump Gears
Courtesy of GENERAL MOTORS CORP.

2. Install the oil pump gears.

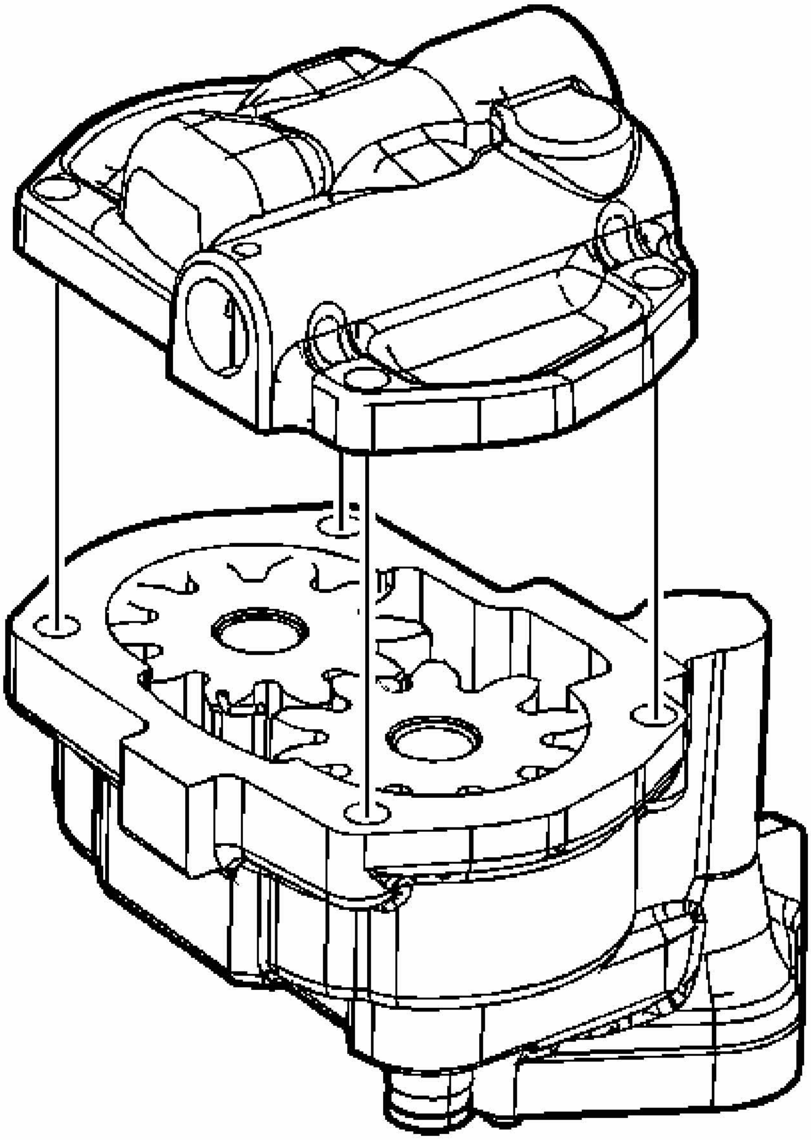


Fig. 406: Identifying Oil Pump Cover
Courtesy of GENERAL MOTORS CORP.

3. Install the oil pump cover.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

4. Install the oil pump cover bolts.

Tighten: Tighten the oil pump cover bolts to 10 N.m (89 lb in).

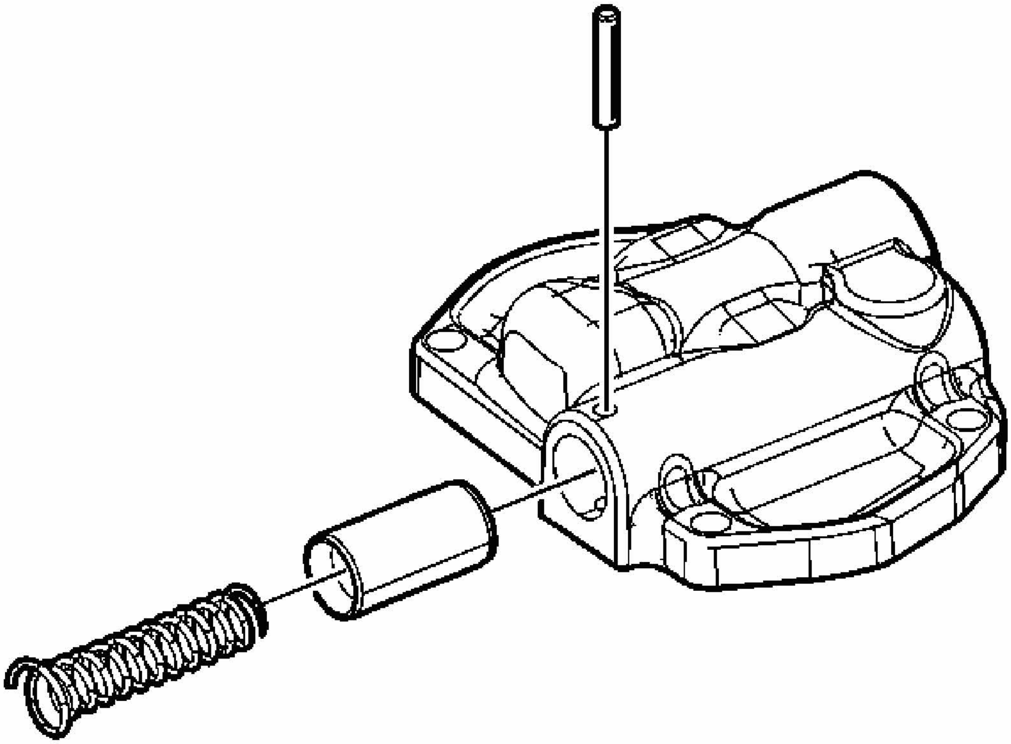


Fig. 407: Identifying Oil Pressure Relief Valve Components
Courtesy of GENERAL MOTORS CORP.

5. Install the pressure regulator valve.
6. Install the pressure regulator spring.
7. Install the cotter pin.

IMPORTANT: Make sure the cotter pin is properly secured.

8. Apply sealer GM P/N 12346004, (Canadian P/N 10953480) or the equivalent to the new suction pipe.
9. Tap the new suction pipe into place using a plastic hammer and **J 22144** . See Special Tools.

ENGINE FRONT COVER CLEANING AND INSPECTION

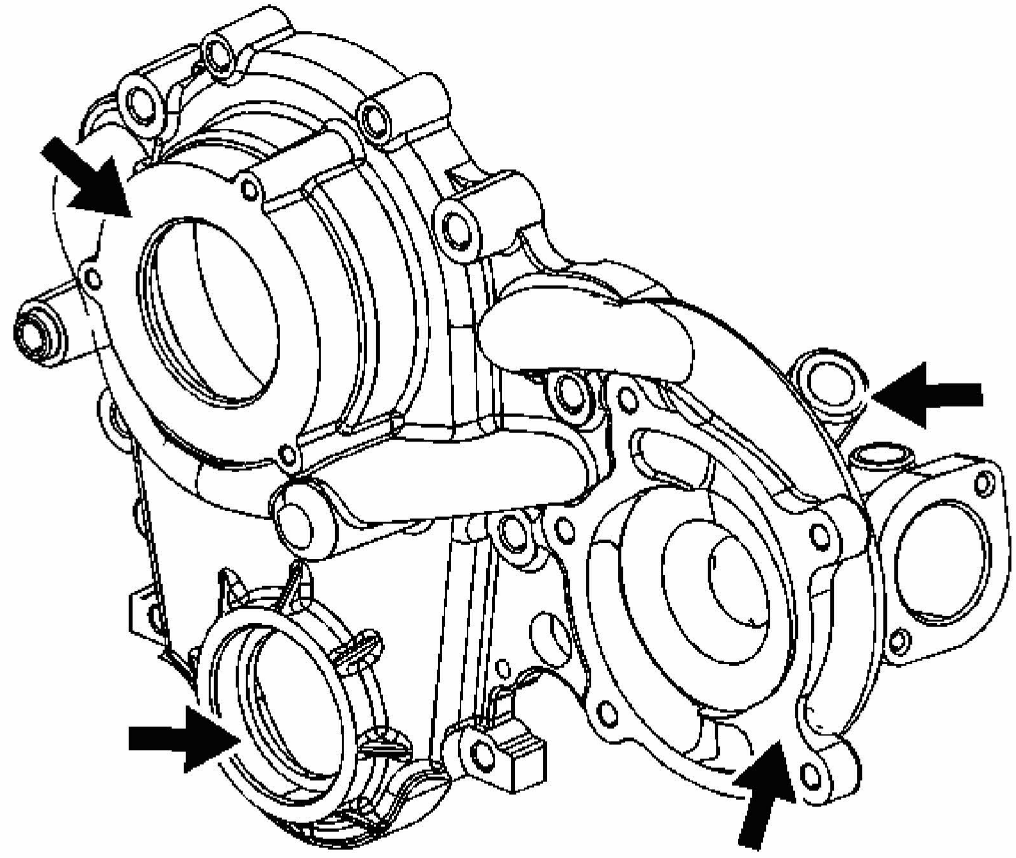


Fig. 408: View Of Engine Front Cover
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

1. Clean the engine front cover with solvent.
2. Dry the engine front cover with compressed air.
3. Inspect the engine front cover sealing surfaces for damage.
4. Inspect the engine front cover threaded holes.
5. Repair or replace the engine front cover as needed.

VALVE ROCKER ARM COVER CLEANING AND INSPECTION

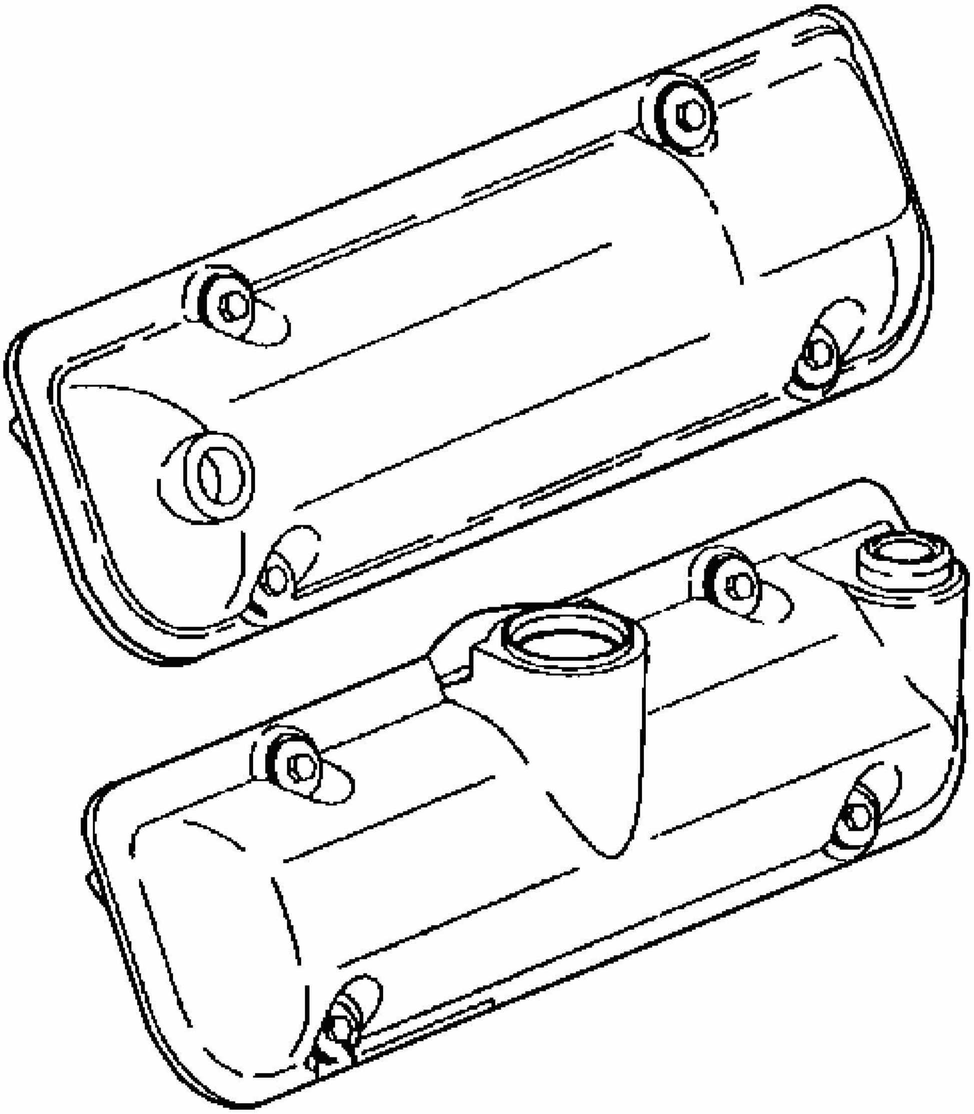


Fig. 409: Cleaning Valve Rocker Arm Covers
Courtesy of GENERAL MOTORS CORP.

1. Remove all rubber grommets from the valve rocker arm covers.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

2. Clean the valve rocker arm covers with solvent.
3. Dry the valve rocker arm covers with compressed air.

4. Inspect the valve rocker arm covers for damage and replace if necessary.

POSITIVE CRANKCASE VENTILATION (PCV) VALVE CLEANING AND INSPECTION

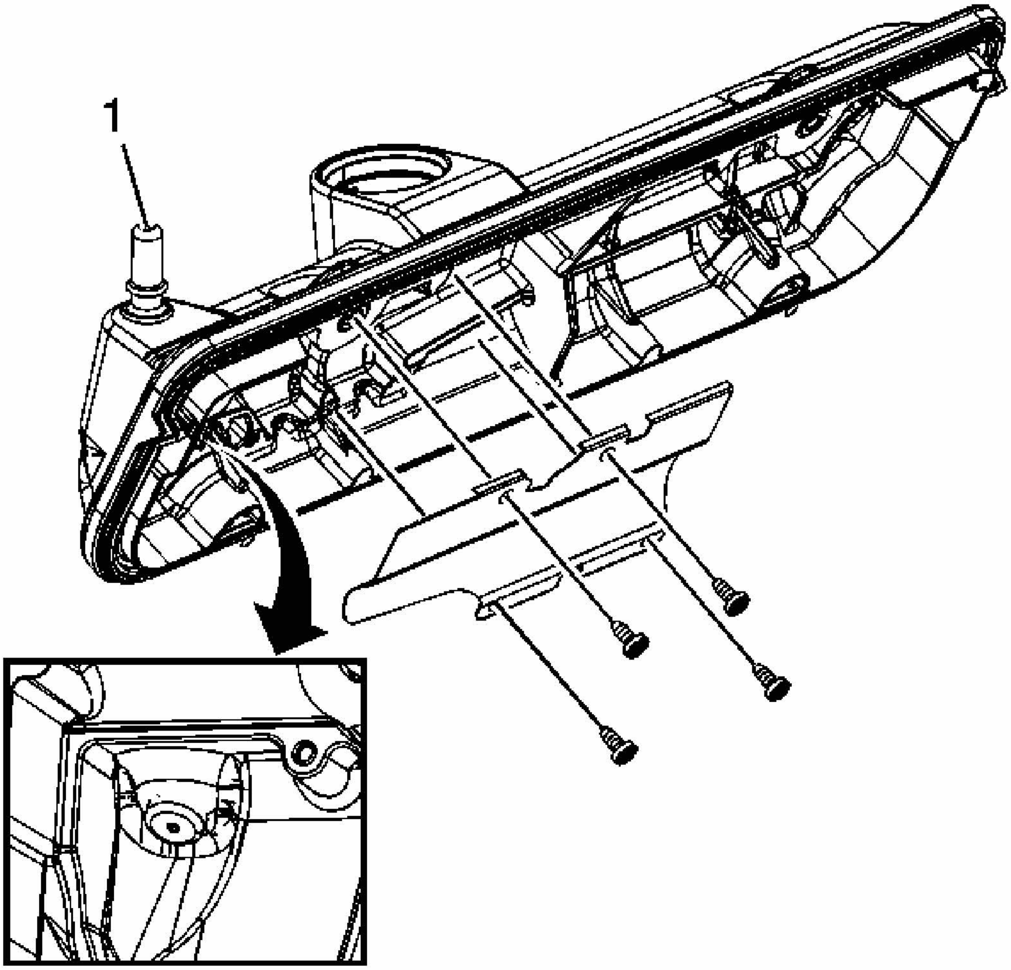


Fig. 410: Identifying Positive Crankcase Ventilation (PCV) Valve
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The positive crankcase ventilation (PCV) valve is a fixed orifice system. Do not attempt to remove the valve from the valve rocker arm cover. Failure to do so may result in damage to the rocker arm valve cover.

1. Flush the carbon from the PCV valve orifices (1) using solvent.
2. Dry the PCV valve orifices using compressed air.

OIL PAN CLEANING AND INSPECTION

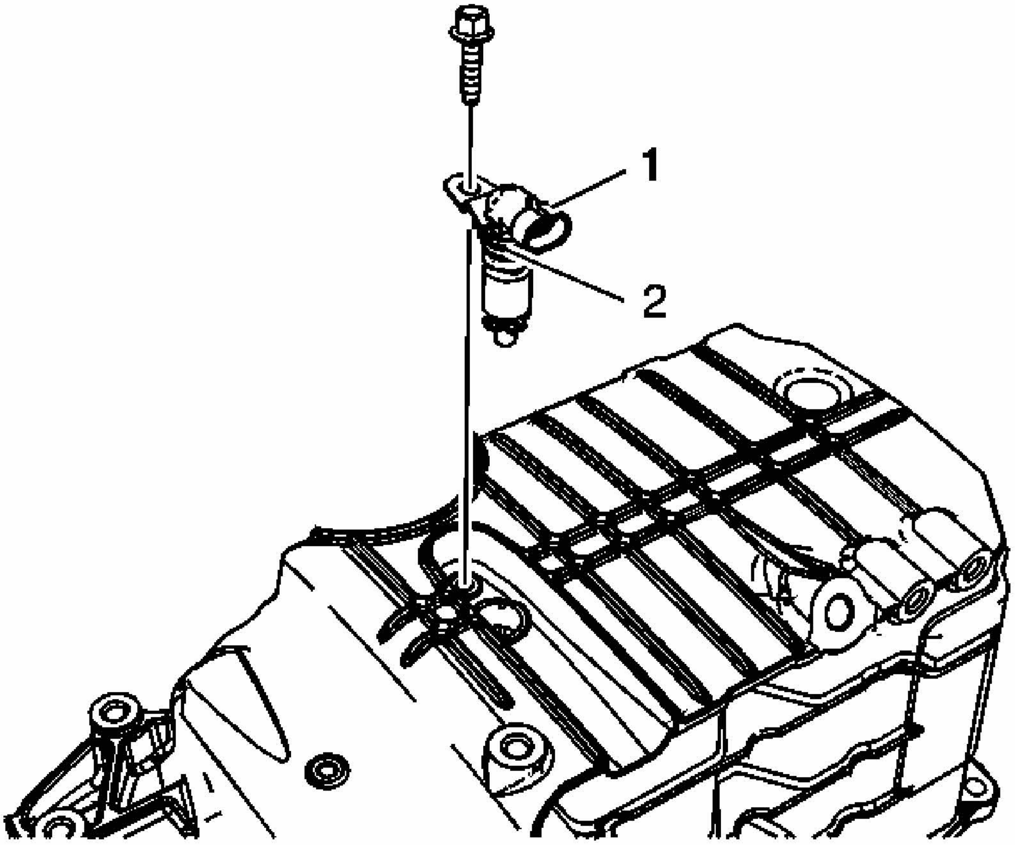


Fig. 411: Identifying Oil Level Sensor
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil level sensor.
2. Inspect the O-ring seal (2) and the electrical connector (1) for wear or damage. Repair or replace as necessary.

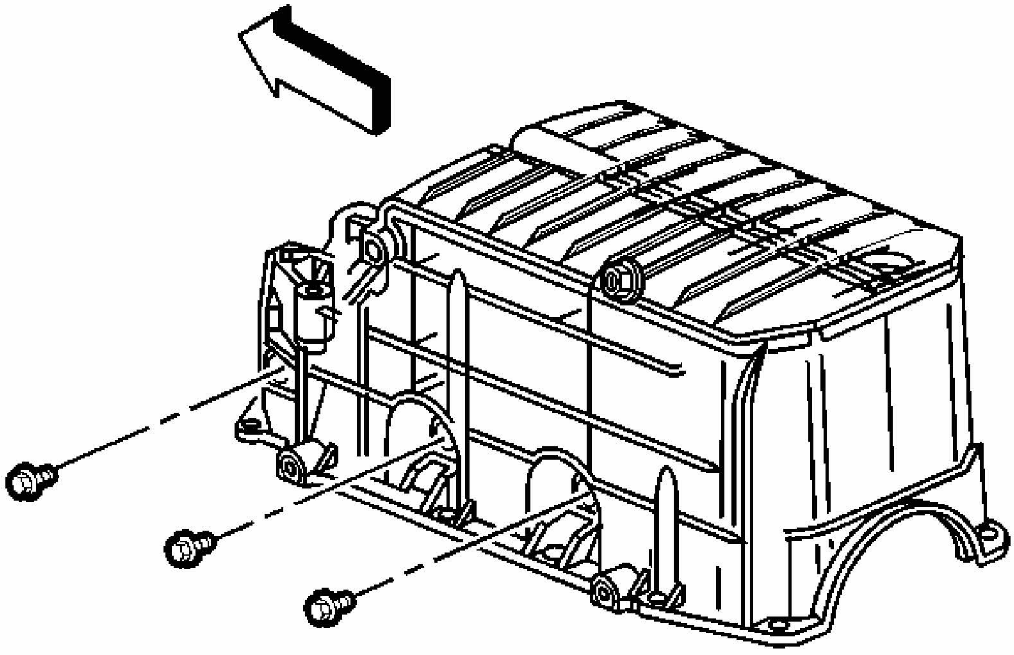


Fig. 412: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

3. Clean the oil pan with solvent. Remove all sludge and debris from the oil pan.
4. Dry the oil pan with compressed air.
5. Inspect the oil pan sealing surface for damage and replace if necessary.

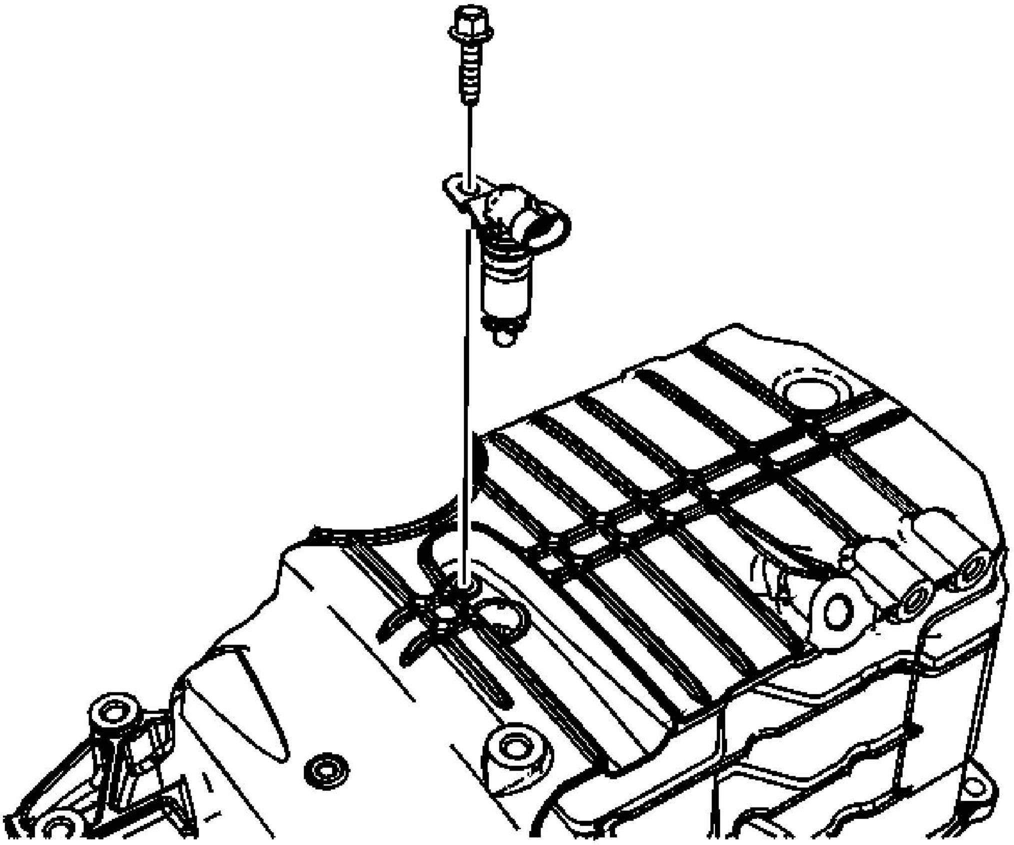


Fig. 413: View Of Oil Level Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

6. Install the oil level sensor and bolt.

   Tighten: Tighten the oil level sensor bolt to 10 N.m (89 lb in).

INTAKE MANIFOLD CLEANING AND INSPECTION - LOWER

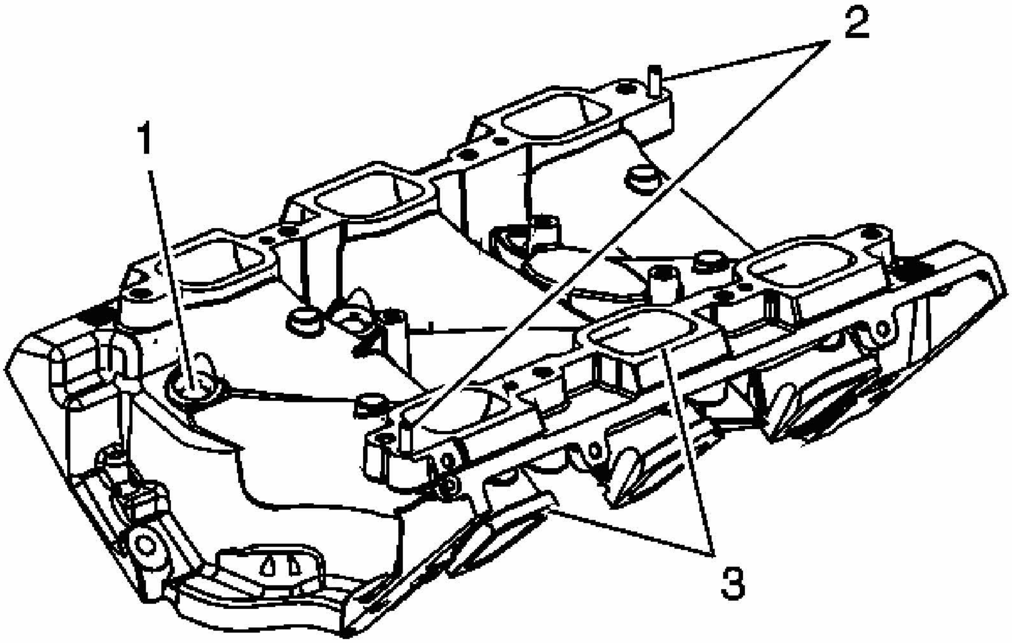


Fig. 414: View Of Lower Intake Manifold
Courtesy of GENERAL MOTORS CORP.

1. Clean the intake manifold gasket mating surfaces (3) using GM P/N 12346139 (Canadian P/N 10953463) or equivalent.
2. Clean the fuel injector bores (1).
3. Inspect the lower intake manifold locating pins (2) for damage. Replace as necessary.
4. Inspect the intake manifold for damage.

IMPORTANT: If replacing the lower intake manifold, make sure to transfer or replace the locating pins as necessary.

5. Repair or replace the intake manifold as necessary.

INTAKE MANIFOLD CLEANING AND INSPECTION - UPPER

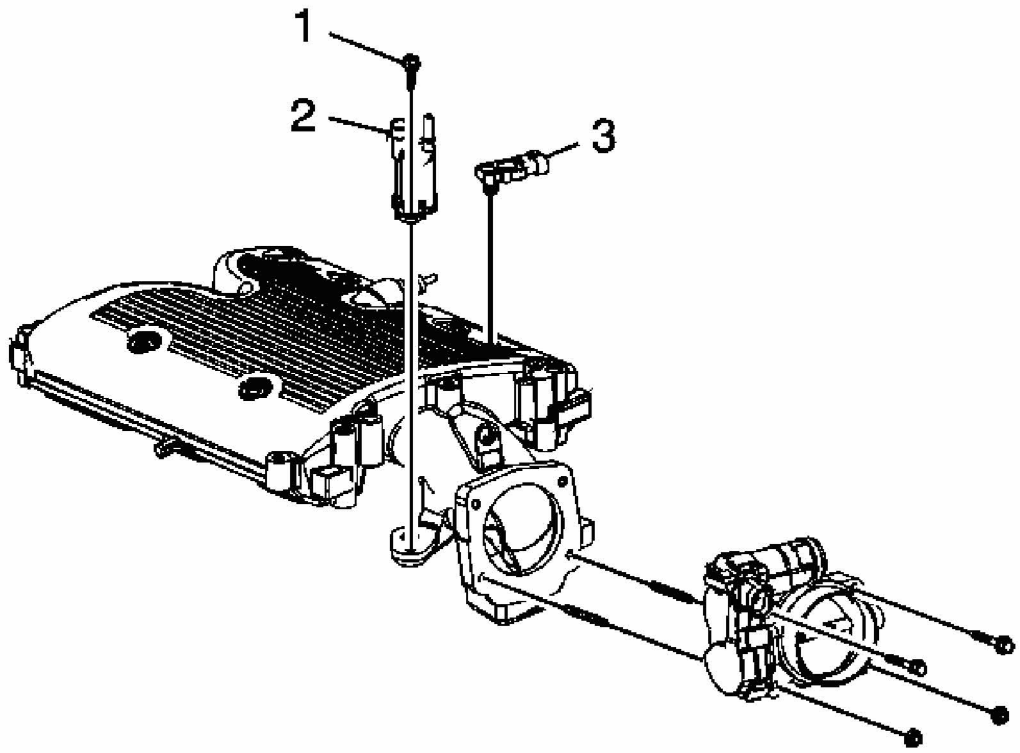


Fig. 415: Throttle Body Bolts And Nuts
Courtesy of GENERAL MOTORS CORP.

1. Remove the throttle body bolts and nuts.
2. Remove the throttle body.
3. Remove the throttle body studs, if required.
4. Remove the manifold absolute pressure (MAP) sensor (3).
5. Remove the evaporative emissions (EVAP) purge valve bolt (1).
6. Remove the EVAP purge valve (2).

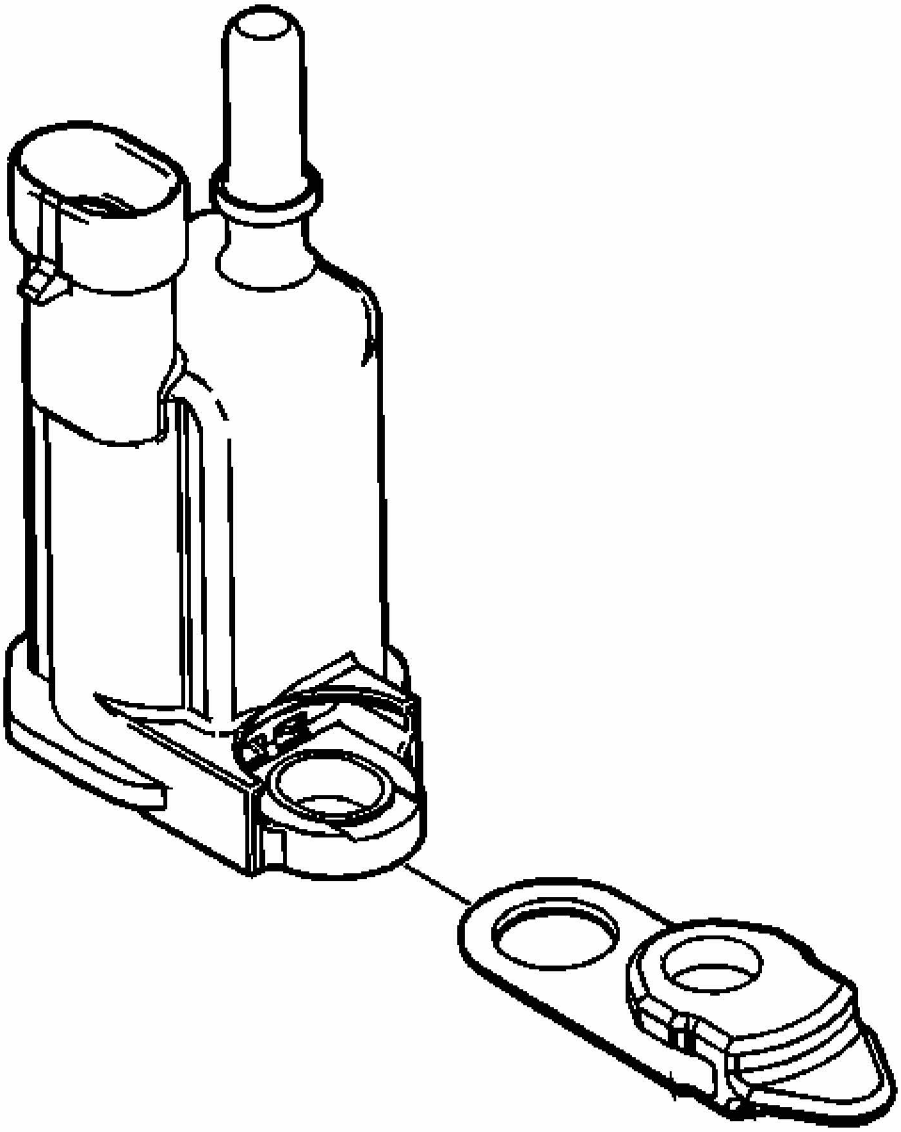


Fig. 416: Identifying EVAP Purge Valve Isolator
Courtesy of GENERAL MOTORS CORP.

7. Remove the EVAP purge valve isolator, if equipped.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

8. Clean the intake manifold with solvent.

9. Dry the intake manifold with compressed air.
10. Inspect all gasket mating surfaces for nicks or cracks and replace if necessary.
11. Inspect the EVAP purge valve seal for damage and replace if necessary.
12. Install the EVAP purge valve isolator, if equipped.

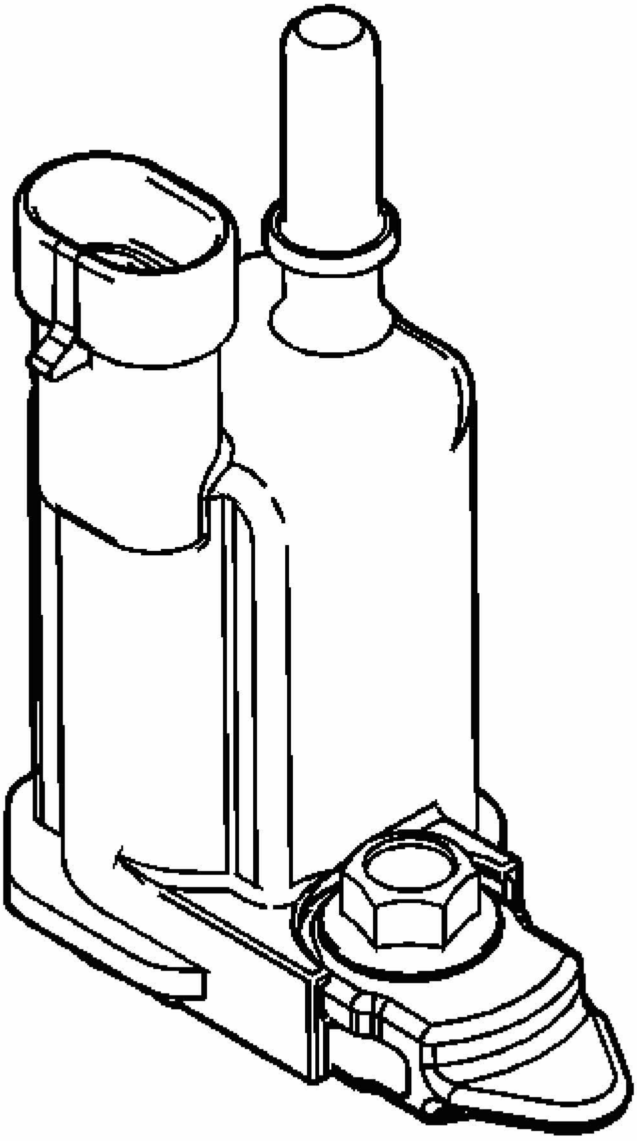


Fig. 417: Checking EVAP Purge Valve Isolator Installation
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **Ensure that the EVAP purge valve isolator is installed properly as shown, with the isolator covering the top and bottom of the purge valve bolt hole flange. Failure to do so may cause improper EVAP purge valve operation.**

13. Install the EVAP purge valve (2).

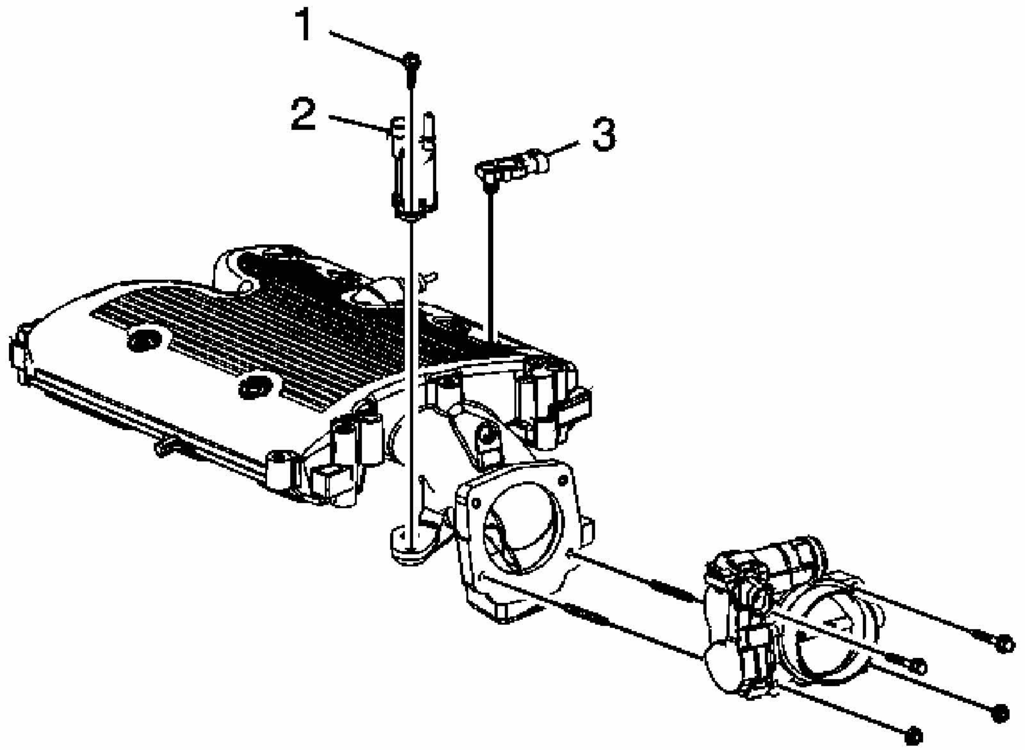


Fig. 418: Locating EVAP Purge Valve Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

14. Install the EVAP purge valve bolt (1).

    Tighten: Tighten the EVAP purge valve bolt to 16 N.m (12 lb ft).

15. Inspect the MAP sensor seal for damage and replace if necessary.
16. Install the MAP sensor (3).

17. Install the throttle body studs, if required.

    Tighten: Tighten the throttle body studs to 6 N.m (53 lb in).

18. Inspect the throttle body seal for damage and replace if necessary.
19. Install the throttle body.
20. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) to the throttle body bolt and nut threads.
21. Install the throttle body bolts and nuts.

    Tighten: Tighten the throttle body bolts and nuts to 10 N.m (89 lb in).

EXHAUST MANIFOLD CLEANING AND INSPECTION

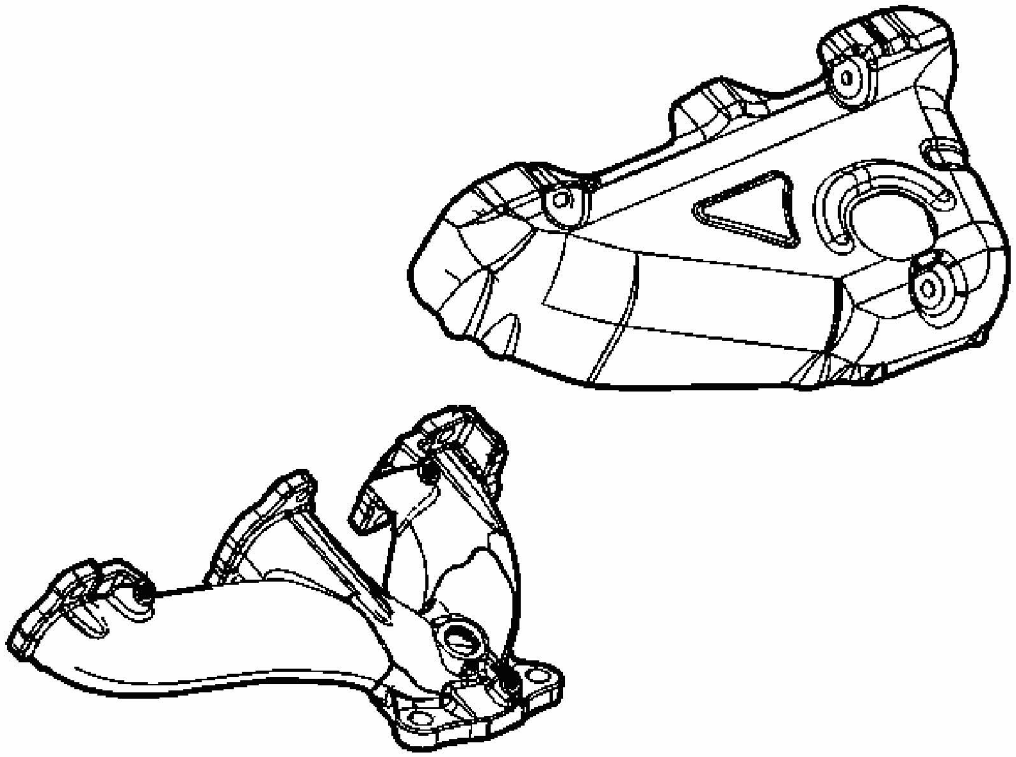


Fig. 419: Cleaning Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

1. Clean the exhaust manifold and heat shield in solvent.
2. Dry the exhaust manifold and heat shield with compressed air.
3. Inspect the exhaust manifold for cracks or damage.

WATER PUMP CLEANING AND INSPECTION

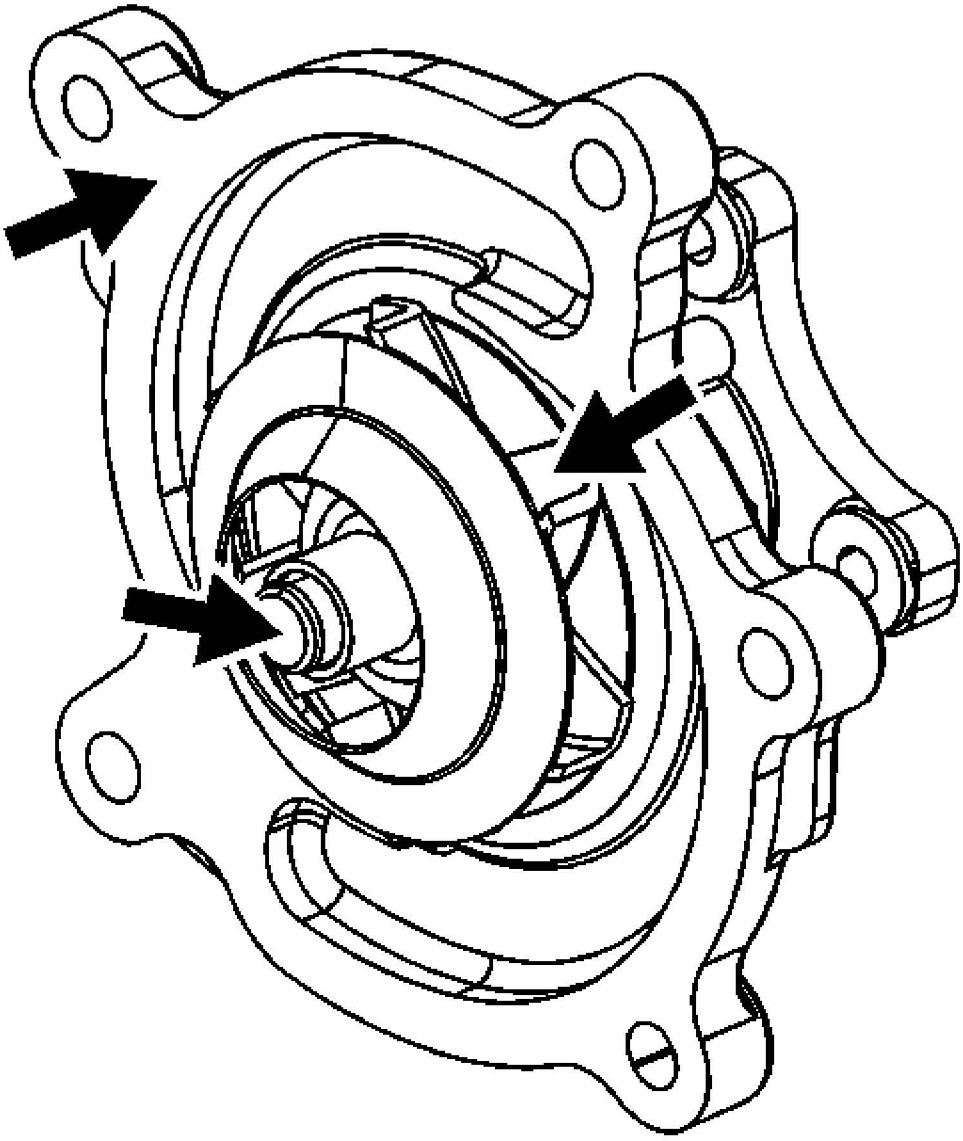


Fig. 420: Rear View Of Water Pump
Courtesy of GENERAL MOTORS CORP.

1. Remove all gasket material from the sealing surface.
2. Inspect the water pump impeller for damage.
3. Inspect the water pump shaft for looseness.
4. Replace the water pump if necessary.

THREAD REPAIR

General purpose thread repair kits are available commercially.

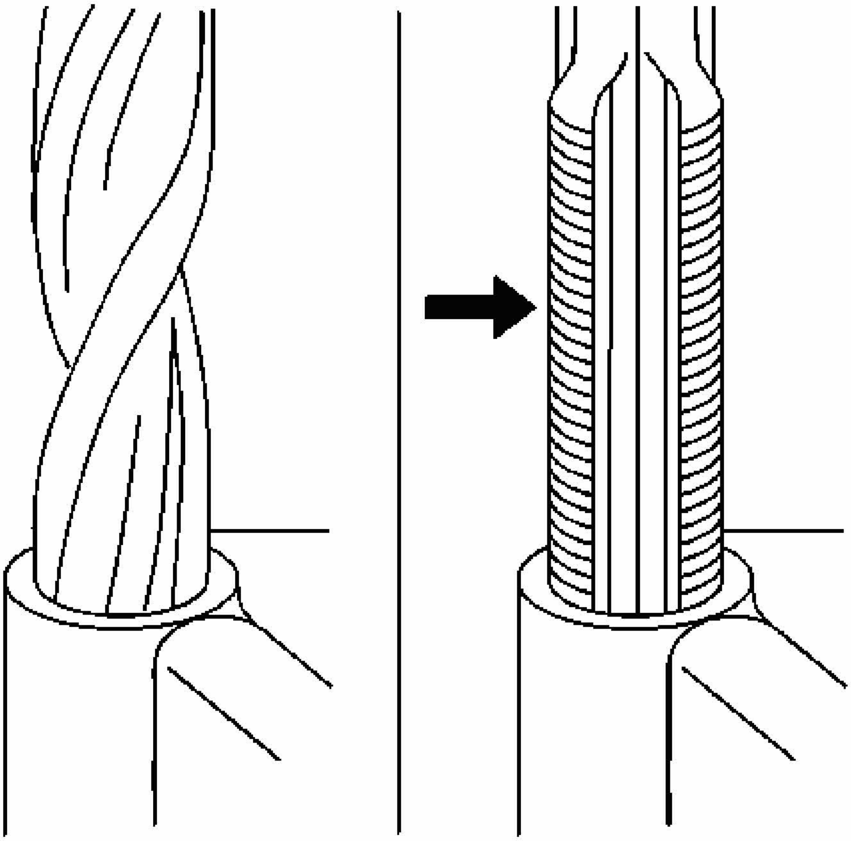


Fig. 421: Drilling & Tapping Damaged Threads
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.

IMPORTANT: Refer to the thread repair kit manufacturer's instructions regarding the size of the drill and which tap to use. Always avoid any buildup of chips. Back out the tap every few turns and remove the chips.

1. Determine the size, the pitch, and the depth of the damaged thread.
2. Adjust the stop collars on the cutting tool as needed. Tap the stop collars to the required depth.
3. Drill out the damaged thread.
4. Remove the chips.
5. Apply clean engine oil to the top thread.
6. Use the tap in order to cut new thread.
7. Clean the thread.

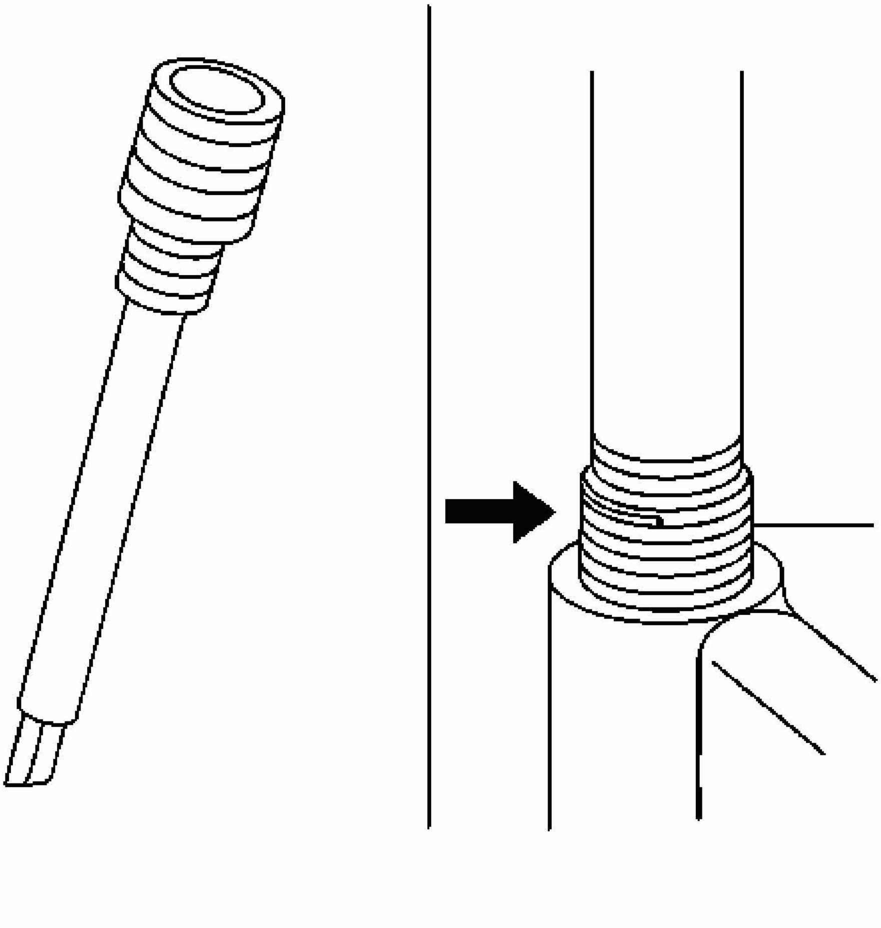


Fig. 422: Installing Thread Insert

Courtesy of GENERAL MOTORS CORP.

8. Screw the thread insert onto the mandrel of the thread insert installer. Engage the tang of the thread insert onto the end of the mandrel.

IMPORTANT: The thread insert should be flush to 1 turn below the surface.

9. Lubricate the thread insert with clean engine oil - except when installing in aluminum - and install the thread insert.
10. If the tang of the thread insert does not break off when backing out the thread insert installer, break off the tang using a drift punch.

SERVICE PRIOR TO ASSEMBLY

Dirt will cause premature wear of the rebuilt engine. Clean all of the components. Use the proper tools in order to measure components when inspecting for excessive wear. Repair or replace the components that are not within the manufacturers specification. When components are reinstalled into an engine, return the components to their original location, position, and direction. During assembly, lubricate all of the moving parts with clean engine oil or engine assembly lubricant unless otherwise specified. This will provide initial lubrication when the engine is first started.

CAMSHAFT BEARING INSTALLATION

Tools Required

J 33049 Camshaft Bearing Service Set. See **Special Tools**.

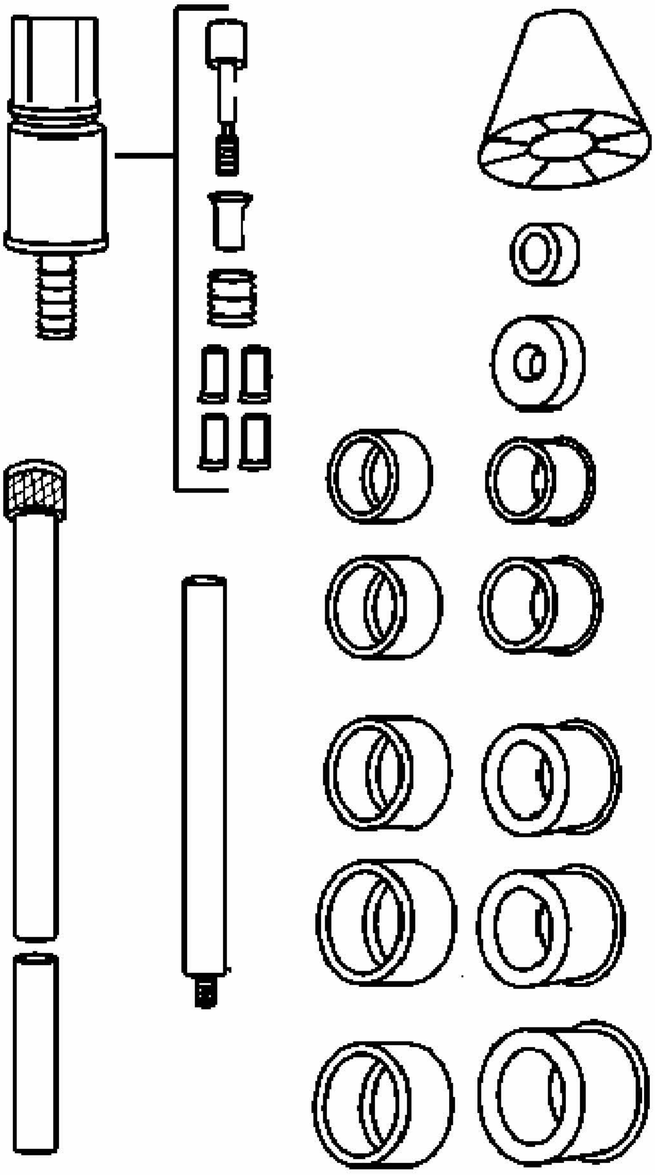


Fig. 423: Camshaft Bearing Service Set
Courtesy of GENERAL MOTORS CORP.

1. Assemble the **J 33049** according to the manufacturer's instructions. See **Special Tools**.

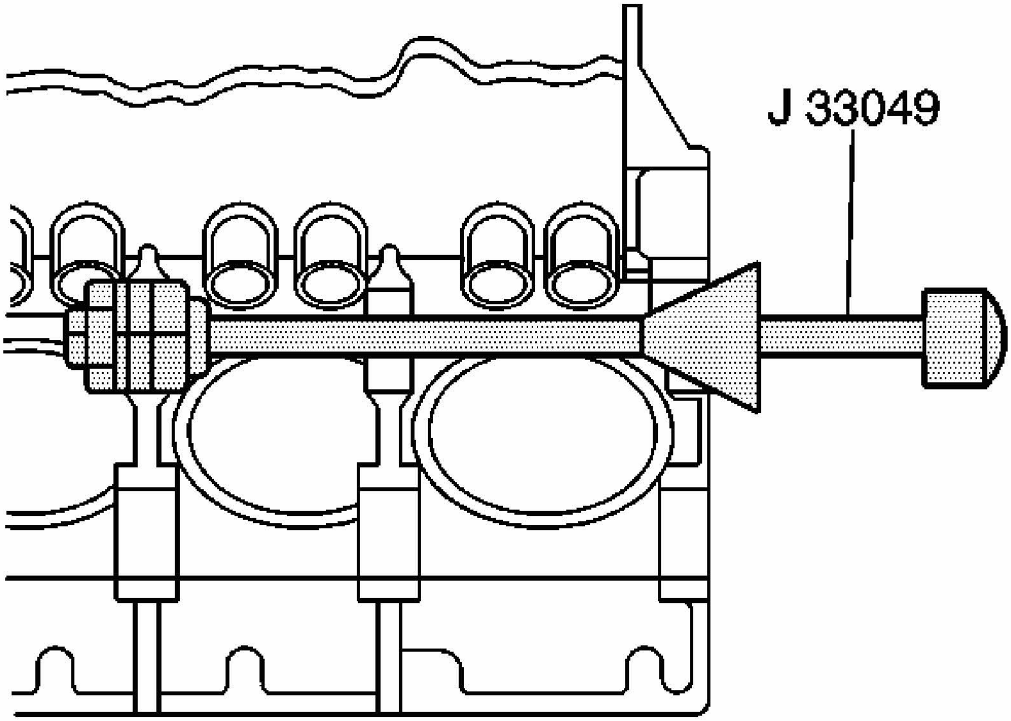


Fig. 424: Removing/Installation Camshaft Inner Bearing Using J 33049
Courtesy of GENERAL MOTORS CORP.

NOTE: Severe engine damage may result if the oil holes are not correctly aligned.

2. Install the camshaft bearings in the following order:
    1. Index the camshaft bearing oil holes with the engine block oil passages.
    2. Place the bearing on the **J 33049** . See Special Tools.
    3. Install the third camshaft bearing.
    4. Install the second camshaft bearing.
    5. Install the outer camshaft bearings.

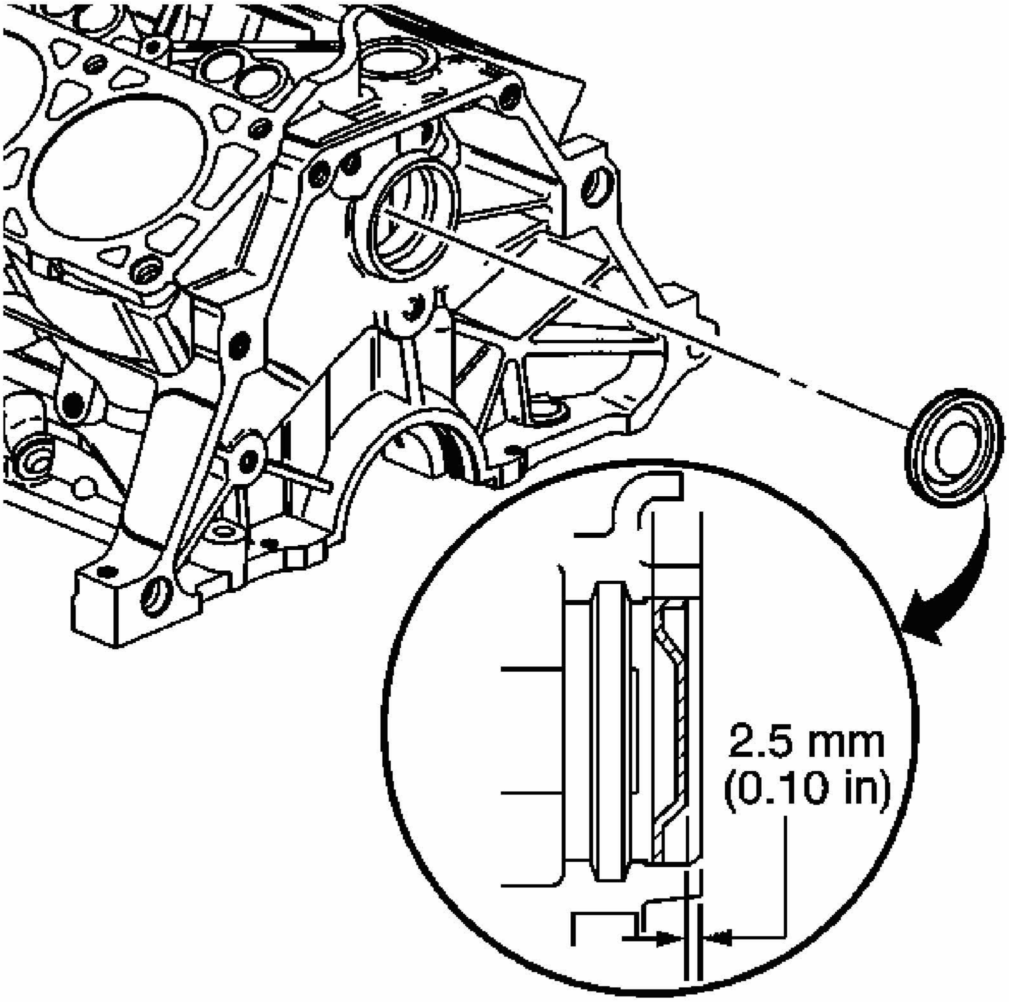


Fig. 425: Identifying Camshaft Rear Bearing Hole Plug Installation Depth
Courtesy of GENERAL MOTORS CORP.

3. Apply sealer GM P/N 12377901 (Canadian P/N 10953504) or the equivalent to the camshaft rear bearing hole plug.
4. Install the camshaft rear bearing hole plug.

PISTON OIL NOZZLE INSTALLATION

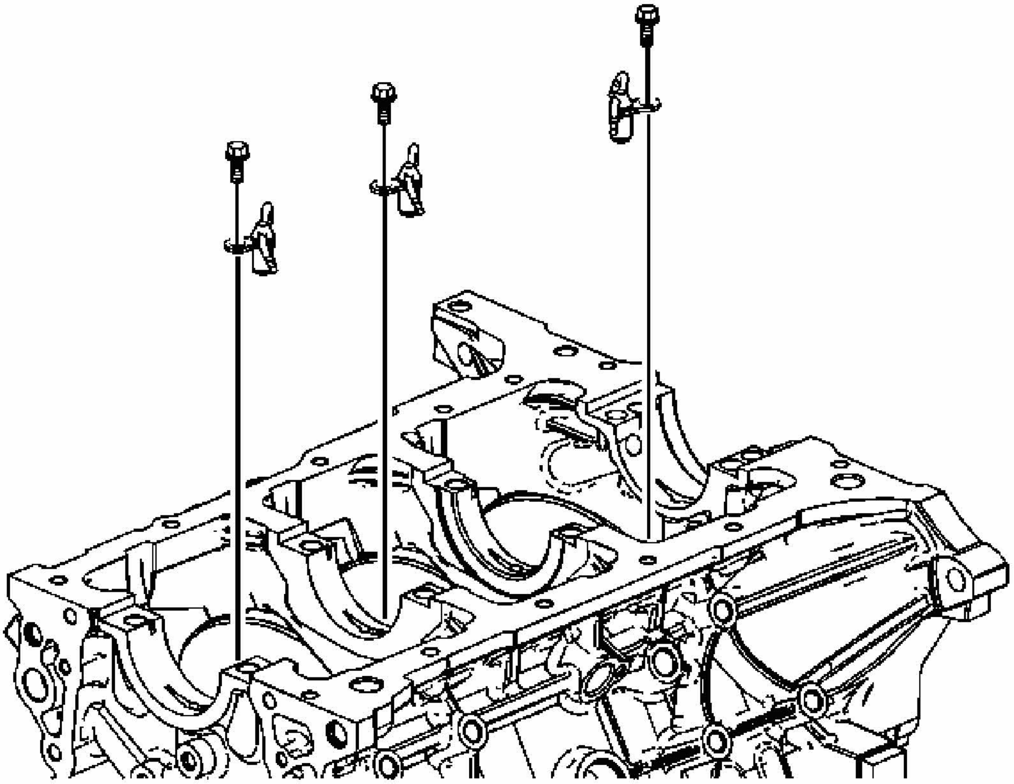


Fig. 426: Identifying Piston Oil Nozzles & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Position the piston oil nozzles in the engine block.

   NOTE: **Refer to Fastener Notice .**

2. Install the bolts retaining the piston oil nozzles to the engine block.

   Tighten: Tighten the bolt to 10 N.m (89 lb in).

CRANKSHAFT AND BEARINGS INSTALLATION

Tools Required

J 45059 Angle Meter. See **Special Tools**.

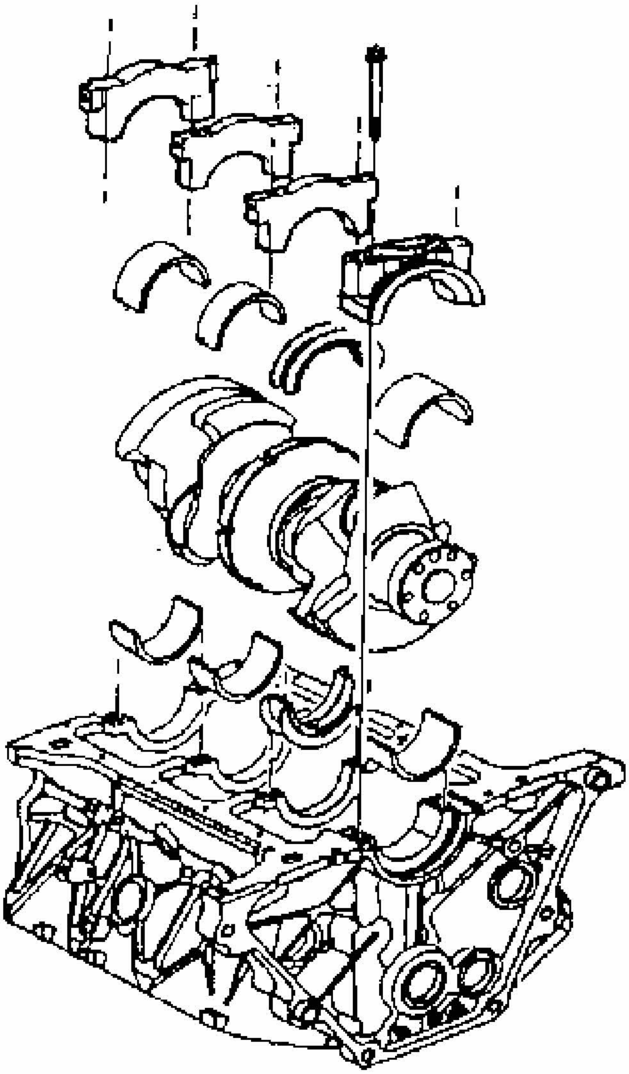


Fig. 427: View Of Crankshaft, Main Bearings And Bearing Caps
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the crankshaft bearing cap bolt holes and the crankshaft bearing cap mating surfaces are clean and dry.

1. Dip the crankshaft bearing cap bolts in clean engine oil.

NOTE: Upper and lower inserts may be different. Do not obstruct any oil passages.

2. Place the crankshaft bearing inserts into the crankshaft bearing cap and into the engine block.

IMPORTANT: The crankshaft bearing inserts will project slightly when put into place. Ensure that the bearing inserts project an equal distance on both sides. Ensure that the insert tangs are engaged.

3. Lubricate the crankshaft main bearing surface with clean engine oil.
4. Install the crankshaft.

NOTE: In order to prevent the possibility of cylinder block or crankshaft bearing cap damage, the crankshaft bearing caps are tapped into the cylinder block cavity using a brass, lead, or a leather mallet before the attaching bolts are installed. Do not use attaching bolts to pull the crankshaft bearing caps into the seats. Failure to use this process may damage a cylinder block or a bearing cap.

5. Install the crankshaft main bearing caps. Apply a small amount of sealer GM P/N 1052942 (Canadian P/N 10953466) to the rear of the #4 crankshaft main bearing cap sealing surface.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

6. Install the crankshaft main bearing cap bolts.

   Tighten: Use the **J 45059** in order to tighten the crankshaft main bearing cap bolts to 50 N. See **Special Tools**.m (37 lb ft) plus 77 degrees.

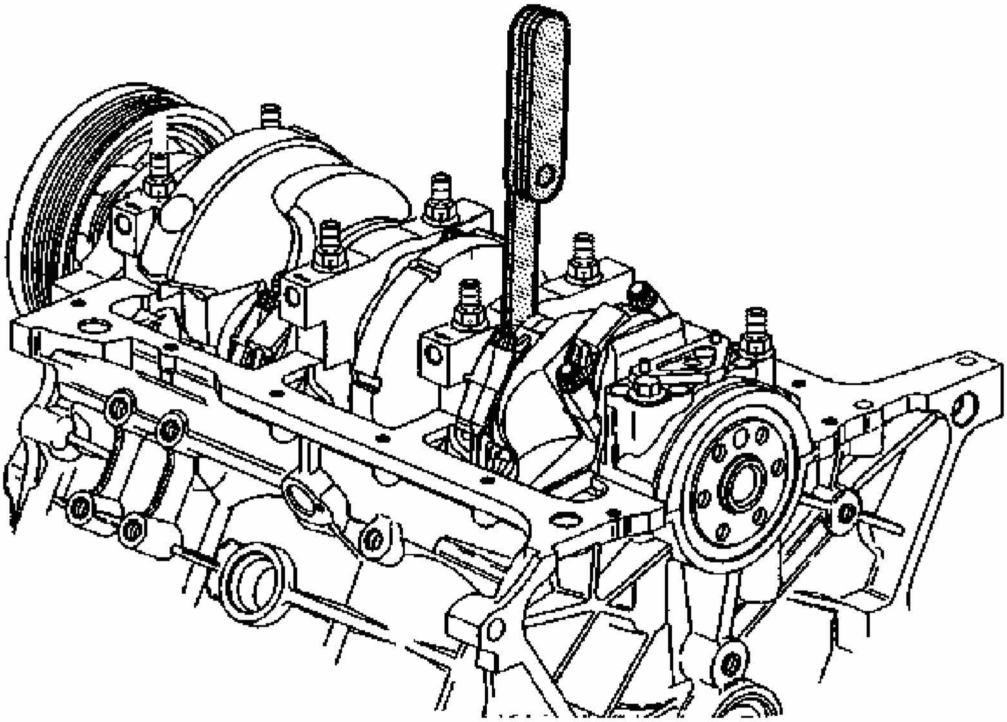


Fig. 428: Measuring Crankshaft End Play
Courtesy of GENERAL MOTORS CORP.

7. Measure the crankshaft end play.
    1. Thrust the crankshaft forward or rearward.
    2. Insert a feeler gage between the number 3 crankshaft bearing and the bearing surface of the crankshaft and measure the bearing clearance. The proper crankshaft end play clearance is 0.06-0.21 mm (0.002-0.008 in).
    3. If the bearing clearance is not within specifications, inspect the thrust surfaces for nicks, gouges or raised metal. Minor imperfections may be removed with a fine stone.

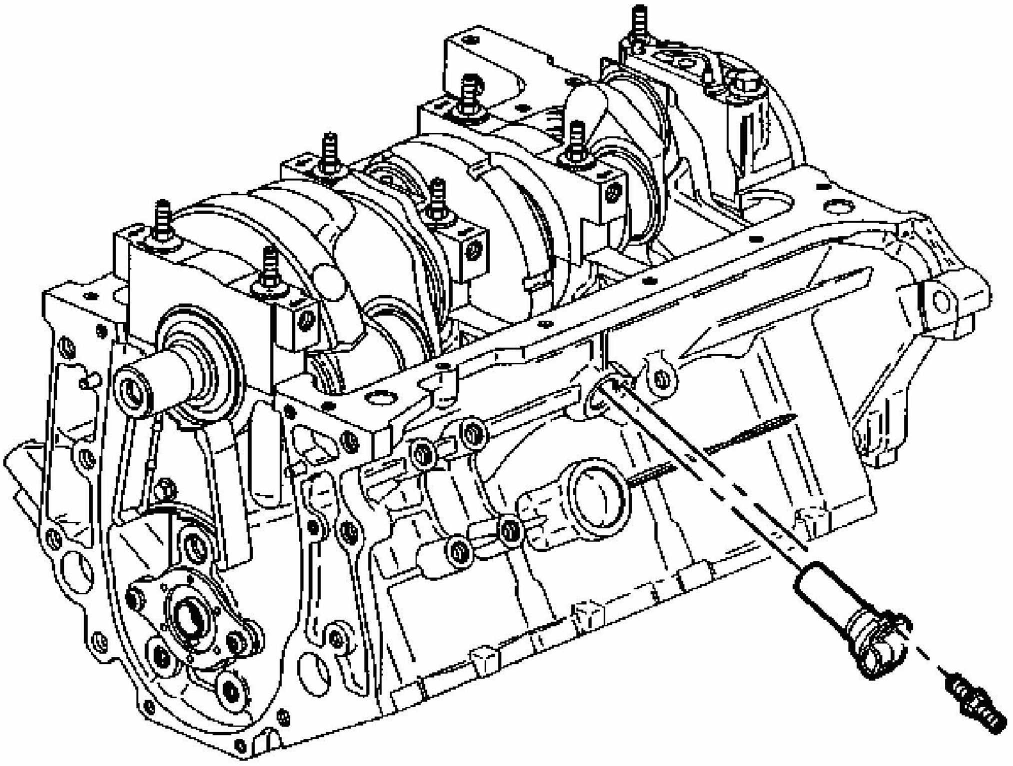


Fig. 429: View Of Crankshaft Position Sensor & Stud
Courtesy of GENERAL MOTORS CORP.

8. Install the crankshaft position sensor into the side of the engine block.
9. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or the equivalent to the crankshaft position sensor stud threads.
10. Install the crankshaft position sensor stud.

    Tighten: Tighten the crankshaft position sensor stud to 11 N.m (98 lb in).

11. Install the crankshaft position sensor shield and nut.

    Tighten: Tighten the crankshaft position sensor shield nut to 11 N.m (98 lb in).

CRANKSHAFT REAR OIL SEAL INSTALLATION

Tools Required

J 34686 Rear Main Seal Installer. See **Special Tools**.

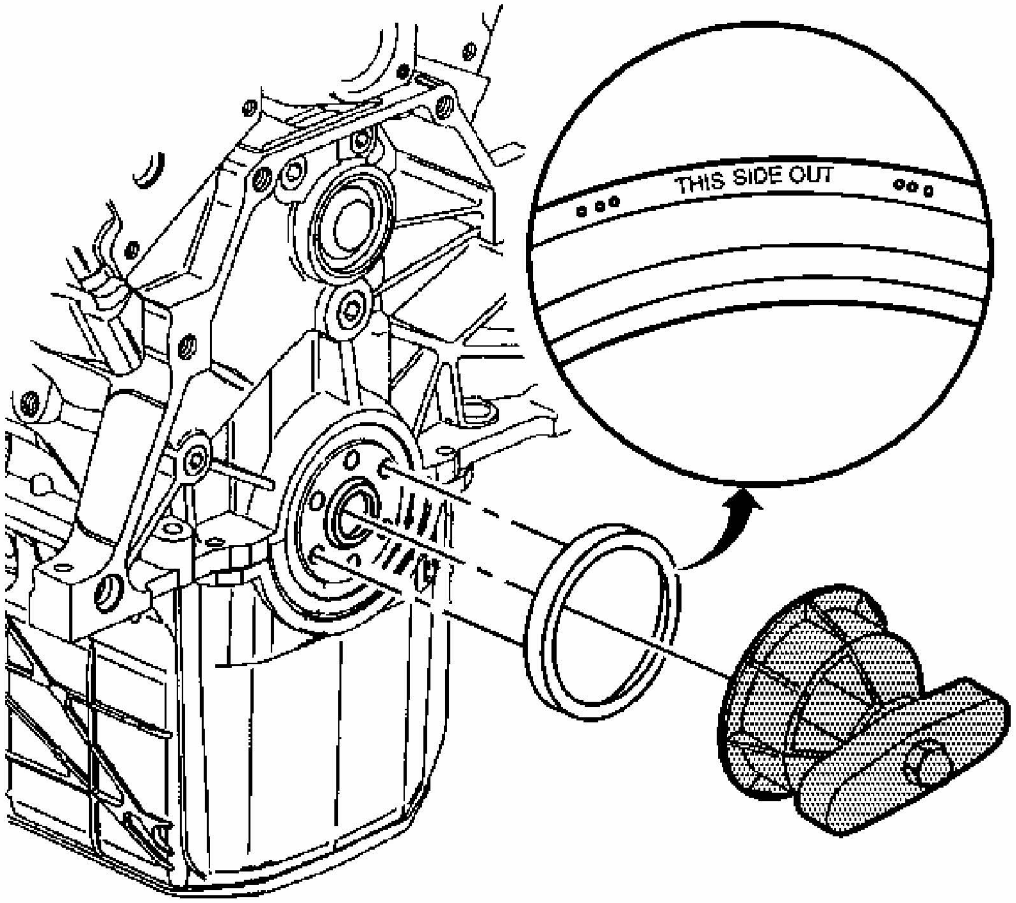


Fig. 430: Installing Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not apply or use any oil lubrication on the crankshaft rear oil seal, or the seal installer. Do not touch the sealing lip of the oil seal once the protective sleeve is removed. Doing so will damage/deform the seal.

NOTE: Clean the crankshaft sealing surface with a clean, lint free towel. Inspect lead-in edge of crankshaft for burrs/sharp edges that could damage the rear main oil seal. Remove burrs/sharp edges with crocus cloth before proceeding.

IMPORTANT: Notice the direction of the rear oil seal. The new design seal is a reverse style as opposed to what has been used in the past.

"THIS SIDE OUT" has been stamped into the seal as shown in the graphic.

1. Carefully remove the protection sleeve from the new crankshaft rear oil seal.
2. Install the crankshaft rear oil seal onto the **J 34686** by sliding the crankshaft rear oil seal over the mandrel using a twisting motion until the back of the crankshaft rear oil seal bottoms squarely against the collar of the tool. See **Special Tools**.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

3. Perform the following steps in order to install the crankshaft rear oil seal:
    1. Align the dowel pin of the **J 34686** with the dowel pin in the crankshaft. See **Special Tools**.
    2. Attach the **J 34686** to the crankshaft by hand, or tighten attaching screws to 5 N. See **Special Tools**.m (45 lb in).
    3. Turn the T-handle of the **J 34686** in order to engage allow the collar to push the seal into the bore. See **Special Tools**.

       Turn the handle until the collar is tight against the engine block. Ensure that the seal is seated properly.
    4. Loosen the T-handle until the T-handle comes to a stop.
    5. Remove the attaching screws.

PISTON, CONNECTING ROD, AND BEARING INSTALLATION

Tools Required

- **J 6125-1B** Slide Hammer with Adapter. See **Special Tools**.
- **J 8037** Ring Compressor. See **Special Tools**.
- **J 41348** Bearing Cap Puller. See **Special Tools**.
- **J 41556** Connecting Rod Guide. See **Special Tools**.
- **J 43654** Piston Pin Clip Remover and Installer. See **Special Tools**.
- **J 43690** Rod Bearing Clearance Checking Tool. See **Special Tools**.
- **J 43690-100** Rod Bearing Clearance Checking Tool-Adapter Kit. See **Special Tools**.
- **J 45059** Angle Meter. See **Special Tools**.

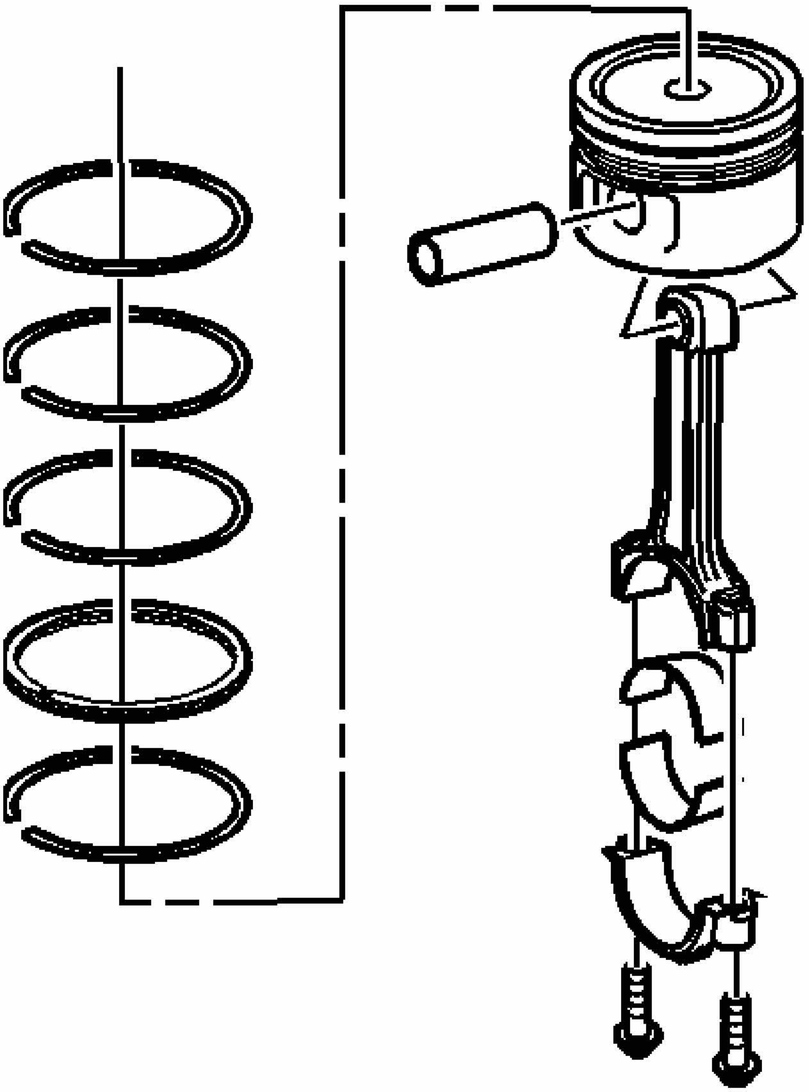


Fig. 431: Lubricating Piston Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The piston and cylinder bore have been measured and the bore has been sized for the proper clearance. Install the piston and connecting rod assembly into the proper cylinder bore. The piston alignment mark MUST face the front of the engine block.

1. Lightly lubricate the following components with clean engine oil:
   - The piston

- The piston pin
- The piston rings
- The cylinder bore
- The bearing surfaces

2. Stagger the oil control ring end gaps a minimum of 90 degrees.
3. Stagger the compression ring end gaps a minimum of 25 mm (1.0 in).
4. Install the **J 8037** onto the piston and compress the piston rings. See **Special Tools**.

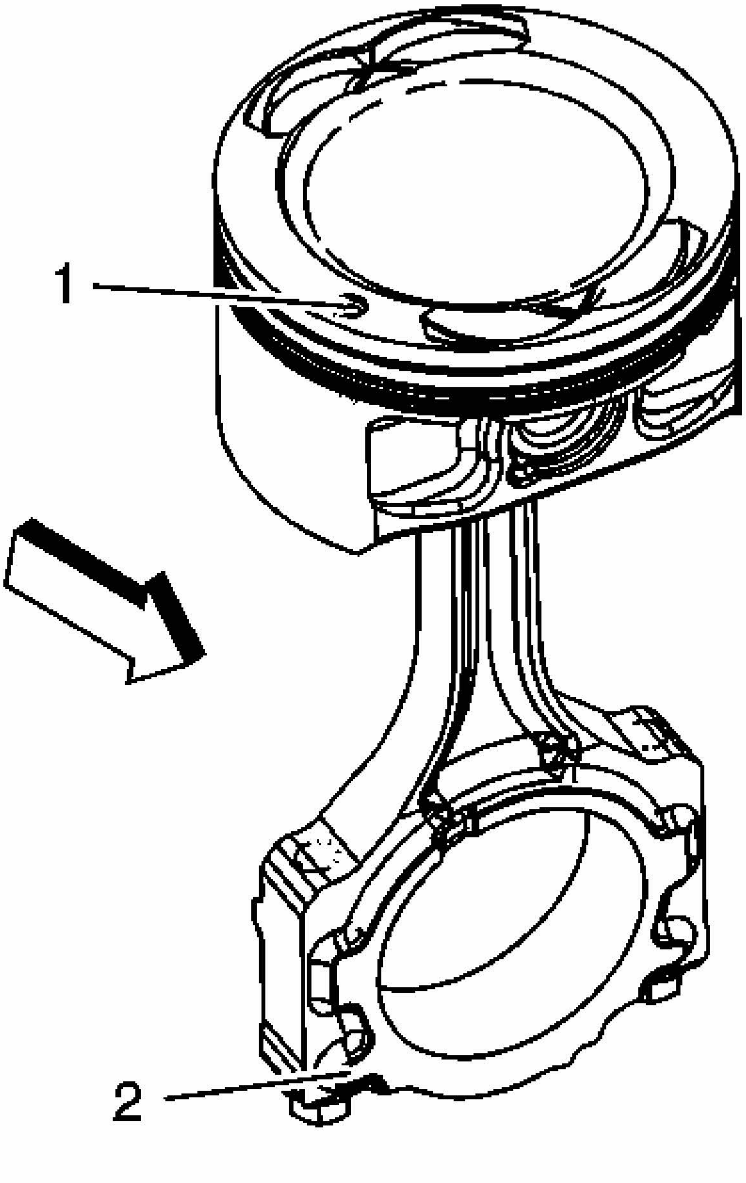


Fig. 432: Identifying Correct Piston Installation
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When assembling the connecting rod to the piston, make sure the connecting rod reference mark (2) is facing towards front of engine, and is in proper correlation with the front of engine piston reference mark (1).

5. Align the piston pin bore with the connecting rod pin bore.

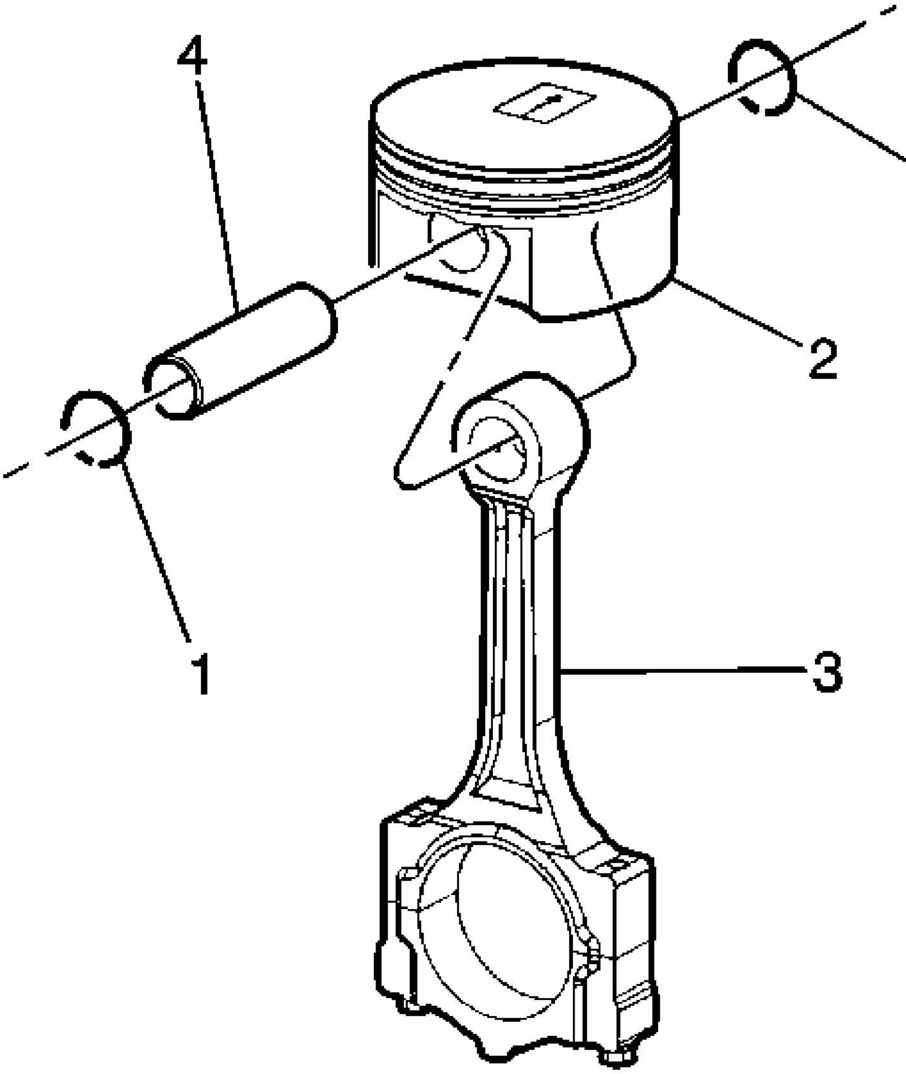


Fig. 433: Exploded View Of Piston & Connecting Rod Assembly

Courtesy of GENERAL MOTORS CORP.

6. Slide the piston pin (4) into the piston and the connecting rod (3).

IMPORTANT: NEW piston pin retainers must be used. Never reuse the piston pin retainers.

7. Install NEW piston pin retainers (1) using the **J 43654** . See **Special Tools**.
8. Ensure that the piston pin retainers are fully seated in their grooves.
9. Repeat these procedures for the remaining pistons.
10. Install the **J 41556** into the connecting rod. See **Special Tools**.

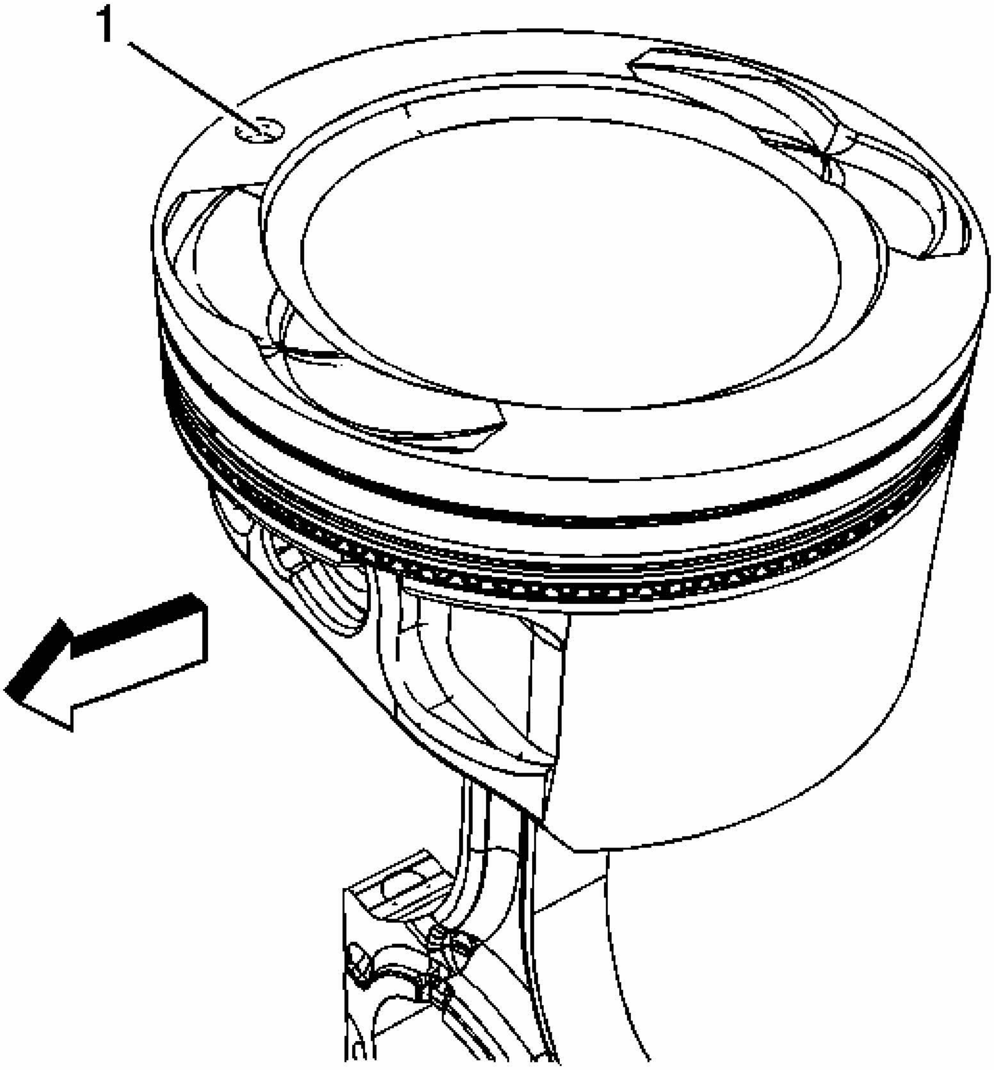


Fig. 434: Ensure That The Alignment Marks (1) Face The Front Of The Engine
Courtesy of GENERAL MOTORS CORP.

NOTE: Pistons are specific to right hand and left hand applications. Prior to installation, ensure that the alignment marks (1) face the front of the engine. Failure to do so may lead to engine damage.

11. If installing a LH piston, reference the alignment marks.

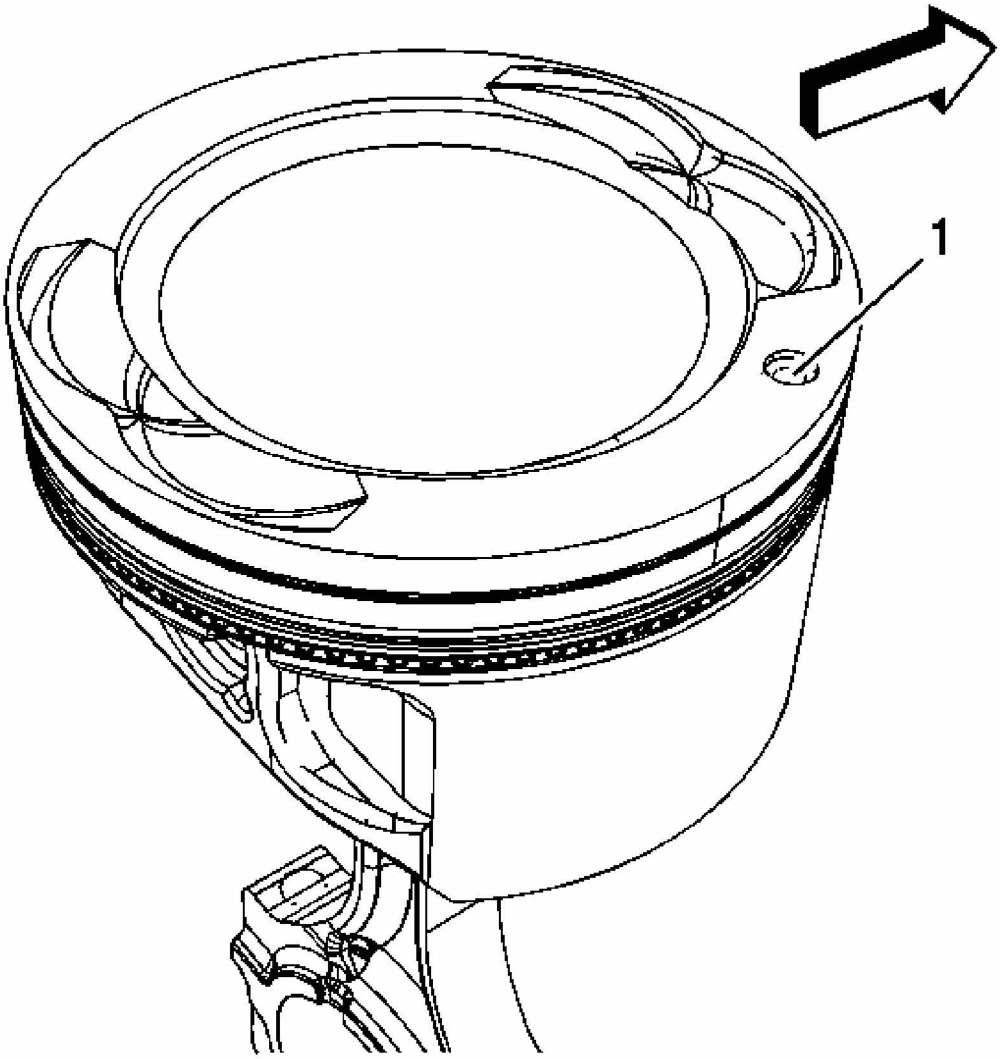


Fig. 435: Ensure That The Alignment Marks (1) Face The Front Of The Engine
Courtesy of GENERAL MOTORS CORP.

NOTE: **Pistons are specific to right hand and left hand applications. Prior to installation, ensure that the alignment marks (1) face the front of the engine. Failure to do so may lead to engine damage.**

12. If installing a RH piston, reference the alignment marks.

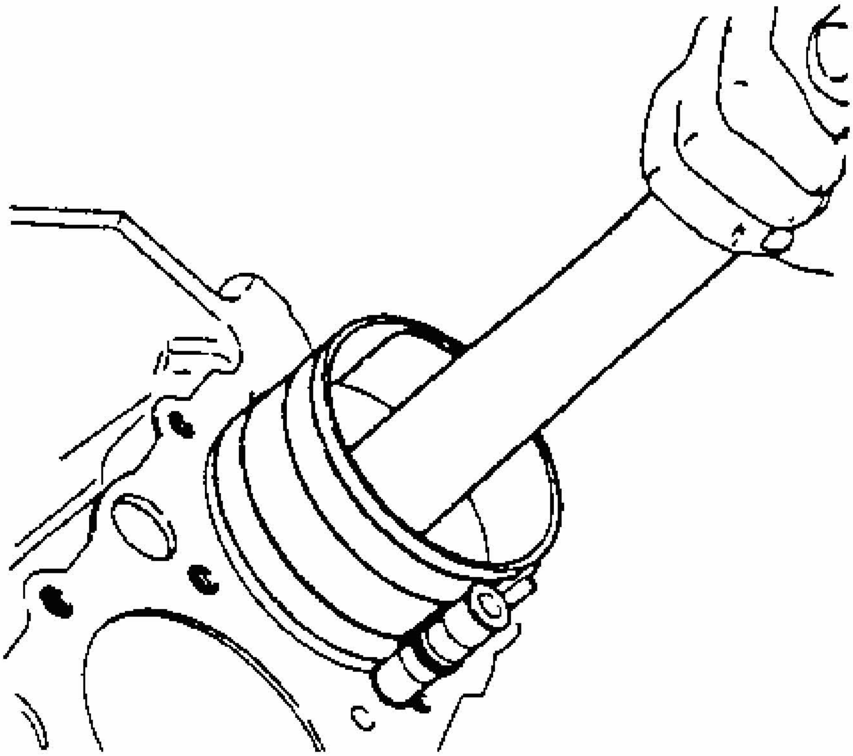


Fig. 436: Installing Piston & Connecting Rod Assembly Into Cylinder
Courtesy of GENERAL MOTORS CORP.

13. Install the piston and connecting rod assembly into the proper cylinder bore.
14. Hold the piston ring compressor firmly against the engine block. Using a wooden hammer handle, lightly tap the top of the piston until all of the piston rings enter the cylinder bore.

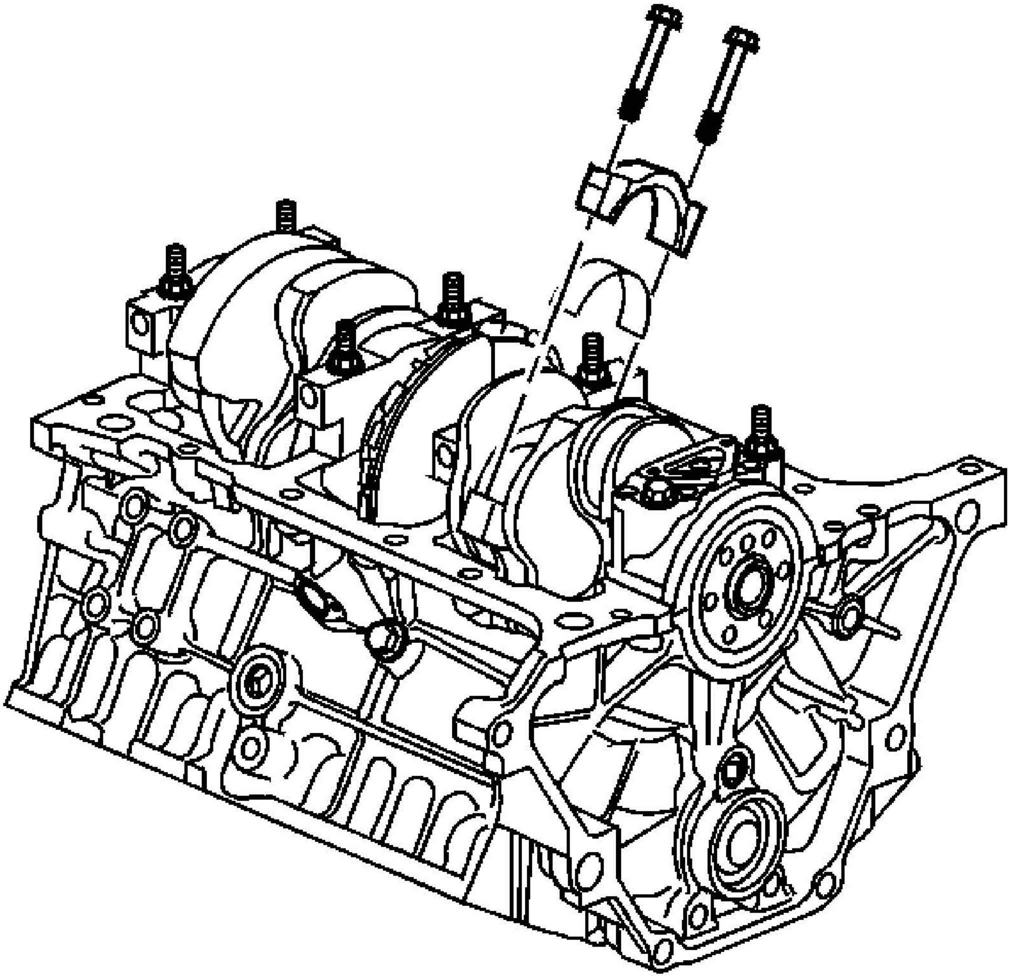


Fig. 437: View Of Bearing, Bearing Cap & Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When installing the pistons into the cylinder bore, make sure not to contact the piston oil nozzle with the connecting rod. Failure to do so may damage the piston oil nozzle, resulting in potential engine damage.

15. Using **J 41556** , guide the connecting rod end onto the crankshaft journal. See **Special Tools**.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

16. Install the bearing, bearing cap and bolts.

    Tighten:

    1. Tighten the connecting rod bearing cap bolts a first pass to 25 N.m (18 lb ft).
    2. Tighten the connecting rod bearing cap bolts a final pass to 110 degrees using the **J 45059** . See **Special Tools**.

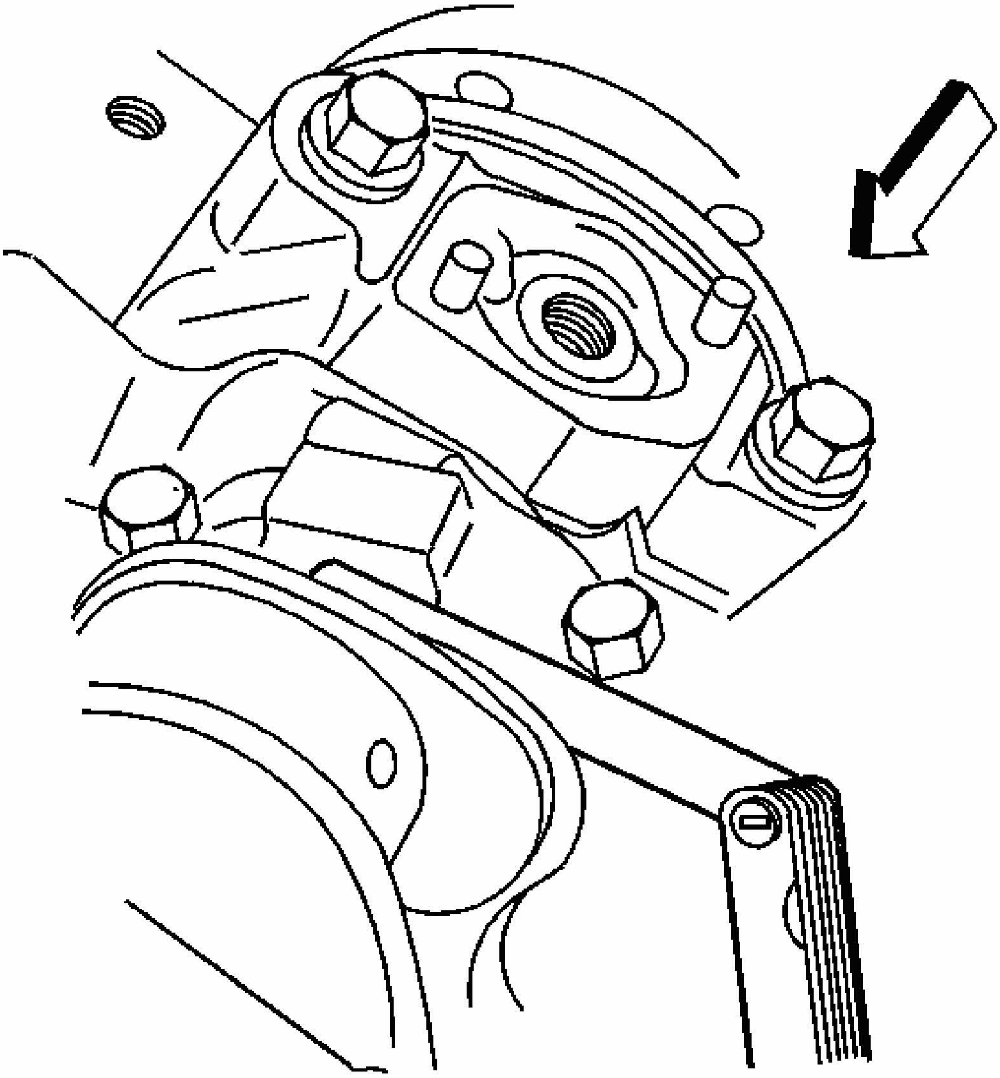


Fig. 438: Measuring Connecting Rod Side Clearance
Courtesy of GENERAL MOTORS CORP.

17. With the pistons and connecting rods installed, use a soft faced mallet and lightly tap

each connecting rod assembly parallel to the crankpin to make sure that the rods have side clearance.

18. Measure the connecting rod side clearance using a feeler gage or dial indicator. Connecting rod side clearance should be within 0.18-0.44 mm (0.007-0.017 in).

Measuring Connecting Rod Bearing Clearance Using J 43690 and J 43690-100

J 43690 and **J 43690-100** have been developed as a more accurate method to measure connecting rod bearing clearances. See **Special Tools**. The instructions below provide an overview of tool set and usage. For more detailed information, refer to the tool instruction sheets as supplied by the tool manufacturer.

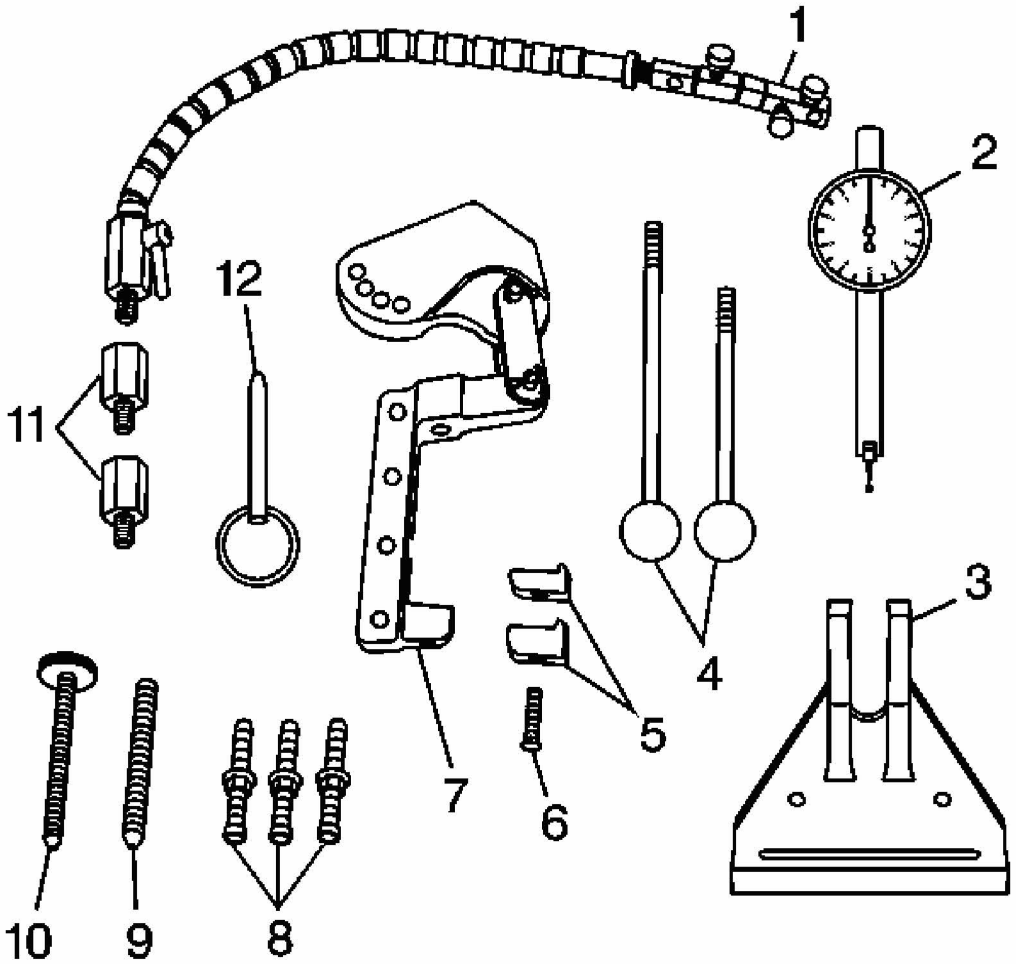


Fig. 439: Identifying Rod Bearing Clearance Checking Tool
Courtesy of GENERAL MOTORS CORP.

1. **J 43690** Rod Bearing Checking Tool includes. See **Special Tools**.
    - J 43690-20 Swivel Base (1)
    - J 43690-19 Dial Indicator (2)
    - J 43690-2 Base (3)
    - J 43690-5,-6 Handle (4)
    - J 43690-10,-11 Foot (5)
    - 280307 Screw (6)
    - J 43690-1 Pivot Arm Assembly (7)
    - J 43690-3,-7,-8 Screws (8)
    - 280319 Screw (9)
    - 280311 Screw (10)
    - J 43690-17,-18 Adapter (11)
    - 280310 Pin (12)

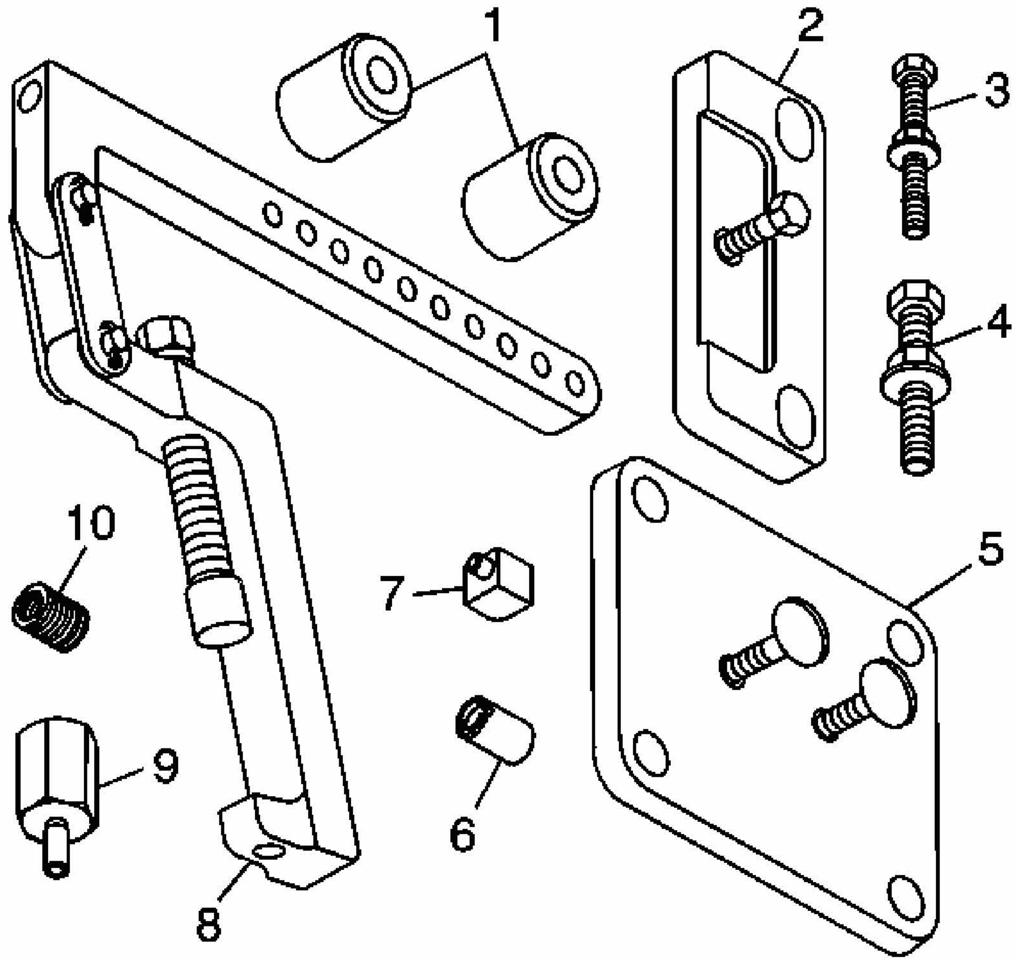


Fig. 440: Identifying Rod Bearing Clearance Tool - Adapter Kit
Courtesy of GENERAL MOTORS CORP.

2. **J 43690-100** Rod Bearing Checking Tool - Adapter Kit includes. See **Special Tools**.
    - J 43690-104 Spacer (1)
    - J 43690-105 Retainer Plate (2)
    - 505478 Bolt (3)
    - 511341 Bolt (4)
    - J 43690-106 Retainer Plate (5)
    - J 43690-107 Cap (6)
    - J 43690-102 Foot (7)
    - J 43690-101 Pivot Arm Assembly (8)
    - J 43690-103 Adapter (9)

- 505439 Adapter (10)

IMPORTANT: The crankshaft must be secure with no movement or rotation in order to obtain an accurate reading.

3. Rotate the crankshaft until the journal/connecting rod to be measured is in the 12 o'clock position.
4. Remove the crankshaft main bearing cap bolts.
5. Remove the crankshaft main lower bearing cap.
6. Insert a piece of paper stock onto the crankshaft journal.

NOTE: In order to prevent the possibility of cylinder block or crankshaft bearing cap damage, the crankshaft bearing caps are tapped into the cylinder block cavity using a brass, lead, or a leather mallet before the attaching bolts are installed. Do not use attaching bolts to pull the crankshaft bearing caps into the seats. Failure to use this process may damage a cylinder block or a bearing cap.

NOTE: This bolt is designed to permanently stretch when tightened. The correct part number fastener must be used to replace this type of fastener. Do not use a bolt that is stronger in this application. If the correct bolt is not used, the parts will not be tightened correctly. The system or the components may be damaged.

7. Install the crankshaft main bearing cap and bolts. Start the crankshaft main bearing cap bolts by hand. Ensure the bottom of the crankshaft main bearing cap is parallel to the bottom of the channel.

   Tighten:

   1. Tighten the crankshaft main bearing cap bolts in equal increments. Do not completely tighten one bolt at a time to prevent the cap from being cocked.
   2. Tighten the bolts to 50 N.m (37 lb ft) to fully seat the crankshaft main bearing caps. Loosen the bolts 360 degrees counterclockwise.
   3. Tighten the bolts to 20 N.m (15 lb ft), then 50 N.m (37 lb ft).
   4. Use **J 45059** to tighten the bolts to 77 degrees. See **Special Tools**.

8. Install the following:
   - J 43690-101 (8)
   - J 43690-5 (4)

- J 43690-2 (3)
- J 43690-7 (8)
- 280310 (12)
- J 43690-17 (11)

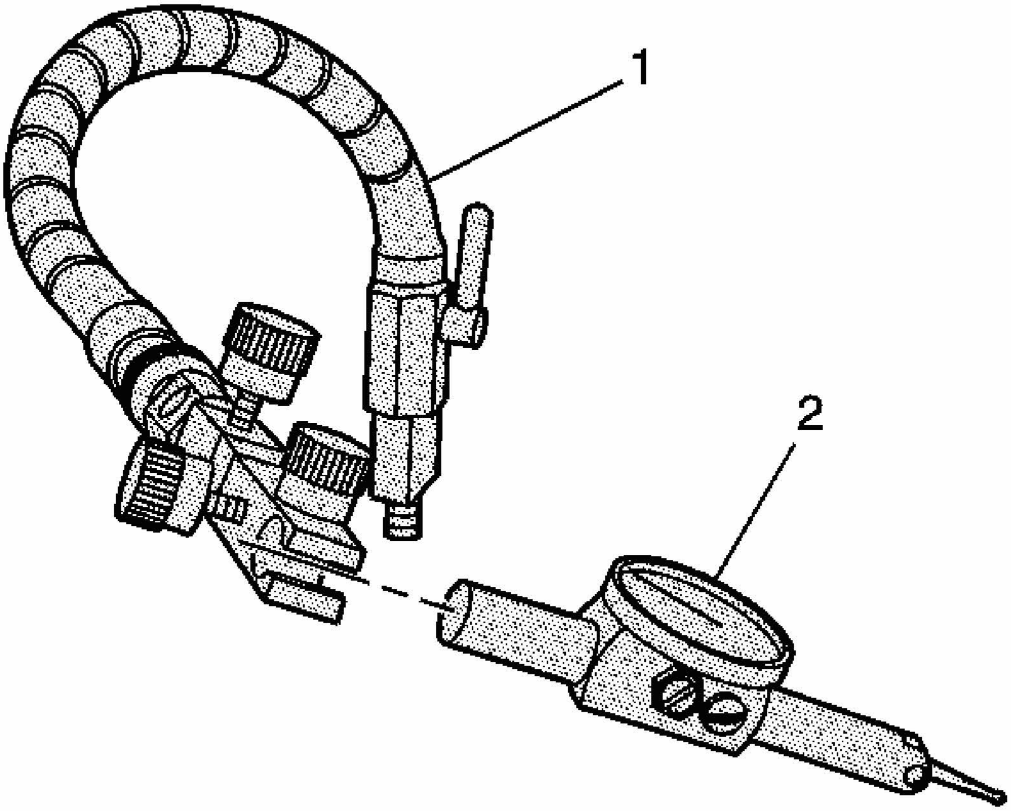


Fig. 441: View Of Swivel Base & Dial Indicator
Courtesy of GENERAL MOTORS CORP.

9. Install the swivel base (1) and dial indicator (2).
10. Adjust per the manufacturers instructions and measure the connecting rod bearing clearance. The connecting rod bearing clearance should be between 0.0127-0.0660 mm (0.0005-0.0026 in).

CAMSHAFT INSTALLATION

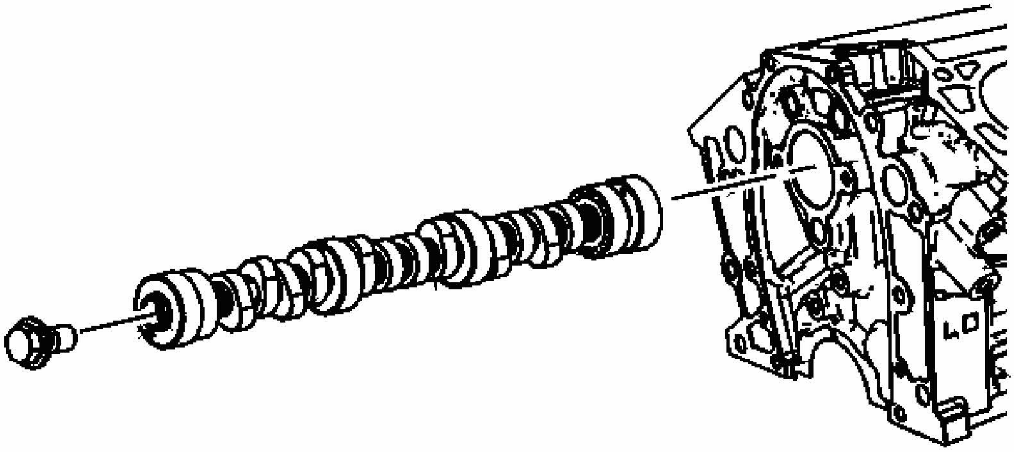


Fig. 442: Inspecting Camshaft Journals
Courtesy of GENERAL MOTORS CORP.

1. Coat the camshaft journals with clean engine oil.
2. Coat the camshaft lobes with prelube GM P/N 12345501 (Canadian P/N 992704) or the equivalent.
3. Install the camshaft using the following procedure:
    1. Install the camshaft sprocket bolt into the camshaft. Tighten finger tight only.
    2. Carefully rotate the camshaft while installing the camshaft into the camshaft bearings.

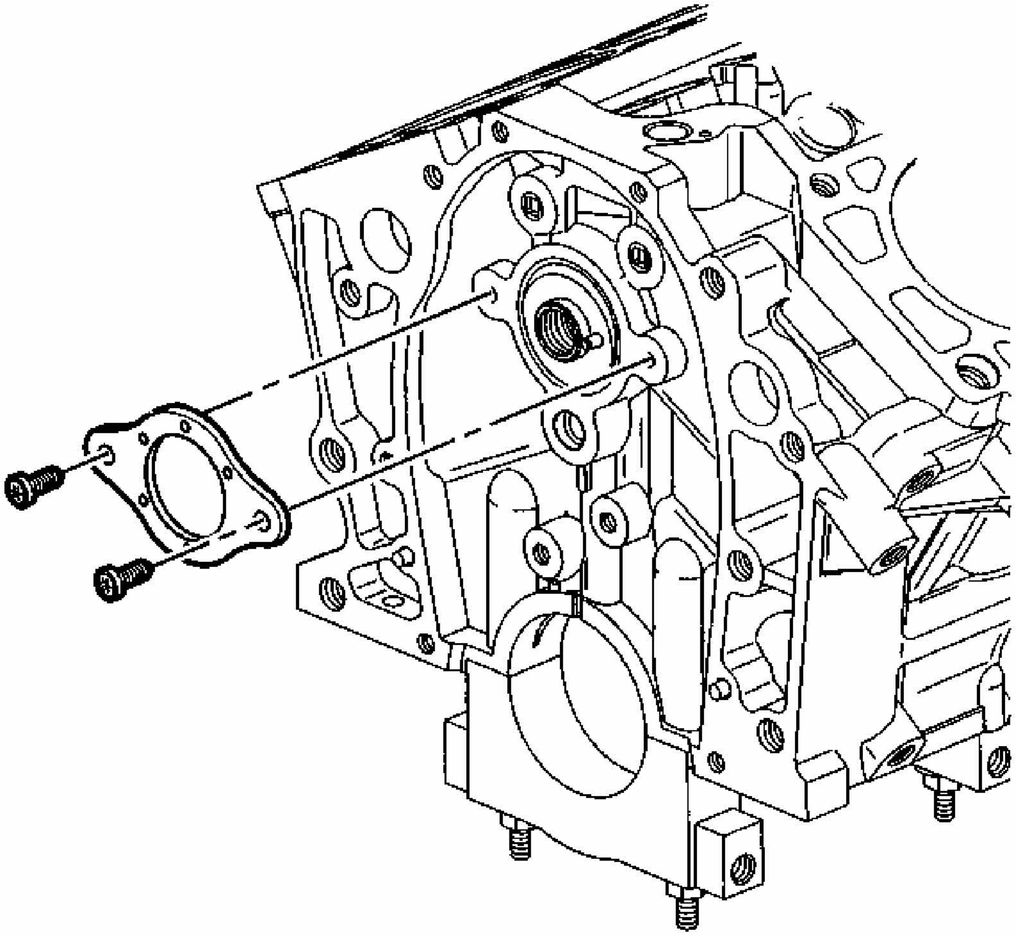


Fig. 443: View Of Camshaft Thrust Plate
Courtesy of GENERAL MOTORS CORP.

4. Install the camshaft thrust plate.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

5. Install the camshaft thrust plate screws.

Tighten: Tighten the camshaft thrust plate screws to 10 N.m (89 lb in).

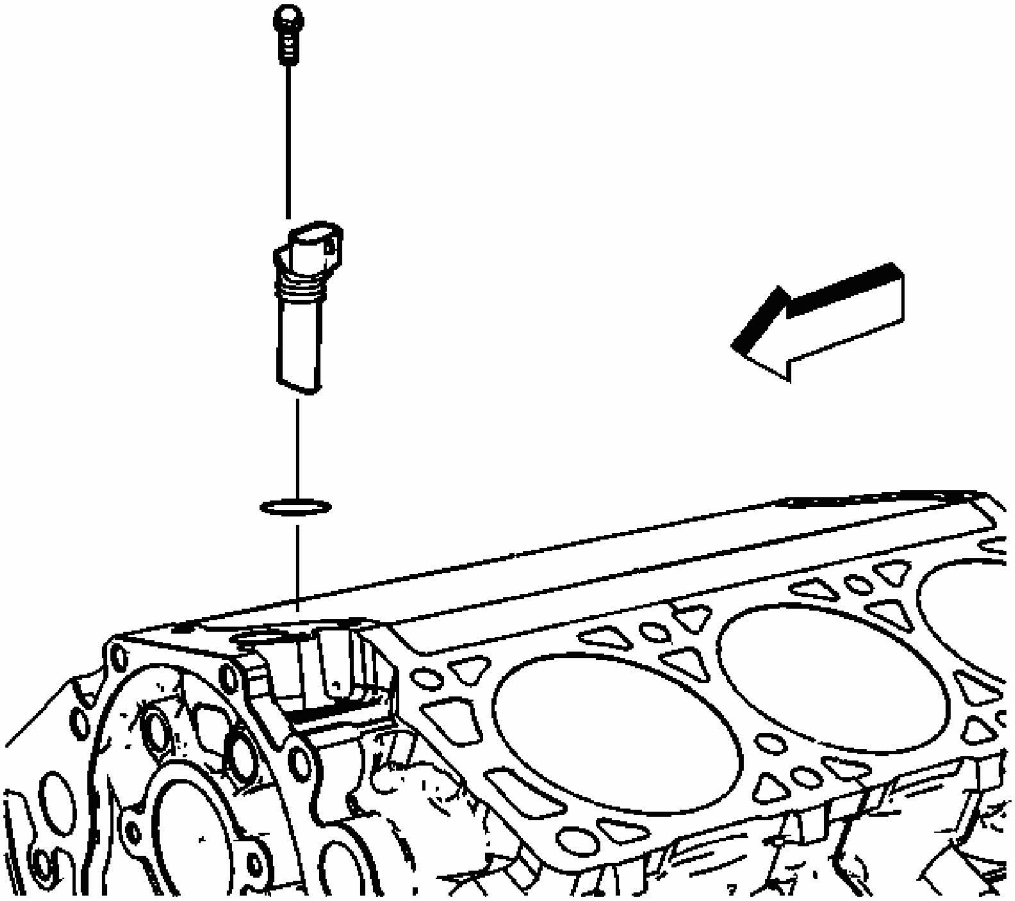


Fig. 444: View Of Camshaft Position Sensor
Courtesy of GENERAL MOTORS CORP.

6. Install the camshaft position sensor.
7. Install the camshaft position sensor bolt.

   Tighten: Tighten the camshaft position sensor bolt to 10 N.m (89 lb in).

TIMING CHAIN AND SPROCKETS INSTALLATION

Tools Required

EN-47719 Tensioner Compressor. See Special Tools.

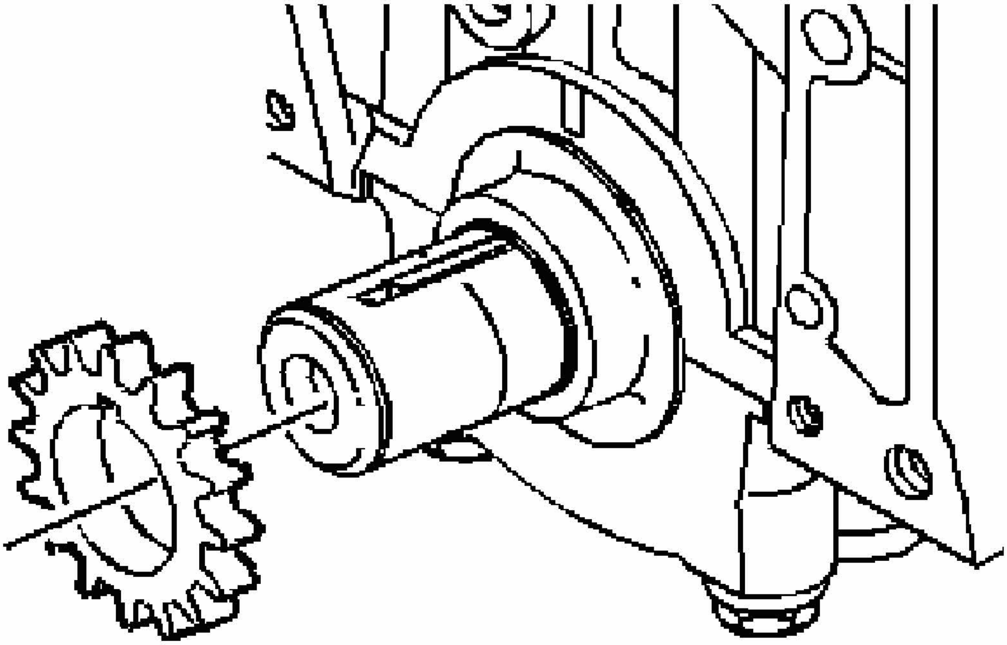


Fig. 445: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

1. Install the crankshaft sprocket.
2. Apply prelube GM P/N 12345501 (Canadian P/N 992704) or the equivalent to the crankshaft sprocket thrust surface.

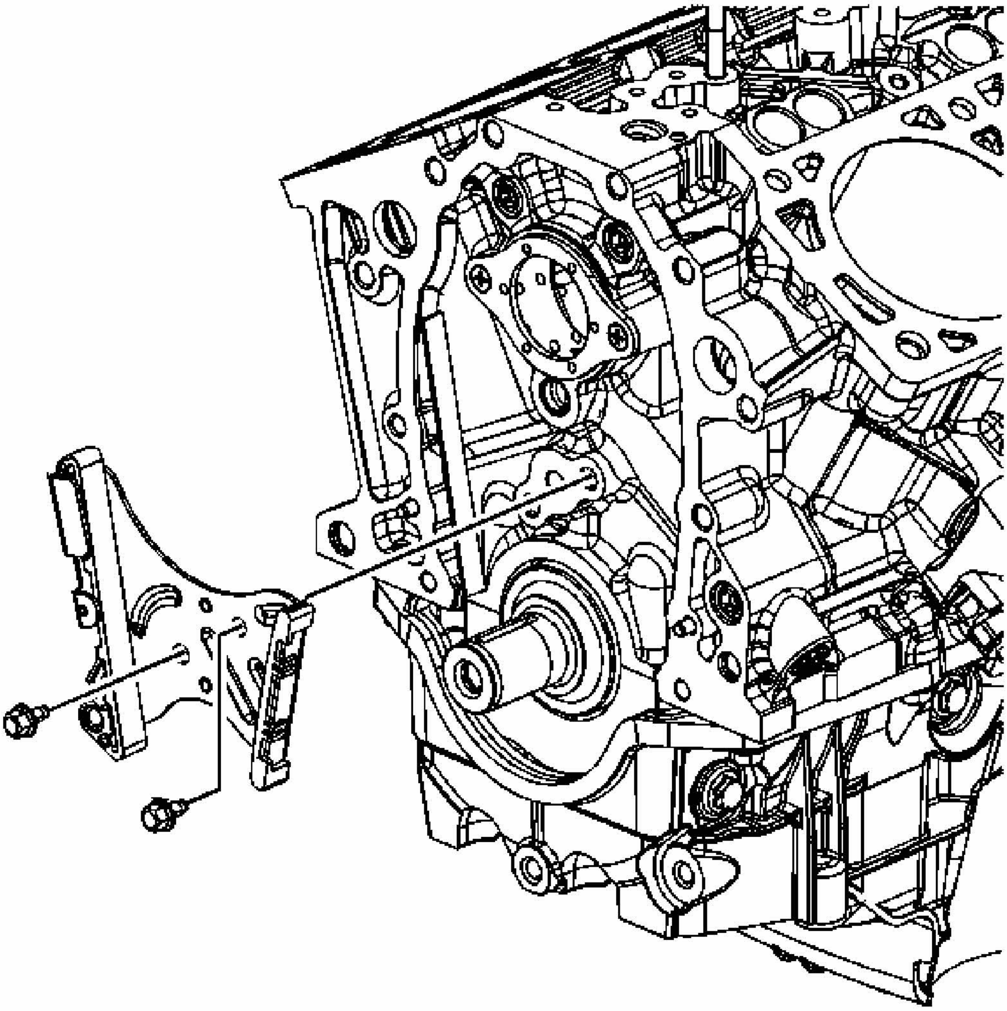


Fig. 446: View Of Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the timing chain tensioner.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

4. Install the timing chain tensioner bolts.

Tighten: Tighten the timing chain tensioner bolts to 21 N.m (15 lb ft).

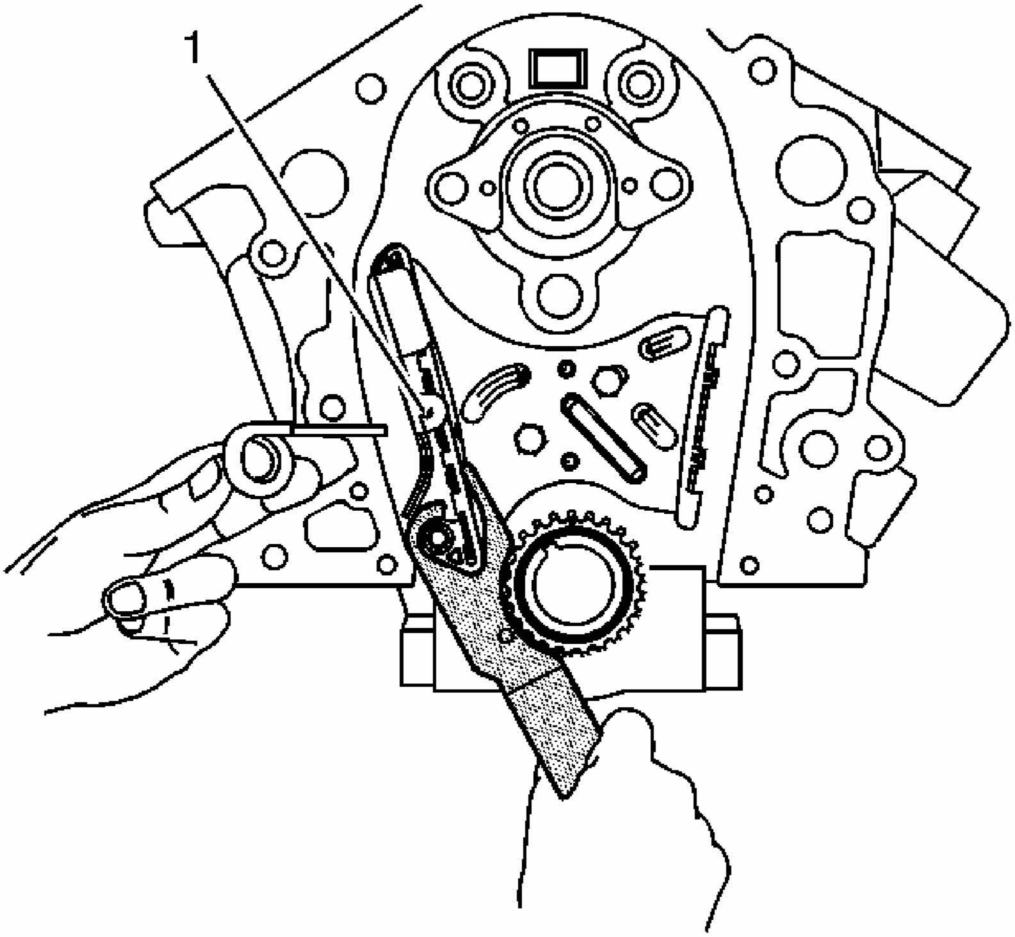


Fig. 447: Collapsing Tensioner
Courtesy of GENERAL MOTORS CORP.

5. Using the **EN-47719** , fully collapse the tensioner, and place the tensioner retaining pin into the retaining hole (1). See **Special Tools**.

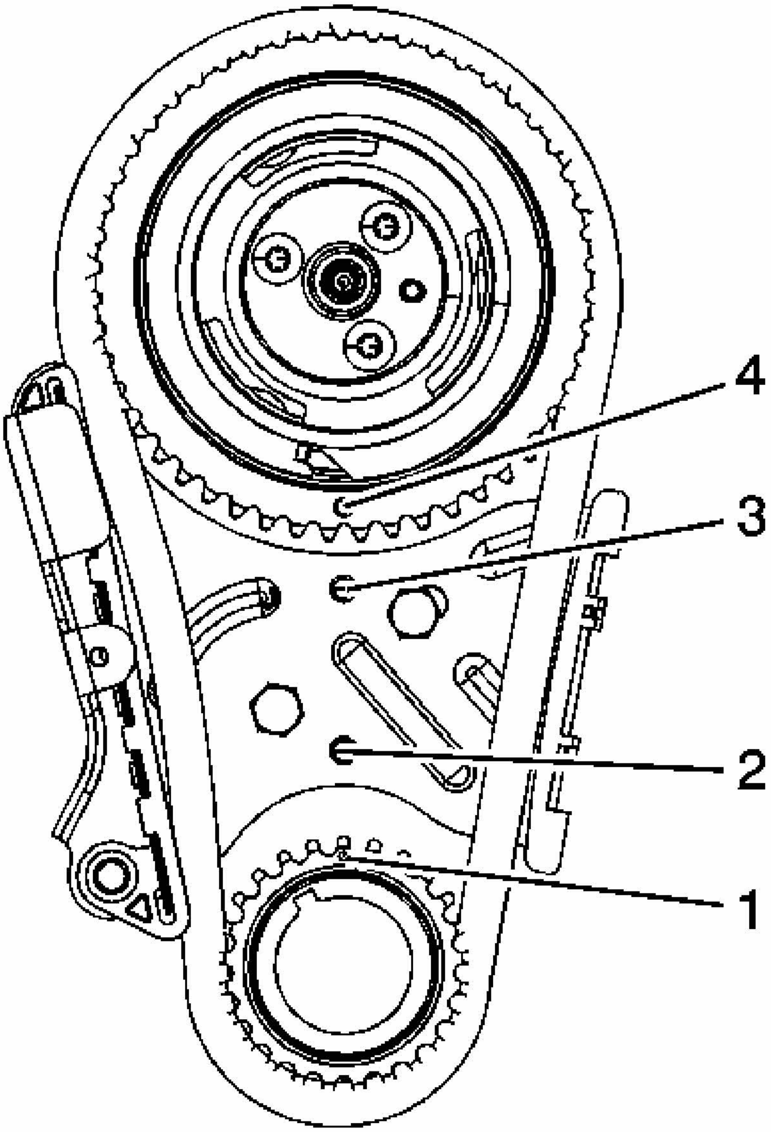


Fig. 448: Identifying Timing Marks & Tensioner
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Always install a NEW camshaft position actuator filter anytime the camshaft position actuator is removed or installed. Refer to Camshaft and Bearings Cleaning and Inspection for filter changing instructions.

6. Align the crankshaft timing mark (1) to the timing mark on the bottom of the timing

chain tensioner (2).

7. Hold the camshaft sprocket with the timing chain hanging down and install the timing chain to the crankshaft gear.
8. Align the timing mark on the camshaft gear (4) with the timing mark on top of the timing chain tensioner (3).

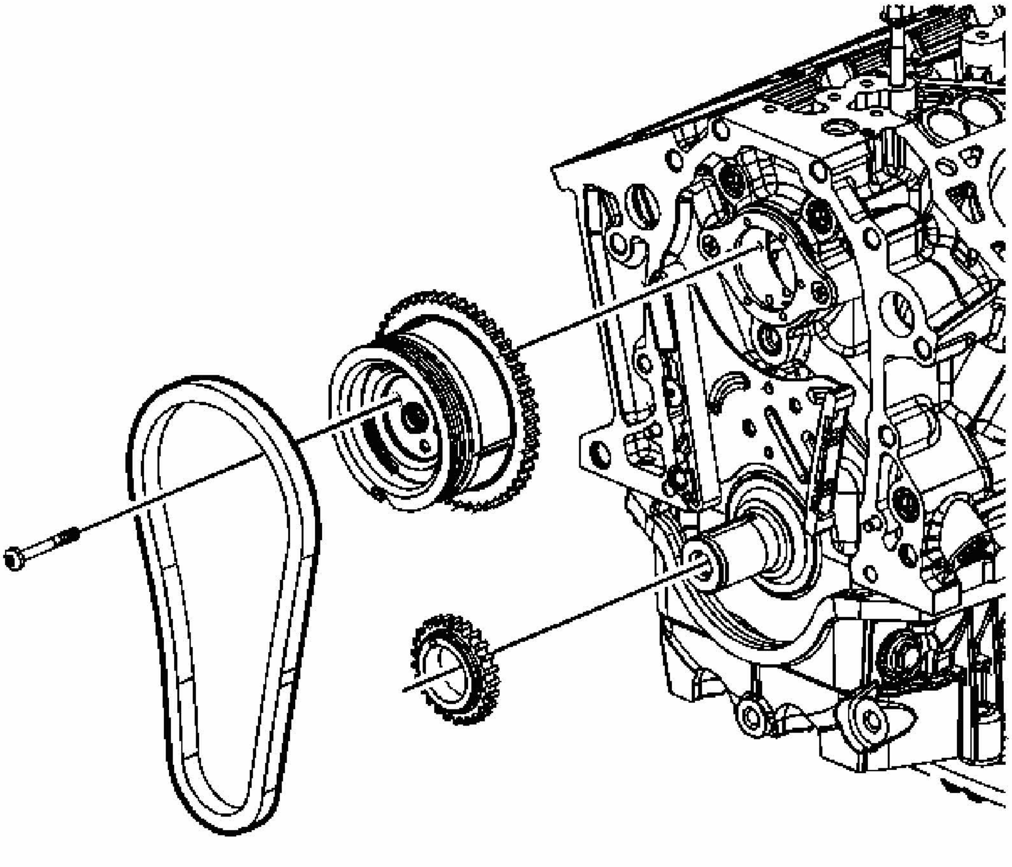


Fig. 449: Identifying Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

9. Align the dowel in the camshaft sprocket with the dowel hole in the camshaft.
10. Draw the camshaft sprocket onto the camshaft using the mounting bolts.

    Tighten: Tighten the bolts to 16 N.m (12 lb ft).

11. Remove the tensioner retaining pin.
12. Coat the crankshaft and camshaft sprocket with engine oil.

ENGINE FRONT COVER INSTALLATION

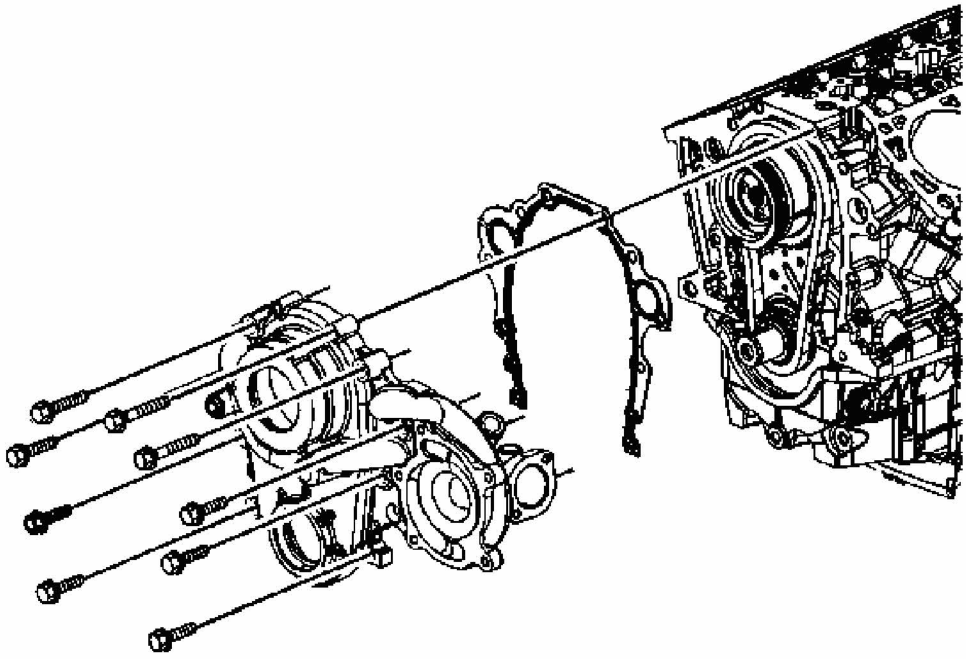


Fig. 450: Identifying Engine Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the front cover and the front cover gasket.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

2. Install the front cover bolts.

Tighten: Tighten the front cover bolts to 25 N.m (18 lb ft).

CRANKSHAFT FRONT OIL SEAL INSTALLATION

Tools Required

J 35468 Cover Aligner and Seal Installer. See **Special Tools**.

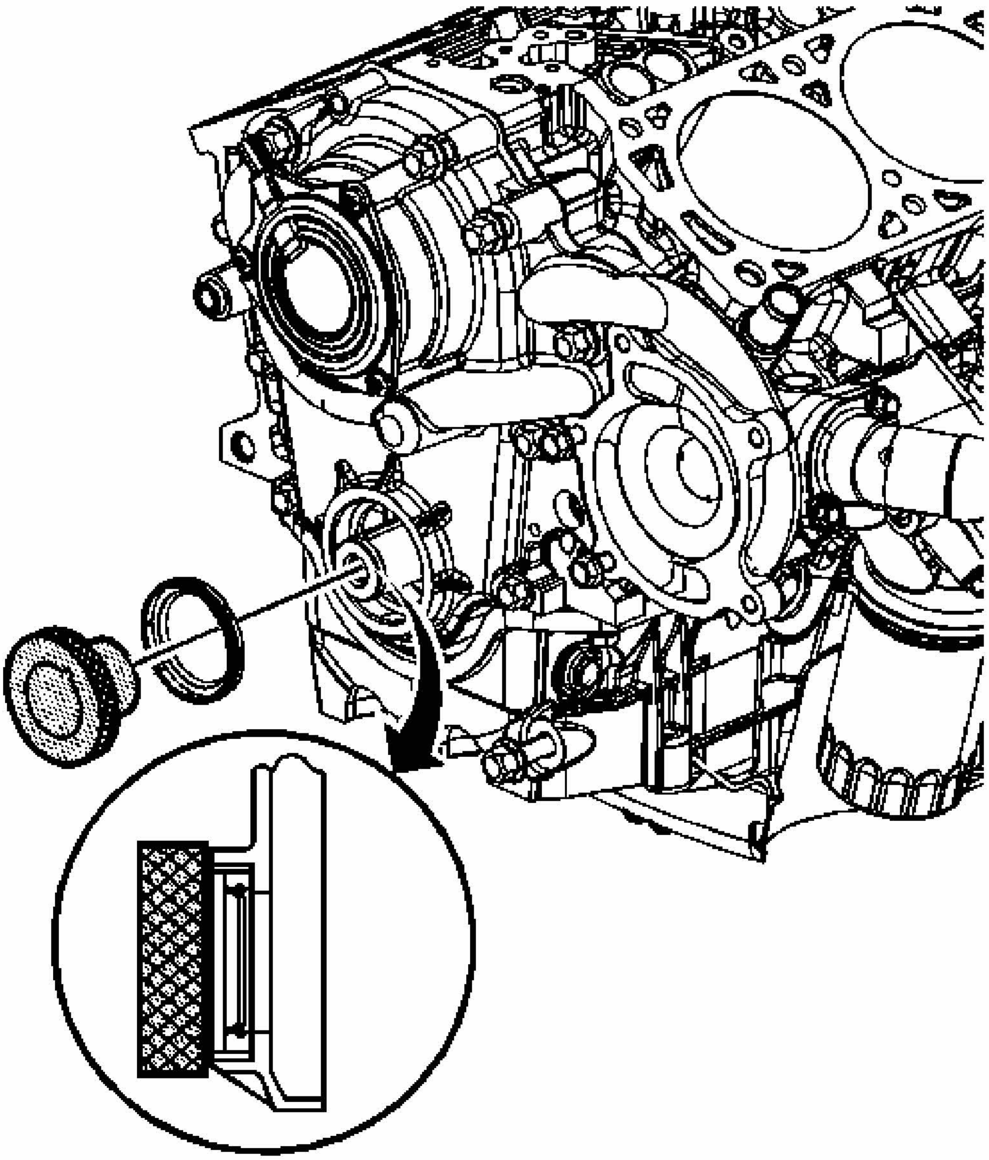


Fig. 451: View Of Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Align the **J 35468** and the crankshaft front oil seal with the engine front cover and crankshaft. See Special Tools.
2. Install the crankshaft front oil seal using the **J 35468** and a suitable tool. See Special Tools.

OIL PUMP DRIVE INSTALLATION

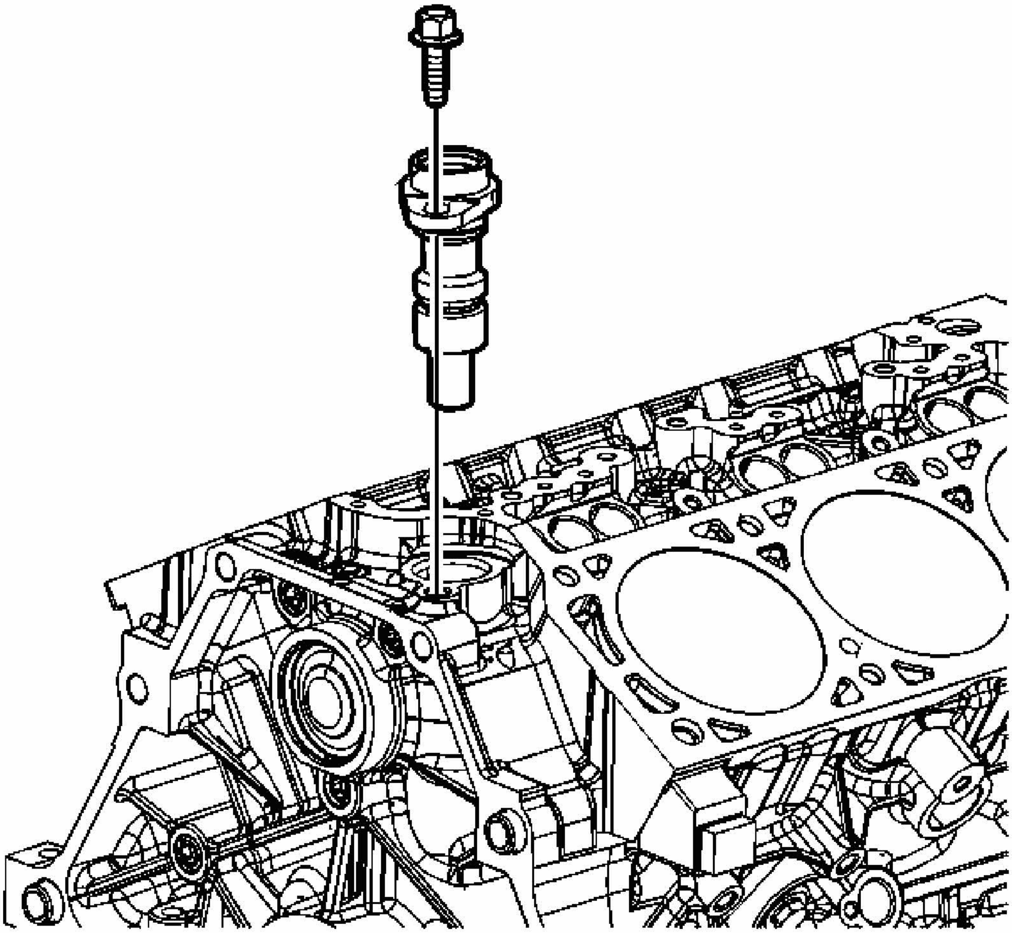


Fig. 452: Identifying Oil Pump Drive
Courtesy of GENERAL MOTORS CORP.

1. Apply prelube GM P/N 12345501 (Canadian P/N 992704) or the equivalent to the oil pump drive gear.
2. Apply engine oil to the oil pump drive gear assembly for ease of assembly.
3. Install the oil pump drive gear assembly.
4. Install the oil pump drive gear clamp.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

5. Install the oil pump drive gear clamp bolt.

   Tighten: Tighten the oil pump drive gear clamp bolt to 36 N.m (27 lb ft).

CAMSHAFT POSITION ACTUATOR MAGNET INSTALLATION

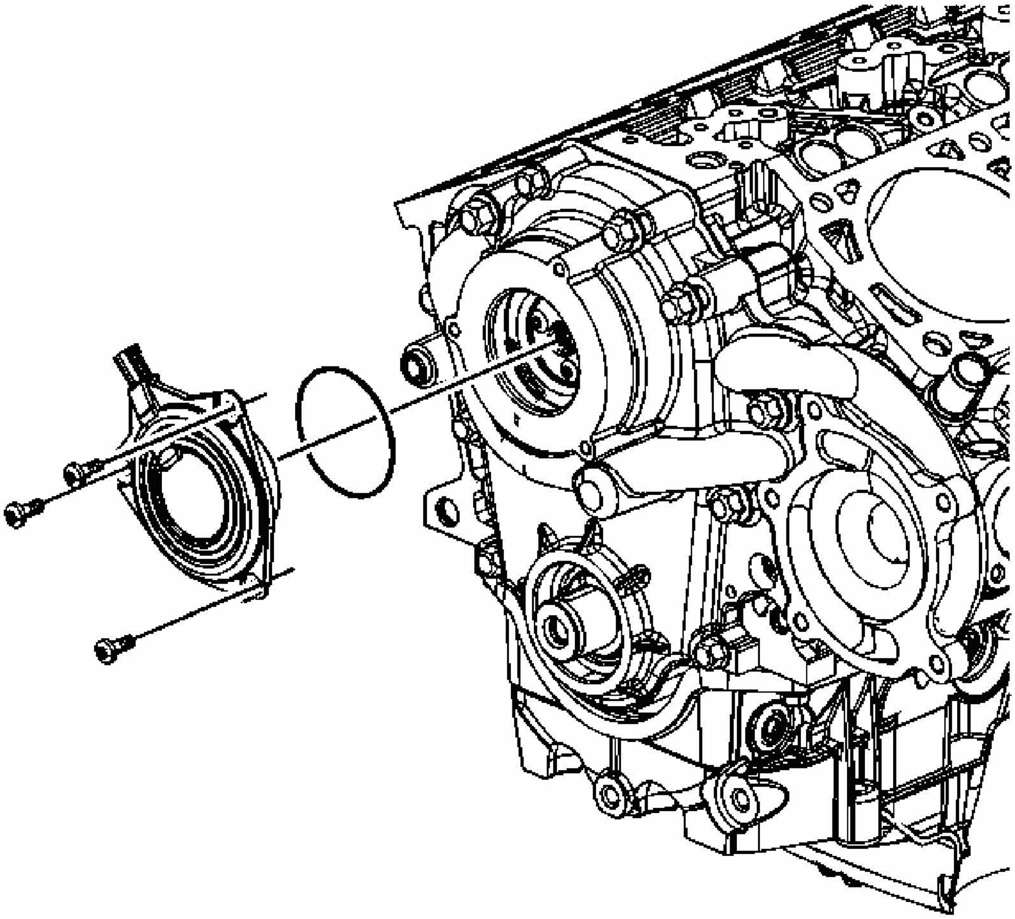


Fig. 453: Identifying Camshaft Position Actuator Magnet
Courtesy of GENERAL MOTORS CORP.

1. Install the camshaft position actuator magnet and O-ring seal into the front cover.

NOTE: Refer to FASTENER NOTICE .

2. Install the camshaft position actuator magnet bolts.

Tighten: Tighten the camshaft position actuator magnet bolts to 10 N.m (89 lb in).

OIL PUMP INSTALLATION

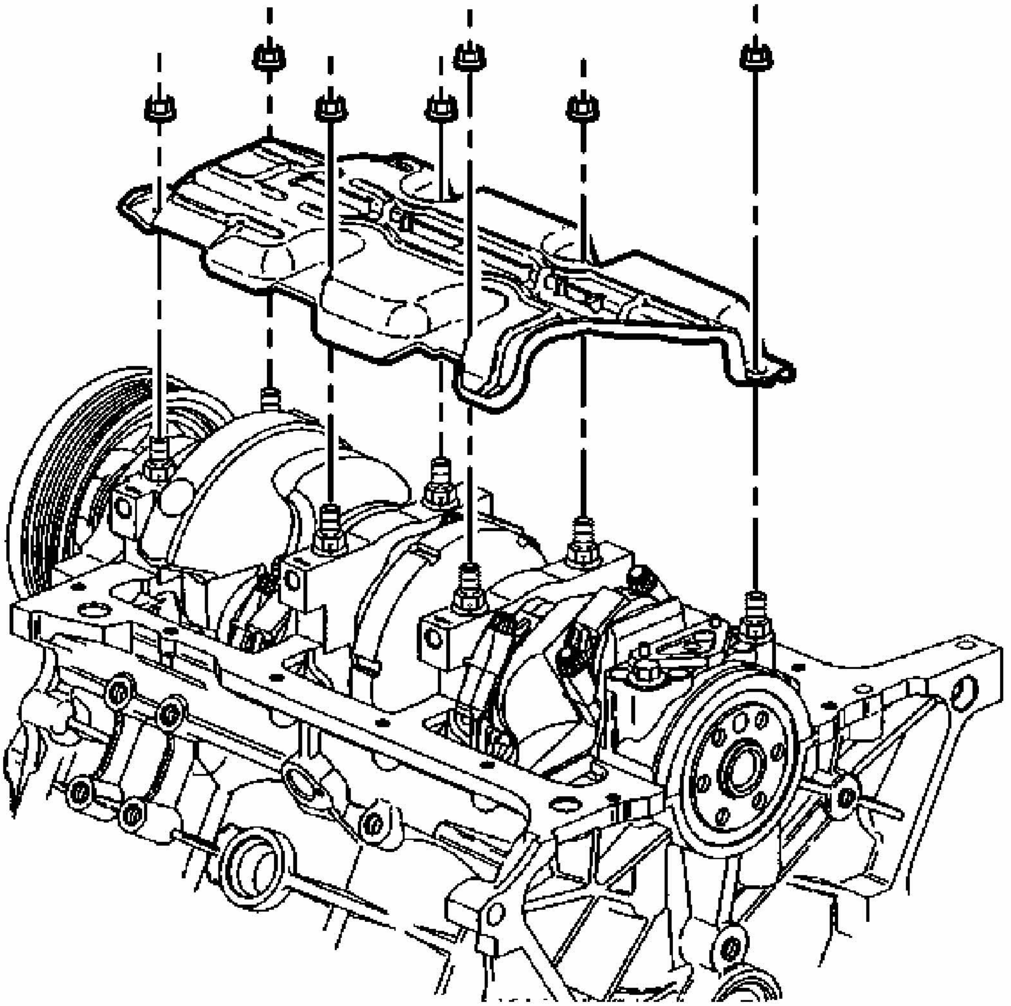


Fig. 454: View Of Crankshaft Oil Deflector & Nuts
Courtesy of GENERAL MOTORS CORP.

1. Install the crankshaft oil deflector.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

2. Install the crankshaft oil deflector nuts.

   Tighten: Tighten the crankshaft oil deflector nuts to 25 N.m (18 lb ft).

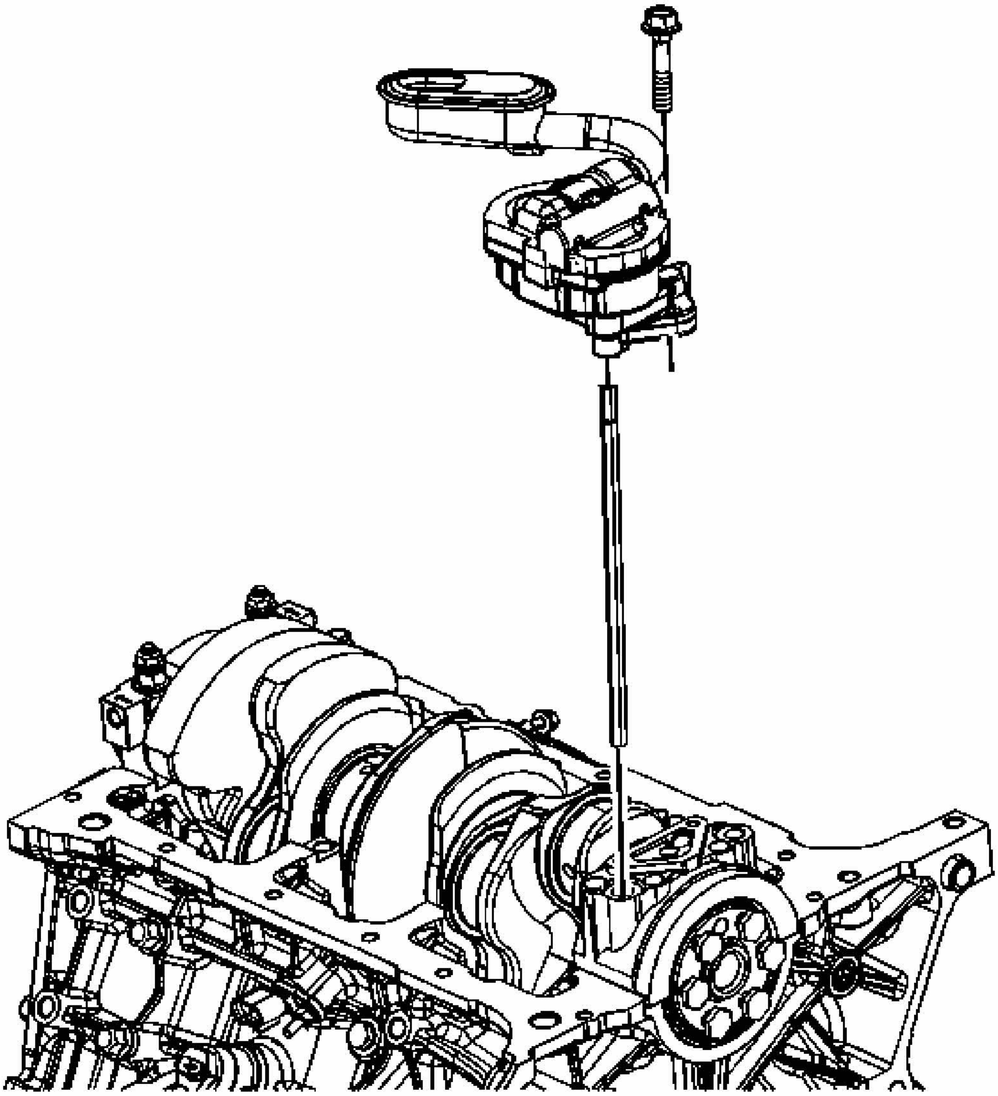


Fig. 455: Identifying Oil Pump, Screen & Driveshaft
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not reuse the oil pump driveshaft retainer. During assembly, install a NEW oil pump driveshaft retainer.

3. Install the oil pump.
4. Position the oil pump onto the pins.
5. Install the oil pump bolt attaching the oil pump to the rear crankshaft bearing cap.

Tighten: Tighten the oil pump bolt to 41 N.m (30 lb ft).

OIL PAN INSTALLATION

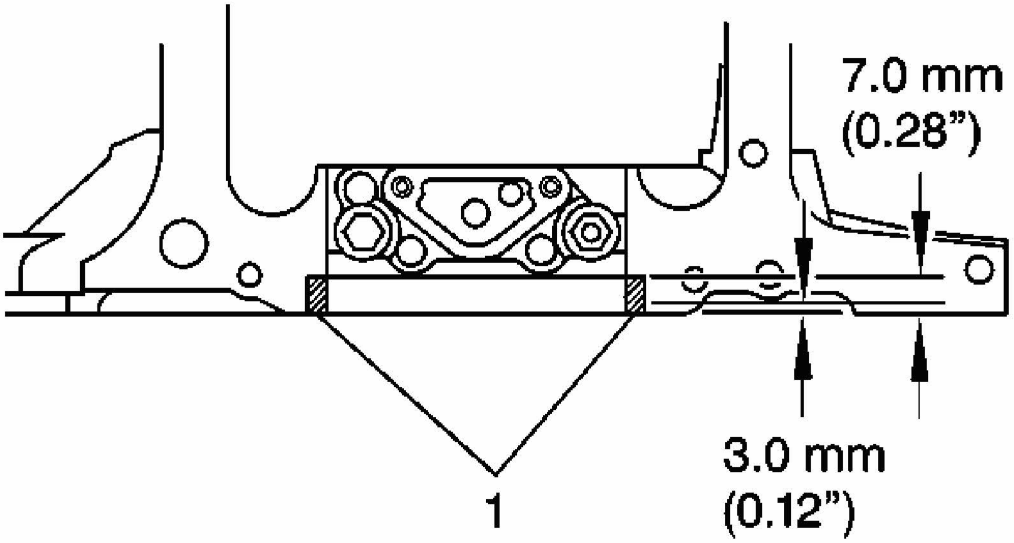


Fig. 456: Illustrating Proper Sealer Application
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer GM P/N 12378521, (Canadian P/N 88901148) or the equivalent to both sides of the crankshaft rear main bearing cap (1). Press sealer into gap using a putty knife.

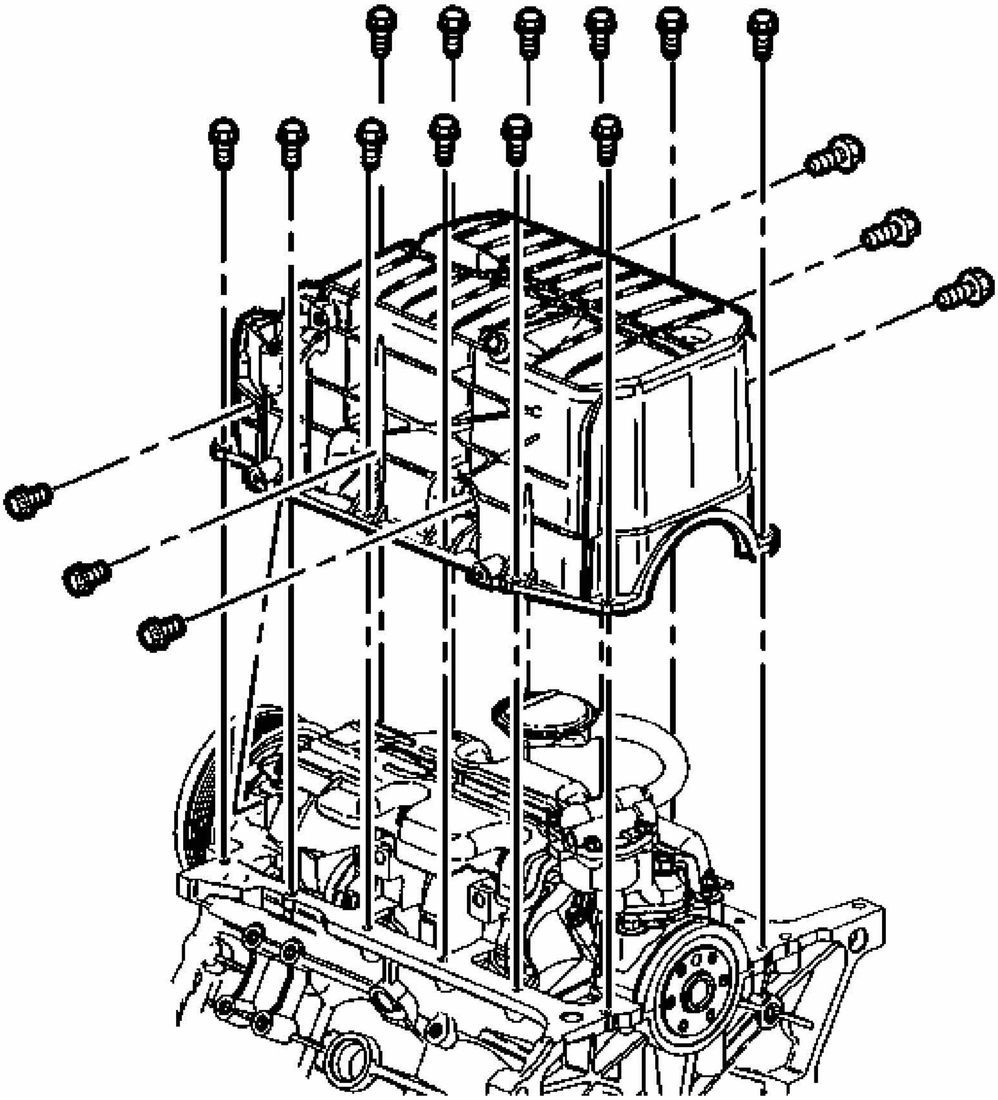


Fig. 457: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the oil pan gasket.
3. Install the oil pan.

NOTE: Refer to FASTENER NOTICE In Cautions and Notices.

4. Install the oil pan bolts.

Tighten: Tighten the oil pan bolts to 25 N.m (18 lb ft).

5. Install the oil pan side bolts.

   Tighten: Tighten the oil pan side bolts to 50 N.m (37 lb ft).

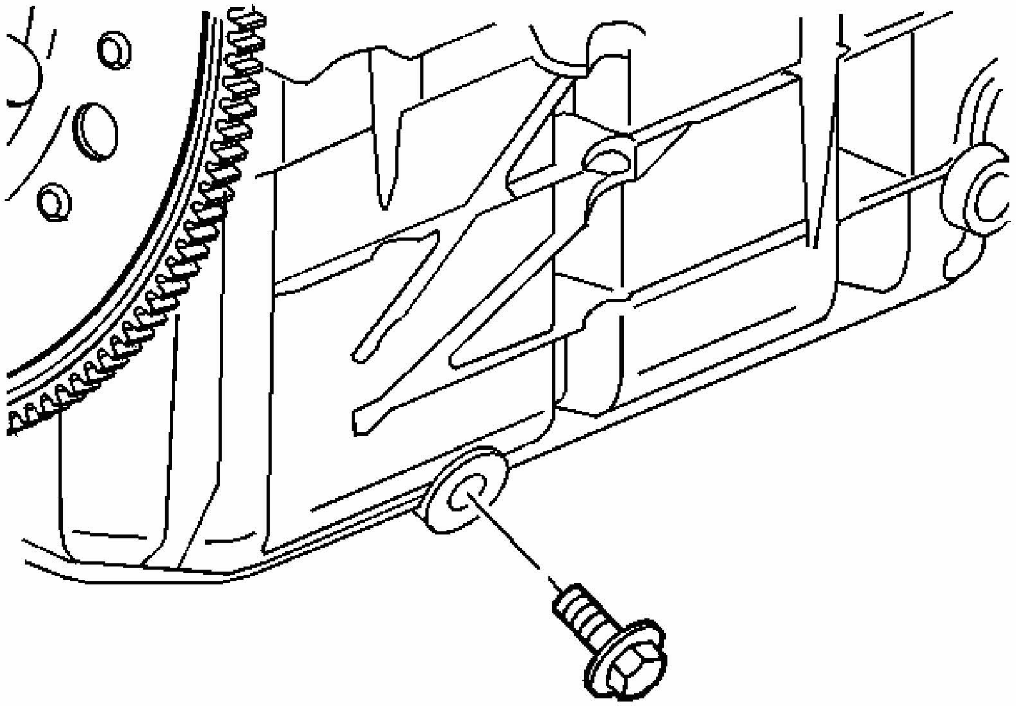


Fig. 458: View Of Oil Pan Drain Plug
Courtesy of GENERAL MOTORS CORP.

6. Install the oil pan drain plug.

   Tighten: Tighten the oil pan drain plug to 25 N.m (18 lb ft).

CYLINDER HEAD INSTALLATION - LEFT

Tools Required

J 45059 Angle Meter. See **Special Tools**.

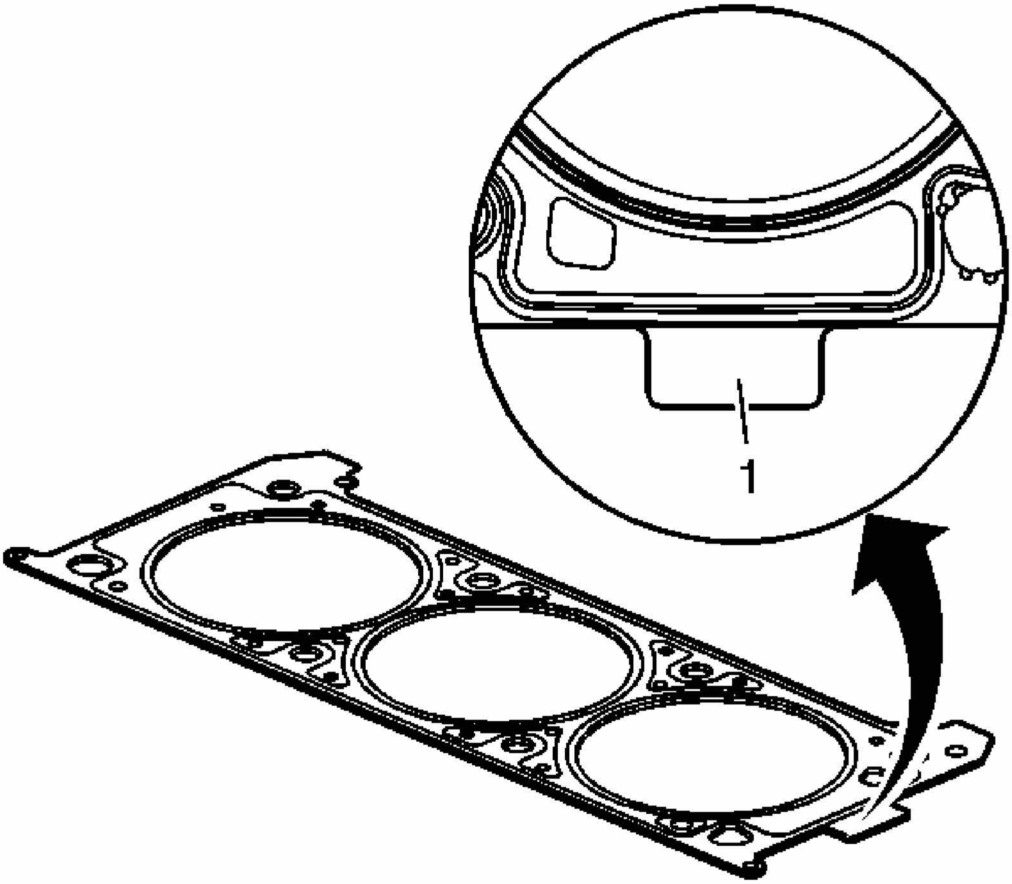


Fig. 459: Identifying Proper Cylinder Head Gasket Installation
Courtesy of GENERAL MOTORS CORP.

NOTE: **Head gaskets are specific for right hand and left hand applications, and also must be installed with the correct side facing up. Note the markings (1) on the head gaskets for proper installation. Failure to do so may lead to engine damage.**

NOTE: **This component uses torque-to-yield bolts. When servicing this component do not reuse the bolts, New torque-to-yield bolts must be installed. Reusing used torque-to-yield bolts will not provide proper bolt torque and clamp load. Failure to install NEW torque-to-yield bolts may lead to engine damage.**

1. Install the cylinder head locator dowel pins, if necessary.
2. Inspect the cylinder head locator dowel pins for proper installation.

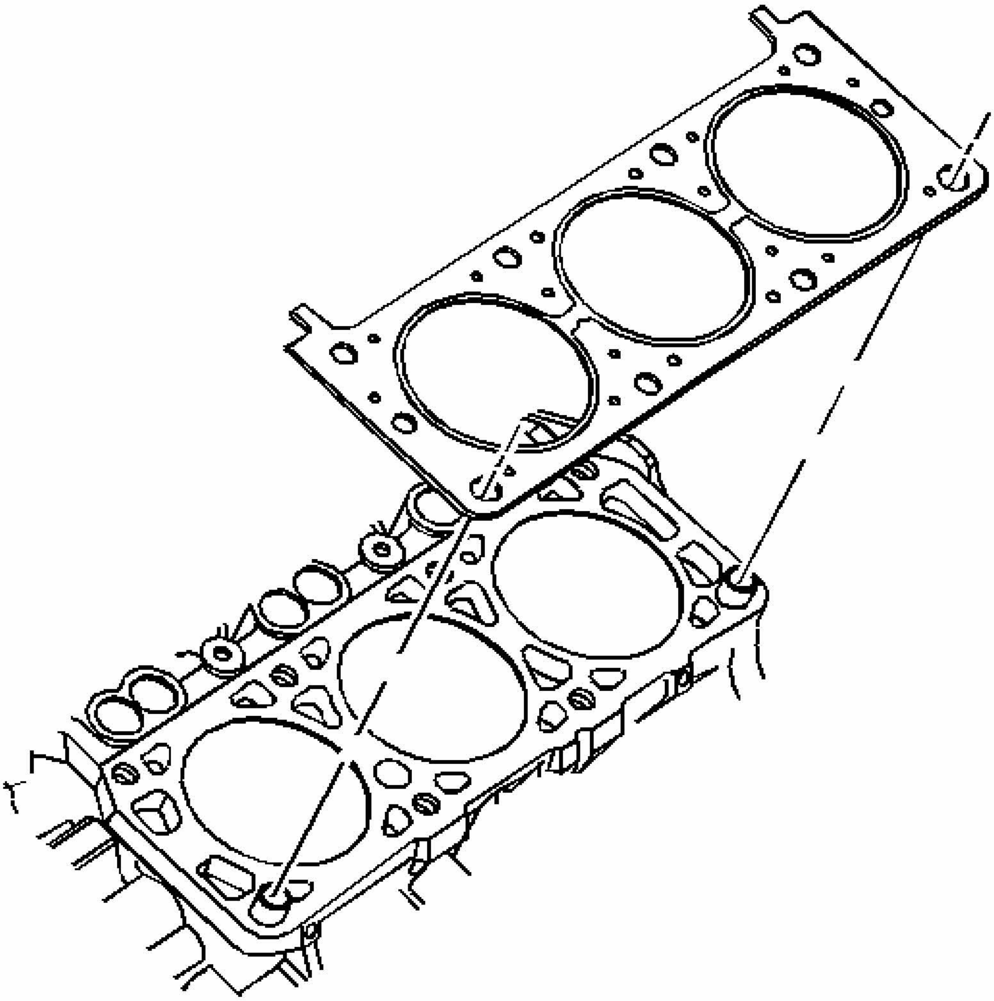


Fig. 460: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install the cylinder head gasket.

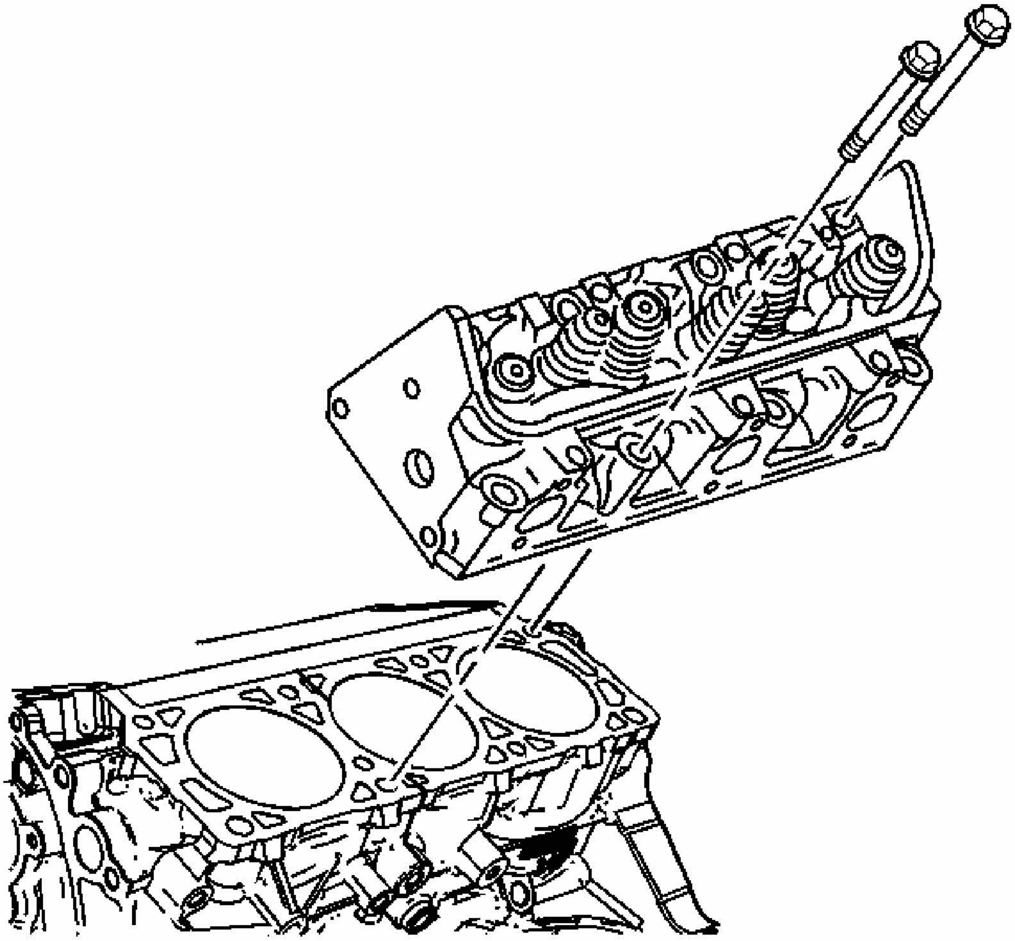


Fig. 461: Removing/Installing Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Install the cylinder head.

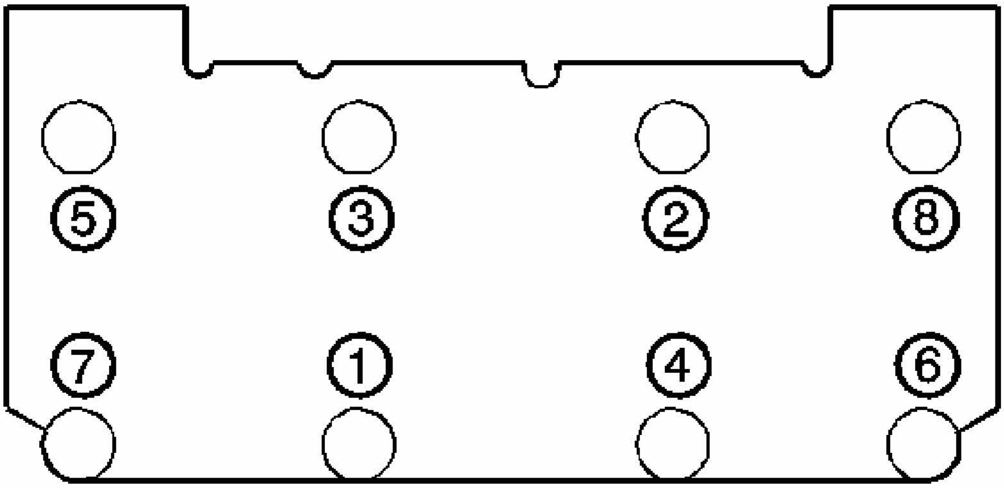


Fig. 462: View Of Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE .**

5. Install the new cylinder head bolts.

   Tighten:

   1. Tighten the cylinder head bolts a first pass in sequence to 60 N.m (44 lb ft).
   2. Tighten the cylinder head bolts a final pass in sequence to 95 degrees using the **J 45059** . See **Special Tools**.

CYLINDER HEAD INSTALLATION - RIGHT

Tools Required

J 45059 Angle Meter. See **Special Tools**.

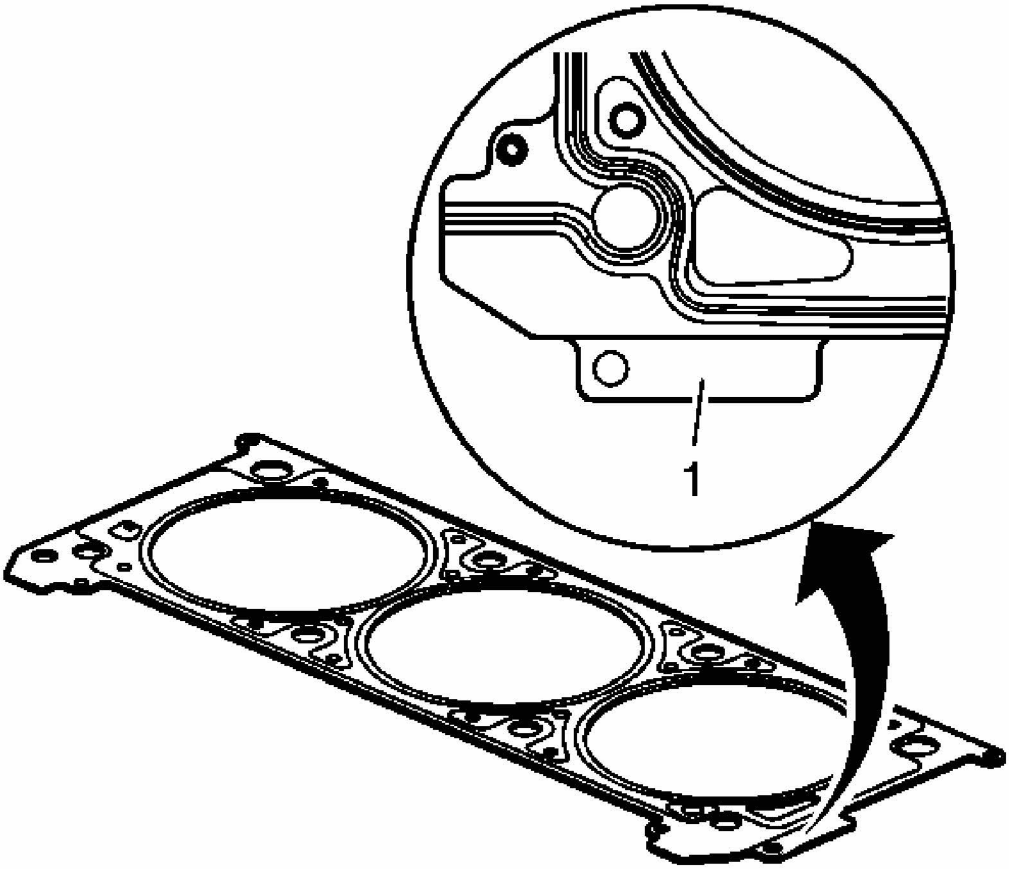


Fig. 463: Identifying Proper Cylinder Head Gasket Installation
Courtesy of GENERAL MOTORS CORP.

NOTE: **Head gaskets are specific for right hand and left hand applications, and also must be installed with the correct side facing up. Note the markings (1) on the head gaskets for proper installation. Failure to do so may lead to engine damage.**

NOTE: **This component uses torque-to-yield bolts. When servicing this component do not reuse the bolts, New torque-to-yield bolts must be installed. Reusing used torque-to-yield bolts will not provide proper bolt torque and clamp load. Failure to install NEW torque-to-yield bolts may lead to engine damage.**

1. Install the cylinder head locator dowel pins, if necessary.
2. Inspect the cylinder head locator dowel pins for proper installation.

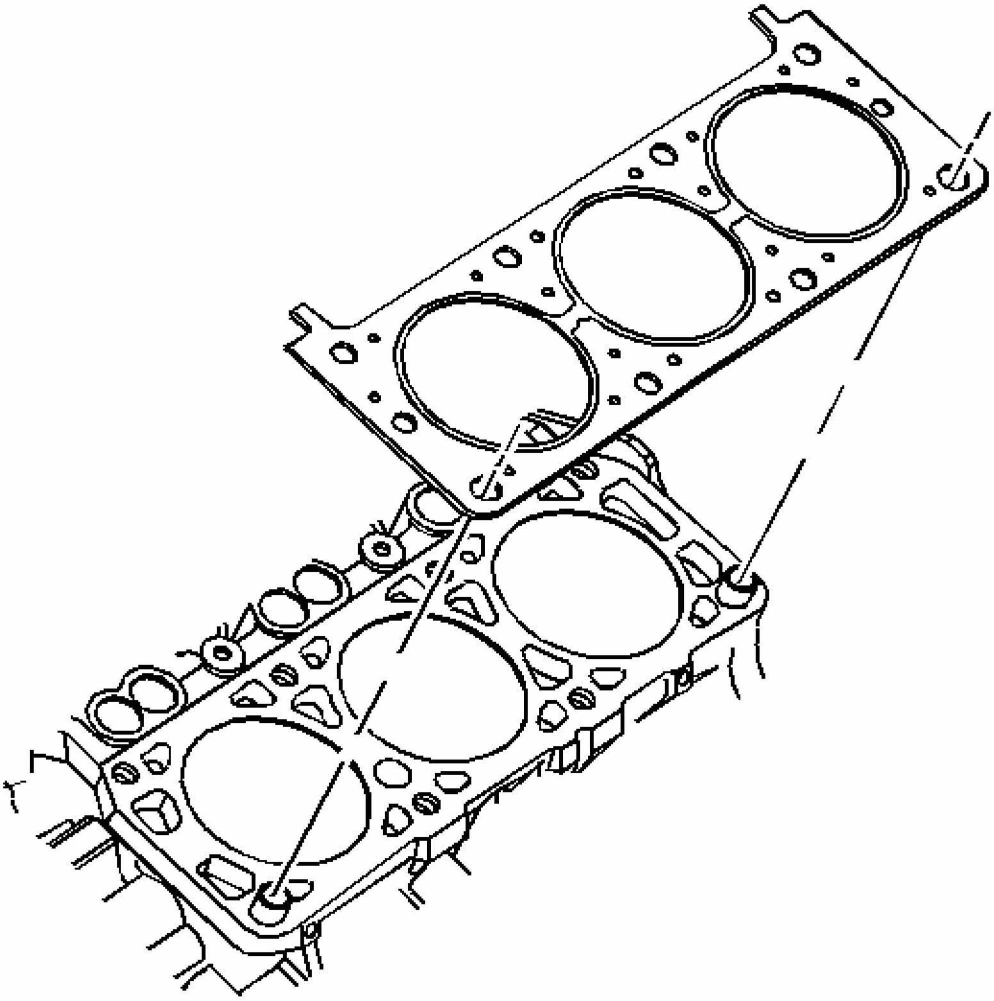


Fig. 464: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install the cylinder head gasket.

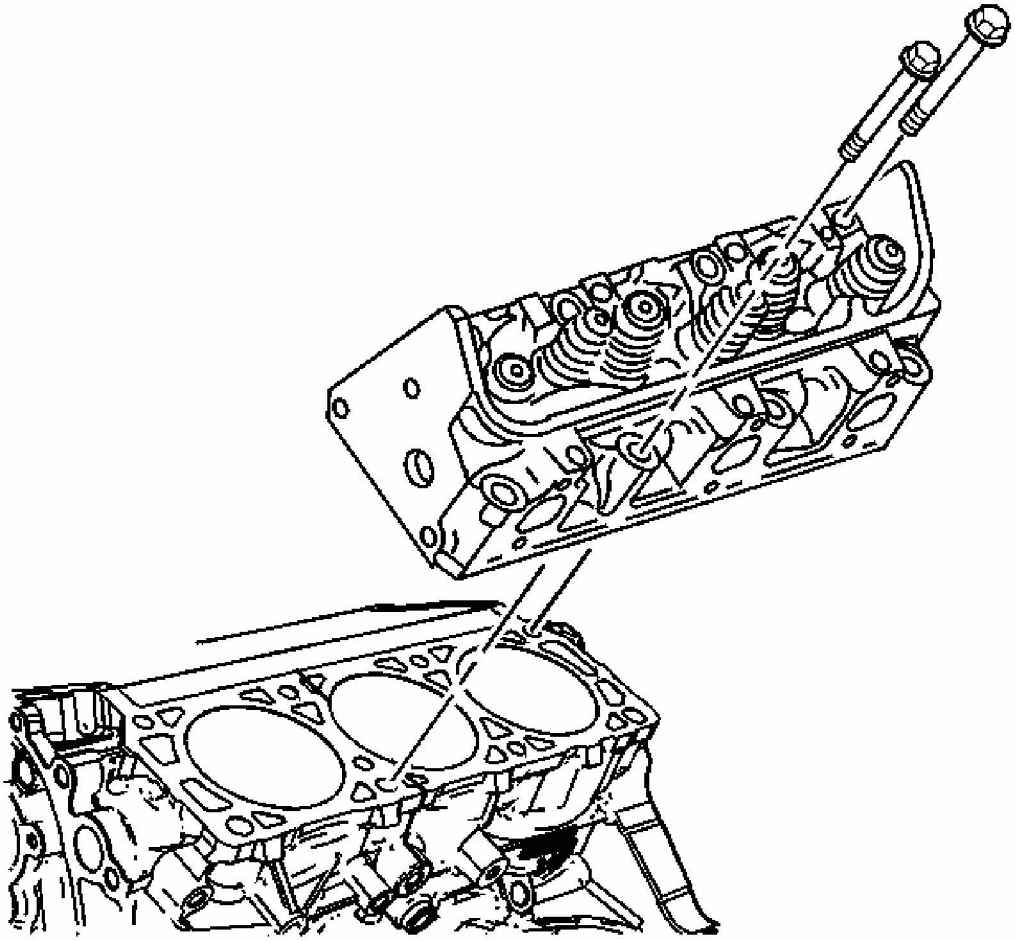


Fig. 465: Removing/Installing Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Install the cylinder head.

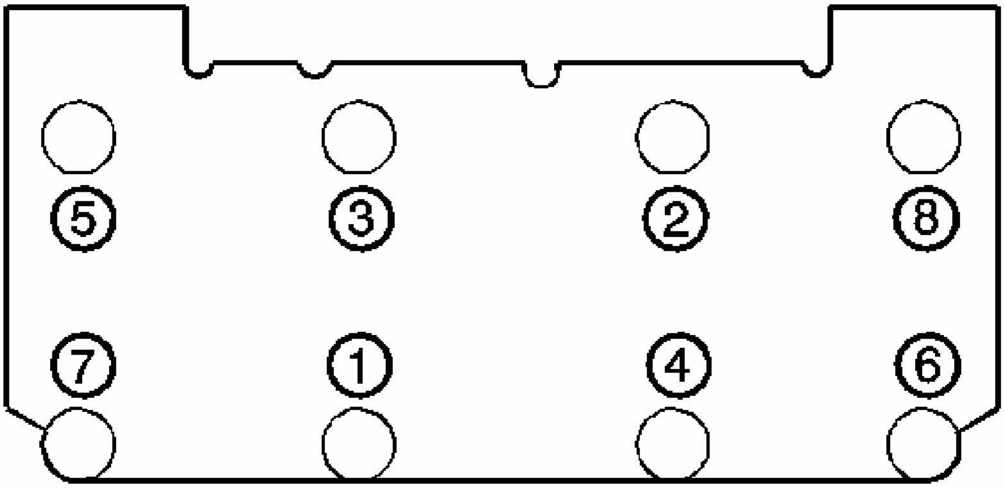


Fig. 466: View Of Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE .**

5. Install the new cylinder head bolts.

   Tighten:

   1. Tighten the cylinder head bolts a first pass in sequence to 60 N.m (44 lb ft).
   2. Tighten the cylinder head bolts a final pass in sequence to 95 degrees using the **J 45059** . See **Special Tools**.

WATER PUMP INSTALLATION

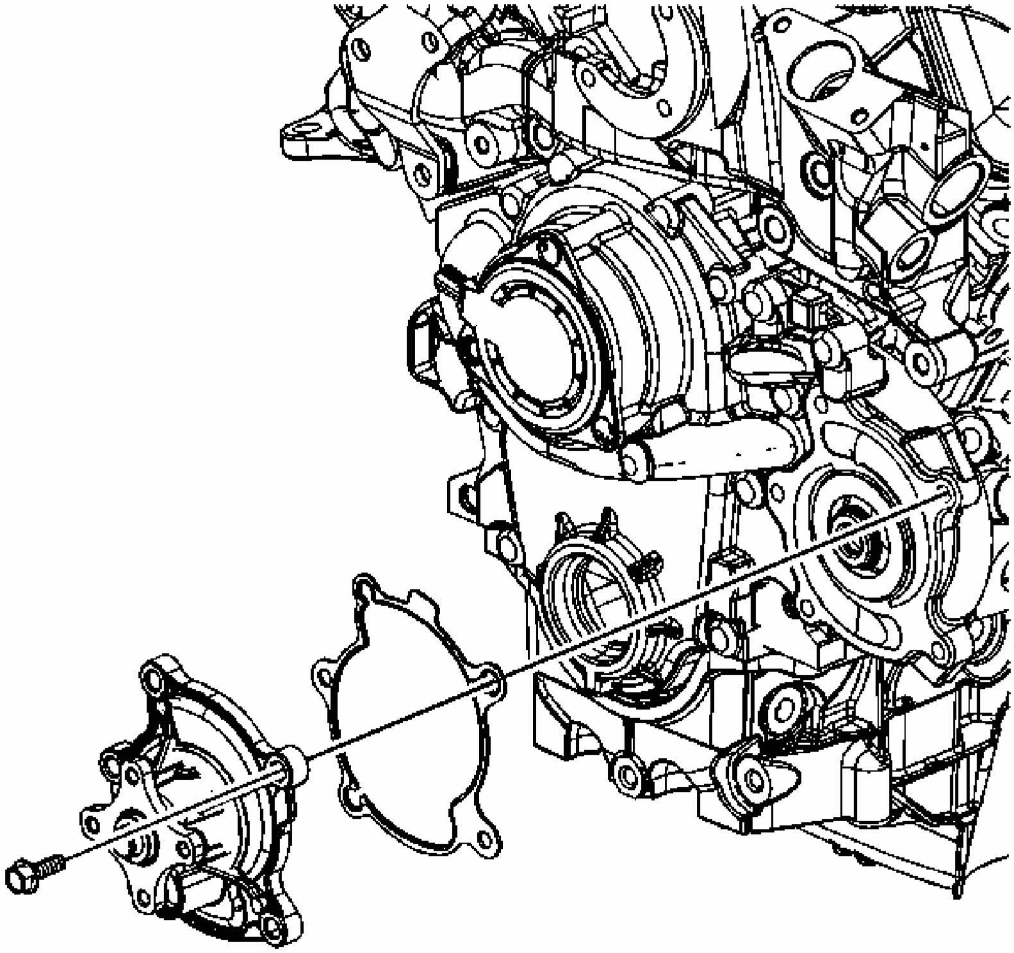


Fig. 467: View Of Water Pump, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the water pump gasket.
2. Install the water pump.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

3. Install the water pump bolts.

Tighten: Tighten the water pump bolts to 10 N.m (89 lb in).

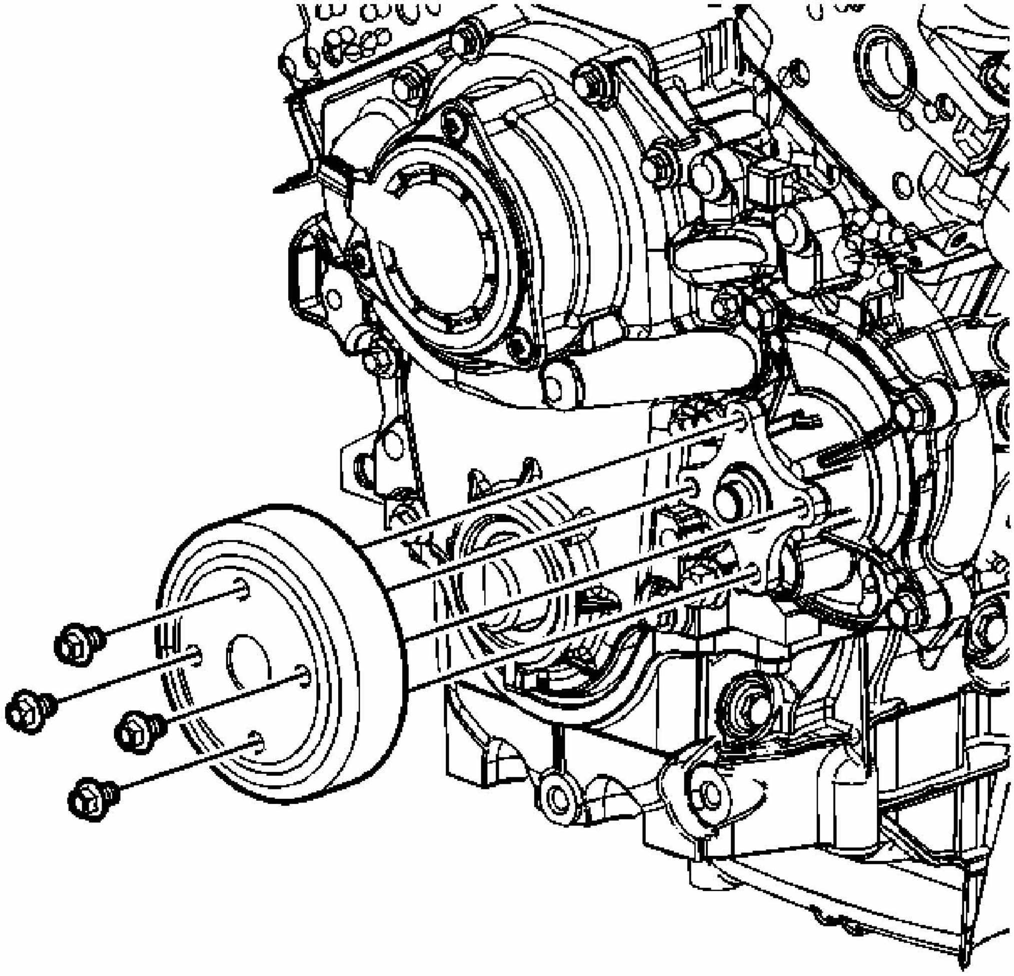


Fig. 468: View Of Water Pump Pulley & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the water pump pulley.
5. Install the water pump pulley bolts.

   Tighten: Tighten the water pump pulley bolts to 25 N.m (18 lb ft).

VALVE LIFTER INSTALLATION

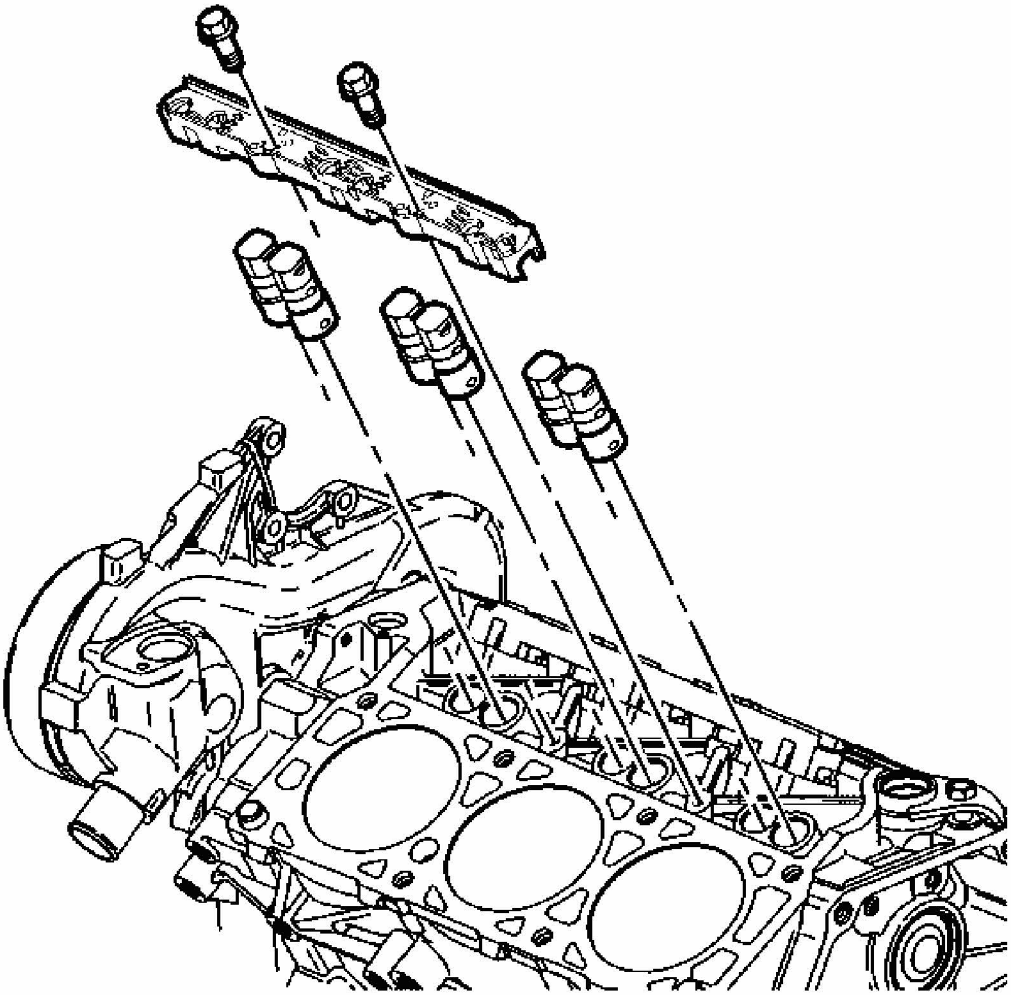


Fig. 469: View Of Valve Lifters & Lifter Guides
Courtesy of GENERAL MOTORS CORP.

1. Coat the valve lifters using prelube GM P/N 12345501 (Canadian P/N 992704) or the equivalent.
2. Install the valve lifters in their original locations.
3. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or the equivalent to the threads.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

4. Install the valve lifter guides and guide bolts.

Tighten: Tighten the valve lifter guide bolts to 10 N.m (89 lb in).

VALVE ROCKER ARM AND PUSH ROD INSTALLATION

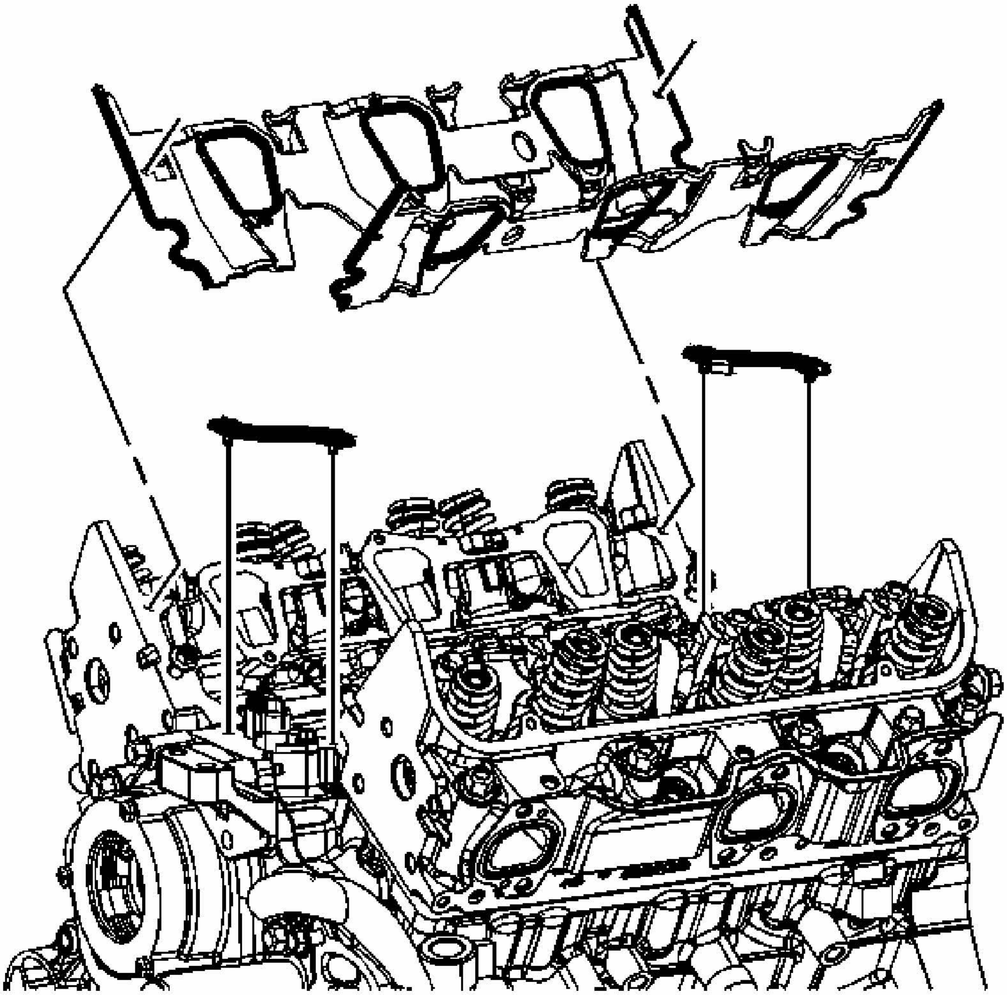


Fig. 470: Identifying Intake Manifold Gaskets & Seals
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All gasket mating surfaces must be free of oil and foreign material. Use GM P/N 12346139 (Canadian P/N 10953463) or equivalent to clean surfaces.

IMPORTANT: Room temperature vulcanizing (RTV) sealer is not to be placed under the lower intake manifold gaskets.

1. Install the lower intake manifold gaskets.

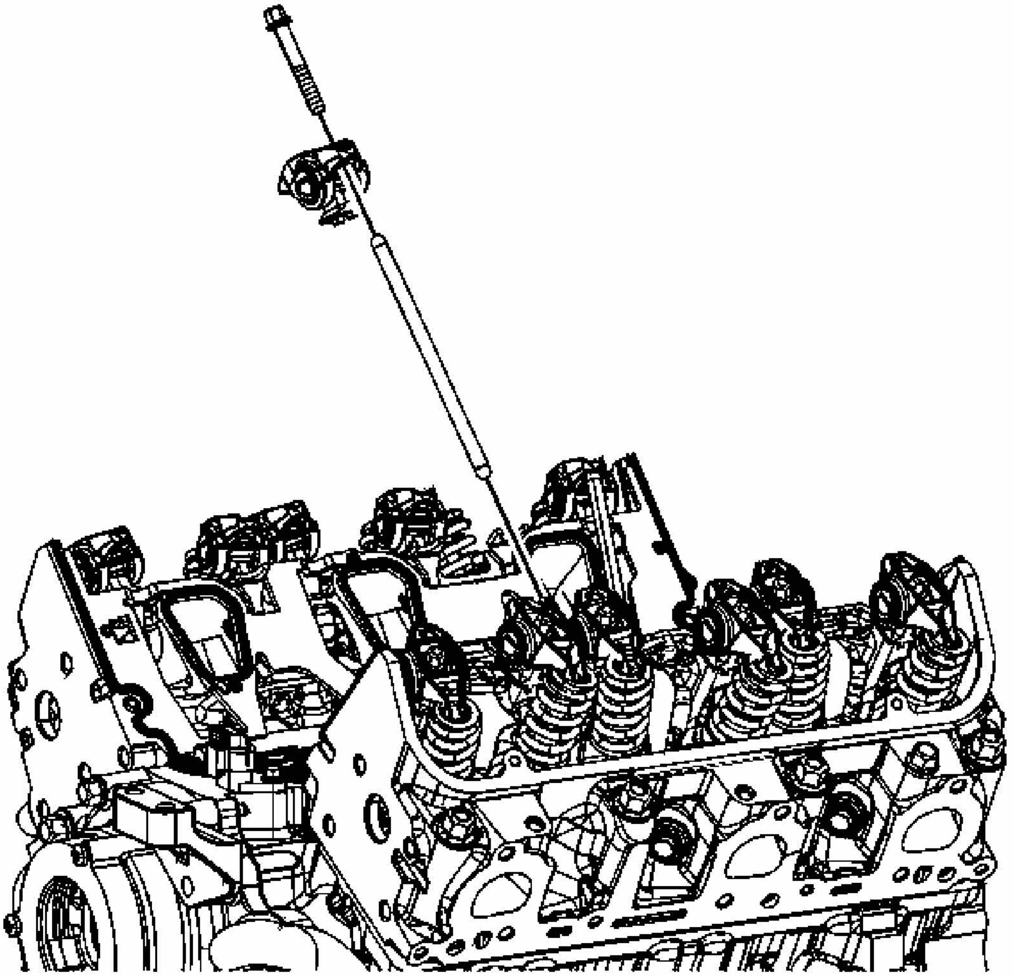


Fig. 471: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

2. Coat the ends of the push rods using prelube GM P/N 12345501 (Canadian P/N 992704) or the equivalent.

IMPORTANT: The intake valve push rods measure 147.51 mm (5.81 in) and the exhaust valve push rods measure 154.87 mm (6.1 in) in length.

3. Install the push rods in their original location.
4. Coat the rocker arm friction surfaces using prelube GM P/N 12345501 (Canadian P/N

992704) or the equivalent.

IMPORTANT: Shims (P/N 88894006) may be required under the valve rocker arm pedestals if reconditioning has been performed on the cylinder head or its components.

5. Install the valve rocker arms in their original positions.

NOTE: Refer to FASTENER NOTICE .

6. Install the valve rocker arm bolts.

Tighten: Tighten the valve rocker arm bolts to 34 N.m (25 lb ft).

INTAKE MANIFOLD INSTALLATION - LOWER

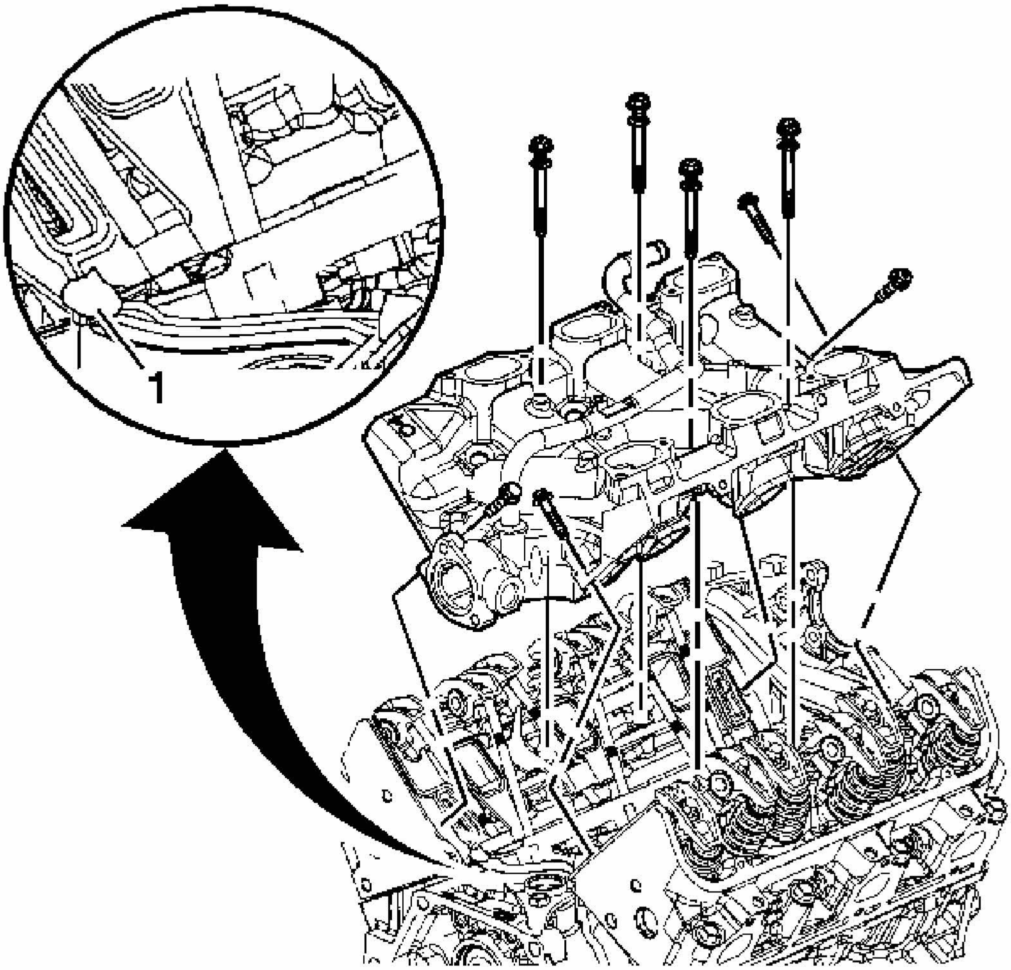


Fig. 472: View Of Lower Intake Manifold
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All gasket-mating surfaces need to be free of oil and foreign material. Use GM P/N 12346139 (Canadian P/N 10953463) or equivalent to clean surfaces.

1. With gaskets and seals in place apply a small drop 8-10 mm (0.31-0.39 in) of RTV sealer GM P/N 12378521 (Canadian P/N 88901148) or equivalent to the 4 corners of the intake manifold to block joints (1).

IMPORTANT: To ensure proper lower intake manifold orientation during installation, make sure the intake port marked 1 faces the front of the engine.

2. Install the lower intake manifold.

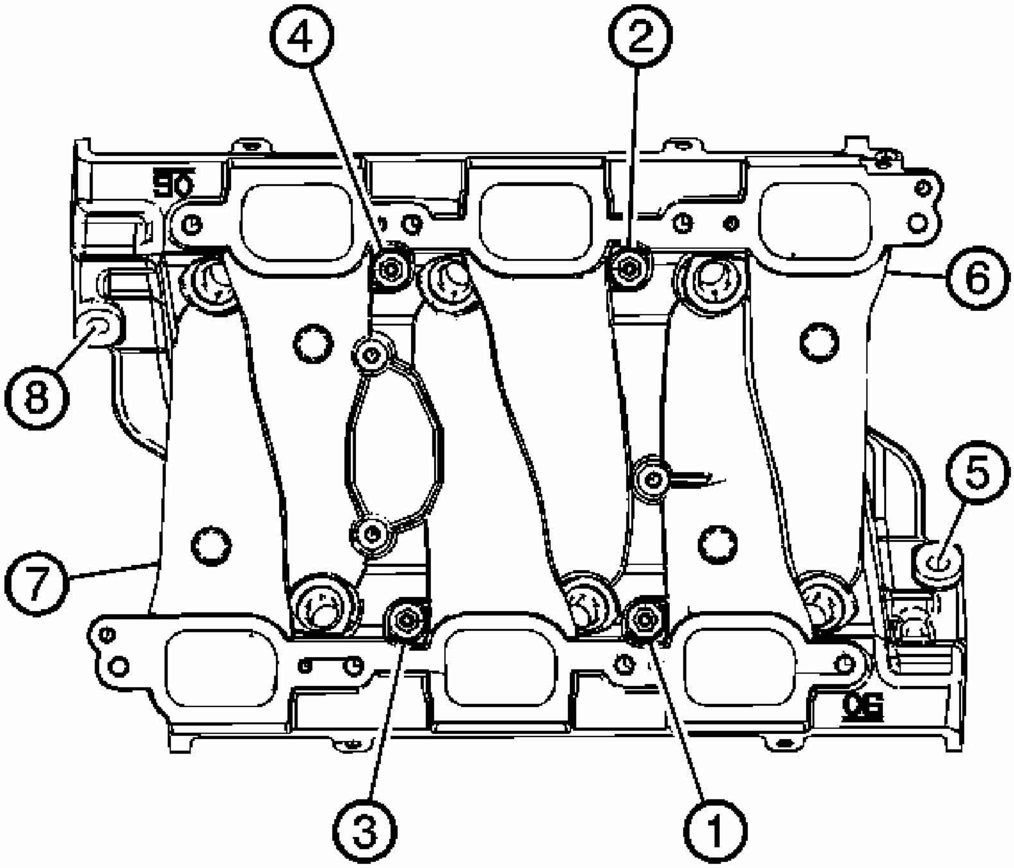


Fig. 473: Identifying Lower Intake Manifold Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.

NOTE: Failure to tighten vertical bolts before the diagonal bolts may cause an oil leak.

3. Apply sealer GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the lower intake manifold bolt threads.

NOTE: **Refer to FASTENER NOTICE .**

4. Install the new lower intake manifold bolts if applicable, in sequence.

   Tighten:

   1. Tighten the lower intake manifold bolts in sequence to 7 N.m (62 lb in) on the first pass.
   2. Tighten the lower intake manifold bolts (1, 2, 3, 4) in sequence to 13 N.m (115 lb in) on the final pass.
   3. Tighten the lower intake manifold bolts (5, 6, 7, 8) in sequence to 25 N.m (18 lb ft) on the final pass.

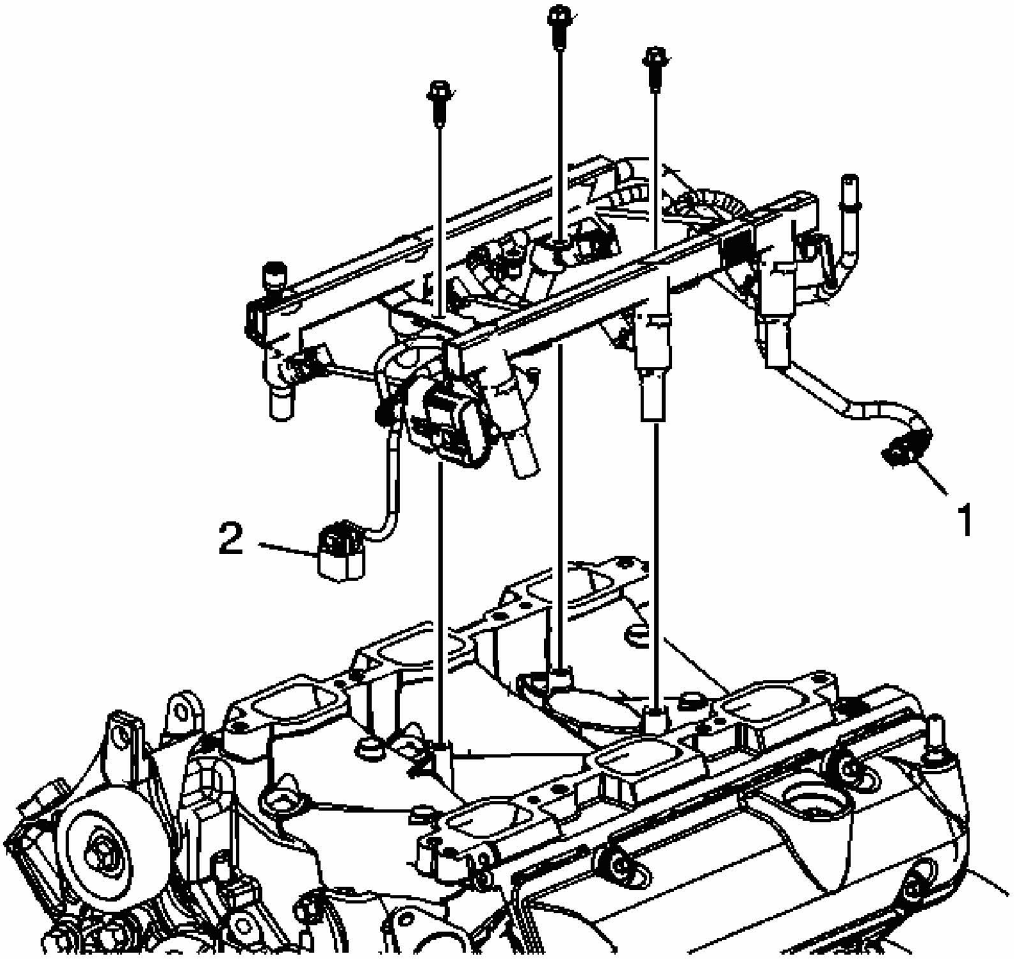


Fig. 474: Identifying Lower Intake Manifold Attachments

Courtesy of GENERAL MOTORS CORP.

5. Inspect the fuel rail, and fuel injectors for damage and replace if necessary.
6. Install NEW lower fuel injector O-rings.
7. Lubricate the fuel injector O-rings using GM P/N 12345616 (Canadian P/N 993182) or equivalent.

IMPORTANT: To ensure proper fuel rail orientation during installation, make sure the fuel feed pipe faces the rear of the engine.

8. Install the injector nozzles into the lower intake manifold injector bores.
9. Press on the injector rail using the palms of both hands until the injectors are fully seated.
10. Install the fuel injector rail bolts.

    Tighten: Tighten the fuel injector rail bolts to 10 N.m (89 lb in).

11. Connect the coolant temperature sensor (1).
12. Connect the camshaft position (CMP) sensor (2).

INTAKE MANIFOLD INSTALLATION - UPPER

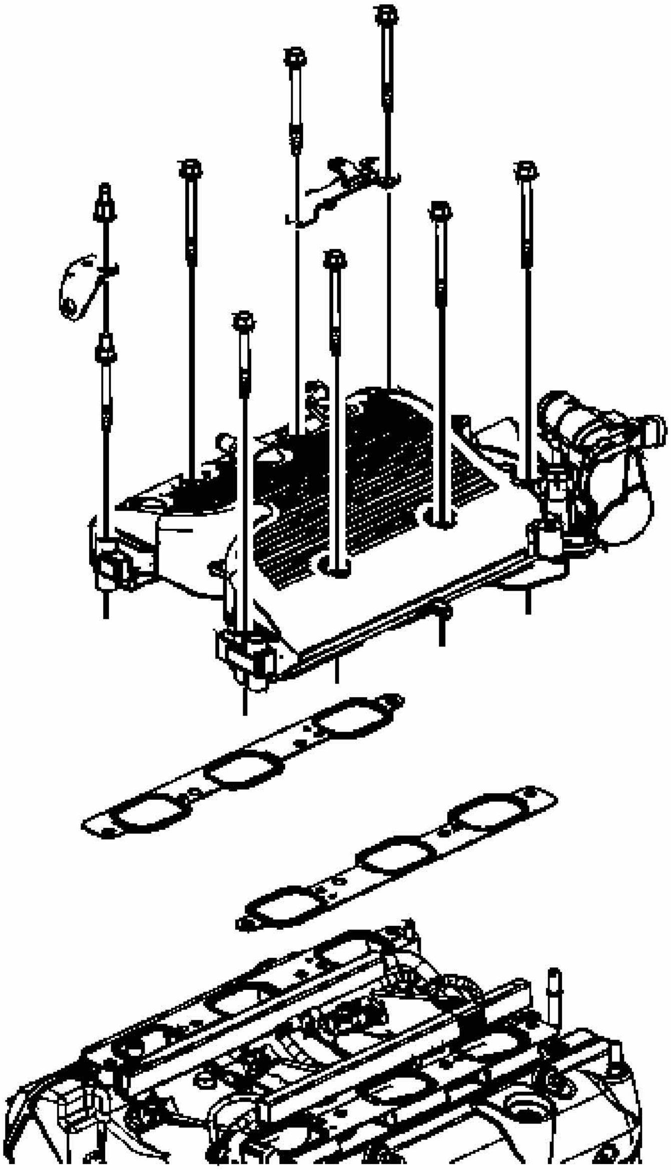


Fig. 475: Installing The Upper Intake Manifold Gaskets And Manifold
Courtesy of GENERAL MOTORS CORP.

1. Install the upper intake manifold gaskets and manifold.
2. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the upper intake manifold bolt threads.

NOTE: **Refer to FASTENER NOTICE in Cautions and**

Notices.

3. Install the MAP sensor bracket, upper intake manifold bolts, and the upper intake manifold stud.

   Tighten: Tighten the upper intake manifold bolts and stud to 25 N.m (18 lb ft).

VALVE ROCKER ARM COVER INSTALLATION - LEFT

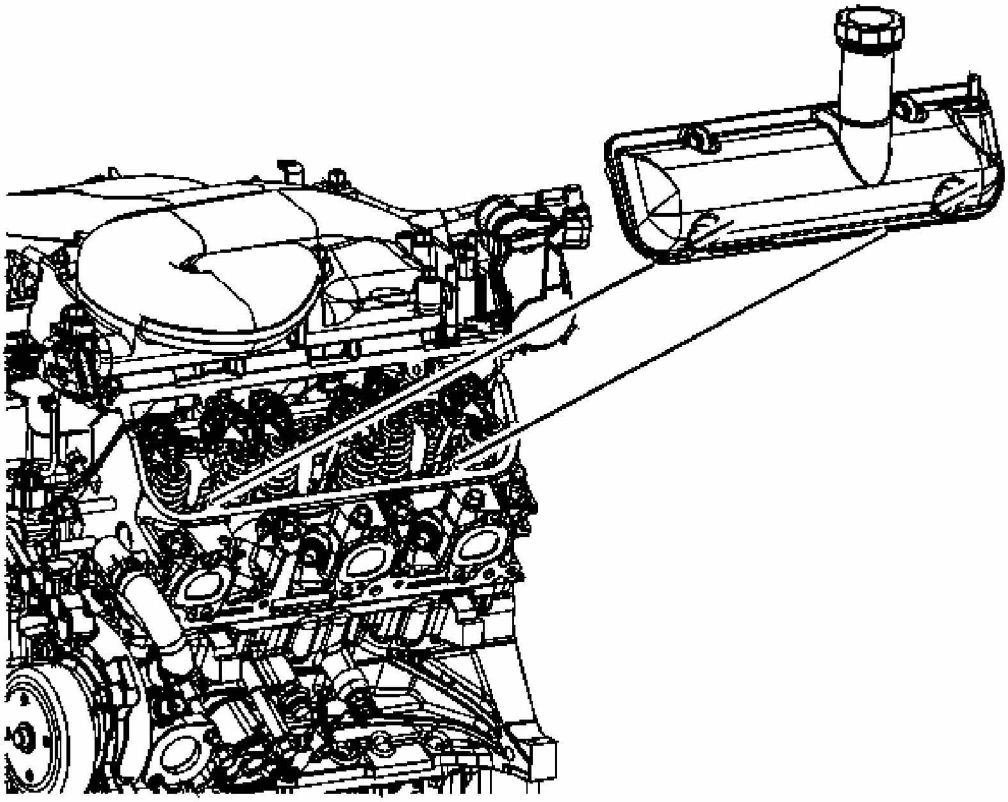


Fig. 476: Identifying Left Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All gasket-mating surfaces need to be free of oil and foreign material. Use GM P/N 12346139 (Canadian P/N 10953463) or equivalent to clean surfaces.

1. Install the valve rocker arm cover gasket into the valve rocker arm cover.

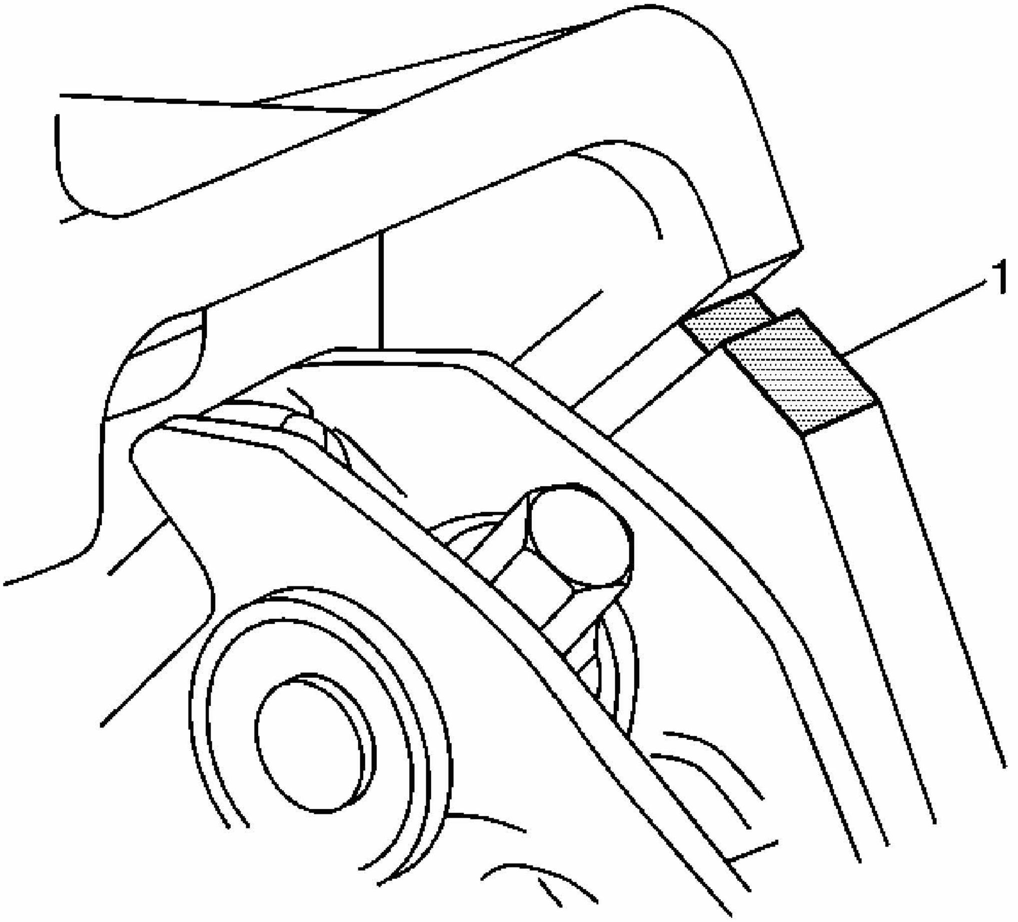


Fig. 477: Identifying Cylinder Head To Lower Intake Manifold Joint
Courtesy of GENERAL MOTORS CORP.

2. Apply sealer GM P/N 12378521 (Canadian P/N 88901148) or equivalent to the surfaces where the cylinder head and intake manifold meet (1).
3. Install the valve rocker arm cover.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

4. Install the valve rocker arm cover bolts, if necessary.

Tighten: Tighten the valve rocker arm cover bolts to 10 N.m (89 lb in).

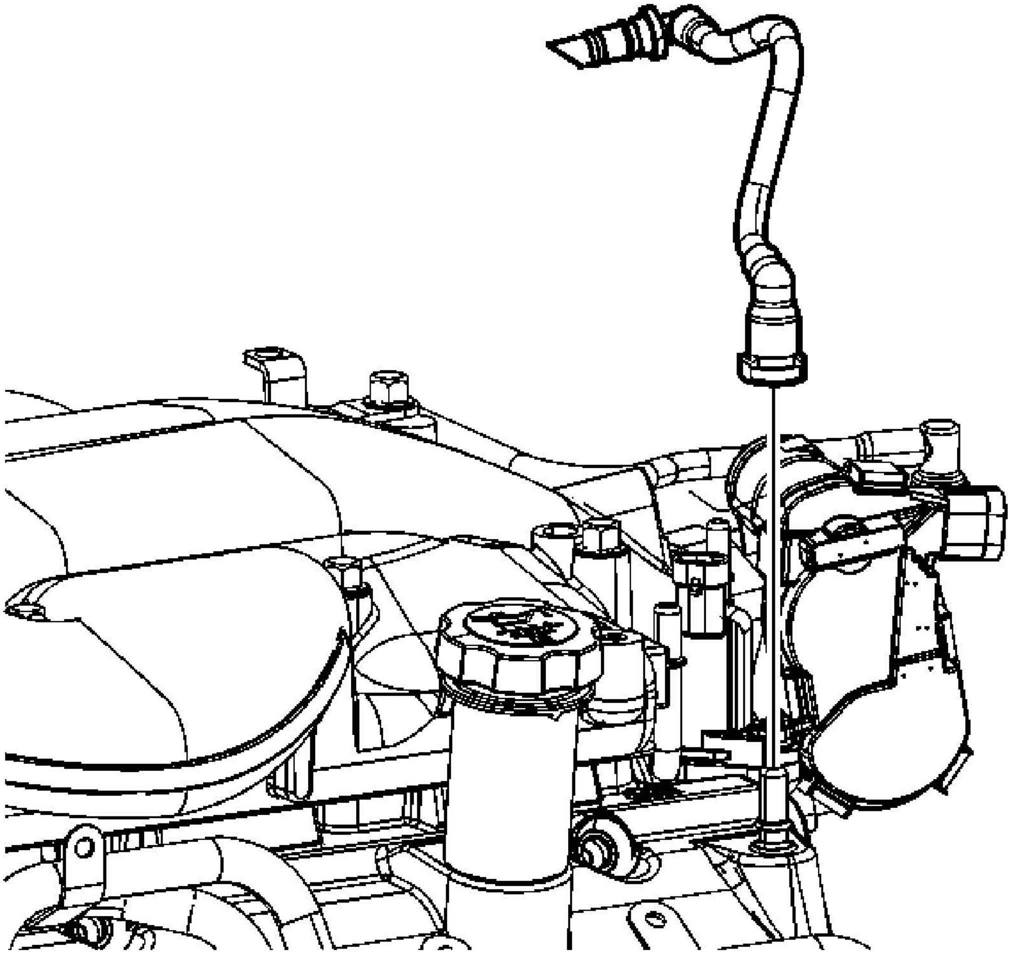


Fig. 478: Installing The Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Install the fresh air tube.

VALVE ROCKER ARM COVER INSTALLATION - RIGHT

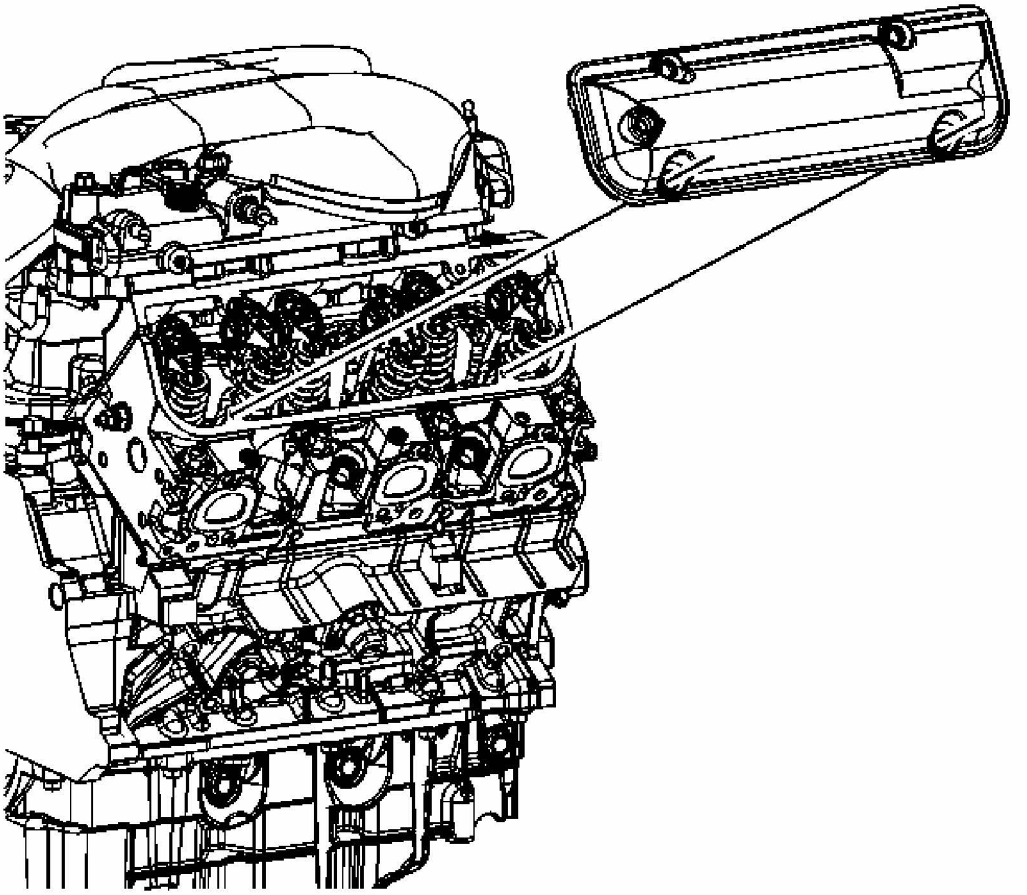


Fig. 479: View Of Right Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All gasket-mating surfaces need to be free of oil and foreign material. Use GM P/N 12346139 (Canadian P/N 10953463) or equivalent to clean surfaces.

1. Install the valve rocker arm cover gasket into the valve rocker arm cover.

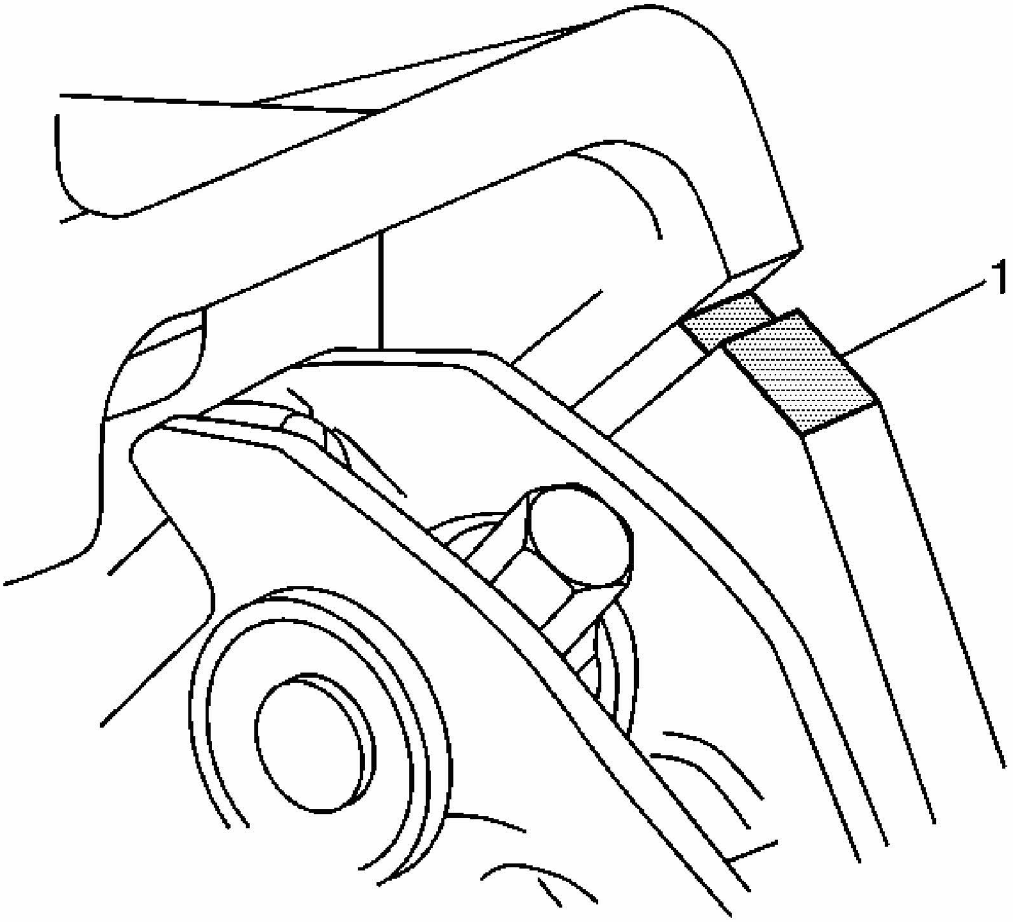


Fig. 480: Identifying Cylinder Head To Lower Intake Manifold Joint
Courtesy of GENERAL MOTORS CORP.

2. Apply sealer GM P/N 12378521 (Canadian P/N 88901148) or equivalent to the surfaces where the cylinder head and intake manifold meet (1).
3. Install the valve rocker arm cover.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

4. Install the valve rocker arm cover bolts, if necessary.

Tighten: Tighten the valve rocker arm cover bolts to 10 N.m (89 lb in).

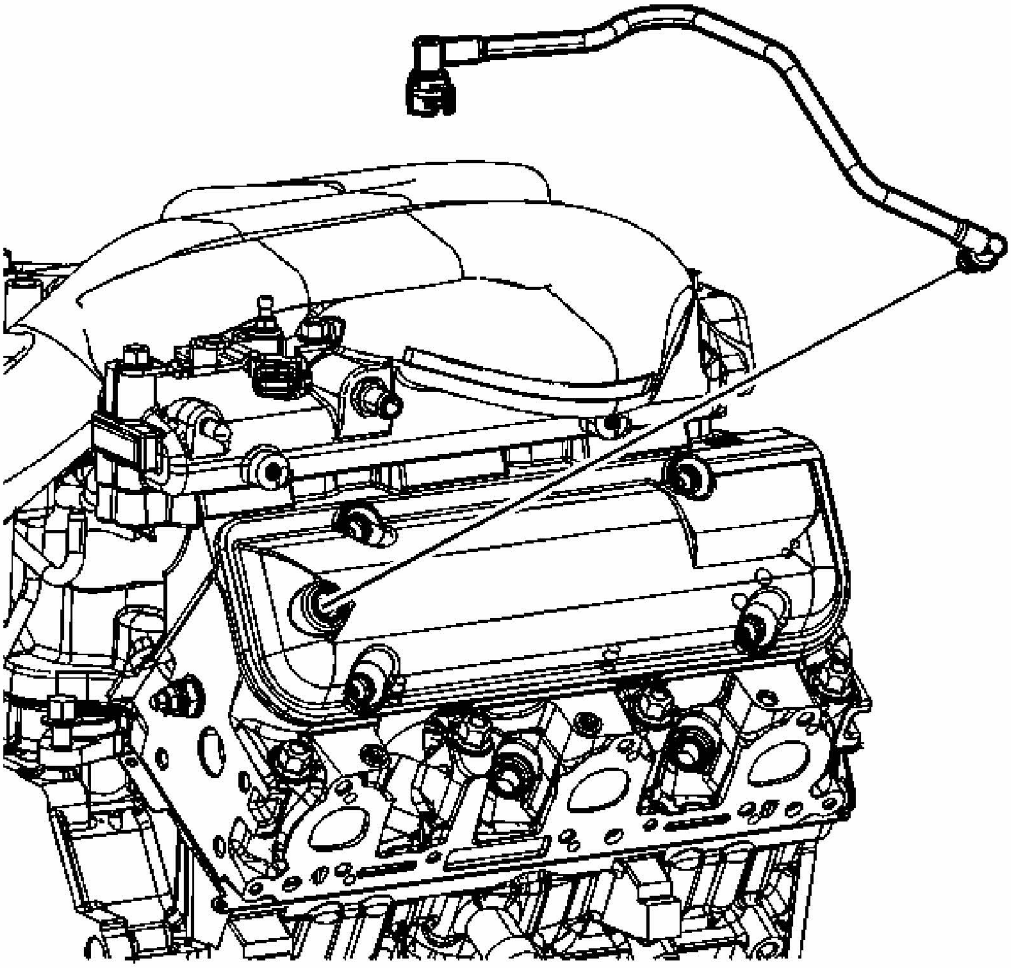


Fig. 481: Identifying Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Install the fresh air tube into the valve rocker arm cover.

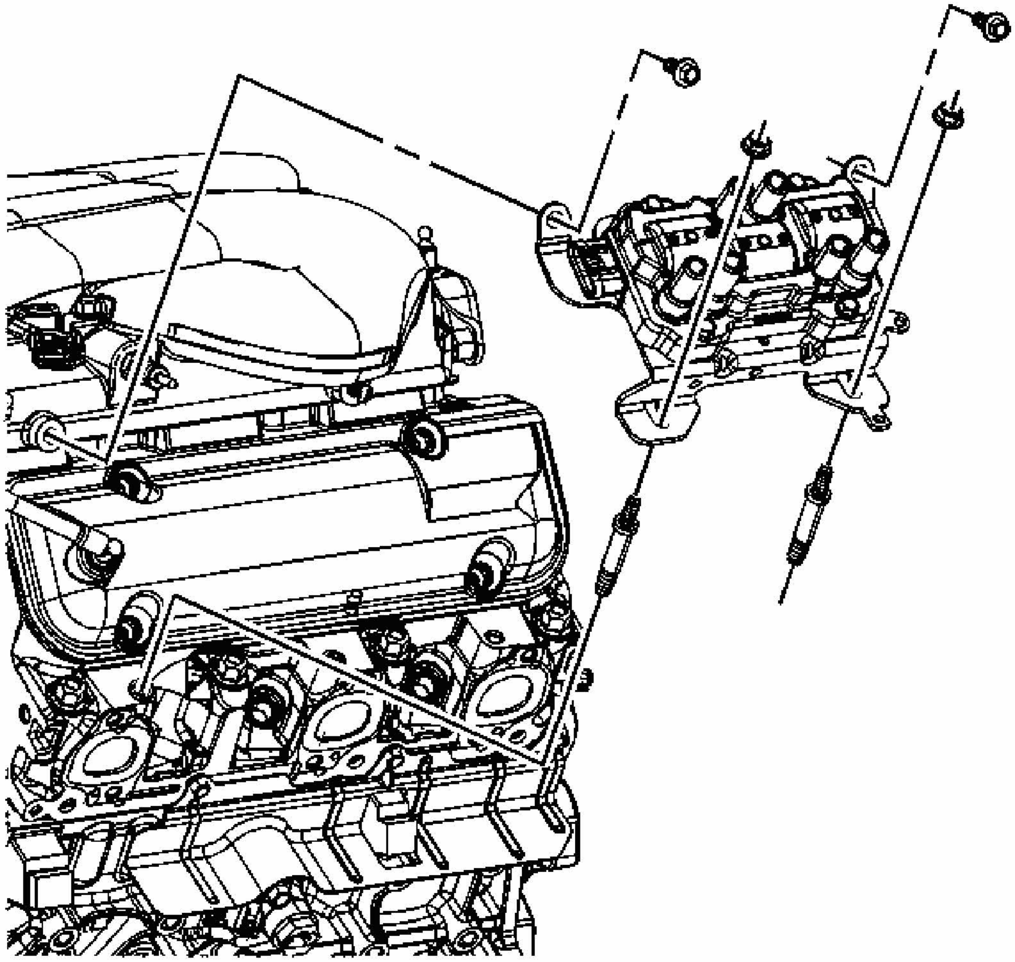


Fig. 482: Identifying Ignition Coil Assembly, Studs & Nuts
Courtesy of GENERAL MOTORS CORP.

6. Install the ignition coil assembly studs, if necessary.

   Tighten: Tighten the ignition coil assembly studs to 25 N.m (18 lb ft).

7. Install the ignition coil assembly.
8. Install the ignition coil assembly bolts and nuts.

   Tighten: Tighten the ignition coil assembly bolts and nuts to 25 N.m (18 lb ft).

WATER OUTLET AND THERMOSTAT INSTALLATION

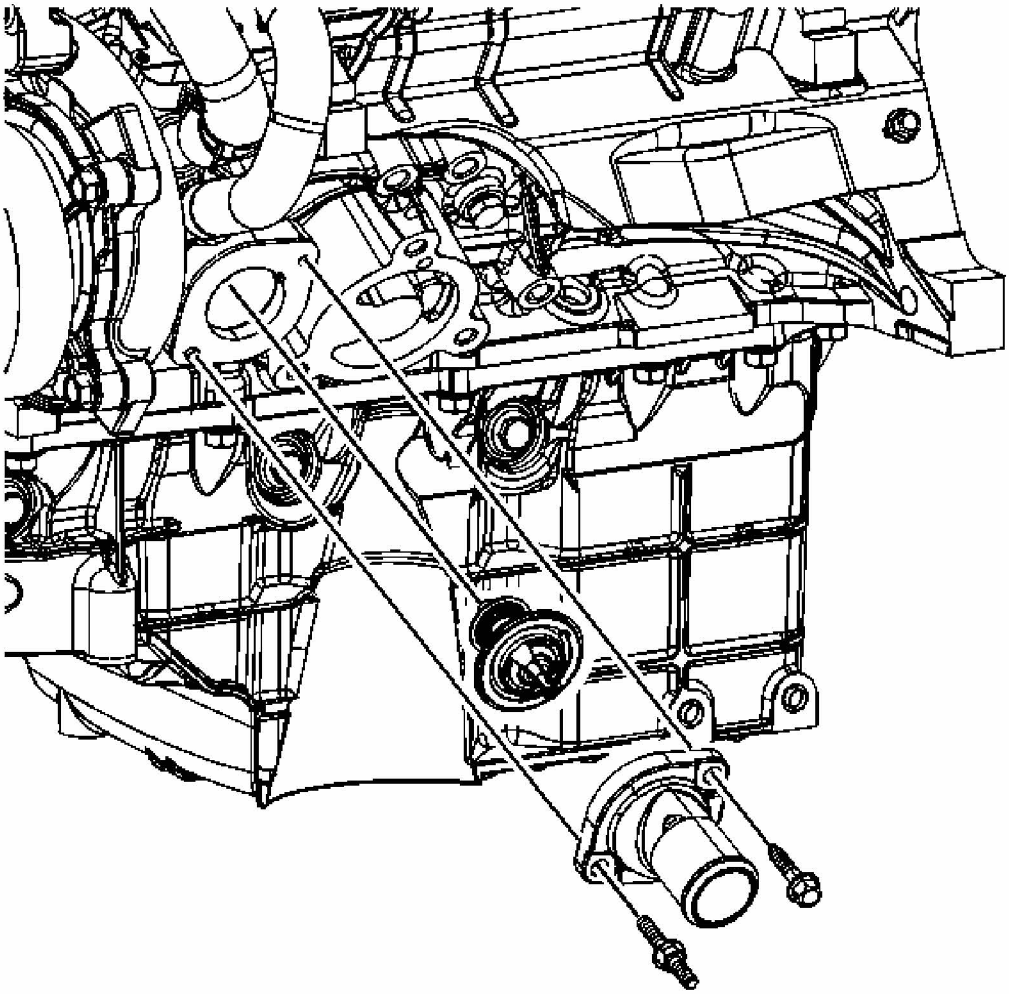


Fig. 483: Identifying Thermostat Housing Bolt/Stud
Courtesy of GENERAL MOTORS CORP.

1. Install the thermostat.
2. Install the water outlet.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

3. Install the water outlet bolts.

Tighten: Tighten the water outlet bolts to 25 N.m (18 lb ft).

EXHAUST MANIFOLD INSTALLATION - LEFT

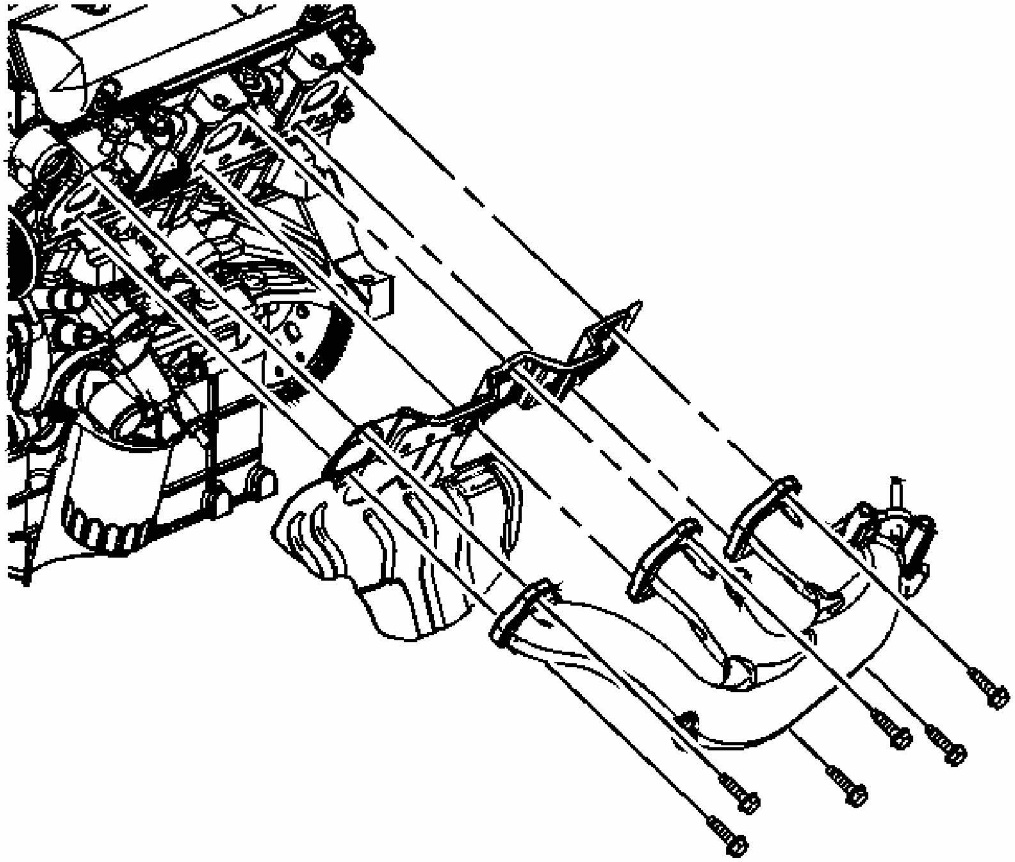


Fig. 484: View Of Left Exhaust Manifold & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the exhaust manifold gasket.
2. Install the exhaust manifold.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

3. Install the exhaust manifold bolts.

Tighten: Tighten the exhaust manifold bolts to 20 N.m (15 lb ft).

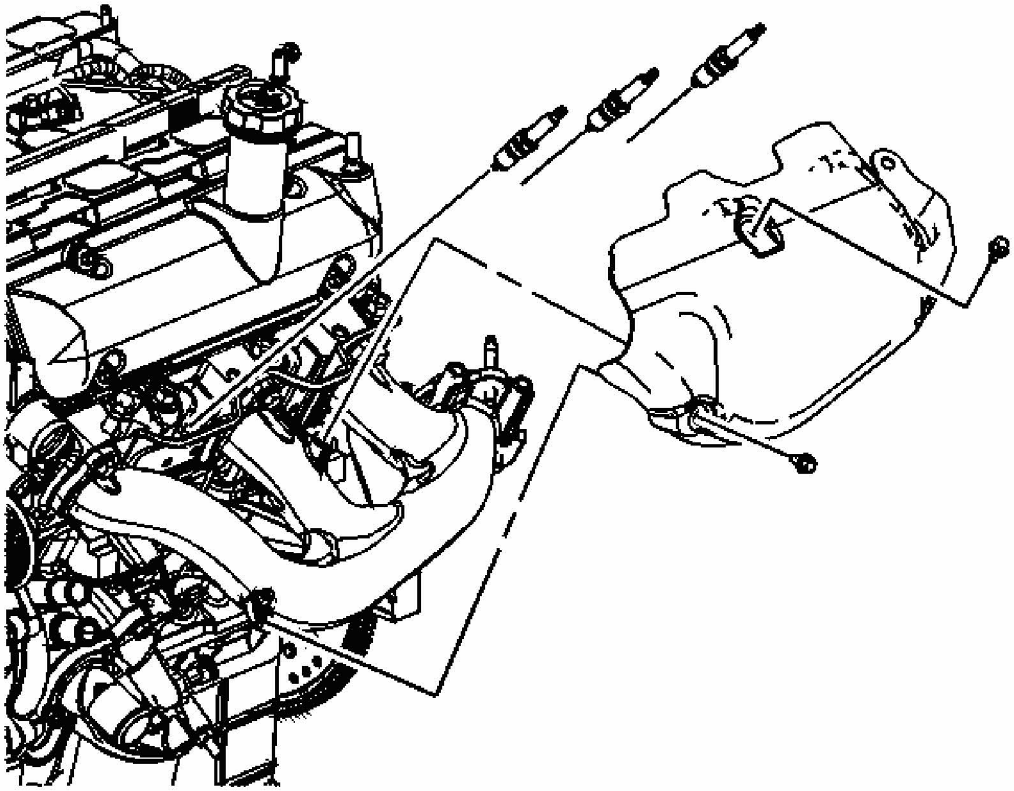


Fig. 485: View Of Spark Plugs & Heat Shield
Courtesy of GENERAL MOTORS CORP.

4. Install the exhaust manifold heat shield.
5. Install the exhaust manifold heat shield bolts.

   Tighten: Tighten the exhaust manifold heat shield bolts to 10 N.m (89 lb in).

6. Install the spark plugs.

   Tighten: Tighten the spark plugs to 15 N.m (11 lb ft).

7. Install the spark plug wires.

EXHAUST MANIFOLD INSTALLATION - RIGHT

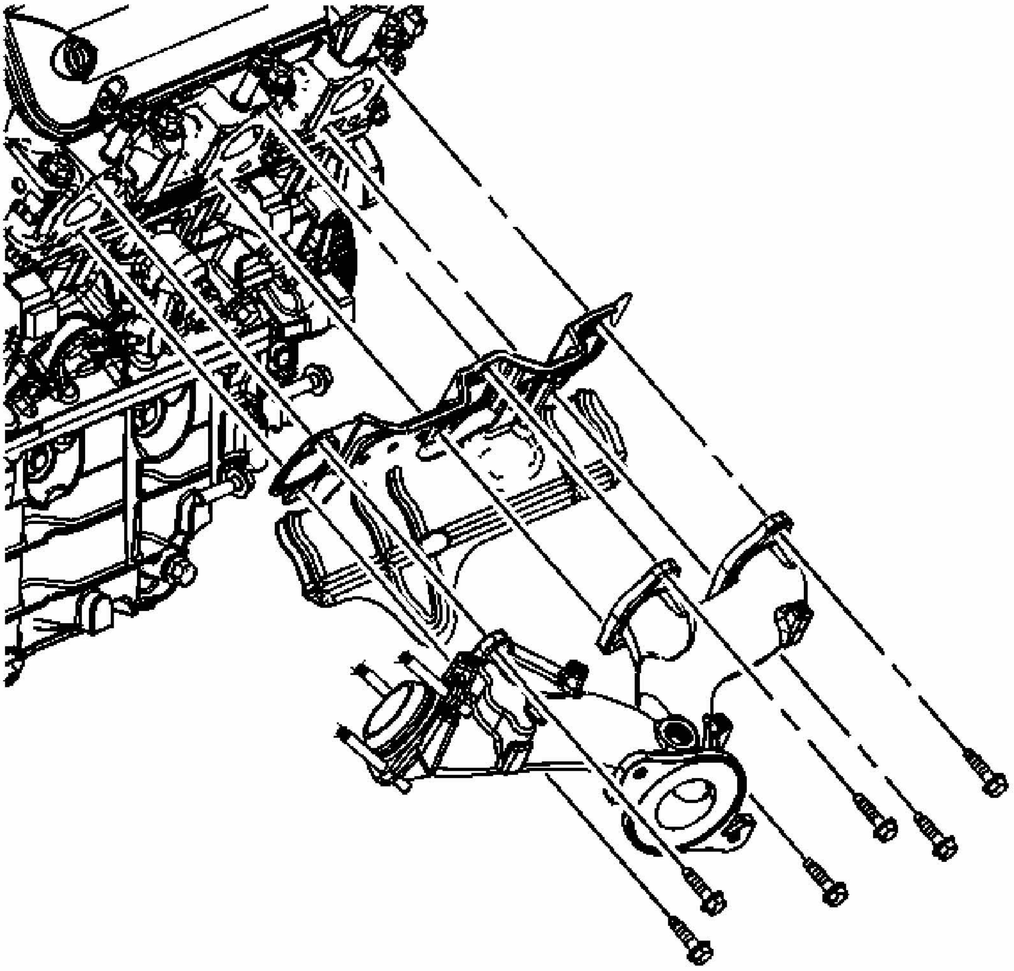


Fig. 486: View Of Right Exhaust Manifold & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the exhaust manifold gasket.
2. Install the exhaust manifold.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

3. Install the exhaust manifold bolts.

Tighten: Tighten the exhaust manifold bolts to 20 N.m (15 lb ft).

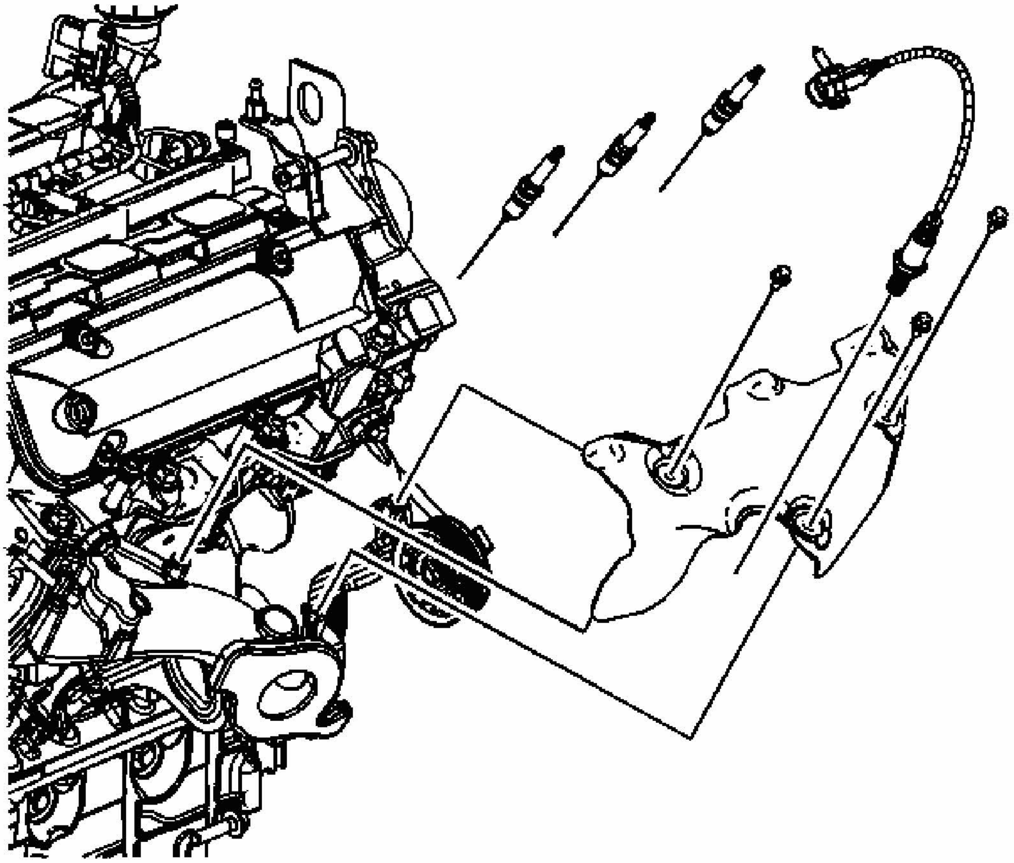


Fig. 487: Identifying Right Side Spark Plugs, HO2S & Heat Shield
Courtesy of GENERAL MOTORS CORP.

4. Install the exhaust manifold heat shield.
5. Install the exhaust manifold heat shield bolts.

   Tighten: Tighten the exhaust manifold heat shield bolts to 10 N.m (89 lb in).

6. Install the spark plugs.

   Tighten: Tighten the spark plugs to 15 N.m (11 lb ft).

7. Install the spark plug wires.
8. Install the heated oxygen sensor.

   Tighten: Tighten the heated oxygen sensor to 42 N.m (31 lb ft).

EXHAUST CROSSOVER PIPE INSTALLATION

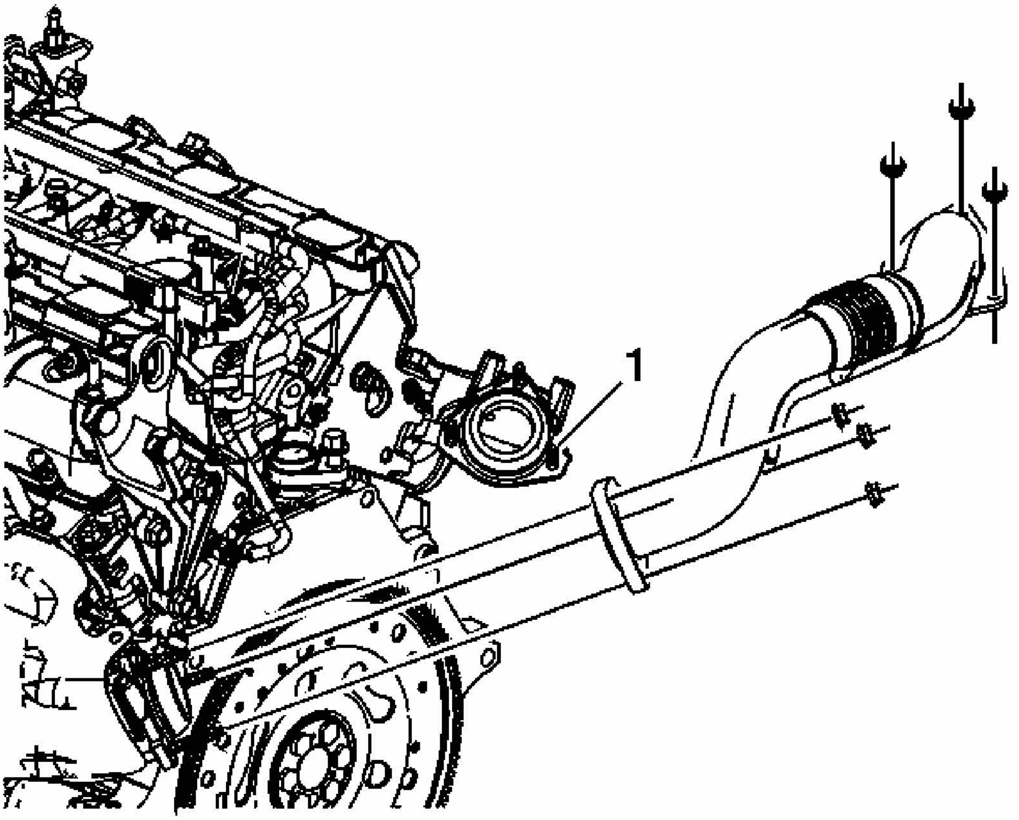


Fig. 488: Identifying Exhaust Crossover Pipe & Nuts
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

1. Install the exhaust crossover pipe studs (1) if necessary.

   Tighten: Tighten the exhaust crossover pipe studs to 25 N.m (18 lb ft).

2. Install the exhaust crossover pipe.
3. Install the exhaust crossover pipe nuts.

   Tighten: Tighten the exhaust crossover pipe nuts to 25 N.m (18 lb ft).

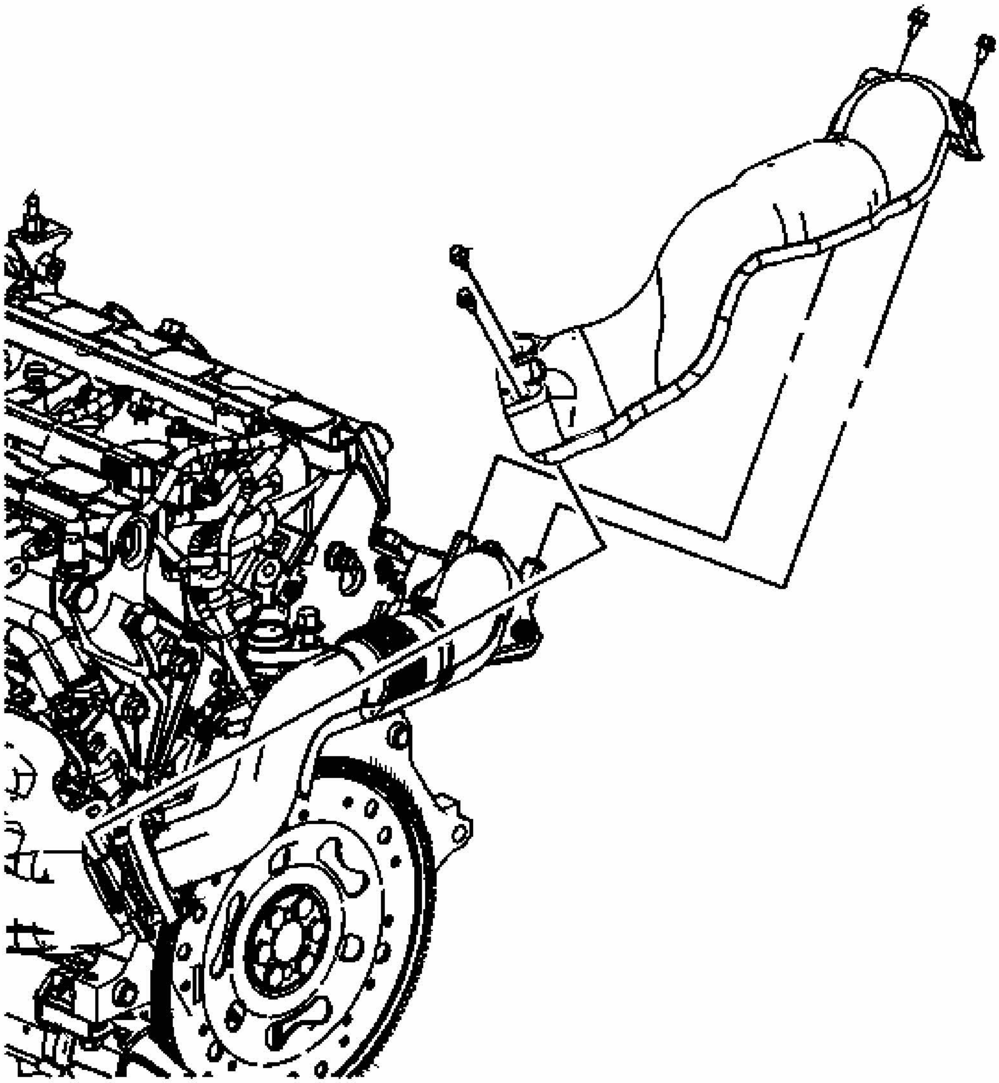


Fig. 489: Identifying Exhaust Crossover Pipe Heat Shield
Courtesy of GENERAL MOTORS CORP.

4. Install the exhaust crossover heat shield.
5. Install the exhaust crossover heat shield bolts.

Tighten: Tighten the exhaust crossover heat shield bolts to 10 N.m (89 lb in).

OIL FILTER ADAPTER INSTALLATION

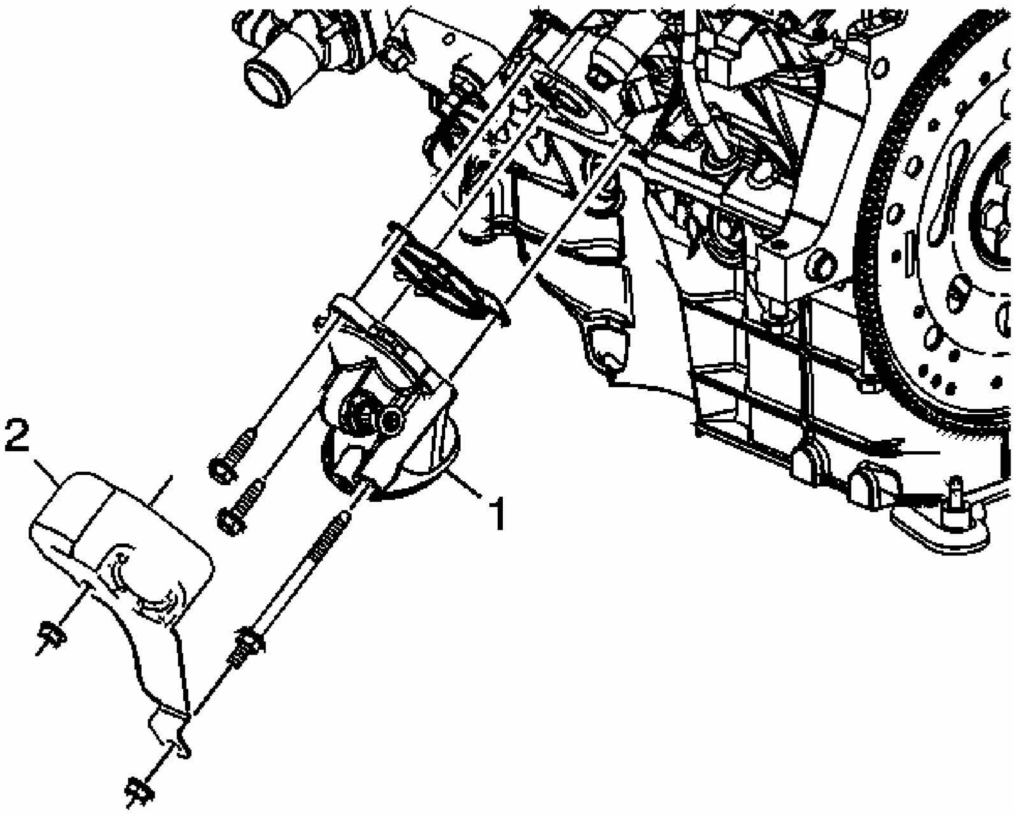


Fig. 490: Identifying Oil Filter Adapter & Heat Shield
Courtesy of GENERAL MOTORS CORP.

NOTE: Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.

1. Install the oil filter adapter (1) and gasket.
2. Apply threadlocker P/N 21485277 to the bolt threads if required.

   NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

3. Install the oil filter adapter bolts.

   Tighten: Tighten the oil filter adapter bolts to 25 N.m (18 lb ft).

4. Install the oil filter adapter heat shield (2).
5. Install the oil filter adapter heat shield nuts.

   Tighten: Tighten the oil filter adapter heat shield nuts to 25 N.m (18 lb ft).

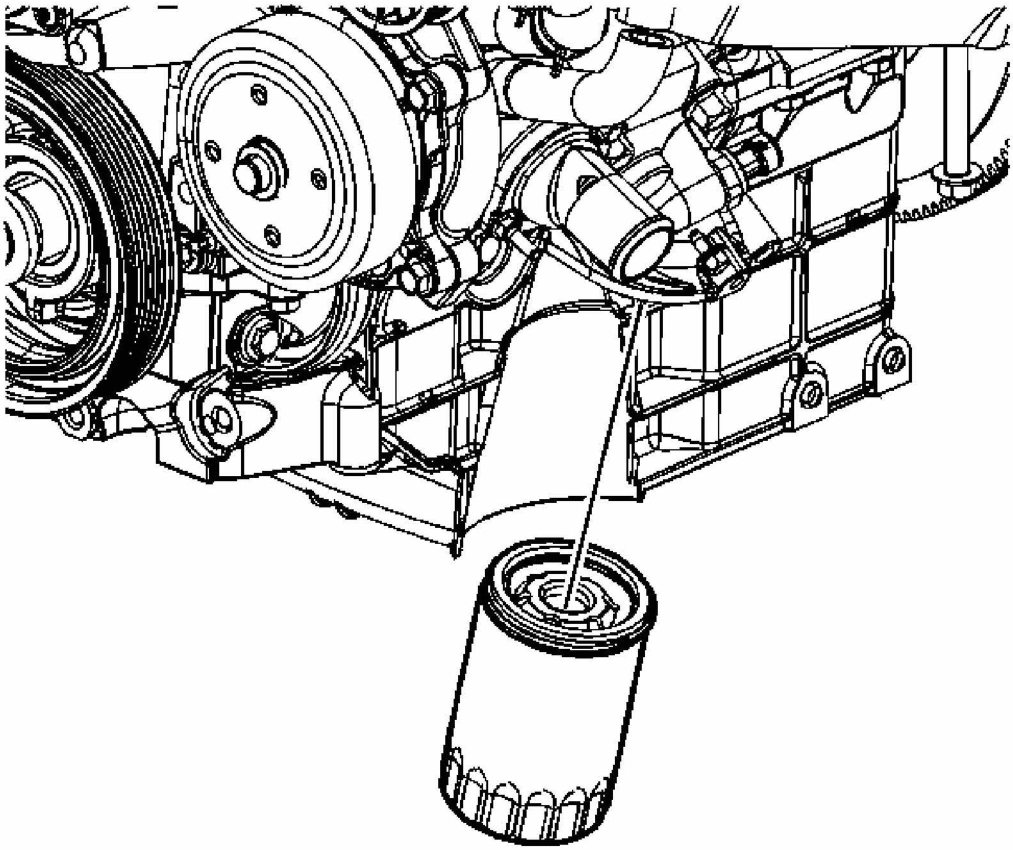


Fig. 491: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

6. Install the oil filter.

   Tighten: Tighten the oil filter to 30 N.m (22 lb ft).

OIL LEVEL INDICATOR AND TUBE INSTALLATION

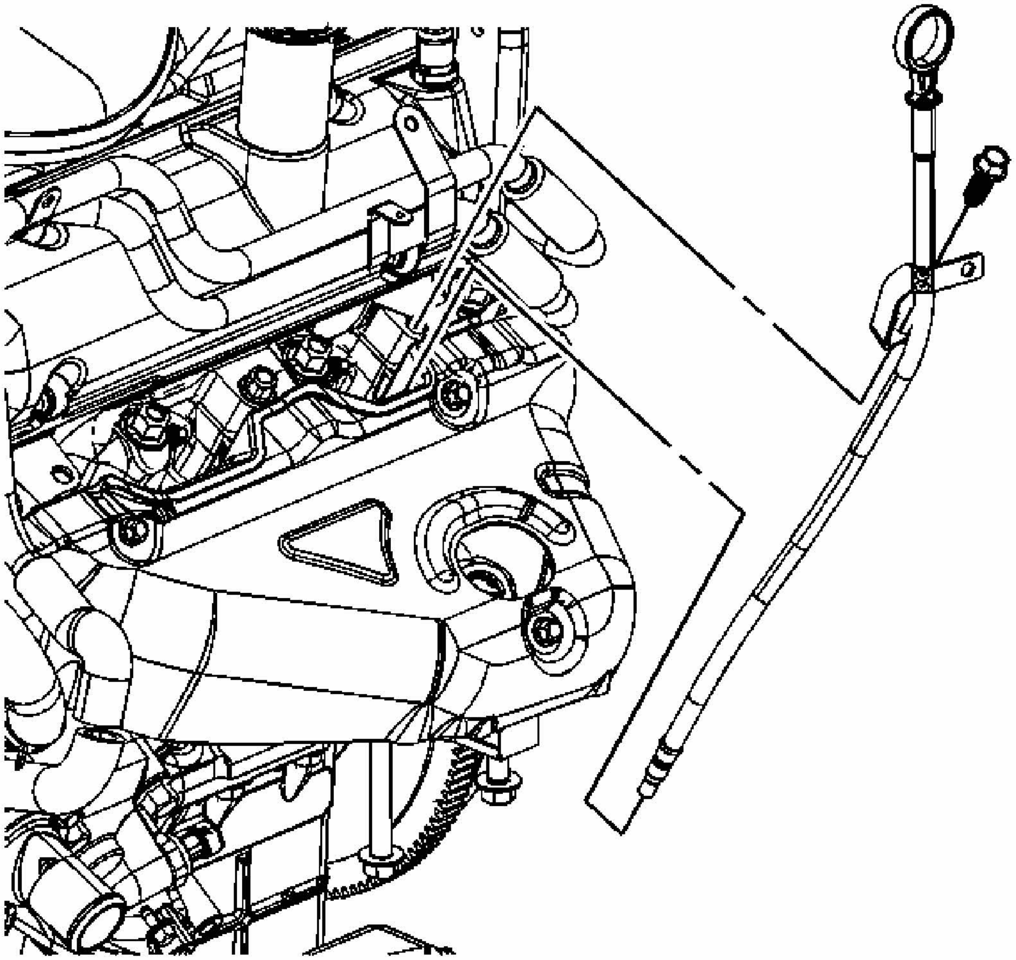


Fig. 492: View Of Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Install the oil level indicator tube and oil level indicator.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the oil level indicator tube bolt.

Tighten: Tighten the oil level indicator tube bolt to 25 N.m (18 lb ft).

ENGINE MOUNT STRUT AND ENGINE LIFT BRACKET INSTALLATION

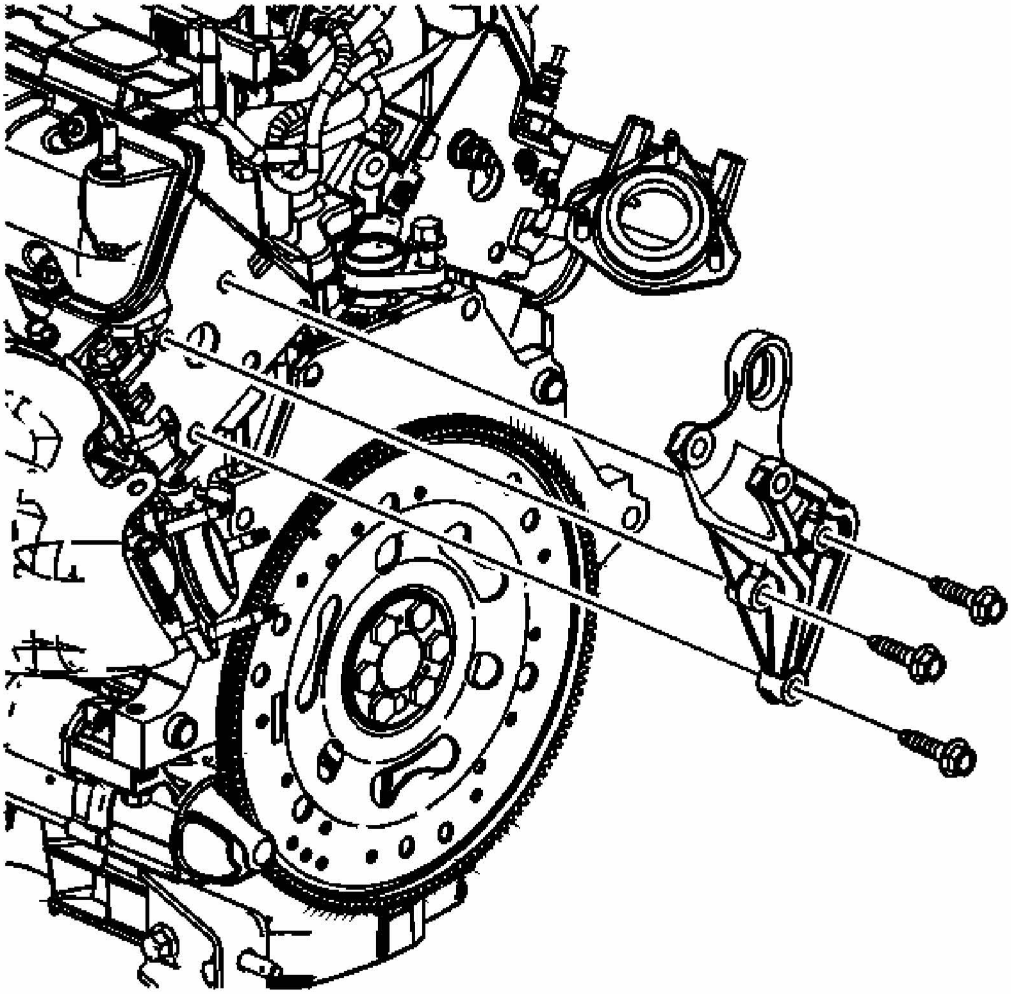


Fig. 493: Identifying Engine Lift Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount strut and engine lift bracket and bracket bolts.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the bolts.

Tighten: Tighten the bolts to 50 N.m (37 lb ft).

ENGINE MOUNT SUPPORT AND STRUT BRACKET INSTALLATION

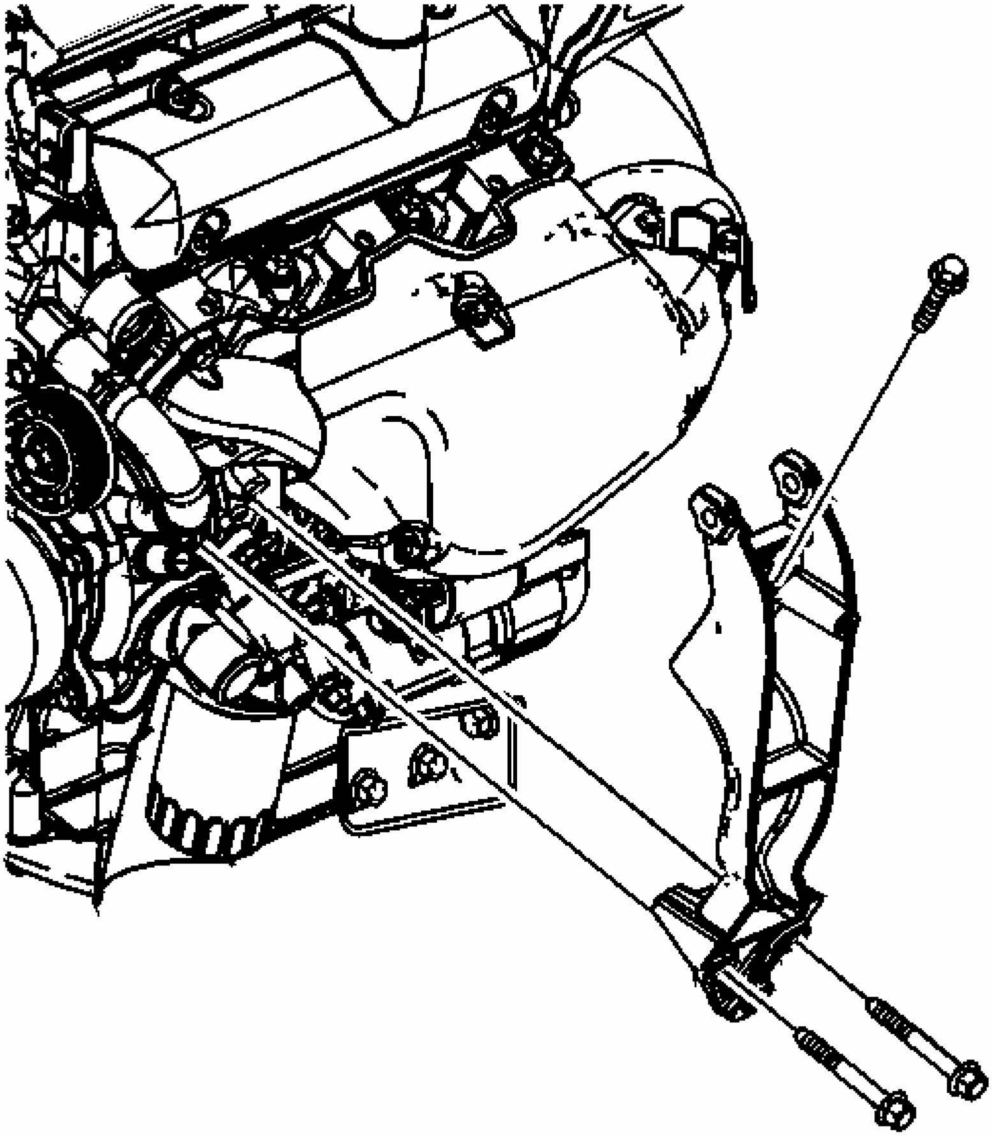


Fig. 494: View Of Engine Mount Support & Strut Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount support and strut bracket and bracket bolts.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

2. Tighten the bolts.

Tighten: Tighten the bolts to 50 N.m (37 lb ft).

COOLANT CROSSOVER PIPE INSTALLATION

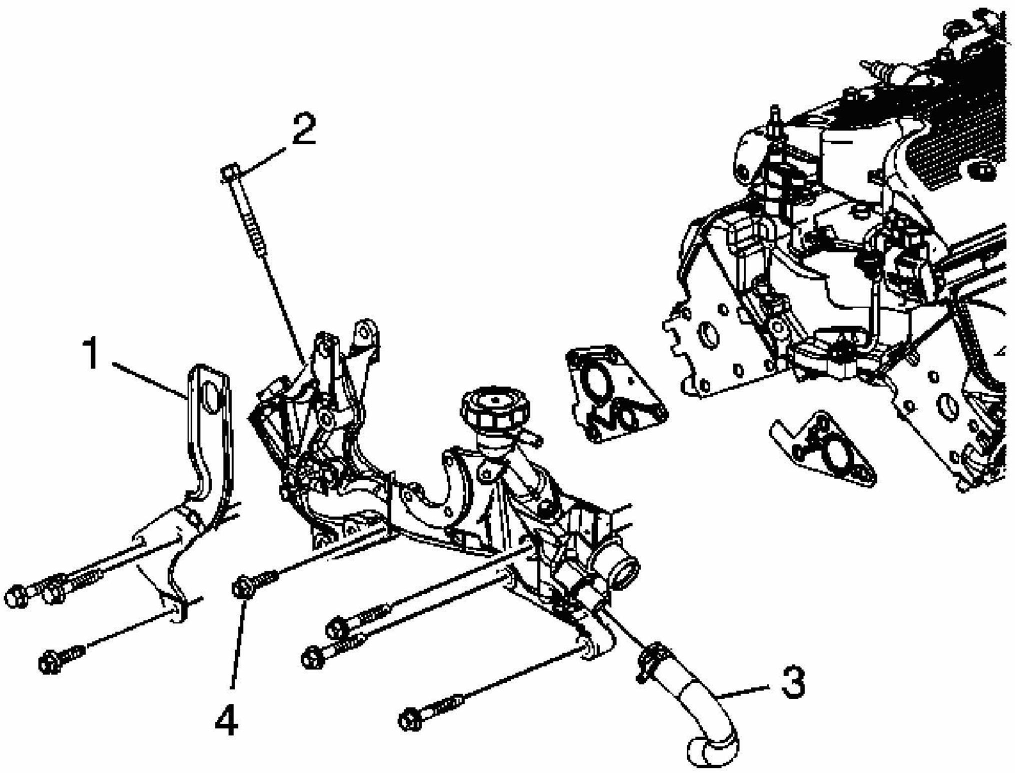


Fig. 495: View Of Coolant Crossover Pipe Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant crossover pipe gaskets and the coolant crossover pipe assembly onto the engine.

   NOTE: **Refer to Fastener Notice .**

2. Install the engine lift bracket (1) and the front coolant crossover pipe bolts (4).

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

3. Install the side coolant crossover pipe bolt (2).

   Tighten: Tighten the bolt to 10 N.m (89 lb in).

4. Install the thermal bypass hose (3) and securely fasten the hose clamp.

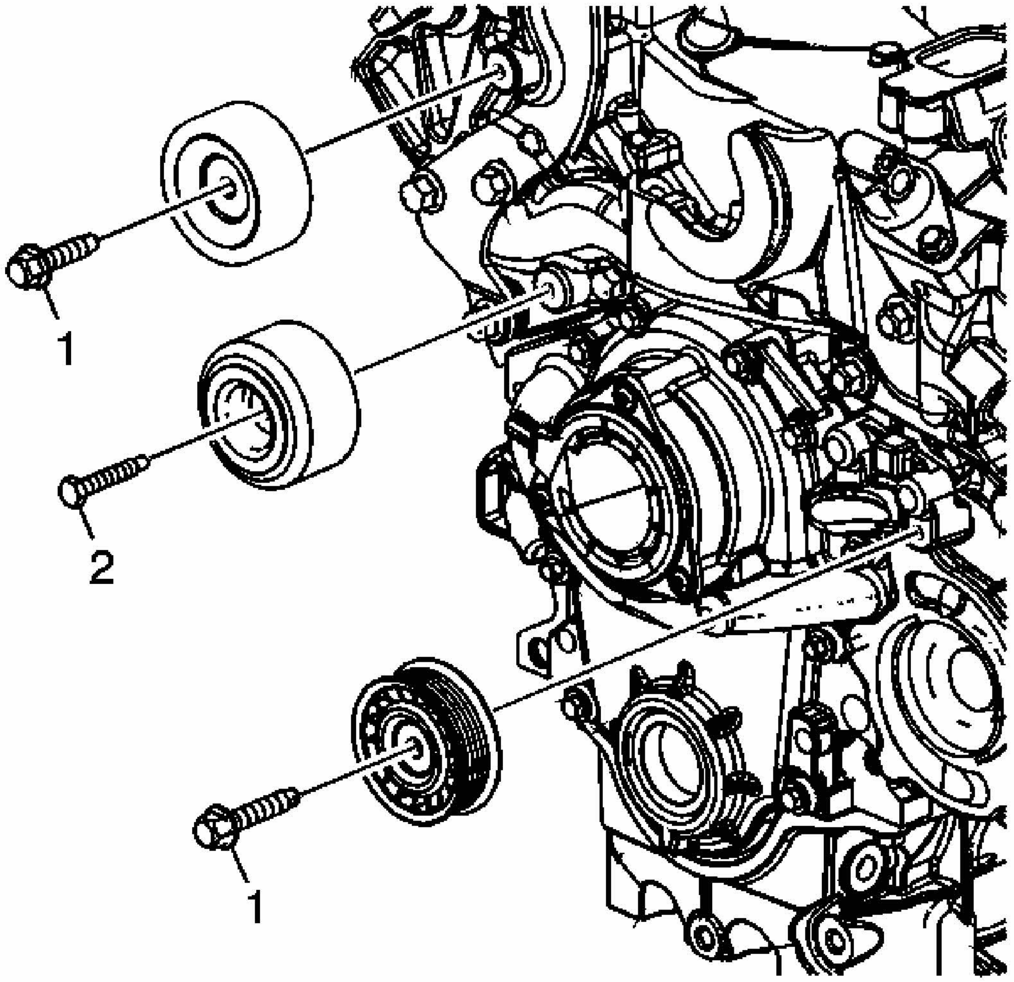


Fig. 496: Identifying Idler Pulley Bolts & Pulleys
Courtesy of GENERAL MOTORS CORP.

5. Install the idler pulleys and bolts.

Tighten:

- Tighten the bolts (1) to 50 N.m (37 lb ft).
- Tighten the bolt (2) to 30 N.m (22 lb ft).

DRIVE BELT TENSIONER INSTALLATION

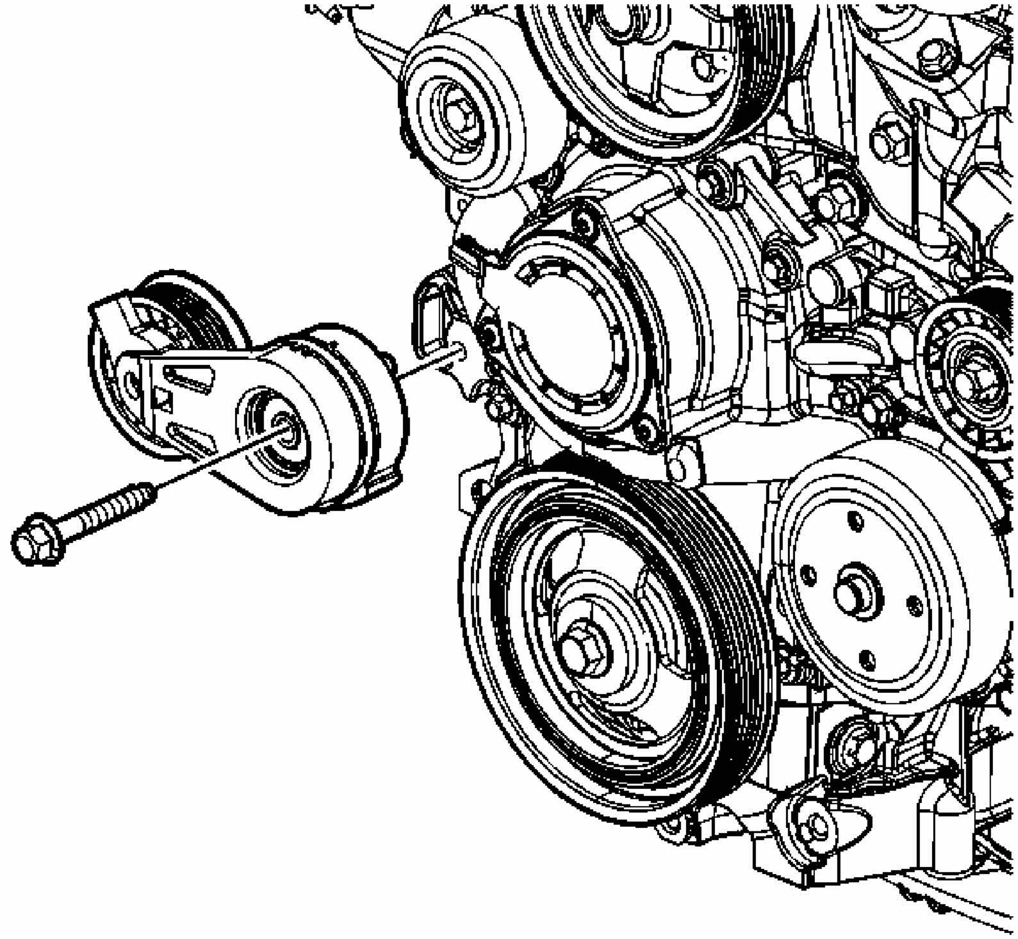


Fig. 497: View Of Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Install the drive belt tensioner.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

2. Install the drive belt tensioner bolt.

Tighten: Tighten the drive belt tensioner bolt to 50 N.m (37 lb ft).

ENGINE FLYWHEEL INSTALLATION (AUTOMATIC TRANSMISSION)

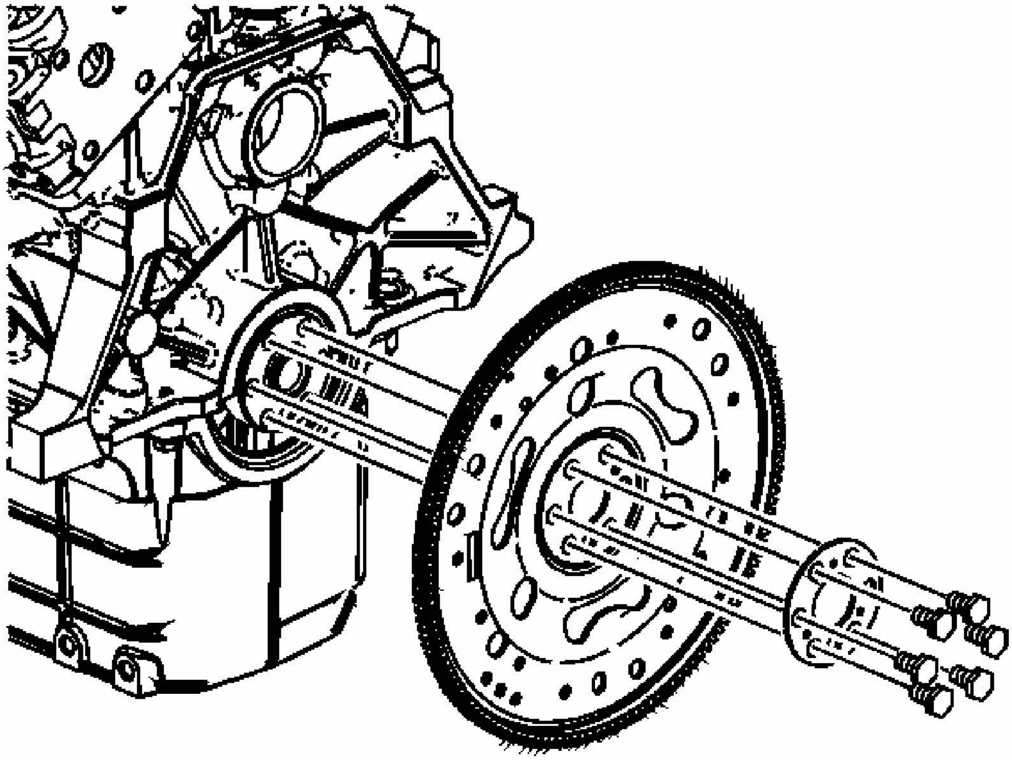


Fig. 498: Identifying Flywheel & Bolts (Automatic Transmission)
Courtesy of GENERAL MOTORS CORP.

1. If equipped with an automatic transmission, install the flywheel.

NOTE: **Refer to FASTENER NOTICE .**

2. Install the flywheel bolts.

Tighten: Tighten the flywheel bolts to 70 N.m (52 lb ft).

ENGINE FLYWHEEL INSTALLATION (MANUAL TRANSMISSION)

Tools Required

J 45059 Angle Meter. See **Special Tools**.

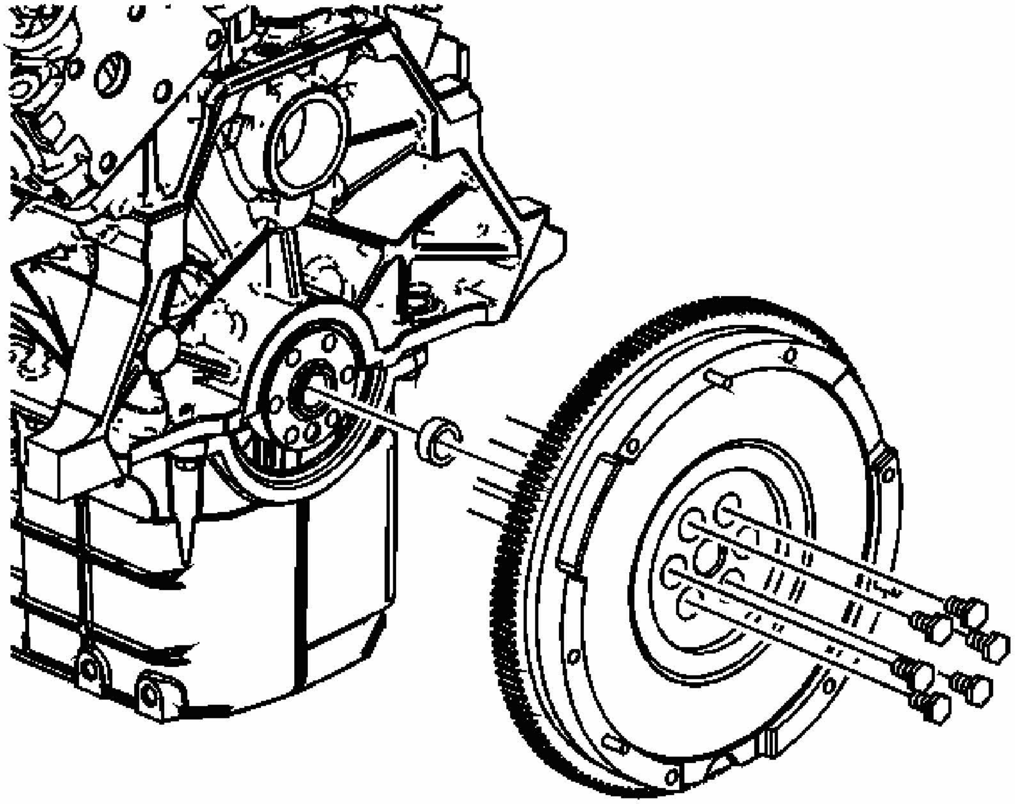


Fig. 499: Identifying Flywheel Bolts (Manual Transmission)
Courtesy of GENERAL MOTORS CORP.

1. Install the clutch pilot bearing.
2. Install the flywheel/pressure plate.

   NOTE: **Refer to FASTENER NOTICE .**

3. Install the flywheel/pressure plate bolts.

   Tighten: Tighten the flywheel/pressure plate bolts to 50 N.m (37 lb ft) plus an additional 70 degrees using the **J 45059** . See **Special Tools**.

CRANKSHAFT BALANCER INSTALLATION

Tools Required

- **J 29113** Balancer and Crank Sprocket Puller. See **Special Tools**.

- **J 45059** Angle Meter. See Special Tools.

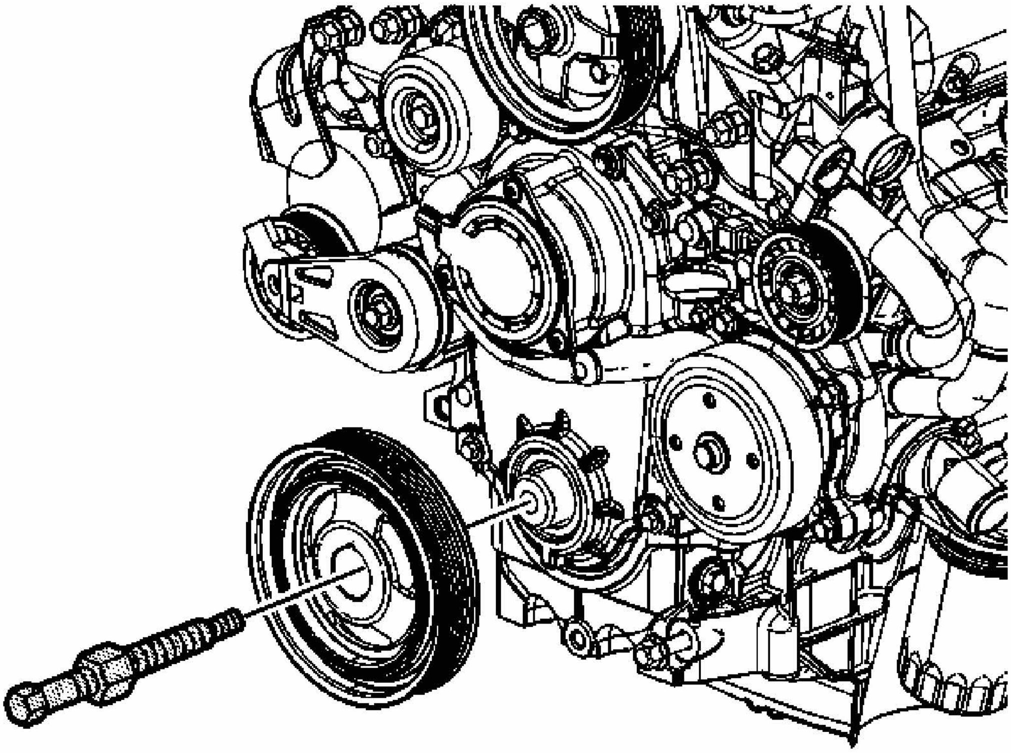


Fig. 500: Installing Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer GM P/N 12378521 (Canadian P/N 88901148) or the equivalent to the keyway of the crankshaft balancer.
2. Place the crankshaft balancer into position over the key in the crankshaft.

NOTE: Do NOT use a power-assisted tool with the special tool in order to remove or install this component. You cannot properly control the alignment of this component using a power-assisted tool, and this can damage the component.

3. Install the **J 29113** onto the crankshaft. See Special Tools.
4. Rotate the hex nut on the **J 29113** to install the crankshaft balancer onto the crankshaft. See Special Tools.
5. Remove the **J 29113** from the crankshaft. See Special Tools.

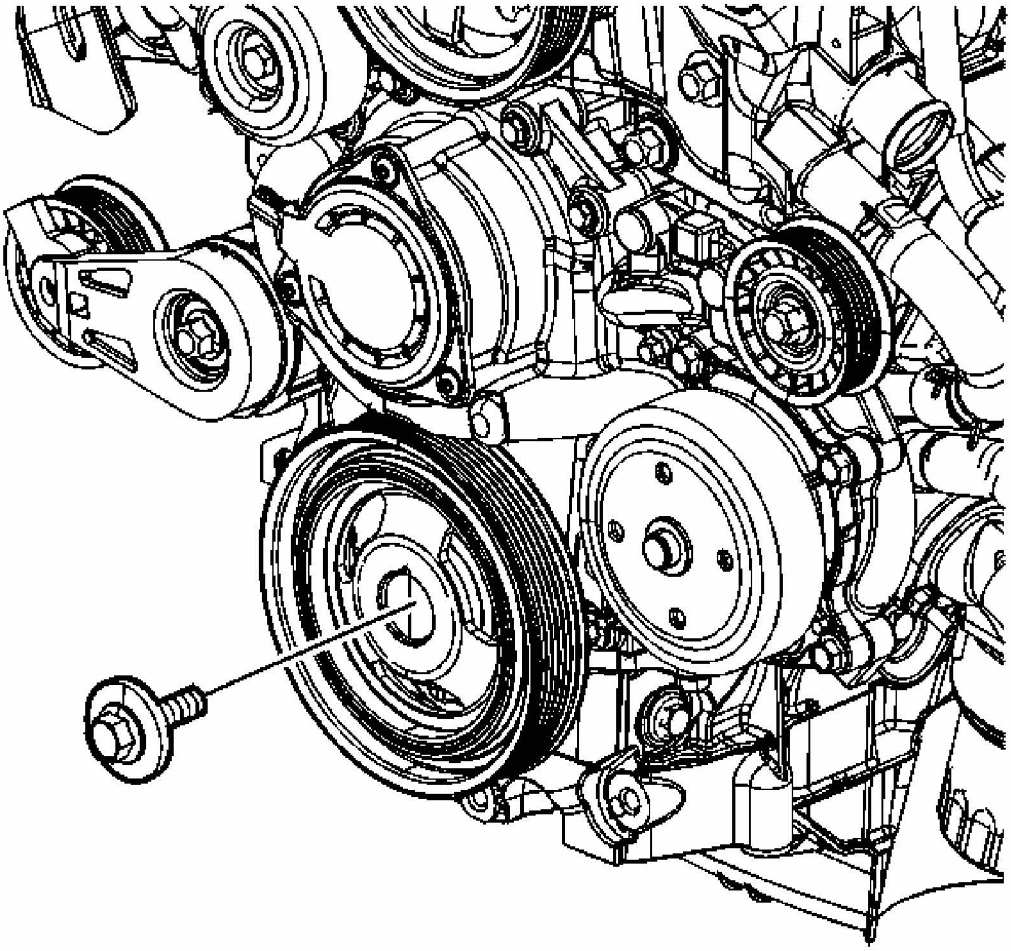


Fig. 501: Identifying Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

6. Install the crankshaft balancer washer and bolt.

Tighten:

- Tighten the crankshaft balancer bolt a first pass to 70 N.m (52 lb ft).
- Tighten the crankshaft balancer bolt a final pass to 70 degrees using the **J 45059** . See **Special Tools**.

ENGINE PRELUBING

Tools Required

- **J-21867-6** Oil Pressure Adapter Fitting. See **Special Tools**.
- **J 45299** Engine Preluber. See **Special Tools**.

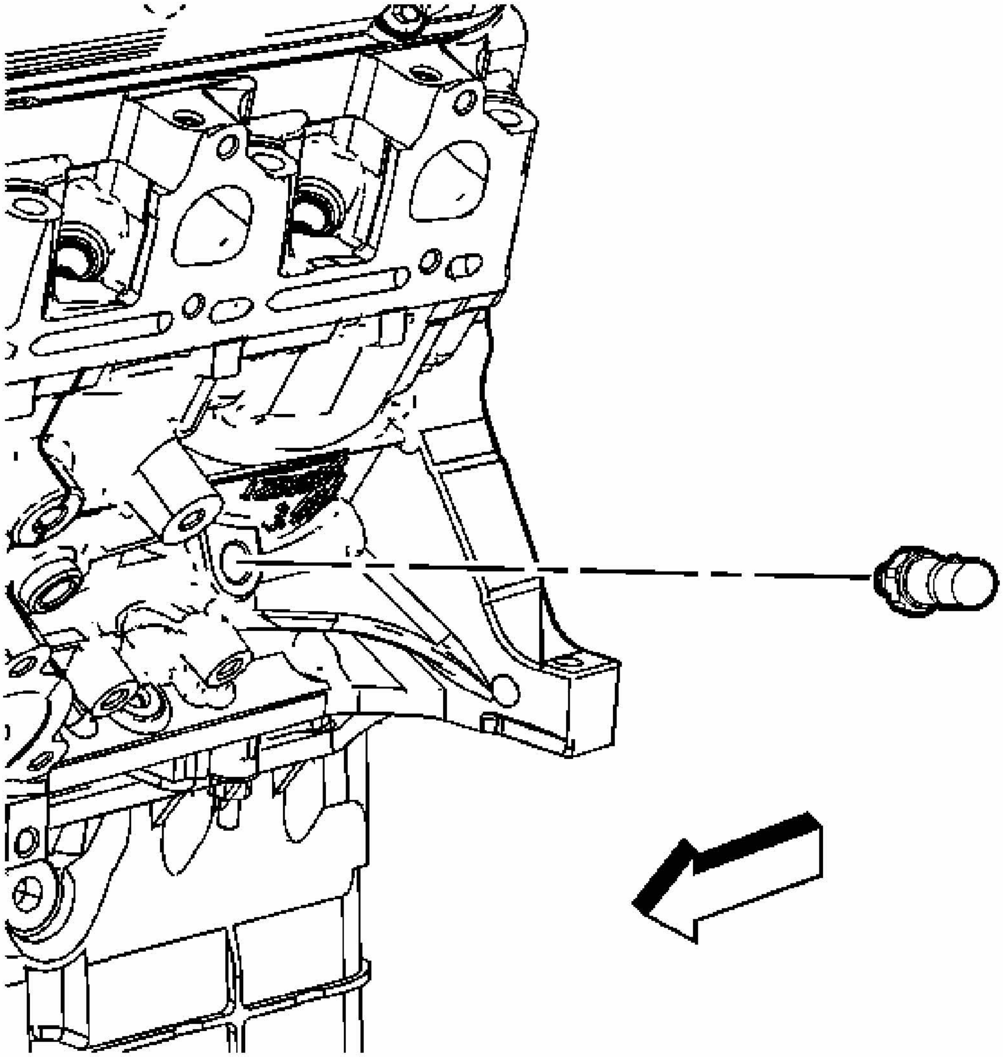


Fig. 502: Locating Engine Oil Pressure Indicator Switch
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

IMPORTANT: A constant/continuous flow of clean engine oil is required in order to properly prime the engine. Be sure to use an approved engine oil as specified in the owners manual.

1. Remove the engine oil filter, fill with clean engine oil, and reinstall.

   Tighten: Tighten the oil filter to 30 N.m (22 lb ft).

2. Locate the engine oil pressure indicator switch on the left side of the engine and remove.
3. Install the 1/4 inch adapter P/N 509373 and the **J-21867-6** . See **Special Tools**.

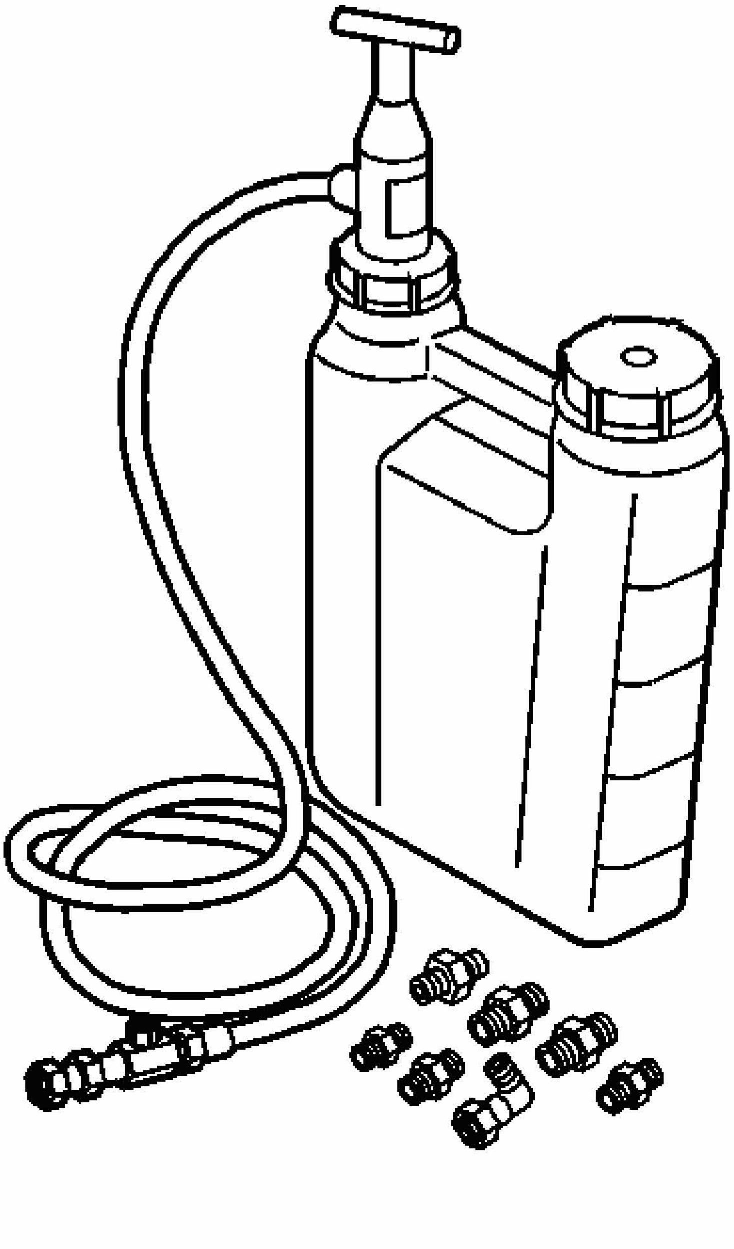


Fig. 503: Identifying Engine Preluber J 45299
Courtesy of GENERAL MOTORS CORP.

4. Install the flexible hose to the adapter and open the valve.
5. Pump the handle on **J 45299** to flow a minimum of 1-2 quarts of engine oil. See **Special Tools**. Observe the flow of engine oil through the flexible hose and into the engine assembly.
6. Close the valve and remove the flexible hose and adapter from the engine.

7. Install the engine oil pressure indictor switch.

   Tighten: Tighten the engine oil pressure indictor switch to 16 N.m (12 lb ft).

8. Top off the engine oil to the proper level.

DESCRIPTION AND OPERATION

CRANKCASE VENTILATION SYSTEM DESCRIPTION

A close crankcase ventilation system is used in order to provide a more complete scavenging of the crankcase vapors. Fresh air from the throttle body is supplied to the crankcase, mixed with blow-by gases, and then passed through a crankcase ventilation valve into the intake manifold.

The primary control is through the crankcase ventilation valve which meters the flow at a rate depending on manifold vacuum. To maintain idle quality, the crankcase ventilation valve restricts the flow when intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent tube into the engine air inlet to be consumed by normal combustion.

Filtered fresh air is routed from upstream of the throttle blade to the front of the right rocker arm cover via a formed nylon tube. To reduce the potential of oil pullover into the throttle bore area due the back flow of the ventilation system, the fitting in the right rocker arm cover is shielded from the rocker arms. From there, fresh air and gases are routed through the crankcase and up to the opposite rocker arm cover where the positive crankcase ventilation (PCV) valve is located. Gases are then routed through a formed nylon tube to the intake manifold.

DRIVE BELT SYSTEM DESCRIPTION

The drive belt system consists of the following components:

- The drive belt
- The drive belt tensioner
- The crankshaft balancer pulley
- The accessory drive components
    - The generator
    - The A/C compressor
    - The power steering

The drive belt system uses one belt. The drive belt is thin so that it can bend backwards and has several ribs to match the grooves in the pulleys. The drive belt is made of different types of rubbers (chloroprene or EPDM) and have different layers or plys containing either fiber cloth or cords for reinforcement.

Both sides of the drive belt may be used to drive the different accessory drive components. When the back side of the drive belt is used to drive a pulley, the pulley is smooth.

The drive belt is pulled by the crankshaft balancer pulley across the accessory drive component pulleys. The spring loaded drive belt tensioner keeps constant tension on the drive belt to prevent the drive belt from slipping. The drive belt tensioner arm will move when loads are applied to the drive belt by the accessory drive components and the crankshaft.

ENGINE COMPONENT DESCRIPTION

The cylinder block is made of cast alloy iron. The cylinder block has 6 cylinders that are arranged in a V shape. There are 3 cylinders in each bank. The cylinder banks are set at a 60 degree angle from each other.

Starting from the front of the engine (accessory belt end), the right bank cylinders are 2, 4, 6. The left bank cylinders are 1, 3, 5.

Four main bearings support the crankshaft. The crankshaft is retained by the bearing caps. The bearing caps are machined with the block for proper alignment and clearances. The main bearing caps are drilled and tapped for the structural oil pan side bolts.

The aluminum cylinder heads have individual intake and exhaust ports for each cylinder. The valve guides are pressed in. The roller rocker arms are located on a pedestal in a slot in the cylinder head. The roller rocker arms are retained on individual threaded bolts.

The crankshaft is forged steel with deep rolled fillets on all 6 crankpins and all 4 main journals. Four steel-backed aluminum bearings are used. The #3 bearing is the end-thrust bearing.

The camshaft is made from a new metal composite design. The camshaft profile is a hydraulic roller design. The camshaft is supported by 4 journals. The camshaft includes an oil pump drive gear.

The pistons are cast aluminum using 2 compression rings and 1 oil control ring. The pistons also have 2 polymer coated patches on the skirt for noise reduction. The piston pin is offset 0.8 mm (0.031 in) towards the major thrust side. This placement allows for a gradual change in thrust pressure against the cylinder wall as the piston travels its path. The pins are made of chromium steel and have a floating fit in the pistons. The pins are retained in the connecting rods by piston pin retainer clips.

The connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal.

A roller rocker type valve train is used. Motion is transmitted from the camshaft through the hydraulic roller lifter and from the pushrod to the roller rocker arm. The rocker arm pivots on the needle roller bearings. The rocker arm transmits the camshaft motion to the valve. The rocker arm pedestal is located in a slot in the cylinder head. The rocker arm is retained in the cylinder head by a bolt. The pushrod is located by the rocker arm.

The intake manifold is a 2-piece cast aluminum unit. The intake manifold centrally supports a fuel rail with 6 fuel injectors.

The exhaust manifolds are cast nodular iron.

LUBRICATION DESCRIPTION

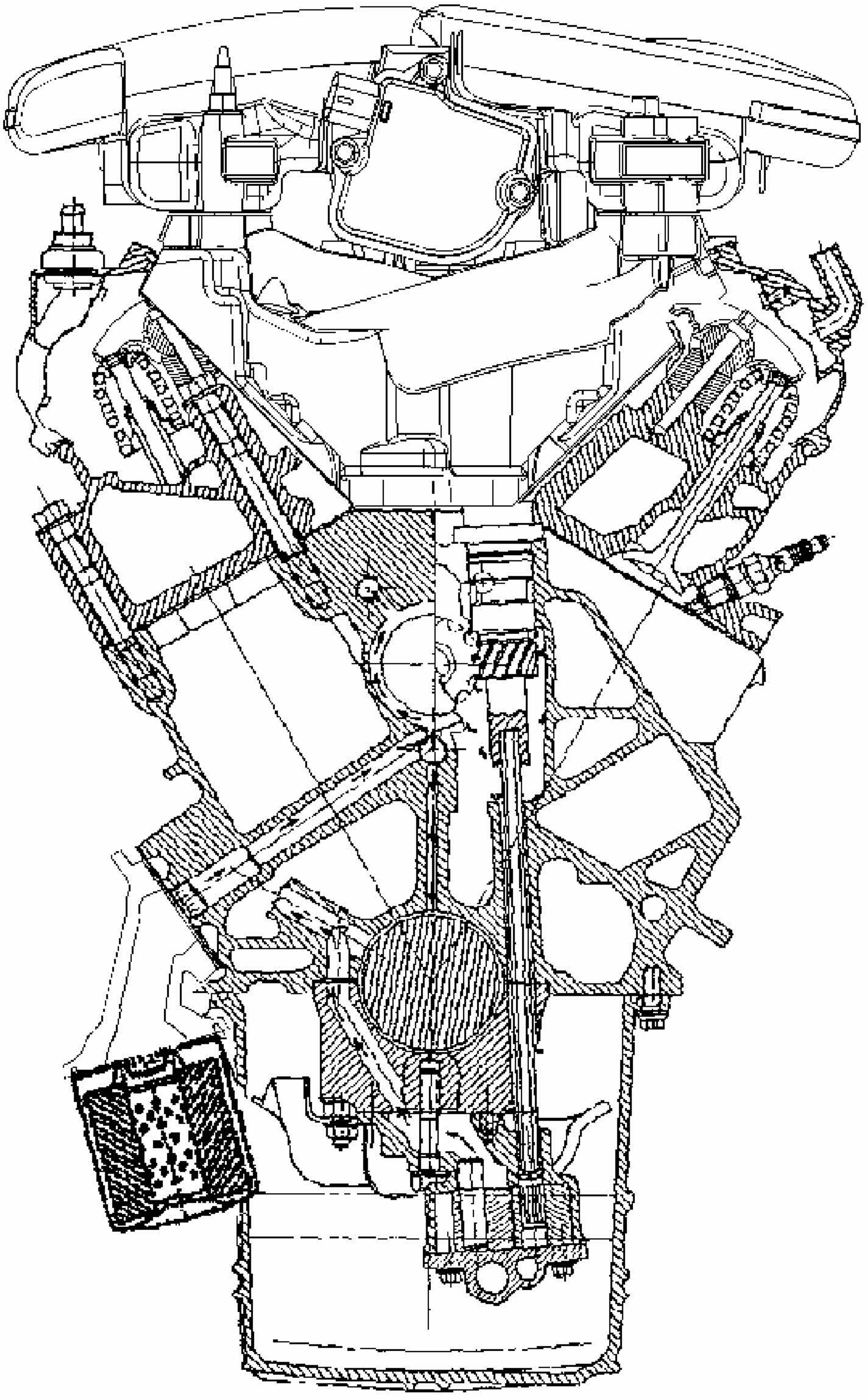


Fig. 504: Front View
Courtesy of GENERAL MOTORS CORP.

Full pressure lubrication, through a full flow oil filter, is furnished by a gear type oil pump. The oil is drawn up through the pickup screen and the tube. The oil passes through the pump to the oil filter.

The oil filter is a full flow paper element unit. An oil filter bypass is used in order to ensure oil supply during the following conditions:

- On a cold start
- If the filter is plugged
- If the filter develops excessive pressure drop

The bypass is designed to open at 69-83 kPa (10-12 psi).

A priority oil delivery system supplies oil first to the crankshaft journals. The oil from the crankshaft main bearings is supplied to the connecting rod bearings by intersecting the passages drilled in the crankshaft. The passages supply the oil to the crankshaft main bearings and the camshaft bearings through the intersecting vertical drilled holes. The oil passages from the camshaft journals supply oil to the hydraulic lifters, and the piston oil nozzles. The camshaft phaser is fed oil from the number 1 camshaft bearing journal.

The piston oil nozzles lubricate the pistons and cylinder walls. A not-serviceable check valve integrated into the nozzle prevents oil bleed down from the nozzle when the engine is not running.

The hydraulic lifters pump oil up through the pushrods to the rocker arms. The cast dams in the crankcase casting direct the oil that drains back from the rocker arms onto the camshaft lobes. The camshaft chain drive is lubricated by indirect oil splash.

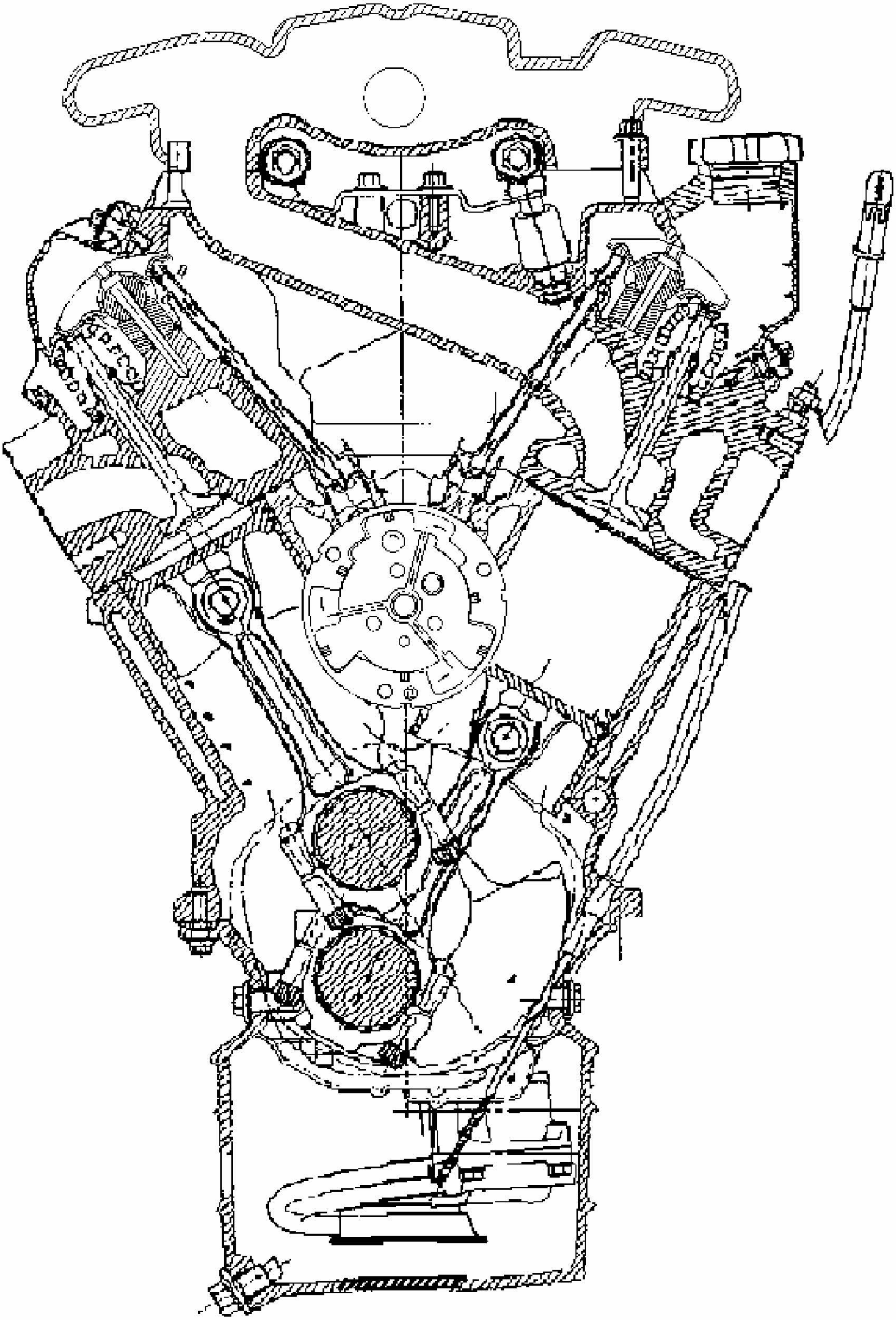


Fig. 505: Rear View

Courtesy of GENERAL MOTORS CORP.

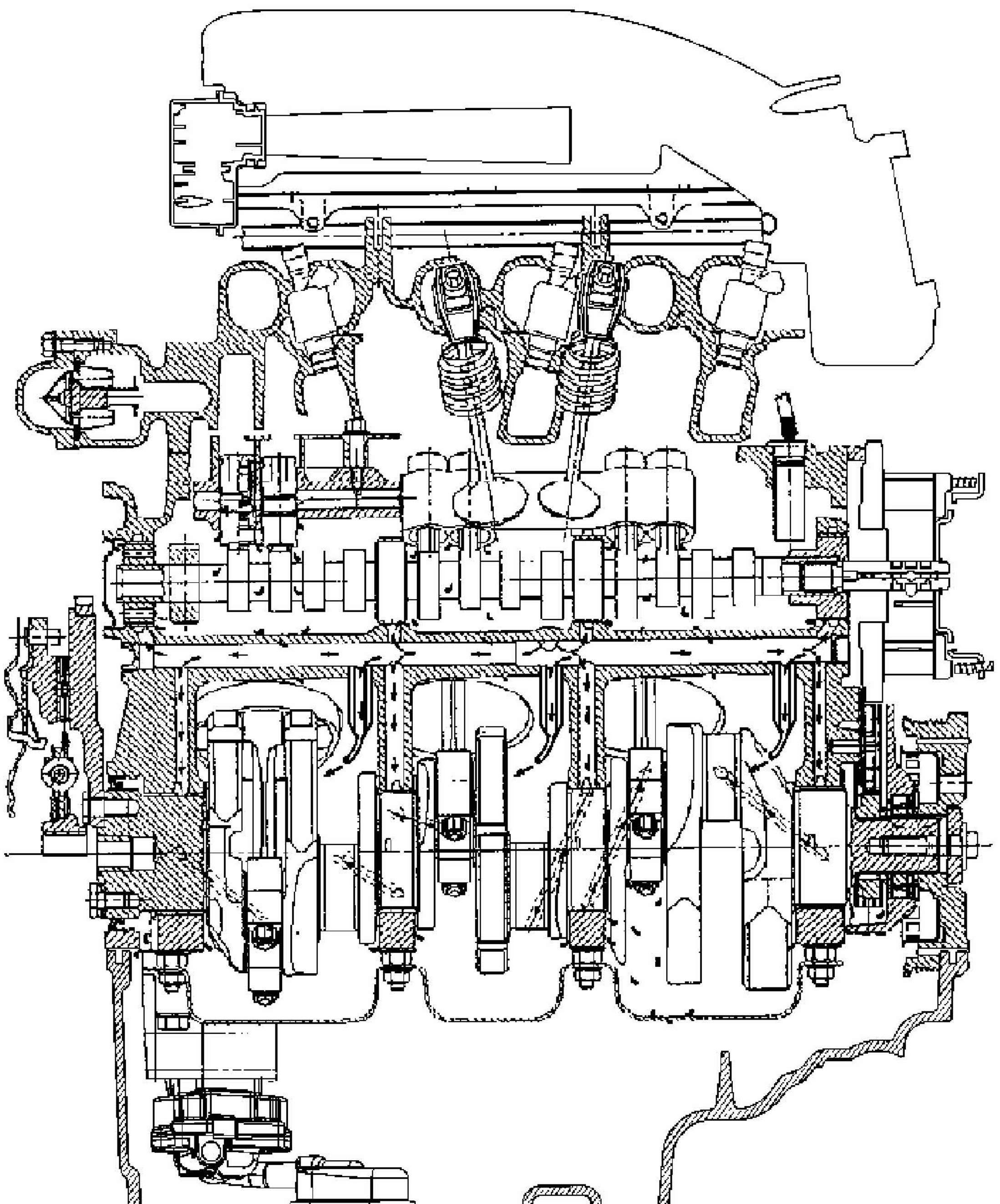


Fig. 506: Right View
Courtesy of GENERAL MOTORS CORP.

CLEANLINESS AND CARE

An automobile engine is a combination of many of the following surfaces:

- Machined
- Honed

- Polished
- Lapped

The tolerances of these surfaces are measured in the ten-thousandths of an inch. When you service any internal engine part, cleanliness and care are important. Apply a liberal coating of engine oil to the friction areas during assembly in order to protect and lubricate the surfaces on initial operation. Throughout this information, practice proper cleaning and protection procedures to the machined surfaces and to the friction areas.

NOTE: Engine damage may result if an abrasive paper, pad, or motorized wire brush is used to clean any engine gasket surfaces.

Whenever you remove the valve train components, keep the components in order. Follow this procedure in order to install the components in the same locations and with the same mating surfaces as when removed.

CAUTION: Refer to BATTERY DISCONNECT CAUTION in Cautions and Notices.

Disconnect the negative battery cables before you perform any major work on the engine.

SEPARATING PARTS

In addition to the room temperature vulcanizing (RTV) sealant's sealing capabilities, the RTV sealants may form an adhesive bond between the components. This may make the components difficult to remove or to separate. If possible, bump the components sideways rather than using prying tools in order to remove the components. This technique prevents damage when the bonding strength of the RTV sealant is stronger than the component itself. Perform bumping at the bends or at the reinforced areas in order to prevent part distortion.

REPLACING ENGINE GASKETS

1. Do not reuse any gasket unless otherwise specified. Reusable gaskets will be identified in the service procedure. Do not apply sealant to any gasket or sealing surface unless called out in the service procedure.
2. Use a rubber mallet in order to separate components. Bump the part sideways in order to loosen the components. Perform the bumping at the bends or at the reinforced areas in order to prevent the distortion of components.

IMPORTANT: Do not use any other method or technique in order to remove the gasket material from a components.
Do not use the following items in order to clean the gasket surfaces:

- **Abrasive pads**
- **Sand paper**
- **Power tools**

These methods of cleaning may damage the component. Abrasive pads also produce a fine grit that the oil filter cannot remove from the oil. This grit is abrasive and may cause internal engine damage.

3. Remove all of the gasket and the sealing material from the component using a plastic or a wood scraper. Do not gouge or scrape the sealing surfaces.

IMPORTANT: Do not allow the sealant to enter any blind threaded holes. The sealant may cause the following conditions:

- **Prevent you from properly seating the bolt**
- **Cause damage when you tighten the bolt**

4. When assembling components, use only the sealant specified in the service procedure. Ensure that the sealing surfaces are clean and free of debris or oil. When applying sealant to a component, apply a bead size as specified in the service procedure.
5. Tighten the bolts to the specifications.

USE OF ROOM TEMPERATURE VULCANIZING (RTV) AND ANAEROBIC SEALER

The following 2 types of sealer are commonly used in engines:

- The RTV sealer
- The anaerobic gasket eliminator sealer

Follow the service procedure instructions. Use the correct sealer in the proper place in order to prevent oil leaks. Do not interchange the 2 types of sealers. Use the sealer recommended in the service procedure.

Applying RTV Sealer

- Do not use the room temperature vulcanizing (RTV) sealant in areas where extreme temperatures are expected. These areas include the following locations:
    - The exhaust manifold
    - The head gasket
    - The other surfaces where gasket eliminator is specified

- Use a rubber mallet in order to separate the components sealed with RTV sealant. Bump the part sideways in order to shear the RTV sealer. Perform the bumping at the bends or the reinforced areas in order to prevent distortion of the components. The RTV sealant is weaker in shear (lateral) strength than in tensile (vertical) strength.

IMPORTANT: Do not use any other method or technique in order to remove the gasket material from a component.

- Do not use the following items in order to clean the gasket surfaces:
  - Abrasive pads
  - Sand Paper
  - Power tools

These methods of cleaning may damage the part.

Abrasive pads also produce a fine grit that the oil filter cannot remove from the oil. This grit is abrasive and may cause internal engine damage.

- Remove all of the gasket material from the component using a plastic or a wood scraper. Use Loctite® brand gasket remover P/N 4MA or the equivalent. Follow all of the safety recommendations and the directions that are on the container.

IMPORTANT: Do not allow the sealer to enter the blind threaded holes. The sealer may cause the following conditions:

  - Prevent you from properly seating the bolt
  - Cause damage when you tighten the bolt
- Apply the RTV sealant to a clean surface. Use a bead size as specified in the procedure. Apply the bead to the inside of any bolt holes.
- Assemble the components while the RTV sealant is still wet (within 3 minutes). Do not wait for the RTV sealant to skin over.

IMPORTANT: Do not overtighten the bolts.

- Tighten the bolts to specifications.

Applying Anaerobic Sealer

The anaerobic gasket eliminator hardens in the absence of air. This type of sealer is used where 2 rigid parts (such as castings) are assembled together. When 2 rigid parts are disassembled and no sealer or gasket is readily noticeable, the parts were probably assembled using a gasket eliminator.

IMPORTANT: Do not use any other method or technique in order to remove the gasket material from a component.

Do not use the following items in order to clean the gasket surfaces:

- Abrasive pads
- Sand paper
- Power tools

These methods of cleaning may damage the part.

Abrasive pads also produce a fine grit that the oil filter cannot remove from the oil. This grit is abrasive and may cause internal engine damage.

- Remove all of the gasket material from the component using a plastic or a wood scraper. Use Loctite® brand gasket remover P/N 4MA or the equivalent. Follow all of the safety recommendations and the directions that are on the container.
- Apply a continuous bead of the gasket eliminator to 1 flange. Clean and dry any surfaces that you will reseal.

IMPORTANT: Anaerobic sealed joints that are partially torqued and allowed to cure more than 5 minutes may result in incorrect shimming and sealing of the joint.

- Do not allow the sealer to enter the blind threaded holes. The sealer may cause the following conditions:
  - Prevent you from properly seating the bolt
  - Cause damage when you tighten the bolt
- Spread the sealer evenly in order to get a uniform coating on the sealing surface.
- Tighten the bolts to the specifications.
- Remove the excess sealer from the outside of the joint.

TOOLS AND EQUIPMENT

Work in a clean and well-lit area. Have the following components available before you begin to work:

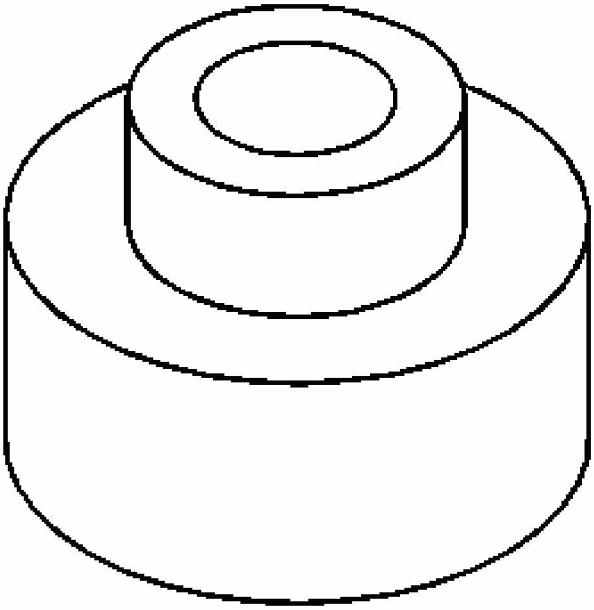
- A suitable parts cleaning tank
- A compressed air supply
- Trays, in order to keep the parts and the fasteners organized
- An adequate set of hand tools

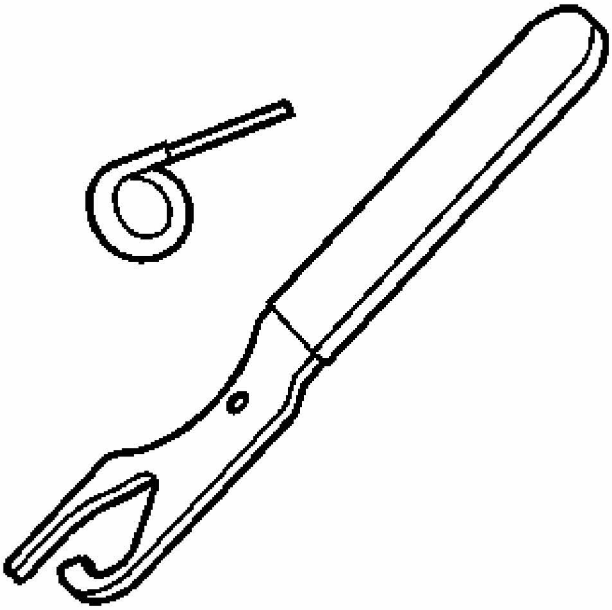
An approved engine repair stand will prevent personal injury or damage to the engine components. The special tools are designed in order to quickly and safely accomplish the operations for which the tools are intended. Using the tools will minimize possible damage to the engine components. Precision measuring tools are required for the inspection of certain critical components. Torque wrenches are needed for the correct assembly of various parts.

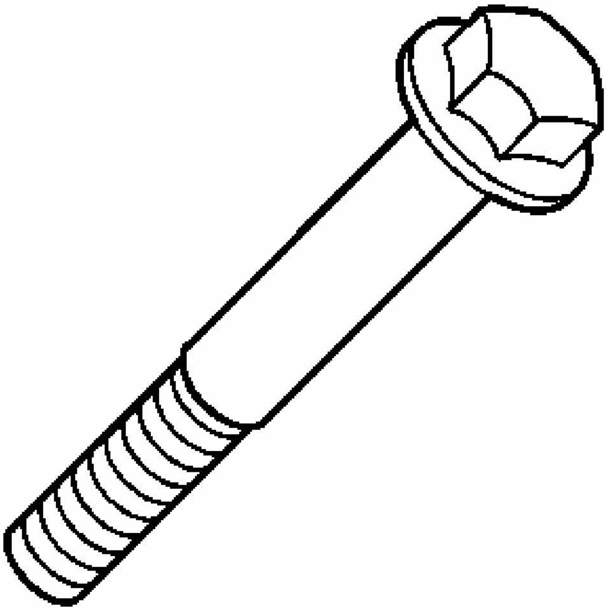
SPECIAL TOOLS AND EQUIPMENT

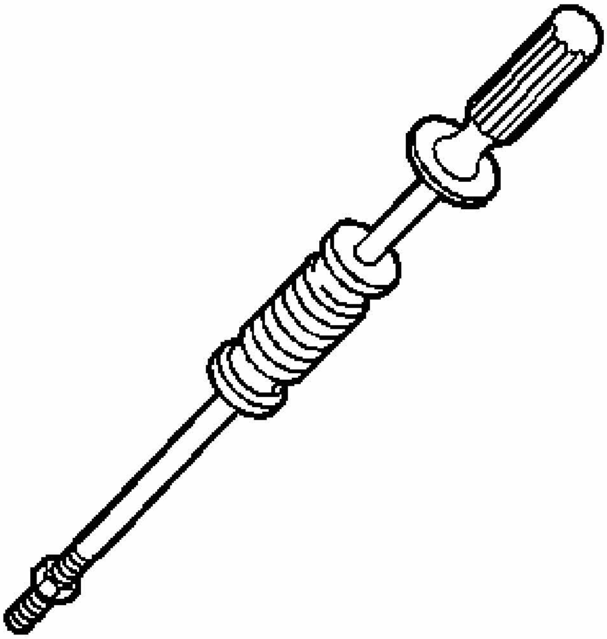
SPECIAL TOOLS

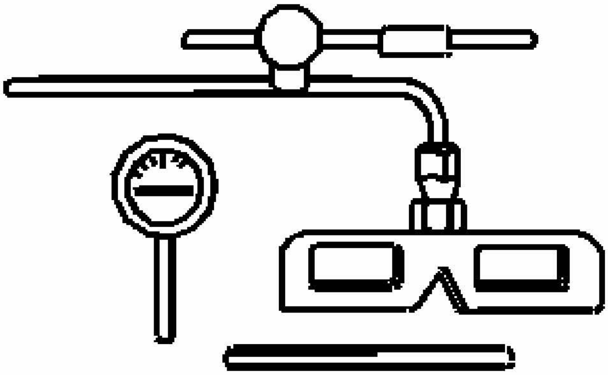
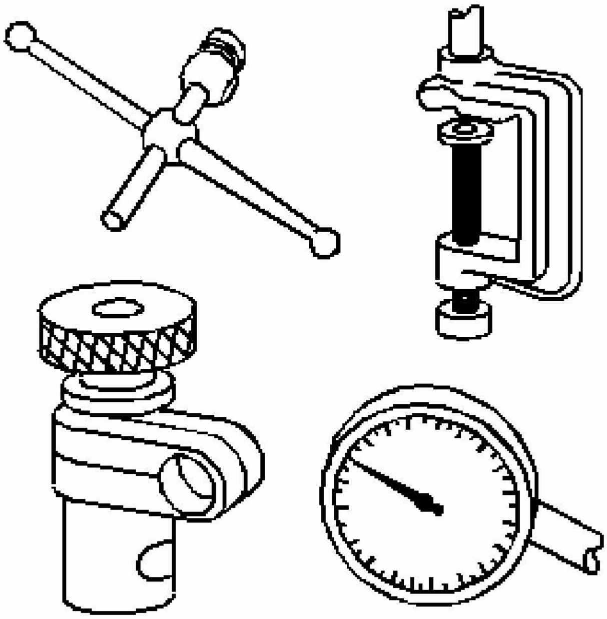
Special Tools

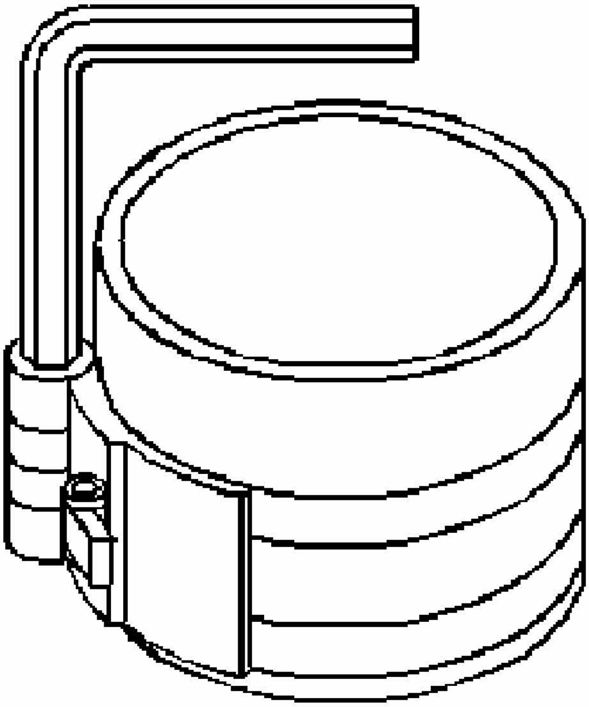
Illustration	Tool Number/Description
	EN 46359 Puller End Protector

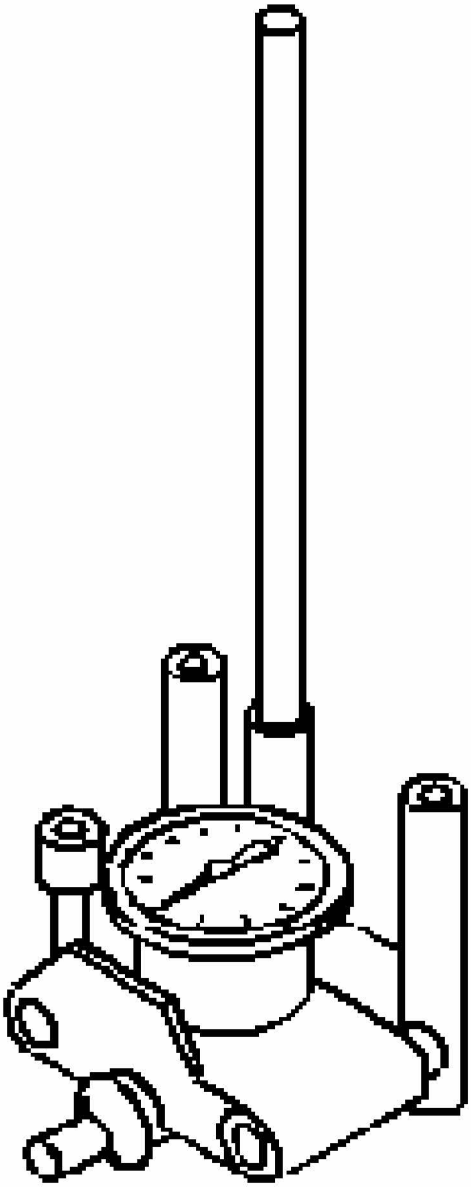
	EN 47719 Tensioner Compressor
	EN 47823 Valve Spring Compressor Adapter

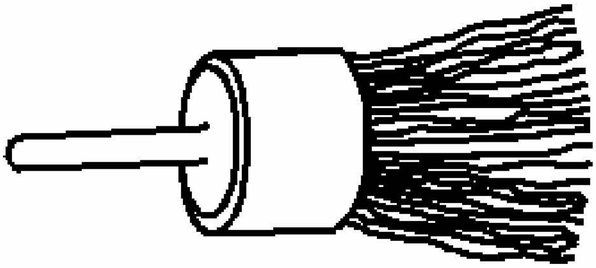
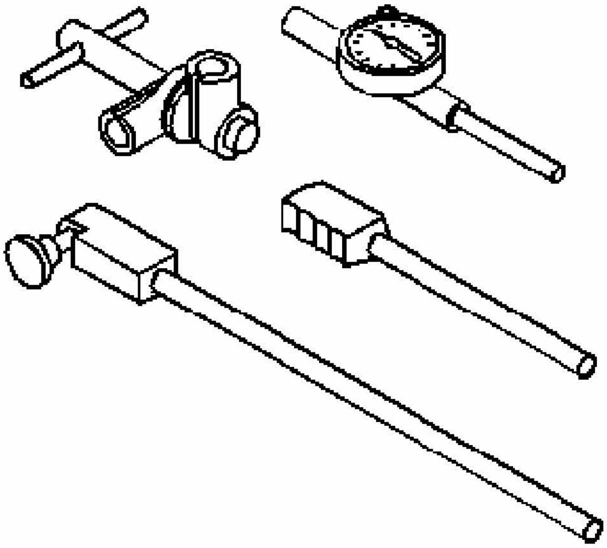
	
	J 5892-D Valve Spring Compressor

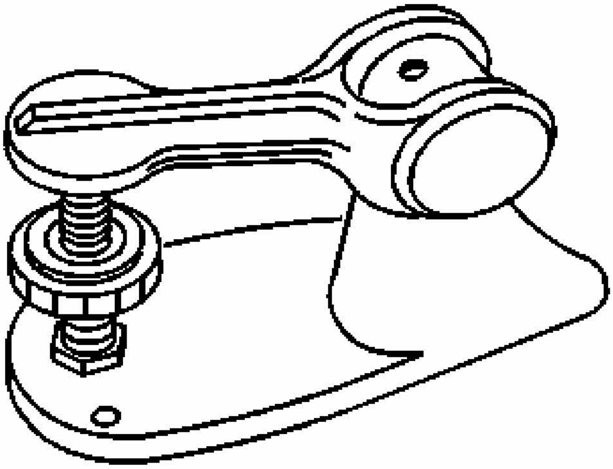
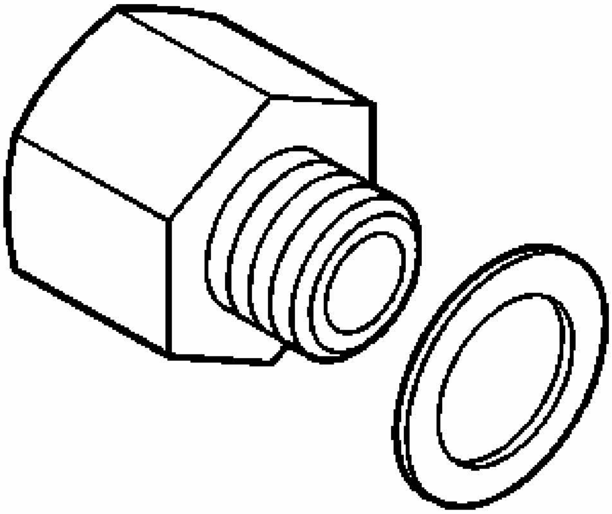
	J 6125-1B Slide Hammer with Adapter

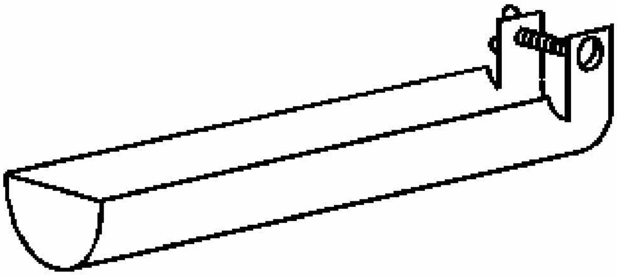
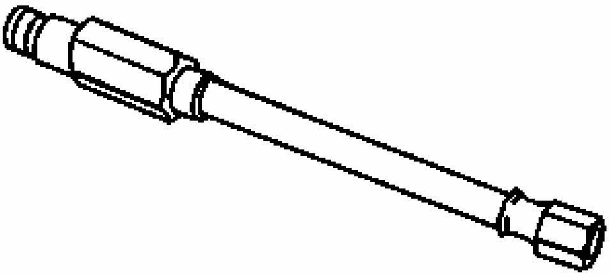
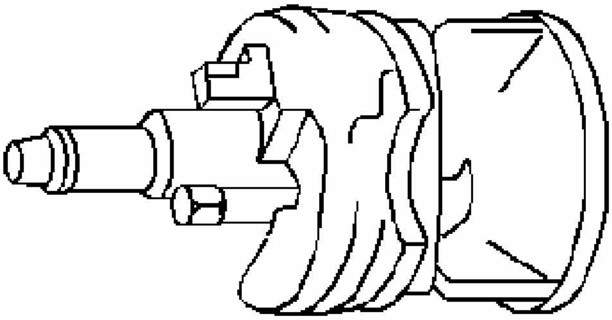
	J 7872 Magnetic Base Dial Indicator
	J 8001 Dial Indicator Set

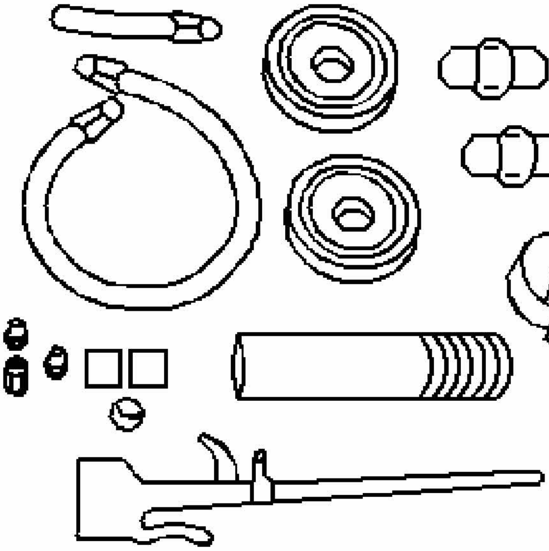
	J 8037 Ring Compressor

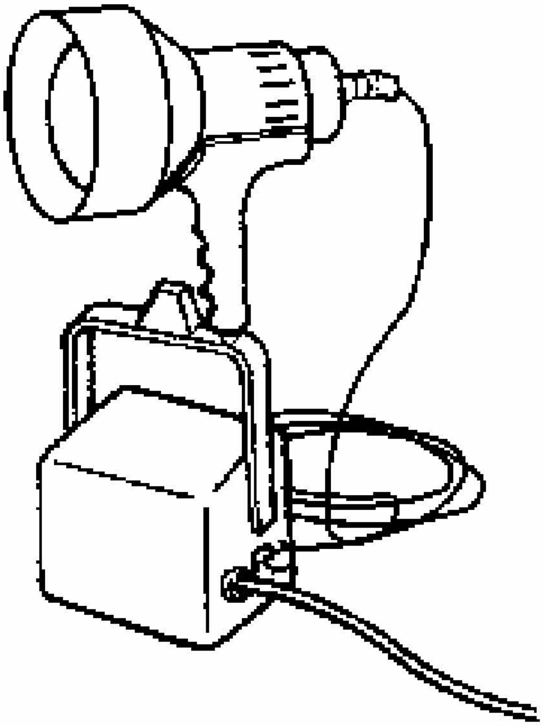
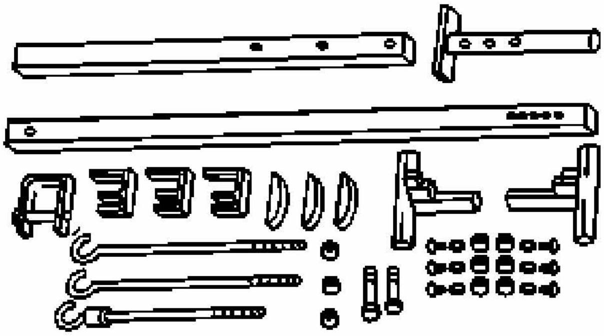
	J 8087 Cylinder Bore Gage

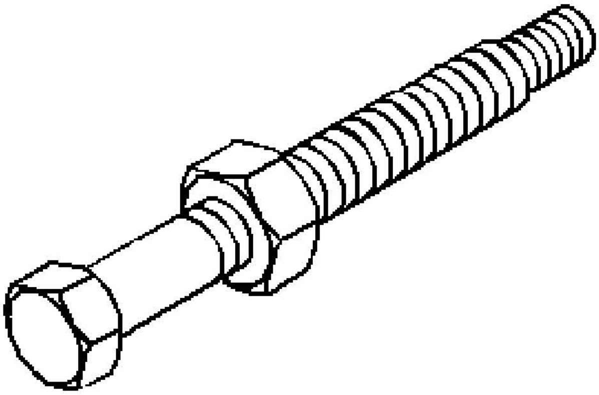
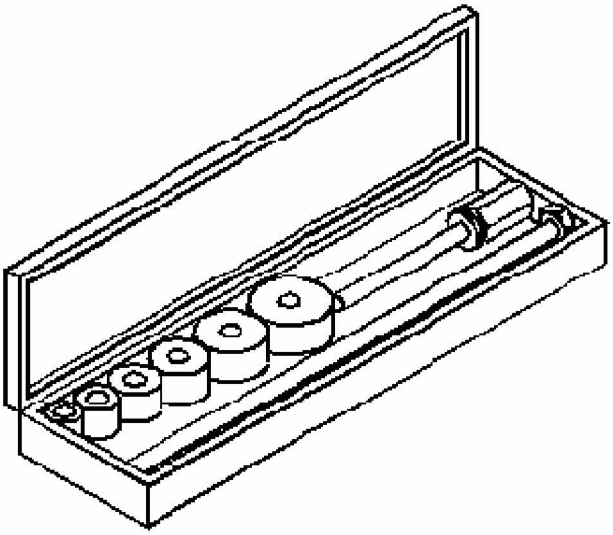
	J 8089 Carbon Removal Brush
	J 8520 Cam Lobe Lift Indicator

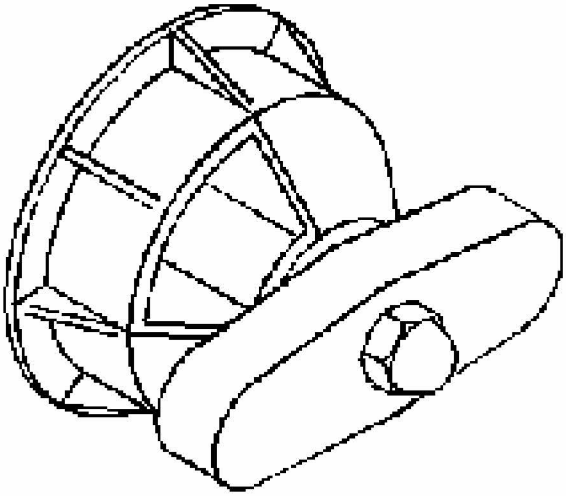
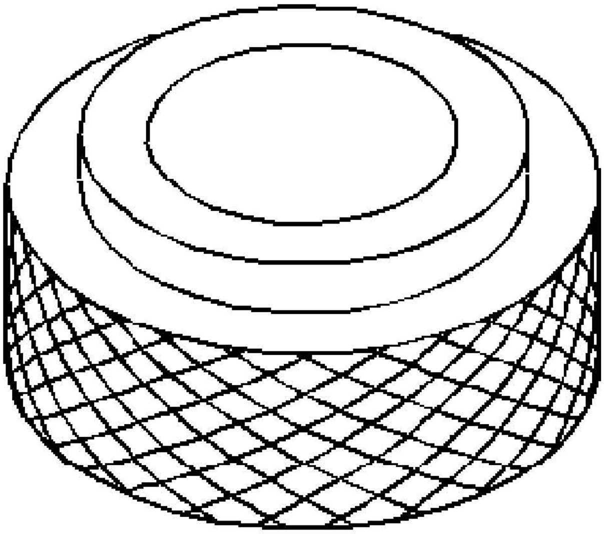
	J 9666 Valve Spring Tester
	J 21867-6 Oil Pressure Adapter Fitting

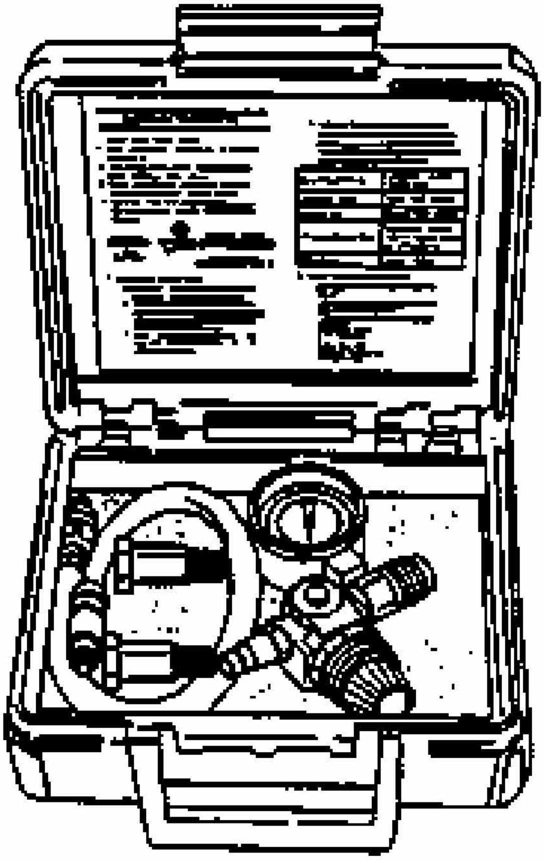
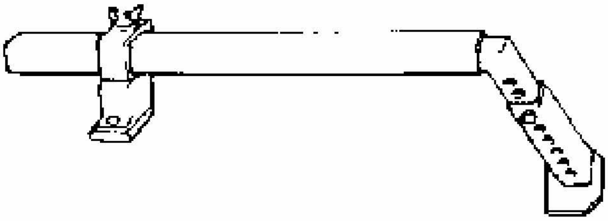
	J 22144 Oil Suction Pipe Installer
	J 22794 Spark Plug Port Adapter
	J 24270 Cylinder Bore Ridge Reamer

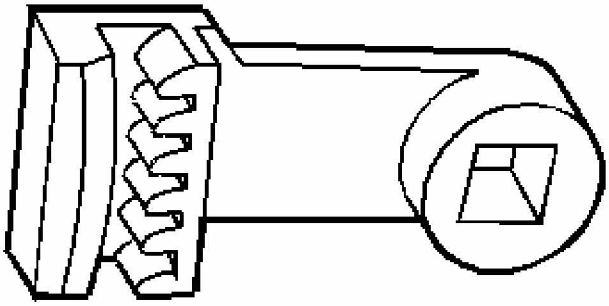
	J 25087-C Oil Pressure Tester and Pump Primer
	J 28428-E High Intensity Black Light Kit

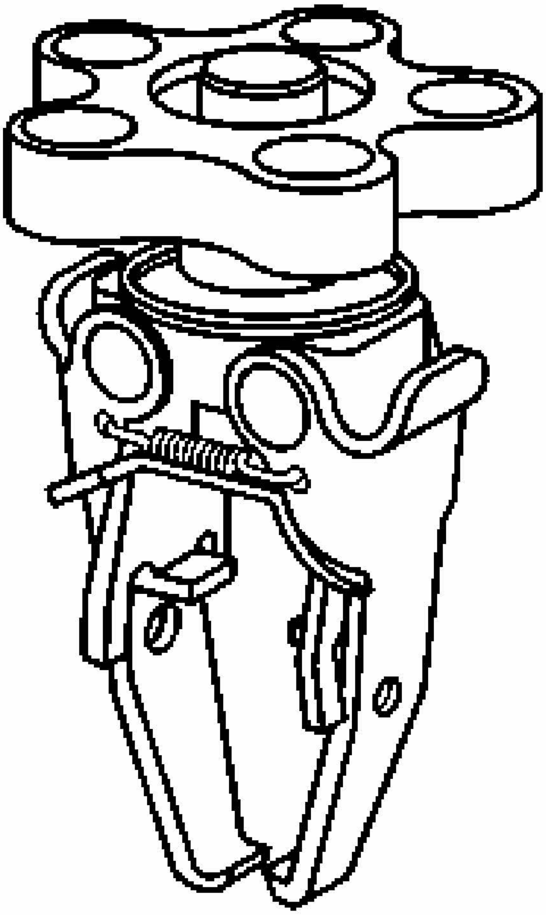
	
	J 28467-B Universal Engine Support Fixture

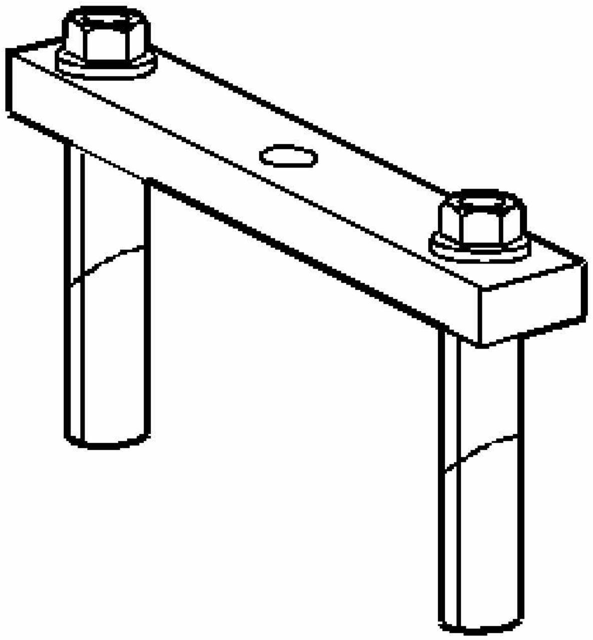
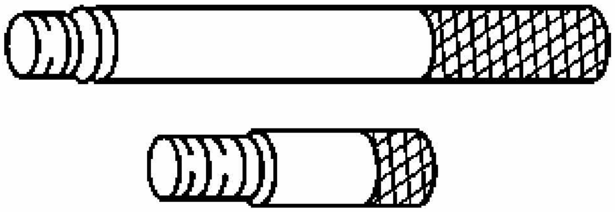
	J 29113 Balancer and Crank Sprocket Puller
	J 33049 Camshaft Bearing Service Set

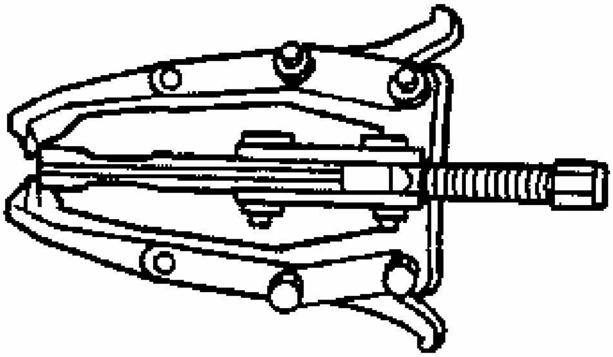
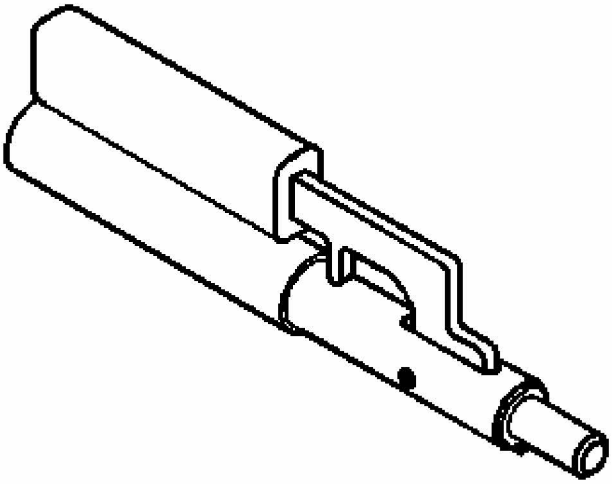
	J 34686 Rear Main Seal Installer
	J 35468 Cover Aligner and Seal Installer

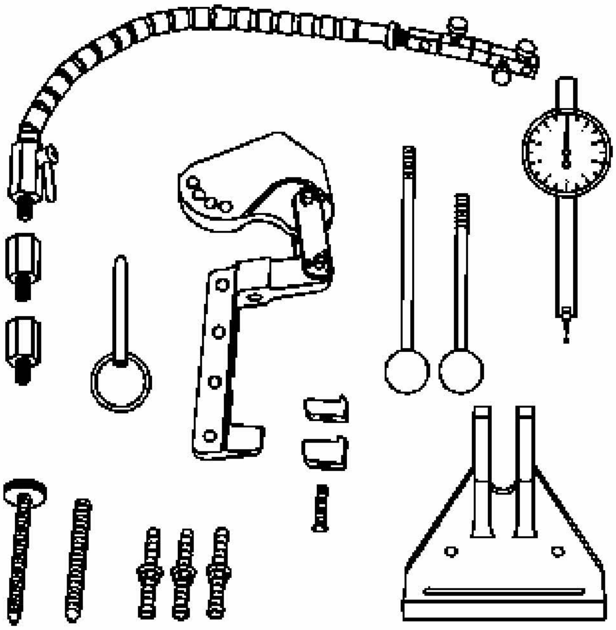
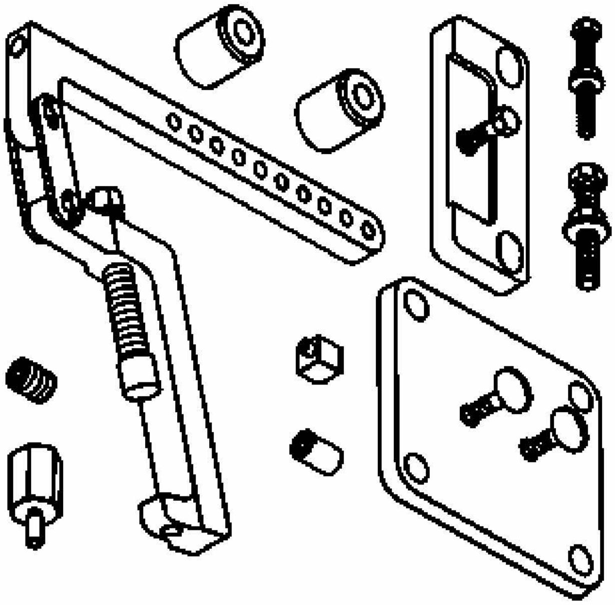
	J 35667-A Cylinder Leakdown Tester
	J 36462 Engine Support Adapter Leg

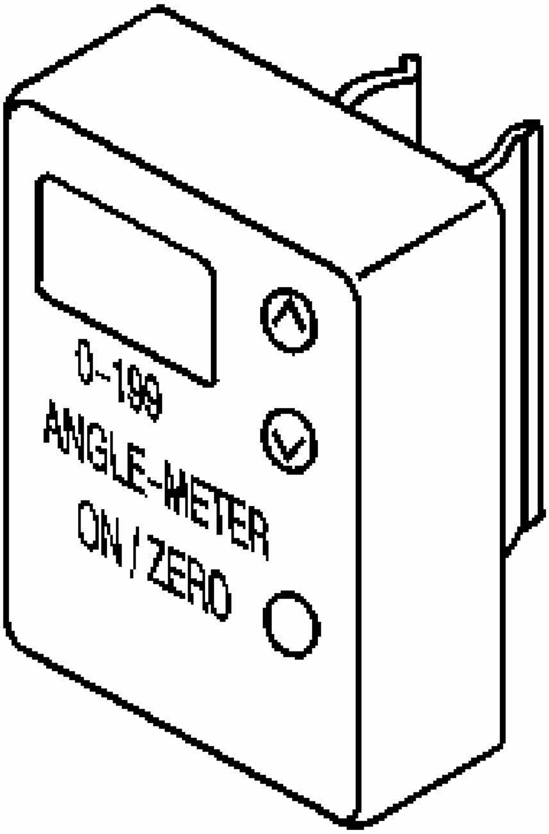
	J 37096 Flywheel Holder
	J 38606 Valve Spring Compressor

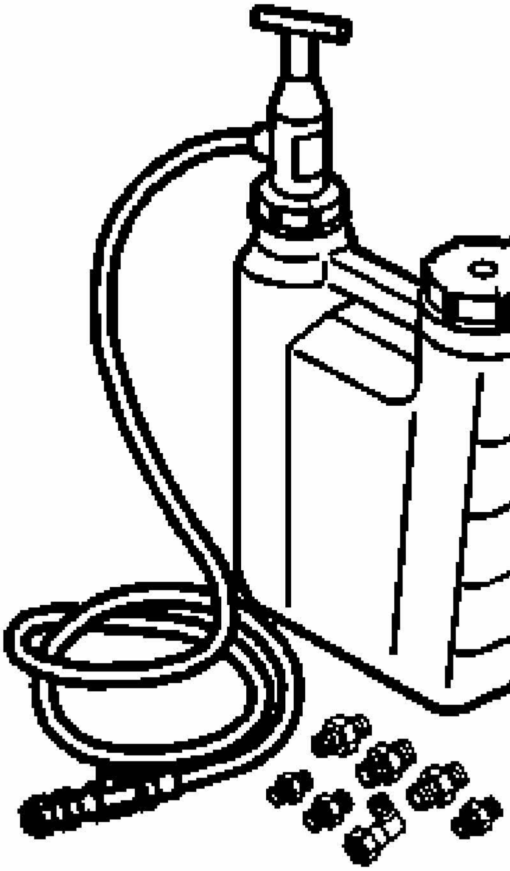
	
	J 39505 Torque Wrench Adapter

	J 41348 Bearing Cap Puller
	J 41556 Connecting Rod Guide

	J 41816 Crankshaft Balancer Remover
	J 43654 Piston Pin Clip Remover and Installer

	J 43690 Rod Bearing Clearance Checking Tool
	J 43690-100 Rod Bearing Clearance Checking Tool - Adapter Kit

 0-199 ANGLE-METER ON / ZERO	J 45059 Angle Meter

	J 45299 Engine Preluber

2006 ENGINE

Engine Mechanical - 3.9L - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
A/C Compressor Bracket Bolt	50 N.m	37 lb ft
Camshaft Position Actuator Assembly Bolt	16 N.m	12 lb ft
Camshaft Position Actuator Magnet Bolt	10 N.m	89 lb in
Camshaft Position Sensor Bolt	10 N.m	89 lb in
Camshaft Thrust Plate Screw	10 N.m	89 lb in
Clutch Pressure Plate Bolt	25 N.m	18 lb ft
Connecting Rod Bearing Cap Bolt		
• First Pass	25 N.m	18 lb ft
• Final Pass	110 degrees	
Coolant Crossover Pipe Bolt - Front	50 N.m	37 lb ft
Coolant Crossover Pipe Bolt - Side	10 N.m	89 lb in
Coolant Drain Plug	19 N.m	14 lb ft
Coolant Temperature Sensor	23 N.m	17 lb ft
Crankshaft Balancer Bolt		
• First Pass	125 N.m	92 lb ft
• Final Pass	130 degrees	
Crankshaft Main Bearing Cap Bolt/Stud		
• First Pass	50 N.m	37 lb ft
• Final Pass	77 degrees	
Crankshaft Oil Deflector Nut	25 N.m	18 lb ft
Crankshaft Position Sensor Stud	11 N.m	98 lb in
Crankshaft Position Sensor Shield Nut	11 N.m	98 lb in
Cylinder Head Bolt		
• First Pass	60 N.m	44 lb ft
• Final Pass	95 degrees	
Drive Belt Idler Pulley Bolt - 13 mm	30 N.m	22 lb ft
Drive Belt Idler Pulley Bolt - 15 mm	50 N.m	37 lb ft

Drive Belt Tensioner Bolt	50 N.m	37 lb ft
Engine Block Heater	50 N.m	37 lb ft
Engine Block Plug	60 N.m	44 lb ft
Engine Front Cover Bolt	25 N.m	18 lb ft
Engine Lift Bracket Bolt -	70 N.m	52 lb ft
Engine Oil Pressure Switch	16 N.m	12 lb ft
Engine Mount Strut and Engine Lift Bracket Bolts	50 N.m	37 lb ft
Engine Mount Support and Strut Bracket Bolts	50 N.m	37 lb ft
Engine Wiring Harness Bracket Bolt	13 N.m	115 lb in
EVAP Purge Valve Bolt	12 N.m	106 lb in
Exhaust Crossover Heat Shield Bolts	10 N.m	89 lb in
Exhaust Crossover Pipe Nuts	25 N.m	18 lb ft
Exhaust Crossover Pipe Studs	25 N.m	18 lb ft
Exhaust Manifold Bolt	20 N.m	15 lb ft
Exhaust Manifold Heat Shield Bolt	10 N.m	89 lb in
Exhaust Manifold Lower Heat Shield Bolt	10 N.m	89 lb in
Flywheel Bolt - Automatic Transmission	70 N.m	52 lb ft
Flywheel Bolt - Manual Transmission		
First Pass	50 N.m	37 lb ft
Final Pass	70 degrees	
Front Oil Gallery Plug	33 N.m	24 lb ft
Fuel Injector Rail Bolt	10 N.m	89 lb in
Heater Inlet Pipe Stud	35 N.m	26 lb ft
Heated Oxygen Sensor	42 N.m	31 lb ft
Heater Inlet and Outlet Pipe Bolt - 10 mm	10 N.m	89 lb in
Heater Inlet and Outlet Pipe Bolt/Nut - 13 mm	25 N.m	18 lb ft
Ignition Coil Bracket Bolt/Nut/Stud	25 N.m	18 lb ft
Knock Sensor	25 N.m	18 lb ft
Lower Intake Manifold Bolt - Center		
• First Pass	7 N.m	62 lb in
• Final Pass	13 N.m	115 lb ft
Lower Intake Manifold Bolt - Corner		
• First Pass	7 N.m	62 lb in
• Final Pass	25 N.m	18 lb ft
Oil Filter Adapter Bolt	25 N.m	18 lb ft
Oil Filter Adapter Heat Shield Nuts	25 N.m	18 lb ft
Oil Filter	30 N.m	22 lb ft

Oil Filter Fitting	39 N.m	29 lb ft
Oil Level Indicator Tube Bolt	25 N.m	18 lb ft
Oil Pan Bolt	25 N.m	18 lb ft
Oil Pan Drain Plug	25 N.m	18 lb ft
Oil Pan Side Bolt	50 N.m	37 lb ft
Oil Pan Support Bracket Bolt	50 N.m	37 lb ft
Oil Pump Cover Bolt	10 N.m	89 lb in
Oil Pump Drive Gear Clamp Bolt	36 N.m	27 lb ft
Oil Pump Mounting Bolt	41 N.m	30 lb ft
Piston Oil Nozzle Bolt	10 N.m	89 lb in
Rear Oil Gallery Plug - 3/8 inch	33 N.m	24 lb ft
Spark Plug	15 N.m	11 lb ft
Throttle Body Bolt/Nut	10 N.m	89 lb in
Throttle Body Stud	6 N.m	53 lb in
Timing Chain Tensioner Bolt	21 N.m	15 lb ft
Upper Intake Manifold Bolt/Stud	25 N.m	18 lb ft
Valve Lifter Guide Bolt	10 N.m	89 lb in
Valve Lifter Oil Manifold Cover Plate Bolt	25 N.m	18 lb ft
Valve Rocker Arm Bolt	34 N.m	25 lb ft
Valve Rocker Arm Cover Bolt	10 N.m	89 lb in
Water Outlet Bolt/Stud	25 N.m	18 lb ft
Water Pump Bolt	10 N.m	89 lb in
Water Pump Pulley Bolt	25 N.m	18 lb ft

ENGINE MECHANICAL SPECIFICATIONS

Engine Mechanical Specifications

Application	Specification	
	Metric	English
General Data		
• Engine Type	60 degree V-6	
• Displacement	3.9L	238 cu in
• RPO	LZ9	
• VIN	1	
• Bore	99 mm	3.90 in
• Stroke	84 mm	3.31 in
• Compression Ratio	9.8:1	

• Firing Order	123456	
• Spark Plug Gap	1.00 mm	0.040 in
Block		
• Camshaft Bearing Bore Diameter - Front and Rear	55.26-55.31 mm	2.175-2.177 in
• Camshaft Bearing Bore Diameter - Middle #2, #3	54.75-54.80 mm	2.155-2.157 in
• Crankshaft Main Bearing Bore Diameter	72.1535-72.0695 mm	2.840-2.841 in
• Crankshaft Main Bearing Bore Out-of-Round	0.008 mm	0.00031 in
• Cylinder Bore Diameter	99.000-99.018 mm	3.897-3.898 in
• Cylinder Bore Out-of-Round - Diameter - Production	0.026 mm	0.0010 in
• Cylinder Bore Out-of-Round - Diameter - Service	0.030 mm	0.0011 in
• Cylinder Bore Taper - Production	0.026 mm	0.0010 in
• Cylinder Bore Taper - Service	0.030 mm	0.0011 in
• Cylinder Head Deck Height	224 mm	8.818 in
• Cylinder Head Deck Surface Flatness	0.05 mm per 150 mm	0.0019 in per 5.905 in
• Valve Lifter Bore Diameter	21.417-21.455 mm	0.843-0.844 in
Camshaft		
• Camshaft Bearing Inside Diameter	51.500-51.525 mm	2.028-2.029 in
• Camshaft Journal Diameter	51.415-51.440 mm	2.024-2.025 in
• Camshaft Journal Out-of-Round	0.025 mm	0.001 in
• Camshaft Lobe Lift - Exhaust	6.9263 mm	0.2727 in
• Camshaft Lobe Lift - Intake	6.9263 mm	0.2727 in
Cooling System		
• Capacity	12.4 liters	13.1 quarts
• Thermostat Full Open Temperature	195 degrees	
Connecting Rod		

• Connecting Rod Bearing Clearance	0.18-0.062 mm	0.0007-0.017 in
• Connecting Rod Bore Diameter	60.322-60.338 mm	2.375-2.376 in
• Connecting Rod Bore Out-of-Round	0.006 mm	0.00023 in
• Connecting Rod Length - Center to Center	150 mm	5.9 in
• Connecting Rod Side Clearance	0.200-0.241 mm	0.008-0.009 in
Crankshaft		
• Connecting Rod Journal Diameter	57.122-57.138 mm	2.248-2.249 in
• Connecting Rod Journal Out-of-Round	0.005 mm	0.0002 in
• Connecting Rod Journal Taper	0.005 mm	0.0002 in
• Connecting Rod Journal Width	21.92-22.08 mm	0.863-0.869 in
• Crankshaft End Play	0.060-0.210 mm	0.0024-0.0083 in
• Crankshaft Main Bearing Journal Width	23.9-24.1 mm	0.941-0.949 in
• Crankshaft Main Bearing Clearance - Except #3	0.019-0.064 mm	0.0008-0.0025 in
• Crankshaft Main Bearing Clearance - #3 Thrust Bearing	0.032-0.077 mm	0.0012-0.0030 in
• Crankshaft Main Journal Diameter	67.239-67.257 mm	2.6473-2.6483 in
• Crankshaft Main Journal Out-of-Round	0.005 mm	0.0002 in
• Crankshaft Main Journal Taper	0.005 mm	0.0002 in
• Crankshaft Rear Flange Runout	0.04 mm	0.0016 in
Cylinder Head		
• Combustion Chamber Depth - at Measurement Point	2.2 mm	0.087 in
• Surface Finish - Maximum	2.8 RA	
• Surface Flatness - Block Deck	0.08 mm Per 152 mm	0.003 in Per 6 in
• Surface Flatness - Exhaust Manifold Deck	0.1 mm	0.004 in
• Surface Flatness - Intake Manifold Deck	0.1 mm	0.004 in
• Valve Guide Bore - Exhaust	8.01 mm	0.315 in
• Valve Guide Bore - Intake	8.01 mm	0.315 in
• Valve Guide Installed Height	16.6 mm	0.654 in
Lubrication System		

• Oil Capacity - with Filter	3.8 liter	4.0 quarts
• Oil Capacity - without Filter	3.3 liter	3.5 quarts
• Oil Pressure - @ 1850 RPM	207-310 kPa	30-45 PSI
Oil Pump		
• Gear Diameter	38.05-38.10 mm	1.498-1.500 in
• Gear Pocket - Depth	30.52-30.58 mm	1.202-1.204 in
• Gear Pocket - Diameter	38.176-38.226 mm	1.503-1.505 in
• Gears Lash	0.094-0.195 mm	0.0037-0.0077 in
• Relief Valve-to-Bore Clearance	0.038-0.089 mm	0.0015-0.0035 in
Piston Ring End Gap		
• First Compression Ring	0.15-0.30 mm	0.006-0.011 in
• Second Compression Ring	0.25-0.45 mm	0.009-0.017 in
• Oil Control Ring	0.15-0.65 mm	0.06-0.025 in
Piston Ring to Groove Clearance		
• First Compression Ring	0.03-0.065 mm	0.001-0.002 in
• Second Compression Ring	0.02-0.055 mm	0.0007-0.002 in
• Oil Control Ring	0.01 mm	0.004 in
Piston Ring Thickness		
• First Compression Ring	1.175-1.190 mm	0.046-0.047 in
• Second Compression Ring	1.475-1.490 mm	0.058 in
• Oil Control Ring - Maximum	2.50 mm	0.098 in
Piston		
• Piston Diameter - production	98.970-99.008 mm	3.896-3.897 in
• Piston Diameter - service limit	98.950 mm	3.895 in
• Piston Pin Bore Diameter	23.957-23.962 mm	0.943 in
• Piston Ring Groove Width	1.22-1.24 mm	0.048-0.049 in
• Piston to Bore Clearance - production	-0.008-0.048 mm	-0.0003-0.0018 in
• Piston to Bore Clearance - service limit - Maximum	0.080 mm	0.003 in
Pin		
• Piston Pin Clearance to Connecting Rod	-0.004--0.021	-0.0001--0.0008

Bore - Press Fit	mm	in
• Piston Pin Clearance to Piston Pin Bore	0.002-0.010 mm	0.00008-0.0004 in
• Piston Pin Diameter	23.952-23.955 mm	0.942-0.943 in
• Piston Pin Length	64.21-64.44 mm	2.57-2.53 in
Valves		
• Valve Face Angle	45 degrees	
• Valve Seat Angle	46 degrees	
• Valve Seat Depth - Intake - from deck face	7.9-8.1 mm	0.311-0.318 in
• Valve Seat Depth - Exhaust - from deck face	8.9-9.1 mm	0.350-0.358 in
• Valve Seat Width - Intake	1.55-1.80 mm	0.061-0.071 in
• Valve Seat Width - Exhaust	1.70-2.0 mm	0.067-0.079 in
• Valve Stem-to-Guide Clearance	0.026-0.068 mm	0.0010-0.0027 in
Valve Lifters/Push Rods		
• Push Rod Length - Intake	146.0 mm	5.75 in
• Push Rod Length - Exhaust	152.5 mm	6.0 in
Valve Springs		
• Valve Spring Free Length	48.5 mm	1.89 in
• Valve Spring Installed Height	43.2 mm	1.701 in
• Valve Spring Load - Closed	320 N 43.2 mm	75 lb 1.701 in
• Valve Spring Load - Open	1036 N 32 mm	230 lb 1.260 in
• Valve Spring Total Number of Coils	6.55	

SEALERS, ADHESIVES, AND LUBRICANTS

Sealers, Adhesives, and Lubricants

Application	Type of Material	GM Part Number	
		United States	Canada
Camshaft Rear Bearing Hole Plug	Sealant	12377901	10953504
Coolant Drain Plug	Sealant	12346004	10953480
Coolant Temperature Sensor Threads	Sealant	12346004	10953480
Crankshaft Balancer Keyway	Sealant	12378521	88901148
Crankshaft Position Sensor Bolt/Stud Threads	Threadlock	12345382	10953489

Engine Block Coolant Drain Plug Threads	Sealant	12346004	10953480
Engine Block Oil Gallery Plug Threads	Sealant	12346004	10953480
Engine Front Cover Bolt Threads	Sealant	12346004	10953480
Engine Front Cover Gasket Lower Tabs	Sealant	12346004	10953480
Engine Oil	5W-30 Oil	12345610	993193
Engine Oil Cooler Fitting Threads	Sealant	12346004	10953480
Engine Oil Supplement	Lubricant	1052367	992869
Intake Manifold Bolt Threads - Upper and Lower	Threadlock	12345382	10953489
Intake Manifold Coolant Pipe	Sealant	12345493	10953488
Intake Manifold to Engine Block Mating Surface	Sealant	12378521	88901148
Intake Manifold Tuning Valve	Lubricant	1051344	993037
Oil Filter Bypass Hole Plug Threads	Sealant	12346004	10953480
Oil Pan Surface at Rear Crankshaft Main Bearing Cap	Sealant	12378521	88901148
Oil Pressure Switch Threads	Sealant	12346004	10953480
Oil Pump Suction Pipe	Sealant	12346004	10953480
Piston and Piston Pin	5W-30 Oil	12345610	993193
Rear Crankshaft Main Bearing Cap	Sealant	1052942	10953466
Throttle Body Stud and Bolts	Threadlock	12345382	10953489
Valve Lifter and Camshaft Prelube	Lubricant	12345501	992704
Valve Lifter Guide Bolt Threads	Threadlock	12345382	10953489
Valve Rocker Arm Cover Notch at Cylinder Head and Lower Intake Manifold	Sealant	12378521	88901148

COMPONENT LOCATOR

DISASSEMBLED VIEWS

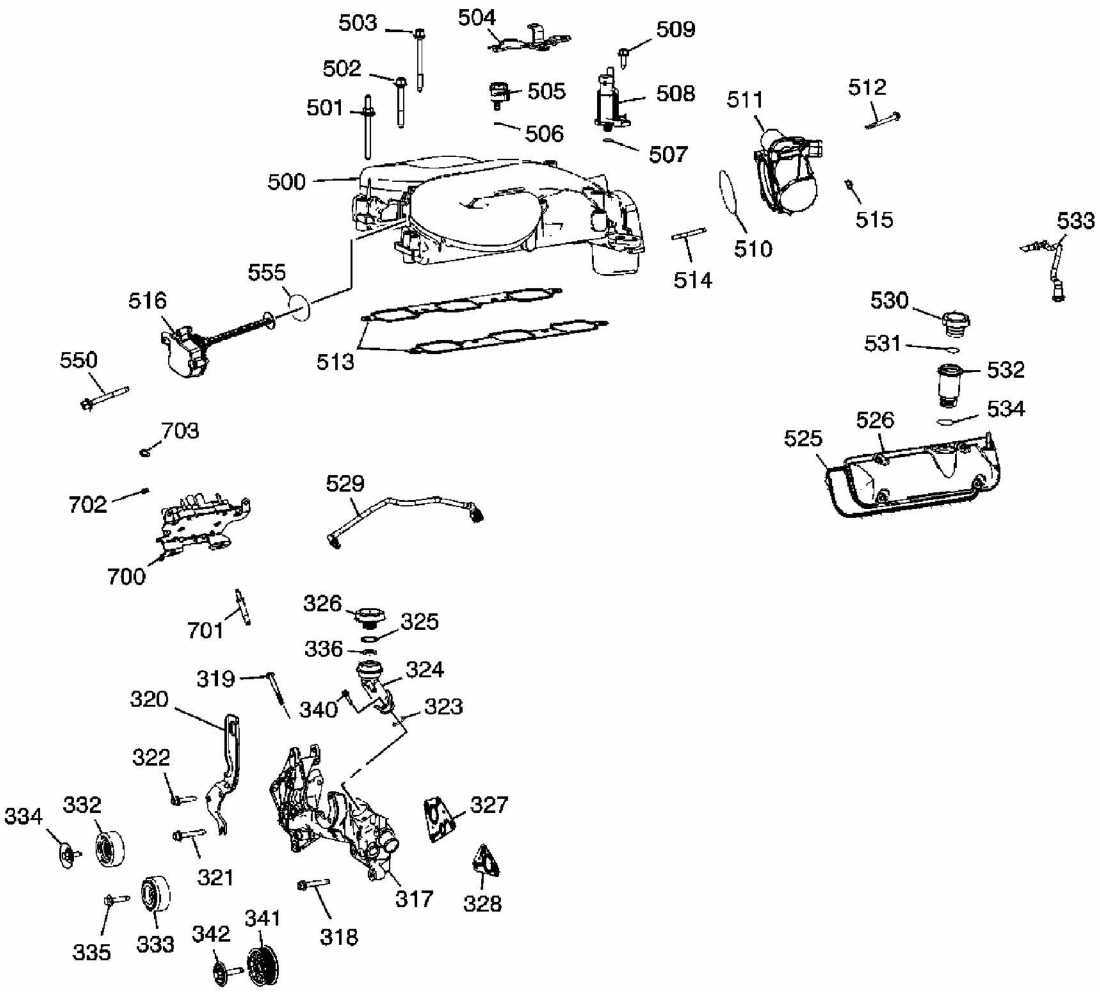

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Fig. 1: Upper Intake Manifold And Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 1

Callout	Component Name
317	Coolant Crossover Pipe
318	Coolant Crossover Pipe Bolt - Small
319	Coolant Crossover Pipe Bolt - Large
320	Engine Lift Bracket - Front
321	Engine Lift Bracket Bolt - Small
322	Engine Lift Bracket Bolt - Large
323	Coolant Fill Adapter Seal
324	Coolant Fill Adapter
325	Coolant Fill Cap Seal - Large
326	Coolant Fill Cap
327	Coolant Crossover Pipe Gasket - Right

328	Coolant Crossover Pipe Gasket - Left
332	Idler Pulley - Upper
333	Idler Pulley - Lower
334	Idler Pulley Bolt - Upper
335	Idler Pulley Bolt - Lower
336	Coolant Fill Cap Seal - Small
340	Coolant Fill Adapter Bolt
341	Idler Pulley
342	Idler Pulley Bolt
500	Upper Intake Manifold
501	Upper Intake Manifold Stud
502	Upper Intake Manifold Bolt - Large
503	Upper Intake Manifold Bolt - Small
504	MAP Sensor Bracket
505	MAP Sensor
506	MAP Sensor Seal
507	EVAP Purge Valve Seal
508	EVAP Purge Valve
509	EVAP Purge Valve Bolt
510	Throttle Body Seal
511	Throttle Body
512	Throttle Body Bolt
513	Upper Intake Manifold Gasket
514	Throttle Body Stud
515	Throttle Body Nut
516	Intake Manifold Tuning Valve
525	Valve Rocker Cover Seal
526	Valve Rocker Cover - LH
529	PCV Tube - Fresh Air
530	Oil Fill Cap
531	Oil Fill Cap Seal
532	Oil Fill Tube
533	PCV Tube - Fool Air
534	Oil Fill Tube Seal
550	Intake Manifold Tuning Valve Bolt
555	Intake Manifold Tuning Valve Seal
700	Ignition Coil Assembly
701	Ignition Coil Assembly Stud

	Ignition Coil Assembly Nut
703	Ignition Coil Assembly Bolt

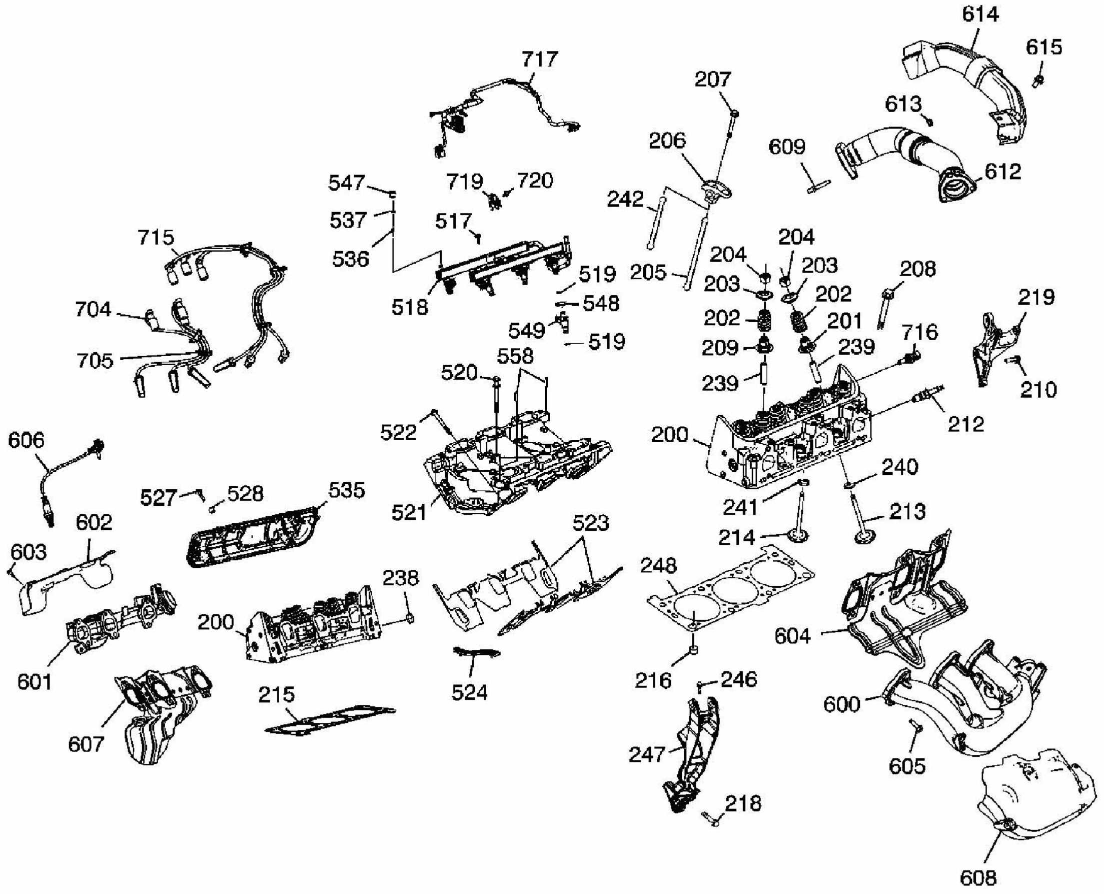
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Fig. 2: Lower Intake Manifold, Cylinder Head, And Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
200	Cylinder Head
201	Valve Seal - Exhaust
202	Valve Spring
203	Valve Spring Cap
204	Valve Stem Key
205	Valve Pushrod - Exhaust
206	Valve Rocker Arm
207	Valve Rocker Arm Bolt
208	Cylinder Head Bolt
209	Valve Seal - Intake

210	Engine Mount Strut Bracket Bolt
212	Spark Plug
213	Exhaust Valve
214	Intake Valve
215	Cylinder Head Gasket - RH
216	Cylinder Head Locating Pin
218	Engine Mount Strut and A/C Compressor Bracket Bolt - Long
219	Engine Mount Strut Bracket
238	Cylinder Head Expansion Plug
239	Valve Guide
240	Valve Seat - Exhaust
241	Valve Seat - Intake
242	Valve Pushrod - Intake
246	Engine Mount Strut and A/C Compressor Bracket Bolt - Short
247	Engine Mount Strut and A/C Compressor Bracket
248	Cylinder Head Gasket - LH
517	Fuel Rail Bolt
518	Fuel Rail
519	Fuel Injector Seal
520	Lower Intake Manifold Bolt - Long
521	Lower Intake Manifold
522	Lower Intake Manifold Bolt - Short
523	Lower Intake Manifold Gasket
524	Lower Intake Manifold Seal
527	Valve Rocker Cover Bolt
528	Valve Rocker Cover Bolt Grommet
535	Valve Rocker Cover - RH
536	Fuel Schrader Valve
537	Fuel Service Port Cap Seal
547	Fuel Service Port Cap
548	Fuel Injector Retaining Clip
549	Fuel Injector
558	Lower Intake Manifold Locating Pin
600	Exhaust Manifold - Left
601	Exhaust Manifold - Right
602	Exhaust Manifold Heat Shield - Right - Upper
603	Exhaust Manifold Heat Shield Bolt
604	Exhaust Manifold Gasket - LH

	Exhaust Manifold Bolt
606	Heated Oxygen Sensor
607	Exhaust Manifold Gasket - RH
608	Exhaust Manifold Heat Shield - Left - Upper
609	Exhaust Crossover Stud
612	Exhaust Crossover
613	Exhaust Crossover Nut
614	Exhaust Crossover Heat Shield
615	Exhaust Crossover Heat Shield Bolt
704	Spark Plug Wire Harness - Front
705	Spark Plug Wire Support Clip
715	Spark Plug Wire Harness - Rear
716	Coolant Temperature Sensor
717	Wiring Harness
719	Wiring Connector Bracket
720	Wiring Connector Bracket Bolt

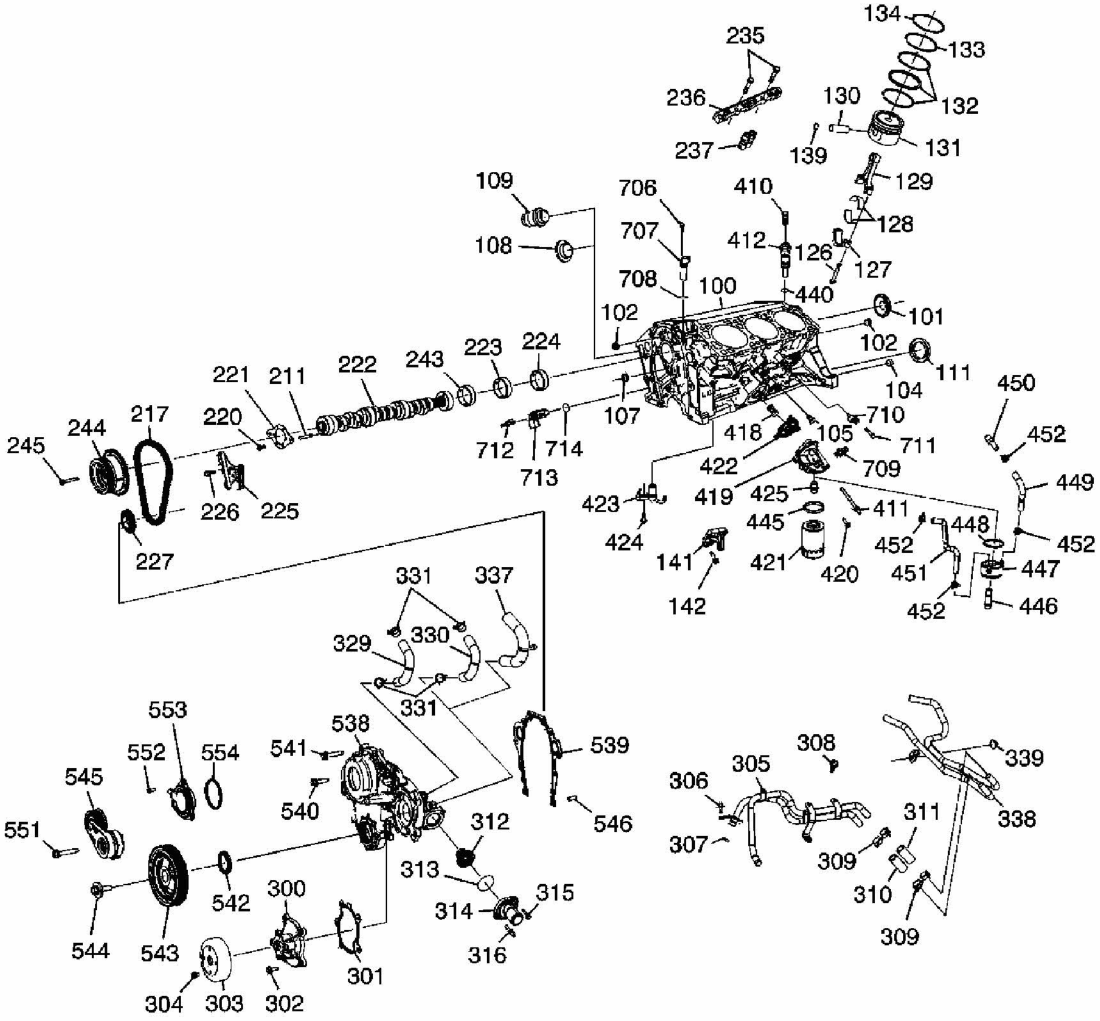
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Fig. 3: Engine Block And Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
100	Engine Block
101	Camshaft Rear Bearing Hole Plug
102	Engine Block Oil Gallery Plug
104	Transmission Locating Pin
105	Engine Block Coolant Drain Hole Plug
107	Engine Block Oil Gallery Plug - Front
108	Engine Block Heater Plug
109	Engine Block Heater
111	Crankshaft Rear Oil Seal
126	Connecting Rod Bearing Cap Bolt
127	Connecting Rod Bearing Cap

128	Connecting Rod Bearing
129	Connecting Rod
130	Piston Pin
131	Piston
132	Piston Ring - Oil Control
133	Piston Ring - Compression - Lower
134	Piston Ring - Compression - Upper
139	Piston Pin Retainer Clip
141	A/C Compressor Bracket
142	A/C Compressor Bracket Bolt
211	Camshaft Position Actuator Filter
217	Timing Chain
220	Camshaft Thrust Plate Bolt
221	Camshaft Thrust Plate
222	Camshaft
223	Camshaft Bearing - 2 and 3
224	Camshaft Bearing - 4
225	Timing Chain Tensioner
226	Timing Chain Tensioner Bolt
227	Crankshaft Sprocket
235	Valve Lifter Guide Bolt
236	Valve Lifter Guide
237	Valve Lifter
243	Camshaft Bearing - 1
244	Camshaft Position Actuator
245	Camshaft Position Actuator Bolt
300	Water Pump
301	Water Pump Gasket
302	Water Pump Bolt
303	Water Pump Pulley
304	Water Pump Pulley Bolt
305	Heater Inlet and Outlet Pipe Assembly - to Coolant Crossover
306	Heater Inlet and Outlet Pipe Assembly Bolt - to Coolant Crossover
307	Heater Inlet and Outlet Pipe Assembly Seal
308	Heater Inlet and Outlet Pipe Assembly Bolt - to Cylinder Head
309	Heater Inlet and Outlet Pipe Assembly Hose Clamp
310	Heater Inlet and Outlet Pipe Assembly Hose - Small
311	Heater Inlet and Outlet Pipe Assembly Hose - Large

	Thermostat
313	Thermostat Seal
314	Thermostat Housing
315	Thermostat Housing Bolt
316	Thermostat Housing Stud
329	Thermal Bypass Hose
330	Thermal Bypass Hose - W/O Oil Cooler
331	Thermal Bypass Hose Clamp
337	Thermal Bypass Hose - W/Oil Cooler
338	Heater Inlet and Outlet Pipe Assembly
339	Heater Inlet and Outlet Pipe Assembly Nut
410	Oil Pump Drive Bolt
411	Oil Filter Adapter Stud
412	Oil Pump Drive
418	Oil Filter Bypass Valve
419	Oil Filter Adapter
420	Oil Filter Adapter Bolt - Small
421	Oil Filter
422	Oil Filter Adapter Gasket
423	Piston Oil Nozzle
424	Piston Oil Nozzle Bolt
425	Oil Filter Fitting
440	Oil Pump Drive Seal
445	Oil Filter Gasket
446	Oil Cooler Connector
447	Oil Cooler Assembly
448	Oil Cooler Assembly Seal
449	Oil Cooler Hose - Inlet
450	Oil Cooler Fitting
451	Oil Cooler Hose - Outlet
452	Oil Cooler Hose Clamp
538	Engine Front Cover
539	Engine Front Cover Gasket
540	Engine Front Cover Bolt - Small
541	Engine Front Cover Bolt - Large
542	Crankshaft Front Oil Seal
543	Crankshaft Balancer
544	Crankshaft Balancer Bolt

	Belt Tensioner
546	Engine Front Cover Locating Pin
551	Belt Tensioner Bolt
552	Camshaft Position Actuator Magnet Bolt
553	Camshaft Position Actuator Magnet
554	Camshaft Position Actuator Magnet Seal
706	Camshaft Sensor Bolt
707	Camshaft Sensor
708	Camshaft Sensor Seal
709	Engine Oil Pressure Sensor
710	Knock Sensor
711	Knock Sensor Bolt
712	Crankshaft Position Sensor Stud
713	Crankshaft Position Sensor
714	Crankshaft Position Sensor Seal

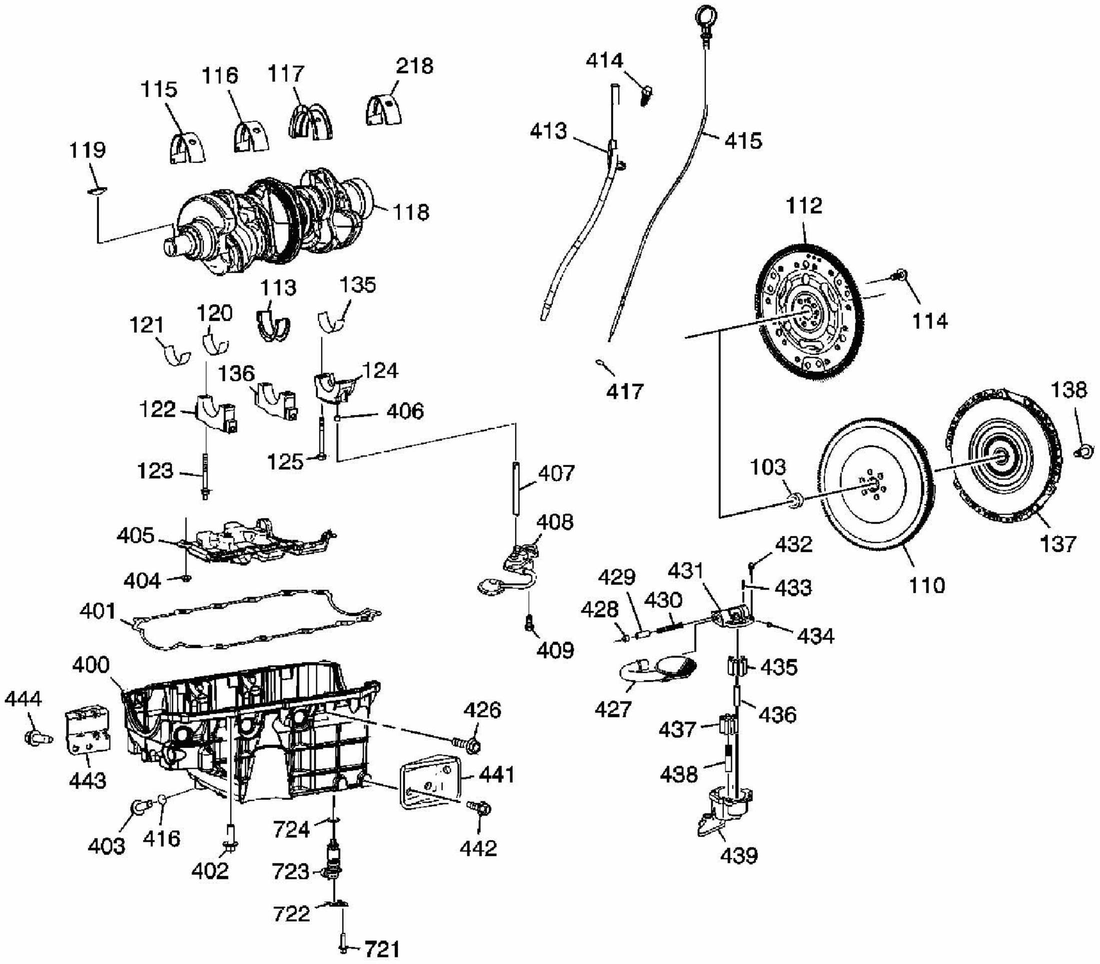
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Fig. 4: Crankshaft And Components

Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
103	Clutch Pilot Bearing
110	Flywheel - Manual
112	Flywheel - Automatic
113	Crankshaft Lower Bearing - 3
114	Flywheel Bolt
115	Crankshaft Upper Bearing - 1
116	Crankshaft Upper Bearing - 2
117	Crankshaft Upper Bearing - 3
118	Crankshaft
119	Crankshaft Balancer Key
120	Crankshaft Lower Bearing - 2
121	Crankshaft Lower Bearing - 1
122	Crankshaft Bearing Cap - 1
123	Crankshaft Bearing Cap Stud
124	Crankshaft Bearing Cap - 4
125	Crankshaft Bearing Cap Bolt
135	Crankshaft Lower Bearing - 4
136	Crankshaft Bearing Cap - 2 and 3
137	Clutch Pressure Plate
138	Clutch Pressure Plate Bolt
218	Crankshaft Upper Bearing - 4
400	Oil Pan
401	Oil Pan Gasket
402	Oil Pan Bolt - to Engine Block
403	Oil Pan Drain Plug
404	Crankshaft Oil Deflector Nut
405	Crankshaft Oil Deflector
406	Oil Pump Locating Pin
407	Oil Pump Shaft
408	Oil Pump
409	Oil Pump Bolt
413	Oil Level Indicator Tube
414	Oil Level Indicator Tube Bolt
415	Oil Level Indicator
416	Oil Pan Drain Plug Seal

417	Oil Level Indicator Seal
426	Oil Pan Bolt - Side of Pan
427	Oil Pump Screen
428	Oil Pump Plug
429	Oil Pump Valve
430	Oil Pump Spring
431	Oil Pump Cover
432	Oil Pump Cover Bolt
433	Oil Pump Pin
434	Oil Pressure Relief Valve Bore Plug
435	Oil Pump Driven Gear
436	Oil Pump Driven Shaft
437	Oil Pump Drive Gear
438	Oil Pump Drive Shaft
439	Oil Pump Housing
441	Oil Pan Support Bracket - LH
442	Oil Pan Support Bracket Bolt - LH
443	Oil Pan Support Bracket - RH
444	Oil Pan Support Bracket Bolt - RH
721	Engine Oil Level Indicator Switch Bolt
722	Engine Oil Level Indicator Switch Clip
723	Engine Oil Level Indicator Switch
724	Engine Oil Level Indicator Seal

ENGINE IDENTIFICATION

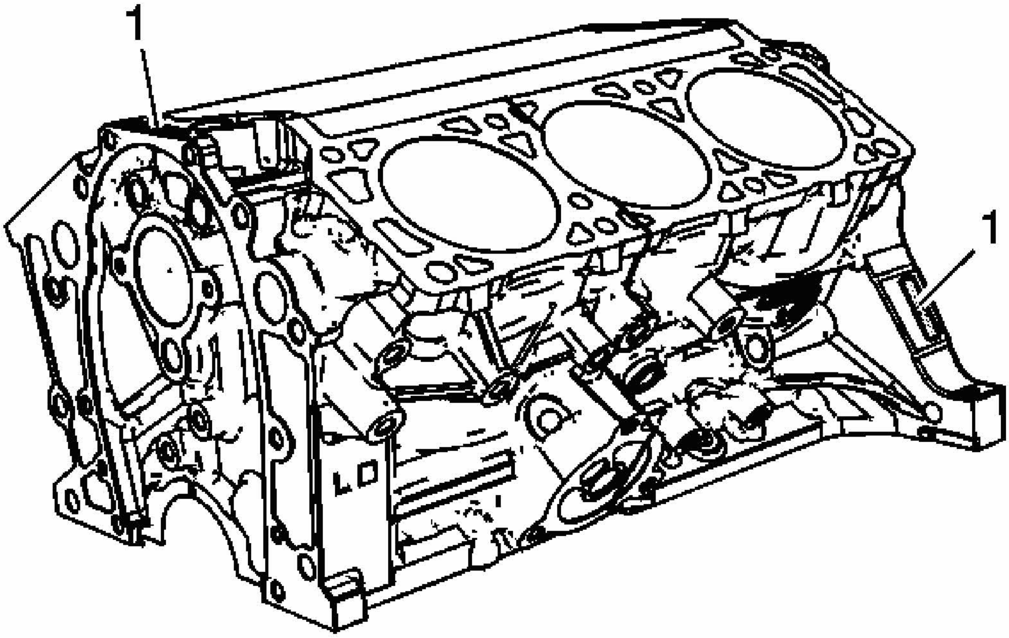


Fig. 5: Locating Vehicle Identification Tags
Courtesy of GENERAL MOTORS CORP.

The Vehicle Identification Number - VIN derivative (1) for 3900 LZ9 is stamped or laser etched on the front and left side of the engine block. The Vehicle Identification Number - VIN derivative is nine digits long and can be used to determine if a vehicle contains the original engine.

- The first digit identifies the division.
- The second digit identifies the model year.
- The third digit identifies the assembly plant.
- The fourth through ninth digits are the last six digits of the Vehicle Identification Number - VIN.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - ENGINE MECHANICAL

Begin the system diagnosis by reviewing the **Disassembled Views**, **Engine Component Description** , **Drive Belt System Description** and **Lubrication Description** in Engine Mechanical. Reviewing the description and operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the description and operation information will also help you determine if the condition described by the customer is normal operation. Refer to **Symptoms - Engine Mechanical** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

SYMPTOMS - ENGINE MECHANICAL

Strategy Based Diagnostics

1. Perform A **DIAGNOSTIC STARTING POINT - ENGINE CONTROLS** in Engine Controls before using the symptom tables - if applicable.
2. Review the system operations in order to familiarize yourself with the system functions. Refer to **Disassembled Views**, **Engine Component Description** , **Drive Belt System Description** and **Lubrication Description** in Engine Mechanical.

All diagnosis on a vehicle should follow a logical process. Strategy based diagnostics is a uniform approach for repairing all systems. The diagnostic flow may always be used in order to resolve a system problem. The diagnostic flow is the place to start when repairs are necessary. For a detailed explanation, refer to **Strategy Based Diagnosis** in General Information.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Engine. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Check for the correct oil level, proper oil viscosity, and correct filter application.
- Verify the exact operating conditions under which the concern exists. Note factors such as engine RPM, ambient temperature, engine temperature, amount of engine warm-up time, and other specifics.
- Compare the engine sounds - if applicable to a known good engine and make sure you are not trying to correct a normal condition.

Intermittent

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating properly.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Base Engine Misfire without Internal Engine Noises**
- **Base Engine Misfire with Abnormal Internal Lower Engine Noises**

- **Base Engine Misfire with Abnormal Valve Train Noise**
- **Base Engine Misfire with Coolant Consumption**
- **Base Engine Misfire with Excessive Oil Consumption**
- **Upper Engine Noise, Regardless of Engine Speed**
- **Lower Engine Noise, Regardless of Engine Speed**
- **Engine Noise Under Load**
- **Engine Will Not Crank - Crankshaft Will Not Rotate**
- **Engine Compression Test**
- **Engine Noise on Start-Up, but Only Lasting a Few Seconds**
- **Oil Consumption Diagnosis**
- **Oil Pressure Diagnosis and Testing**
- **Oil Leak Diagnosis**
- **Drive Belt Chirping Diagnosis**
- **Drive Belt Squeal Diagnosis**
- **Drive Belt Whine Diagnosis**
- **Drive Belt Rumbling Diagnosis**
- **Drive Belt Vibration Diagnosis**
- **Drive Belt Falls Off Diagnosis**
- **Drive Belt Tensioner Diagnosis**
- **Valve Rocker Arm Cover Replacement - Left**

BASE ENGINE MISFIRE WITHOUT INTERNAL ENGINE NOISES

Base Engine Misfire without Internal Engine Noises

Cause	Correction
Engine oil level overfull, causing aeration	Drain excess oil and adjust oil level to proper specification.
Abnormalities - severe cracking, bumps, or missing areas in the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine RPM variations and lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	Replace the drive belt. Refer to **Drive Belt Tensioner Replacement**.
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout may lead to a misfire DTC A misfire code may be present without an	Inspect the components, and repair or replace as required.

actual misfire condition.	
Loose or improperly installed engine flywheel or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer as required. Refer to **Engine Flywheel Replacement** or **Crankshaft Balancer Replacement**.
Restricted exhaust system A severe restriction in the exhaust flow can cause significant loss of engine performance and may set a DTC. Possible causes of restrictions include collapsed or dented pipes or plugged mufflers and/or catalytic converters.	Repair or replace as required.
Improperly installed or damaged vacuum hoses	Repair or replace as required.
Improper sealing between the intake manifold and cylinder heads or throttle body.	Replace the intake manifold, gaskets, cylinder heads, and/or throttle body as required.
Worn or loose rocker arms (The rocker arm bearing end caps and/or needle bearings should be intact and in the proper position.	Replace the valve rocker arms as required.
Worn or bent pushrods	Replace the pushrods.
Stuck valves Carbon buildup on the valve stem can cause the valve not to close properly.	Repair or replace as required.
Excessively worn or out of time timing chain	Replace the timing chain and sprockets as required.
Worn camshaft lobes	Replace the camshaft and valve lifters.
Excessive oil pressure A lubrication system with excessive oil pressure may lead to excessive valve lifter pump-up and loss of compression.	• Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing** . • Repair or replace the oil pump as required.
Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages. Refer to **Diagnostic Starting Point - Engine Cooling** . Coolant consumption may or may not cause the engine to overheat.	• Inspect for spark plugs saturated by coolant. Refer to **Spark Plug Inspection** in Engine Controls. • Inspect the cylinder heads, engine block, and/or head gaskets. • Repair or replace as required.
Worn Piston Rings Oil consumption may or may not cause the	• Inspect the spark plugs for oil

engine to misfire.	deposits. Refer to **Spark Plug Inspection** in Engine Controls. - Inspect the cylinders for a loss of compression. Refer to **Engine Compression Test** . - Perform cylinder leak down and compression testing to identify the cause. - Repair or replace as required.

BASE ENGINE MISFIRE WITH ABNORMAL INTERNAL LOWER ENGINE NOISES

Base Engine Misfire with Abnormal Internal Lower Engine Noises

Cause	Correction
Abnormalities - severe cracking, bumps or missing areas in the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine RPM variations, noises similar to a faulty lower engine and also lead to a misfire condition. A misfire code may be present without an actual misfire condition.	Replace the drive belt. Refer to **Drive Belt Tensioner Replacement**.
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout A misfire code may be present without an actual misfire condition.	Inspect the components, repair or replace as required.
Loose or improperly installed engine flywheel or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer as required. Refer to **Engine Flywheel Replacement** or **Crankshaft Balancer Replacement**.
Worn Piston Rings - Oil consumption may or may not cause the engine to misfire.	- Inspect the spark plugs for oil deposits. Refer to **Spark Plug Inspection** in Engine Controls. - Inspect the cylinders for a loss of compression. Refer to **Engine Compression Test** . - Perform cylinder leak down and compression testing to determine the cause. - Repair or replace as required.

Worn Crankshaft Thrust Bearings Severely worn thrust surfaces on the crankshaft and/or thrust bearing may permit fore and aft movement of the crankshaft and create a DTC without an actual misfire condition.	Replace the crankshaft and bearings as required.

BASE ENGINE MISFIRE WITH ABNORMAL VALVE TRAIN NOISE

Base Engine Misfire with Abnormal Valve Train Noise

Cause	Correction
Engine oil level overfull, causing aeration	Drain excess oil and adjust oil level to proper specification.
Worn or loose rocker arms The rocker arm bearing end caps and/or needle bearings should intact within the rocker arm assembly.	Replace the valve rocker arms as required.
Worn or bent pushrods	Replace the pushrods.
Stuck valves Carbon buildup on the valve stem can cause the valve not to close properly.	Repair or replace as required.
Excessively worn or mis-aligned timing chain	Replace the timing chain and sprockets as required.
Worn camshaft lobes	Replace the camshaft and valve lifters.
Sticking lifters	Replace as required.
Malfunctioning camshaft position actuator. Improper viscosity oil, contaminated oil, or a plugged or missing camshaft position actuator filter can cause the camshaft position actuator locking pin to malfunction.	• Verify correct oil viscosity by changing the engine oil and oil filter and re-evaluating the concern. • Inspect for a missing or plugged camshaft position actuator filter. • If filter is missing, replace the filter, replace the camshaft position actuator, and change the engine oil and oil filter. • If filter is plugged, replace the filter, and change the engine oil and oil filter. • If no problem is found with the camshaft position actuator filter, replace the camshaft position actuator and change the engine oil and oil

	filter.

BASE ENGINE MISFIRE WITH COOLANT CONSUMPTION

Base Engine Misfire with Coolant Consumption

Cause	Correction
Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages. Refer to **Diagnostic Starting Point - Engine Cooling** in Engine Cooling. Coolant consumption may or may not cause the engine to overheat.	• Inspect for spark plugs saturated by coolant. Refer to **Spark Plug Inspection** in Engine Controls. • Perform a cylinder leak down test. • Inspect the cylinder heads and engine block for damage to the coolant passages and/or a faulty head gasket. • Repair or replace as required.

BASE ENGINE MISFIRE WITH EXCESSIVE OIL CONSUMPTION

Base Engine Misfire with Excessive Oil Consumption

Cause	Correction
Worn valves, valve guides and/or valve stem oil seals	• Inspect the spark plugs for oil deposits. Refer to **Spark Plug Inspection** in Engine Controls. • Repair or replace as required.
Worn Piston Rings Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs for oil deposits. Refer to **Spark Plug Inspection** in Engine Controls. • Inspect the cylinders for a loss of compression. Refer to **Engine Compression Test** . • Perform cylinder leak down and compression testing to determine the cause. • Repair or replace as required.

ENGINE NOISE ON START-UP, BUT ONLY LASTING A FEW SECONDS

Engine Noise on Start-Up, but Only Lasting a Few Seconds

Cause	Correction
IMPORTANT: **The camshaft position actuator may make a slight tapping noise upon cold startup. This is due to the viscosity of the oil that has not yet warmed to proper operating temperatures, and should**	

be considered normal for the first 3.5 minutes of cold engine operation.	
Incorrect oil filter without anti-drainback feature	Install the correct oil filter.
Incorrect oil viscosity	1. Drain the oil. 2. Install the correct viscosity oil.
Worn crankshaft thrust bearing	1. Inspect the thrust bearing and crankshaft. 2. Repair or replace as required.
High valve lifter leak down rate	Replace the lifters as required.
Excessive crank/rod bearing clearances	1. Inspect the crankshaft and rod bearings. 2. Repair or replace as required.

UPPER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Upper Engine Noise, Regardless of Engine Speed

Cause	Correction
IMPORTANT: **The camshaft position actuator may make a slight tapping noise upon cold startup. This is due to the viscosity of the oil that has not yet warmed to proper operating temperatures, and should be considered normal for the first 3.5 minutes of cold engine operation.**	
Engine oil level overfull, causing aeration	Drain excess oil and adjust oil level to proper specification.
Low oil pressure	1. Perform an oil pressure test. Refer **Oil Pressure Diagnosis and Testing** . 2. Repair or replace as required.
Loose and/or worn valve rocker arm attachments	1. Inspect the valve rocker arm stud, nut, or bolt. 2. Repair or replace as required.
Worn valve rocker arm	Replace the valve rocker arm.
Bent or damaged push rod	Inspect the following components, and replace as required: • The valve rocker arm • The valve push rod • The valve lifter
Improper lubrication to the valve rocker arms	Inspect the following components, and repair or replace as required:

	• The valve rocker arm • The valve push rod • The valve lifter • The oil filter bypass valve • The oil pump and pump screen • The engine block oil galleries
Broken valve spring	Replace the valve spring.
Worn and/or damaged valve rotators	Replace the valve rotators as required.
Worn or dirty valve lifters	Replace the valve lifters.
Stretched or broken timing chain and/or damaged sprocket teeth	Replace the timing chain and sprockets.
Worn timing chain tensioner (if applicable)	Replace the timing chain tensioners as required.
Worn engine camshaft lobes	1. Inspect the engine camshaft lobes. 2. Replace the camshaft and valve lifters as required.
Damaged, broken, or dirty, balance shaft sprocket teeth (if applicable)	Inspect the following components, and repair as required: • The balance shaft gear • The camshaft gear • The balance shaft rear bushing
Worn valve guides or valve stems	Inspect the following components, and repair as required: • The valves • The valve guides
Stuck Valves (Carbon on the valve stem or valve seat may cause the valve to stay open)	Inspect the following components, and repair as required: • The valves • The valve guides
Malfunctioning camshaft position actuator. Improper viscosity oil, contaminated oil,	• Verify correct oil viscosity by changing the engine oil and oil filter and reevaluating the concern. • Inspect for a missing or plugged camshaft position actuator filter. • If filter is missing, replace the filter, replace the camshaft position

or a plugged or missing camshaft position actuator filter can cause the camshaft position actuator locking pin to malfunction.	actuator, and change the engine oil and oil filter. - If filter is plugged, replace the filter, and change the engine oil and oil filter. - If no problem is found with the camshaft position actuator filter, replace the camshaft position actuator and change the engine oil and oil filter.

LOWER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Lower Engine Noise, Regardless of Engine Speed

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing** . 2. Repair or replace damaged components as required.
Worn accessory drive components Abnormalities such as severe cracking, bumps or missing areas in the accessory drive belt and/or misalignment of system components.	1. Inspect the accessory drive system. 2. Repair or replace as required.
Loose or damaged crankshaft balancer	1. Inspect the crankshaft balancer. 2. Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the knock sensor system. Refer to **Electronic Ignition (EI) System Diagnosis** in Engine Controls.
Loose torque converter bolts	1. Inspect the torque converter bolts and flywheel. 2. Repair or replace as required.
Loose or damaged flywheel	Repair or replace the flywheel.
Damaged oil pan, contacting the oil pump screen An oil pan that has been damaged may improperly position the oil pump screen, preventing proper oil flow to the oil pump.	1. Inspect the oil pan. 2. Inspect the oil pump screen 3. Repair or replace as required.
Oil pump screen loose, damaged or	

restricted	1. Inspect the oil pump screen. 2. Repair or replace as required.
Excessive piston-to-cylinder bore clearance	1. Inspect the piston and cylinder bore. 2. Repair as required.
Excessive piston pin-to-bore clearance	1. Inspect the piston, piston pin, and the connecting rod. 2. Repair or replace as required.
Excessive connecting rod bearing clearance	Inspect the following components, and repair as required: • The connecting rod bearings • The connecting rods • The crankshaft • The crankshaft journals
Excessive crankshaft bearing clearance	Inspect the following components, and repair as required: • The crankshaft bearings • The crankshaft journals
Incorrect piston, piston pin and connecting rod installation Pistons must be installed with the mark or dimple on the top of the piston facing the front of the engine. Piston pins must be centered in the connecting rod pin bore.	1. Verify the pistons, piston pins and connecting rods are installed correctly. 2. Repair as required.

ENGINE NOISE UNDER LOAD

Engine Noise Under Load

Cause	Correction
IMPORTANT: **The camshaft position actuator may make a slight tapping noise upon cold startup. This is due to the viscosity of the oil that has not yet warmed to proper operating temperatures, and should be considered normal for the first 3.5 minutes of cold engine operation.**	
Low oil pressure	1. Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing** . 2. Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the knock sensor system. Refer to **Electronic**

	Ignition (EI) System Diagnosis in Engine Controls.
Loose torque converter bolts	1. Inspect the torque converter bolts and flywheel. 2. Repair as required.
Cracked flywheel - automatic transmission	1. Inspect the flywheel bolts and flywheel. 2. Repair as required.
Excessive connecting rod bearing clearance	Inspect the following components, and repair as required: • The connecting rod bearings • The connecting rods • The crankshaft
Excessive crankshaft bearing clearance	Inspect the following components, and repair as required: • The crankshaft bearings • The crankshaft journals • The cylinder block crankshaft bearing bore
Malfunctioning camshaft position actuator. Improper viscosity oil, contaminated oil, or a plugged or missing camshaft position actuator filter can cause the camshaft position actuator locking pin to malfunction.	• Verify correct oil viscosity by changing the engine oil and oil filter and reevaluating the concern. • Inspect for a missing or plugged camshaft position actuator filter. • If filter is missing, replace the filter, replace the camshaft position actuator, and change the engine oil and oil filter. • If filter is plugged, replace the filter, and change the engine oil and oil filter. • If no problem is found with the camshaft position actuator filter, replace the camshaft position actuator and change the engine oil and oil filter.

ENGINE WILL NOT CRANK - CRANKSHAFT WILL NOT ROTATE

Engine Will Not Crank - Crankshaft Will Not Rotate

Cause	Correction
Seized accessory drive system component	1. Remove accessory drive belt or belts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Hydraulically locked cylinder • Coolant/antifreeze in cylinder • Oil in cylinder • Fuel in cylinder	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket or gaskets. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
Seized automatic transmission torque converter	1. Remove the torque converter bolts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Broken timing chain and/or timing chain gears	1. Inspect timing chain and gears. 2. Repair as required.
Material in cylinder • Broken valve • Piston material • Foreign material	1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
Seized crankshaft or connecting rod bearings	1. Inspect crankshaft and connecting rod bearings. 2. Repair as required.
Bent or broken connecting rod	1. Inspect connecting rods. 2. Repair as required.
Broken crankshaft	1. Inspect crankshaft. 2. Repair as required.

COOLANT IN COMBUSTION CHAMBER

Coolant in Combustion Chamber

Cause	Correction
DEFINITION: Excessive white smoke and/or coolant type odor coming from the exhaust pipe may indicate coolant in the combustion chamber. Low coolant levels, an	

inoperative cooling fan, or a faulty thermostat may lead to an "overtemperature" condition which may cause engine component damage. 1. A slower than normal cranking speed may indicate coolant entering the combustion chamber. Refer to **Engine Will Not Crank - Crankshaft Will Not Rotate** . 2. Remove the spark plugs and inspect for spark plugs saturated by coolant or coolant in the cylinder bore. 3. Inspect by performing a **Cylinder Leakage Test** . During this test, excessive air bubbles within the coolant may indicate a faulty gasket or damaged component. 4. Inspect by performing a cylinder compression test. Two cylinders "side-by-side" on the engine block, with low compression, may indicate a failed cylinder head gasket. Refer to **Engine Compression Test** .	
Cracked intake manifold or failed gasket	Replace the components as required.
Warped cylinder head	Machine the cylinder head to the proper flatness, if applicable and replace the cylinder head gasket. Refer to **Cylinder Head Replacement - Left** or **Cylinder Head Replacement - Right**.
Cracked cylinder head	Replace the cylinder head and gasket.
Cracked cylinder liner or engine block	Replace the components as required.
Cylinder head or engine block porosity	Replace the components as required.

COOLANT IN ENGINE OIL

Coolant in Engine Oil

Cause	Correction
DEFINITION: Foamy or discolored oil or an engine oil "overfill" condition may indicate coolant entering the engine crankcase. Low coolant levels, an inoperative cooling fan, or a faulty thermostat may lead to an "overtemperature" condition which may cause engine component damage. Contaminated engine oil and oil filter should be changed. 1. Inspect the oil for excessive foaming or an overfill condition. Oil diluted by coolant may not properly lubricate the crankshaft bearings and may lead to component damage. Refer to **Lower Engine Noise, Regardless of Engine Speed** . 2. Inspect by performing a **Cylinder Leakage Test** . During this test, excessive air bubbles within the cooling system may indicate a faulty gasket or damaged component. 3. Inspect by performing a cylinder compression test. Two cylinders "side-by-side" on the engine block with low compression may indicate a failed cylinder head	

gasket. Refer to **Engine Compression Test** .	
Faulty external engine oil cooler	Replace the components as required.
Warped cylinder head	Machine the cylinder head to proper flatness, if applicable, and replace the cylinder head gasket. Refer to **Cylinder Head Replacement - Left** or **Cylinder Head Replacement - Right**.
Cracked cylinder head	Replace the cylinder head and gasket.
Cracked cylinder liner or engine block	Replace the components as required.
Cylinder head, or block, porosity	Replace the components as required.

ENGINE COMPRESSION TEST

A compression pressure test of the engine cylinders determines the condition of the rings, the valves, and the head gasket.

IMPORTANT: Remove the Powertrain Control Module (PCM) and the ignition fuses from the I/P fuse block. Refer to Engine Electrical Component Views in Wiring Systems.

1. Disable the ignition.
2. Disable the fuel systems.
3. Remove the spark plugs from all the cylinders.
4. Remove the air duct from the throttle body.
5. Block the throttle plate in the open position.
6. Measure the engine compression, using the following procedure:
    1. Firmly install the compression gauge to the spark plug hole.
    2. Have an assistant crank the engine through at least 4 compression strokes in the testing cylinder.
    3. Record the readings on the gauge at each stroke.
    4. Disconnect the gauge.
    5. Repeat the compression test for each cylinder.
7. Record the compression readings from all of the cylinders using **J 38722** .
    - The lowest reading should not be less than 70 percent of the highest reading.
    - No cylinder reading should be less than 689 kPa (100 psi).
8. The following list contains examples of the possible measurements:
    - When the compression measurement is normal, the compression builds up quickly and evenly to the specified compression on each cylinder.
    - When the compression is low on the first stroke and tends to build up on the

following strokes, but does not reach the normal compression, the piston rings may be the cause.

- If the compression improves considerably with the addition of three squirts of oil, the piston rings may be the cause.
- When the compression is low on the first stroke and does not build up in the following strokes, the valves may be the cause.
- The addition of oil does not affect the compression, the valves may be the cause.
- When the compression is low on two adjacent cylinders, or coolant is present in the crankcase, the head gasket may be the cause.

9. Remove the block from the throttle plate.
10. Install the air duct to the throttle body.
11. Install the spark plugs.
12. Install the Powertrain Control Module (PCM) fuse.
13. Install the ignition fuse to the I/P fuse block.

CYLINDER LEAKAGE TEST

Tools Required

J 35667-A Cylinder Leakdown Tester

With the use of air pressure, a cylinder leakage test will aid in the diagnosis. Use the cylinder leakage test in conjunction with the engine compression test in order to isolate the cause of leaking cylinders.

CAUTION: Refer to BATTERY DISCONNECT CAUTION in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Remove the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls.
3. Install the **J 35667-A** .
4. Measure each cylinder on the compression stroke, with both valves closed.

IMPORTANT: Hold the crankshaft balancer bolt in order to prevent piston movement.

5. Apply air pressure, using the **J 35667-A** . Refer to the manufacturer's instructions.
6. Record the cylinder leakage readings for each cylinder.

IMPORTANT:

- **Normal cylinder leakage is from 12 to 18 percent.**
- **Make a note of any cylinder with more leakage than**

the other cylinders.
- **Any cylinder with 30 percent leakage or more requires service.**

7. Inspect the 4 primary areas in order to properly diagnose a leaking cylinder.
8. If air is heard from the intake or exhaust system, perform the following procedure:
   - Remove the valve rocker arm cover of the suspect cylinder head.
     - Ensure that both valves are closed.
     - Inspect the cylinder head for a broken valve spring.
   - Remove and inspect the suspect cylinder head. Refer to **Cylinder Head Cleaning and Inspection** .
9. If air is heard from the crankcase system at the crankcase - oil filler tube, perform the following procedure:
   1. Remove the piston from the suspect cylinder.
   2. Inspect the piston and connecting rod assembly. Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** .
   3. Inspect the engine block. Refer to **Engine Block Cleaning and Inspection** .
10. If bubbles are found in the radiator, perform the following procedure:
    - Remove and inspect both cylinder heads. Refer to **Cylinder Head Cleaning and Inspection** .
    - Inspect the engine block. Refer to **Engine Block Cleaning and Inspection** .
11. Remove the **J 35667-A** .
12. Install the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls.
13. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** in Engine Electrical.

OIL CONSUMPTION DIAGNOSIS

An engine that has excessive oil consumption uses 0.9 L (1 qt) of oil, or more, within 3 200 km (2,000 mi). The following list indicates the conditions and corrections of excessive oil consumption:

- An improperly read oil level indicator dipstick
  - Inspect the oil level while the vehicle is parked on a level surface.
  - Allow adequate drain-down time.
- Improper oil viscosity

  Use the recommended SAE viscosity for prevailing temperatures.

- Continuous high-speed driving
- Severe hauling, such as a trailer. This causes decreased oil mileage.
- A malfunctioning crankcase ventilation system
- External oil leaks
    - Tighten the bolts, as needed.
    - Replace the gaskets and seals, as needed.
- Worn or omitted valve guides and/or valve stem seals
    - Ream the guides.
    - Install oversized service valves and/or new valve stem seals.
- Broken or worn piston rings
- Improperly installed or unseated piston rings
- Improperly installed or improperly fitted piston
- Plugged cylinder head gasket oil drain holes
- Damaged intake gaskets

OIL PRESSURE DIAGNOSIS AND TESTING

Low or No Oil Pressure

The following conditions may cause low or no oil pressure:

- Low oil level

  Fill to the full mark on the oil level indicator.

- Incorrect or malfunctioning oil pressure switch

  Replace the oil pressure switch.

- Incorrect or malfunctioning oil pressure gauge

  Replace the oil pressure gauge.

- Improper oil viscosity or diluted oil
    - Install oil of proper viscosity for expected temperature.
    - Install new oil if the oil is diluted.
- A worn or dirty oil pump

  Clean or replace the oil pump.

- A plugged oil filter

Replace the oil filter.

- A loose or plugged oil pickup screen

  Replace the oil pickup screen.

- A hole in the oil pickup tube

  Replace the oil pickup tube.

- Excessive rod, main, or cam bearing clearance

  Replace the bearings.

- Cracked, porous, or plugged oil gallery

  Repair or replace the engine block.

- Missing or improperly installed gallery plugs

  Install or repair the plugs as needed.

- A stuck pressure regulator valve
  - Inspect the pressure regulator valve for sticking in the bore.
  - Inspect the bore for scoring and burrs.
- A worn or poorly machined camshaft

  Replace the camshaft.

- Worn valve guides

  Repair the valve guides as needed.

Oil Pressure Testing

Tools Required

- **J-21867-6** Oil Pressure Adapter Fitting
- **J 25087-C** Oil Pressure Tester

If the vehicle has low oil pressure complete the following steps:

1. Inspect the oil level.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

3. Remove the oil filter.
4. Assemble the plunger valve in the large hole of the **J 25087-C** base. Insert the hose in the small hole of the **J 25087-C** base. Connect the gauge to the end of the hose.
5. Insert the flat side of the rubber plug in the bypass valve without depressing the bypass valve.
6. Install the **J 25087-C** and **J-21867-6** on the filter mounting pad.
7. Start the engine.
8. Inspect the overall oil pressure, the oil pressure switch, and for noisy lifters. Ensure that the engine is at operating temperature before inspecting the oil pressure. The oil pressure should be approximately 414 kPa (60 psi) at 1,850 RPM using 5W-30 engine oil.
9. If adequate oil pressure is indicated, test the oil pressure switch.
10. If a low reading is indicated, press the valve on the tester base in order to isolate the oil pump and/or its components from the lubricating system. An adequate reading at this time indicates a good pump and the previous low pressure was due to worn bearings, etc. A low reading while pressing the valve indicates a faulty pump.

OIL LEAK DIAGNOSIS

Tools Required

J 28428-E High Intensity Black Light Kit

You may repair most fluid leaks by first visually locating the leak, repairing or replacing the component, or by resealing the gasket surface. Once the leak is identified, determine the cause of the leak. Repair the leak and the cause of leak.

Locating and Identifying the Leak

Use the visual inspection method in order to determine if the leaking fluid is one of the following items:

- Engine oil
- Transmission fluid
- Power steering fluid
- Brake fluid
- Some other fluid

Visual Inspection Method

Complete the following steps in order to perform the visual inspection method:

1. Bring the vehicle to normal operating temperature.

2. Park the vehicle over a large sheet of paper, or other clean surface.
3. Wait several minutes, then inspect for dripping fluids.
4. Identify the type of fluid, and the approximate location of the leak.
5. Visually inspect the suspected area. Use a small mirror if necessary.
6. Inspect for leaks at sealing surfaces, fittings, or from cracked or damaged components.
7. If you cannot locate the leak, perform the following steps:
   1. Completely clean the entire engine and surrounding components.
   2. Operate the vehicle for several miles at normal operation temperature and at varying speeds.
   3. Park the vehicle over a large sheet of paper, or other clean surface.
   4. Wait several minutes, then inspect for dripping fluids.
   5. Identify the type of fluid, and the approximate location of the leak.
   6. Visually inspect the suspected area. Use a small mirror if necessary.
8. If you still cannot locate the leak, use the powder method or the black light and dye method.

Powder Method

1. Completely clean the entire engine and surrounding components.
2. Apply an aerosol-type powder, baby powder, foot powder, etc., to the suspected area.
3. Operate the vehicle for several miles at normal operation temperature and at varying speeds.
4. Identify the type of fluid, and the approximate location of the leak, from the discolorations in the powder surface.
5. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas.

   Refer to **Possible Causes for Leaks** if necessary.

Black Light and Dye Method

A dye and light kit is available for finding leaks.

1. Use the **J 28428-E** or the equivalent. Refer to the manufacturer's instructions when using the tool.
2. Visually inspect the suspected area. Use a small mirror if necessary

   Refer to **Possible Causes for Leaks** if necessary.

Possible Causes for Leaks

Inspect the vehicle for the following conditions:

- Higher than recommended fluid levels
- Higher than recommended fluid pressures
- Plugged or malfunctioning fluid filters or pressure bypass valves
- Plugged or malfunctioning engine ventilation system
- Improperly tightened or damaged fasteners
- Cracked or porous components
- Improper sealants or gaskets where required
- Improper sealant or gasket installation
- Damaged or worn gaskets or seals
- Damaged or worn sealing surfaces

CRANKCASE VENTILATION SYSTEM INSPECTION/DIAGNOSIS

Crankcase Ventilation System Inspection/Diagnosis

Symptom	Correction
External oil leak	Inspect for any of the following conditions: • Restricted or kinked positive crankcase ventilation (PCV) hose or engine vent hose • Damaged, incorrect, or incorrectly installed PCV hose • Excessive crankcase pressure
Rough idle	Inspect for any of the following conditions: • Restricted or kinked PCV hose or engine vent hose • Leaking (damaged) PCV hose • Vacuum hoses worn or not properly installed
Stalling or low idle speed	Inspect for any of the following conditions: • Restricted or kinked engine vent hose • Leaking (damaged) PCV hose
High idle speed	Inspect for a leaking (damaged) PCV hose
Sludge in the engine	Inspect for restricted or kinked PCV hose or engine vent hose

DRIVE BELT CHIRPING DIAGNOSIS

Drive Belt Chirping Diagnosis

Step	Action	Yes	No
DEFINITION: The following items are indications of chirping: • A high pitched noise that is heard once per revolution of the drive belt or a pulley • It usually occurs on cold damp mornings • Verify the condition by spraying water on the belt. The noise should stop momentarily.			
1	Check for misalignment of the pulleys. Are any of the pulleys misaligned?	Go to **Step 2**	Go to **Step 3**
2	Replace any misaligned pulleys. Is the chirp still present?	Go to **Step 3**	System OK
3	Check for bent or cracked brackets. Are there any bent or cracked brackets?	Go to **Step 4**	Go to **Step 5**
4	Replace any bent or cracked brackets. Is the chirp still present?	Go to **Step 5**	System OK
5	Check for any loose or missing fasteners. Are there any loose or missing fasteners?	Go to **Step 6**	Go to **Step 7**
6	1. Tighten any loose fasteners. 2. Replace any missing fasteners. Refer to **Fasteners** . Is the chirp still present?	Go to **Step 7**	System OK
7	Check for a bent pulley flange. Is there a bent pulley flange?	Go to **Step 8**	Go to **Step 9**
8	Replace the pulley. Is the chirp still present?	Go to **Step 9**	System OK
9	Check for severe pilling, exceeding 1/3 of the belt groove depth. Is there severe pilling?	Go to **Step 10**	-
10	Replace the drive belt. Refer to **Drive Belt Replacement**. Is the repair complete?	-	System OK

DRIVE BELT SQUEAL DIAGNOSIS

Drive Belt Squeal Diagnosis

Step	Action	Yes	No
DEFINITION: The following items are indications of squeal: • A loud screeching noise that is caused by a slipping drive belt-This is unusual for a drive belt with multiple ribs.			

• The noise occurs when a heavy load is applied to the drive belt, such as an air conditioning compressor engagement snapping the throttle, or slipping on a seized pulley.			
1	Check for a misaligned pulley. Is there a pulley misaligned?	Go to **Step 3**	Go to **Step 2**
2	Check for correct drive belt length. Is the drive belt the correct length?	Go to **Step 4**	Go to **Step 5**
3	Repair or replace with new parts as necessary. Is the repair complete?	System OK	-
4	Check the drive belt tensioner for proper operation. Is the drive belt tensioner operating correctly?	Go to **Step 3**	Go to **Step 5**
5	Check for correct pulley size. Are the pulleys the correct size?	Go to **Step 6**	Go to **Step 3**
6	Check for seized bearings. Is there a seized bearing?	Go to **Step 3**	System OK

DRIVE BELT WHINE DIAGNOSIS

Drive Belt Whine Diagnosis

Step	Action	Yes	No
DEFINITION: A high pitched continuous noise that may be caused by a failed bearing			
1	Check for a worn accessory component bearing. Is a bearing making the noise?	Go to **Step 2**	System OK
2	Install new part as necessary. Is the repair complete?	System OK	-

DRIVE BELT RUMBLING DIAGNOSIS

Drive Belt Rumbling Diagnosis

Step	Action	Yes	No
DEFINITION: • A low pitch tapping noise caused by drive belt misalignment • This noise occurs on cold start-up at idle. • A low frequency noise heard once per revolution of the drive belt			
1	Check for severe pilling. Is there severe pilling of more than 1/3 of the rib depth?	Go to **Step 2**	System OK

2	Clean the drive belt pulleys. Is the repair complete?	System OK	Go to **Step 3**
3	Install a new drive belt. Refer to **Drive Belt Replacement**. Is the repair complete?	System OK	-

DRIVE BELT VIBRATION DIAGNOSIS

Drive Belt Vibration Diagnosis

Step	Action	Yes	No
1	1. Remove the drive belt. 2. Inspect the drive belt tensioner pulley. Is the drive belt tensioner pulley loose or misaligned?	Go to **Step 4**	Go to **Step 2**
2	Rotate the drive belt tensioner. Does the tensioner rotate without any unusual resistance or binding?	Go to **Step 3**	Go to **Step 4**
3	1. Use a torque wrench in order to measure the torque required to move the tensioner off of the stop. 2. Use a torque wrench on a known good tensioner in order to measure the torque required to move the tensioner off of the stop. Is the first torque reading within 10 percent of the second torque reading?	System OK	Go to **Step 4**
4	Replace the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**. Is the repair complete?	System OK	-

DRIVE BELT FALLS OFF DIAGNOSIS

Diagnostic Aids

- If the drive belts repeatedly fall off the drive belt pulleys, this is because of pulley misalignment.
- An extra load that is quickly applied on released by an accessory drive component may cause the drive belt to fall off the pulleys. Verify the accessory drive components operate properly.
- If the drive belt is the incorrect length, the drive belt tensioner may not keep the proper

tension on the drive belt.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This inspection is to verify the condition of the drive belt. Damage to the belt may have occurred when it came off of the pulleys. The drive belt may have been damaged, which caused the drive belt to fall off. Inspect the belt for cuts, tears, sections of ribs missing, or damaged belt plys.

4: Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley, or the pulley bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across 2 or 3 pulleys. If a misaligned pulley is found, refer to that accessory drive component for the proper installation procedure for that pulley.

5: Inspecting the pulleys for being bent should include inspecting for a dent or other damage to the pulleys that would prevent the drive belt from not seating properly in all of the pulley grooves or on the smooth surface of a pulley when the back side of the belt is used to drive the pulley.

6: Accessory drive component brackets that are bent or cracked will let the drive belt fall off.

7: Inspecting of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer, or washer was installed. Missing, loose, or the wrong fasteners may cause pulley misalignment from the bracket moving under load. Over tightening of the fasteners may cause misalignment of the accessory component bracket.

Drive Belt Falls Off Diagnosis

Step	Action	Yes	No
NOTE: Refer to Belt Dressing Notice . DEFINITION: The drive belt falls off the pulleys or may not ride correctly on the pulleys.			
1	Did you review the Symptoms - Engine Mechanical operation and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Mechanical**
2	Inspect for a damaged drive belt. Did you find the condition?	Go to **Step 3**	Go to **Step 4**
3	Install a new drive belt. Refer to **Drive Belt Replacement**.		

	Does the drive belt continue to fall off?	Go to **Step 4**	System OK
4	Inspect for misalignment of the pulleys. Did you find and repair the condition?	Go to **Step 12**	Go to **Step 5**
5	Inspect for a bent or dented pulley. Did you find and repair the condition?	Go to **Step 12**	Go to **Step 6**
6	Inspect for a bent or a cracked bracket. Did you find and repair the condition?	Go to **Step 12**	Go to **Step 7**
7	Inspect for improper, loose, or missing fasteners. Did you find loose or missing fasteners?	Go to **Step 8**	Go to **Step 9**
8	1. Tighten any loose fasteners. 2. Replace improper or missing fasteners. Refer to **Fasteners** in General Information. Does the drive belt continue to fall off?	Go to **Step 9**	System OK
9	Test the drive belt tensioner for operating correctly. Refer to **Drive Belt Tensioner Diagnosis**. Does the drive belt tensioner operate correctly?	Go to **Step 11**	Go to **Step 10**
10	Replace the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**. Does the drive belt continue to fall off?	Go to **Step 11**	System OK
11	Inspect for failed drive belt idler and drive belt tensioner pulley bearings. Did you find and repair the condition?	Go to **Step 12**	Go to Diagnostic Aids
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

DRIVE BELT EXCESSIVE WEAR DIAGNOSIS

Diagnostic Aids

Excessive wear on a drive belt is usually caused by an incorrect installation or the wrong drive belt for the application.

Minor misalignment of the drive belt pulleys will not cause excessive wear, but will probably cause the drive belt to make a noise or to fall off.

Excessive misalignment of the drive belt pulleys will cause excessive wear but may also make the drive belt fall off.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: The inspection is to verify the drive belt is correctly installed on all of the drive belt pulleys. Wear on the drive belt may be caused by mispositioning the drive belt by one groove on a pulley.

3: The installation of a drive belt that is too wide or too narrow will cause wear on the drive belt. The drive belt ribs should match all of the grooves on all of the pulleys.

4: This inspection is to verify the drive belt is not contacting any parts of the engine or body while the engine is operating. There should be sufficient clearance when the drive belt accessory drive components load varies. The drive belt should not come in contact with an engine or a body component when snapping the throttle.

Drive Belt Excessive Wear Diagnosis

Step	Action	Yes	No
NOTE: **Refer to Belt Dressing Notice .** DEFINITION: Wear at the outside ribs of the drive belt due to an incorrectly installed drive belt.			
1	Did you review the Symptoms - Engine Mechanical operation and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Mechanical**
2	Inspect the drive belt for the proper installation. Refer to **Drive Belt Replacement**. Did you find this condition?	Go to **Step 5**	Go to **Step 3**
3	Inspect for the proper drive belt. Did you find this condition?	Go to **Step 5**	Go to **Step 4**
4	Inspect for the drive belt rubbing against a bracket, hose, or wiring harness. Did you find and repair the condition?	Go to **Step 6**	Go to Diagnostic Aids
5	Replace the drive belt. Refer to **Drive Belt Replacement**. Did you complete the replacement?	Go to **Step 6**	-
6	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

DRIVE BELT TENSIONER DIAGNOSIS

Drive Belt Tensioner Diagnosis

Step	Action	Yes	No
1	1. Remove the drive belt. 2. Inspect the drive belt tensioner pulley. Is the drive belt tensioner pulley loose or misaligned?	Go to **Step 4**	Go to **Step 2**
2	Rotate the drive belt tensioner. Does the tensioner rotate without any unusual resistance or binding?	Go to **Step 3**	Go to **Step 4**
3	1. Use a torque wrench in order to measure the torque required to move the tensioner off of the stop. 2. Use a torque wrench on a known good tensioner in order to measure the torque required to move the tensioner off of the stop. Is the first torque reading within 10 percent of the second torque reading?	System OK	Go to **Step 4**
4	Replace the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**. Is the repair complete?	System OK	-

REPAIR INSTRUCTIONS

INTAKE MANIFOLD COVER REPLACEMENT

Removal Procedure

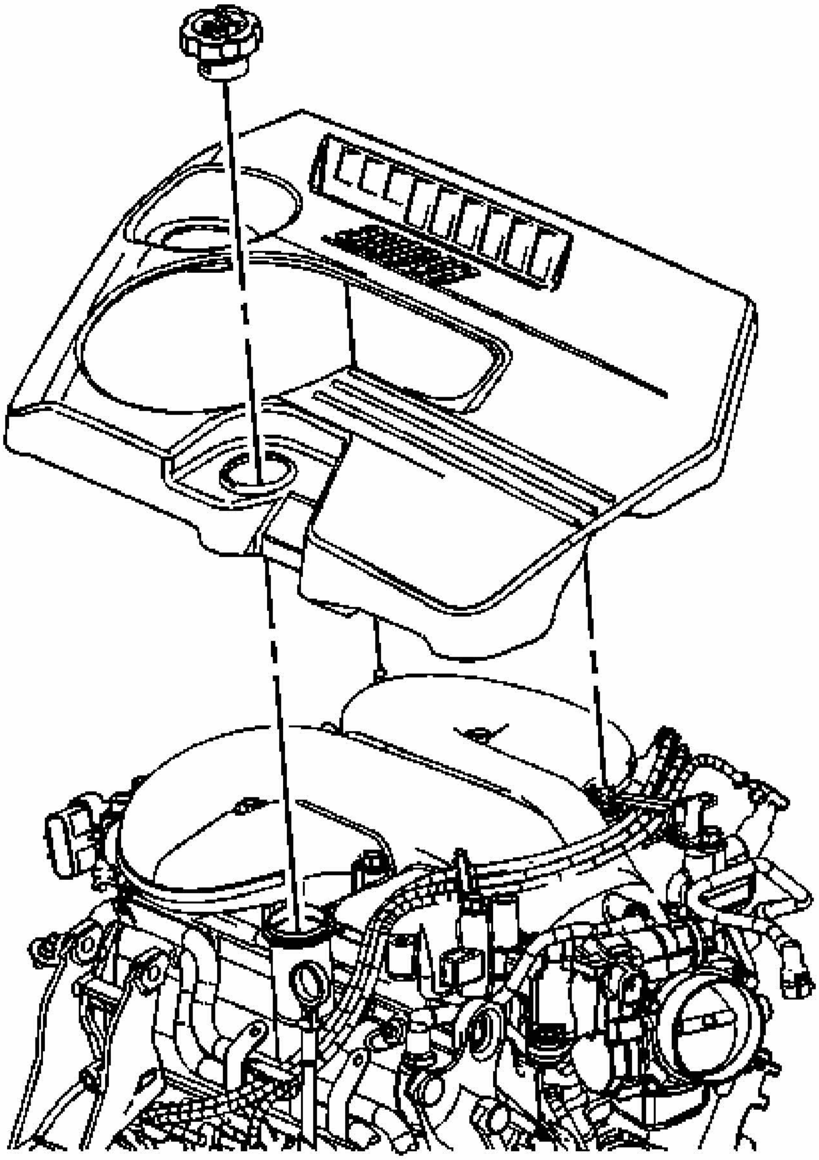


Fig. 6: View Of Engine Oil Fill Cap
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine oil fill cap.
2. Pull up on the cover in order to disengage the cover from the studs.

Installation Procedure

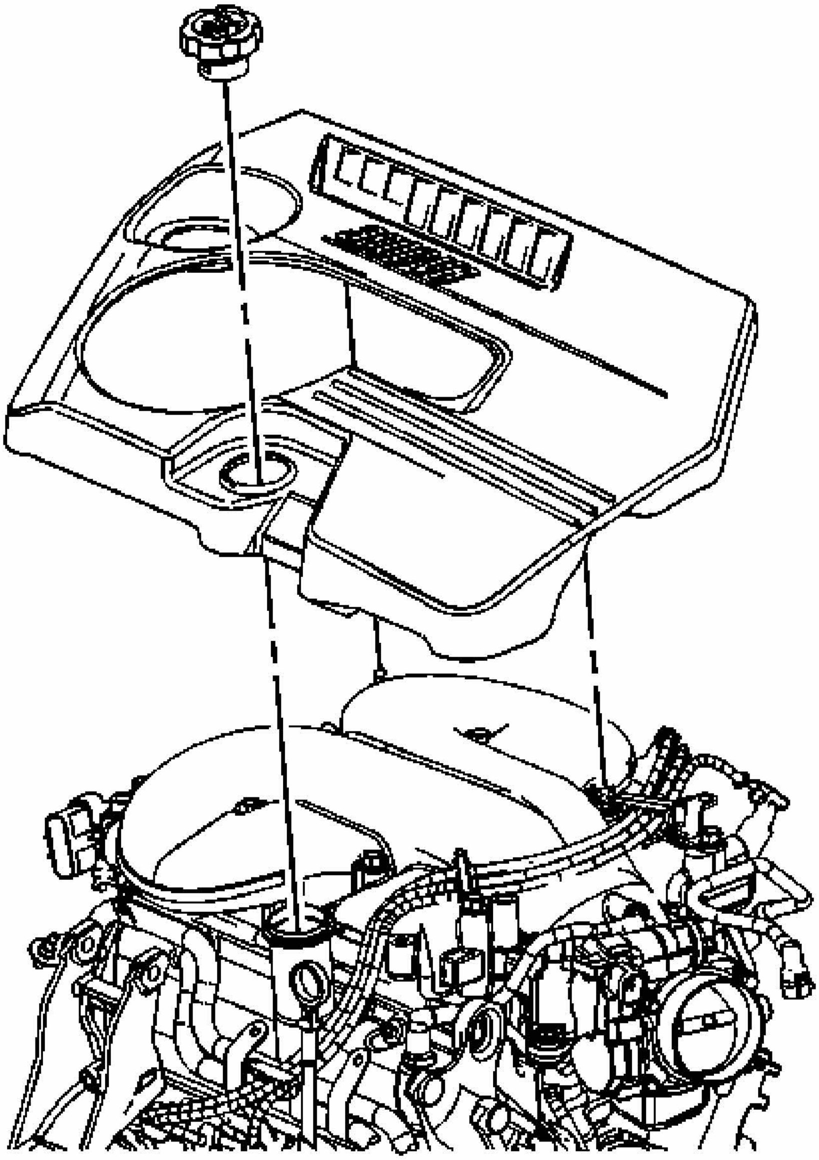


Fig. 7: View Of Engine Oil Fill Cap
Courtesy of GENERAL MOTORS CORP.

1. Align the cover to the studs on the engine. Push down on the cover above the studs in order to engage the cover grommets to the studs.
2. Install the engine oil fill cap.

DRIVE BELT REPLACEMENT

Removal Procedure

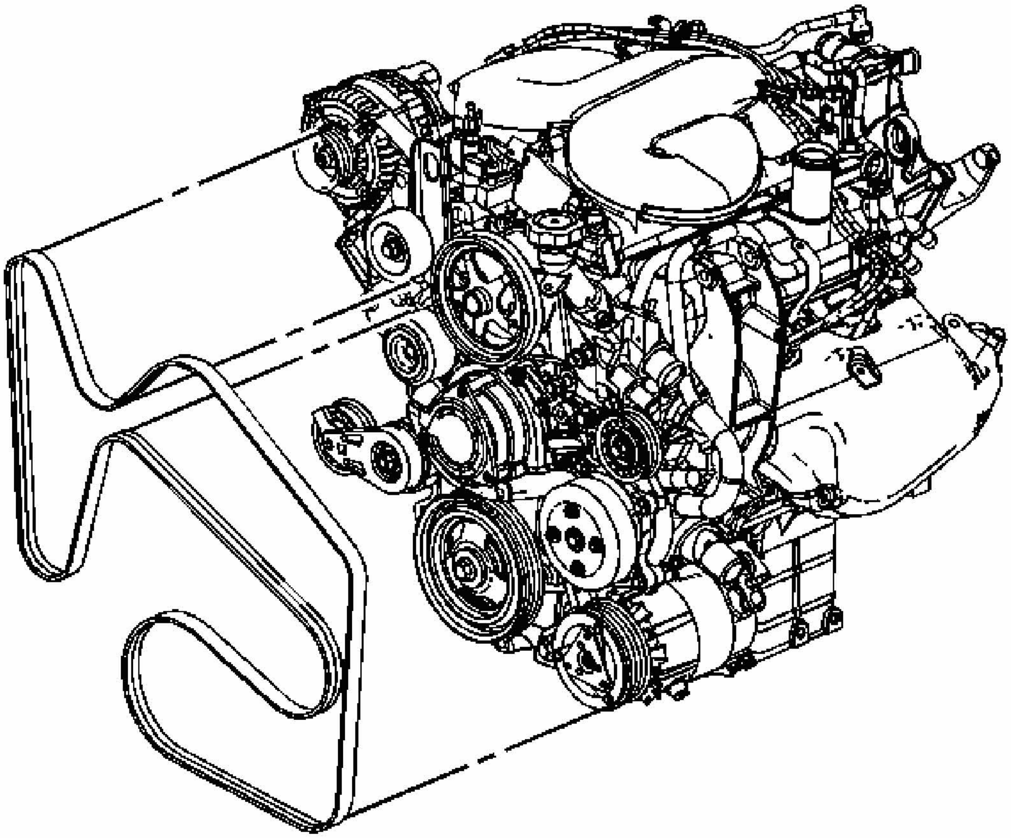


Fig. 8: Identifying Drive Belt
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner. Refer to **Air Cleaner Assembly Replacement** .
2. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
3. Rotate the drive belt tensioner clockwise in order to release the tensioner spring tension.
4. Remove the drive belt from around the tensioner pulley.
5. Release the drive belt tensioner.
6. Remove the drive belt from around all other pulleys.

Installation Procedure

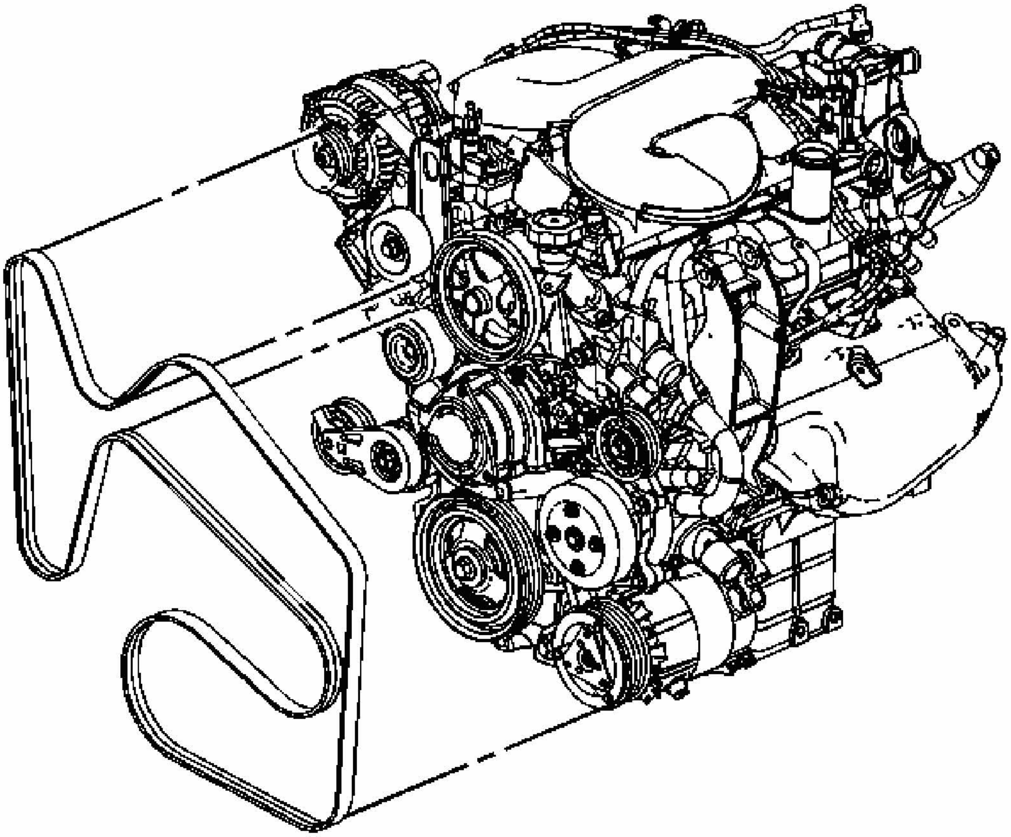


Fig. 9: Identifying Drive Belt
Courtesy of GENERAL MOTORS CORP.

1. Install the drive belt around all the pulleys except for the tensioner pulley.
2. Rotate the drive belt tensioner clockwise in order to release the tensioner spring tension.
3. Install the drive belt around the tensioner pulley.
4. Release the drive belt tensioner.
5. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
6. Install the air cleaner. Refer to **Air Cleaner Assembly Replacement** .

DRIVE BELT IDLER PULLEY REPLACEMENT

Removal Procedure

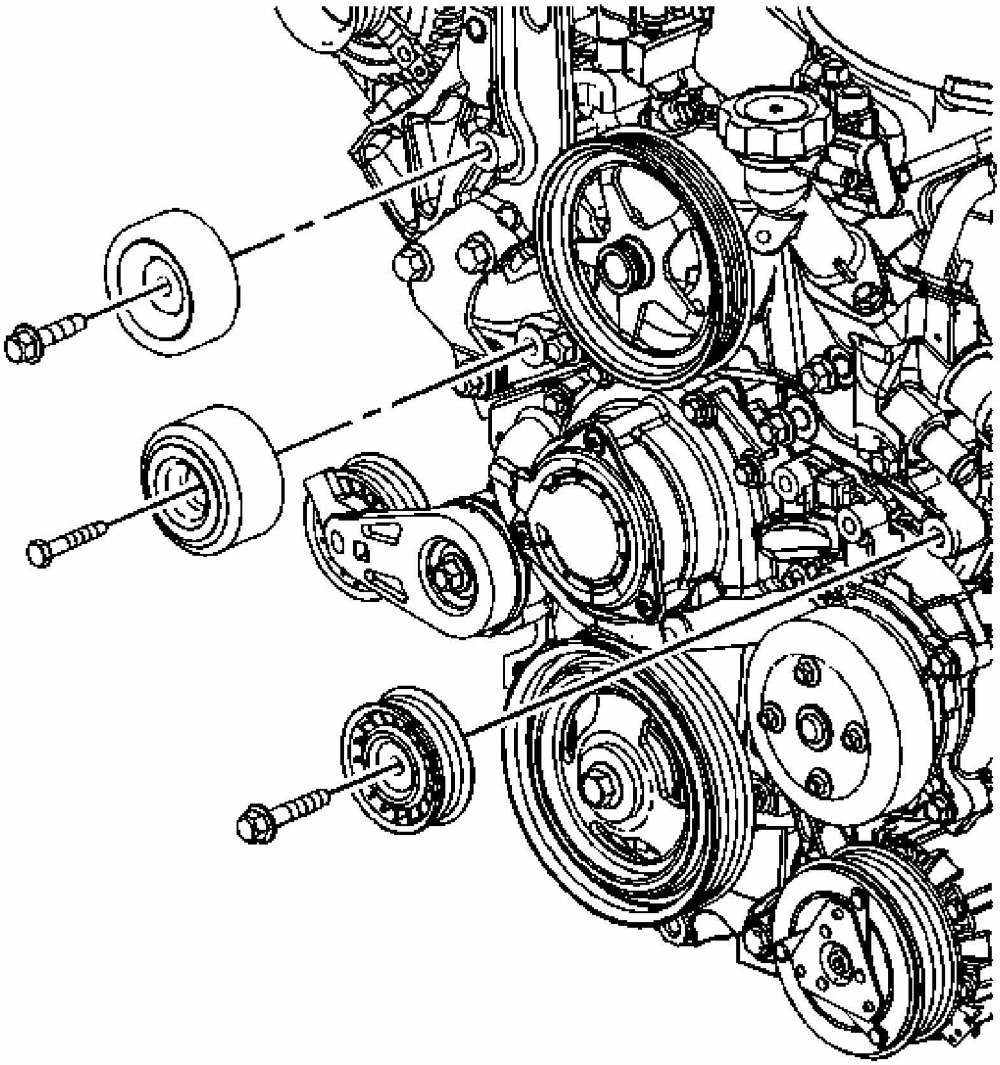


Fig. 10: View Of Drive Belt Idler Pulleys & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Loosen the required drive belt idler pulley bolt.
2. Remove the drive belt. Refer to **Drive Belt Replacement**.
3. Remove the drive belt idler pulley.

Installation Procedure

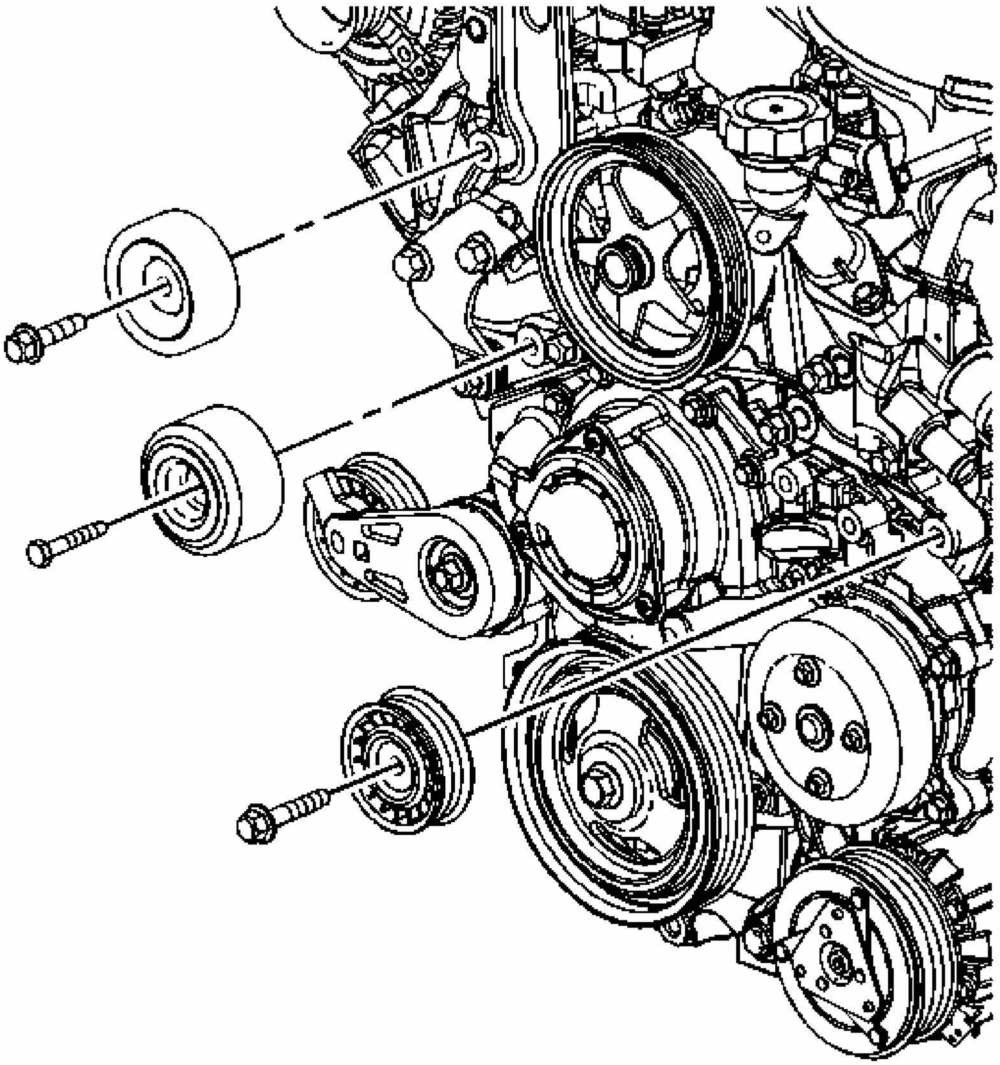


Fig. 11: Drive Belt Idler Pulleys & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the drive belt idler pulley.
2. Install the drive belt. Refer to **Drive Belt Replacement**.

NOTE: **Refer to Fastener Notice .**

3. Tighten the required drive belt idler pulley bolt.

Tighten: Tighten the bolt to 50 N.m (37 lb ft).

DRIVE BELT TENSIONER REPLACEMENT

Removal Procedure

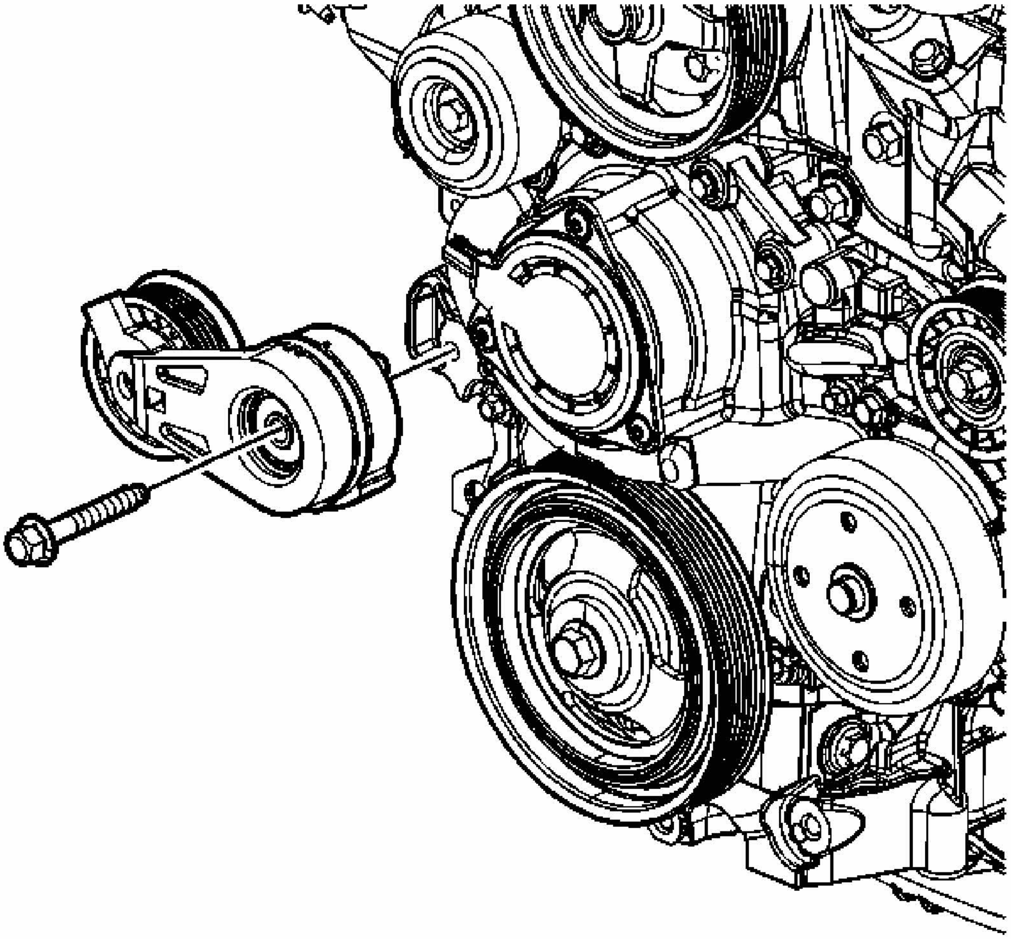


Fig. 12: Identifying Drive Belt Tensioner & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Remove the drive belt tensioner bolt.
3. Remove the drive belt tensioner.

Installation Procedure

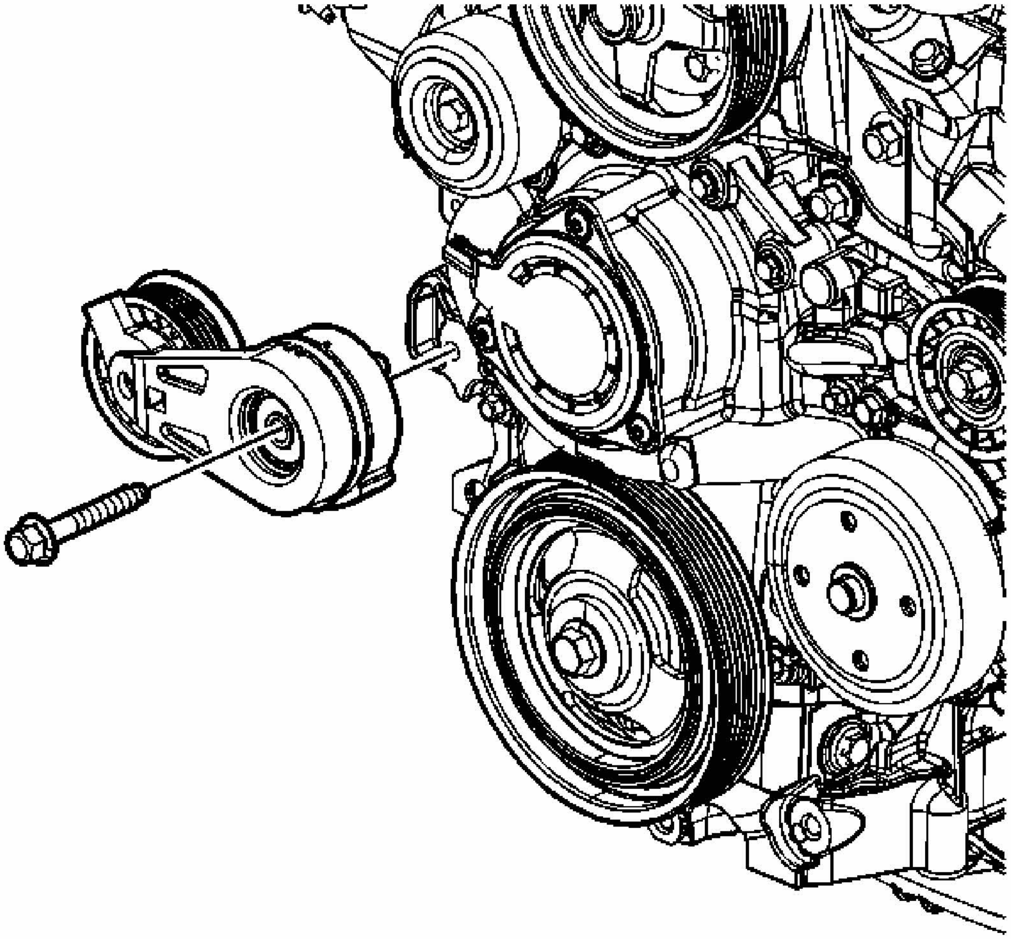


Fig. 13: Identifying Drive Belt Tensioner & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the drive belt tensioner.

   NOTE: **Refer to Fastener Notice .**

2. Install the drive belt tensioner bolt.

   Tighten: Tighten the bolt to 50 N.m (37 lb ft).

3. Install the drive belt. Refer to **Drive Belt Replacement**.

ENGINE SUPPORT FIXTURE

Tools Required

- **J 28467-B** Engine Support Fixture
- **J 36462** Engine Support Adapter Leg

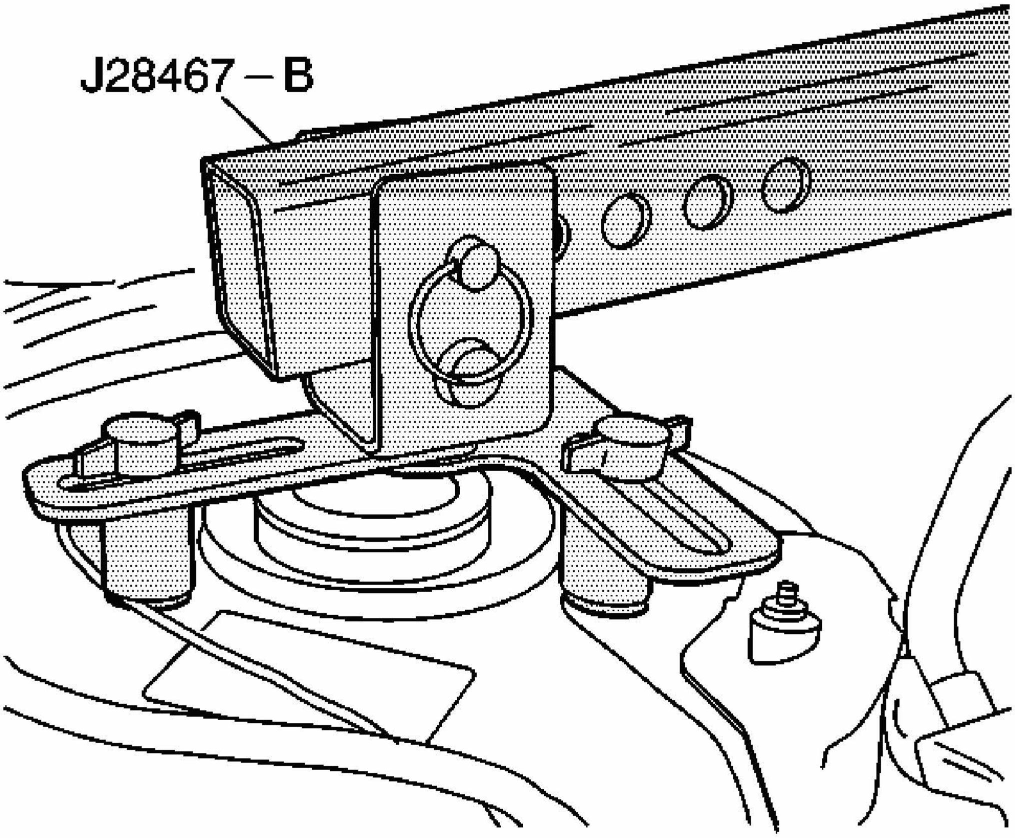


Fig. 14: Identifying Thread Support Nuts (J 28467-33A)
Courtesy of GENERAL MOTORS CORP.

1. Raise the hood.
2. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
3. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .
4. Install the J 28467-33A thread support nuts onto the strut attaching studs.
5. Install the J 28467-5A strut tower support assemblies over the J 28467-33A thread support nuts.
6. Install the J 28467-5 T-bolts with 5/16-inch washers through the J 28467-5A strut

tower support assemblies into the J 28467-33A thread support nuts. Hand tighten the bolts.

7. Install the two J 28467-1A cross bracket assemblies over the J 28467-3 strut tower tube.
8. Install the J 28467-3 strut tower tube into the J 28467-5A strut tower support assemblies.
9. Install the J 28467-10 1/2-inch x 2.5-inch quick release pin through the J 28467-5A strut tower support assemblies and J 28467-3 the strut tower tube on one side only.

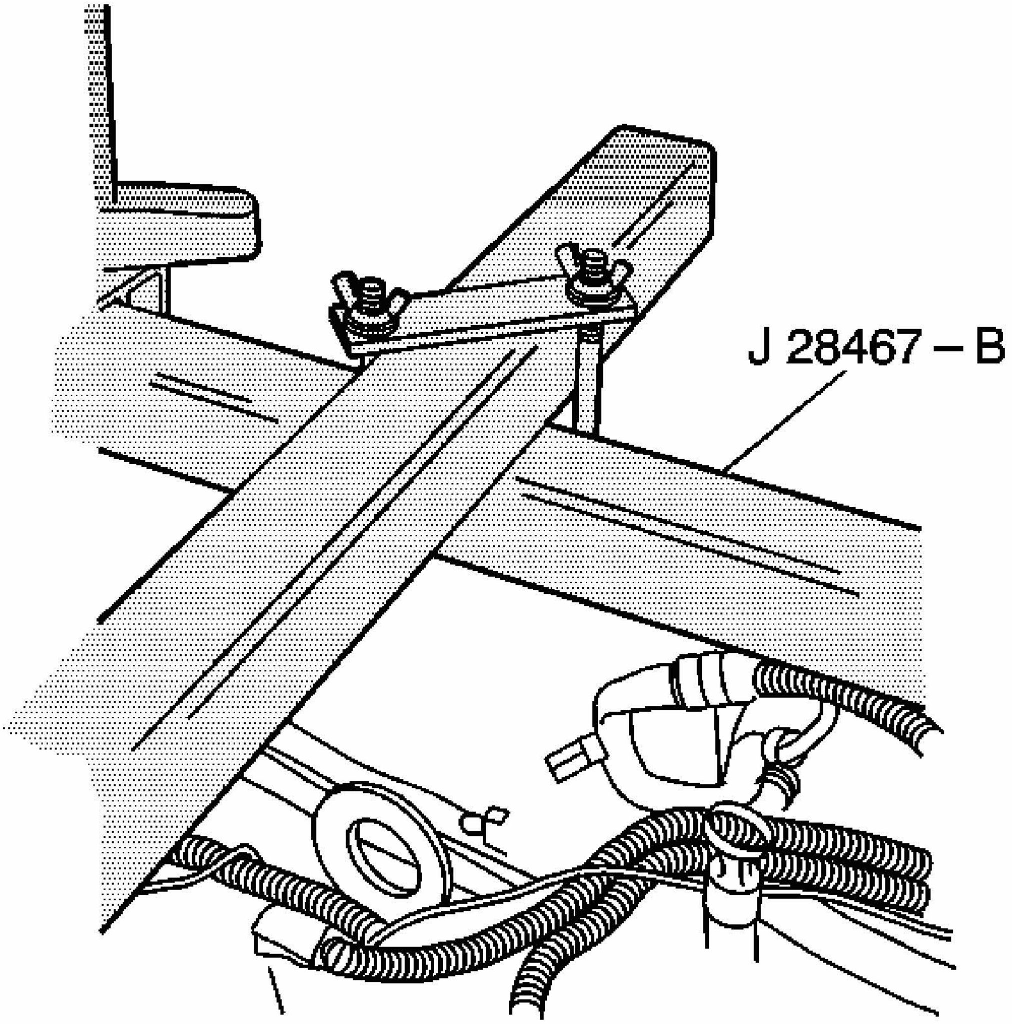


Fig. 15: Identifying Radiator Shelf Tube (J 28467-2A)
Courtesy of GENERAL MOTORS CORP.

10. Install the J 28467-2A radiator shelf tube through the J 28467-1A driver side cross bracket assembly on the top of the J 28467-3 strut tower tube.
11. Place the rubber padded foot of the J 28467-4A front support assembly on the vehicle radiator shelf. The foot position used in the J 28467-4A front support assembly depends on the vehicle application.
12. Install the J 28467-9 7/16-inch x 2.0-inch quick release pin through the hole in the J 28467-4A front support assembly in order to level the J 28467-2A radiator shelf tube. The hole used in the J 28467-4A front support assembly depends on the vehicle application.
13. Install the J 28467-7A lift hook through the J 28467-6A lift hook bracket.
14. Install the 1/2-inch lift hook washer and J 28467-34 lift hook wing nut onto the J 28467-7A lift hook.
15. Install the J 28467-6A assembled lift hook bracket over the J 28467-2A radiator shelf tube.
16. Adjust the J 28467-2A radiator shelf tube and the J 28467-6A assemblage lift hook bracket in order to align the hook with the left (front), rear of engine, lift hook bracket part of the left engine mount strut bracket.
17. Hand tighten the J 28467-1A driver side cross bracket assembly wing nuts.
18. Install the J 28467-2A second radiator shelf tube through the J 28467-1A passenger side cross bracket assembly on the top of the J 28467-3 strut tower tube.
19. Place the rubber padded foot of the J 28467-4A front support assembly on the vehicle radiator shelf. The foot position used in the J 28467-4A front support assembly depends on the vehicle application.
20. Install the J 28467-9 7/16-inch x 2.0-inch quick release pin through the hole in the J 28467-4A front support assembly in order to level the J 28467-2A radiator shelf tube. The hole used in the J 28467-4A front support assembly depends on the vehicle application.
21. Install the J 28467-7A lift hook through the J 28467-6A lift hook bracket.
22. Install the 1/2-inch lift hook washer and J 28467-34 lift hook wing nut onto the J 28467-7 lift hook A.
23. Install the J 28467-6A assemblage lift hook bracket over the J 28467-2A radiator shelf tube.
24. Adjust the J 28467-2A radiator shelf tube and the J 28467-6A assemblage lift hook bracket in order to align the hook with the right rear, front of engine, lift hook bracket located next to the generator.
25. Hand tighten the J 28467-1A passenger side cross bracket assembly wing nuts.
26. Hand tighten the J 28467-34 lift hook wing nuts securely in order to remove all slack from the engine support fixture assembly.

ENGINE MOUNT INSPECTION

IMPORTANT: Before replacing any engine mount due to suspected fluid loss, verify that the source of the fluid is the engine mount, not the engine or accessories.

1. Install the engine support fixture. Refer to **Engine Support Fixture**.
2. Observe the engine mount while raising the engine. Raising the engine removes the weight from the engine mount and creates slight tension on the rubber.
3. Replace the engine mount if the engine mount exhibits any of the following conditions:
    - The hard rubber is covered with heat check cracks.
    - The rubber is separated from the metal plate of the engine mount.
    - The rubber is split through the center of the engine mount.
    - The engine mount itself is leaking fluid.
4. For engine mount replacement. Refer to **Engine Mount Replacement**.

ENGINE MOUNT REPLACEMENT

Removal Procedure

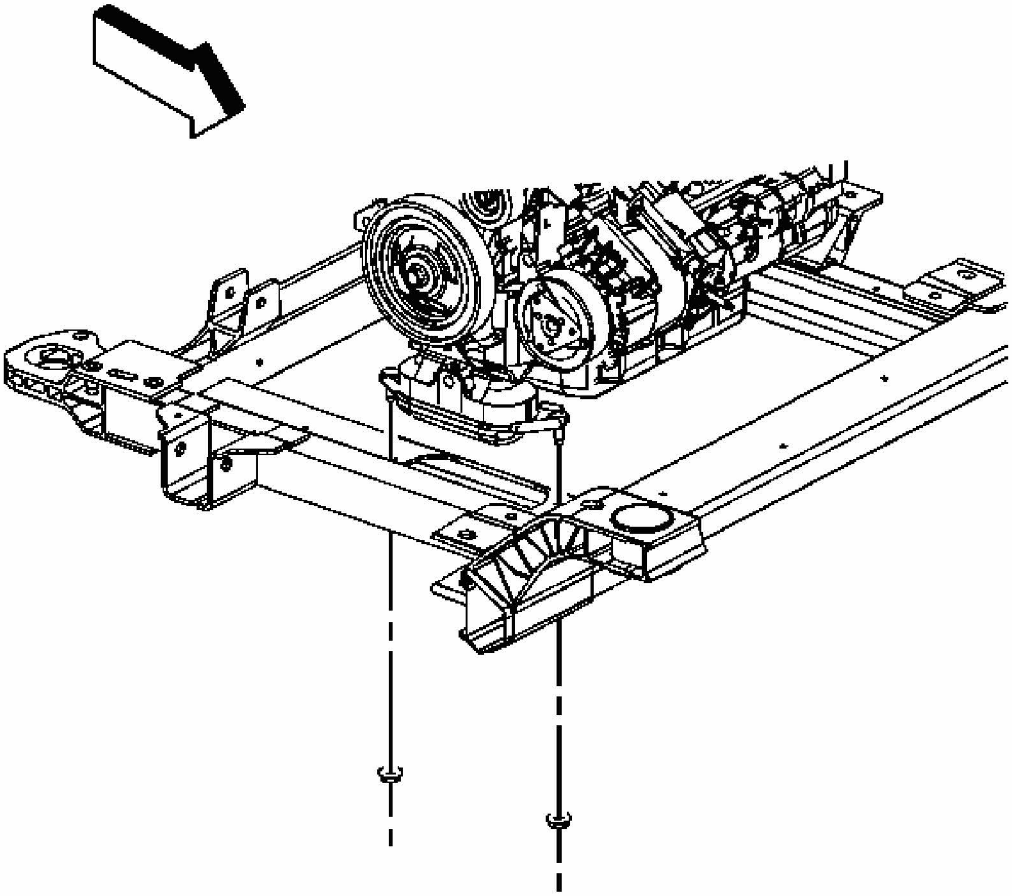


Fig. 16: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

1. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
2. Remove the engine splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
3. Remove the engine mount to frame nuts.

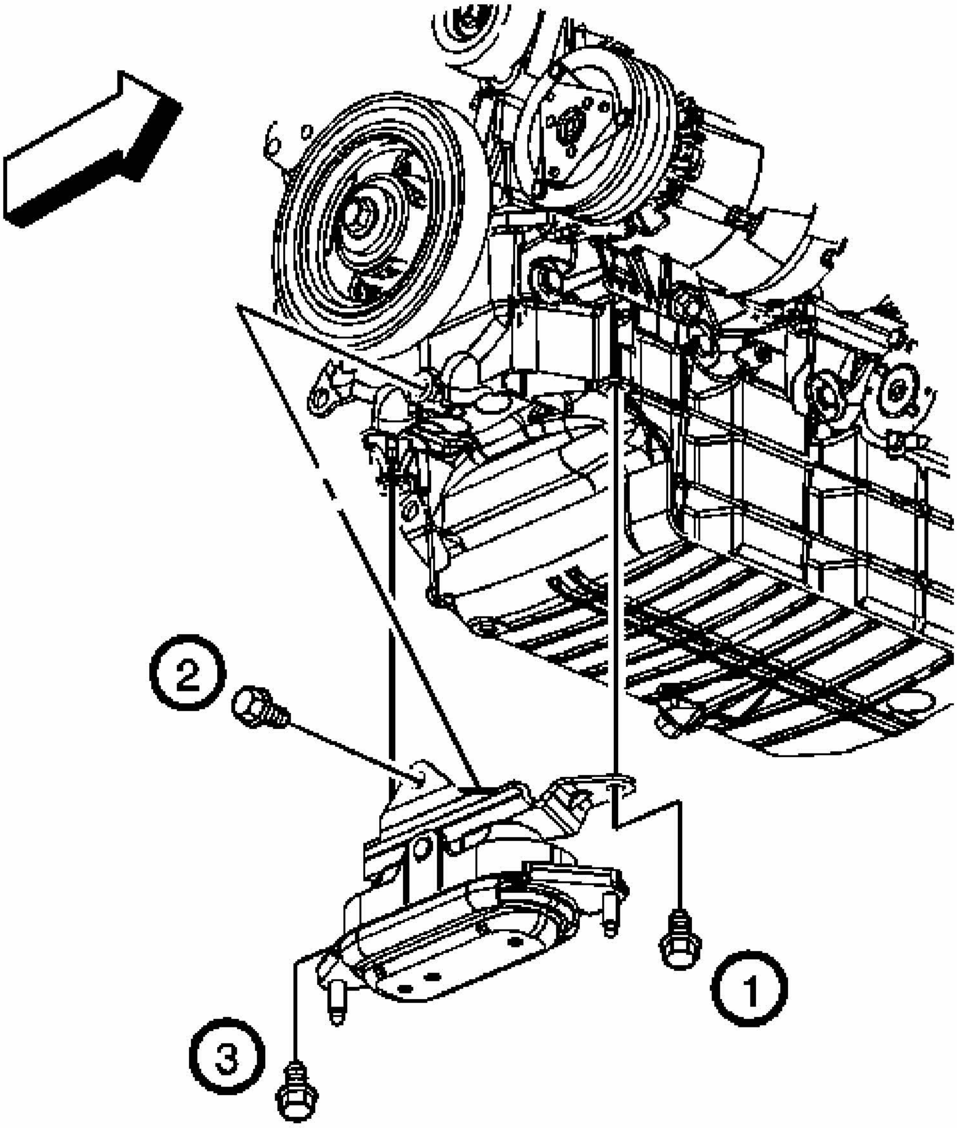


Fig. 17: Locating Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

4. Place an adjustable jack and a block of wood under the oil pan.
5. Remove the engine mount bracket bolts.
6. Using the adjustable jack and block of wood, raise the engine until the engine mount/bracket can be removed.
7. Remove the engine mount/bracket from the vehicle.

Installation Procedure

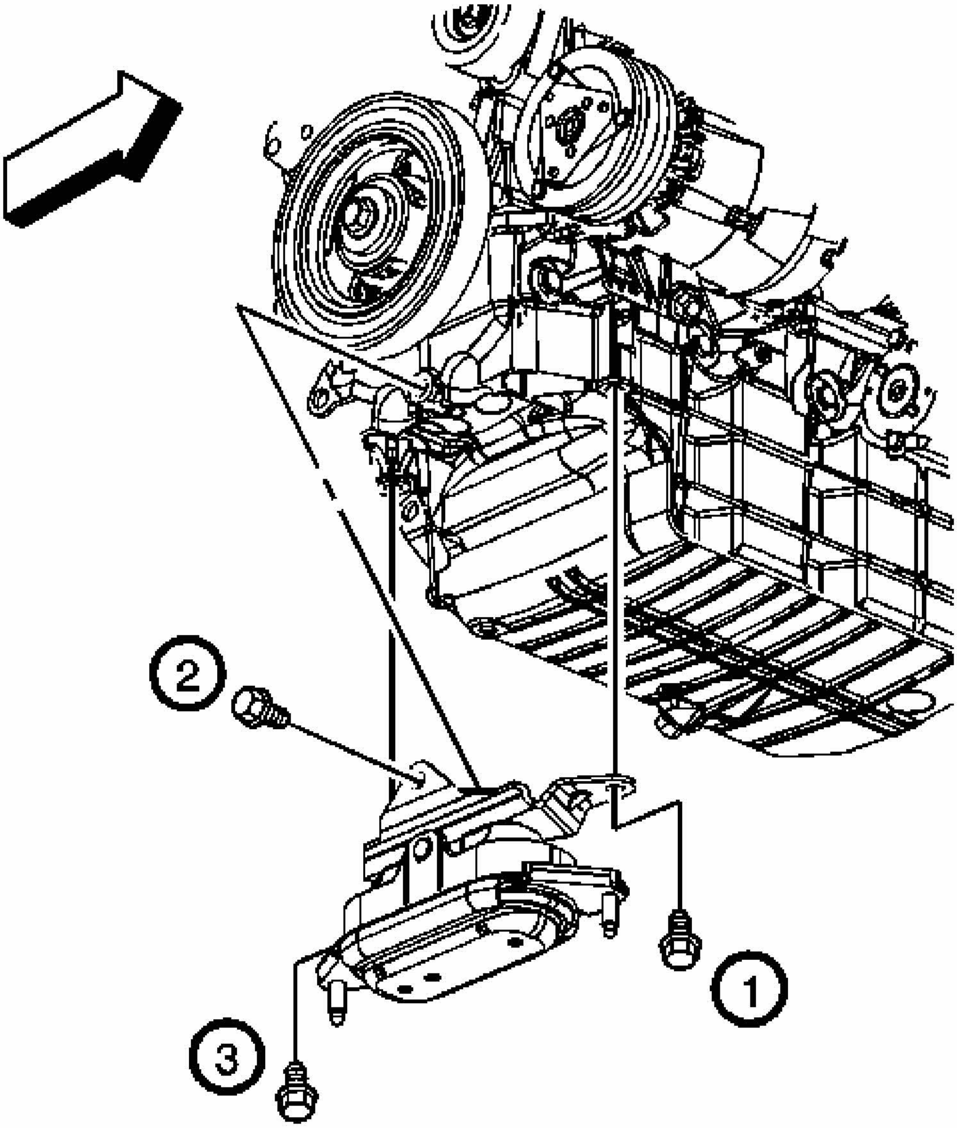


Fig. 18: Locating Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

1. Position the engine mount/bracket to the engine.
2. Install the engine mount bracket bolts.

NOTE: **Refer to Fastener Notice .**

3. Tighten the engine mount bracket bolts.

   Tighten: Tighten the bolts in the sequence shown to 50 N.m (37 lb ft).

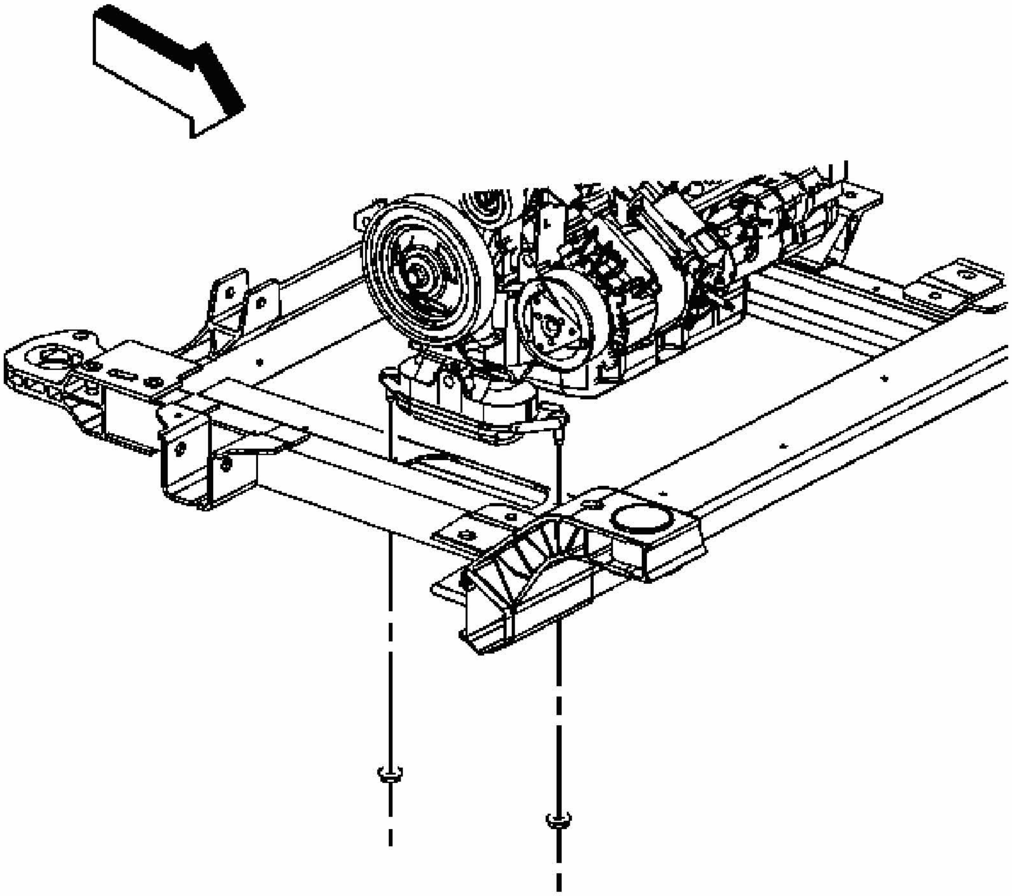


Fig. 19: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

4. Lower the engine using the adjustable jack until the engine mount rests on the frame.
5. Remove the adjustable jack and block of wood from under the vehicle.
6. Install the engine mount to frame nuts.

   Tighten: Tighten the nuts to 50 N.m (37 lb ft).

7. Install the engine splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
8. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .

ENGINE MOUNT BRACKET REPLACEMENT

Removal Procedure

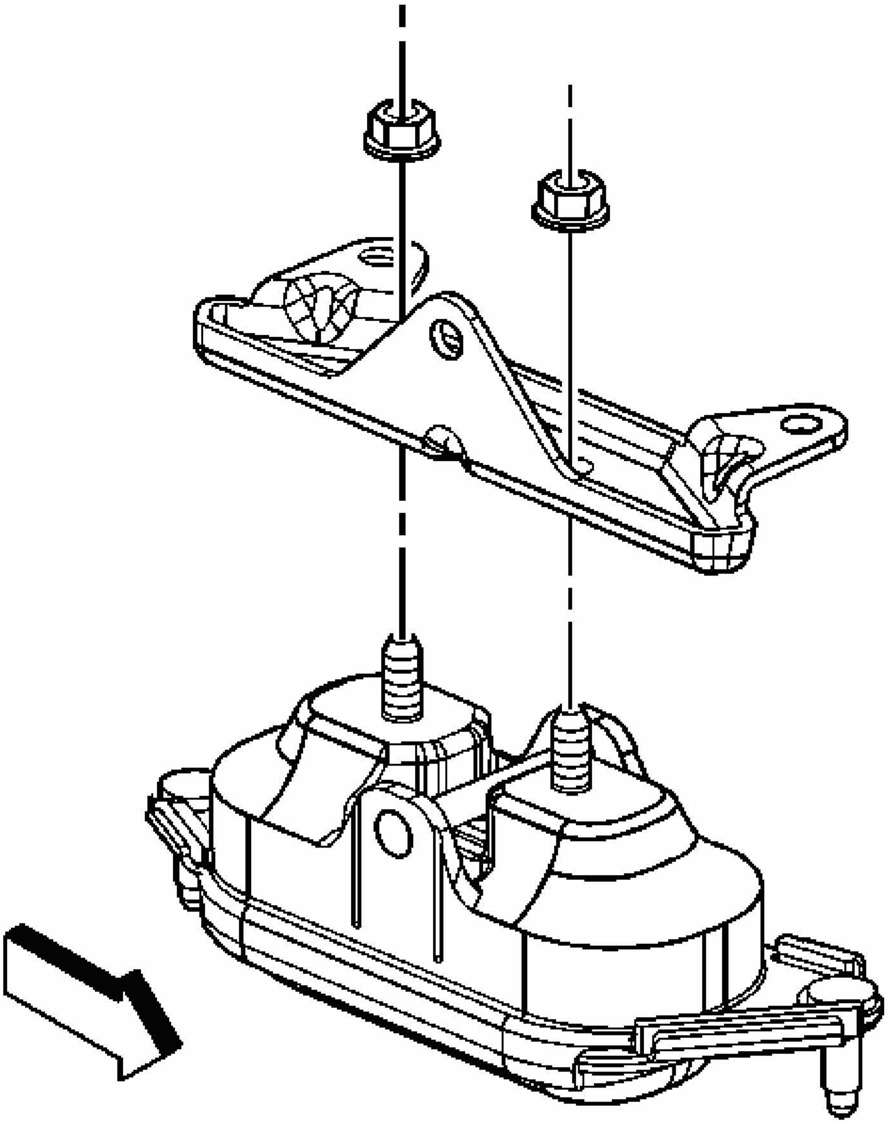


Fig. 20: View Of Engine Mount & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount. Refer to **Engine Mount Replacement**.
2. Remove the engine mount bracket to mount nuts.
3. Remove the engine mount bracket.

Installation Procedure

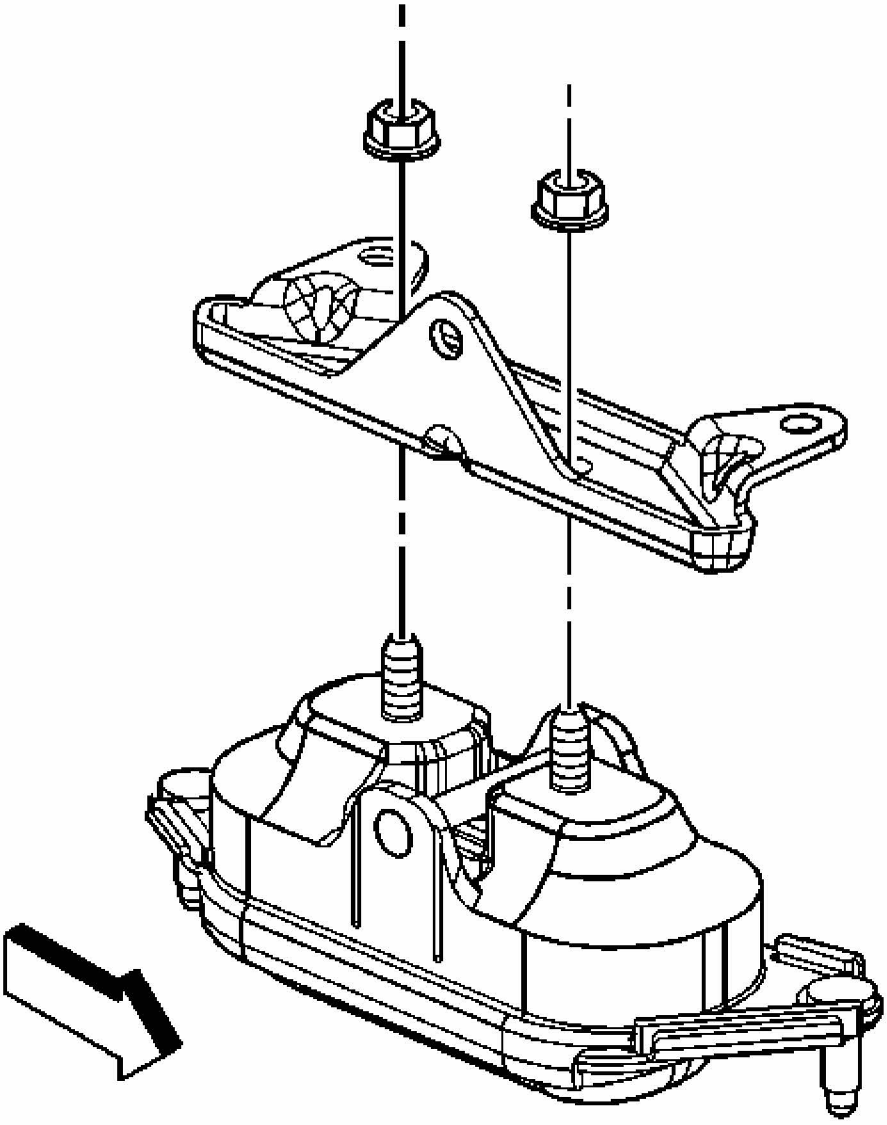


Fig. 21: View Of Engine Mount & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount bracket to the mount.

NOTE: **Refer to Fastener Notice .**

2. Install the engine mount bracket to mount nuts.

   Tighten: Tighten the nuts to 50 N.m (37 lb ft).

3. Install the engine mount. Refer to **Engine Mount Replacement**.

ENGINE MOUNT STRUT REPLACEMENT

Removal Procedure

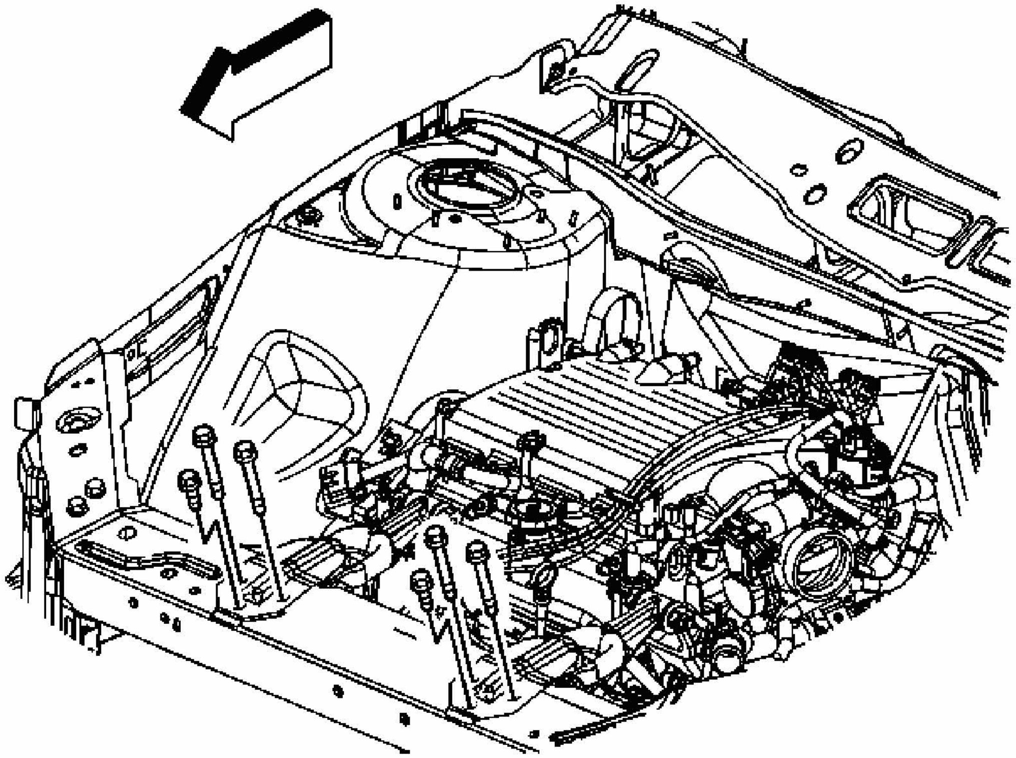


Fig. 22: View Of Engine Mount Strut & Radiator Support Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount strut to radiator support bolts.

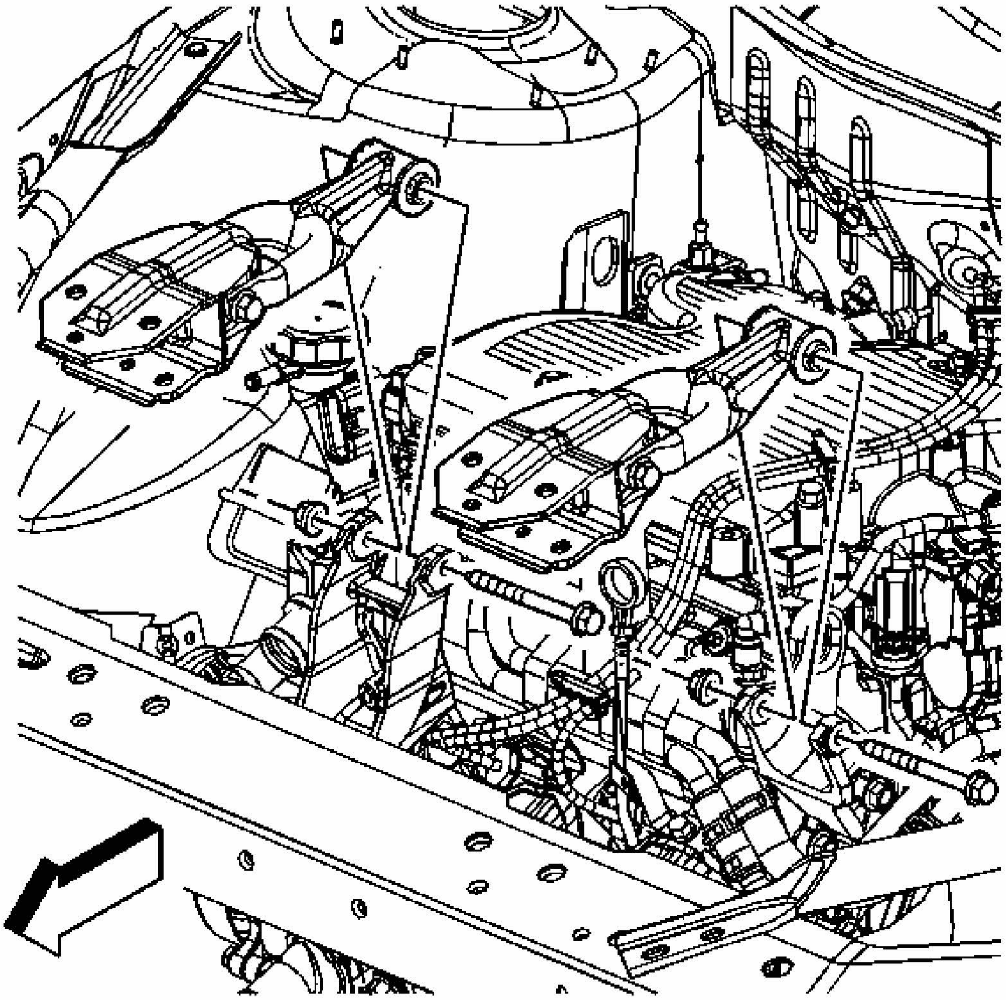


Fig. 23: View Of Engine Mount Struts
Courtesy of GENERAL MOTORS CORP.

2. Remove the engine mount strut to engine mount strut bracket bolts/nuts.
3. Remove the engine mount struts.

Installation Procedure

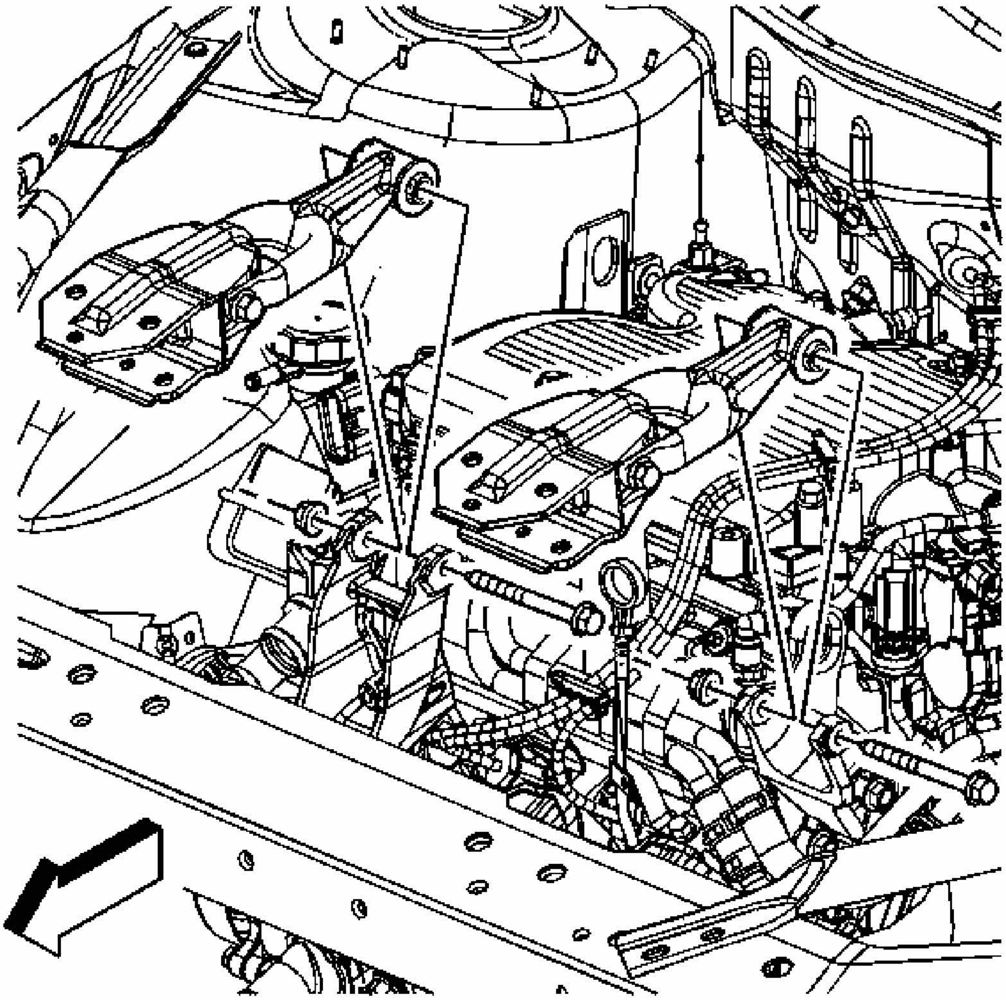


Fig. 24: View Of Engine Mount Struts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount struts.
2. Install the engine mount strut to engine mount strut bracket bolts/nuts.

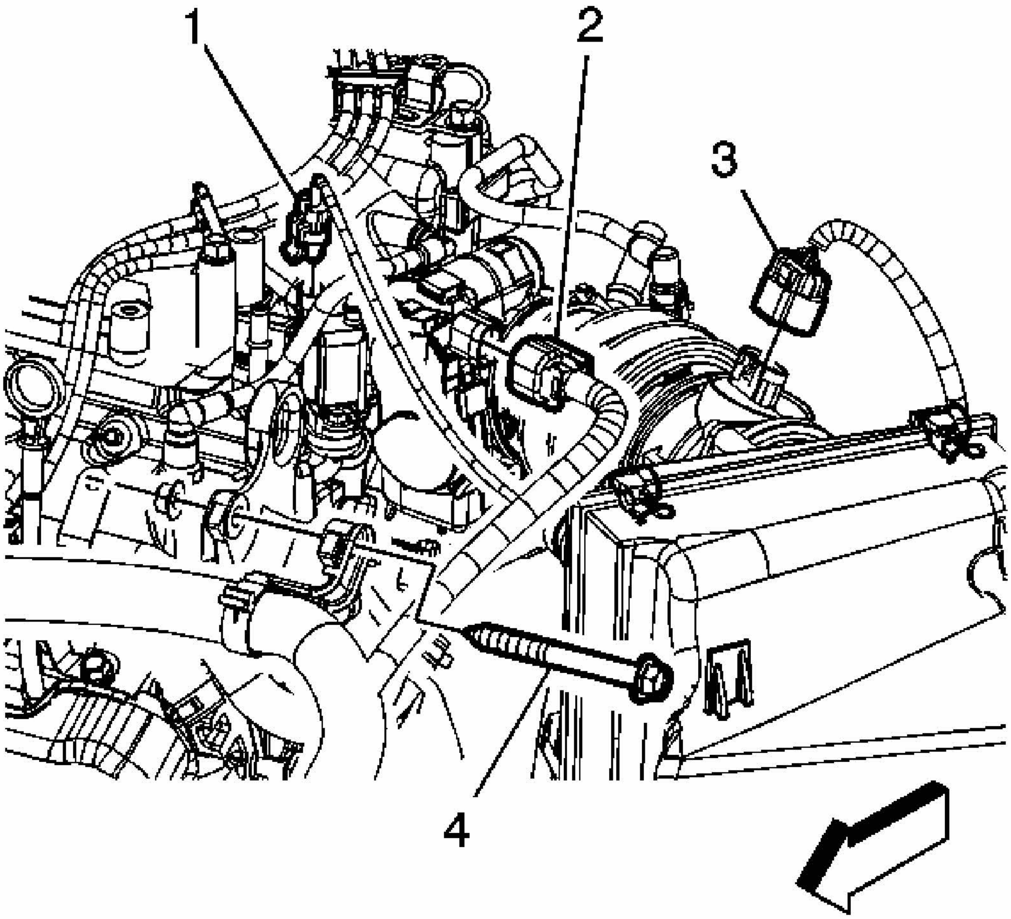


Fig. 25: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. On the right side, ensure that the engine harness clamp is sandwiched between the bolt (4) and the strut bracket.

NOTE: **Refer to Fastener Notice .**

4. Tighten the engine mount strut to engine mount strut bracket bolts/nuts.

   Tighten: Tighten the bolts/nuts to 50 N.m (37 lb ft).

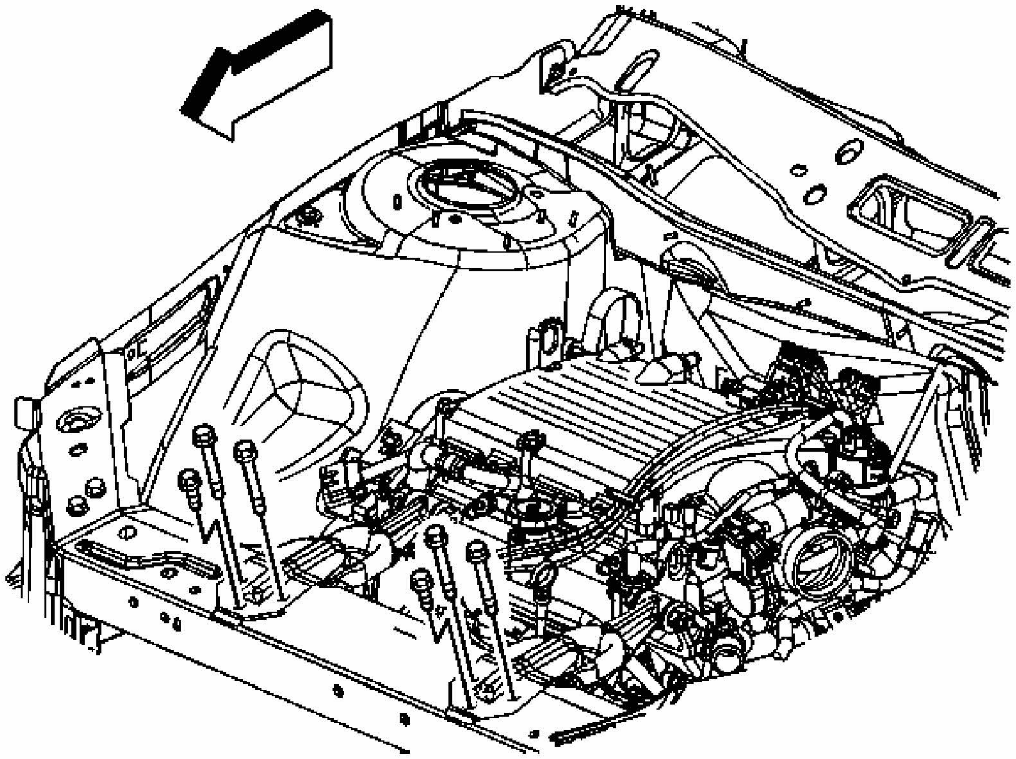


Fig. 26: View Of Engine Mount Strut & Radiator Support Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the engine mount strut to radiator support bolts.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

ENGINE MOUNT STRUT BRACKET REPLACEMENT - LEFT

Removal Procedure

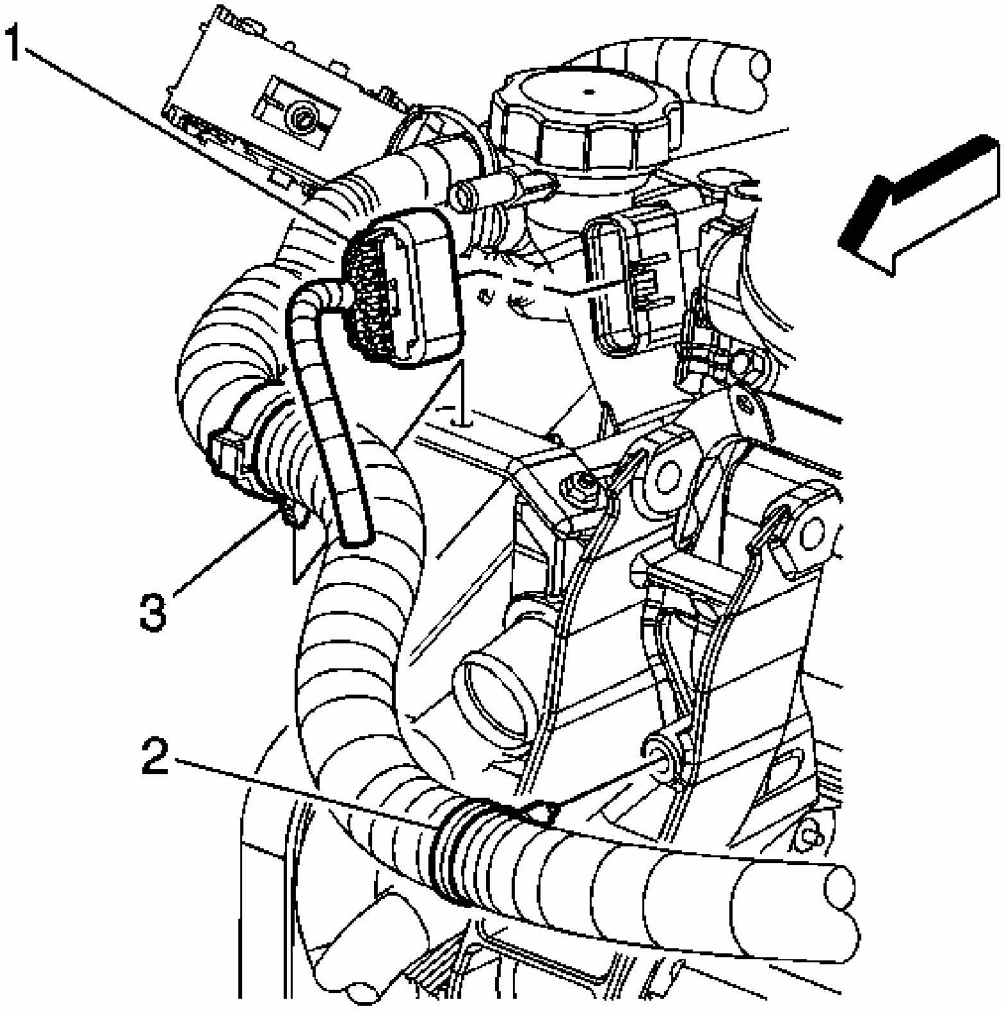


Fig. 27: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount strut. Refer to **Engine Mount Strut Replacement**.
2. Remove the engine harness clip (2) from the strut bracket.

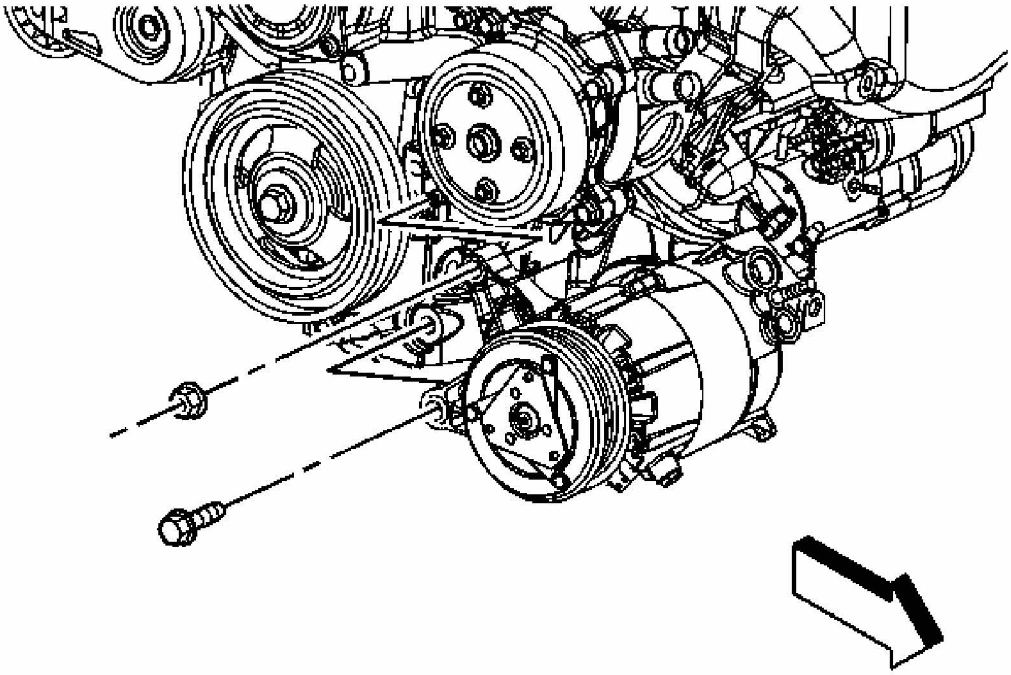


Fig. 28: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Remove the air conditioning (A/C) compressor front bolt/nut.

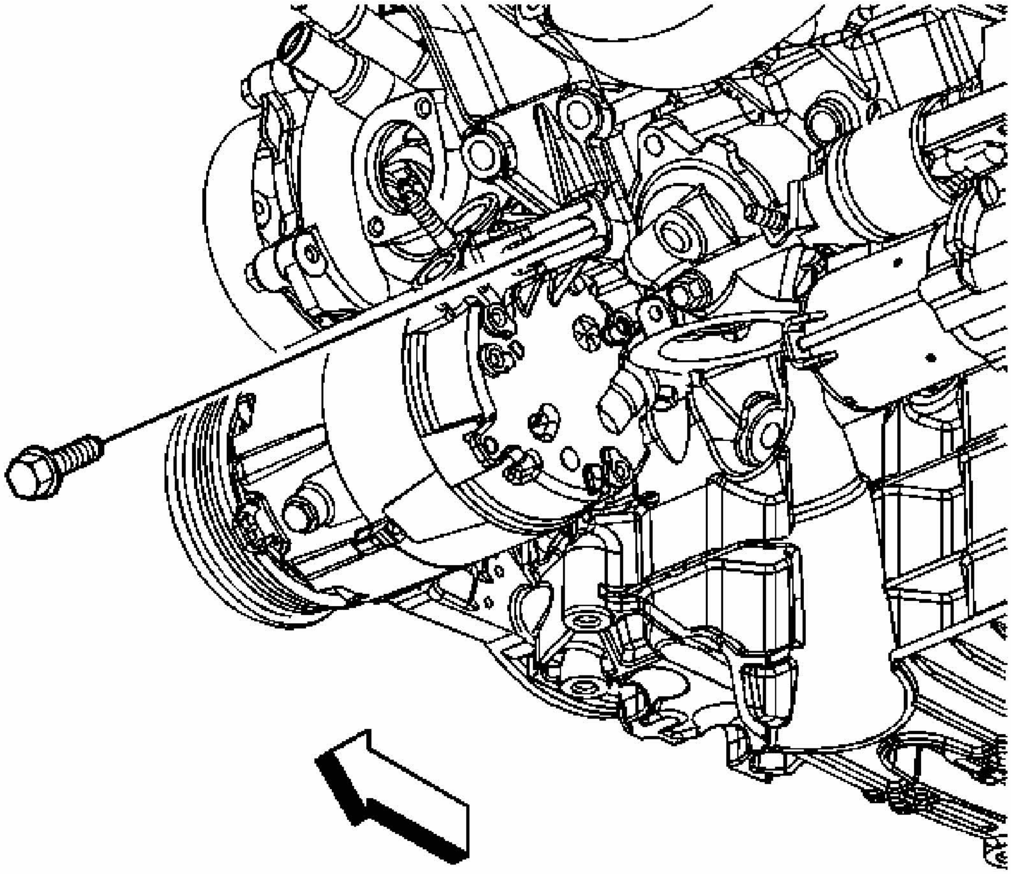


Fig. 29: Locating A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the A/C compressor rear bolt.
6. Reposition the A/C compressor.

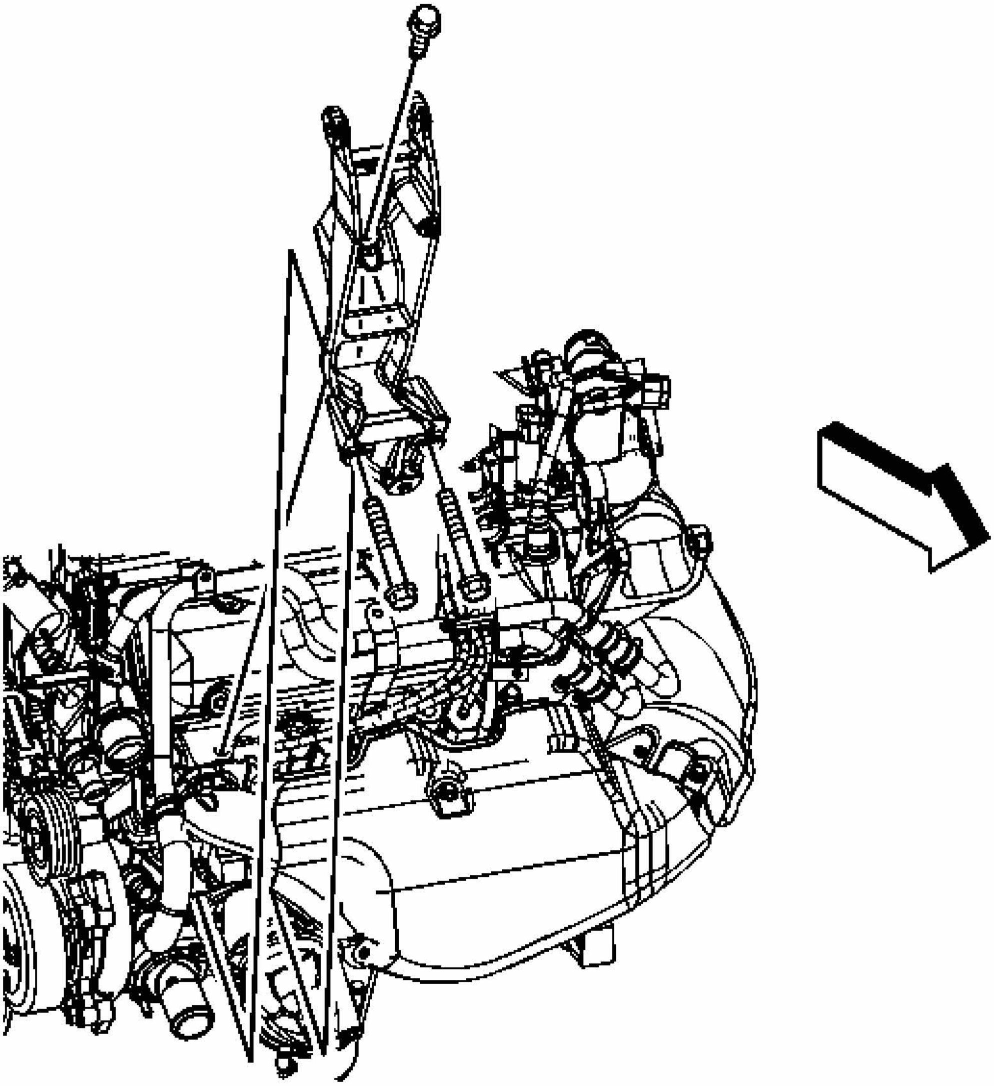


Fig. 30: Locating Engine Mount Strut Bracket & Lower Engine Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the engine mount strut bracket to engine lower bolts.
8. Lower the vehicle.
9. Remove the engine mount strut bracket to engine upper bolt.
10. Remove the engine mount strut bracket.

Installation Procedure

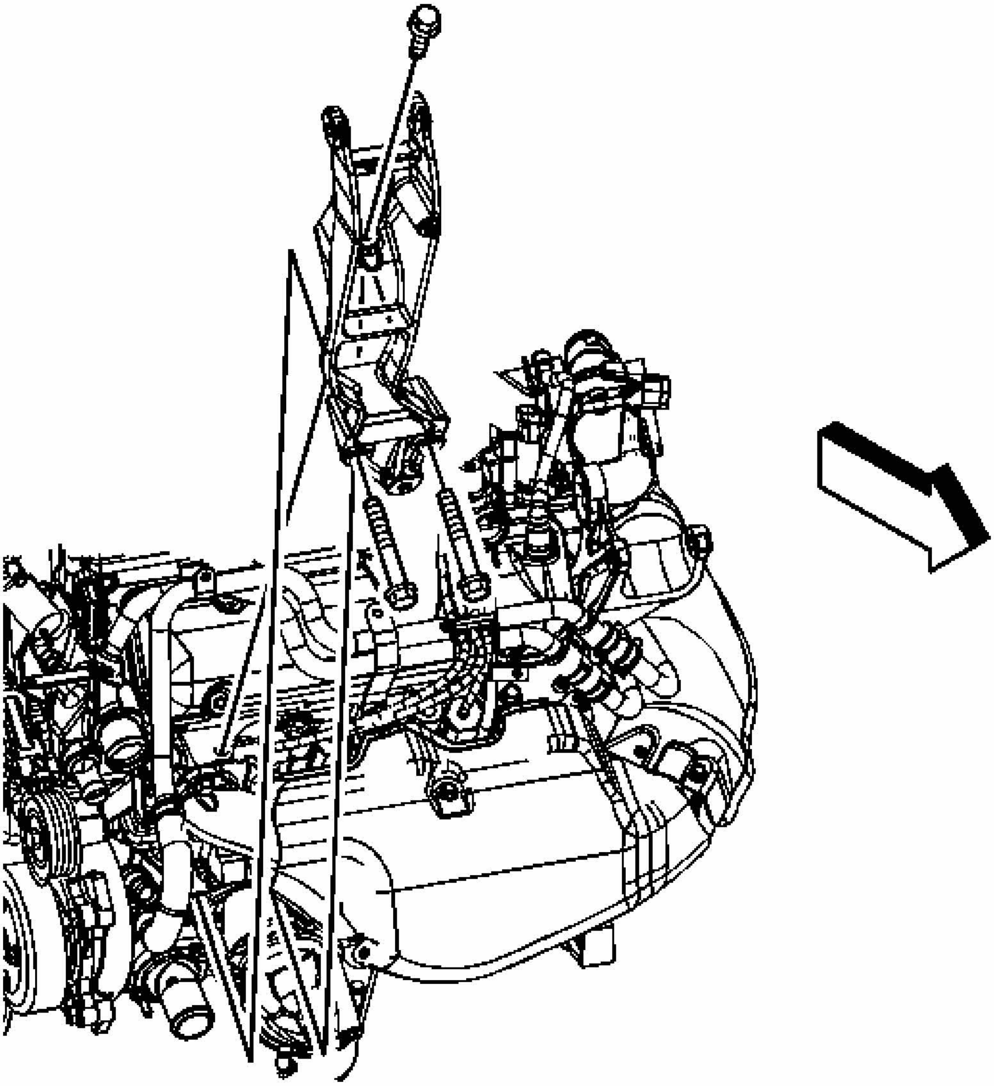


Fig. 31: Locating Engine Mount Strut Bracket & Lower Engine Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount strut bracket.
2. Loosely install the engine mount strut bracket to engine upper bolt.
3. Raise and support the vehicle.

NOTE: **Refer to Fastener Notice .**

4. Install the engine mount strut bracket to engine lower bolts.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

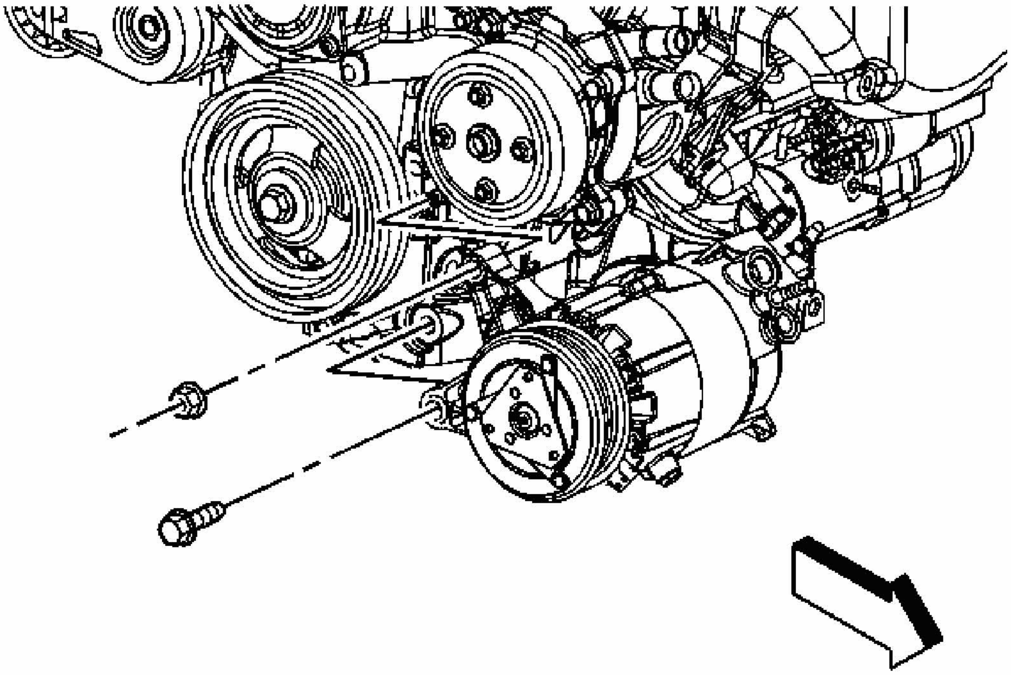


Fig. 32: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

5. Position the A/C compressor to the engine block.
6. Install the A/C compressor front nut and bolt until snug.

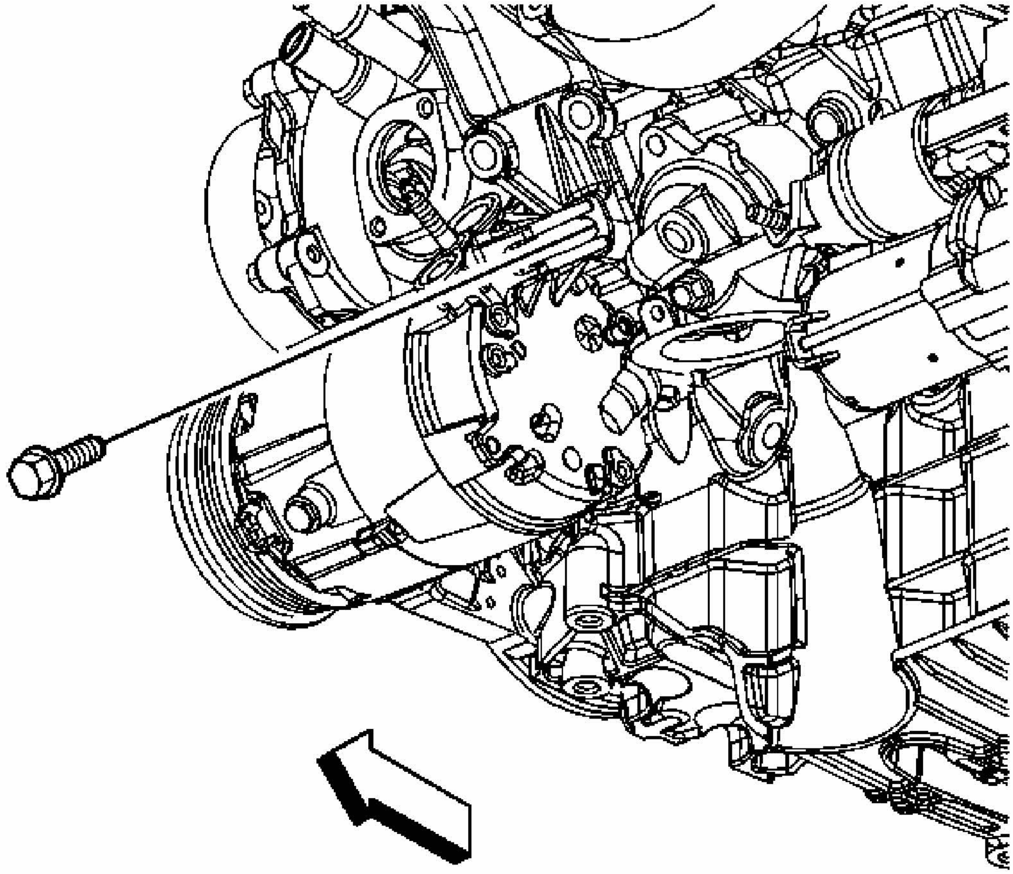


Fig. 33: Locating A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

7. Install the A/C compressor rear bolt until snug.
8. Tighten the A/C compressor nut first, then the rear bolt and finally the front bolt.

   Tighten: Tighten the bolts/nut to 50 N.m (37 lb ft).

9. Lower the vehicle.

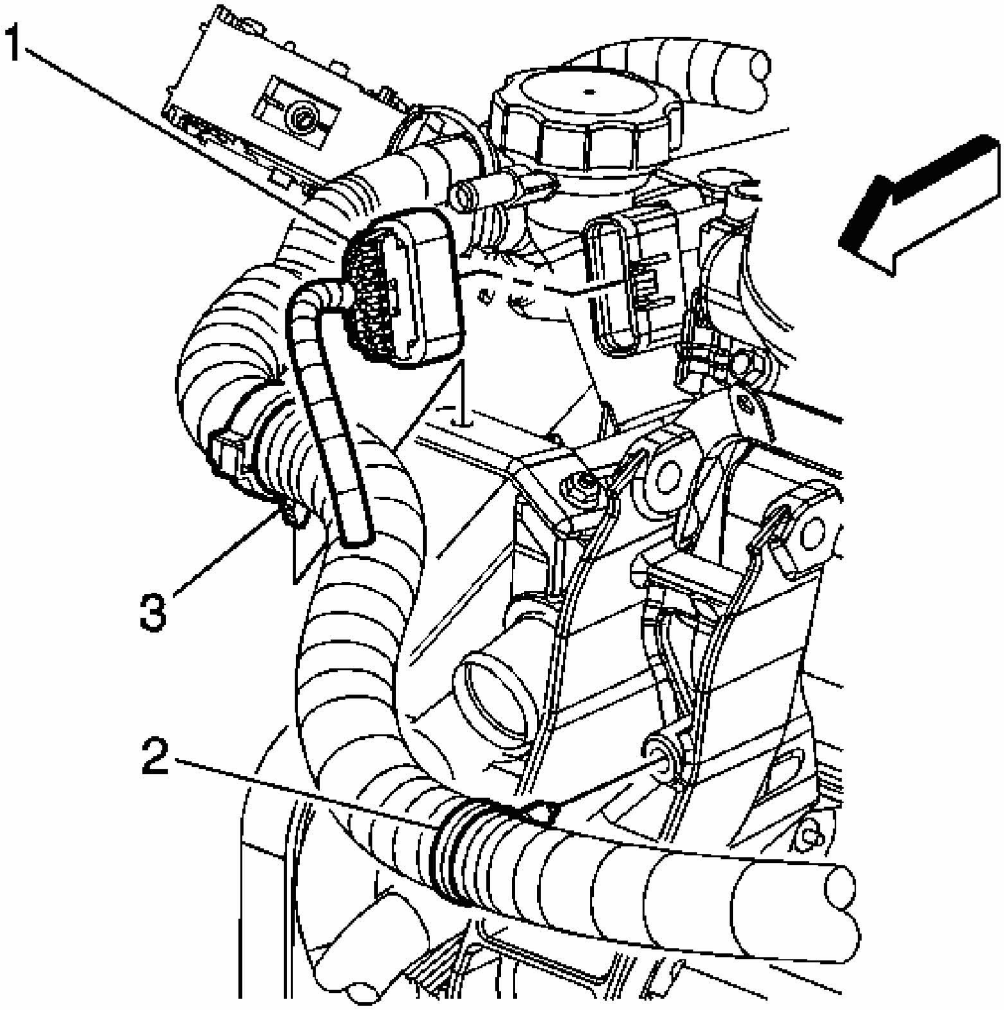


Fig. 34: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

10. Tighten the engine mount strut bracket to engine upper bolt.

    Tighten: Tighten the bolts to 25 N.m (18 lb ft).

11. Install the engine harness clip (2) to the strut bracket.
12. Install the engine mount strut. Refer to **Engine Mount Strut Replacement**.

ENGINE MOUNT STRUT BRACKET REPLACEMENT - RIGHT

Removal Procedure

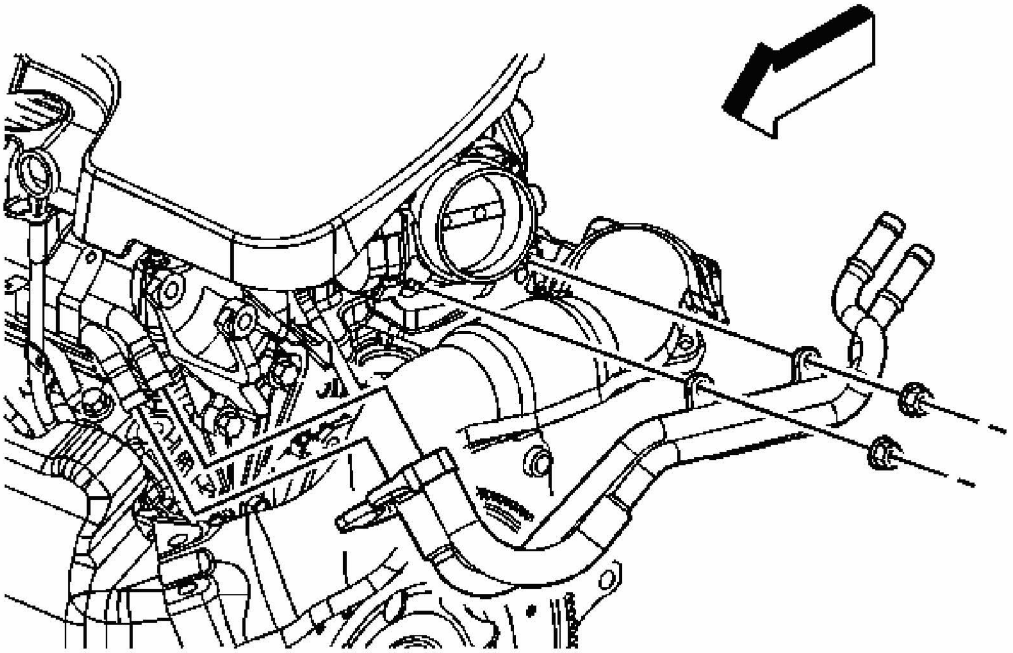


Fig. 35: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
2. Remove the engine mount strut. Refer to **Engine Mount Strut Replacement**.
3. Remove the heater inlet and outlet hose clamp nuts from the throttle body studs.
4. Reposition the heater inlet and outlet hose clamps at the pipes.
5. Remove the heater inlet and outlet hoses from the engine pipes.
6. Remove the heater inlet and outlet hose clamp from the throttle body studs.
7. Reposition the inlet and outlet hoses.

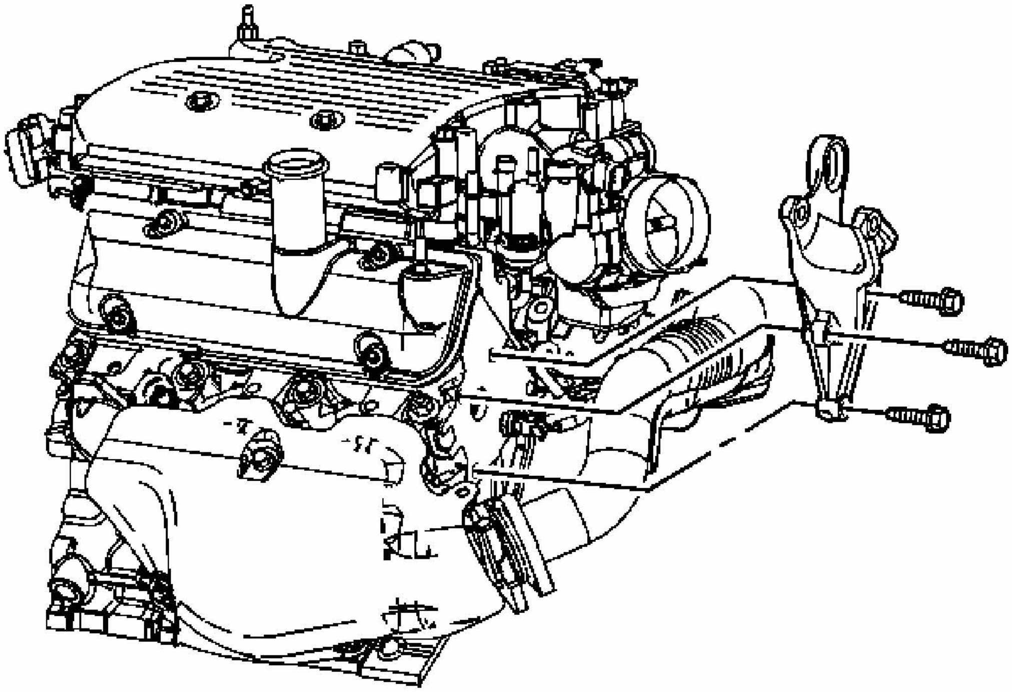


Fig. 36: View Of Engine Mount Strut Bracket
Courtesy of GENERAL MOTORS CORP.

8. Remove the engine mount strut bracket to cylinder head bolts.
9. Remove the engine mount strut bracket.

Installation Procedure

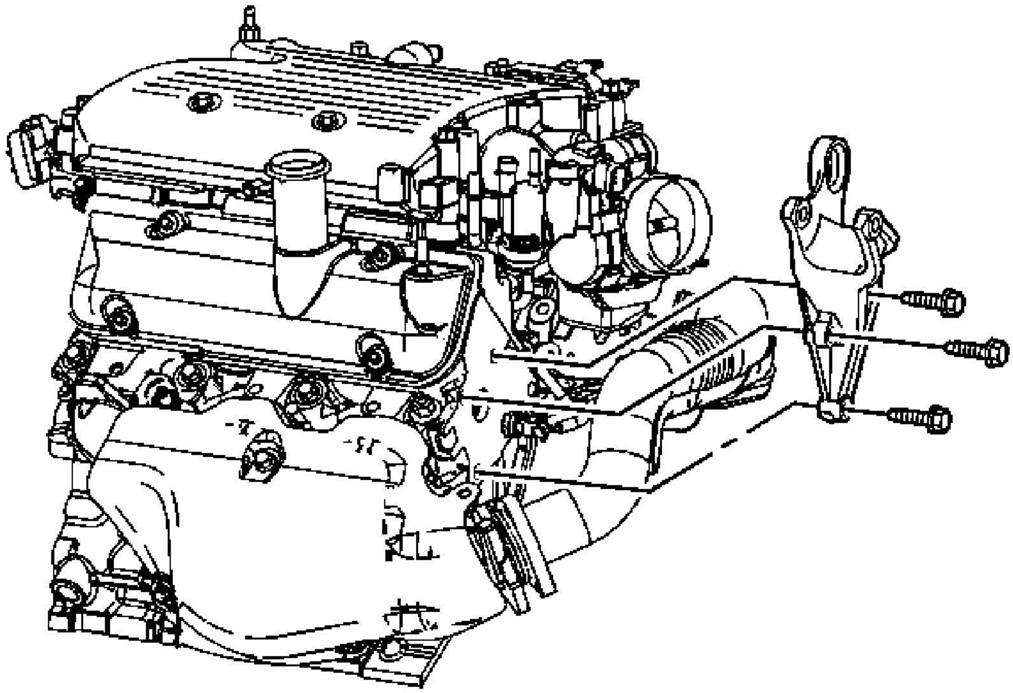


Fig. 37: View Of Engine Mount Strut Bracket
Courtesy of GENERAL MOTORS CORP.

1. Position the engine mount strut bracket to the cylinder head.

   NOTE: **Refer to Fastener Notice .**

2. Install the engine mount strut bracket to cylinder head bolts.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

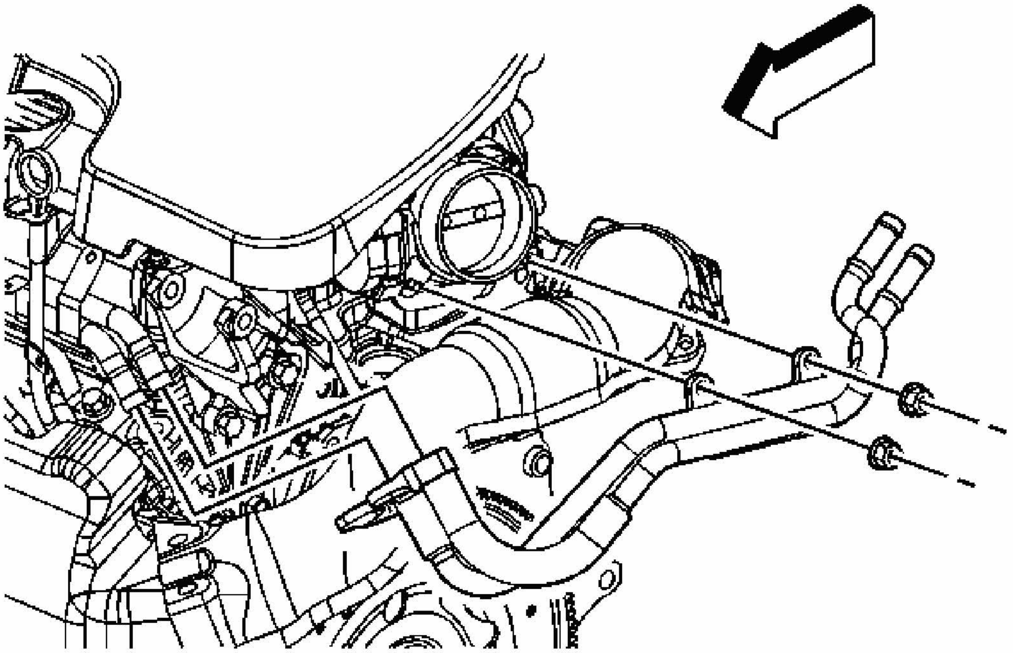


Fig. 38: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

3. Position and install the heater inlet and outlet hoses to the engine pipes.
4. Install the heater inlet and outlet hose clamp to the throttle body studs.
5. Position the heater inlet and outlet hose clamps at the pipes.
6. Install the heater inlet and outlet hose clamp nuts to the throttle body studs.

   Tighten: Tighten the nuts to 10 N.m (89 lb ft).

7. Install the engine mount strut. Refer to **Engine Mount Strut Replacement**.
8. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

OIL FILTER ADAPTER AND BYPASS VALVE ASSEMBLY REPLACEMENT

Removal Procedure

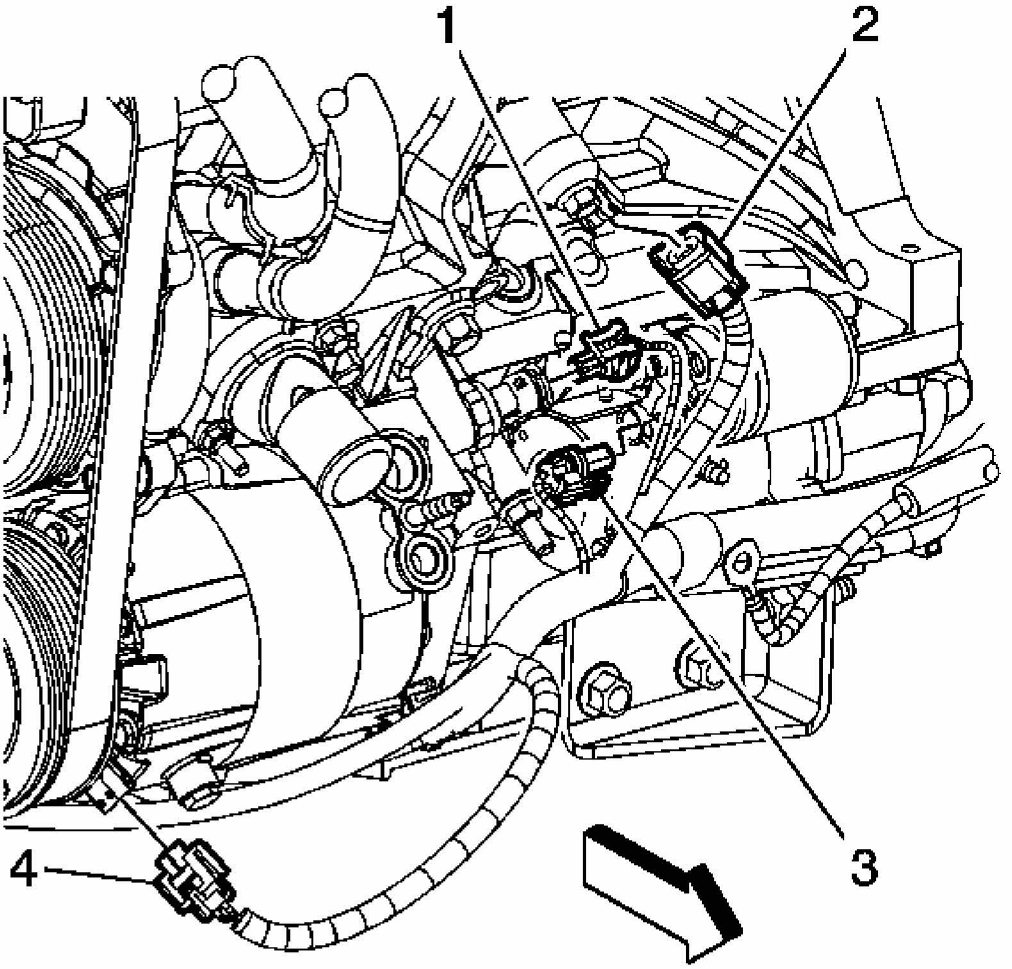


Fig. 39: Locating Oil Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Disconnect the oil pressure sensor electrical connector (1).

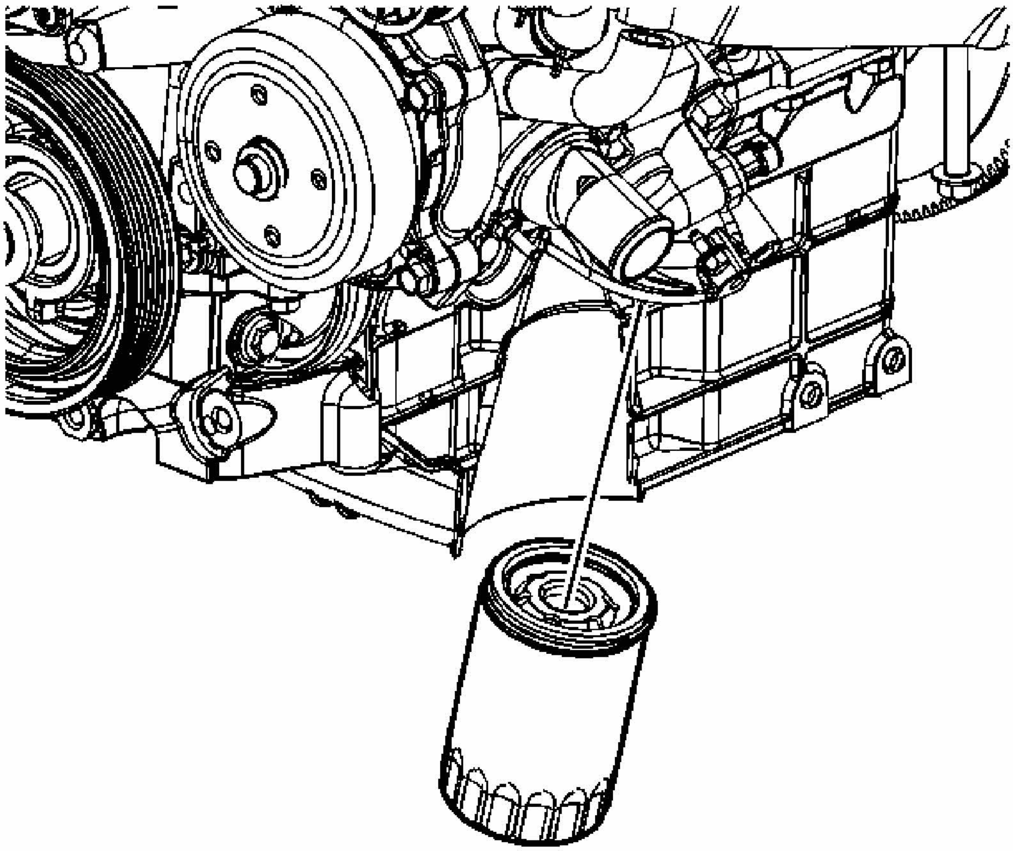


Fig. 40: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil filter.

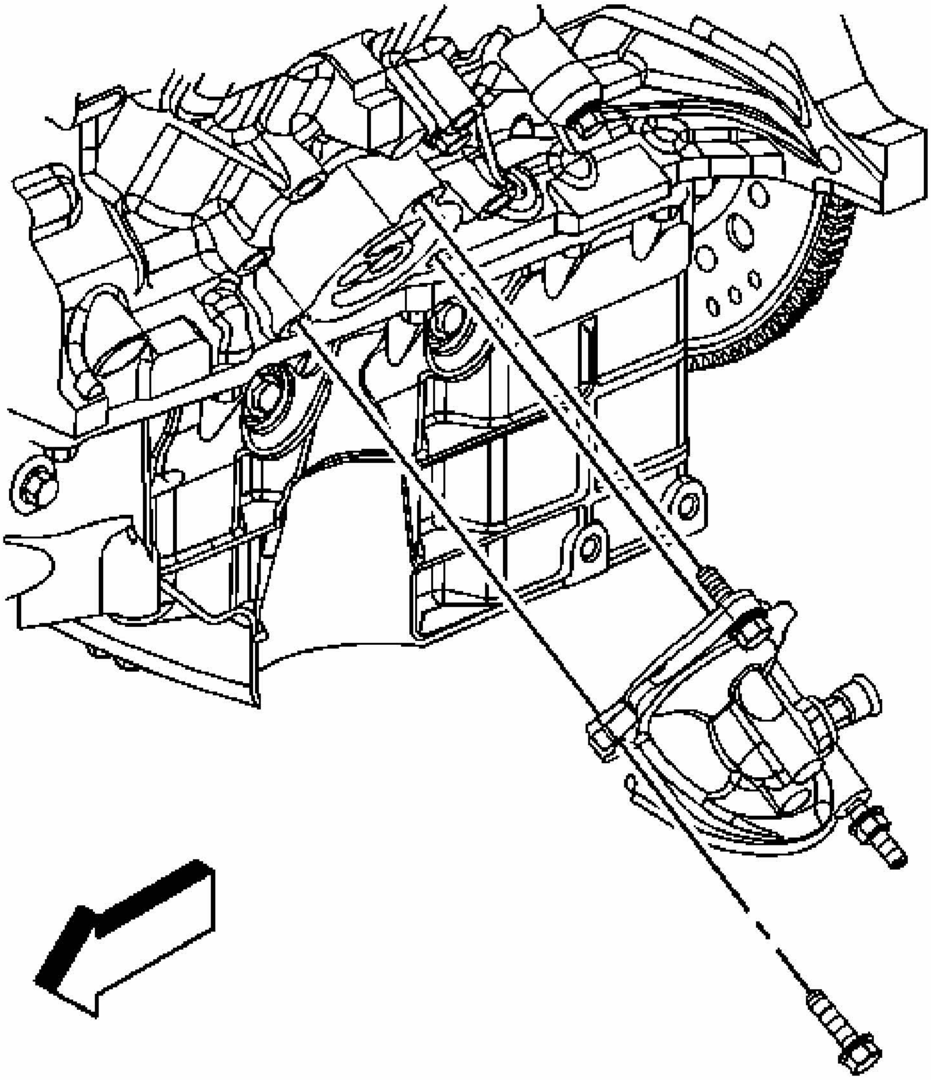


Fig. 41: Identifying Oil Filter Adapter Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

4. Remove the oil filter adapter bolts and stud.
5. Remove the oil filter adapter and gasket.

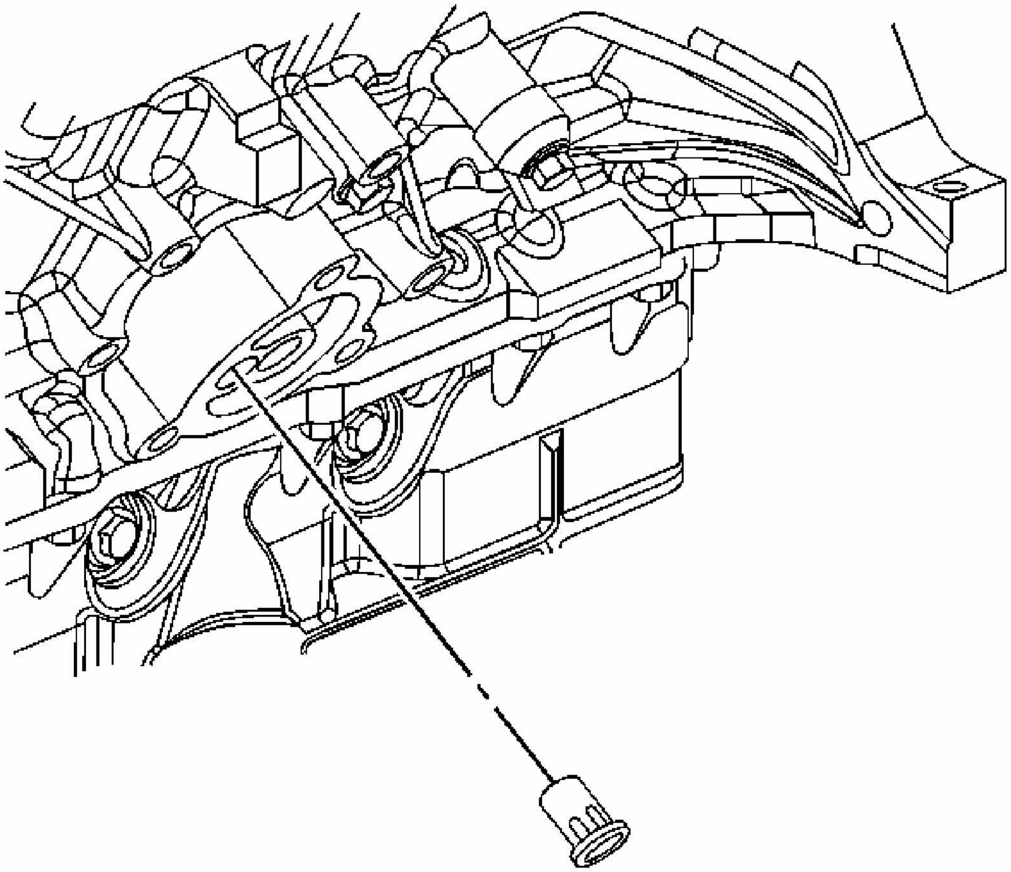


Fig. 42: Locating Oil Filter Bypass Hole & Bypass Valve
Courtesy of GENERAL MOTORS CORP.

6. Insert a flat-bladed tool into the oil filter bypass hole and remove the oil filter bypass valve.

Installation Procedure

NOTE: **Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.**

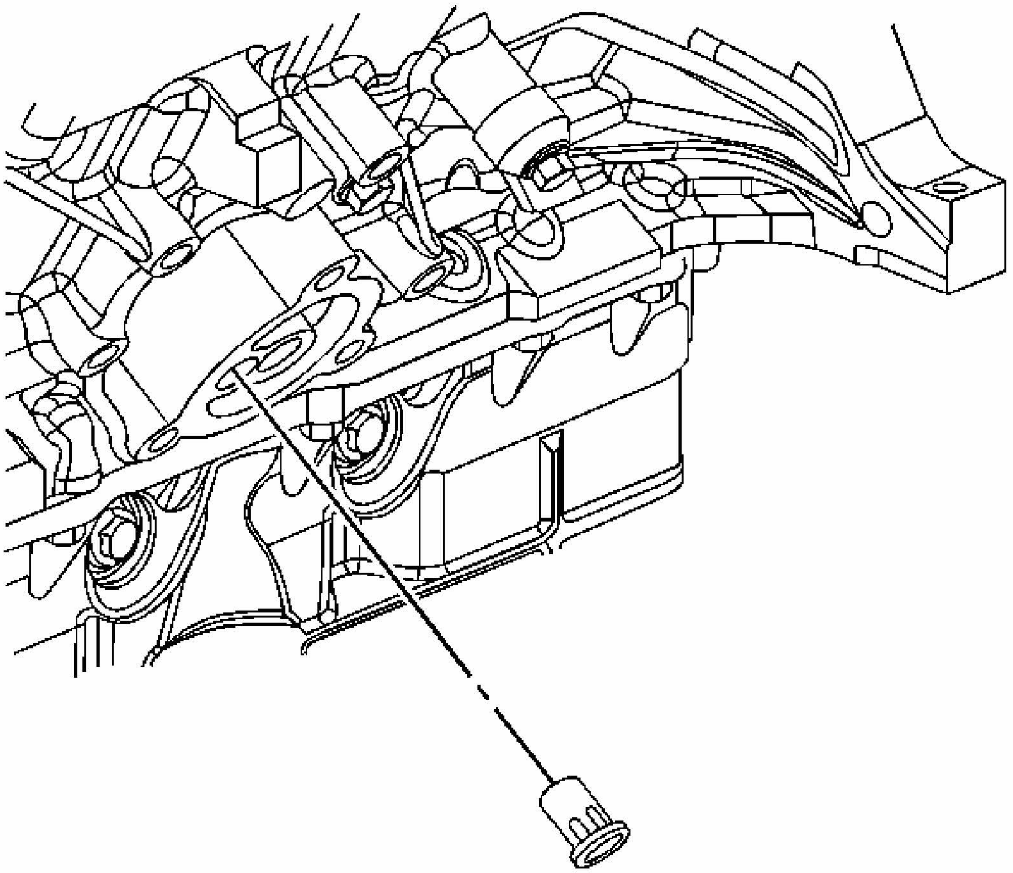


Fig. 43: Locating Oil Filter Bypass Hole & Bypass Valve
Courtesy of GENERAL MOTORS CORP.

1. Install the oil filter bypass valve. Seat the valve fully below the bypass valve hole chamfer.

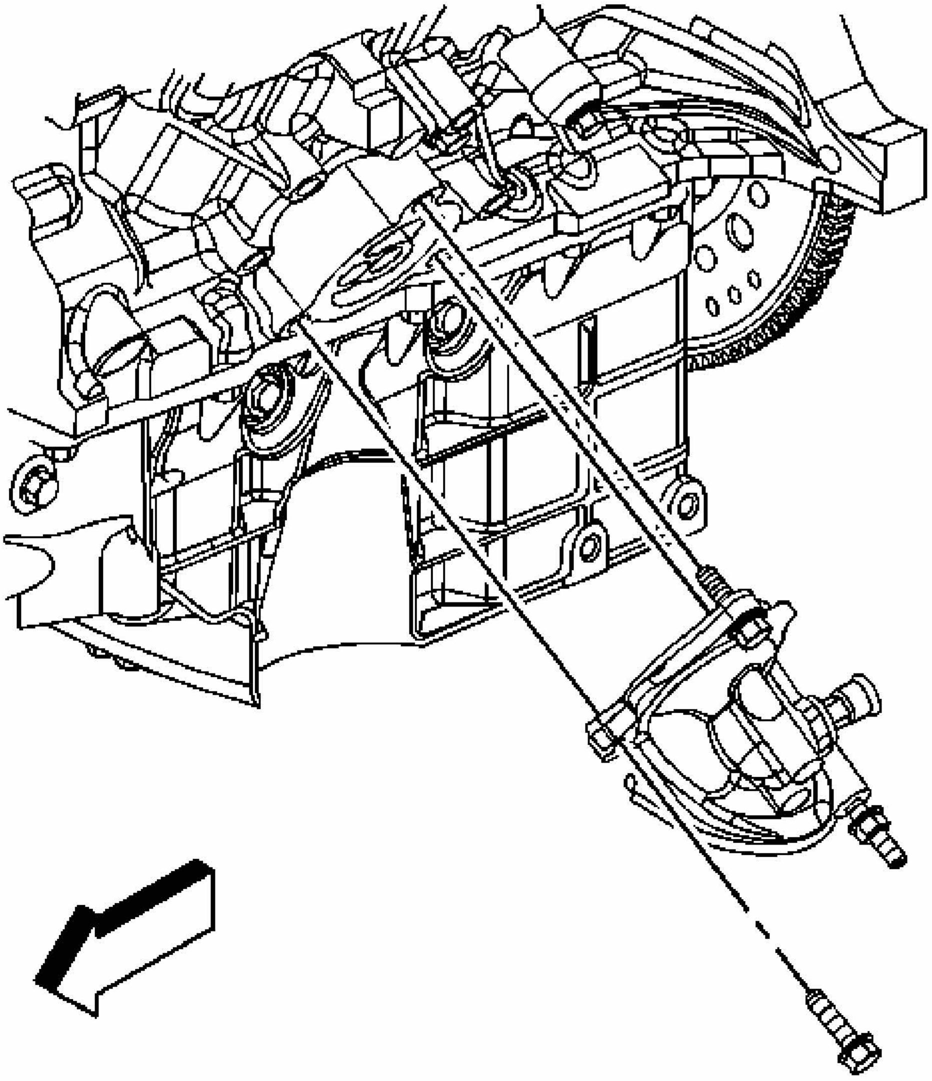


Fig. 44: Identifying Oil Filter Adapter Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

2. Position the oil filter adapter and gasket to the engine.
3. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent to the bolt/stud threads, if required.

NOTE: **Refer to Fastener Notice .**

4. Install the oil filter adapter bolts and stud.

   Tighten: Tighten the bolts and stud to 25 N.m (18 lb ft).

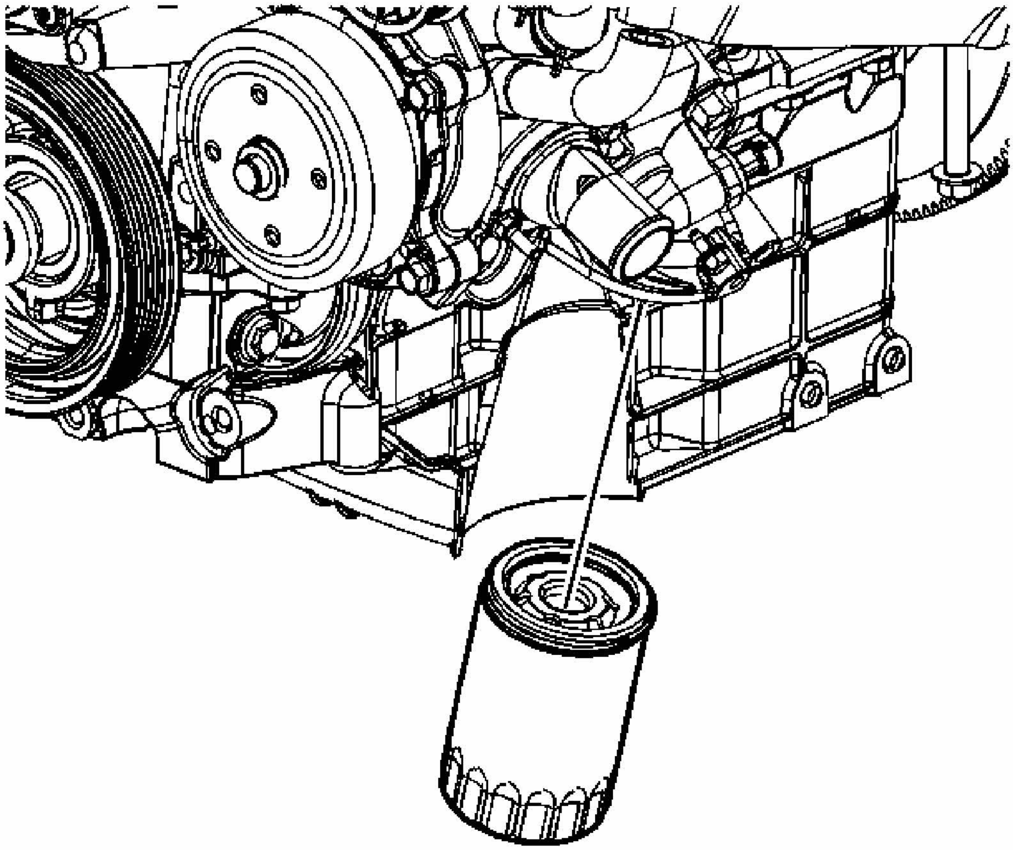


Fig. 45: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

5. Install the oil filter.

   Tighten: Tighten the filter to 30 N.m (22 lb ft).

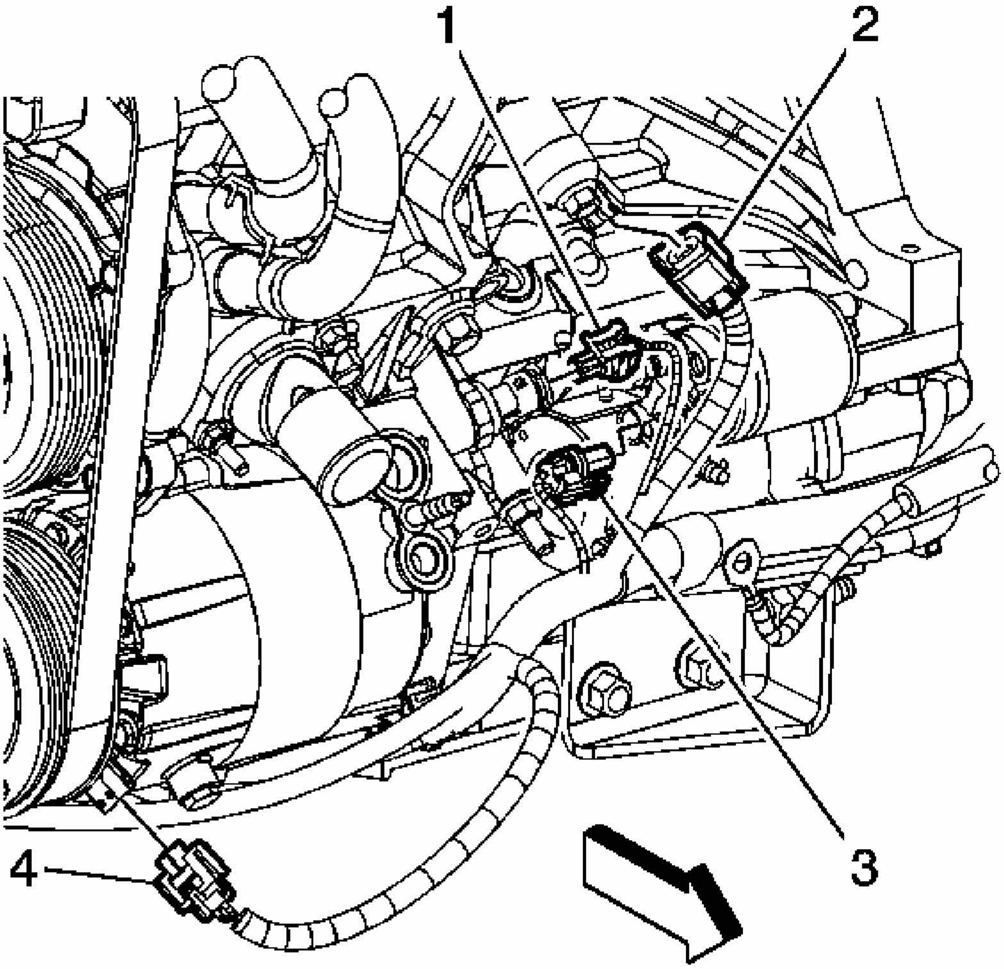


Fig. 46: Locating Oil Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the oil pressure sensor electrical connector (1).
7. Lower the vehicle.
8. Check and fill the crankcase, if necessary.

OIL LEVEL INDICATOR AND TUBE REPLACEMENT

Removal Procedure

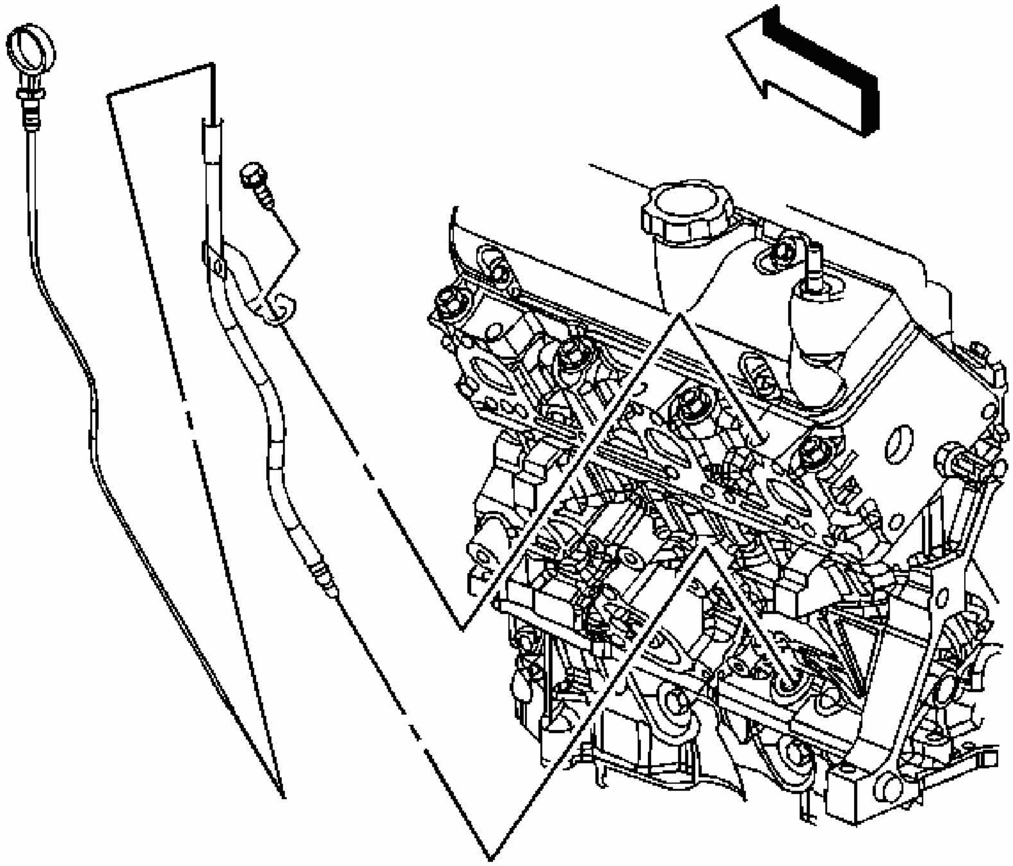


Fig. 47: Identifying Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil level indicator.
2. Remove the oil level indicator tube bracket bolt.
3. Remove the oil level indicator tube.
4. Inspect the oil level indicator tube O-ring seal, for damage, replace as necessary.

Installation Procedure

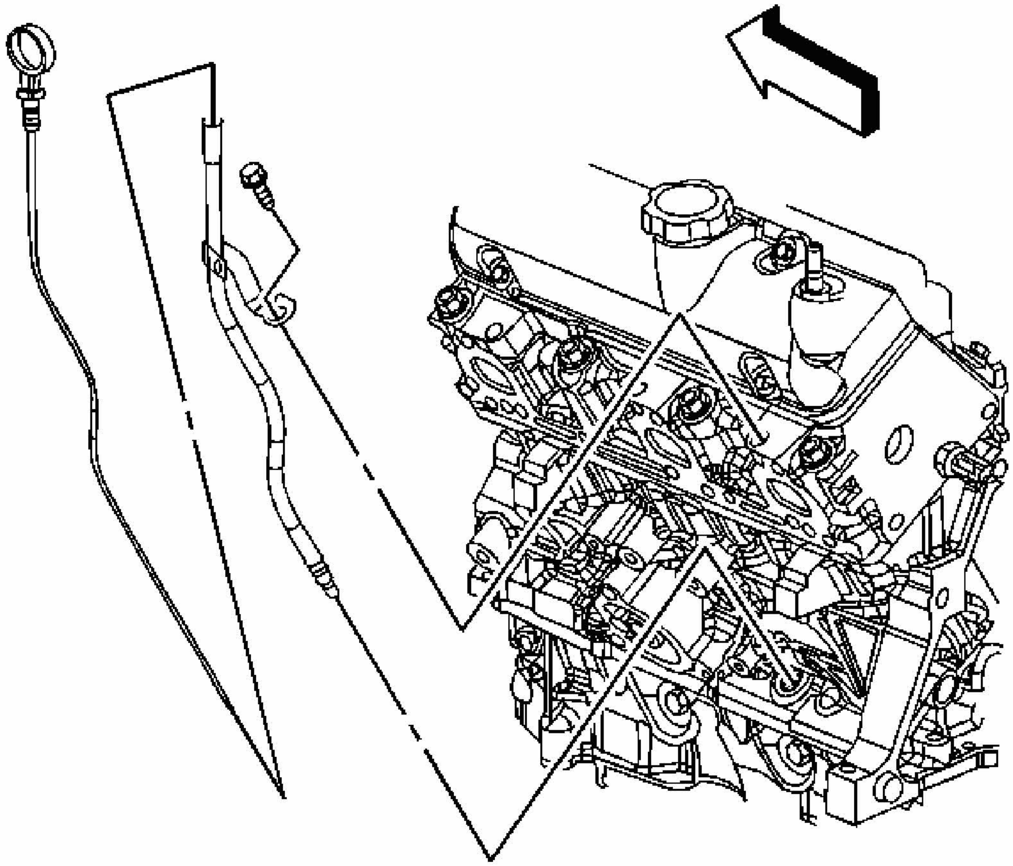


Fig. 48: Identifying Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the oil level indicator tube O-ring seal with clean engine oil.
2. Install the oil level indicator tube into the engine block.

NOTE: **Refer to FASTENER NOTICE .**

3. Install the oil level indicator tube bracket bolt.

   Tighten: Tighten the bolt to 25 N.m (18 lb ft).

4. Install the oil level indicator.

INTAKE MANIFOLD REPLACEMENT - UPPER

Removal Procedure

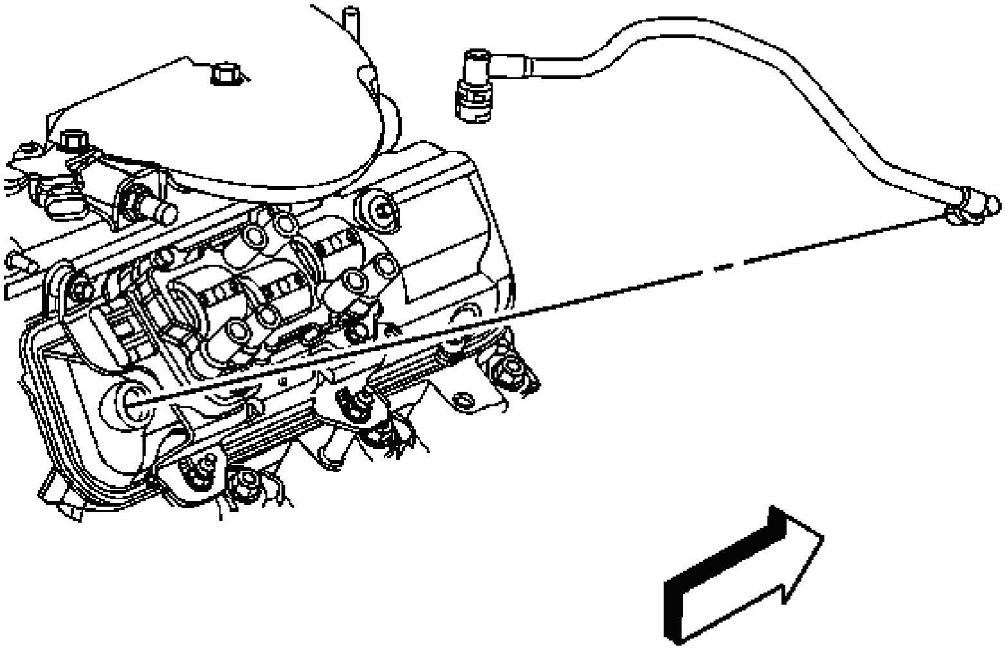


Fig. 49: Identifying Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .
2. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement** .
3. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
4. Remove the positive crankcase ventilation (PCV) fresh air tube. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

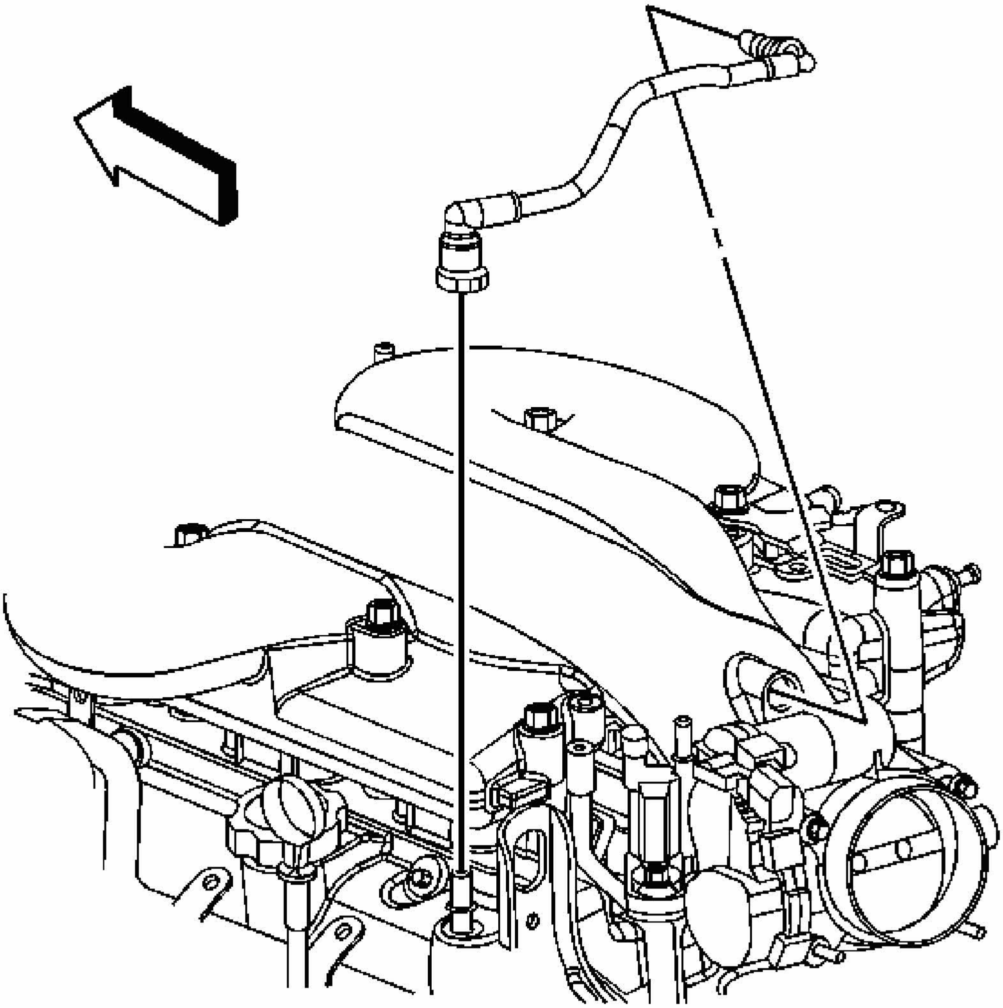


Fig. 50: Identifying Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Remove the PCV foul air tube. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

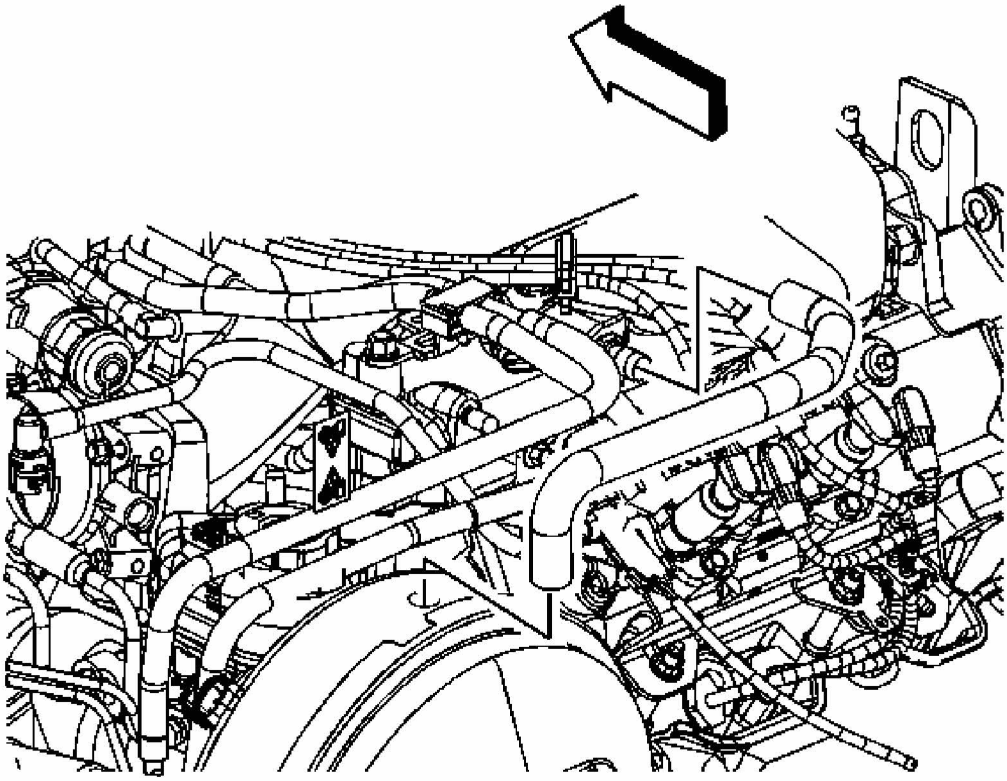


Fig. 51: View Of Brake Booster Vacuum Hose & Intake Manifold Fitting
Courtesy of GENERAL MOTORS CORP.

6. Remove the brake booster vacuum hose from the intake manifold fitting.

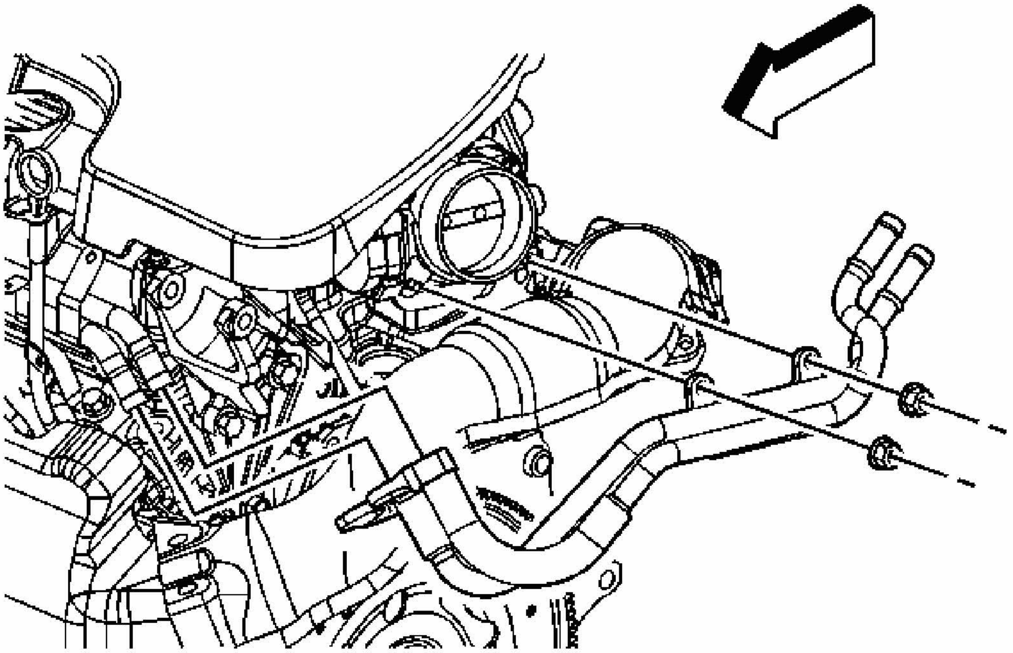


Fig. 52: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

7. Reposition the heater inlet and outlet hose/pipe clamps at the engine pipes.
8. Remove the heater inlet and outlet hose/pipe clamp nuts from the throttle body studs.
9. Remove the heater inlet and outlet hoses/pipes from the engine pipes and the throttle body studs.
10. Reposition the hoses/pipes out of the way.

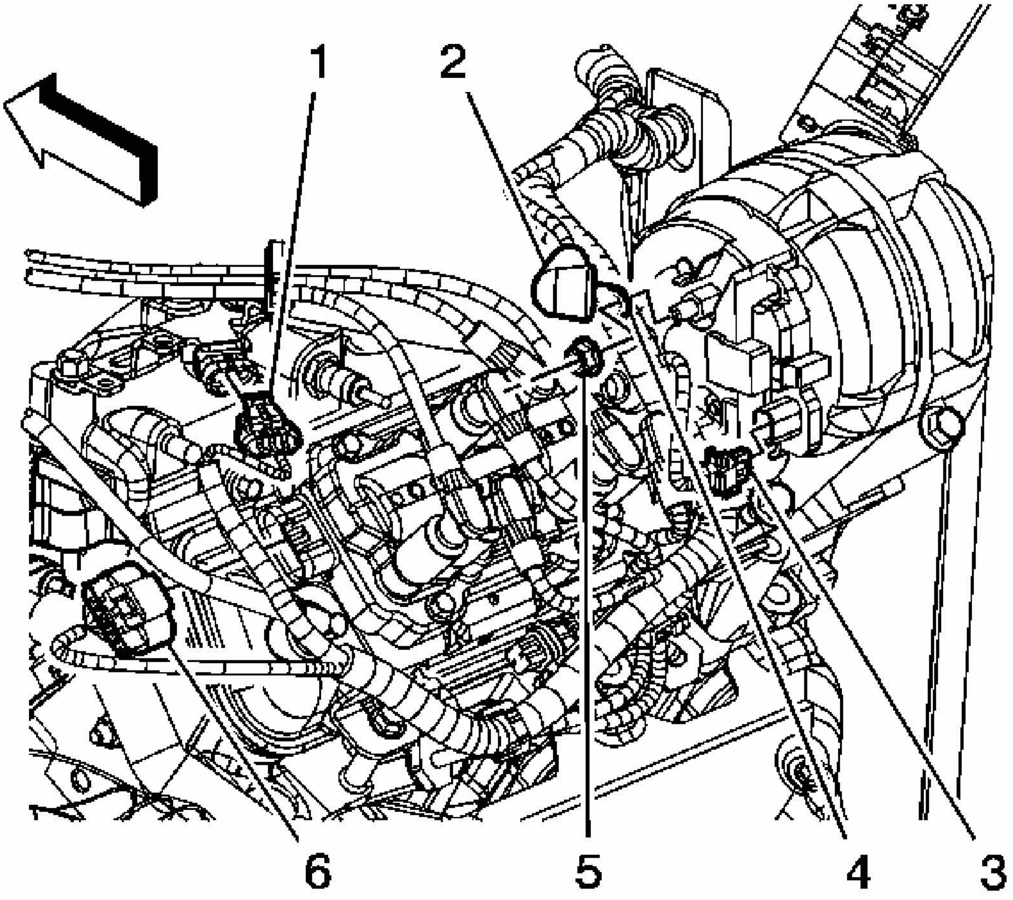


Fig. 53: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

11. Remove the fuel feed and evaporative emission (EVAP) line clip from the manifold absolute pressure (MAP) sensor bracket.
12. Disconnect the MAP sensor electrical connector (1).

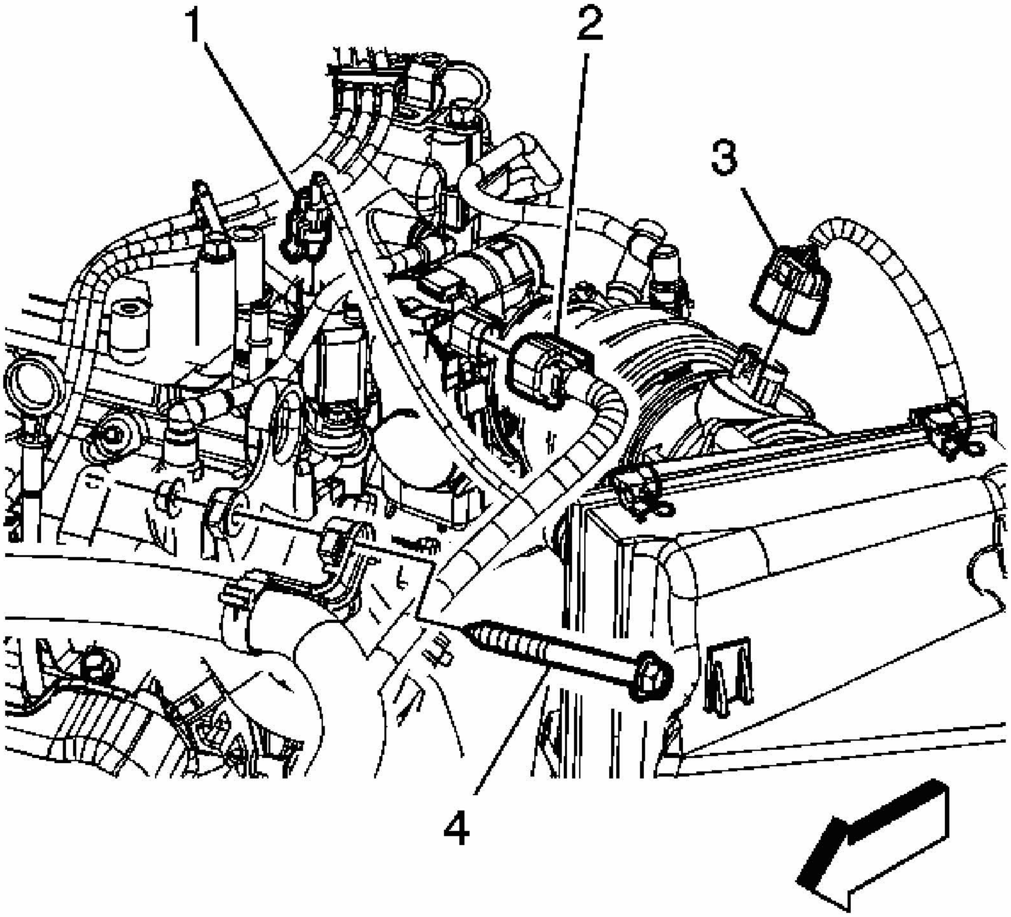


Fig. 54: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

13. Disconnect the EVAP canister purge solenoid electrical connector (1).
14. Disconnect the chassis EVAP line quick connect fitting from the purge solenoid. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
15. Disconnect the electronic throttle control (ETC) electrical connector (2).

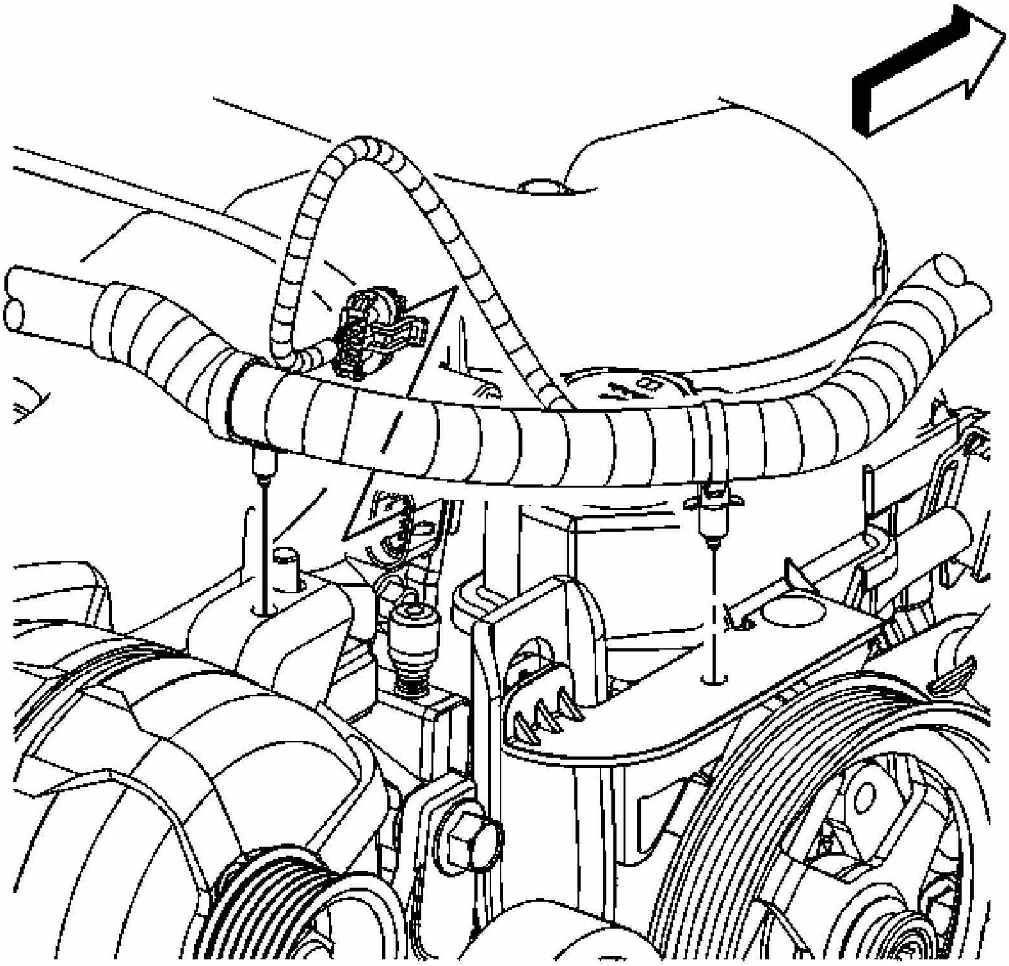


Fig. 55: View Of Intake Manifold Tuning Valve Electrical Connector
Courtesy of GENERAL MOTORS CORP.

16. Disconnect the intake manifold tuning valve electrical connector.

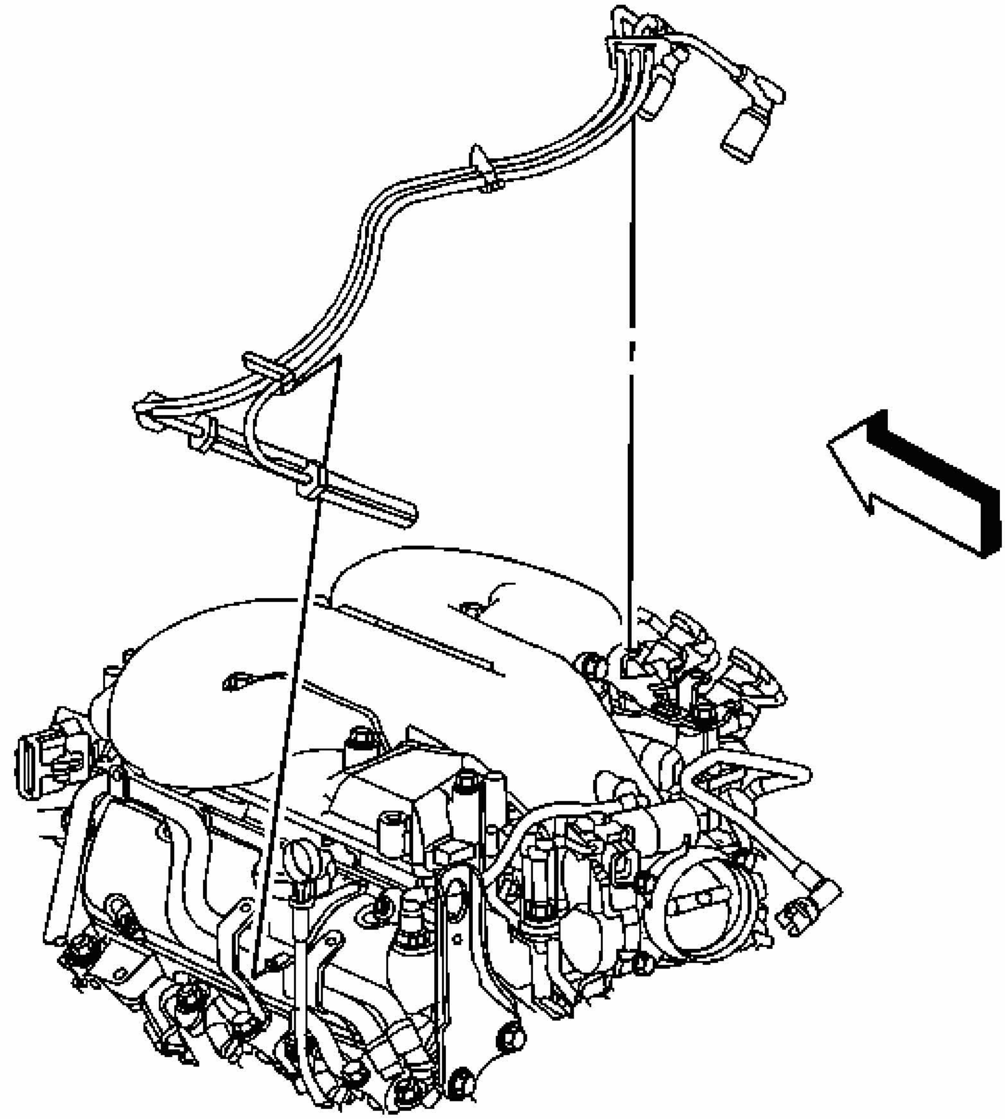


Fig. 56: View Of Left Spark Plug/Coil Harness
Courtesy of GENERAL MOTORS CORP.

17. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
18. Disconnect the left side spark plug wires from the spark plugs.
19. Disconnect the left side spark plug wires from the ignition coil.
20. Disengage the spark plug wire retainer clips from the intake manifold bracket and the heater inlet/outlet hose/pipe bracket.
21. Remove the left side spark plug wires.

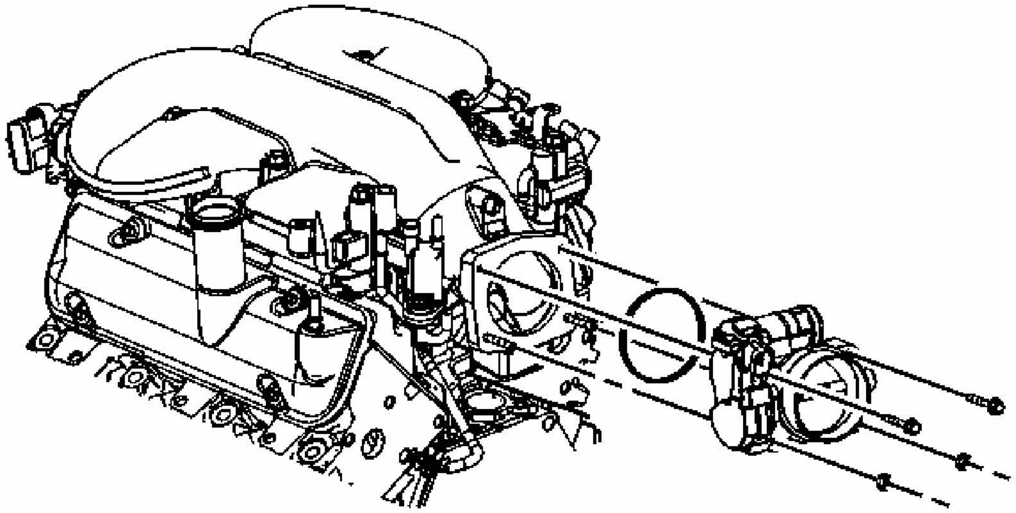


Fig. 57: Locating Throttle Body, Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

22. Remove the throttle body bolts and nuts.
23. Remove the throttle body and gasket.

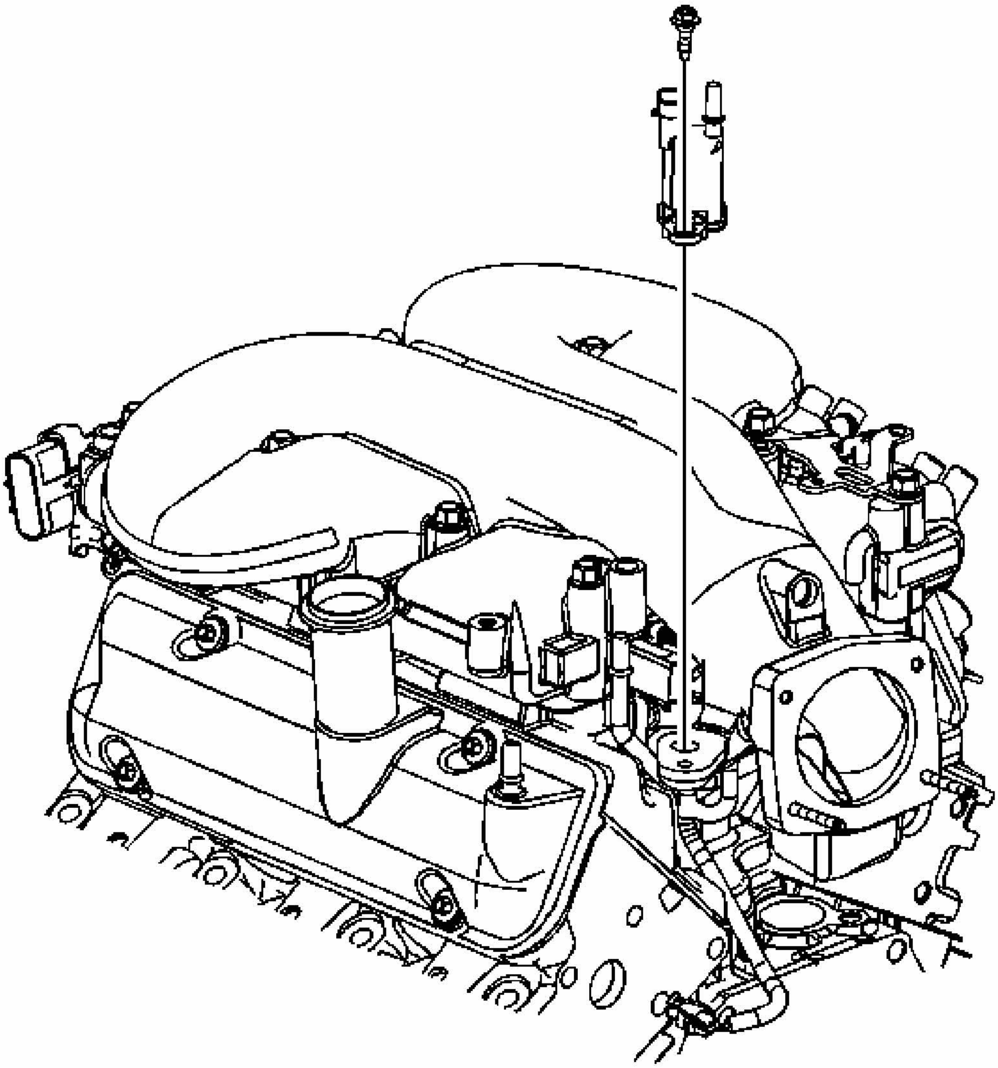


Fig. 58: Locating EVAP Canister Purge Solenoid Valve Bolt
Courtesy of GENERAL MOTORS CORP.

24. Remove the EVAP canister purge solenoid valve bolt.
25. Remove the EVAP canister purge solenoid valve.

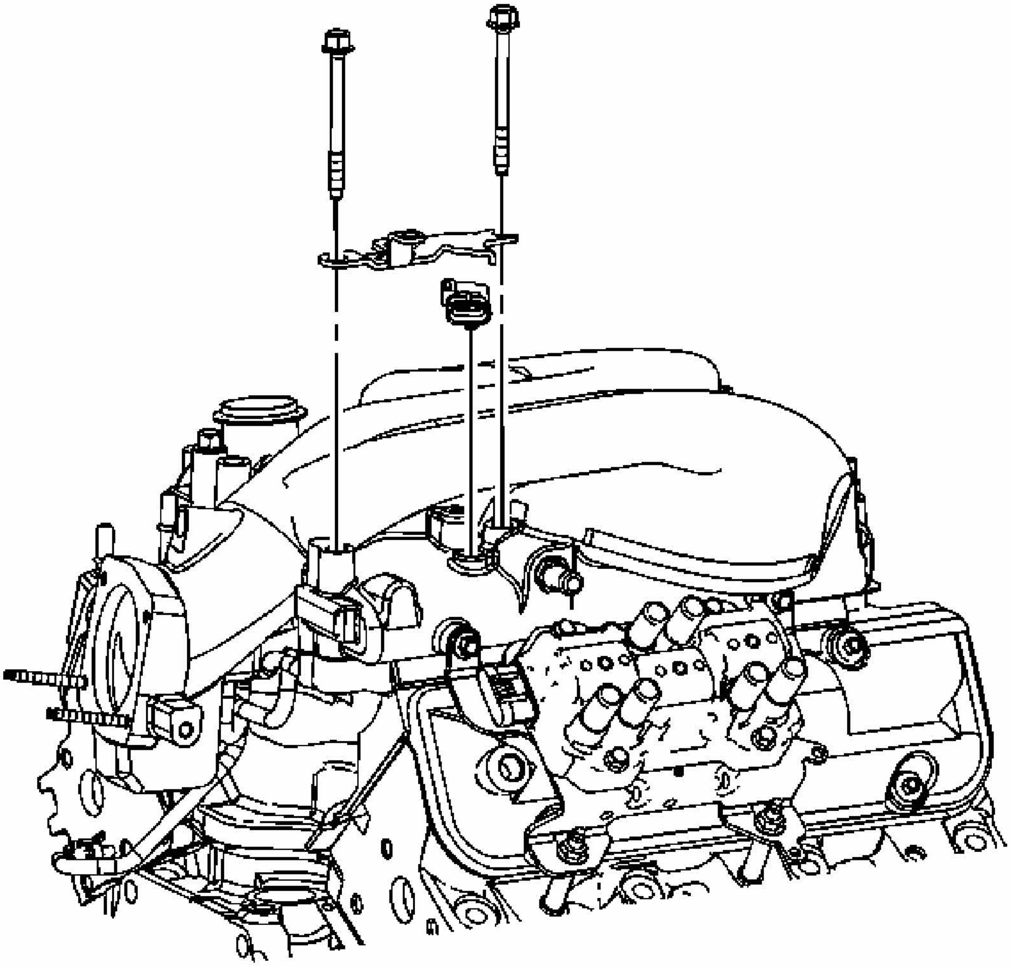


Fig. 59: View Of MAP Sensor Bracket/Upper Intake Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

26. Remove the MAP sensor bracket/upper intake manifold bolts.
27. Remove the MAP sensor bracket and sensor.

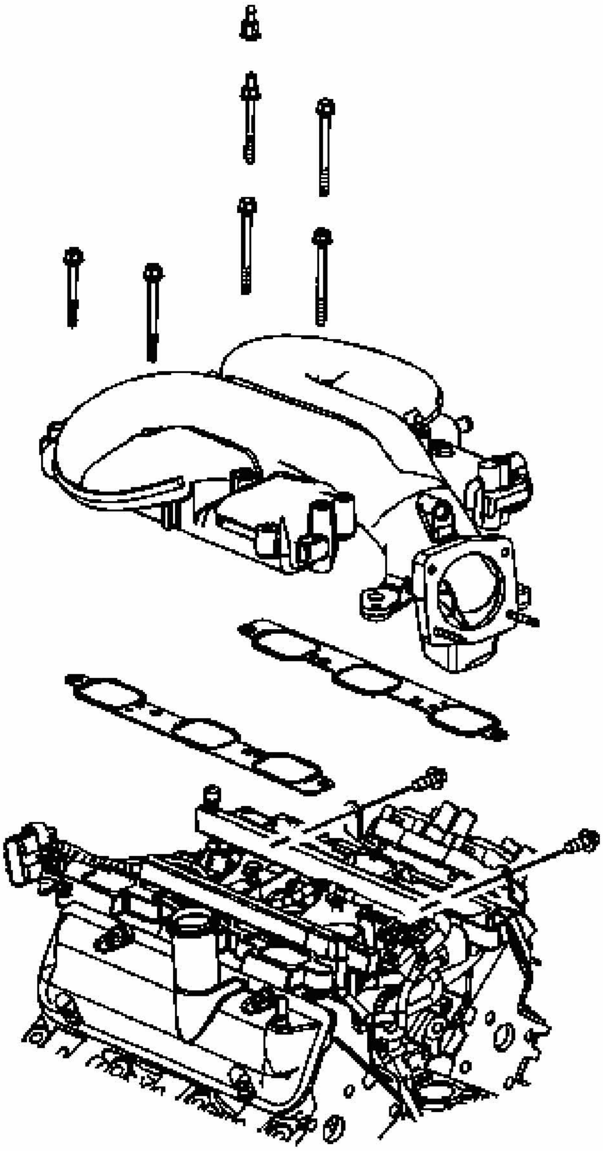


Fig. 60: View Of Intake Manifold, Ignition Coil Bracket, Gaskets & Bolts
Courtesy of GENERAL MOTORS CORP.

28. Remove the ignition coil bracket to intake manifold bolts.
29. Remove the intake manifold cover ball stud nut from the intake manifold stud.
30. Remove the upper intake manifold bolts and stud.
31. Separate and remove the upper intake manifold from the lower intake manifold.
32. Remove the upper to lower intake manifold gaskets.

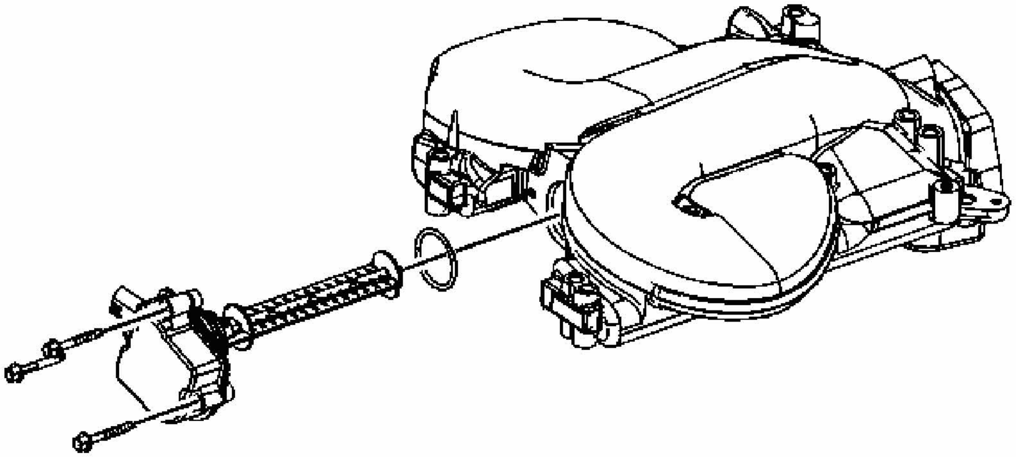


Fig. 61: View Of Intake Manifold Tuning Valve
Courtesy of GENERAL MOTORS CORP.

33. Remove the intake manifold tuning valve bolts, valve, and seal.
34. Clean the upper intake to lower intake gasket mating surfaces.

Installation Procedure

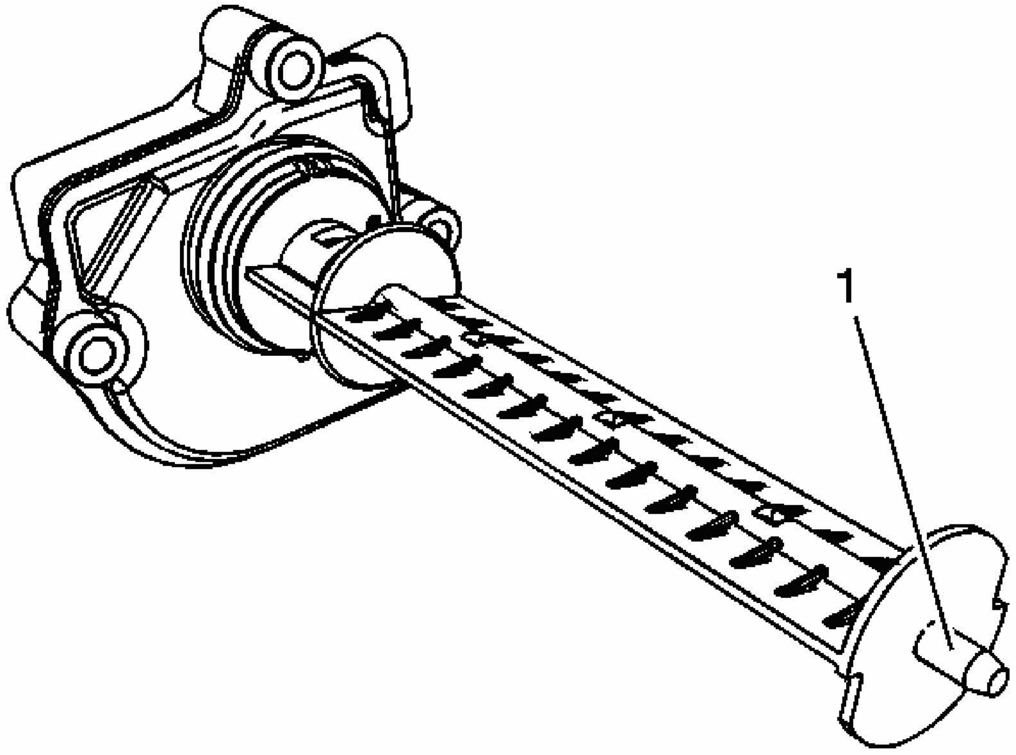


Fig. 62: View Of Tuning Valve Blade
Courtesy of GENERAL MOTORS CORP.

1. Inspect the intake manifold tuning valve seal for damage. The tuning valve blade attachment to motor should be tight, with no looseness or slack present. Replace as necessary.
2. Apply lubricant GM P/N 01050344 (Canadian P/N 993037) or equivalent to the nose of the valve blade (1).

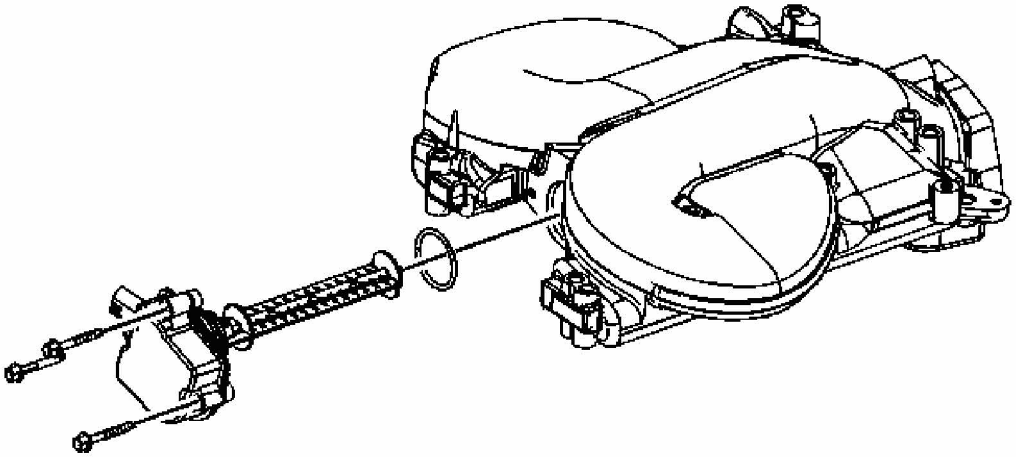


Fig. 63: View Of Intake Manifold Tuning Valve
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

3. Install the intake manifold tuning valve seal, valve, and bolts.

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

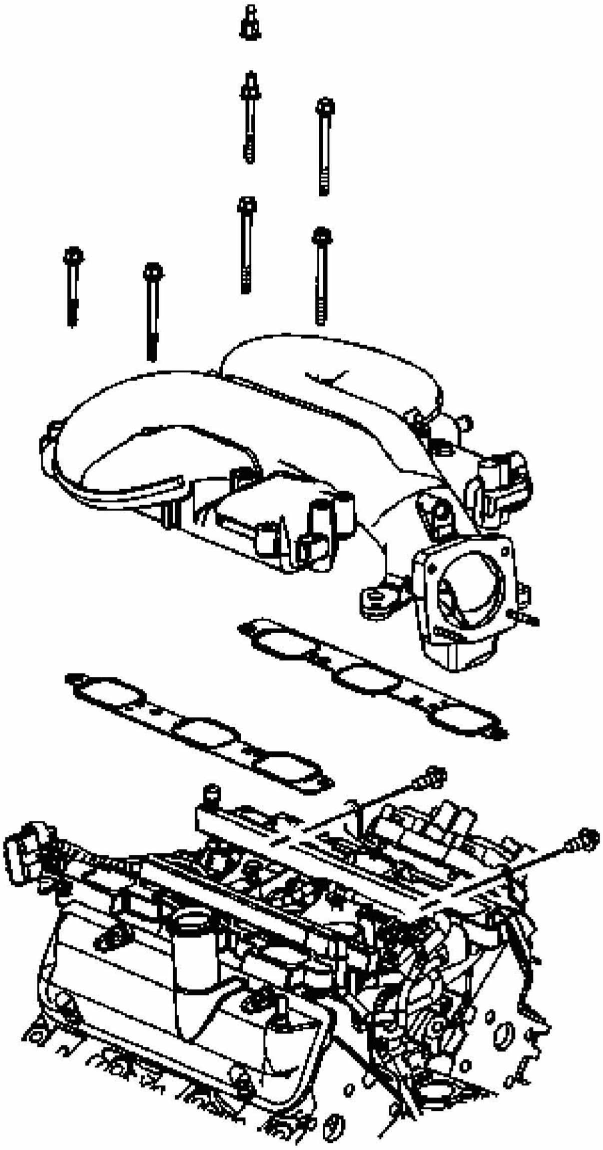


Fig. 64: View Of Intake Manifold, Ignition Coil Bracket, Gaskets & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install NEW upper to lower intake manifold gaskets.
5. Install the upper intake manifold onto the lower intake manifold.
6. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or equivalent, to the upper intake manifold bolts/stud threads.
7. Install the upper intake manifold bolts and stud.

Tighten: Tighten the bolts and stud to 25 N.m (18 lb ft).

8. Install the intake manifold cover ball stud nut to the intake manifold stud.

   Tighten: Tighten the nut to 5 N.m (44 lb in).

9. Install the ignition coil bracket to intake manifold bolts.

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

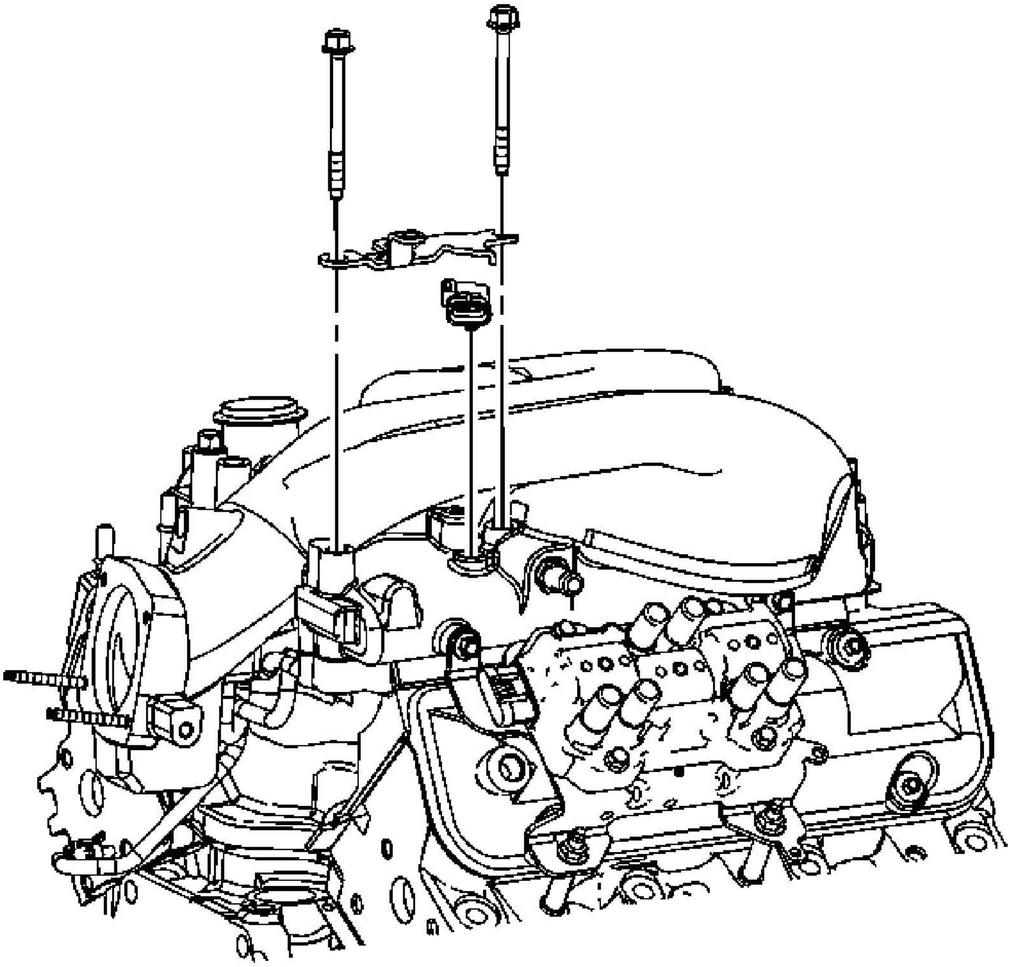


Fig. 65: View Of MAP Sensor Bracket/Upper Intake Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

10. Install the MAP sensor and bracket.
11. Install the MAP sensor bracket/upper intake manifold bolts.

Tighten: Tighten the bolts to 25 N.m (18 lb ft).

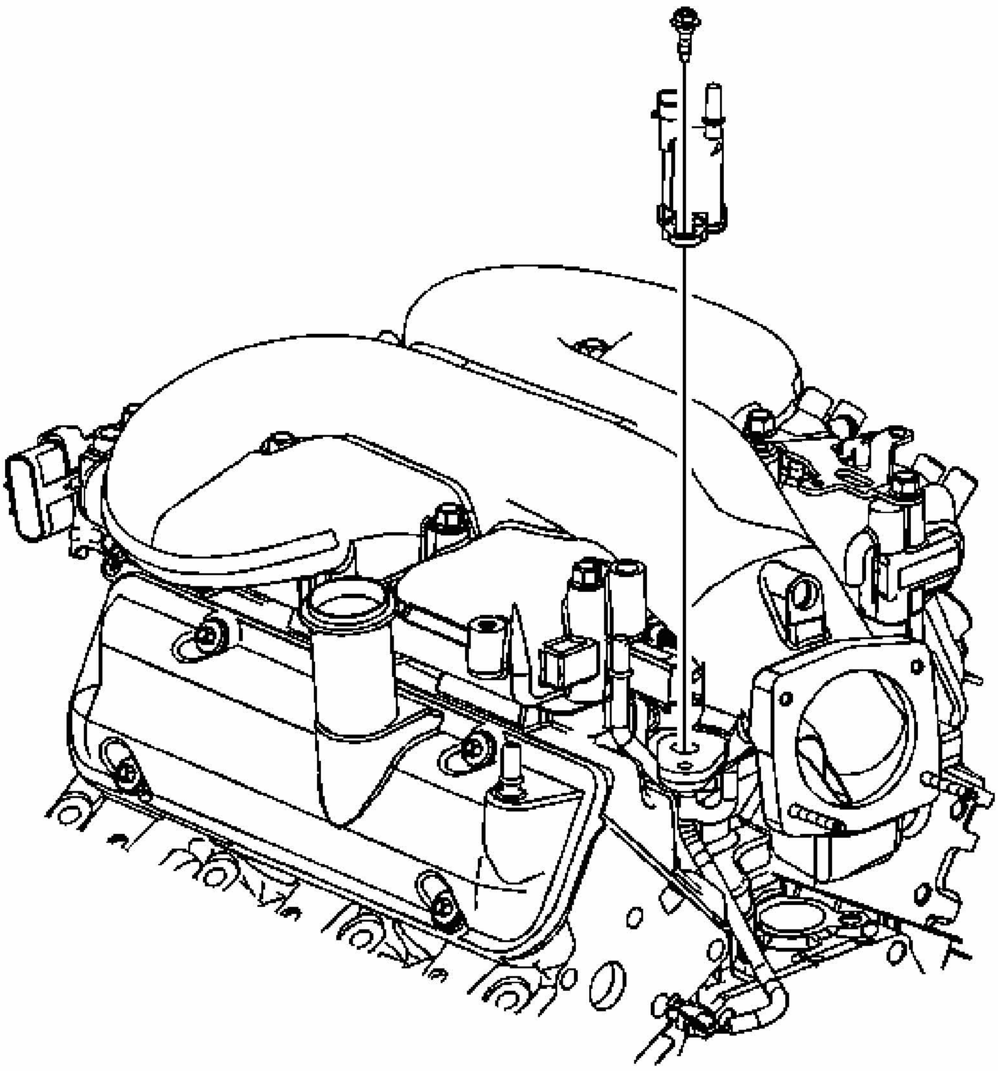


Fig. 66: Locating EVAP Canister Purge Solenoid Valve & Bolt
Courtesy of GENERAL MOTORS CORP.

12. Install the EVAP canister purge solenoid valve.
13. Install the EVAP canister purge solenoid valve bolt.

Tighten: Tighten the bolts to 16 N.m (12 lb ft).

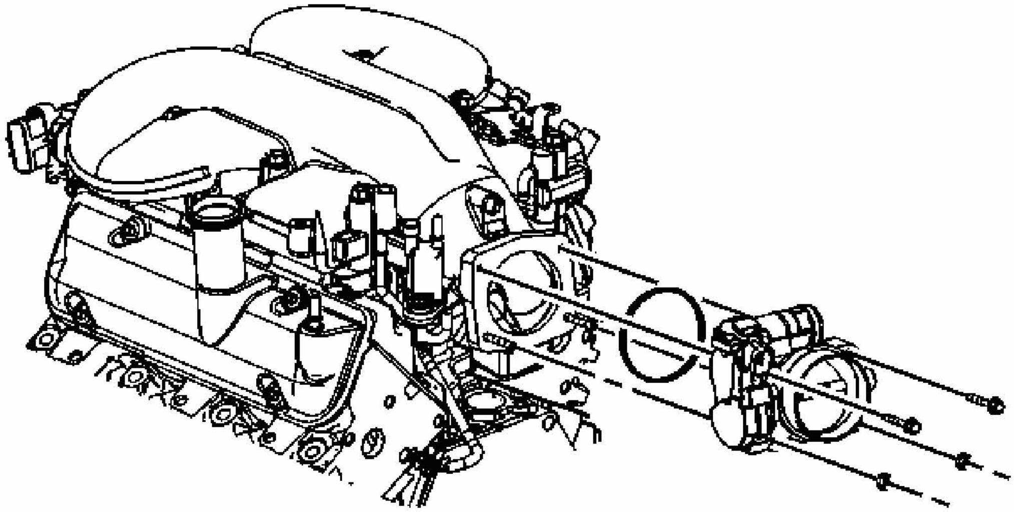


Fig. 67: Locating Throttle Body, Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

14. Inspect the throttle body seal for damage. Replace as necessary.
15. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or equivalent, to the throttle body bolts/studs threads.
16. Position the throttle body gasket and throttle body to the intake.
17. Install the throttle body bolts and nuts.

    Tighten: Tighten the bolts/studs to 10 N.m (89 lb in).

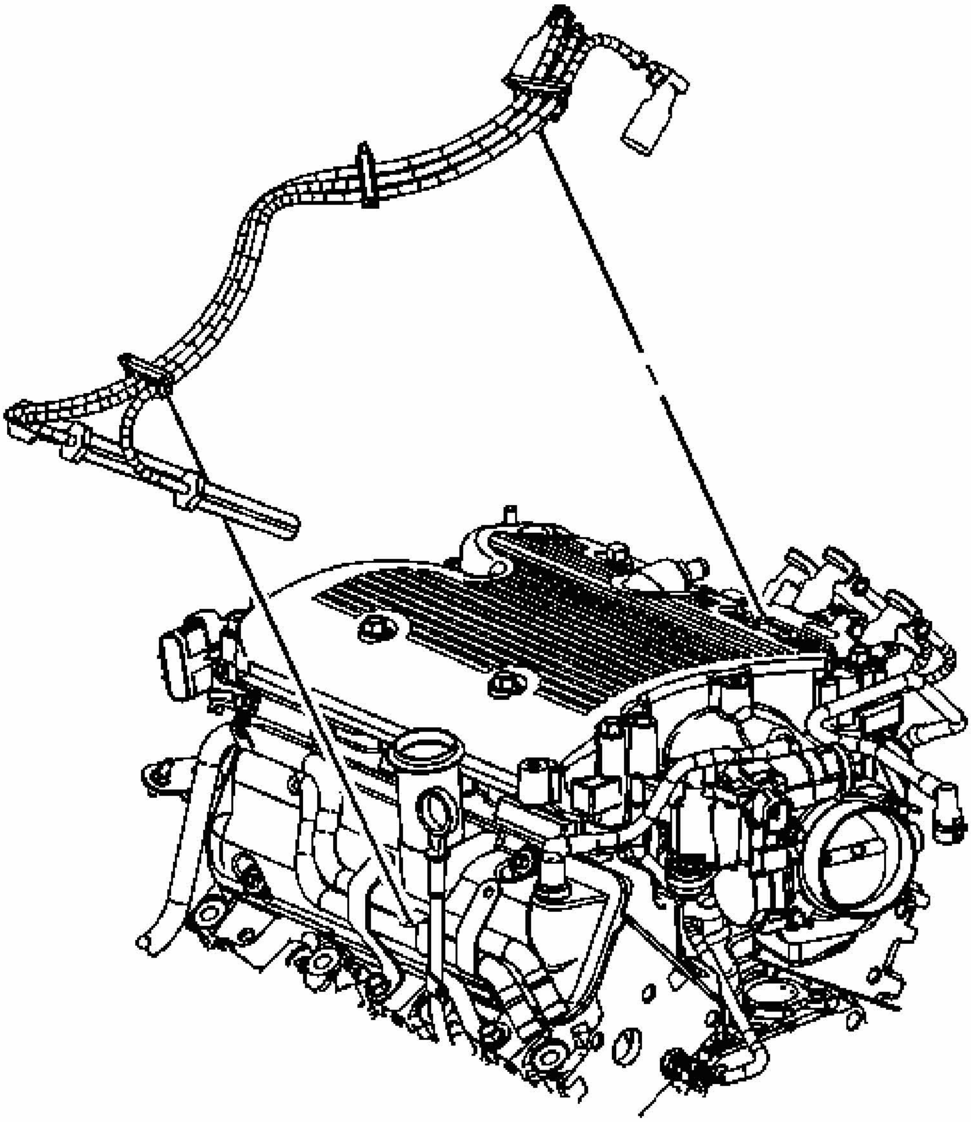


Fig. 68: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

18. Install the left side spark plug wires.
19. Engage the spark plug wire retainer clips to the intake manifold bracket and the heater inlet/outlet hose/pipe bracket.
20. Connect the left side spark plug wires to the ignition coil.
21. Connect the left side spark plug wires to the spark plugs.
22. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .

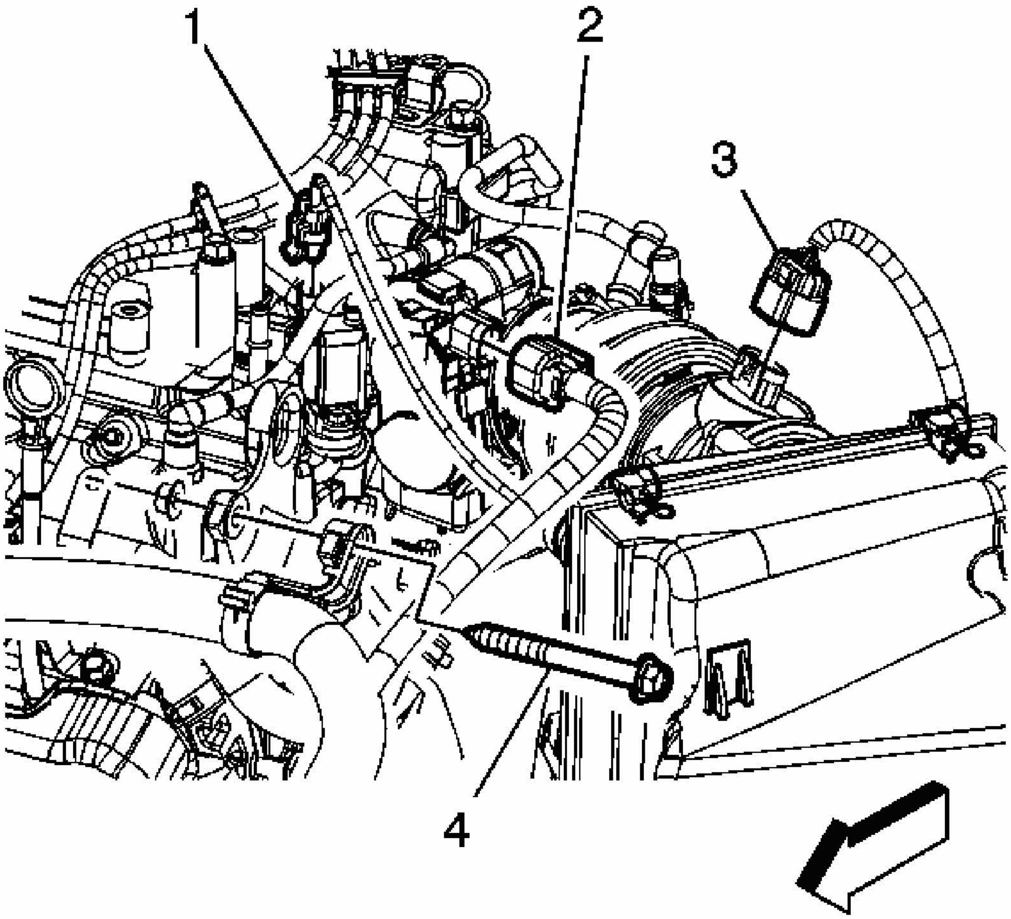


Fig. 69: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

23. Connect the EVAP canister purge solenoid electrical connector (1).
24. Connect the chassis EVAP line quick connect fitting to the purge solenoid. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
25. Connect the ETC electrical connector (2).

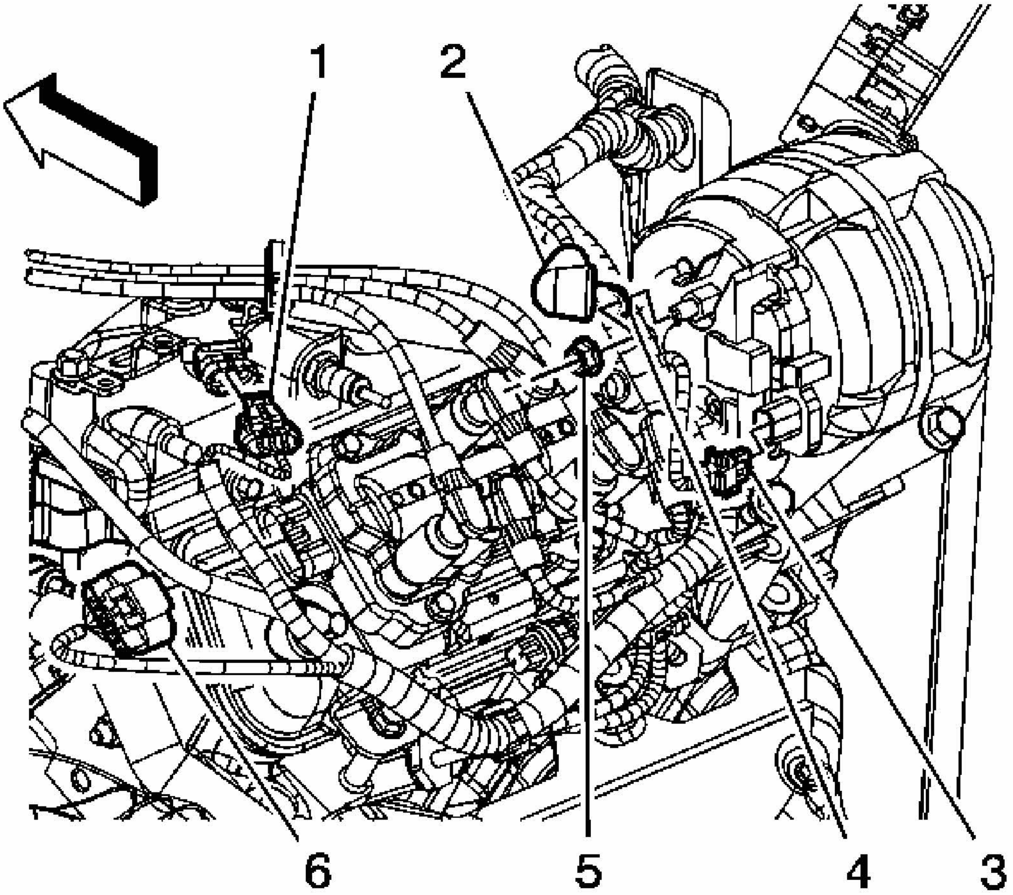


Fig. 70: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

26. Connect the MAP sensor electrical connector (1).
27. Install the fuel feed and EVAP line clip to the MAP sensor bracket.

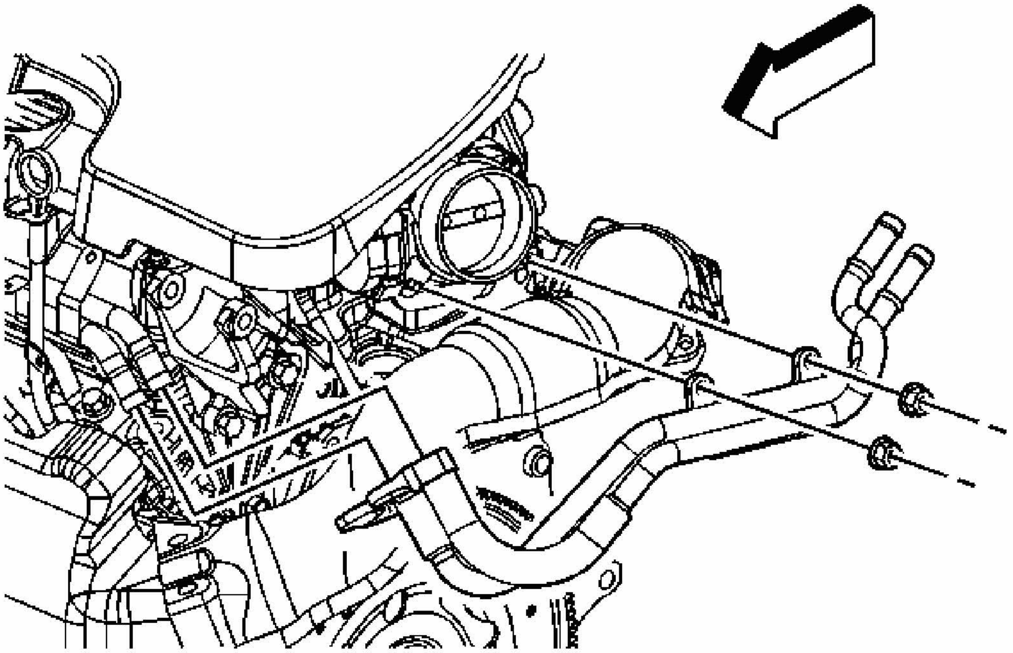


Fig. 71: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

28. Position the hoses/pipes.
29. Install the heater inlet and outlet hoses/pipes to the engine pipes and the throttle body studs.
30. Install the heater inlet and outlet hose/pipe clamp nuts to the throttle body studs.

    Tighten: Tighten the nuts to 10 N.m (89 lb in).

31. Position the heater inlet and outlet hose/pipe clamps at the engine pipes.

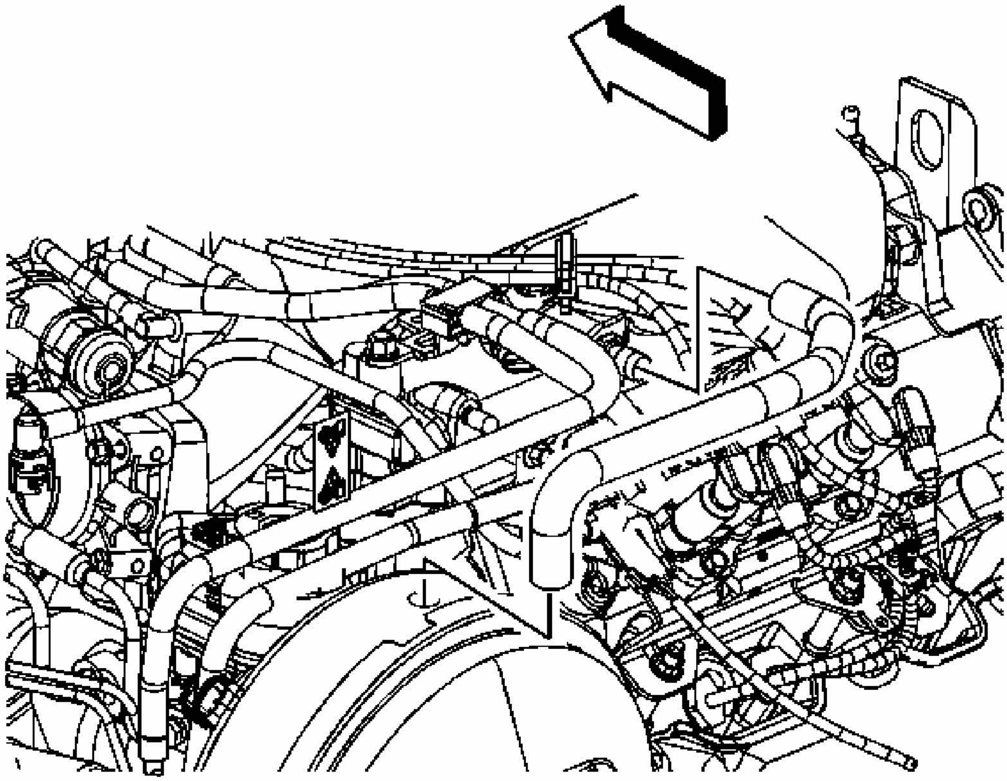


Fig. 72: View Of Brake Booster Vacuum Hose & Intake Manifold Fitting
Courtesy of GENERAL MOTORS CORP.

32. Install the brake booster vacuum hose to the intake manifold.

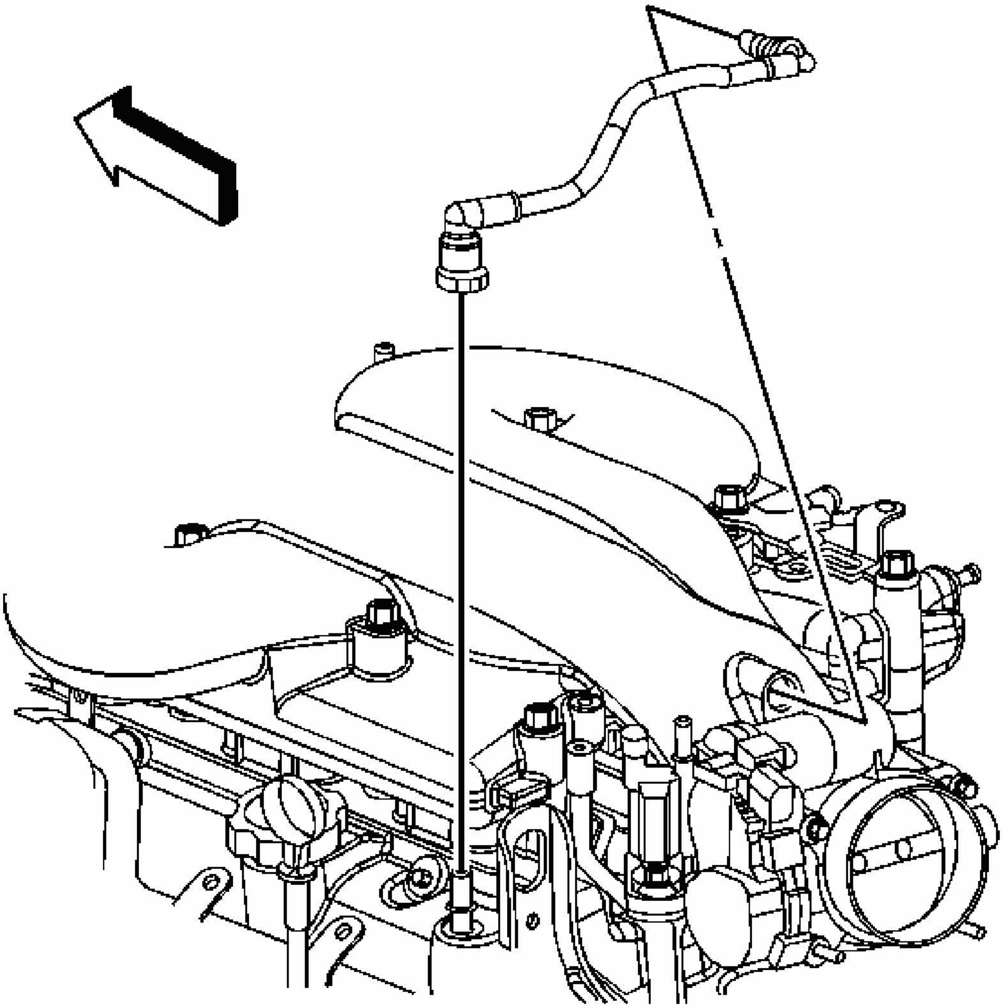


Fig. 73: Identifying Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

33. Install the PCV foul air tube. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

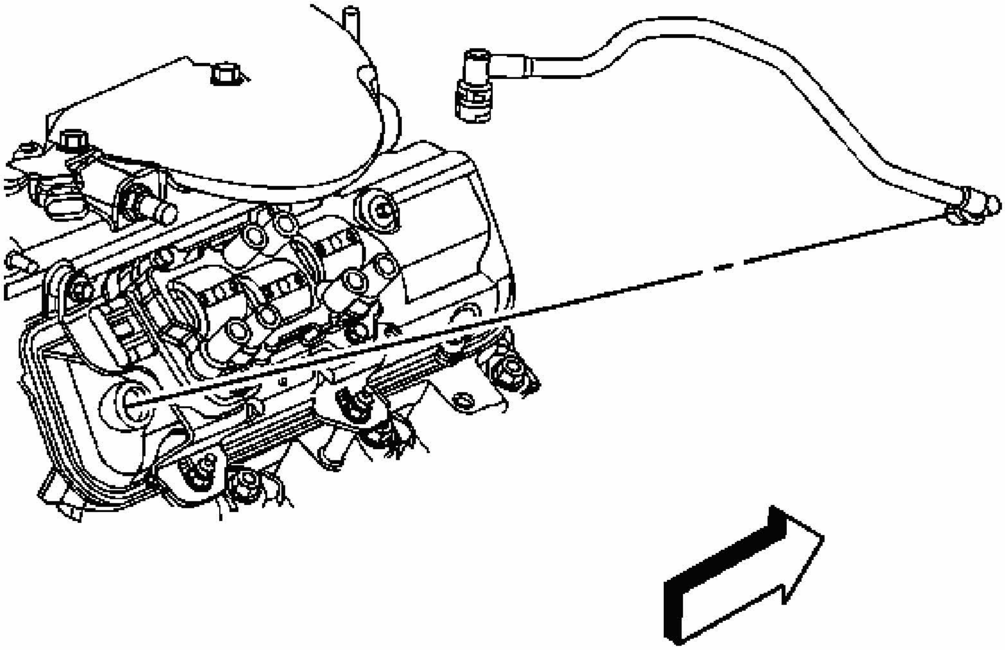


Fig. 74: Identifying Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

34. Install the PCV fresh air tube. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
35. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
36. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement** .
37. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .

INTAKE MANIFOLD REPLACEMENT - LOWER

Removal Procedure

IMPORTANT: **This engine uses a sequential multiport fuel injection system. Injector wiring harness connectors must be connected to their appropriate fuel injector or exhaust emissions and engine**

performance may be seriously affected.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .
2. Remove the upper intake manifold. Refer to **Intake Manifold Replacement - Upper**.
3. Remove the left valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Left**.
4. Remove the right valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Right**.
5. Disconnect the fuel feed line from the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .

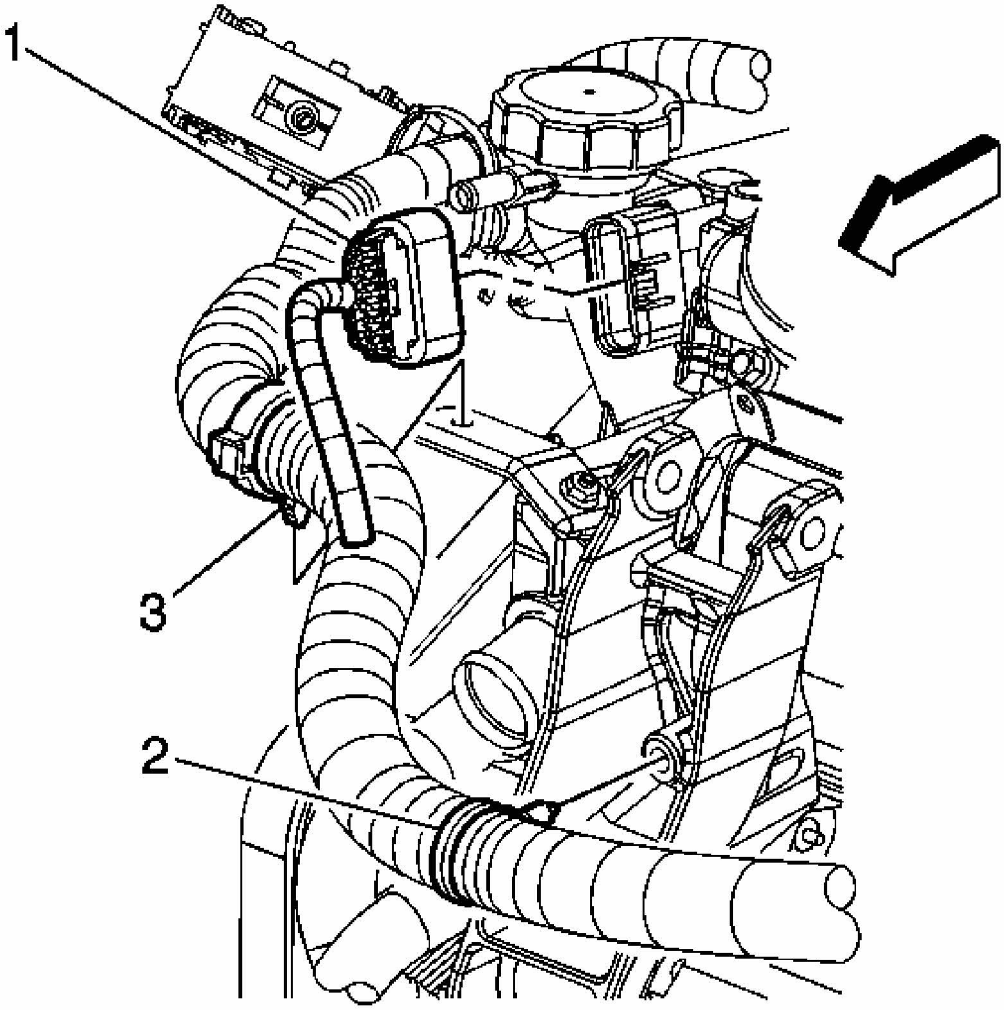


Fig. 75: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

6. Disconnect fuel injector inline connector (1).

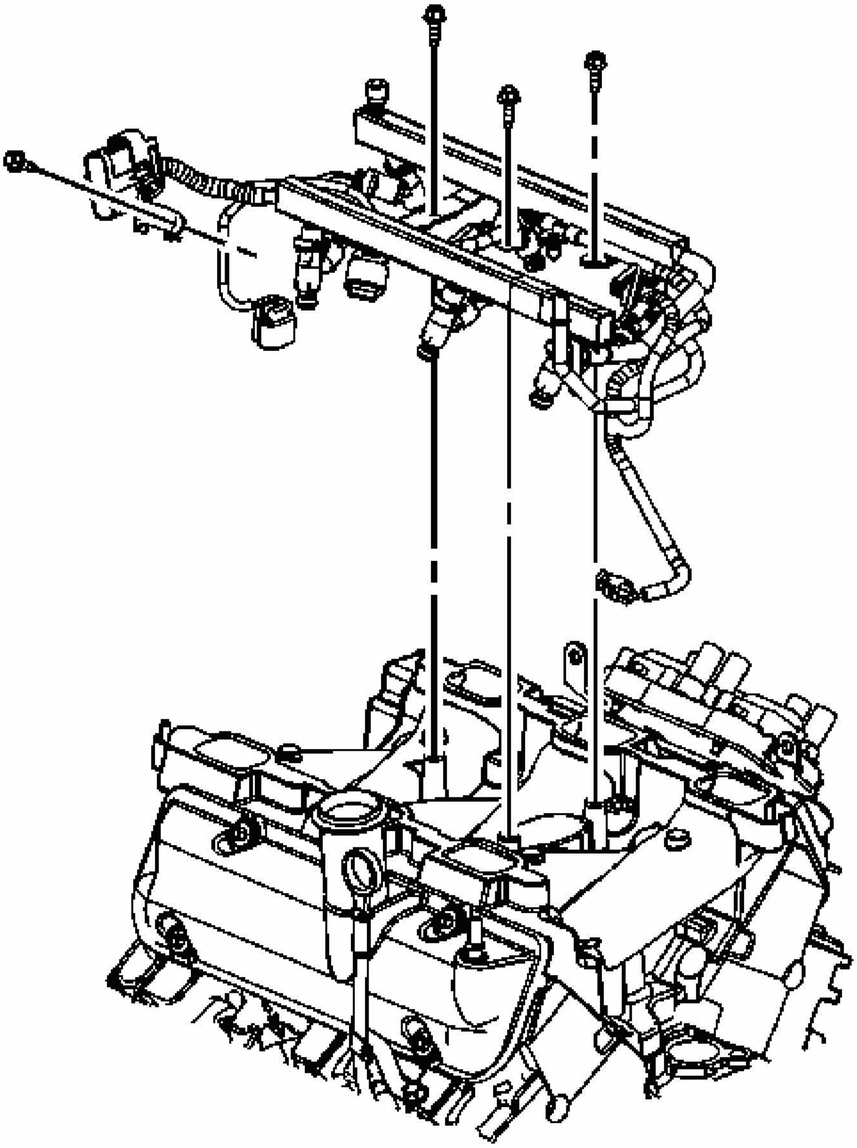


Fig. 76: View Of Fuel Rail Assembly & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

7. Remove the fuel injector harness connector bracket bolt from the intake manifold.
8. Disconnect the engine coolant temperature (ECT) electrical connector.
9. Disconnect the camshaft position (CMP) sensor electrical connector.
10. Remove the fuel injector rail bolts.
11. Remove the fuel rail.

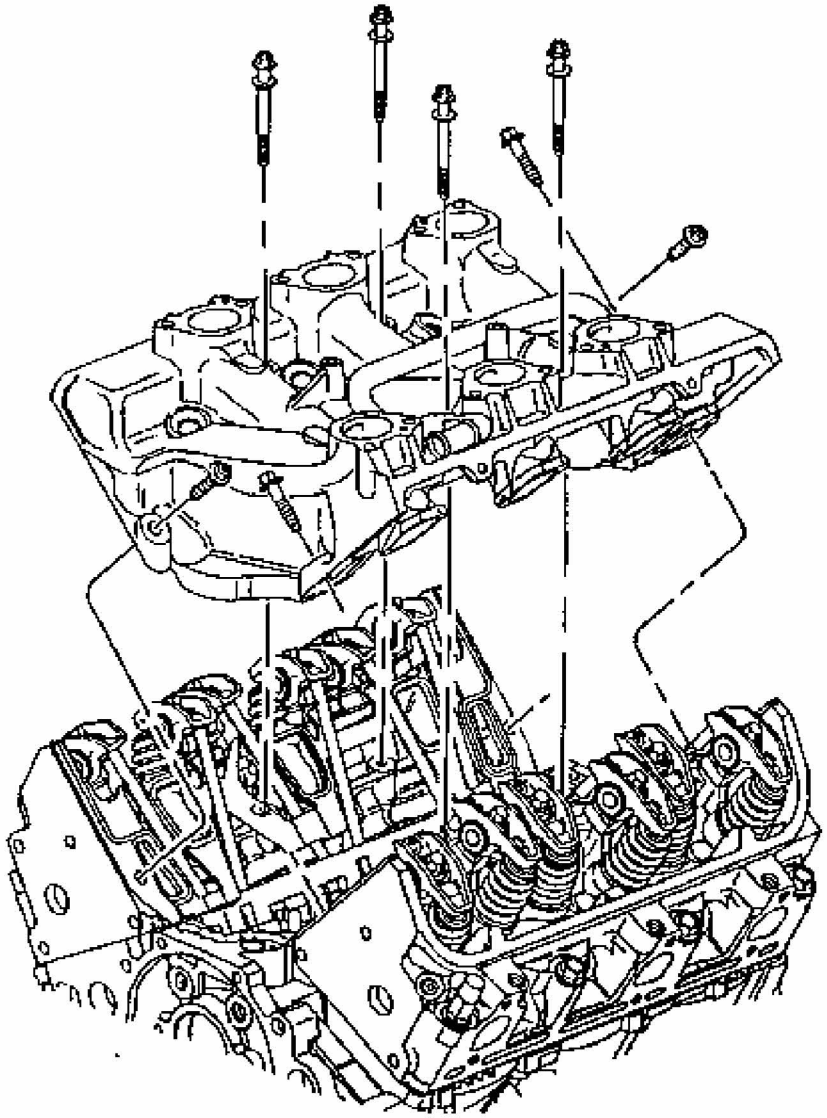


Fig. 77: View Of Lower Intake Manifold & Bolts
Courtesy of GENERAL MOTORS CORP.

12. Remove the lower intake manifold bolts.
13. Remove the lower intake manifold.

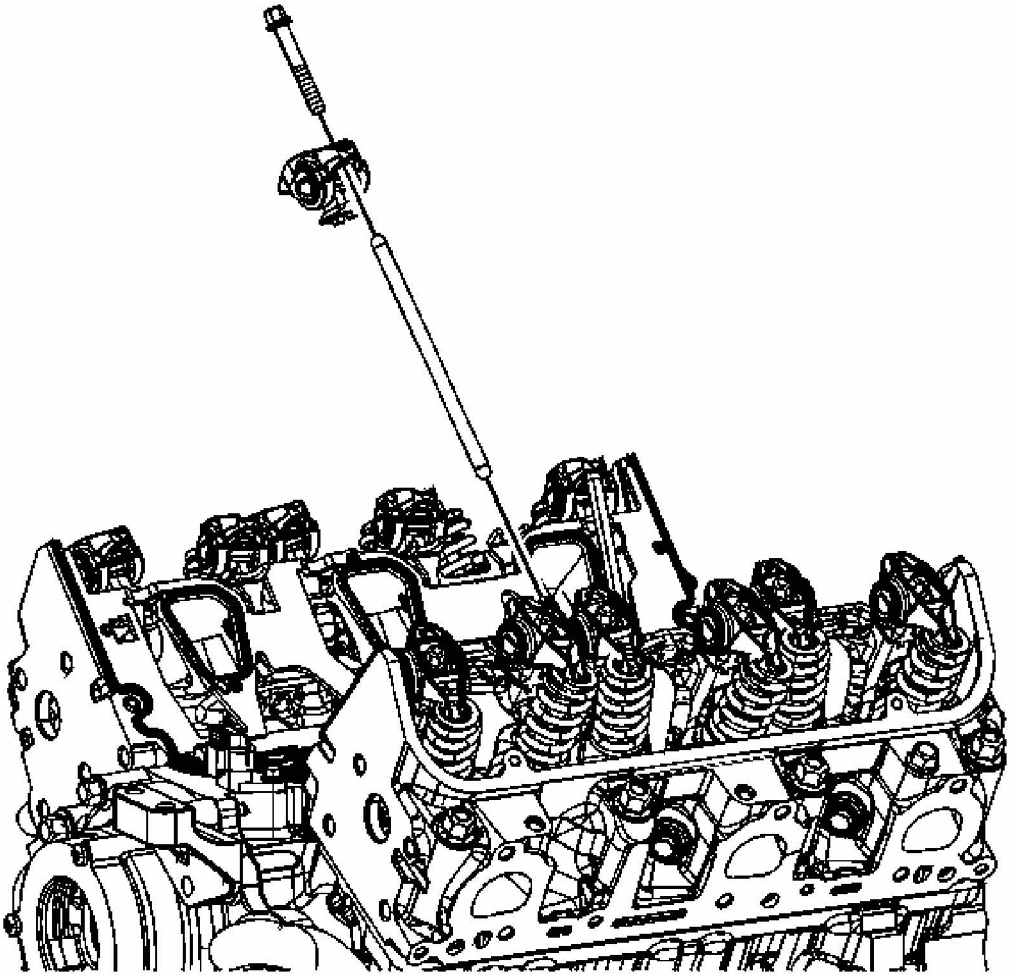


Fig. 78: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

14. Loosen the valve rocker arm bolts.

IMPORTANT: Place the valve train components in a rack in order to ensure that the components are installed in the same location from which they where removed.

15. Remove the valve rocker arms.
16. Remove the push rods.
    - The intake push rods measure 147.51 mm (5.81 in).
    - The exhaust push rods measure 154.87 mm (6.1 in).

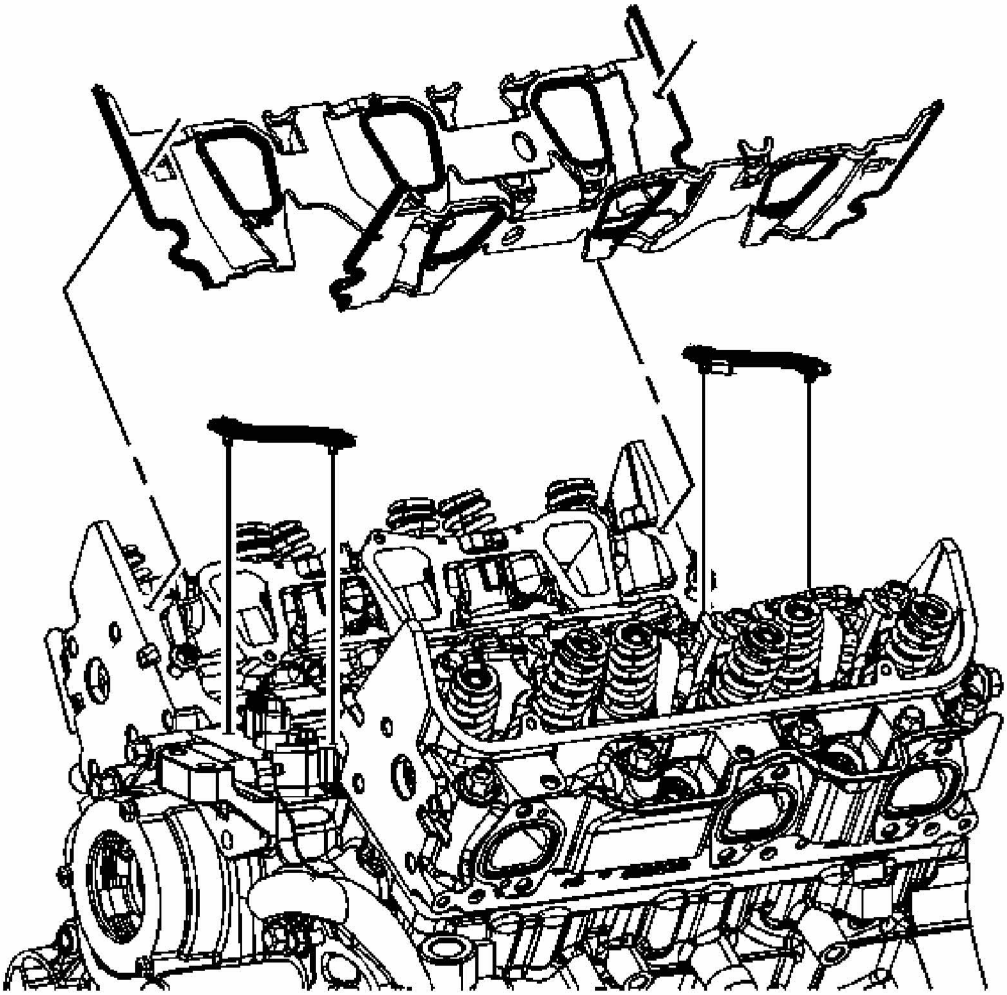


Fig. 79: Identifying Intake Manifold Gaskets & Seals
Courtesy of GENERAL MOTORS CORP.

17. Remove the lower intake manifold gaskets and seals.
18. Clean the lower intake manifold gasket and seal surfaces on the cylinder heads and the engine block.
19. Clean the gasket and seal surfaces on the lower intake manifold with degreaser.
20. Remove all the loose room temperature vulcanizing (RTV) sealer (1).

Installation Procedure

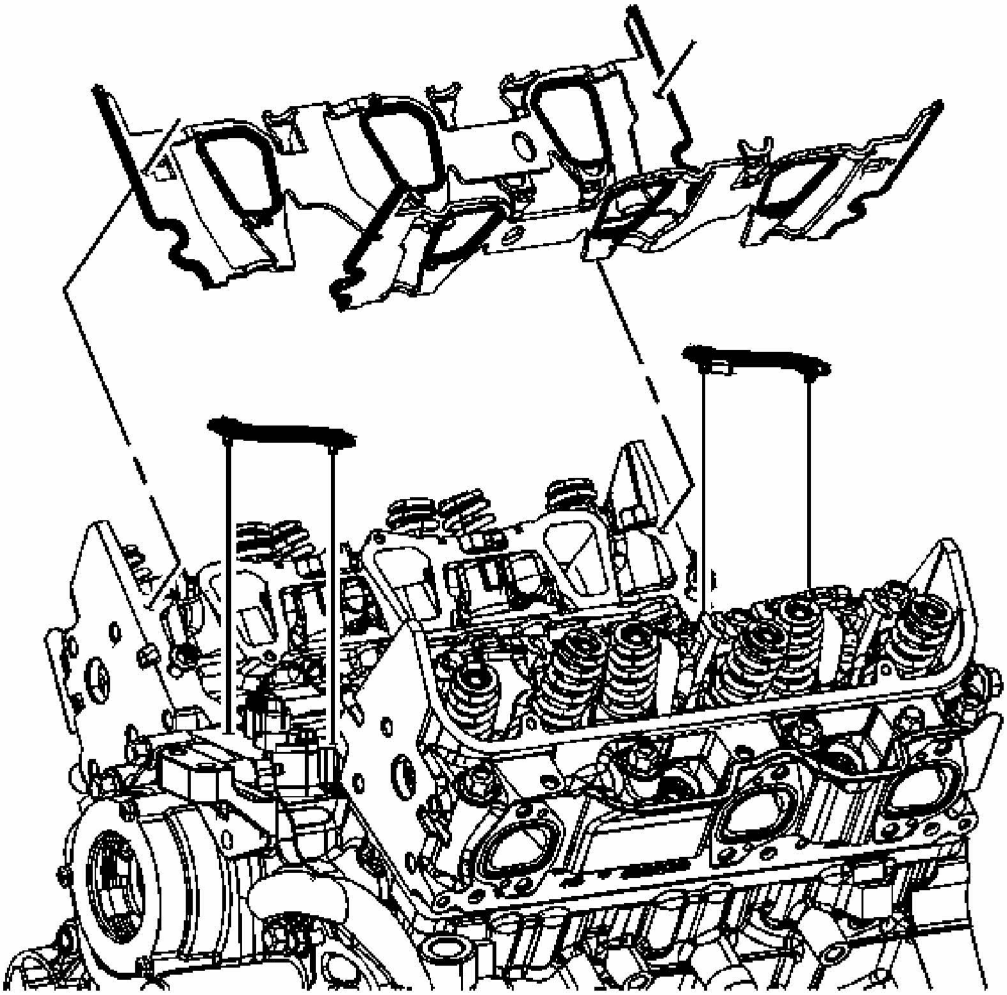


Fig. 80: Identifying Intake Manifold Gaskets & Seals
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **All gasket mating surfaces need to be free of oil and foreign material. Use GM P/N 12346139 (Canadian P/N 10953463) or equivalent, to clean the surfaces.**
- **RTV sealer is NOT to be placed under the lower intake manifold gaskets.**

1. Install the lower intake manifold gaskets and seals.

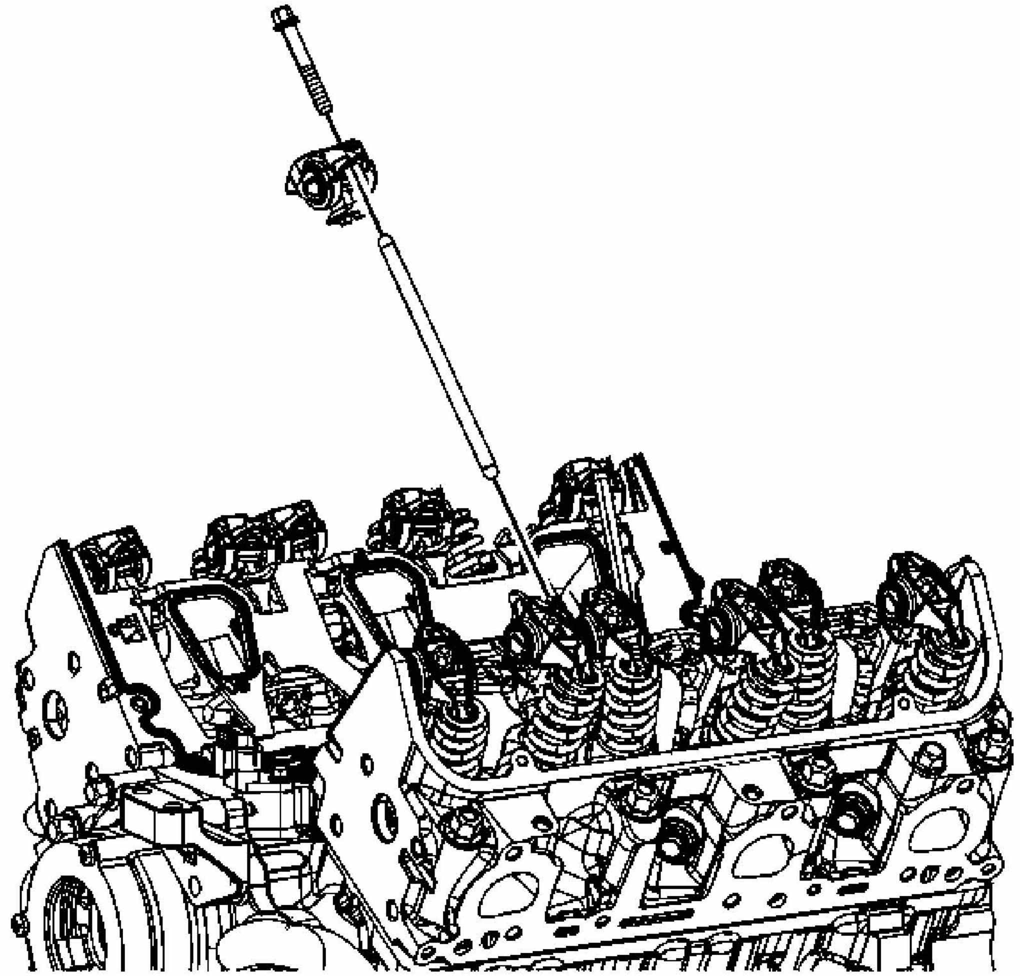


Fig. 81: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

2. Coat the ends of the push rods using prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent.

IMPORTANT: The intake valve push rods measure 146 mm (5.75 in) and the exhaust valve push rods measure 152.5 mm (6 in).

3. Install the push rods in their original location.
4. Coat the rocker arm friction surfaces using prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent.

IMPORTANT: Shims (P/N 88894006) may be required under the valve

rocker arm pedestals if reconditioning has been performed on the cylinder head or its components.

5. Install the valve rocker arms in their original positions.

NOTE: **Refer to Fastener Notice .**

6. Install the valve rocker arm bolts.

Tighten: Tighten the bolts to 34 N.m (25 lb ft).

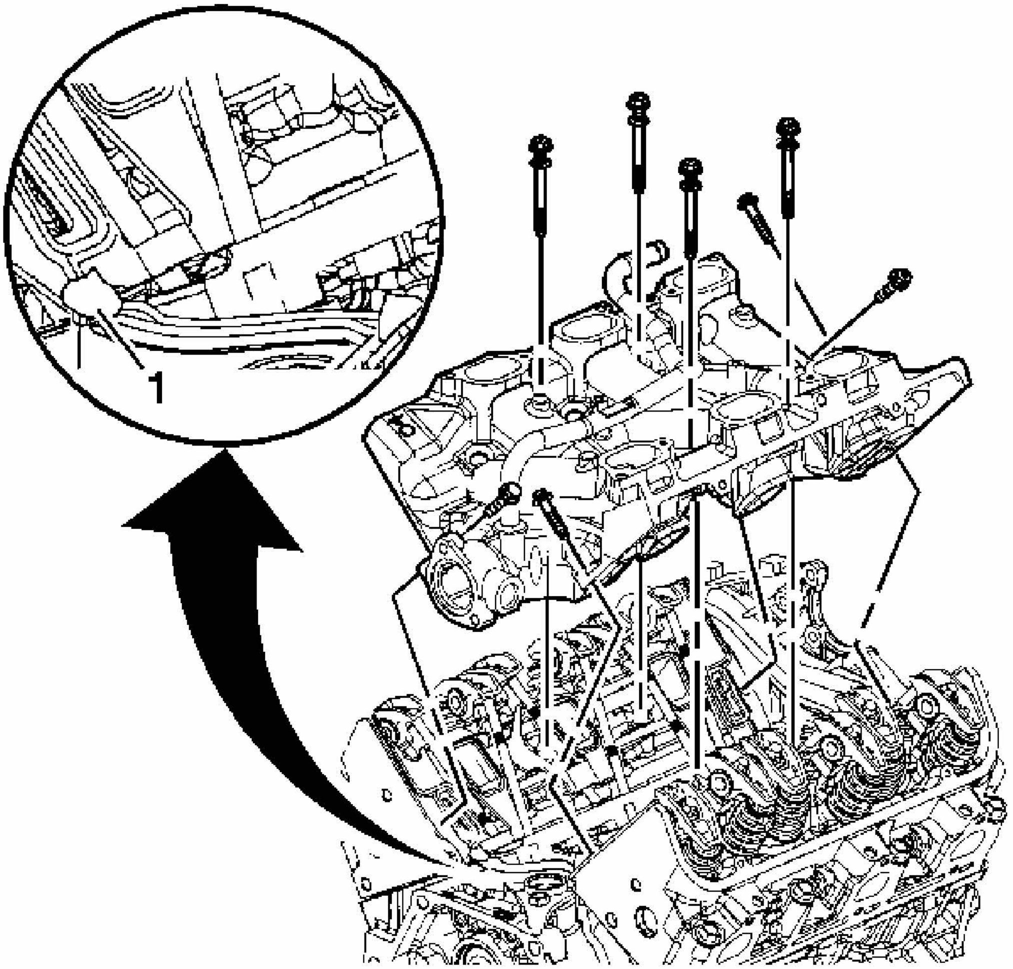


Fig. 82: View Of Lower Intake Manifold
Courtesy of GENERAL MOTORS CORP.

7. With the NEW gaskets and seals in place, apply a small drop, 8-10 mm (0.031-0.39 in) of RTV sealer GM P/N 12378521 (Canadian P/N 88901148) or equivalent to the 4 corners of the intake manifold to engine block joints (1).
8. Install the lower intake manifold.

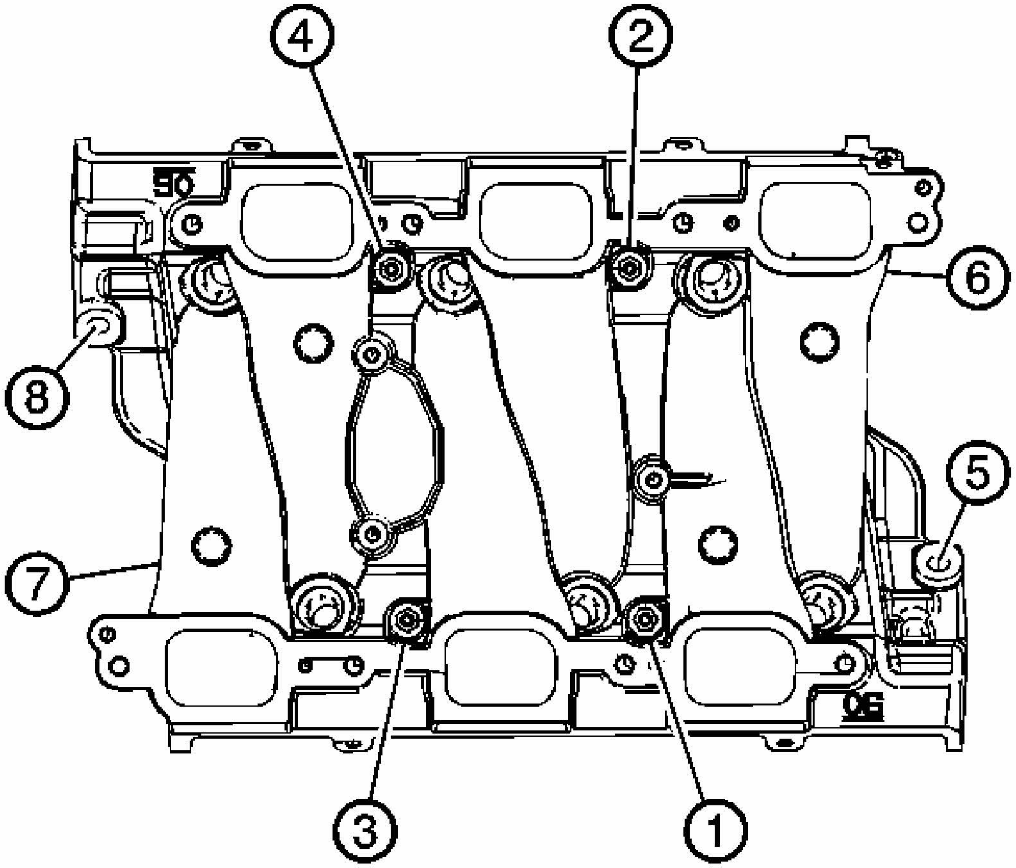


Fig. 83: Identifying Lower Intake Manifold Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.**
Failure to tighten vertical bolts before the diagonal bolts may cause an oil leak.

9. Apply sealer GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the lower intake manifold bolt threads.
10. Install the lower intake manifold bolts.
11. Tighten the lower intake manifold bolts in the sequence shown.

    Tighten:

    1. Tighten the bolts (1, 2, 3, 4) in sequence to 16 N.m (12 lb ft).
    2. Tighten the bolts (5, 6, 7, 8) in sequence to 25 N.m (18 lb ft).

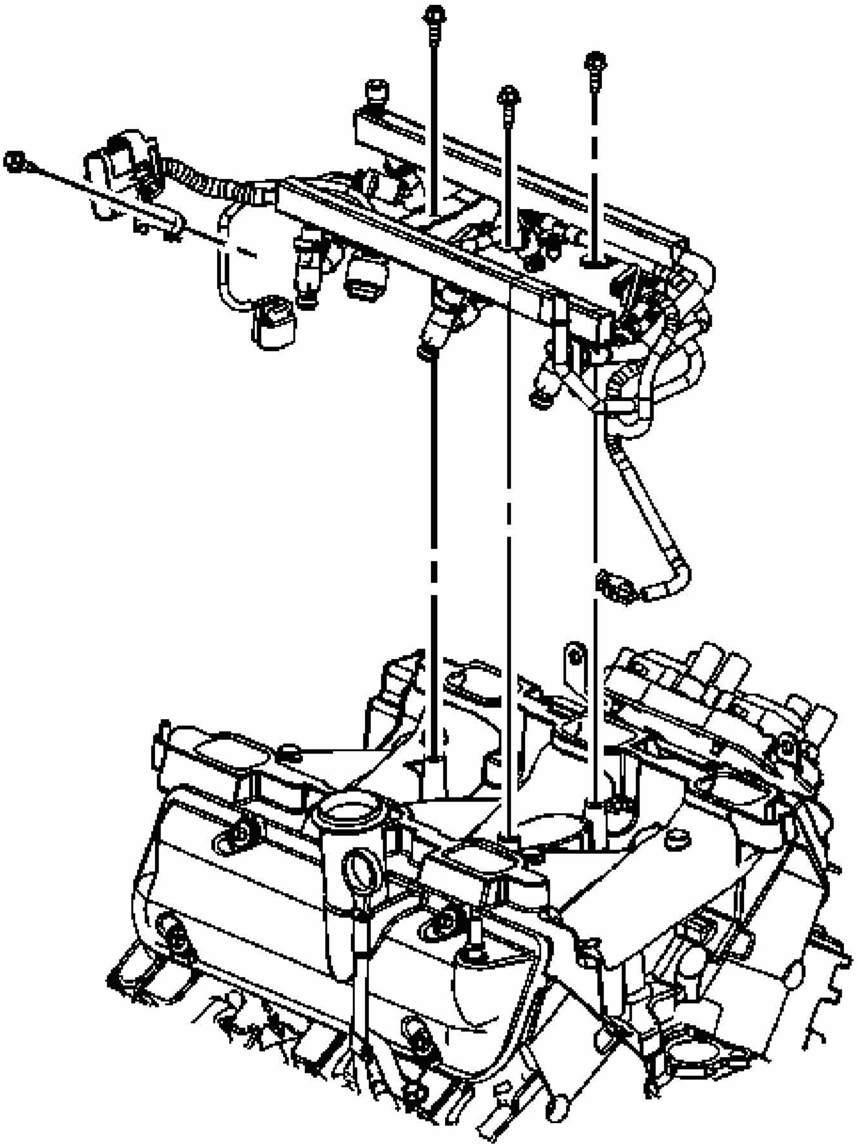


Fig. 84: View Of Fuel Rail Assembly & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

12. Inspect the fuel rail, fuel injectors, and fuel injector O-rings for damage and replace as necessary.
13. Lubricate the fuel injector O-rings using GM P/N 12345616 (Canadian P/N 993182).
14. Install the injector nozzles into the lower intake manifold injector bores.
15. Press on the injector rail using the palms of both hands until the injector are fully

seated.

16. Install the fuel injector rail bolts.

    Tighten: Tighten the bolts to 10 N.m (89 lb in).

17. Connect the CMP sensor electrical connector.
18. Connect the ECT electrical connector (1).
19. Position the fuel injector harness connector bracket to the intake manifold.
20. Install the fuel injector harness connector bracket bolt.

    Tighten: Tighten the bolt to 8 N.m (71 lb in).

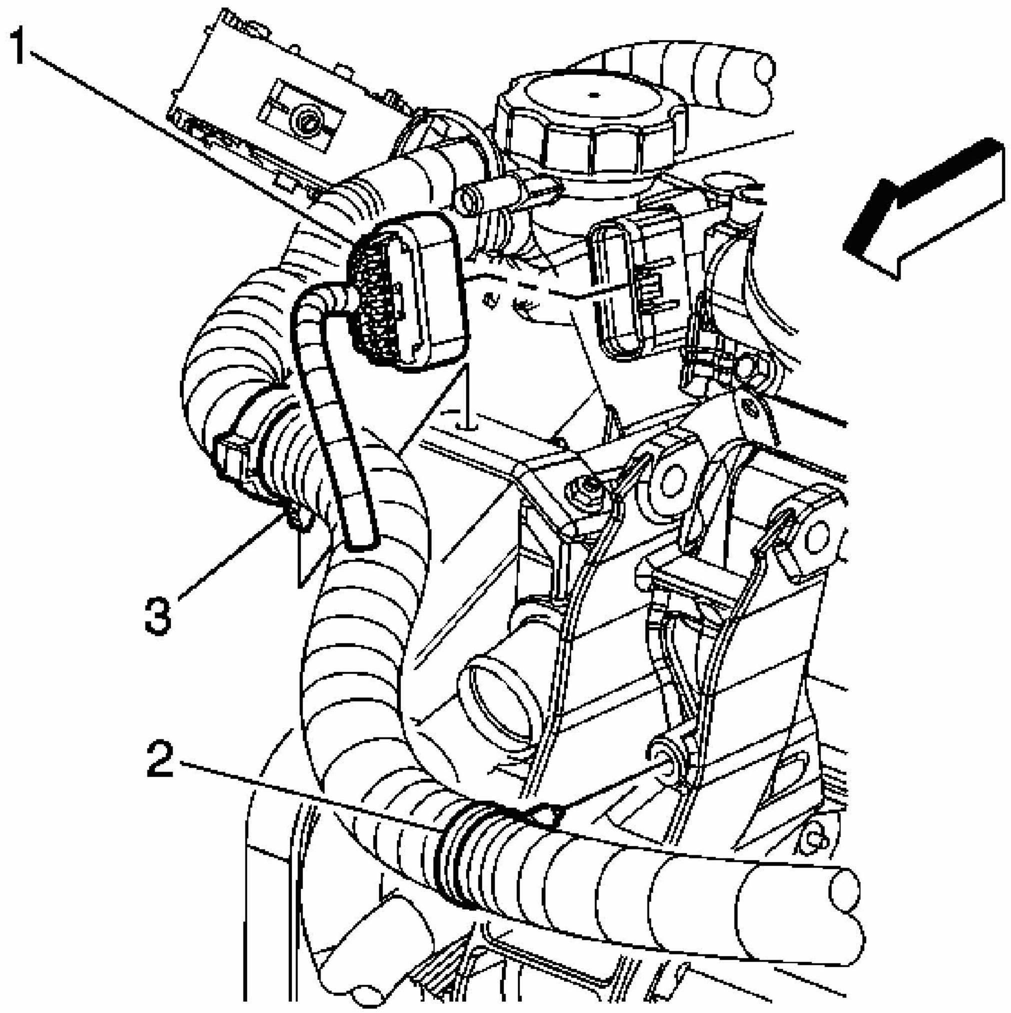


Fig. 85: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

21. Connect fuel injector inline connector.
22. Connect the fuel feed line to the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .
23. Install the right valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Right**.
24. Install the left valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Left**.
25. Install the upper intake manifold. Refer to **Intake Manifold Replacement - Upper**.
26. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .

CRANKCASE VENTILATION HOSES/PIPES REPLACEMENT

Removal Procedure

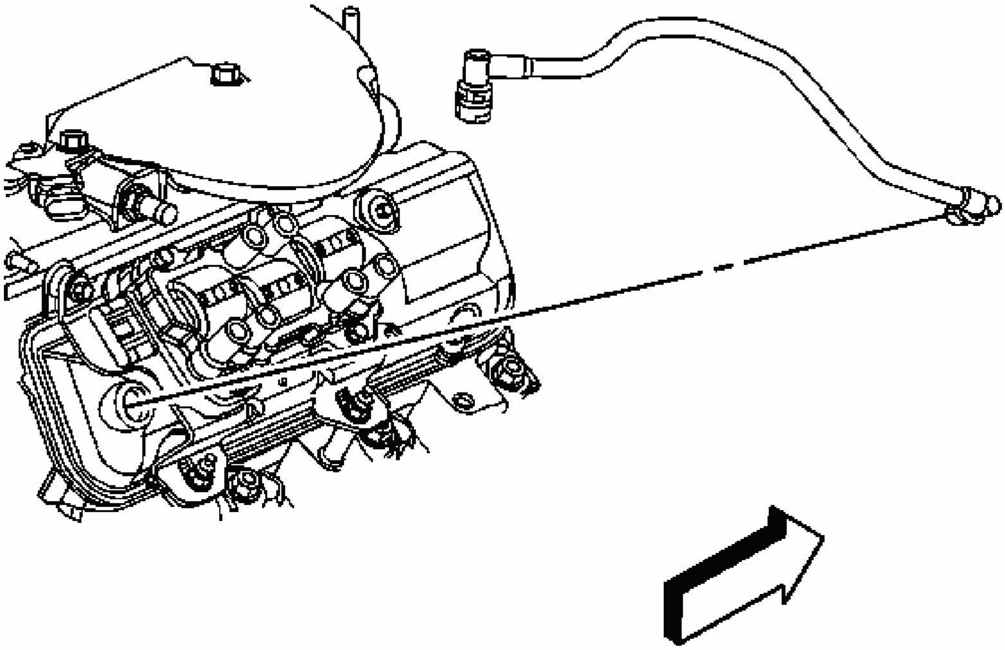


Fig. 86: Identifying Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Disconnect the positive crankcase ventilation (PCV) fresh air tube from the air cleaner outlet duct. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
3. Remove the PCV fresh air tube from the rocker arm cover.
4. Remove the PCV fresh air tube from the vehicle.

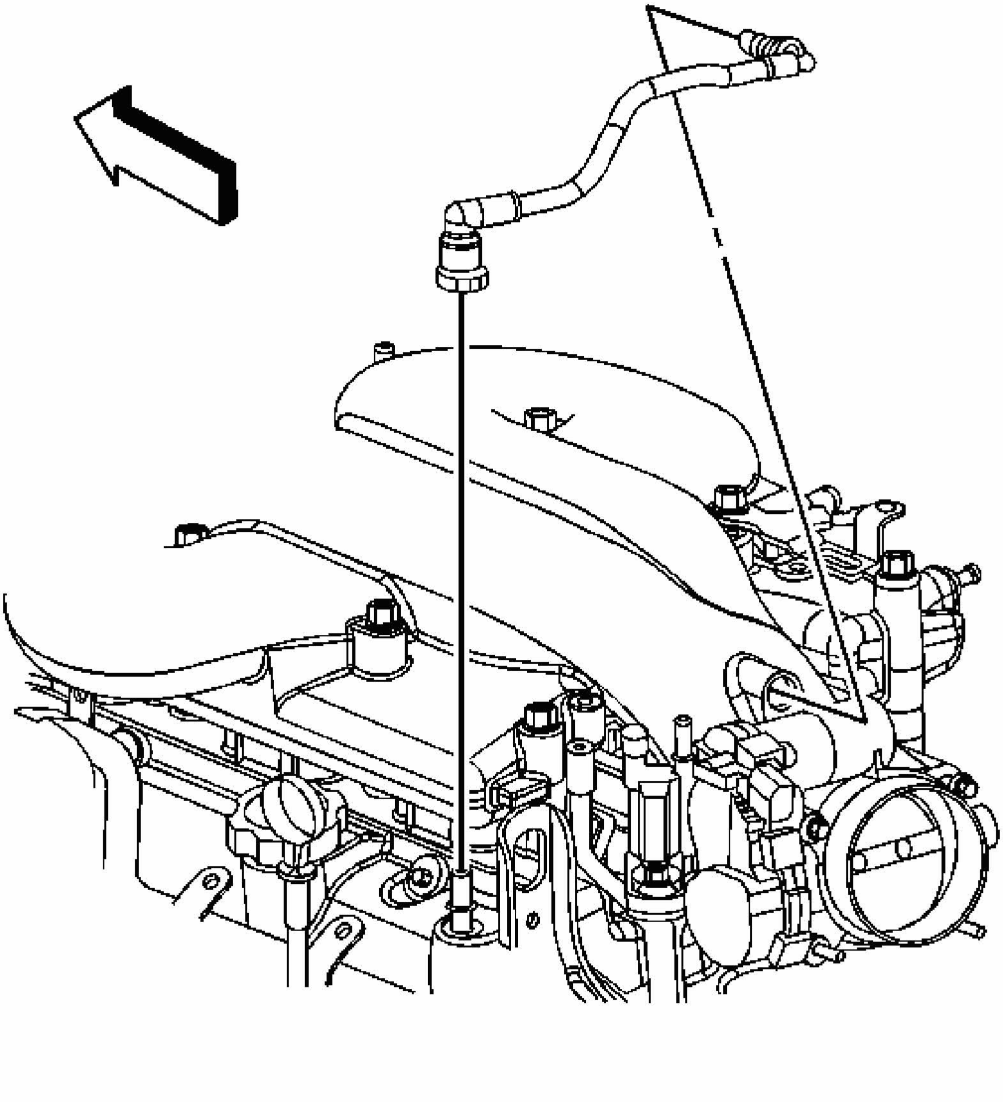


Fig. 87: Identifying Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the PCV foul air tube from the PCV valve. Refer to **Quick Connect Fitting (s) Service (Plastic Collar)** .
6. Remove the PCV foul air tube from the intake manifold.

7. Remove the PCV foul air tube from the vehicle.

Installation Procedure

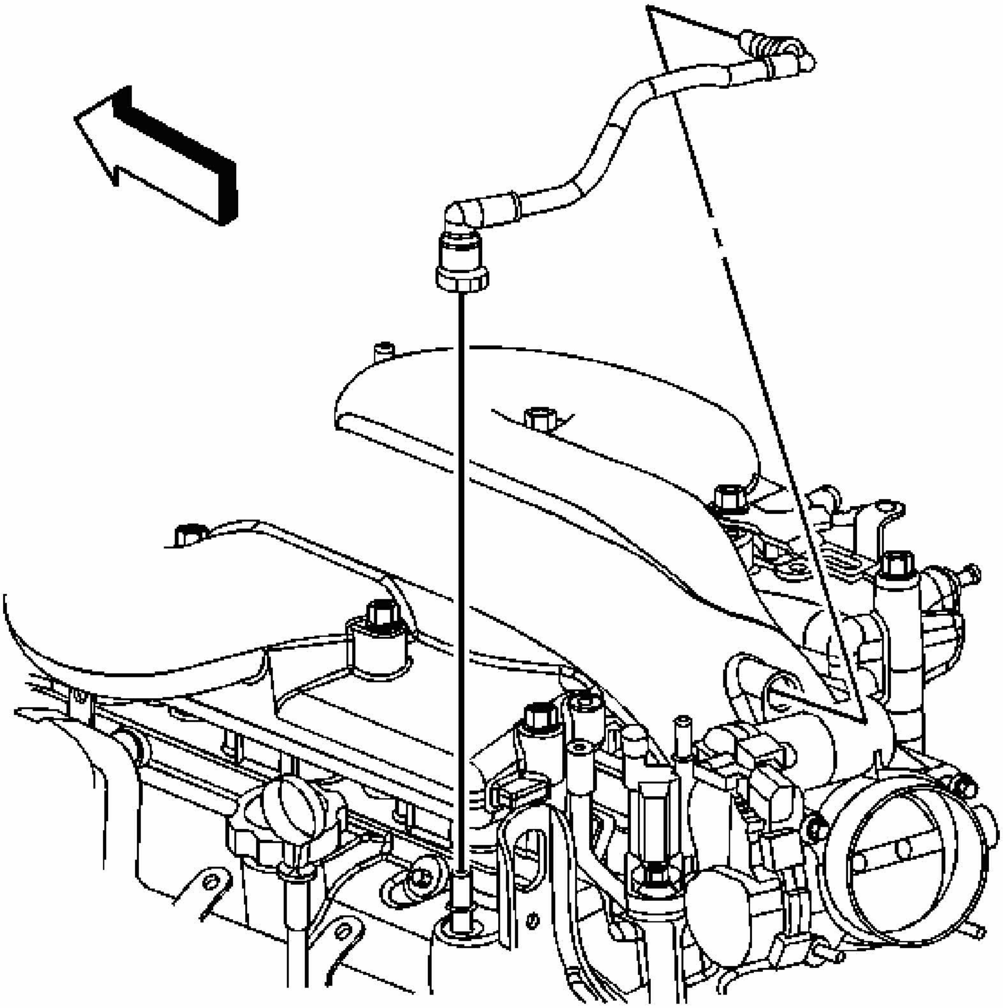


Fig. 88: Identifying Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

1. Install the PCV foul air tube to the vehicle.
2. Install the PCV foul air tube to the intake manifold.
3. Connect the PCV foul air tube to the PCV valve. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

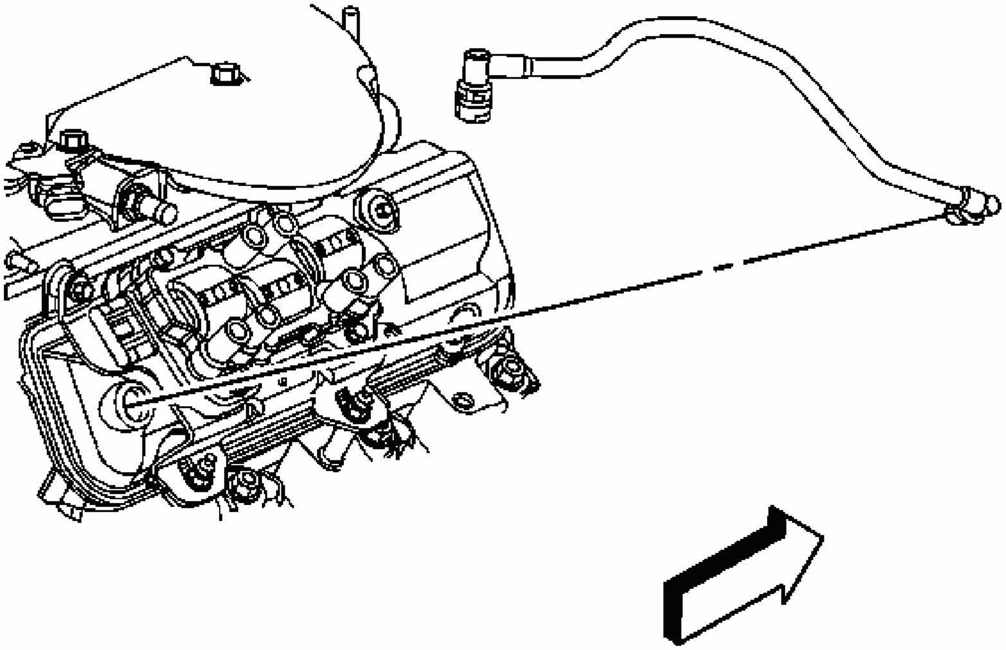


Fig. 89: Identifying Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

4. Install the PCV fresh air tube to the vehicle.
5. Install the PCV fresh air tube to the rocker arm cover.
6. Connect the PCV fresh air tube to the air cleaner outlet duct. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
7. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

VALVE ROCKER ARM COVER REPLACEMENT - LEFT

Removal Procedure

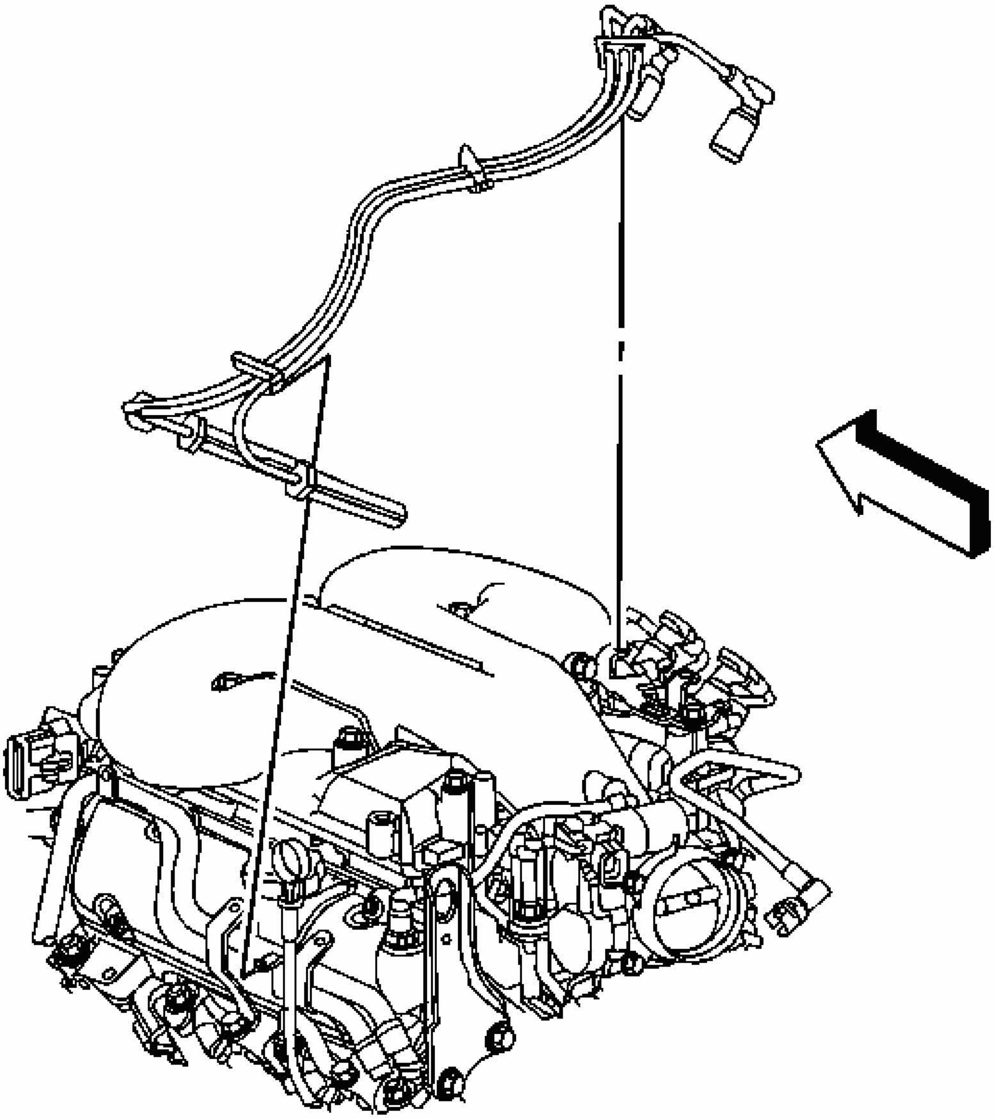


Fig. 90: View Of Left Spark Plug/Coil Harness
Courtesy of GENERAL MOTORS CORP.

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
2. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
3. Remove the oil level indicator tube. Refer to **Oil Level Indicator and Tube**

Replacement.

4. Disconnect the left spark plug wires from the spark plugs.
5. Remove the spark plug wire harness clip from the heater inlet and outlet front pipe bracket.
6. Reposition the spark plug harness.

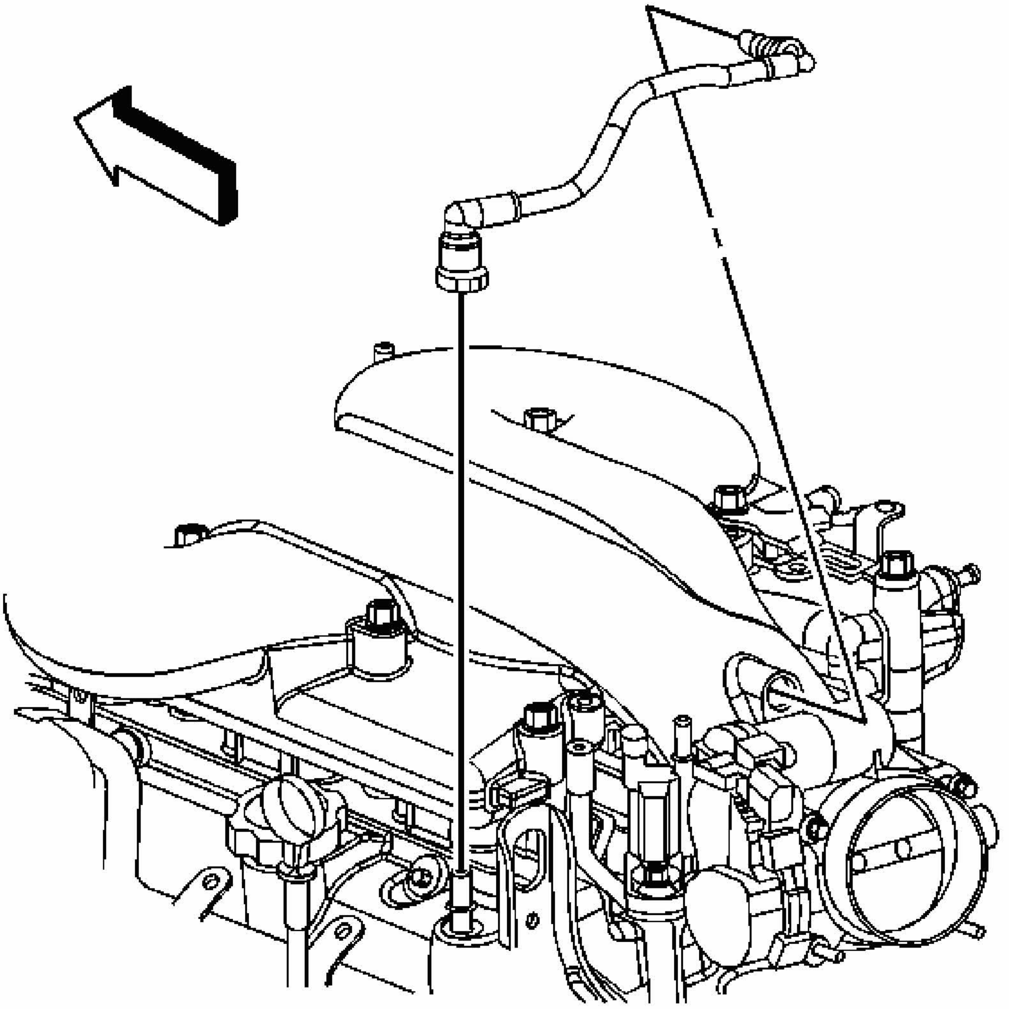


Fig. 91: Identifying Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

7. Remove the positive crankcase ventilation (PCV) foul air tube. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
8. Remove the left engine mount strut bracket. Refer to **Engine Mount Strut Bracket**

Replacement - Left.

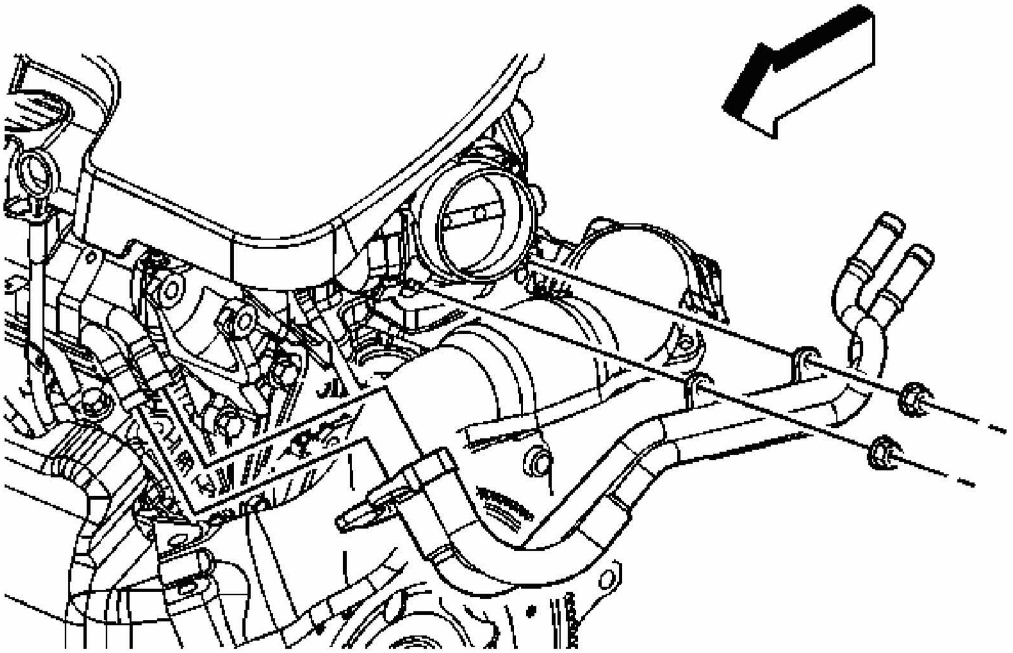


Fig. 92: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

9. Reposition the heater inlet and outlet hose/pipe clamps at the engine inlet and outer pipes.
10. Remove the heater inlet and outlet hose/pipe clip nuts at the throttle body.
11. Remove the heater inlet and outer hoses/pipes from the engine inlet and outlet pipes.
12. Remove the clips from the throttle body studs. Reposition the hose/pipe assembly.

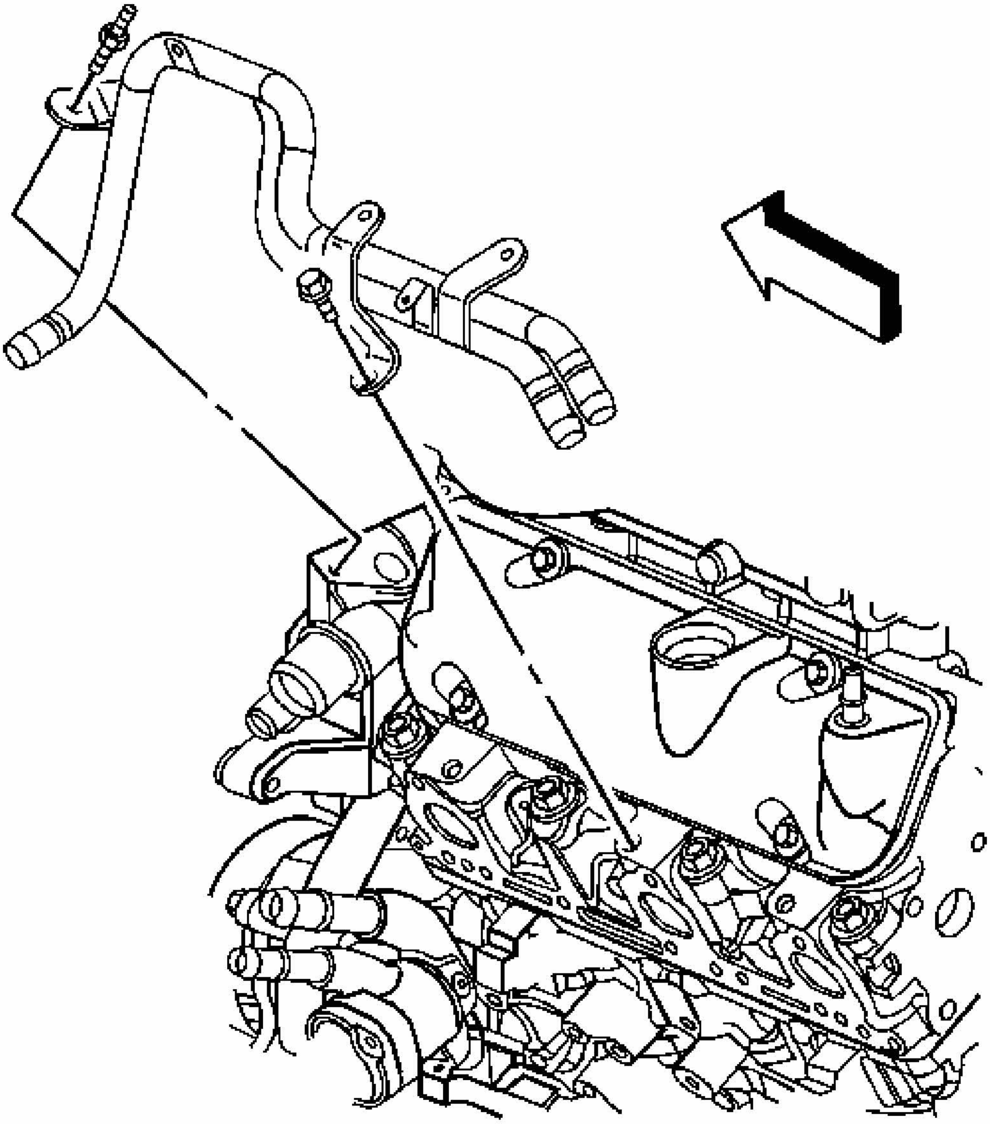


Fig. 93: Front Heater Outlet Hose & Outlet Heater Pipe
Courtesy of GENERAL MOTORS CORP.

13. Remove the front heater outlet hose from the outlet heater pipe.
14. Remove the heater inlet and outlet pipe bolt and stud.
15. Remove the heater inlet and outlet pipe from the vehicle.

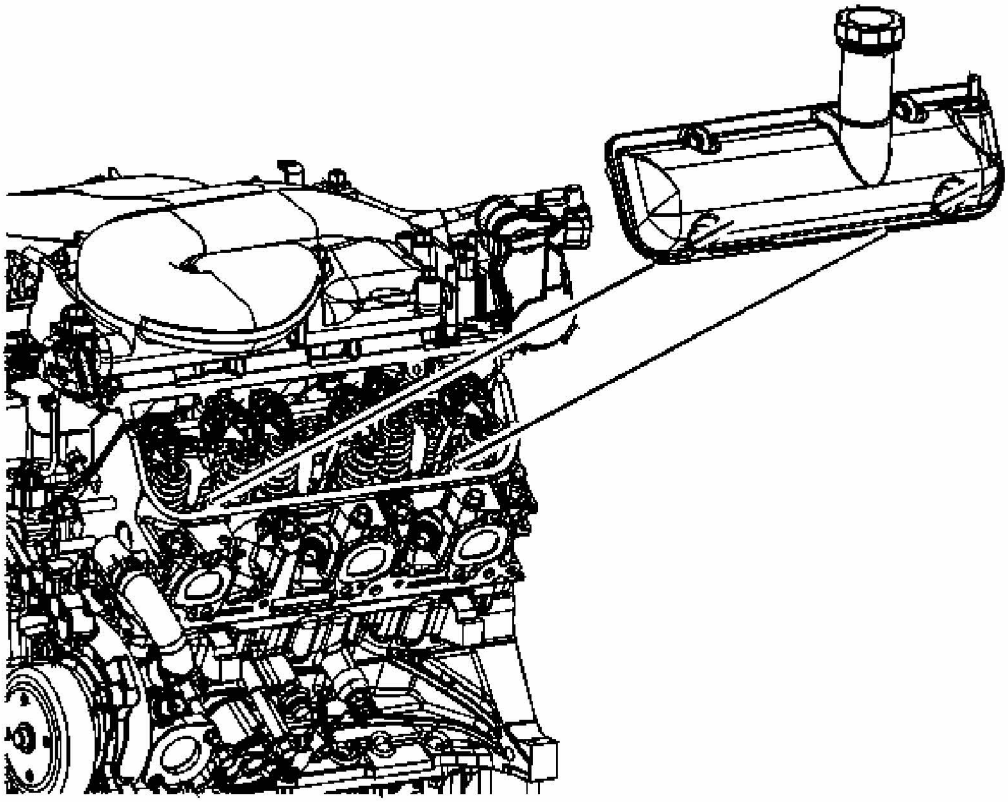


Fig. 94: Identifying Left Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

16. Loosen the valve rocker arm cover bolts.

IMPORTANT: When removing the valve rocker arm cover, ensure the gasket stays in place attached to the cylinder head.

17. Remove the valve rocker arm cover. If necessary, bump the end of the cover with the palm of your hand or a soft rubber mallet if the cover adheres to the cylinder head.
18. Cut the RTV in the channel where the intake, cylinder head and valve rocker arm cover meet with a suitable tool.
19. Remove the valve cover gasket.
20. Clean the sealing surface on the cylinder head with degreaser.

Installation Procedure

IMPORTANT: All gasket mating surfaces need to be free of oil and foreign

material. Use GM P/N 12346139 (Canadian P/N 10953463) or equivalent, to clean the surfaces.

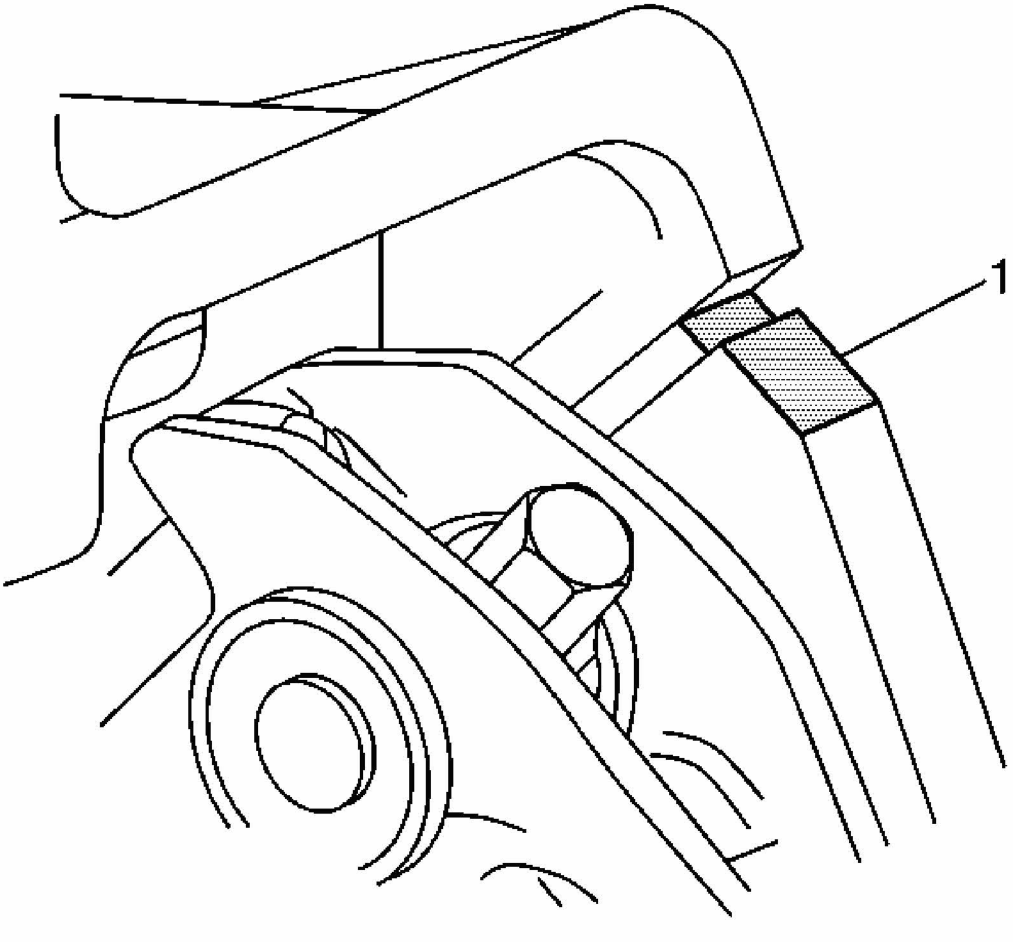


Fig. 95: Identifying Cylinder Head To Lower Intake Manifold Joint
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW valve rocker arm cover gasket into the groove in the valve rocker arm cover. Ensure that the gasket is properly seated in the groove of the valve rocker arm cover.
2. Apply sealant GM P/N 12378521 (Canadian P/N 88901148) or equivalent, at the cylinder head to the surfaces where the cylinder head and intake manifold meet (1).

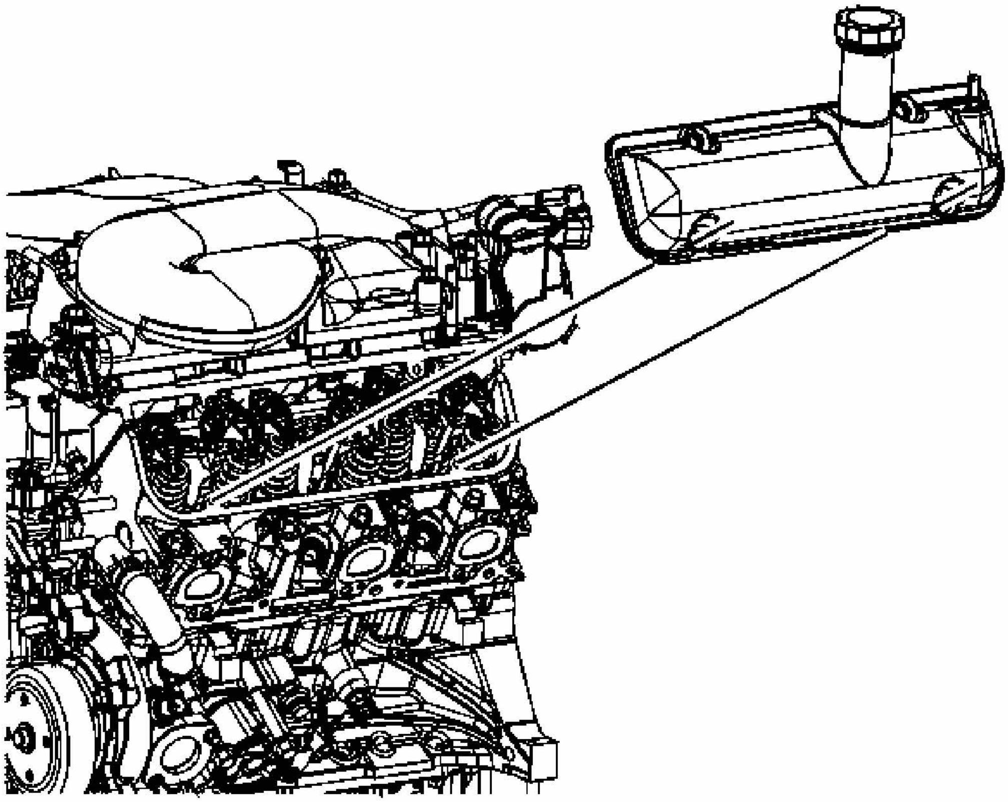


Fig. 96: Identifying Left Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

3. Install the valve rocker arm cover.

NOTE: **Refer to Fastener Notice .**

IMPORTANT: **Use an alternating criss-cross pattern when tightening the valve rocker cover bolts. Failure to do so may result in oil leakage from the valve cover due to improper seating of the gasket.**

4. Tighten the valve rocker arm cover bolts.

Tighten: Tighten the bolts to 10 N.m (89 lb in).

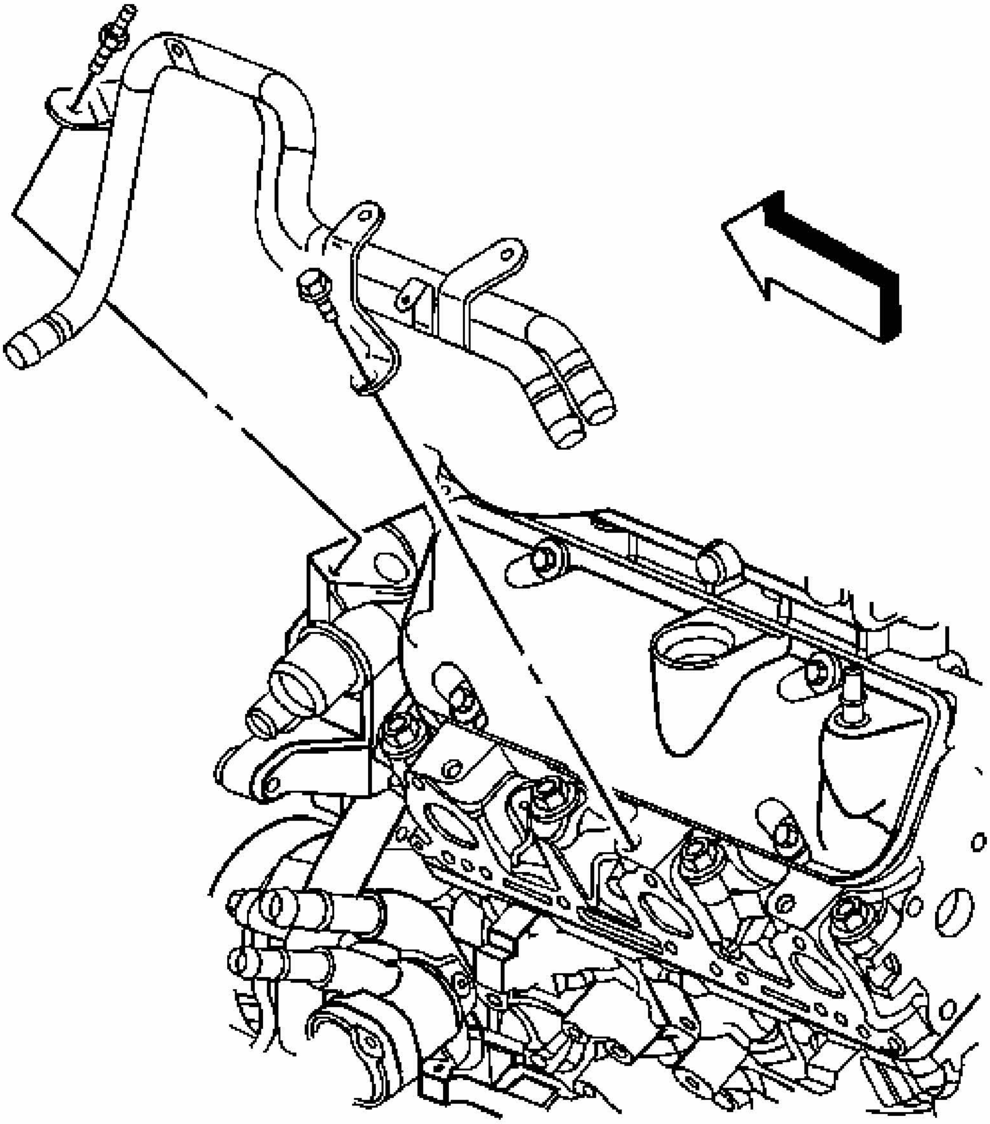


Fig. 97: Front Heater Outlet Hose & Outlet Heater Pipe
Courtesy of GENERAL MOTORS CORP.

5. Install the heater inlet and outlet pipe to the vehicle.
6. Install the heater inlet and outlet pipe bolt and stud.

Tighten:

- Tighten the bolt to 25 N.m (18 lb ft).
- Tighten the stud to 10 N.m (89 lb in).

7. Install the front heater outlet hose to the outlet heater pipe.

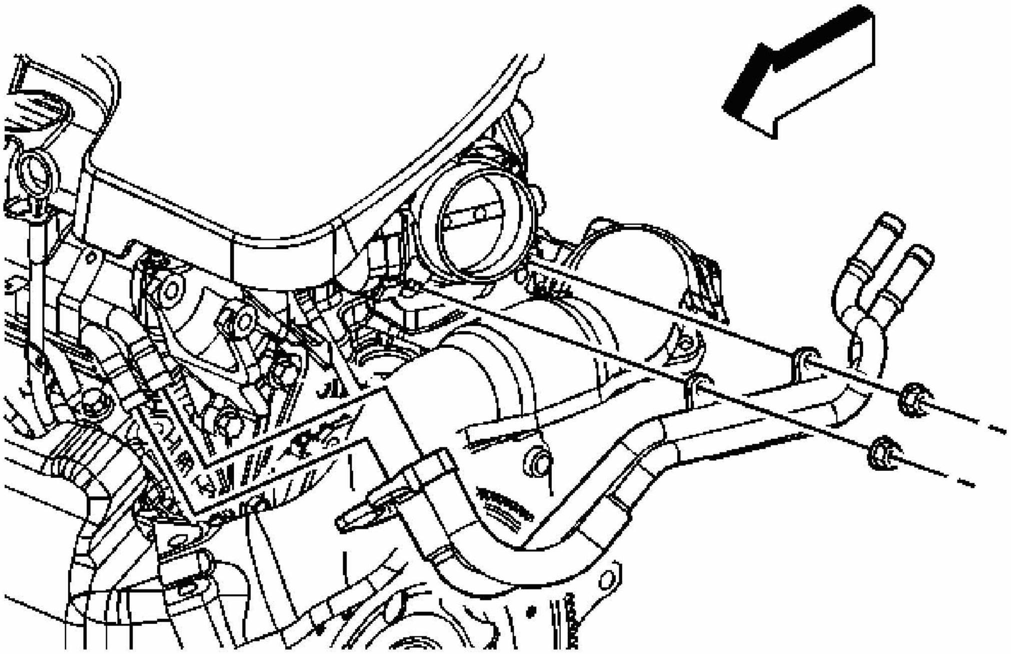


Fig. 98: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

8. Position the hose/pipe assembly. Install the clips to the throttle body studs.
9. Install the heater inlet and outer hoses/pipes to the engine inlet and outlet pipes.
10. Install the heater inlet and outlet hose/pipe clip nuts at the throttle body.

    Tighten: Tighten the nuts to 10 N.m (89 lb in).

11. Position the heater inlet and outlet hose/pipe clamps at the engine inlet and outer pipes.
12. Install the left engine mount strut bracket. Refer to **Engine Mount Strut Bracket Replacement - Left**.

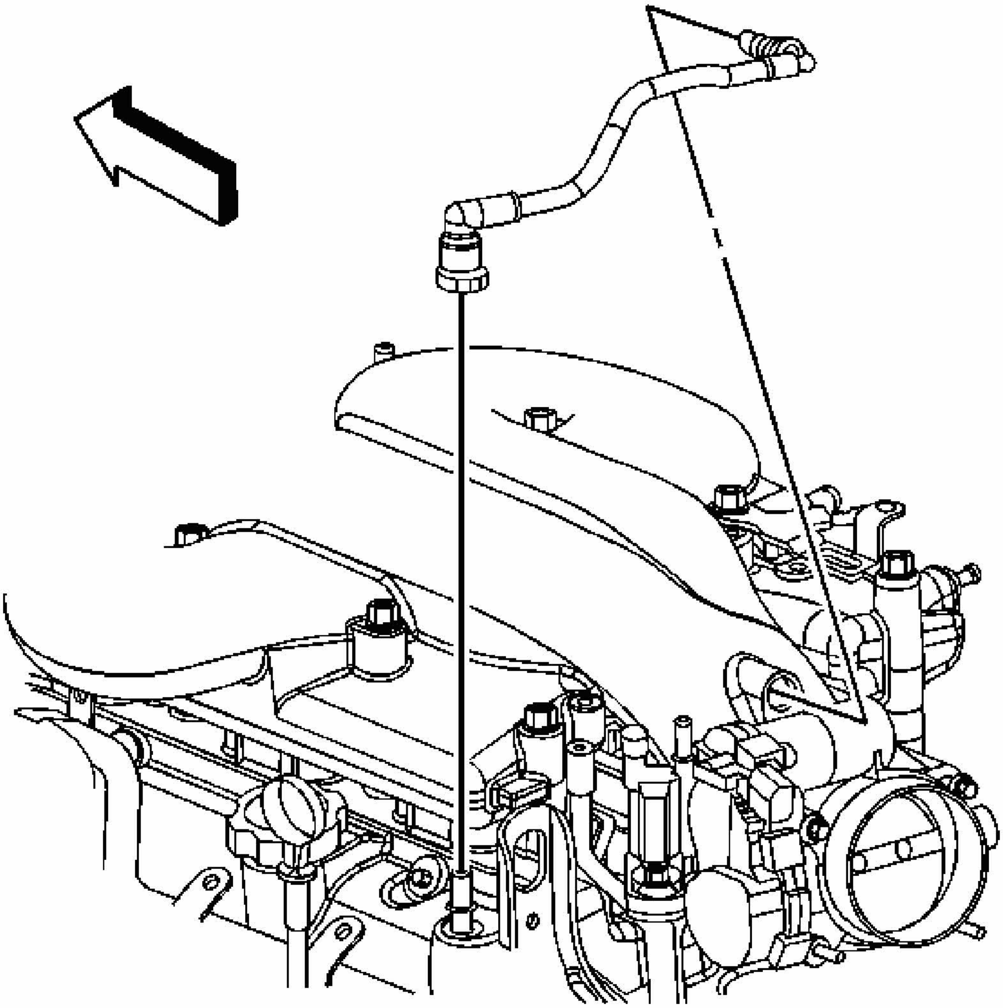


Fig. 99: Identifying Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

13. Install the PCV foul air tube. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

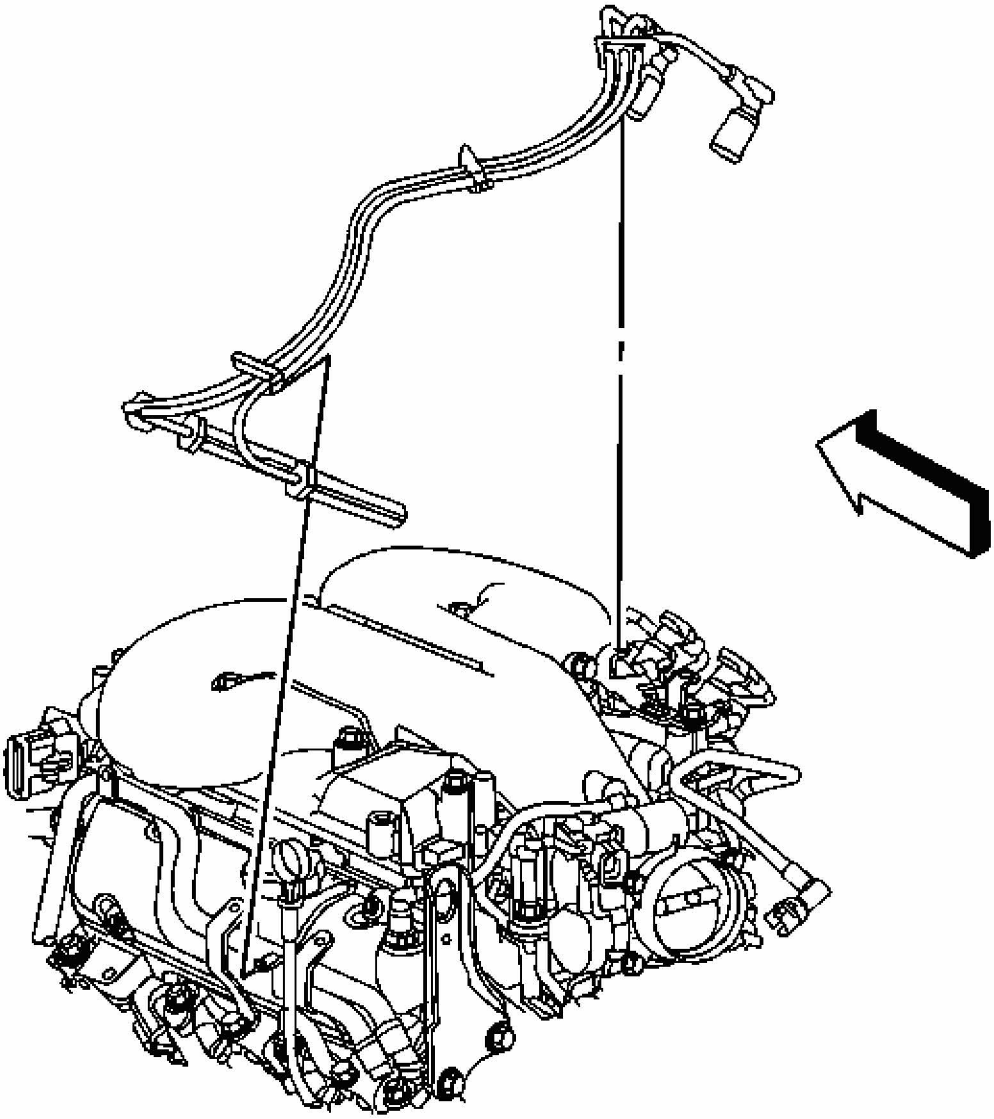


Fig. 100: View Of Left Spark Plug/Coil Harness
Courtesy of GENERAL MOTORS CORP.

14. Position the spark plug harness.
15. Install the spark plug wire harness clip to the heater inlet and outlet front pipe bracket.
16. Connect the left spark plug wires to the spark plugs.
17. Install the oil level indicator tube. Refer to **Oil Level Indicator and Tube Replacement**.
18. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

19. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

VALVE ROCKER ARM COVER REPLACEMENT - RIGHT

Removal Procedure

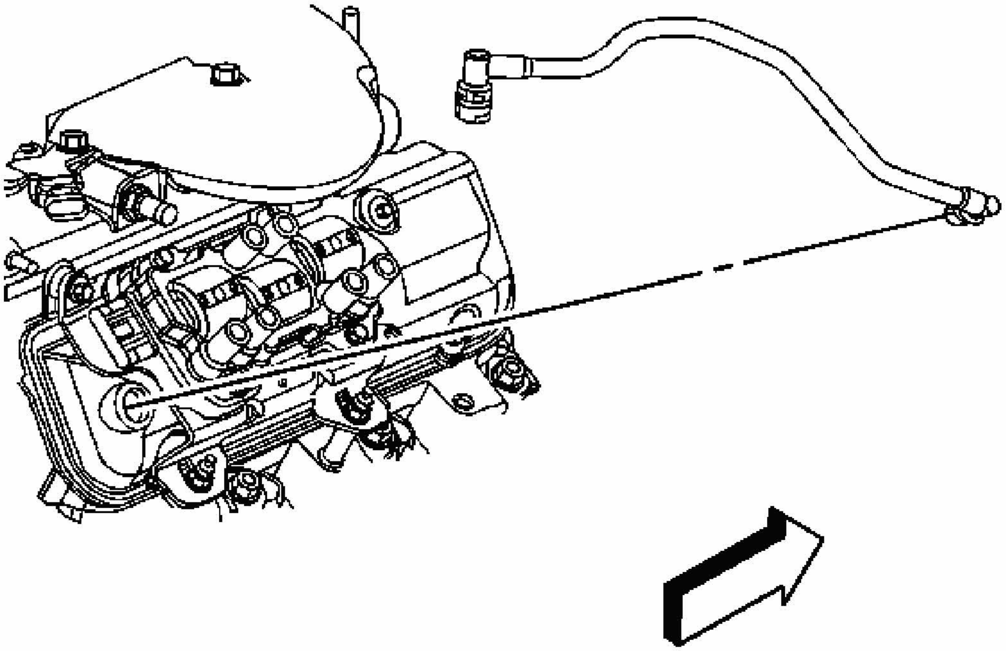


Fig. 101: Identifying Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** .
2. Disconnect the positive crankcase ventilation (PCV) fresh air tube from the air cleaner outlet duct. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
3. Remove the PCV fresh air tube from the right side valve rocker arm cover.

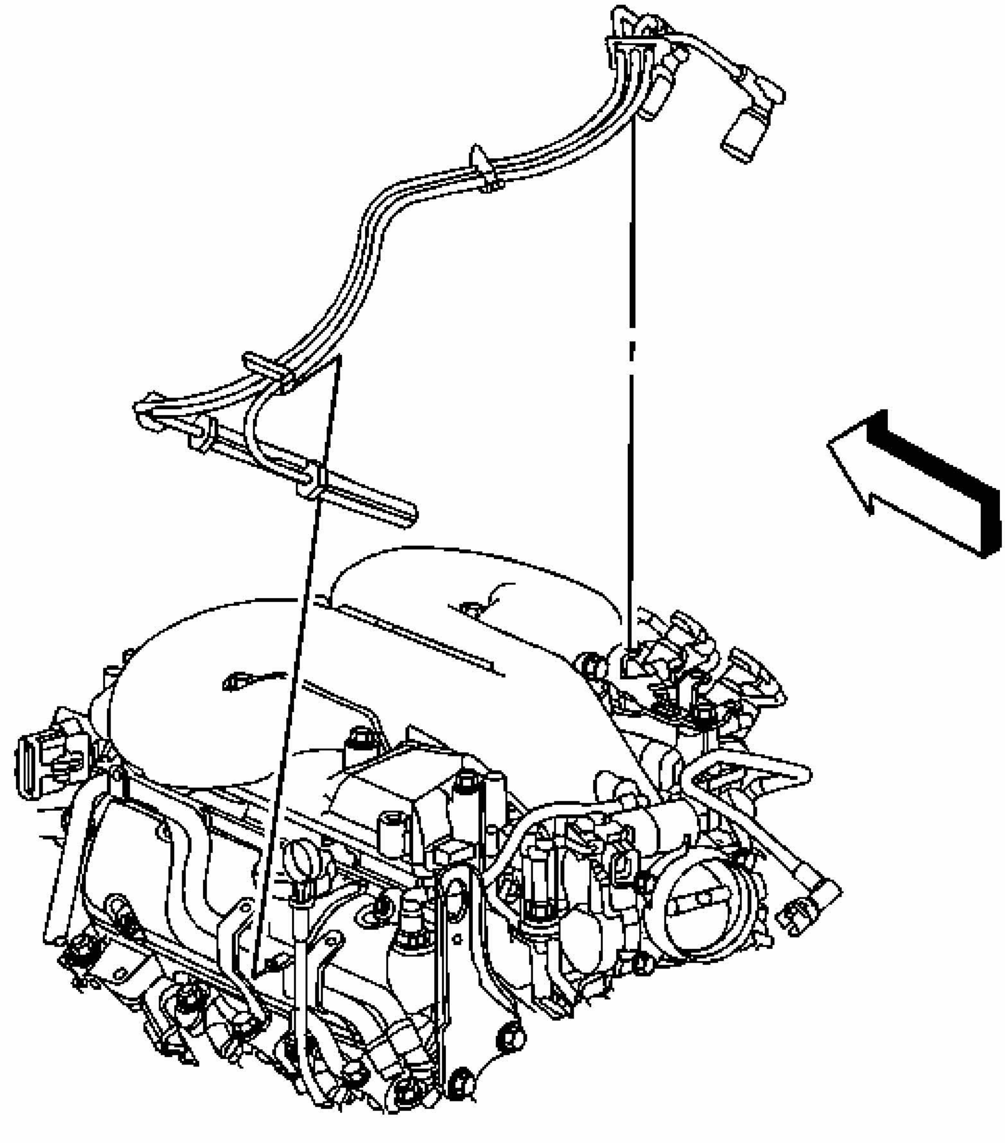


Fig. 102: View Of Left Spark Plug/Coil Harness
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the left side spark plug wires from the ignition coil.

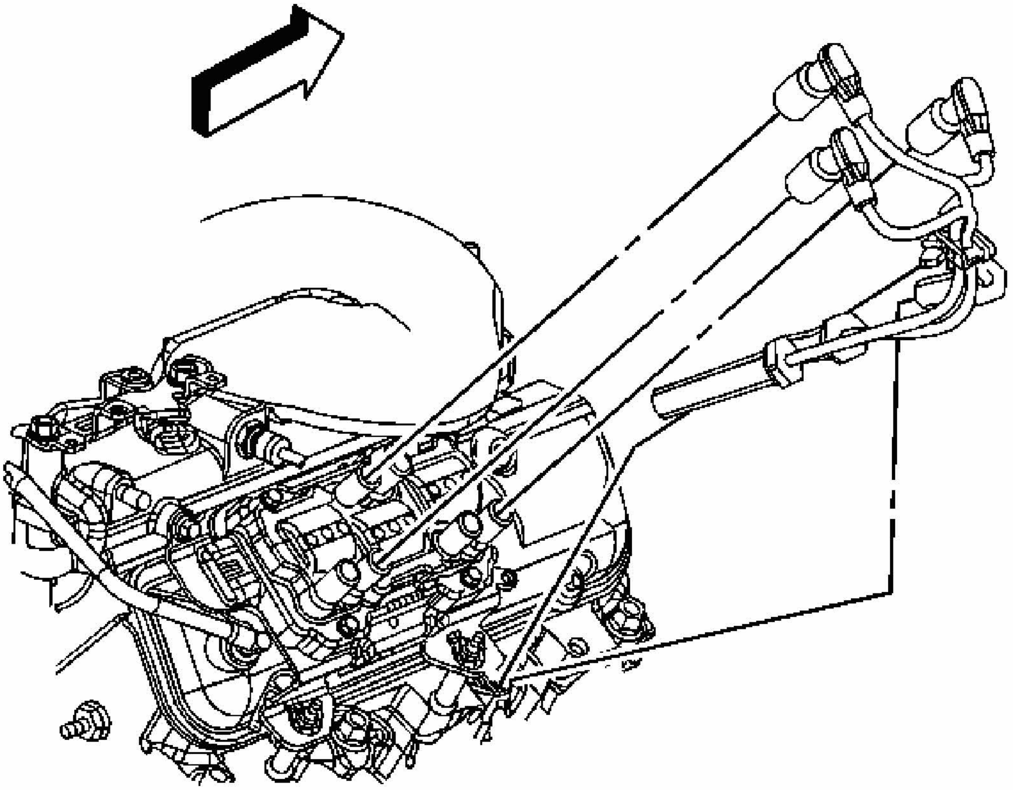


Fig. 103: View Of Spark Plug Wire Assembly
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the right side spark plug wires from the spark plugs.
6. Disconnect the right side spark plug wires from the ignition coil.
7. Remove the right side spark plug harness clip from the ignition coil bracket.
8. Remove the spark plug harness.

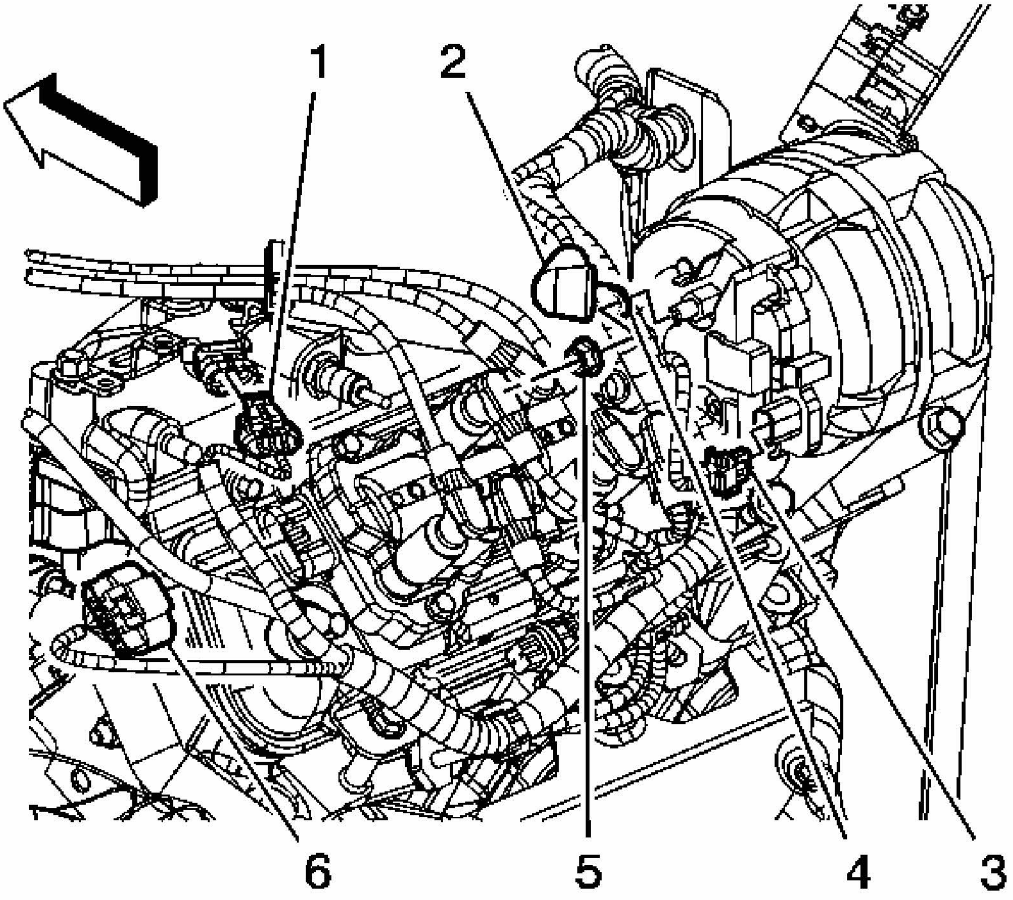


Fig. 104: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).
10. Disconnect the ignition coil electrical connector (6).
11. Remove the engine harness clip from the ignition coil bracket.

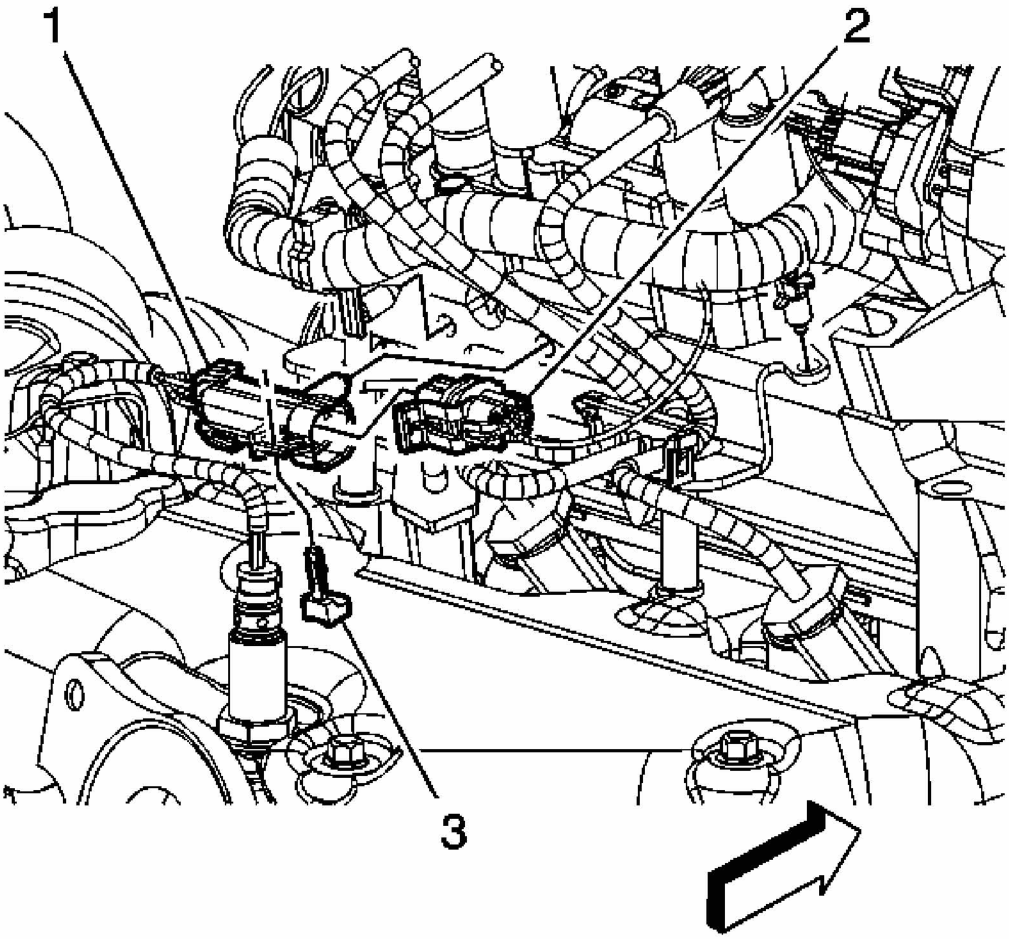


Fig. 105: Identifying The HO2S Electrical Connector
Courtesy of GENERAL MOTORS CORP.

12. Remove the heated oxygen sensor (HO2S) electrical connector clip (1) from the ignition coil bracket.

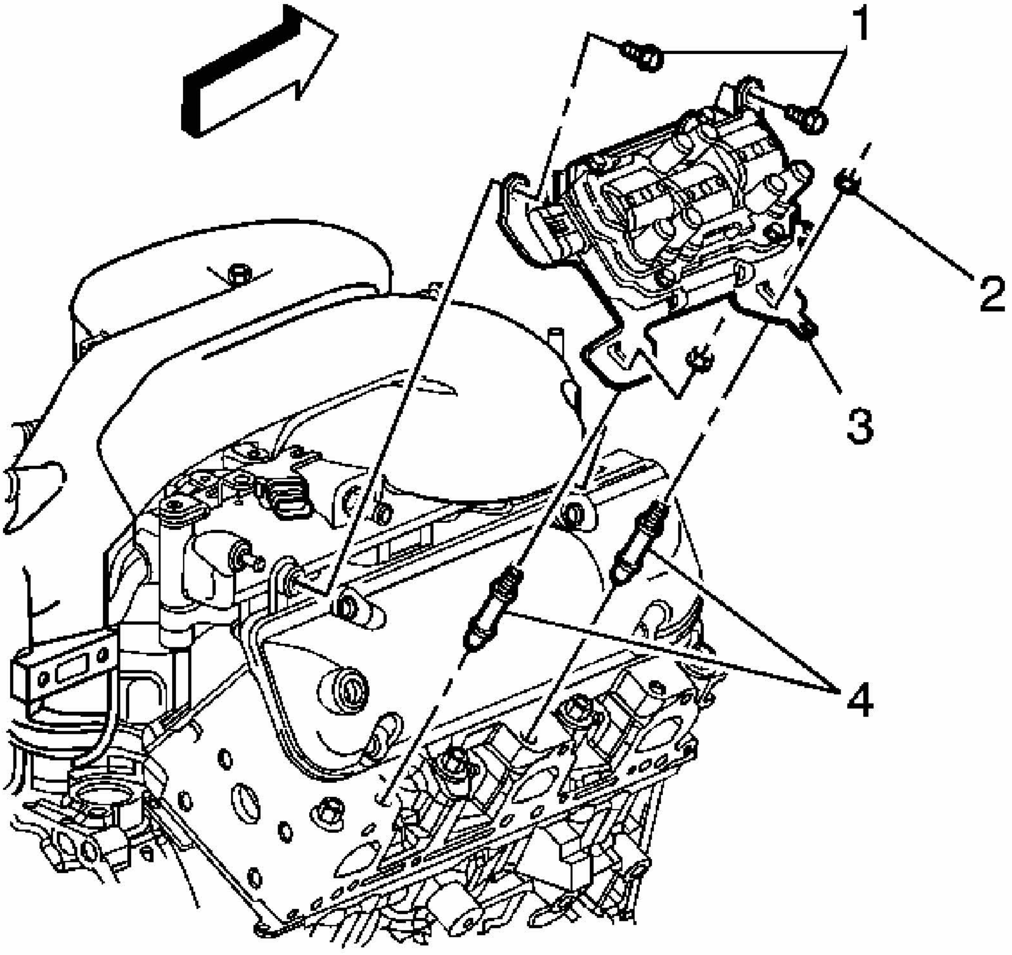


Fig. 106: Identifying Ignition Coil Bracket, Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

13. Remove the ignition coil bracket nuts (2).
14. Remove the ignition coil bracket bolts (1).
15. Remove the ignition coil.

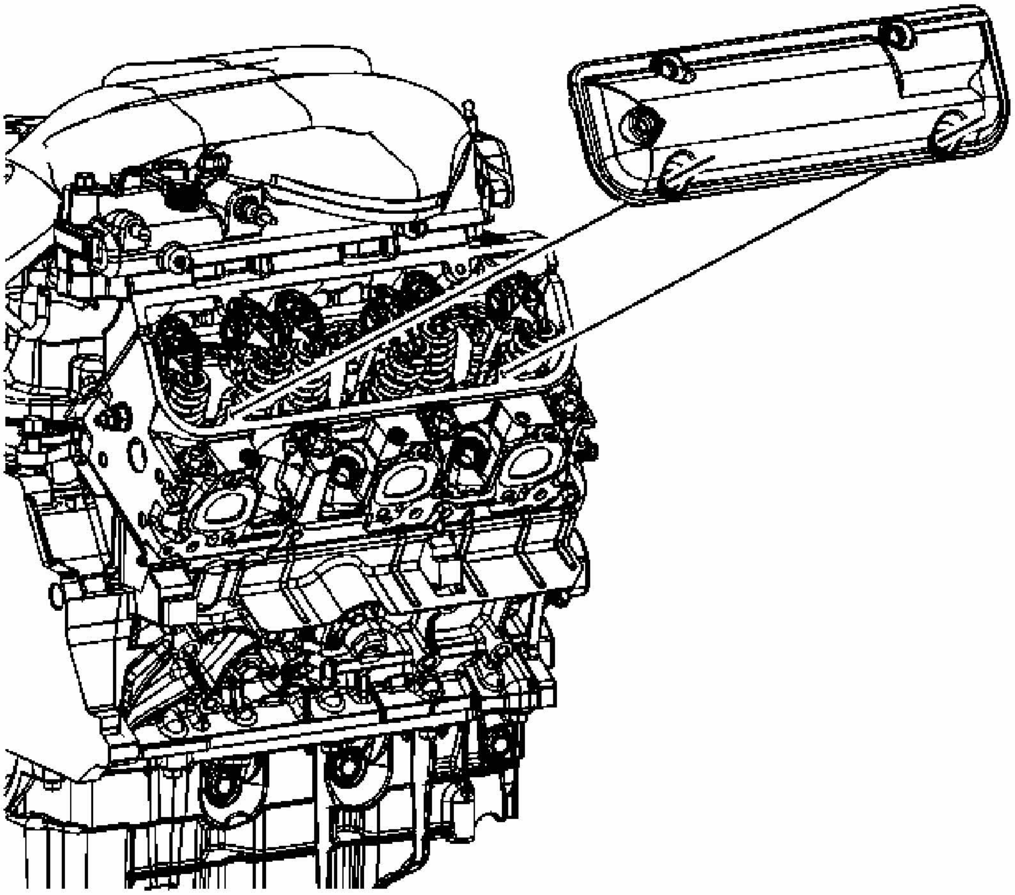


Fig. 107: View Of Right Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

16. Loosen the valve rocker arm cover bolts.

IMPORTANT: When removing the valve rocker arm cover, ensure the gasket stays in place attached to the cylinder head.

17. Remove the valve rocker arm cover. Bump the end of the cover with the palm of your hand or a soft rubber mallet if the cover adheres to the cylinder head.
18. Cut the room temperature vulcanizing (RTV) sealer in the channel where the intake, cylinder head and valve rocker arm cover meet with a suitable tool.
19. Remove the valve cover gasket.
20. Clean the sealing surface on the cylinder head with degreaser.

Installation Procedure

IMPORTANT: All gasket mating surfaces need to be free of oil and foreign material. Use GM P/N 12346139 (Canadian P/N 10953463) or equivalent, to clean the surfaces.

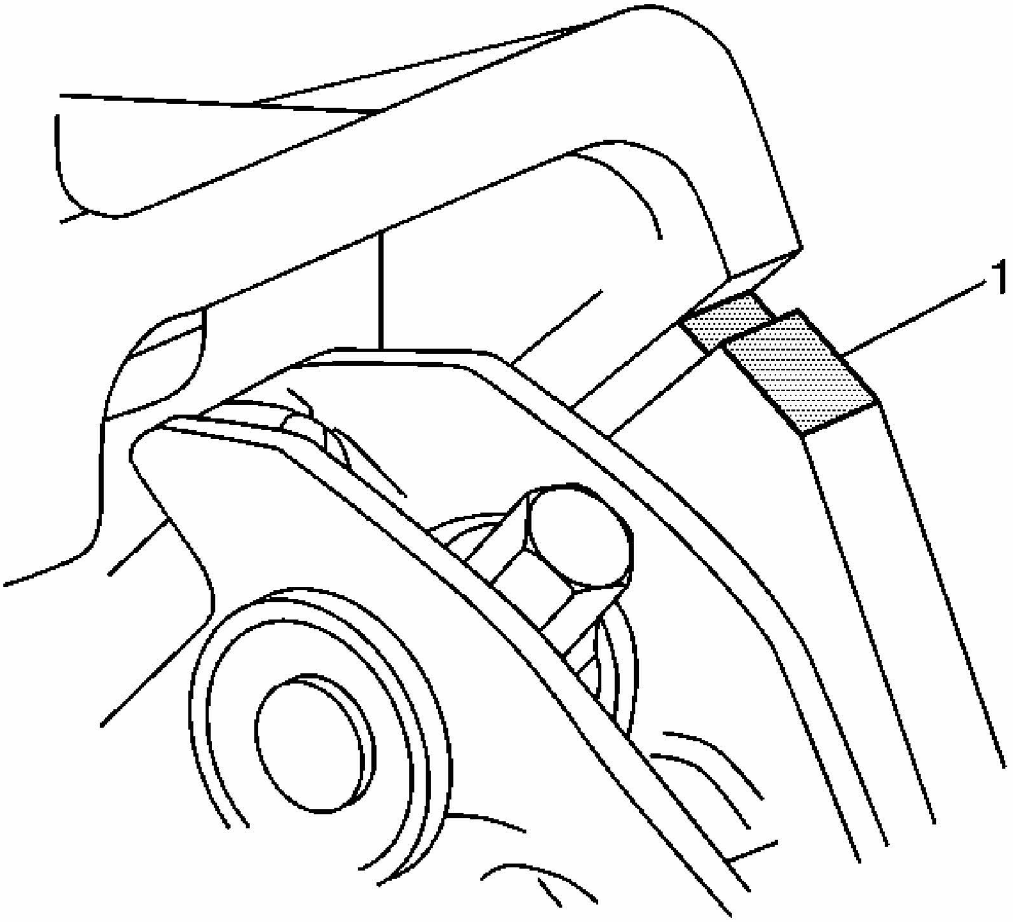


Fig. 108: Identifying Cylinder Head To Lower Intake Manifold Joint
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW valve rocker arm cover gasket into the groove in the valve rocker arm cover. Ensure that the gasket is properly seated in the groove of the valve rocker arm cover.
2. Apply sealant GM P/N 12378521 (Canadian P/N 88901148) or equivalent, at the cylinder head to the surfaces where the cylinder head and intake manifold meet (1).

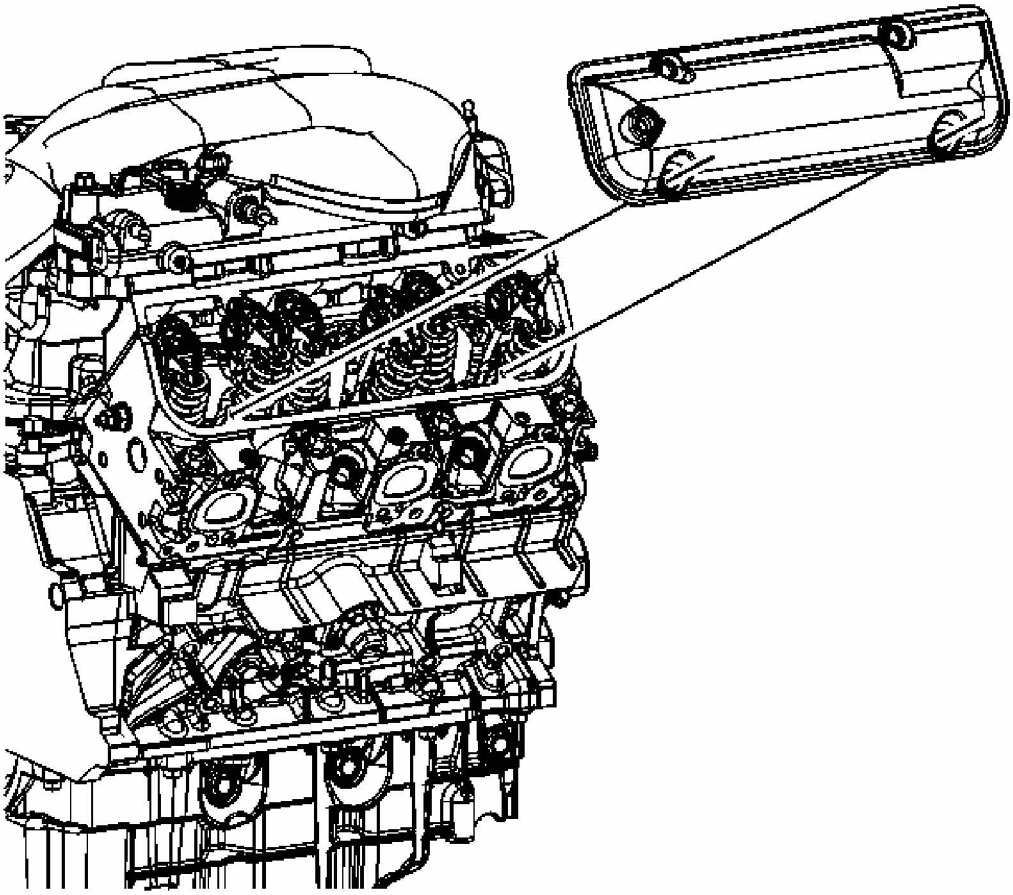


Fig. 109: View Of Right Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

3. Install a new gasket to the valve rocker arm cover. Ensure that the gasket is properly seated in the groove of the valve rocker arm cover.
4. Install the right valve rocker arm cover.

NOTE: **Refer to Fastener Notice .**

IMPORTANT: **Use an alternating criss-cross pattern when tightening the valve rocker cover bolts. Failure to do so may result in oil leakage from the valve cover due to improper seating of the gasket.**

5. Tighten the valve rocker arm cover bolts.

Tighten: Tighten the bolts to 10 N.m (89 lb in).

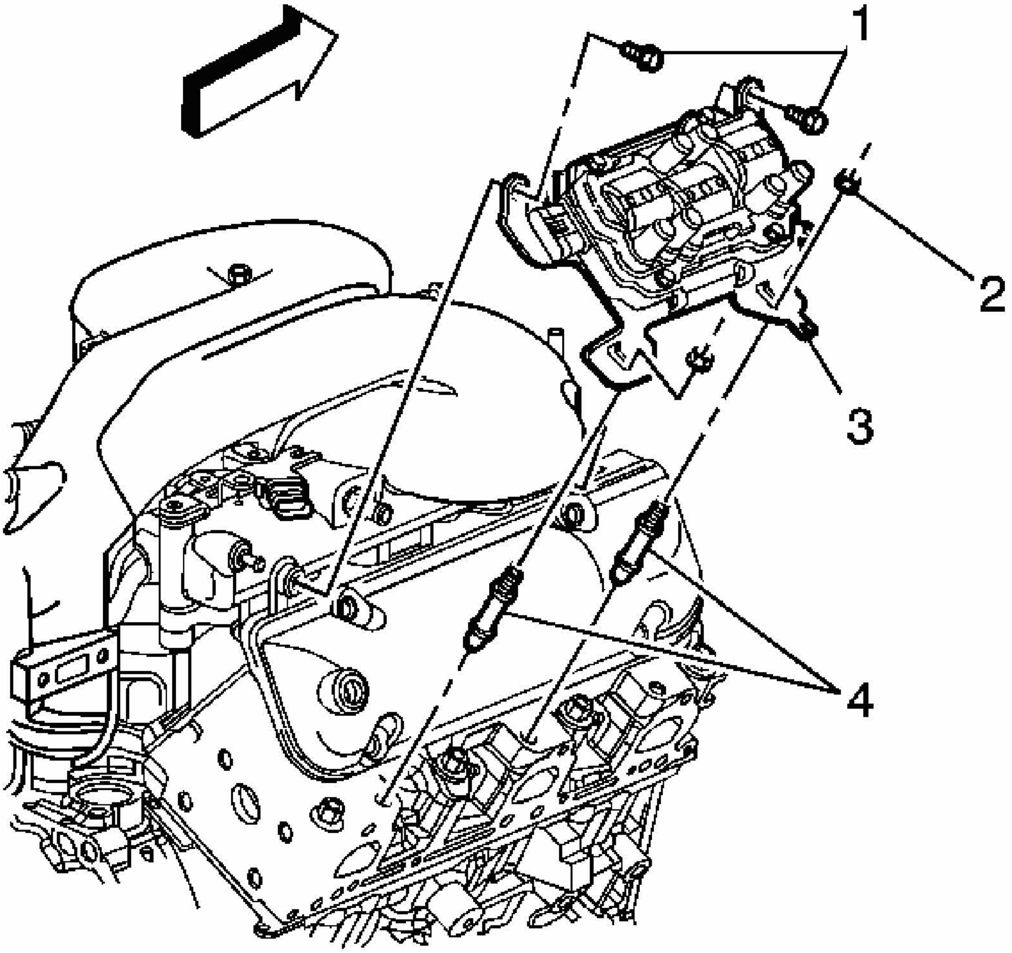


Fig. 110: Identifying Ignition Coil Bracket Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

6. Install the ignition coil.
7. Install the ignition coil bracket bolts (1).
8. Install the ignition coil bracket nuts (2).

Tighten: Tighten the bolts/nuts to 25 N.m (18 lb ft).

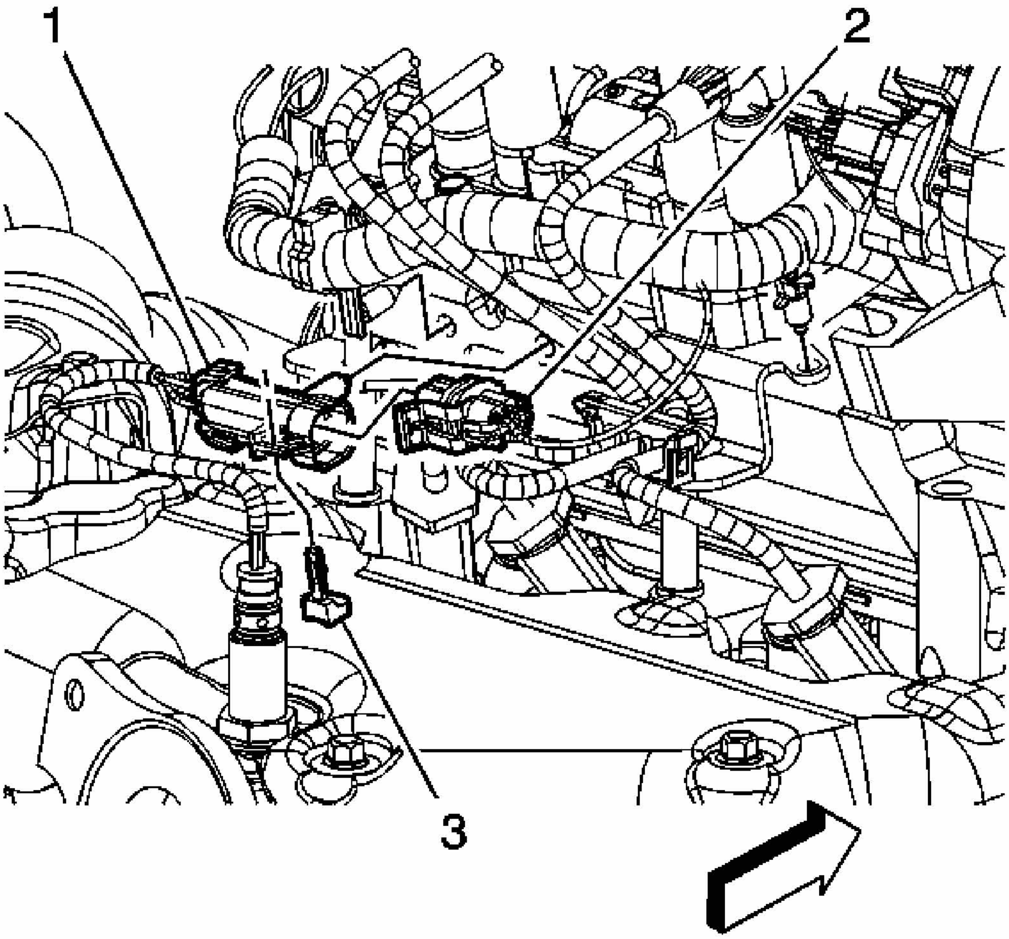


Fig. 111: Identifying The HO2S Electrical Connector
Courtesy of GENERAL MOTORS CORP.

9. Install the HO2S electrical connector clip (1) to the ignition coil bracket.

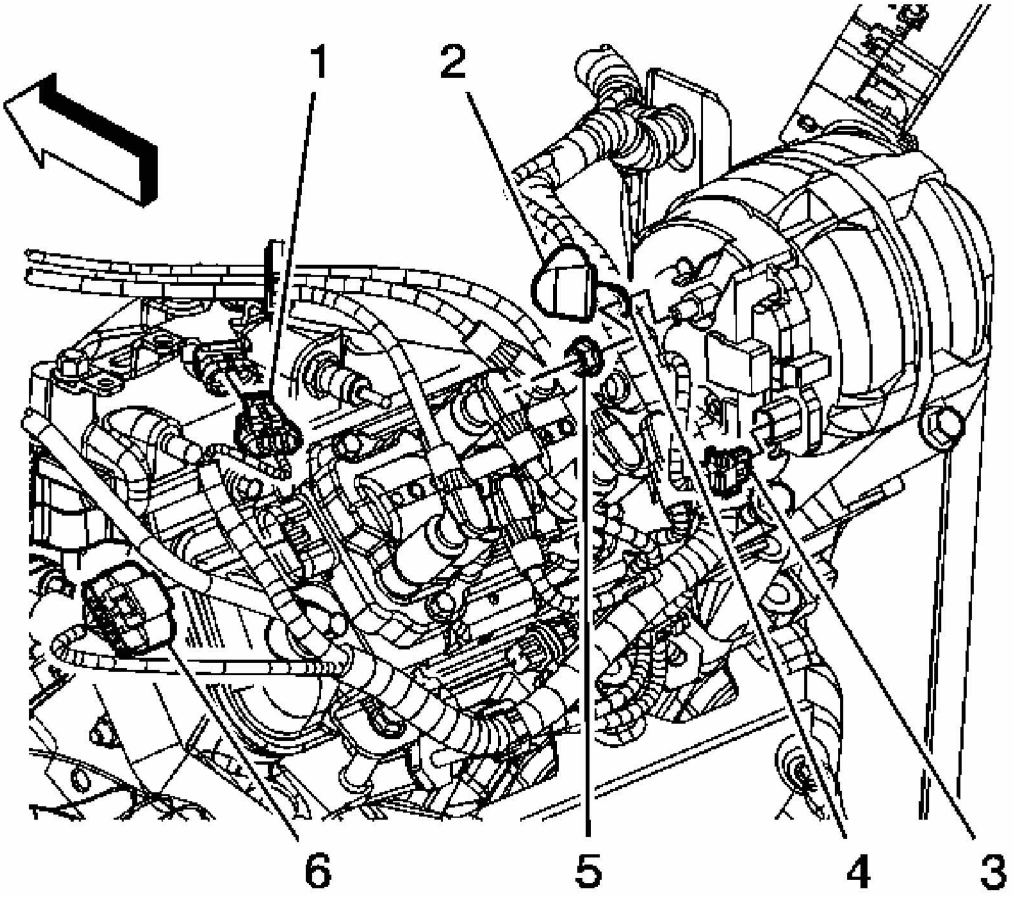


Fig. 112: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

10. Install the engine harness clip to the ignition coil bracket.
11. Connect the ignition coil electrical connector (6).
12. Connect the MAP sensor electrical connector (1).

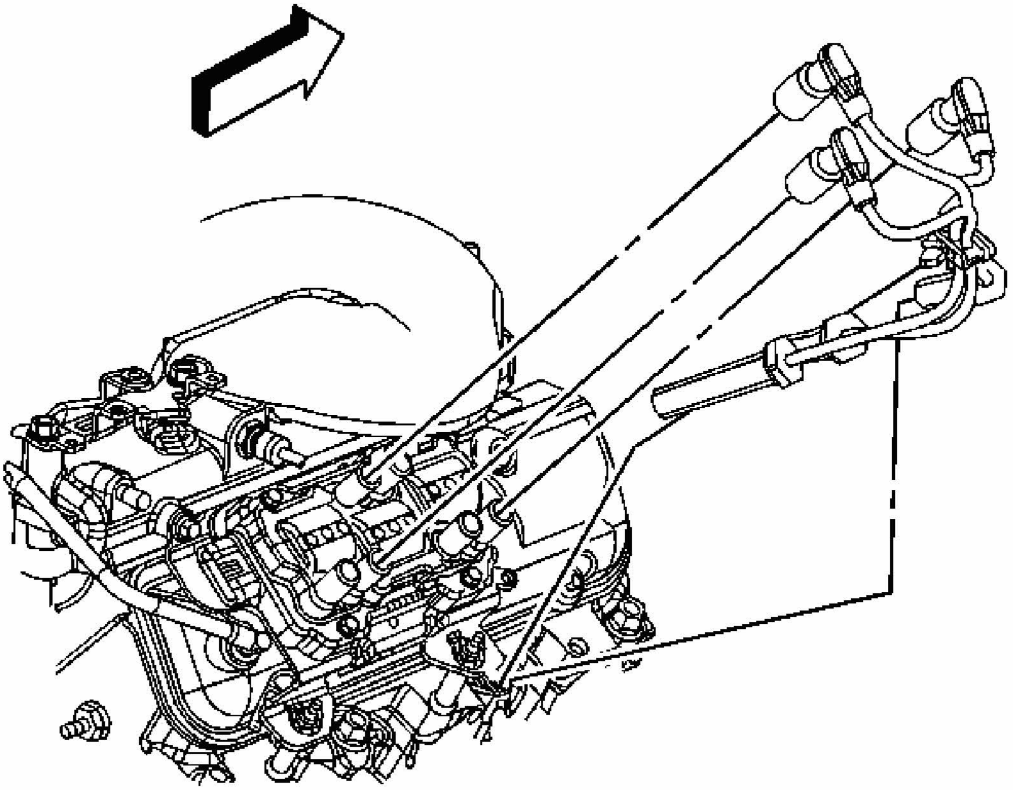


Fig. 113: View Of Spark Plug Wire Assembly
Courtesy of GENERAL MOTORS CORP.

13. Install the spark plug harness.
14. Connect the right side spark plug wires to the spark plugs.
15. Connect the right side spark plug wires to the ignition coil.
16. Install the right side spark plug harness clip to the ignition coil bracket.

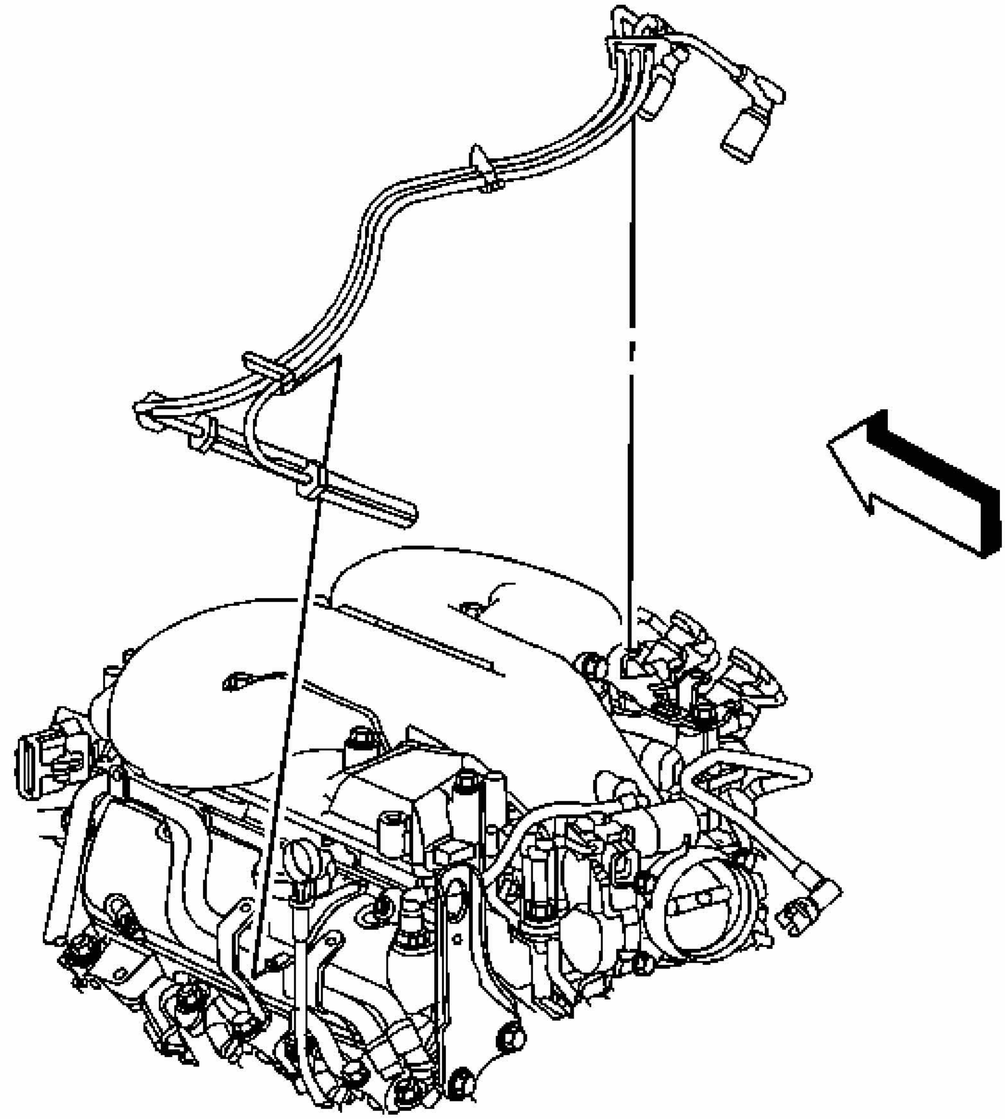


Fig. 114: View Of Left Spark Plug/Coil Harness
Courtesy of GENERAL MOTORS CORP.

17. Connect the left side spark plug wires to the ignition coil.

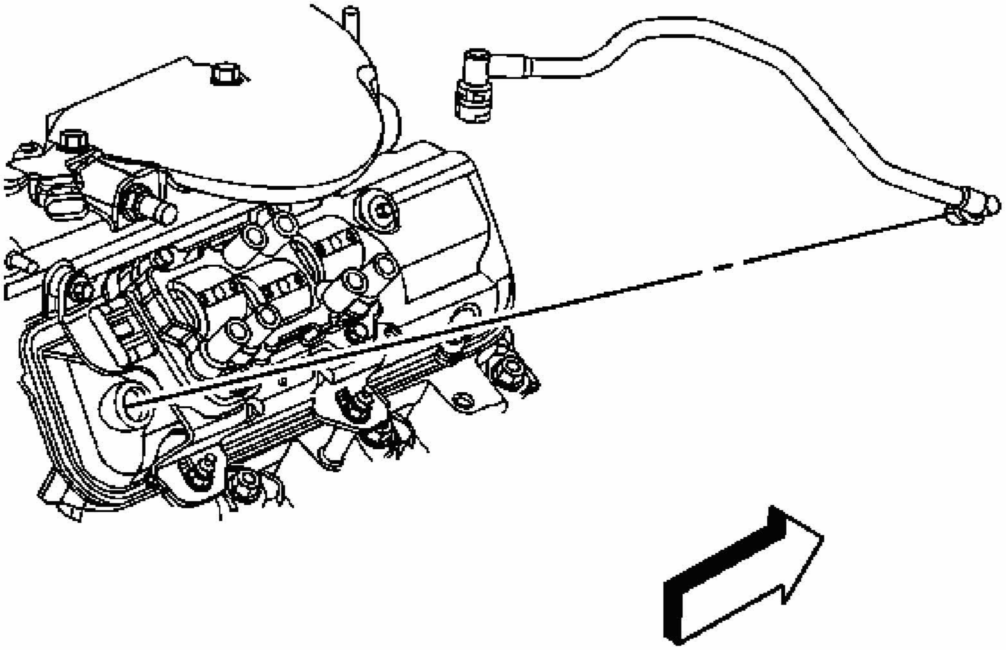


Fig. 115: Identifying Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

18. Install the PCV fresh air tube to the right side valve rocker arm cover.
19. Connect the PCV fresh air tube to the air cleaner outlet duct. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
20. Install the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** .

VALVE ROCKER ARM AND PUSH ROD REPLACEMENT

Removal Procedure

IMPORTANT: Place the valve train components in a rack in order to ensure that the components are installed in the same location from which they were removed.

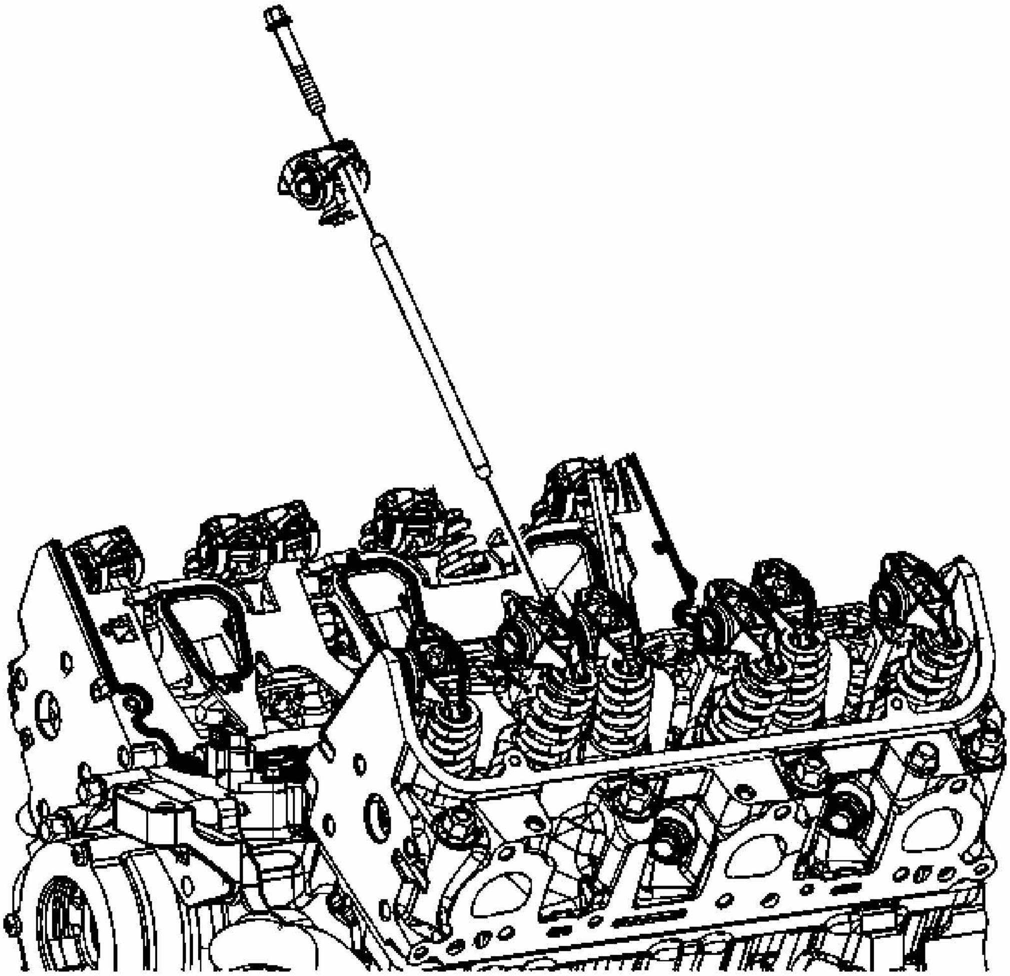


Fig. 116: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the valve rocker arm covers. Refer to **Valve Rocker Arm Cover Replacement - Left** or **Valve Rocker Arm Cover Replacement - Right**.
2. Loosen the valve rocker arm bolts.
3. Remove the rocker arms.
4. Remove the pushrods.
    - The intake push rods measure 147.51 mm (5.81 in).
    - The exhaust push rods measure 154.87 mm (6.1 in).

Installation Procedure

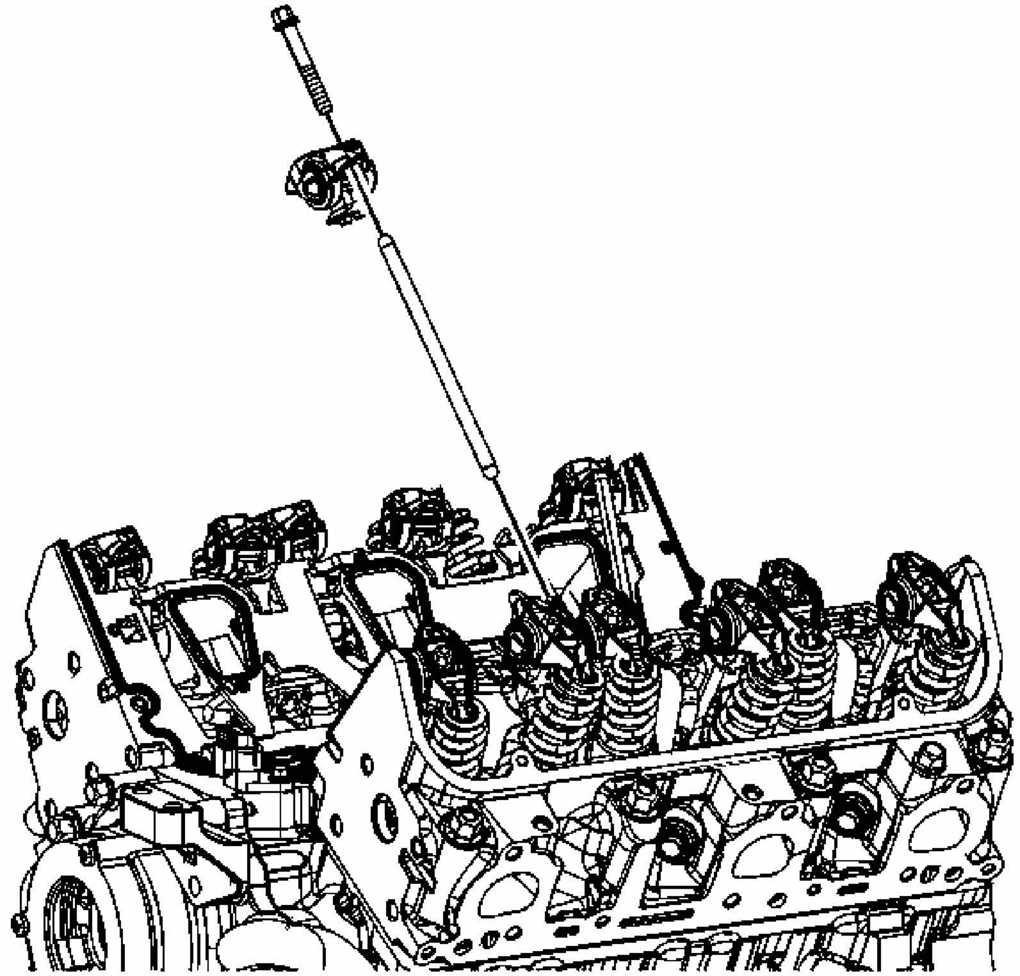


Fig. 117: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Coat the ends of the pushrods using prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent.
2. Install the pushrods.
   - The intake pushrods are identified with yellow stripes.
   - The exhaust pushrods are identified with blue stripes.
3. Ensure that the pushrods seat in the lifter bore.
4. Coat the rocker arm friction surfaces using prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent.

IMPORTANT: Shims (88894006) may be required under the valve rocker

arm pedestals if reconditioning has been performed on the cylinder head or its components.

5. Install the rocker arms.

   NOTE: **Refer to Fastener Notice .**

6. Install the rocker arm bolts.

   Tighten: Tighten the bolts to 34 N.m (25 lb ft).

7. Install the valve rocker arm covers. Refer to **Valve Rocker Arm Cover Replacement - Left** or **Valve Rocker Arm Cover Replacement - Right**.

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT

Tools Required

- **J 22794** Spark Plug Port Adapter
- **J 38606** Valve Spring Compressor

Removal Procedure

IMPORTANT:

- **Before removing the valve locks, rotate the engine so that the piston in the cylinder you are working on is at top dead center (TDC). This will eliminate the possibility of the valve accidentally falling inside the cylinder.**
- **Loosen the spark plug, and clean any dirt and/or debris from the spark plug recess area before removing.**

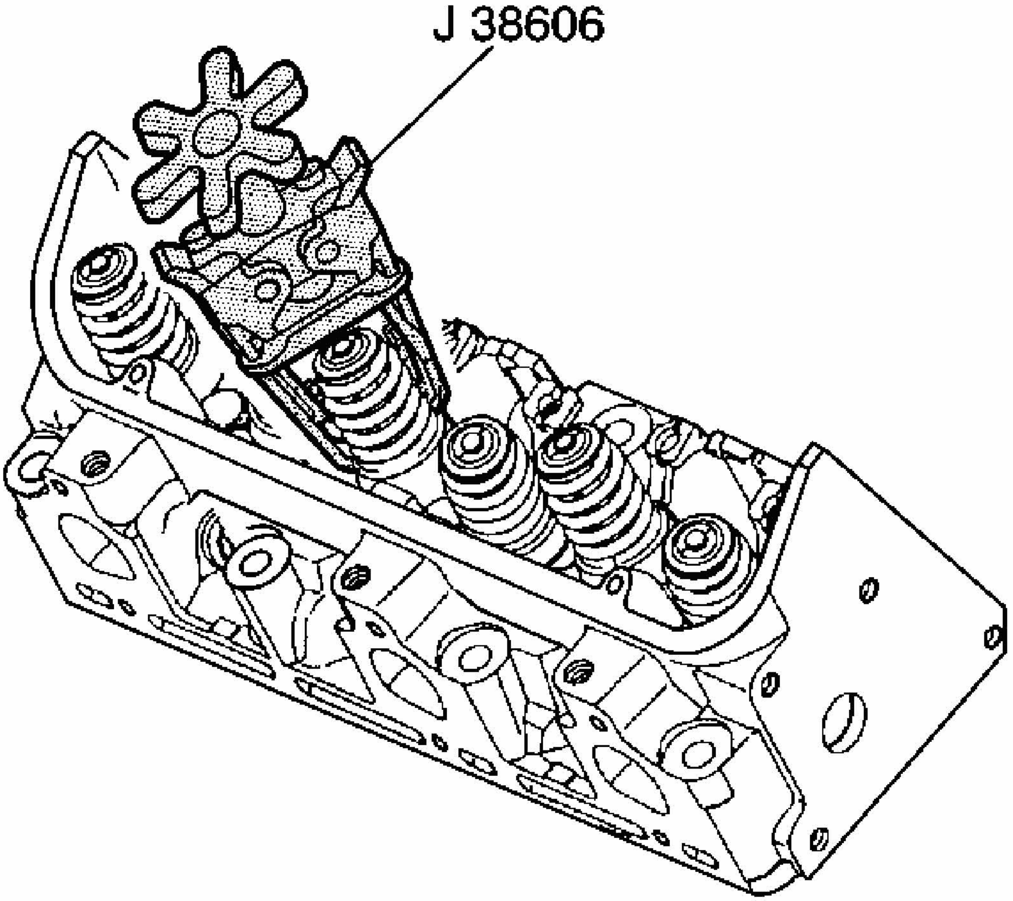


Fig. 118: Compressing Valve Springs
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug. Refer to **Spark Plug Replacement** .
2. Remove the rocker arm. Refer to **Valve Rocker Arm and Push Rod Replacement**.
3. Install the **J 22794** into the spark plug port. Apply compressed air in order to hold the valves in place.
4. Install the **J 38606** onto the valve spring.

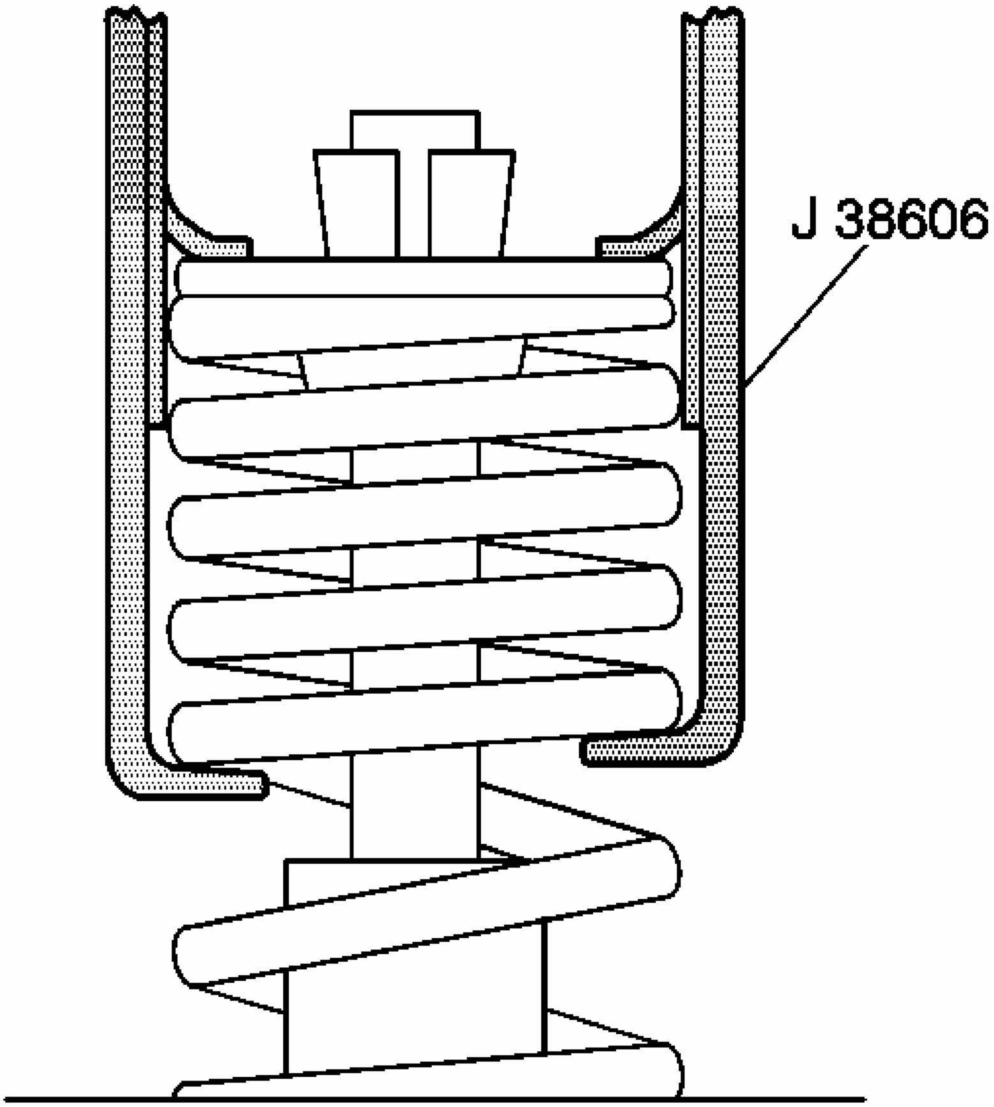


Fig. 119: Compressing Valve Spring
Courtesy of GENERAL MOTORS CORP.

5. Compress the valve spring using the **J 38606** .

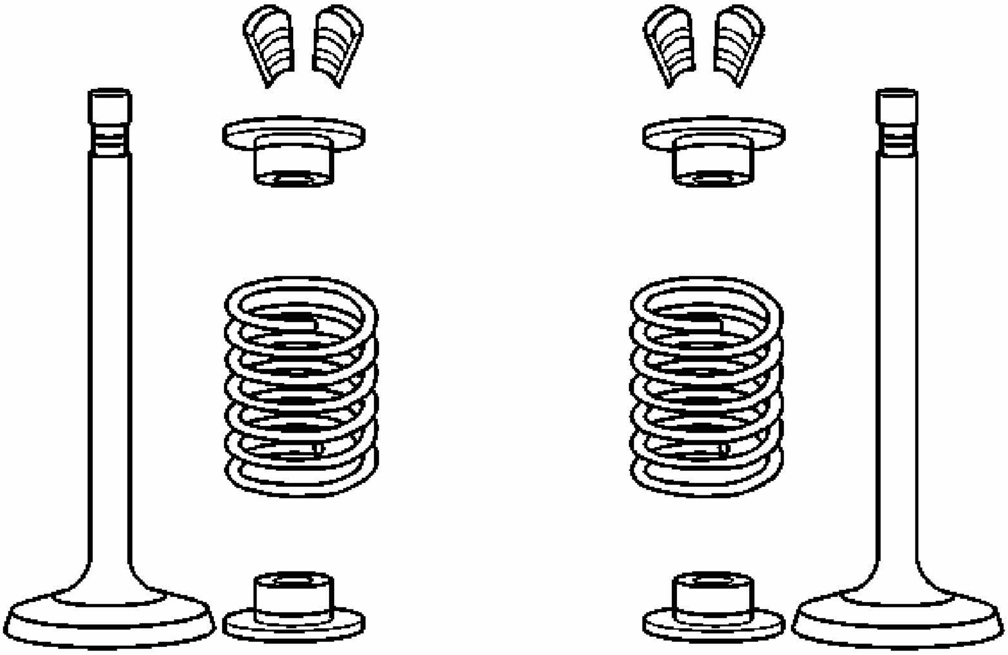


Fig. 120: Valve Locks, Caps, Seats & Spring
Courtesy of GENERAL MOTORS CORP.

6. Remove the valve spring cap keys.
7. Remove the valve cap.
8. Remove the valve spring.
9. Remove the valve stem oil seal.

Installation Procedure

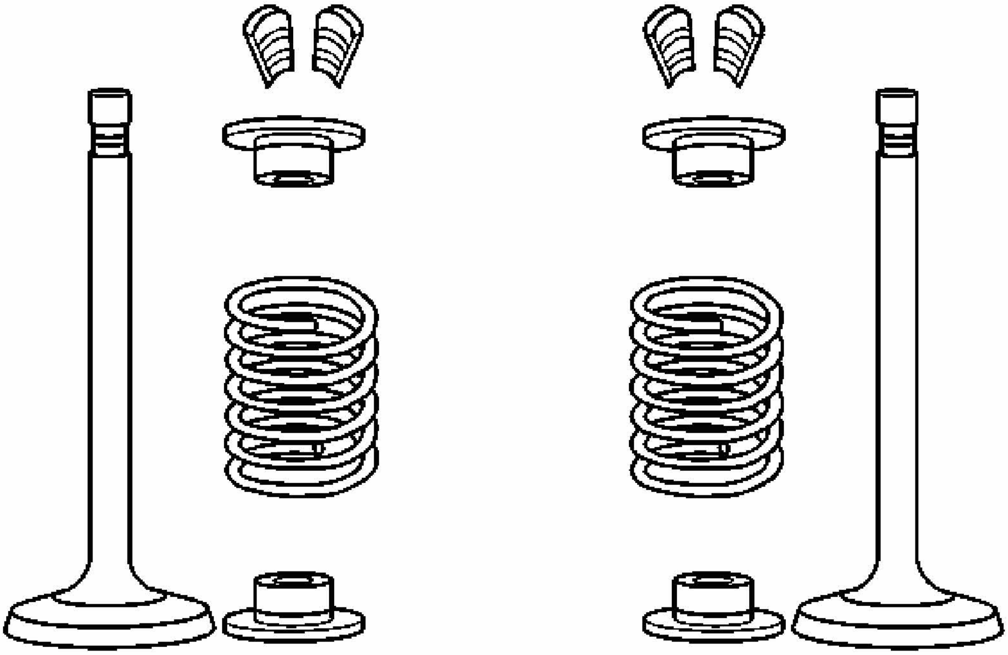


Fig. 121: Valve Locks, Caps, Seats & Spring
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the valve stem with clean engine oil.
2. Install the valve stem oil seal.
3. Install the valve spring.
4. Install the valve cap.

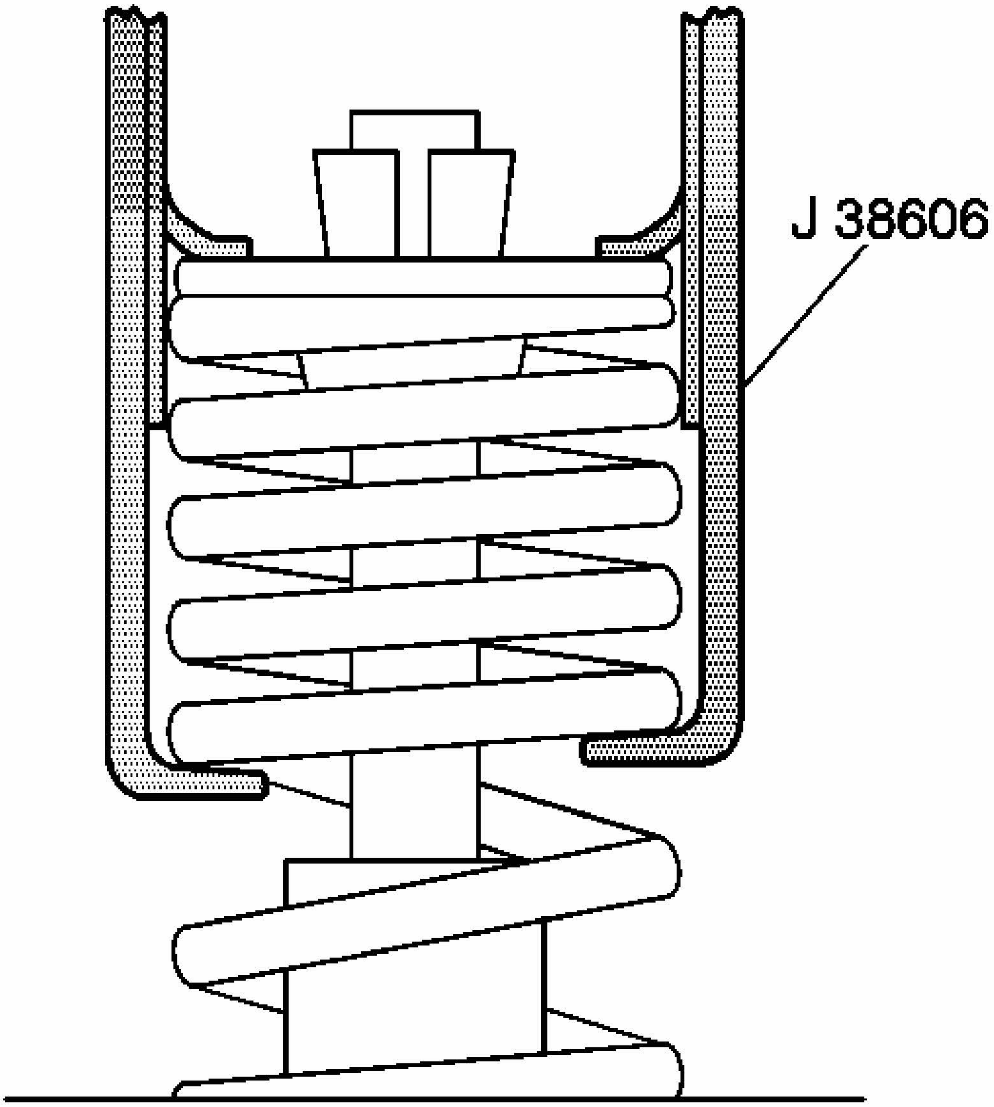


Fig. 122: Compressing Valve Spring
Courtesy of GENERAL MOTORS CORP.

5. Compress the valve spring using the **J 38606** .
6. Install the valve cap keys. If necessary, use grease in order to hold the valve cap keys in place.

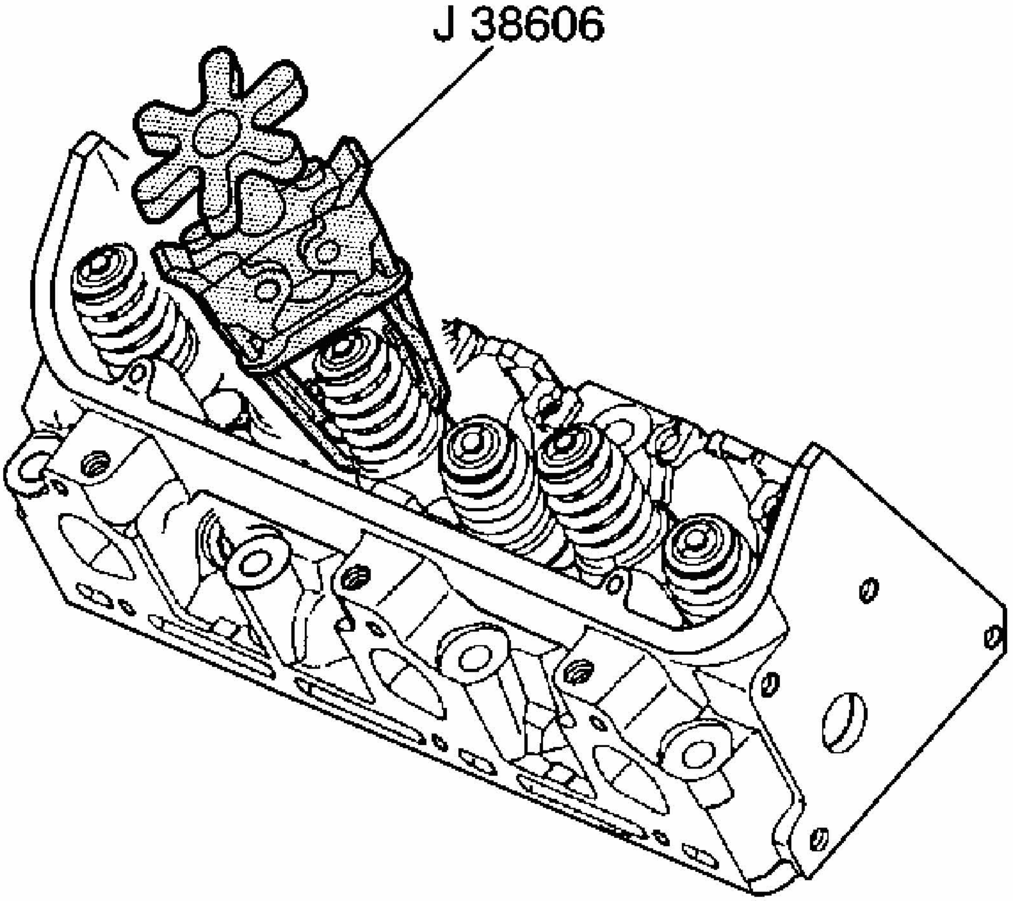


Fig. 123: Compressing Valve Springs
Courtesy of GENERAL MOTORS CORP.

7. Release the valve spring using the **J 38606** .
8. Ensure the valve cap keys are seated.
9. Remove the compressed air and remove the **J 22794** from the spark plug port.
10. Install the rocker arm. Refer to **Valve Rocker Arm and Push Rod Replacement**.
11. Install the spark plug. Refer to **Spark Plug Replacement** .

VALVE LIFTER REPLACEMENT

Removal Procedure

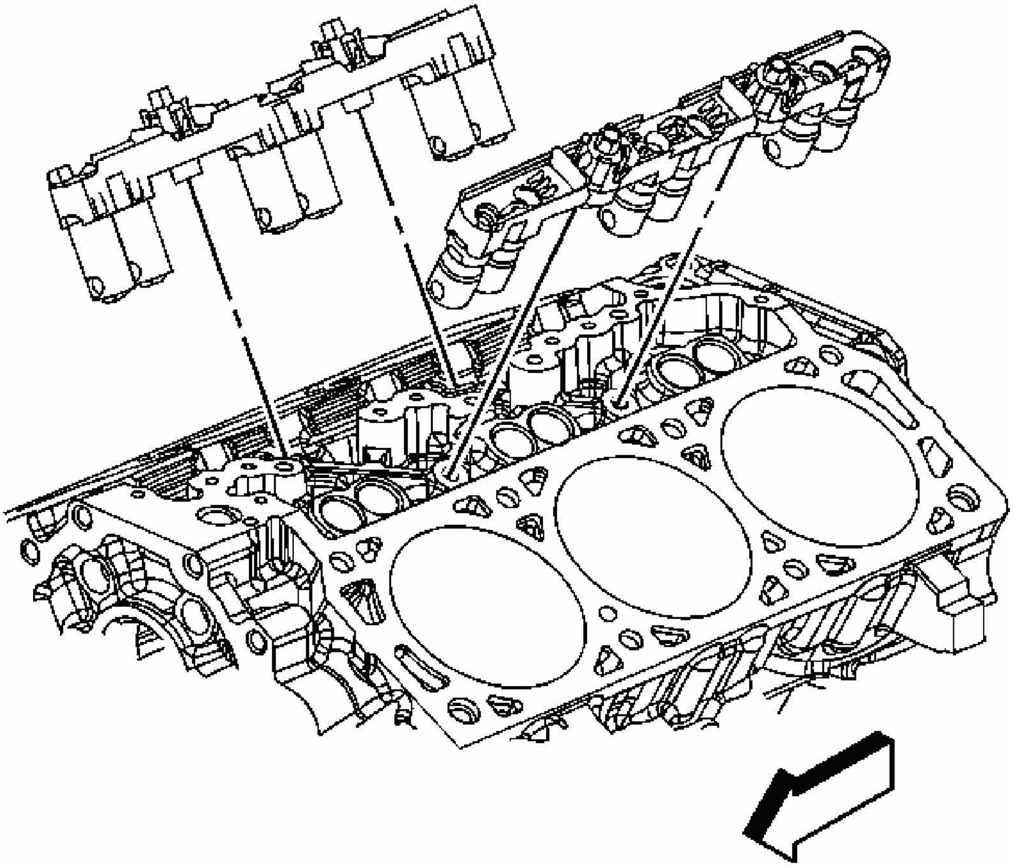


Fig. 124: Identifying Valve Lifter Guides
Courtesy of GENERAL MOTORS CORP.

1. Remove the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
2. Remove the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.

IMPORTANT: The valve lifter guide bolts are not removable.

3. Loosen the valve lifter guide bolts.
4. Remove the valve lifter guides.

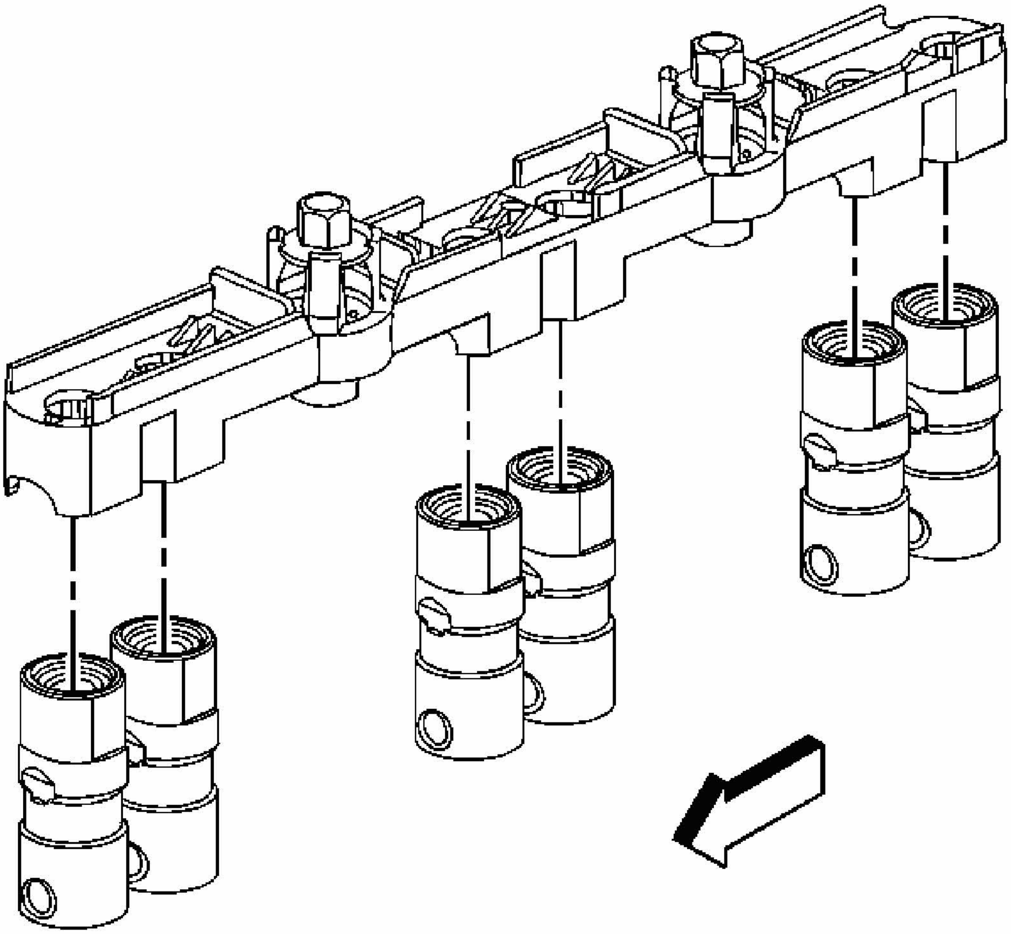


Fig. 125: Identifying Valve Lifters
Courtesy of GENERAL MOTORS CORP.

5. Remove the valve lifters from the valve lifter guides.
6. Clean all gasket surfaces with degreaser.

Installation Procedure

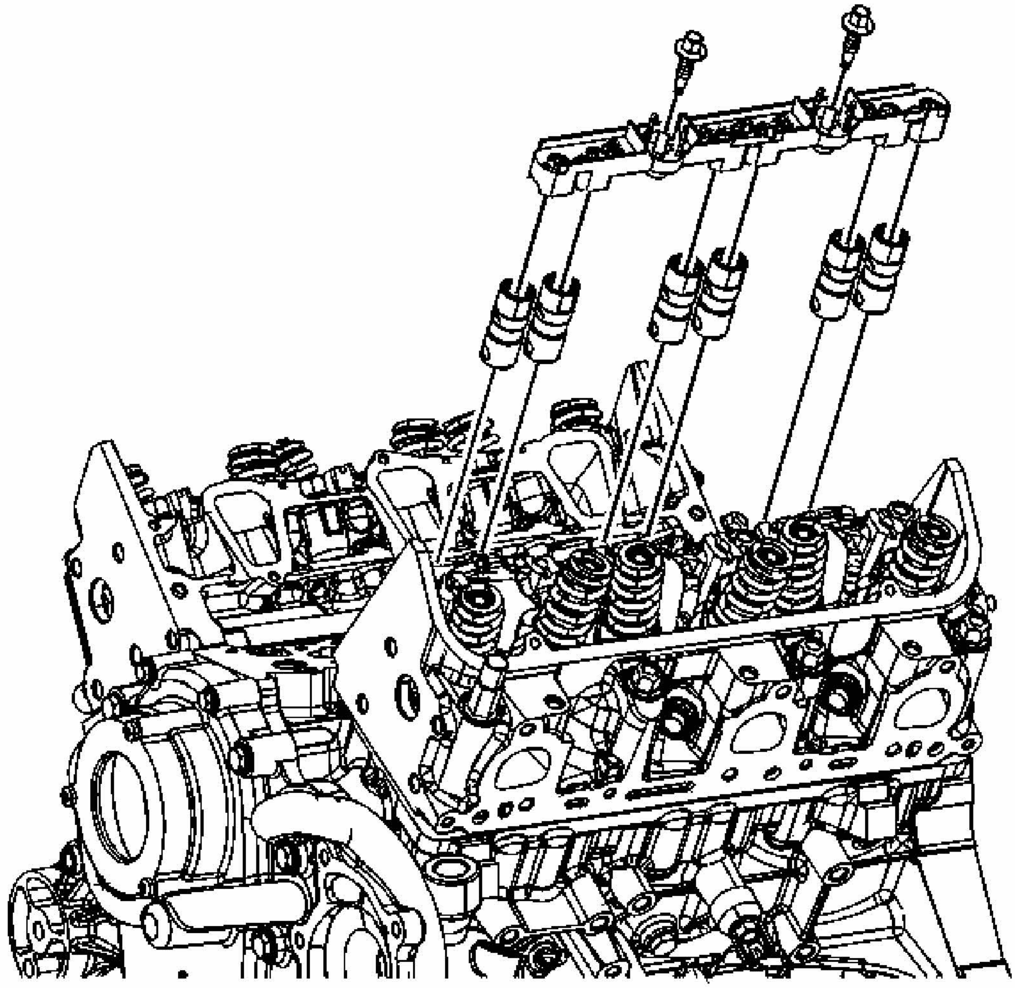


Fig. 126: View Of Valve Lifter Guides
Courtesy of GENERAL MOTORS CORP.

1. Coat the valve lifters using prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent.
2. Install the valve lifters to the cylinder bores.
3. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the valve lifter guide bolt threads.
4. Install the valve lifter guides.

NOTE: **Refer to Fastener Notice .**

5. Tighten the valve lifter guide bolts.

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

6. Install the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
7. Install the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.

CRANKSHAFT BALANCER REPLACEMENT

Tools Required

- **EN 46359** Puller End Protector
- **J 29113** Balancer and Crank Sprocket Installer
- **J 37096** Flywheel Holder
- **J 41816** Harmonic Balancer Remover
- **J 45059** Angle Meter

Removal Procedure

NOTE: The inertial weight section of the crankshaft balancer is assembled to the hub with a rubber type material. The correct installation procedures (with the proper tool) must be followed or movement of the inertial weight section of the hub will destroy the tuning of the crankshaft balancer.

1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Remove the right front tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
4. Remove the right engine splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
5. Install adjustable jack stands under the frame.
6. Loosen the left side frame bolts and remove the right side frame bolts.
7. Using the jack stands, lower the right side of the frame in order to access the crankshaft balancer.
8. Remove the torque converter covers.
9. Install the **J 37096** to the flywheel in order to prevent flywheel rotation.

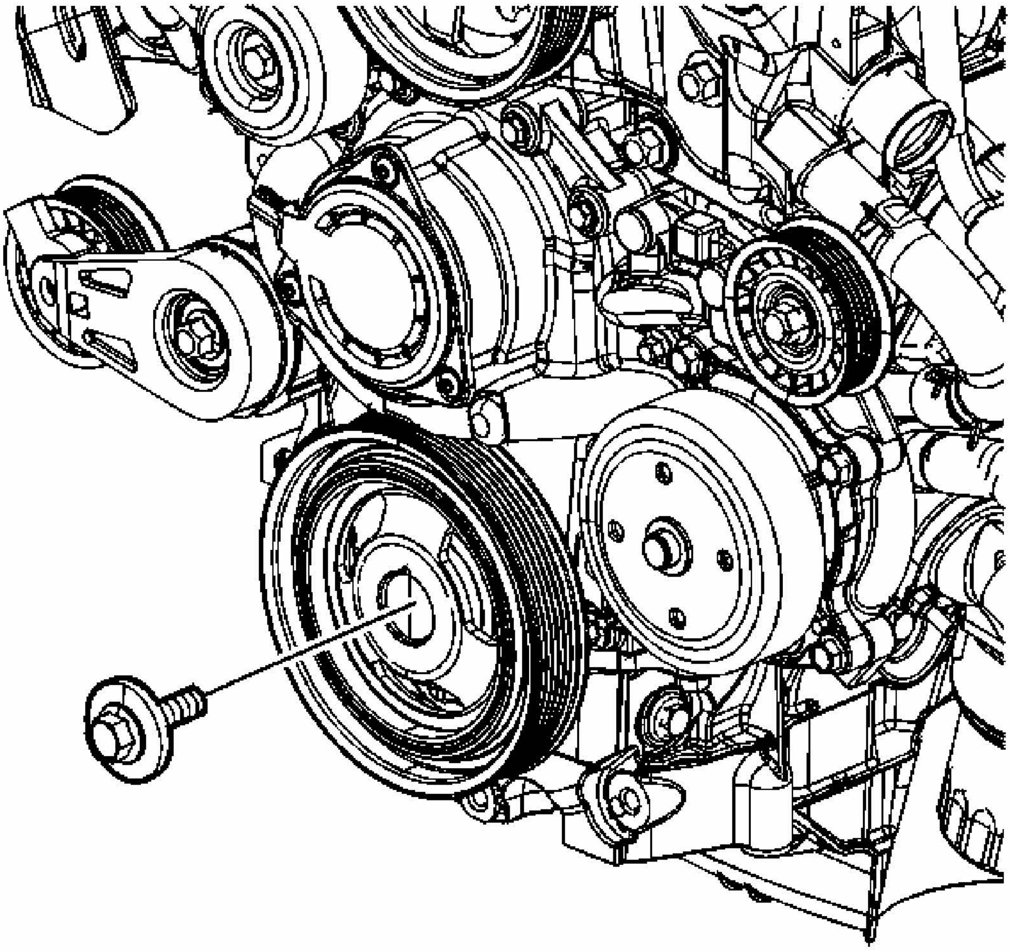


Fig. 127: Identifying Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

10. Remove the crankshaft balancer bolt and the washer.

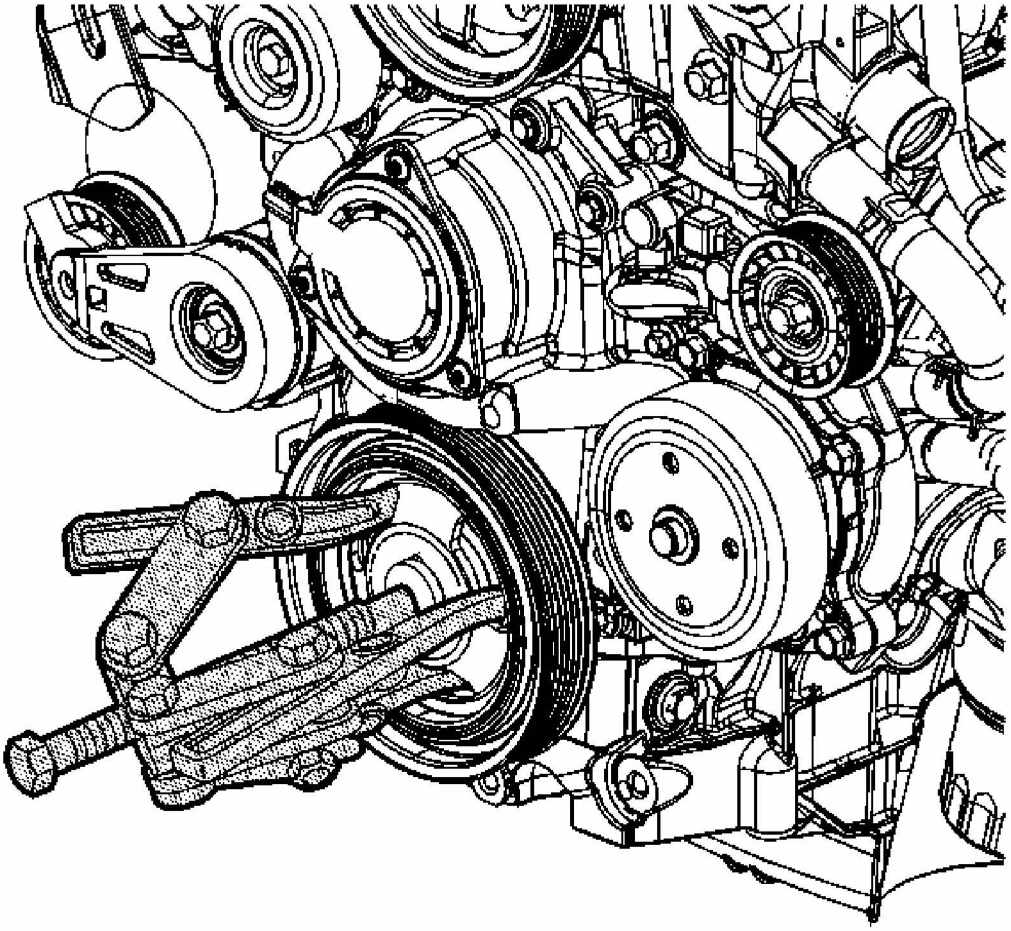


Fig. 128: Identifying Crankshaft Balancer Removing Tool J 41816
Courtesy of GENERAL MOTORS CORP.

NOTE: **Do NOT use a power-assisted tool with the special tool in order to remove or install this component. You cannot properly control the alignment of this component using a power-assisted tool, and this can damage the component.**

11. Remove the crankshaft balancer using the **J 41816** and **EN 46359** .

Installation Procedure

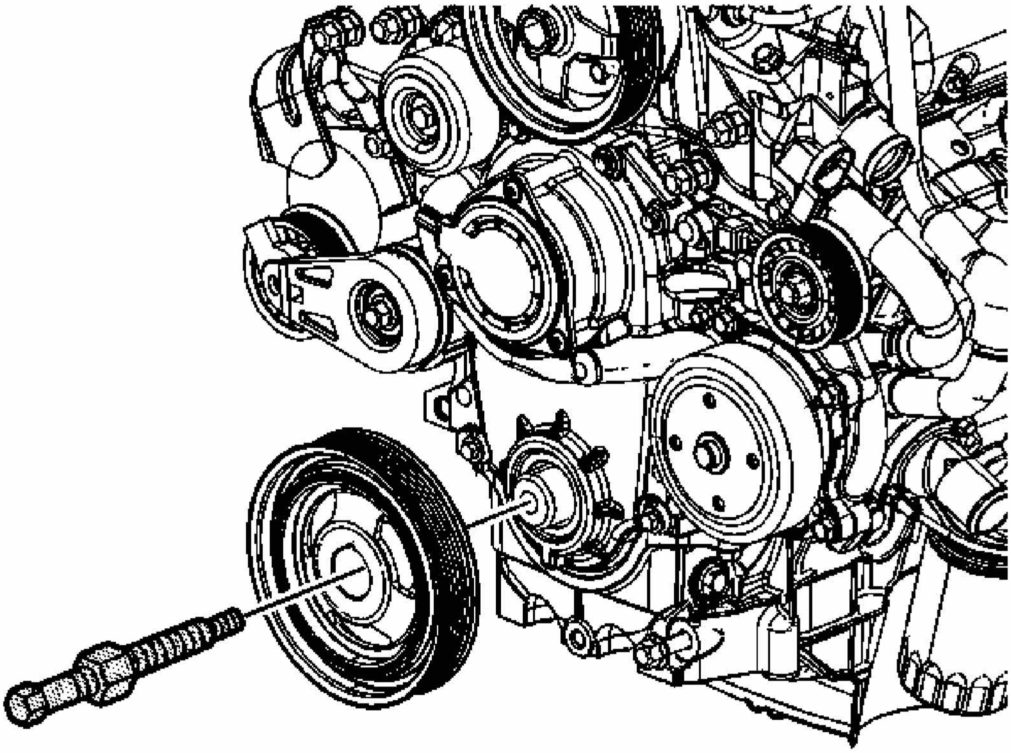


Fig. 129: View Of Balancer & Crank Sprocket Puller (J 29113)
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer GM P/N 12378521 (Canadian P/N 88901148) or equivalent to the keyway of the crankshaft balancer.
2. Place the crankshaft balancer into position over the key in the crankshaft.
3. Thread the **J 29113** into the crankshaft.
4. Rotate the hex nut on the **J 29113** in order to install the crankshaft balancer onto the crankshaft.
5. Remove the **J 29113** from the crankshaft.

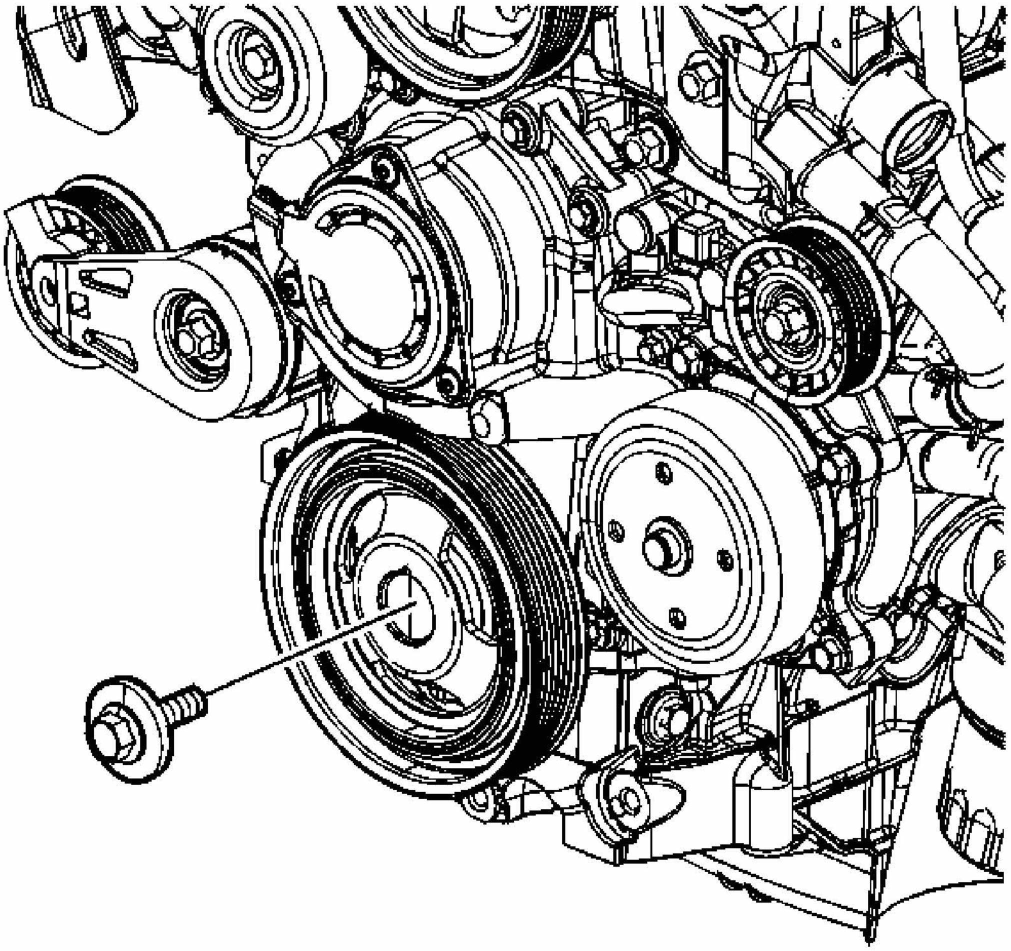


Fig. 130: Identifying Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

6. Install the crankshaft balancer washer and the bolt.

NOTE: **Refer to Fastener Notice .**

7. Tighten the crankshaft balancer bolt.

Tighten: Tighten the bolt to 70 N.m (52 lb ft) plus an additional 70 degrees using the **J 45059** .

8. Remove the **J 45059** from the flywheel.
9. Install the torque converter covers.

10. Raise the frame into the original position.
11. Install and tighten the right and left side frame bolts.

    Tighten: Tighten the bolts to 100 N.m (74 lb ft) plus an additional 90 degrees using the **J 45059** .

12. Install the right engine splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
13. Install the right front tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
14. Lower the vehicle.
15. Install the drive belt. Refer to **Drive Belt Replacement**.

OIL PAN REPLACEMENT

Tools Required

J 39505 Torque Wrench Adapter

Removal Procedure

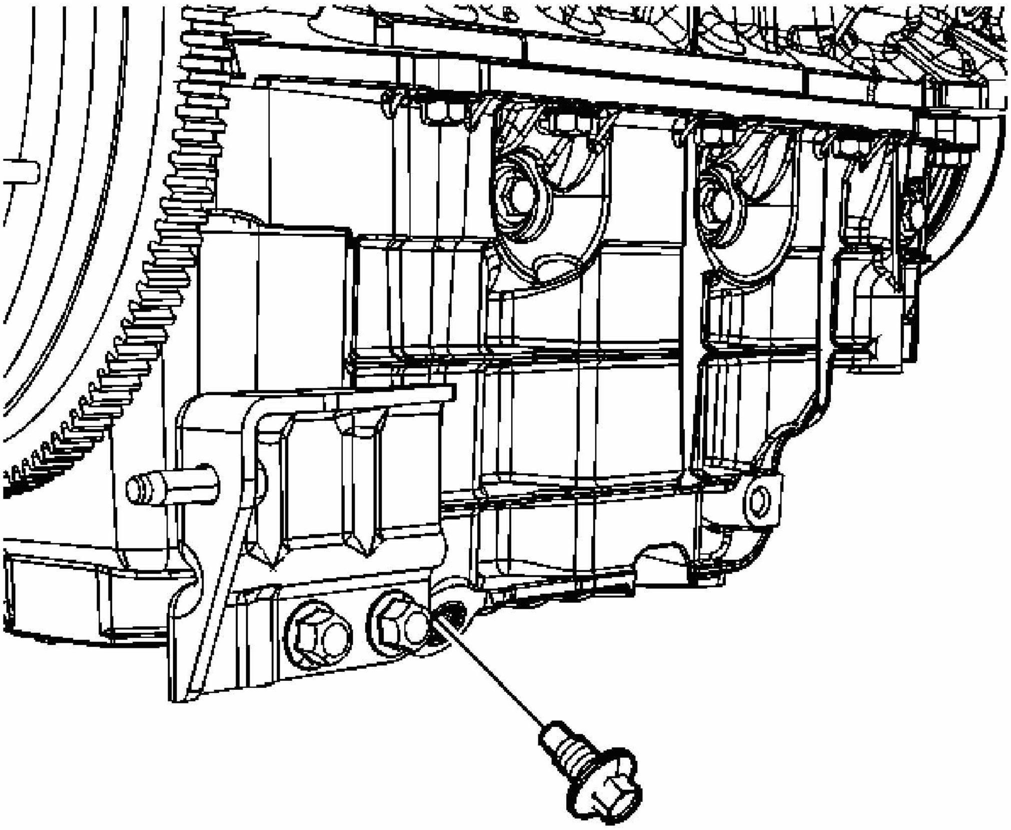


Fig. 131: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .
2. Remove the engine mount struts. Refer to **Engine Mount Strut Replacement**.
3. Install the engine support fixture. Refer to **Engine Support Fixture**.
4. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)** .
5. Remove the oil pan drain plug.
6. Drain the crankcase.
7. Reinstall the oil pan drain plug.

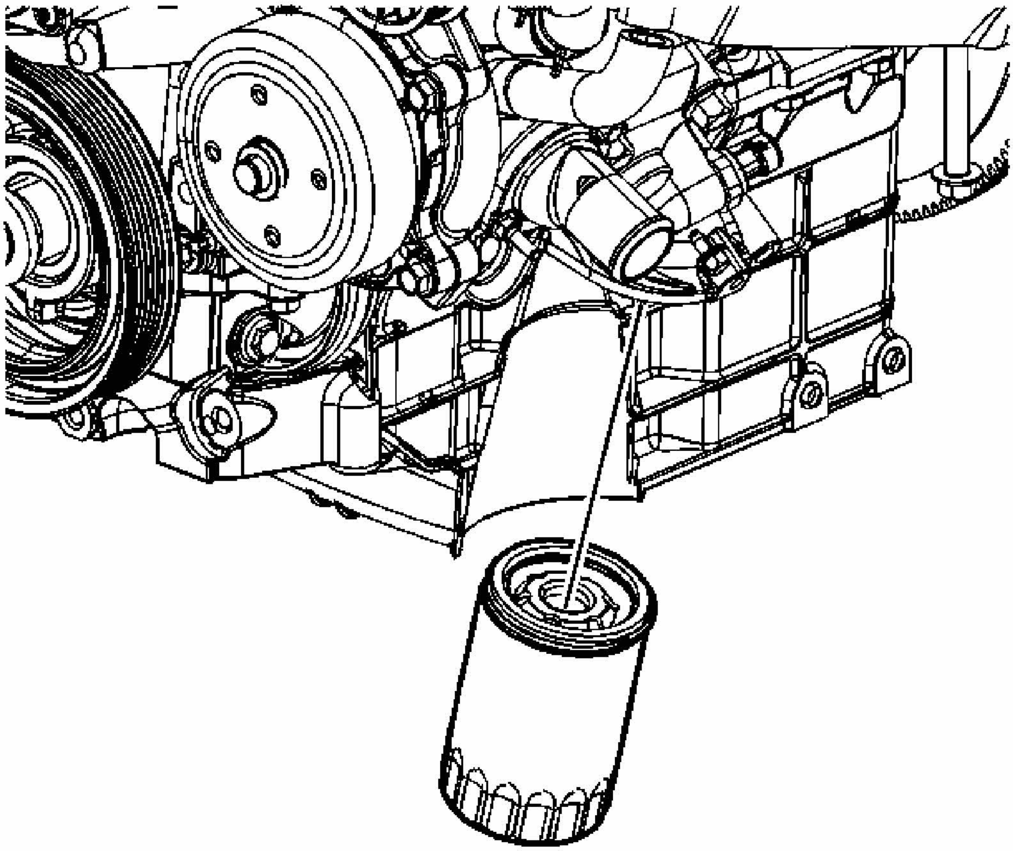


Fig. 132: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

8. Remove the oil filter.
9. Remove the starter. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)** .

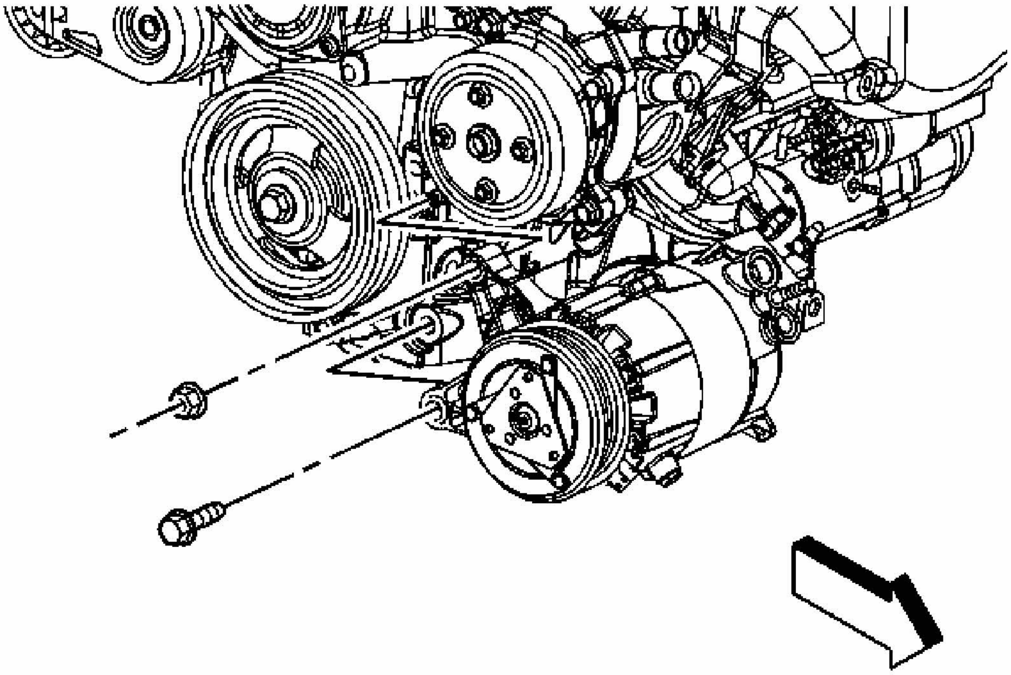


Fig. 133: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

10. Remove the air conditioning (A/C) compressor nut and bolt.

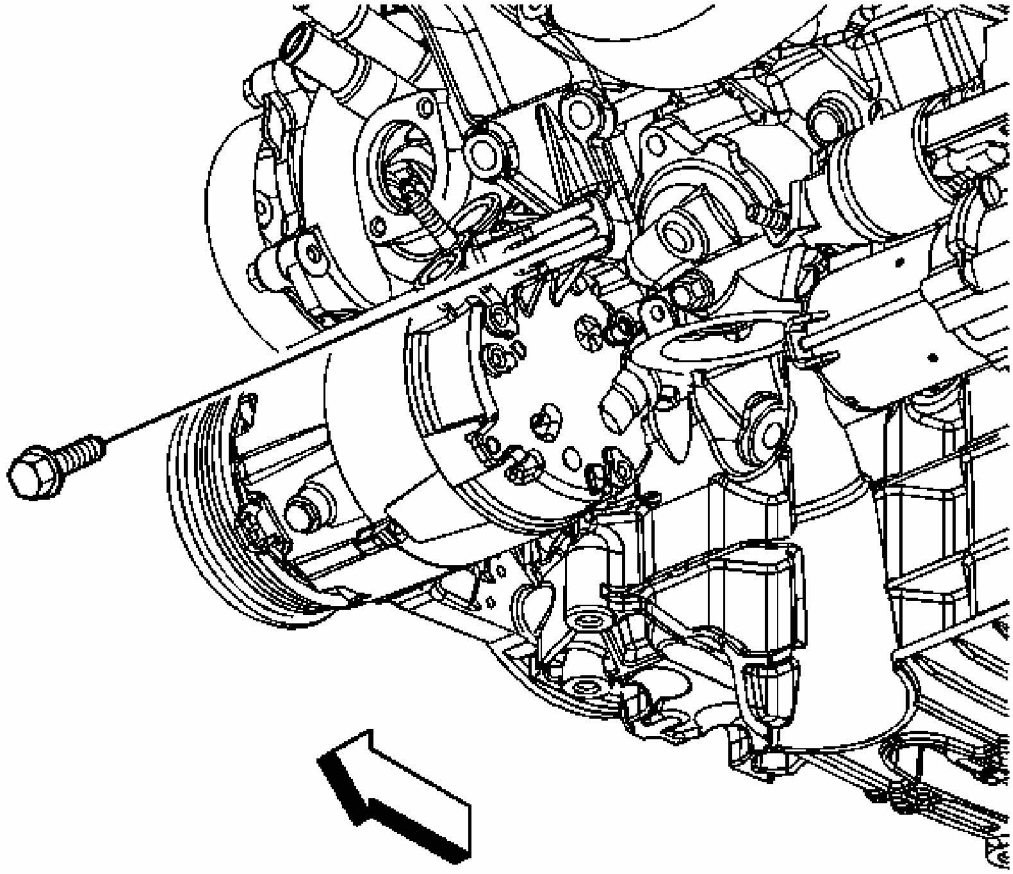


Fig. 134: Locating A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

11. Remove the A/C compressor rear bolt and position the compressor aside.

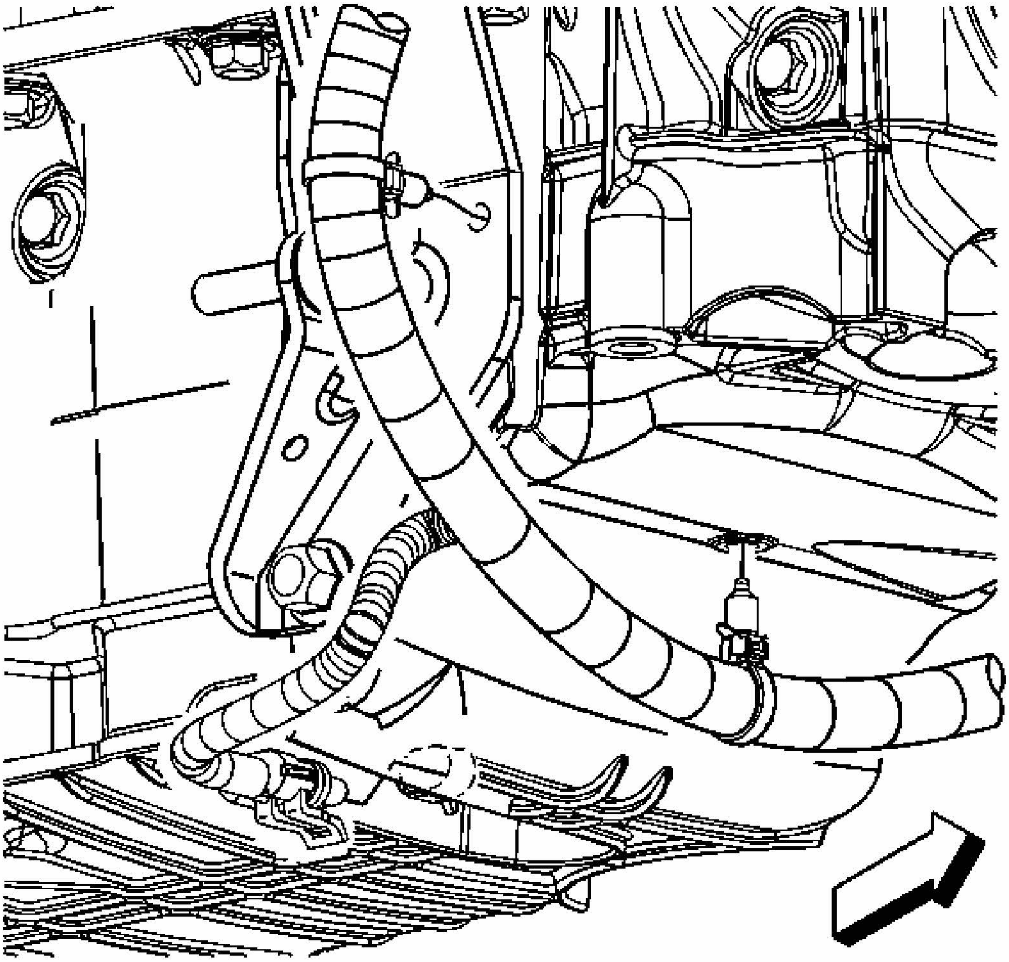


Fig. 135: Locating Engine Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

12. Disconnect the oil level sensor electrical connector.
13. Remove the engine harness clips from the oil pan and the transaxle brace.

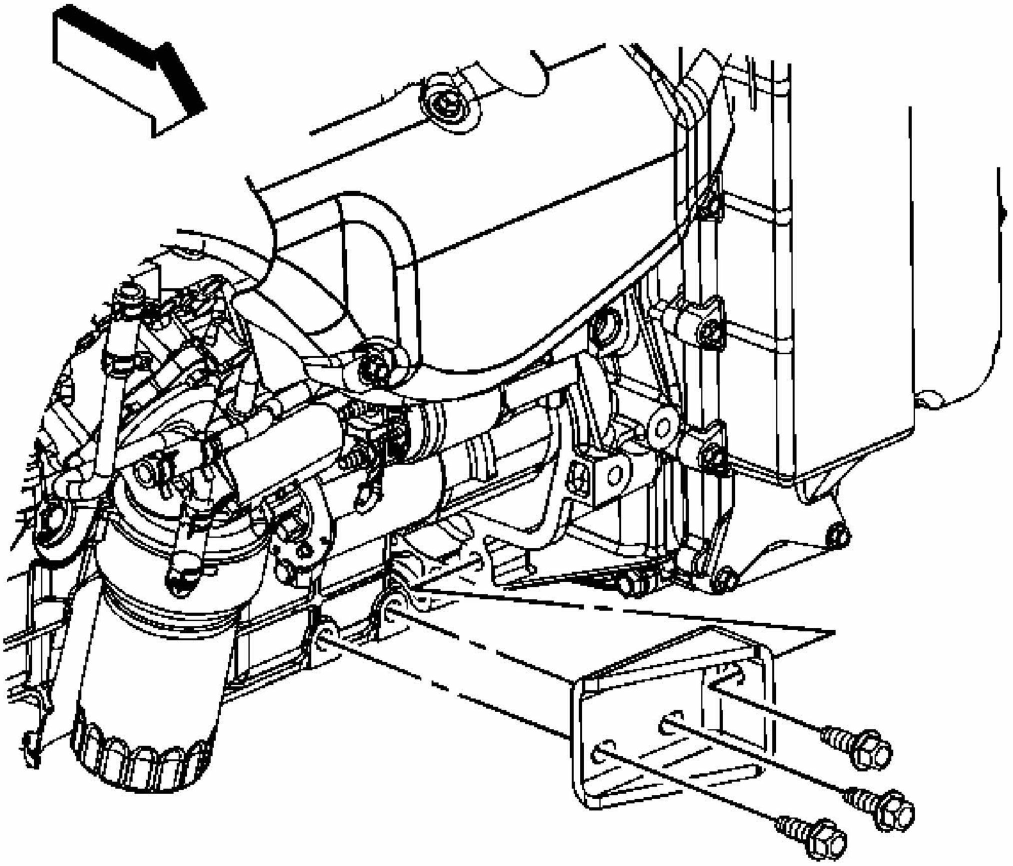


Fig. 136: View Of Front Transaxle Brace & Engine Bolts
Courtesy of GENERAL MOTORS CORP.

14. Remove the front transaxle brace to engine bolts and the brace.

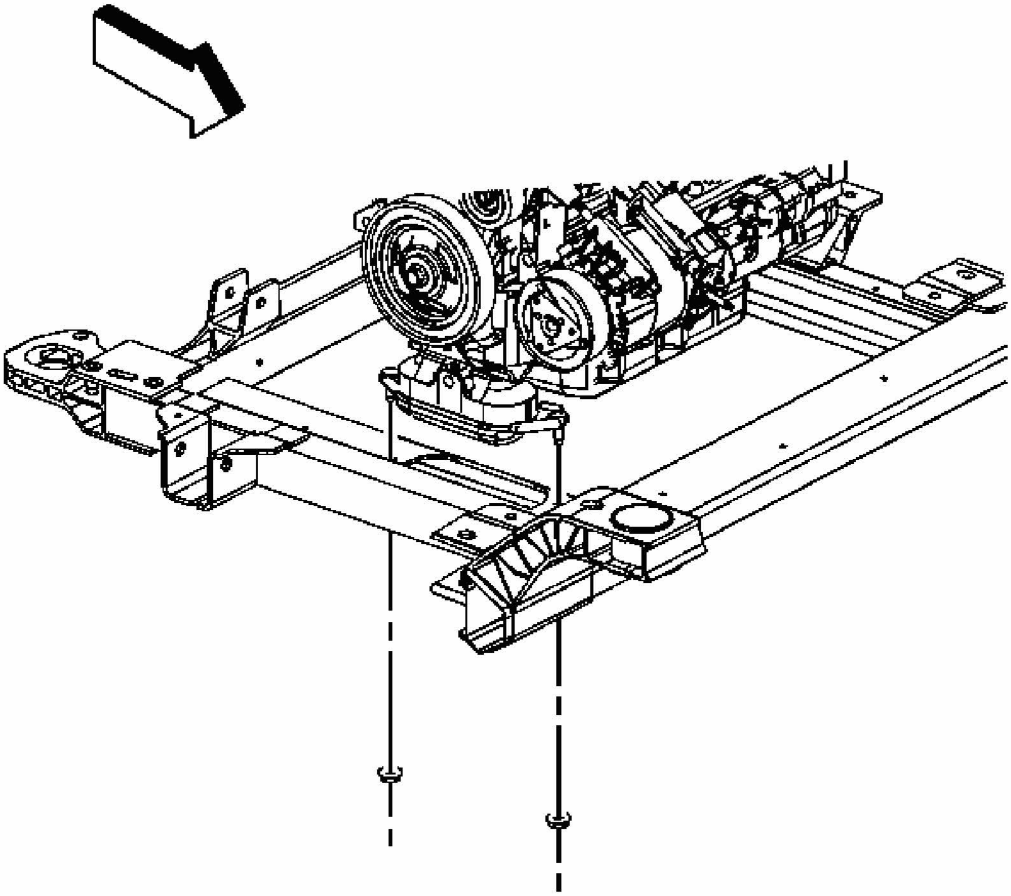


Fig. 137: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

15. Remove the engine mount lower nuts.
16. Loosen the transaxle mount lower nuts. Refer to **Transmission Mount Replacement - Left** .

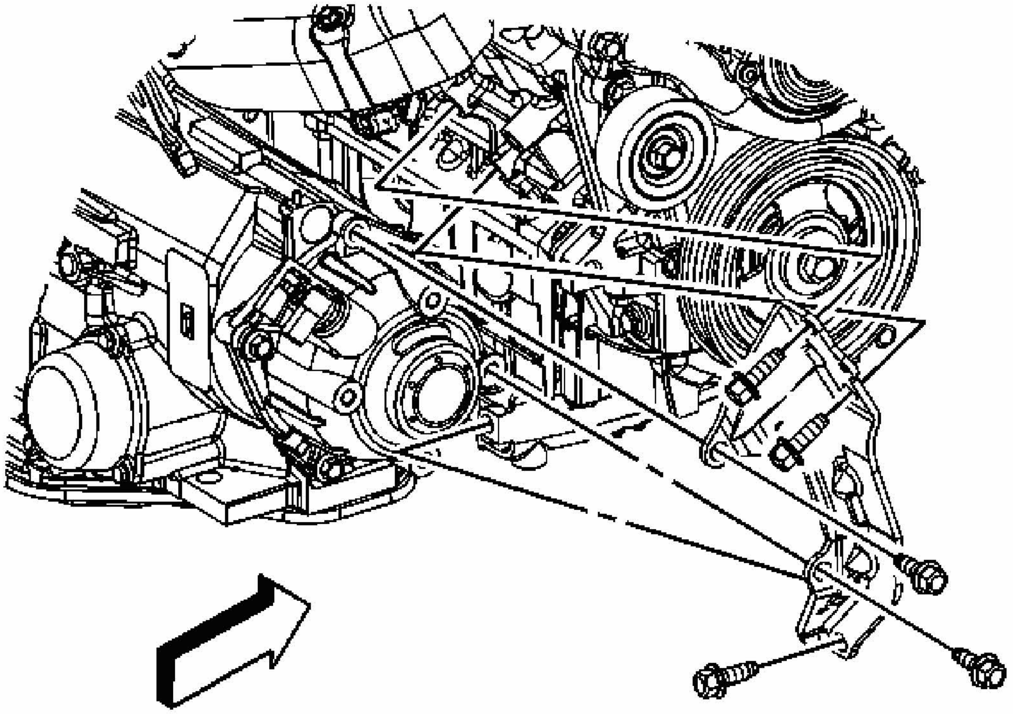


Fig. 138: Locating Rear Transaxle Brace To Engine/Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

17. Remove the rear transaxle brace to engine/oil pan bolts.
18. Lower the vehicle.
19. Using the engine support fixture, raise the engine.
20. Raise the engine.
21. Remove the steering shaft intermediate pinch bolt. Refer to **Intermediate Steering Shaft Replacement** .

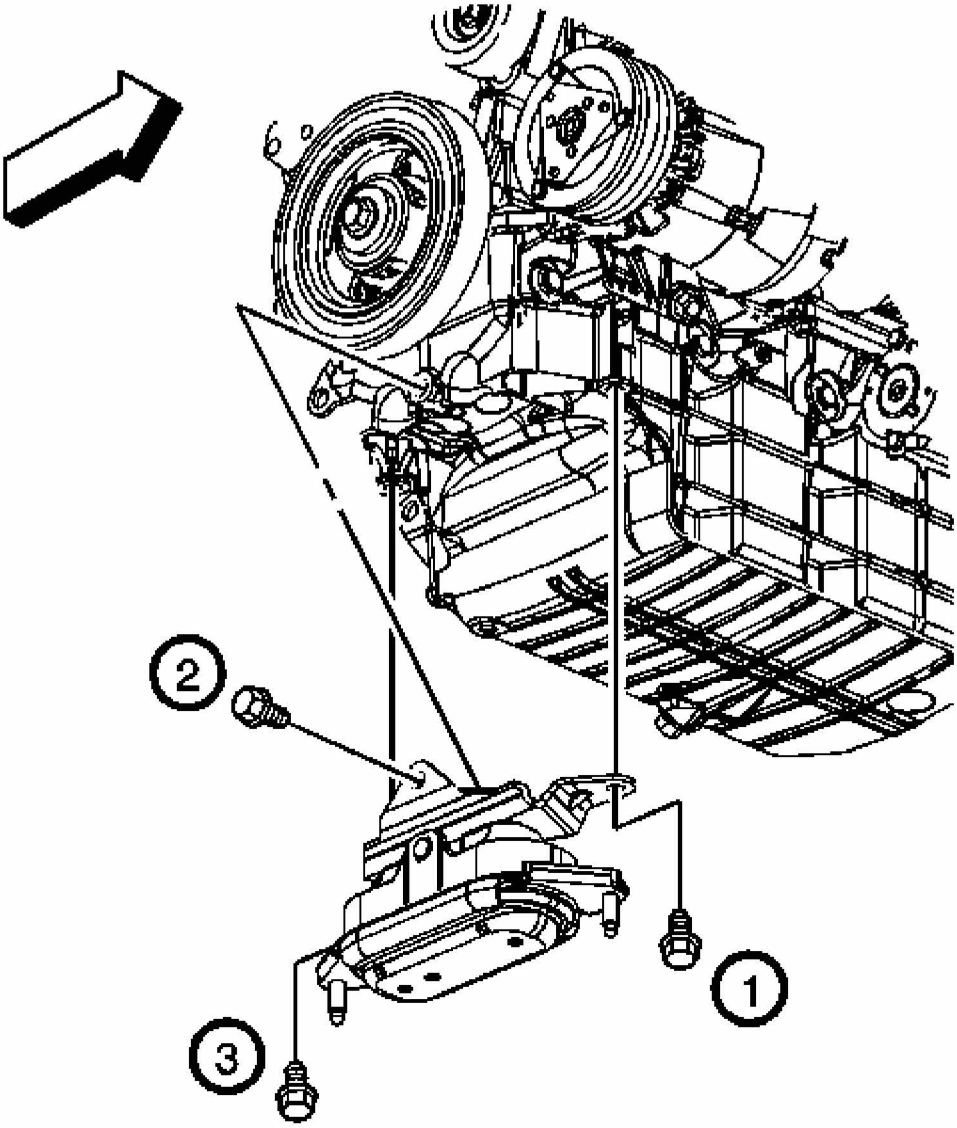


Fig. 139: Locating Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

22. Remove the engine mount bracket bolts.
23. Remove the engine mount and bracket.
24. Remove the right side lower ball joint from the steering knuckle. Refer to **Lower Ball Joint Replacement** .
25. Remove the right side outer tie rod from the steering knuckle. Refer to **Rack and Pinion Outer Tie Rod End Replacement** .

26. Remove the right side stabilizer link. Refer to **Stabilizer Shaft Link Replacement** .
27. Install the jackstands to the frame.
28. Remove the right side frame bolts and loosen the left side frame bolts. Refer to **Frame Replacement** .
29. Using the jackstands, lower the right side of the frame.

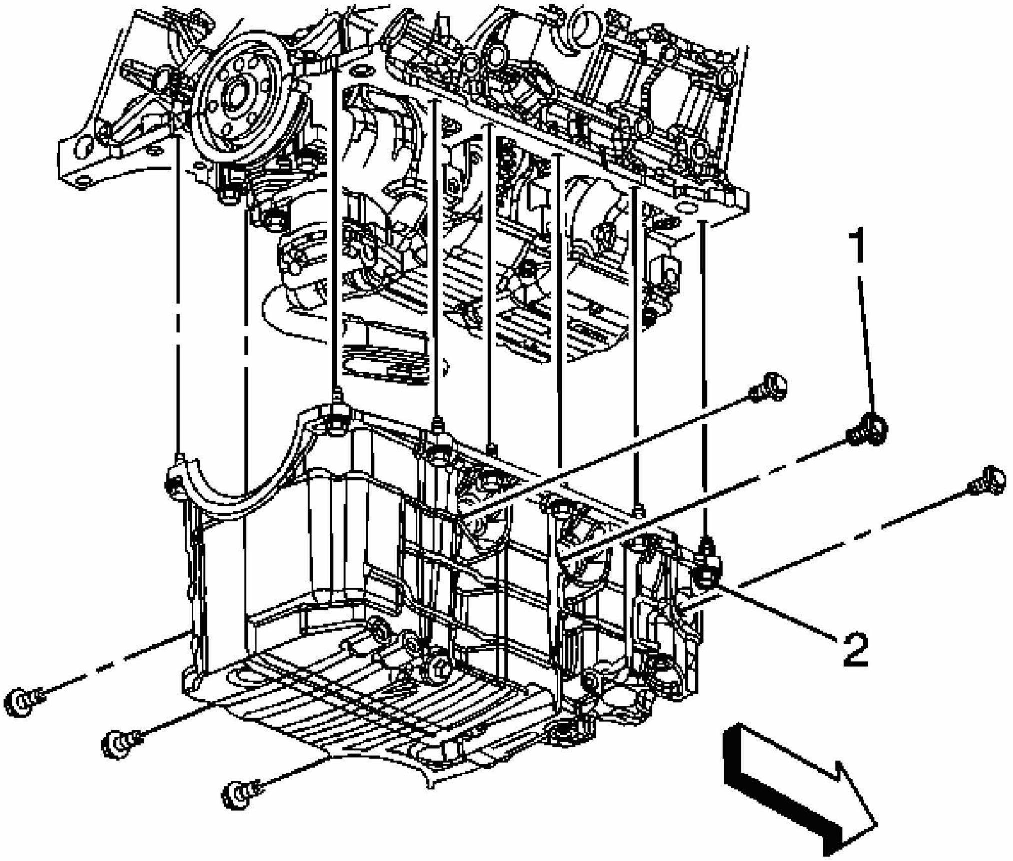


Fig. 140: Identifying Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

30. Using the **J 39505** , remove the right side oil pan side bolts.
31. Remove the left side oil pan side bolts (1).
32. Remove the oil pan bolts (2).
33. Remove the oil pan.
34. Remove the oil pan gasket.
35. Clean the following items:

- The oil pan flanges
- The oil pan rail
- The front cover
- The rear main bearing cap
- The threaded holes

Installation Procedure

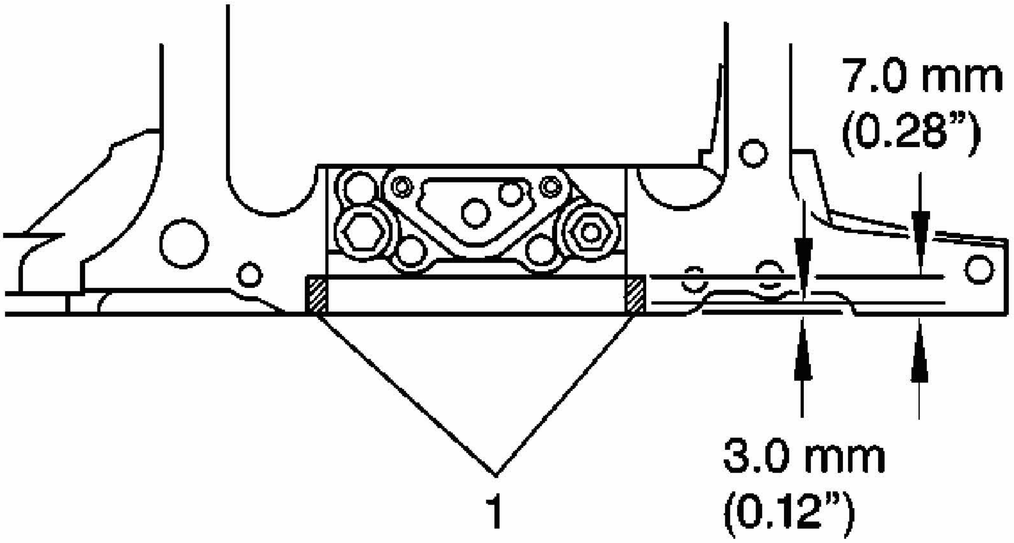


Fig. 141: Illustrating Proper Sealer Application
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer GM P/N 12378521 (Canadian P/N 88901148) or equivalent to both sides of the crankshaft rear main bearing cap (1). Press the sealer into the gap using a putty knife.

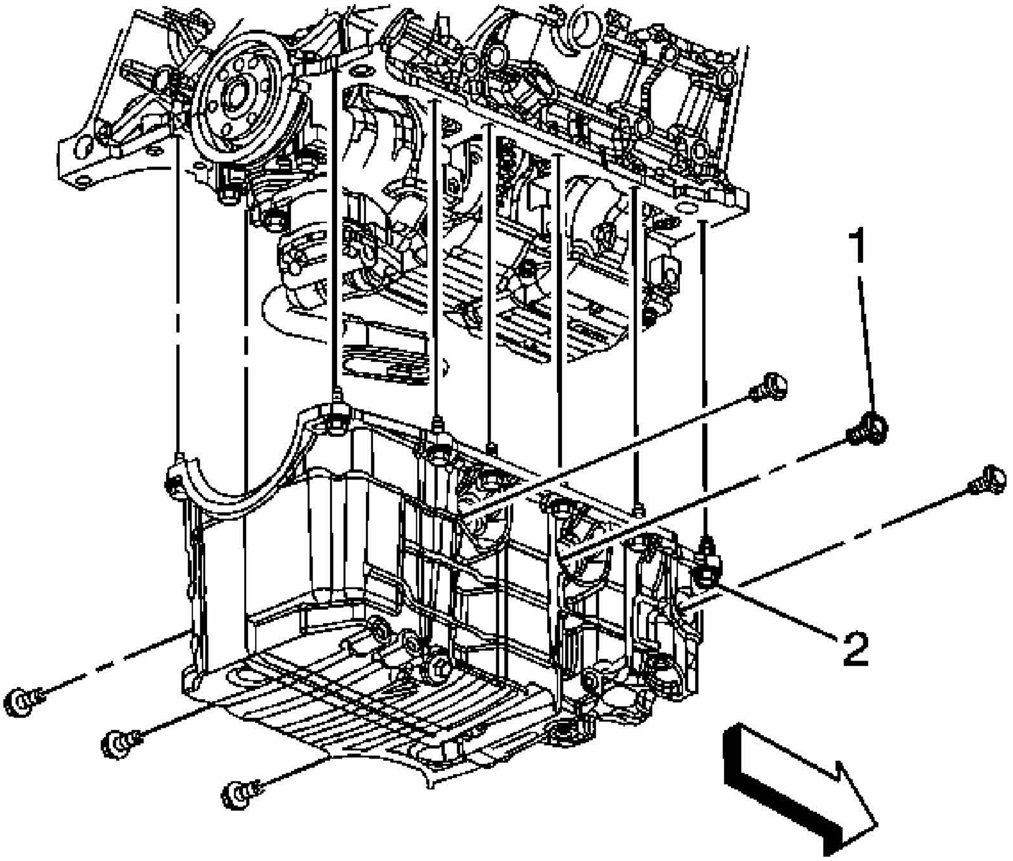


Fig. 142: Identifying Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW oil pan gasket.
3. Position the oil pan to the engine.

NOTE: **Refer to Fastener Notice .**

4. Install the oil pan bolts (2).

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

5. Install the left side oil pan side bolts (1).
6. Using the **J 39505** , install the right side oil pan side bolts.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

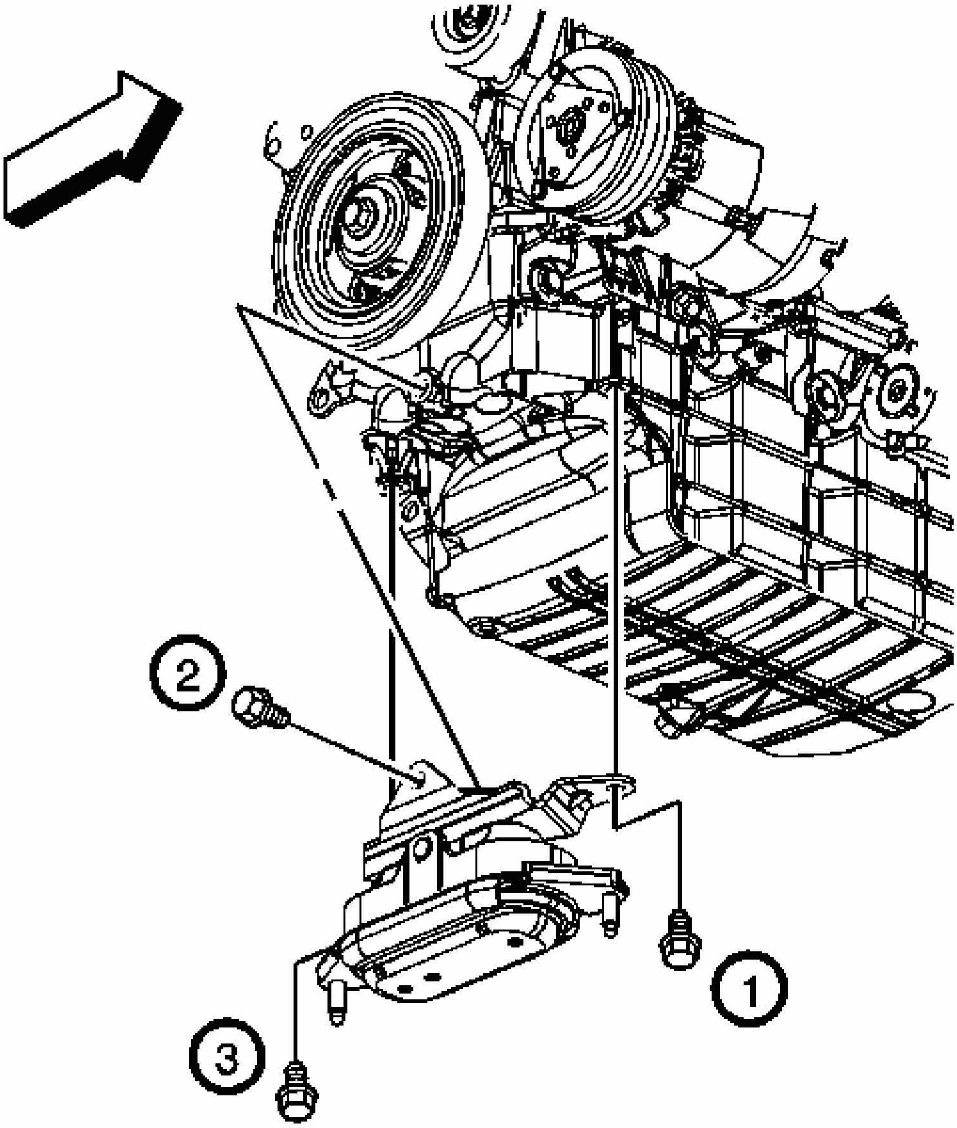


Fig. 143: Locating Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

7. Using the jackstands, raise the right side of the frame to the original position.
8. Install the right side frame bolts and tighten the left and right side frame bolts. Refer to **Frame Replacement** .
9. Remove the jackstands from under the frame.
10. Install the right side stabilizer link. Refer to **Stabilizer Shaft Link Replacement** .
11. Install the right side outer tie rod to the steering knuckle. Refer to **Rack and Pinion**

Outer Tie Rod End Replacement .

12. Install the right side lower ball joint to the steering knuckle. Refer to **Lower Ball Joint Replacement** .
13. Position the engine mount and bracket to the oil pan.
14. Install the engine mount bracket bolts.

    Tighten: Tighten the bolts to 50 N.m (37 lb ft).

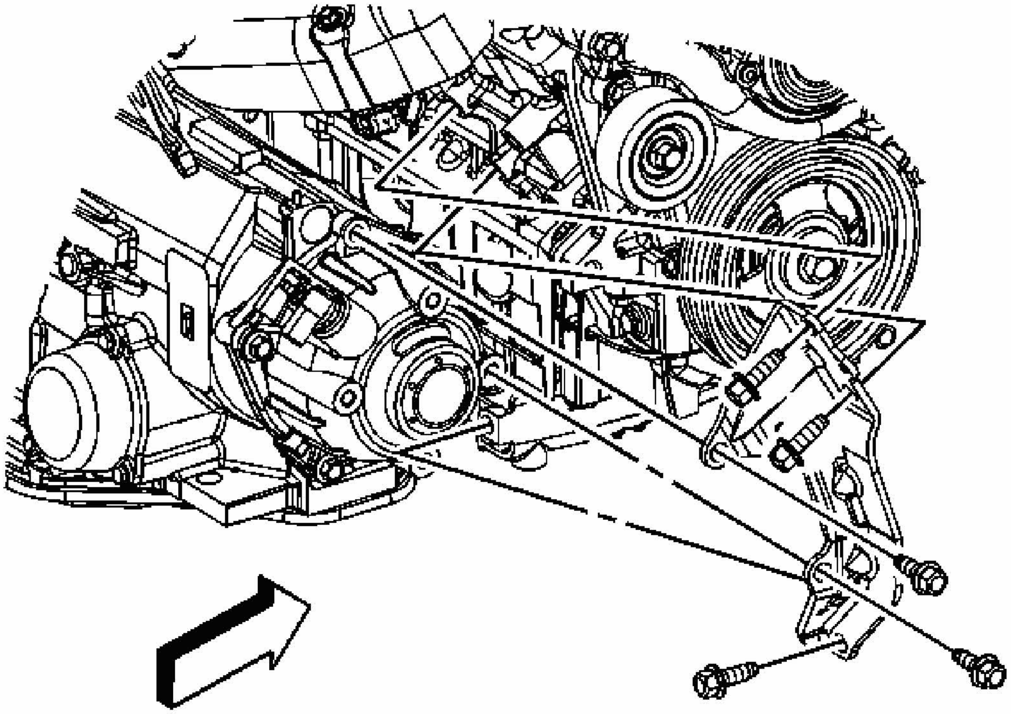


Fig. 144: Locating Rear Transaxle Brace To Engine/Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

15. Install the steering shaft intermediate pinch bolt. Refer to **Intermediate Steering Shaft Replacement** .
16. Lower the vehicle.
17. Using the engine support fixture, lower the engine.
18. Raise the vehicle.
19. Install the rear transaxle brace to engine/oil pan bolts.

    Tighten: Tighten the bolts to 63 N.m (46 lb ft).

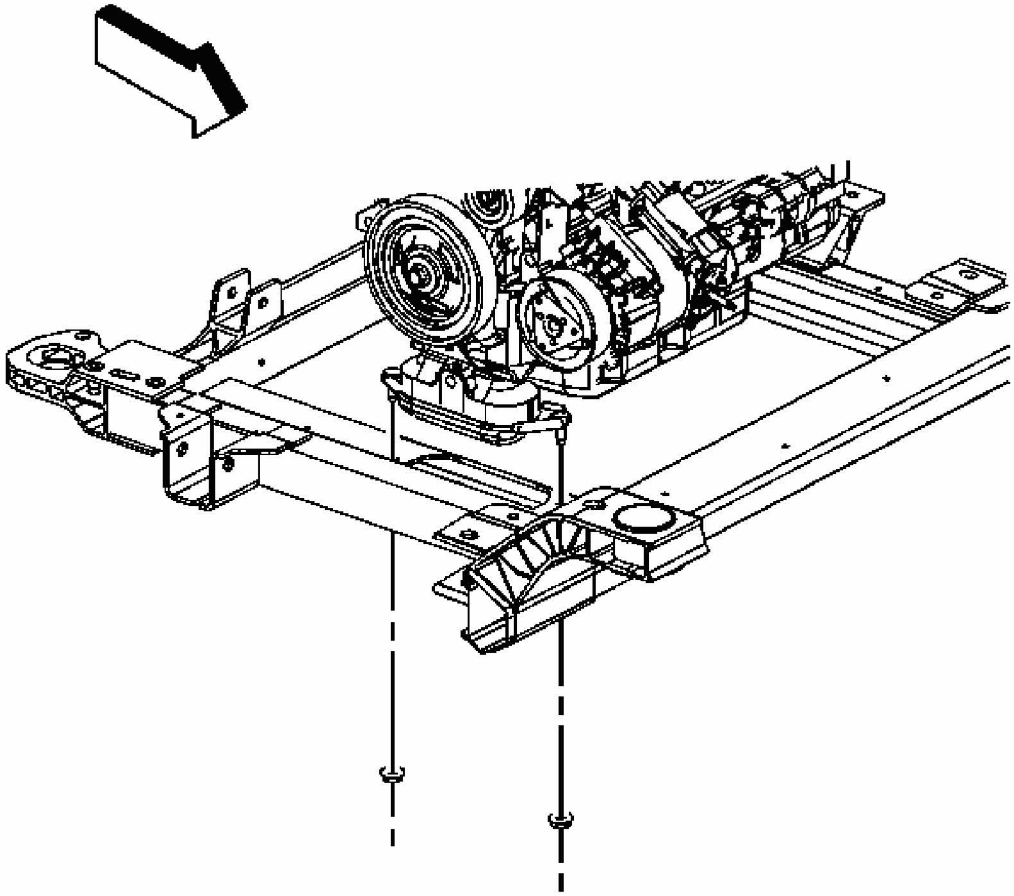


Fig. 145: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

20. Install the engine mount lower nuts.

    Tighten: Tighten the nuts to 50 N.m (37 lb ft).

21. Tighten the transaxle mount lower nuts. Refer to **Transmission Mount Replacement - Left** .

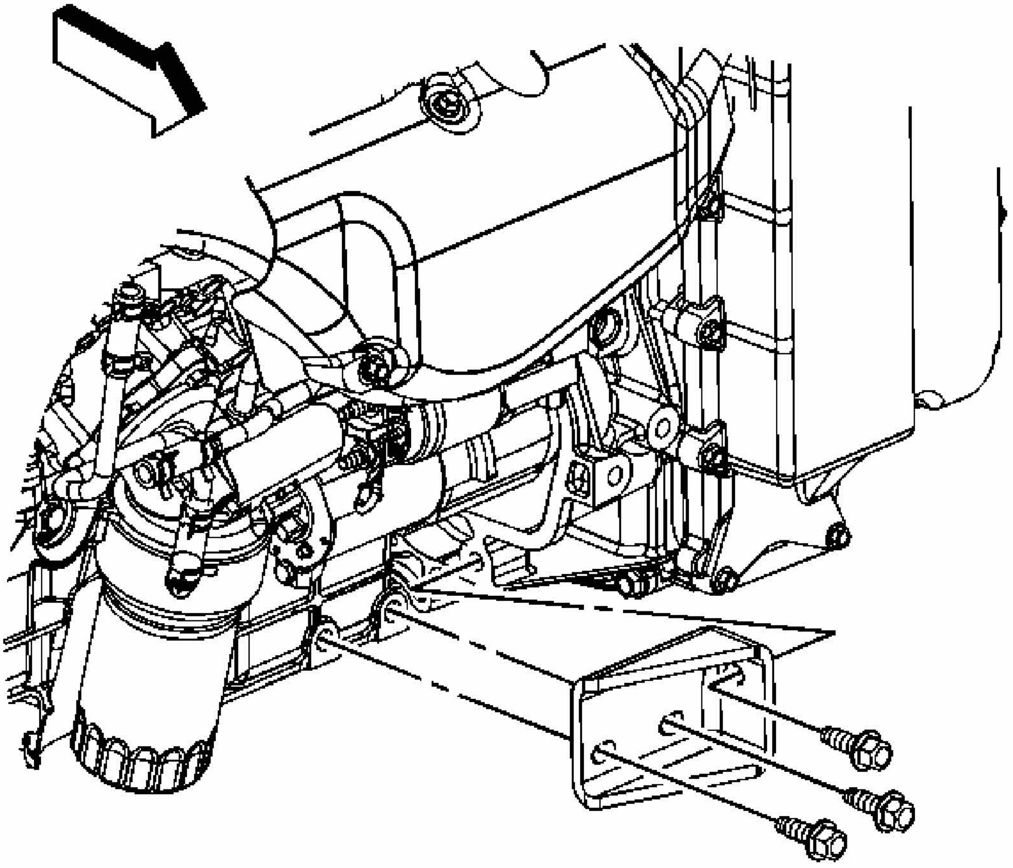


Fig. 146: View Of Front Transaxle Brace & Engine Bolts
Courtesy of GENERAL MOTORS CORP.

22. Install the front transaxle brace and the brace to engine bolts.

    Tighten: Tighten the bolts to 63 N.m (46 lb ft).

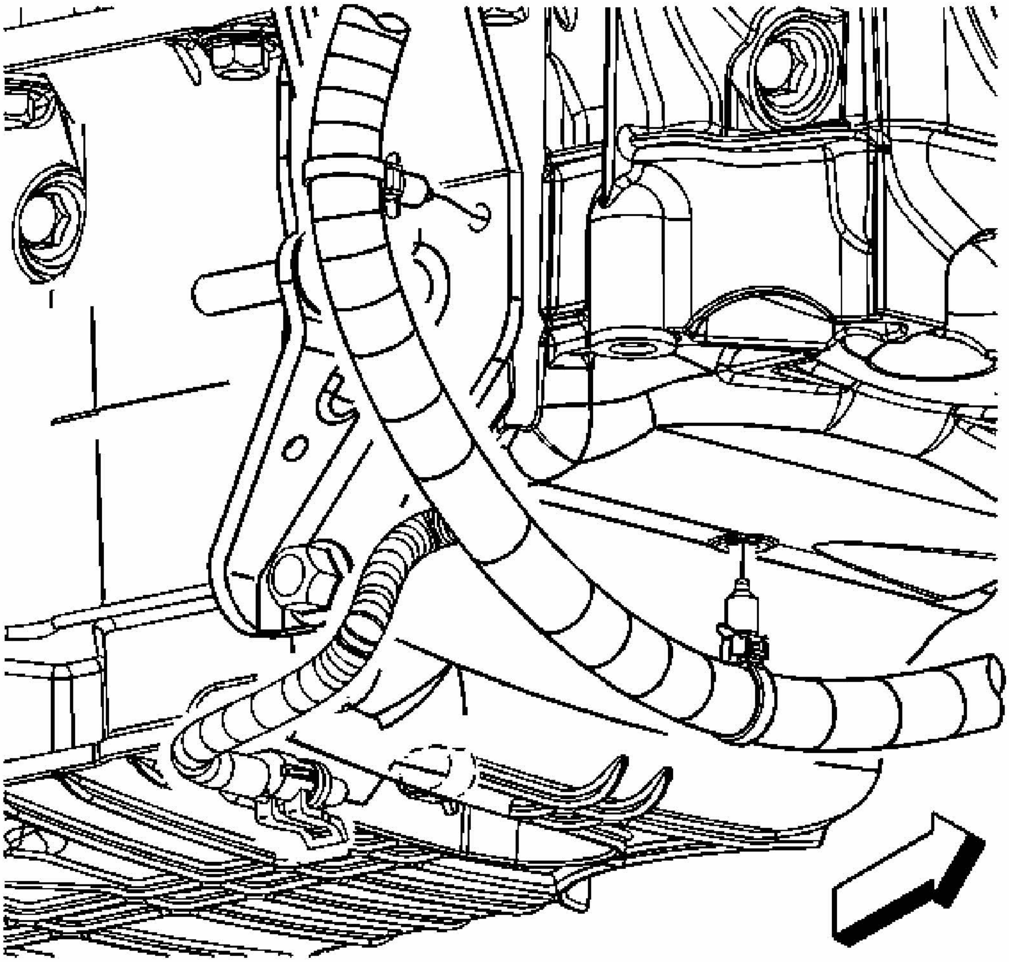


Fig. 147: Locating Engine Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

23. Connect the oil level sensor electrical connector.
24. Install the engine harness clips to the oil pan and the transaxle brace.

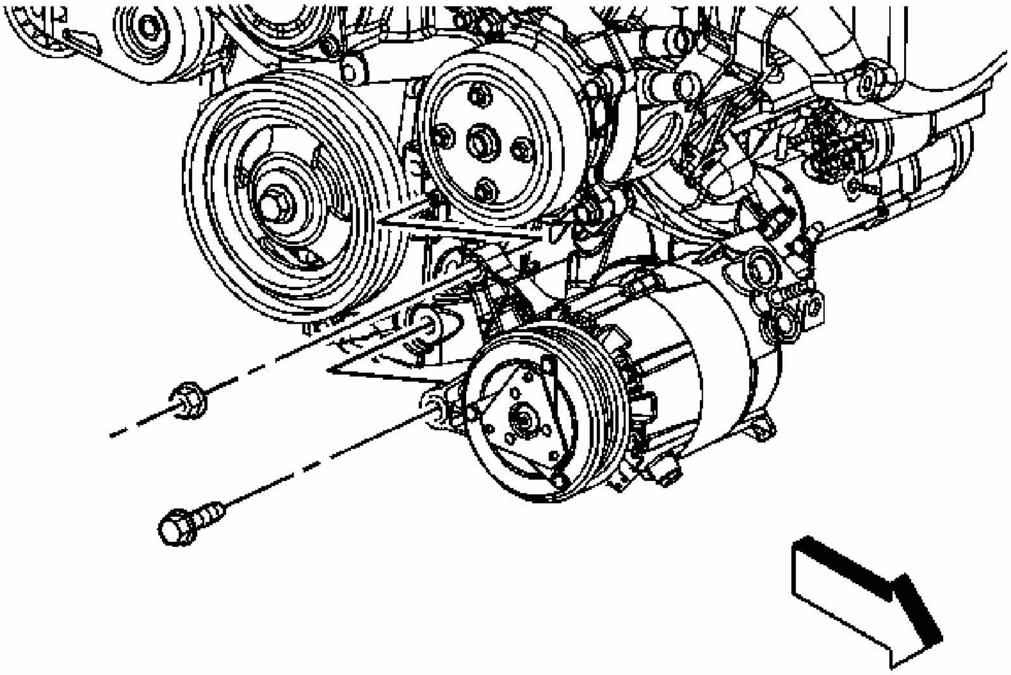


Fig. 148: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

25. Position the A/C compressor, and install the A/C compressor nut and bolt.

    Tighten: Tighten the bolt/nut to 50 N.m (37 lb ft).

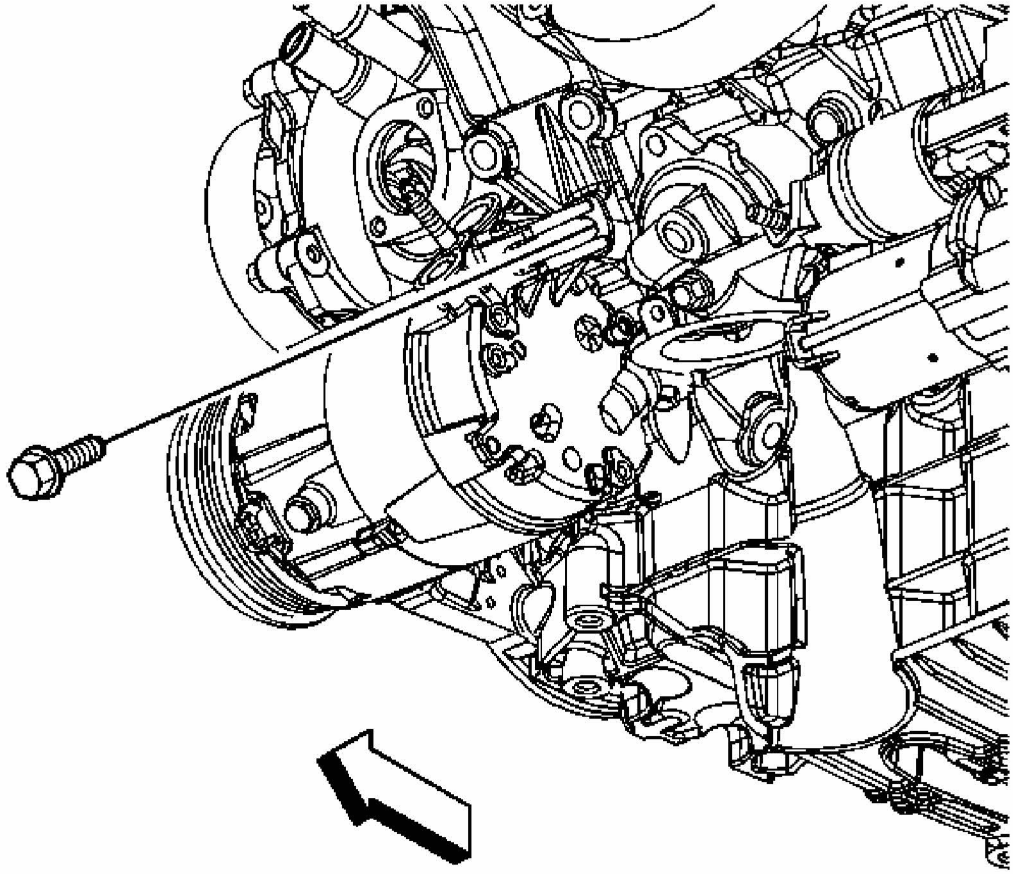


Fig. 149: Locating A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

26. Install the A/C compressor rear bolt.

    Tighten: Tighten the bolt to 50 N.m (37 lb ft).

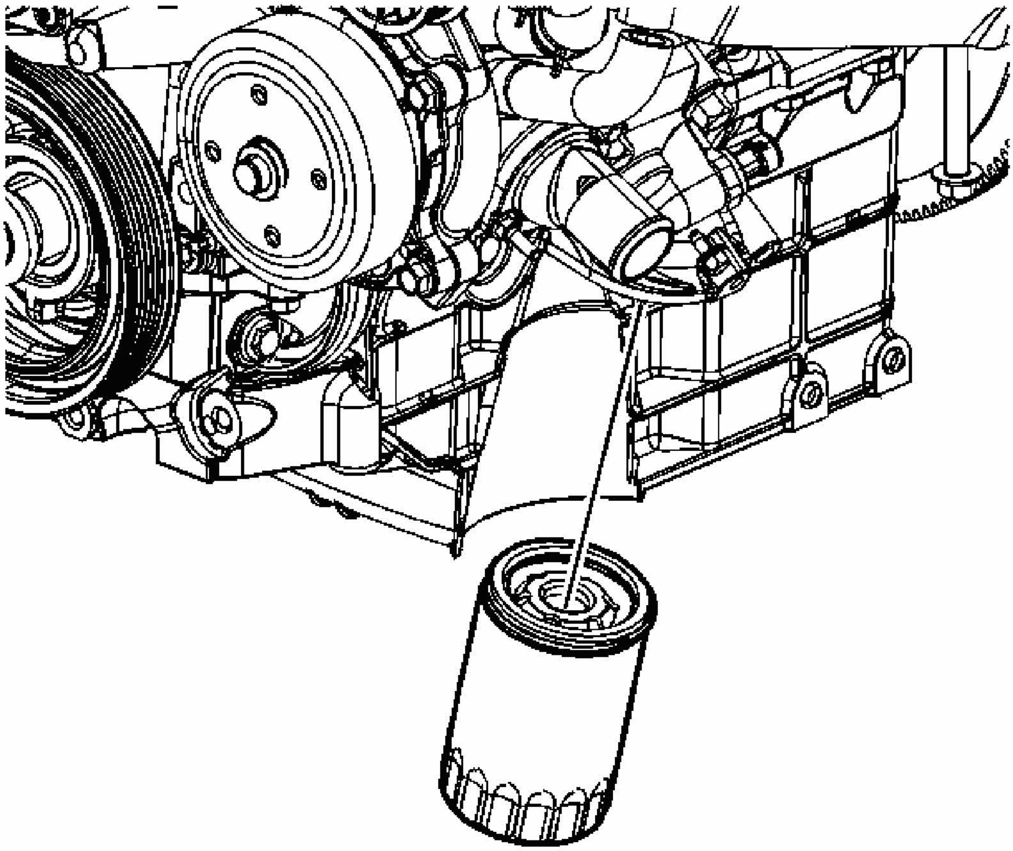


Fig. 150: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

27. Install the starter. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)** .
28. Install the oil filter.
29. Install the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)** .
30. Lower the vehicle.
31. Remove the engine support fixture.
32. Install the engine mount struts. Refer to **Engine Mount Strut Replacement**.
33. Fill the crankcase with new engine oil.
34. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .

ENGINE OIL PRESSURE SENSOR AND/OR SWITCH REPLACEMENT

Removal Procedure

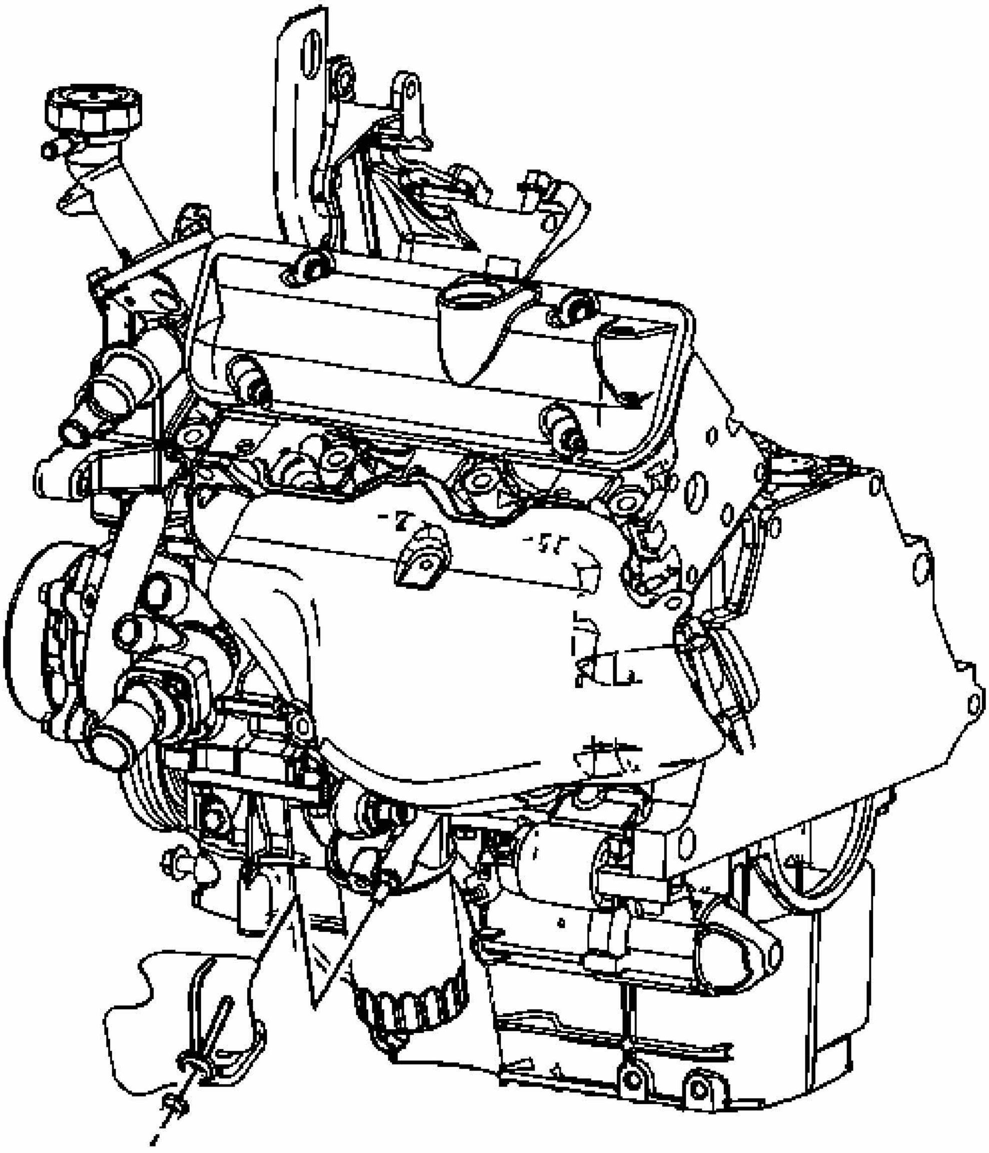


Fig. 151: Locating Oil Pressure Sensor Heat Shield & Nut
Courtesy of GENERAL MOTORS CORP.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the oil pressure sensor heat shield nut and shield.

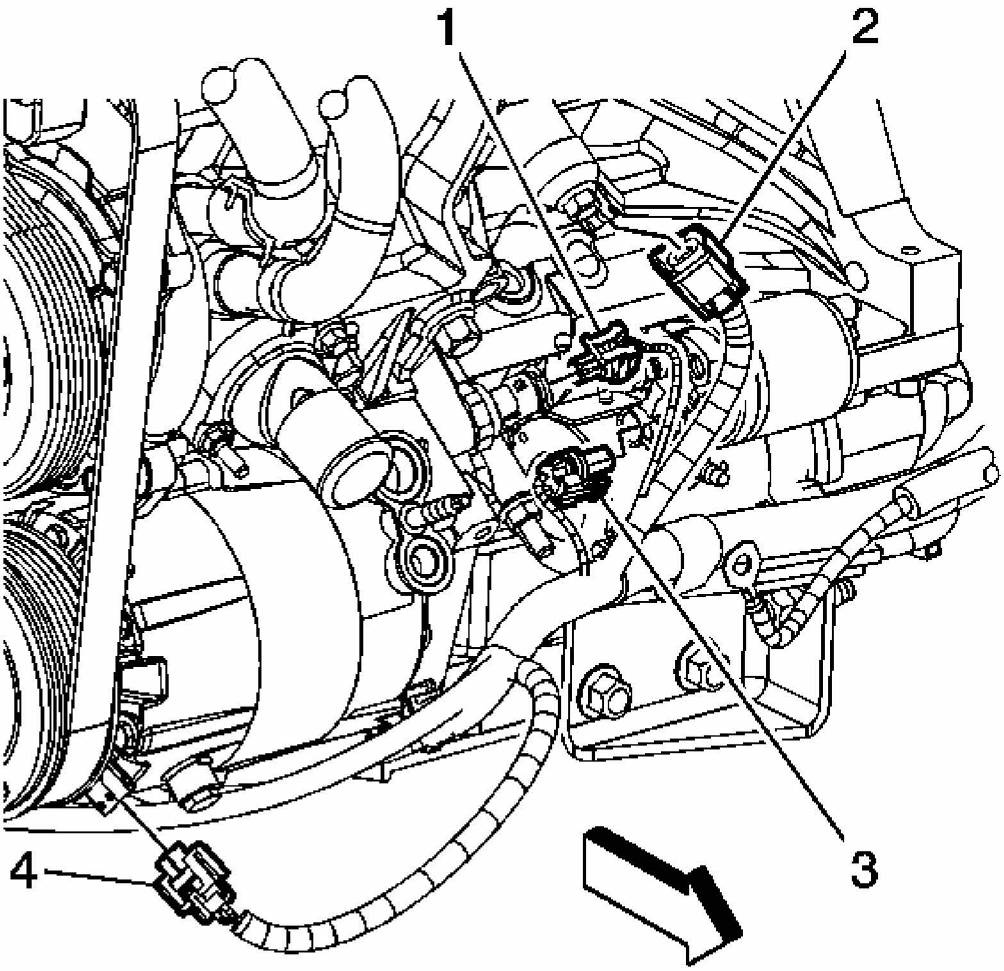


Fig. 152: Locating Oil Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the engine oil pressure sensor electrical connector (1).

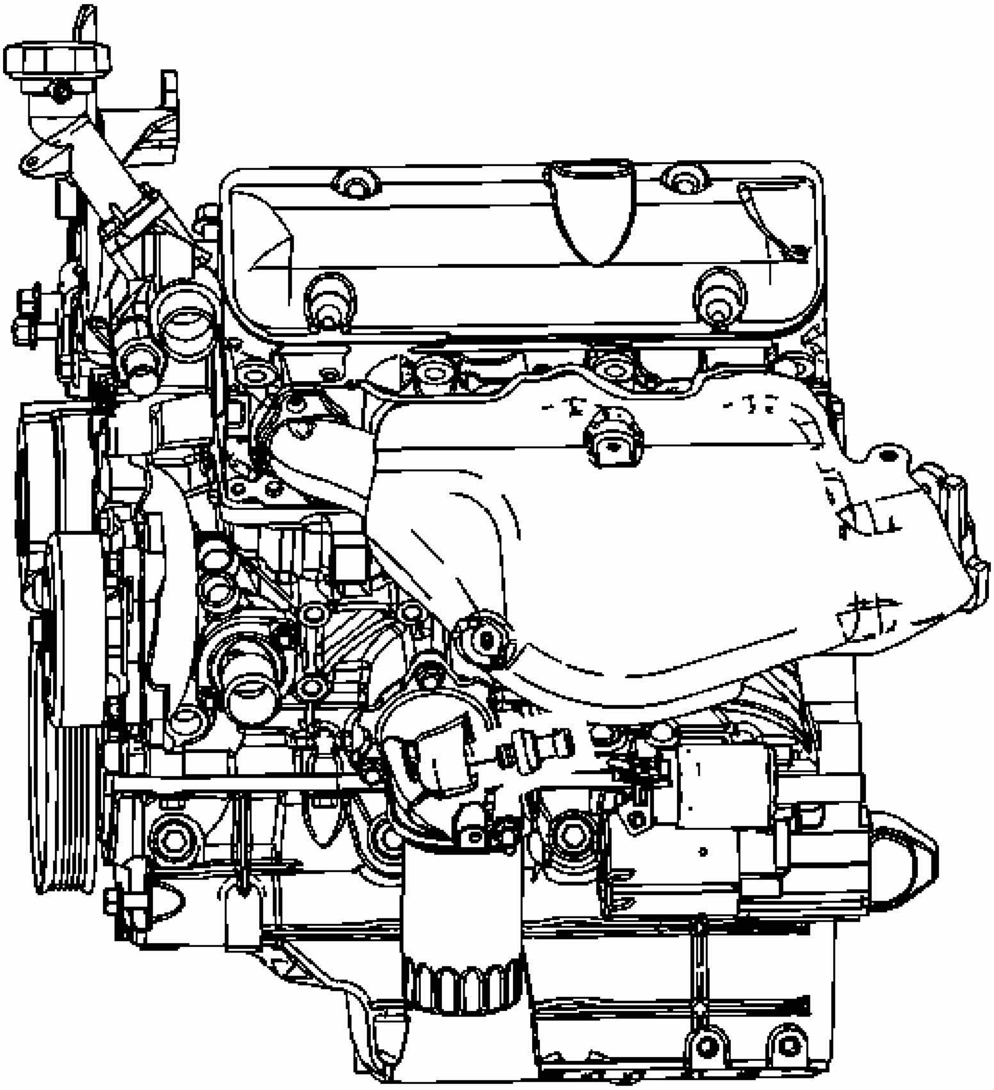


Fig. 153: Locating Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine oil pressure sensor.

Installation Procedure

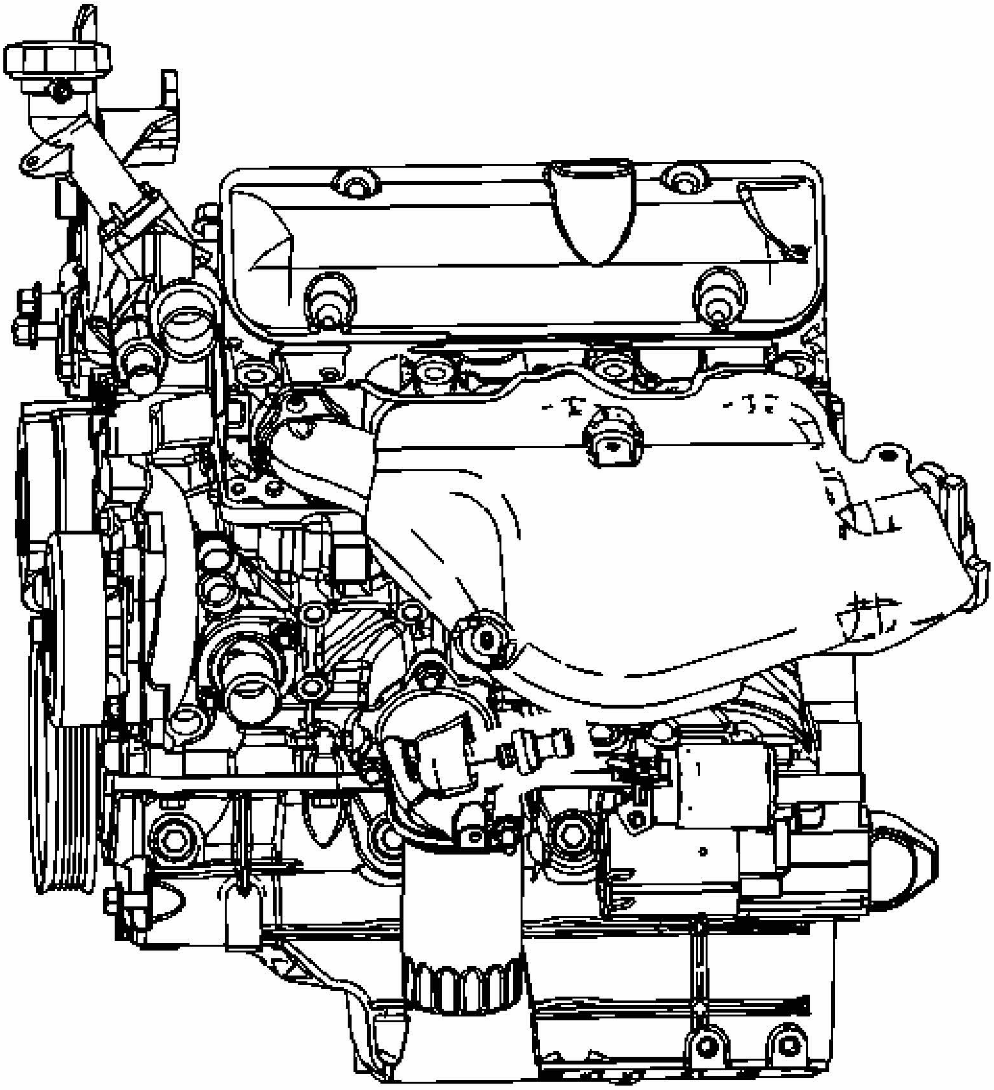


Fig. 154: Locating Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

1. Install the engine oil pressure sensor.

   Tighten: Tighten the sensor to 16 N.m (12 lb ft).

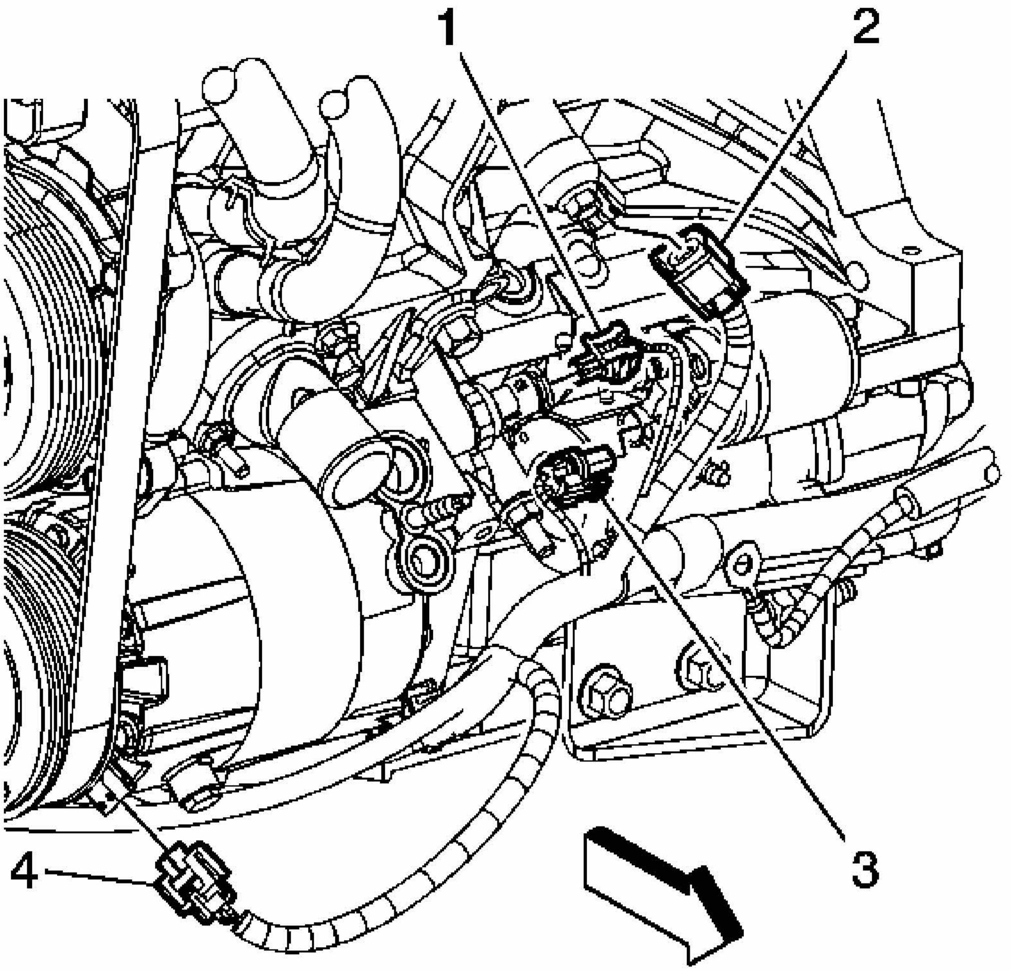


Fig. 155: Locating Oil Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Connect the engine oil pressure sensor electrical connector (1).

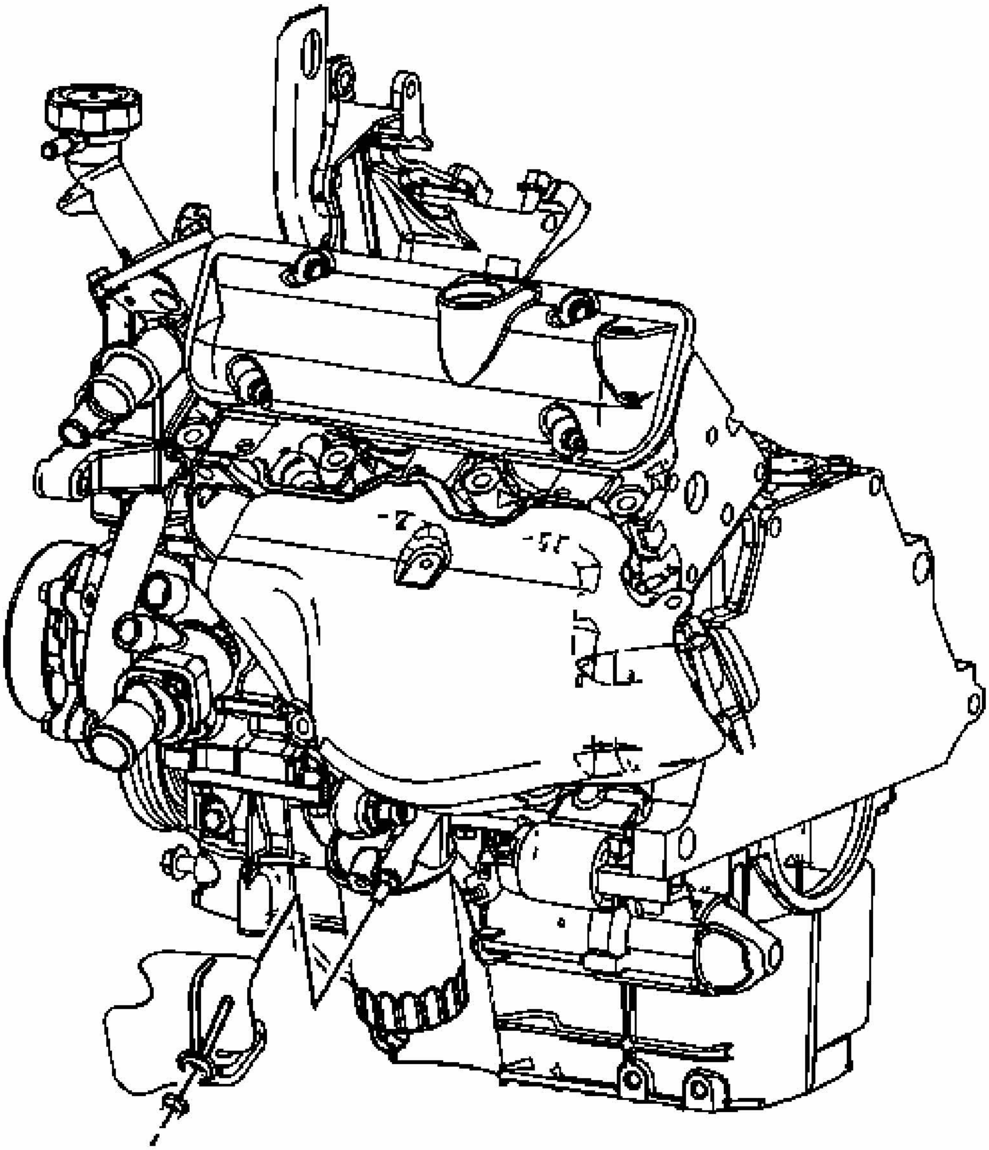


Fig. 156: Locating Oil Pressure Sensor Heat Shield & Nut
Courtesy of GENERAL MOTORS CORP.

3. Install the oil pressure sensor heat shield and nut.

   Tighten: Tighten the nut to 10 N.m (89 lb in).

4. Lower the vehicle.

ENGINE OIL LEVEL SENSOR AND/OR SWITCH REPLACEMENT

Removal Procedure

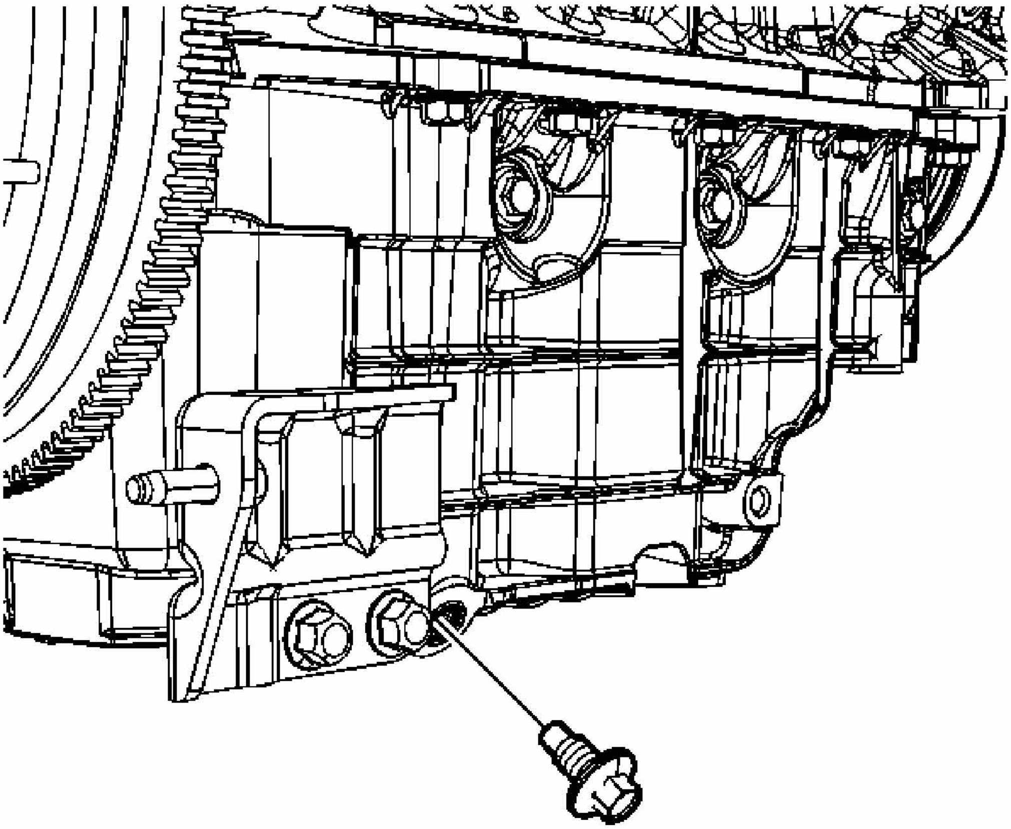


Fig. 157: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the oil pan drain plug.
3. Drain the crankcase.
4. Reinstall the oil pan drain plug.

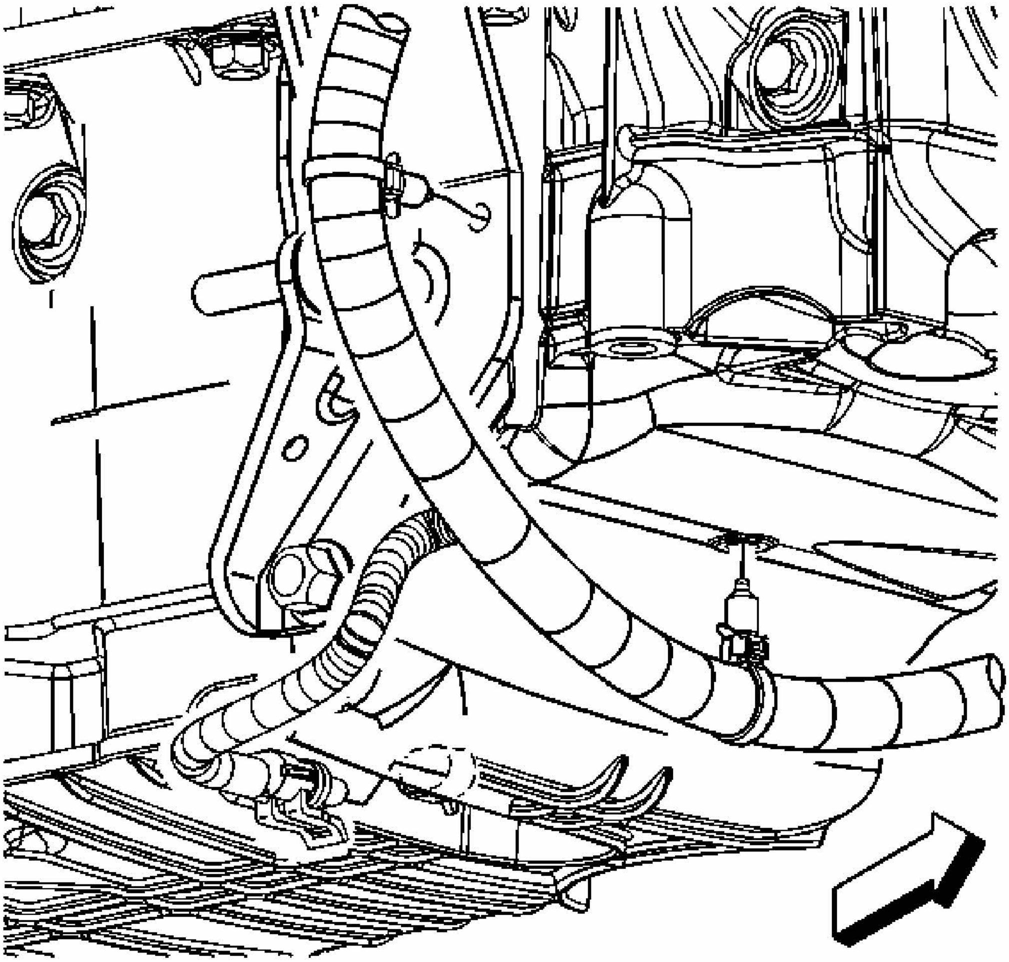


Fig. 158: Locating Engine Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the engine oil level sensor electrical connector.

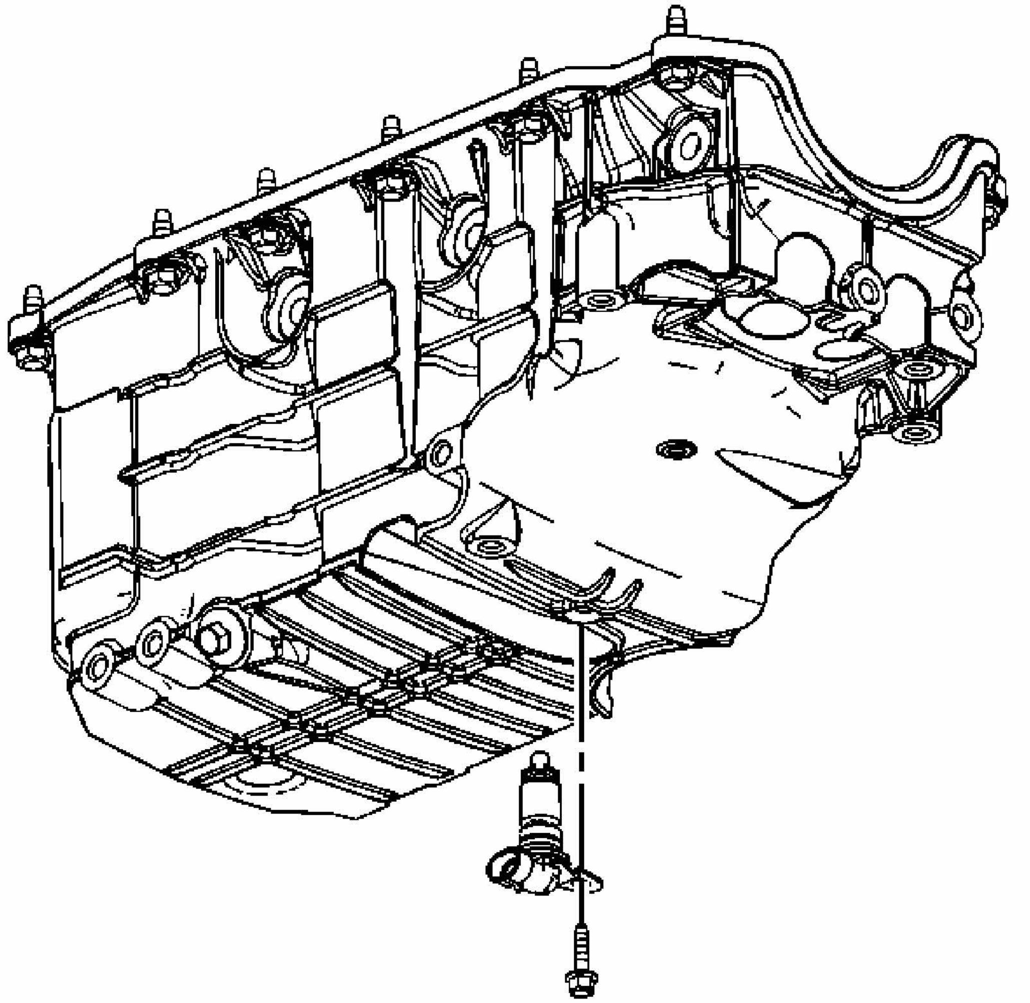


Fig. 159: Identifying Engine Oil Level Sensor Bolt & Sensor
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine oil level sensor bolt and sensor.

Installation Procedure

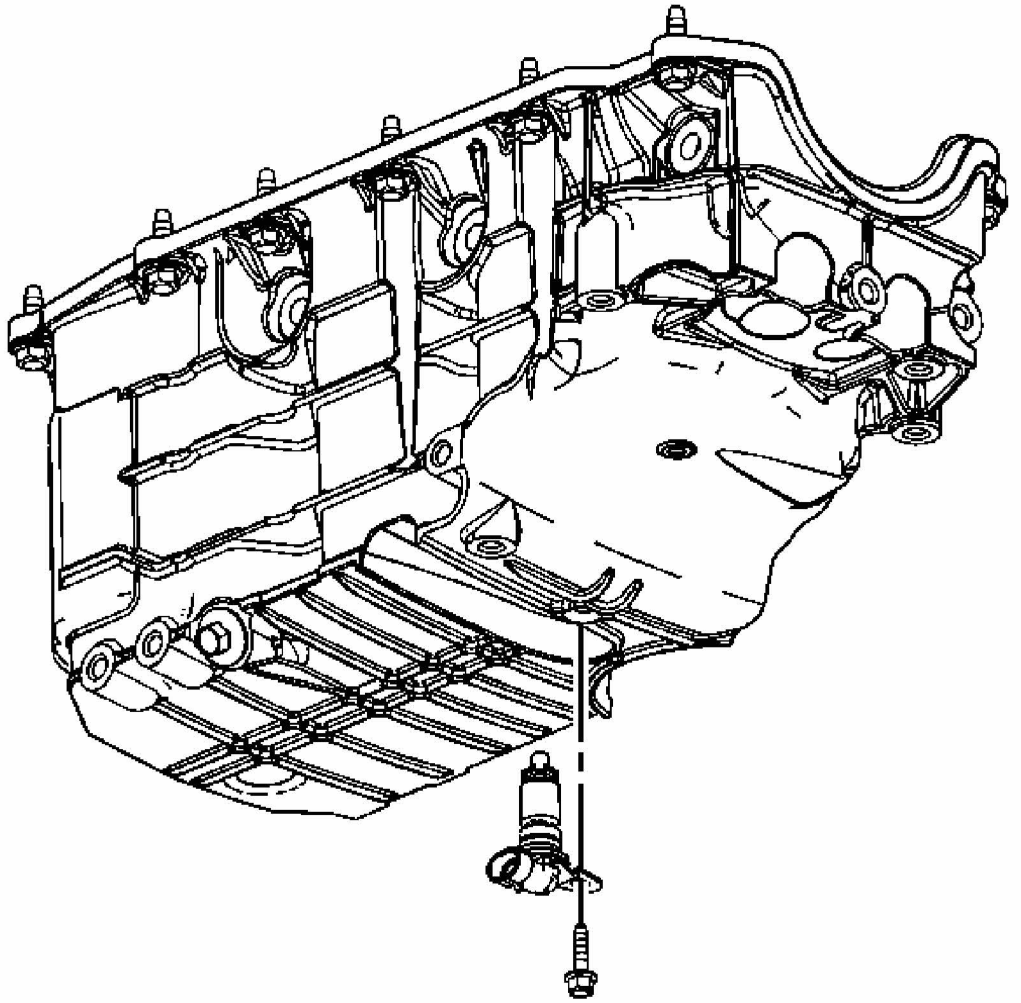


Fig. 160: Identifying Engine Oil Level Sensor Bolt & Sensor
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

1. Install the engine oil level sensor and bolt.

   Tighten: Tighten the bolt to 10 N.m (89 lb in).

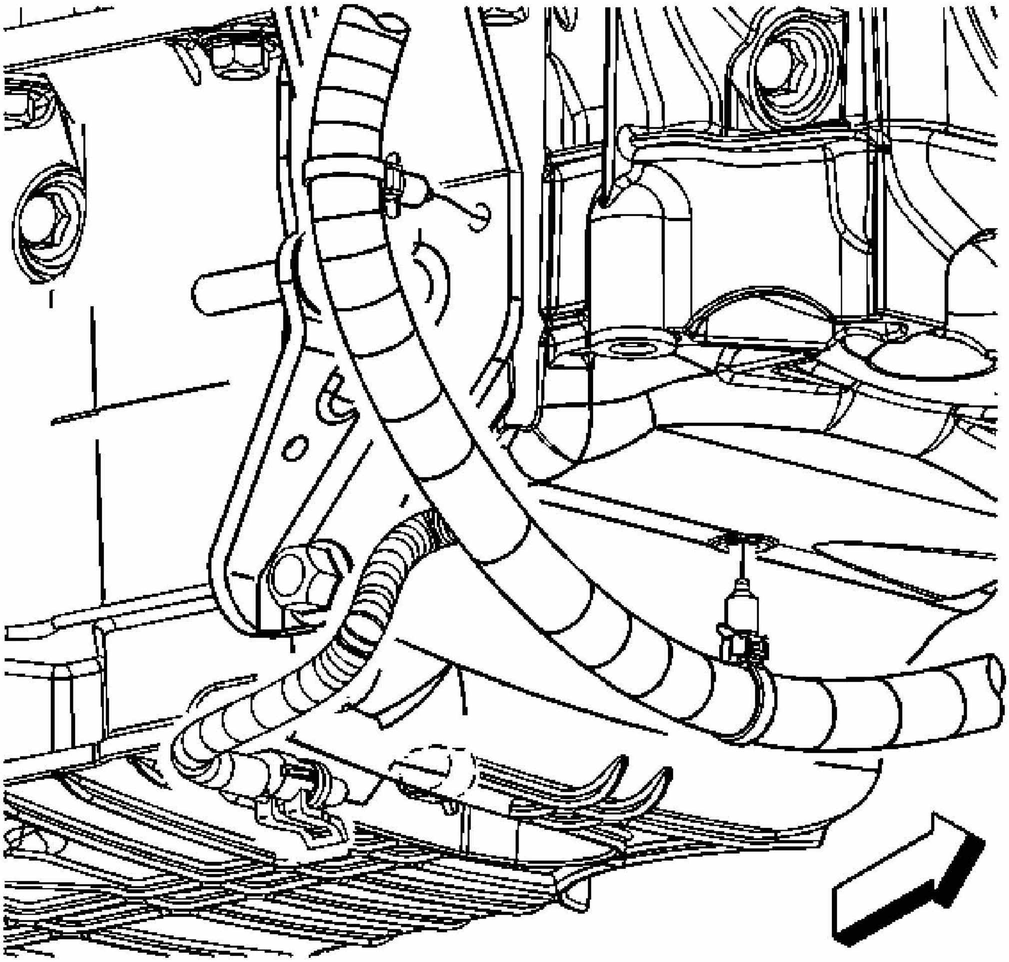


Fig. 161: Locating Engine Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Connect the engine oil level sensor electrical connector.
3. Lower the vehicle.
4. Refill the crankcase with new engine oil.

OIL PUMP REPLACEMENT

Removal Procedure

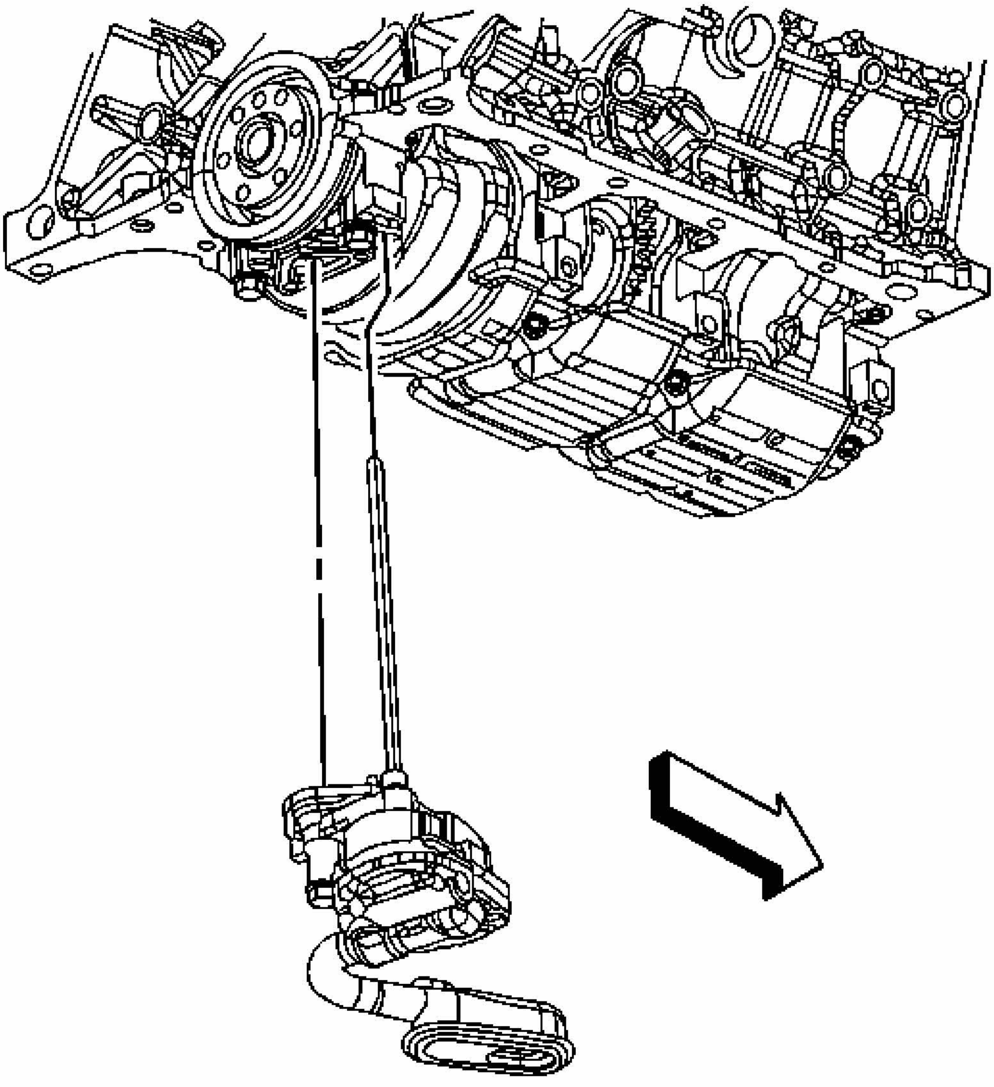


Fig. 162: Identifying Oil Pump & Oil Pump Drive Shaft
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pan. Refer to **Oil Pan Replacement**.
2. Remove the oil pump bolt.
3. Remove the oil pump and the oil pump drive shaft.

Installation Procedure

IMPORTANT: Rotate the oil pump drive shaft as necessary in order to obtain the engagement with the oil pump drive unit.

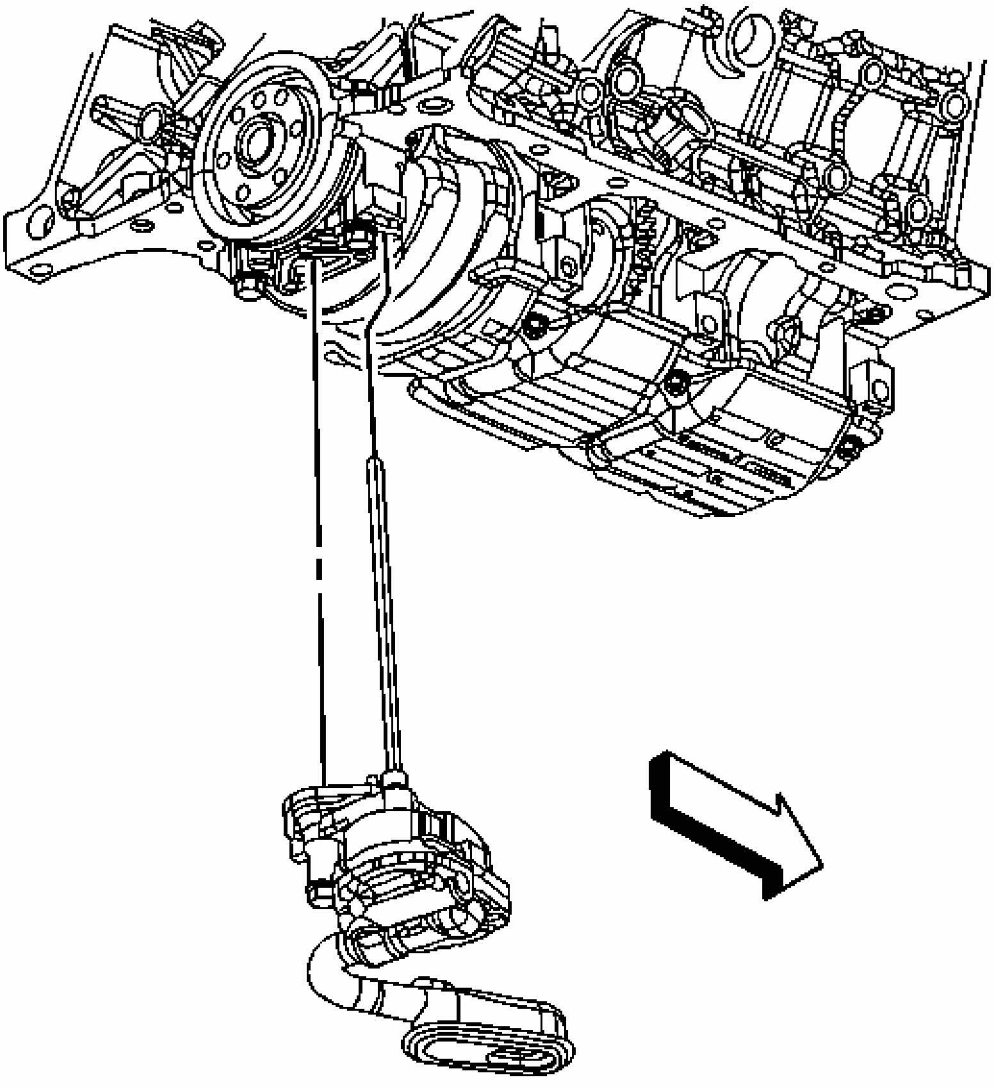


Fig. 163: Identifying Oil Pump & Oil Pump Drive Shaft
Courtesy of GENERAL MOTORS CORP.

1. Install the oil pump drive shaft and the oil pump.

   NOTE: **Refer to Fastener Notice .**

2. Install the oil pump bolt.

   Tighten: Tighten the bolt to 41 N.m (30 lb ft).

3. Install the oil pan. Refer to **Oil Pan Replacement**.

OIL PUMP DRIVE REPLACEMENT

Removal Procedure

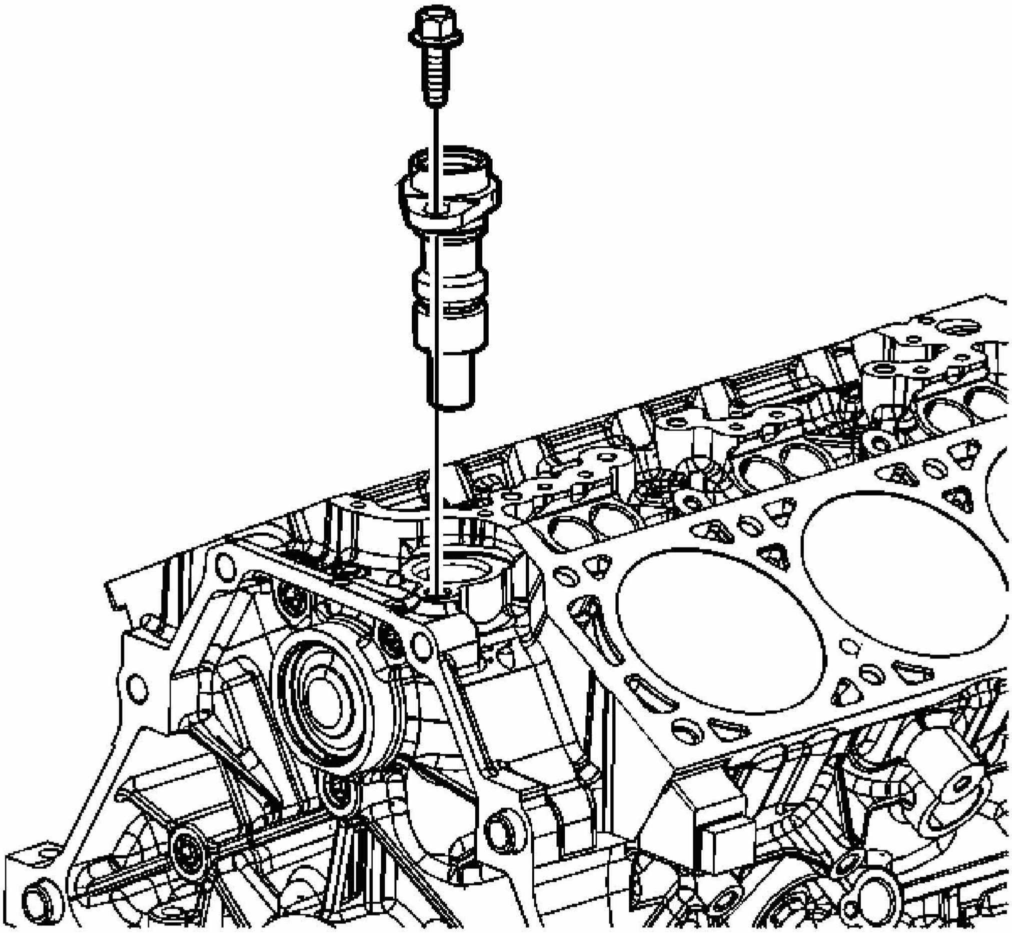


Fig. 164: Identifying Oil Pump Drive
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Remove the oil pump drive bolt.
3. Remove the oil pump drive.
4. Remove the oil pump drive seal.

Installation Procedure

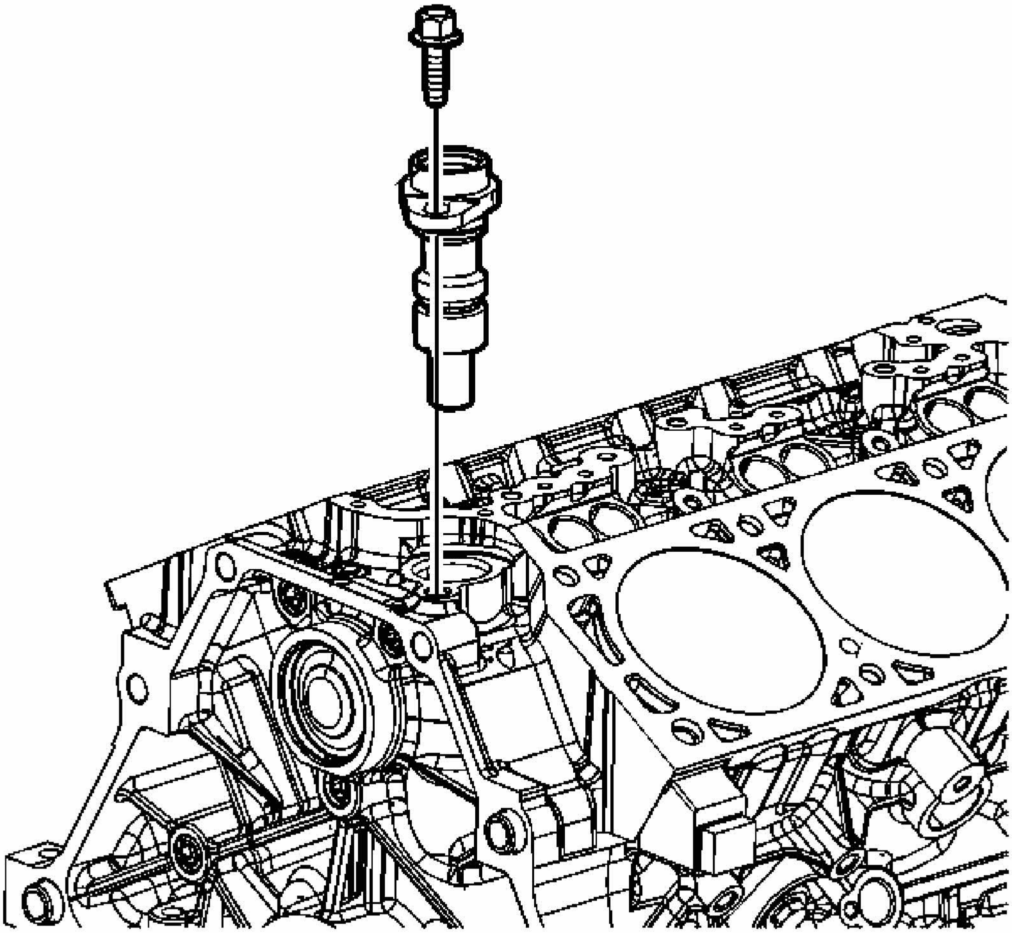


Fig. 165: Identifying Oil Pump Drive
Courtesy of GENERAL MOTORS CORP.

1. Install the oil pump drive seal. Coat the seal or bore in the engine block with clean engine oil.
2. Apply prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent to the oil pump drive gear.
3. Install the oil pump drive.

NOTE:	**Refer to Fastener Notice .**

4. Install the oil pump drive bolt.

Tighten: Tighten the bolt to 50 N.m (37 lb ft).

5. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

Tools Required

J 35468 Cover Aligner and Seal Installer

Removal Procedure

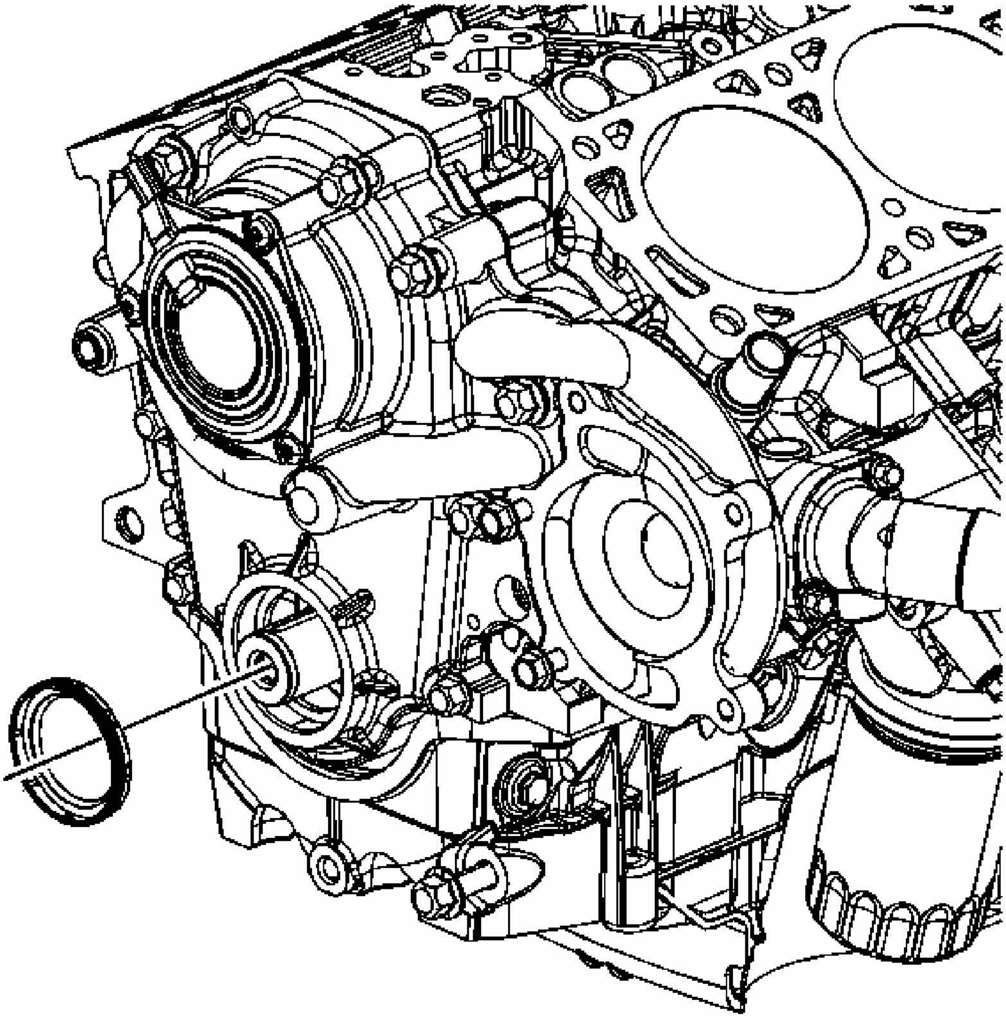


Fig. 166: Identifying Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

2. Remove the crankshaft key from the keyway.
3. Pry out the crankshaft front oil seal using a suitable tool. Use care not to damage the engine front cover or the crankshaft.

Installation Procedure

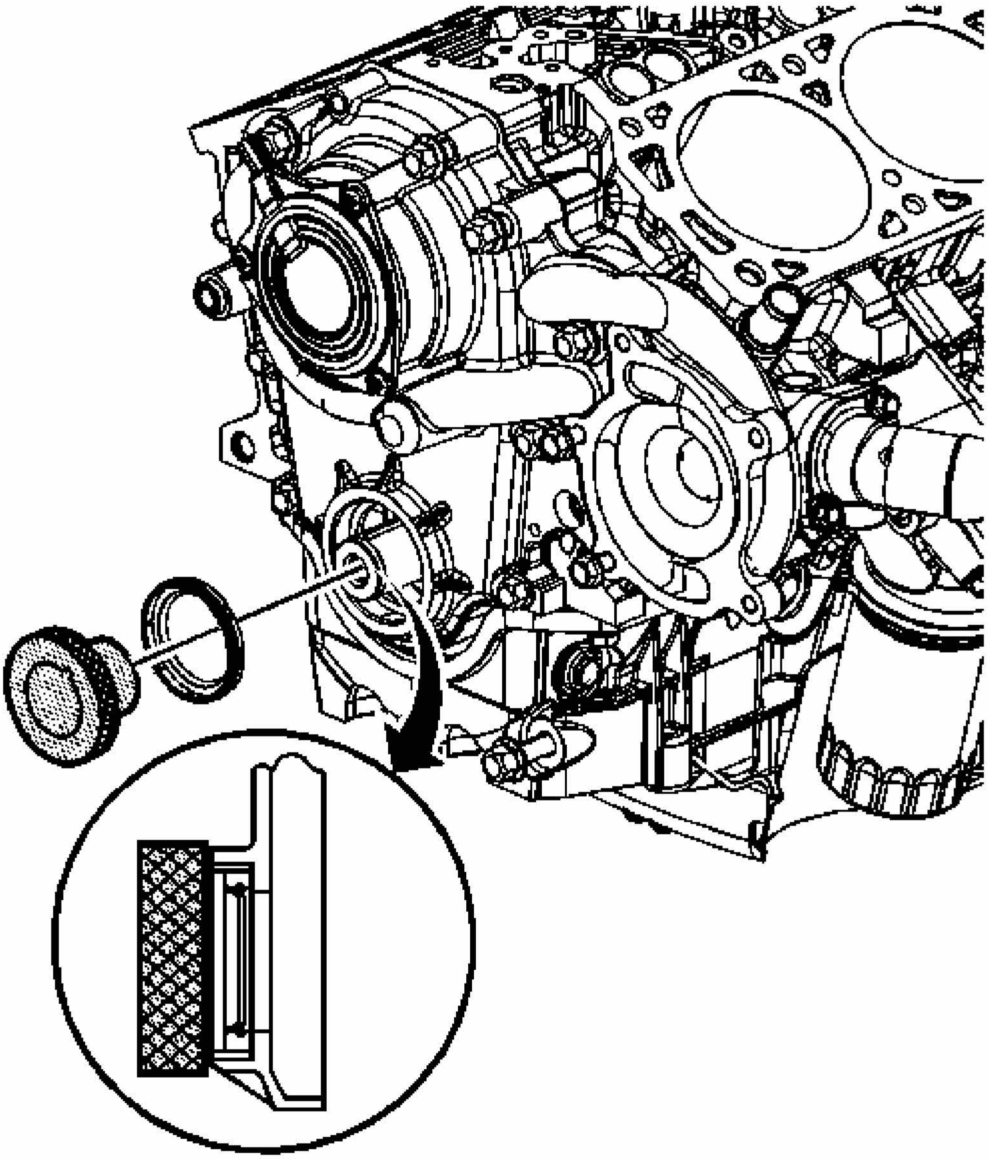


Fig. 167: View Of Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the NEW oil seal with clean engine oil.
2. Align the **J 35468** and the crankshaft front oil seal with the engine front cover and crankshaft.
3. Install the crankshaft front oil seal using **J 35468** and a suitable tool.
4. Install the crankshaft key into the keyway.
5. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

CAMSHAFT POSITION ACTUATOR MAGNET REPLACEMENT

Removal Procedure

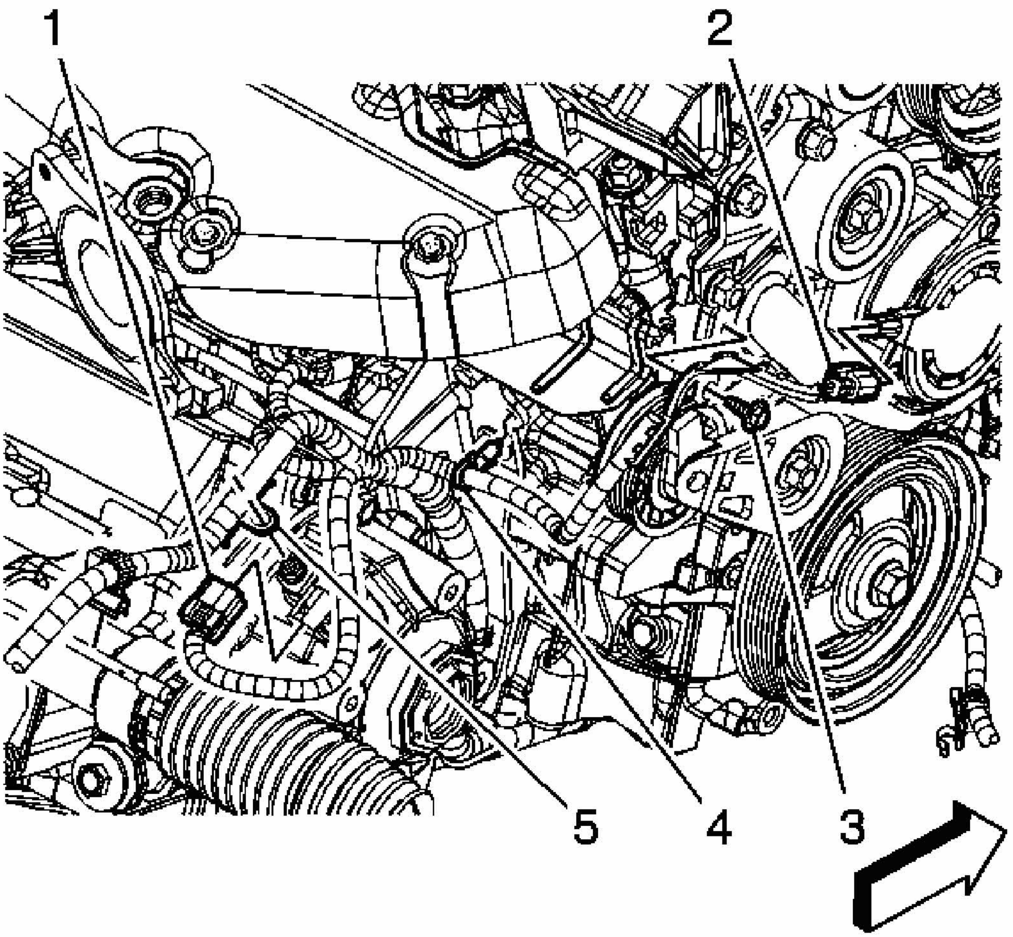


Fig. 168: Locating Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

2. Disconnect the camshaft position actuator magnet electrical connector (2).

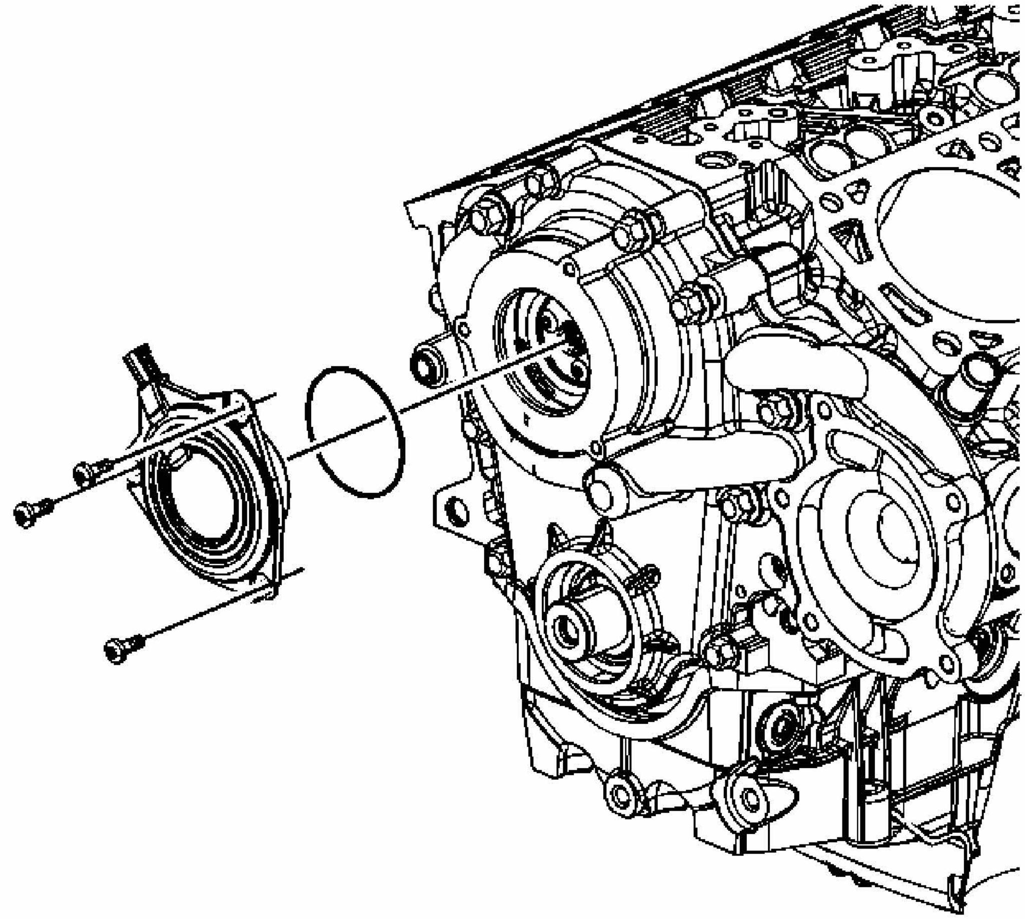


Fig. 169: Identifying Camshaft Position Actuator Magnet & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the camshaft position actuator magnet bolts.
4. Remove the camshaft position actuator magnet and O-ring seal.

Installation Procedure

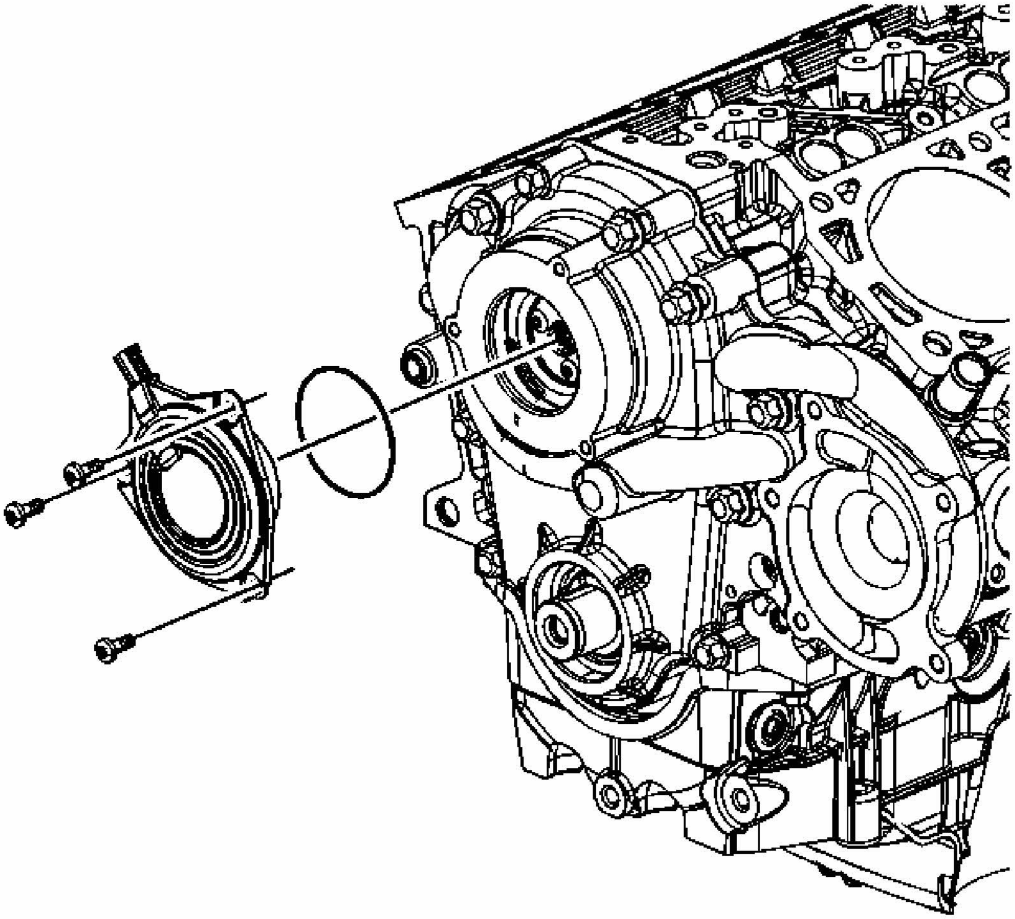


Fig. 170: Identifying Camshaft Position Actuator Magnet & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the camshaft position actuator magnet O-ring seal and magnet.

NOTE: **Refer to Fastener Notice .**

2. Install the camshaft position actuator magnet bolts.

Tighten: Tighten the bolts to 10 N.m (89 lb in).

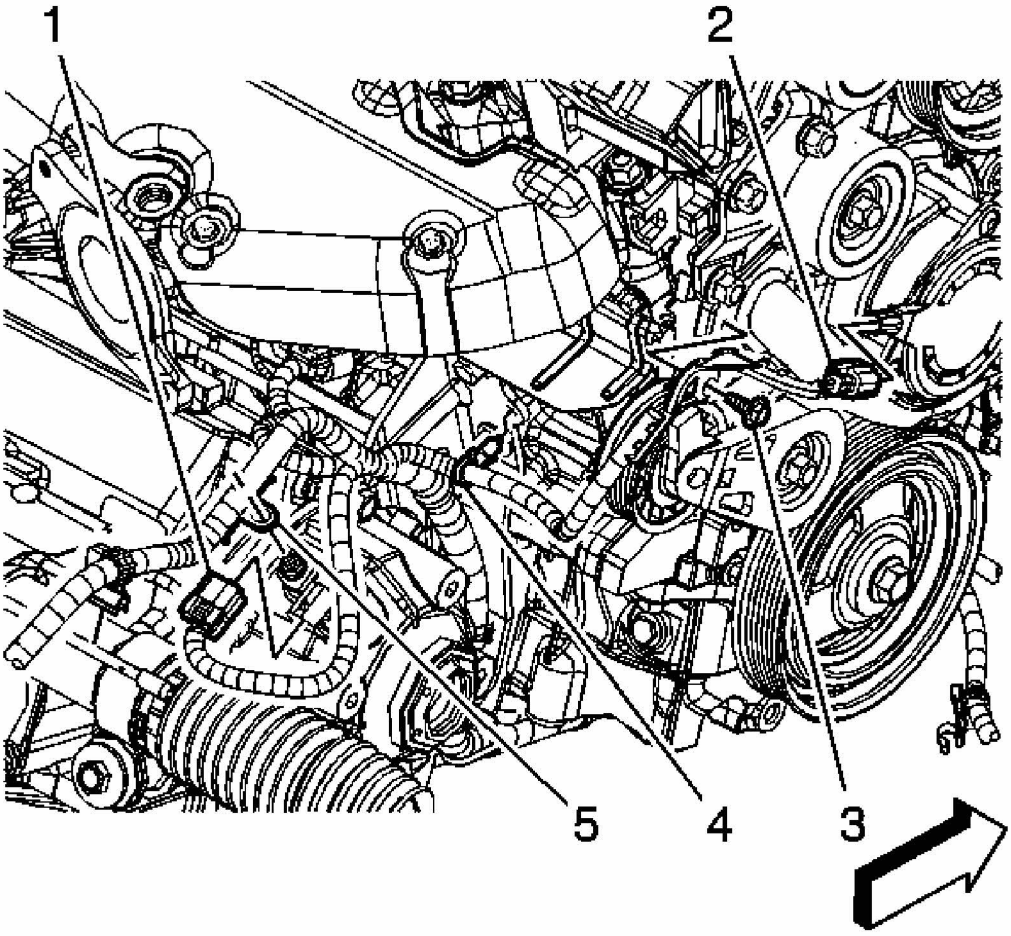


Fig. 171: Locating Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the camshaft position actuator magnet electrical connector (2)
4. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

ENGINE FRONT COVER REPLACEMENT

Removal Procedure

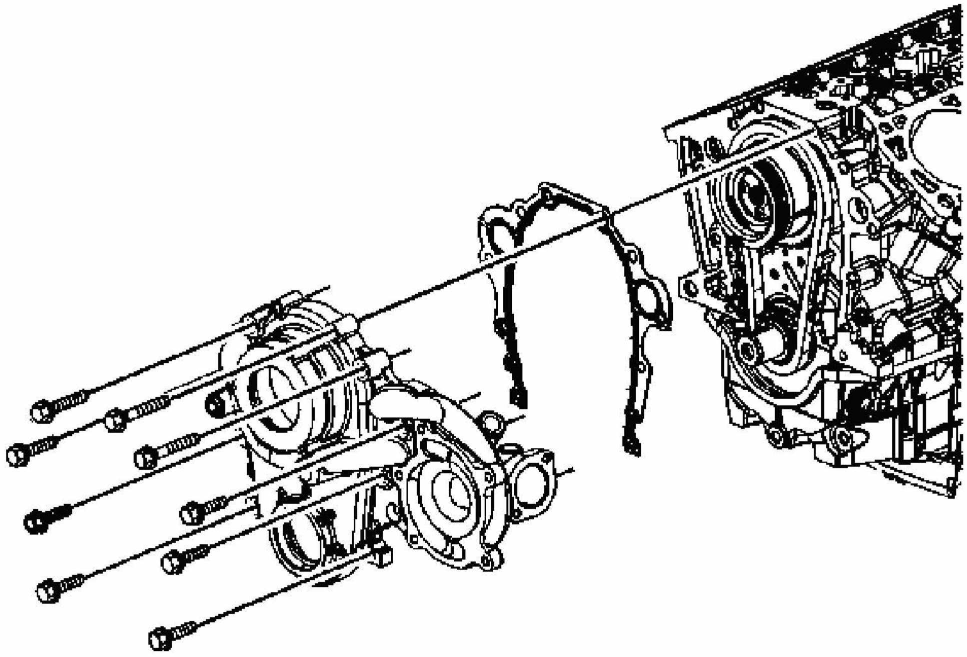


Fig. 172: Identifying Engine Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
2. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
3. Remove the oil pan. Refer to **Oil Pan Replacement**.
4. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement** .
5. Remove the crankshaft position actuator magnet. Refer to **Camshaft Position Actuator Magnet Replacement**.
6. Remove the thermostat housing. Refer to **Thermostat Housing Replacement (RPOs LZE/LZ4/LZ9)** or **Thermostat Housing Replacement (RPO LS4)** .
7. Remove the water pump. Refer to **Water Pump Replacement (RPOs LZE/LZ4/LZ9)**

or **Water Pump Replacement (RPO LS4)** .

8. Remove the engine front cover bolts.
9. Remove the engine front cover.
10. Remove the engine front cover gasket.

Installation Procedure

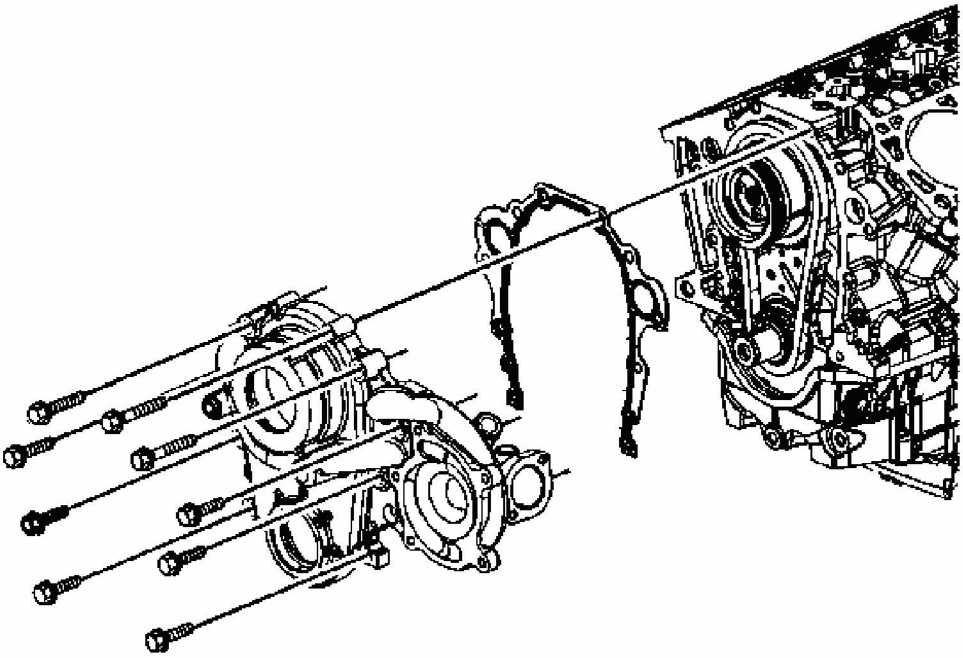


Fig. 173: Identifying Engine Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the engine front cover gasket.
2. Install the engine front cover.

NOTE: **Refer to Fastener Notice .**

3. Install the engine front cover bolts.

Tighten: Tighten the bolts to 257 N.m (18 lb ft).

4. Install the water pump. Refer to **Water Pump Replacement (RPOs LZE/LZ4/LZ9)** or **Water Pump Replacement (RPO LS4)** .
5. Install the thermostat housing. Refer to **Thermostat Housing Replacement (RPOs LZE/LZ4/LZ9)** or **Thermostat Housing Replacement (RPO LS4)** .
6. Install the crankshaft position actuator magnet. Refer to **Camshaft Position Actuator Magnet Replacement**.
7. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
8. Install the oil pan. Refer to **Oil Pan Replacement**.
9. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
10. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

TIMING CHAIN AND SPROCKETS REPLACEMENT

Tools Required

EN-47719 Tensioner Compressor

Removal Procedure

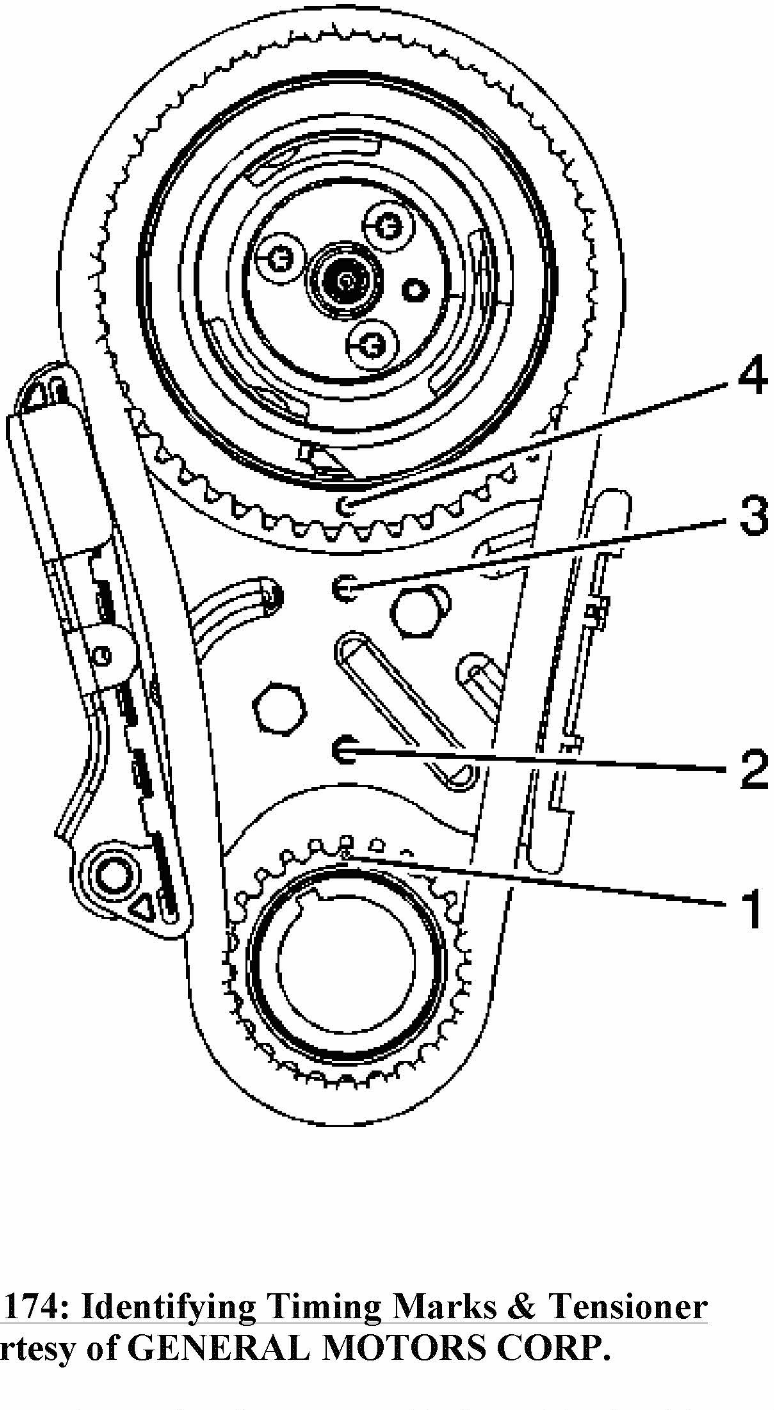


Fig. 174: Identifying Timing Marks & Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Align the crankshaft timing mark (1) to the timing mark on the bottom of the timing chain tensioner (2).
3. Align the timing mark on the camshaft gear (3) with the timing mark on top of the timing chain tensioner (4).

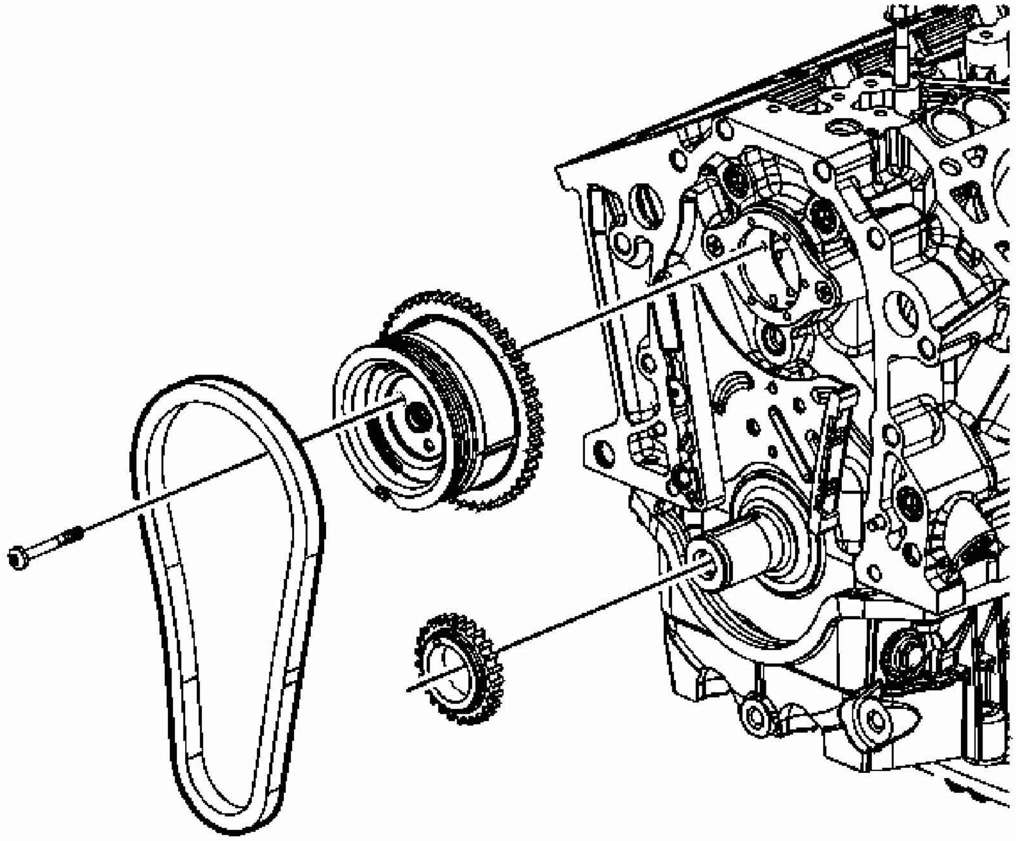


Fig. 175: View Of Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

4. Remove the camshaft sprocket bolts.
5. Remove the timing chain, camshaft, and crankshaft sprockets.

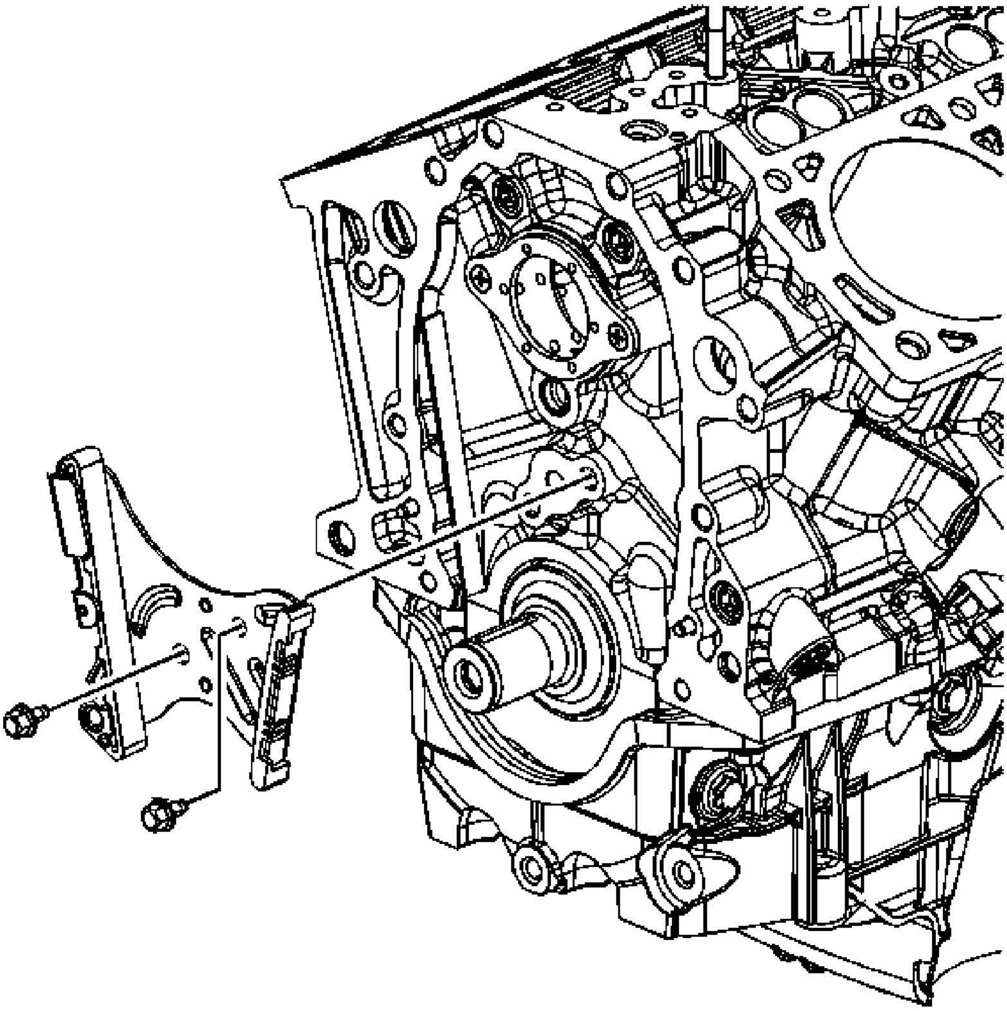


Fig. 176: View Of Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the timing chain tensioner bolts.
7. Remove the timing chain tensioner.

Installation Procedure

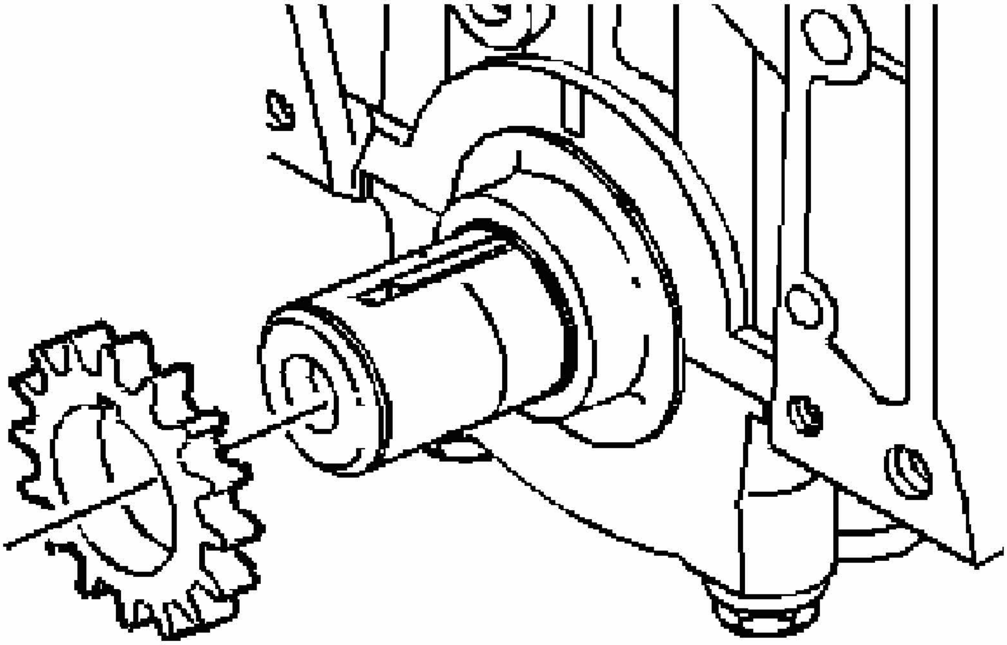


Fig. 177: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

1. Install the crankshaft sprocket.
2. Apply prelube GM P/N 12345501 (Canadian P/N 992704) or equivalent to the crankshaft sprocket thrust surface.

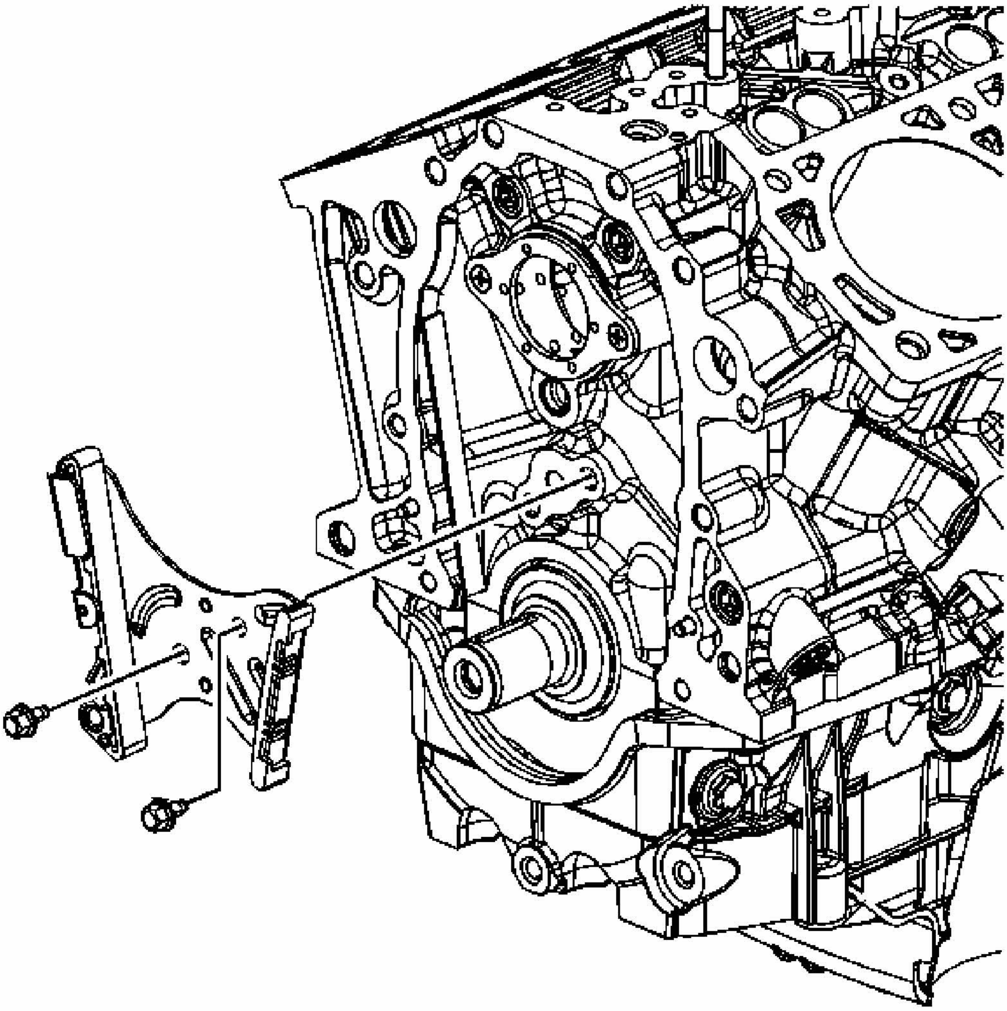


Fig. 178: View Of Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the timing chain tensioner.

NOTE: **Refer to Fastener Notice .**

4. Install the timing chain tensioner bolts.

Tighten: Tighten the bolts 21 N.m (15 lb ft).

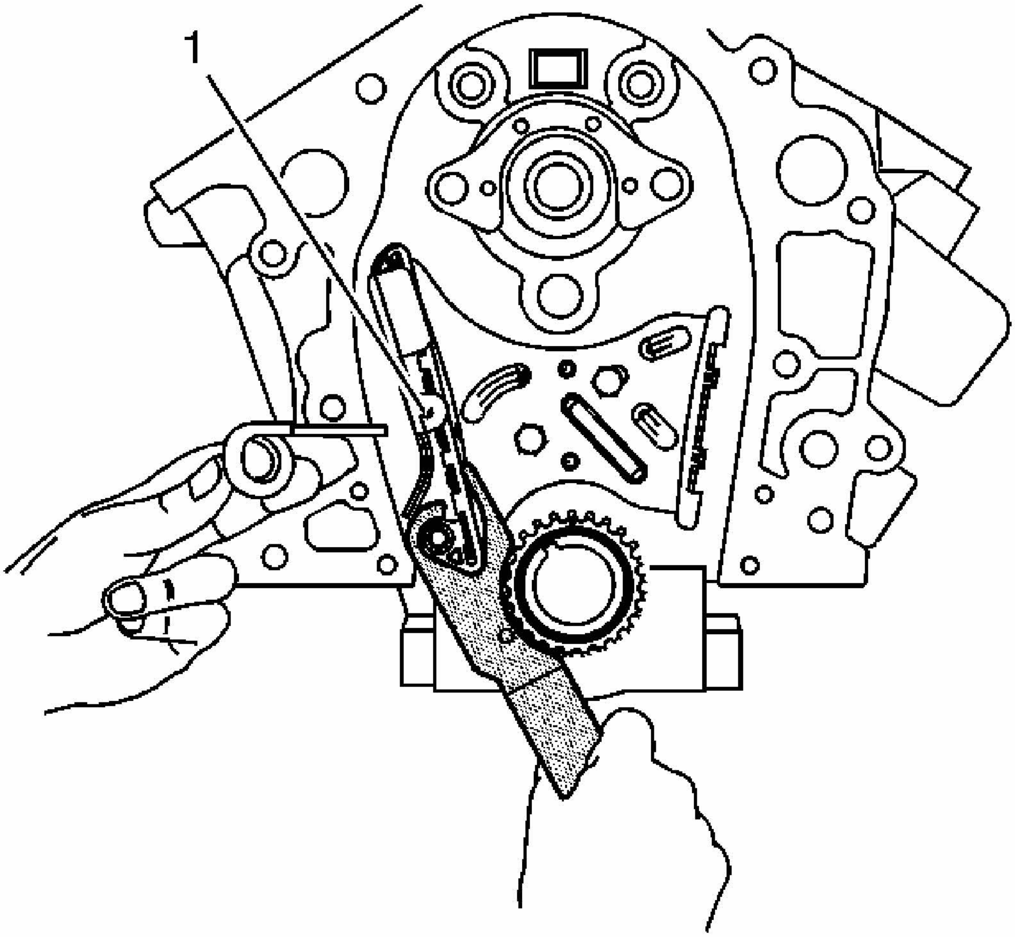


Fig. 179: Collapsing Tensioner
Courtesy of GENERAL MOTORS CORP.

5. Using the **EN-47719** , fully collapse the tensioner, and place the tensioner retaining pin into the retaining hole (1).

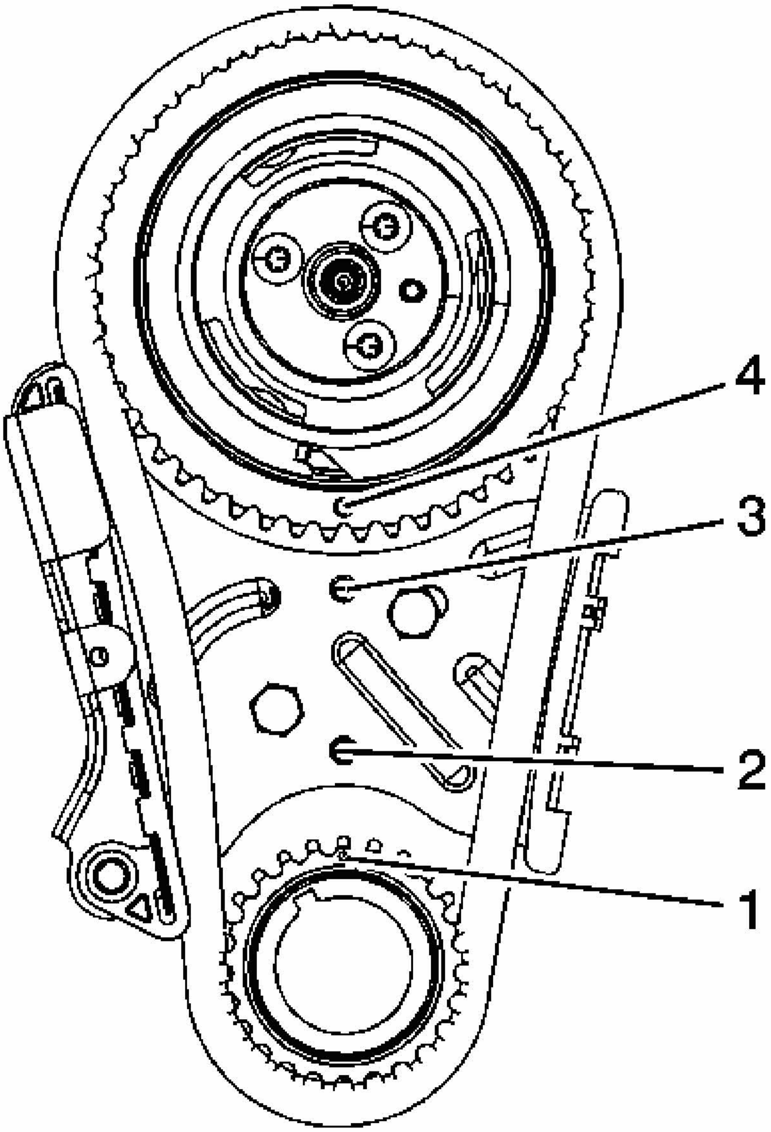


Fig. 180: Identifying Timing Marks & Tensioner
Courtesy of GENERAL MOTORS CORP.

6. Align the crankshaft timing mark (1) to the timing mark on the bottom of the timing chain tensioner (2).
7. Hold the camshaft sprocket with the timing chain hanging down and install the timing chain to the crankshaft gear.
8. Align the timing mark on the camshaft gear (3) with the timing mark on top of the timing chain tensioner (4).

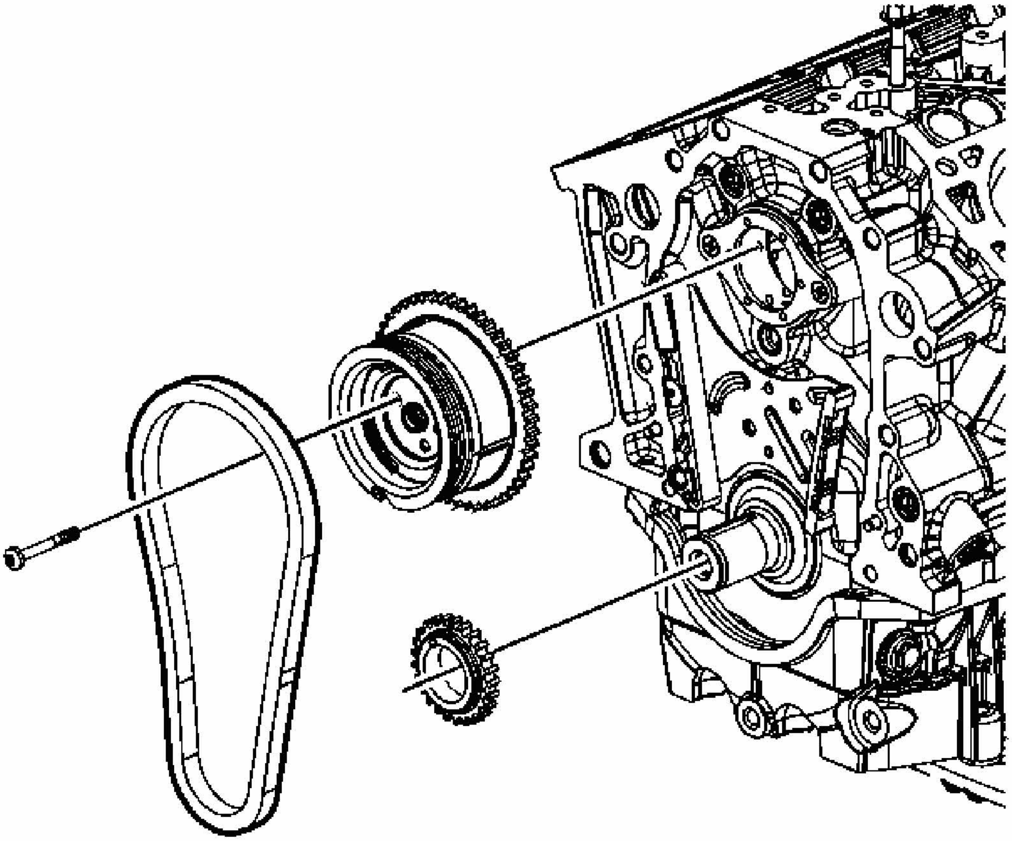


Fig. 181: View Of Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

9. Align the dowel in the camshaft sprocket with the dowel hole in the camshaft.
10. Draw the camshaft sprocket onto the camshaft using the mounting bolts.

    Tighten: Tighten the bolts 16 N.m (12 lb ft).

11. Coat the crankshaft and camshaft sprockets with clean engine oil.
12. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

CYLINDER HEAD REPLACEMENT - LEFT

Tools Required

J 45059 Angle Meter

Removal Procedure

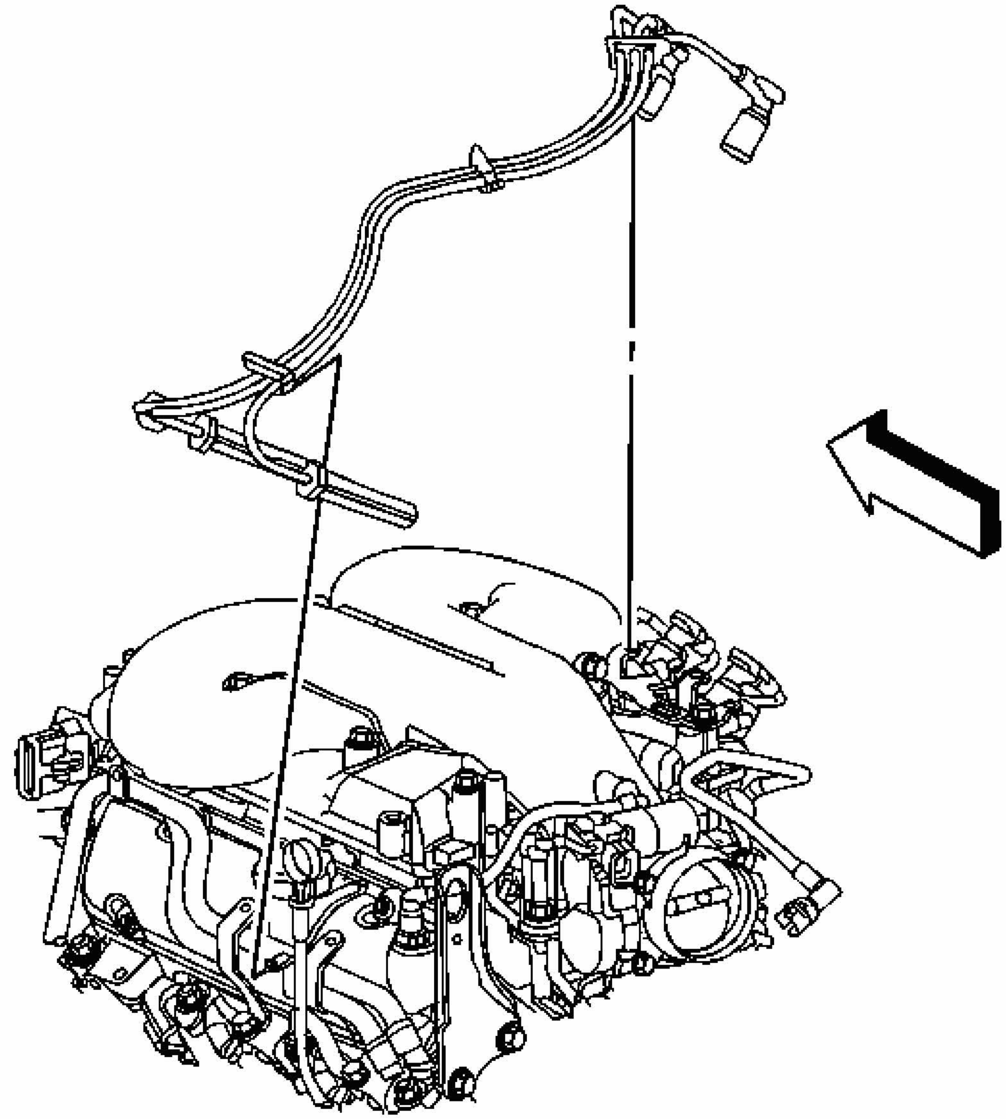


Fig. 182: View Of Left Spark Plug/Coil Harness
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
2. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
3. Lower the vehicle.

4. Remove the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
5. Remove the valve rocker arms and the pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
6. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement - Left (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Left (RPO LS4)** .
7. Remove the oil level indicator tube. Refer to **Oil Level Indicator and Tube Replacement**.
8. Disconnect the left spark plug wires from the spark plugs.
9. Remove the spark plug wire clips from the brackets.
10. Disconnect and remove the left spark plug wires from the ignition coil.

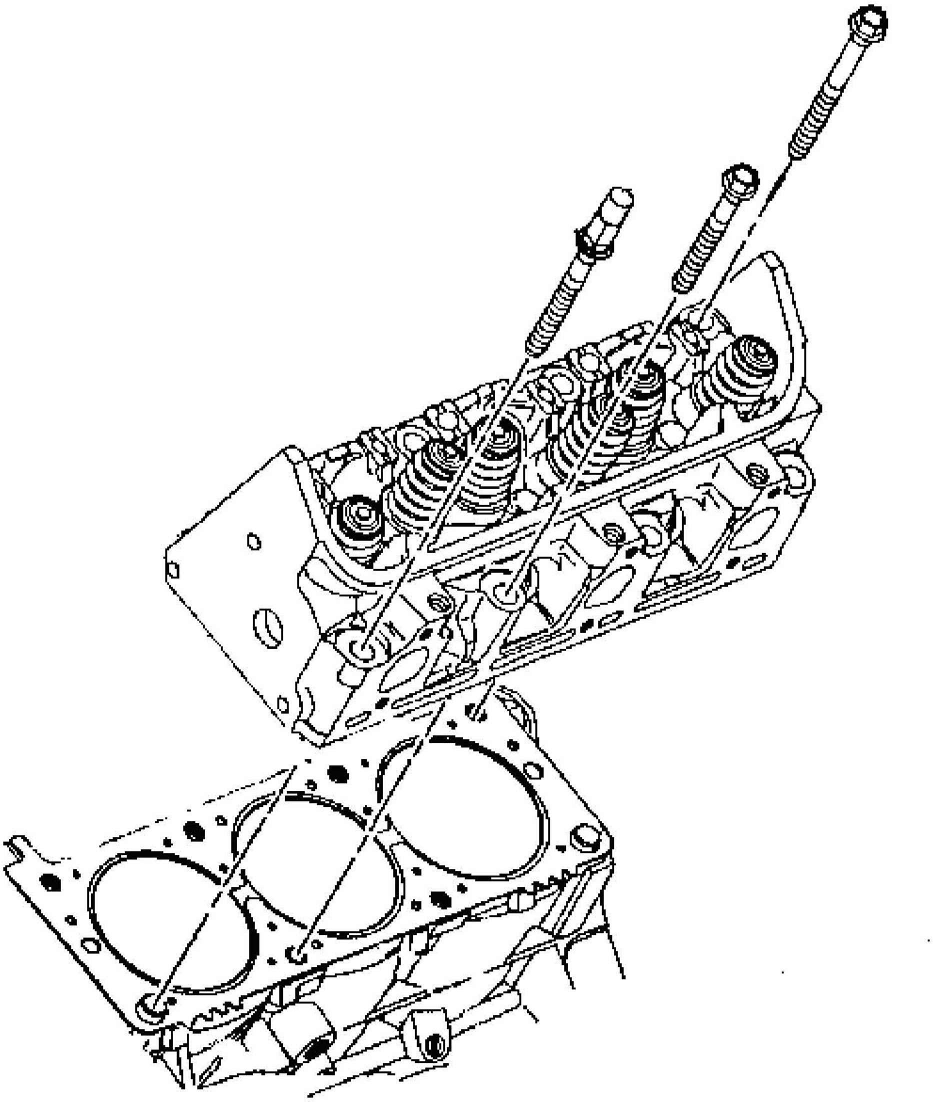


Fig. 183: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

11. Remove the left spark plugs. Refer to **Spark Plug Replacement** .
12. Remove and discard the cylinder head bolts.
13. Remove the cylinder head.

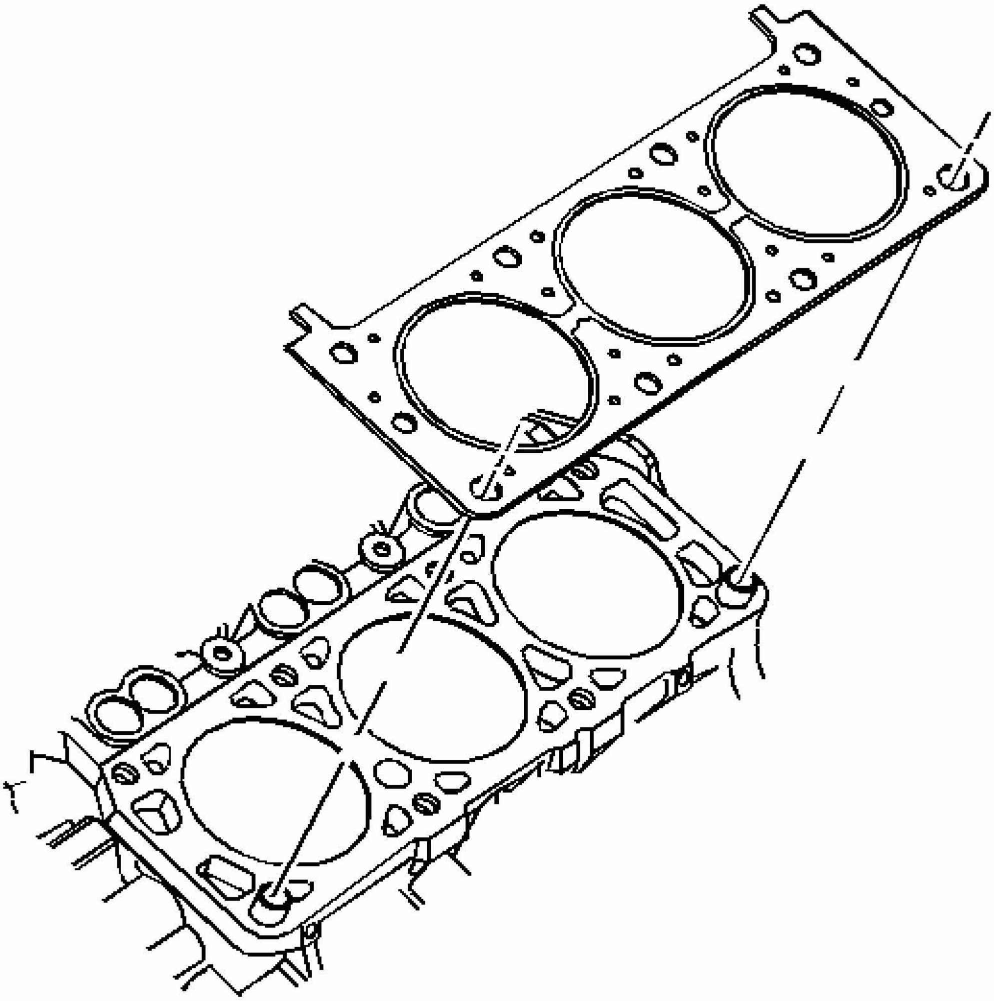


Fig. 184: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

14. Remove and discard the cylinder head gasket.
15. Remove the cylinder head locator dowel pins, if necessary.

Installation Procedure

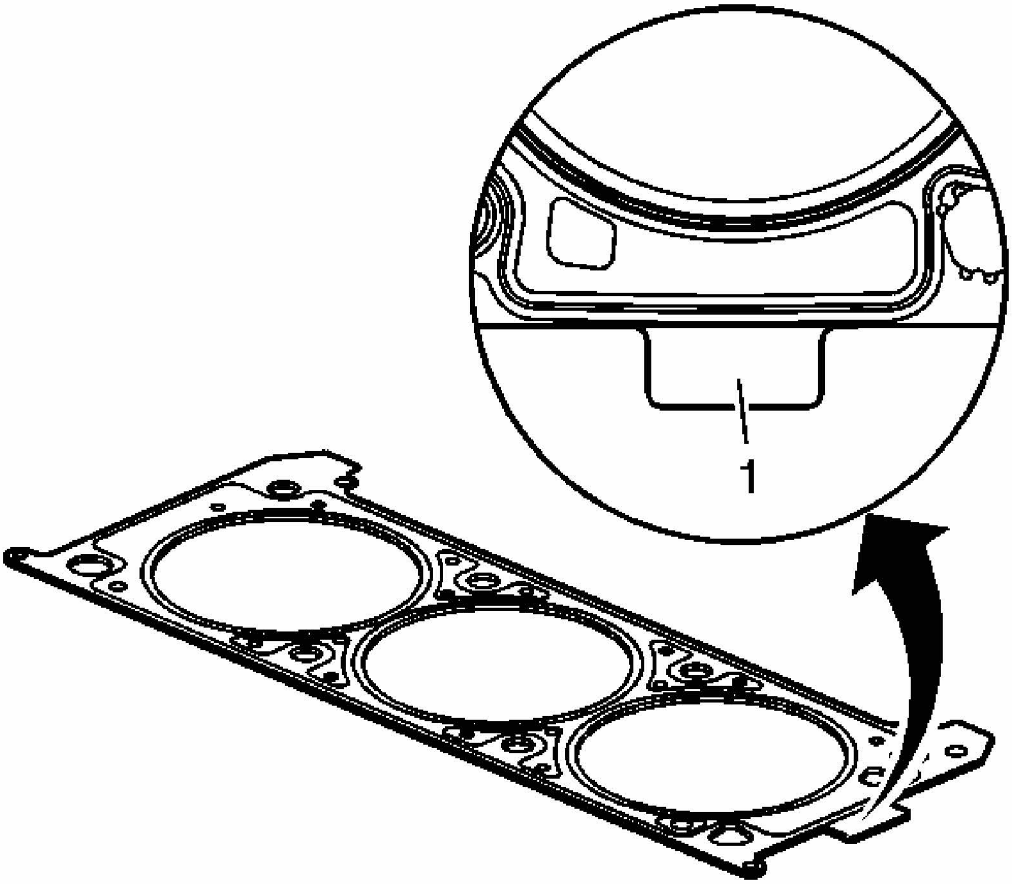


Fig. 185: Identifying Proper Cylinder Head Gasket Installation
Courtesy of GENERAL MOTORS CORP.

NOTE: **Head gaskets are specific for right hand and left hand applications, and also must be installed with the correct side facing up. Note the markings (1) on the head gaskets for proper installation. Failure to do so may lead to engine damage.**

1. Install the cylinder head locator dowel pins, if necessary.
2. Inspect the cylinder head locator dowel pins for proper installation.

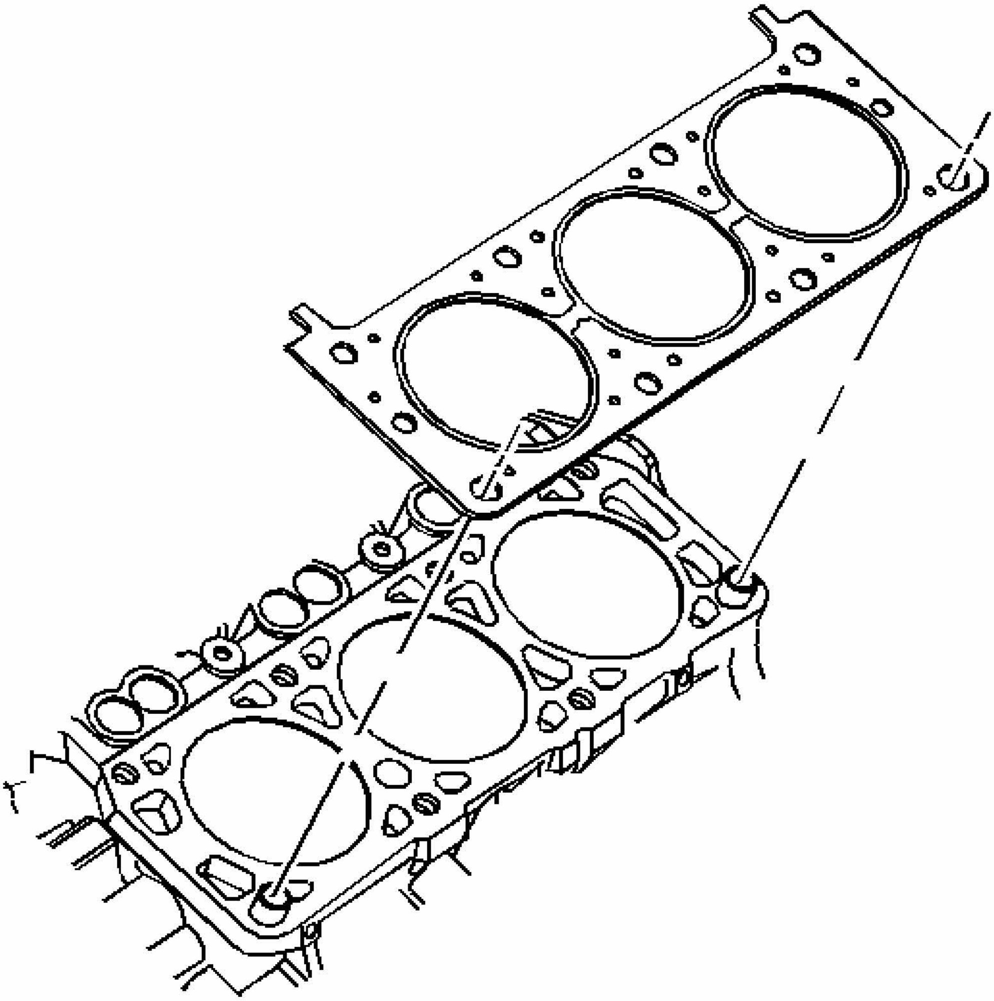


Fig. 186: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install a NEW cylinder head gasket.

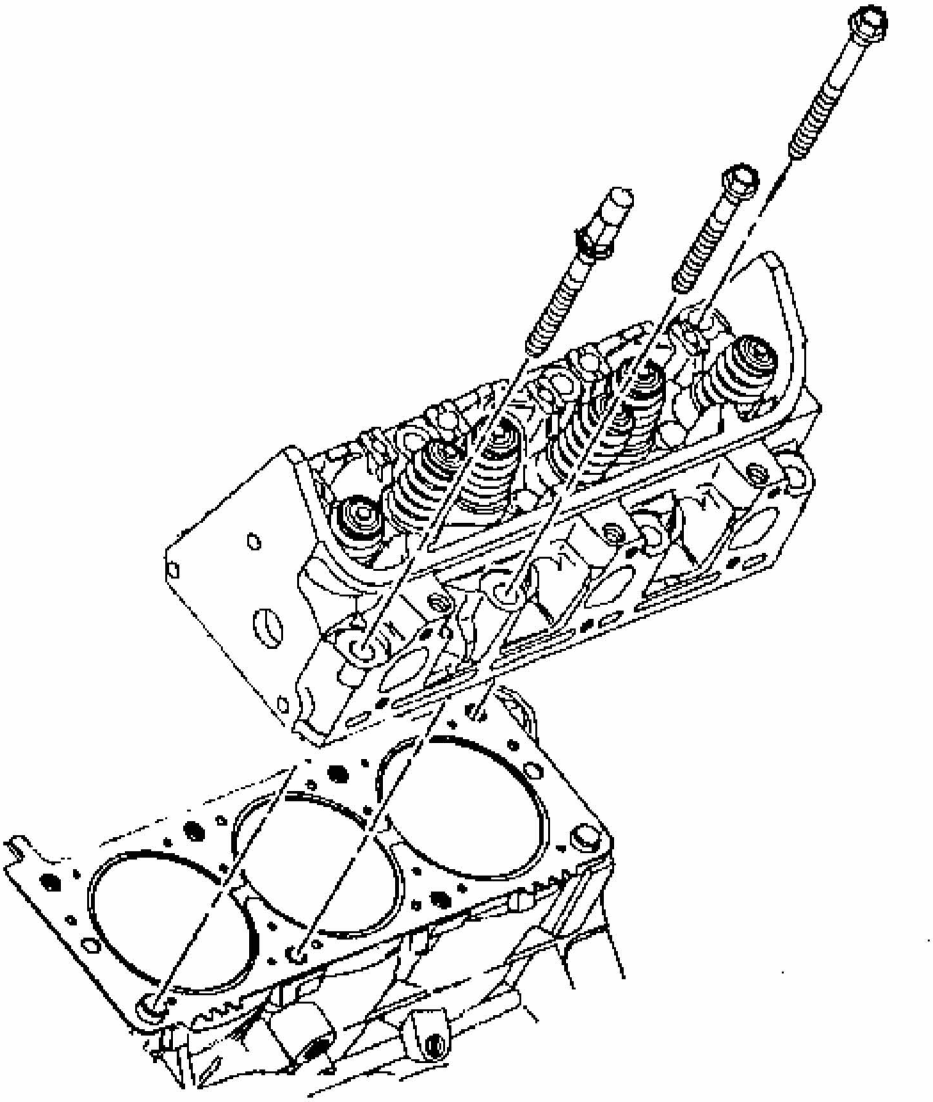


Fig. 187: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Install the cylinder head onto the locator pins and the engine.

NOTE: **This component uses torque-to-yield bolts. When servicing this component do not reuse the bolts, New torque-to-yield bolts must be installed. Reusing used torque-to-yield bolts will not provide proper bolt torque and clamp load. Failure to install NEW torque-to-yield bolts may lead to engine damage.**

5. Install NEW cylinder head bolts finger tight.

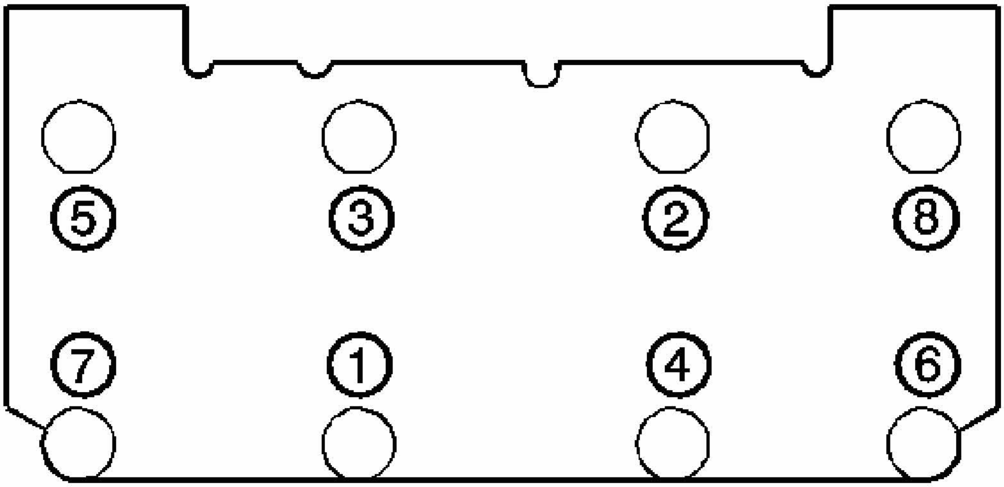


Fig. 188: View Of Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

6. Tighten the cylinder head bolts.

   Tighten: Tighten the bolts in sequence to 60 N.m (44 lb ft) plus an additional 95 degrees using the **J 45059** .

7. Install the left spark plugs. Refer to **Spark Plug Replacement** .

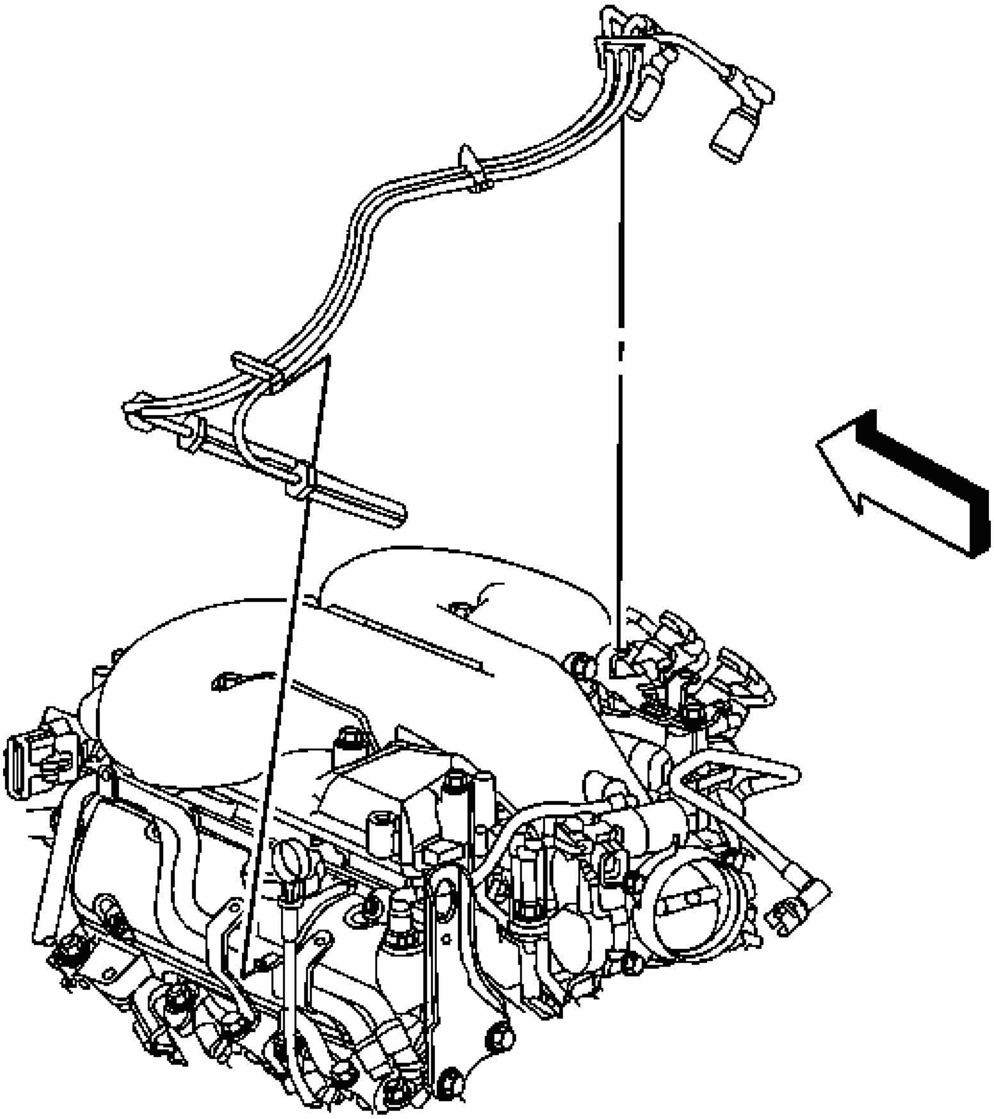


Fig. 189: View Of Left Spark Plug/Coil Harness
Courtesy of GENERAL MOTORS CORP.

8. Install and connect the left spark plug wires to the ignition coil.
9. Install the spark plug wire clips to the brackets.
10. Connect the left spark plug wires to the spark plugs.
11. Install the oil level indicator tube. Refer to **Oil Level Indicator and Tube Replacement**.
12. Install the exhaust manifold. Refer to **Exhaust Manifold Replacement - Left (RPOs**

LZE/LZ4/LZ9) or **Exhaust Manifold Replacement - Left (RPO LS4)** .

13. Install the valve rocker arms and the pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
14. Install the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
15. Fill the engine with oil. Refer to **Engine Oil and Oil Filter Replacement**.
16. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
17. Inspect for leaks.

CYLINDER HEAD REPLACEMENT - RIGHT

Tools Required

J 45059 Angle Meter

Removal Procedure

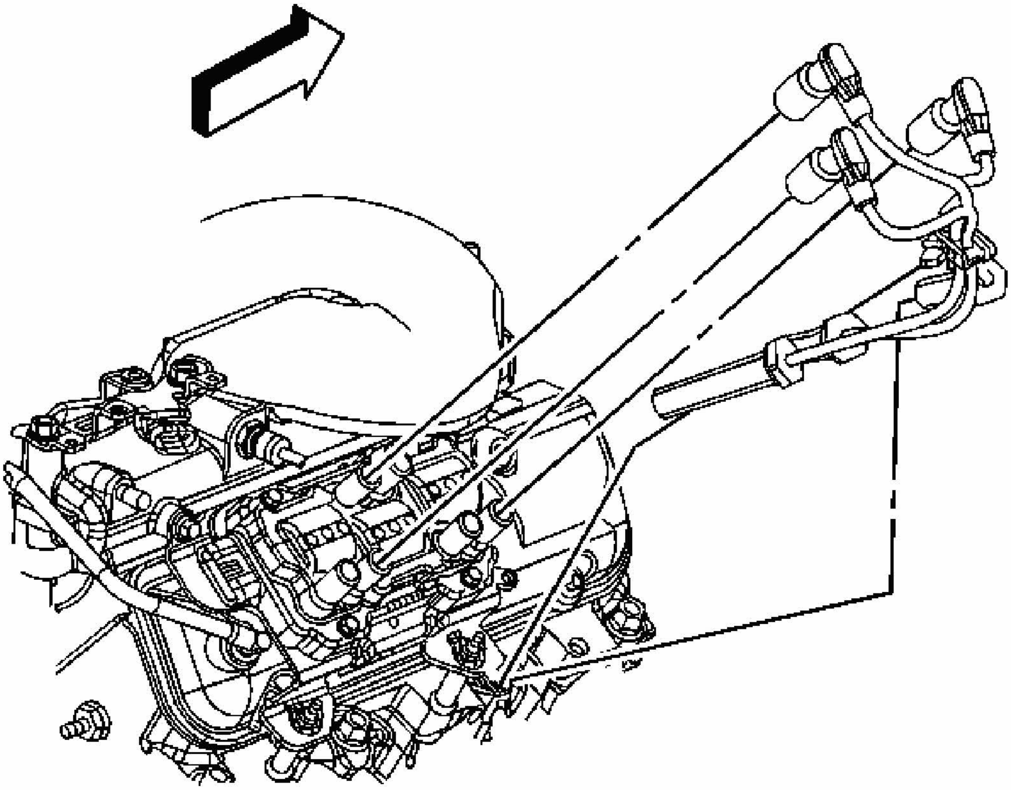


Fig. 190: View Of Spark Plug Wire Assembly
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
2. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
3. Lower the vehicle.
4. Remove the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
5. Remove the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement** .
6. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement - Right (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Right (RPO LS4)** .
7. Disconnect the right spark plug wires from the spark plugs.
8. Remove the spark plug wire clip from the bracket.

9. Disconnect and remove the right spark plug wires from the ignition coil.
10. Remove the right spark plugs. Refer to **Spark Plug Replacement** .
11. Remove the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** .

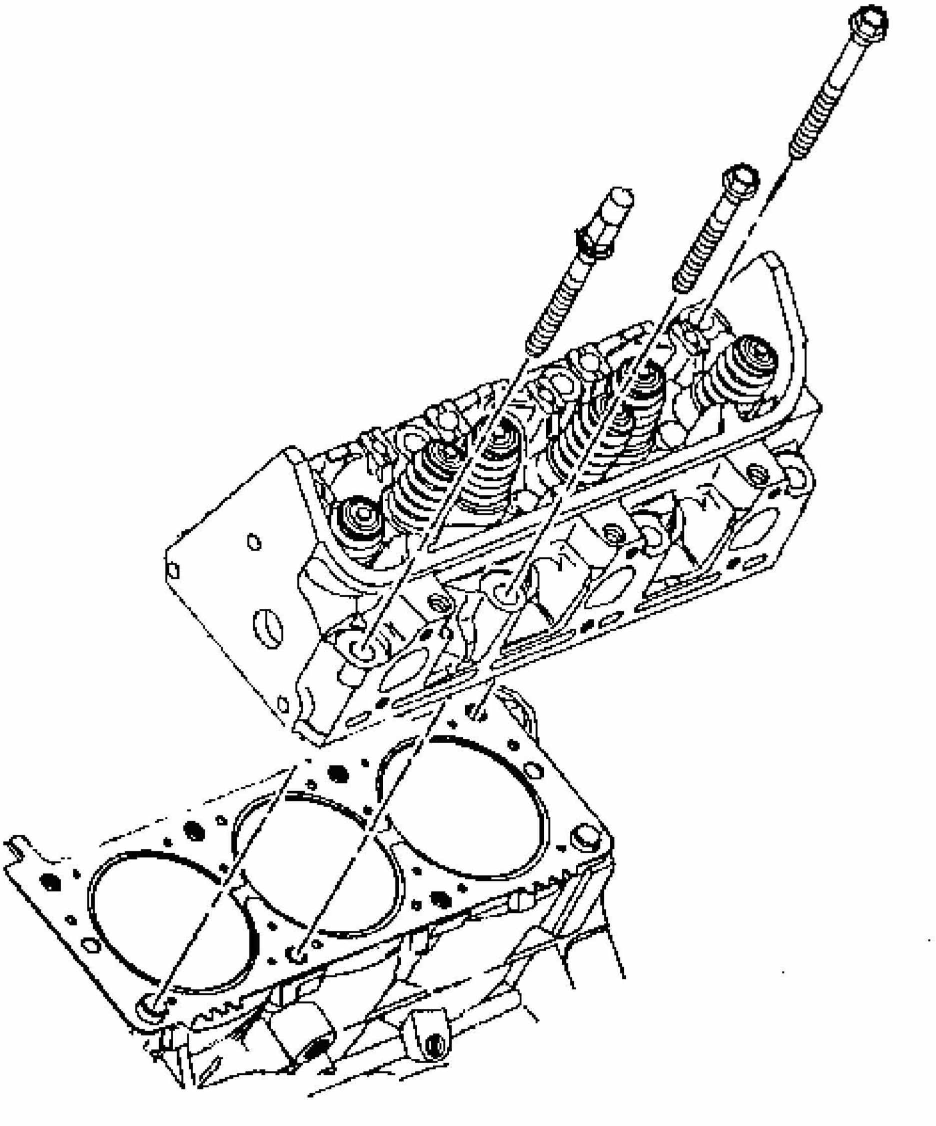


Fig. 191: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

12. Remove and discard the cylinder head bolts.

13. Remove the cylinder head.

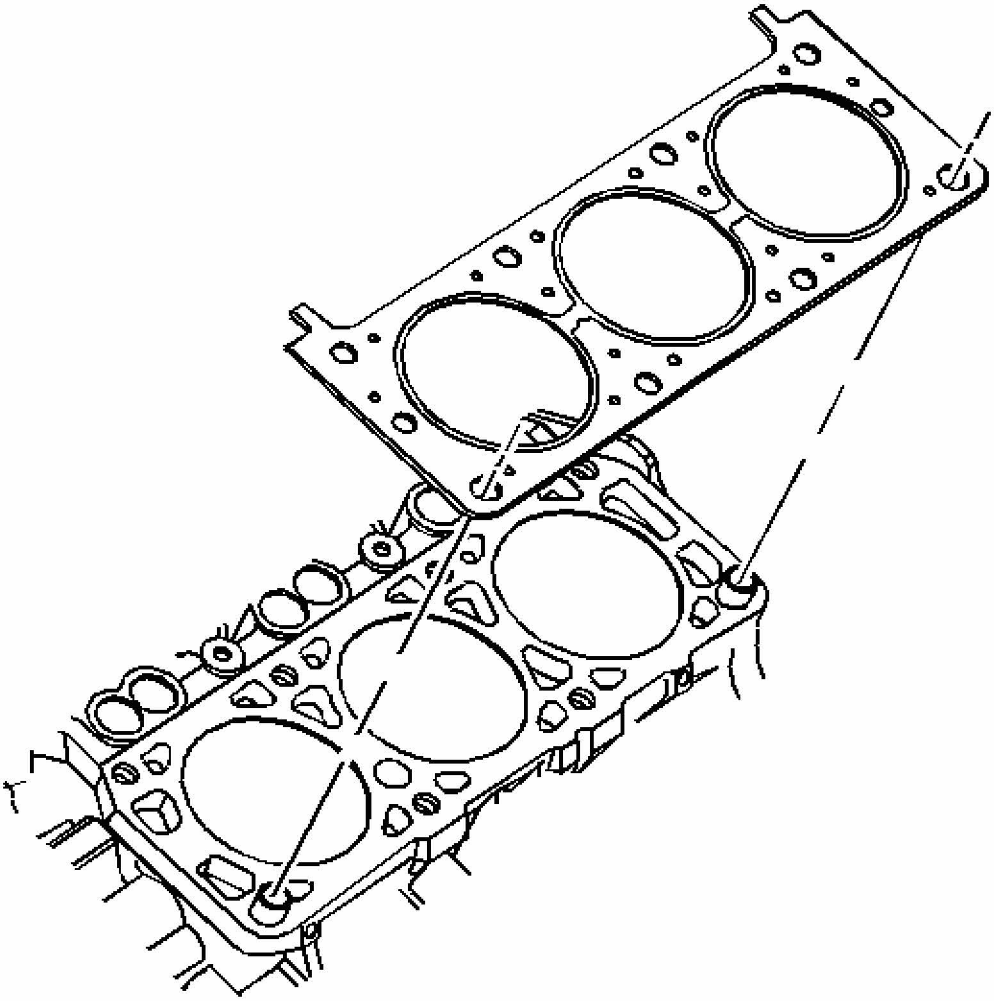


Fig. 192: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

14. Remove and discard the cylinder head gasket.
15. Remove the cylinder head locator dowel pins, if necessary.

Installation Procedure

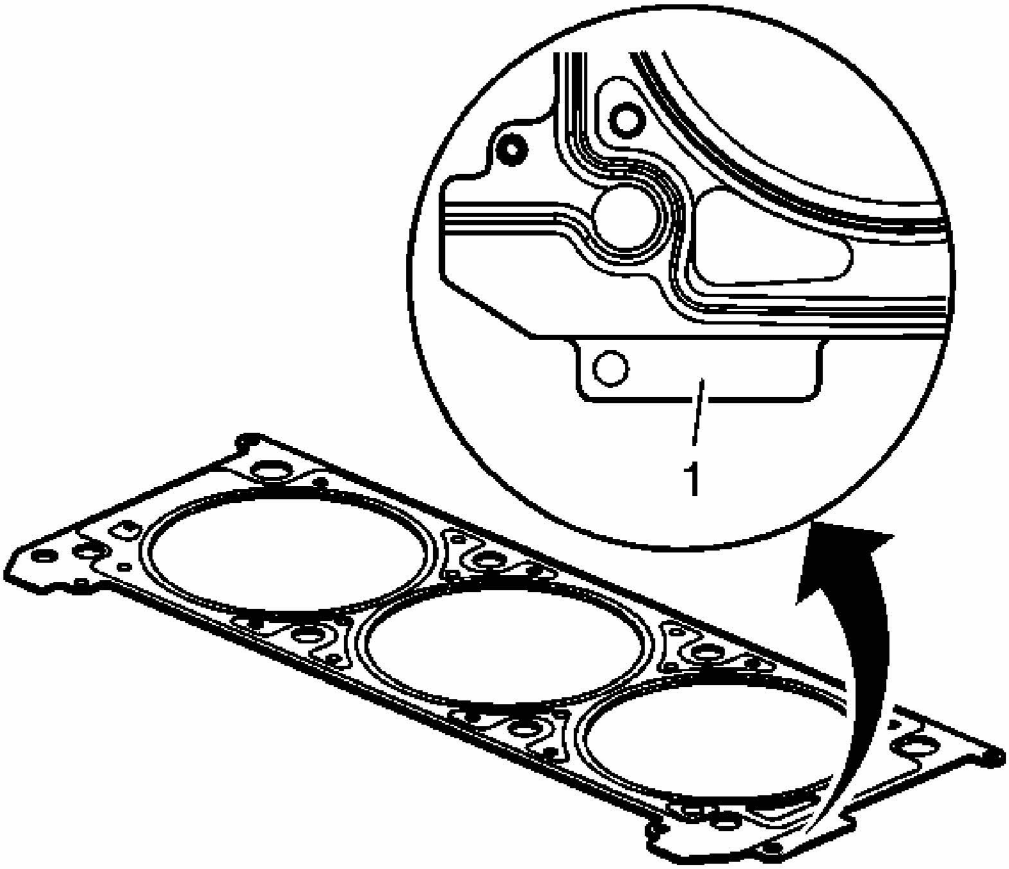


Fig. 193: Identifying Proper Cylinder Head Gasket Installation
Courtesy of GENERAL MOTORS CORP.

NOTE: Head gaskets are specific for right hand and left hand applications, and also must be installed with the correct side facing up. Note the markings (1) on the head gaskets for proper installation. Failure to do so may lead to engine damage.

1. Install the cylinder head locator dowel pins, if necessary.
2. Inspect the cylinder head locator dowel pins for proper installation.

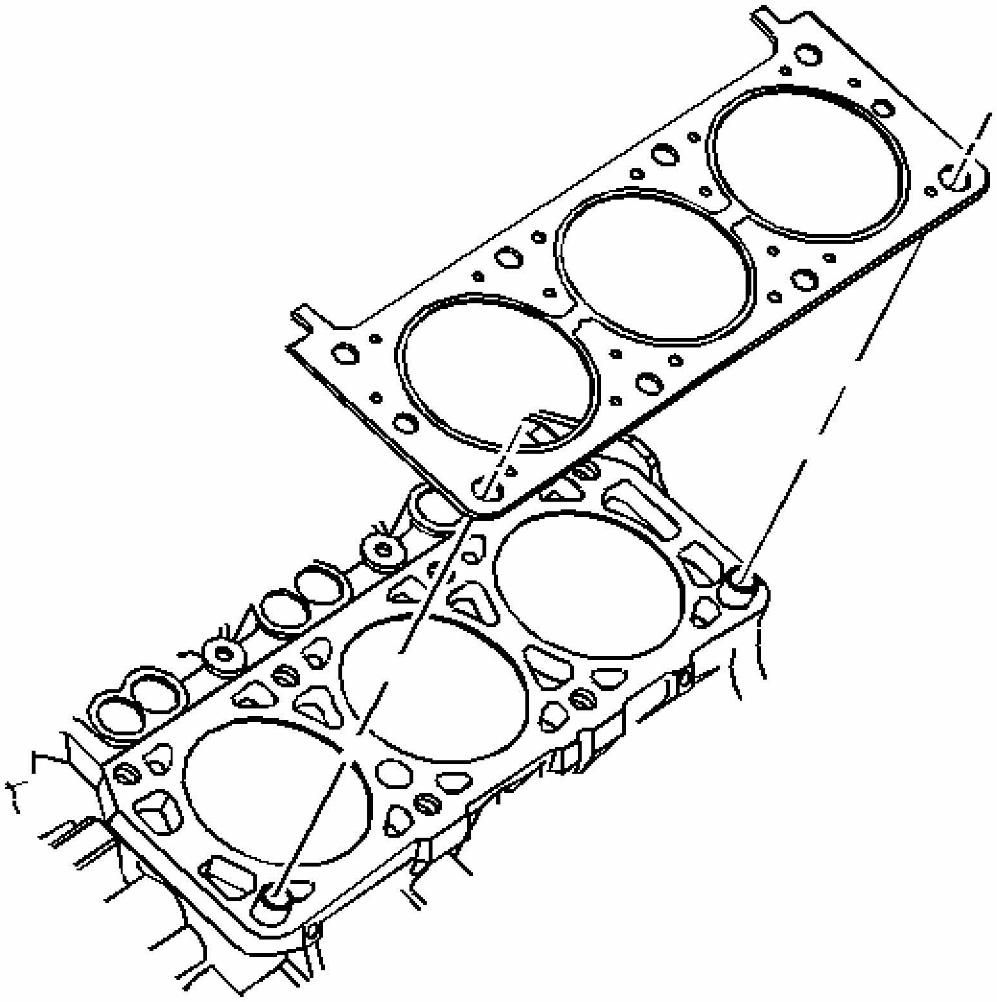


Fig. 194: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install a NEW cylinder head gasket.

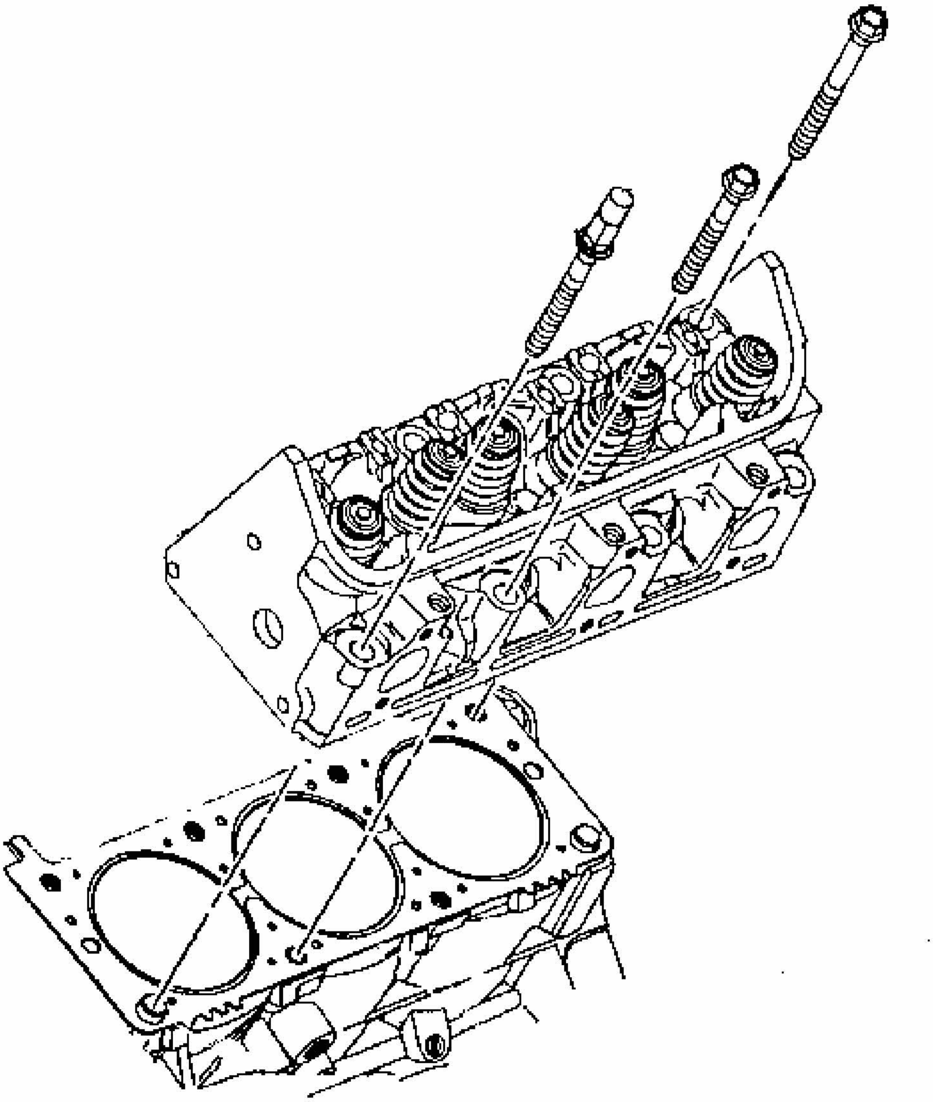


Fig. 195: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Install the cylinder head onto the locator pins and the engine.

NOTE: **This component uses torque-to-yield bolts. When servicing this component do not reuse the bolts, New torque-to-yield bolts must be installed. Reusing used torque-to-yield bolts will not provide proper bolt torque and clamp load. Failure to install NEW torque-to-yield bolts may lead to engine damage.**

5. Install NEW cylinder head bolts finger tight.

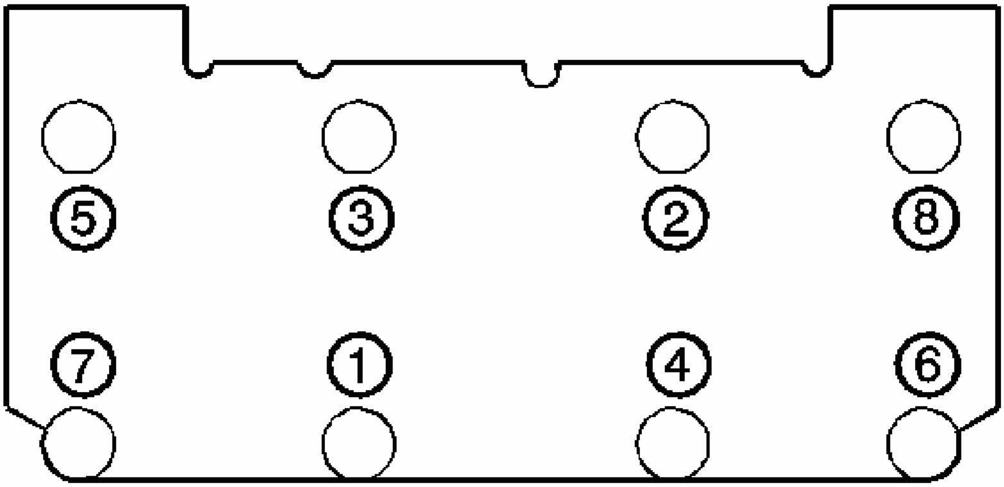


Fig. 196: View Of Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

6. Tighten the cylinder head bolts.

   Tighten: Tighten the bolts in sequence to 60 N.m (44 lb ft) plus an additional 95 degrees using the **J 45059** .

7. Install the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** .
8. Install the right spark plugs. Refer to **Spark Plug Replacement** .

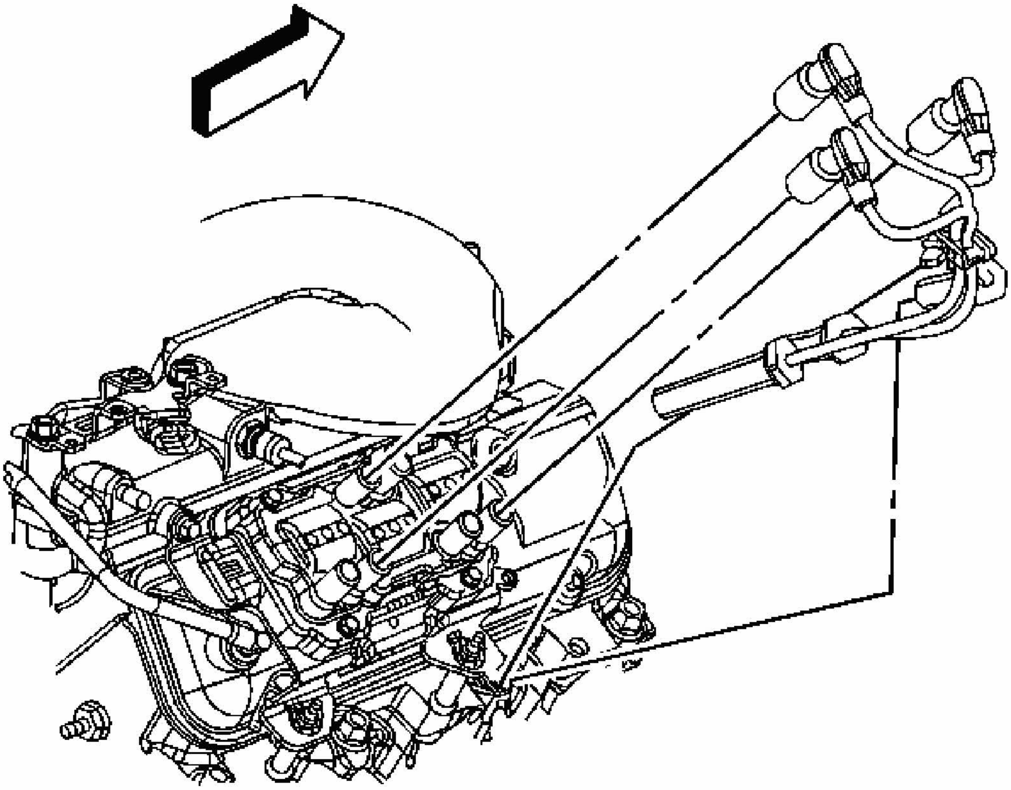


Fig. 197: View Of Spark Plug Wire Assembly
Courtesy of GENERAL MOTORS CORP.

9. Install and connect the right spark plug wires to the ignition coil.
10. Install the spark plug wire clip to the bracket.
11. Connect the right spark plug wires to the spark plugs.
12. Install the exhaust manifold. Refer to **Exhaust Manifold Replacement - Right (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Right (RPO LS4)** .
13. Install the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement** .
14. Install the lower intake manifold. Refer to **Intake Manifold Replacement - Lower** .
15. Fill the engine with oil. Refer to **Engine Oil and Oil Filter Replacement** .
16. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

17. Inspect for leaks.

ENGINE FLYWHEEL REPLACEMENT

Tools Required

J 37096 Flywheel Holder

Removal Procedure

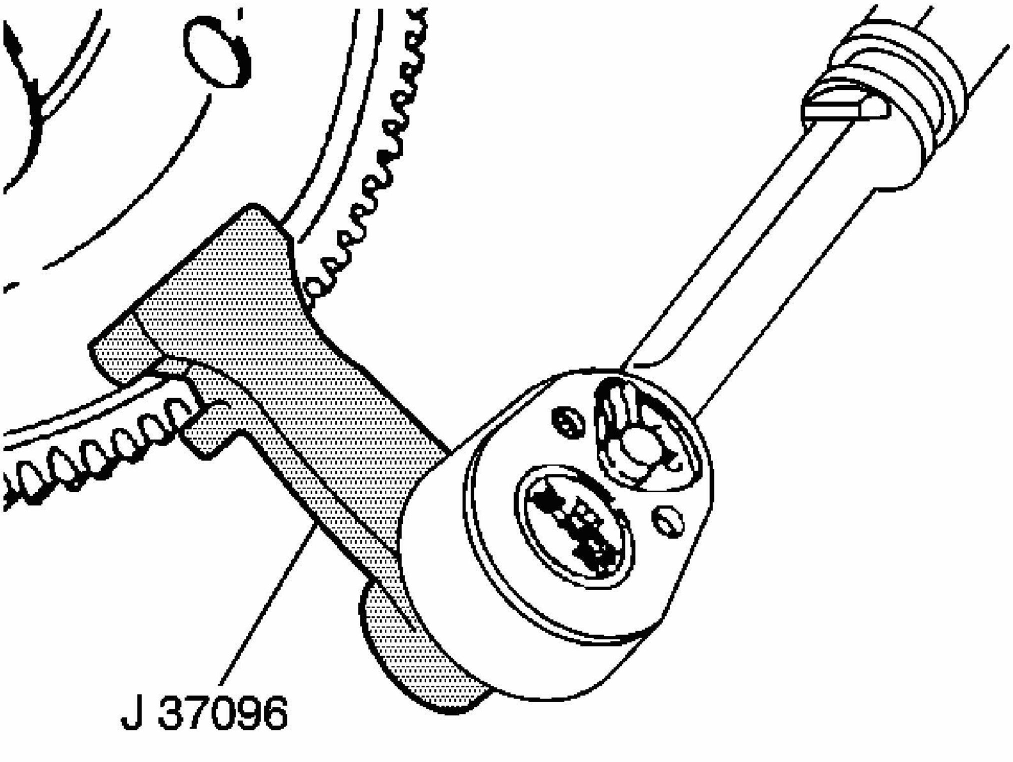


Fig. 198: Holding Flywheel
Courtesy of GENERAL MOTORS CORP.

1. Remove the automatic transaxle, if equipped. Refer to **Transmission Replacement (RPOs LZE/LZ9)** or **Transmission Replacement (RPO LS4)** .
2. Use the **J 37096** to secure the flywheel in order to prevent the crankshaft from rotating.

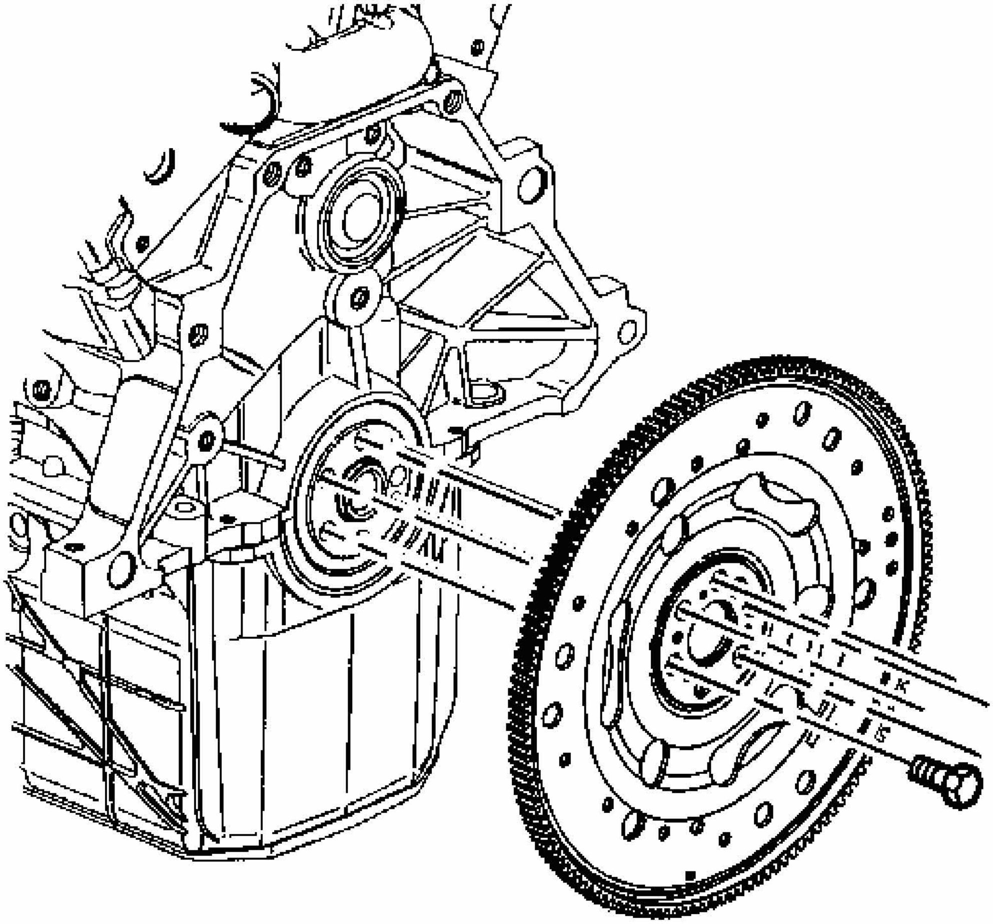


Fig. 199: View Of Flywheel
Courtesy of GENERAL MOTORS CORP.

3. Loosen the flywheel bolts.
4. Remove 5 of the 6 flywheel bolts leaving one bolt at the top of the crankshaft.
5. Grip the flywheel and remove the remaining bolt. Do not drop the flywheel when removing the final bolt.
6. Remove the engine flywheel.
7. Clean the engine flywheel bolt threads and bolt holes.

Installation Procedure

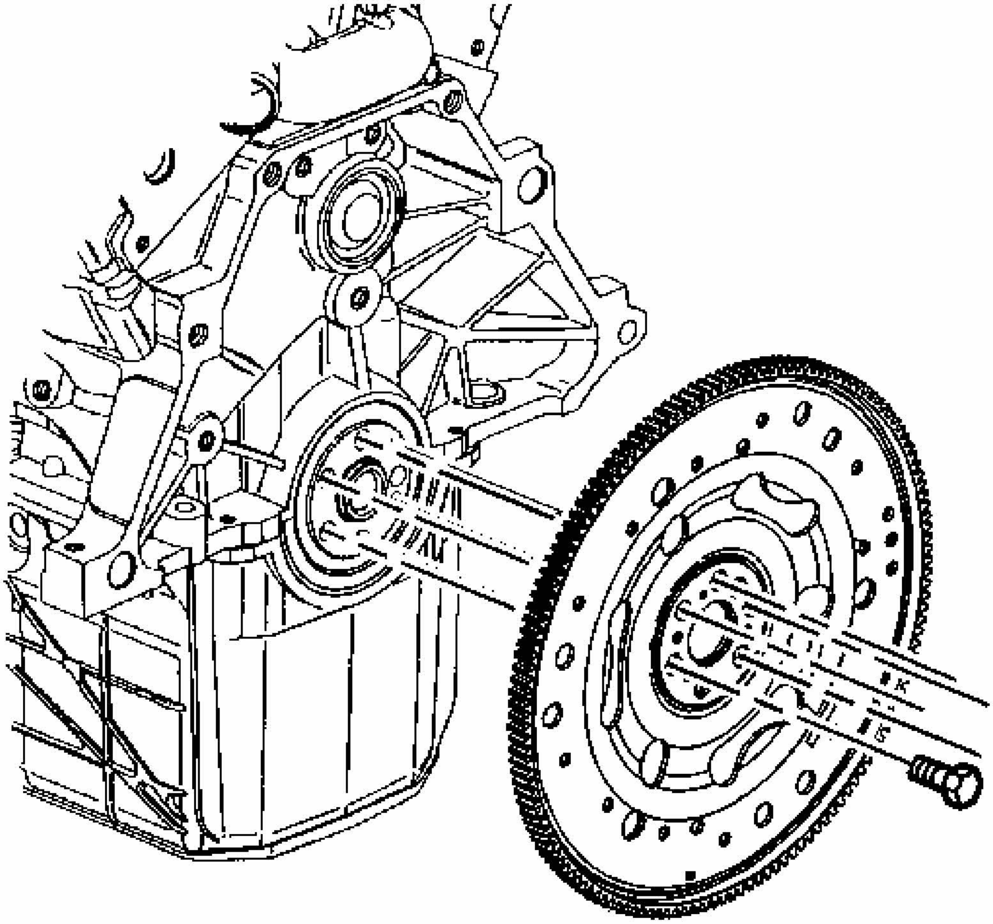


Fig. 200: View Of Flywheel
Courtesy of GENERAL MOTORS CORP.

1. Position the flywheel to the crankshaft.
2. Install the flywheel bolts finger tight.
3. Use the **J 37096** to secure the flywheel in order to prevent the crankshaft from rotating.

NOTE: **Refer to Fastener Notice .**

4. Tighten the engine flywheel bolts.

Tighten: Tighten the bolts to 70 N.m (52 lb ft).

5. Install the automatic transaxle, if equipped. Refer to **Transmission Replacement (RPOs LZE/LZ9)** or **Transmission Replacement (RPO LS4)** .

CRANKSHAFT REAR OIL SEAL REPLACEMENT

Tools Required

J 34686 Rear Main Seal Installer

Removal Procedure

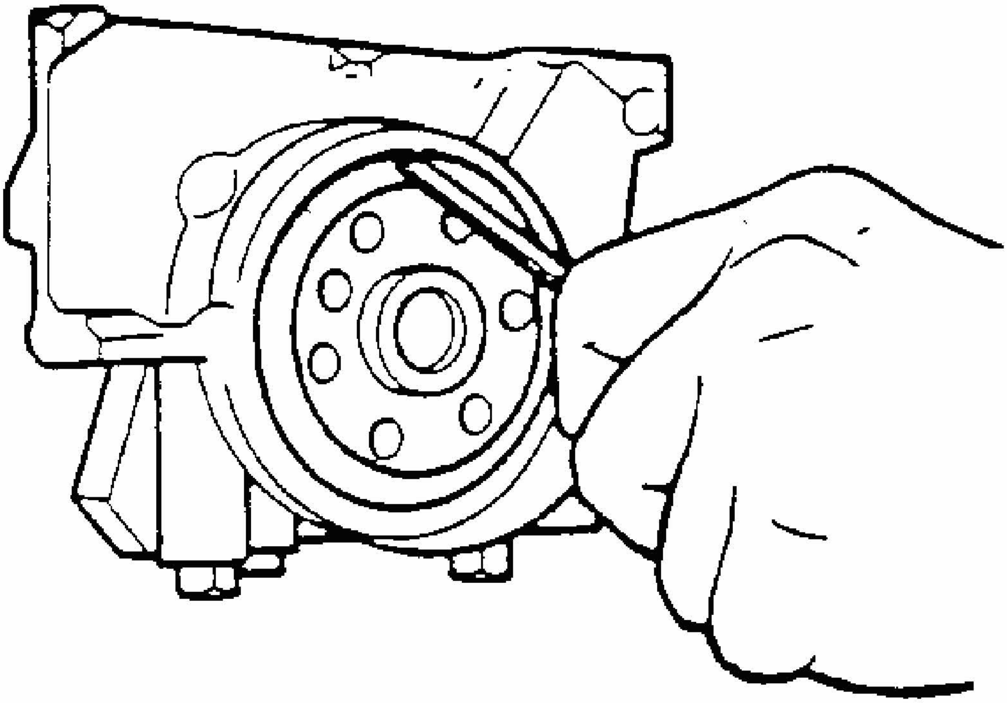


Fig. 201: Removing Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the flywheel. Refer to **Engine Flywheel Replacement** .

IMPORTANT: Do not nick the crankshaft sealing surface when removing the seal.

2. Insert a flat-bladed or similar tool through the dust lip at an angle.
3. Pry the crankshaft rear oil seal out by moving the handle of the tool towards the end of

the crankshaft.

4. Repeat, as necessary around the crankshaft rear oil seal, until the seal is removed.

Installation Procedure

NOTE: Do not apply or use any oil lubrication on the crankshaft rear oil seal, or the seal installer. Do not touch the sealing lip of the oil seal once the protective sleeve is removed. Doing so will damage/deform the seal.

NOTE: Clean the crankshaft sealing surface with a clean, lint free towel. Inspect lead-in edge of crankshaft for burrs/sharp edges that could damage the rear main oil seal. Remove burrs/sharp edges with crocus cloth before proceeding.

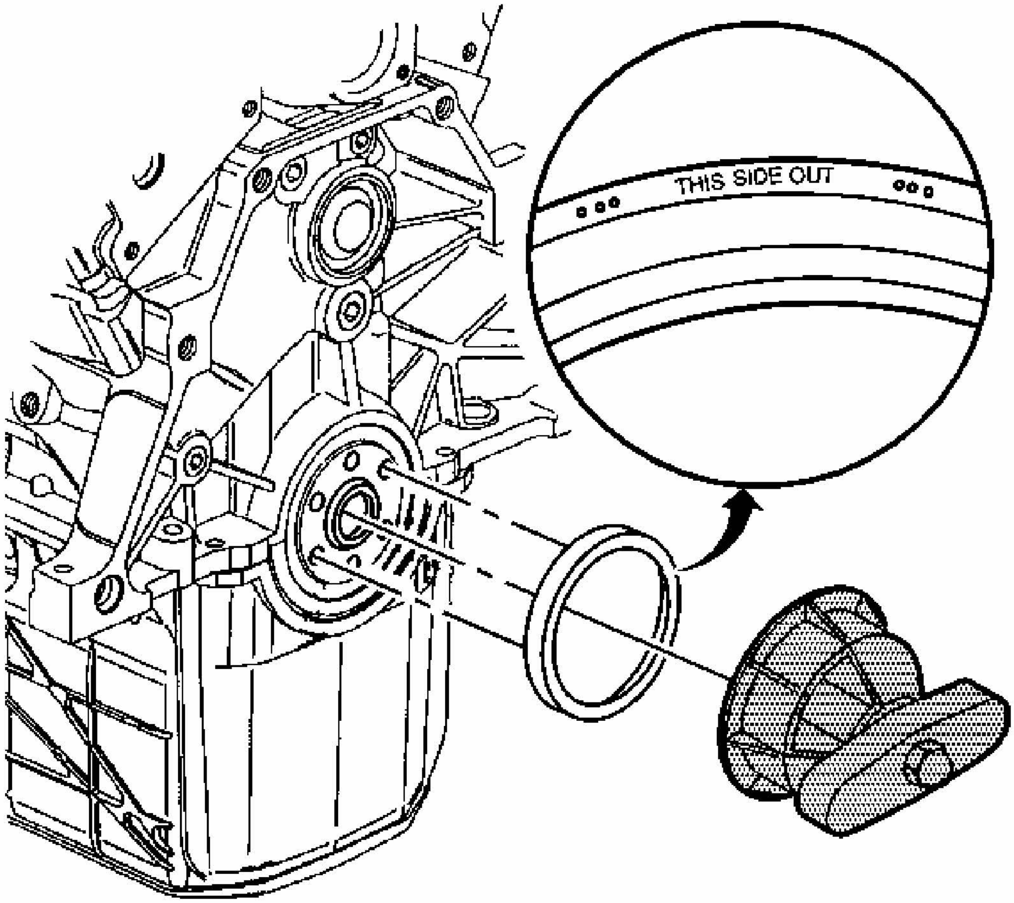


Fig. 202: Installing Crankshaft Rear Oil Seal

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Notice the direction of the rear oil seal. The new design seal is a reverse style as opposed to what has been used in the past. "THIS SIDE OUT" has been stamped into the seal, as shown in the graphic.

1. Carefully remove the protection sleeve from the NEW crankshaft rear oil seal.
2. Install the crankshaft rear oil seal onto the **J 34686** by sliding the crankshaft rear oil seal over the mandrel using a twisting motion until the back of the crankshaft rear oil seal bottoms squarely against the collar of the tool.
3. Perform the following steps in order to install the crankshaft rear oil seal:
    1. Align the dowel pin of the **J 34686** with the dowel pin in the crankshaft.
    2. Attach the **J 34686** to the crankshaft by hand, or tighten the attaching screws to 5 N.m (45 lb in).
    3. Turn the T-handle of the **J 34686** in order to engage and allow the collar to push the seal into the bore. Turn the handle until the collar is tight against the engine block. Ensure that the seal is seated properly.
    4. Loosen the T-handle until the handle comes to a stop.
    5. Remove the attaching screws.
4. Install the engine flywheel. Refer to **Engine Flywheel Replacement** .

CAMSHAFT REAR BEARING HOLE PLUG REPLACEMENT

Removal Procedure

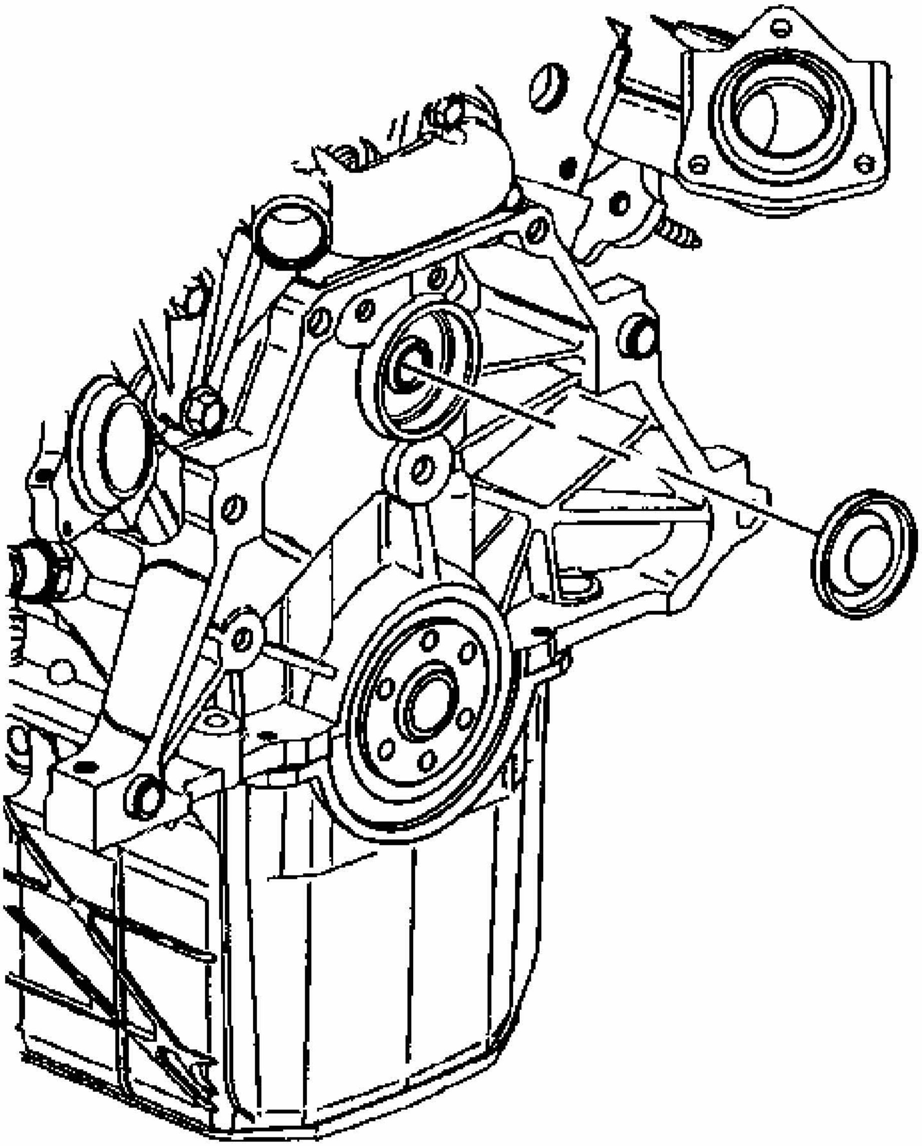


Fig. 203: View Of Camshaft Rear Bearing Hole Plug
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine flywheel. Refer to **Engine Flywheel Replacement** .
2. Remove the camshaft rear bearing hole plug.

Installation Procedure

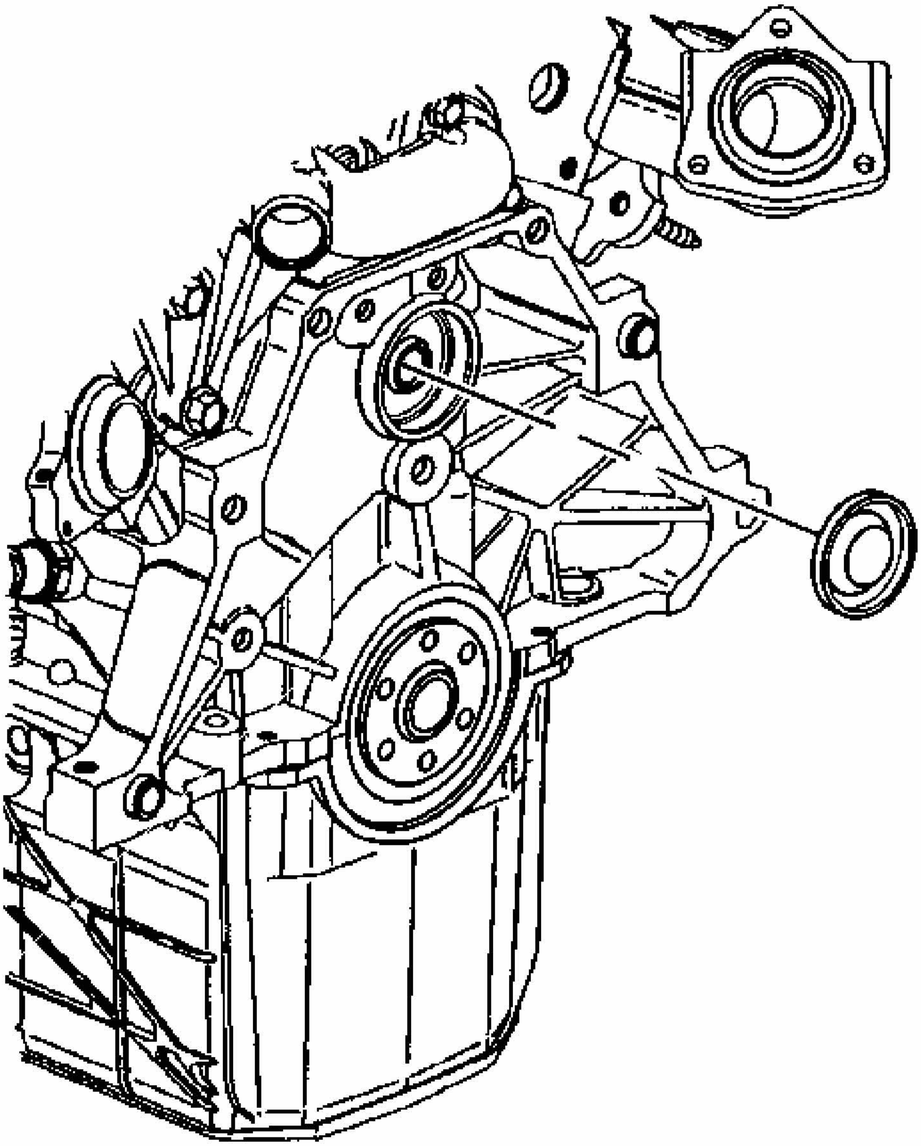


Fig. 204: View Of Camshaft Rear Bearing Hole Plug
Courtesy of GENERAL MOTORS CORP.

1. Coat the camshaft rear bearing hole plug with sealer GM P/N 12377901 (Canadian P/N 10953504) or equivalent.
2. Install the camshaft rear bearing hole plug.

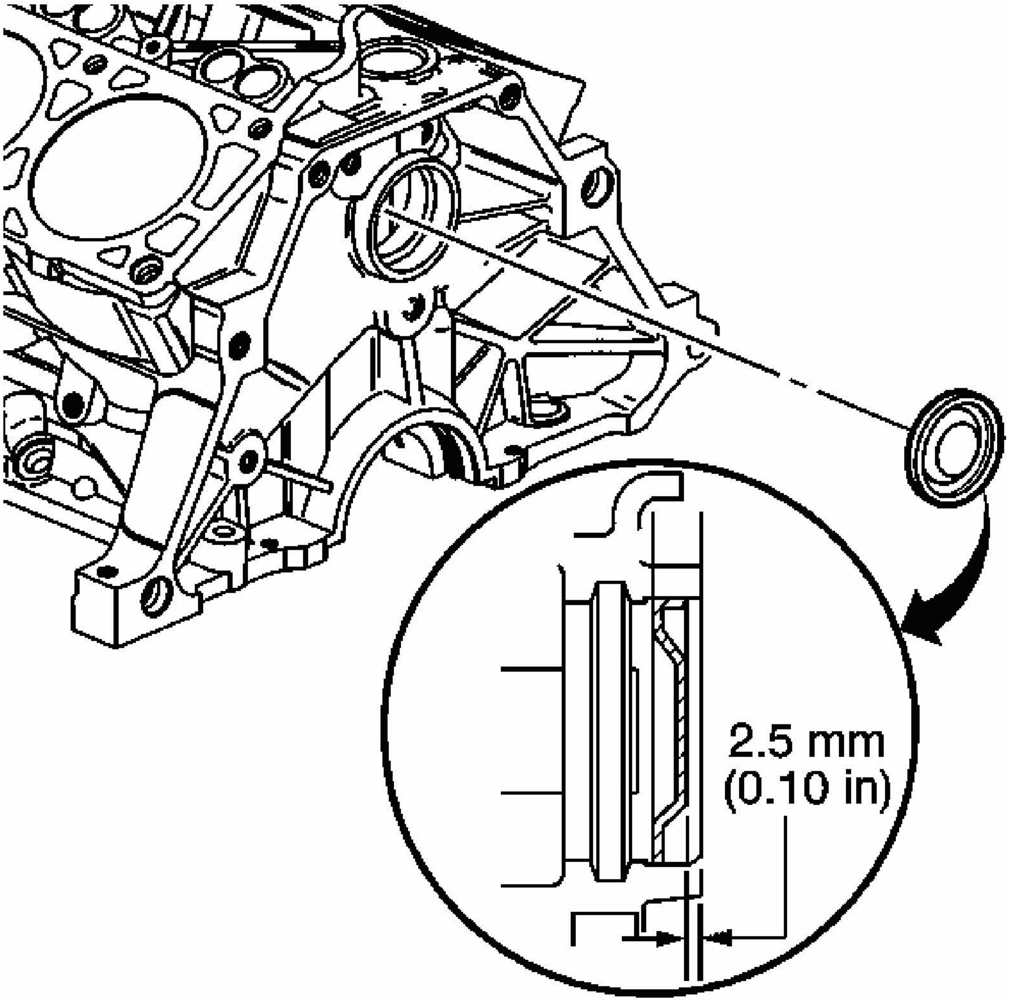


Fig. 205: Identifying Camshaft Rear Bearing Hole Plug Installation Depth
Courtesy of GENERAL MOTORS CORP.

3. Ensure that the camshaft rear bearing plug is installed to specifications.
4. Install the engine flywheel. Refer to **Engine Flywheel Replacement** .

ENGINE REPLACEMENT

Removal Procedure

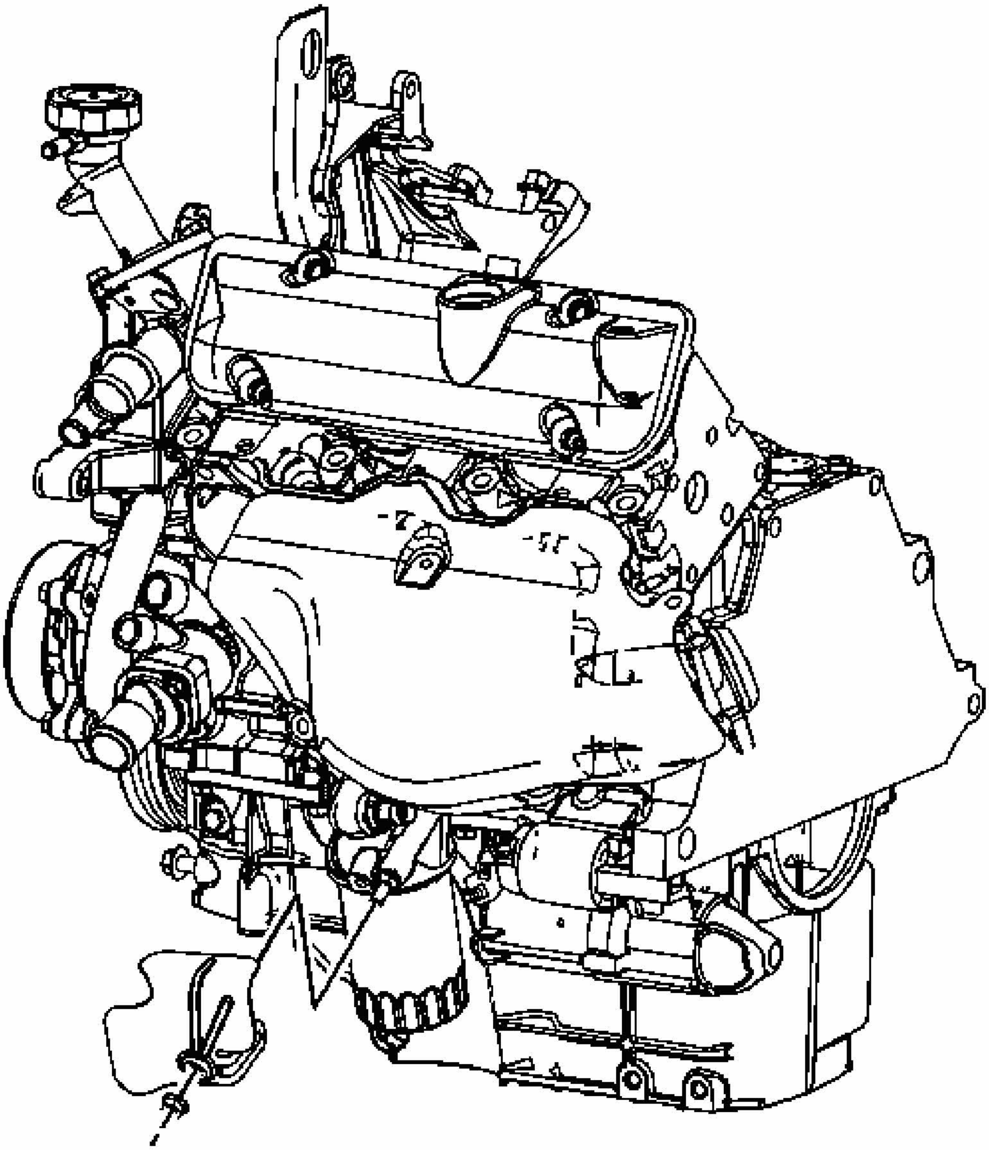


Fig. 206: Locating Oil Pressure Sensor Heat Shield & Nut
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .
2. Remove the hood. Refer to **Hood Replacement** .
3. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

4. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
5. Remove the engine mount struts. Refer to **Engine Mount Strut Replacement**.
6. Remove the drive belt. Refer to **Drive Belt Replacement**.
7. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
8. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
9. Remove the oil pressure sensor heat shield nuts and shield.

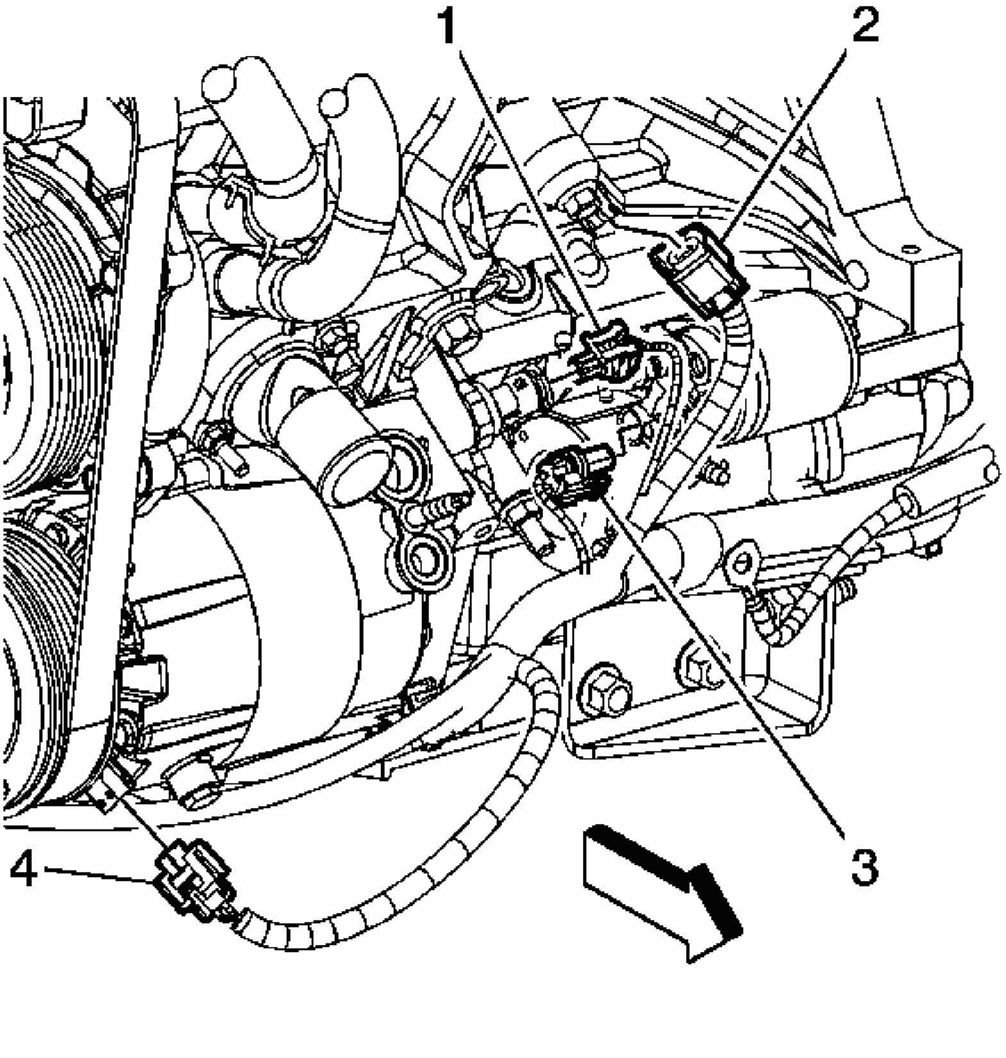


Fig. 207: Locating Oil Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

10. Disconnect the oil pressure sensor electrical connector (1).
11. Disconnect the knock sensor electrical connector (2).
12. Disconnect the starter motor electrical connector (3).
13. Disconnect the air conditioning (A/C) compressor electrical connector (4).

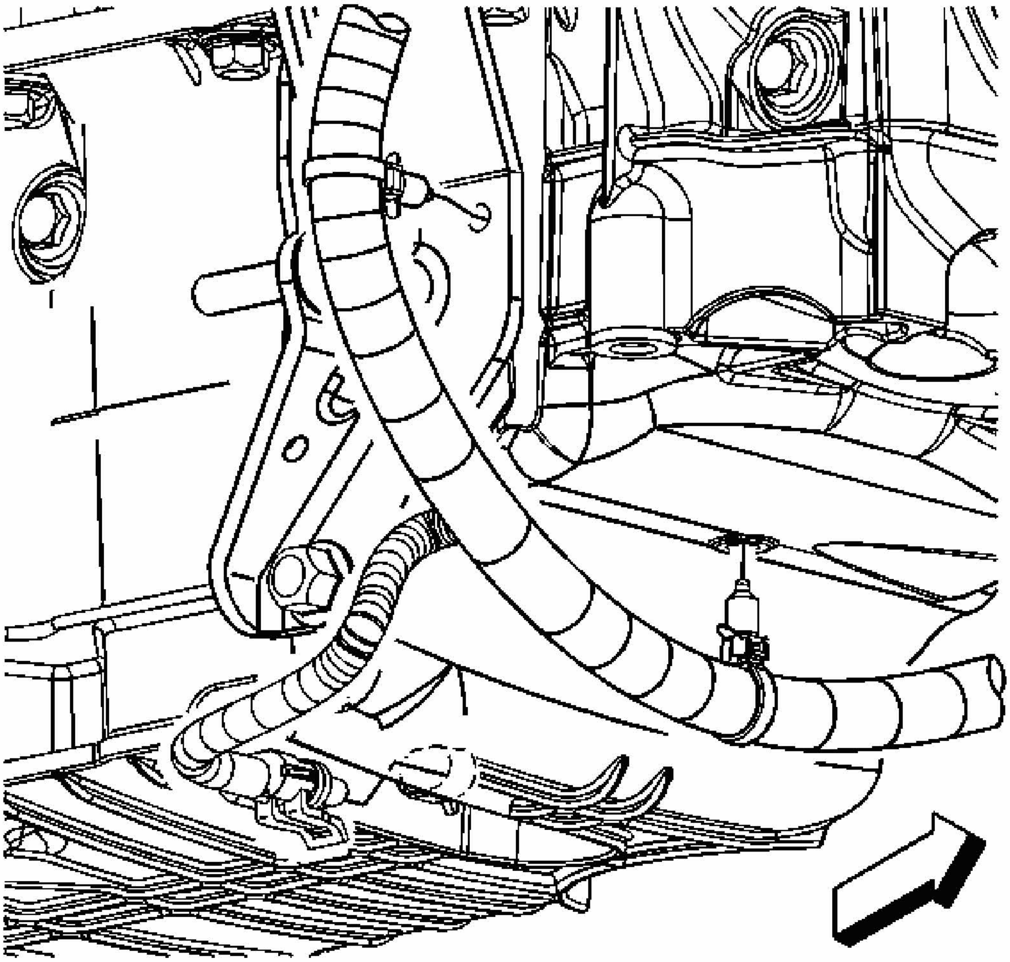


Fig. 208: Locating Engine Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

14. Disconnect the oil level sensor electrical connector.
15. Remove the engine harness clips from the transaxle brace and the oil pan.
16. Lower the vehicle.

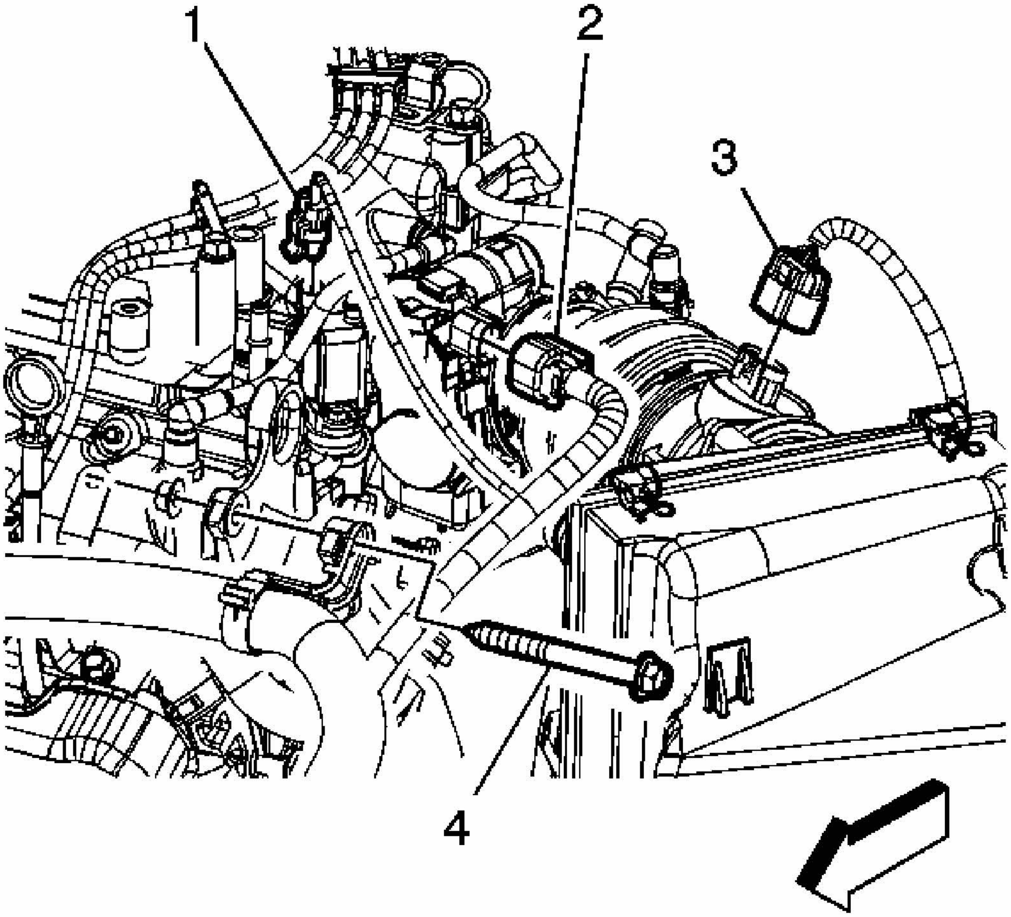


Fig. 209: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

17. Disconnect the evaporative emission (EVAP) canister purge solenoid electrical connector (1).
18. Disconnect the electronic throttle control (ETC) electrical connector (2).

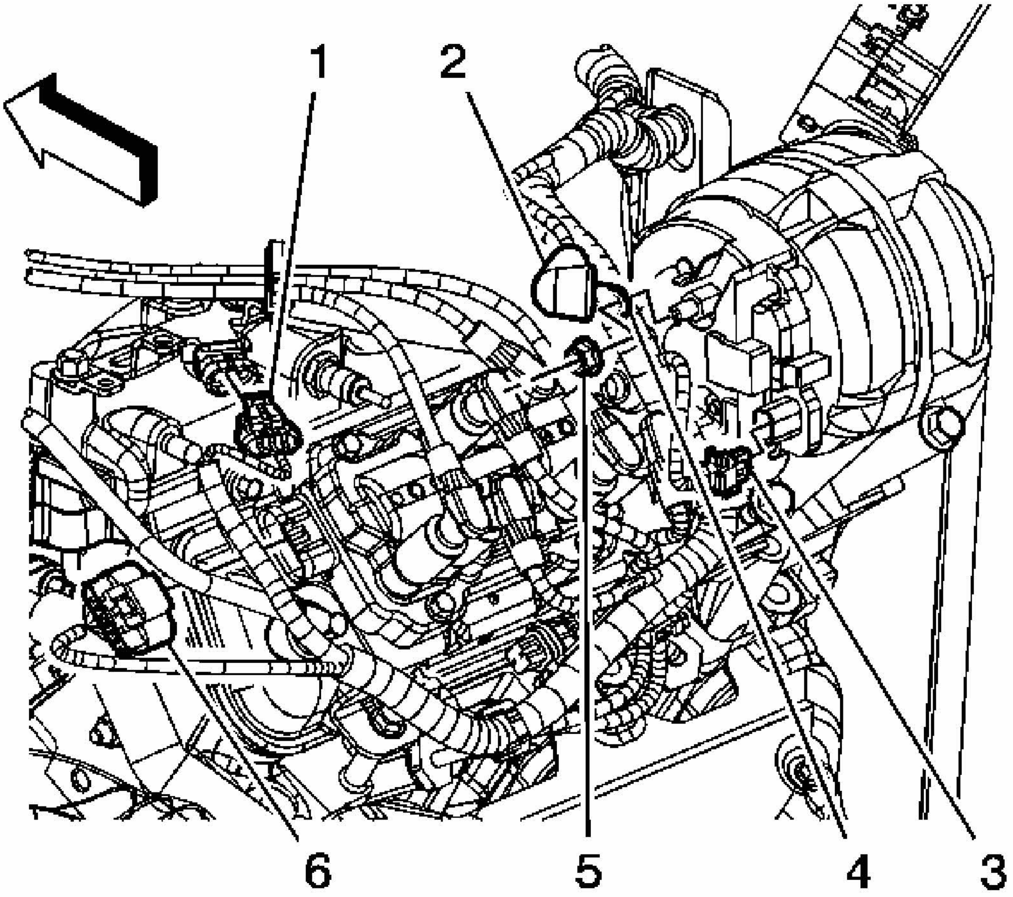


Fig. 210: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

19. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).
20. Reposition the generator terminal boot (2).
21. Remove the generator terminal nut (5).
22. Remove the generator terminal (4) from the stud.
23. Disconnect the generator electrical connector (3).
24. Disconnect the ignition coil electrical connector (6).

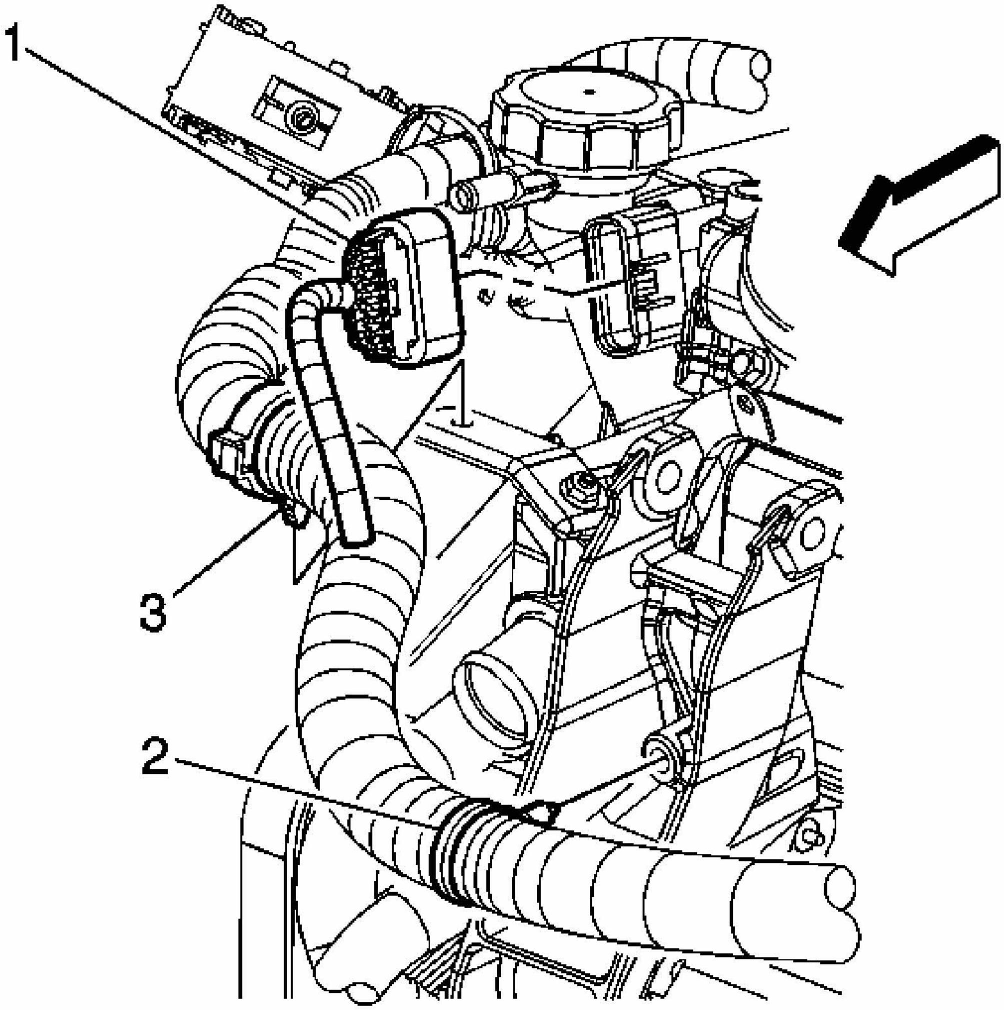


Fig. 211: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

25. Disconnect the fuel injector inline (1) electrical connector.
26. Remove the engine harness clips (2, 3) from the brackets.

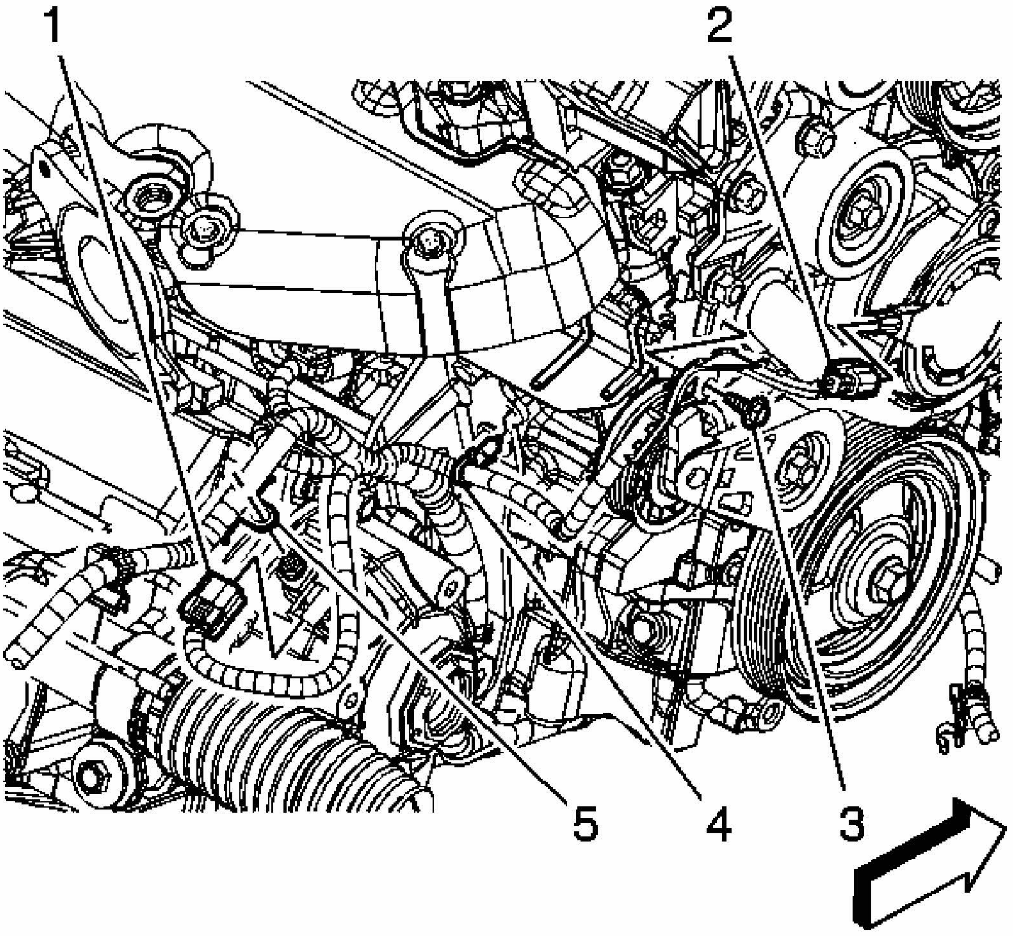


Fig. 212: Locating Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

27. Disconnect the camshaft phasor sensor electrical connector (2).
28. Remove the engine harness clip bolt (3).
29. Remove the engine harness clip (4) from the transaxle bracket.

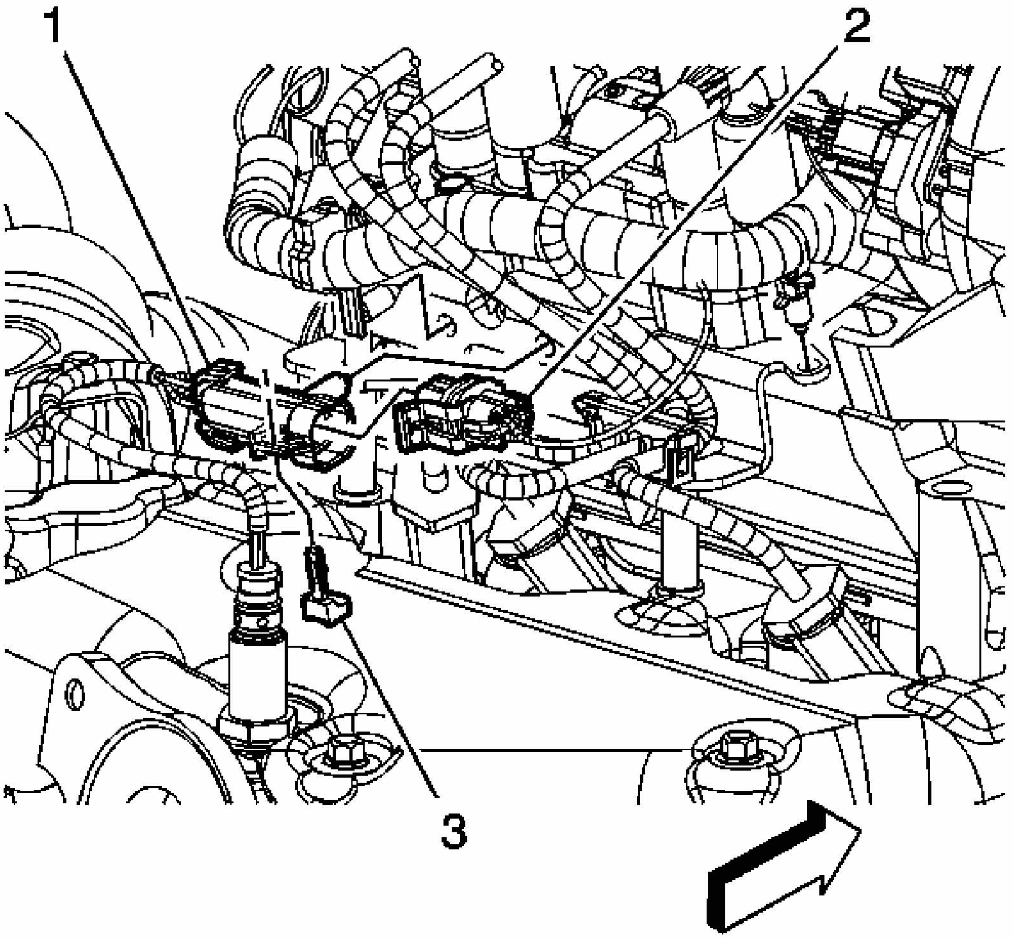


Fig. 213: Identifying The HO2S Electrical Connector
Courtesy of GENERAL MOTORS CORP.

30. Remove the connector position assurance (CPA) retainer (3).
31. Disconnect the rear upper heated oxygen sensor (HO2S) electrical connector (2).

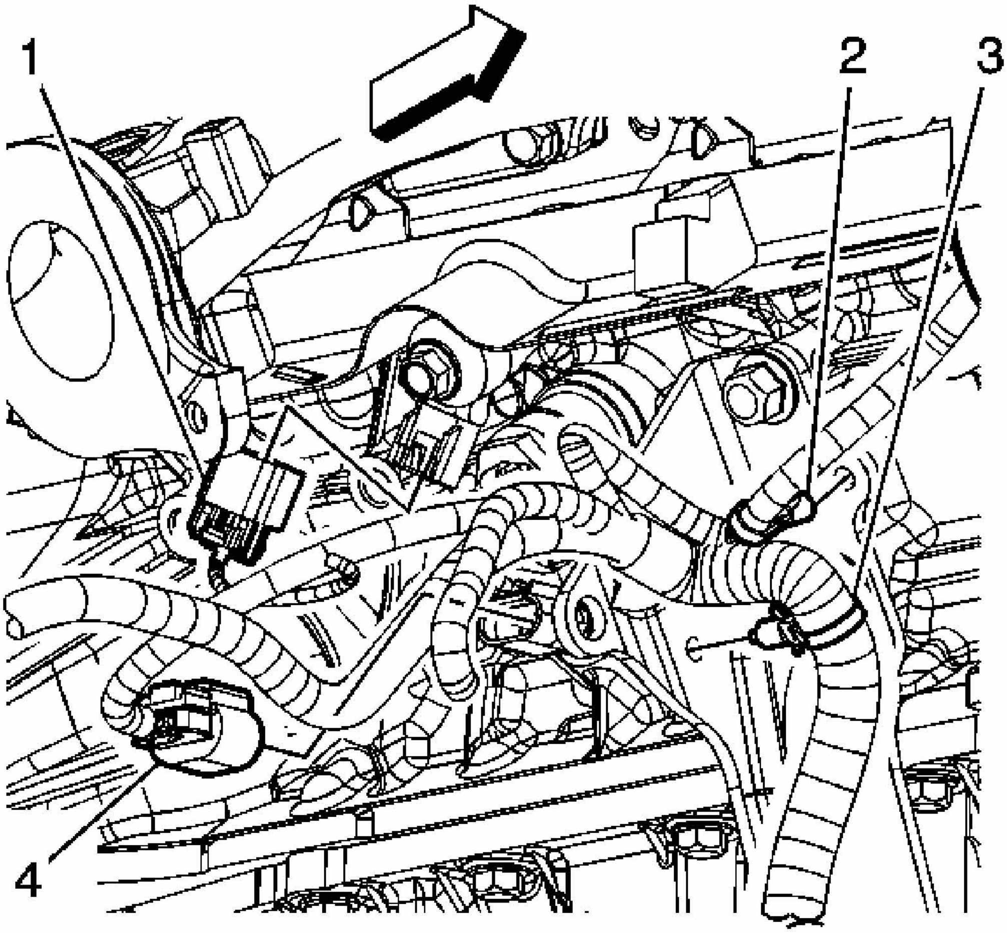


Fig. 214: Locating CKP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

32. Disconnect the knock sensor electrical connector (1).
33. Disconnect the crankshaft position (CKP) sensor electrical connector (4).
34. Remove the engine harness clips (2, 3) from the transaxle brace.

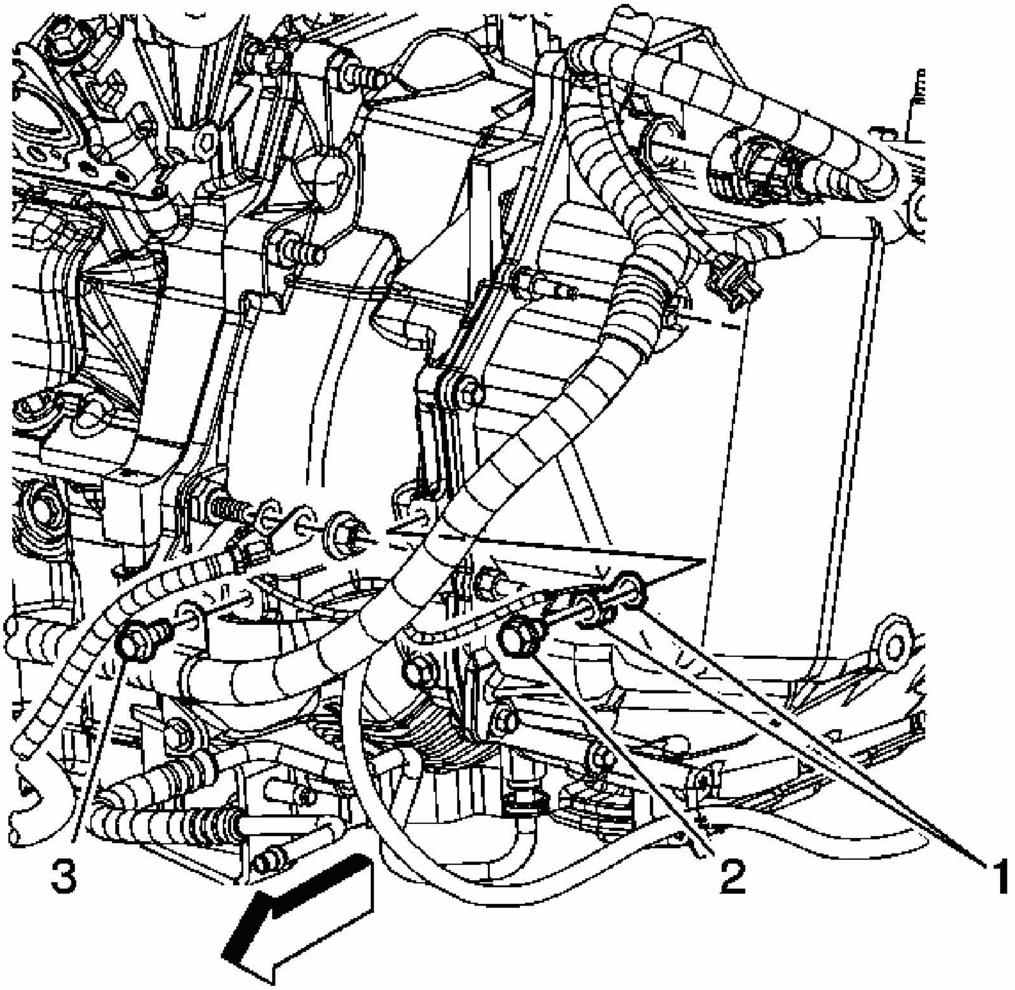


Fig. 215: View Of Engine Harness Ground Bolt
Courtesy of GENERAL MOTORS CORP.

35. Remove the engine harness ground bolt (2).
36. Remove the engine harness ground terminals (1) from the transmission.
37. Remove the engine harness clip bolt (3) from the transmission.
38. Reposition all branches of the engine harness out of the way.
39. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)** .

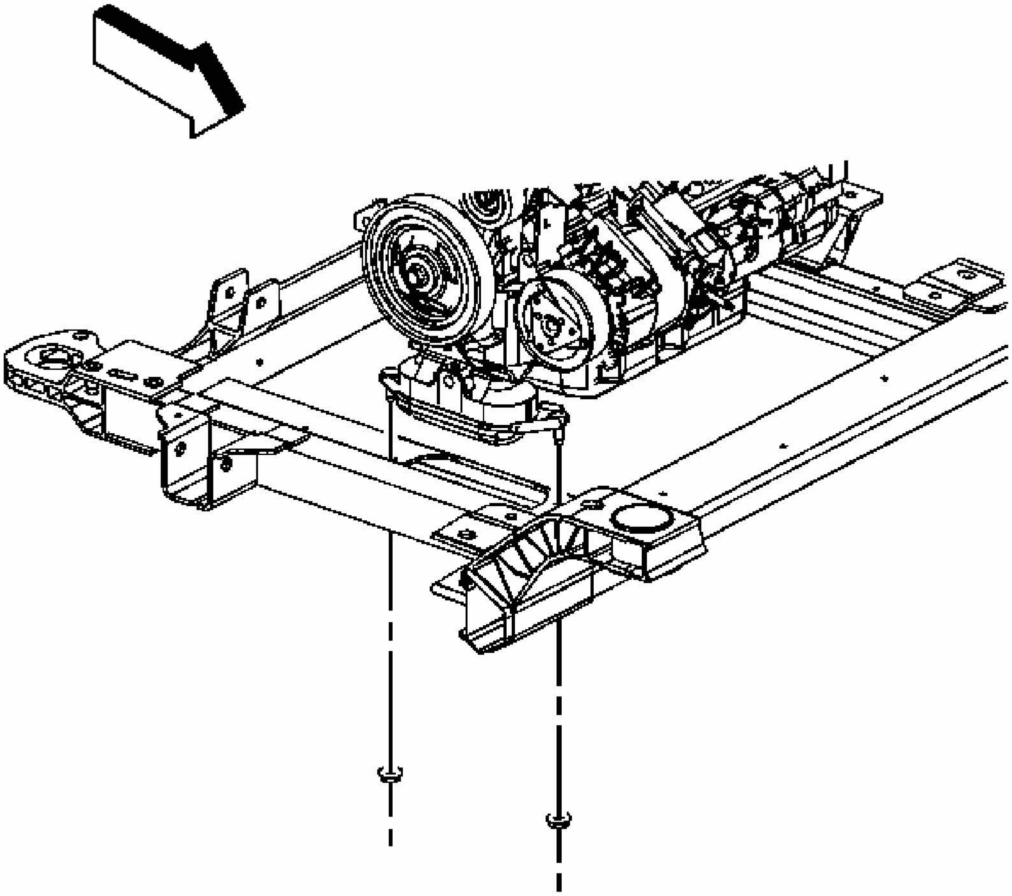


Fig. 216: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

40. Remove the engine mount lower nuts.

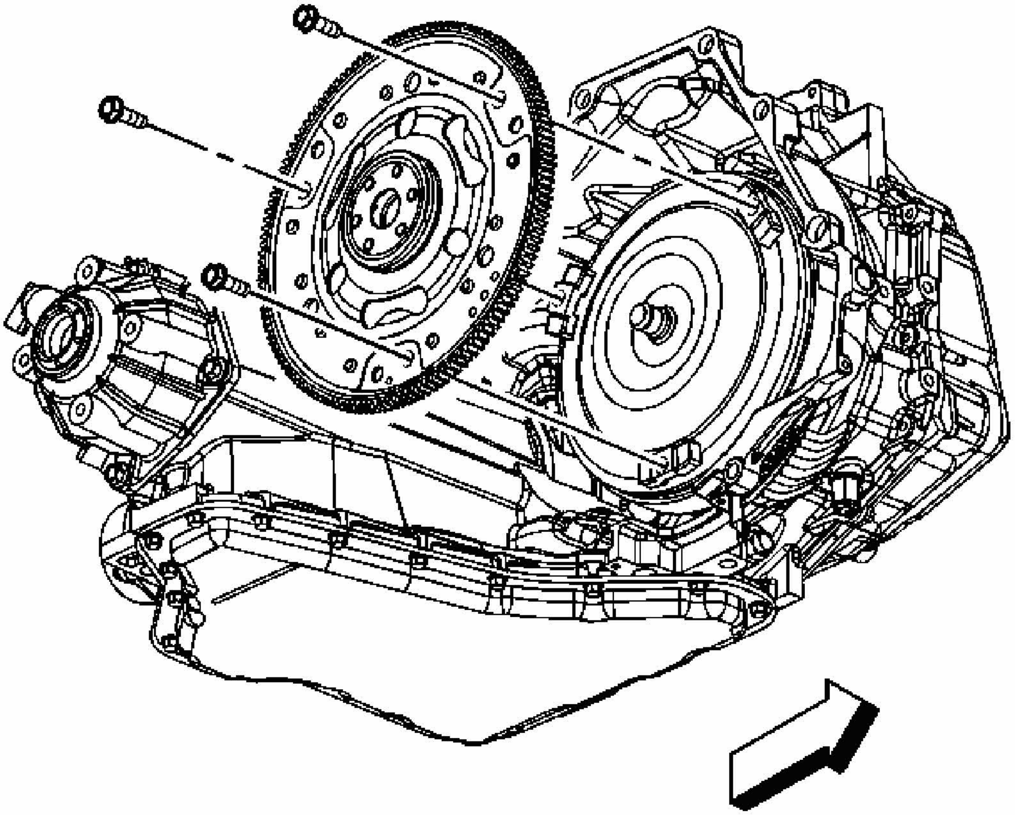


Fig. 217: Locating Torque Converter Bolts
Courtesy of GENERAL MOTORS CORP.

41. Remove the torque converter cover. Refer to **Torque Converter Cover Replacement** .
42. Remove the starter motor. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)** .
43. Remove the torque converter bolts.

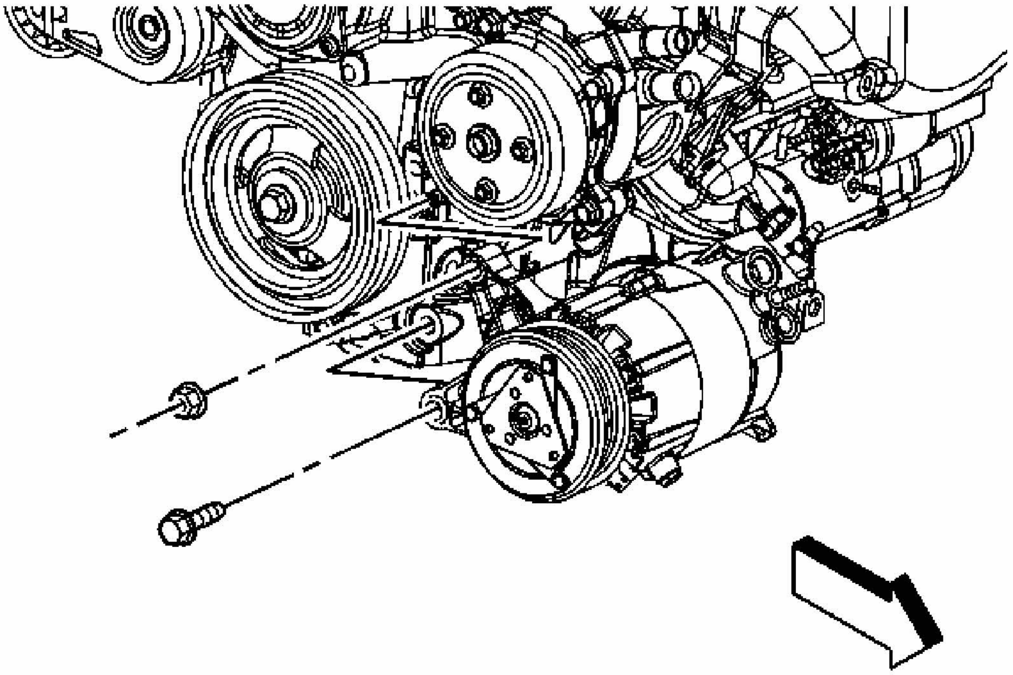


Fig. 218: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

44. Remove the A/C compressor front bolt and nut.

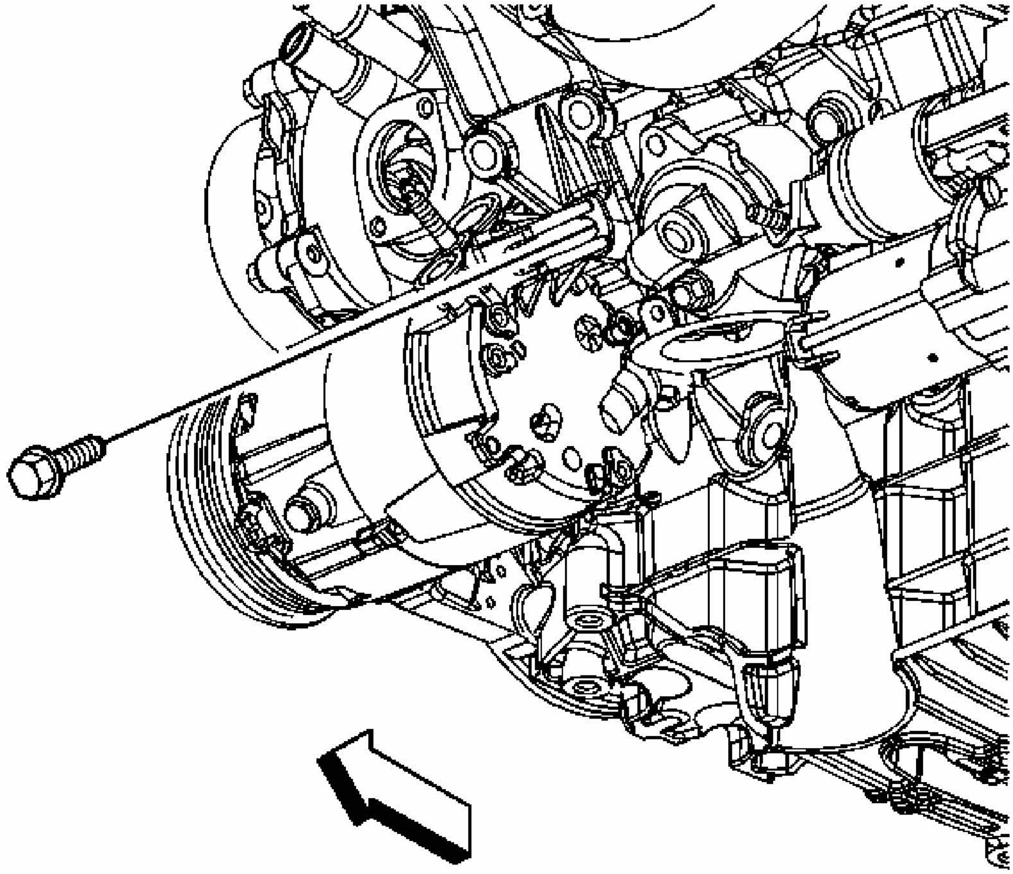


Fig. 219: Locating A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

45. Remove the A/C compressor rear bolt and reposition the compressor off to the side. DO NOT discharge the A/C system.

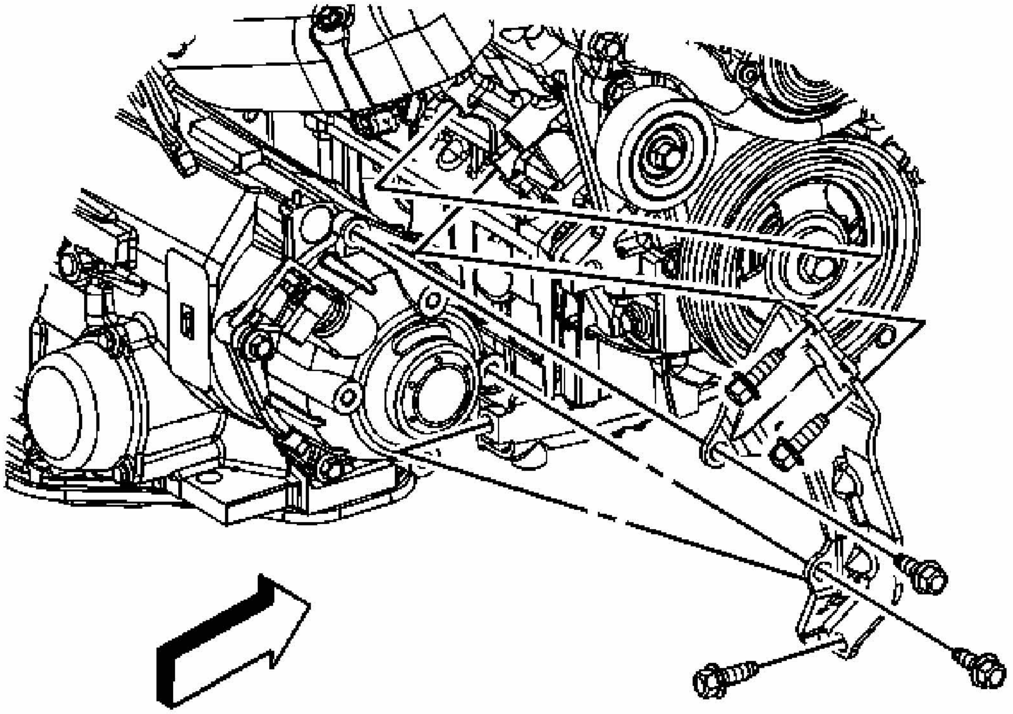


Fig. 220: Locating Rear Transaxle Brace To Engine/Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

46. Remove the transaxle brace to transaxle bolts.
47. Remove the transaxle brace to engine bolts.
48. Remove the transaxle brace.

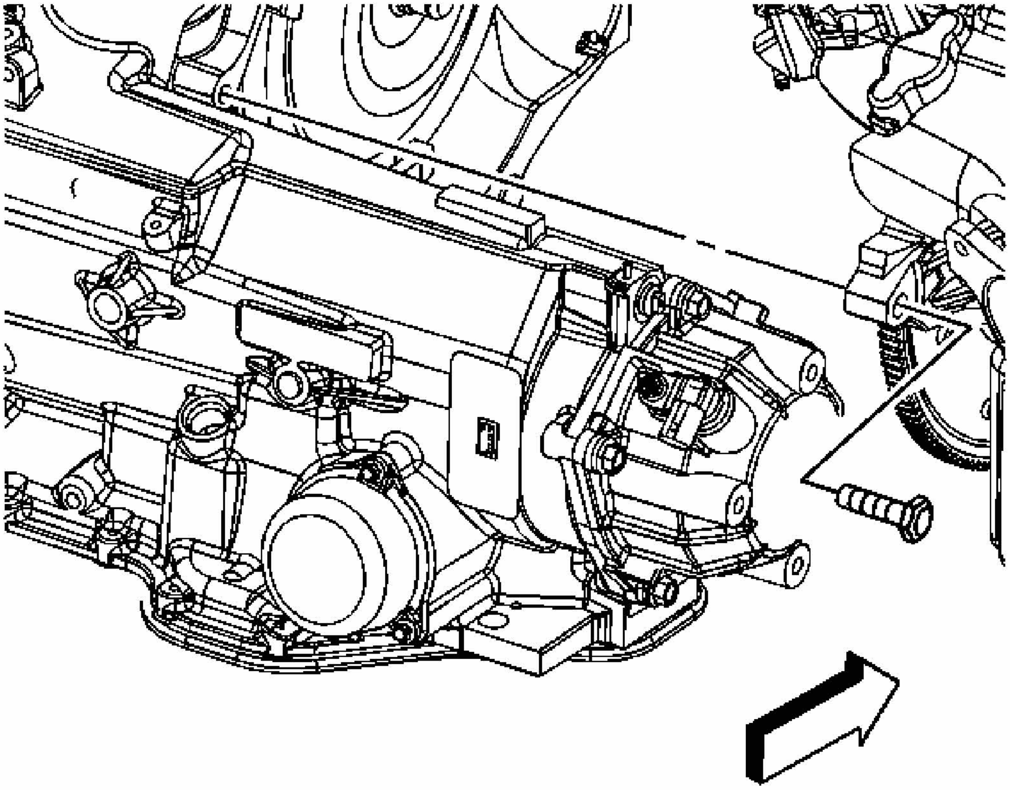


Fig. 221: View Of Transaxle-To-Engine Lower Rear Bolt
Courtesy of GENERAL MOTORS CORP.

49. Remove the transaxle-to-engine lower rear bolt.

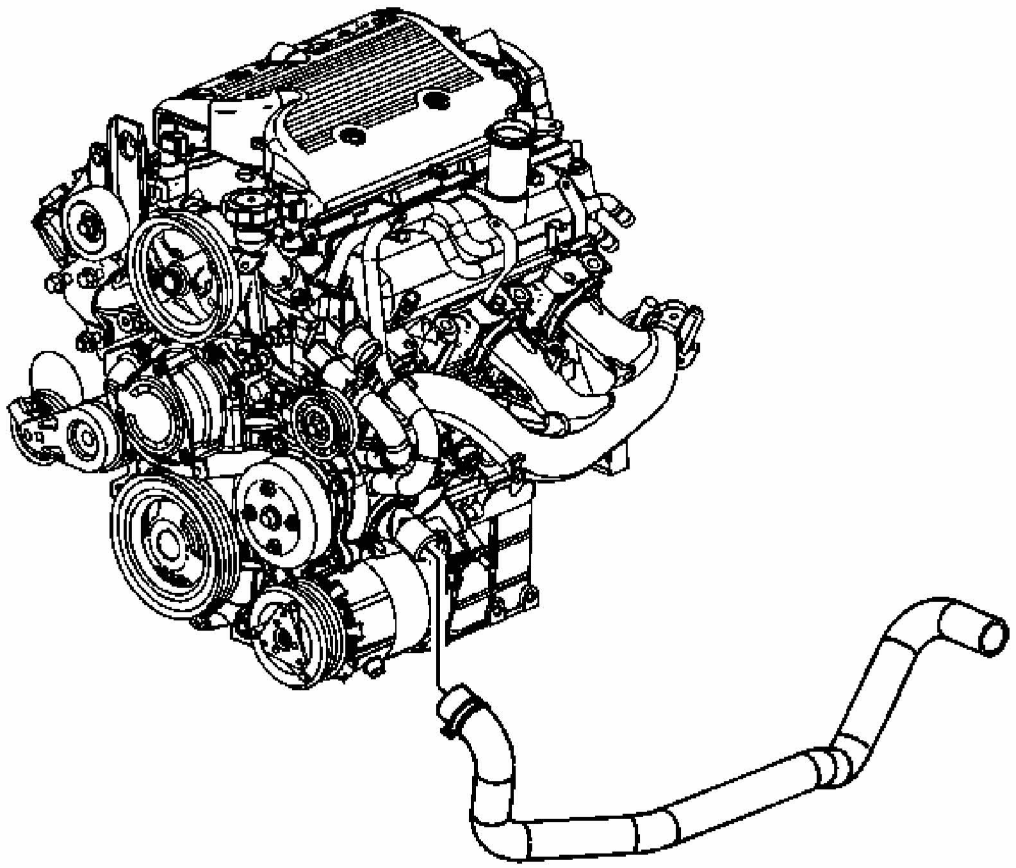


Fig. 222: Identifying Radiator Outlet Hose Clamp & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

50. Reposition the radiator outlet hose clamp at the thermostat housing.
51. Remove the radiator outlet hose from the thermostat housing.
52. Lower the vehicle and support the transaxle.

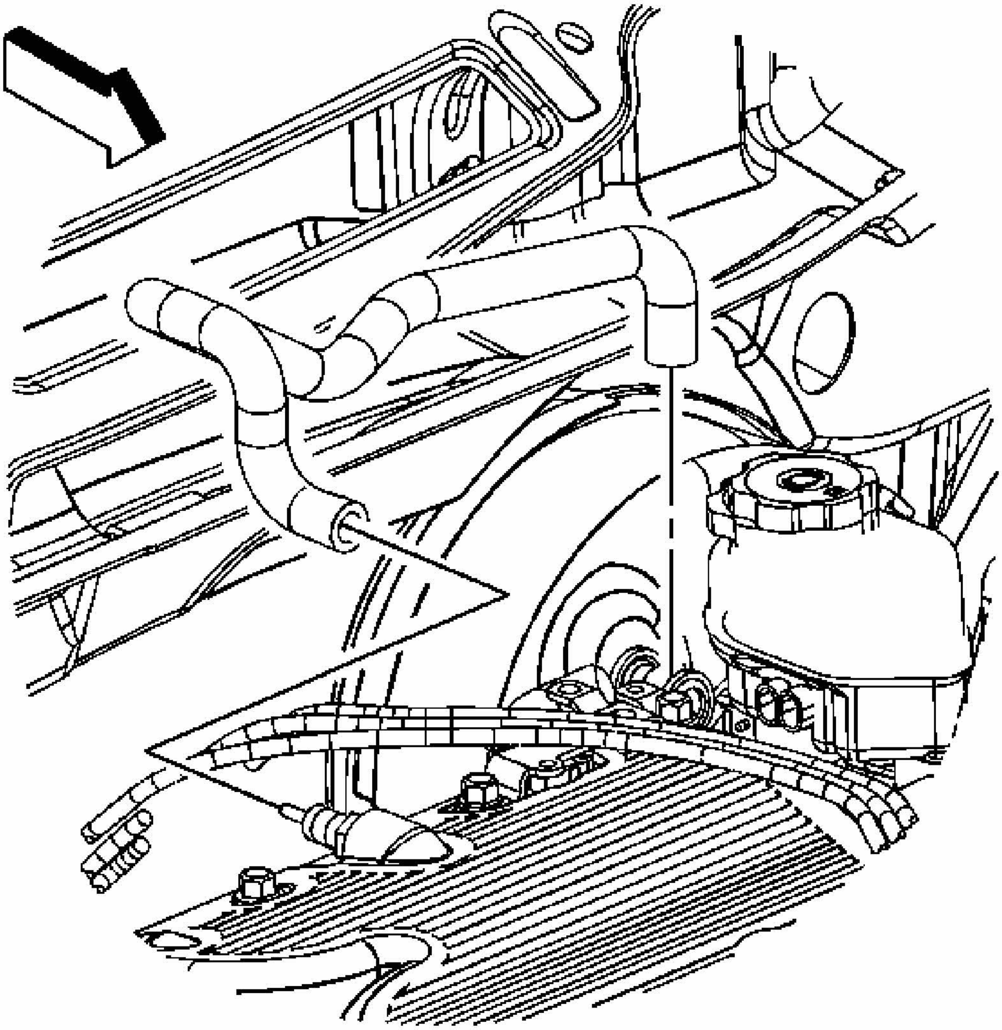


Fig. 223: View Of Brake Booster Vacuum Hose & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

53. Remove the brake booster vacuum hose from the intake manifold.

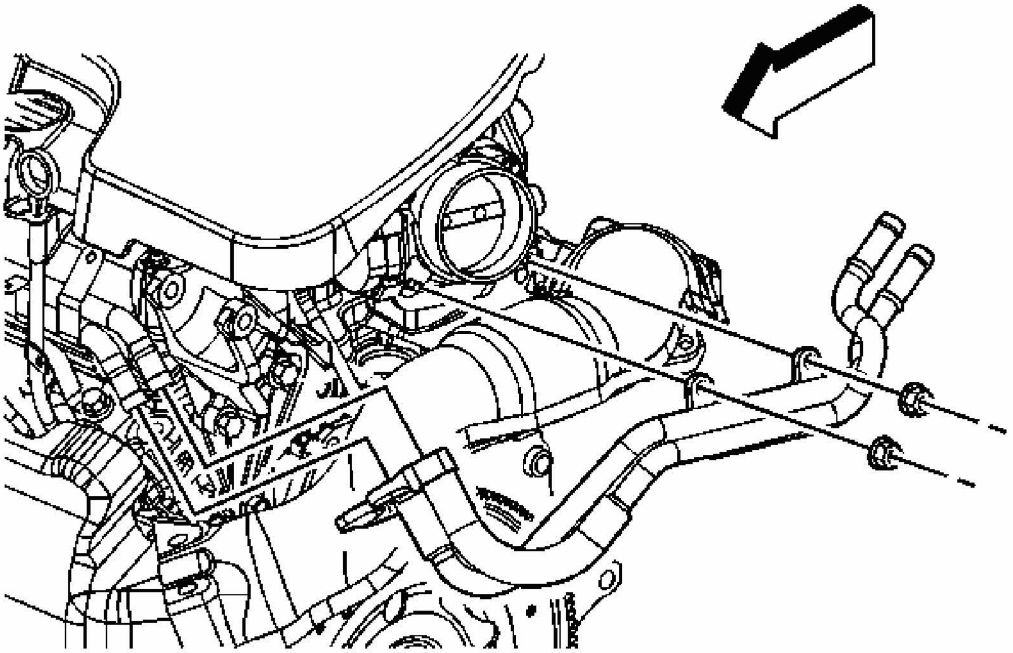


Fig. 224: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

54. Reposition the heater inlet and outlet hose clamps at the engine.
55. Remove the heater inlet and outlet hoses from the engine pipes.
56. Remove the exhaust crossover pipe. Refer to **Exhaust Crossover Pipe Replacement (RPOs LZE/LZ4/LZ9)** or **Exhaust Crossover Pipe Replacement (RPO LS4)** .
57. Disconnect the fuel feed line from the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .
58. Disconnect the EVAP purge line from the canister purge solenoid. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

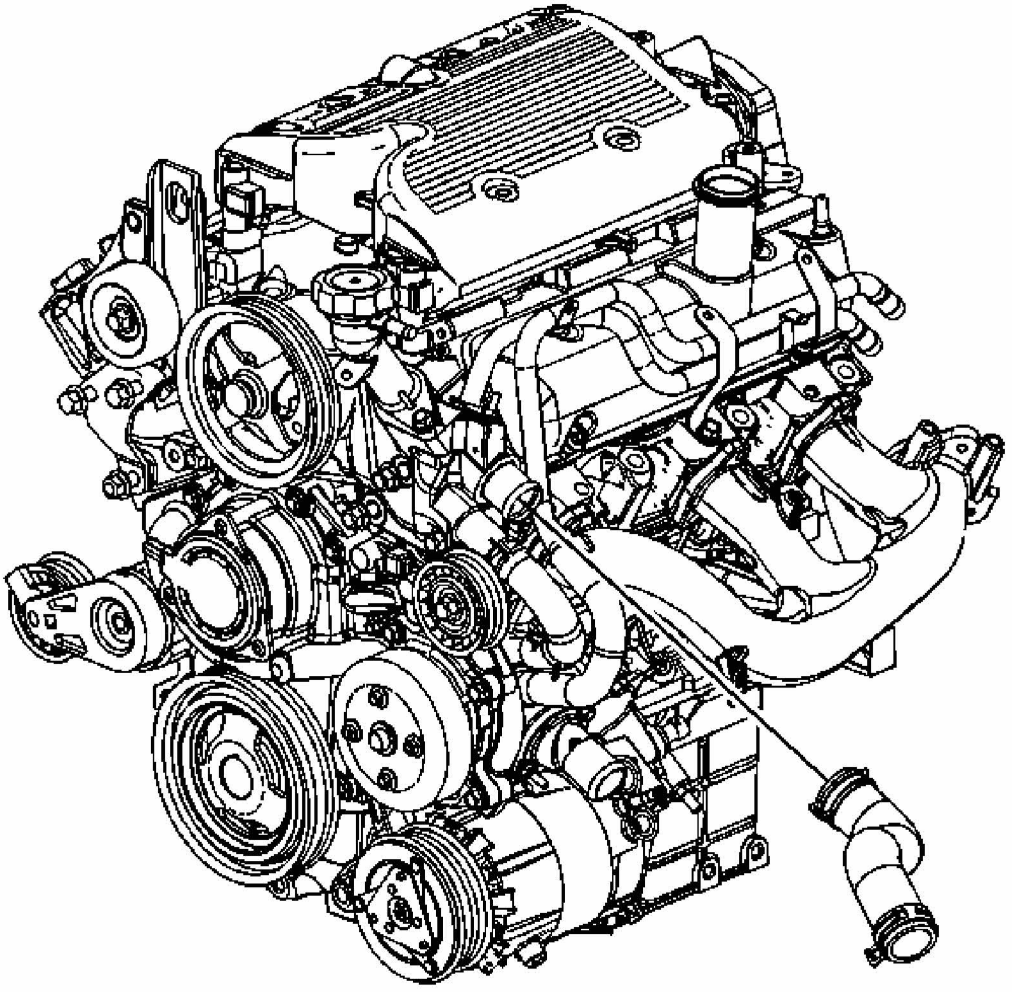


Fig. 225: View Of Radiator Inlet Hose & Crossover Pipe
Courtesy of GENERAL MOTORS CORP.

59. Reposition the radiator inlet hose clamp at the engine.
60. Remove the radiator inlet hose from the engine.

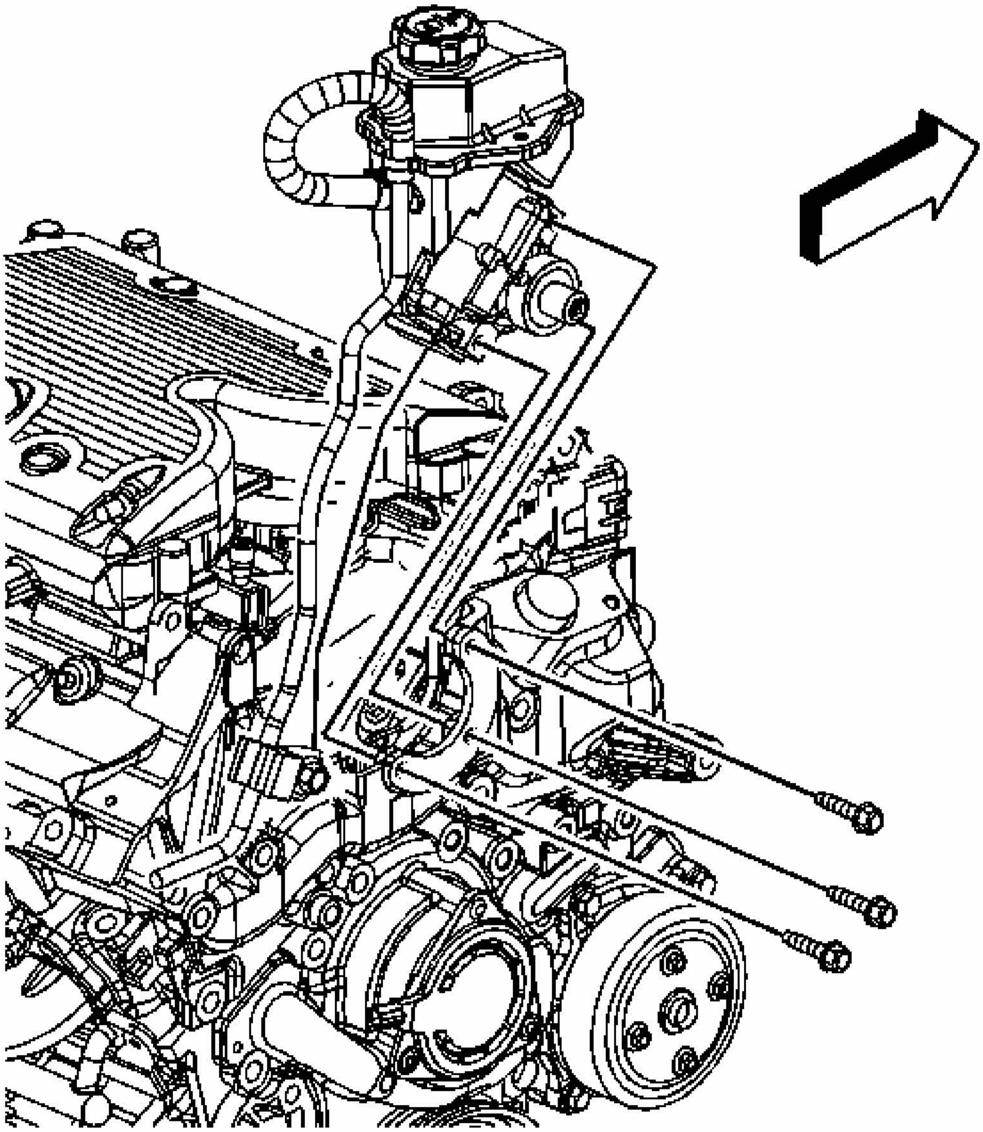


Fig. 226: Power Steering Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

61. Remove the power steering pump bolts and reposition. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)** .
62. Install a engine lifting device to the engine.

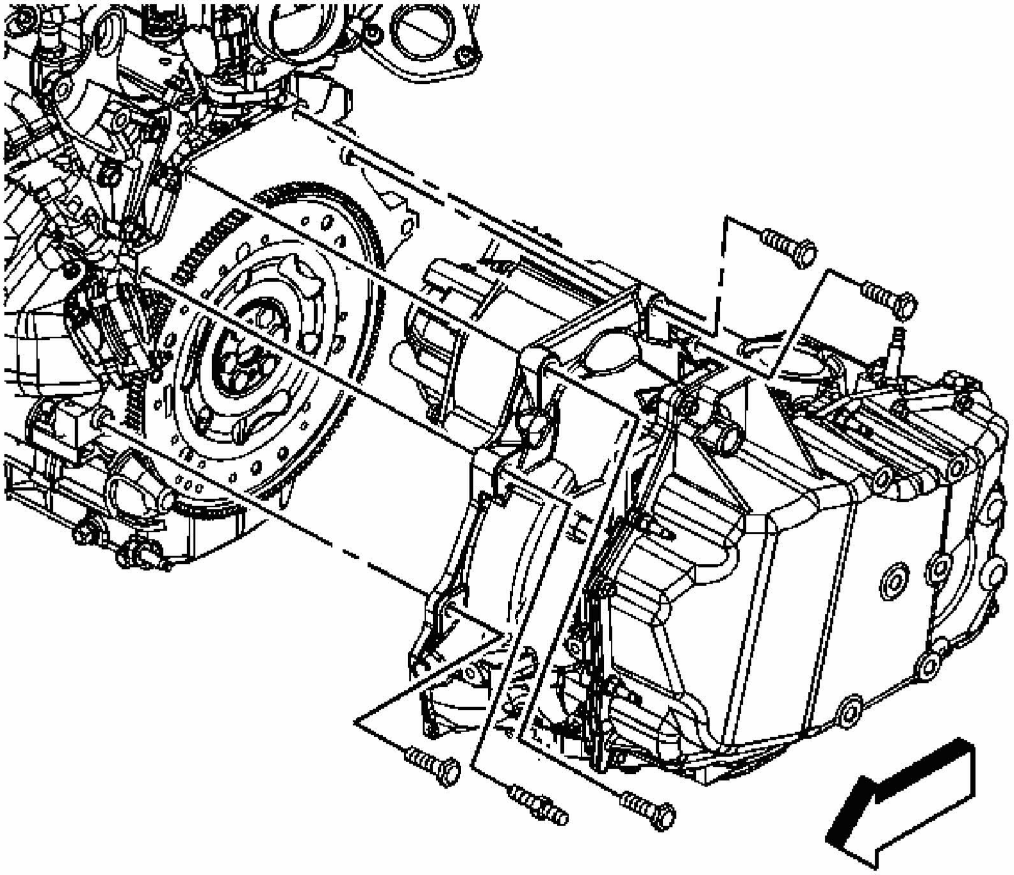


Fig. 227: View Of Transaxle-To-Engine Bolts/Studs
Courtesy of GENERAL MOTORS CORP.

63. Remove the transaxle-to-engine bolts/studs.
64. Remove the engine from the vehicle.
65. Remove the flywheel. Refer to **Engine Flywheel Removal (Automatic Transmission)** or **Engine Flywheel Removal (Manual Transmission)** .
66. Install the engine to a engine stand.

Installation Procedure

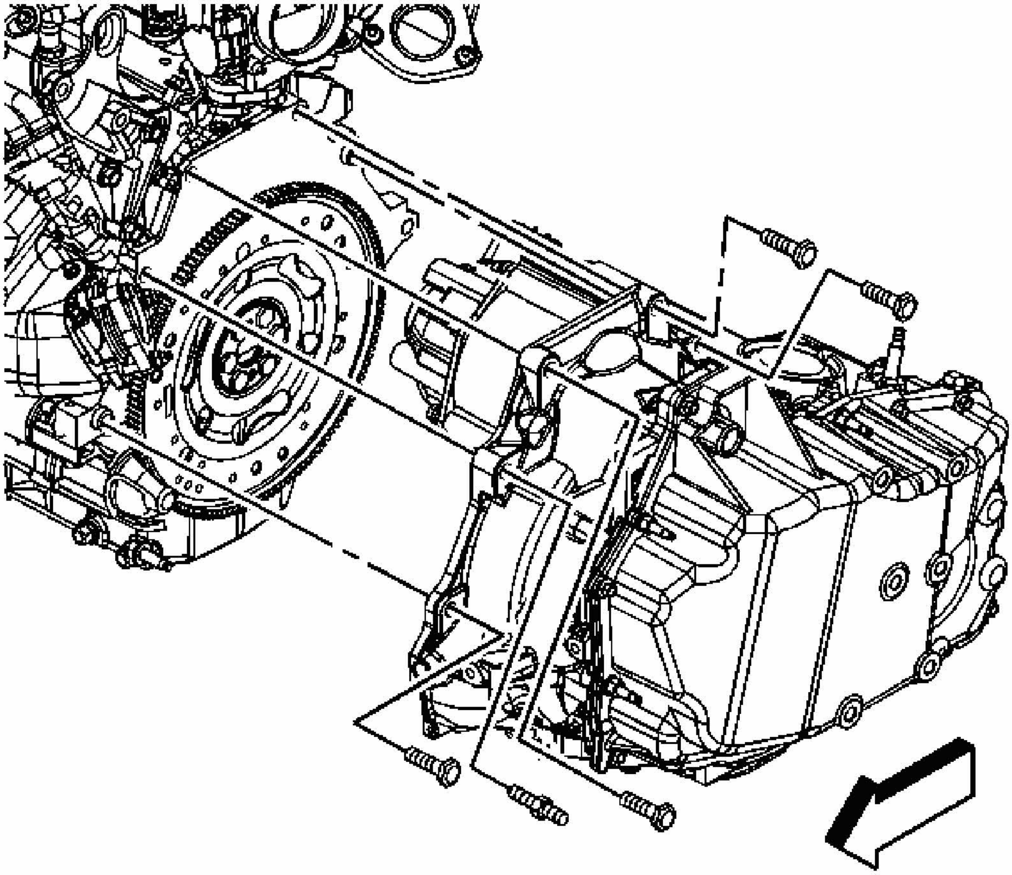


Fig. 228: View Of Transaxle-To-Engine Bolts/Studs
Courtesy of GENERAL MOTORS CORP.

1. Install a engine lifting devise to the engine.
2. Remove the engine from the engine stand.
3. Install the flywheel. Refer to **Engine Flywheel Installation (Automatic Transmission)** or **Engine Flywheel Installation (Manual Transmission)** .
4. Install the engine to the vehicle.

NOTE: **Refer to Fastener Notice .**

5. Install the transaxle-to-engine bolts/studs.

Tighten: Tighten the bolts/stud to 75 N.m (55 lb ft).

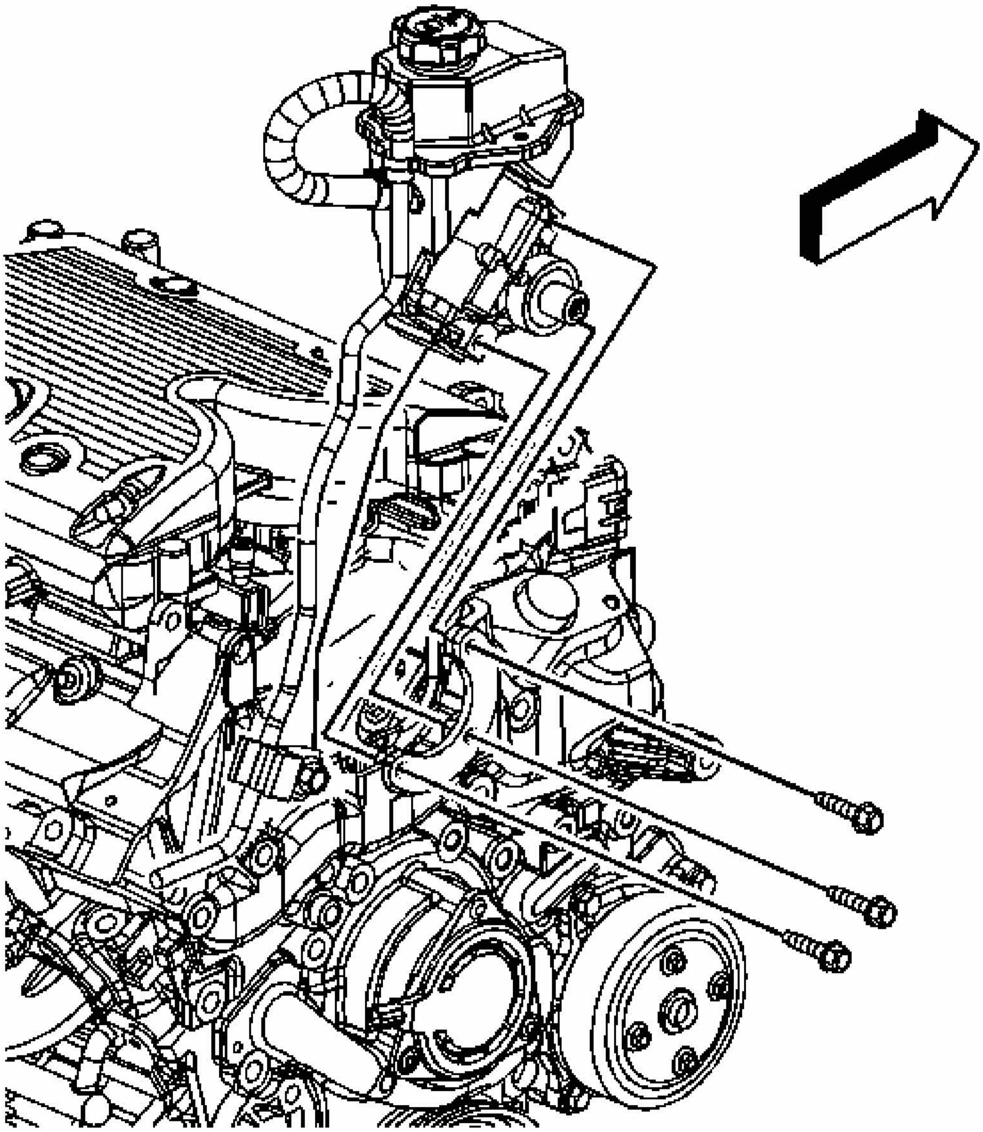


Fig. 229: Power Steering Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine lifting device from the engine.
7. Position and install the power steering pump bolts. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)** .

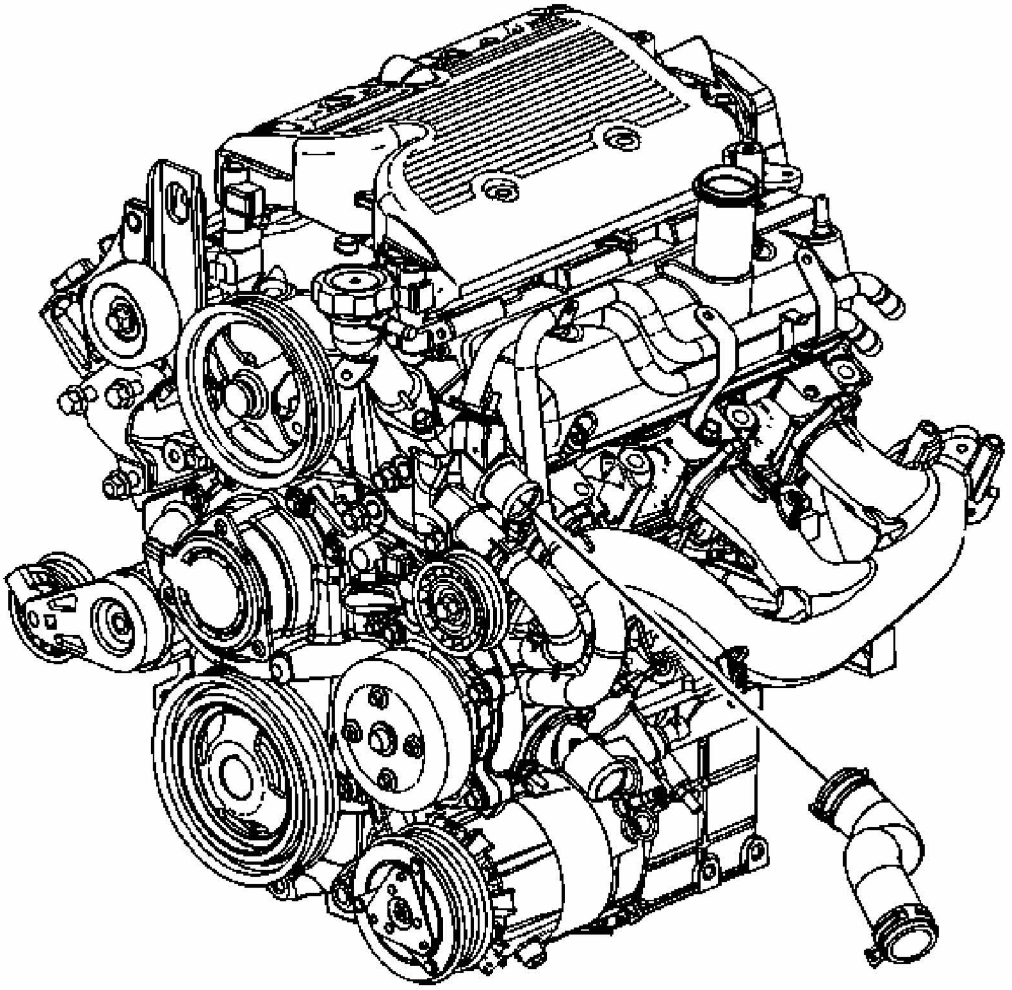


Fig. 230: View Of Radiator Inlet Hose & Crossover Pipe
Courtesy of GENERAL MOTORS CORP.

8. Install the radiator inlet hose to the engine.
9. Position the radiator inlet hose clamp at the engine.

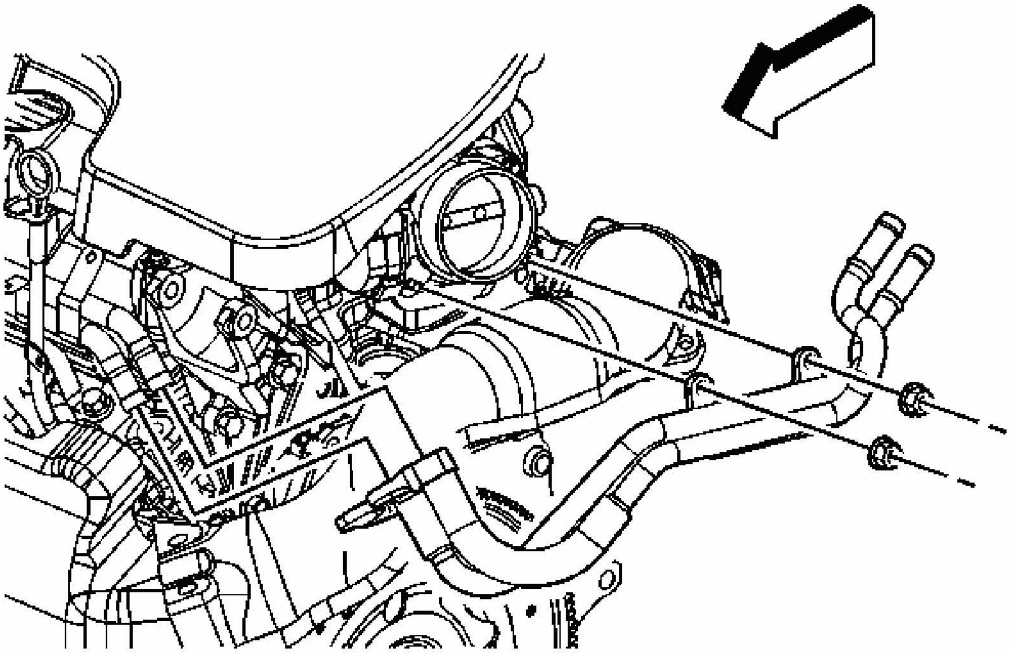


Fig. 231: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

10. Connect the EVAP purge line to the canister purge solenoid. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
11. Connect the fuel feed line to the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .
12. Install the exhaust crossover pipe. Refer to **Exhaust Crossover Pipe Replacement (RPOs LZE/LZ4/LZ9)** or **Exhaust Crossover Pipe Replacement (RPO LS4)** .
13. Install the heater inlet and outlet hoses to the engine pipes.
14. Position the heater inlet and outlet hose clamps at the engine.

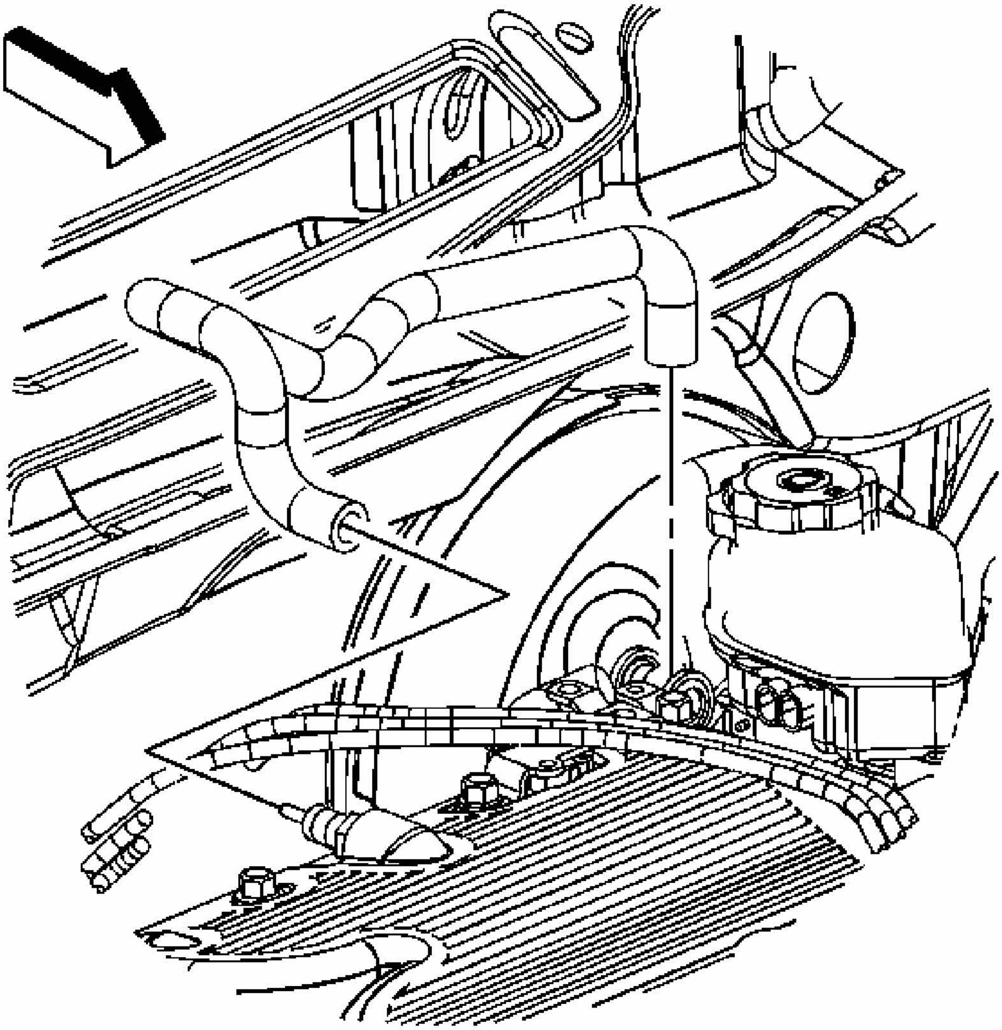


Fig. 232: View Of Brake Booster Vacuum Hose & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

15. Install the brake booster vacuum hose to the intake manifold.

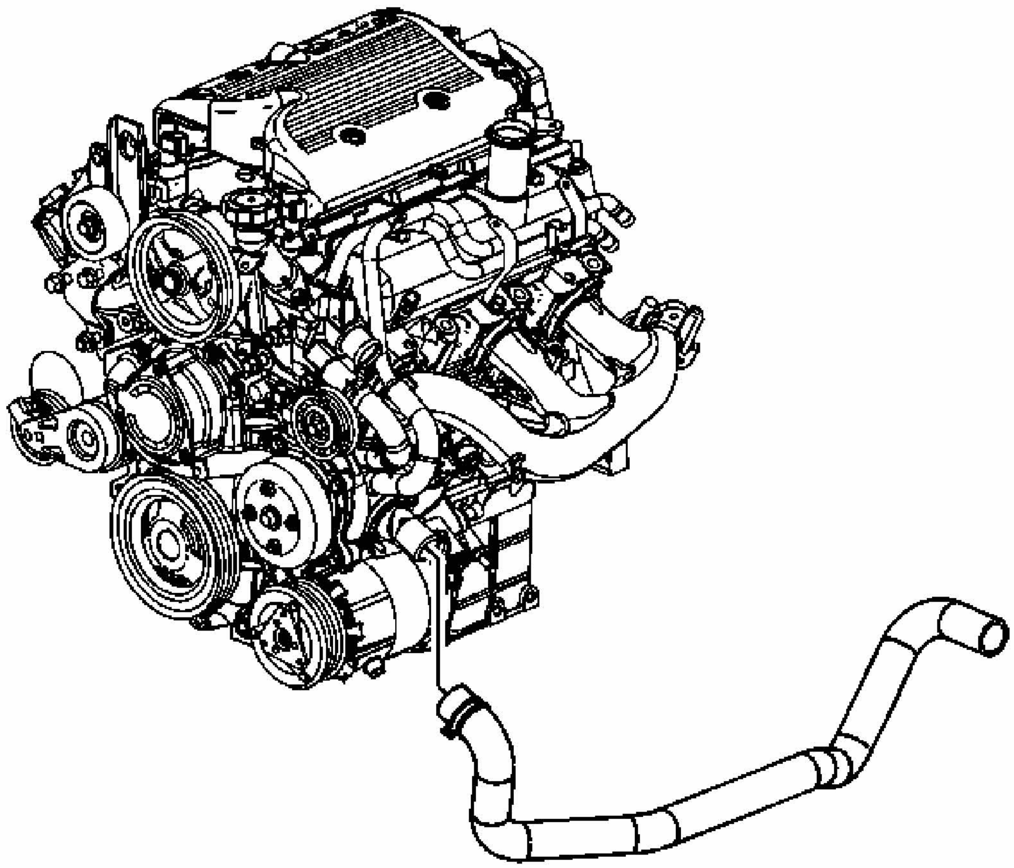


Fig. 233: Identifying Radiator Outlet Hose Clamp & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

16. Install the radiator outlet hose to the thermostat housing.
17. Position the radiator outlet hose clamp at the thermostat housing.
18. Raise and support the vehicle.

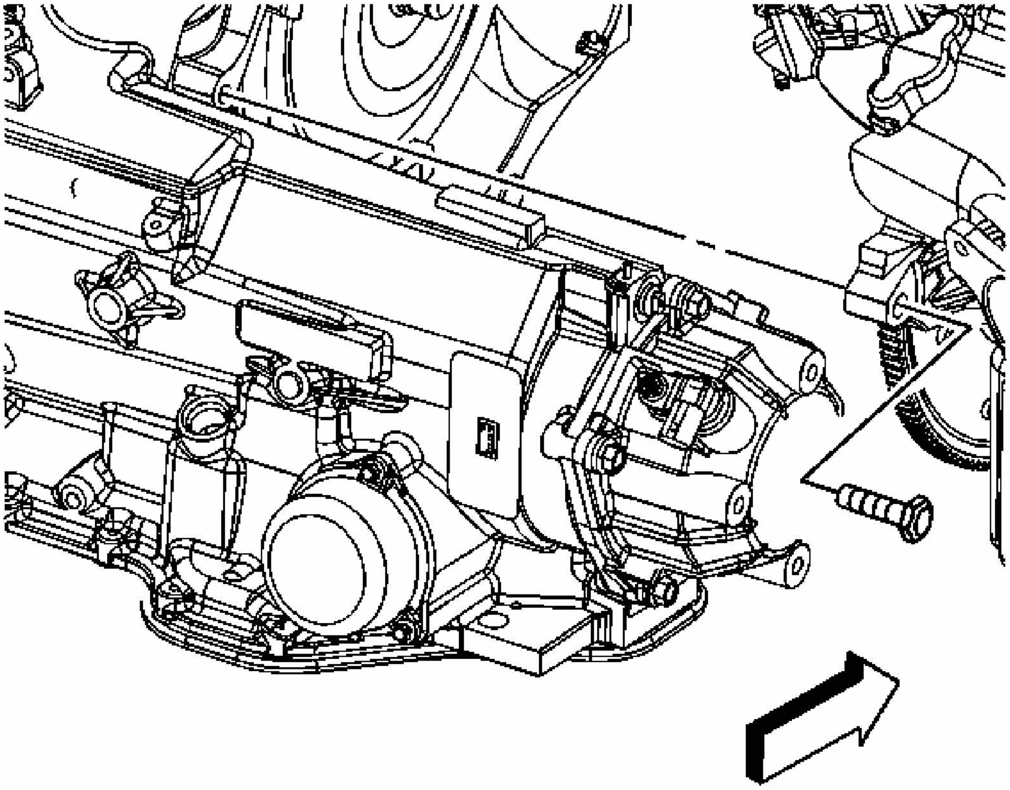


Fig. 234: View Of Transaxle-To-Engine Lower Rear Bolt
Courtesy of GENERAL MOTORS CORP.

19. Install the transaxle-to-engine lower rear bolt.

    Tighten: Tighten the bolt to 75 N.m (55 lb ft).

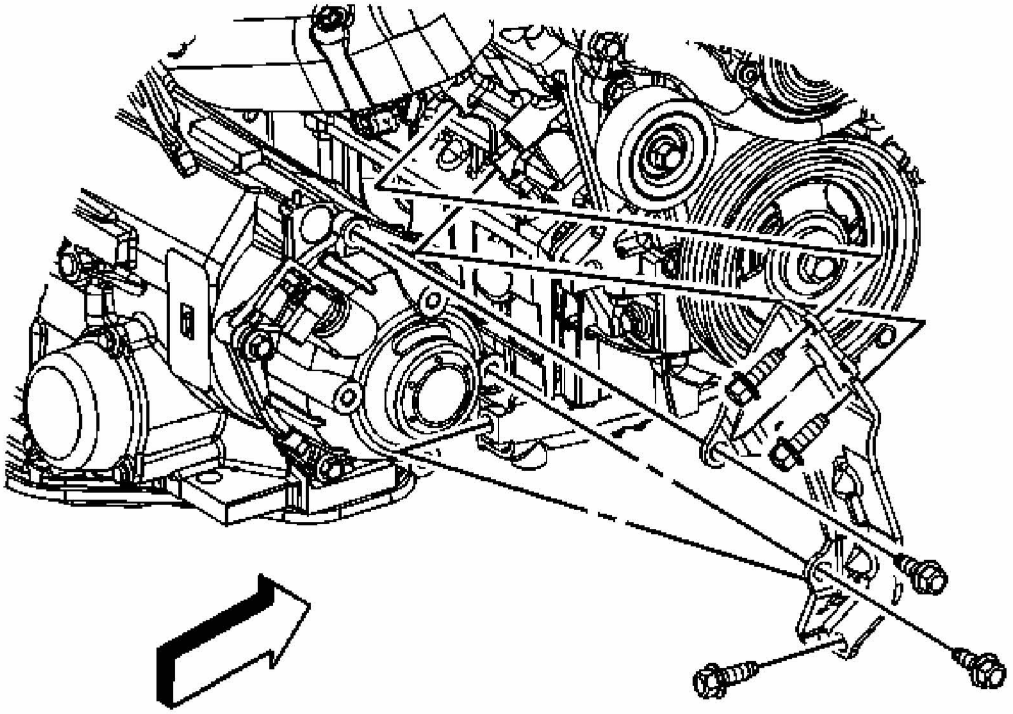


Fig. 235: Locating Rear Transaxle Brace To Engine/Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

20. Install the transaxle brace.
21. Install the transaxle brace to engine bolts.
22. Install the transaxle brace to transaxle bolts.

Tighten: Tighten the bolts to 63 N.m (46 lb ft).

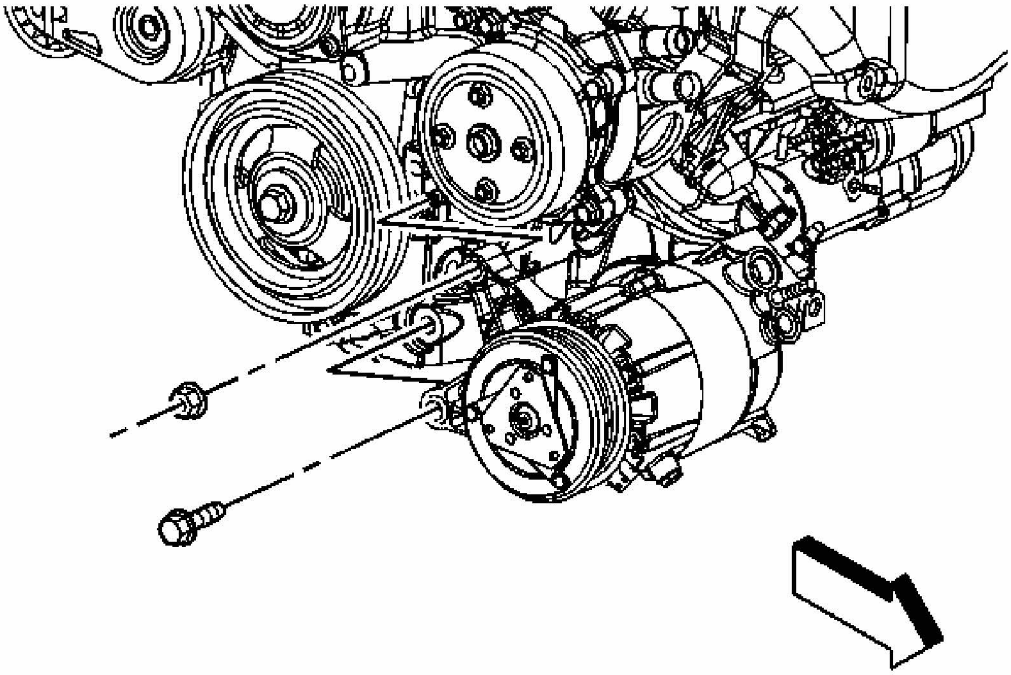


Fig. 236: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

23. Position the A/C compressor and install the compressor front bolt and nut.

    Tighten: Tighten the bolt/nut to 50 N.m (37 lb ft).

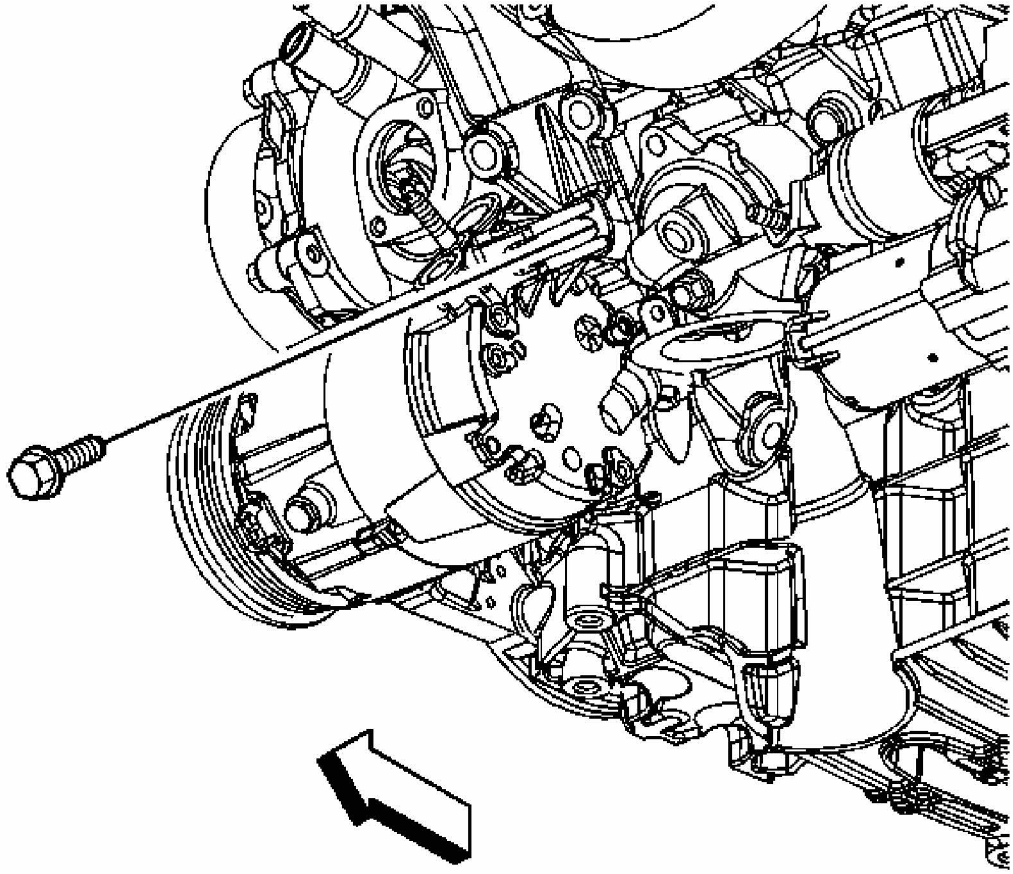


Fig. 237: Locating A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

24. Install the A/C compressor rear bolt.

    Tighten: Tighten the bolt to 50 N.m (37 lb ft).

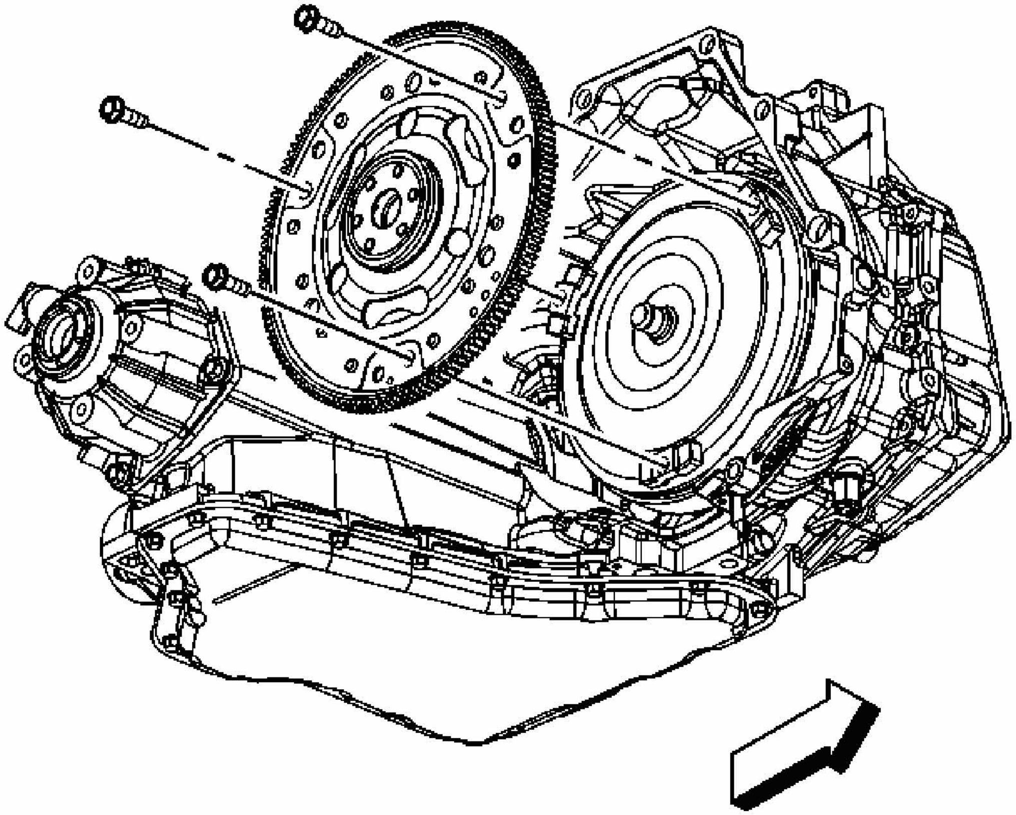


Fig. 238: Locating Torque Converter Bolts
Courtesy of GENERAL MOTORS CORP.

25. Install the torque converter bolts.

    Tighten: Tighten the bolts to 63 N.m (46 lb ft).

26. Install the starter motor. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)** .
27. Install the torque converter cover. Refer to **Torque Converter Cover Replacement** .

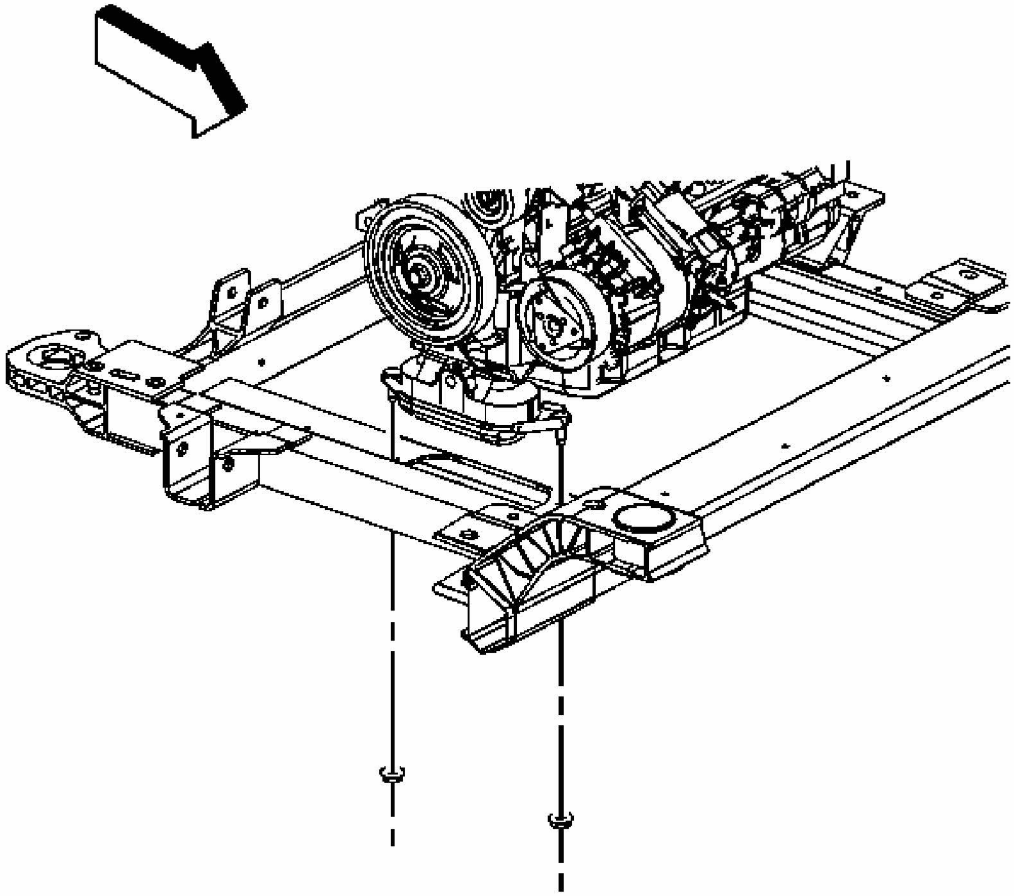


Fig. 239: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

28. Install the engine mount lower nuts.

    Tighten: Tighten the nuts to 50 N.m (37 lb ft).

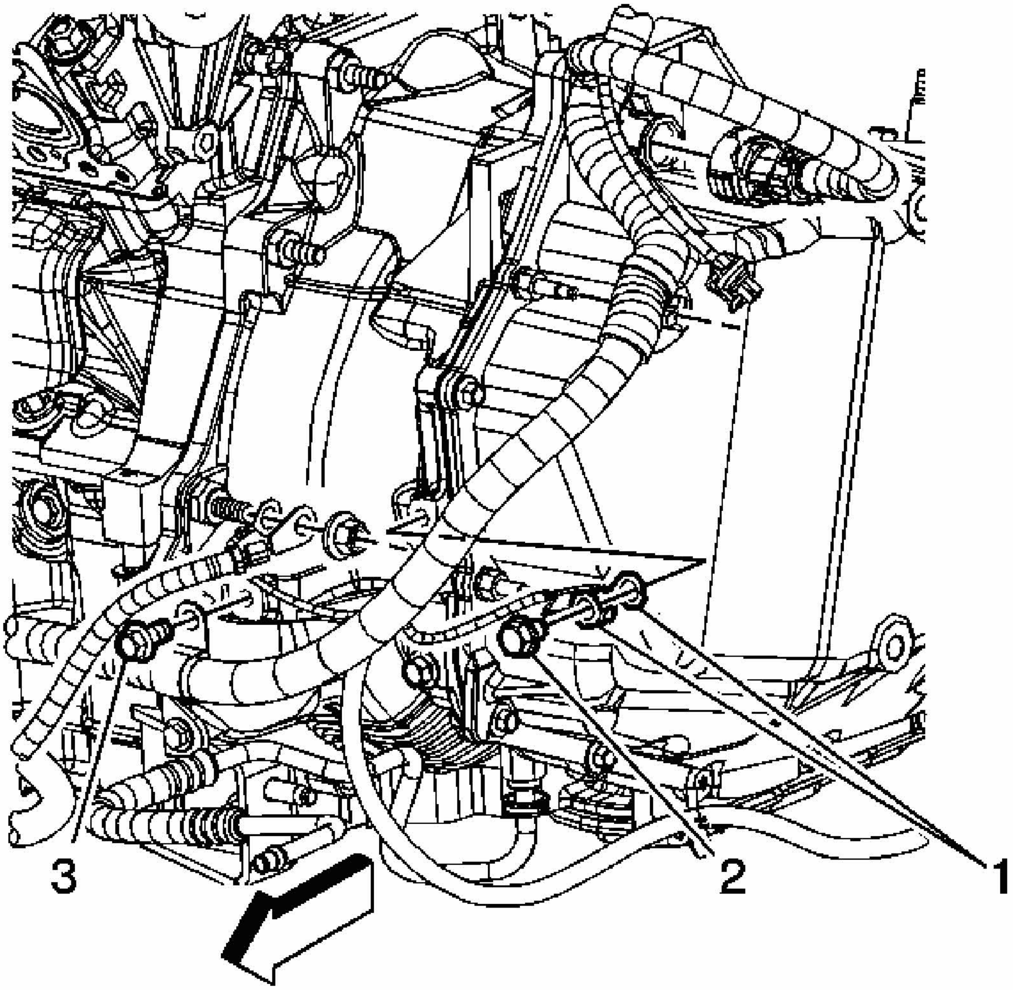


Fig. 240: View Of Engine Harness Ground Bolt
Courtesy of GENERAL MOTORS CORP.

29. Install the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)** .
30. Position the engine harness over the engine.
31. Position the engine harness ground terminals (1) to the transmission.
32. Install the engine harness ground bolt (2).

    Tighten: Tighten the bolt to 25 N.m (18 lb ft).

33. Install the engine harness clip bolt (3) to the transmission.

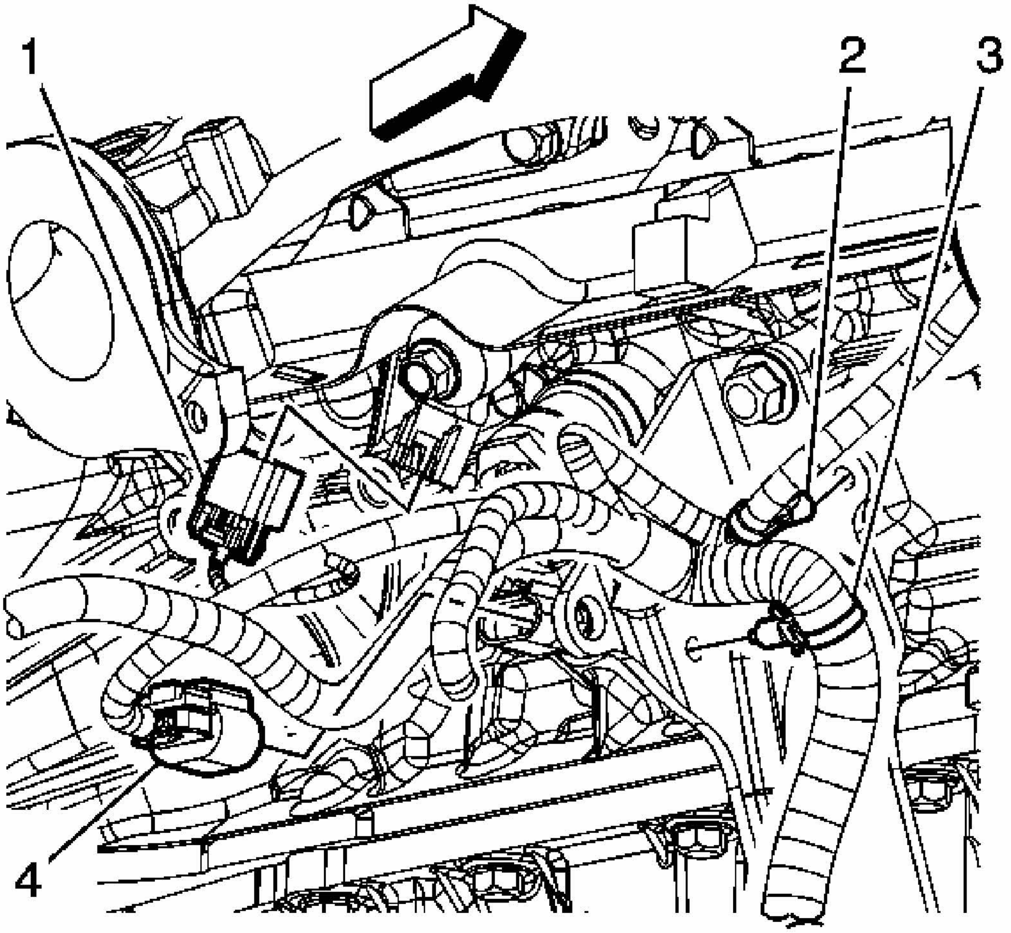


Fig. 241: Locating CKP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

34. Connect the CKP sensor electrical connector (4).
35. Connect the knock sensor electrical connector (1).
36. Install the engine harness clips (2, 3) to the transaxle brace.
37. Lower the vehicle.

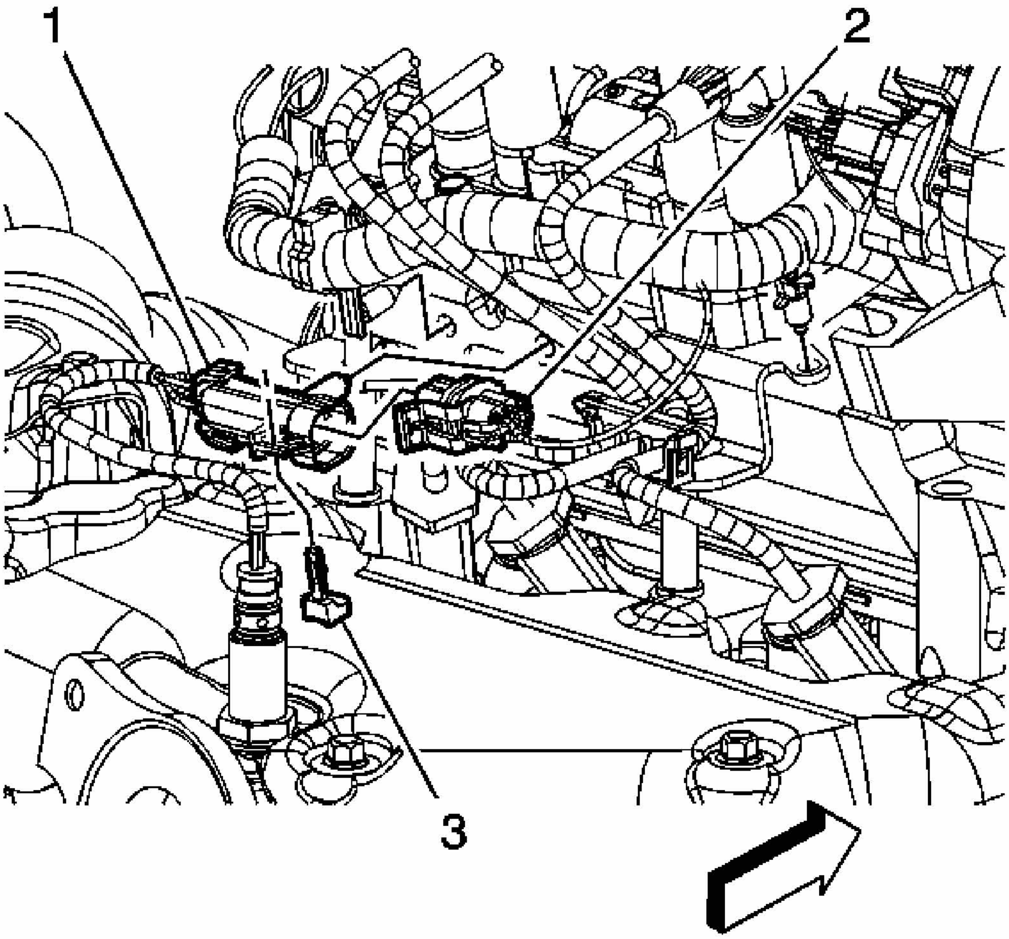


Fig. 242: Identifying The HO2S Electrical Connector
Courtesy of GENERAL MOTORS CORP.

38. Connect the rear upper HO2S electrical connector (2).
39. Install the CPA retainer (3).

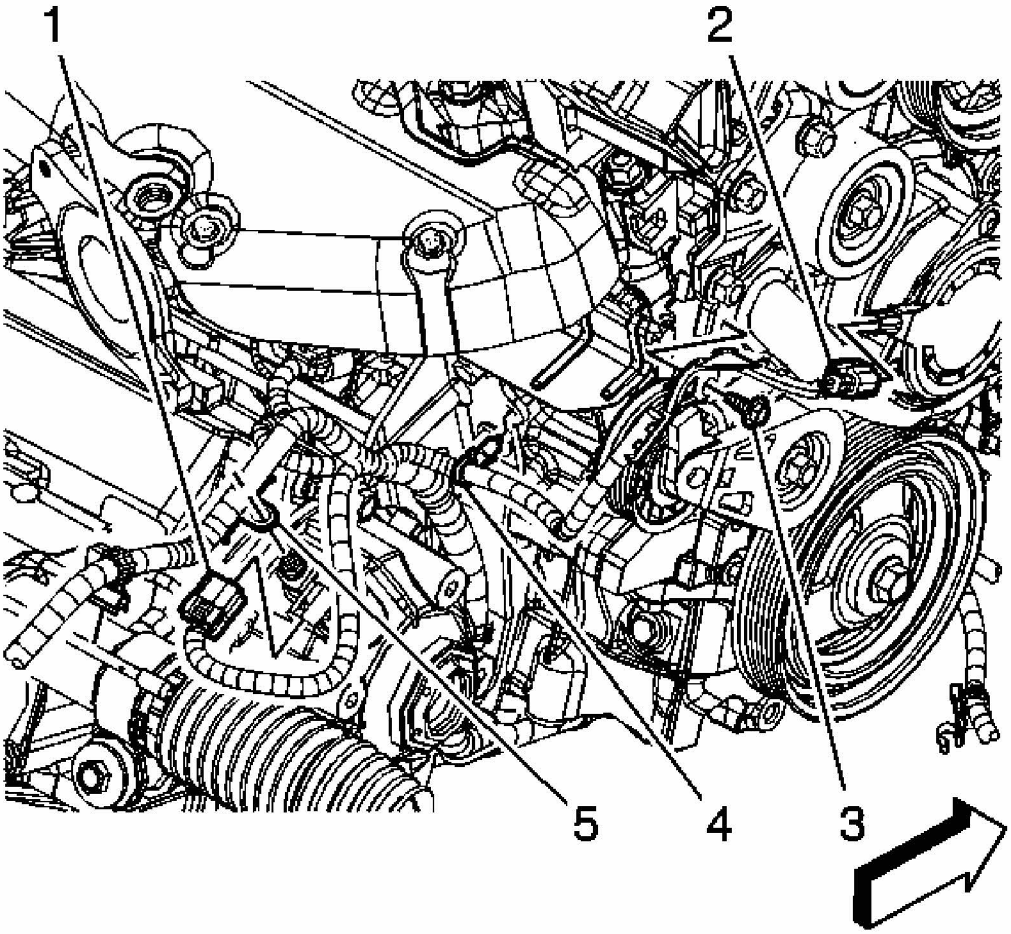


Fig. 243: Locating Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

40. Install the engine harness clip (4) to the transaxle bracket.
41. Install the engine harness clip bolt (3).

    Tighten: Tighten the bolt to 25 N.m (18 lb ft).

42. Connect the camshaft phasor sensor electrical connector (2).

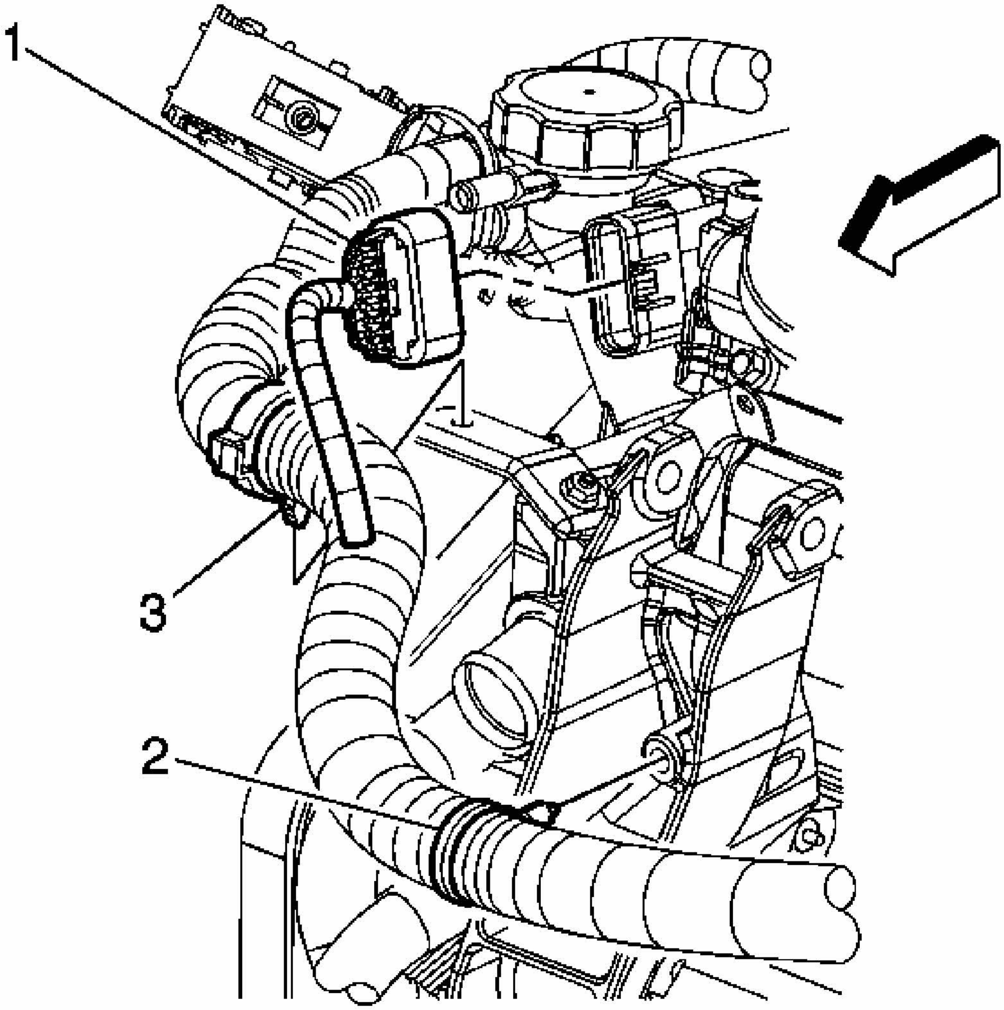


Fig. 244: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

43. Connect the fuel injector inline (1) electrical connector.
44. Install the engine harness clips (2, 3) to the brackets.

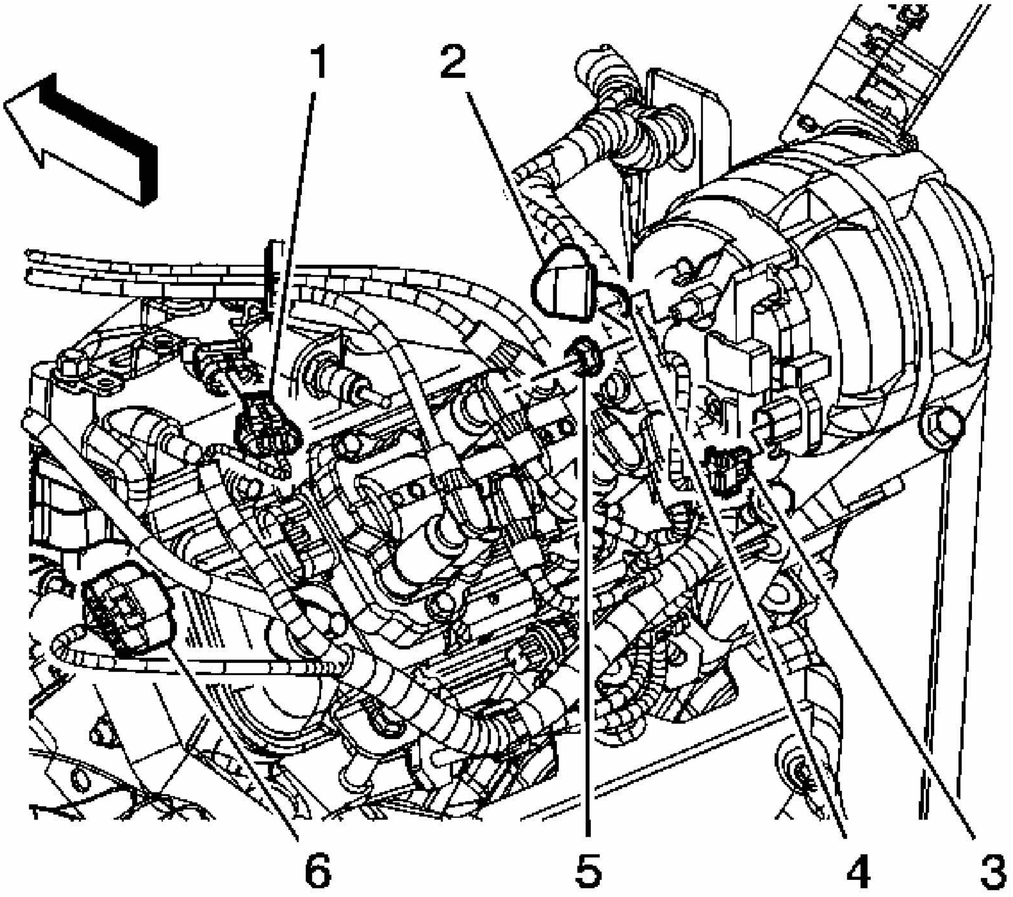


Fig. 245: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

45. Connect the ignition coil electrical connector (6).
46. Connect the generator electrical connector (3).
47. Install the generator terminal (4).
48. Install the generator terminal nut (5).

    Tighten: Tighten the nut to 30 N.m (22 lb ft).

49. Position the generator terminal boot (2).
50. Connect the MAP sensor electrical connector (1).

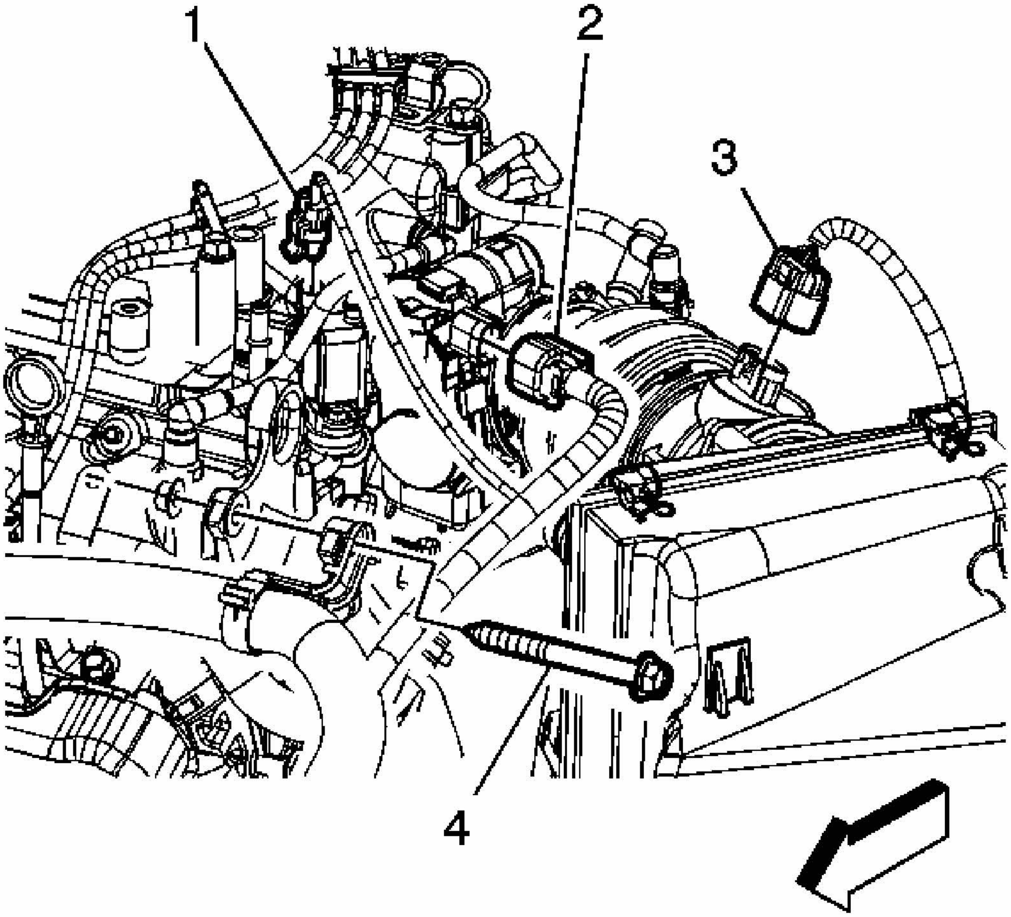


Fig. 246: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

51. Connect the ETC (2) electrical connector.
52. Connect the EVAP canister purge solenoid (1) electrical connector.

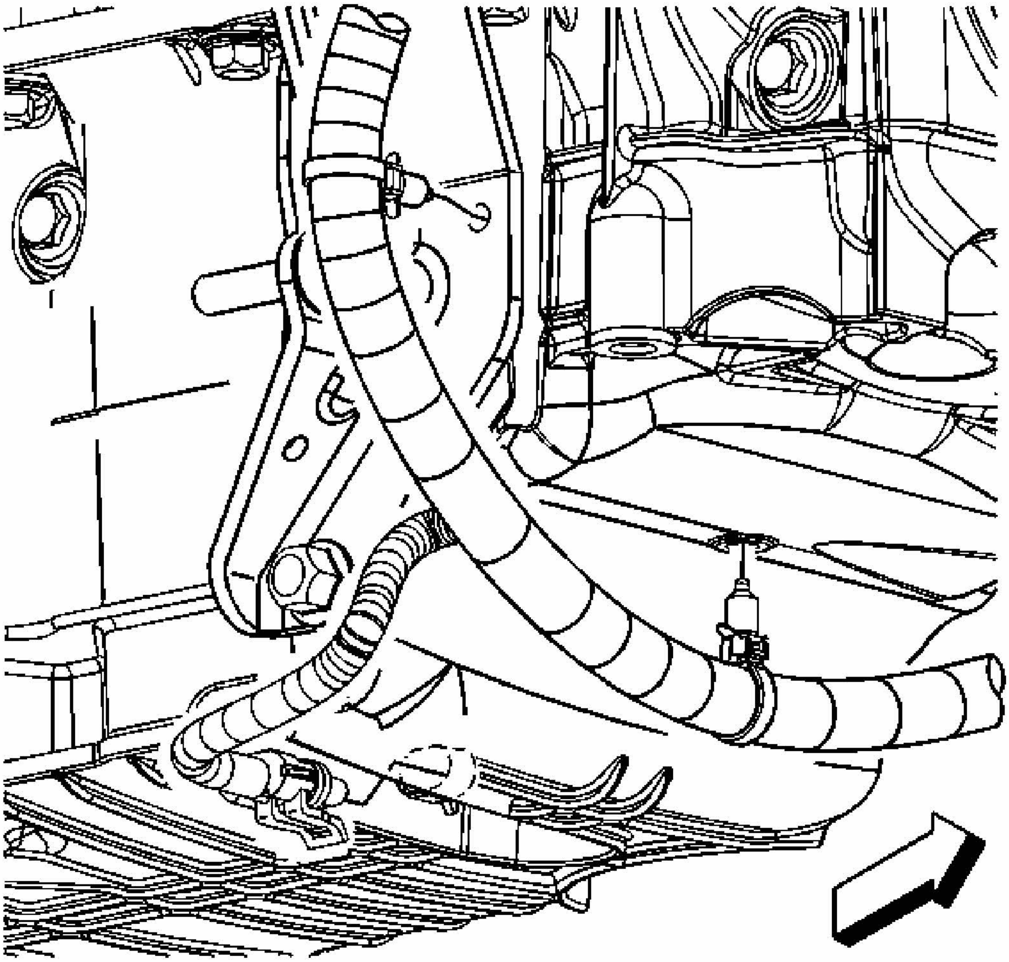


Fig. 247: Locating Engine Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

53. Raise the vehicle.
54. Connect the oil level sensor electrical connector.
55. Install the engine harness clips to the transaxle brace and the oil pan.

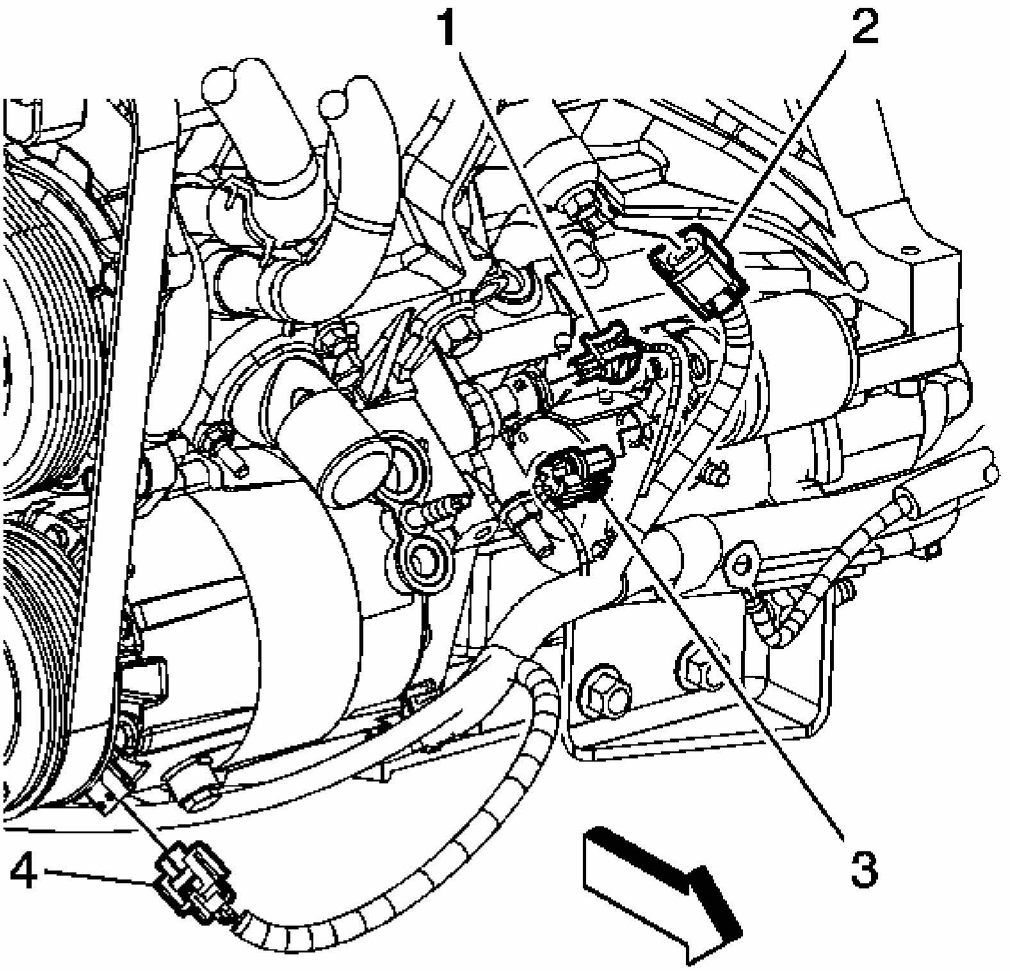


Fig. 248: Locating Oil Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

56. Connect the A/C compressor electrical connector (4).
57. Connect the starter motor electrical connector (3)
58. Connect the knock sensor (2) electrical connector.
59. Connect the oil pressure sensor (1) electrical connector.

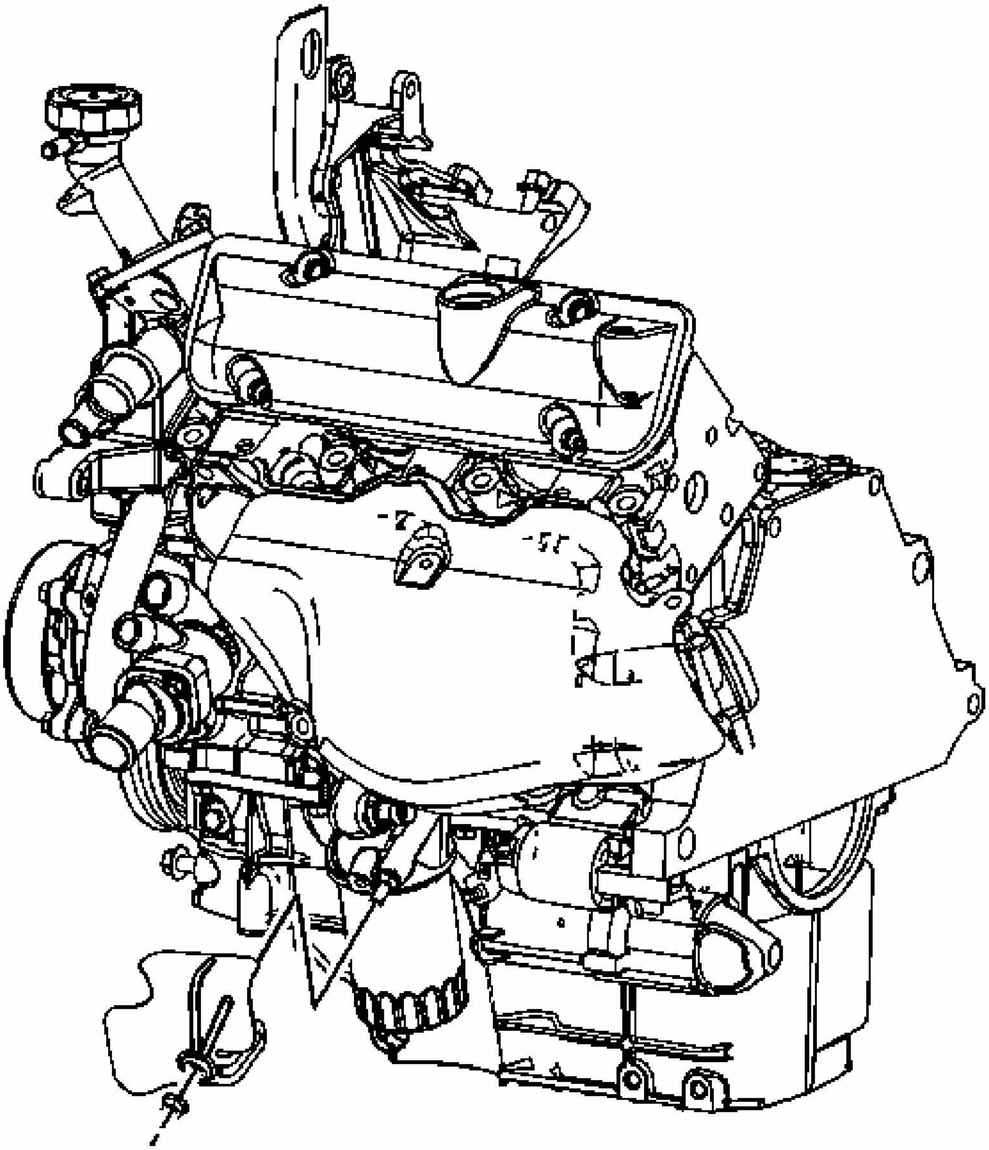


Fig. 249: Locating Oil Pressure Sensor Heat Shield & Nut
Courtesy of GENERAL MOTORS CORP.

60. Install the oil pressure sensor heat shield and nuts.

    Tighten: Tighten the nuts to 10 N.m (89 lb in).

61. Lower the vehicle.
62. Install the engine mount struts. Refer to **Engine Mount Strut Replacement**.

63. Install the drive belt. Refer to **Drive Belt Replacement**.
64. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
65. Install the hood. Refer to **Hood Replacement** .
66. Fill the engine with oil. Refer to **Engine Oil and Oil Filter Replacement**.
67. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
68. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
69. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .

ENGINE OIL AND OIL FILTER REPLACEMENT

Removal Procedure

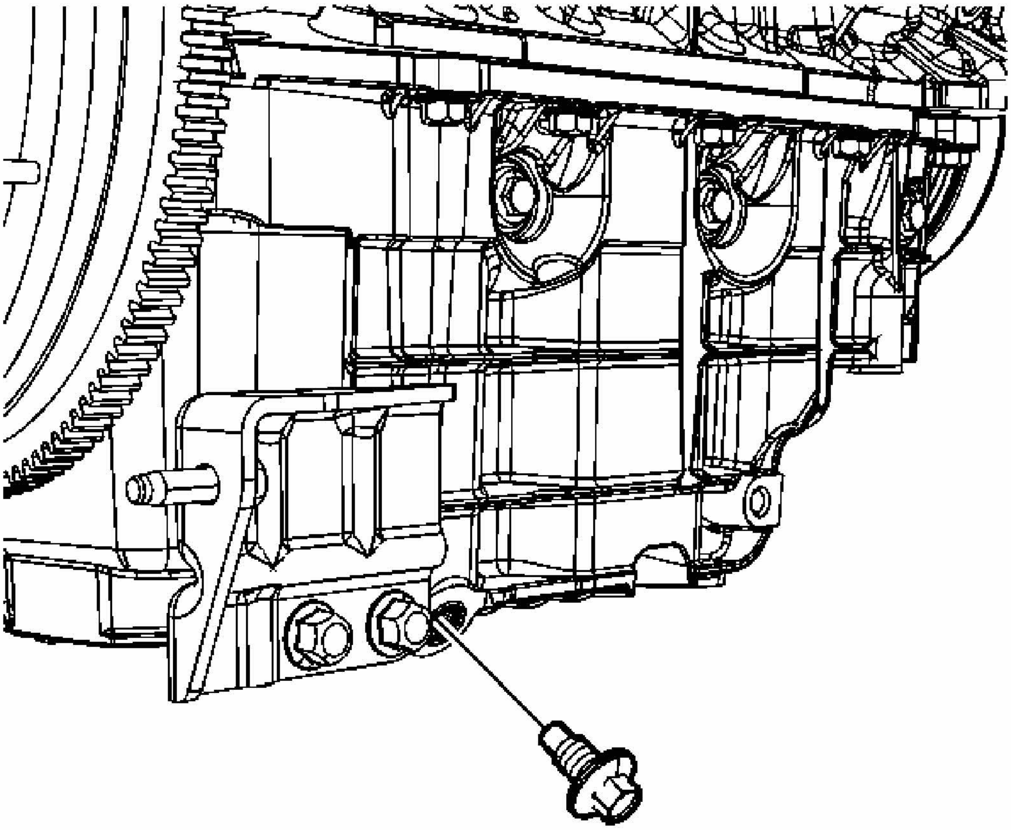


Fig. 250: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the oil pan drain plug.
3. Allow the engine oil to drain completely.

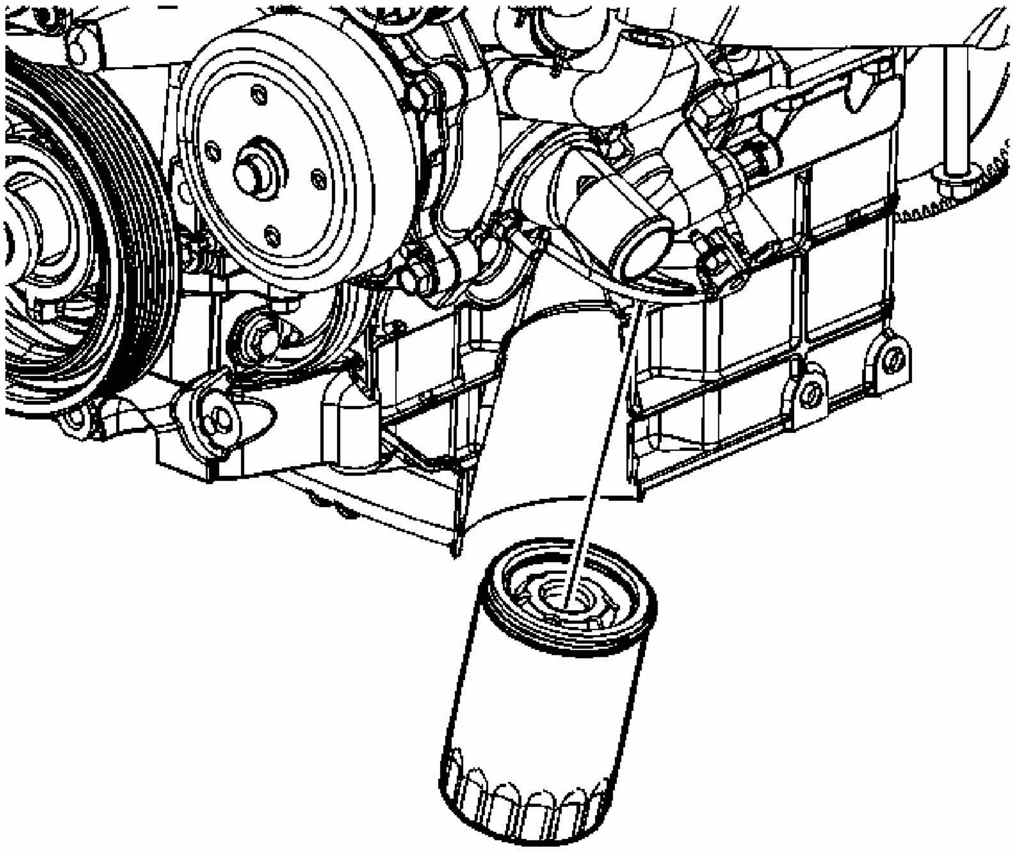


Fig. 251: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

4. Remove the oil filter.

Installation Procedure

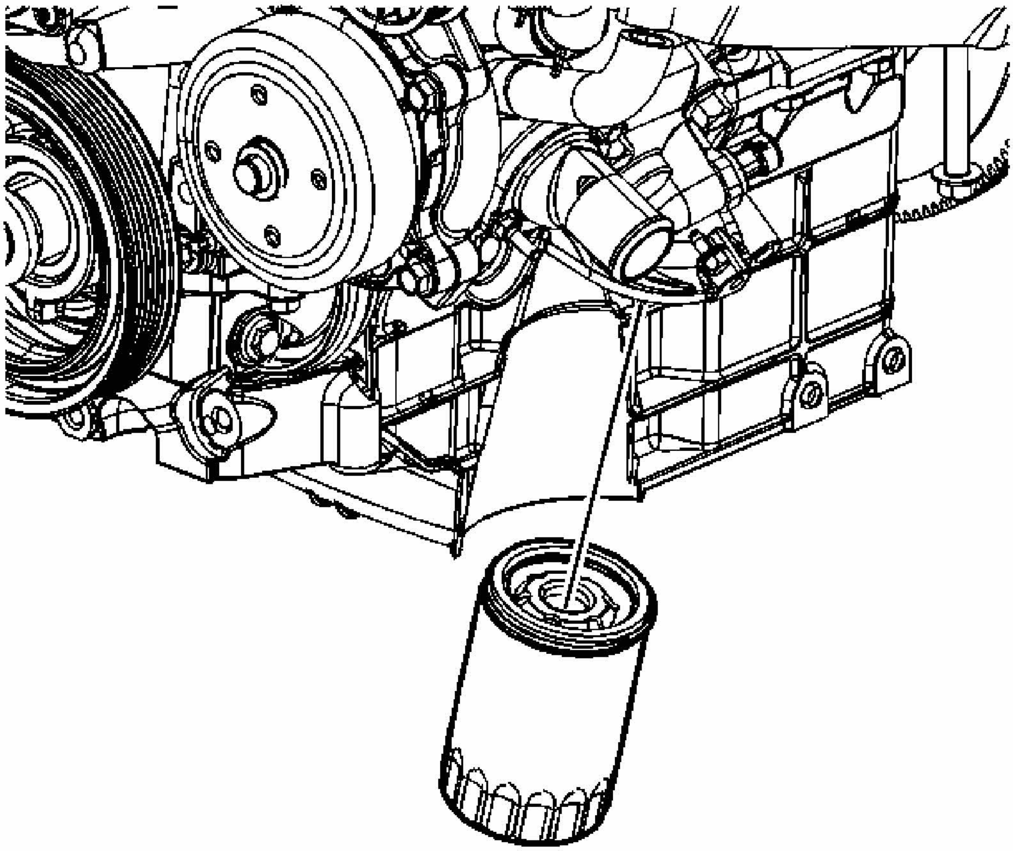


Fig. 252: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

1. Install the oil filter.

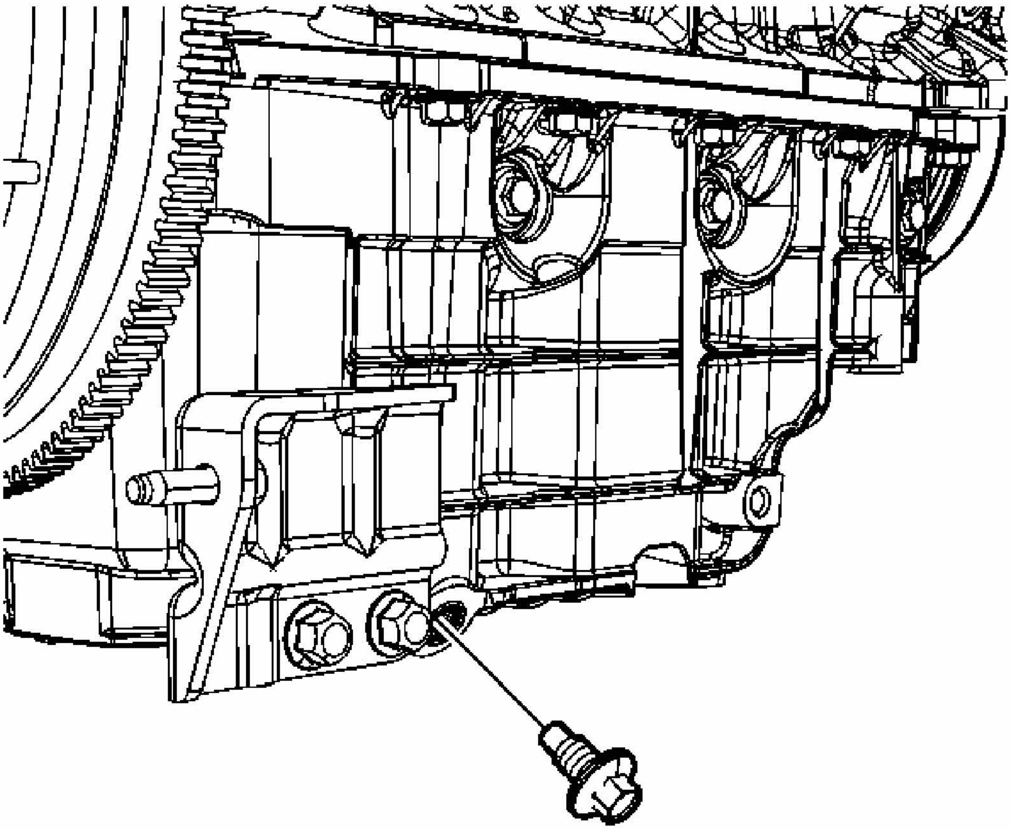


Fig. 253: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

2. Install the oil pan drain bolt.

   Tighten: Tighten the bolt to 26 N.m (19 lb ft).

3. Lower the vehicle.
4. Fill the engine with oil to the appropriate level.
5. Start engine and inspect for leaks.

DRAINING FLUIDS AND OIL FILTER REMOVAL

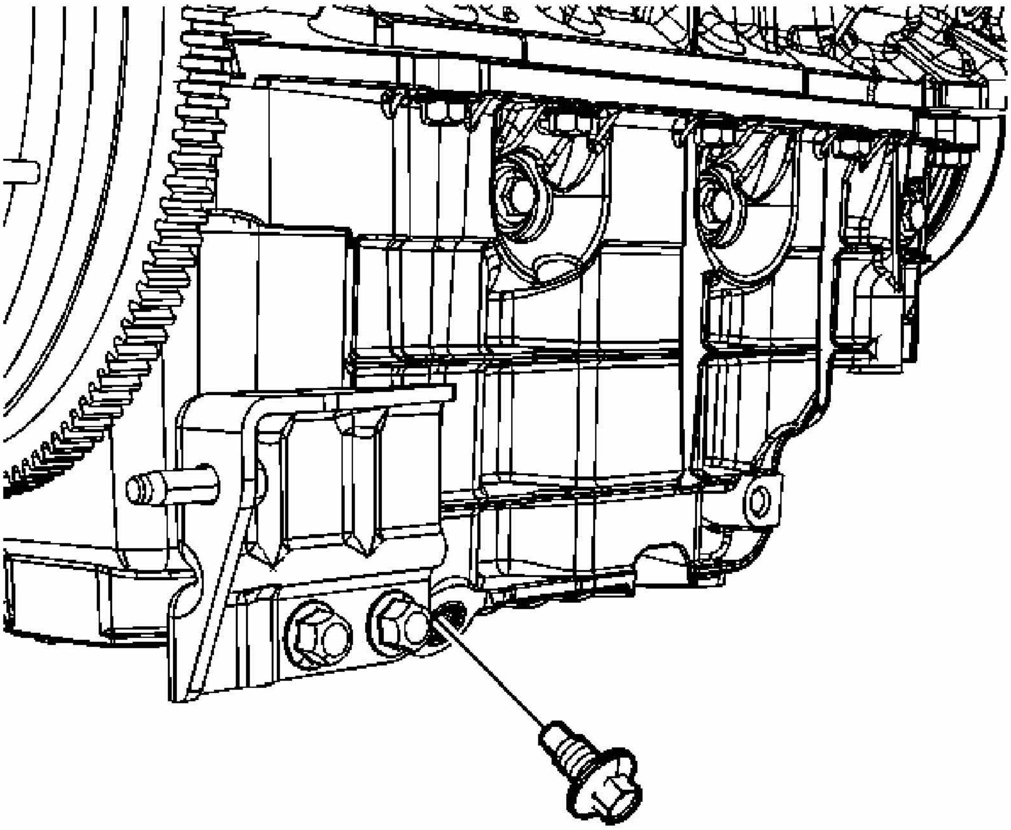


Fig. 254: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pan drain plug.
2. Drain the engine oil.

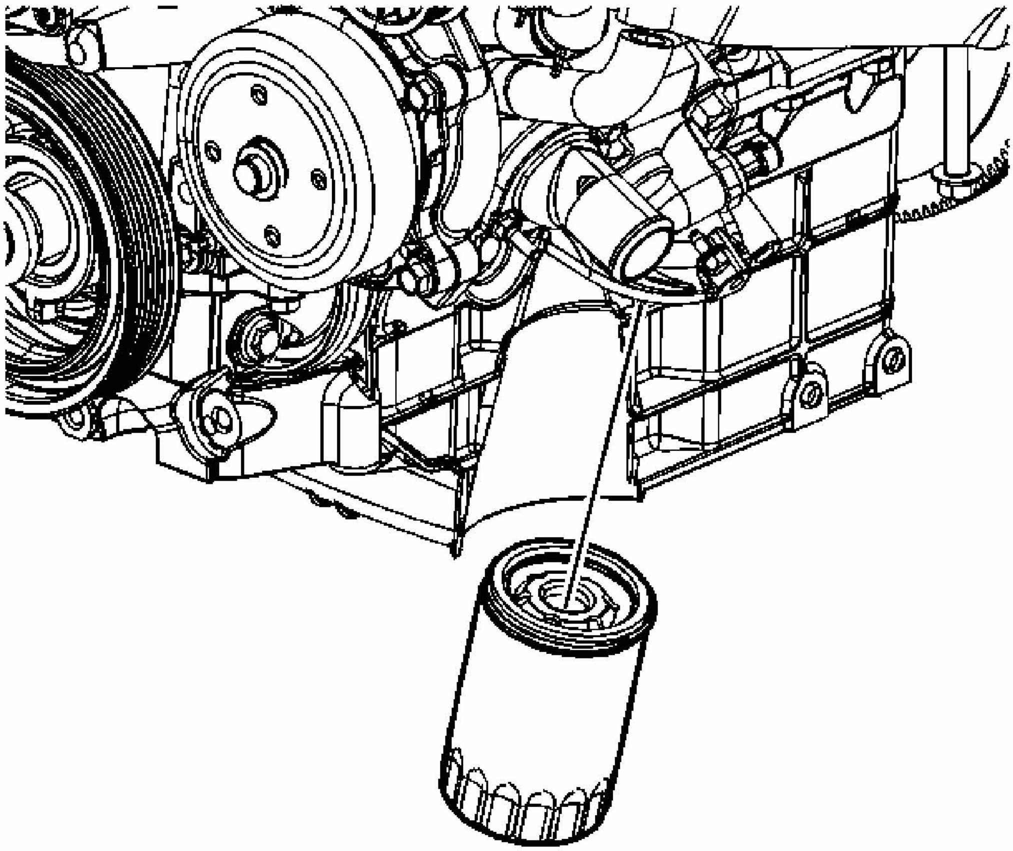


Fig. 255: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil filter.

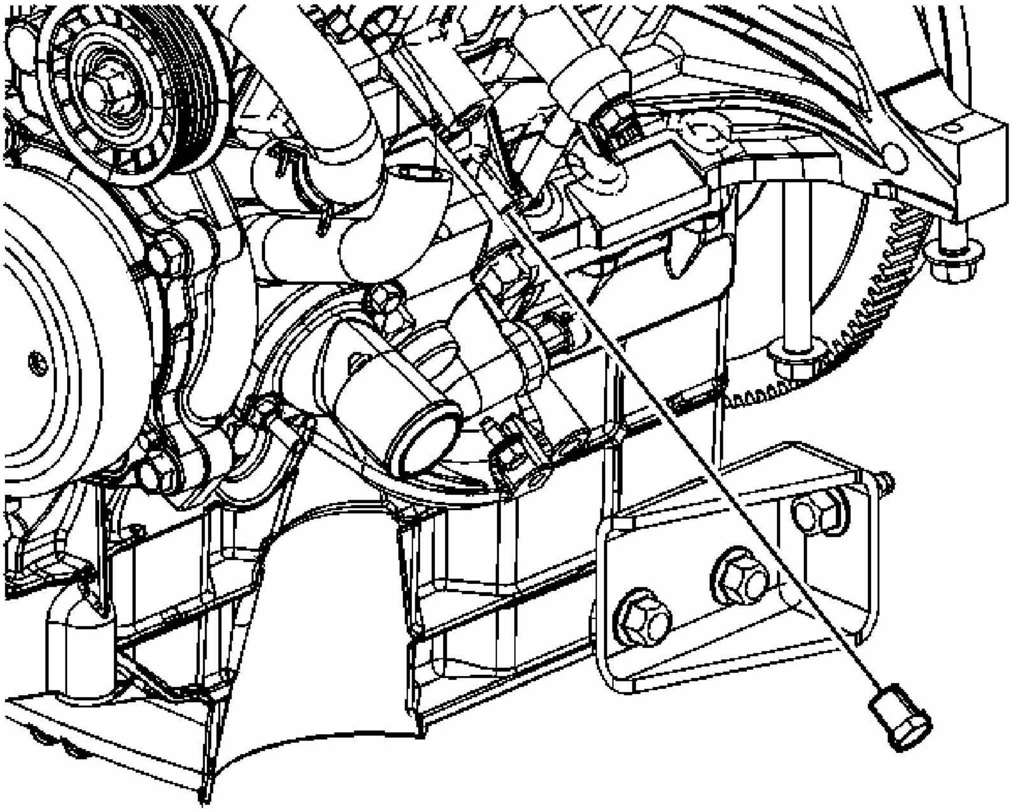


Fig. 256: Identifying Left Side Coolant Drain Plug
Courtesy of GENERAL MOTORS CORP.

4. Remove the coolant drain plug from the left side.

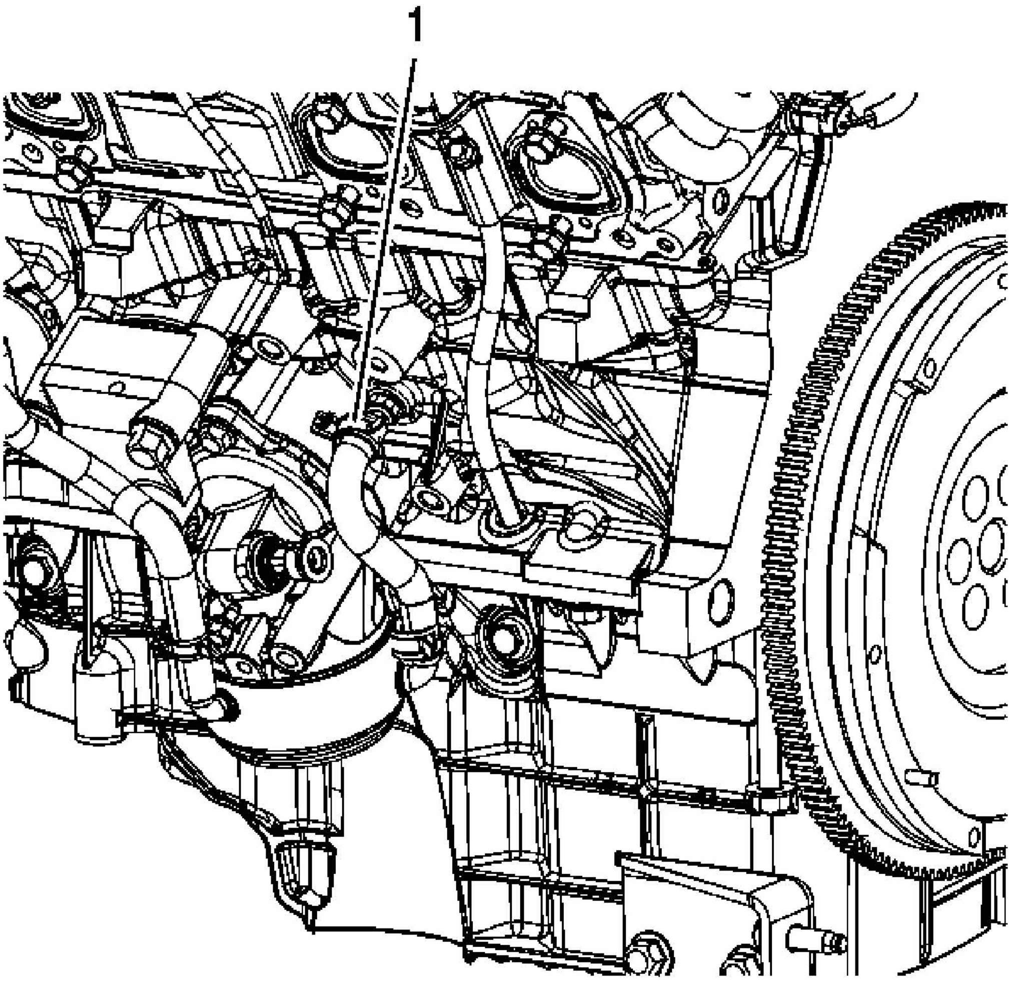


Fig. 257: Locating Upper Inlet Hose Clamp (1)
Courtesy of GENERAL MOTORS CORP.

5. If equipped with an oil cooler (RPO-KC4), reposition the upper inlet hose clamp (1).
6. Remove the oil cooler inlet hose from the block outlet.

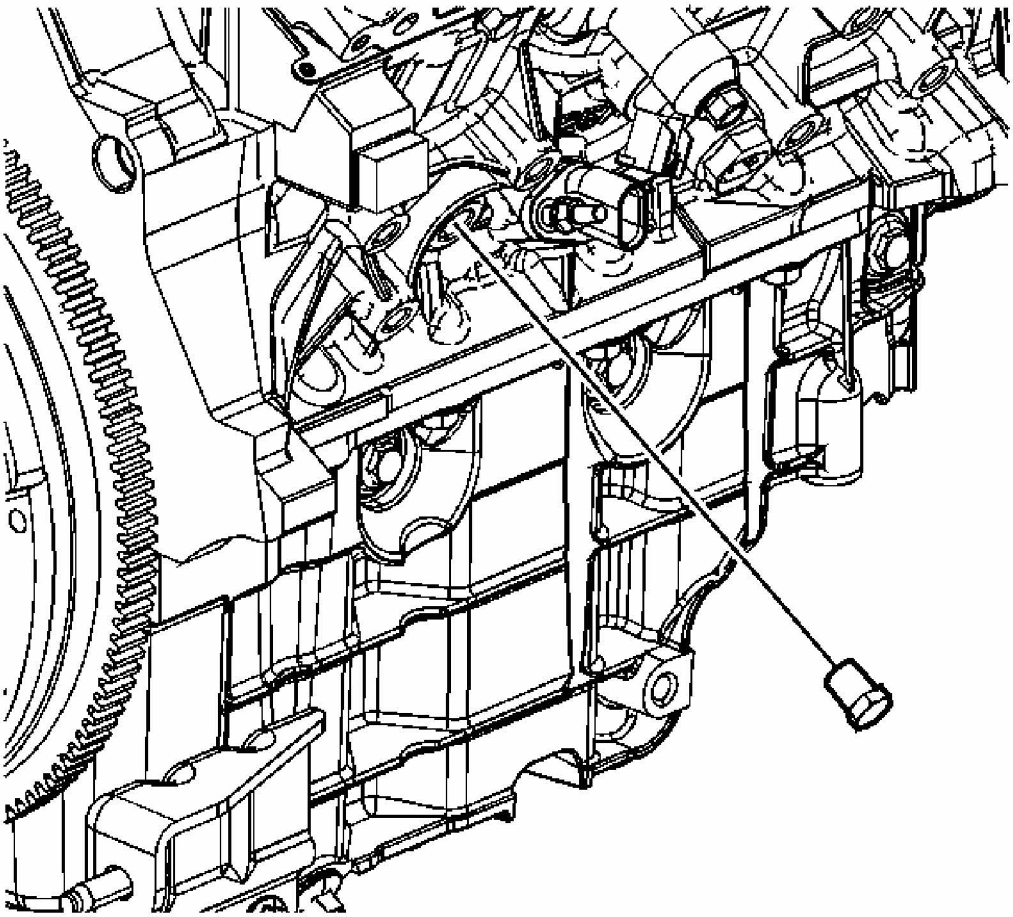


Fig. 258: Identifying Right Side Coolant Drain Plug
Courtesy of GENERAL MOTORS CORP.

7. If not equipped with an oil cooler (RPO-KC4), remove the coolant drain plug from the right side.
8. Drain the coolant.

CRANKSHAFT BALANCER REMOVAL

Tools Required

- **J 41816** Crankshaft Balancer Remover
- **EN 46359** Puller End Protector

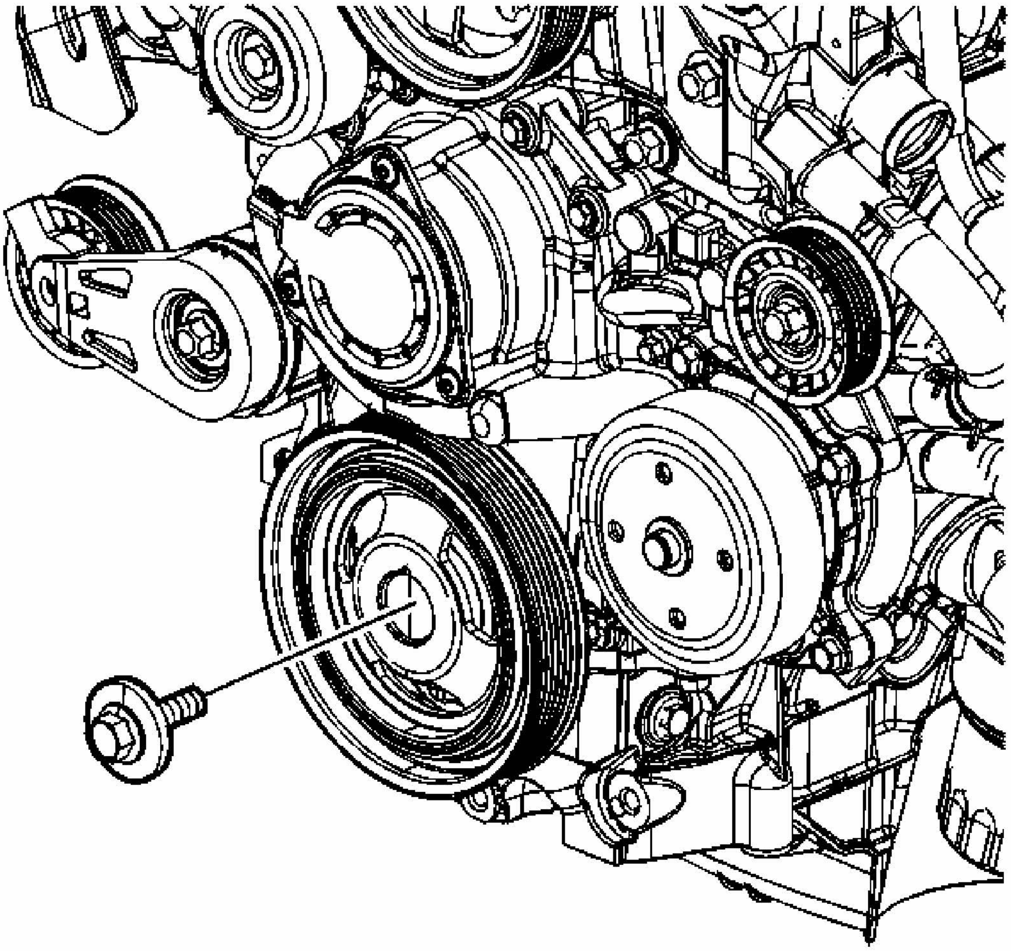


Fig. 259: Identifying Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

1. Remove the crankshaft balancer bolt and washer.

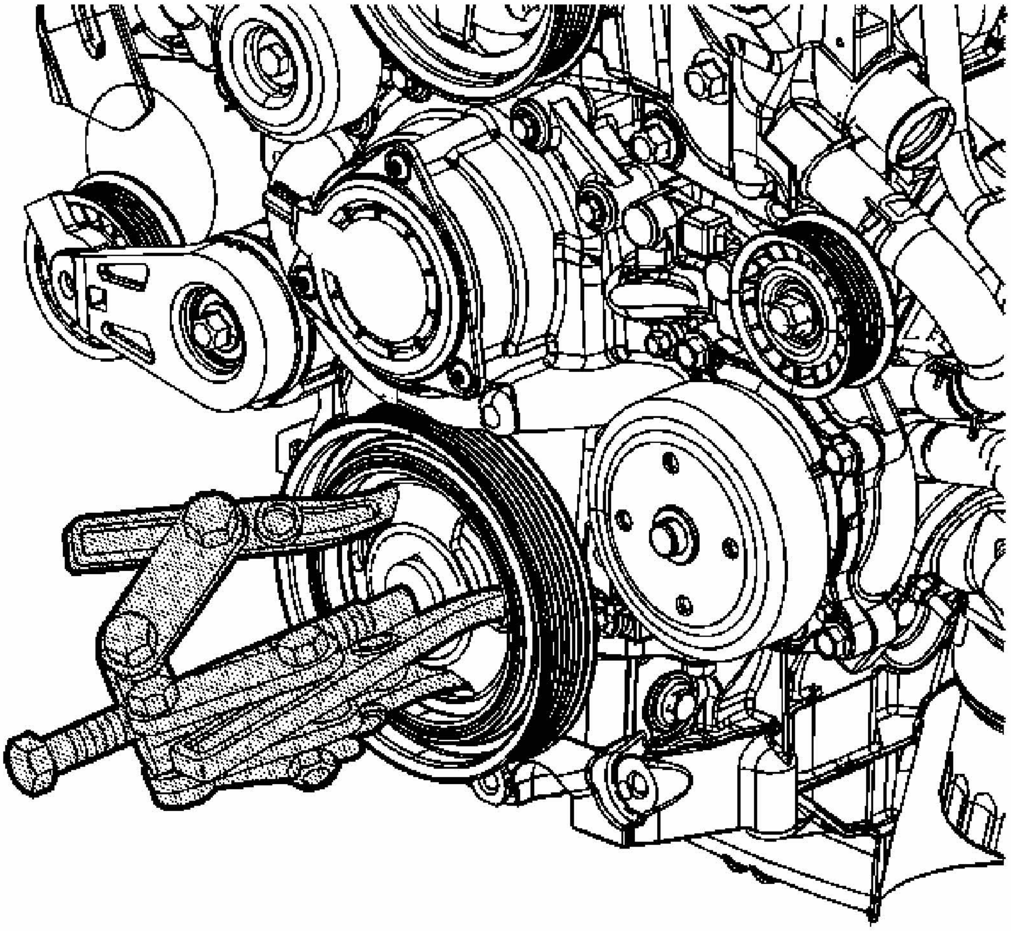


Fig. 260: Removing The Crankshaft Balancer Using The J 41816 Along With EN 46359
Courtesy of GENERAL MOTORS CORP.

NOTE: **Do NOT use a power-assisted tool with the special tool in order to remove or install this component. You cannot properly control the alignment of this component using a power-assisted tool, and this can damage the component.**

2. Remove the crankshaft balancer using the **J 41816** along with **EN 46359** .

ENGINE FLYWHEEL REMOVAL (AUTOMATIC TRANSMISSION)

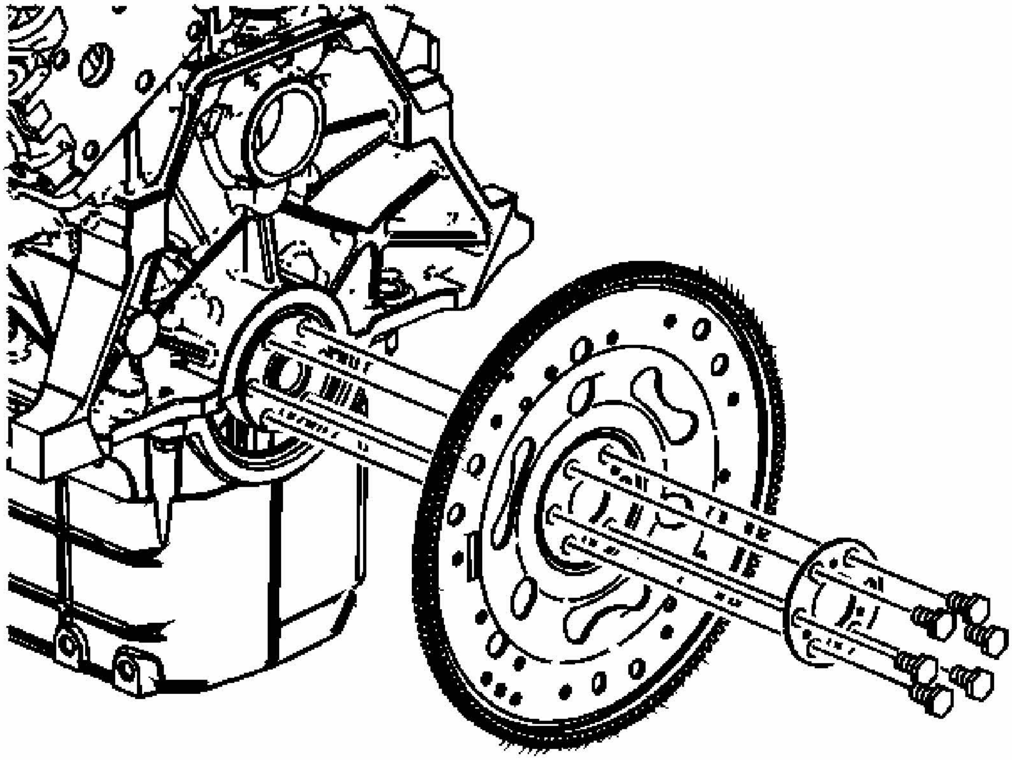


Fig. 261: Identifying Flywheel & Bolts (Automatic Transmission)
Courtesy of GENERAL MOTORS CORP.

1. If equipped with an automatic transmission, remove the flywheel bolts.
2. Remove the flywheel.

ENGINE FLYWHEEL REMOVAL (MANUAL TRANSMISSION)

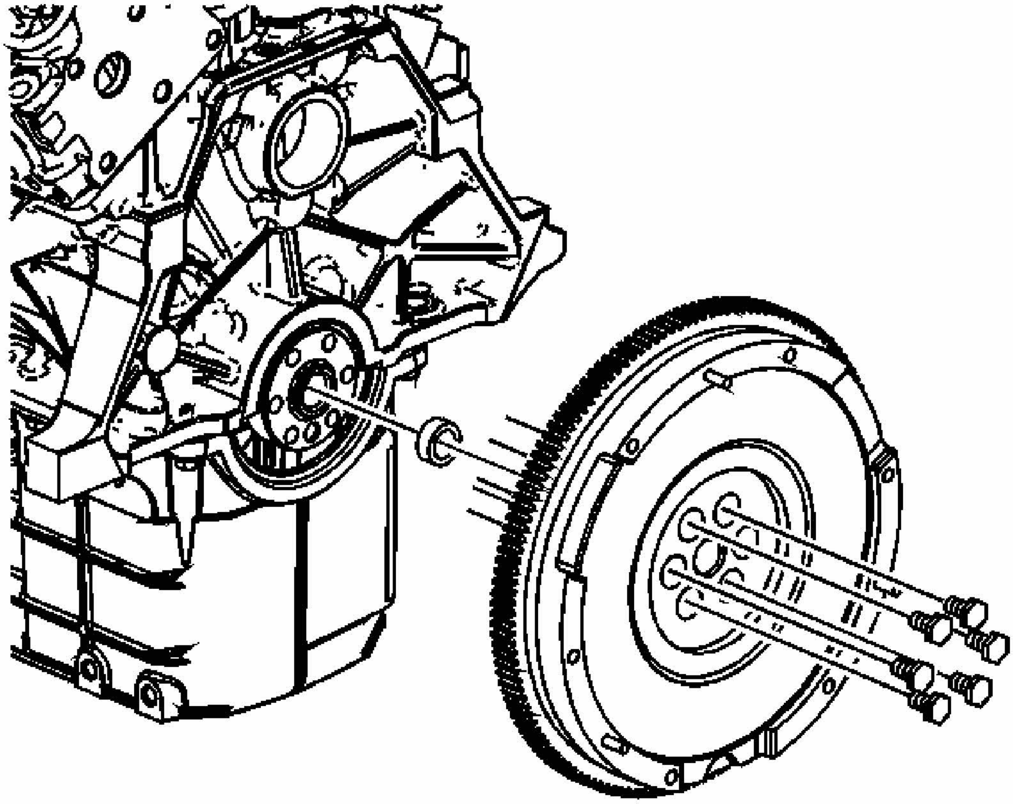


Fig. 262: Identifying Flywheel Bolts (Manual Transmission)
Courtesy of GENERAL MOTORS CORP.

1. Remove the flywheel/pressure plate bolts.
2. Remove the flywheel/pressure plate.
3. Remove the clutch pilot bearing.

DRIVE BELT TENSIONER REMOVAL

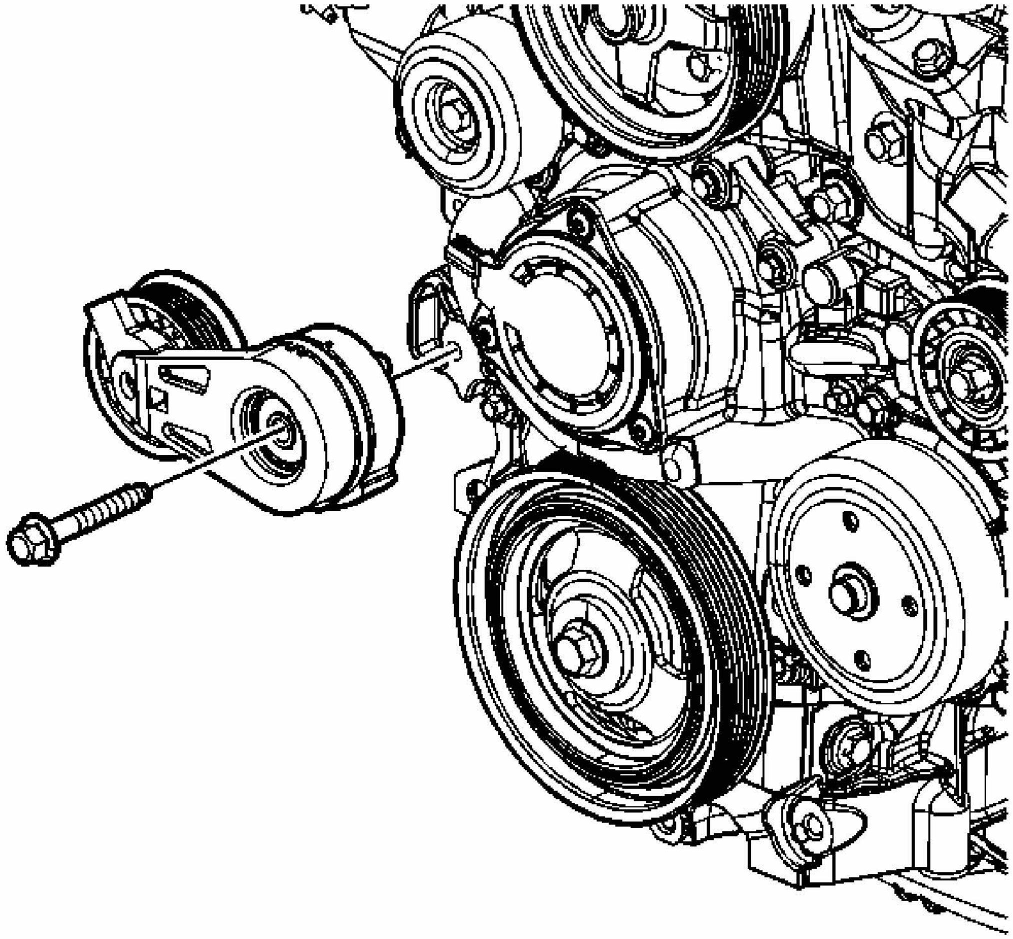


Fig. 263: Identifying Drive Belt Tensioner & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the drive belt tensioner bolt.
2. Remove the drive belt tensioner.

ENGINE MOUNT STRUT AND ENGINE LIFT BRACKET REMOVAL

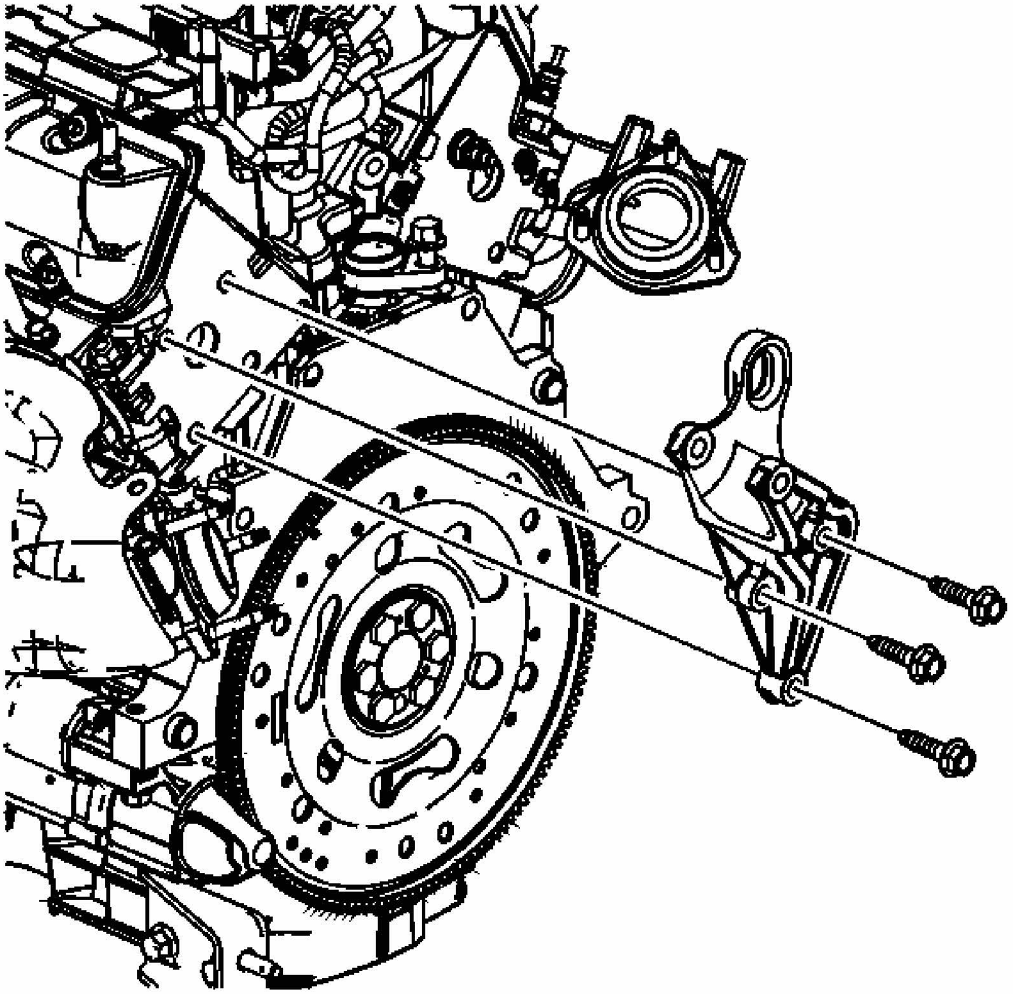


Fig. 264: Identifying Engine Lift Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount strut and engine lift bracket bolts.
2. Remove the engine mount strut and engine lift bracket.

ENGINE MOUNT SUPPORT AND STRUT BRACKET REMOVAL

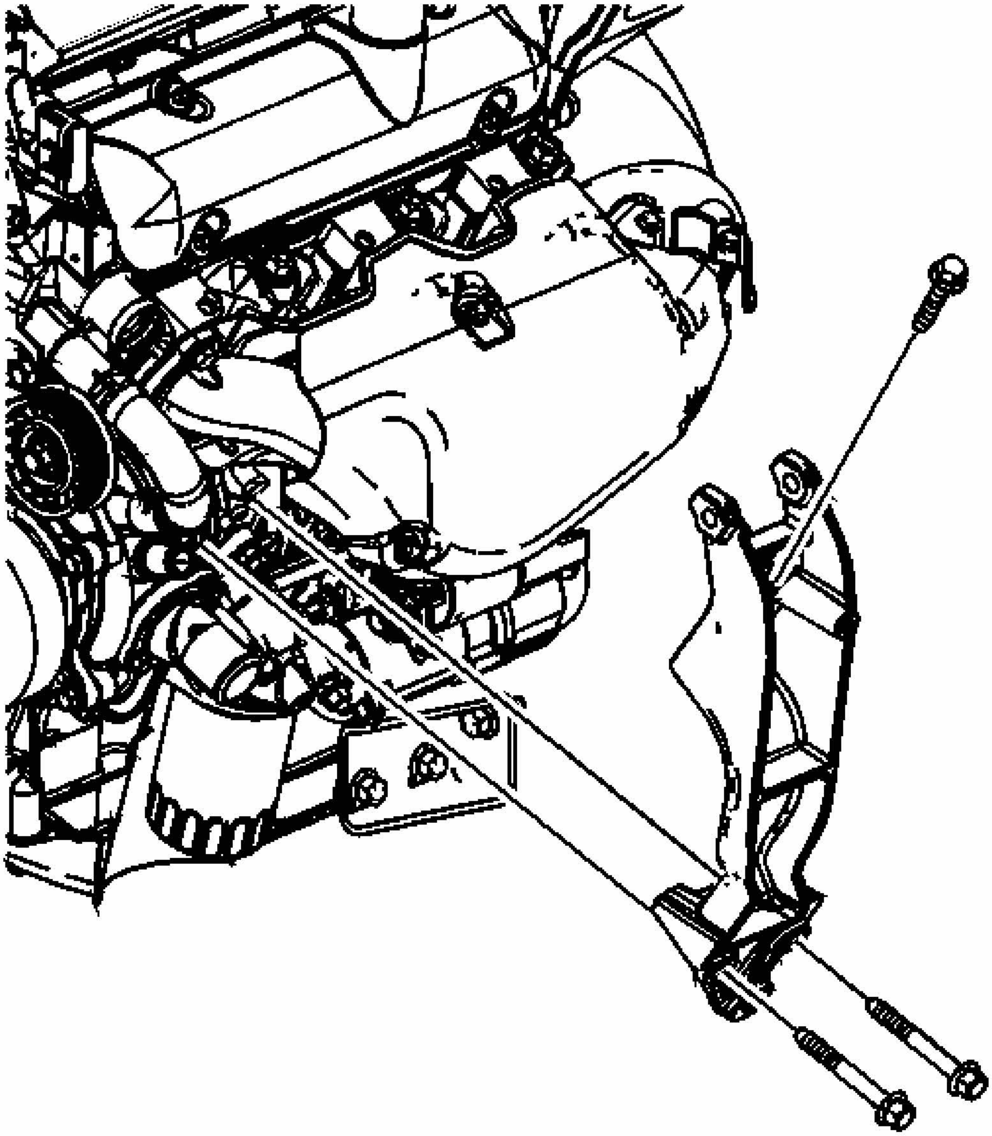


Fig. 265: View Of Engine Mount Support & Strut Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount support and strut bracket bolts.
2. Remove the engine mount support and strut bracket.

COOLANT CROSSOVER PIPE REMOVAL

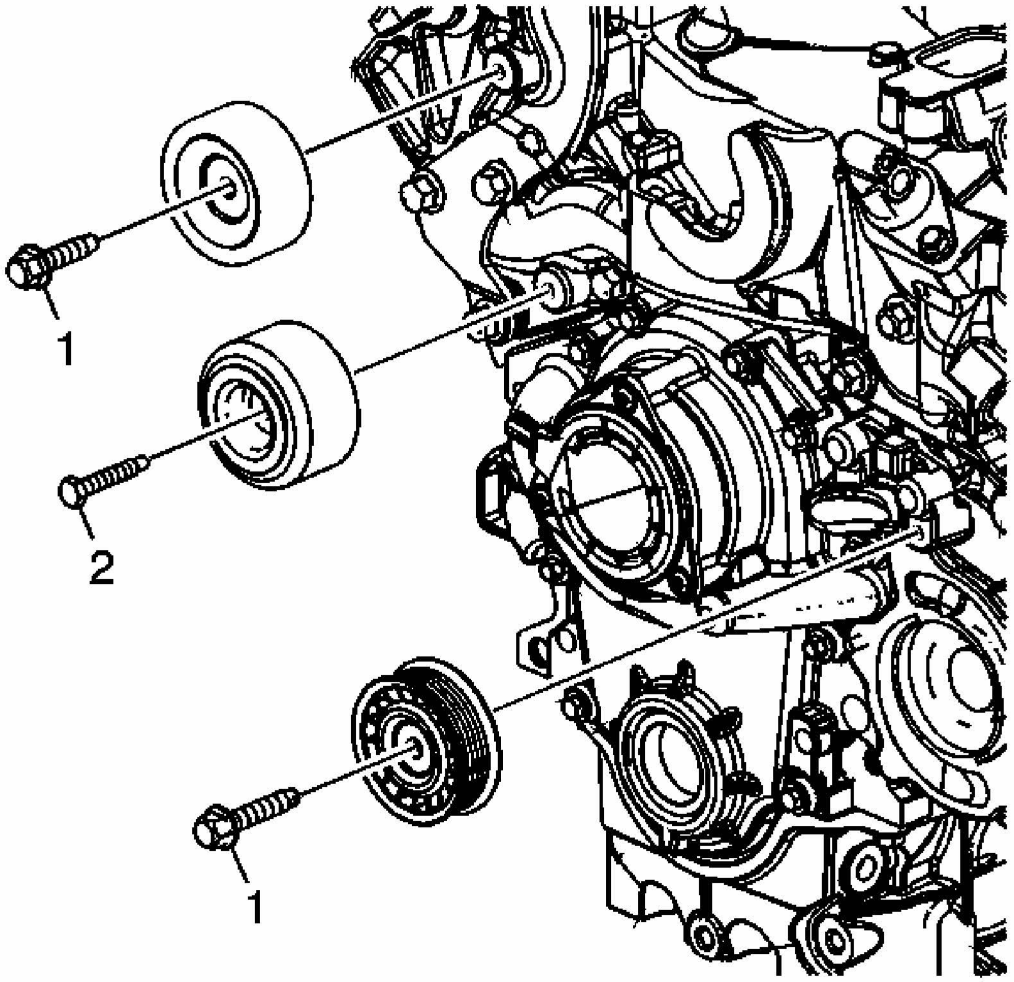


Fig. 266: Identifying Idler Pulley Bolts & Pulleys
Courtesy of GENERAL MOTORS CORP.

1. Remove the idler pulley bolts and pulleys.

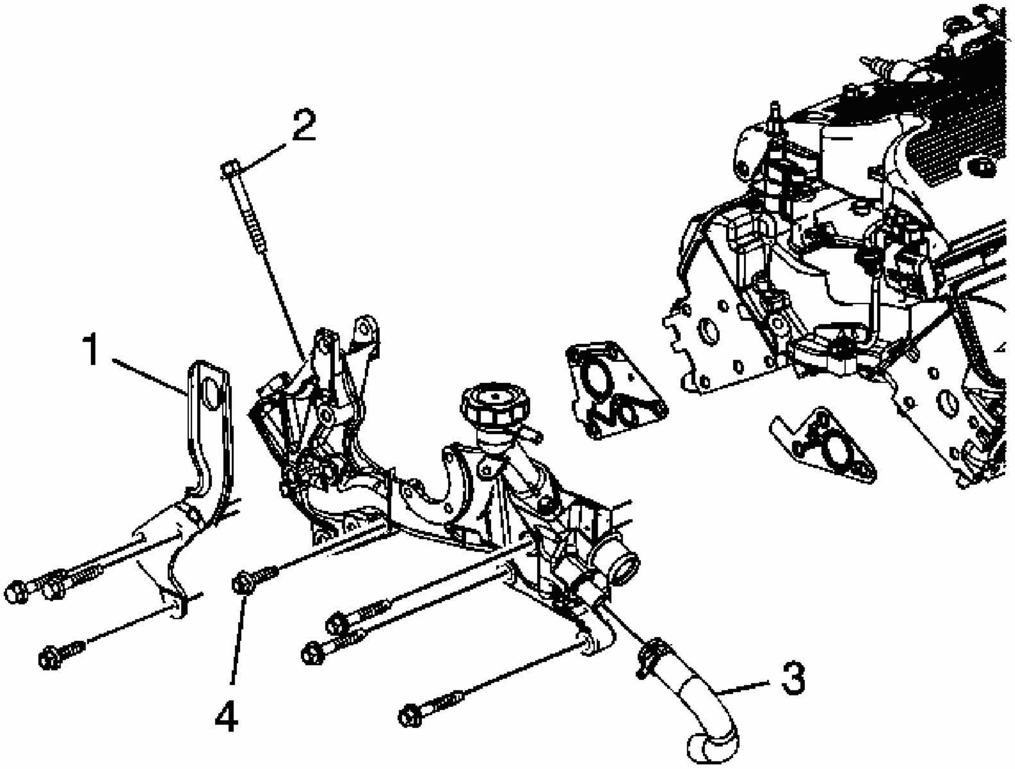


Fig. 267: View Of Coolant Crossover Pipe Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Loosen the thermal bypass hose clamp and remove the hose (3) from the coolant crossover pipe.
3. Remove the coolant crossover pipe bolts (2, 4), engine lift bracket (1), and the coolant crossover pipe assembly.
4. Remove the coolant crossover pipe gaskets.

OIL LEVEL INDICATOR AND TUBE REMOVAL

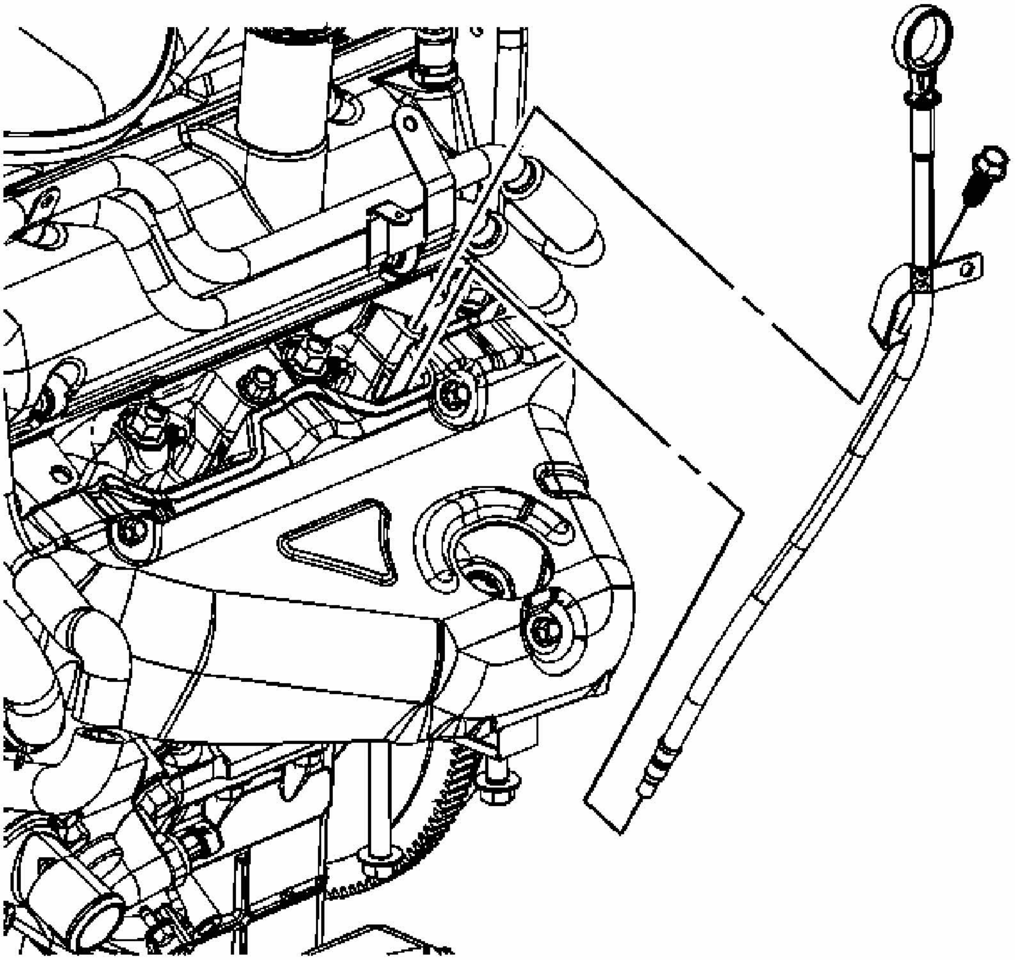


Fig. 268: View Of Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil level indicator tube bolt.
2. Remove the oil level indicator and oil level indicator tube.

OIL FILTER ADAPTER REMOVAL

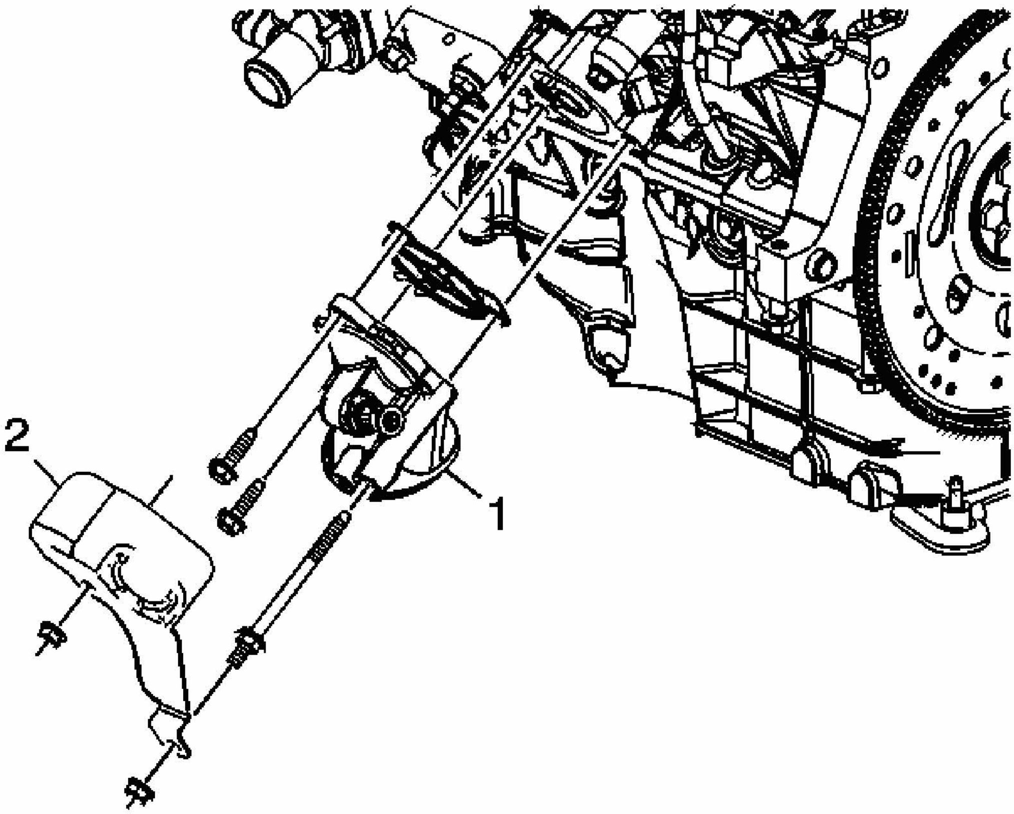


Fig. 269: Identifying Oil Filter Adapter & Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil filter adapter heat shield nuts.
2. Remove the oil filter adapter heat shield (2).
3. Remove the oil filter adapter bolts.
4. Remove the oil filter adapter (1) and gasket.

EXHAUST CROSSOVER PIPE REMOVAL

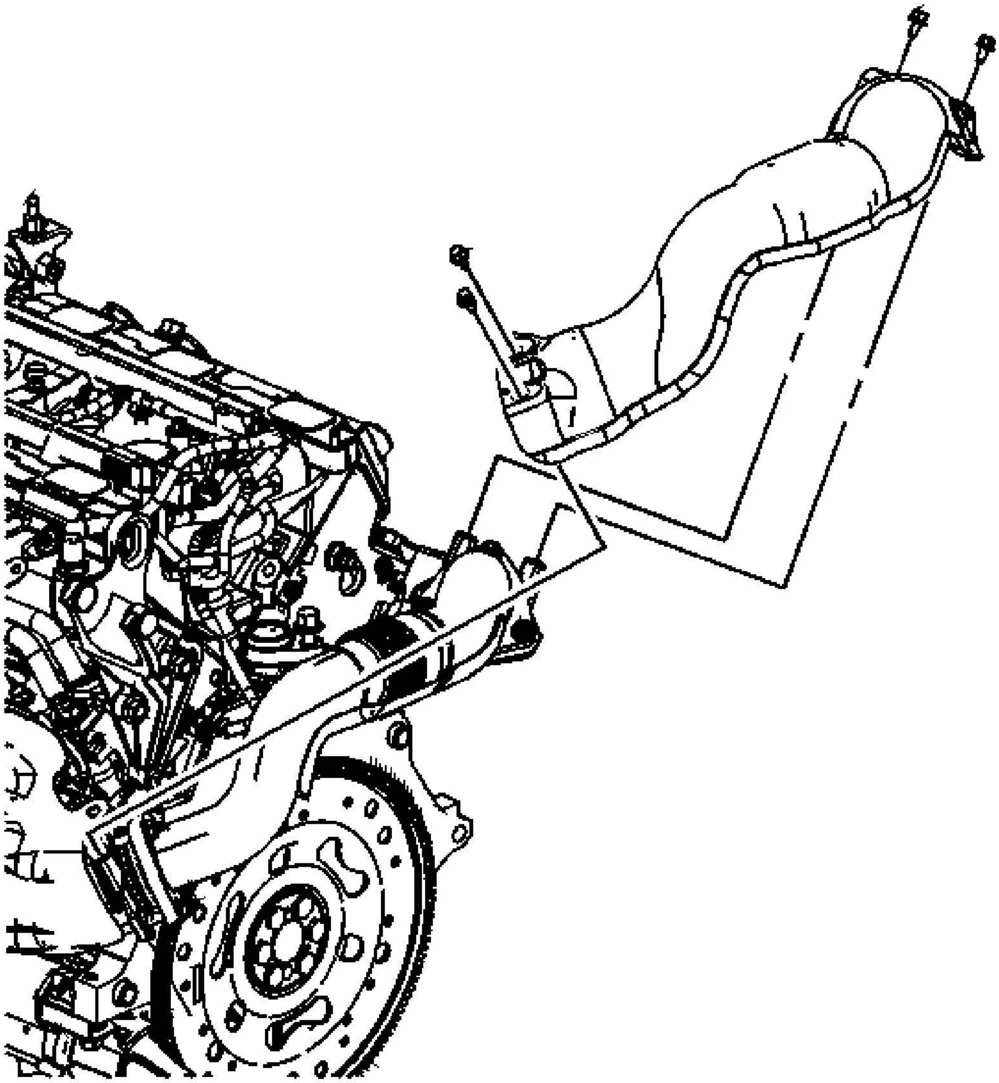


Fig. 270: Identifying Exhaust Crossover Pipe Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the exhaust crossover heat shield pipe bolts.
2. Remove the exhaust crossover heat shield.

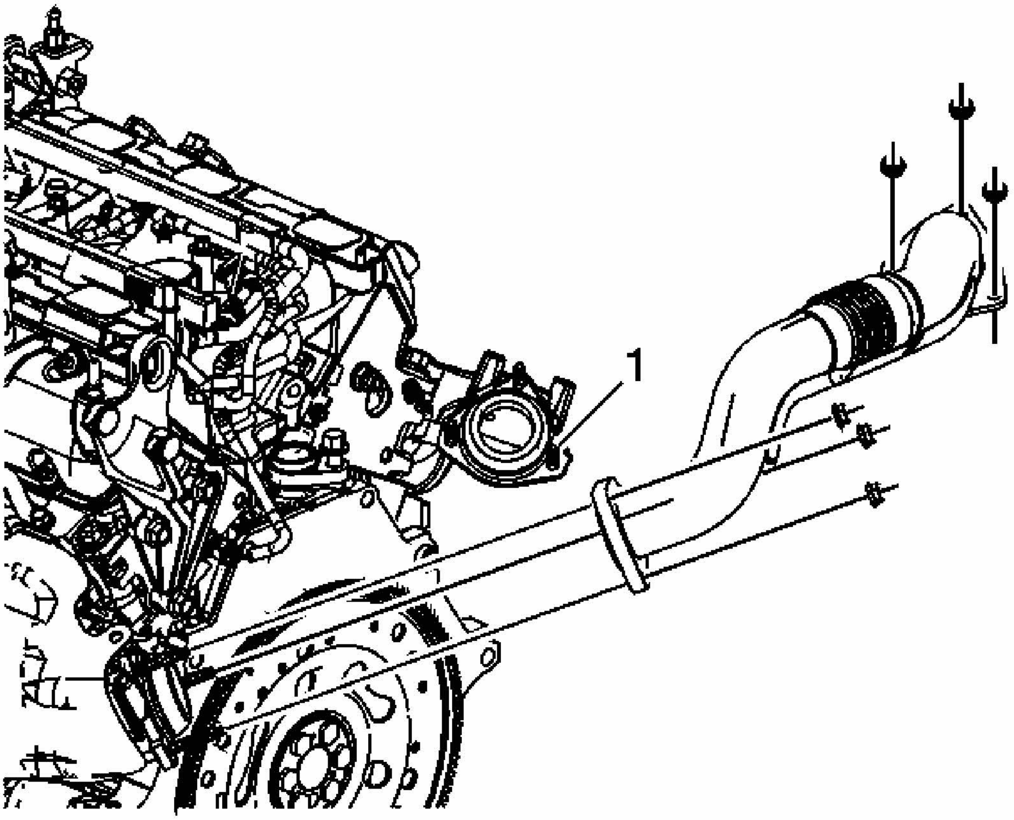


Fig. 271: Identifying Exhaust Crossover Pipe & Nuts
Courtesy of GENERAL MOTORS CORP.

3. Remove the exhaust crossover pipe nuts.
4. Remove the exhaust crossover pipe studs (1) if necessary.
5. Remove the exhaust crossover pipe.

EXHAUST MANIFOLD REMOVAL - LEFT

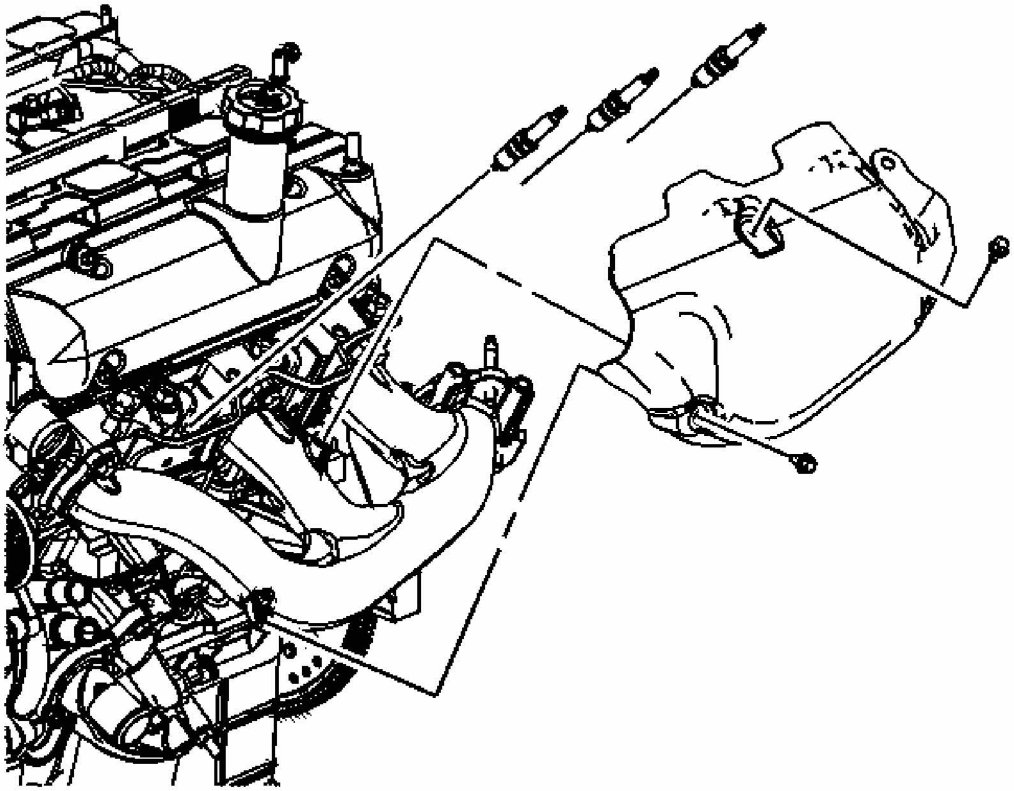


Fig. 272: View Of Spark Plugs & Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug wires and spark plugs.
2. Remove the exhaust manifold heat shield bolts.
3. Remove the exhaust manifold heat shield.

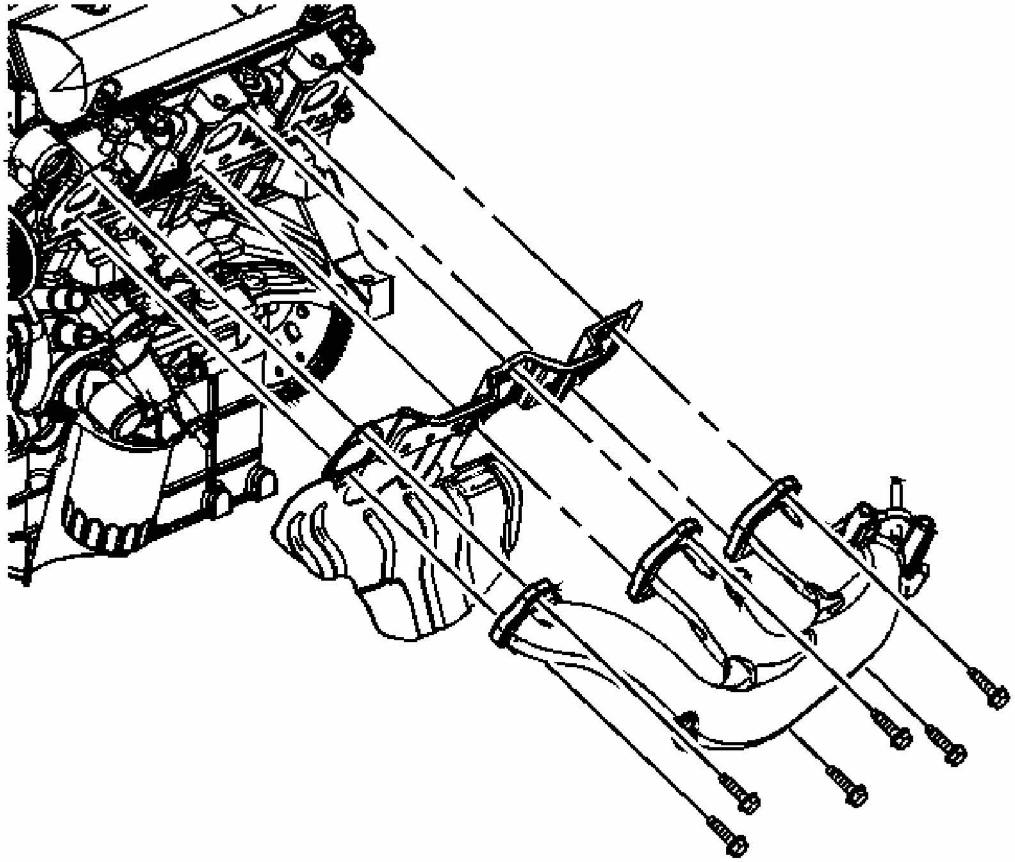


Fig. 273: View Of Left Exhaust Manifold & Gasket
Courtesy of GENERAL MOTORS CORP.

4. Remove the exhaust manifold bolts.
5. Remove the exhaust manifold.
6. Remove the exhaust manifold gasket.

EXHAUST MANIFOLD REMOVAL - RIGHT

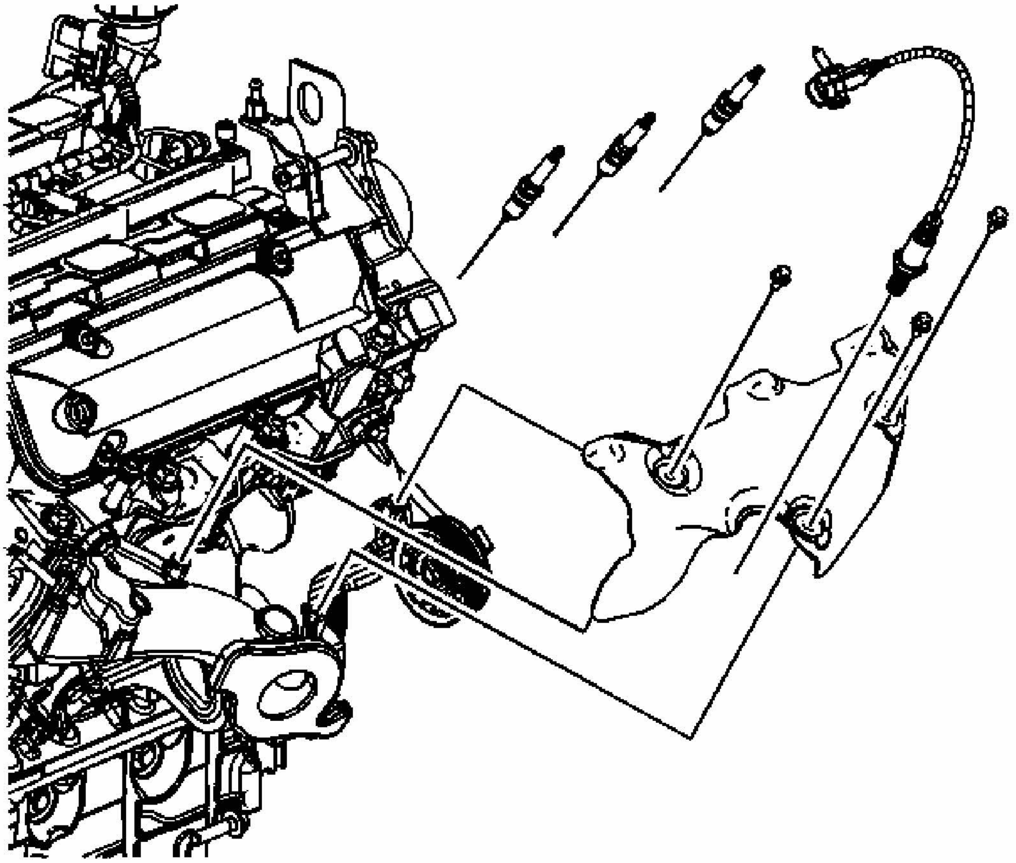


Fig. 274: Identifying Right Side Spark Plugs, HO2S & Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the heated oxygen sensor.
2. Remove the spark plug wires and spark plugs.
3. Remove the exhaust manifold heat shield bolts.
4. Remove the exhaust manifold heat shield.

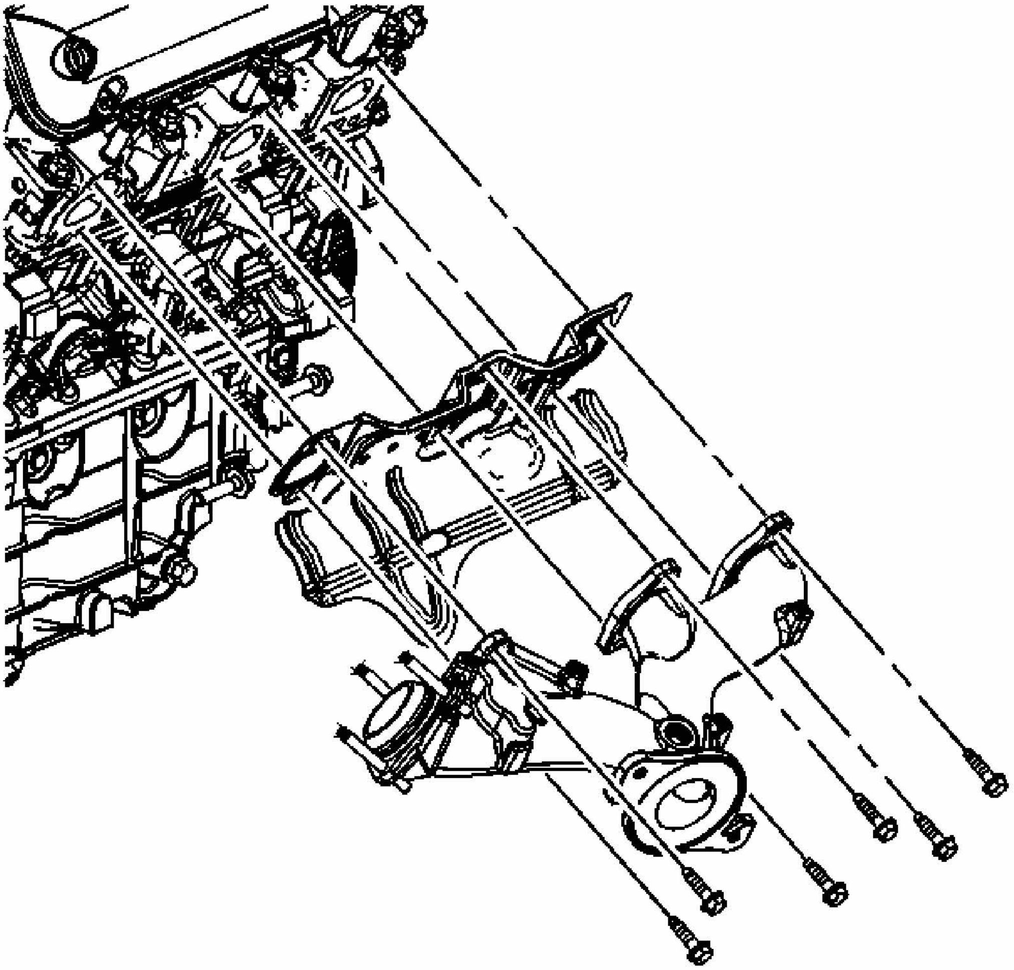


Fig. 275: View Of Right Exhaust Manifold & Gasket
Courtesy of GENERAL MOTORS CORP.

5. Remove the exhaust manifold bolts.
6. Remove the exhaust manifold.
7. Remove the exhaust manifold gasket.

WATER OUTLET AND THERMOSTAT REMOVAL

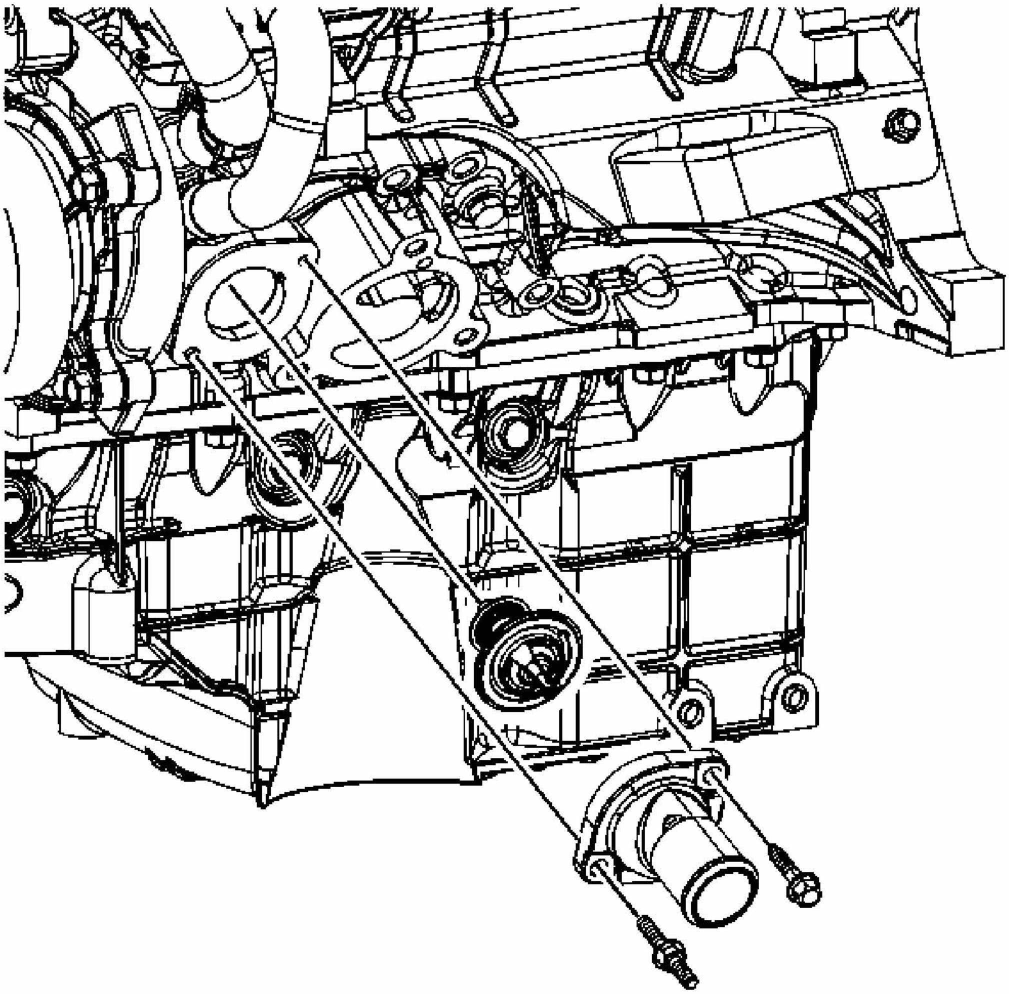


Fig. 276: Identifying Thermostat Housing Bolt/Stud
Courtesy of GENERAL MOTORS CORP.

1. Remove the water outlet bolts.
2. Remove the water outlet.
3. Remove the thermostat.

VALVE ROCKER ARM COVER REMOVAL - LEFT

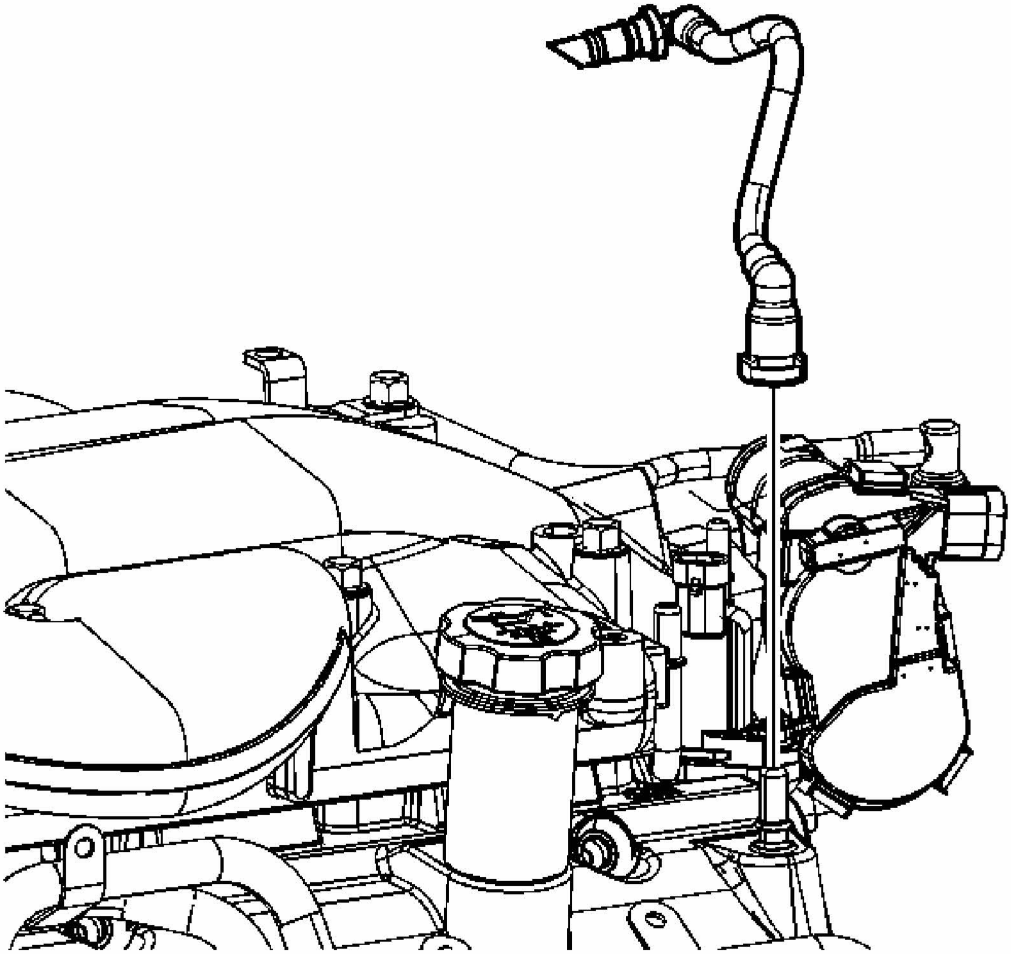


Fig. 277: Locating Positive Crankcase Ventilation Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the positive crankcase ventilation (PCV) tube.

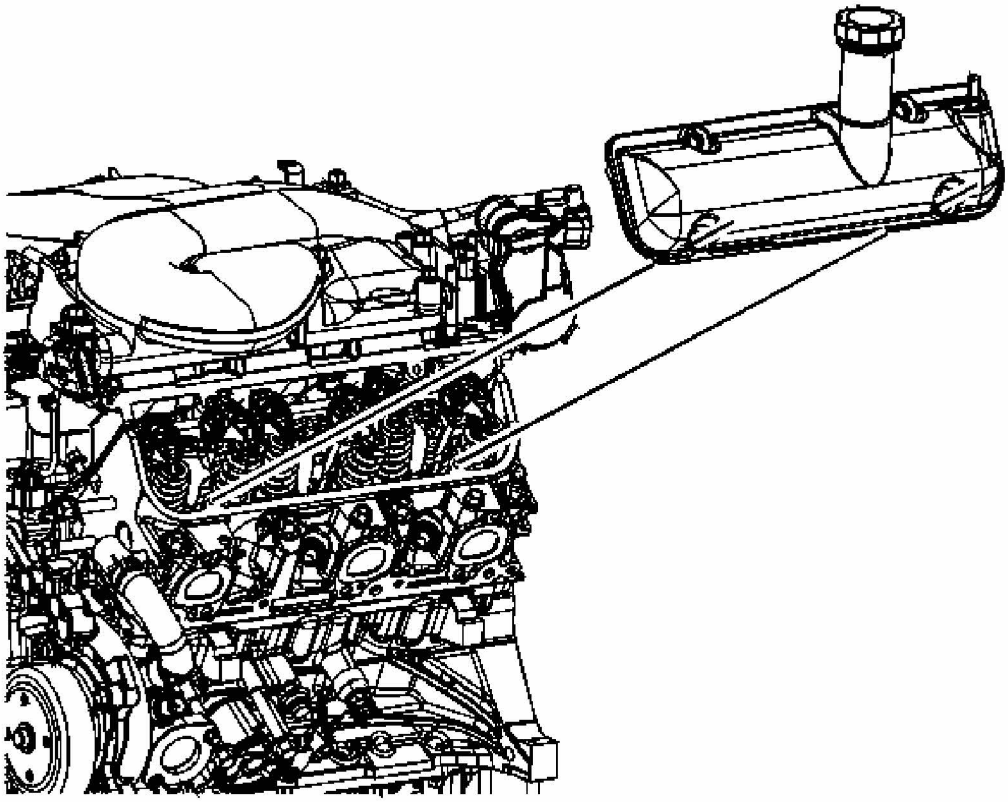


Fig. 278: Identifying Left Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

2. Remove the valve rocker arm cover bolts.

IMPORTANT: When removing the valve rocker arm cover make sure the gasket stays in place attached to the cylinder head.

3. Remove the valve rocker arm cover.
4. Cut the room temperature vulcanizing (RTV) in the channel where the intake, cylinder head and valve rocker arm cover meet with a suitable tool.
5. Remove the valve rocker arm cover gasket.

VALVE ROCKER ARM COVER REMOVAL - RIGHT

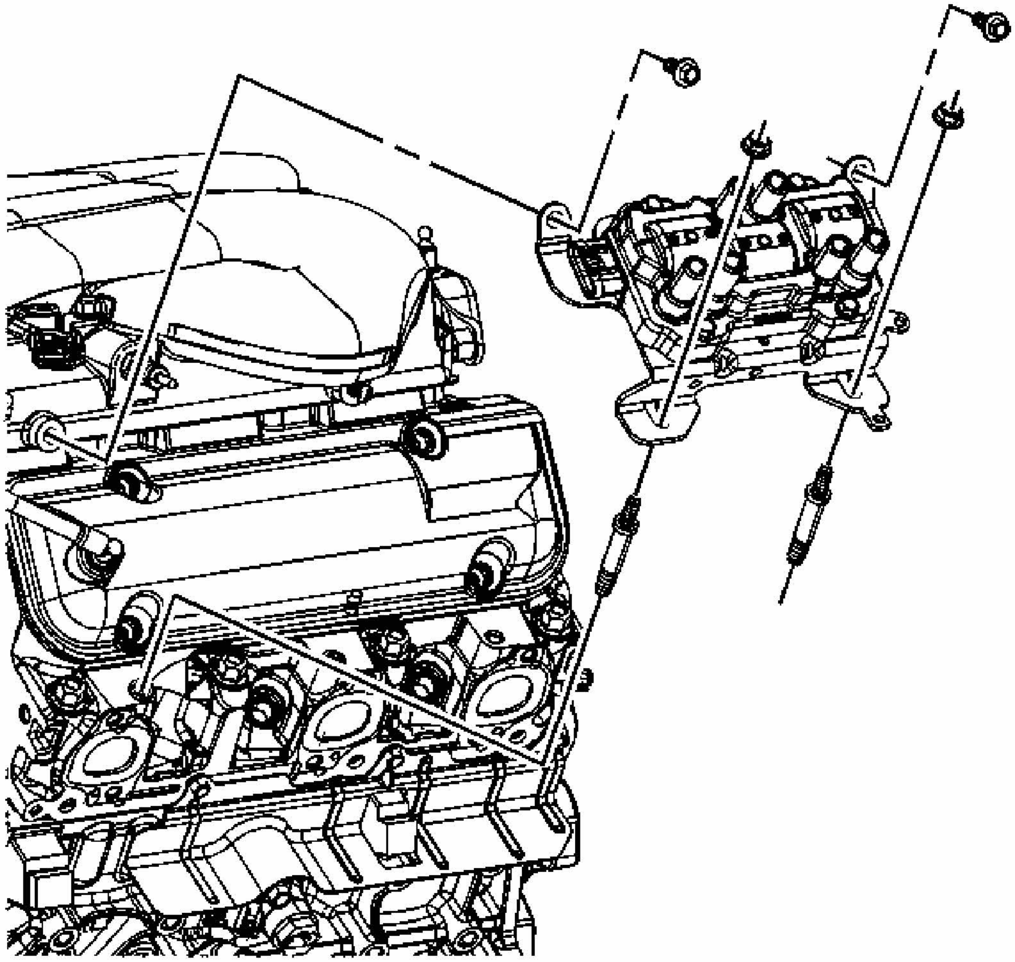


Fig. 279: Identifying Ignition Coil Assembly, Studs & Nuts
Courtesy of GENERAL MOTORS CORP.

1. Remove any remaining spark plug wires from their retainers.
2. Remove the ignition coil assembly bolts and nuts.
3. Remove the ignition coil assembly.
4. Remove the ignition coil assembly studs, if necessary.

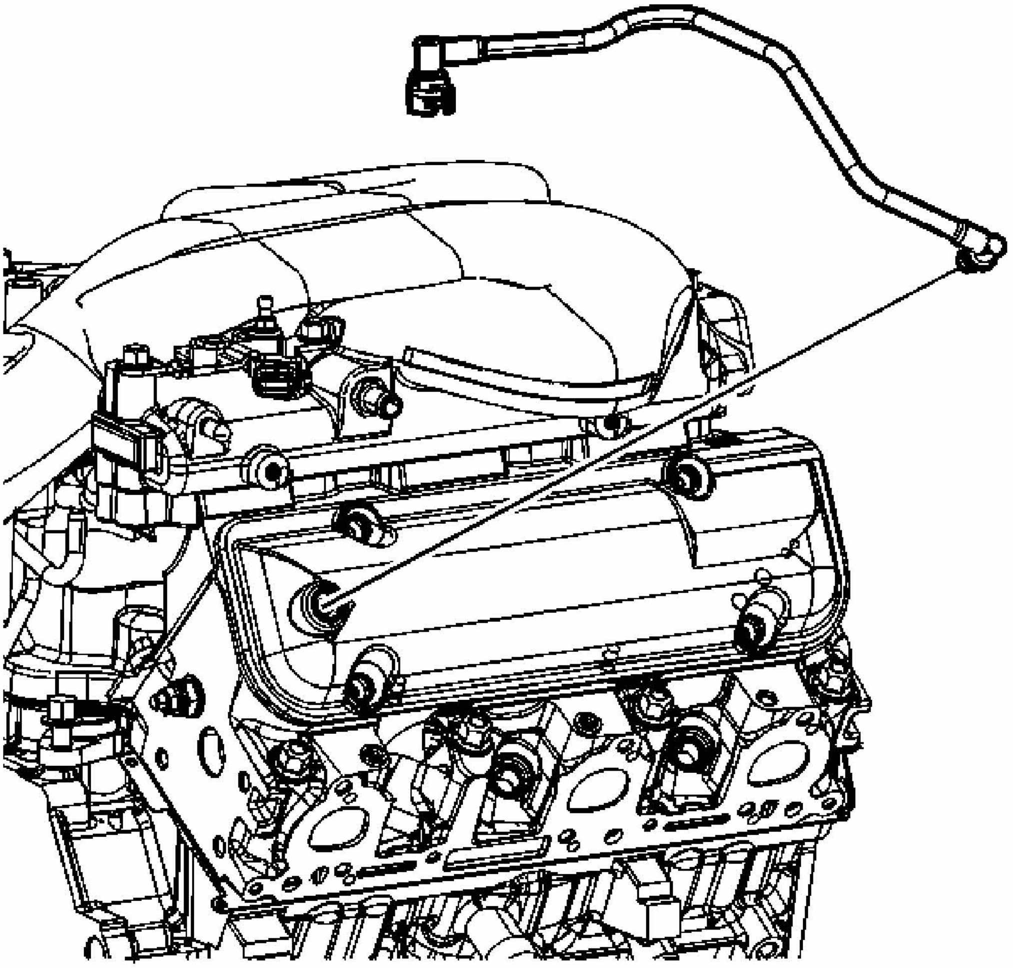


Fig. 280: Identifying Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Remove the fresh air tube from the valve rocker arm cover.

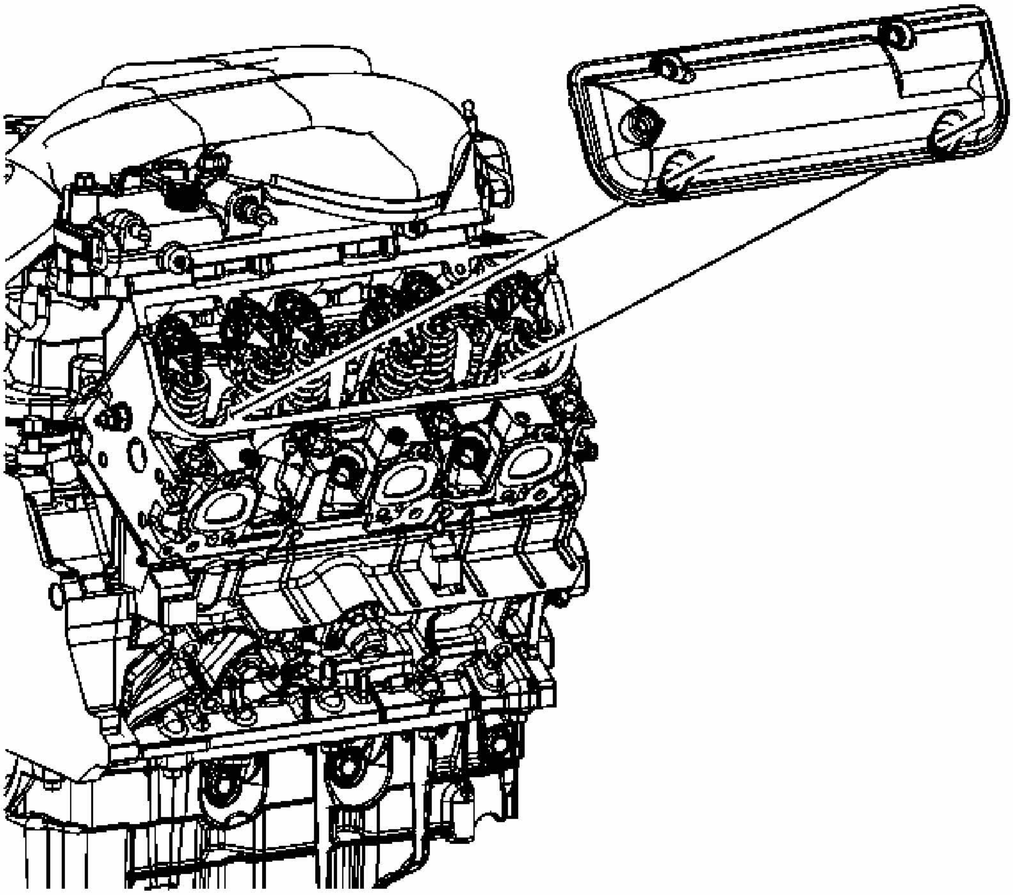


Fig. 281: View Of Right Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

6. Remove the valve rocker arm cover bolts.

IMPORTANT: When removing the valve rocker arm cover make sure the gasket stays in place attached to the cylinder head.

7. Remove the valve rocker arm cover.
8. Cut the room temperature vulcanizing (RTV) in the channel where the intake, cylinder head and valve rocker arm cover meet with a suitable tool.
9. Remove the valve rocker arm cover gasket.

INTAKE MANIFOLD REMOVAL - UPPER

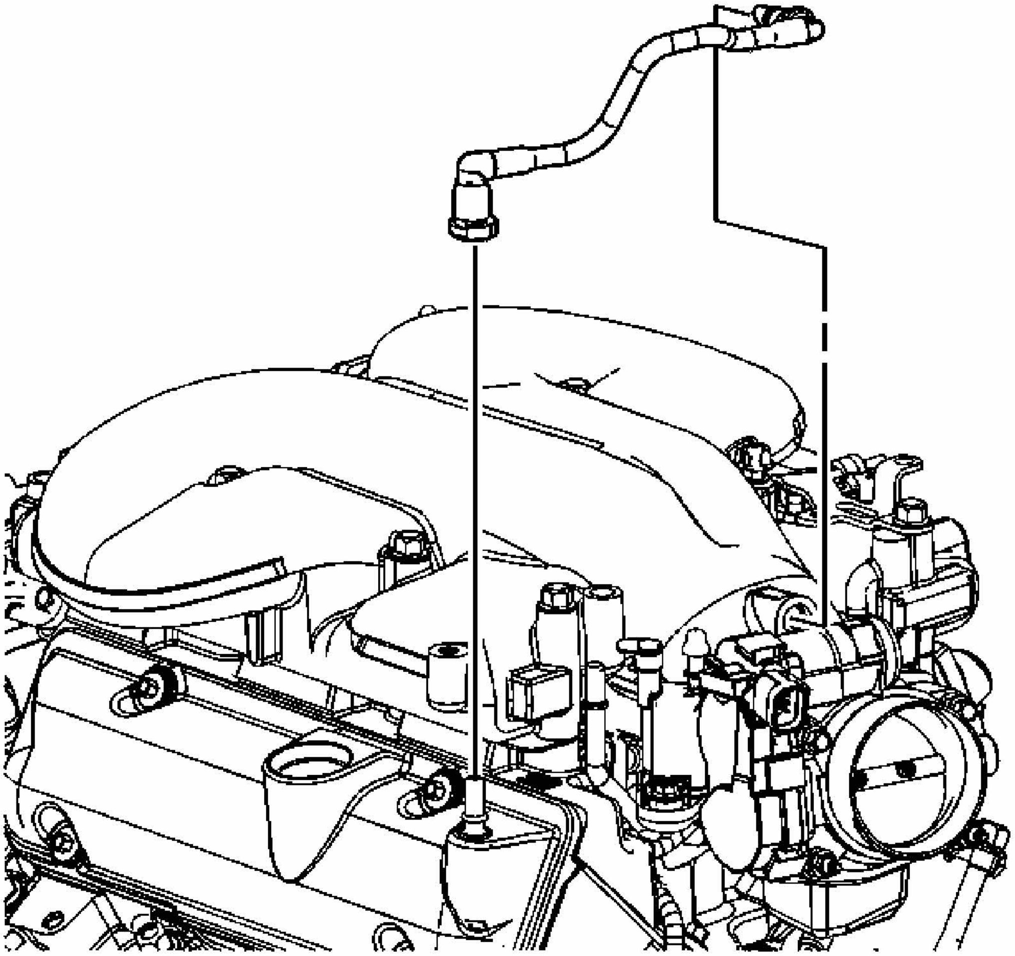


Fig. 282: Identifying PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the foul air PCV tube.

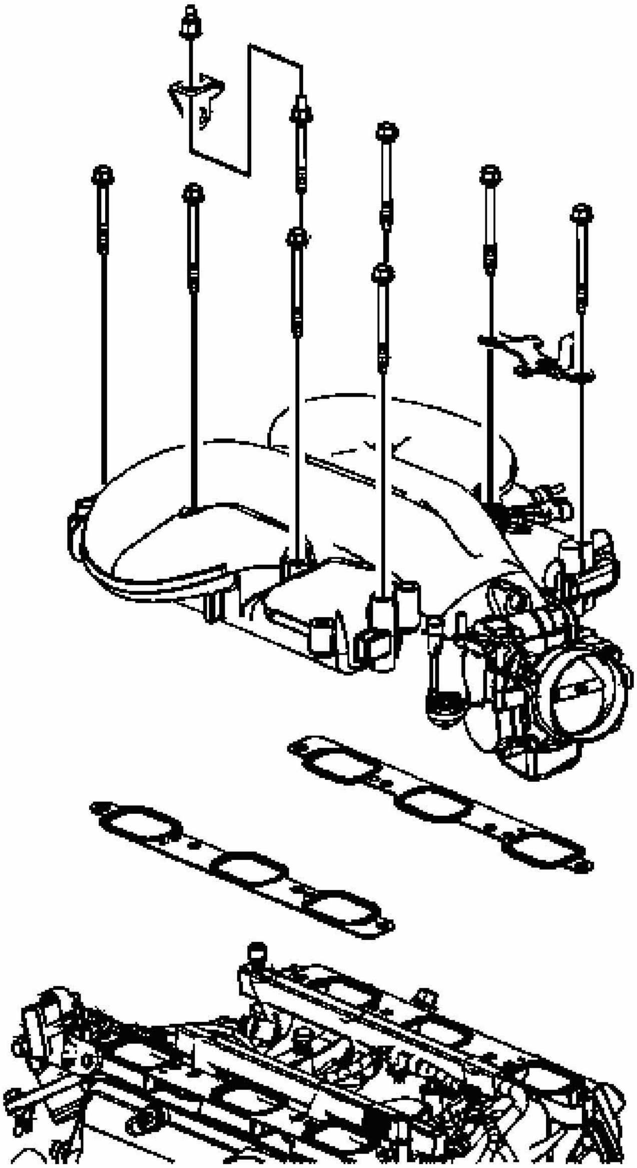


Fig. 283: View Of Upper Intake Manifold Bolts, Studs & Gaskets
Courtesy of GENERAL MOTORS CORP.

2. Remove the upper intake manifold bolts, stud, and manifold absolute pressure (MAP) sensor bracket.
3. Remove the upper intake manifold and gaskets.

INTAKE MANIFOLD REMOVAL - LOWER

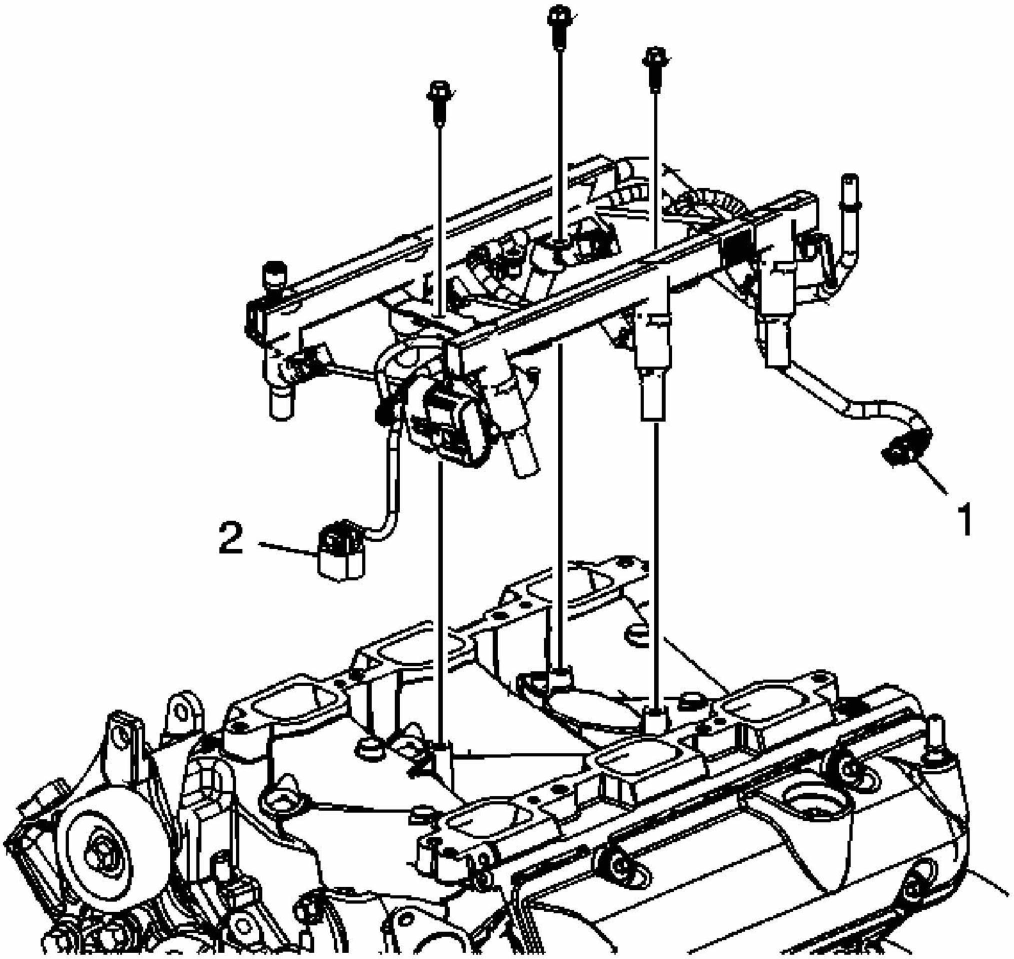


Fig. 284: Identifying Lower Intake Manifold Attachments
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the coolant temperature sensor (1).
2. Disconnect the camshaft position (CMP) sensor (2).
3. Remove the fuel injector rail bolts.
4. Remove the fuel rail assembly.

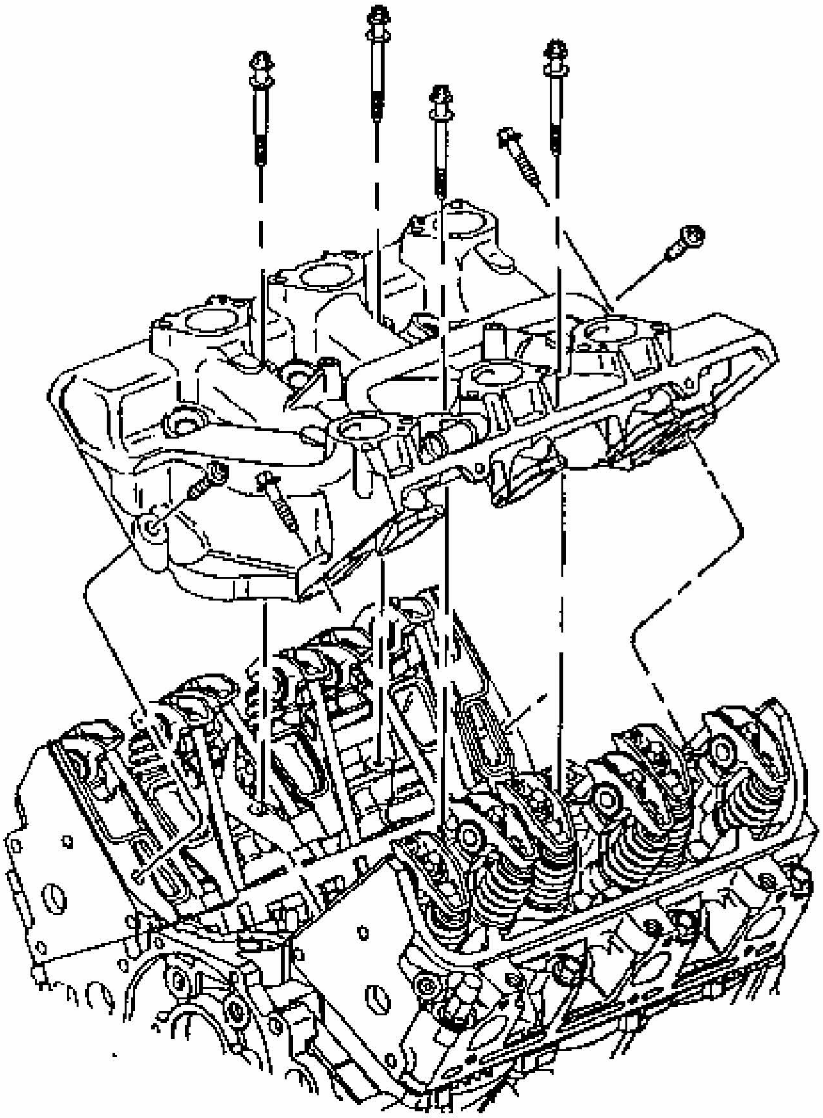


Fig. 285: View Of Lower Intake Manifold & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the lower intake manifold bolts and discard.
6. Remove the lower intake manifold.

VALVE ROCKER ARM AND PUSH ROD REMOVAL

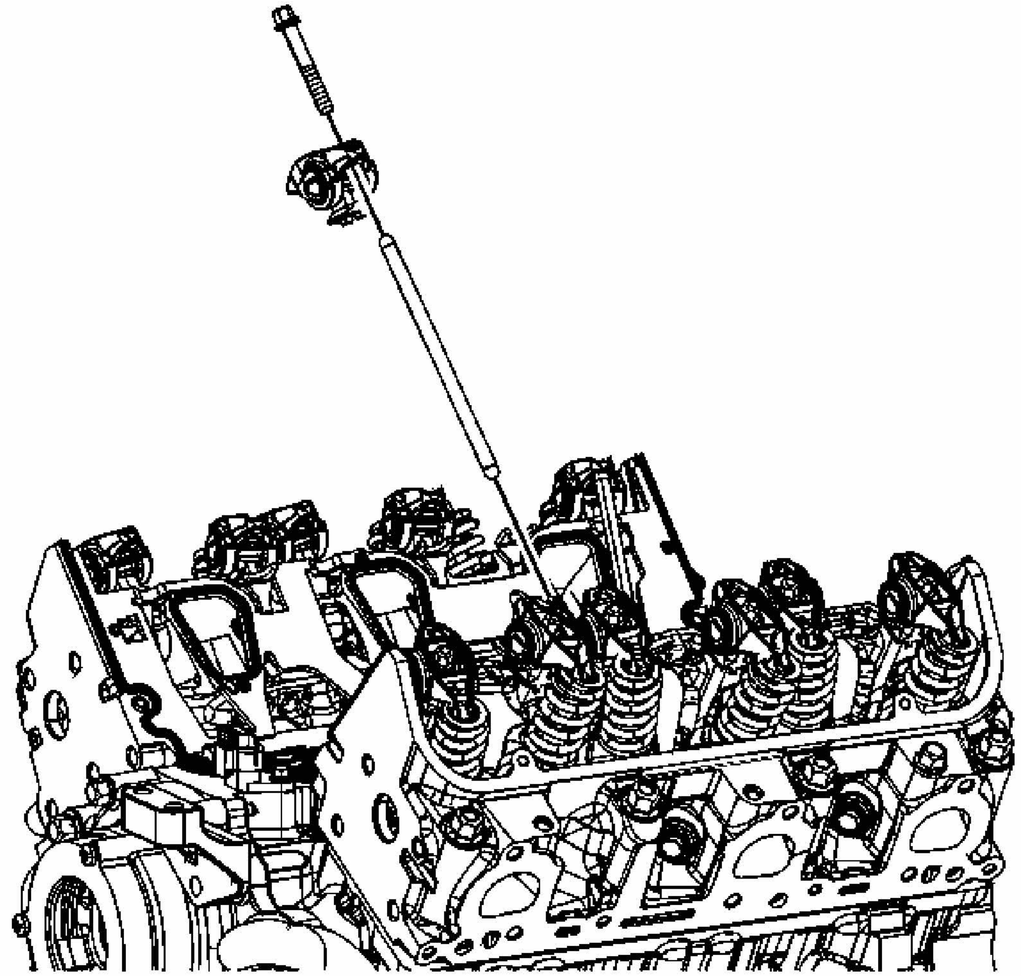


Fig. 286: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Loosen the valve rocker arm bolts.

IMPORTANT: Place the valve train components in a rack in order to ensure that the components are installed in the same location from which they where removed.

2. Remove the valve rocker arms.
3. Remove the push rods.
    - The intake push rods measure 147.51 mm (5.81 in).
    - The exhaust push rods measure 154.87 mm (6.1 in).

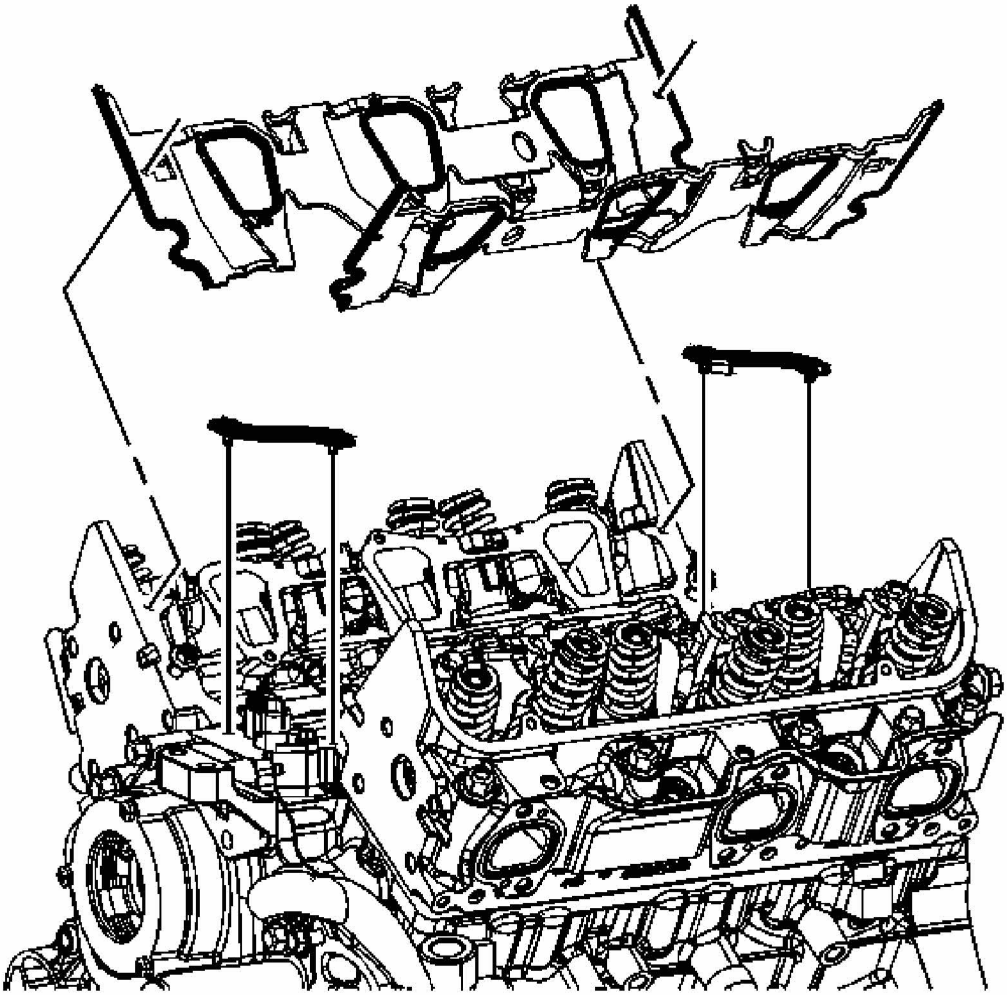


Fig. 287: Identifying Intake Manifold Gaskets & Seals
Courtesy of GENERAL MOTORS CORP.

4. Remove the intake manifold gaskets.

VALVE LIFTER REMOVAL

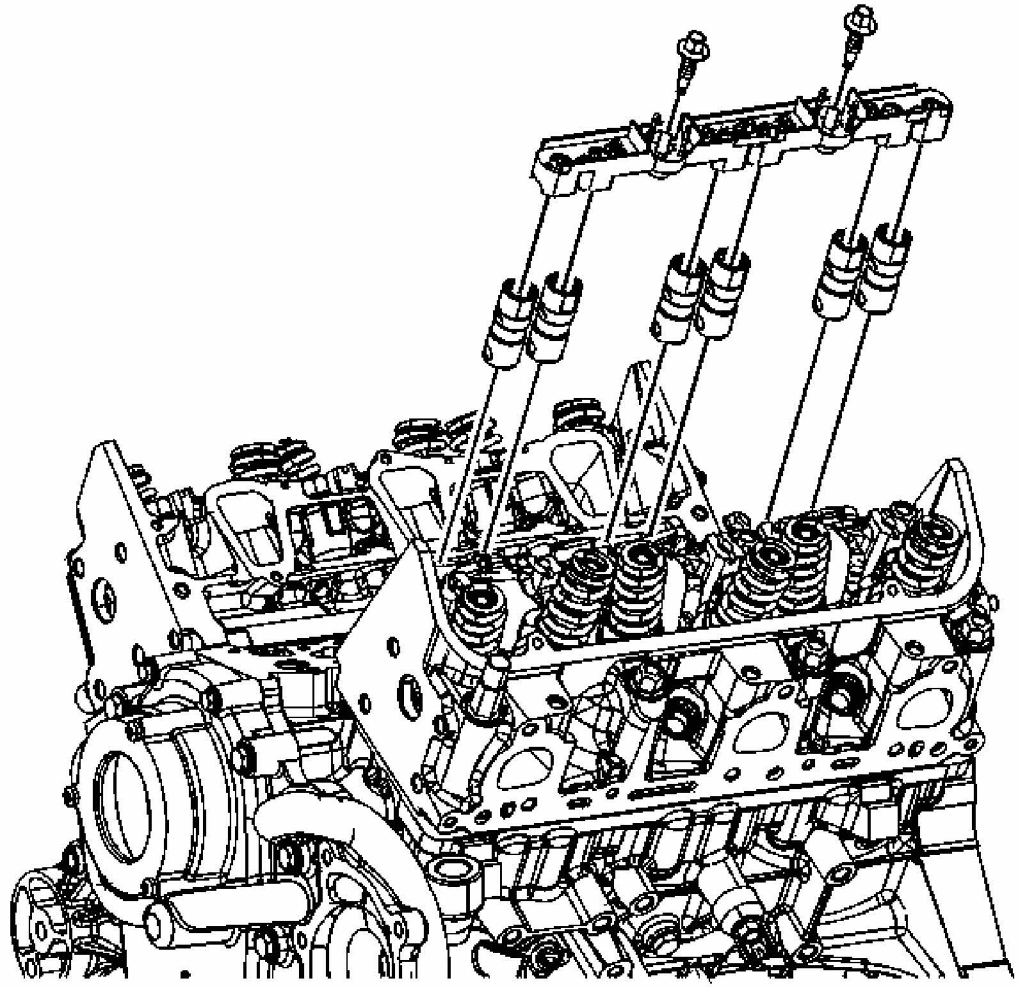


Fig. 288: View Of Valve Lifter Guides
Courtesy of GENERAL MOTORS CORP.

1. Remove the valve lifter guide bolts.
2. Remove the valve lifter guides.

IMPORTANT: Once removed, place the valve lifters in an organized order so the valve lifters can be installed into the original locations.

3. Remove the valve lifters.

WATER PUMP REMOVAL

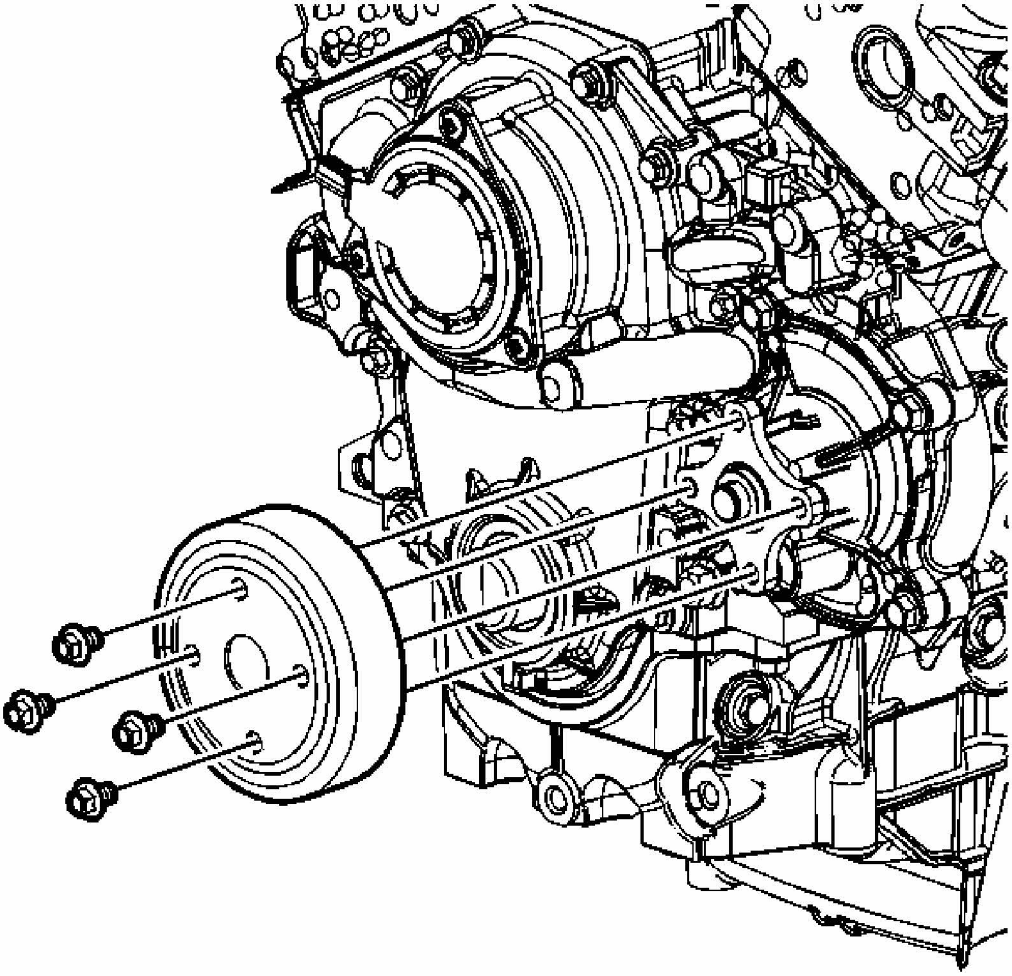


Fig. 289: View Of Water Pump Pulley & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the water pump pulley bolts.
2. Remove the water pump pulley.

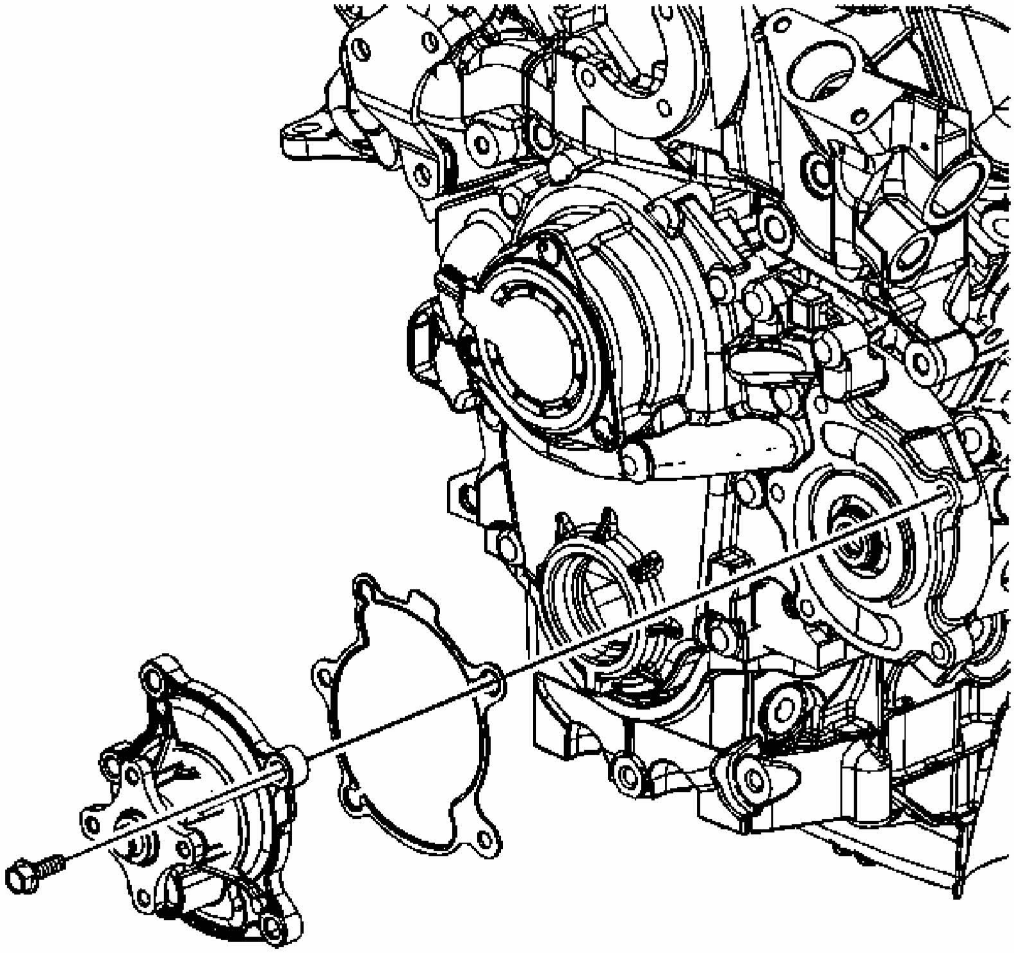


Fig. 290: View Of Water Pump, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

3. Remove the water pump bolts.
4. Remove the water pump.
5. Remove the water pump gasket.

CYLINDER HEAD REMOVAL - LEFT

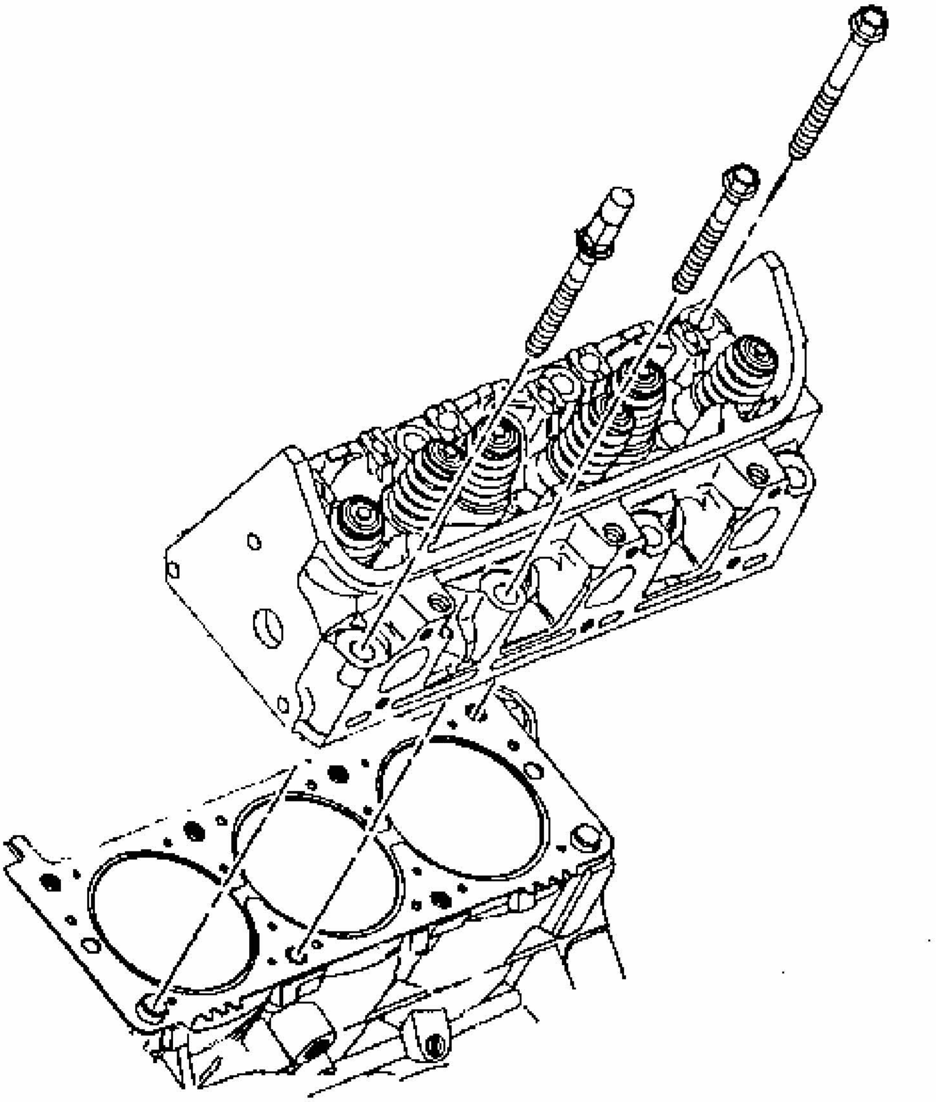


Fig. 291: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

1. Remove the cylinder head bolt and discards.
2. Remove the cylinder head.

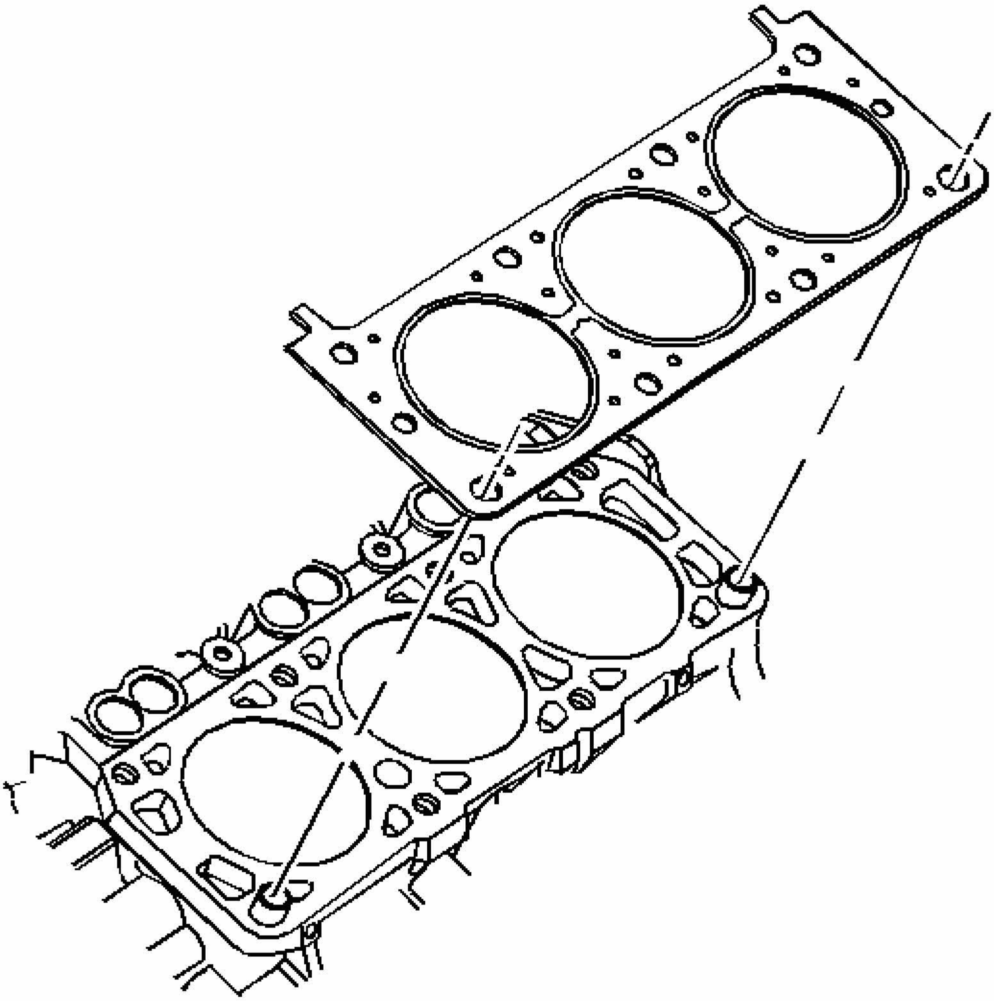


Fig. 292: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Remove the cylinder head gasket.
4. Remove the cylinder head locator dowel pins, if required.

CYLINDER HEAD REMOVAL - RIGHT

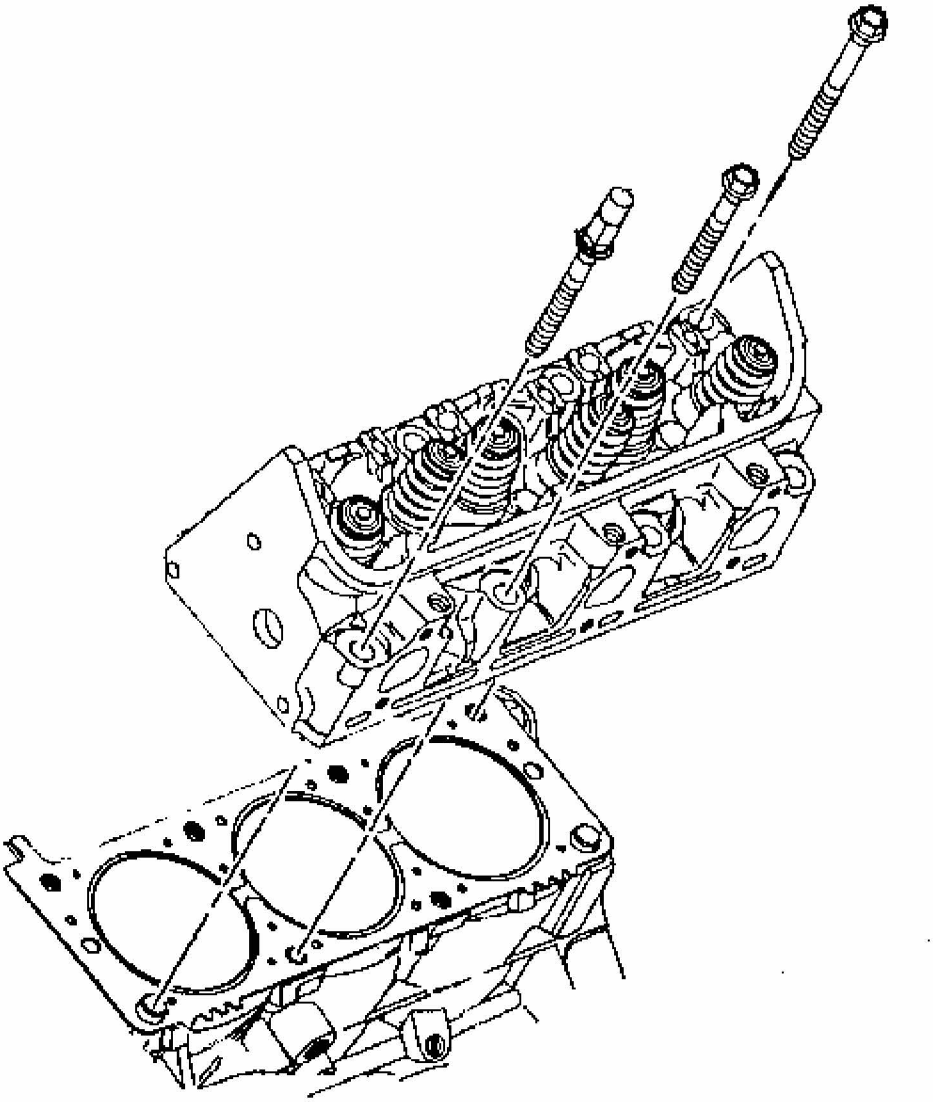


Fig. 293: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

1. Remove the cylinder head bolts and discard.
2. Remove the cylinder head.

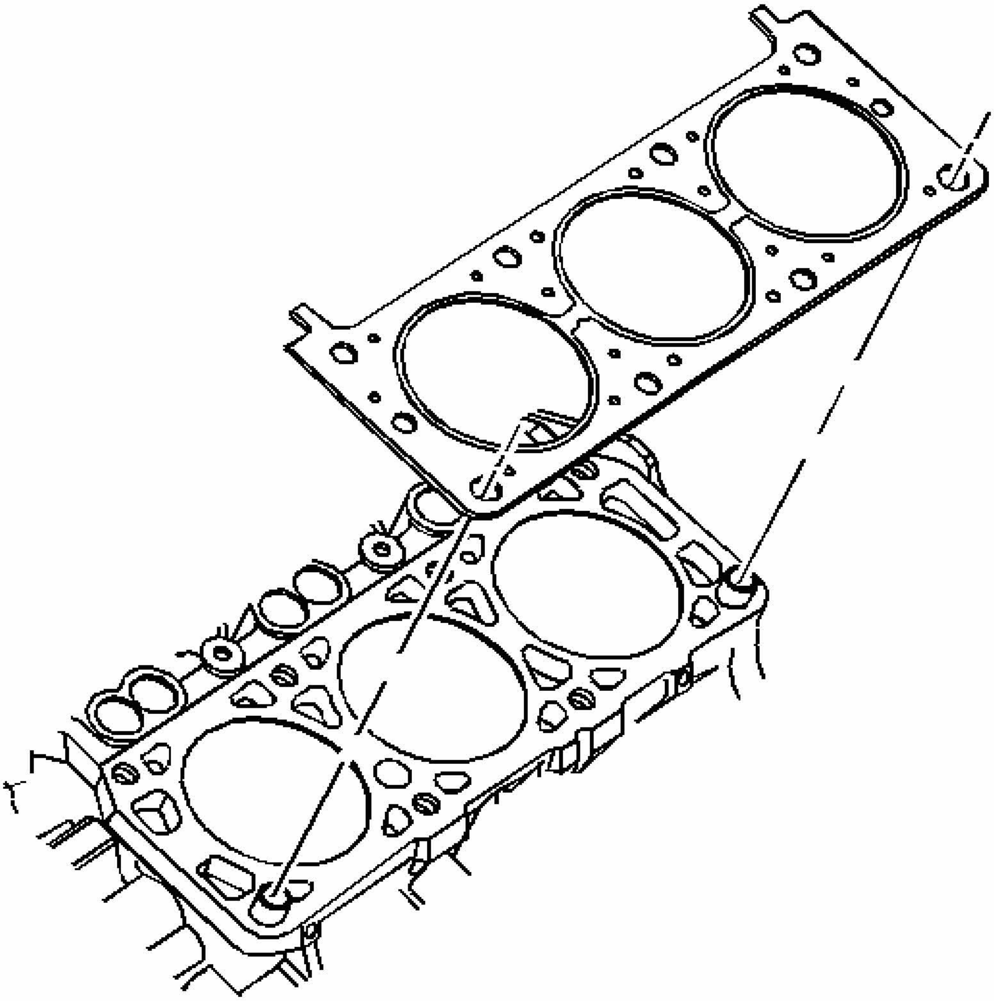


Fig. 294: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Remove the cylinder head gasket.
4. Remove the cylinder head locator dowel pins, if required.

OIL PAN REMOVAL

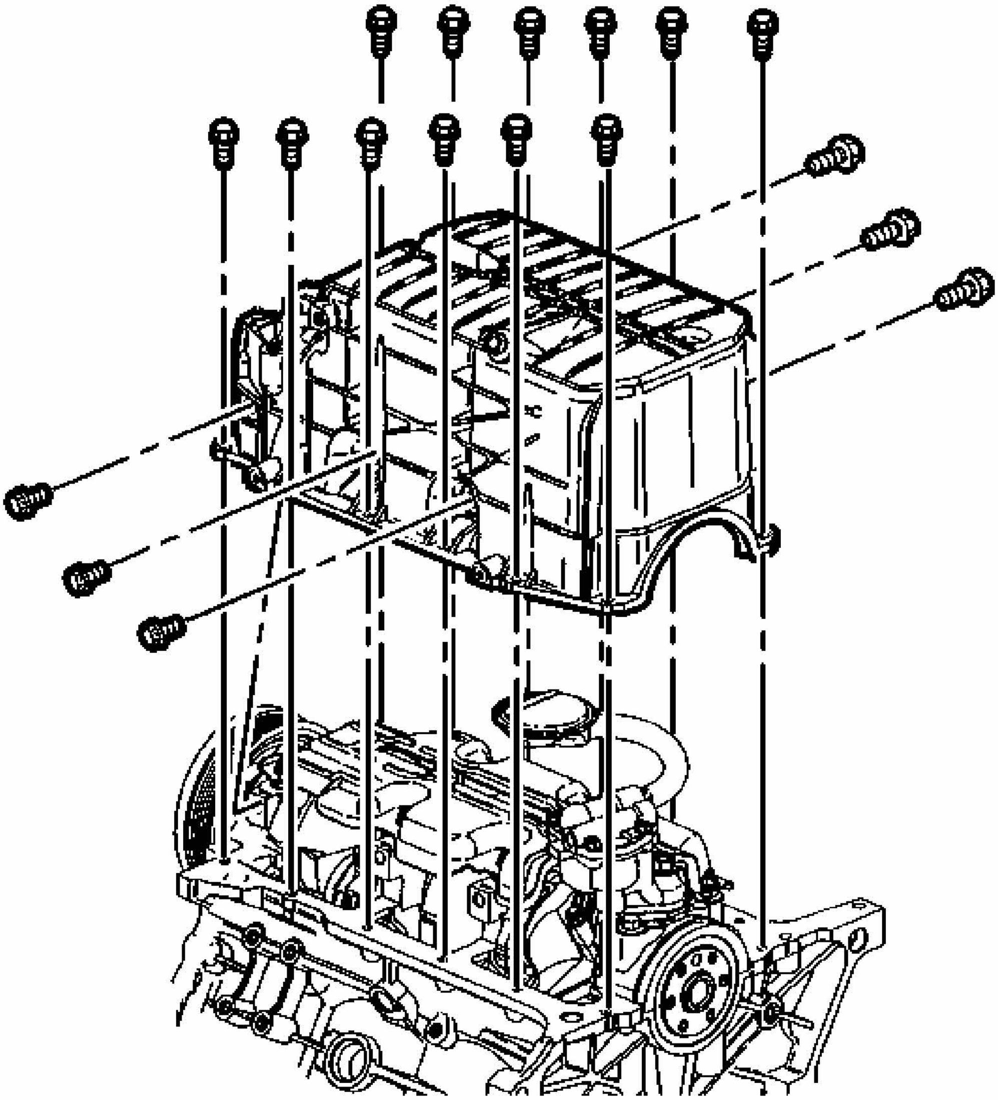


Fig. 295: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pan support bracket bolts and brackets as needed
2. Remove the oil pan side bolts.
3. Remove the oil pan bolts.
4. Remove the oil pan.
5. Remove the oil pan gasket.

OIL PUMP REMOVAL

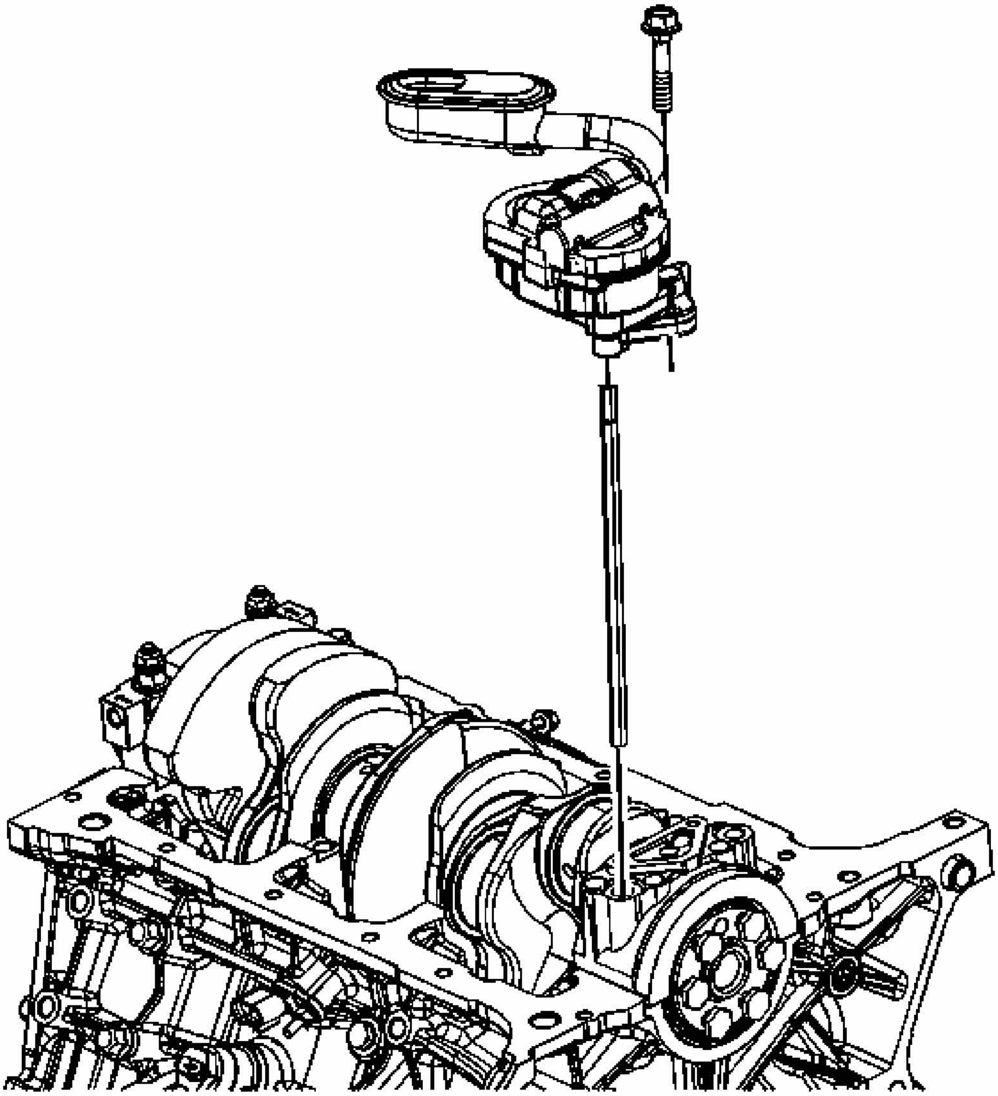


Fig. 296: View Of Oil Pump & Oil Pump Drive Shaft
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pump bolt.
2. Remove the oil pump and oil pump drive shaft.

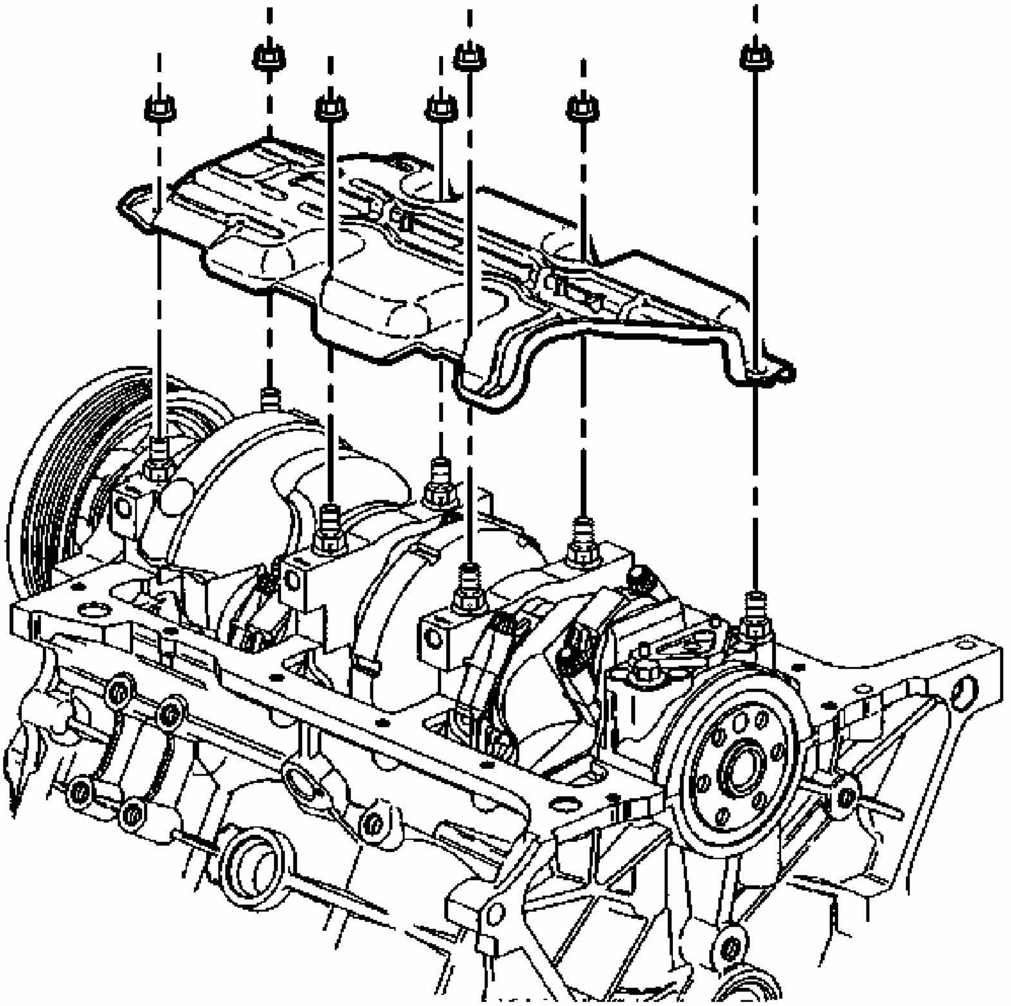


Fig. 297: View Of Crankshaft Oil Deflector & Nuts
Courtesy of GENERAL MOTORS CORP.

3. Remove the crankshaft oil deflector nuts.
4. Remove the crankshaft oil deflector.

CAMSHAFT POSITION ACTUATOR MAGNET REMOVAL

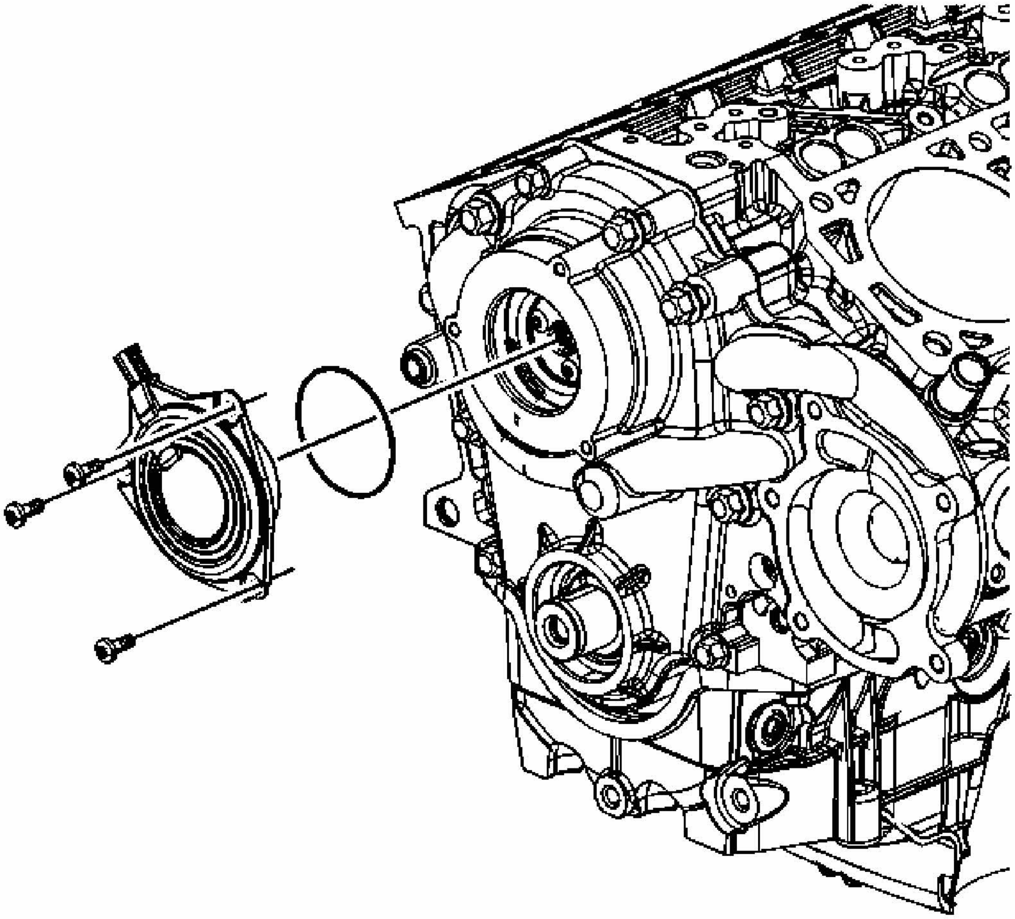


Fig. 298: Identifying Camshaft Position Actuator Magnet & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the camshaft position actuator magnet bolts.
2. Remove the camshaft position actuator magnet and O-ring seal.

OIL PUMP DRIVE REMOVAL

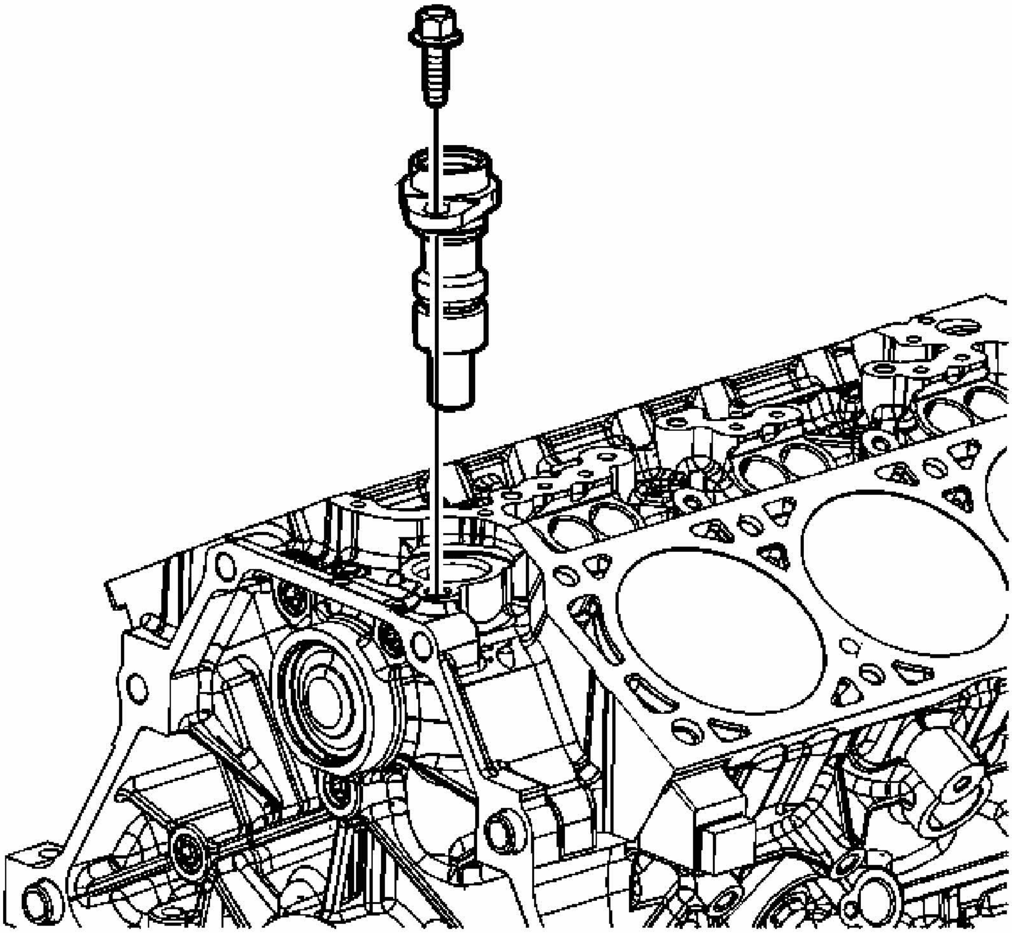


Fig. 299: Identifying Oil Pump Drive
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pump drive clamp bolt.
2. Remove the oil pump drive clamp.
3. Remove the oil pump drive.

CRANKSHAFT FRONT OIL SEAL REMOVAL

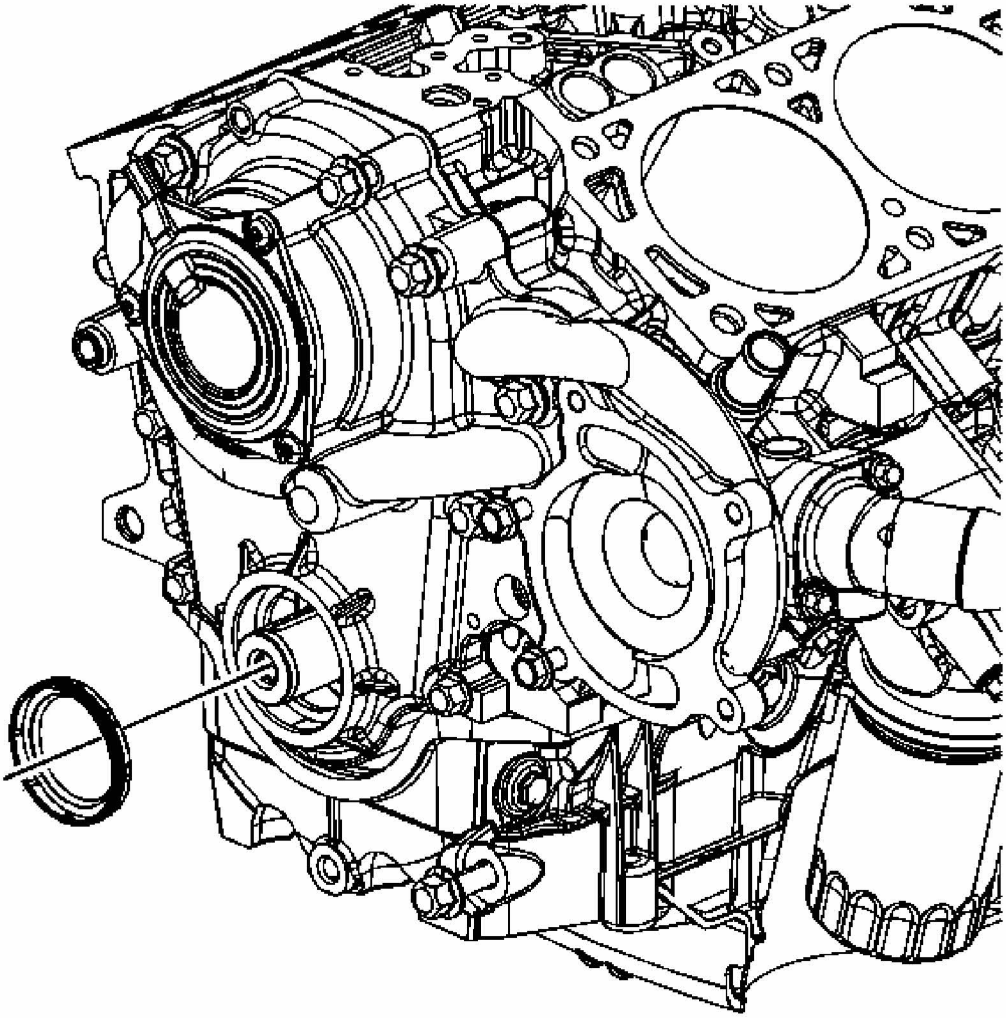


Fig. 300: Identifying Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

Pry out the crankshaft front oil seal using a suitable tool. Use care not to damage the engine front cover or the crankshaft.

ENGINE FRONT COVER REMOVAL

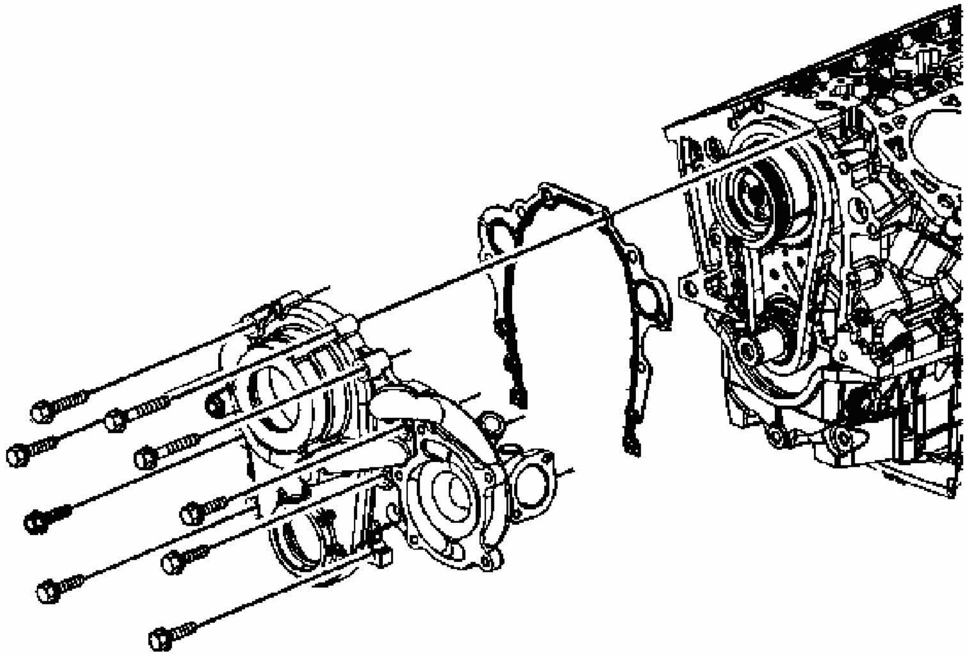


Fig. 301: Identifying Engine Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine front cover bolts.
2. Remove the engine front cover.
3. Remove the engine front cover gasket.

TIMING CHAIN AND SPROCKETS REMOVAL

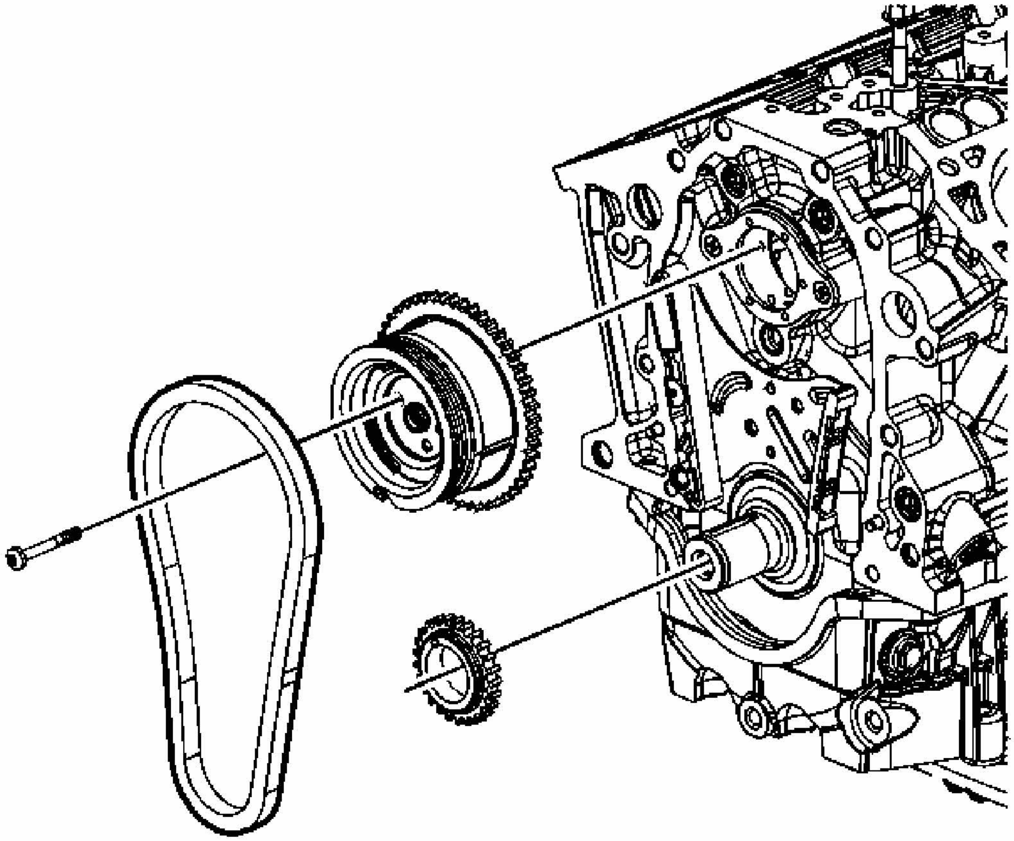


Fig. 302: View Of Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

1. Remove the camshaft sprocket bolts.
2. Remove the timing chain and sprockets.

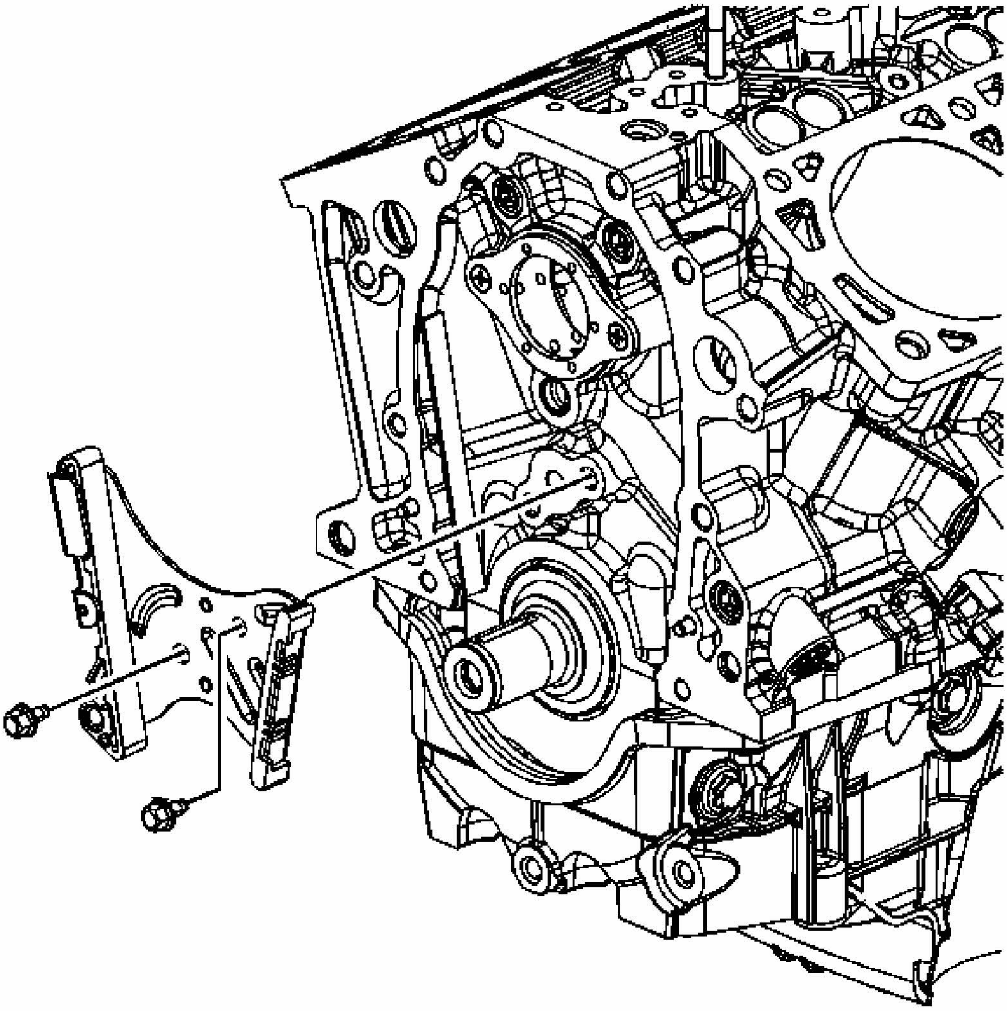


Fig. 303: View Of Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the timing chain tensioner bolts.
4. Remove the timing chain tensioner.

CAMSHAFT REMOVAL

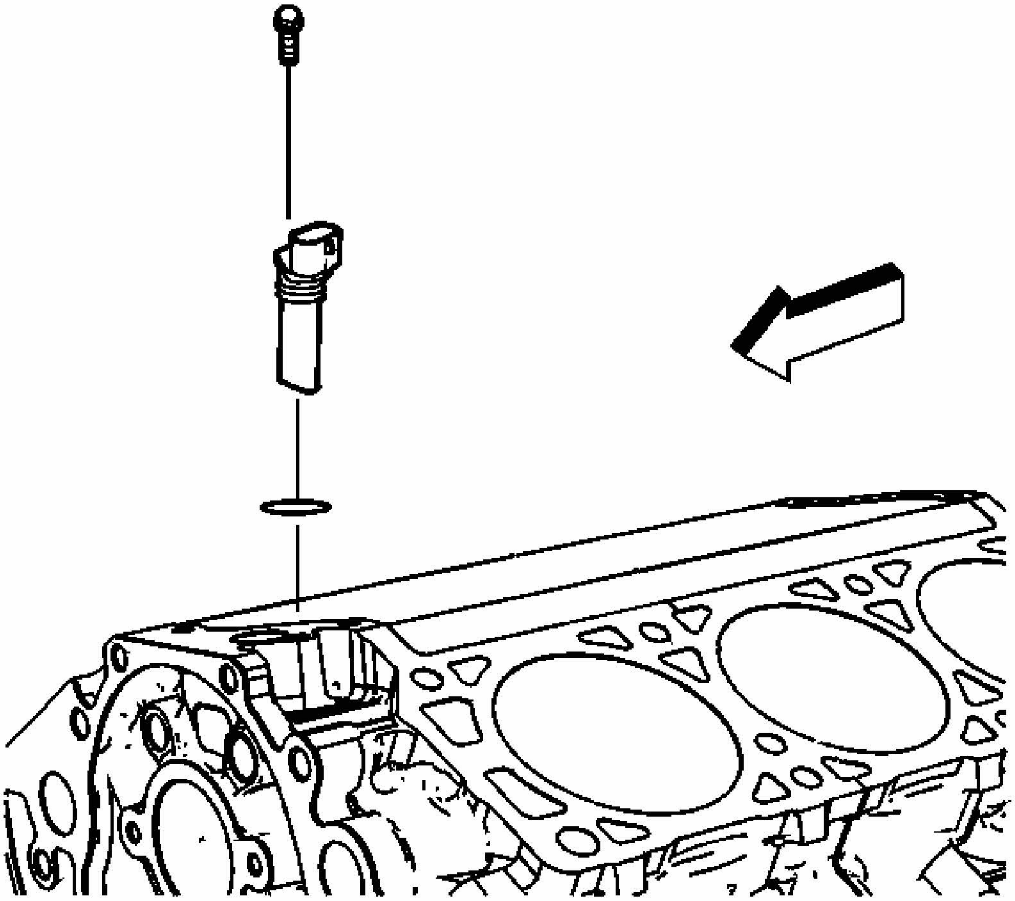


Fig. 304: View Of Camshaft Position Sensor
Courtesy of GENERAL MOTORS CORP.

1. Remove the camshaft position sensor bolt.
2. Remove the camshaft position sensor.

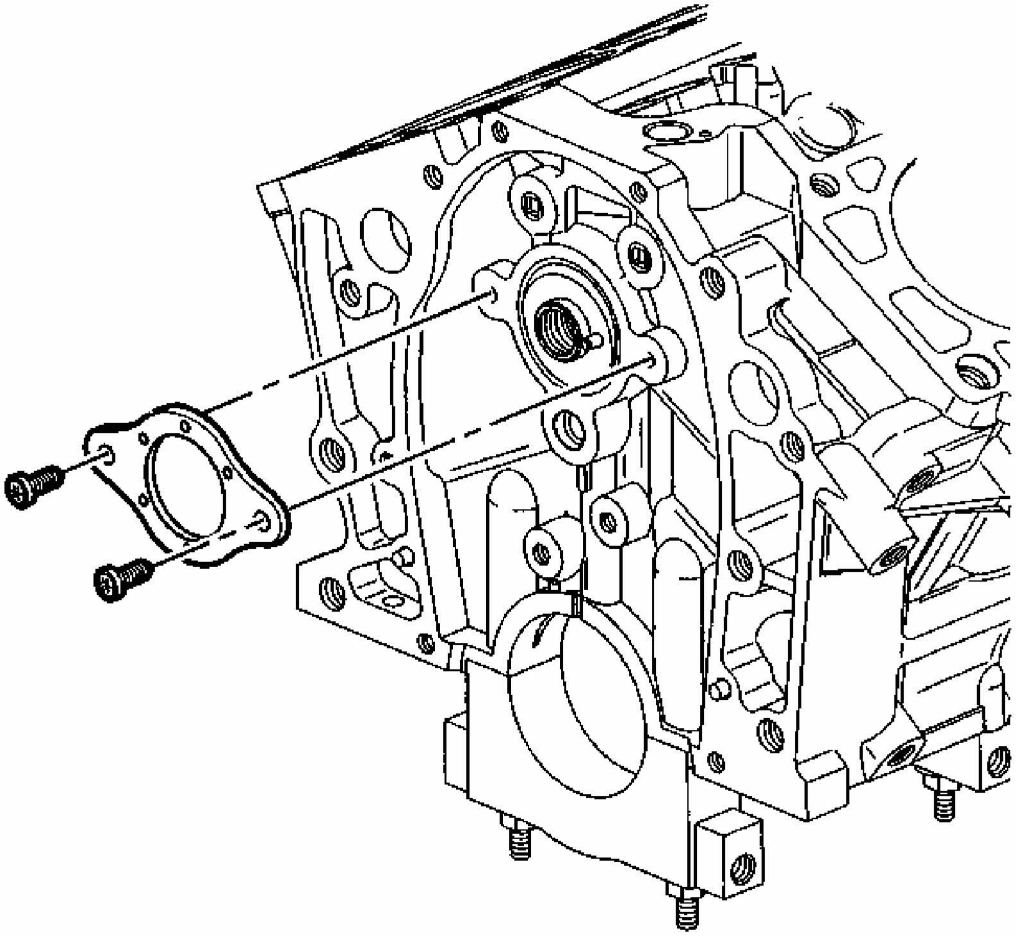


Fig. 305: View Of Camshaft Thrust Plate
Courtesy of GENERAL MOTORS CORP.

3. Remove the camshaft thrust plate screws.
4. Remove the camshaft thrust plate.

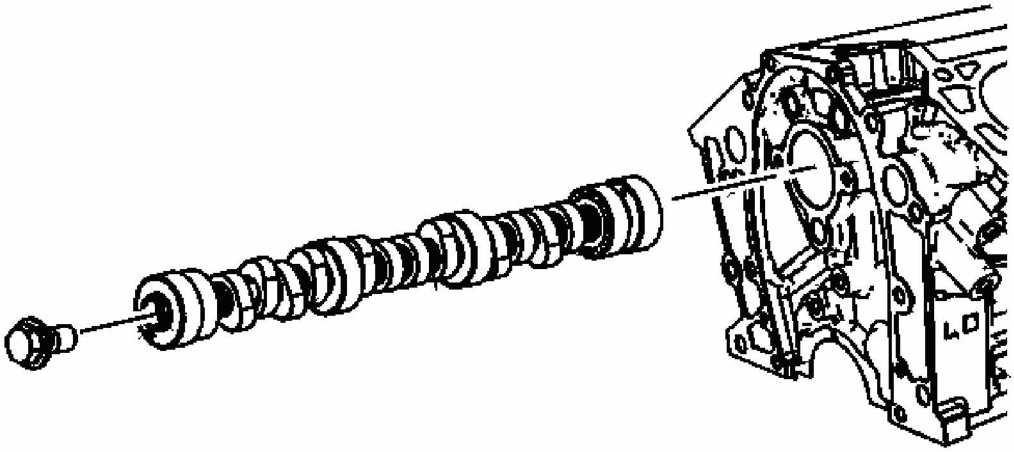


Fig. 306: Inspecting Camshaft Journals
Courtesy of GENERAL MOTORS CORP.

NOTE: All camshaft journals are the same diameter, so care must be used in removing or installing the camshaft to avoid damage to the camshaft bearings.

5. Complete the following steps in order to remove the camshaft.
    1. Install the camshaft sprocket bolt into the camshaft. Tighten finger tight only.
    2. Carefully rotate and remove the camshaft from the engine block.

PISTON, CONNECTING ROD, AND BEARING REMOVAL

Tools Required

- **J 24270** Cylinder Bore Ridge Reamer
- **J 41556** Connecting Rod Guide

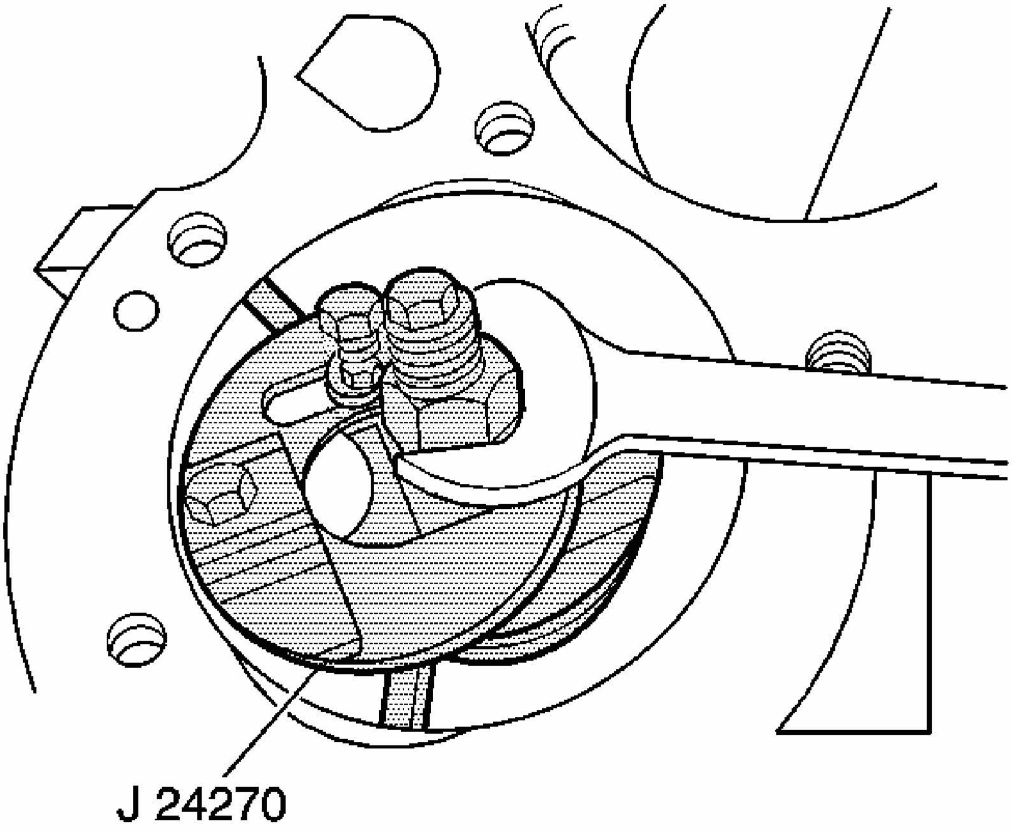


Fig. 307: Removing Cylinder Bore Ring Ridge
Courtesy of GENERAL MOTORS CORP.

1. Mark the piston with the number of the cylinder from which the piston is being removed.
2. Mark the connecting rod and the connecting rod cap in order to ensure correct assembly.

NOTE: **If there is a pronounced ridge at the top of the piston travel, the ridge must be removed with a ridge reamer before the piston and connecting rod assembly are removed. Applying force may break the piston rings or damage the piston.**

3. Use the **J 24270** in order to remove the cylinder bore ring ridge. Complete the following steps:
    1. Turn the crankshaft until the piston is at the bottom of the stroke.
    2. Cover the piston with a cloth.

3. Remove the cylinder ring ridge.
4. Turn the crankshaft until the piston is at the top of the stroke.
5. Remove the cloth.
6. Remove the metal shavings from the cylinder and piston.

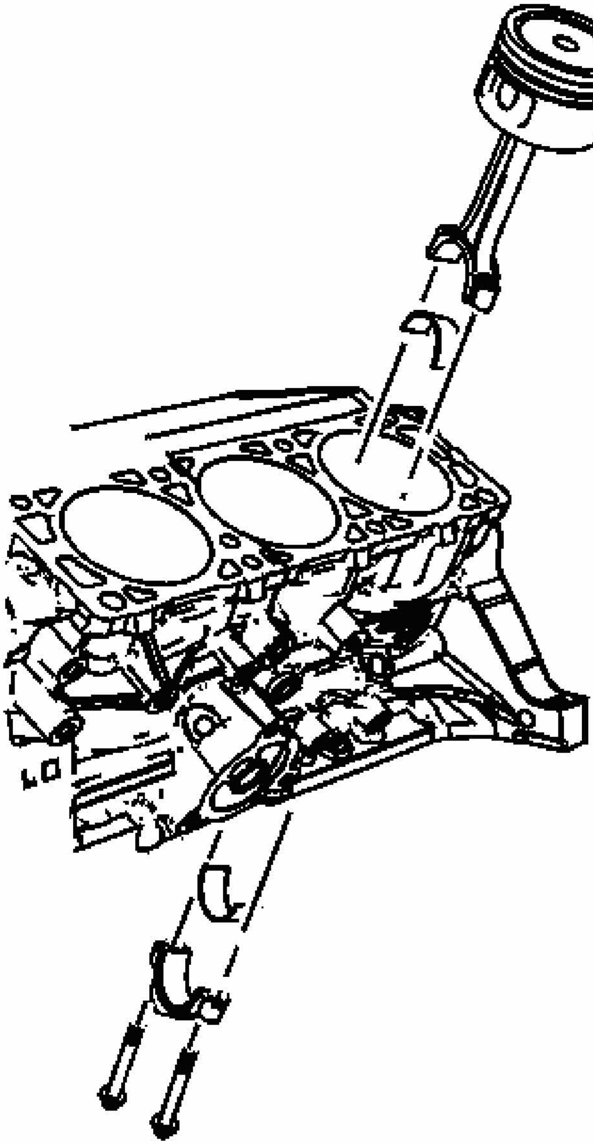


Fig. 308: View Of Connecting Rod & Piston Assembly
Courtesy of GENERAL MOTORS CORP.

4. Remove the connecting rod bolts.
5. Remove the connecting rod cap.
6. Remove the connecting rod bearing half.
7. Install **J 41556** into the connecting rod.
8. Remove the connecting rod and piston assembly from the engine with a suitable tool.

CRANKSHAFT REAR OIL SEAL REMOVAL

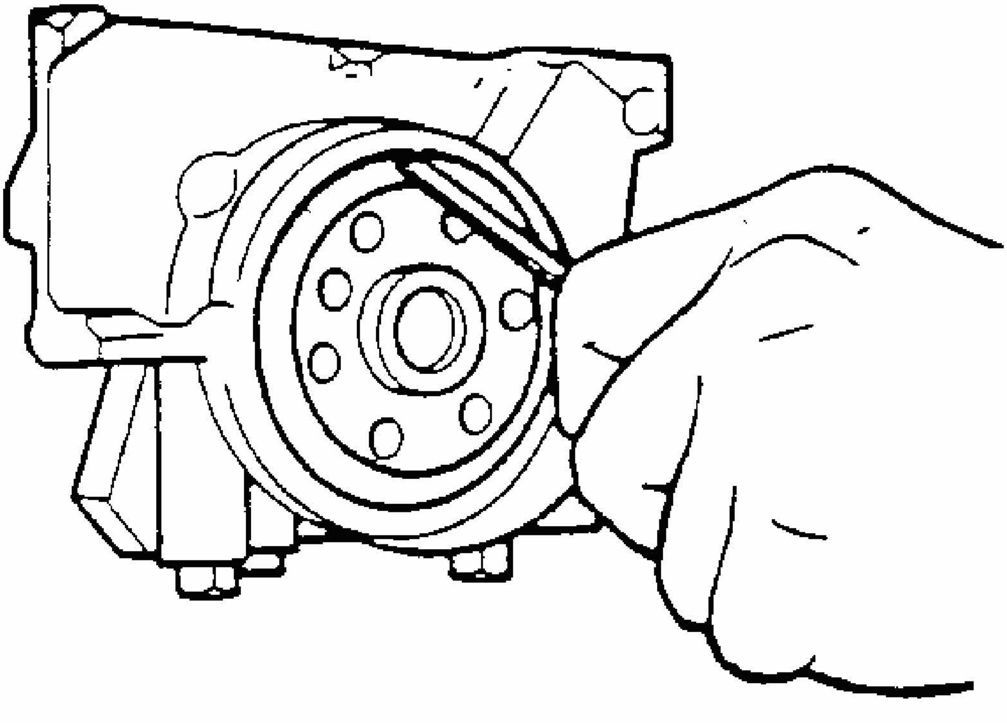


Fig. 309: Removing Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the crankshaft rear oil seal.

IMPORTANT: Do not damage the crankshaft or seal bore.

2. Pry out the crankshaft rear oil seal out using a suitable tool.

CRANKSHAFT AND BEARINGS REMOVAL

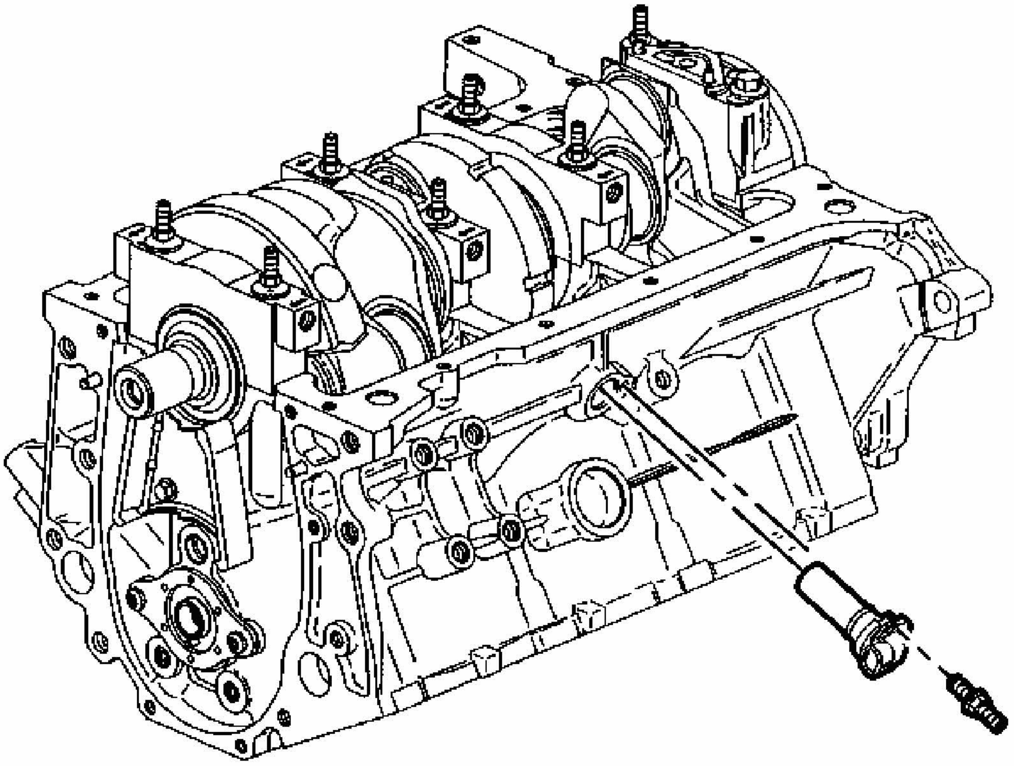


Fig. 310: View Of Crankshaft Position Sensor & Stud
Courtesy of GENERAL MOTORS CORP.

1. Remove the crankshaft position sensor heat shield nut and heat shield.
2. Remove the crankshaft position sensor stud.
3. Remove the crankshaft position sensor from the side of the block.

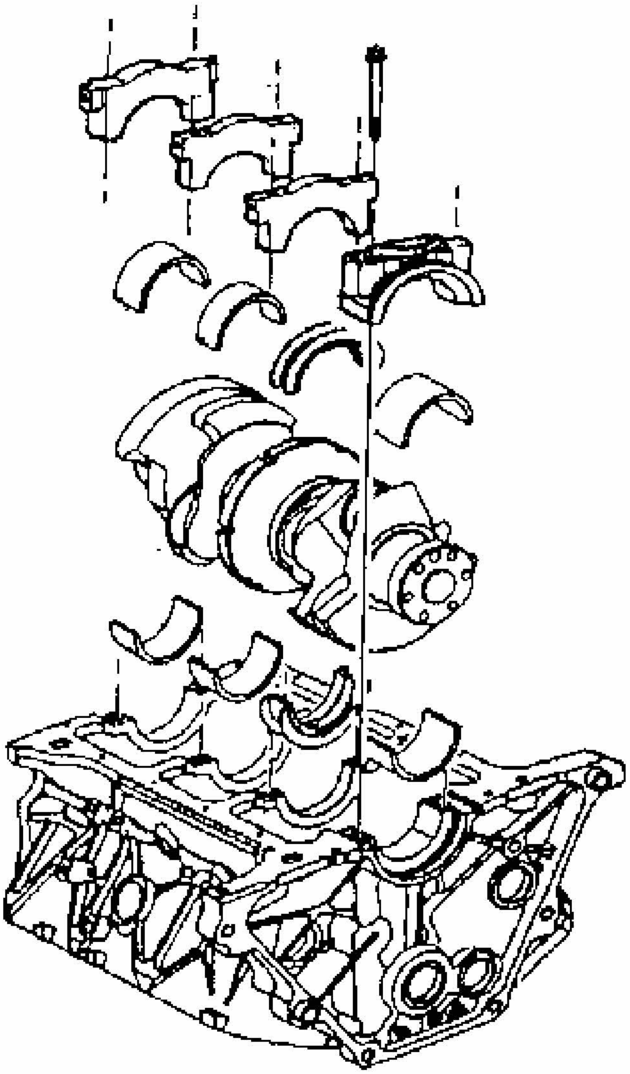


Fig. 311: View Of Crankshaft, Main Bearings And Bearing Caps
Courtesy of GENERAL MOTORS CORP.

4. Remove the crankshaft main bearing cap bolt and studs.
5. Remove the crankshaft main bearing caps and lower crankshaft main bearing halves.

IMPORTANT: Use Care when handling the crankshaft. Avoid damage to the crankshaft position sensor reluctor wheel teeth. Nicks, burrs or other damage to the teeth may effect On-board Diagnostics (OBD) II system performance.

6. Remove the crankshaft.
7. Remove the upper crankshaft main bearing halves.

PISTON OIL NOZZLE REMOVAL

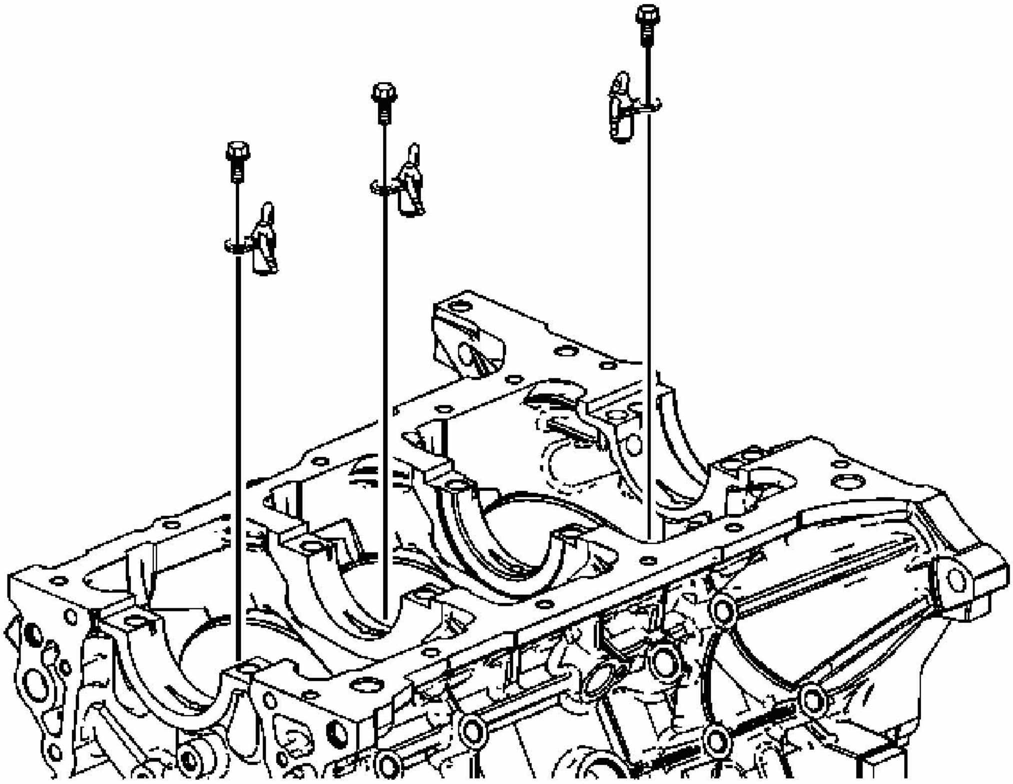


Fig. 312: Identifying Piston Oil Nozzles & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the bolts retaining the piston oil nozzles to the engine block.
2. Remove the piston oil nozzles.

CAMSHAFT BEARING REMOVAL

Tools Required

J 33049 Camshaft Bearing Service Set

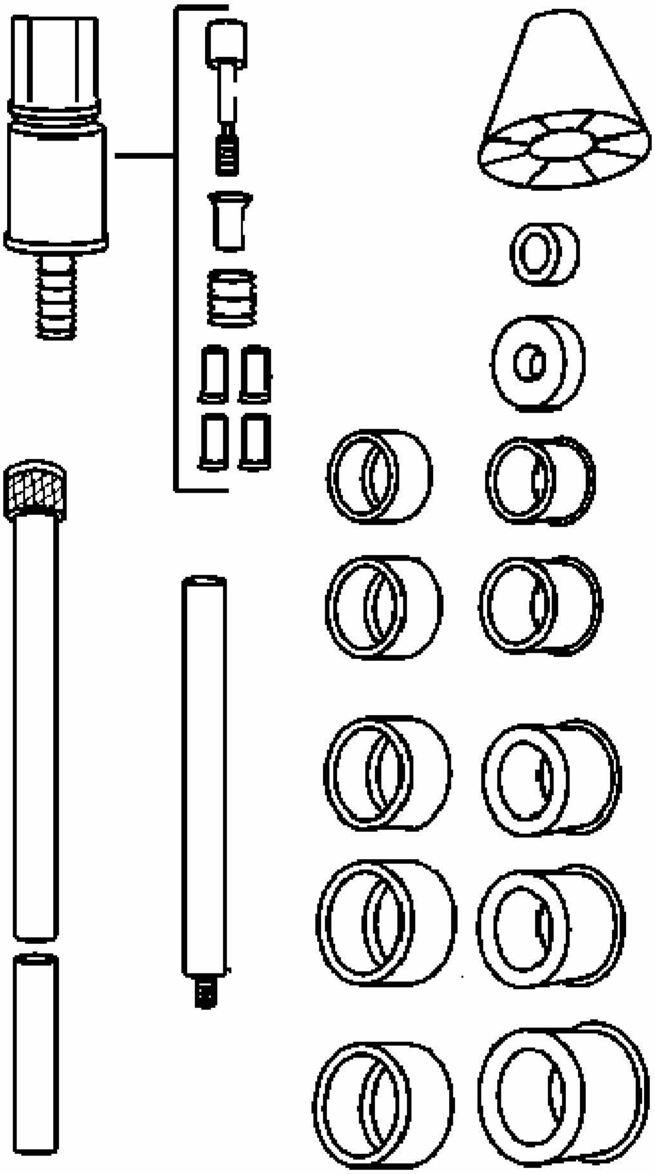


Fig. 313: Camshaft Bearing Service Set
Courtesy of GENERAL MOTORS CORP.

1. Select the expander assembly and driving washer.
2. Assemble the **J 33049** .

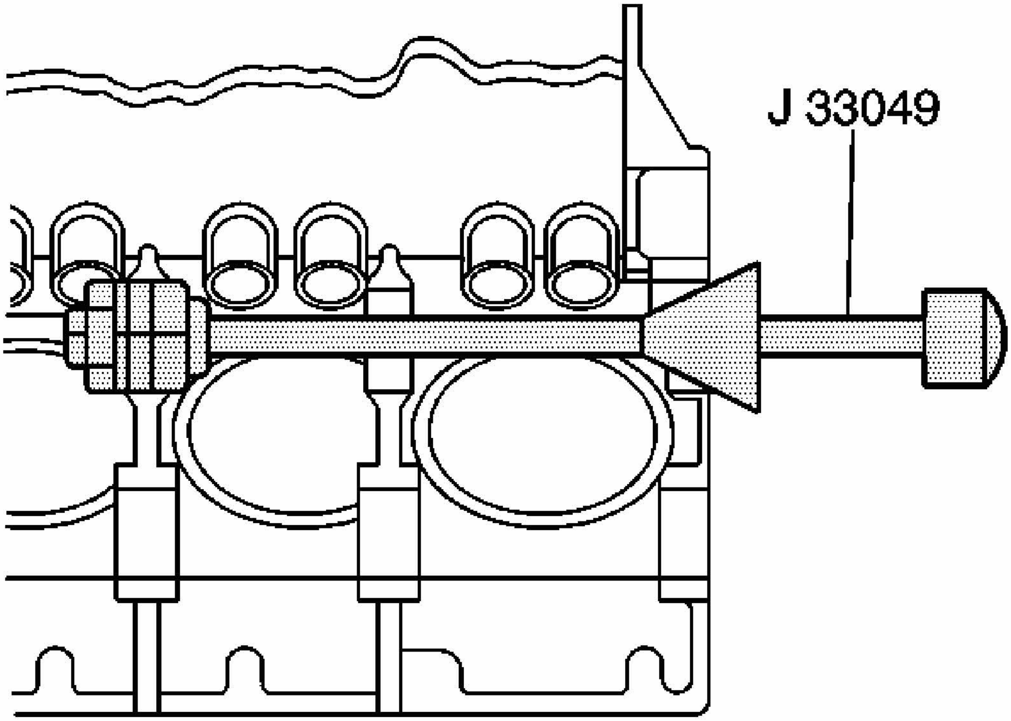


Fig. 314: Removing/Installation Camshaft Inner Bearing Using J 33049
Courtesy of GENERAL MOTORS CORP.

3. Drive out the camshaft bearings. Use the **J 33049** .

ENGINE BLOCK DISASSEMBLE

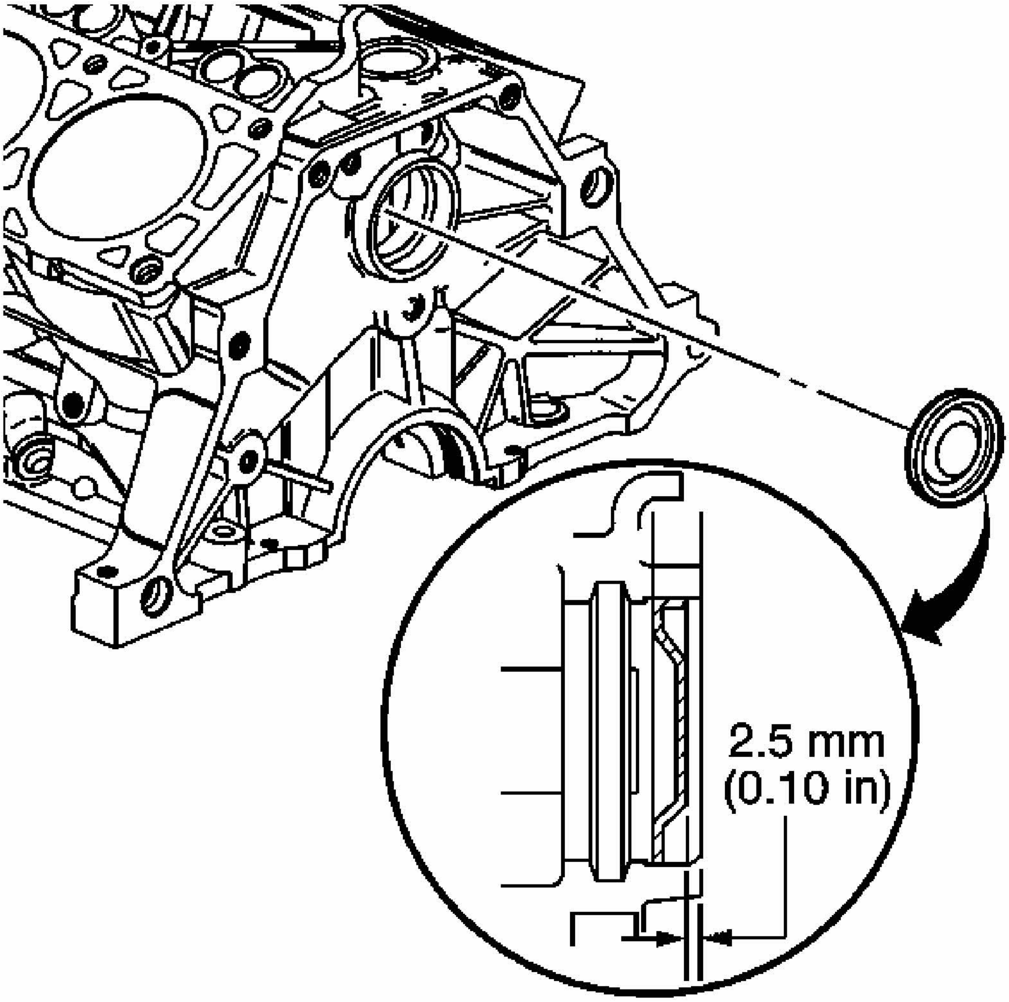


Fig. 315: Identifying Camshaft Rear Bearing Hole Plug Installation Depth
Courtesy of GENERAL MOTORS CORP.

NOTE: **Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.**

1. Remove the camshaft rear bearing hole plug.

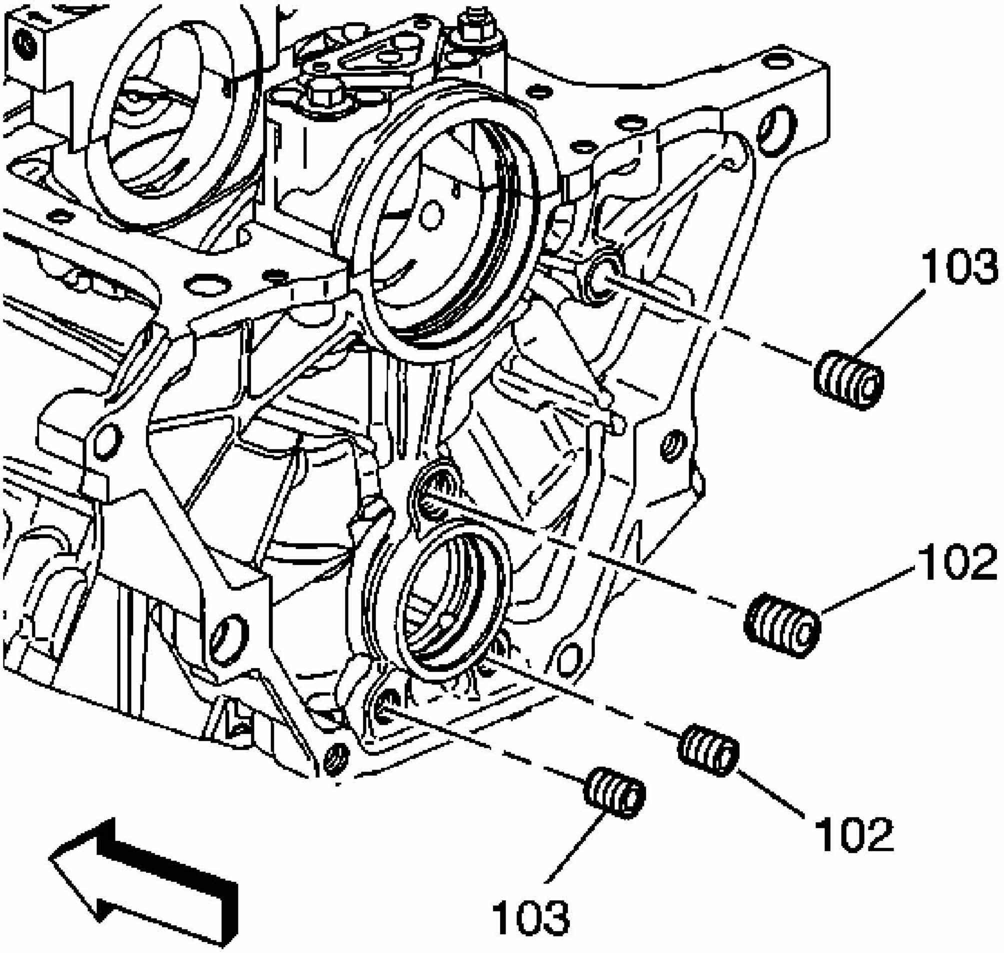


Fig. 316: View Of Rear Oil Gallery Plugs (102, 103)
Courtesy of GENERAL MOTORS CORP.

2. Remove the rear oil gallery plugs (102, 103).

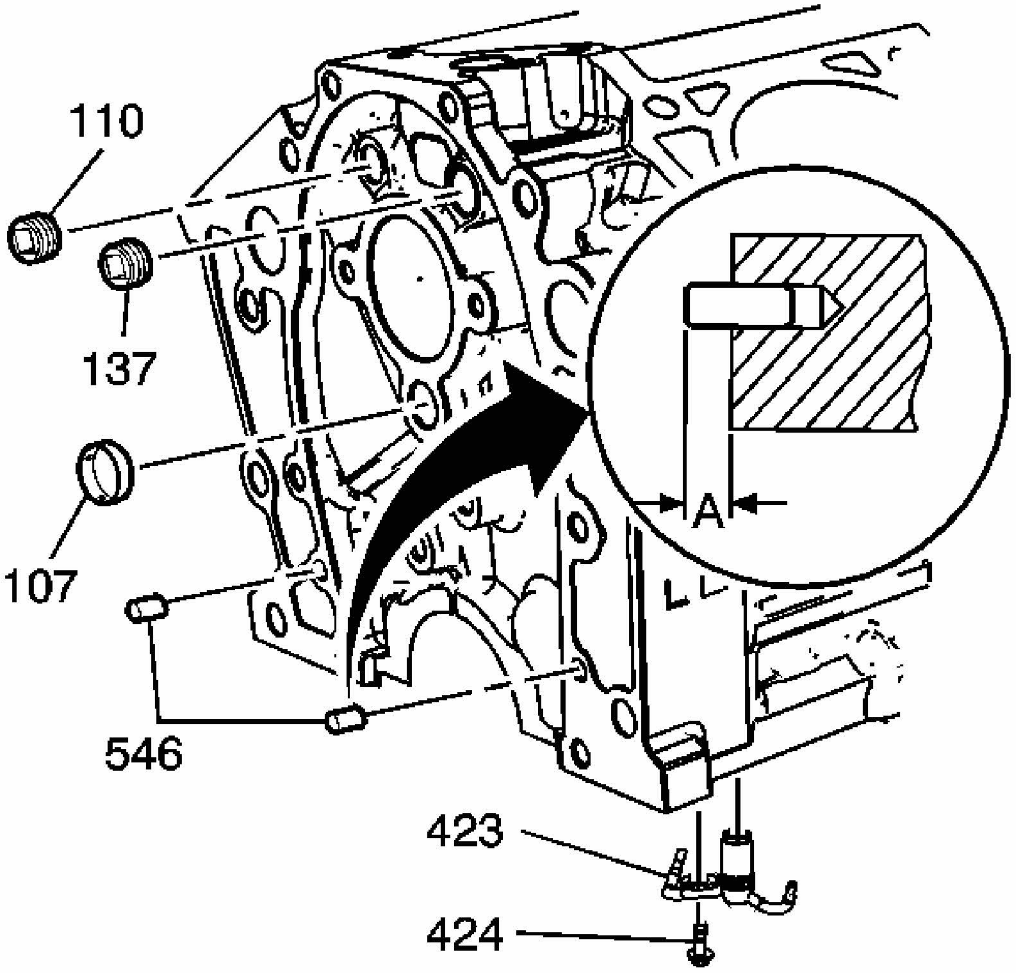


Fig. 317: View Of Front Oil Gallery Plugs (107, 110, 137)
Courtesy of GENERAL MOTORS CORP.

3. Remove the front oil gallery plugs (107, 110, 137).
4. Remove the engine front cover locating pins (546).

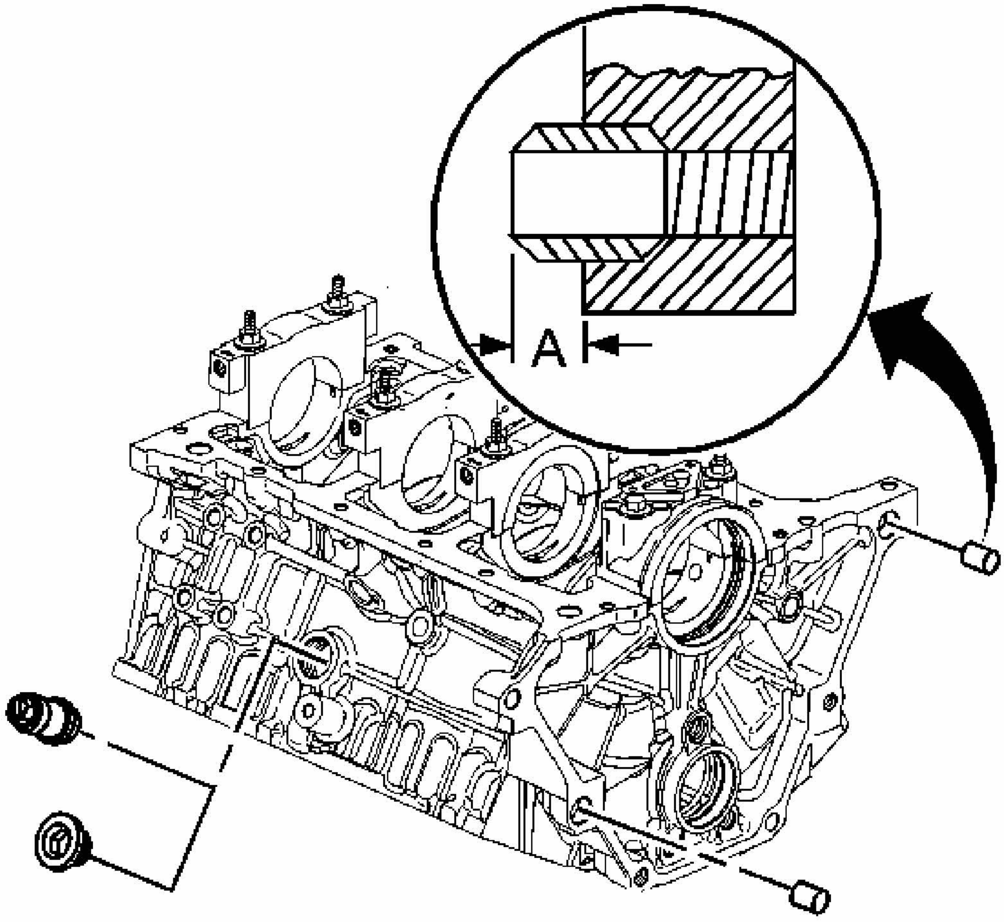


Fig. 318: View Of Engine Block Plug
Courtesy of GENERAL MOTORS CORP.

5. Remove the engine block plug.
6. Remove the transmission locating pins.

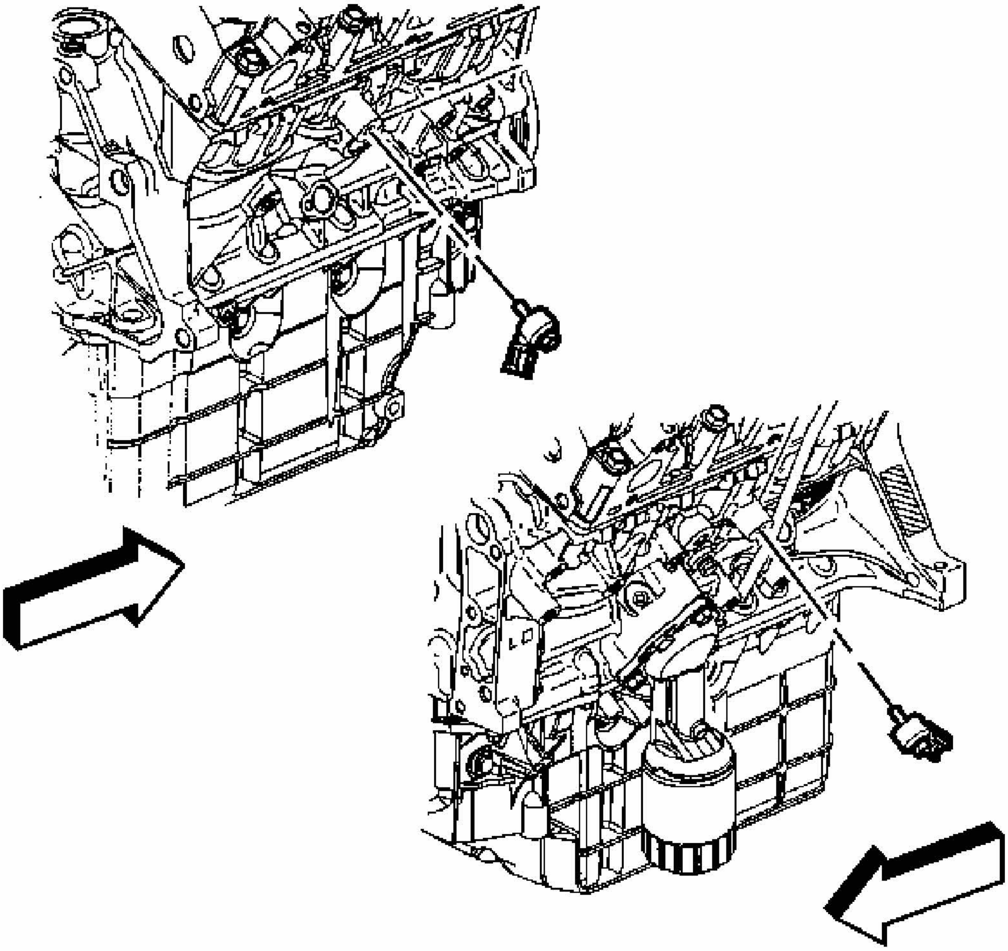


Fig. 319: View Of Knock Sensors
Courtesy of GENERAL MOTORS CORP.

7. Remove the knock sensors.

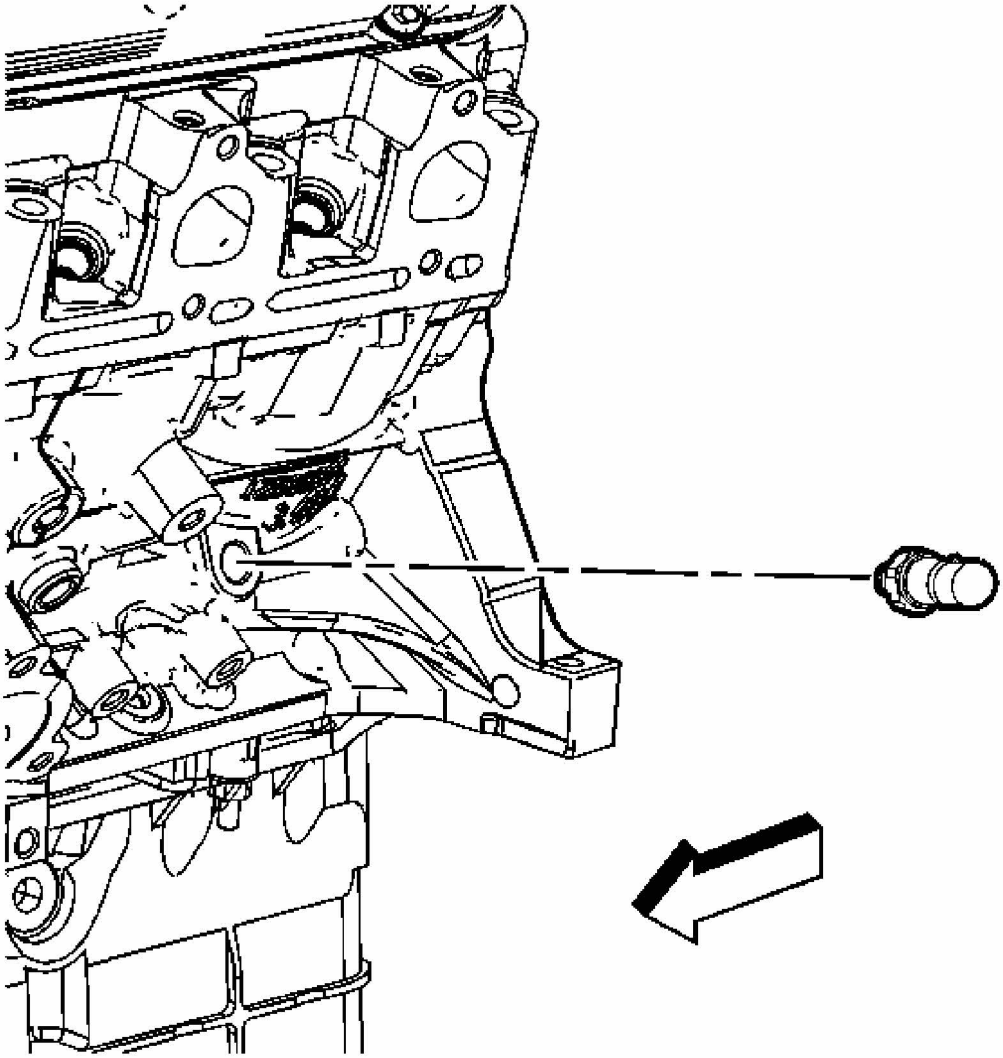


Fig. 320: Locating Engine Oil Pressure Indicator Switch
Courtesy of GENERAL MOTORS CORP.

8. Remove the engine oil pressure indicator switch.

ENGINE BLOCK HEATER REMOVAL

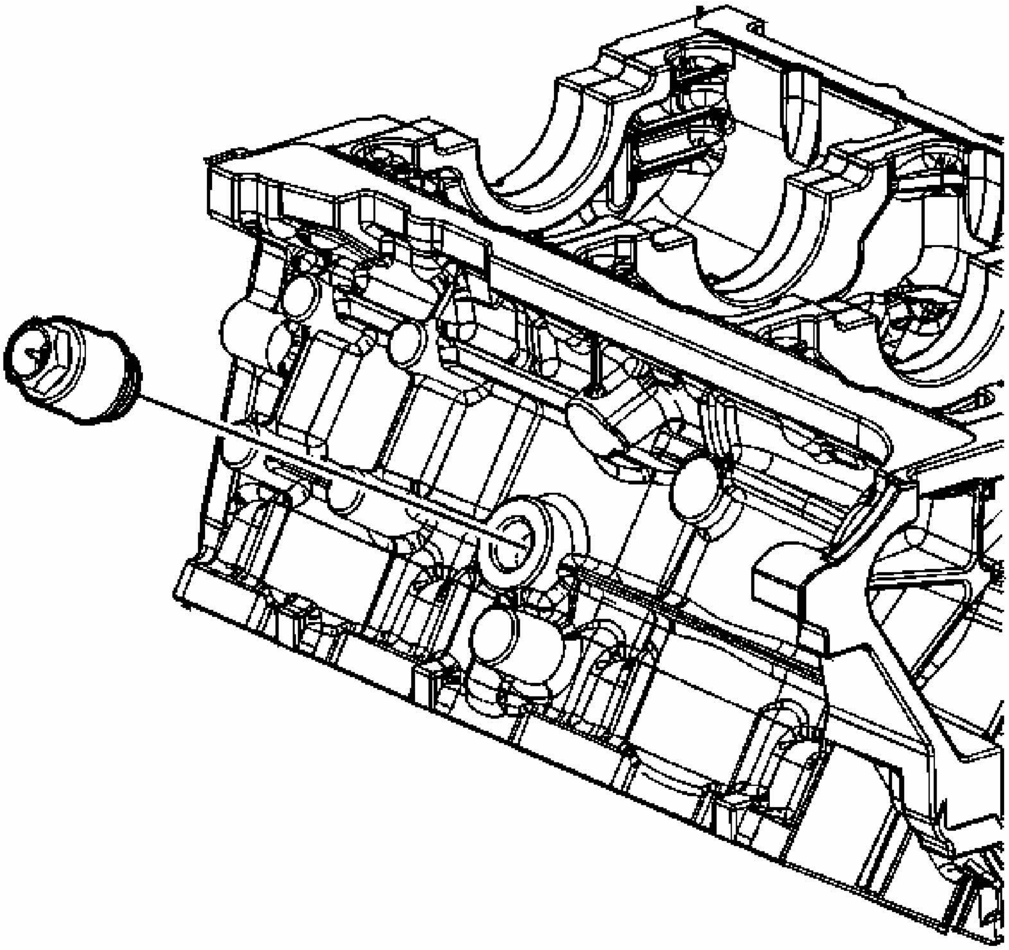


Fig. 321: View Of Engine Block Heater
Courtesy of GENERAL MOTORS CORP.

Remove the engine block heater from engine block.

ENGINE BLOCK CLEANING AND INSPECTION

Tools Required

- **J 8001** Dial Indicator Set
- **J 8087** Cylinder Bore Gage

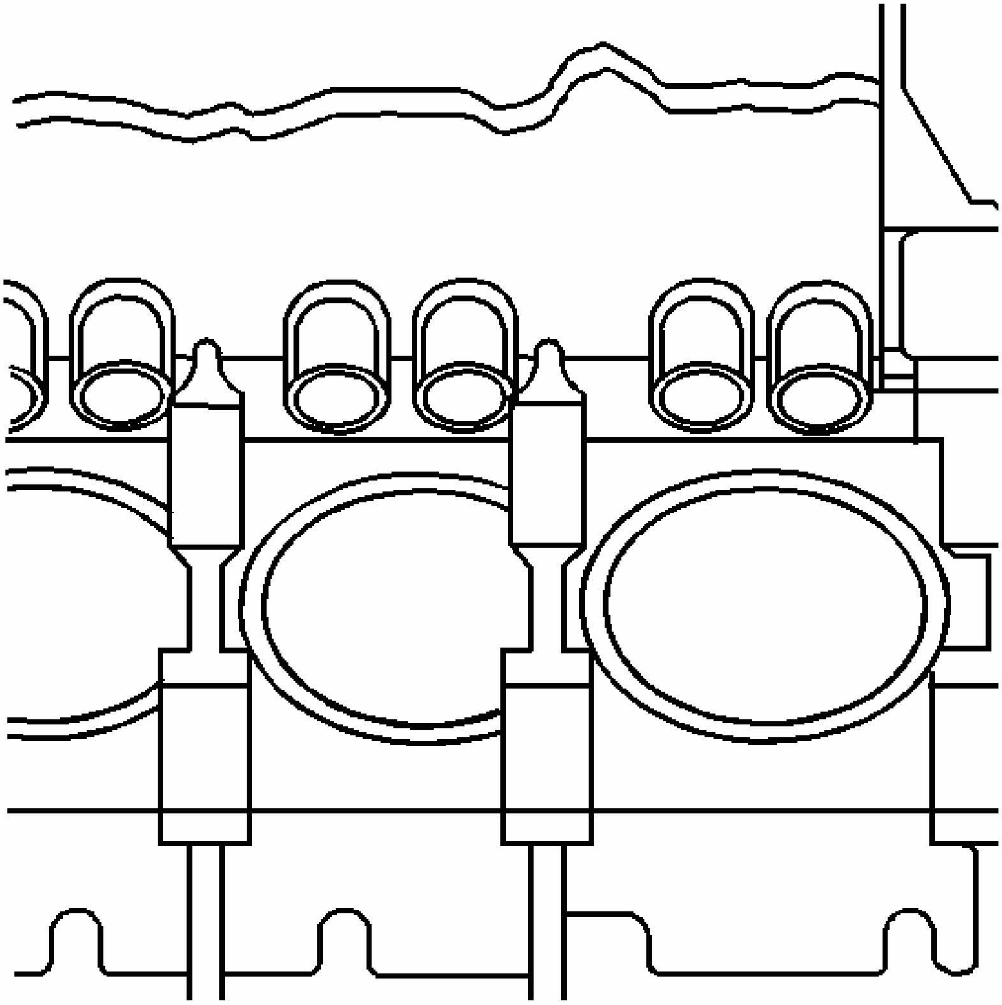


Fig. 322: View Of Gasket Mating Surfaces
Courtesy of GENERAL MOTORS CORP.

1. Clean the sealing material from the gasket mating surfaces.
2. Boil the engine block in caustic solution.
3. Flush the engine block with clean water or steam.
4. Clean the oil passages.
5. Clean the blind holes.
6. Spray the cylinder bores and the machined surfaces with engine oil.
7. Inspect the threaded holes.
8. Clean the holes with a tap. Drill out the holes and install thread inserts, as needed.

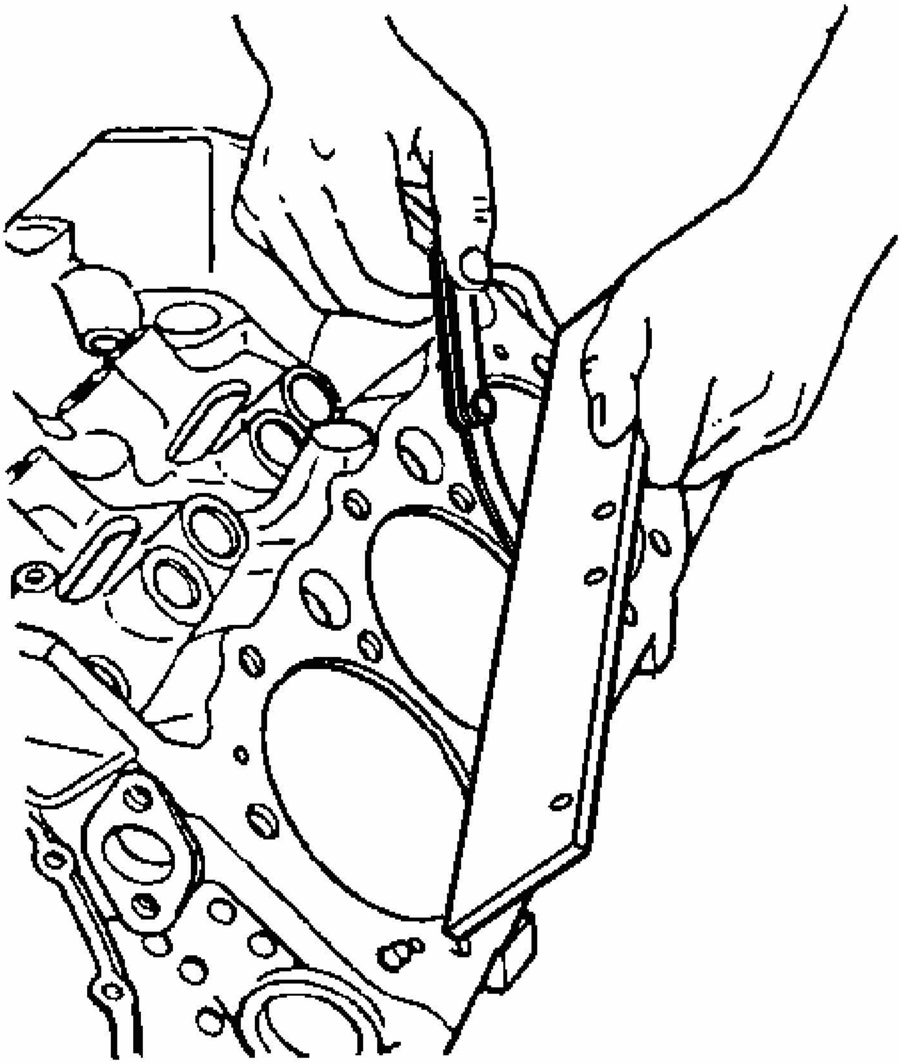


Fig. 323: Testing Block Deck Surface For Flatness
Courtesy of GENERAL MOTORS CORP.

9. Use a straight edge and a feeler gauge in order to test the deck surface for flatness. Replace the block if it is outside of the specification limit.
10. Inspect the oil pan rail for nicks.

    Inspect the front cover attaching area for nicks.

    Use a flat mill file in order to remove any nicks.

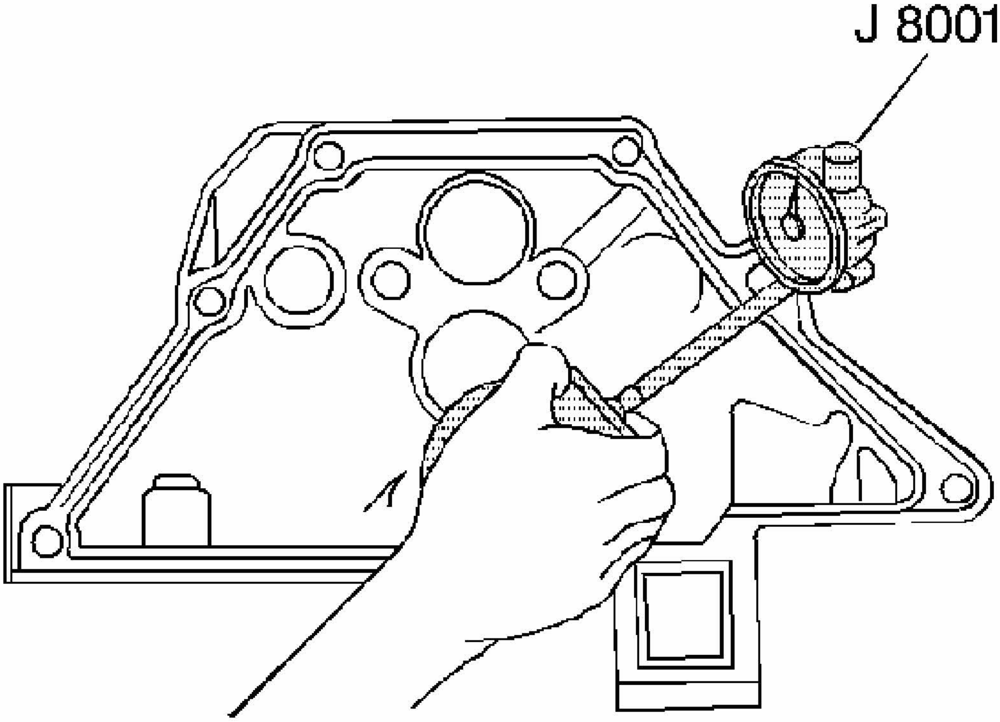


Fig. 324: Inspect Mating Surfaces Of Transmission Case
Courtesy of GENERAL MOTORS CORP.

11. Inspect the mating surfaces of the transmission case.

    NOTE: A broken flywheel may result if the transmission case mating surface is not flat.

12. Use the following procedure in order to measure the engine block flange runout at the 6 mounting bolt hole bosses:
    1. Temporarily install the crankshaft. Measure the crankshaft flange runout.
    2. Hold the **J 8001** gage plate flat against the crankshaft flange.
    3. Place the dial indicator stem on the transmission mounting bolt hole boss. Set the indicator to 0.
    4. Record the readings obtained from all of the bolt hole bosses. The measurements should not vary more than 0.25 mm (0.010 in).
    5. Retest the crankshaft flange runout if the readings vary more than 0.25 mm (0.010 in). If the crankshaft flange runout is not within the specification, replace the engine block.

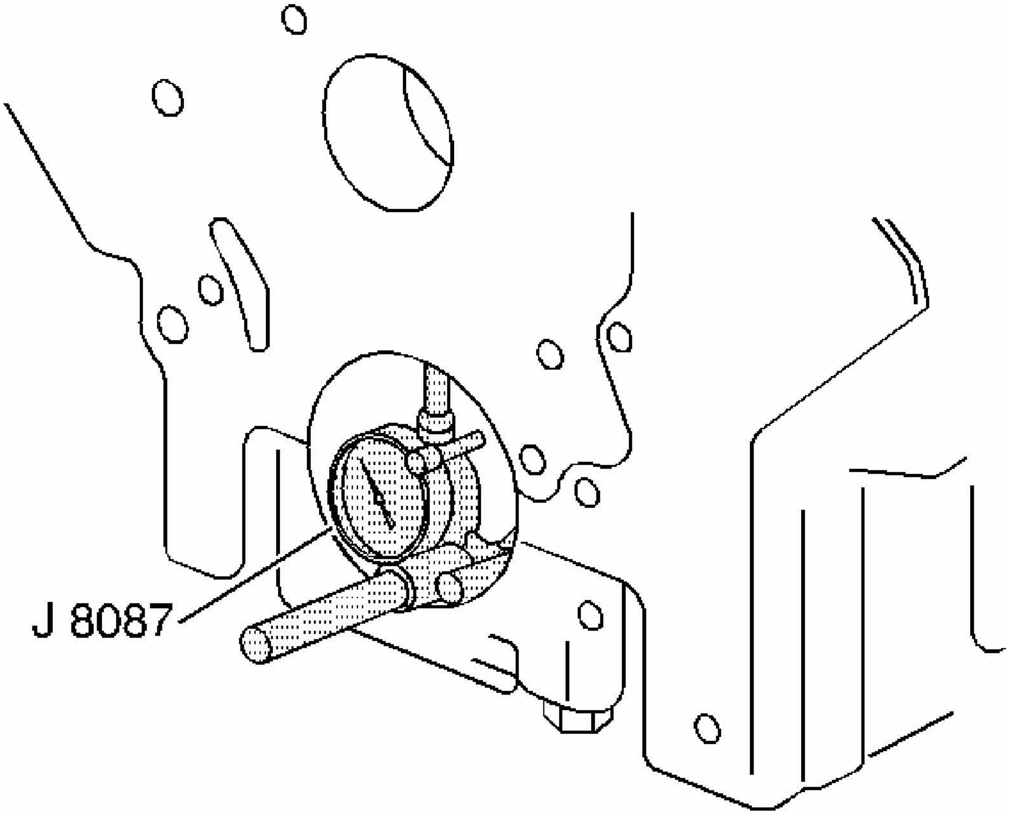


Fig. 325: Inspecting Crankshaft Main Bearing Bores
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Perform the following inspections, and reconditioning if necessary, with the crankshaft main bearing caps installed and tightened to specification.

13. Inspect the crankshaft main bearing bores. Use the **J 8087** in order to measure the bearing bore concentricity and alignment at the following locations:
    - The camshaft
    - The crankshaft
14. Replace the engine block if the bores are out of specification.

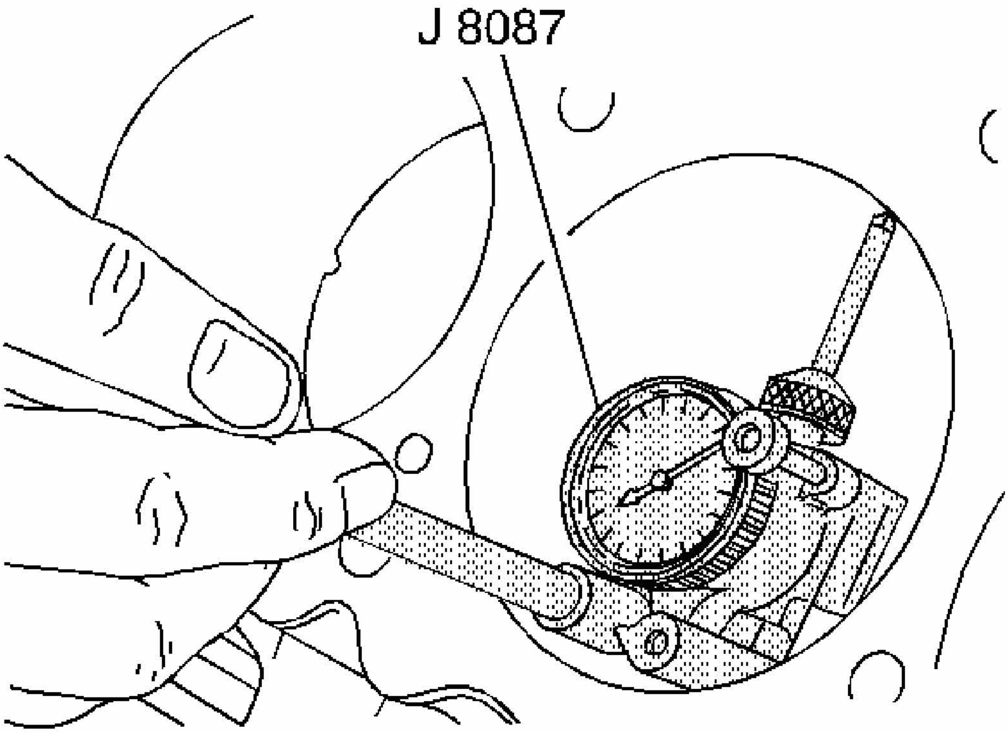


Fig. 326: Inspecting Cylinder Bores Using J 8087
Courtesy of GENERAL MOTORS CORP.

15. Use the **J 8087** in order to inspect the cylinder bores. Inspect the bores for the following conditions:
    - Wear
    - Taper
    - Runout
    - Ridging

IMPORTANT: If the bore is worn beyond the limits, refit the bore with 0.5 mm (0.02 in) oversized pistons.

16. Leave sufficient material in order to allow honing when fitting the piston.

CYLINDER BORING AND HONING

Boring Procedure

1. Before honing or boring, measure all of the new pistons. Select the smallest piston for

the piston fitting. Slightly varied pistons in a set may provide correction, if the first piston is too loosely fitted.

2. Before using any type of boring bar, file the top of the engine block to remove any dirt or burrs. If the cylinder block is not straight, the boring bar may be tilted, causing the bored cylinder wall to have incorrect right angles to the crankshaft.
3. Carefully follow the instructions furnished by the manufacturer regarding use of equipment.
4. Install all crankshaft main bearing caps to specification when boring cylinders. Cover or tape the crankshaft bearings and other internal parts to protect these parts during the boring or honing operation.
5. Leave 0.03 mm (0.001 in) on the diameter for finish honing when performing the final cut with a boring bar. Carefully perform the honing and boring operation to maintain the specified clearances between pistons, rings, and cylinder bores.

Honing Procedure

1. Follow the manufacturer's recommendations for use, cleaning, and lubrication when honing the cylinders. Use only clean, sharp stones of the proper grade for the amount of material to be removed. Dull, dirty stones cut unevenly and generate excessive heat. When using coarse or medium-grade stones, leave sufficient metal so all stone marks may be removed with the fine stones used for finishing to provide the proper clearance.
2. During the honing operation, thoroughly clean the cylinder bore. Check for the correct piston fit.

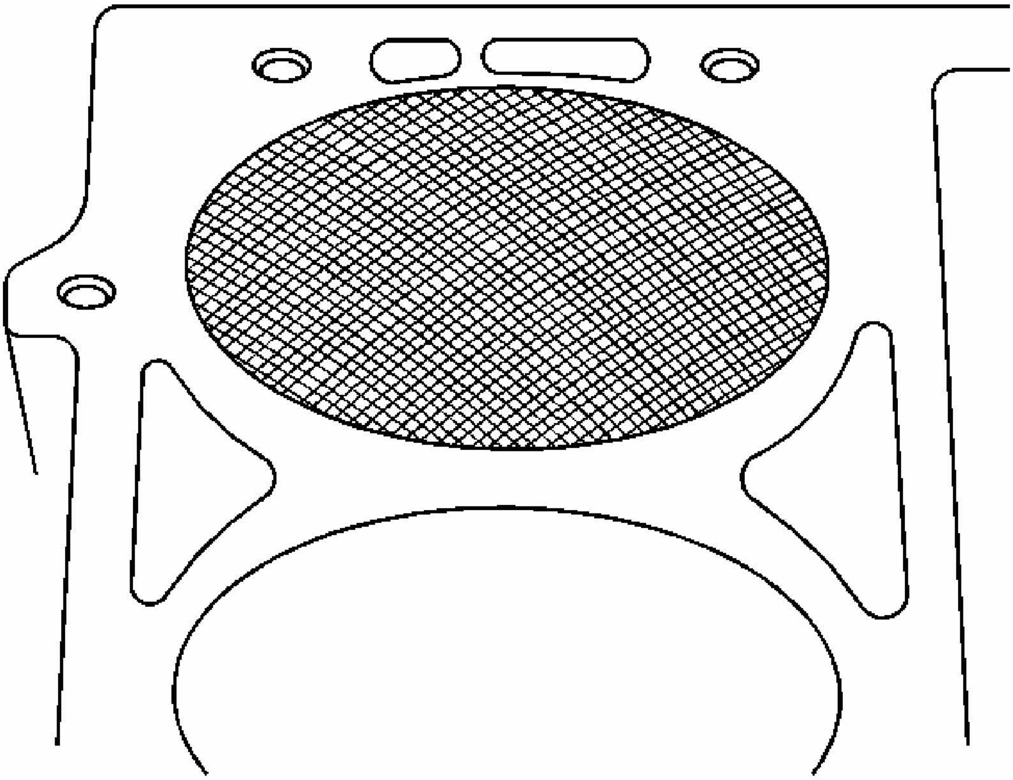


Fig. 327: Identifying Cylinder Bore Cross Hatch Pattern
Courtesy of GENERAL MOTORS CORP.

3. Make full strokes in the cylinder to eliminate taper. Repeatedly check the measurement at the top, the middle, and the bottom of the cylinder bore.

NOTE: Handle the pistons with care. Do not force the pistons through the cylinder until you hone the cylinder to the correct size. The piston can be distorted through careless handling.

4. When finish honing a cylinder bore to fit a piston, move the hone up and down at a sufficient speed to obtain a fine and uniform surface finish in a cross hatch pattern.
5. The finish marks should be clean but not sharp. The finish marks should be free from imbedded particles and torn or folded metal.
6. Determine the finish hone cylinder measurement by measuring the piston to be installed, and by adding the average of the clearance specification. Measure the block and the piston at normal room temperature.

7. True up the refinished cylinder bores. Final hone each cylinder bore to remove all stone or cutter marks.
8. After final honing and before the piston is checked for fit, clean the bores with hot water and detergent. Scrub the bores with a stiff bristle brush and rinse the bores thoroughly with hot water. Do not allow any abrasive material to remain in the cylinder bores. This abrasive material will wear the new rings, the cylinder bores, and the bearings lubricated by the contaminated oil. After washing dry the bore.
9. Permanently mark the piston for the cylinder to which the piston has been fitted.
10. Apply clean engine oil to each bore to prevent rusting.

ENGINE BLOCK ASSEMBLE

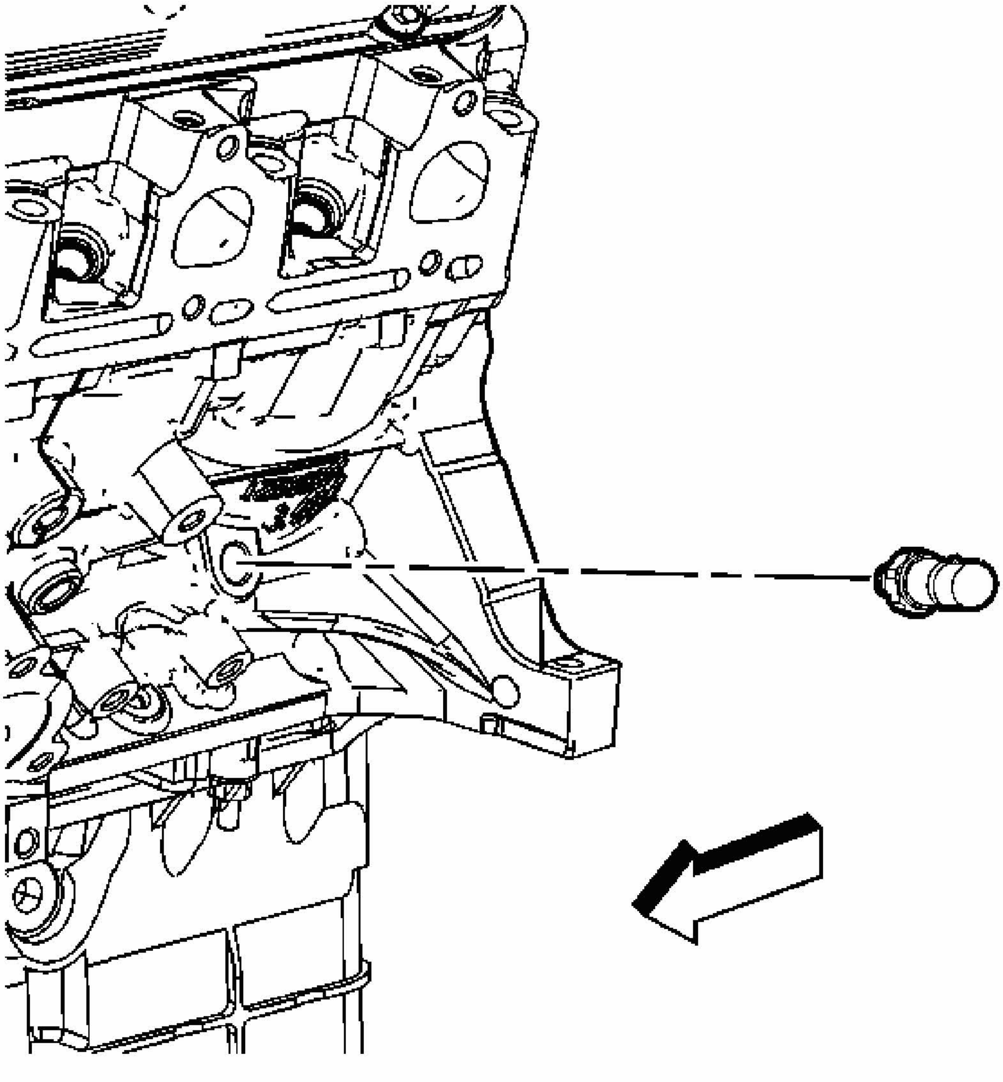


Fig. 328: Locating Engine Oil Pressure Indicator Switch
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the oil pressure switch threads.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the engine oil pressure switch.

Tighten: Tighten the engine oil pressure switch to 16 N.m (12 lb ft).

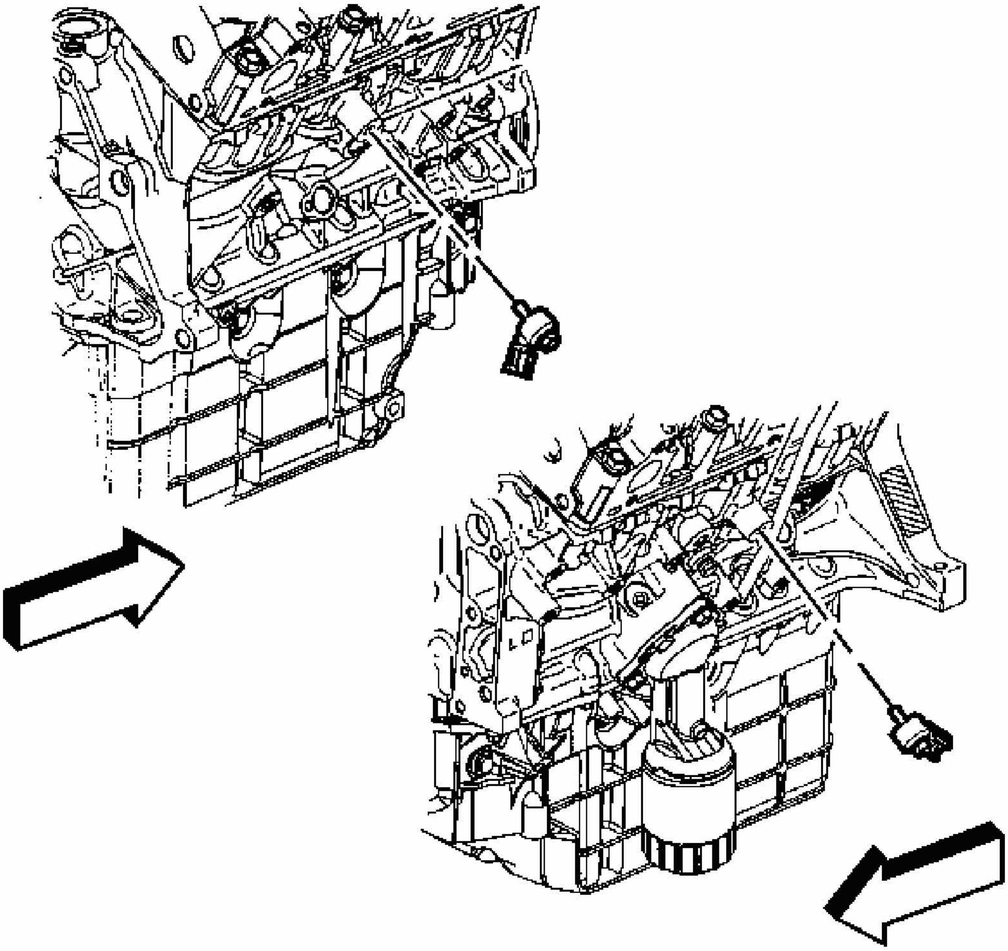


Fig. 329: View Of Knock Sensors
Courtesy of GENERAL MOTORS CORP.

3. Install the knock sensors.

   Tighten: Tighten the knock sensors to 25 N.m (18 lb ft).

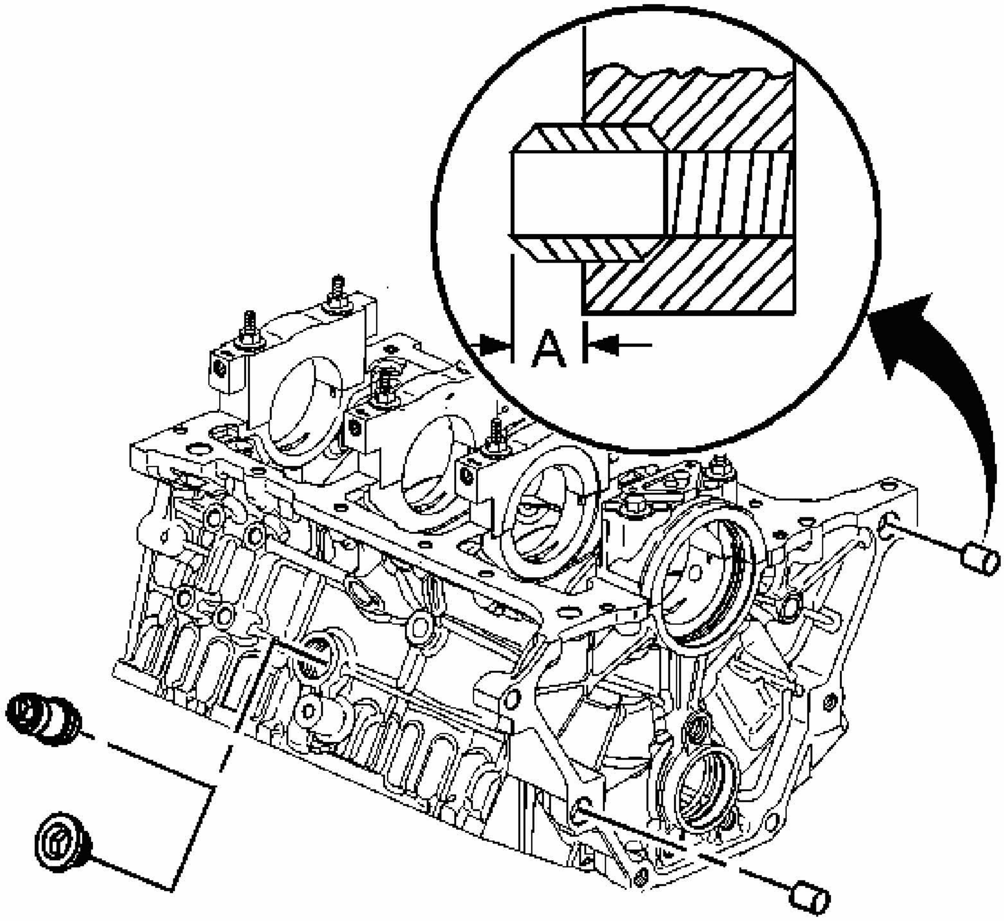


Fig. 330: View Of Engine Block Plug
Courtesy of GENERAL MOTORS CORP.

4. Apply sealer GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the engine block plug.
5. Install a NEW engine block plug.

   Tighten: Tighten the engine block plug to 60 N.m (44 lb ft).

6. Install the transmission locating pins. The installation height should be 8.3-9.3 mm (0.327-0.366 in) (A).

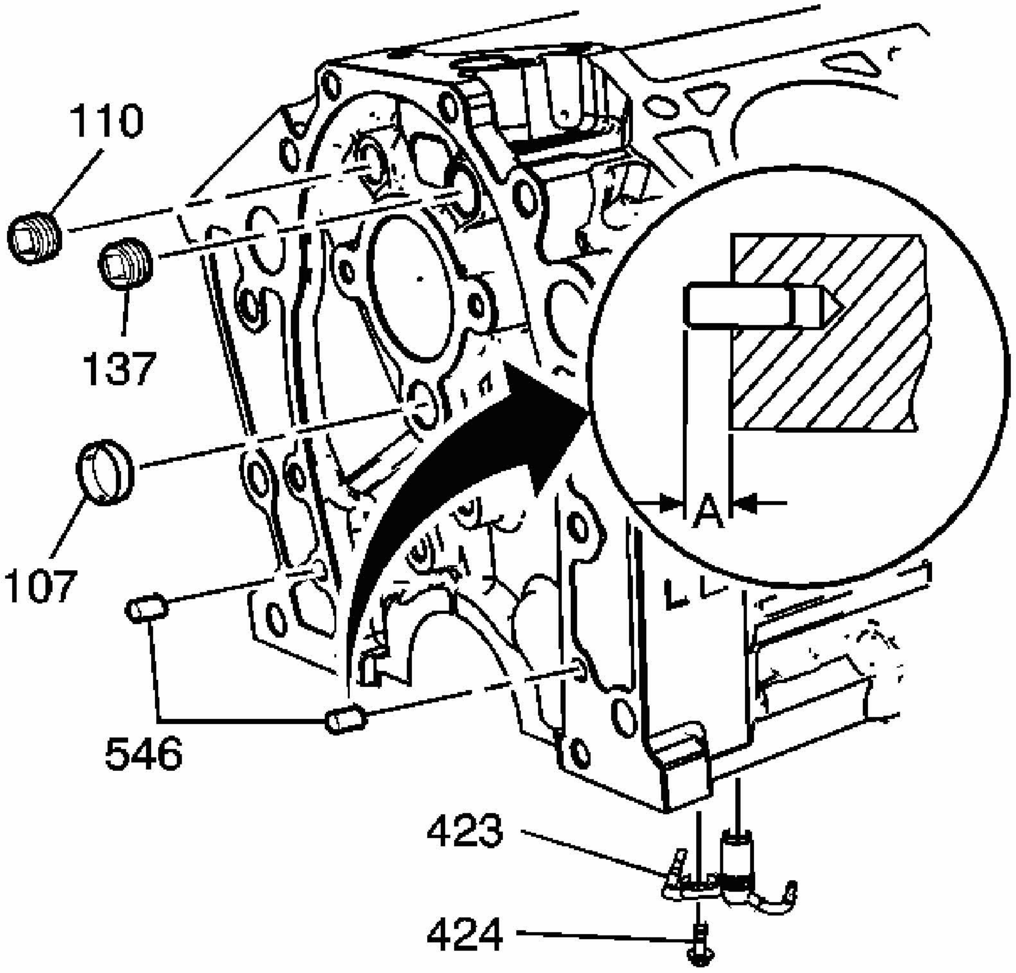


Fig. 331: View Of Front Oil Gallery Plugs (107, 110, 137)
Courtesy of GENERAL MOTORS CORP.

7. Apply sealer GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the front oil gallery plug threads (110, 137).
8. Install the front oil gallery plug (110).

   Tighten: Tighten the front oil gallery plug to 19 N.m (14 lb ft).

9. Install the front oil gallery plug (137).

   Tighten: Tighten the front oil gallery plug to 33 N.m (24 lb ft).

10. Apply sealer GM P/N 12377901 (Canadian P/N 10953504), or equivalent to the front oil gallery plug (107).

11. Install the front oil gallery plug (107) so that it is 1.5 mm (0.06 in) below flush of the engine block.
12. Install the engine front cover locating pins (546). The installation height should be 5.8-8.2 mm (0.228-0.323 in) (A).

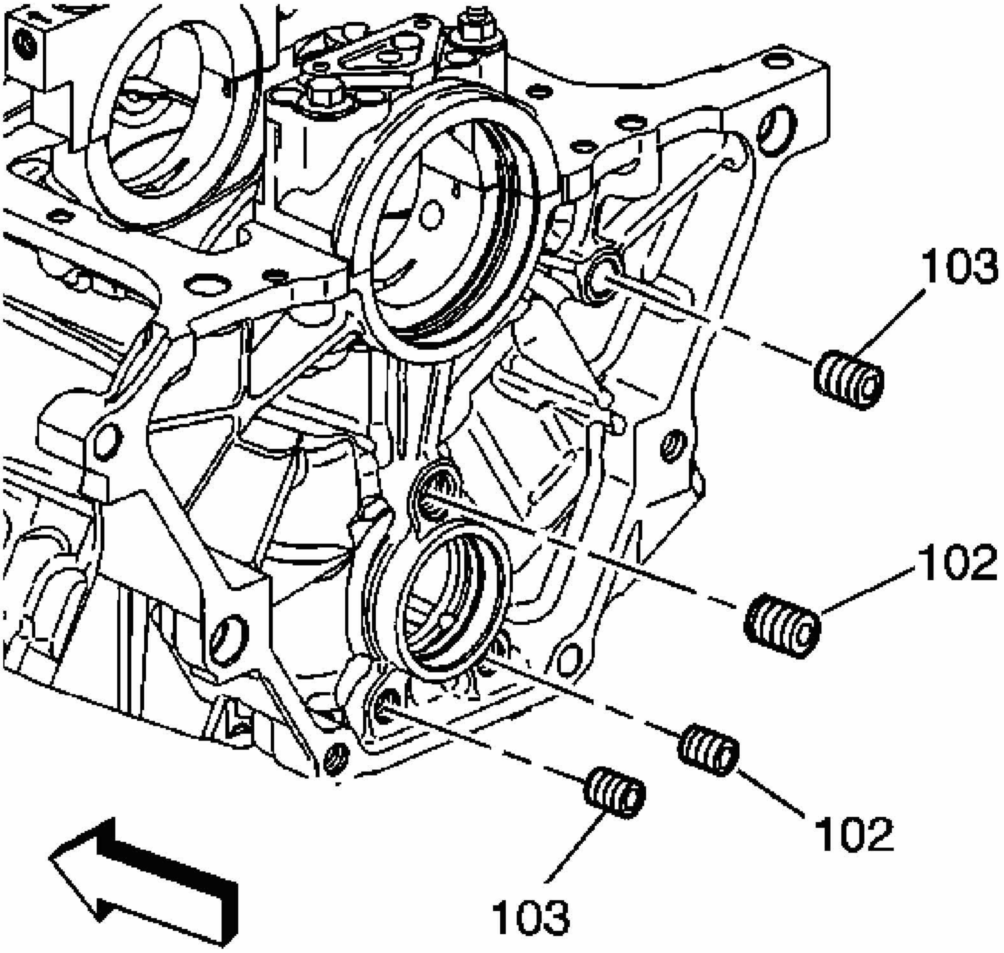


Fig. 332: View Of Rear Oil Gallery Plugs (102, 103)
Courtesy of GENERAL MOTORS CORP.

13. Apply Sealer GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the rear oil gallery plugs.
14. Install the rear oil gallery plugs (103).

Tighten: Tighten the rear oil gallery plugs to 19 N.m (14 lb ft).

15. Install the rear oil gallery plugs (102).

    Tighten: Tighten the rear oil gallery plugs to 33 N.m (24 lb ft).

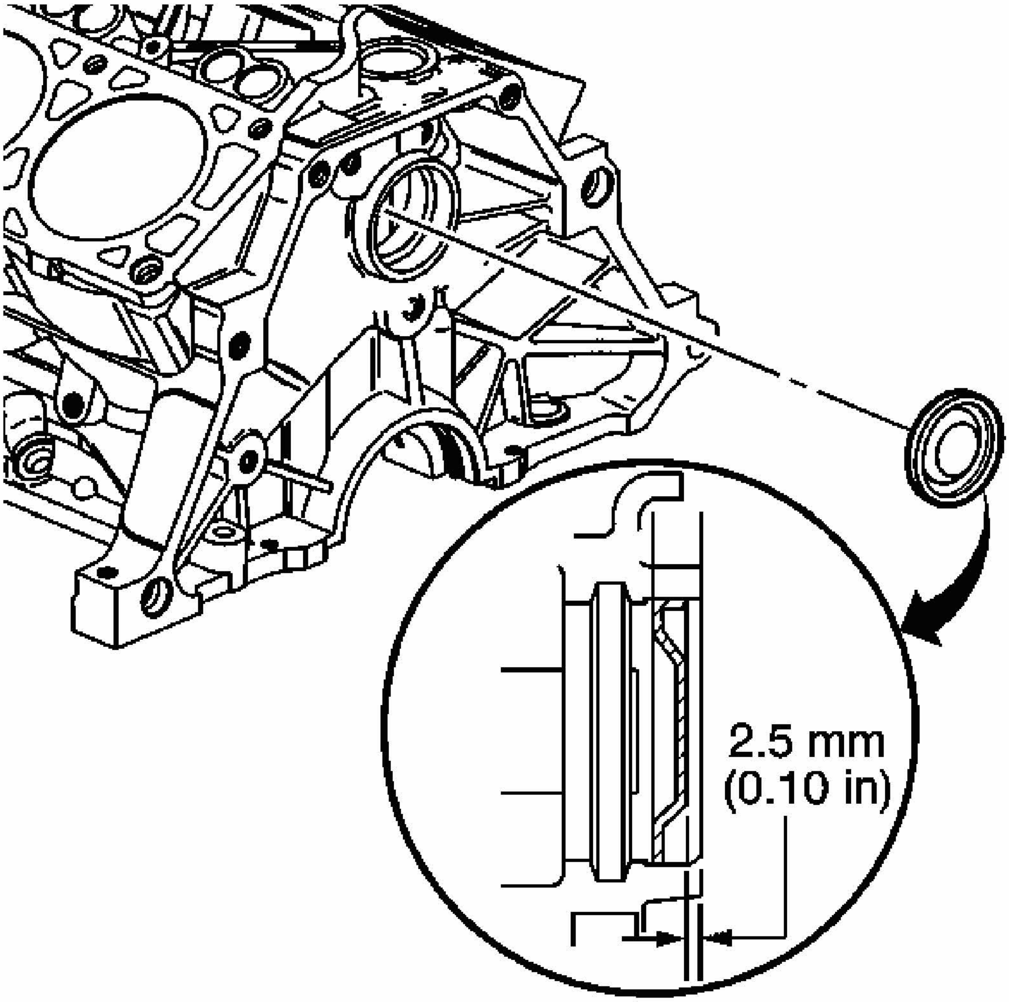


Fig. 333: Identifying Camshaft Rear Bearing Hole Plug Installation Depth
Courtesy of GENERAL MOTORS CORP.

16. Apply sealer GM P/N 12377901 (Canadian P/N 10953504), or equivalent to the camshaft rear bearing hole plug.
17. Install the camshaft rear bearing hole plug.

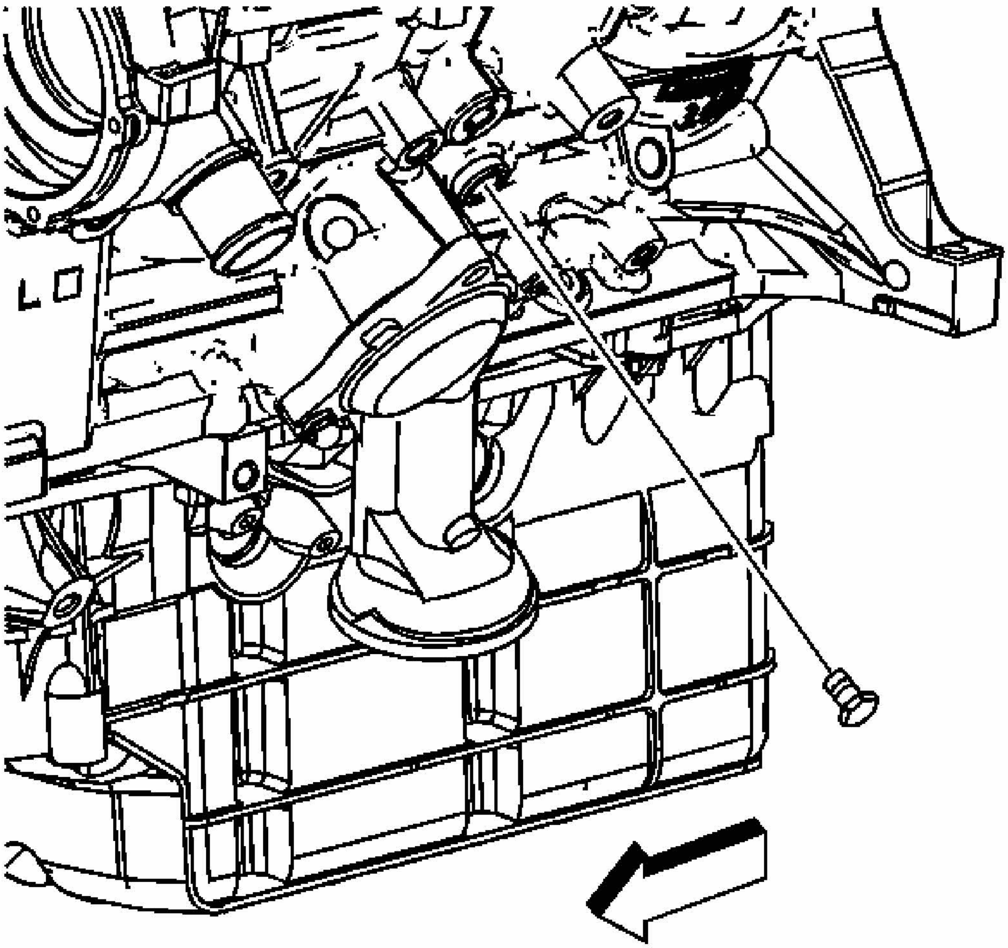


Fig. 334: View Of Coolant Drain Plug From Left Side
Courtesy of GENERAL MOTORS CORP.

NOTE: **Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.**

18. Apply sealer GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the left and right coolant drain plug threads.
19. Install the left coolant drain plug.

    Tighten: Tighten the left coolant drain plug to 19 N.m (14 lb ft).

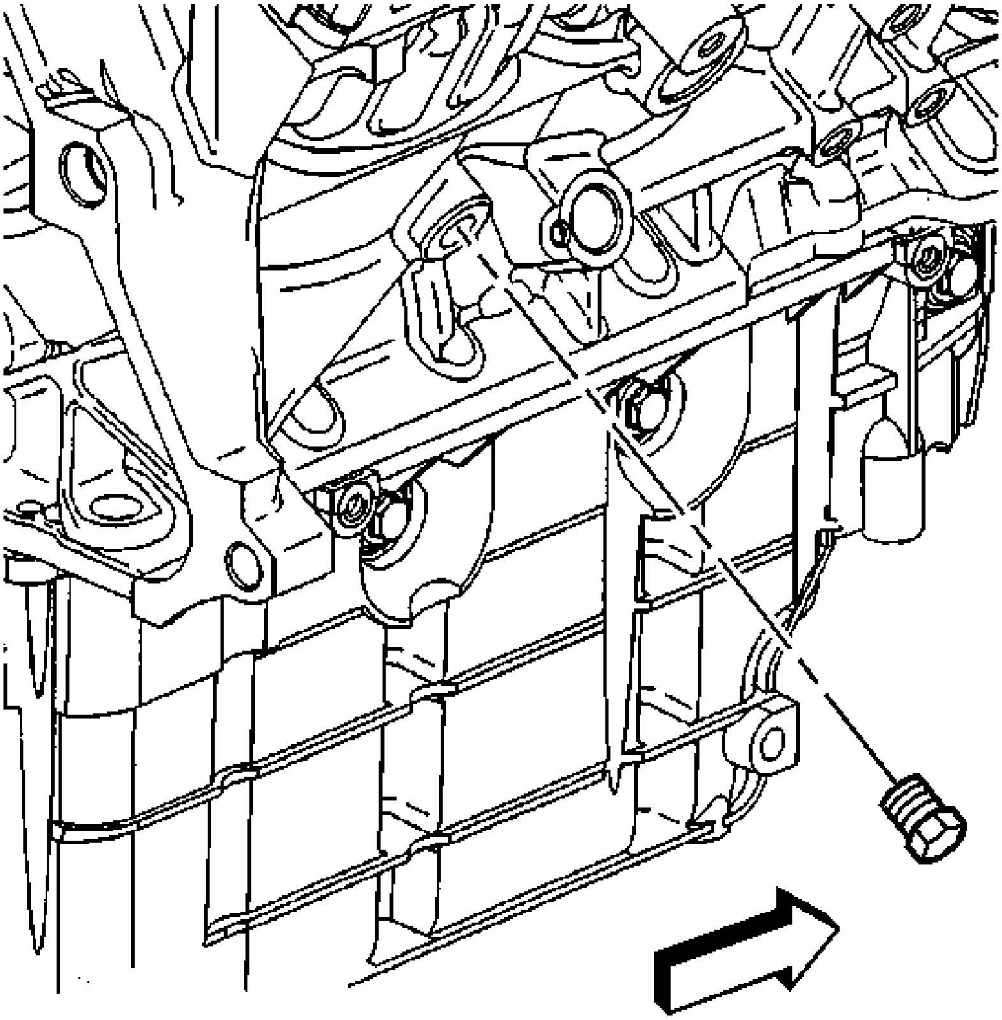


Fig. 335: View Of Right Coolant Drain Plug
Courtesy of GENERAL MOTORS CORP.

20. Install the right coolant drain plug.

    Tighten: Tighten the right coolant drain plug to 19 N.m (14 lb ft).

PISTON OIL NOZZLE CLEANING AND INSPECTION

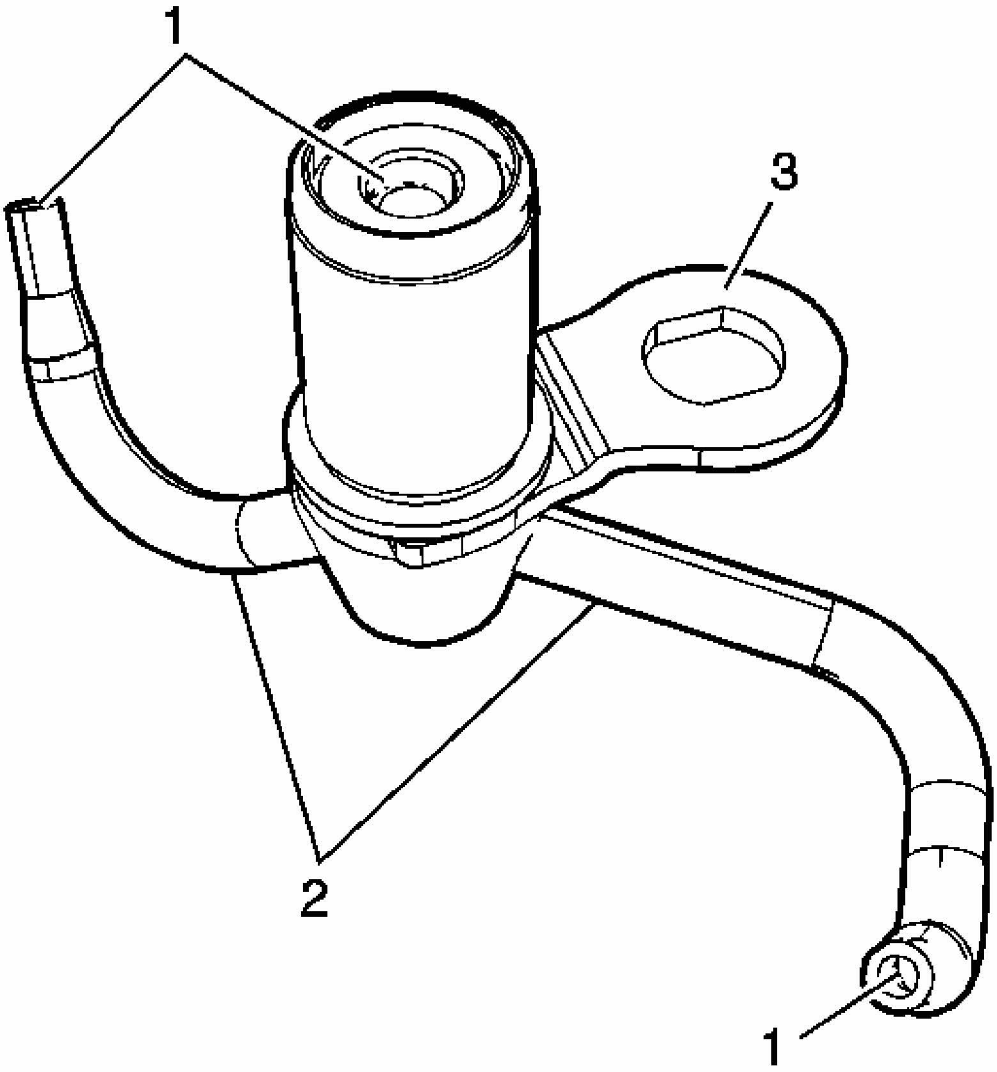


Fig. 336: Inspecting Piston Oil Nozzle
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Cleaning Solvent Caution .

1. Clean the piston oil nozzle in cleaning solvent using GM P/N 10953463 (Canadian P/N 88901148) or equivalent.

CAUTION: Wear safety glasses in order to avoid eye damage.

2. Dry the nozzle with compressed air.
3. Inspect the piston oil nozzle for the following:
    - For cracks or damage
    - Plugged oil passages (1)
    - Bent, misaligned, or cracked oil nozzle tubes (2)
    - Bent or broken clip (3)

CRANKSHAFT AND BEARINGS CLEANING AND INSPECTION

Tools Required

- **J 8087** Cylinder Bore Gage
- **J 45059** Angle Meter

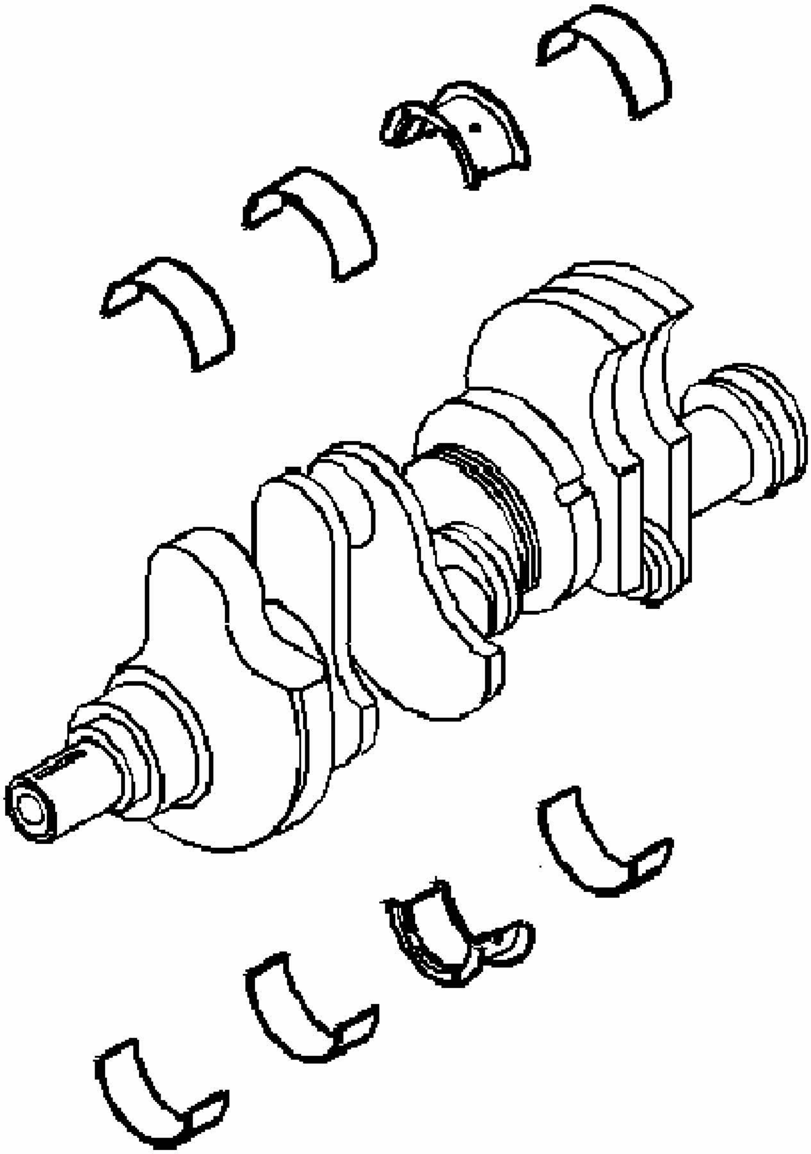


Fig. 337: View Of Crankshaft & Bearings
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **Use Care when handling the crankshaft. Avoid damage to the crankshaft position sensor reluctor wheel teeth. Nicks, burrs or other damage to the teeth may effect on-board diagnostics (OBD) 2 system performance.**

1. Clean the crankshaft of the following elements:

- Oil
- Sludge
- Carbon

2. Inspect the crankshaft oil passages for obstructions.

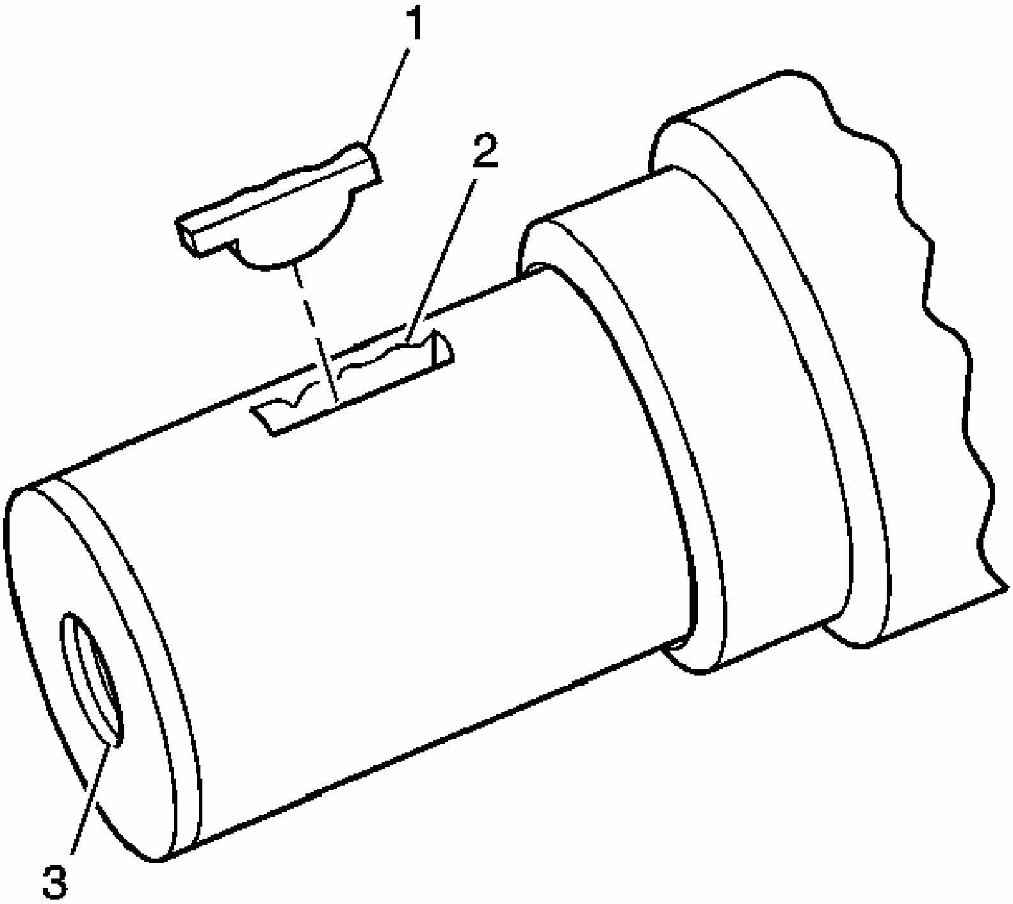


Fig. 338: Inspecting Crankshaft Keyway
Courtesy of GENERAL MOTORS CORP.

3. Inspect the crankshaft keyway for the following conditions:
    - A worn crankshaft key (1)
    - A worn crankshaft keyway (2)
4. Inspect the crankshaft threads (3) for damage.

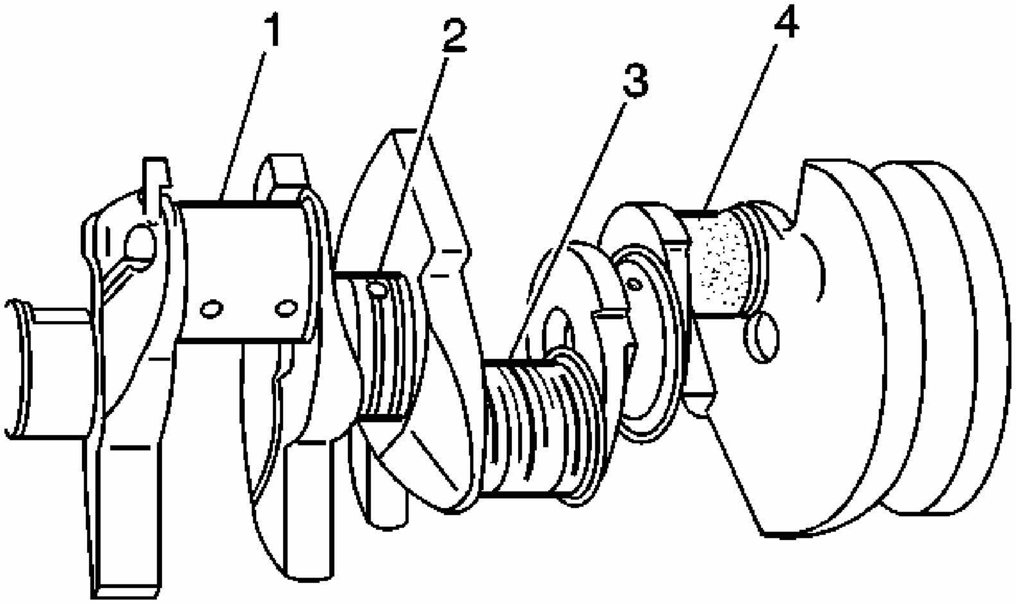


Fig. 339: Identifying Different Crankshaft Journal Wear Patterns
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If cracks, severe gouges or burned spots are found, replace the crankshaft. Remove slight roughness using a fine polishing cloth soaked in clean engine oil. Remove any burrs using a fine oil stone.

5. Inspect the crankshaft bearing journals and the crankshaft thrust surfaces for the following conditions:
    - Wear without any grooves or scratches (1)
    - Grooves or scoring (2)
    - Scratches or excessive wear (3)
    - Pitting or embedded bearing material (4)-Inspect the corresponding crankshaft bearing inserts for embedded material and determine the source of the material.
    - Overheating or discoloration

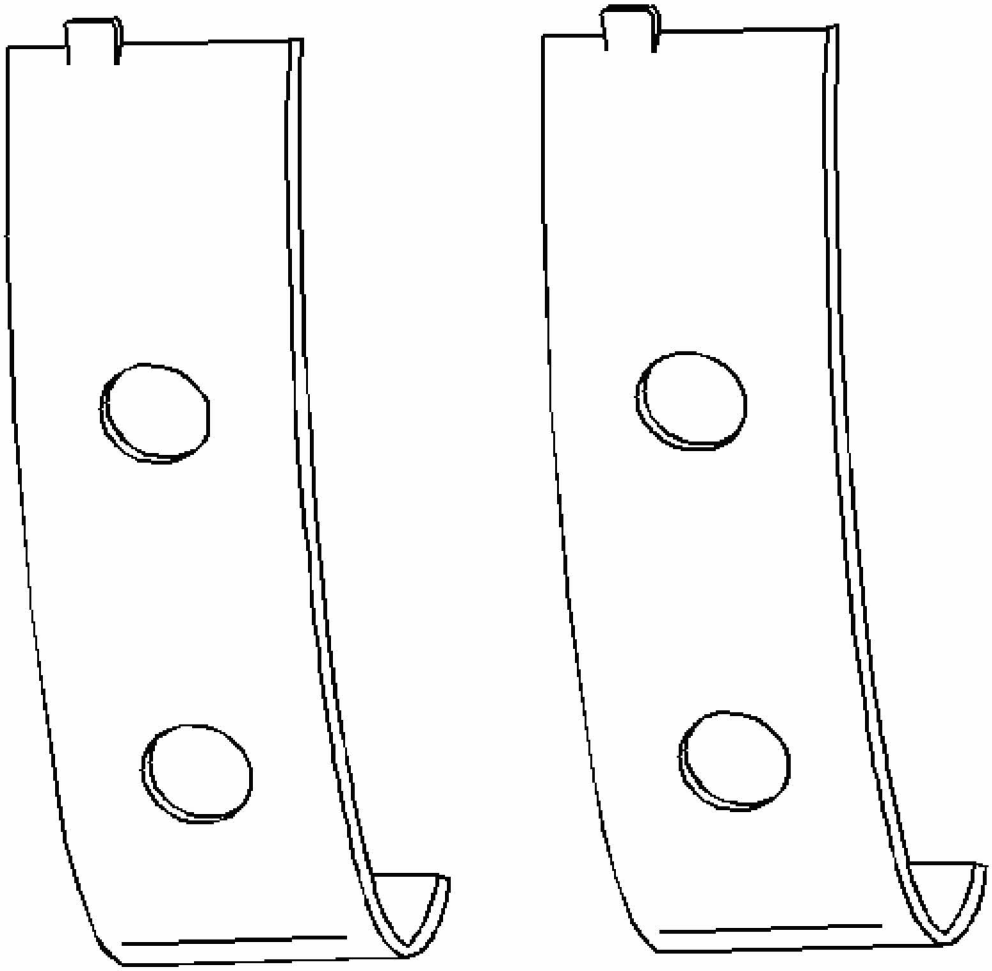


Fig. 340: View Of Crankshaft Bearings
Courtesy of GENERAL MOTORS CORP.

6. The crankshaft bearings are the precision insert type.
7. Inspect the outer surfaces of the crankshaft bearings for the following conditions:
   - Wear-surface wear indicates either movement of the insert, or high spots in the surrounding material - spot wear.
   - Overheating or discoloration
   - Looseness or rotation indicated by flattened tangs and wear grooves

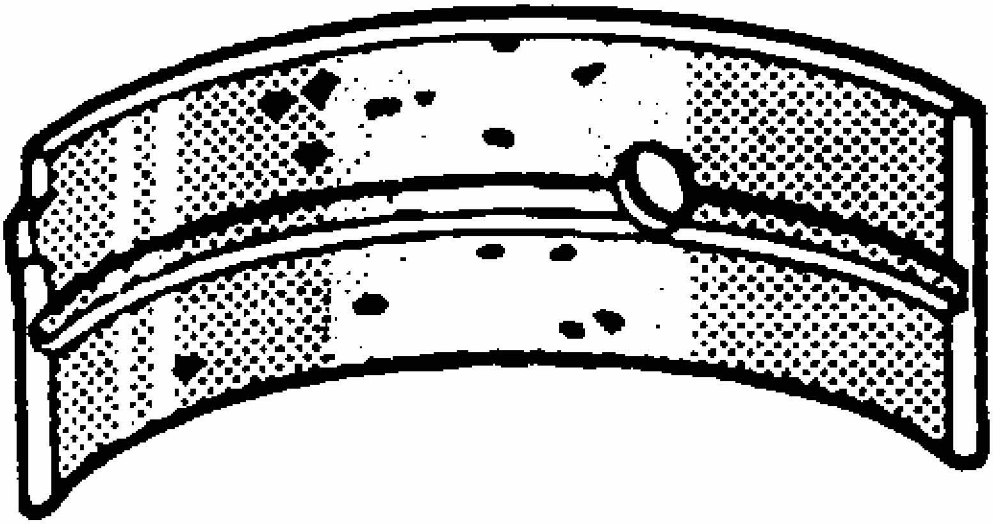


Fig. 341: Identifying Crankshaft Bearing Craters Or Pockets
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Note the location of the crankshaft main bearing high spots. If the spots are not in line, the crankshaft is bent. Replace the crankshaft.

8. Inspect the crankshaft main bearings for craters or pockets. Flattened sections on the crankshaft bearing halves also indicate fatigue.
9. Inspect the thrust surfaces of the main thrust bearing for the following conditions:
    - Wear
    - Grooving-Grooves are caused by irregularities of the crankshaft thrust surface.

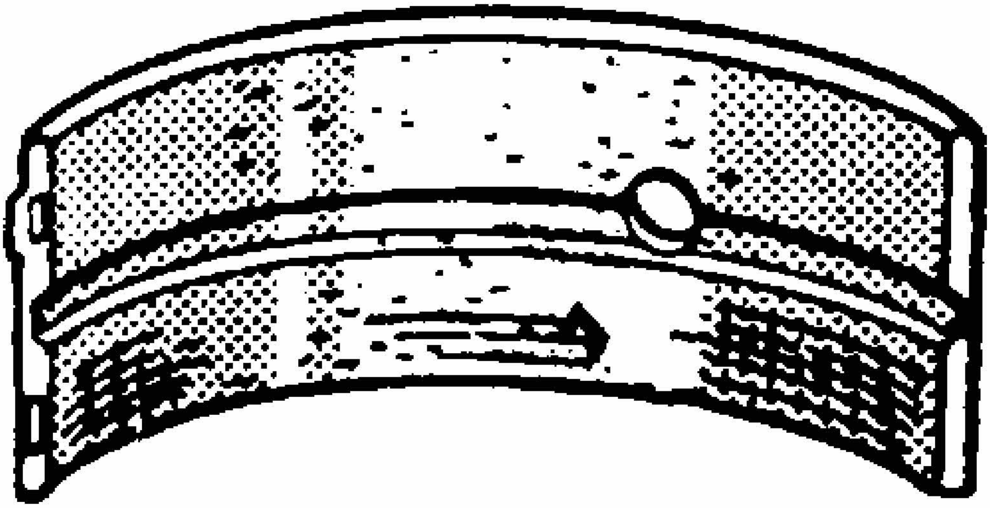


Fig. 342: Identifying Connecting Rod Bearing Scoring Or Discoloration
Courtesy of GENERAL MOTORS CORP.

10. Inspect the crankshaft bearings for excessive scoring or discoloration.
11. Inspect the crankshaft main bearings for dirt or imbedded debris.

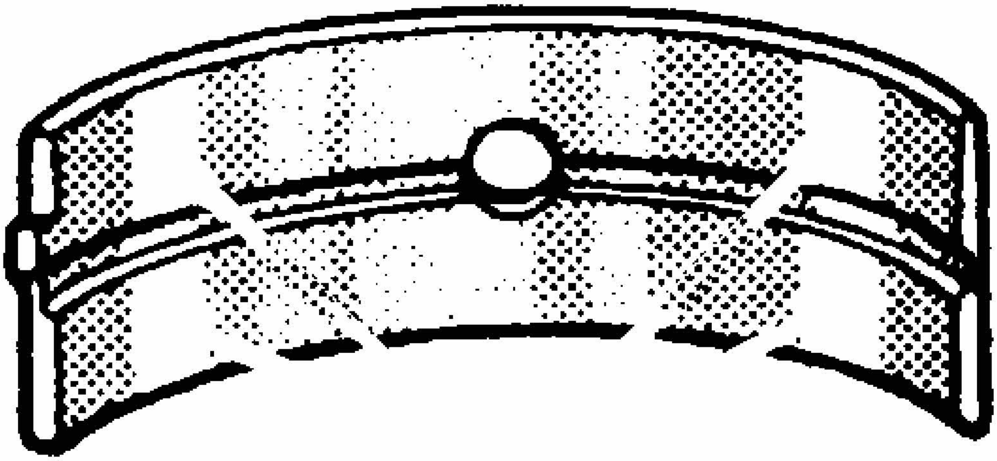


Fig. 343: Crankshaft Bearing Polished Sections (Improper Seating)

Courtesy of GENERAL MOTORS CORP.

12. Inspect the crankshaft main bearings for improper seating indicated by bright, polished sections.
13. Inspect the crankshaft bearings for uneven side-to-side wear. This may indicate a bent crankshaft or a tapered bearing journal.

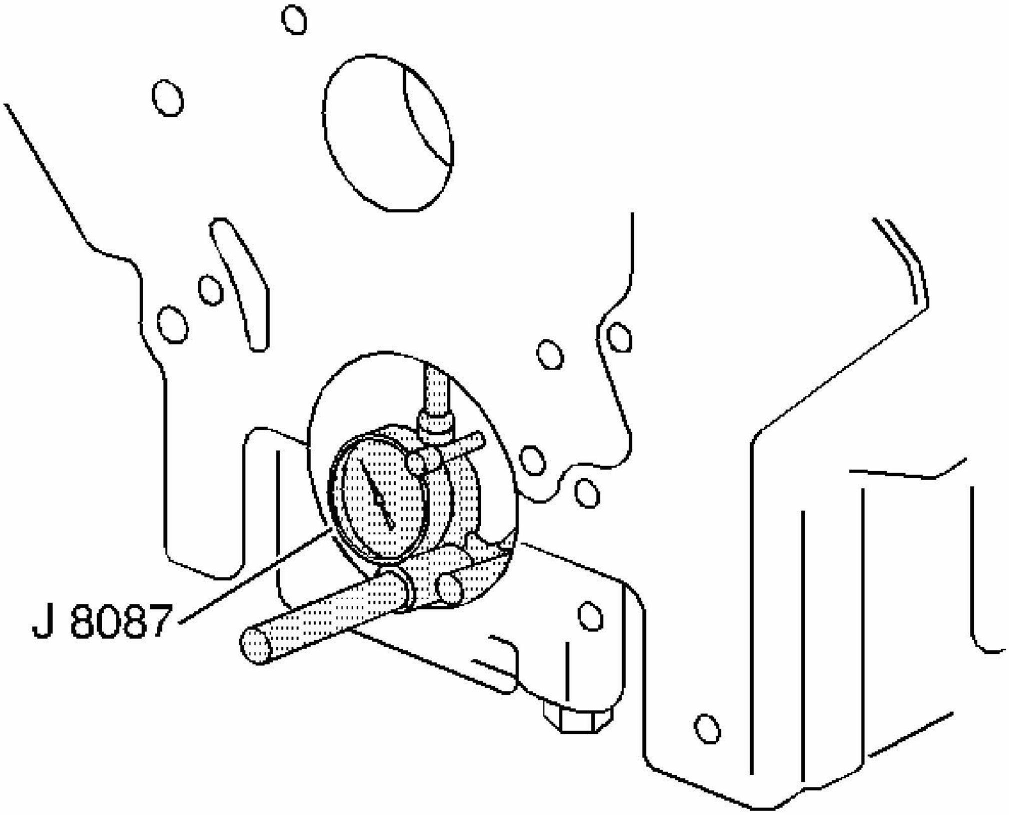


Fig. 344: Inspecting Crankshaft Main Bearing Bores
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If crankshaft bearing failure is due to conditions other than normal wear, investigate the cause of the condition. Inspect the crankshaft or connecting rod bearing bores.

14. Inspect the connecting rod bearing bores or crankshaft main bearing bores using the following procedure:
    1. Tighten the bearing cap to specification.

2. Use the **J 8087** in order to measure the bearing bore for taper and out-of-round. Record the readings for bearing selection.
3. No taper or out-of-round should exist.

Bearing Selection

Measure the bearing clearance to determine the correct replacement bearing insert size. There are two methods to measure bearing clearance. Method A gives more reliable results and is preferred.

- Method A yields measurement from which the bearing clearance can be computed.
- Method B yields the bearing clearance directly. Method B does not give any indication of bearing run-out.

Method A

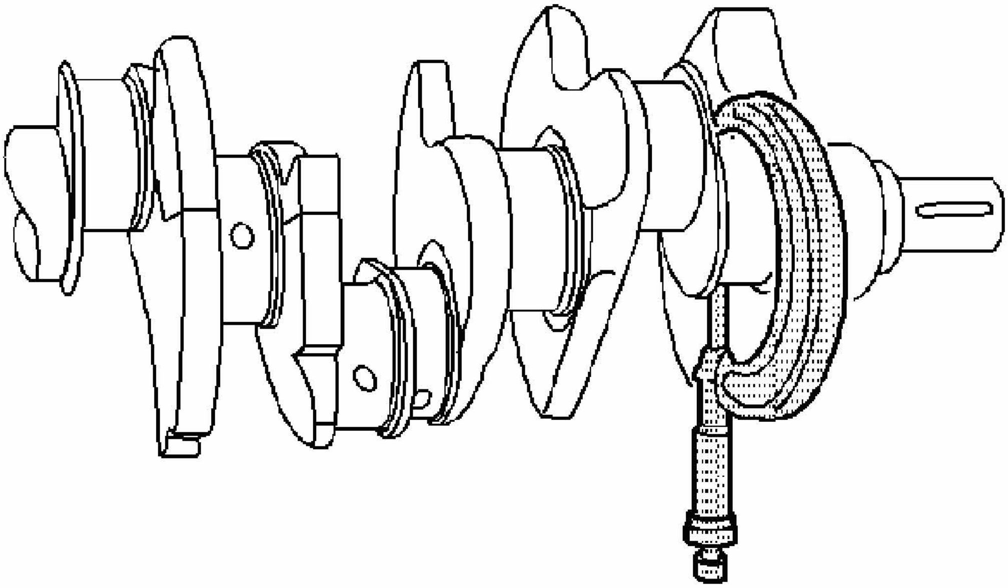


Fig. 345: Measuring Crankshaft Bearing Journal Diameter
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not mix inserts of different nominal size in the same bearing bore.

1. Measure the crankshaft bearing journal diameter with a micrometer in several places,

90 degrees apart. Average the measurements.

2. Measure the crankshaft bearing journal taper and runout.
3. Install the crankshaft bearing inserts. Tighten the bearing cap bolts to specification using **J 45059** .
4. Measure the connecting rod inside diameter in the same direction as the length of the rod with an inside micrometer.
5. Measure the crankshaft main bearing inside diameter with an inside micrometer.
6. Select a set of bearing inserts that will produce the desired clearance.
7. If the specified clearances cannot be met, the crankshaft journals must be reconditioned and undersized bearing inserts installed.

Method B

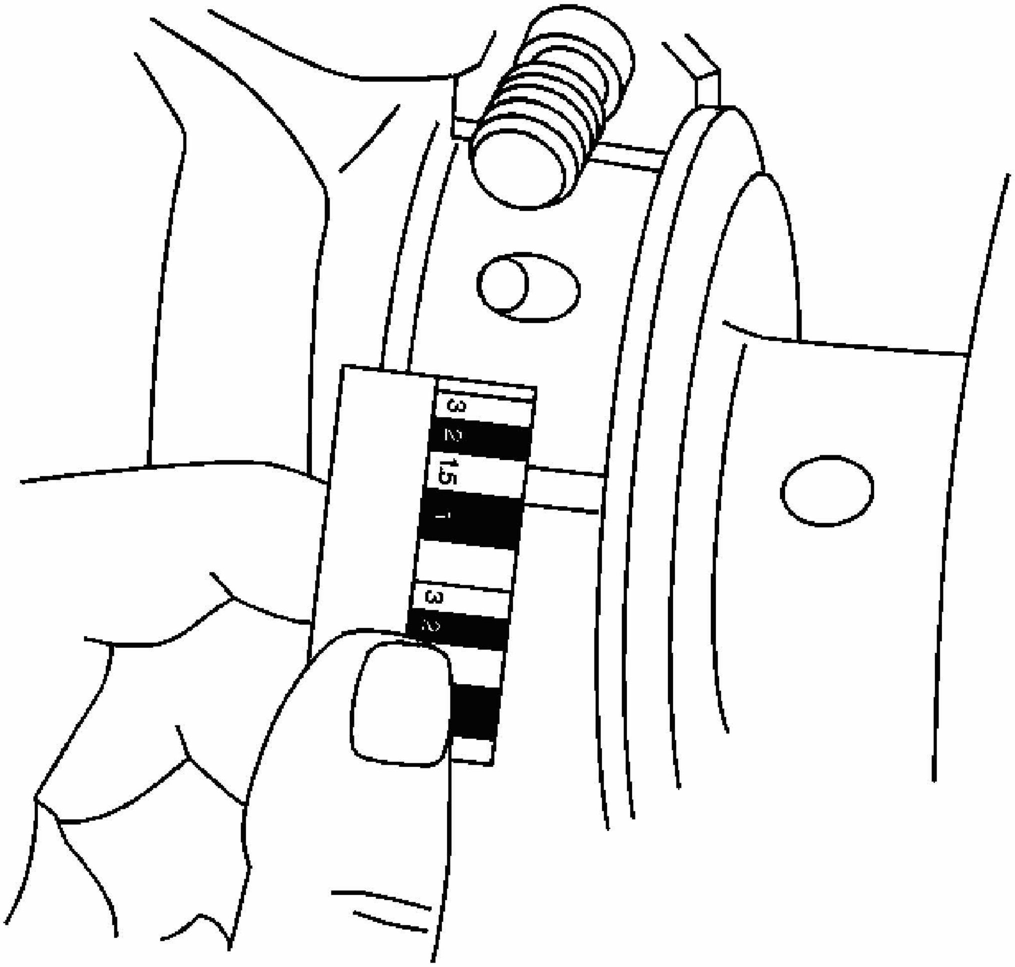


Fig. 346: Measuring Gaging Plastic
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not mix inserts of different nominal size in the same bearing bore.

1. Clean the used bearing inserts.
2. Install the used bearing inserts.
3. Place a piece of gaging plastic across the entire bearing width.
4. Install the bearing caps.

NOTE: In order to prevent the possibility of cylinder block or crankshaft bearing cap damage, the crankshaft bearing caps are tapped into the cylinder block cavity using a brass, lead, or a leather mallet before the attaching bolts are installed. Do not use attaching bolts to pull the crankshaft bearing caps into the seats. Failure to use this process may damage a cylinder block or a bearing cap.

5. Install the bearing cap bolts to specification using **J 45059** .

IMPORTANT: Do not rotate the crankshaft.

6. Remove the bearing cap, leaving the gaging plastic in place. It does not matter whether the gaging plastic adheres to the journal or to the bearing cap.
7. Measure the gaging plastic at its widest point with the scale printed on the gaging plastic package.
8. Remove the gaging plastic.
9. Select a set of bearing inserts that will produce the desired clearance.

CRANKSHAFT BALANCER CLEANING AND INSPECTION

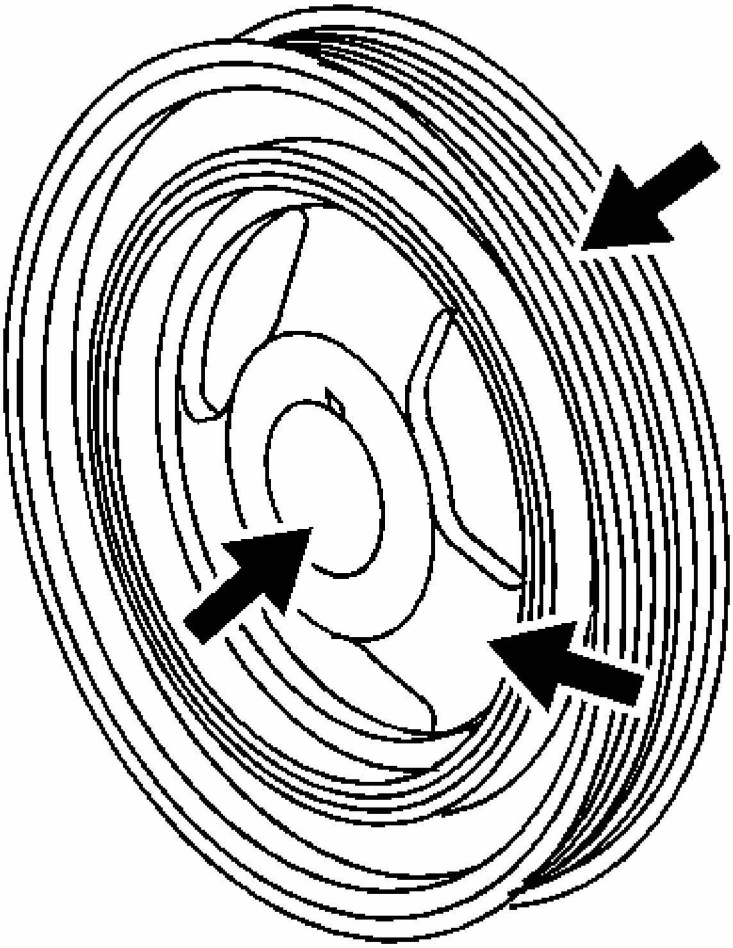


Fig. 347: View Of Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

1. Clean the crankshaft balancer in solvent.
2. Clean the belt grooves of all dirt or debris with a wire brush.
3. Inspect the crankshaft balancer for the following:

IMPORTANT: A crankshaft balancer hub seal surface with excessive scoring, grooves, rust or other damage must be replaced. Minor imperfections on the hub seal surface may be

removed with polishing compound or fine grade emery cloth.

- Worn, grooved, or damaged hub seal surface

IMPORTANT: In order for the belt to track properly, the belt grooves should be free of all dirt, debris, nicks, gouges or other damage. Minor imperfections may be removed with a fine file.

- Dirty or damaged belt grooves.
- Worn, chunking or deteriorated rubber between the hub and pulley

ENGINE FLYWHEEL CLEANING AND INSPECTION

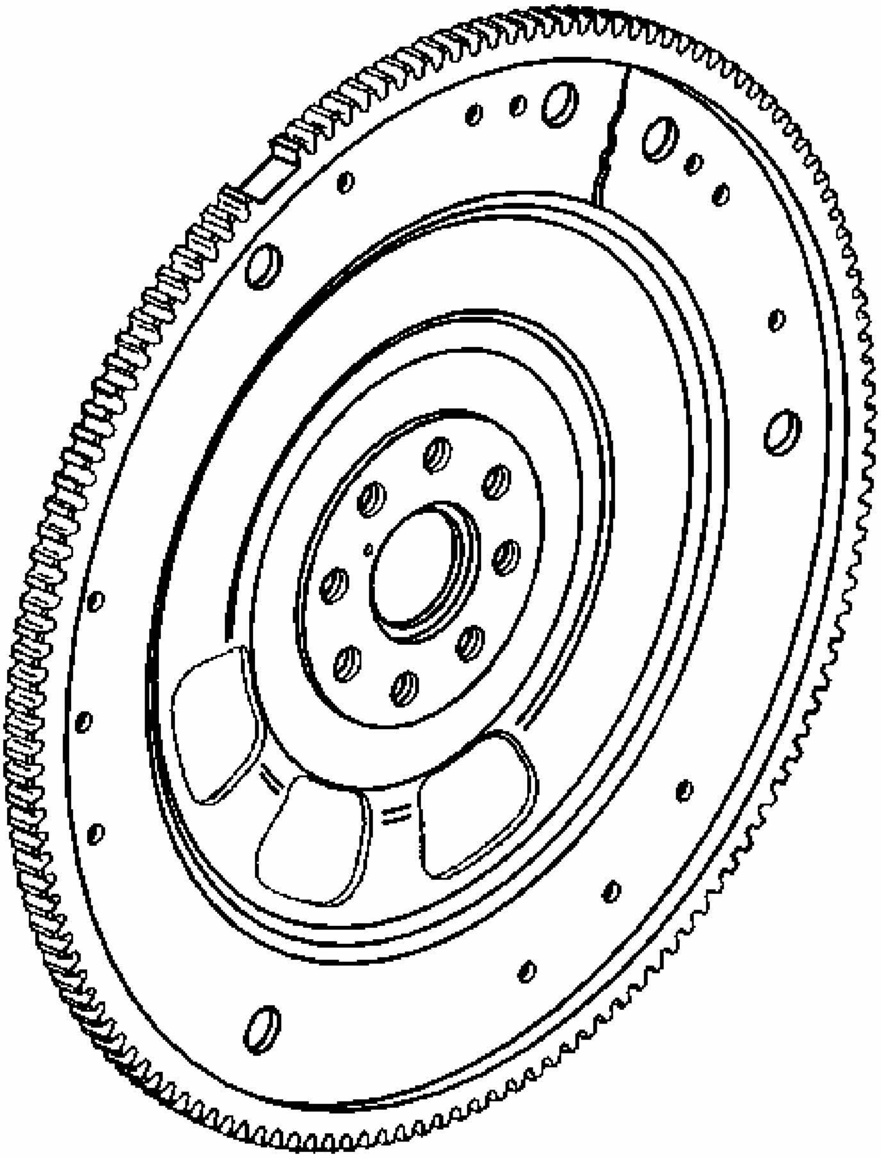


Fig. 348: Inspecting Engine Flywheel
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

1. Clean the engine flywheel with solvent.
2. Dry the engine flywheel with compressed air.

3. Inspect the engine flywheel for the following:
    - Damaged ring gear teeth
    - Stress cracks around the flywheel-to-crankshaft bolt hole locations

PISTON, CONNECTING ROD, AND BEARINGS CLEANING AND INSPECTION

Tools Required

- **J 8087** Cylinder Bore Gage
- **EN-46745** Piston Pin Retainer Remover and Installer

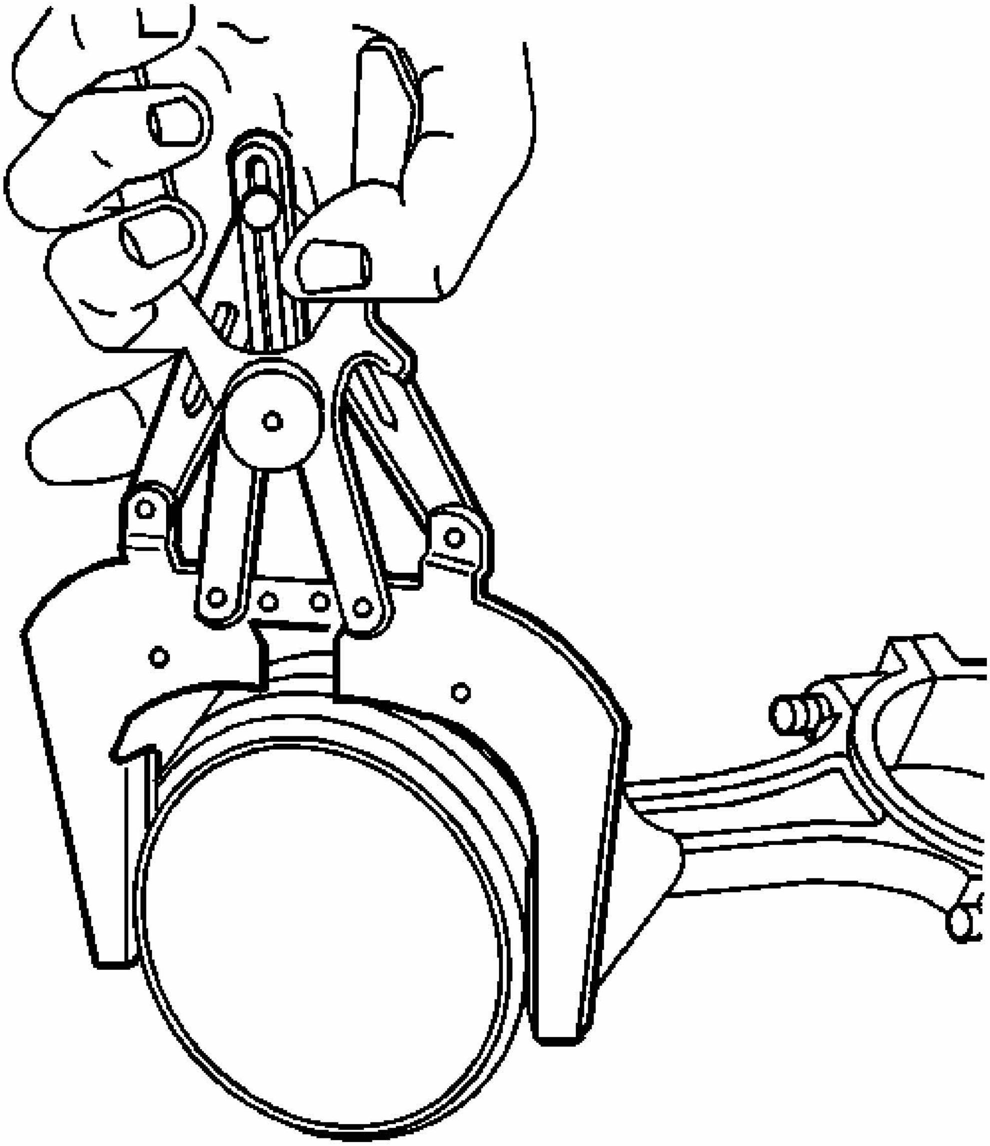


Fig. 349: Cleaning The Piston Ring Grooves With Suitable Ring Groove Cleaning Tool
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

IMPORTANT: Measurement of all components should be taken with the components at room temperature. Do not use a wire brush in order to clean any part of the piston or connecting rod

assembly.

IMPORTANT: Some steps in this procedure may reflect on a disassembled oversized piston. Others will only apply to the standard size pistons that are NOT to be disassembled.

1. Clean the piston and connecting rod in solvent.
2. Dry off the piston and connecting rod with compressed air.
3. Clean the piston ring grooves with a suitable ring groove cleaning tool.
4. Clean the piston oil lubrication holes and slots.

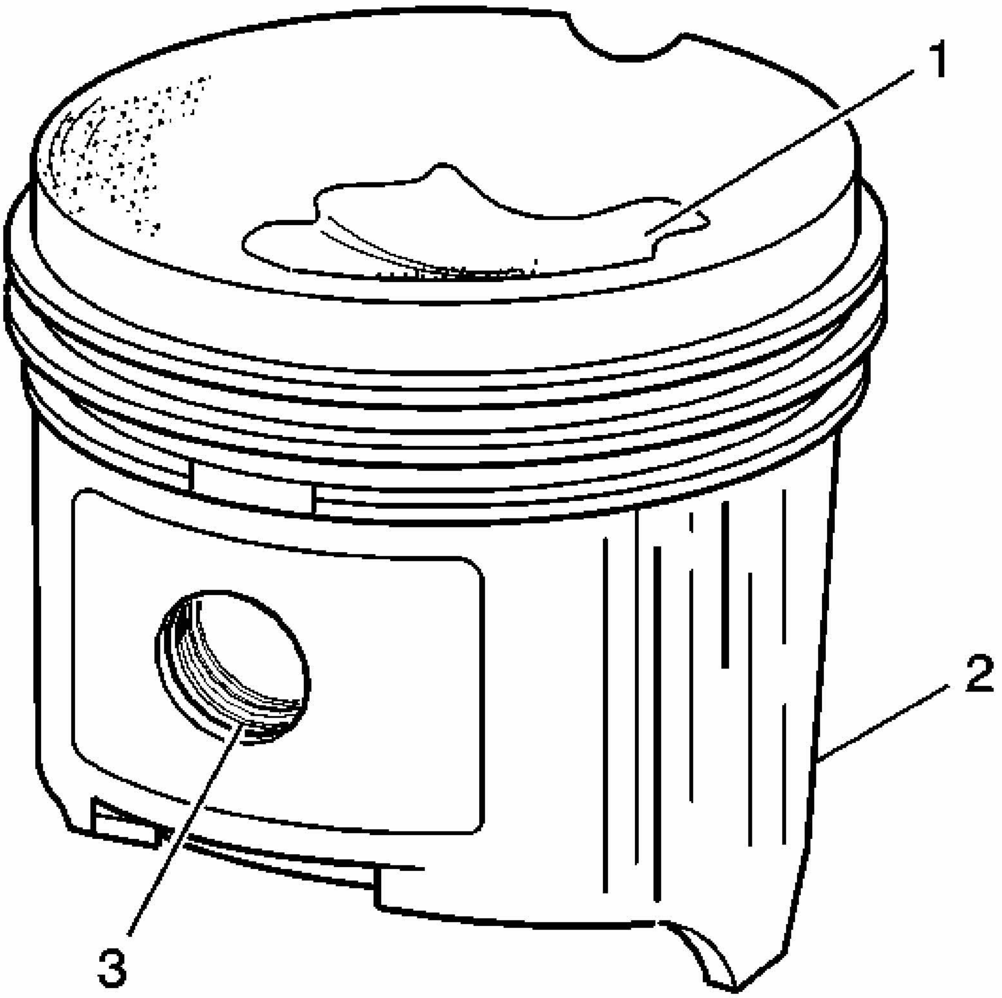


Fig. 350: Identifying Piston Damage Inspection Areas

Courtesy of GENERAL MOTORS CORP.

5. Inspect the piston for the following:
    - Eroded areas (1) on the top of the piston
    - Scuffed or damaged skirt (2)
    - Damage to the pin bore (3)
    - Cracks in the piston ring lands, the piston skirt, or the pin bosses
    - Piston ring grooves for nicks, burrs, or other warpage which may cause the piston ring to bind
6. Inspect the piston pin for scoring, wear or other damage.

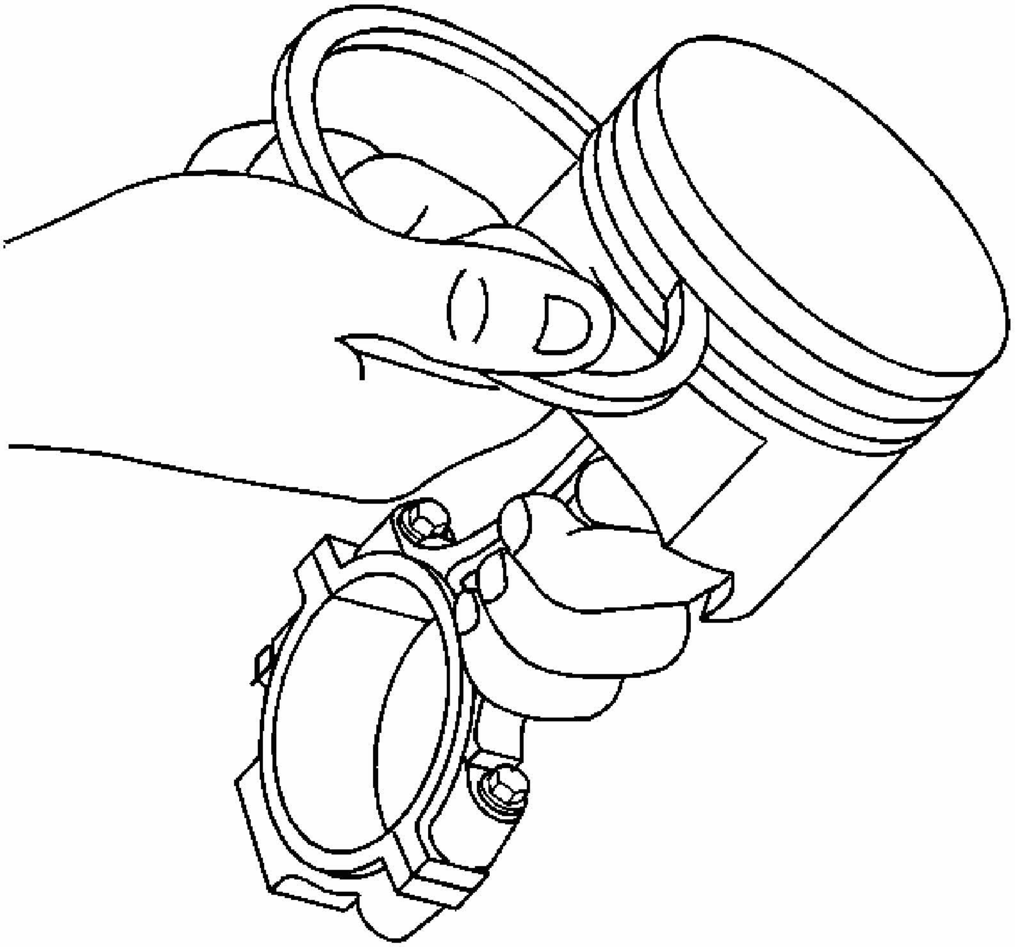


Fig. 351: Inserting Piston Ring Into Ring Groove
Courtesy of GENERAL MOTORS CORP.

7. Measure the piston ring-to-piston ring groove side clearance.
    1. Insert the edge of the piston ring into the piston ring groove.
    2. Roll the piston ring completely around the piston ring groove.
        - If binding is caused by distorted piston ring groove, replace the piston.
        - If binding is caused by a distorted piston ring, replace the piston ring.

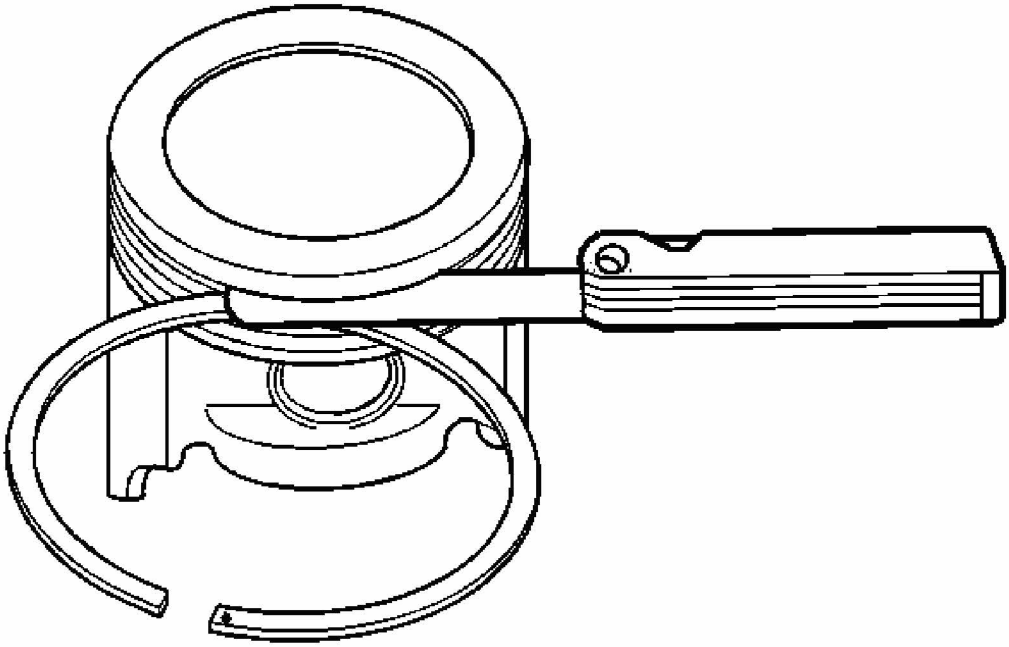


Fig. 352: Measuring Piston Ring Side Clearance
Courtesy of GENERAL MOTORS CORP.

8. Measure the piston ring side clearance with a feeler gage.
9. If the side clearance is too small try another ring set.
10. If the proper piston ring-to-piston ring groove clearance cannot be achieved, replace the piston and pin assembly.
    - Proper ring-to-piston ring groove clearance for the top ring is 0.03-0.065 mm (0.001-0.002 in).
    - Proper ring-to-piston ring groove clearance for the second ring is 0.04-0.078 mm (0.002-0.003 in).

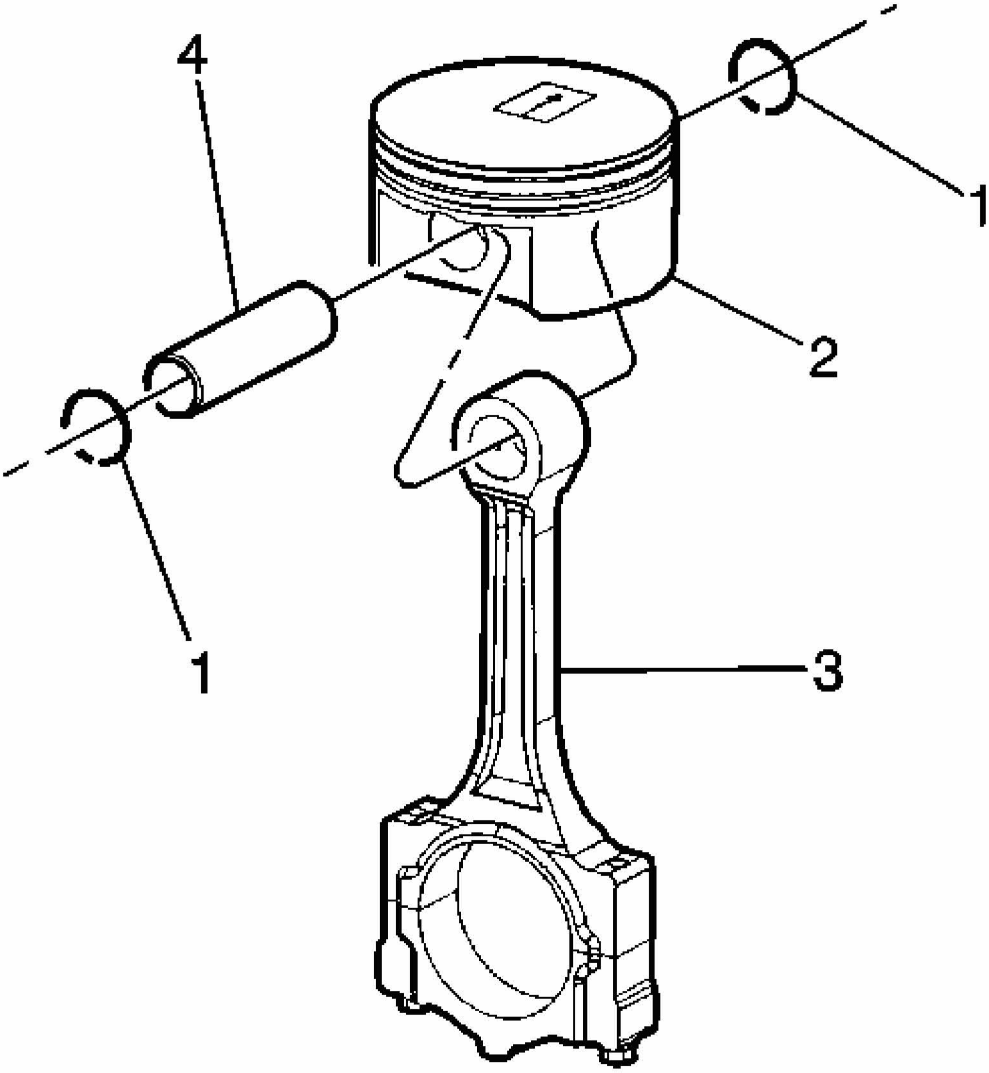


Fig. 353: Exploded View Of Piston & Connecting Rod Assembly
Courtesy of GENERAL MOTORS CORP.

11. Using the **EN-46745** , remove the piston pin retainers (1).
12. Discard the oil piston pin retainers.
13. Slide the piston pin (4) out of the piston (2), disconnecting the piston from the connecting rod (3).

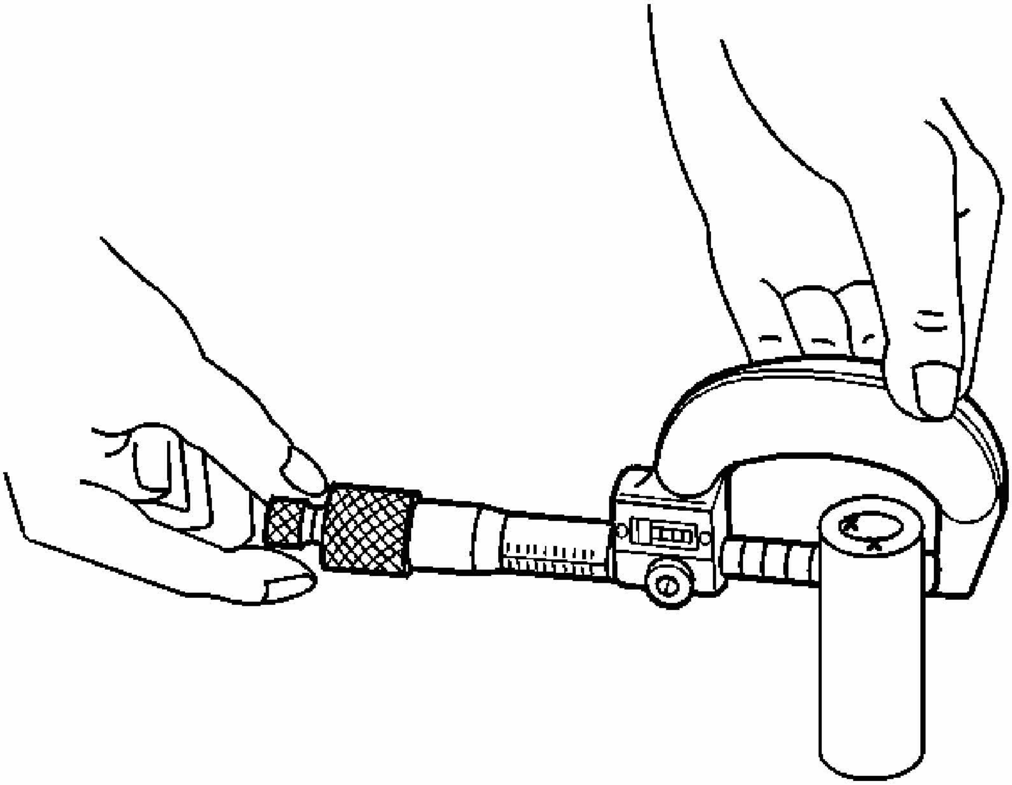


Fig. 354: Measuring Piston Pin Diameter
Courtesy of GENERAL MOTORS CORP.

14. Measure the piston pin diameter using and outside micrometer.

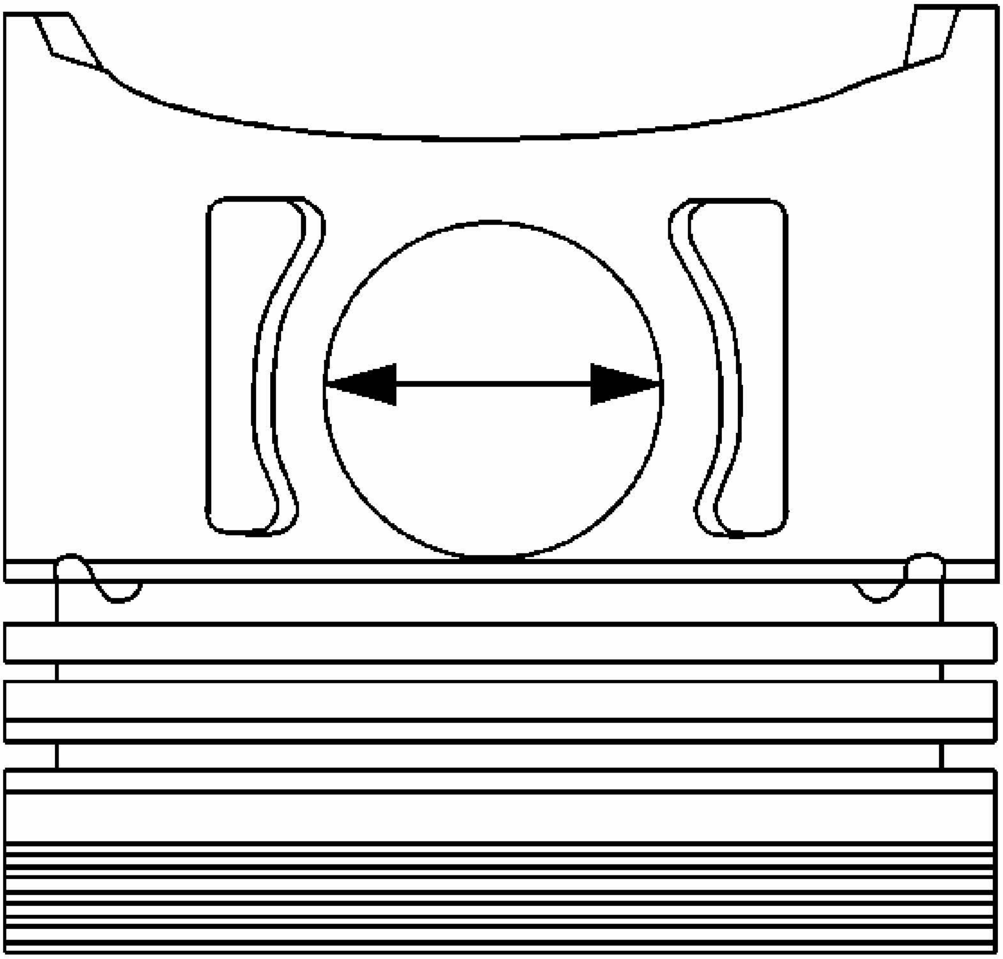


Fig. 355: Measuring The Piston Pin Bore
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **When fitting pistons, consider both the pistons and the cylinder bore conditions together. Production and service pistons have the same nominal weight and may be intermixed without affecting engine balance. If necessary, used pistons may be fitted selectively to any cylinder of the engine, providing the pistons are in good condition and the same weight. Do not cut oversize pistons down or the engine balance may be affected. Finish hone when selecting the pistons.**

15. Measure the piston pin bore using an inside micrometer.

16. Subtract the piston pin diameter from the piston pin bore diameter in order to determine the piston pin-to-piston pin bore clearance.
17. Piston-to-piston pin bore clearance must measure 0.002-0.010 mm (0.00008-0.0004 in). Replace the piston and the piston pin if the piston and the piston pin are not within specifications.

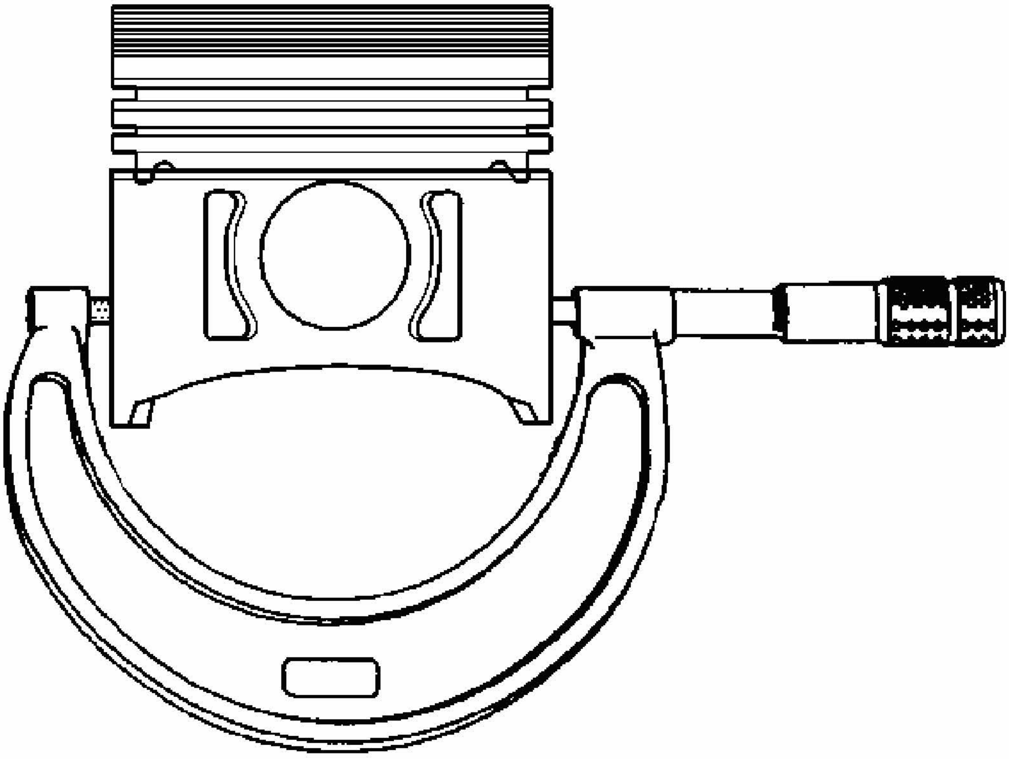


Fig. 356: Measuring Piston Diameter
Courtesy of GENERAL MOTORS CORP.

18. Measure the piston diameter with a micrometer at a right angle to the piston bore with the piston pin removed, and record the measurement. Measure the piston at 43 mm (1.692 in) from dome of piston. Piston diameter must measure no less than 98.950 mm (3.895 in). Replace the piston and the pin as an assembly if the piston is not within specifications.

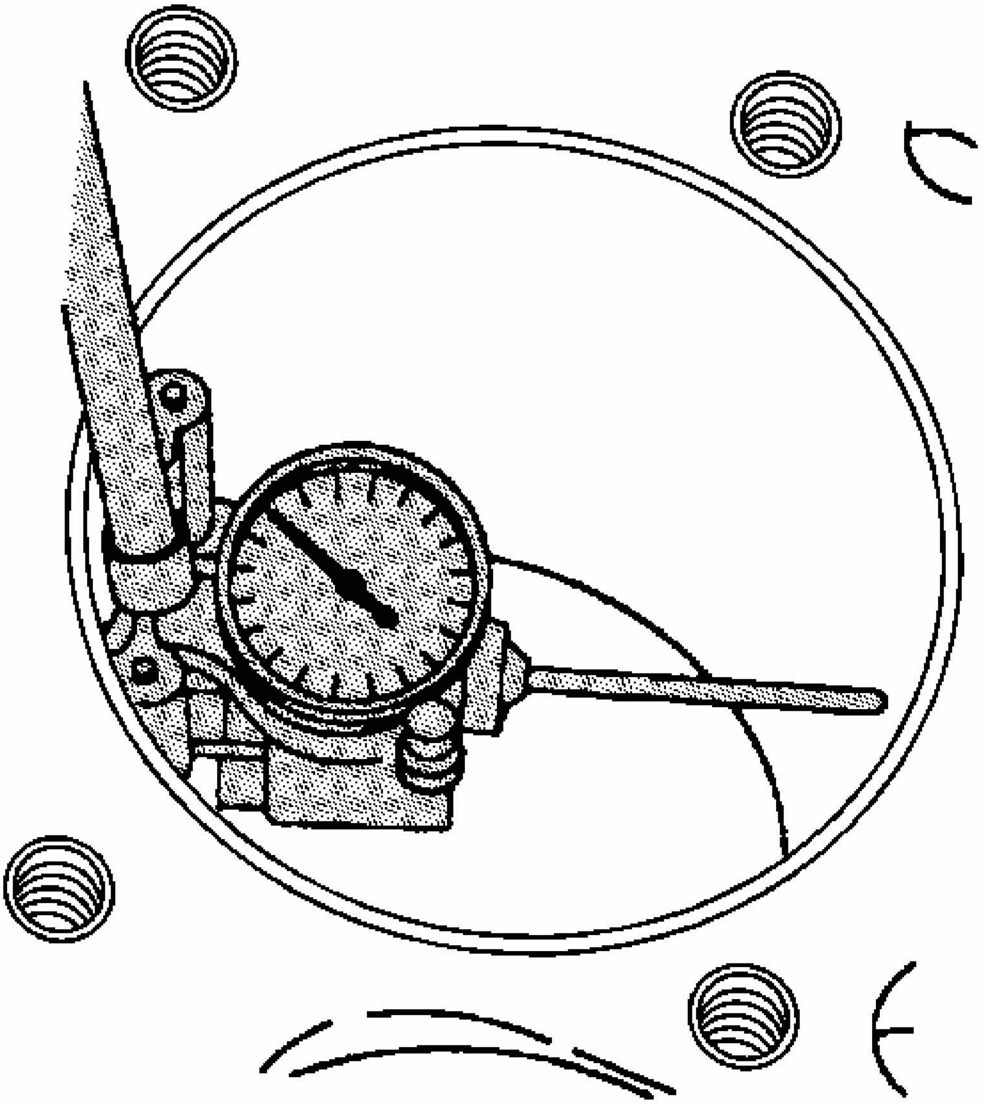


Fig. 357: Measuring Cylinder Bore
Courtesy of GENERAL MOTORS CORP.

19. Measure the cylinder bore, using **J 8087** .

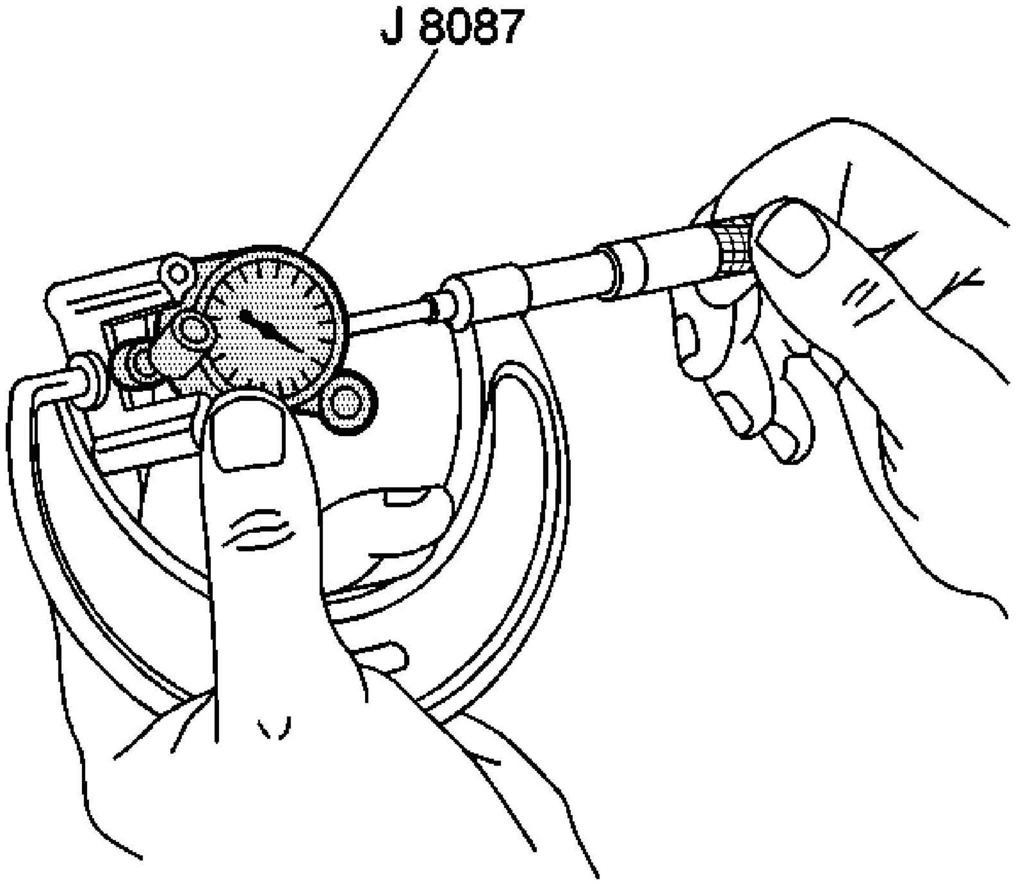


Fig. 358: Measuring Bore Gauge With Micrometer
Courtesy of GENERAL MOTORS CORP.

20. Measure the **J 8087** . Record this reading.
21. Subtract the diameter of the piston from the diameter of the cylinder bore to determine the piston-to-bore clearance. The cylinder bore clearance must be no more than 0.080 mm (0.003 in).
22. If a used piston is not acceptable, inspect the service piston size and determine if a new piston may be selected. Service pistons are available in standard and 0.5 mm (0.012 in) oversize.
23. When a piston has been selected, mark the piston in order to identify the cylinder for which the piston was fitted.

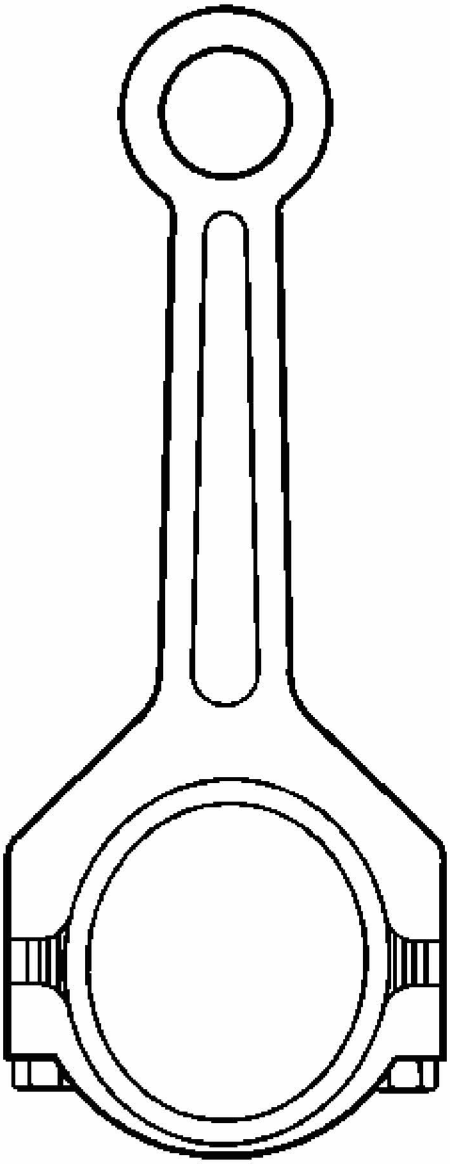


Fig. 359: View Of Connecting Rod
Courtesy of GENERAL MOTORS CORP.

24. Inspect the connecting rod for an out-of-round bearing bore. If the out-of-round measurement exceeds 0.005 mm (0.0002 in) the connecting rod must be replaced.

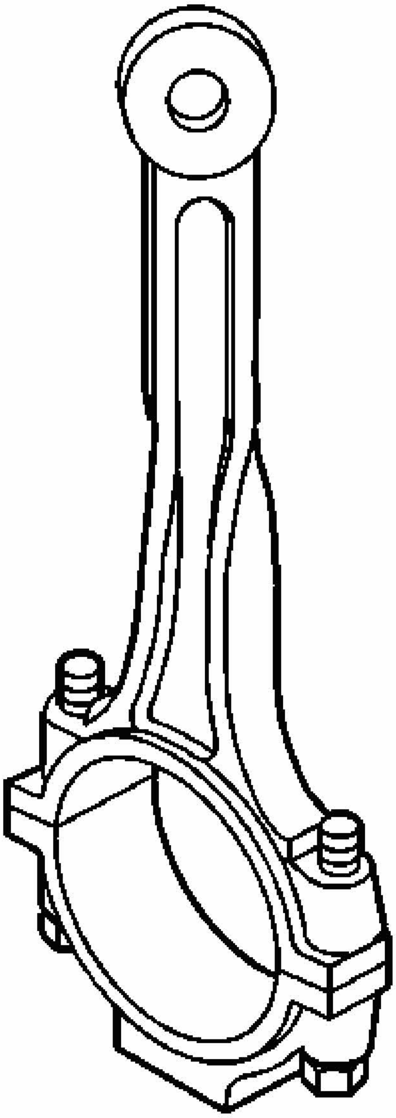


Fig. 360: Identifying Twisted Connecting Rod
Courtesy of GENERAL MOTORS CORP.

25. Inspect the connecting rod for twisting.
    1. Install the connecting rod cap.
    2. Place the connecting rod assembly on a checking fixture. Inspect the assembly for bending or twisting.
    3. Do not attempt to straighten the connecting rod. Ensure that the connecting rod meets the following conditions:

  - The connecting rods are not bent more than 0.18 mm (0.007 in).
  - The connecting rods are not twisted more than 0.38 mm (0.015 in).
4. Replace any bent or twisted connecting rods.
5. Inspect the new connecting rods before using the new rods.

26. Inspect the connecting rod for damage to the bearing cap and bolt threads.

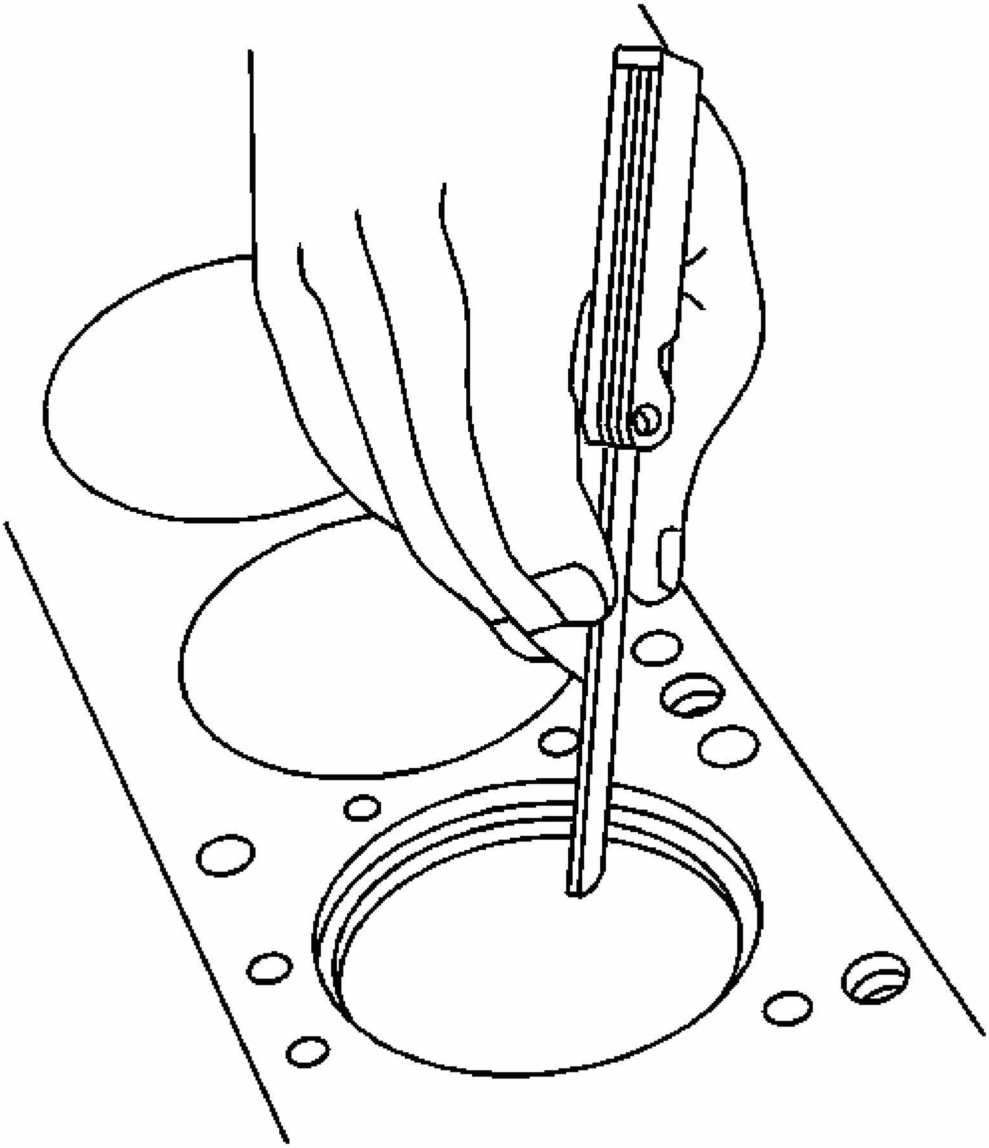


Fig. 361: Measuring Piston Ring End Gap
Courtesy of GENERAL MOTORS CORP.

27. Measure the piston compression ring end gap.

    IMPORTANT: Fit each compression ring to the cylinder in which it will be used.

    1. Place the compression ring into the cylinder bore.
    2. Push the compression ring into the bottom of the cylinder bore to approximately 6.5 mm (0.25 in) above ring travel. The ring must be square to the cylinder wall.
    3. Use a feeler gage in order to measure the end gap. The first compression ring end gap must measure 0.15-0.30 mm (0.006-0.011 in), the second compression ring must measure 0.25-0.45 mm (0.009-0.017 in).
    4. Select another size ring set if the end gap exceeds specifications. If ring gap clearance is below specifications, increase the gap by carefully filing off excess material.

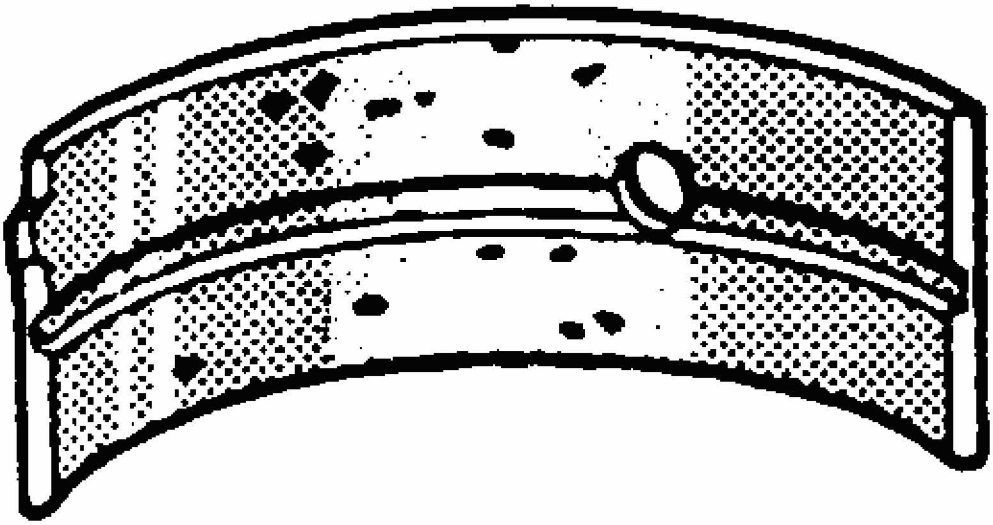


Fig. 362: Identifying Crankshaft Bearing Craters Or Pockets
Courtesy of GENERAL MOTORS CORP.

28. Inspect the connecting rod bearings for craters or pockets. Flattened sections on the connecting rod bearing halves may indicate fatigue.

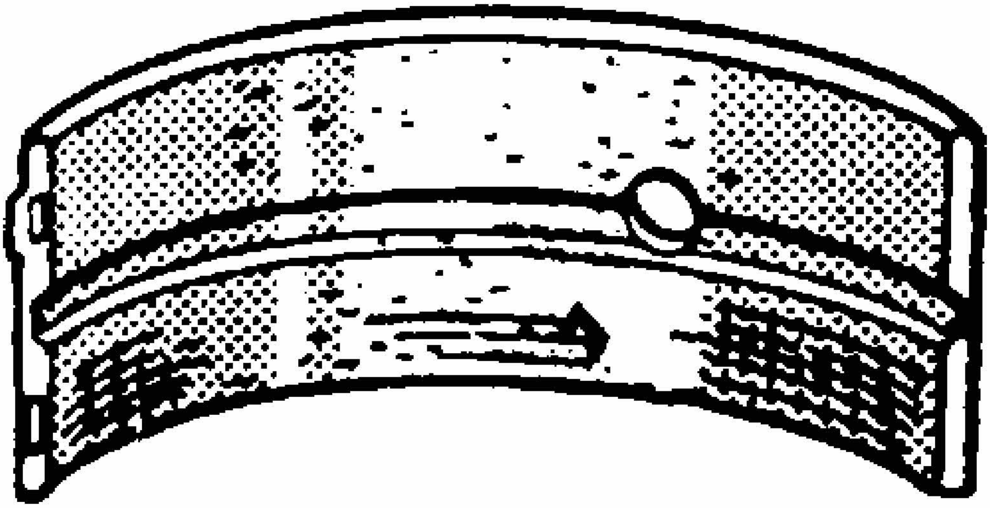


Fig. 363: Identifying Connecting Rod Bearing Scoring Or Discoloration
Courtesy of GENERAL MOTORS CORP.

29. Inspect the connecting rod bearings for excess scoring or discoloration.
30. Inspect the connecting rod bearings for dirt or debris imbedded into the connecting rod bearing halves.

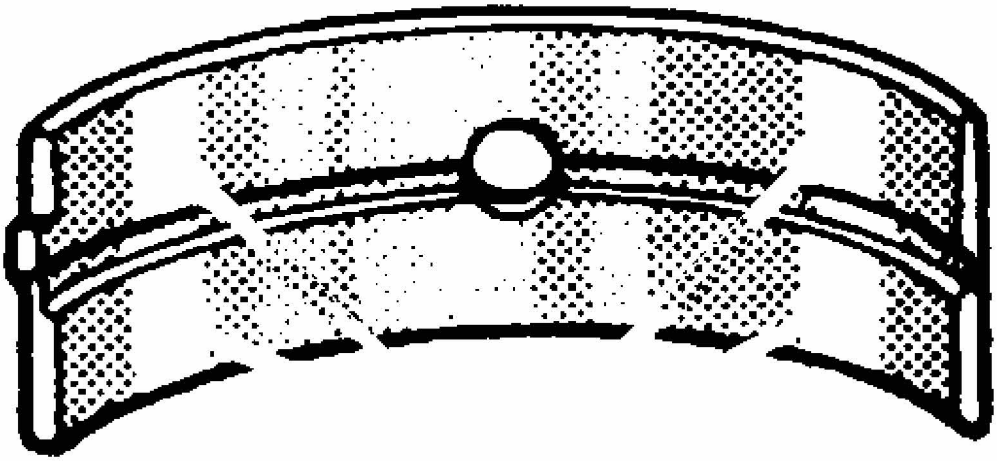


Fig. 364: Crankshaft Bearing Polished Sections (Improper Seating)
Courtesy of GENERAL MOTORS CORP.

31. Inspect the connecting rod bearings for improper seating indicated by bright, polished sections of the bearings.
32. Inspect the inside of the connecting rod bearing and the outside diameter of the connecting rod bearing journal for wear. This indicates high spots.

CAMSHAFT AND BEARINGS CLEANING AND INSPECTION

Tools Required

J 7872 Magnetic Base Dial Indicator Set

1. Remove and discard the camshaft position actuator filter (1).
2. Clean the camshaft with cleaning solvent.

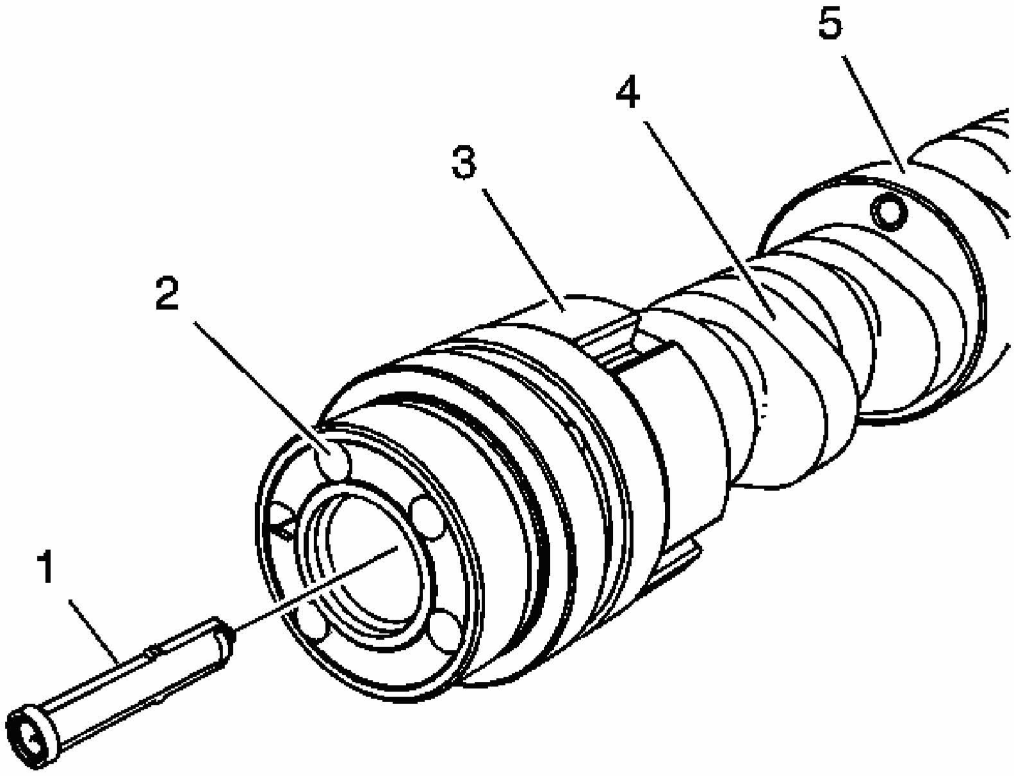


Fig. 365: Identifying Camshaft Inspection Points
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to CLEANING SOLVENT CAUTION in Cautions and Notices.

3. Inspect the camshaft for the following conditions:
    - Scored camshaft bearing journals (5)
    - Damaged camshaft lobes (4)
    - Damaged camshaft position sensor reluctor area (3)
    - Damaged threads (2)

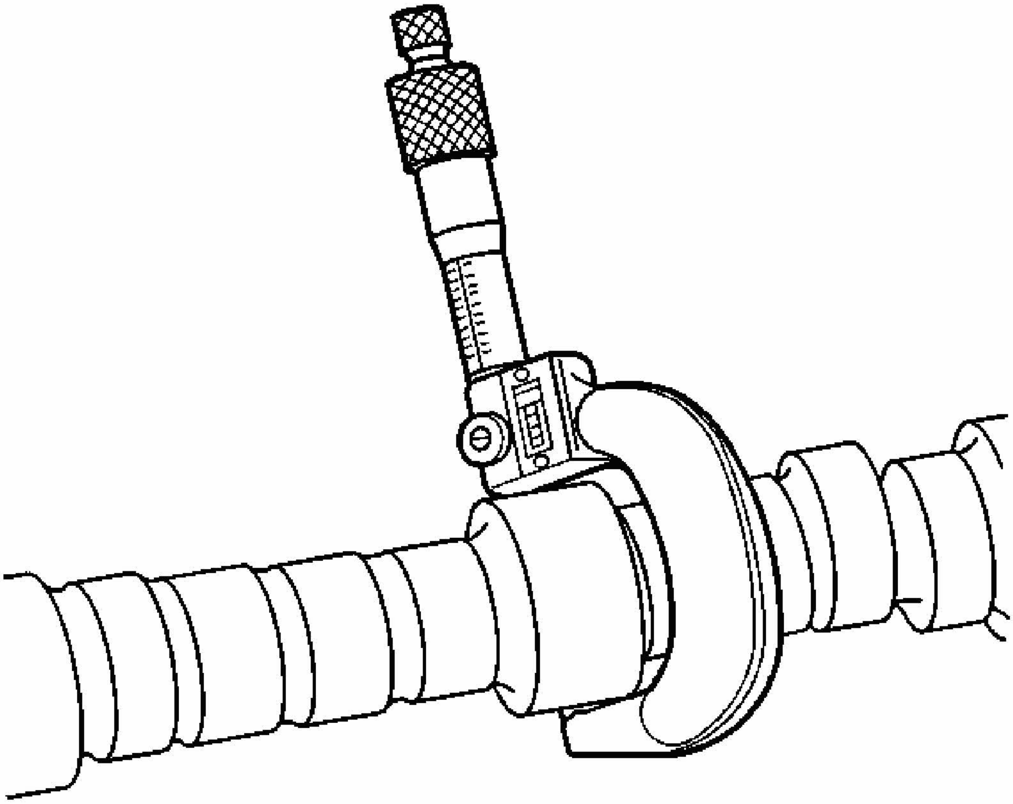


Fig. 366: Measure Camshaft Journals With Micrometer
Courtesy of GENERAL MOTORS CORP.

4. Measure the camshaft journals using a micrometer.

    If the camshaft journals are not within specifications, replace the camshaft.

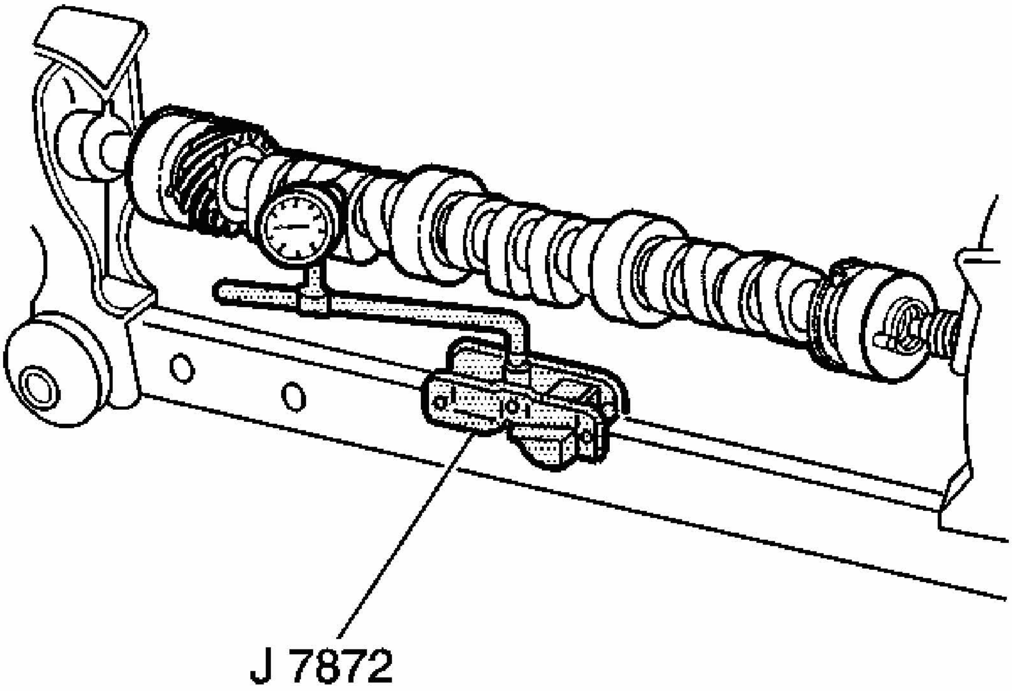


Fig. 367: Measuring Camshaft With J 7872
Courtesy of GENERAL MOTORS CORP.

5. Measure the camshaft runout using the **J 7872** .
    1. Mount the camshaft in V-blocks between the centers.
    2. Use the **J 7872** in order to measure the intermediate camshaft journal.
6. Measure the camshaft lobe lift using the **J 7872** .
    1. Lubricate the camshaft using GM P/N 12345501 (Canadian P/N 992704) or the equivalent.
    2. Set the camshaft on V-blocks.
    3. Use the **J 7872** in order to measure the lobe lift.
7. If the runout or lobe lift is not within specifications, replace the camshaft.

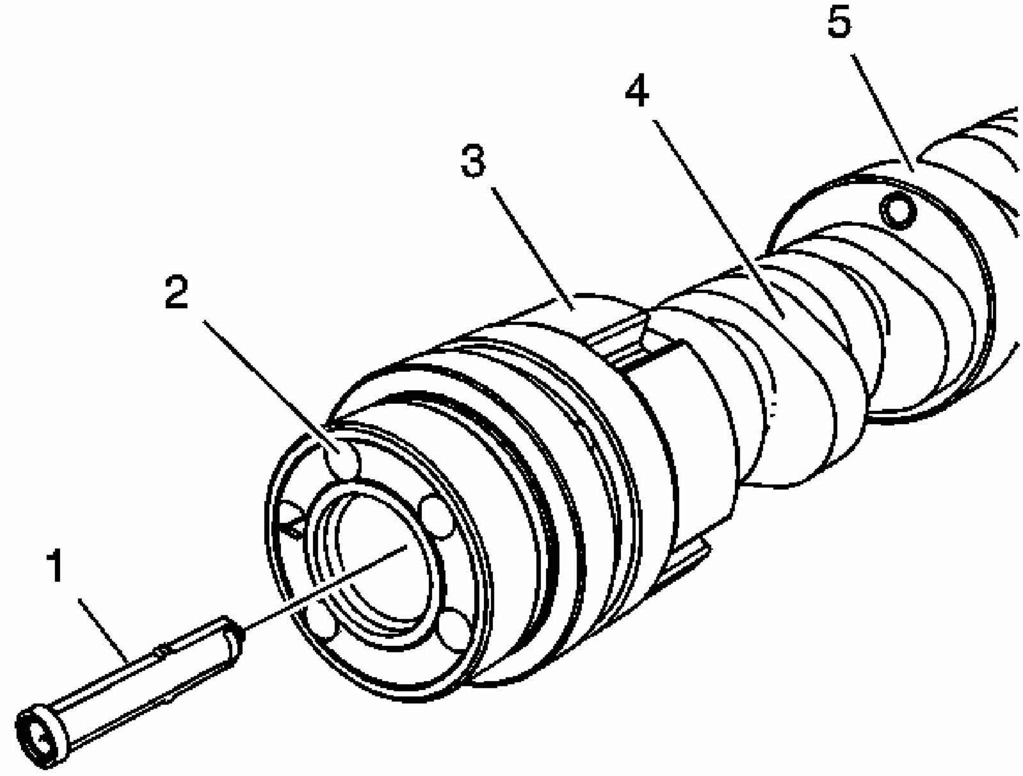


Fig. 368: Identifying Camshaft Inspection Points
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Always install a NEW camshaft position actuator filter anytime the camshaft position actuator is removed or installed.

8. Install a NEW camshaft position actuator filter (1).

TIMING CHAIN AND SPROCKETS CLEANING AND INSPECTION

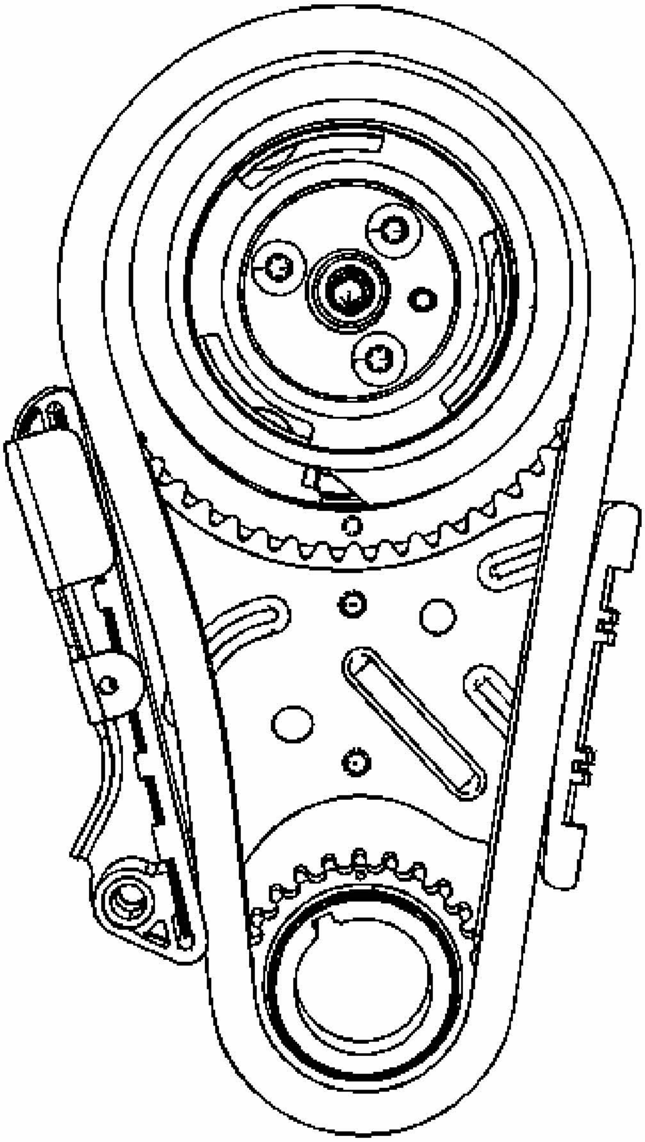


Fig. 369: View Of Timing Chain, Sprockets & Tensioners
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

1. Clean all components with cleaning solvent.
2. Dry the components with compressed air.
3. Inspect the timing chain for binding or wear.

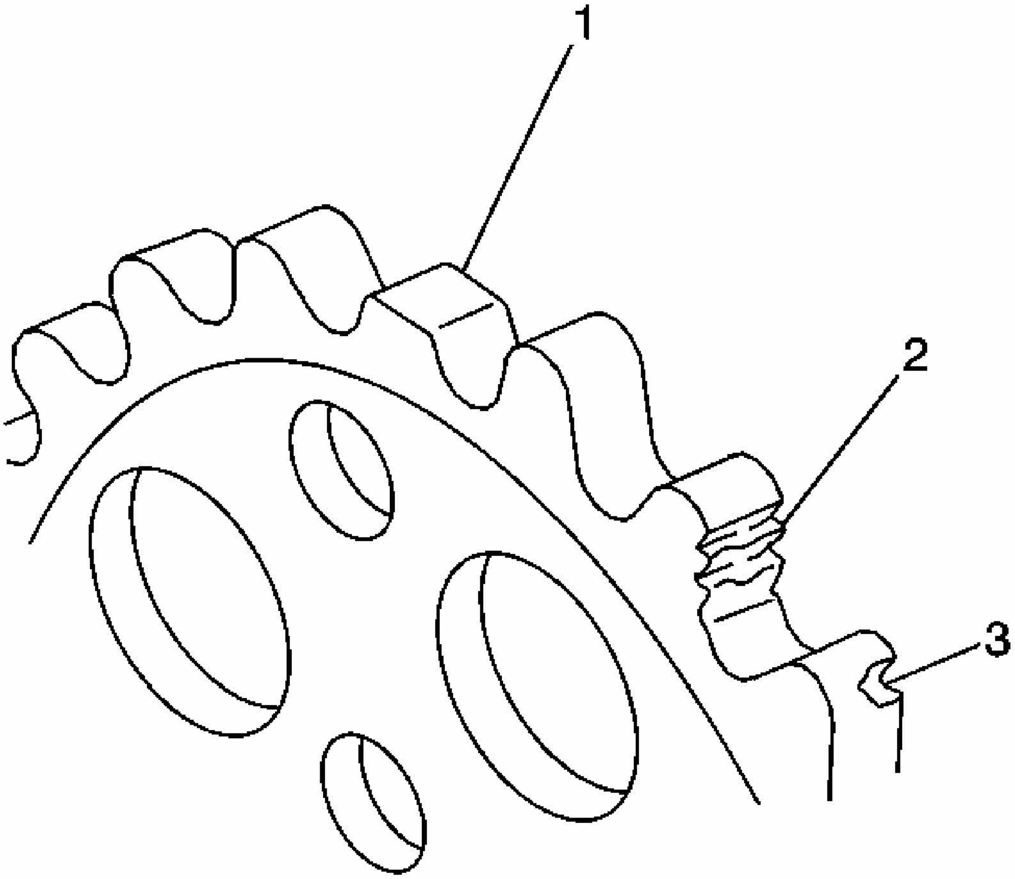


Fig. 370: Identifying Damaged Sprocket Teeth
Courtesy of GENERAL MOTORS CORP.

4. Inspect the camshaft and crankshaft sprockets for:
   - Worn teeth (1)
   - Broken teeth (2)
   - Chipped teeth (3)

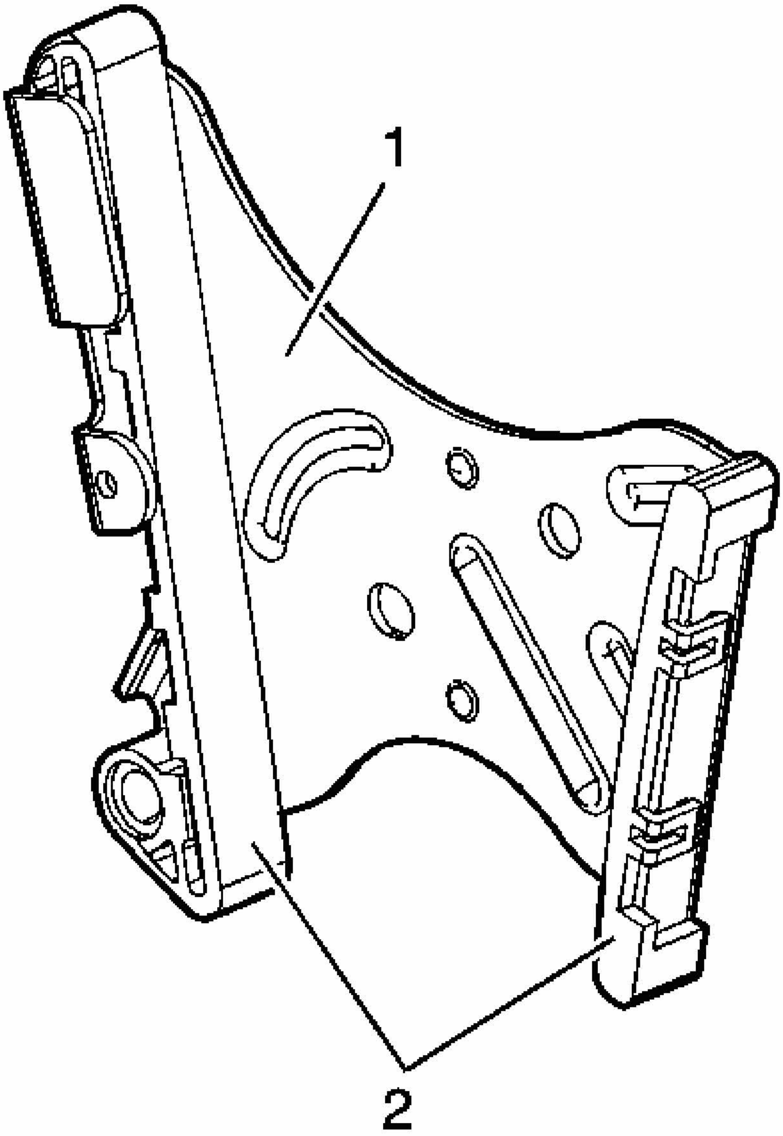


Fig. 371: Identifying Damaged Timing Chain Tensioner & Chain Tensioner Slides
Courtesy of GENERAL MOTORS CORP.

5. Inspect the timing chain tensioner (1) and timing chain tensioner slides (2) for excessive wear or cracks. Repair or replace as required.

CAMSHAFT POSITION ACTUATOR MAGNET CLEANING AND INSPECTION

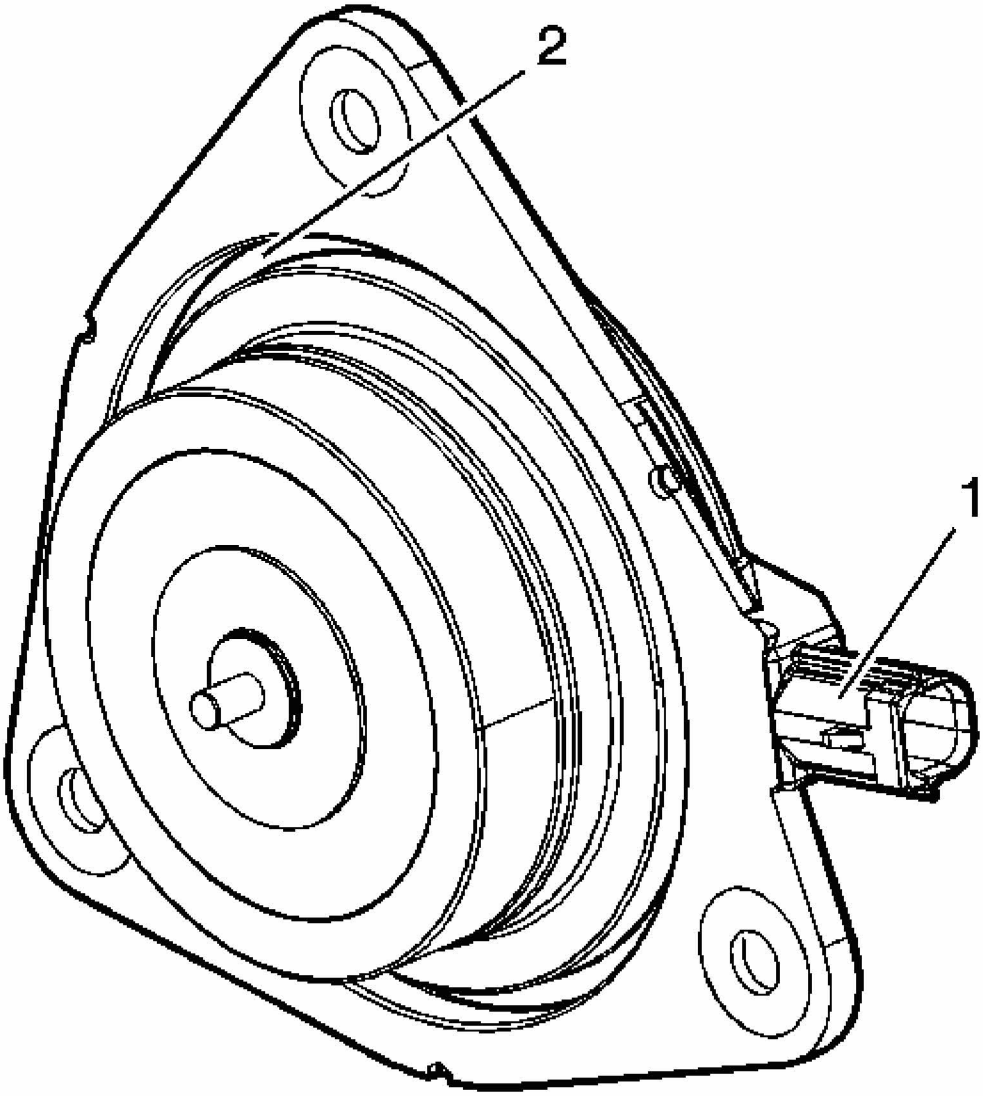


Fig. 372: Identifying Sealing Area & Magnet
Courtesy of GENERAL MOTORS CORP.

1. Inspect the camshaft position actuator magnet for the following conditions:
    - The camshaft position actuator magnet wiring connector (1) for damage.
    - The camshaft position actuator magnet O-ring seal and sealing area (2) for damage.
2. Repair or replace the camshaft position actuator housing and/or components as necessary.

CAMSHAFT POSITION ACTUATOR CLEANING AND INSPECTION

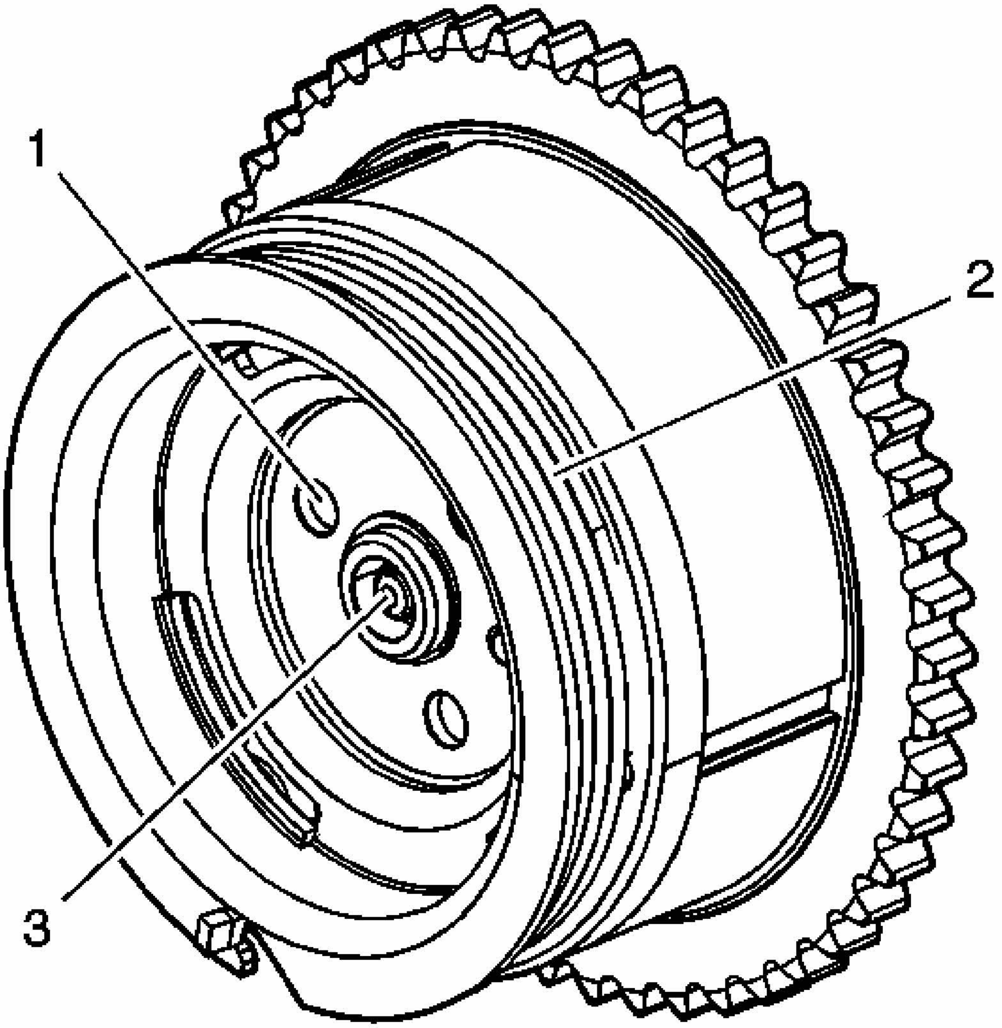


Fig. 373: Identifying Camshaft Position Actuator
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to CLEANING SOLVENT CAUTION in Cautions and Notices.

1. Clean the camshaft position actuator components with solvent.

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.

2. Dry the camshaft position actuator components with compressed air.
3. Inspect the camshaft position actuator for the following conditions:
   - The camshaft position actuator mounting bores (1) for damage.
   - The camshaft position actuator return spring (2) for nicks or damage.
   - The camshaft position actuator valve surface for pitting or damage (3).
4. Repair or replace the camshaft position actuator as necessary.

VALVE LIFTERS CLEANING AND INSPECTION

1. Clean the valve lifters in cleaning solvent.

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.

2. Dry the valve lifters with compressed air.

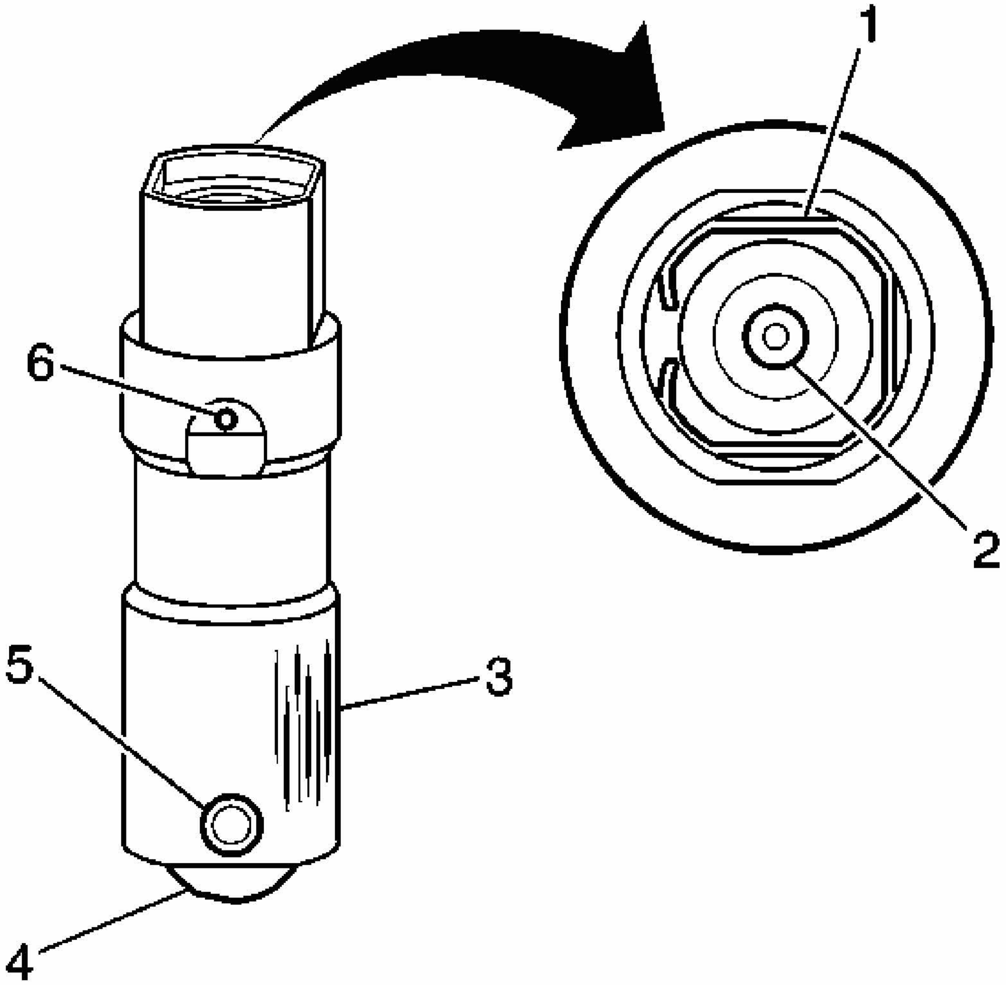


Fig. 374: Inspecting Areas Of Valve Lifters
Courtesy of GENERAL MOTORS CORP.

3. Inspect the valve lifters for the following:
   - Bent or broken clip (1)
   - Worn push rod socket (2)
   - Scuffed or worn sides (3)

     If the valve lifter shows wear, inspect the engine block lifter bores for wear or damage.

   - Flat spots on the roller (4)
   - Loose or damaged pin (5)

- Plugged oil hole (6)
- Worn or damaged roller bearing

  The roller should rotate freely with no binding or roughness.

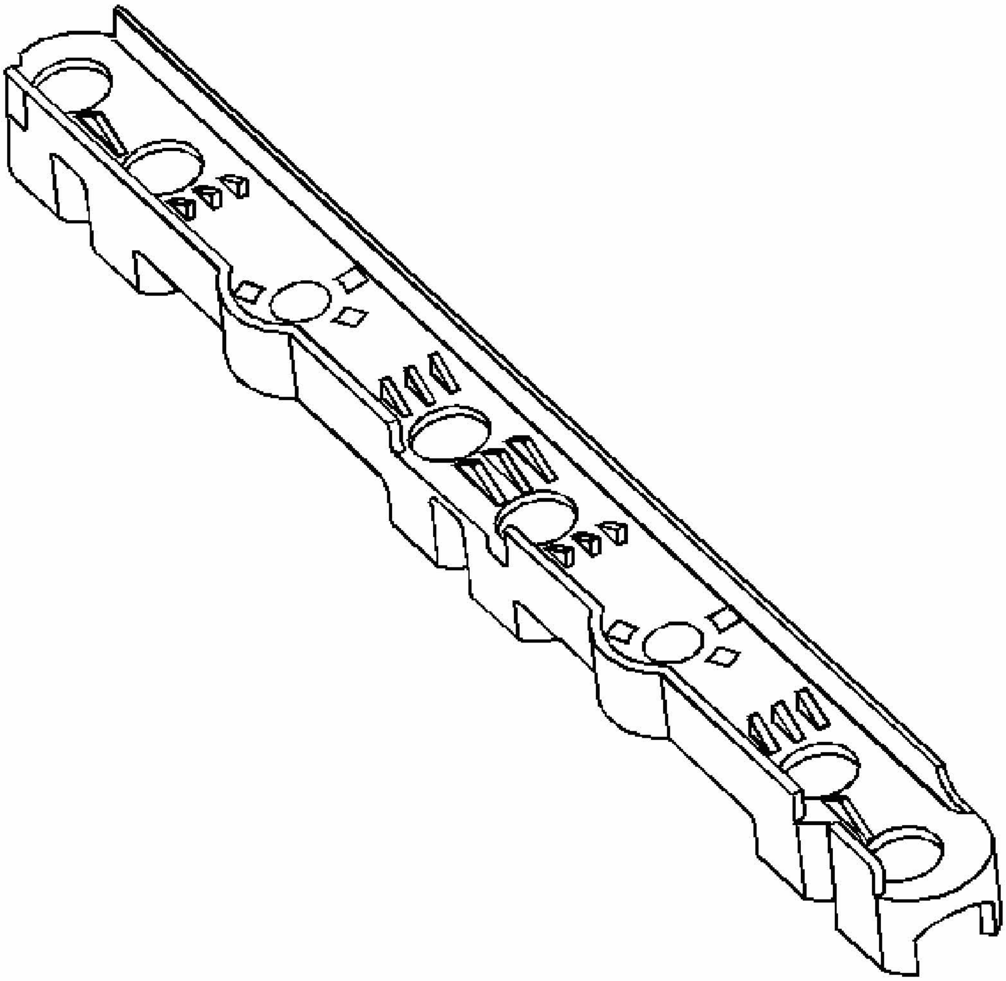


Fig. 375: View Of Valve Lifter Guides
Courtesy of GENERAL MOTORS CORP.

4. Inspect the valve lifter guides for the following:
   - For cracks or damage
   - Excessive wear in the lifter mounting bores

VALVE ROCKER ARM AND PUSH RODS CLEANING AND INSPECTION

CAUTION: Refer to CLEANING SOLVENT CAUTION in Cautions and Notices.

1. Clean the valve rocker arms and push rods in cleaning solvent.

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.

2. Dry the valve rocker arms and push rods with compressed air.

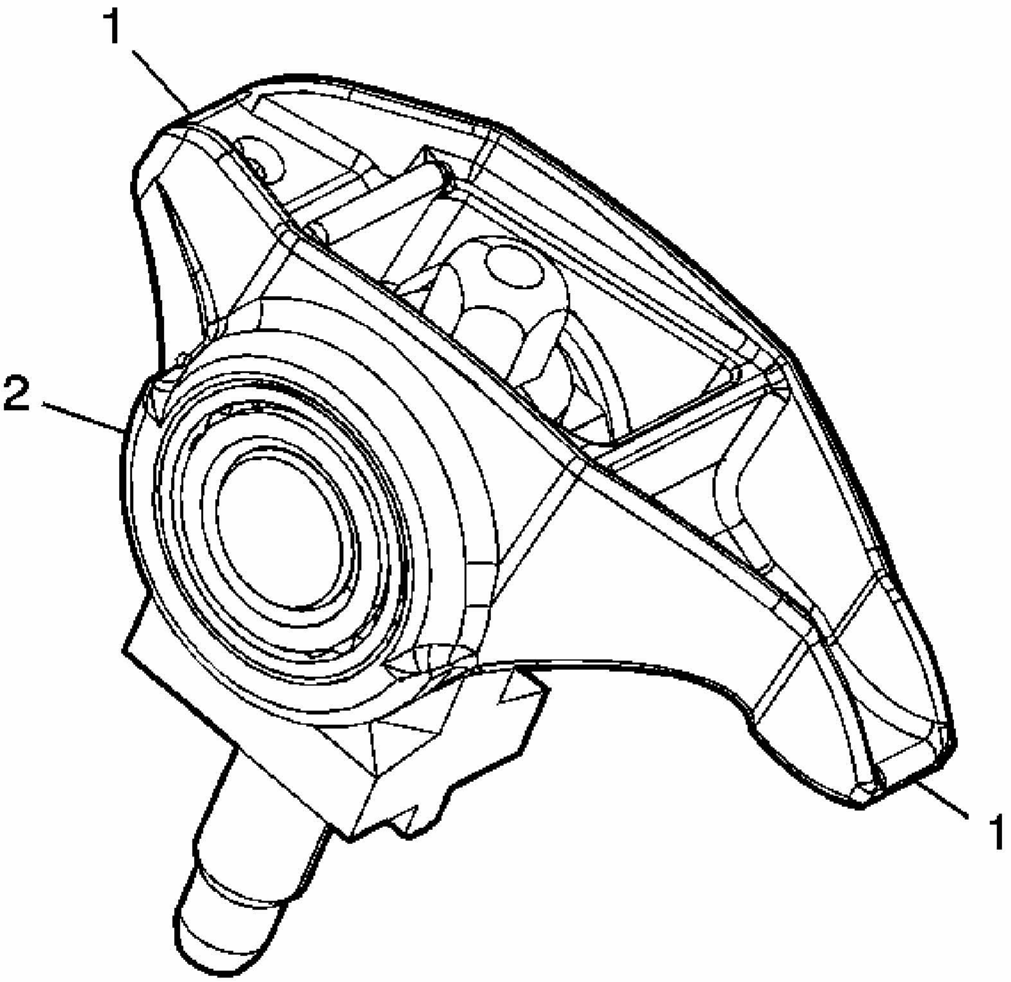


Fig. 376: Inspecting Rocker Arm Assemblies
Courtesy of GENERAL MOTORS CORP.

3. Inspect the valve rocker arms for the following conditions:

- Excessive wear at the valve contact or push rod socket area (1)
- A loose or damaged pin (2)
- A worn or damaged roller bearing (2)

  The roller should rotate freely with no binding or roughness.

- The bolt threads for damage

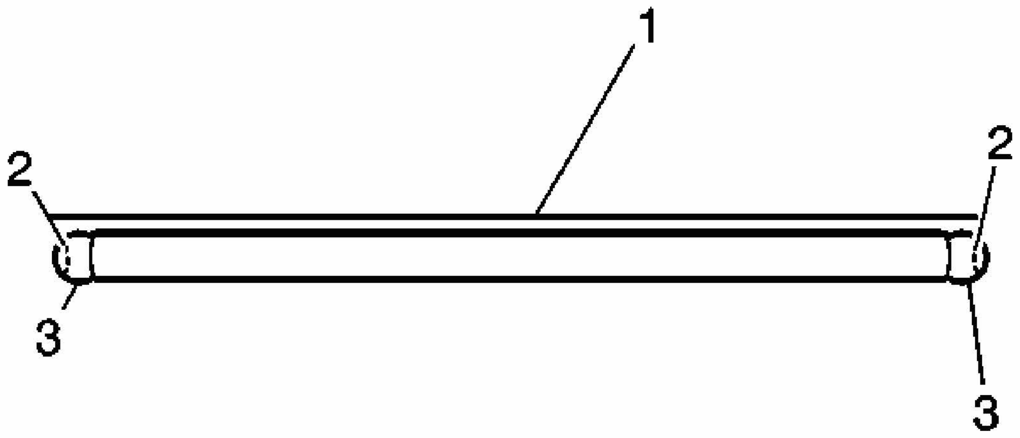


Fig. 377: Inspecting Push Rods
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Keep the push rods in order. The intake and exhaust are different lengths.

4. Inspect the push rods for the following conditions:
   - Straightness using a straight edge (1)
   - Excessive wear on the push rod ends (3)
   - Clogging of the oil passage (2)

CYLINDER HEAD DISASSEMBLE

Tools Required

- **EN-47823** Valve Spring Compressor Adapter
- **J 5892-D** Valve Spring Compressor

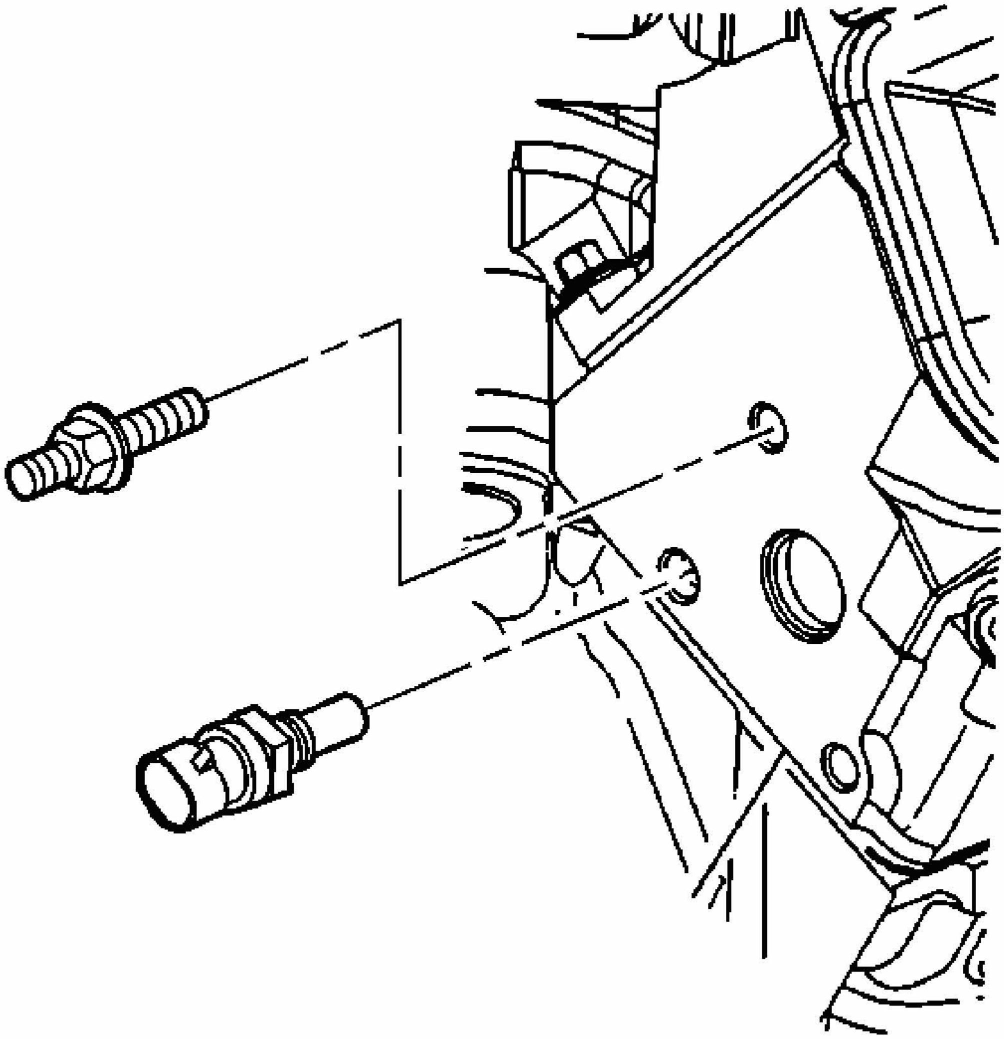


Fig. 378: View Of Heater Inlet Pipe Stud & Coolant Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

1. Remove the heater inlet pipe stud from the right cylinder head, if required.
2. Remove the coolant temperature sensor from the right cylinder head, if required.

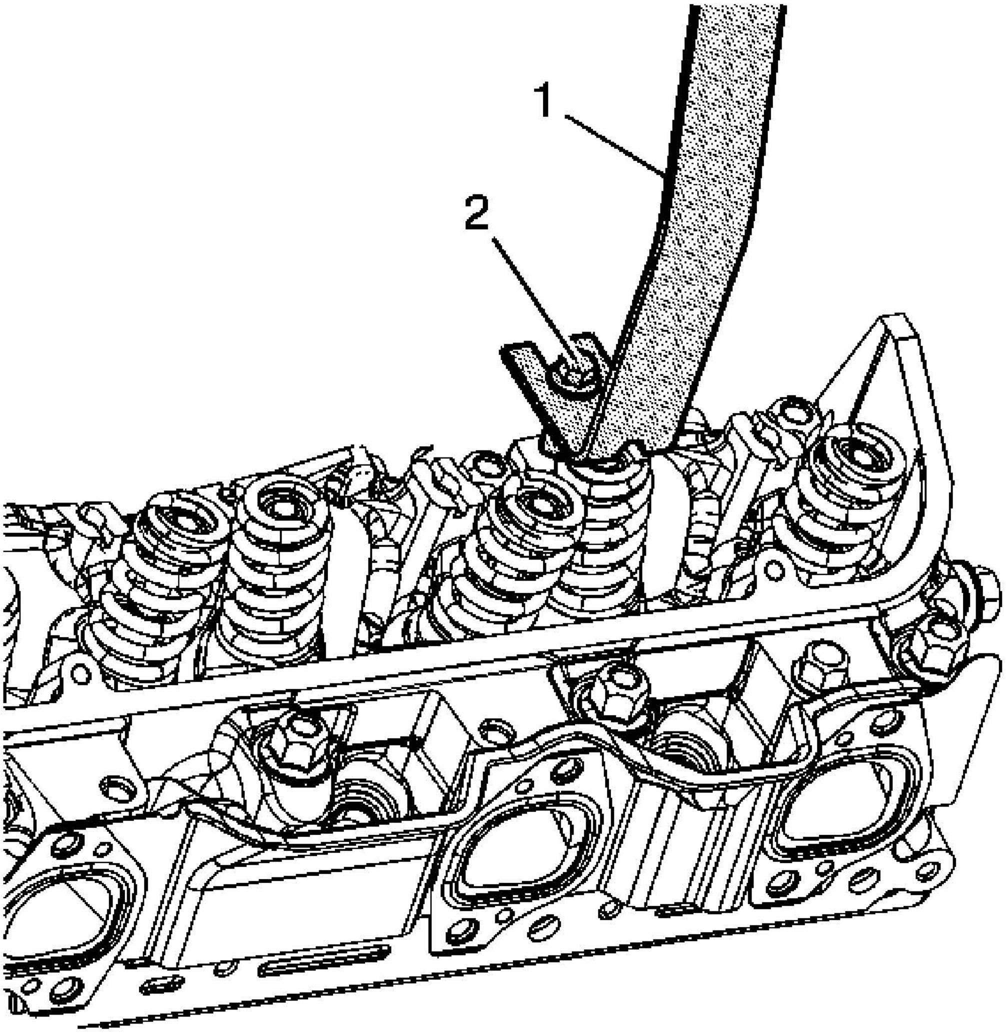


Fig. 379: Compressing Valve Spring
Courtesy of GENERAL MOTORS CORP.

3. Using caution so as not to damage the valve spring or valve spring dampener, compress the valve springs using the **J 5892-D** (1) and the **EN-47823** (2).

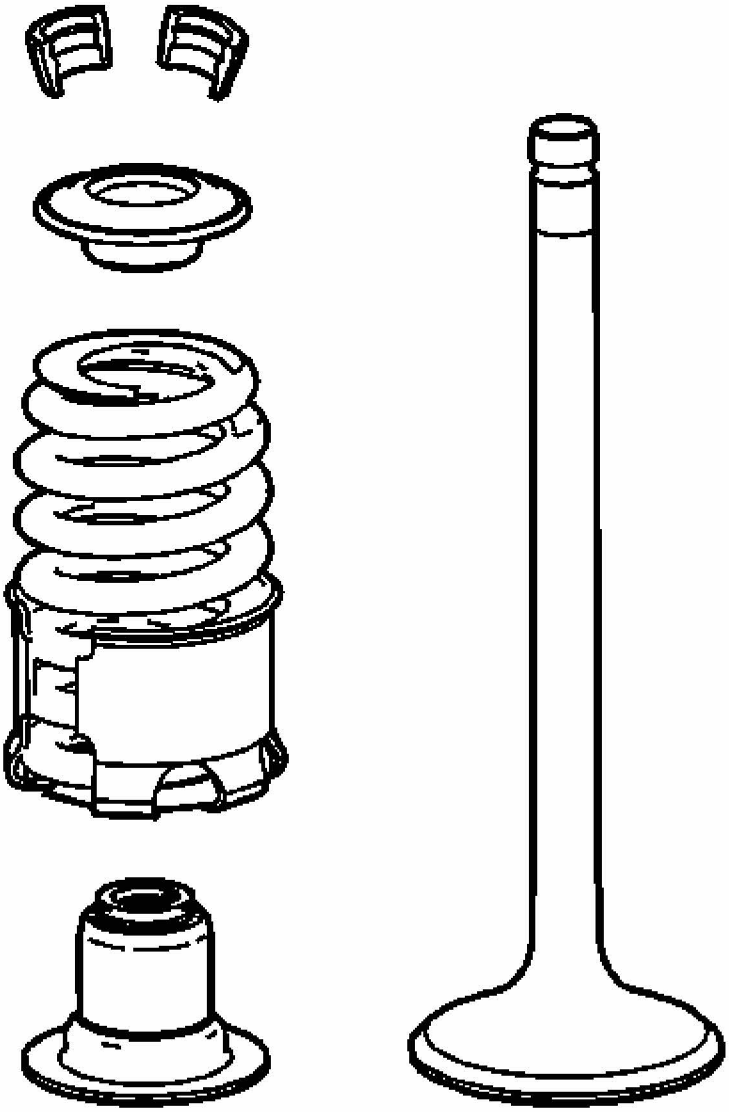


Fig. 380: Identifying Valve Components
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not damage the valve guide. Remove any burrs that have formed at the key groove by chamfering the valve stem with an oil stone or a file.

IMPORTANT: Ensure that the valve train components are marked, organized or sorted when disassembling the cylinder

head. Install the valve train components in the original location from which the component were removed.

4. Remove the valve spring cap keys.
5. Remove the valve spring caps.
6. Remove the valve spring assembly.
7. Remove the valves.
8. Remove the valve stem oil seals and spring seats as an assembly.
9. Inspect all valve components for any damage or excess wear. Repair or replace as necessary.

CYLINDER HEAD CLEANING AND INSPECTION

Tools Required

- **J 8089** Carbon Removing Brush
- **J 9666** Valve Spring Tester

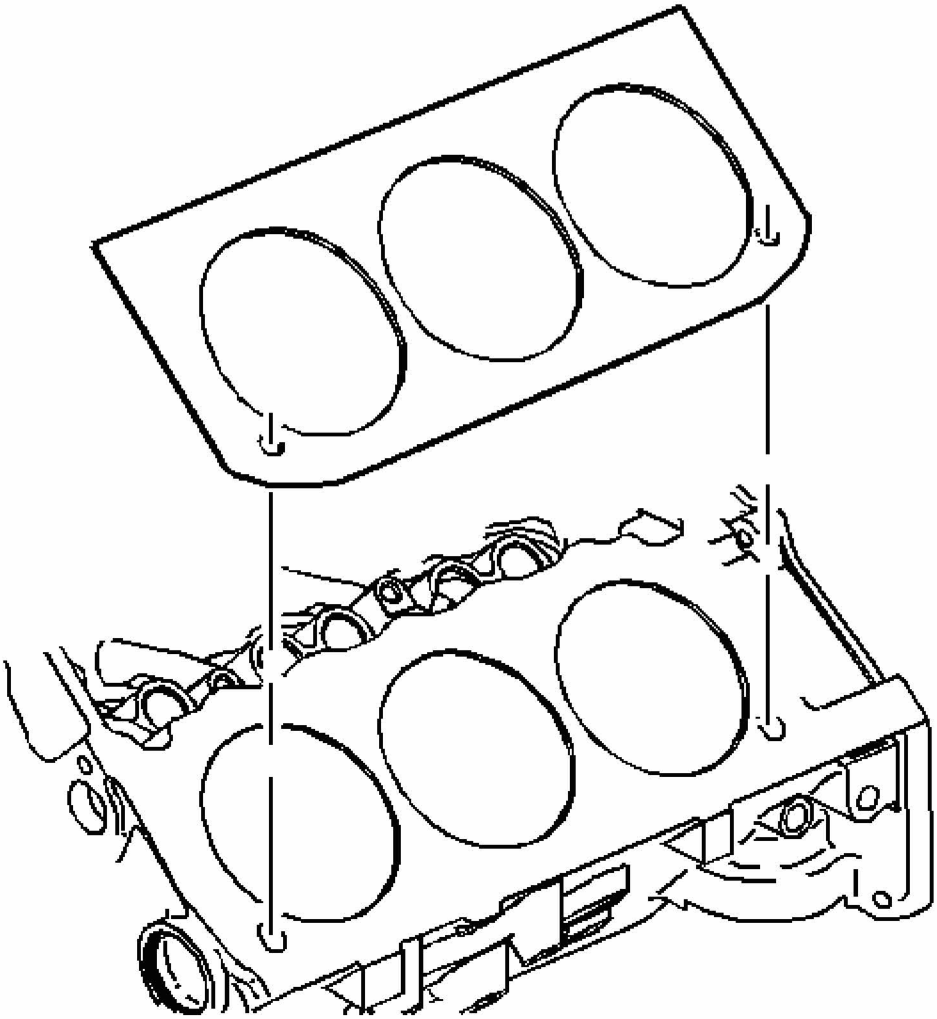


Fig. 381: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

1. Inspect the cylinder head gasket and the mating surfaces. Inspect for leaks, corrosion, and blowby.
2. If the gasket failed, determine the cause. The following conditions may cause gasket failure:
    - Improper installation
    - A loose or warped cylinder head
    - Missing, off location, or not fully seated dowel pins
    - Low torque on the cylinder head bolts

- Cylinder head bolts with the incorrect length
- A warped engine block surface
- Scratched surfaces
- Excessive intake manifold torque
- Cracked engine block threaded holes

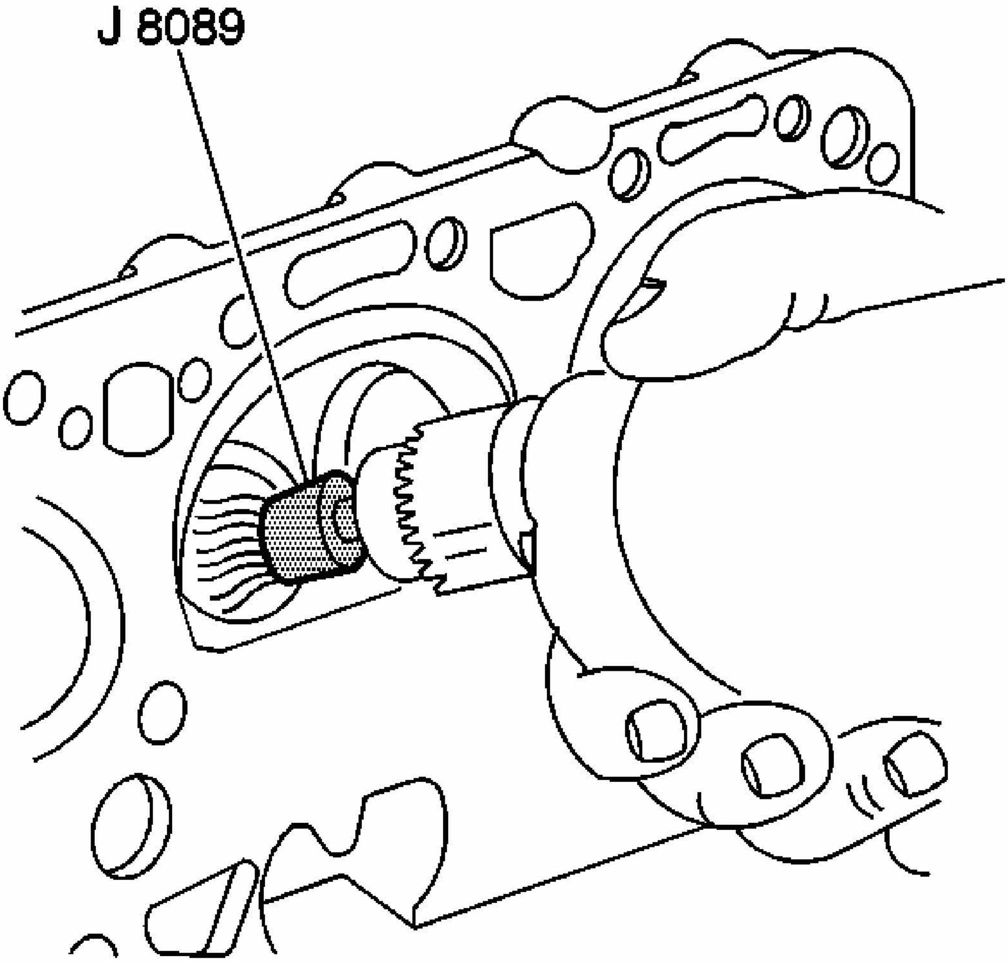


Fig. 382: Removing Carbon From Combustion Chambers
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.

IMPORTANT: Do not scuff the

chamber.

3. Use the **J 8089** in order to remove the carbon from the combustion chambers.
4. Clean the following components:
   - The gasket surfaces

     Do not use a motorized brush on any gasket sealing surface.

   - Valve stems and heads on a buffing wheel
   - The bolt hole threads

     Remove all dirt, debris, or threadlocking material from the bolt holes.

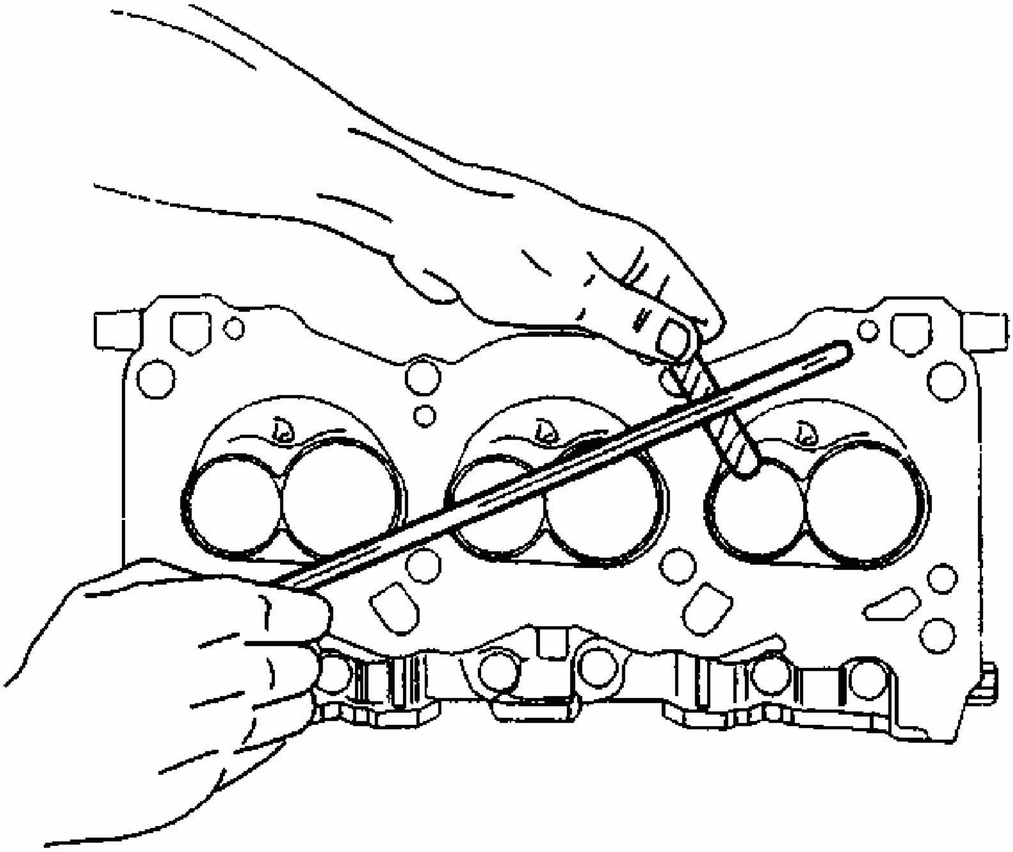


Fig. 383: Inspecting Cylinder Head Mating Surfaces For Flatness
Courtesy of GENERAL MOTORS CORP.

5. Inspect the cylinder head mating surfaces for flatness. Replace the cylinder head if it is

outside of the specification limit.

6. Inspect the cylinder head for cracks.
7. Inspect the cylinder head deck for corrosion. Do not attempt to weld the cylinder head. If the cylinder head is damaged, replace the cylinder head.

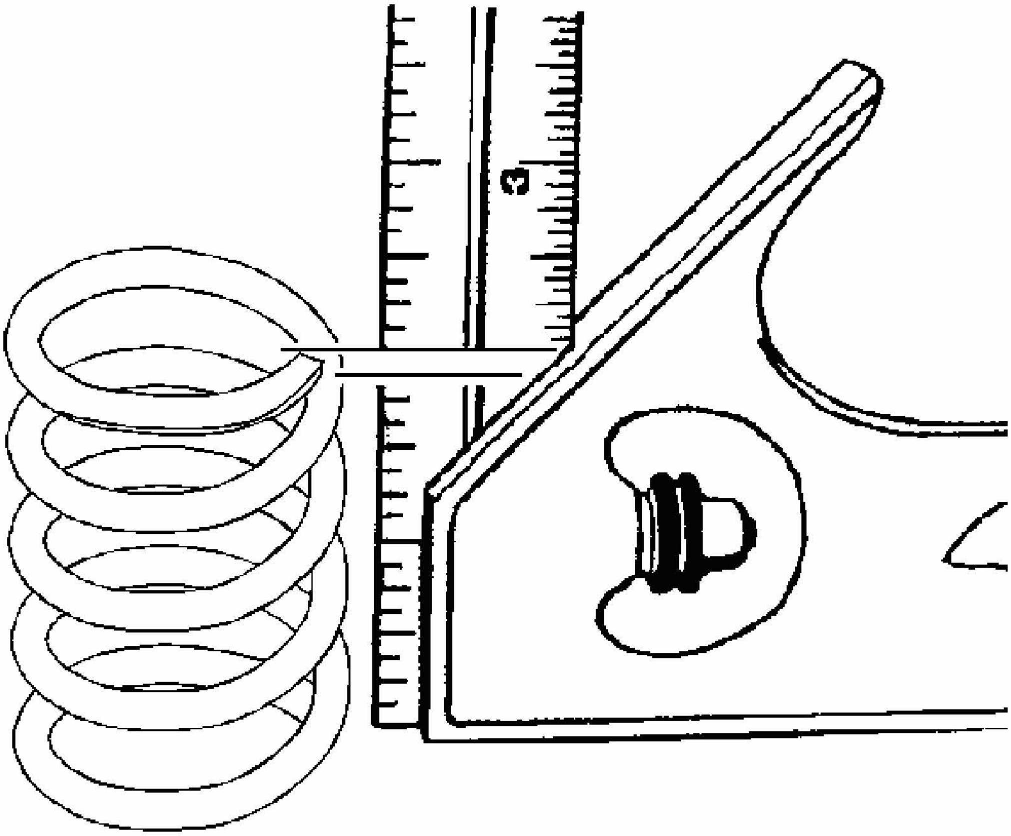


Fig. 384: Inspecting Valve Spring For Squareness
Courtesy of GENERAL MOTORS CORP.

8. Inspect the valve springs for squareness.

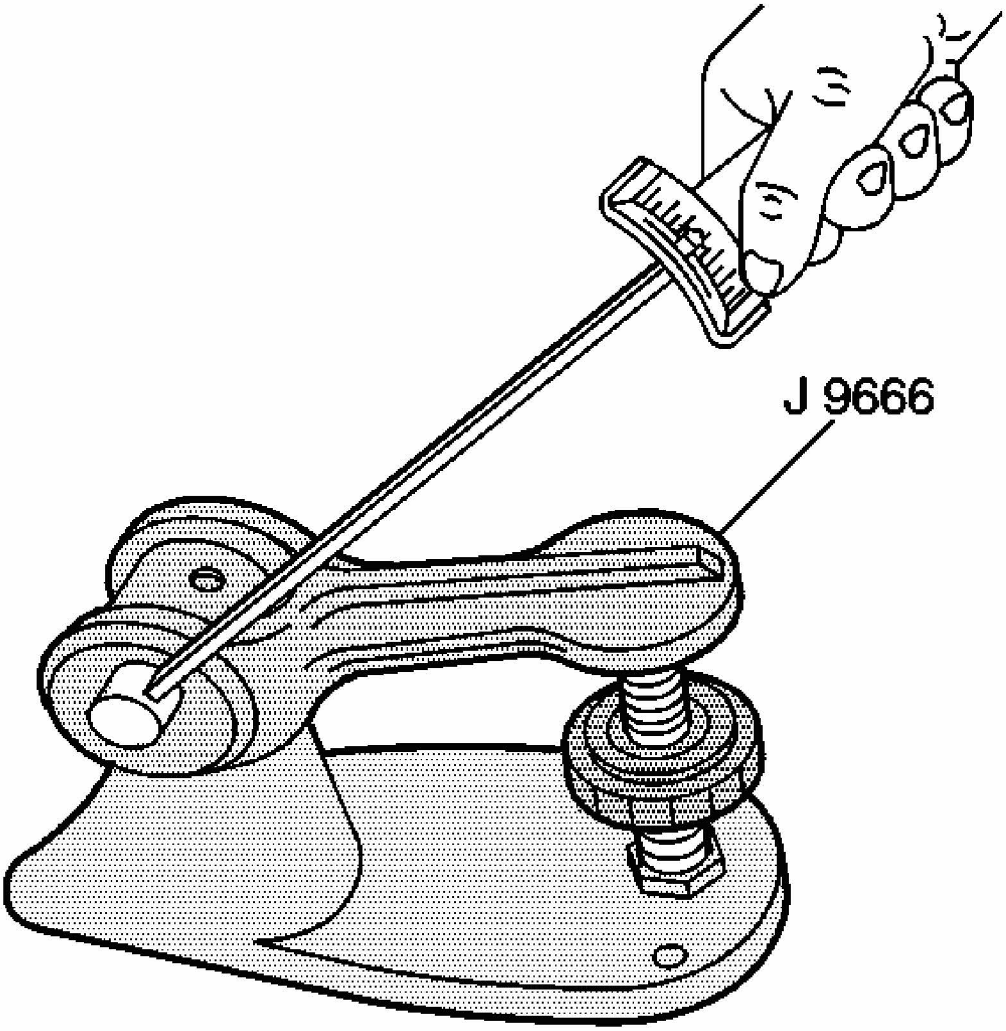


Fig. 385: Measuring Valve Spring Tension
Courtesy of GENERAL MOTORS CORP.

9. Use the **J 9666** in order to measure the valve spring tension.

   Replace the spring if the spring tension is not within specification.

VALVE GUIDE REAMING/VALVE AND SEAT GRINDING

Tools Required

J 8520 Camshaft Lobe Lift Indicator Set

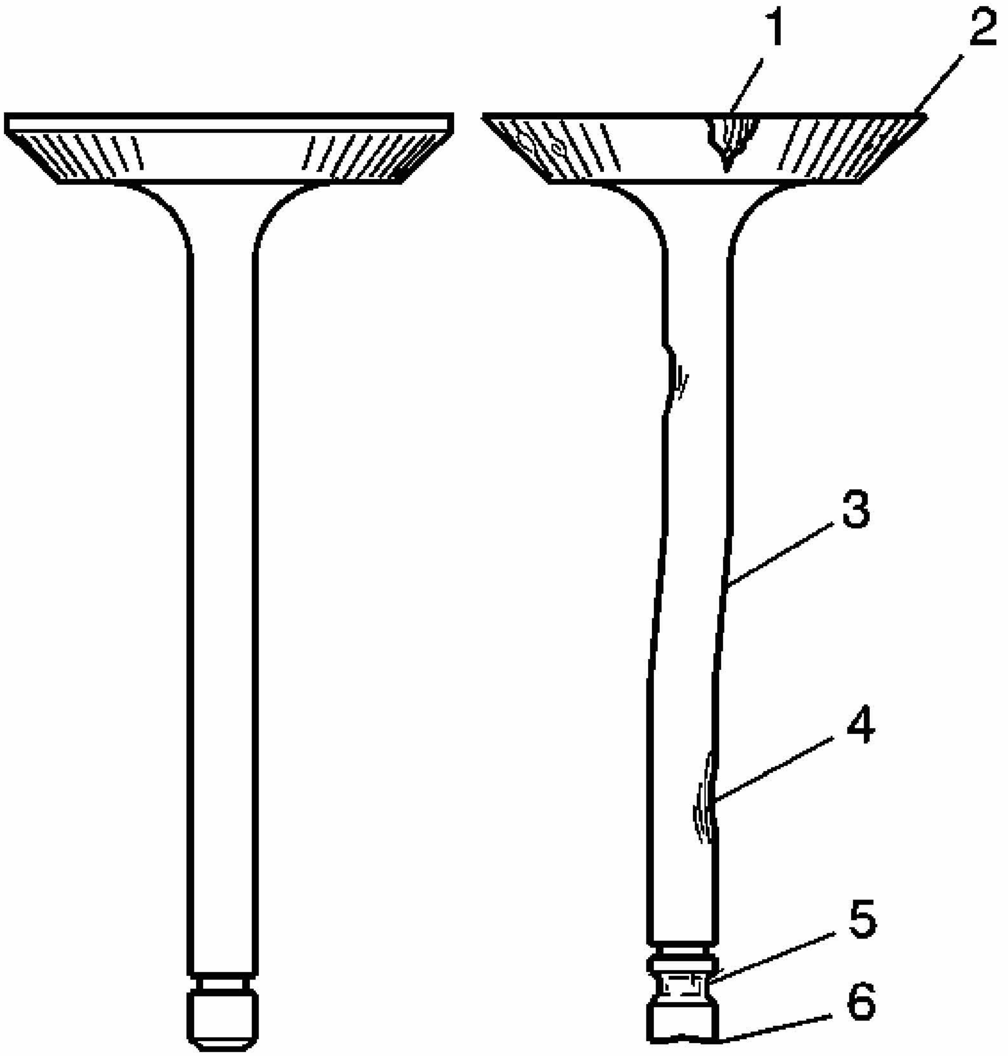


Fig. 386: Identifying Inspection Points For Valves Damage
Courtesy of GENERAL MOTORS CORP.

1. Inspect the valves for the following conditions:
    - Burnt or eroded areas (1)
    - A worn margin (2)
    - A bent stem (3)
    - A worn or scored stem (4)
    - A worn key groove (5)
    - A worn stem tip (6)

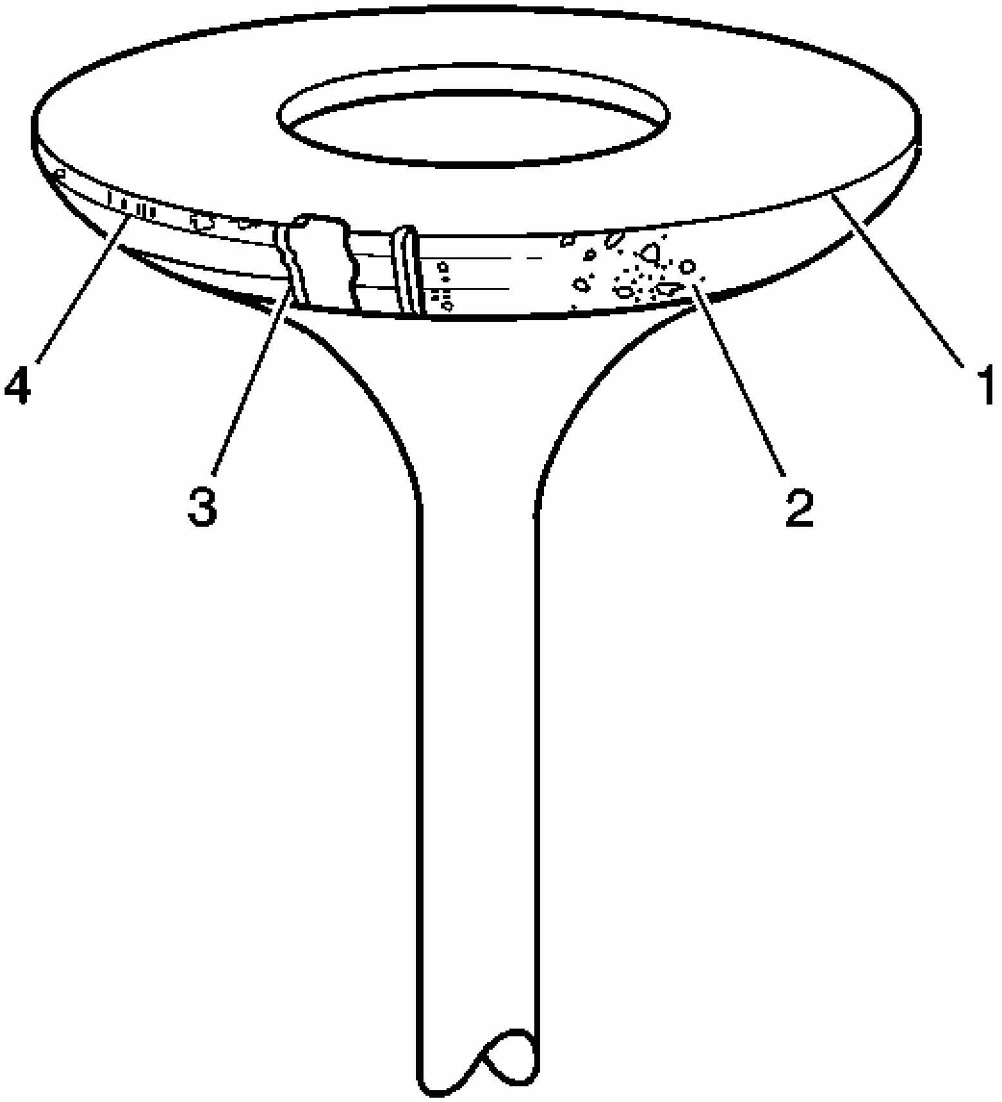


Fig. 387: Inspecting Valve Face For Burning, Pitting & Cracking
Courtesy of GENERAL MOTORS CORP.

2. Inspect the valve face for the following conditions:
    - Worn margin (4)
    - No margin (1)
    - Pitted surfaces (2)
    - Burnt or eroded areas (3)
3. Inspect the valve seats for a loose fit in the cylinder head.

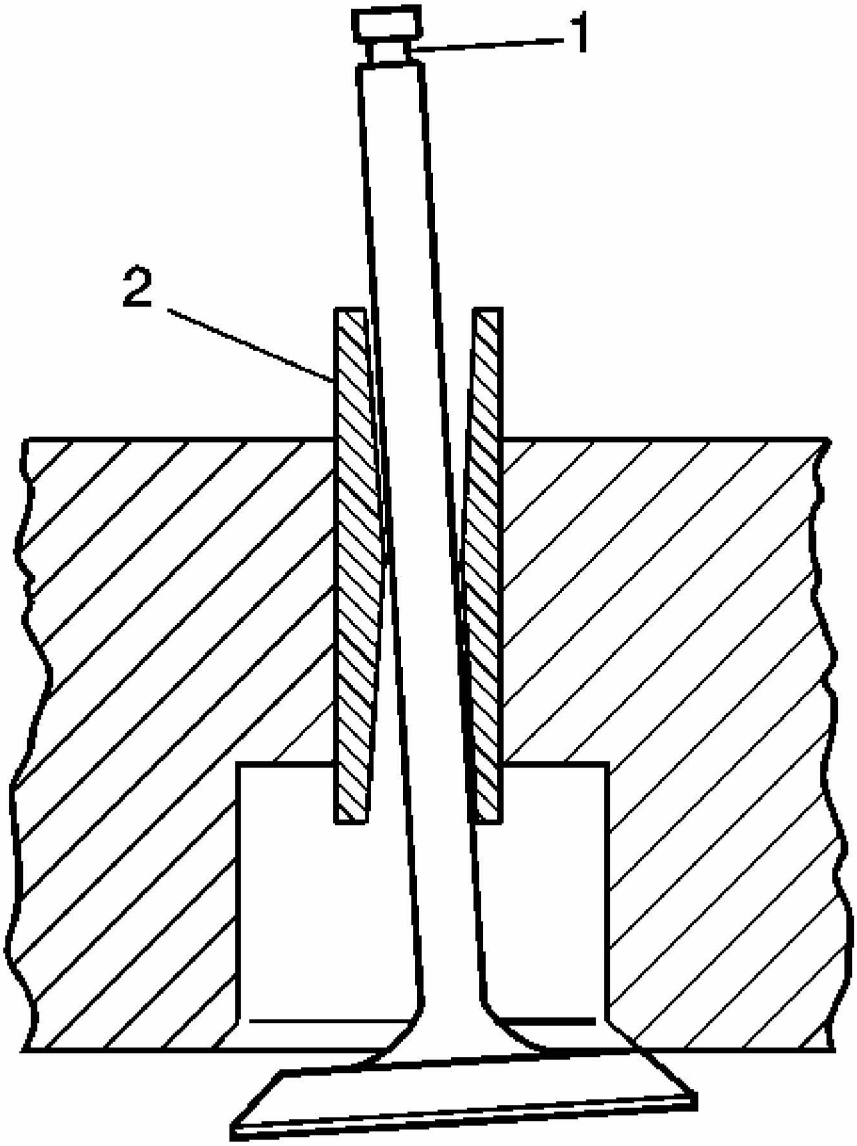


Fig. 388: Inspecting For Excessive Valve Stem To Guide Clearance
Courtesy of GENERAL MOTORS CORP.

NOTE: **Proper valve stem-to-valve guide clearance is necessary for proper engine operation and component life. Excessive clearance may cause a noisy valve train, premature valve stem oil seal failure, excessive oil consumption and related component damage. Insufficient clearance may cause a noisy valve train, rough engine operation or sticking valves**

that may lead to related component damage. Failure to inspect valve stem-to-valve guide clearance and repair or replace necessary components may lead to extensive engine damage.

IMPORTANT: Excessive valve stem-to guide clearance may cause the following conditions:

- **A noisy valve train**
- **Premature valve stem oil seal wear**
- **Component damage**
- **Excessive engine oil consumption**

4. Inspect for excessive valve stem (1) to guide (2) clearance.

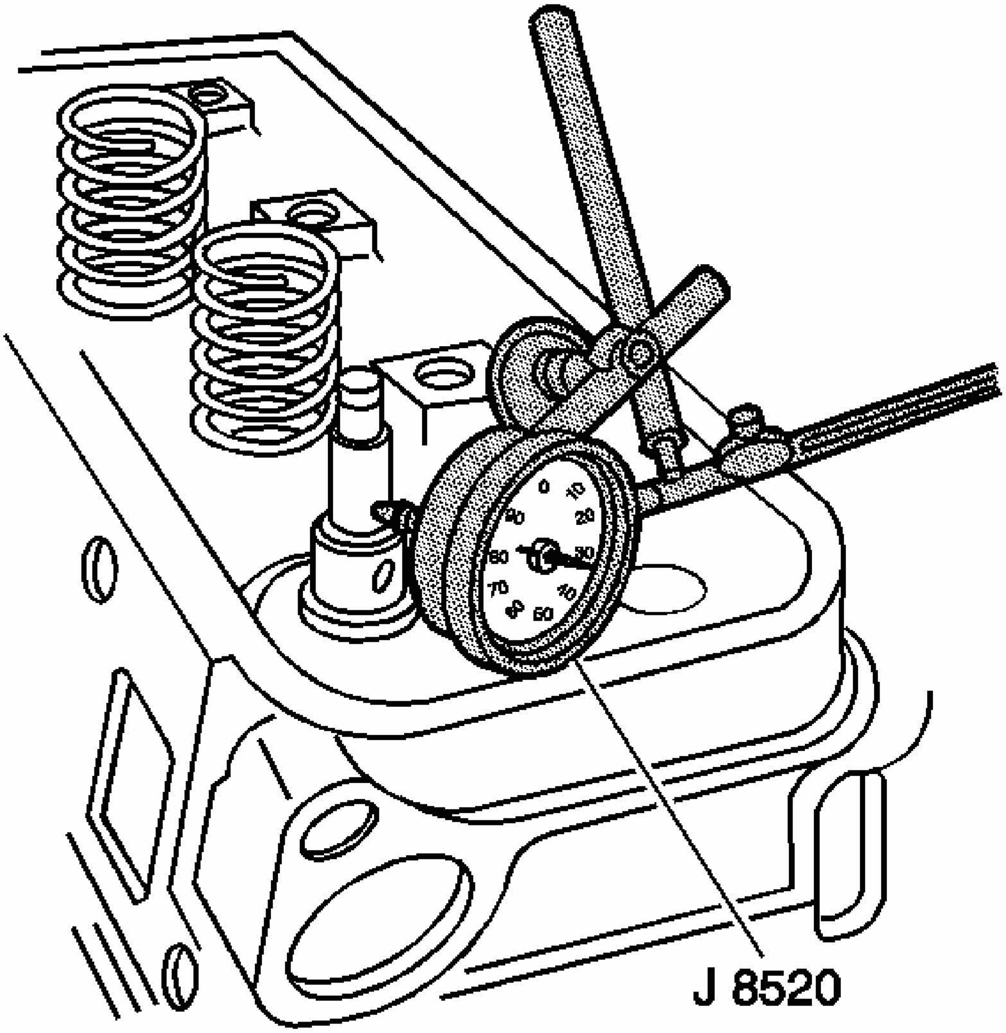


Fig. 389: Identifying J 8520
Courtesy of GENERAL MOTORS CORP.

5. Use a dial indicator in order to measure the valve stem-to-guide clearance. Complete the following steps:
    1. Install the valve into the guide.
    2. Install the **J 8520** onto the cylinder head.
    3. Locate the dial indicator so that the movement of the valve stem from side to side, crosswise to the cylinder head, will cause a direct movement on the indicator stem.
    4. Ensure that the indicator stem contacts the side of the valve stem just above the valve guide.

5. Drop the valve head about 2 mm (1/8 in) off the valve seat.
6. Use light pressure and move the valve stem side to side in order to obtain a clearance reading.
7. If the valve stem to guide clearance is not within specification, replace the valve and/or repair the guide in order to obtain the proper clearances.

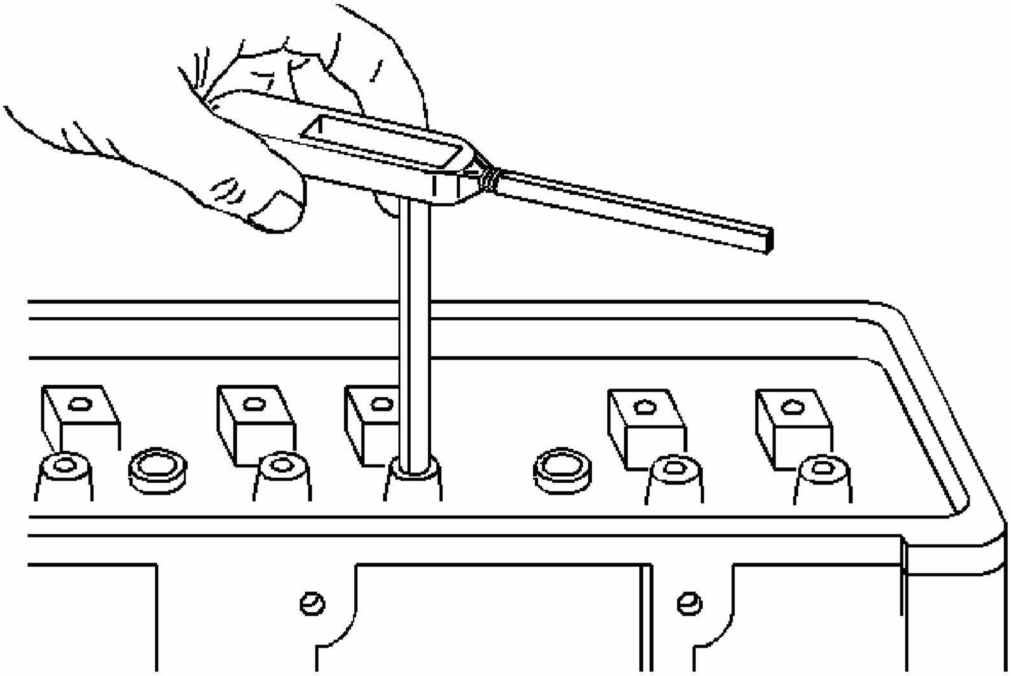


Fig. 390: Reaming Valve Guides For Oversize Valves
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Replace a valve stem that has excessive scoring or wear. A valve guide that is worn and has excessive stem-to-guide clearance may need to be sleeved.

6. Ream the valve guides for oversize valves if the clearance exceeds the specifications.

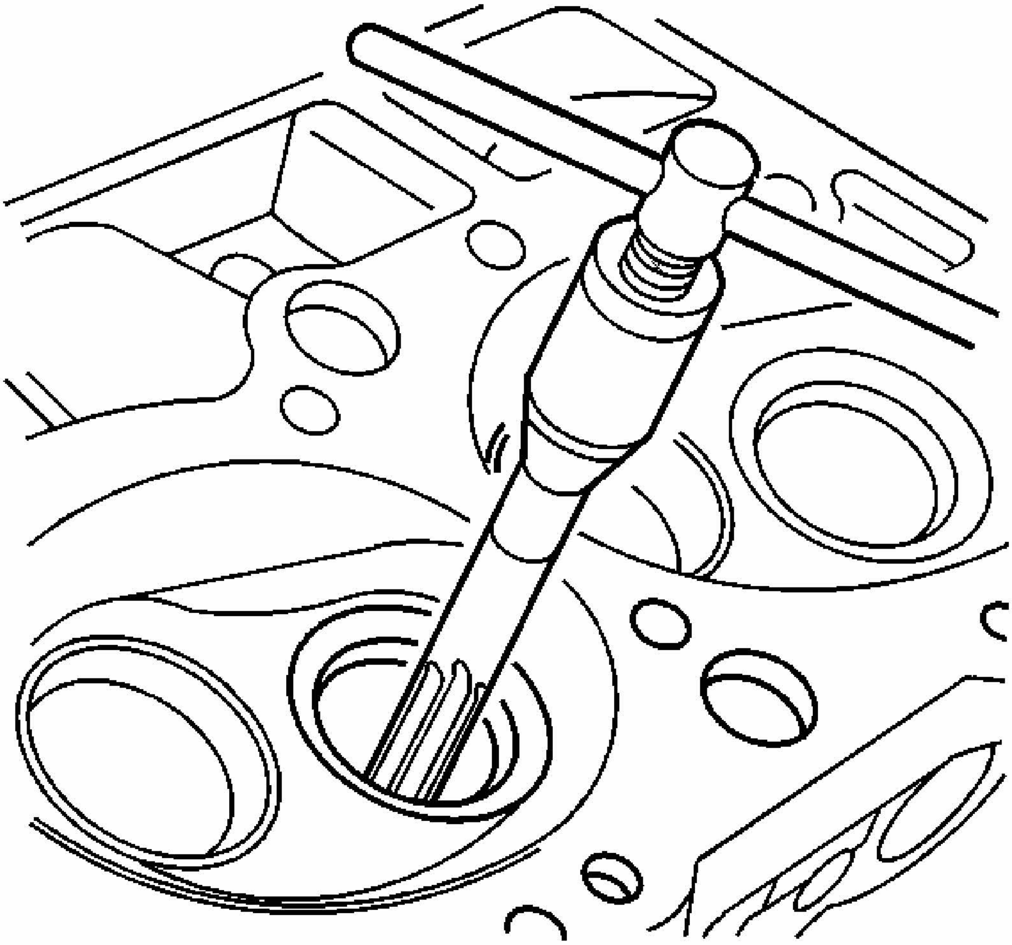


Fig. 391: Reaming Valve Guide
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Follow the manufacturers instructions when using valve guide reamers, sleeves, and installers.

7. Ream the valve guide in order to obtain the proper specification.

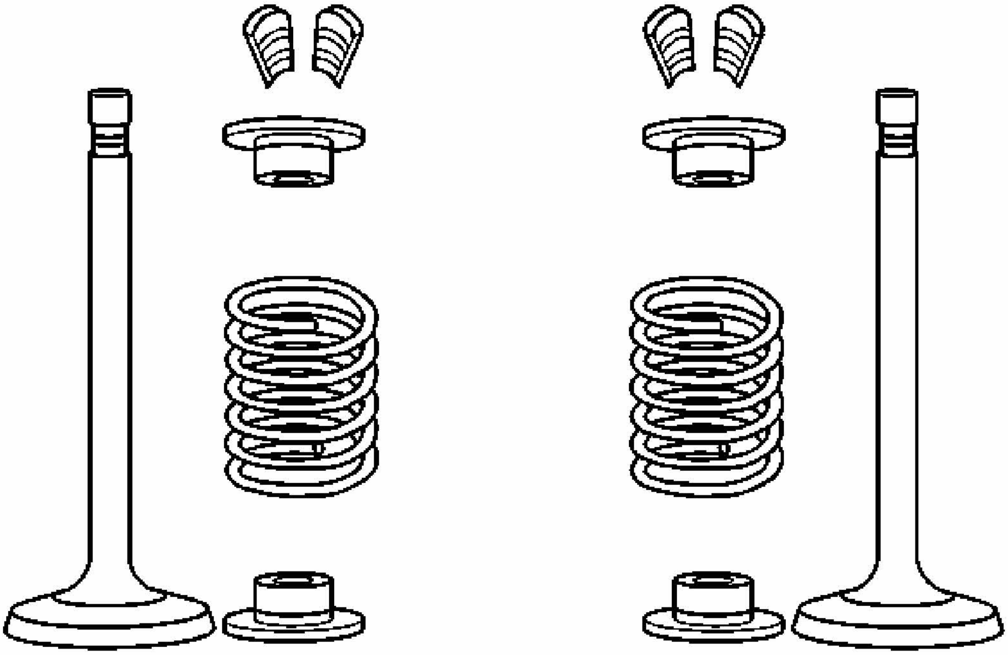


Fig. 392: Valve Locks, Caps, Seats & Spring
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Valves that are pitted must be refaced to the proper angle. Replace valve stems that show excessive wear, or replace valves that are warped. Several different types of equipment are available for refacing valves and valve seats. Follow the manufacturers recommendations when performing these procedures.

8. Inspect the valves for excessive scoring.

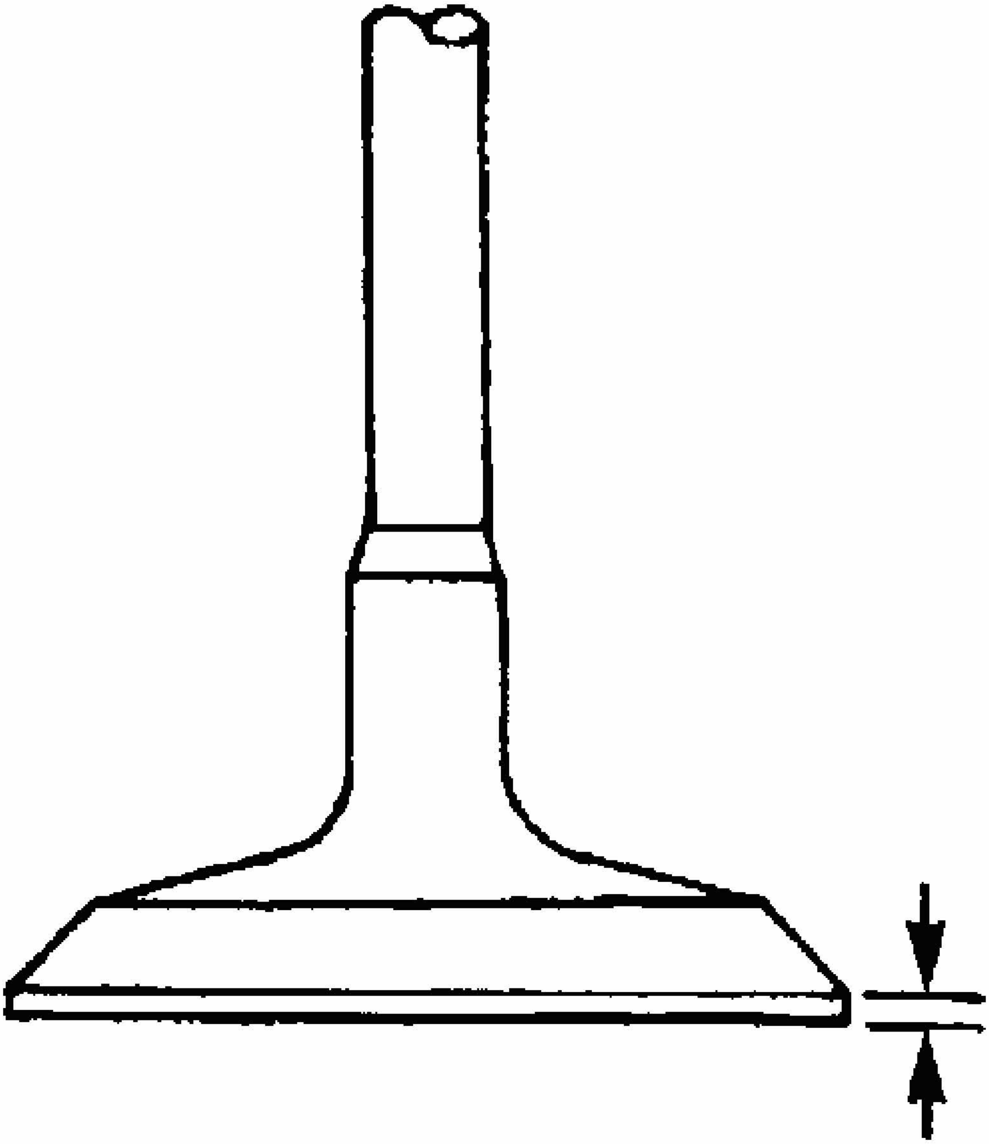


Fig. 393: Inspecting Valve Margin
Courtesy of GENERAL MOTORS CORP.

9. Inspect the valve face.

   Replace the valve if the valve margin is not within specifications after grinding.

10. Reface pitted valves on a valve refacing machine in order to ensure the correct relationship between the head and the stem.

IMPORTANT: Reconditioning the valve seats is very important. Ensure perfect seating of the valves in the engine in order to deliver optimum power and performance. Clean the valve guides of all debris and dirt before grinding the valve seat.

11. Recondition the valve seats after reaming the valve guide bores or installing the new valve guides.
12. The valve seats should be concentric to within 0.05 mm (0.031 in) total indicator reading.

CYLINDER HEAD ASSEMBLE

Tools Required

- **EN-47823** Valve Spring Compressor Adapter
- **J 5892-D** Valve Spring Compressor

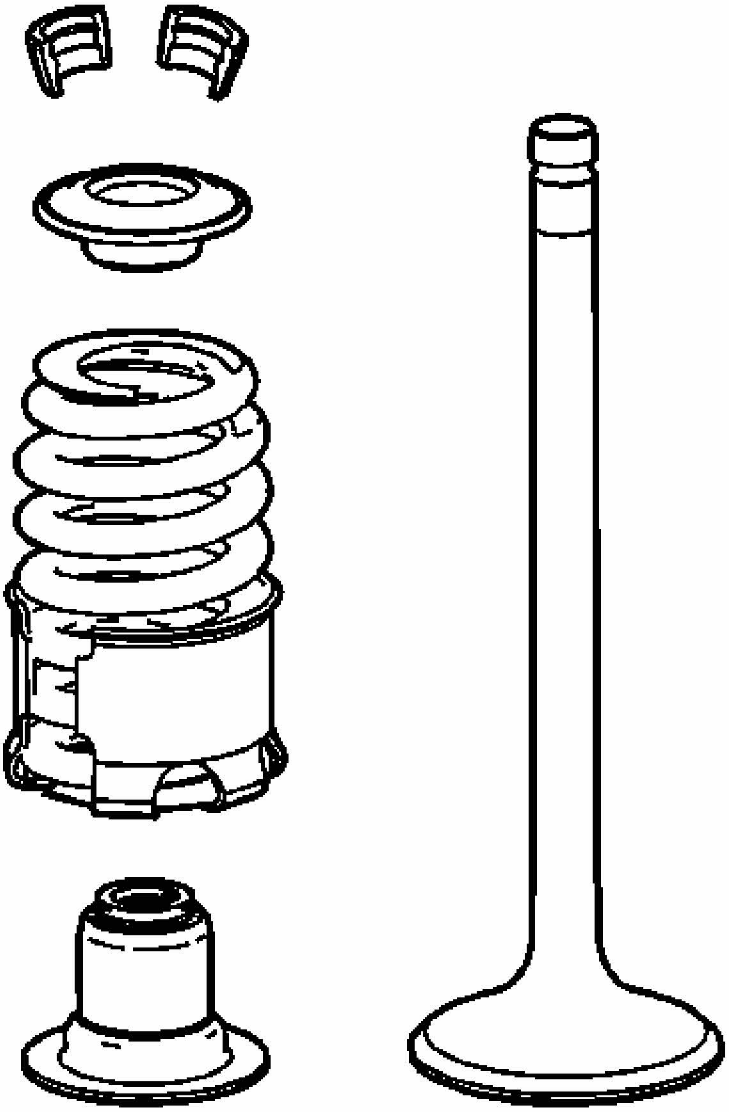


Fig. 394: Identifying Valve Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use oversize valve stem seals if you install oversize valves.

1. Lubricate the valve stem with clean engine oil.
2. Install the valves.
3. Lightly tap the new or reconditioned valves into the valve seat.

4. Install the valve stem oil seals, ensuring proper intake - black seal and exhaust - brown seal, seals are installed.
5. Install the valve springs.
6. Install the valve spring caps.

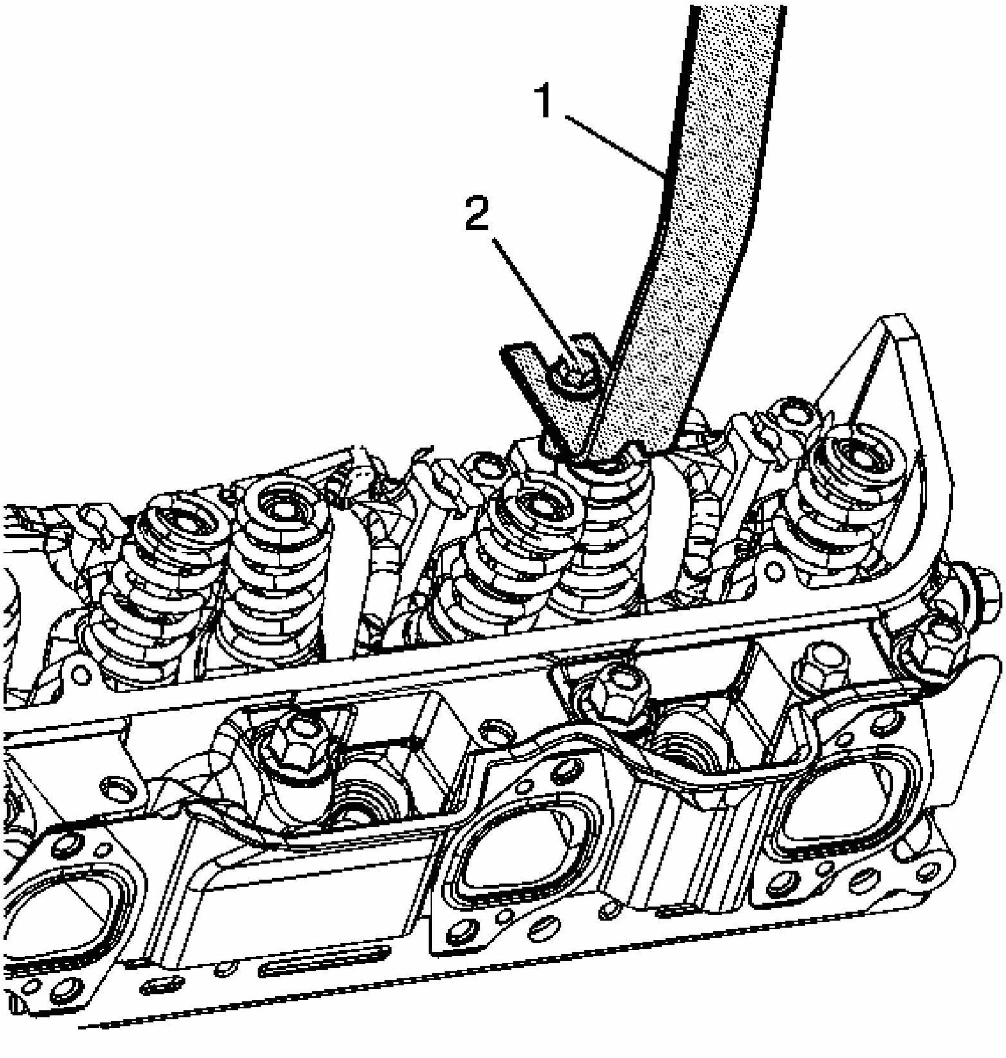


Fig. 395: Compressing Valve Spring
Courtesy of GENERAL MOTORS CORP.

7. Using caution so as not to damage the valve spring or valve spring dampener, compress the valve springs using the **J 5892-D** (1) and the **EN-47823** (2).
8. Install the valve spring cap keys. Hold the valves in place with grease, if necessary.
9. Release the valve springs.

10. Ensure that the valve locks are seated.

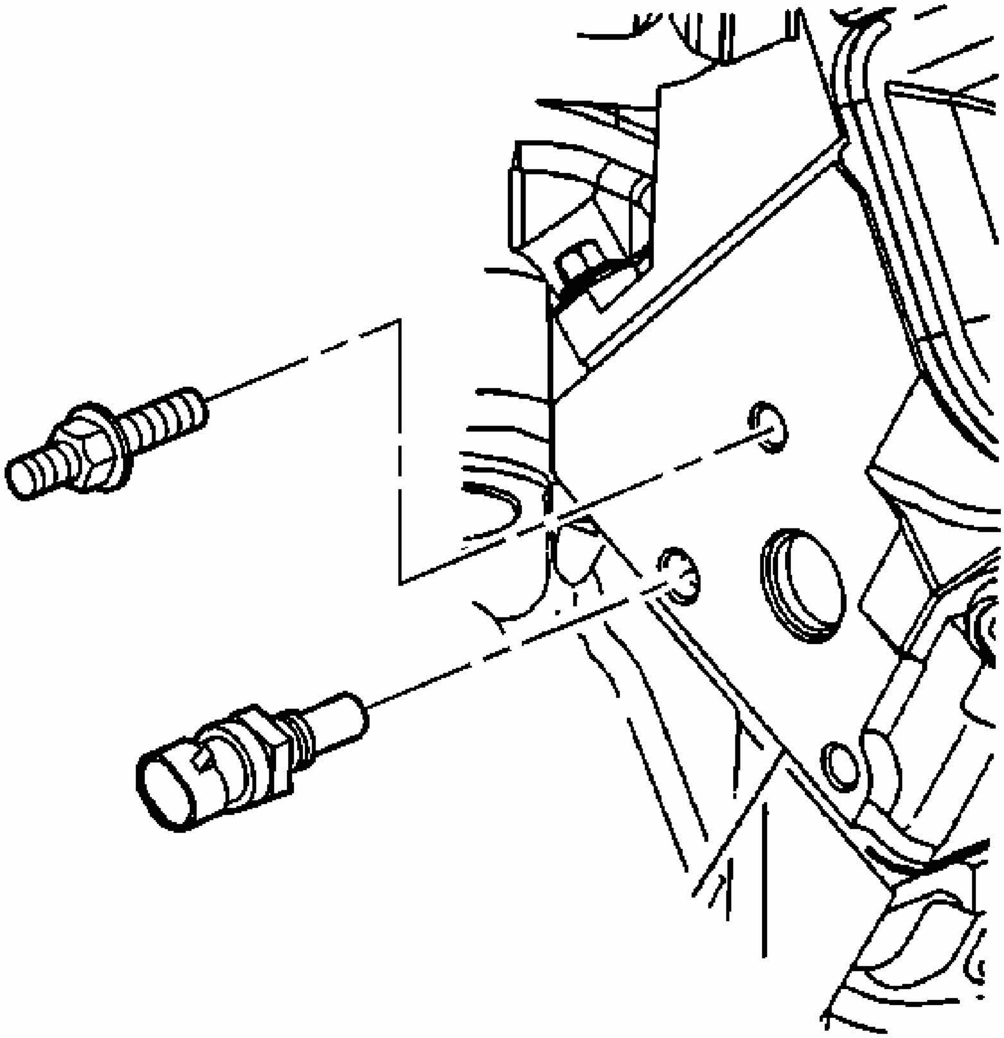


Fig. 396: View Of Heater Inlet Pipe Stud & Coolant Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

11. Apply sealer P/N 21485278 to the coolant temperature sensor.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

12. Install the coolant temperature sensor, if required.

Tighten: Tighten the coolant temperature sensor to 23 N.m (17 lb ft).

13. Install the heater inlet pipe stud, if required.

    Tighten: Tighten the heater inlet pipe stud to 35 N.m (26 lb ft).

OIL PUMP DISASSEMBLE

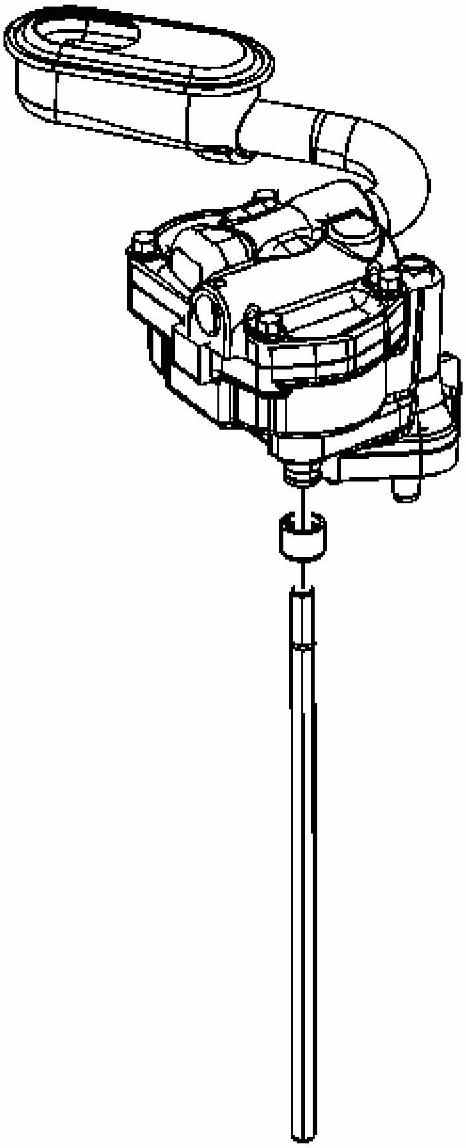


Fig. 397: Identifying Oil Pump
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pump driveshaft and oil pump driveshaft retainer.

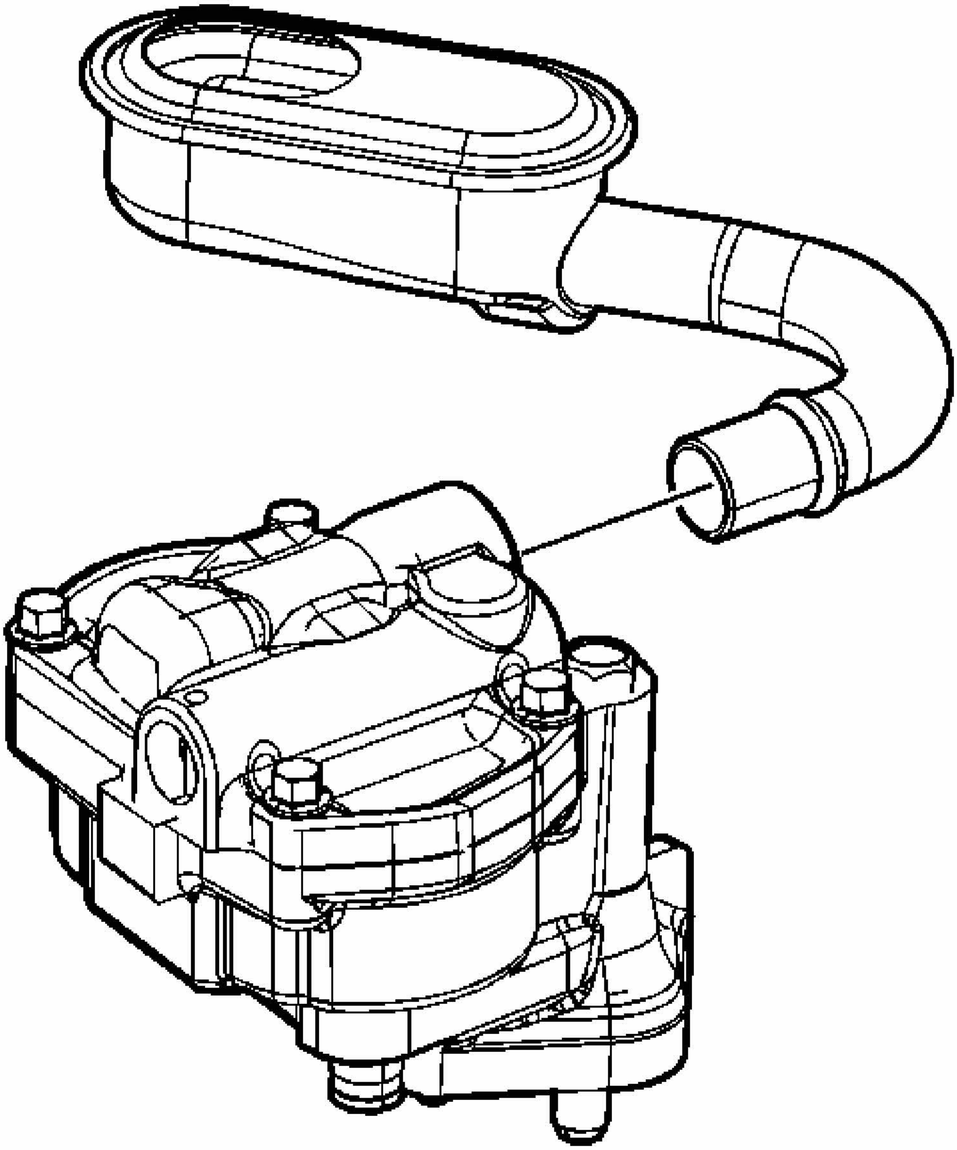


Fig. 398: Identifying Oil Pump & Screen
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **DO NOT remove the oil pump screen from the pipe. The pipe and oil pump screen are serviced as a complete assembly.**

2. Remove the oil pump screen, if necessary.

   The oil pump screen has a press fit into the oil pump cover.

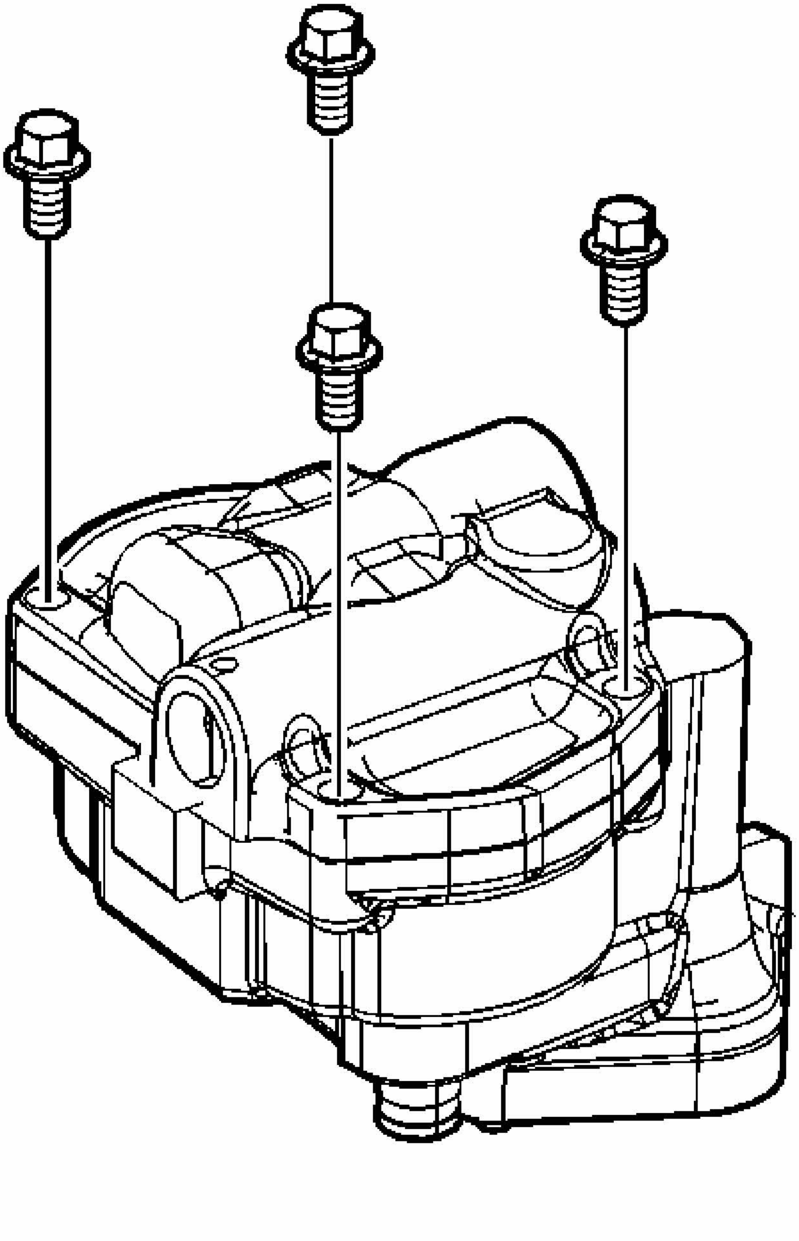


Fig. 399: Identifying Oil Pump Cover Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil pump cover bolts.

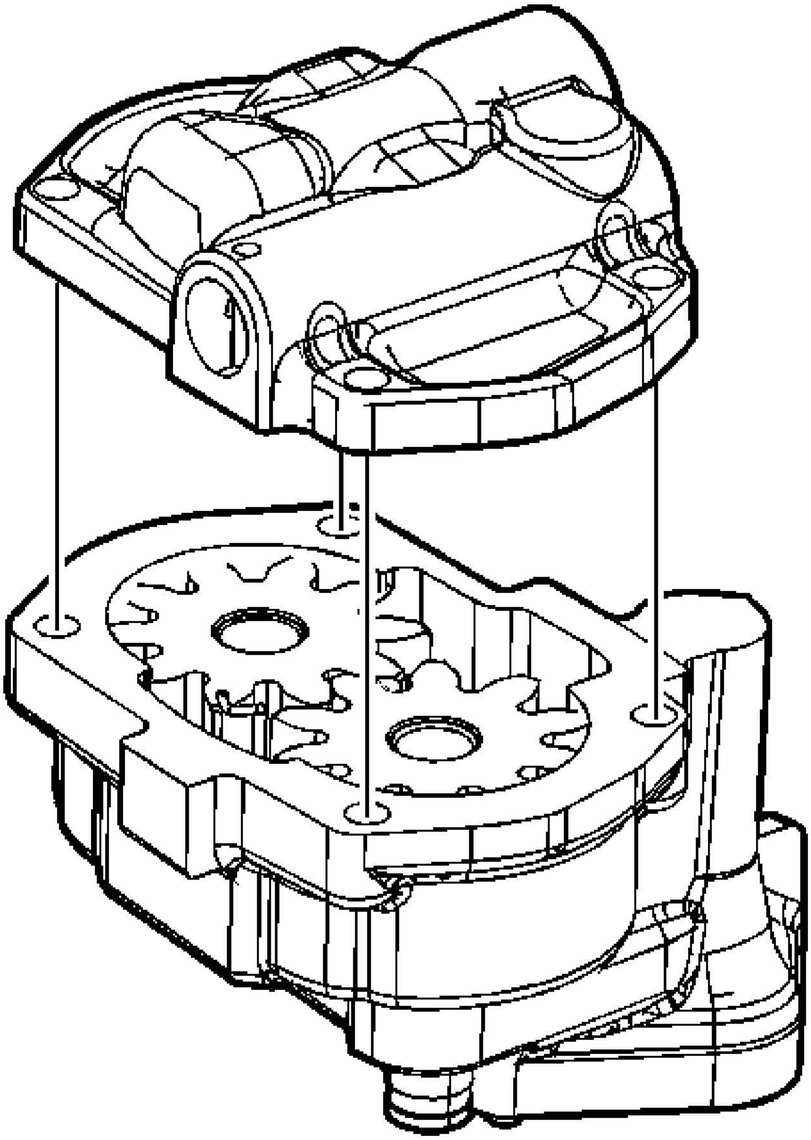


Fig. 400: Identifying Oil Pump Cover
Courtesy of GENERAL MOTORS CORP.

4. Remove the oil pump cover.

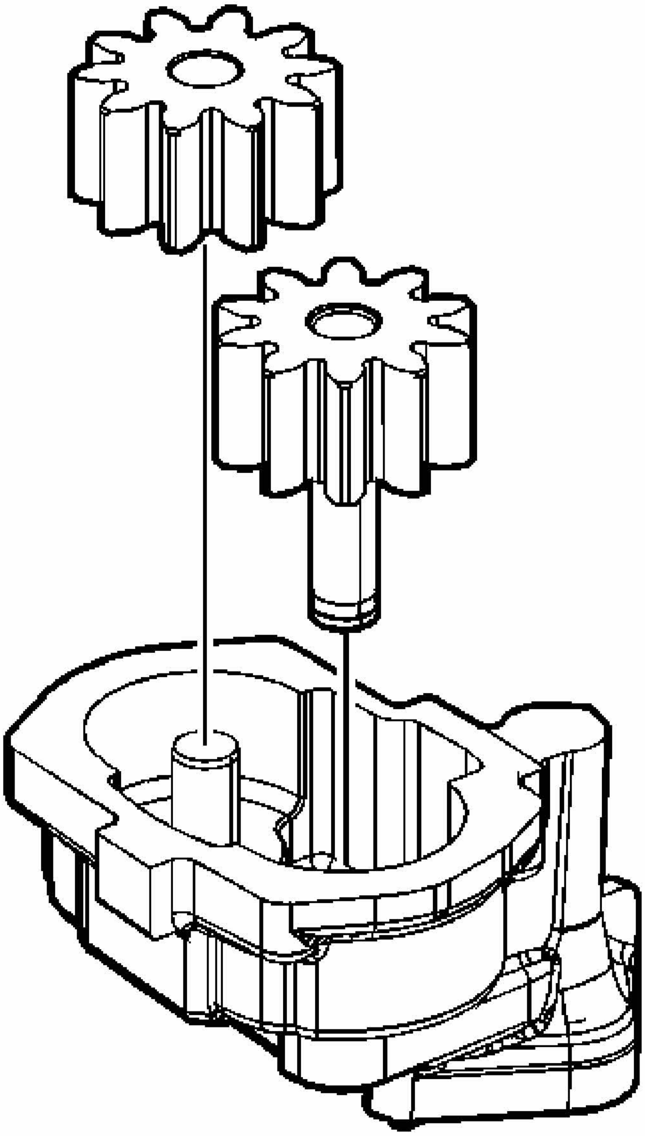


Fig. 401: Identifying Oil Pump Gears
Courtesy of GENERAL MOTORS CORP.

5. Remove the oil pump drive gear and the oil pump driven gear.
6. Matchmark the gear teeth for assembly.

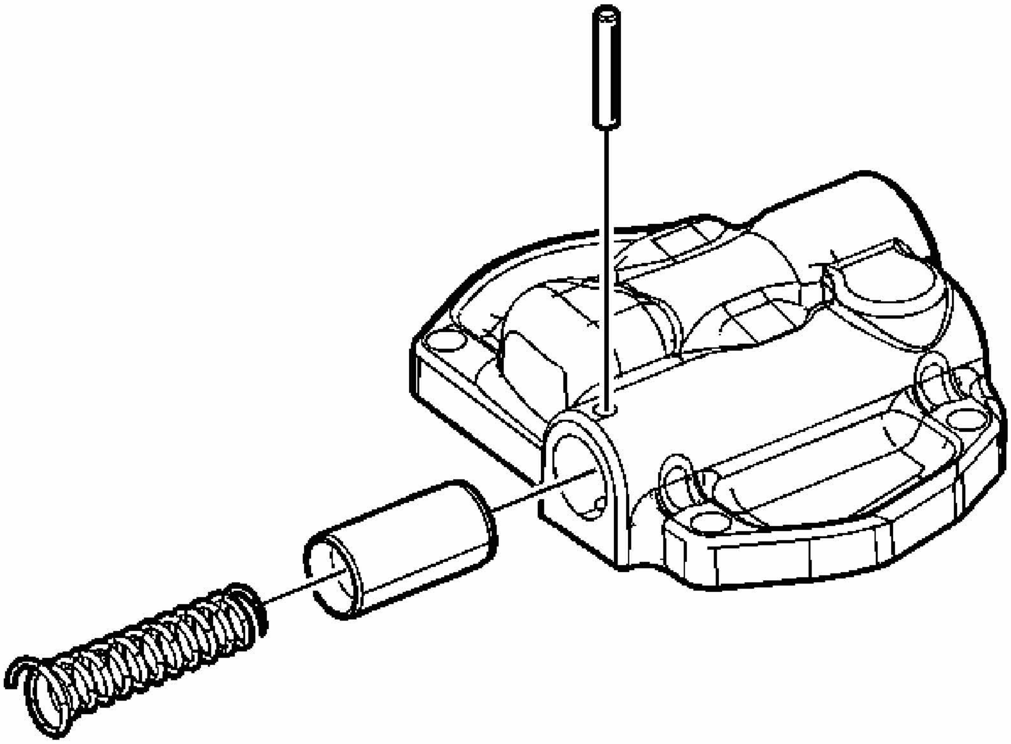


Fig. 402: Identifying Pressure Regulator Valve Spring
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.

CAUTION: In some models, the pressure regulator valve spring is under pressure. Remove the retaining pin carefully in order to avoid bodily injury.

7. Remove the following items:
    1. The oil pump pressure relief valve spring straight pin.
    2. The oil pump pressure relief spring.

CAUTION: Refer to CLEANING SOLVENT CAUTION in Cautions and Notices.

    3. The oil pump pressure relief valve. If the valve is stuck, soak the pump housing in cleaning solvent.

OIL PUMP CLEANING AND INSPECTION

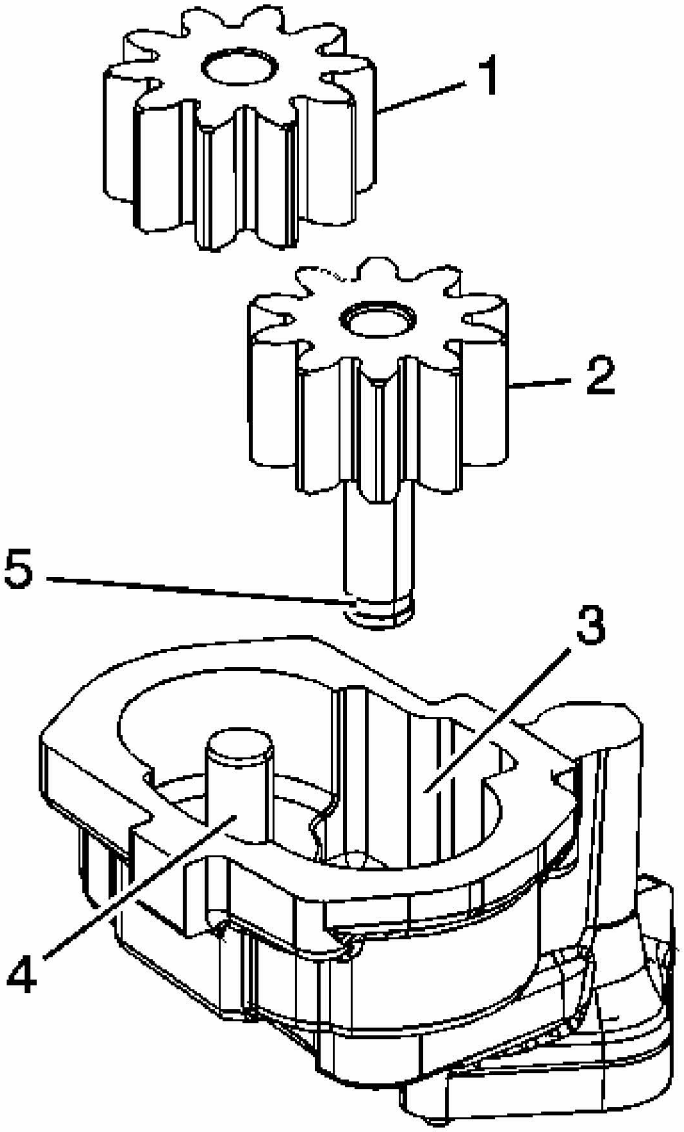


Fig. 403: Identifying Oil Pump Components
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to CLEANING SOLVENT CAUTION in Cautions and Notices.

1. Clean all parts of sludge, oil, and varnish by soaking in cleaning solvent.

2. Inspect for foreign material and determine the source of the foreign material.
3. Inspect the pump housing and cover for the following conditions:
    - Cracks or casting imperfections
    - Scoring (3)
    - Damaged threads
4. Do not attempt to repair the pump housing.

    Replace the pump housing.

5. Inspect the oil pump gears for the following conditions:
    - Scoring (1)
    - Excessive wear (2)
6. Inspect the idler shaft for looseness or scoring (4).

    If loose or damaged, replace the oil pump.

7. Inspect the drive gear shaft for looseness or scoring (5).

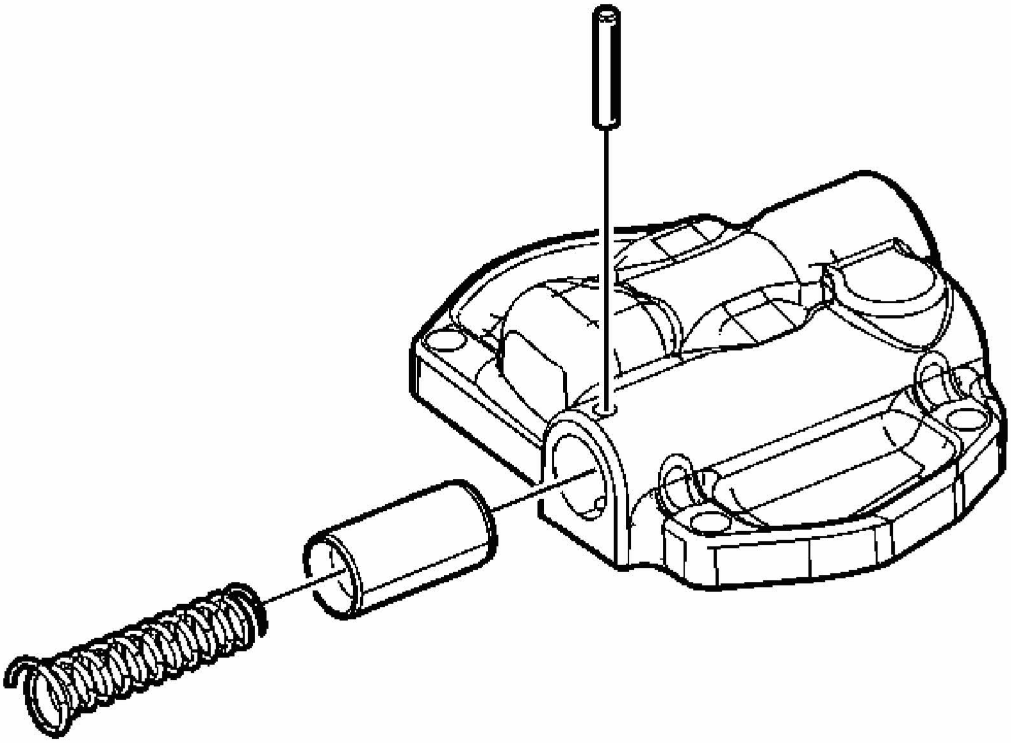


Fig. 404: Identifying Oil Pressure Relief Valve Components
Courtesy of GENERAL MOTORS CORP.

8. Inspect the pressure regulator valve for the following conditions:
    - Scoring
    - Sticking

    Burrs may be removed using a fine oil stone.

9. Inspect the pressure regulator valve spring for the following conditions:
    - Loss of tension
    - Bending
10. Inspect the suction pipe and screen assembly for the following conditions:
    - Looseness

      If the suction pipe is loose, bent or has been removed, replace the pump body cover and suction pipe.

    - Broken wire mesh or screen

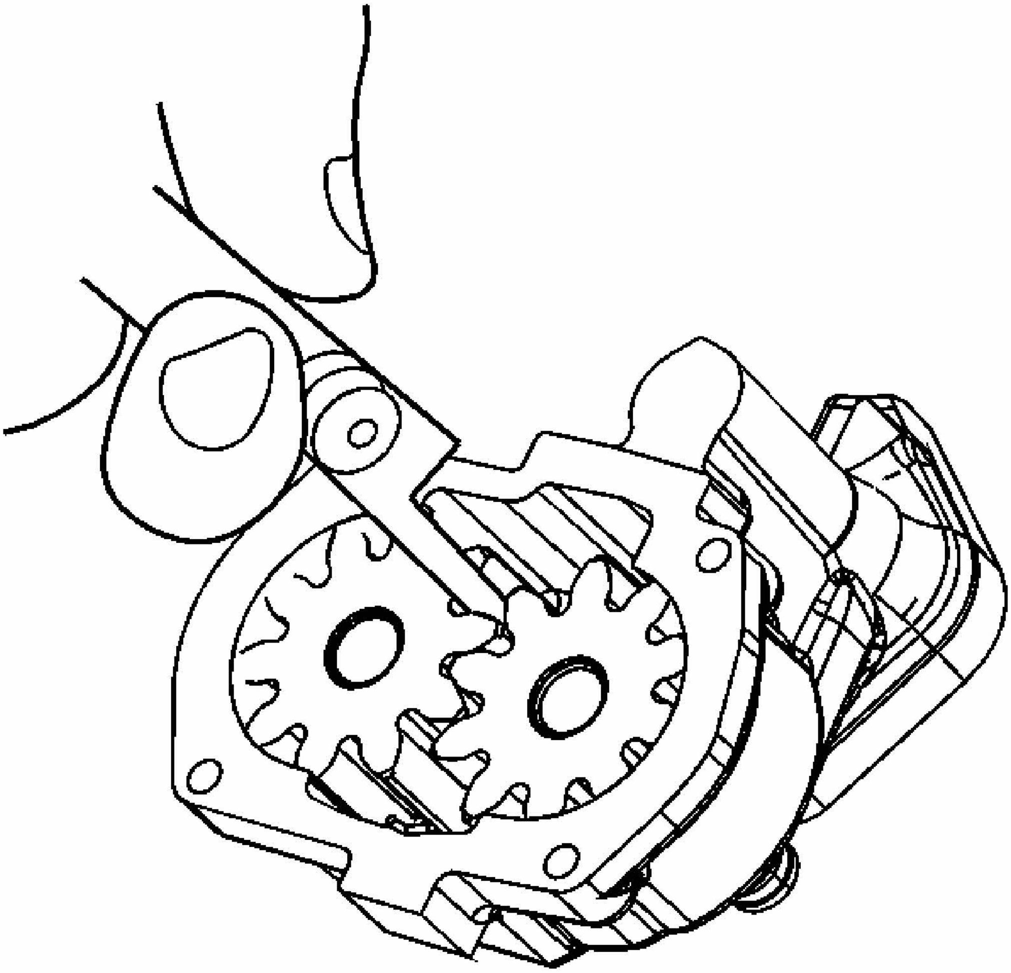


Fig. 405: Measuring Oil Pump Gear Lash
Courtesy of GENERAL MOTORS CORP.

11. Measure the oil pump gear lash. Install the gears, and measure in several places.

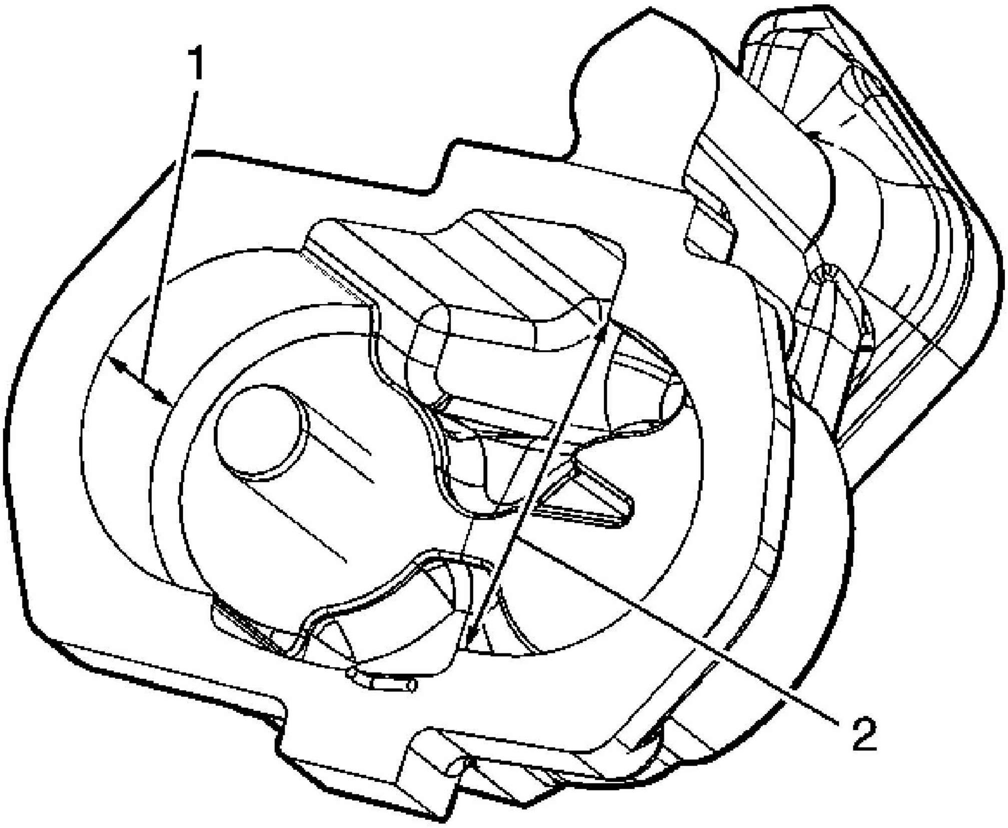


Fig. 406: Measuring Oil Pump Housing Gear Pocket
Courtesy of GENERAL MOTORS CORP.

12. Measure the oil pump housing gear pocket (1, 2).

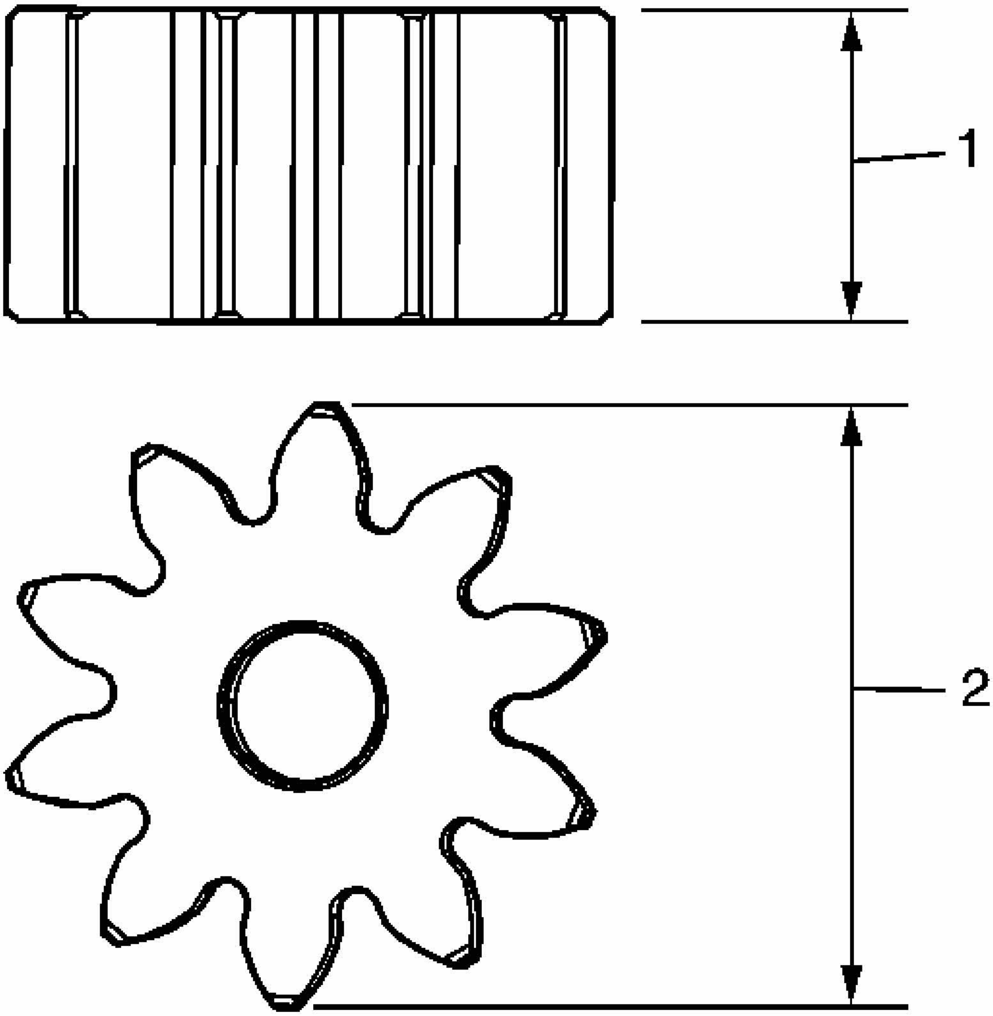


Fig. 407: Measuring Oil Pump Gears
Courtesy of GENERAL MOTORS CORP.

13. Measure the oil pump gears (1, 2).

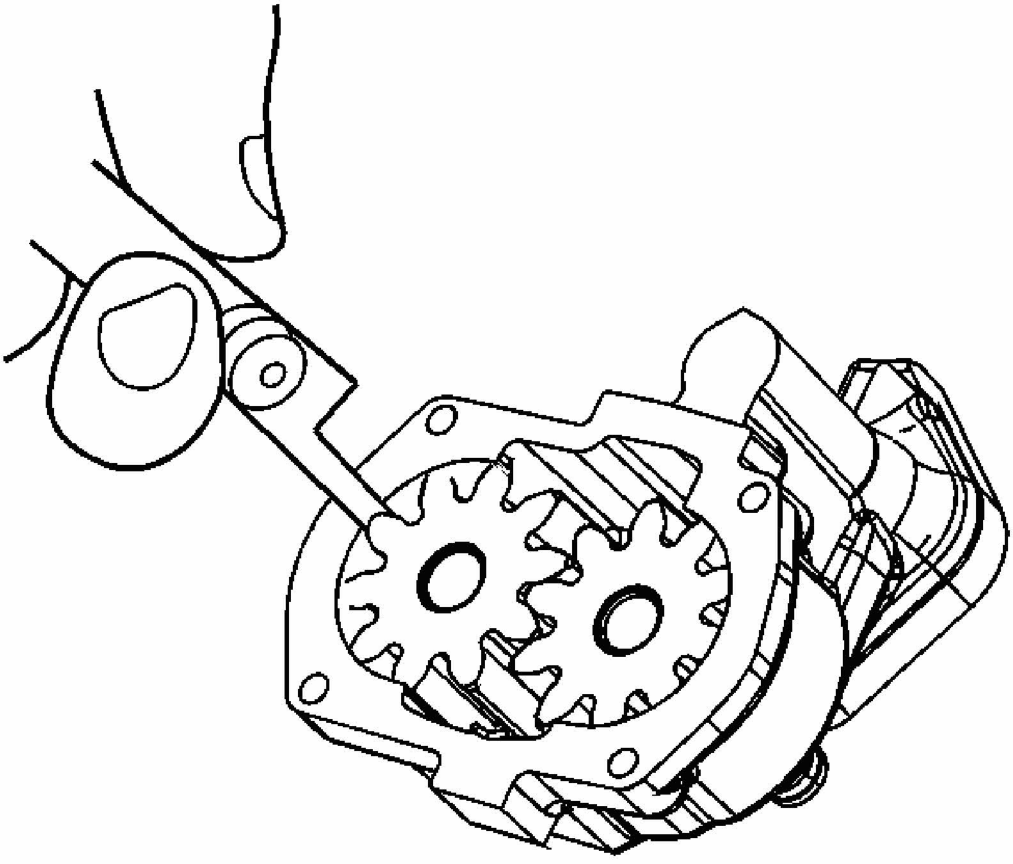


Fig. 408: Measuring Oil Pump Gear Side Clearance
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When deciding pump serviceability based on end clearance, consider depth of the wear pattern in the pump cover.

14. Measure the oil pump gear side clearance.

OIL PUMP ASSEMBLE

Tools Required

J 22144 Oil Suction Pipe Installer

1. Lubricate all the internal oil pump parts using engine oil during assembly.

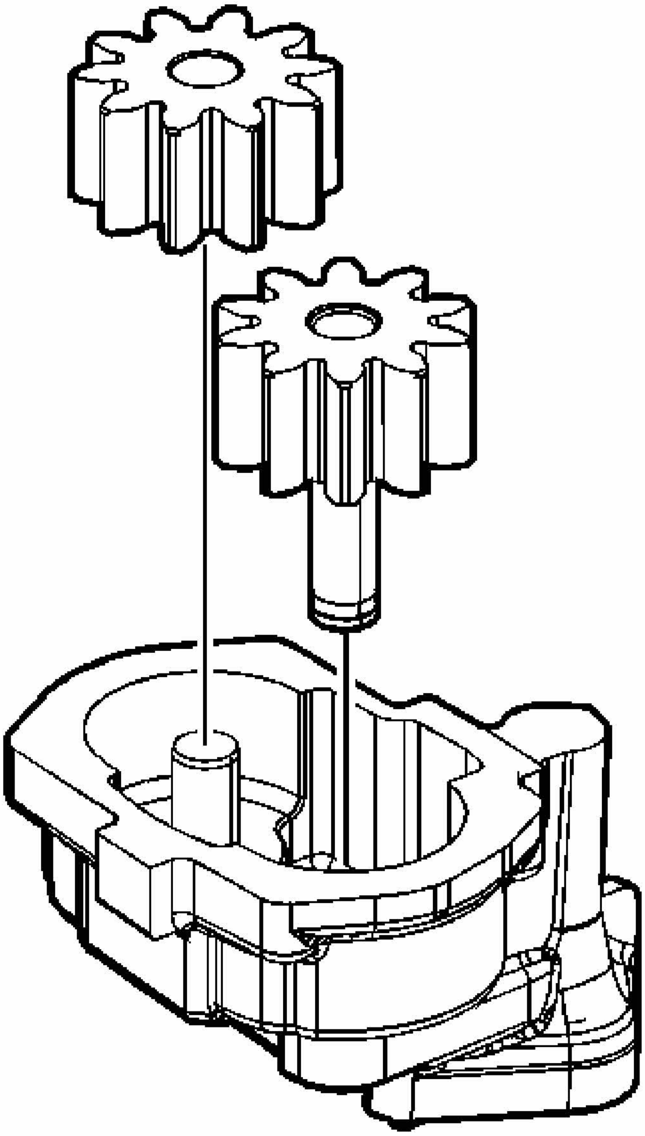


Fig. 409: Identifying Oil Pump Gears
Courtesy of GENERAL MOTORS CORP.

2. Install the oil pump gears.

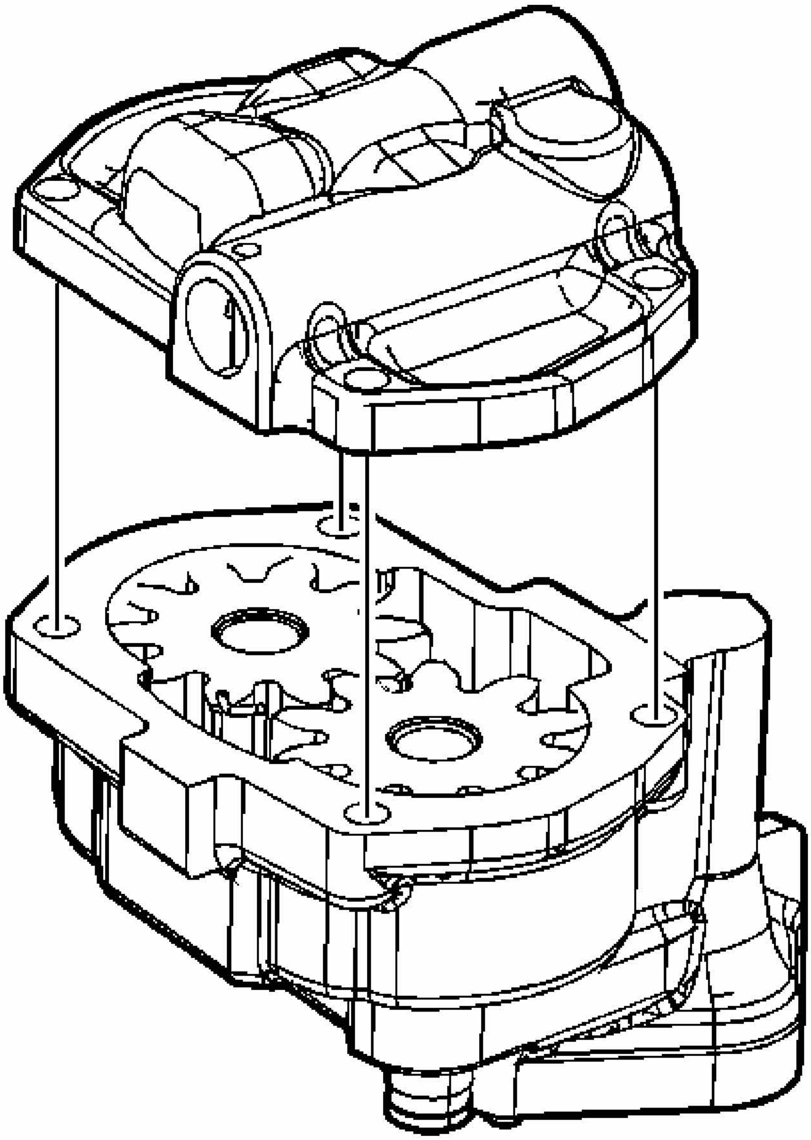


Fig. 410: Identifying Oil Pump Cover
Courtesy of GENERAL MOTORS CORP.

3. Install the oil pump cover.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

4. Install the oil pump cover bolts.

Tighten: Tighten the oil pump cover bolts to 10 N.m (89 lb in).

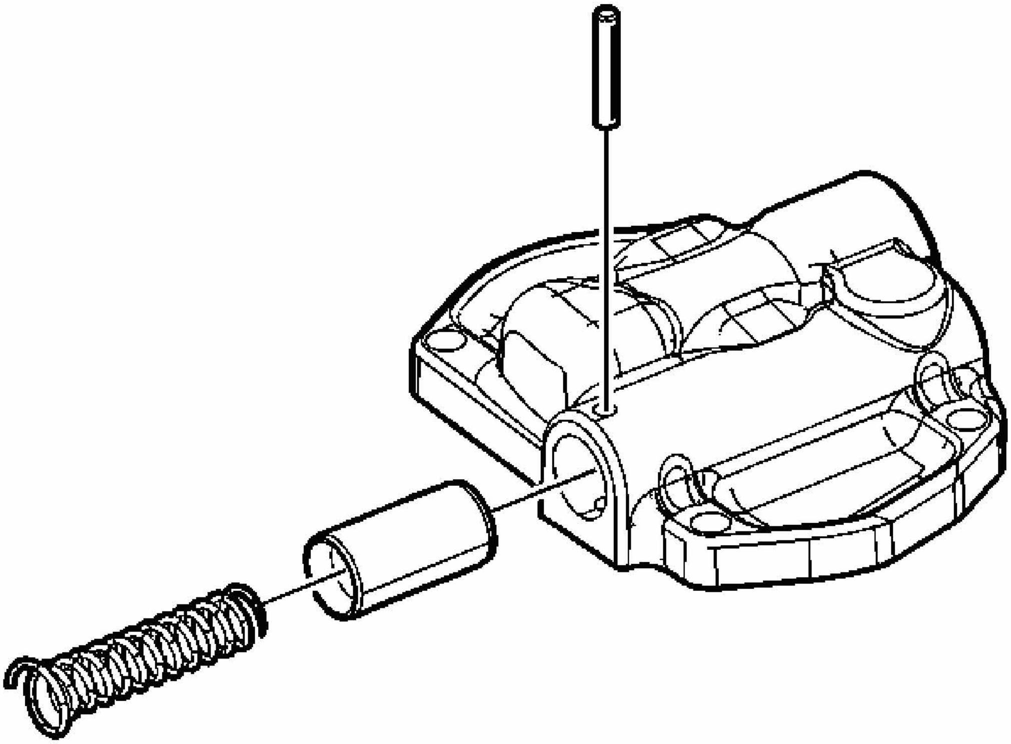


Fig. 411: Identifying Oil Pressure Relief Valve Components
Courtesy of GENERAL MOTORS CORP.

5. Install the pressure regulator valve.
6. Install the pressure regulator spring.
7. Install the cotter pin.

IMPORTANT: Make sure the cotter pin is properly secured.

8. Apply sealer GM P/N 12346004, (Canadian P/N 10953480) or the equivalent to the new suction pipe.
9. Tap the new suction pipe into place using a plastic hammer and **J 22144** .

ENGINE FRONT COVER CLEANING AND INSPECTION

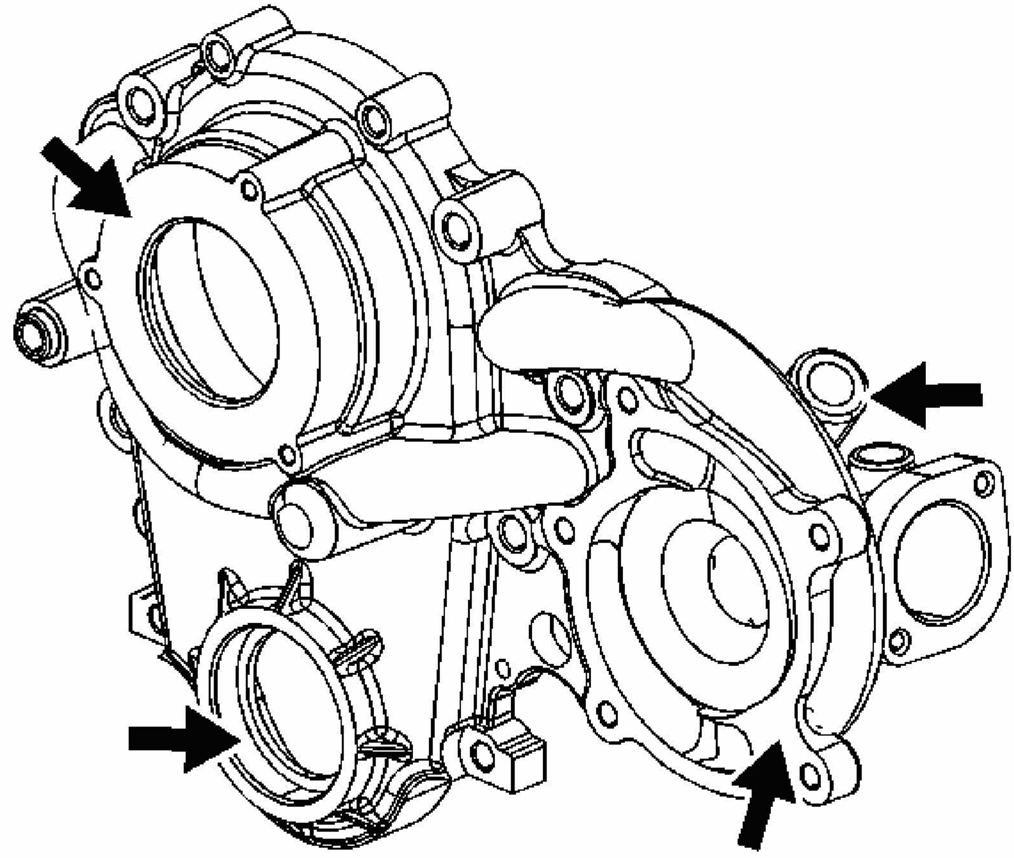


Fig. 412: View Of Engine Front Cover
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

1. Clean the engine front cover with solvent.
2. Dry the engine front cover with compressed air.
3. Inspect the engine front cover sealing surfaces for damage.
4. Inspect the engine front cover threaded holes.
5. Repair or replace the engine front cover as needed.

VALVE ROCKER ARM COVER CLEANING AND INSPECTION

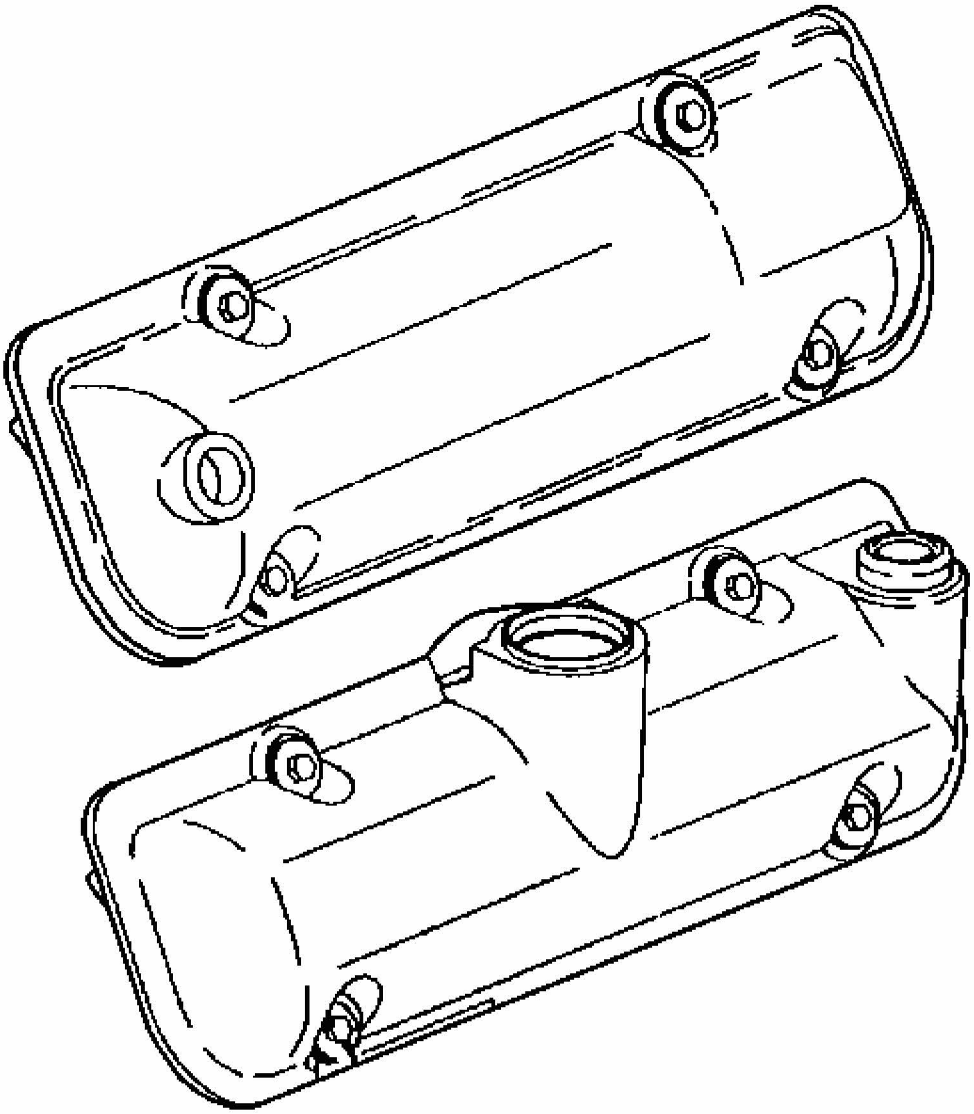


Fig. 413: Cleaning Valve Rocker Arm Covers
Courtesy of GENERAL MOTORS CORP.

1. Remove all rubber grommets from the valve rocker arm covers.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

2. Clean the valve rocker arm covers with solvent.
3. Dry the valve rocker arm covers with compressed air.

4. Inspect the valve rocker arm covers for damage and replace if necessary.

POSITIVE CRANKCASE VENTILATION (PCV) VALVE CLEANING AND INSPECTION

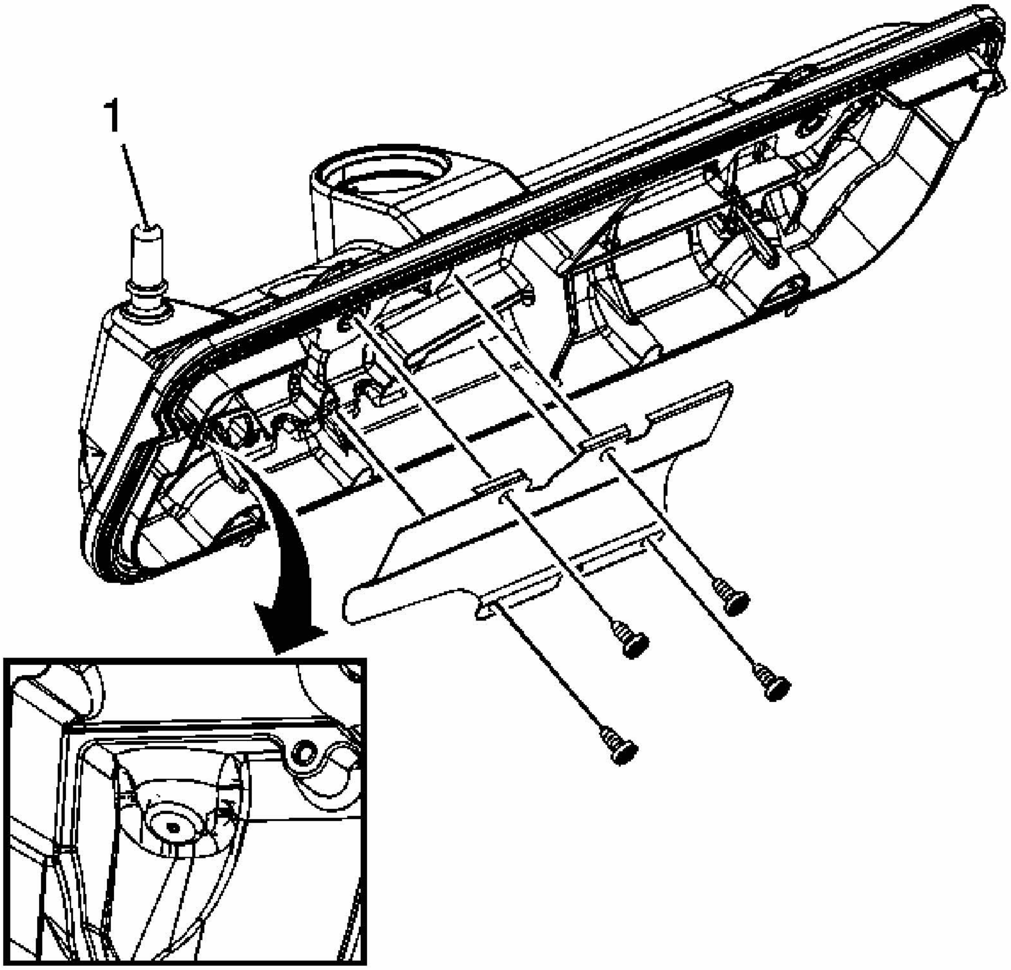


Fig. 414: Identifying Positive Crankcase Ventilation (PCV) Valve
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The positive crankcase ventilation (PCV) valve is a fixed orifice system. Do not attempt to remove the valve from the valve rocker arm cover. Failure to do so may result in damage to the rocker arm valve cover.

1. Flush the carbon from the PCV valve orifices (1) using solvent.
2. Dry the PCV valve orifices using compressed air.

OIL PAN CLEANING AND INSPECTION

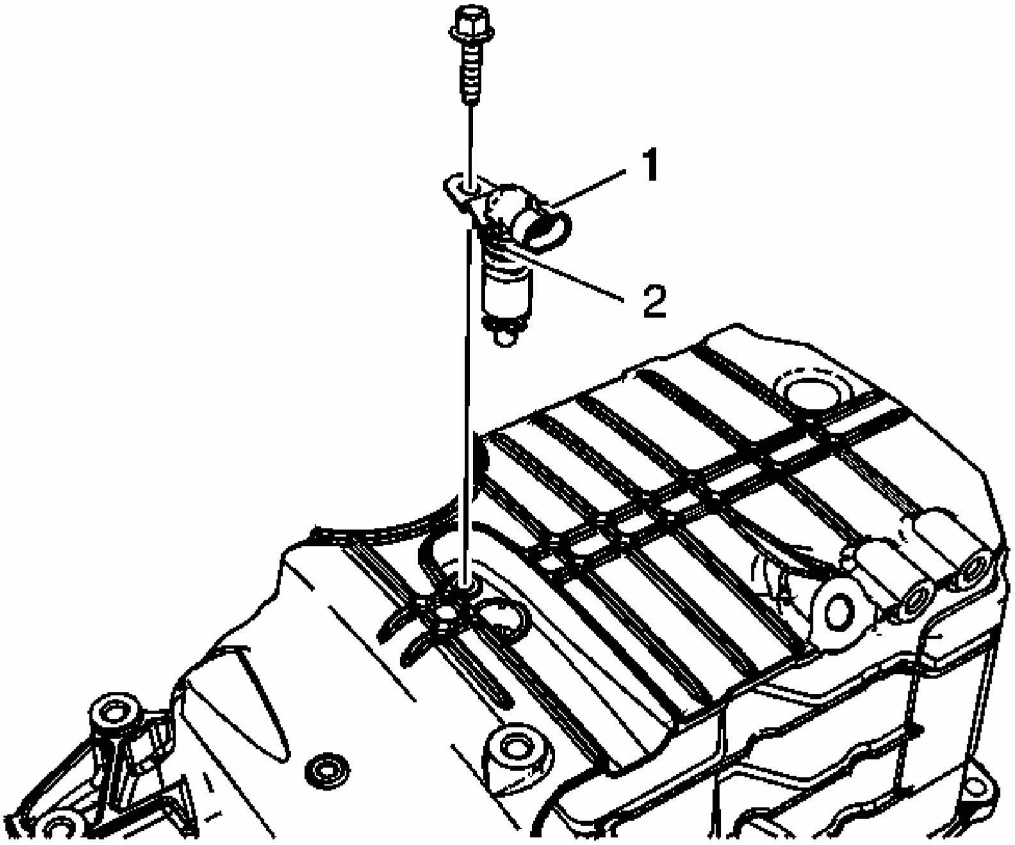


Fig. 415: Identifying Oil Level Sensor
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil level sensor.
2. Inspect the O-ring seal (2) and the electrical connector (1) for wear or damage. Repair or replace as necessary.

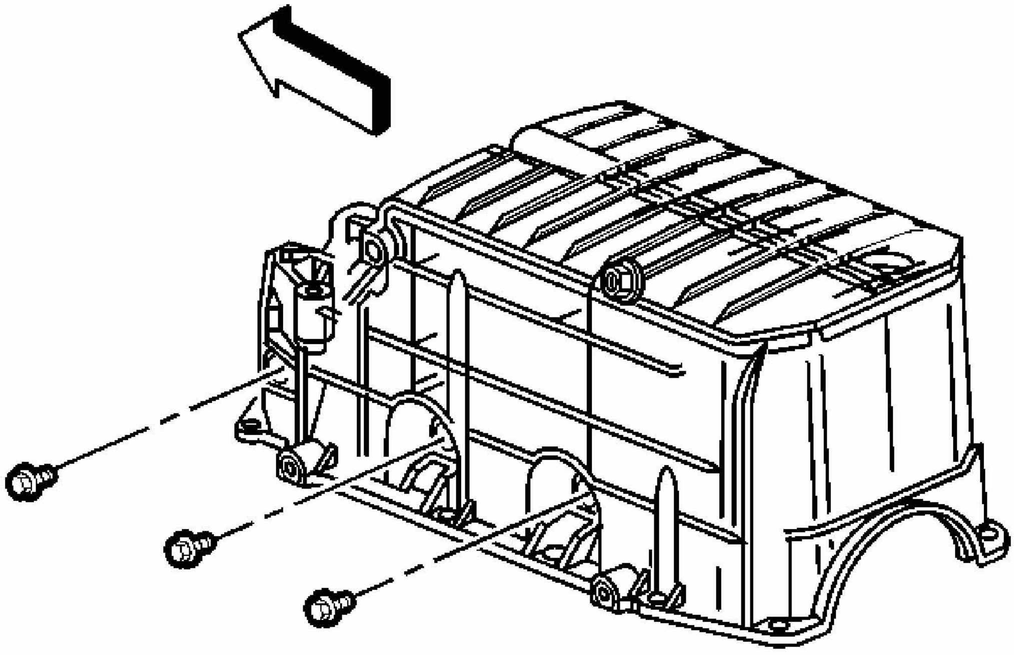


Fig. 416: Oil Pan
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

3. Clean the oil pan with solvent. Remove all sludge and debris from the oil pan.
4. Dry the oil pan with compressed air.
5. Inspect the oil pan sealing surface for damage and replace if necessary.

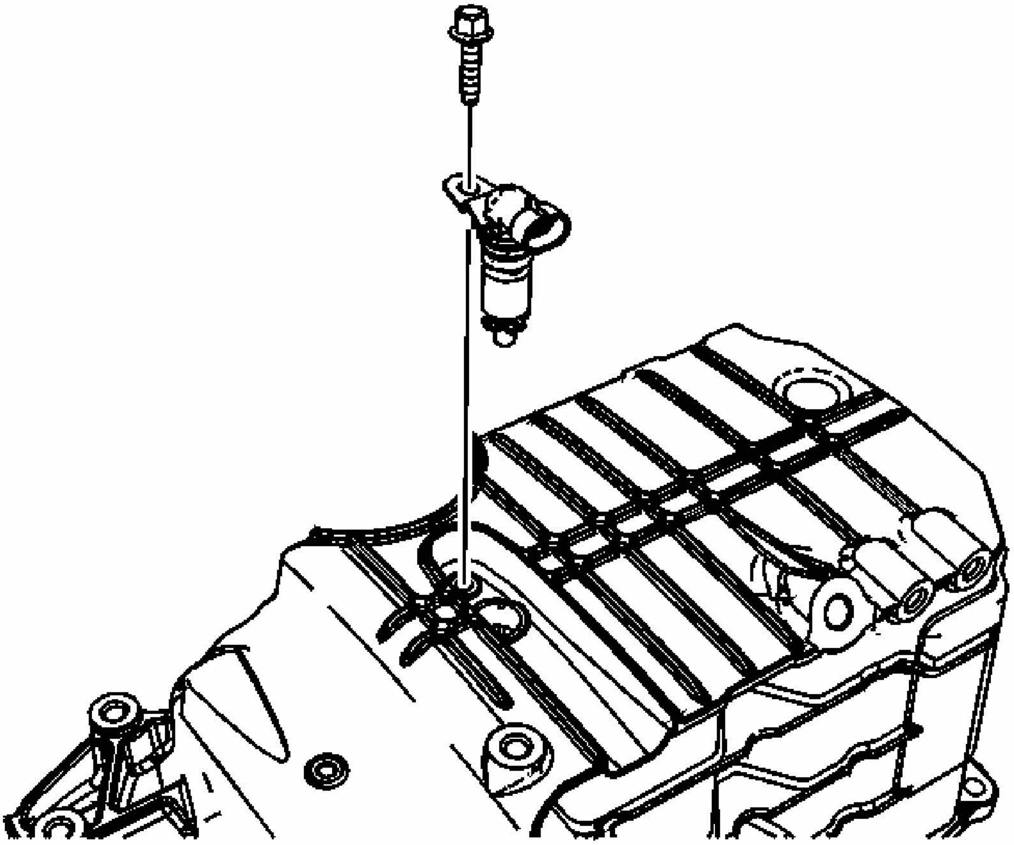


Fig. 417: View Of Oil Level Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

6. Install the oil level sensor and bolt.

   Tighten: Tighten the oil level sensor bolt to 10 N.m (89 lb in).

INTAKE MANIFOLD CLEANING AND INSPECTION - LOWER

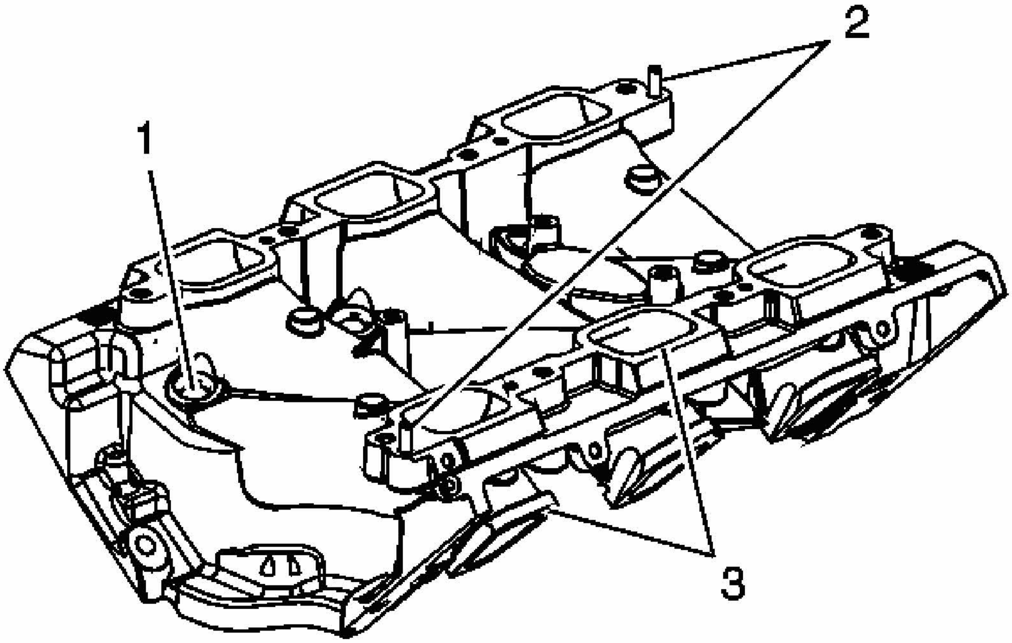


Fig. 418: View Of Lower Intake Manifold
Courtesy of GENERAL MOTORS CORP.

1. Clean the intake manifold gasket mating surfaces (3) using GM P/N 12346139 (Canadian P/N 10953463) or equivalent.
2. Clean the fuel injector bores (1).
3. Inspect the lower intake manifold locating pins (2) for damage. Replace as necessary.
4. Inspect the intake manifold for damage.

IMPORTANT: If replacing the lower intake manifold, make sure to transfer or replace the locating pins as necessary.

5. Repair or replace the intake manifold as necessary.

INTAKE MANIFOLD CLEANING AND INSPECTION - UPPER

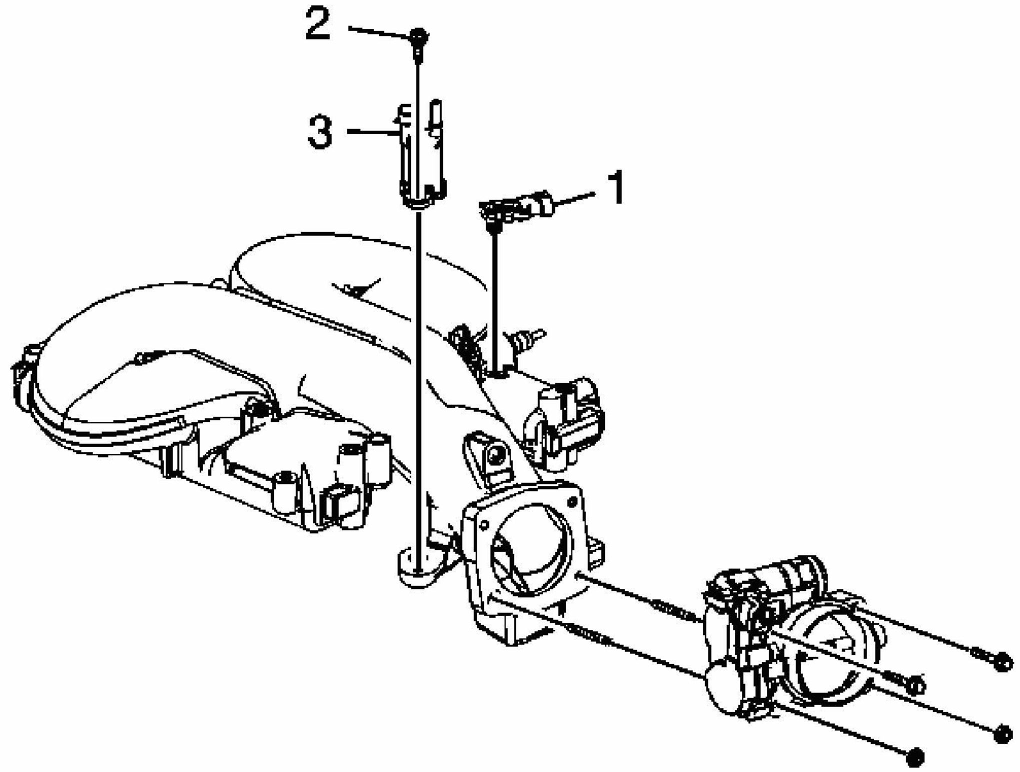


Fig. 419: Identifying EVAP Canister Purge Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

1. Remove the throttle body bolts and nuts.
2. Remove the throttle body.
3. Remove the throttle body studs, if required.
4. Remove the manifold absolute pressure (MAP) sensor (1).
5. Remove the evaporative emissions (EVAP) purge valve bolt (2).
6. Remove the EVAP purge valve (3).

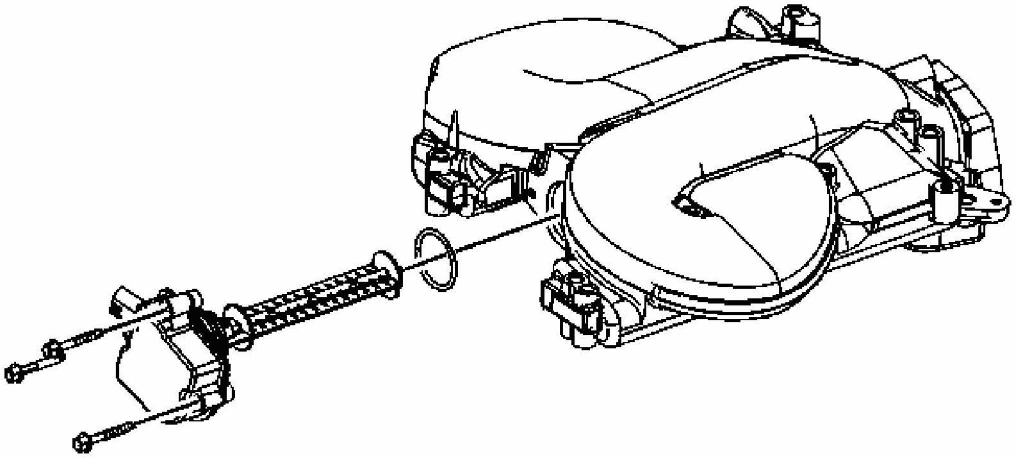


Fig. 420: View Of Intake Manifold Tuning Valve
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If at any time the intake manifold tuning valve blade becomes separated from the actuator, DO NOT cycle the actuator. Cycling the actuator without the blade attached will offset the calibration, and the entire intake manifold tuning valve assembly will need to be replaced.

7. Remove the intake manifold tuning valve bolts.
8. Remove the intake manifold tuning valve.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

9. Clean the intake manifold with solvent.
10. Dry the intake manifold with compressed air.
11. Inspect all gasket mating surfaces for nicks or cracks and replace if necessary.
12. Inspect the intake manifold tuning valve seal for damage. Inspect the intake manifold tuning valve blade for cracks, missing material, or looseness. The tuning valve blade attachment to the motor should be tight, with no slack present. Replace if necessary.

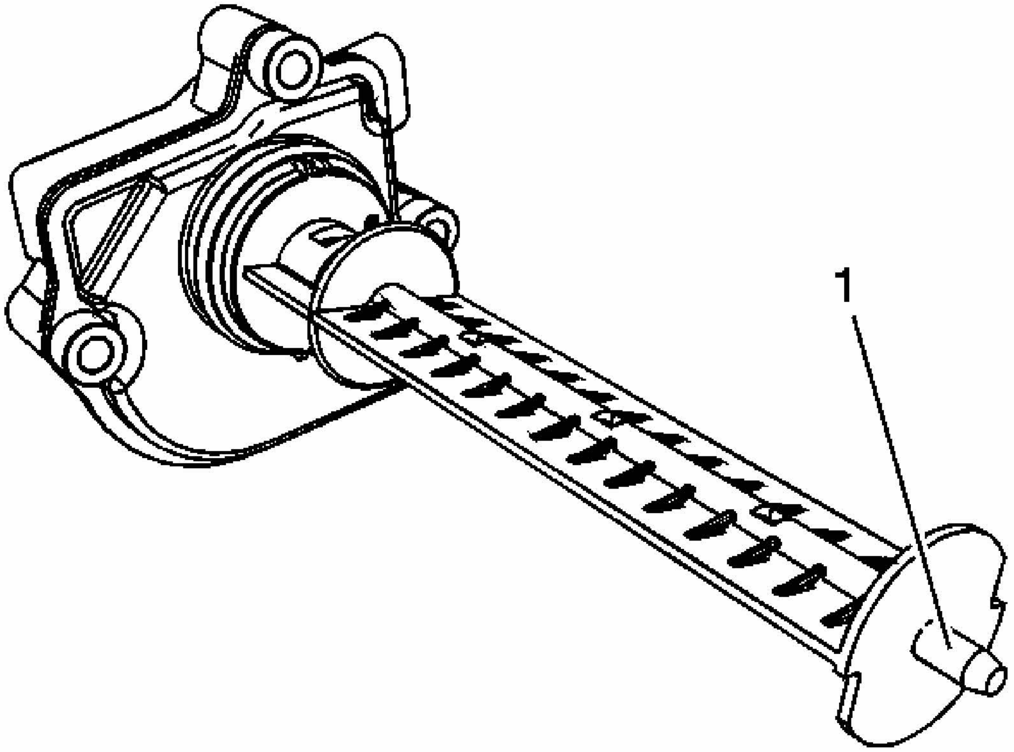


Fig. 421: View Of Tuning Valve Blade
Courtesy of GENERAL MOTORS CORP.

13. Apply lubricant GM P/N 1051344 (Canadian P/N 993037) to the valve shaft (1).

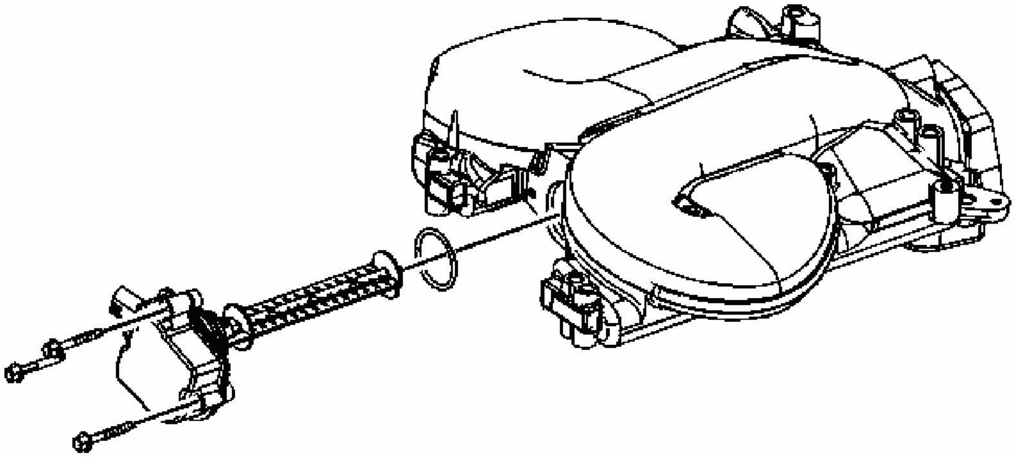


Fig. 422: View Of Intake Manifold Tuning Valve
Courtesy of GENERAL MOTORS CORP.

14. Install the intake manifold tuning valve, ensuring proper alignment is achieved. Failure to do so may result in the valve getting jammed or stuck in the intake manifold.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

15. Install the intake manifold tuning valve bolts.

Tighten: Tighten the intake manifold tuning valve bolts to 10 N.m (89 lb in).

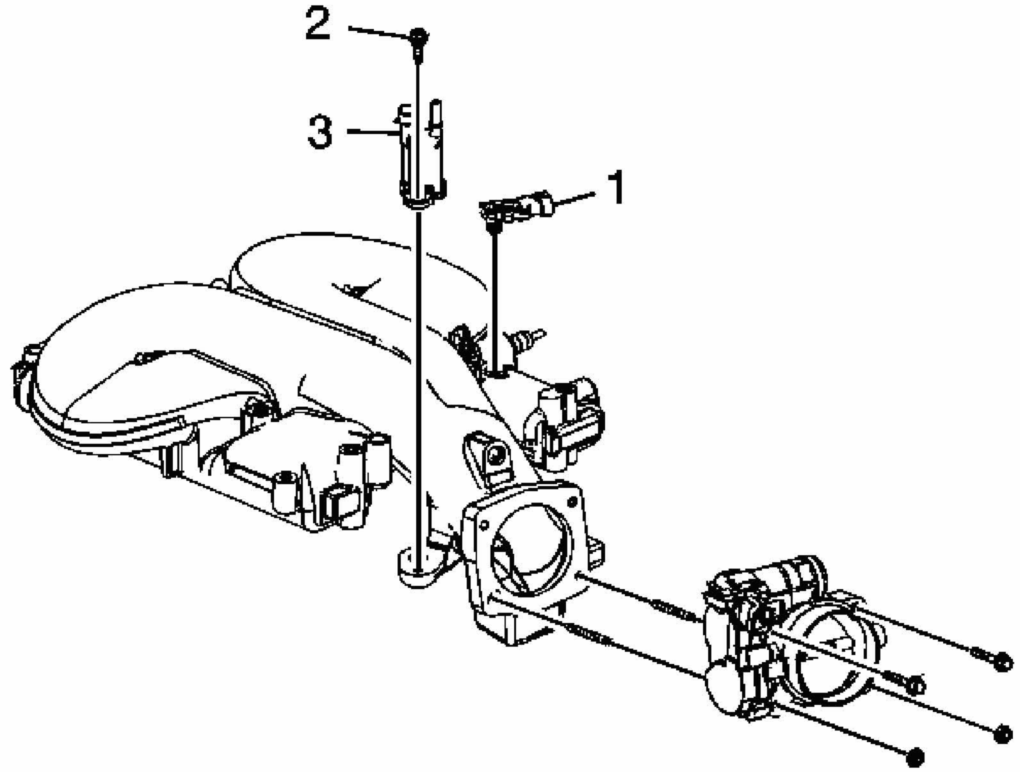


Fig. 423: Identifying EVAP Canister Purge Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

16. Inspect the EVAP purge valve seal for damage and replace if necessary.
17. Install the EVAP purge valve (3).
18. Install the EVAP purge valve bolt (2).

Tighten: Tighten the EVAP purge valve bolt to 16 N.m (12 lb ft).

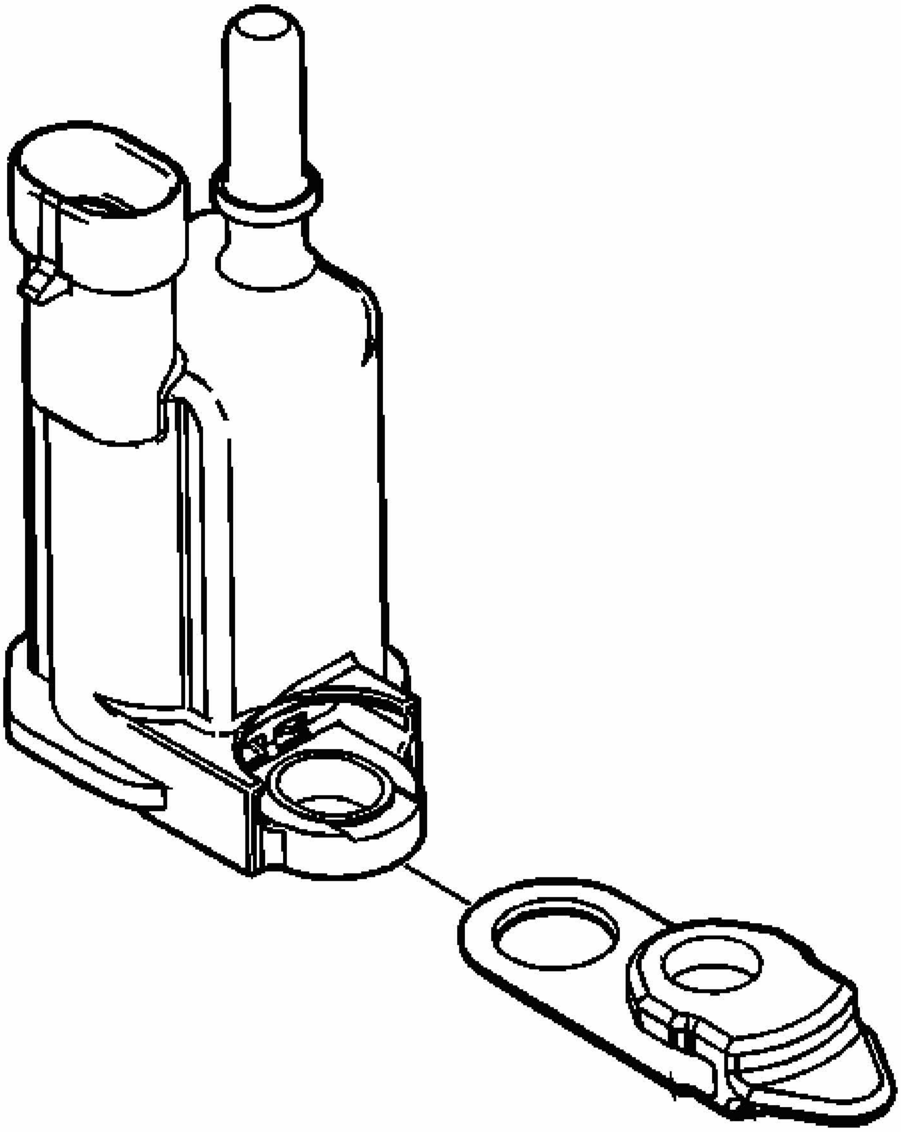


Fig. 424: Identifying EVAP Purge Valve Isolator
Courtesy of GENERAL MOTORS CORP.

19. Inspect the MAP sensor seal for damage and replace if necessary.
20. Install the MAP sensor (1).
21. Install the throttle body studs, if required.

Tighten: Tighten the throttle body studs to 6 N.m (53 lb in).

22. Inspect the throttle body seal for damage and replace if necessary.
23. Install the throttle body.
24. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) to the throttle body bolt and nut threads.
25. Install the throttle body bolts and nuts.

    Tighten: Tighten the throttle body bolts and nuts to 10 N.m (89 lb in).

EXHAUST MANIFOLD CLEANING AND INSPECTION

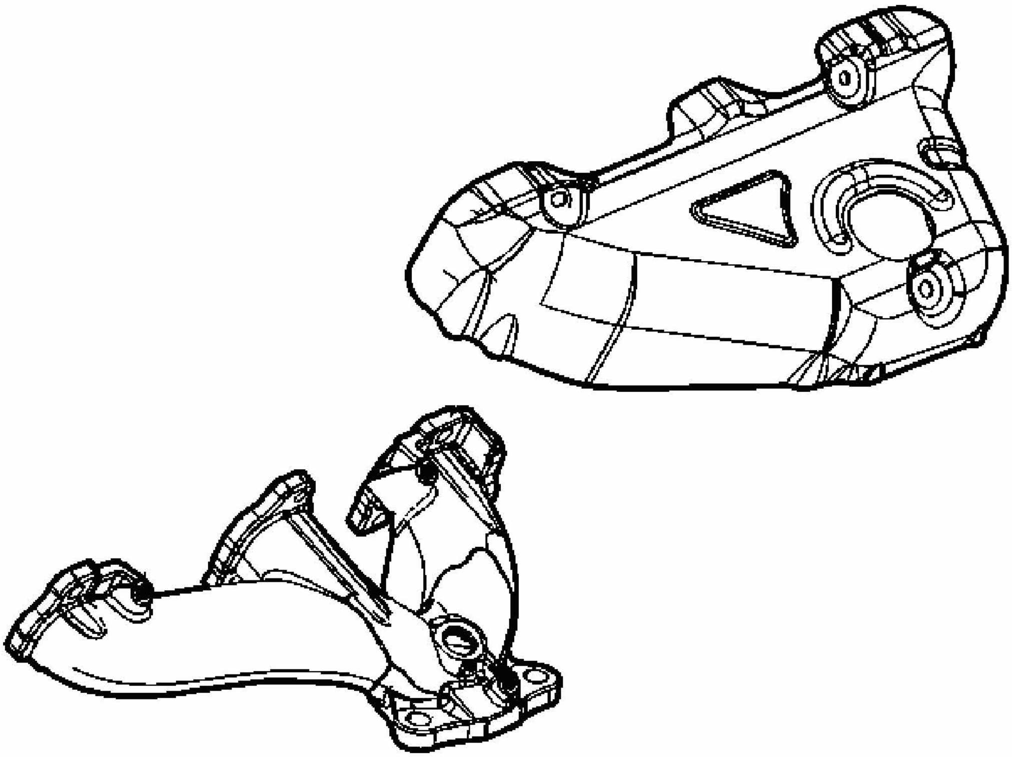


Fig. 425: View Of Exhaust Manifolds
Courtesy of GENERAL MOTORS CORP.

CAUTION: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

1. Clean the exhaust manifold and heat shield in solvent.
2. Dry the exhaust manifold and heat shield with compressed air.

3. Inspect the exhaust manifold for cracks or damage.

WATER PUMP CLEANING AND INSPECTION

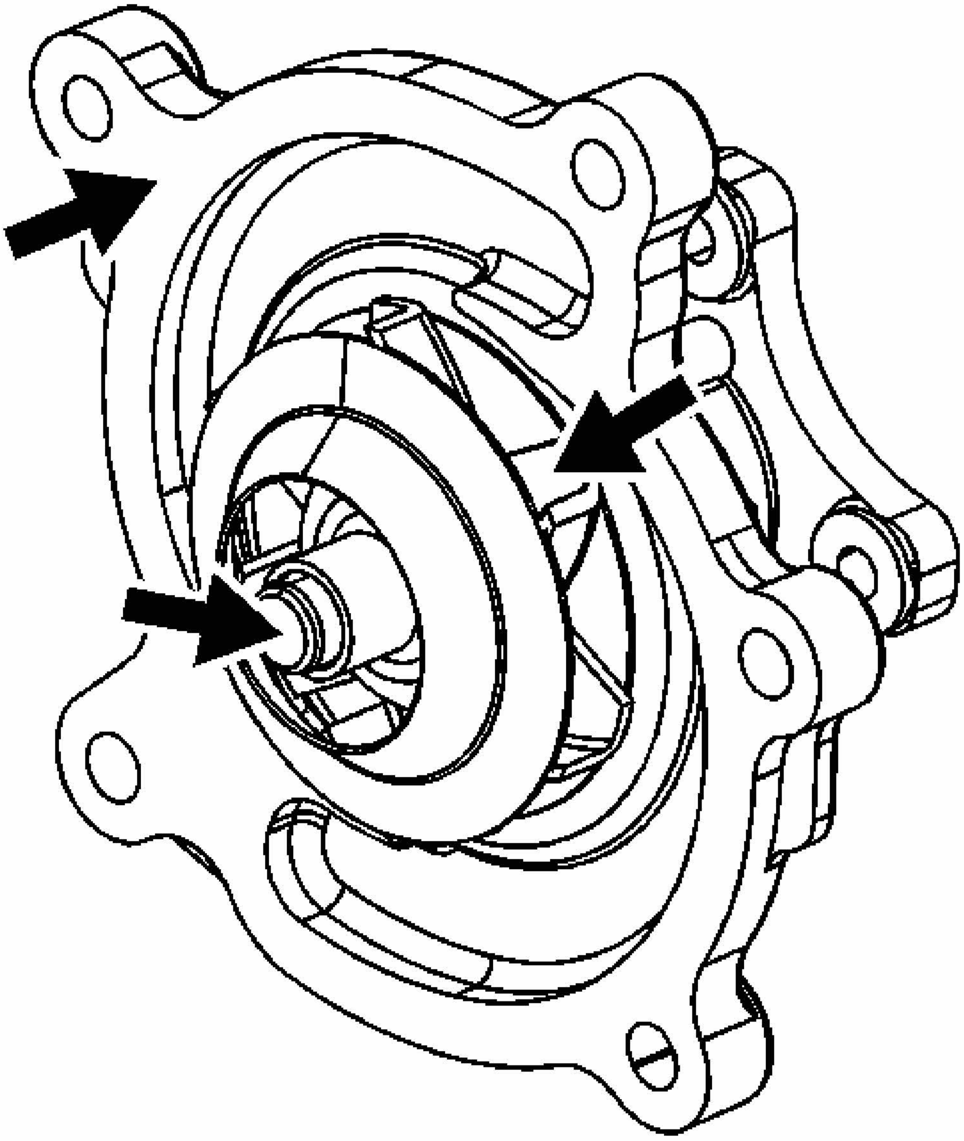


Fig. 426: Rear View Of Water Pump
Courtesy of GENERAL MOTORS CORP.

1. Remove all gasket material from the sealing surface.
2. Inspect the water pump impeller for damage.

3. Inspect the water pump shaft for looseness.
4. Replace the water pump if necessary.

THREAD REPAIR

General purpose thread repair kits are available commercially.

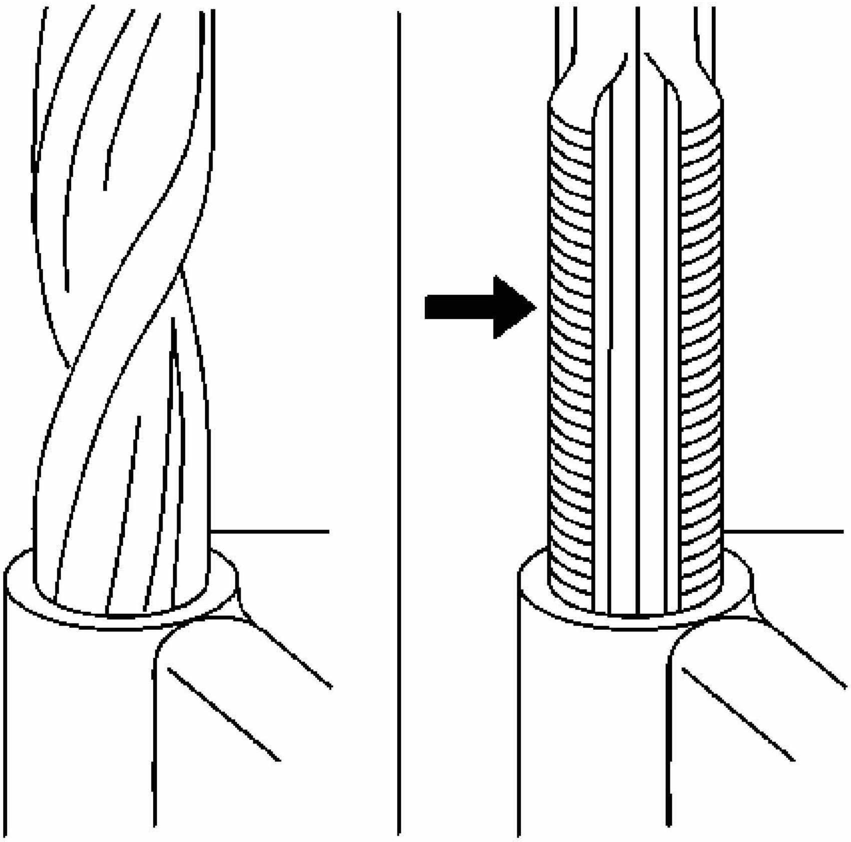


Fig. 427: Drilling & Tapping Damaged Threads
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.

IMPORTANT: Refer to the thread repair kit manufacturer's instructions regarding the size of the drill and which tap to use. Always avoid any buildup of chips. Back out the tap every few

turns and remove the chips.

1. Determine the size, the pitch, and the depth of the damaged thread.
2. Adjust the stop collars on the cutting tool as needed. Tap the stop collars to the required depth.
3. Drill out the damaged thread.
4. Remove the chips.
5. Apply clean engine oil to the top thread.
6. Use the tap in order to cut new thread.
7. Clean the thread.

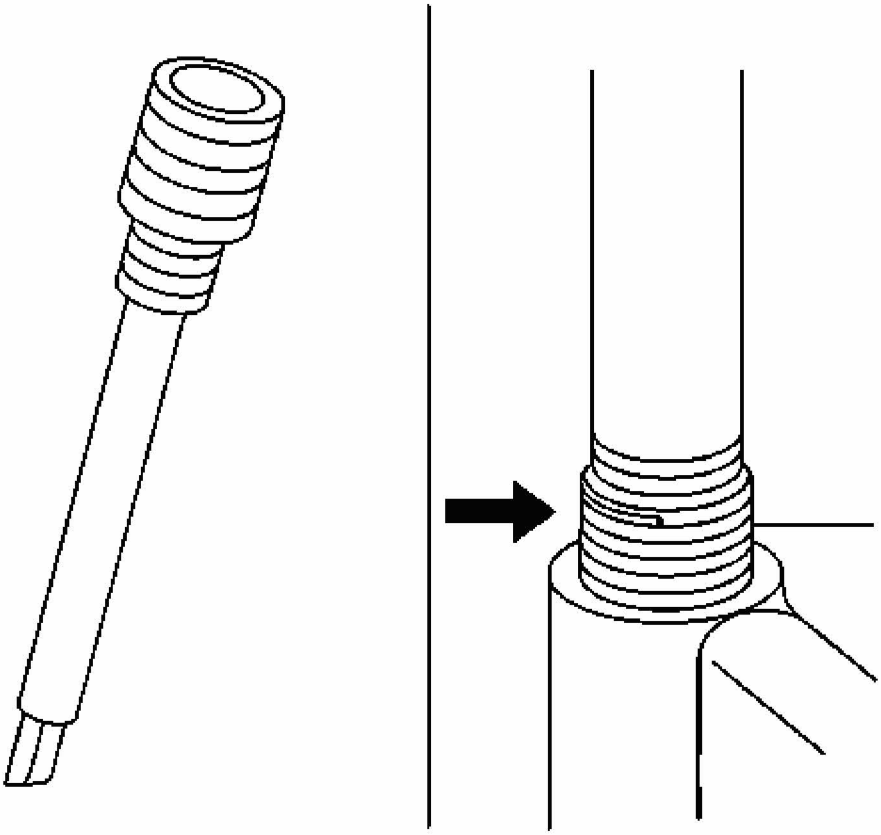


Fig. 428: Installing Thread Insert
Courtesy of GENERAL MOTORS CORP.

8. Screw the thread insert onto the mandrel of the thread insert installer. Engage the tang

of the thread insert onto the end of the mandrel.

IMPORTANT: The thread insert should be flush to 1 turn below the surface.

9. Lubricate the thread insert with clean engine oil - except when installing in aluminum - and install the thread insert.
10. If the tang of the thread insert does not break off when backing out the thread insert installer, break off the tang using a drift punch.

SERVICE PRIOR TO ASSEMBLY

Dirt will cause premature wear of the rebuilt engine. Clean all of the components. Use the proper tools in order to measure components when inspecting for excessive wear. Repair or replace the components that are not within the manufacturers specification. When components are reinstalled into an engine, return the components to their original location, position, and direction. During assembly, lubricate all of the moving parts with clean engine oil or engine assembly lubricant unless otherwise specified. This will provide initial lubrication when the engine is first started.

CAMSHAFT BEARING INSTALLATION

Tools Required

J 33049 Camshaft Bearing Service Set

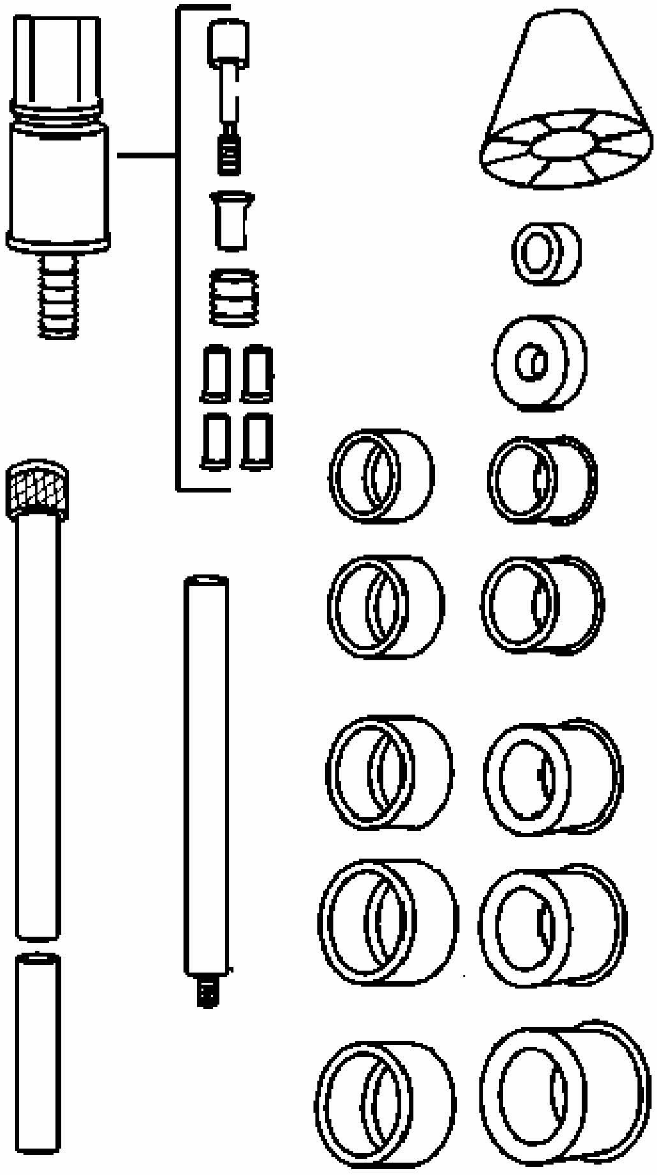


Fig. 429: Camshaft Bearing Service Set
Courtesy of GENERAL MOTORS CORP.

1. Assemble the **J 33049** according to the manufacturer's instructions.

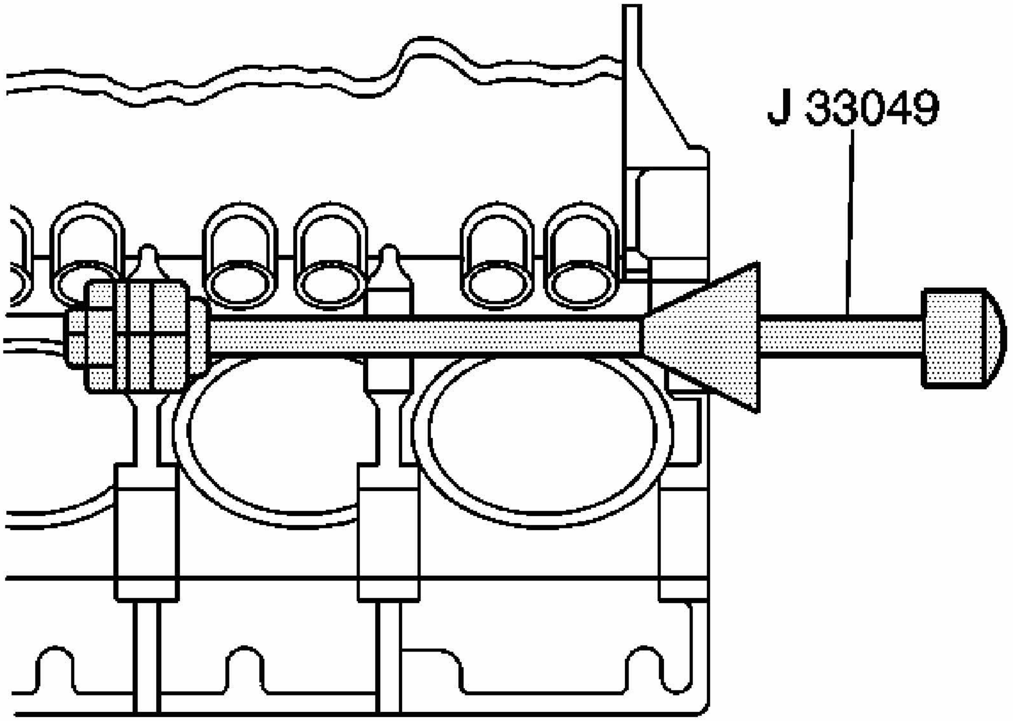


Fig. 430: Removing/Installation Camshaft Inner Bearing Using J 33049
Courtesy of GENERAL MOTORS CORP.

NOTE: Severe engine damage may result if the oil holes are not correctly aligned.

2. Install the camshaft bearings in the following order:
    1. Index the camshaft bearing oil holes with the engine block oil passages.
    2. Place the bearing on the **J 33049** .
    3. Install the third camshaft bearing.
    4. Install the second camshaft bearing.
    5. Install the outer camshaft bearings.

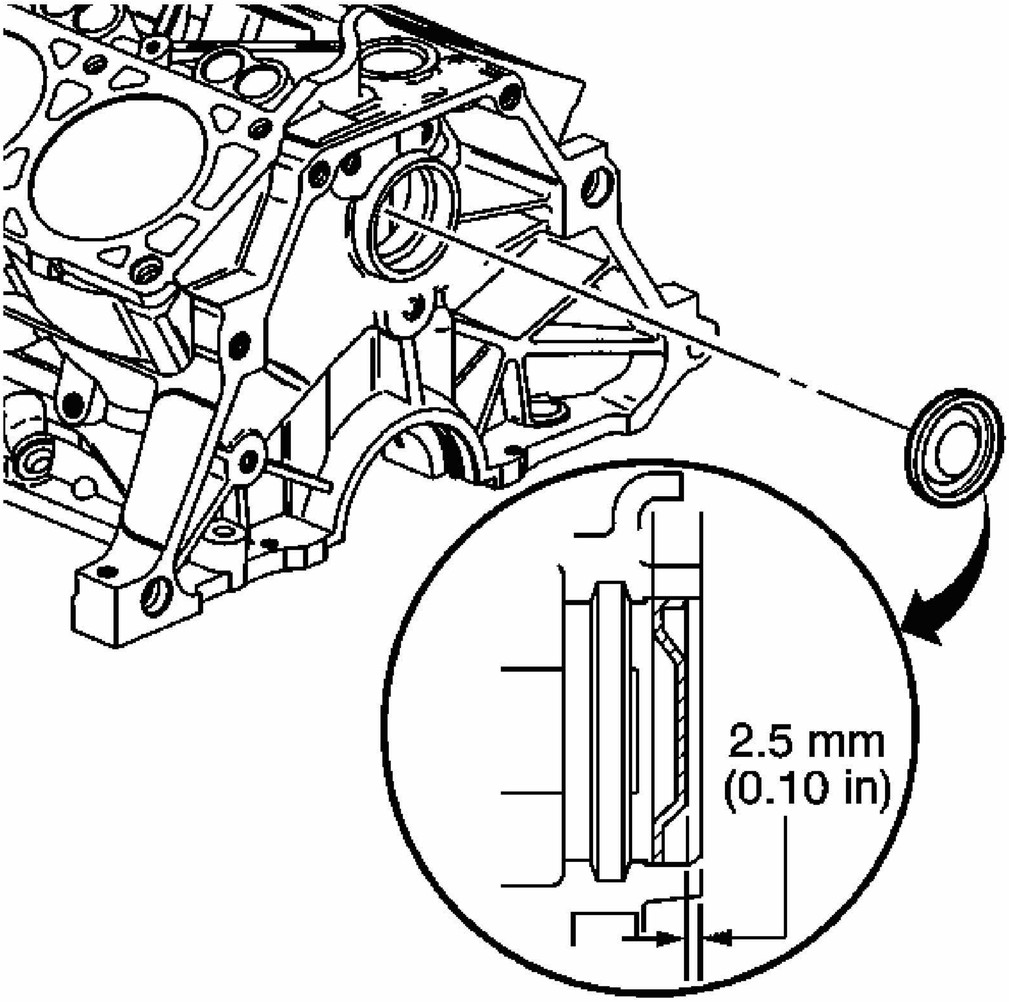


Fig. 431: Identifying Camshaft Rear Bearing Hole Plug Installation Depth
Courtesy of GENERAL MOTORS CORP.

3. Apply sealer GM P/N 12377901 (Canadian P/N 10953504) or the equivalent to the camshaft rear bearing hole plug.
4. Install the camshaft rear bearing hole plug.

PISTON OIL NOZZLE INSTALLATION

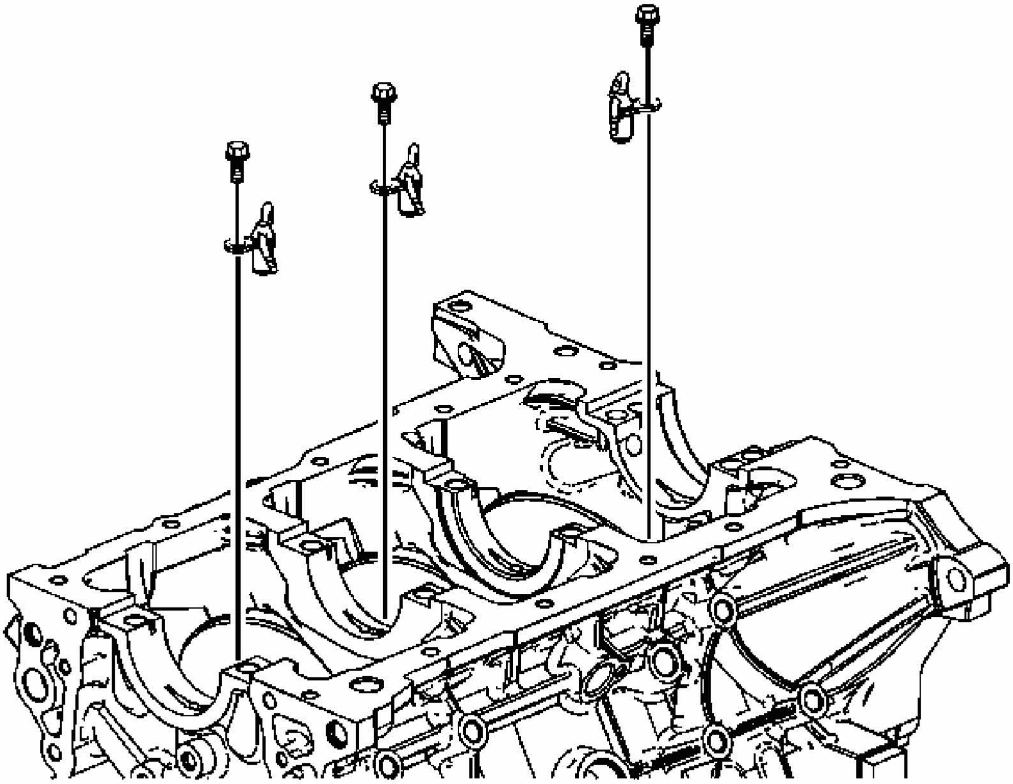


Fig. 432: Identifying Piston Oil Nozzles & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Position the piston oil nozzles in the engine block.

NOTE: **Refer to Fastener Notice .**

2. Install the bolts retaining the piston oil nozzles to the engine block.

   Tighten: Tighten the bolt to 10 N.m (89 lb in).

CRANKSHAFT AND BEARINGS INSTALLATION

Tools Required

J 45059 Angle Meter

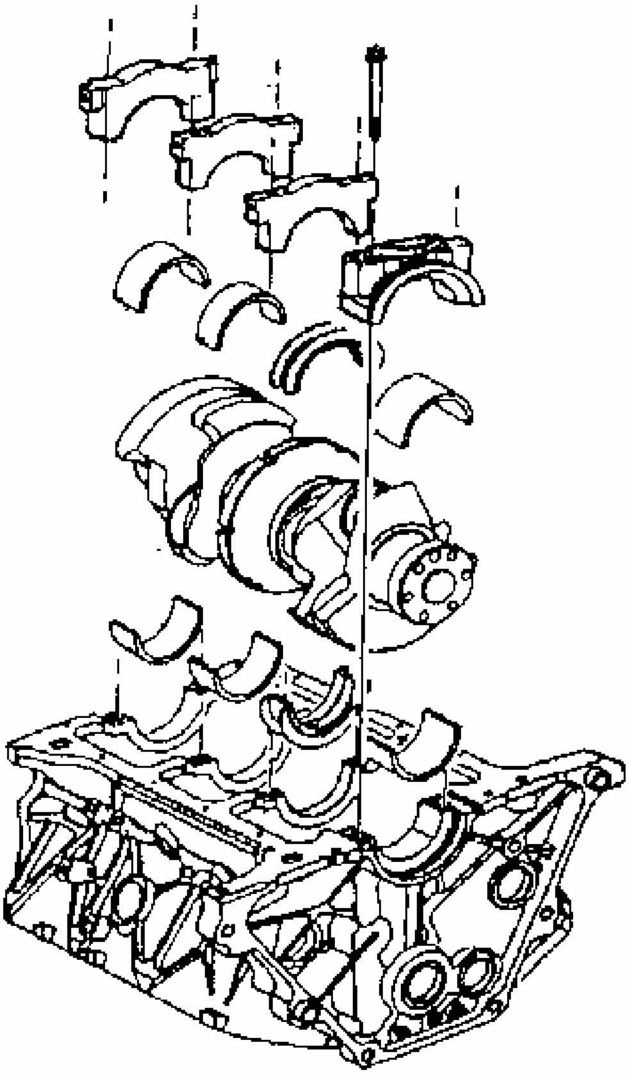


Fig. 433: View Of Crankshaft, Main Bearings And Bearing Caps
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the crankshaft bearing cap bolt holes and the crankshaft bearing cap mating surfaces are clean and dry.

1. Dip the crankshaft bearing cap bolts in clean engine oil.

NOTE: Upper and lower inserts may be different. Do not obstruct any oil passages.

2. Place the crankshaft bearing inserts into the crankshaft bearing cap and into the engine block.

   IMPORTANT: The crankshaft bearing inserts will project slightly when put into place. Ensure that the bearing inserts project an equal distance on both sides. Ensure that the insert tangs are engaged.

3. Lubricate the crankshaft main bearing surface with clean engine oil.
4. Install the crankshaft.

   NOTE: In order to prevent the possibility of cylinder block or crankshaft bearing cap damage, the crankshaft bearing caps are tapped into the cylinder block cavity using a brass, lead, or a leather mallet before the attaching bolts are installed. Do not use attaching bolts to pull the crankshaft bearing caps into the seats. Failure to use this process may damage a cylinder block or a bearing cap.

5. Install the crankshaft main bearing caps. Apply a small amount of sealer GM P/N 1052942 (Canadian P/N 10953466) to the rear of the #4 crankshaft main bearing cap sealing surface.

   NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

6. Install the crankshaft main bearing cap bolts.

   Tighten: Use the **J 45059** in order to tighten the crankshaft main bearing cap bolts to 50 N.m (37 lb ft) plus 77 degrees.

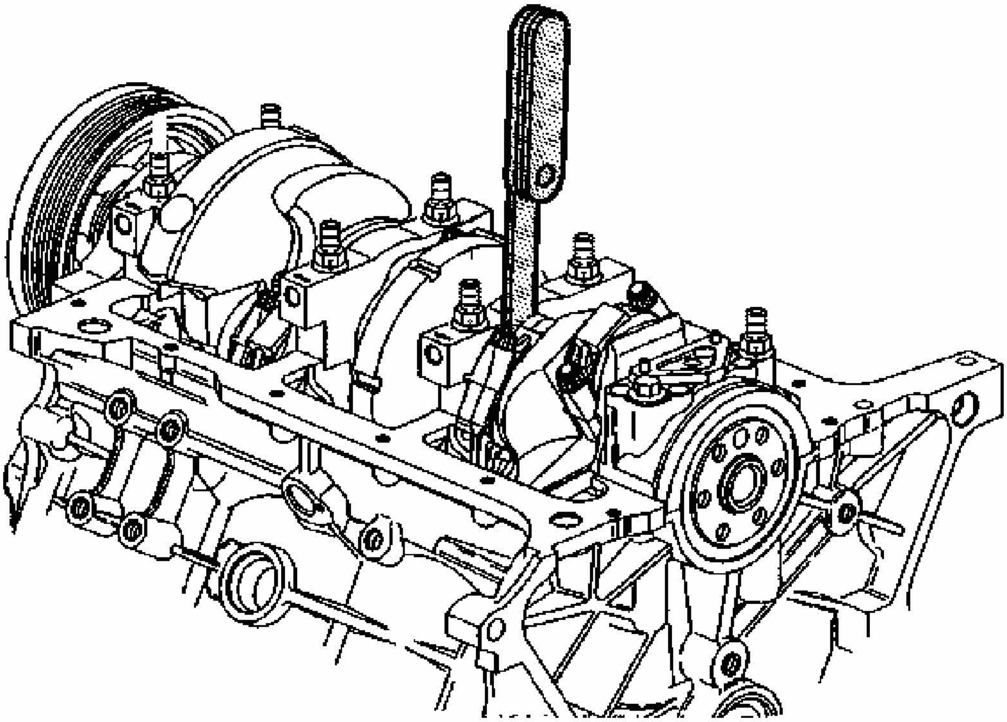


Fig. 434: Measuring Crankshaft End Play
Courtesy of GENERAL MOTORS CORP.

7. Measure the crankshaft end play.
    1. Thrust the crankshaft forward or rearward.
    2. Insert a feeler gage between the number 3 crankshaft bearing and the bearing surface of the crankshaft and measure the bearing clearance. The proper crankshaft end play clearance is 0.06-0.21 mm (0.002-0.008 in).
    3. If the bearing clearance is not within specifications, inspect the thrust surfaces for nicks, gouges or raised metal. Minor imperfections may be removed with a fine stone.

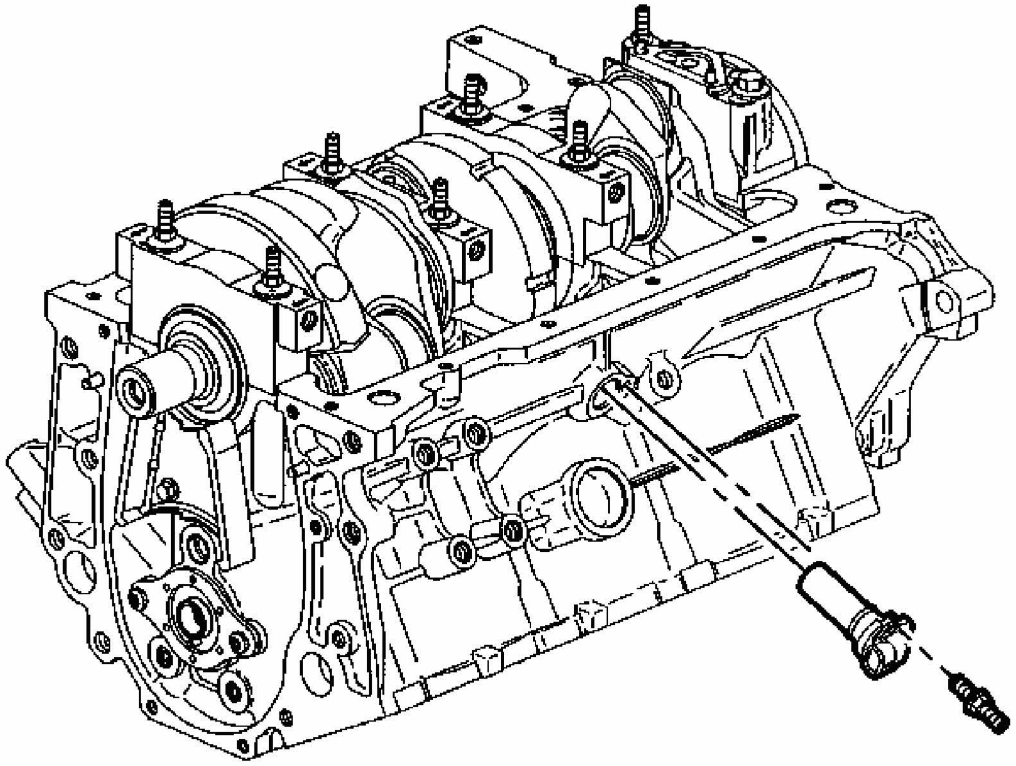


Fig. 435: View Of Crankshaft Position Sensor & Stud
Courtesy of GENERAL MOTORS CORP.

8. Install the crankshaft position sensor into the side of the engine block.
9. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or the equivalent to the crankshaft position sensor stud threads.
10. Install the crankshaft position sensor stud.

    Tighten: Tighten the crankshaft position sensor stud to 11 N.m (98 lb in).

11. Install the crankshaft position sensor shield and nut.

    Tighten: Tighten the crankshaft position sensor shield nut to 11 N.m (98 lb in).

ENGINE BLOCK HEATER INSTALLATION

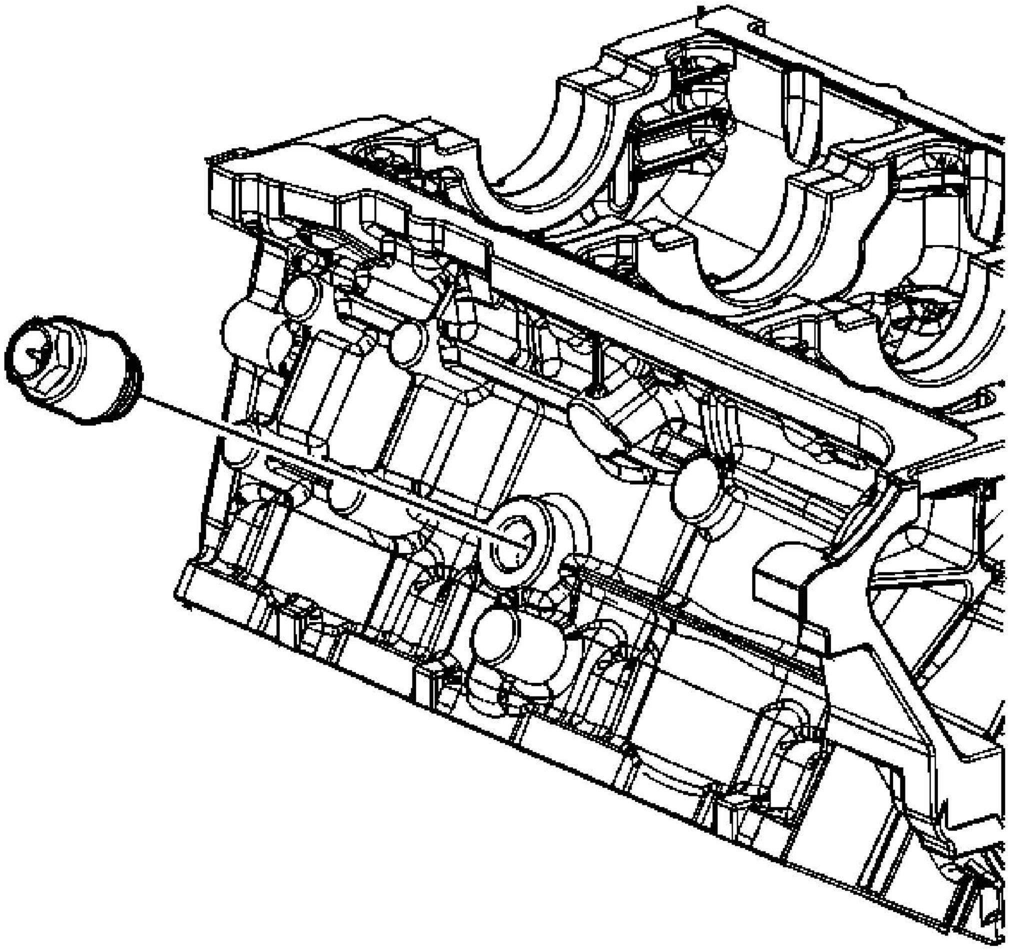


Fig. 436: View Of Engine Block Heater
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer GM P/N 12346004 (Canadian P/N 1095380), or equivalent to the engine block heater.

NOTE:	**Refer to Fastener Notice .**

2. Install the engine block heater into the engine block.

Tighten: Tighten engine block heater to 50 N.m (37 lb ft).

CRANKSHAFT REAR OIL SEAL INSTALLATION

Tools Required

J 34686 Rear Main Seal Installer

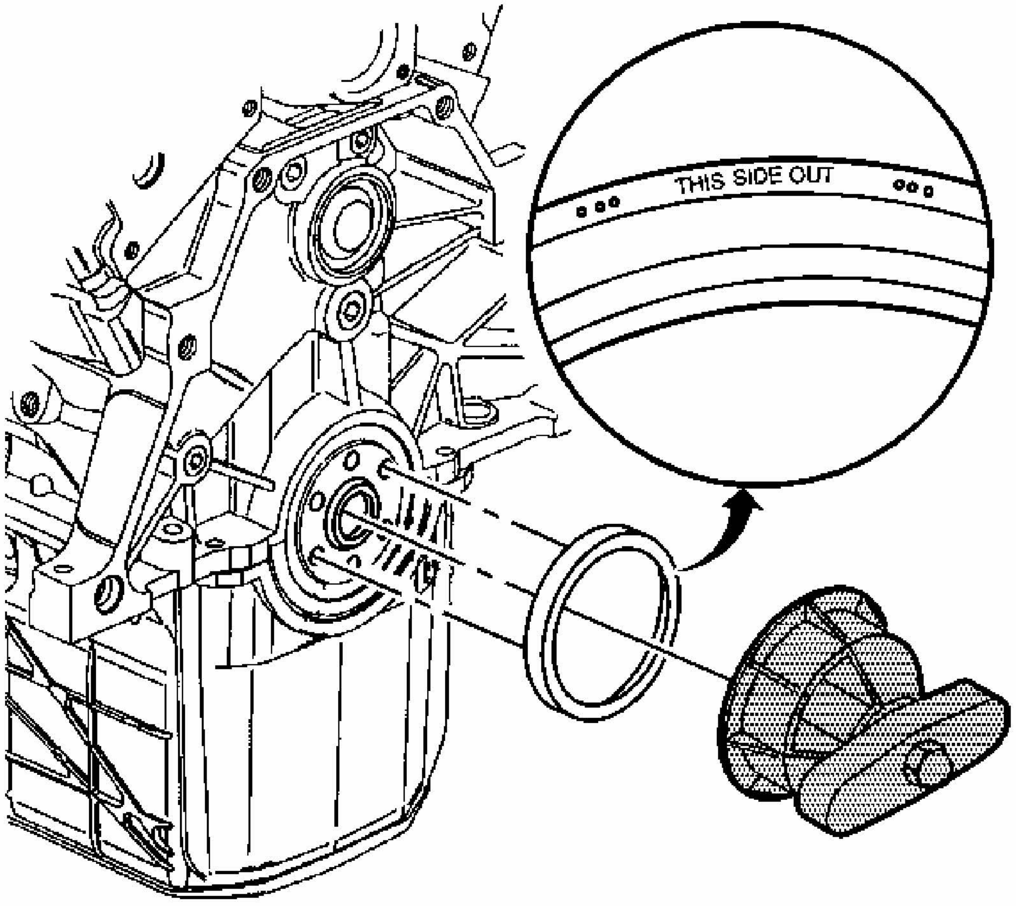


Fig. 437: Installing Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

NOTE: **Do not apply or use any oil lubrication on the crankshaft rear oil seal, or the seal installer. Do not touch the sealing lip of the oil seal once the protective sleeve is removed. Doing so will damage/deform the seal.**

NOTE: **Clean the crankshaft sealing surface with a clean, lint free towel. Inspect lead-in edge of crankshaft for burrs/sharp edges that could damage the rear main oil seal. Remove burrs/sharp edges with crocus cloth before proceeding.**

IMPORTANT: Notice the direction of the rear oil seal. The new design seal is a reverse style as opposed to what has been used in the past. "THIS SIDE OUT" has been stamped into the seal as shown in the graphic.

1. Carefully remove the protection sleeve from the new crankshaft rear oil seal.

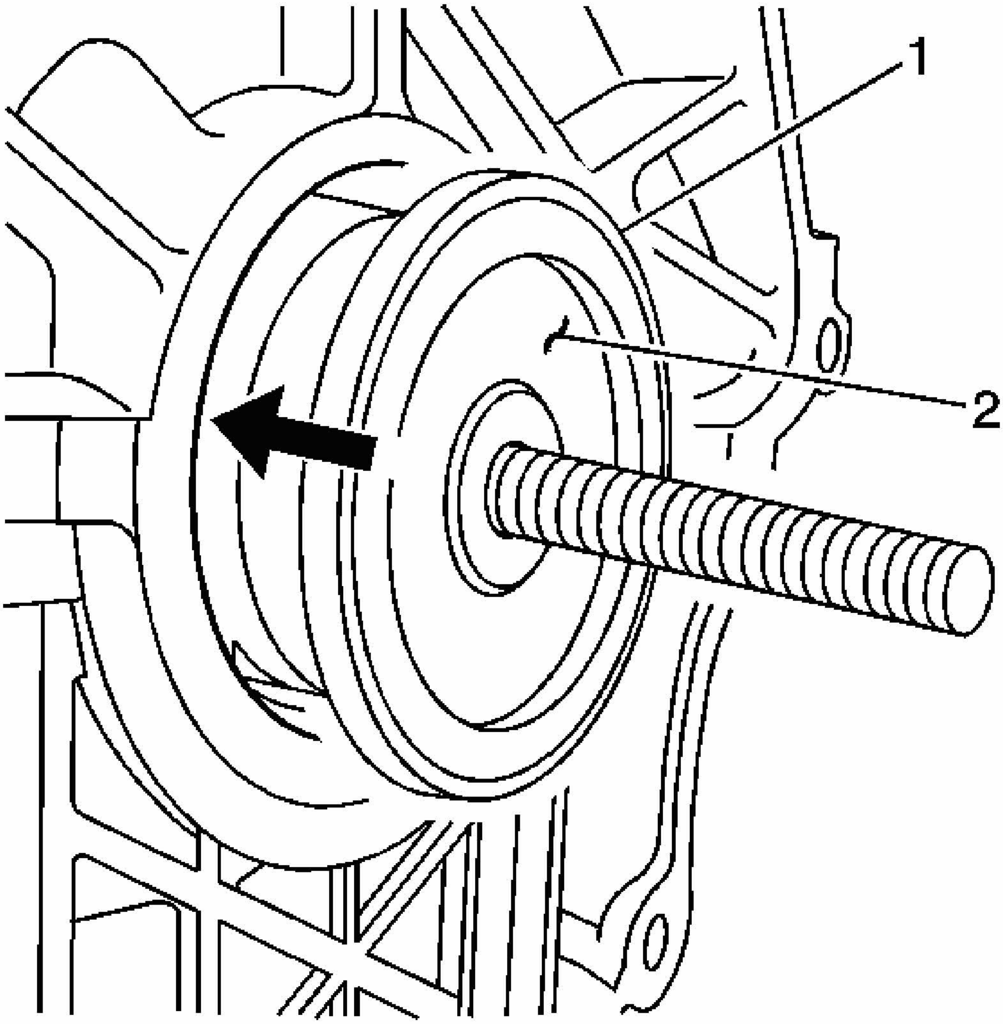


Fig. 438: View Of Rear Main Seal Mandrel
Courtesy of GENERAL MOTORS CORP.

2. Install the crankshaft rear oil seal (1) onto the **J 34686** by sliding the crankshaft rear oil seal over the mandrel using a twisting motion until the back of the crankshaft rear oil seal bottoms squarely against the collar of the tool.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

3. Perform the following steps in order to install the crankshaft rear oil seal:
    1. Align the dowel pin of the **J 34686** with the dowel pin in the crankshaft.
    2. Attach the **J 34686** to the crankshaft by hand, or tighten attaching screws to 5 N.m (45 lb in).
    3. Turn the T-handle of the **J 34686** in order to engage allow the collar to push the seal into the bore.

        Turn the handle until the collar is tight against the engine block. Ensure that the seal is seated properly.

    4. Loosen the T-handle until the T-handle comes to a stop.

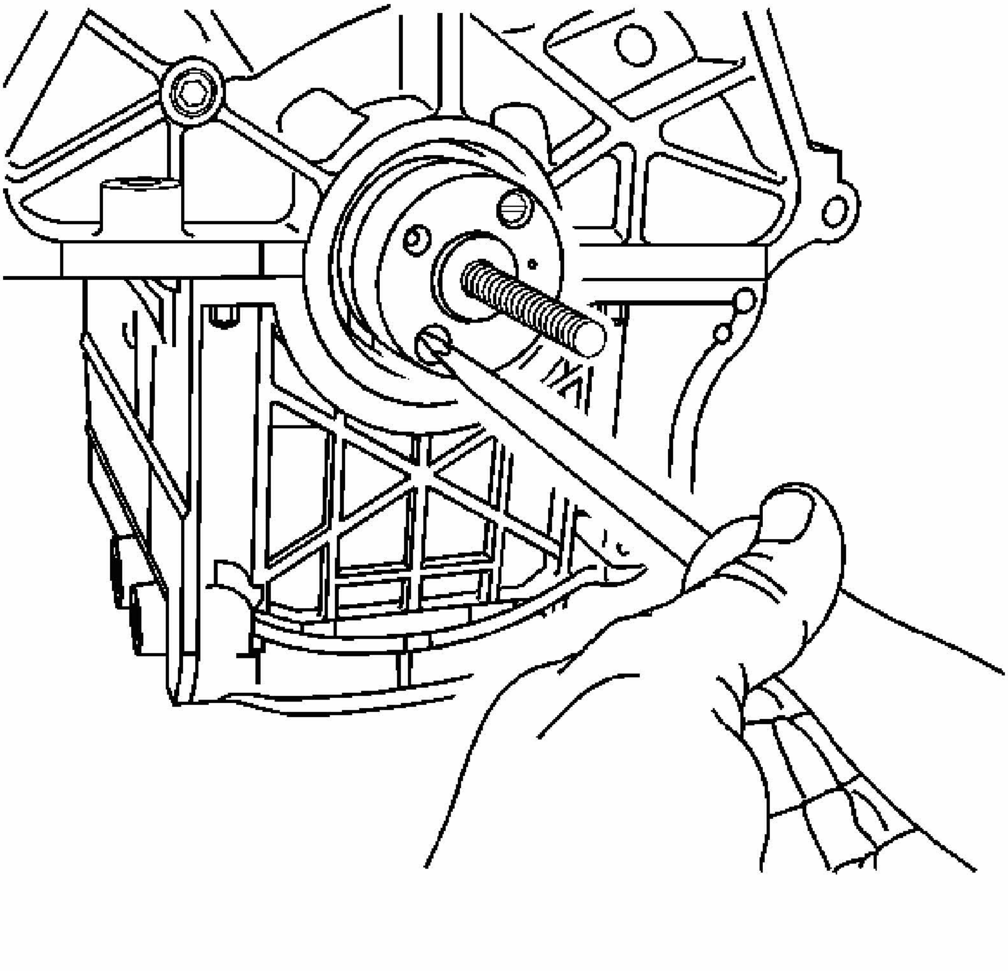


Fig. 439: Mandrel Screws

Courtesy of GENERAL MOTORS CORP.

5. Remove the attaching screws.

PISTON, CONNECTING ROD, AND BEARING INSTALLATION

Tools Required

- **J 6125-1B** Slide Hammer with Adapter
- **J 8037** Ring Compressor
- **J 41348** Bearing Cap Puller
- **J 41556** Connecting Rod Guide
- **J 43654** Piston Pin Clip Remover and Installer
- **J 43690** Rod Bearing Clearance Checking Tool
- **J 43690-100** Rod Bearing Clearance Checking Tool-Adapter Kit
- **J 45059** Angle Meter

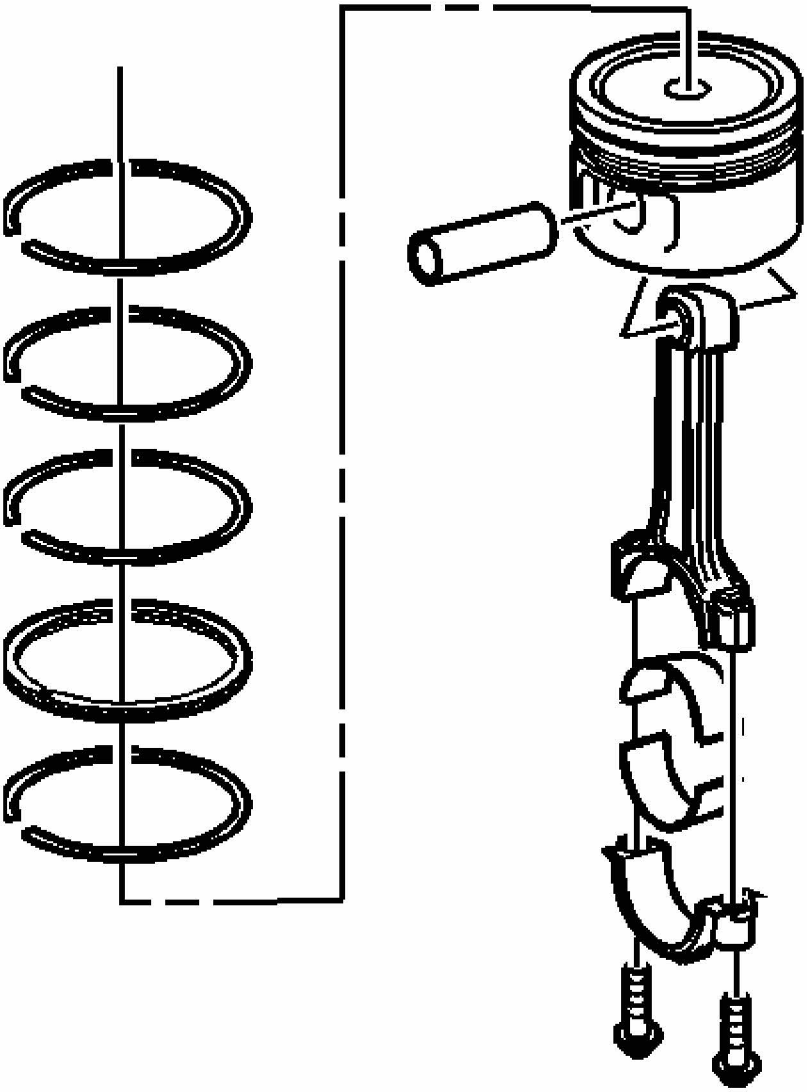


Fig. 440: Lubricating Piston Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The piston and cylinder bore have been measured and the bore has been sized for the proper clearance. Install the piston and connecting rod assembly into the proper cylinder bore. The piston alignment mark MUST face the front of the engine block.

1. Lightly lubricate the following components with clean engine oil:
   - The piston

- The piston pin
- The piston rings
- The cylinder bore
- The bearing surfaces

2. Stagger the oil control ring end gaps a minimum of 90 degrees.
3. Stagger the compression ring end gaps a minimum of 25 mm (1.0 in).
4. Install the **J 8037** onto the piston and compress the piston rings.

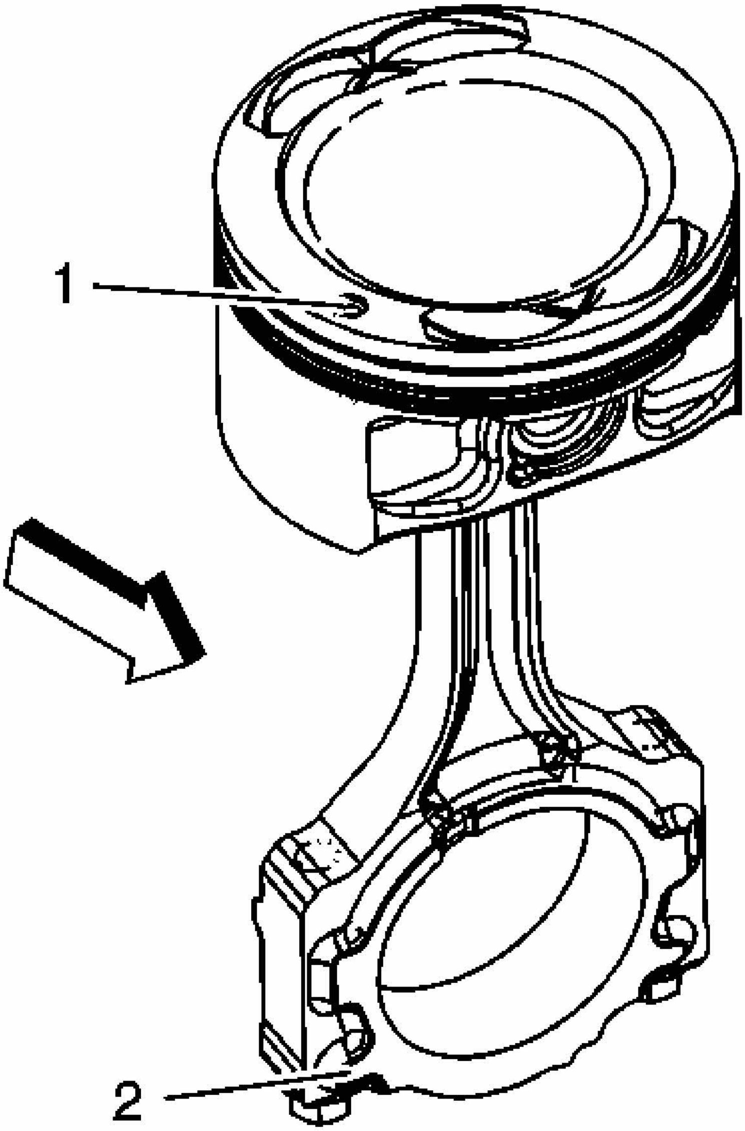


Fig. 441: Identifying Correct Piston Installation
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When assembling the connecting rod to the piston, make sure the connecting rod reference mark (2) is facing towards front of engine, and is in proper correlation with the front of engine piston reference mark (1).

5. Align the piston pin bore with the connecting rod pin bore.

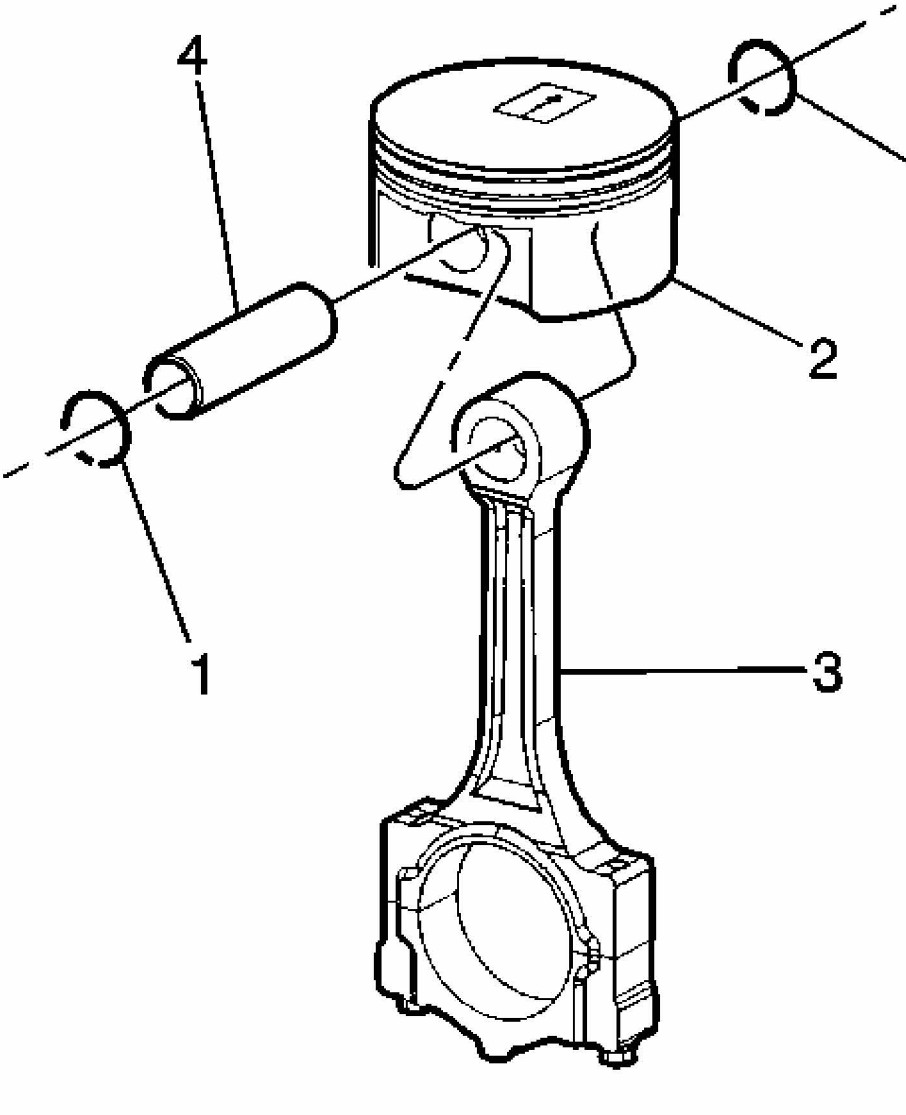


Fig. 442: Exploded View Of Piston & Connecting Rod Assembly

Courtesy of GENERAL MOTORS CORP.

6. Slide the piston pin (4) into the piston and the connecting rod (3).

IMPORTANT: NEW piston pin retainers must be used. Never reuse the piston pin retainers.

7. Install NEW piston pin retainers (1) using the **J 43654** .
8. Ensure that the piston pin retainers are fully seated in their grooves.
9. Repeat these procedures for the remaining pistons.
10. Install the **J 41556** into the connecting rod.

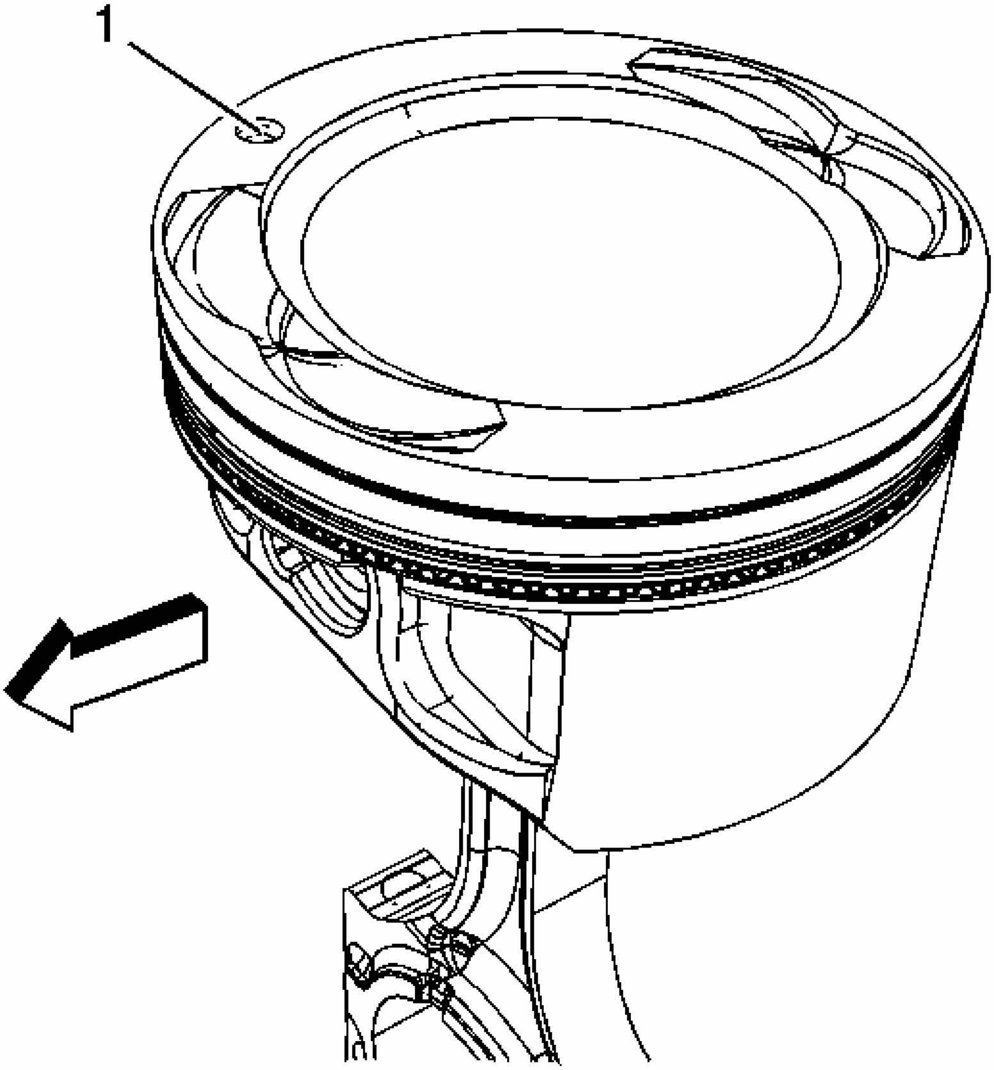


Fig. 443: Ensure That The Alignment Marks (1) Face The Front Of The Engine
Courtesy of GENERAL MOTORS CORP.

NOTE: Pistons are specific to right hand and left hand applications. Prior to installation, ensure that the alignment marks (1) face the front of the engine. Failure to do so may lead to engine damage.

11. If installing a LH piston, reference the alignment marks.

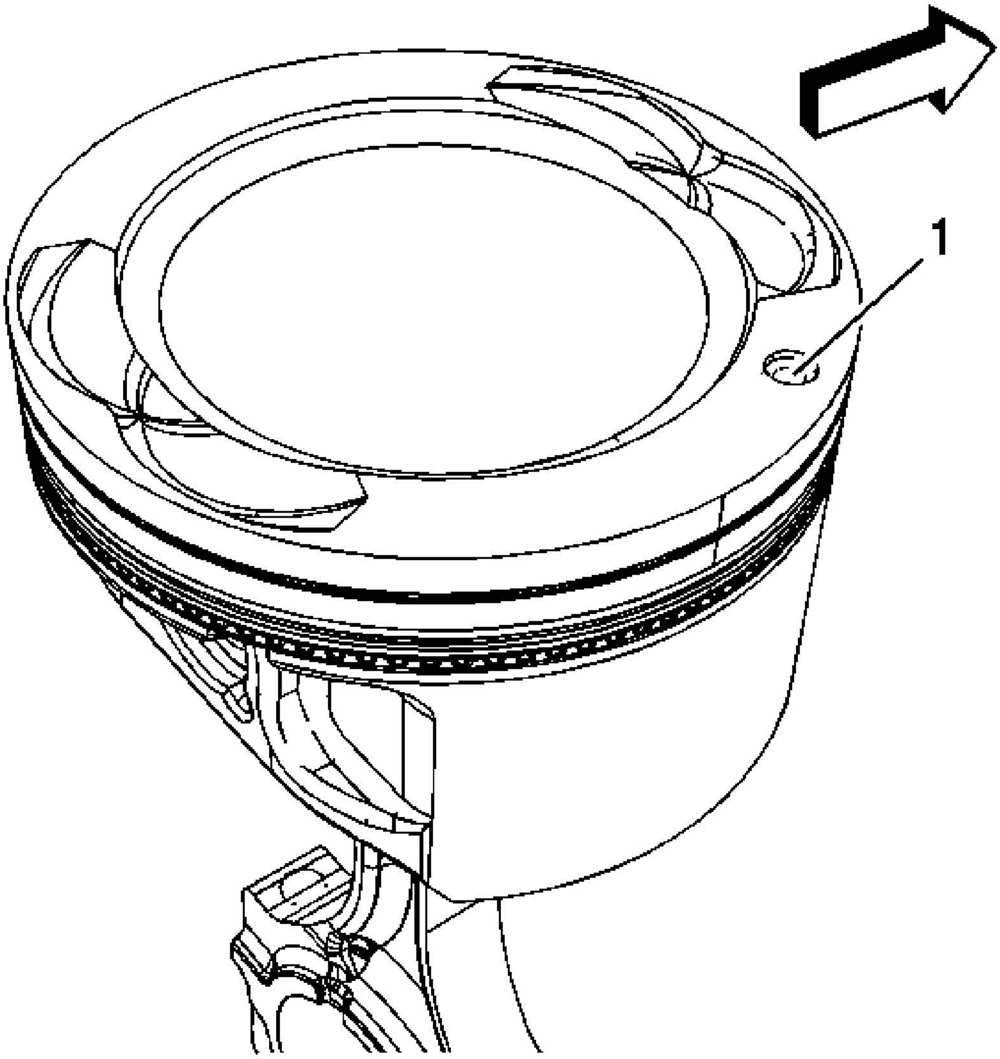


Fig. 444: Ensure That The Alignment Marks (1) Face The Front Of The Engine
Courtesy of GENERAL MOTORS CORP.

NOTE: Pistons are specific to right hand and left hand applications. Prior to installation, ensure that the alignment marks (1) face the front of the engine. Failure to do so may lead to engine damage.

12. If installing a RH piston, reference the alignment marks.

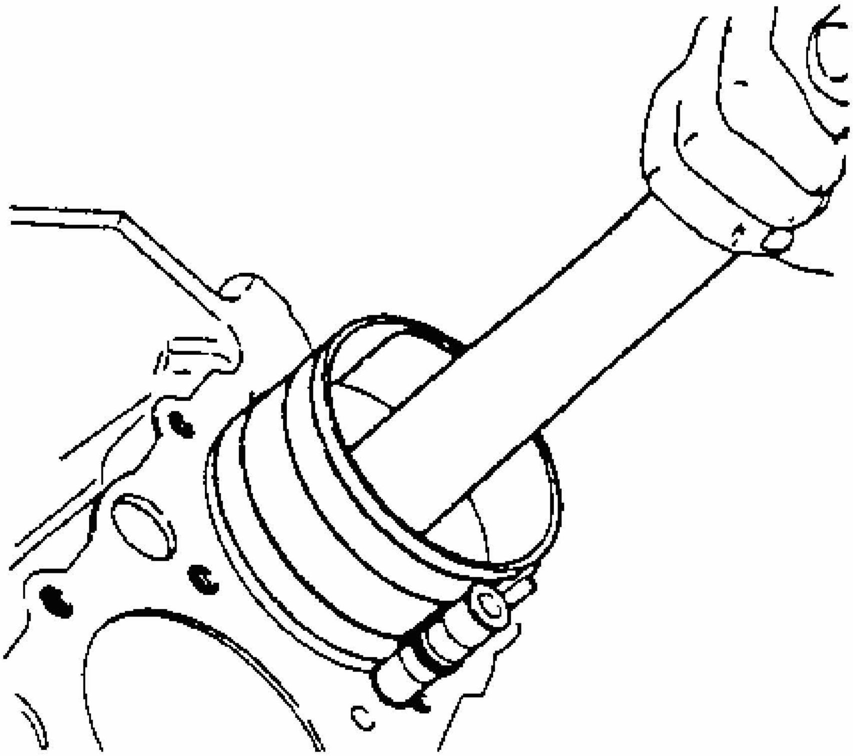


Fig. 445: View Of Installation Of Piston & Connecting Rod Assembly
Courtesy of GENERAL MOTORS CORP.

13. Install the piston and connecting rod assembly into the proper cylinder bore.
14. Hold the piston ring compressor firmly against the engine block. Using a wooden hammer handle, lightly tap the top of the piston until all of the piston rings enter the cylinder bore.

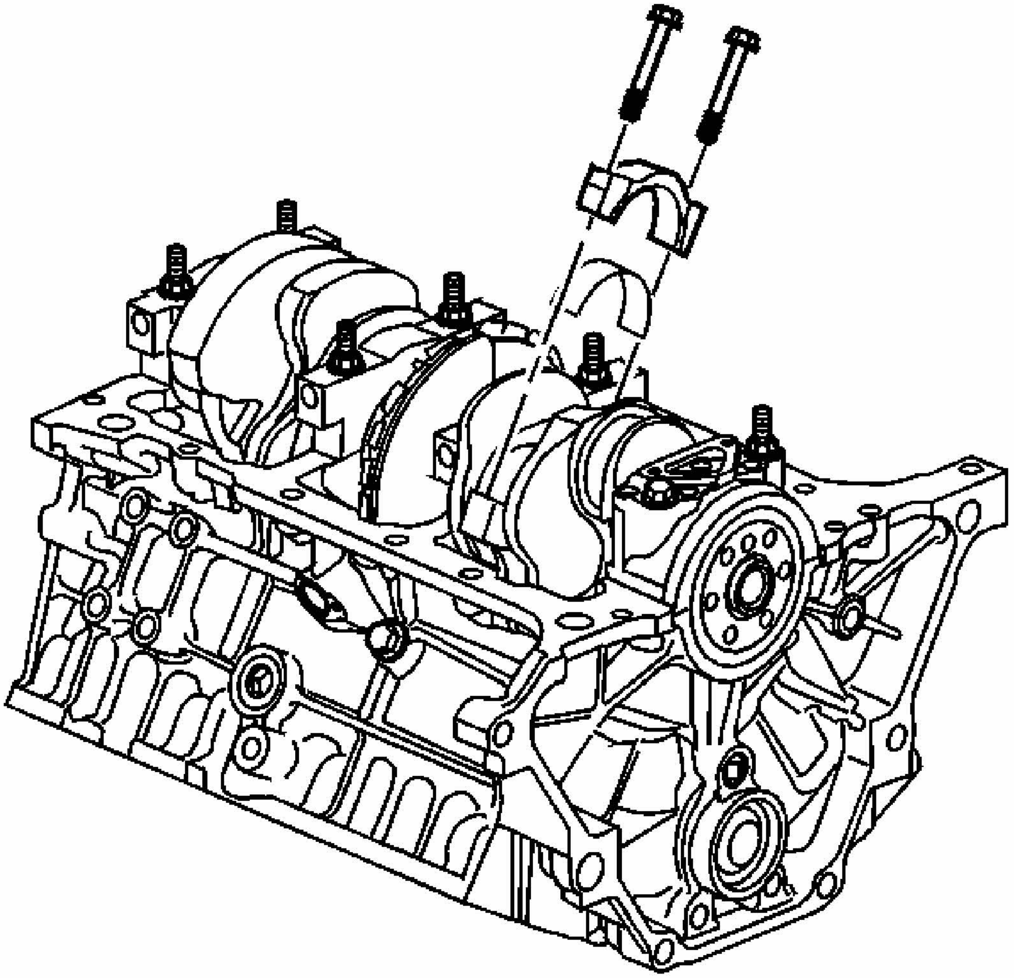


Fig. 446: View Of Bearing, Bearing Cap & Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **When installing the pistons into the cylinder bore, make sure not to contact the piston oil nozzle with the connecting rod. Failure to do so may damage the piston oil nozzle, resulting in potential engine damage.**

15. Using **J 41556** , guide the connecting rod end onto the crankshaft journal.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

16. Install the bearing, bearing cap and bolts.

Tighten:

1. Tighten the connecting rod bearing cap bolts a first pass to 25 N.m (18 lb ft).
2. Tighten the connecting rod bearing cap bolts a final pass to 110 degrees using the **J 45059** .

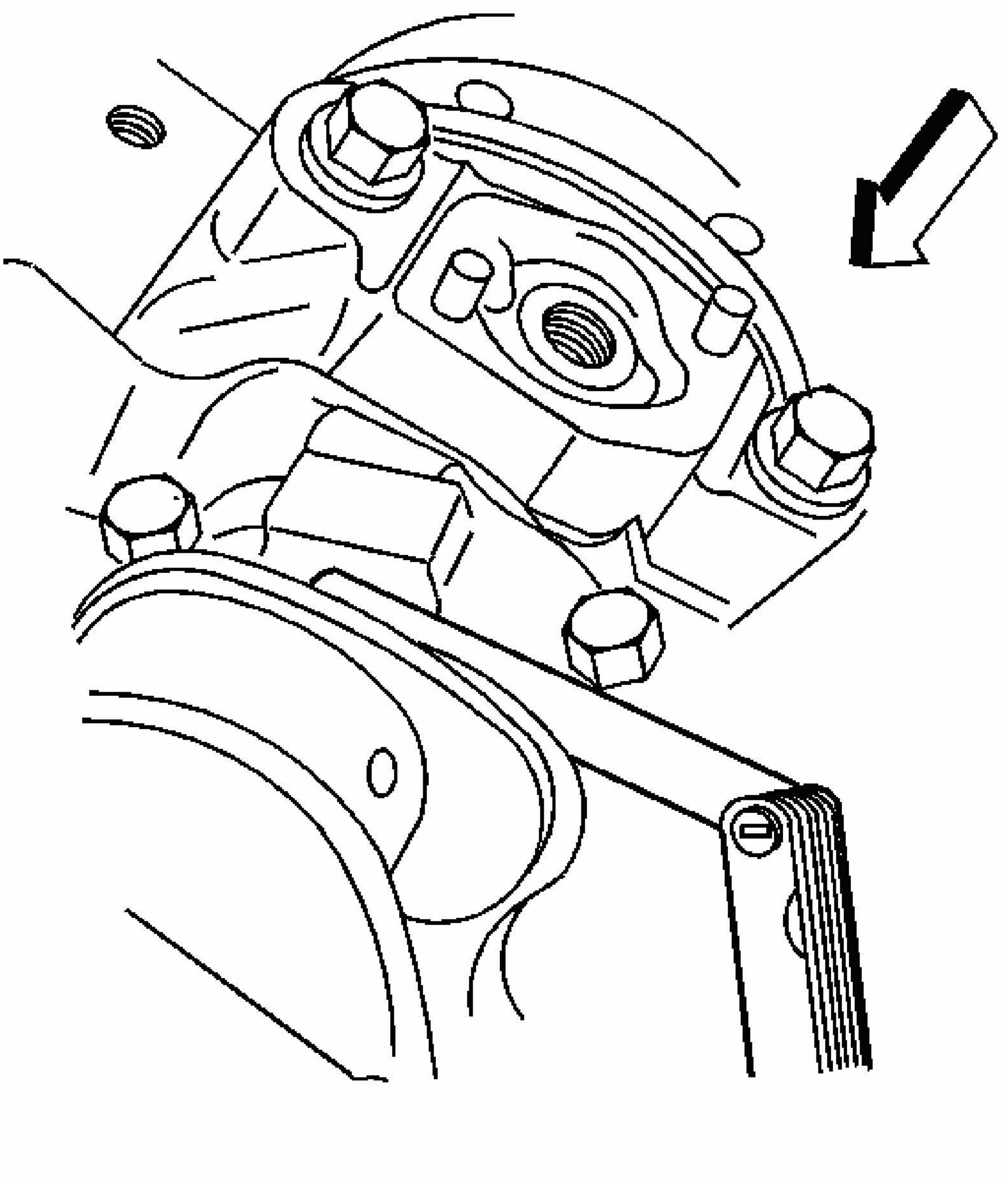


Fig. 447: Measuring Connecting Rod Side Clearance
Courtesy of GENERAL MOTORS CORP.

17. With the pistons and connecting rods installed, use a soft faced mallet and lightly tap each connecting rod assembly parallel to the crankpin to make sure that the rods have side clearance.

18. Measure the connecting rod side clearance using a feeler gage or dial indicator. Connecting rod side clearance should be within 0.18-0.44 mm (0.007-0.017 in).

Measuring Connecting Rod Bearing Clearance Using J 43690 and J 43690-100

J 43690 and **J 43690-100** have been developed as a more accurate method to measure connecting rod bearing clearances. The instructions below provide an overview of tool set and usage. For more detailed information, refer to the tool instruction sheets as supplied by the tool manufacturer.

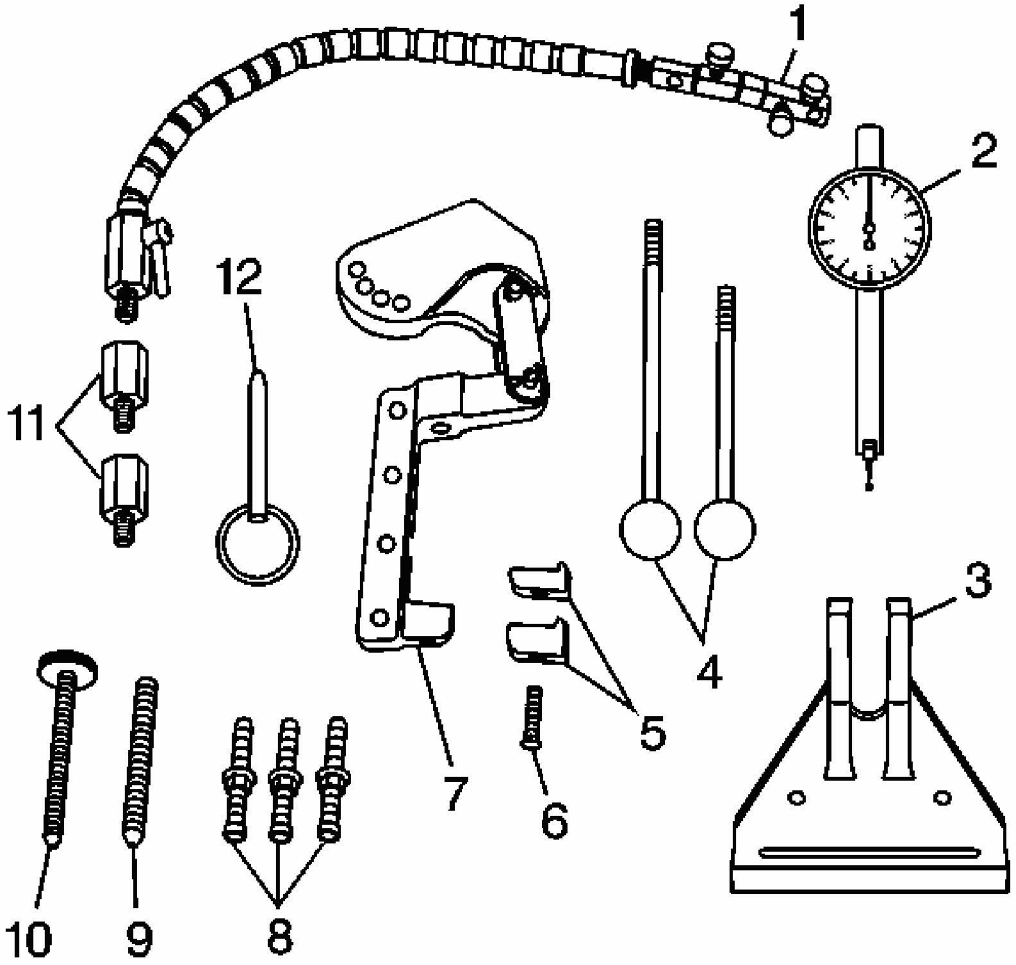


Fig. 448: Identifying Rod Bearing Clearance Checking Tool
Courtesy of GENERAL MOTORS CORP.

1. **J 43690** Rod Bearing Checking Tool includes:
   - J 43690-20 Swivel Base (1)

- J 43690-19 Dial Indicator (2)
- J 43690-2 Base (3)
- J 43690-5,-6 Handle (4)
- J 43690-10,-11 Foot (5)
- 280307 Screw (6)
- J 43690-1 Pivot Arm Assembly (7)
- J 43690-3,-7,-8 Screws (8)
- 280319 Screw (9)
- 280311 Screw (10)
- J 43690-17,-18 Adapter (11)
- 280310 Pin (12)

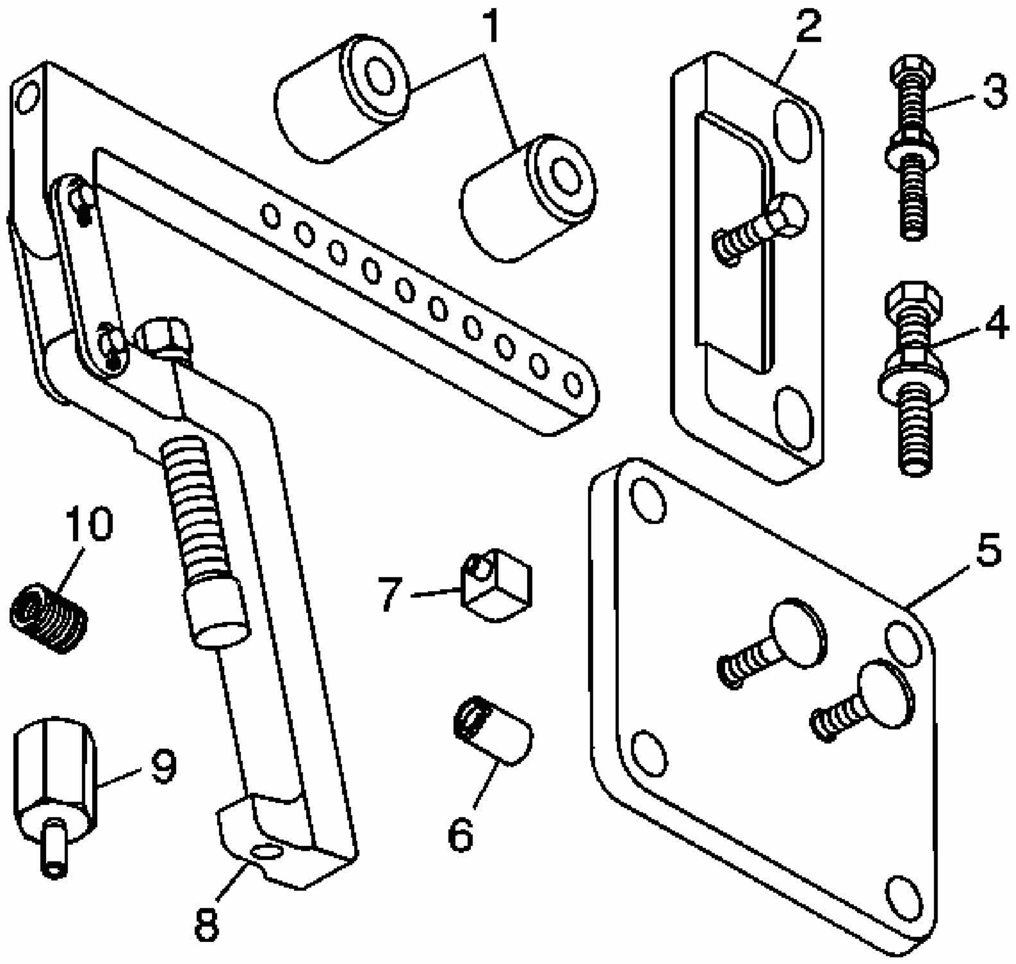


Fig. 449: Identifying Rod Bearing Clearance Tool - Adapter Kit
Courtesy of GENERAL MOTORS CORP.

2. **J 43690-100** Rod Bearing Checking Tool - Adapter Kit includes:
    - J 43690-104 Spacer (1)
    - J 43690-105 Retainer Plate (2)
    - 505478 Bolt (3)
    - 511341 Bolt (4)
    - J 43690-106 Retainer Plate (5)
    - J 43690-107 Cap (6)
    - J 43690-102 Foot (7)
    - J 43690-101 Pivot Arm Assembly (8)
    - J 43690-103 Adapter (9)
    - 505439 Adapter (10)

IMPORTANT: The crankshaft must be secure with no movement or rotation in order to obtain an accurate reading.

3. Rotate the crankshaft until the journal/connecting rod to be measured is in the 12 o'clock position.
4. Remove the crankshaft main bearing cap bolts.
5. Remove the crankshaft main lower bearing cap.
6. Insert a piece of paper stock onto the crankshaft journal.

NOTE: In order to prevent the possibility of cylinder block or crankshaft bearing cap damage, the crankshaft bearing caps are tapped into the cylinder block cavity using a brass, lead, or a leather mallet before the attaching bolts are installed. Do not use attaching bolts to pull the crankshaft bearing caps into the seats. Failure to use this process may damage a cylinder block or a bearing cap.

NOTE: This bolt is designed to permanently stretch when tightened. The correct part number fastener must be used to replace this type of fastener. Do not use a bolt that is stronger in this application. If the correct bolt is not used, the parts will not be tightened correctly. The system or the components may be damaged.

7. Install the crankshaft main bearing cap and bolts. Start the crankshaft main bearing cap

bolts by hand. Ensure the bottom of the crankshaft main bearing cap is parallel to the bottom of the channel.

Tighten:

1. Tighten the crankshaft main bearing cap bolts in equal increments. Do not completely tighten one bolt at a time to prevent the cap from being cocked.
2. Tighten the bolts to 50 N.m (37 lb ft) to fully seat the crankshaft main bearing caps. Loosen the bolts 360 degrees counterclockwise.
3. Tighten the bolts to 20 N.m (15 lb ft), then 50 N.m (37 lb ft).
4. Use **J 45059** to tighten the bolts to 77 degrees.

8. Install the following:
    - J 43690-101 (8)
    - J 43690-5 (4)
    - J 43690-2 (3)
    - J 43690-7 (8)
    - 280310 (12)
    - J 43690-17 (11)

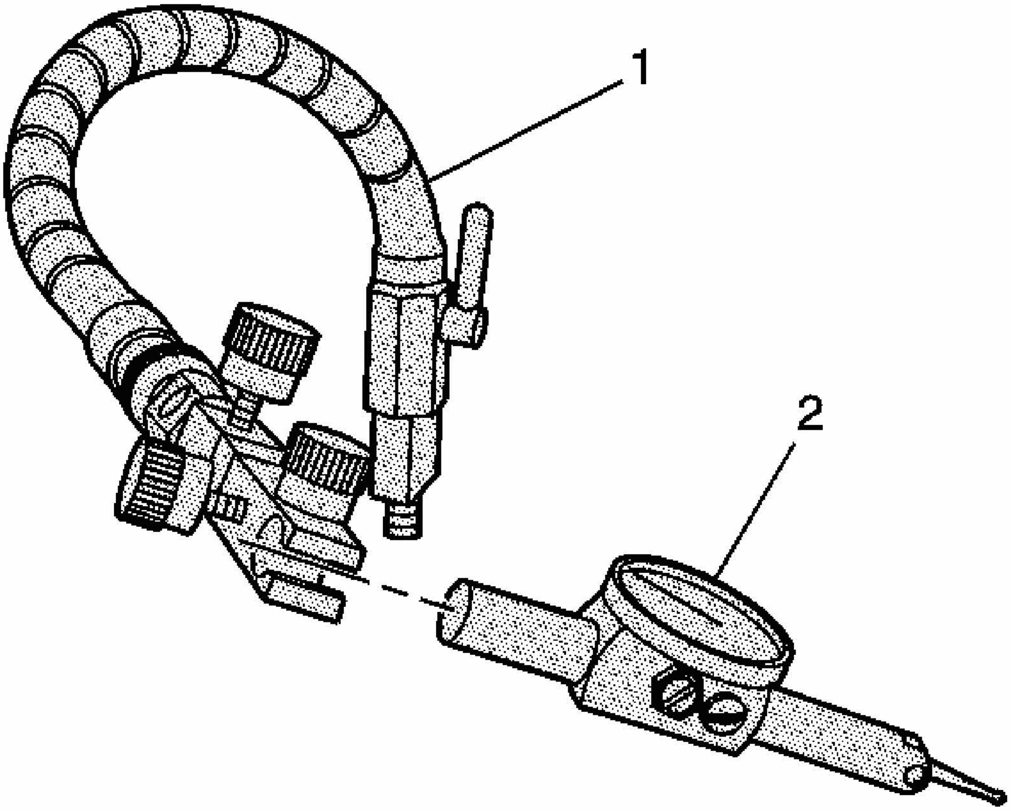


Fig. 450: View Of Swivel Base & Dial Indicator
Courtesy of GENERAL MOTORS CORP.

9. Install the swivel base (1) and dial indicator (2).
10. Adjust per the manufacturers instructions and measure the connecting rod bearing clearance. The connecting rod bearing clearance should be between 0.0127-0.0660 mm (0.0005-0.0026 in).

CAMSHAFT INSTALLATION

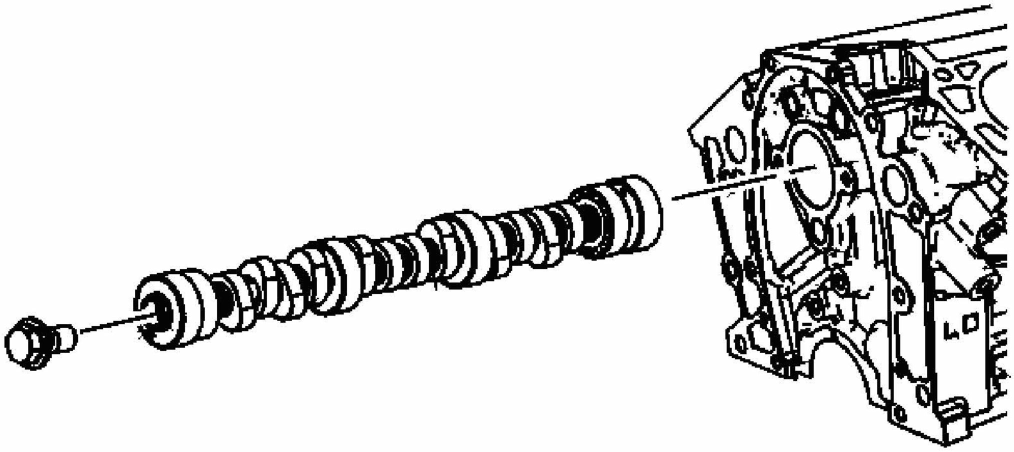


Fig. 451: Inspecting Camshaft Journals
Courtesy of GENERAL MOTORS CORP.

1. Coat the camshaft journals with clean engine oil.
2. Coat the camshaft lobes with prelube GM P/N 12345501 (Canadian P/N 992704) or the equivalent.
3. Install the camshaft using the following procedure:
    1. Install the camshaft sprocket bolt into the camshaft. Tighten finger tight only.
    2. Carefully rotate the camshaft while installing the camshaft into the camshaft bearings.

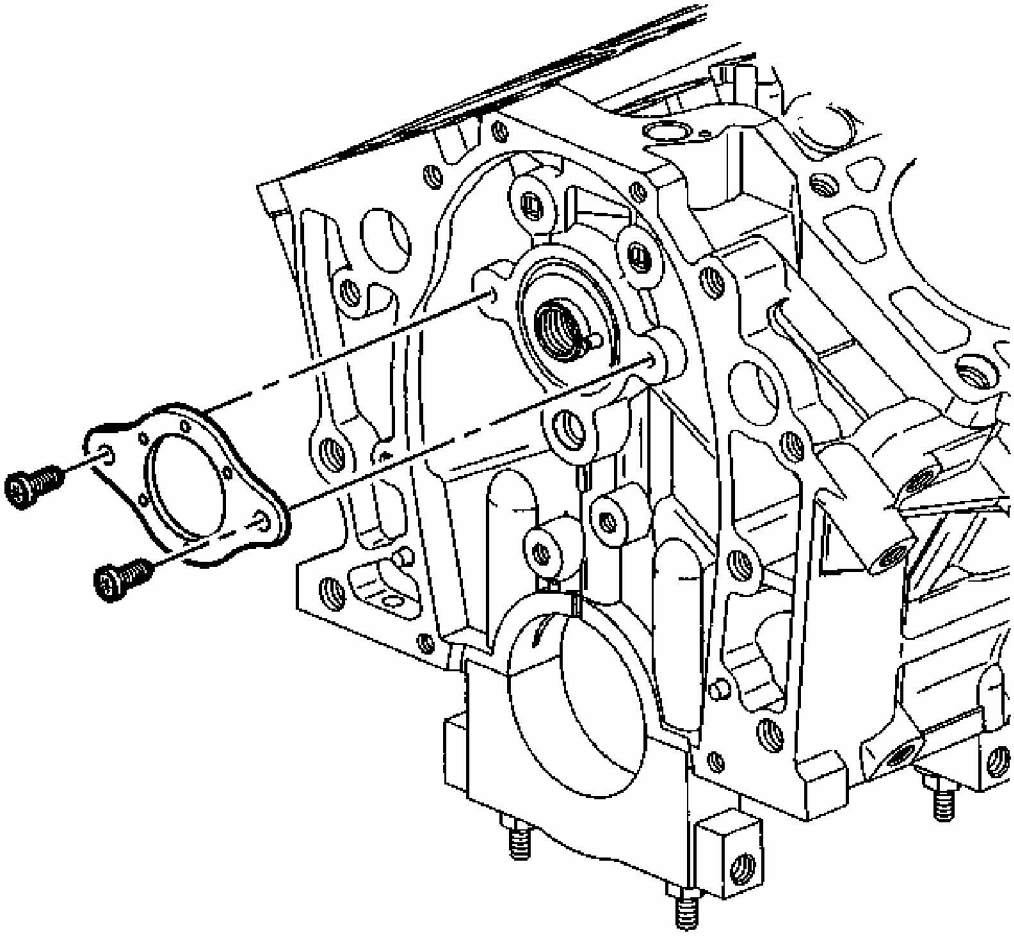


Fig. 452: View Of Camshaft Thrust Plate
Courtesy of GENERAL MOTORS CORP.

4. Install the camshaft thrust plate.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

5. Install the camshaft thrust plate screws.

Tighten: Tighten the camshaft thrust plate screws to 10 N.m (89 lb in).

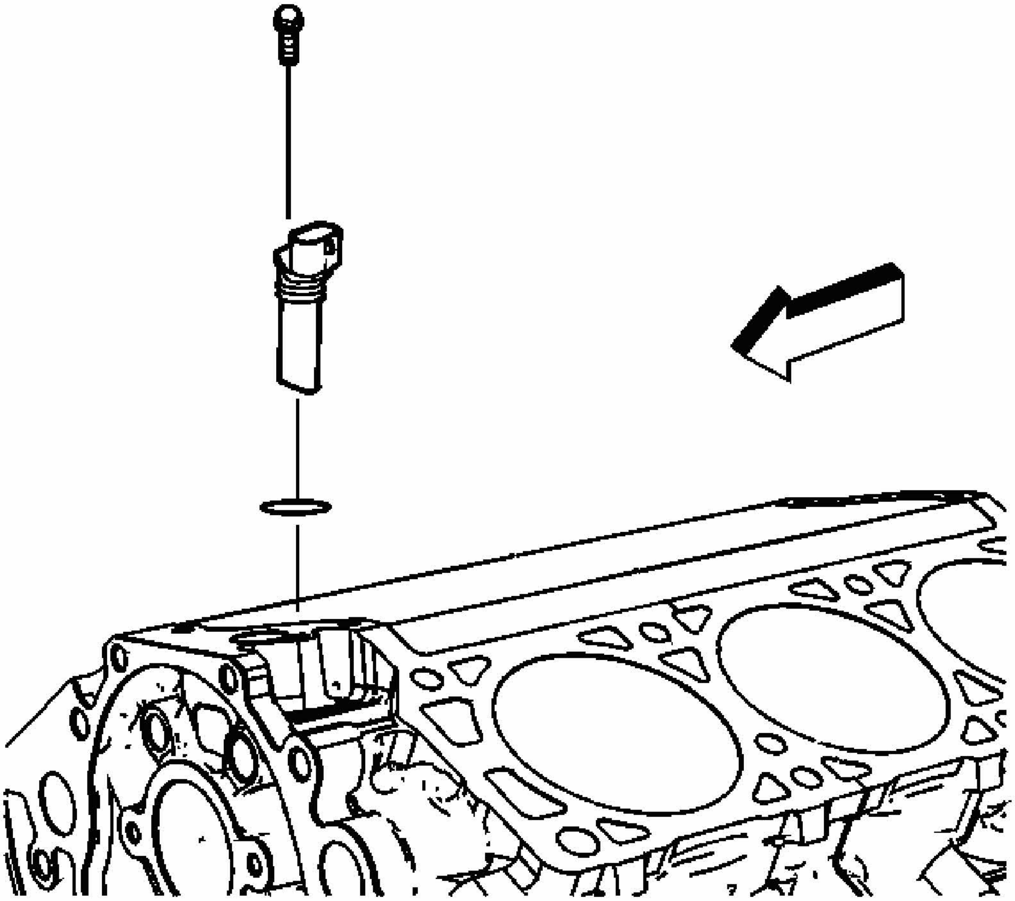


Fig. 453: View Of Camshaft Position Sensor
Courtesy of GENERAL MOTORS CORP.

6. Install the camshaft position sensor.
7. Install the camshaft position sensor bolt.

   Tighten: Tighten the camshaft position sensor bolt to 10 N.m (89 lb in).

TIMING CHAIN AND SPROCKETS INSTALLATION

Tools Required

EN-47719 Tensioner Compressor

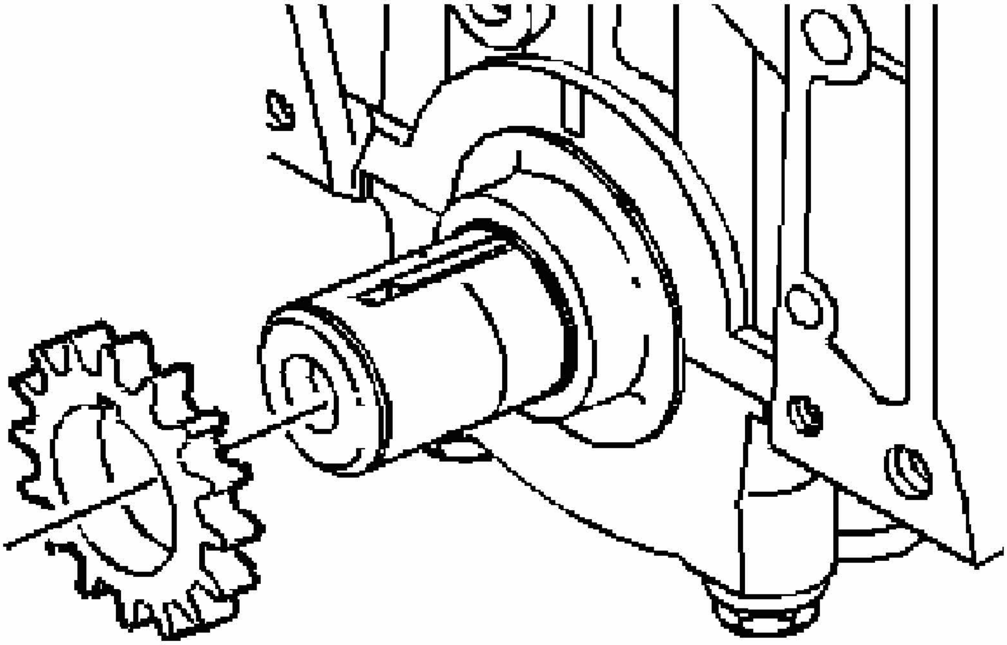


Fig. 454: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

1. Install the crankshaft sprocket.
2. Apply prelube GM P/N 12345501 (Canadian P/N 992704) or the equivalent to the crankshaft sprocket thrust surface.

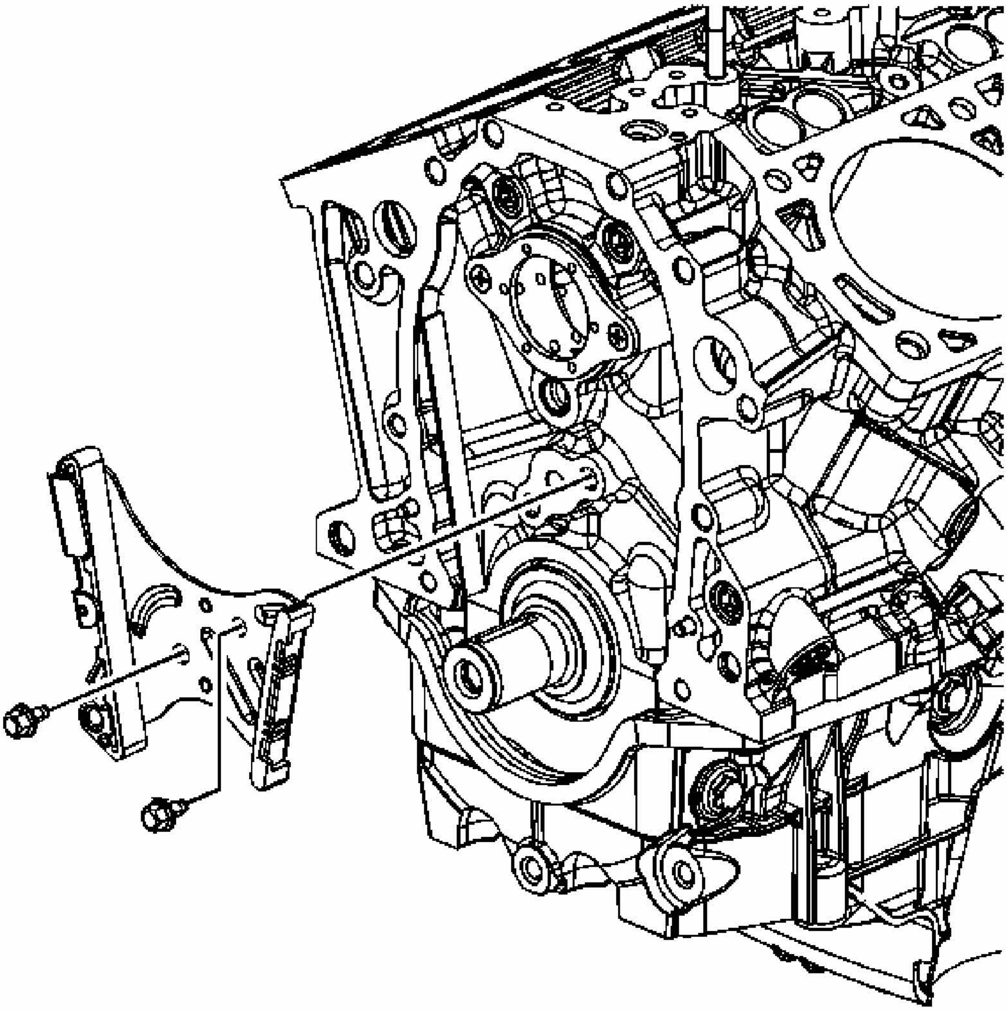


Fig. 455: View Of Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the timing chain tensioner.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

4. Install the timing chain tensioner bolts.

Tighten: Tighten the timing chain tensioner bolts to 21 N.m (15 lb ft).

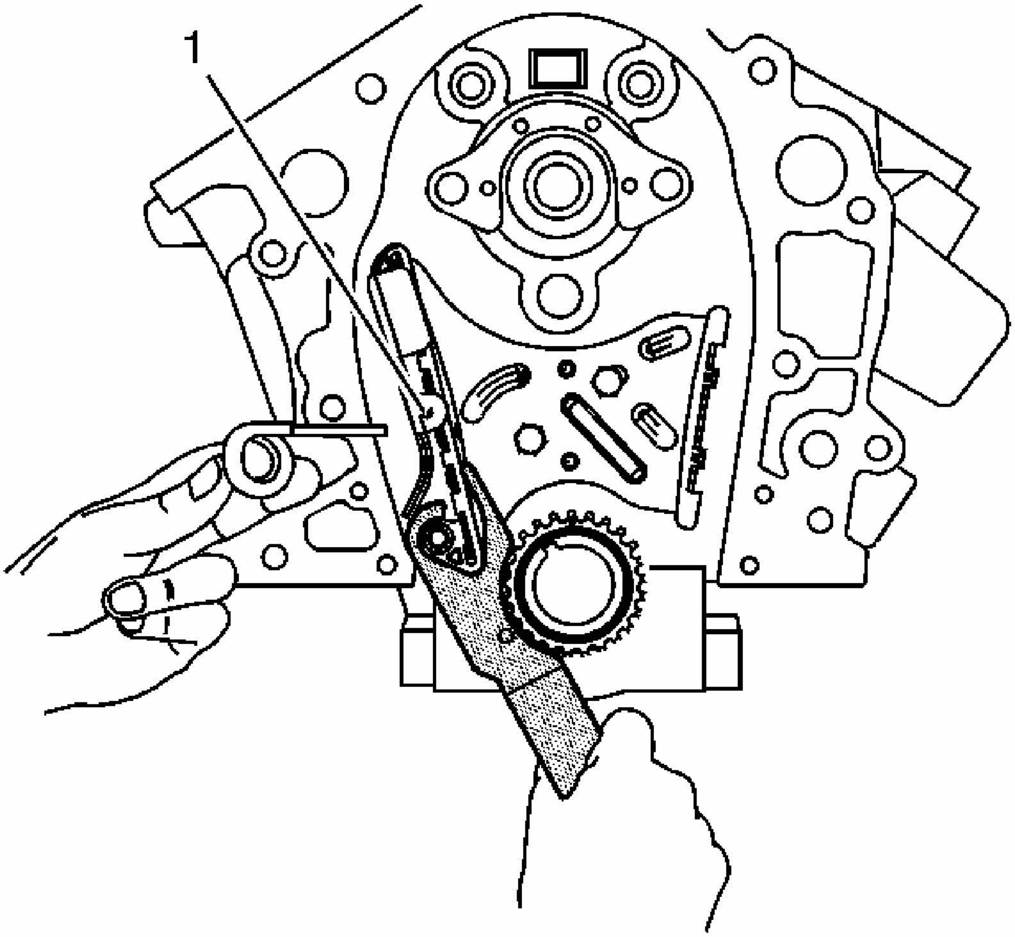


Fig. 456: Collapsing Tensioner
Courtesy of GENERAL MOTORS CORP.

5. Using the **EN-47719** , fully collapse the tensioner, and place the tensioner retaining pin into the retaining hole (1).

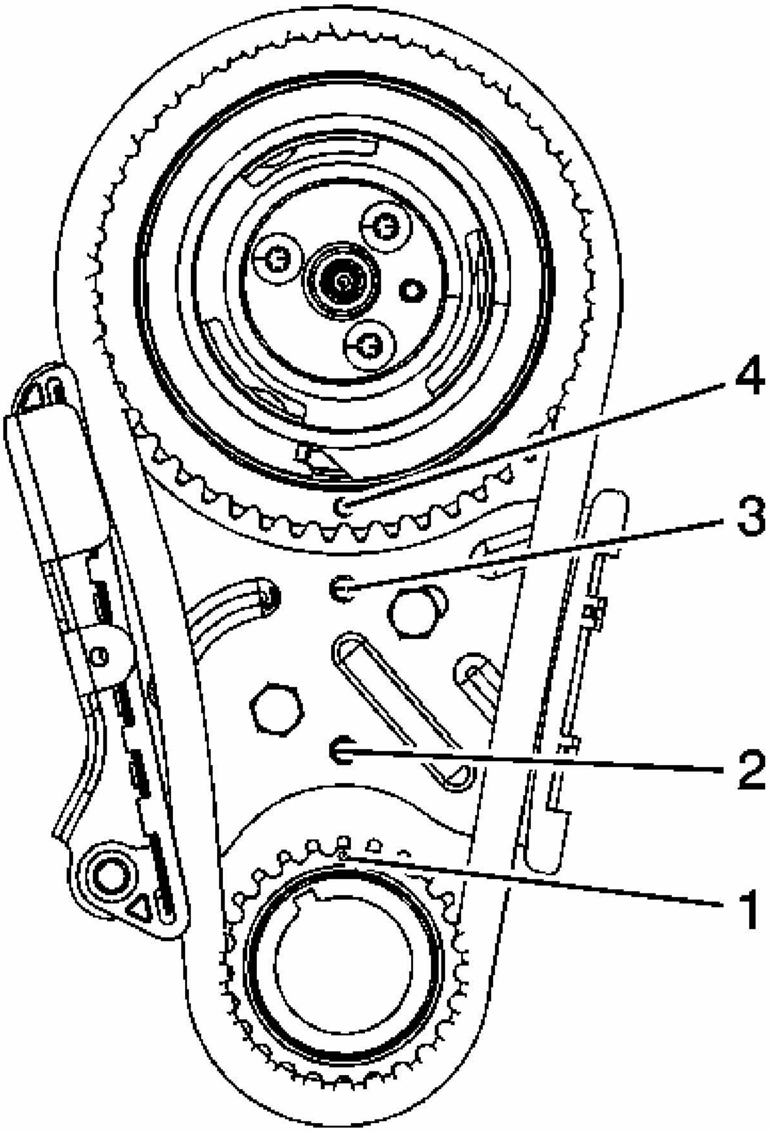


Fig. 457: Identifying Timing Marks & Tensioner
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Always install a NEW camshaft position actuator filter anytime the camshaft position actuator is removed or installed. Refer to Camshaft and Bearings Cleaning and Inspection for filter changing instructions.

6. Align the crankshaft timing mark (1) to the timing mark on the bottom of the timing

chain tensioner (2).

7. Hold the camshaft sprocket with the timing chain hanging down and install the timing chain to the crankshaft gear.
8. Align the timing mark on the camshaft gear (4) with the timing mark on top of the timing chain tensioner (3).

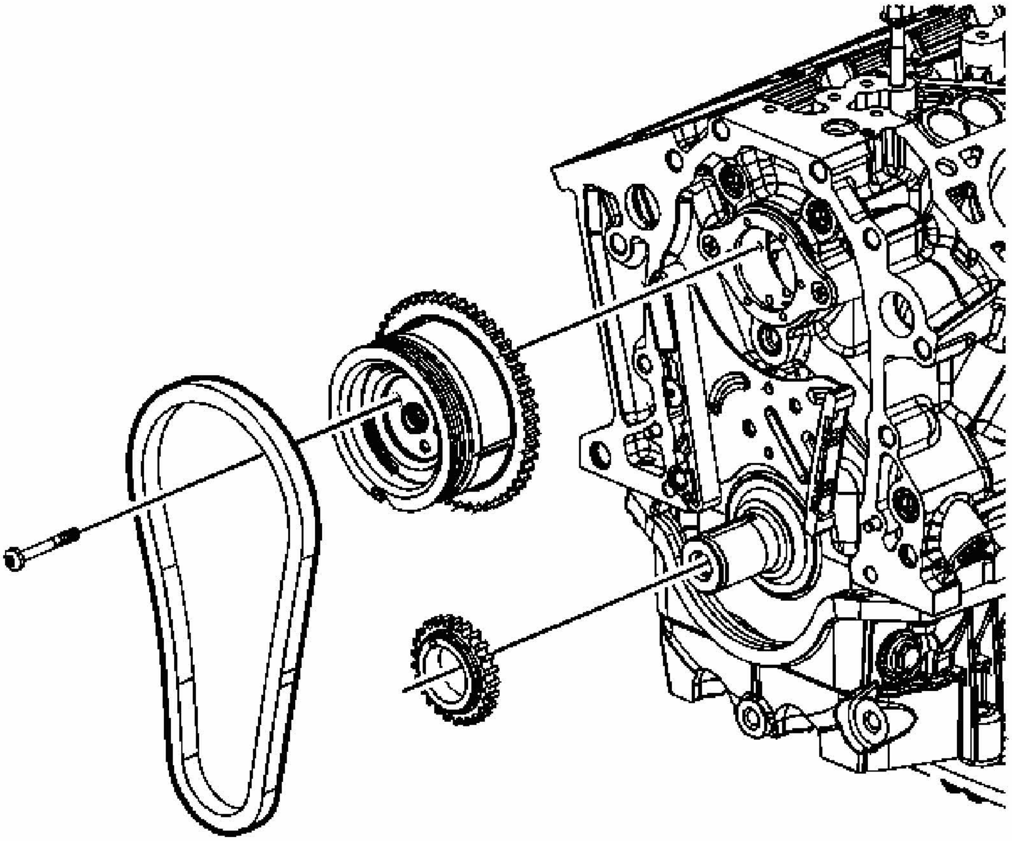


Fig. 458: Identifying Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

9. Align the dowel in the camshaft sprocket with the dowel hole in the camshaft.
10. Draw the camshaft sprocket onto the camshaft using the mounting bolts.

    Tighten: Tighten the bolts to 16 N.m (12 lb ft).

11. Remove the tensioner retaining pin.
12. Coat the crankshaft and camshaft sprocket with engine oil.

ENGINE FRONT COVER INSTALLATION

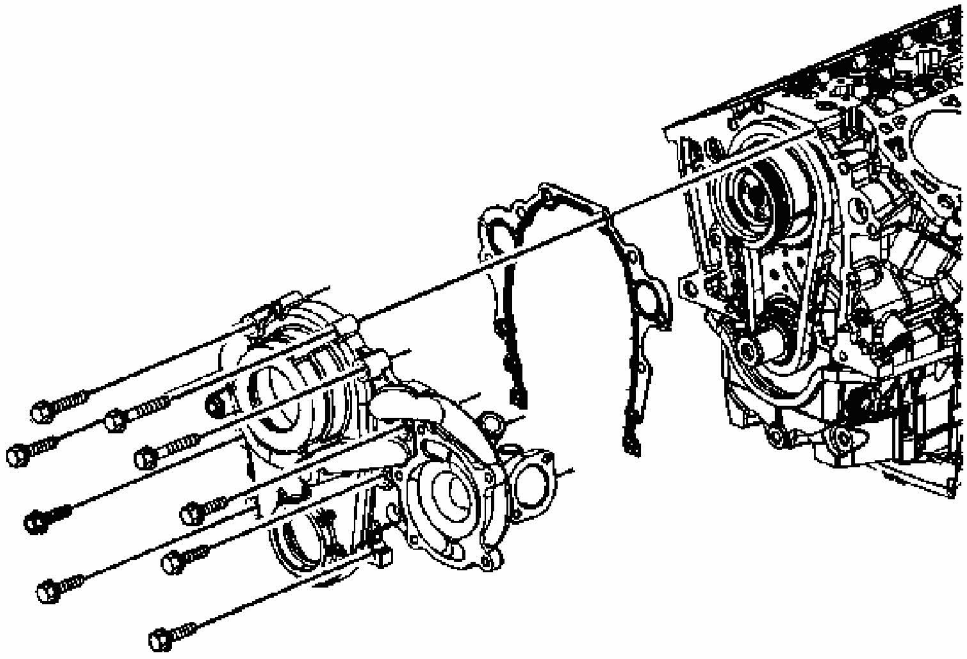


Fig. 459: Identifying Engine Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the front cover and the front cover gasket.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the front cover bolts.

Tighten: Tighten the front cover bolts to 25 N.m (18 lb ft).

CRANKSHAFT FRONT OIL SEAL INSTALLATION

Tools Required

J 35468 Cover Aligner and Seal Installer

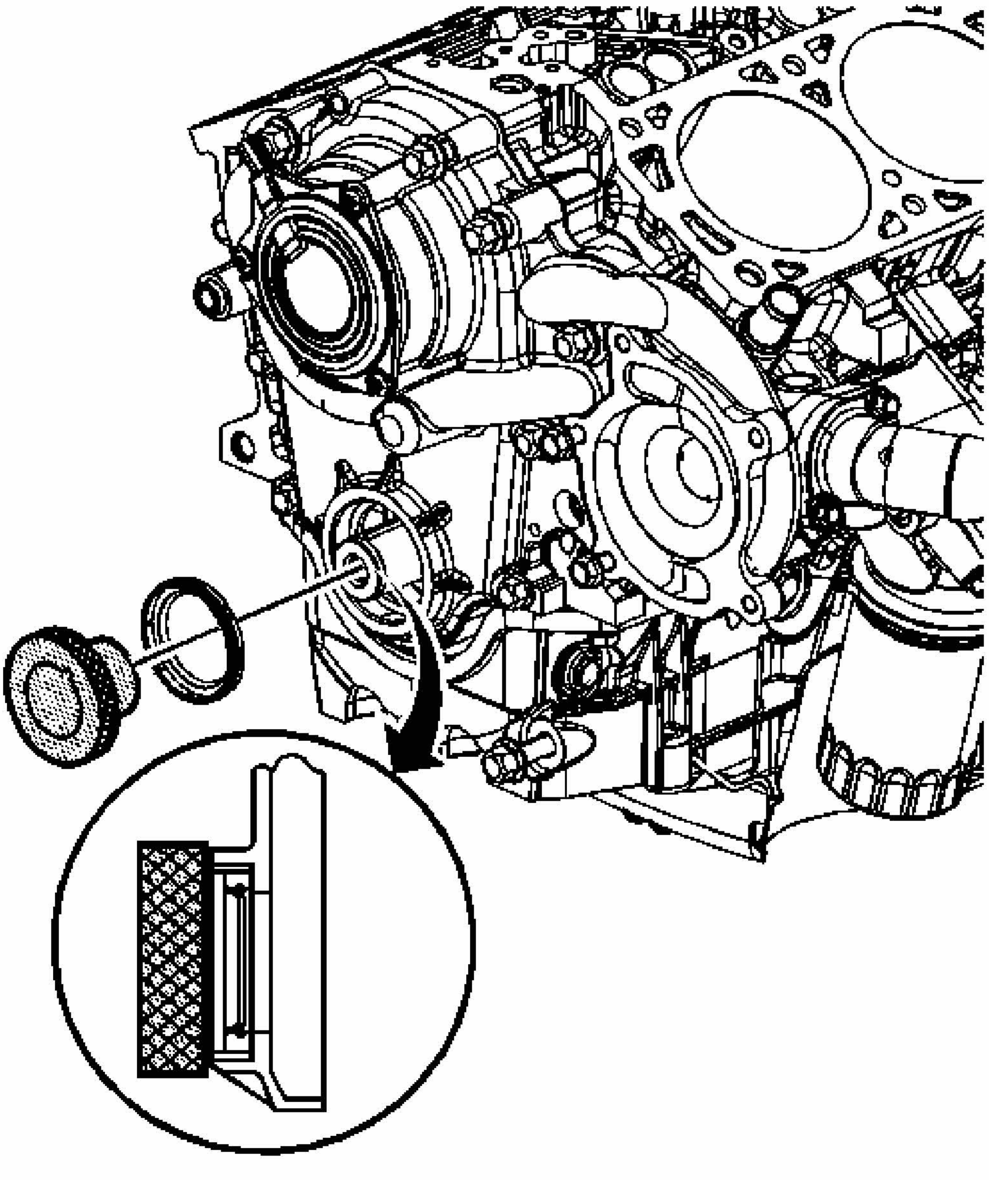


Fig. 460: View Of Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Align the **J 35468** and the crankshaft front oil seal with the engine front cover and crankshaft.
2. Install the crankshaft front oil seal using the **J 35468** and a suitable tool.

OIL PUMP DRIVE INSTALLATION

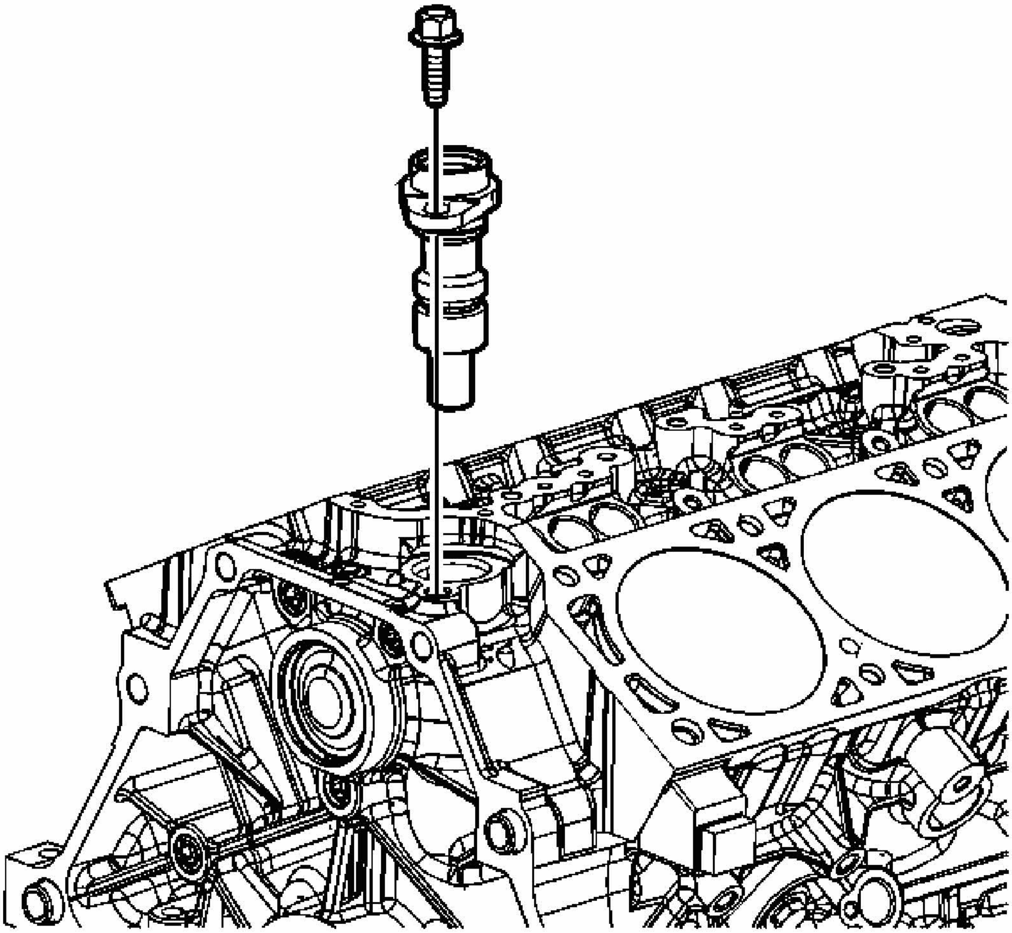


Fig. 461: Identifying Oil Pump Drive
Courtesy of GENERAL MOTORS CORP.

1. Apply prelube GM P/N 12345501 (Canadian P/N 992704) or the equivalent to the oil pump drive gear.
2. Apply engine oil to the oil pump drive gear assembly for ease of assembly.
3. Install the oil pump drive gear assembly.
4. Install the oil pump drive gear clamp.

NOTE: **Refer to FASTENER NOTICE Fastener Notice in Cautions and Notices.**

5. Install the oil pump drive gear clamp bolt.

Tighten: Tighten the oil pump drive gear clamp bolt to 36 N.m (27 lb ft).

CAMSHAFT POSITION ACTUATOR MAGNET INSTALLATION

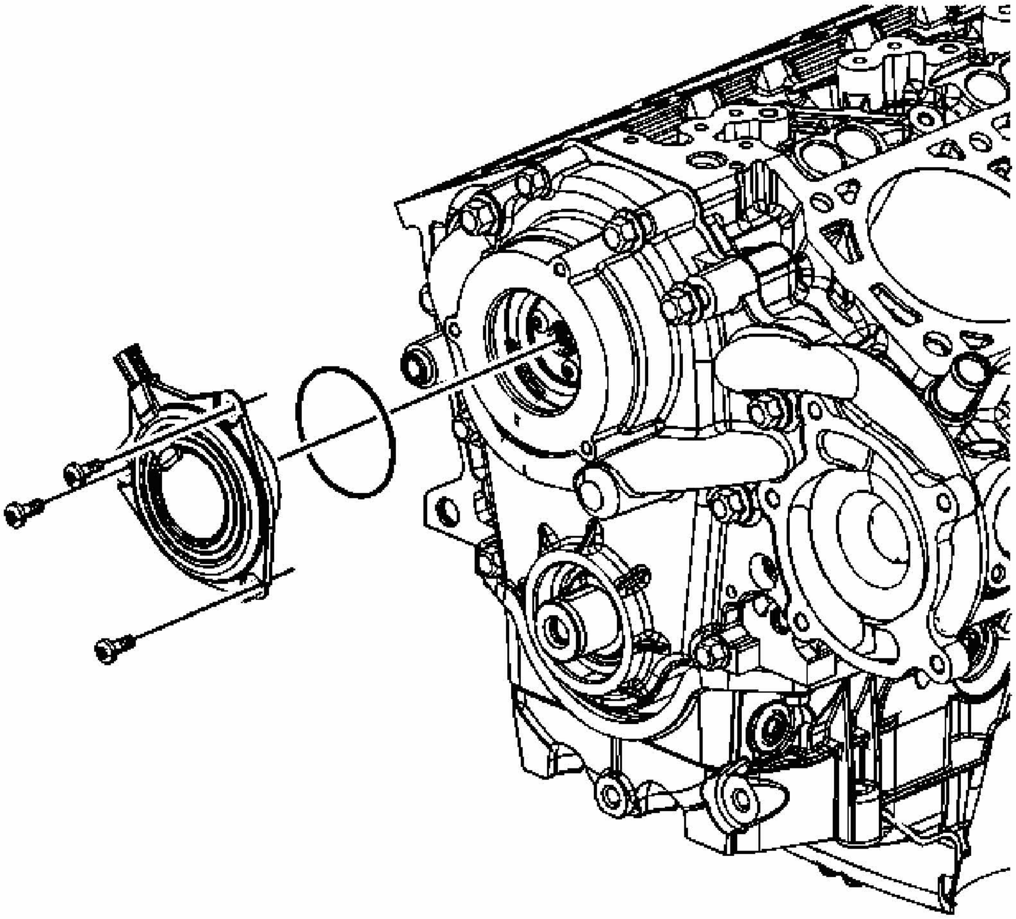


Fig. 462: Identifying Camshaft Position Actuator Magnet & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the camshaft position actuator magnet and O-ring seal into the front cover.

NOTE:	**Refer to FASTENER NOTICE .**

2. Install the camshaft position actuator magnet bolts.

   Tighten: Tighten the camshaft position actuator magnet bolts to 10 N.m (89 lb in).

OIL PUMP INSTALLATION

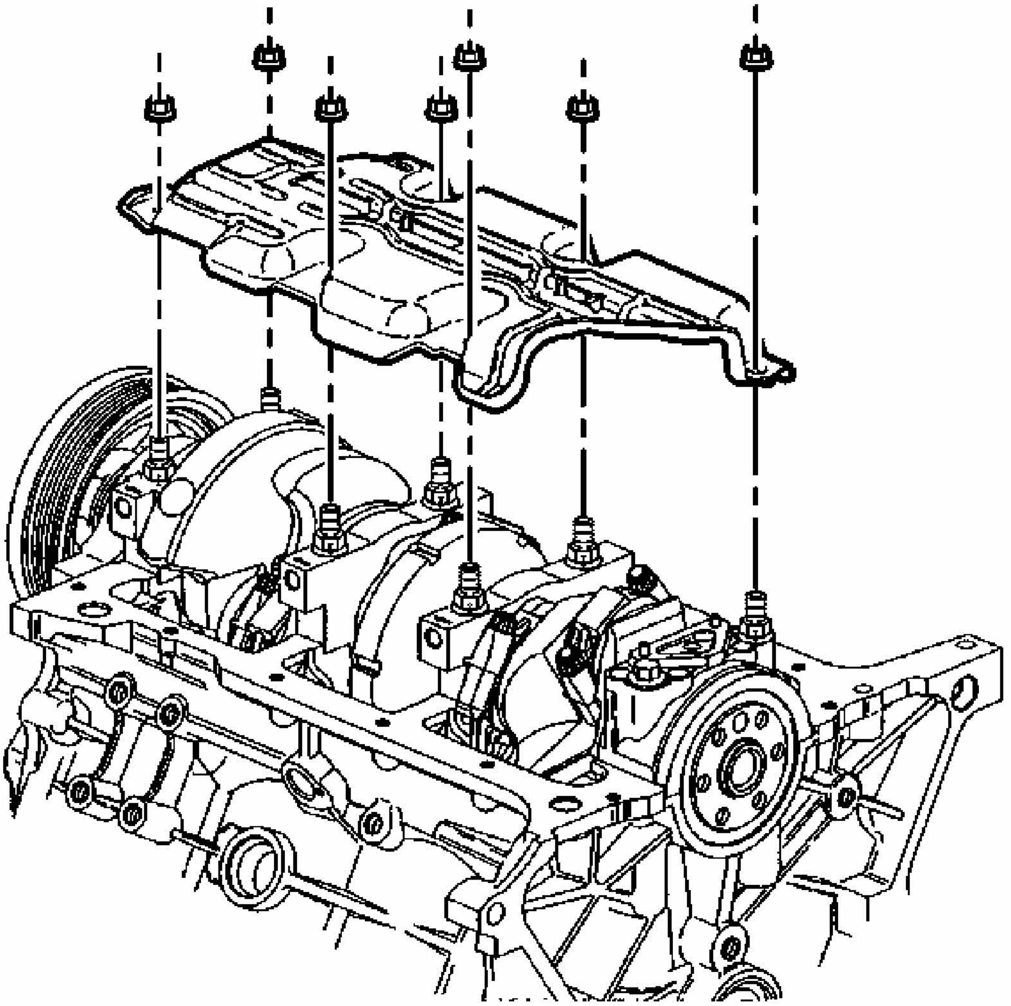


Fig. 463: View Of Crankshaft Oil Deflector & Nuts
Courtesy of GENERAL MOTORS CORP.

1. Install the crankshaft oil deflector.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the crankshaft oil deflector nuts.

Tighten: Tighten the crankshaft oil deflector nuts to 25 N.m (18 lb ft).

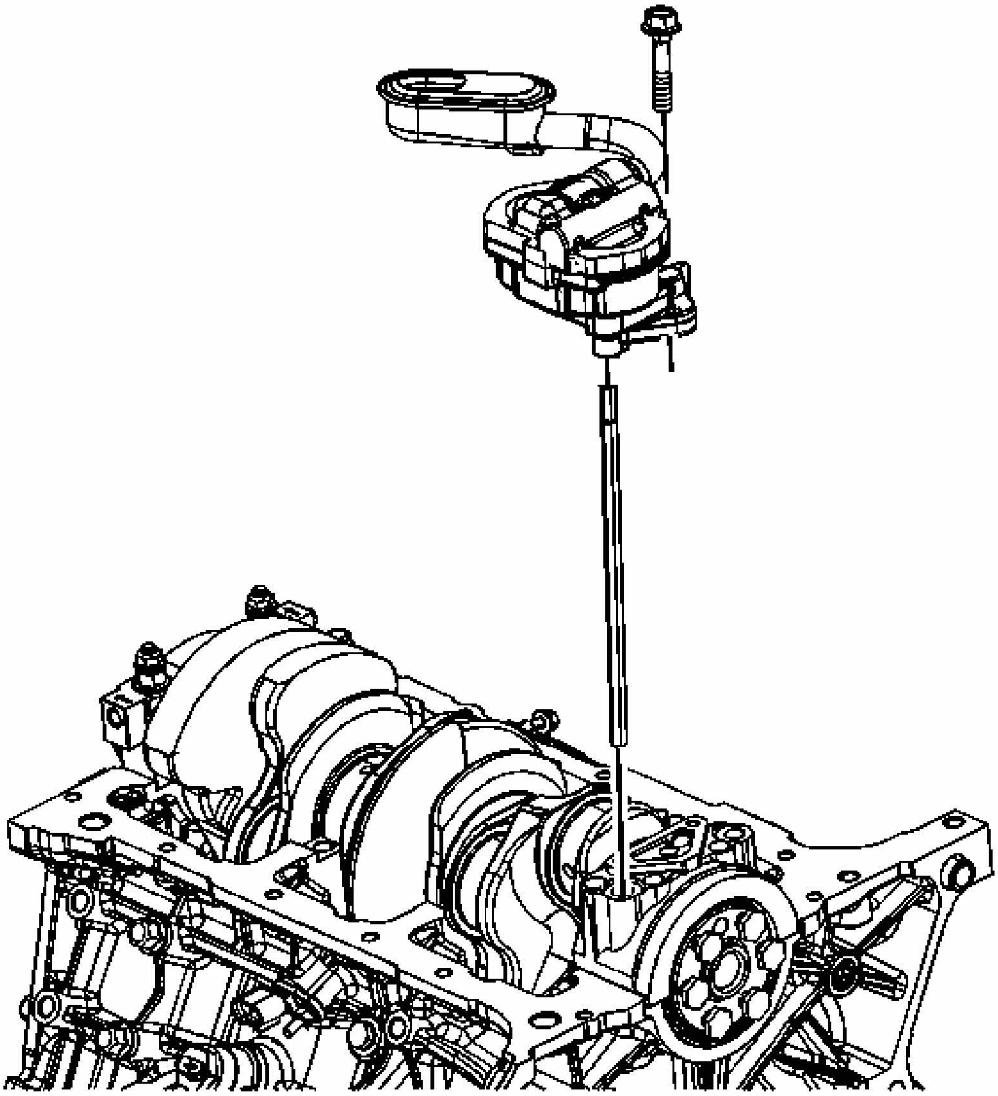


Fig. 464: Identifying Oil Pump, Screen & Driveshaft
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not reuse the oil pump driveshaft retainer. During assembly, install a NEW oil pump driveshaft retainer.

3. Install the oil pump.
4. Position the oil pump onto the pins.
5. Install the oil pump bolt attaching the oil pump to the rear crankshaft bearing cap.

Tighten: Tighten the oil pump bolt to 41 N.m (30 lb ft).

OIL PAN INSTALLATION

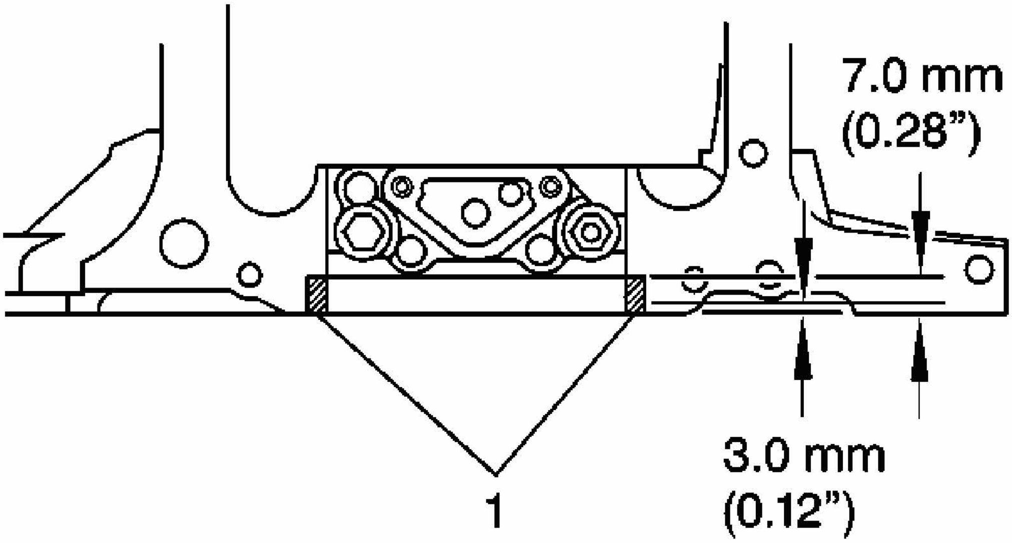


Fig. 465: Illustrating Proper Sealer Application
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer GM P/N 12378521, (Canadian P/N 88901148) or the equivalent to both sides of the crankshaft rear main bearing cap (1). Press sealer into gap using a putty knife.

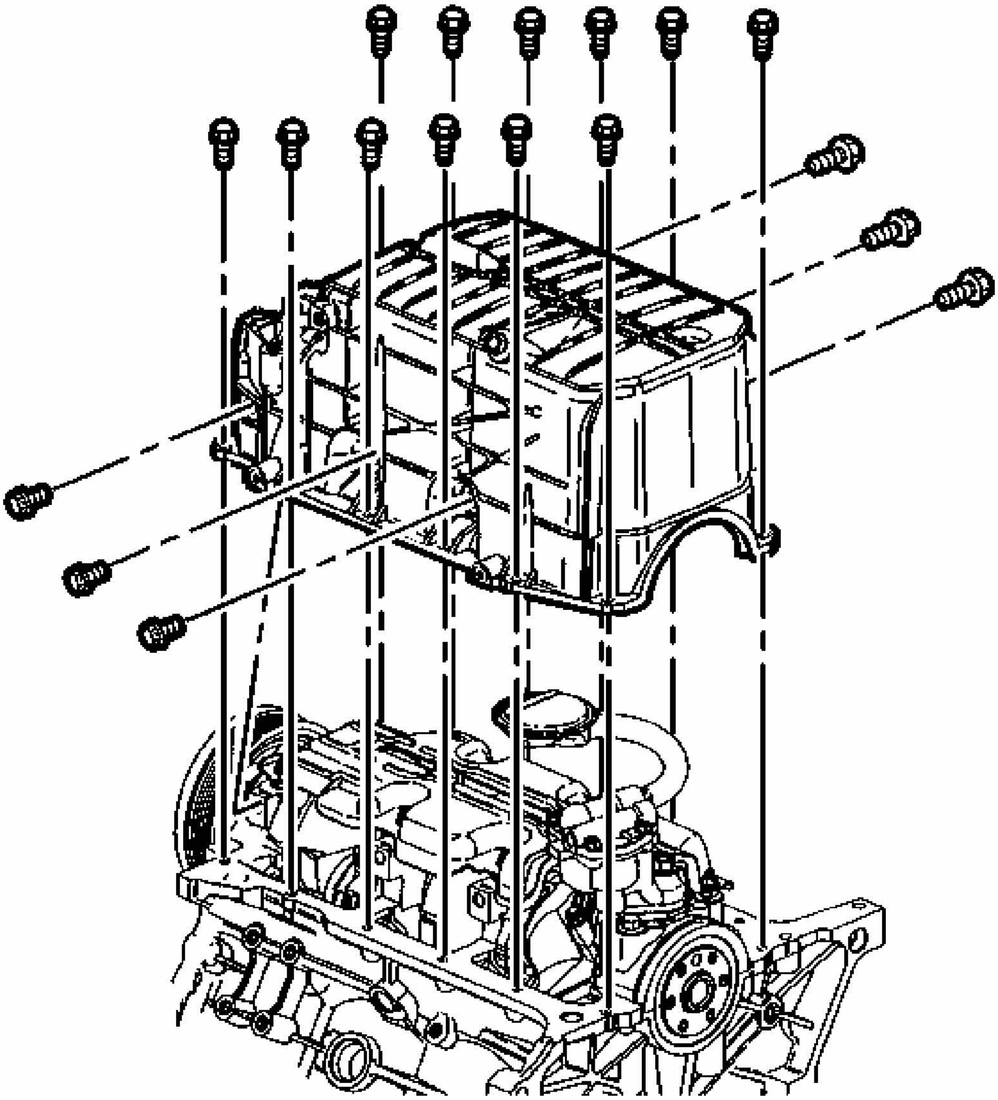


Fig. 466: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the oil pan gasket.
3. Install the oil pan.

NOTE: **Refer to FASTENER NOTICE In Cautions and Notices.**

4. Install the oil pan bolts.

Tighten: Tighten the oil pan bolts to 25 N.m (18 lb ft).

5. Install the oil pan side bolts.

   Tighten: Tighten the oil pan side bolts to 50 N.m (37 lb ft).

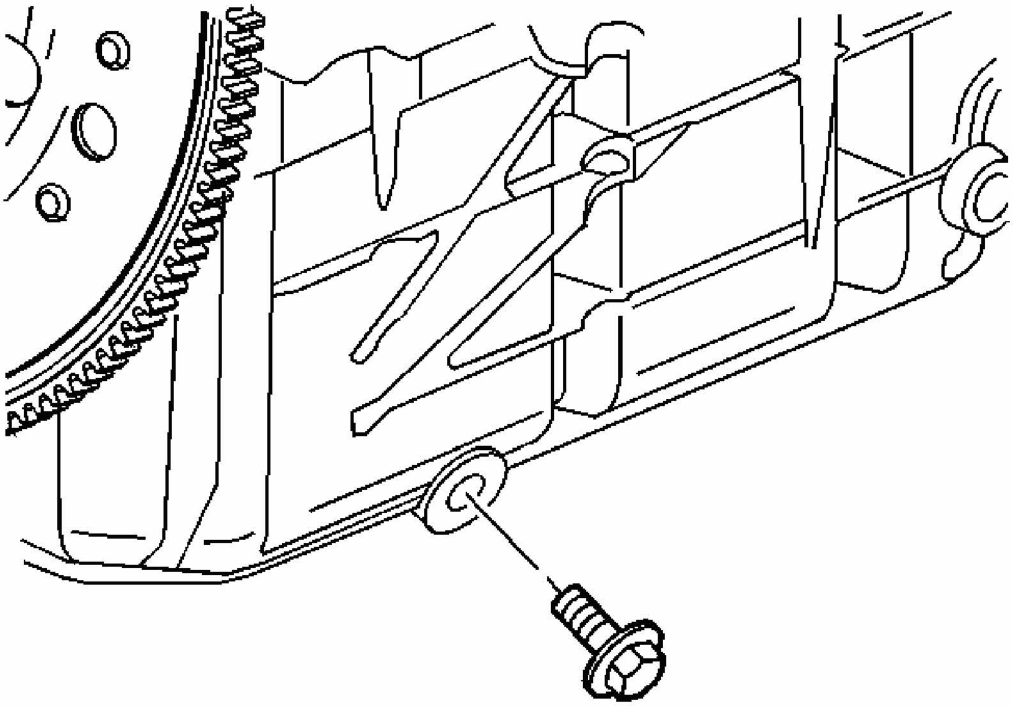


Fig. 467: View Of Oil Pan Drain Plug
Courtesy of GENERAL MOTORS CORP.

6. Install the oil pan drain plug.

   Tighten: Tighten the oil pan drain plug to 25 N.m (18 lb ft).

CYLINDER HEAD INSTALLATION - LEFT

Tools Required

J 45059 Angle Meter

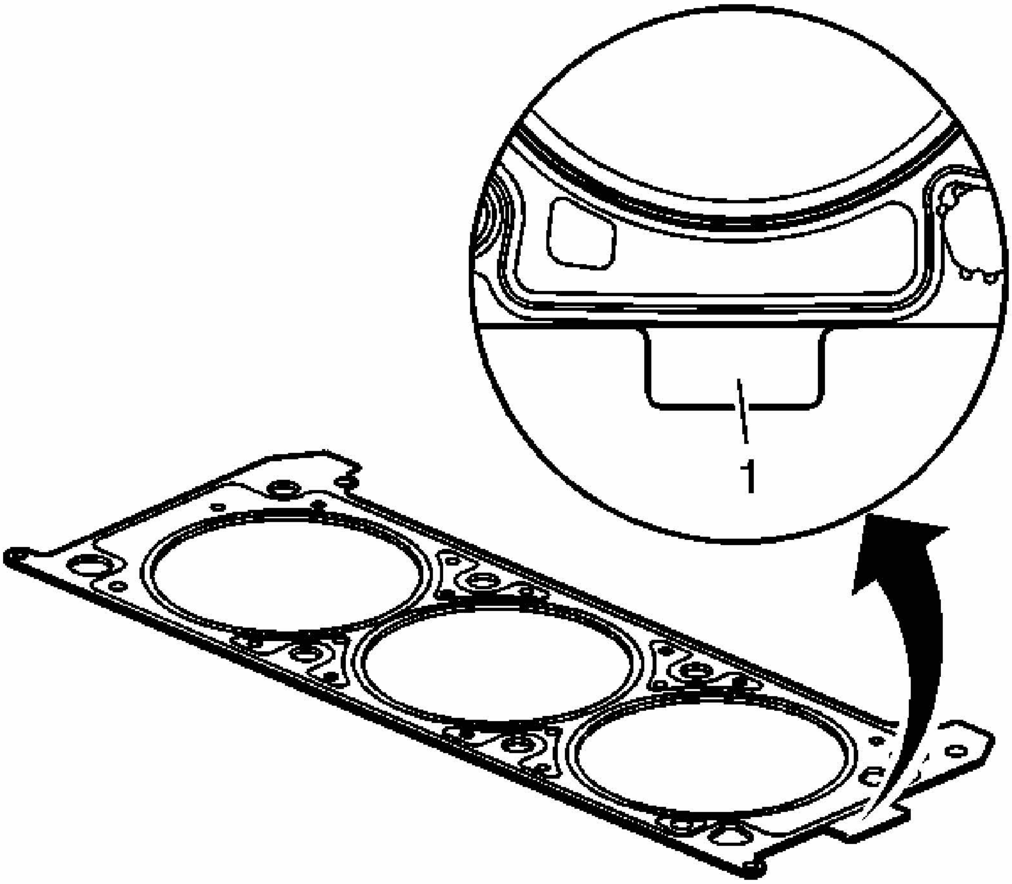


Fig. 468: Identifying Proper Cylinder Head Gasket Installation
Courtesy of GENERAL MOTORS CORP.

NOTE: **Head gaskets are specific for right hand and left hand applications, and also must be installed with the correct side facing up. Note the markings (1) on the head gaskets for proper installation. Failure to do so may lead to engine damage.**

NOTE: **This component uses torque-to-yield bolts. When servicing this component do not reuse the bolts, New torque-to-yield bolts must be installed. Reusing used torque-to-yield bolts will not provide proper bolt torque and clamp load. Failure to install NEW torque-to-yield bolts may lead to engine damage.**

1. Install the cylinder head locator dowel pins, if necessary.
2. Inspect the cylinder head locator dowel pins for proper installation.

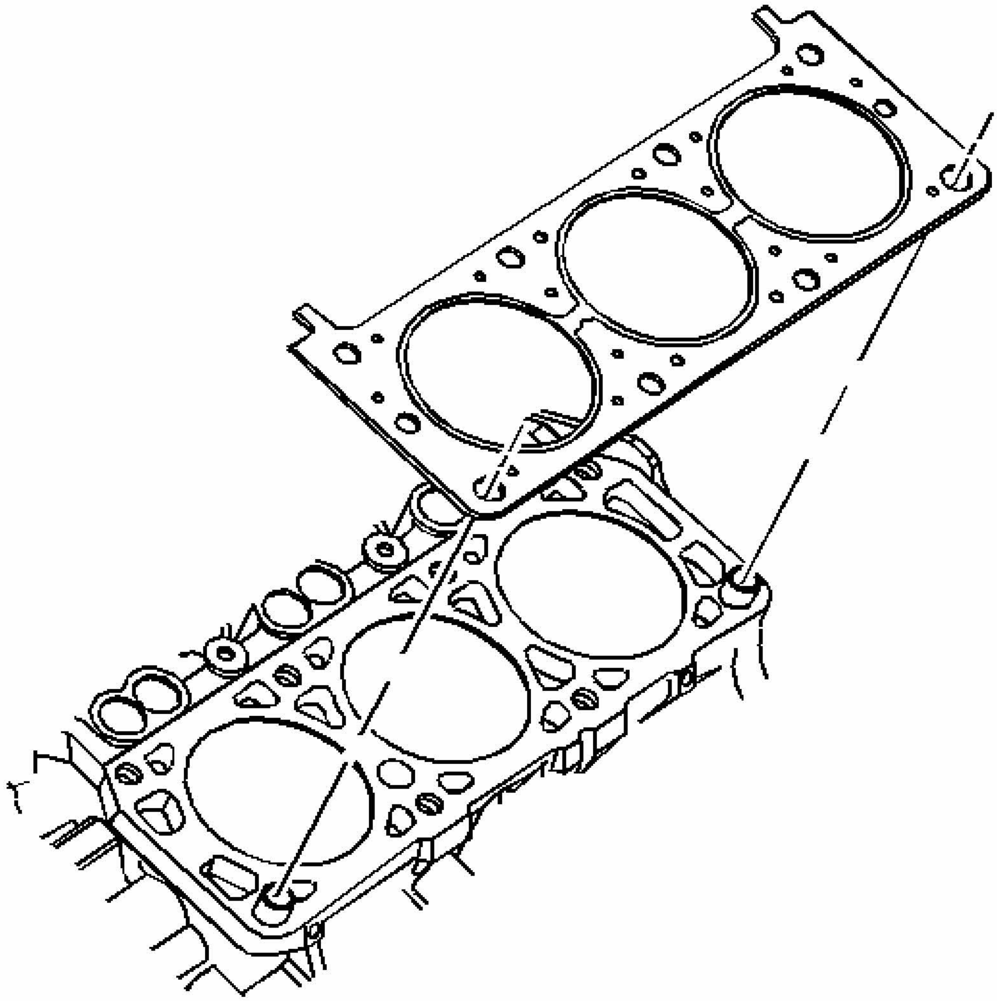


Fig. 469: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install the cylinder head gasket.

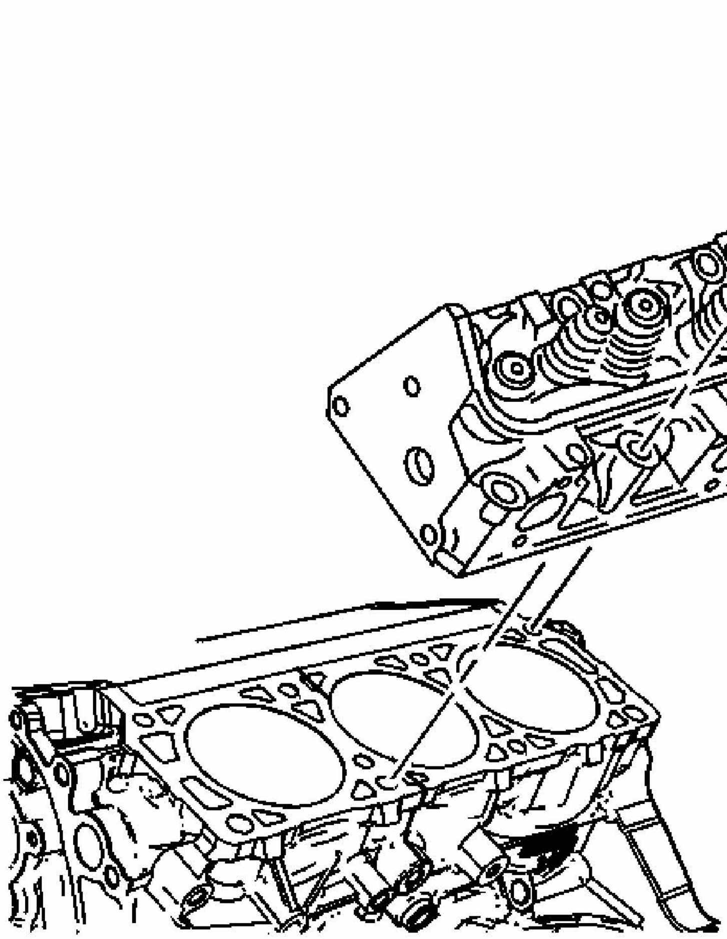


Fig. 470: Removing/Installing Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Install the cylinder head.

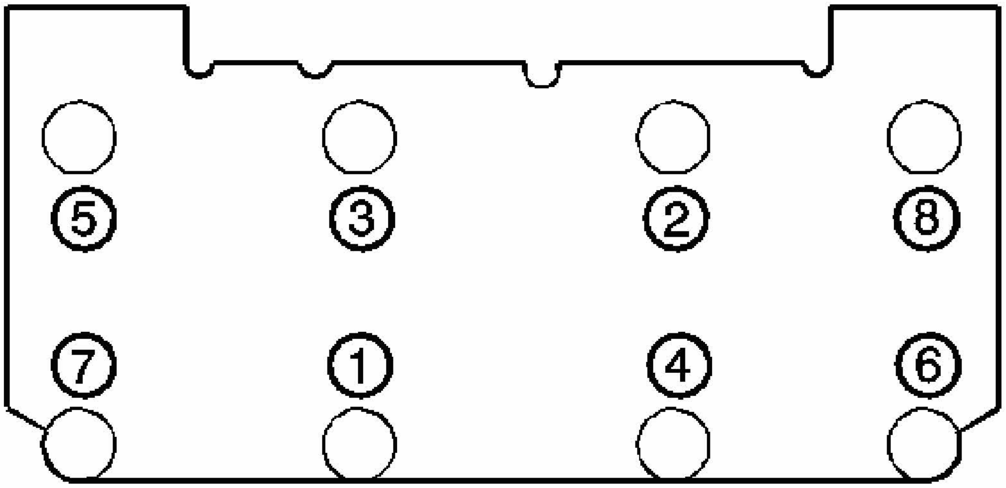


Fig. 471: View Of Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE .**

5. Install the new cylinder head bolts.

   Tighten:

   1. Tighten the cylinder head bolts a first pass in sequence to 60 N.m (44 lb ft).
   2. Tighten the cylinder head bolts a final pass in sequence to 95 degrees using the **J 45059** .

CYLINDER HEAD INSTALLATION - RIGHT

Tools Required

J 45059 Angle Meter

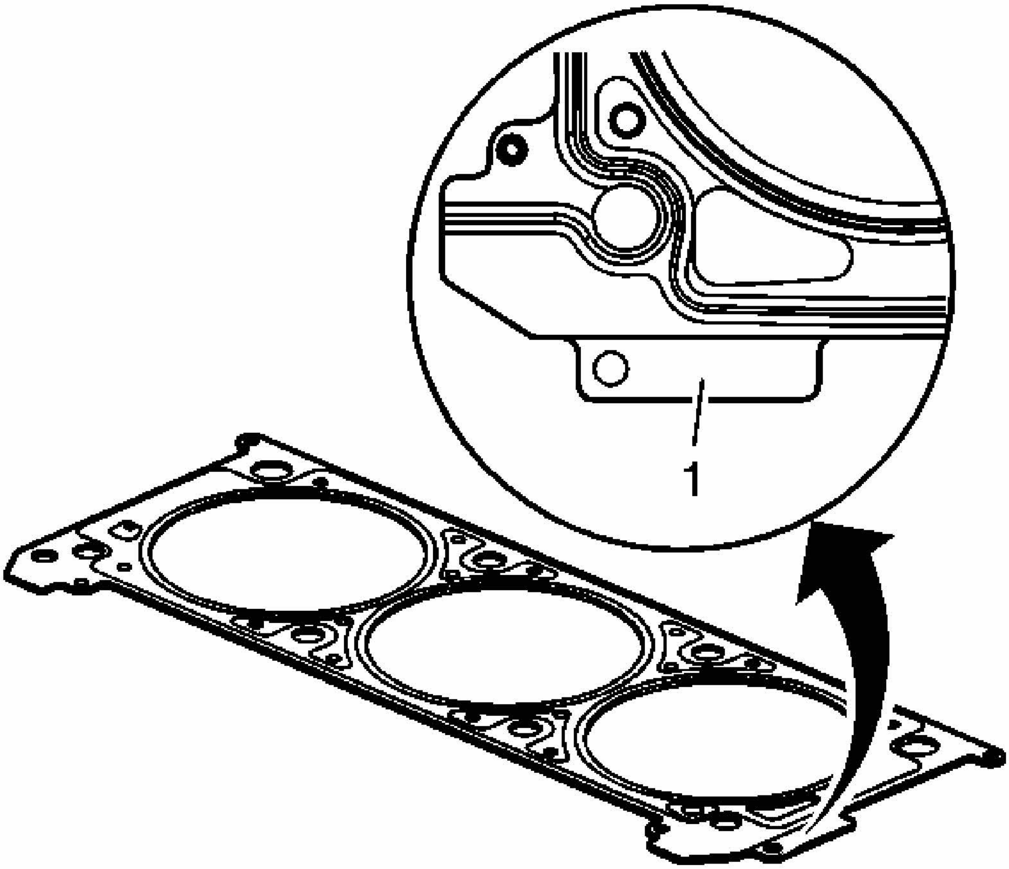


Fig. 472: Identifying Proper Cylinder Head Gasket Installation
Courtesy of GENERAL MOTORS CORP.

NOTE: Head gaskets are specific for right hand and left hand applications, and also must be installed with the correct side facing up. Note the markings (1) on the head gaskets for proper installation. Failure to do so may lead to engine damage.

NOTE: This component uses torque-to-yield bolts. When servicing this component do not reuse the bolts, New torque-to-yield bolts must be installed. Reusing used torque-to-yield bolts will not provide proper bolt torque and clamp load. Failure to install NEW torque-to-yield bolts may lead to engine damage.

1. Install the cylinder head locator dowel pins, if necessary.
2. Inspect the cylinder head locator dowel pins for proper installation.

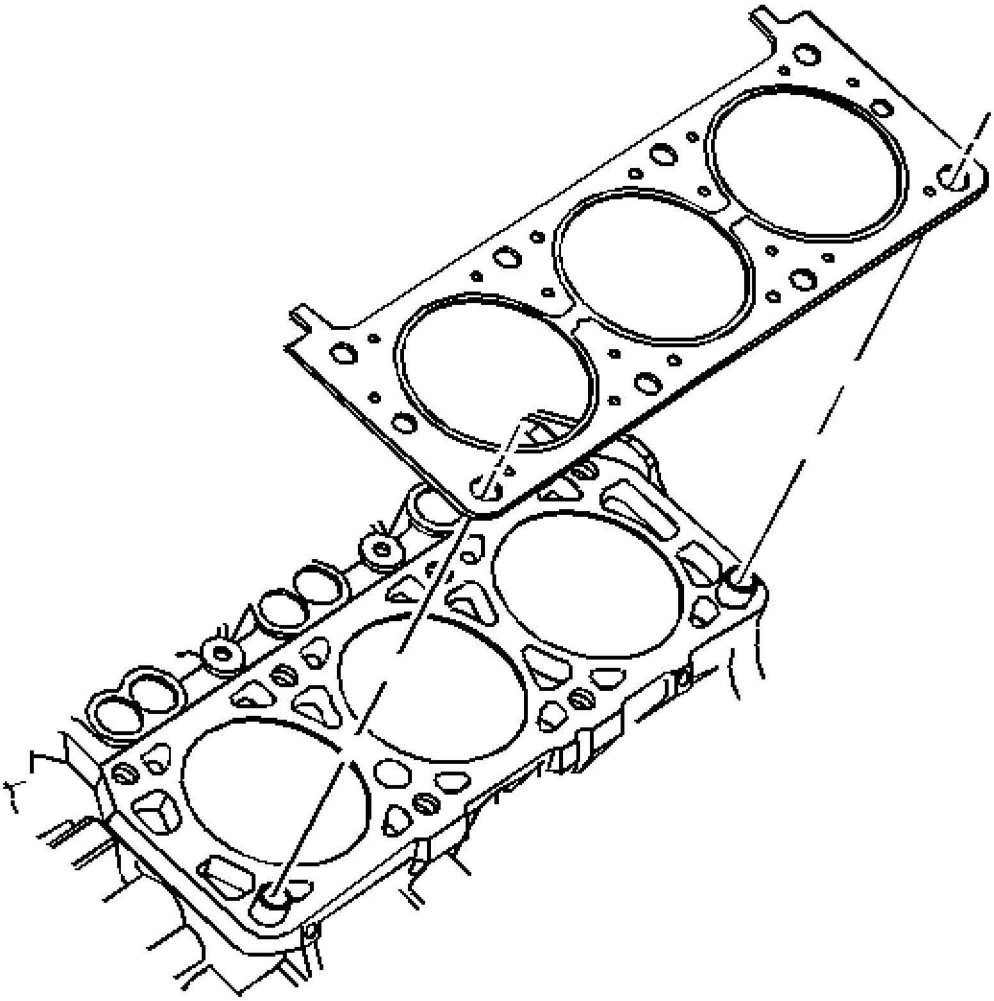


Fig. 473: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install the cylinder head gasket.

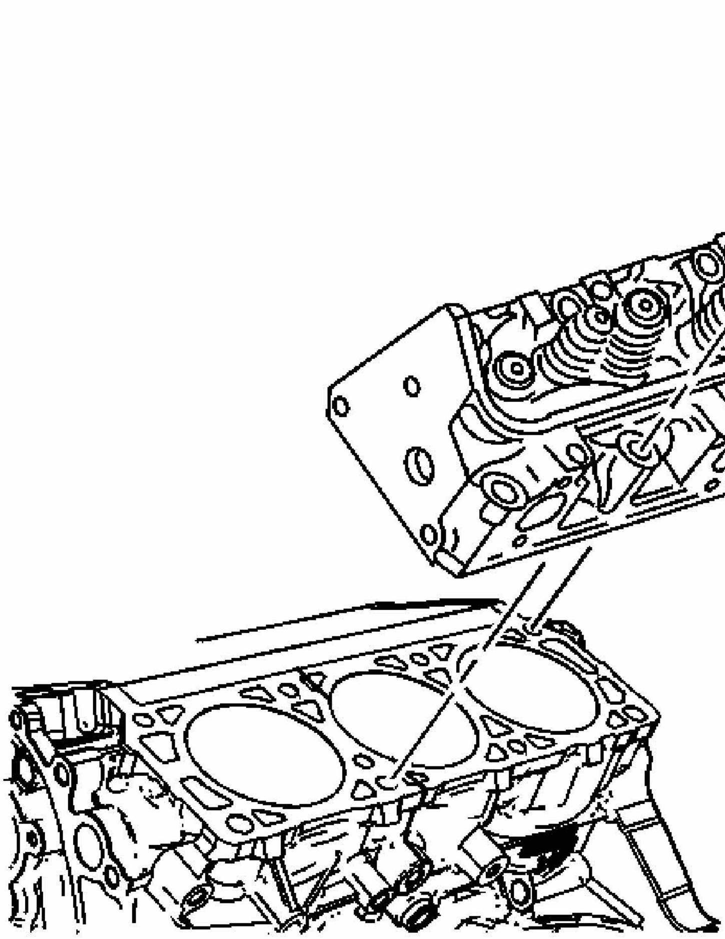


Fig. 474: Removing/Installing Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Install the cylinder head.

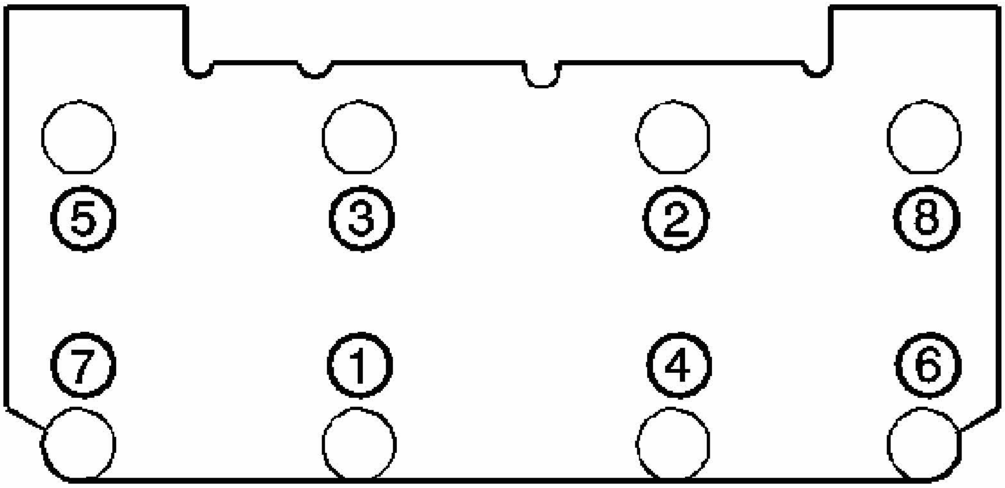


Fig. 475: View Of Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE .**

5. Install the new cylinder head bolts.

   Tighten:

   1. Tighten the cylinder head bolts a first pass in sequence to 60 N.m (44 lb ft).
   2. Tighten the cylinder head bolts a final pass in sequence to 95 degrees using the **J 45059** .

WATER PUMP INSTALLATION

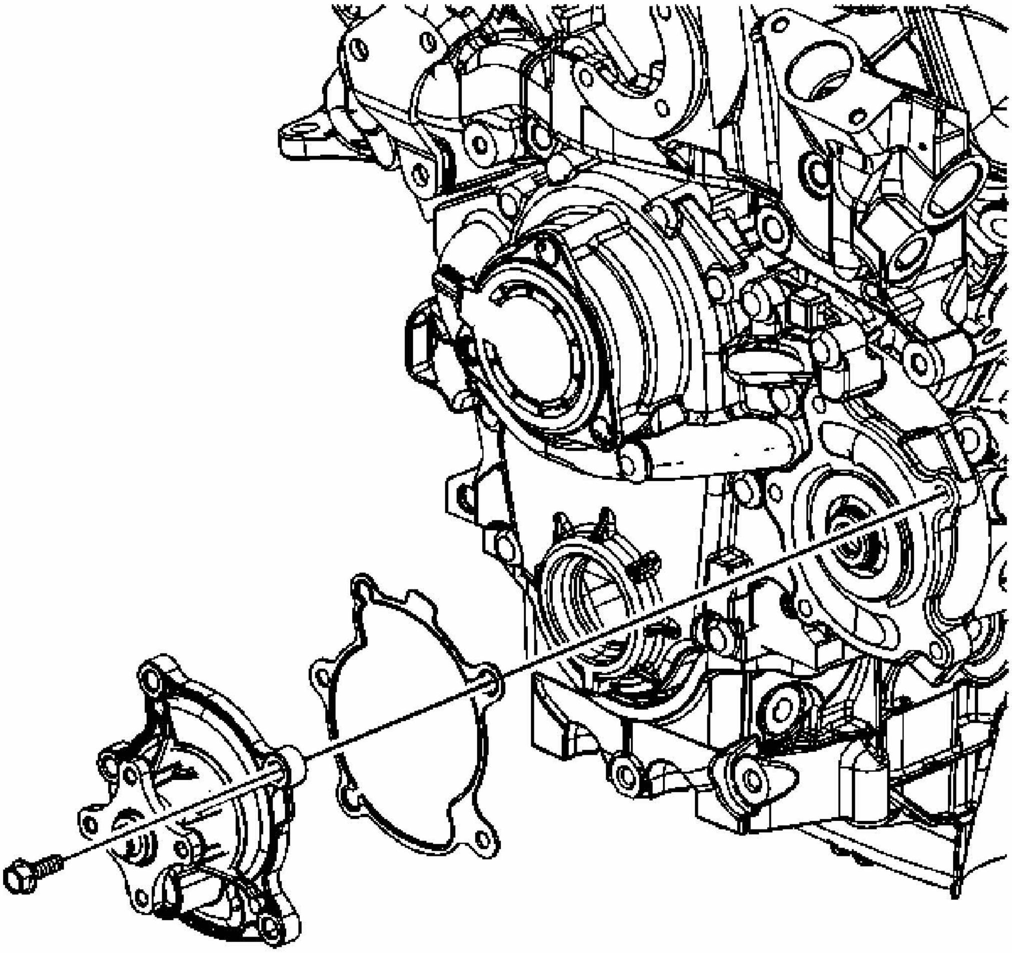


Fig. 476: View Of Water Pump, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the water pump gasket.
2. Install the water pump.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

3. Install the water pump bolts.

Tighten: Tighten the water pump bolts to 10 N.m (89 lb in).

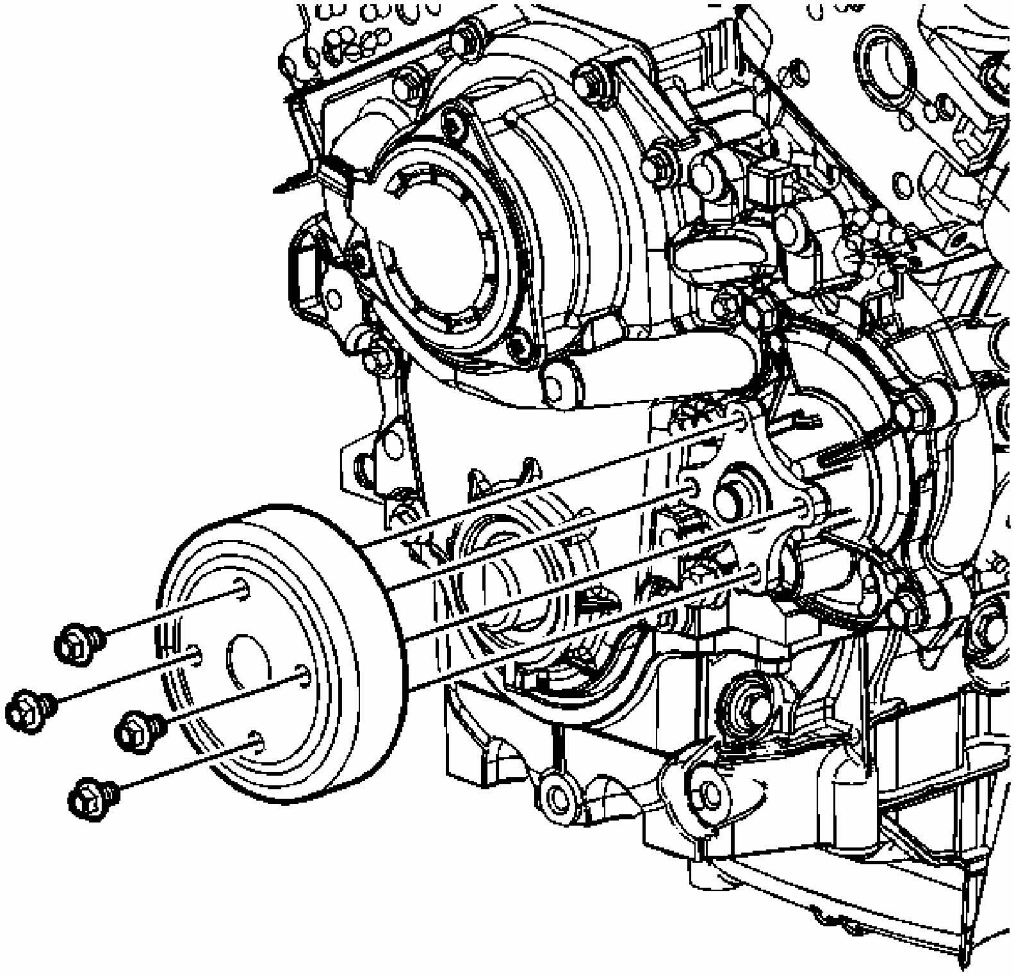


Fig. 477: View Of Water Pump Pulley & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the water pump pulley.
5. Install the water pump pulley bolts.

   Tighten: Tighten the water pump pulley bolts to 25 N.m (18 lb ft).

VALVE LIFTER INSTALLATION

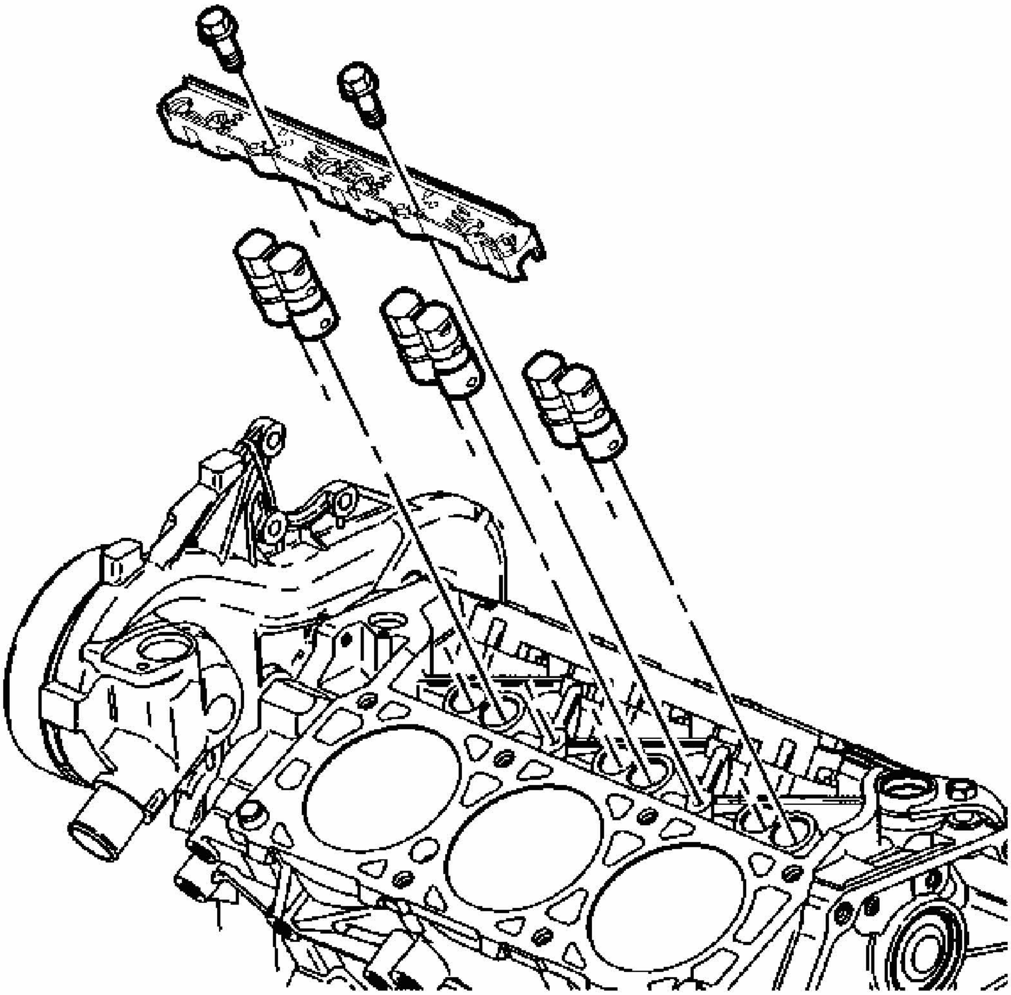


Fig. 478: View Of Valve Lifters & Lifter Guides
Courtesy of GENERAL MOTORS CORP.

1. Coat the valve lifters using prelube GM P/N 12345501 (Canadian P/N 992704) or the equivalent.
2. Install the valve lifters in their original locations.
3. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or the equivalent to the threads.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

4. Install the valve lifter guides and guide bolts.

Tighten: Tighten the valve lifter guide bolts to 10 N.m (89 lb in).

VALVE ROCKER ARM AND PUSH ROD INSTALLATION

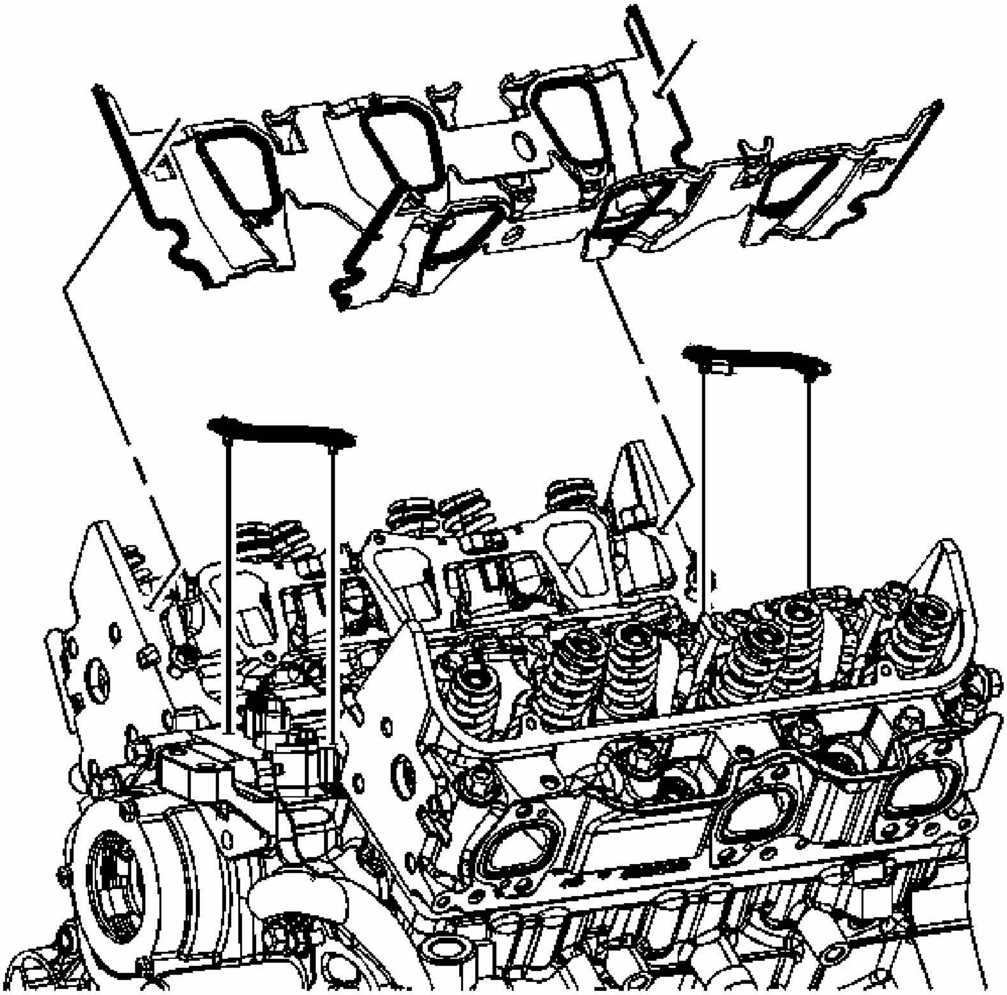


Fig. 479: Identifying Intake Manifold Gaskets & Seals
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **All gasket mating surfaces must be free of oil and foreign material. Use GM P/N 12346139 (Canadian P/N 10953463) or equivalent to clean surfaces.**

IMPORTANT: **Room temperature vulcanizing (RTV) sealer is not to be placed under the lower intake manifold gaskets.**

1. Install the lower intake manifold gaskets.

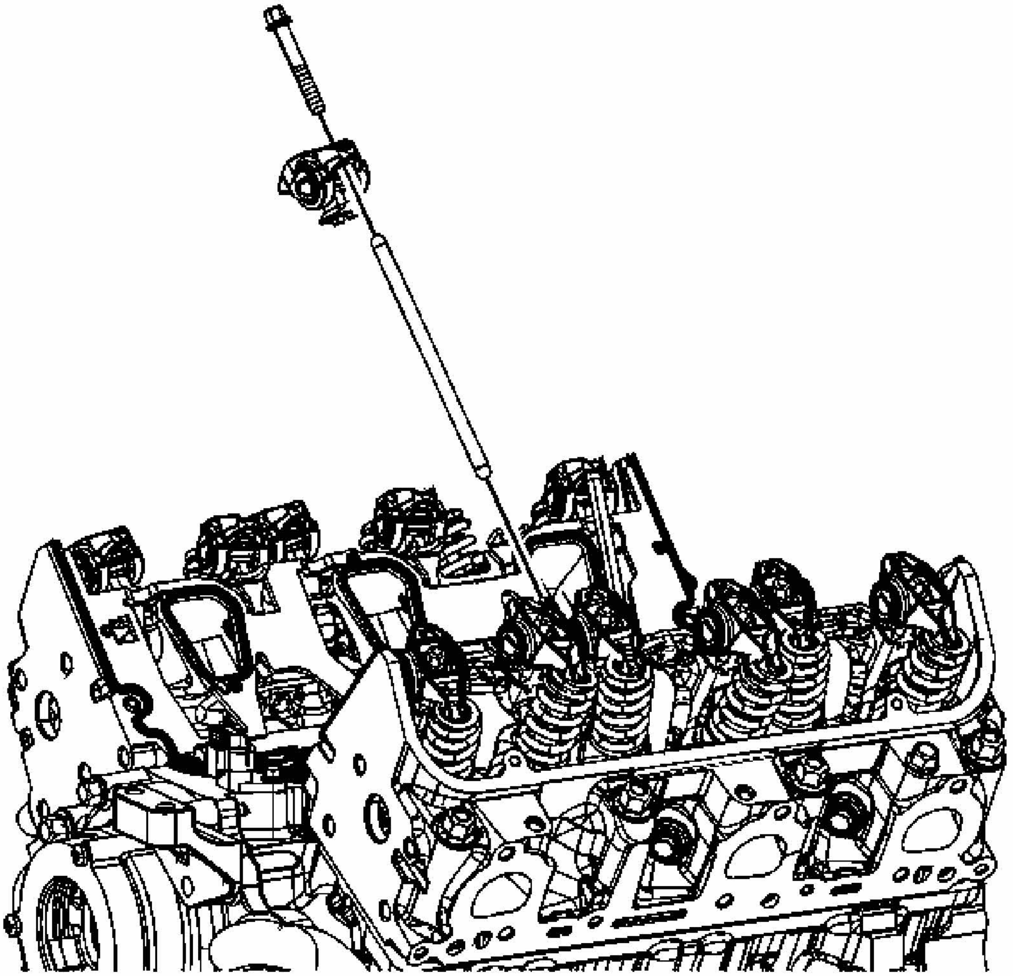


Fig. 480: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

2. Coat the ends of the push rods using prelube GM P/N 12345501 (Canadian P/N 992704) or the equivalent.

IMPORTANT: The intake valve push rods measure 147.51 mm (5.81 in) and the exhaust valve push rods measure 154.87 mm (6.1 in) in length.

3. Install the push rods in their original location.
4. Coat the rocker arm friction surfaces using prelube GM P/N 12345501 (Canadian P/N

992704) or the equivalent.

IMPORTANT: Shims (P/N 88894006) may be required under the valve rocker arm pedestals if reconditioning has been performed on the cylinder head or its components.

5. Install the valve rocker arms in their original positions.

NOTE: Refer to FASTENER NOTICE .

6. Install the valve rocker arm bolts.

Tighten: Tighten the valve rocker arm bolts to 34 N.m (25 lb ft).

INTAKE MANIFOLD INSTALLATION - LOWER

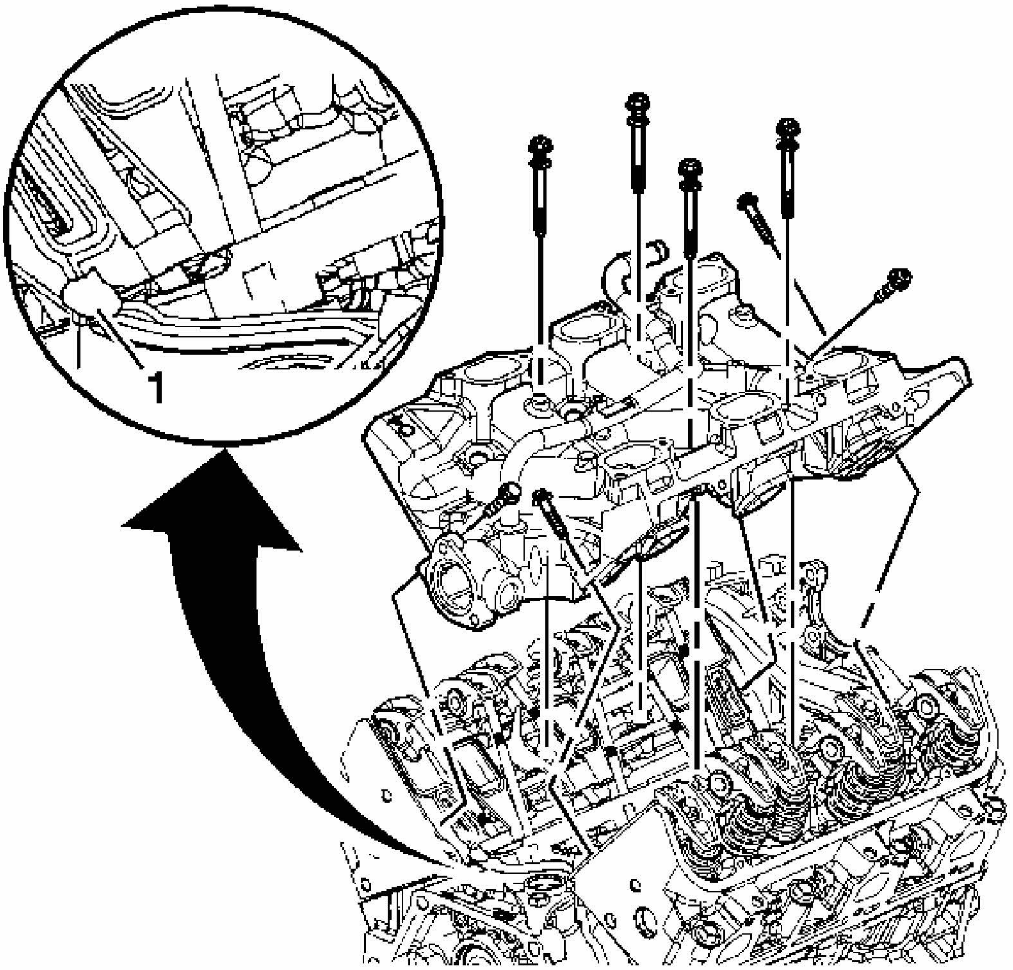


Fig. 481: View Of Lower Intake Manifold
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All gasket-mating surfaces need to be free of oil and foreign material. Use GM P/N 12346139 (Canadian P/N 10953463) or equivalent to clean surfaces.

1. With gaskets and seals in place apply a small drop 8-10 mm (0.31-0.39 in) of RTV sealer GM P/N 12378521 (Canadian P/N 88901148) or equivalent to the 4 corners of the intake manifold to block joints (1).

IMPORTANT: To ensure proper lower intake manifold orientation during installation, make sure the intake port marked 1 faces the front of the engine.

2. Install the lower intake manifold.

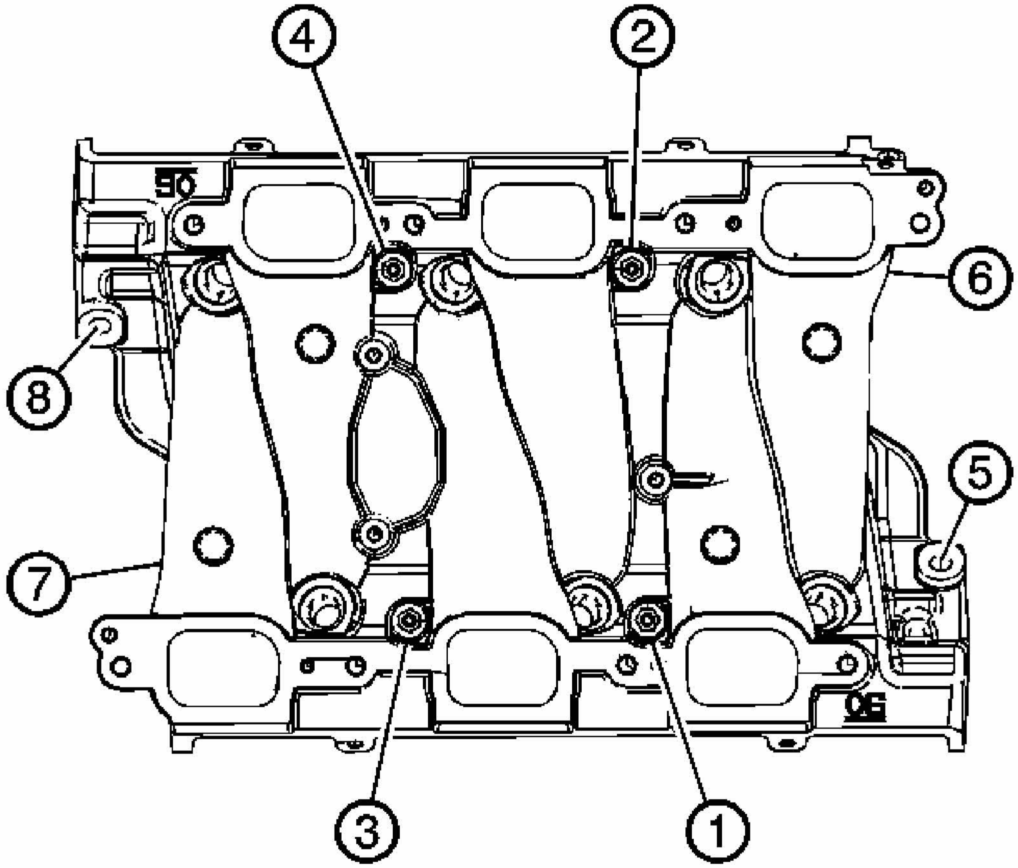


Fig. 482: Identifying Lower Intake Manifold Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.**

NOTE: **Failure to tighten vertical bolts before the diagonal bolts may cause an oil leak.**

3. Apply sealer GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the lower intake manifold bolt threads.

NOTE: **Refer to FASTENER NOTICE .**

4. Install the new lower intake manifold bolts if applicable, in sequence.

   Tighten:

   1. Tighten the lower intake manifold bolts in sequence to 7 N.m (62 lb in) on the first pass.
   2. Tighten the lower intake manifold bolts (1, 2, 3, 4) in sequence to 13 N.m (115 lb in) on the final pass.
   3. Tighten the lower intake manifold bolts (5, 6, 7, 8) in sequence to 25 N.m (18 lb ft) on the final pass.

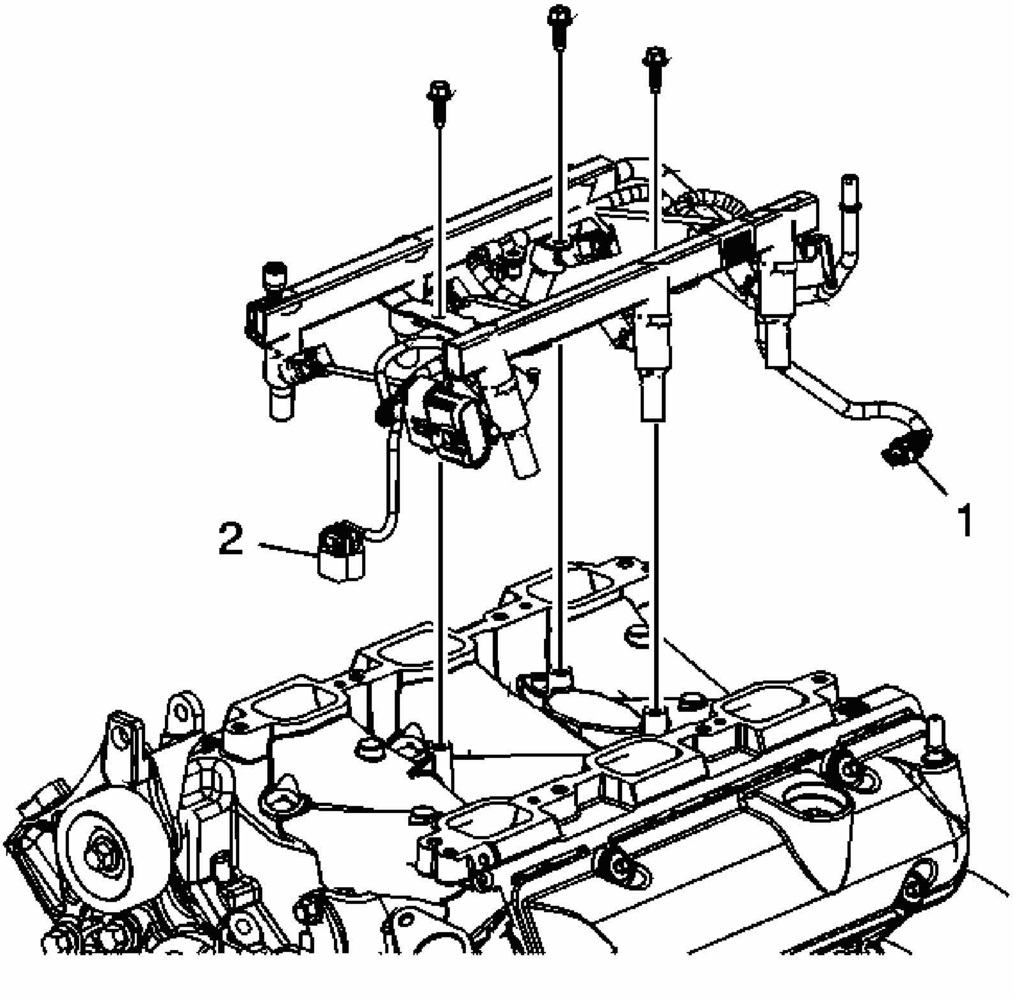


Fig. 483: Identifying Lower Intake Manifold Attachments

Courtesy of GENERAL MOTORS CORP.

5. Inspect the fuel rail, and fuel injectors for damage and replace if necessary.
6. Install NEW lower fuel injector O-rings.
7. Lubricate the fuel injector O-rings using GM P/N 12345616 (Canadian P/N 993182) or equivalent.

IMPORTANT: To ensure proper fuel rail orientation during installation, make sure the fuel feed pipe faces the rear of the engine.

8. Install the injector nozzles into the lower intake manifold injector bores.
9. Press on the injector rail using the palms of both hands until the injectors are fully seated.
10. Install the fuel injector rail bolts.

    Tighten: Tighten the fuel injector rail bolts to 10 N.m (89 lb in).

11. Connect the coolant temperature sensor (1).
12. Connect the camshaft position (CMP) sensor (2).

INTAKE MANIFOLD INSTALLATION - UPPER

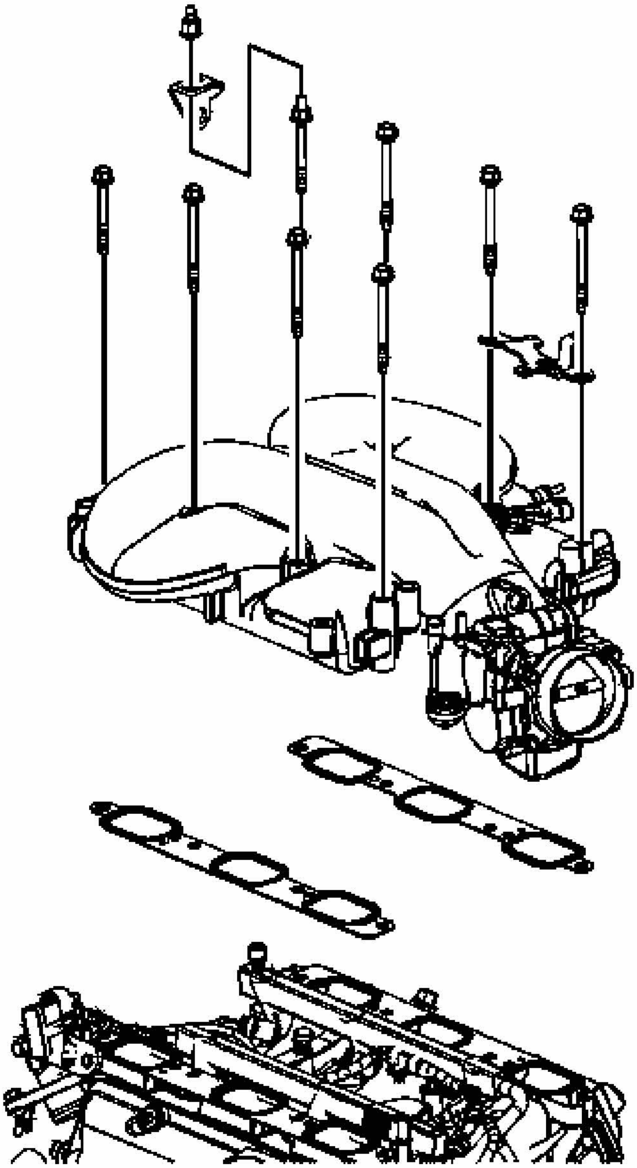


Fig. 484: View Of Upper Intake Manifold Bolts, Studs & Gaskets
Courtesy of GENERAL MOTORS CORP.

1. Install the upper intake manifold gaskets and manifold.
2. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the upper intake manifold bolt threads.

NOTE: Refer to FASTENER NOTICE in Cautions and

Notices.

3. Install the upper intake manifold bolts, stud, and MAP sensor bracket.

   Tighten: Tighten the upper intake manifold bolts and stud to 25 N.m (18 lb ft).

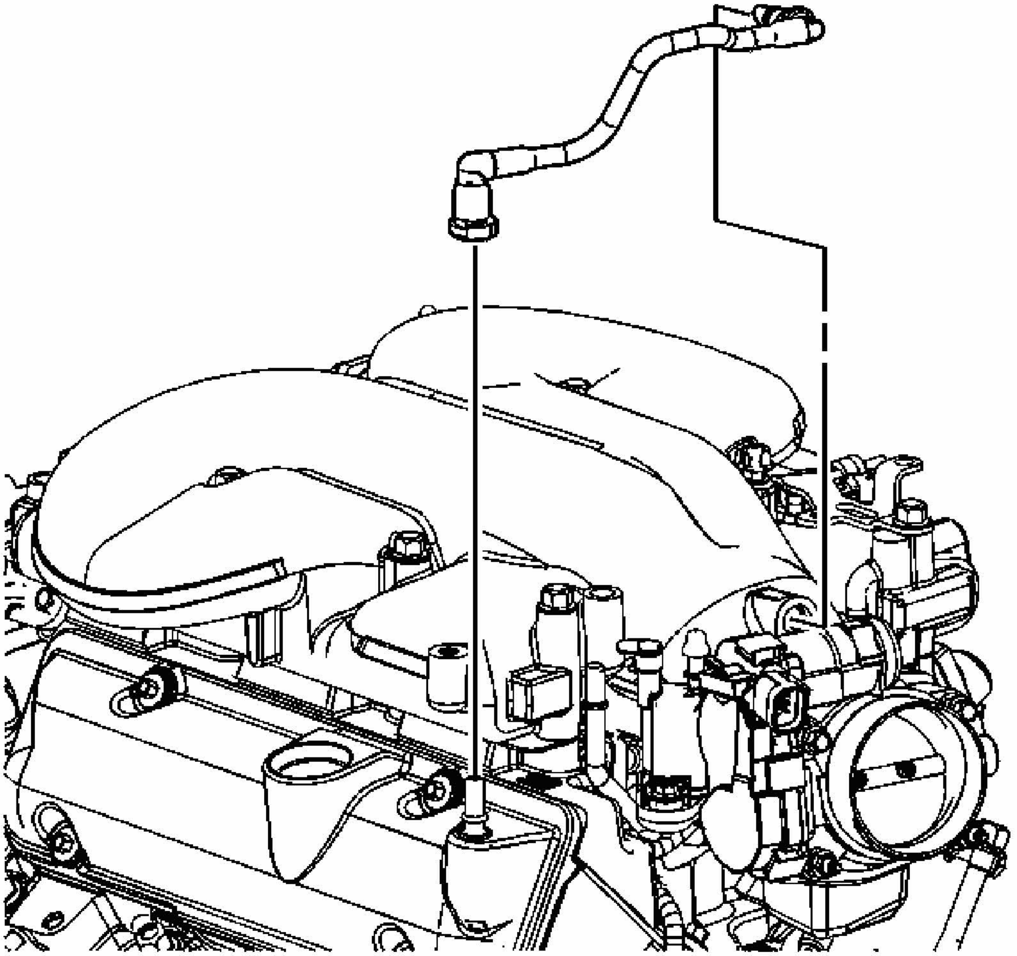


Fig. 485: Identifying PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

4. Install the foul air PCV tube.

VALVE ROCKER ARM COVER INSTALLATION - LEFT

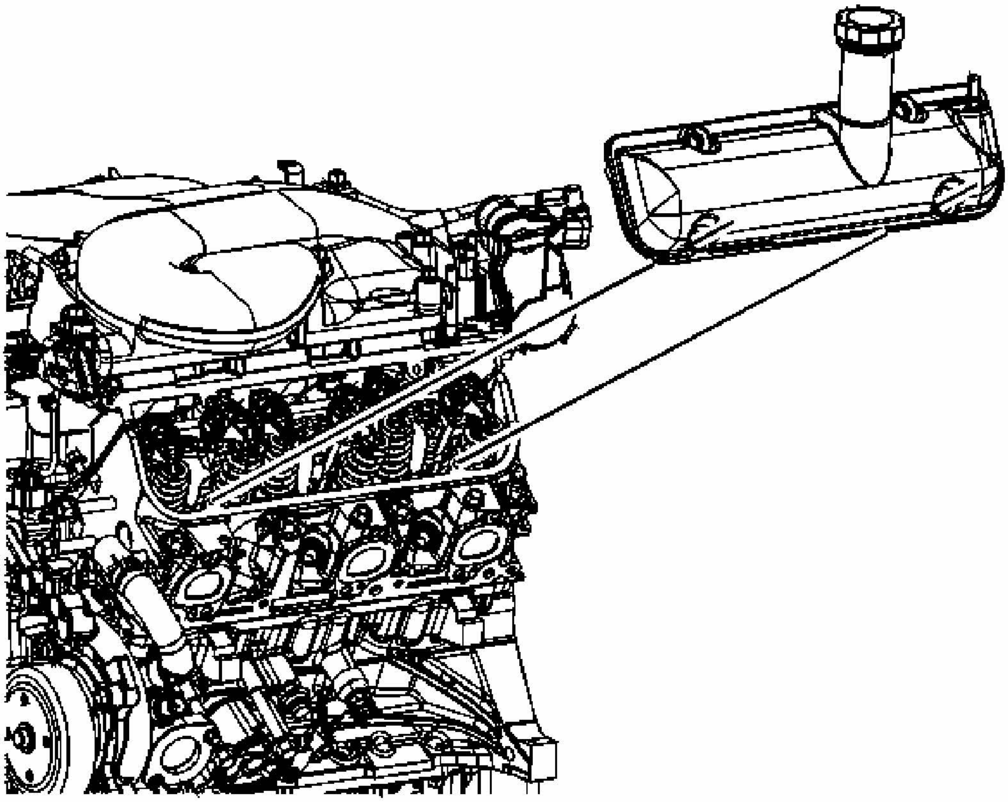


Fig. 486: Identifying Left Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All gasket-mating surfaces need to be free of oil and foreign material. Use GM P/N 12346139 (Canadian P/N 10953463) or equivalent to clean surfaces.

1. Install the valve rocker arm cover gasket into the valve rocker arm cover.

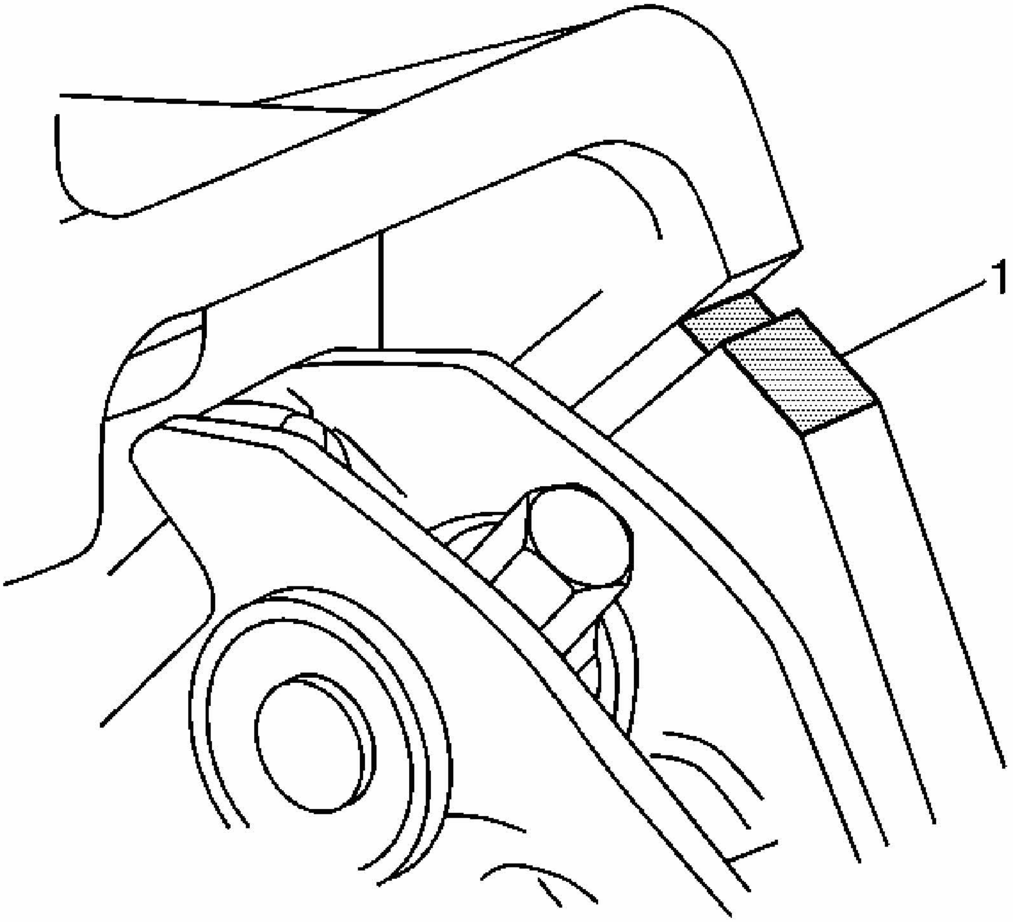


Fig. 487: Identifying Cylinder Head To Lower Intake Manifold Joint
Courtesy of GENERAL MOTORS CORP.

2. Apply sealer GM P/N 12378521 (Canadian P/N 88901148) or equivalent to the surfaces where the cylinder head and intake manifold meet (1).
3. Install the valve rocker arm cover.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

4. Install the valve rocker arm cover bolts, if necessary.

Tighten: Tighten the valve rocker arm cover bolts to 10 N.m (89 lb in).

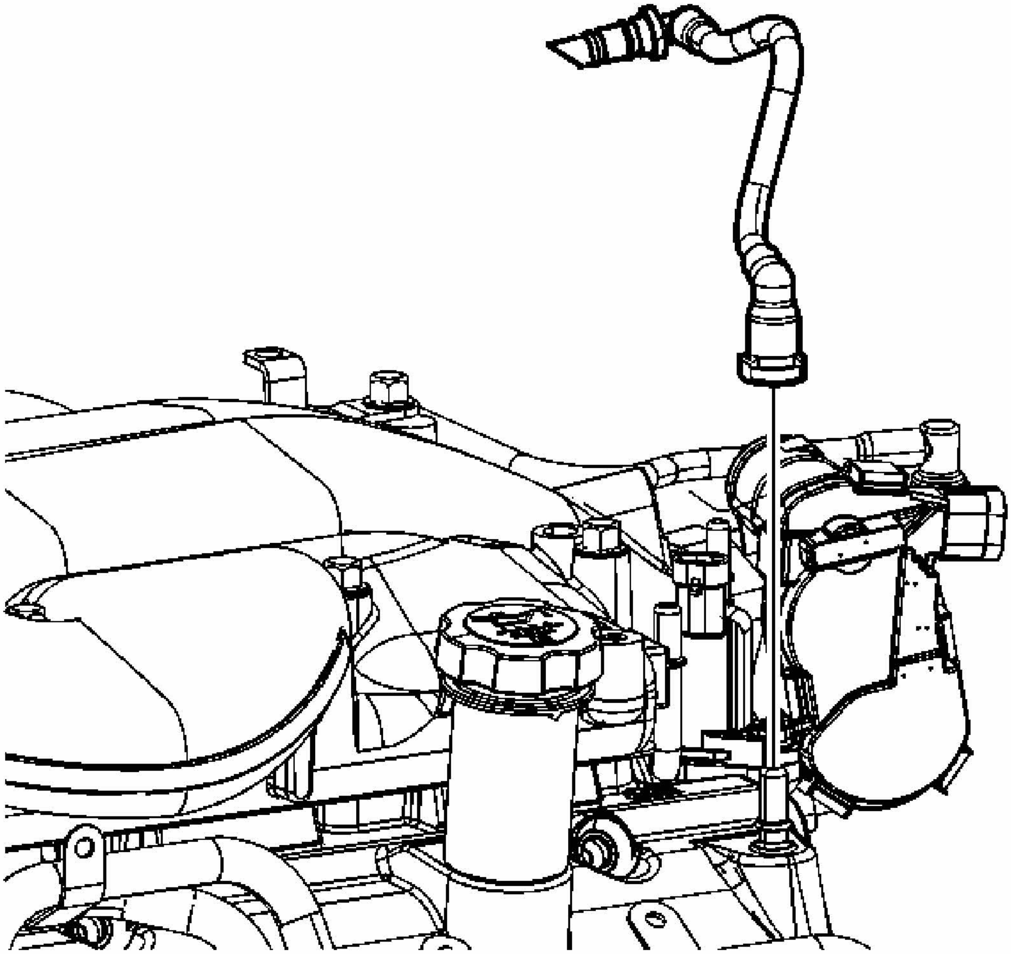


Fig. 488: Locating Positive Crankcase Ventilation Tube
Courtesy of GENERAL MOTORS CORP.

5. Install the fresh air tube.

VALVE ROCKER ARM COVER INSTALLATION - RIGHT

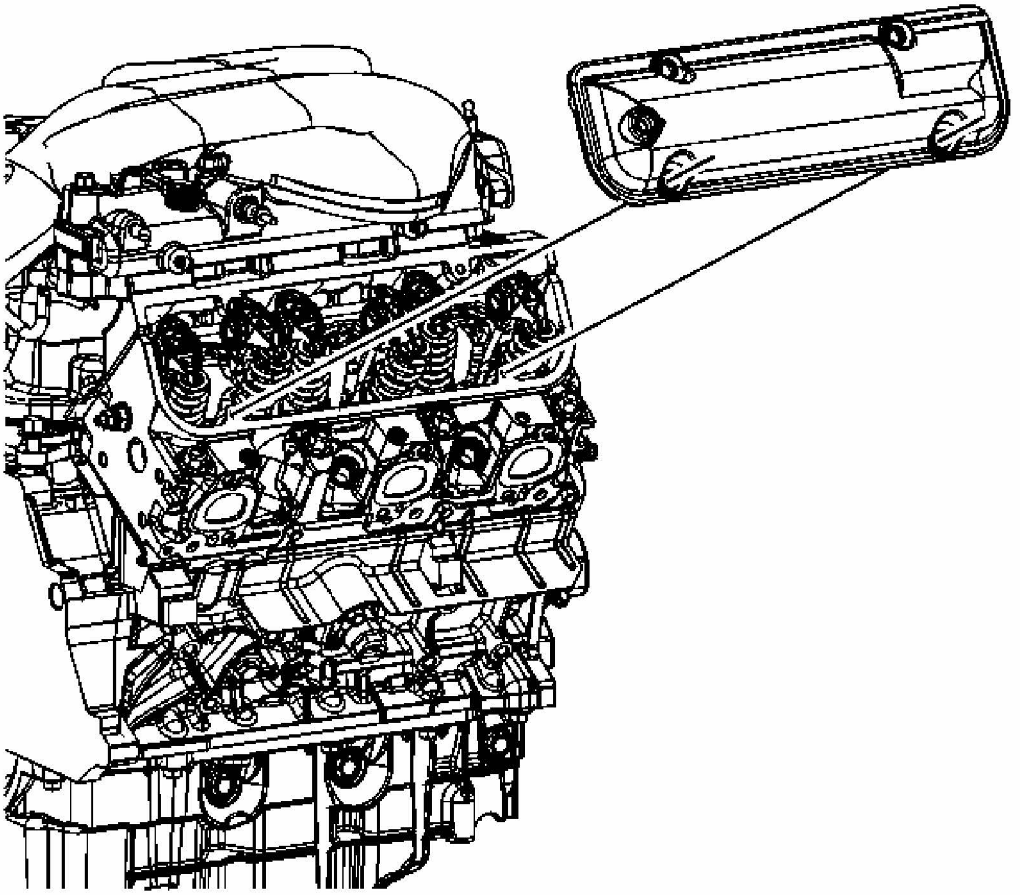


Fig. 489: View Of Right Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All gasket-mating surfaces need to be free of oil and foreign material. Use GM P/N 12346139 (Canadian P/N 10953463) or equivalent to clean surfaces.

1. Install the valve rocker arm cover gasket into the valve rocker arm cover.

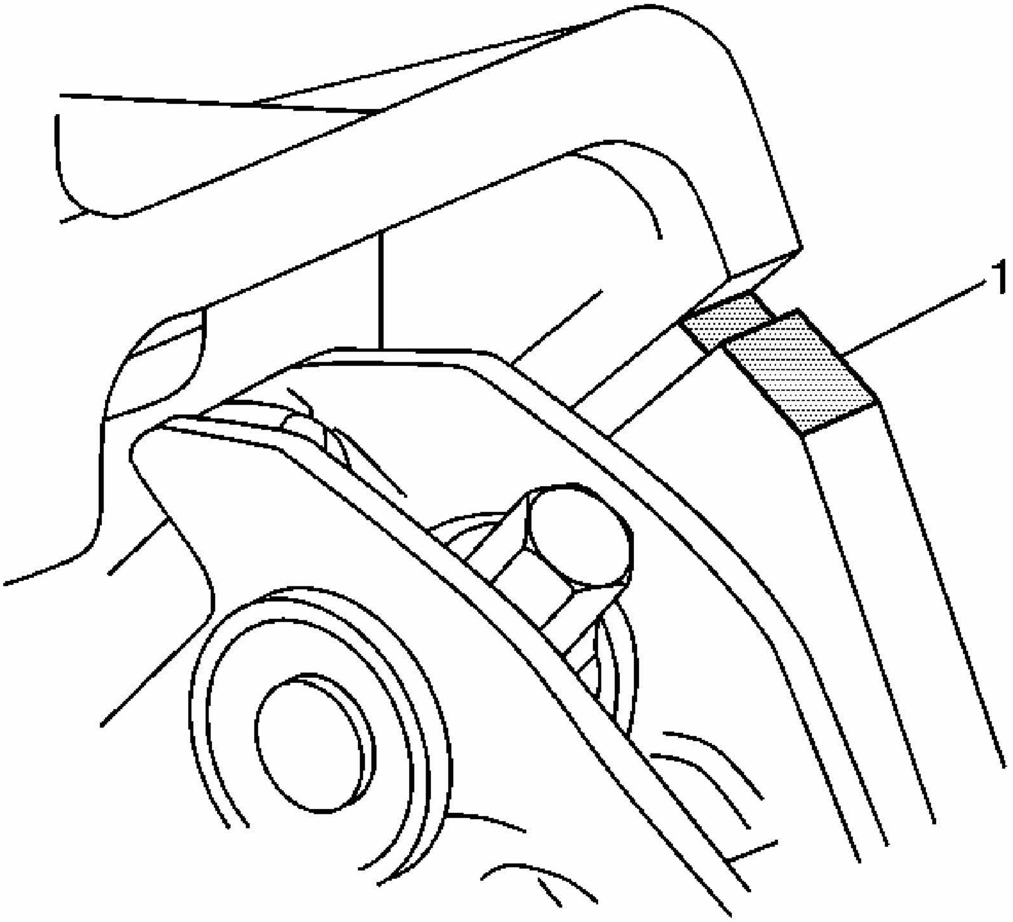


Fig. 490: Identifying Cylinder Head To Lower Intake Manifold Joint
Courtesy of GENERAL MOTORS CORP.

2. Apply sealer GM P/N 12378521 (Canadian P/N 88901148) or equivalent to the surfaces where the cylinder head and intake manifold meet (1).
3. Install the valve rocker arm cover.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

4. Install the valve rocker arm cover bolts, if necessary.

Tighten: Tighten the valve rocker arm cover bolts to 10 N.m (89 lb in).

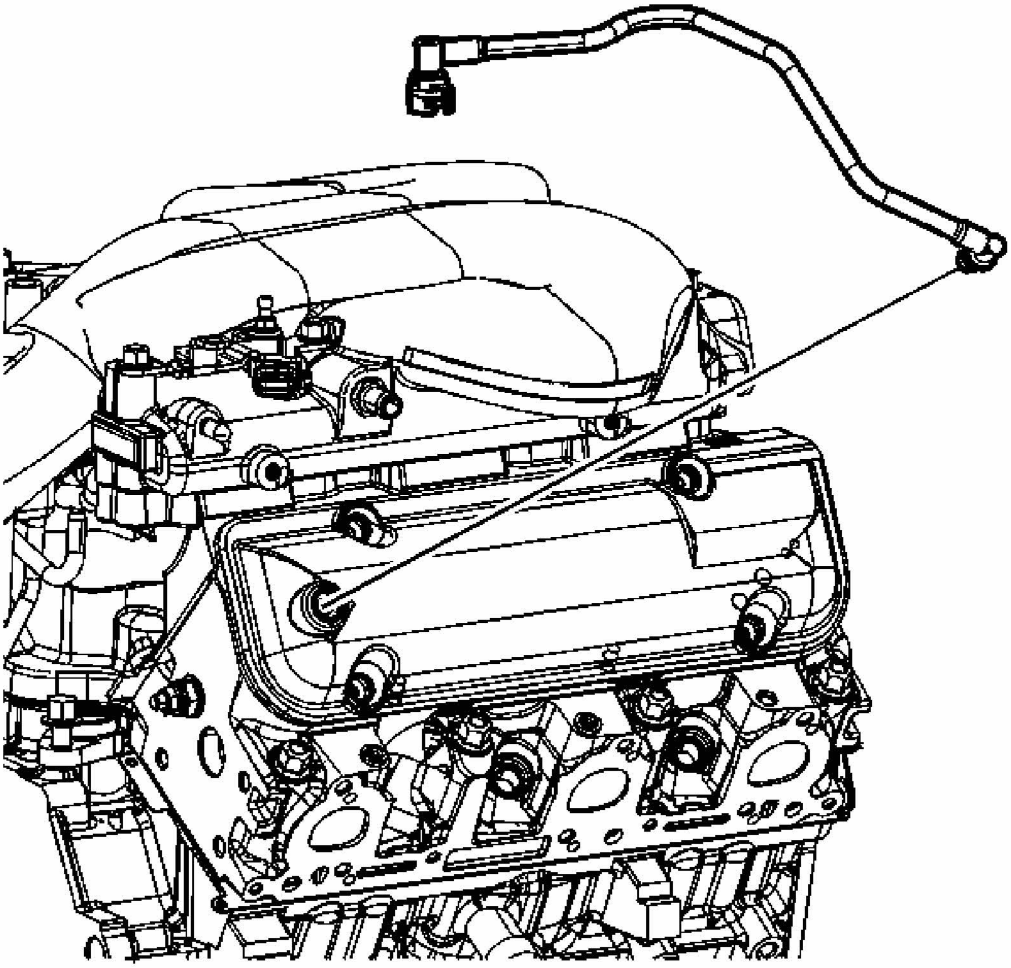


Fig. 491: Identifying Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Install the fresh air tube into the valve rocker arm cover.

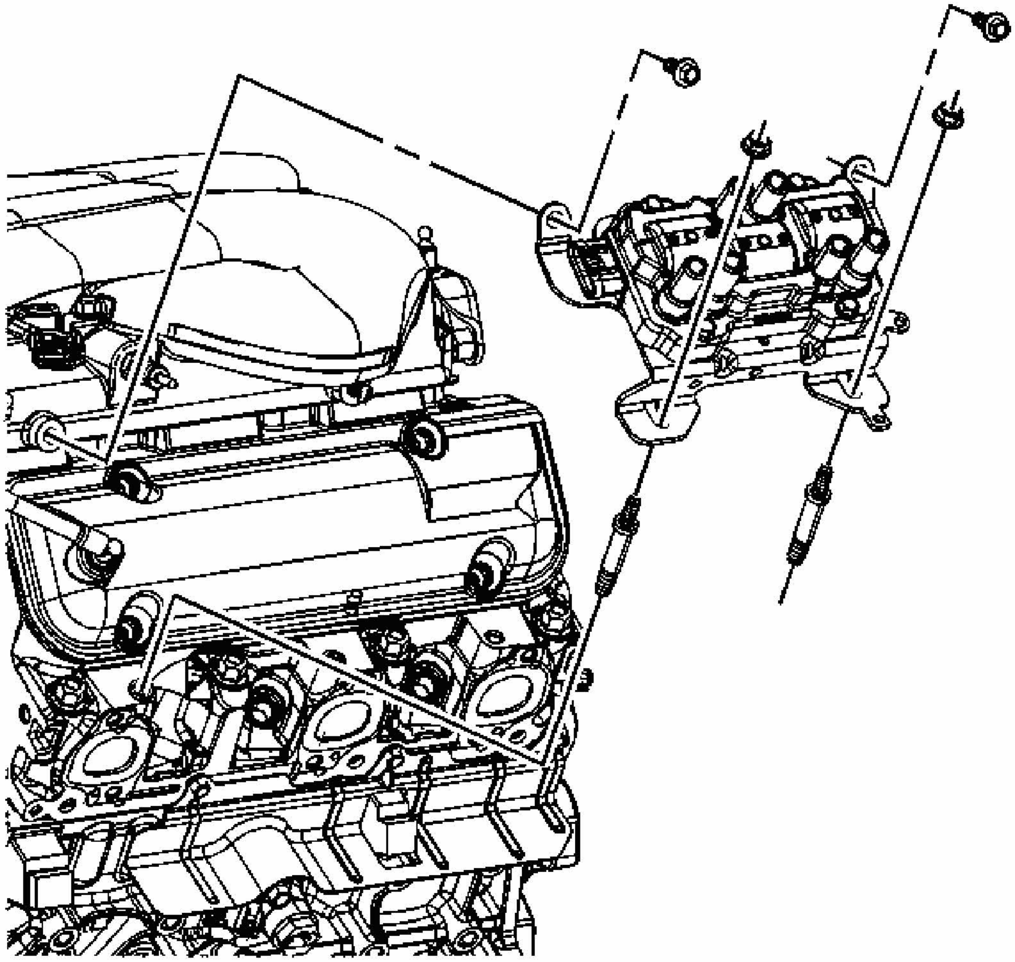


Fig. 492: Identifying Ignition Coil Assembly, Studs & Nuts
Courtesy of GENERAL MOTORS CORP.

6. Install the ignition coil assembly studs, if necessary.

   Tighten: Tighten the ignition coil assembly studs to 25 N.m (18 lb ft).

7. Install the ignition coil assembly.
8. Install the ignition coil assembly bolts and nuts.

   Tighten: Tighten the ignition coil assembly bolts and nuts to 25 N.m (18 lb ft).

WATER OUTLET AND THERMOSTAT INSTALLATION

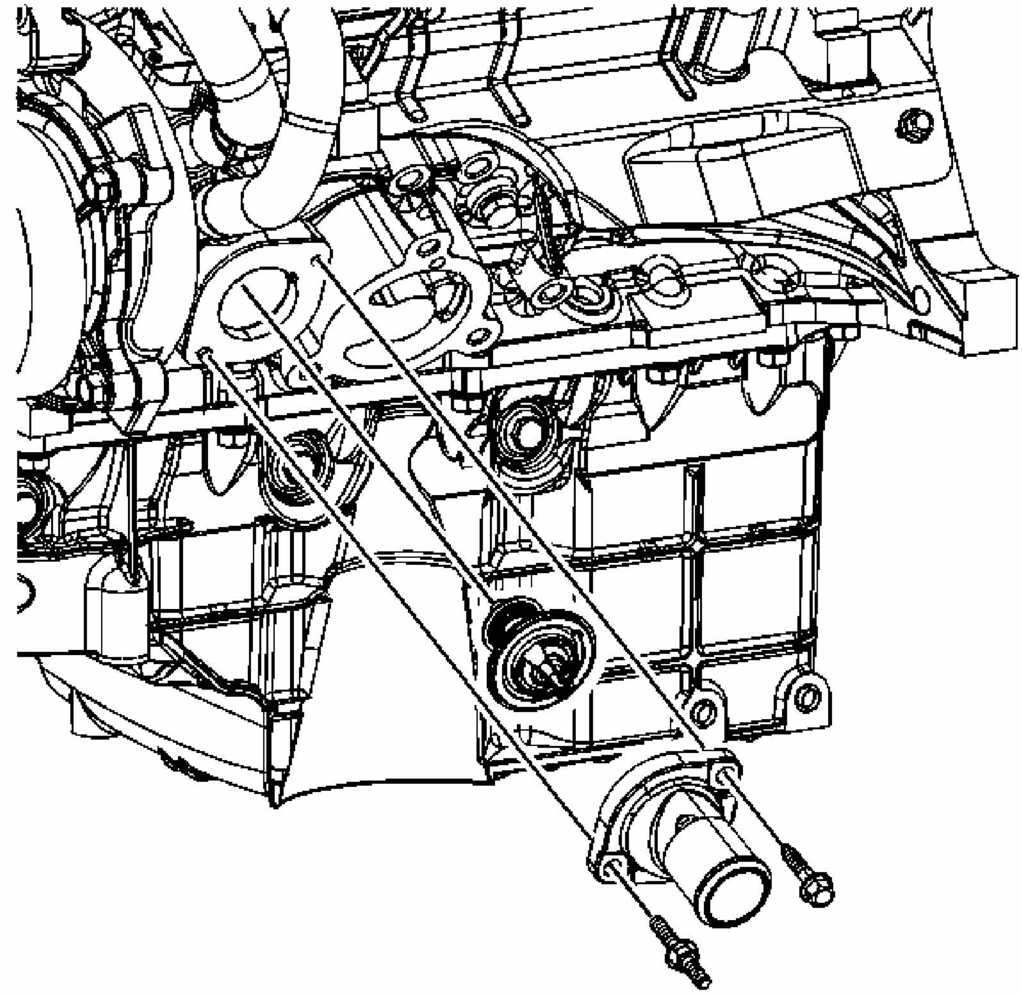


Fig. 493: Identifying Thermostat Housing Bolt/Stud
Courtesy of GENERAL MOTORS CORP.

1. Install the thermostat.
2. Install the water outlet.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

3. Install the water outlet bolts.

Tighten: Tighten the water outlet bolts to 25 N.m (18 lb ft).

EXHAUST MANIFOLD INSTALLATION - LEFT

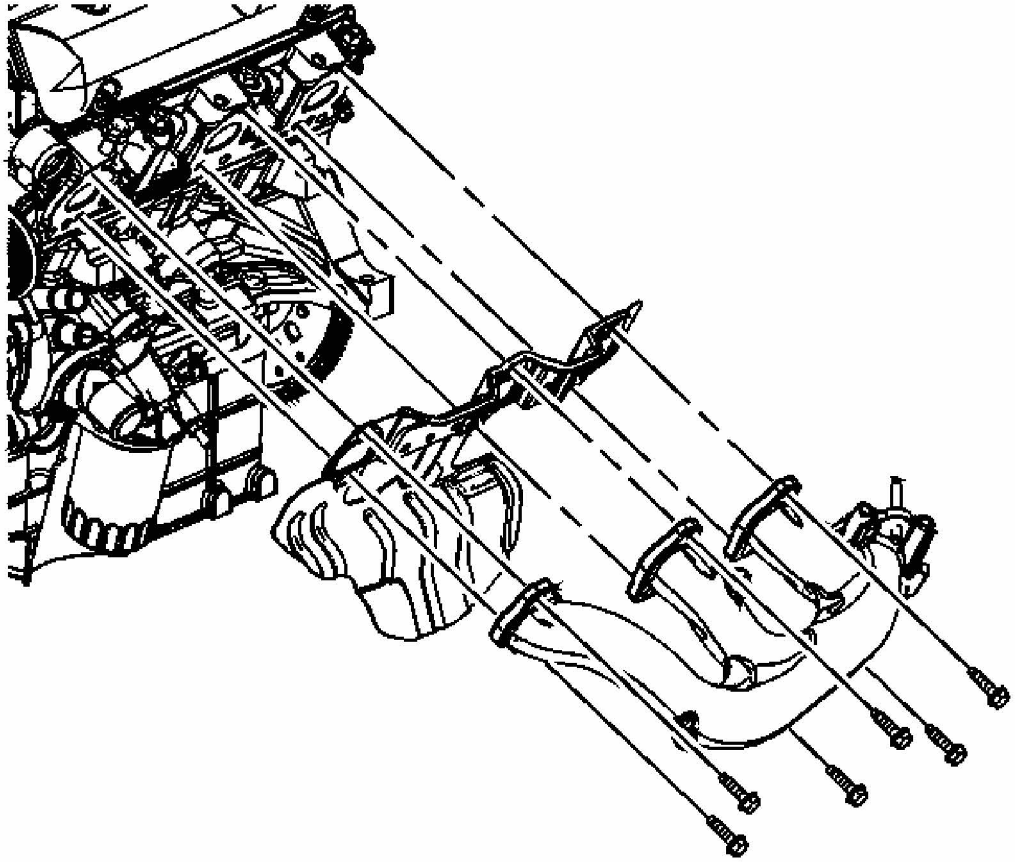


Fig. 494: View Of Left Exhaust Manifold & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the exhaust manifold gasket.
2. Install the exhaust manifold.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

3. Install the exhaust manifold bolts.

Tighten: Tighten the exhaust manifold bolts to 20 N.m (15 lb ft).

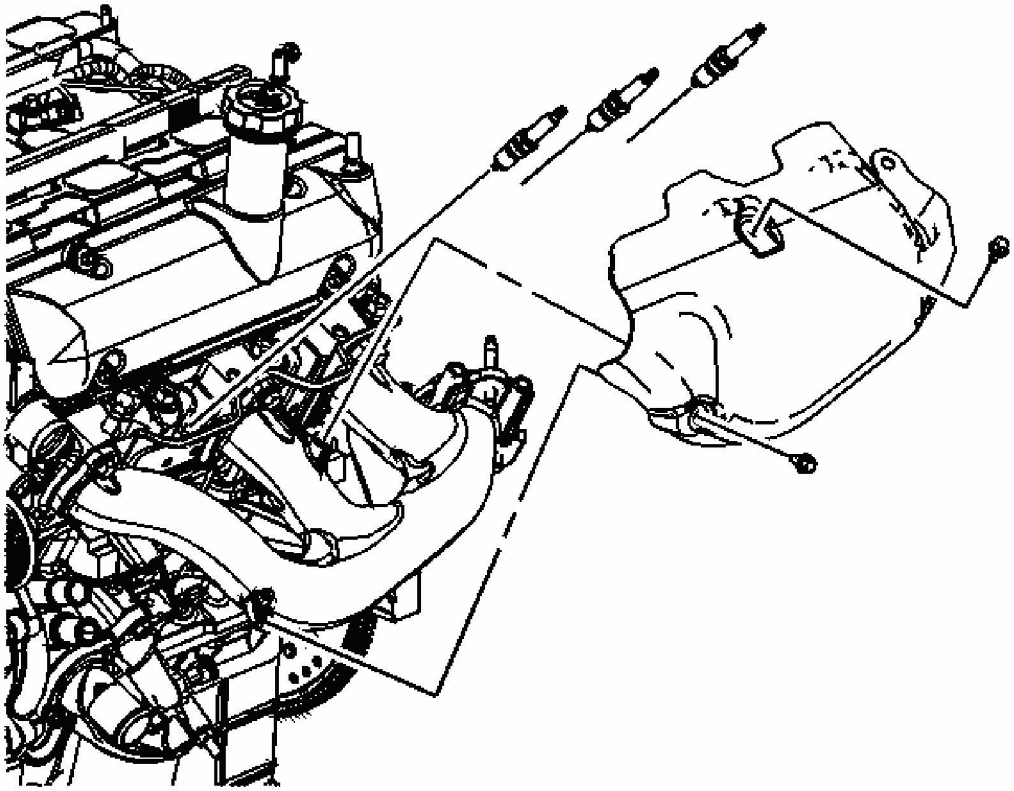


Fig. 495: View Of Spark Plugs & Heat Shield
Courtesy of GENERAL MOTORS CORP.

4. Install the exhaust manifold heat shield.
5. Install the exhaust manifold heat shield bolts.

   Tighten: Tighten the exhaust manifold heat shield bolts to 10 N.m (89 lb in).

6. Install the spark plugs.

   Tighten: Tighten the spark plugs to 15 N.m (11 lb ft).

7. Install the spark plug wires.

EXHAUST MANIFOLD INSTALLATION - RIGHT

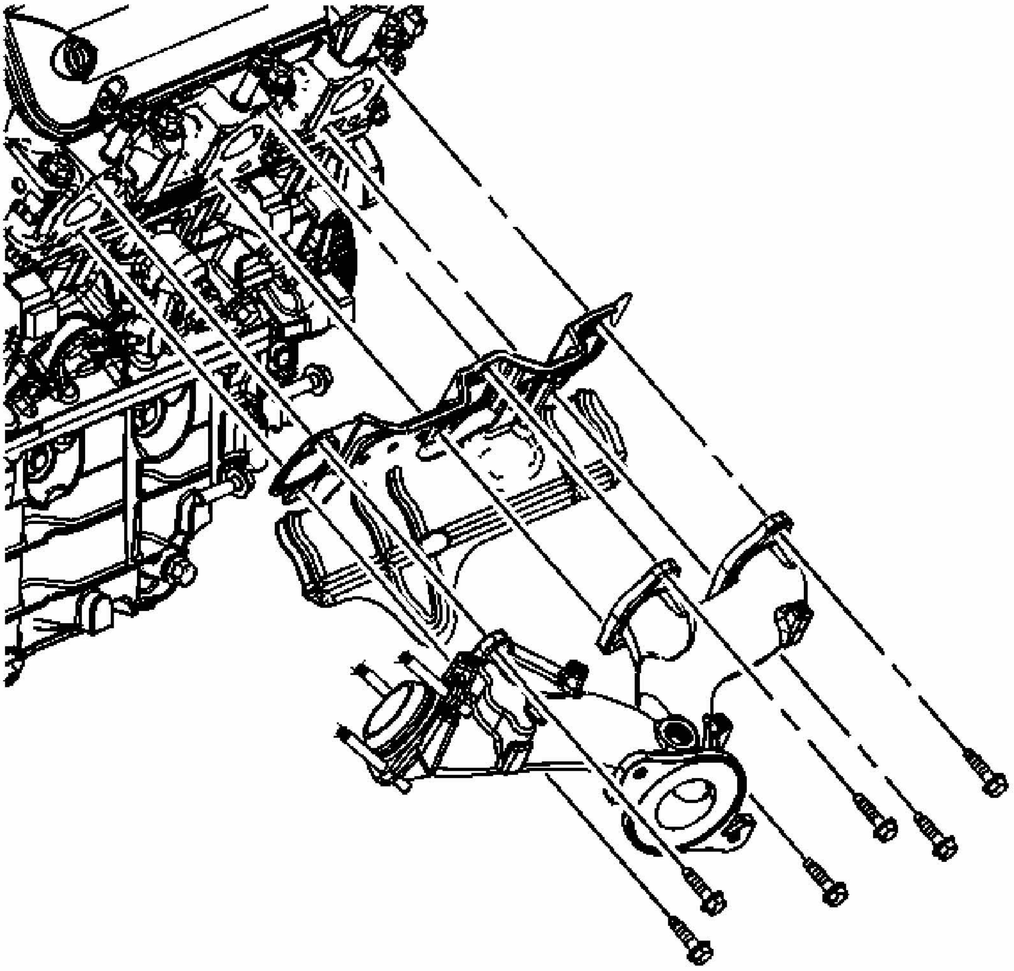


Fig. 496: View Of Right Exhaust Manifold & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the exhaust manifold gasket.
2. Install the exhaust manifold.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

3. Install the exhaust manifold bolts.

Tighten: Tighten the exhaust manifold bolts to 20 N.m (15 lb ft).

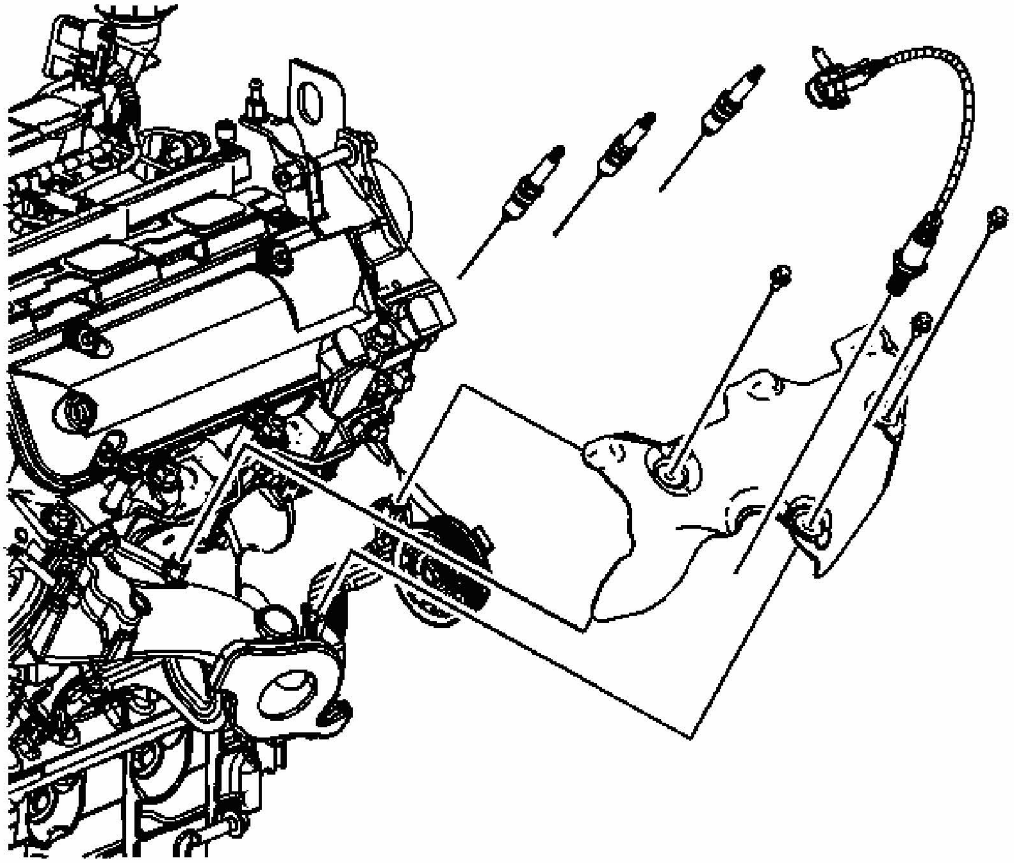


Fig. 497: Identifying Right Side Spark Plugs, HO2S & Heat Shield
Courtesy of GENERAL MOTORS CORP.

4. Install the exhaust manifold heat shield.
5. Install the exhaust manifold heat shield bolts.

   Tighten: Tighten the exhaust manifold heat shield bolts to 10 N.m (89 lb in).

6. Install the spark plugs.

   Tighten: Tighten the spark plugs to 15 N.m (11 lb ft).

7. Install the spark plug wires.
8. Install the heated oxygen sensor.

   Tighten: Tighten the heated oxygen sensor to 42 N.m (31 lb ft).

EXHAUST CROSSOVER PIPE INSTALLATION

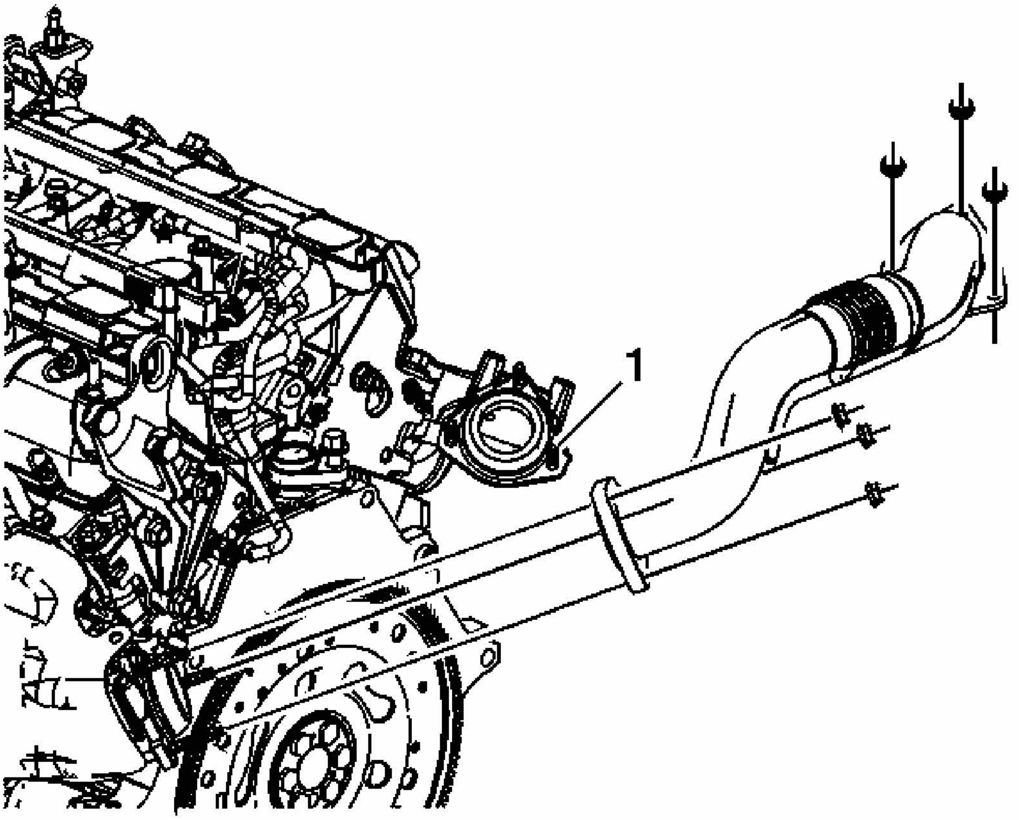


Fig. 498: Identifying Exhaust Crossover Pipe & Nuts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

1. Install the exhaust crossover pipe studs (1) if necessary.

   Tighten: Tighten the exhaust crossover pipe studs to 25 N.m (18 lb ft).

2. Install the exhaust crossover pipe.
3. Install the exhaust crossover pipe nuts.

   Tighten: Tighten the exhaust crossover pipe nuts to 25 N.m (18 lb ft).

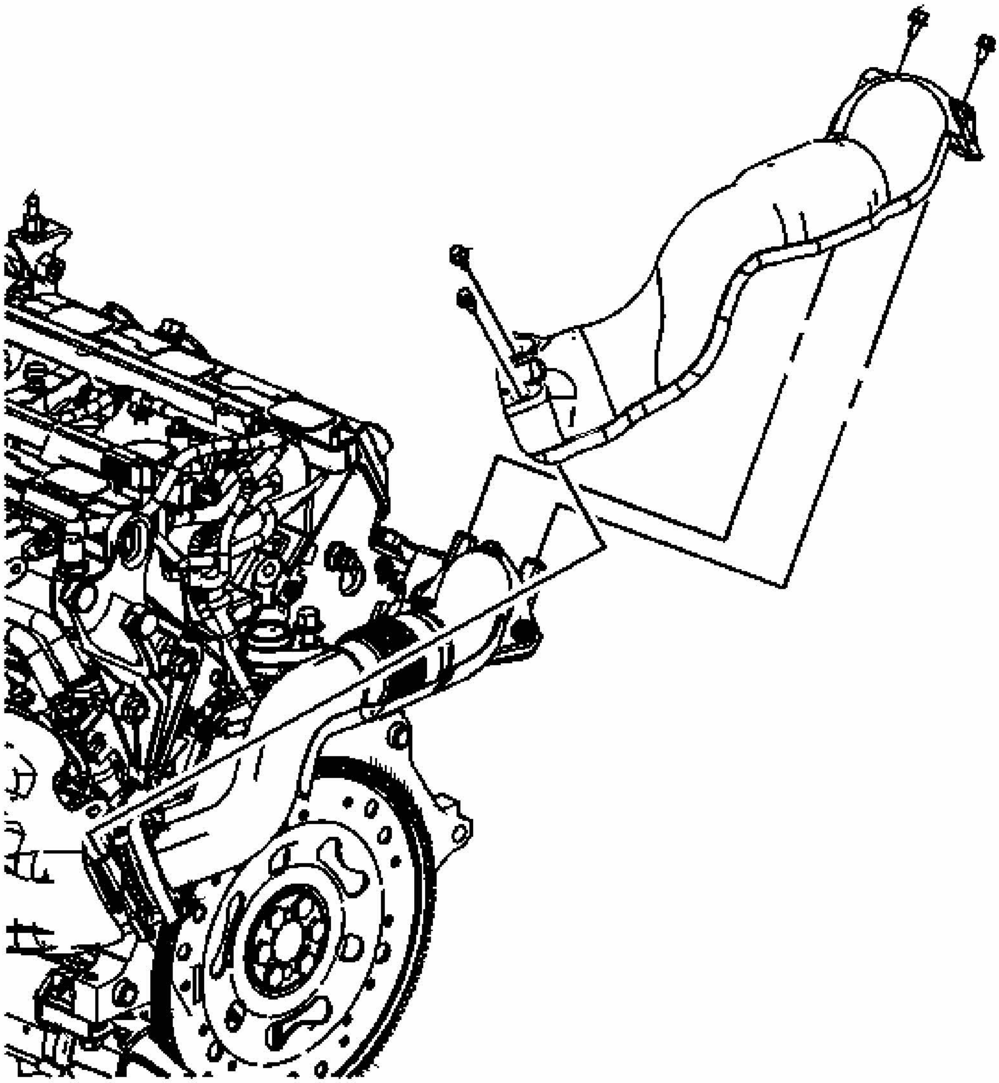


Fig. 499: Identifying Exhaust Crossover Pipe Heat Shield
Courtesy of GENERAL MOTORS CORP.

4. Install the exhaust crossover heat shield.
5. Install the exhaust crossover heat shield bolts.

Tighten: Tighten the exhaust crossover heat shield bolts to 10 N.m (89 lb in).

OIL FILTER ADAPTER INSTALLATION

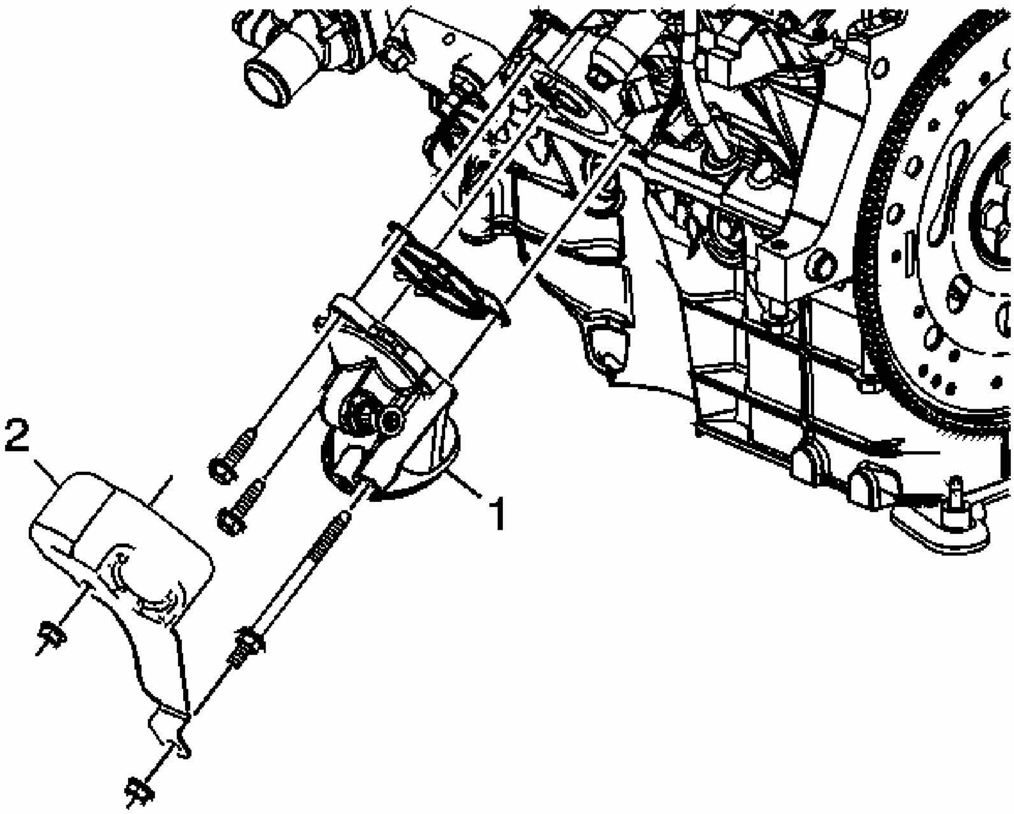


Fig. 500: Identifying Oil Filter Adapter & Heat Shield
Courtesy of GENERAL MOTORS CORP.

NOTE: Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.

1. Install the oil filter adapter (1) and gasket.
2. Apply threadlocker P/N 21485277 to the bolt threads if required.

   NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

3. Install the oil filter adapter bolts.

   Tighten: Tighten the oil filter adapter bolts to 25 N.m (18 lb ft).

4. Install the oil filter adapter heat shield (2).
5. Install the oil filter adapter heat shield nuts.

   Tighten: Tighten the oil filter adapter heat shield nuts to 25 N.m (18 lb ft).

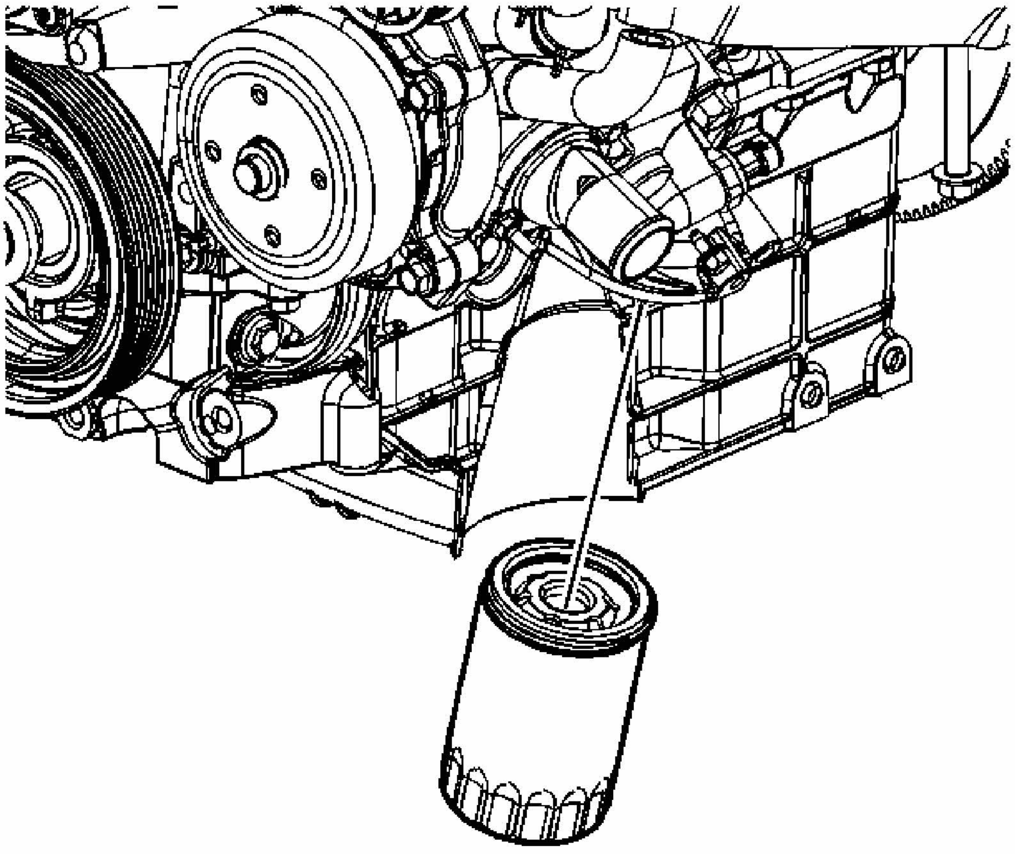


Fig. 501: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

6. Install the oil filter.

   Tighten: Tighten the oil filter to 30 N.m (22 lb ft).

OIL LEVEL INDICATOR AND TUBE INSTALLATION

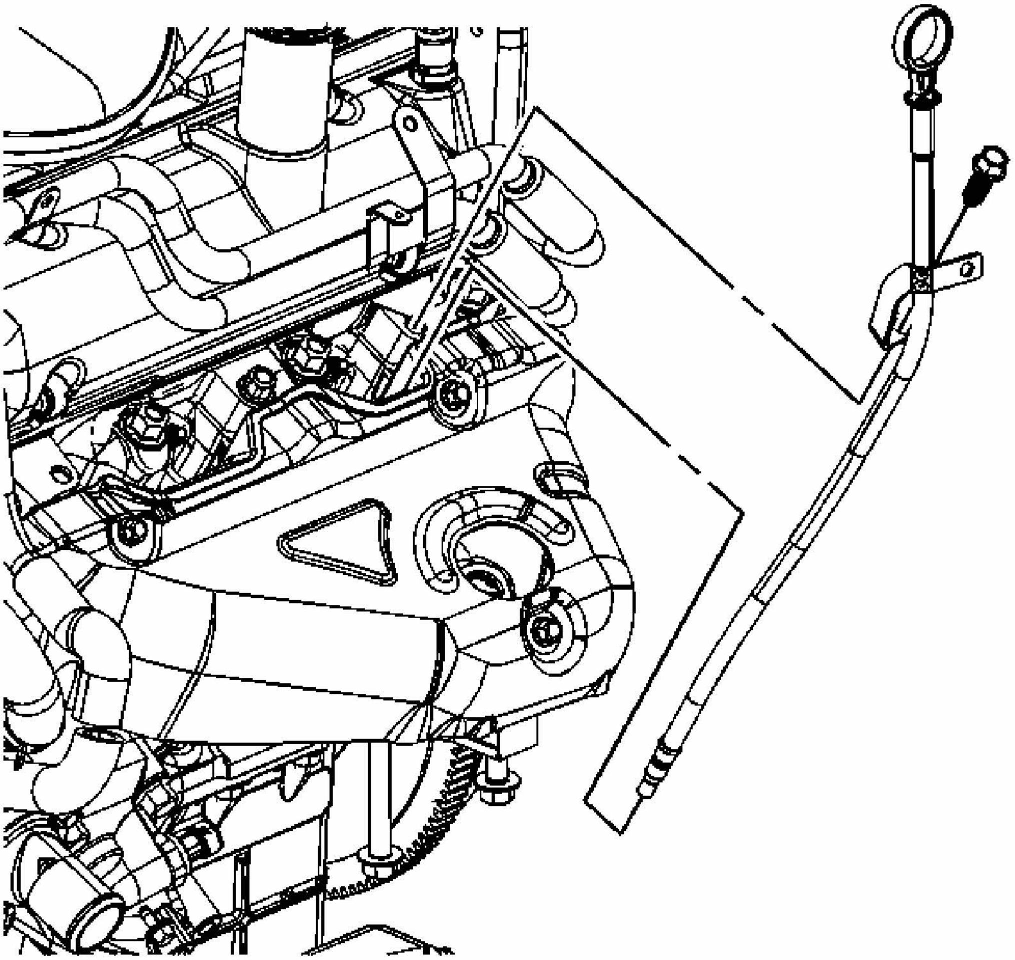


Fig. 502: View Of Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Install the oil level indicator tube and oil level indicator.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

2. Install the oil level indicator tube bolt.

Tighten: Tighten the oil level indicator tube bolt to 25 N.m (18 lb ft).

COOLANT CROSSOVER PIPE INSTALLATION

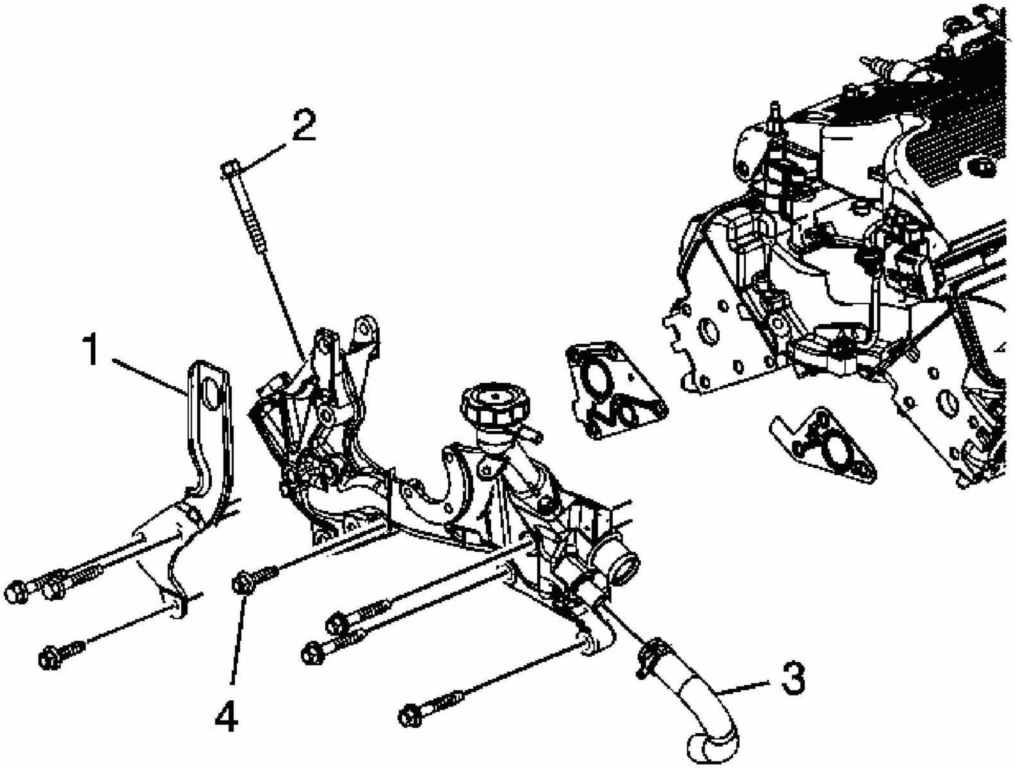


Fig. 503: View Of Coolant Crossover Pipe Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant crossover pipe gaskets and the coolant crossover pipe assembly onto the engine.

   NOTE: **Refer to Fastener Notice .**

2. Install the engine lift bracket (1) and the front coolant crossover pipe bolts (4).

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

3. Install the side coolant crossover pipe bolt (2).

   Tighten: Tighten the bolt to 10 N.m (89 lb in).

4. Install the thermal bypass hose (3) and securely fasten the hose clamp.

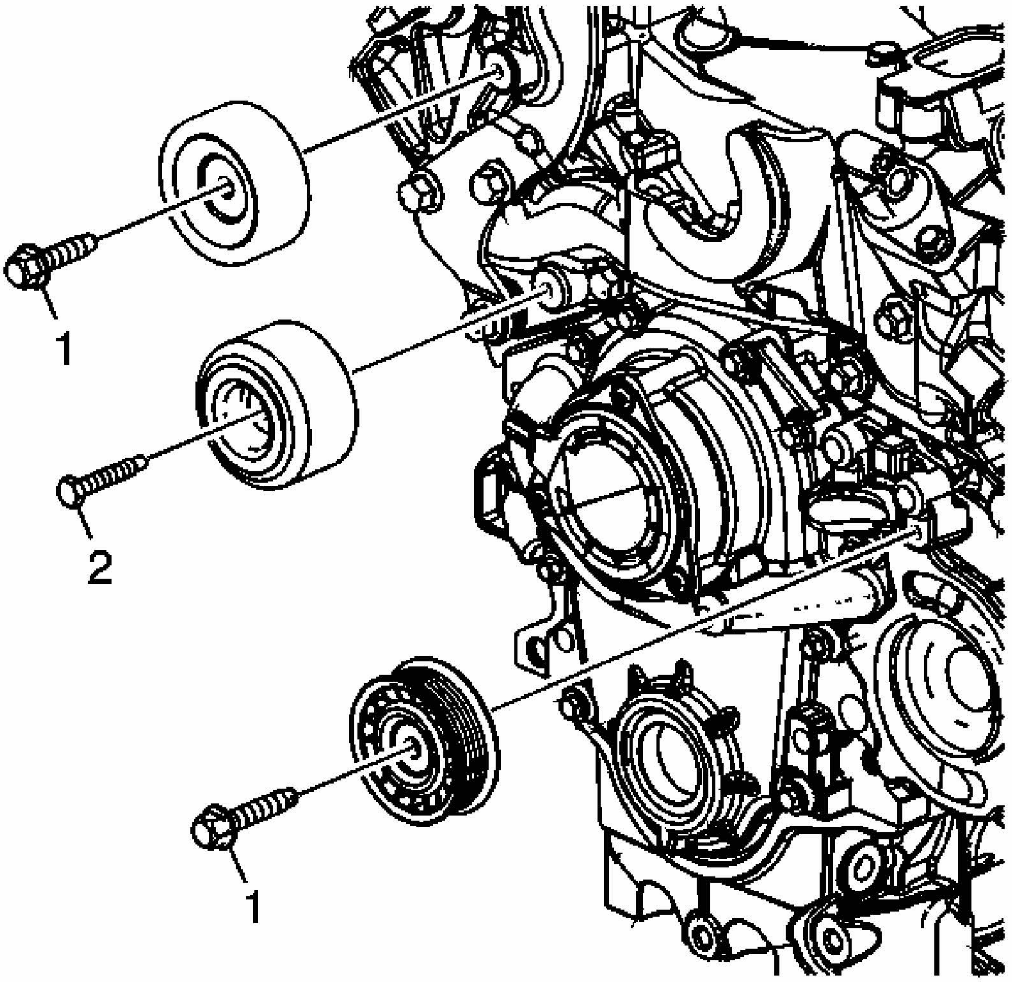


Fig. 504: Identifying Idler Pulley Bolts & Pulleys
Courtesy of GENERAL MOTORS CORP.

5. Install the idler pulleys and bolts.

   Tighten:

   - Tighten the bolts (1) to 50 N.m (37 lb ft).
   - Tighten the bolt (2) to 30 N.m (22 lb ft).

ENGINE MOUNT SUPPORT AND STRUT BRACKET INSTALLATION

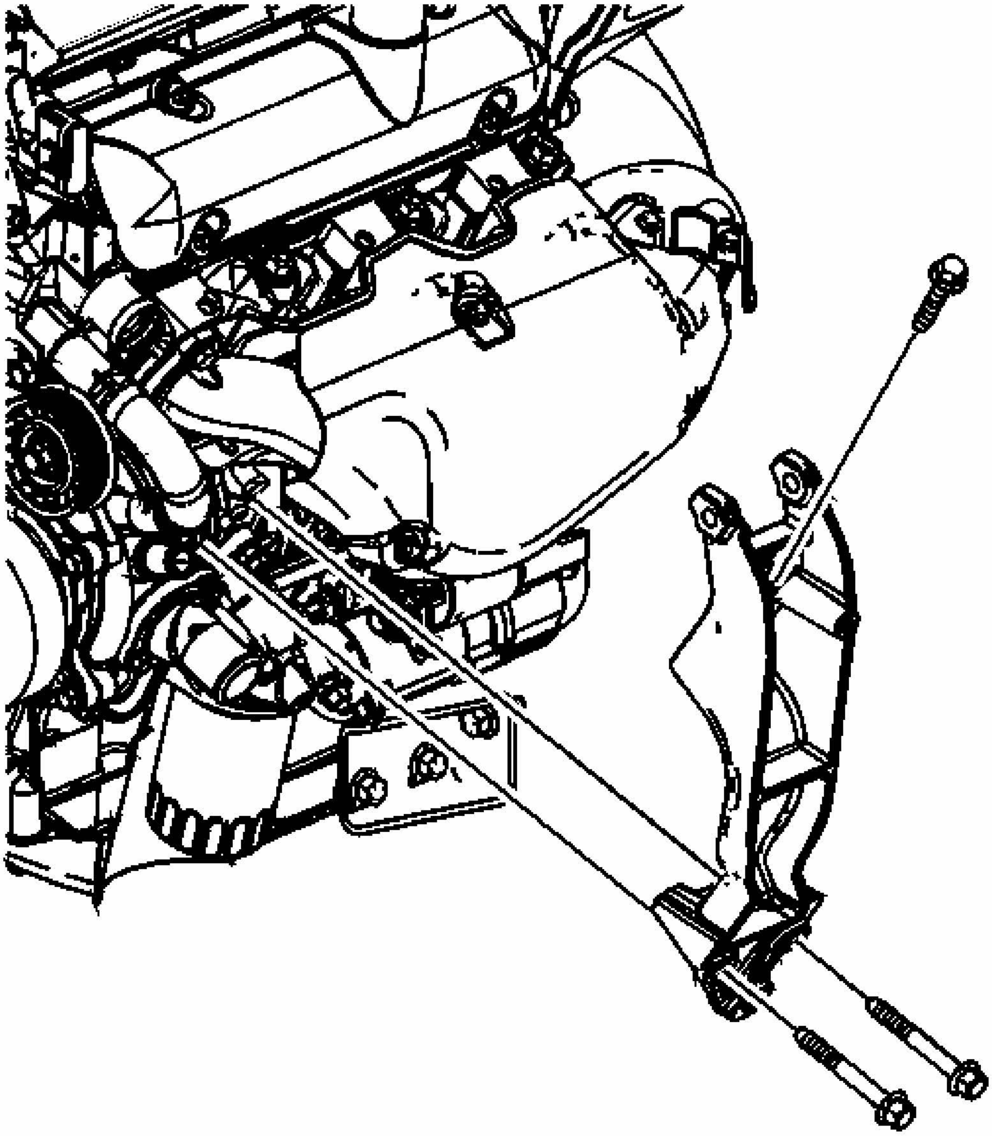


Fig. 505: View Of Engine Mount Support & Strut Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount support and strut bracket and bracket bolts.

   NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

2. Tighten the bolts.

Tighten: Tighten the bolts to 50 N.m (37 lb ft).

ENGINE MOUNT STRUT AND ENGINE LIFT BRACKET INSTALLATION

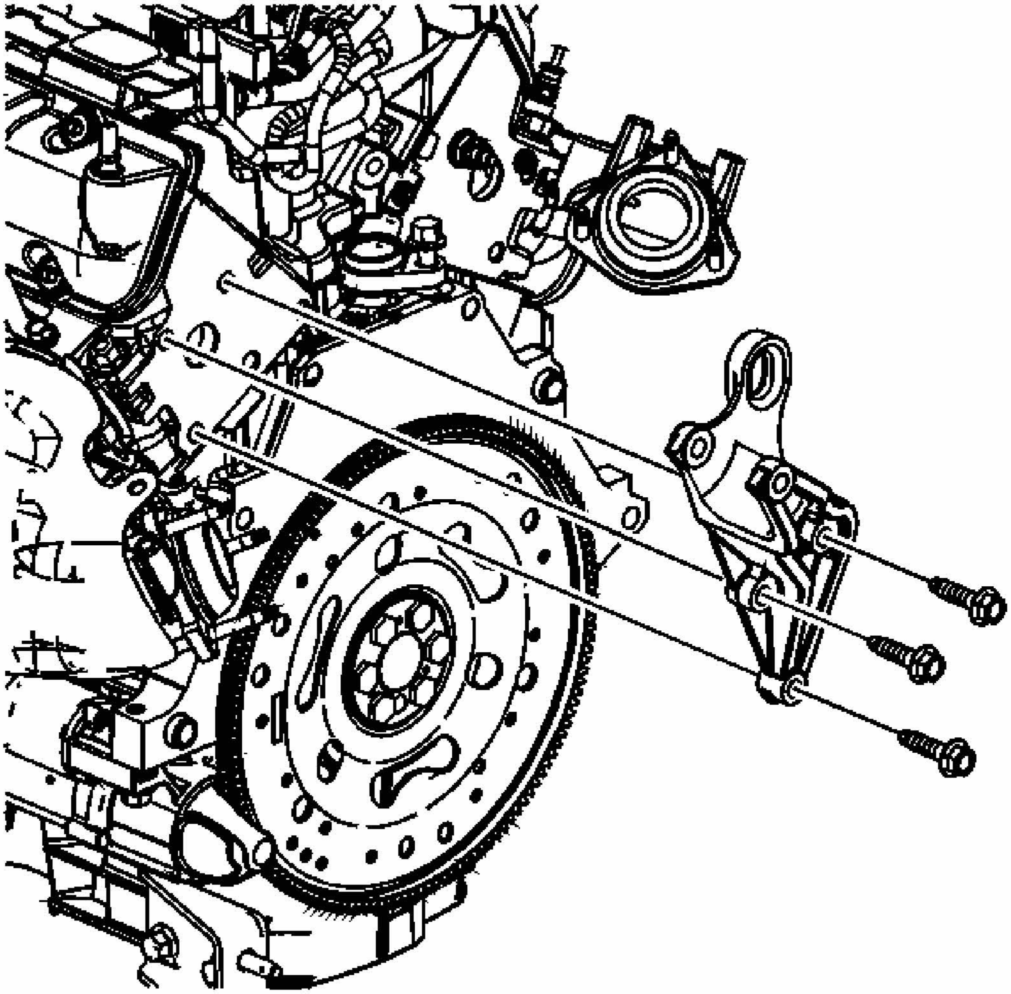


Fig. 506: Identifying Engine Lift Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount strut and engine lift bracket and bracket bolts.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the bolts.

Tighten: Tighten the bolts to 50 N.m (37 lb ft).

DRIVE BELT TENSIONER INSTALLATION

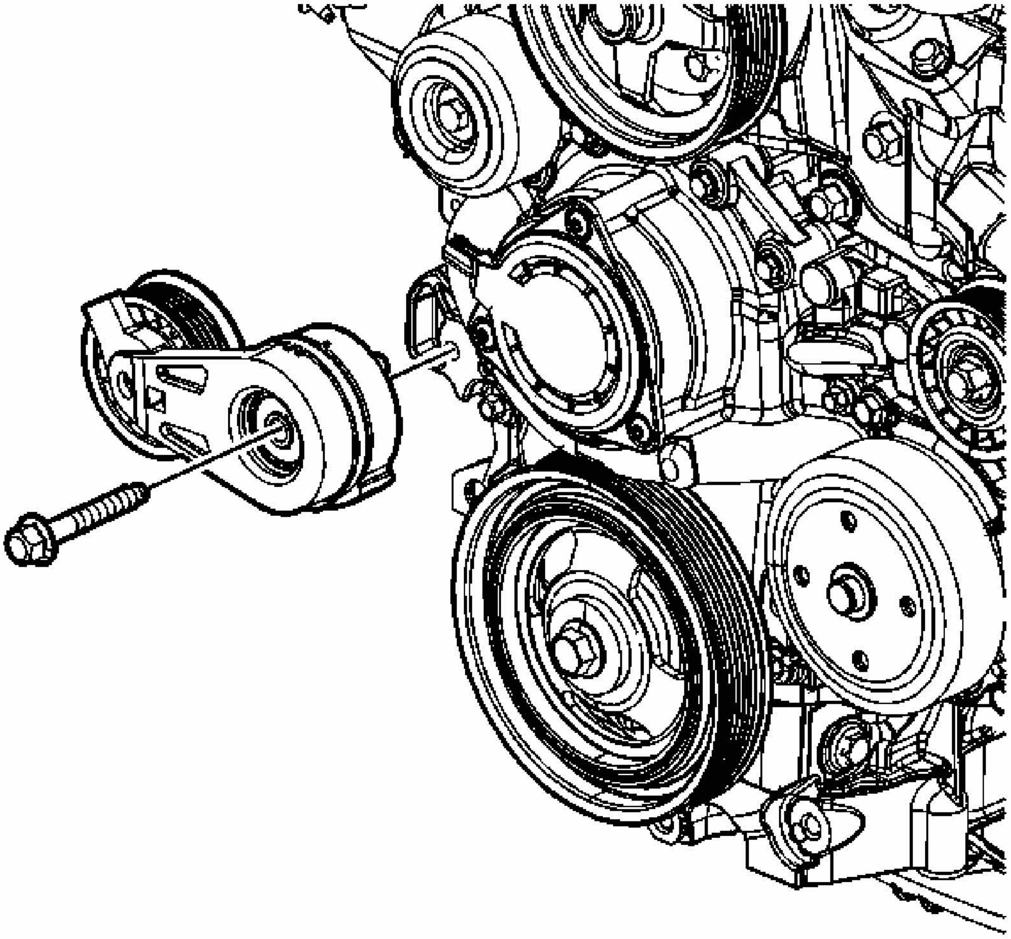


Fig. 507: Identifying Drive Belt Tensioner & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the drive belt tensioner.

   NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

2. Install the drive belt tensioner bolt.

   Tighten: Tighten the drive belt tensioner bolt to 50 N.m (37 lb ft).

ENGINE FLYWHEEL INSTALLATION (AUTOMATIC TRANSMISSION)

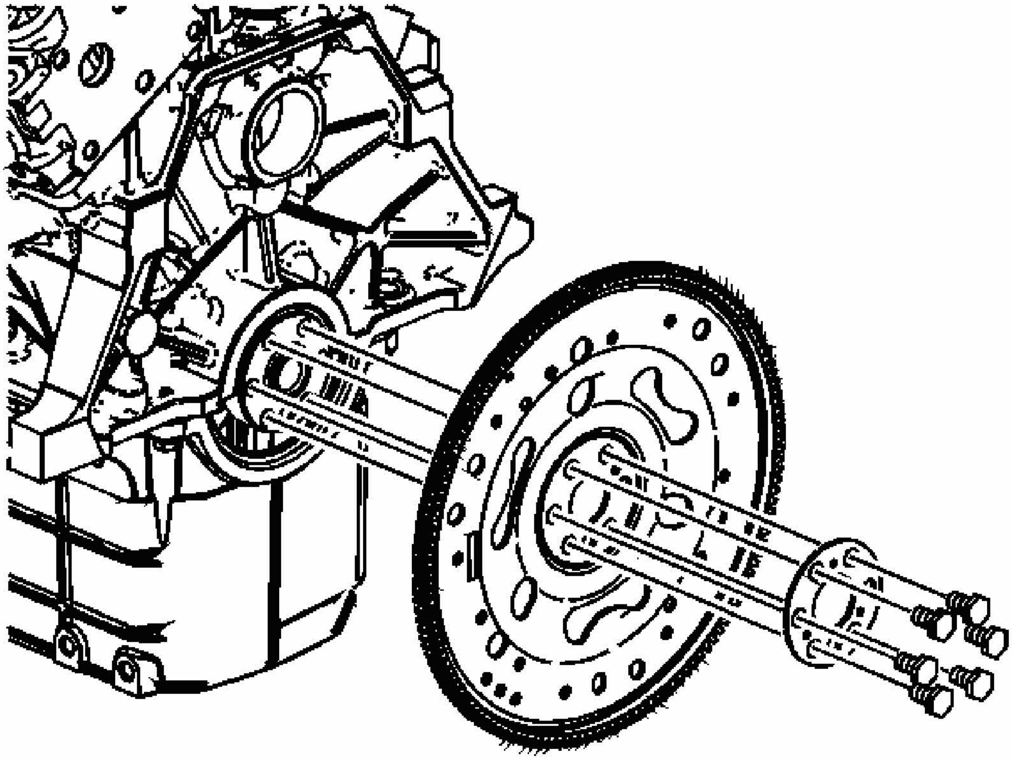


Fig. 508: Identifying Flywheel & Bolts (Automatic Transmission)
Courtesy of GENERAL MOTORS CORP.

1. If equipped with an automatic transmission, install the flywheel.

NOTE: Refer to FASTENER NOTICE .

2. Install the flywheel bolts.

Tighten: Tighten the flywheel bolts to 70 N.m (52 lb ft).

ENGINE FLYWHEEL INSTALLATION (MANUAL TRANSMISSION)

Tools Required

J 45059 Angle Meter

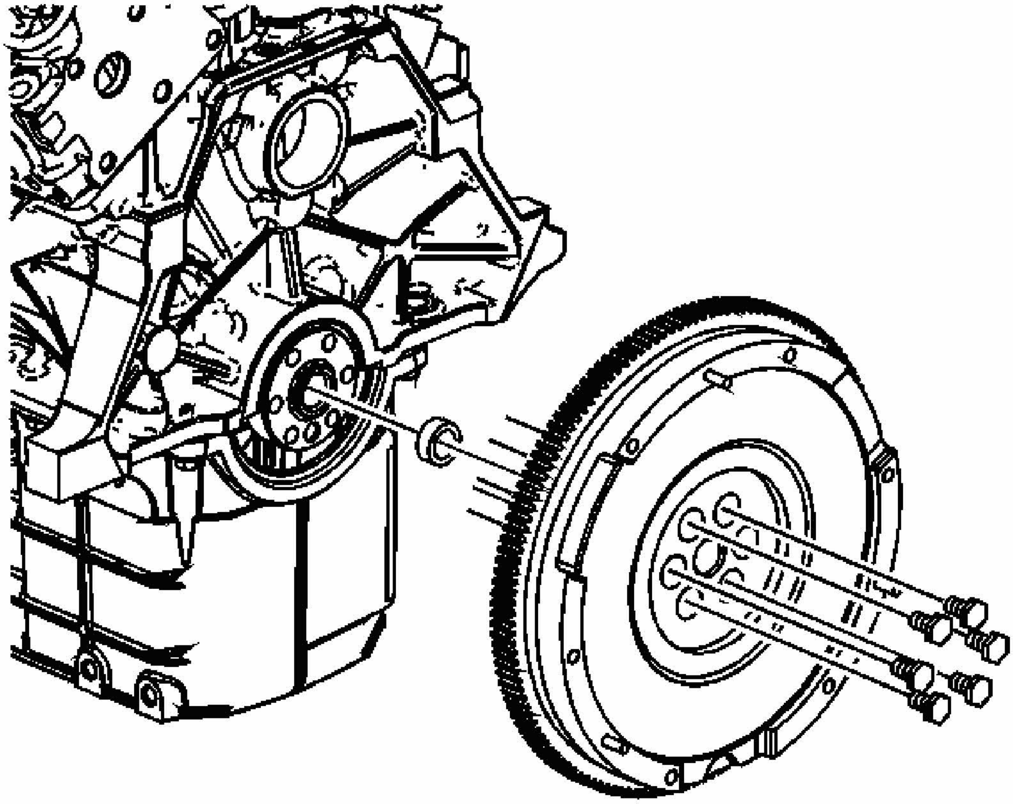


Fig. 509: Identifying Flywheel Bolts (Manual Transmission)
Courtesy of GENERAL MOTORS CORP.

1. Install the clutch pilot bearing.
2. Install the flywheel/pressure plate.

   NOTE: Refer to FASTENER NOTICE .

3. Install the flywheel/pressure plate bolts.

   Tighten: Tighten the flywheel/pressure plate bolts to 50 N.m (37 lb ft) plus an additional 70 degrees using the **J 45059** .

CRANKSHAFT BALANCER INSTALLATION

Tools Required

- **J 29113** Balancer and Crank Sprocket Puller

- **J 45059** Angle Meter

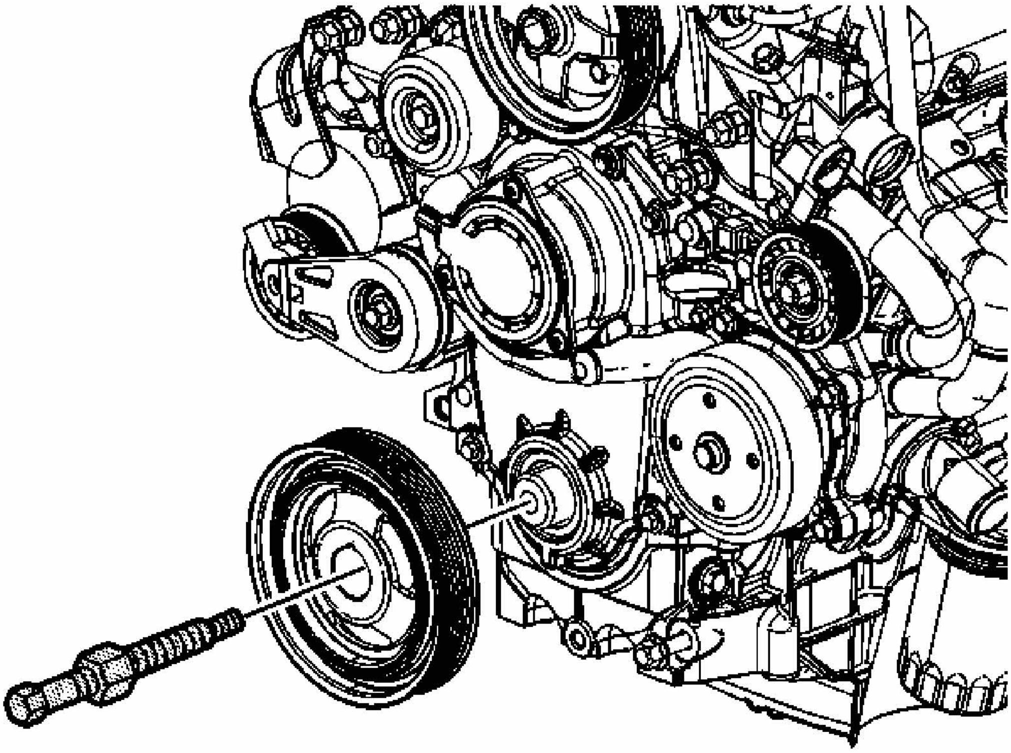


Fig. 510: View Of Balancer & Crank Sprocket Puller (J 29113)
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer GM P/N 12378521 (Canadian P/N 88901148) or the equivalent to the keyway of the crankshaft balancer.
2. Place the crankshaft balancer into position over the key in the crankshaft.

NOTE: Do NOT use a power-assisted tool with the special tool in order to remove or install this component. You cannot properly control the alignment of this component using a power-assisted tool, and this can damage the component.

3. Install the **J 29113** onto the crankshaft.
4. Rotate the hex nut on the **J 29113** to install the crankshaft balancer onto the crankshaft.
5. Remove the **J 29113** from the crankshaft.

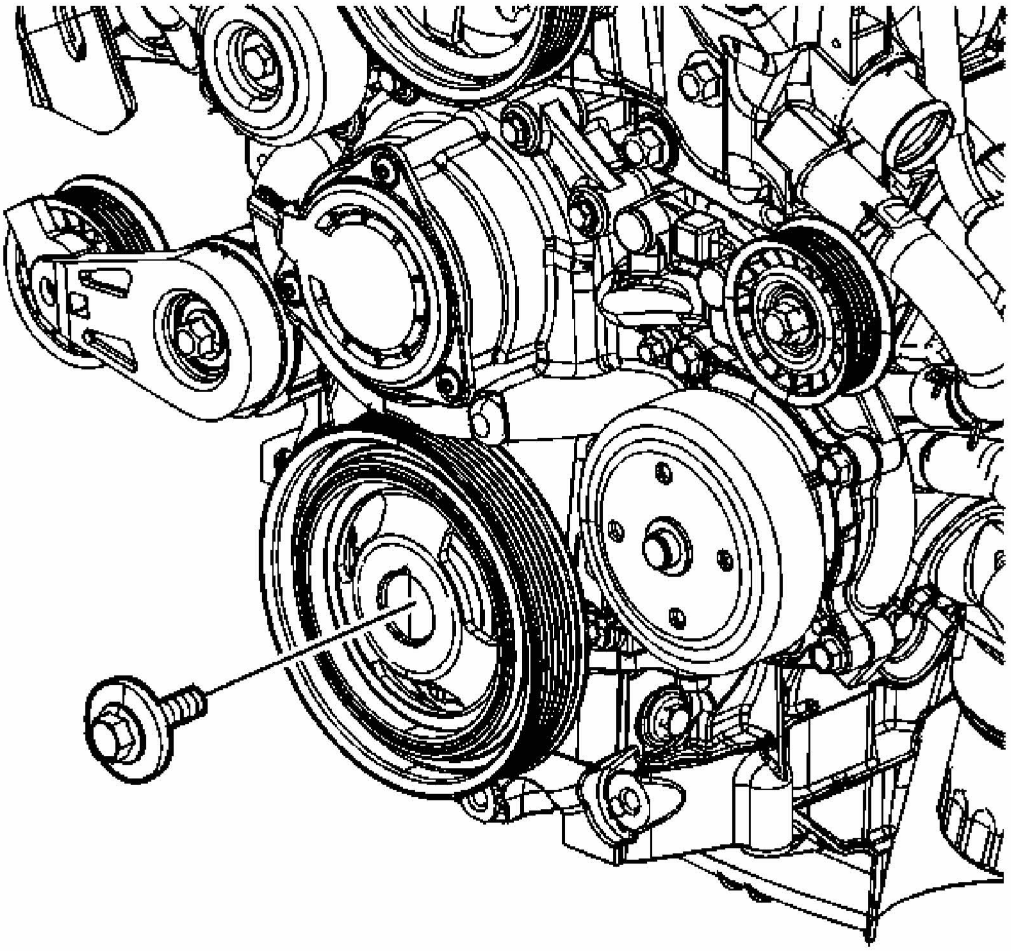


Fig. 511: Identifying Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

6. Install the crankshaft balancer washer and bolt.

Tighten:

- Tighten the crankshaft balancer bolt a first pass to 70 N.m (52 lb ft).
- Tighten the crankshaft balancer bolt a final pass to 70 degrees using the **J 45059** .

ENGINE PRELUBING

Tools Required

- **J-21867-6** Oil Pressure Adapter Fitting
- **J 45299** Engine Preluber

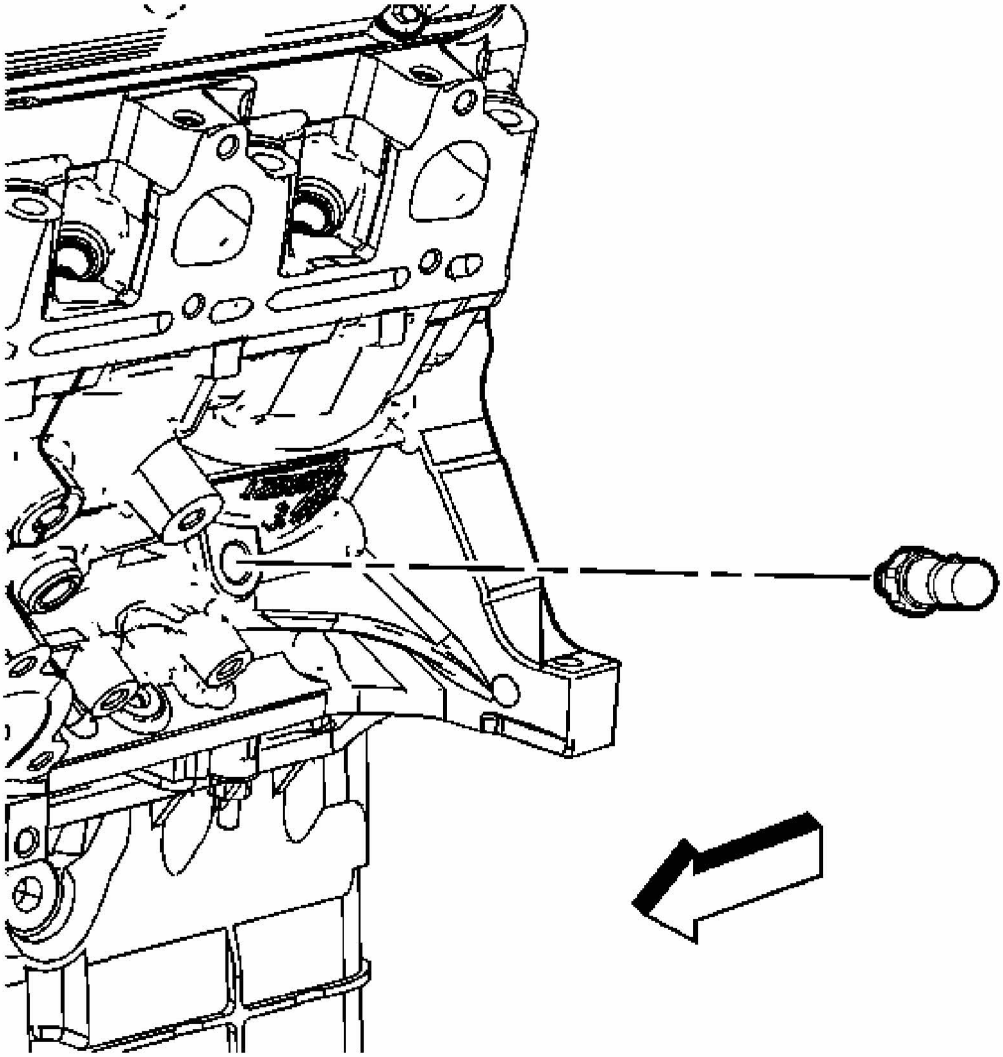


Fig. 512: Locating Engine Oil Pressure Indicator Switch
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

IMPORTANT: **A constant/continuous flow of clean engine oil is required in order to properly prime the engine. Be sure to use an approved**

engine oil as specified in the owners manual.

1. Remove the engine oil filter, fill with clean engine oil, and reinstall.

   Tighten: Tighten the oil filter to 30 N.m (22 lb ft).

2. Locate the engine oil pressure indicator switch on the left side of the engine and remove.
3. Install the 1/4 inch adapter P/N 509373 and the **J-21867-6** .

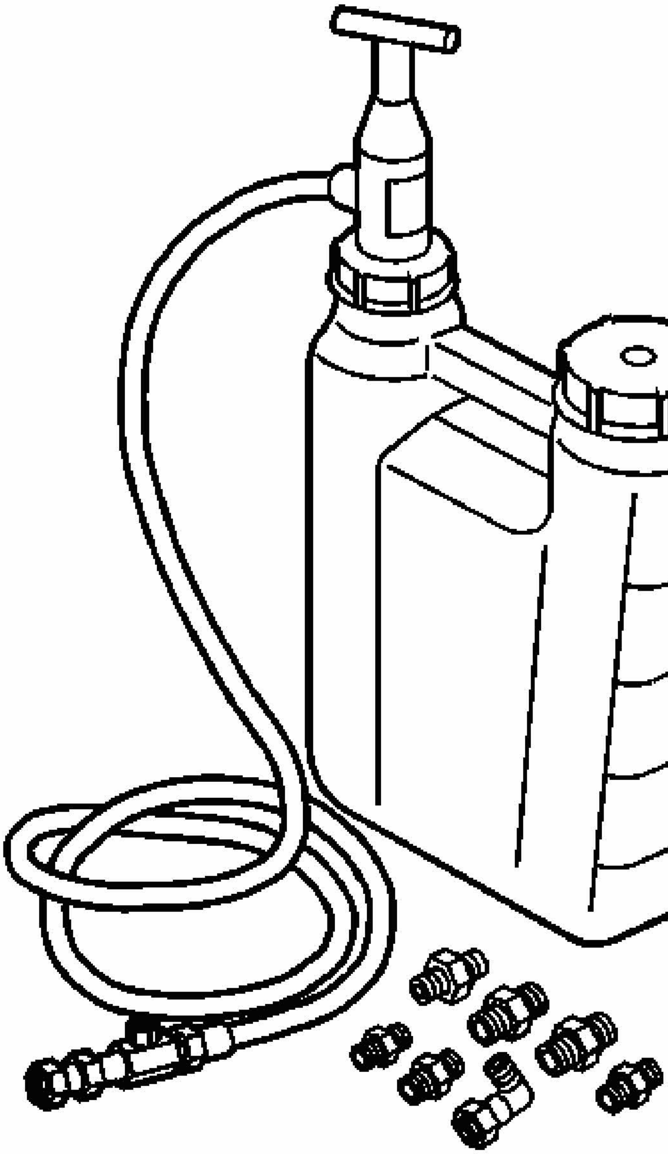


Fig. 513: Identifying Engine Preluber J 45299
Courtesy of GENERAL MOTORS CORP.

4. Install the flexible hose to the adapter and open the valve.
5. Pump the handle on **J 45299** to flow a minimum of 1-2 quarts of engine oil. Observe the flow of engine oil through the flexible hose and into the engine assembly.
6. Close the valve and remove the flexible hose and adapter from the engine.
7. Install the engine oil pressure indictor switch.

Tighten: Tighten the engine oil pressure indictor switch to 16 N.m (12 lb ft).

8. Top off the engine oil to the proper level.

DESCRIPTION AND OPERATION

CRANKCASE VENTILATION SYSTEM DESCRIPTION

General Description

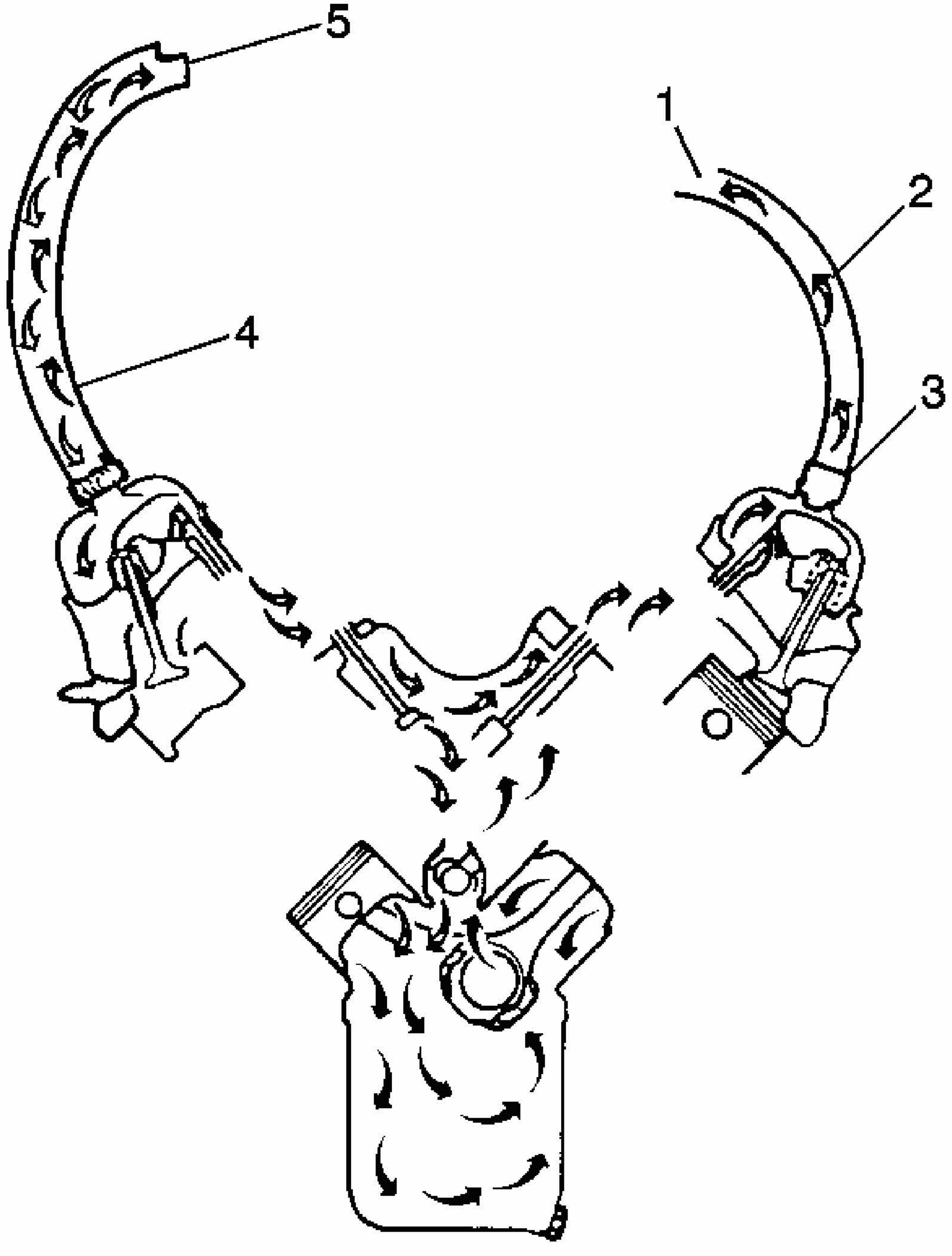


Fig. 514: Crankcase Ventilation System Flow Diagram
Courtesy of GENERAL MOTORS CORP.

A crankcase ventilation system is used to consume crankcase vapors (1) in the combustion process instead of venting them to atmosphere. Fresh air from the throttle body is supplied to the crankcase, mixed with blow by gases, and then passed through a positive crankcase ventilation (PCV) valve (3) into the intake manifold.

Operation

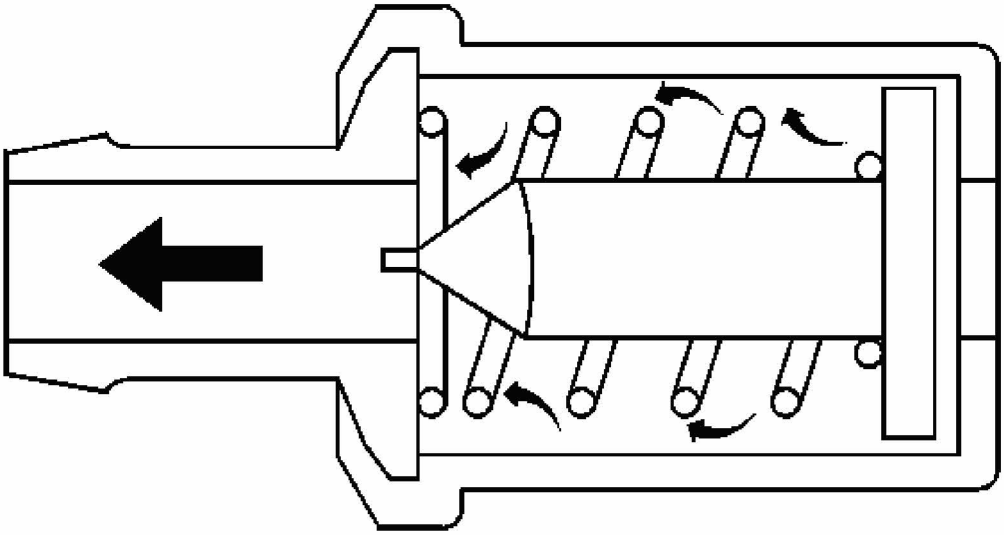


Fig. 515: Crankcase Ventilation System Flow Diagram
Courtesy of GENERAL MOTORS CORP.

The primary control is through the positive crankcase ventilation (PCV) valve which meters the flow at a rate depending on inlet vacuum. To maintain idle quality, the PCV valve restricts the flow when inlet vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow by gases to back flow through the crankcase vent into the throttle body to be consumed by normal combustion.

DRIVE BELT SYSTEM DESCRIPTION

The drive belt system consists of the following components:

- The drive belt
- The drive belt tensioner
- The crankshaft balancer pulley
- The accessory drive components
    - The generator
    - The A/C compressor
    - The water pump

The drive belt system uses one belt. The drive belt is thin so that it can bend backwards and has several ribs to match the grooves in the pulleys. The drive belt is made of different types of rubbers (chloroprene or EPDM) and have different layers or plys containing either fiber cloth or cords for reinforcement.

Both sides of the drive belt may be used to drive the different accessory drive components. When the back side of the drive belt is used to drive a pulley, the pulley is smooth.

The drive belt is pulled by the crankshaft balancer pulley across the accessory drive component pulleys. The spring loaded drive belt tensioner keeps constant tension on the drive belt to prevent the drive belt from slipping. The drive belt tensioner arm will move when loads are applied to the drive belt by the accessory drive components and the crankshaft.

ENGINE COMPONENT DESCRIPTION

The cylinder block is made of cast alloy iron. The cylinder block has 6 cylinders that are arranged in a V shape. There are 3 cylinders in each bank. The cylinder banks are set at a 60 degree angle from each other.

Starting from the front of the engine (accessory belt end), the right bank cylinders are 2, 4, 6. The left bank cylinders are 1, 3, 5.

Four main bearings support the crankshaft. The crankshaft is retained by the bearing caps. The bearing caps are machined with the block for proper alignment and clearances. The main bearing caps are drilled and tapped for the structural oil pan side bolts.

The aluminum cylinder heads have individual intake and exhaust ports for each cylinder. The valve guides are pressed in. The roller rocker arms are located on a pedestal in a slot in the cylinder head. The roller rocker arms are retained on individual threaded bolts.

The crankshaft is forged steel with deep rolled fillets on all 6 crankpins and all 4 main journals. Four steel-backed aluminum bearings are used. The #3 bearing is the end-thrust bearing.

The camshaft is made from a new metal composite design. The camshaft profile is a hydraulic roller design. The camshaft is supported by 4 journals. The camshaft includes an oil pump drive gear.

The pistons are cast aluminum using 2 compression rings and 1 oil control ring. The pistons also have 2 polymer coated patches on the skirt for noise reduction. The piston pin is offset 0.8 mm (0.031 in) towards the major thrust side. This placement allows for a gradual change in thrust pressure against the cylinder wall as the piston travels its path. The pins are made of chromium steel and have a floating fit in the pistons. The pins are retained in the connecting rods by piston pin retainer clips.

The connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal.

A roller rocker type valve train is used. Motion is transmitted from the camshaft through the hydraulic roller lifter and from the pushrod to the roller rocker arm. The rocker arm pivots on the needle roller bearings. The rocker arm transmits the camshaft motion to the valve. The rocker arm pedestal is located in a slot in the cylinder head. The rocker arm is retained in the cylinder head by a bolt. The pushrod is located by the rocker arm.

The intake manifold is a 2-piece cast aluminum unit. The intake manifold centrally supports a fuel rail with 6 fuel injectors.

The exhaust manifolds are cast nodular iron.

LUBRICATION DESCRIPTION

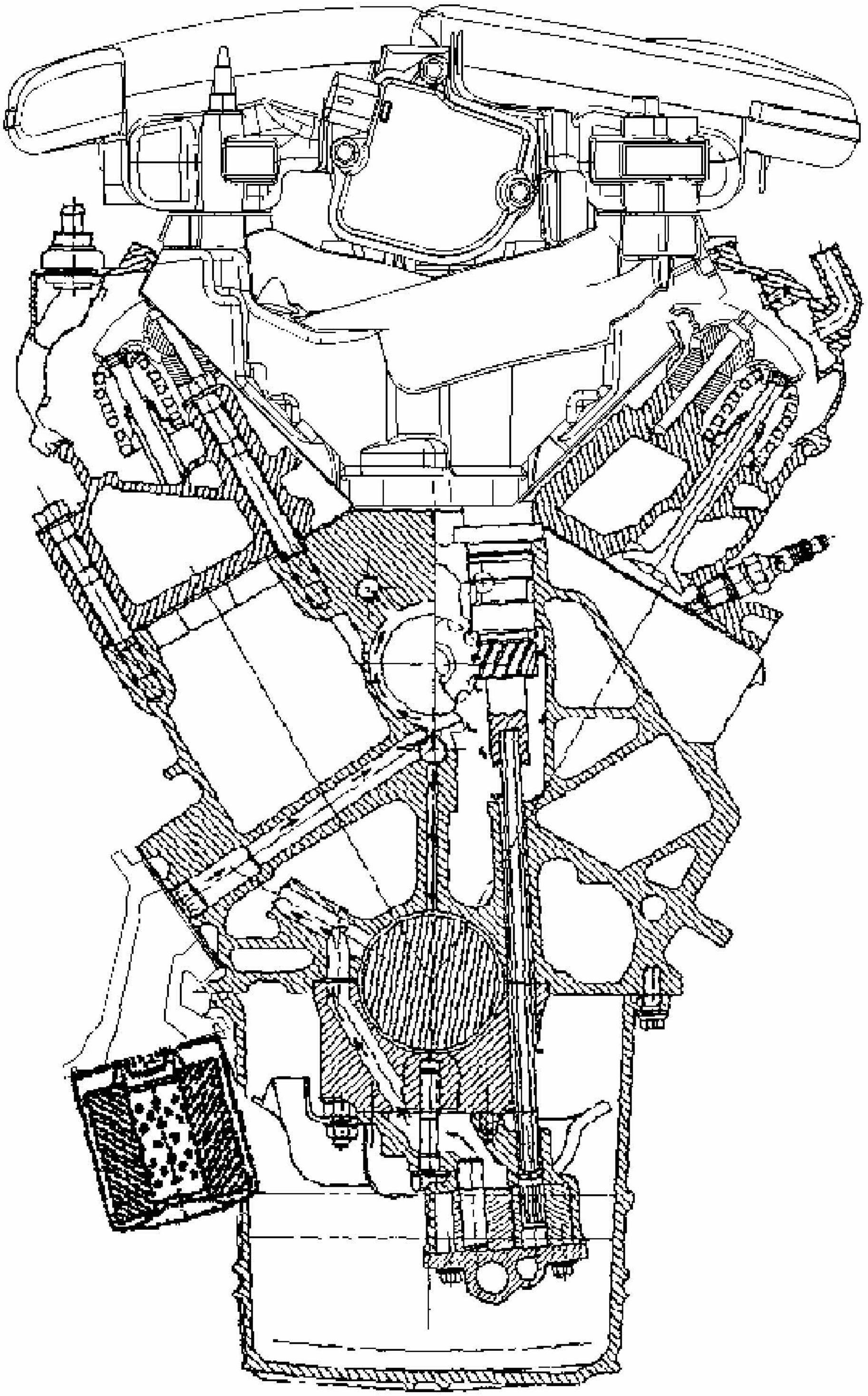


Fig. 516: Front View
Courtesy of GENERAL MOTORS CORP.

Full pressure lubrication, through a full flow oil filter, is furnished by a gear type oil pump. The oil is drawn up through the pickup screen and the tube. The oil passes through the pump to the oil filter.

The oil filter is a full flow paper element unit. An oil filter bypass is used in order to ensure oil supply during the following conditions:

- On a cold start
- If the filter is plugged
- If the filter develops excessive pressure drop

The bypass is designed to open at 69-83 kPa (10-12 psi).

A priority oil delivery system supplies oil first to the crankshaft journals. The oil from the crankshaft main bearings is supplied to the connecting rod bearings by intersecting the passages drilled in the crankshaft. The passages supply the oil to the crankshaft main bearings and the camshaft bearings through the intersecting vertical drilled holes. The oil passages from the camshaft journals supply oil to the hydraulic lifters, and the piston oil nozzles. The camshaft phaser is fed oil from the number 1 camshaft bearing journal.

The piston oil nozzles lubricate the pistons and cylinder walls. A not-serviceable check valve integrated into the nozzle prevents oil bleed down from the nozzle when the engine is not running.

The hydraulic lifters pump oil up through the pushrods to the rocker arms. The cast dams in the crankcase casting direct the oil that drains back from the rocker arms onto the camshaft lobes. The camshaft chain drive is lubricated by indirect oil splash.

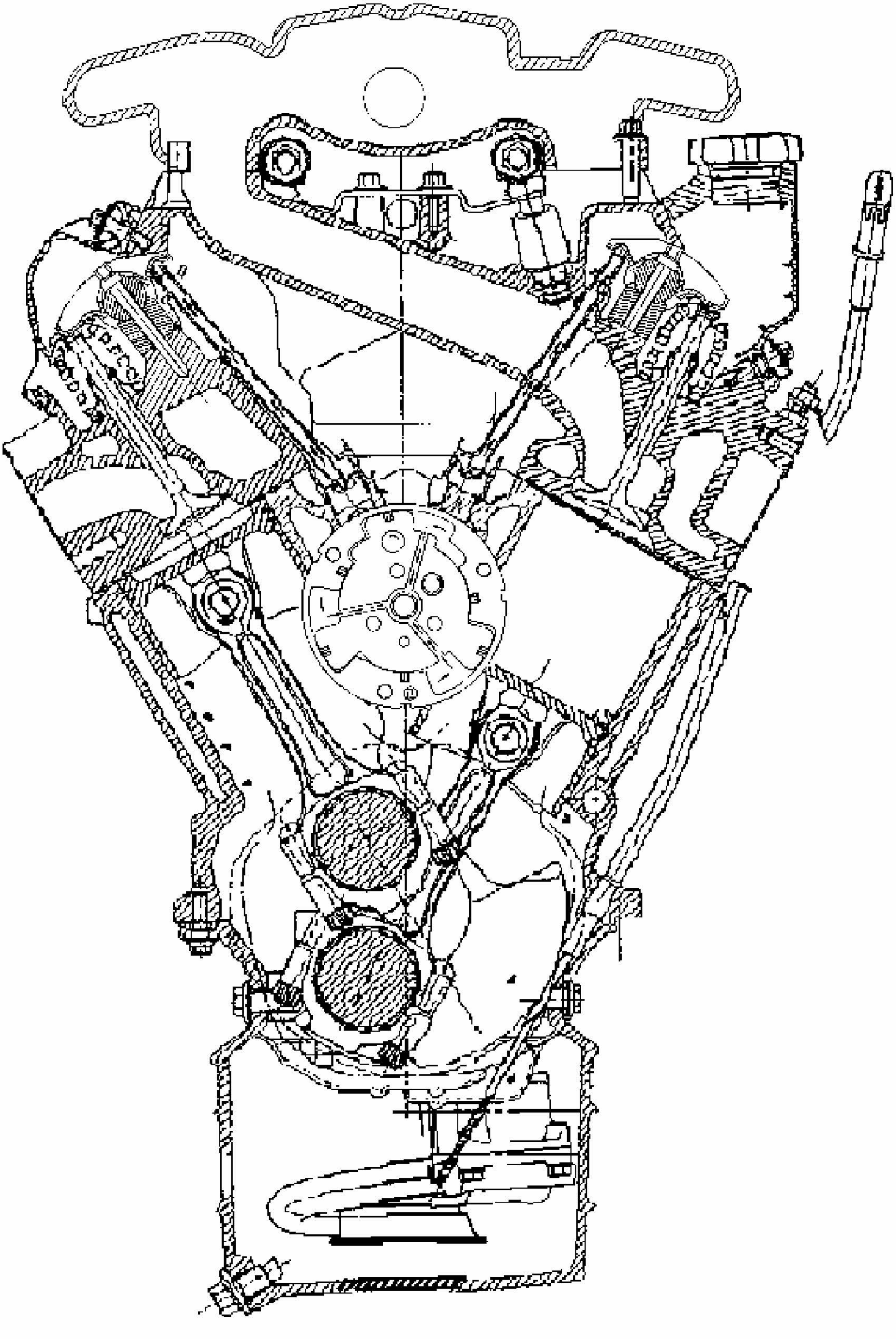


Fig. 517: Rear View Of Lubrication System
Courtesy of GENERAL MOTORS CORP.

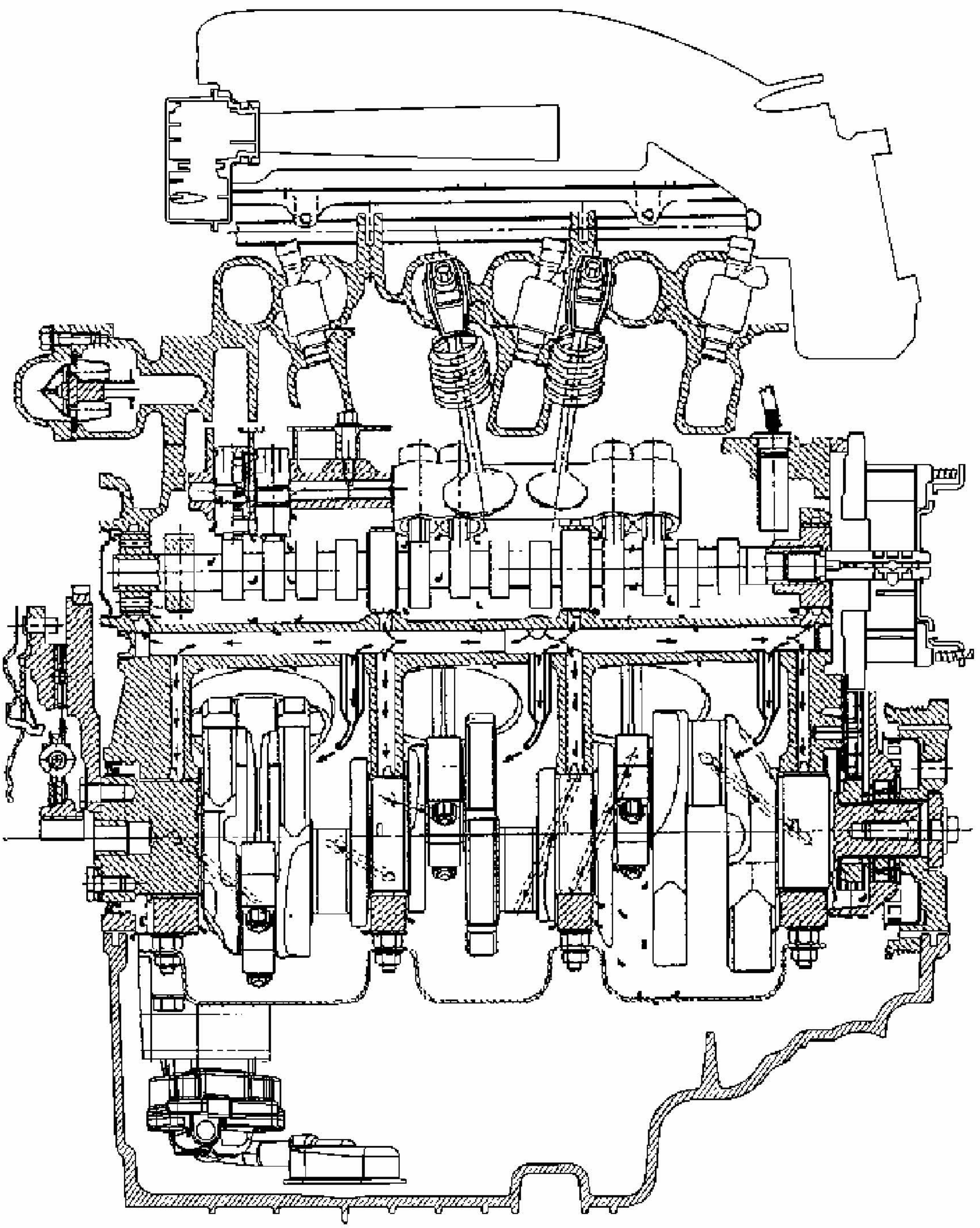


Fig. 518: Right View Of Lubrication System
Courtesy of GENERAL MOTORS CORP.

CLEANLINESS AND CARE

An automobile engine is a combination of many of the following surfaces:

- Machined
- Honed

- Polished
- Lapped

The tolerances of these surfaces are measured in the ten-thousandths of an inch. When you service any internal engine part, cleanliness and care are important. Apply a liberal coating of engine oil to the friction areas during assembly in order to protect and lubricate the surfaces on initial operation. Throughout this section, practice proper cleaning and protection procedures to the machined surfaces and to the friction areas.

NOTE: Engine damage may result if an abrasive paper, pad, or motorized wire brush is used to clean any engine gasket surfaces.

Whenever you remove the valve train components, keep the components in order. Follow this procedure in order to install the components in the same locations and with the same mating surfaces as when removed.

CAUTION: Refer to BATTERY DISCONNECT CAUTION in Cautions and Notices.

Disconnect the negative battery cables before you perform any major work on the engine.

SEPARATING PARTS

In addition to the room temperature vulcanizing (RTV) sealant's sealing capabilities, the RTV sealants may form an adhesive bond between the components. This may make the components difficult to remove or to separate. If possible, bump the components sideways rather than using prying tools in order to remove the components. This technique prevents damage when the bonding strength of the RTV sealant is stronger than the component itself. Perform bumping at the bends or at the reinforced areas in order to prevent part distortion.

REPLACING ENGINE GASKETS

1. Do not reuse any gasket unless otherwise specified. Reusable gaskets will be identified in the service procedure. Do not apply sealant to any gasket or sealing surface unless called out in the service procedure.
2. Use a rubber mallet in order to separate components. Bump the part sideways in order to loosen the components. Perform the bumping at the bends or at the reinforced areas in order to prevent the distortion of components.

IMPORTANT: Do not use any other method or technique in order to remove the gasket material from a components.
Do not use the following items in order to clean the gasket surfaces:

- **Abrasive pads**
- **Sand paper**
- **Power tools**

These methods of cleaning may damage the component. Abrasive pads also produce a fine grit that the oil filter cannot remove from the oil. This grit is abrasive and may cause internal engine damage.

3. Remove all of the gasket and the sealing material from the component using a plastic or a wood scraper. Do not gouge or scrape the sealing surfaces.

IMPORTANT: Do not allow the sealant to enter any blind threaded holes. The sealant may cause the following conditions:

- **Prevent you from properly seating the bolt**
- **Cause damage when you tighten the bolt**

4. When assembling components, use only the sealant specified in the service procedure. Ensure that the sealing surfaces are clean and free of debris or oil. When applying sealant to a component, apply a bead size as specified in the service procedure.
5. Tighten the bolts to the specifications.

USE OF ROOM TEMPERATURE VULCANIZING (RTV) AND ANAEROBIC SEALER

The following 2 types of sealer are commonly used in engines:

- The RTV sealer
- The anaerobic gasket eliminator sealer

Follow the service procedure instructions. Use the correct sealer in the proper place in order to prevent oil leaks. Do not interchange the 2 types of sealers. Use the sealer recommended in the service procedure.

Applying RTV Sealer

- Do not use the room temperature vulcanizing (RTV) sealant in areas where extreme temperatures are expected. These areas include the following locations:
    - The exhaust manifold
    - The head gasket
    - The other surfaces where gasket eliminator is specified

- Use a rubber mallet in order to separate the components sealed with RTV sealant. Bump the part sideways in order to shear the RTV sealer. Perform the bumping at the bends or the reinforced areas in order to prevent distortion of the components. The RTV sealant is weaker in shear (lateral) strength than in tensile (vertical) strength.

IMPORTANT: Do not use any other method or technique in order to remove the gasket material from a component.

- Do not use the following items in order to clean the gasket surfaces:
  - Abrasive pads
  - Sand Paper
  - Power tools

These methods of cleaning may damage the part.

Abrasive pads also produce a fine grit that the oil filter cannot remove from the oil. This grit is abrasive and may cause internal engine damage.

- Remove all of the gasket material from the component using a plastic or a wood scraper. Use Loctite® brand gasket remover P/N 4MA or the equivalent. Follow all of the safety recommendations and the directions that are on the container.

IMPORTANT: Do not allow the sealer to enter the blind threaded holes. The sealer may cause the following conditions:

  - Prevent you from properly seating the bolt
  - Cause damage when you tighten the bolt
- Apply the RTV sealant to a clean surface. Use a bead size as specified in the procedure. Apply the bead to the inside of any bolt holes.
- Assemble the components while the RTV sealant is still wet (within 3 minutes). Do not wait for the RTV sealant to skin over.

IMPORTANT: Do not overtighten the bolts.

- Tighten the bolts to specifications.

Applying Anaerobic Sealer

The anaerobic gasket eliminator hardens in the absence of air. This type of sealer is used where 2 rigid parts (such as castings) are assembled together. When 2 rigid parts are disassembled and no sealer or gasket is readily noticeable, the parts were probably assembled using a gasket eliminator.

IMPORTANT: Do not use any other method or technique in order to remove the gasket material from a component.

Do not use the following items in order to clean the gasket surfaces:

- Abrasive pads
- Sand paper
- Power tools

These methods of cleaning may damage the part.

Abrasive pads also produce a fine grit that the oil filter cannot remove from the oil. This grit is abrasive and may cause internal engine damage.

- Remove all of the gasket material from the component using a plastic or a wood scraper. Use Loctite® brand gasket remover P/N 4MA or the equivalent. Follow all of the safety recommendations and the directions that are on the container.
- Apply a continuous bead of the gasket eliminator to 1 flange. Clean and dry any surfaces that you will reseal.

IMPORTANT: Anaerobic sealed joints that are partially torqued and allowed to cure more than 5 minutes may result in incorrect shimming and sealing of the joint.

- Do not allow the sealer to enter the blind threaded holes. The sealer may cause the following conditions:
  - Prevent you from properly seating the bolt
  - Cause damage when you tighten the bolt
- Spread the sealer evenly in order to get a uniform coating on the sealing surface.
- Tighten the bolts to the specifications.
- Remove the excess sealer from the outside of the joint.

TOOLS AND EQUIPMENT

Work in a clean and well-lit area. Have the following components available before you begin to work:

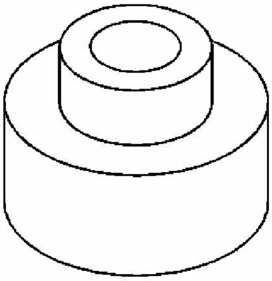
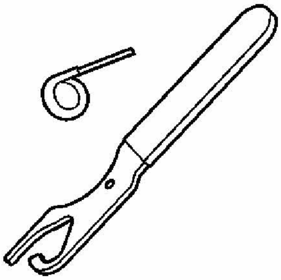
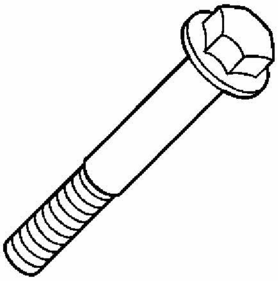
- A suitable parts cleaning tank
- A compressed air supply
- Trays, in order to keep the parts and the fasteners organized
- An adequate set of hand tools

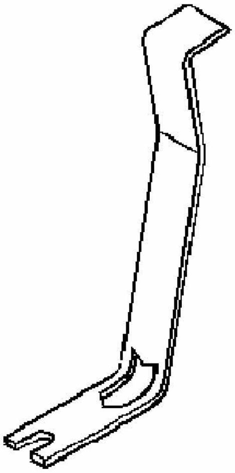
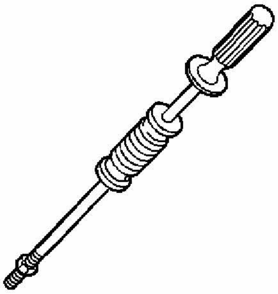
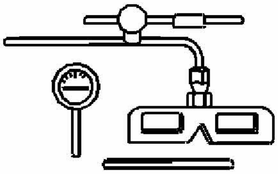
An approved engine repair stand will prevent personal injury or damage to the engine components. The special tools are designed in order to quickly and safely accomplish the operations for which the tools are intended. Using the tools will minimize possible damage to the engine components. Precision measuring tools are required for the inspection of certain critical components. Torque wrenches are needed for the correct assembly of various parts.

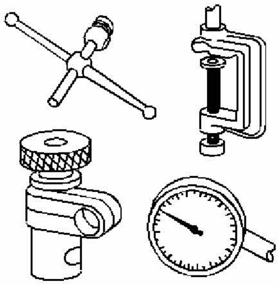
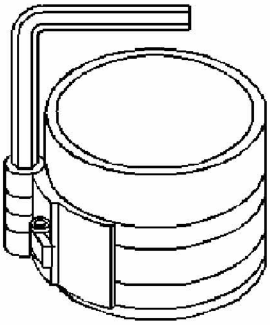
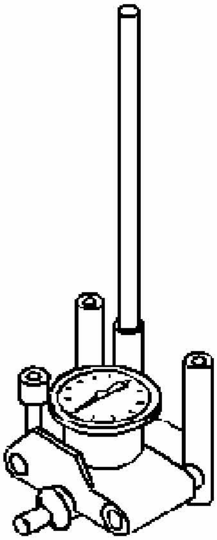
SPECIAL TOOLS AND EQUIPMENT

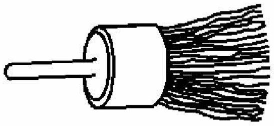
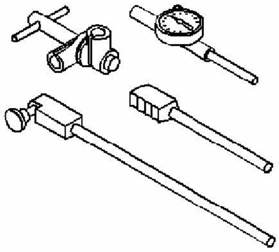
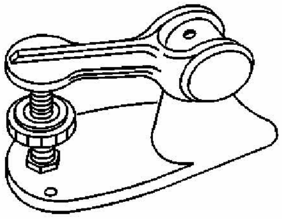
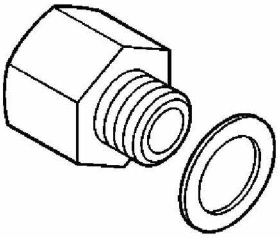
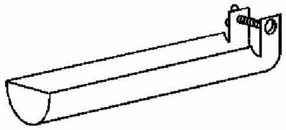
SPECIAL TOOLS

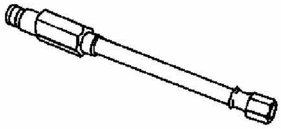
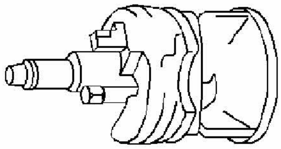
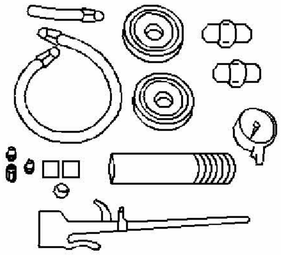
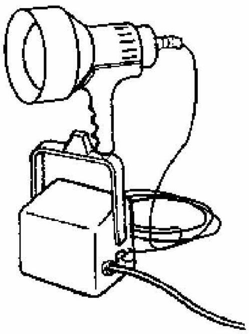
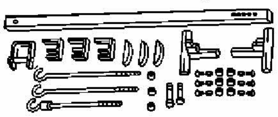
Special Tools

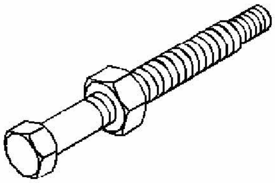
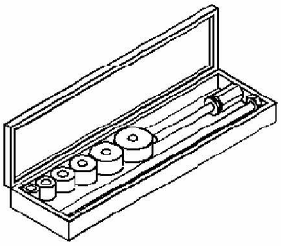
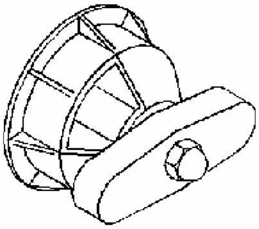
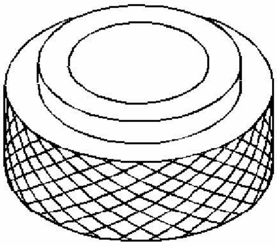
Illustration	Tool Number/Description
	EN 46359 Puller End Protector
	EN 47719 Tensioner Compressor
	EN 47823 Valve Spring Compressor Adapter

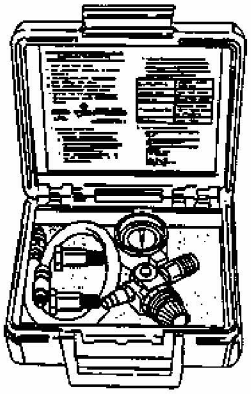
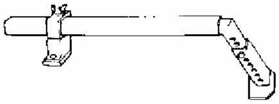
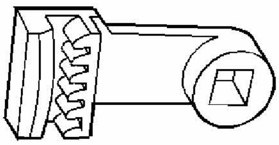
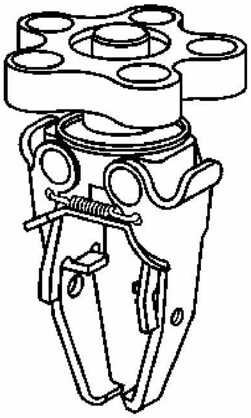
	J 5892-D Valve Spring Compressor
	J 6125-1B Slide Hammer with Adapter
	J 7872 Magnetic Base Dial Indicator
	J 8001 Dial Indicator Set

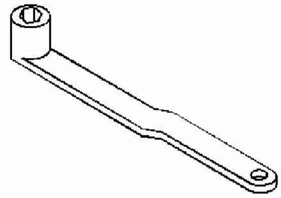
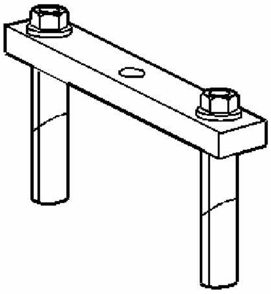
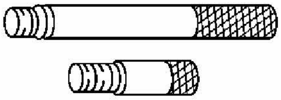
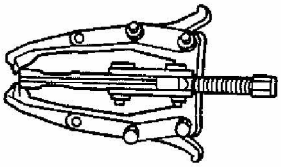
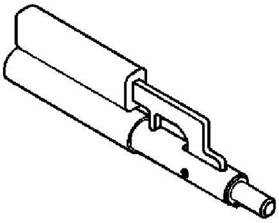
	
	J 8037 Ring Compressor
	J 8087 Cylinder Bore Gage

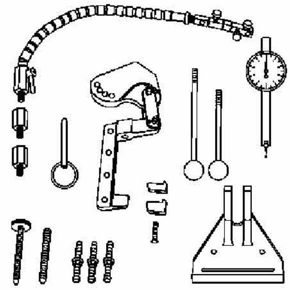
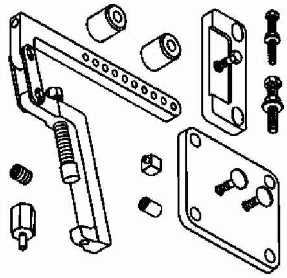
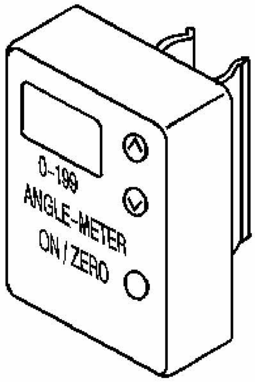
	J 8089 Carbon Removal Brush
	J 8520 Cam Lobe Lift Indicator
	J 9666 Valve Spring Tester
	J 21867-6 Oil Pressure Adapter Fitting
	J 22144 Oil Suction Pipe Installer
	J 22794 Spark Plug Port Adapter

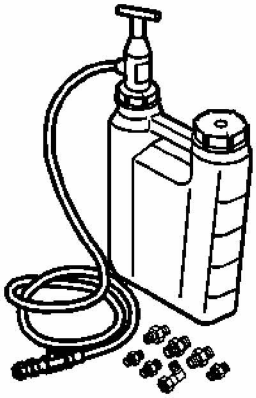
	
	J 24270 Cylinder Bore Ridge Reamer
	J 25087-C Oil Pressure Tester and Pump Primer
	J 28428-E High Intensity Black Light Kit
	J 28467-B Universal Engine Support Fixture

	J 29113 Balancer and Crank Sprocket Puller
	J 33049 Camshaft Bearing Service Set
	J 34686 Rear Main Seal Installer
	J 35468 Cover Aligner and Seal Installer
	J 35667-A

	Cylinder Leakdown Tester
	J 36462 Engine Support Adapter Leg
	J 37096 Flywheel Holder
	J 38606 Valve Spring Compressor

	J 39505 Torque Wrench Adapter
	J 41348 Bearing Cap Puller
	J 41556 Connecting Rod Guide
	J 41816 Crankshaft Balancer Remover
	J 43654 Piston Pin Clip Remover and Installer

	J 43690 Rod Bearing Clearance Checking Tool
	J 43690-100 Rod Bearing Clearance Checking Tool - Adapter Kit
 0-199 ANGLE-METER ON / ZERO	J 45059 Angle Meter
	J 45299 Engine Preluber

2006 ENGINE

Engine Mechanical - 5.3L - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Camshaft Position (CMP) Sensor Bolt	12 N.m	106 lb in
Camshaft Retainer Bolts - Hex Head Bolts	25 N.m	18 lb ft
Camshaft Retainer Bolts - TORX® Head Bolts	15 N.m	11 lb ft
Camshaft Sprocket Bolts	25 N.m	18 lb ft
Connecting Rod Bolts - First Pass	20 N.m	15 lb ft
Connecting Rod Bolts - Final Pass	85 degrees	
Coolant Air Bleed Pipe and Cover Bolts	12 N.m	106 lb in
Coolant Temperature Sensor	20 N.m	15 lb ft
Crankshaft Balancer Bolt - Installation Pass to Ensure the Balancer is Completely Installed	330 N.m	240 lb ft
Crankshaft Balancer Bolt - First Pass - Install a NEW Bolt After the Installation Pass and Tighten as Described in the First and Final Passes	50 N.m	37 lb ft
Crankshaft Balancer Bolt - Final Pass	140 degrees	
Crankshaft Bearing Cap M10 Bolts - First Pass in Sequence	20 N.m	15 lb ft
Crankshaft Bearing Cap M10 Bolts - Final Pass in Sequence	80 degrees	
Crankshaft Bearing Cap M10 Studs - First Pass in Sequence	20 N.m	15 lb ft
Crankshaft Bearing Cap M10 Studs - Final Pass in Sequence	51 degrees	
Crankshaft Bearing Cap M8 Bolts	25 N.m	18 lb ft
Crankshaft Oil Deflector Nuts	25 N.m	18 lb ft
Crankshaft Position (CKP) Sensor Bolt	25 N.m	18 lb ft
Crankshaft Rear Oil Seal Housing Bolts	30 N.m	22 lb ft
Cylinder Head M11 Bolts - First Pass in Sequence	30 N.m	22 lb ft
Cylinder Head M11 Bolts - Second Pass in	90 degrees	

Sequence		
Cylinder Head M11 Bolts - Final Pass in Sequence	70 degrees	
Cylinder Head M8 Bolts - in Sequence	30 N.m	22 lb ft
Cylinder Head Coolant Plug	20 N.m	15 lb ft
EN 47699 Bolt	60 N.m	44 lb ft
Engine Block Coolant Drain Hole Plug	60 N.m	44 lb ft
Engine Block Coolant Heater	50 N.m	37 lb ft
Engine Block Oil Gallery Plugs	60 N.m	44 lb ft
Exhaust Crossover Pipe Nuts	25 N.m	18 lb ft
Exhaust Manifold Bolts - First Pass	15 N.m	11 lb ft
Exhaust Manifold Bolts - Final Pass	20 N.m	15 lb ft
Exhaust Manifold Heat Shield Bolts	9 N.m	80 lb in
Exhaust Manifold Studs	20 N.m	15 lb ft
Flywheel Bolts - First Pass	20 N.m	15 lb ft
Flywheel Bolts - Second Pass	50 N.m	37 lb ft
Flywheel Bolts - Final Pass	100 N.m	74 lb ft
Front Cover Bolts	25 N.m	18 lb ft
Fuel Rail Bolts	10 N.m	89 lb in
Ignition Coil Bracket-to-Valve Rocker Arm Cover Studs	12 N.m	106 lb in
Ignition Coil-to-Bracket Bolts	10 N.m	89 lb in
Intake Manifold Bolts - First Pass in Sequence	5 N.m	44 lb in
Intake Manifold Bolts - Final Pass in Sequence	10 N.m	89 lb in
J 41798 M8 Bolt	25 N.m	18 lb ft
J 41798 M10 Bolts	50 N.m	37 lb ft
Knock Sensor Bolts	20 N.m	15 lb ft
Oil Filter	30 N.m	22 lb ft
Oil Filter Fitting	55 N.m	40 lb ft
Oil Level Indicator Tube Bolt	25 N.m	18 lb ft
Oil Level Sensor Bolt	20 N.m	15 lb ft
Oil Pan Closeout Cover Bolt - Left Side	9 N.m	80 lb in
Oil Pan Closeout Cover Bolt - Right Side	9 N.m	80 lb in
Oil Pan Cover Bolts	12 N.m	106 lb in
Oil Pan Drain Plug	25 N.m	18 lb ft
Oil Pan M6 Bolts - Oil Pan-to-Rear Housing	12 N.m	106 lb in
Oil Pan M8 Bolts - Oil Pan-to-Engine Block and Oil Pan-to-Front Cover	25 N.m	18 lb ft
Oil Pressure Sensor	35 N.m	26 lb ft

Oil Pump Cover Bolts	12 N.m	106 lb in
Oil Pump Relief Valve Plug	12 N.m	106 lb in
Oil Pump Screen Nuts	25 N.m	18 lb ft
Oil Pump Screen-to-Oil Pump Bolt	12 N.m	106 lb in
Oil Pump-to-Engine Block Bolts	25 N.m	18 lb ft
Sight Shield Studs	12 N.m	106 lb in
Spark Plugs	15 N.m	11 lb ft
Throttle Body Bolts	10 N.m	89 lb in
Timing Chain Dampener Bolts	25 N.m	18 lb ft
Valve Lifter Guide Bolts	12 N.m	106 lb in
Valve Lifter Oil Manifold (VLOM) Bolts	25 N.m	18 lb ft
Valve Rocker Arm Bolts	30 N.m	22 lb ft
Valve Rocker Arm Cover Bolts	12 N.m	106 lb in
Water Inlet Housing Bolts	15 N.m	11 lb ft
Water Manifold - M8 Bolts	30 N.m	22 lb ft
Water Manifold - M10 Bolts	60 N.m	44 lb ft
Water Pump Bolts	10 N.m	89 lb in

ENGINE MECHANICAL SPECIFICATIONS

Engine Mechanical Specifications

Application	Specification	
	Metric	English
General		
• Engine Type	V8	
• Displacement	5.3L	325 CID
• RPO	LS4	
• VIN	C	
• Bore	96.0-96.018 mm	3.779-3.78 in
• Stroke	92.0 mm	3.622 in
• Compression Ratio	9.9:1	
• Firing Order	1-8-7-2-6-5-4-3	
• Displacement on Demand Cylinders	1-4-6-7	
• Spark Plug Gap	1.02 mm	0.04 in
Block		
• Camshaft Bearing Bore 1 and 5 Diameter	59.58-59.63 mm	2.345-2.347 in
	59.08-59.13 mm	2.325-2.327 in

• Camshaft Bearing Bore 2 and 4 Diameter		
• Camshaft Bearing Bore 3 Diameter	58.58-58.63 mm	2.306-2.308 in
• Crankshaft Main Bearing Bore Diameter	69.871-69.889 mm	2.75-2.751 in
• Crankshaft Main Bearing Bore Out-of-Round	0.006 mm	0.0002 in
• Cylinder Bore Diameter	96.0-96.018 mm	3.779-3.78 in
• Cylinder Head Deck Height - Measuring from the Centerline of Crankshaft to the Deck Face	234.57-234.82 mm	9.235-9.245 in
• Cylinder Head Deck Surface Flatness - Measured Within a 152.4 mm (6.0 in) Area	0.11 mm	0.004 in
• Cylinder Head Deck Surface Flatness - Measuring the Overall Length of the Block Deck	0.22 mm	0.008 in
• Valve Lifter Bore Diameter	21.417-21.443 mm	0.843-0.844 in
Camshaft		
• Camshaft End Play	0.025-0.305 mm	0.001-0.012 in
• Camshaft Journal Diameter	54.99-55.04 mm	2.164-2.166 in
• Camshaft Journal Out-of-Round	0.025 mm	0.001 in
• Camshaft Lobe Lift - Intake - Non Displacement on Demand Cylinders	7.2 mm	0.283 in
• Camshaft Lobe Lift - Intake - Displacement on Demand Cylinders	7.33 mm	0.289 in
• Camshaft Lobe Lift - Exhaust - Non Displacement on Demand Cylinders	7.2 mm	0.283 in
• Camshaft Lobe Lift - Exhaust - Displacement on Demand Cylinders	7.33 mm	0.289 in
• Camshaft Runout - Measured at the Intermediate Journals	0.05 mm	0.002 in
Connecting Rod		
• Connecting Rod Bearing Clearance - Production	0.023-0.065 mm	0.0009-0.0025 in
• Connecting Rod Bearing Clearance - Service	0.023-0.076 mm	0.0009-0.003 in

• Connecting Rod Bore Diameter - Bearing End	56.505-56.525 mm	2.224-2.225 in
• Connecting Rod Bore Out-of-Round - Bearing End - Production	0.004-0.008 mm	0.00015-0.0003 in
• Connecting Rod Bore Out-of-Round - Bearing End - Service	0.004-0.008 mm	0.00015-0.0003 in
• Connecting Rod Side Clearance	0.11-0.51 mm	0.00433-0.02 in
Crankshaft		
• Connecting Rod Journal Diameter - Production	53.318-53.338 mm	2.0991-2.0999 in
• Connecting Rod Journal Diameter - Service	53.308 mm	2.0987 in
• Connecting Rod Journal Out-of-Round - Production	0.005 mm	0.0002 in
• Connecting Rod Journal Out-of-Round - Service	0.01 mm	0.0004 in
• Connecting Rod Journal Taper - Maximum for 1/2 of Journal Length - Production	0.005 mm	0.0002 in
• Connecting Rod Journal Taper - Maximum for 1/2 of Journal Length - Service	0.02 mm	0.00078 in
• Crankshaft End Play	0.04-0.2 mm	0.0015-0.0078 in
• Crankshaft Main Bearing Clearance - Production	0.02-0.052 mm	0.0008-0.0021 in
• Crankshaft Main Bearing Clearance - Service	0.02-0.065 mm	0.0008-0.0025 in
• Crankshaft Main Journal Diameter - Production	64.992-65.008 mm	2.558-2.559 in
• Crankshaft Main Journal Diameter - Service	64.992 mm	2.558 in
• Crankshaft Main Journal Out-of-Round - Production	0.003 mm	0.000118 in
• Crankshaft Main Journal Out-of-Round - Service	0.008 mm	0.0003 in
• Crankshaft Main Journal Taper - Production	0.01 mm	0.0004 in
• Crankshaft Main Journal Taper - Service	0.02 mm	0.00078 in
• Crankshaft Rear Flange Runout	0.05 mm	0.002 in

• Crankshaft Reluctor Ring Runout - Measured 1.0 mm (0.04 in) Below Tooth Diameter	0.7 mm	0.028 in
• Crankshaft Thrust Surface - Production	26.14-26.22 mm	1.029-1.0315 in
• Crankshaft Thrust Surface - Service	26.22 mm	1.0315 in
• Crankshaft Thrust Surface Runout	0.025 mm	0.001 in
Cylinder Head		
• Cylinder Head Height/Thickness - Measured from the Cylinder Head Deck to the Valve Rocker Arm Cover Seal Surface	120.2 mm	4.732 in
• Surface Flatness - Block Deck - Measured Within a 152.4 mm (6.0 in) Area	0.08 mm	0.003 in
• Surface Flatness - Block Deck - Measuring the Overall Length of the Cylinder Head	0.1 mm	0.004 in
• Surface Flatness - Exhaust Manifold Deck	0.13 mm	0.005 in
• Surface Flatness - Intake Manifold Deck	0.08 mm	0.0031 in
• Valve Guide Installed Height - Measured from the Spring Seat Surface to the Top of the Guide	17.32 mm	0.682 in
Intake Manifold		
• Surface Flatness - Measured at Gasket Sealing Surfaces and Measured Within a 200 mm (7.87 in) Area that Includes 2 Runner Port Openings	0.3 mm	0.118 in
Lubrication System		
• Oil Capacity - with Filter	5.7 liters	6.0 quarts
• Oil Capacity - without Filter	5.2 liters	5.5 quarts
• Oil Pressure - Minimum - Hot	41 kPa at 1,000 engine RPM 124 kPa at 2,000 engine RPM 165 kPa at 4,000 engine RPM	6 psig at 1,000 engine RPM 18 psig at 2,000 engine RPM 24 psig at 4,000 engine RPM
• Displacement on Demand Relief Valve Oil Pressure - as Measured at Oil Pressure Sensor Location	379-517 kPa Maximum	55-75 psig Maximum
Oil Pan		

• Front Cover Alignment - at Oil Pan Surface	0.0-0.5 mm	0.0-0.02 in
• Crankshaft Rear Oil Seal Housing Alignment - at Oil Pan Surface	0.0-0.5 mm	0.0-0.02 in
• Oil Pan Alignment - to Rear of Engine Block at Transmission Bell Housing Mounting Surface	0.0-0.25 mm	0.0-0.01 in
Piston Rings		
• Piston Ring End Gap - First Compression Ring - Measured in Cylinder Bore - Production	0.23-0.44 mm	0.009-0.017 in
• Piston Ring End Gap - First Compression Ring - Measured in Cylinder Bore - Service	0.23-0.5 mm	0.009-0.0196 in
• Piston Ring End Gap - Second Compression Ring - Measured in Cylinder Bore - Production	0.44-0.7 mm	0.017-0.027 in
• Piston Ring End Gap - Second Compression Ring - Measured in Cylinder Bore - Service	0.44-0.76 mm	0.0173-0.03 in
• Piston Ring End Gap - Oil Control Ring - Measured in Cylinder Bore - Production	0.18-0.75 mm	0.007-0.029 in
• Piston Ring End Gap - Oil Control Ring - Measured in Cylinder Bore - Service	0.18-0.81 mm	0.007-0.032 in
• Piston Ring to Groove Clearance - First Compression Ring - Production	0.04-0.085 mm	0.00157-0.00335 in
• Piston Ring to Groove Clearance - First Compression Ring - Service	0.04-0.085 mm	0.00157-0.00335 in
• Piston Ring to Groove Clearance - Second Compression Ring - Production	0.04-0.078 mm	0.00157-0.0031 in
• Piston Ring to Groove Clearance - Second Compression Ring - Service	0.04-0.078 mm	0.00157-0.0031 in
• Piston Ring to Groove Clearance - Oil Control Ring - Production	0.012-0.2 mm	0.0005-0.0078 in
• Piston Ring to Groove Clearance - Oil Control Ring - Service	0.012-0.2 mm	0.0005-0.0078 in
Pistons and Pins		
• Piston - Piston Diameter - Measured Over Skirt Coating	96.002-96.036 mm	3.779-3.78 in

• Piston - Piston to Bore Clearance - Production	-0.036 to +0.016 mm	-0.0014 to +0.0006 in
• Piston - Piston to Bore Clearance - Service Limit with Skirt Coating Worn Off	0.071 mm	0.0028 in
• Pin - Piston Pin Clearance-to-Piston Pin Bore - Production	0.002-0.01 mm	0.00008-0.00004 in
• Pin - Piston Pin Clearance-to-Piston Pin Bore - Service	0.002-0.015 mm	0.00008-0.00006 in
• Pin - Piston Pin Fit in Connecting Rod Bore - Production	0.007-0.02 mm	0.00027-0.00078 in
• Pin - Piston Pin Fit in Connecting Rod Bore - Service	0.007-0.022 mm	0.00027-0.00086 in
• Pin - Piston Pin Diameter	23.997-24.0 mm	0.9447-0.9448 in
Valve System		
• Valves - Valve Face Angle	45 degrees	
• Valves - Valve Face Width	1.25 mm	0.05 in
• Valves - Valve Lash	Net Lash - No Adjustment	
• Valves - Valve Lift - Intake - Non Displacement on Demand (DoD)	12.24 mm	0.482 in
• Valves - Valve Lift - Exhaust - Non Displacement on Demand (DoD)	12.24 mm	0.482 in
• Valves - Valve Lift - Intake - Displacement on Demand (DoD)	12.46 mm	0.49 in
• Valves - Valve Lift - Exhaust - Displacement on Demand (DoD)	12.46 mm	0.49 in
• Valves - Valve Lift - Exhaust	11.85 mm	0.466 in
• Valves - Valve Seat Angle	46 degrees	
• Valves - Valve Seat Runout	0.05 mm	0.002 in
• Valves - Valve Seat Width - Exhaust	1.78 mm	0.07 in
• Valves - Seat Width - Intake	1.02 mm	0.04 in
• Valves - Valve Stem Diameter - Production	7.955-7.976 mm	0.313-0.314 in
• Valves - Valve Stem Diameter - Service	7.95 mm	0.313 in
• Valves - Valve Stem-to-Guide Clearance - Production - Intake	0.025-0.066 mm	0.001-0.0026 in
• Valves - Valve Stem-to-Guide Clearance -		

Service - Intake	0.093 mm	0.0037 in
• Valves - Valve Stem-to-Guide Clearance - Production - Exhaust	0.025-0.066 mm	0.001-0.0026 in
• Valves - Valve Stem-to-Guide Clearance - Service - Exhaust	0.093 mm	0.0037 in
• Rocker Arms - Valve Rocker Arm Ratio	1.70:1	
• Valve Springs - Valve Spring Free Length	52.9 mm	2.08 in
• Valve Springs - Valve Spring Installed Height	45.75 mm	1.8 in
• Valve Springs - Valve Spring Load - Closed	340 N at 45.75 mm	76 lb at 1.8 in
• Valve Springs - Valve Spring Load - Open	980 N at 33.55 mm	220 lb at 1.32 in

SEALERS, ADHESIVES, AND LUBRICANTS

Sealers, Adhesives, and Lubricants

Application	Type of Material	GM Part Number	
		United States	Canada
Coolant Temperature Sensor Threads	Sealant	12346004	10953480
Cylinder Head Core Hole Plugs	Threadlock	12345382	10953489
Cylinder Head Plug	Threadlock	12345382	10953489
Engine Block Oil Gallery Plug - Front	Threadlock	12345382	10953489
Engine Block Oil Gallery Plug Washers	Sealant	12346004	10953480
Engine Oil	5W-30 Oil	12345610	993193
Engine Oil Pressure Sensor Threads	Sealant	12346004	10953480
Engine Oil Supplement	Fluorescent Dye	12345795	10953470
Exhaust Manifold Bolts	Threadlock	12345493	10953488
Flywheel Bolts	Threadlock	12345382	10953489
Fuel Injection Fuel Rail Bolts	Threadlock	12345382	10953489
Ignition Coil Bracket-to-Valve Cover Studs	Threadlock	12345382	10953489
Ignition Coil-to-Bracket Bolts	Threadlock	12345382	10953489
Intake Manifold Bolts	Threadlock	12345382	10953489
Oil Pan Surface at Front Cover and Rear Housing	Sealant	12378190	-
Thread Repair Component Cleaner	Cleaner	12346139	10953463

Thread Repair Component Cleaner	Cleaner	12377981	10953463
Thread Repair Cutting Oil	Lubricant	1052864	992881

THREAD REPAIR SPECIFICATIONS

Engine Block - Front/Rear Views

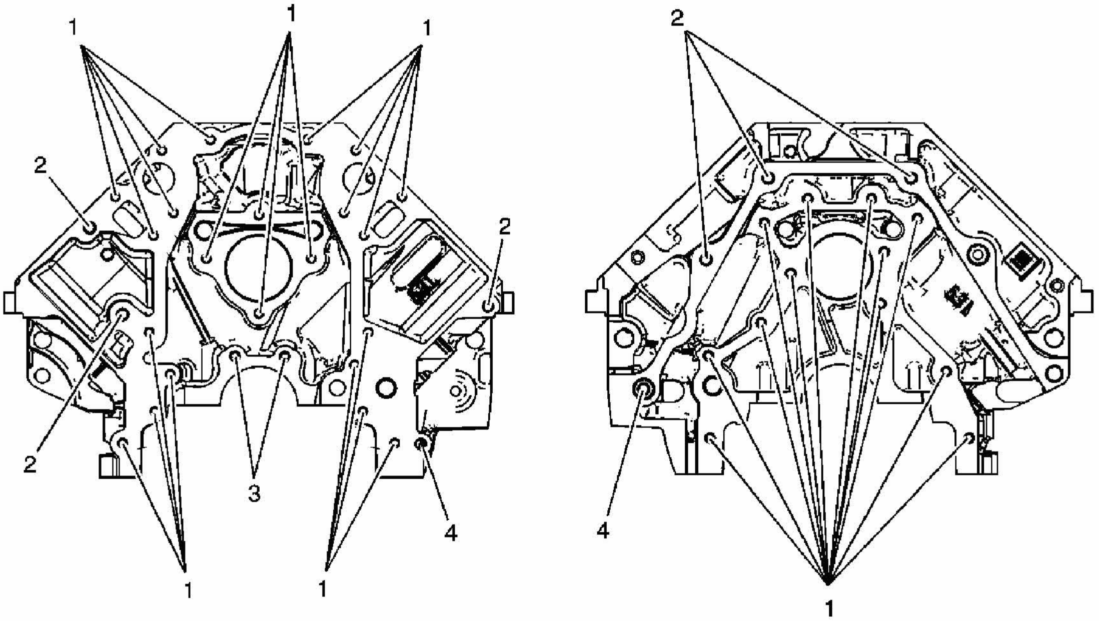


Fig. 1: View Of Engine Block - Front/Rear
Courtesy of GENERAL MOTORS CORP.

Engine Block - Front/Rear Views

Hole	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth - Maximum mm (in)	Tap Depth - Maximum mm (in)
J 42385-								
1	M8 x 1.25	210	206	207	208	209	22.5 (0.885)	17.5 (0.688)
2	M10 x 1.5	215	211	212	213	214	33.5 (1.32)	27 (1.06)
3	M8 x 1.25	210	206	207	208	209	Thru	Thru
4	M10 x 1.5	215	211	212	213	214	Thru	Thru

Engine Block - Left/Right Side Views

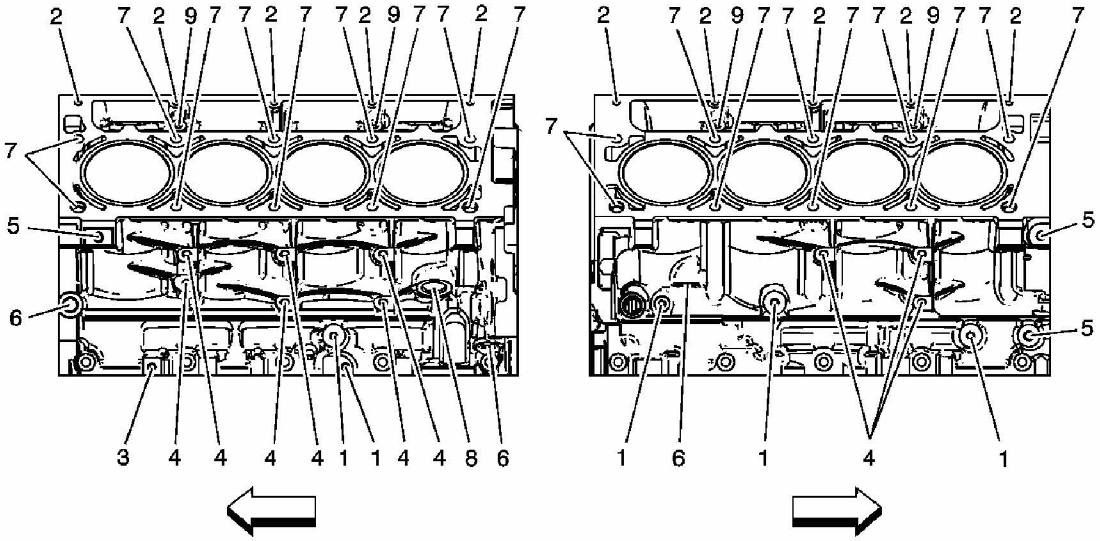


Fig. 2: View Of Engine Block - Left/Right Side
Courtesy of GENERAL MOTORS CORP.

Engine Block - Left/Right Side Views

Hole	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth - Maximum mm (in)	Tap Depth - Maximum mm (in)
				J 42385-				
1	M8 x 1.25	210	206	207	208	209	22.5 (0.885)	17.5 (0.688)
2	M8 x 1.25	210	206	207	208	209	28.5 (1.122)	23.0 (0.905)
3	M8 x 1.25	210	206	207	208	209	21.5 (0.846)	16.0 (0.629)
4	M10 x 1.5	215	211	212	213	214	29.0 (1.141)	23.0 (0.905)
5	M10 x 1.5	215	211	212	213	214	27.0 (1.062)	21.5 (0.846)
6	M16 x 1.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	M11 x 2.0	108	105	N/A	106	107	69.0 (2.72)	60.0 (2.36)
8	M28 x 1.25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	M6 x 1.0	205	201	202	203	204	22.5 (0.886)	15.0 (0.591)

Bolt hole 7 has a 30 mm (1.18 in) counterbore included in the 69.0 mm (2.72 in) drill depth. Use sleeve J 42385-315 with the drill and tap.

Engine Block - Top/Bottom Views

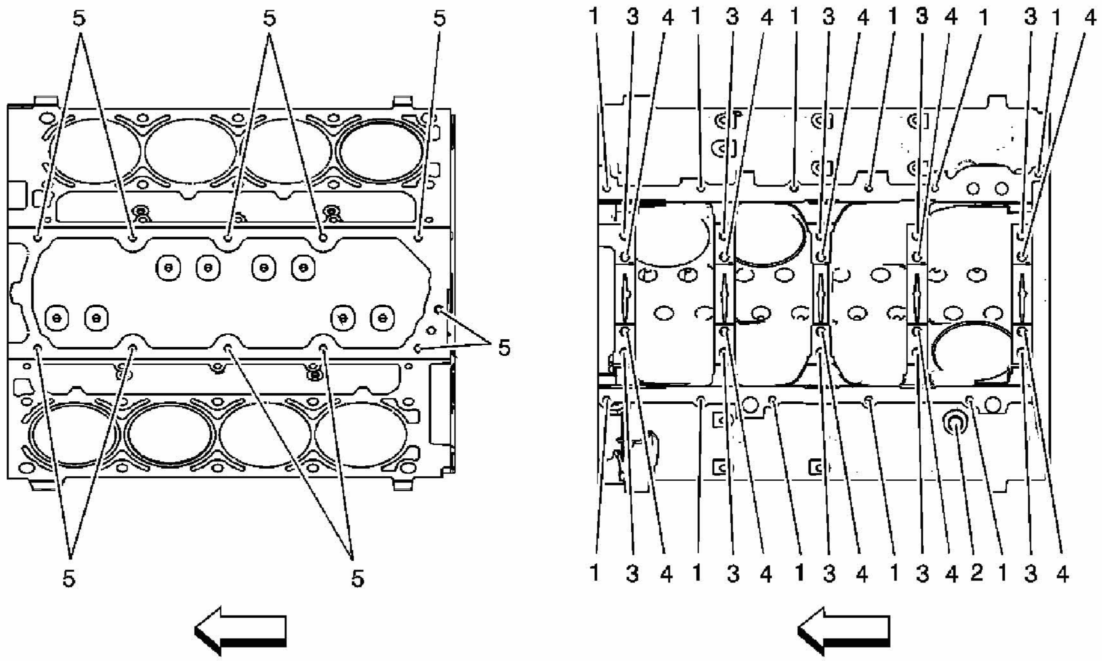


Fig. 3: View Of Engine Block - Top/Bottom
Courtesy of GENERAL MOTORS CORP.

Engine Block - Top/Bottom Views

Hole	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth - Maximum mm (in)	Tap Depth - Maximum mm (in)
J 42385-								
1	M8 x 1.25	210	206	207	208	209	22.5 (0.885)	17.5 (0.688)
2	M16 x 1.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	M10 x 2.0	104	101	N/A	102	103	31.0 (1.22)	25.5 (1.0)
4	M10 x 2.0	104	101	N/A	102	103	53.5 (2.10)	44.0 (1.73)
5	M8 x 1.25	210	206	207	208	209	26.5 (1.043)	19.0 (0.748)
- Bolt hole 3 has a 1.5 mm (0.059 in) counterbore included in the 31.0 mm (1.22								

in) drill depth. Use sleeve J 42385-316 with the drill and tap.

- Bolt hole 4 has a 20.5 mm (0.807 in) counterbore included in the 53.5 mm (2.10 in) drill depth.

Cylinder Head - Top/End Views

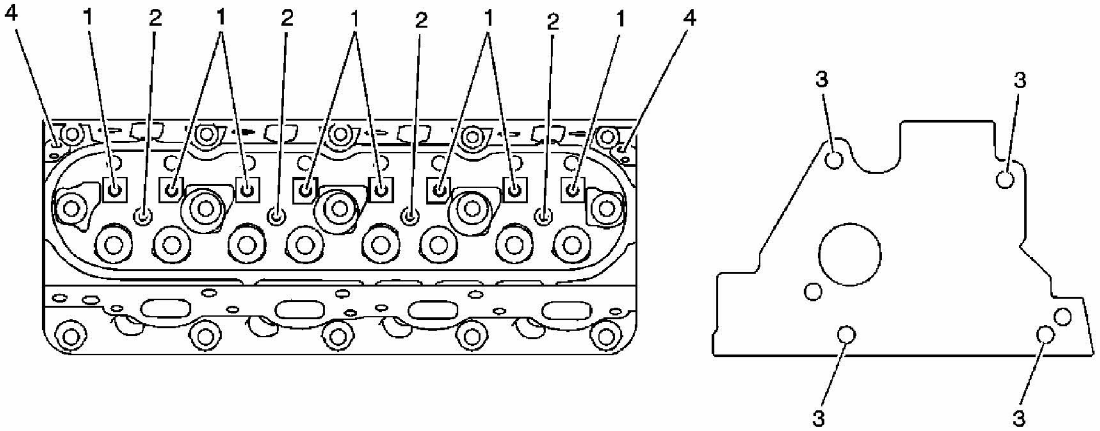


Fig. 4: Cylinder Head - Top/End Views
Courtesy of GENERAL MOTORS CORP.

Cylinder Head - Top/End Views

Hole	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth - Maximum mm (in)	Tap Depth - Maximum mm (in)
J 42385-								
1	M8 x 1.25	210	206	207	208	209	26.5 (1.04)	19.0 (0.784)
2	M6 x 1.0	205	201	202	203	204	20.05 (0.789)	16.05 (0.632)
3	M10 x 1.5	215	211	212	213	214	28.0 (1.10)	20.0 (0.787)
4	M6 x 1.0	205	201	202	203	204	22.5 (0.885)	15.0 (0.688)

Cylinder Head - Intake/Exhaust Side Views

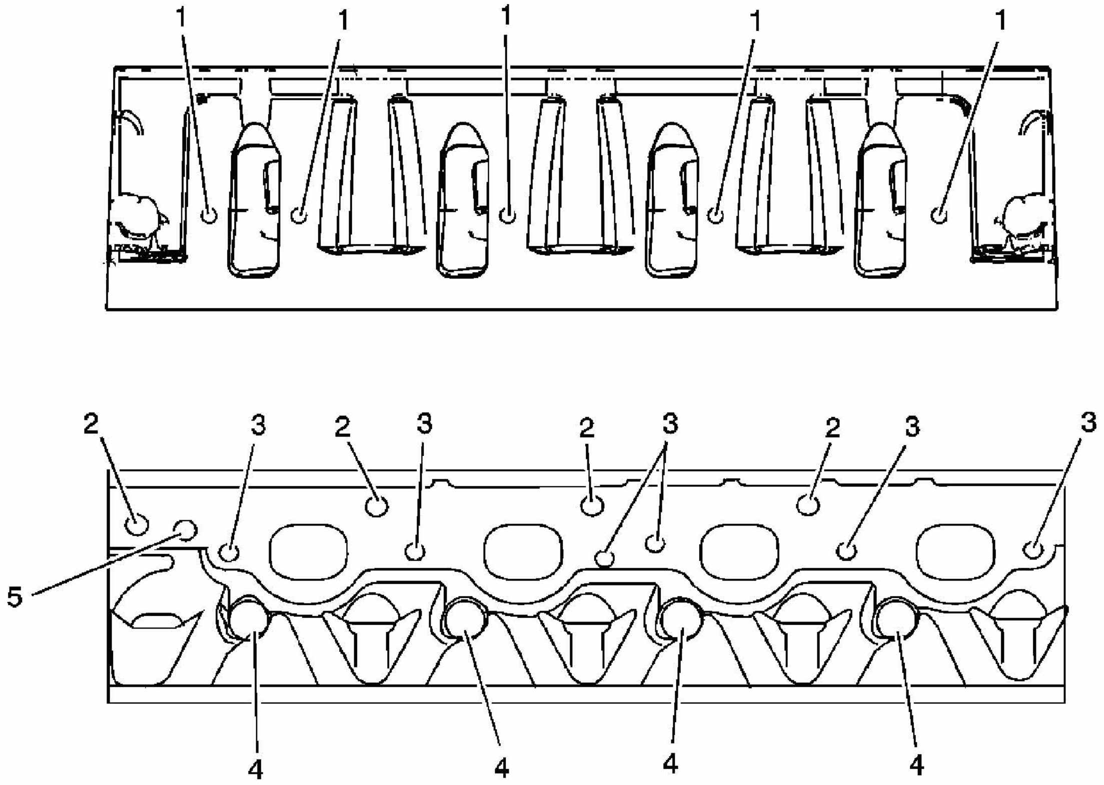


Fig. 5: Cylinder Head - Intake/Exhaust Side Views
Courtesy of GENERAL MOTORS CORP.

Cylinder Head - Intake/Exhaust Side Views

Hole	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth - Maximum mm (in)	Tap Depth - Maximum mm (in)
J 42385-								
1	M6 x 1.0	205	201	202	203	204	Thru	Thru
2	M10 x 1.5	215	211	212	213	214	28.0 (1.10)	20.0 (0.787)
3	M8 x 1.25	210	206	207	208	209	21.0 (0.826)	16.0 (0.629)
4	M14 x 1.25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	M12 x 1.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A

COMPONENT LOCATOR

DISASSEMBLED VIEWS

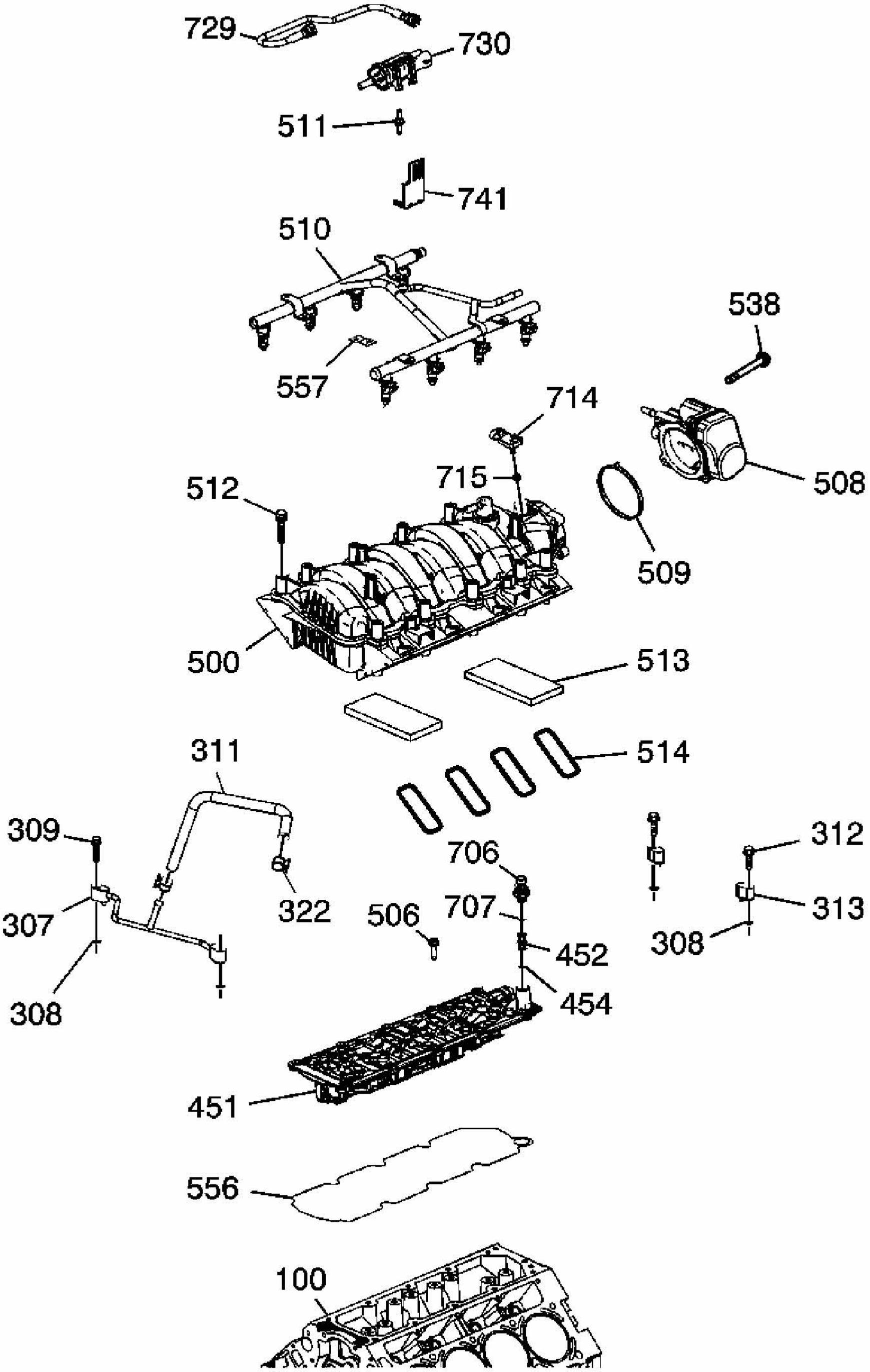

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Fig. 6: Intake Manifold/Upper Engine
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 6

Callout	Component Name
100	Engine Block

307	Engine Coolant Air Bleed Pipe
308	Seal
308	Seal
309	Bolt
311	Coolant Hose
312	Bolt
313	Engine Coolant Air Bleed Cover
322	Clamp
451	Valve Lifter Oil Manifold (VLOM)
452	Valve Lifter Oil Filter
454	O-Ring
500	Intake Manifold
506	Bolt
508	Throttle Body
509	Throttle Body Gasket
510	Fuel Rail with Injectors
511	Bolt
512	Bolt
513	Seal
514	Intake Manifold Gasket
538	Bolt
556	VLOM Gasket
557	Fuel Rail Ground Strap
706	Oil Pressure Sensor
707	Washer
714	Manifold Absolute Pressure (MAP) Sensor
715	O-Ring
729	Evaporative Emission (EVAP) Canister Purge Tube
730	EVAP Canister Purge Solenoid Valve
741	EVAP Canister Purge Solenoid Valve Bracket

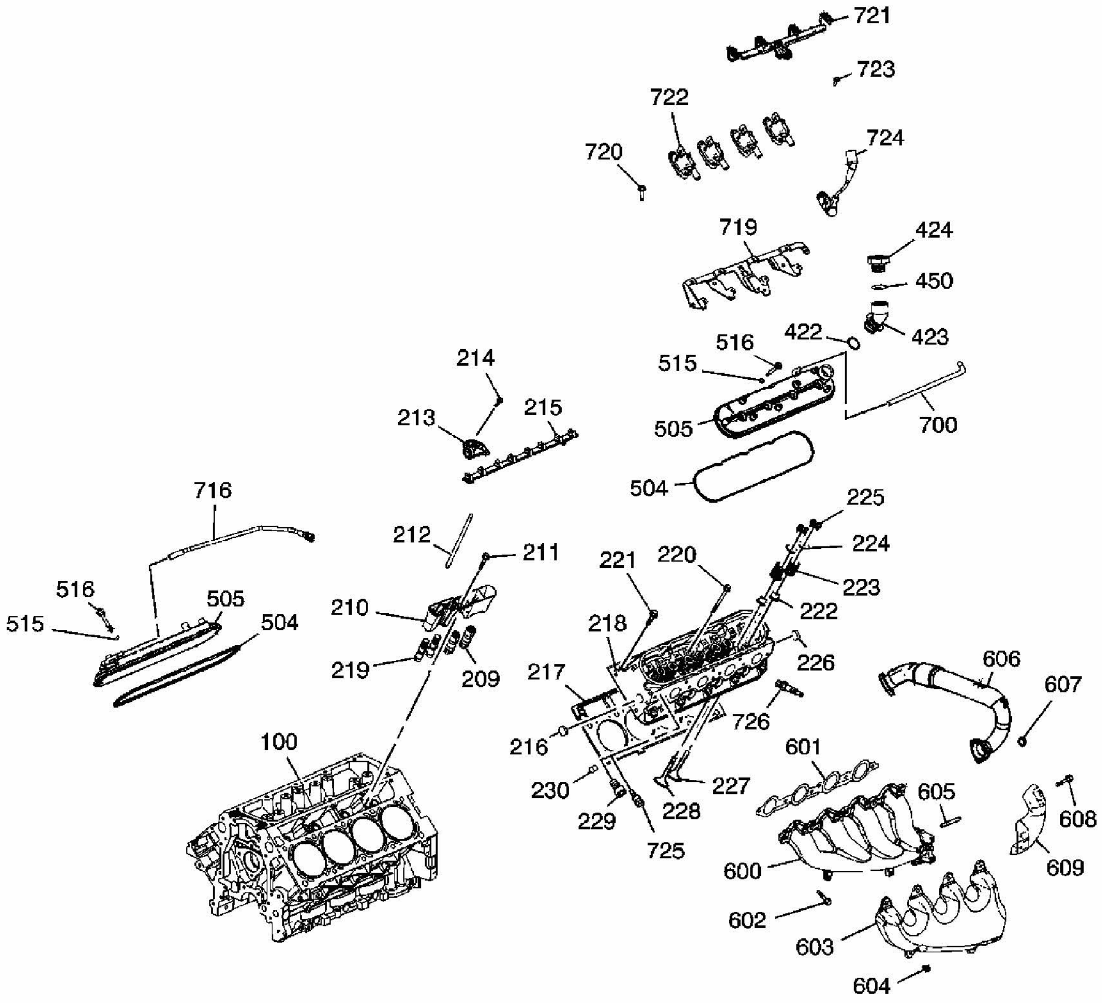
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Fig. 7: Cylinder Head/Upper Engine
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 7

Callout	Component Name
100	Engine Block
209	Valve Lifter - Non Displacement on Demand
210	Valve Lifter Guide
211	Bolt
212	Pushrod
213	Rocker Arm
214	Bolt
215	Rocker Arm Pivot Support
216	Core Hole Plug
217	Cylinder Head Gasket
218	Cylinder Head

219	Valve Lifter - Displacement on Demand
220	Bolt - M11
221	Bolt - M8
222	Valve Stem Oil Seal
223	Valve Spring
224	Valve Spring Cap
225	Valve Stem Key
226	Core Hole Plug
227	Intake Valve
228	Exhaust Valve
229	Cylinder Head Coolant Plug
230	Cylinder Head Locating Pin
422	Oil Fill Tube O-Ring
423	Oil Fill Tube
424	Oil Fill Cap
450	Oil Fill Cap O-Ring
504	Valve Cover Gasket
504	Valve Cover Gasket
505	Valve Cover
505	Valve Cover
515	Valve Cover Bolt Grommet
515	Valve Cover Bolt Grommet
516	Bolt
516	Bolt
600	Exhaust Manifold
601	Exhaust Manifold Gasket
602	Bolt
603	Exhaust Manifold Heat Shield
604	Bolt
605	Stud
606	Exhaust Pipe
607	Nut
608	Bolt
609	Heat Shield
700	Positive Crankcase Ventilation (PCV) Hose - Fresh Air
716	PCV Hose - Dirty Air
719	Ignition Coil Bracket
720	Bolt

	Ignition Coil Wire Harness
722	Ignition Coil
723	Bolt
724	Spark Plug Wire
725	Coolant Temperature Sensor (CTS)
726	Spark Plug

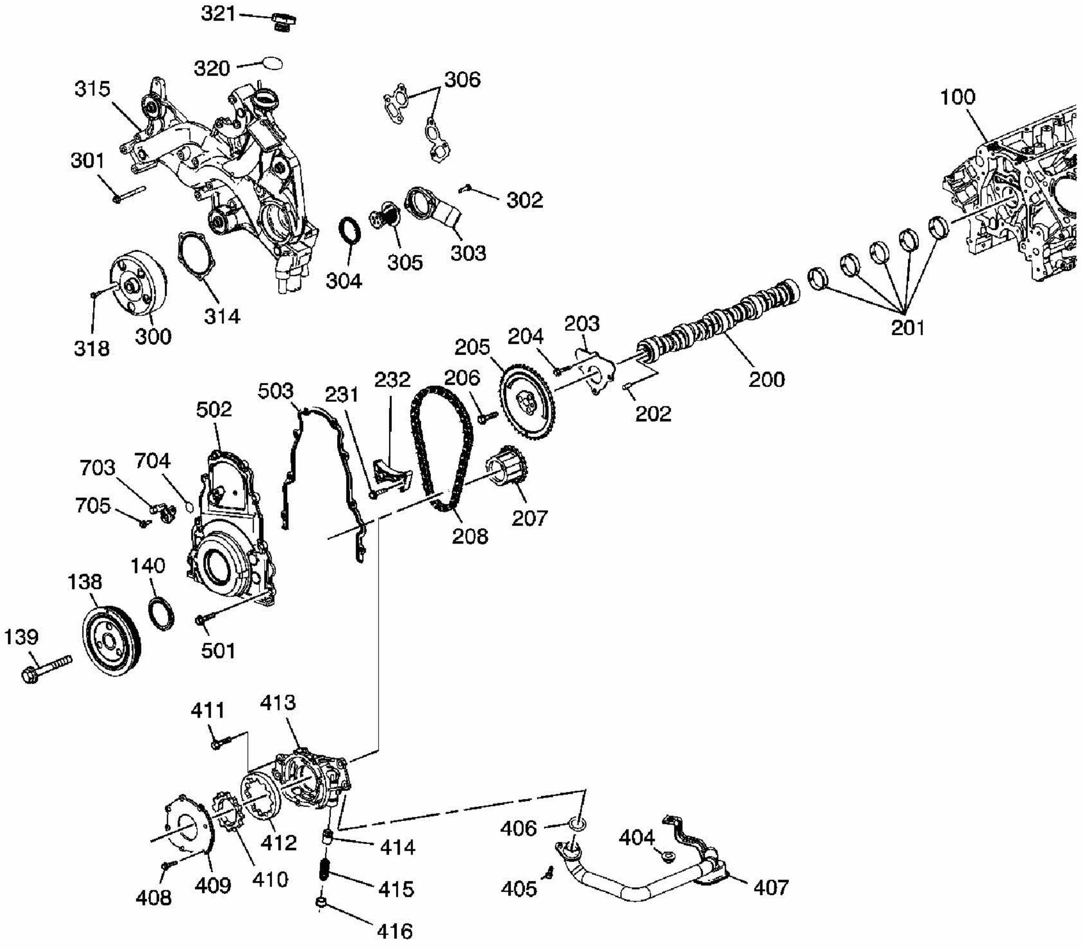
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Fig. 8: Front of Engine
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 8

Callout	Component Name
100	Engine Block
138	Crankshaft Balancer
139	Bolt
140	Crankshaft Front Oil Seal
200	Camshaft

201	Camshaft Bearings
202	Camshaft Sprocket Locating Pin
203	Camshaft Retainer Plate
204	Bolt
205	Camshaft Sprocket
206	Bolt
207	Crankshaft Sprocket
208	Timing Chain
231	Bolt
232	Timing Chain Dampener
300	Water Pump
301	Bolt
302	Bolt
303	Water Inlet Housing
304	O-Ring
305	Thermostat
306	Water Pump Gasket
314	Water Pump Gasket
315	Water Manifold
318	Bolt
320	O-Ring
321	Coolant Cap
404	Nut
405	Bolt
406	O-Ring
407	Oil Pump Screen
408	Bolt
409	Oil Pump Cover
410	Drive Gear
411	Bolt
412	Driven Gear
413	Oil Pump Assembly
414	Pressure Relief Valve
415	Pressure Relief Valve Spring
416	Plug
501	Bolt
502	Front Cover
503	Front Cover Gasket

	Camshaft Position (CMP) Sensor
704	O-Ring
705	Bolt

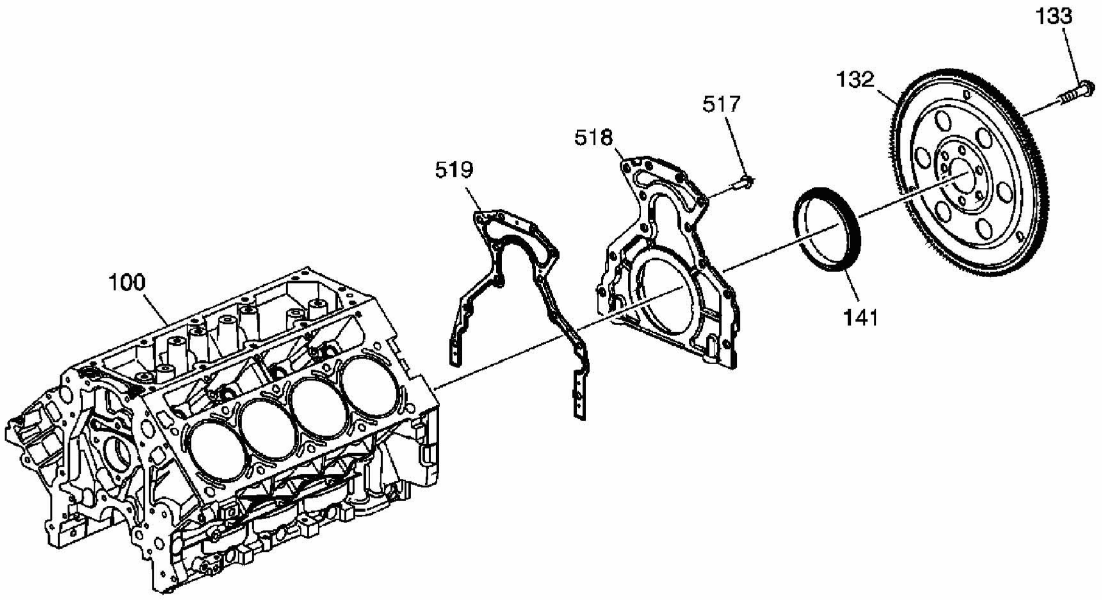

Fig. 9: Rear of Engine
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 9

Callout	Component Name
100	Engine Block
132	Flex Plate - Automatic Transmission
133	Bolt
141	Crankshaft Rear Oil Seal
517	Bolt
518	Crankshaft Rear Oil Seal Housing
519	Crankshaft Rear Oil Seal Housing Gasket

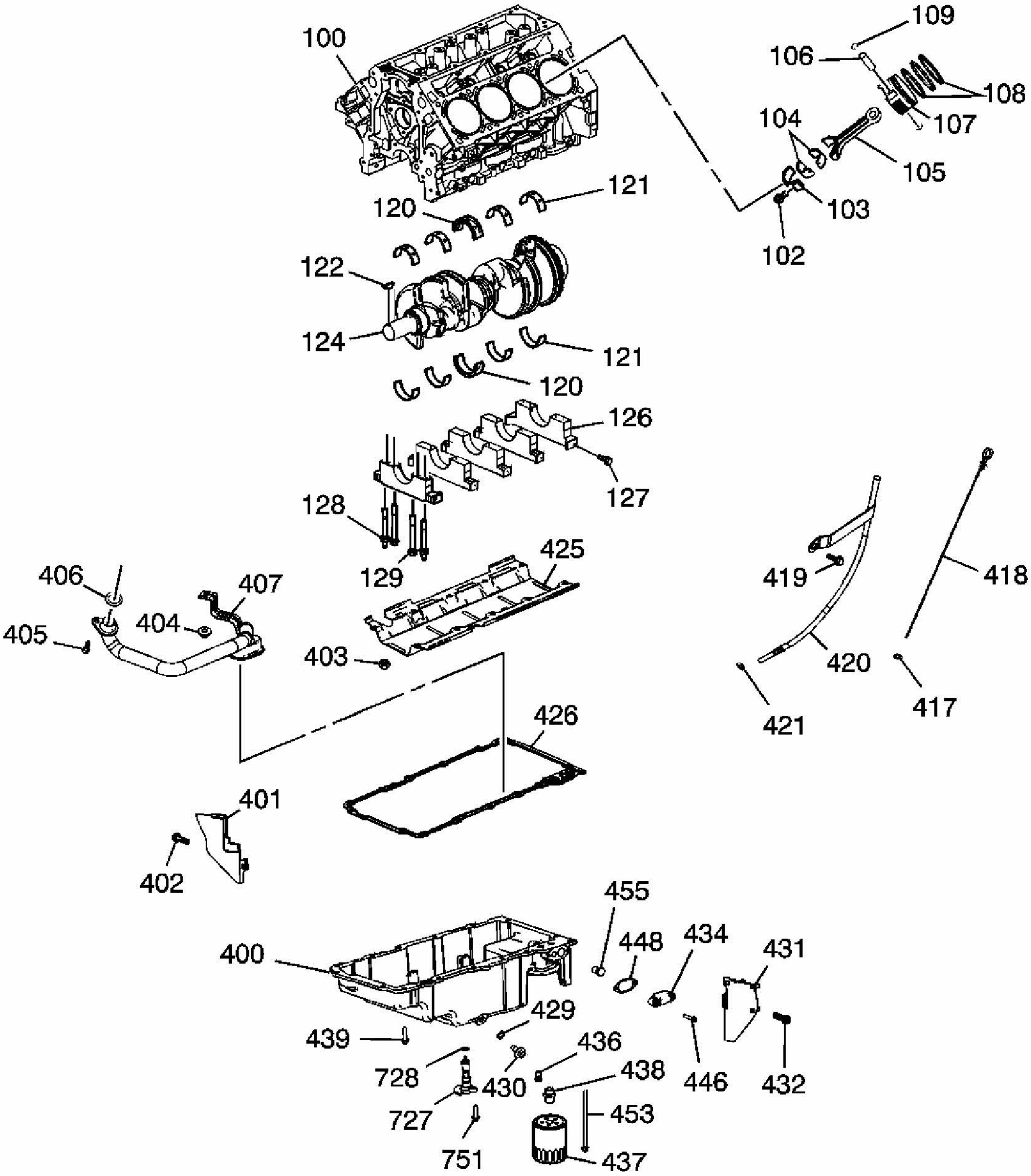
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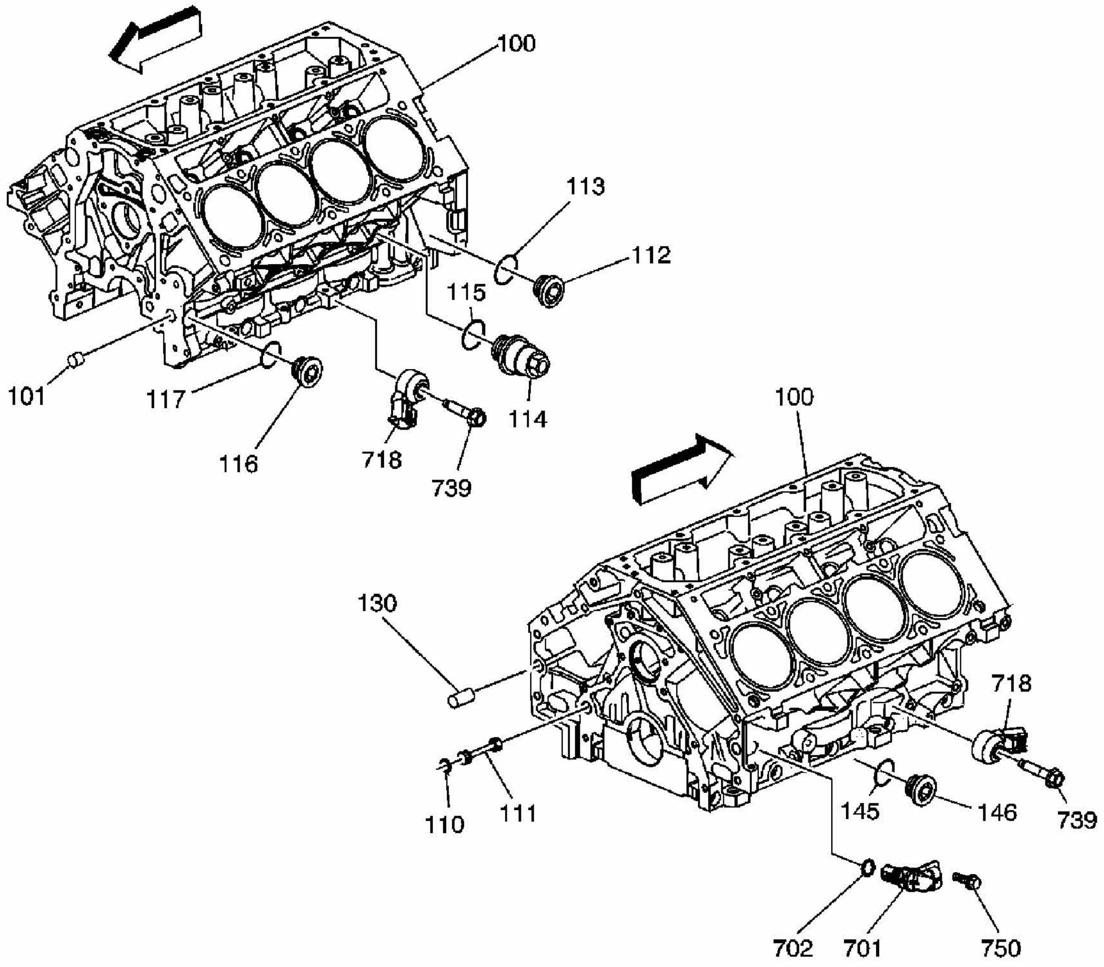
Fig. 10: Lower Engine Assembly
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 10

Callout	Component Name
100	Engine Block
102	Bolt
103	Connecting Rod Cap
104	Connecting Rod Bearings
105	Connecting Rod

106	Piston Pin
107	Piston
108	Piston Rings
109	Retainer
120	Crankshaft Thrust Bearing
120	Crankshaft Thrust Bearing
121	Crankshaft Main Bearing
121	Crankshaft Main Bearing
122	Crankshaft Sprocket Key
124	Crankshaft
126	Crankshaft Bearing Cap
127	Bolt - M8
128	Stud - M10
129	Bolt - M10
400	Oil Pan
401	Cover - Right
402	Bolt
403	Nut
404	Nut
405	Bolt
406	O-Ring
407	Oil Pump Screen
417	O-Ring
418	Oil Level Indicator
419	Bolt
420	Oil Level Indicator Tube
421	O-Ring
425	Crankshaft Oil Deflector
426	Oil Pan Gasket
429	O-Ring
430	Oil Pan Drain Plug
431	Cover - Left
432	Bolt
434	Cover
436	Oil Filter Bypass Valve
437	Oil Filter
438	Oil Filter Fitting
439	Bolt

	Bolt
448	Oil Pan Cover Gasket
453	Bolt
455	Oil Pressure Relief Valve - Displacement on Demand
727	Oil Level Sensor
728	O-Ring
751	Bolt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145
146
739
702
701
750

Fig. 11: Engine Block Plugs/Sensors
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 11

Callout	Component Name
100	Engine Block
100	Engine Block
101	Oil Gallery Plug - Front
110	O-Ring

111	Oil Gallery Plug - Rear
112	Oil Gallery Plug - Side
113	Washer
114	Coolant Heater
115	Washer
116	Oil Gallery Plug - Side
117	Washer
130	Transmission Housing Locating Pin
145	Washer
146	Engine Block Coolant Drain Hole Plug
701	Crankshaft Position (CKP) Sensor
702	O-Ring
718	Knock Sensor
718	Knock Sensor
739	Bolt
739	Bolt
750	Bolt

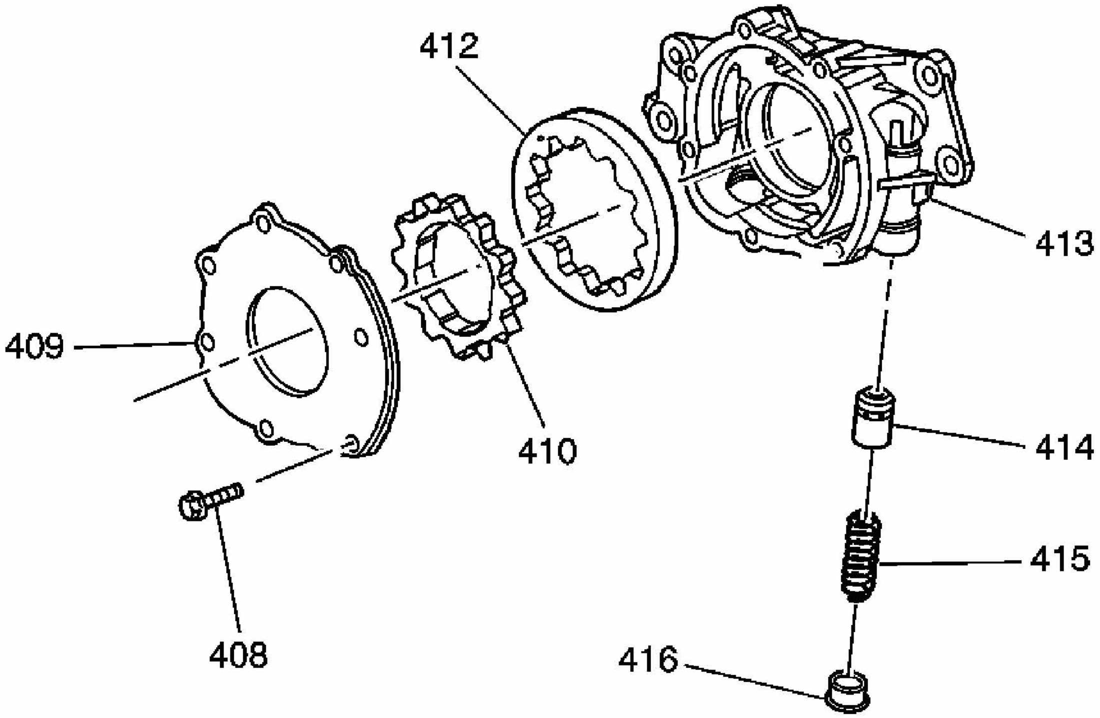

Fig. 12: Exploded View Of Oil Pump Assembly
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 12

Callout	Component Name
408	Bolt
409	Oil Pump Housing Cover
410	Oil Pump Drive Gear
412	Oil Pump Driven Gear
413	Oil Pump
414	Oil Pump Pressure Relief Valve
415	Oil Pump Pressure Relief Valve Spring
416	Oil Pump Housing Plug

ENGINE IDENTIFICATION

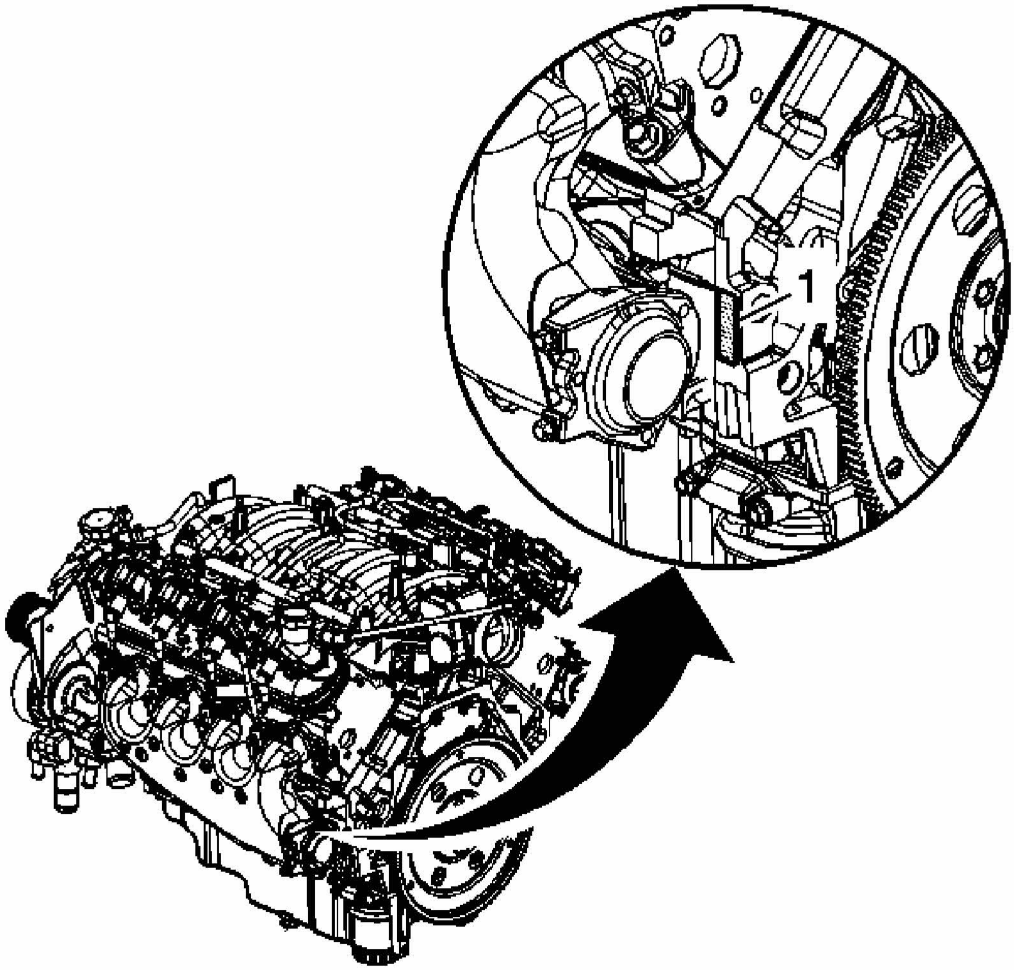

Fig. 13: Locating Vehicle Identification Number (VIN)

Courtesy of GENERAL MOTORS CORP.

The vehicle identification number (VIN) is located on the left side rear of the engine block (1) and is typically a 9 digit number stamped or laser-etched onto the engine at the vehicle assembly plant.

- The first digit identifies the division.
- The second digit identifies the model year.
- The third digit identifies the assembly plant.
- The fourth through ninth digits are the last 6 digits of the VIN.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - ENGINE MECHANICAL

Begin the system diagnosis by reviewing the **Disassembled Views**, **Engine Component Description**, **Lubrication Description (Main Pressure Below 65 psi - DoD Off)** or **Lubrication Description (Main Pressure Above 65 psi - DoD Off)** or **Lubrication Description (Main Pressure Below 65 psi - DoD On)** or **Lubrication Description (Main Pressure Above 65 psi - DoD On)**, **Displacement on Demand (DoD) System Description** and**Drive Belt System Description**. Reviewing the description and operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the description and operation information will also help you determine if the condition described by the customer is normal operation. Refer to **Symptoms - Engine Mechanical** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

SYMPTOMS - ENGINE MECHANICAL

Strategy Based Diagnostics

1. Perform the **Diagnostic System Check - Vehicle** in Vehicle DTC Information before using the symptom tables, if applicable.
2. Review the system operations in order to familiarize yourself with the system functions. Refer to **Disassembled Views**, **Engine Component Description**, **Lubrication Description (Main Pressure Below 65 psi - DoD Off)** or **Lubrication Description (Main Pressure Above 65 psi - DoD Off)** or **Lubrication Description (Main Pressure Below 65 psi - DoD On)** or **Lubrication Description (Main Pressure Above 65 psi - DoD On)**, **Displacement on Demand (DoD) System Description** and **Drive Belt System Description**.

All diagnosis on a vehicle should follow a logical process. Strategy based diagnostics is a uniform approach for repairing all systems. The diagnostic flow may always be used in order to resolve a system condition. The diagnostic flow is the place to start when repairs are necessary. For a detailed explanation, refer to **Strategy Based Diagnosis** in General Information.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Engine. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Check for the correct oil level, proper oil viscosity, and correct filter application.
- Verify the exact operating conditions under which the concern exists. Note factors such as engine RPM, ambient temperature, engine temperature, amount of engine warm-up time, and other specifics.
- Compare the engine sounds, if applicable, to a known good engine and make sure you are not trying to correct a normal condition.

Intermittent

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating properly.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Base Engine Misfire without Internal Engine Noises**
- **Base Engine Misfire with Abnormal Internal Lower Engine Noises**
- **Base Engine Misfire with Abnormal Valve Train Noise**
- **Base Engine Misfire with Coolant Consumption**
- **Base Engine Misfire with Excessive Oil Consumption**
- **Engine Noise on Start-Up, but Only Lasting a Few Seconds**
- **Upper Engine Noise, Regardless of Engine Speed**
- **Lower Engine Noise, Regardless of Engine Speed**
- **Engine Noise Under Load**
- **Engine Will Not Crank - Crankshaft Will Not Rotate**
- **Coolant in Combustion Chamber**
- **Coolant in Engine Oil**
- **Displacement on Demand (DoD) System Diagnosis**
- **Engine Compression Test**
- **Displacement on Demand (DoD) System Compression Test**

- **Cylinder Leakage Test**
- **Oil Consumption Diagnosis**
- **Oil Pressure Diagnosis and Testing**
- **Displacement on Demand (DoD) Oil Pressure Relief Valve Diagnosis and Testing**
- **Displacement on Demand (DoD) Valve Lifter Oil Manifold Diagnosis and Testing**
- **Oil Leak Diagnosis**
- **Drive Belt Chirping Diagnosis**
- **Drive Belt Squeal Diagnosis**
- **Drive Belt Whine Diagnosis**
- **Drive Belt Rumbling Diagnosis**
- **Drive Belt Vibration Diagnosis**
- **Drive Belt Falls Off Diagnosis**
- **Drive Belt Excessive Wear Diagnosis**
- **Drive Belt Tensioner Diagnosis**

BASE ENGINE MISFIRE WITHOUT INTERNAL ENGINE NOISES

Base Engine Misfire without Internal Engine Noises

Cause	Correction
Abnormalities, such as severe cracking, bumps, or missing areas in the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine RPM variations and lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	Replace the drive belt. Refer to **Drive Belt Replacement - Accessory**.
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout May lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	Inspect the components and repair or replace, as required.
Loose or improperly installed engine flywheel or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer, as required. Refer to **Engine Flywheel Replacement** or **Crankshaft Balancer Replacement**.
Restricted exhaust system A severe restriction in the exhaust flow can cause significant loss of engine performance and may set a DTC. Possible causes of restrictions include collapsed or dented pipes or plugged mufflers and/or	Repair or replace, as required.

catalytic converters.	
Improperly installed or damaged vacuum hoses	Repair or replace, as required.
Improper sealing between the intake manifold and cylinder heads or throttle body	Replace the intake manifold, gaskets, cylinder heads, and/or throttle body, as required.
Improperly installed or damaged MAP sensor The sealing grommet of the MAP sensor should not be torn or damaged.	Repair or replace the MAP sensor, as required.
Worn or loose rocker arms The rocker arm bearing end caps and/or needle bearings should be intact and in the proper position.	Replace the valve rocker arms, as required.
Worn or bent pushrods	• Replace the pushrods. • Inspect the top of the pistons for valve contact. If the top of the piston shows valve contact, replace the piston and pin assembly.
Stuck valves Carbon buildup on the valve stem can cause the valve not to close properly.	Repair or replace, as required.
Excessively worn or mis-aligned timing chain	Replace the timing chain and sprockets, as required.
Worn camshaft lobes	Replace the camshaft and valve lifters.
Excessive oil pressure A lubrication system with excessive oil pressure may lead to excessive valve lifter pump-up and loss of compression.	• Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing**. • Repair or replace the oil pump, as required.
Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages Coolant consumption may or may not cause the engine to overheat.	1. Inspect for spark plugs saturated by coolant. Refer to **Spark Plug Inspection** in Engine Controls - 5.3L. 2. Inspect the cylinder heads, engine block, and/or head gaskets. Refer to **Coolant in Combustion Chamber**. 3. Repair or replace, as required.
Worn piston rings	1. Inspect the spark plugs for

Oil consumption may or may not cause the engine to misfire.	oil deposits. Refer to **Spark Plug Inspection** in Engine Controls - 5.3L. 2. Inspect the cylinders for a loss of compression. Refer to **Engine Compression Test**. 3. Perform cylinder leak down and compression testing to identify the cause. Refer to **Cylinder Leakage Test**. 4. Repair or replace, as required.
A damaged crankshaft reluctor wheel A damaged crankshaft reluctor wheel can result in different symptoms depending on the severity and location of the damage. • Systems with electronic communications, DIS or coil per cylinder, and severe reluctor ring damage may exhibit periodic loss of crankshaft position, stop delivering a signal, and then sync the crankshaft position. • Systems with electronic communication, DIS or coil per cylinder, and slight reluctor ring damage may exhibit no loss of crankshaft position and no misfire may occur. However, a P0300 DTC may be set. • Systems with mechanical communications, high voltage switch, and severe reluctor ring damage may cause additional pulses and effect fuel and spark delivery to the point of generating a P0300 DTC or P0336.	Replace the sensor and/or crankshaft, as required.

BASE ENGINE MISFIRE WITH ABNORMAL INTERNAL LOWER ENGINE NOISES

Base Engine Misfire with Abnormal Internal Lower Engine Noises

Cause	Correction
Abnormalities, such as severe cracking, bumps or missing areas in the accessory drive belt Abnormalities in the accessory drive system and/or	Replace the drive belt. Refer to **Drive Belt Replacement - Accessory**.

components may cause engine RPM variations, noises similar to a faulty lower engine and also lead to a misfire condition. A misfire code may be present without an actual misfire condition.	
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout A misfire code may be present without an actual misfire condition.	Inspect the components and repair or replace, as required.
Loose or improperly installed engine flywheel or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer, as required. Refer to **Engine Flywheel Replacement** or **Crankshaft Balancer Replacement**.
Worn piston rings Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs for oil deposits. Refer to **Spark Plug Inspection** in Engine Controls - 5.3L. • Inspect the cylinders for a loss of compression. Refer to **Engine Compression Test**. • Perform cylinder leak down and compression testing to determine the cause. Refer to **Cylinder Leakage Test**. • Repair or replace, as required.
Worn crankshaft thrust bearings Severely worn thrust surfaces on the crankshaft and/or thrust bearing may permit fore and aft movement of the crankshaft and create a DTC without an actual misfire condition.	Replace the crankshaft and bearings, as required.

BASE ENGINE MISFIRE WITH ABNORMAL VALVE TRAIN NOISE

Base Engine Misfire with Abnormal Valve Train Noise

Cause	Correction
Worn or loose rocker arms The rocker arm bearing end caps and/or needle bearings should be intact within the rocker arm assembly.	Replace the valve rocker arms, as required.

Worn or bent pushrods	- Replace the pushrods. - Inspect the top of the pistons for valve contact. If the top of the piston shows valve contact, replace the piston and pin assembly.
Stuck valves Carbon buildup on the valve stem can cause the valve not to close properly.	Repair or replace, as required.
Excessively worn or mis-aligned timing chain	Replace the timing chain and sprockets, as required.
Worn camshaft lobes	Replace the camshaft and valve lifters.
Sticking lifters	Replace, as required.
Improper operation of the displacement on demand system	Inspect the system for proper operation. Refer to **Diagnostic Starting Point - Engine Mechanical**.

BASE ENGINE MISFIRE WITH COOLANT CONSUMPTION

Base Engine Misfire with Coolant Consumption

Cause	Correction
Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages Coolant consumption may or may not cause the engine to overheat.	- Inspect for spark plugs saturated by coolant. Refer to **Spark Plug Inspection** in Engine Controls - 5.3L. - Perform a cylinder leak down test. Refer to **Cylinder Leakage Test**. - Inspect the cylinder heads and engine block for damage to the coolant passages and/or a faulty head gasket. Refer to **Coolant in Combustion Chamber**. - Repair or replace, as required.

BASE ENGINE MISFIRE WITH EXCESSIVE OIL CONSUMPTION

Base Engine Misfire with Excessive Oil Consumption

Cause	Correction
Worn valves, valve guides and/or valve stem oil seals	1. Inspect the spark plugs for oil deposits. Refer to **Spark Plug Inspection** in Engine Controls - 5.3L. 2. Repair or replace, as required.
Worn piston rings	1. Inspect the spark plugs for oil

Oil consumption may or may not cause the engine to misfire.	deposits. Refer to **Spark Plug Inspection** in Engine Controls - 5.3L. 2. Inspect the cylinders for a loss of compression. Refer to **Engine Compression Test**. 3. Perform cylinder leak down and compression testing to determine the cause. Refer to **Cylinder Leakage Test**. 4. Repair or replace, as required.

ENGINE NOISE ON START-UP, BUT ONLY LASTING A FEW SECONDS

Engine Noise on Start-Up, but Only Lasting a Few Seconds

Cause	Correction
Incorrect oil filter without anti-drainback feature	Install the correct oil filter.
Incorrect oil viscosity	1. Drain the oil. 2. Install the correct viscosity oil.
High valve lifter leak down rate	Replace the lifters, as required.
Worn crankshaft thrust bearing	1. Check the crankshaft end play. 2. Inspect the thrust bearing and crankshaft. 3. Repair or replace, as required.
Damaged or faulty oil filter bypass valve	1. Inspect the oil filter bypass valve for proper operation. 2. Repair or replace, as required.

UPPER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Upper Engine Noise, Regardless of Engine Speed

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing**. 2. Repair or replace, as required.
Loose and/or worn valve rocker arm attachments	1. Inspect the valve rocker arm, bolt, and pedestal. 2. Repair or replace, as required.
Worn or damaged valve rocker arm	1. Inspect the rocker arm for wear or

	missing needle bearings 2. Replace the valve rocker arms, as required.
Bent or damaged push rod	Inspect the following components and replace, as required: • The valve rocker arm • The valve push rod • The valve lifter • The valve lifter guide • The piston Inspect the top of the pistons for valve contact. If the top of the piston shows valve contact, replace the piston and pin assembly.
Improper lubrication to the valve rocker arms	Inspect the following components and repair or replace, as required: • The valve rocker arm • The valve push rod • The valve lifter • The oil filter bypass valve • The oil pump and pump screen • Improper operation of the displacement on demand (DoD) oil pressure relief valve • The engine block oil galleries
Broken valve spring	Replace the valve spring and spring shim.
Worn or dirty valve lifters	Replace the valve lifters.
DoD valve lifter with a broken spring	Replace, as required.
Stretched or broken timing chain and/or damaged sprocket teeth	Replace the timing chain and sprockets.
Worn engine camshaft lobes	1. Inspect the engine camshaft lobes. 2. Replace the camshaft and valve lifters, as required.
Worn valve guides or valve stems	Inspect the following components and repair, as required:

	- The valves - The valve guides
Stuck valves Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the following components and repair, as required: - The valves - The valve guides
Cut or damaged oil pump screen O-ring seal which may cause aeration of the engine oil	Repair, as required. Refer to **Oil Pressure Diagnosis and Testing**.

LOWER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Lower Engine Noise, Regardless of Engine Speed

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing**. 2. Repair or replace damaged components, as required.
Worn accessory drive components Abnormalities such as severe cracking, bumps or missing areas in the accessory drive belt and/or misalignment of system components.	1. Inspect the accessory drive system. 2. Repair or replace, as required.
Loose or damaged crankshaft balancer	1. Inspect the crankshaft balancer. 2. Repair or replace, as required.
Detonation or spark knock	Verify the correct operation of the ignition controls system. Refer to **Detonation/Spark Knock** in Engine Controls - 5.3L.
Loose torque converter bolts	1. Inspect the torque converter bolts and flywheel. 2. Repair or replace, as required.
Loose or damaged flywheel	Repair or replace the flywheel.
Oil pump screen loose, damaged or restricted	1. Inspect the oil pump screen. 2. Repair or replace, as required.
Excessive piston-to-cylinder bore clearance	1. Inspect the piston and cylinder bore. 2. Repair, as required.
Excessive piston pin-to-bore clearance	1. Inspect the piston, pin, and

	connecting rod. 2. Replace the piston and pin as an assembly, as required.
Excessive connecting rod bearing clearance	Inspect the following components and repair, as required: - The connecting rod bearings - The connecting rods - The crankshaft - The crankshaft journals
Excessive crankshaft bearing clearance	Inspect the following components and repair, as required: - The crankshaft bearings - The crankshaft journals
Incorrect piston, piston pin and connecting rod installation Pistons must be installed with the mark or dimple on the top of the piston facing the front of the engine. Piston pins must be centered in the connecting rod pin bore.	1. Verify the pistons, piston pins and connecting rods are installed correctly. Refer to **Piston, Connecting Rod, and Bearing Installation**. 2. Repair, as required.

ENGINE NOISE UNDER LOAD

Engine Noise Under Load

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to **Oil Pressure Diagnosis and Testing**. 2. Repair or replace, as required.
Detonation or spark knock	Verify the correct operation of the ignition controls. Refer to **Detonation/Spark Knock** in Engine Controls - 5.3L.
Loose torque converter bolts	1. Inspect the torque converter bolts and flex plate. 2. Repair, as required.
Cracked flex plate - automatic transmission	1. Inspect the flex plate bolts and flex plate. 2. Repair, as required.
Excessive connecting rod bearing clearance	Inspect the following components and repair, as required:

	• The connecting rod bearings • The connecting rods • The crankshaft
Excessive crankshaft bearing clearance	Inspect the following components and repair, as required: • The crankshaft bearings • The crankshaft journals • The cylinder block crankshaft bearing bore

ENGINE WILL NOT CRANK - CRANKSHAFT WILL NOT ROTATE

Engine Will Not Crank - Crankshaft Will Not Rotate

Cause	Correction
Seized accessory drive system component	1. Remove the accessory drive belts. 2. Confirm that the engine will rotate. Rotate the crankshaft by hand at the crankshaft balancer or flex plate location. 3. Repair or replace the components, as required.
Seized automatic transmission torque converter	1. Remove the torque converter-to-flex plate bolts. 2. Confirm that the engine will rotate. Rotate the crankshaft by hand at the crankshaft balancer or flex plate location. 3. Repair or replace the components, as required.
Broken timing chain	1. Inspect the timing chain and gears. 2. Repair or replace the components, as required.
Seized timing chain or timing gears	1. Inspect the timing chain and gears for foreign material or a seized chain. 2. Repair or replace the components, as required.
Seized or broken camshaft	1. Inspect the camshaft and the

	camshaft bearings. 2. Repair or replace the components, as required.
Bent valve in the cylinder head	1. Inspect the valves and the cylinder heads. 2. Repair or replace the components, as required.
Seized oil pump	1. Inspect the oil pump assembly. 2. Repair or replace, as required.
Hydraulically locked cylinder - Coolant/antifreeze in the cylinder - Oil in the cylinder - Fuel in the cylinder	1. Remove spark plugs and check for fluid in the cylinder. When rotating the engine with the spark plugs removed, the piston, on compression stroke, will push fluid from the combustion chamber. Refer to **Coolant in Combustion Chamber**. 2. Inspect for failed/broken head gaskets. 3. Inspect for a cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector. 5. Repair or replace the components, as required.
Material in the cylinder - Broken valve - Broken piston rings - Piston material - Foreign material	1. Inspect the cylinder for damaged components and/or foreign materials. 2. Repair or replace the components, as required.
Seized crankshaft or connecting rod bearings	1. Inspect crankshaft and connecting rod bearings. 2. Repair or replace the components, as required.
Bent or broken connecting rod	1. Inspect the connecting rods. 2. Replace the piston, pin and connecting rod as an assembly, as required.
Broken crankshaft	1. Inspect the crankshaft.

	2. Repair or replace the components, as required.

COOLANT IN COMBUSTION CHAMBER

Coolant in Combustion Chamber

Cause	Correction
DEFINITION: Excessive white smoke and/or coolant type odor coming from the exhaust pipe may indicate coolant in the combustion chamber. Low coolant levels, an inoperative cooling fan, or a faulty thermostat may lead to an overtemperature condition which may cause engine component damage. 1. A slower than normal cranking speed may indicate coolant entering the combustion chamber. Refer to **Engine Will Not Crank - Crankshaft Will Not Rotate**. 2. Remove the spark plugs and inspect for spark plugs saturated by coolant or coolant in the cylinder bore. 3. Inspect by performing a cylinder leak-down test. During this test, excessive air bubbles within the coolant may indicate a faulty gasket or damaged component. 4. Inspect by performing a cylinder compression test. 2 cylinders side-by-side on the engine block, with low compression, may indicate a failed cylinder head gasket. Refer to **Engine Compression Test**.	
Cracked intake manifold or failed gasket	Replace the components, as required.
Faulty cylinder head gasket	Replace the head gasket and components, as required. Refer to **Cylinder Head Cleaning and Inspection** and **Cylinder Head Replacement - Left** or **Cylinder Head Replacement - Right**.
Warped cylinder head	Machine the cylinder head to the proper flatness, if applicable and replace the cylinder head gasket. Refer to **Cylinder Head Cleaning and Inspection**.
Cracked cylinder head	Replace the cylinder head and gasket.
Cracked cylinder liner or engine block	Replace the components, as required.
Cylinder head or engine block porosity	Replace the components, as required.

COOLANT IN ENGINE OIL

Coolant in Engine Oil

Cause	Correction
DEFINITION: Foamy or discolored oil or an engine oil overfill condition may indicate coolant entering the engine crankcase. Low coolant levels, an inoperative cooling fan,	

or a faulty thermostat may lead to an overtemperature condition which may cause engine component damage. Contaminated engine oil and oil filter should be changed. 1. Inspect the oil for excessive foaming or an overfill condition. Oil diluted by coolant may not properly lubricate the crankshaft bearings and may lead to component damage. Refer to **Lower Engine Noise, Regardless of Engine Speed**. 2. Inspect by performing a cylinder leak-down test. During this test, excessive air bubbles within the cooling system may indicate a faulty gasket or damaged component. 3. Inspect by performing a cylinder compression test. 2 cylinders side-by-side on the engine block with low compression may indicate a failed cylinder head gasket. Refer to **Engine Compression Test**.	
Faulty external engine oil cooler	Replace the components, as required.
Faulty cylinder head gasket	Replace the head gasket and components, as required. Refer to **Cylinder Head Cleaning and Inspection** and **Cylinder Head Replacement - Left** or **Cylinder Head Replacement - Right**.
Warped cylinder head	Machine the cylinder head to proper flatness, if applicable, and replace the cylinder head gasket. Refer to **Cylinder Head Cleaning and Inspection**.
Cracked cylinder head	Replace the cylinder head and gasket.
Cracked cylinder liner or engine block	Replace the components, as required.
Cylinder head or block porosity	Replace the components, as required.

DISPLACEMENT ON DEMAND (DOD) SYSTEM DIAGNOSIS

1. Check the engine oil level. Fill, as required.
2. Using the scan tool, check for diagnostic codes within the engine control module (ECM). Refer to **Diagnostic System Check - Vehicle** in Vehicle DTC Information. Repair, as required.
3. Verify proper engine oil pressure and operation of the displacement on demand (DoD) oil pressure relief valve. Refer to **Oil Pressure Diagnosis and Testing**.
4. Verify proper operation of the DoD system components. Refer to **Displacement on Demand (DoD) System Compression Test**.
5. Remove the valve lifter oil manifold (VLOM). Refer to **Valve Lifter Oil Manifold Replacement**.
6. Verify proper operation of the VLOM. Refer to **Displacement on Demand (DoD) Valve Lifter Oil Manifold Diagnosis and Testing**.

7. Replace the DoD valve lifters, as required. Both intake and exhaust lifters should be replaced in pairs. Refer to **Valve Lifter Replacement**.

ENGINE COMPRESSION TEST

1. Charge the battery if the battery is not fully charged.
2. Disable the ignition system.
3. Disable the fuel injection system.
4. Remove all spark plugs.
5. Turn the ignition to the ON position.
6. Depress the accelerator pedal to position the throttle plate wide open.
7. Start with the compression gage at zero and crank the engine through 4 compression strokes, 4 puffs.
8. Check the compression for each cylinder. Record the readings.
9. If a cylinder has low compression, inject approximately 15 ml (1 tablespoon) of engine oil into the combustion chamber through the spark plug hole. Check the compression again and record the reading.
10. The minimum compression in any 1 cylinder should not be less than 70 percent of the highest cylinder. No cylinder should read less than 690 kPa (100 psi). For example, if the highest pressure in any 1 cylinder is 1 035 kPa (150 psi), the lowest allowable pressure for any other cylinder would be 725 kPa (105 psi). (1 035 x 70% = 725) (150 x 70% = 105).
    - Normal - Compression builds up quickly and evenly to the specified compression for each cylinder.
    - Piston Rings Leaking - Compression is low on the first stroke. Compression builds up with the following strokes, but does not reach normal. Compression improves considerably when you add oil.
    - Valves Leaking - Compression is low on the first stroke. Compression usually does not build up on the following strokes. Compression does not improve much when you add oil.
    - If 2 adjacent cylinders have lower than normal compression, and injecting oil into the cylinders does not increase the compression, the cause may be a head gasket leaking between the cylinders.

DISPLACEMENT ON DEMAND (DOD) SYSTEM COMPRESSION TEST

The Displacement on Demand (DoD) System Compression Test is a functional test of the valve lifter oil manifold (VLOM) and valve lifters. Using a compression gage, the technician can monitor the specific cylinders ability to go into and out of DoD as commanded by the scan tool. The actual pressure values on the compression gage are not as critical as is observing the on-off switching action of the solenoid and valve lifters.

1. Measure the engine oil level. Fill, as required.
2. Perform the Diagnostic System Check - Vehicle. Refer to **Diagnostic System Check - Vehicle** in Vehicle DTC Information.
3. Disable the ignition system for the cylinder to be tested, by disconnecting the electrical wire harness to the ignition coil.
4. Disable the fuel injection system for the cylinder to be tested, by disconnecting the electrical wire harness to the fuel injector.
5. Remove the spark plug and wire for the cylinder to be tested.
6. Install a 0-1378 kPa (0-200 psi) compression gage.
7. Start the engine.
8. Using the scan tool output controls, command the solenoid ON, for the cylinder to be deactivated.
9. Depress the Schrader valve on the compression gage in order to release the pressure and zero the gage. With the engine running and the cylinder in DoD mode, the compression reading should be less than 172 kPa (25 psi).
10. Using the scan tool, de-energize the solenoid while observing the reading on the compression gage. With the engine running and the cylinder NOT in DoD mode, the compression gage reading should increase quickly to greater than 345 kPa (50 psi).

IMPORTANT: Only 1 cylinder can be tested at a time. When testing has been completed on a specific cylinder, the wire harness electrical connectors, spark plug, and spark plug wire must be installed prior to testing of each additional cylinder.

11. Test each of the 4 DoD cylinders, 1 at a time. If the readings are not within specifications, remove and test the VLOM, as required. Refer to **Valve Lifter Oil Manifold Replacement** and **Displacement on Demand (DoD) Valve Lifter Oil Manifold Diagnosis and Testing**.
12. If the compression test has been performed and all DoD cylinders are operating within specifications, the DoD system is performing as designed and no repairs are required.
13. Clear the DTCs with a scan tool.

CYLINDER LEAKAGE TEST

Tools Required

J 35667-A Cylinder Head Leakdown Tester or equivalent

IMPORTANT: A leakage test may be performed in order to measure cylinder/combustion chamber leakage. High cylinder leakage

may indicate one or more of the following conditions:

- **Worn or burnt valves**
- **Broken valve springs**
- **Stuck valve lifters**
- **Incorrect valve lash**
- **Damaged piston**
- **Worn piston rings**
- **Worn or scored cylinder bore**
- **Damaged cylinder head gasket**
- **Cracked or damaged cylinder head**
- **Cracked or damaged engine block**

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the battery ground negative cable.
2. Remove the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls - 5.3L.
3. Rotate the crankshaft to place the piston in the cylinder being tested at top dead center (TDC) of the compression stroke.
4. Install the **J 35667-A** or equivalent.

IMPORTANT: It may be necessary to hold the crankshaft balancer bolt to prevent the crankshaft from rotating.

5. Apply shop air pressure to the **J 35667-A** and adjust according to the manufacturers instructions.
6. Record the cylinder leakage value. Cylinder leakage that exceeds 25 percent is considered excessive and may require component service. In excessive leakage situations, inspect for the following conditions:
   - Air leakage noise at the throttle body or air inlet hose that may indicate a worn or burnt intake valve or a broken valve spring.
   - Air leakage noise at the exhaust system tailpipe that may indicate a worn or burnt exhaust valve or a broken valve spring.
   - Air leakage noise from the crankcase, oil level indicator tube, or oil fill tube that may indicate worn piston rings, a damaged piston, a worn or scored cylinder bore, a damaged engine block or a damaged cylinder head.
   - Air bubbles in the cooling system may indicate a damaged cylinder head or a damaged cylinder head gasket.

7. Perform the leakage test on the remaining cylinders and record the values.

OIL CONSUMPTION DIAGNOSIS

Oil Consumption Diagnosis

Checks	Causes
Excessive oil consumption, not due to leaks, is the use of 1 L (1 qt) or more of engine oil within 3 200 kilometers (2,000 miles).	
Preliminary	The causes of excessive oil consumption may include the following conditions: • External oil leaks Refer to **Oil Leak Diagnosis**. • Incorrect oil level or improper reading of the oil level indicator With the vehicle on a level surface, run the engine for a few minutes, allow adequate drain down time, 2-3 minutes, and check for the correct engine oil level. • Improper oil viscosity Refer to the vehicle owners manual and use the recommended SAE grade and viscosity for the prevailing temperatures. • Continuous high speed driving and/or severe usage • Crankcase ventilation system restrictions or malfunctioning components • Worn valve guides and/or valve stems • Worn or improperly installed valve stem oil seals • Piston rings broken, worn, or not seated properly Allow adequate time for the rings to seat. Replace worn piston rings as necessary. • Piston and rings improperly installed or not fitted to the cylinder bore

OIL PRESSURE DIAGNOSIS AND TESTING

Tools Required

- **J 21867** Pressure Gage. See **Special Tools**.
- **J 42907** Oil Pressure Tester. See **Special Tools**.

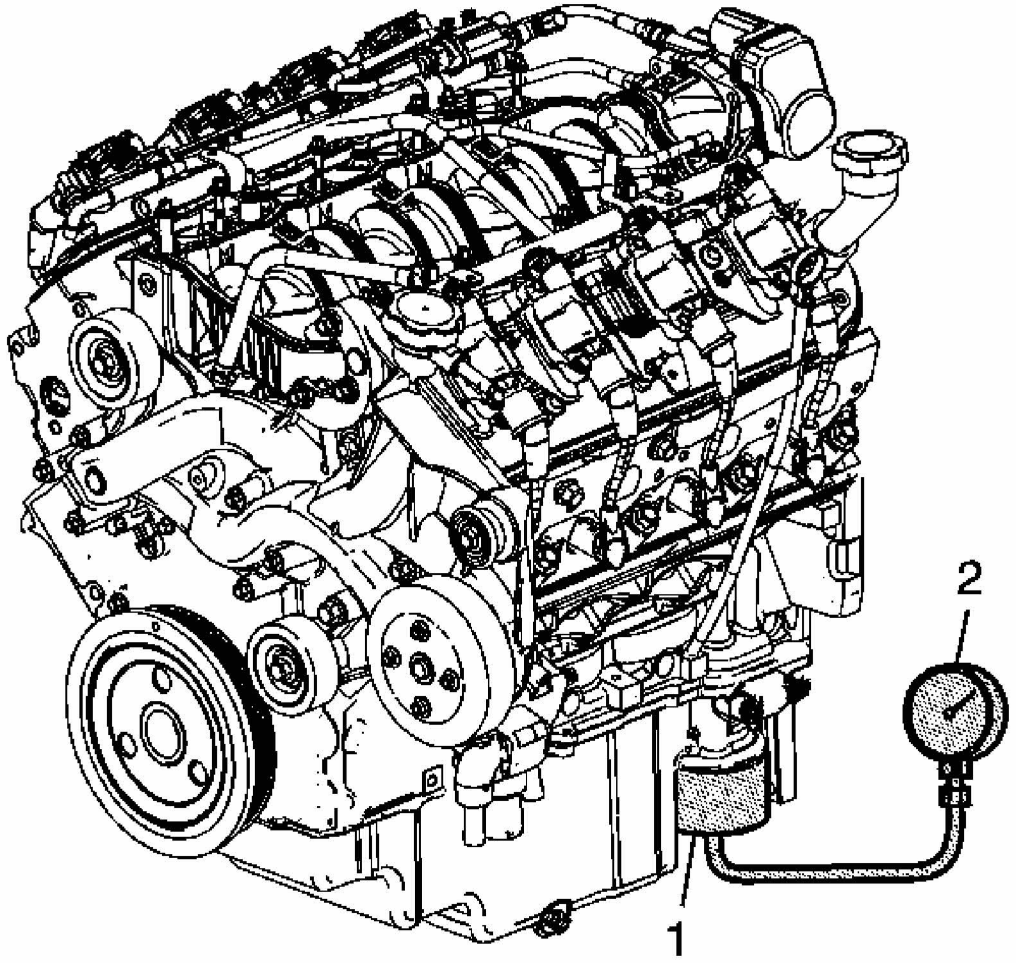

Fig. 14: Measuring Engine Oil Pressure
Courtesy of GENERAL MOTORS CORP.

1. With the vehicle on a level surface, run the vehicle for a few minutes, allow adequate drain down time, 2-3 minutes, and measure the oil level.
2. If required, add the recommended grade engine oil and fill the crankcase until the oil level measures full on the oil level indicator.
3. Run the engine briefly, 10-15 seconds, and verify low or no oil pressure on the vehicle gage or light.

4. Listen for a noisy valve train or a knocking noise.
5. Inspect for the following conditions:
   - Oil diluted by water or glycol antifreeze

     Refer to **Coolant in Engine Oil** .

   - Foamy oil, which may be caused by a cut or damaged oil pump screen O-ring seal
6. Remove the oil filter and install the **J 42907** (1). See **Special Tools**.
7. Install **J 21867** (2), or equivalent to the **J 42907** (1). See **Special Tools**.
8. Run the engine and measure the engine oil pressure.
9. Compare the readings to **Engine Mechanical Specifications**.
10. If the engine oil pressure is below specifications, inspect the engine for 1 or more of the following conditions:
    - Oil pump worn or dirty

      Refer to **Oil Pump Cleaning and Inspection** .

    - Oil pump-to-engine block bolts loose

      Refer to **Oil Pump, Screen and Crankshaft Oil Deflector Installation** .

    - Oil pump screen loose, plugged, or damaged
    - Oil pump screen O-ring seal missing or damaged
    - Malfunctioning oil pump pressure relief valve
    - Excessive bearing clearance
    - Cracked, porous, or restricted oil galleries
    - Oil gallery plugs missing or incorrectly installed

      Refer to **Engine Block Plug Installation** .

    - Improper operation of the Displacement on Demand (DoD) oil pressure relief valve

      Refer to **Displacement on Demand (DoD) Oil Pressure Relief Valve Diagnosis and Testing** .

DISPLACEMENT ON DEMAND (DOD) OIL PRESSURE RELIEF VALVE DIAGNOSIS AND TESTING

Tools Required

- **J-21867-16** Oil Pressure Adapter. See **Special Tools**.

- **J 21867** Pressure Gage. See Special Tools.
- **J 42907** Oil Pressure Testing Tool. See Special Tools.

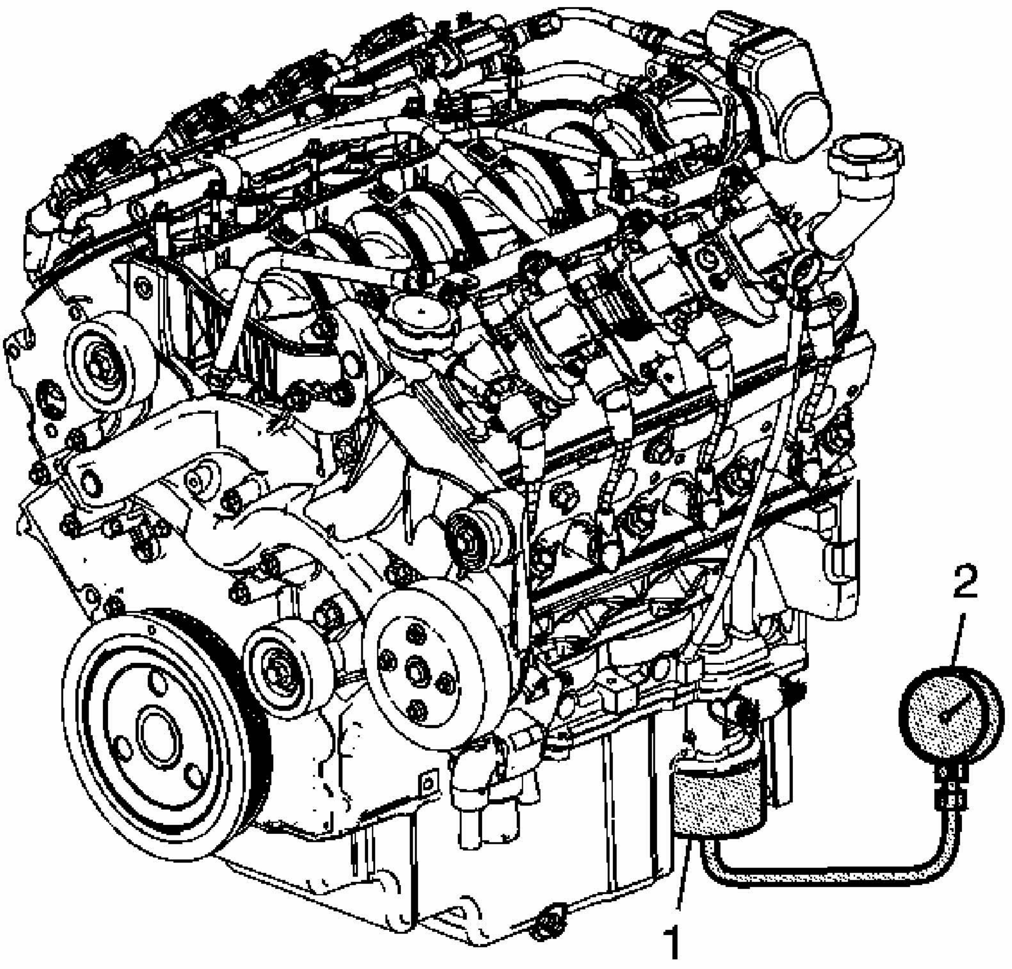

Fig. 15: Measuring Engine Oil Pressure
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: This test is performed to verify the operation of the oil pressure relief valve. Refer to Displacement on Demand (DoD) System Description and Lubrication Description (Main Pressure Below 65 psi - DoD Off) or Lubrication Description (Main Pressure Above 65 psi - DoD Off) or Lubrication Description (Main Pressure Below 65 psi - DoD On) or Lubrication Description (Main Pressure Above 65 psi - DoD On).

1. Remove the oil filter and install the **J 42907** (1). See **Special Tools**.
2. Install **J 21867** (2) or equivalent to the **J 42907** (1). See **Special Tools**.

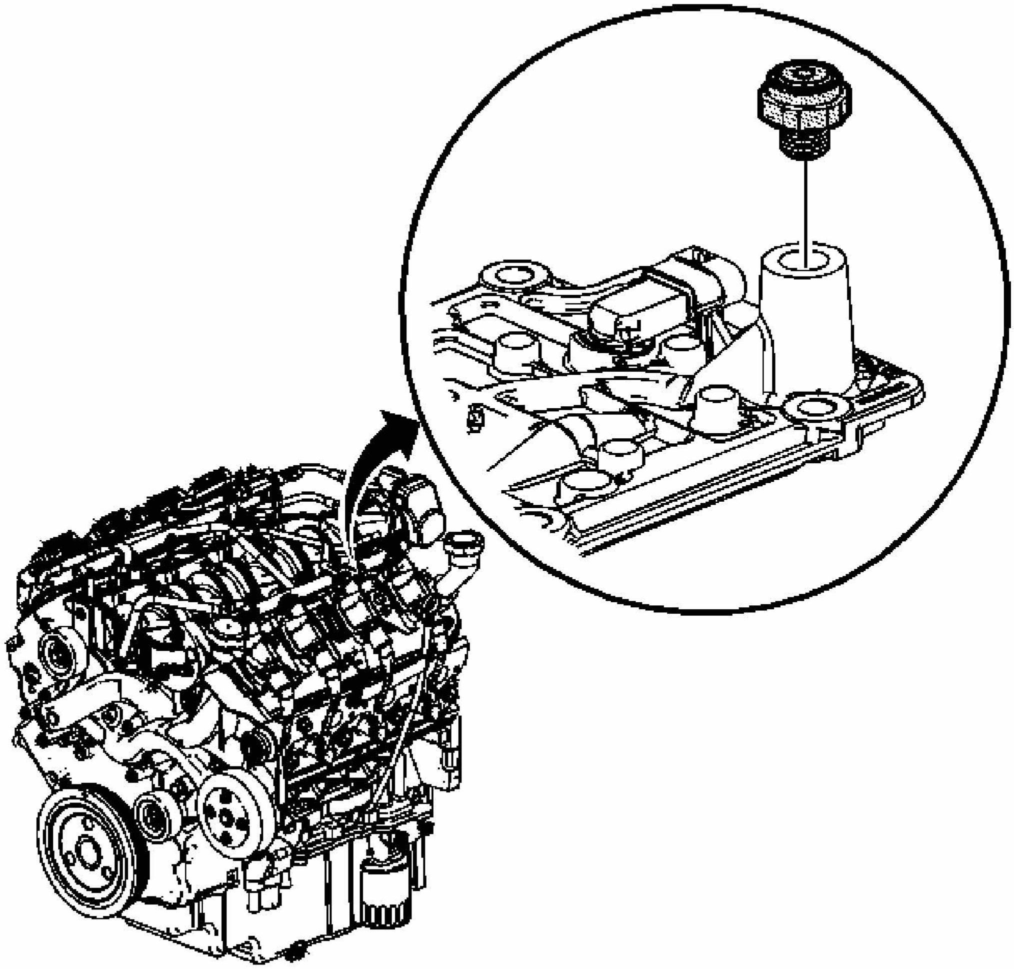

Fig. 16: View Of Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil pressure sensor and install the **J-21867-16** . See **Special Tools**.

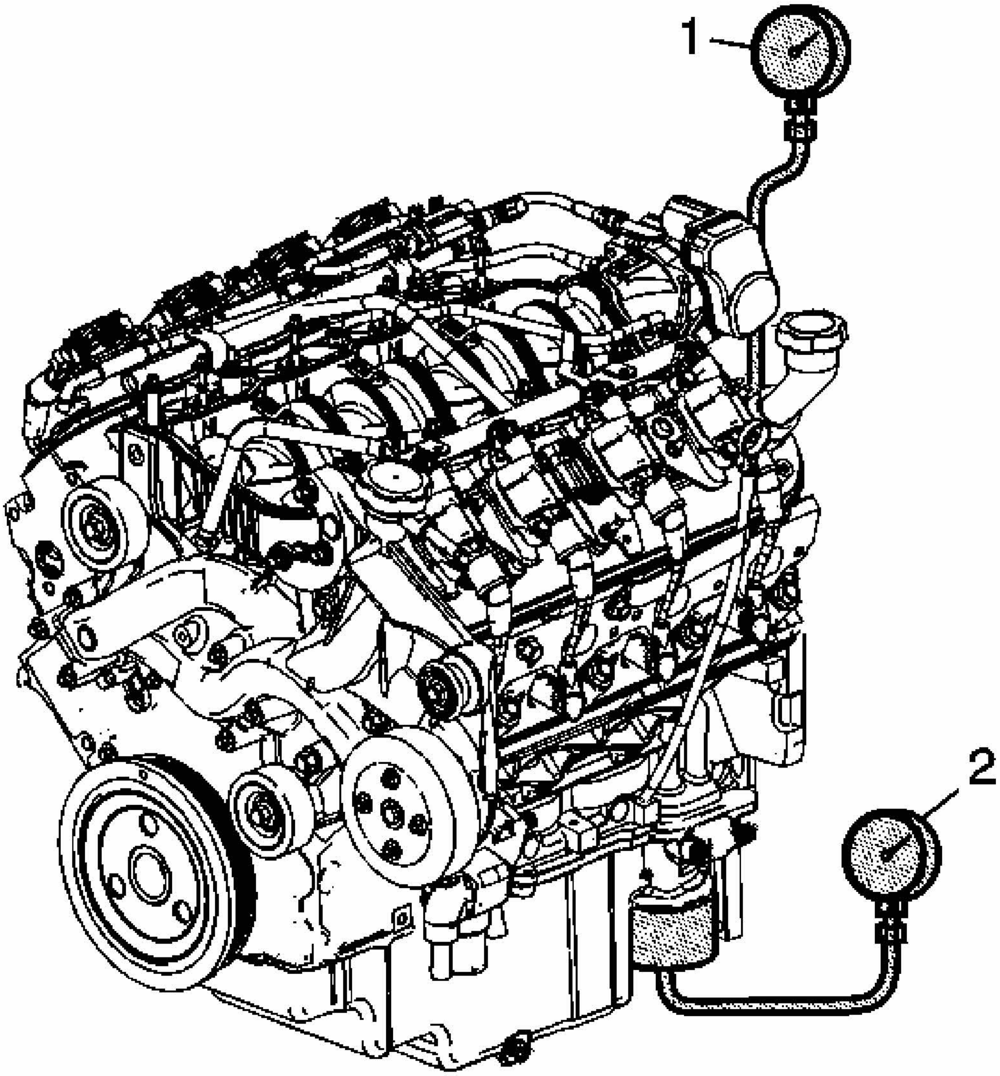

Fig. 17: Measuring Engine Oil Pressure While Observing Both Gages
Courtesy of GENERAL MOTORS CORP.

4. Install **J 21867** (1) or equivalent to the **J-21867-16** . See Special Tools.
5. Run the engine and measure the engine oil pressure while observing both gages.

   Operate the throttle as required to increase and decrease the engine oil pressure.

   - With the engine running and the lower pressure gage (2) measuring below 448 kPa (65 psi), both gages should display the same pressure reading. If the readings are not the same and the lower pressure gage (2) has a higher reading, the oil pressure relief valve is stuck in the open position or the valve lifter oil manifold filter is plugged.

- With the engine running and the lower pressure gage (2) measuring above 448 kPa (65 psi), the upper gage (1) should display no greater than 448 kPa (65 psi). If the reading on the upper pressure gage (1) is greater than 448 kPa (65 psi), the oil pressure relief valve is stuck in the closed position.

6. Repair as required.

DISPLACEMENT ON DEMAND (DOD) VALVE LIFTER OIL MANIFOLD DIAGNOSIS AND TESTING

Tools Required

- **EN-46999** Displacement-on-Demand Tester. See Special Tools.
- **EN-46999-1** Displacement-on-Demand Tester Air Adapter. See Special Tools.
- **EN-46999-5** Displacement-on-Demand Tester Harness - Small Block V8. See Special Tools.

IMPORTANT:

- **This component test applies only to vehicles with functional displacement-on-demand.**
- **A minimum shop air source of 206 kPa (30 psi) is required for manifold testing.**
- **A water bleed is located on the side of the EN-46999 . See Special Tools. Occasionally, depress the valve in order to remove excess water from the tool.**

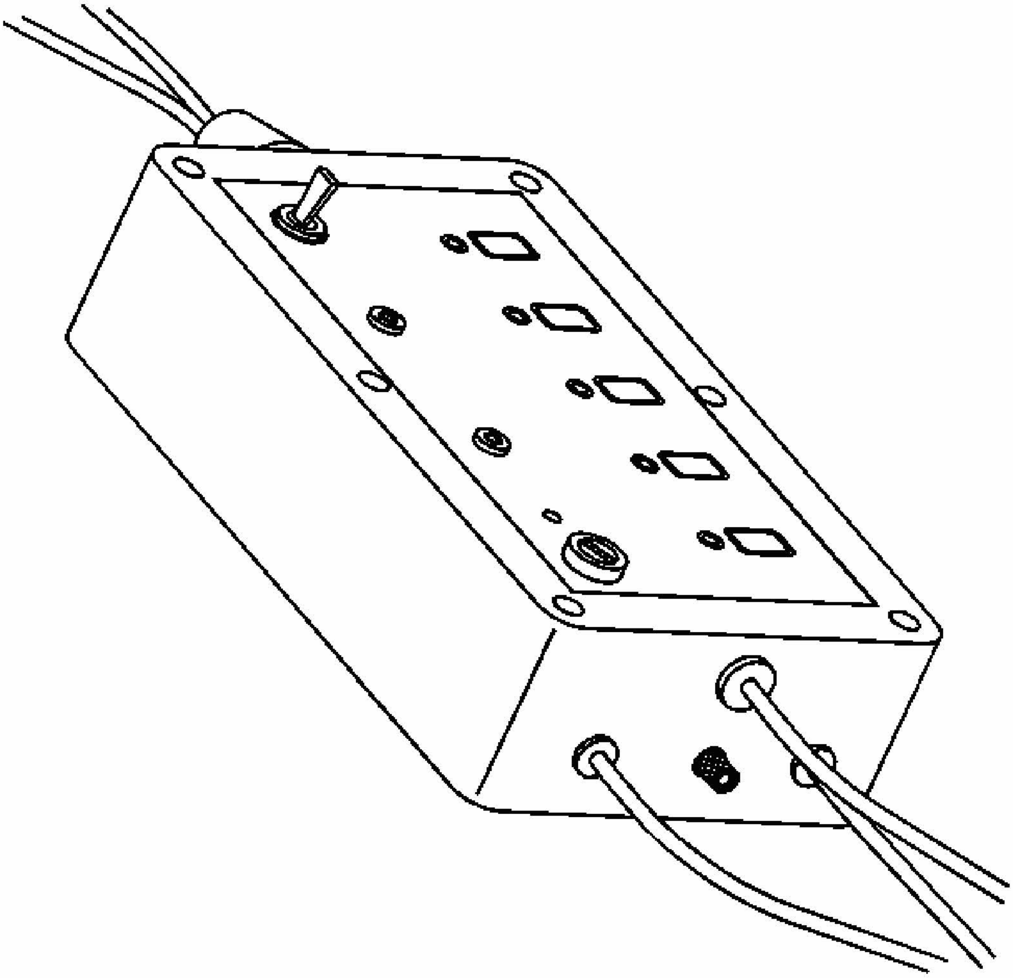

Fig. 18: Displacement On-Demand Tester
Courtesy of GENERAL MOTORS CORP.

The manifold bench test provides a maximum 206 kPa (30 psi) of filtered shop air to the manifold and will test each solenoid/valve for the following conditions:

- Proper operation
- A stuck open condition - constant air flow
- A stuck closed condition - no air flow
- A flow restriction within the manifold

1. Individually depress each of the buttons 1-4 on the **EN-46999** in order to activate each of the solenoid/valves. See **Special Tools**. When activating each solenoid/valve, a loud click should be heard from the solenoid and an increased amount of air will exit the

outlet ports.

- Button 1 will energize the solenoid/valve 1 for engine cylinder number 1.
- Button 2 will energize the solenoid/valve 2 for engine cylinder number 4.
- Button 3 will energize the solenoid/valve 3 for engine cylinder number 6.
- Button 4 will energize the solenoid/valve 4 for engine cylinder number 7.

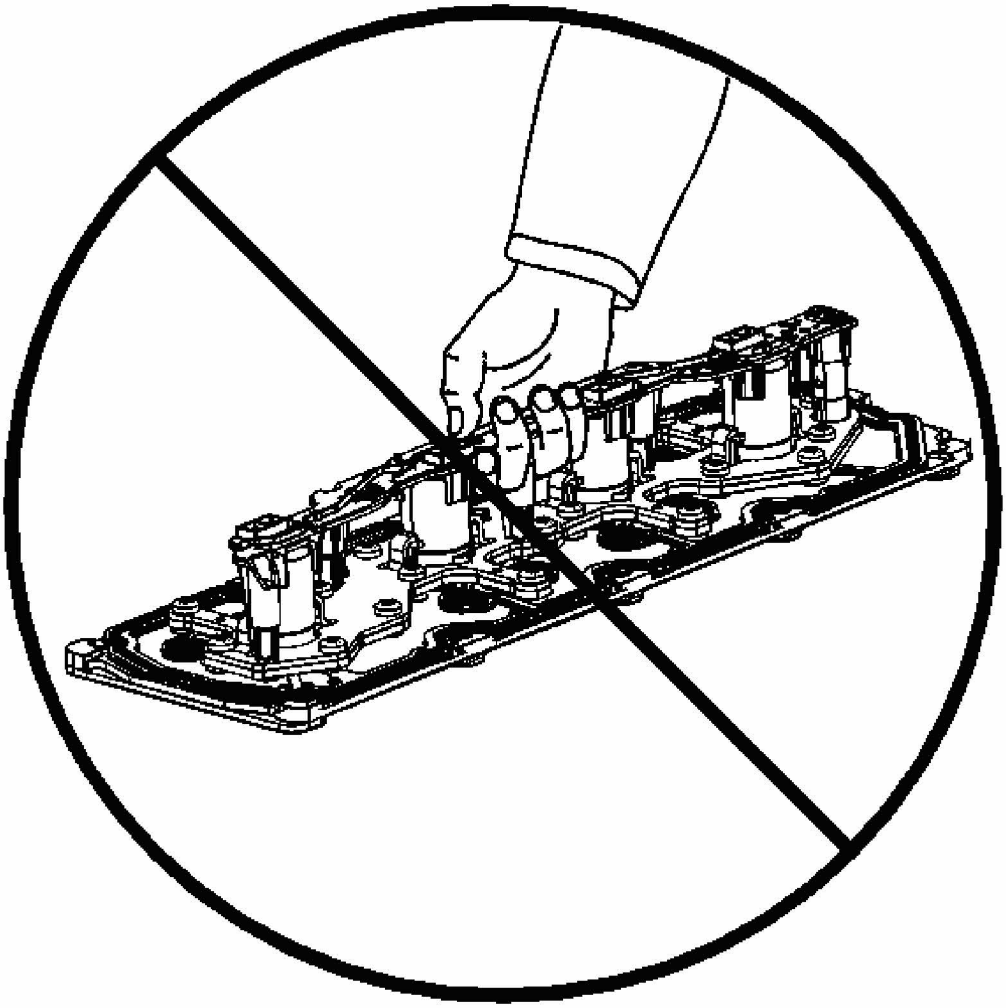

Fig. 19: Do Not Lift The Manifold Assembly By The Electrical Lead Frame
Courtesy of GENERAL MOTORS CORP.

2. Do not lift the manifold assembly by the electrical lead frame.

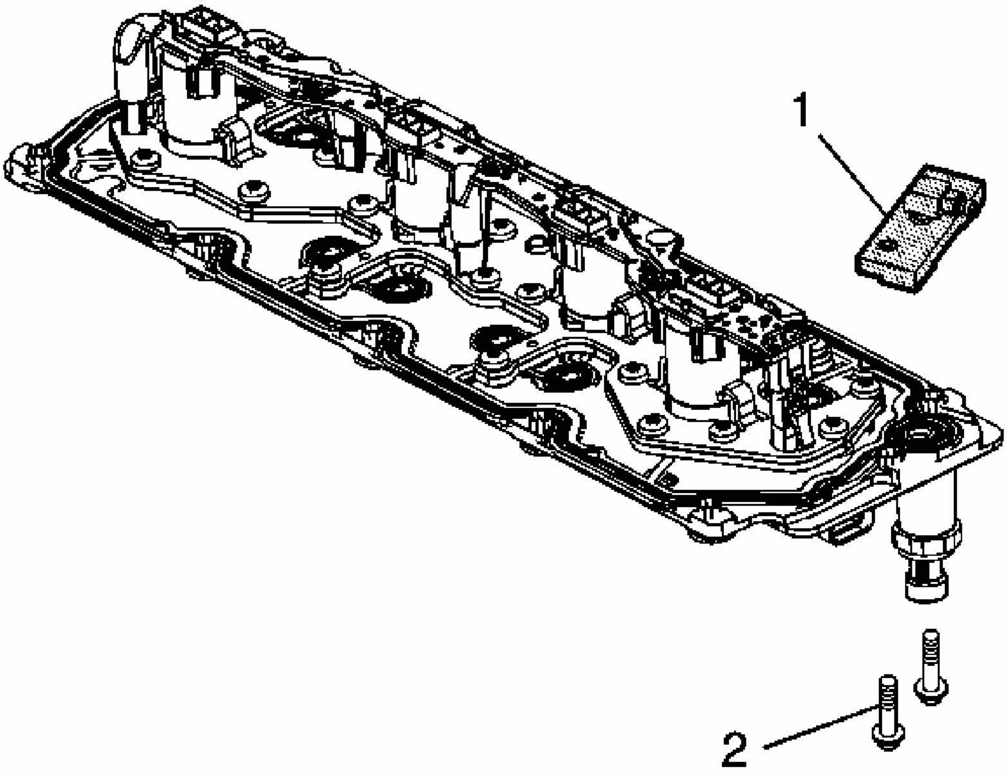

Fig. 20: Displacement-on-Demand Tester Air Adapter
Courtesy of GENERAL MOTORS CORP.

3. Install the **EN-46999-1** (1) to the manifold. See **Special Tools**.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

4. Install 2 of the manifold bolts (2) to the **EN-46999-1** . See **Special Tools**.

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

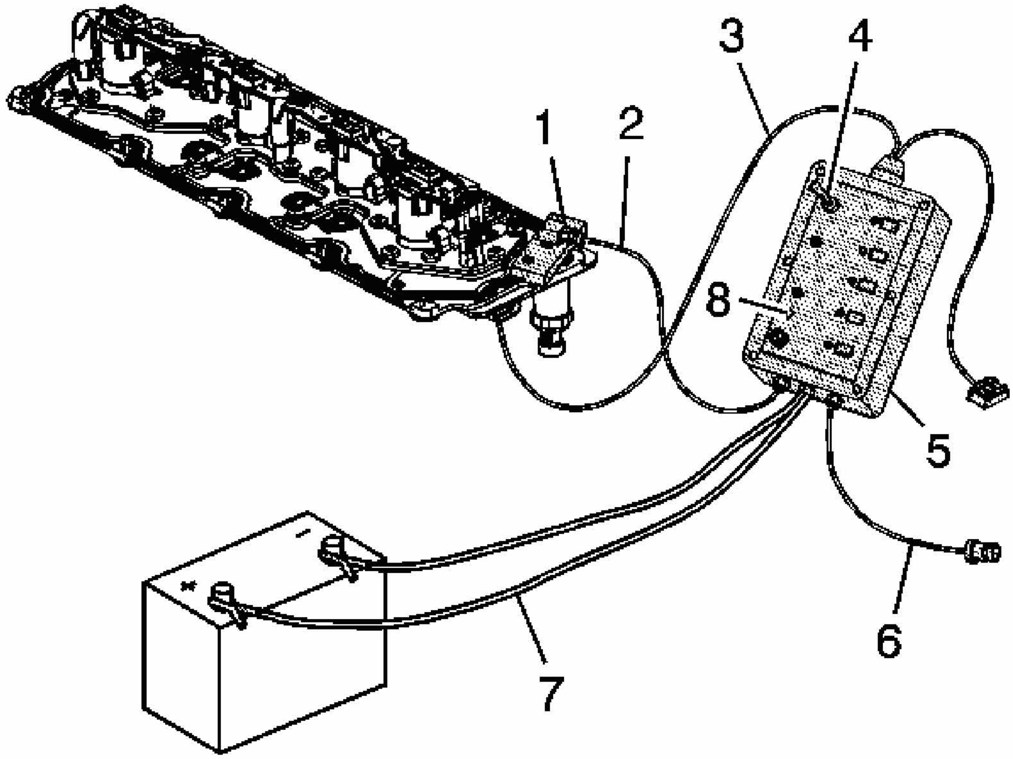

Fig. 21: Connecting Air Out Hose
Courtesy of GENERAL MOTORS CORP.

5. Connect the air out hose (2) of the **EN-46999** (5) to the **EN-46999-1** (1). See **Special Tools**. Verify the air supply switch (4) is in the off position.
6. Connect the air in hose (6) of the **EN-46999** (5) to a shop air source. See **Special Tools**.
7. Connect the 12 volt power supply connectors (7) of the **EN-46999** (5) to a 12 volt power supply. See **Special Tools**. Verify the Power light (8) on the tool is illuminated. If the light on the tool is not illuminated when connected to a 12 volt power supply, test and/or replace the 3 amp fuse.
8. Connect the **EN-46999-5** power cable (3) to the electrical connector of the manifold. See **Special Tools**.

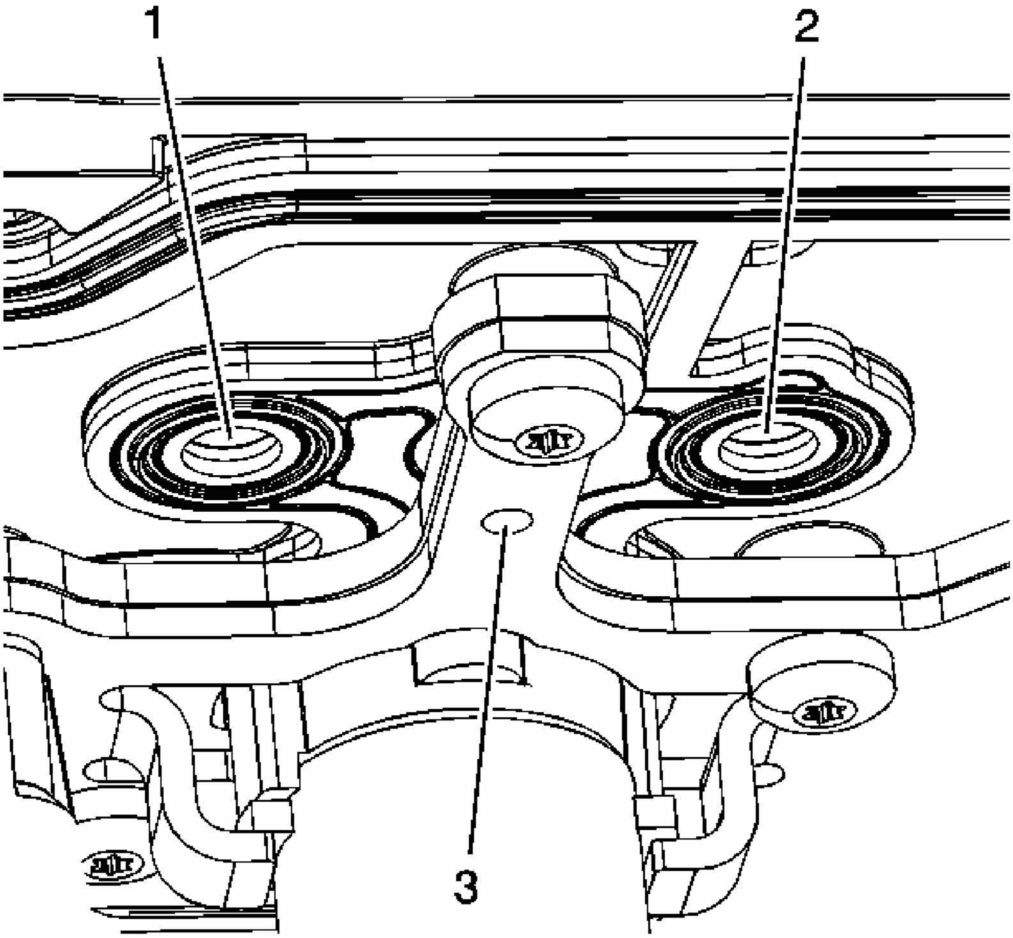

Fig. 22: Bleed Holes & Outlet Ports
Courtesy of GENERAL MOTORS CORP.

9. Turn the air supply switch of the **EN-46999** to the ON position. See **Special Tools**. With the air supply connected to the manifold assembly and the solenoid/valves in the closed position, a limited amount of air will exit each of the bleed holes (3) and outlet ports (1, 2) of the manifold.

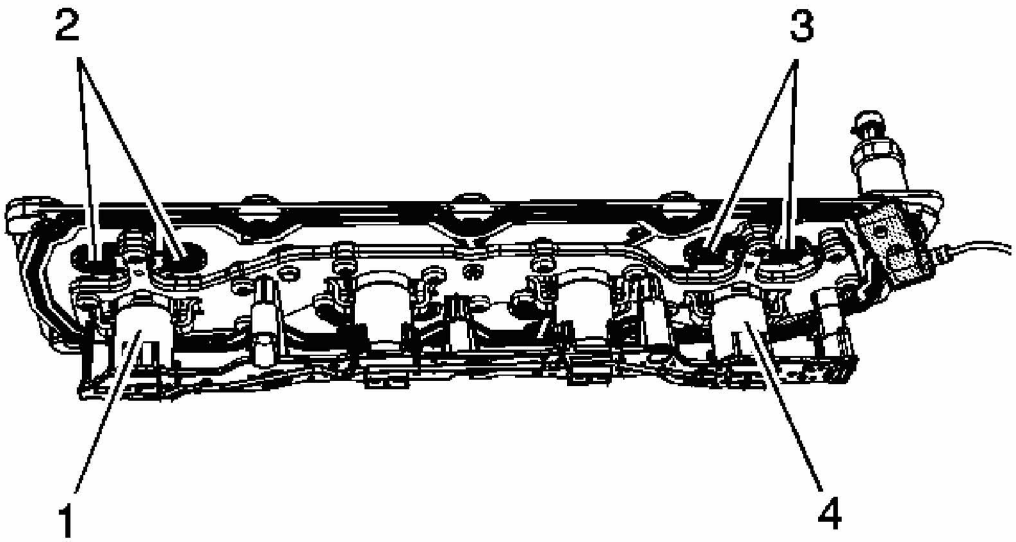

Fig. 23: Testing Solenoid/Valves
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The manifold must be tested in the proper position to ensure the solenoid/valves operate as designed.

10. Position the manifold assembly onto a bench at a 45 degree angle in order to test solenoid/valves 1 and 4.
11. Depress button number 1 on the tool to activate solenoid/valve 1. With button 1 depressed, the solenoid/valve (1) should open, allowing an increased amount of air to exit the outlet ports (2) of the manifold.
12. Depress button number 4 on the tool to activate solenoid/valve 4. With button 4 depressed, the solenoid/valve (4) should open, allowing an increased amount of air to exit the outlet ports (3) of the manifold.

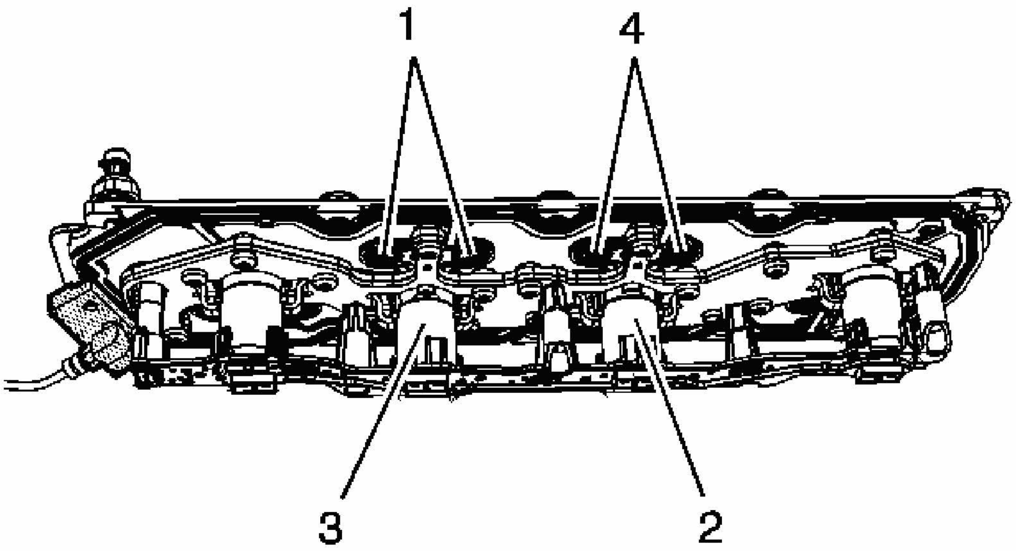

Fig. 24: View Of Solenoid/Valves 2 & 3
Courtesy of GENERAL MOTORS CORP.

13. Reposition the manifold assembly onto a bench at a 45 degree angle in order to test solenoid/valves 2 and 3.
14. Depress button number 2 on the tool to activate solenoid/valve 2. With button 2 depressed, the solenoid/valve (2) should open, allowing an increased amount of air to exit the outlet ports (4) of the manifold.
15. Depress button number 3 on the tool to activate solenoid/valve 3. With button 3 depressed, the solenoid/valve (3) should open, allowing an increased amount of air to exit the outlet ports (1) of the manifold.
16. When the test is completed, turn the air source switch on the **EN-46999** to the off position and disconnect the tool from the 12-volt power supply, shop air source and manifold assembly. See **Special Tools**.
17. If after testing, it has been determined that 1 or more of the solenoid/valves is not functioning properly, replace the manifold as an assembly.
18. If after testing, it has been determined that the solenoid/valves are functioning properly, replace the valve lifters, as required. Both intake and exhaust lifters should be replaced in pairs.

OIL LEAK DIAGNOSIS

Oil Leak Diagnosis

Step	Action	Yes	No

IMPORTANT: **You can repair most fluid leaks by first visually locating the leak, repairing or replacing the component, or by resealing the gasket surface. Once the leak is identified, determine the cause of the leak. Repair the cause of the leak as well as the leak itself.**			
1	1. Operate the vehicle until it reaches normal operating temperature. 2. Park the vehicle on a level surface, over a large sheet of paper or other clean surface. 3. Wait 15 minutes. 4. Check for drippings. Are drippings present?	Go to **Step 2**	System OK
2	Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 3**
3	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Check for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 4**
4	1. Completely clean the entire engine and surrounding components. 2. Operate the vehicle for several kilometers, miles, at normal operating temperature and at varying speeds. 3. Park the vehicle on a level surface, over a large sheet of paper or other clean surface. 4. Wait 15 minutes. 5. Identify the type of fluid, and the approximate location of the leak. Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 5**

5	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Check for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 6**
6	1. Completely clean the entire engine and surrounding components. 2. Apply an aerosol-type powder, baby powder, foot powder, etc., to the suspected area. 3. Operate the vehicle for several kilometers, miles, at normal operating temperature and at varying speeds. 4. Identify the type of fluid, and the approximate location of the leak, from the discolorations in the powder surface. Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 7**
7	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Check for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 8**
8	Use the **J 28428-E** High-Intensity Black Light Kit in order to identify the type of fluid, and the approximate location of the leak. Refer to the manufacturer's instructions when using the		

	tool. Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	Go to **Step 9**
9	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Check for leaks at the following locations: - Sealing surfaces - Fittings - Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to **Step 10**	System OK
10	1. Inspect the engine for mechanical damage. Special attention should be shown to the following areas: - Higher than recommended fluid levels - Higher than recommended fluid pressures - Plugged or malfunctioning fluid filters or pressure bypass valves - Plugged or malfunctioning engine ventilation system - Improperly tightened or damaged fasteners - Cracked or porous components - Improper sealants or gaskets where required - Improper sealant or gasket installation - Damaged or worn gaskets or seals - Damaged or worn sealing surfaces 2. Inspect the engine for customer modifications. Is there mechanical damage, or customer modifications to the engine?	Go to **Step 11**	System OK

11	Repair or replace all damaged or modified components. Does the engine still leak oil?	Go to **Step 1**	System OK

CRANKCASE VENTILATION SYSTEM INSPECTION/DIAGNOSIS

Crankcase Ventilation System Inspection/Diagnosis

Symptom	Correction
External oil leak	Inspect for any of the following conditions: • Restricted positive crankcase ventilation (PCV) orifice • Restricted or kinked PCV hose or engine vent hose • Damaged, incorrect, or incorrectly installed PCV orifice or hose • Excessive crankcase pressure
Rough Idle	Inspect for any of the following conditions: • Restricted PCV orifice • Restricted or kinked PCV hose or engine vent hose • Leaking (damaged) PCV orifice or hose • Vacuum hoses worn or not properly installed
Stalling or slow idle speed	Inspect for any of the following conditions: • Restricted PCV valve • Restricted or kinked PCV hose or engine vent hose • Leaking (damaged) PCV valve or hose
High idle speed	Inspect for a leaking (damaged) PCV orifice or hose
Sludge in the engine	Inspect for any of the following conditions: • Restricted PCV orifice • Restricted or kinked PCV hose or engine vent hose

DRIVE BELT CHIRPING DIAGNOSIS

Diagnostic Aids

The chirping noise may be intermittent due to moisture on the drive belts or the accessory drive pulleys. In order to duplicate the customer concern, it may be necessary to spray a small amount of water onto the drive belts. If spraying water onto the drive belts duplicates the symptom, cleaning the accessory drive pulleys may be the most probable solution.

A loose or improper installation of a body or suspension component, or other items on the vehicle may also cause the chirping noise.

Test Description

The numbers below refer to the steps in the diagnostic table.

> **2:** The chirping noise may not be engine related. This step is to verify that the engine is making the noise. If the engine is not making the noise do not proceed any further in this table.
>
> **3:** The noise may be an internal engine noise. Remove the drive belts and operate the engine for a few seconds, this will verify if the chirping noise is related to the drive belts or not. With the drive belts removed the water pump will not operate and the engine may overheat. Also DTCs may set when the engine is operated with the drive belts removed.
>
> **4:** Inspect the drive belts for signs of pilling. Pilling is the small balls, pills, or strings in the drive belt grooves caused by the accumulation of rubber dust.
>
> **6:** Misalignment of the accessory drive pulleys may be caused from improper mounting or incorrect installation of an accessory drive component, or the pulley may be bent inward or outward from a previous repair. Test for a misaligned accessory drive pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found, refer to that accessory drive component for the proper removal and installation procedure for that pulley.
>
> **10:** Inspection of the fasteners can eliminate the possibility that a incorrect bolt, nut, spacer, or washer was installed.
>
> **12:** Inspection of the accessory drive pulleys should include inspecting for bends, dents, or other damage to the pulleys that would prevent the drive belts from seating properly in the pulley grooves or on the smooth surface of the pulley when the back side of the drive belt is used to drive the pulley.
>
> **14:** Replacing the drive belts when it is not damaged or there is not excessive pilling will only be a temporary repair.

Drive Belt Chirping Diagnosis

<table>
<tr><th>Step</th><th>Action</th><th>Yes</th><th>No</th></tr>
<tr><td colspan="4">NOTE:
Refer to BELT DRESSING NOTICE in Cautions and Notices.
DEFINITION: The following items are indications of chirping:
• A high pitched noise that is heard once per revolution of the drive belts or an accessory drive pulley
• Chirping may occur on cold damp start-up conditions and will subside once the</td></tr>
</table>

	vehicle reaches normal operating temperature.		
1	Did you review the Symptoms - Engine Mechanical diagnostic information, and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Mechanical**
2	Verify that there is a chirping noise. Does the engine make the chirping noise?	Go to **Step 3**	Go to **Diagnostic Aids**
3	1. Remove the drive belts. Refer to **Drive Belt Replacement - Accessory**. 2. Operate the engine for no longer than 30-40 seconds. Does the chirping noise still exist?	Go to **Engine Noise on Start-Up, but Only Lasting a Few Seconds**	Go to **Step 4**
4	Inspect for severe drive belt pilling exceeding 1/3 of the drive belt groove depth. Do the drive belt grooves have pilling?	Go to **Step 5**	Go to **Step 6**
5	Clean the accessory drive pulleys with a suitable wire brush. Were the accessory drive pulleys cleaned?	Go to **Step 15**	-
6	Inspect for a misaligned accessory drive pulleys. Is there a misaligned accessory drive pulleys?	Go to **Step 7**	Go to **Step 8**
7	Replace and/or repair the misaligned accessory drive pulleys. Were the misaligned accessory drive pulleys replaced and/or repaired?	Go to **Step 15**	-
8	Inspect for a bent or cracked accessory drive brackets. Did you find any bent or cracked accessory drive brackets?	Go to **Step 9**	Go to **Step 10**
9	Replace the bent and/or cracked accessory drive brackets. Was the bent and/or cracked accessory drive brackets replaced?	Go to **Step 15**	-
10	Inspect for incorrect, loose and/or missing fasteners. Were there any incorrect, loose, and/or missing fasteners found?	Go to **Step 11**	Go to **Step 12**
	1. Replace any incorrect and/or missing fasteners.		

11	2. Tighten any loose fasteners. Refer to **Fastener Tightening Specifications**. Were the fasteners replaced and/or tightened?	Go to **Step 15**	-
12	Inspect for a bent accessory drive pulleys. Was a bent accessory drive pulleys found?	Go to **Step 13**	Go to **Step 14**
13	Replace the bent accessory drive pulleys. Was the bent accessory drive pulleys replaced?	Go to **Step 15**	-
14	Replace the drive belts. Refer to **Drive Belt Replacement - Accessory**. Was the drive belts replaced?	Go to **Step 15**	-
15	1. Clear any codes. 2. Run the engine in order to verify the repair. Does the chirping noise still exist?	-	System OK

DRIVE BELT SQUEAL DIAGNOSIS

Diagnostic Aids

A loose or improper installation of a body, or suspension component, or other items on the vehicle may cause the squeal noise.

If the squeal is intermittent, verify that it is not the accessory drive components by varying their loads, making sure they are operating to their maximum capacity. An overcharged air conditioning (A/C) system, a power steering system restriction or the incorrect fluid, or a failing generator are suggested items to inspect.

Test Description

The numbers below refer to the steps in the diagnostic table.

2: The squeal may not be engine related. This step is to verify that the engine is making the noise. If the engine is not making the noise do not proceed further in this table

3: The squeal may be an internal engine noise. Remove the drive belts and operate the engine for a few seconds, this will verify if the squealing noise is related to the drive belts or an accessory drive component. With the drive belts removed the water pump will not operate and the engine may overheat. Also, DTCs may set when the engine is operated with the drive belts removed.

4: This test is to verify that an accessory drive components does not have a seized bearing. With the belts removed, test the bearings in the accessory drive components for smooth operation. Also test the accessory drive components with the engine operating by varying the load on the accessory drive components to verify that the components is operating properly.

5: This test is to verify that the drive belts tensioners are not operating properly. If the drive belt tensioners are not operating properly, proper belt tension may not be achieved to keep the drive belts from slipping which could cause a squealing noise.

6: This test is to verify that the drive belts is not too long, which would prevent the drive belt tensioners from operating properly. Also if the incorrect length drive belts was installed, it may not be routed correctly and may be turning an accessory drive component in the incorrect direction.

7: Misalignment of the accessory drive pulleys may be caused from improper mounting or incorrect installation of a accessory drive component, or the pulley may be bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found, refer to that accessory drive component for the proper removal and installation procedure for that pulley.

8: Inspect the accessory drive pulleys to verify that they are the correct diameter or width. Using a known good vehicle, compare the accessory drive pulleys.

Drive Belt Squeal Diagnosis

Step	Action	Yes	No
NOTE: **Refer to BELT DRESSING NOTICE in Cautions and Notices.** DEFINITION: The following items are indications of drive belt squeal: • A loud screeching noise that is caused by a slipping drive belts (this is unusual for a drive belt with multiple ribs) • The squeal occurs when a heavy load is applied to the drive belts, such as an A/C compressor engagement, snapping the throttle, slipping on a seized pulley, or a faulty accessory drive component.			
1	Did you review the Symptoms - Engine Mechanical diagnostic information, and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Mechanical**
2	Verify that there is a squealing noise. Does the engine make the squeal noise?	Go to **Step 3**	Go to Diagnostic Aids
3	1. Remove the drive belts. Refer to **Drive Belt Replacement - Accessory**. 2. Operate the engine for no longer than	Go to **Engine Noise on Start-**	

	30-40 seconds. Does the squealing noise still exist?	**Up, but Only Lasting a Few Seconds**	Go to **Step 4**
4	Inspect for a seized accessory drive component bearing or a faulty accessory drive component. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 5**
5	Inspect the drive belt tensioner for proper operation. Refer to **Drive Belt Excessive Wear Diagnosis**. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 6**
6	Check for the correct length drive belts. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 7**
7	Inspect for a misaligned pulley. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 8**
8	Inspect for an incorrect size pulley. Did you find and correct the condition?	Go to **Step 9**	-
9	1. Install the drive belts. Refer to **Drive Belt Replacement - Accessory**. 2. Clear any codes. 3. Run the engine in order to verify the repair. Does the squealing noise still exist?	-	System OK

DRIVE BELT WHINE DIAGNOSIS

Diagnostic Aids

The drive belts will not cause the whine.

If the whine is intermittent, verify that it is not the accessory drive components by varying their loads, making sure they are operating to their maximum capacity. An overcharged A/C system, a power steering system restriction or the incorrect fluid, or a failing generator are suggested items to inspect.

Test Description

The numbers below refer to the steps in the diagnostic table.

> **3:** This test is to verify that the whine is being caused by the accessory drive components. Remove the drive belts and operate the engine for a few seconds, this will verify if the whining noise is related to the accessory drive component. With the drive belts removed the water pump will not operate and the engine may overheat. Also

DTCs may set when the engine is operated with the drive belts removed.

4: This inspection should include checking the drive belt tensioner and the drive belt idler pulley bearings. The drive belts may have to be installed and the accessory drive components operated separately by varying their loads. Refer to the suspected accessory drive component for the proper removal and installation procedure.

Drive Belt Whine Diagnosis

Step	Action	Yes	No
NOTE: **Refer to BELT DRESSING NOTICE in Cautions and Notices.** DEFINITION: A high pitched continuous noise that may be caused by an accessory drive component failed bearing			
1	Did you review the Symptoms - Engine Mechanical diagnostic information, and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Mechanical**
2	Verify that there is a whining noise. Does the engine make the whining noise?	Go to **Step 3**	Go to **Diagnostic Aids**
3	1. Remove the drive belts. Refer to **Drive Belt Replacement - Accessory**. 2. Operate the engine for no longer than 30-40 seconds. Does the whining noise still exist?	Go to **Engine Noise on Start-Up, but Only Lasting a Few Seconds**	Go to **Step 4**
4	1. Inspect for a failed accessory drive component bearing. 2. Install the drive belts. Refer to **Drive Belt Replacement - Accessory**. Did you find and correct the condition?	Go to **Step 5**	-
5	1. Clear any codes. 2. Run the engine in order to verify the repair. Does the whining still exist?	-	System OK

DRIVE BELT RUMBLING DIAGNOSIS

Diagnostic Aids

Vibration from the engine operating may cause a body component or another part of the vehicle to make rumbling noise.

The drive belts may have a condition that can not be seen or felt. Sometimes replacing the drive belts may be the only repair for the symptom.

If after replacing the drive belts and completing the diagnostic table, the rumbling is only heard with the drive belts installed, there might be an accessory drive component failure. Varying the load on the accessory drive components may aid in identifying which component is causing the rumbling noise.

Test Description

The numbers below refer to the steps in the diagnostic table.

> **2:** This test is to verify that the symptom is present during diagnosing. Other vehicle components may cause a similar symptom.
>
> **3:** This test is to verify that the drive belts is causing the rumbling. Rumbling may be confused with an internal engine noise due to the similarity in the description. Remove only one drive belt at a time if the vehicle has multiple drive belts. Operate the engine for a few seconds, this will verify if the rumbling noise is related to the drive belts or not. With the drive belts removed the water pump will not operate and the engine may overheat. Also DTCs may set when the engine is operated with the drive belts removed.
>
> **4:** Inspect the drive belts to ensure that the drive belts is not the cause of the noise. Small cracks across the ribs of the drive belts will not cause the noise. Belt separation is identified by the plys of the belt separating, this may be seen at the edge of the belt or felt as a lump in the belt.
>
> **5:** Small amounts of pilling is a normal condition and acceptable. When the pilling is severe the drive belts does not have a smooth surface for proper operation.

Drive Belt Rumbling Diagnosis

Step	Action	Yes	No
NOTE: **Refer to BELT DRESSING NOTICE in Cautions and Notices.** DEFINITION: • A low pitch tapping, knocking, or thumping noise heard at or just above idle • Heard once per revolution of the drive belts or pulleys • Rumbling may be caused from: o Pilling, the accumulation of rubber dust that forms small balls (pills) or strings in the drive belts pulley groove. o The separation of the drive belts			

	○ A damaged drive belts		
1	Did you review the Symptoms - Engine Mechanical diagnostic information, and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Mechanical**
2	Verify that there is a rumbling noise. Does the engine make the rumbling noise?	Go to **Step 3**	Go to **Diagnostic Aids**
3	1. Remove the drive belts. Refer to **Drive Belt Replacement - Accessory**. 2. Operate the engine for no longer than 30-40 seconds. Does the rumbling noise still exist?	Go to **Engine Noise on Start-Up, but Only Lasting a Few Seconds**	Go to **Step 4**
4	Inspect the drive belts for damage, separation, or sections of missing ribs. Were any of these conditions found?	Go to **Step 7**	Go to **Step 5**
5	Inspect for severe pilling of more than 1/3 of the drive belt groove depth. Do the drive belt grooves have pilling?	Go to **Step 6**	Go to **Step 7**
6	1. Clean the drive belt pulleys using a suitable wire brush. 2. Reinstall the drive belts. Refer to **Drive Belt Replacement - Accessory**. Did you complete the repair?	Go to **Step 8**	-
7	Install a new drive belts. Refer to **Drive Belt Replacement - Accessory**. Did you complete the replacement?	Go to **Step 8**	-
8	1. Clear any codes. 2. Run the engine in order to verify the repair. Does the rumbling noise still exist?	-	System OK

DRIVE BELT VIBRATION DIAGNOSIS

Diagnostic Aids

The accessory drive components may have an affect on engine vibration. An overcharged A/C system, a power steering system restriction, or the incorrect fluid, or an extra load placed on the generator are suggested items to inspect. To help identify an intermittent or an improper condition, vary the loads on the accessory drive components.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

2: This test is to verify that the vibration is present during diagnosing. Other vehicle components may cause a similar symptom such as the exhaust system, or the drivetrain.

3: This test is to verify that the drive belts or accessory drive components may be causing the vibration. Remove the drive belts and operate the engine for a few seconds, this will verify if the vibration is related to the drive belts or not. With the drive belts removed the water pump will not operate and the engine may overheat. Also DTCs may set when the engine is operated with the drive belts removed.

4: The drive belts may cause a vibration. While the drive belts is removed this is the best time to inspect the condition of the drive belts.

6: Inspection of the fasteners can eliminate the possibility that a incorrect bolt, nut, spacer, or washer was installed.

8: This step should only be performed if the fan is driven by the drive belt. Inspect the engine cooling fan for bent, twisted, loose, or cracked blades. Inspect the fan clutch for smooth operation. Inspect for a bent fan shaft or bent mounting flange.

9: Inspect the water pump drive shaft for being bent. Also inspect the water pump bearings for smooth operation and excessive play. Compare the water pump with a known, good water pump.

10: Accessory drive component brackets that are bent, cracked, or loose may put an extra strain on that accessory drive component causing it to vibrate.

Drive Belt Vibration Diagnosis

Step	Action	Yes	No
NOTE: **Refer to BELT DRESSING NOTICE in Cautions and Notices.** DEFINITION: The following items are indications of drive belt vibration: • The vibration is engine-speed related. • The vibration may be sensitive to accessory load.			
1	Did you review the Symptoms - Engine Mechanical diagnostic information, and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Mechanical**
2	Verify that the vibration is engine related. Does the engine make the vibration?	Go to **Step 3**	Go to **Diagnostic Aids**
	1. Remove the drive belts. Refer to **Drive Belt Replacement - Accessory**.	Go to **Diagnostic**	

3	2. Operate the engine for no longer than 30-40 seconds. Does the engine still make the vibration?	**Starting Point - Vibration Diagnosis and Correction** in Vibration Diagnosis and Correction	Go to **Step 4**
4	Inspect the drive belts for wear, damage, debris build-up and missing drive belt ribs. Were any of these conditions found?	Go to **Step 5**	Go to **Step 6**
5	Install a new drive belts. Refer to **Drive Belt Replacement - Accessory**. Did you complete the replacement?	Go to **Step 11**	-
6	Inspect for incorrect, loose, and/or missing fasteners. Were any of these conditions found?	Go to **Step 7**	Go to **Step 8**
7	1. Replace any incorrect and/or missing fastener. 2. Tighten any loose fasteners. Refer to **Fastener Tightening Specifications**. Were the fasteners replaced and/or tightened?	Go to **Step 11**	-
8	Inspect for damaged fan blades or a bent fan clutch shaft. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 9**
9	Inspect for a bent water pump drive shaft. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 10**
10	Inspect for a bent or cracked accessory drive brackets. Did you find and correct the condition?	Go to **Step 11**	-
11	1. Clear any codes. 2. Run the engine in order to verify the repair. Does the vibration still exist?	-	System OK

DRIVE BELT FALLS OFF DIAGNOSIS

Diagnostic Aids

If the drive belts repeatedly falls off the accessory drive pulleys, this may be caused by a pulley misalignment.

An extra load that is quickly applied or released by an accessory drive component may also cause the drive belts to fall off. Verify that the accessory drive components are operating properly.

If the drive belts is the incorrect length, the drive belt tensioner may not maintain the proper tension on the drive belts.

Test Description

The numbers below refer to the steps in the diagnostic table.

> **2:** This inspection is to verify the condition of the drive belts. Damage may have occurred to the drive belts when the drive belts fell off the pulley. Inspect the drive belts for cuts, tears, sections of ribs missing, or damaged belt plys.
>
> **4:** Misalignment of the accessory drive pulleys may be caused from improper mounting or incorrect installation of a accessory drive component, or the pulley may be bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across 2 or 3 pulleys. If a misaligned pulley is found, refer to that accessory drive component for the proper removal and installation procedure of that pulley.
>
> **5:** Inspection of the accessory drive pulleys should include inspecting for bends, dents, or other damage that would prevent the drive belt from seating properly in the pulley grooves or on the smooth surface of a pulley when the back side of the drive belts is used to drive the pulley.
>
> **6:** Accessory drive component brackets that are bent or cracked will also cause the drive belts to fall off.
>
> **7:** Inspection of the fasteners can eliminate the possibility that a incorrect bolt, nut, spacer, or washer was installed. Missing, loose, or incorrect fasteners may cause pulley misalignment from the accessory drive brackets moving under load. Over tightening the fasteners may cause misalignment of the accessory component brackets.

Drive Belt Falls Off Diagnosis

Step	Action	Yes	No
NOTE: **Refer to BELT DRESSING NOTICE in Cautions and Notices.** DEFINITION: The drive belts fall off the pulleys or may not ride correctly on the pulleys.			
1	Did you review the Symptoms - Engine Mechanical diagnostic information, and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Mechanical**

2	Inspect for a damaged drive belts. Was a damaged drive belts found?	Go to **Step 3**	Go to **Step 4**
3	Install a new drive belts. Refer to **Drive Belt Replacement - Accessory**. Does the drive belts continue to fall off?	Go to **Step 4**	System OK
4	Inspect for a misaligned accessory drive pulleys. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 5**
5	Inspect for a bent or dented accessory drive pulleys. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 6**
6	Inspect for a bent or a cracked accessory drive brackets. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 7**
7	Inspect for incorrect, loose and/or missing fasteners. Were there any incorrect, loose and/or missing fasteners?	Go to **Step 8**	Go to **Step 9**
8	1. Replace any incorrect and/or missing fasteners. 2. Tighten any loose fasteners. Refer to **Fastener Tightening Specifications**. Does the drive belt continue to fall off?	Go to **Step 9**	System OK
9	Test the drive belt tensioner for correct operation. Refer to **Drive Belt Tensioner Diagnosis**. Does the drive belt tensioner operate correctly?	Go to **Step 11**	Go to **Step 10**
10	Replace the drive belt tensioner. Refer to **Drive Belt Replacement - Accessory**. Does the drive belt continue to fall off?	Go to **Step 11**	System OK
11	Inspect for a failed drive belt idler and/or tensioner pulley bearing. Did you find and repair the condition?	Go to **Step 12**	-
12	Run the engine in order to verify the repair. Does the drive belt still fall off?	-	System OK

DRIVE BELT EXCESSIVE WEAR DIAGNOSIS

Diagnostic Aids

Excessive wear on a drive belts is usually caused by incorrect installation or the incorrect drive belts for the application.

Minor misalignment of the accessory drive pulleys will not cause excessive wear, but will probably cause the drive belts to make a noise or fall off.

Excessive misalignment of the accessory drive pulleys will cause excessive wear and may also make the drive belts fall off.

Test Description

The numbers below refer to the steps in the diagnostic table.

> **2:** This inspection is to verify that the drive belts is correctly installed on all of the accessory drive pulleys. Wear on the drive belts may be caused by mispositioning the drive belts by one or more grooves on a pulleys.
>
> **3:** The installation of a drive belts that is too wide or too narrow will cause wear on the drive belts. The drive belts ribs should match all of the grooves on the pulleys.
>
> **4:** This inspection is to verify that the drive belts is not contacting any part of the engine or body while the engine is operating. There should be sufficient clearance when the accessory drive components load varies. The drive belts should not come in contact with an engine or a body component when snapping the throttle.

Drive Belt Excessive Wear Diagnosis

Step	Action	Yes	No
NOTE: **Refer to BELT DRESSING NOTICE in Cautions and Notices.** DEFINITION: Wear at the outside ribs of the drive belts due to incorrect installation of the drive belts.			
1	Did you review the Symptoms - Engine Mechanical diagnostic information, and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Mechanical**
2	Inspect the drive belts for proper installation. Is the drive belts installed properly?	Go to **Step 5**	Go to **Step 3**
3	Inspect for the correct drive belts. Is the correct drive belt installed?	Go to **Step 5**	Go to **Step 4**
4	Inspect the drive belts for signs of rubbing against a bracket, hose, or wiring harness. Was the drive belts rubbing against anything?	Go to **Step 5**	Go to **Diagnostic Aids**
5	Replace the drive belts. Refer to **Drive Belt Replacement - Accessory**.		

	Did you complete the replacement?	Go to **Step 6**	-
6	Run the engine in order to verify the repair. Is there still excessive drive belt wear?	-	System OK

DRIVE BELT TENSIONER DIAGNOSIS

Inspection Procedure

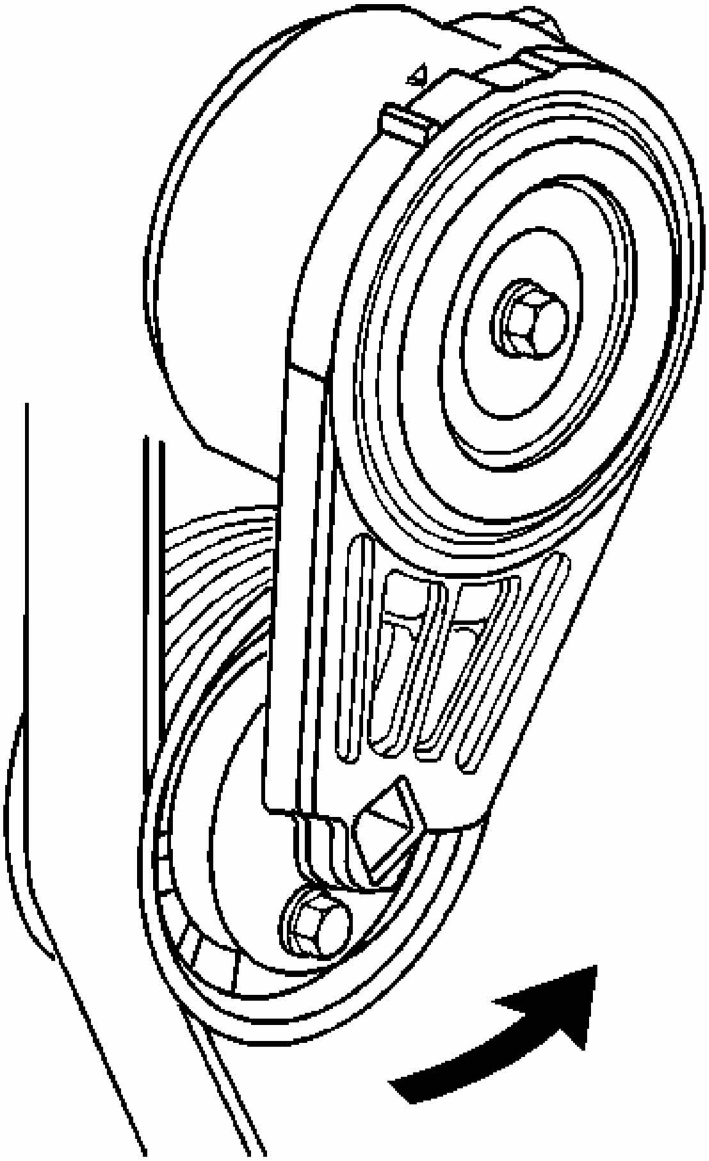

Fig. 25: Releasing Drive Belt Tension

Courtesy of GENERAL MOTORS CORP.

NOTE: Allowing the drive belt tensioner to snap into the free position may result in damage to the tensioner.

IMPORTANT: When the engine is operating the drive belt tensioner arm will move. Do not replace the drive belt tensioner because of movement in the drive belt tensioner arm.

1. Remove the drive belt. Refer to **Drive Belt Replacement - Accessory**.
2. Move the drive belt tensioner through its full travel.
   - The movement should feel smooth.
   - There should be no binding.
   - The tensioner should return freely.
3. If any binding is observed, replace the drive belt tensioner. Refer to **Drive Belt Replacement - Accessory**.
4. Install the drive belt. Refer to of **Drive Belt Replacement - Accessory**.

REPAIR INSTRUCTIONS

DRIVE BELT REPLACEMENT - ACCESSORY

Tools Required

EN-47988 Serpentine Belt Tension Unloader. See **Special Tools**.

Removal Procedure

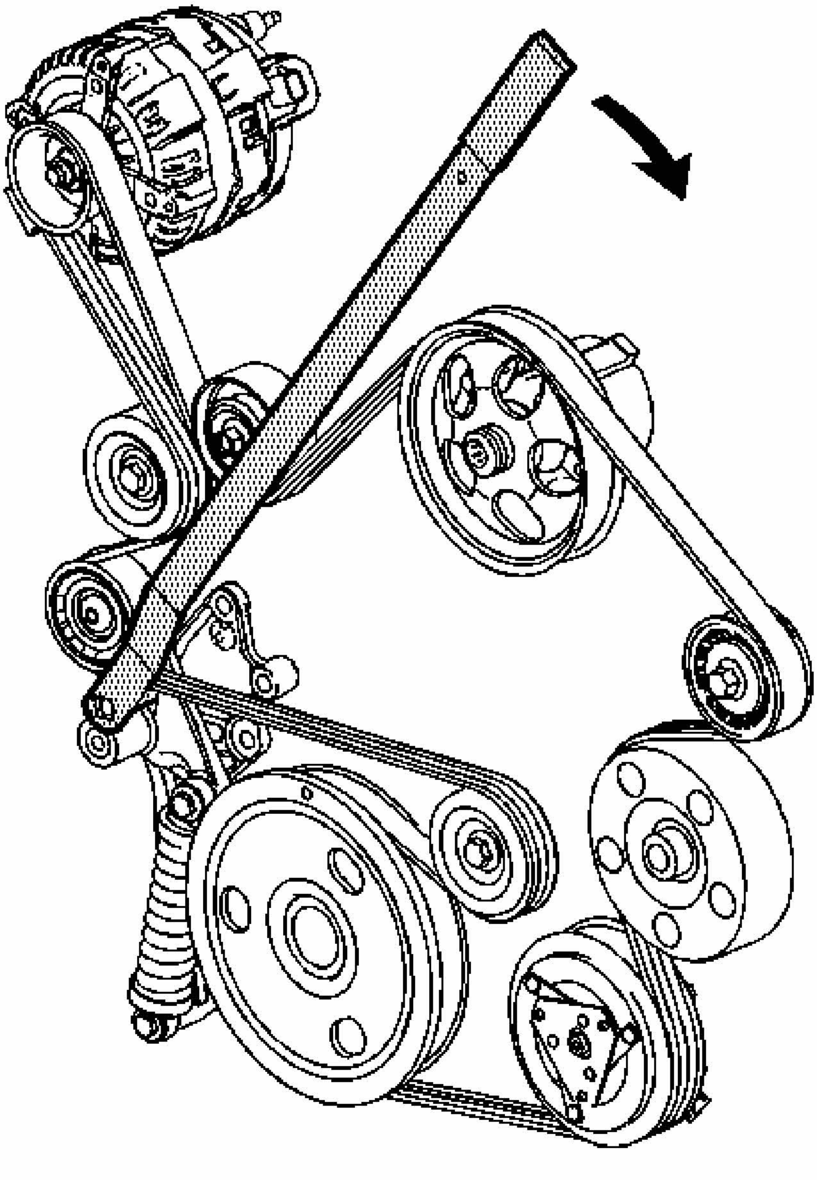

Fig. 26: Rotating The Drive Belt Tensioner Clockwise
Courtesy of GENERAL MOTORS CORP.

1. Using the **EN-47988** , rotate the drive belt tensioner clockwise in order to relieve tension on the drive belt. See **Special Tools**.
2. Remove the drive belt from the drive belt tensioner and pulleys.
3. Slowly release the tension on the drive belt tensioner.

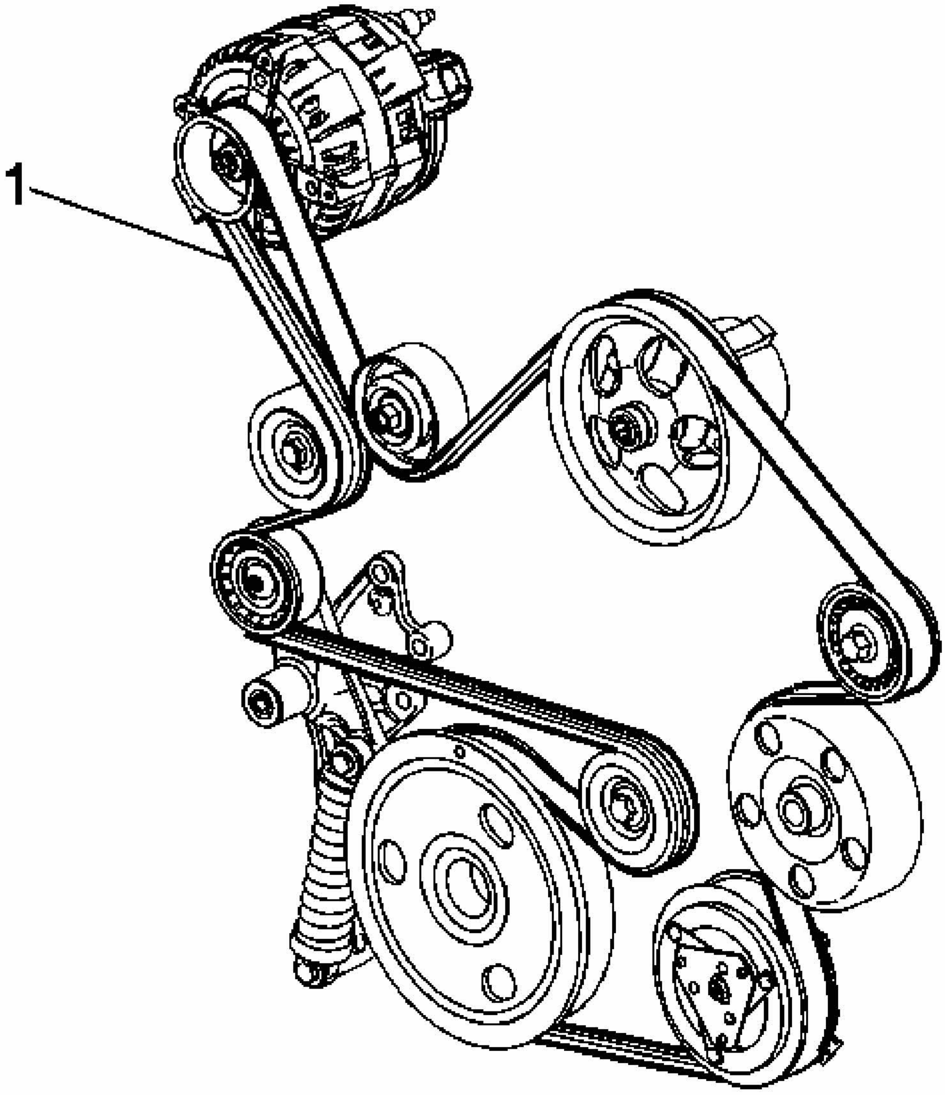

Fig. 27: View Of Drive Belt, Drive Belt Tensioner & Pulleys
Courtesy of GENERAL MOTORS CORP.

4. Clean and inspect the belt surfaces of the pulleys.

Installation Procedure

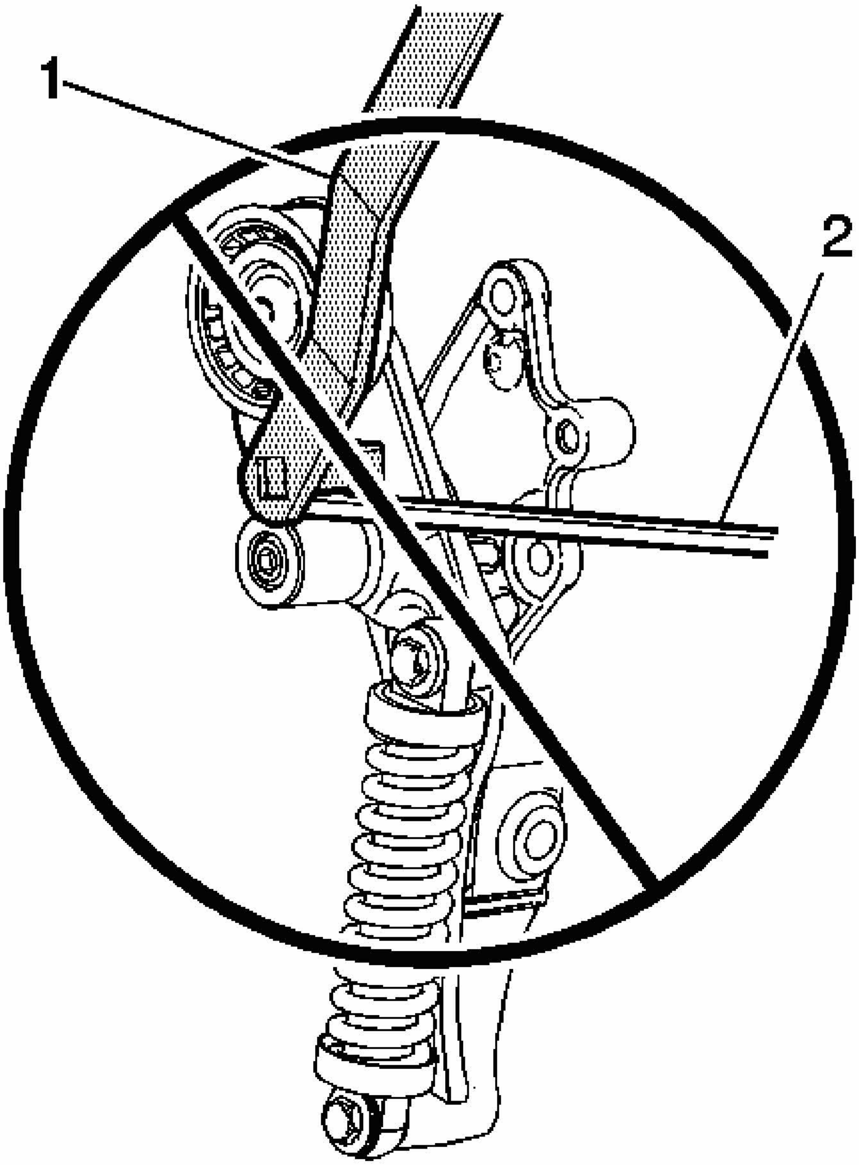

Fig. 28: Using The EN-47988, To The Belt Tensioner That The EN-47988 Is NOT Installed Above The Drive Belt
Courtesy of GENERAL MOTORS CORP.

1. Route the drive belt around all the pulleys except the power steering pump pulley.
2. Using the **EN-47988** (1), to the belt tensioner that the **EN-47988** is NOT installed above the drive belt (2).

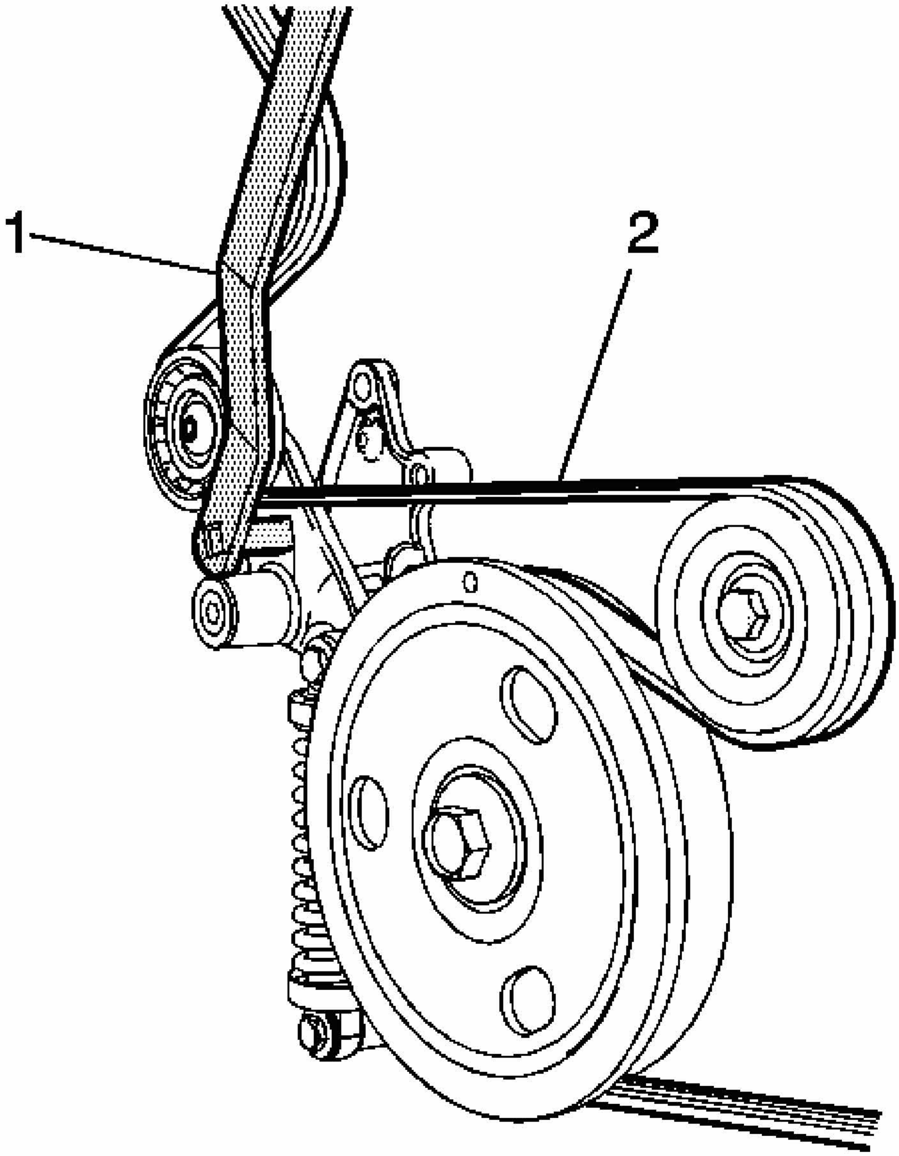

Fig. 29: Ensure That When Installing The EN-47988, To The Belt Tensioner That The EN-47988 Is Installed Below The Drive Belt
Courtesy of GENERAL MOTORS CORP.

3. Ensure that when installing the **EN-47988** (1), to the belt tensioner that the **EN-47988** is installed below the drive belt (2).
4. Rotate the **EN-47988** clockwise in order to relieve the tension on the belt tensioner.
5. Ensure that the drive belt is still properly routed around all the other pulleys, then

install the drive belt over the power steering pump pulley.

6. Slowly release the **EN-47988** .
7. Remove the **EN-47988** from the belt tensioner.
8. Inspect the drive belt for proper installation and alignment.
9. Position the UBEC, if required.
10. Install the passenger side diagonal brace, if required.

DRIVE BELT IDLER PULLEY REPLACEMENT

Removal Procedure

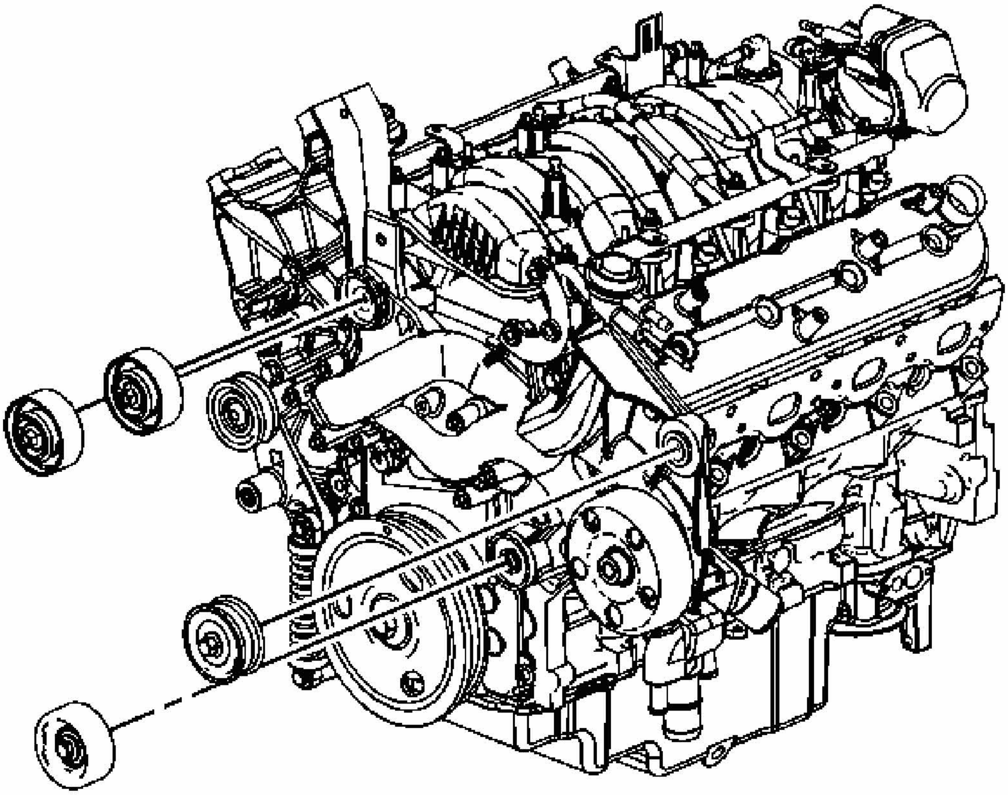

Fig. 30: Drive Belt Idler Pulley
Courtesy of GENERAL MOTORS CORP.

1. Remove the accessory drive belt. Refer to **Drive Belt Replacement - Accessory**.
2. Loosen the necessary drive belt idler pulley bolt.
3. Remove the necessary drive belt idler pulley.

Installation Procedure

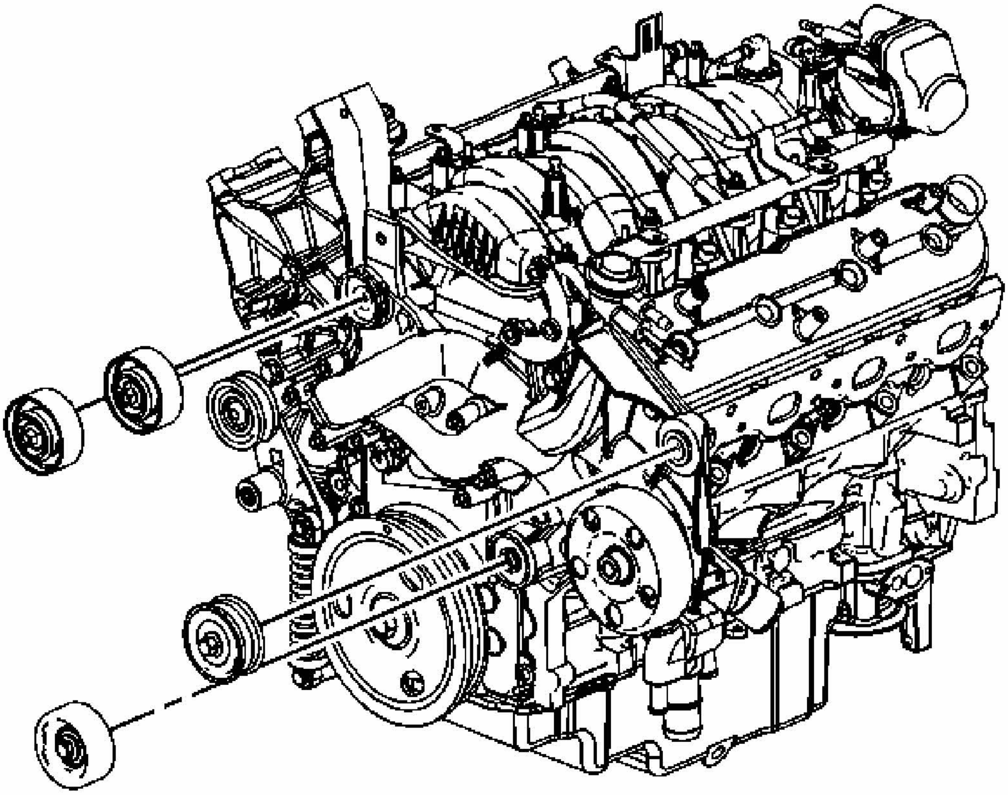

Fig. 31: Drive Belt Idler Pulley
Courtesy of GENERAL MOTORS CORP.

1. Position the necessary drive belt idler pulley to the coolant manifold and/or generator bracket.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

2. Tighten the necessary drive belt idler pulley bolt.

   Tighten: Tighten the bolt to 50 N.m (37 lb ft).

3. Install the drive belt. Refer to **Drive Belt Replacement - Accessory**.

DRIVE BELT TENSIONER REPLACEMENT - ACCESSORY

Removal Procedure

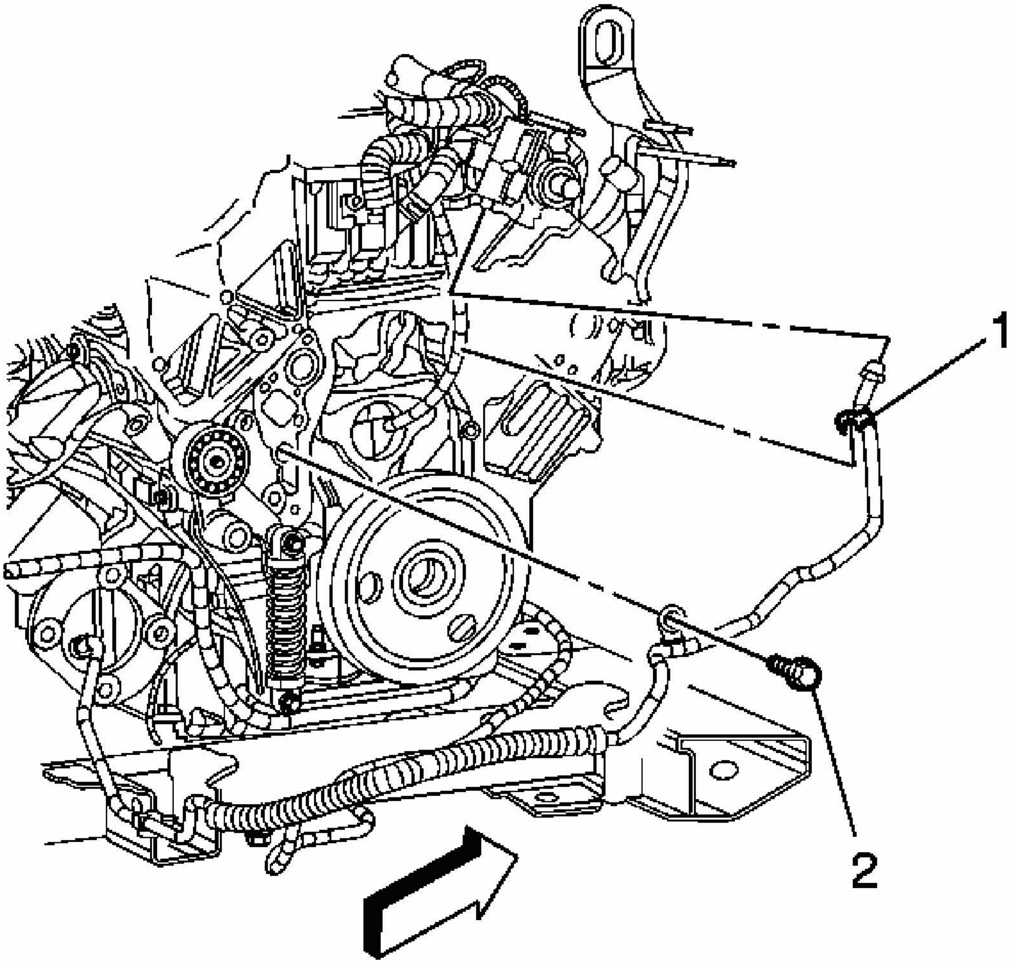

Fig. 32: Locating Power Steering Gear Inlet Hose Retainer Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the accessory drive belt. Refer to **Drive Belt Replacement - Accessory**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Remove the right wheel and tire. Refer to **TIRE AND WHEEL REMOVAL AND INSTALLATION** .
4. Remove the right engine splash shield.
5. Remove the power steering gear inlet hose retainer bolt (2).

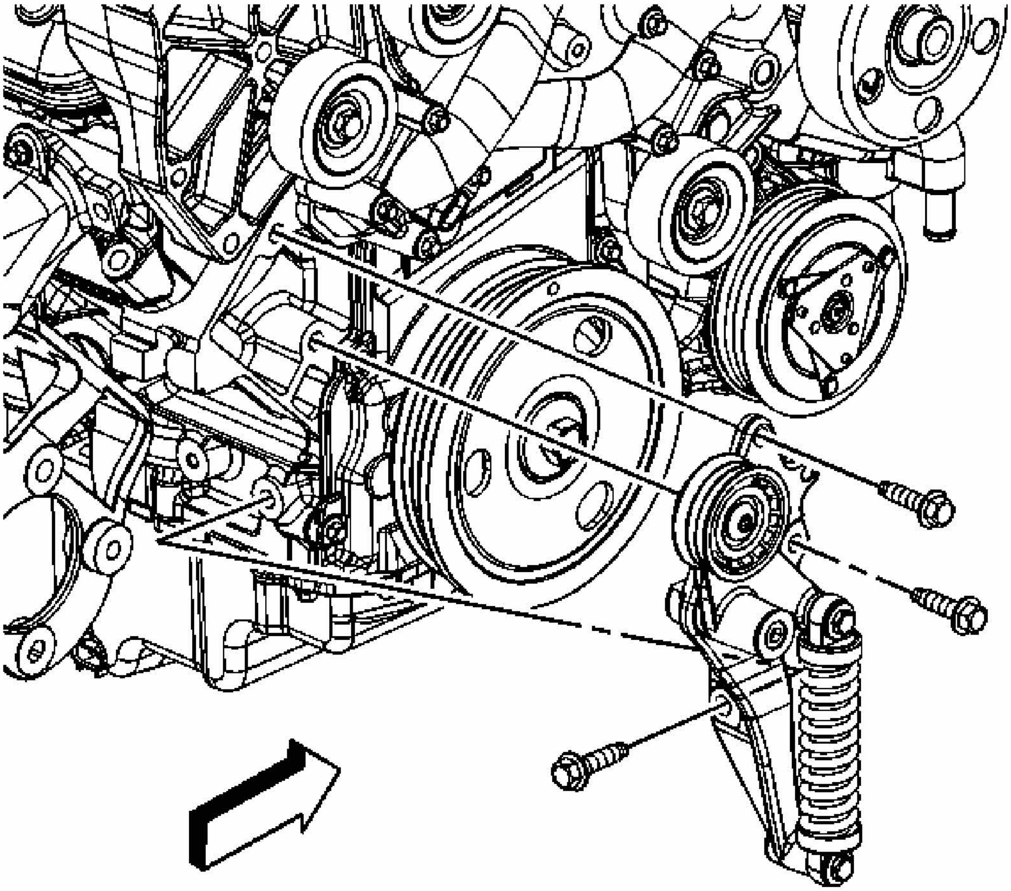

Fig. 33: Drive Belt Tensioner Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the drive belt tensioner bolts.
7. Remove the drive belt tensioner.

Installation Procedure

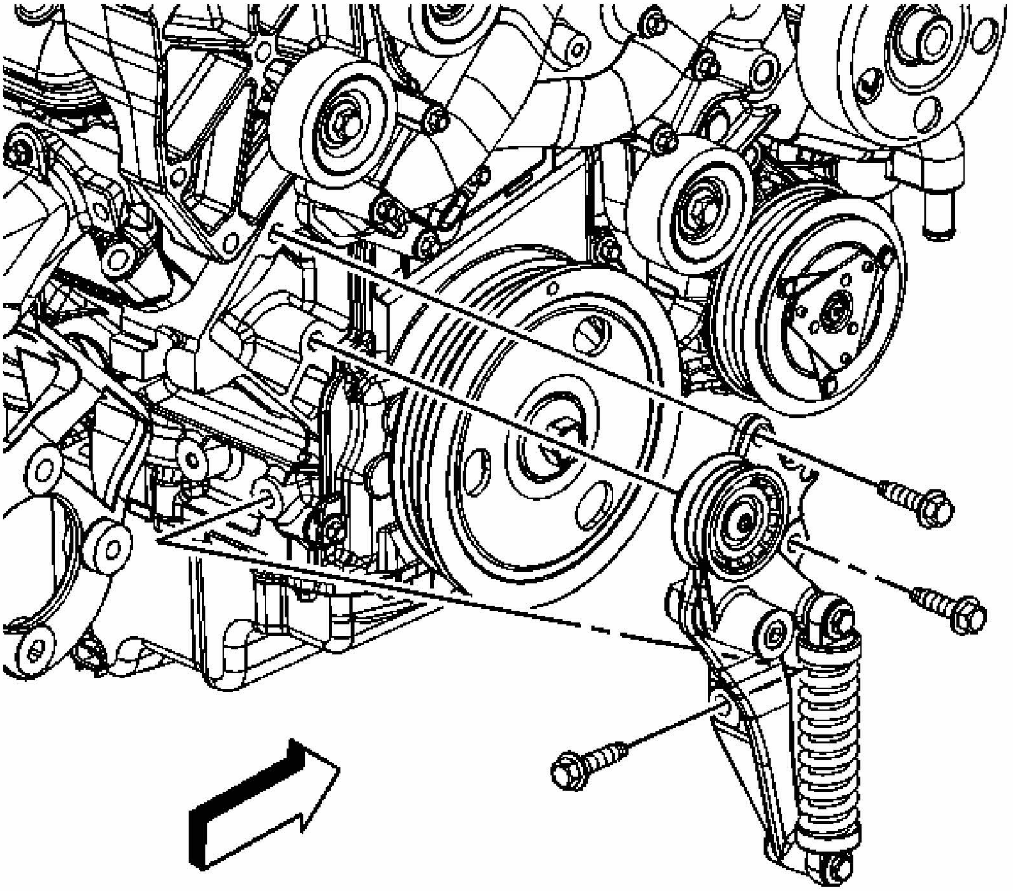

Fig. 34: Drive Belt Tensioner Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the drive belt tensioner.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the drive belt tensioner bolts.

Tighten: Tighten the bolts to 50 N.m (37 lb ft).

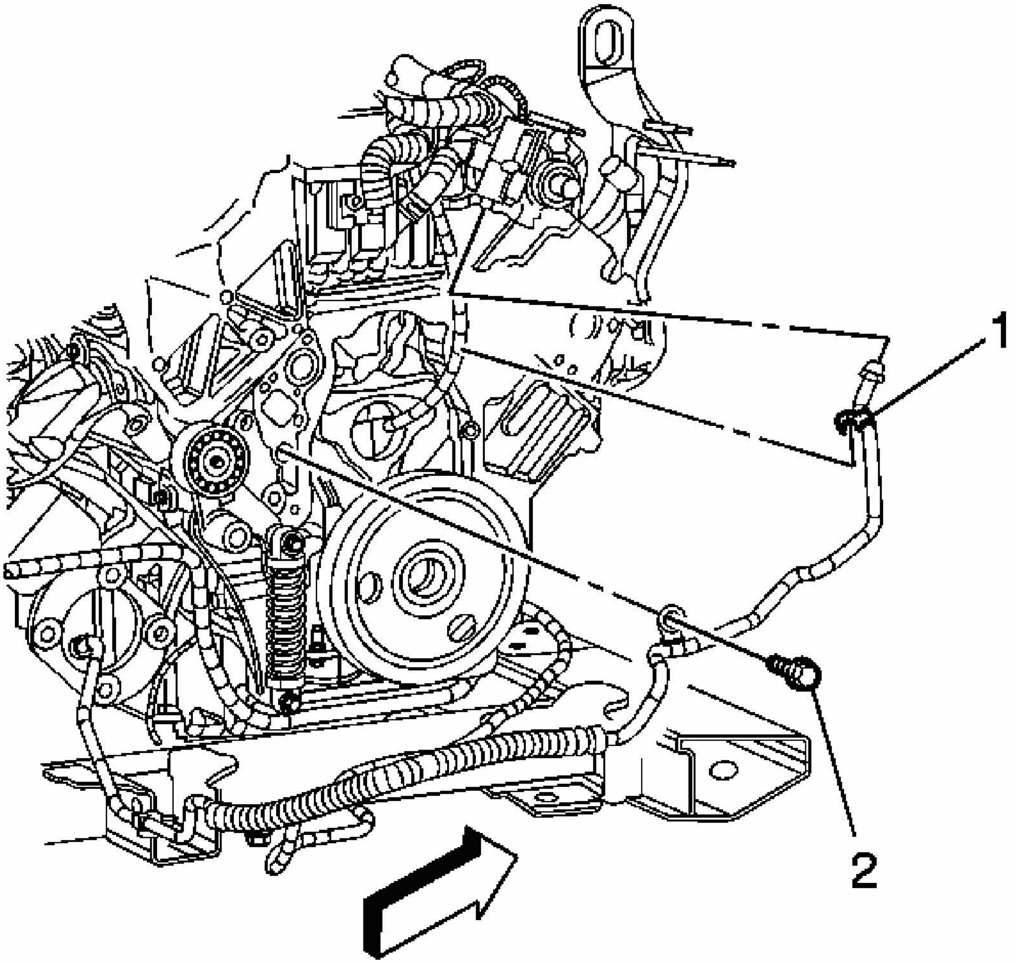

Fig. 35: Locating Power Steering Gear Inlet Hose Retainer Bolt
Courtesy of GENERAL MOTORS CORP.

3. Install the power steering gear inlet hose retainer bolt (2).

   Tighten: Tighten the bolt to 9 N.m (80 lb in).

4. Install the right engine splash shield.
5. Install the right wheel and tire. Refer to **TIRE AND WHEEL REMOVAL AND INSTALLATION** .
6. Lower the vehicle.
7. Install the accessory drive belt. Refer to **Drive Belt Replacement - Accessory**.

ENGINE SUPPORT FIXTURE

Tools Required

- **J 28467-B** Universal Engine Support Fixture
- **J 28467-501** Engine Support Fixture Adapters. See **Special Tools**.
- **J 42451-1** Engine Support Adapter

Installation Procedure

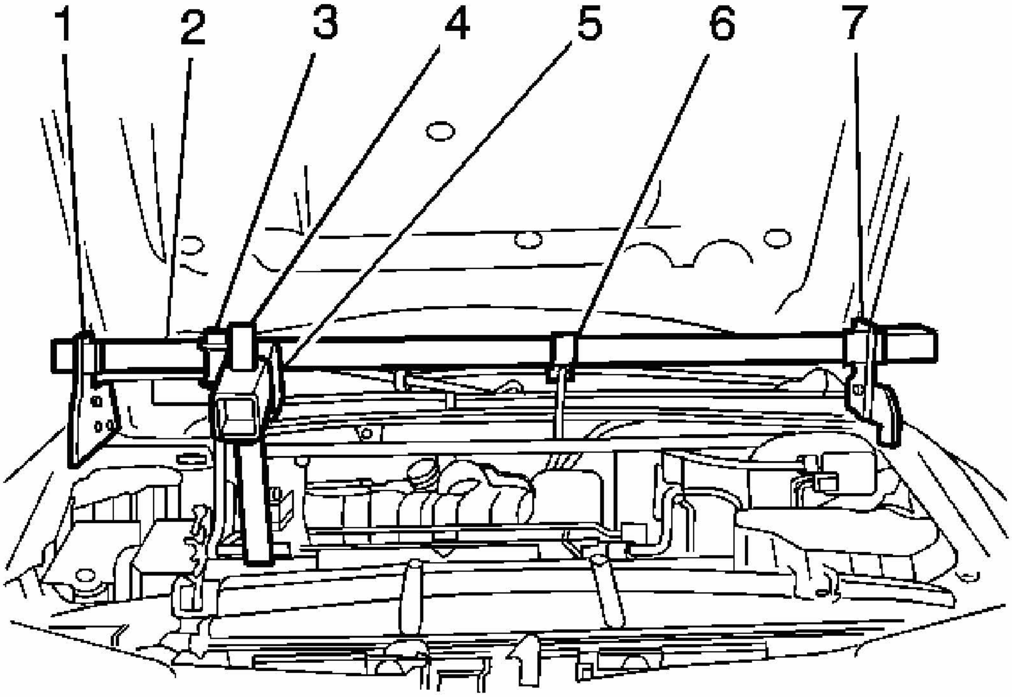

Fig. 36: Identifying Engine Support Adapter
Courtesy of GENERAL MOTORS CORP.

1. Remove the left bank ignition coils. Refer to **Ignition Coil(s) Replacement** .
2. Install **J 42451-1** bracket onto the left front of engine.
3. Install the **J 28467-501** (1, 7) onto fender rails near the strut towers. See **Special Tools**.
4. Install the J 28467-3 cross car tube (2) to the **J 28467-501** (1, 7). See **Special Tools**.
5. Install the J 28467-2A radiator shelf tube on top of the J 28467-3 cross car tube (2) over the **J 42504** . See **Special Tools**.
6. Install the round tube of the J 28467-4A front support assembly (4) through the large hole in the J 28467-2A radiator shelf tube. The hole used in the J 28467-2A radiator shelf tube (5) depends on the vehicle application.

7. Place the rubber padded foot of the J 28467-4A front support assembly on the upper tie bar.
8. Install the J 28467-9 7/16-inch x 2.0-inch quick release pin through the hole in the J 28467-4A front support assembly in order to level the J 28467-2A radiator shelf tube.
9. Install the J 28467-7A lift hook through the J 28467-6A lift hook bracket (5).
10. Install the J 28467-6A assembled lift hook bracket (6) over the J 28467-3 strut tower tube (2).

ENGINE MOUNT STRUT REPLACEMENT

Removal Procedure

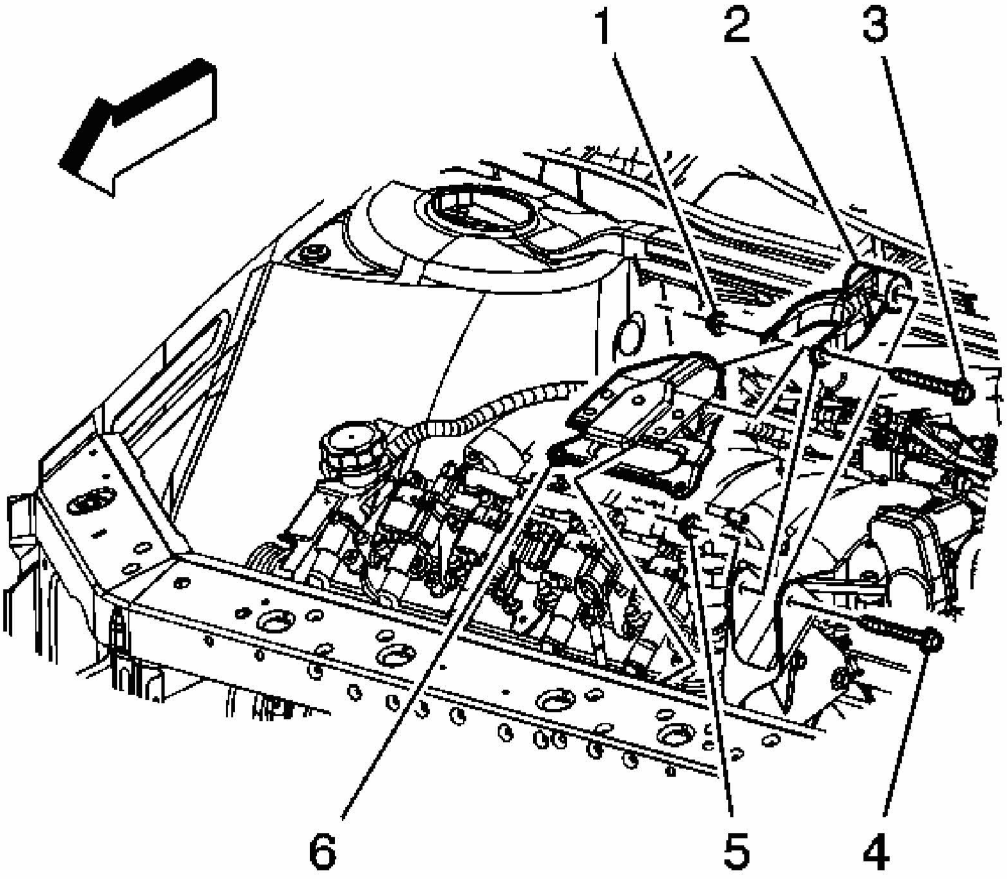

Fig. 37: View Of Engine Mount Strut
Courtesy of GENERAL MOTORS CORP.

1. Remove the forward engine mount strut bolt (3) and nut (1).

2. Remove the rear engine mount strut bolt (4) and nut (5).
3. Remove the engine mount strut (2).
4. Inspect the rubber in the engine mount strut for the following conditions:
    - Hardness
    - Splitting
    - Cracking

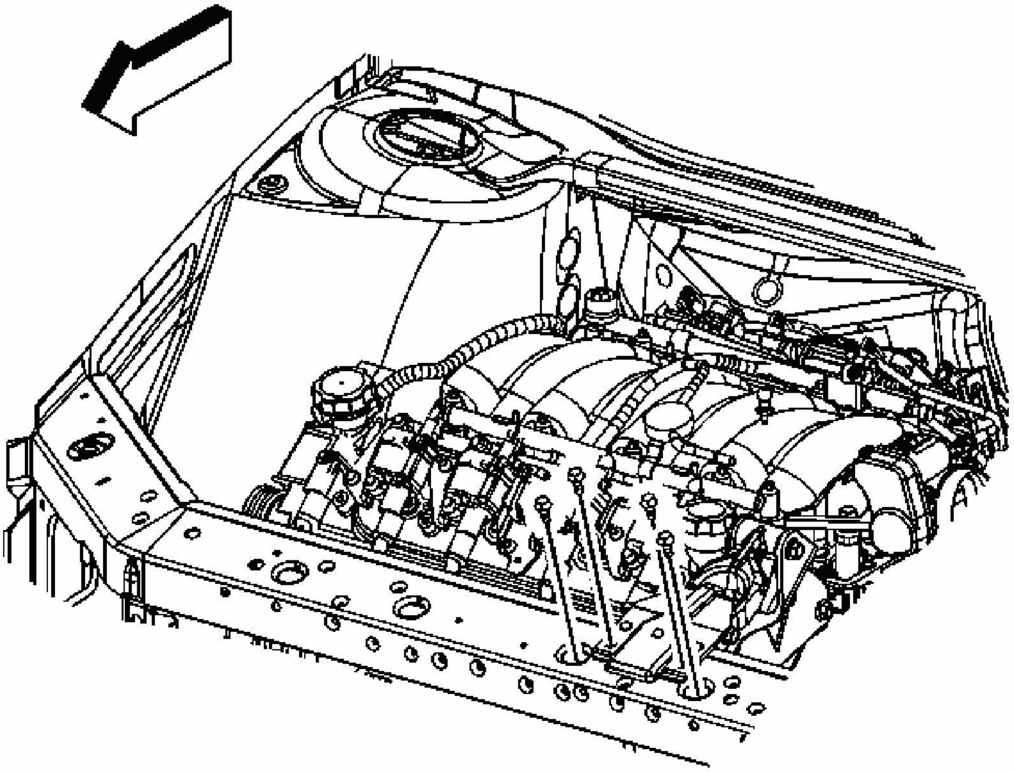

Fig. 38: View Of Engine Mount Strut Bracket (Body Side)
Courtesy of GENERAL MOTORS CORP.

5. If necessary, remove the engine mount strut bracket bolts (body side).
6. If necessary, remove the engine mount strut bracket (body side).

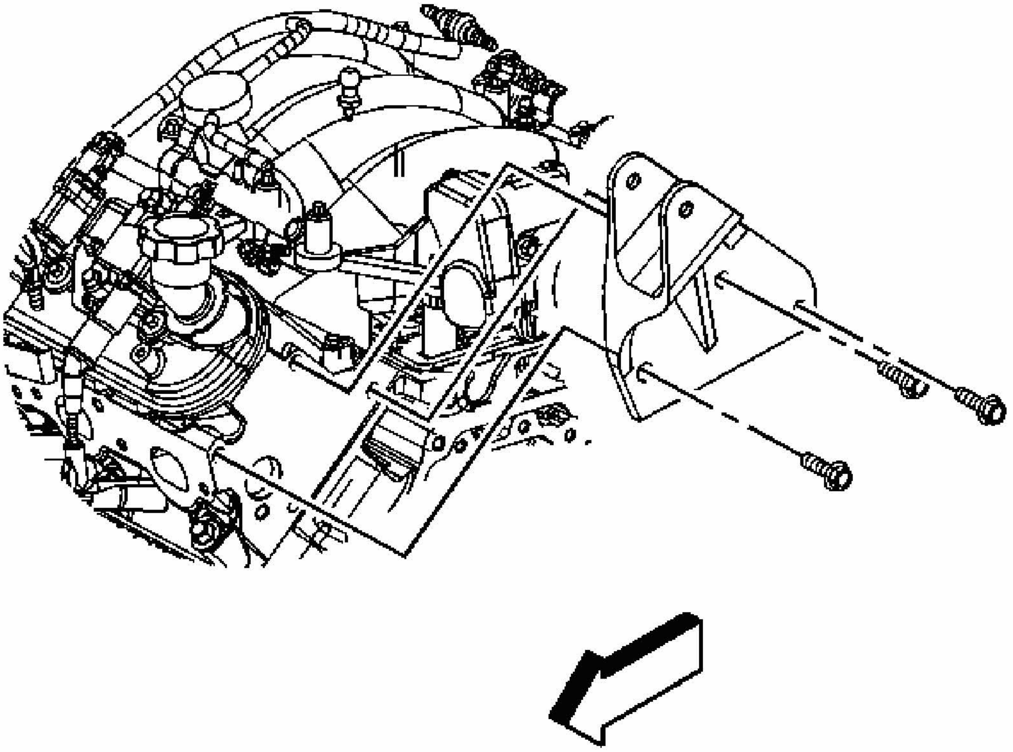

Fig. 39: View Of Engine Mount Strut Bracket (Engine Side)
Courtesy of GENERAL MOTORS CORP.

7. Remove the heater pipe bracket bolt from the engine mount.
8. If necessary, remove the engine mount strut bracket bolts (engine side).
9. If necessary, remove the engine mount strut bracket (engine side).

Installation Procedure

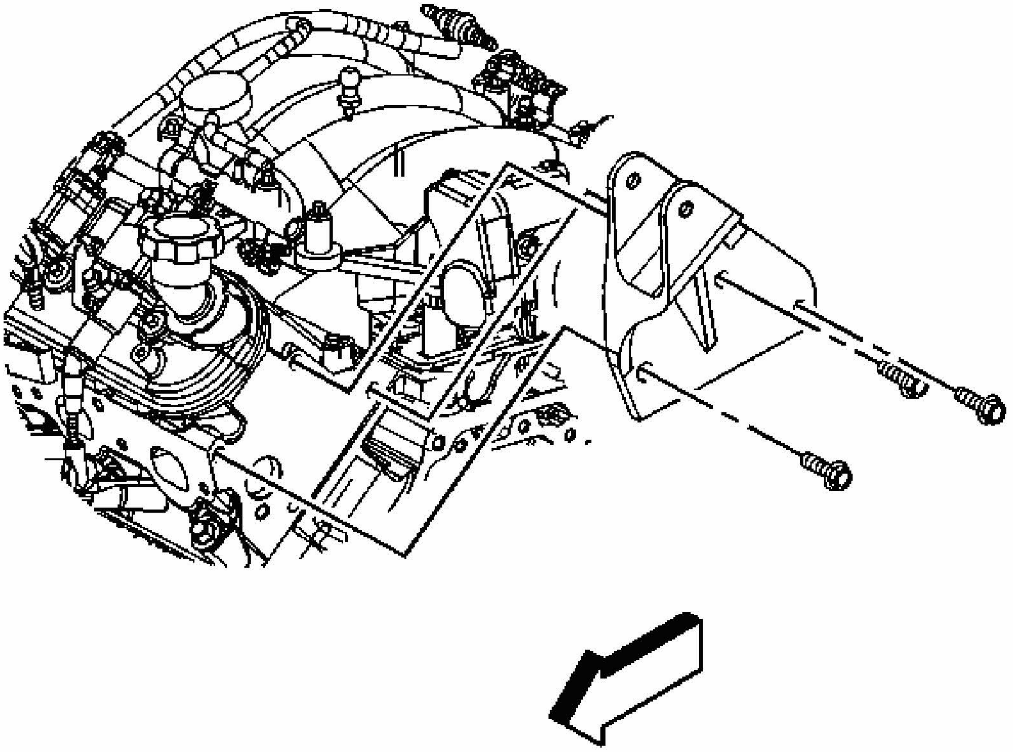

Fig. 40: View Of Engine Mount Strut Bracket (Engine Side)
Courtesy of GENERAL MOTORS CORP.

1. If necessary, position the engine mount strut bracket (engine side) to the cylinder head.

   NOTE: **Refer to Fastener Notice .**

2. If necessary, install the engine mount strut bracket bolts (engine side).

   Tighten: Tighten the bolts to 48 N.m (35 lb ft).

3. Install the heater pipe bracket bolt.

   Tighten: Tighten the bolt to 16 N.m (12 lb ft).

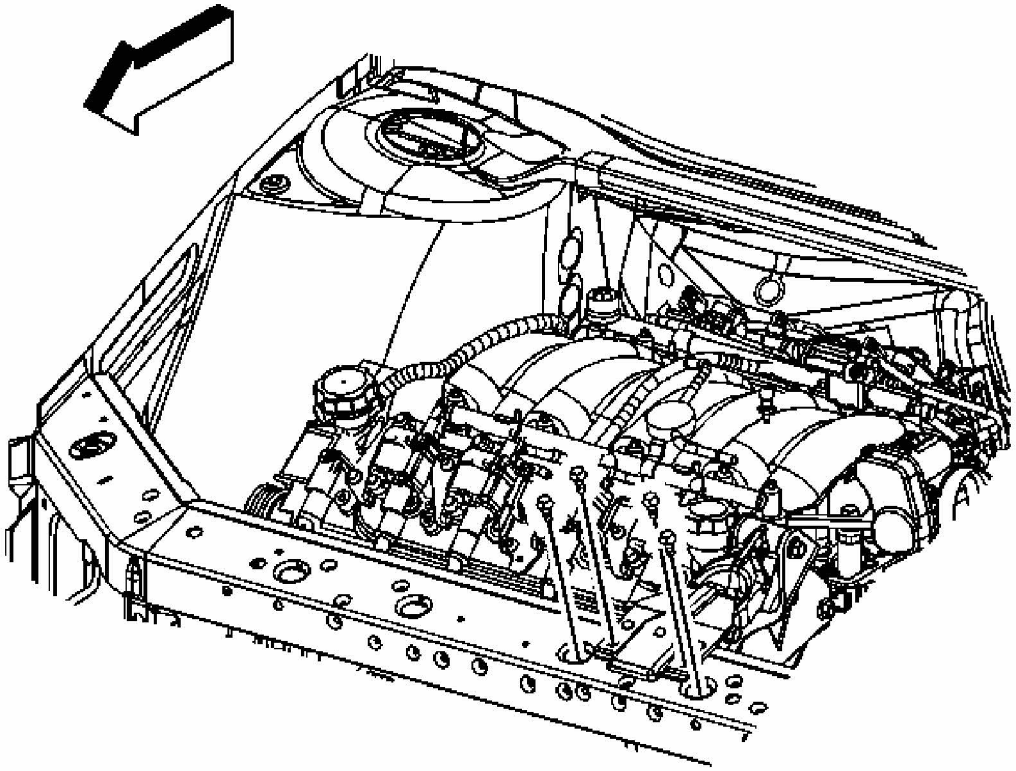

Fig. 41: View Of Engine Mount Strut Bracket (Body Side)
Courtesy of GENERAL MOTORS CORP.

4. If necessary, position the engine mount strut bracket (body side) to the vehicle.
5. If necessary, install the engine mount strut bracket bolts (body side).

   Tighten: Tighten the bolt to 48 N.m (35 lb ft).

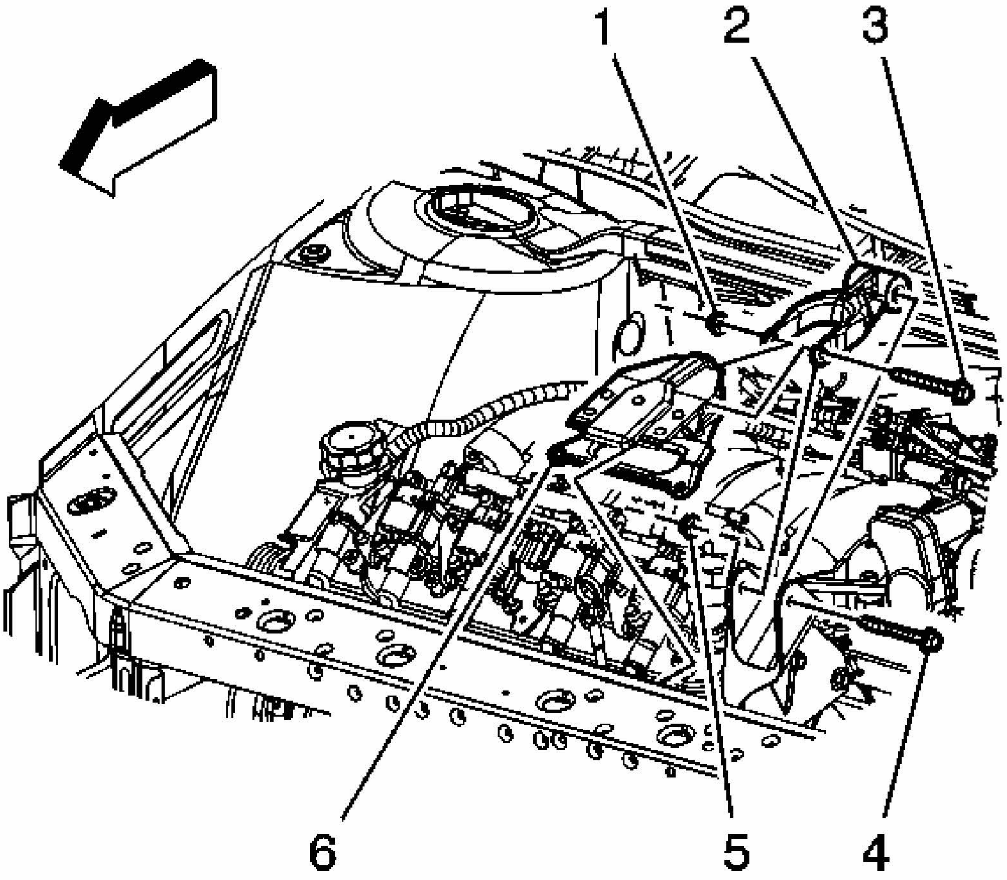

Fig. 42: View Of Engine Mount Strut
Courtesy of GENERAL MOTORS CORP.

6. Install the engine mount strut (2).
7. Install the rear engine mount strut bolt (4) and nut (5).

   Tighten: Tighten the bolt/nut to 48 N.m (35 lb ft).

8. Install the forward engine mount strut bolt (3) and nut (1).

   Tighten: Tighten the bolt/nut to 48 N.m (35 lb ft).

ENGINE MOUNT INSPECTION

Inspection Procedure

IMPORTANT: Before replacing any engine mount due to suspected fluid loss,

verify that the source of the fluid is the engine mount, not the engine or accessories.

1. Install the engine support fixture. Refer to **Engine Support Fixture**.
2. Raise the engine in order to remove the weight from the engine mount and to create slight tension in the rubber.
3. Observe the engine mount while raising the engine. Replace the engine mount if the engine mount exhibits any of the following conditions:
    - The hard rubber surface is covered with heat check cracks.
    - The rubber is separated from the metal plate of the engine mount.
    - The rubber is split through the center of the engine mount.
4. If there is movement between the metal plate of the engine mount and its attaching points, lower the engine on the engine mount. Tighten the bolts or nuts attaching the engine mount to the frame or engine mount bracket.
5. For information on the transaxle mount, refer to **Transmission Mount Inspection** in Automatic Transaxle - 4T65-E.

ENGINE MOUNT REPLACEMENT - LEFT

Removal Procedure

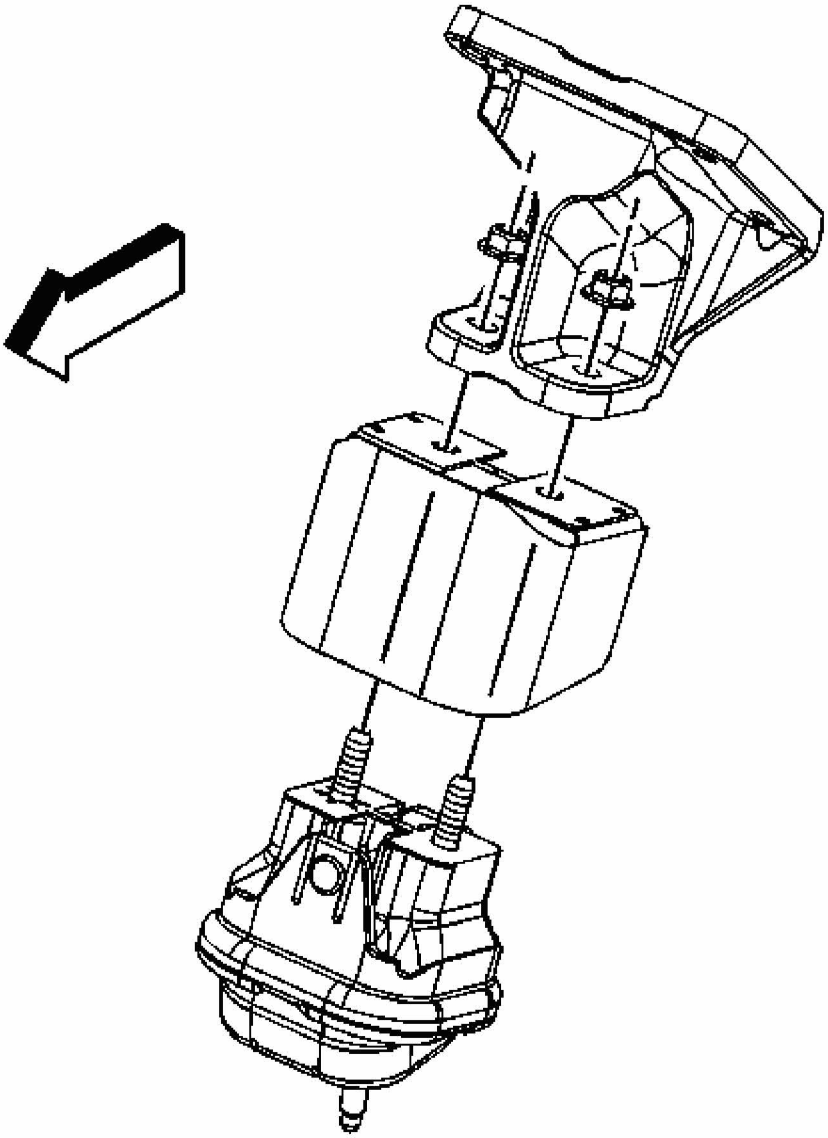

Fig. 43: Exploded View Of Lower Engine Mount
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount strut. Refer to **Engine Mount Strut Replacement**.
2. Remove the left exhaust manifold. Refer to **Exhaust Manifold Replacement - Left (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Left (RPO LS4)** .
3. Remove the upper engine mount nuts.
4. Install the engine support fixture. Refer to **Engine Support Fixture**.

5. Using the engine support fixture, raise the engine.

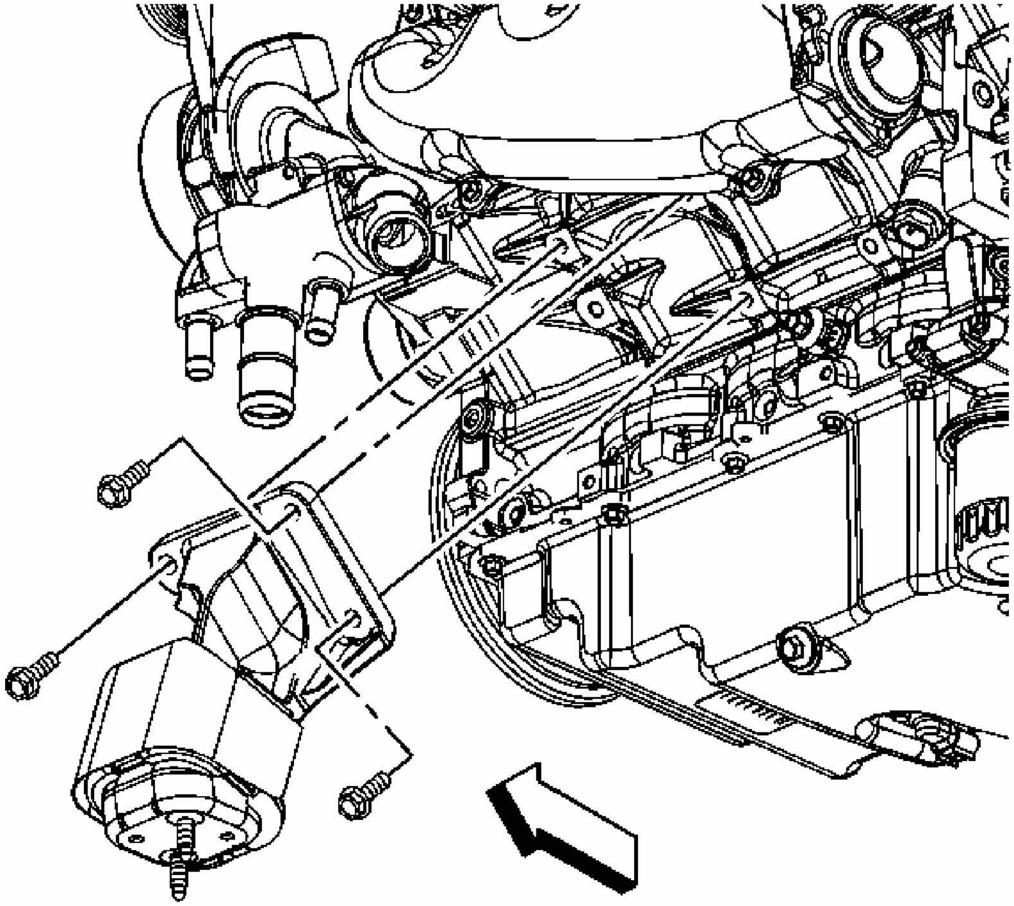

Fig. 44: View Of Lower Engine Mount & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine mount bracket bolts.
7. Remove the engine mount bracket.
8. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

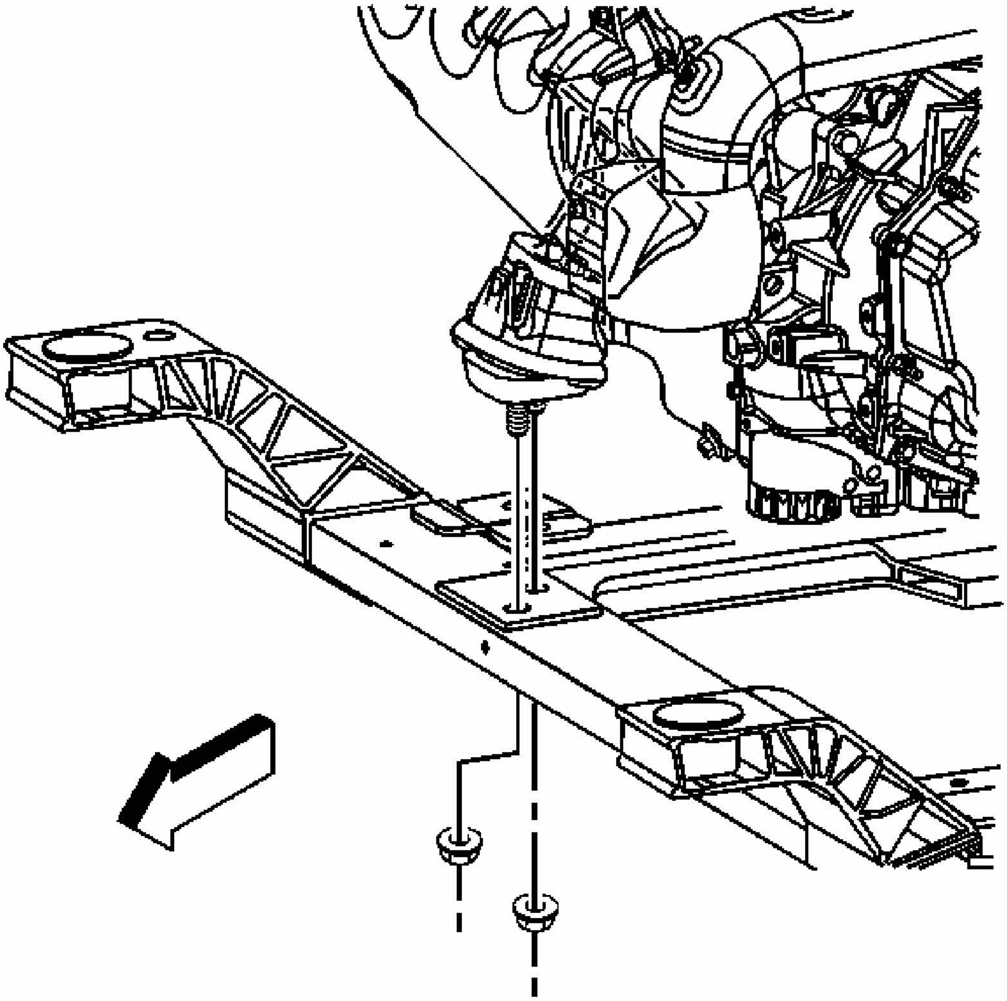

Fig. 45: View Of Lower Engine Mount
Courtesy of GENERAL MOTORS CORP.

9. Remove the lower engine mount nuts.
10. Remove the engine mount.
11. Remove the engine mount heat shield, if necessary.

Installation Procedure

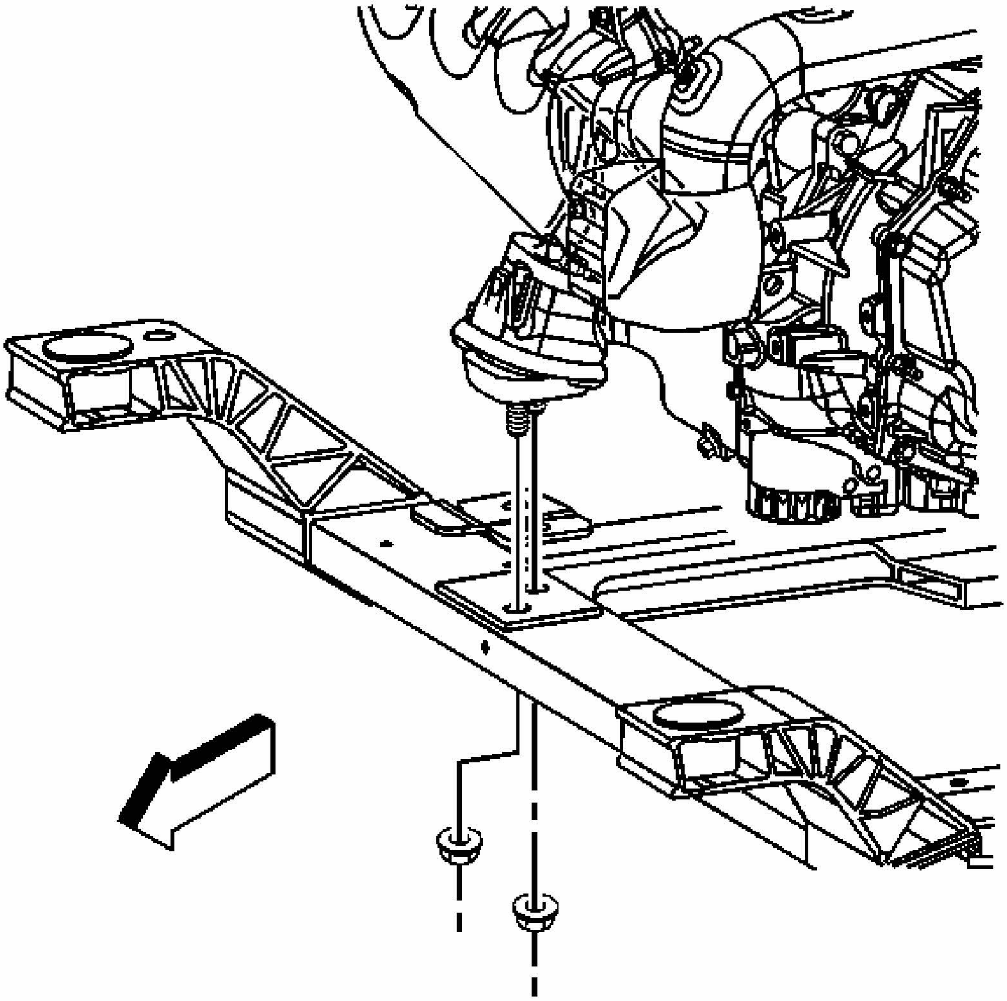

Fig. 46: View Of Lower Engine Mount
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount heat shield, if necessary.
2. Install the engine mount to the engine.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the lower engine mount nuts.

Tighten: Tighten the nuts to 50 N.m (37 lb ft).

4. Lower the vehicle.

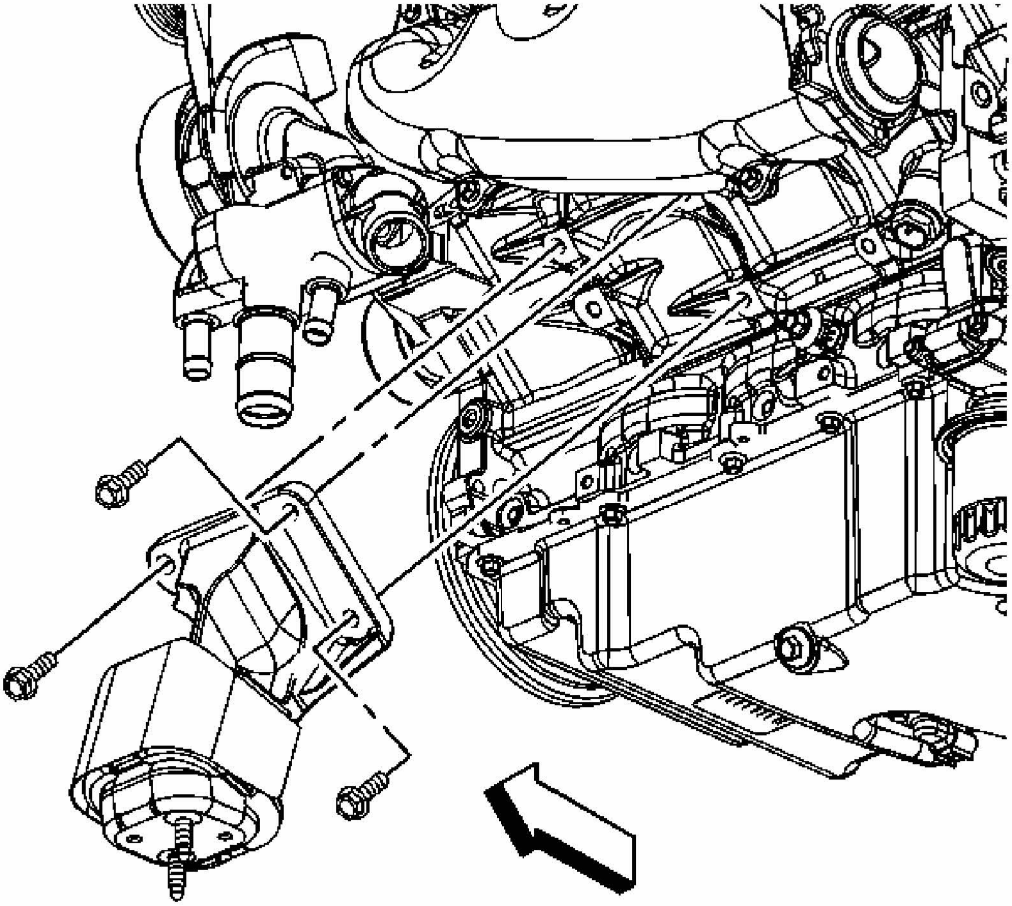

Fig. 47: View Of Lower Engine Mount & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the engine mount bracket.
6. Install the engine mount bracket bolts.

Tighten: Tighten the bolts to 50 N.m (37 lb ft).

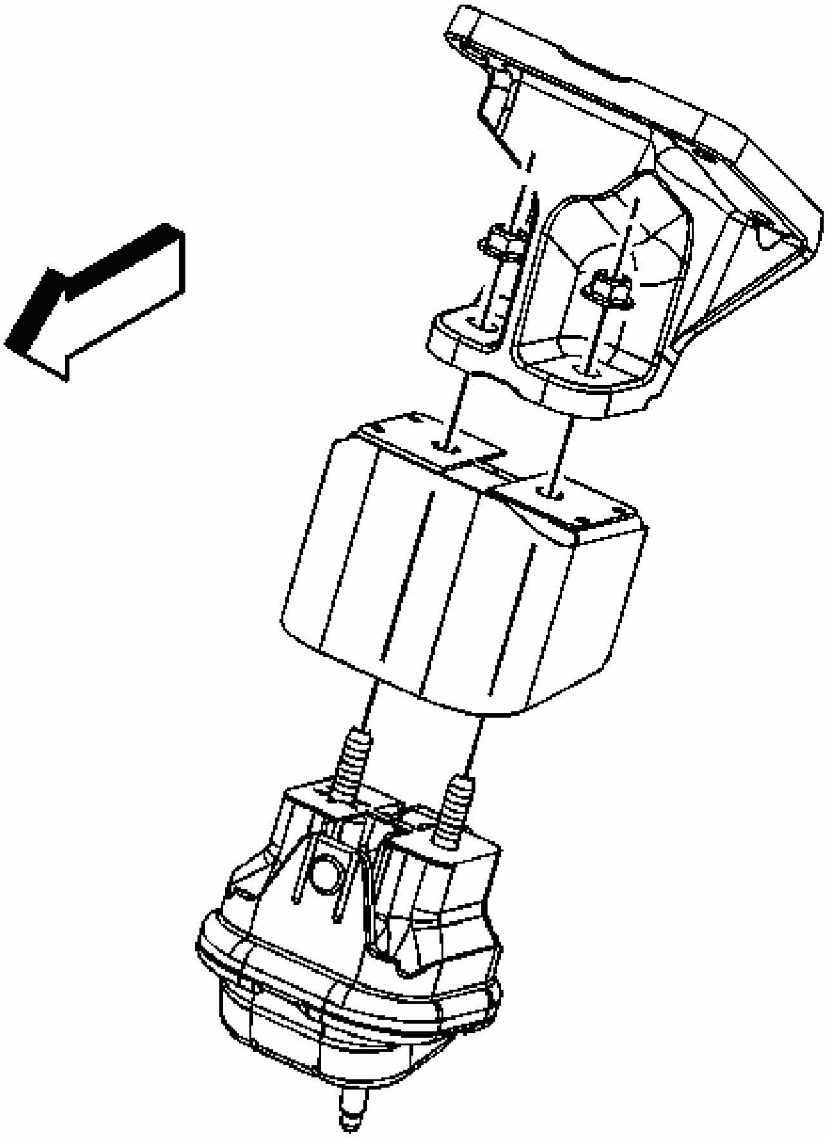

Fig. 48: Exploded View Of Lower Engine Mount
Courtesy of GENERAL MOTORS CORP.

7. Using the engine support fixture, lower the engine.
8. Remove the engine support fixture.
9. Install the upper engine mount nuts.

   Tighten: Tighten the nuts to 50 N.m (37 lb ft).

10. Install the left exhaust manifold. Refer to **Exhaust Manifold Replacement - Left (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Left (RPO LS4)** .
11. Install the engine mount strut. Refer to **Engine Mount Strut Replacement**.

ENGINE MOUNT BRACKET REPLACEMENT - LEFT

Removal Procedure

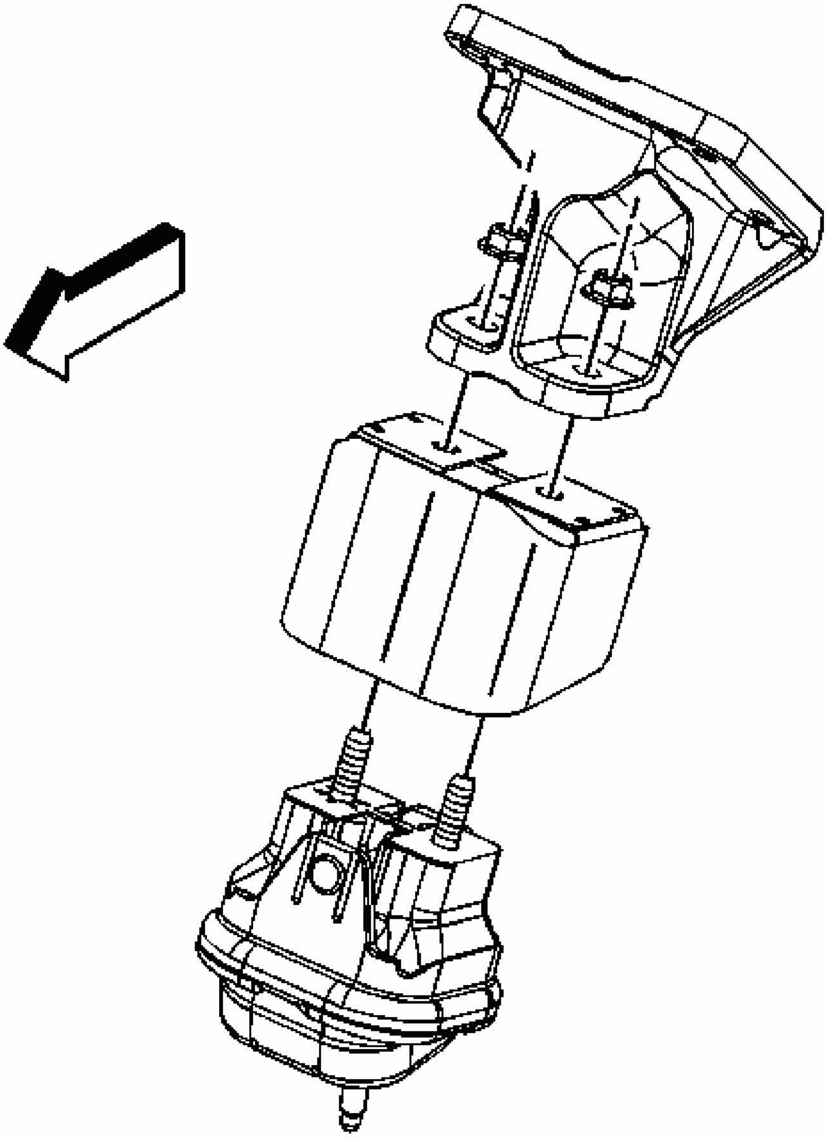

Fig. 49: Exploded View Of Lower Engine Mount
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount strut. Refer to **Engine Mount Strut Replacement**.
2. Remove the left exhaust manifold. Refer to **Exhaust Manifold Replacement - Left (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Left (RPO LS4)** .
3. Remove the upper engine mount nuts.
4. Install the engine support fixture. Refer to **Engine Support Fixture**.
5. Using the engine support fixture, raise the engine.

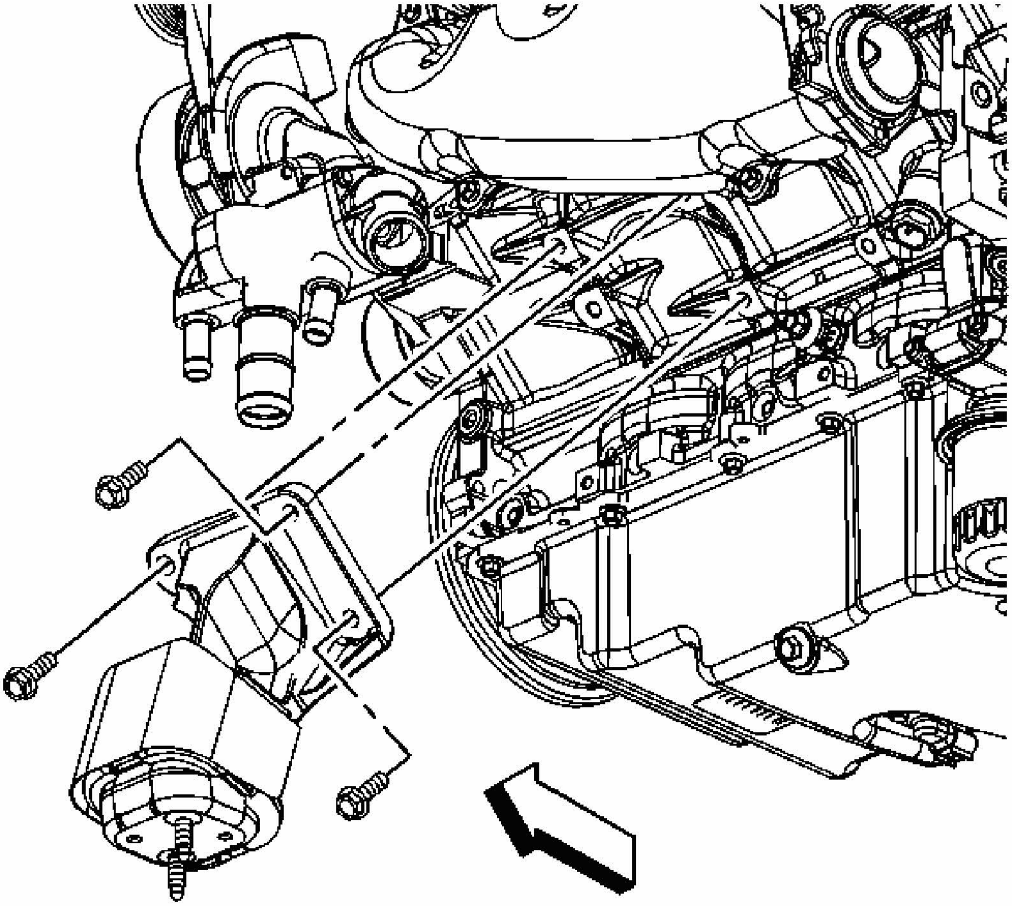

Fig. 50: View Of Lower Engine Mount & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine mount bracket bolts.
7. Remove the engine mount bracket.

Installation Procedure

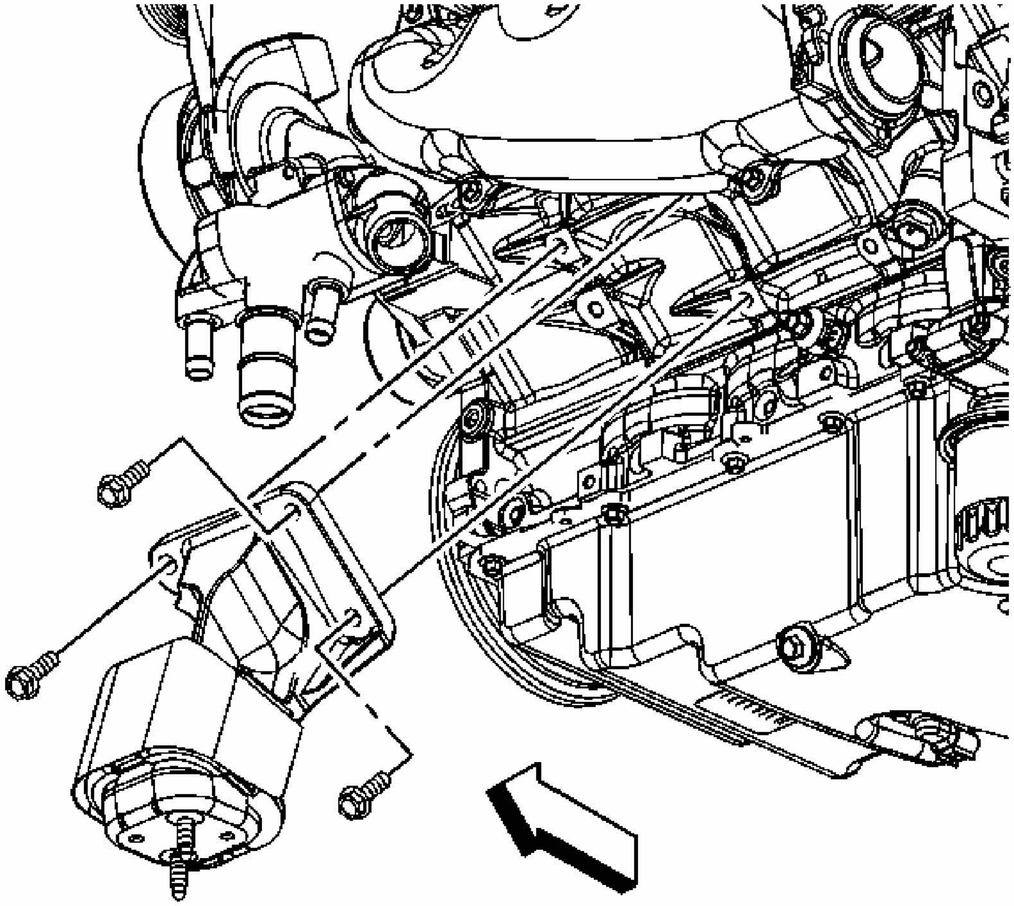

Fig. 51: View Of Lower Engine Mount & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount bracket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the engine mount bracket bolts.

Tighten: Tighten the bolts to 50 N.m (37 lb ft).

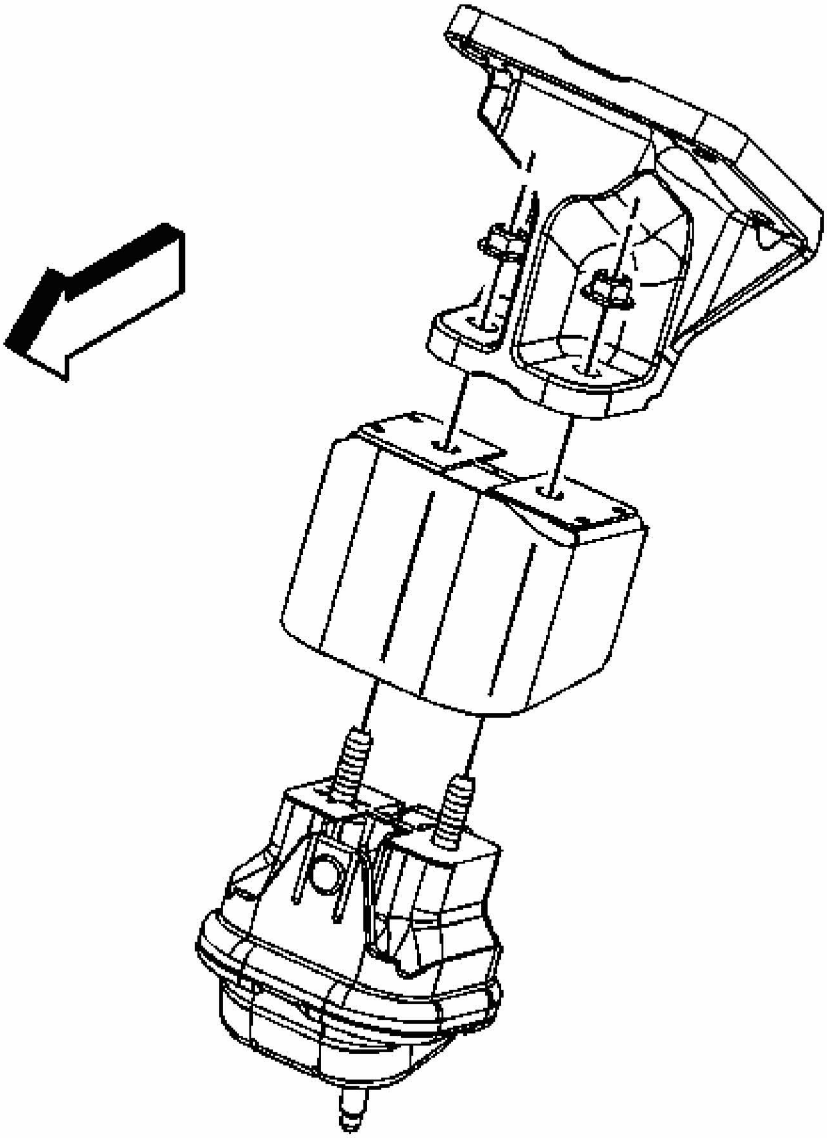

Fig. 52: Exploded View Of Lower Engine Mount
Courtesy of GENERAL MOTORS CORP.

3. Using the engine support fixture, lower the engine.
4. Remove the engine support fixture.
5. Install the upper engine mount nuts.

Tighten: Tighten the nuts to 50 N.m (37 lb ft).

6. Install the left exhaust manifold. Refer to **Exhaust Manifold Replacement - Left (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Left (RPO LS4)** .
7. Install the engine mount strut. Refer to **Engine Mount Strut Replacement**.

ENGINE MOUNT REPLACEMENT - RIGHT

Removal Procedure

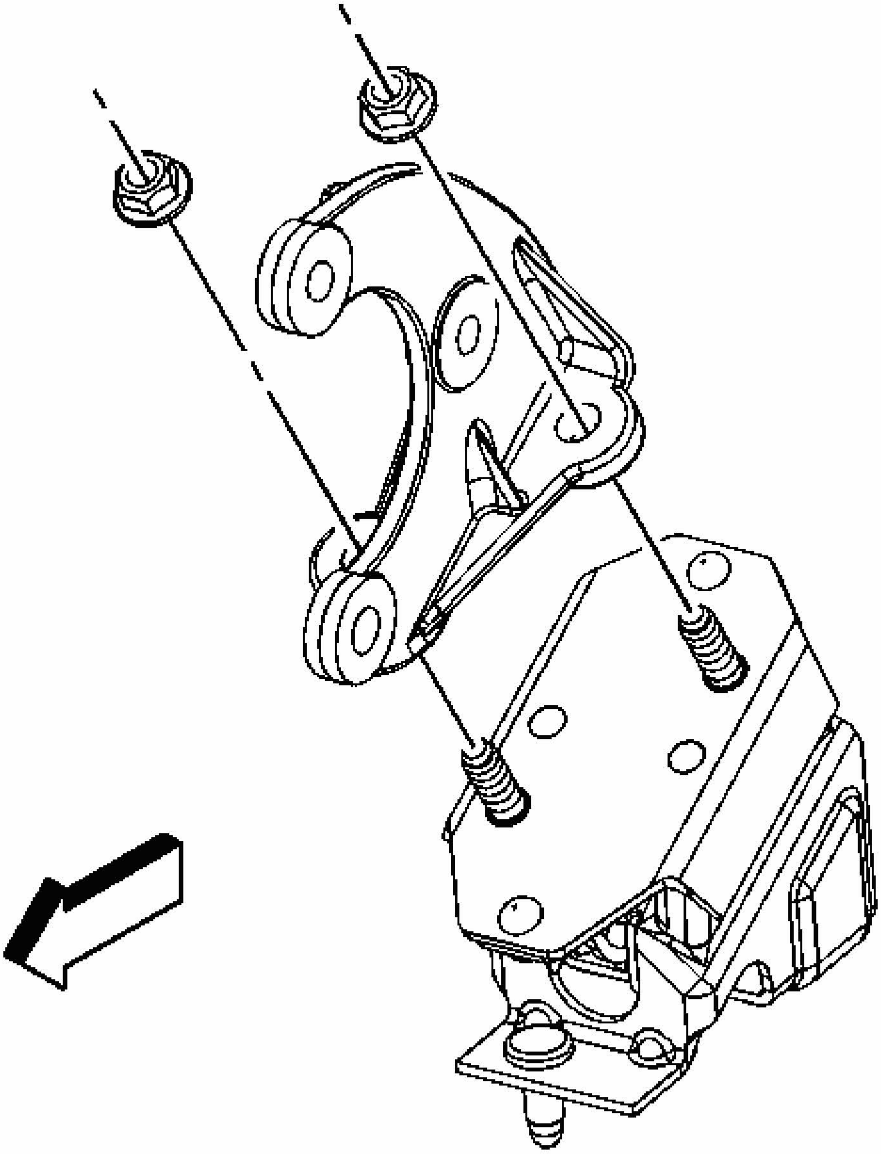

Fig. 53: Exploded View Of Right Engine Mount

Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount strut. Refer to **Engine Mount Strut Replacement**.
2. Remove the right exhaust manifold. Refer to **Exhaust Manifold Replacement - Right (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Right (RPO LS4)** .
3. Remove the upper engine mount nuts.
4. Install the engine support fixture. Refer to **Engine Support Fixture**.
5. Using the engine support fixture, raise the engine.

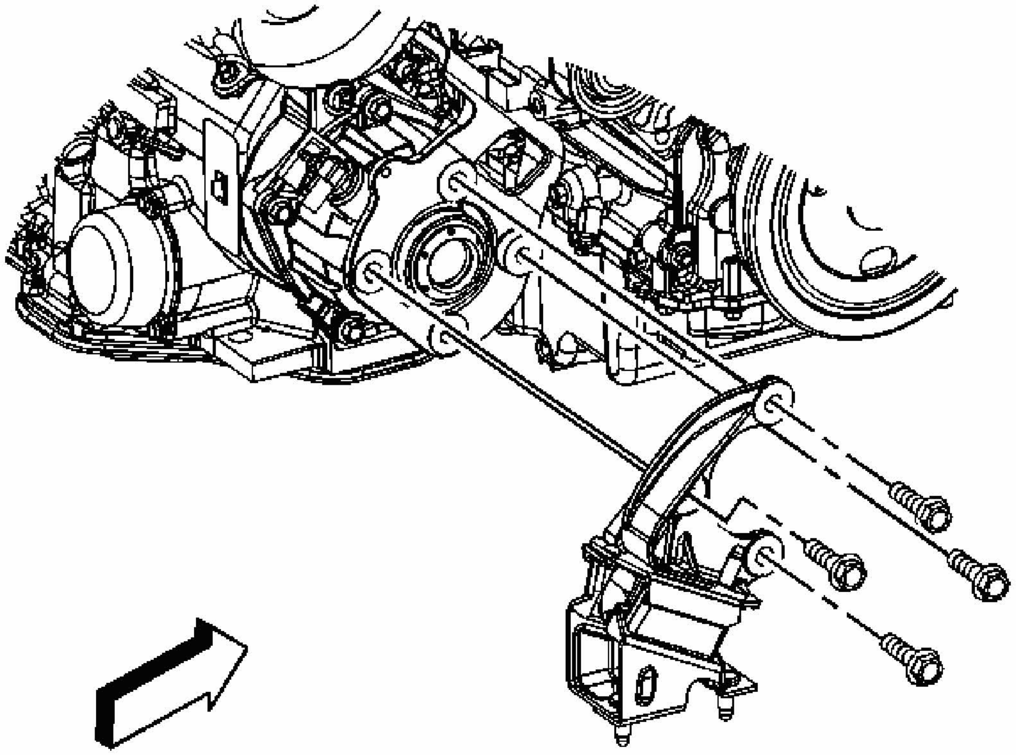

Fig. 54: View Of Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine mount bracket bolts.
7. Remove the engine mount bracket.
8. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

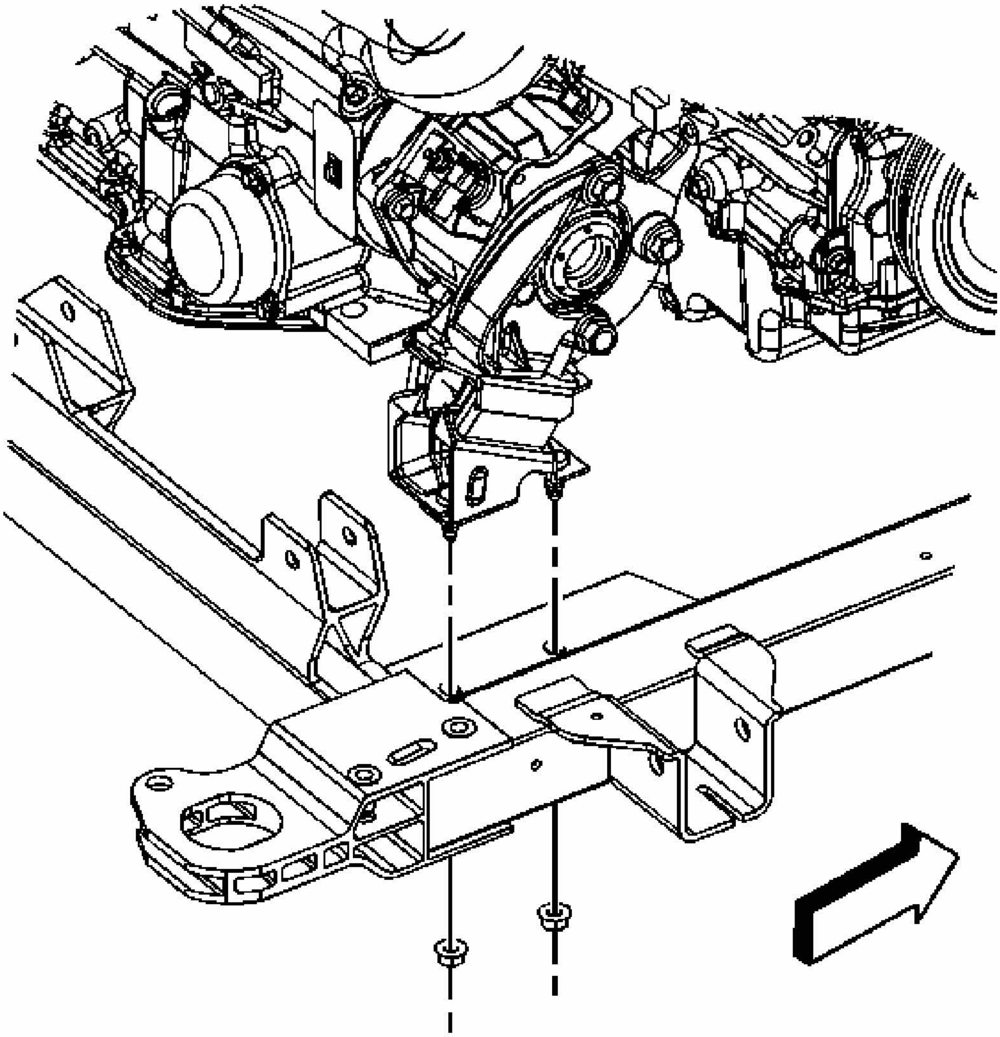

Fig. 55: View Of Engine Mount Bracket Nuts
Courtesy of GENERAL MOTORS CORP.

9. Remove the lower engine mount nuts.
10. Remove the engine mount.

Installation Procedure

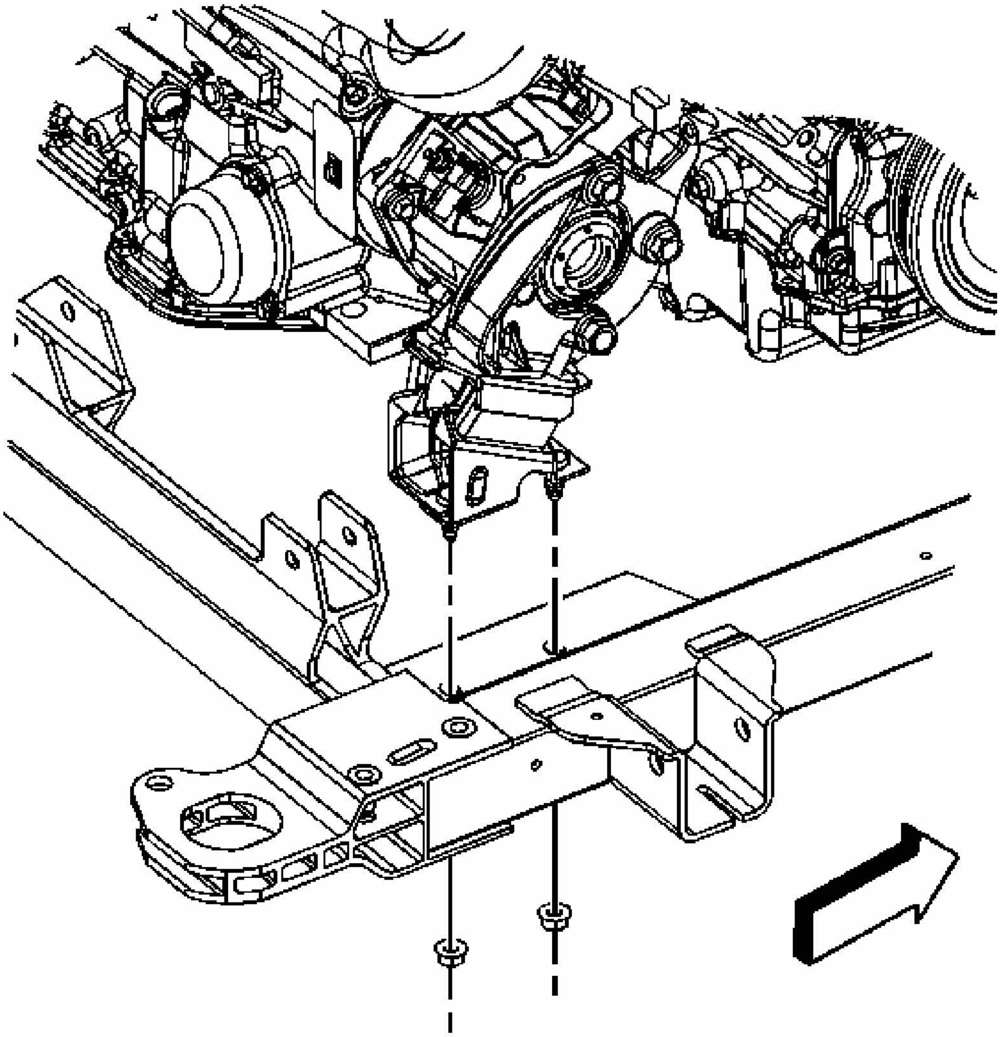

Fig. 56: View Of Engine Mount Bracket Nuts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the lower engine mount nuts.

Tighten: Tighten the nuts to 50 N.m (37 lb ft).

3. Lower the vehicle.

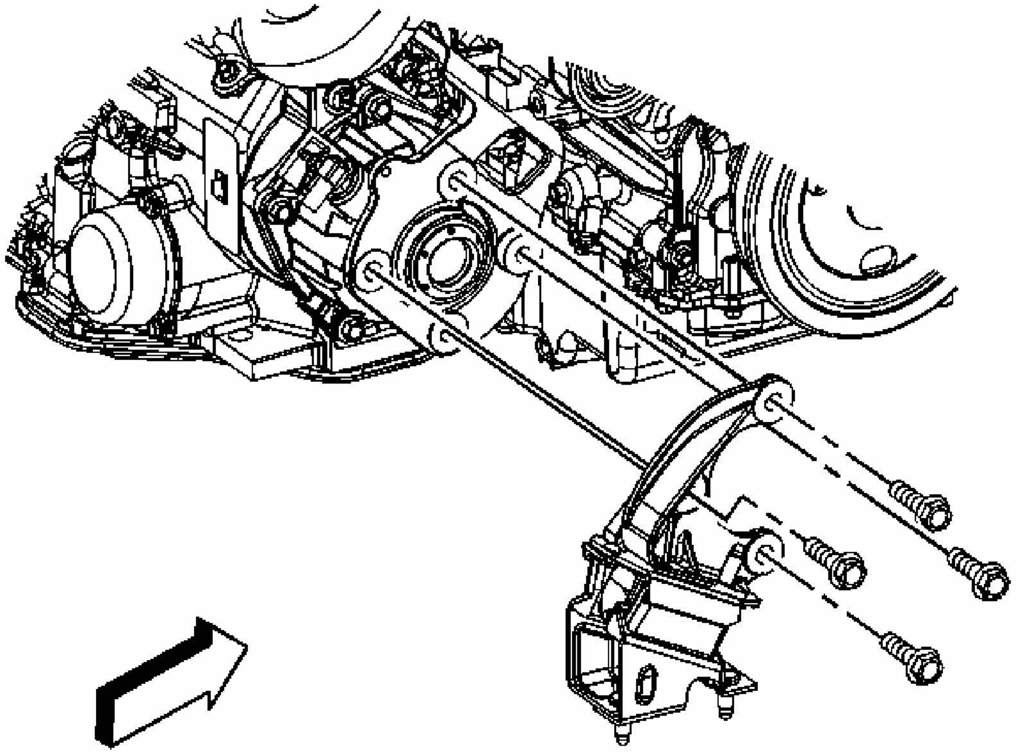

Fig. 57: View Of Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

4. Install the engine mount bracket.
5. Install the engine mount bracket bolts.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

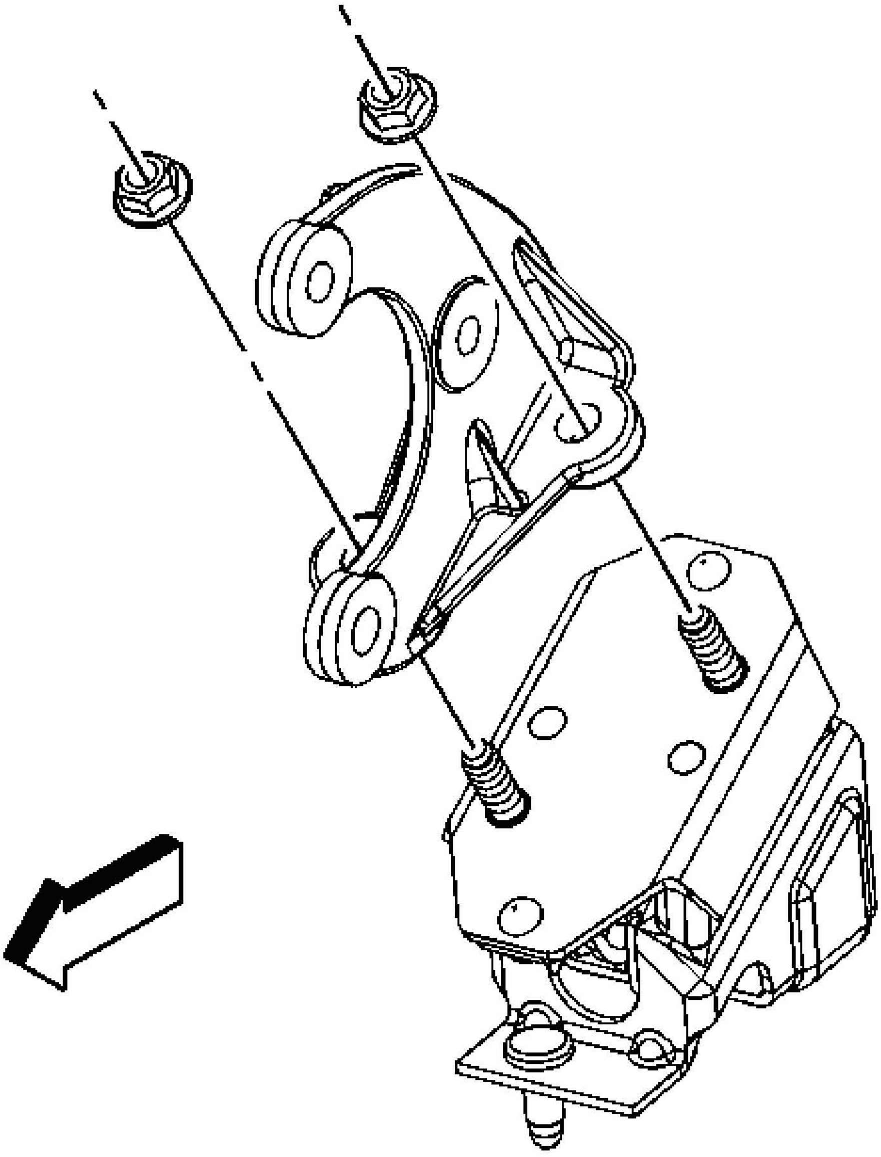

Fig. 58: Exploded View Of Right Engine Mount
Courtesy of GENERAL MOTORS CORP.

6. Using the engine support fixture, lower the engine.
7. Remove the engine support fixture.
8. Install the upper engine mount nuts.

Tighten: Tighten the nuts to 50 N.m (37 lb ft).

9. Install the right exhaust manifold. Refer to **Exhaust Manifold Replacement - Right (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Right (RPO LS4)** .
10. Install the engine mount strut. Refer to **Engine Mount Strut Replacement**.

ENGINE MOUNT BRACKET REPLACEMENT - RIGHT

Removal Procedure

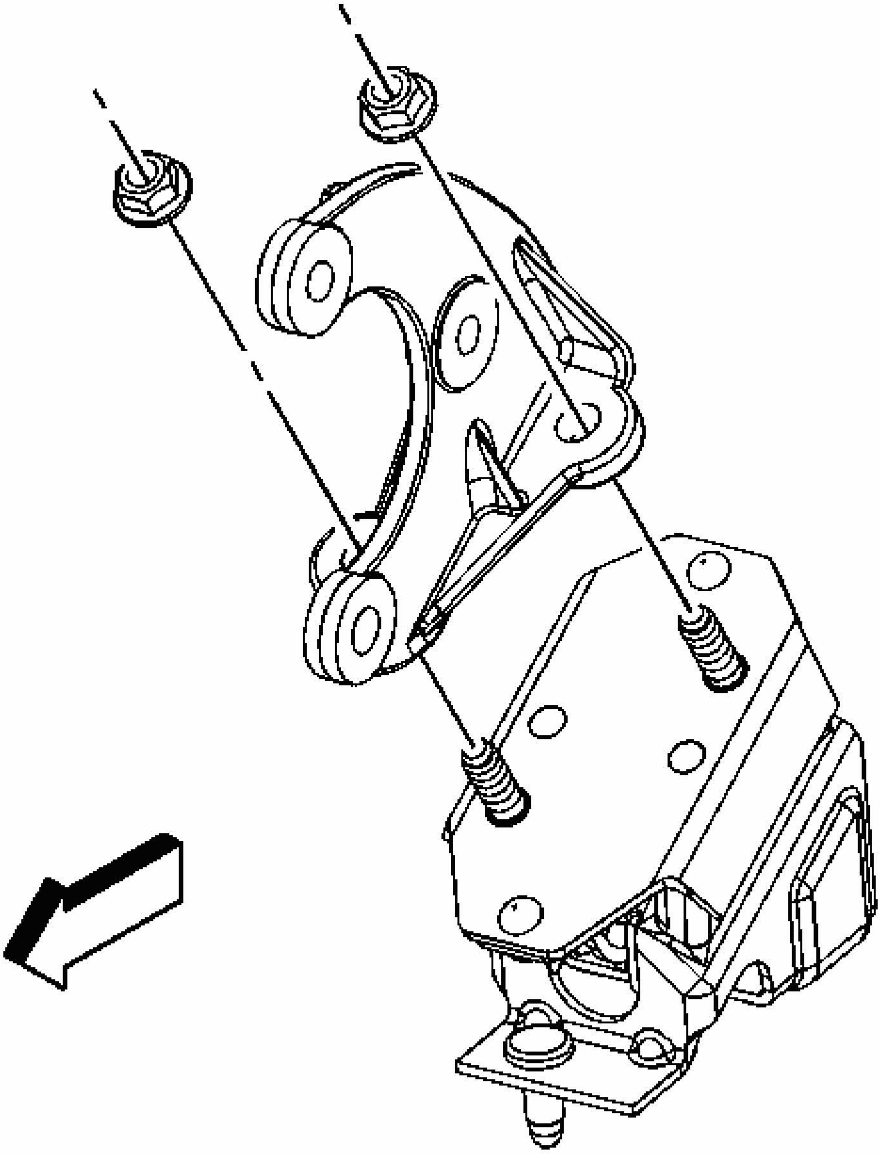

Fig. 59: Exploded View Of Right Engine Mount

Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount strut. Refer to **Engine Mount Strut Replacement**.
2. Remove the right exhaust manifold. Refer to **Exhaust Manifold Replacement - Right (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Right (RPO LS4)** .
3. Remove the upper engine mount nuts.
4. Install the engine support fixture. Refer to **Engine Support Fixture**.
5. Using the engine support fixture, raise the engine.

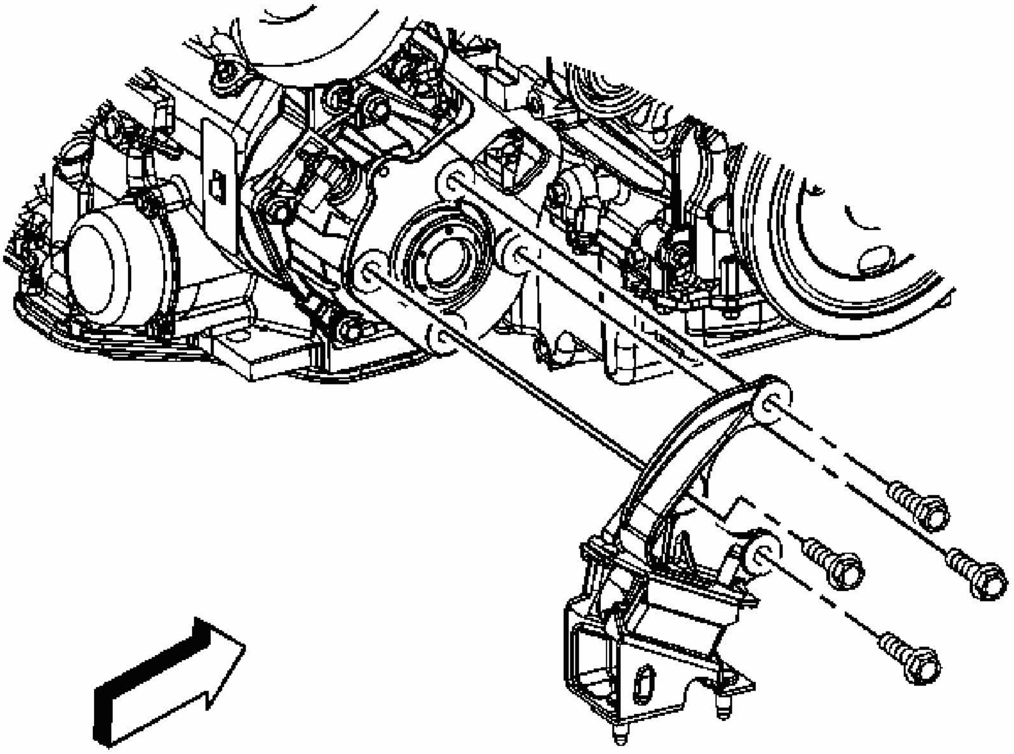

Fig. 60: View Of Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine mount bracket bolts.
7. Remove the engine mount bracket.

Installation Procedure

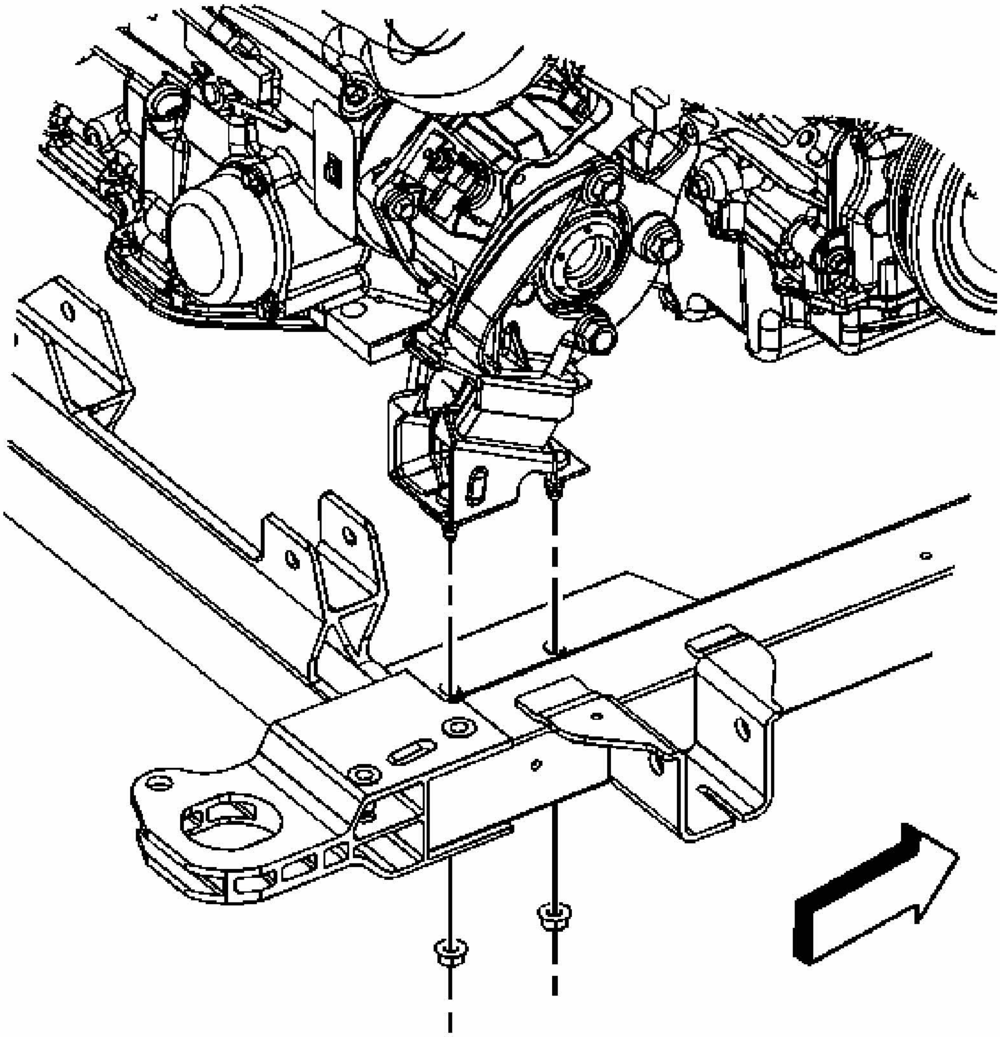

Fig. 61: View Of Engine Mount Bracket Nuts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

2. Install the lower engine mount nuts.

Tighten: Tighten the nuts to 50 N.m (37 lb ft).

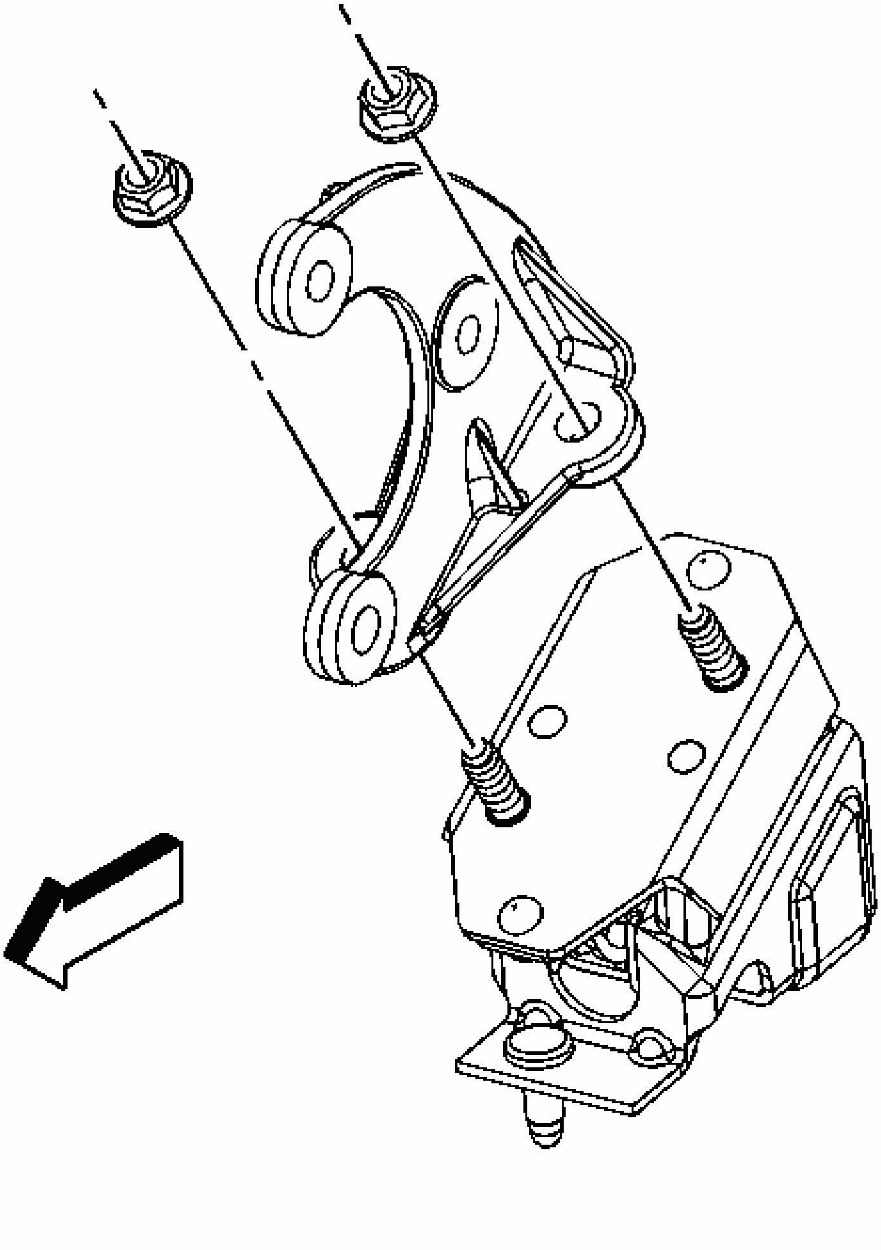

Fig. 62: Exploded View Of Right Engine Mount
Courtesy of GENERAL MOTORS CORP.

3. Using the engine support fixture, lower the engine.
4. Remove the engine support fixture.
5. Install the upper engine mount nuts.

Tighten: Tighten the nuts to 50 N.m (37 lb ft).

6. Install the right exhaust manifold. Refer to **Exhaust Manifold Replacement - Right (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Right (RPO LS4)** .
7. Install the engine mount strut. Refer to **Engine Mount Strut Replacement**.

ENGINE SIGHT SHIELD REPLACEMENT

Removal Procedure

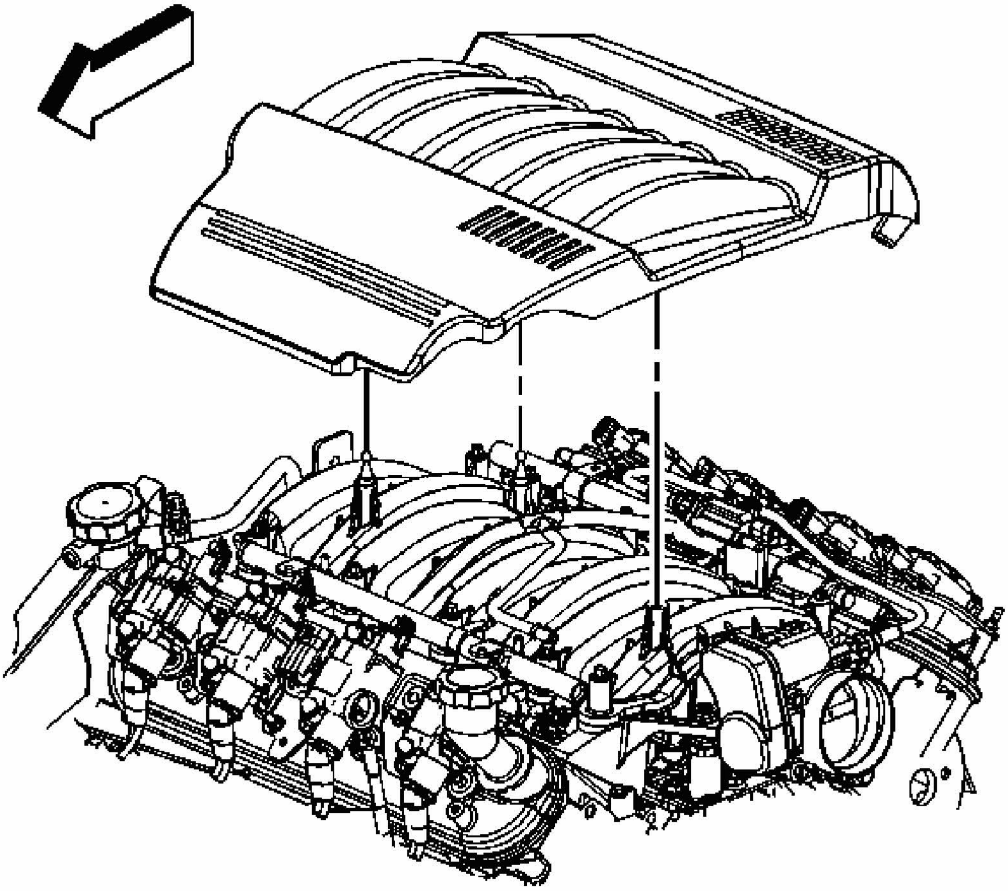

Fig. 63: View Of Sight Shield
Courtesy of GENERAL MOTORS CORP.

1. Pull up on the front and rear of the sight shield in order to disengage sight shield from the studs.
2. Remove the engine sight shield from the vehicle.

Installation Procedure

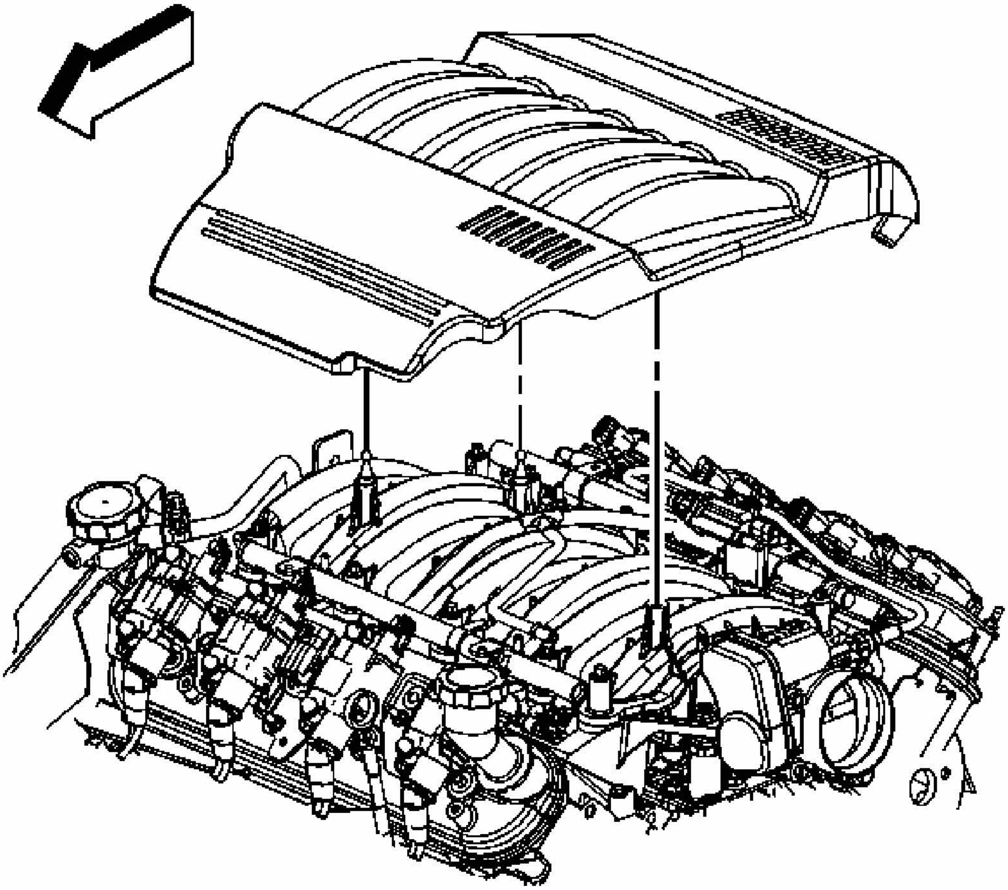

Fig. 64: View Of Sight Shield
Courtesy of GENERAL MOTORS CORP.

1. Align the sight shield to the studs on the intake manifold.
2. Push down in the 3 locations in order to secure the sight shield to the studs.

CRANKCASE VENTILATION HOSES/PIPES REPLACEMENT

Removal Procedure

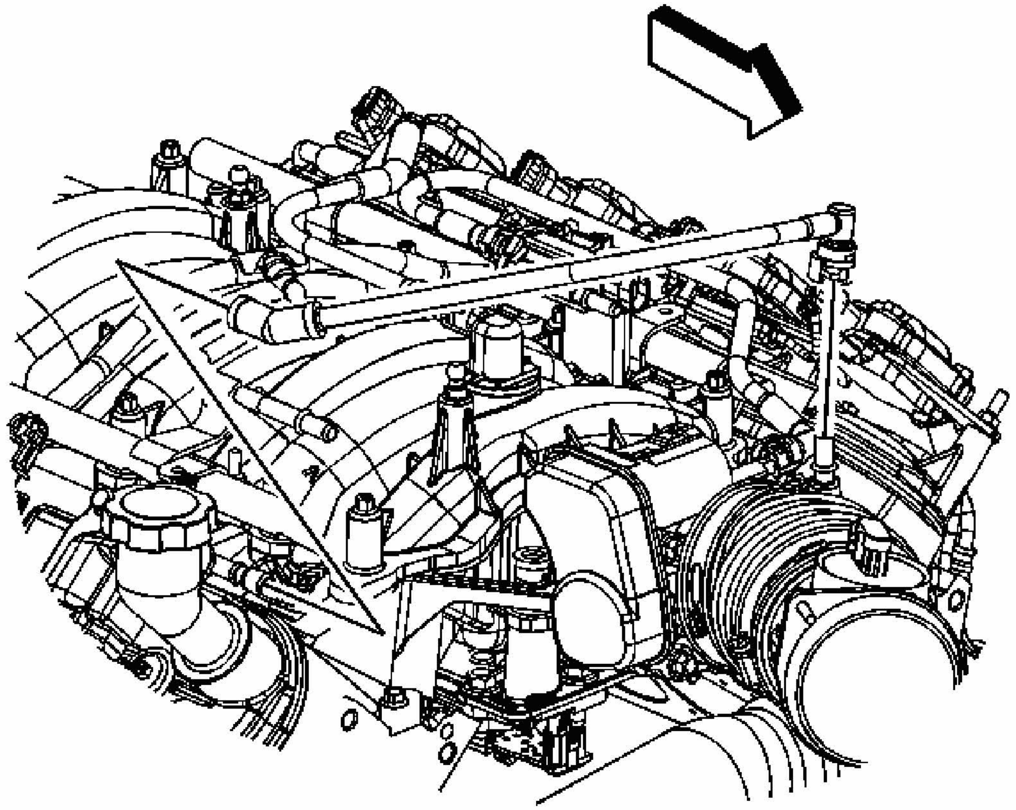

Fig. 65: View Of Positive Crankcase Ventilation (PCV) Clean Air Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement**.
2. If removing the positive crankcase ventilation (PCV) clean air tube perform the following:
    1. Remove the PCV clean air tube from the air intake duct.
    2. Remove the PCV clean air tube from the rocker arm cover.
    3. Remove the PCV clean air tube.

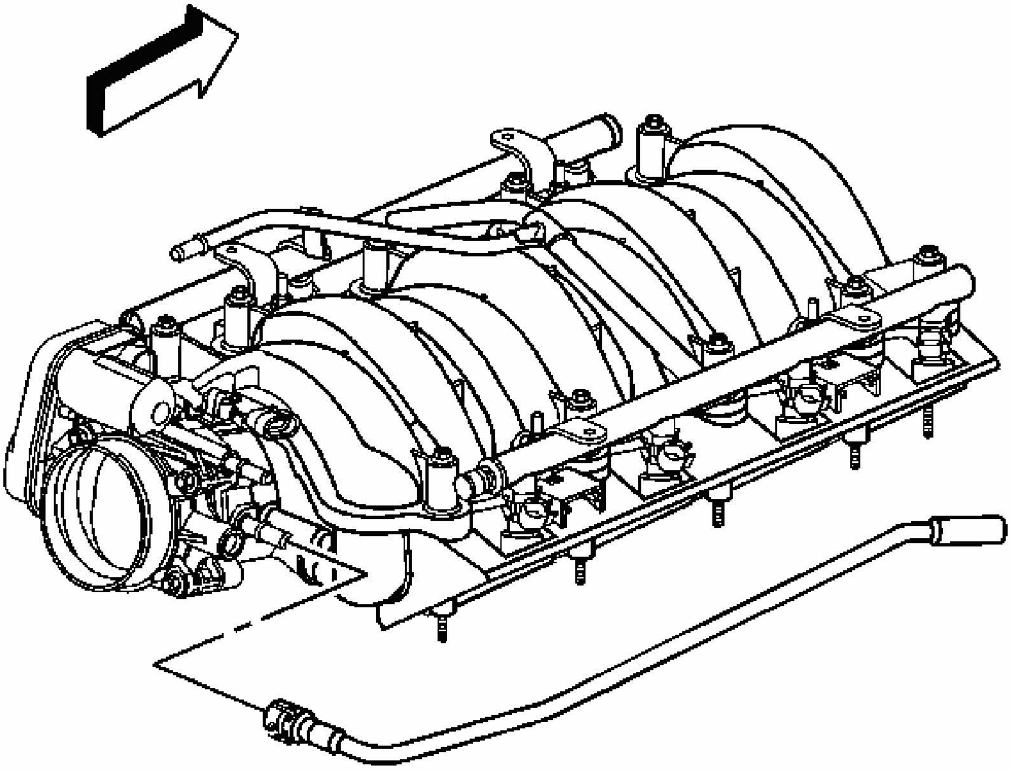

Fig. 66: View Of Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

3. If removing the PCV foul air tube perform the following:
    1. Remove the PCV foul air tube from the intake manifold.
    2. Remove the PCV foul air tube from the rocker arm cover.
    3. Remove the PCV foul air tube.

Installation Procedure

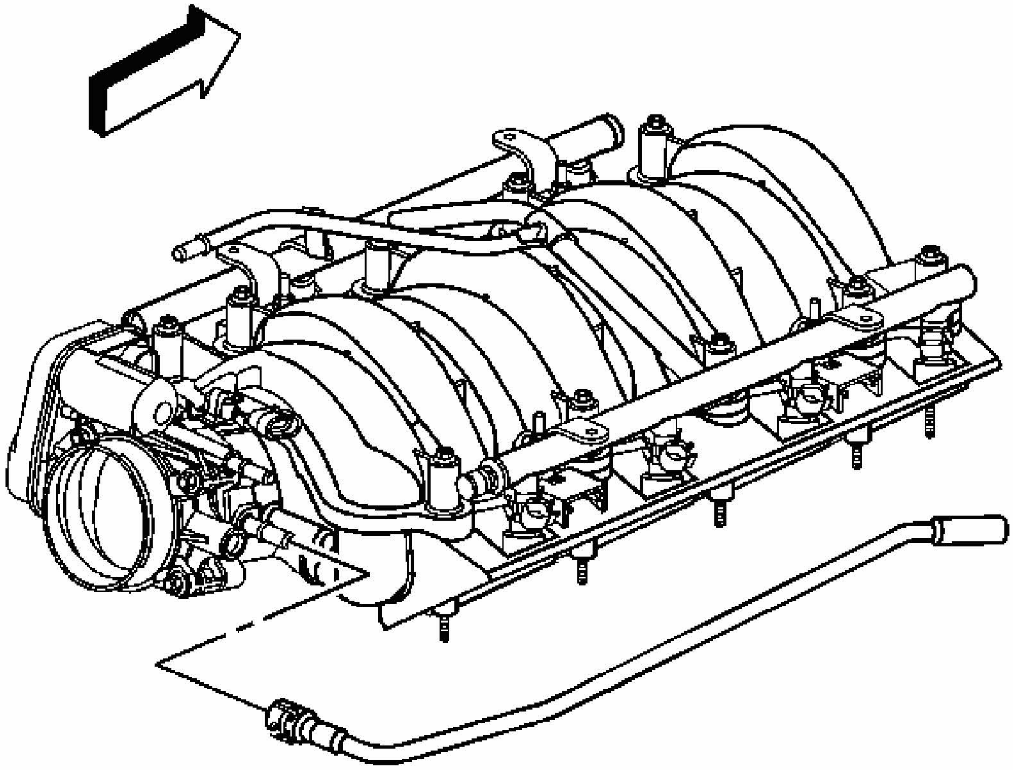

Fig. 67: View Of Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

1. If installing the PCV foul air tube perform the following:
    1. Install the PCV foul air tube.
    2. Install the PCV foul air tube to the rocker arm cover.
    3. Install the PCV foul air tube to the intake manifold.

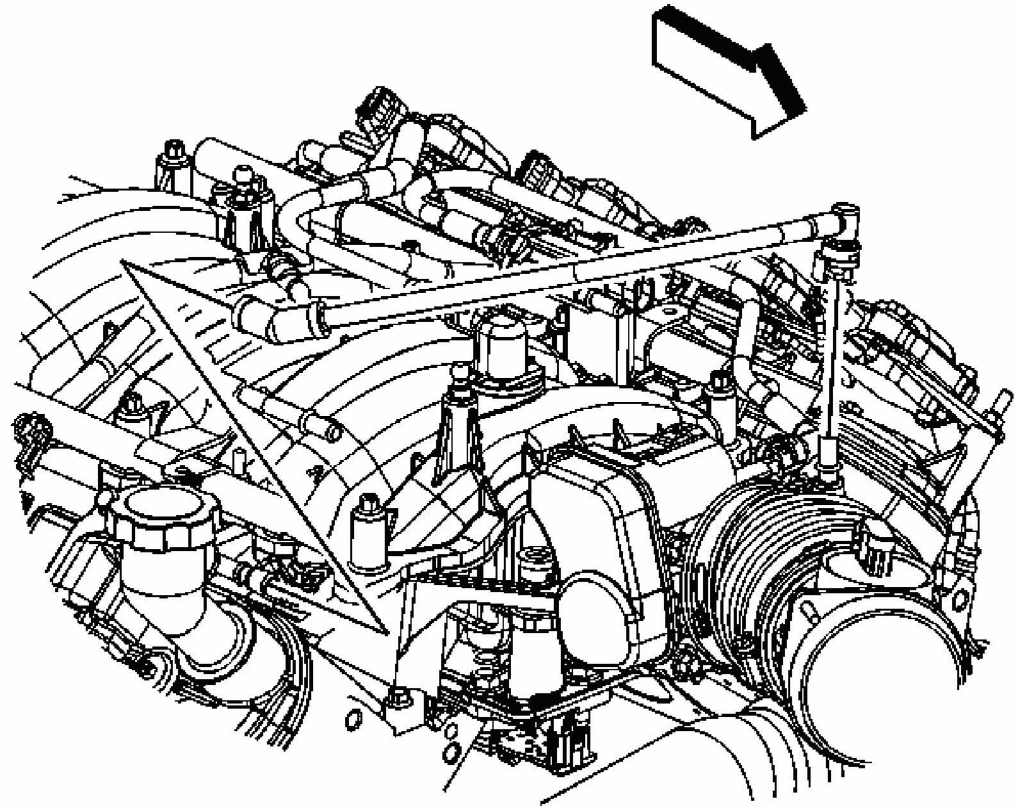

Fig. 68: View Of Positive Crankcase Ventilation (PCV) Clean Air Tube
Courtesy of GENERAL MOTORS CORP.

2. If installing the PCV clean air tube perform the following:
   1. Install the PCV clean air tube.
   2. Install the PCV clean air tube to the rocker arm cover.
   3. Install the PCV clean air tube to the air intake duct.
3. Install the engine sight shield. Refer to **Engine Sight Shield Replacement**.

VALVE LIFTER OIL FILTER REPLACEMENT

Removal Procedure

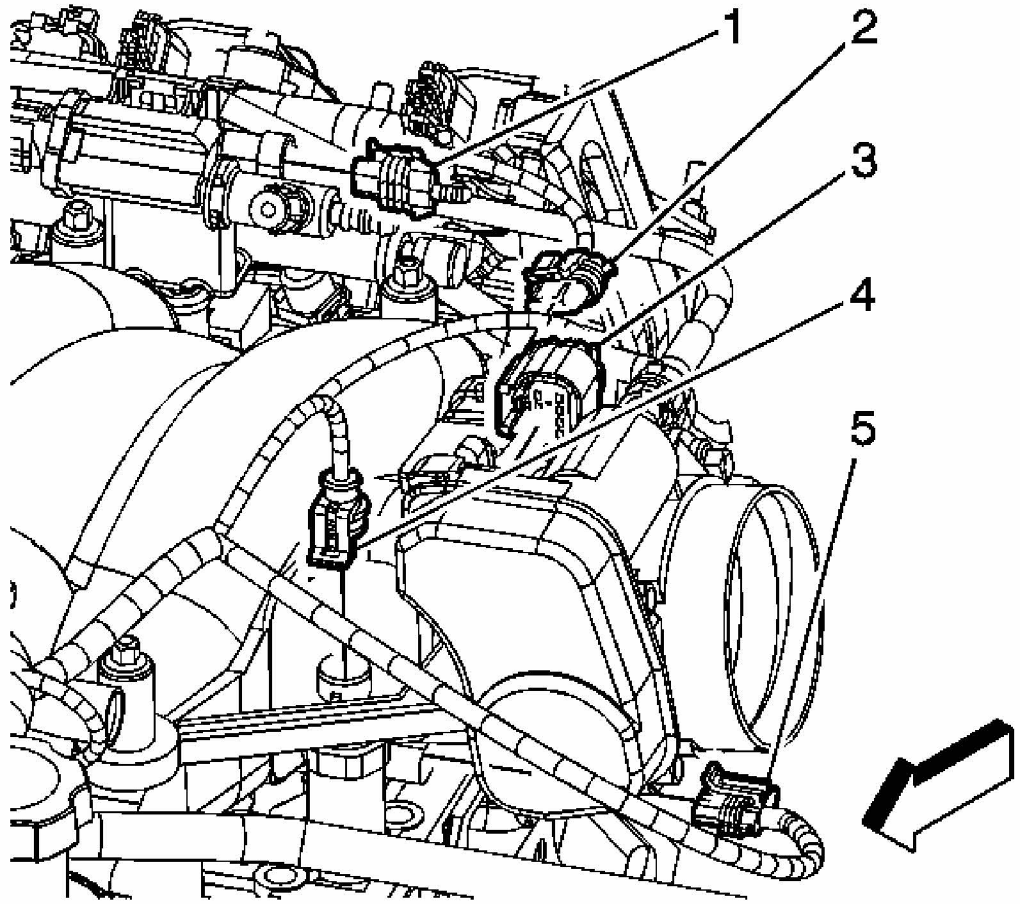

Fig. 69: View Of Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement**.
2. Disconnect the oil pressure sensor electrical connector (4).

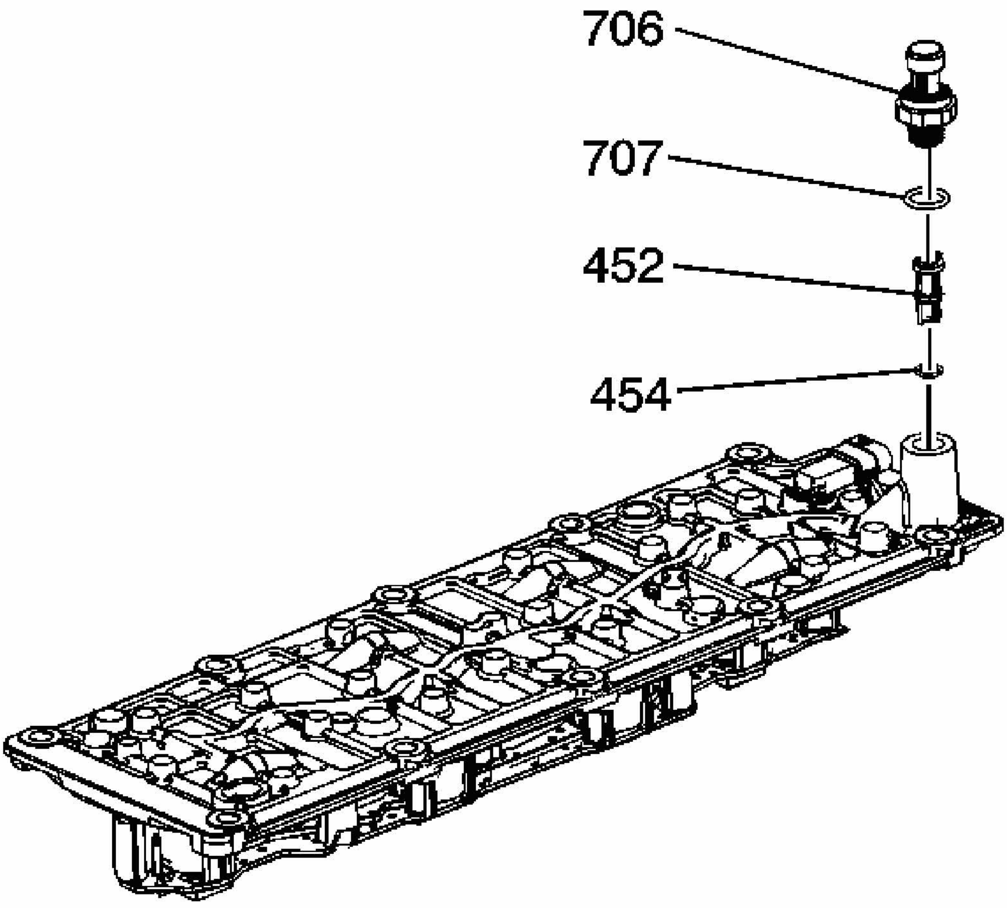

Fig. 70: View Of Oil Pressure Sensor, Washer And Valve Lifter Oil Filter
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not allow debris to enter the oil passages of the intake manifold.

3. Remove the oil pressure sensor (706) and washer (707).
4. Remove the oil filter (452) and O-ring seal (454).
5. Inspect the O-ring seal (454) for cuts or damage.
6. If the filter is plugged or the O-ring seal is cut or damaged, replace the filter and O-ring seal as an assembly.

Installation Procedure

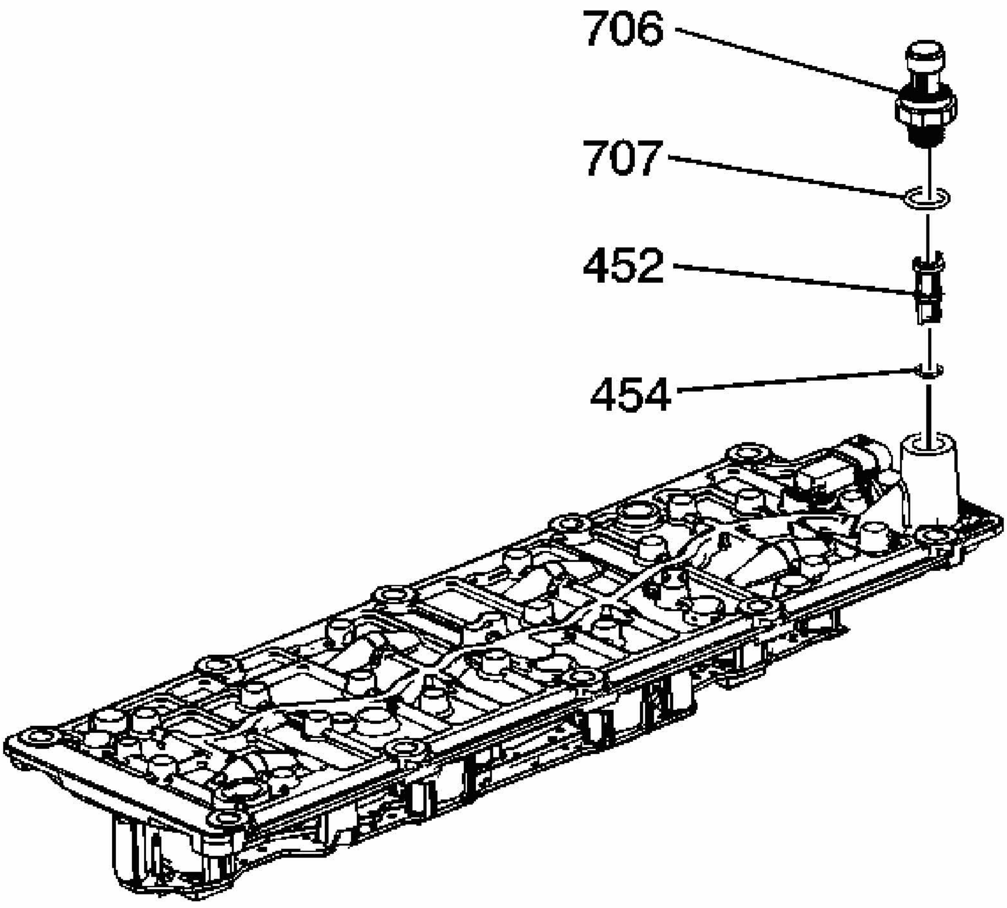

Fig. 71: View Of Oil Pressure Sensor, Washer And Valve Lifter Oil Filter
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW oil filter (452) and O-ring seal (454).
2. Apply sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent to the threads of the NEW oil pressure sensor.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

3. Install the oil pressure sensor (706) and washer (707).

Tighten: Tighten the sensor to 20 N.m (15 lb ft).

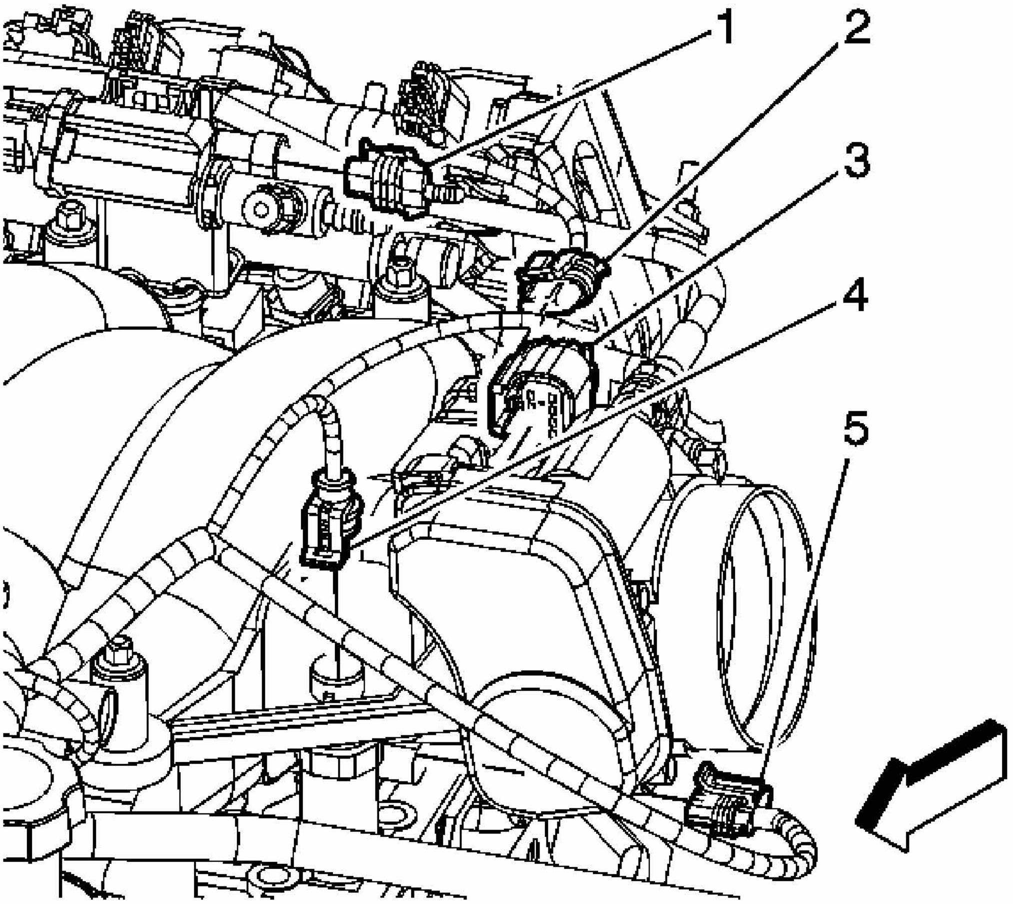

Fig. 72: View Of Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

4. Connect the oil pressure sensor electrical connector (4).
5. Install the engine sight shield. Refer to **Engine Sight Shield Replacement**.

INTAKE MANIFOLD REPLACEMENT

Removal Procedure

IMPORTANT: The intake manifold, throttle body, fuel rail, and injectors may be removed as an assembly. If not servicing the individual components, remove the manifold as a complete assembly.

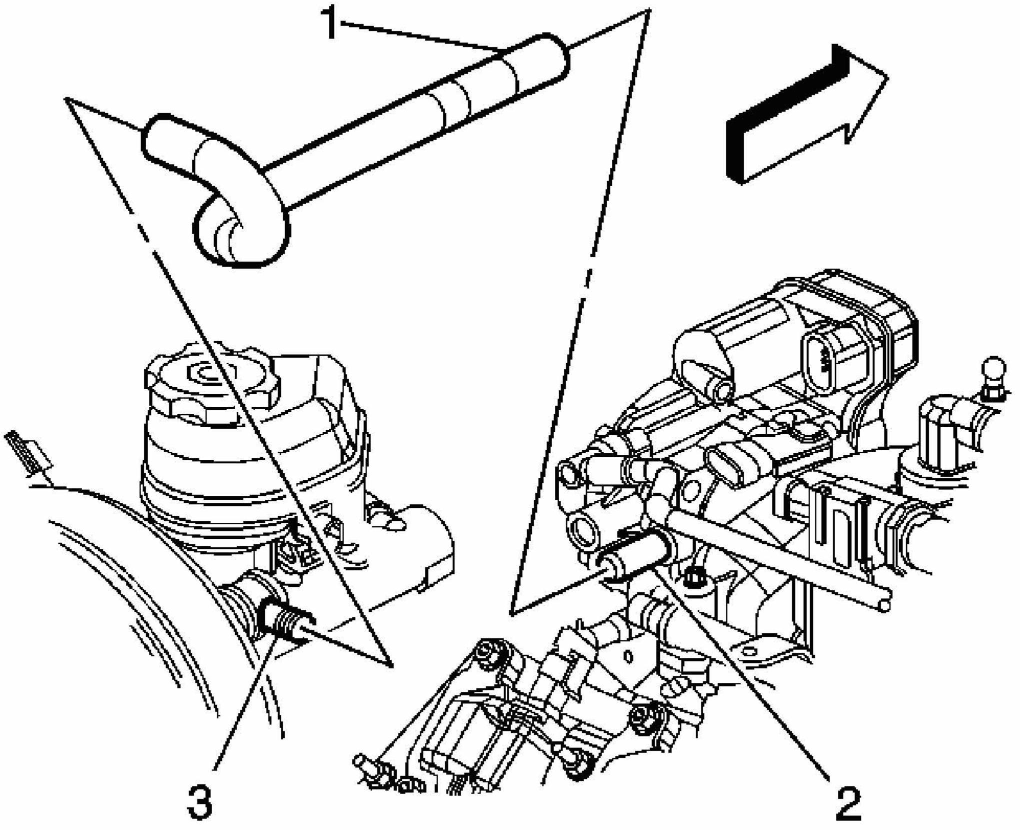

Fig. 73: View Of Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

1. Remove the throttle body. Refer to **Throttle Body Assembly Replacement** .
2. Remove the fuel injectors. Refer to **Fuel Injector Replacement** .
3. Remove the brake booster vacuum hose (1) from the intake manifold (2) and the booster check valve (3).

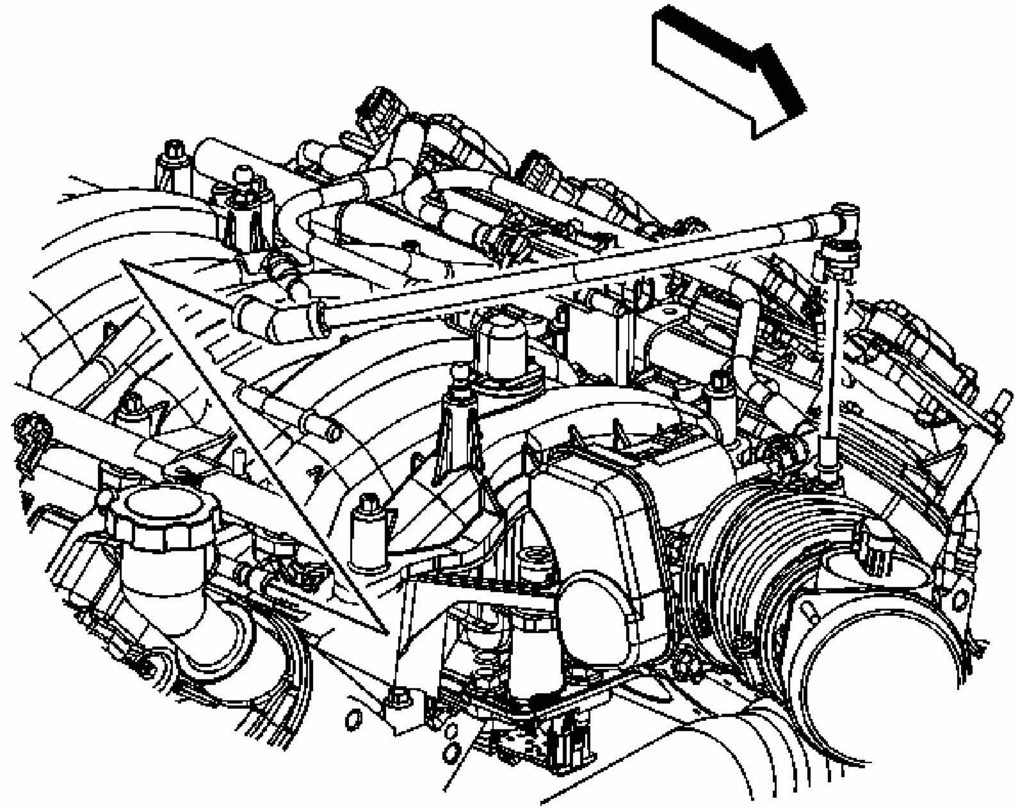

Fig. 74: View Of Positive Crankcase Ventilation (PCV) Clean Air Tube
Courtesy of GENERAL MOTORS CORP.

4. Remove the positive crankcase ventilation (PCV) clean air tube from the air intake duct and valve rocker arm cover. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

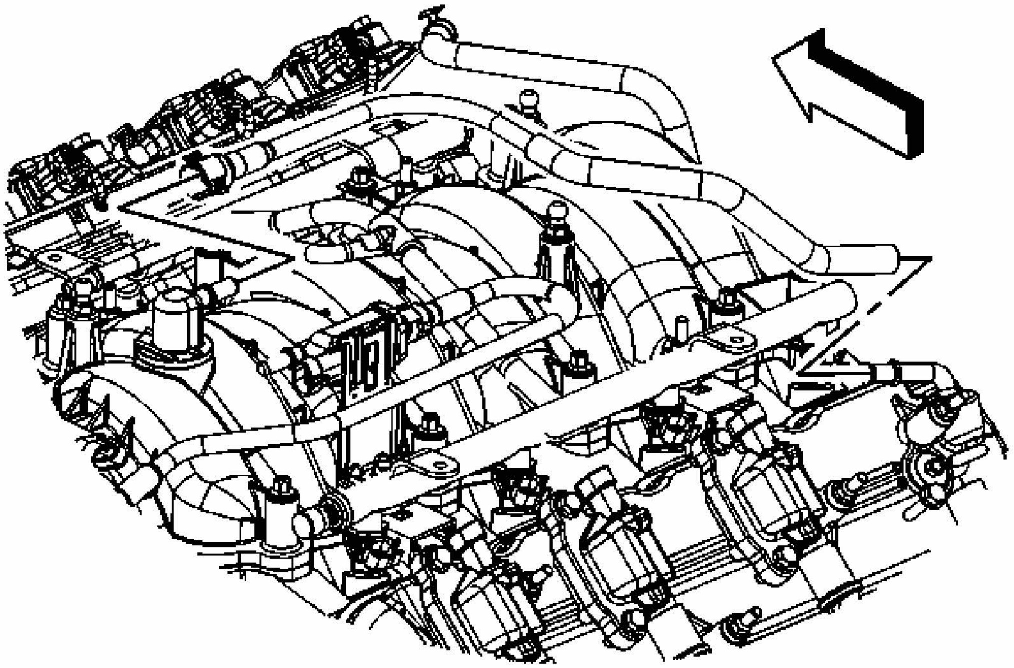

Fig. 75: PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Remove the PCV foul air tube from the intake manifold and valve rocker arm cover. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

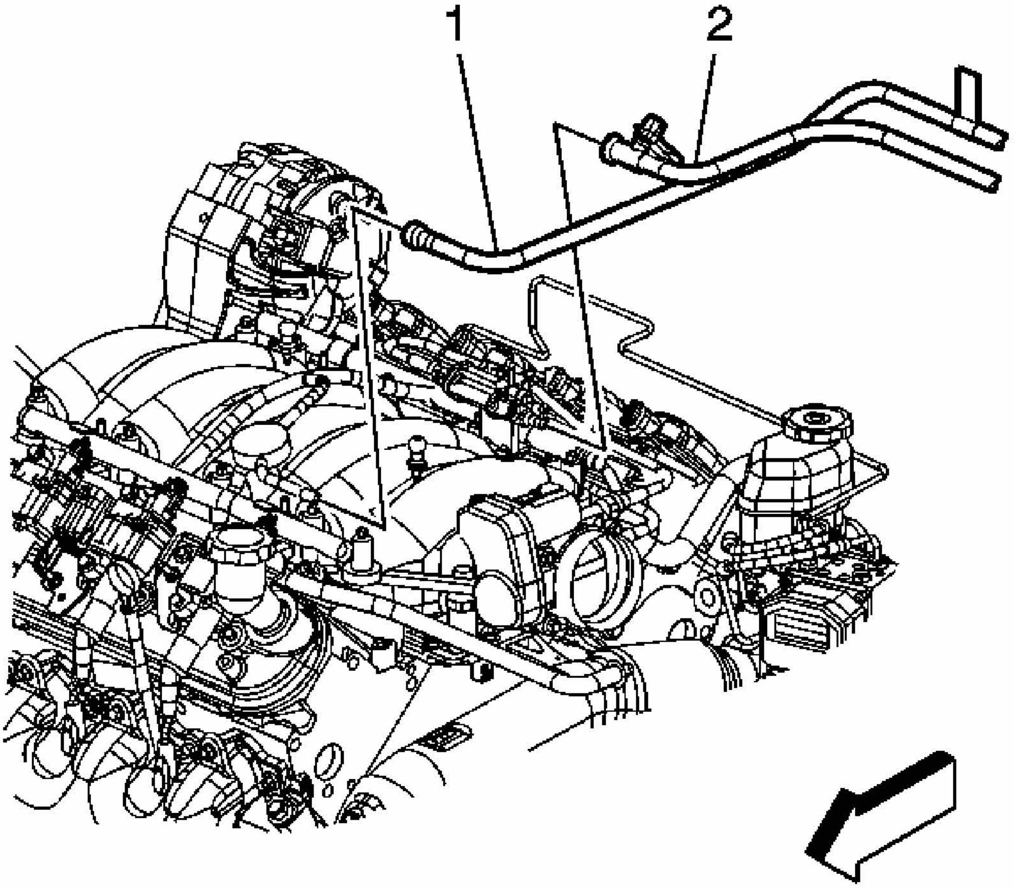

Fig. 76: View Of Fuel Feed Line & Evaporative Emission (EVAP) Line
Courtesy of GENERAL MOTORS CORP.

6. Remove the evaporative emission (EVAP) purge solenoid tube (2) from the solenoid and reposition. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

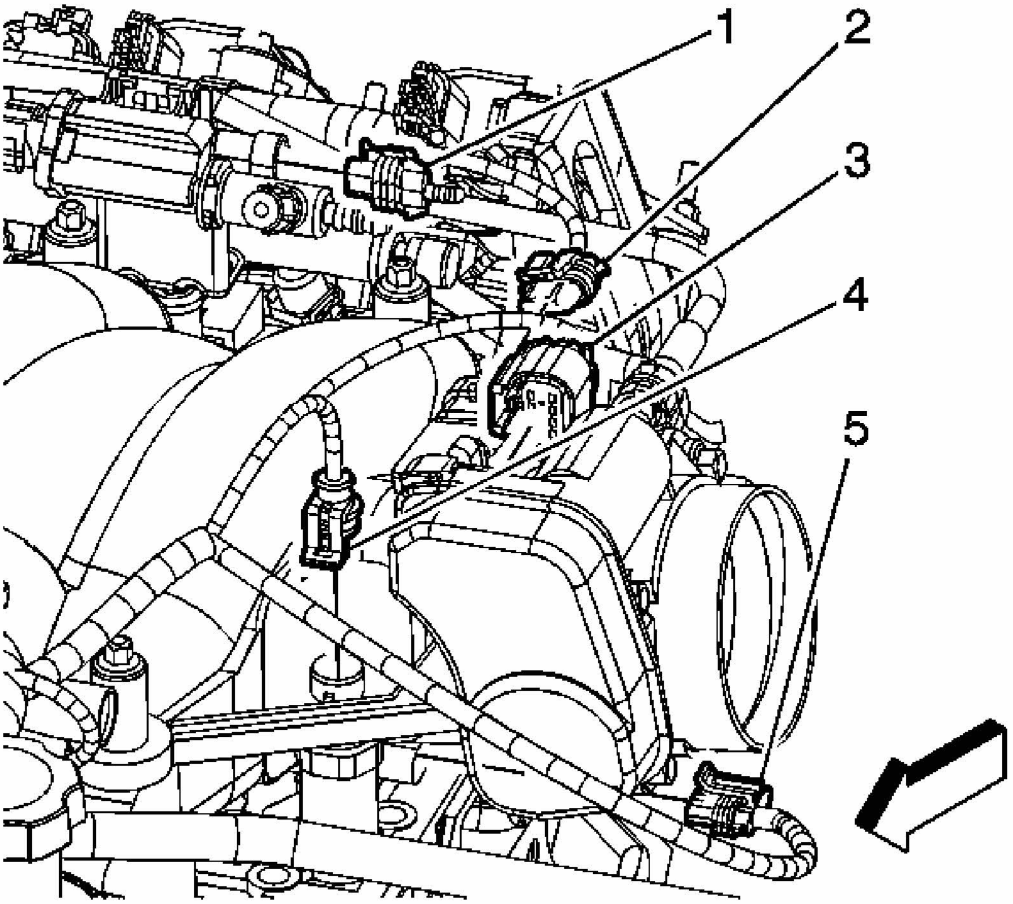

Fig. 77: View Of Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the following electrical connectors:
    - EVAP purge solenoid (1)
    - Manifold absolute pressure (MAP) sensor (2)
    - Oil pressure sensor (4)
    - Valve lifter oil manifold (5)

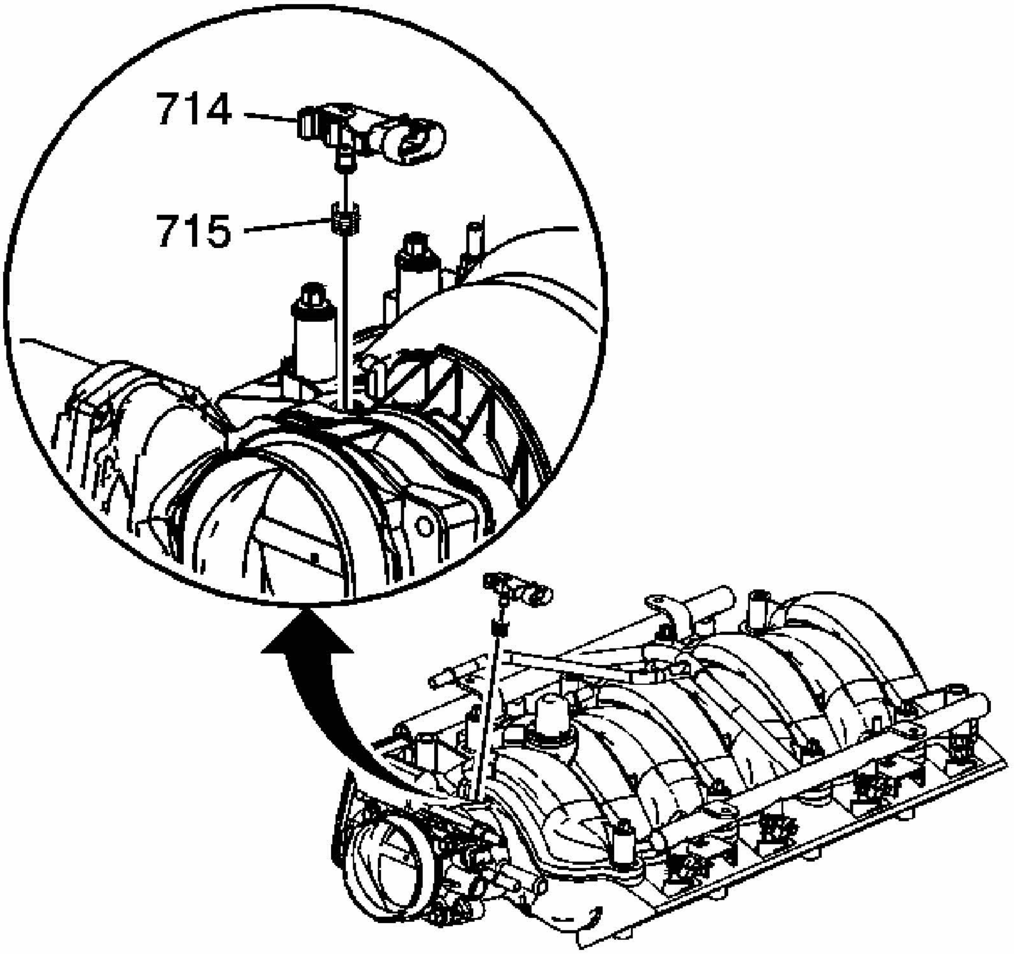

Fig. 78: View Of MAP Sensor
Courtesy of GENERAL MOTORS CORP.

8. Remove the MAP sensor (714) from the intake manifold.

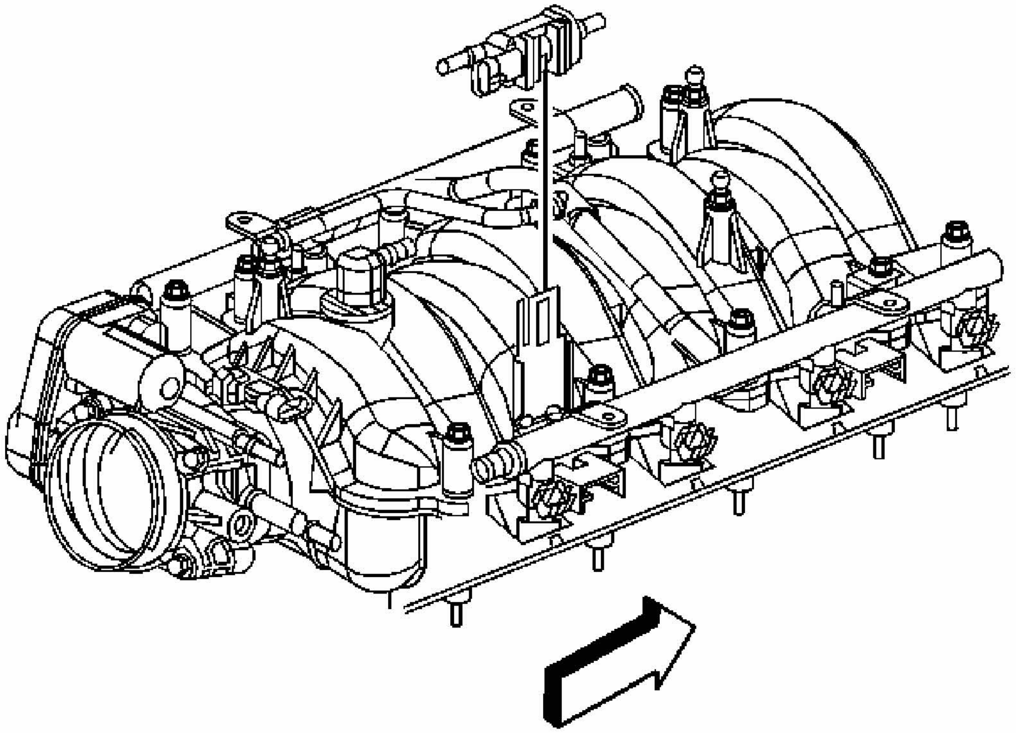

Fig. 79: EVAP Purge Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

9. Remove the EVAP purge solenoid valve and bracket.

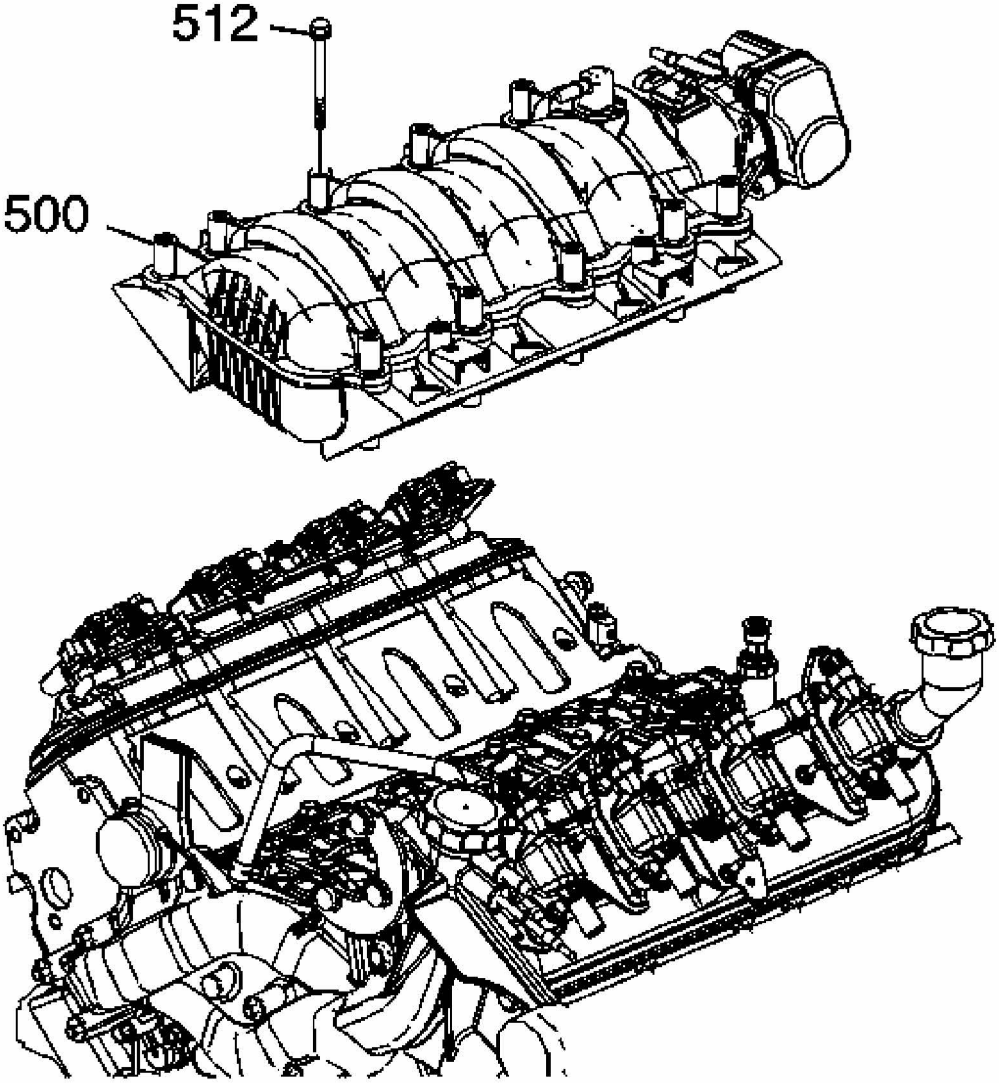

Fig. 80: View Of The Intake Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove the intake manifold bolts (512).
11. Remove the intake manifold (500).

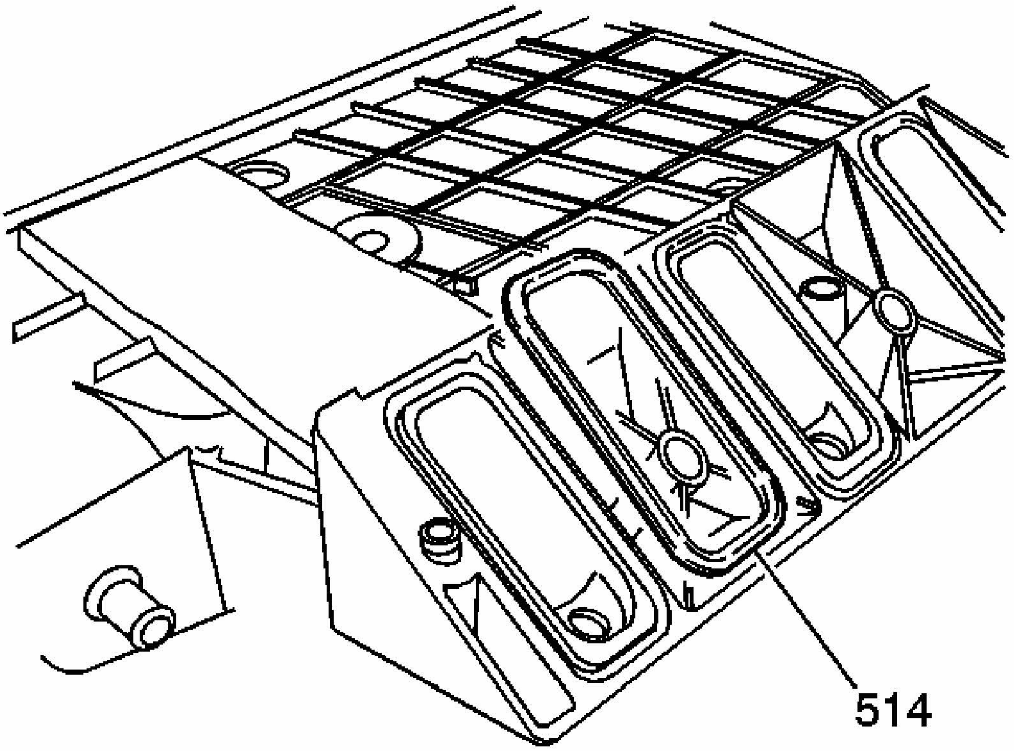

Fig. 81: View Of Intake Manifold-To-Cylinder Head Gaskets
Courtesy of GENERAL MOTORS CORP.

12. Remove and discard the intake manifold gaskets (514).

Installation Procedure

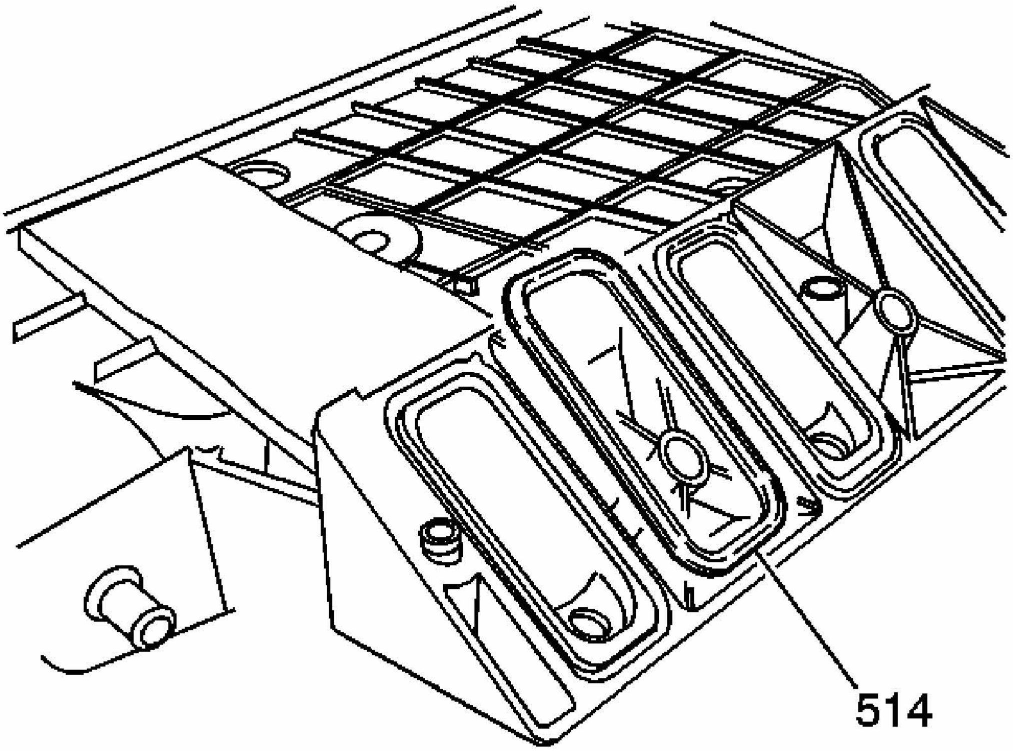

Fig. 82: View Of Intake Manifold-To-Cylinder Head Gaskets
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW intake manifold gaskets (514).

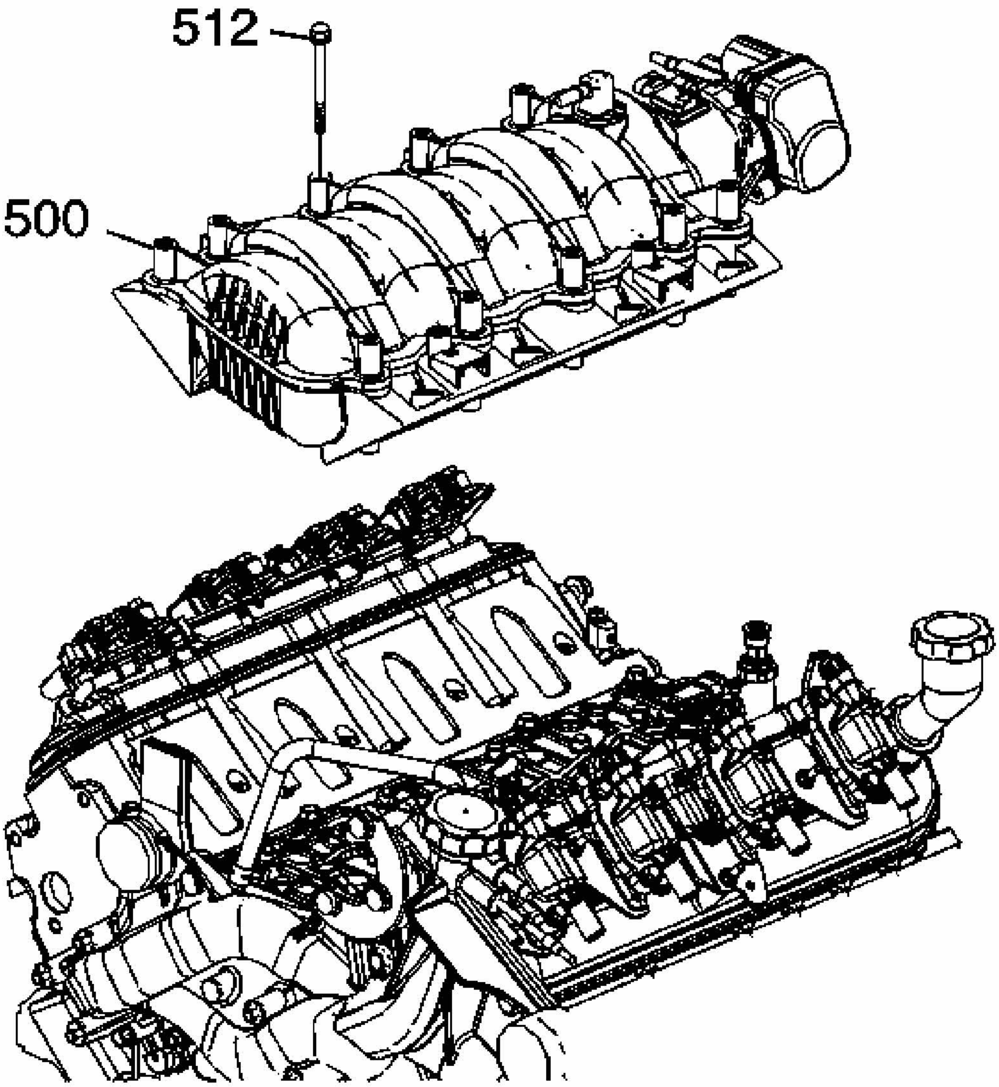

Fig. 83: View Of The Intake Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the intake manifold (500).
3. Apply a band of threadlock GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the threads of the intake manifold bolts (512).

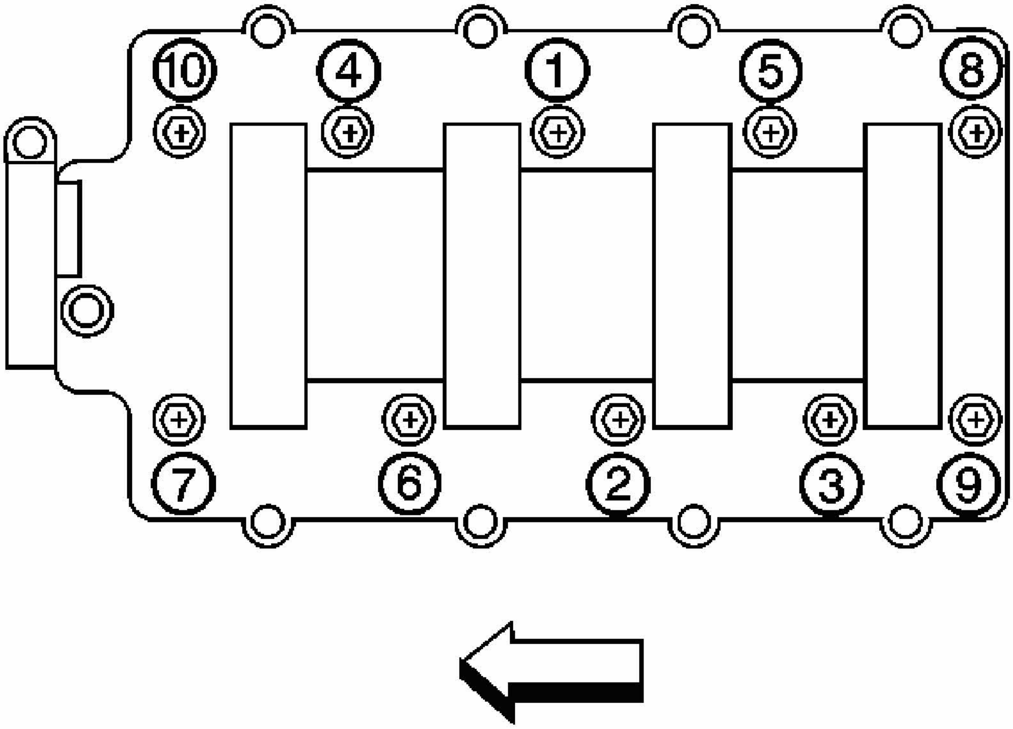

Fig. 84: Identifying Intake Manifold Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

4. Install the intake manifold bolts.

Tighten:

- Tighten the bolts a first pass in sequence to 5 N.m (44 lb in).
- Tighten the bolts a first pass in sequence to 10 N.m (89 lb in).

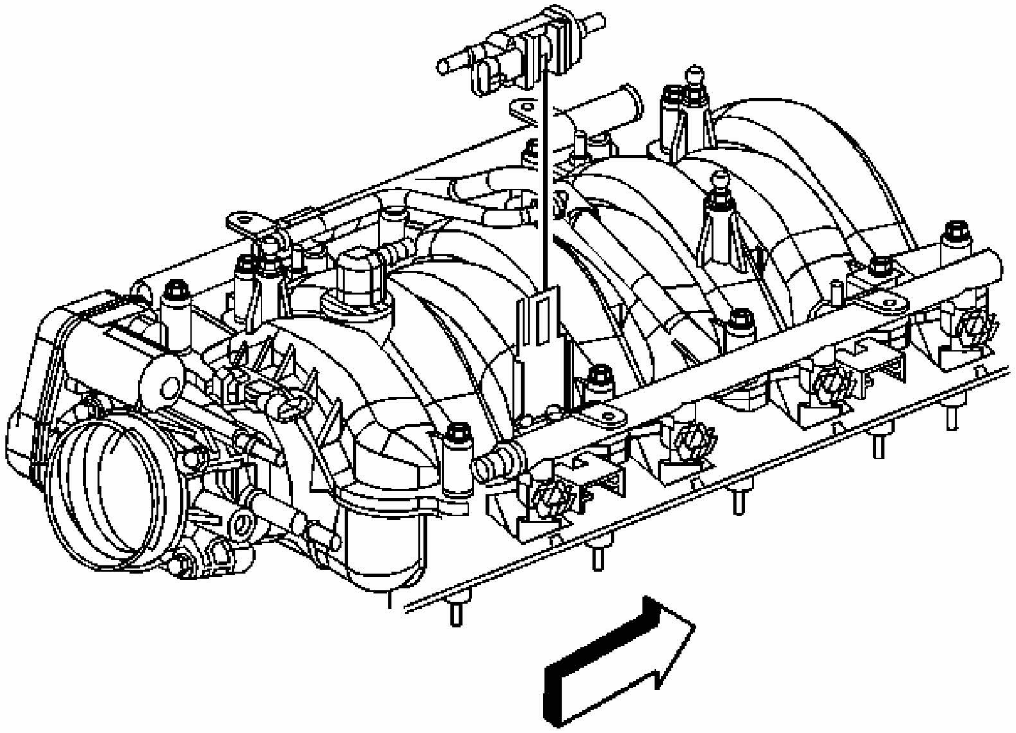

Fig. 85: EVAP Purge Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

5. Install the EVAP purge solenoid bracket and solenoid.

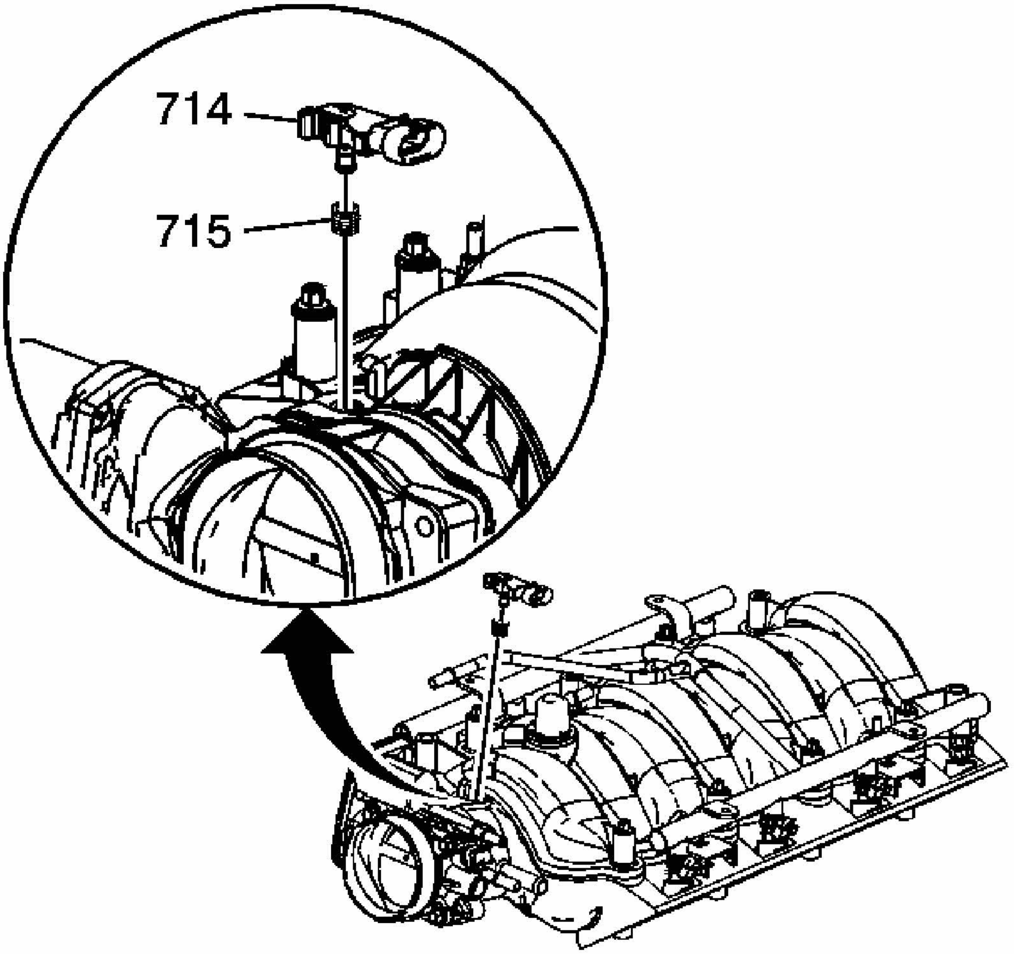

Fig. 86: View Of MAP Sensor
Courtesy of GENERAL MOTORS CORP.

6. Install the MAP sensor (714) to the intake manifold.

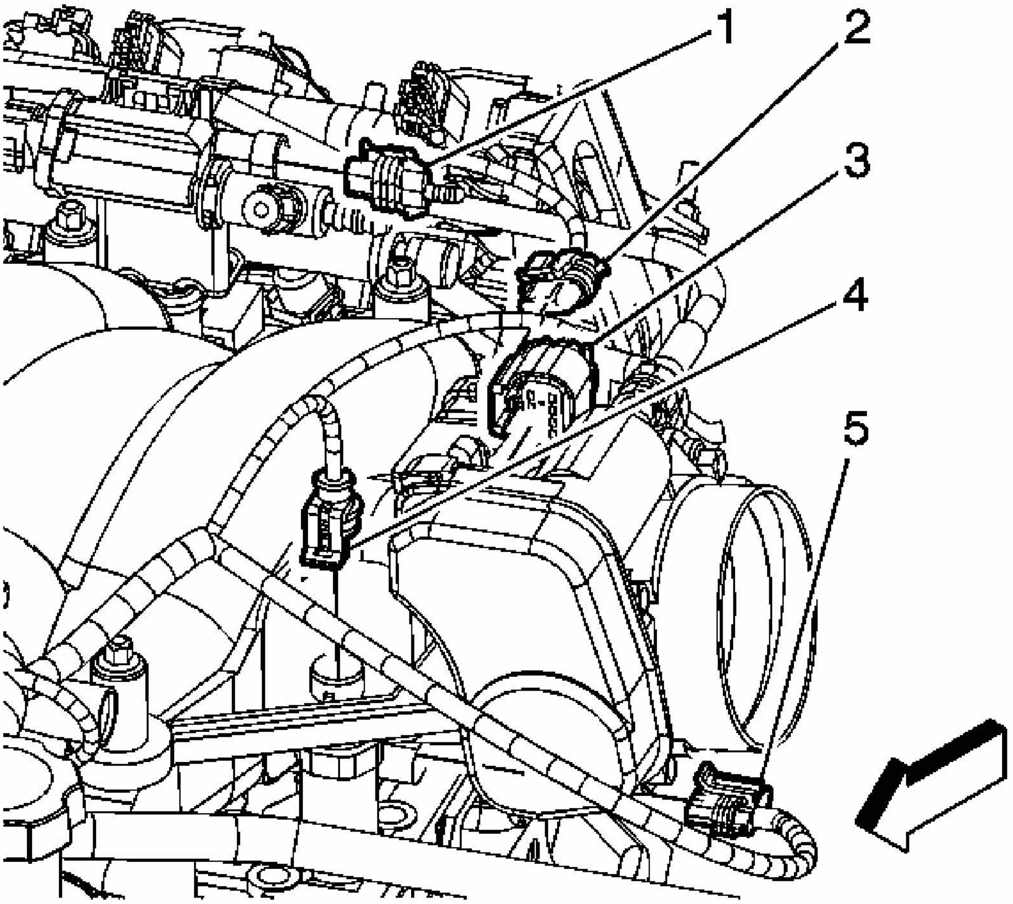

Fig. 87: View Of Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

7. Connect the following electrical connectors:
    - EVAP purge solenoid (1)
    - MAP sensor (2)
    - Oil pressure sensor (4)
    - Valve lifter oil manifold (5)

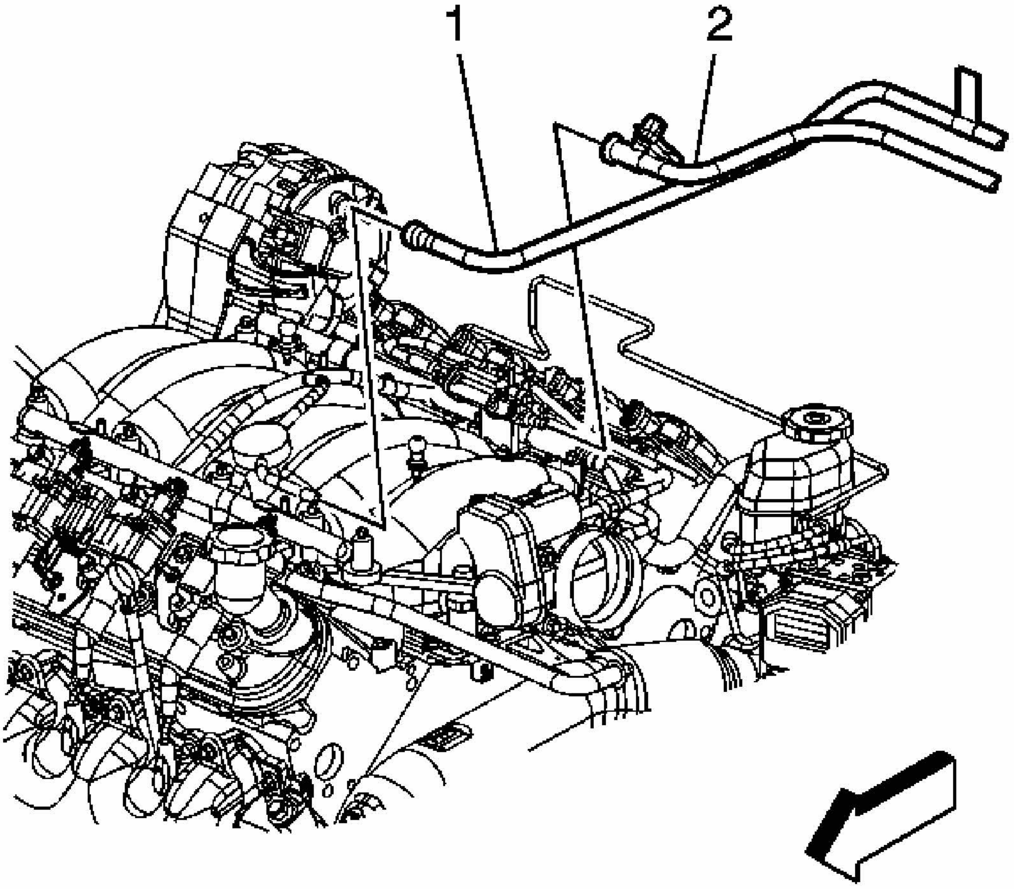

Fig. 88: View Of Fuel Feed Line & Evaporative Emission (EVAP) Line
Courtesy of GENERAL MOTORS CORP.

8. Position and install the EVAP purge solenoid tube (2) to the solenoid. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

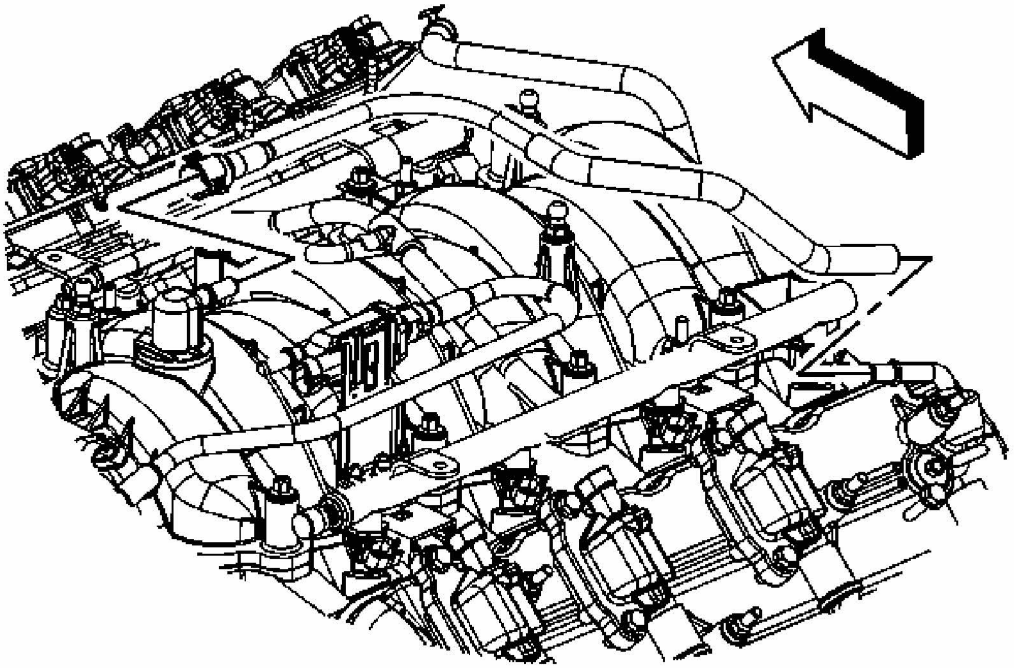

Fig. 89: PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

9. Install the PCV foul air tube to the intake manifold and valve rocker arm cover. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

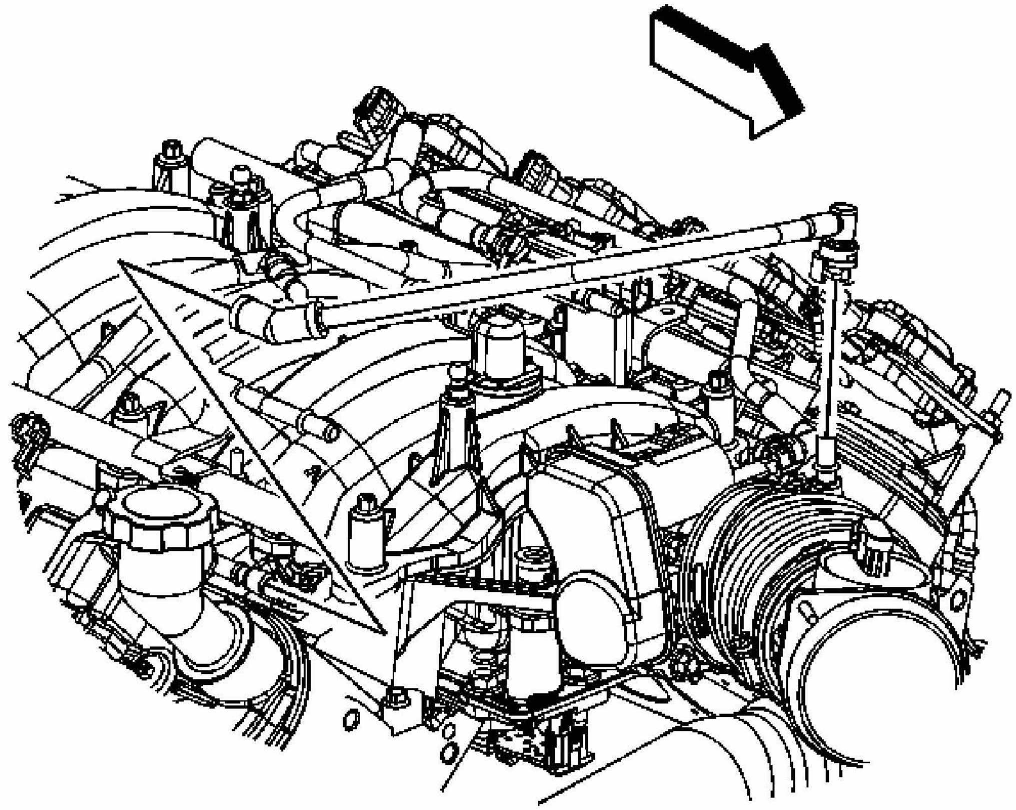

Fig. 90: View Of Positive Crankcase Ventilation (PCV) Clean Air Tube
Courtesy of GENERAL MOTORS CORP.

10. Install the PCV clean air tube to the air intake duct and valve rocker arm cover. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

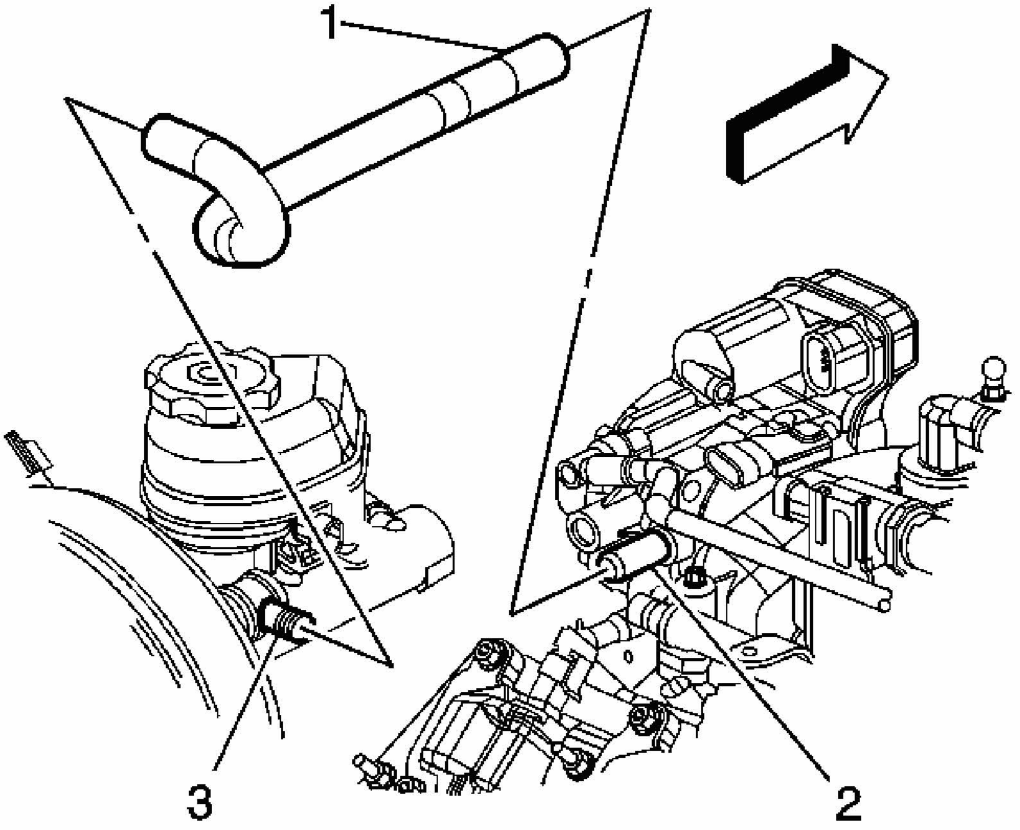

Fig. 91: View Of Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

11. Install the brake booster vacuum hose (1) to the intake manifold (2) and the booster check valve (3).
12. Install the fuel injectors. Refer to **Fuel Injector Replacement** .
13. Install the throttle body. Refer to **Throttle Body Assembly Replacement** .

VALVE LIFTER OIL MANIFOLD REPLACEMENT

Removal Procedure

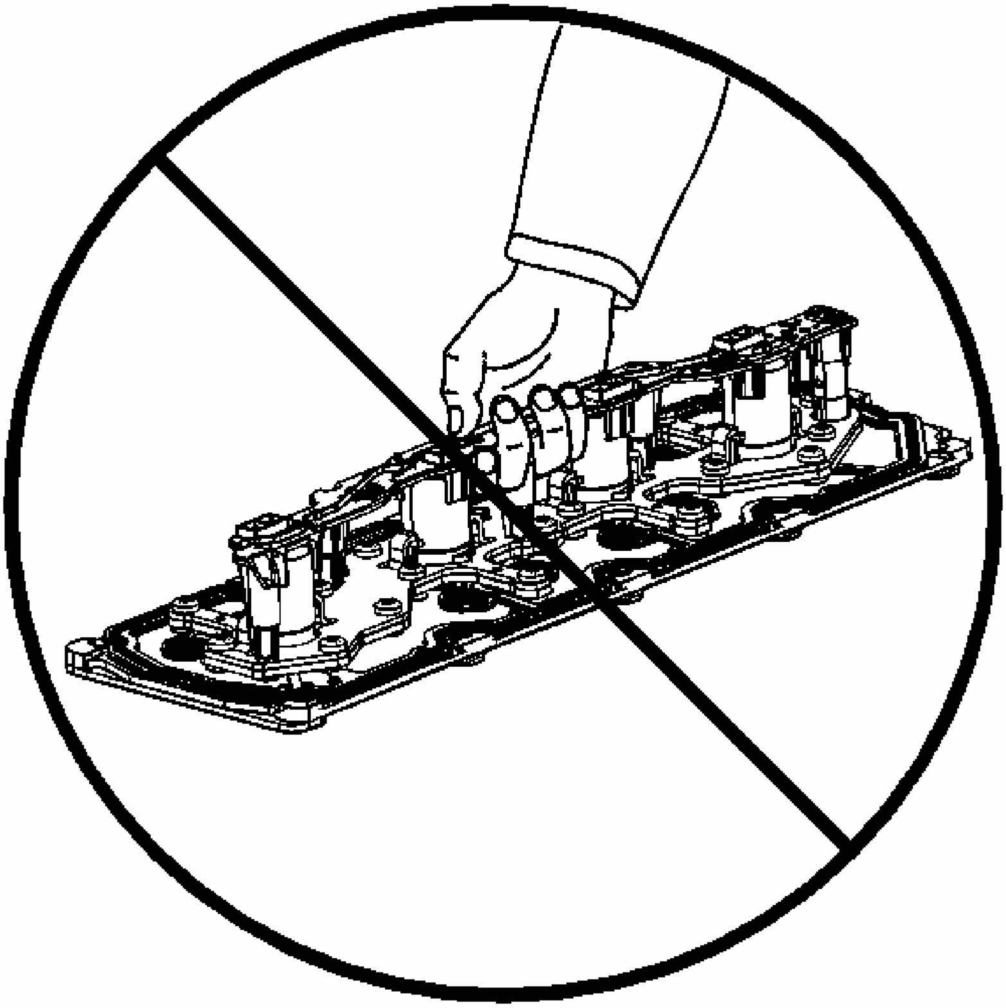

Fig. 92: Valve Lifter Oil Manifold
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
2. Do not lift the manifold assembly by the electrical lead frame.

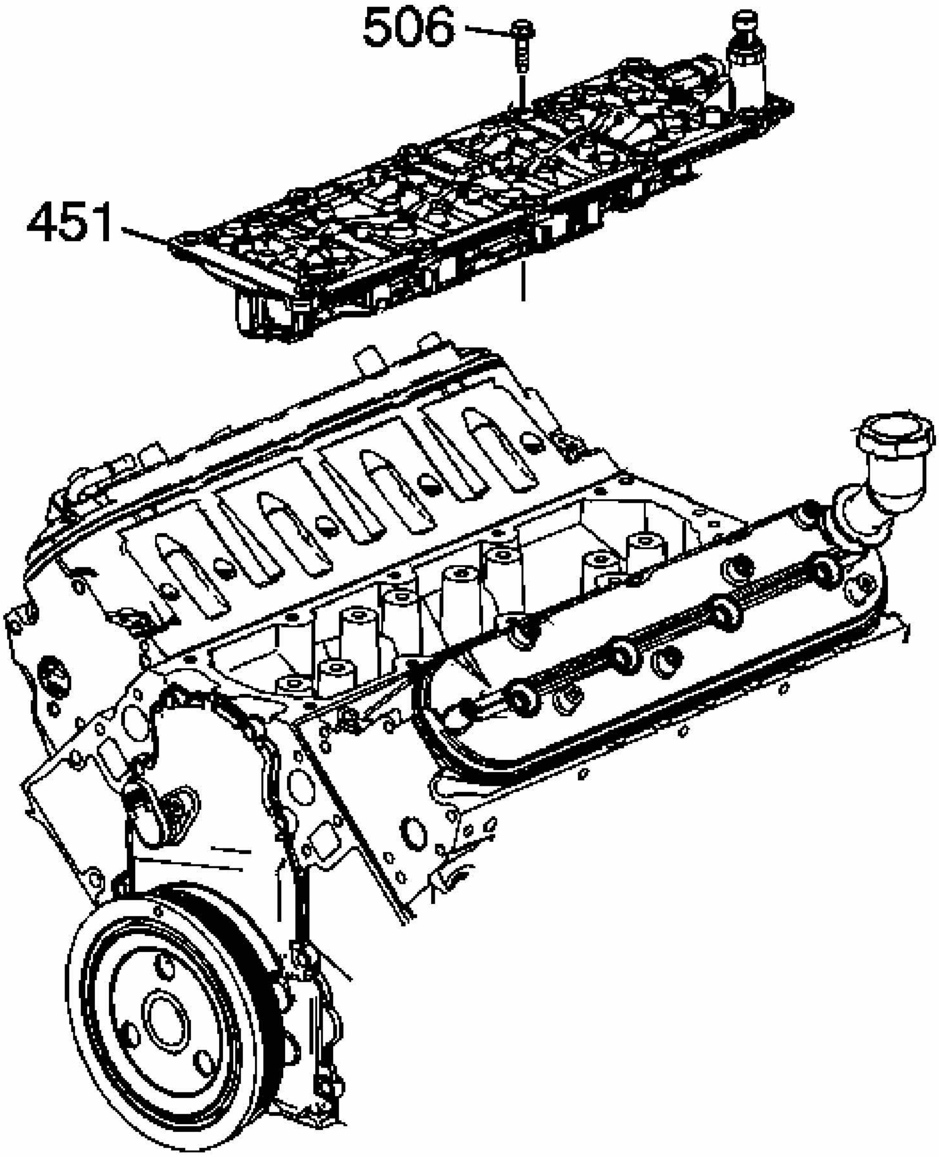

Fig. 93: View Of Valve Lifter Oil Manifold & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the valve lifter oil manifold bolts (506).

IMPORTANT: Do not allow dirt or debris to enter the oil passages of the manifold. Plug as required.

4. Remove the valve lifter oil manifold (451).

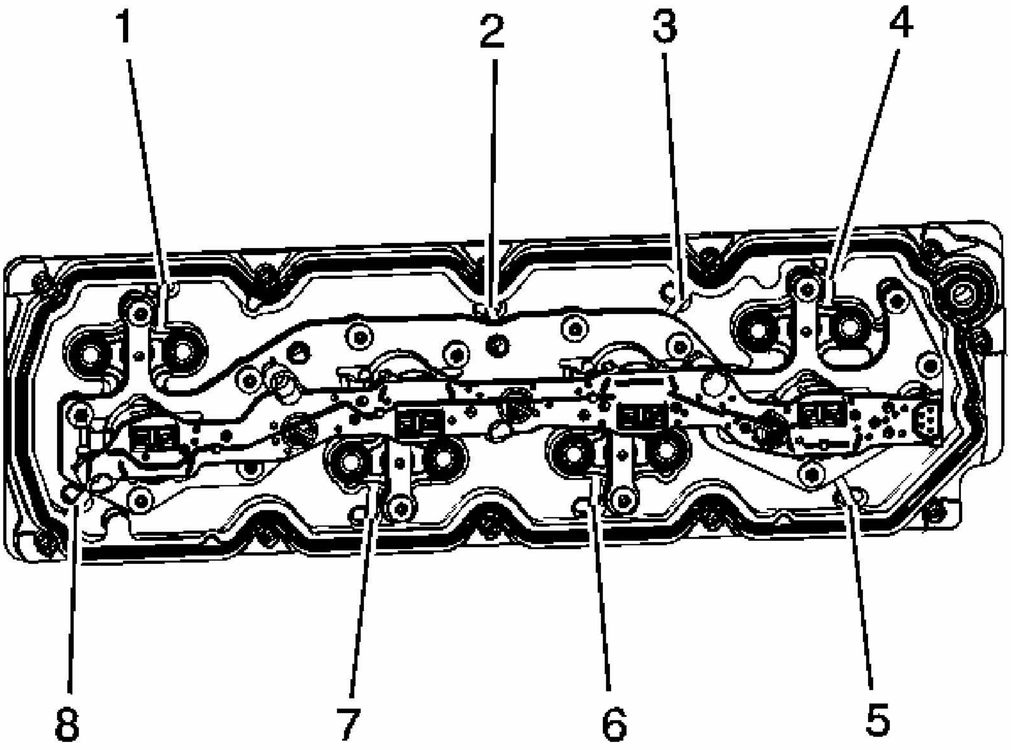

Fig. 94: Gasket Retaining Strap Locations
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Remove only the outer gasket from the manifold. Do not disassemble any of the internal components of the manifold in an attempt to remove the eight inner sealing gaskets. If the inner gaskets are cut or damaged, replace the manifold as an assembly. Only use a wire-cutter type tool in order to minimize the amount of debris. Do not use a rotary-type cutting tool on the retaining straps.

5. Identify the 8 gasket retaining strap locations (1-8).

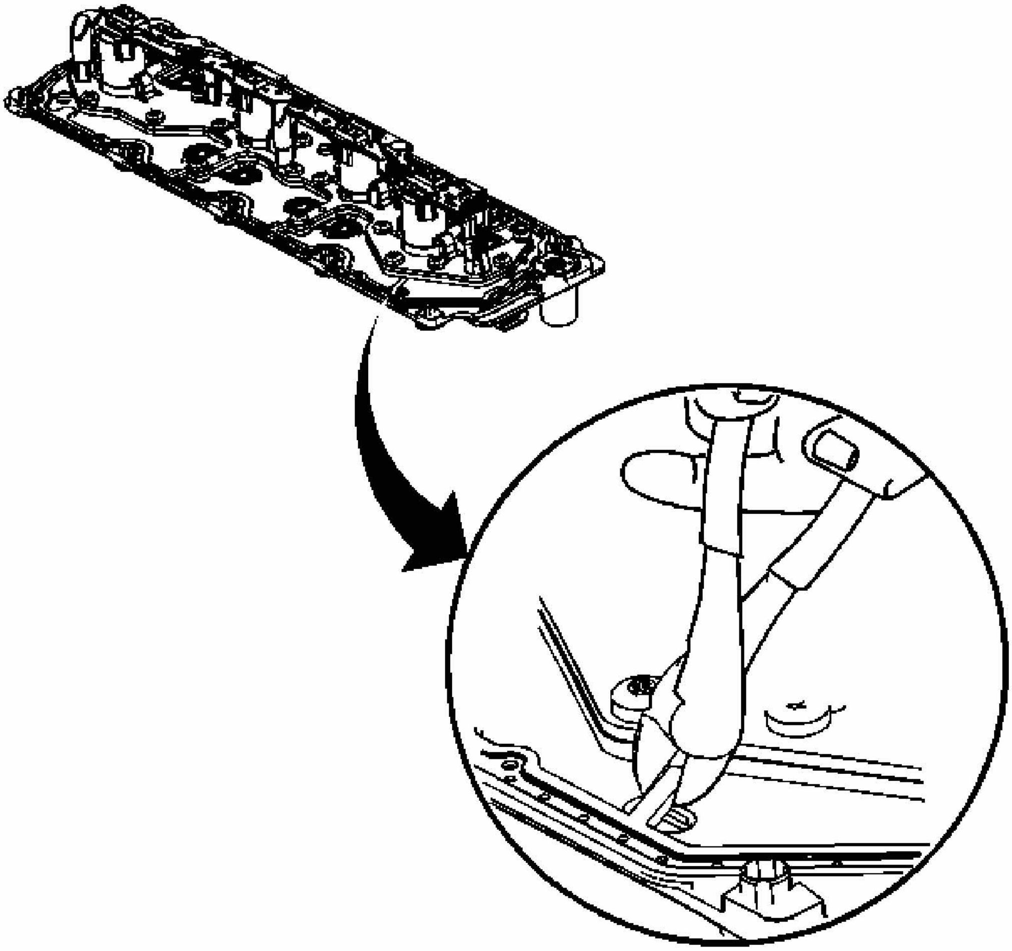

Fig. 95: Cutting Retaining Straps On Outer Gasket
Courtesy of GENERAL MOTORS CORP.

6. Using a wire-cutter type tool, snip the 8 retaining straps of the outer gasket.

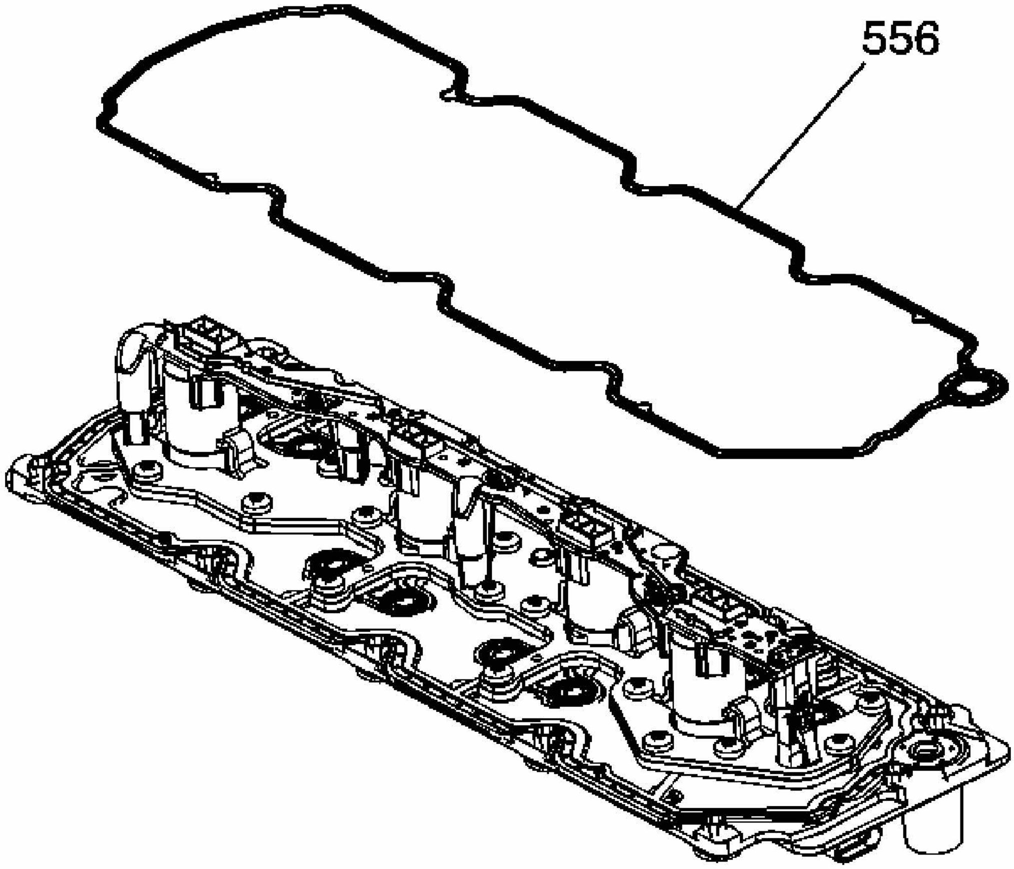

Fig. 96: View Of Outer Gasket
Courtesy of GENERAL MOTORS CORP.

7. Remove the outer gasket (556) from the manifold.

Installation Procedure

IMPORTANT: All gasket surfaces should be free of oil or other foreign material during assembly.

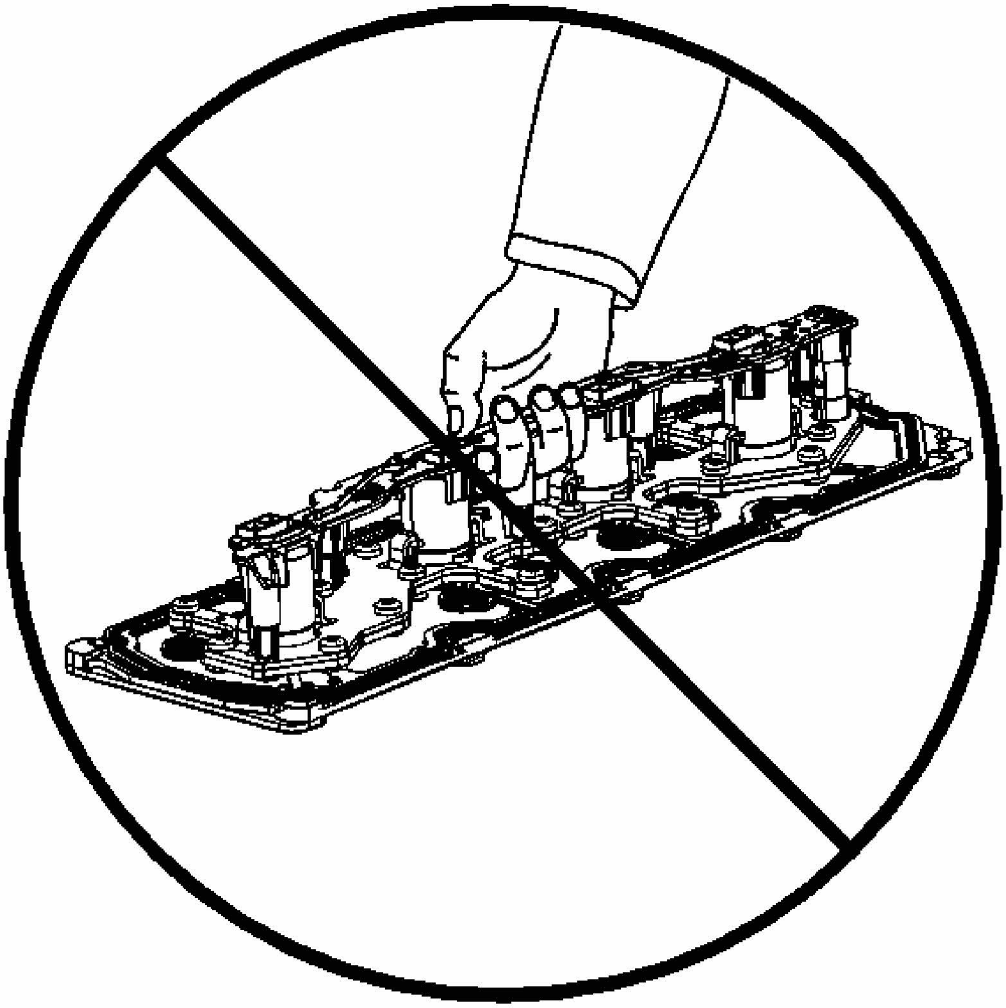

Fig. 97: Valve Lifter Oil Manifold
Courtesy of GENERAL MOTORS CORP.

1. Do not lift the manifold assembly by the electrical lead frame.

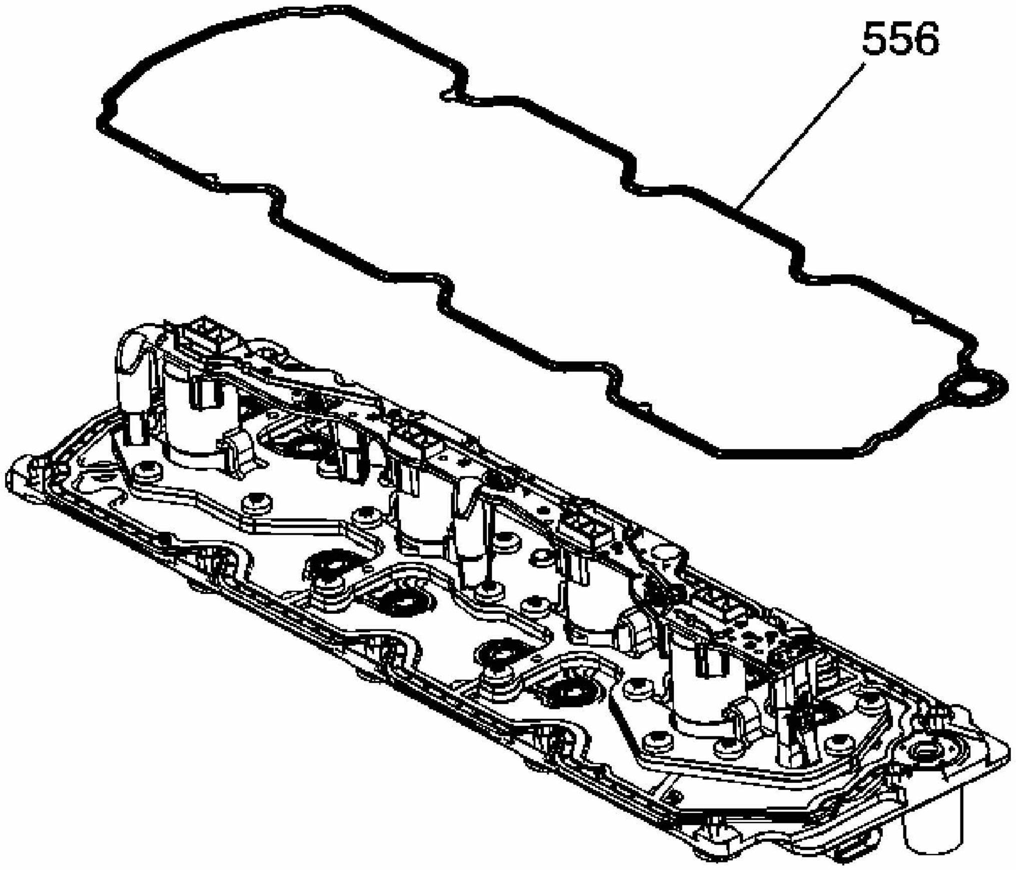

Fig. 98: View Of Outer Gasket
Courtesy of GENERAL MOTORS CORP.

2. Install the outer gasket (556) onto the manifold.

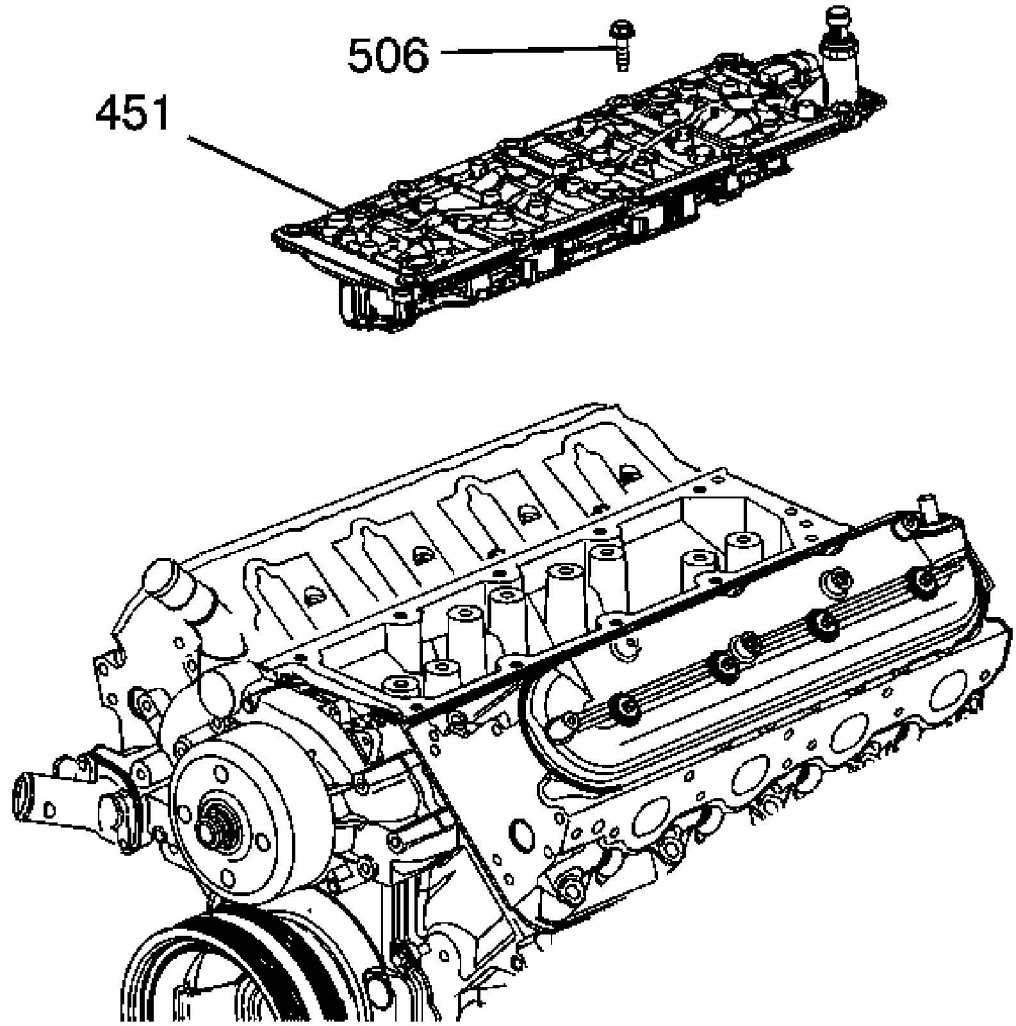

Fig. 99: View Of Valve Lifter Oil Manifold
Courtesy of GENERAL MOTORS CORP.

3. Install the valve lifter oil manifold (451).

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

4. Install the valve lifter oil manifold bolts (506).

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

5. Install the intake manifold. Refer to **Intake Manifold Replacement**.

VALVE ROCKER ARM COVER REPLACEMENT - LEFT

Removal Procedure

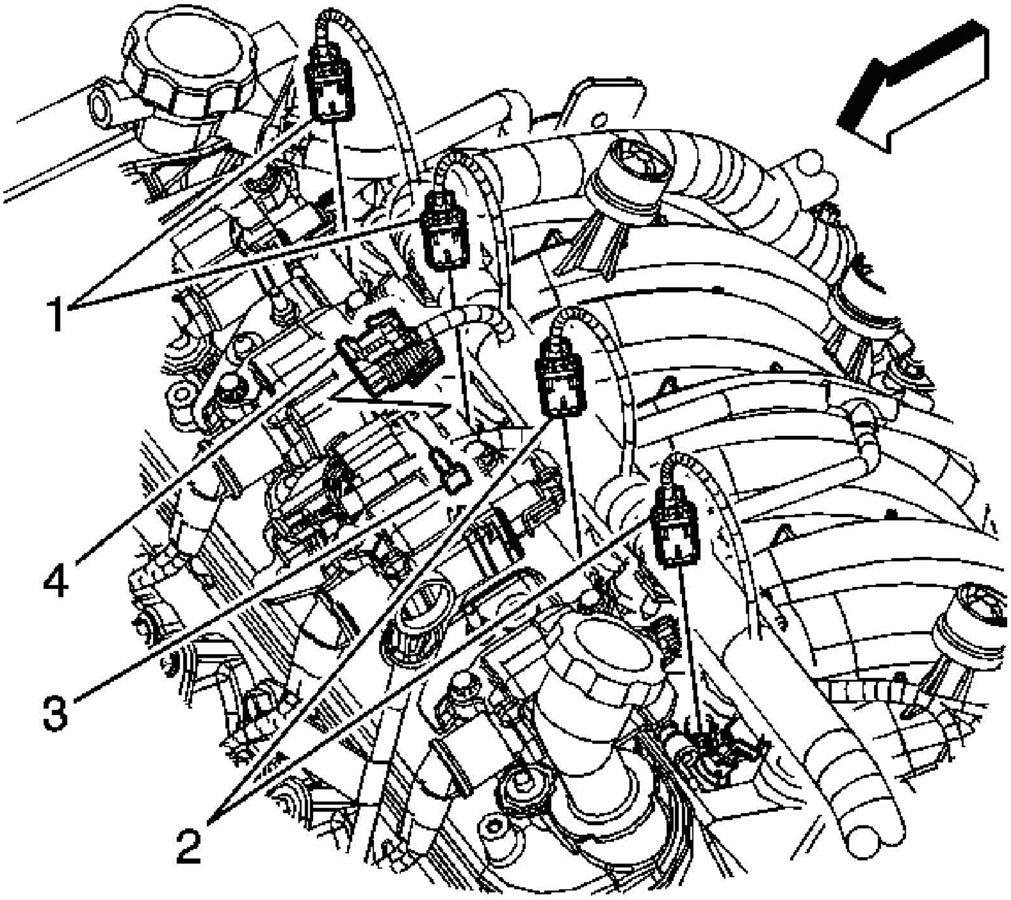

Fig. 100: View Of Ignition Coil Main Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine sight shield, if required. Refer to **Engine Sight Shield Replacement**.
2. Remove the connector position assurance (CPA) retainer (3).
3. Disconnect the ignition coil main electrical connector (4).
4. Reposition the engine harness, as necessary.

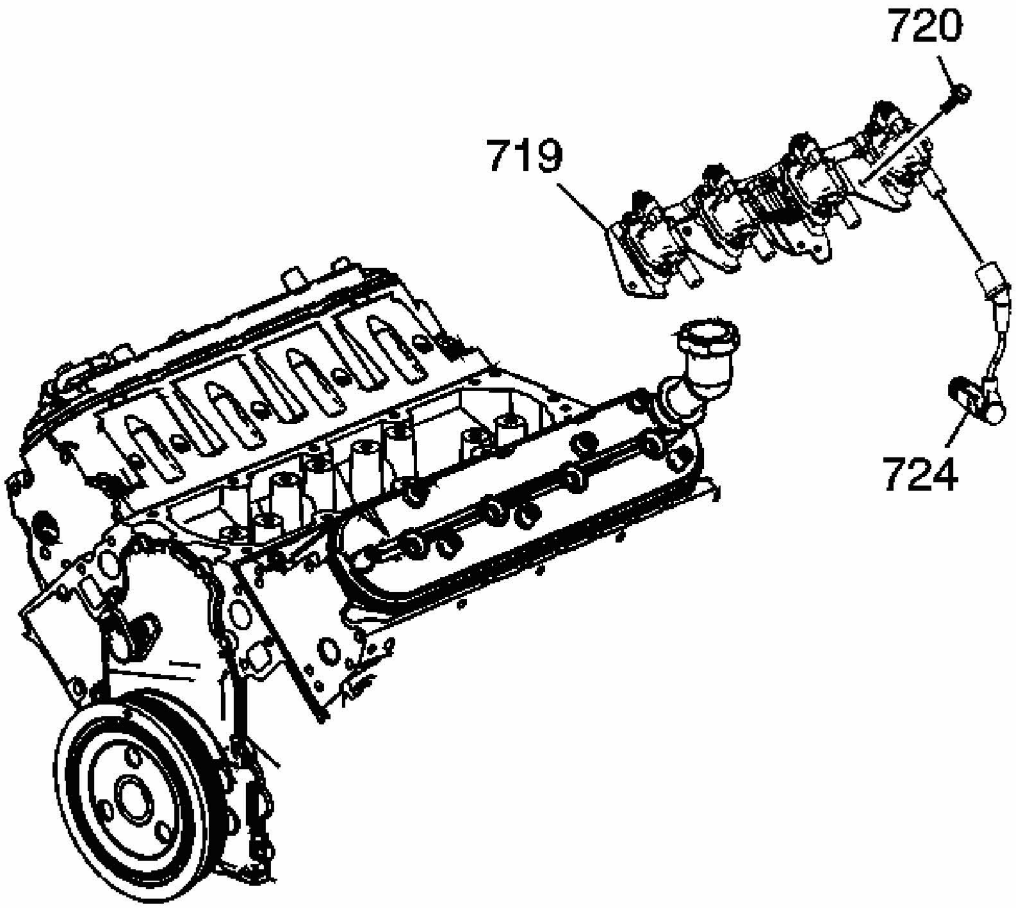

Fig. 101: View Of The Ignition Coil And Bracket Assembly
Courtesy of GENERAL MOTORS CORP.

5. Remove the spark plug wires (724) from the ignition coils.
    1. Twist each plug wire 1/2 turn.
    2. Pull only on the boot in order to remove the wire from the ignition coil.
6. Remove the ignition coil bracket bolts (720).
7. Remove the ignition coil and bracket assembly (719).

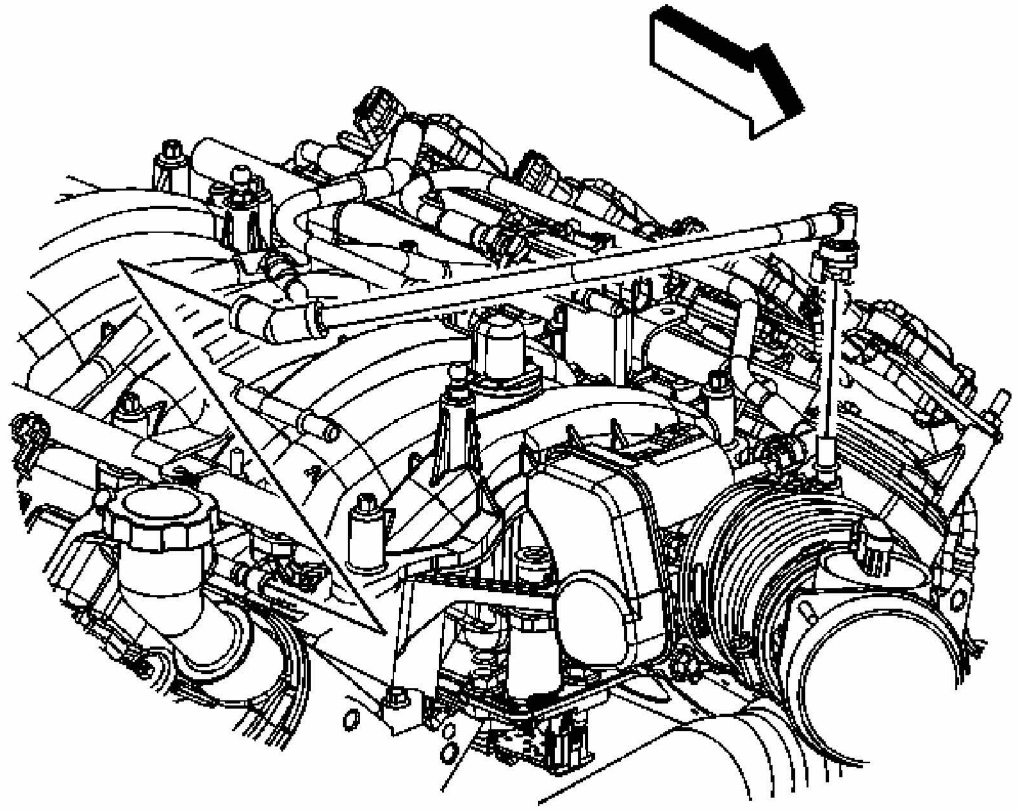

Fig. 102: View Of Positive Crankcase Ventilation (PCV) Clean Air Tube
Courtesy of GENERAL MOTORS CORP.

8. Remove the positive crankcase ventilation (PCV) clean air tube from the valve rocker arm cover.

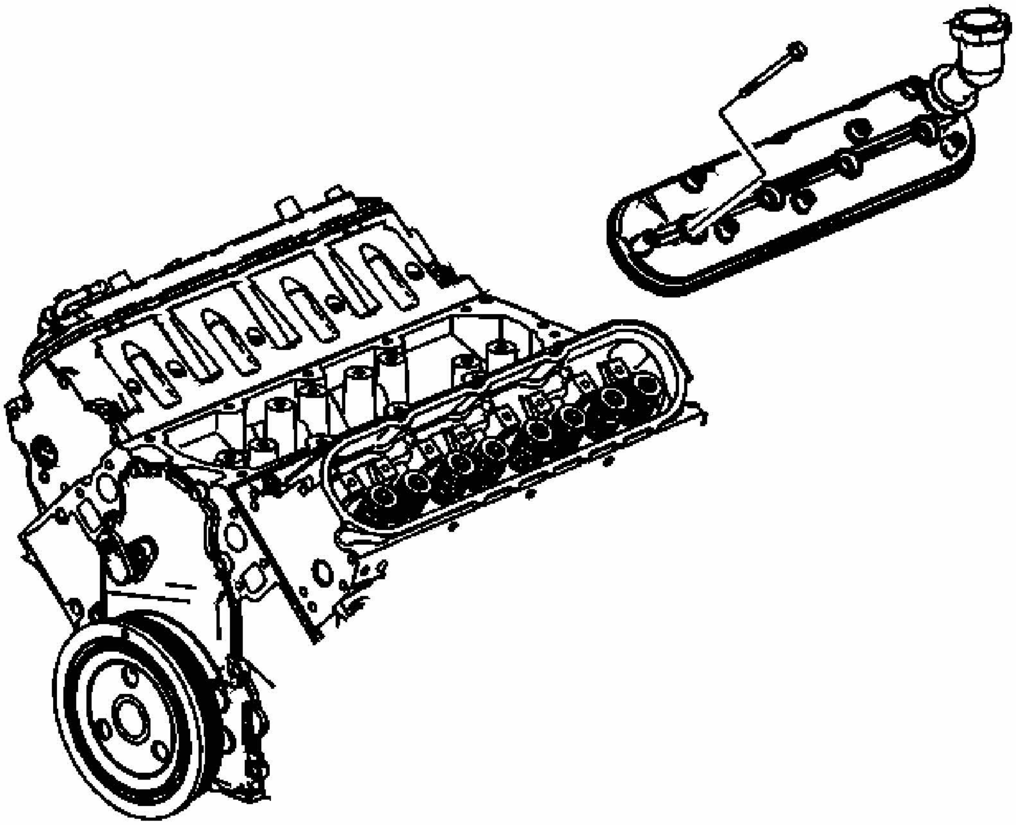

Fig. 103: View Of Valve Rocker Arm Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

9. Remove the valve rocker arm cover bolts and cover.

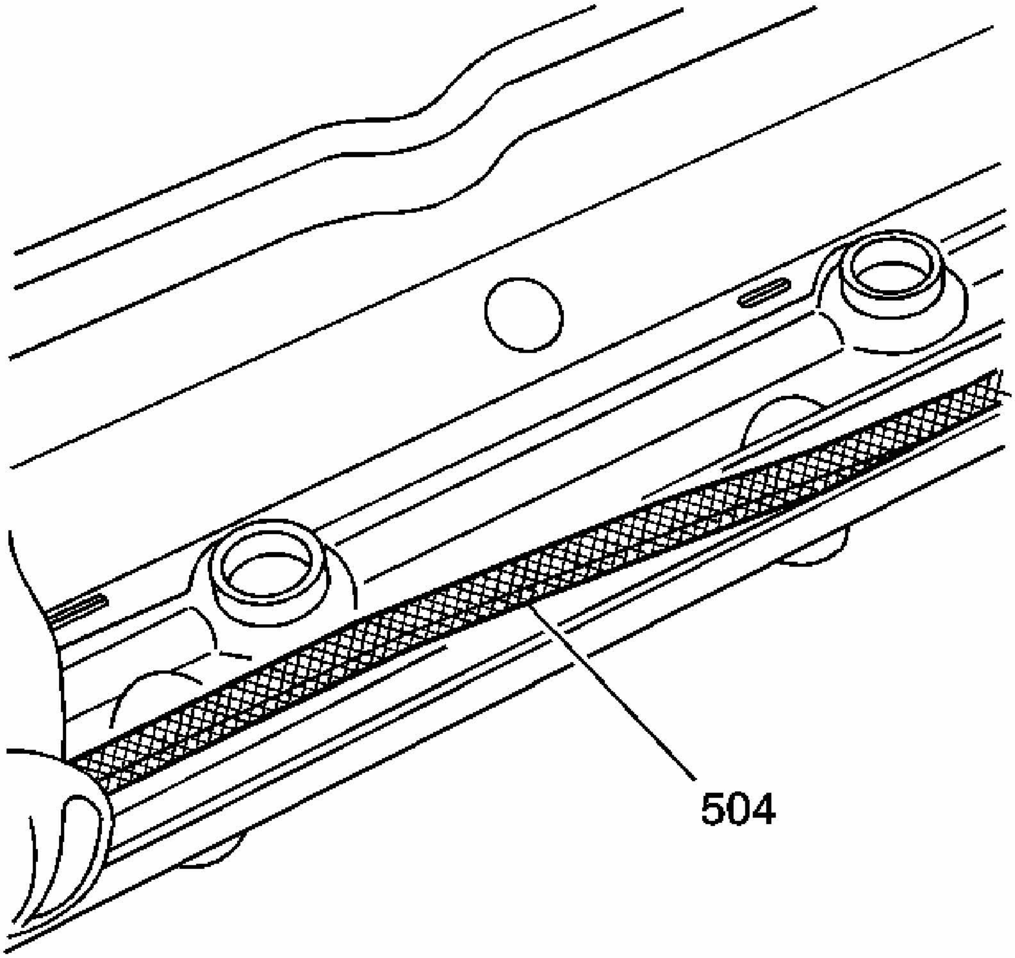

Fig. 104: View Of Valve Rocker Arm Cover Gasket
Courtesy of GENERAL MOTORS CORP.

10. Remove and discard the old the gasket (504) from the valve rocker arm cover.
11. Remove the valve rocker arm cover bolt grommets, if cut or damaged.

IMPORTANT: Do not remove the oil fill tube from the rocker cover unless service is required. If the oil fill tube has been removed, install a NEW tube during assembly.

12. Remove the oil fill cap from the oil fill tube, if necessary.
13. Remove the oil fill tube, if necessary.
14. Discard the oil fill tube, if necessary.

Installation Procedure

IMPORTANT:

- **All gasket surfaces should be free of oil an/or other foreign material during assembly.**
- **DO NOT reuse the valve rocker arm cover gasket.**
- **The valve rocker arm cover bolt grommets may be reused.**

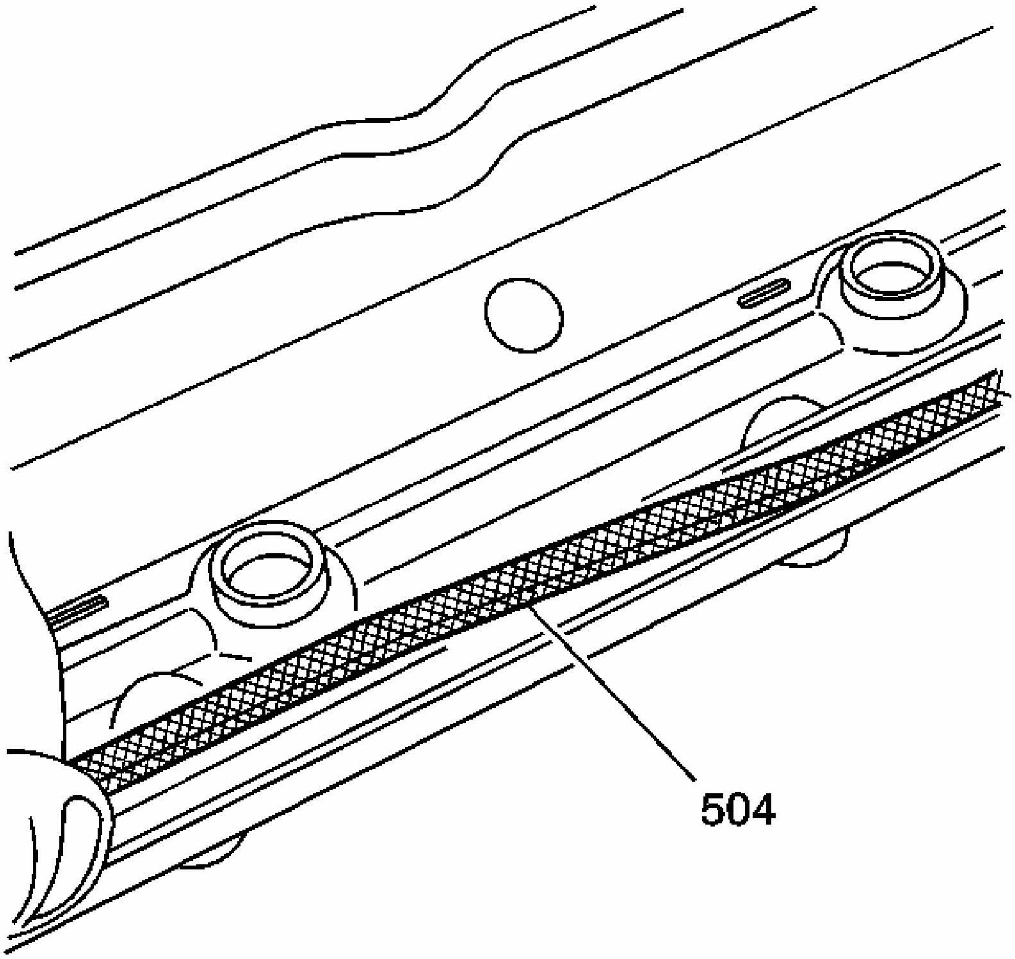

Fig. 105: View Of Valve Rocker Arm Cover Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW gasket (504) into the groove of the valve rocker arm cover.

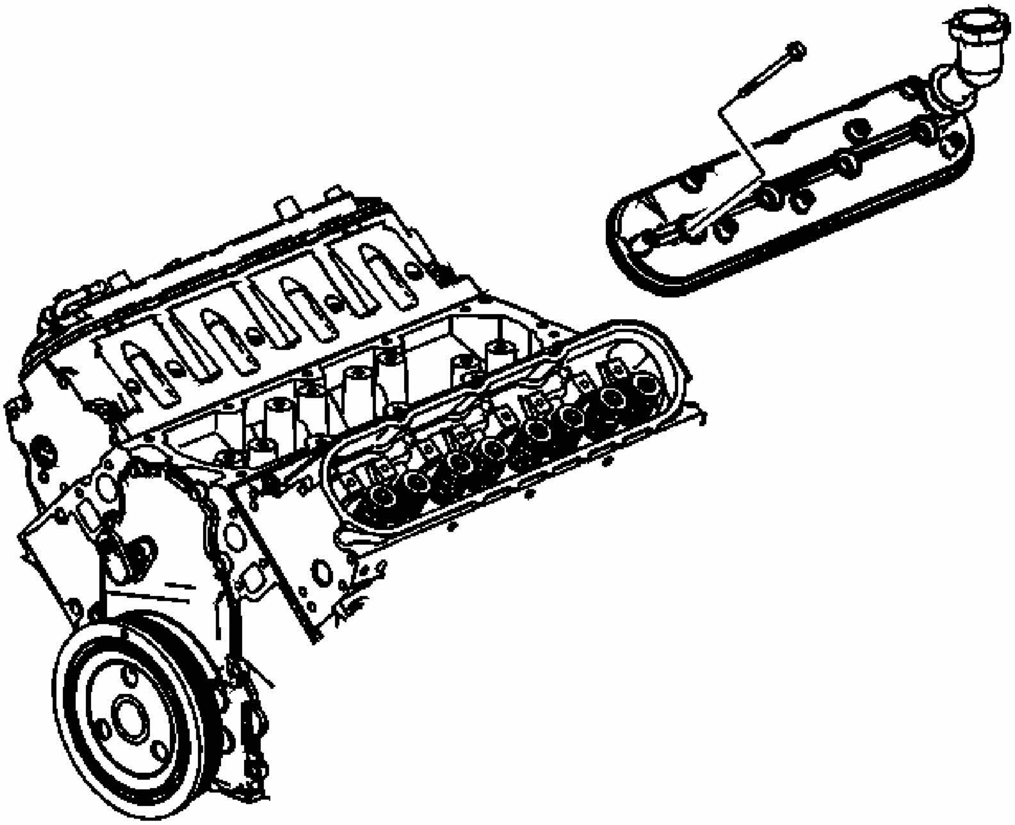

Fig. 106: View Of Valve Rocker Arm Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW oil fill tube to the valve rocker arm cover, if necessary.
3. Install NEW valve rocker arm cover bolt grommets, if necessary.

NOTE: **Refer to Fastener Notice .**

4. Install the valve rocker arm cover and bolts.

   Tighten: Tighten the bolts to 12 N.m (106 lb in).

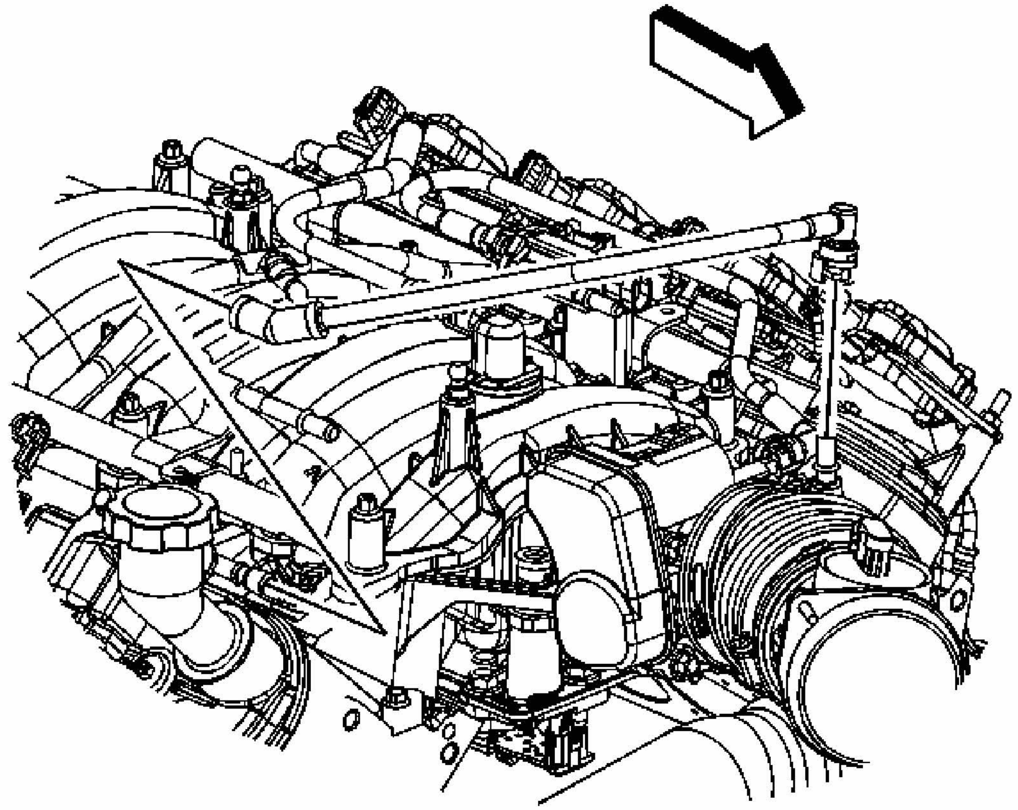

Fig. 107: View Of Positive Crankcase Ventilation (PCV) Clean Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Remove the positive crankcase ventilation (PCV) clean air tube from the valve rocker arm cover.

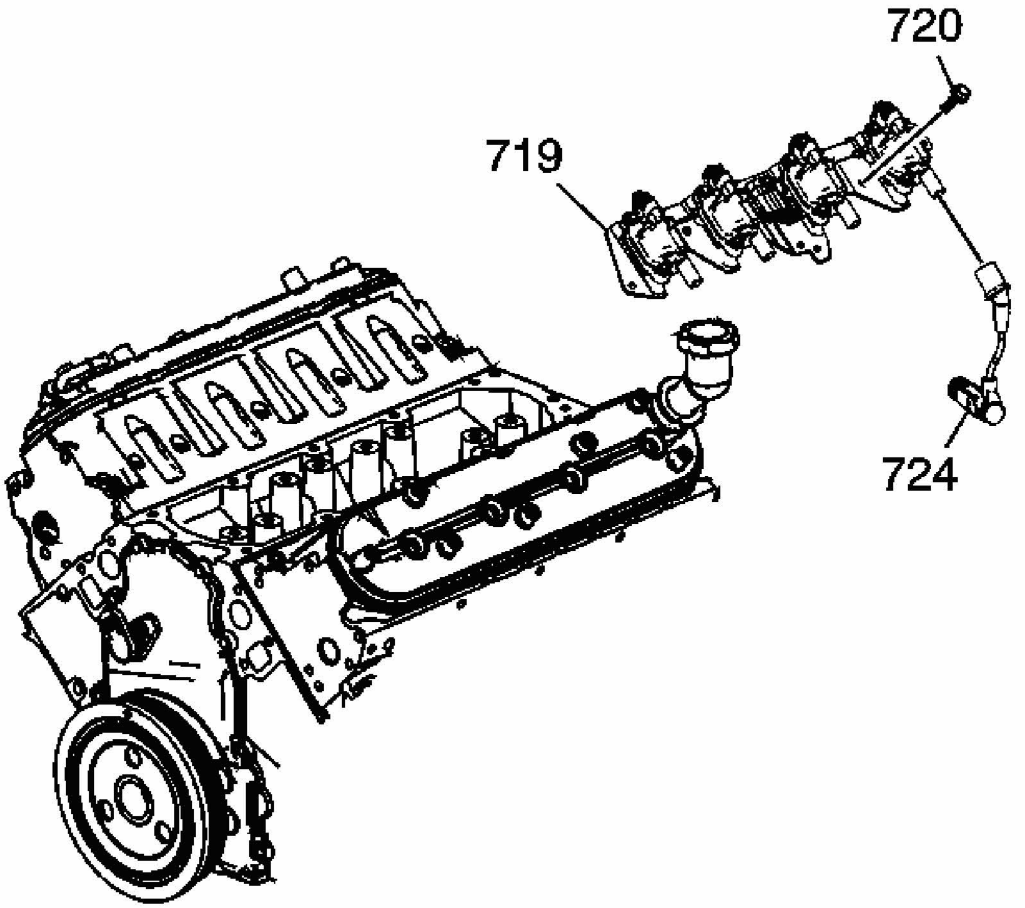

Fig. 108: View Of The Ignition Coil And Bracket Assembly
Courtesy of GENERAL MOTORS CORP.

6. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the threads of the ignition coil bracket bolts.
7. Install the ignition coil and bracket assembly.
8. Install the ignition coil bracket bolts.

   Tighten: Tighten the bolts to 12 N.m (106 lb in).

9. Install the spark plug wires (724) to the ignition coils.

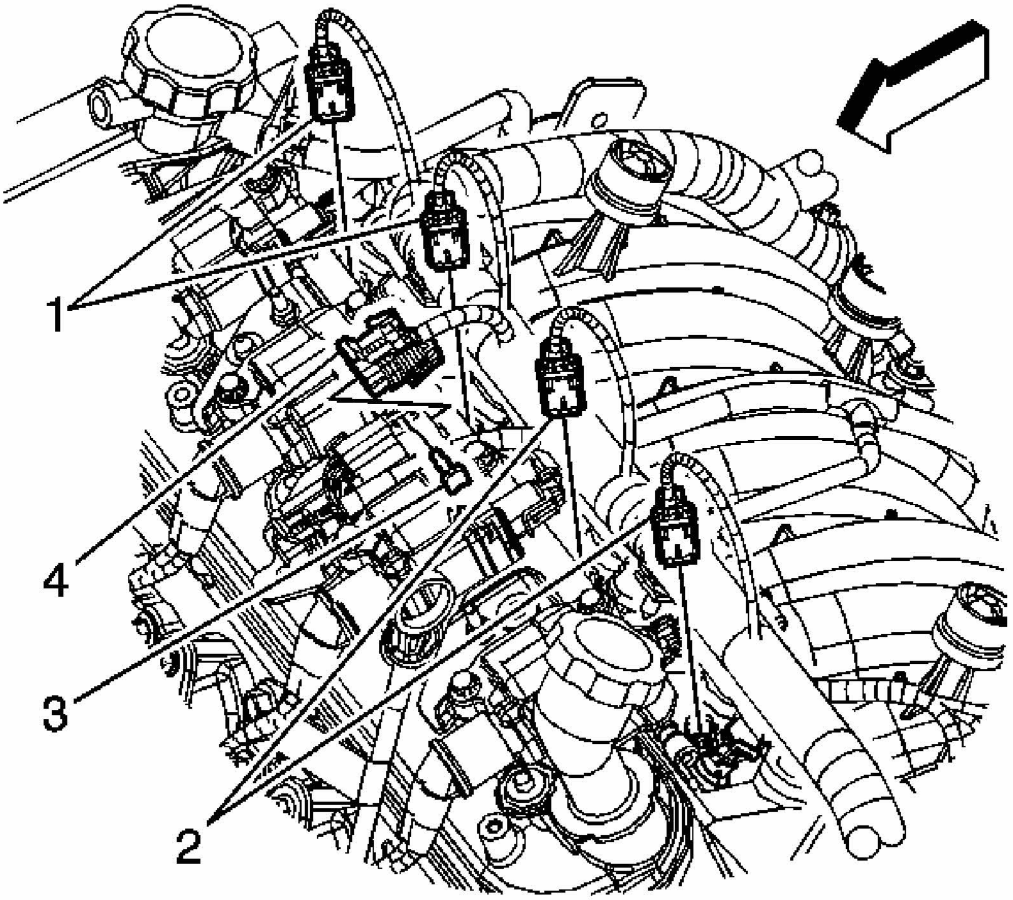

Fig. 109: View Of Ignition Coil Main Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

10. Position the engine harness, as necessary.
11. Connect the ignition coil main electrical connector (4).
12. Install the CPA retainer (3).
13. Install the engine sight shield, if required. Refer to **Engine Sight Shield Replacement**.

VALVE ROCKER ARM COVER REPLACEMENT - RIGHT

Removal Procedure

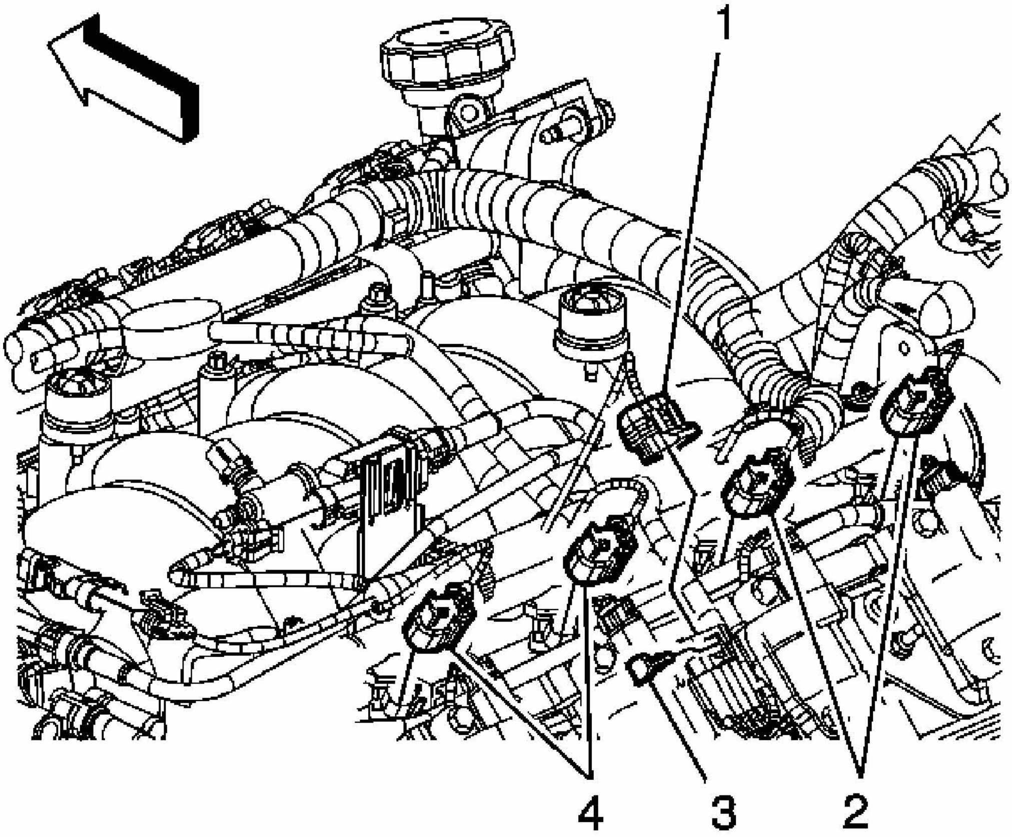

Fig. 110: View Of Ignition Coil Main Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine sight shield, if required. Refer to **Engine Sight Shield Replacement**.
2. Remove the connector position assurance (CPA) retainer (3).
3. Disconnect the ignition coil main electrical connector (4).
4. Reposition the engine harness, if necessary.

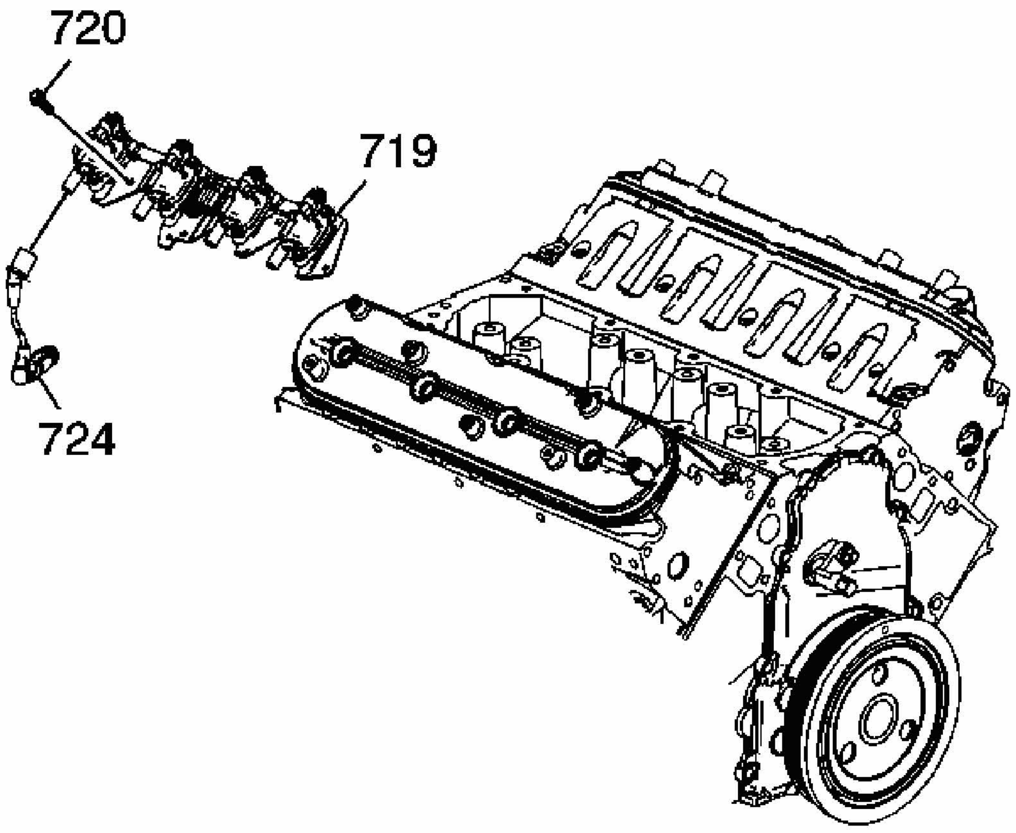

Fig. 111: View Of Ignition Coil And Bracket Assembly
Courtesy of GENERAL MOTORS CORP.

5. Remove the spark plug wires (724) from the ignition coils.
    1. Twist each plug wire 1/2 turn.
    2. Pull only on the boot in order to remove the wire from the ignition coil.
6. Remove the ignition coil bracket bolts (720).
7. Remove the ignition coil and bracket assembly (719).

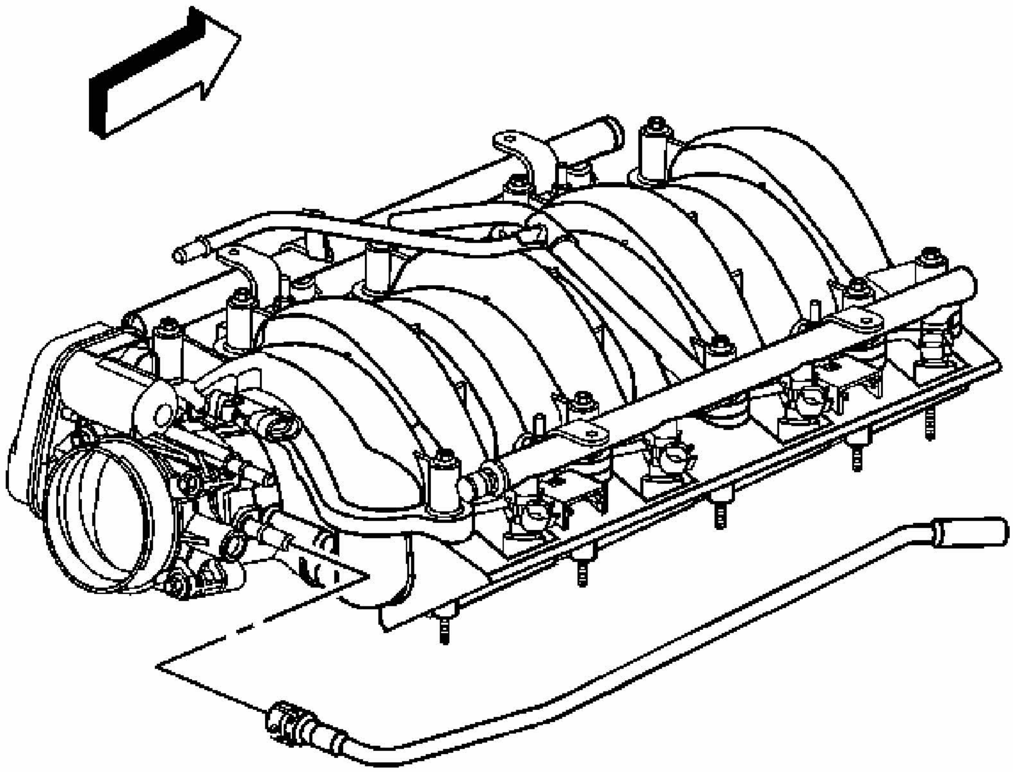

Fig. 112: View Of Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

8. Remove the positive crankcase ventilation (PCV) foul air hose from the intake manifold and valve rocker arm cover.

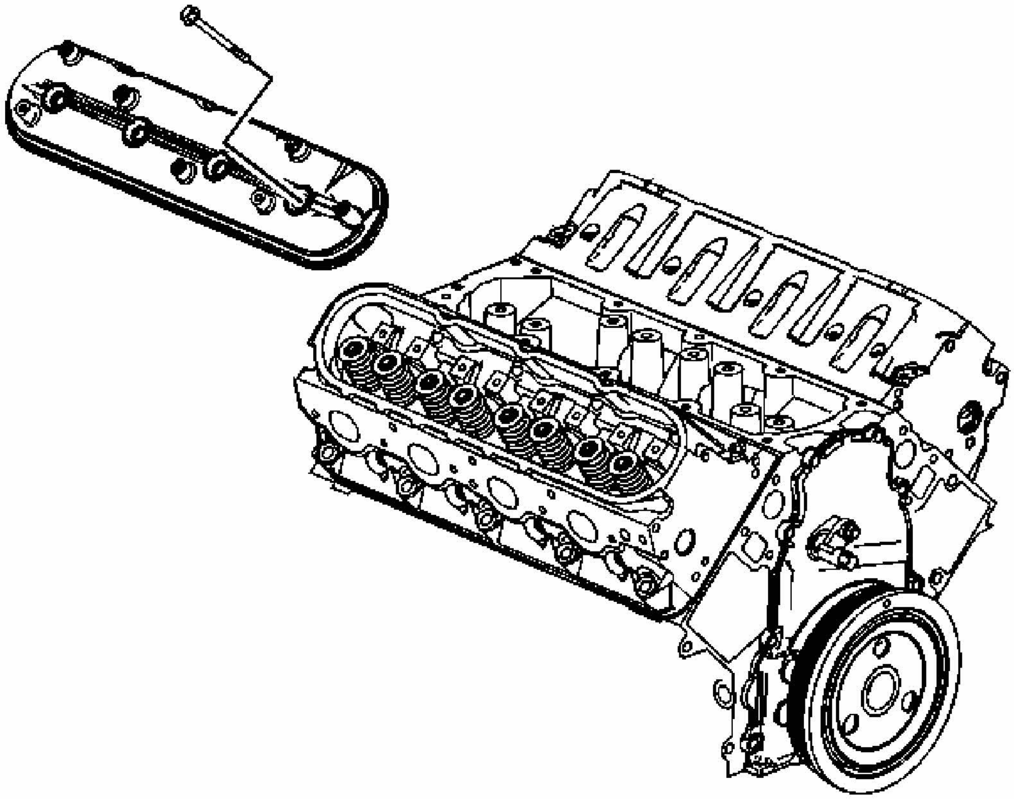

Fig. 113: View Of Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

9. Remove the valve rocker arm cover bolts and cover.

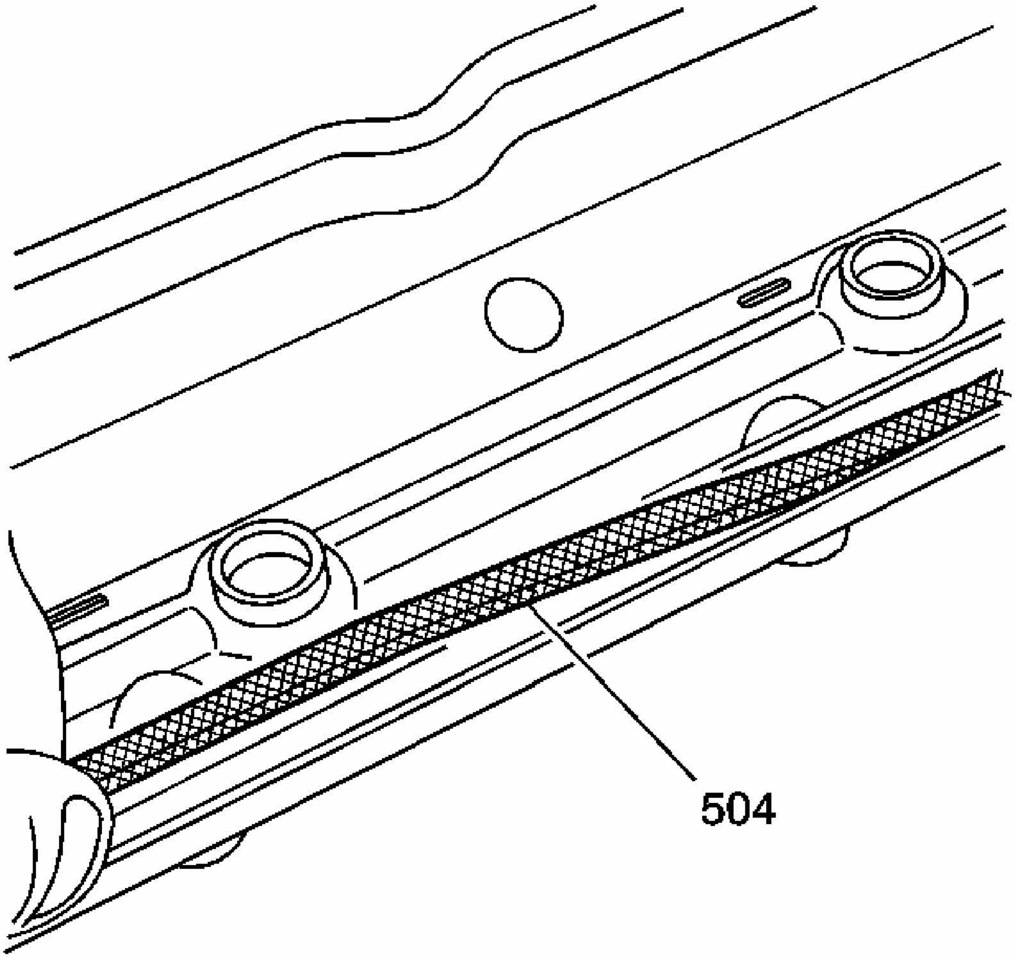

Fig. 114: View Of Valve Rocker Arm Cover Gasket
Courtesy of GENERAL MOTORS CORP.

10. Remove and discard the old the gasket (504) from the valve rocker arm cover.
11. Remove the valve rocker arm cover bolt grommets, if cut or damaged.

Installation Procedure

IMPORTANT:

- **All gasket surfaces should be free of oil or other foreign material during assembly.**
- **DO NOT reuse the valve rocker arm cover gasket.**
- **The valve rocker arm cover bolt grommets may be reused.**

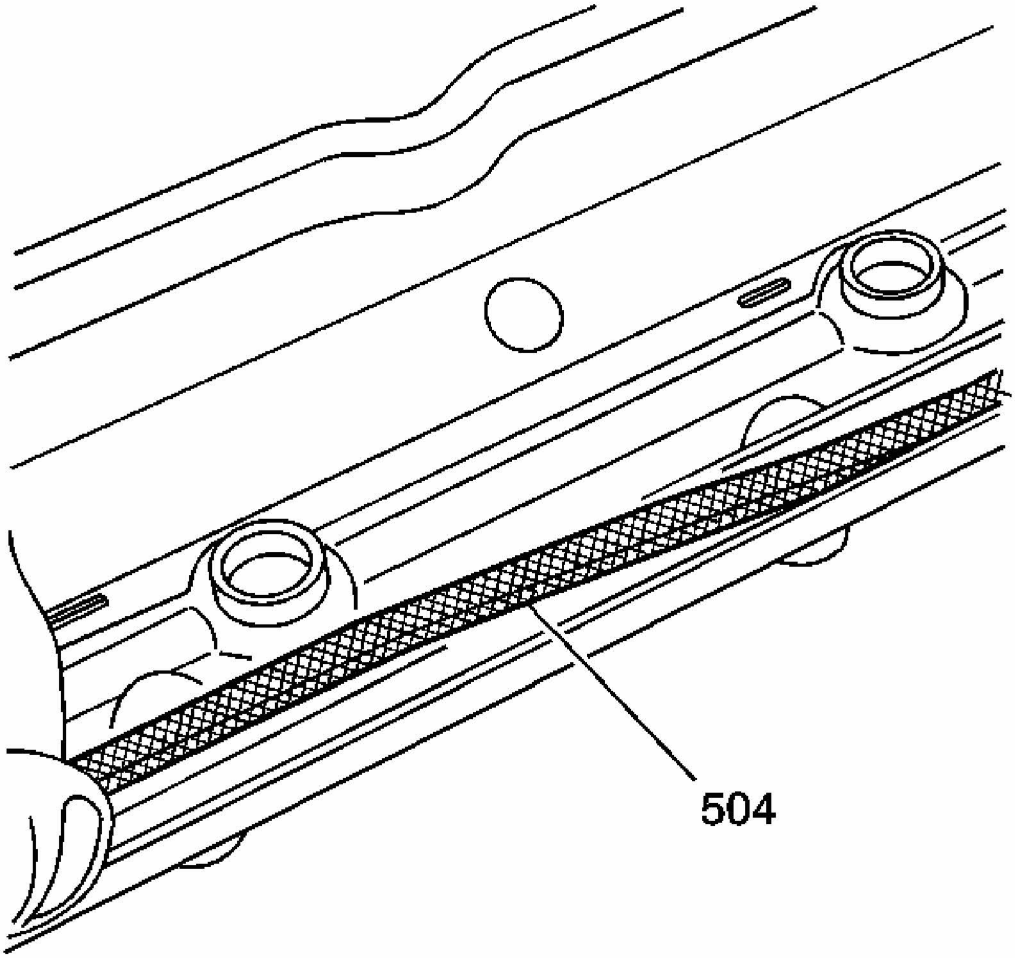

Fig. 115: View Of Valve Rocker Arm Cover Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW gasket (504) into the groove of the valve rocker arm cover.

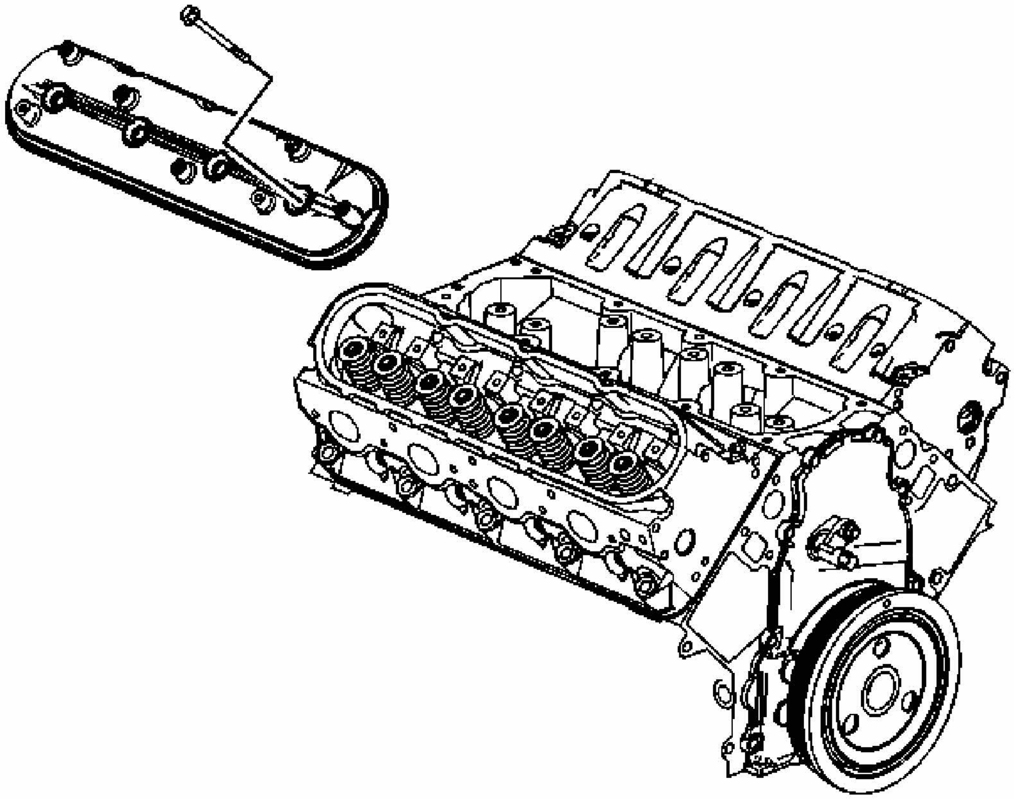

Fig. 116: View Of Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

2. Install NEW valve rocker arm cover bolt grommets, if necessary.
3. Install the valve rocker arm cover and bolts.

NOTE: Refer to Fastener Notice .

4. Install the rocker arm cover bolts and grommets.

Tighten: Tighten the bolts to 12 N.m (106 lb in).

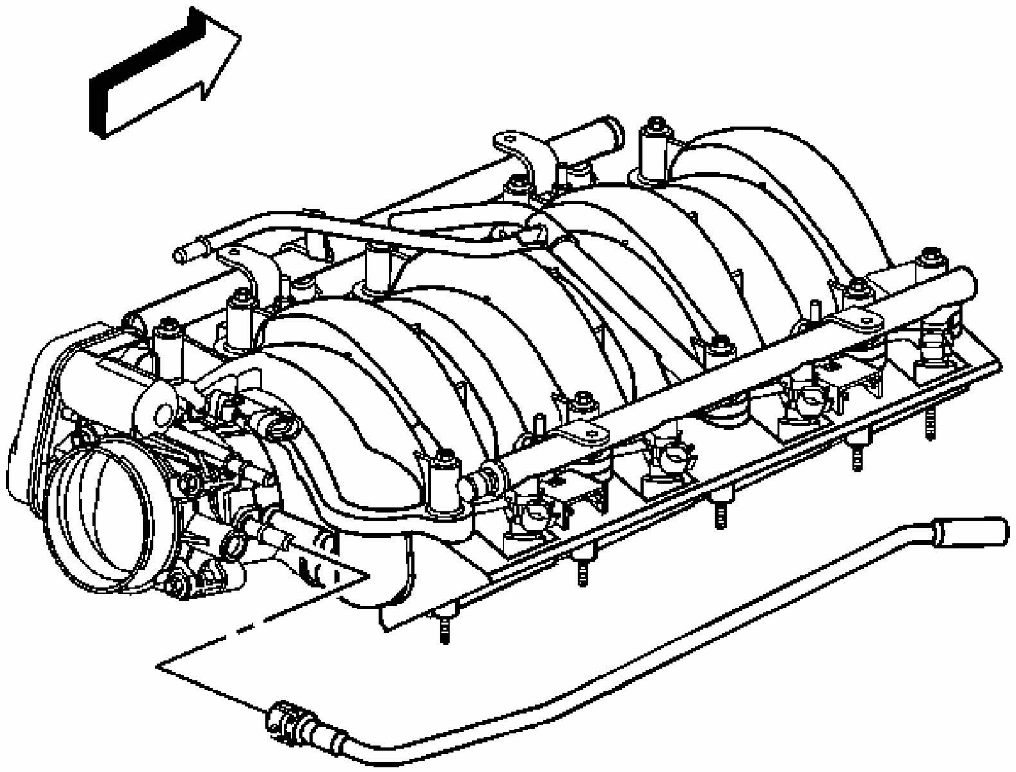

Fig. 117: View Of Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Install the PCV foul air hose to the intake manifold and valve rocker arm cover.

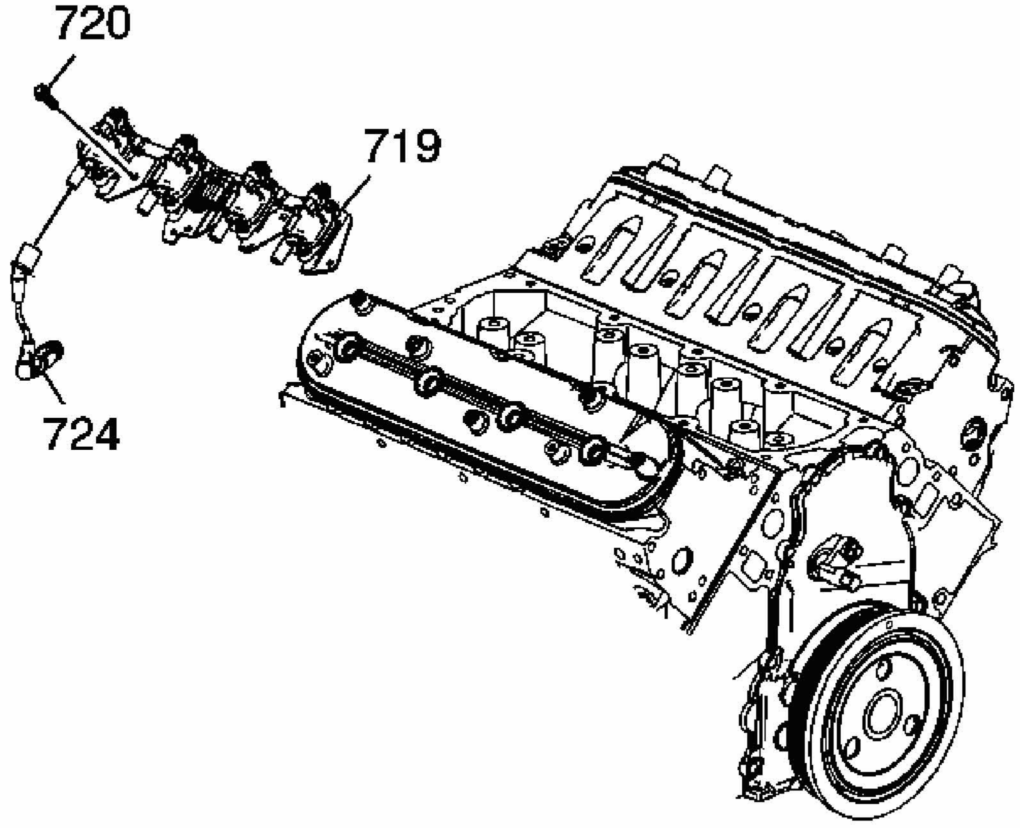

Fig. 118: View Of Ignition Coil And Bracket Assembly
Courtesy of GENERAL MOTORS CORP.

6. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the threads of the ignition coil bracket bolts.
7. Install the ignition coil and bracket assembly (719).
8. Install the ignition coil bracket bolts (720).

   Tighten: Tighten the bolts to 12 N.m (106 lb in).

9. Install the spark plug wires (724) from the ignition coils.

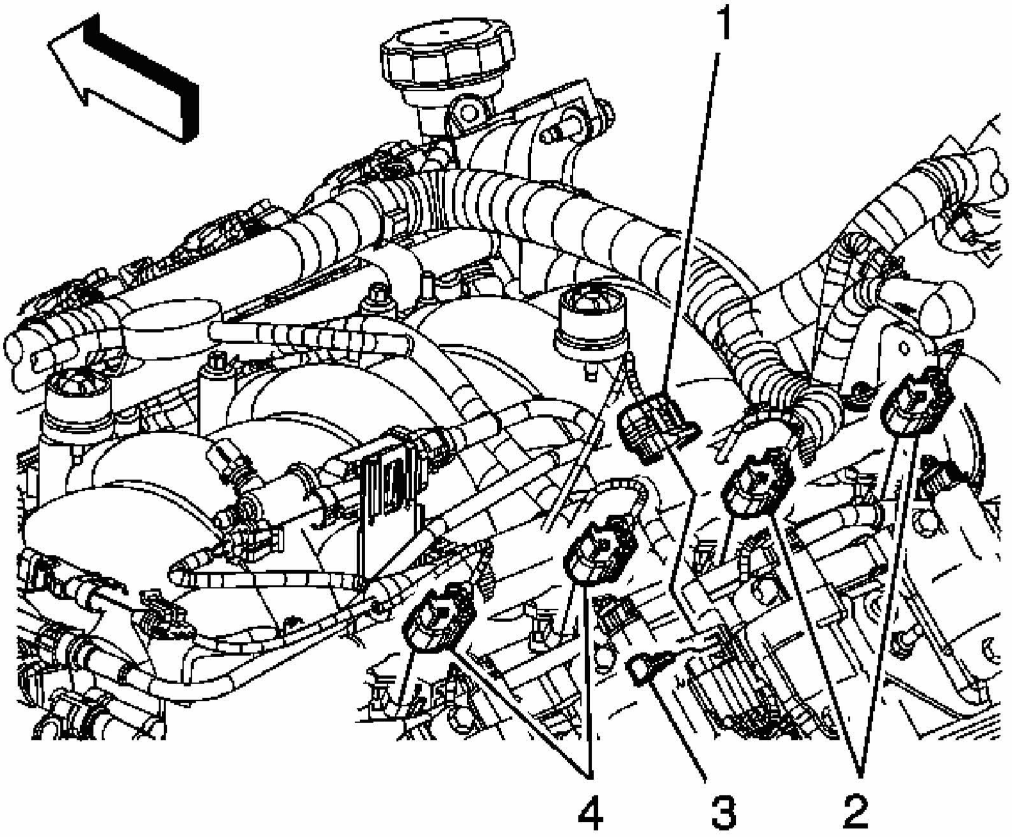

Fig. 119: View Of Ignition Coil Main Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

10. Position the engine harness, if necessary.
11. Connect the ignition coil main electrical connector (4).
12. Install the CPA retainer (3).
13. Install the engine sight shield, if required. Refer to **Engine Sight Shield Replacement**.

VALVE ROCKER ARM AND PUSH ROD REPLACEMENT

Removal Procedure

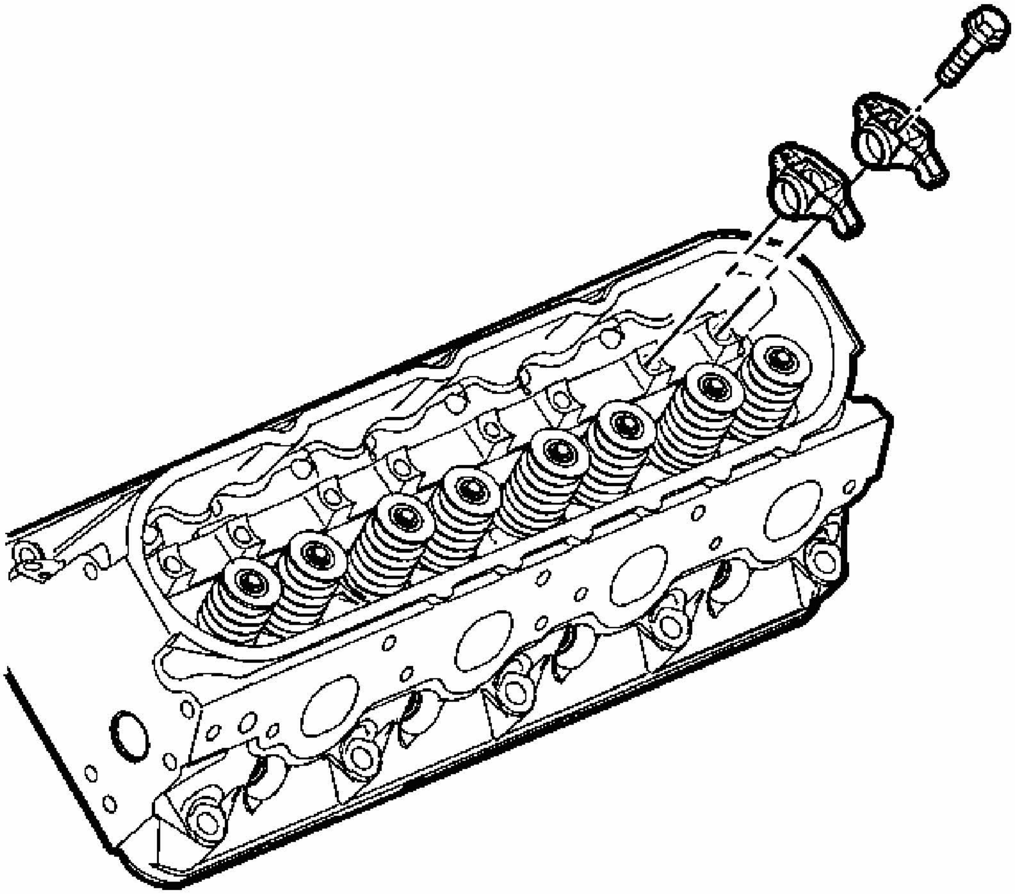

Fig. 120: View Of Rocker Arms & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Left** and/or **Valve Rocker Arm Cover Replacement - Right**.

IMPORTANT: Place the valve rocker arm, pushrod, and pivot support, in a rack so that the can be installed in the same location from which they were removed.

2. Remove the valve rocker arm bolt.
3. Remove the valve rocker arm.

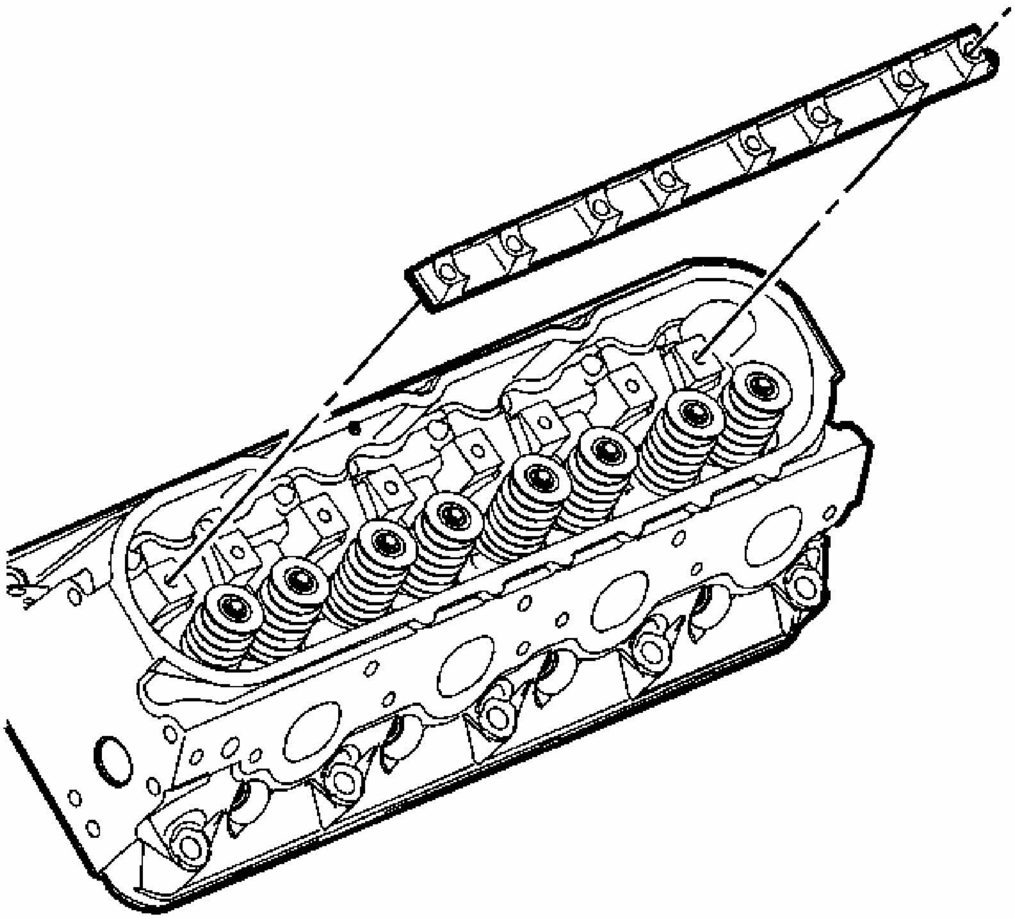

Fig. 121: View Of Valve Rocker Arm Pivot Support
Courtesy of GENERAL MOTORS CORP.

4. Remove the valve rocker arm pivot support.

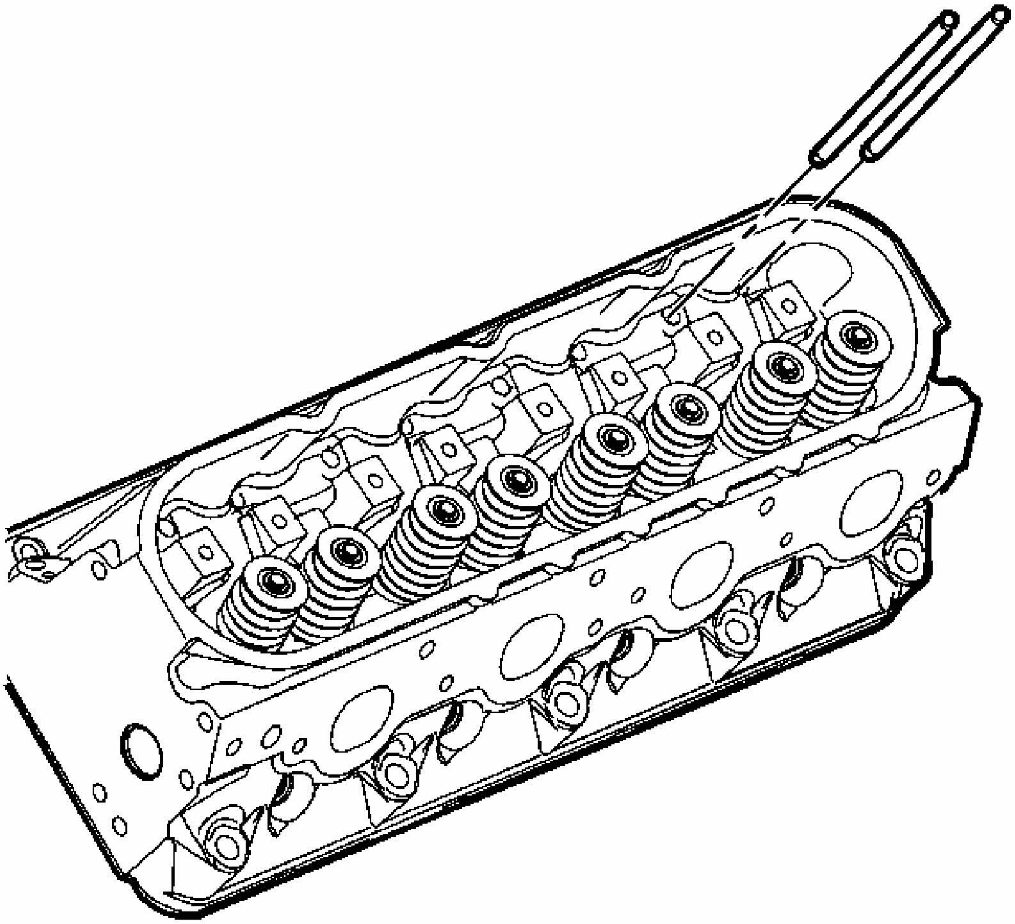

Fig. 122: View Of Pushrods
Courtesy of GENERAL MOTORS CORP.

5. Remove the pushrod.
6. Clean and inspect the valve rocker arm and pushrod. Refer to **Valve Rocker Arm and Push Rods Cleaning and Inspection**.

Installation Procedure

IMPORTANT:

- **When reusing the valve train components, always install the components to their original location and position.**
- **Valve lash is net build, no valve adjustment is required.**

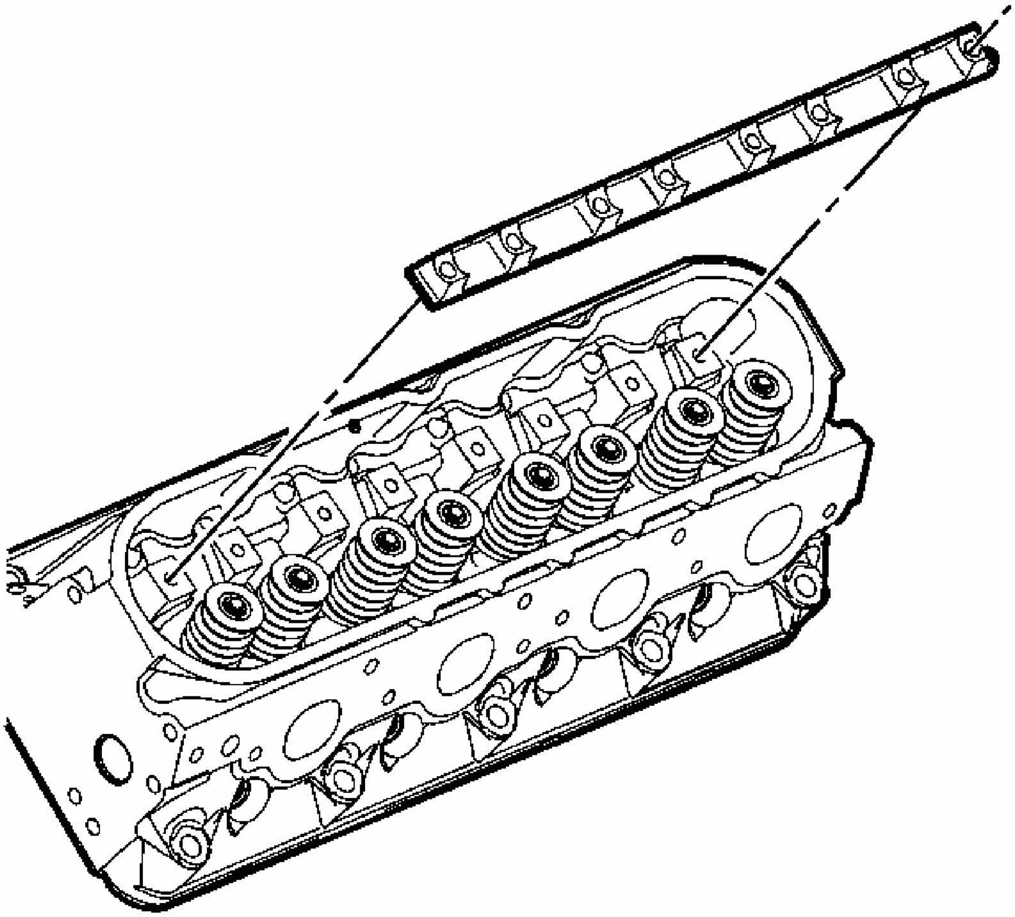

Fig. 123: View Of Valve Rocker Arm Pivot Support
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the valve rocker arm and pushrod with clean engine oil.
2. Lubricate the flange of the valve rocker arm bolt with clean engine oil.
3. Install the valve rocker arm pivot support.

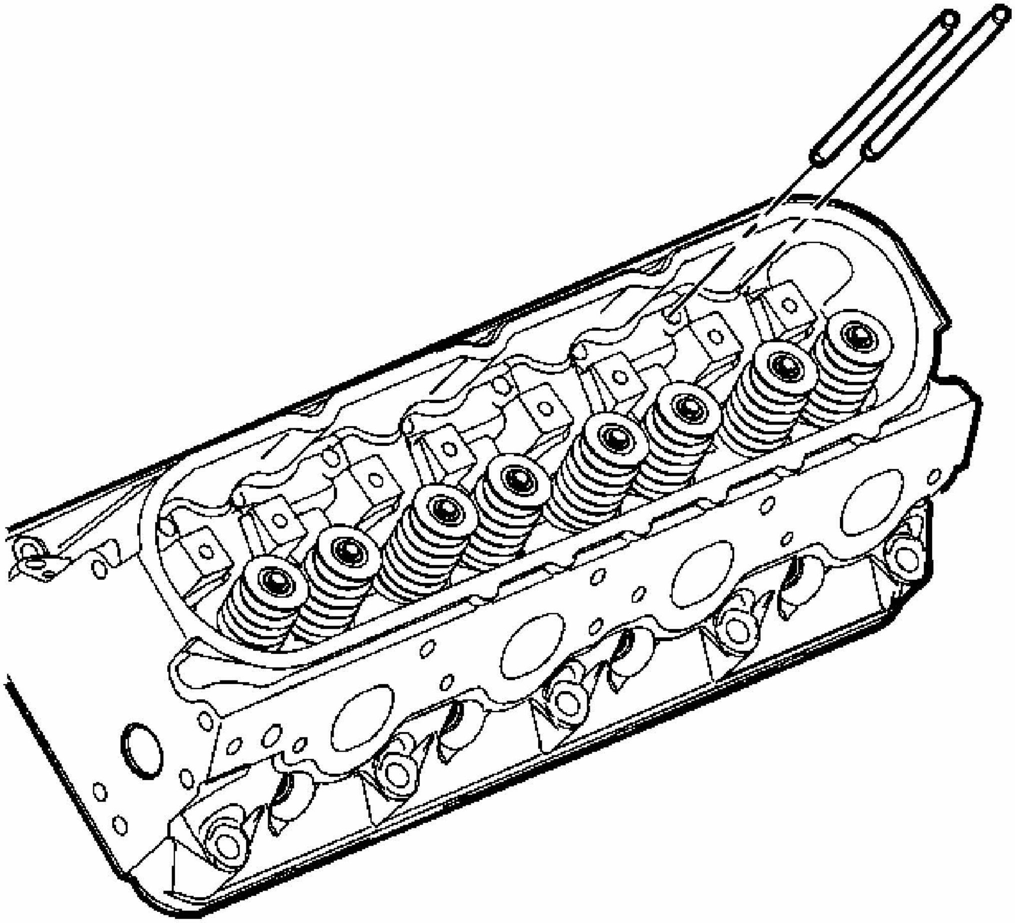

Fig. 124: View Of Pushrods
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Make sure that the pushrod seats properly to the valve lifter socket.

4. Install the pushrod.

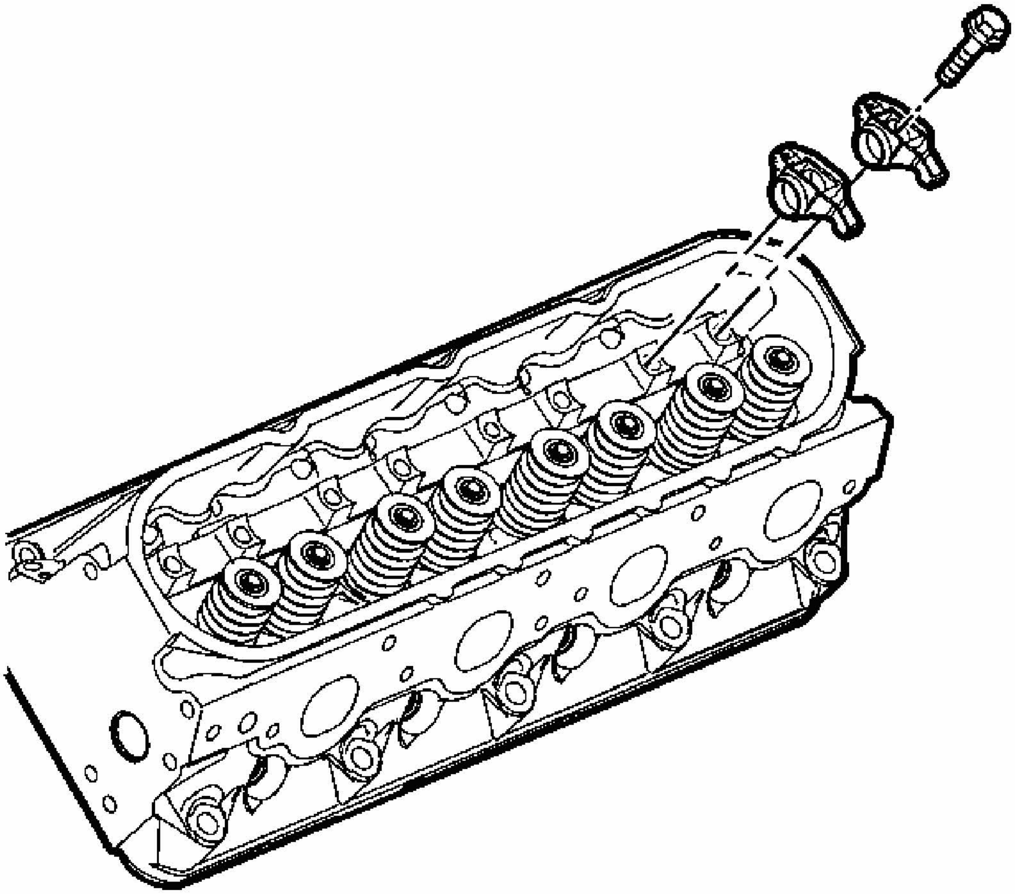

Fig. 125: View Of Rocker Arms & Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the pushrod seat properly to the ends of the rocker arm. DO NOT tighten the rocker arm bolt at this time.

5. Install the rocker arm and bolt.
6. Rotate the crankshaft until the number one piston is at top dead center (TDC) of the compression stroke. In this position, cylinder number one rocker arms will be off lobe lift, and the crankshaft sprocket key will be at the 1:30 position.

   The engine firing order is 1, 8, 7, 2, 6, 5, 4, 3.

   Cylinders 1, 3, 5, and 7 are the left bank.

Cylinder 2, 4, 6, and 8 are the right bank.

NOTE: Refer to Fastener Notice in Cautions and Notices.

7. With the engine in the number one firing position, tighten the following valve rocker arm bolts:

   Tighten:

   - Tighten cylinders 1, 2, 7, and 8 exhaust valve rocker arm bolts to 30 N.m (22 lb ft).
   - Tighten cylinders 1, 3, 4, and 5 intake valve rocker arm bolts to 30 N.m (22 lb ft).

8. Rotate the crankshaft 360 degrees.
9. Tighten the following valve rocker arm bolts:

   Tighten:

   - Tighten cylinders 3, 4, 5, and 6 exhaust valve rocker arm bolts to 30 N.m (22 lb ft).
   - Tighten cylinders 2, 6, 7, and 8 intake valve rocker arm bolts to 30 N.m (22 lb ft).

10. Install the valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Left** and/or **Valve Rocker Arm Cover Replacement - Right**.

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT

Tools Required

- **J 22794** Spark Plug Port Adapter
- **J 38606** Valve Spring Compressor

Removal Procedure

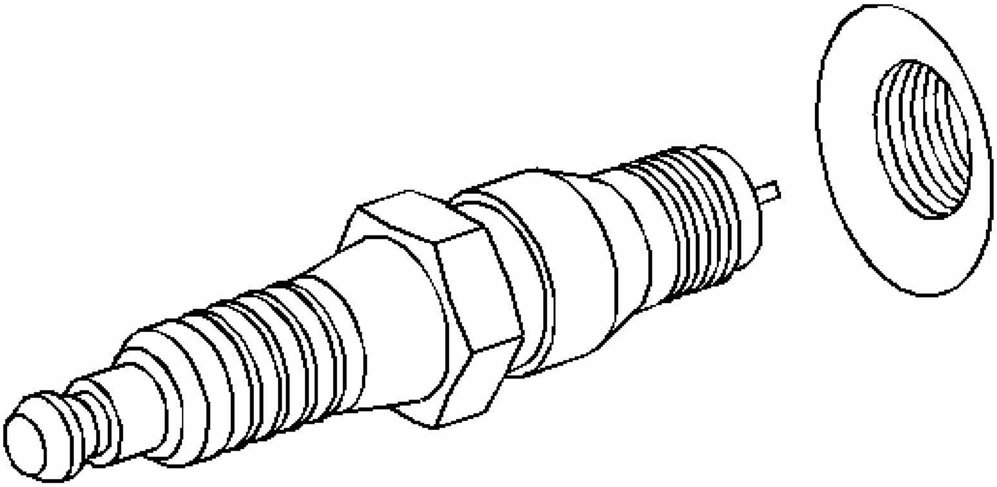

Fig. 126: View Of Spark Plug And Sparkplug Seat
Courtesy of GENERAL MOTORS CORP.

1. Remove the valve rocker arm. Refer to **Valve Rocker Arm and Push Rod Replacement**.

IMPORTANT: Remove the spark plugs from the cylinder head with the engine at room temperature.

2. Loosen the spark plug 1 or 2 turns.
3. Brush or air blast away any dirt or debris from around the spark plug.
4. Remove the spark plug.

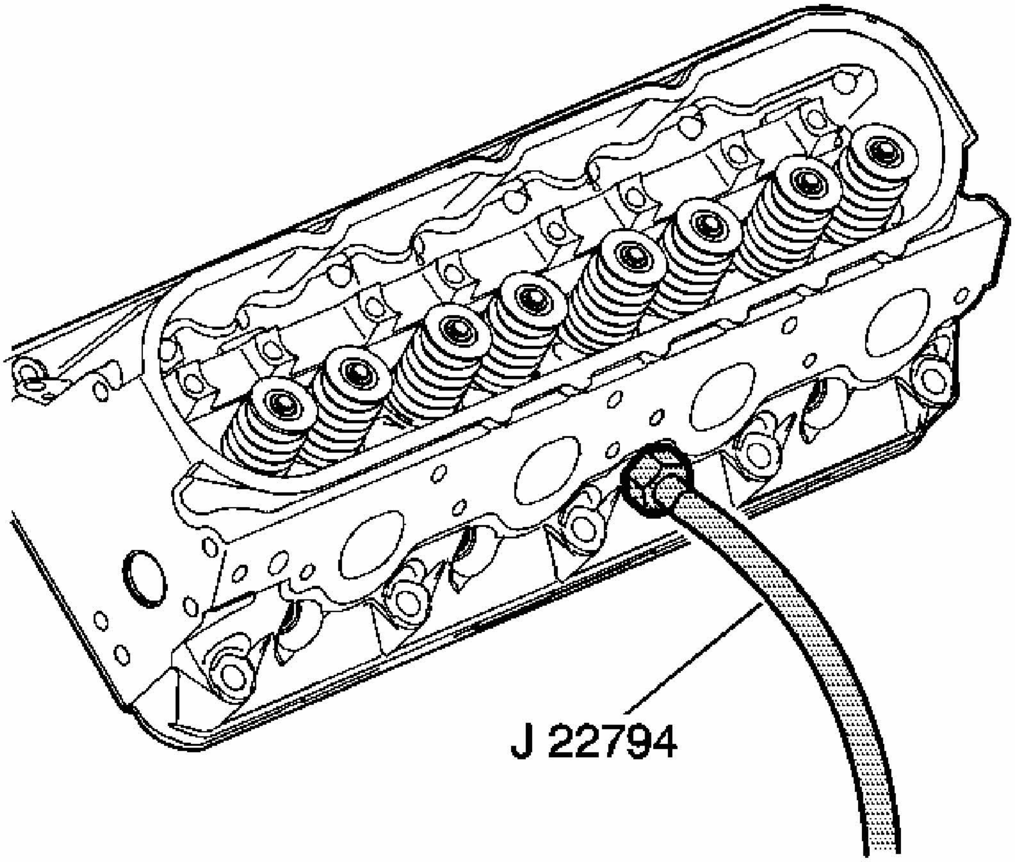

Fig. 127: Applying Compressed Air To J 22794
Courtesy of GENERAL MOTORS CORP.

5. Install the **J 22794** into the spark plug hole.
6. Attach an air hose to the **J 22794** .
7. Apply compressed air to the **J 22794** in order to hold the valves in place.

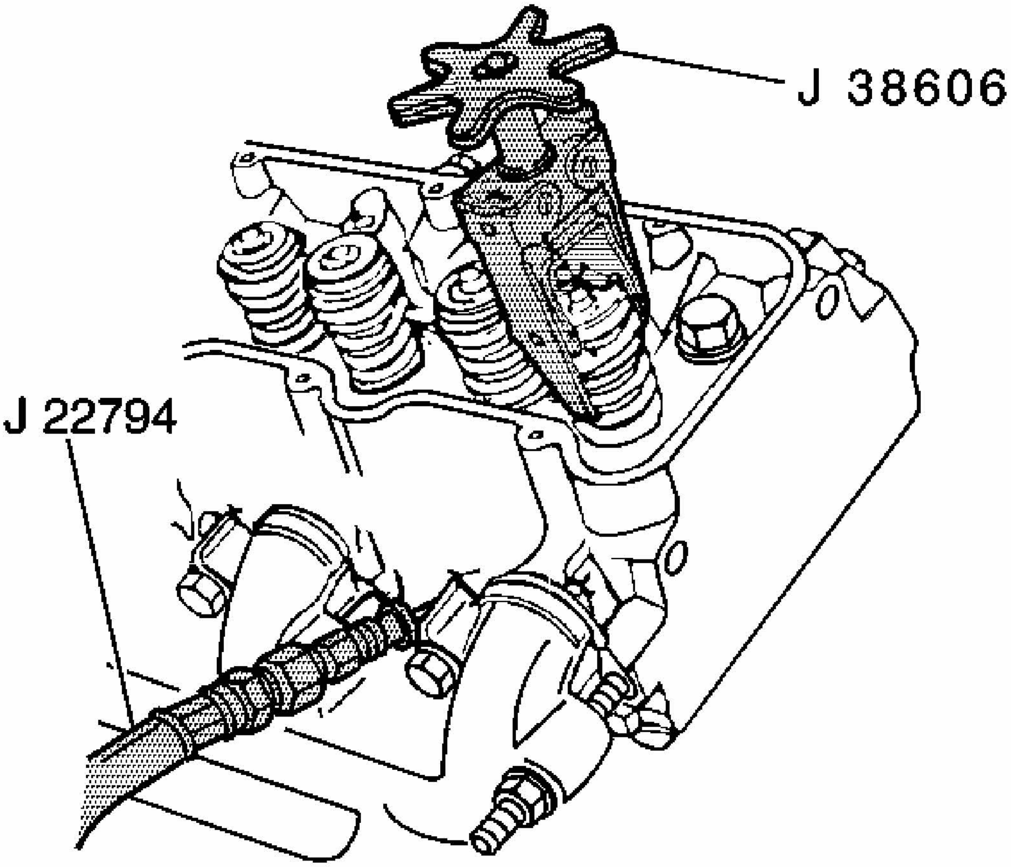

Fig. 128: Compress The Valve Spring (Cylinder Head Installed) Using Special Tools
Courtesy of GENERAL MOTORS CORP.

8. Using the **J 38606** compress the valve spring.

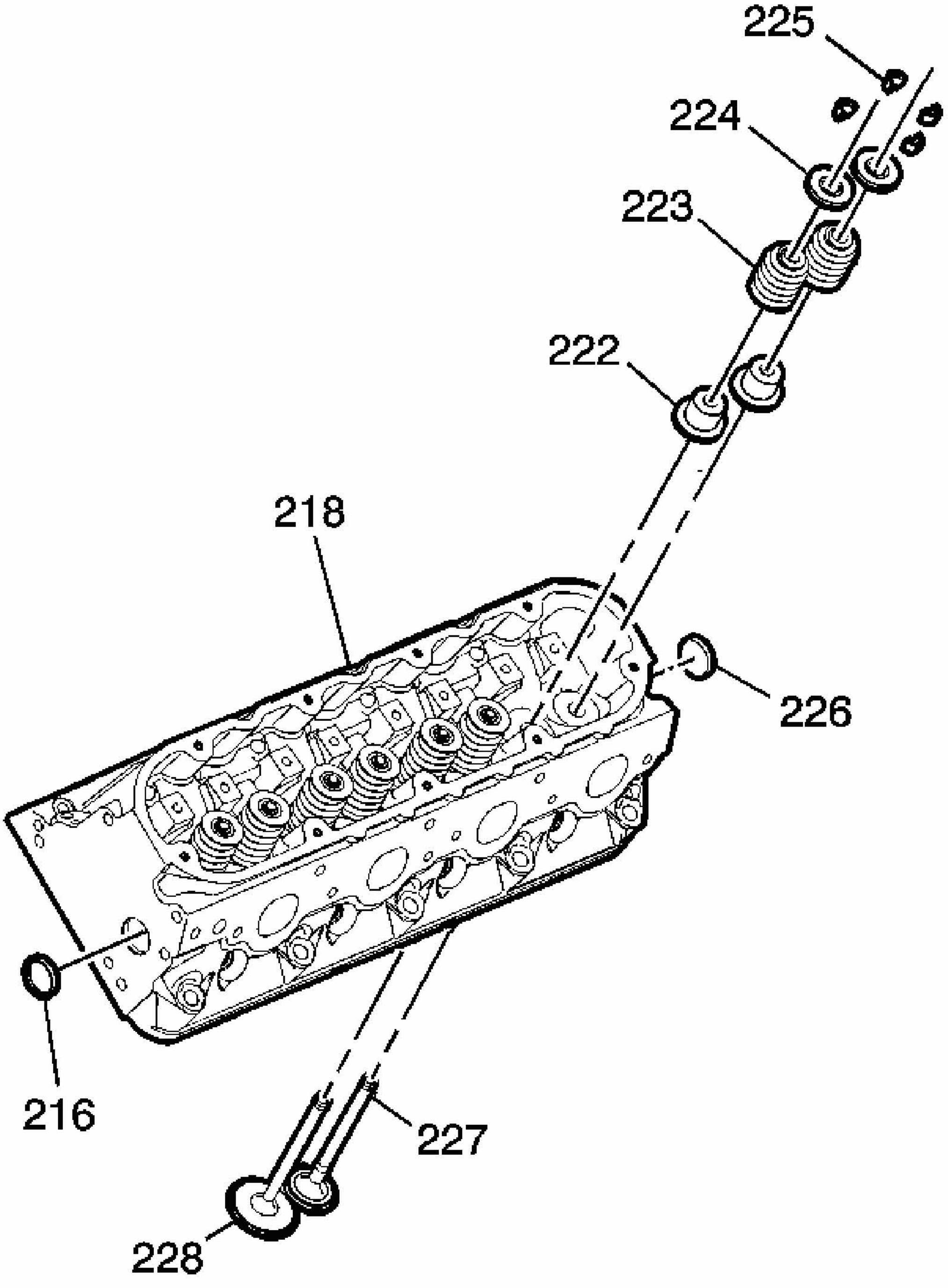
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Fig. 129: View Of Cylinder Head Components
Courtesy of GENERAL MOTORS CORP.

9. Remove the valve stem keys (225).
10. Using the **J 38606** carefully release the valve spring tension.

11. Remove the **J 38606** .
12. Remove the valve spring cap (224).
13. Remove the valve spring (223).
14. Remove the valve stem oil seal (222).

Installation Procedure

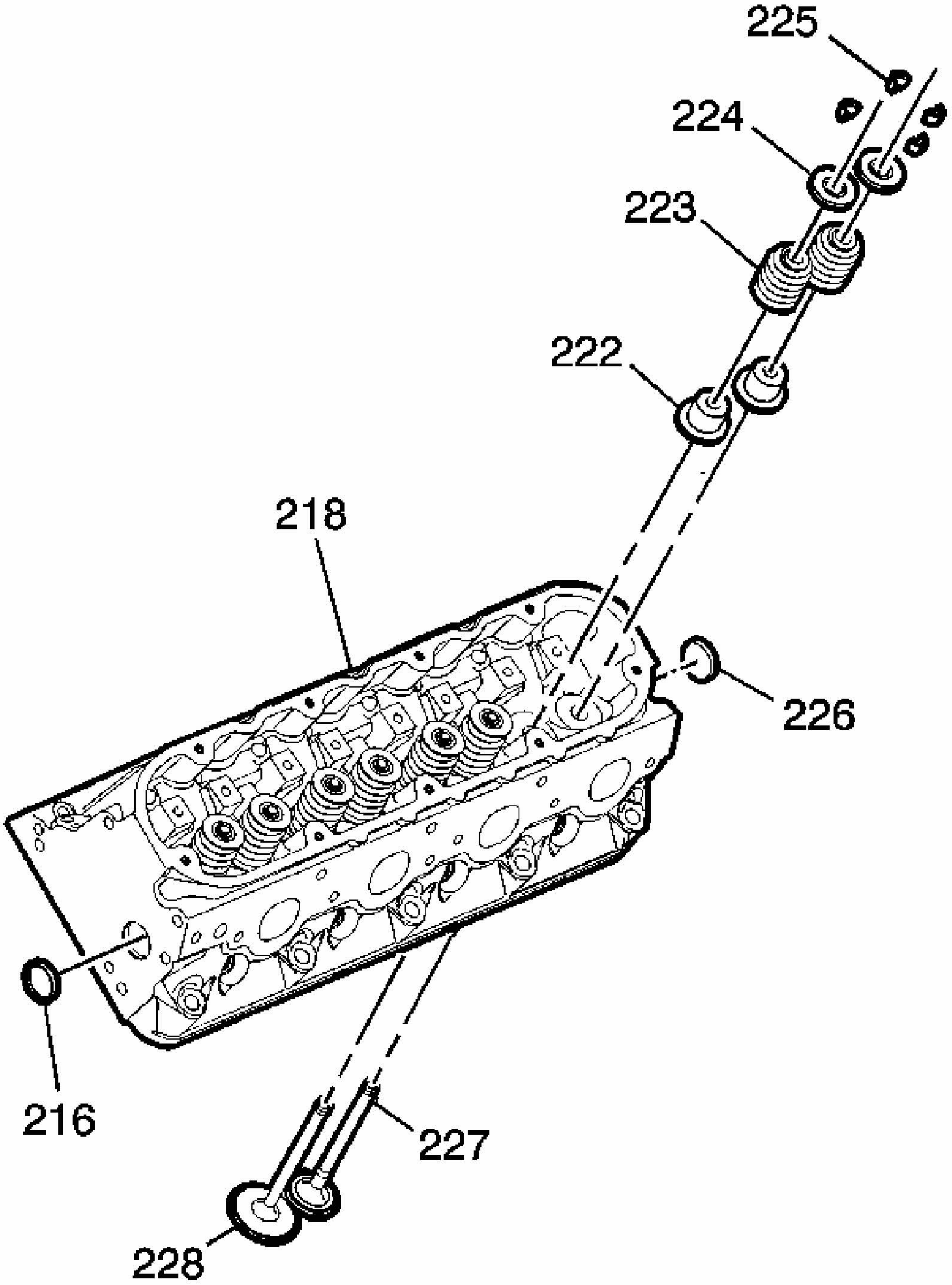
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Fig. 130: View Of Cylinder Head Components
Courtesy of GENERAL MOTORS CORP.

1. Clean the cylinder head valve spring seat and area.
2. Install the valve stem oil seal (222).

3. Install the valve spring (223).
4. Install the valve spring cap (224).

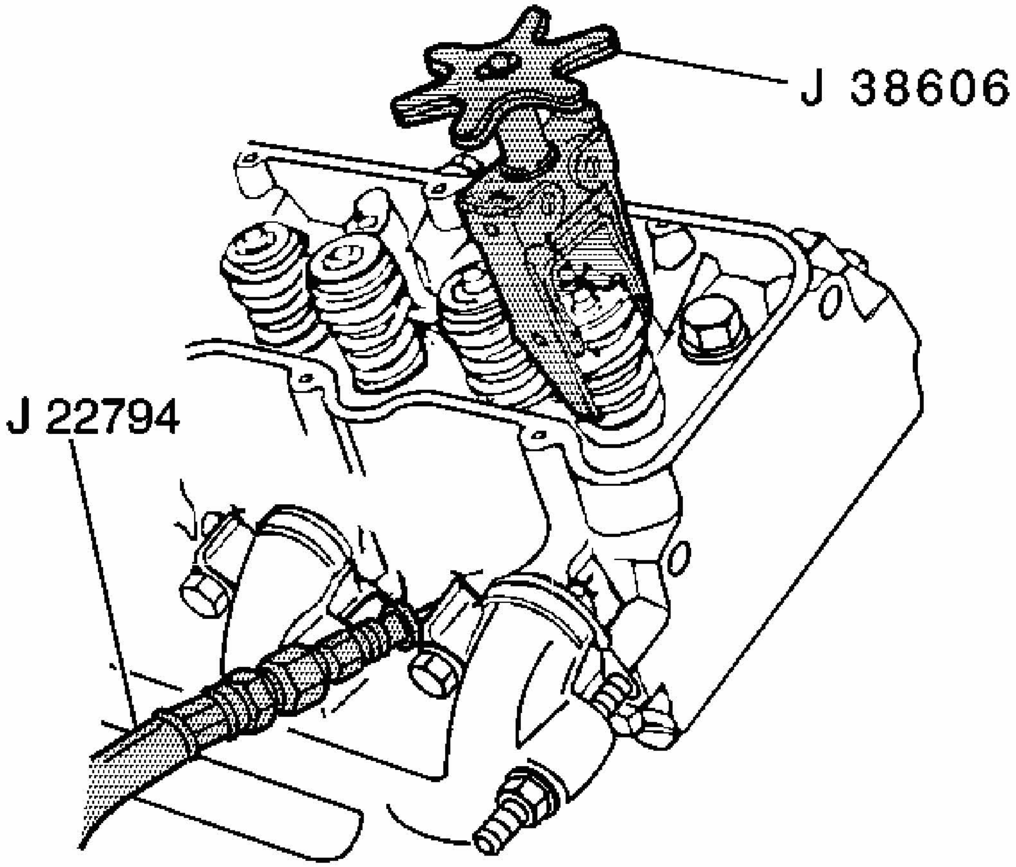


Fig. 131: Compress The Valve Spring (Cylinder Head Installed) Using Special Tools
Courtesy of GENERAL MOTORS CORP.

5. Compress the valve spring using the **J 38606** .
6. Install the valve stem keys.
    1. Use grease in order to hold the valve stem keys in place.
    2. Make sure the keys seat properly in the groove of the valve stem.
    3. Using the **J 38606** carefully release the valve spring tension, making sure the valve stem keys stay in place.
    4. Remove the **J 38606** .
    5. Tap the end of the valve stem with a plastic faced hammer to seat the keys, if

necessary.

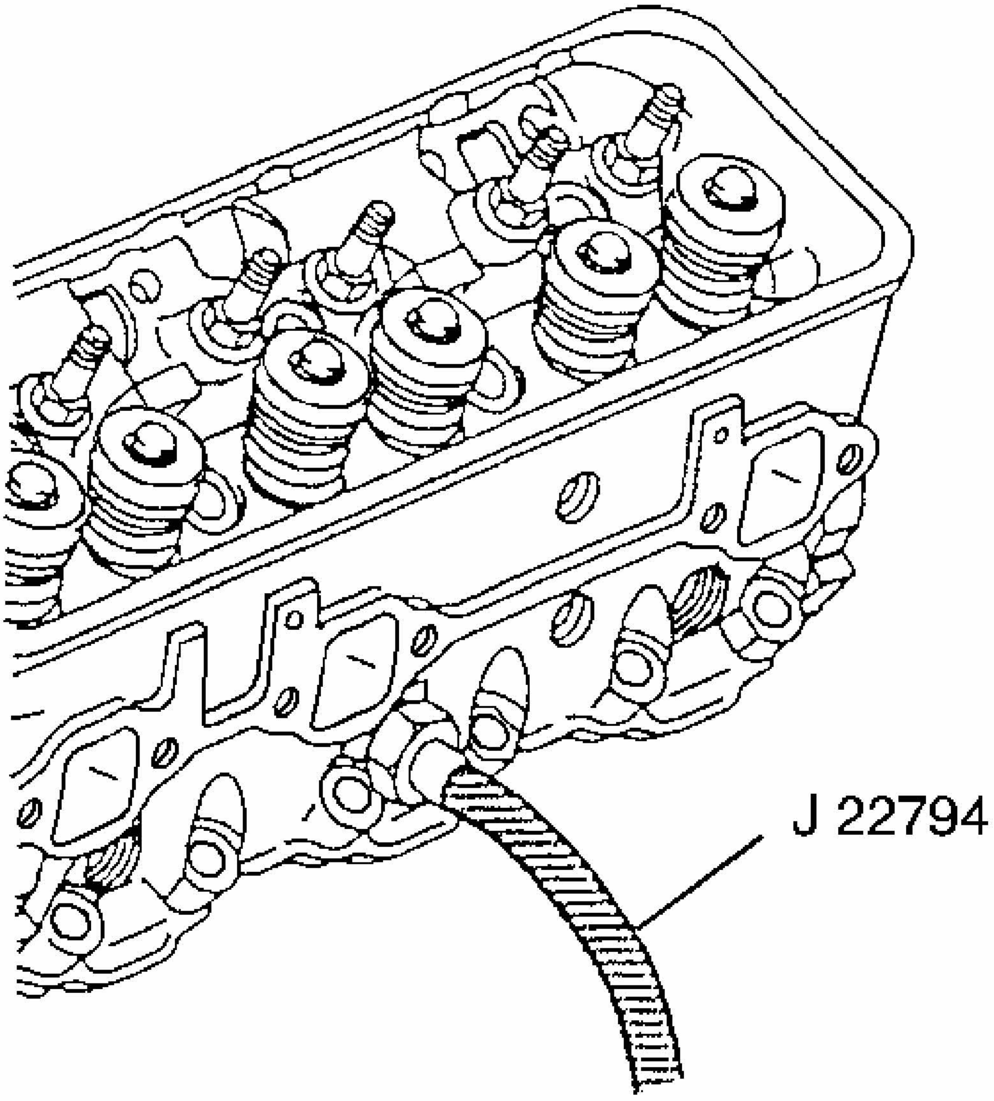


Fig. 132: View Of J 22794
Courtesy of GENERAL MOTORS CORP.

7. Remove the compressed air supply from the **J 22794** .
8. Remove the **J 22794** from the spark plug port.

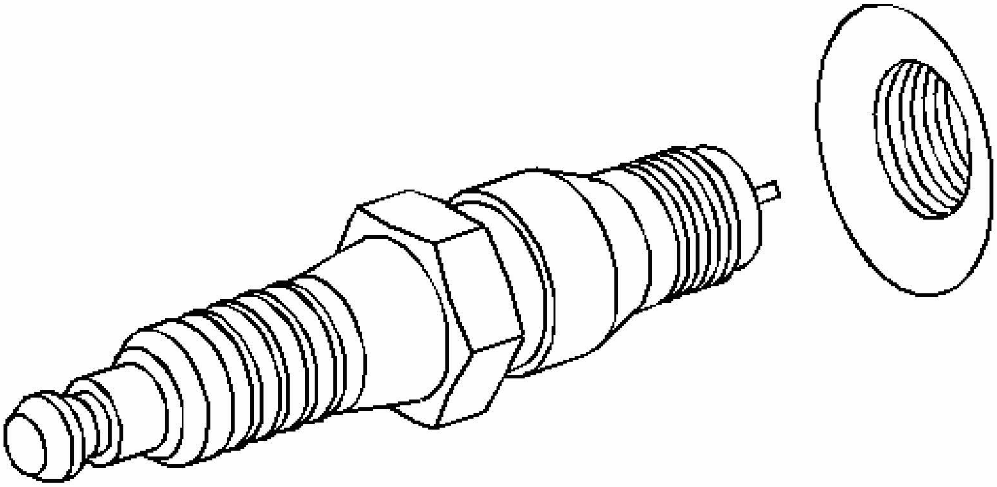


Fig. 133: View Of Spark Plug And Sparkplug Seat
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

9. Hand start the spark plug.

   Tighten: Tighten the spark plug to 15 N.m (11 lb ft).

10. Install the valve rocker arm. Refer to **Valve Rocker Arm and Push Rod Replacement**.

OIL LEVEL INDICATOR AND TUBE REPLACEMENT

Removal Procedure

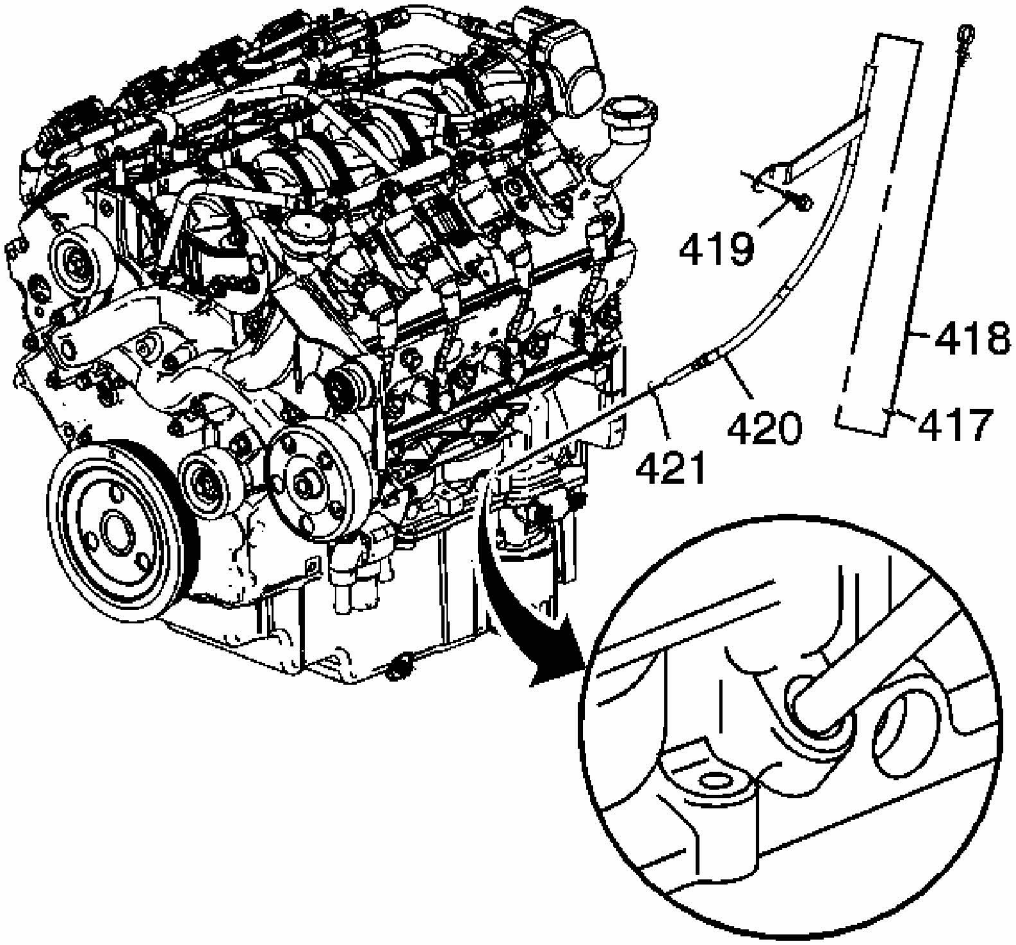


Fig. 134: View Of Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil level indicator (418) from the tube.
2. Remove the oil level indicator tube bolt (419).
3. Remove the oil level indicator tube (420) from the engine block.

IMPORTANT: Inspect the O-ring for cuts or damage. The seal may be reused if it is not cut or damaged.

4. Remove the O-ring seal from the tube, if necessary.

Installation Procedure

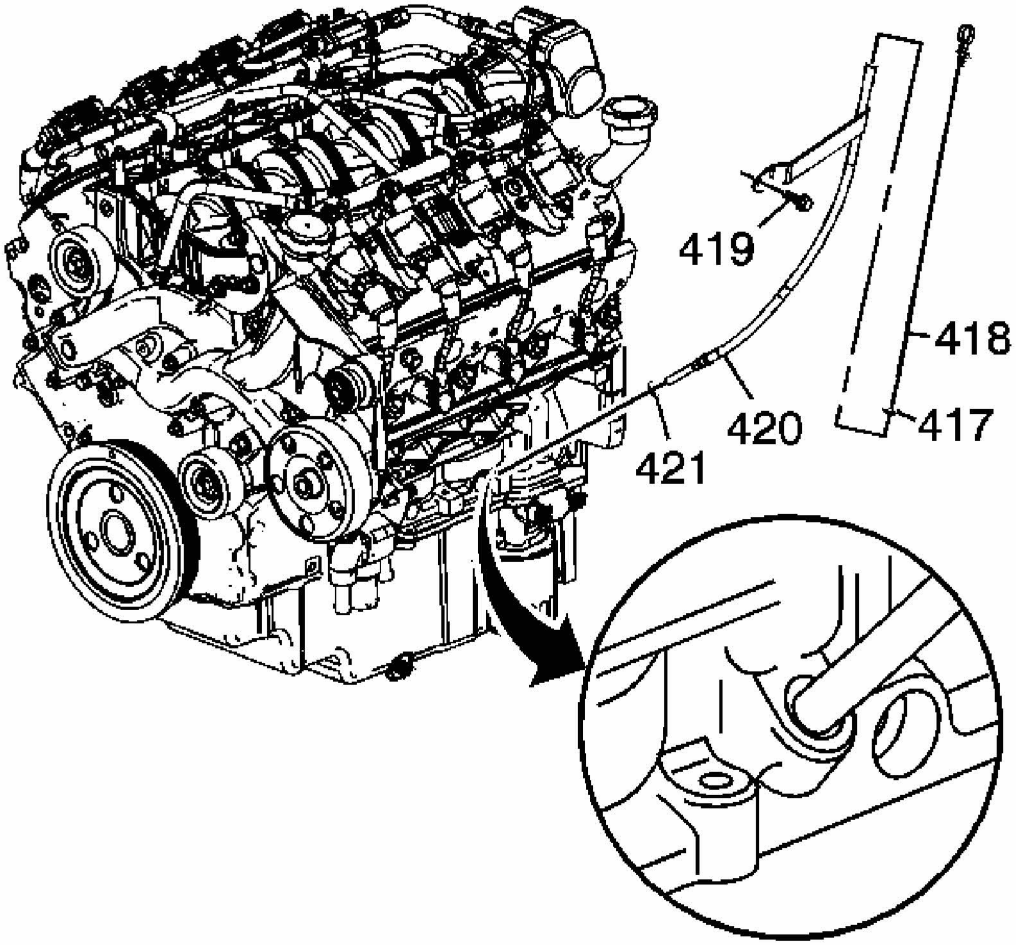


Fig. 135: View Of Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the O-ring seal with clean engine oil.
2. Install the O-ring seal onto the oil level indicator tube, if necessary.
3. Install the oil level indicator tube (420) to the engine block. The tube must be installed with the collar flush to the block.

NOTE: **Refer to Fastener Notice .**

4. Install the oil level indicator tube bolt (419)

Tighten: Tighten the bolt to 25 N.m (18 lb ft).

5. Install the oil level indicator (418) to the tube.

CYLINDER HEAD REPLACEMENT - LEFT

Tools Required

- **J 42385-100** Head/Main Bolt Thread Repair Kit. See **Special Tools**.
- **J 42385-200** Common Threads Repair Kit. See **Special Tools**.
- **J 45059** Torque Angle Meter

Removal Procedure

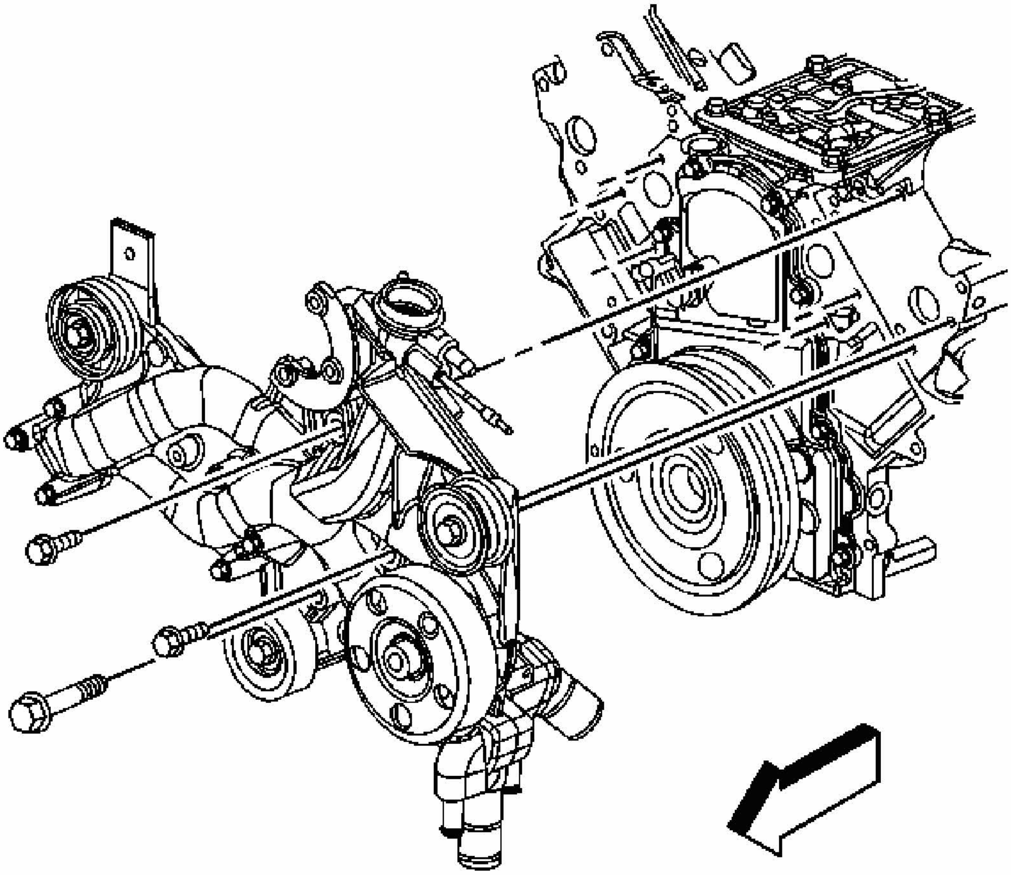


Fig. 136: Water Pump Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
2. Remove the coolant air bleed pipe. Refer to **Coolant Air Bleed Pipe Assembly**

Replacement (RPO LS4) .

3. Remove the left exhaust manifold. Refer to **Exhaust Manifold Replacement - Left (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Left (RPO LS4)** .
4. Remove the pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
5. Remove the power steering pump pulley. Refer to **Power Steering Pulley Replacement (LS4)** or **Power Steering Pulley Replacement (LZ4/LZE/LZ9)** .
6. Remove the 3 coolant manifold bolts to the cylinder head.

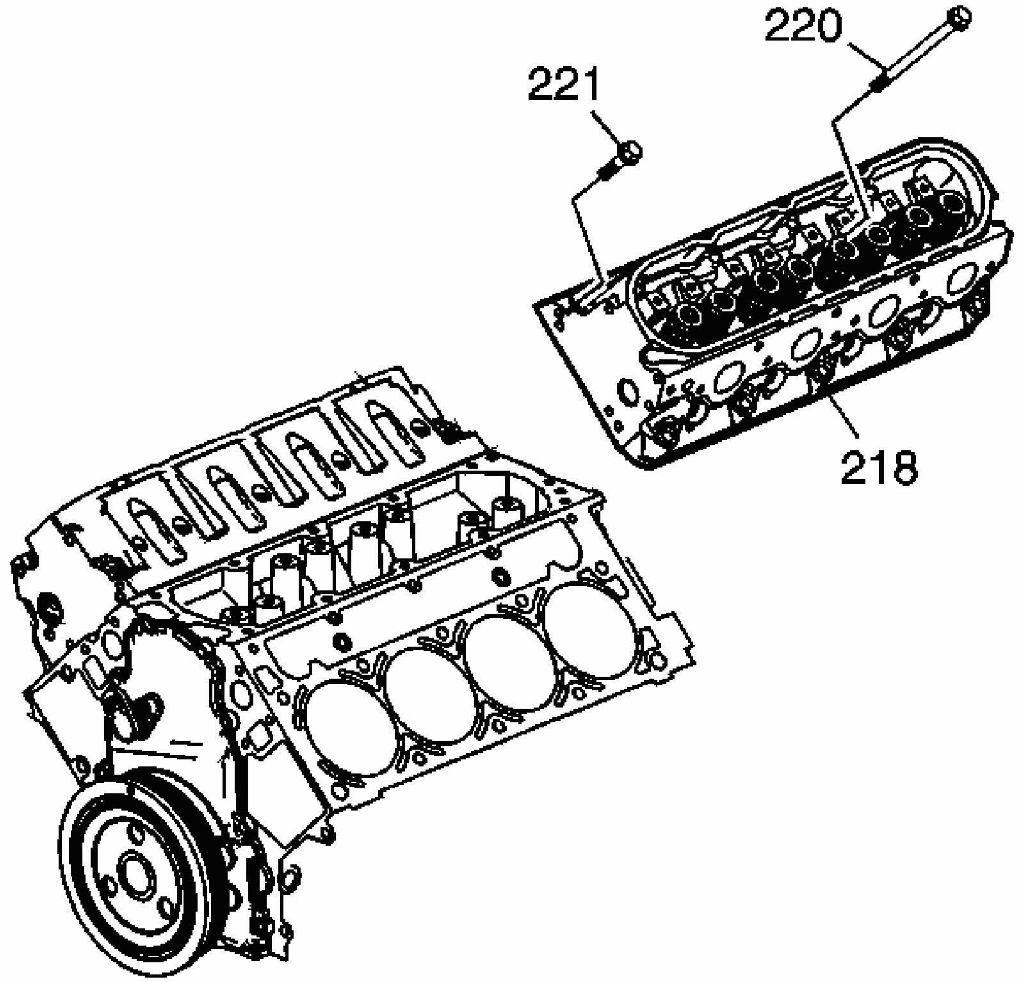


Fig. 137: View Of Cylinder Head & Bolts (Left)
Courtesy of GENERAL MOTORS CORP.

7. Remove the engine mount strut and bracket. Refer to **Engine Mount Strut Replacement**.

IMPORTANT: The cylinder head bolts are of a torque to yield design and are NOT to be used again.

8. Remove and discard the cylinder head bolts (220, 221).

NOTE: After removal, place the cylinder head on 2 wood blocks in order to prevent damage to the sealing surfaces.

9. Remove the cylinder head.

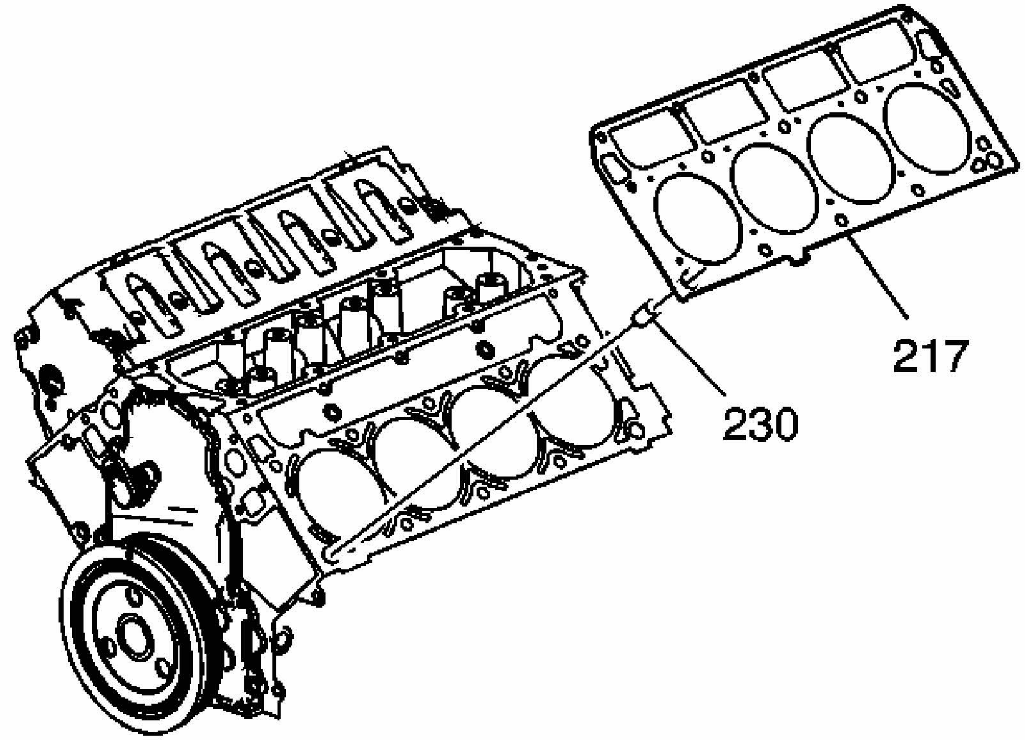


Fig. 138: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

10. Remove and discard the cylinder head gasket (217).
11. Clean and inspect the cylinder head. Refer to **Cylinder Head Cleaning and Inspection**.

Installation Procedure

CAUTION: Wear safety glasses in order to avoid eye

damage.

NOTE: Clean all dirt, debris, and coolant from the engine block cylinder head bolt holes. Failure to remove all foreign material may result in damaged threads, improperly tightened fasteners or damage to components.

IMPORTANT:

- **Do not reuse the cylinder head bolts. Install NEW cylinder head bolts during assembly.**
- **Do not use any type of sealant on the cylinder head gasket (unless specified).**
- **The cylinder head gaskets must be installed in the proper direction and position.**

1. Clean the cylinder head bolt holes, if required. **J 42385-100** can be used to clean the threads of old threadlocking material. See **Special Tools**.
2. Clean the engine block bolt holes, if required. **J 42385-200** can be used to clean the threads of old threadlocking material. See **Special Tools**.
3. Use spray cleaner GM P/N 12346139 or P/N 12377981, (Canadian P/N 10953463), or equivalent into the hole.
4. Clean the cylinder head bolt holes with compressed air.
5. Check the cylinder head locating pins for proper installation.

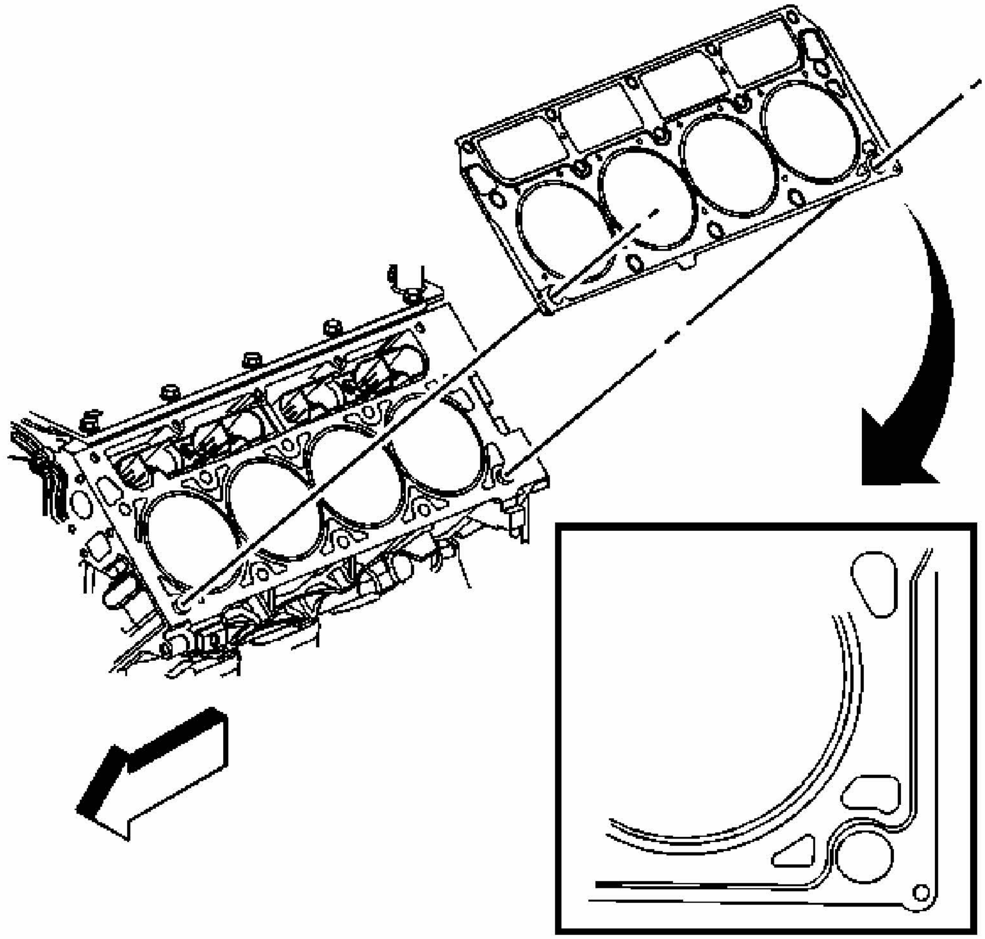


Fig. 139: Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

6. Inspect the displacement markings on the cylinder head gasket, for the proper usage.

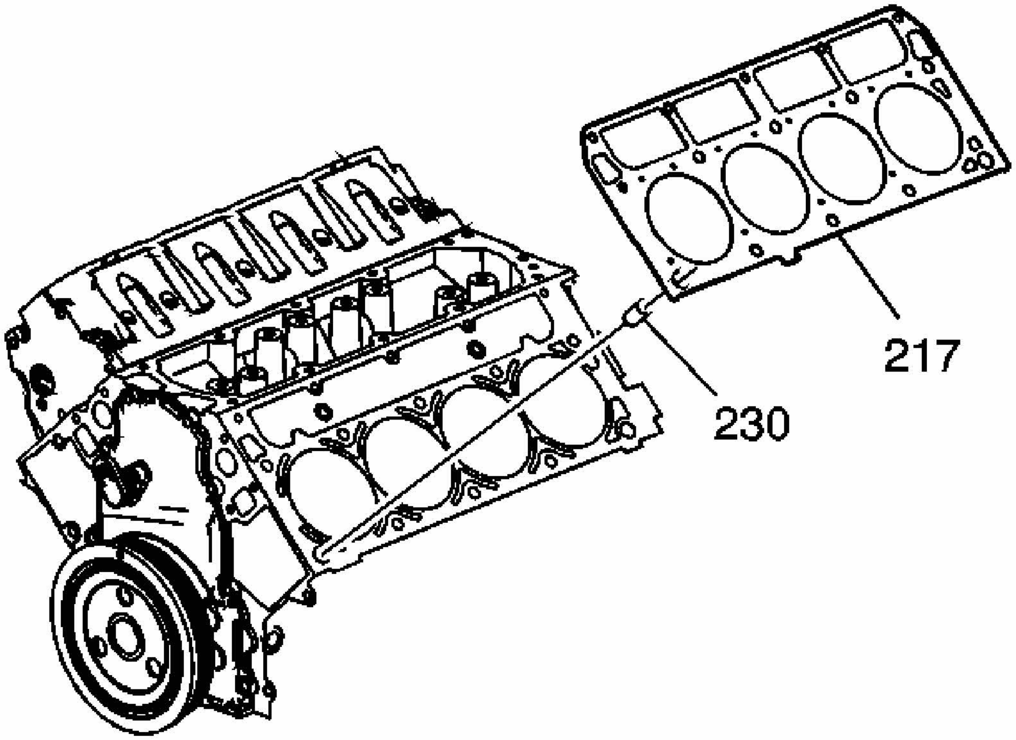


Fig. 140: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

7. Install the NEW cylinder head gasket (217) onto the locating pins.

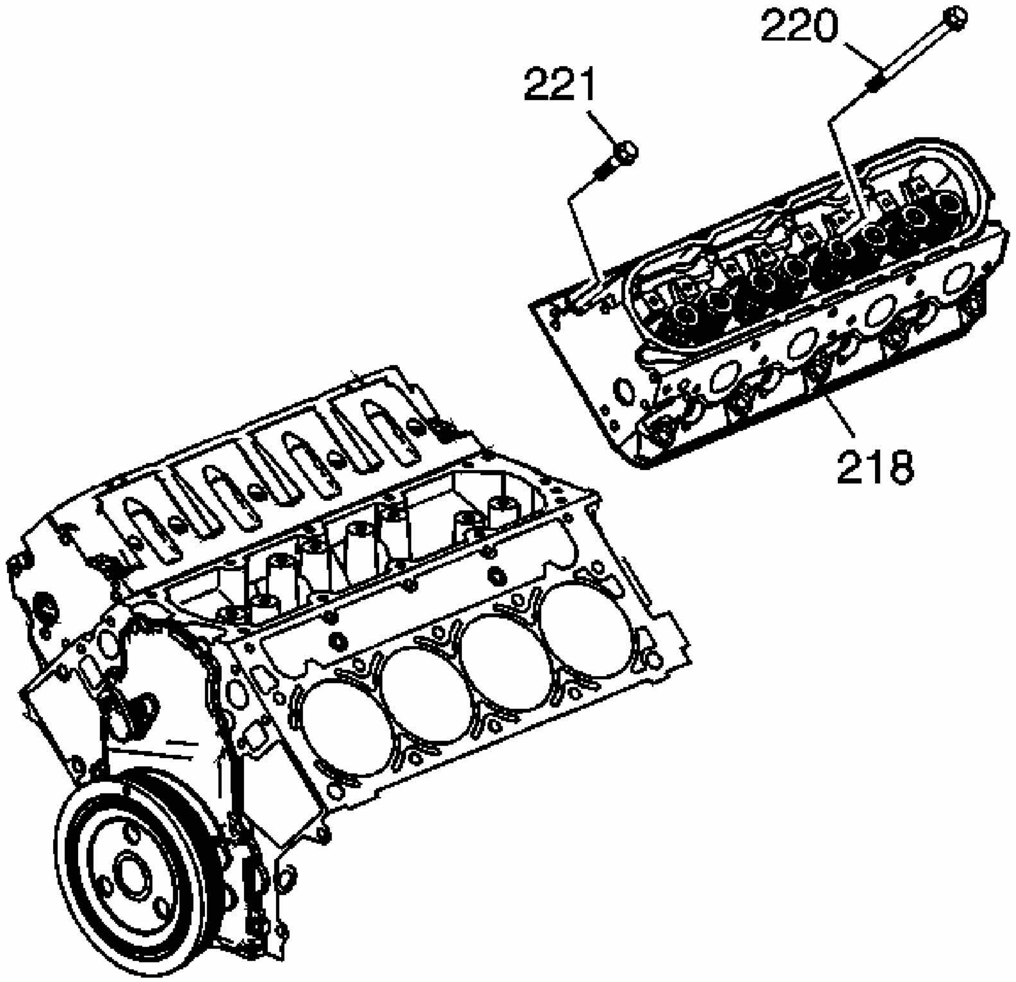


Fig. 141: View Of Cylinder Head & Bolts (Left)
Courtesy of GENERAL MOTORS CORP.

8. Install the cylinder head onto the locating pins.
9. Install the NEW cylinder head bolts (220, 221).

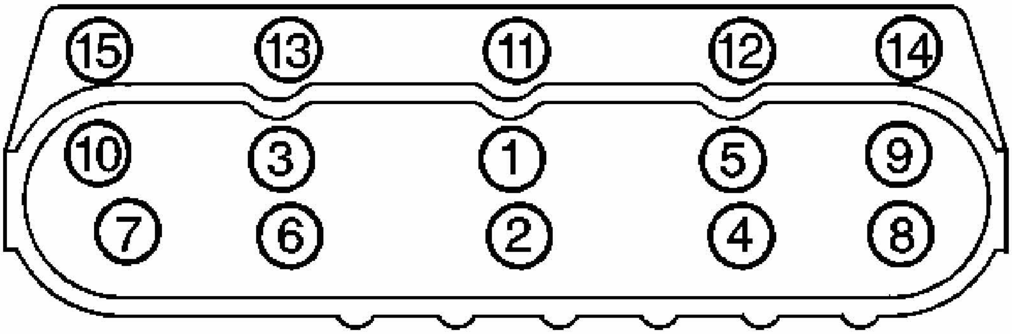


Fig. 142: Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

10. Tighten the cylinder head bolts.

    Tighten:

    1. Tighten the M11 bolts (1-10) a first pass in sequence to 30 N.m (22 lb ft).
    2. Tighten the M11 bolts (1-10) a second pass in sequence to 90 degrees using **J 45059** .
    3. Tighten the M11 bolts (1-10) a final pass in sequence to 70 degrees using **J 45059** .
    4. Tighten the M8 bolts (11-15) to 30 N.m (22 lb ft). Begin with the center bolt (11) and alternating side-to-side, work outward tightening all of the bolts.

11. Install the engine mount strut and bracket. Refer to **Engine Mount Strut Replacement**.

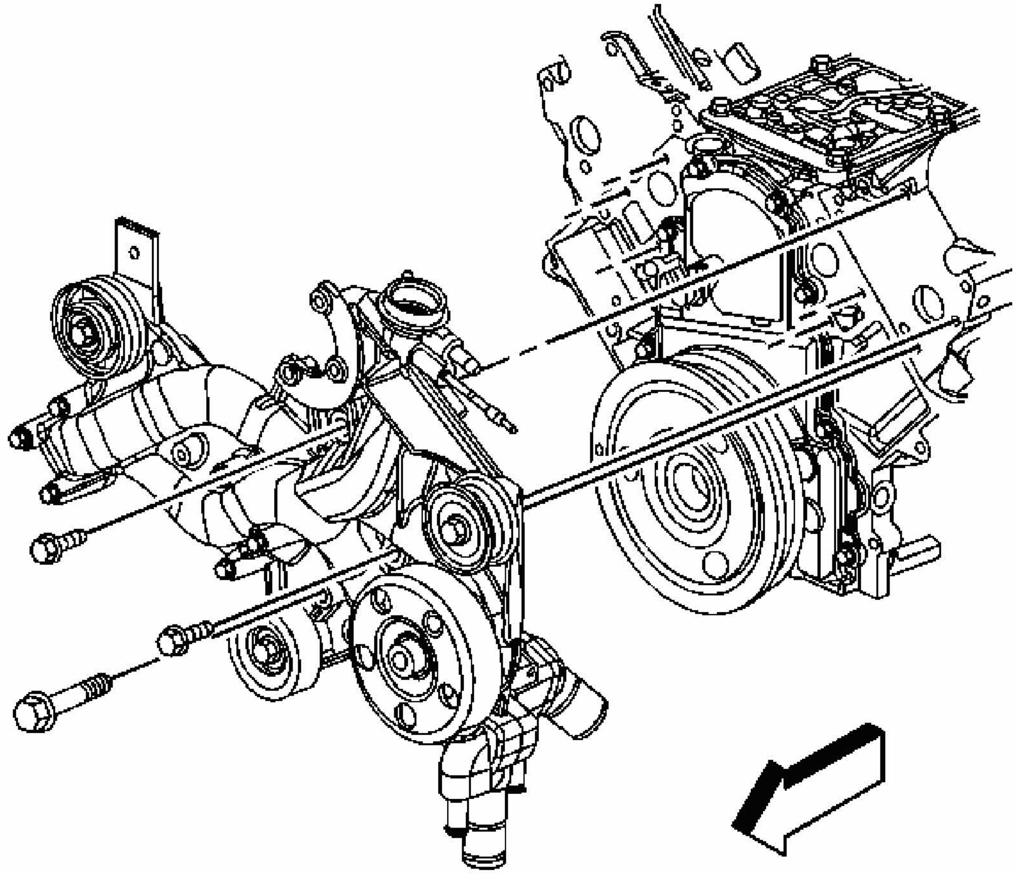


Fig. 143: Water Pump Assembly
Courtesy of GENERAL MOTORS CORP.

12. Install the 3 coolant manifold bolts to the cylinder head.

    Tighten: Tighten the bolts to 50 N.m (37 lb ft).

13. Install the power steering pump pulley. Refer to **Power Steering Pulley Replacement (LS4)** or **Power Steering Pulley Replacement (LZ4/LZE/LZ9)** .
14. Install the pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
15. Install the left exhaust manifold. Refer to **Exhaust Manifold Replacement - Left (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Left (RPO LS4)** .
16. Install the coolant air bleed pipe. Refer to **Coolant Air Bleed Pipe Assembly Replacement (RPO LS4)** .
17. Install the intake manifold. Refer to **Intake Manifold Replacement**.

CYLINDER HEAD REPLACEMENT - RIGHT

Tools Required

- **J 42385-100** Head/Main Bolt Thread Repair Kit. See **Special Tools**.
- **J 42385-200** Common Threads Repair Kit. See **Special Tools**.
- **J 45059** Torque Angle Meter

Removal Procedure

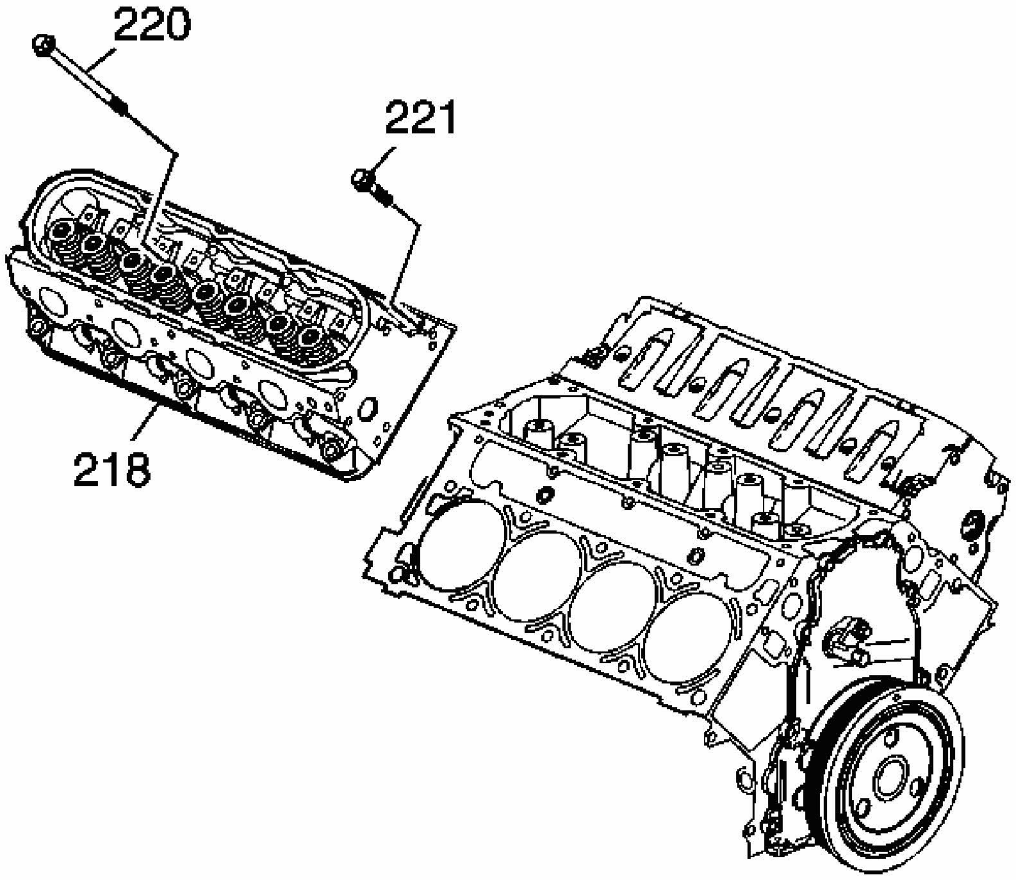


Fig. 144: View Of Cylinder Head & Bolt (Right)
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
2. Remove the coolant air bleed pipe. Refer to **Coolant Air Bleed Pipe Assembly Replacement (RPO LS4)** .
3. Remove the generator bracket. Refer to **Generator Bracket Replacement (RPO**

LS4) .

4. Remove the right exhaust manifold. Refer to **Exhaust Manifold Replacement - Right (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Right (RPO LS4)** .
5. Remove the pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.

IMPORTANT: The cylinder head bolts are of a torque to yield design and are NOT to be used again.

6. Remove and discard the cylinder head bolts (220, 221).

NOTE: After removal, place the cylinder head on 2 wood blocks in order to prevent damage to the sealing surfaces.

7. Remove the cylinder head (217).

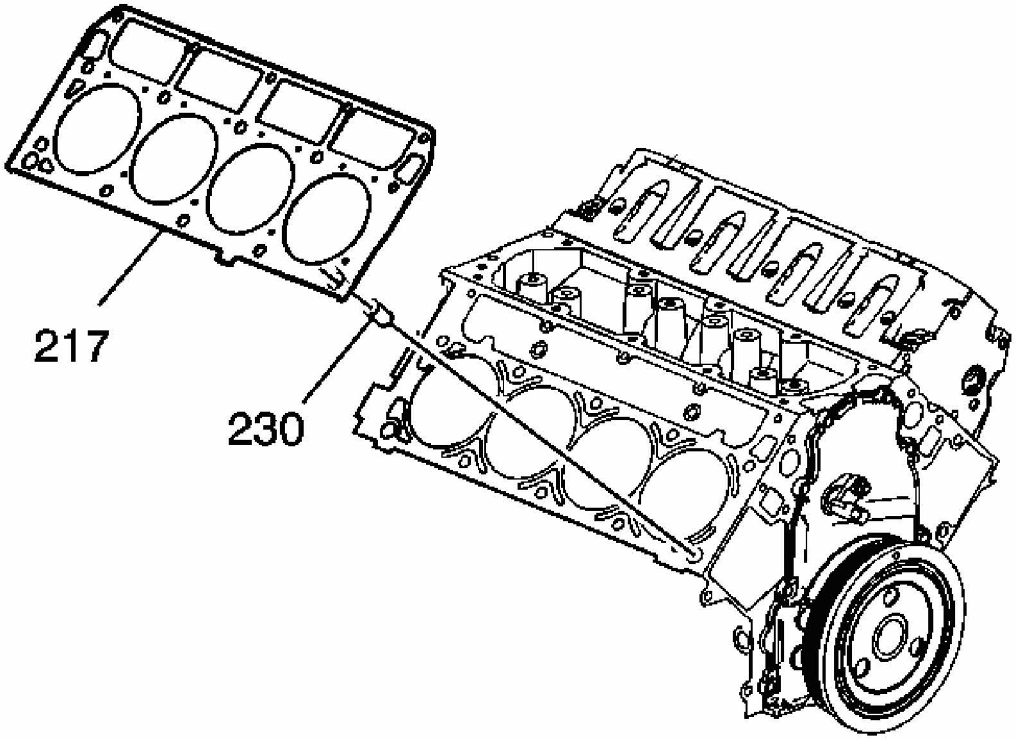


Fig. 145: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

8. Remove and discard the cylinder head gasket (217).

9. Clean and inspect the cylinder head. Refer to **Cylinder Head Cleaning and Inspection**.

Installation Procedure

CAUTION: Wear safety glasses in order to avoid eye damage.

NOTE: Clean all dirt, debris, and coolant from the engine block cylinder head bolt holes. Failure to remove all foreign material may result in damaged threads, improperly tightened fasteners or damage to components.

IMPORTANT:

- **Do not reuse the cylinder head bolts. Install NEW cylinder head bolts during assembly.**
- **Do not use any type of sealant on the cylinder head gasket (unless specified).**
- **The cylinder head gaskets must be installed in the proper direction and position.**

1. Clean the cylinder head bolt holes, if required. **J 42385-100** can be used to clean the threads of old threadlocking material. See **Special Tools**.
2. Clean the engine block bolt holes, if required. **J 42385-200** can be used to clean the threads of old threadlocking material. See **Special Tools**.
3. Use spray cleaner GM P/N 12346139 or P/N 12377981, (Canadian P/N 10953463), or equivalent into the hole.
4. Clean the cylinder head bolt holes with compressed air.
5. Check the cylinder head locating pins for proper installation.

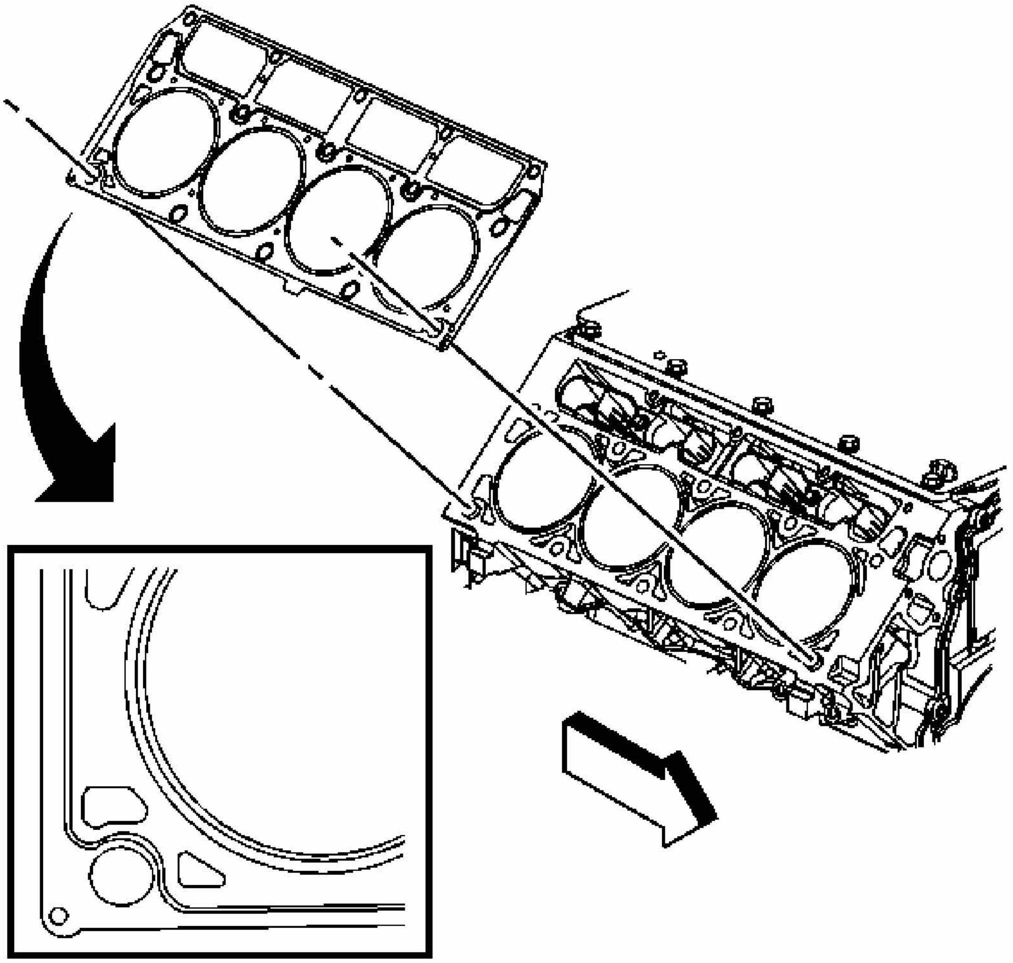


Fig. 146: Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

6. Inspect the displacement markings on the cylinder head gasket, for the proper usage.

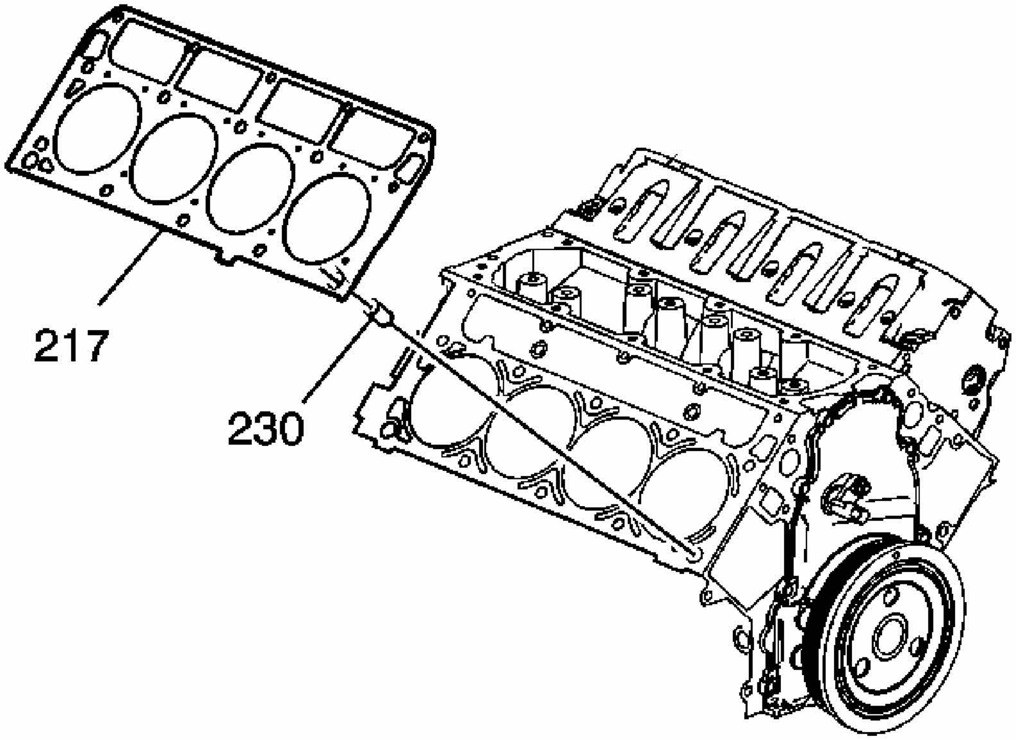


Fig. 147: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

7. Install the NEW cylinder head gasket (217) onto the locating pins.

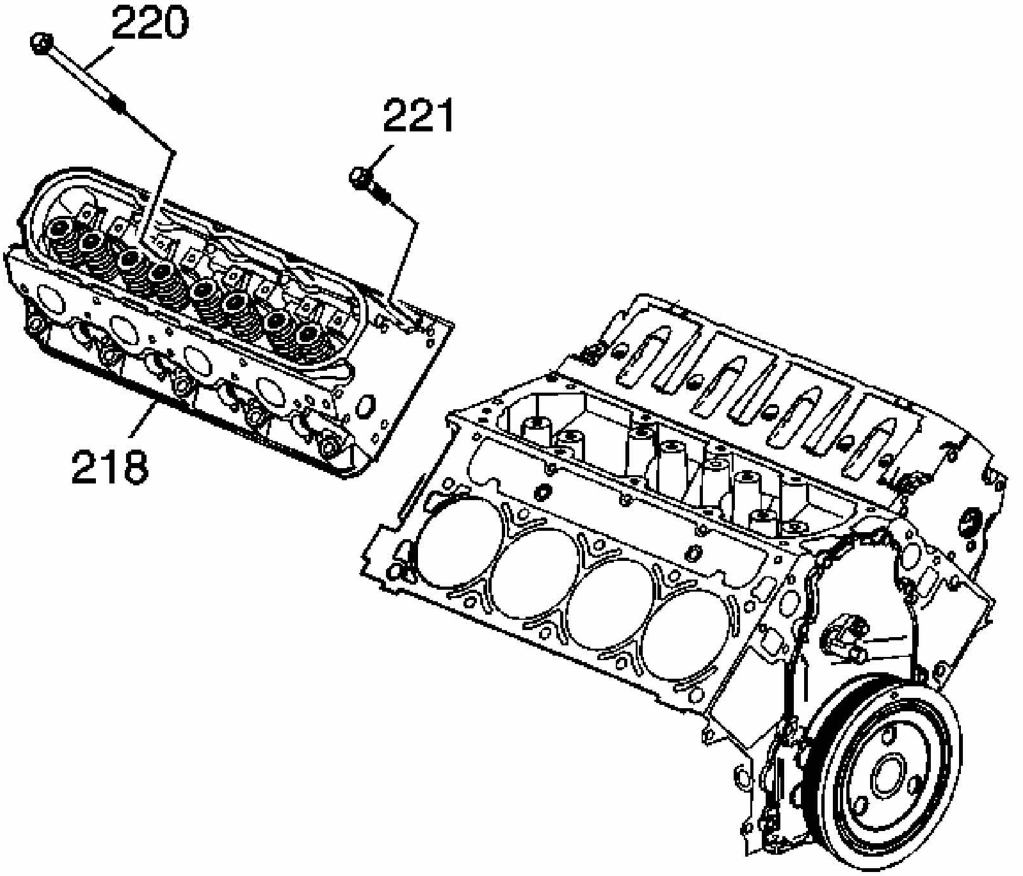


Fig. 148: View Of Cylinder Head & Bolt (Right)
Courtesy of GENERAL MOTORS CORP.

8. Install the cylinder head (217) onto the locating pins.
9. Install the NEW cylinder head bolts (220, 221).

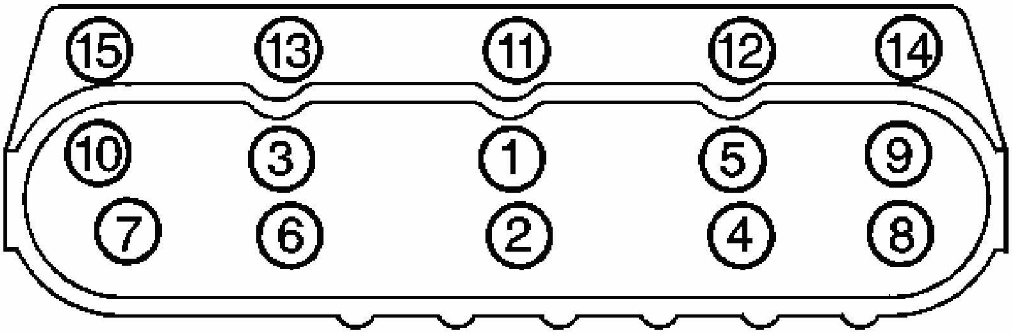


Fig. 149: Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

10. Tighten the cylinder head bolts.

    Tighten:

    1. Tighten the M11 bolts (1-10) a first pass in sequence to 30 N.m (22 lb ft).
    2. Tighten the M11 bolts (1-10) a second pass in sequence to 90 degrees using **J 45059** .
    3. Tighten the M11 bolts (1-10) a final pass in sequence to 70 degrees using **J 45059** .
    4. Tighten the M8 bolts (11-15) to 30 N.m (22 lb ft). Begin with the center bolt (11) and alternating side-to-side, work outward tightening all of the bolts.

11. Install the pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
12. Install the right exhaust manifold. Refer to **Exhaust Manifold Replacement - Right (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Right (RPO LS4)** .
13. Install the generator bracket. Refer to **Generator Bracket Replacement (RPO LS4)** .
14. Install the coolant air bleed pipe. Refer to **Coolant Air Bleed Pipe Assembly Replacement (RPO LS4)** .
15. Install the intake manifold. Refer to **Intake Manifold Replacement**.

VALVE LIFTER REPLACEMENT

Tools Required

J 3049-A Valve Lifter Remover. See **Special Tools**.

Removal Procedure

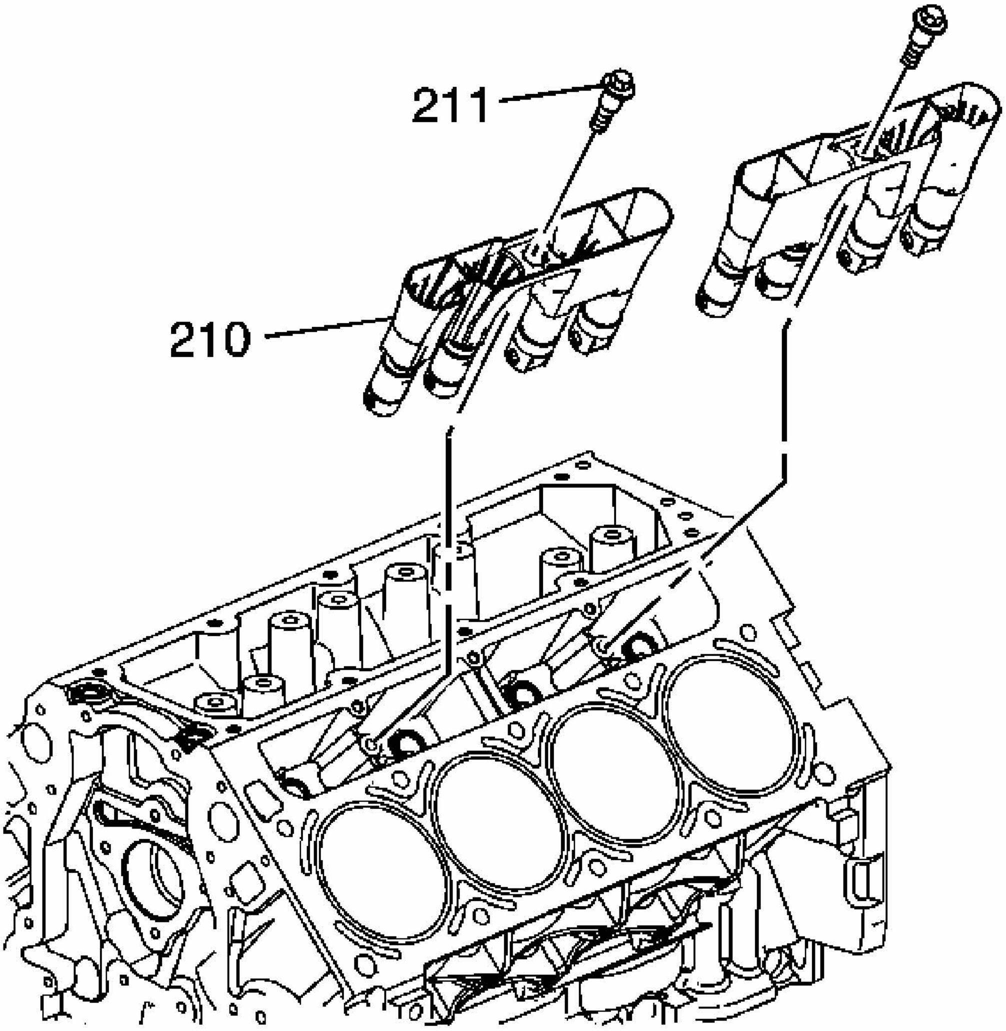


Fig. 150: View Of Lifter Guides & Lifters
Courtesy of GENERAL MOTORS CORP.

1. Remove the cylinder head. Refer to **Cylinder Head Replacement - Left** and/or **Cylinder Head Replacement - Right**.
2. Remove the lifter guide bolts (211).

IMPORTANT: Note the installed position of the guides. The notched area of the guide is to align with the locating tab of the block.

3. Remove the lifter guides (210) with lifters.

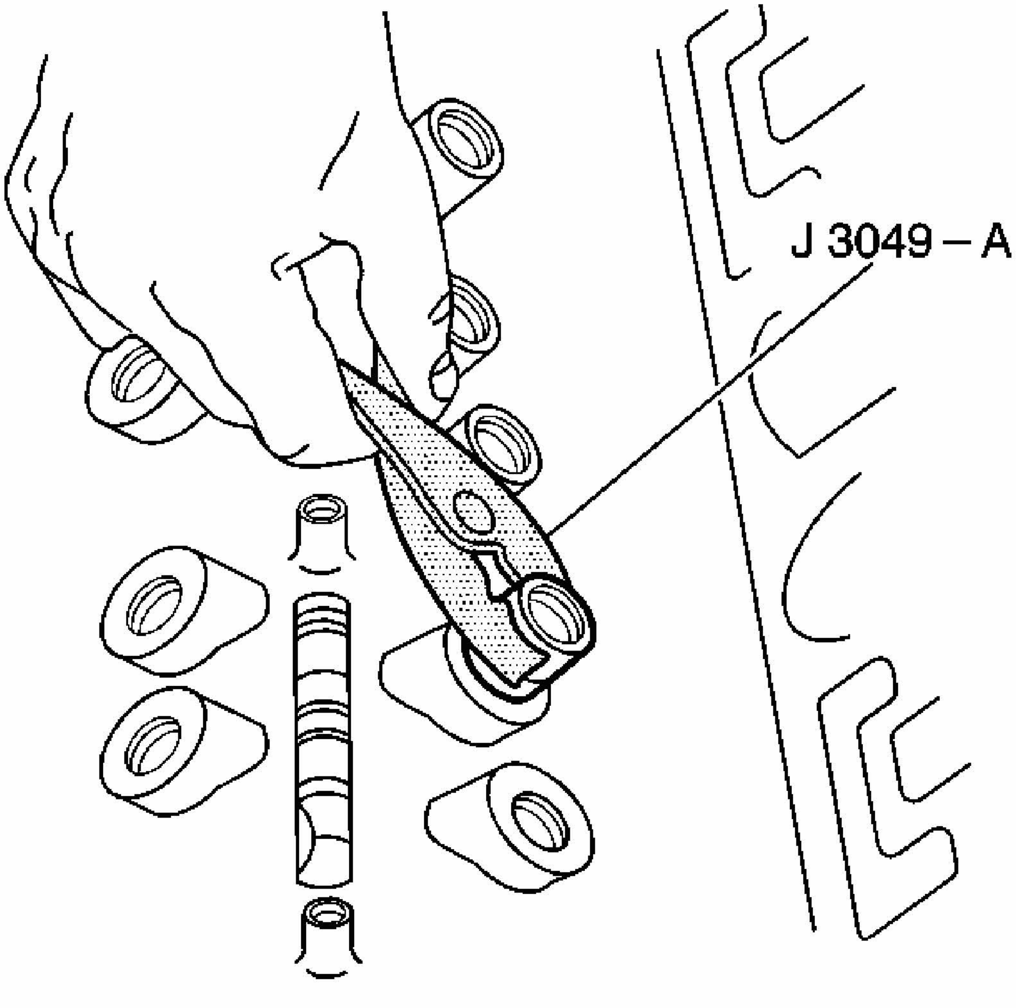


Fig. 151: Using J 3049-A To Remove The Stuck Valve Lifters
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Some valve lifters may be stuck in their bores because of gum or varnish deposits.

4. Use the **J 3049-A** or equivalent in order to remove the valve lifters, if necessary. See Special Tools.

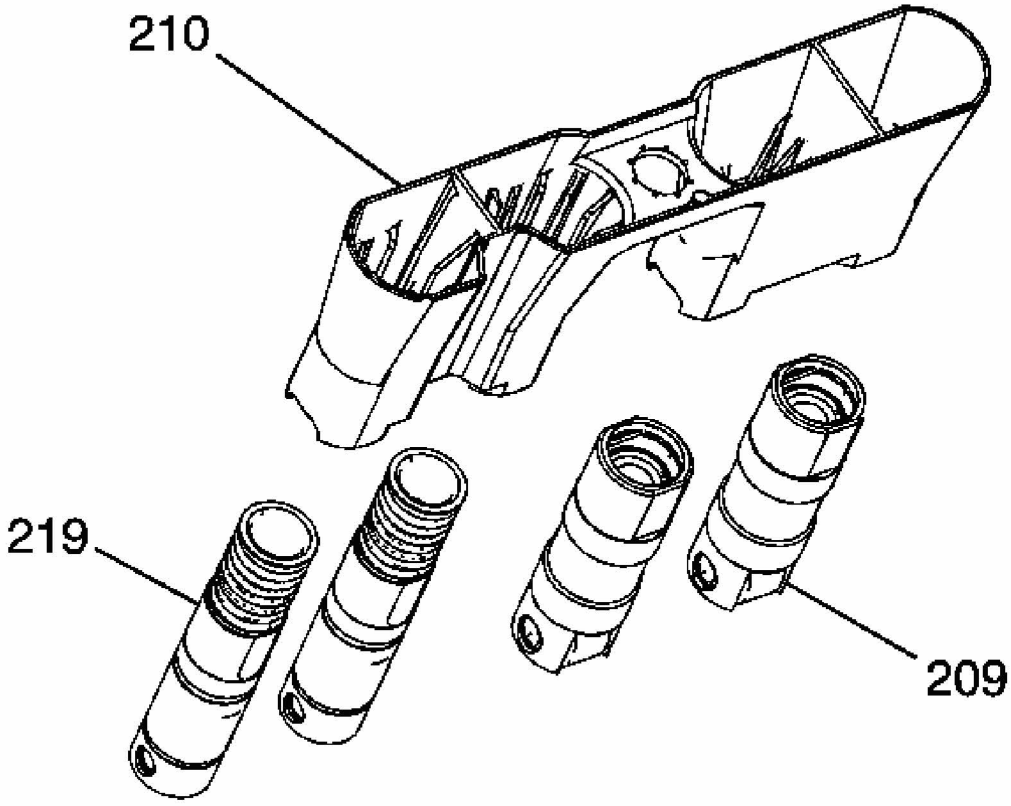


Fig. 152: Exploded View Of Lifter Guides & Lifters
Courtesy of GENERAL MOTORS CORP.

5. Remove the valve lifters (209, 219) from the guide (210).

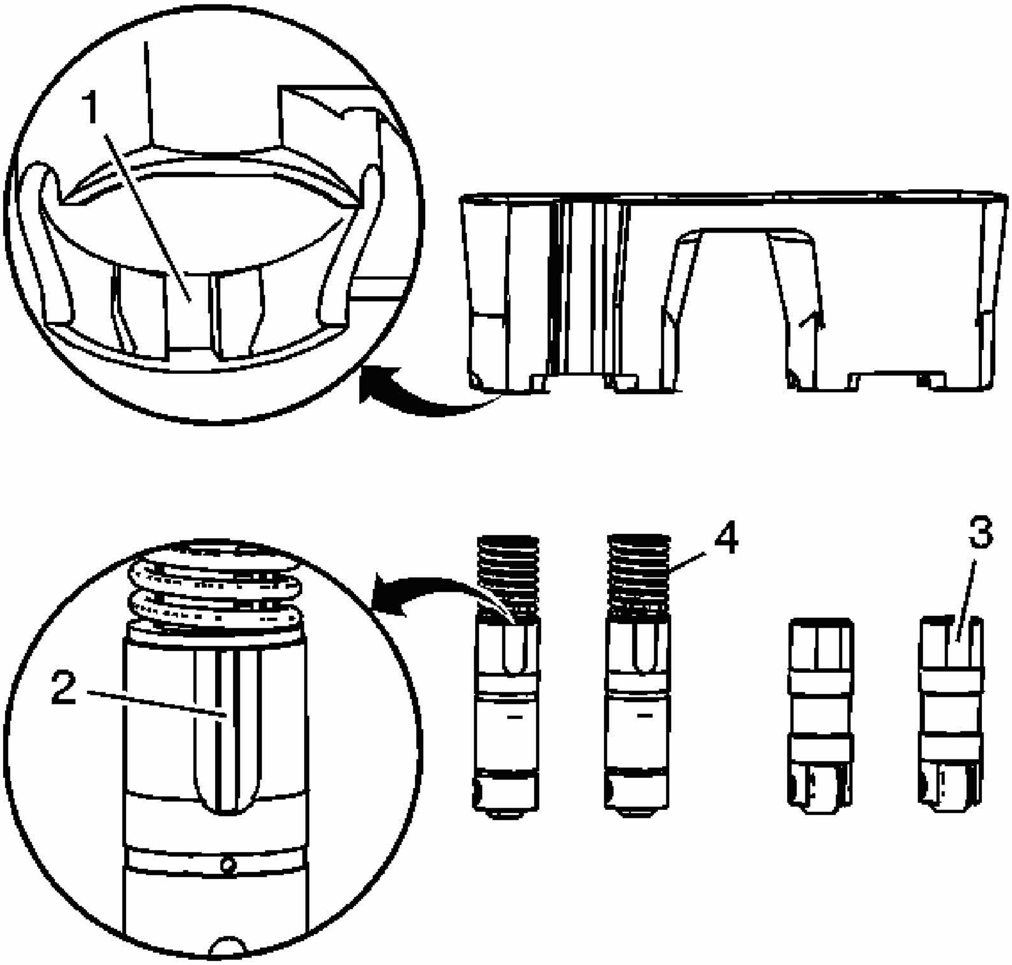


Fig. 153: Inserting Valve Lifters Into Lifter Guides
Courtesy of GENERAL MOTORS CORP.

6. Organize or mark the components so that they can be installed in the same location from which they were removed. The displacement on demand lifters are installed into the guide by aligning the notched area of the guide (1) with the raised surface on the side of the lifter (2).
7. Clean and inspect the valve lifters. Refer to **Valve Lifters and Guides Cleaning and Inspection**.

Installation Procedure

IMPORTANT:
- **When reusing the valve lifters, install the lifters in their original locations.**

- **If camshaft replacement is required, the valve lifters must also be replaced.**
- **Each of the four valve guide assemblies will contain two displacement on demand valve lifters and two non-displacement on demand valve lifters.**
- **With the lifters and guides properly installed, cylinders 1, 4, 6, and 7 lifter bores will each contain two displacement on demand valve lifters.**

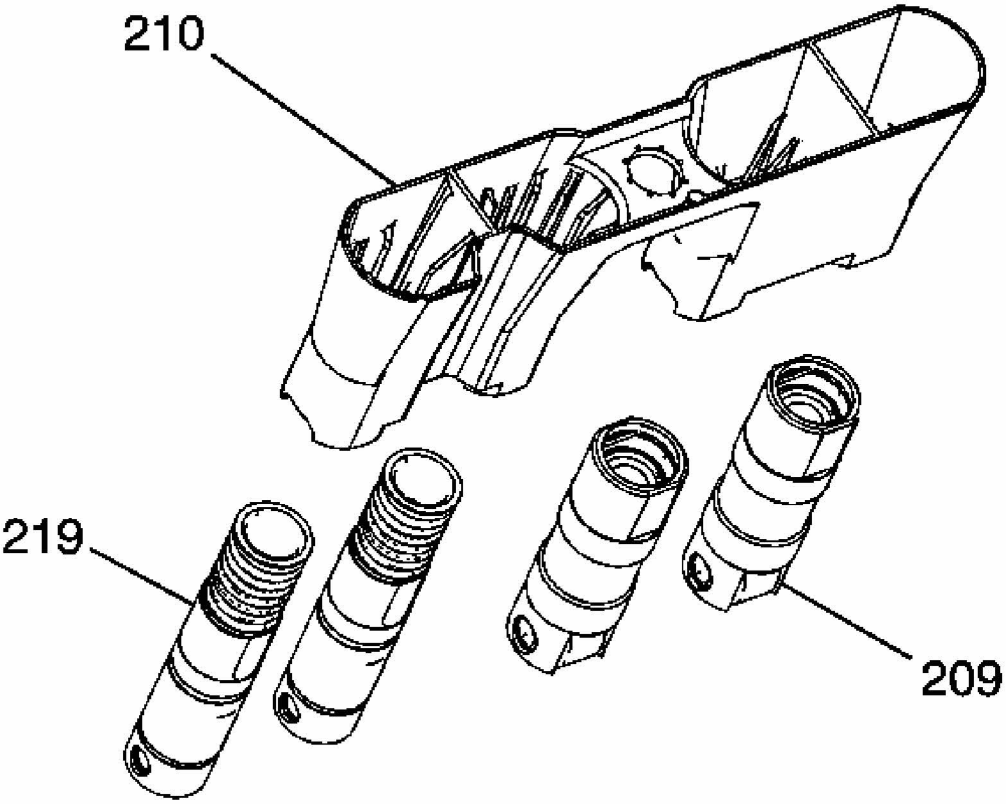


Fig. 154: Exploded View Of Lifter Guides & Lifters
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the valve lifters (209, 219) and engine block valve lifter bores with clean engine oil.

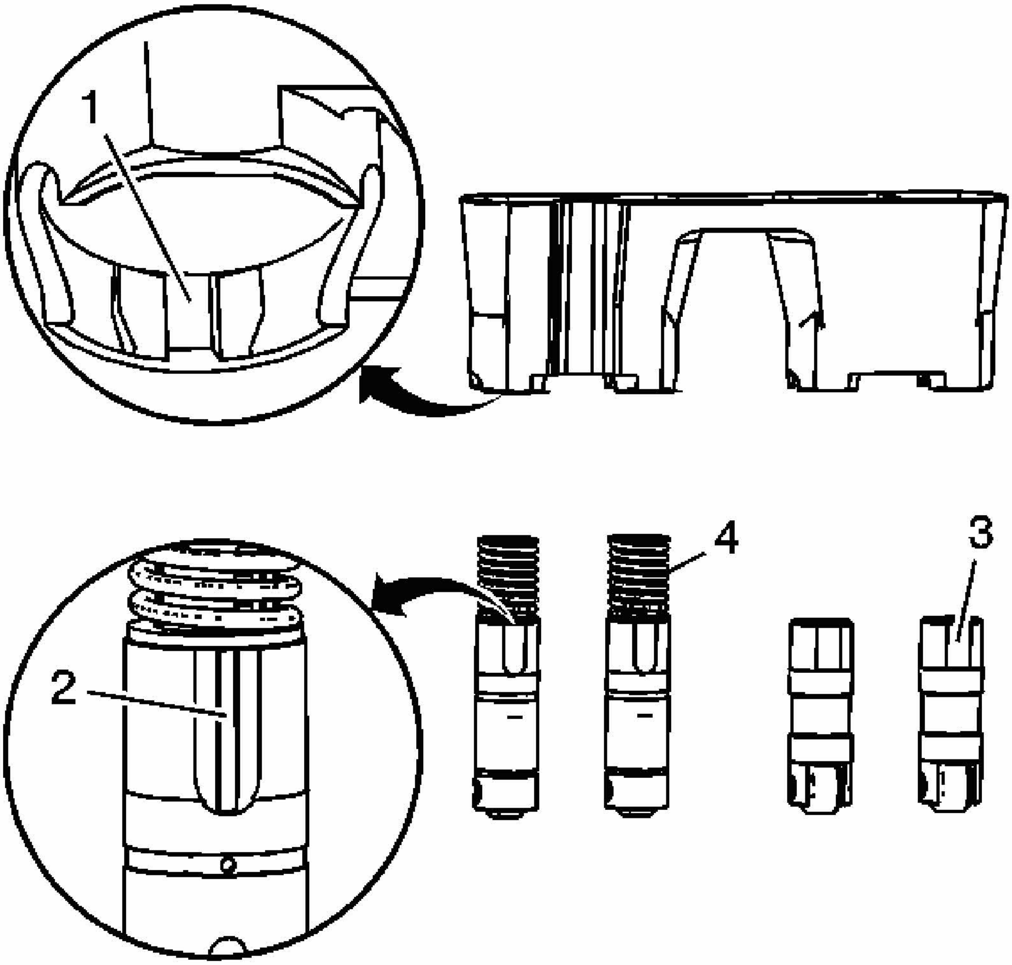


Fig. 155: Inserting Valve Lifters Into Lifter Guides
Courtesy of GENERAL MOTORS CORP.

2. Insert the valve lifters into the lifter guides (210).
    - Align the flat area (3) on the top of the non-displacement on demand lifter with the flat area in the lifter guide bore.
    - The displacement on demand lifters are to be installed into the guide, with the notch in the guide (2) of the lifter.

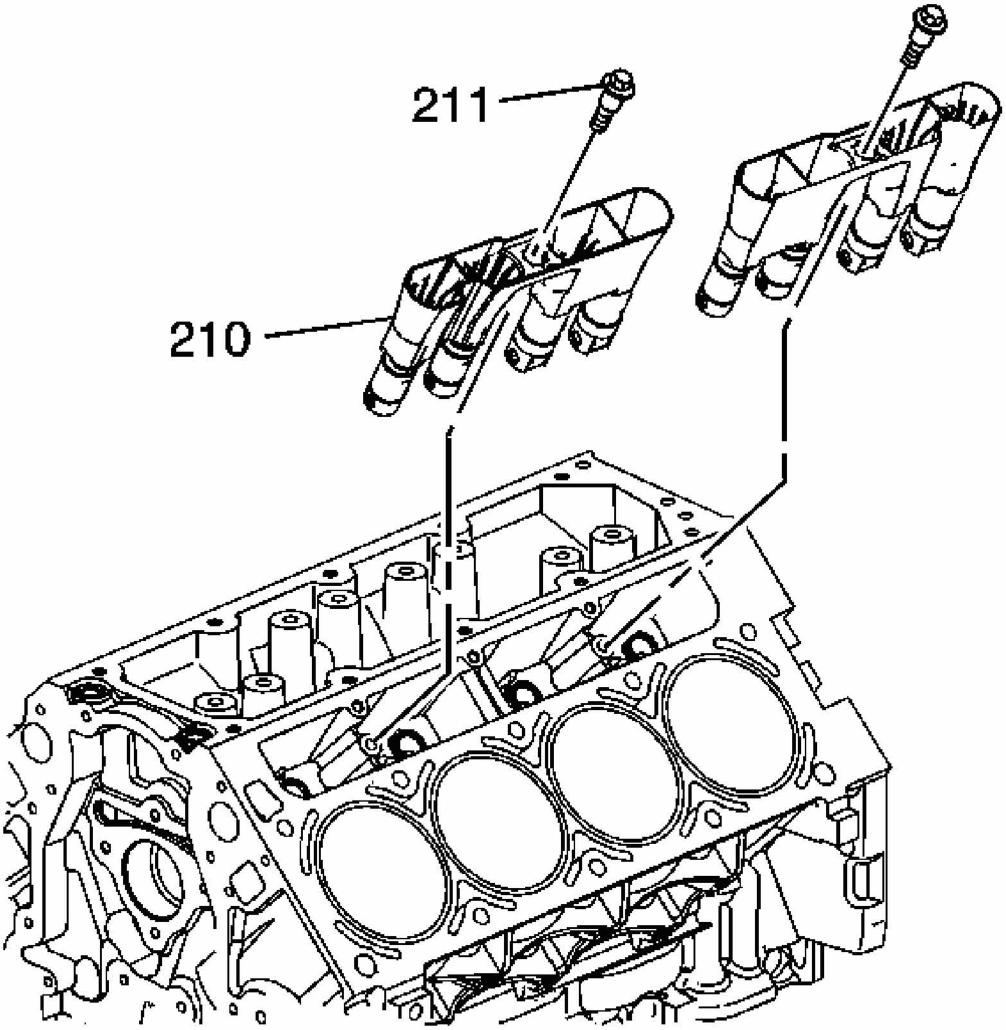


Fig. 156: View Of Lifter Guides & Lifters
Courtesy of GENERAL MOTORS CORP.

3. Install the valve lifter guides (210) with lifters to the engine block.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the valve lifter guide bolts (211).

   Tighten: Tighten the bolts to 12 N.m (106 lb in).

5. Install the cylinder head. Refer to **Cylinder Head Replacement - Left** and/or **Cylinder**

Head Replacement - Right.

CRANKSHAFT BALANCER REPLACEMENT

Tools Required

- **EN 47699** Flywheel Holding Tool. See **Special Tools**.
- **J 41665** Crankshaft Balancer and Sprocket Installer. See **Special Tools**.
- **J 41816** Crankshaft Balancer Remover
- **J 41816-2** Crankshaft End Protector. See **Special Tools**.
- **J 42640** Steering Column Anti-Rotation Pin. See **Special Tools**.
- **J 45059** Torque Angle Meter

Removal Procedure

1. Install a **J 42640** . See **Special Tools**. Refer to **Steering Column Replacement** .
2. Remove the accessory drive belt. Refer to **Drive Belt Replacement - Accessory**.
3. Remove the air cleaner upper housing. Refer to **Air Cleaner Assembly Replacement** .
4. Remove the engine mount strut. Refer to **Engine Mount Strut Replacement**.
5. Remove the starter motor. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)** .
6. Remove the front fender splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
7. Remove the transmission bellhousing bolt located at approximately the 10 o'clock position when looking from the rear of the engine.
8. Disconnect the transaxle cooler lines at the transaxle. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .
9. Remove the stabilizer shaft link lower nuts. Refer to **Stabilizer Shaft Link Replacement** .
10. Remove the intermediate steering shaft pinch bolt and separate the shaft from the steering gear. Refer to **Intermediate Steering Shaft Replacement** .
11. Remove the front lower air deflector braces and the deflector. Refer to **Radiator Air Baffle and Deflector Replacement - Lower** .
12. Remove the radiator to frame braces.
13. Install the engine support fixture. Refer to **Engine Support Fixture**.
14. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
15. Remove the frame to body bolts.

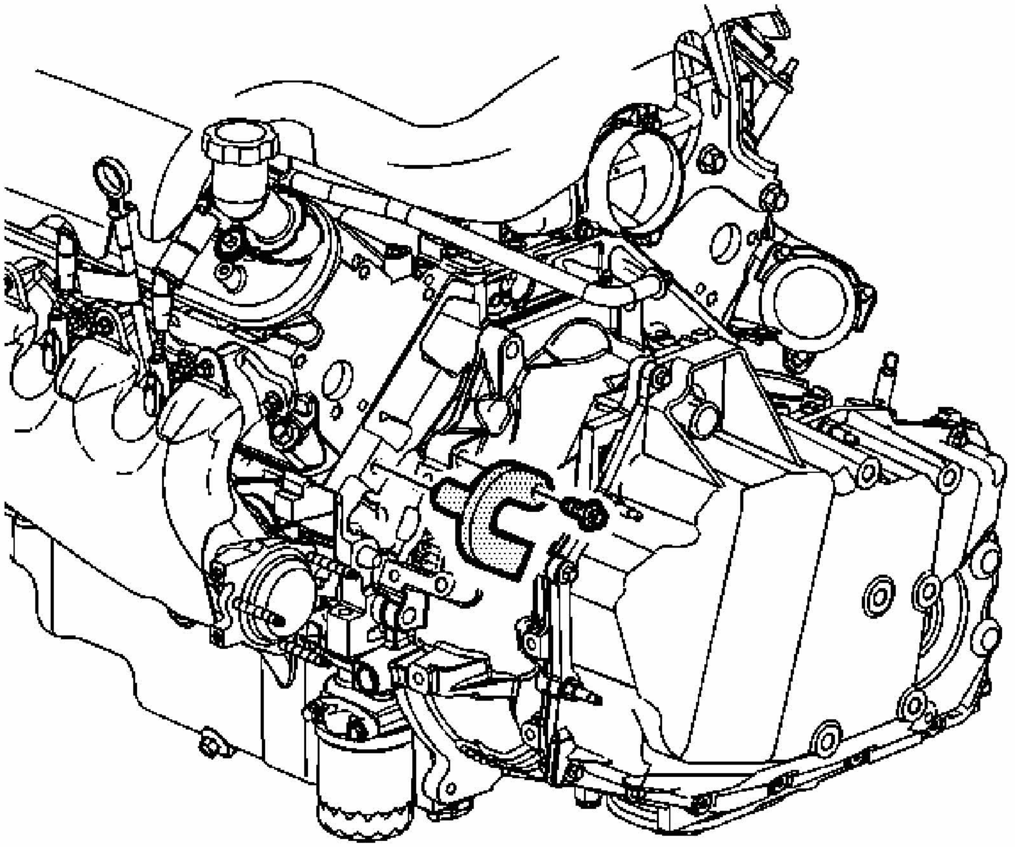


Fig. 157: Installing The EN 47699 And Bolt To The Block And Flywheel
Courtesy of GENERAL MOTORS CORP.

16. Install the **EN 47699** and bolt to the block and flywheel. See **Special Tools**.

    Tighten: Tighten the bolt to 60 N.m (44 lb ft).

17. Remove the right front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
18. Lower the engine approximately 100 mm (4 in).

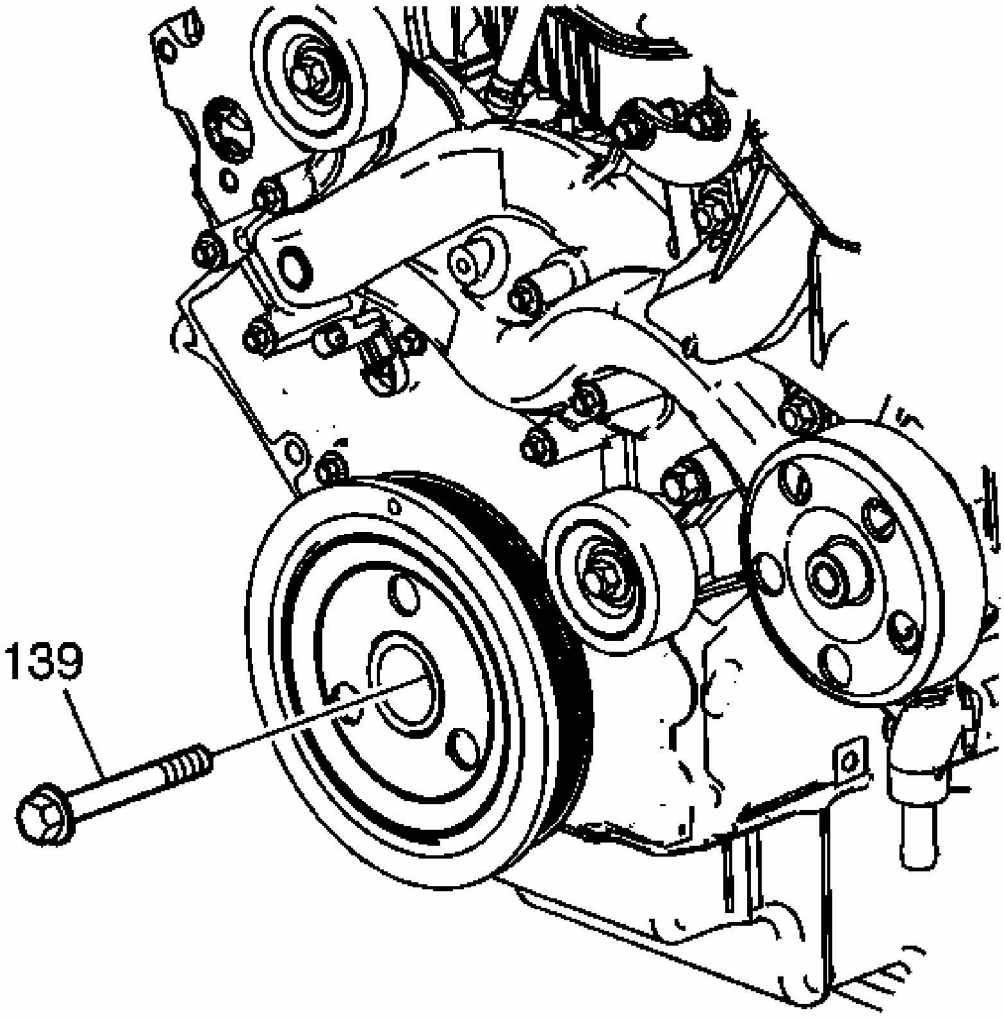


Fig. 158: View Of Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

19. Remove the crankshaft balancer bolt (139).

    Do not discard the crankshaft balancer bolt. The balancer bolt will be used during the balancer installation procedure.

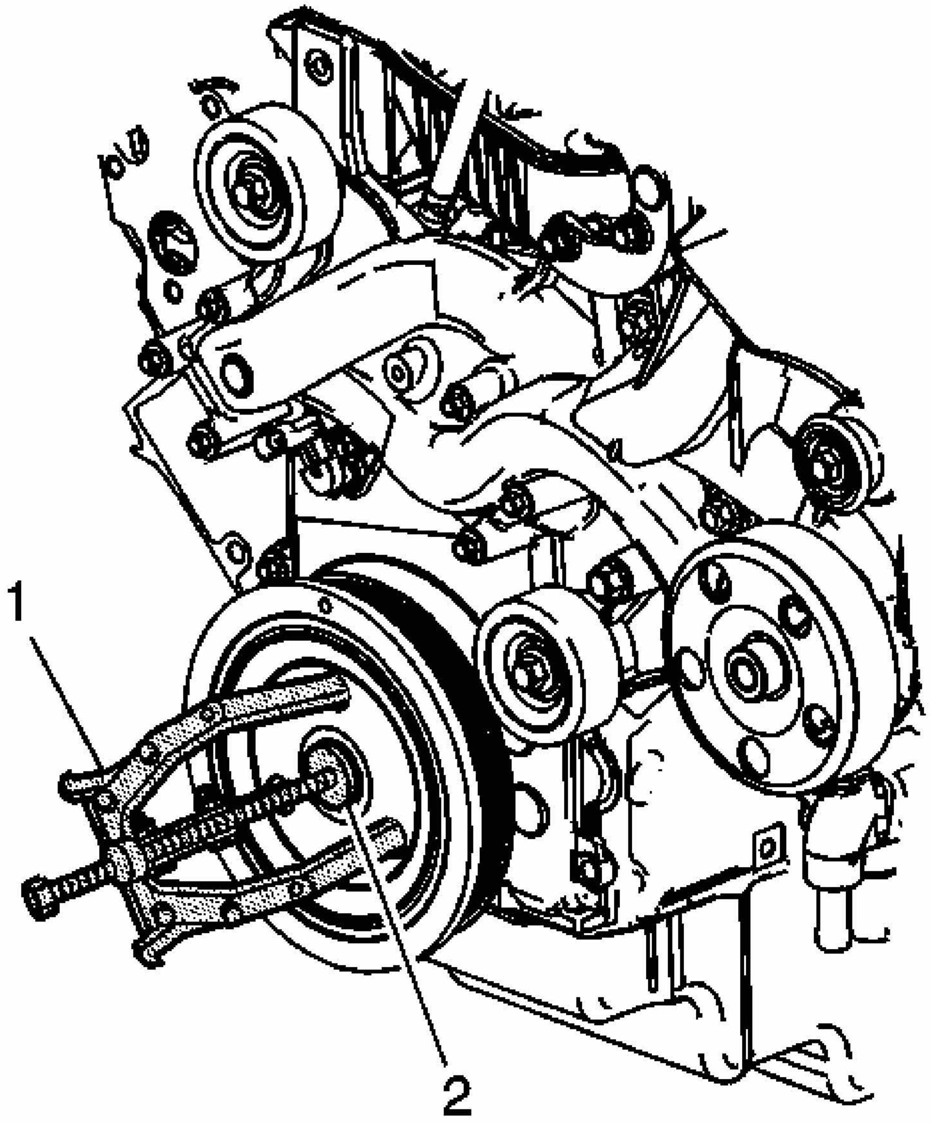


Fig. 159: Installing Special Tools To Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

20. Install the **J 41816** (1) and the **J 41816-2** (2), to the crankshaft balancer. See **Special Tools**.

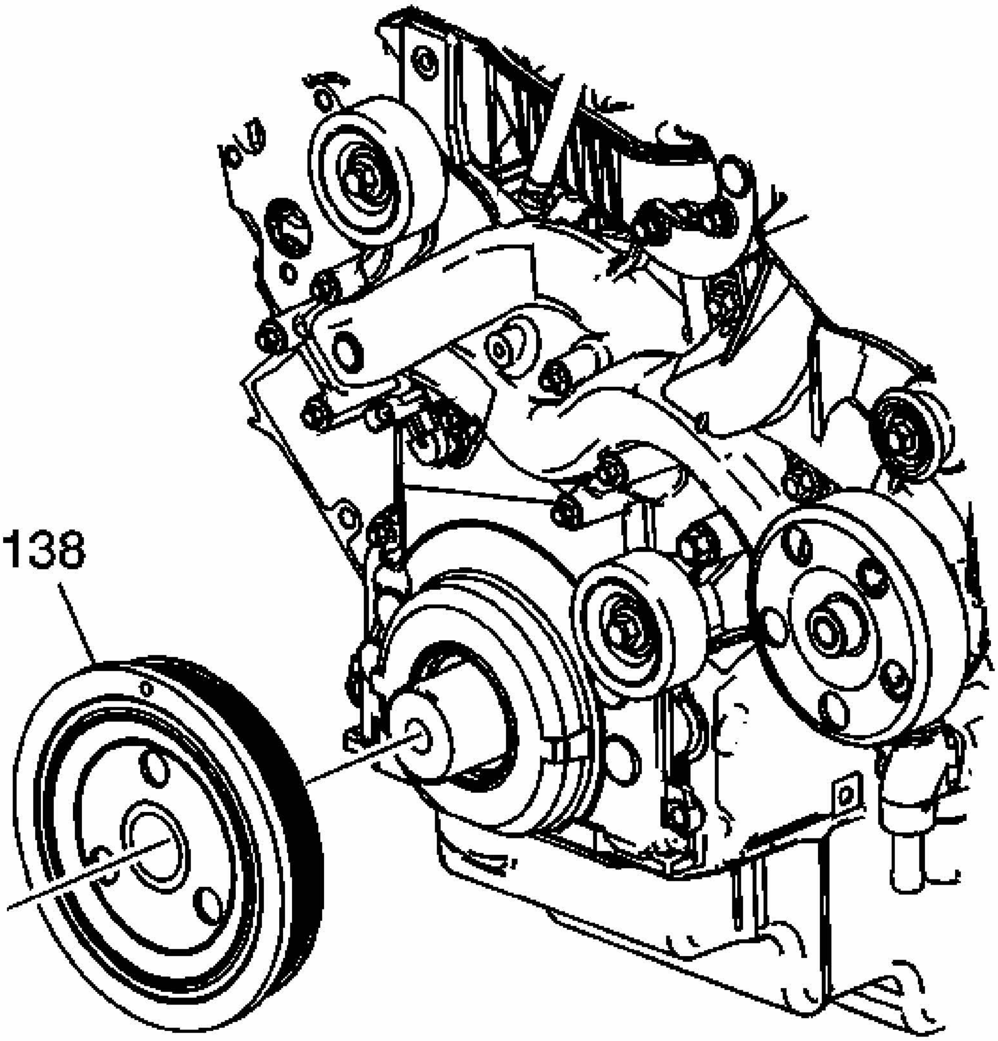


Fig. 160: View Of Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

21. Remove the crankshaft balancer (138).
22. Remove the **J 41816** and the **J 41816-2** from the crankshaft balancer. See **Special Tools**.

Installation Procedure

IMPORTANT:

- **The used crankshaft balancer bolt will be used only during the first pass of the balancer installation procedure. Install a NEW bolt and tighten as described in the second, third** and forth passes of the balancer bolt tightening procedure.

- The crankshaft balancer installation and bolt tightening involves a four stage tightening process. The first pass ensures that the balancer is installed completely onto the crankshaft. The second, third, and forth passes tighten the new bolt to the proper torque.

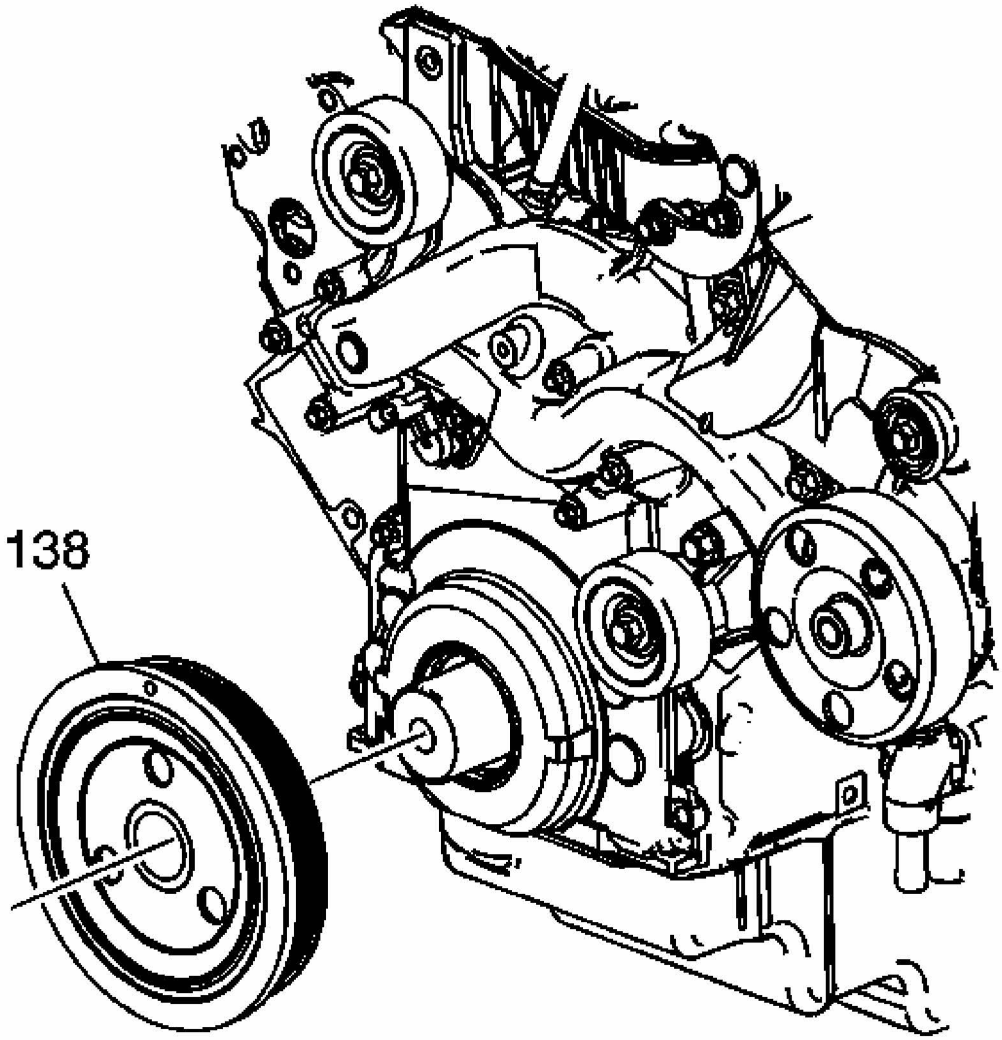


Fig. 161: View Of Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The balancer should be positioned onto the end of the

crankshaft as straight as possible prior to tool installation.

1. Position the crankshaft balancer (138) onto the end of the crankshaft.

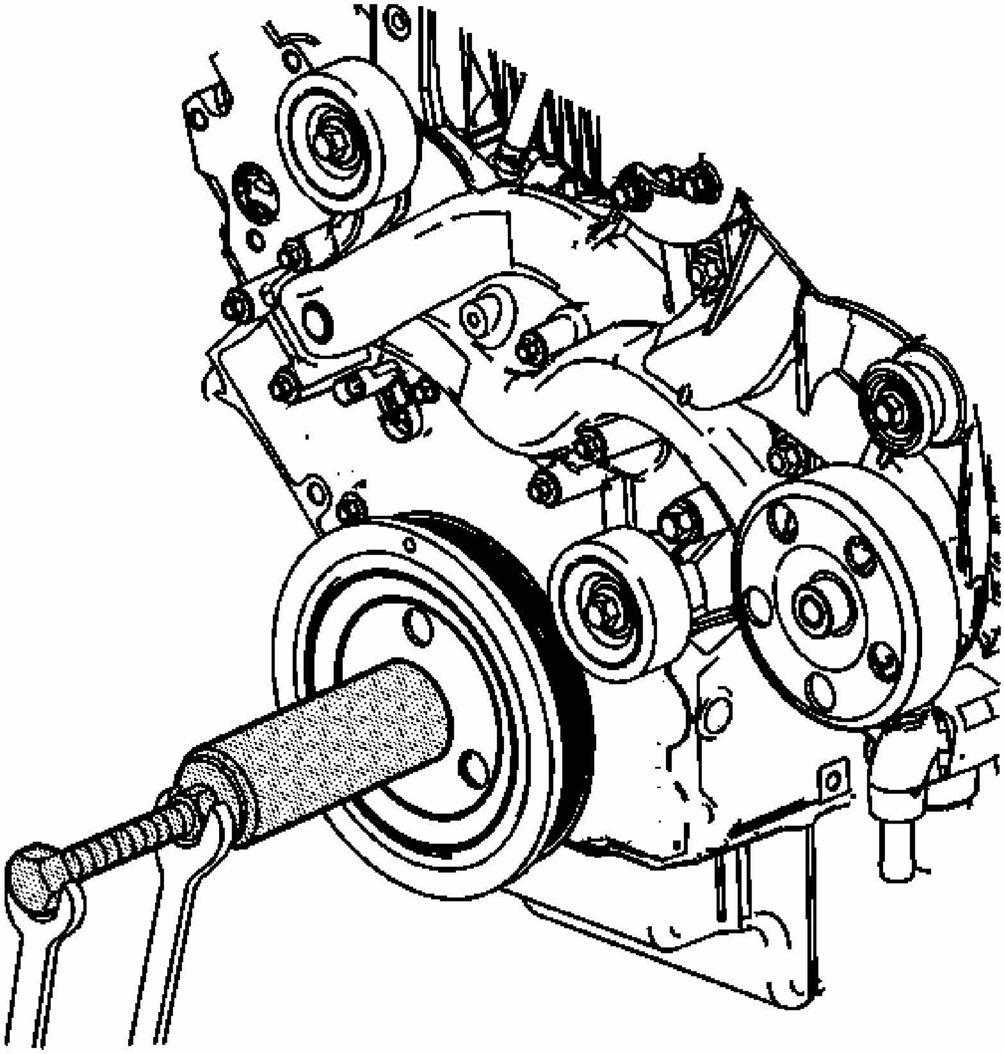


Fig. 162: Using Special Tools To Install Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

2. Using the **J 41665** , install the crankshaft balancer. See **Special Tools**.
    1. Assemble the threaded rod, nut, washer and installer. Insert the smaller end of the installer into the front of the balancer.
    2. Use a wrench and hold the hex end of the threaded rod.

3. Use a second wrench and rotate the installation tool nut clockwise until the balancer is started onto the crankshaft.
4. Remove the tool and reverse the installation tool. Position the larger end of the installer against the front of the balancer.
5. Use a wrench and hold the hex end of the threaded rod.
6. Use a second wrench and rotate the installation tool nut clockwise until the balancer is installed onto the crankshaft.
7. Remove the balancer installation tool.

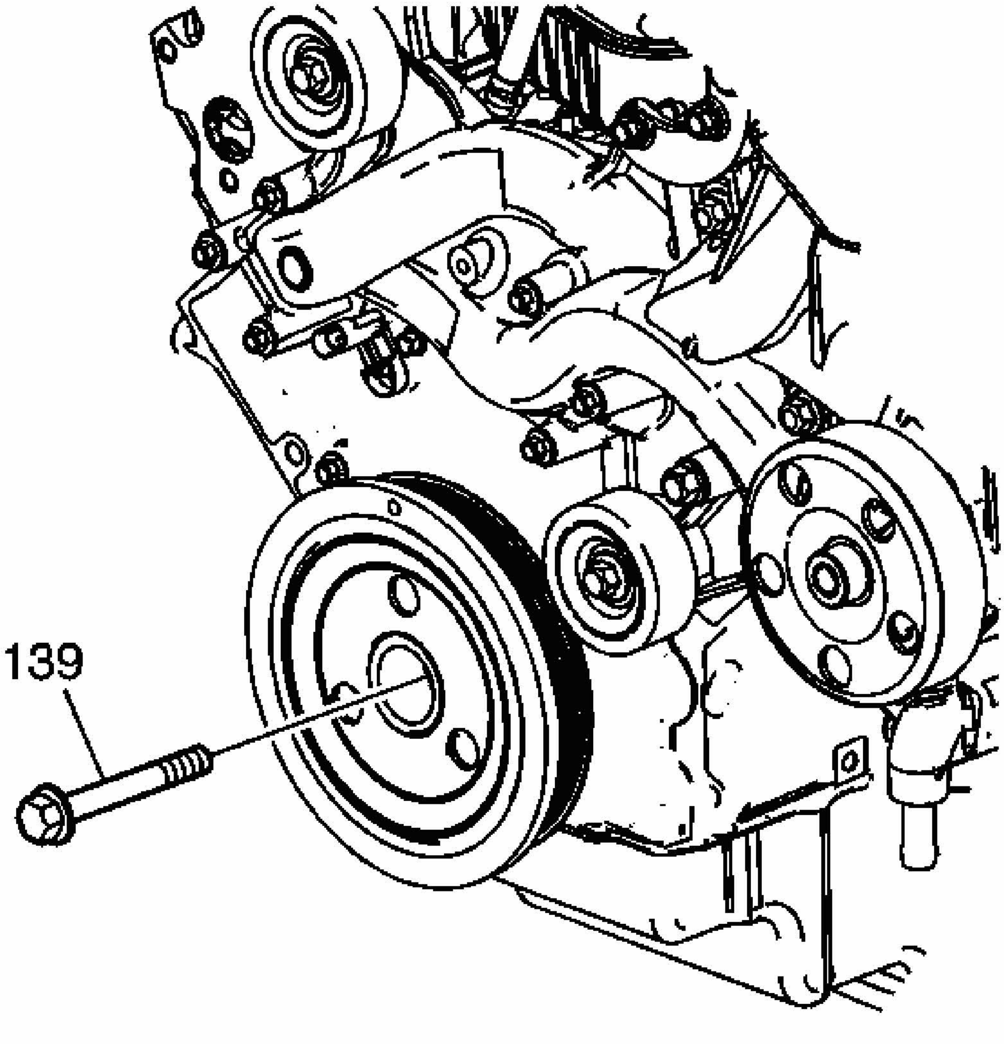


Fig. 163: View Of Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

3. Install the USED crankshaft balancer bolt (139).

   Tighten: Tighten the USED bolt to 330 N.m (240 lb ft).

4. Remove the USED crankshaft balancer bolt.

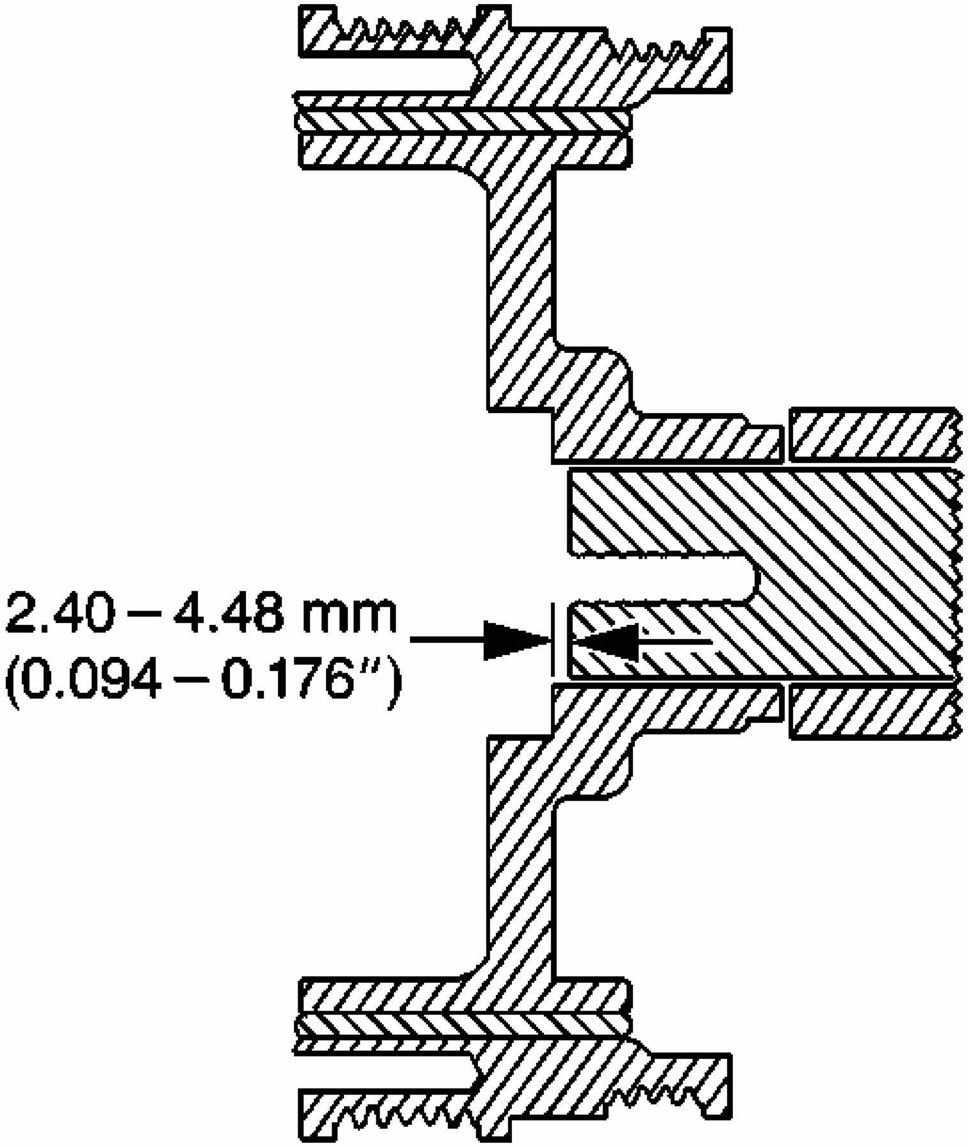


Fig. 164: Identifying Hub To Crankshaft Distance
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The nose of the crankshaft should be recessed 2.4-4.48 mm (0.094-0.176 in) into the balancer bore.

5. Measure for a correctly installed balancer. If the balancer is not installed to the proper dimensions, install the **J 41665** and repeat the installation procedure. See **Special Tools**.

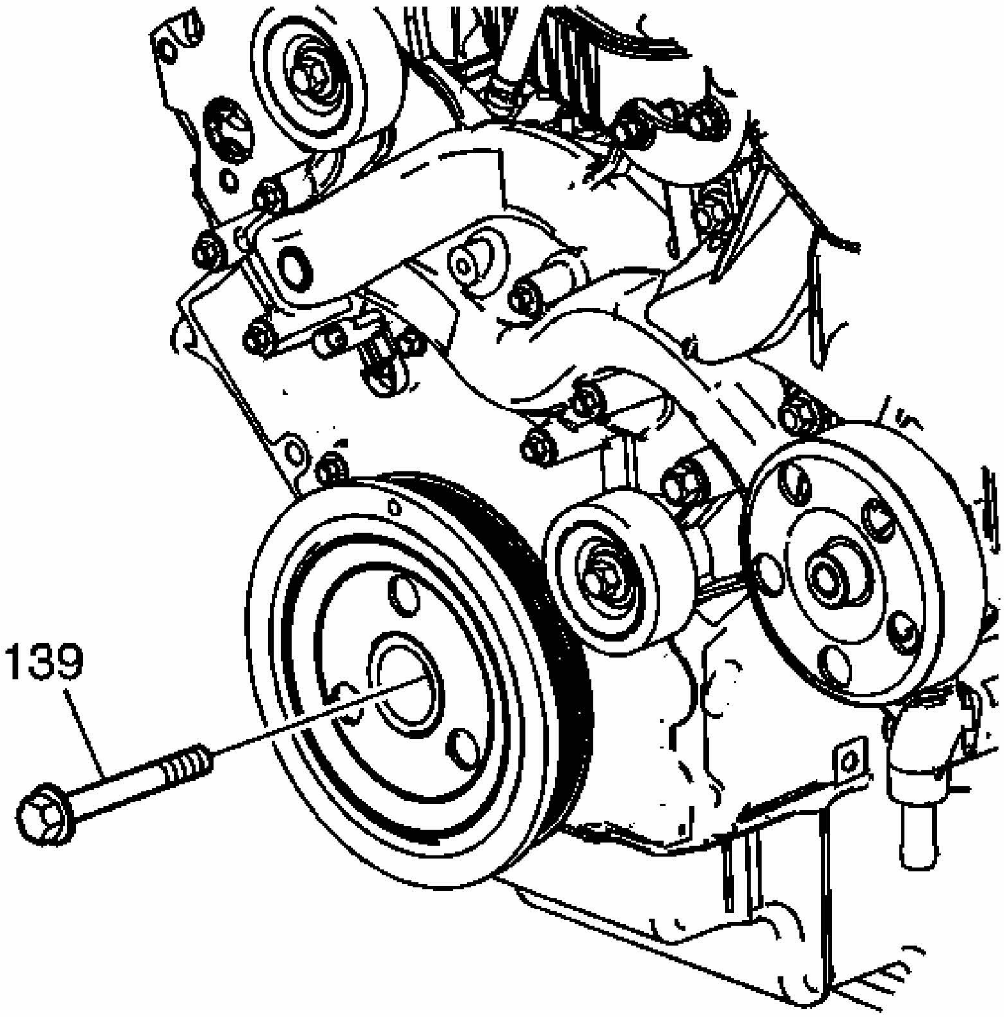


Fig. 165: View Of Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

6. Install a NEW crankshaft balancer bolt (139).

   Tighten:
   - Tighten the bolt a first pass to 50 N.m (37 lb ft).
   - Tighten the bolt a second pass to 140 degrees using **J 45059** .

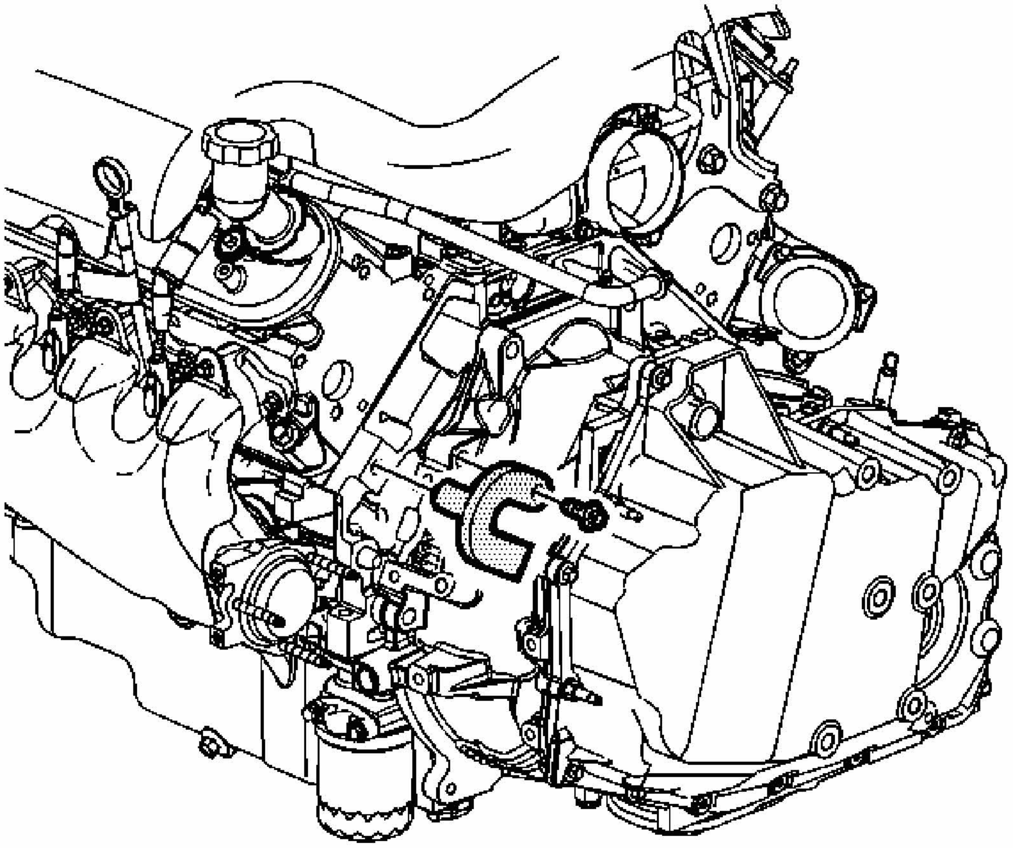


Fig. 166: Removing The EN 47699 And Bolt From The Block And Flywheel
Courtesy of GENERAL MOTORS CORP.

7. Remove the **EN 47699** and bolt from the block and flywheel. See **Special Tools**.
8. Install the transmission bellhousing bolt located at approximately the 10 o'clock position when looking from the rear of the engine.

   Tighten: Tighten the bolt to 75 N.m (55 lb ft).

9. Raise and properly position the frame and install the frame to body bolts. Refer to **Frame Replacement** .

10. Install the frame to radiator braces.
11. Install the front lower air deflector. Refer to **Radiator Air Baffle and Deflector Replacement - Lower** .
12. Connect the intermediate steering shaft to the steering gear. Refer to **Intermediate Steering Shaft Replacement** .
13. Install the stabilizer shaft link lower nuts. Refer to **Stabilizer Shaft Link Replacement** .
14. Connect the transaxle cooler lines to the transaxle. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .
15. Remove the engine support fixture.
16. Install the front fender splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
17. Install the starter motor. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)** in Engine Electrical.
18. Install the air cleaner upper housing. Refer to **Air Cleaner Assembly Replacement** .
19. Install the accessory drive belt. Refer to **Drive Belt Replacement - Accessory**.
20. Install the engine mount strut. Refer to **Engine Mount Strut Replacement**.
21. Install the right front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
22. Perform the crankshaft position (CKP) system variation learn procedure. Refer to **CKP System Variation Learn Procedure** .

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

Tools Required

J 41478 Crankshaft Front Oil Seal Installer. See **Special Tools**.

Removal Procedure

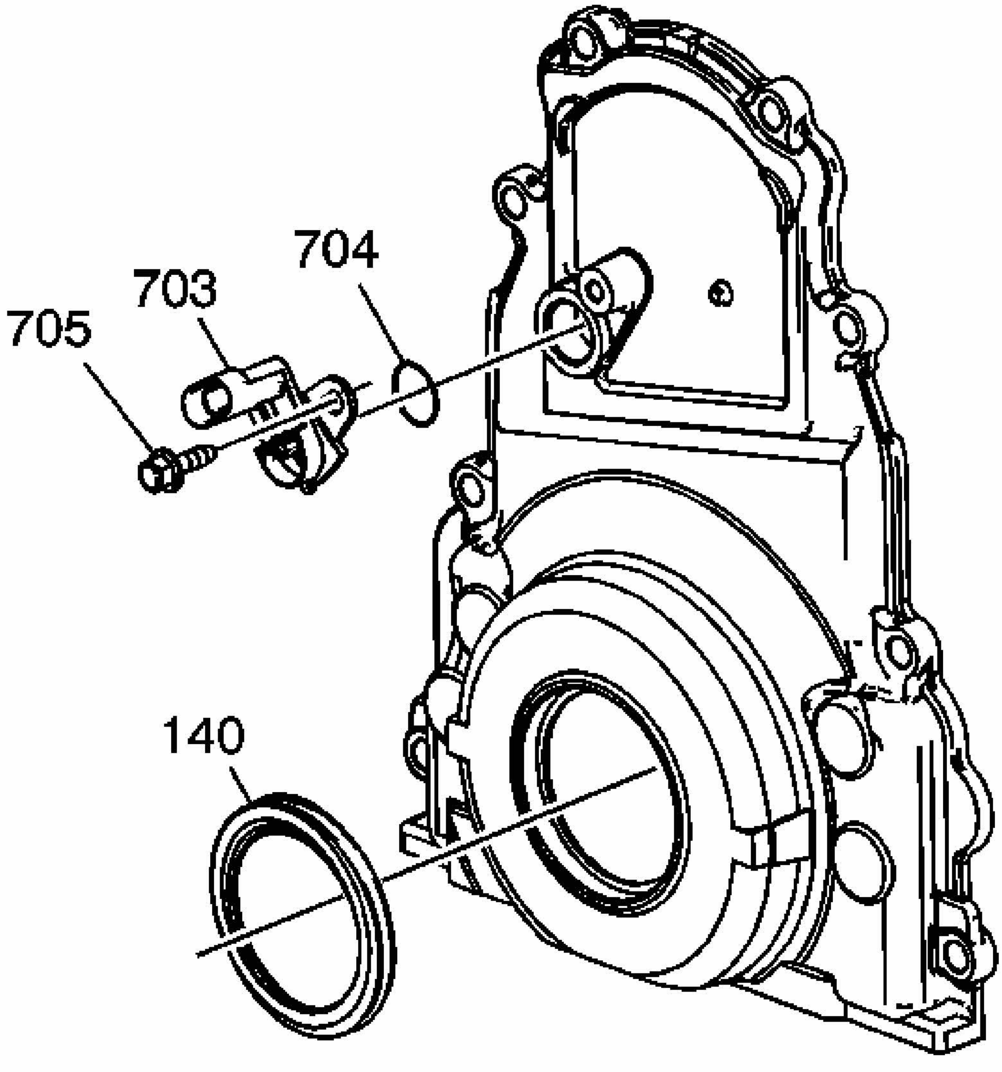


Fig. 167: View Of Crankshaft Oil Seal & Camshaft Position (CMP) Sensor
Courtesy of GENERAL MOTORS CORP.

1. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
2. Remove and discard the crankshaft oil seal (140).

Installation Procedure

IMPORTANT:

- **Do not lubricate the oil seal sealing surface.**
- **Do not reuse the crankshaft oil seal.**

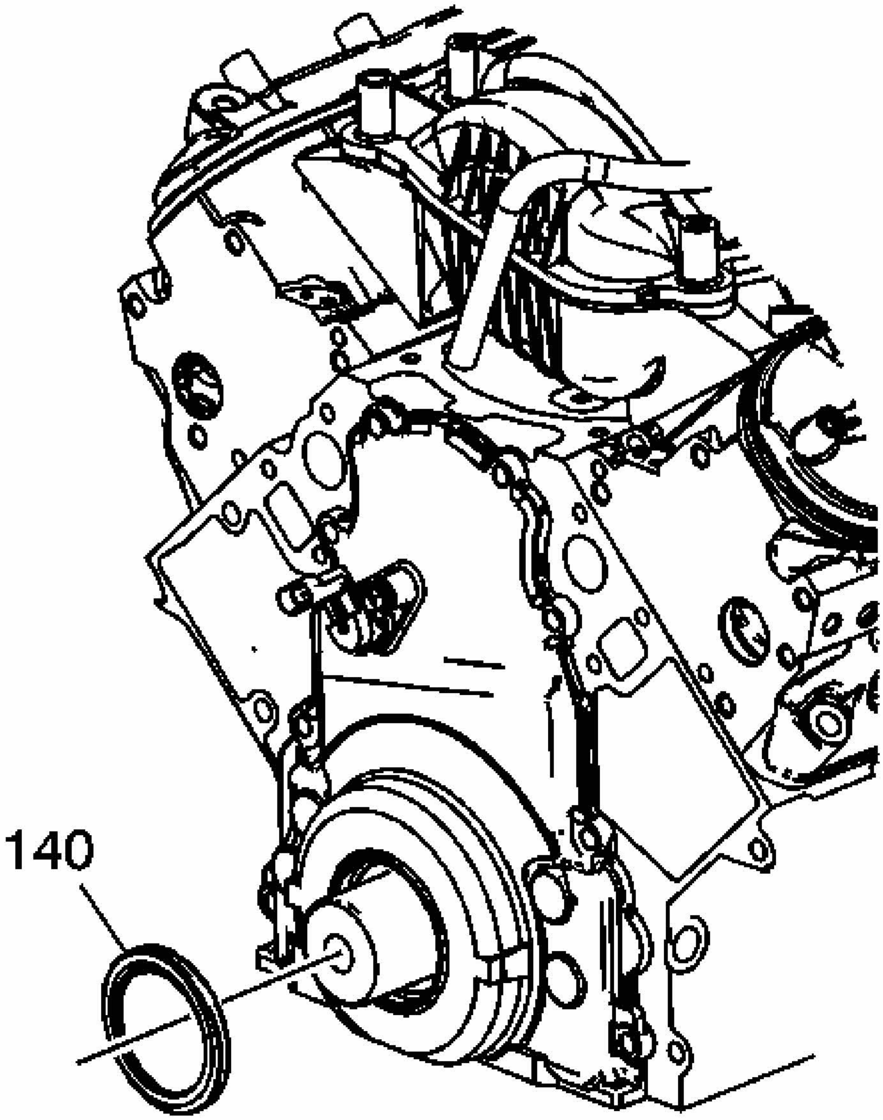


Fig. 168: Aligning The Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the outer edge of the oil seal (140) with clean engine oil.
2. Lubricate the front cover oil seal bore with clean engine oil.

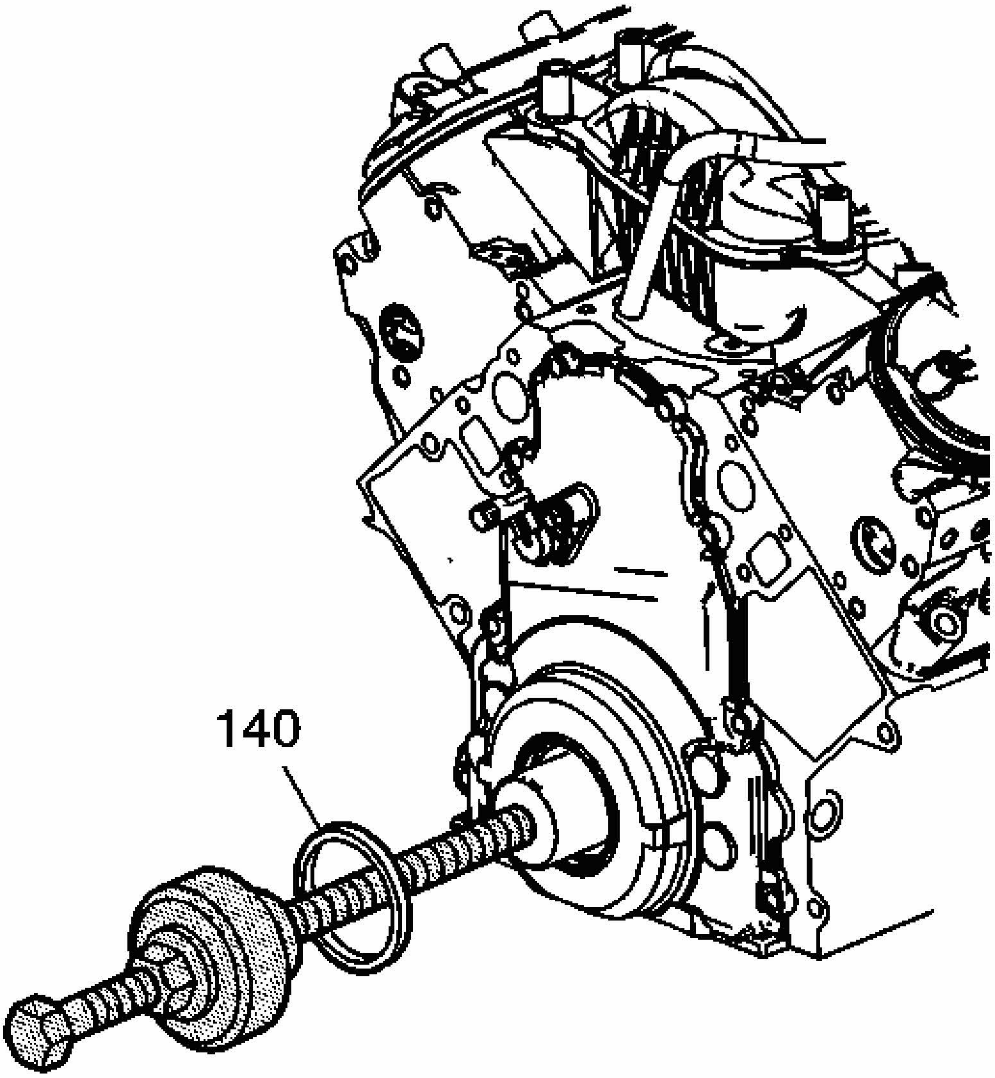


Fig. 169: Using Special Tools To Install Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

3. Install the crankshaft front oil seal (140) onto the **J 41478** . See **Special Tools**.
4. Install the **J 41478** threaded rod with nut, washer, guide, and oil seal into the end of the crankshaft. See **Special Tools**.
5. Using the **J 41478** , install the oil seal into the cover bore. See **Special Tools**.
    1. Use a wrench and hold the hex on the installer bolt.
    2. Use a second wrench and rotate the installer nut clockwise until the seal bottoms in the cover bore.

   3. Remove the **J 41478** . See **Special Tools**.
   4. Inspect the oil seal for proper installation. The oil seal should be installed evenly and completely into the front cover bore.
6. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

ENGINE FRONT COVER REPLACEMENT (FIRST DESIGN)

Tools Required

J 41476 Front and Rear Cover Alignment (at crankshaft seal area). See **Special Tools**.

Removal Procedure

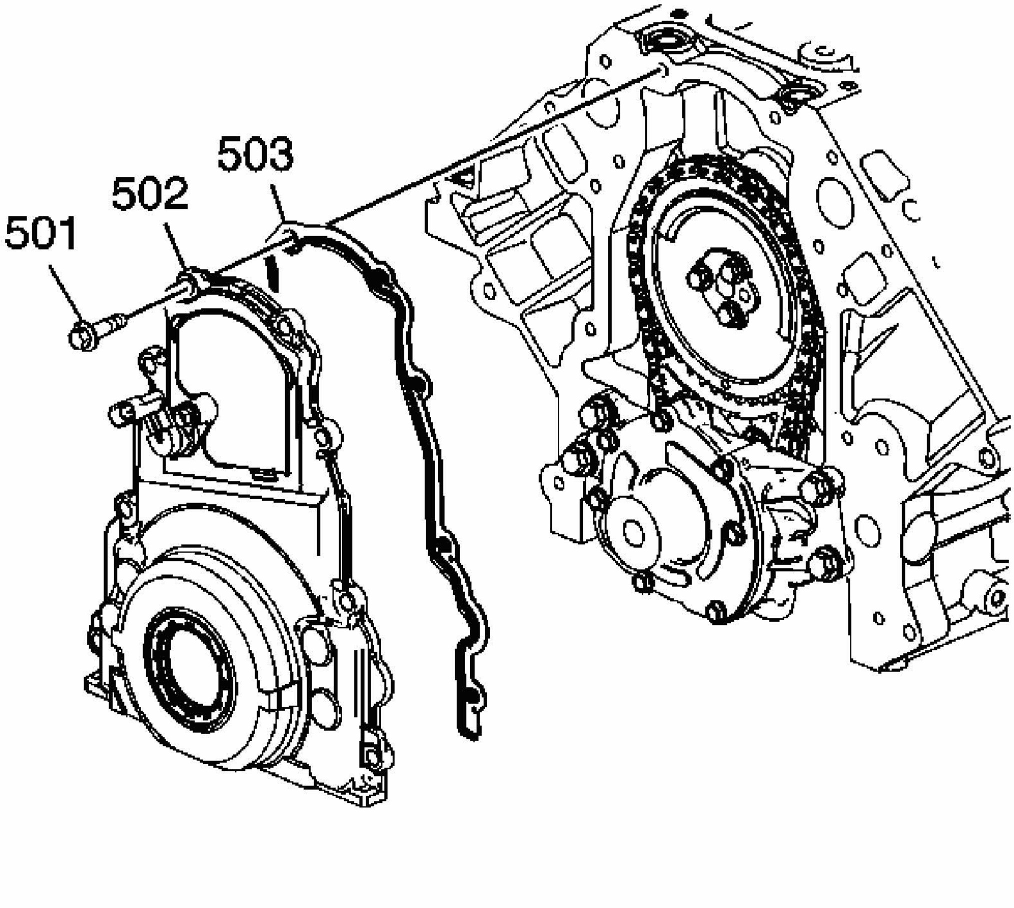


Fig. 170: View Of Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** in Engine Electrical.
2. Remove the power steering pump. Refer to **Power Steering Pump Replacement**

(LS4) or **Power Steering Pump Replacement (LZ4/LZE/LZ9)** in Power Steering System.

3. Remove the coolant pump manifold. Refer to **Coolant Pump Manifold Replacement (RPO LS4)** in Engine Cooling.
4. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
5. Remove the belt tensioner bolt and reposition the tensioner (which blocks the front cover bolt).
6. Remove the oil pan-to-front cover bolts.
7. Remove the front cover bolts (501).
8. Remove the front cover (502) and gasket (503).
9. Discard the front cover gasket.

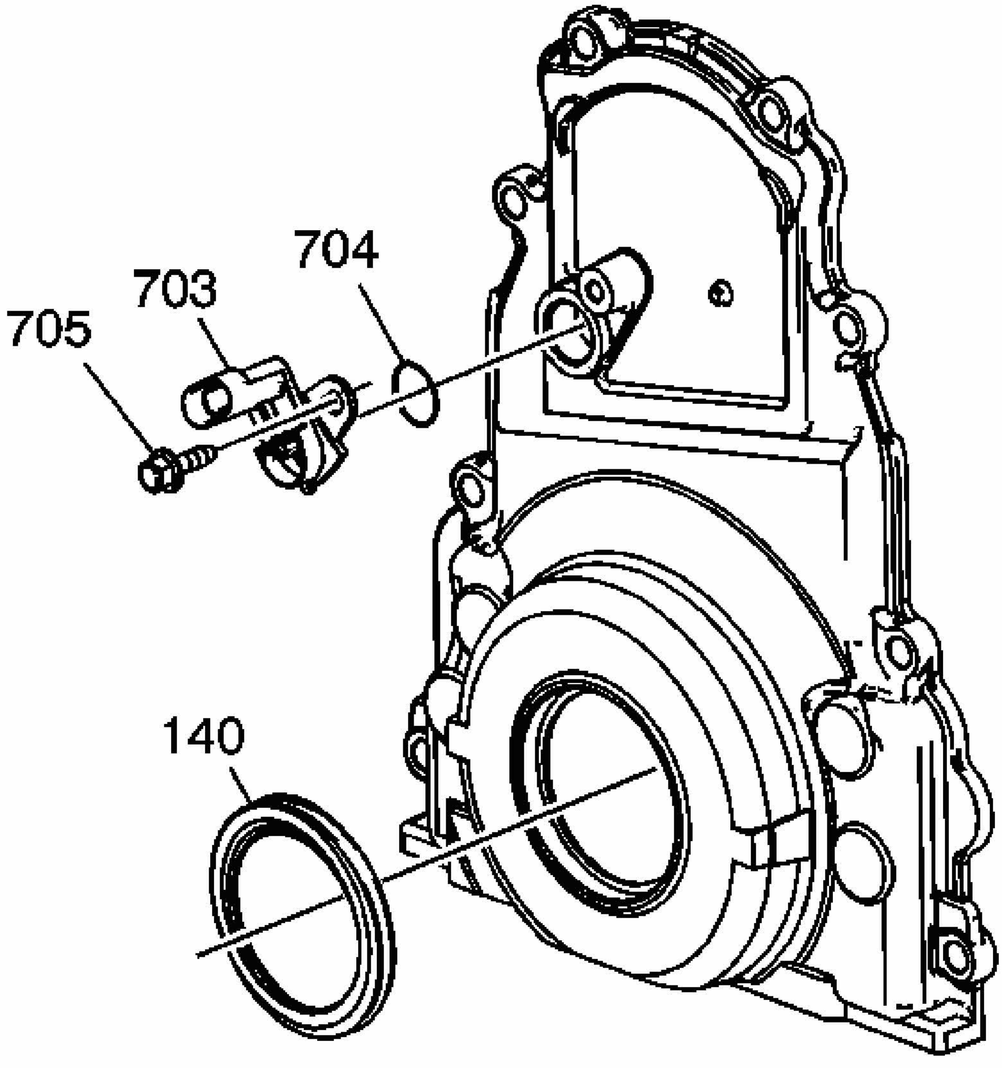


Fig. 171: View Of Crankshaft Oil Seal & Camshaft Position (CMP) Sensor
Courtesy of GENERAL MOTORS CORP.

10. Remove the oil seal (140), if necessary.
11. Remove the camshaft position (CMP) sensor bolt (705) and sensor (703), if necessary.
12. Remove the O-ring seal (704) from the sensor, if necessary.
13. Clean and inspect the engine front cover. Refer to **Engine Front Cover Cleaning and Inspection**.

Installation Procedure

IMPORTANT:

- **Do not reuse the crankshaft oil seal or front cover gasket.**
- **Do not apply any type of sealant to the front cover gasket (unless specified).**
- **The special tool in this procedure is used to properly center the front crankshaft front oil seal.**
  - **All gasket surfaces should be free of oil or other foreign material during assembly.**
  - **The crankshaft front oil seal MUST be centered in relation to the crankshaft.**
  - **An improperly aligned front cover may cause premature front oil seal wear and/or engine oil leaks.**

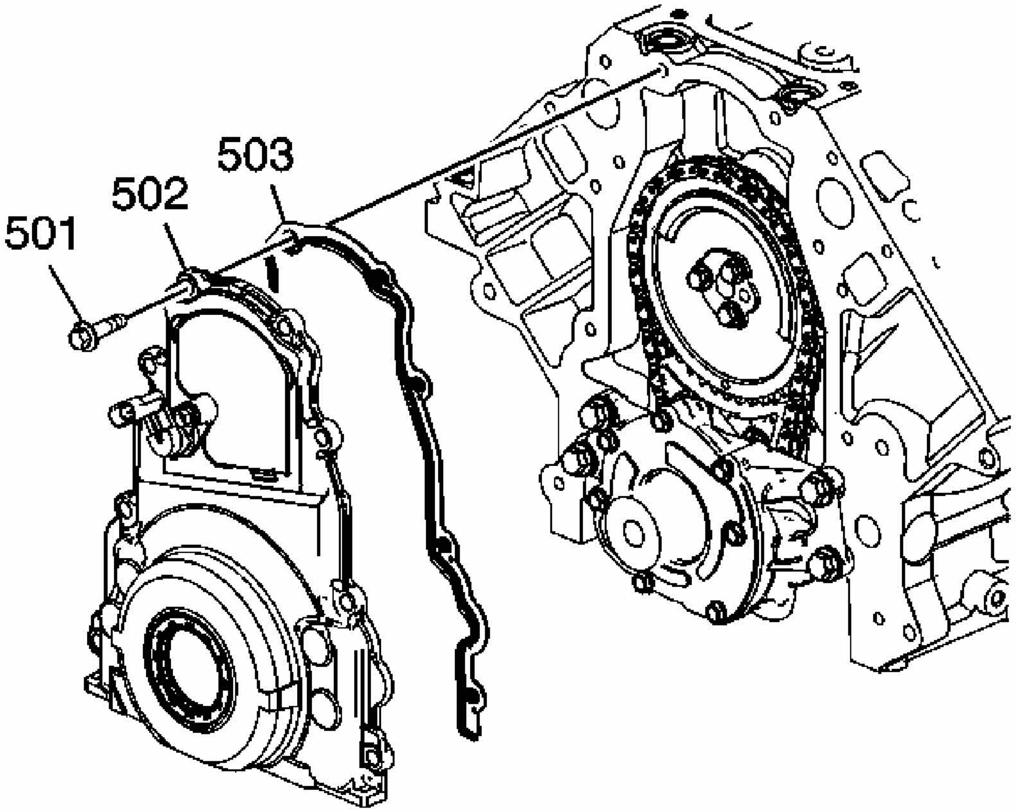


Fig. 172: View Of Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Apply a 5 mm (0.20 in) bead of sealant GM P/N 12378577 or 12346141 (Canadian P/N 89022195) or equivalent 20 mm (0.80 in) long to the oil pan to engine block junction.

2. Install the front cover gasket (503) and cover (502).
3. Install the front cover bolts until snug (502). Do not overtighten.
4. Install the oil pan-to-front cover bolts until snug. Do not over tighten.

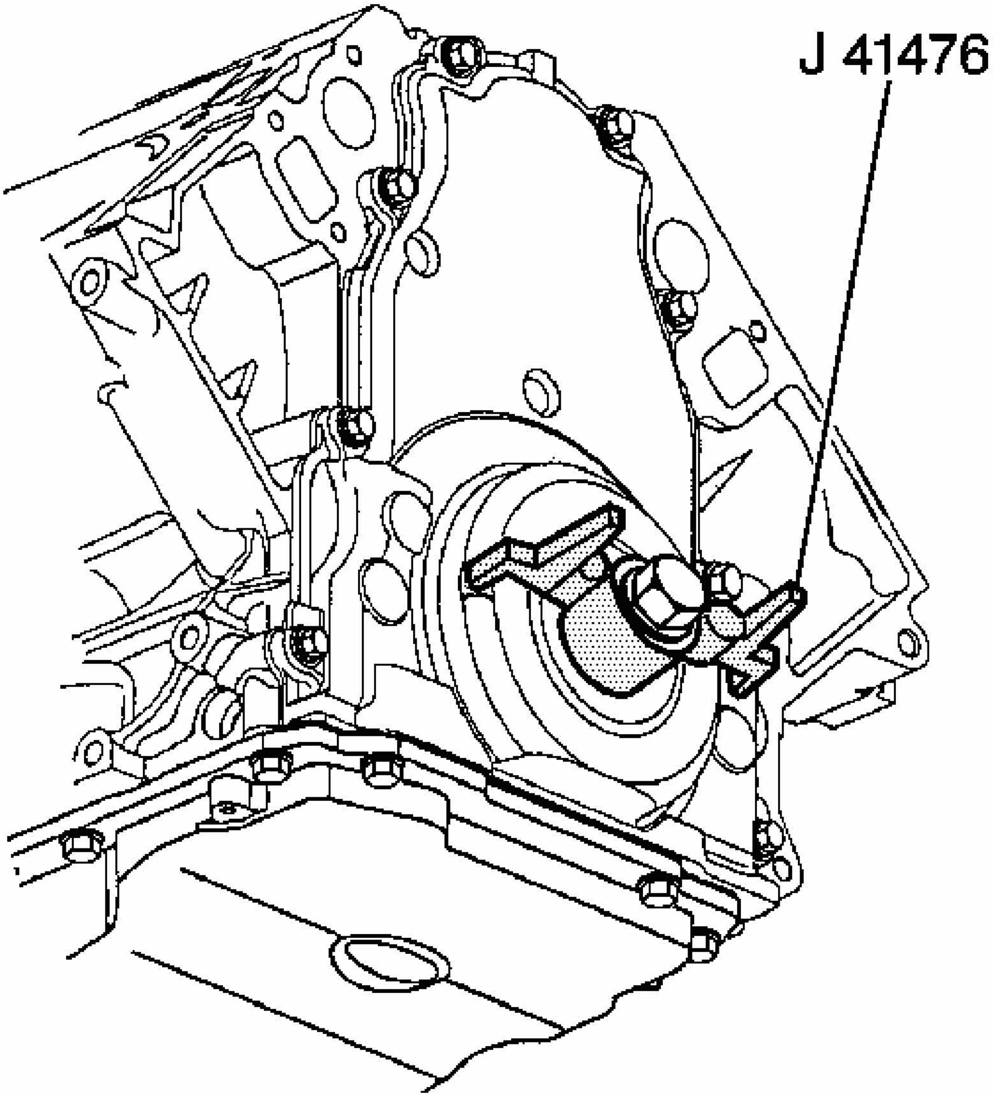


Fig. 173: View of J 41476 Installed To Front Cover
Courtesy of GENERAL MOTORS CORP.

5. Install the **J 41476** to the front cover. See **Special Tools**.
6. Align the tapered legs of the **J 41476** with the machined alignment surfaces on the front cover. See **Special Tools**.

NOTE: Refer to Fastener Notice in Cautions and Notices.

7. Install the crankshaft balancer bolt until snug. Do not overtighten.

   Tighten:

   - Tighten the oil pan to front cover bolts to 25 N.m (18 lb ft).
   - Tighten the engine front cover bolts to 25 N.m (18 lb ft).

8. Remove the **J 41476** . See **Special Tools**.

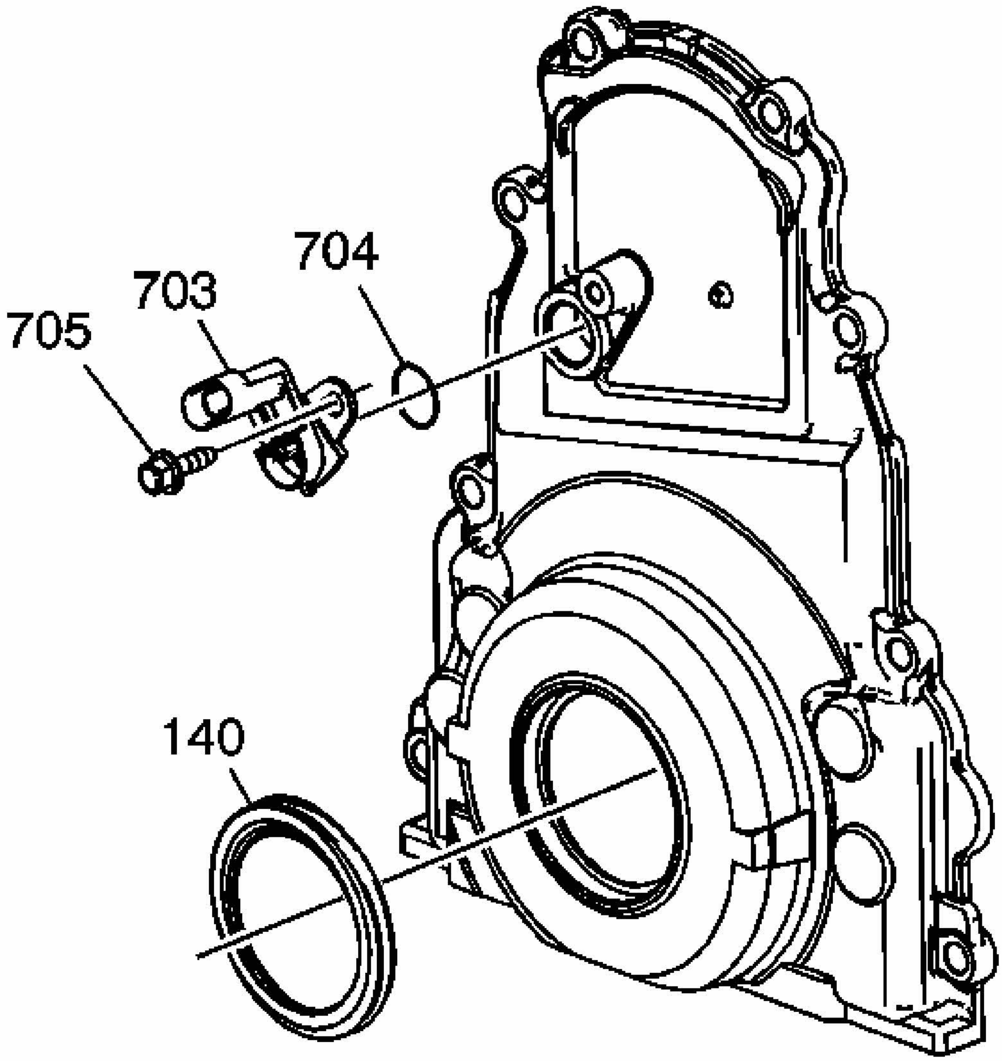


Fig. 174: View Of Crankshaft Oil Seal & Camshaft Position (CMP) Sensor
Courtesy of GENERAL MOTORS CORP.

9. Install a NEW crankshaft front oil seal (140). Refer to **Crankshaft Front Oil Seal Replacement**.
10. Install the coolant pump manifold. Refer to **Coolant Pump Manifold Replacement (RPO LS4)** in Engine Cooling.
11. Inspect the CMP sensor O-ring seal (704) for cuts or damage. If the seal is not cut or damaged, it may be reused.
12. Lubricate the O-ring seal with clean engine oil.
13. Install the O-ring seal (704) onto the CMP sensor.
14. Install the CMP sensor (703) and bolt (705) from the front cover.

    Tighten: Tighten the bolt to 12 N.m (106 lb in).

15. Position the belt tensioner and install the bolt.

    Tighten: Tighten the bolt to 50 N.m (37 lb ft).

16. Install the power steering pump. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)** in Power Steering System.
17. Install the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** in Engine Electrical.

CRANKSHAFT REAR OIL SEAL REPLACEMENT

Tools Required

J 41479 Crankshaft Rear Oil Seal Installer. See **Special Tools**.

Removal Procedure

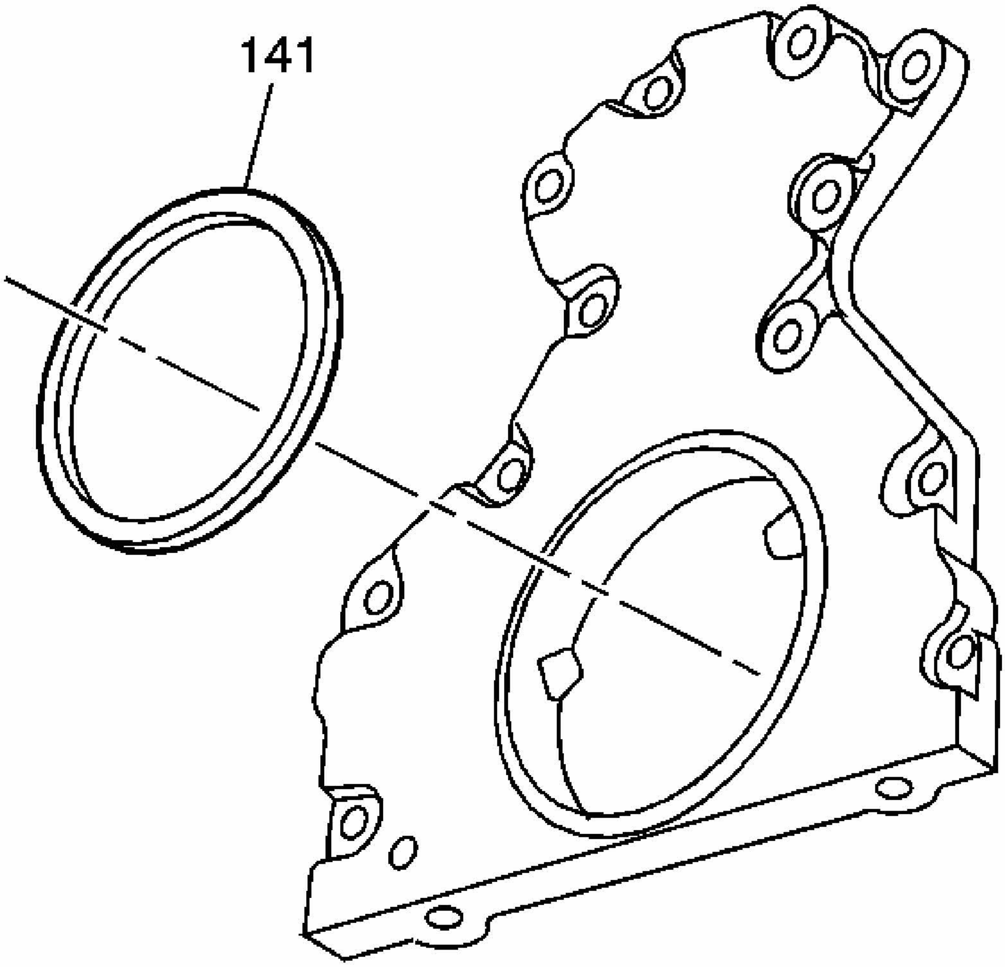


Fig. 175: View Of Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine flywheel. Refer to **Engine Flywheel Replacement**.
2. Remove and discard the crankshaft rear oil seal (141).

Installation Procedure

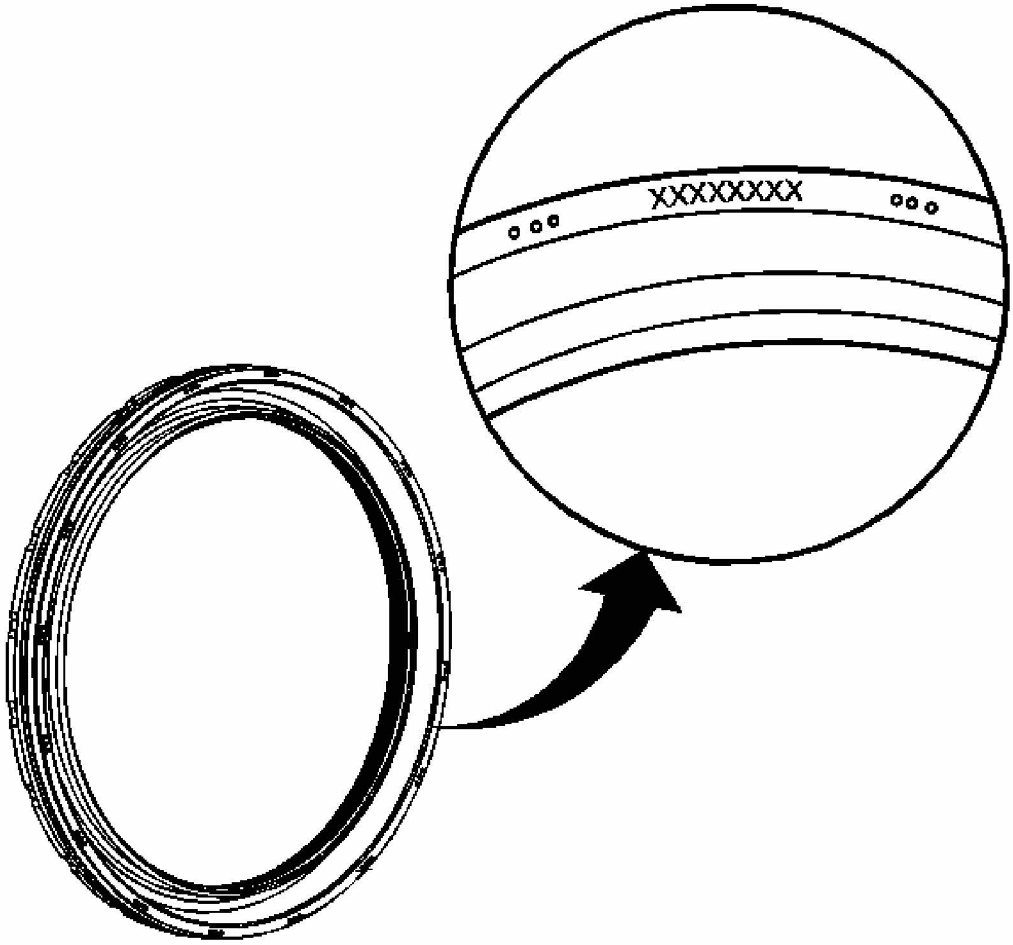


Fig. 176: Identifying Oil Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- Do not lubricate the oil seal inside diameter (ID) or the crankshaft surface.
- Do not reuse the crankshaft rear oil seal.

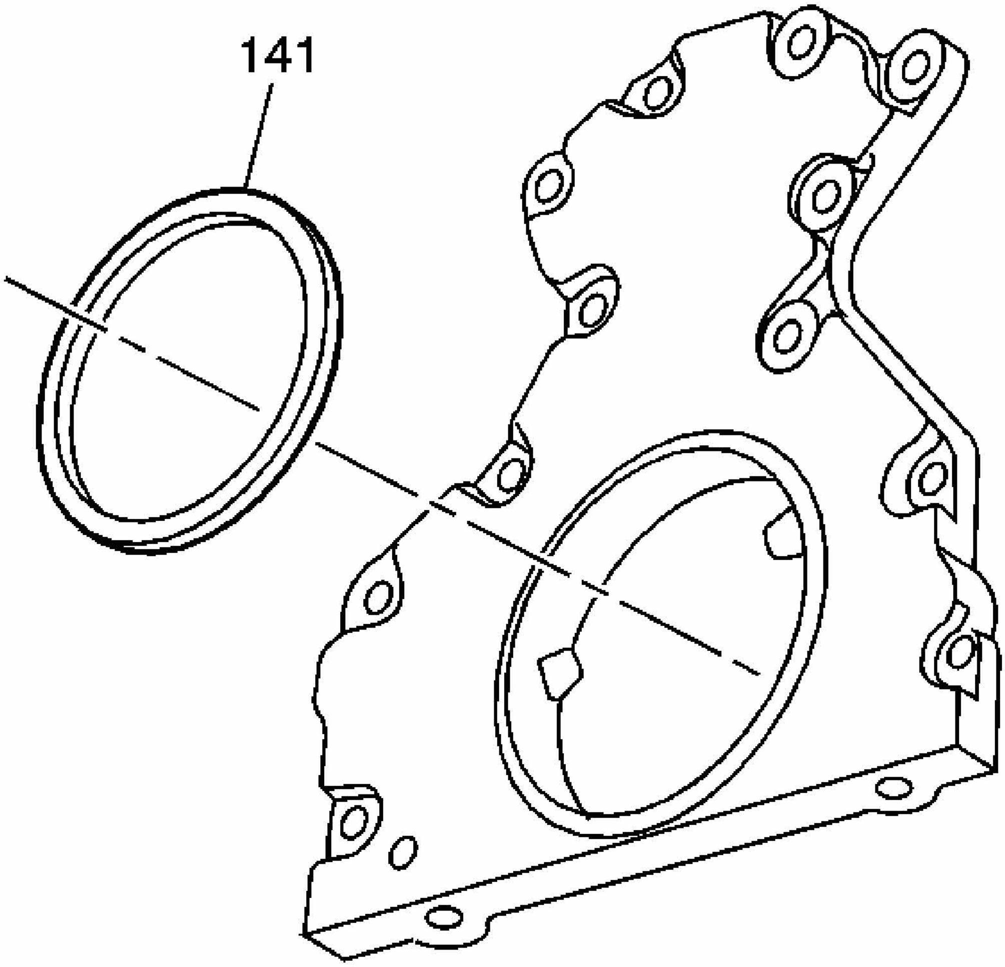


Fig. 177: View Of Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the outside diameter (OD) of the oil seal (141) with clean engine oil. DO NOT allow oil or other lubricants to contact the seal surface.
2. Lubricate the rear cover oil seal bore with clean engine oil. DO NOT allow oil or other lubricants to contact the crankshaft surface.

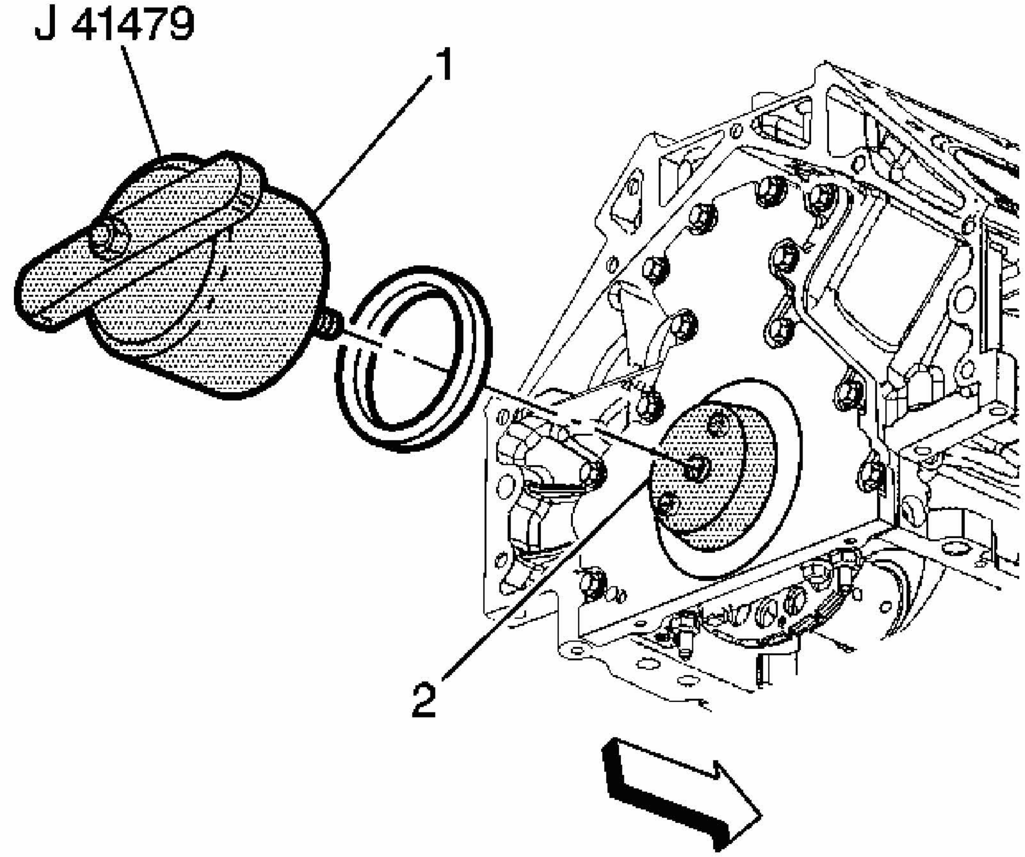


Fig. 178: Installing Crankshaft Rear Oil Seal Using J 41479
Courtesy of GENERAL MOTORS CORP.

3. Install the **J 41479** tapered cone (2) and bolts onto the rear of the crankshaft. See **Special Tools**.
4. Tighten the bolts until snug. Do not overtighten.
5. Install the rear oil seal onto the tapered cone (2) and push the seal to the rear cover bore.
6. Thread the **J 41479** threaded rod into the tapered cone until the tool (1) contacts the oil seal. See **Special Tools**.
7. Align the oil seal into the tool (1).
8. Rotate the handle of the tool (1) clockwise until the seal enters the rear cover and bottoms into the cover bore.
9. Remove the **J 41479** . See **Special Tools**.
10. Install the engine flywheel. Refer to **Engine Flywheel Replacement**.

ENGINE REAR COVER REPLACEMENT

Tools Required

J 41476 Front and Rear Cover Alignment (at crankshaft seal area). See **Special Tools**.

Removal Procedure

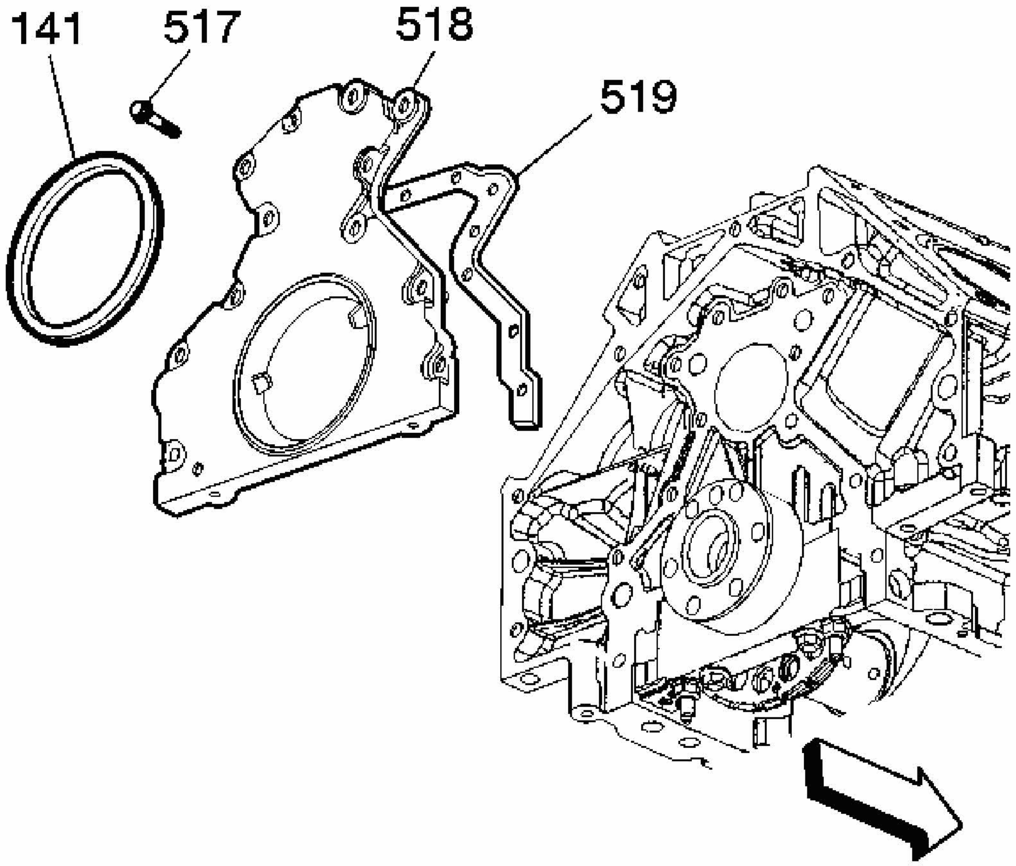


Fig. 179: Exploded View Of Engine Rear Cover
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine flywheel. Refer to **Engine Flywheel Replacement**.
2. Remove the oil pan-to-rear cover bolts.
3. Remove the rear cover bolts (517).
4. Remove the rear cover (518) and gasket (519). Discard the gasket.
5. Remove and discard the rear oil seal (141).

Installation Procedure

IMPORTANT:

- Do not reuse the crankshaft oil seal or rear cover gasket.
- Do not apply any type of sealant to the rear cover gasket, unless specified.
- The special tool in this procedure is used to properly center the crankshaft rear oil seal.
- The crankshaft rear oil seal will be installed after the rear cover has been installed and aligned.

  Install the rear cover without the crankshaft oil seal.

  - All gasket surfaces should be free of oil or other foreign material during assembly.
  - The crankshaft rear oil seal MUST be centered in relation to the crankshaft.
  - An improperly aligned rear cover may cause premature rear oil seal wear and/or engine assembly oil leaks.

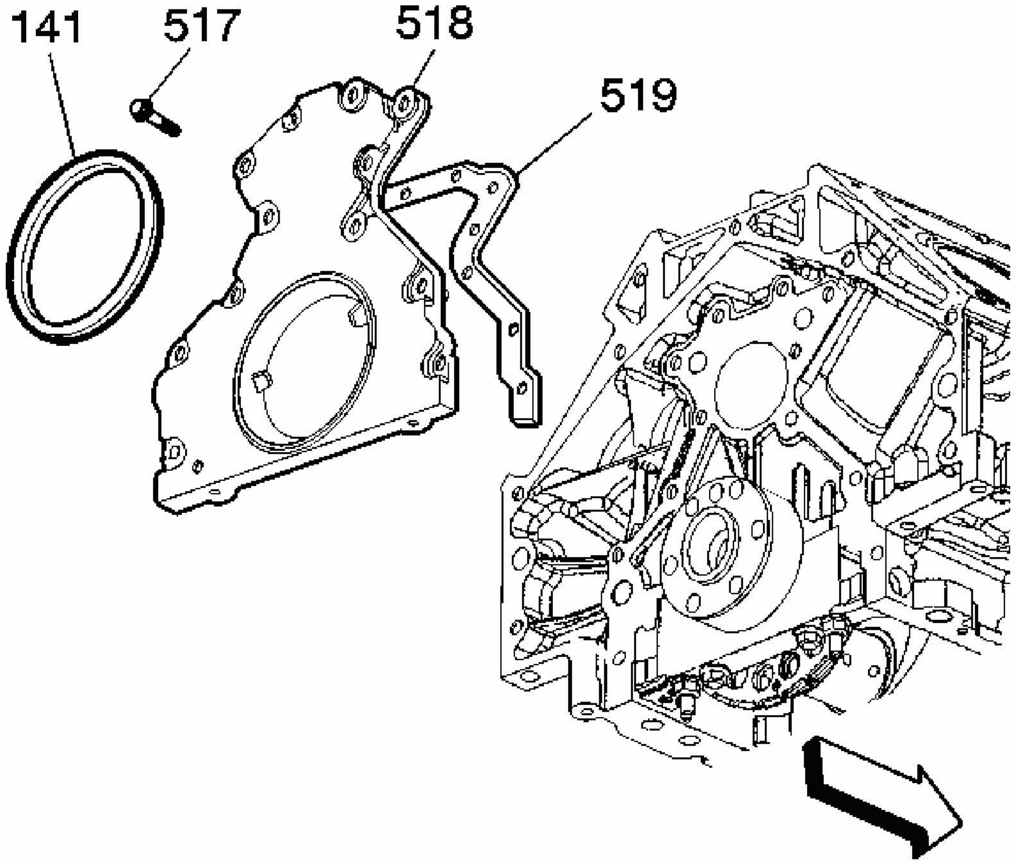


Fig. 180: Exploded View Of Engine Rear Cover
Courtesy of GENERAL MOTORS CORP.

1. Apply a 5 mm (0.20 in) bead of sealant GM U.S. P/N 12378190, or equivalent 20 mm (0.80 in) long to the oil pan to engine block junction.
2. Install the rear cover gasket (519) and cover (518).
3. Install the rear cover bolts (517) until snug. Do not overtighten.
4. Install the oil pan-to-rear cover bolts until snug. Do not overtighten.

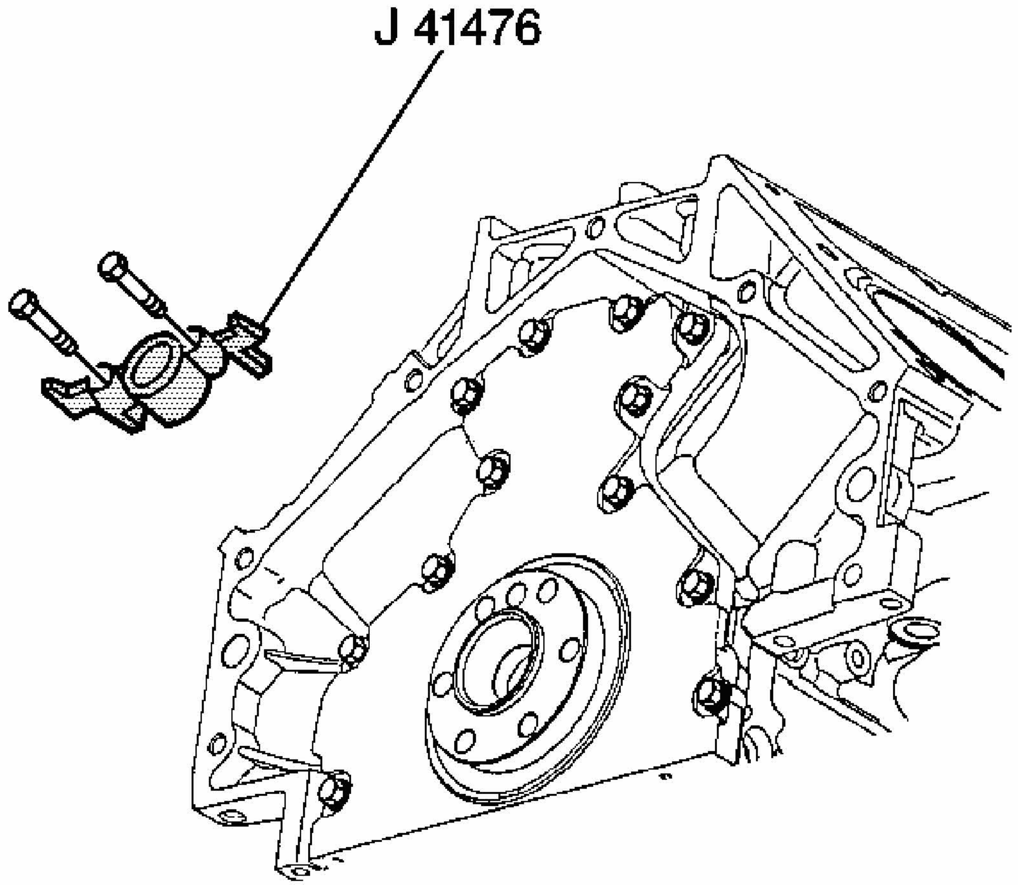


Fig. 181: View Of J 41476
Courtesy of GENERAL MOTORS CORP.

5. Rotate the crankshaft until two opposing flywheel bolt holes are parallel to the oil pan surface.

IMPORTANT: The tapered legs of the alignment tool must enter the rear cover oil seal bore.

6. Install the **J 41476** and bolts onto the rear of the crankshaft. See **Special Tools**.

NOTE: Refer to Fastener Notice in Cautions and Notices.

7. Tighten the **J 41476** mounting bolts until snug. See **Special Tools**. Do not overtighten.

Tighten:

1. Tighten the oil pan-to-rear cover bolts to 12 N.m (106 lb in).
2. Tighten the engine rear cover bolts to 25 N.m (18 lb ft).

8. Remove the **J 41476** . See **Special Tools**.
9. Install a NEW crankshaft rear oil seal. Refer to **Crankshaft Rear Oil Seal Replacement**.
10. Install the engine flywheel. Refer to **Engine Flywheel Replacement**.

OIL FILTER ADAPTER REPLACEMENT

Removal Procedure

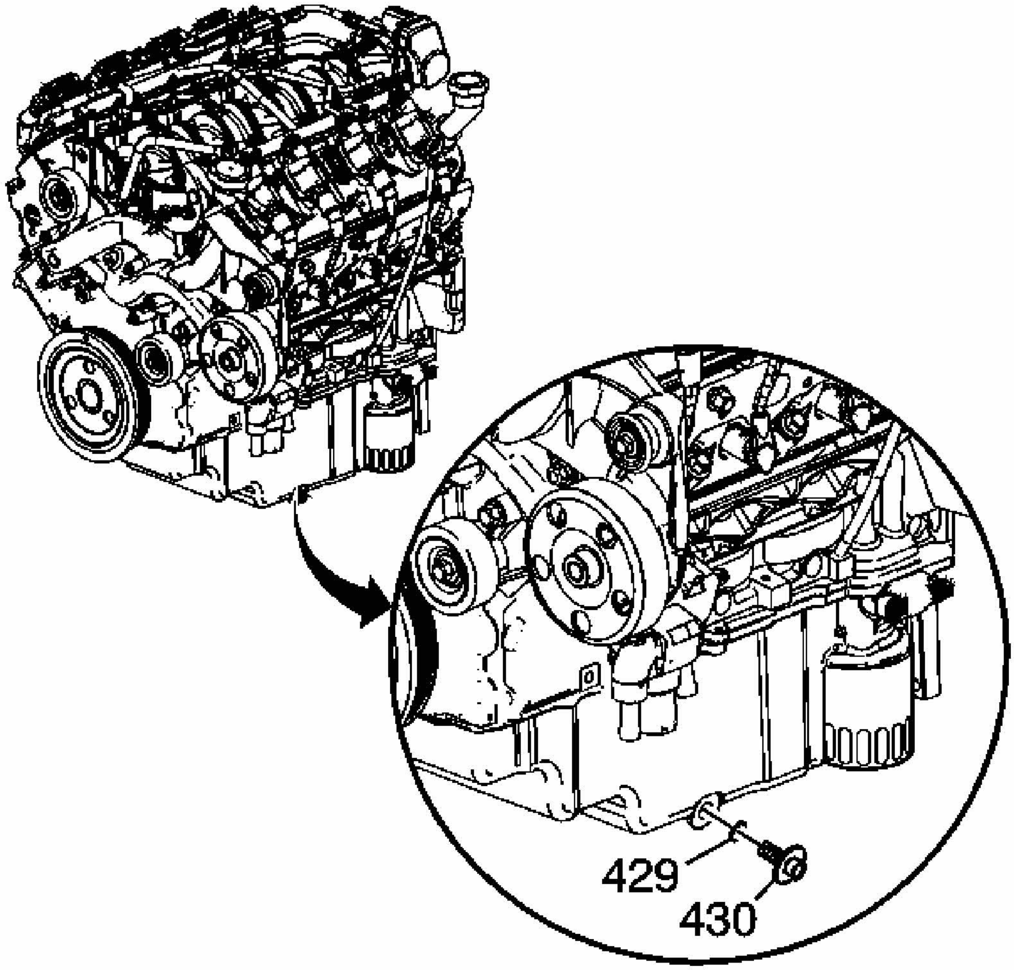


Fig. 182: View Of Oil Pan Drain Plug & O-Ring

Courtesy of GENERAL MOTORS CORP.

1. Open the hood.
2. Remove the oil fill cap.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Remove the oil pan drain plug (430) and O-ring (429).
5. Allow the oil to drain into an appropriate container.

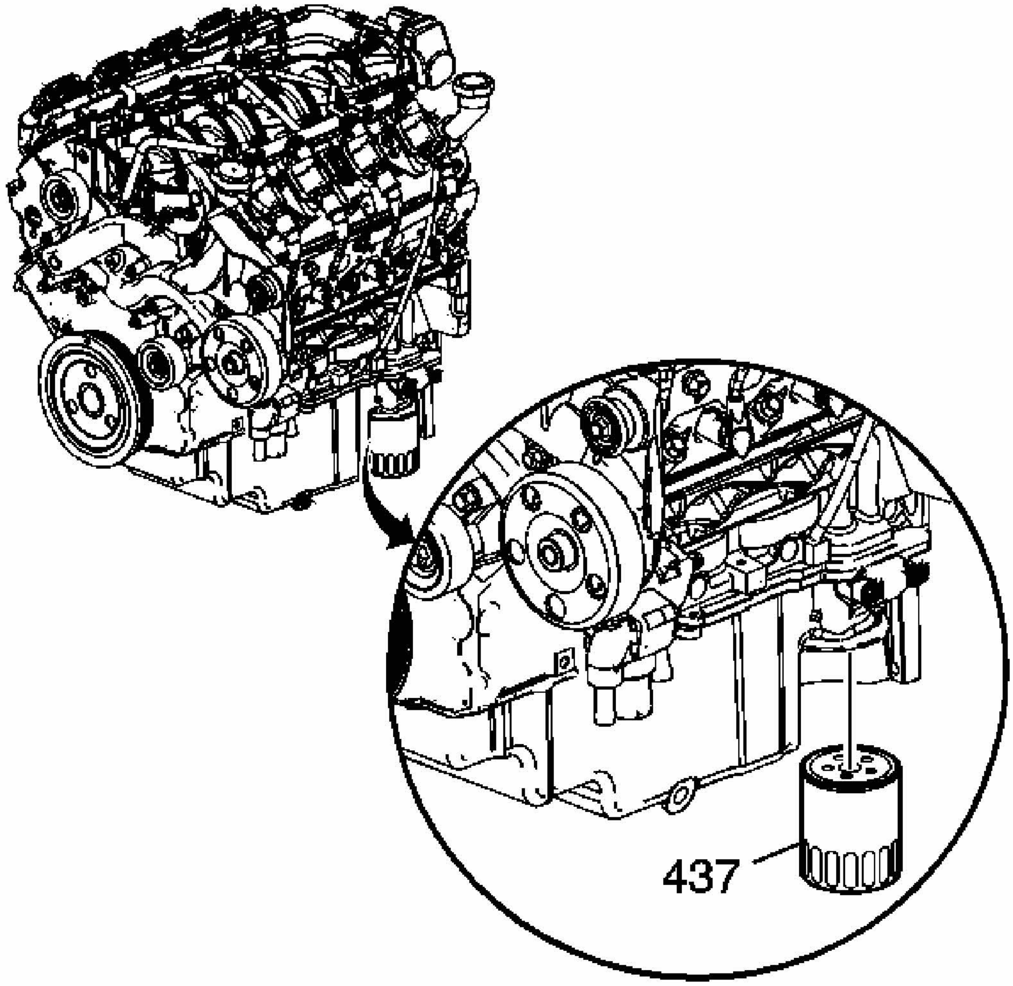


Fig. 183: View Of Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine oil filter (437). Allow the rest of the engine oil to drain into an

appropriate container.

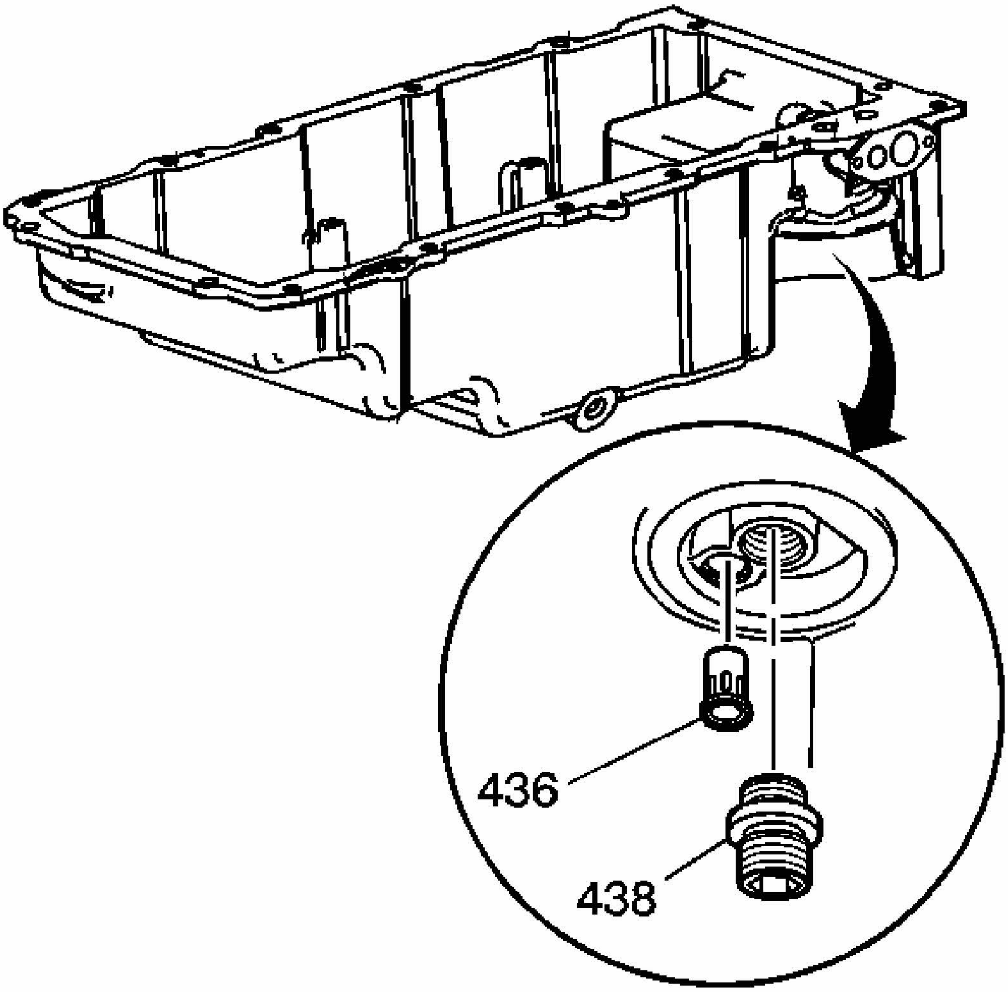


Fig. 184: View Of Oil Filter Adapter & Bypass Valve
Courtesy of GENERAL MOTORS CORP.

7. Remove the oil filter adapter (438).

Installation Procedure

IMPORTANT: Prior to installing a NEW oil filter, ensure that the old oil filter gasket has been removed from the engine block. If not, remove the old gasket.

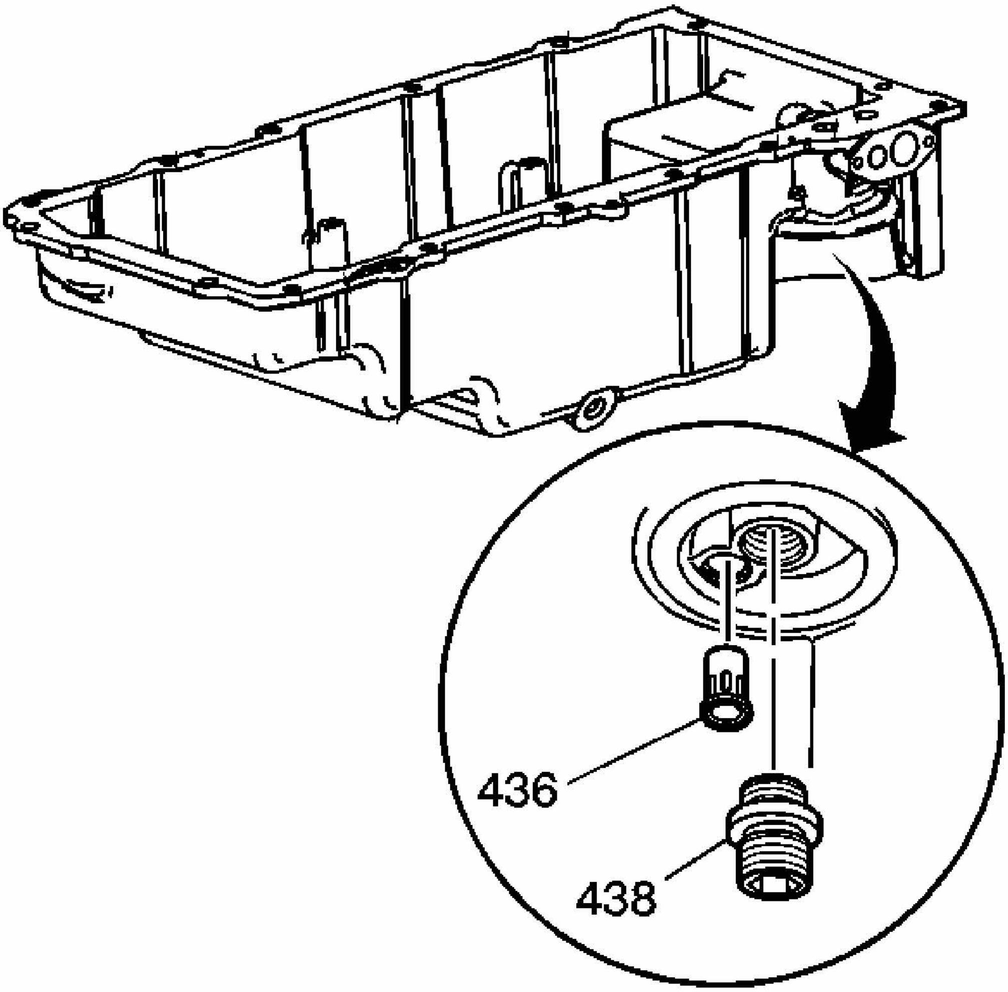


Fig. 185: View Of Oil Filter Adapter & Bypass Valve
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

1. Install a NEW oil filter adapter (438).

   Tighten: Tighten the adapter to 55 N.m (40 lb ft).

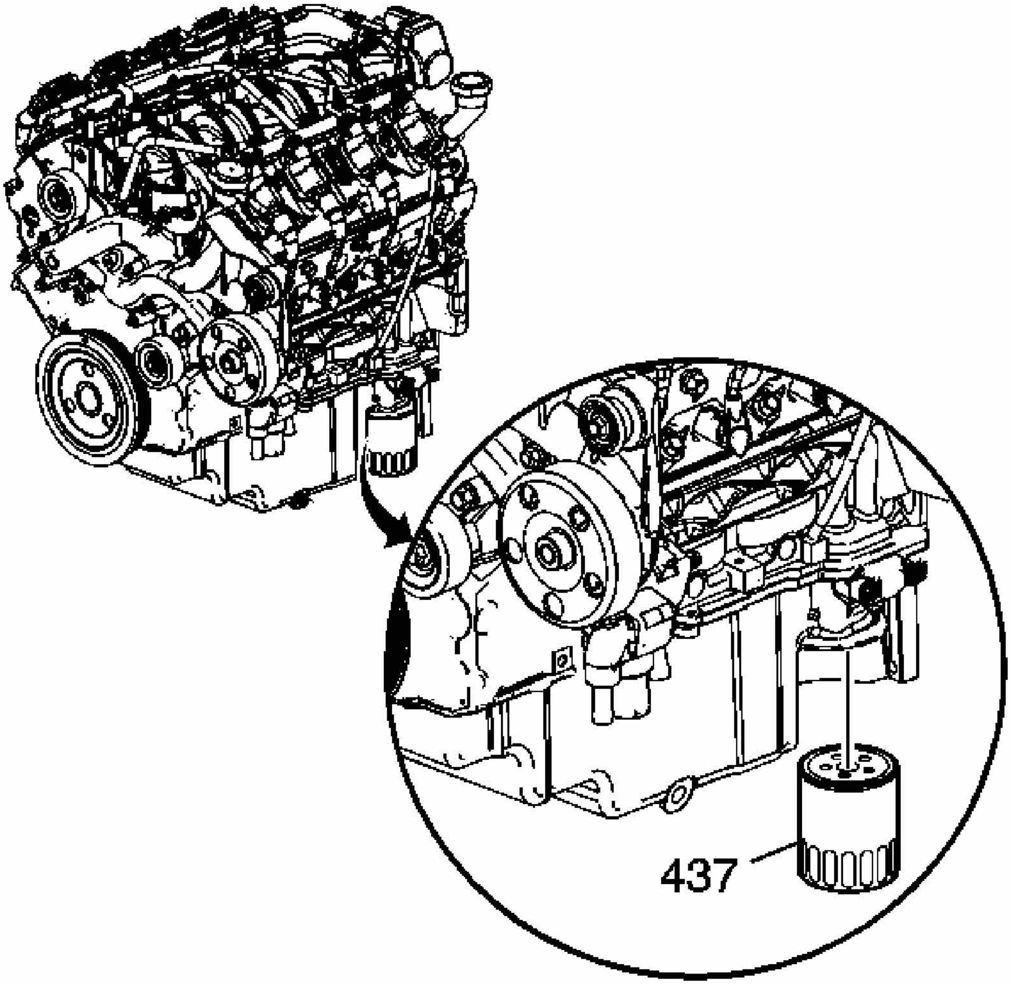


Fig. 186: View Of Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW engine oil filter (437).

   Tighten: Tighten the filter to 30 N.m (22 lb ft).

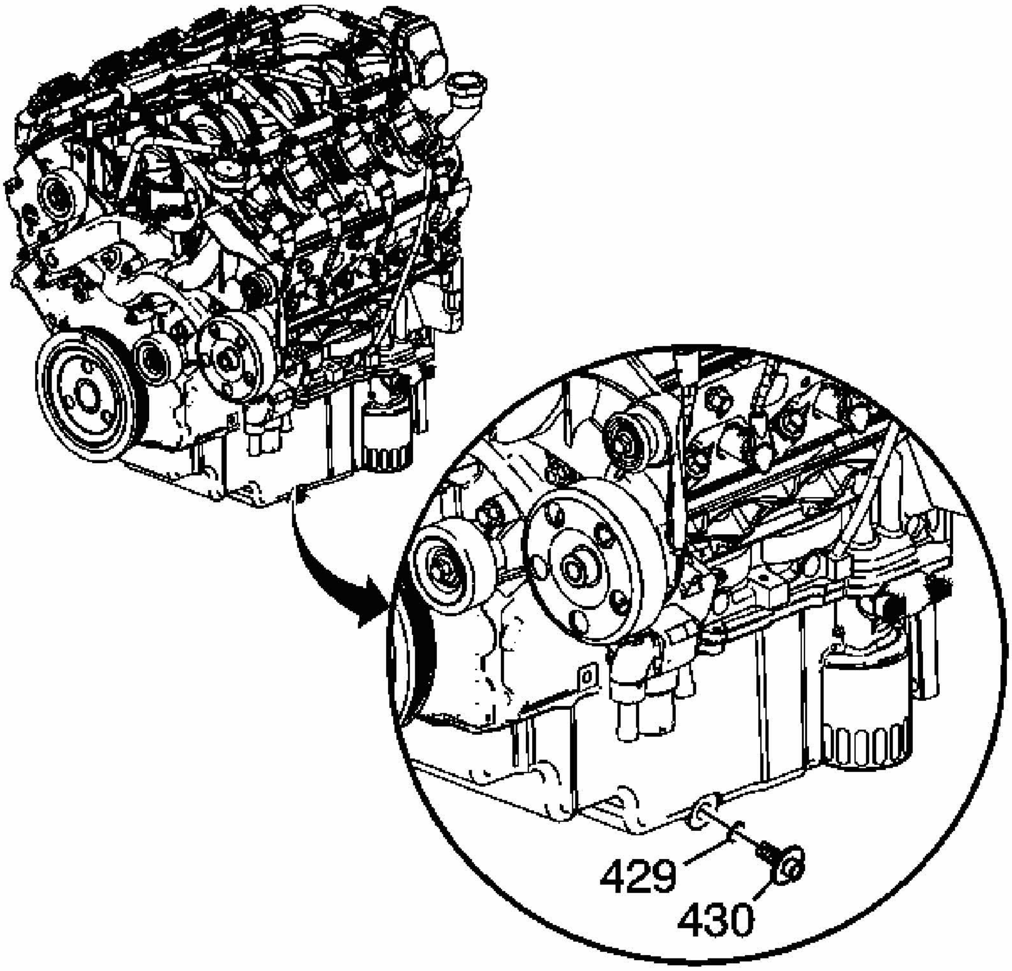


Fig. 187: View Of Oil Pan Drain Plug & O-Ring
Courtesy of GENERAL MOTORS CORP.

3. Install the oil pan drain plug (430) and O-ring (429).

   Tighten: Tighten the drain plug to 25 N.m (18 lb ft).

4. Lower the vehicle.
5. Fill the engine with the appropriate amount and type of NEW engine oil. Refer to **Capacities - Approximate Fluid** and**Fluid and Lubricant Recommendations** .
6. Check the oil level.
7. Install the oil fill cap.
8. Close the hood.
9. Reset the engine oil life monitor, if necessary. Refer to **GM Oil Life System -**

Resetting .

OIL FILTER BYPASS VALVE REPLACEMENT

Removal Procedure

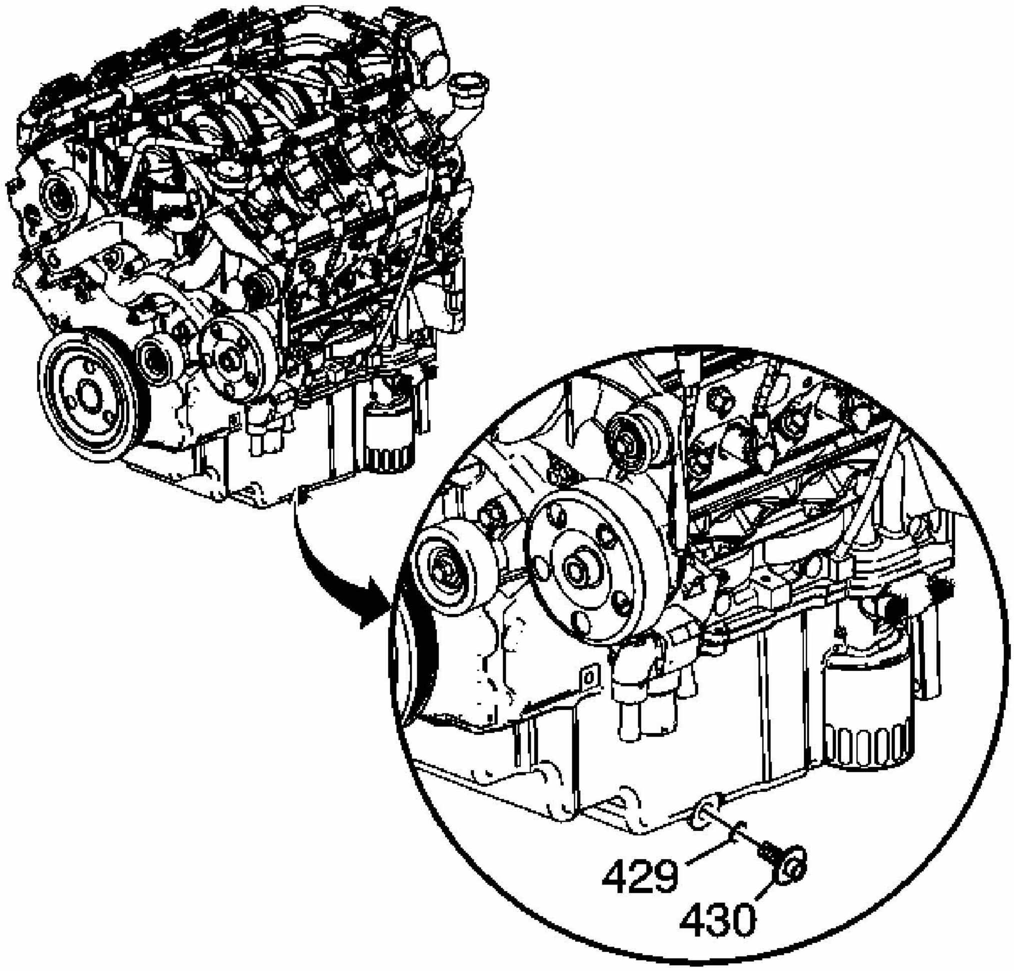


Fig. 188: View Of Oil Pan Drain Plug & O-Ring
Courtesy of GENERAL MOTORS CORP.

1. Open the hood.
2. Remove the oil fill cap.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Remove the oil pan drain plug (430) and O-ring (429).

5. Allow the oil to drain into an appropriate container.

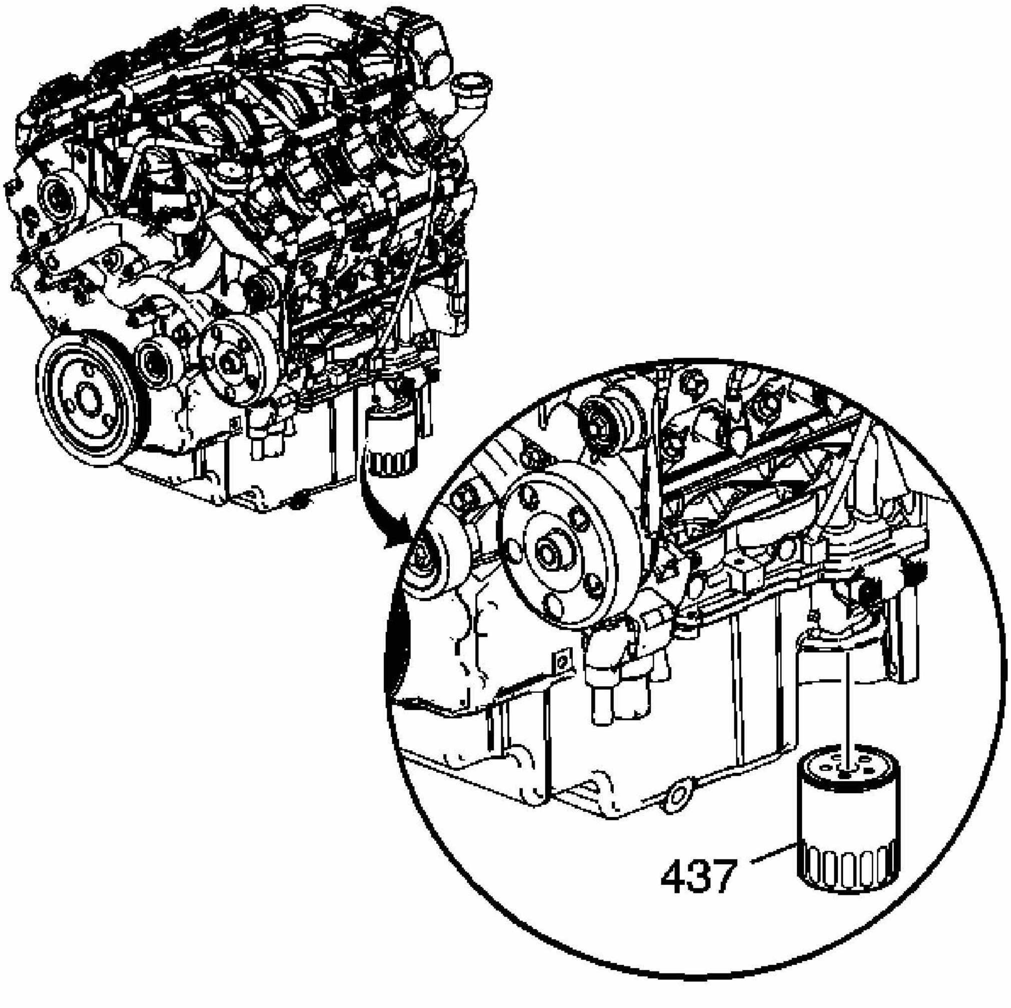


Fig. 189: View Of Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine oil filter (437). Allow the rest of the engine oil to drain into an appropriate container.

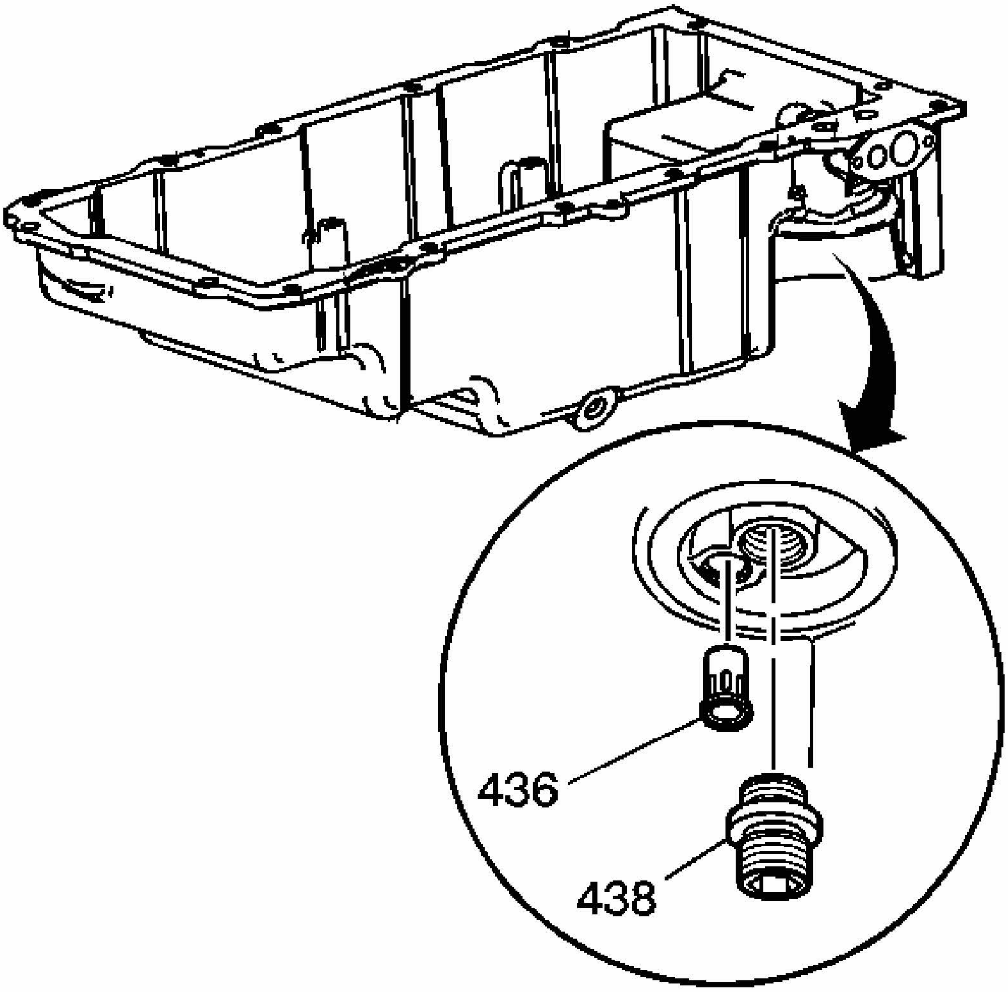


Fig. 190: View Of Oil Filter Adapter & Bypass Valve
Courtesy of GENERAL MOTORS CORP.

7. Remove the oil filter adapter (438).
8. Remove the bypass valve (436).

Installation Procedure

IMPORTANT: Prior to installing a NEW oil filter, ensure that the old oil filter gasket has been removed from the engine block. If not, remove the old gasket.

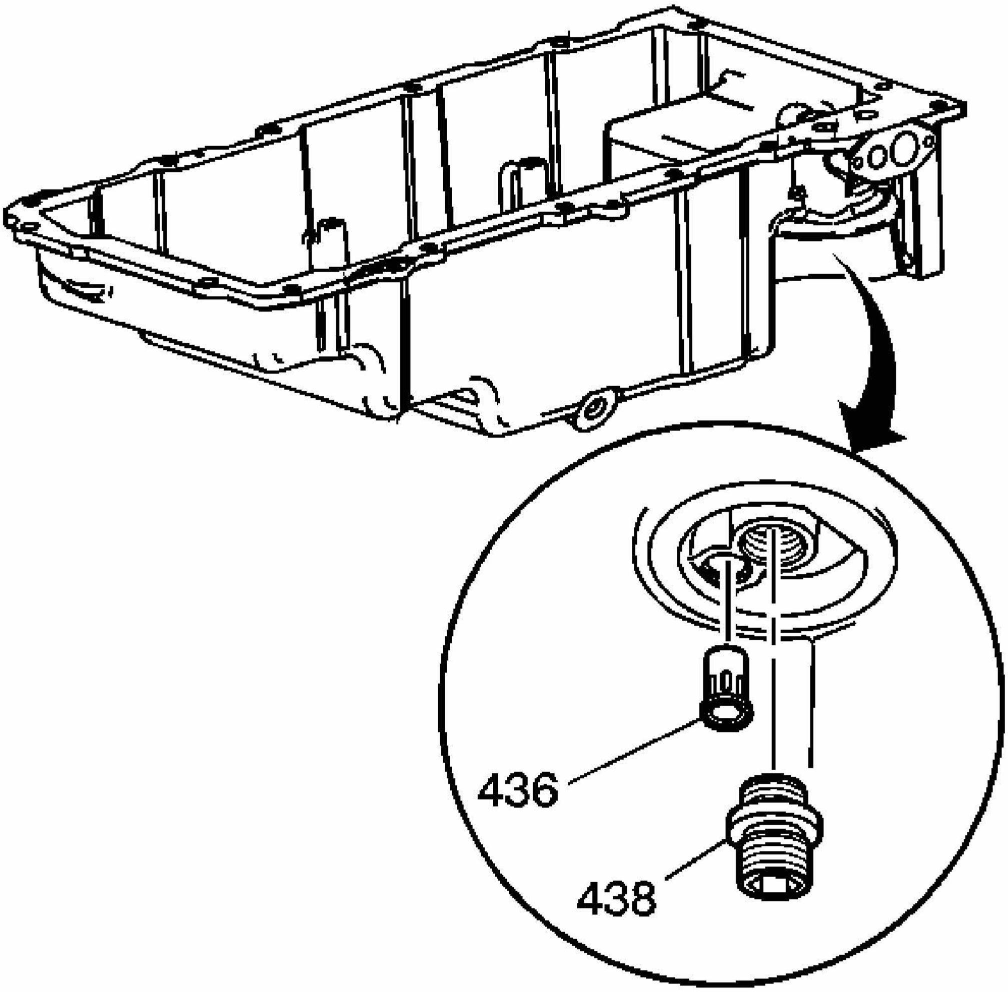


Fig. 191: View Of Oil Filter Adapter & Bypass Valve
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW bypass valve (436).

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install a NEW oil filter adapter (438).

Tighten: Tighten the adapter to 55 N.m (40 lb ft).

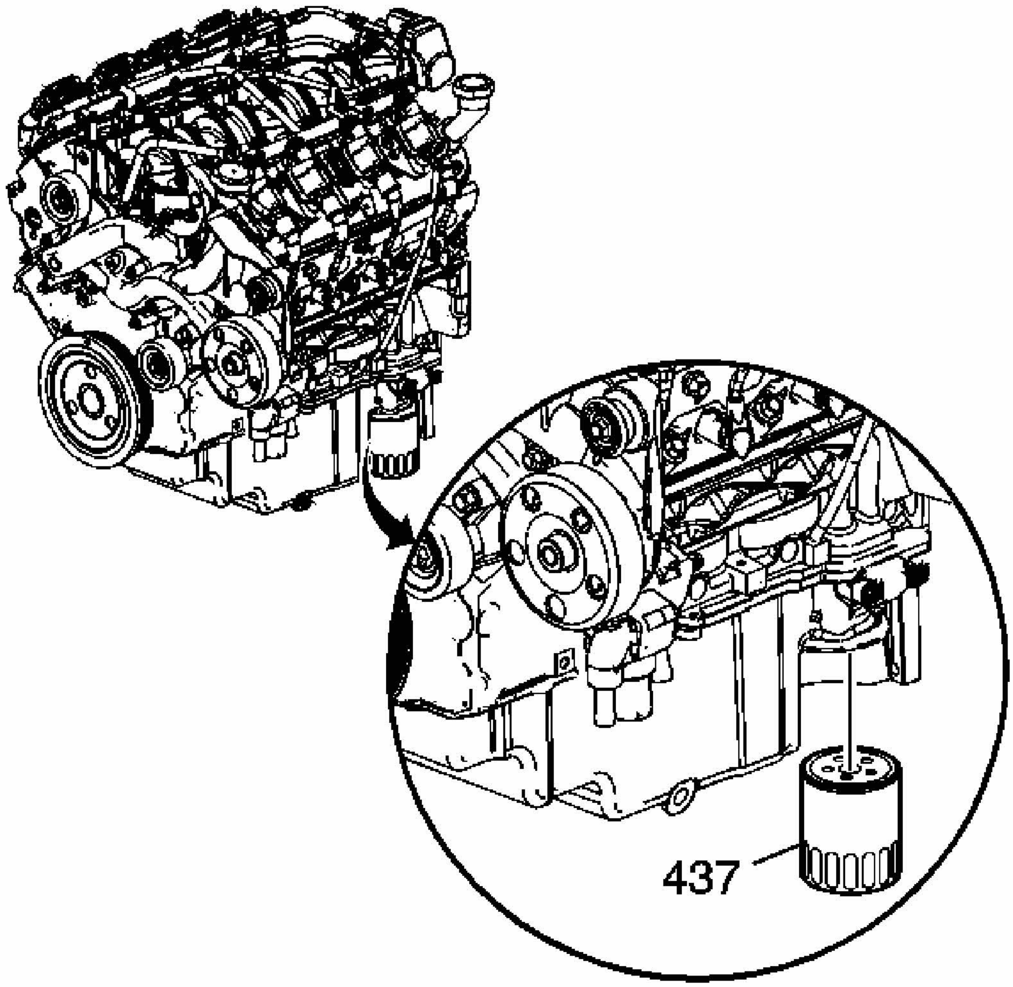


Fig. 192: View Of Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

3. Install a NEW engine oil filter (437).

   Tighten: Tighten the filter to 30 N.m (22 lb ft).

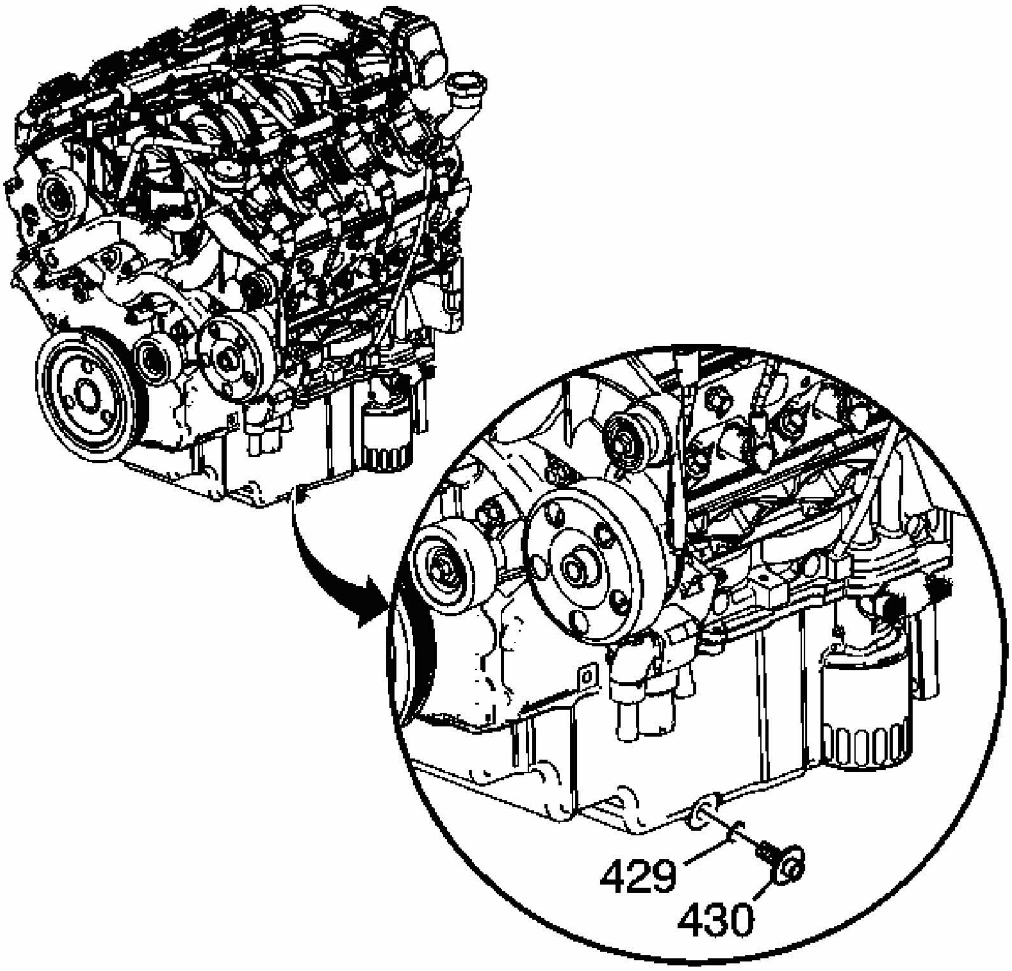


Fig. 193: View Of Oil Pan Drain Plug & O-Ring
Courtesy of GENERAL MOTORS CORP.

4. Install the oil pan drain plug (430) and O-ring (429).

   Tighten: Tighten the drain plug to 25 N.m (18 lb ft).

5. Lower the vehicle.
6. Fill the engine with the appropriate amount and type of NEW engine oil. Refer to **Capacities - Approximate Fluid** and **Fluid and Lubricant Recommendations** .
7. Check the oil level.
8. Install the oil fill cap.
9. Close the hood.
10. Reset the engine oil life monitor, if necessary. Refer to **GM Oil Life System -**

Resetting .

OIL PAN REPLACEMENT

Removal Procedure

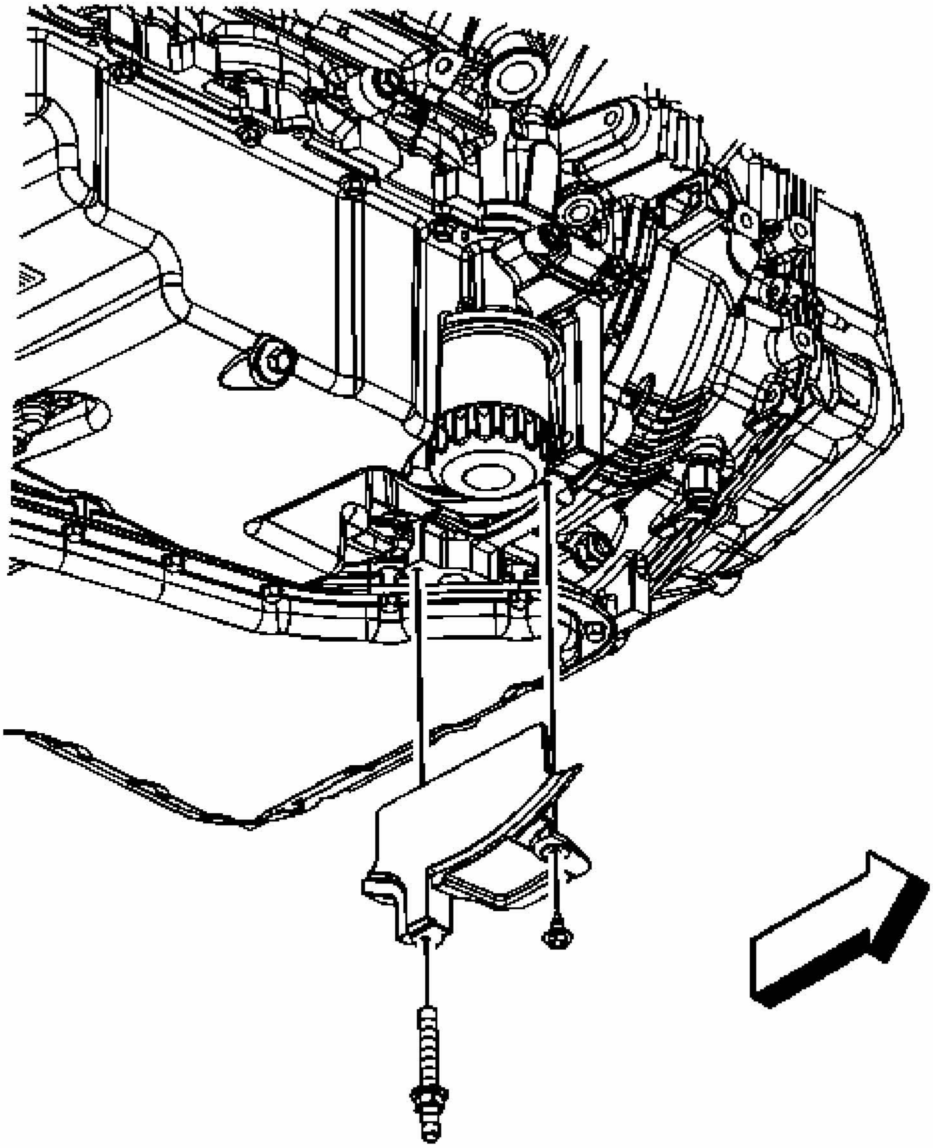


Fig. 194: Transaxle Converter Cover Bolt/Stud And Cover
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine frame. Refer to **Frame Replacement** .

2. Drain the engine oil and remove the engine oil filter.
3. Reinstall the drain plug and oil filter until snug.
4. Remove the transaxle converter cover bolt/stud and cover.

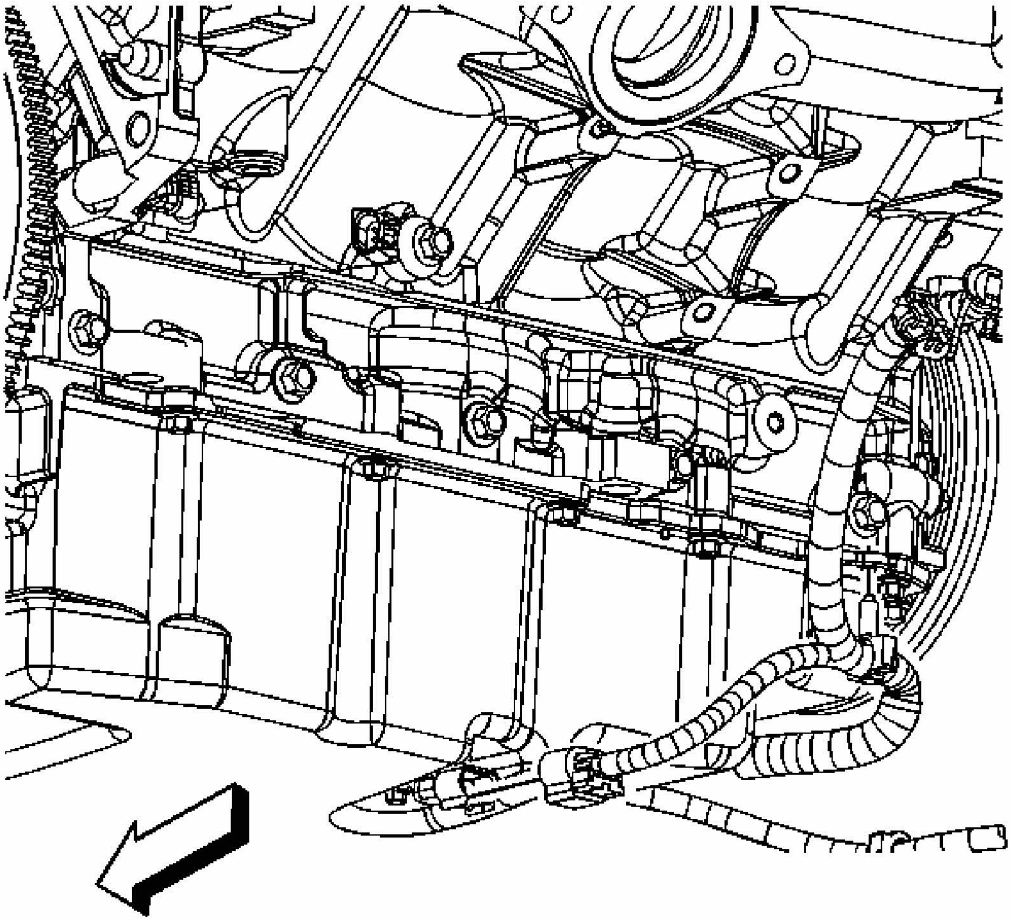


Fig. 195: View Of Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the oil level sensor electrical connector.
6. Remove engine harness retainer from the front of oil pan.

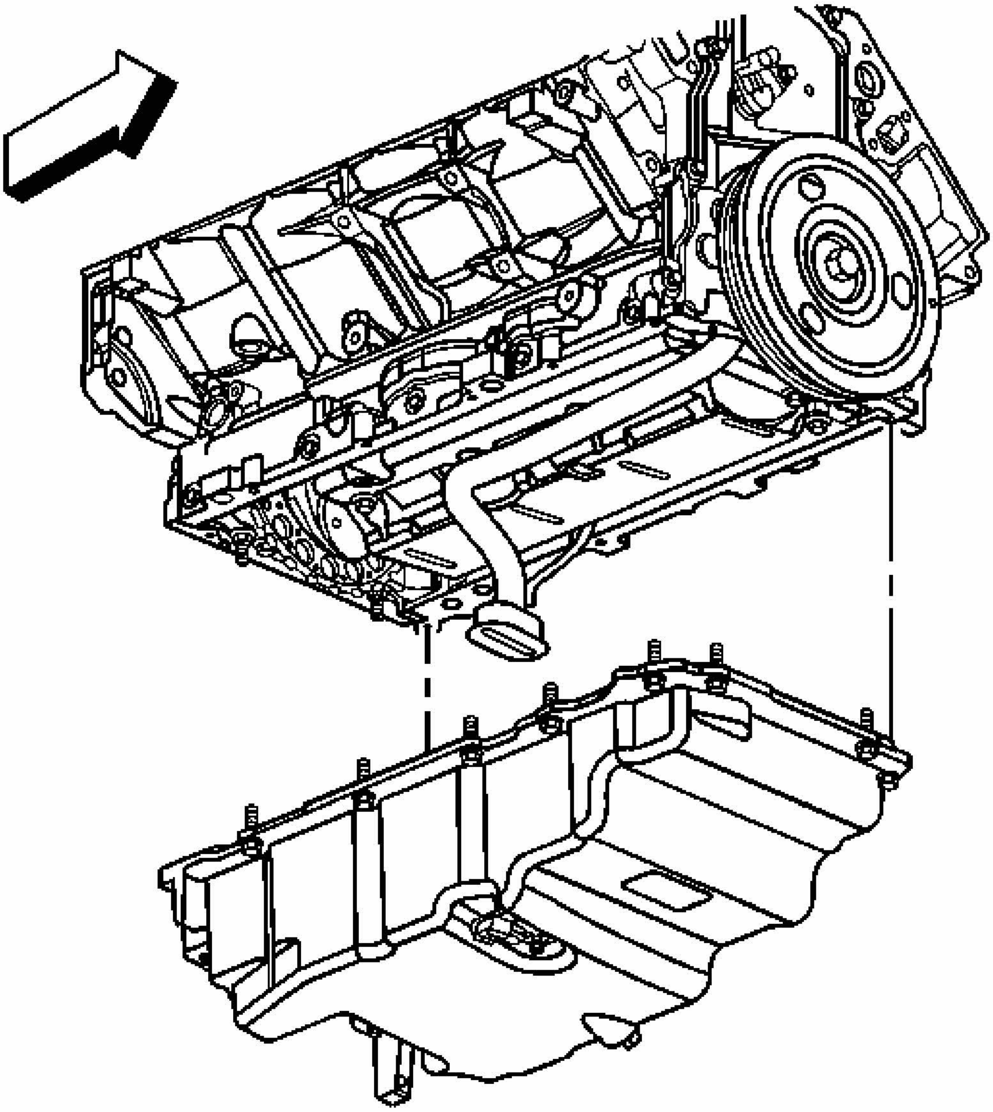


Fig. 196: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the oil pan bolts.
8. Remove the oil pan.

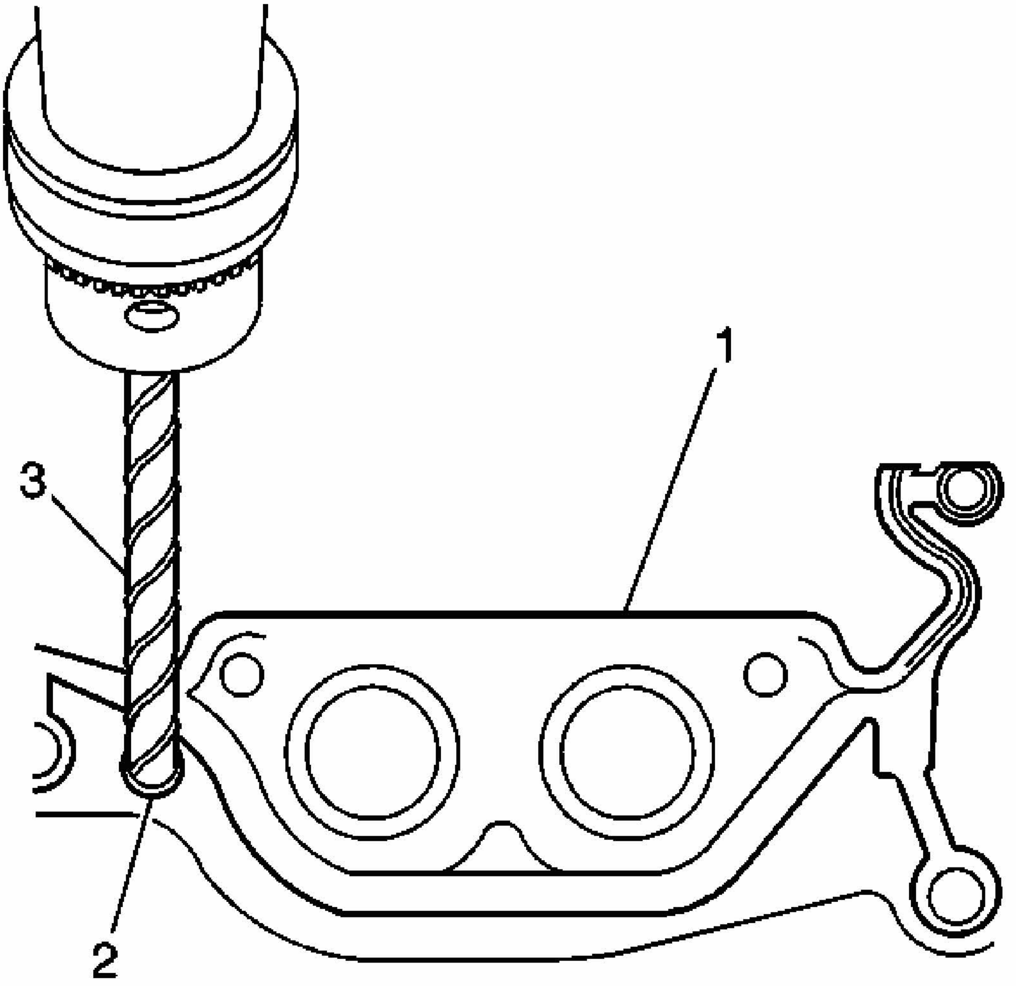


Fig. 197: Drilling Oil Pan Gasket Retaining Rivets
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: DO NOT allow foreign material to enter the oil passages of the oil pan, cap or cover the openings as required.

9. Drill (3) out the oil pan gasket retaining rivets (2), if required.
10. Remove the gasket (1) from the pan.
11. Discard the gasket and rivets.
12. Clean and inspect the engine oil pan. Refer to **Oil Pan Cleaning and Inspection**.

Installation Procedure

IMPORTANT:

- **The alignment of the structural oil pan is critical. The rear bolt hole locations of the oil pan provide mounting points for the transmission housing. To ensure the rigidity of the powertrain and correct transmission alignment, it is important that the rear of the block and the rear of the oil pan are flush, or even. The rear of the oil pan must NEVER protrude beyond the engine block and transmission housing plane.**
- **Do NOT reuse the oil pan gasket.**
- **It is NOT necessary to rivet the NEW gasket to the oil pan.**

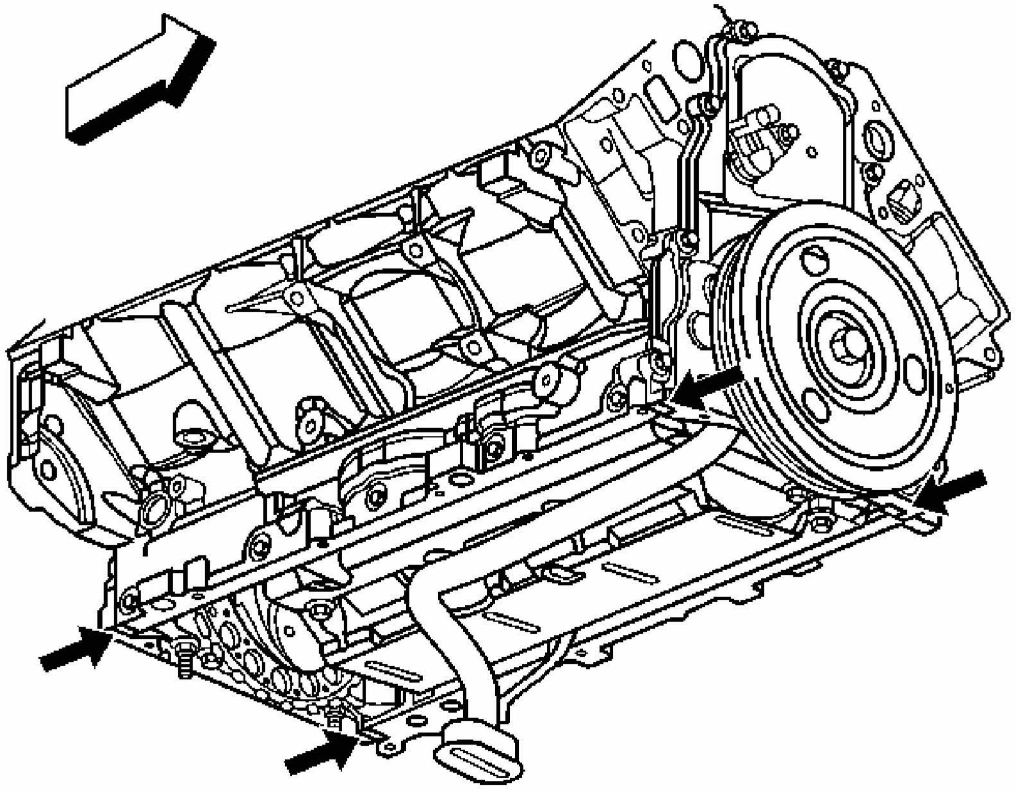


Fig. 198: Applying Bead Of Sealant
Courtesy of GENERAL MOTORS CORP.

1. Apply a 5 mm (0.20 in) bead of sealant GM P/N 12346141 or 12378577 (Canadian P/N 89022195), or equivalent 20 mm (0.80 in) long to the engine block. Apply the sealant directly onto the tabs of the front/rear cover gasket that protrudes into the oil pan surface.

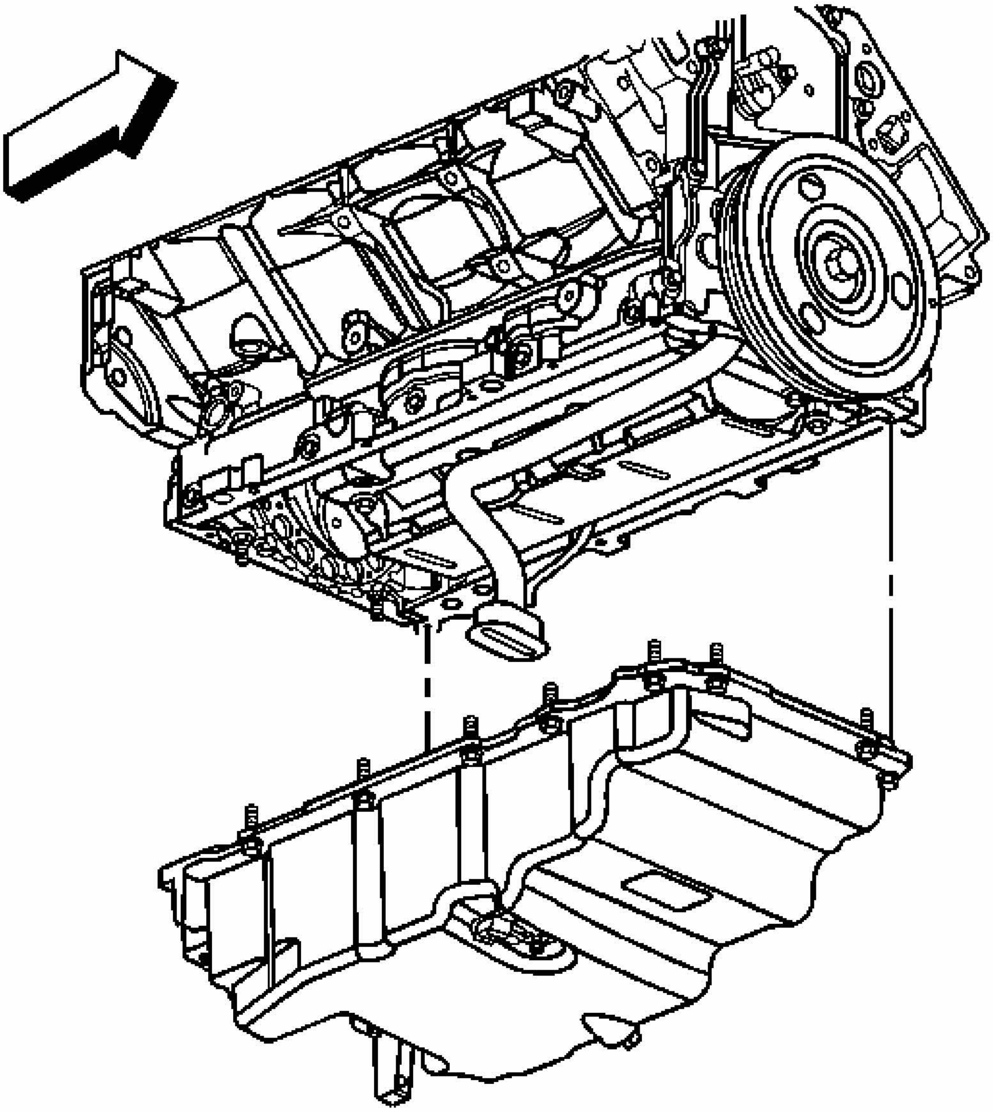


Fig. 199: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Be sure to align the oil gallery passages in the oil pan and engine block properly with the oil pan gasket.

2. Pre-assemble the oil pan gasket to the pan.
    1. Install the gasket onto the pan.
    2. Install the oil pan bolts to the pan and through the gasket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the oil pan, gasket, and bolts to the engine block.

   Tighten:

   - Tighten the oil pan and oil pan-to-front cover bolts to 25 N.m (18 lb ft).
   - Tighten the oil pan-to-rear cover bolts to 12 N.m (106 lb in).
   - Tighten the transmission housing, converter cover, and transmission bolts/stud to 50 N.m (37 lb ft).

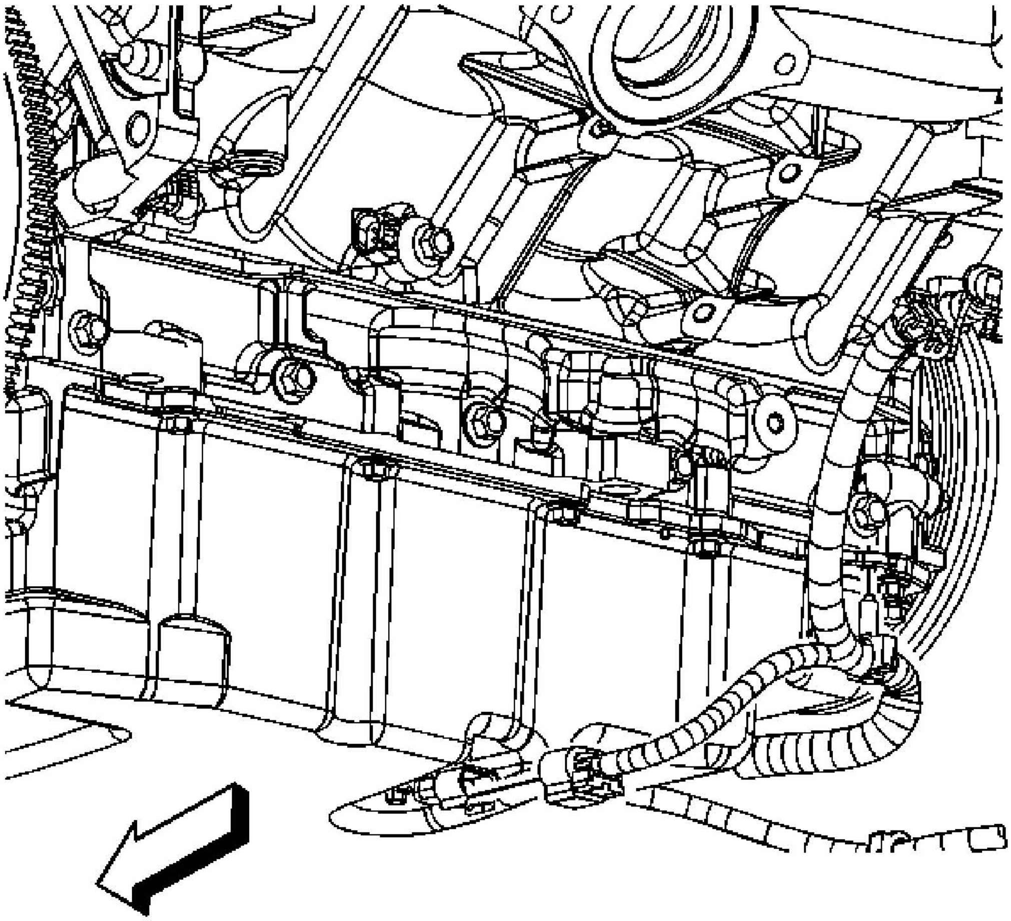


Fig. 200: View Of Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Install engine harness to front of oil pan.

5. Connect the oil level sensor electrical connector.

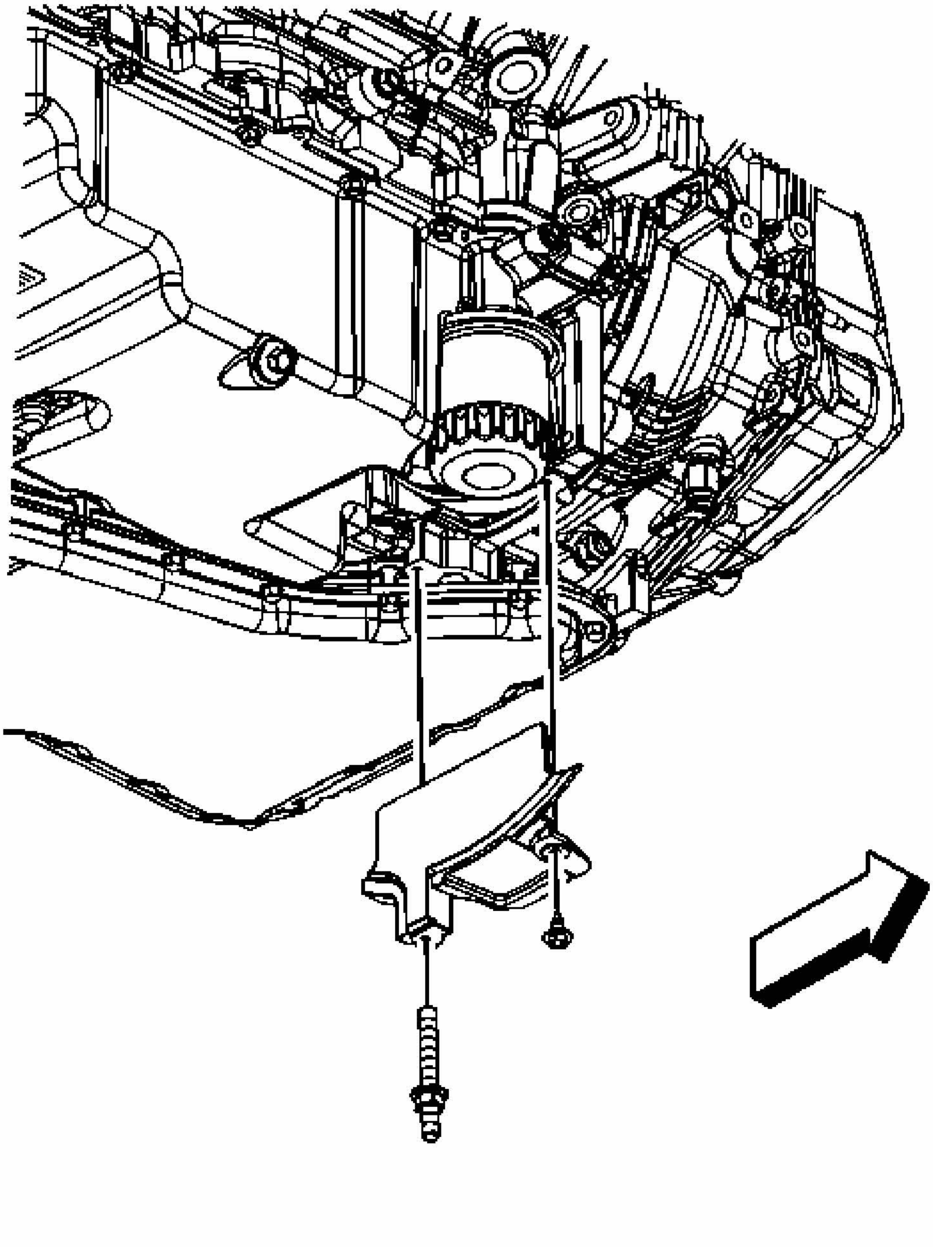


Fig. 201: Transaxle Converter Cover Bolt/Stud And Cover
Courtesy of GENERAL MOTORS CORP.

6. Install the transaxle converter cover and bolt/stud.

   Tighten: Tighten the bolt/stud to 12 N.m (106 lb in).

7. Install new engine oil and a new oil filter. Refer to **Engine Oil and Oil Filter Replacement**.
8. Install the engine frame. Refer to **Frame Replacement** in Frame and Underbody.

VALVE LIFTER OIL PRESSURE RELIEF VALVE REPLACEMENT

Removal Procedure

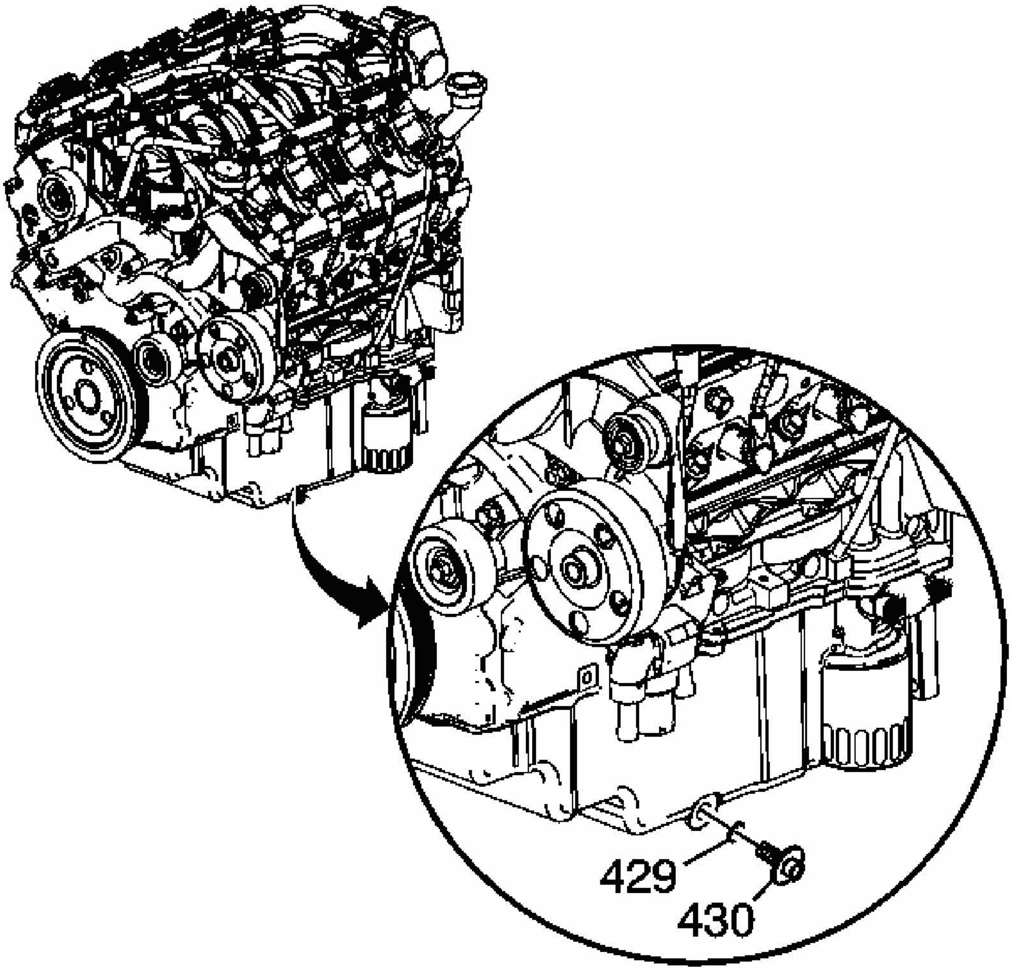


Fig. 202: View Of Oil Pan Drain Plug & O-Ring
Courtesy of GENERAL MOTORS CORP.

1. Open the hood.
2. Remove the oil fill cap.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General

Information.

4. Remove the oil pan drain plug (430) and O-ring (429).
5. Allow the oil to drain into an appropriate container.

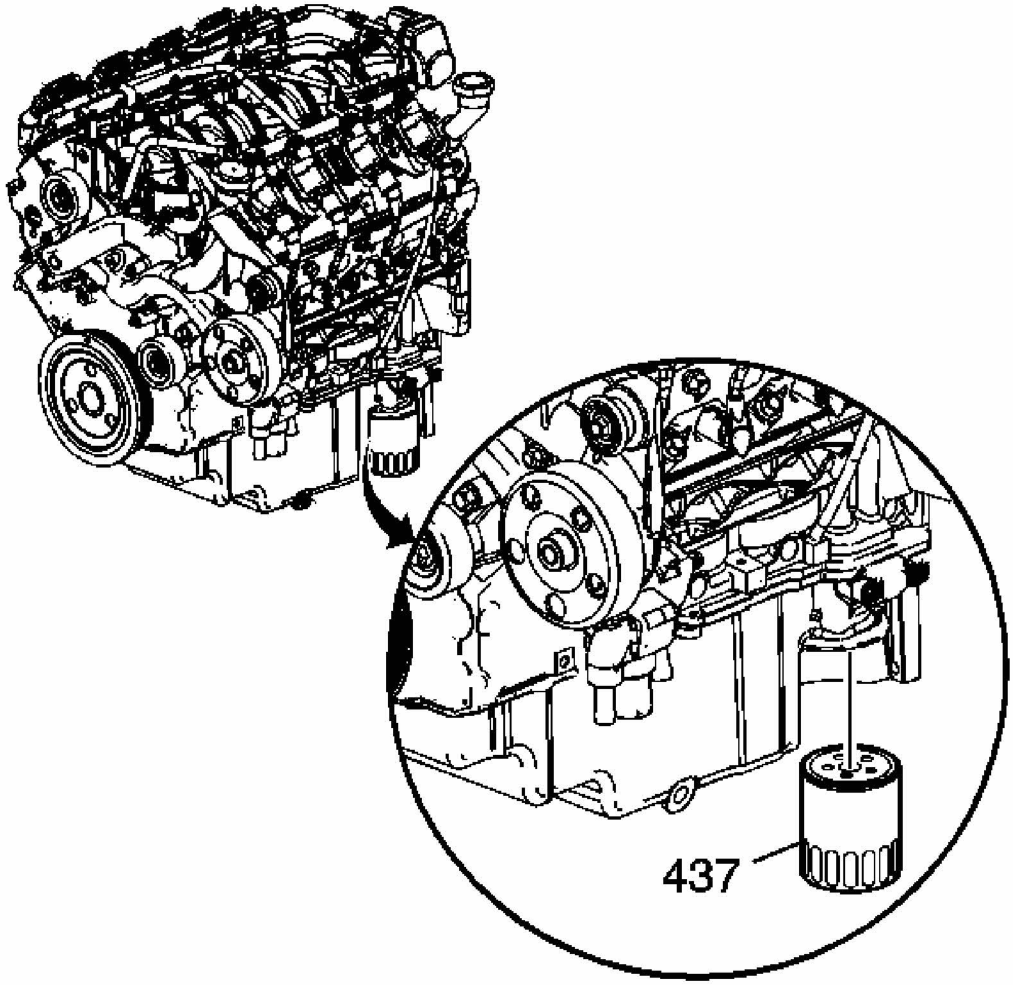


Fig. 203: View Of Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine oil filter (437). Allow the rest of the engine oil to drain into an appropriate container.

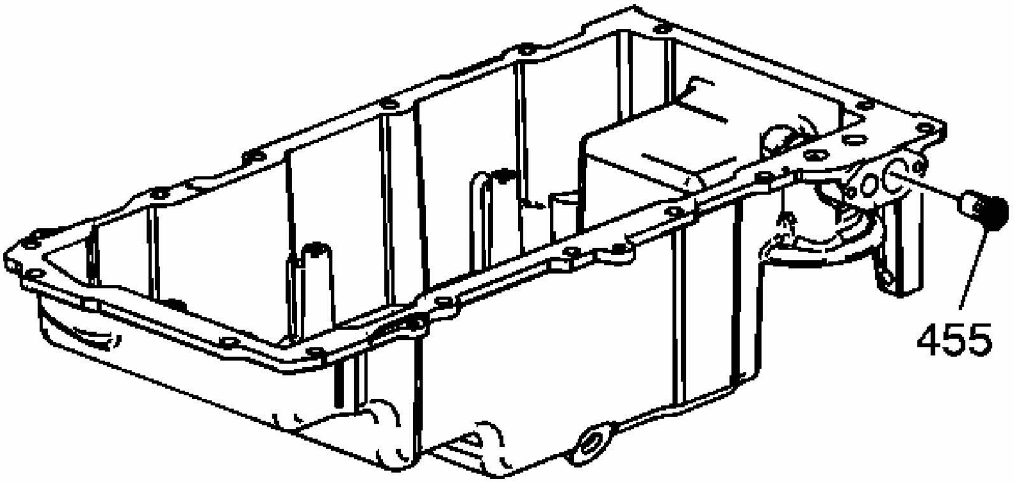


Fig. 204: Valve Lifter Oil Pressure Relief Valve
Courtesy of GENERAL MOTORS CORP.

7. Remove the oil pan cover bolts.
8. Remove the valve lifter oil pressure relief valve (455).

Installation Procedure

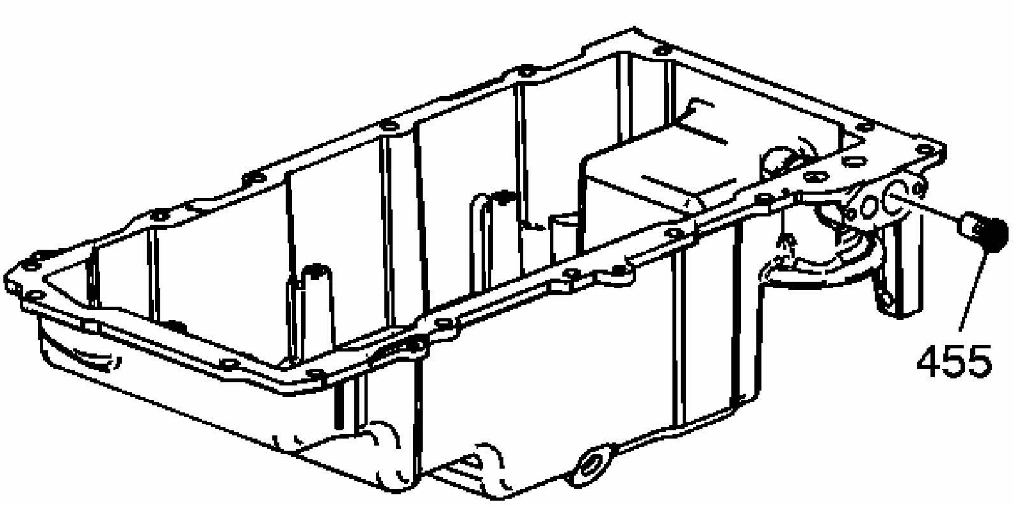


Fig. 205: Valve Lifter Oil Pressure Relief Valve

Courtesy of GENERAL MOTORS CORP.

1. Install the valve lifter oil pressure relief valve (455).

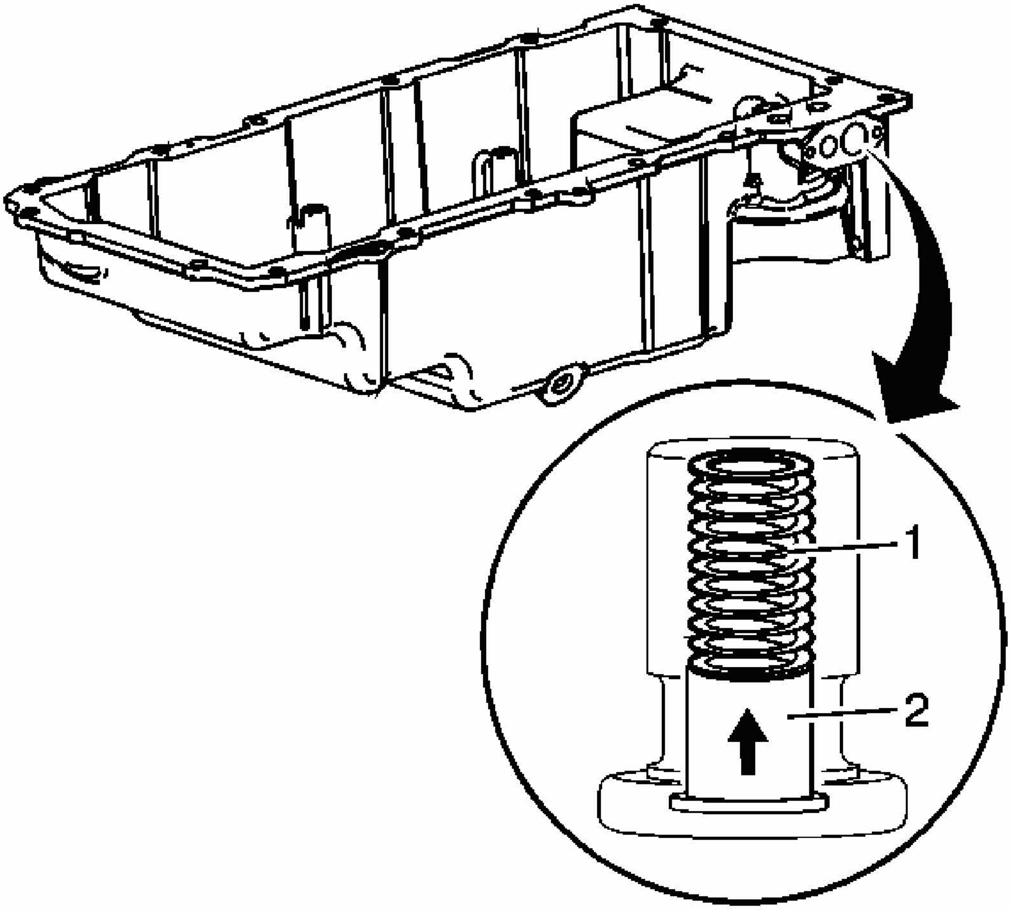


Fig. 206: View Of The Valve Lifter Oil Pressure Relief Valve
Courtesy of GENERAL MOTORS CORP.

2. Inspect the valve lifter oil pressure relief valve for proper operation. Lightly depress the valve (2). The valve spring (1) should seat the valve to the proper closed position.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

3. Install the oil pan cover bolts and cover.

Tighten: Tighten the bolts to 12 N.m (106 lb in).

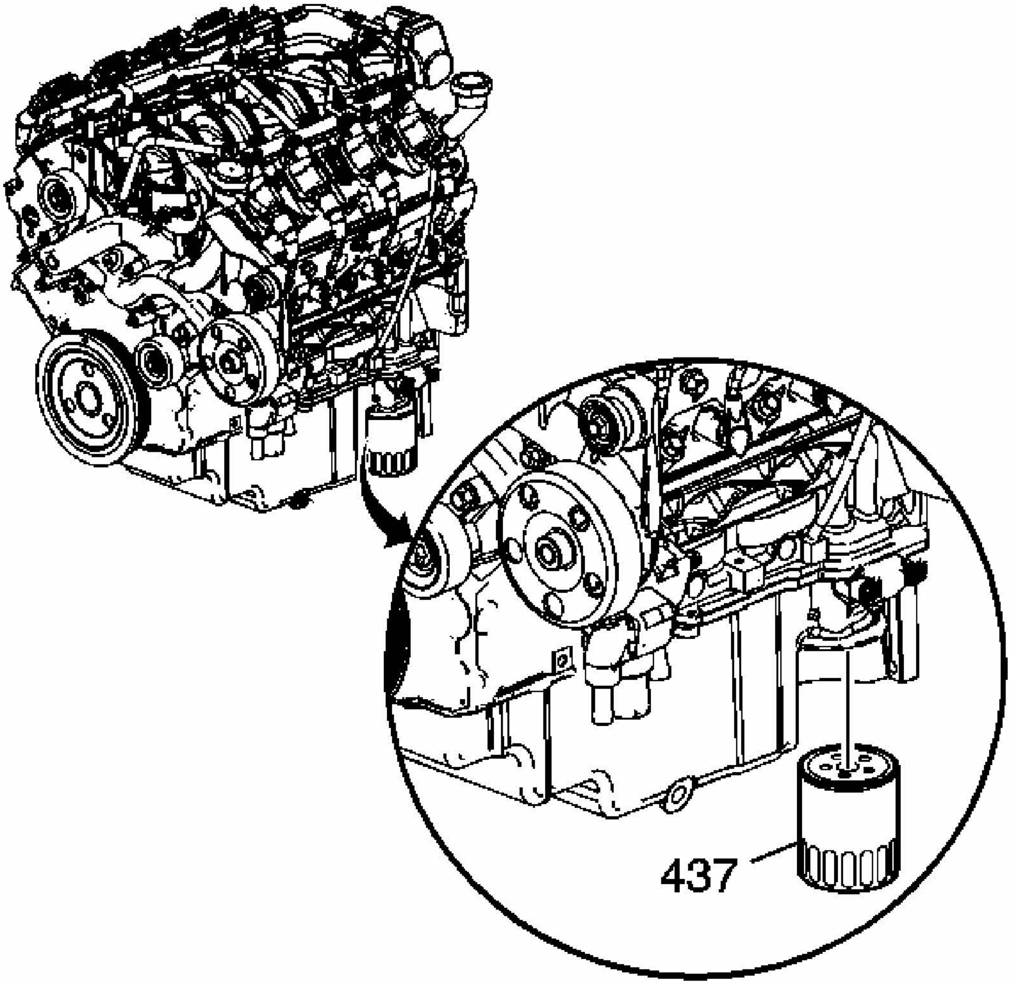


Fig. 207: View Of Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

4. Install a NEW engine oil filter (437).

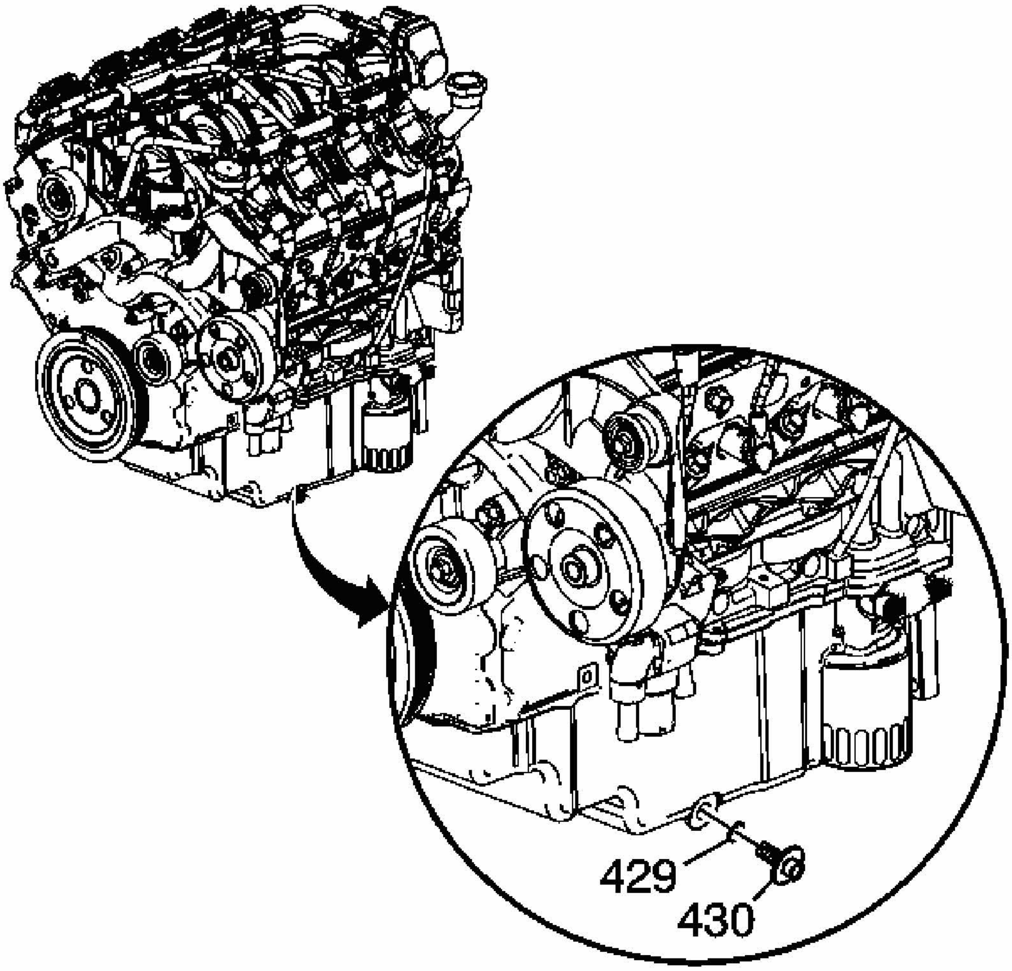


Fig. 208: View Of Oil Pan Drain Plug & O-Ring
Courtesy of GENERAL MOTORS CORP.

5. Install the oil pan drain plug (430) and O-ring (429).
6. Lower the vehicle.
7. Fill the engine with the appropriate amount and type of NEW engine oil. Refer to **Capacities - Approximate Fluid** and**Fluid and Lubricant Recommendations** .
8. Check the oil level.
9. Install the oil fill cap.
10. Open the hood.
11. Reset the engine oil lift monitor, if necessary. Refer to **GM Oil Life System - Resetting** .

ENGINE OIL PRESSURE SENSOR AND/OR SWITCH REPLACEMENT

Tools Required

J 41712 Oil Pressure Sensor Socket. See **Special Tools**.

Removal Procedure

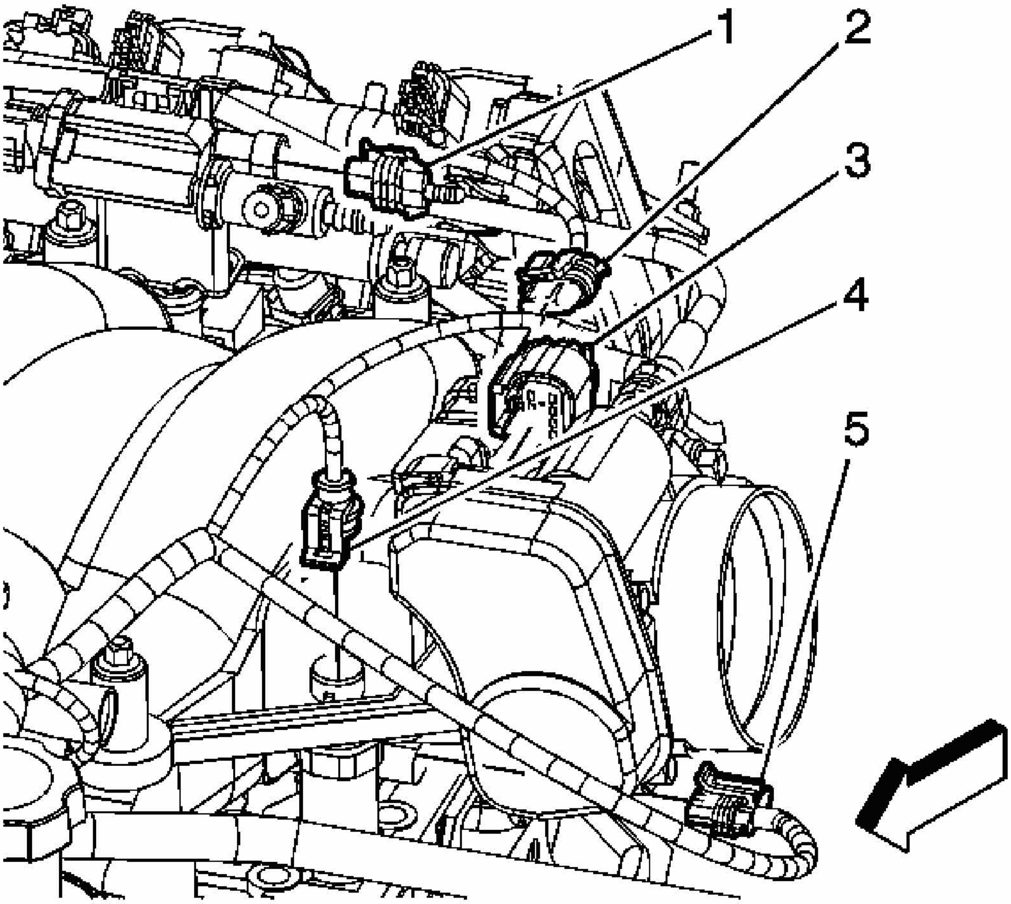


Fig. 209: View Of Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

1. If necessary, remove the engine sight shield. Refer to **Engine Sight Shield Replacement**.
2. Disconnect the oil pressure sensor electrical connector (4).

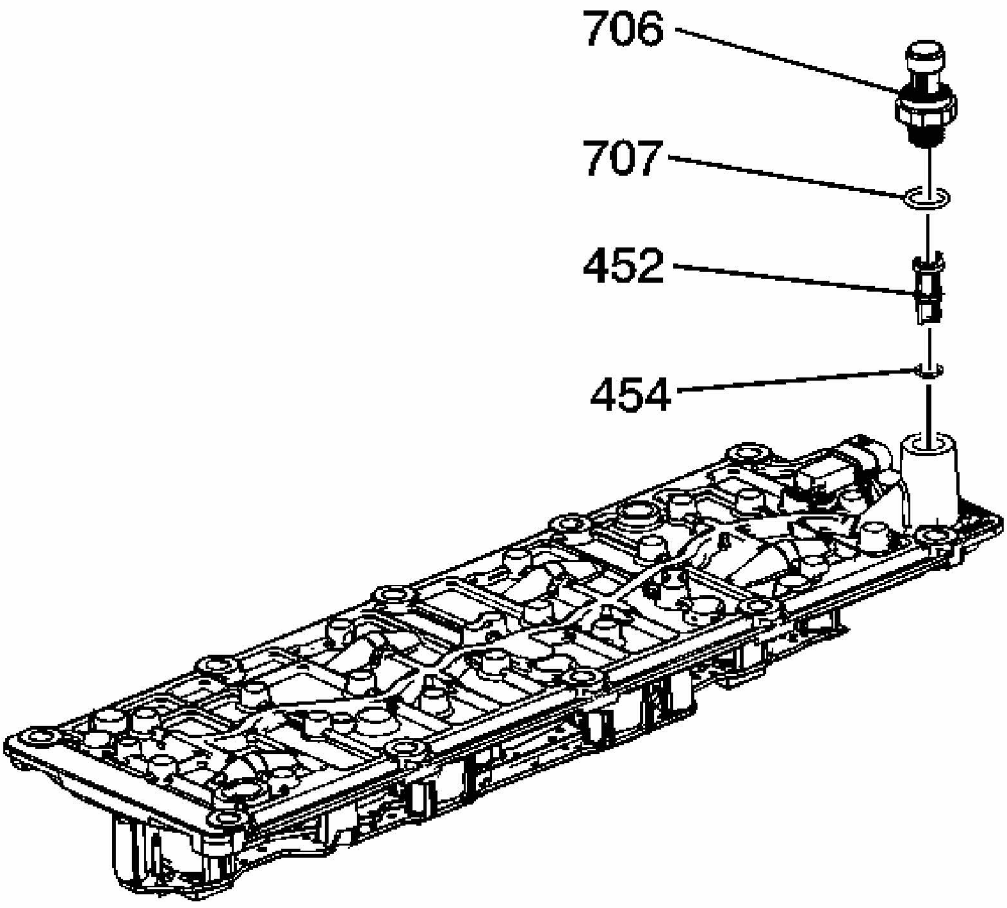


Fig. 210: View Of Oil Pressure Sensor, Washer And Valve Lifter Oil Filter
Courtesy of GENERAL MOTORS CORP.

3. Using **J 41712** , remove the oil pressure sensor (706) and washer (707). See **Special Tools**.

Installation Procedure

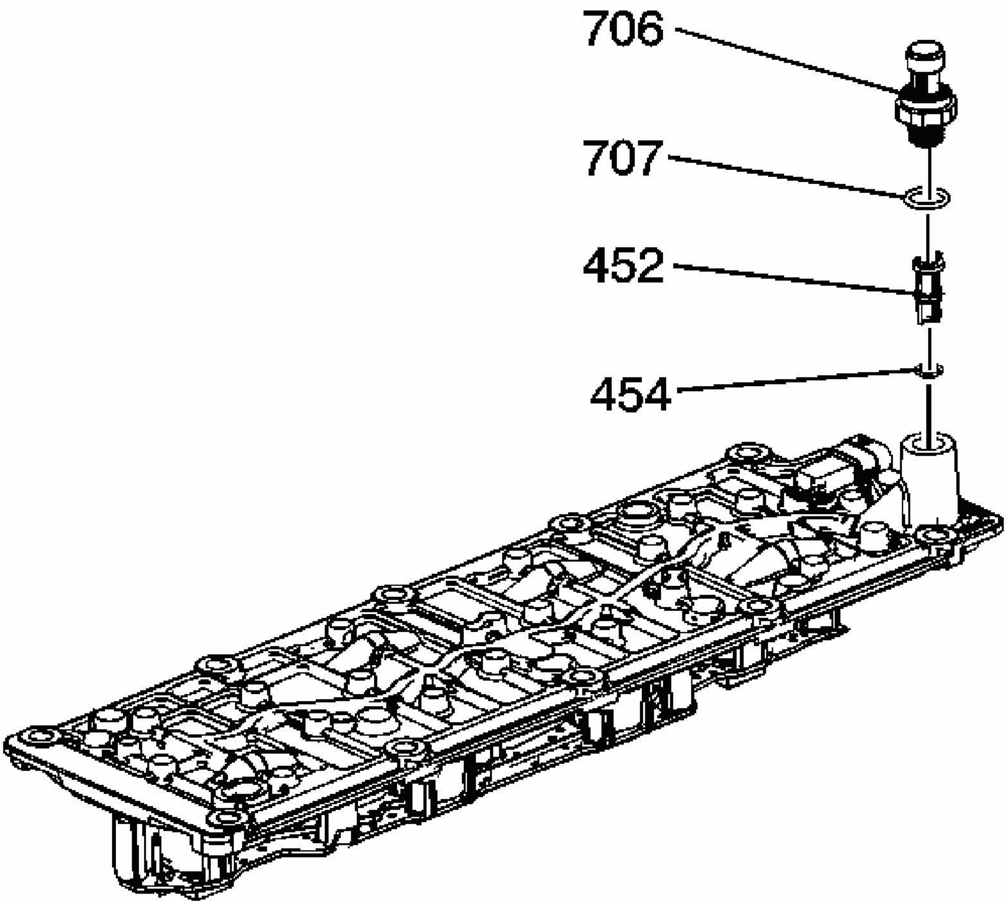


Fig. 211: View Of Oil Pressure Sensor, Washer And Valve Lifter Oil Filter
Courtesy of GENERAL MOTORS CORP.

1. Apply sealant GM P/N 12346004 (Canadian P/N 10953480), or equivalent, to the threads of the oil pressure sensor.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Using **J 41712** , install the oil pressure sensor (706) and washer (707). See **Special Tools**.

   Tighten: Tighten the sensor to 20 N.m (15 lb ft).

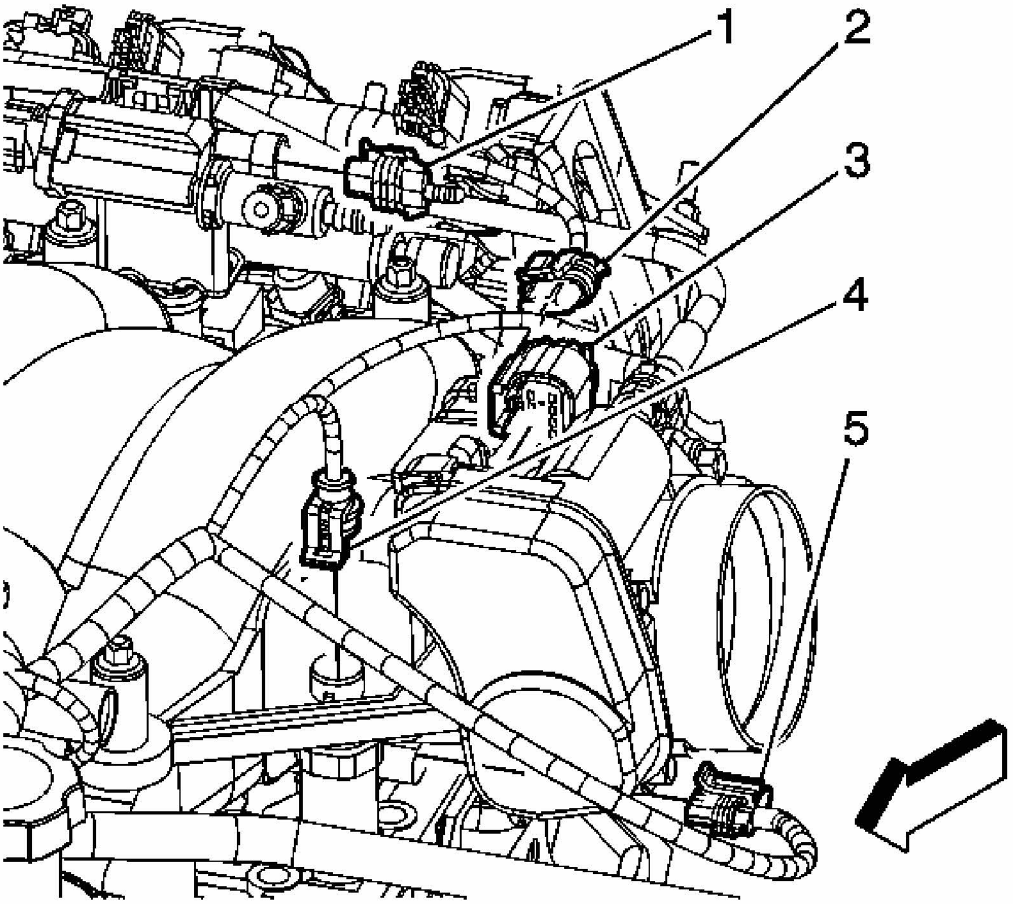


Fig. 212: View Of Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

3. Connect the oil pressure sensor electrical connector (4).
4. If necessary, install the engine sight shield. Refer to **Engine Sight Shield Replacement**.

ENGINE OIL LEVEL SENSOR AND/OR SWITCH REPLACEMENT

Removal Procedure

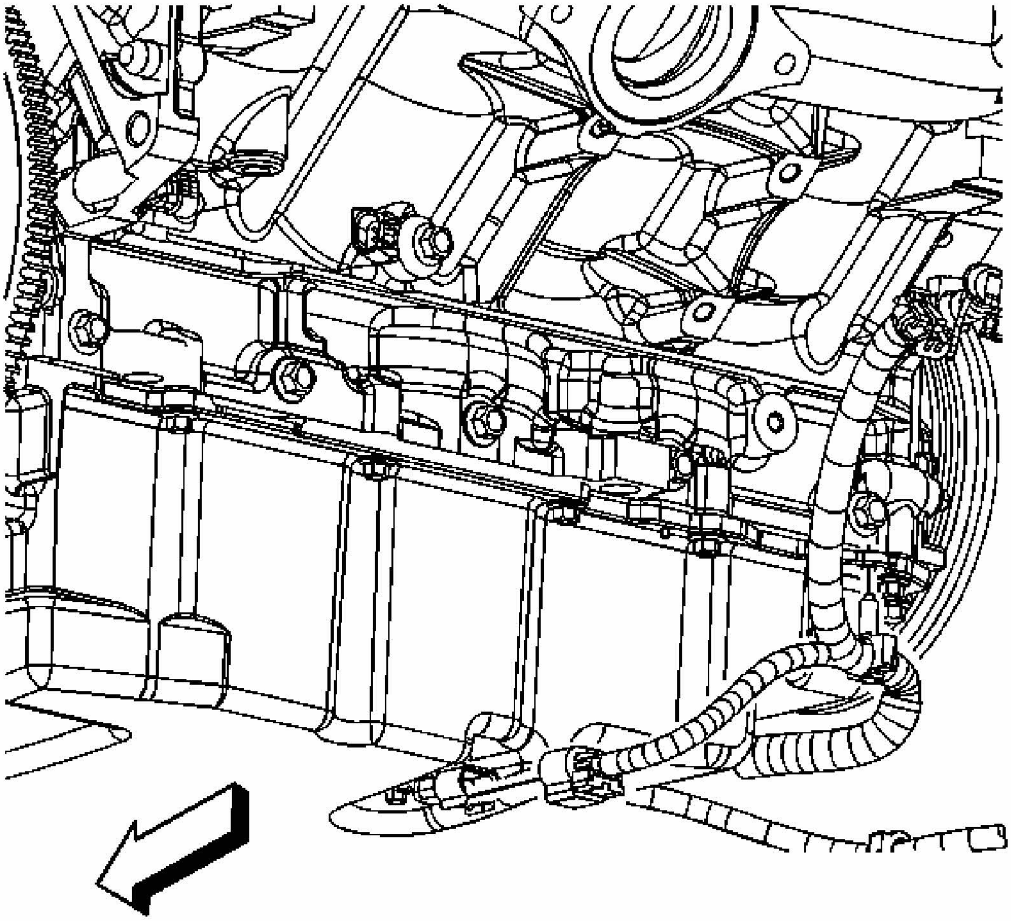


Fig. 213: View Of Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Drain the oil from the oil pan.
3. Disconnect the oil level sensor electrical connector.

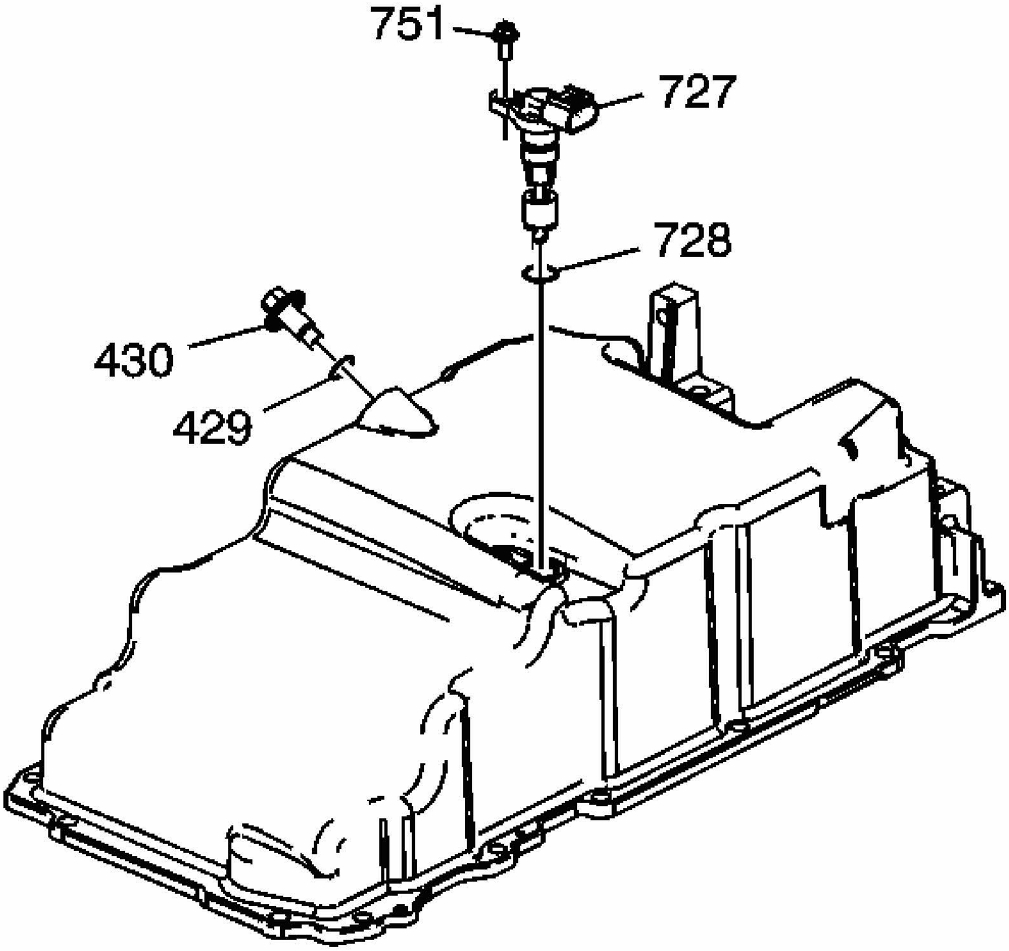


Fig. 214: View Of Oil Pan, Drain Plug & O-Ring, Oil Level Sensor, Bolt & O-Ring
Courtesy of GENERAL MOTORS CORP.

4. Remove the oil level sensor bolt (751).
5. Remove the oil level sensor (727) and O-ring (728) from the oil pan.

Installation Procedure

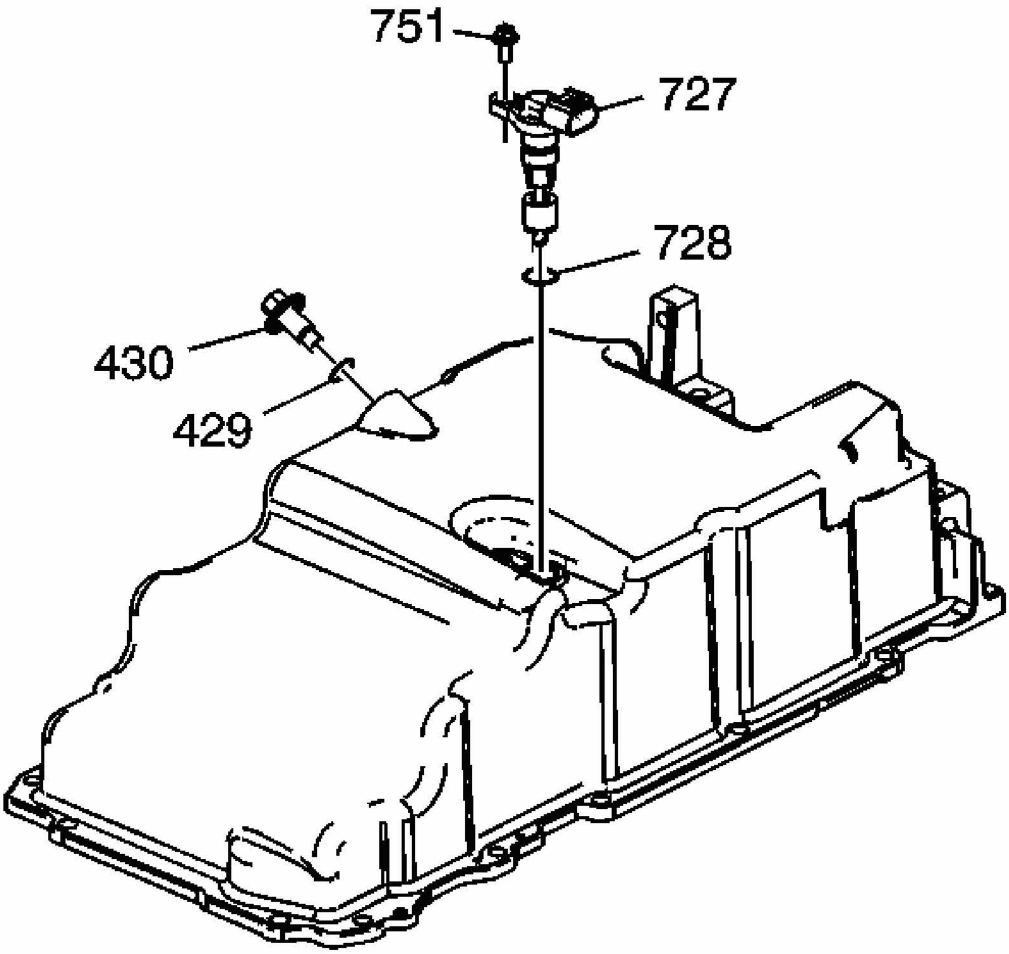


Fig. 215: View Of Oil Pan, Drain Plug & O-Ring, Oil Level Sensor, Bolt & O-Ring
Courtesy of GENERAL MOTORS CORP.

1. Install the oil level sensor (727) and O-ring (728) to the oil pan.

   NOTE: **Refer to Fastener Notice in Cautions and Notices.**

2. Install the oil level sensor bolt (751).

   Tighten: Tighten the bolt to 20 N.m (15 lb ft).

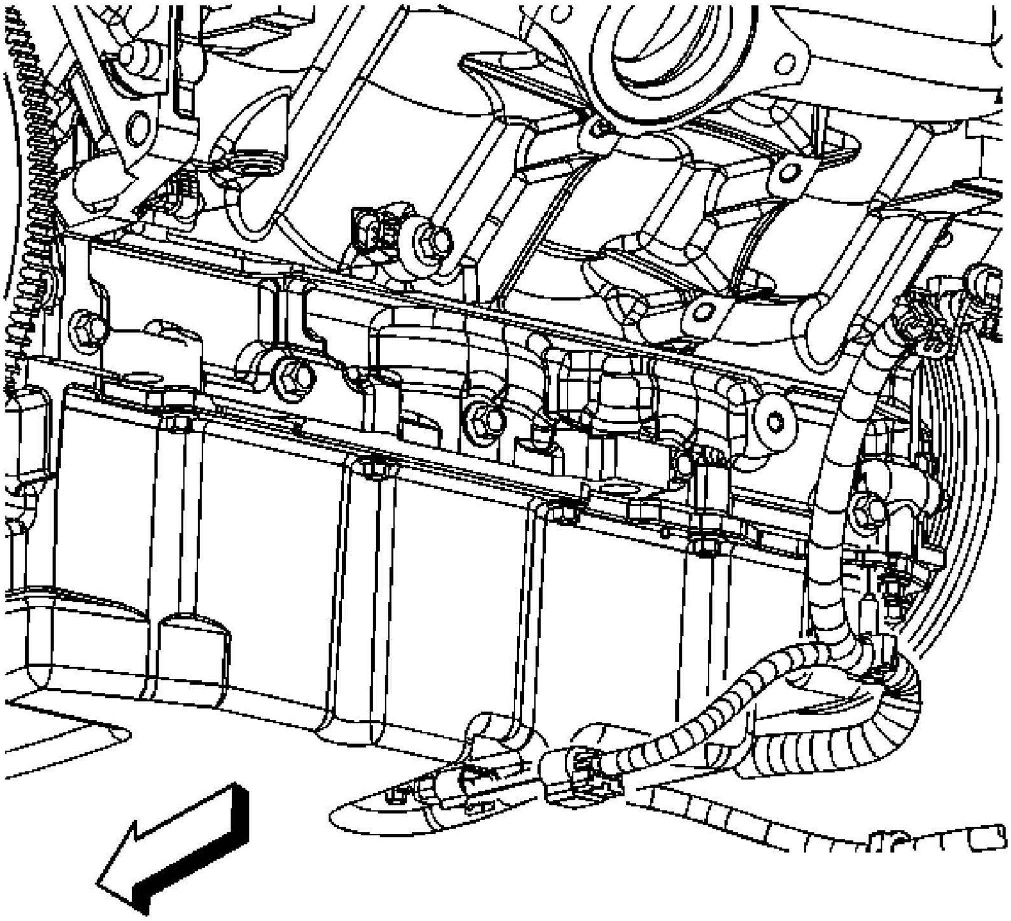


Fig. 216: View Of Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the oil level sensor electrical connector.
4. Lower the vehicle.
5. Refill the engine oil to the proper level.

OIL PUMP, SCREEN AND CRANKSHAFT OIL DEFLECTOR REPLACEMENT

Removal Procedure

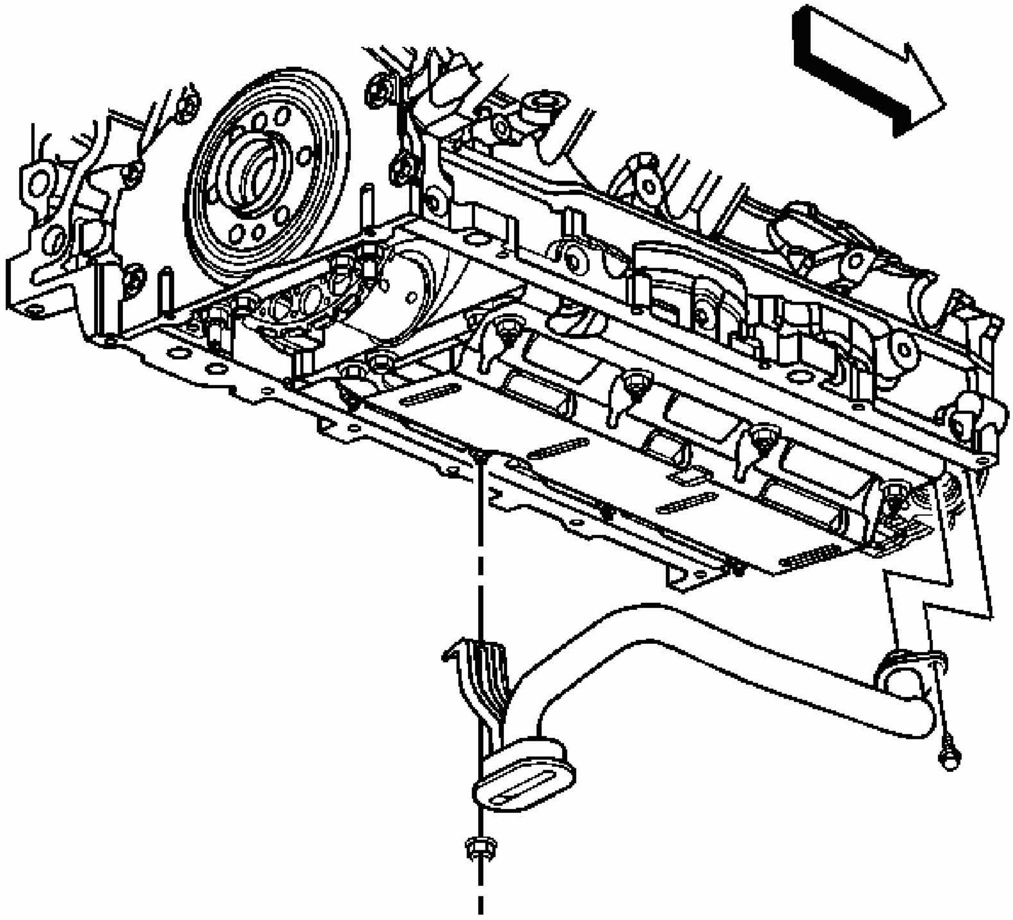


Fig. 217: View Of Oil Pump Screen
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pan. Refer to **Oil Pan Replacement**.
2. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
3. Remove the oil pump screen bolt and nuts.
4. Remove the oil pump screen with O-ring seal.
5. Remove the O-ring seal from the pump screen.
6. Discard the O-ring seal.

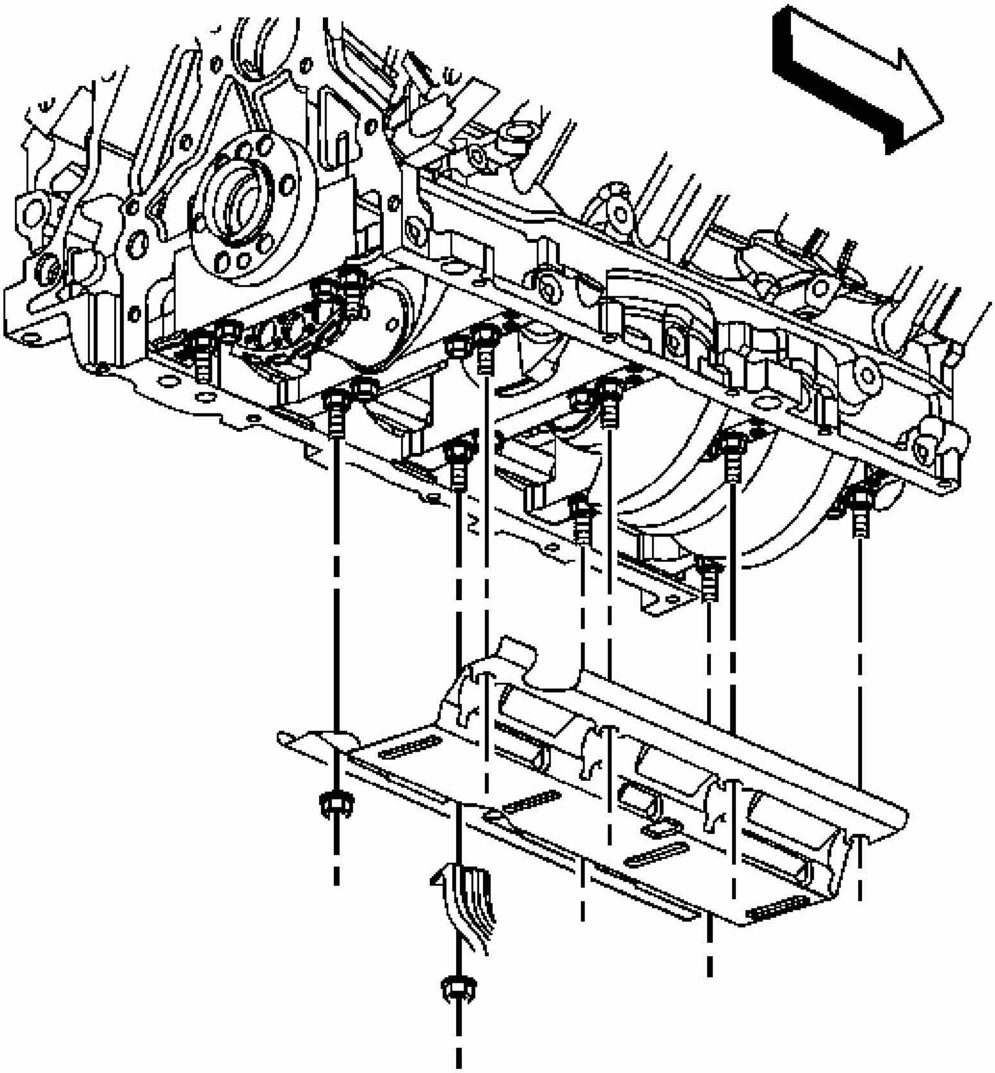


Fig. 218: View Of Crankshaft Oil Deflector & Nuts
Courtesy of GENERAL MOTORS CORP.

7. Remove the remaining crankshaft oil deflector nuts.
8. Remove the crankshaft oil deflector.

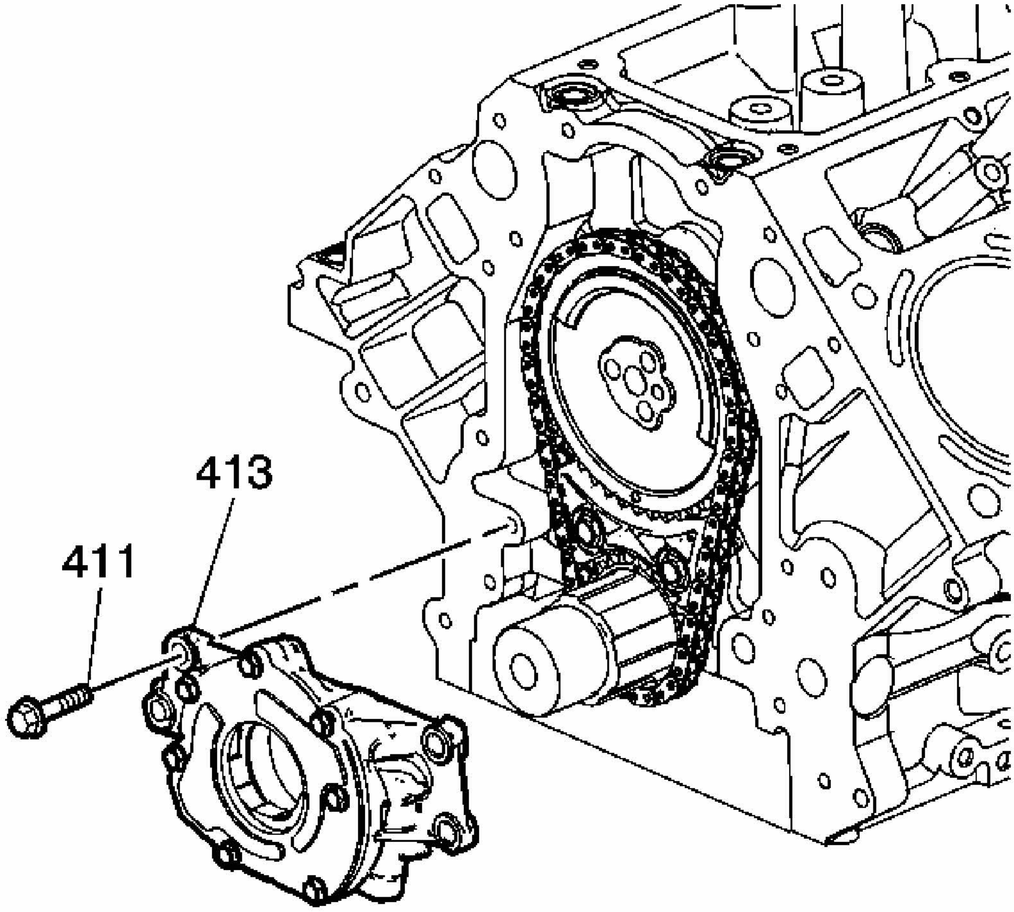


Fig. 219: Removing/Installing Oil Pump Bolts
Courtesy of GENERAL MOTORS CORP.

9. Remove the oil pump bolts (411).

IMPORTANT: Do not allow dirt or debris to enter the oil pump assembly, cap end as necessary.

10. Remove the oil pump (413).
11. Clean and inspect the oil pump. Refer to **Oil Pump Cleaning and Inspection**.

Installation Procedure

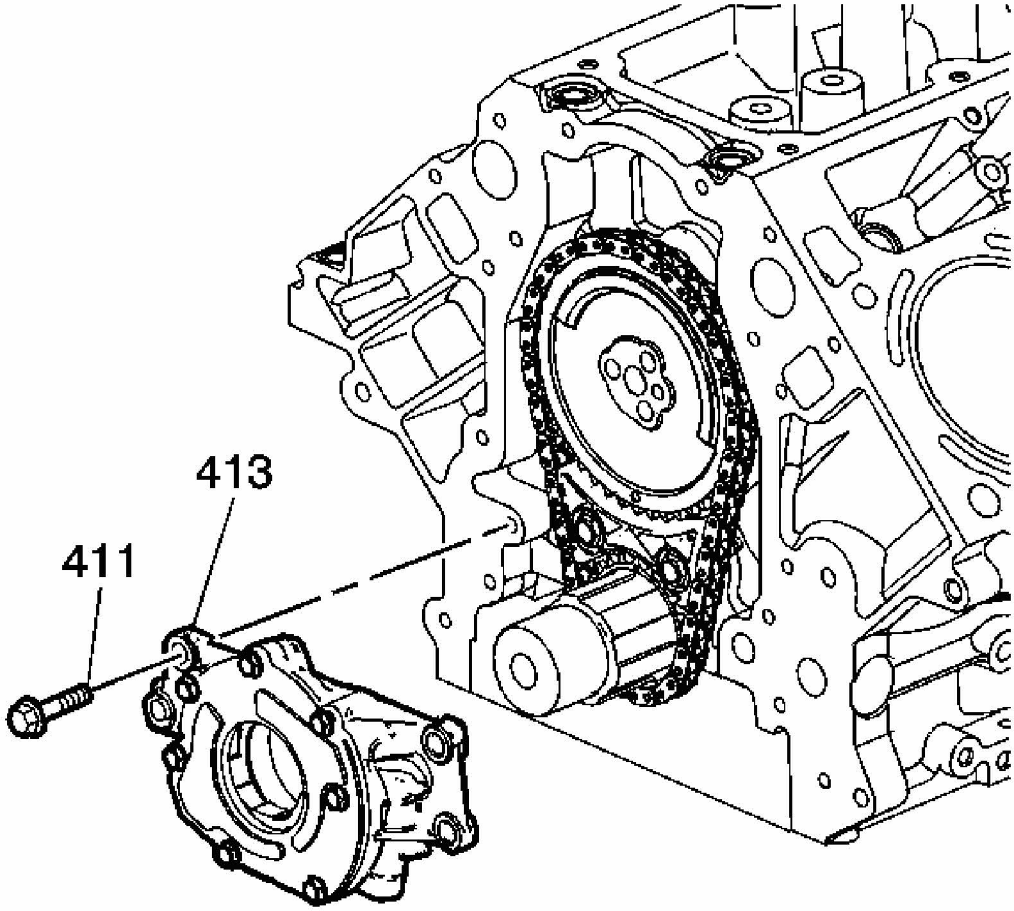


Fig. 220: Removing/Installing Oil Pump Bolts
Courtesy of GENERAL MOTORS CORP.

1. Align the splined surfaces of the crankshaft sprocket and the oil pump drive gear and install the oil pump (413).
2. Install the oil pump onto the crankshaft sprocket until the pump housing contacts the face of the engine block.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

3. Install the oil pump bolts (411).

Tighten: Tighten the bolts to 25 N.m (18 lb ft).

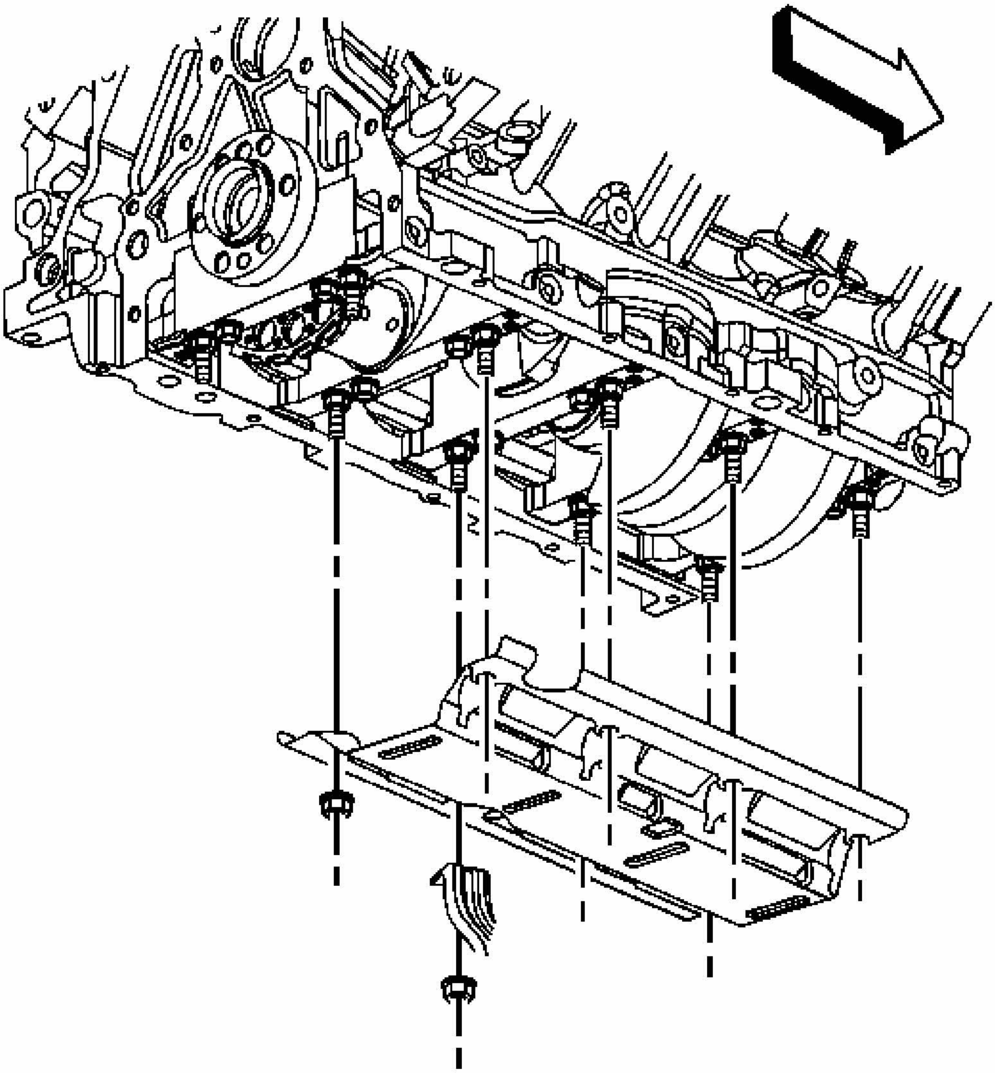


Fig. 221: View Of Crankshaft Oil Deflector & Nuts
Courtesy of GENERAL MOTORS CORP.

4. Install the crankshaft oil deflector and nuts until snug.

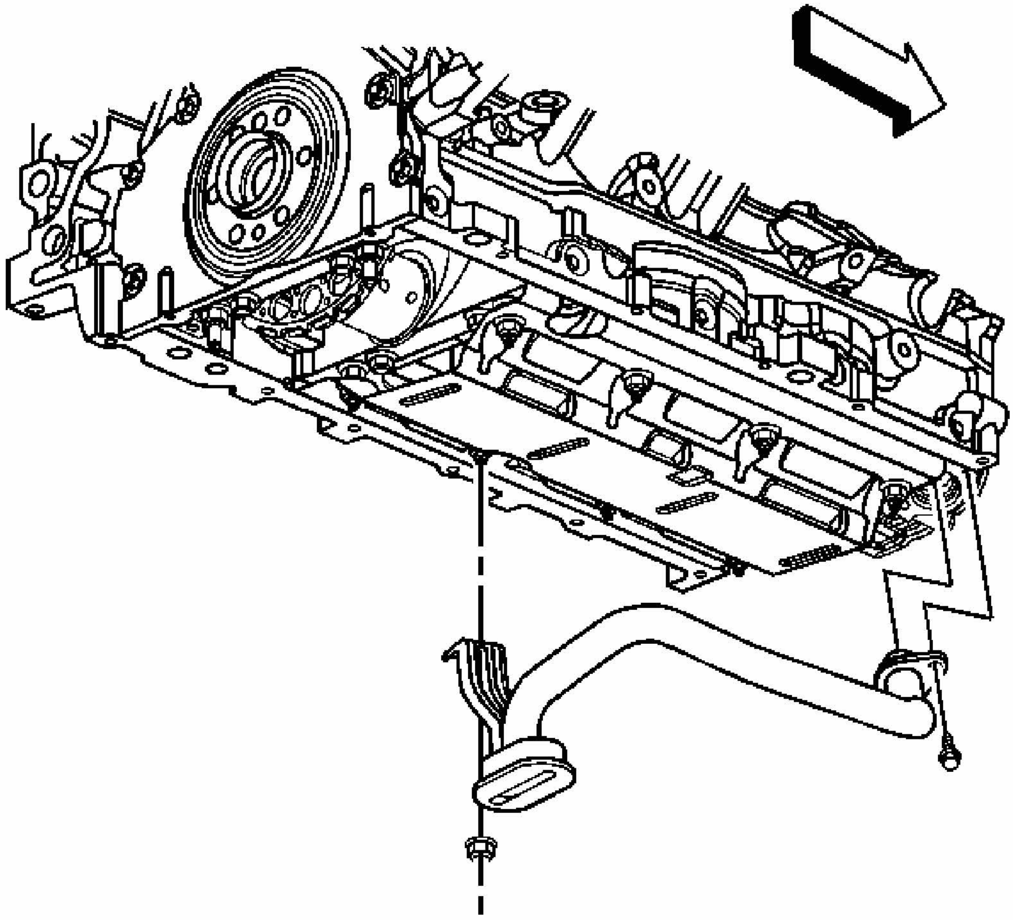


Fig. 222: View Of Oil Pump Screen
Courtesy of GENERAL MOTORS CORP.

5. Lubricate a NEW oil pump screen O-ring seal with clean engine oil.
6. Install the NEW O-ring seal onto the oil pump screen.

   IMPORTANT: Push the oil pump screen tube completely into the oil pump prior to tightening the bolt. Do not allow the bolt to pull the tube into the pump.

   Align the oil pump screen mounting brackets with the correct crankshaft bearing cap studs.

7. Install the oil pump screen.
8. Install the oil pump screen bolt and nuts.

Tighten:

1. Tighten the bolt to 12 N.m (106 lb in).
2. Tighten the nuts to 25 N.m (18 lb ft).

9. Install the engine front cover. Refer to **Engine Front Cover Replacement**.
10. Install the oil pan. Refer to **Oil Pan Replacement**.

TIMING CHAIN AND SPROCKETS REPLACEMENT (FIRST DESIGN)

Tools Required

- **J 8433** Two Jaw Puller
- **J 41816-2** Crankshaft End Protector. See **Special Tools**.
- **J 41558** Crankshaft Sprocket Remover. See **Special Tools**.
- **J 41665** Crankshaft Balancer and Sprocket Installer. See **Special Tools**.

Removal Procedure

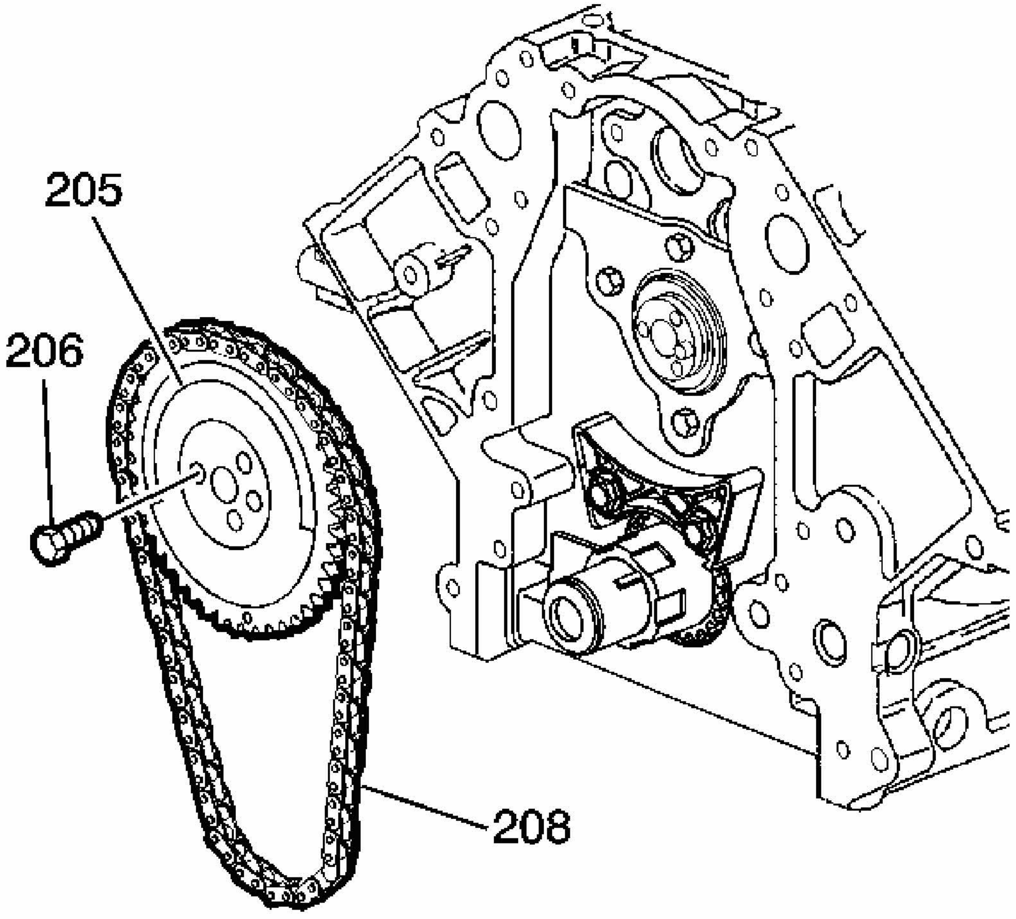


Fig. 223: View Of Camshaft Sprocket, Bolts & Timing Chain
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pump. Refer to **Oil Pump, Screen and Crankshaft Oil Deflector Replacement**.
2. Rotate the crankshaft until the timing marks on the crankshaft and the camshaft sprockets are aligned.

NOTE: **Do not turn the crankshaft assembly after the timing chain has been removed in order to prevent damage to the piston assemblies or the valves.**

3. Remove the camshaft sprocket bolts (206).
4. Remove the camshaft sprocket (205) and timing chain (208).

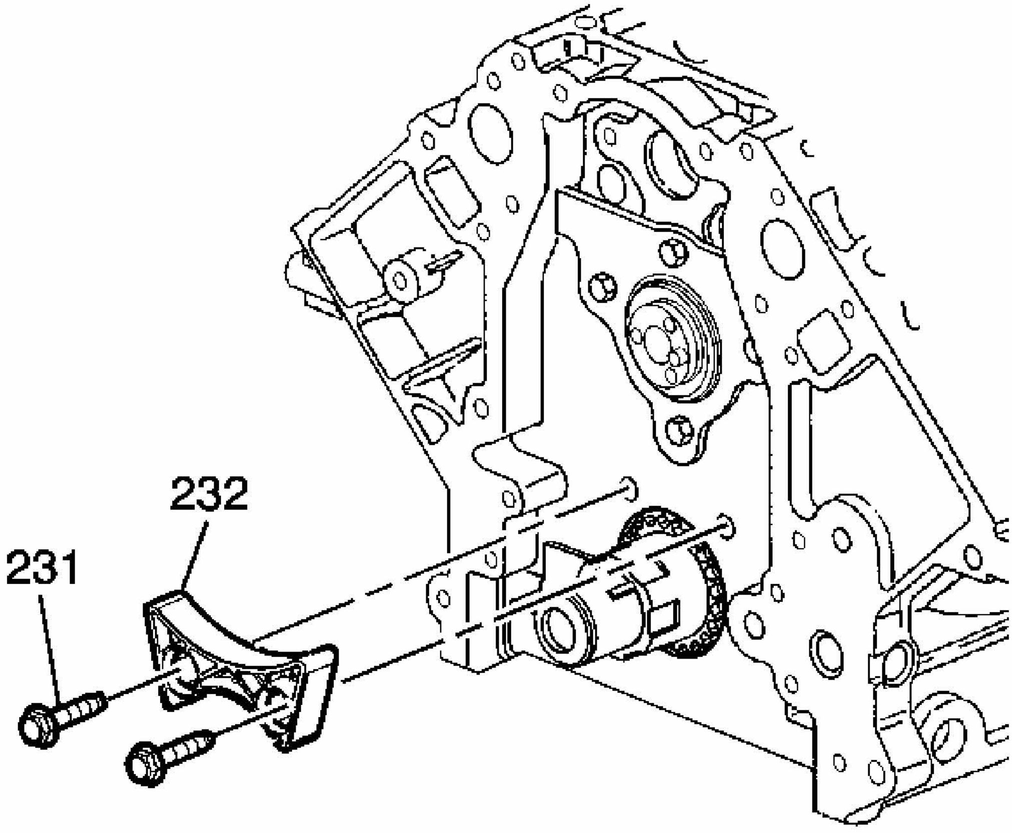


Fig. 224: Timing Chain Dampener & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the timing chain dampener (232) and bolts (231).

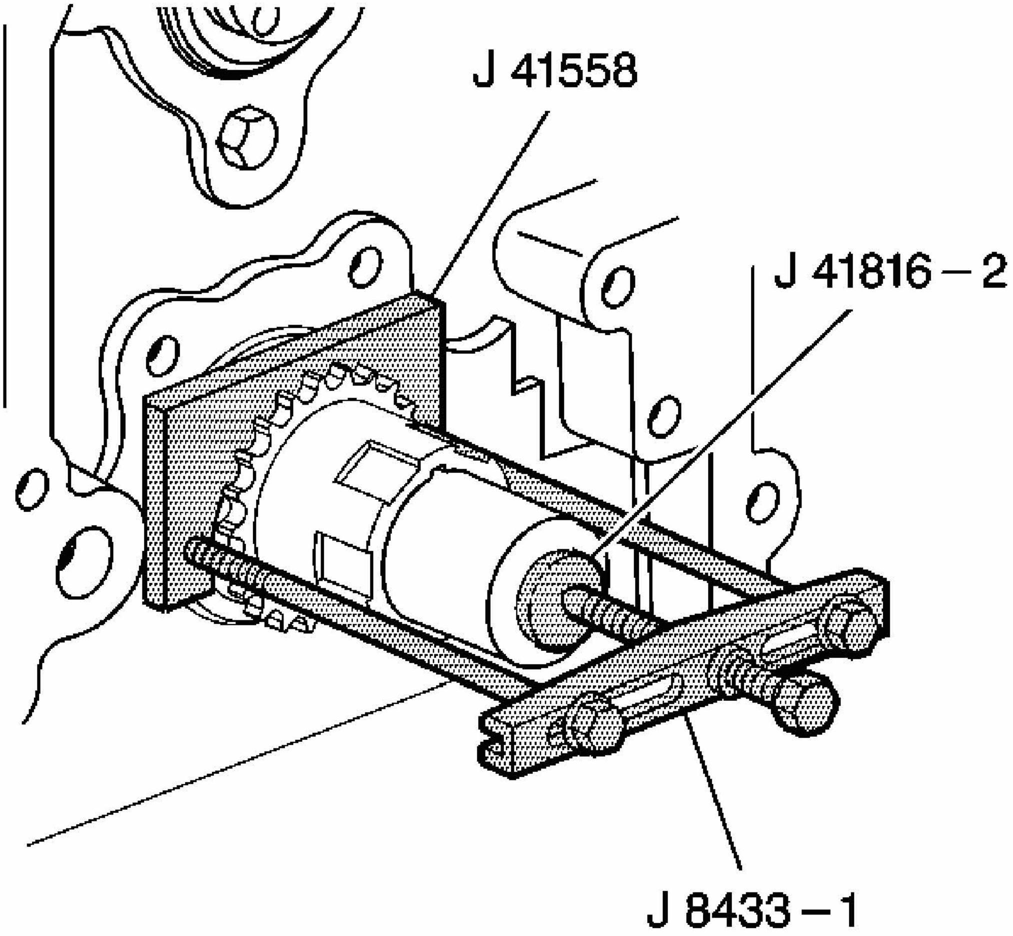


Fig. 225: Removing The Crankshaft Sprocket Using J 8433-1, J 41816-2 & J 41558
Courtesy of GENERAL MOTORS CORP.

6. Using the **J 8433** , **J 41816-2** and the **J 41558** remove the crankshaft sprocket. See **Special Tools**.

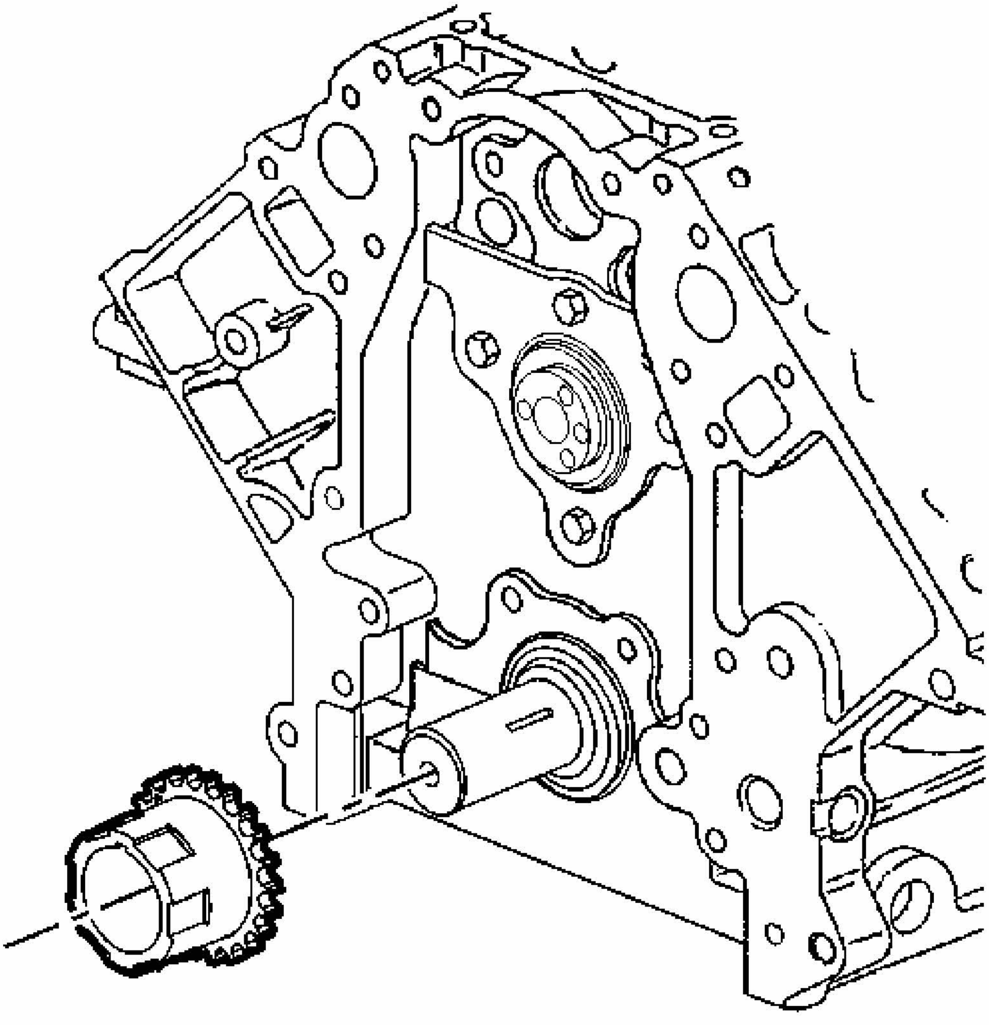


Fig. 226: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

7. Remove the crankshaft sprocket.

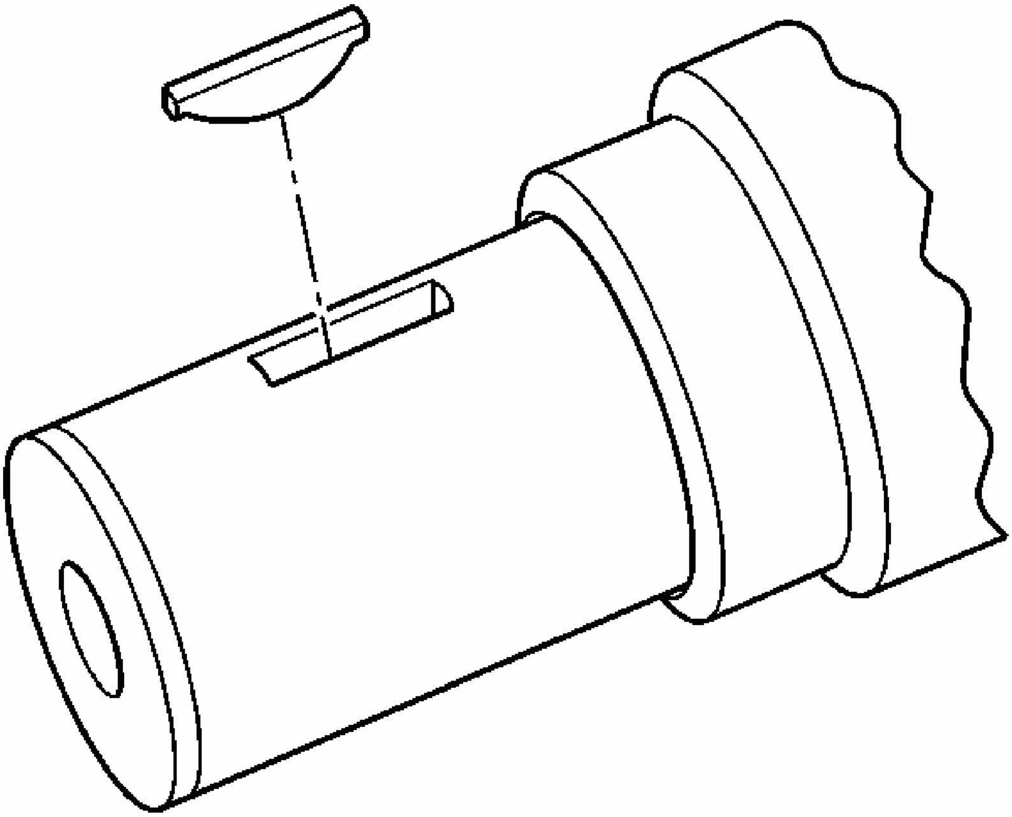


Fig. 227: View Of Crankshaft Key & Keyway
Courtesy of GENERAL MOTORS CORP.

8. Remove the crankshaft sprocket key, if required.
9. Clean and inspect the timing chain and sprockets. Refer to **Timing Chain and Sprockets Cleaning and Inspection**.

Installation Procedure

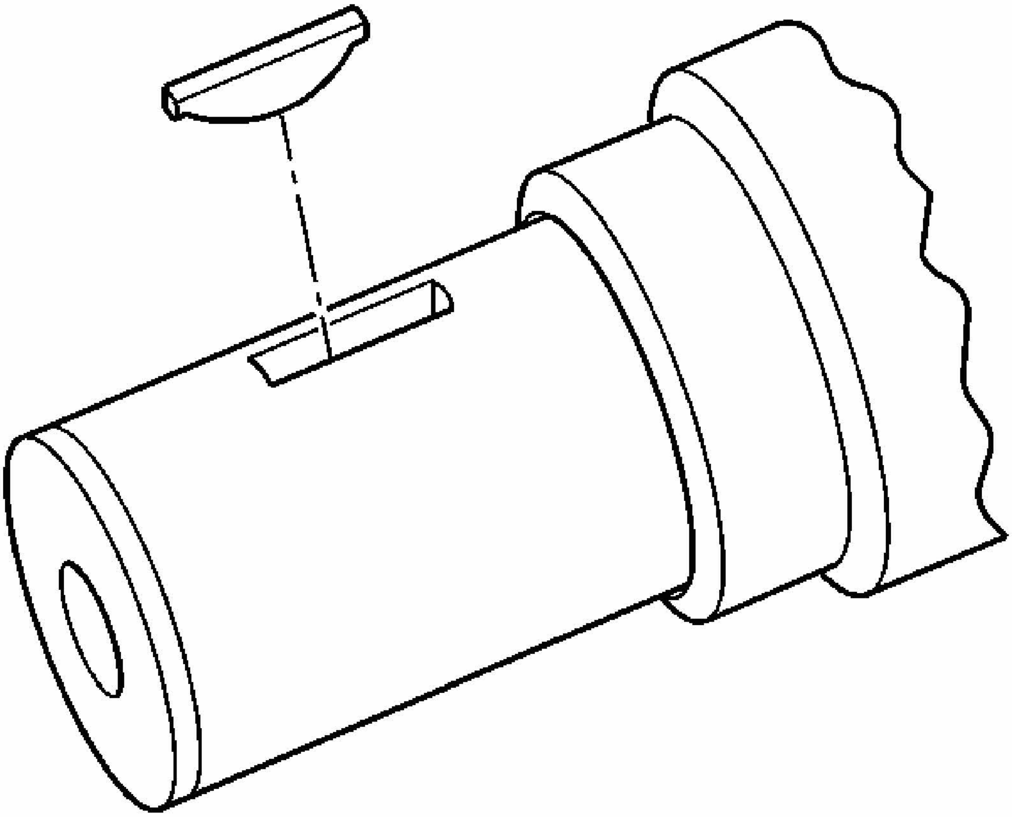


Fig. 228: View Of Crankshaft Key & Keyway
Courtesy of GENERAL MOTORS CORP.

1. Install the key into the crankshaft keyway, if previously removed.

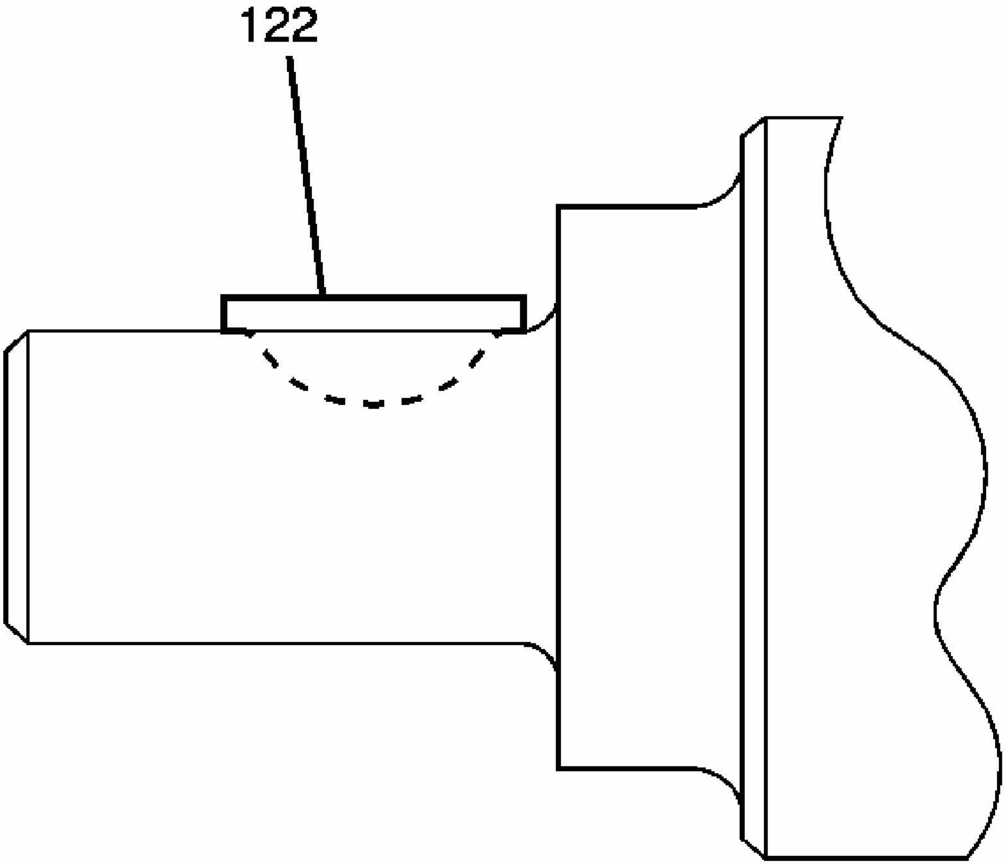


Fig. 229: View Of Installed Crankshaft Key
Courtesy of GENERAL MOTORS CORP.

2. Tap the key (122) into the keyway until both ends of the key bottom onto the crankshaft.

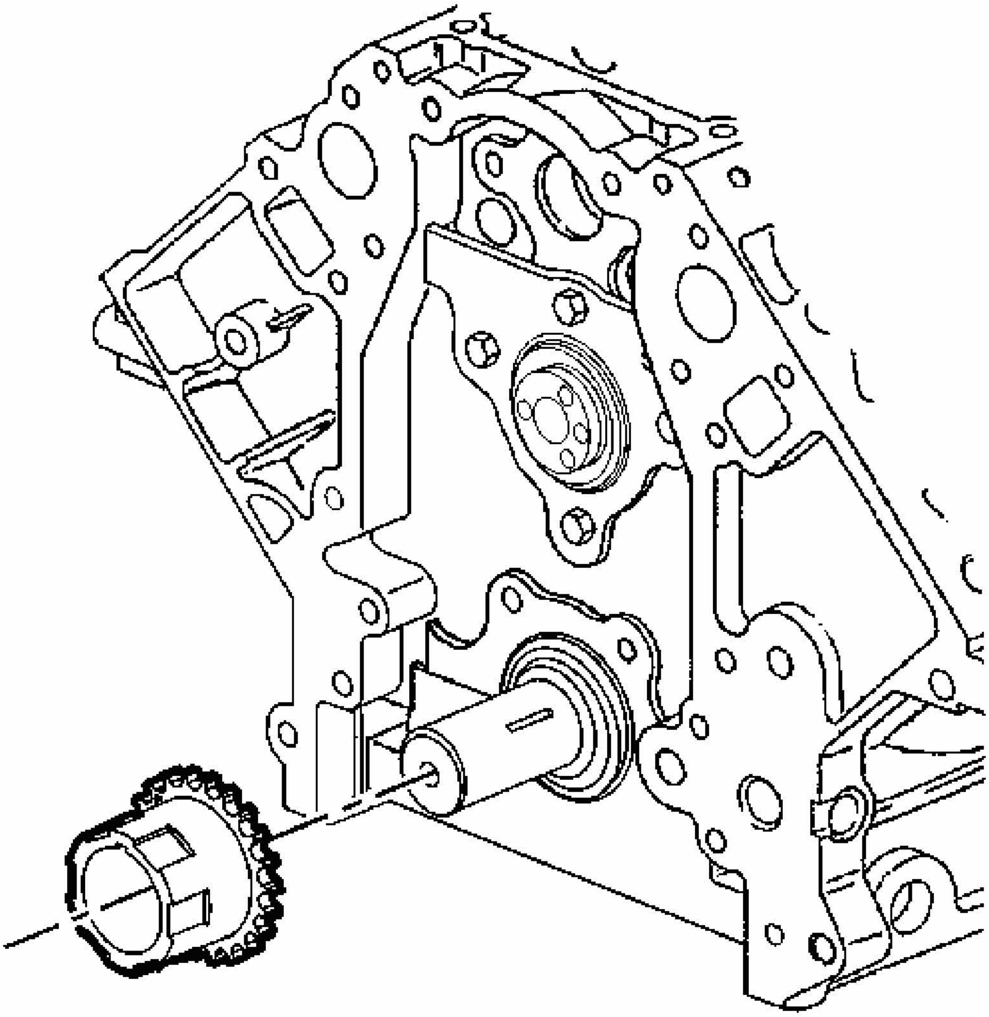


Fig. 230: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

3. Install the crankshaft sprocket onto the front of the crankshaft. Align the crankshaft key with the crankshaft sprocket keyway.

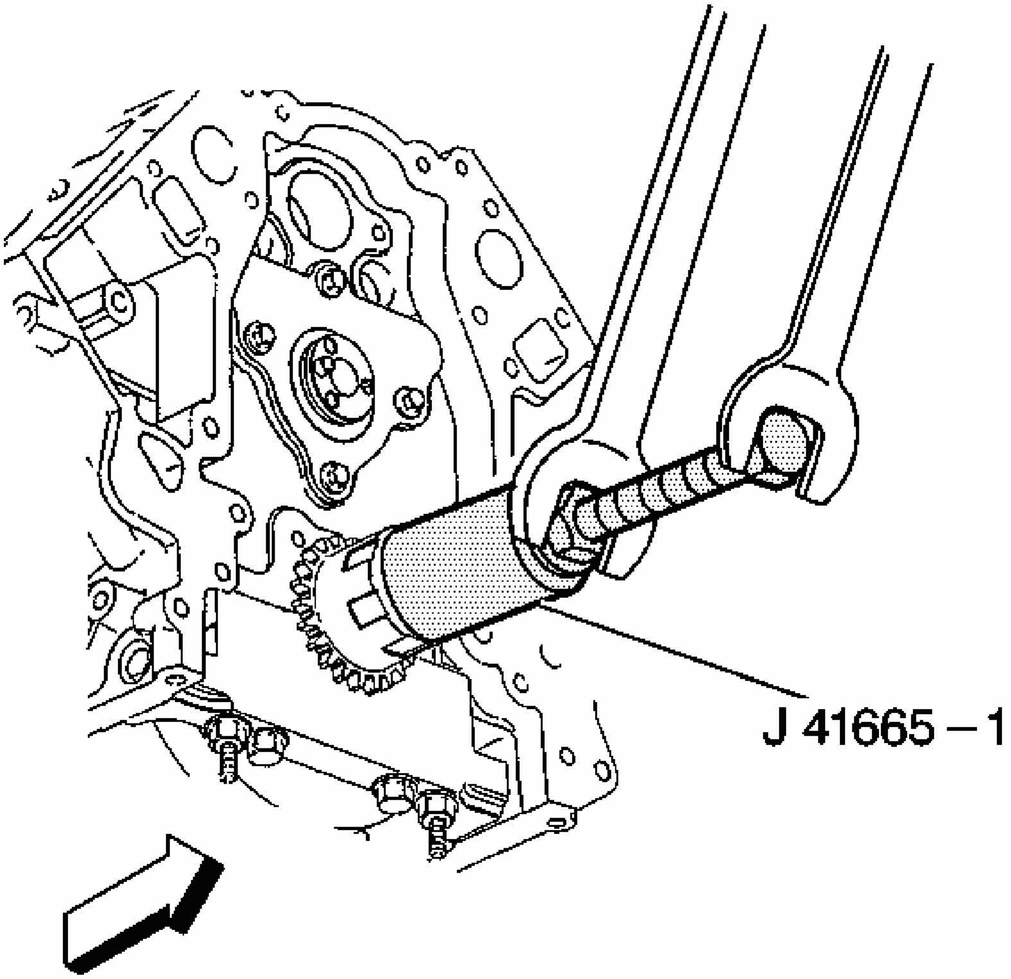


Fig. 231: Using J 41665 To Install Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

4. Using the **J 41665** , install the crankshaft sprocket onto the crankshaft until fully seated against the crankshaft flange. See **Special Tools**.
5. Rotate the crankshaft sprocket until the alignment mark is in the 12 o'clock position.

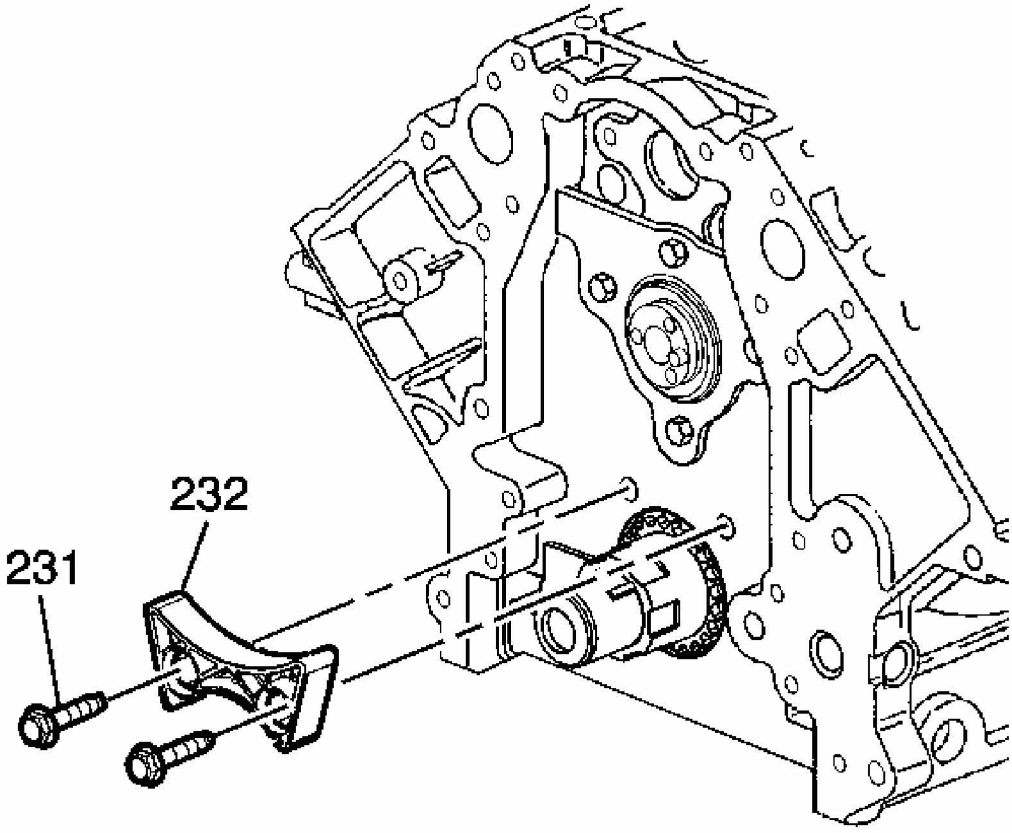


Fig. 232: Timing Chain Dampener & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

6. Install the timing change guide (232) and bolts (231).

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

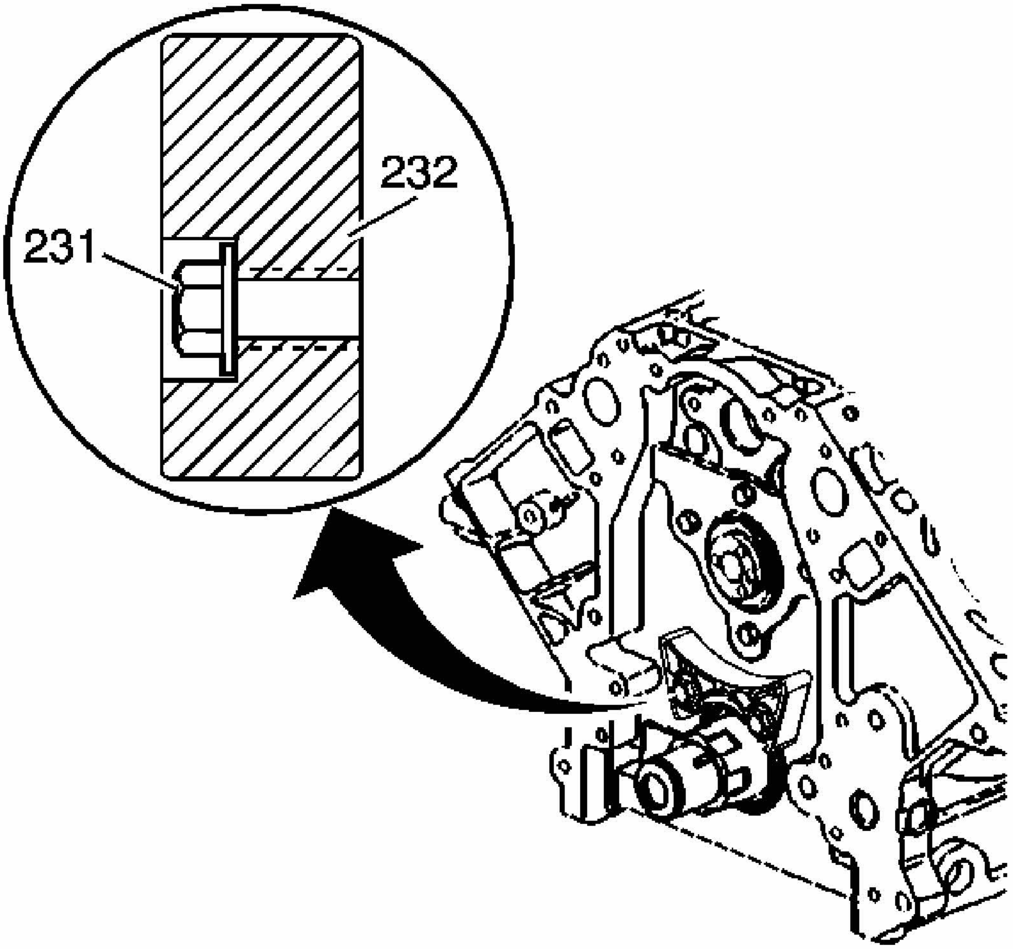


Fig. 233: Identifying Timing Chain Dampener Bolt Proper Installation Position
Courtesy of GENERAL MOTORS CORP.

7. With the chain dampener properly installed, the heads of the bolts (231) should install to flush or below the face of the guide (232).

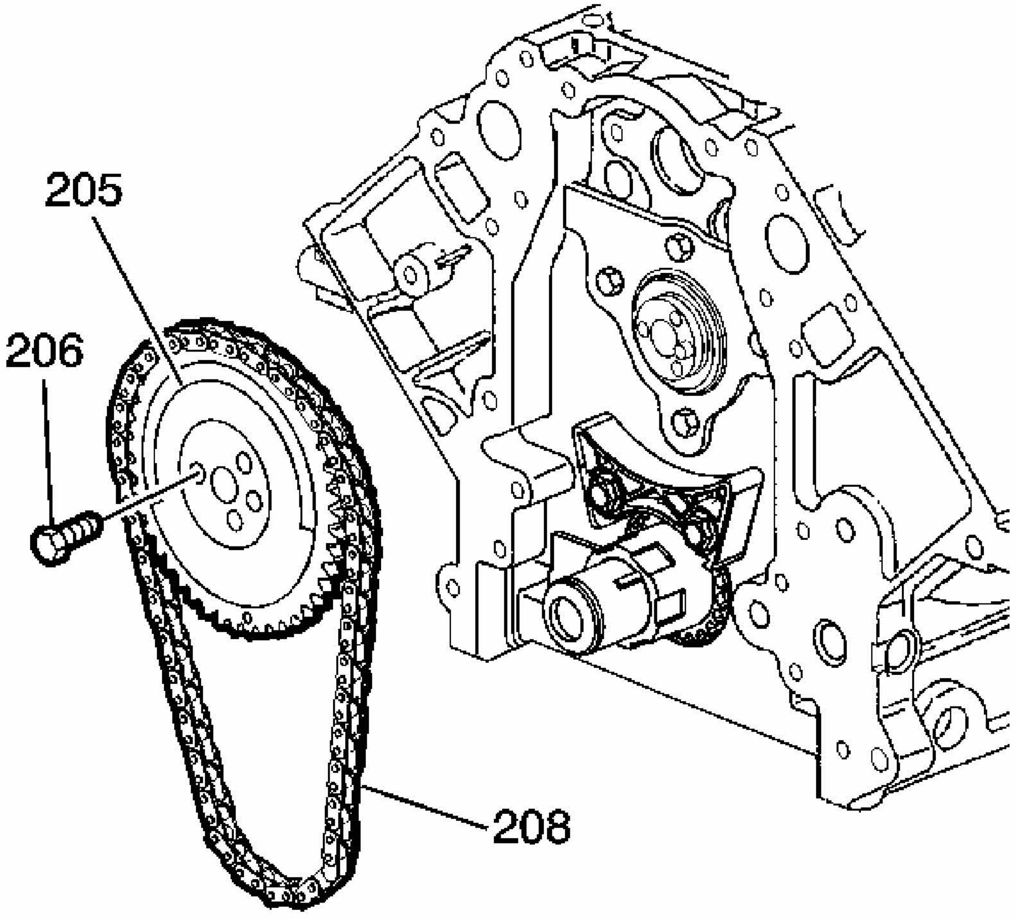


Fig. 234: View Of Camshaft Sprocket, Bolts & Timing Chain
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Properly locate the camshaft sprocket locating pin with the camshaft sprocket alignment hole.**
- **The sprocket teeth and timing chain must mesh.**
- **The camshaft and the crankshaft sprocket alignment marks MUST be aligned properly. Position the camshaft sprocket alignment mark in the 6 o'clock position.**

8. Install the camshaft sprocket (205) and timing chain (208). If necessary, rotate the camshaft or crankshaft sprockets in order to align the timing marks.
9. Install the camshaft sprocket bolts (206).

Tighten: Tighten the bolts to 25 N.m (18 lb ft).

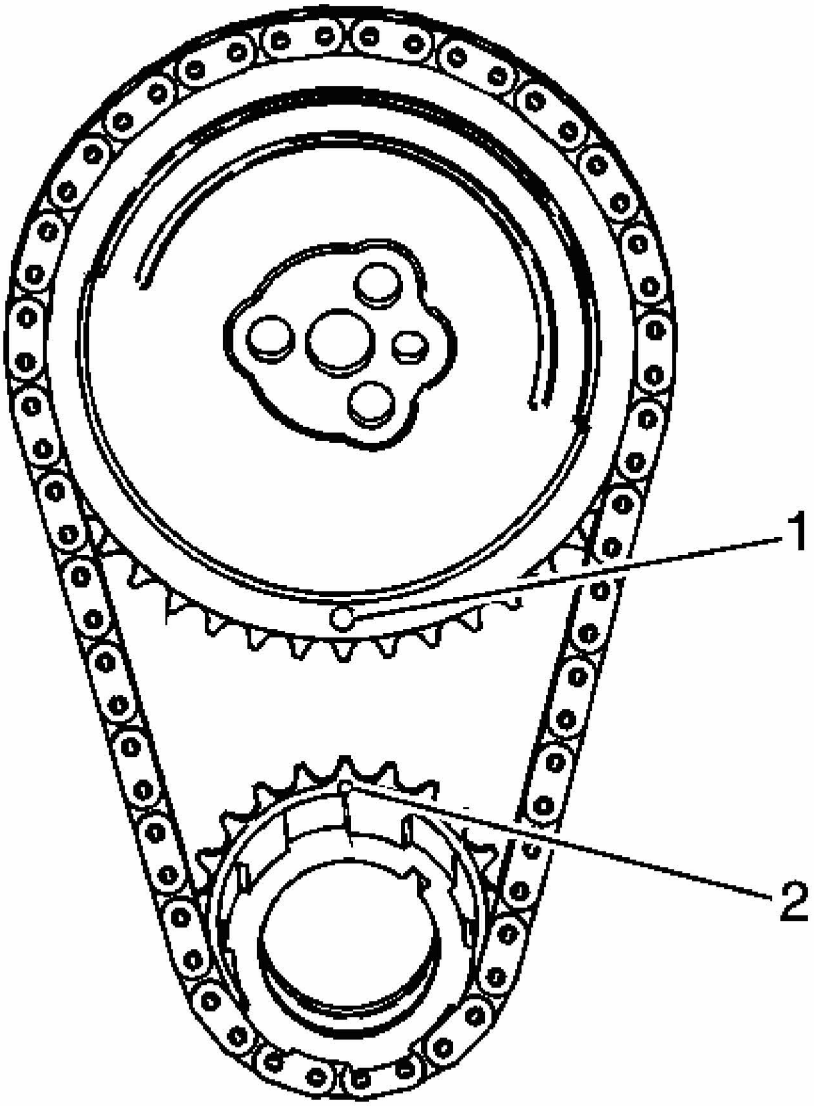


Fig. 235: View Of Camshaft And Crankshaft Timing Marks Aligned
Courtesy of GENERAL MOTORS CORP.

10. Inspect the camshaft (1) and crankshaft (2) sprockets for proper timing mark alignment.
11. Install the oil pump. Refer to **Oil Pump, Screen and Crankshaft Oil Deflector Replacement**.

CAMSHAFT REPLACEMENT (FIRST DESIGN)

Removal Procedure

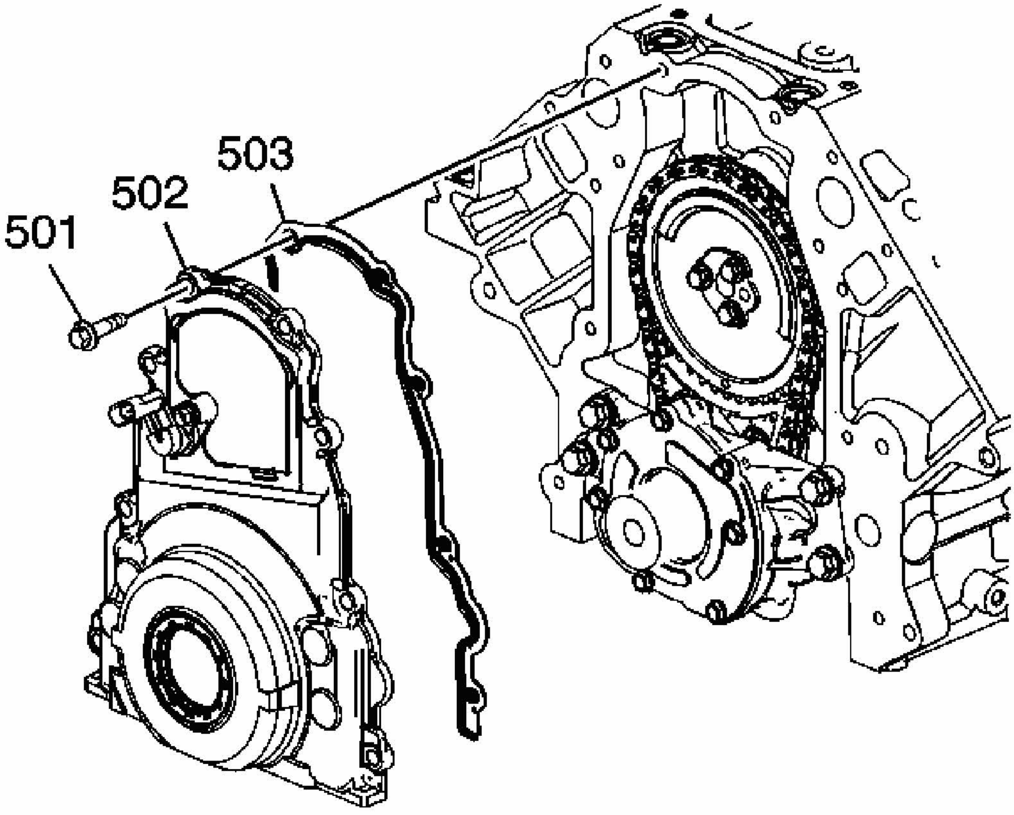


Fig. 236: View Of Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine. Refer to **Engine Replacement**.
2. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Removal**.
3. Remove the oil level indicator. Refer to **Oil Level Indicator and Tube Removal**.
4. Remove the left and right exhaust manifolds. Refer to **Exhaust Manifold Removal - Left** and **Exhaust Manifold Removal - Right**.
5. Remove the water pump. Refer to **Water Pump Removal**.
6. Remove the coolant pump manifold. Refer to **Coolant Pump Manifold Replacement (RPO LS4)** .
7. Remove the intake manifold. Refer to **Intake Manifold Removal**.
8. Remove the valve lifter oil manifold. Refer to **Valve Lifter Oil Manifold Removal**.
9. Remove the coolant air bleed pipe. Refer to **Coolant Air Bleed Pipe Removal**.
10. Remove the left and right valve rocker arm covers. Refer to **Valve Rocker Arm Cover**

Removal - Left and **Valve Rocker Arm Cover Removal - Right**.

11. Remove the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Removal**.
12. Remove the valve lifters. Refer to **Valve Lifter Removal**.
13. Remove the oil pan-to-front cover bolts.
14. Remove the front cover bolts (501).
15. Remove the front cover (502) and gasket (503).

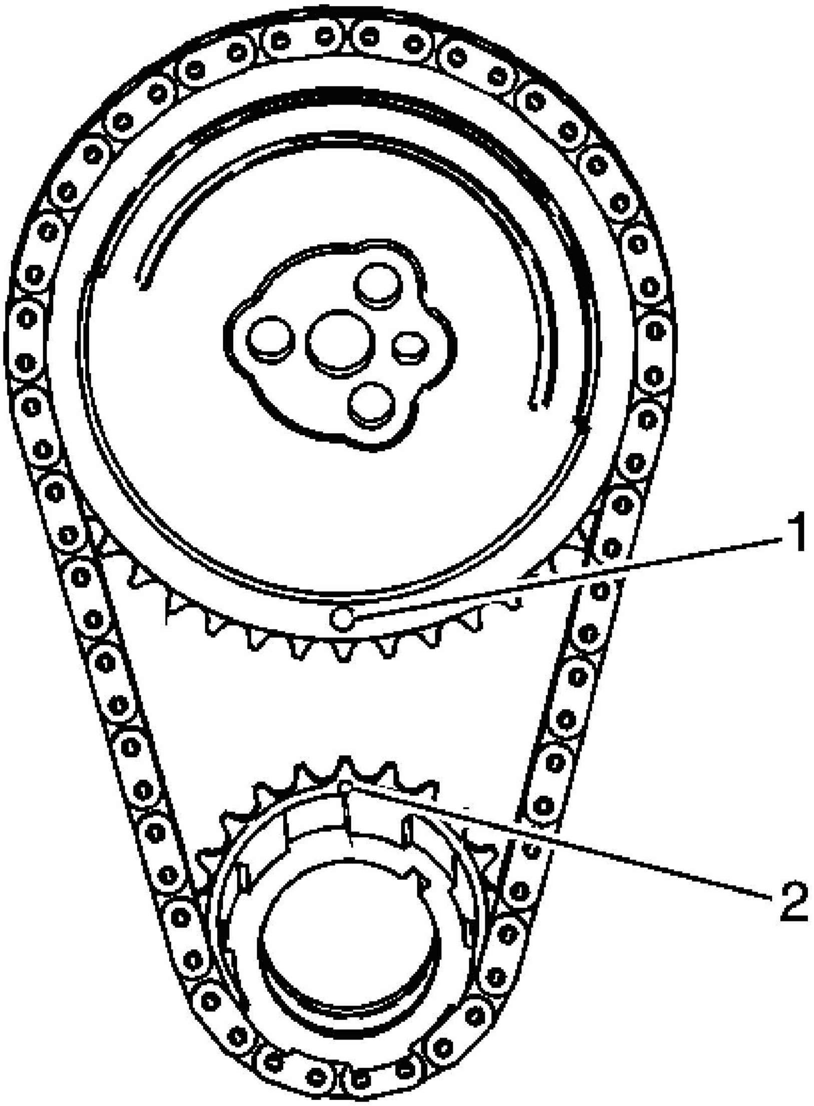


Fig. 237: View Of Camshaft And Crankshaft Timing Marks Aligned

Courtesy of GENERAL MOTORS CORP.

16. Rotate the crankshaft in order to align the timing marks (1, 2).

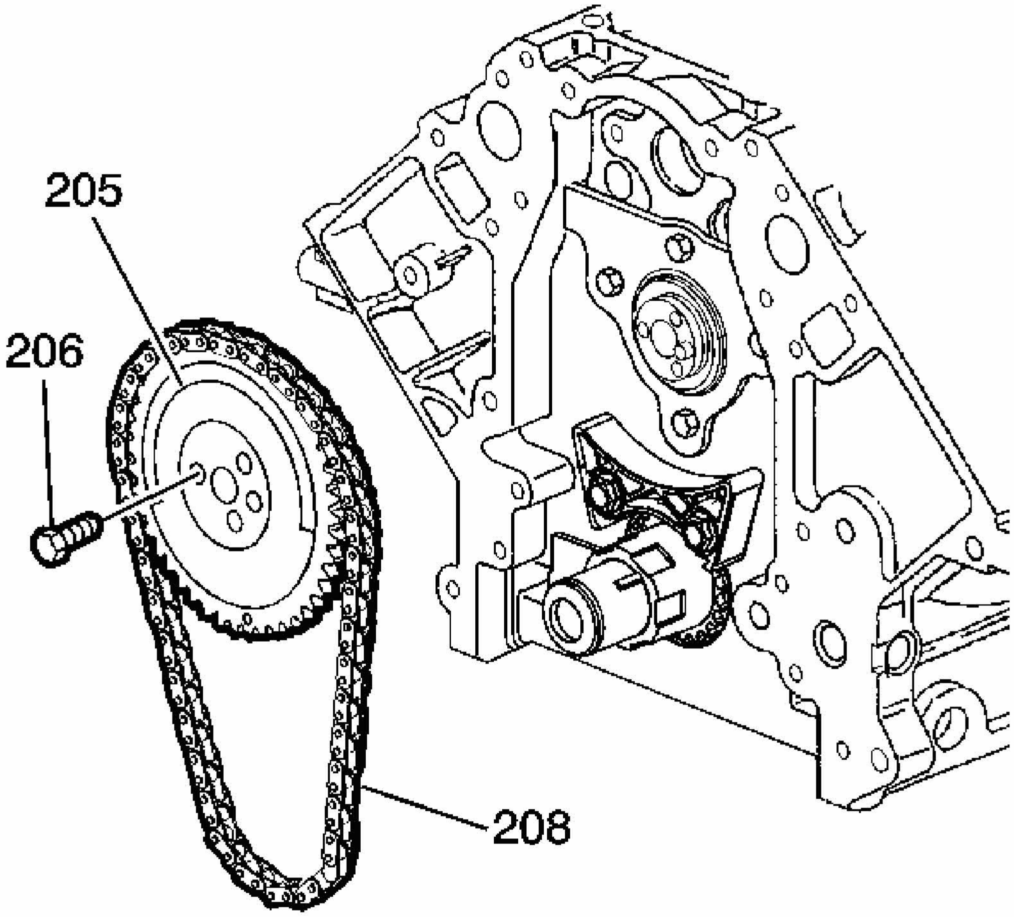


Fig. 238: View Of Camshaft Sprocket, Bolts & Timing Chain
Courtesy of GENERAL MOTORS CORP.

17. Remove the camshaft sprocket bolts (206).
18. Remove the camshaft sprocket (205) and timing chain (208).

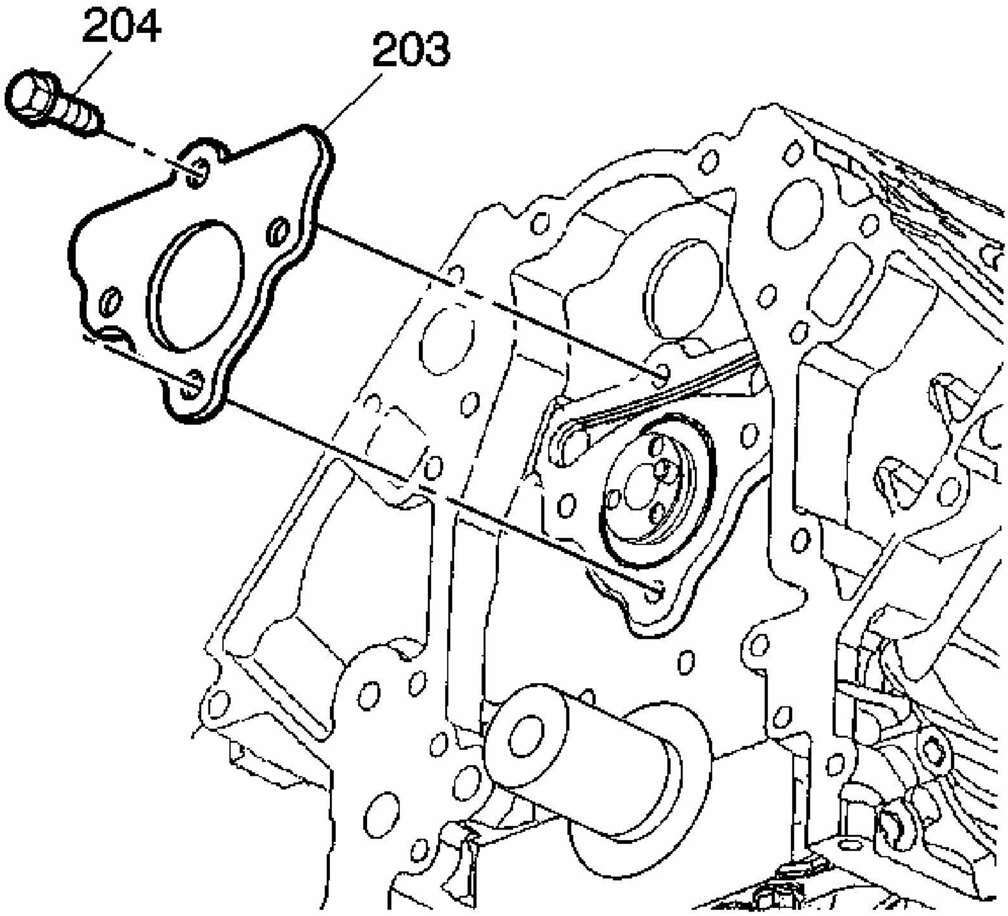


Fig. 239: Camshaft Retainer & Bolts
Courtesy of GENERAL MOTORS CORP.

19. Remove the camshaft retainer bolts (204) and retainer (203).

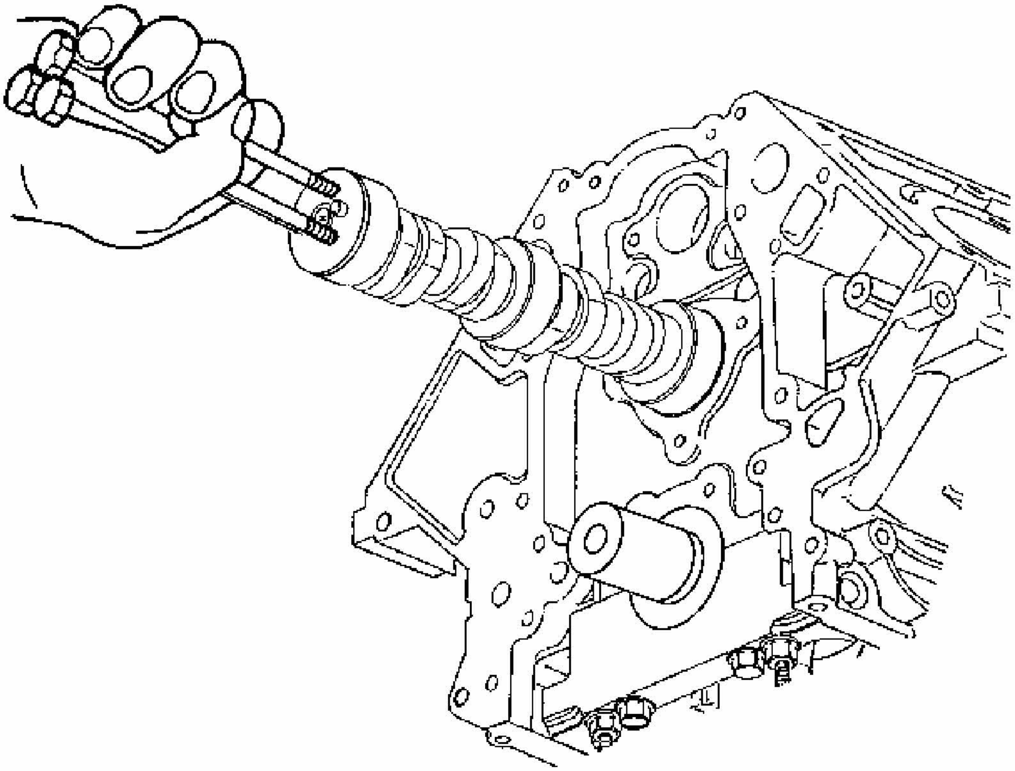


Fig. 240: Removing/Installing The Camshaft
Courtesy of GENERAL MOTORS CORP.

20. Remove the camshaft.
    1. Install 3 M8-125 x 100 mm bolts in the camshaft front bolt holes.
    2. Using the bolts as a handle, carefully rotate and pull the camshaft out of the engine block.
    3. Remove the bolts from the camshaft.

Installation Procedure

IMPORTANT: If camshaft replacement is required, the valve lifters must also be replaced.

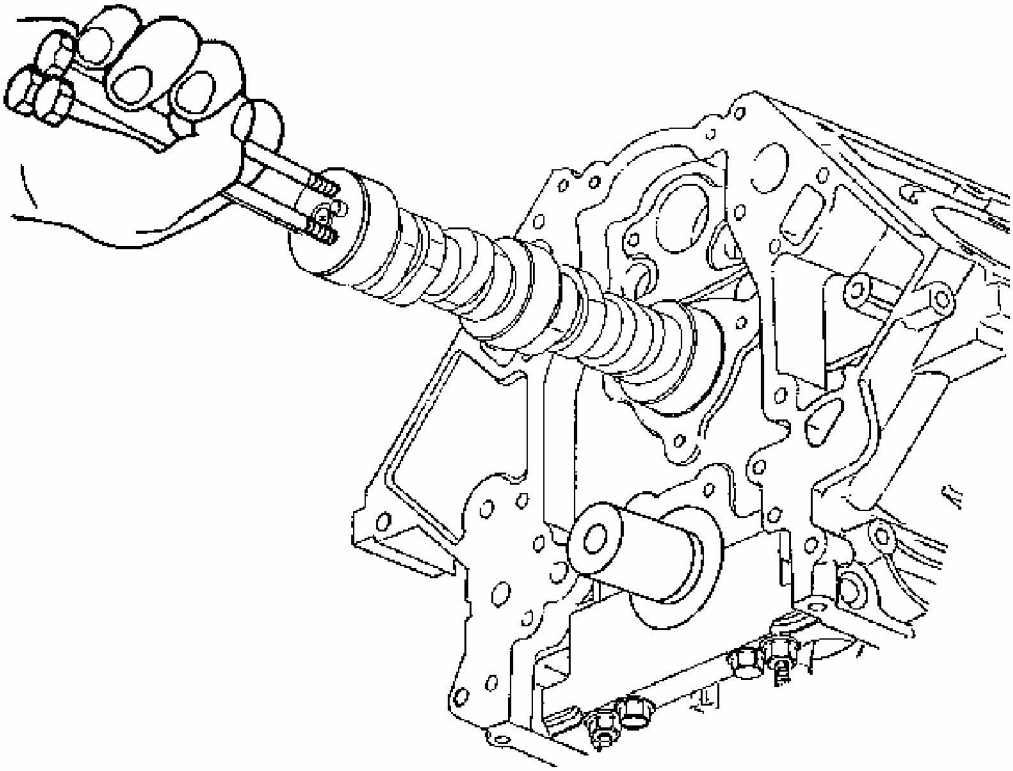


Fig. 241: Removing/Installing The Camshaft
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the camshaft journals and the bearings with clean engine oil.
2. Install 3 M8-125 x 100 mm bolts in the NEW camshaft front bolt holes.
3. Using the bolts as a handle, carefully install the NEW camshaft into the engine block.
4. Remove the 3 bolts from the camshaft.

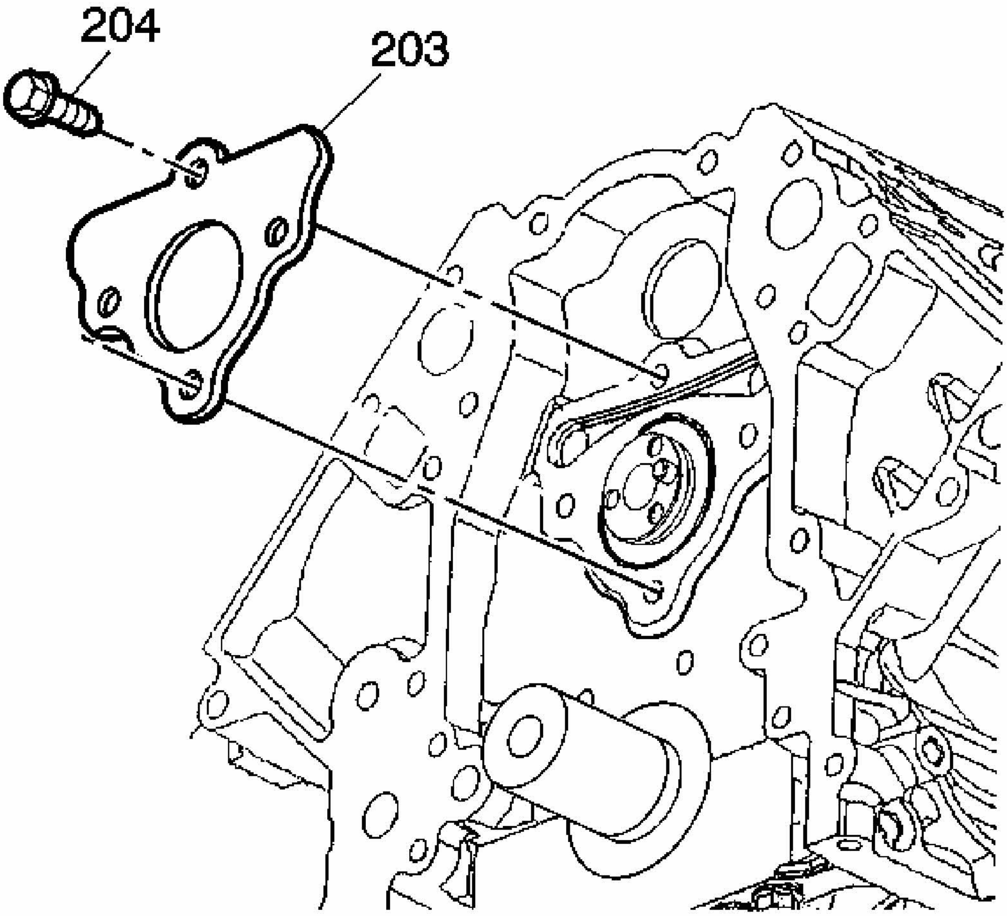


Fig. 242: Camshaft Retainer & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

IMPORTANT:

- **Install the retainer plate with the sealing gasket facing the engine block.**
- **The gasket surface on the engine block should be clean and free of dirt or debris.**

5. Install the camshaft retainer (203) and bolts (204).

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

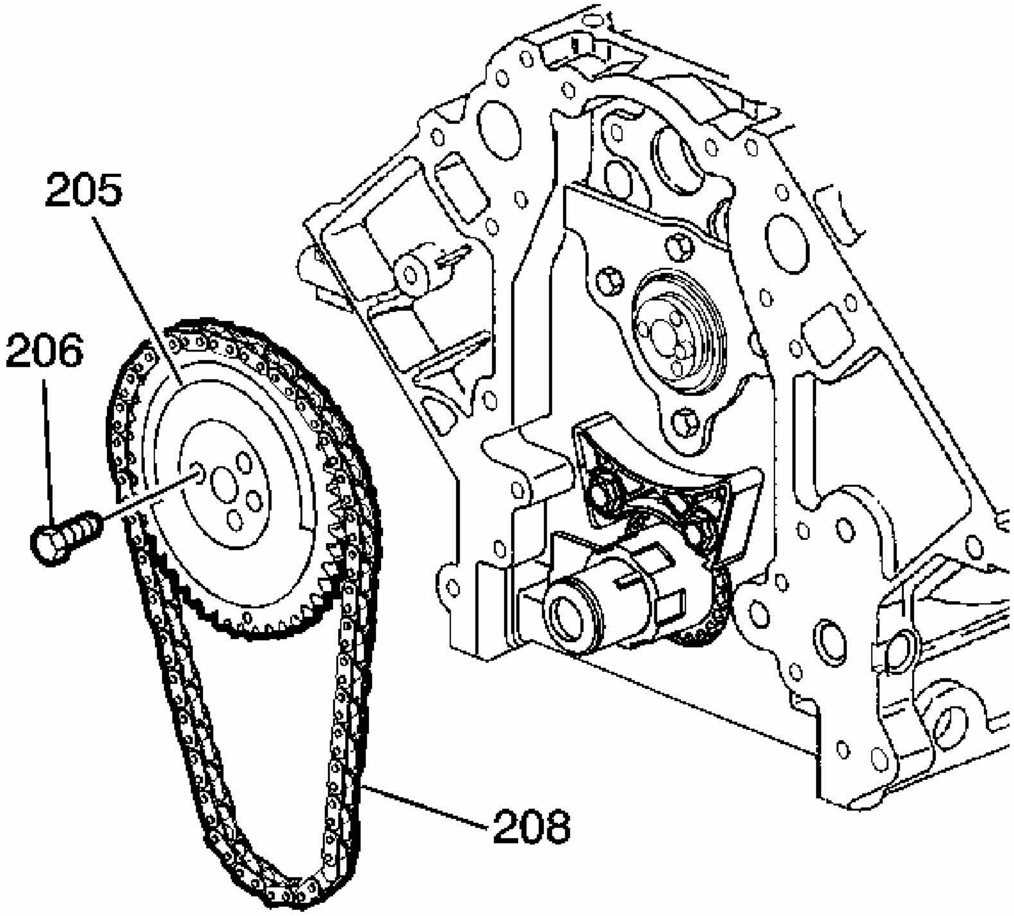


Fig. 243: View Of Camshaft Sprocket, Bolts & Timing Chain
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Properly locate the camshaft sprocket onto the locating pin of the camshaft.**
- **The sprocket teeth and timing chain teeth must mesh.**
- **The camshaft and crankshaft sprocket alignment marks MUST be aligned properly. Position the camshaft sprocket alignment mark in the 6 o'clock position.**

6. Install the camshaft sprocket (205) and timing chain (208). If necessary, rotate the camshaft or crankshaft sprocket in order to align the timing marks.
7. Install the camshaft sprocket bolts (206).

Tighten: Tighten the bolts to 25 N.m (18 lb ft).

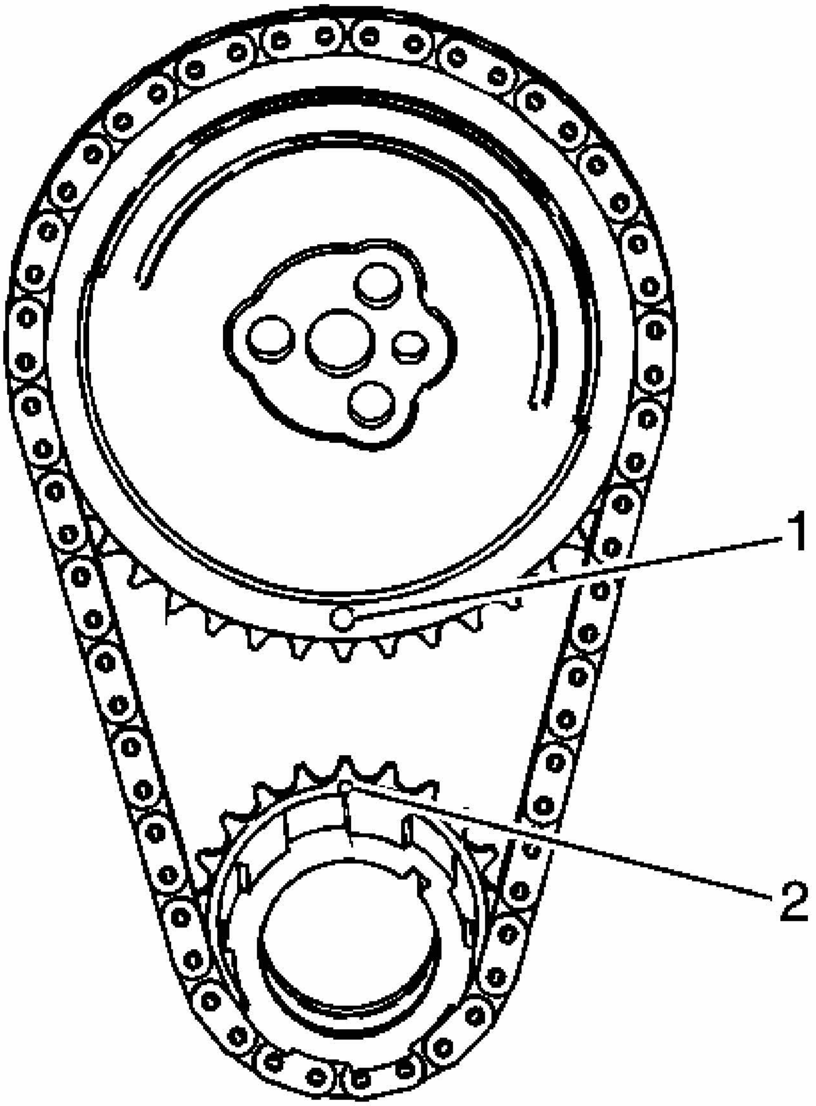


Fig. 244: View Of Camshaft And Crankshaft Timing Marks Aligned
Courtesy of GENERAL MOTORS CORP.

8. Inspect the camshaft (1) and crankshaft (2) sprockets for proper timing mark alignment.

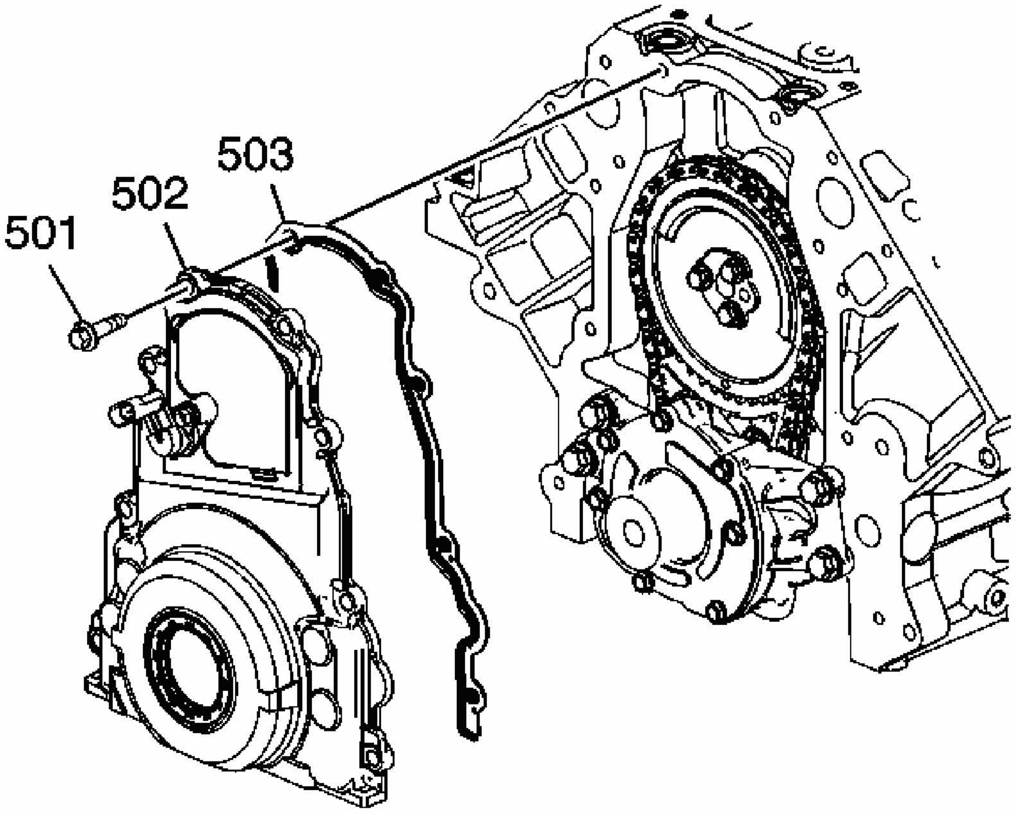


Fig. 245: View Of Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

9. Install the front cover (502). Refer to **Engine Front Cover Installation**
10. Install the oil pan-to-front cover bolts.

    Tighten: Tighten the bolts to 25 N.m (18 lb ft).

11. Install the valve lifters. Refer to **Valve Lifter Installation**.
12. Install the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Installation**.
13. Install the left and right valve rocker arm covers. Refer to **Valve Rocker Arm Cover Installation - Left** and **Valve Rocker Arm Cover Installation - Right**.
14. Install the coolant air bleed pipe. Refer to **Coolant Air Bleed Pipe Installation**.
15. Install the valve lifter oil manifold. Refer to **Valve Lifter Oil Manifold Installation**.
16. Install the intake manifold. Refer to **Intake Manifold Installation**.
17. Install the coolant pump manifold. Refer to **Coolant Pump Manifold Replacement**

(RPO LS4) .

18. Install the water pump. Refer to **Water Pump Installation**.
19. Install the left and right exhaust manifolds. Refer to **Exhaust Manifold Installation - Left** and **Exhaust Manifold Installation - Right**.
20. Install the oil level indicator. Refer to **Oil Level Indicator and Tube Installation**.
21. Install the crankshaft balancer. Refer to **Crankshaft Balancer Installation**.
22. Install the engine. Refer to **Engine Replacement**.

ENGINE FLYWHEEL REPLACEMENT

Removal Procedure

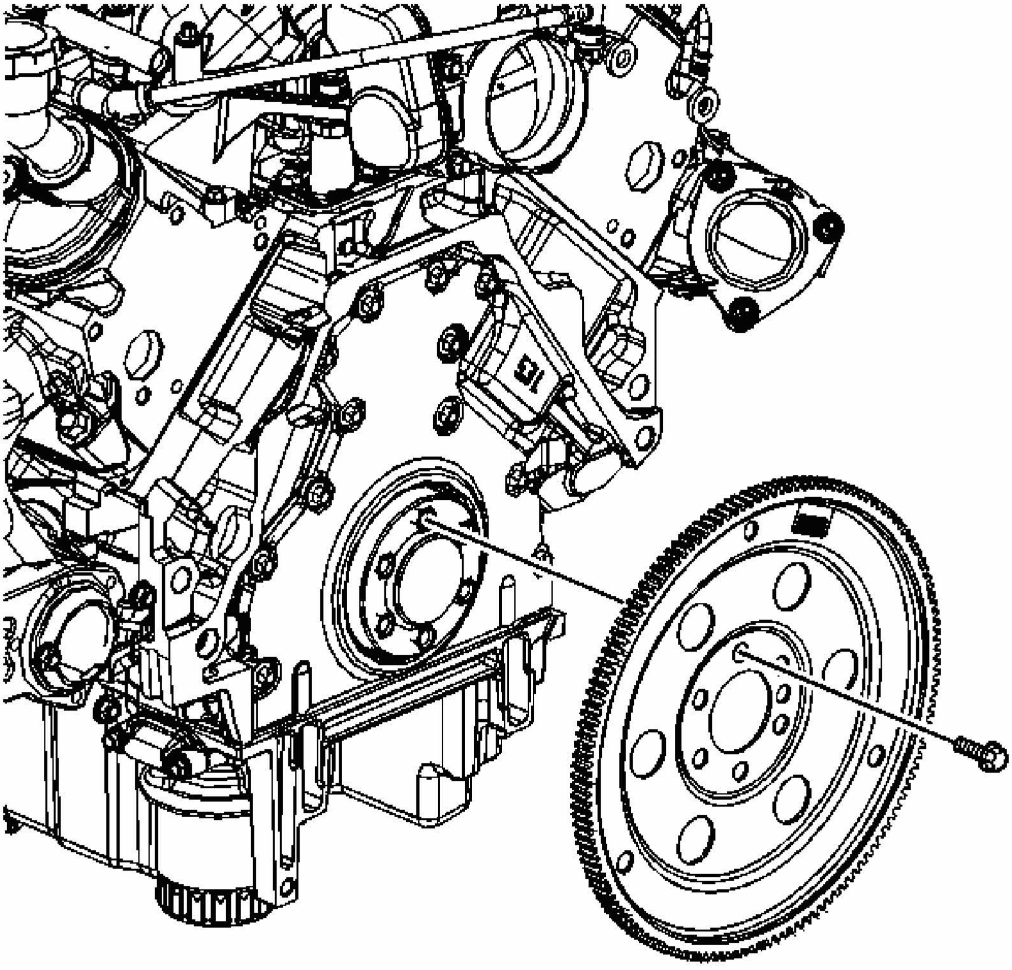


Fig. 246: Identifying Flywheel
Courtesy of GENERAL MOTORS CORP.

1. Remove the automatic transmission. Refer to **Transmission Replacement (RPOs LZE/LZ9)** or **Transmission Replacement (RPO LS4)** in Automatic Transaxle - 4T65-E.
2. Remove the flywheel bolts and flywheel.
3. Clean and inspect the engine flywheel. Refer to **Engine Flywheel Cleaning and Inspection**.

Installation Procedure

IMPORTANT: The flywheel does not use a locating pin for alignment and will not initially seat against the crankshaft flange or spacer if applicable, but will be pulled onto the crankshaft by the engine flywheel bolts. This procedure requires a 3-stage tightening process.

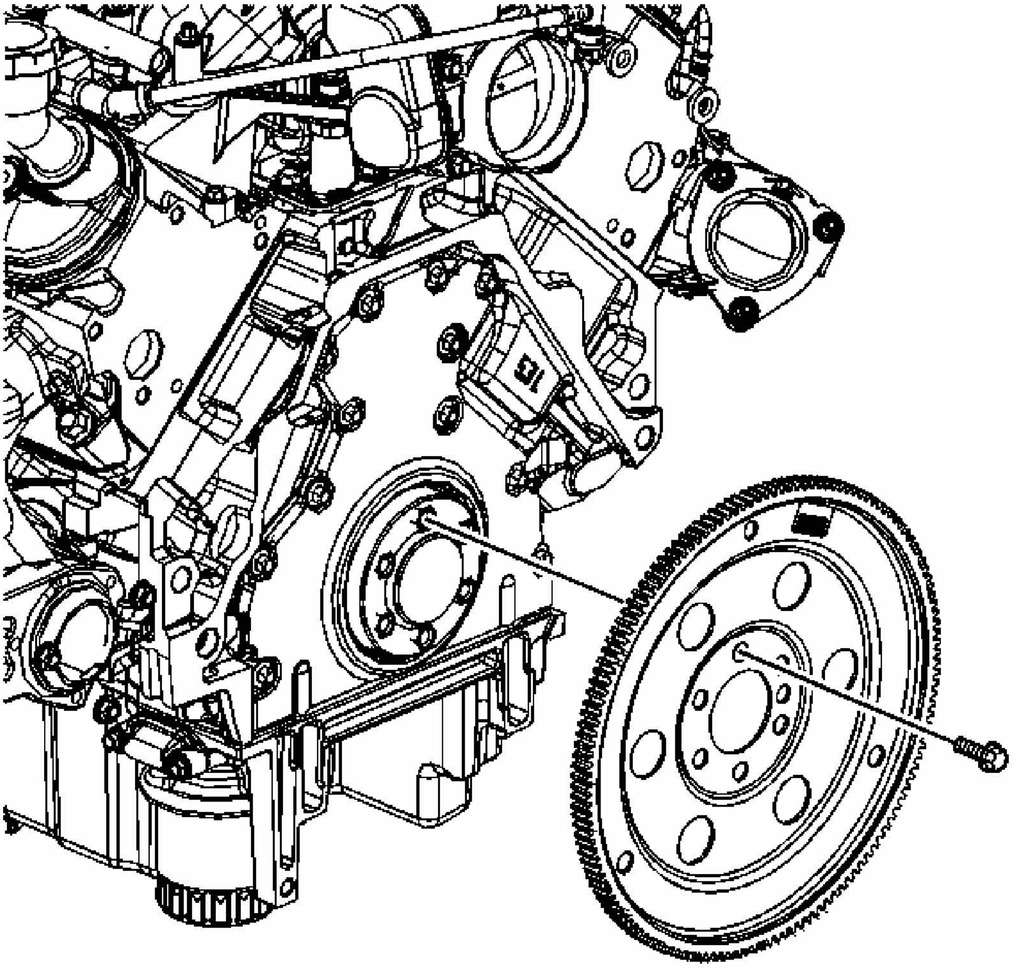


Fig. 247: Identifying Flywheel
Courtesy of GENERAL MOTORS CORP.

1. Install the flywheel to the crankshaft.
2. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent to the threads of the flywheel bolts.

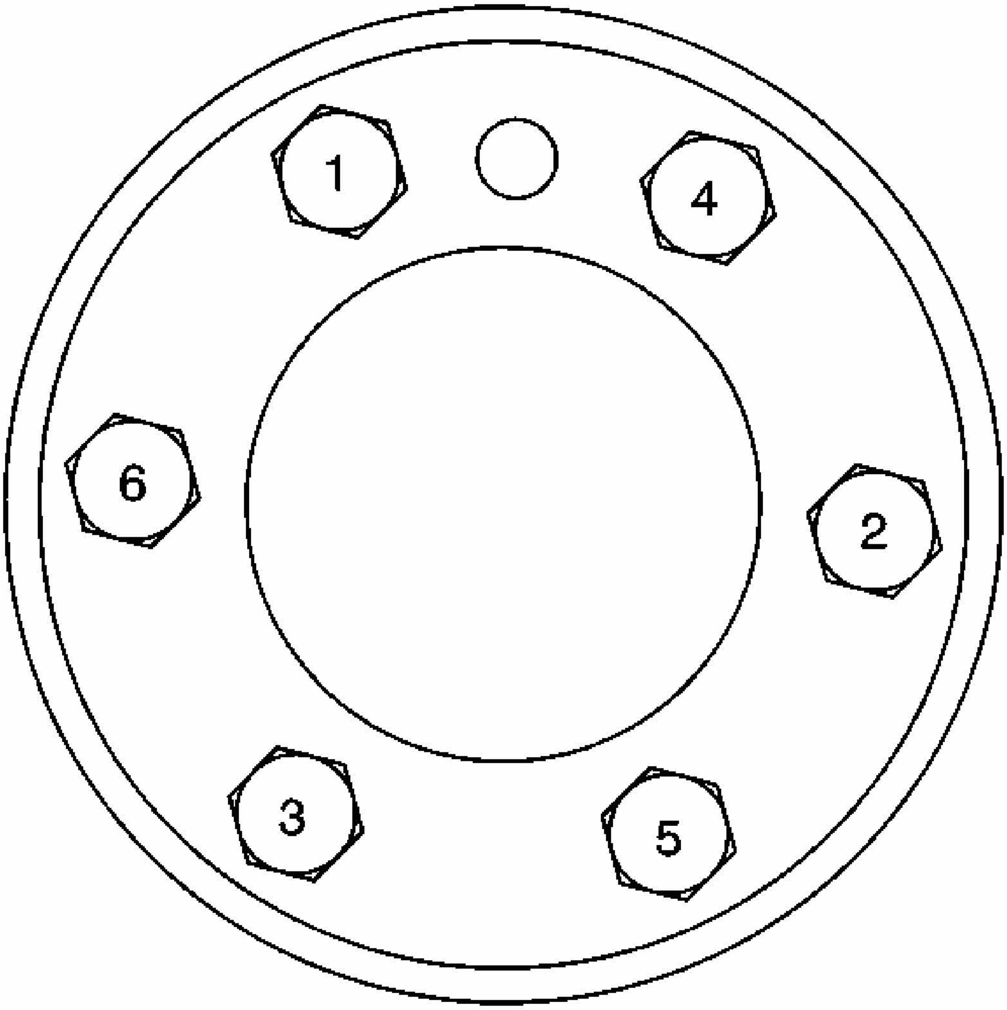


Fig. 248: Identifying Flywheel Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the engine flywheel bolts.

Tighten:

- Tighten the bolts a first pass in sequence to 20 N.m (15 lb ft).
- Tighten the bolts a second pass in sequence to 50 N.m (37 lb ft).
- Tighten the bolts a final pass in sequence to 100 N.m (74 lb ft).

4. Install the automatic transmission. Refer to **Transmission Replacement (RPOs LZE/LZ9)** or **Transmission Replacement (RPO LS4)** in Automatic Transaxle - 4T65-E.

ENGINE REPLACEMENT

Tools Required

- **J 38185** Hose Clamp Pliers. See **Special Tools**.
- **J 39580** Universal Engine Support Table

Removal Procedure

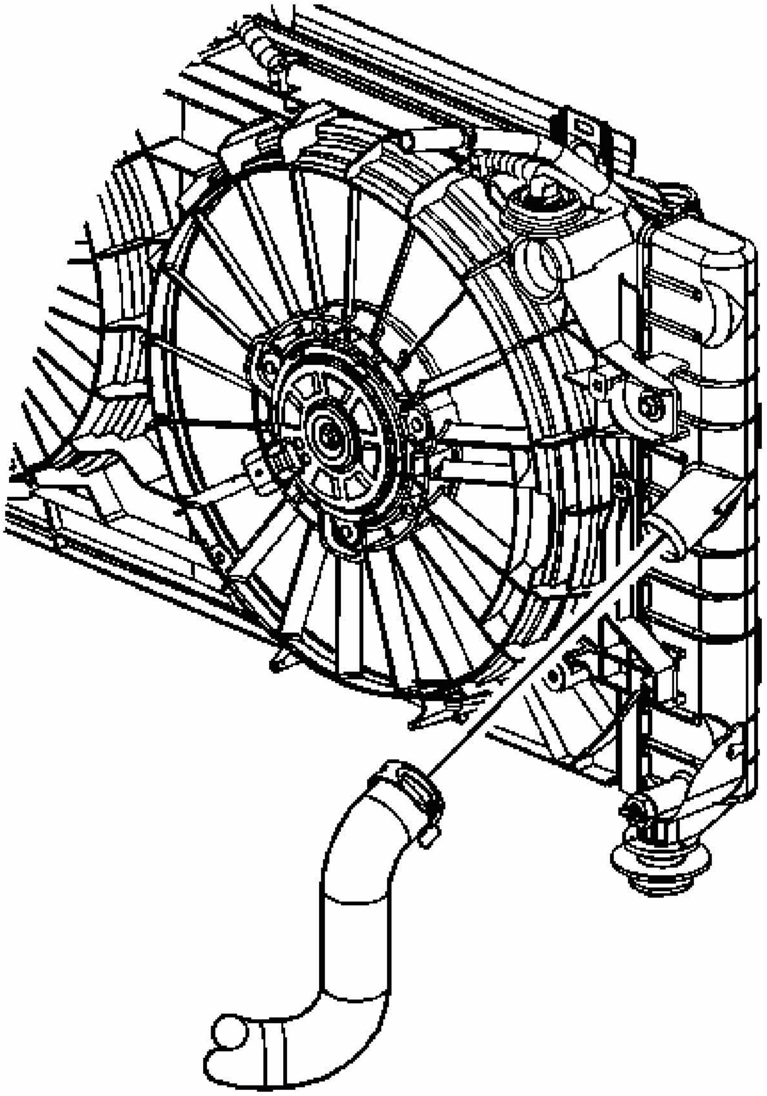


Fig. 249: Inlet Hose At The Radiator
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .
2. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement**.
3. Evacuate the air conditioning (A/C) system. Refer to **Refrigerant Recovery and Recharging** .
4. Remove the front tires and wheels. Refer to **Tire and Wheel Removal and**

Installation .

5. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
6. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
7. Lower the vehicle.
8. Using the **J 38185** reposition the inlet hose clamp at the radiator. See **Special Tools**.
9. Remove the inlet hose from the radiator.

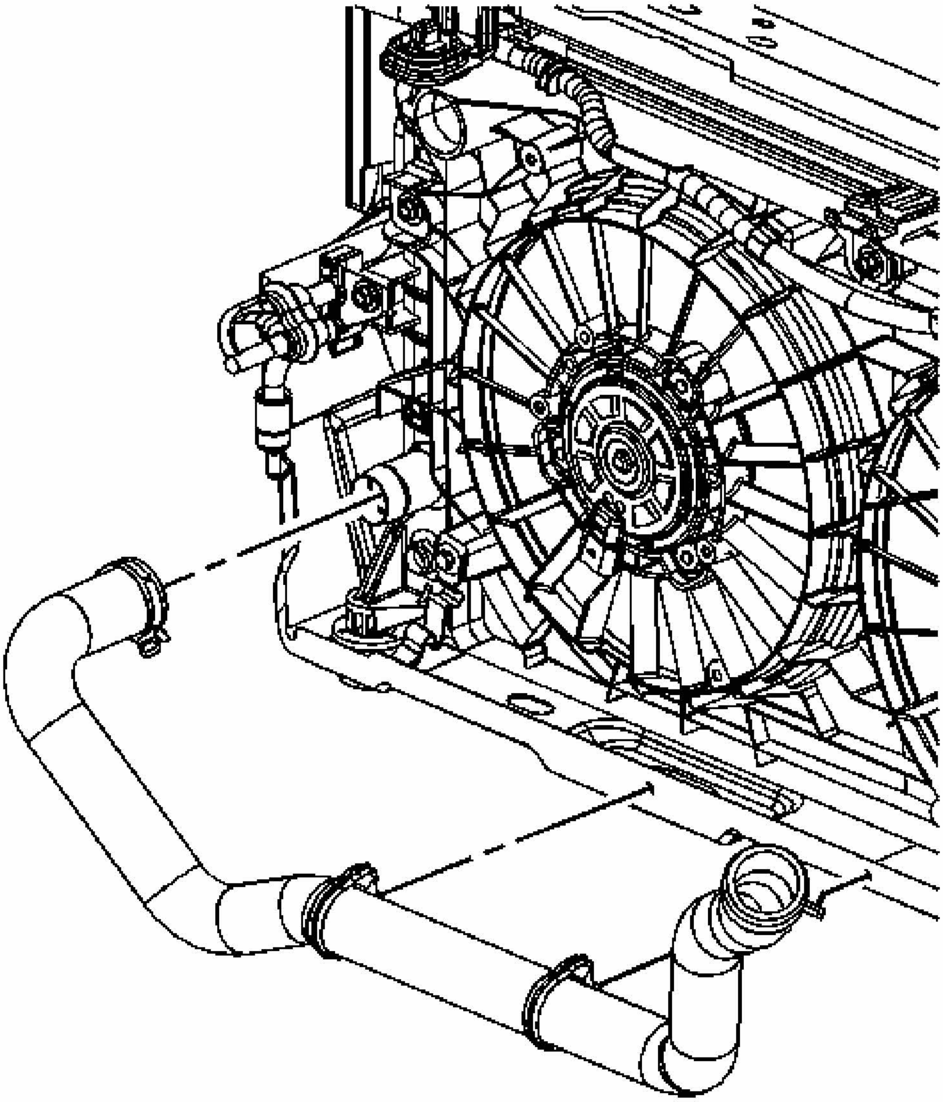


Fig. 250: Outlet Hose At The Radiator
Courtesy of GENERAL MOTORS CORP.

10. Using the **J 38185** reposition the outlet hose clamp at the radiator. See **Special Tools**.
11. Disengage the outlet hose clips from the fan shroud.
12. Remove the outlet hose from the radiator.

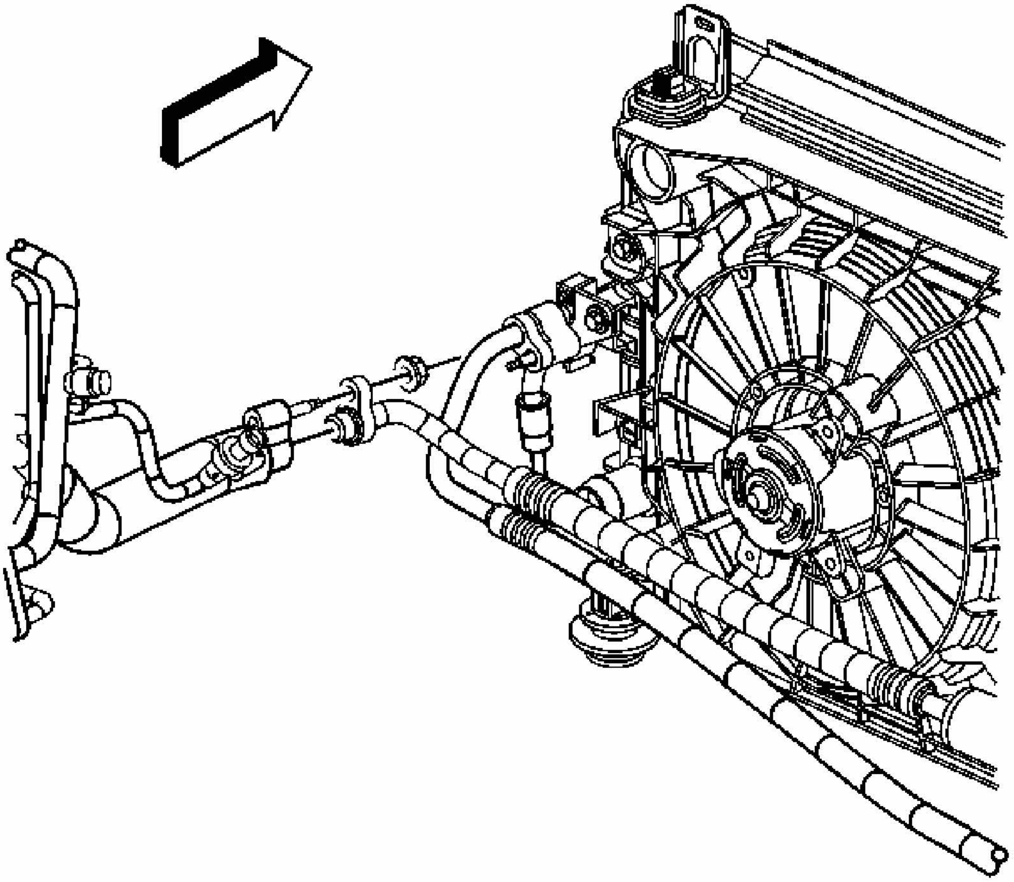


Fig. 251: A/C Compressor Hose Nut & A/C Receiver/Dehydrator Tube
Courtesy of GENERAL MOTORS CORP.

13. Remove the A/C compressor hose nut at the A/C receiver/dehydrator tube.
14. Remove the A/C compressor hose.

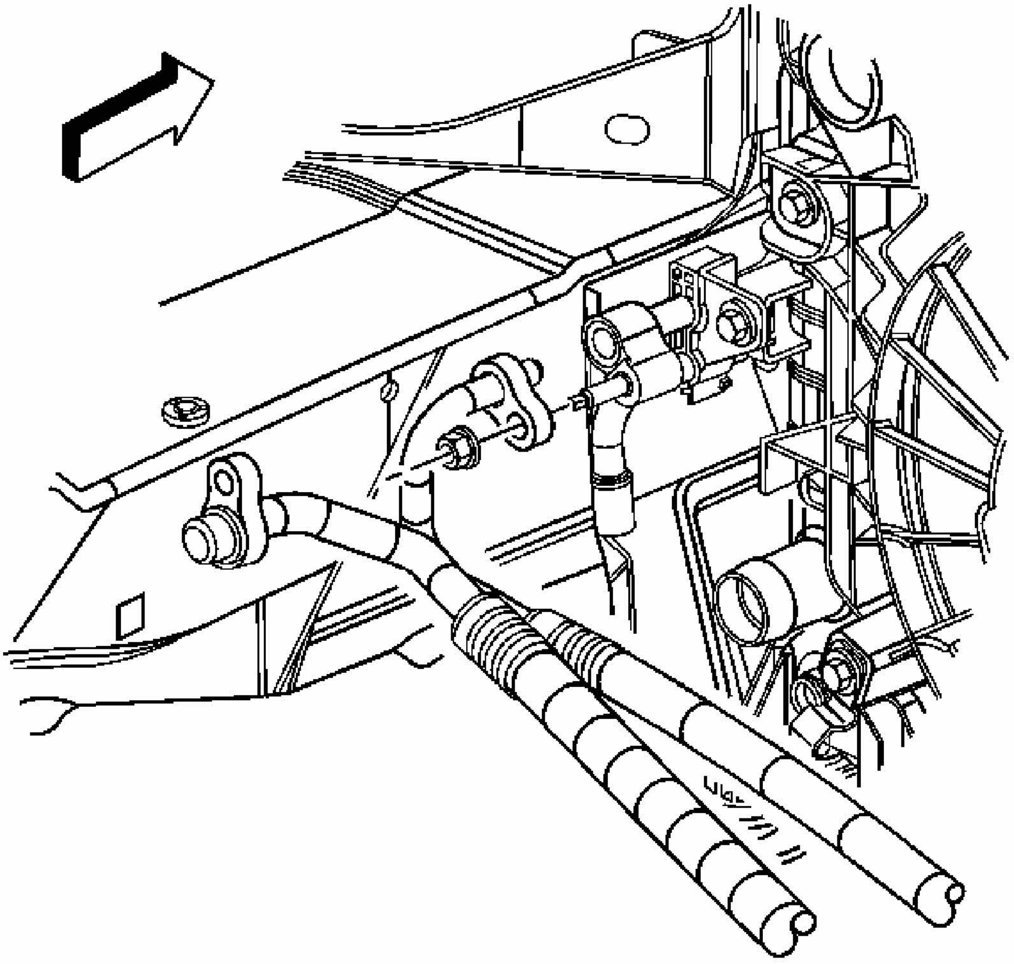


Fig. 252: A/C Compressor Hose & Nut At The A/C Condenser
Courtesy of GENERAL MOTORS CORP.

15. Remove the A/C compressor hose nut at the A/C condenser.
16. Remove the A/C compressor hose.

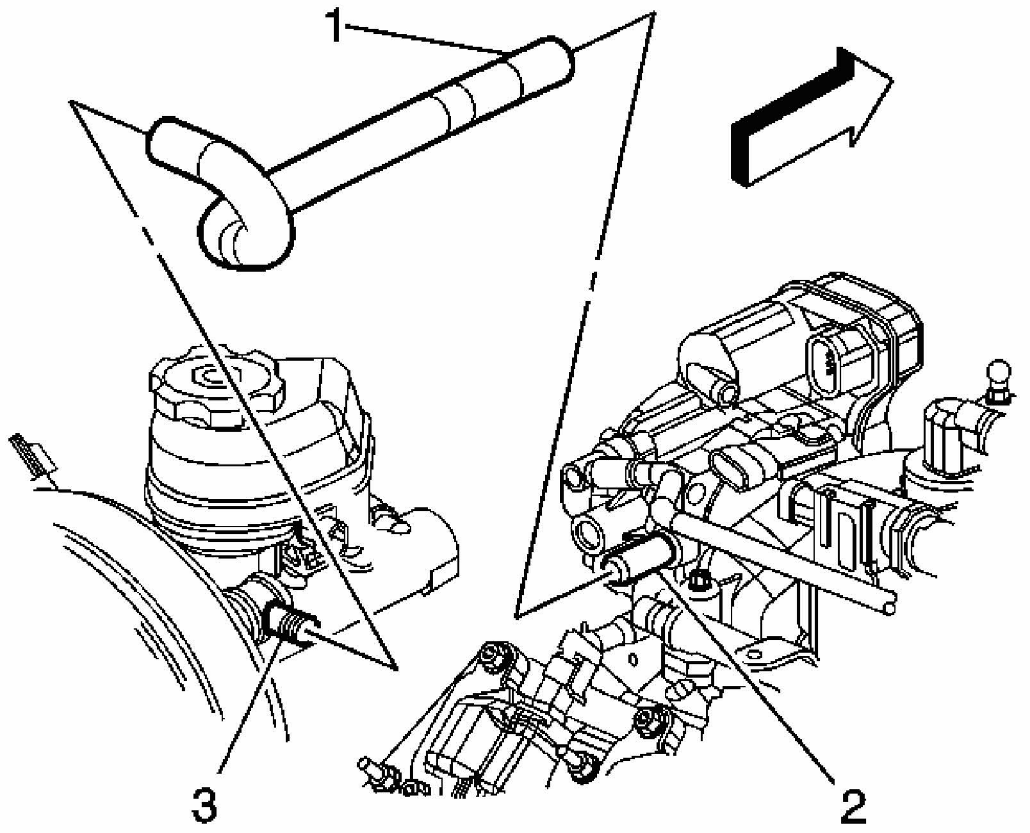


Fig. 253: View Of Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

17. Remove the brake booster vacuum hose from the brake booster (3).
18. Remove the brake booster vacuum hose (1) from the intake manifold (2).

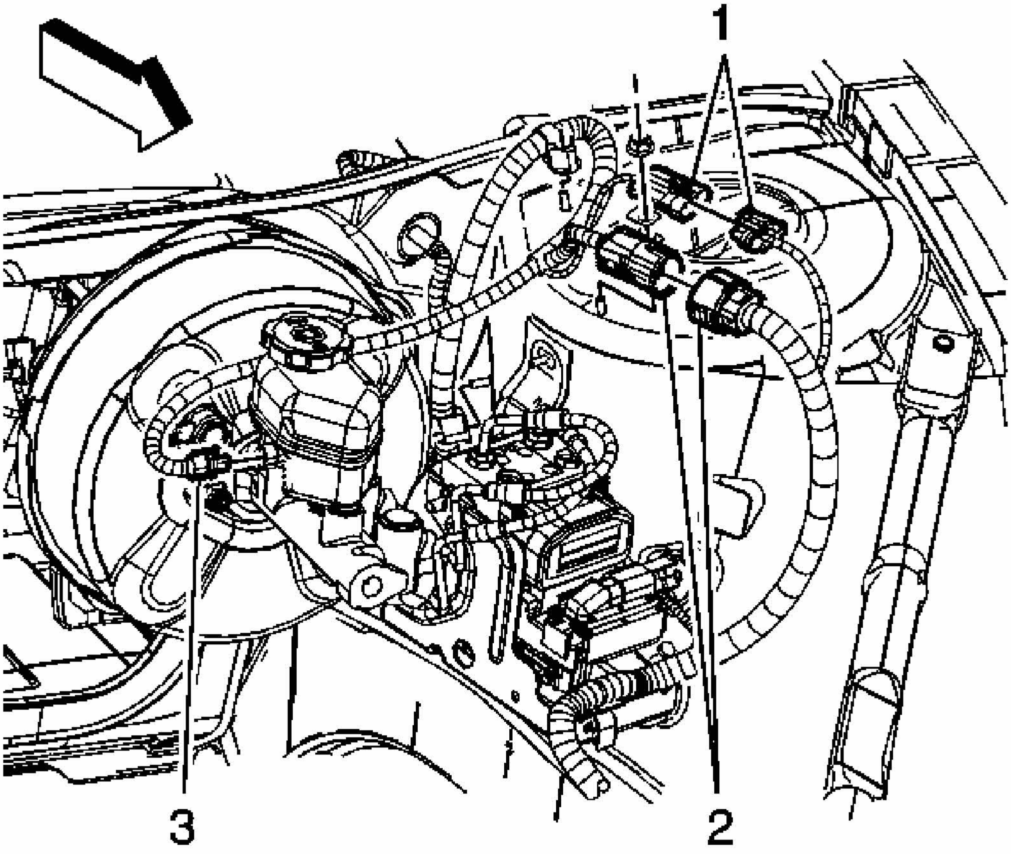


Fig. 254: Engine Harness Electrical Connectors & Brake Fluid Level Switch Electrical Connector
Courtesy of GENERAL MOTORS CORP.

19. Disconnect the engine harness electrical connectors (1, 2) from the instrument panel (I/P) harness electrical connectors.
20. Disconnect the brake fluid level switch electrical connector (3) from the master cylinder.

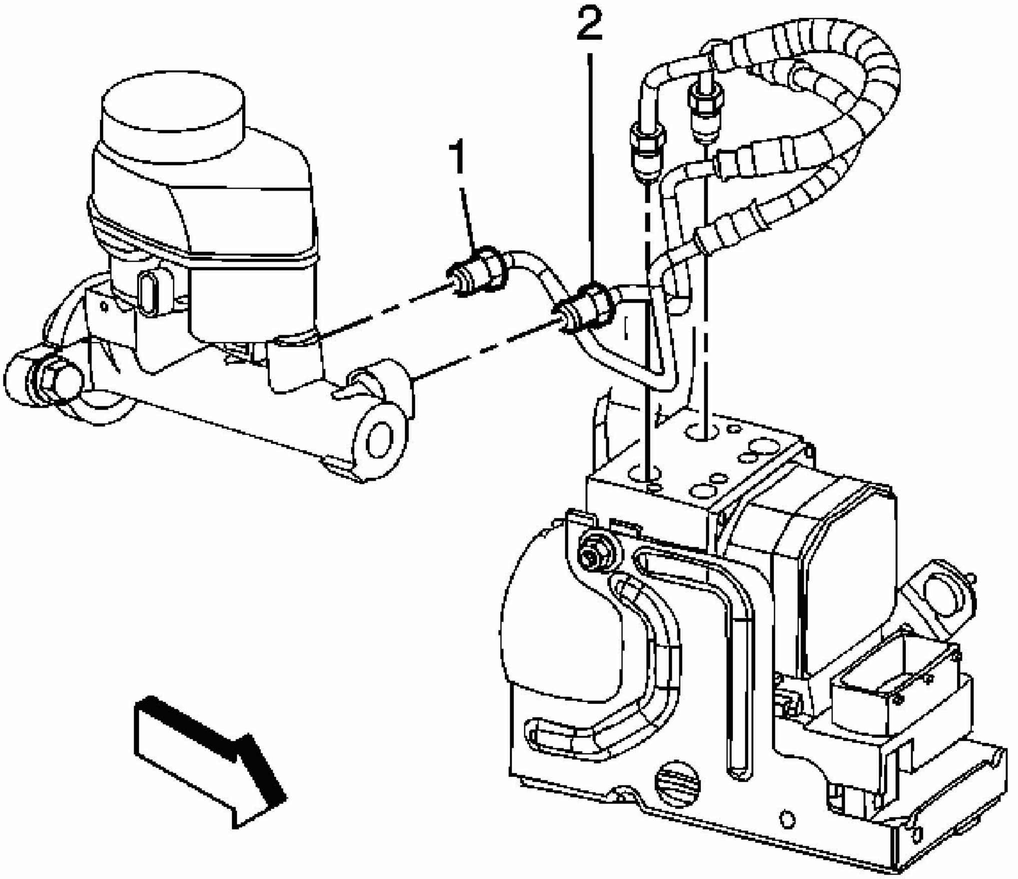


Fig. 255: Master Cylinder Brake Pipe Fittings
Courtesy of GENERAL MOTORS CORP.

21. Remove brake fluid from the master cylinder.
22. Disconnect the from brake pipe fittings (1, 2) from the master cylinder.

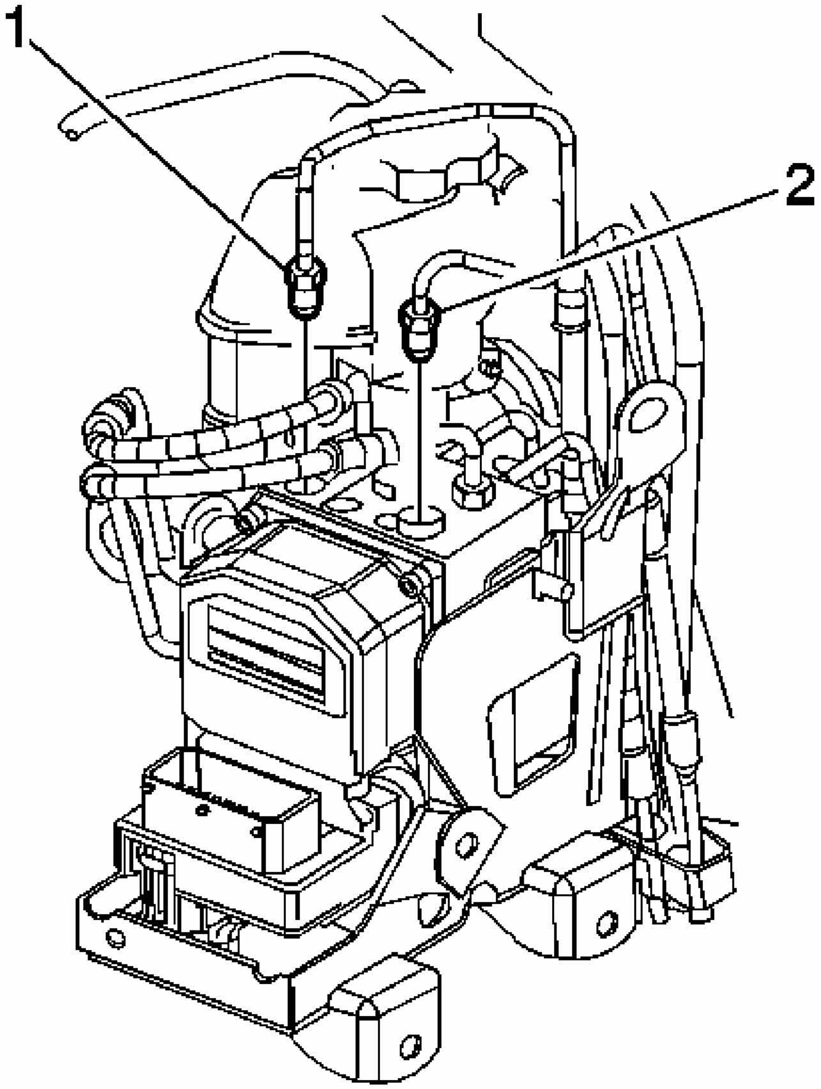


Fig. 256: Anti Lock Brake (ABS) Module Brake Pipe Fittings
Courtesy of GENERAL MOTORS CORP.

23. Disconnect the brake pipe fittings (1, 2) from the antilock brake (ABS) module.

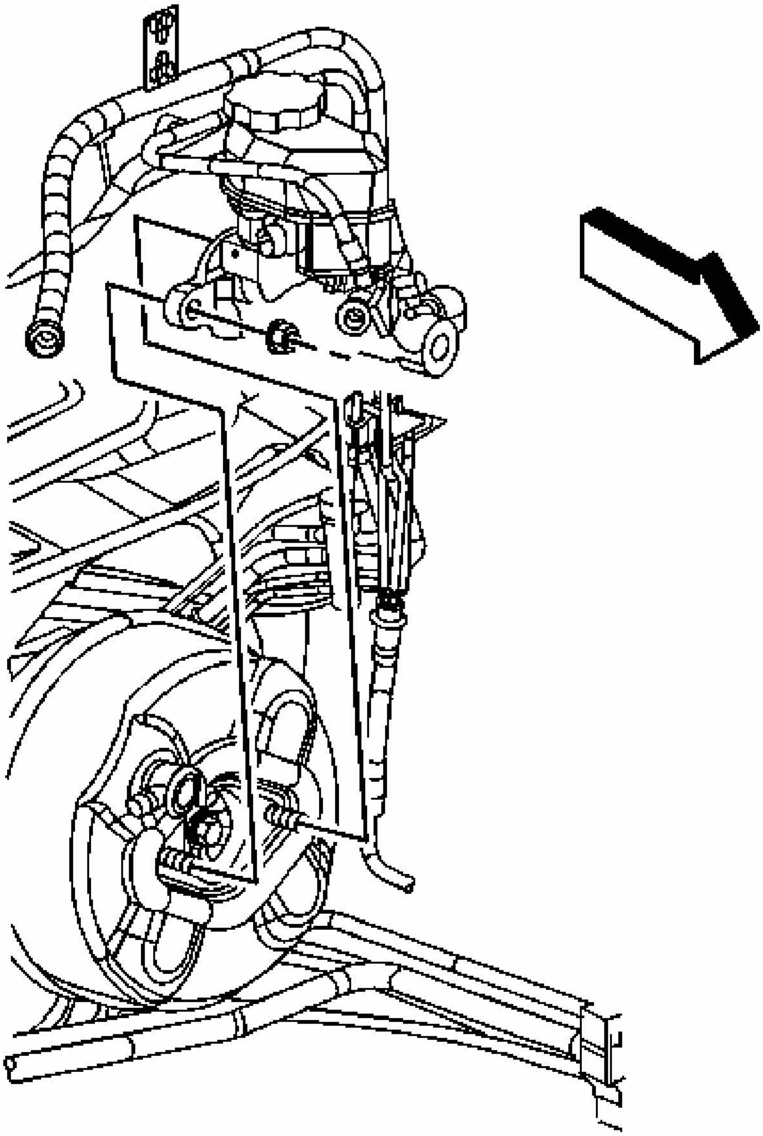


Fig. 257: View Of Master Cylinder & Nuts
Courtesy of GENERAL MOTORS CORP.

24. Remove the master cylinder nuts.
25. Position the master cylinder to the engine. Hold the master cylinder in place using mechanic's wire.

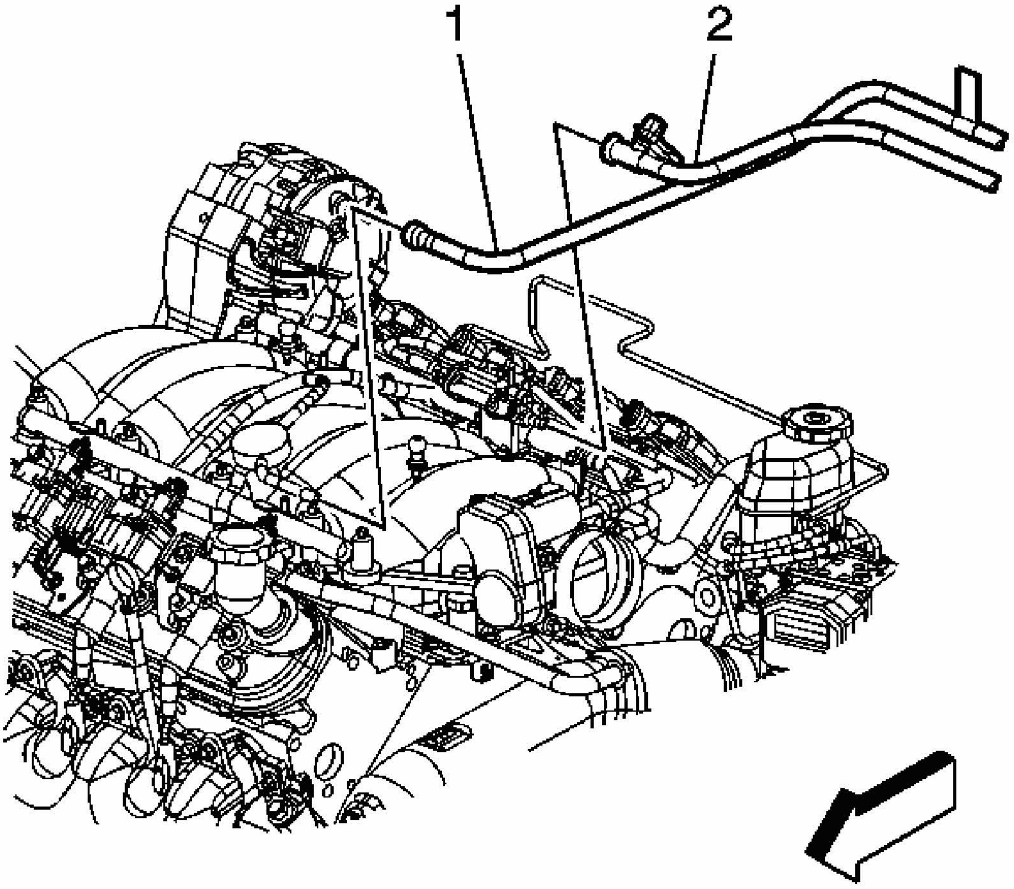


Fig. 258: View Of Fuel Feed Line & Evaporative Emission (EVAP) Line
Courtesy of GENERAL MOTORS CORP.

26. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief Procedure** .
27. Disconnect the fuel feed line (1) from the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .
28. Disconnect the evaporative emission (EVAP) line (2) from the purge solenoid. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

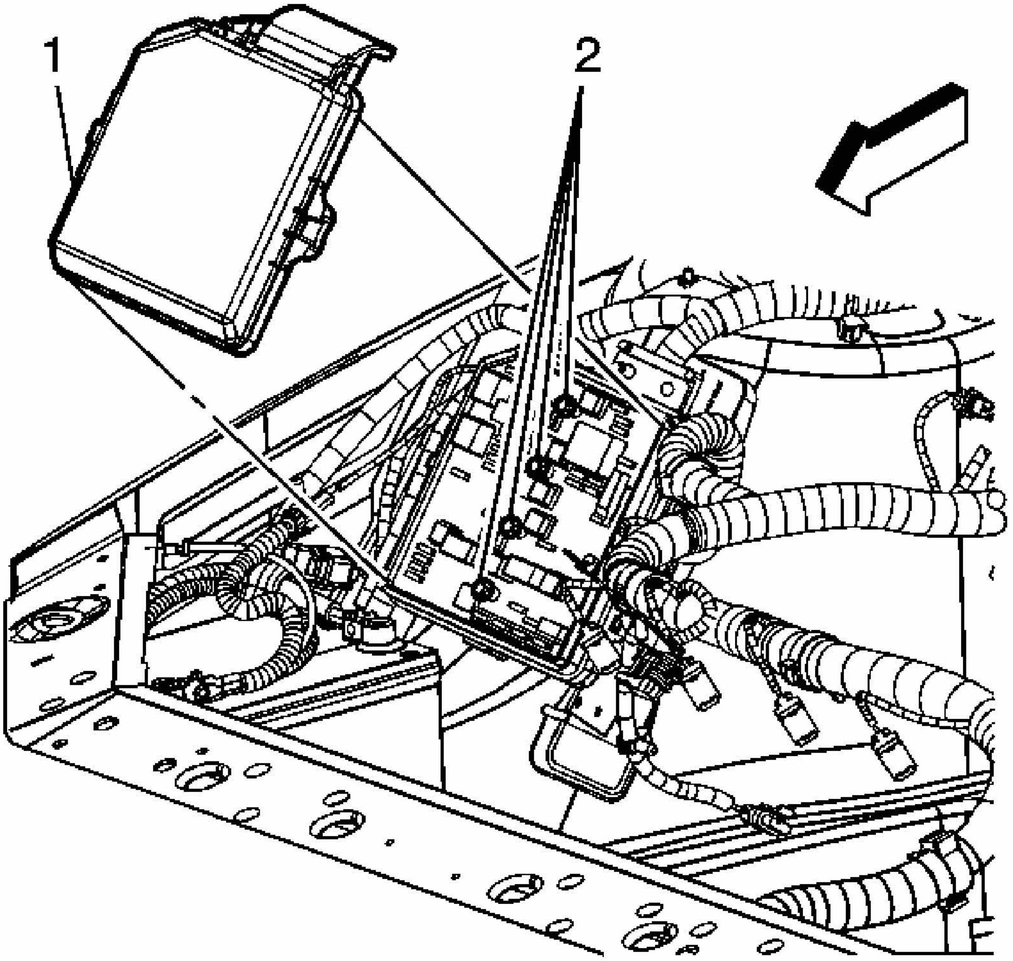


Fig. 259: View Of Bussed Electrical Center (BEC) Cover & Fuse Block
Courtesy of GENERAL MOTORS CORP.

29. Remove the right front fender diagonal brace. Refer to **Brace Replacement - Front Fender Upper Diagonal** .
30. Remove the underhood electrical center cover (1).
31. Loosen the 4 integral bolts (2) attaching the fuse block. Reposition the fuse block.

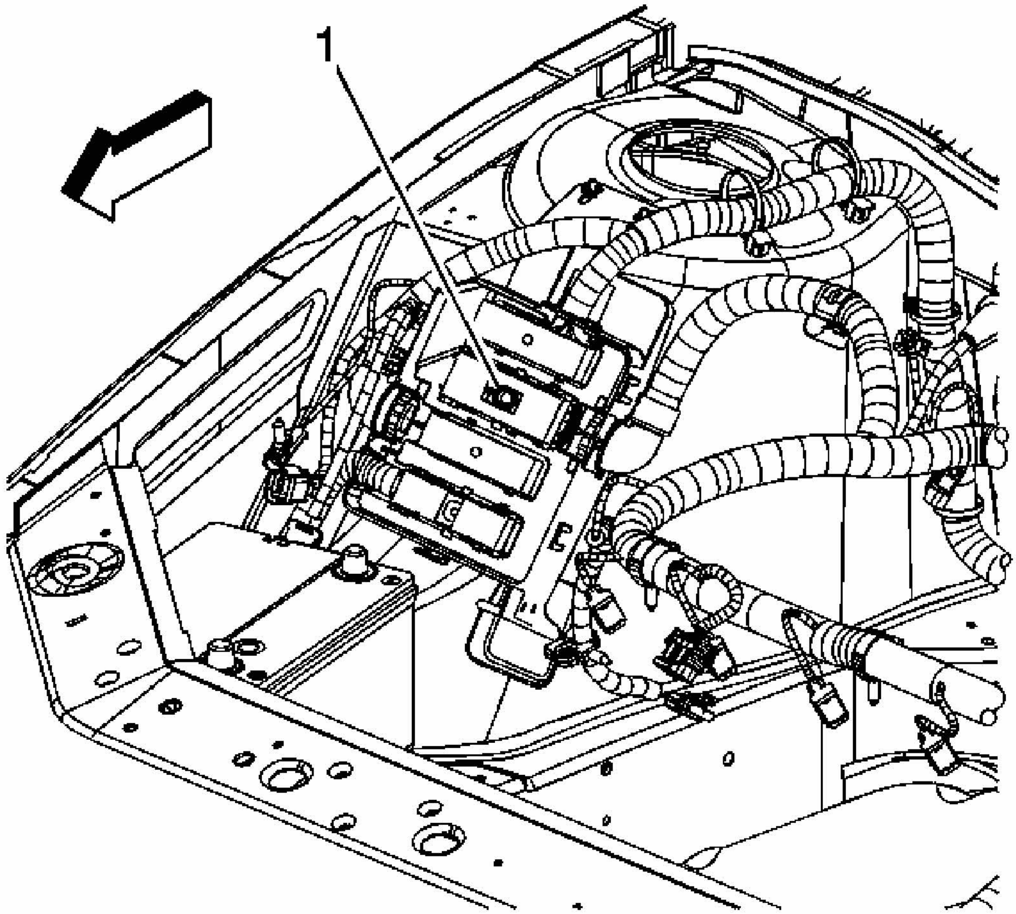


Fig. 260: Engine Harness Connector & Bolt
Courtesy of GENERAL MOTORS CORP.

32. Loosen the engine harness connector bolt (1). Remove the engine harness connector from the bracket.

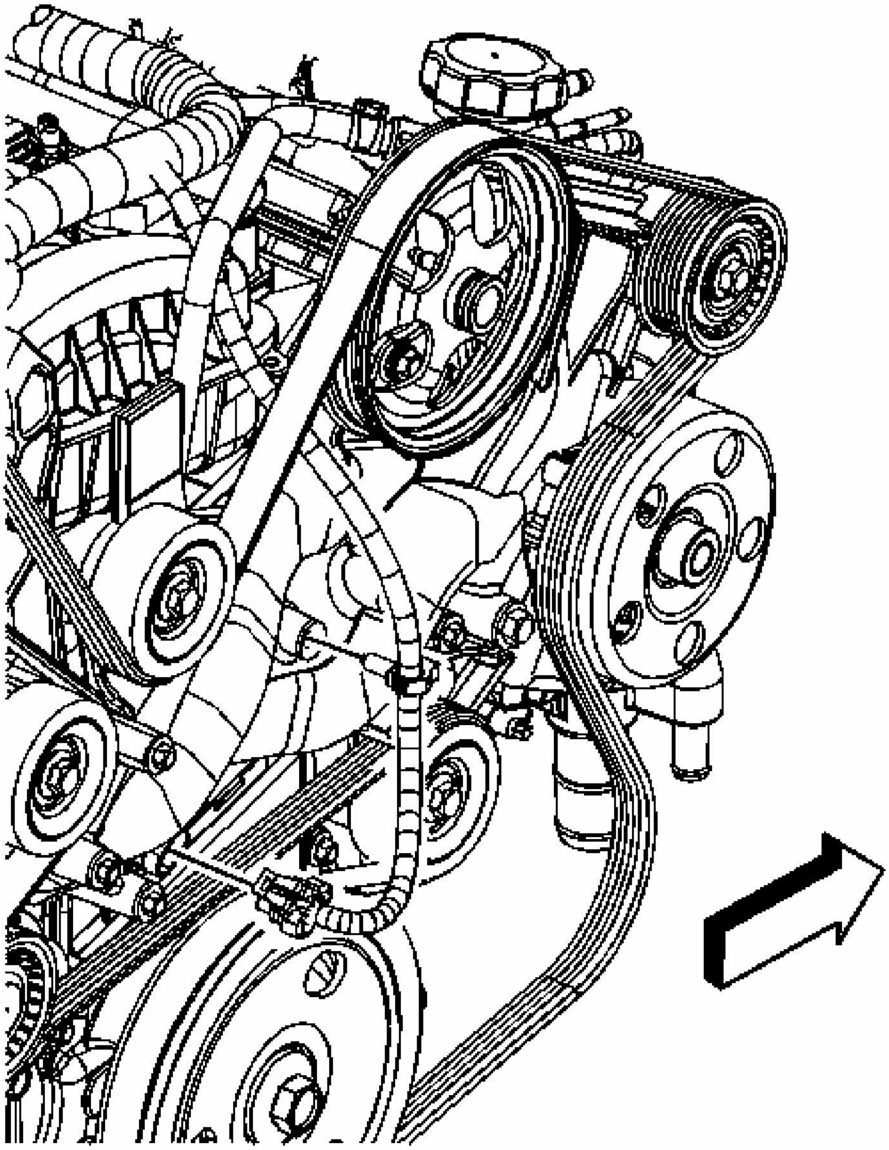


Fig. 261: Camshaft Position (CMP) Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

33. Disconnect the camshaft position sensor lead.

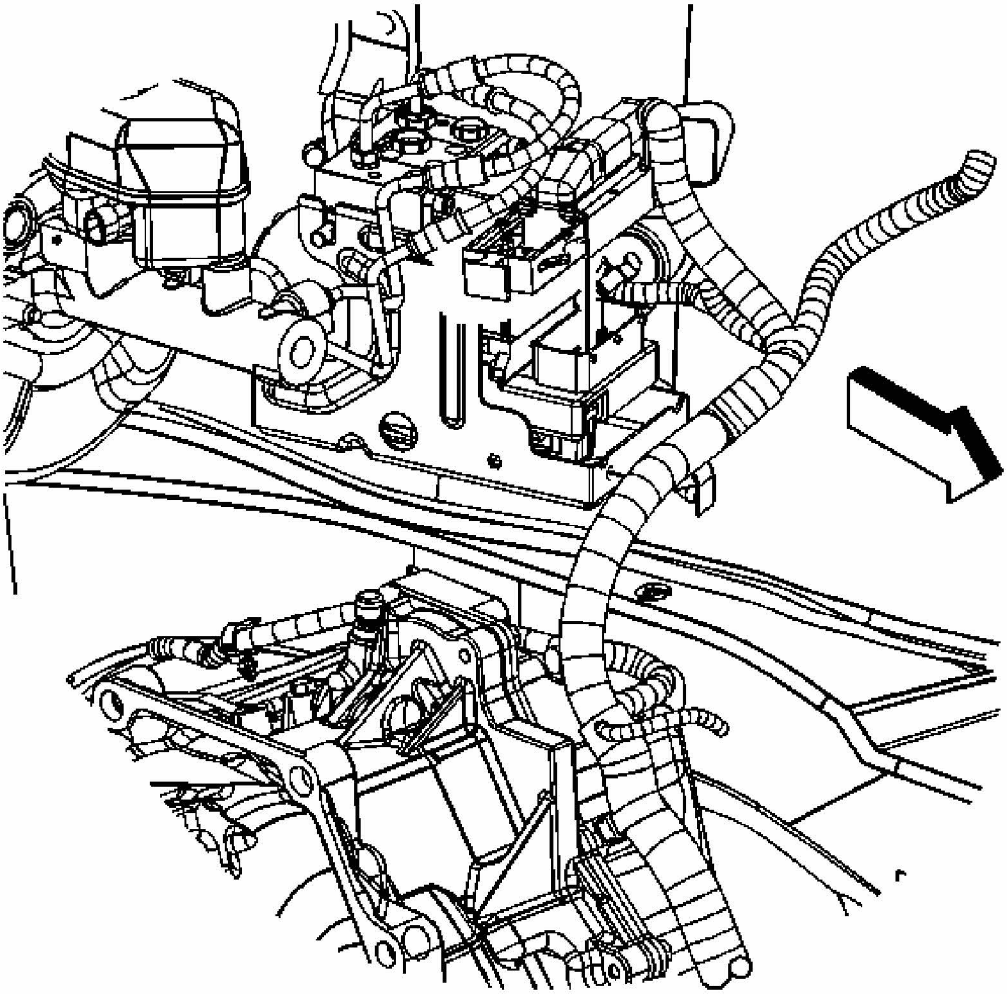


Fig. 262: Engine Harness Electrical Connector At The ABS Module
Courtesy of GENERAL MOTORS CORP.

34. Disconnect the engine harness electrical connector from the ABS module.

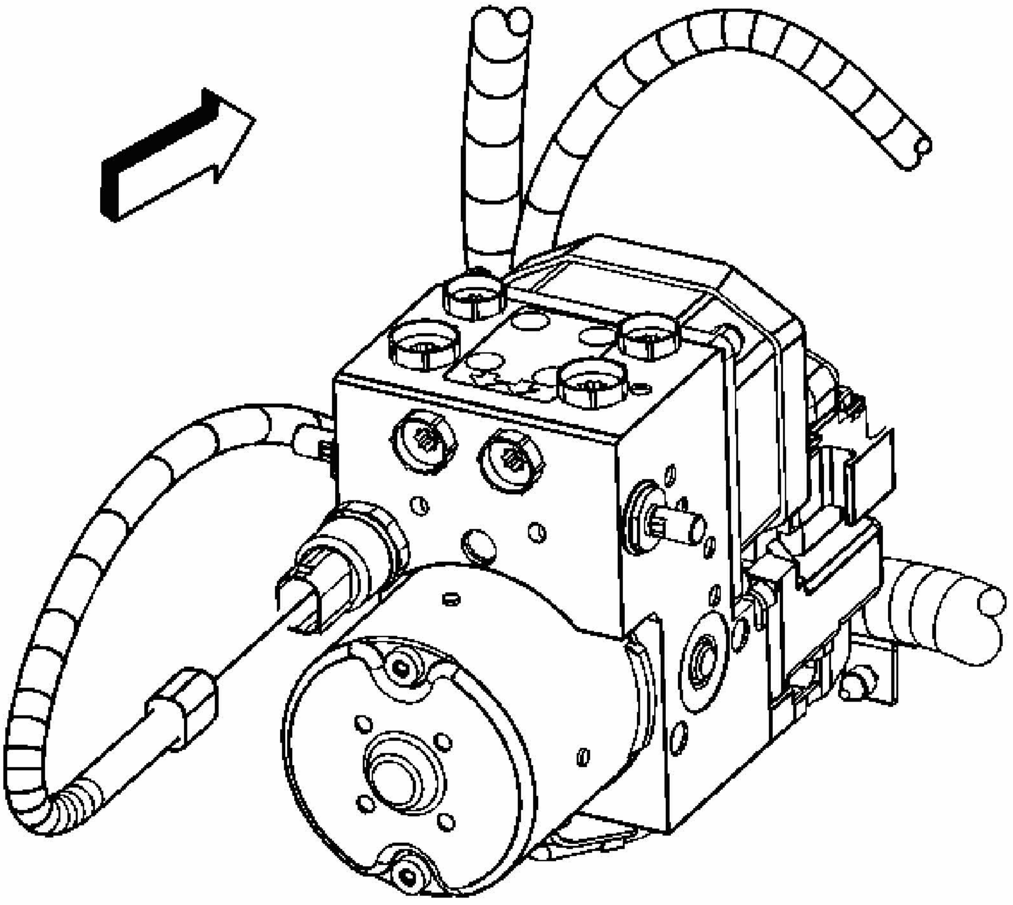


Fig. 263: Engine Harness Electrical Connector & The Electronic Brake Control Module (EBCM)
Courtesy of GENERAL MOTORS CORP.

35. Disconnect the engine harness electrical connector from the electronic brake control module (EBCM).

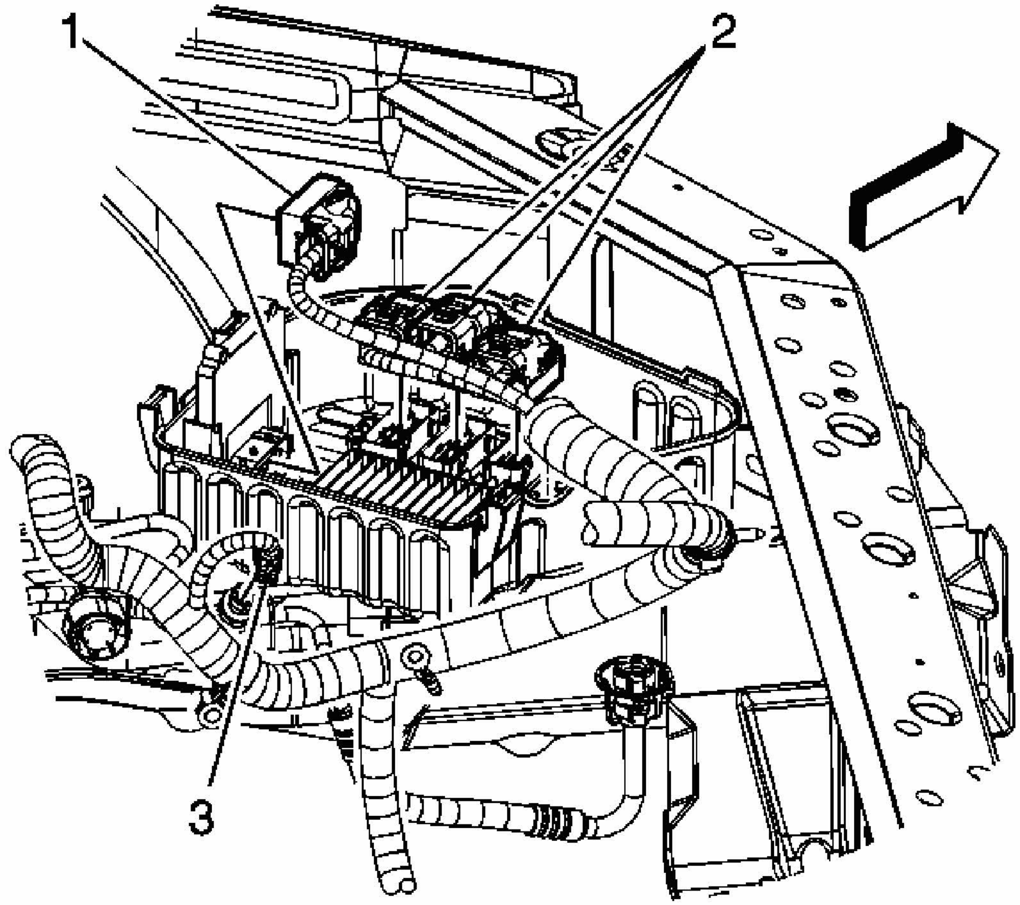


Fig. 264: Transmission Control Module, Engine Control Module & A/C Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

36. Remove the air cleaner assembly. Refer to **Air Cleaner Element Replacement** .
37. Disconnect the following electrical connectors:
    - Transmission control module (TCM) (1)
    - Engine control module (ECM) (2)
    - A/C pressure sensor (3)

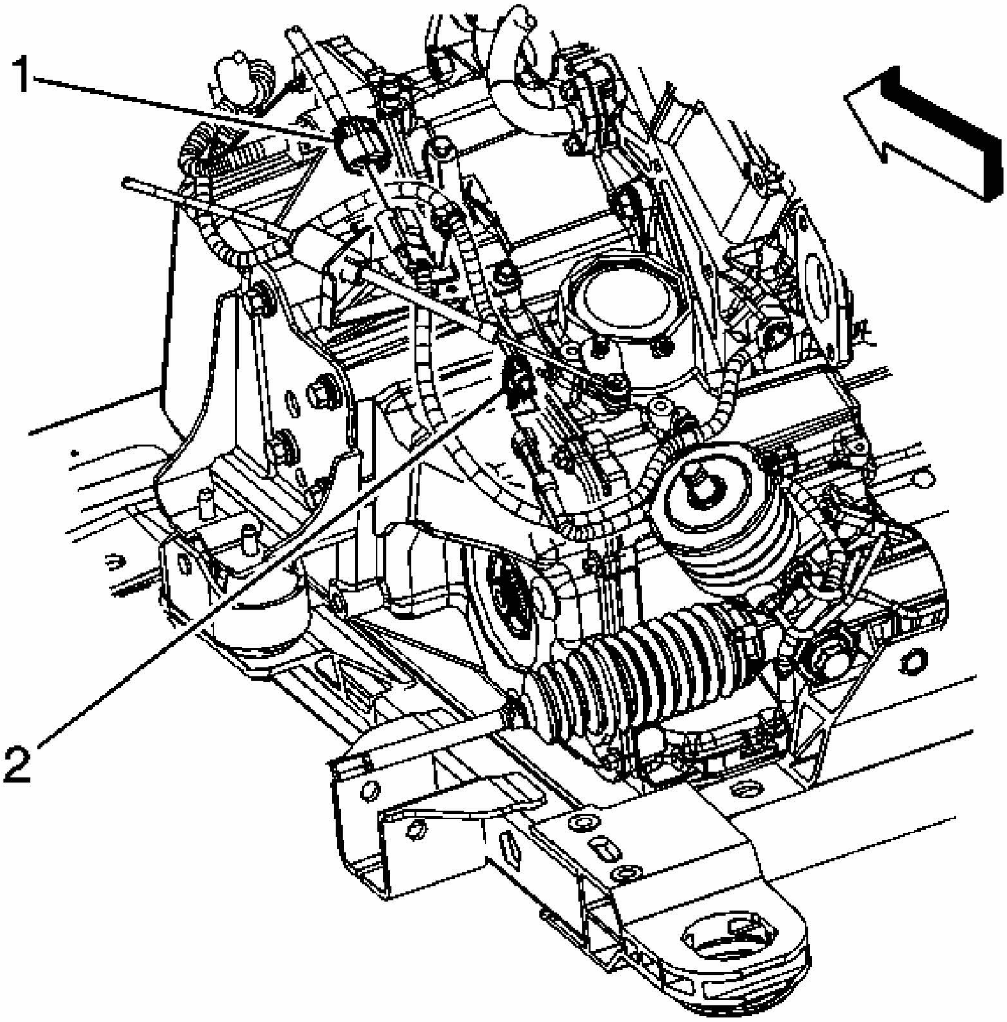


Fig. 265: Crankshaft Position (CKP) Sensor Harness & Power Steering Gear Harness To Engine Harness Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

38. Disconnect the engine harness electrical connector (1) from the crankshaft position (CKP) sensor harness.
39. Disconnect the engine harness electrical connector (2) from the power steering gear harness.
40. Remove the clip attaching the power steering gear harness to the bracket.

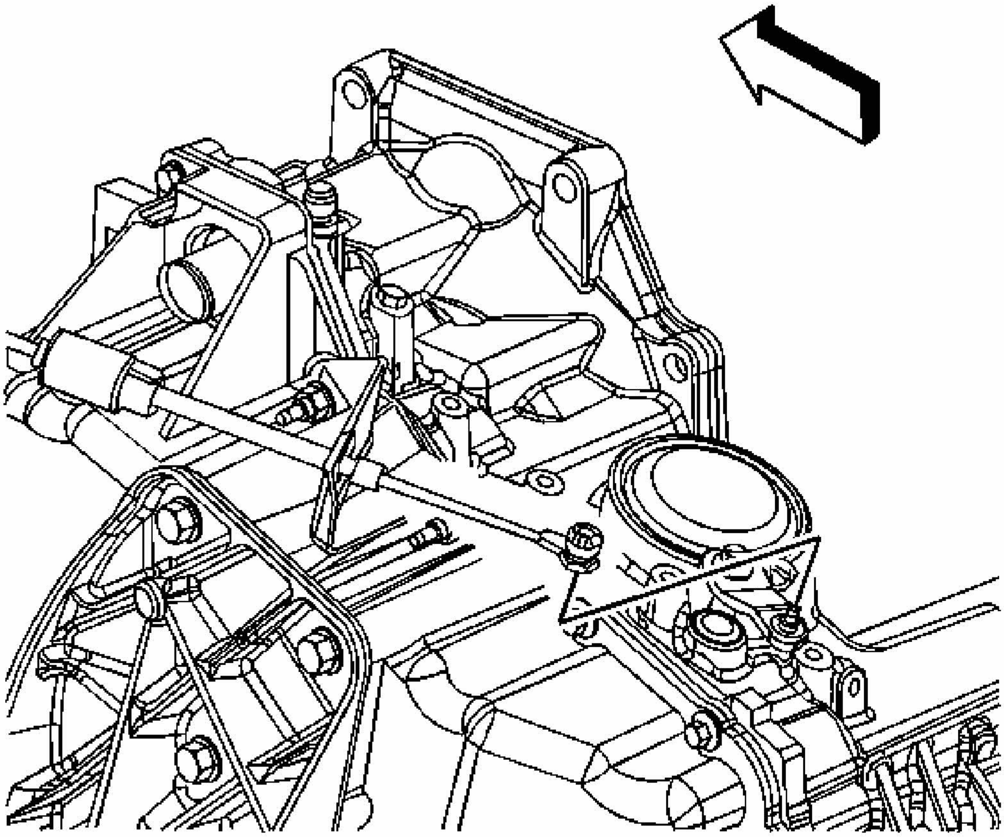


Fig. 266: View Of Shift Cable At Transaxle
Courtesy of GENERAL MOTORS CORP.

41. Remove the shift cable clip.
42. Disconnect the shift cable from the transaxle selector lever stud.
43. Remove the shift cable from the bracket.

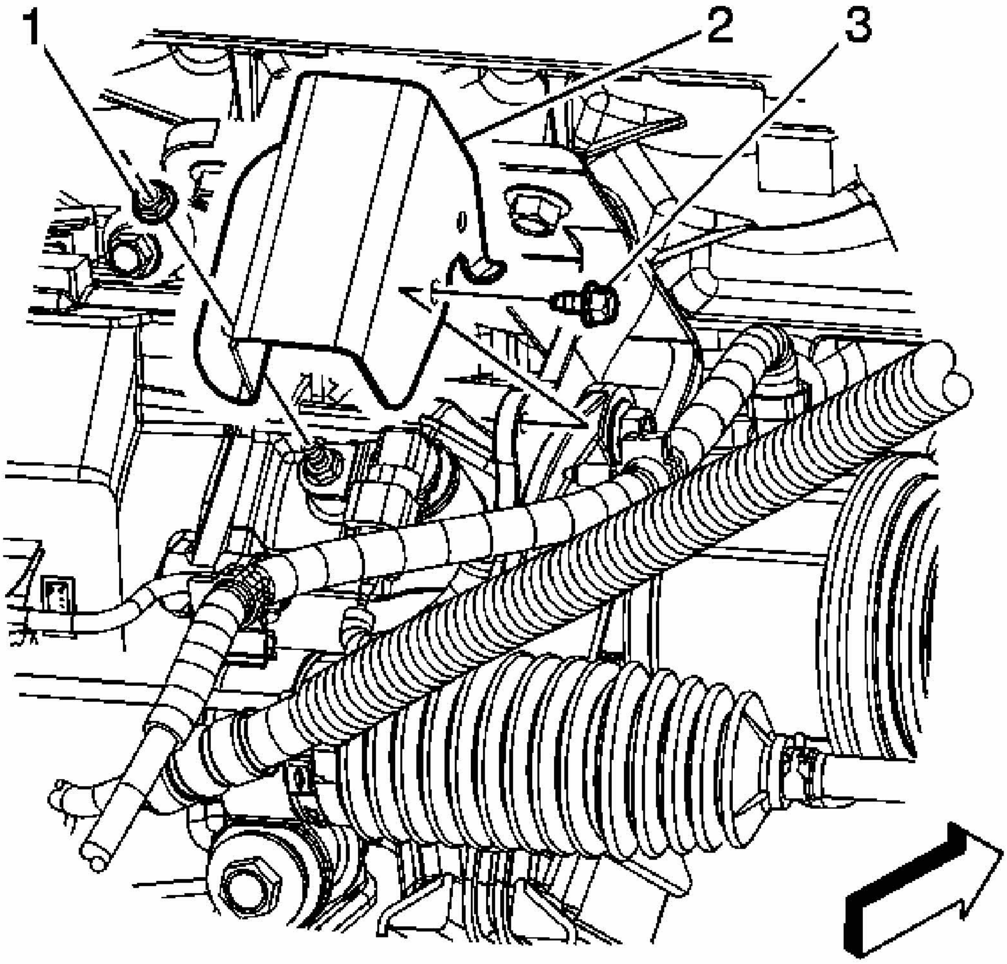


Fig. 267: Vehicle Speed Sensor (VSS) Shield, Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

44. Remove the vehicle speed sensor (VSS) shield nut (1) and bolt (3). Remove the shield (2).

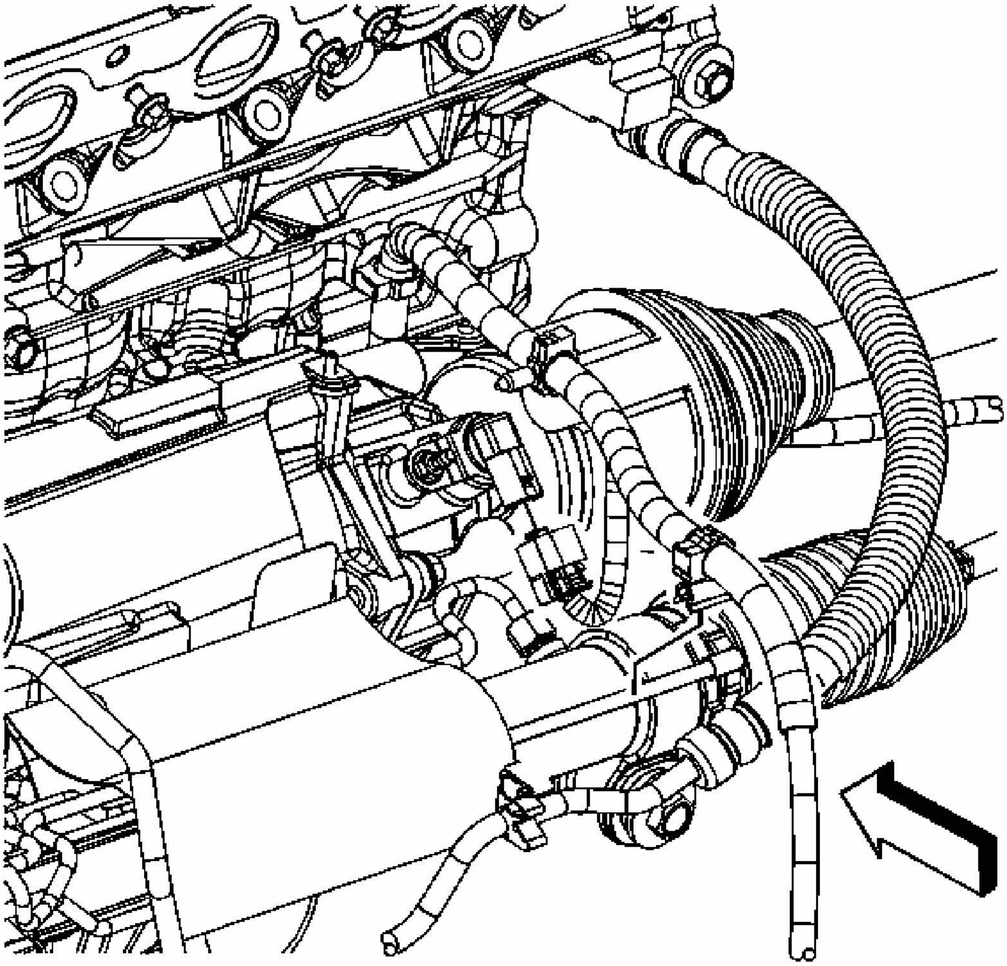


Fig. 268: Engine Wiring Harness Routing
Courtesy of GENERAL MOTORS CORP.

45. Disconnect the engine harness electrical connector from the VSS.
46. Set all branches of the engine wiring harness on top of the engine.

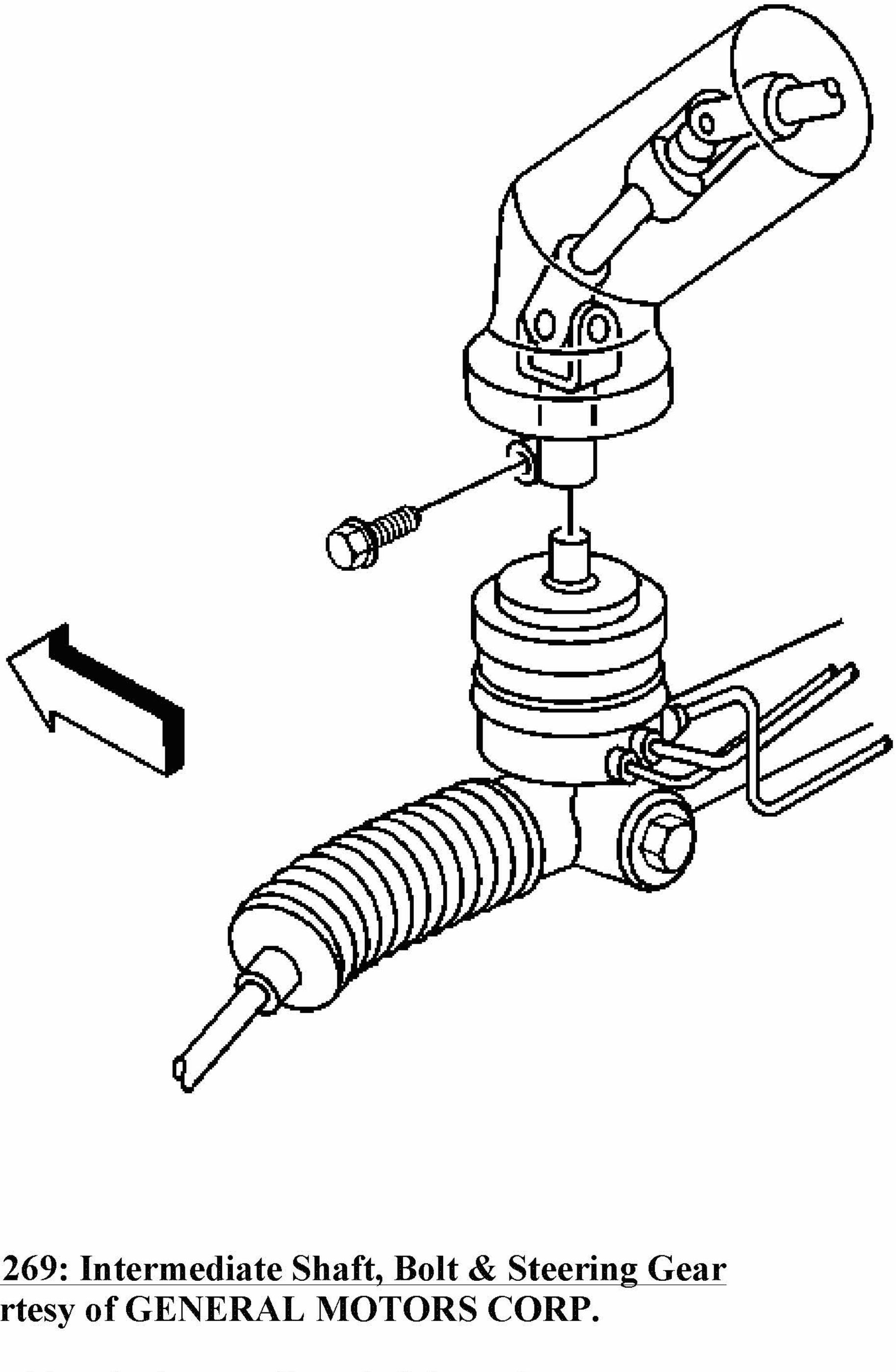


Fig. 269: Intermediate Shaft, Bolt & Steering Gear
Courtesy of GENERAL MOTORS CORP.

47. Reposition the intermediate shaft lower boot.
48. Remove the intermediate shaft to steering gear bolt.
49. Separate the intermediate shaft from the steering gear.
50. Disconnect both front wheel speed sensors. Refer to **Wheel Bearing/Hub Replacement - Front** .
51. Unclip the ABS wire harness from the lower control arm.

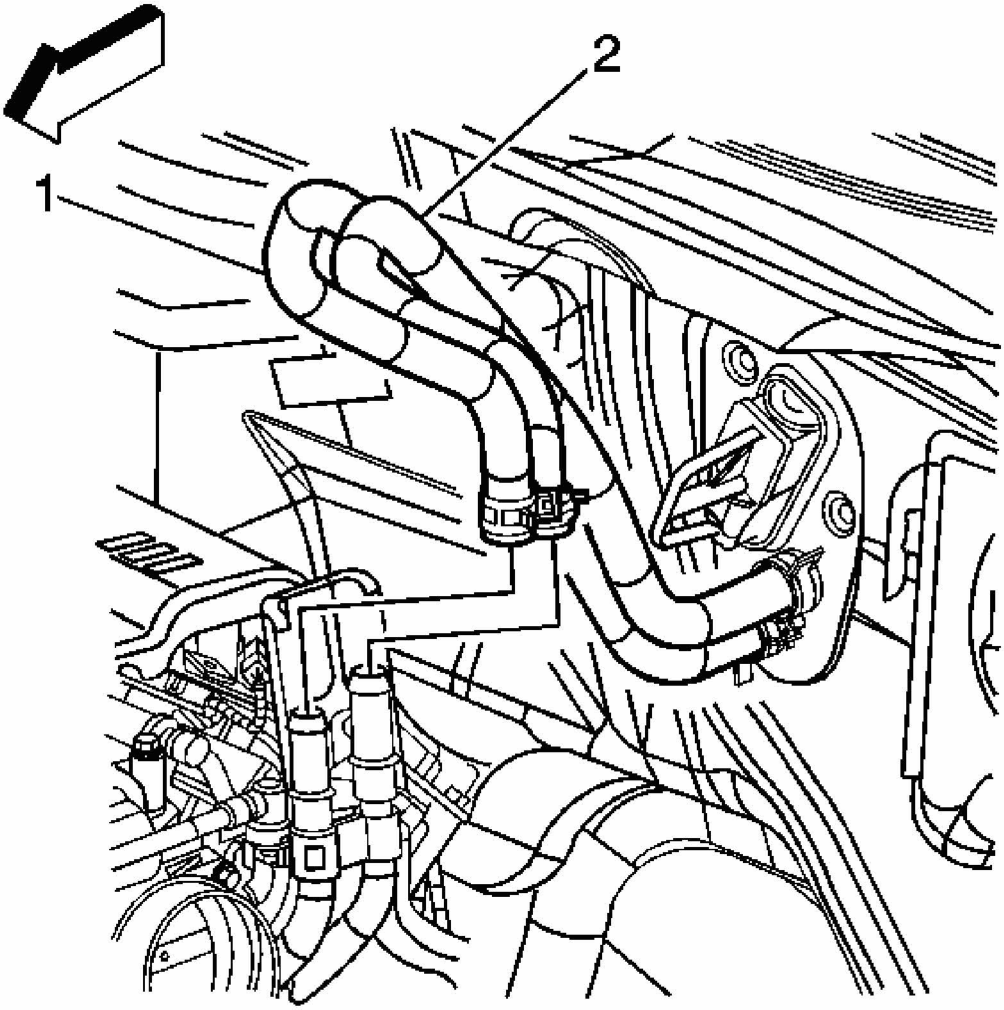


Fig. 270: Heater Inlet & Outlet Hoses
Courtesy of GENERAL MOTORS CORP.

52. Using the **J 38185** reposition the heater inlet and outlet hose clamps. See **Special Tools**.
53. Remove the heater inlet (2) and outlet (1) hoses from the heater inlet/outlet pipe.
54. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
55. Disconnect the stabilizer links from the stabilizer shaft.
56. Disconnect the ball joints from the steering knuckles. Refer to **Lower Ball Joint Replacement** .
57. Disconnect the power steering pressure hose from the steering gear.
58. Disconnect the power steering pressure line clips from the frame.

59. Disconnect the outer tie rod ends from the steering knuckles. Refer to **Rack and Pinion Outer Tie Rod End Replacement** .

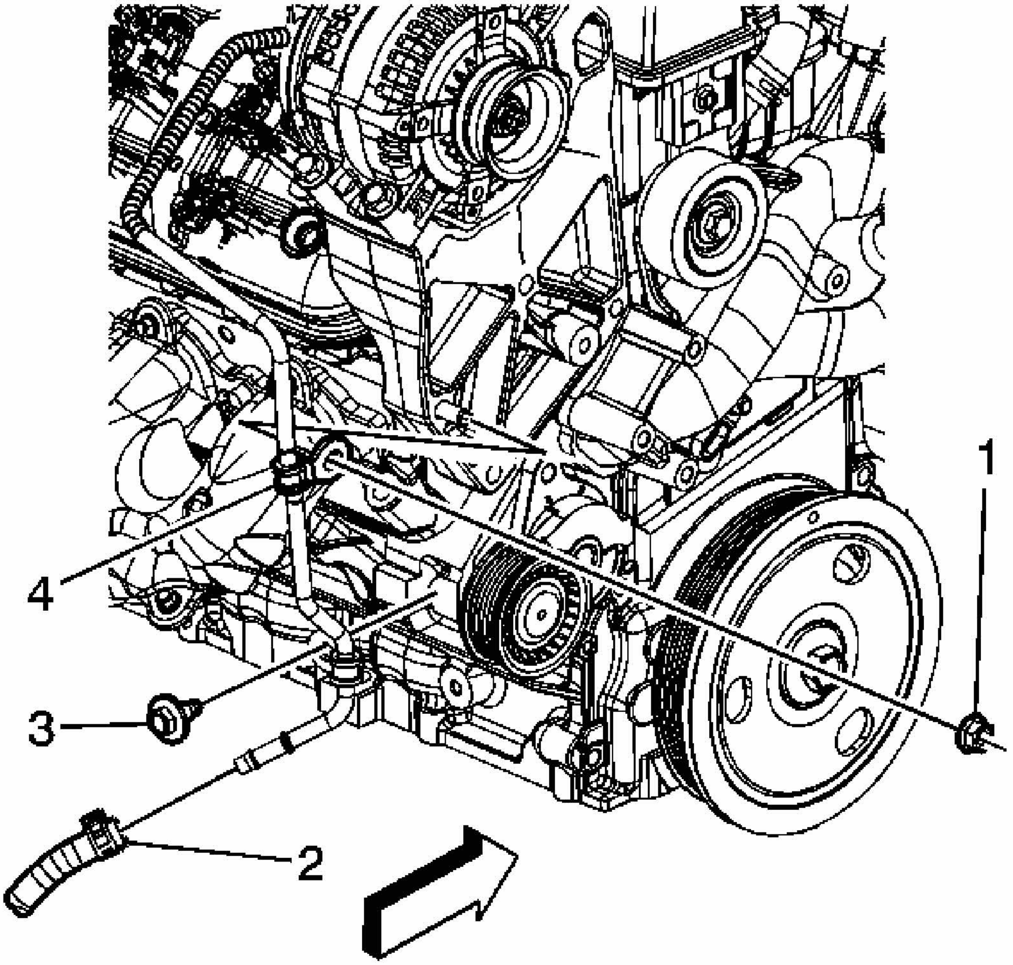


Fig. 271: View Of Power Steering Hose & Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

60. Loosen the power steering hose clamp at the inlet pipe.
61. Remove the power steering hose (2) from the inlet pipe.
62. Remove the left and right wheel drive shafts from the transaxle. Refer to **Wheel Drive Shaft Replacement** .
63. Support the wheel drive shafts using mechanic's wire.

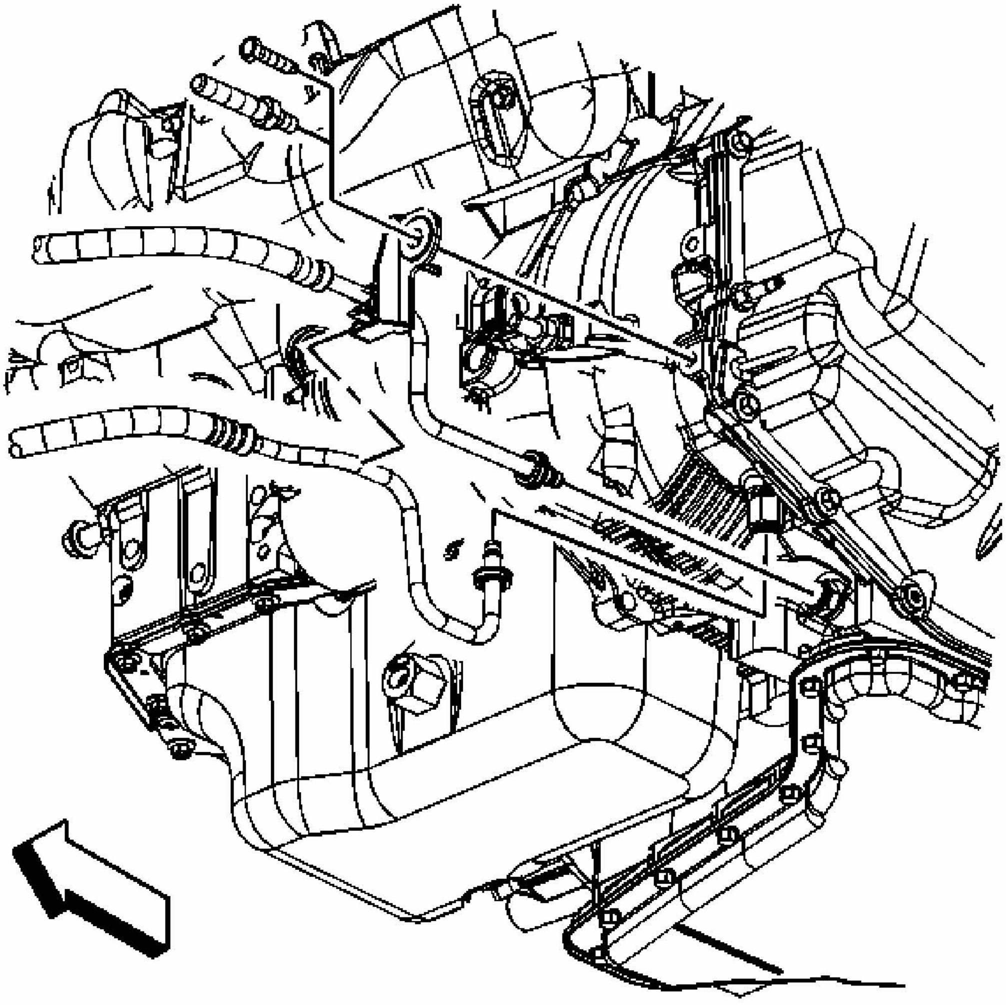


Fig. 272: View Of Transaxle Oil Cooler Lines
Courtesy of GENERAL MOTORS CORP.

64. Remove the transaxle oil cooler line bracket bolt/stud.
65. Disconnect the transaxle oil cooler lines from the transaxle. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .

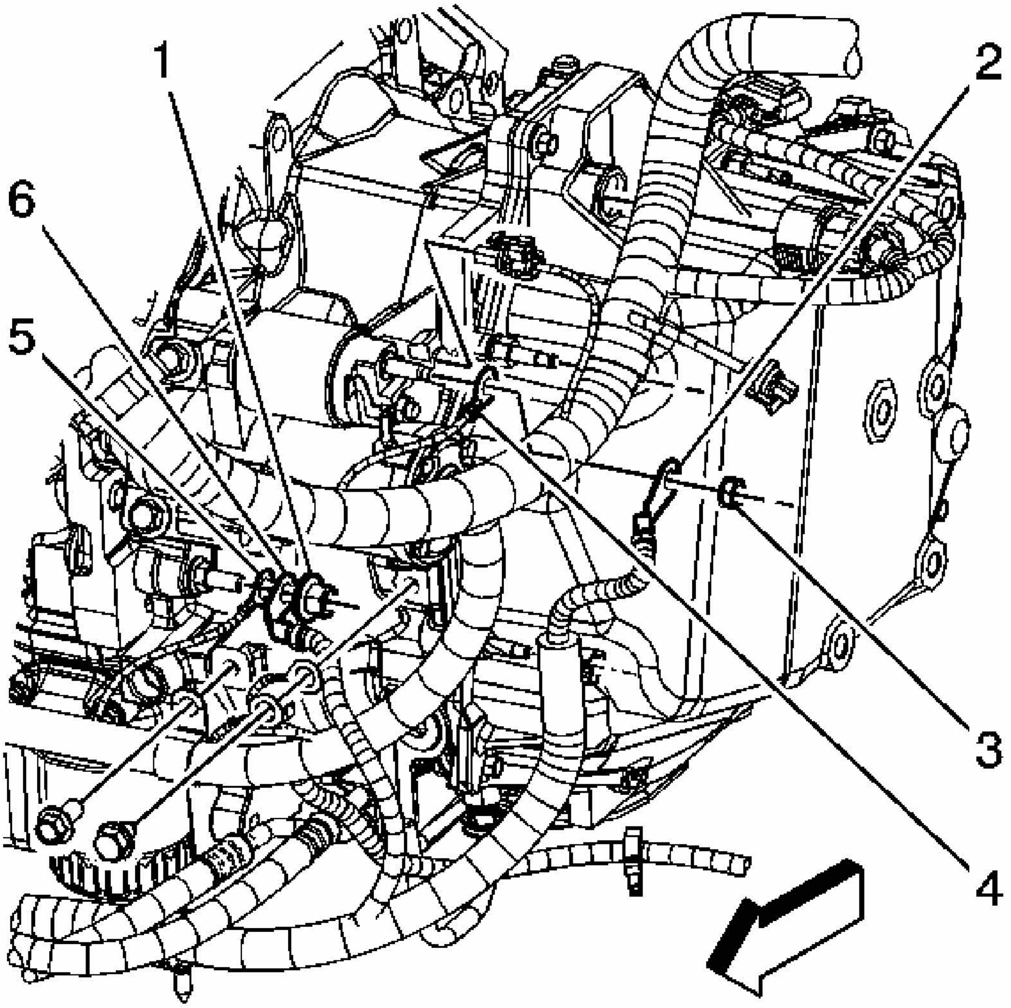


Fig. 273: Battery Positive & Negative Cables
Courtesy of GENERAL MOTORS CORP.

66. Remove the positive battery cable nut (3) from the starter.
67. Remove the cable terminal (2) from the starter.
68. Remove the battery cable ground nut (1).
69. Remove the cable ground terminal (6) from the stud.

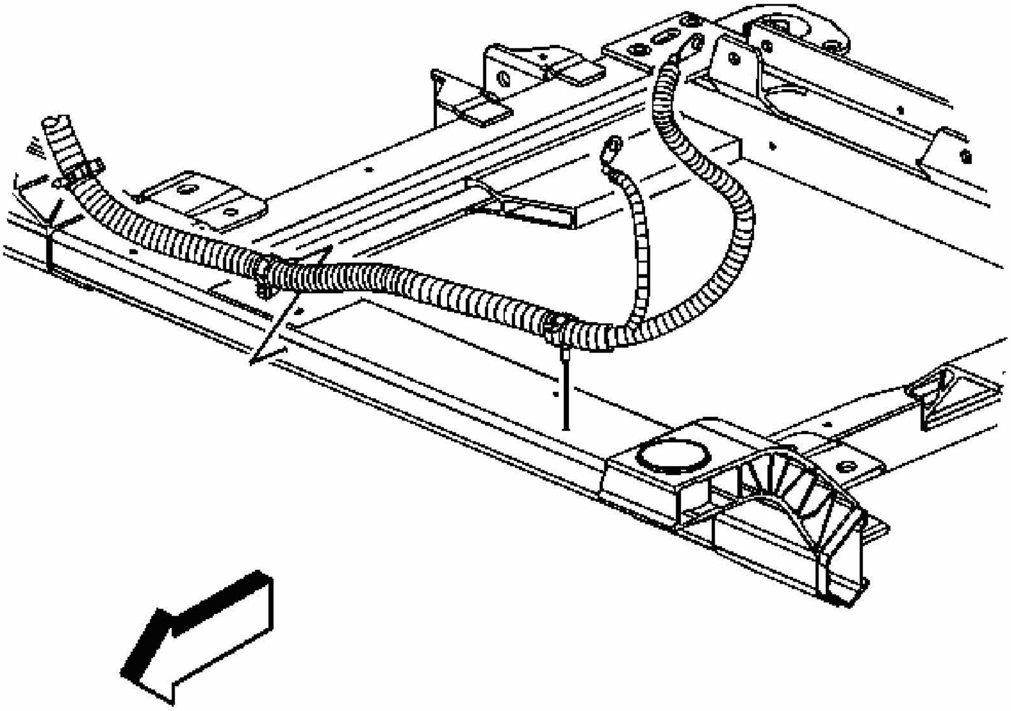


Fig. 274: Battery Cable Retainers
Courtesy of GENERAL MOTORS CORP.

70. Remove the battery cable retainers from the engine frame.
71. Disconnect the exhaust system. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)** .
72. Disconnect the O2 sensor harness pigtail.

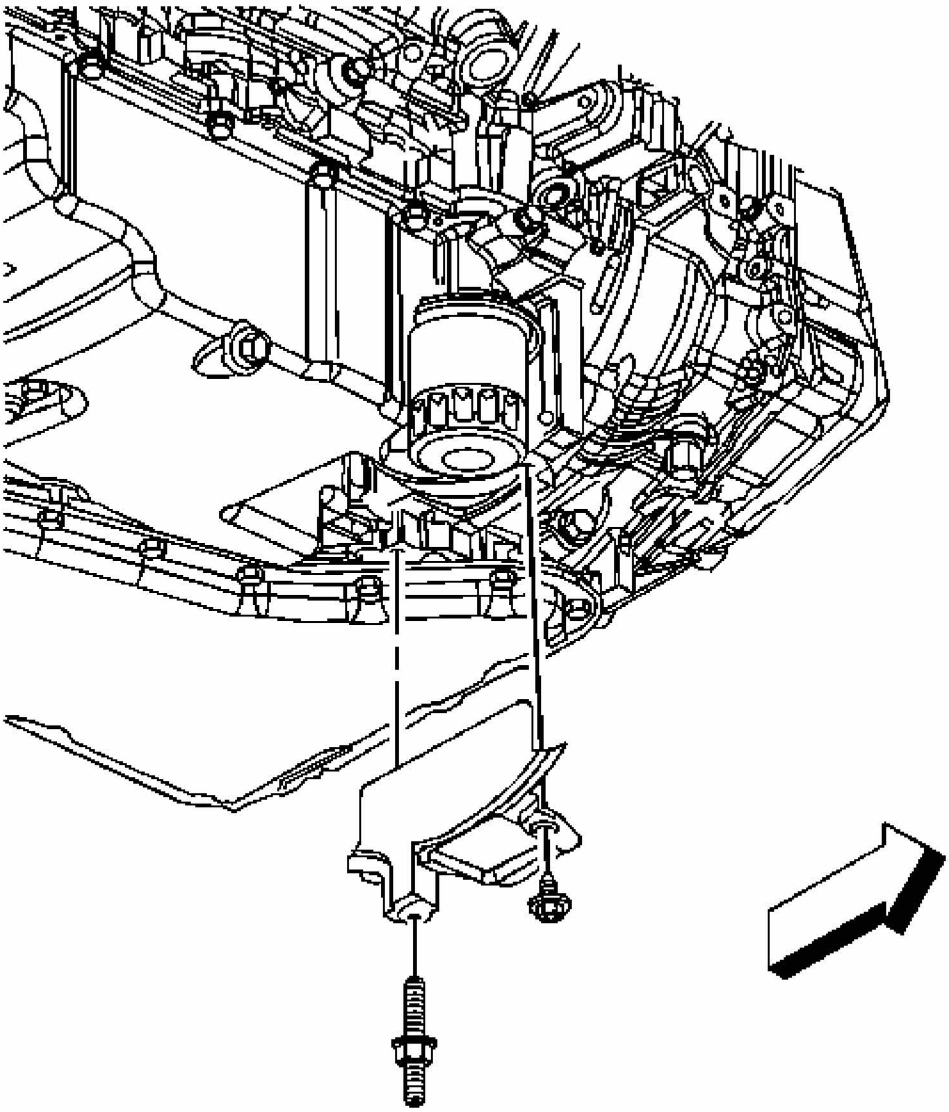


Fig. 275: View Of Transaxle Converter Cover & Bolt/Stud
Courtesy of GENERAL MOTORS CORP.

73. Remove the transaxle converter cover bolt/stud.
74. Remove the converter cover.

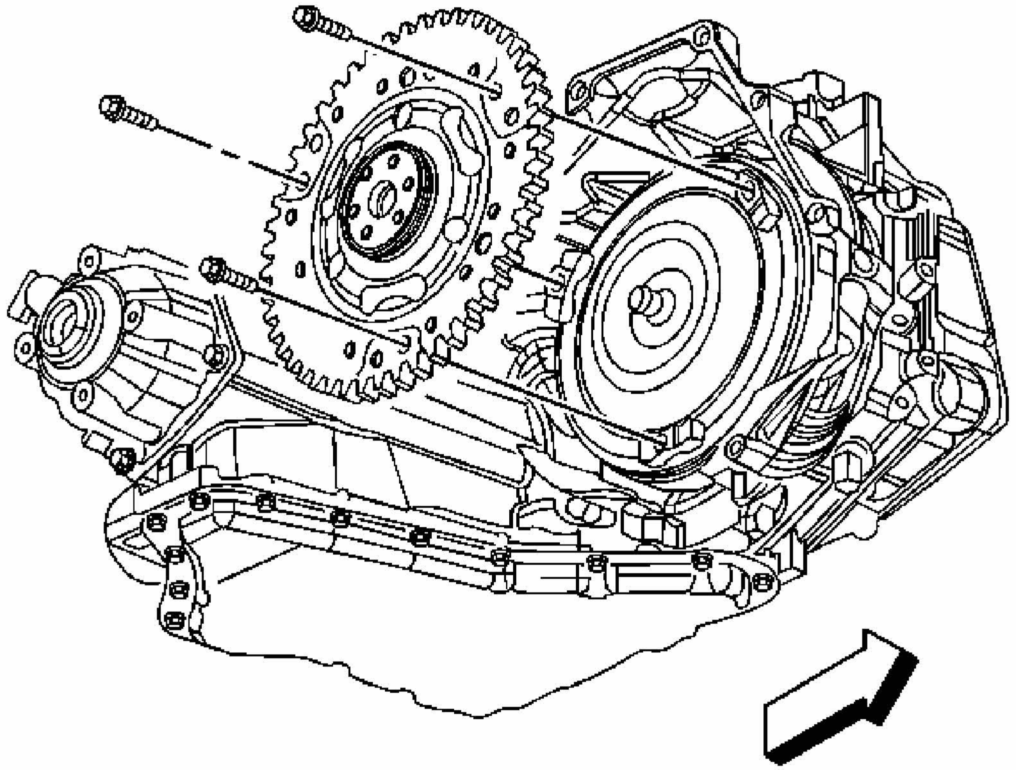


Fig. 276: View Of Flywheel Bolts
Courtesy of GENERAL MOTORS CORP.

75. Remove the flywheel bolts.
76. Remove the front air deflectors. Refer to **Radiator Air Baffle and Deflector Replacement - Lower** .

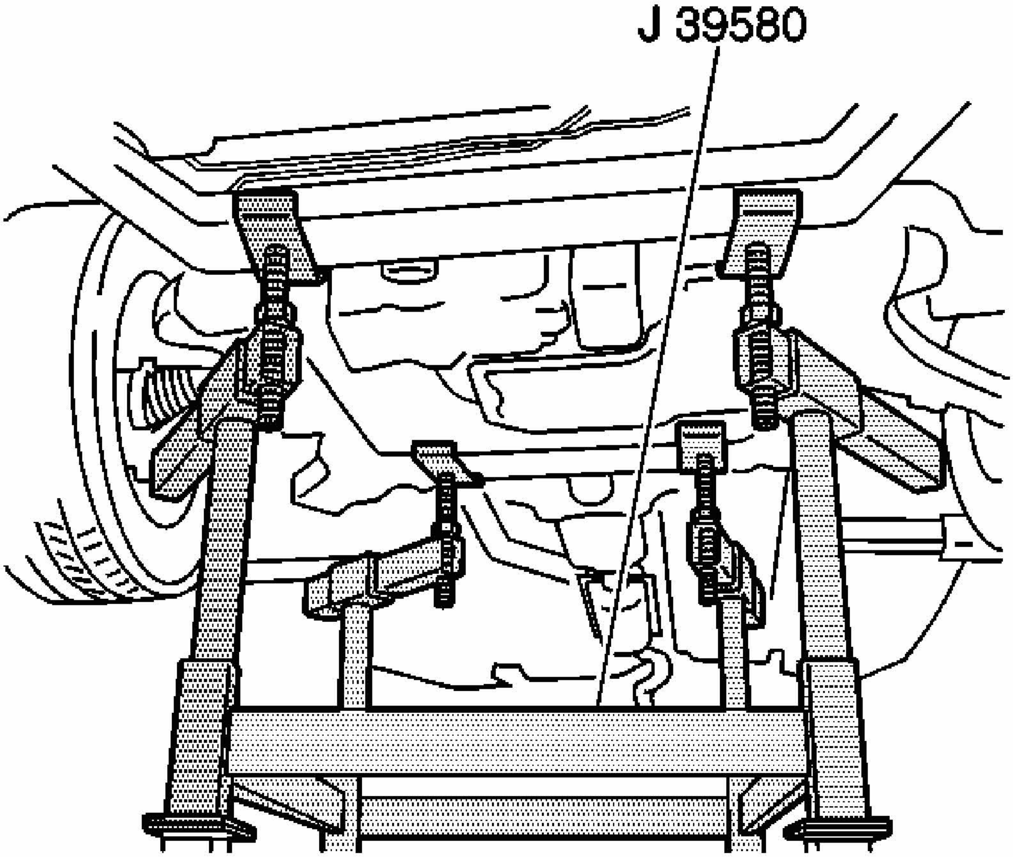


Fig. 277: Identifying Utility Stand
Courtesy of GENERAL MOTORS CORP.

77. Raise the vehicle enough to place **J 39580** under the engine, frame, and front suspension.
78. Support the rear of the vehicle with suitable jackstand.
79. Strap the front of the vehicle to the hoist.
80. Raise the **J 39580** , or lower the vehicle to preload the weight of the engine, frame, and front suspension.
81. Remove the radiator to frame brackets.

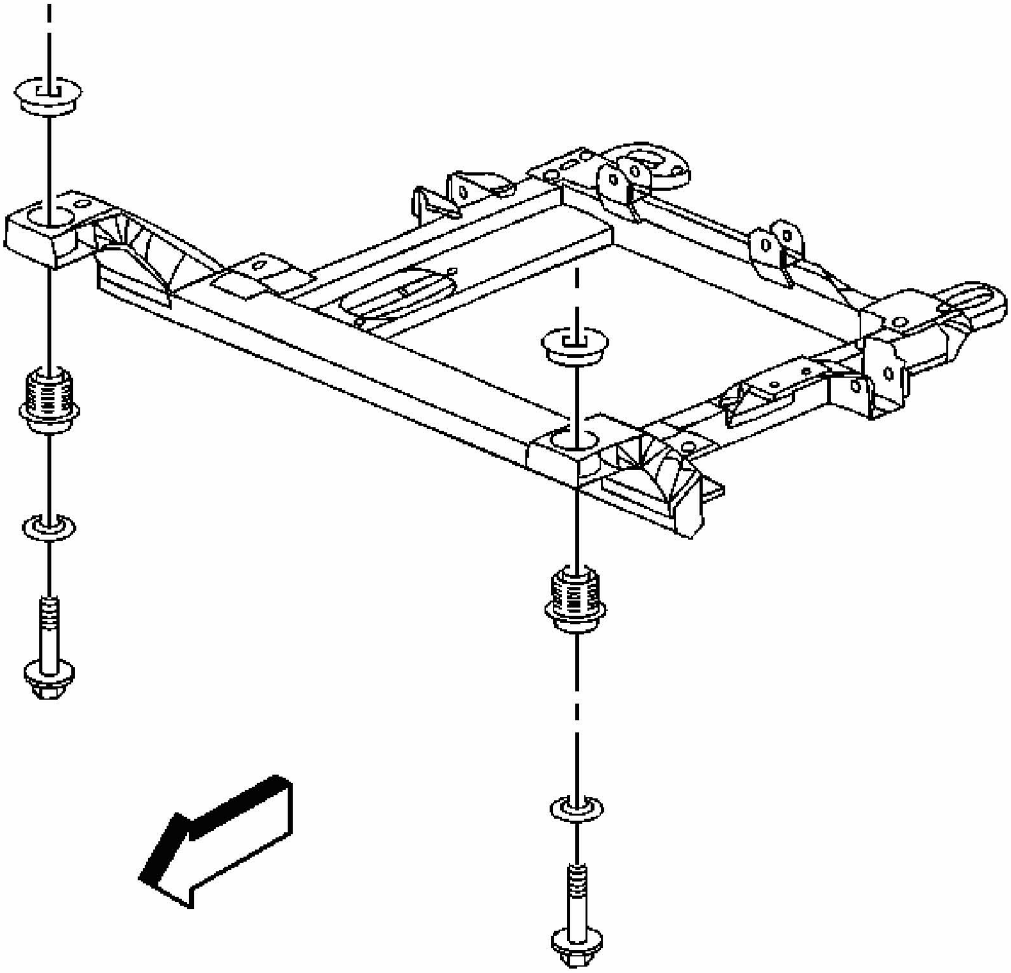


Fig. 278: View Of Engine Frame Front Bolts
Courtesy of GENERAL MOTORS CORP.

82. Remove the engine frame front bolts.

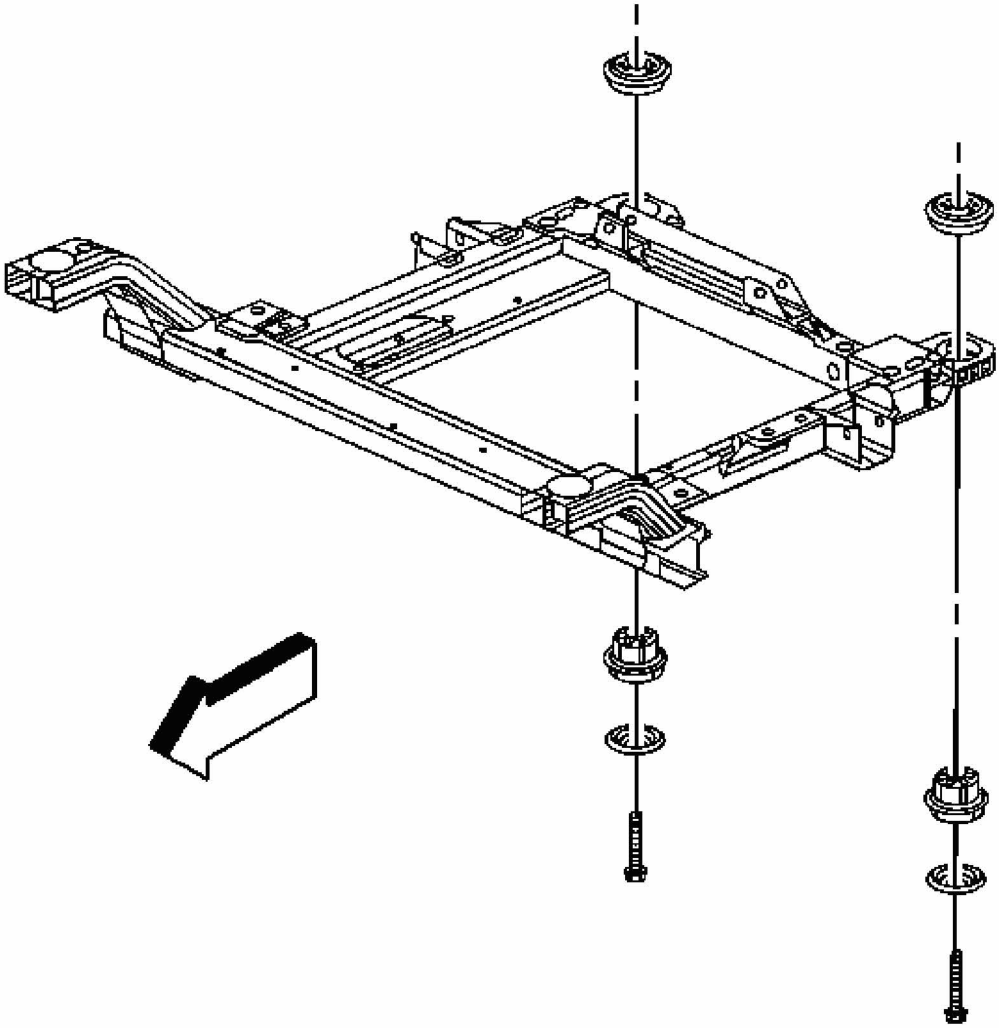


Fig. 279: View Of Engine Frame Rear Bolts
Courtesy of GENERAL MOTORS CORP.

83. Remove the engine frame rear bolts.
84. With the aid of an assistant, lower the **J 39580** and/or raise the vehicle to remove the engine and the frame from the vehicle.
85. Ensure that all hoses, wires, and pipes clear the vehicle during the removal process.
86. Use a suitable engine lift to support the engine.

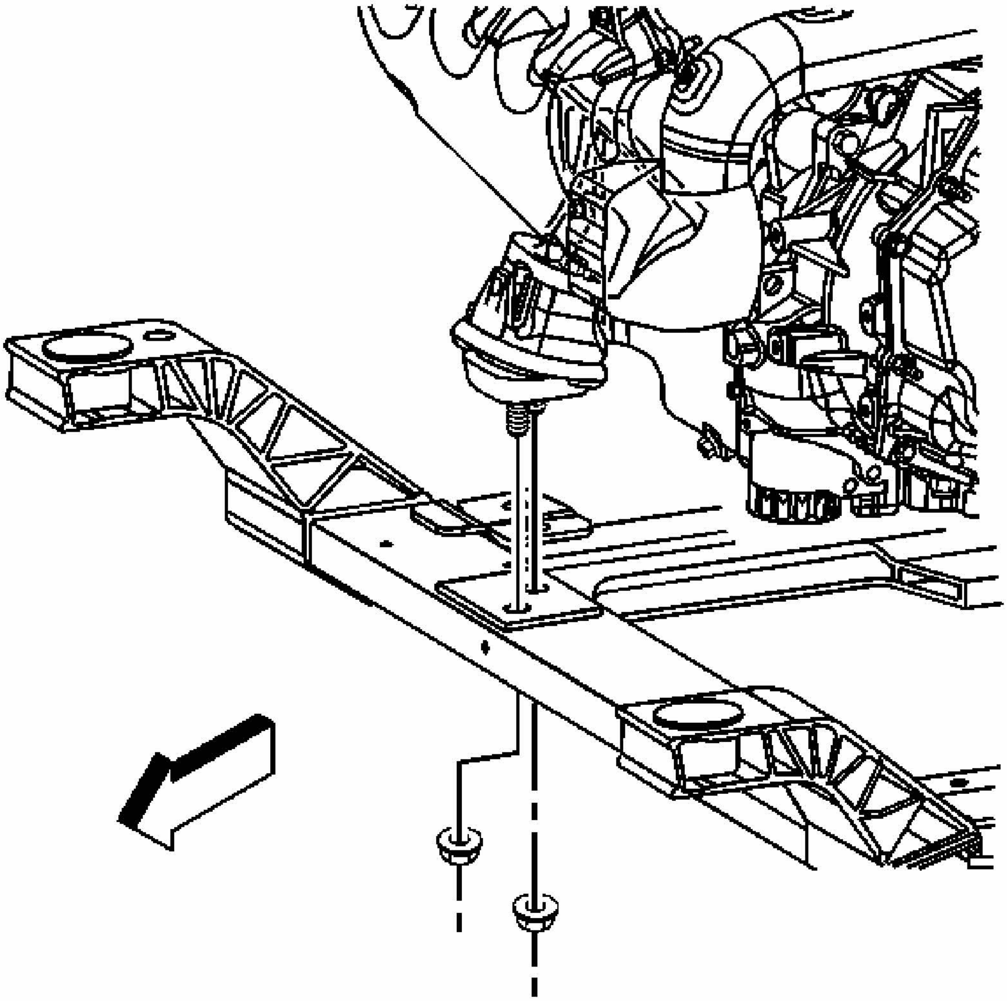


Fig. 280: View Of Lower Engine Mount
Courtesy of GENERAL MOTORS CORP.

87. Remove the front engine mount to frame nuts.

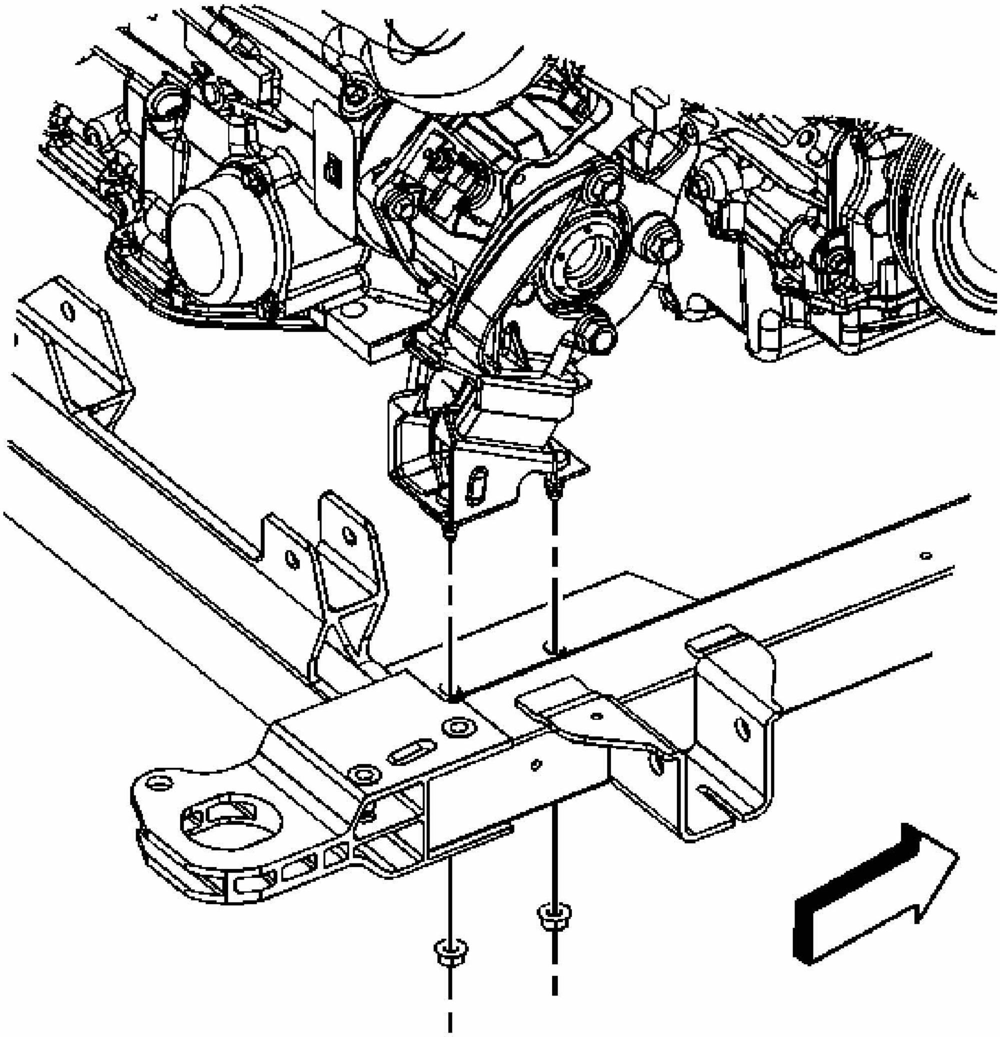


Fig. 281: View Of Engine Mount Bracket Nuts
Courtesy of GENERAL MOTORS CORP.

88. Remove the rear engine mount to frame nuts.

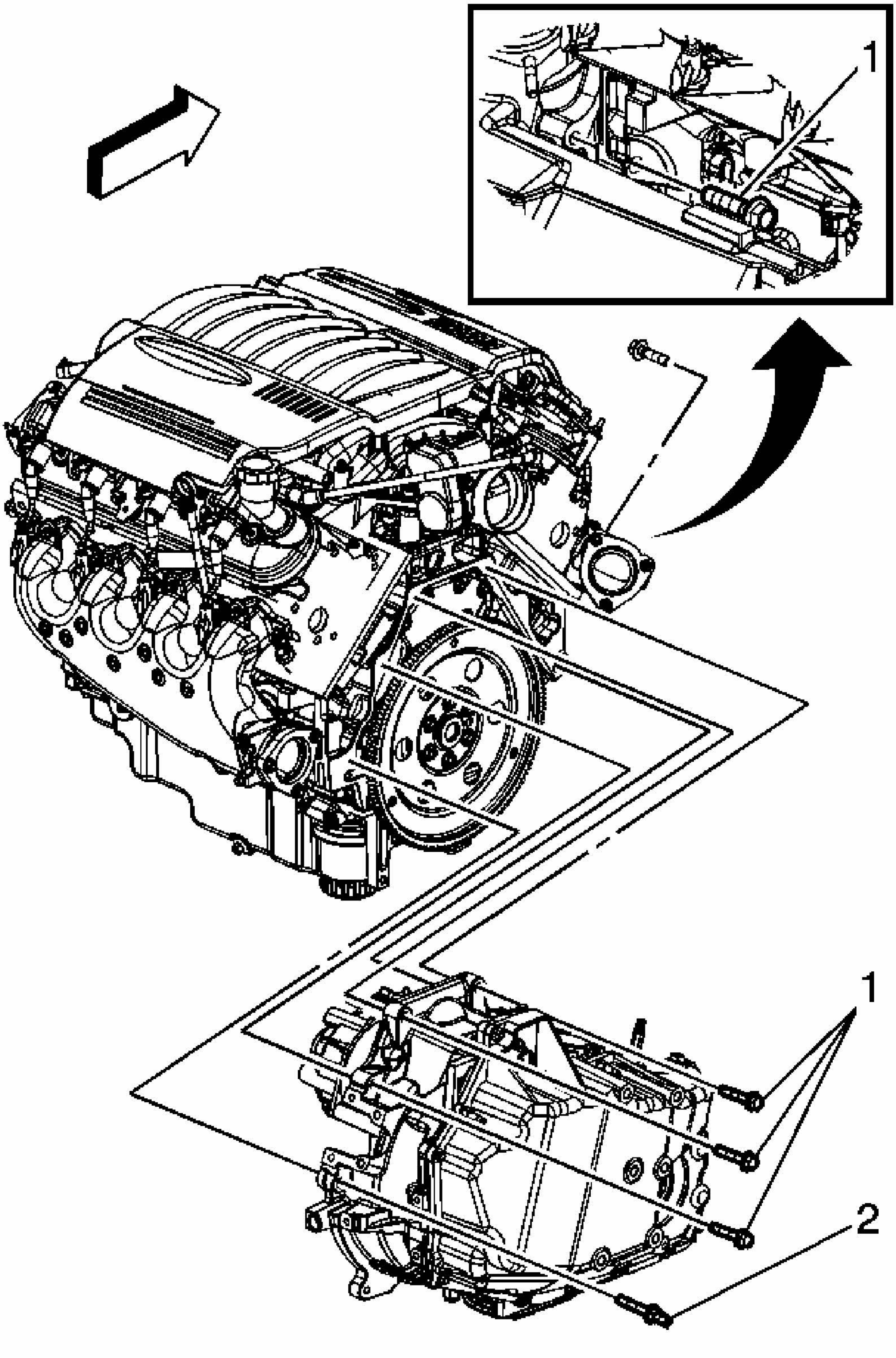


Fig. 282: View Of Transaxle To Engine Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

89. Remove the transaxle to engine bolts (1) and stud (2).
90. Separate the engine from the transaxle.
91. Using a suitable engine lift, remove the engine from the frame.
92. Install the engine onto a suitable engine stand.

Installation Procedure

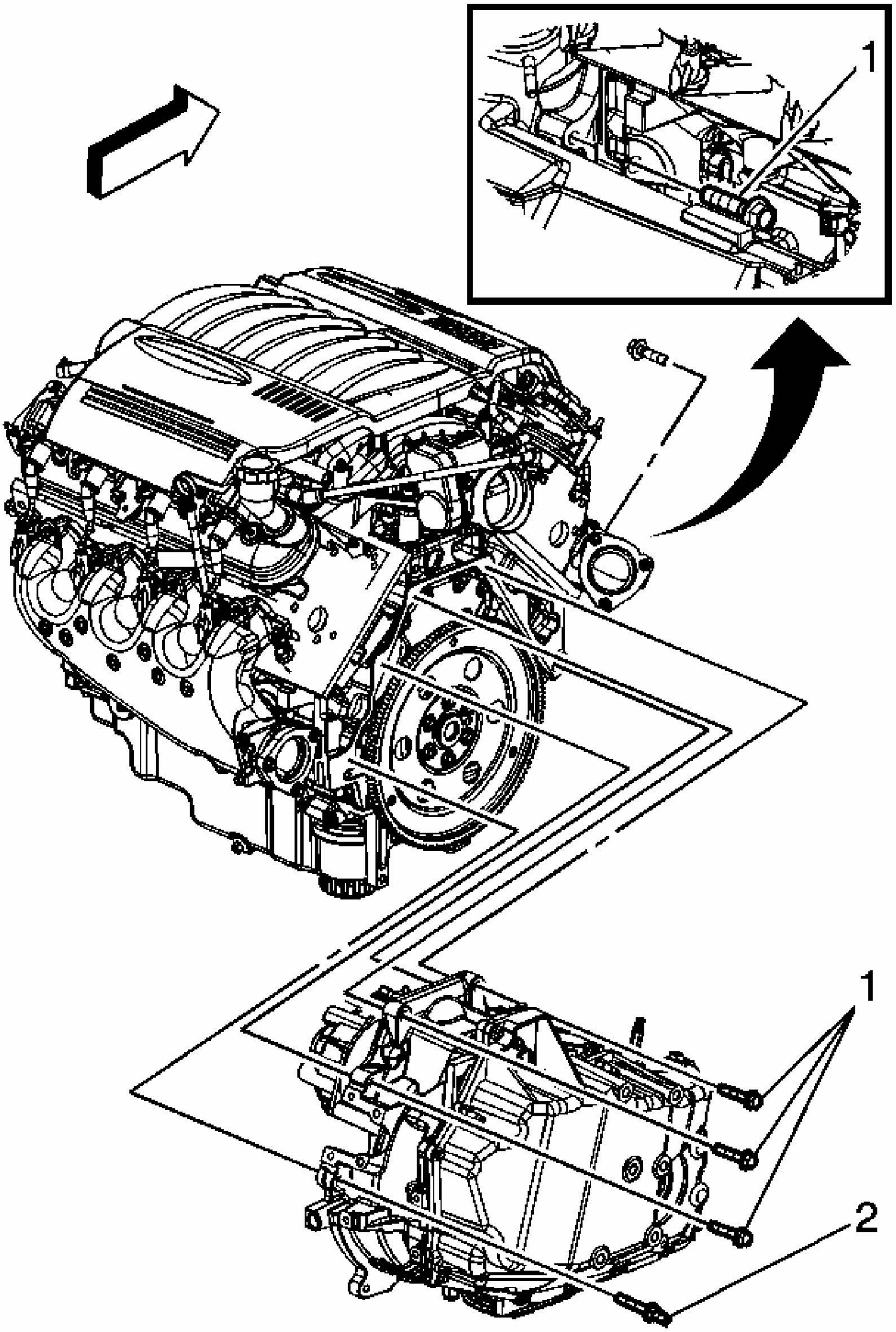


Fig. 283: View Of Transaxle To Engine Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

1. Using a suitable engine lift, remove the engine from the engine stand.
2. Position and install the engine to the frame and the transaxle.

NOTE: **Refer to Fastener Notice .**

3. Install the transaxle to engine bolts (1) and stud (2).

Tighten: Tighten the bolts/stud to 75 N.m (55 lb ft).

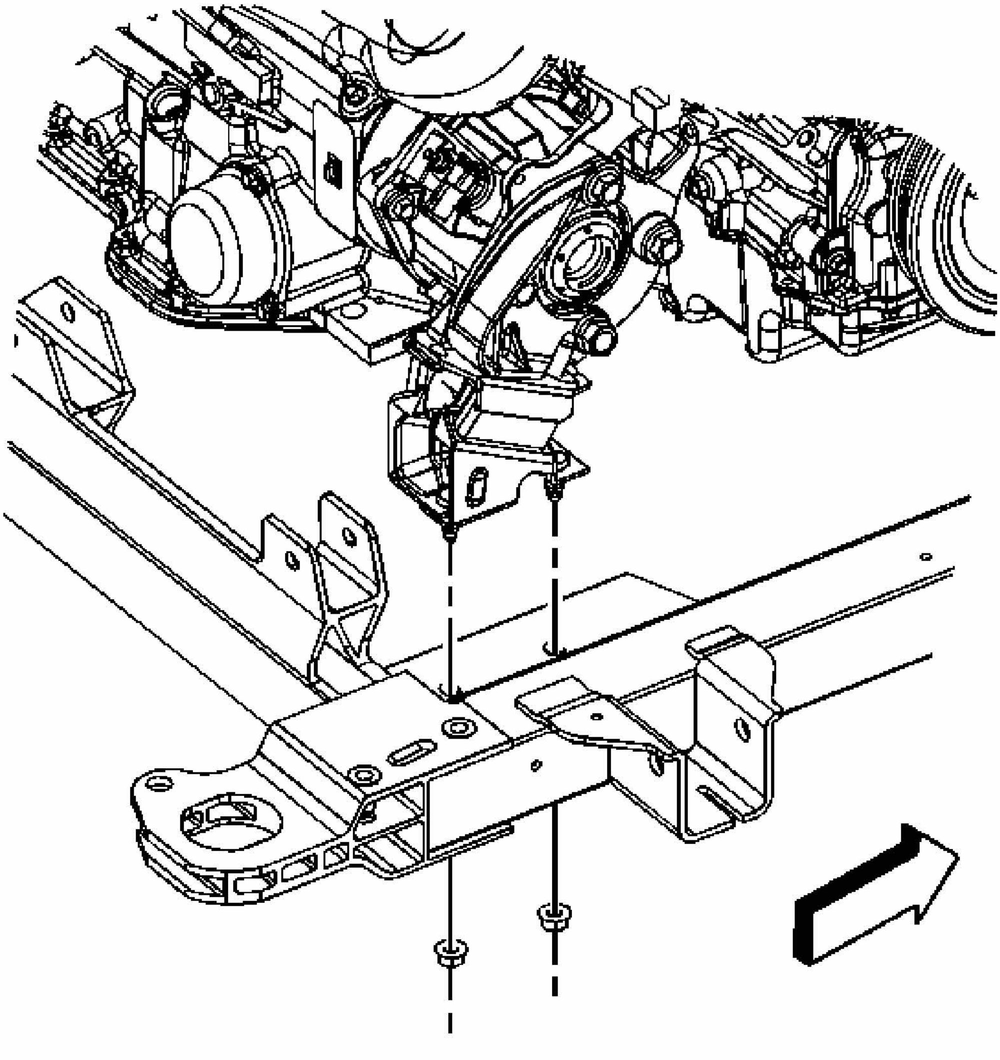


Fig. 284: View Of Engine Mount Bracket Nuts
Courtesy of GENERAL MOTORS CORP.

4. Install the rear engine mount to frame nuts.

   Tighten: Tighten the nuts to 50 N.m (37 lb ft).

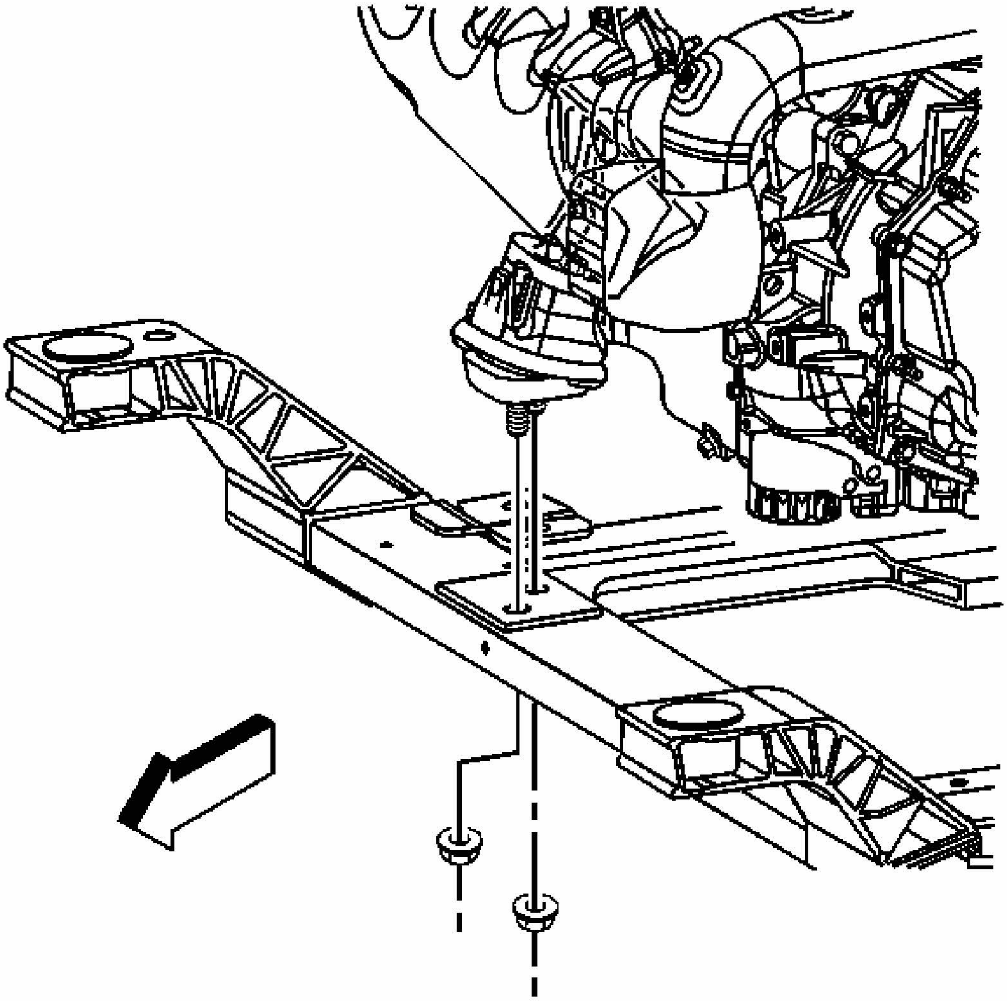


Fig. 285: View Of Lower Engine Mount
Courtesy of GENERAL MOTORS CORP.

5. Install the front engine mount to frame nuts.

   Tighten: Tighten the nuts to 50 N.m (37 lb ft).

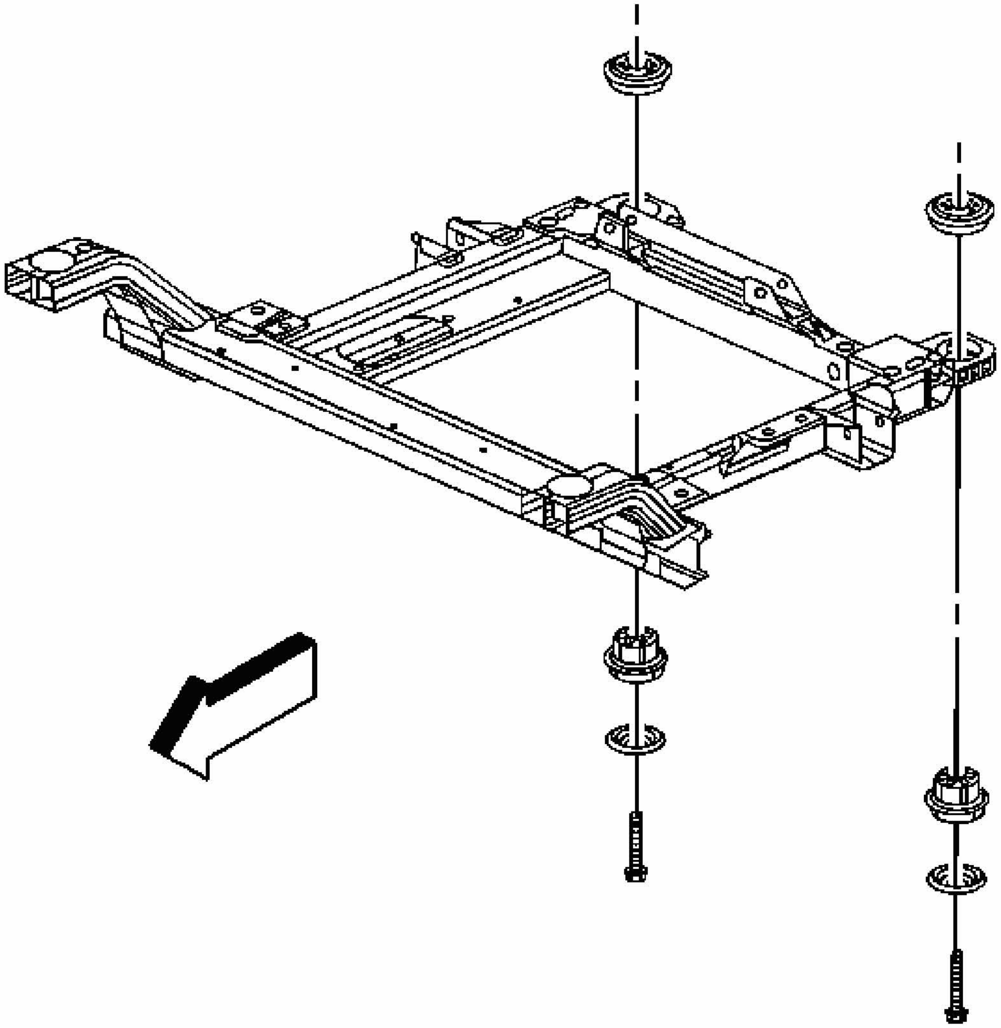


Fig. 286: View Of Engine Frame Rear Bolts
Courtesy of GENERAL MOTORS CORP.

6. Ensure that all hoses, wires, and pipes clear the vehicle during the installation process.
7. With the aid of an assistant, raise the **J 39580** and/or lower the vehicle to install the engine and frame to the vehicle.
8. Install the engine frame rear bolts.

   Tighten: Tighten the bolts to 160 N.m (118 lb ft).

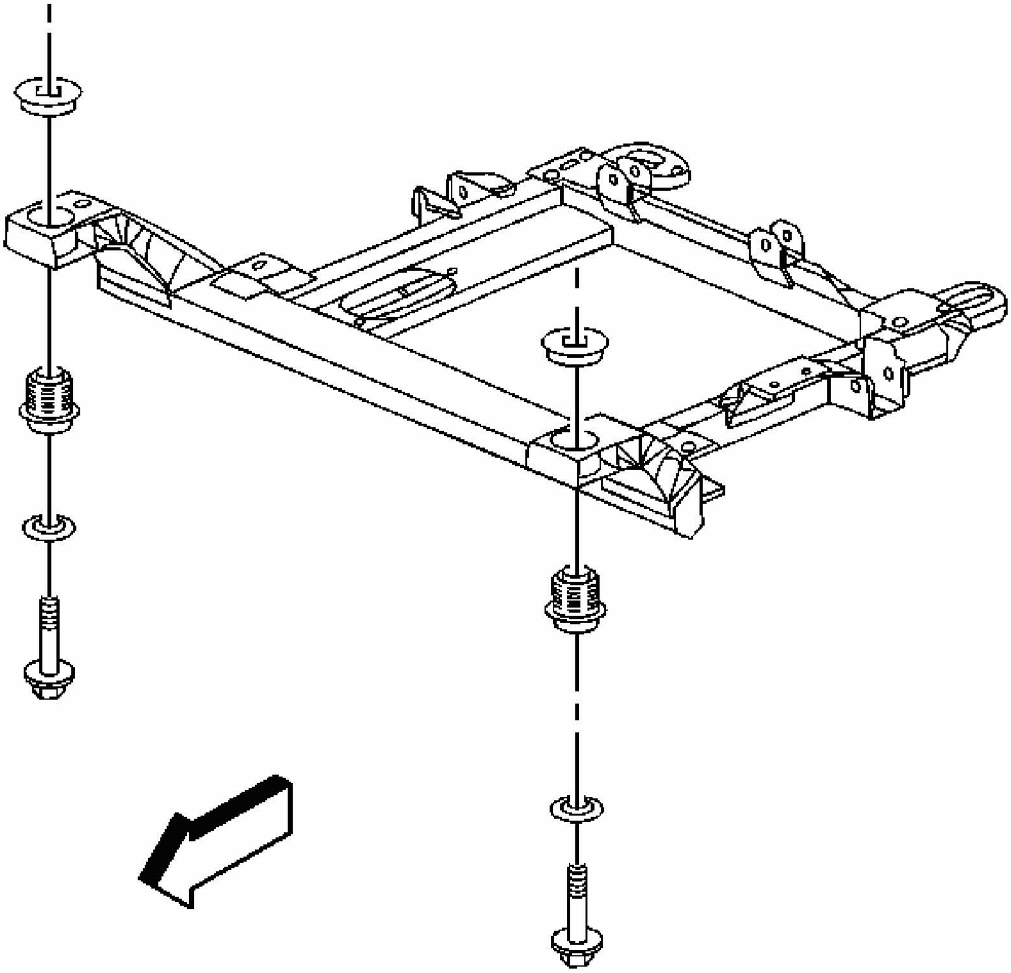


Fig. 287: View Of Engine Frame Front Bolts
Courtesy of GENERAL MOTORS CORP.

9. Install the engine frame front bolts.

   Tighten: Tighten the bolts to 145 N.m (107 lb ft).

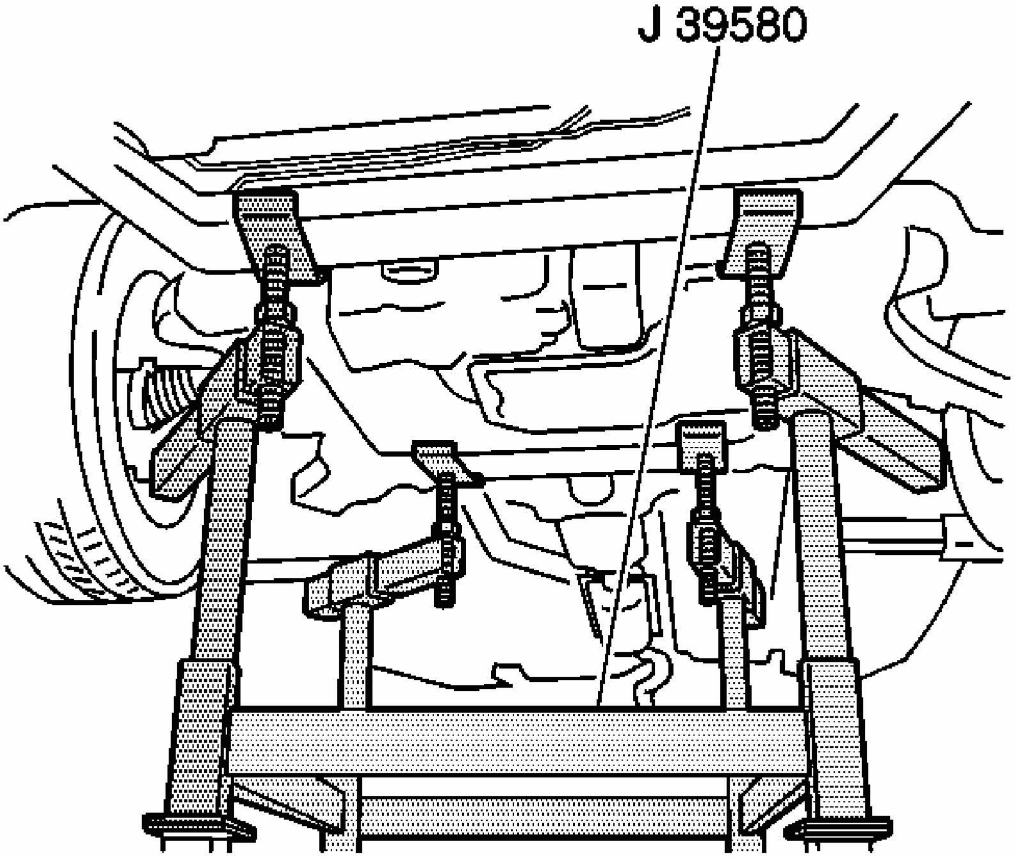


Fig. 288: Identifying Utility Stand
Courtesy of GENERAL MOTORS CORP.

10. Install radiator to front frame brackets.
11. Lower the **J 39580** , or raise the vehicle to preload the weight of the engine, frame, and front suspension.
12. Remove the support from under the rear of the vehicle.
13. Raise the vehicle enough to remove the **J 39580** from under the engine, frame, and front suspension.

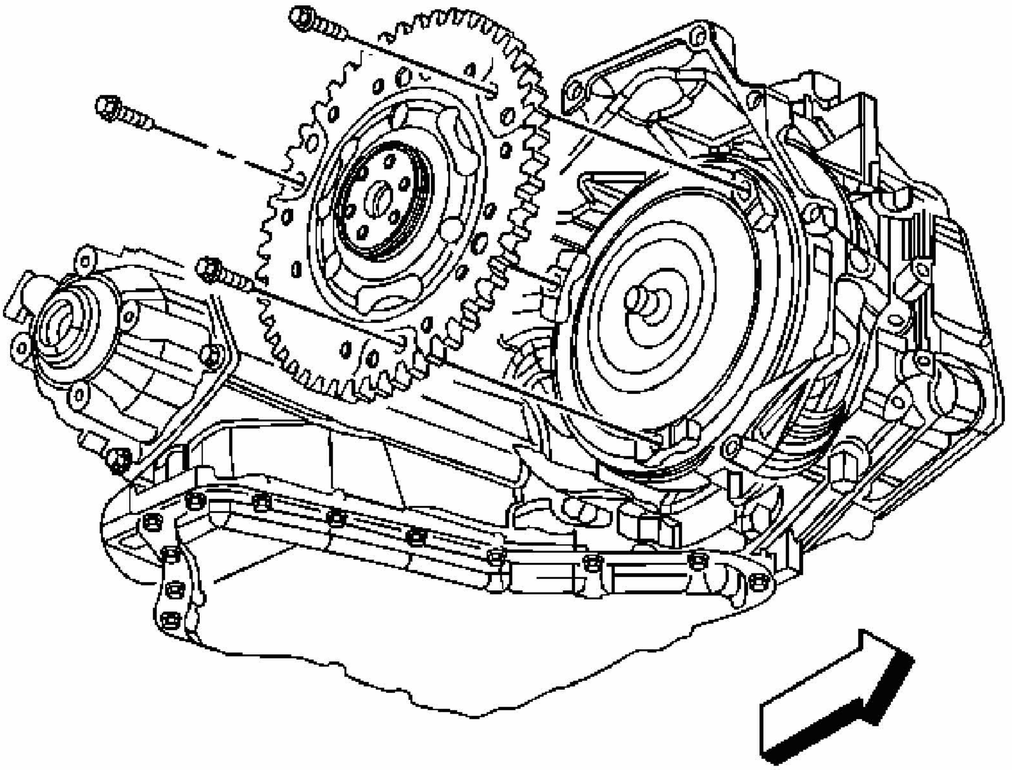


Fig. 289: View Of Flywheel Bolts
Courtesy of GENERAL MOTORS CORP.

14. Connect the exhaust system and connect the O2 sensor harness pigtail. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)** .
15. Install the flywheel bolts.

    Tighten: Tighten the bolts to 63 N.m (47 lb ft).

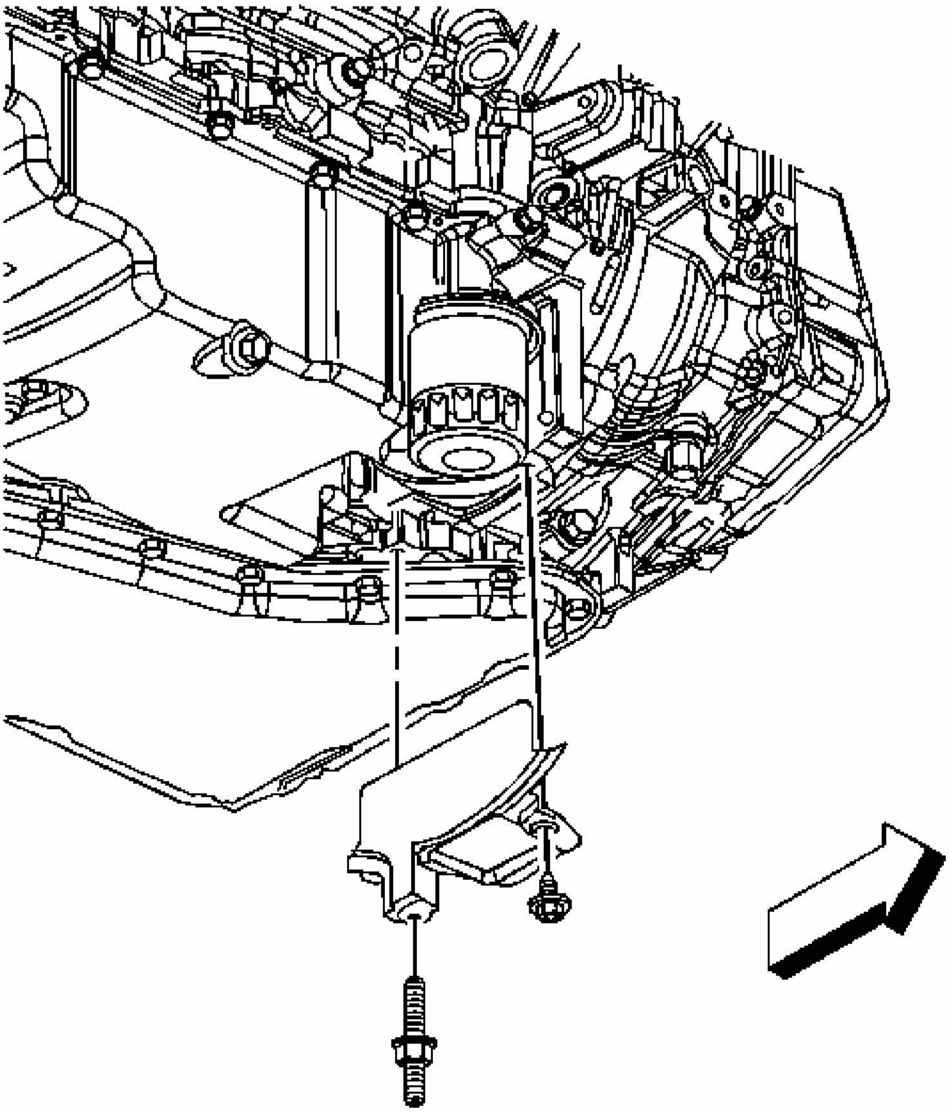


Fig. 290: View Of Transaxle Converter Cover & Bolt/Stud
Courtesy of GENERAL MOTORS CORP.

16. Install the converter cover.
17. Install the transaxle converter cover bolt/stud.

    Tighten: Tighten the bolt/stud to 10 N.m (89 lb in).

18. Install the left and right wheel drive shafts into the transaxle. Refer to **Wheel Drive Shaft Replacement** .

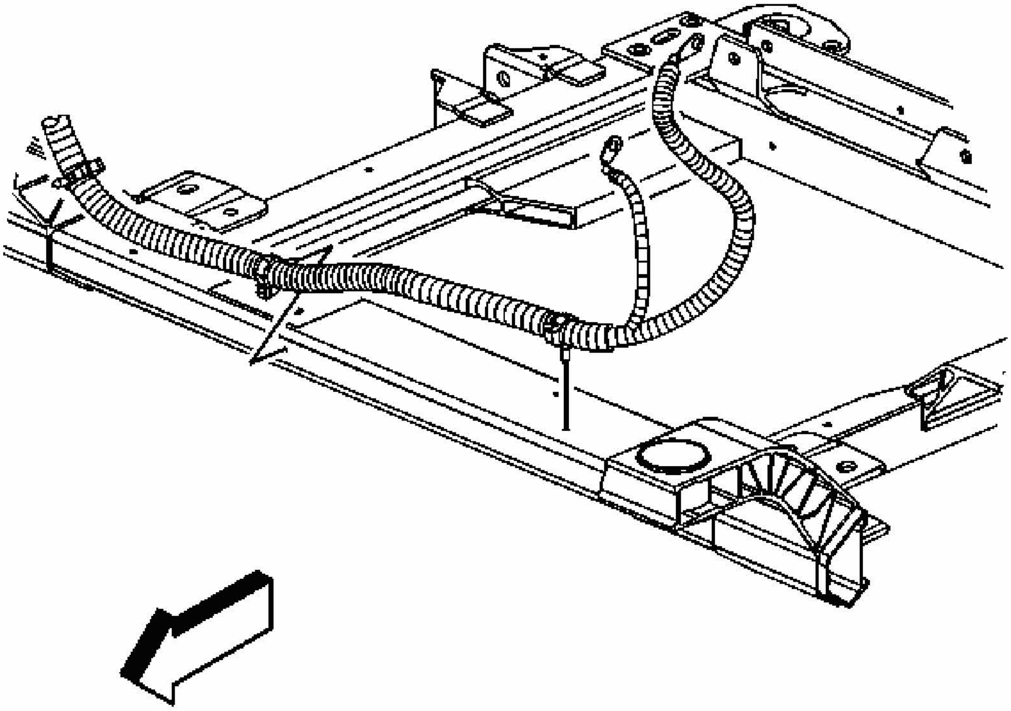


Fig. 291: Battery Cable Retainers
Courtesy of GENERAL MOTORS CORP.

19. Install the battery cable retainers to the engine frame.
20. Install the front air deflector. Refer to **Radiator Air Baffle and Deflector Replacement - Lower** .

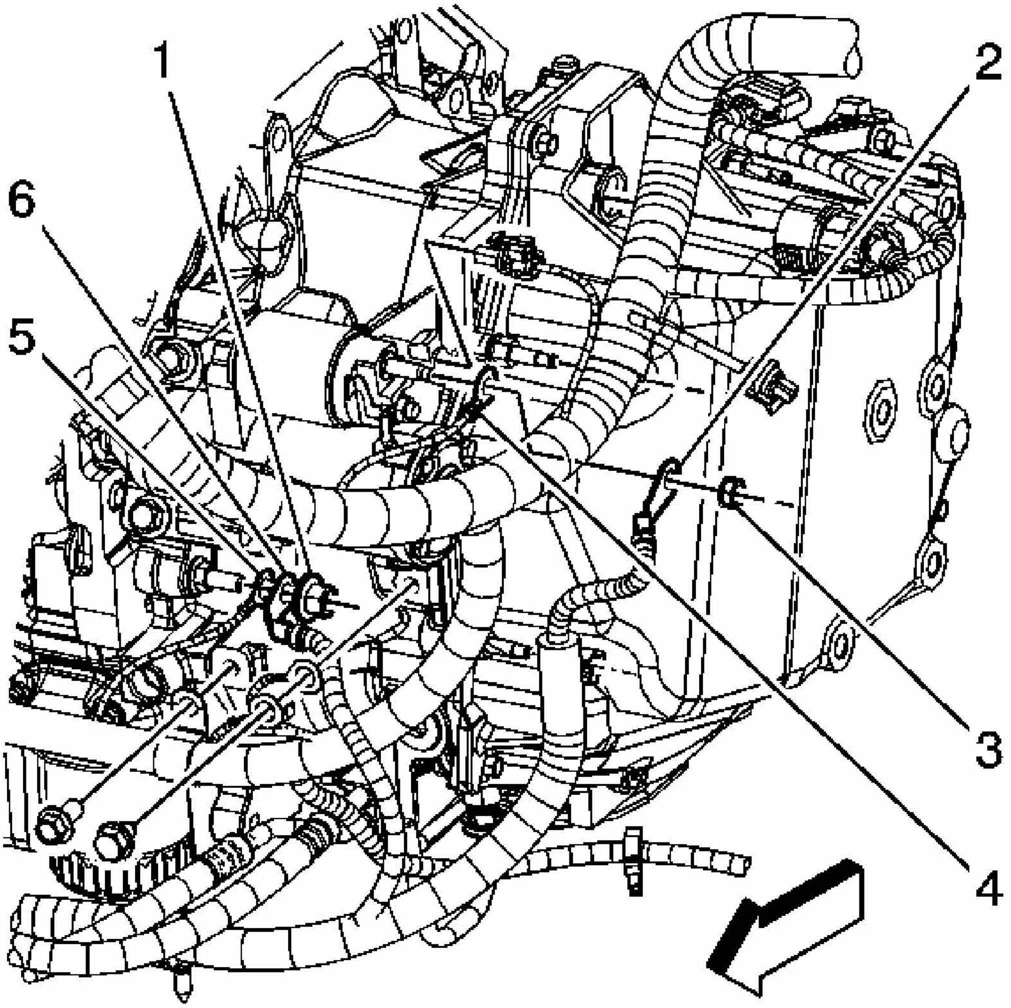


Fig. 292: Battery Positive & Negative Cables
Courtesy of GENERAL MOTORS CORP.

21. Install the cable ground terminal (6) to the stud.
22. Install the battery cable ground nut (1).

    Tighten: Tighten the nut to 30 N.m (22 lb ft).

23. Install the cable terminal (2) to the starter.
24. Install the positive battery cable nut (3) to the starter.

    Tighten: Tighten the nut to 10 N.m (89 lb in).

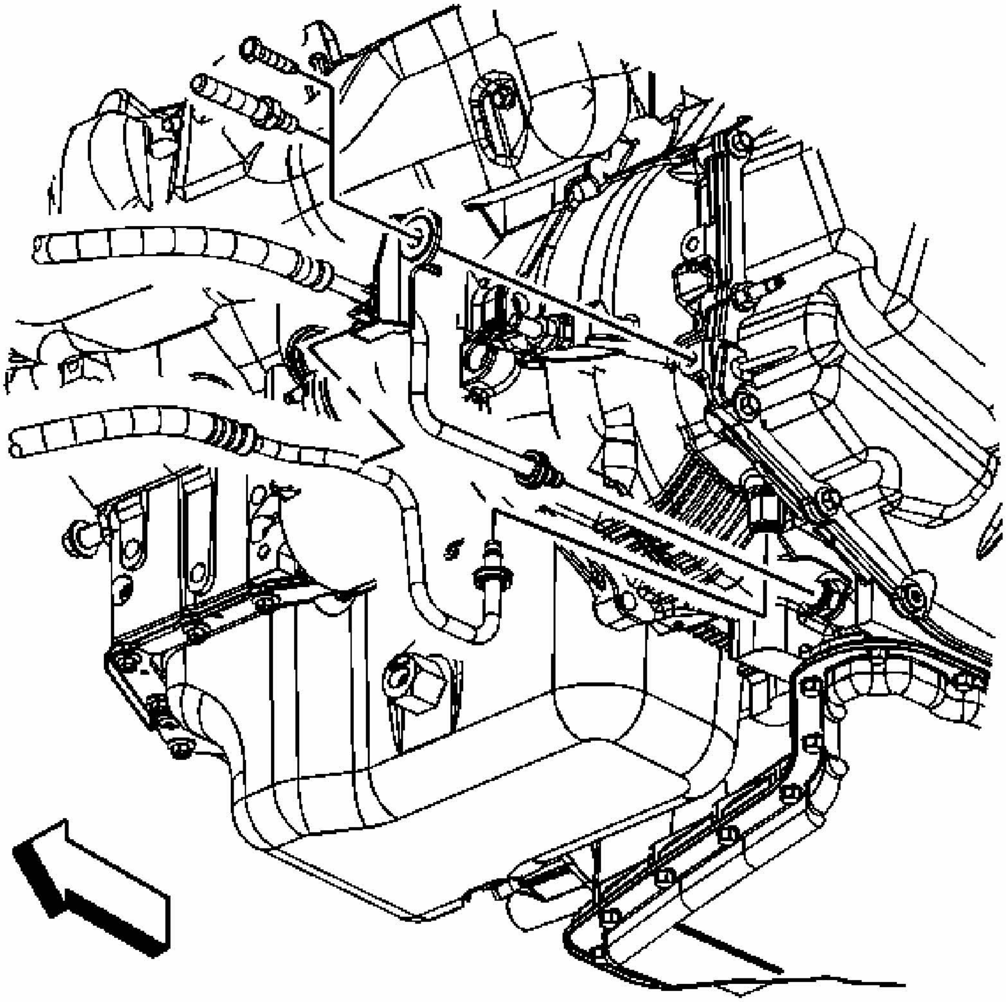


Fig. 293: View Of Transaxle Oil Cooler Lines
Courtesy of GENERAL MOTORS CORP.

25. Connect the transaxle oil cooler lines to the transaxle. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .
26. Install the transaxle oil cooler line bracket bolt/stud.

    Tighten: Tighten the bolt/stud to 25 N.m (18 lb ft).

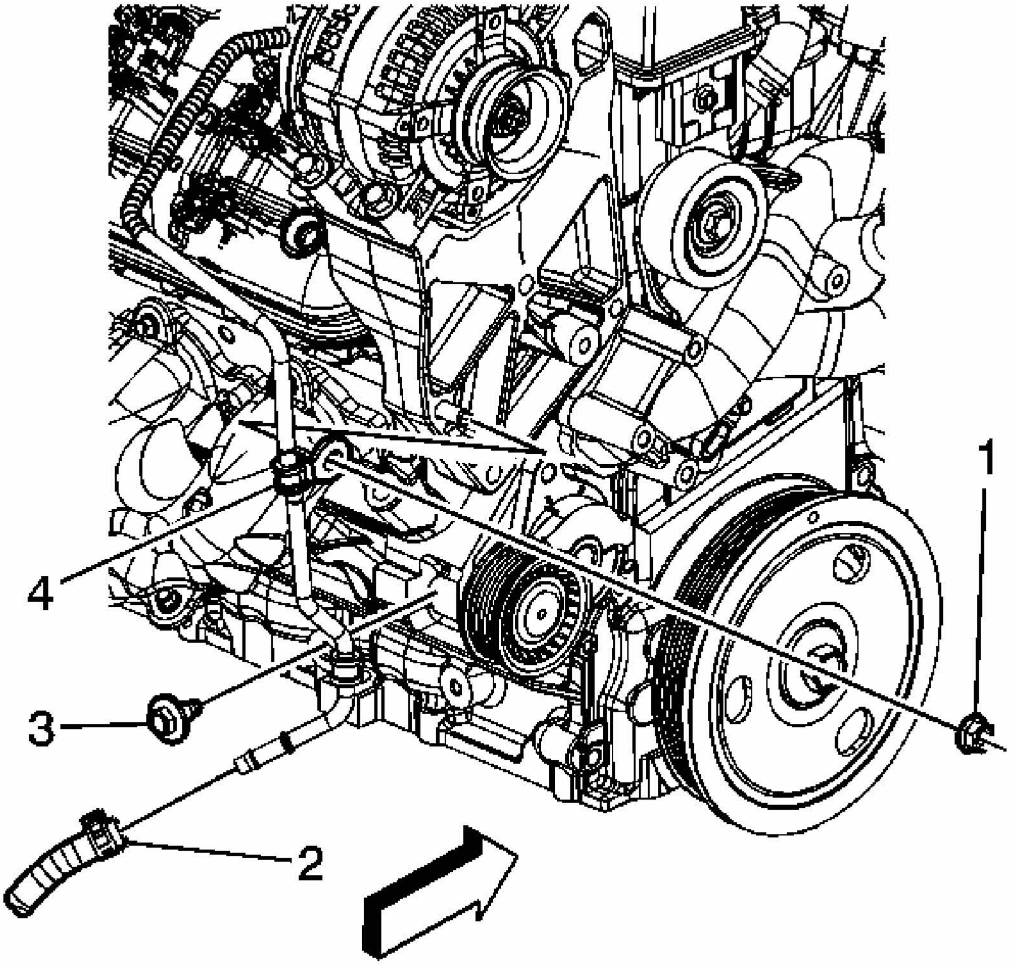


Fig. 294: View Of Power Steering Hose & Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

27. Install the power steering hose (2) to the inlet pipe.
28. Tighten the power steering hose clamp at the inlet pipe.

    Tighten: Tighten the clamp to 6 N.m (53 lb in).

29. Connect the power steering pipe to the steering gear. Refer to **Power Steering Pressure Pipe/Hose Replacement (LS4)** or **Power Steering Pressure Pipe/Hose Replacement (LZ4/LZE/LZ9)** .
30. Connect the power steering pipe to the frame clips.
31. Lower the vehicle.

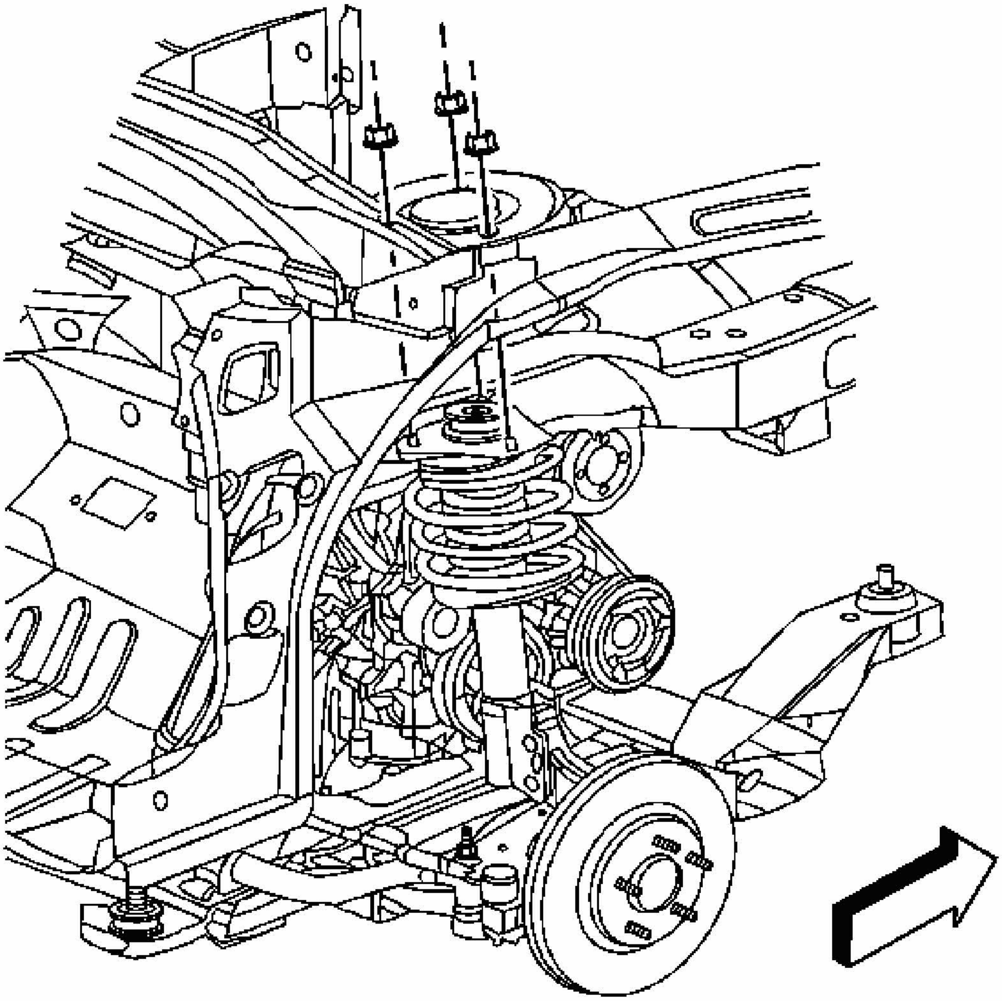


Fig. 295: View Of Upper Strut Nuts
Courtesy of GENERAL MOTORS CORP.

32. Position and install the ball joint nuts. Refer to **Lower Ball Joint Replacement** .
33. Install the sway links to the stabilizer shaft. Refer to **Stabilizer Shaft Link Replacement** .
34. Install the tie rod ends to the steering knuckles. Refer to **Rack and Pinion Outer Tie Rod End Replacement** .
35. Connect the wheel speed sensor electrical connectors.
36. Connect the wheel speed sensor wiring harness to the lower control arm.

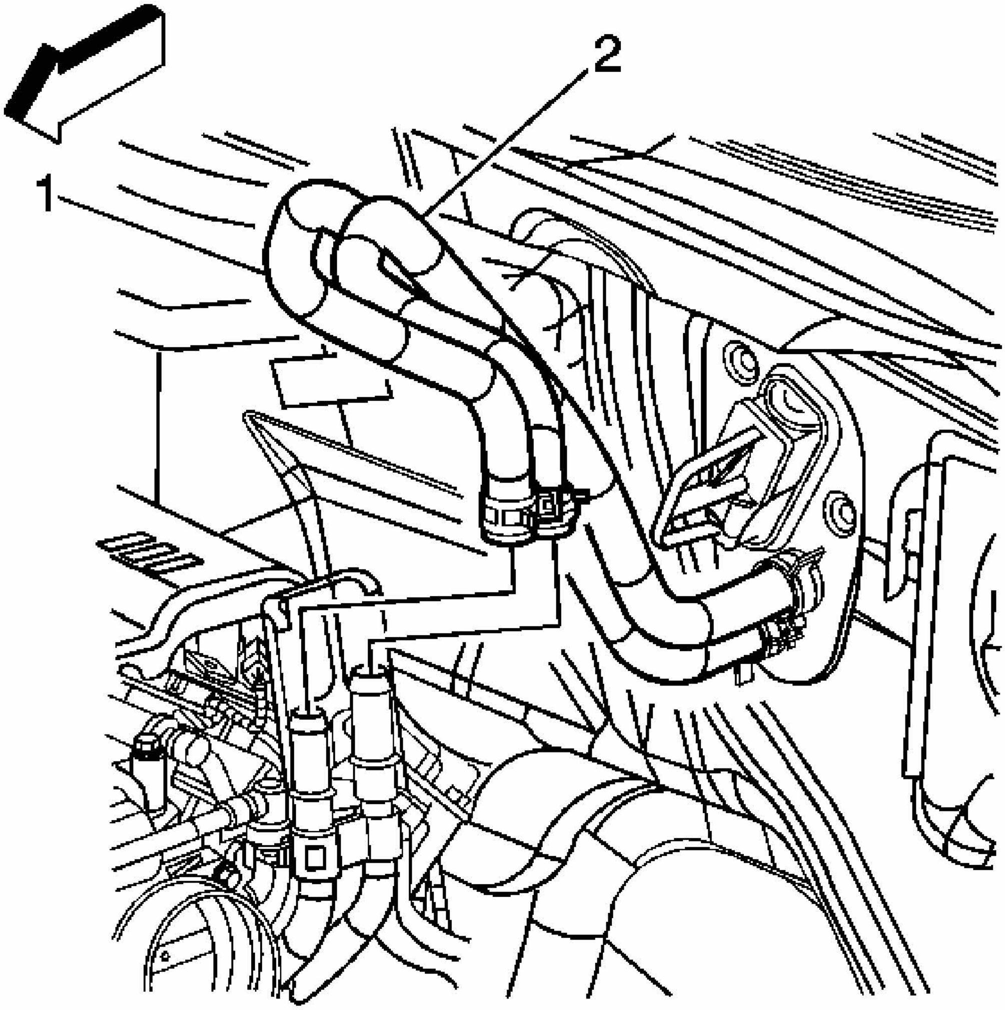


Fig. 296: Heater Inlet & Outlet Hoses
Courtesy of GENERAL MOTORS CORP.

37. Install the heater inlet (2) and outlet (1) hoses to the heater inlet/outlet pipe.
38. Using the **J 38185** position the heater inlet and outlet hose clamps. See **Special Tools**.

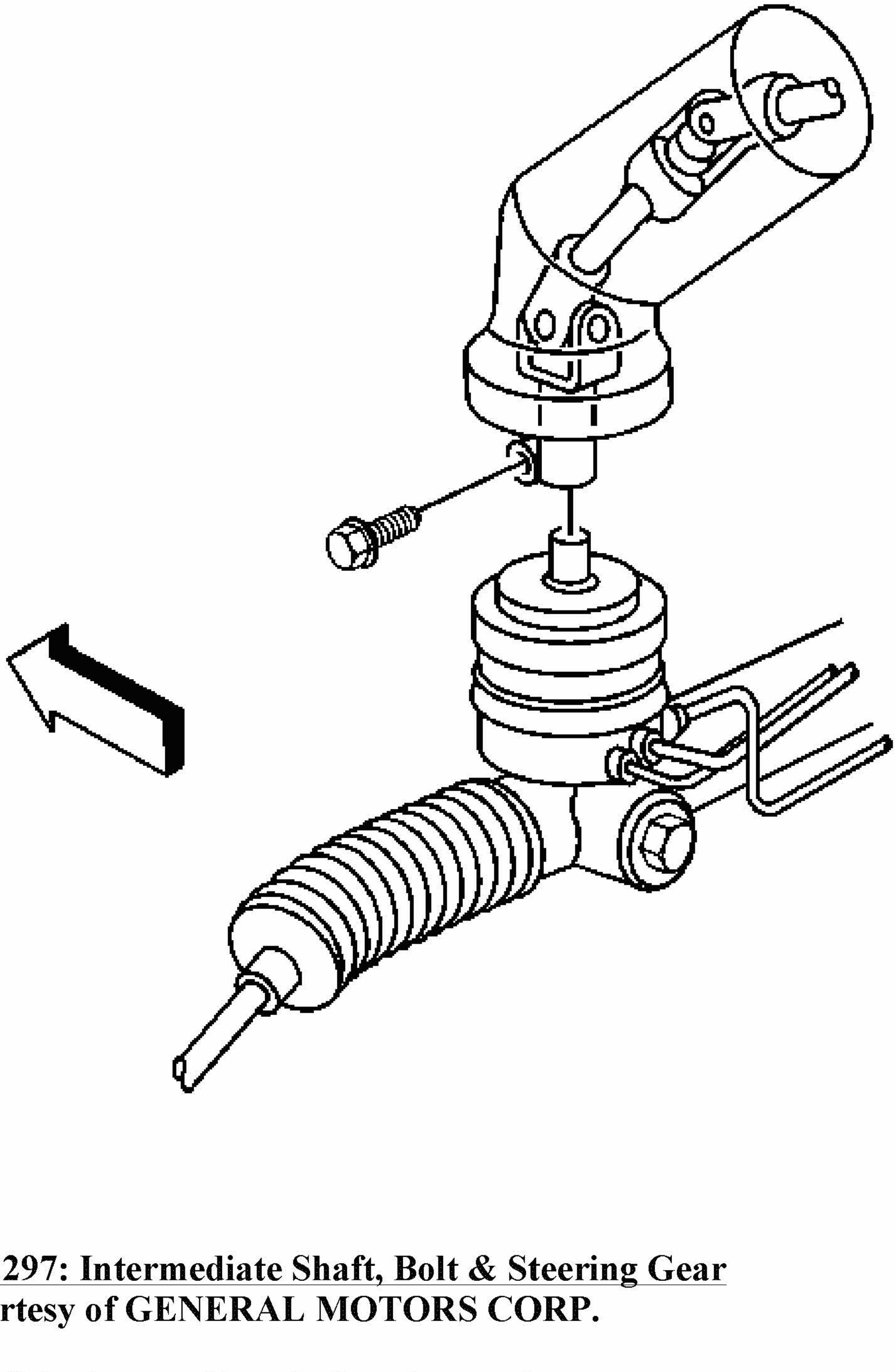


Fig. 297: Intermediate Shaft, Bolt & Steering Gear
Courtesy of GENERAL MOTORS CORP.

39. Install the intermediate shaft to the steering gear.
40. Install the intermediate shaft to steering gear bolt.

    Tighten: Tighten the bolt to 48 N.m (35 lb ft).

41. Position the intermediate shaft lower boot.

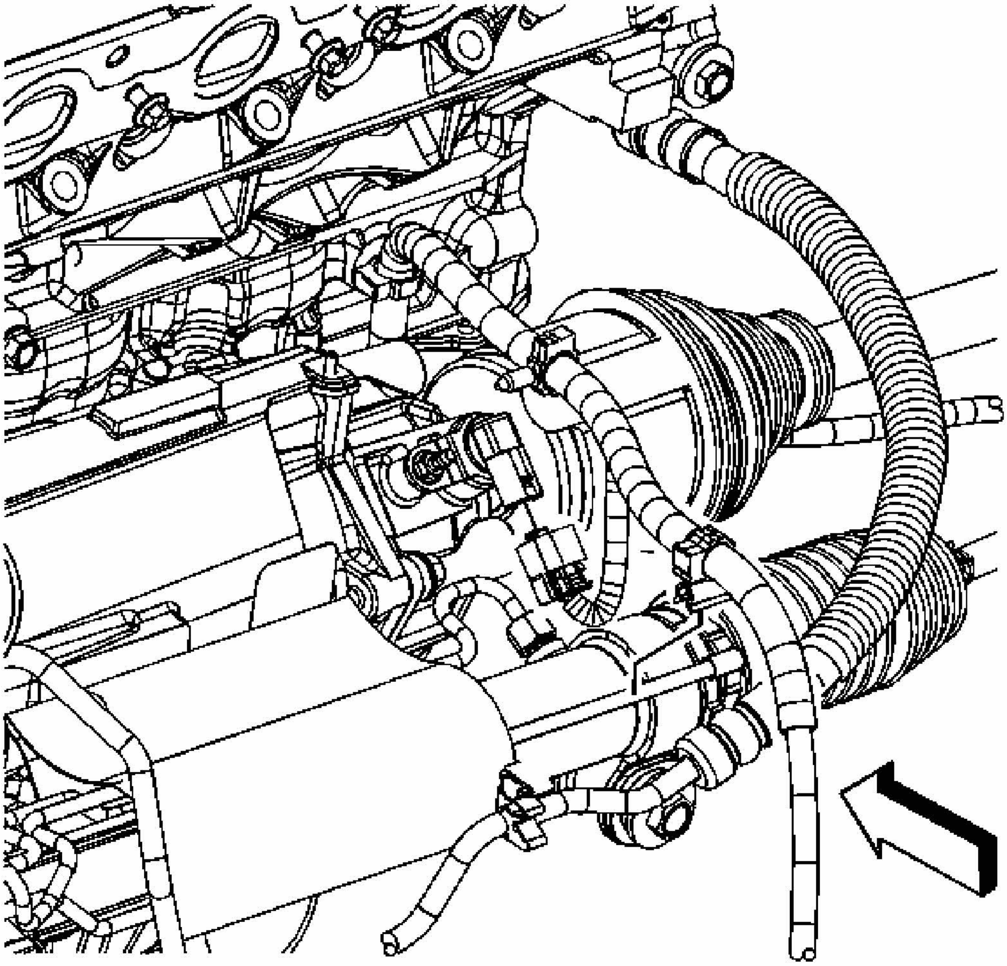


Fig. 298: Engine Wiring Harness Routing
Courtesy of GENERAL MOTORS CORP.

42. Route all branches of the engine wiring harness to their correct locations.
43. Connect the engine harness electrical connector to the VSS.

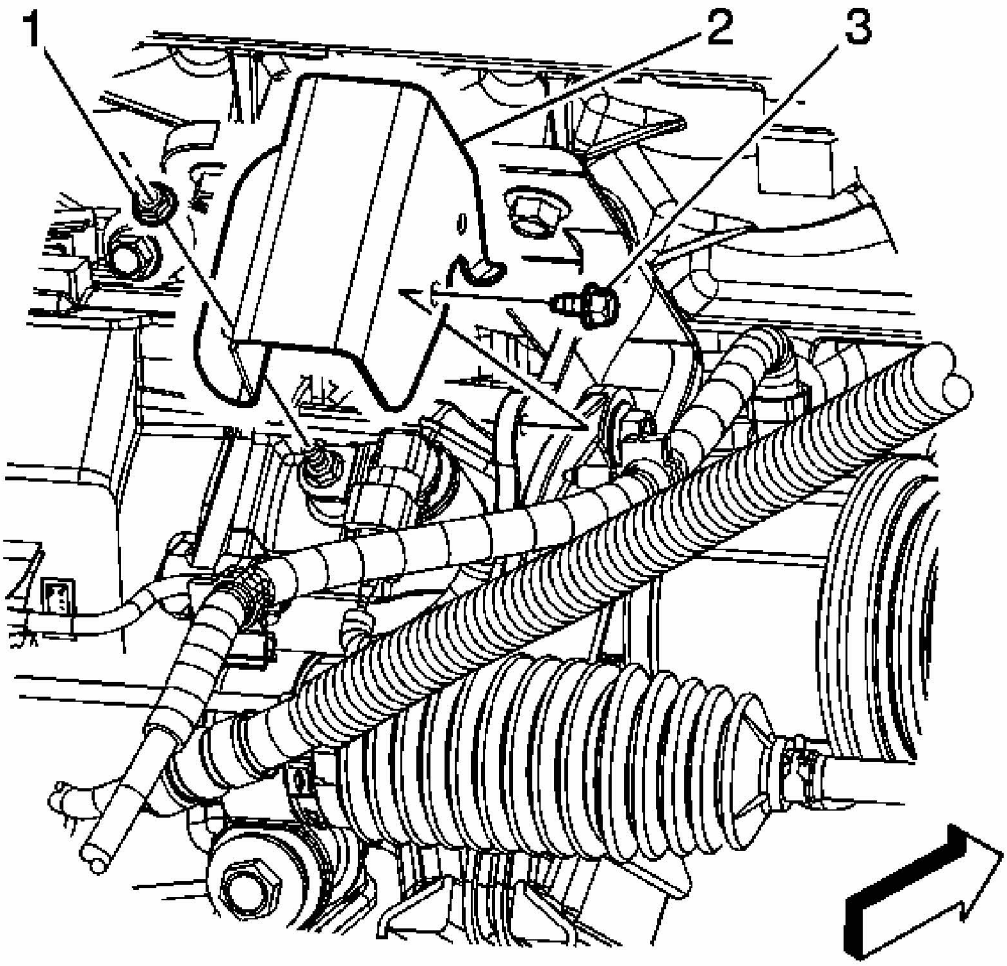


Fig. 299: Vehicle Speed Sensor (VSS) Shield, Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

44. Install the VSS shield (2). Install the VSS shield nut (1) and bolt (3).

    Tighten: Tighten the bolt/nut to 25 N.m (18 lb ft).

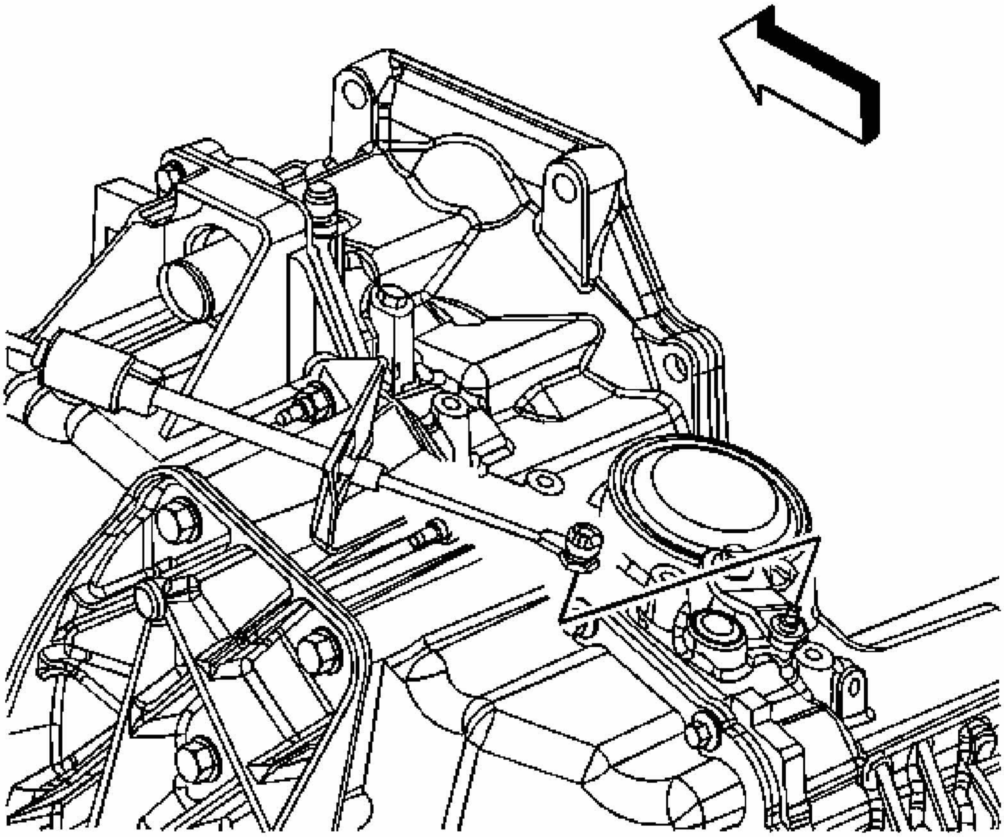


Fig. 300: View Of Shift Cable At Transaxle
Courtesy of GENERAL MOTORS CORP.

45. Install the shift cable to the bracket.
46. Connect the shift cable to the transaxle selector lever stud.
47. Install the shift cable clip.

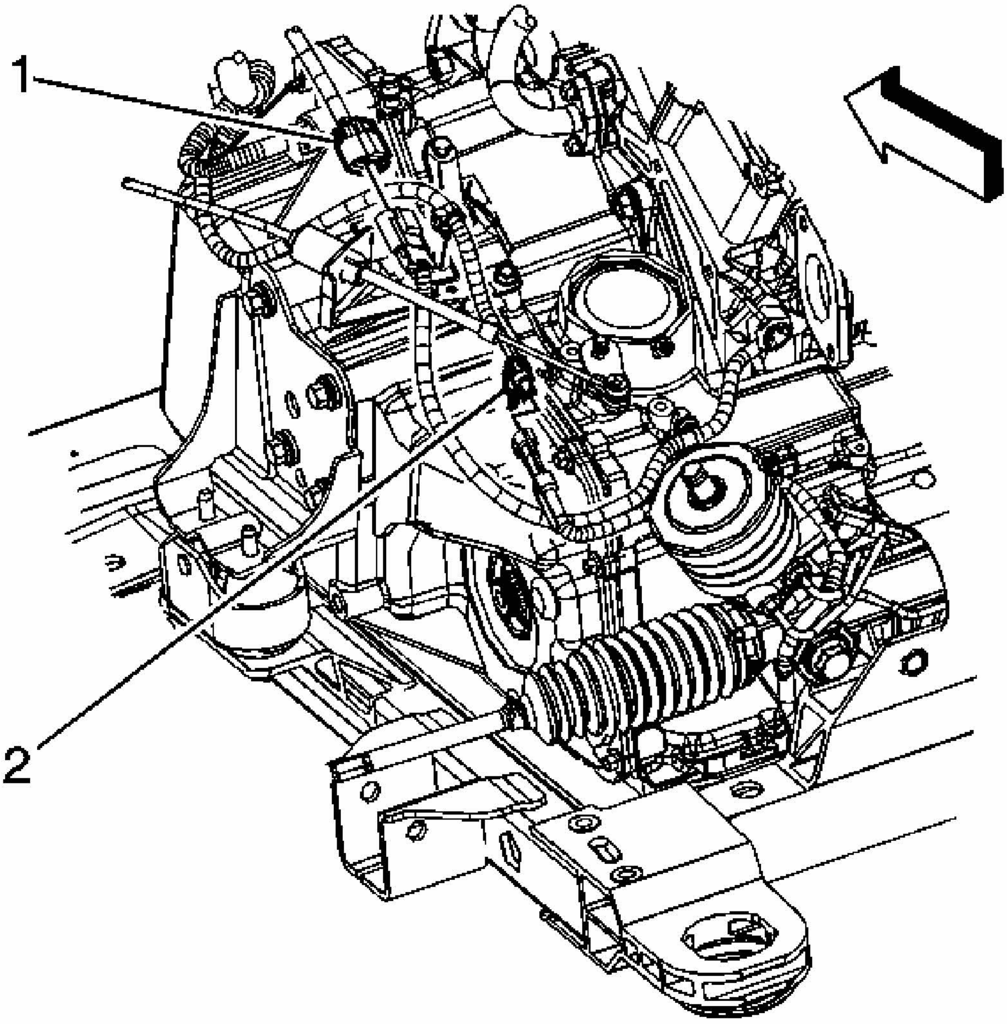


Fig. 301: Crankshaft Position (CKP) Sensor Harness & Power Steering Gear Harness To Engine Harness Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

48. Install the clip attaching the power steering gear harness to the bracket.
49. Connect the engine harness electrical connector (1) to the CKP sensor harness.
50. Connect the engine harness electrical connector (2) to the power steering gear harness.

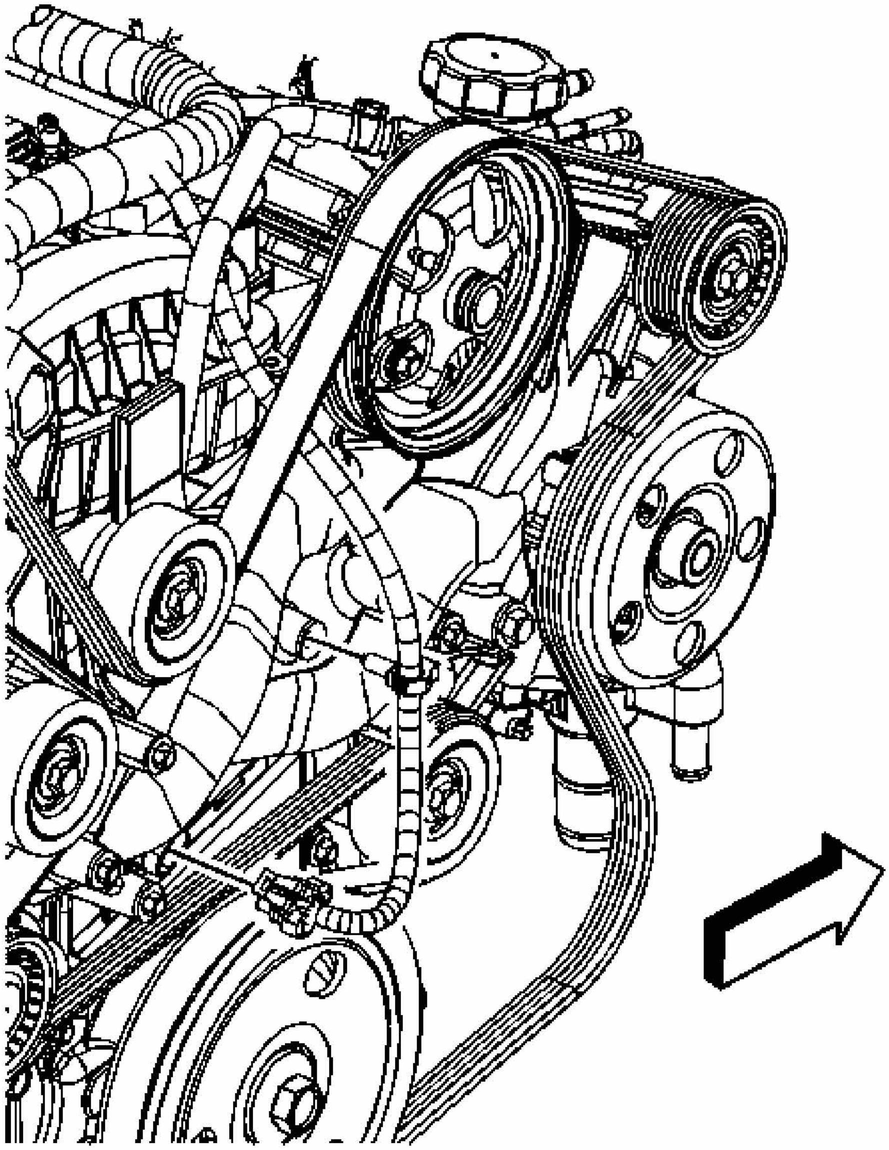


Fig. 302: Camshaft Position (CMP) Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

51. Connect the camshaft position sensor lead to the sensor.

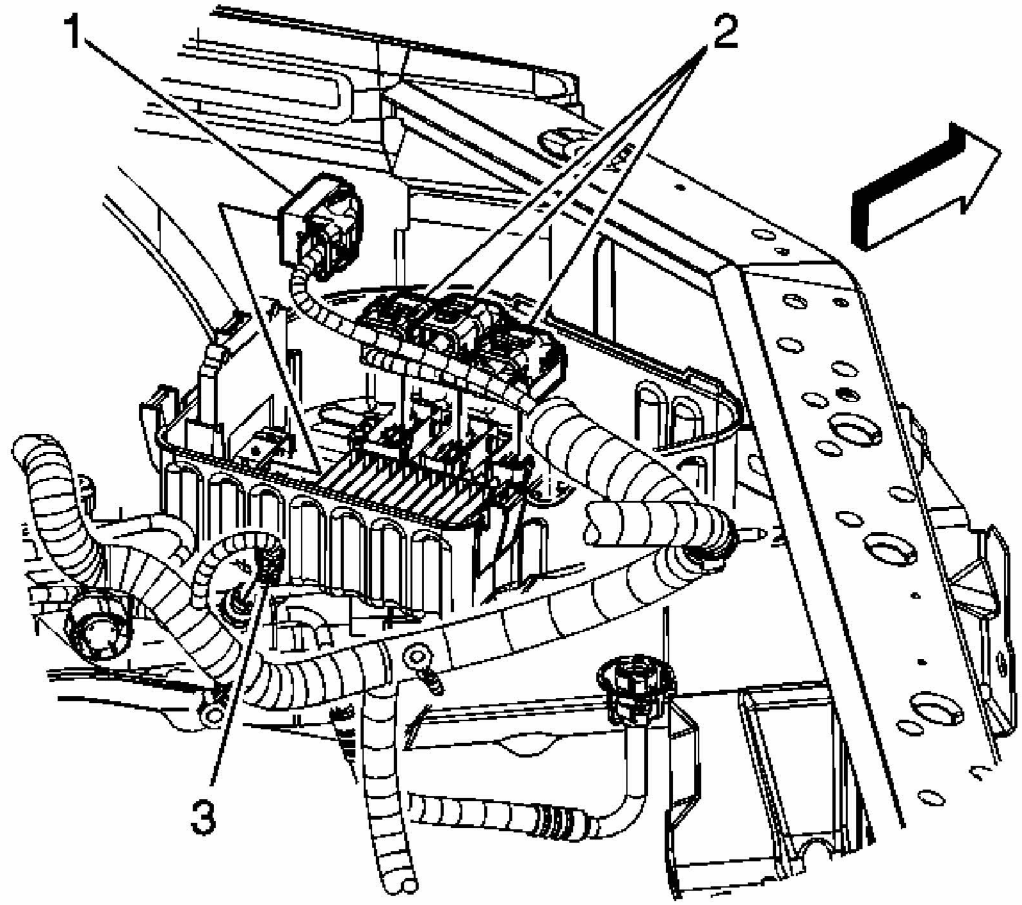


Fig. 303: Transmission Control Module, Engine Control Module & A/C Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

52. Connect the following electrical connectors:
    - TCM (1)
    - ECM (2)
    - A/C pressure sensor (3)
53. Install the air cleaner assembly. Refer to **Air Cleaner Element Replacement** .

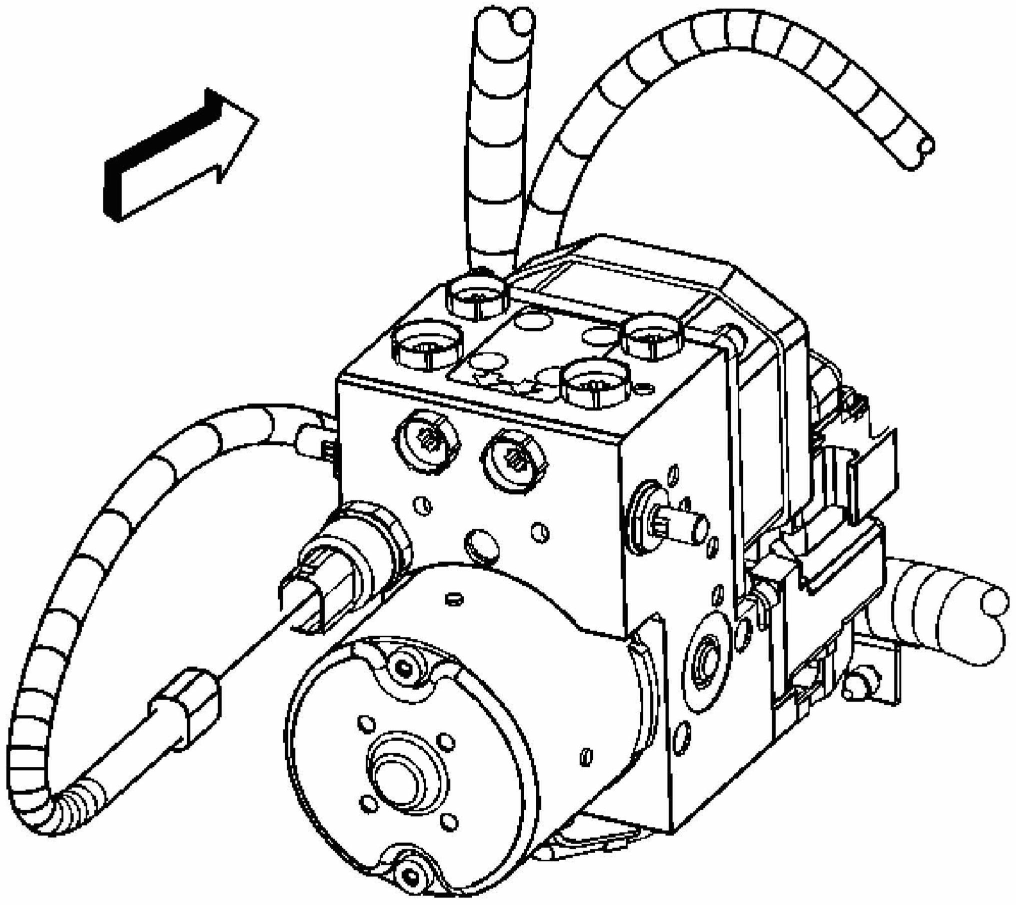


Fig. 304: Engine Harness Electrical Connector & The Electronic Brake Control Module (EBCM)
Courtesy of GENERAL MOTORS CORP.

54. Connect the engine harness electrical connector to the EBCM.

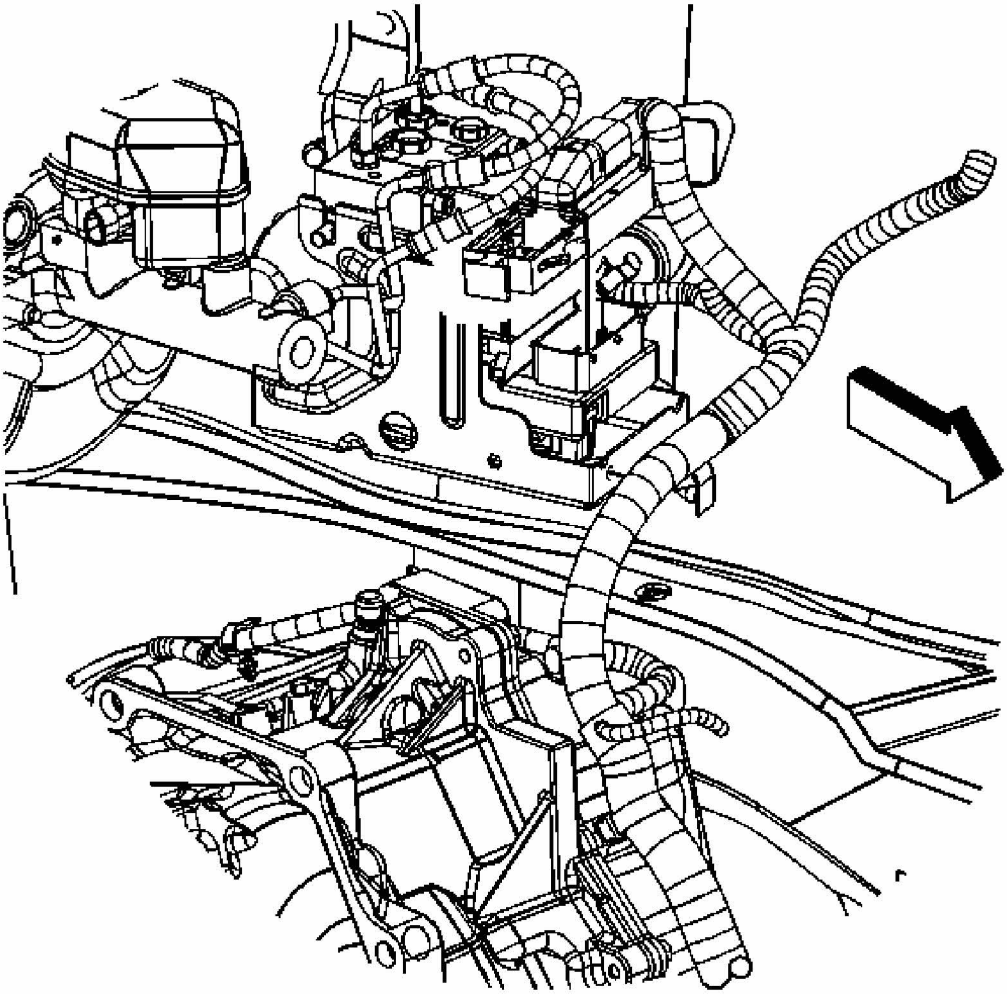


Fig. 305: Engine Harness Electrical Connector At The ABS Module
Courtesy of GENERAL MOTORS CORP.

55. Connect the engine harness electrical connector to the ABS module.

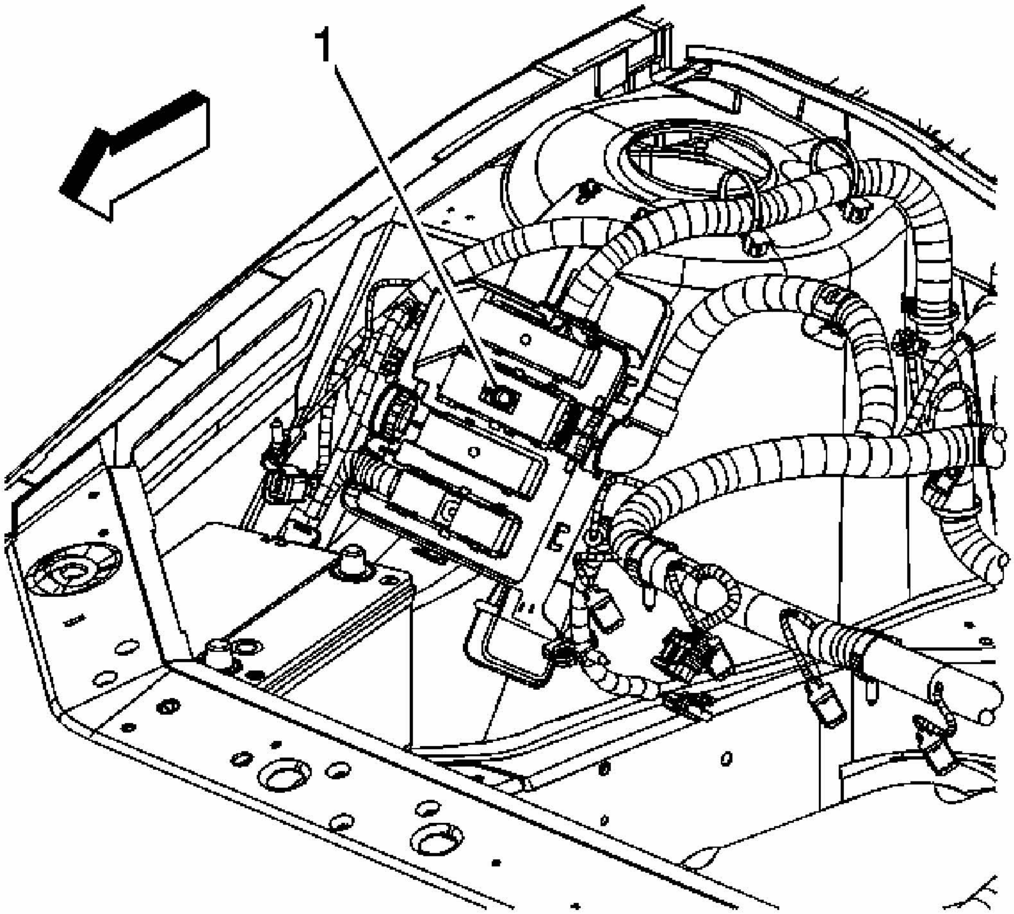


Fig. 306: Engine Harness Connector & Bolt
Courtesy of GENERAL MOTORS CORP.

56. Install the engine harness connector to the bracket. Tighten the engine harness connector bolt (1).

    Tighten: Tighten the bolt to 10 N.m (89 lb in).

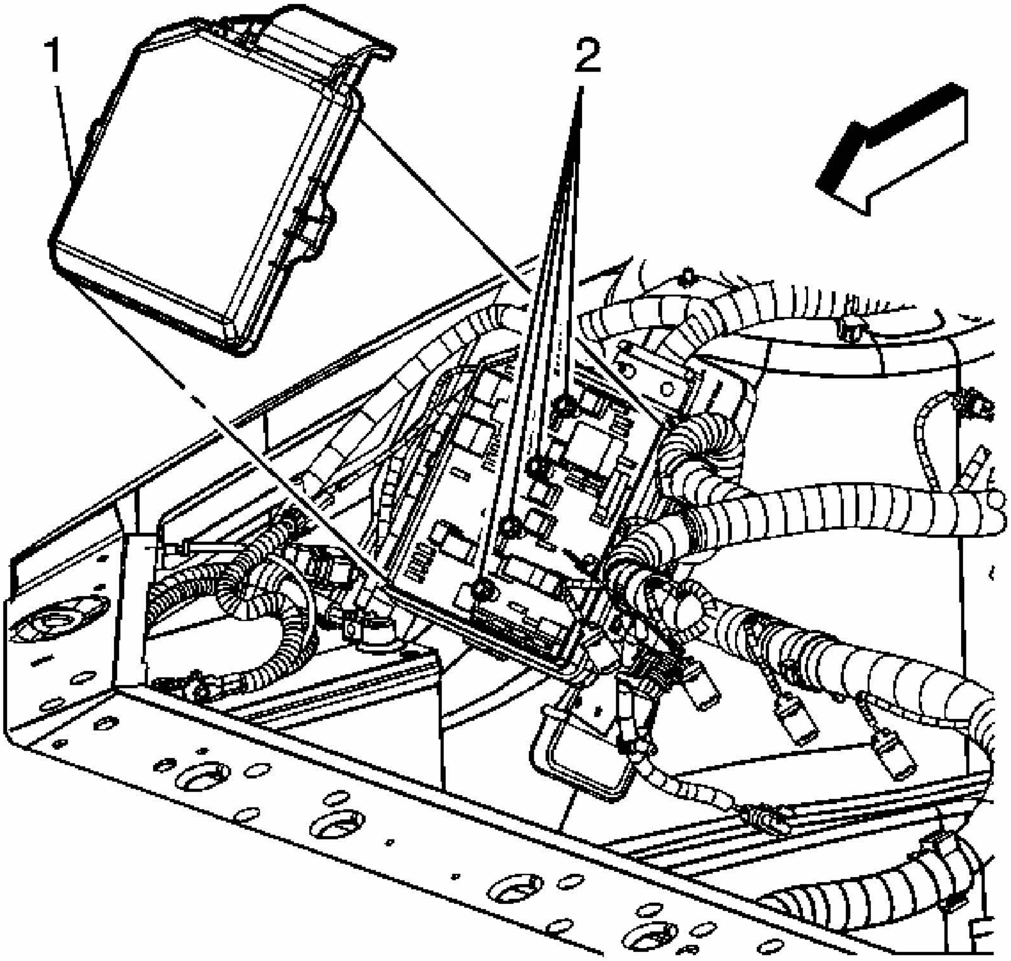


Fig. 307: View Of Bussed Electrical Center (BEC) Cover & Fuse Block
Courtesy of GENERAL MOTORS CORP.

57. Position the fuse block. Tighten the 4 integral bolts (2) attaching the fuse block.

    Tighten: Tighten the bolts to 10 N.m (89 lb in).

58. Install the electrical center cover (1).

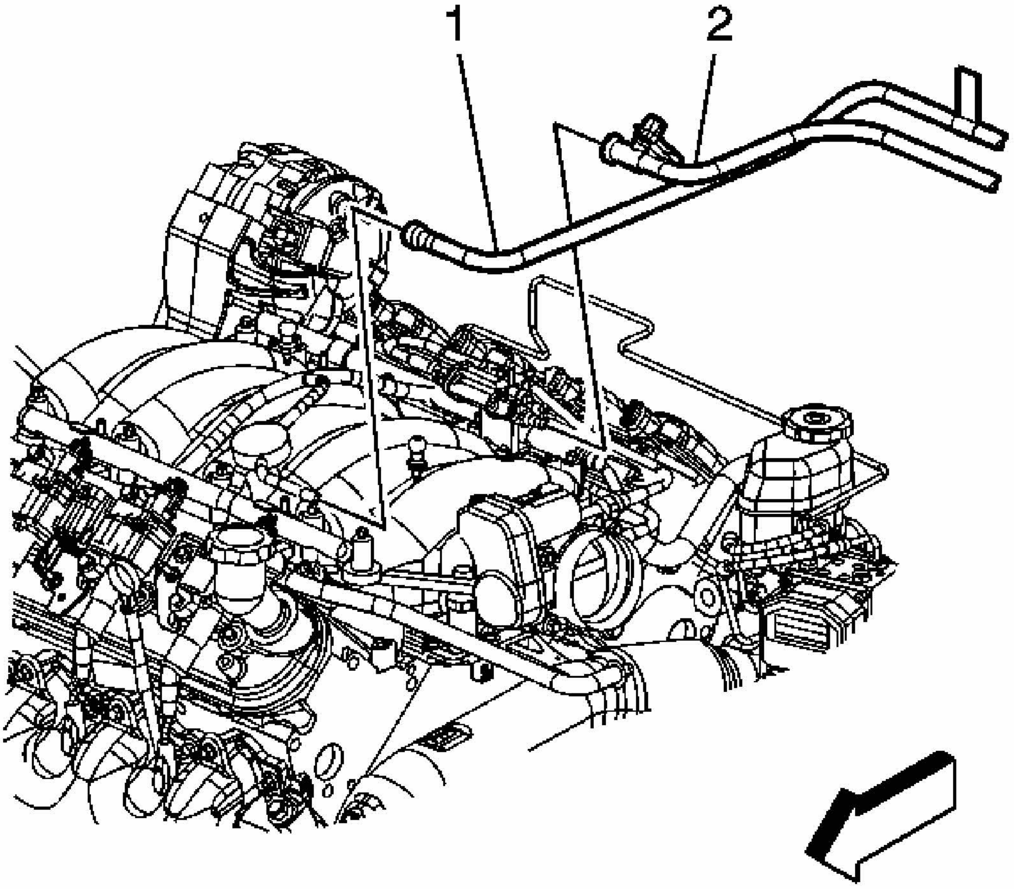


Fig. 308: View Of Fuel Feed Line & Evaporative Emission (EVAP) Line
Courtesy of GENERAL MOTORS CORP.

59. Connect the fuel feed line (1) to the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .
60. Connect the EVAP line (2) to the purge solenoid. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

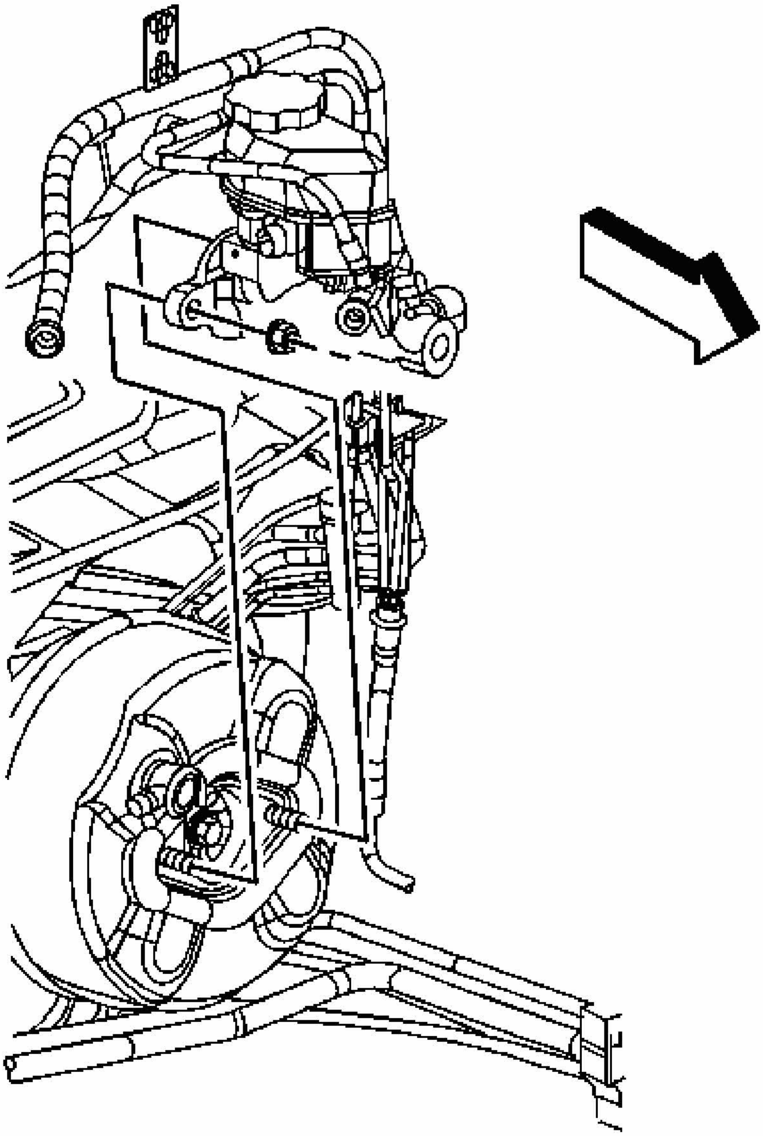


Fig. 309: View Of Master Cylinder & Nuts
Courtesy of GENERAL MOTORS CORP.

61. Remove the mechanic's wire holding the master cylinder. Position the master cylinder to the brake booster.
62. Install the master cylinder nuts.

    Tighten: Tighten the nuts to 33 N.m (24 lb ft).

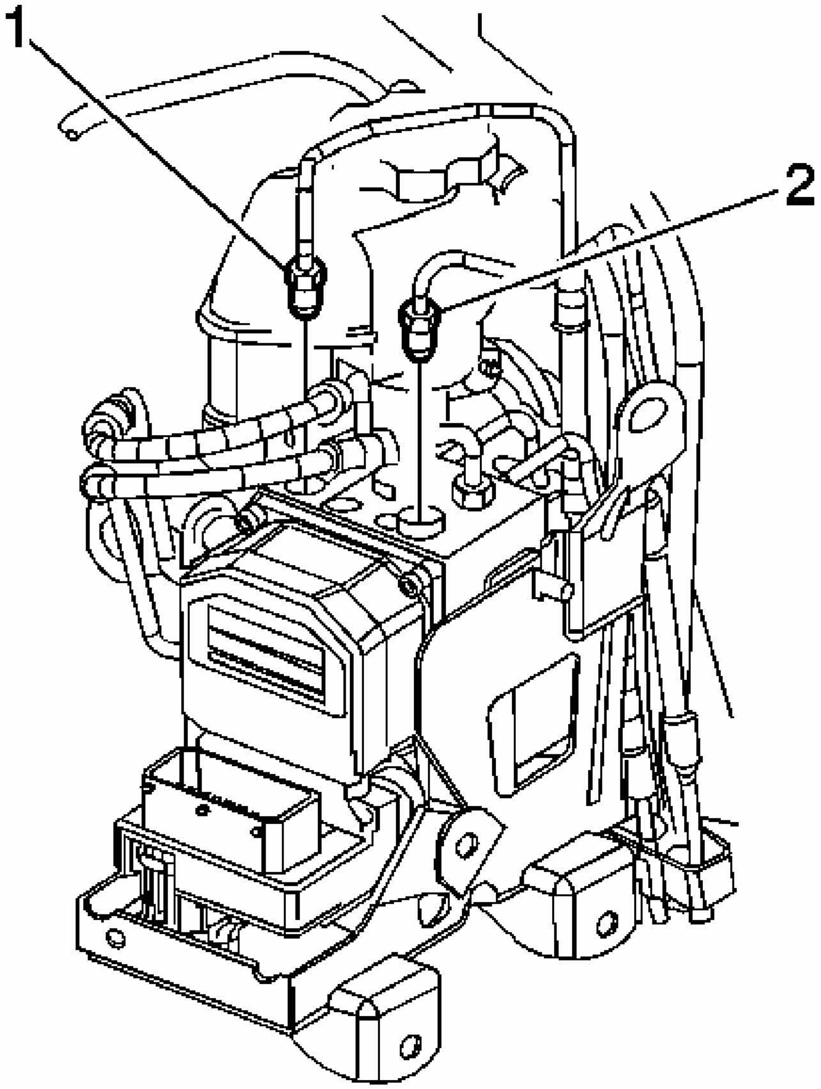


Fig. 310: Anti Lock Brake (ABS) Module Brake Pipe Fittings
Courtesy of GENERAL MOTORS CORP.

63. Connect the brake pipe fittings (1, 2) to the ABS module.

    Tighten: Tighten the fittings to 15 N.m (11 lb ft).

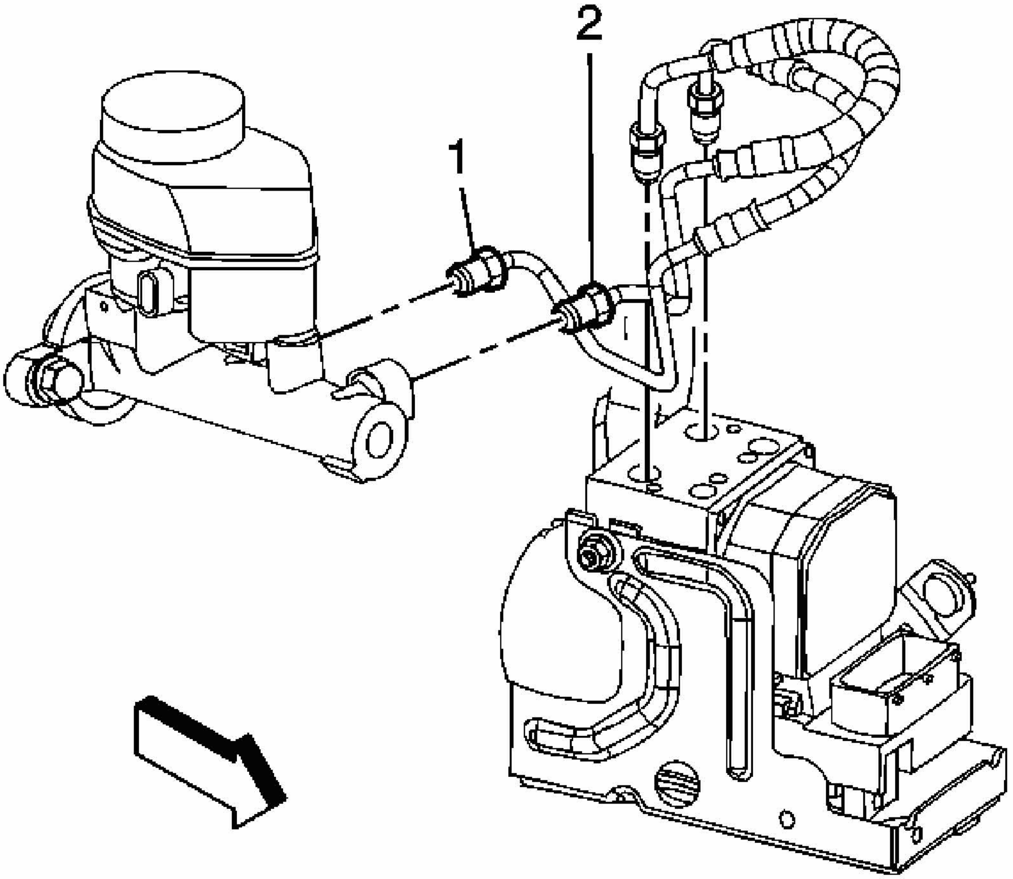


Fig. 311: Master Cylinder Brake Pipe Fittings
Courtesy of GENERAL MOTORS CORP.

64. Connect the from brake pipe fittings (1, 2) to the master cylinder.

    Tighten: Tighten the fittings to 30 N.m (22 lb ft).

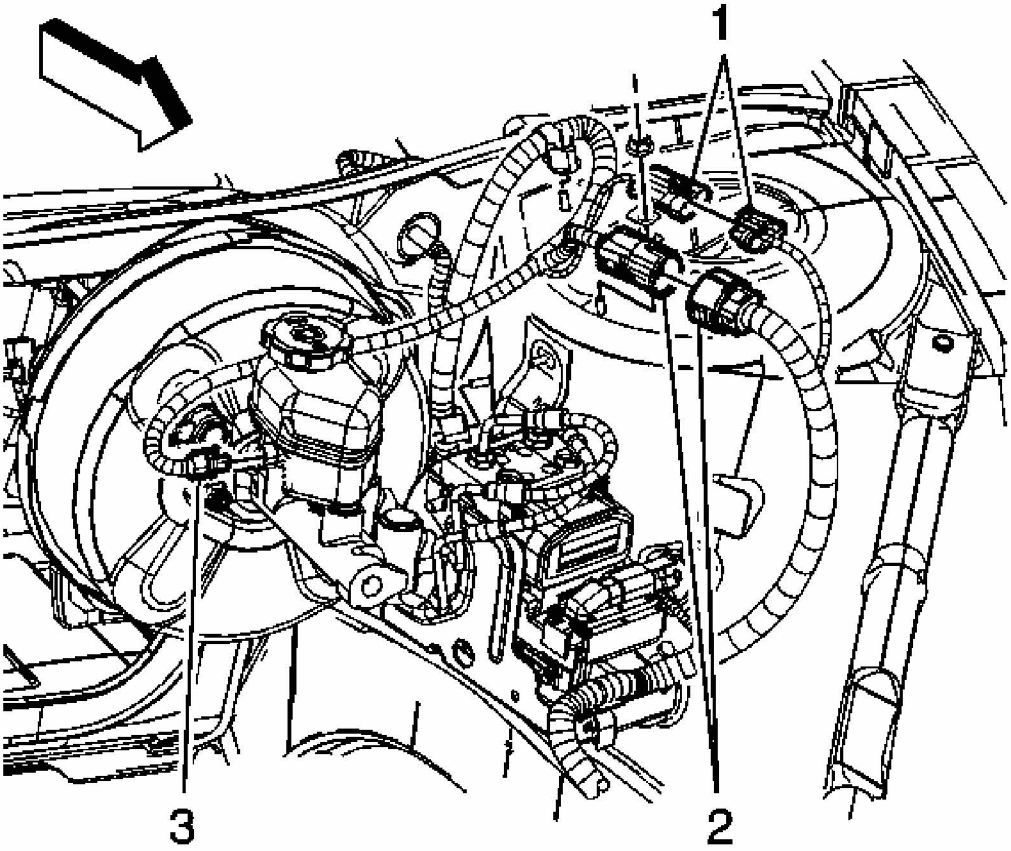


Fig. 312: Engine Harness Electrical Connectors & Brake Fluid Level Switch Electrical Connector
Courtesy of GENERAL MOTORS CORP.

65. Connect the brake fluid level switch electrical connector (3) to the master cylinder.
66. Connect the engine harness electrical connectors (1, 2) to the I/P harness electrical connectors.

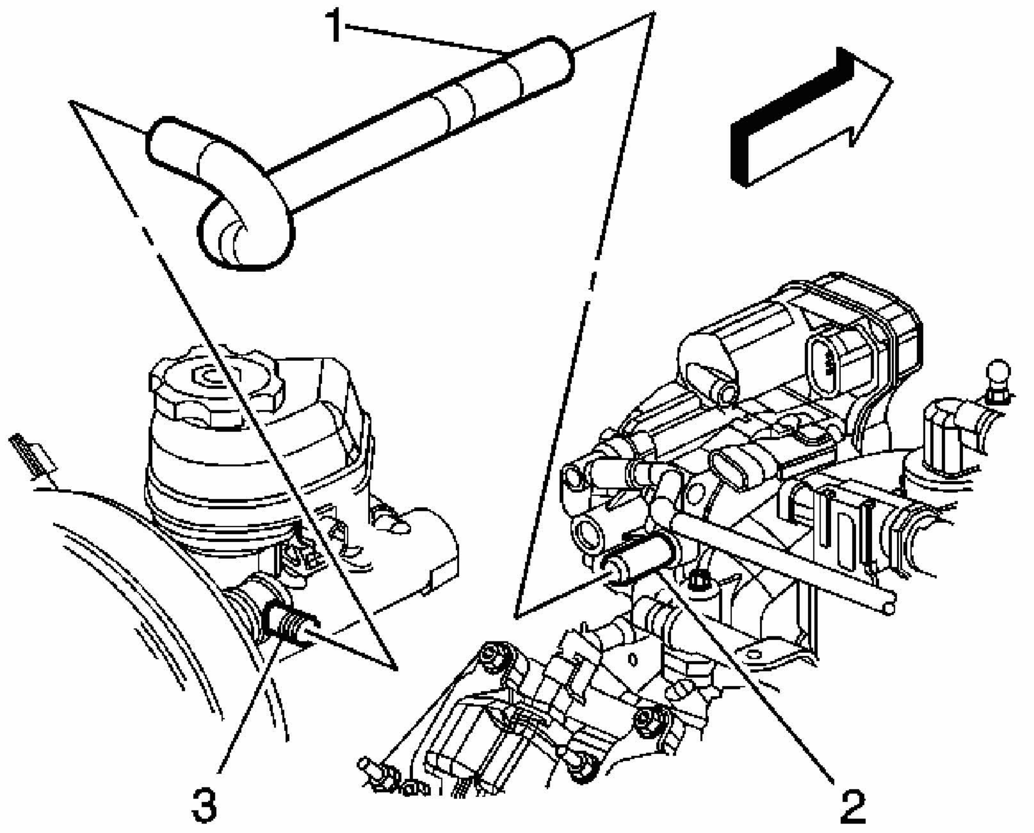


Fig. 313: View Of Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

67. Install the brake booster vacuum hose (1) to the intake manifold (2).
68. Install the brake booster vacuum hose to the brake booster (3).

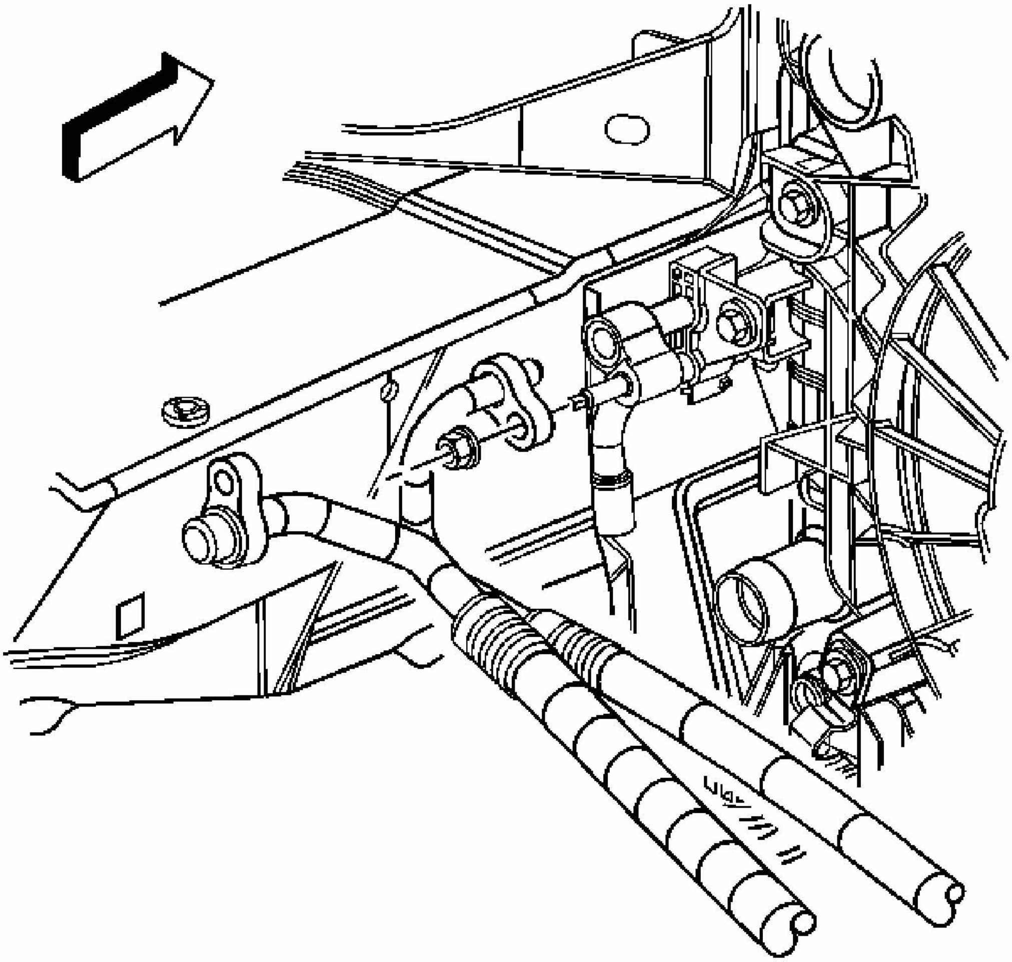


Fig. 314: A/C Compressor Hose & Nut At The A/C Condenser
Courtesy of GENERAL MOTORS CORP.

69. Install the A/C compressor hose.
70. Install the A/C compressor hose nut at the A/C condenser.

    Tighten: Tighten the nut to 16 N.m (12 lb ft).

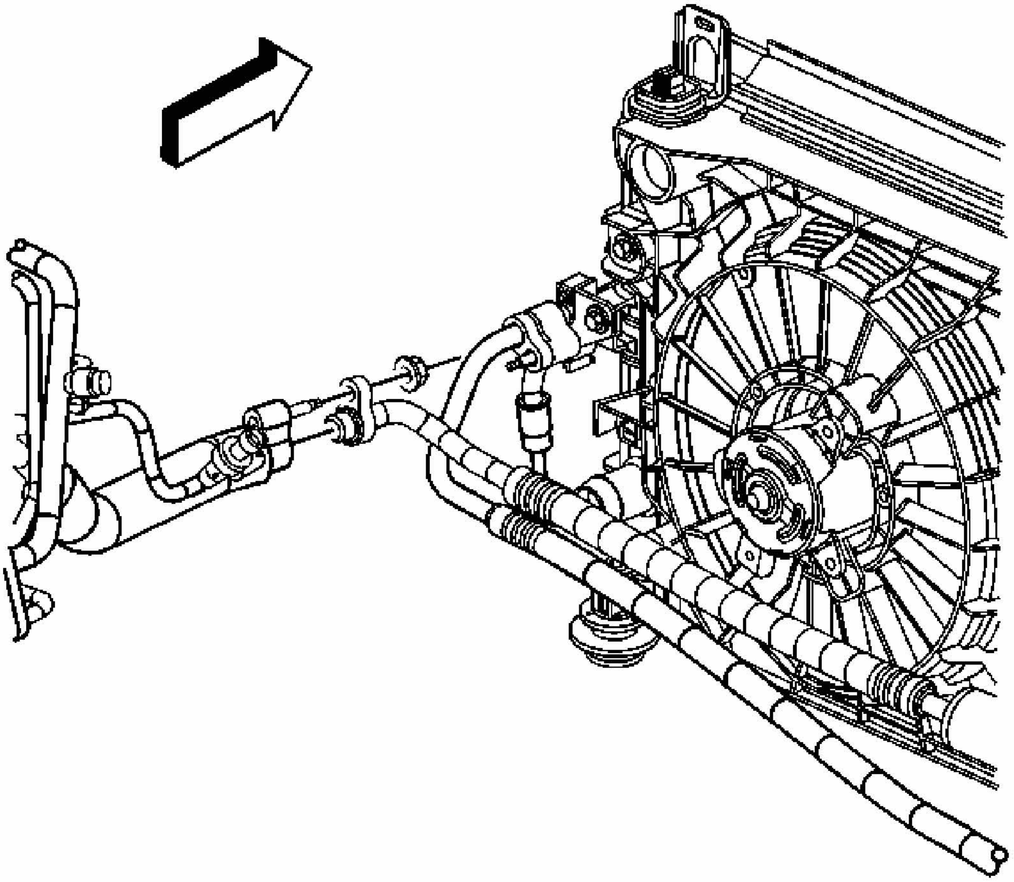


Fig. 315: A/C Compressor Hose Nut & A/C Receiver/Dehydrator Tube
Courtesy of GENERAL MOTORS CORP.

71. Install the A/C compressor hose.
72. Install the A/C compressor hose nut at the A/C receiver/dehydrator tube.

    Tighten: Tighten the nut to 16 N.m (12 lb ft).

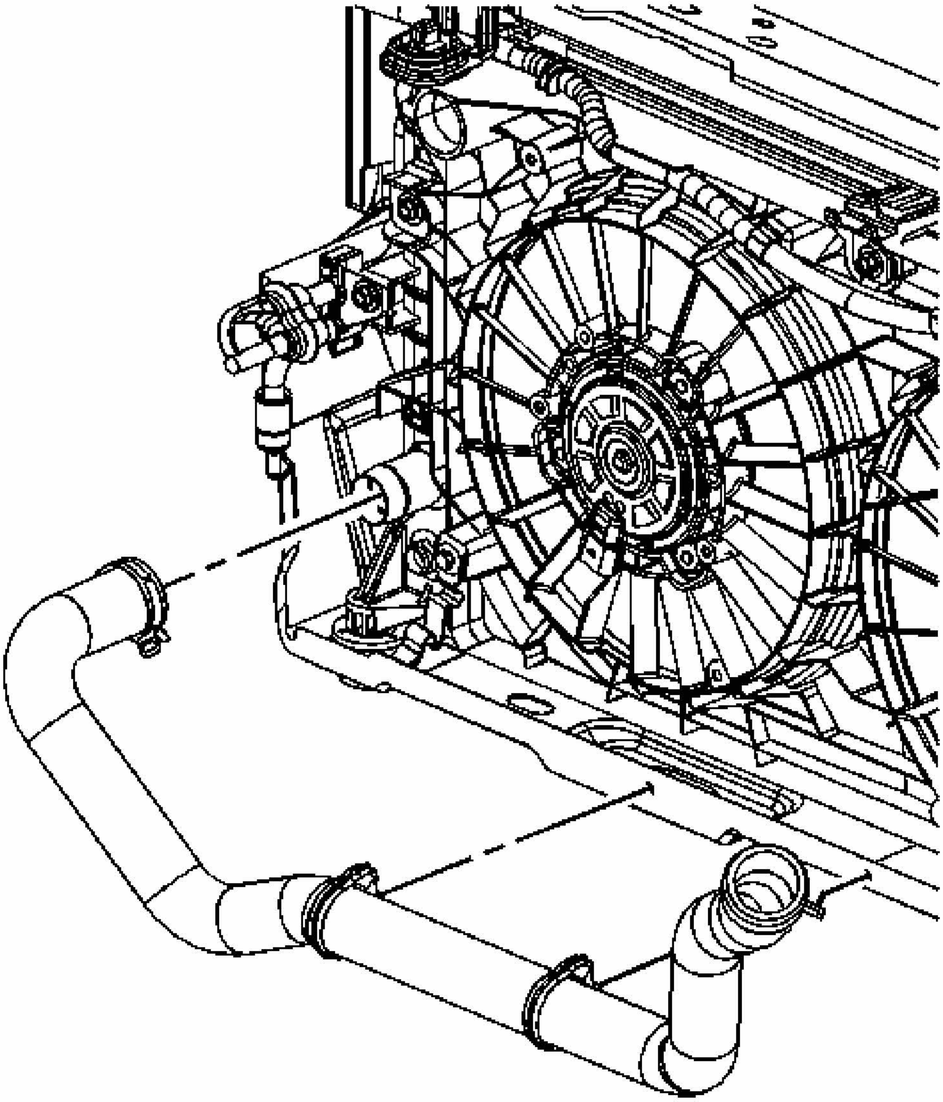


Fig. 316: Outlet Hose At The Radiator
Courtesy of GENERAL MOTORS CORP.

73. Install the outlet hose to the radiator.
74. Connect the outlet hose clips to the fan shroud.
75. Using the **J 38185** position the outlet hose clamp at the radiator. See **Special Tools**.

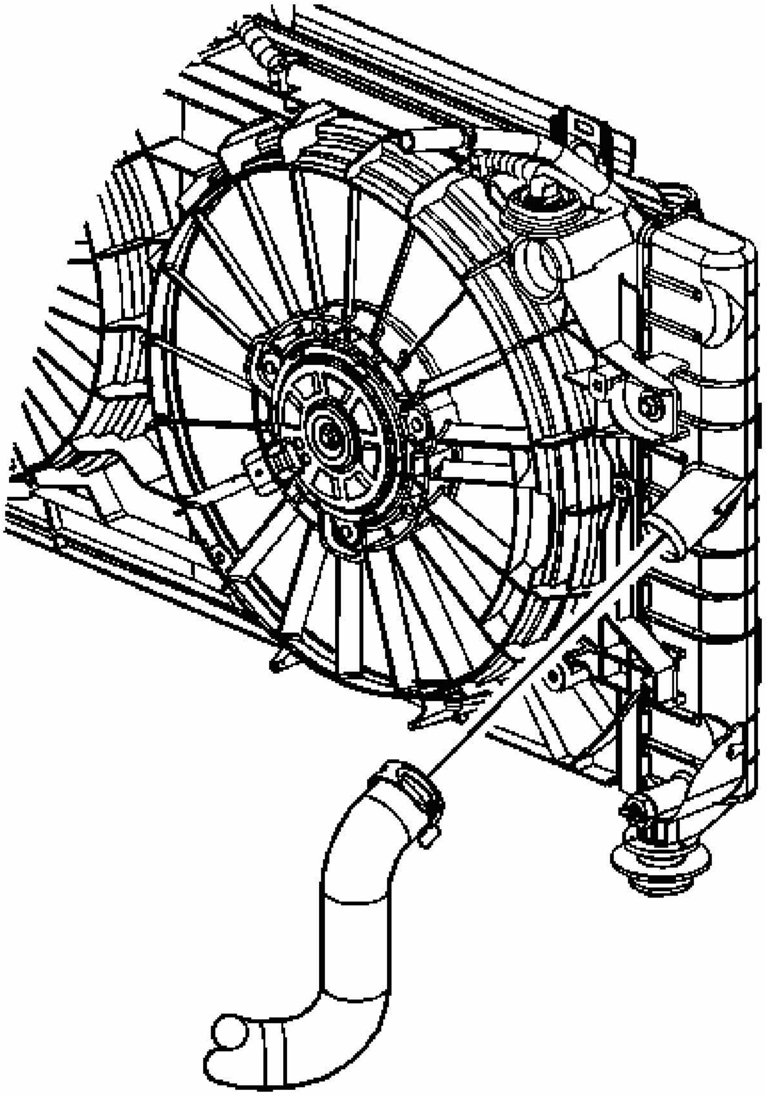


Fig. 317: Inlet Hose At The Radiator
Courtesy of GENERAL MOTORS CORP.

76. Install the inlet hose to the radiator.
77. Using the **J 38185** position the inlet hose clamp at the radiator. See **Special Tools**.
78. Install the front tires and wheels. Refer to **Tire and Wheel Removal and Installation** .
79. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .

80. Install the right fender diagonal brace. Refer to **Brace Replacement - Front Fender Upper Diagonal** .
81. Refill the engine with oil.
82. Recharge the A/C system. Refer to **Refrigerant Recovery and Recharging** .
83. Refill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
84. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .
85. Check the transaxle fluid level, add fluid if necessary. Refer to **Transmission Fluid Checking Procedure** .
86. Install the engine sight shield. Refer to **Engine Sight Shield Replacement**.
87. Run the engine and inspect for leaks.

ENGINE OIL AND OIL FILTER REPLACEMENT

Removal Procedure

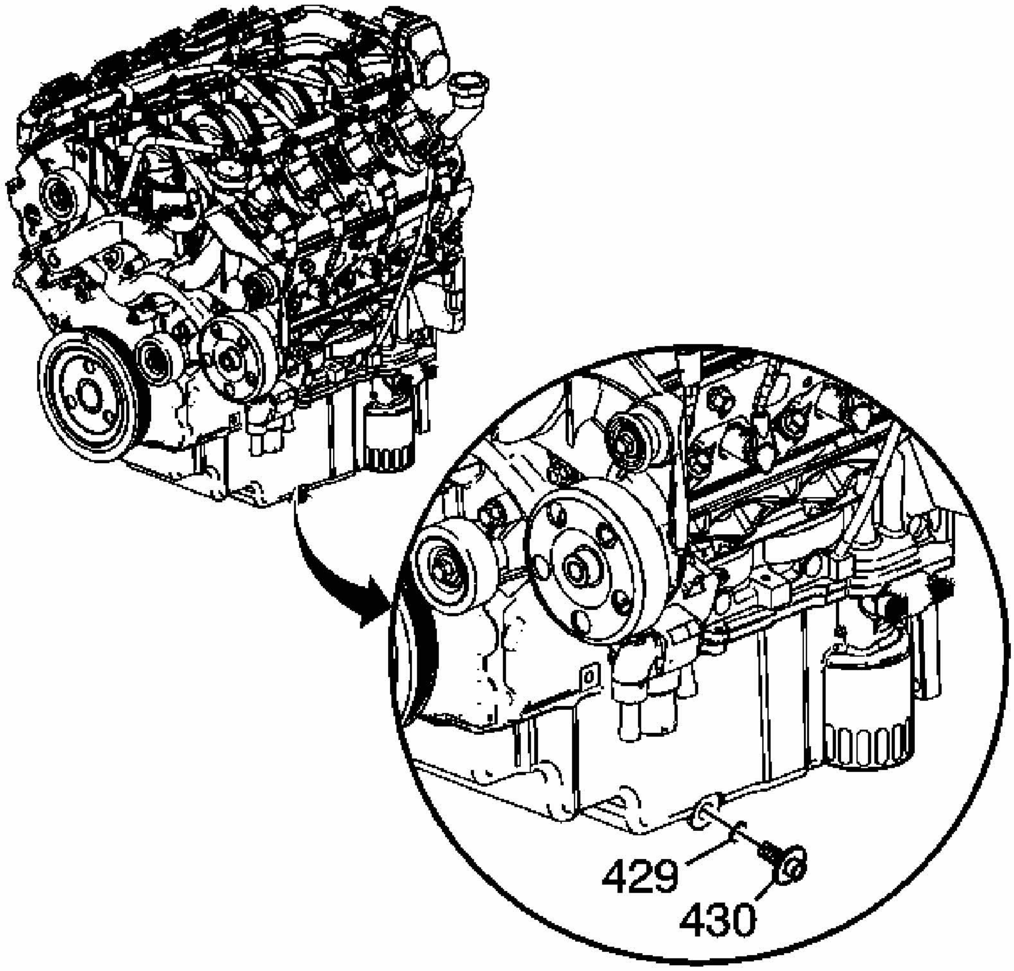


Fig. 318: View Of Oil Pan Drain Plug & O-Ring
Courtesy of GENERAL MOTORS CORP.

1. Open the hood.
2. Remove the oil fill cap.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Remove the oil pan drain plug (430) and O-ring (429).
5. Allow the oil to drain into an appropriate container.

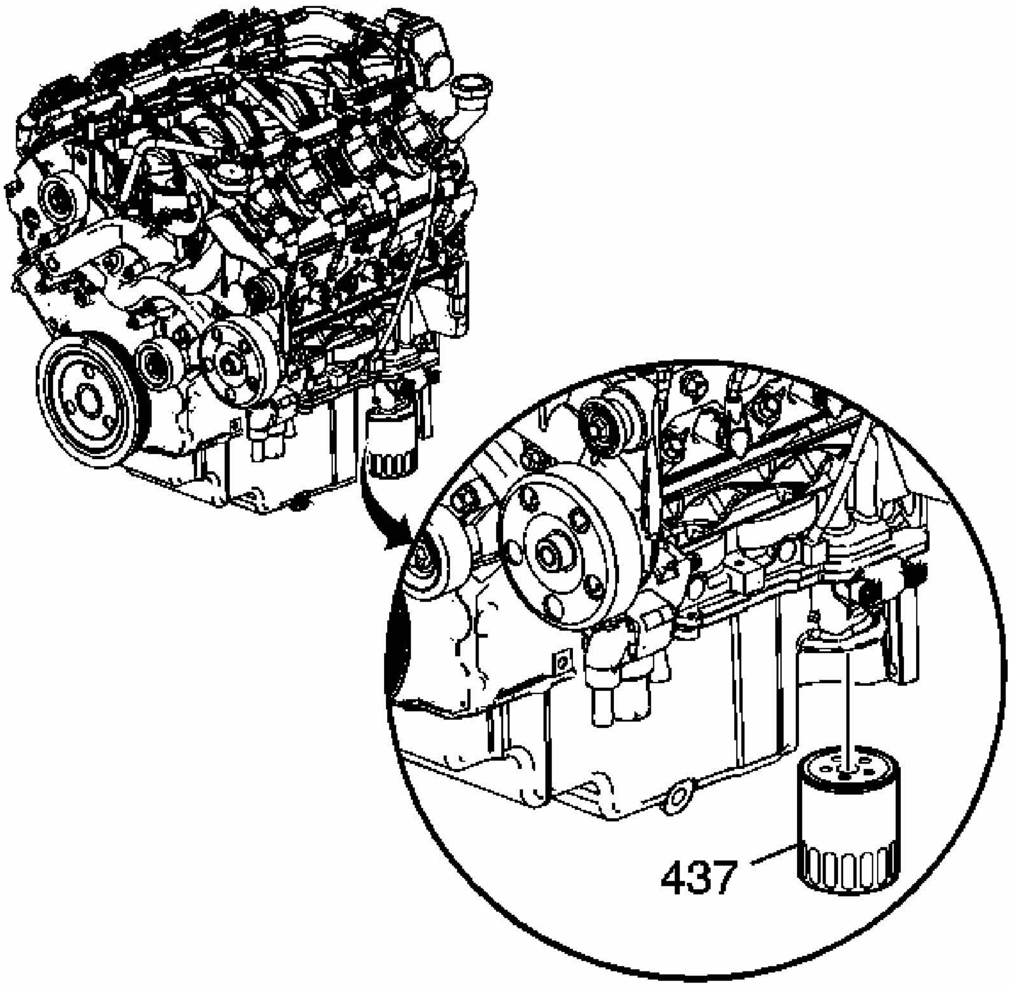


Fig. 319: View Of Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine oil filter (437). Allow the rest of the engine oil to drain into an appropriate container.

Installation Procedure

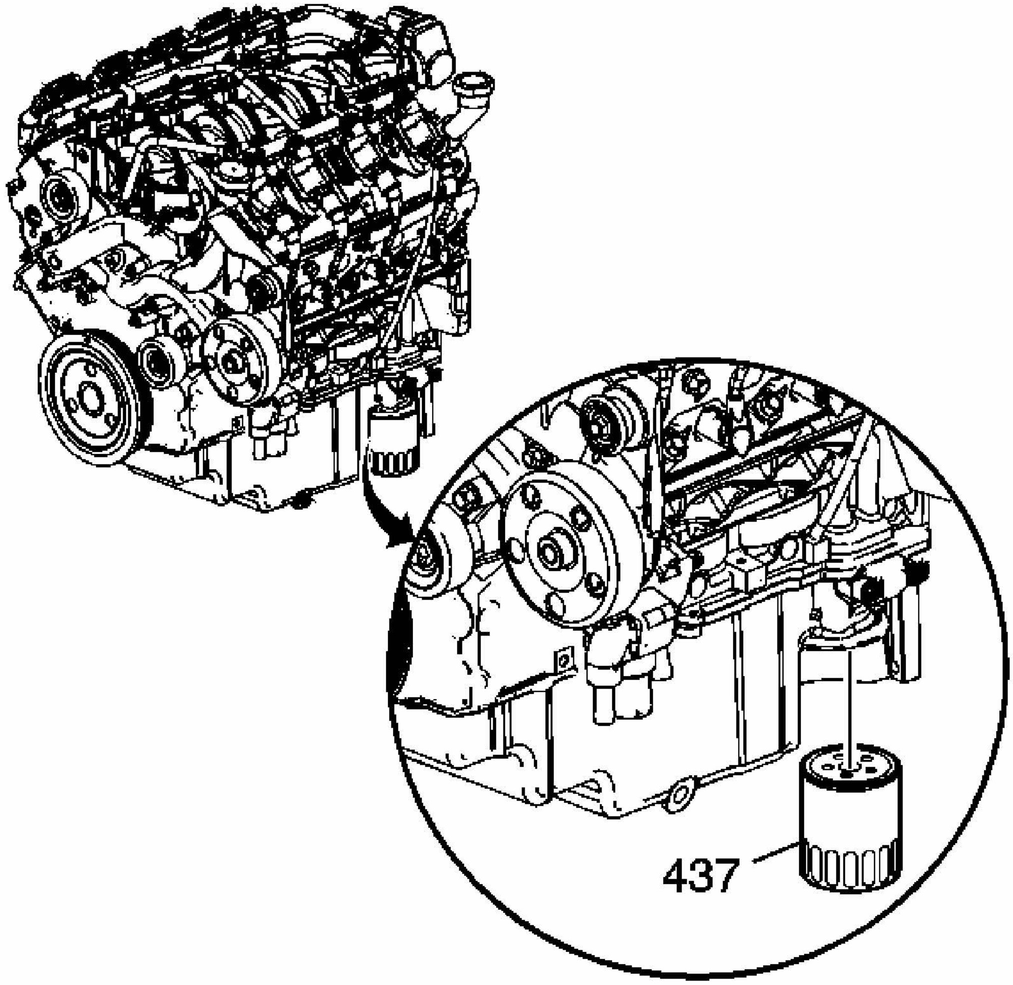


Fig. 320: View Of Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

IMPORTANT: **Prior to installing a NEW oil filter, ensure that the old oil filter gasket has been removed from the engine block. If not, remove the old gasket.**

1. Install a NEW engine oil filter (437).

   Tighten: Tighten the filter to 30 N.m (22 lb ft).

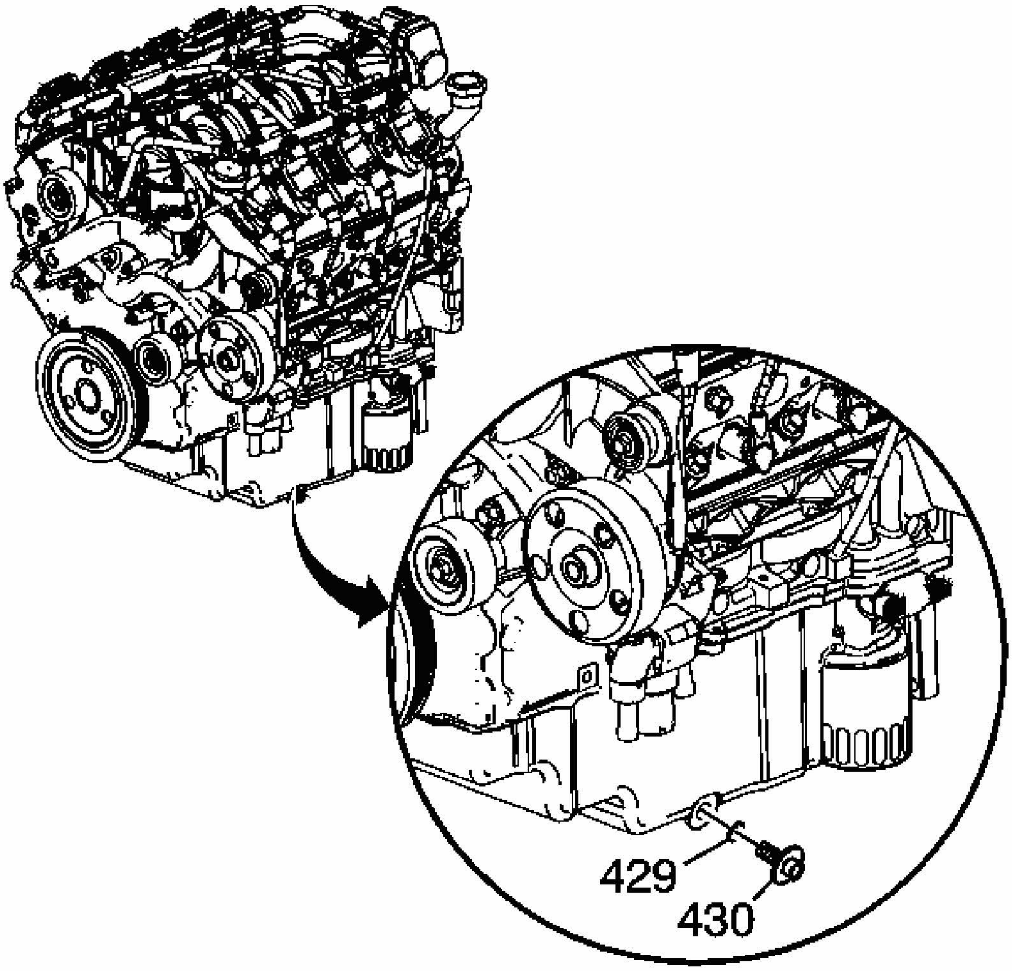


Fig. 321: View Of Oil Pan Drain Plug & O-Ring
Courtesy of GENERAL MOTORS CORP.

2. Install the oil pan drain plug (430) and O-ring (429).

   Tighten: Tighten the drain plug to 25 N.m (18 lb ft).

3. Lower the vehicle.
4. Fill the engine with the appropriate amount and type of NEW engine oil. Refer to **Capacities - Approximate Fluid** and **Fluid and Lubricant Recommendations** .
5. Check the oil level.
6. Install the oil fill cap.
7. Close the hood.
8. Reset the engine oil life monitor, if necessary. Refer to **GM Oil Life System -**

Resetting .

DRAINING FLUIDS AND OIL FILTER REMOVAL

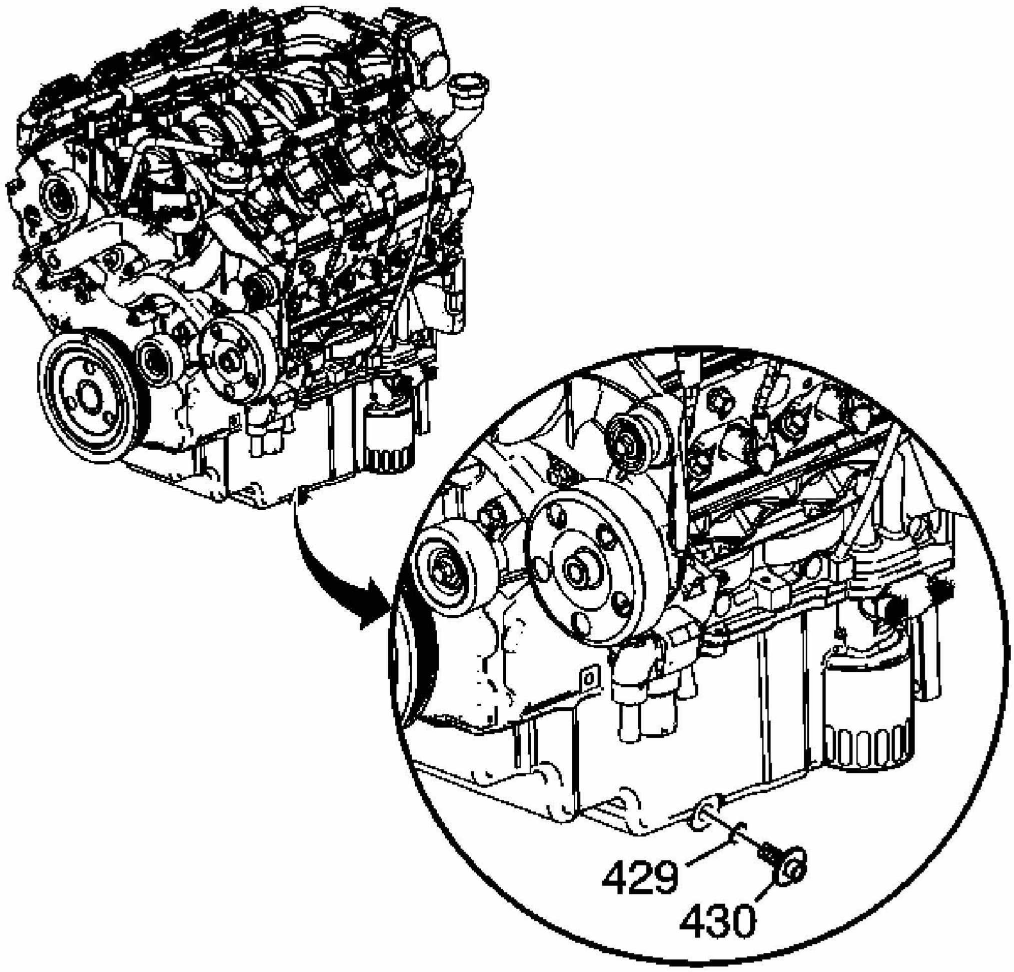


Fig. 322: View Of Oil Pan Drain Plug & O-Ring
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pan drain plug (430) and O-ring (429).

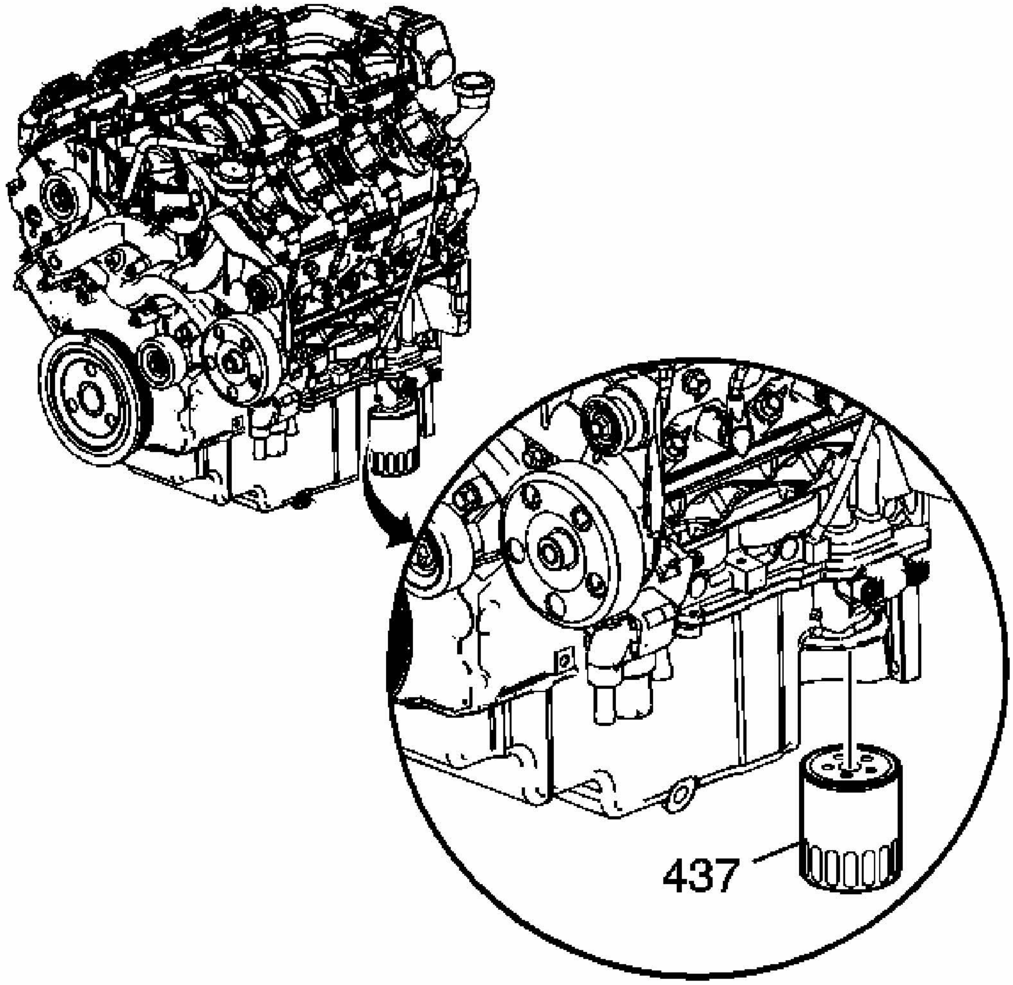


Fig. 323: View Of Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

2. Remove the engine oil filter (437).

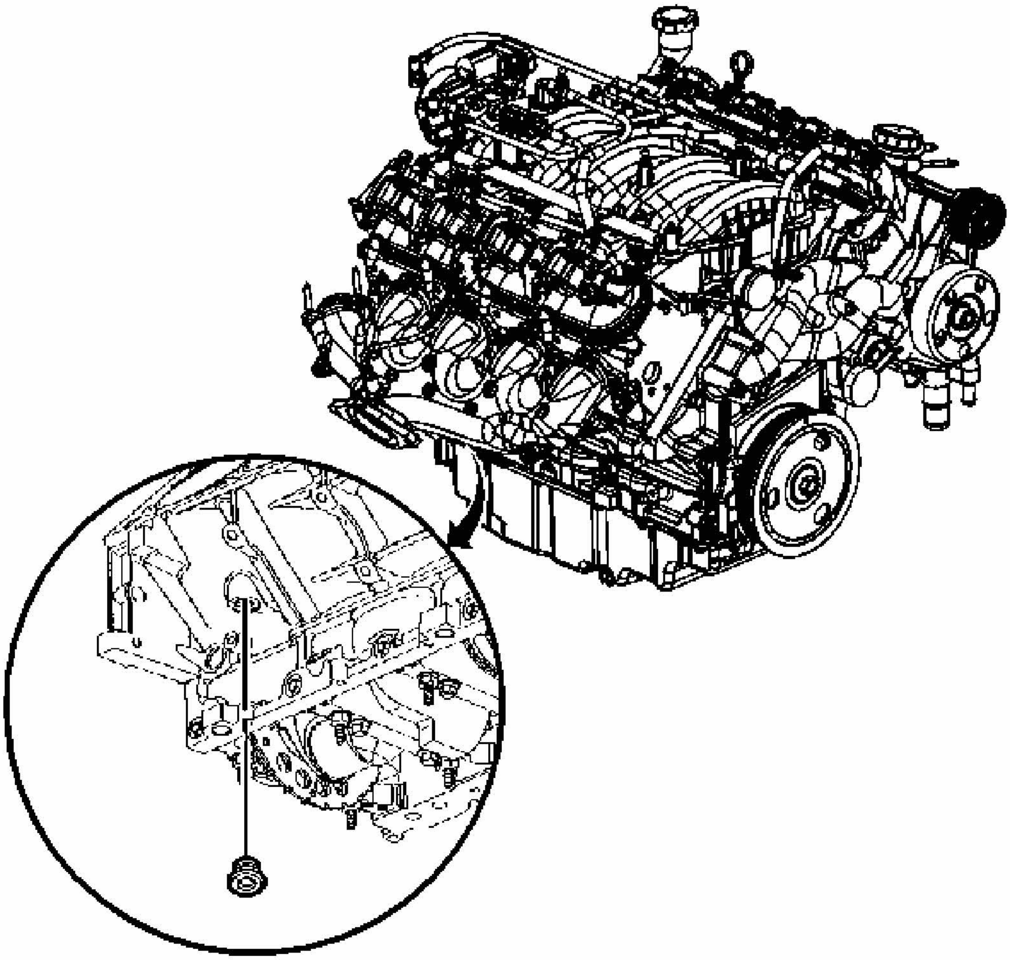


Fig. 324: Right Side Rear Engine Block Coolant Drain Hole Plug And Washer
Courtesy of GENERAL MOTORS CORP.

3. Remove the right side rear engine block coolant drain hole plug and washer.

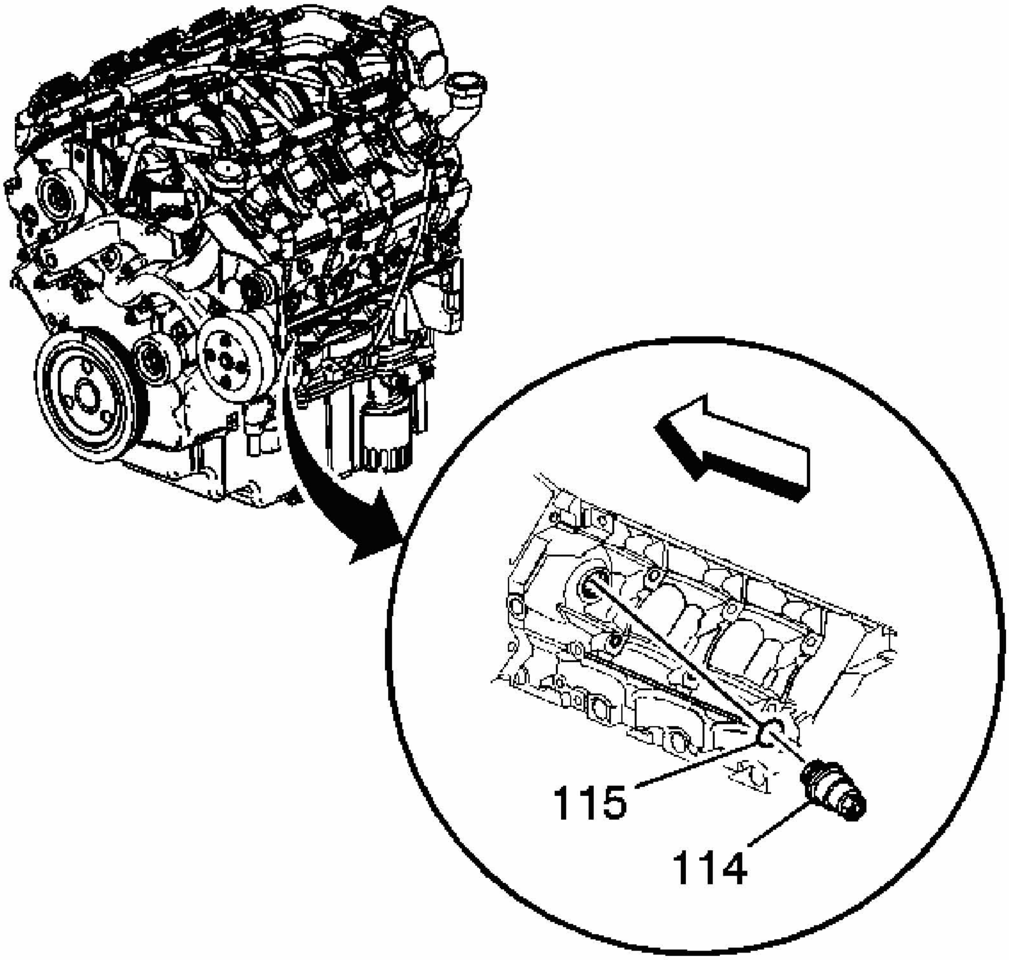


Fig. 325: Engine Block Coolant Heater & Washer
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine block coolant heater (114) and washer (115).

CRANKSHAFT BALANCER REMOVAL

Tools Required

- **J 41816** Crankshaft Balancer Remover
- **J 41816-2** Crankshaft End Protector. See **Special Tools**.
- **EN 47699** Flywheel Holding Tool. See **Special Tools**.

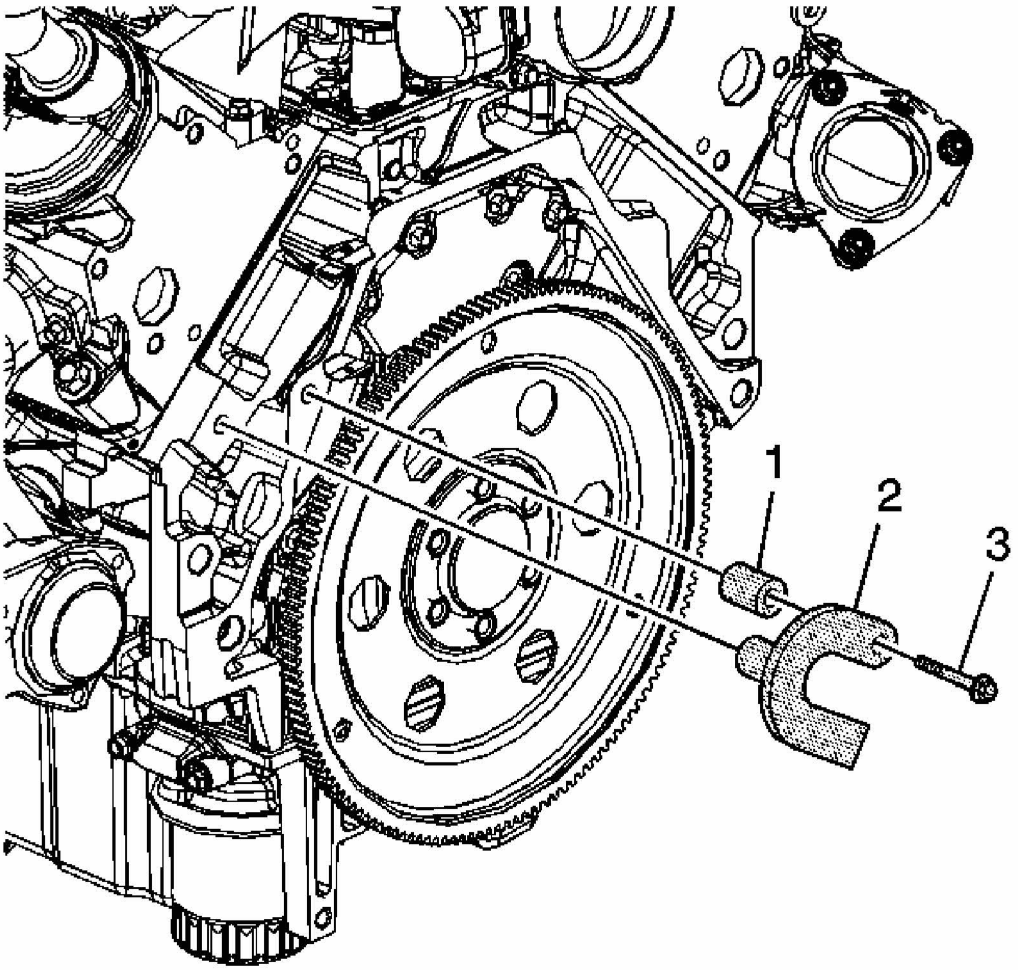


Fig. 326: Installing The EN 47699, Spacer, And Bolt
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not use the crankshaft balancer bolt again. Install a NEW crankshaft balancer bolt during final assembly.

1. Install the **EN 47699** (2), spacer (1), and bolt (3) to the block and flywheel. See **Special Tools**.

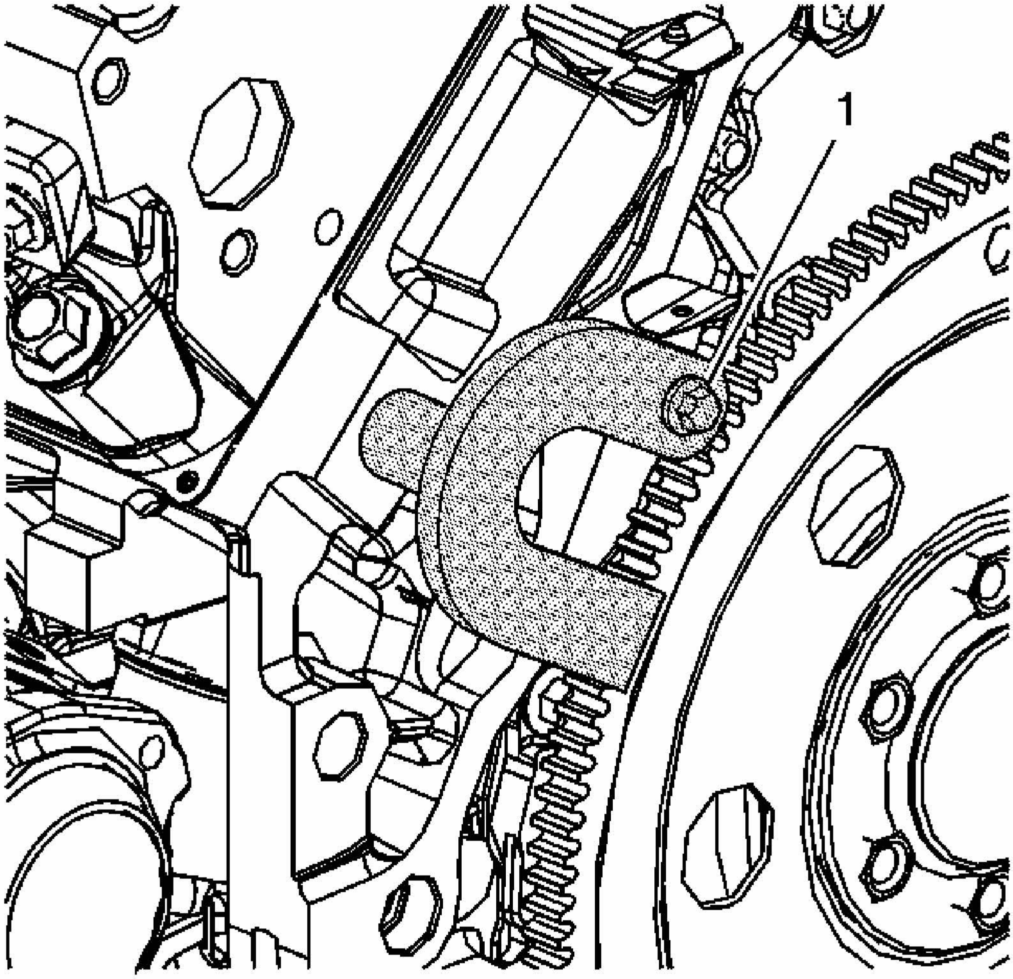


Fig. 327: Identifying Flywheel Holding Tool
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Tighten the **EN 47699** bolt (1). See **Special Tools**.

   Tighten: Tighten the bolt to 60 N.m (44 lb ft).

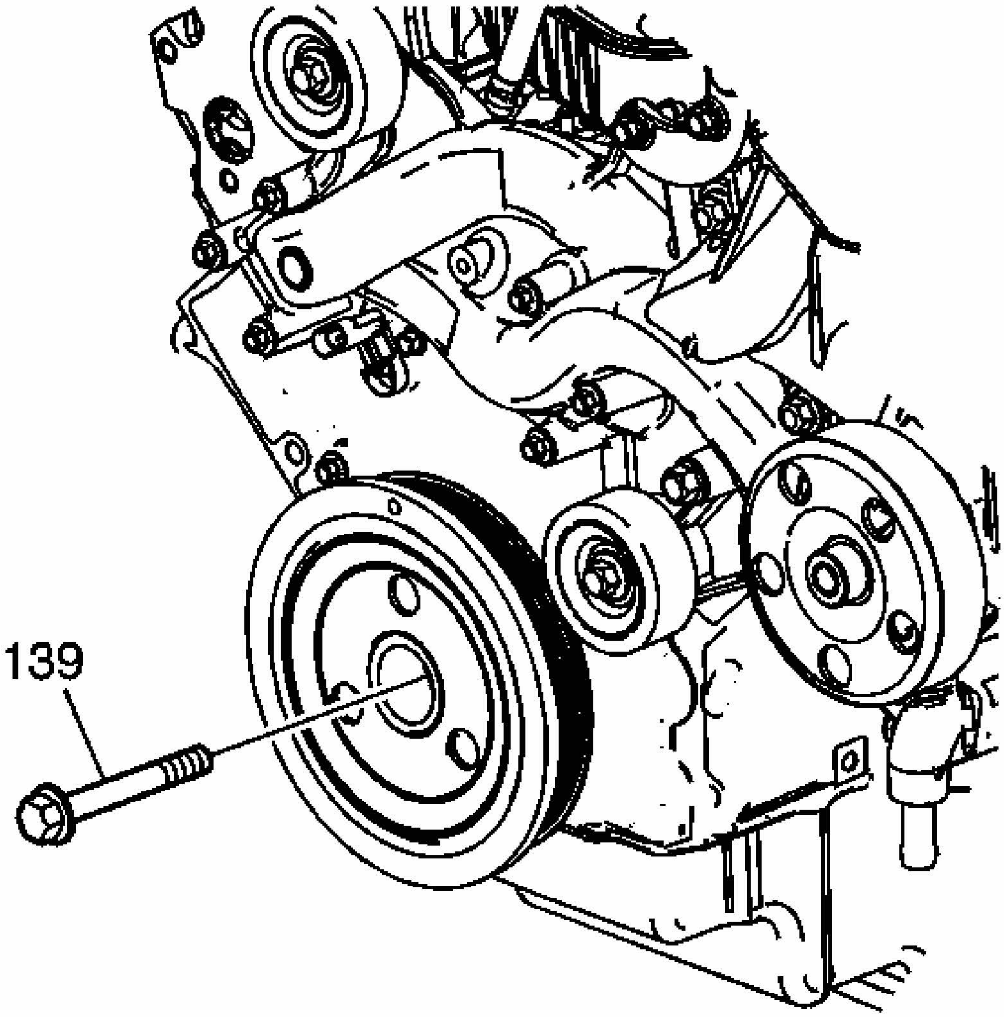


Fig. 328: View Of Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

3. Remove the crankshaft balancer bolt (139).

   Do not discard the crankshaft balancer bolt. The balancer bolt will be used during the balancer installation procedure.

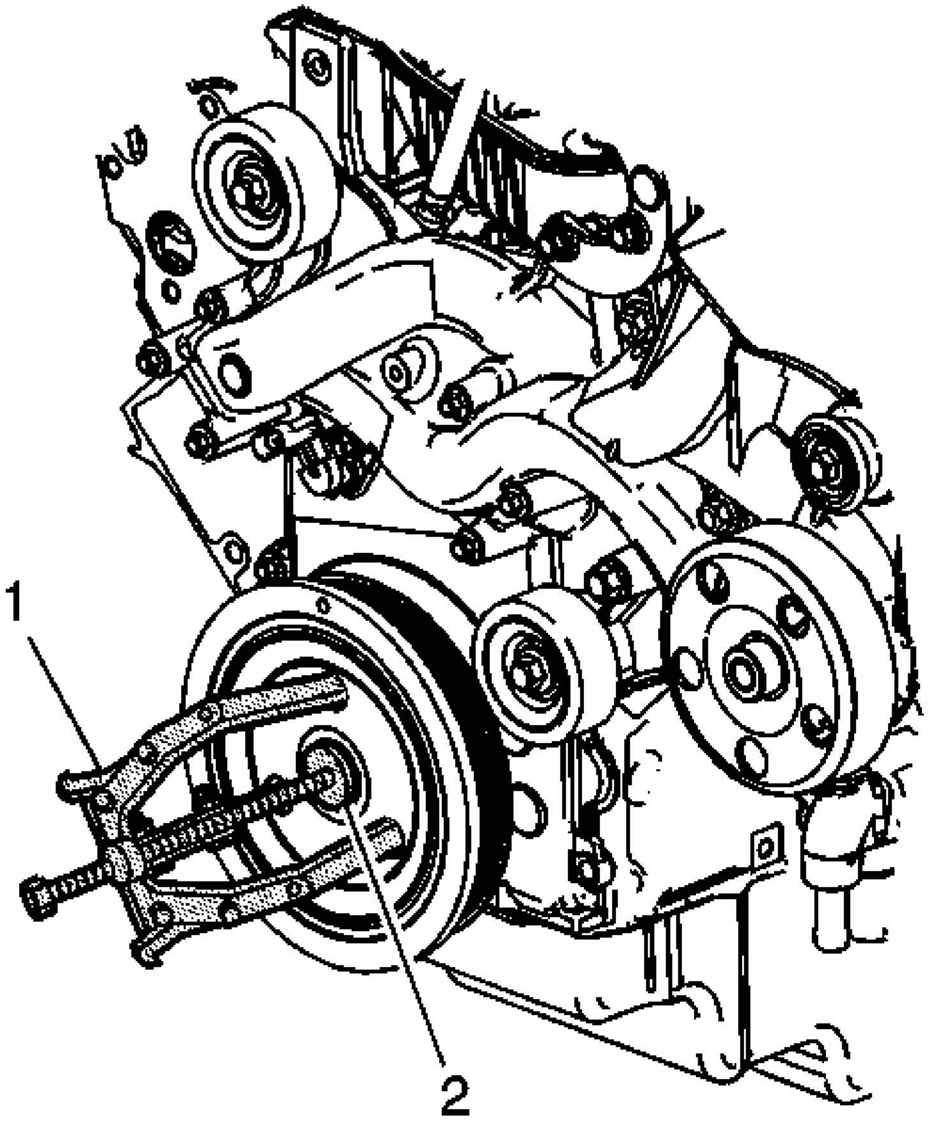


Fig. 329: Installing Special Tools To Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

4. Use the **J 41816** (1) and the **J 41816-2** (2) in order to remove the crankshaft balancer. See **Special Tools**.

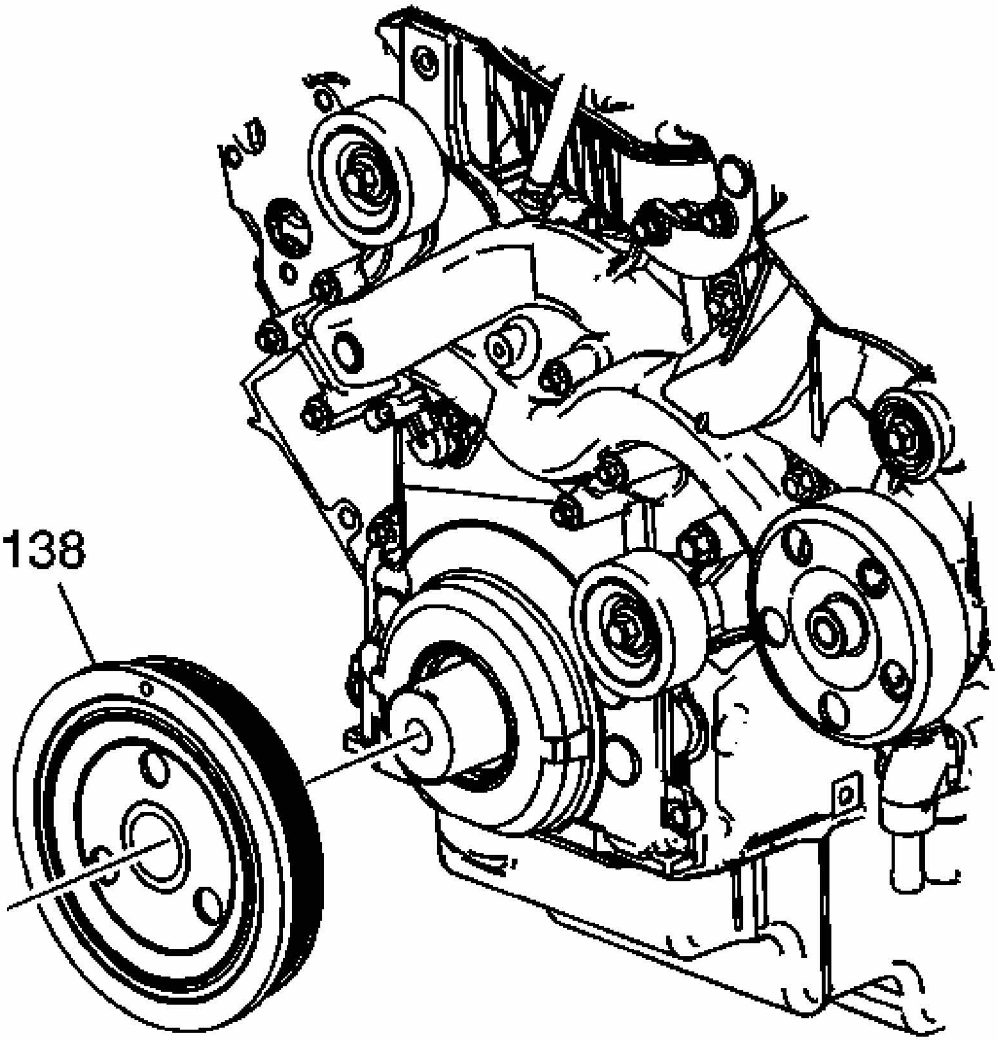


Fig. 330: View Of Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

5. Remove the crankshaft balancer (138).
6. Remove the **EN 47699** , bolt, and spacer. See **Special Tools**.

ENGINE FLYWHEEL REMOVAL

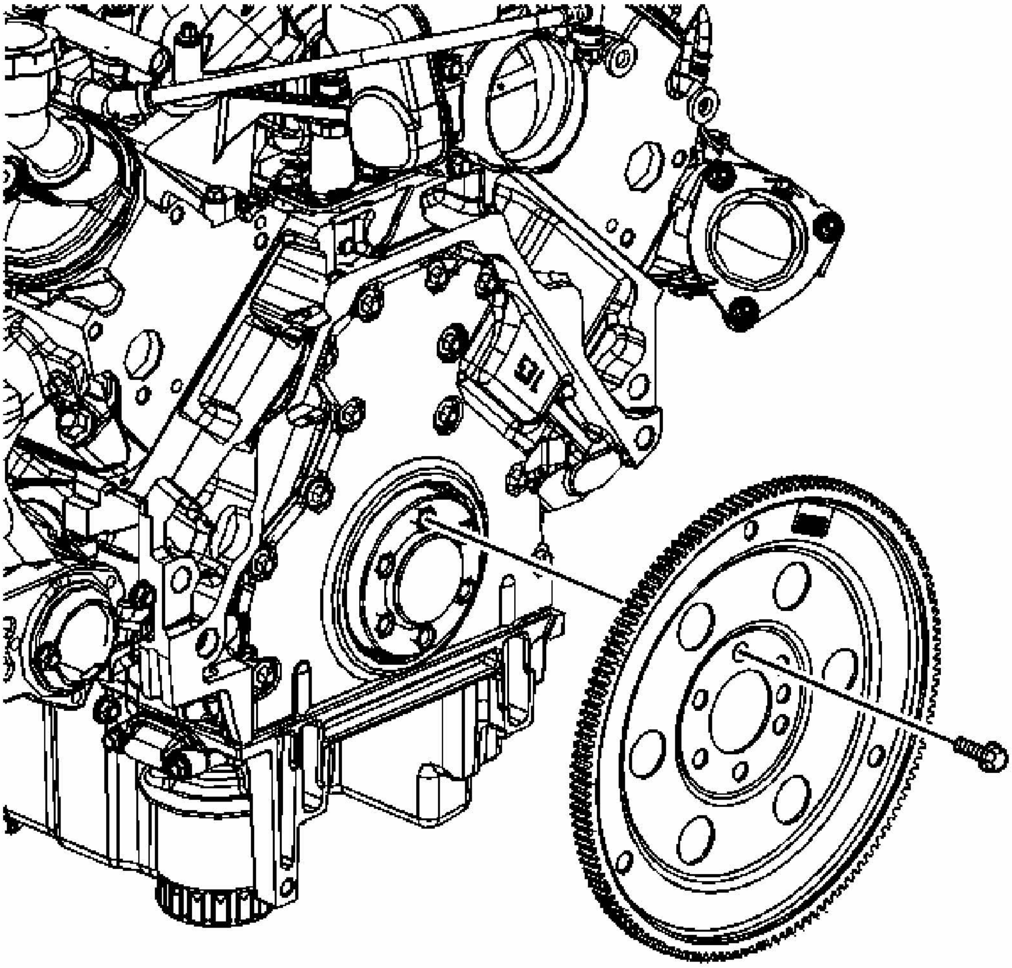


Fig. 331: Identifying Flywheel
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The flex plate does not use a locating pin for alignment and will not initially seat against the crankshaft flange, but will be pulled onto the crankshaft by the engine flex plate bolts. This procedure requires a 3 stage tightening process.

1. Remove the engine flex plate bolts.
2. Remove the flex plate.

OIL LEVEL INDICATOR AND TUBE REMOVAL

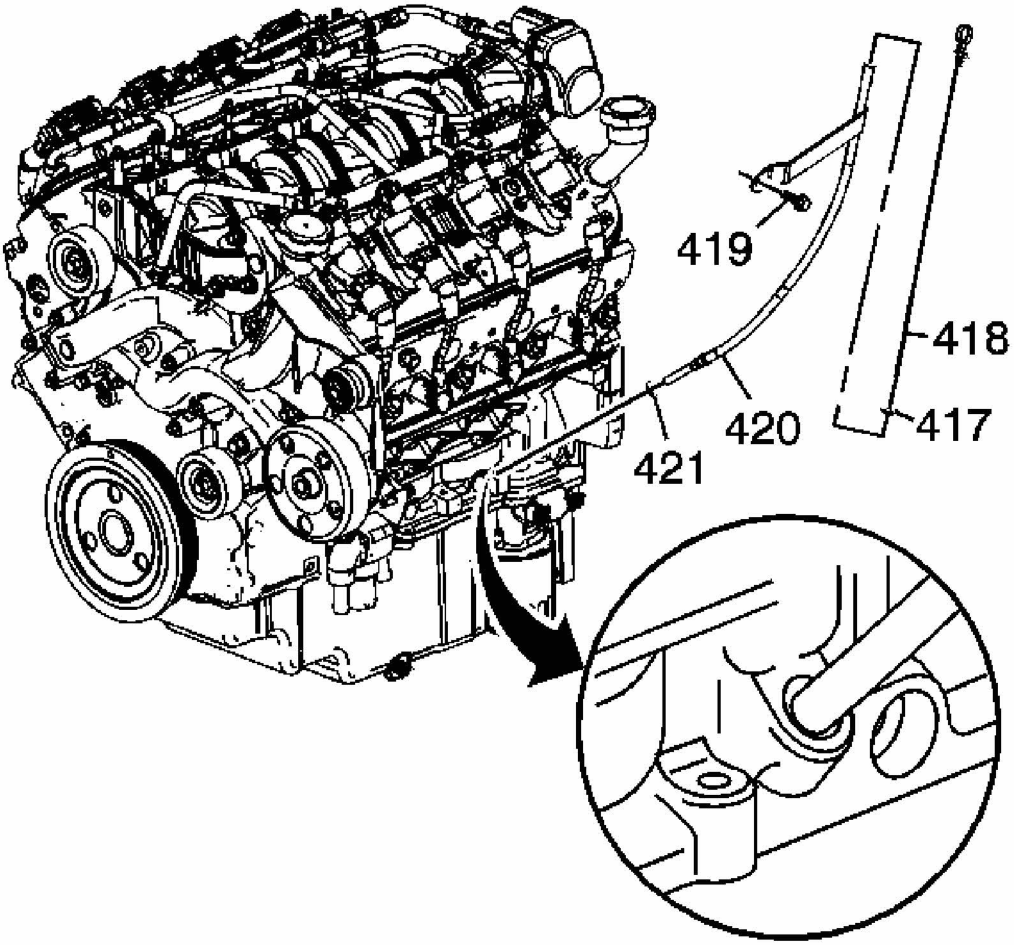


Fig. 332: View Of Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil level indicator (418) from the tube.
2. Remove the oil level indicator tube bolt (419).
3. Remove the oil level indicator tube (420).

IMPORTANT: Inspect the O-ring for cuts or damage. The O-ring may be used again if it is not cut or damaged.

4. Remove the O-ring (421) from the tube, as required.

EXHAUST MANIFOLD REMOVAL - LEFT

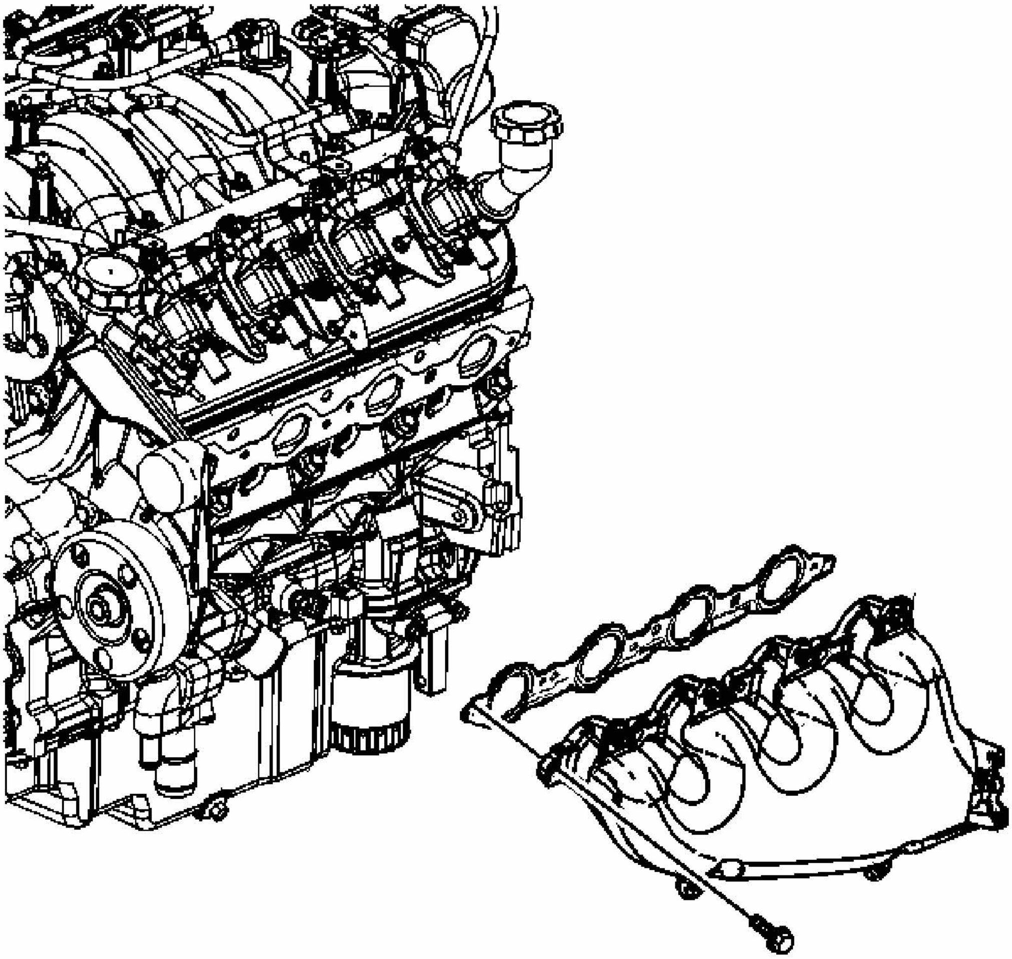


Fig. 333: View Of Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug wires from the spark plugs.
2. Remove the exhaust manifold, bolts, and gasket.
3. Discard the gasket.

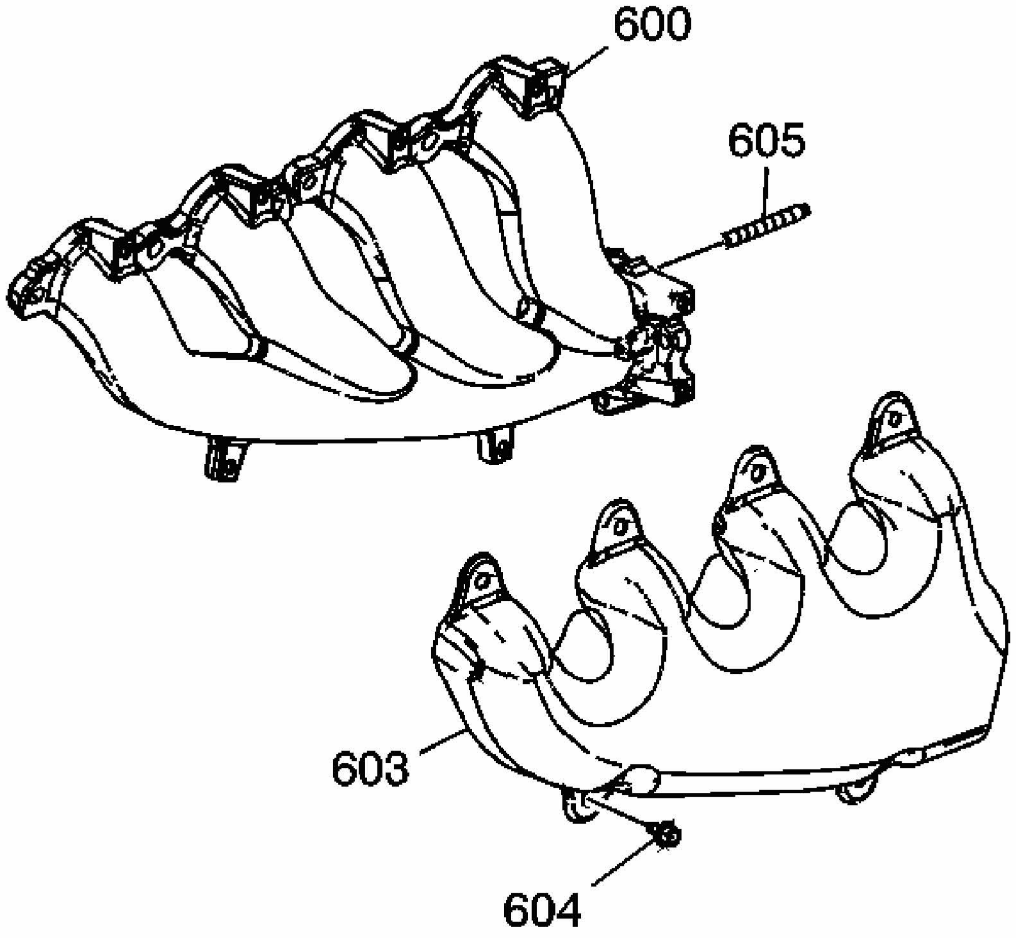


Fig. 334: View Of Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the heat shield (603) and bolts (604) from the manifold (600), as required.
5. Remove the studs (605), as required.

EXHAUST MANIFOLD REMOVAL - RIGHT

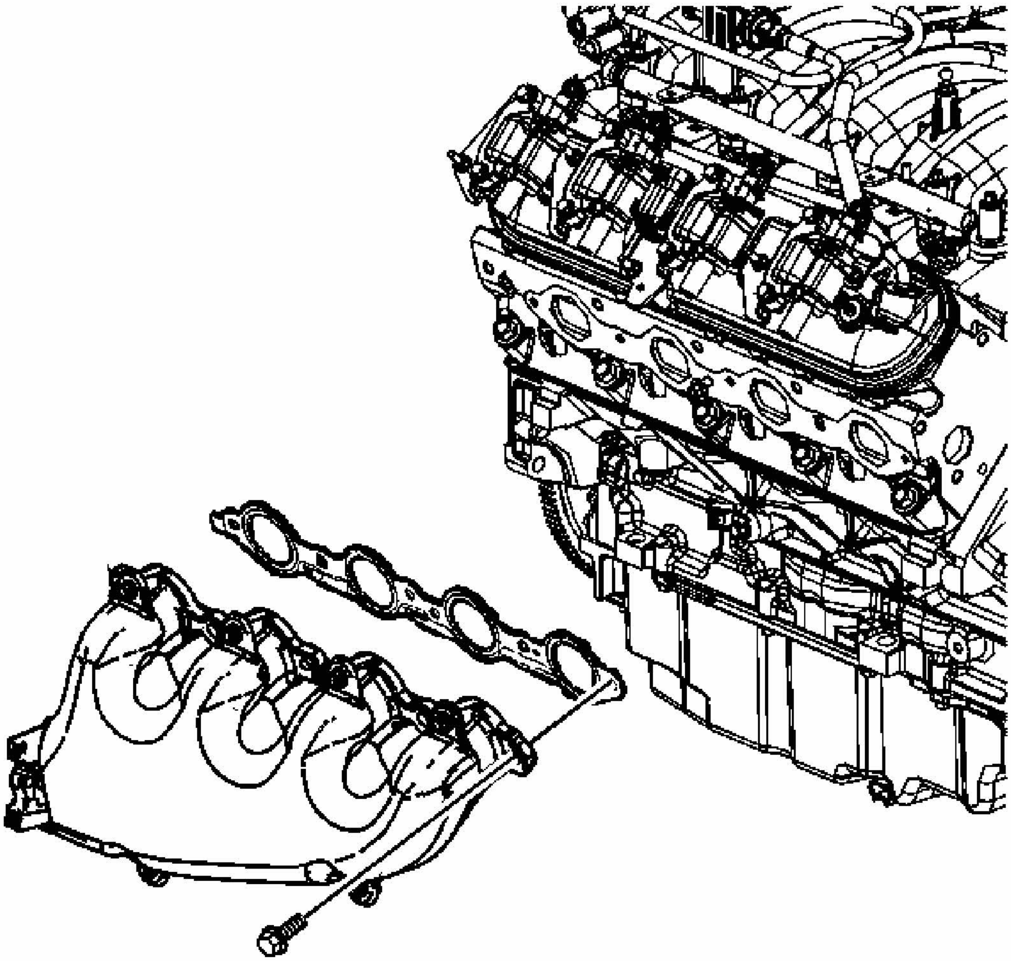


Fig. 335: View Of Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug wires from the spark plugs.
2. Remove the exhaust manifold, bolts, and gasket.
3. Discard the gasket.

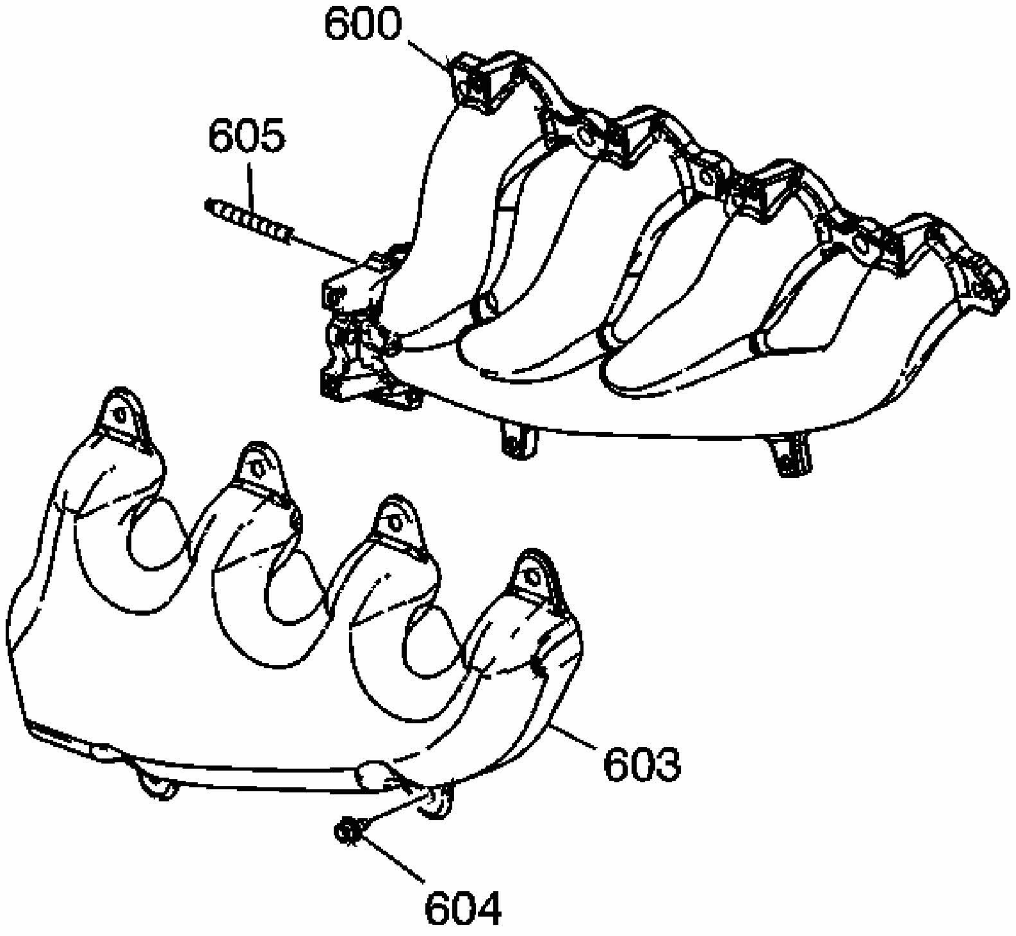


Fig. 336: View Of Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the heat shield (603) and bolts (604) from the manifold (600), as required.
5. Remove the studs (605), as required.

WATER PUMP REMOVAL

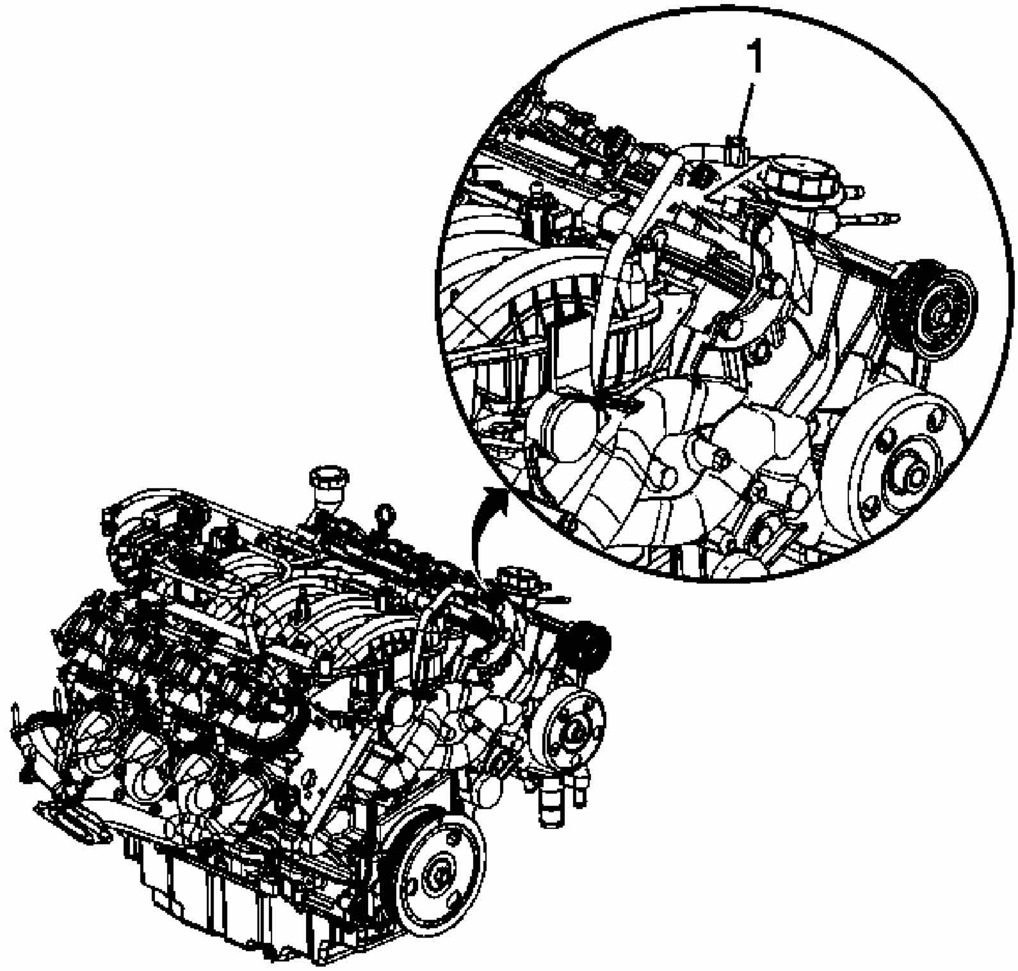


Fig. 337: Engine Coolant Air Bleed Hose And Clamp
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the engine coolant air bleed hose and clamp (1).

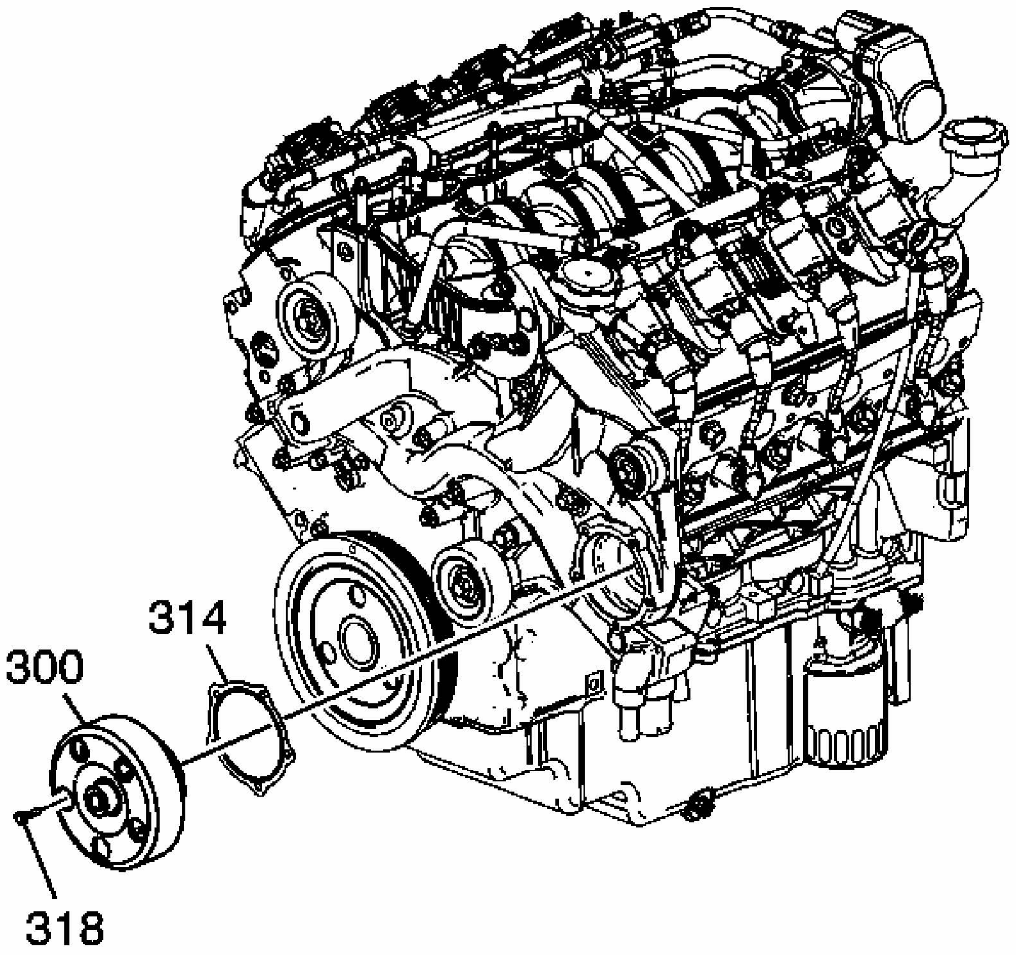


Fig. 338: Water Pump, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

2. Remove the water pump (300), bolts (318), and gasket (314).

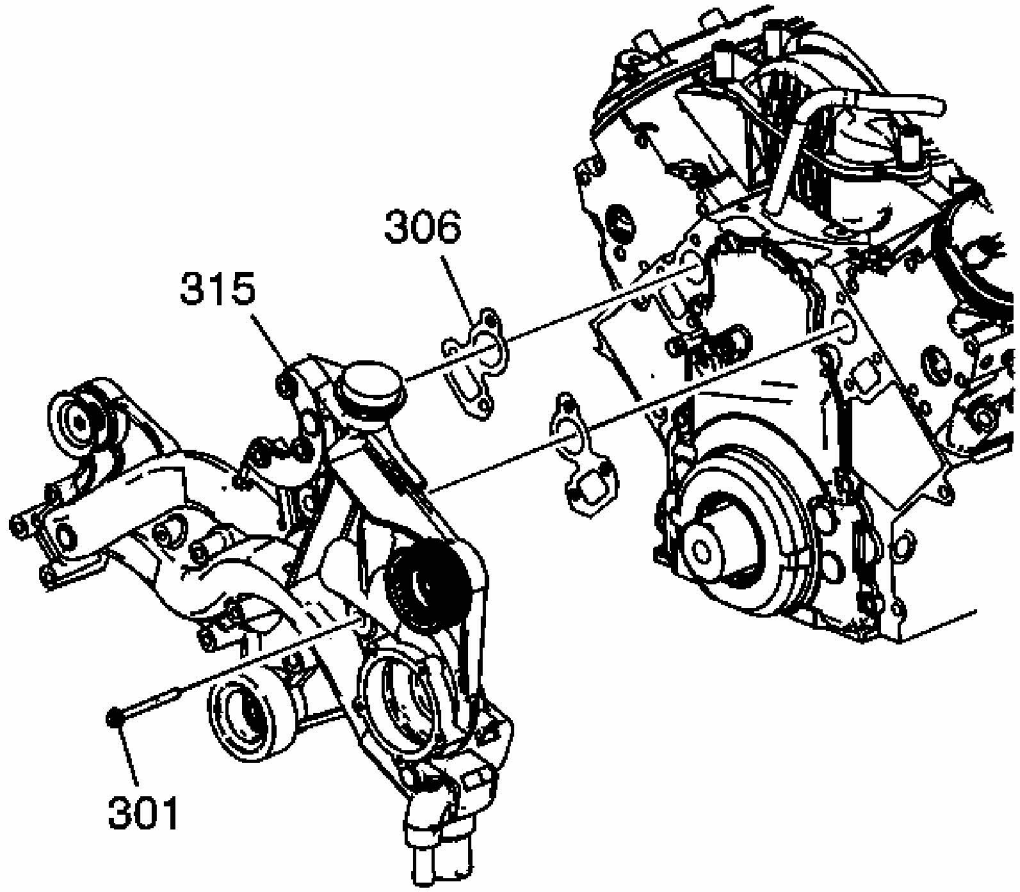


Fig. 339: Water Manifold, Bolts & Gaskets
Courtesy of GENERAL MOTORS CORP.

3. Remove the water manifold (315), bolts (301), and gaskets (306).

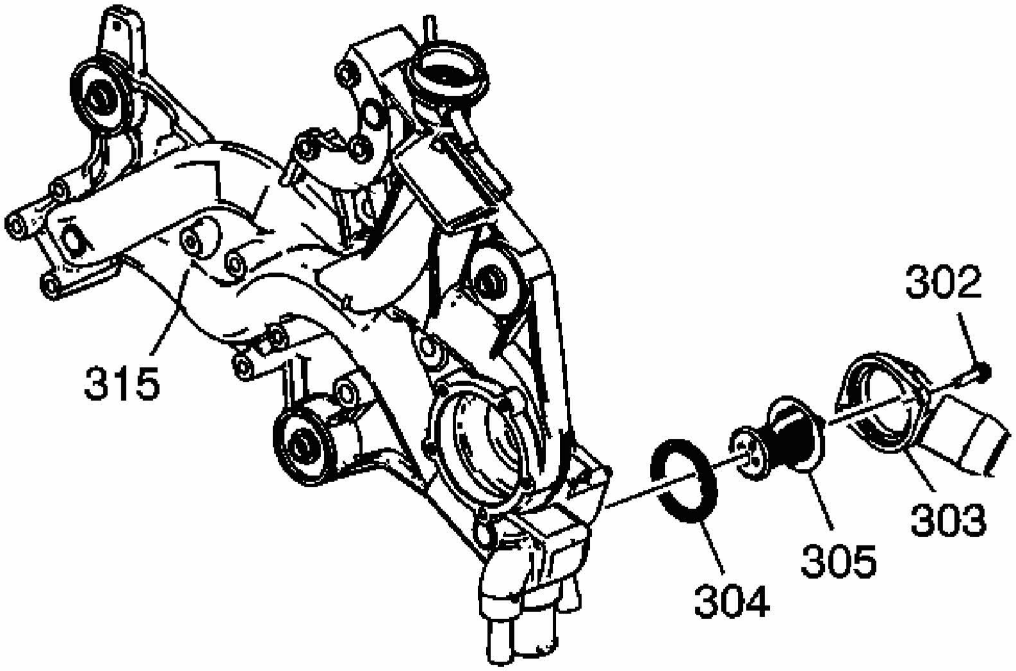


Fig. 340: View Of Thermostat Housing, Bolts, Thermostat, & O-Ring
Courtesy of GENERAL MOTORS CORP.

4. Remove the water inlet housing (303), bolts (302), thermostat (305), and O-ring (304), as required.
5. Discard the gaskets.

THROTTLE BODY REMOVAL

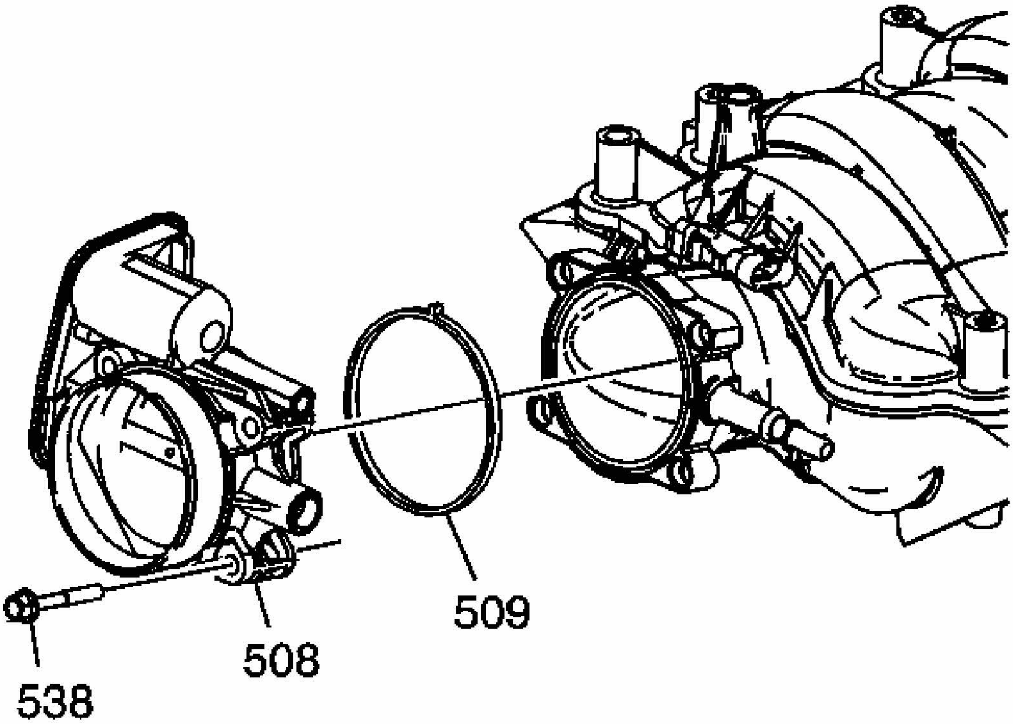


Fig. 341: Exploded View Of Throttle Body
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The intake manifold, throttle body, fuel injection rail, and fuel injectors may be removed as an assembly. If not servicing the individual components, remove the manifold as a complete assembly.

1. Remove the electrical wire harness connectors from the throttle body.
2. Remove the throttle body bolts (538).
3. Remove the throttle body (508).
4. Remove the throttle body gasket (509).
5. Discard the gasket.

FUEL RAIL AND INJECTORS REMOVAL

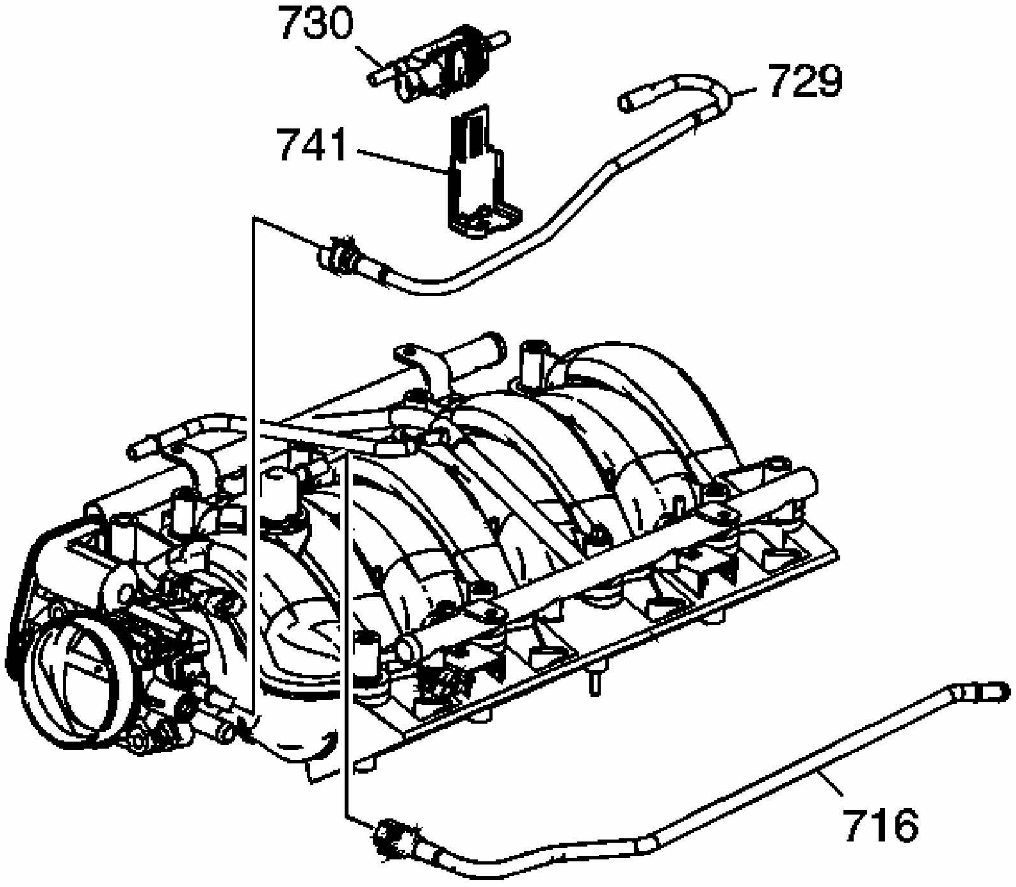


Fig. 342: View Of EVAP Purge Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fuel Rail Stop Bracket Installation Caution in Cautions and Notices.

NOTE:

- **Remove the fuel rail assembly carefully in order to prevent damage to the injector electrical connector terminals and the injector spray tips. Support the fuel rail after the fuel rail is removed in order to avoid damaging the fuel rail components.**
- **Cap the fittings and plug the holes when servicing the fuel system in order to prevent dirt and other contaminants from entering open pipes and passages.**

IMPORTANT: The intake manifold, throttle body, fuel injection rail and fuel injectors may be removed as an assembly. If not servicing the individual components, remove the intake manifold as a complete assembly.

1. Remove the positive crankcase ventilation (PCV) dirty air hose (716).
2. Remove the evaporative emission (EVAP) canister purge solenoid valve (730), bracket (741), and tube (729).

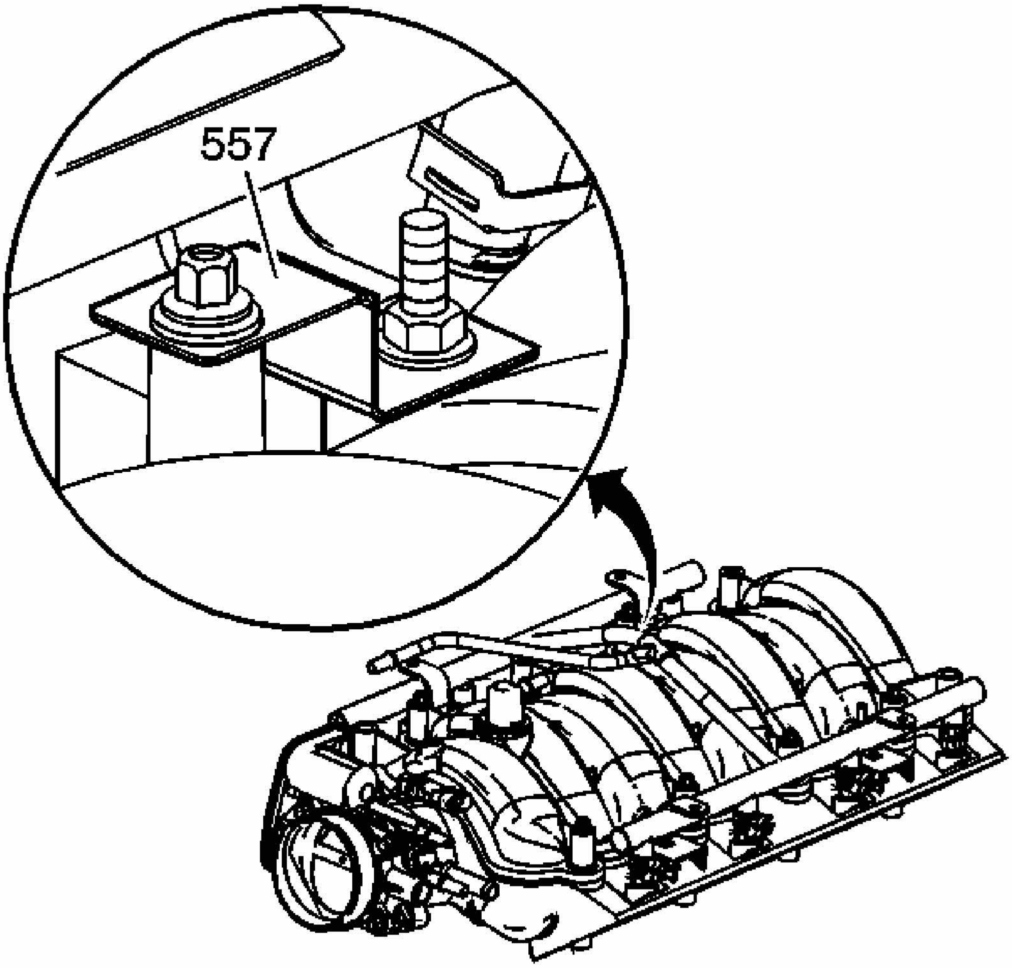


Fig. 343: Note The Location Of The Fuel Rail Ground Strap
Courtesy of GENERAL MOTORS CORP.

3. Note the location of the fuel rail ground strap (557).

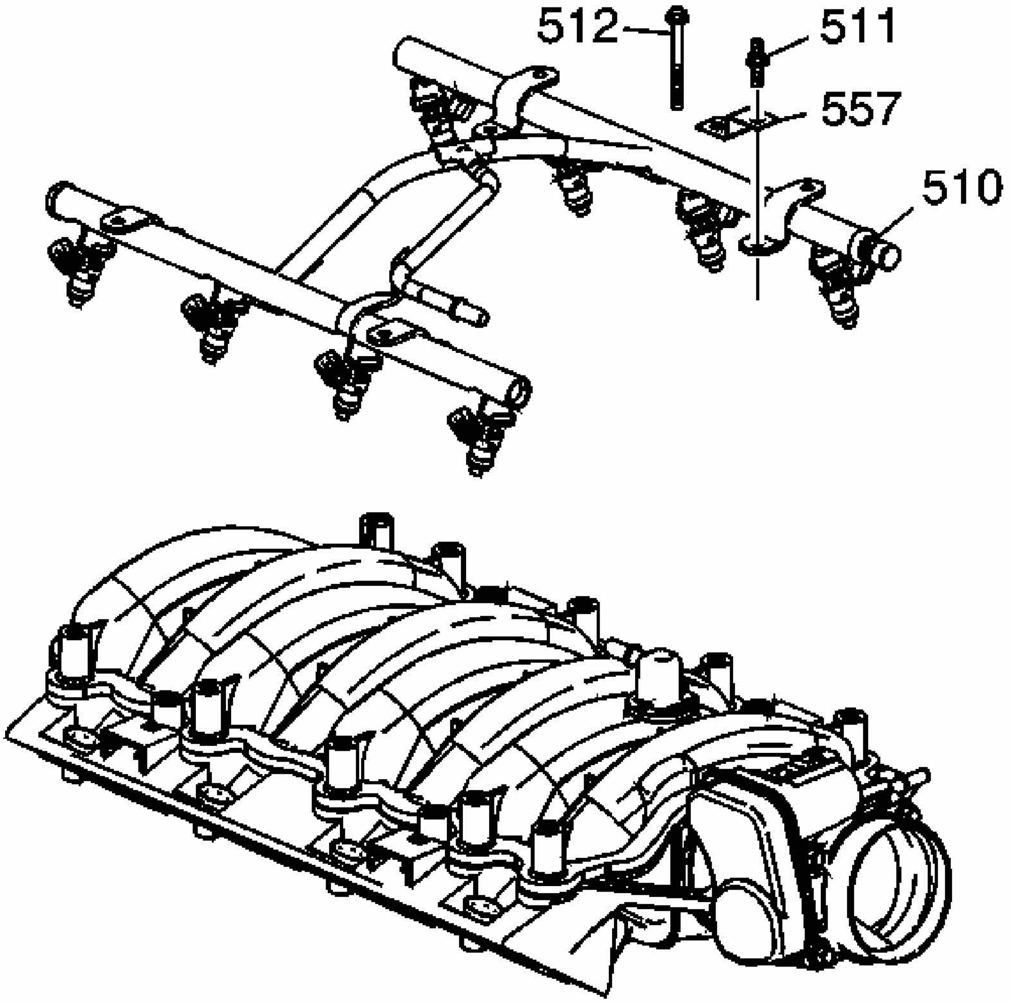


Fig. 344: View Of Fuel Rail Bolts, Ground Strap & Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the fuel rail bolts (511), ground strap (557), and manifold bolt (512).

IMPORTANT:	- **Do not separate the fuel injectors from the fuel rail, unless component service is required.** - **Use cleanliness and care when handling the fuel system components.** - **Do not allow dirt or debris to enter the fuel injectors or fuel rail components. Cap ends, as necessary.**

5. Remove the fuel rail (510) with injectors. Lift evenly on both sides of the fuel rail until

all injectors have left their bores.

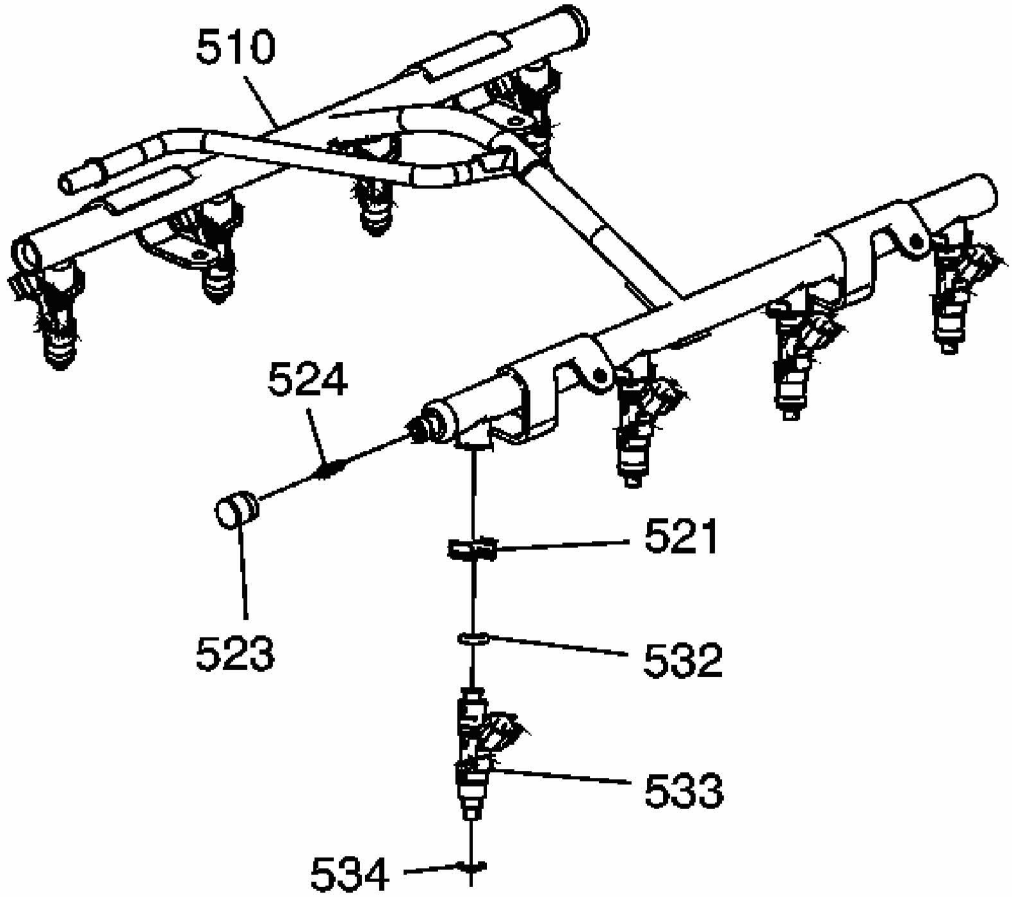


Fig. 345: View Of Fuel Rail With Injectors
Courtesy of GENERAL MOTORS CORP.

6. Remove the fuel injector retainers (521) and fuel injectors (533), as required.
7. Remove the O-rings (532, 534) from the injectors, as required.

INTAKE MANIFOLD REMOVAL

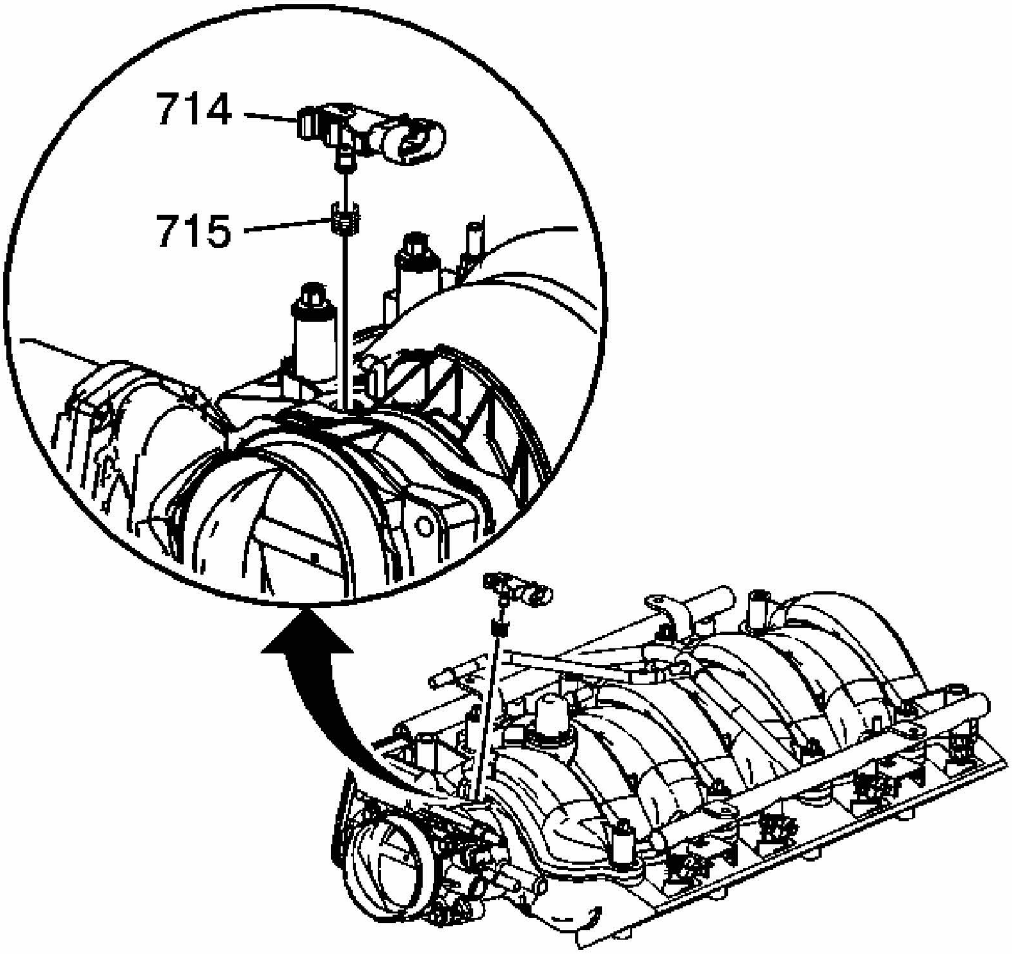


Fig. 346: View Of MAP Sensor
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **The intake manifold, throttle body, fuel injection rail, and fuel injectors may be removed as an assembly. If not servicing the individual components, remove the manifold as a complete assembly.**
- **DO NOT use the intake manifold-to-cylinder head gaskets again.**

1. Remove the manifold absolute pressure (MAP) sensor (714), as required.
2. Remove the grommet (715) from the sensor, as required.

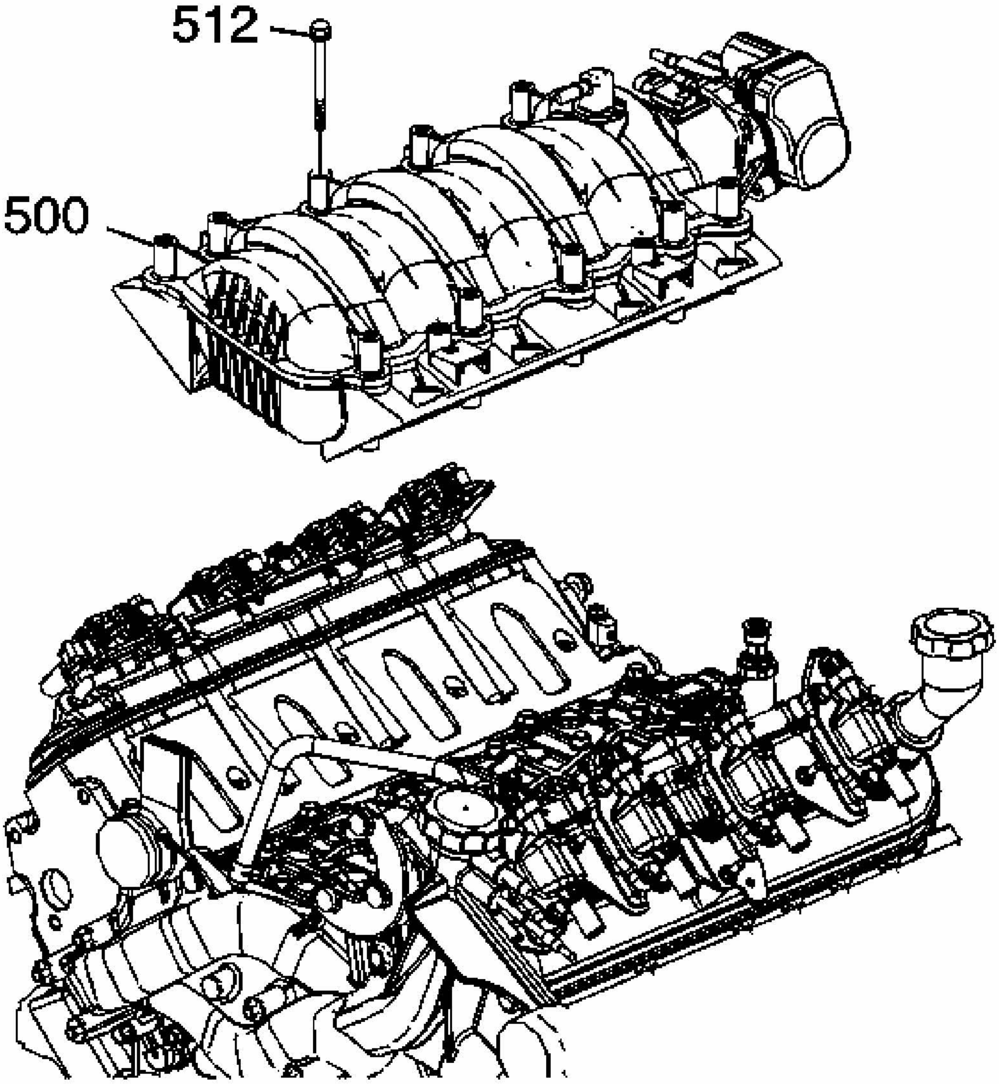


Fig. 347: View Of The Intake Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the intake manifold bolts (512).
4. Remove the intake manifold (500).

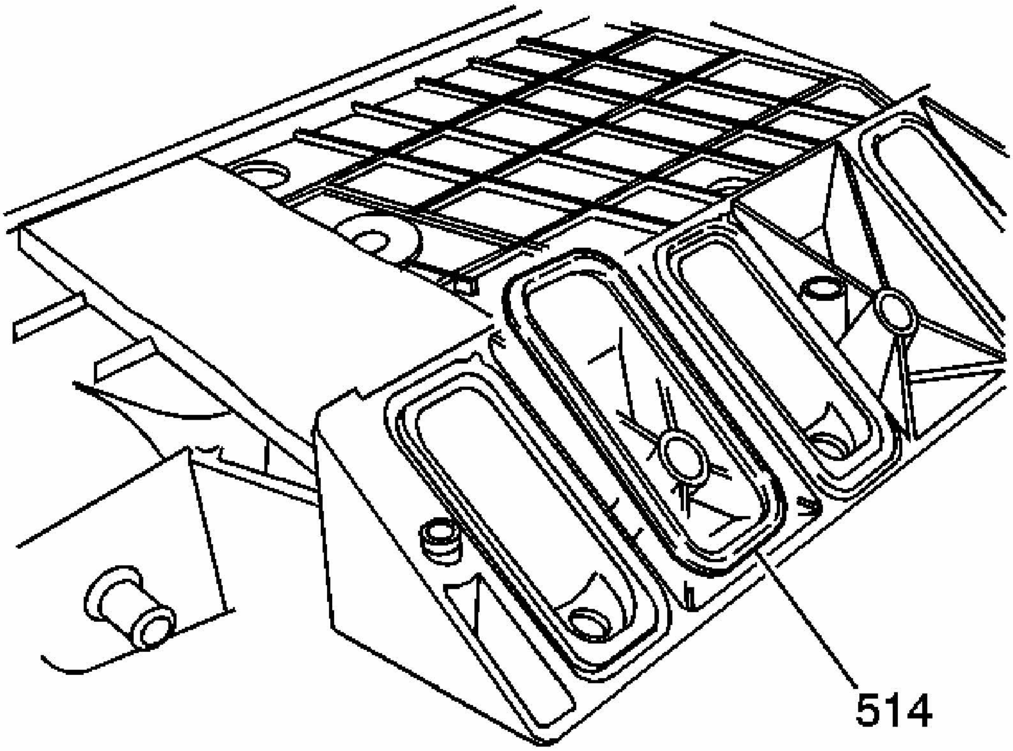


Fig. 348: View Of Intake Manifold-To-Cylinder Head Gaskets
Courtesy of GENERAL MOTORS CORP.

5. Remove the intake manifold gaskets (514).
6. Discard the intake manifold gaskets.

COOLANT AIR BLEED PIPE REMOVAL

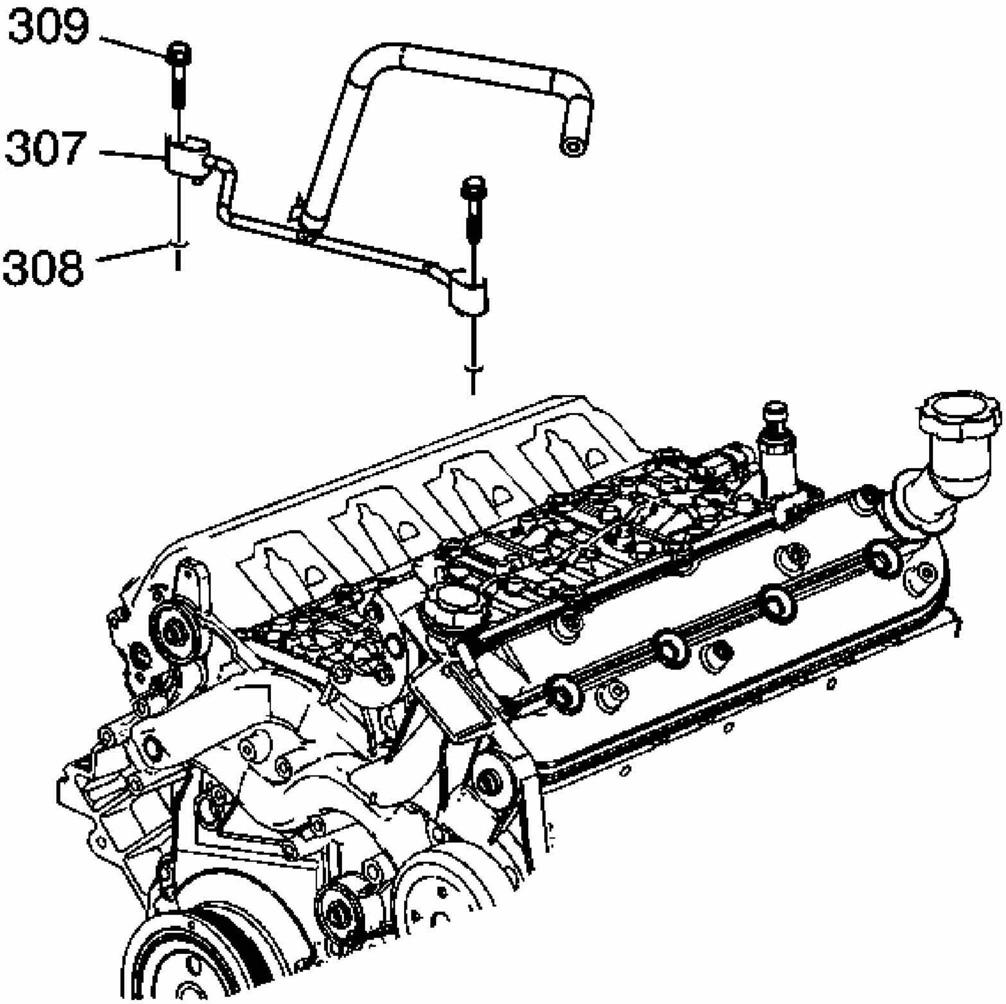


Fig. 349: View Of Coolant Air Bleed Pipe & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine coolant air bleed pipe bolts (309).
2. Remove the pipe (307) with hose and seals (308).

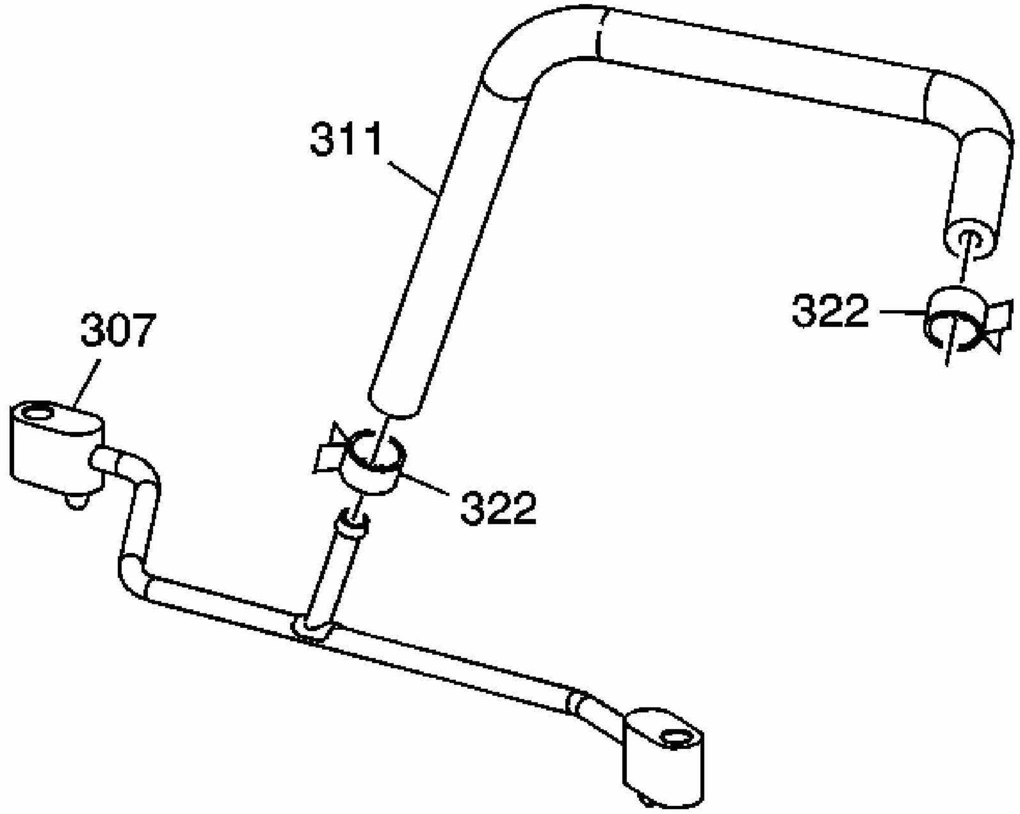


Fig. 350: View Of Coolant Air Bleed Pipe & Clamp
Courtesy of GENERAL MOTORS CORP.

3. Remove the hose (311) and clamps (322) from the pipe (307), as required.

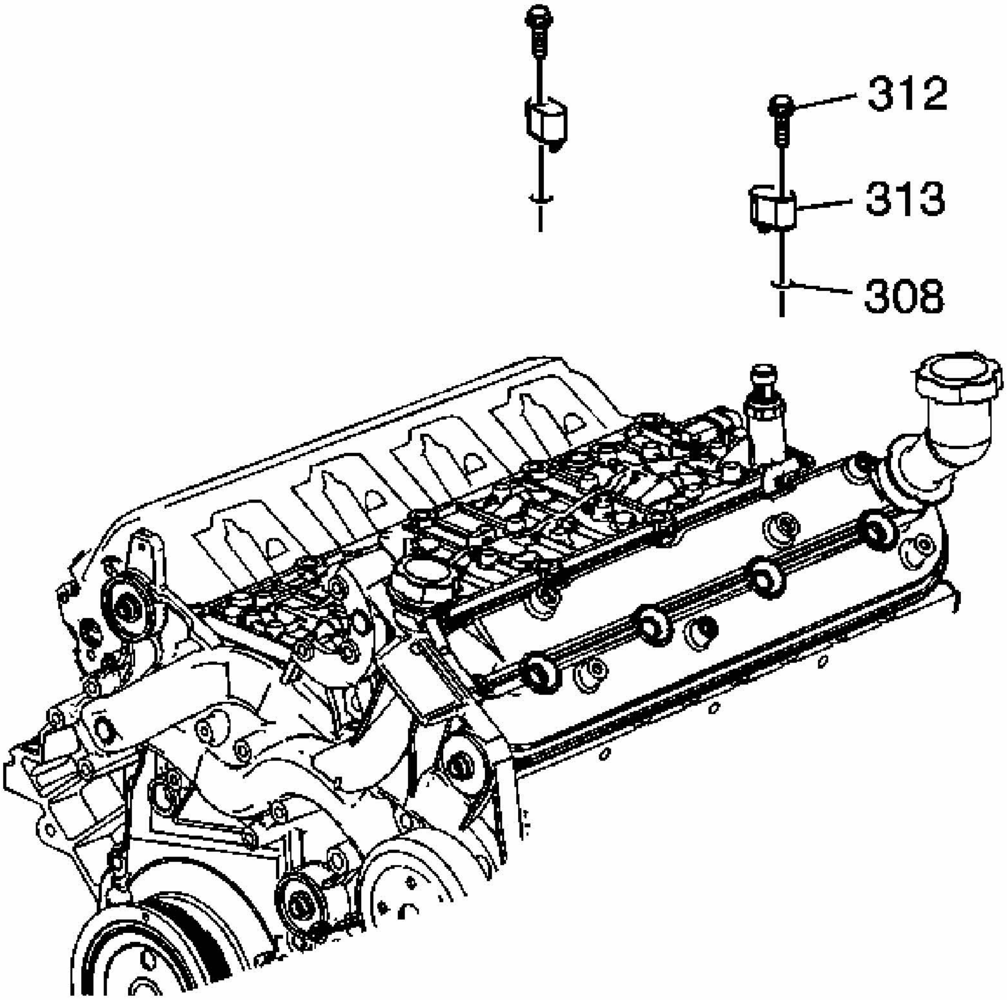


Fig. 351: View Of Engine Coolant Air Bleed Cover, Bolts & Gaskets
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine coolant air bleed cover bolts (312).
5. Remove the covers (313) with seals (308).

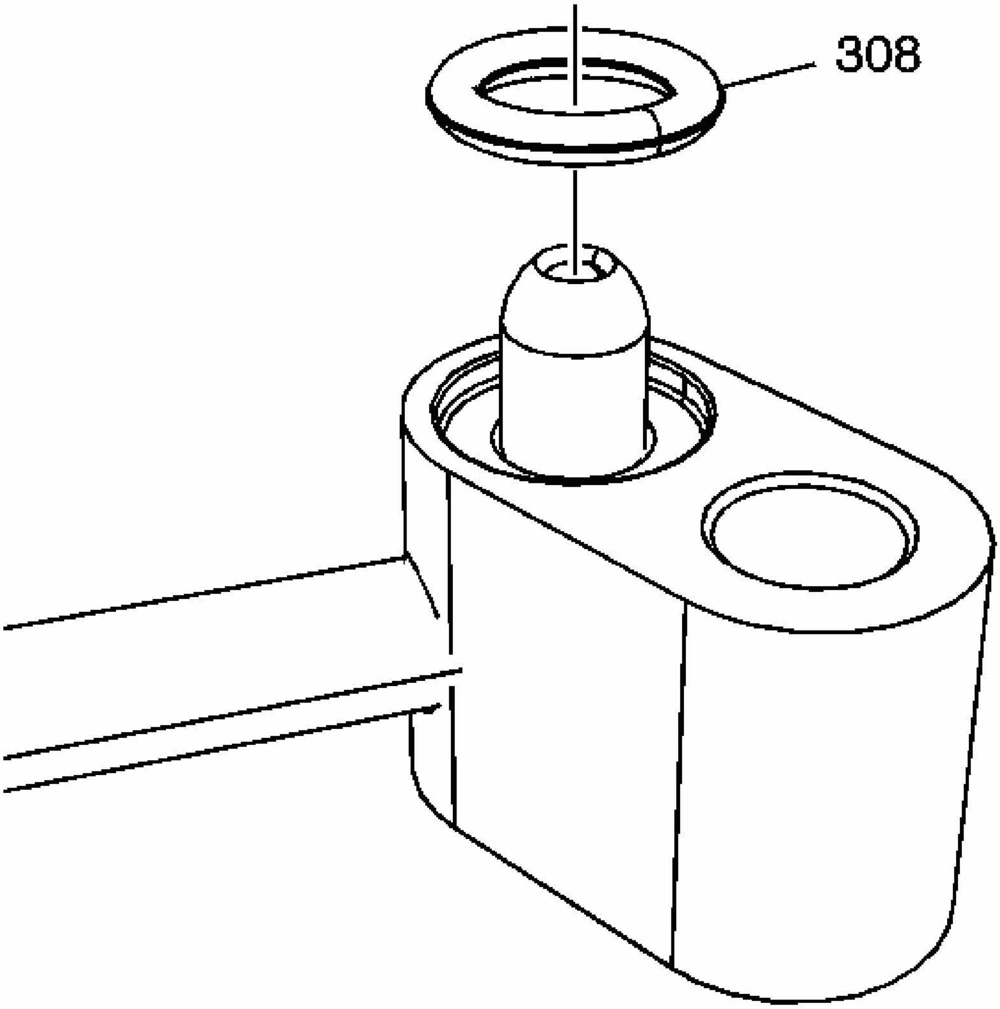


Fig. 352: View Of Coolant Air Bleed Pipe Seal
Courtesy of GENERAL MOTORS CORP.

6. Remove the seals (308) from the pipe and covers.
7. Discard the seals.

VALVE LIFTER OIL MANIFOLD REMOVAL

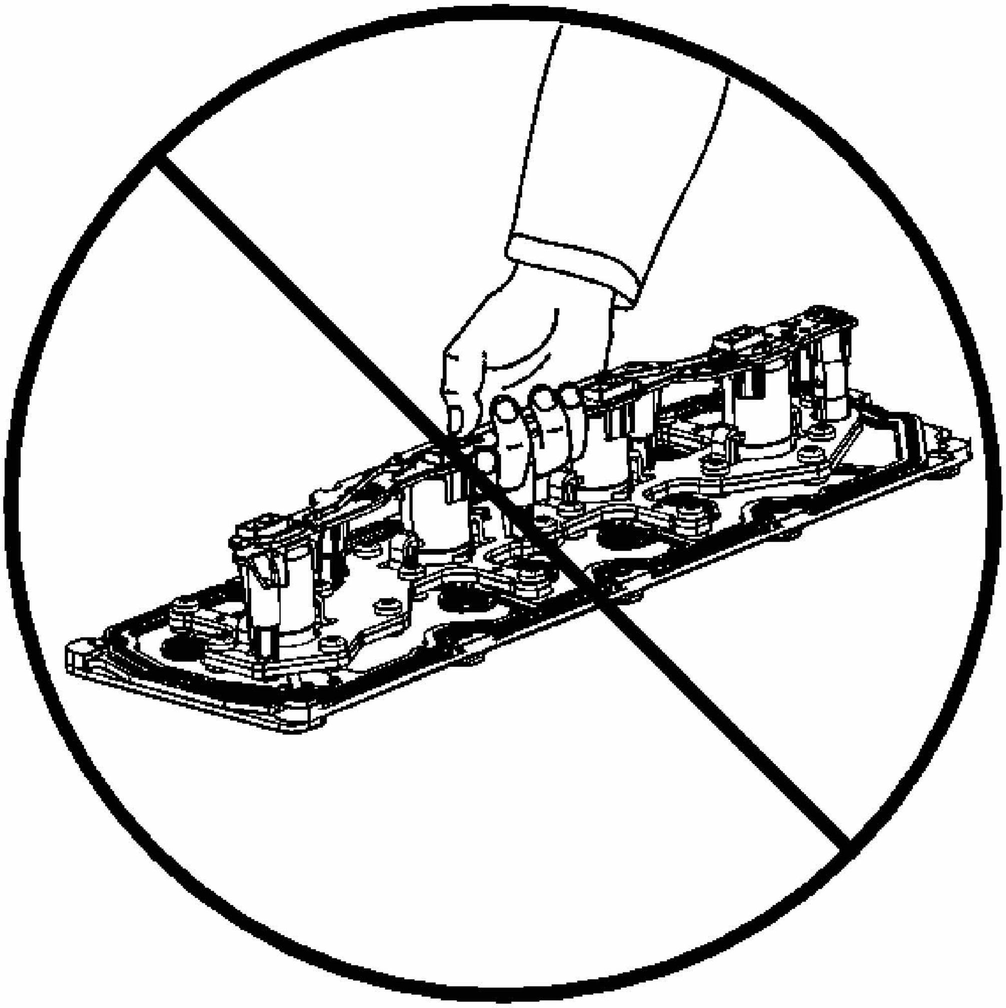


Fig. 353: Valve Lifter Oil Manifold
Courtesy of GENERAL MOTORS CORP.

1. Do not lift the manifold assembly by the electrical lead frame.

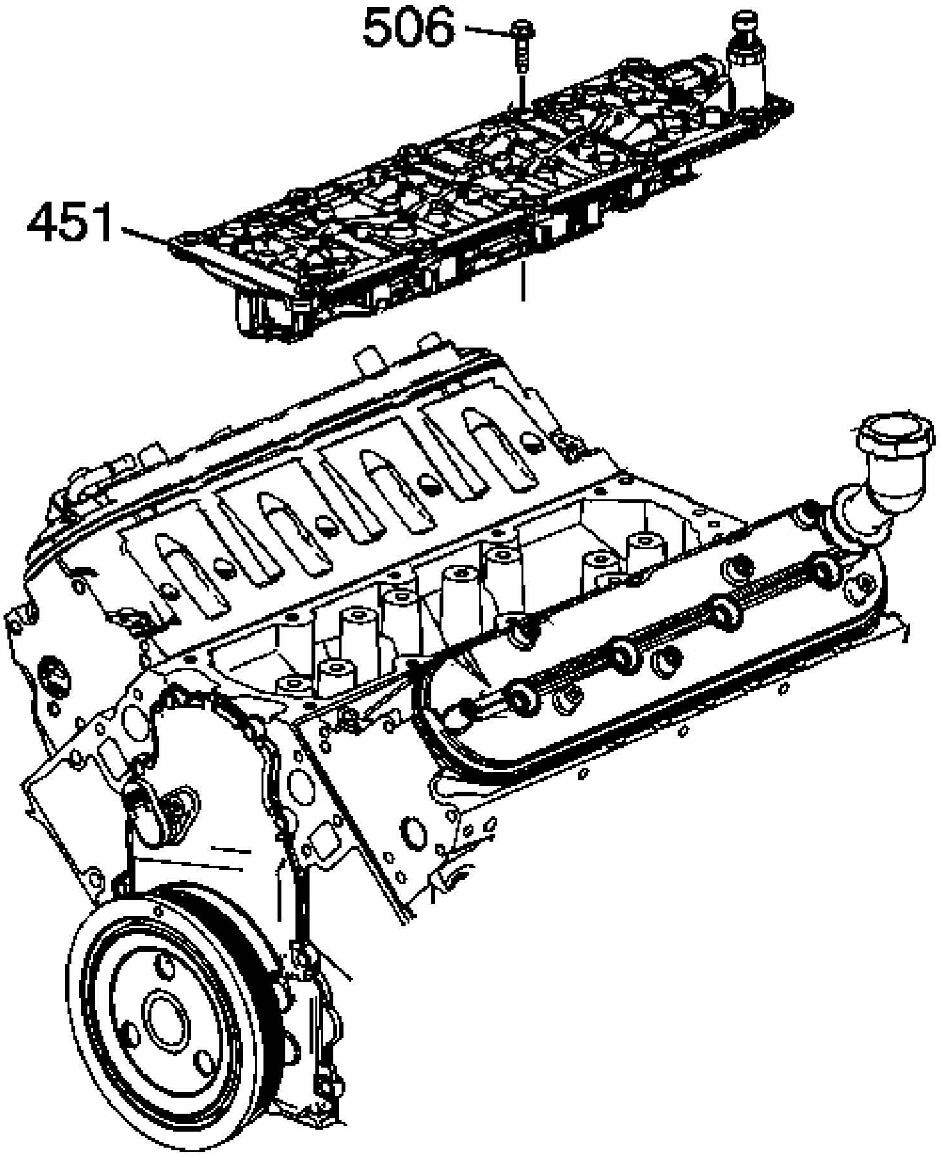


Fig. 354: View Of Valve Lifter Oil Manifold & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Remove the valve lifter oil manifold bolts (506).

IMPORTANT: Do not allow dirt or debris to enter the oil passages of the manifold. Plug, as required.

3. Remove the valve lifter oil manifold (451).

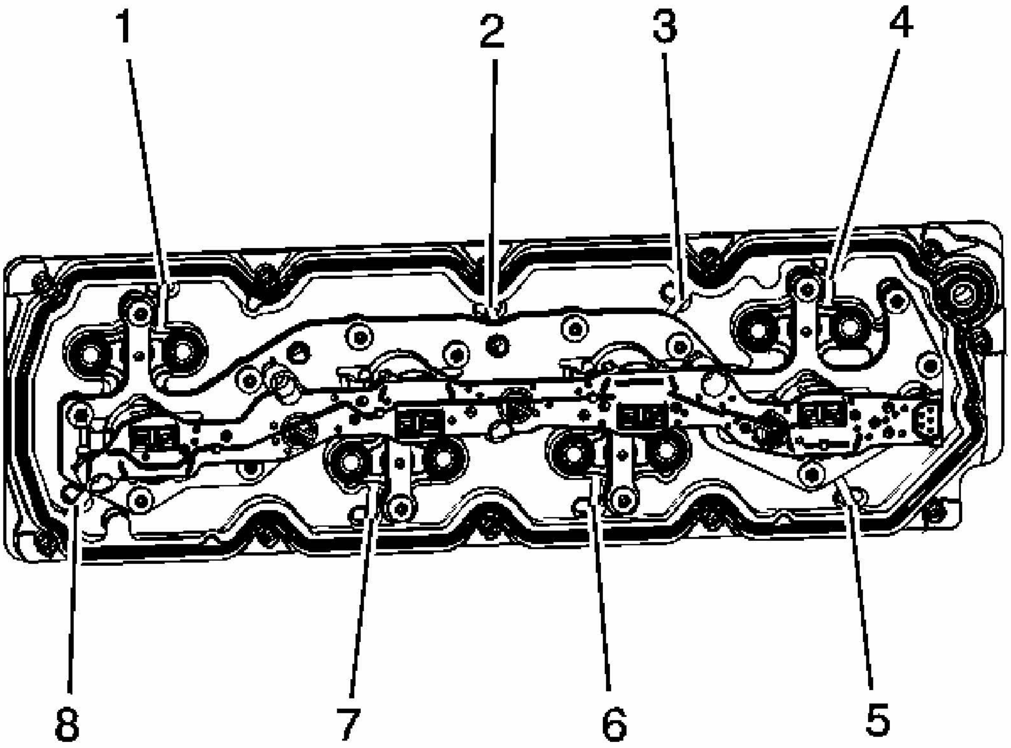


Fig. 355: Gasket Retaining Strap Locations
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **Remove only the outer gasket from the manifold. Do not disassemble any of the internal components of the manifold in an attempt to remove the 8 inner sealing gaskets. If the inner gaskets are cut or damaged, replace the manifold as an assembly. Only use a wire-cutter type tool in order to minimize the amount of debris. Do not use a rotary-type cutting tool on the retaining straps.**

4. Identify the 8 gasket retaining strap locations.

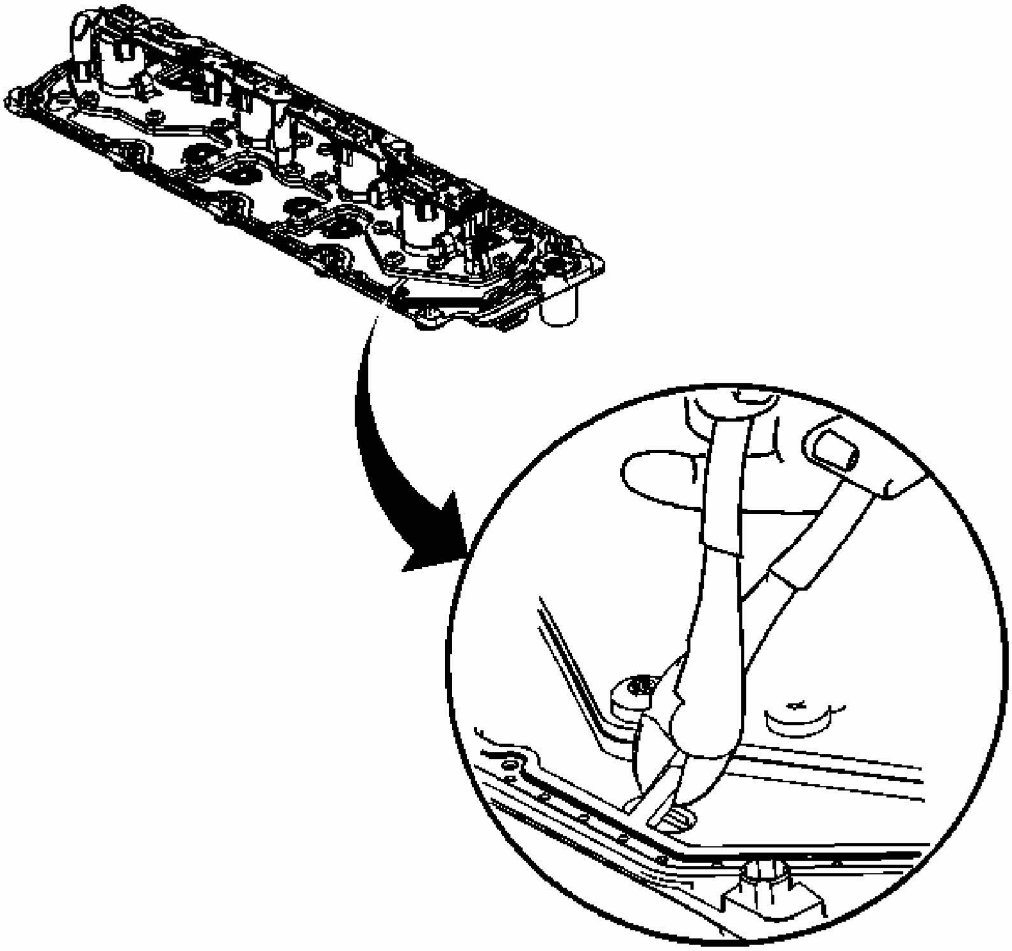


Fig. 356: Cutting Retaining Straps On Outer Gasket
Courtesy of GENERAL MOTORS CORP.

5. Using a wire-cutter type tool, snip the 8 retaining straps of the outer gasket.

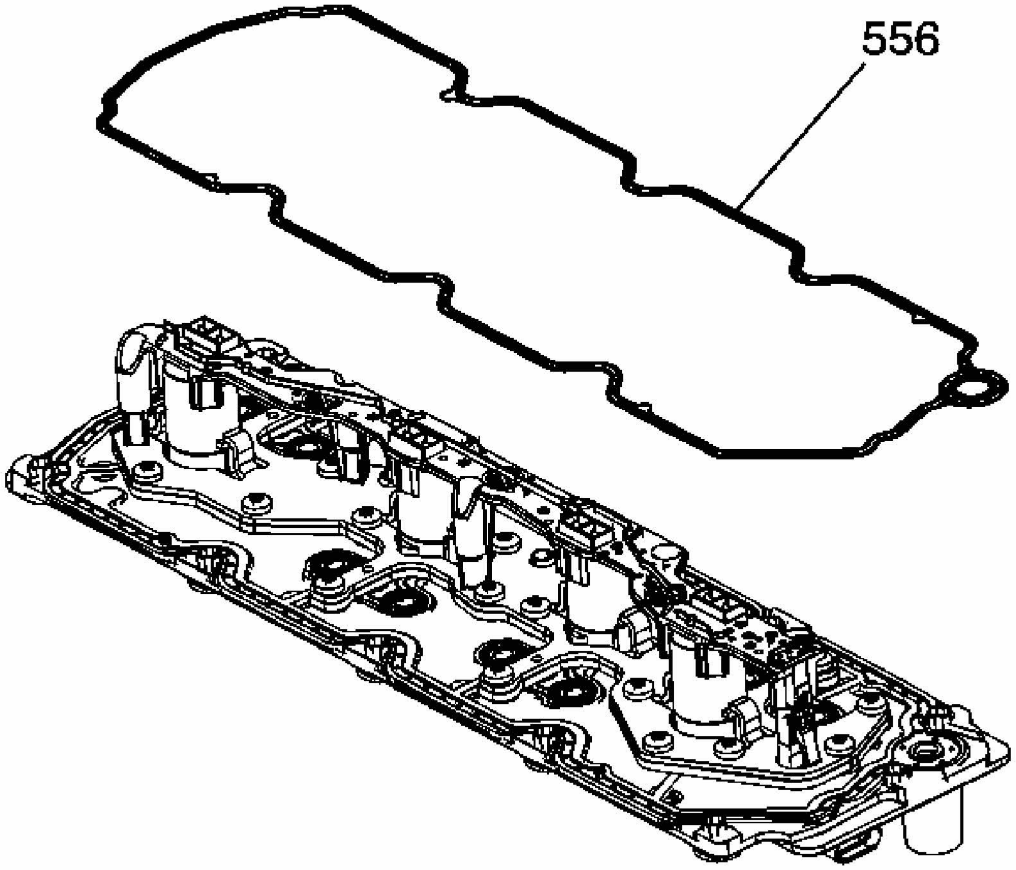


Fig. 357: View Of Outer Gasket
Courtesy of GENERAL MOTORS CORP.

6. Remove the outer gasket (556) from the manifold.

VALVE LIFTER OIL FILTER REMOVAL

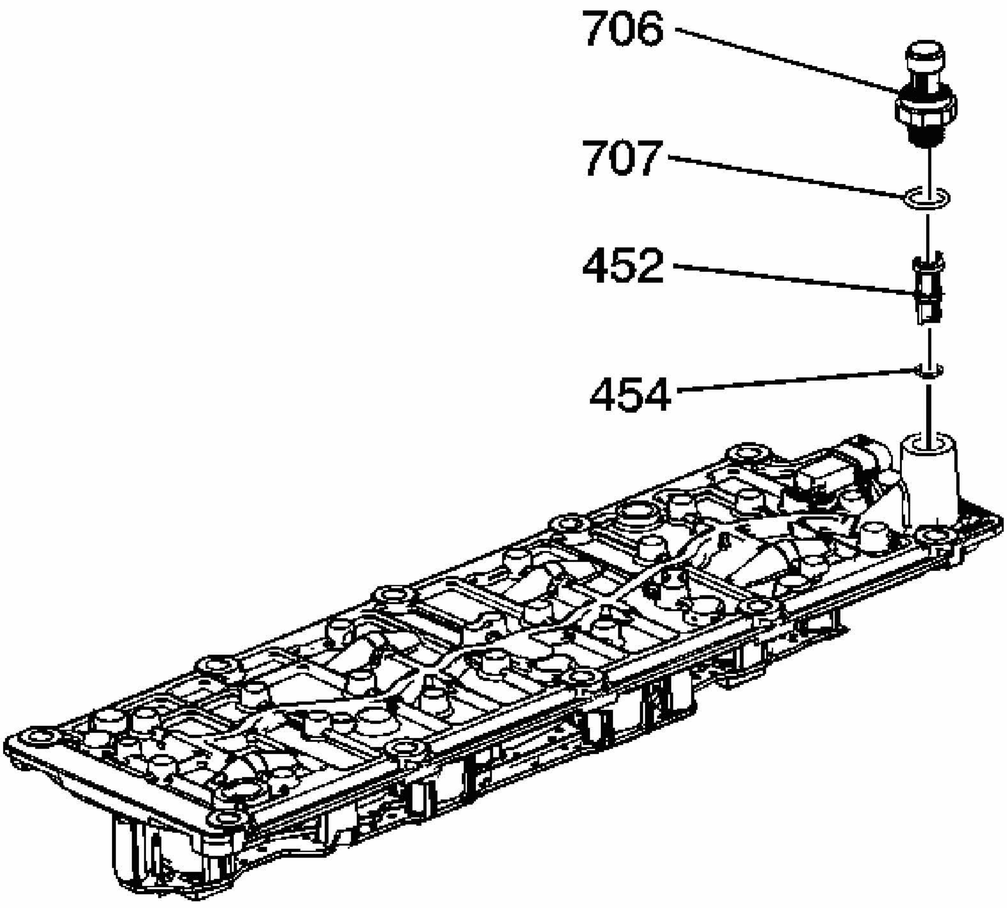


Fig. 358: View Of Oil Pressure Sensor, Washer And Valve Lifter Oil Filter
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not allow dirt or debris to enter the oil passages of the manifold. Plug, as required.

1. Remove the oil pressure sensor (706).
2. Remove the oil filter (452).
3. Inspect the O-ring (454) for cuts or damage. If the filter is plugged or the O-ring is cut or damaged, replace the filter and O-ring as an assembly.

VALVE ROCKER ARM COVER REMOVAL - LEFT

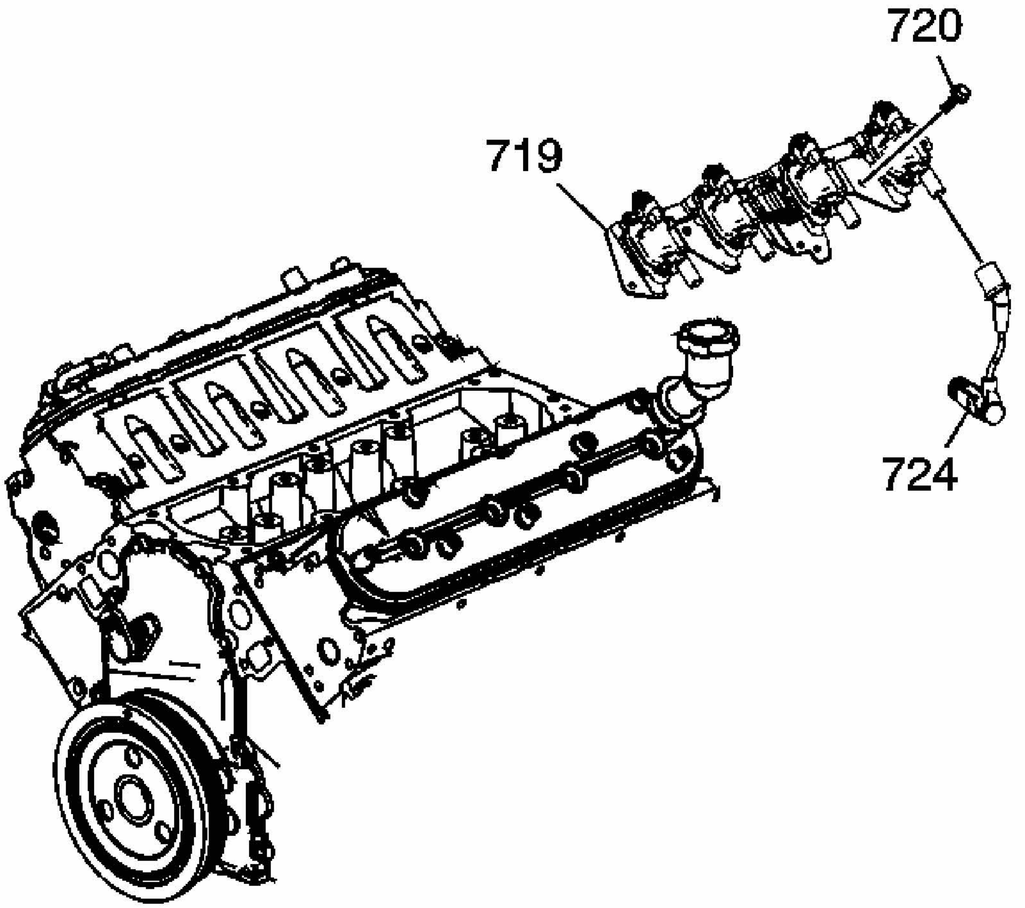


Fig. 359: View Of The Ignition Coil And Bracket Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug wires (724).
2. Remove the ignition coil bracket studs (720).
3. Remove the ignition coil and bracket assembly (719).

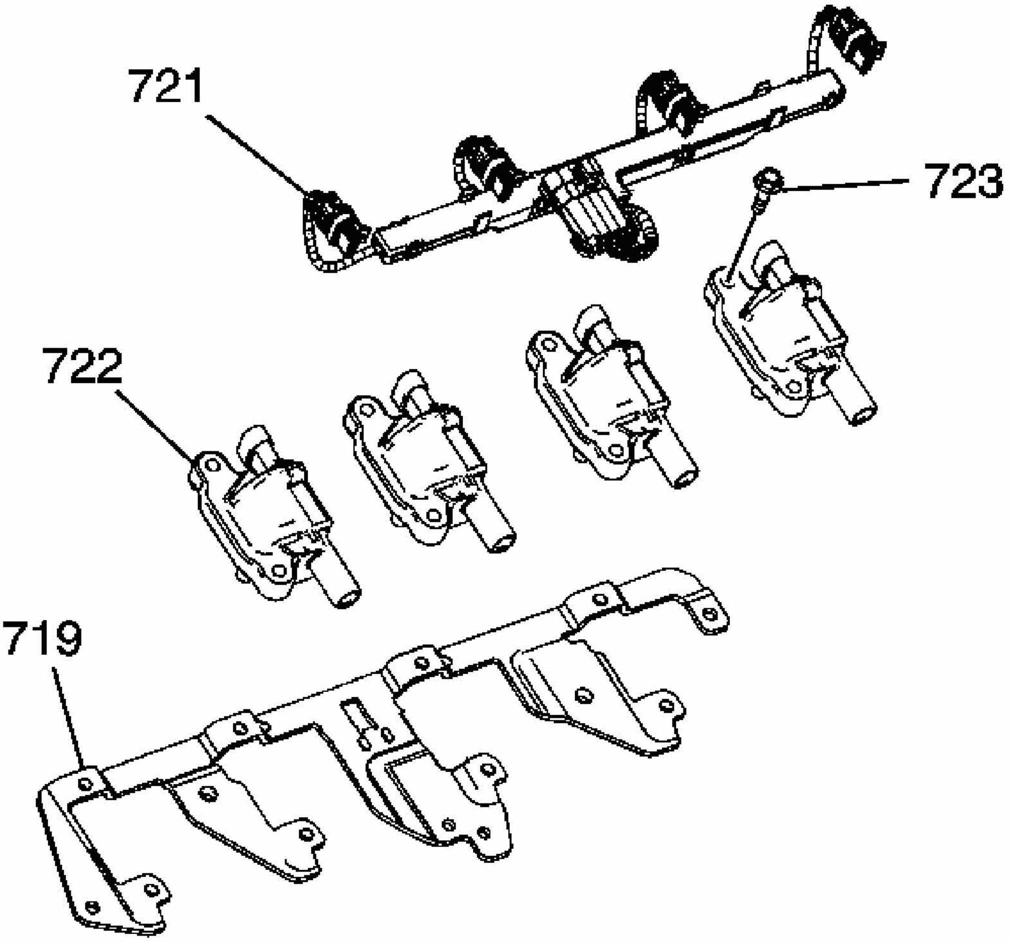


Fig. 360: View Of Bracket, Bolts, Coils & Wire Harness
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the ignition coil electrical connectors.
5. Remove the bolts (723), coils (722), and wire harness (721) from the bracket, as required.

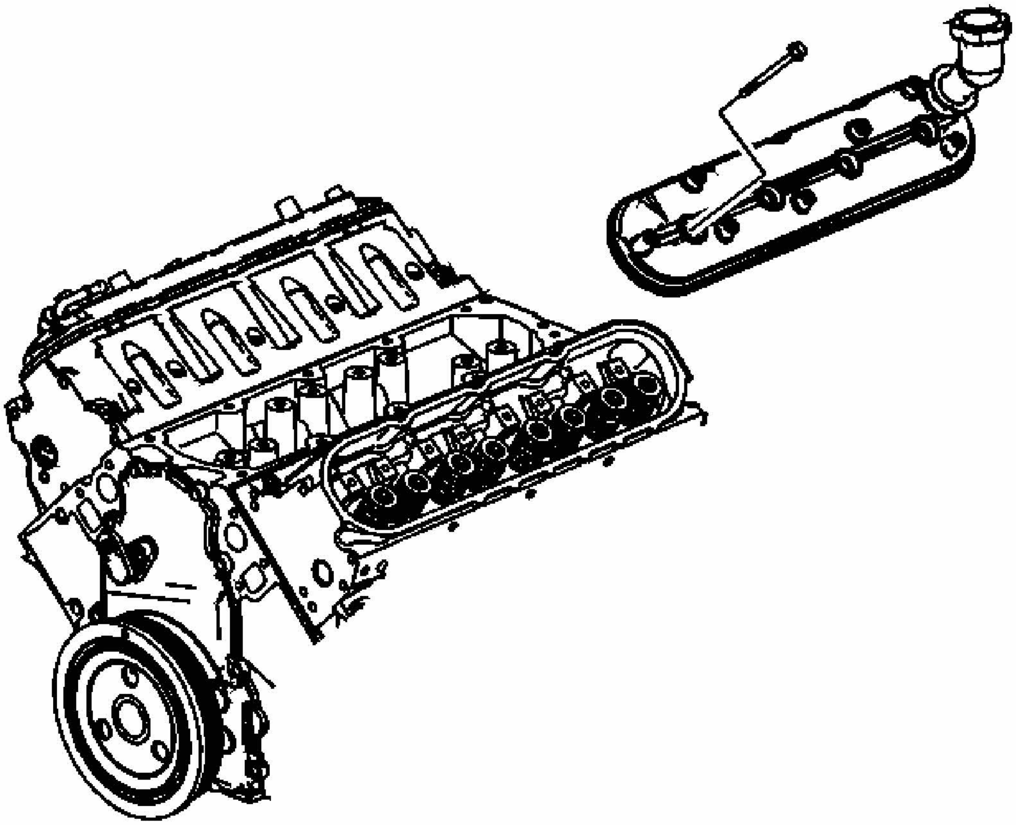


Fig. 361: View Of Valve Rocker Arm Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

6. Remove the valve rocker arm cover bolts and cover.

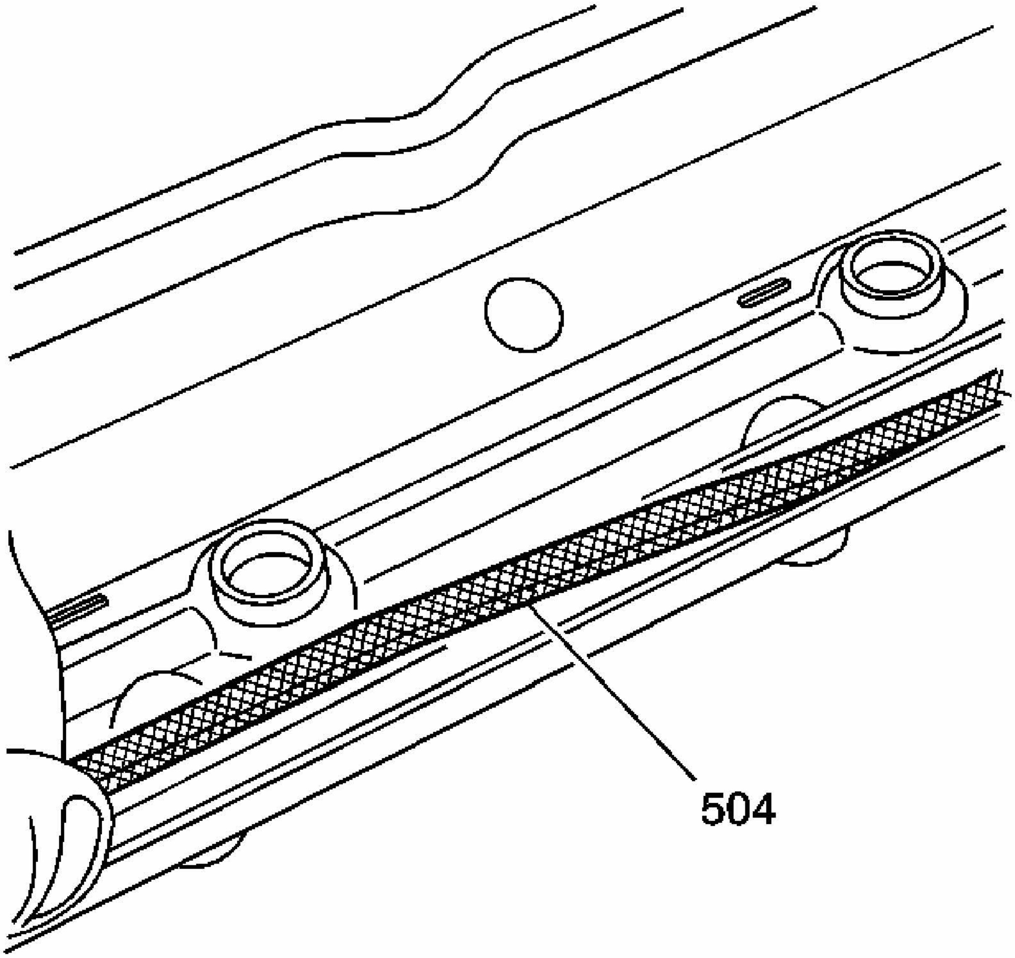


Fig. 362: View Of Valve Rocker Arm Cover Gasket
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not remove the oil fill tube from the cover, unless service is required. If the oil fill tube has been removed from the cover, install a NEW tube during assembly.

7. Remove the gasket (504) from the cover.

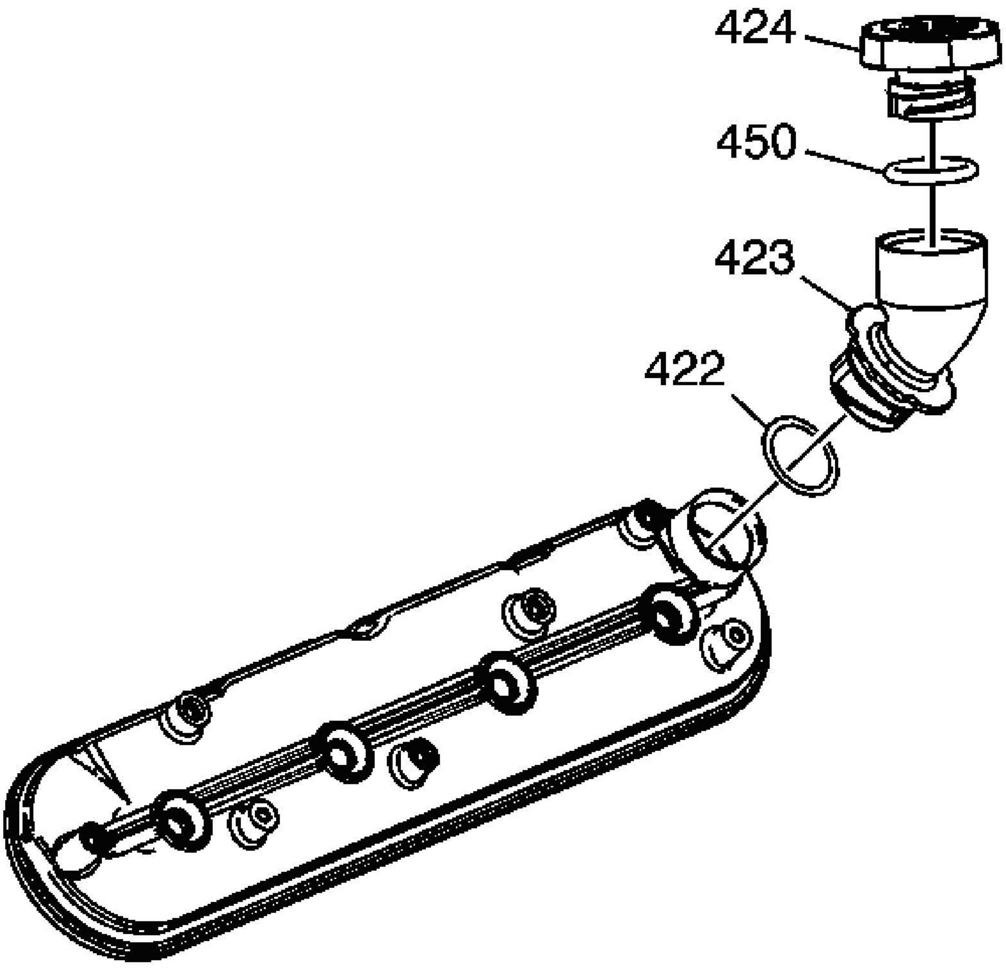


Fig. 363: Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

8. Remove the oil fill cap (424) from the oil fill tube, as required.
9. Remove the oil fill tube (423), as required.
10. Discard the oil fill tube.

VALVE ROCKER ARM COVER REMOVAL - RIGHT

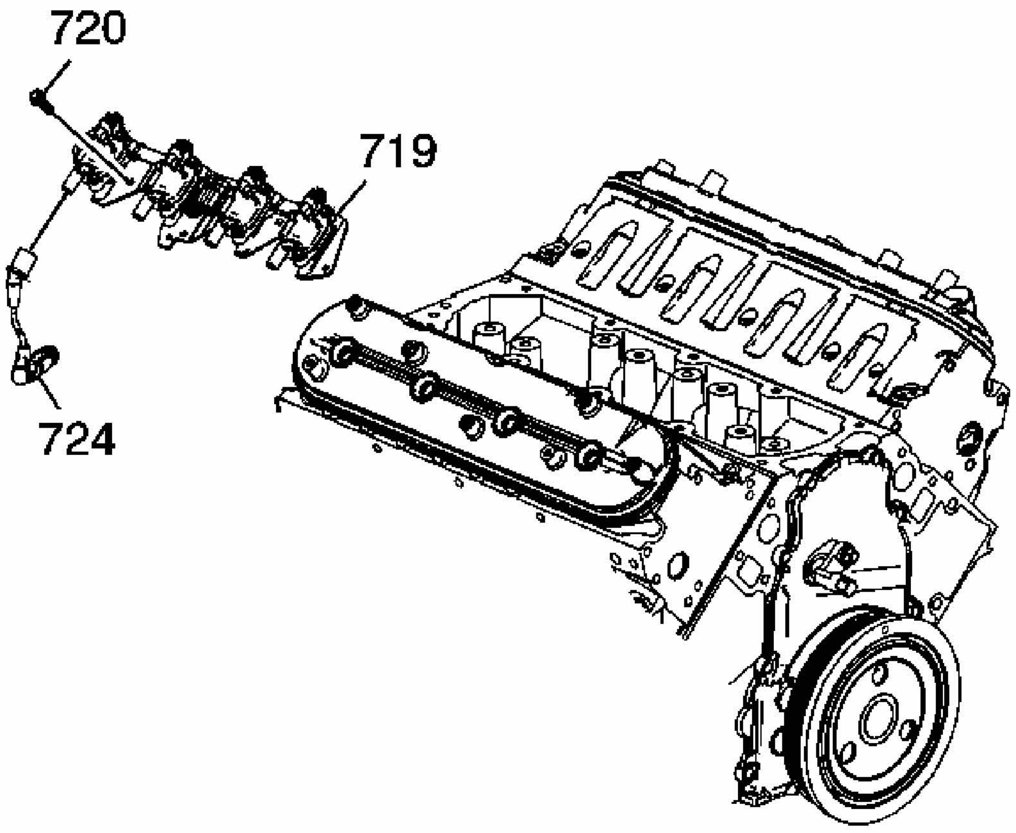


Fig. 364: View Of Ignition Coil And Bracket Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug wires (724).
2. Remove the ignition coil bracket studs (720).
3. Remove the ignition coil and bracket assembly (719).

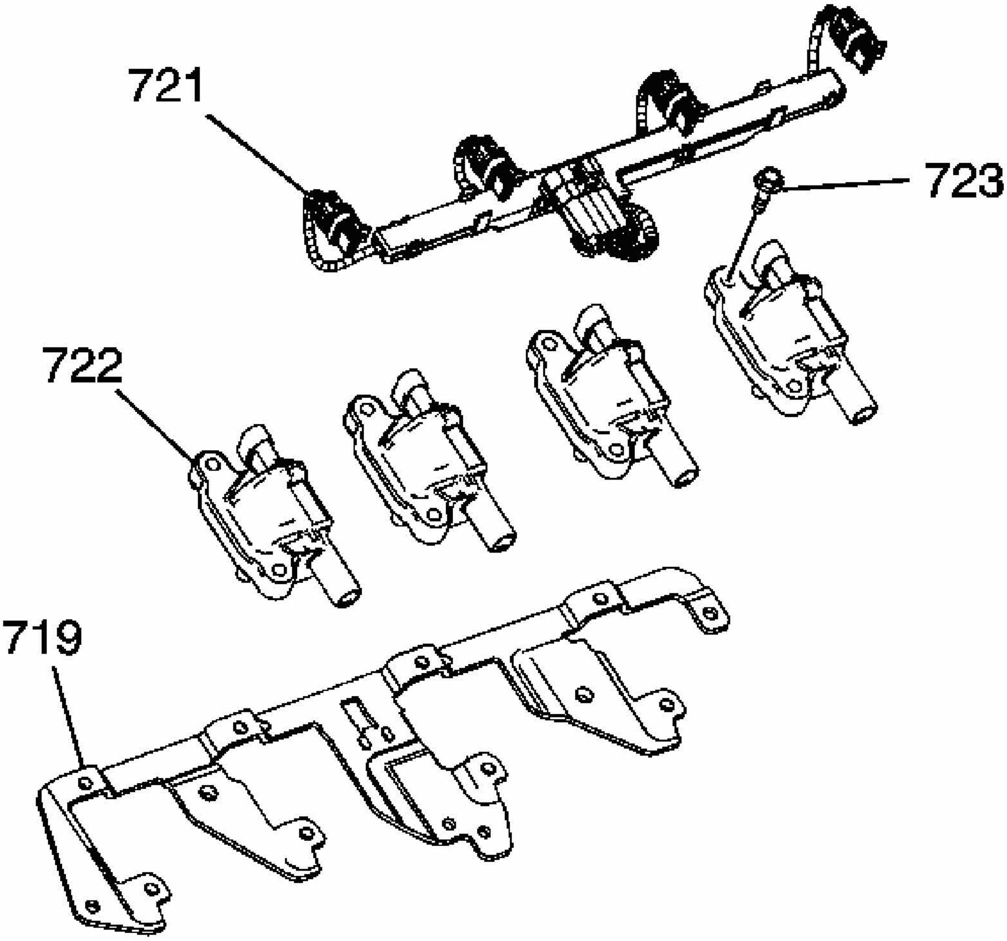


Fig. 365: View Of Bracket, Bolts, Coils & Wire Harness
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the ignition coil electrical connectors.
5. Remove the bolts (723), coils (722), and wire harness (721) from the bracket, as required.

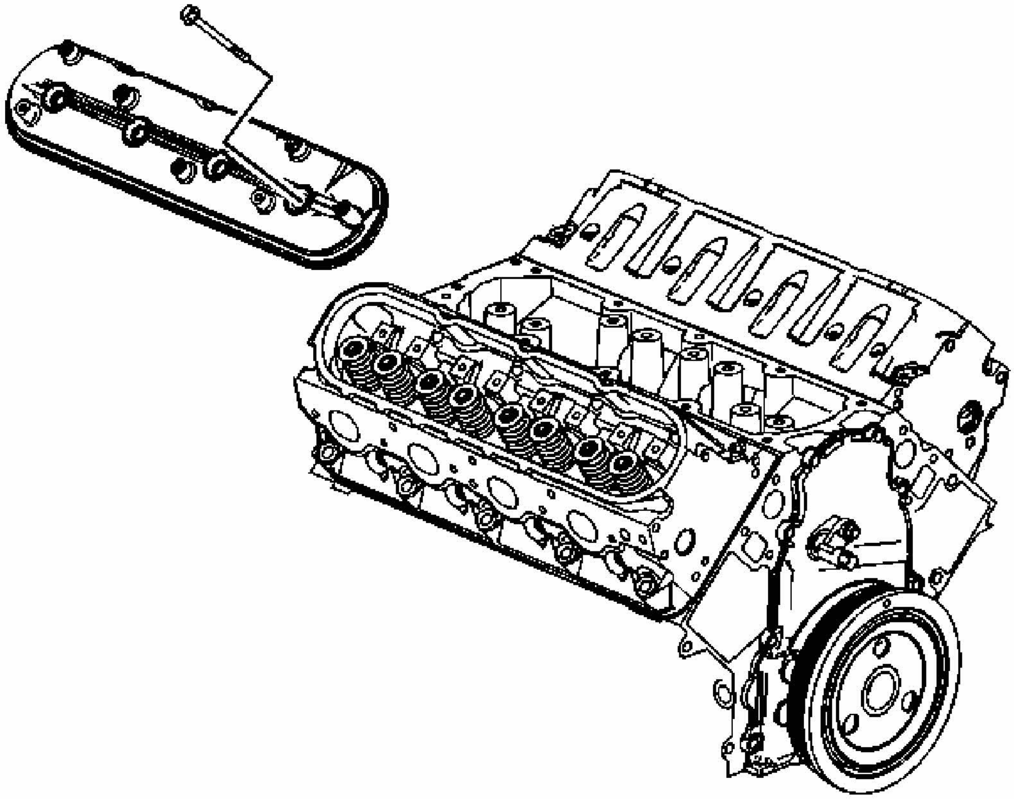


Fig. 366: View Of Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

6. Remove the valve rocker arm cover bolts and cover.

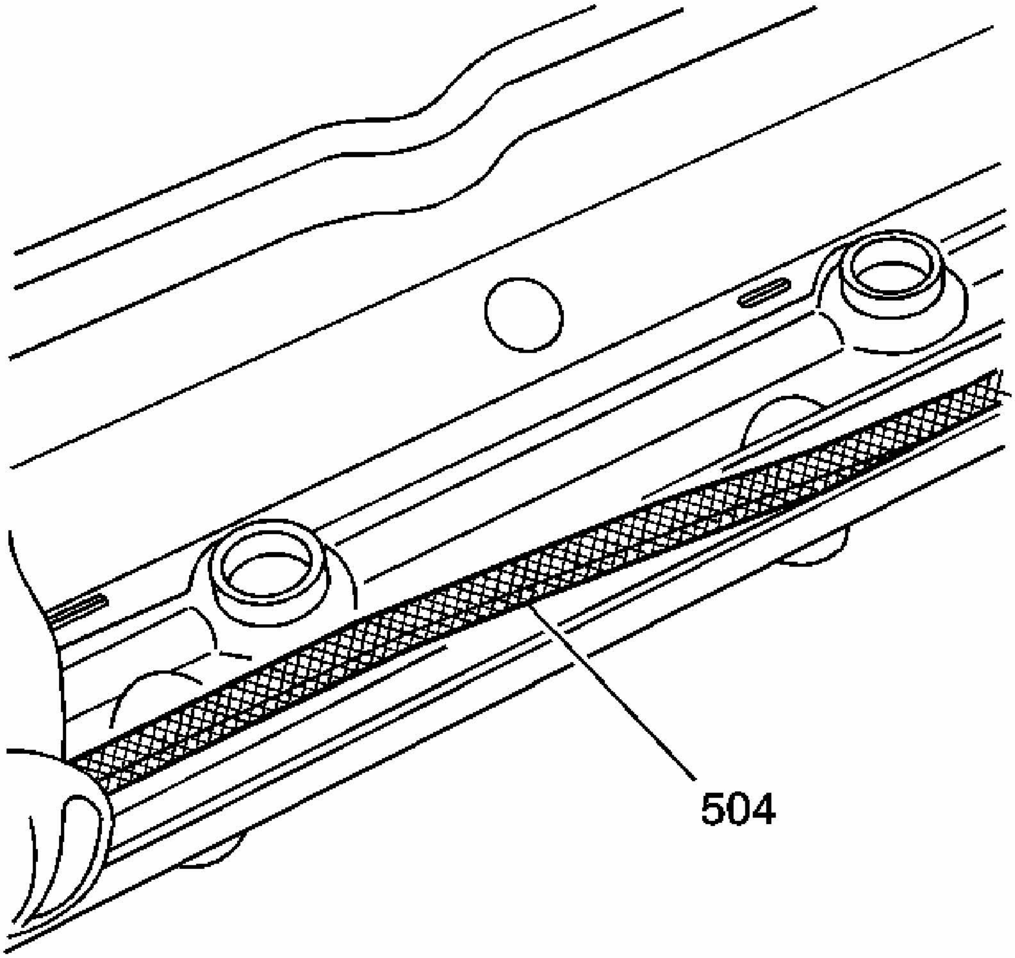


Fig. 367: View Of Valve Rocker Arm Cover Gasket
Courtesy of GENERAL MOTORS CORP.

7. Remove the gasket (504) from the cover.

VALVE ROCKER ARM AND PUSH ROD REMOVAL

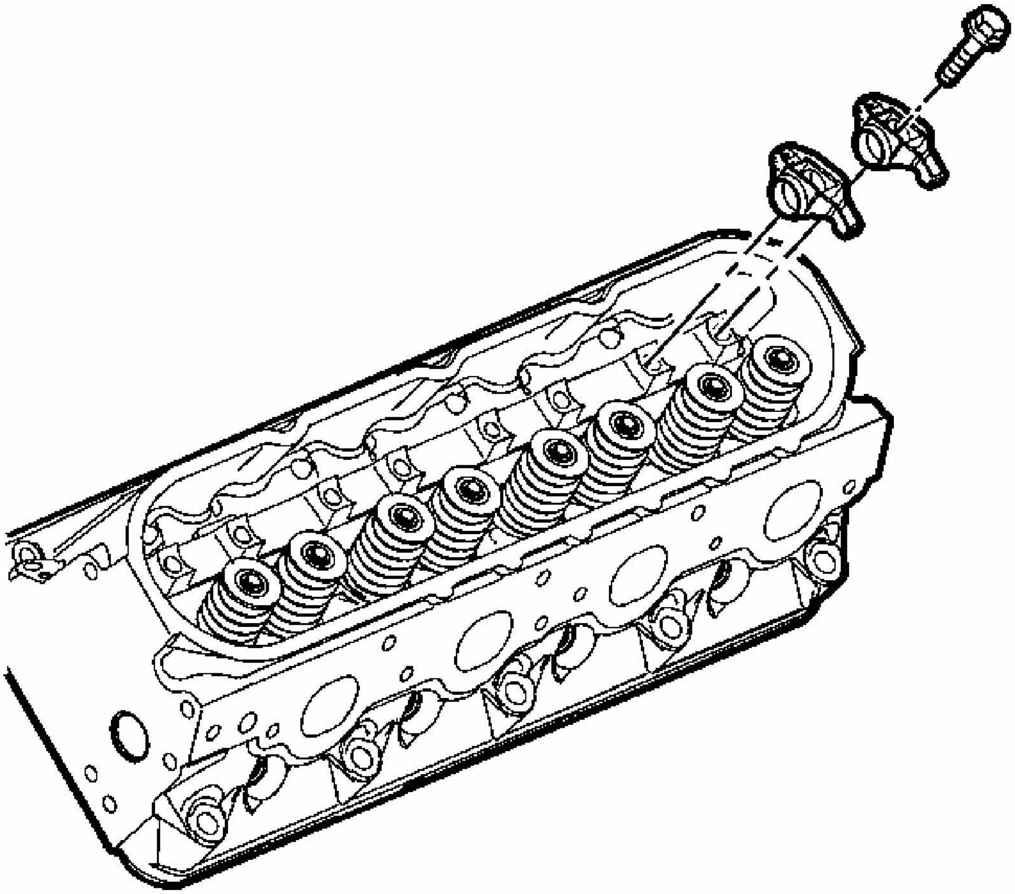


Fig. 368: View Of Rocker Arms & Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Place the valve rocker arms, valve pushrods, and pivot support, in a rack so they can be installed in the same location from which they were removed.

1. Remove the valve rocker arm bolts.
2. Remove the valve rocker arms.

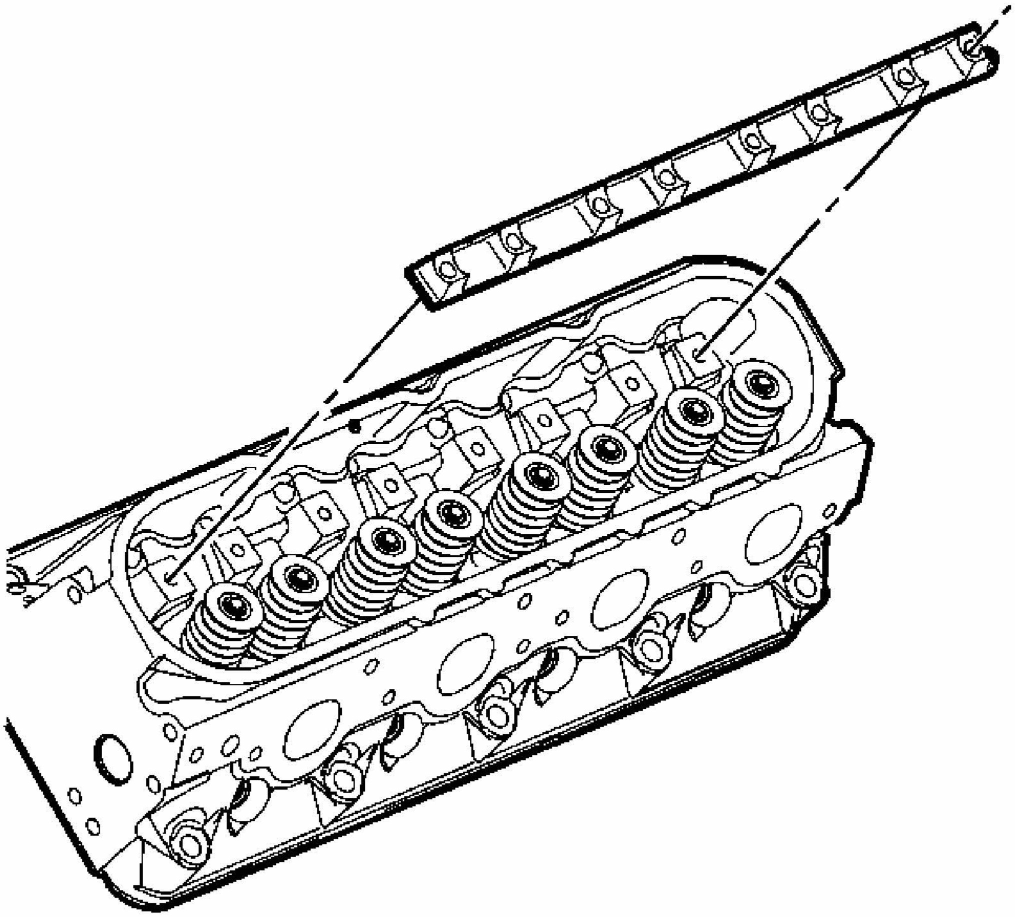


Fig. 369: View Of Valve Rocker Arm Pivot Support
Courtesy of GENERAL MOTORS CORP.

3. Remove the valve rocker arm pivot support.

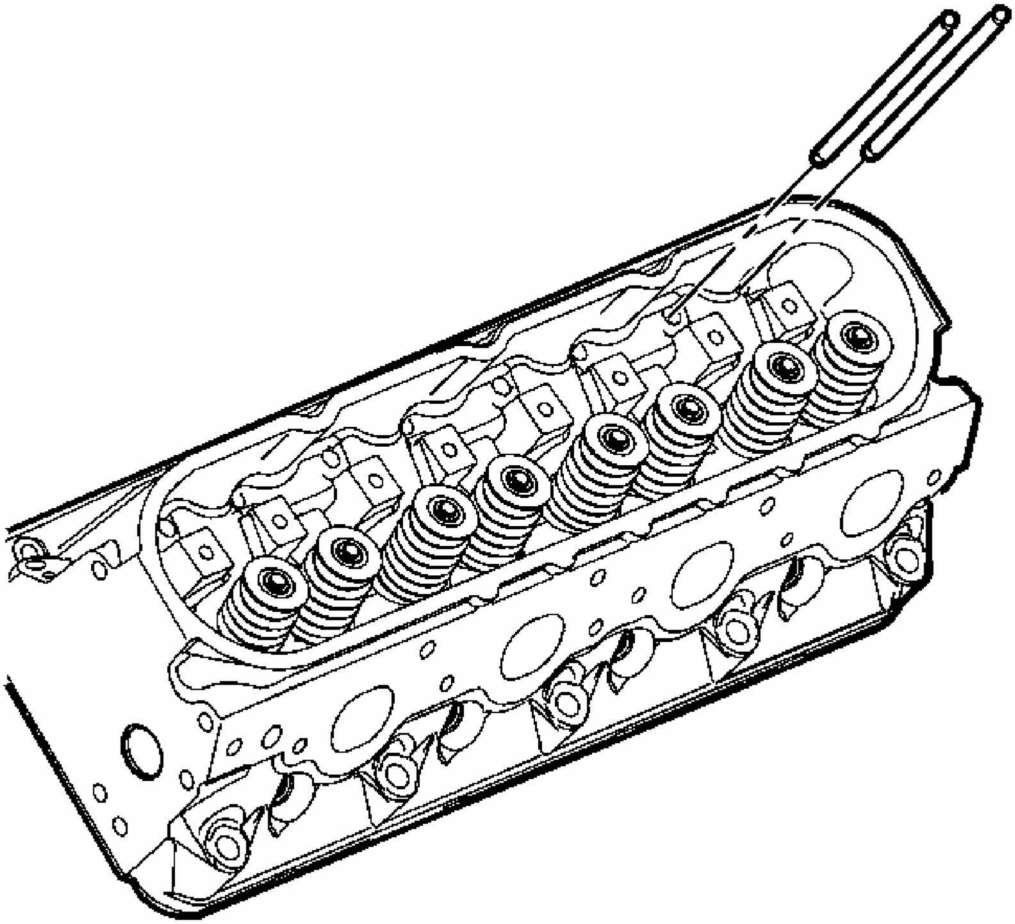


Fig. 370: View Of Pushrods
Courtesy of GENERAL MOTORS CORP.

4. Remove the pushrods.

CYLINDER HEAD REMOVAL - LEFT

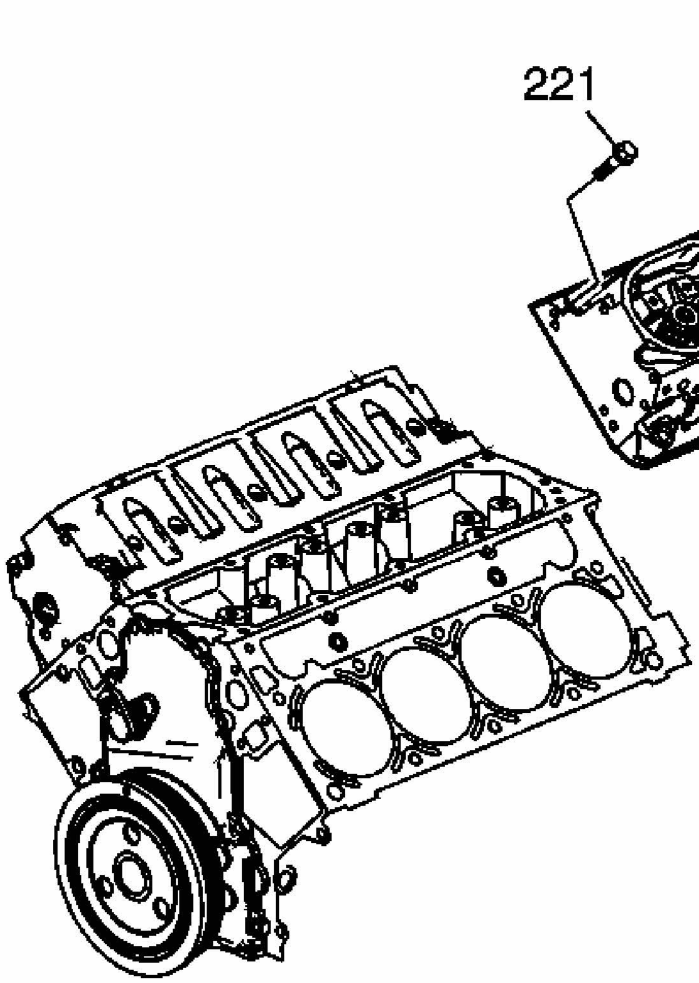


Fig. 371: View Of Cylinder Head & Bolts (Left)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The cylinder head bolts are of a torque-to-yield design and are NOT to be used again. Install NEW cylinder head bolts during assembly.

1. Remove the cylinder head bolts (220, 221).

NOTE: After removal, place the cylinder head on 2 wood blocks in order to prevent damage to the sealing surfaces.

2. Remove the cylinder head (218).

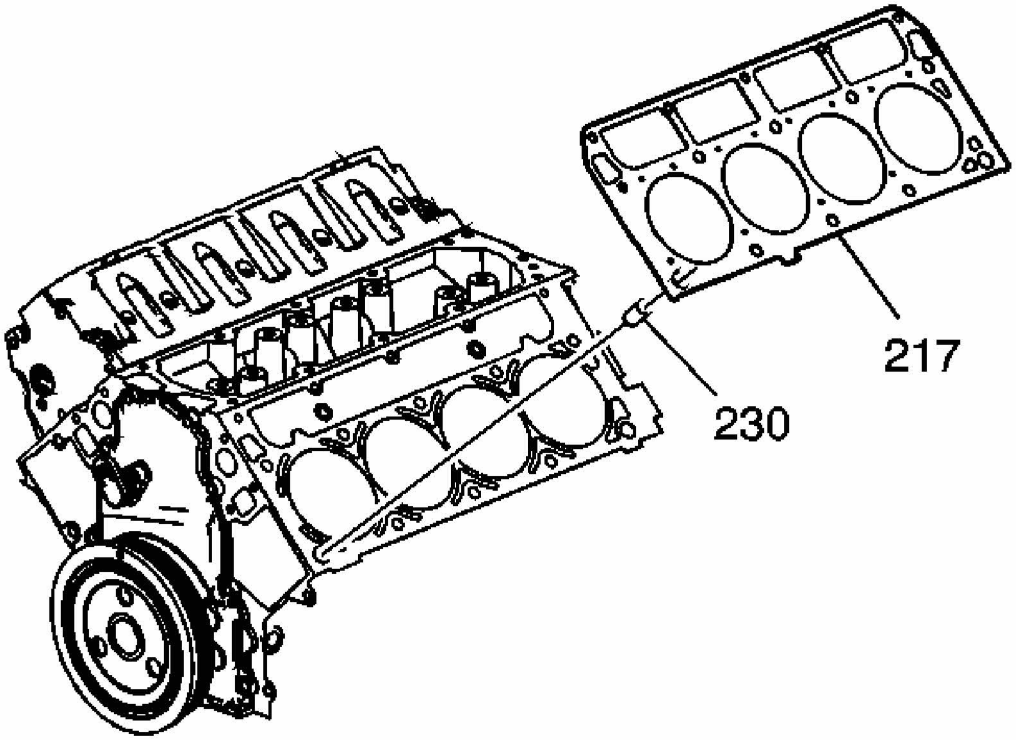


Fig. 372: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

3. Remove the gasket (217) and locating pins (230).
4. Discard the gasket and cylinder head bolts.

CYLINDER HEAD REMOVAL - RIGHT

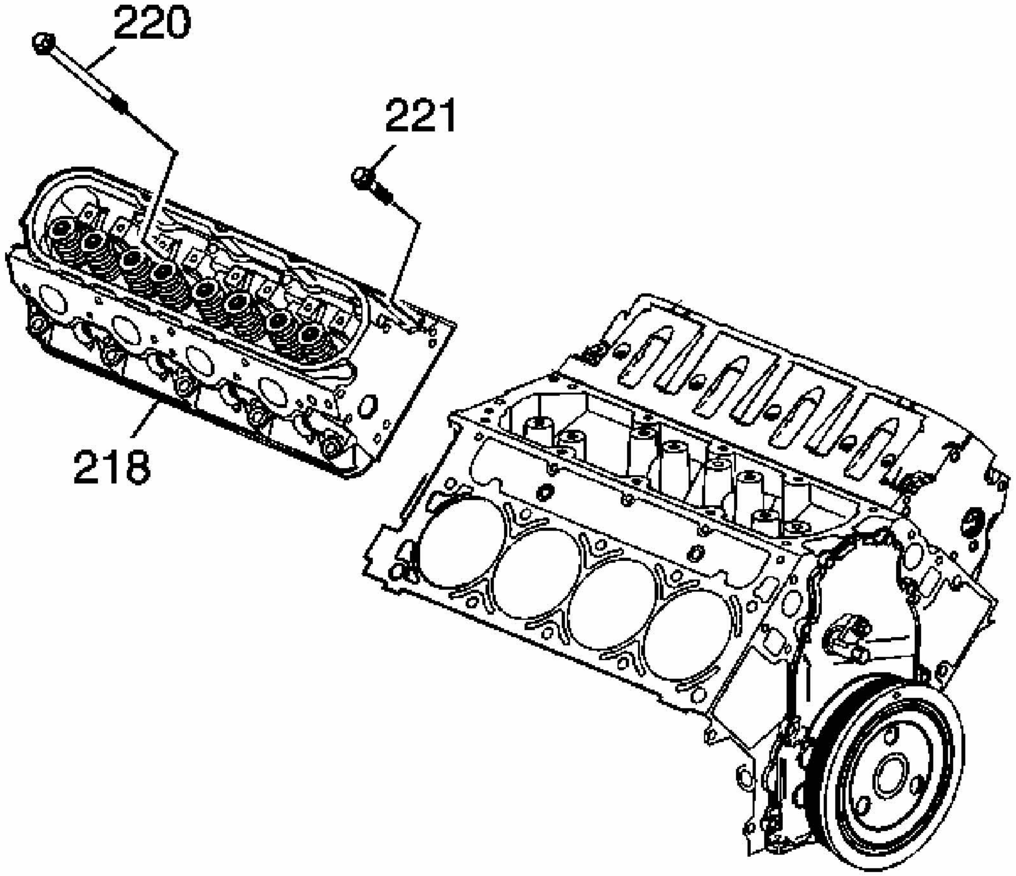


Fig. 373: View Of Cylinder Head & Bolt (Right)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The cylinder head bolts are of a torque-to-yield design and are NOT to be used again. Install NEW cylinder head bolts during assembly.

1. Remove the cylinder head bolts (220, 221).

NOTE: After removal, place the cylinder head on 2 wood blocks in order to prevent damage to the sealing surfaces.

2. Remove the cylinder head (218).

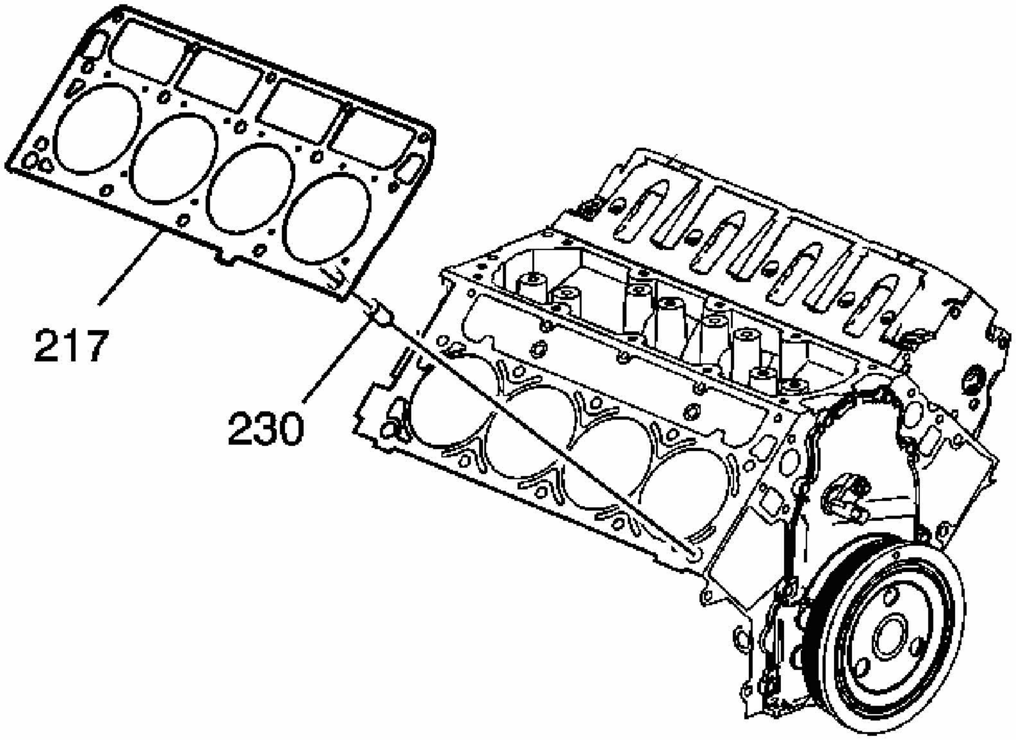


Fig. 374: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

3. Remove the gasket (217) and locating pins (230).
4. Discard the gasket and cylinder head bolts.

VALVE LIFTER REMOVAL

Tools Required

J 3049-A Valve Lifter Remover. See **Special Tools**.

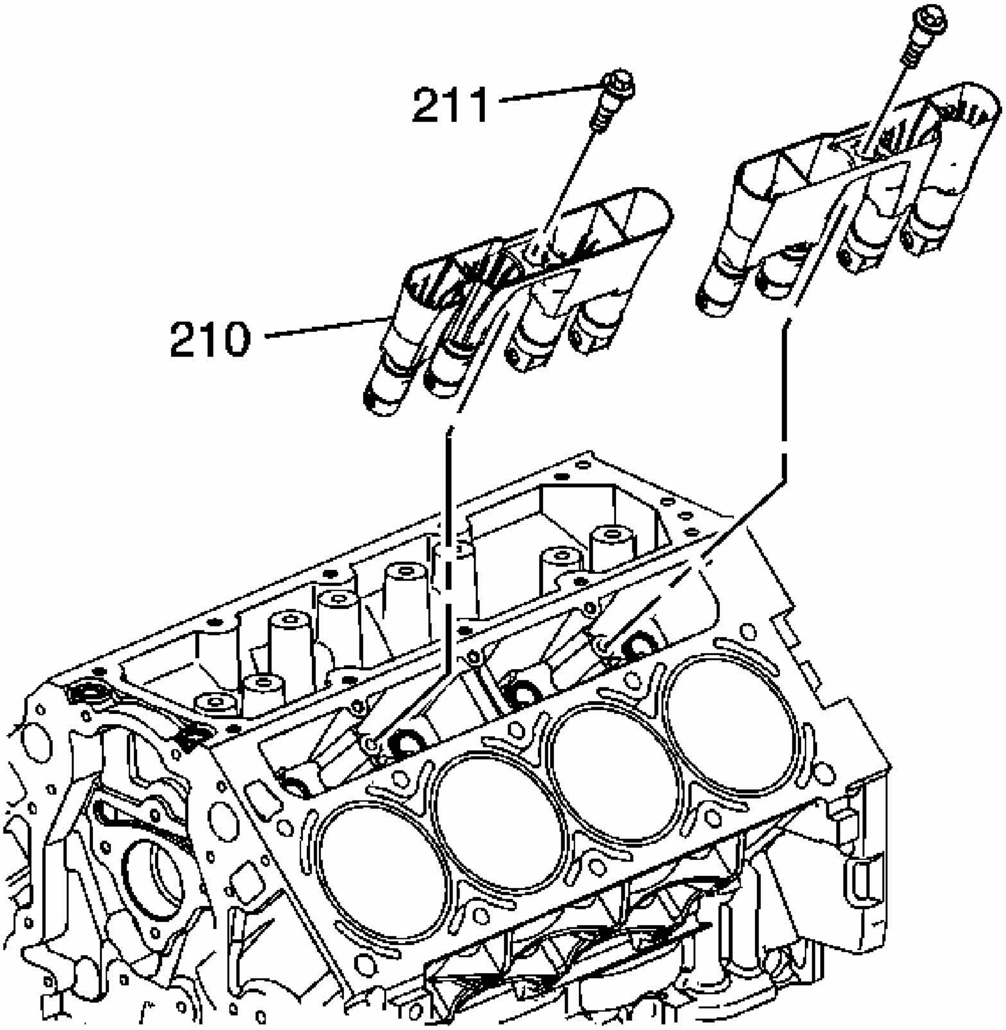


Fig. 375: View Of Lifter Guides & Lifters
Courtesy of GENERAL MOTORS CORP.

1. Remove the bolts (211).
2. Remove the guides (210) with lifters.

   Note the installed position of the guides. The notched area of the guide is to align with the locating tab of the block.

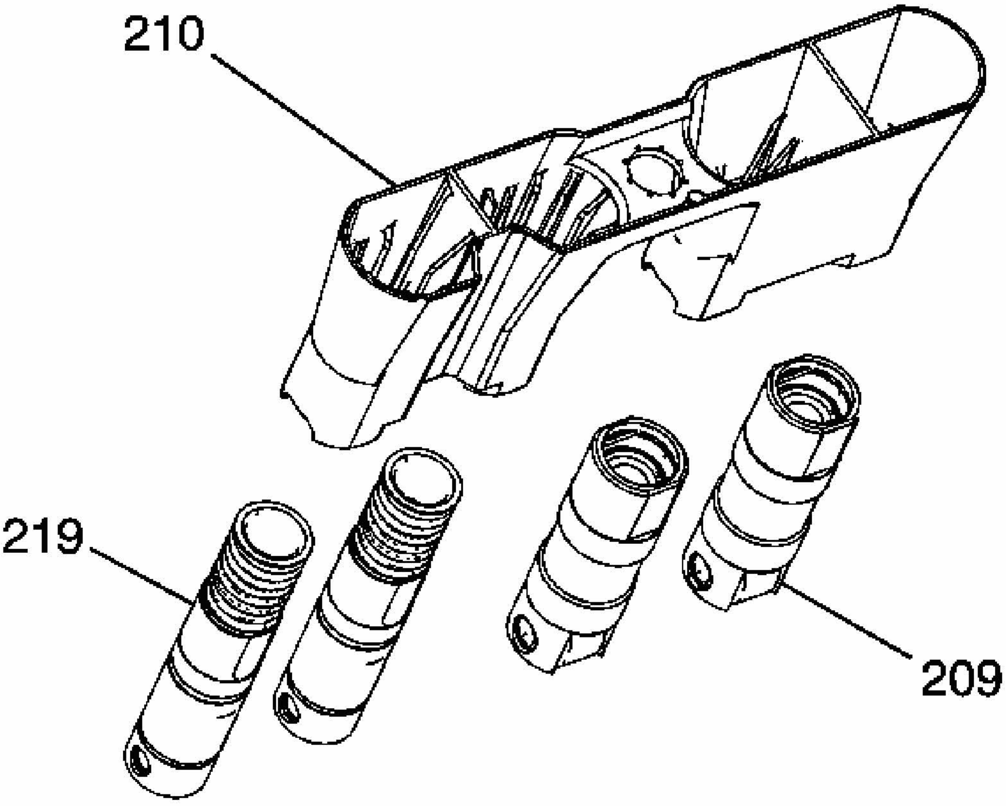


Fig. 376: Exploded View Of Lifter Guides & Lifters
Courtesy of GENERAL MOTORS CORP.

3. Remove the valve lifters (209, 219) from the guide (210).

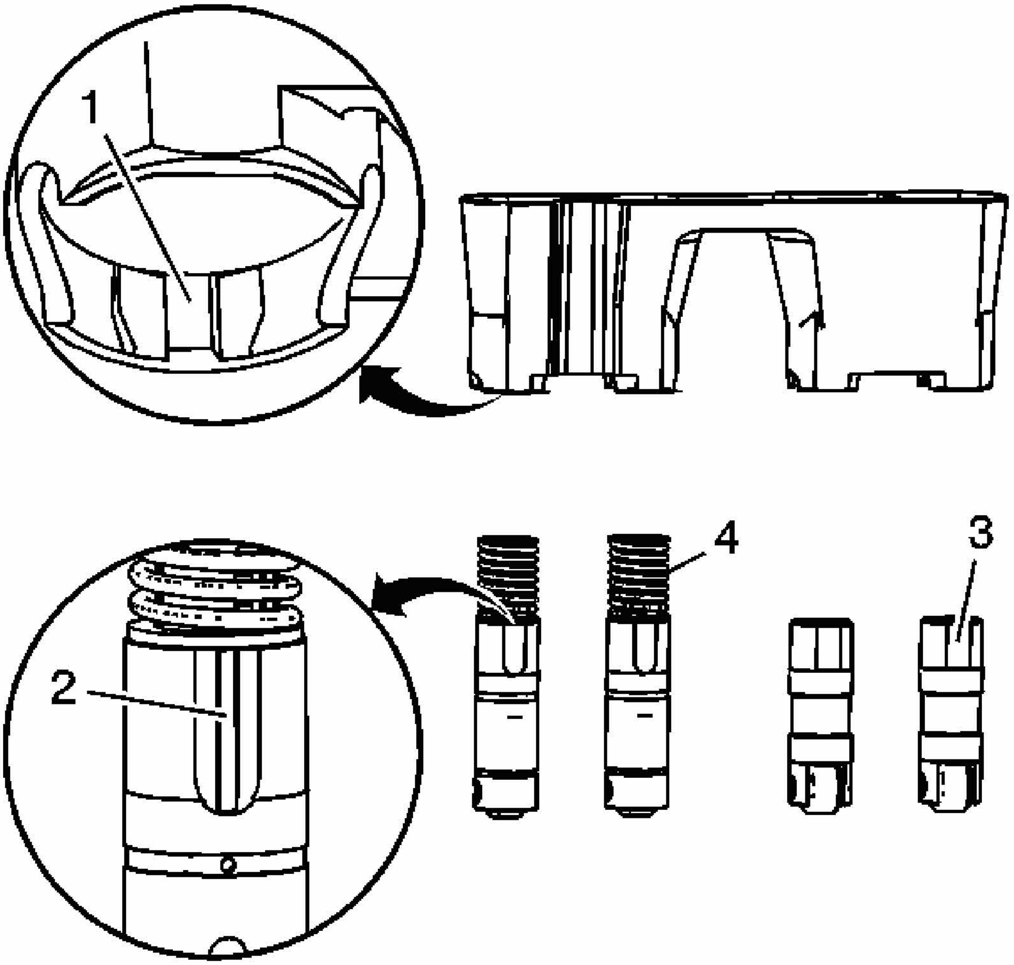


Fig. 377: Inserting Valve Lifters Into Lifter Guides
Courtesy of GENERAL MOTORS CORP.

4. Organize or mark the components so they can be installed in the same location from which they were removed. The displacement on demand lifters (4) are installed into the guide by aligning the notched area of the guide (1) with the raised surface on the side of the lifter (2). Refer to **Separating Parts**.

OIL FILTER AND ADAPTER REMOVAL

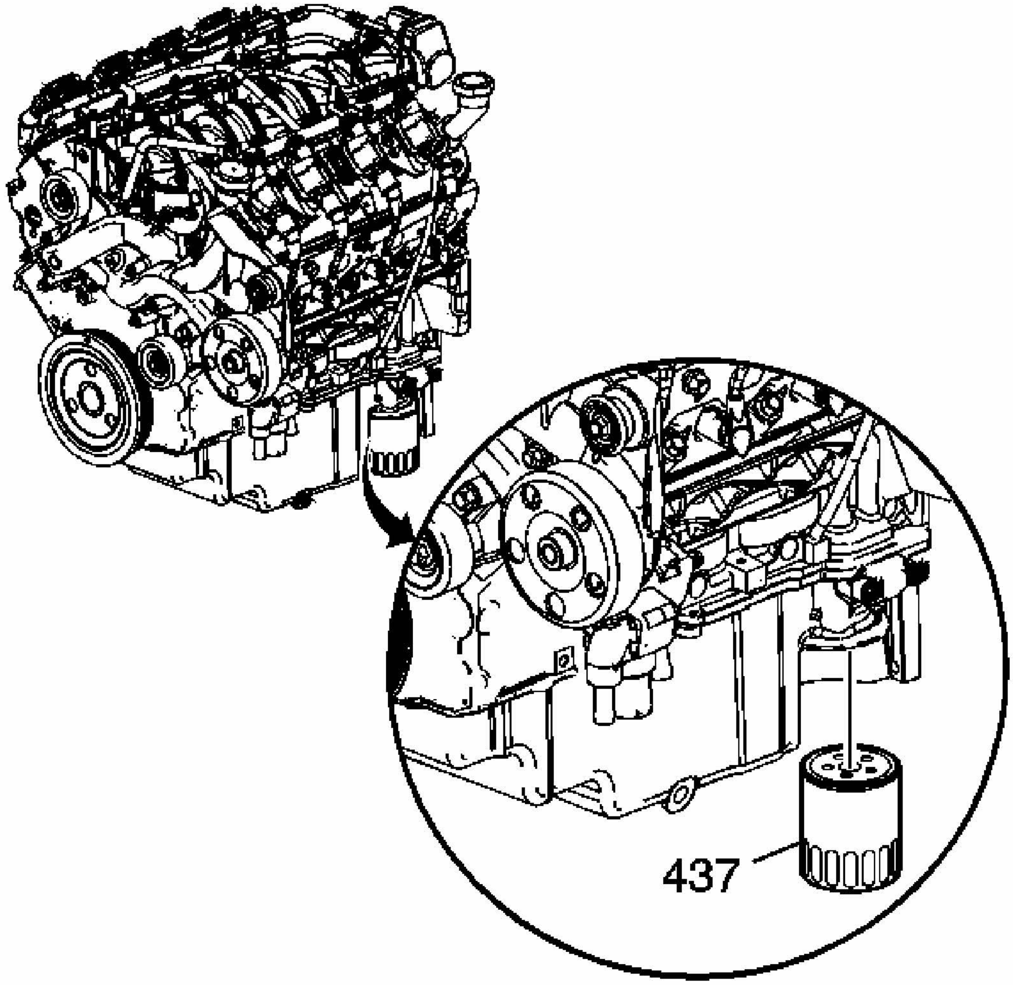


Fig. 378: View Of Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil filter (437).

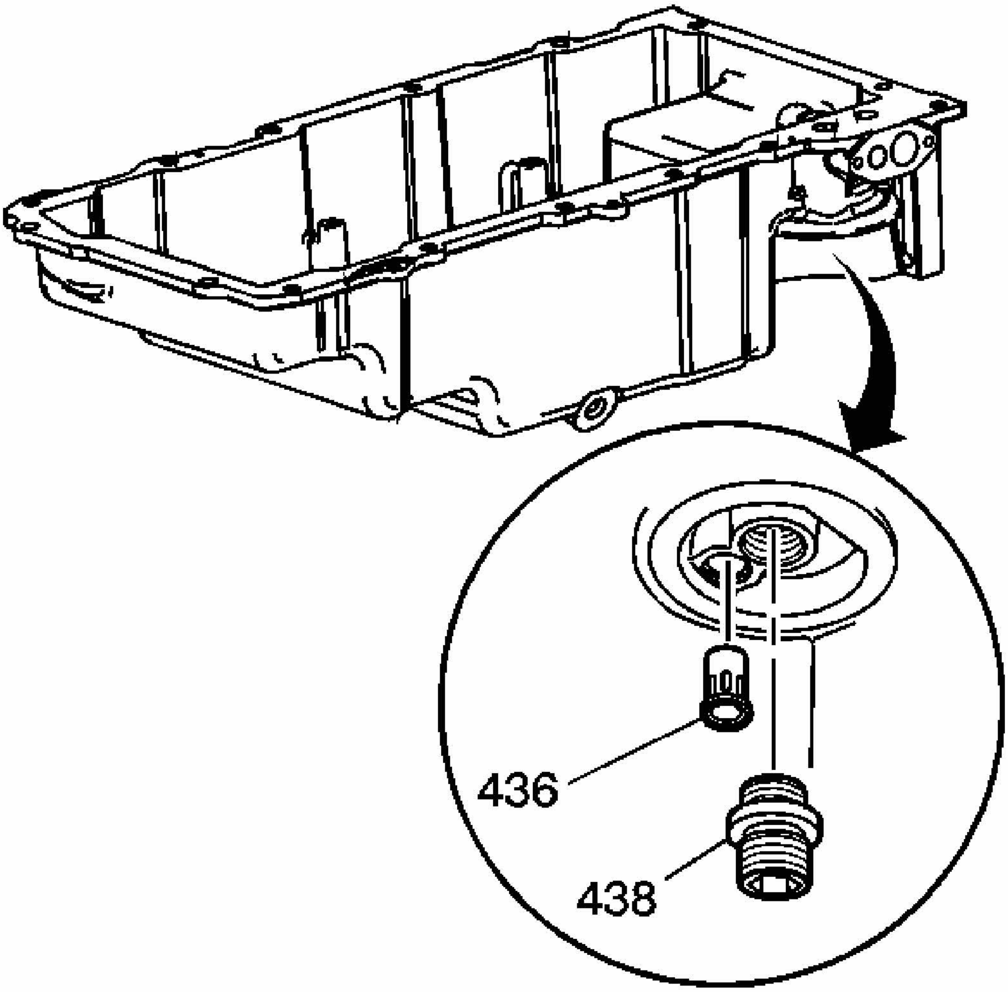


Fig. 379: View Of Oil Filter Adapter & Bypass Valve
Courtesy of GENERAL MOTORS CORP.

2. Remove the oil filter fitting (438) and bypass valve (436), as required.

OIL PAN REMOVAL

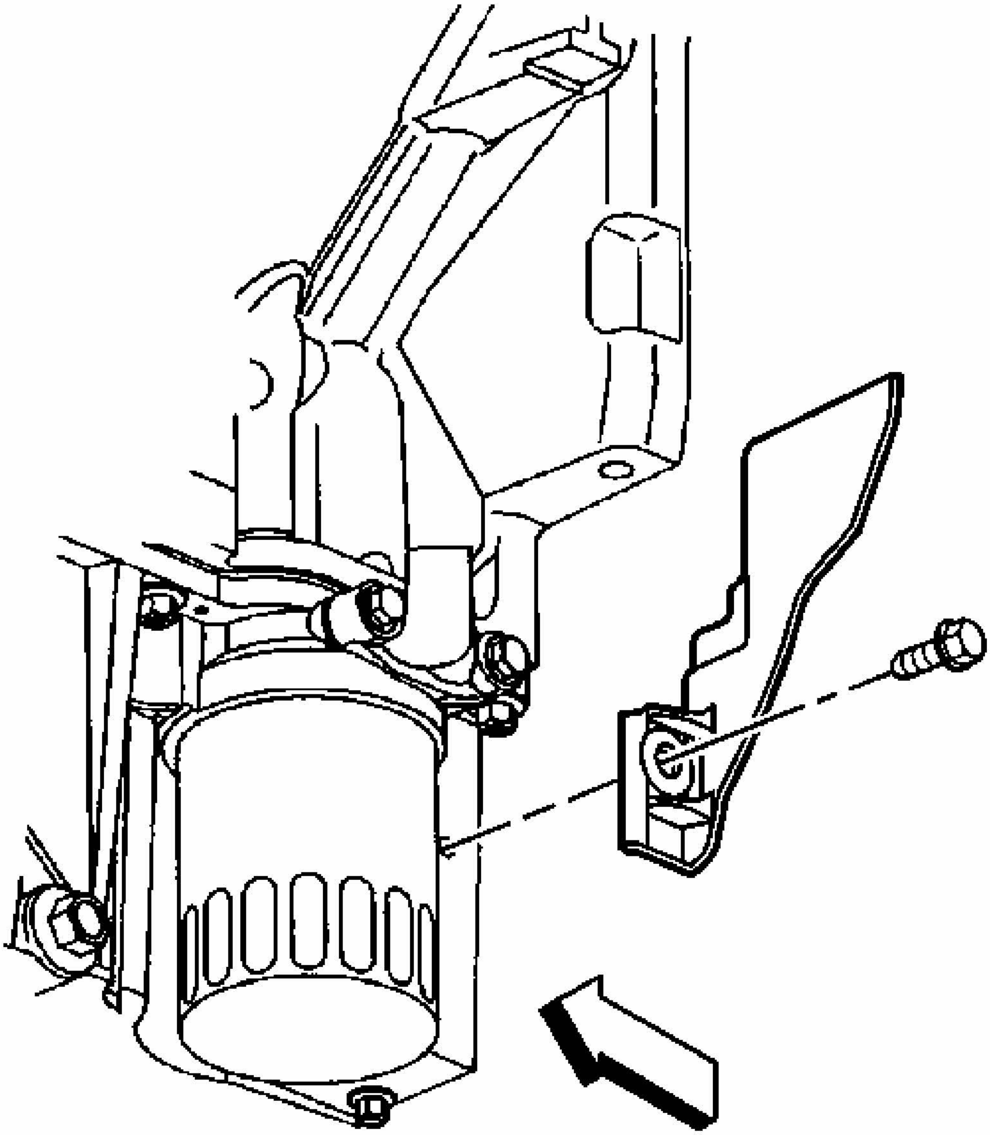


Fig. 380: View Of Left Closeout Cover & Bolt
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **The original oil pan gasket is retained and aligned to the oil pan by rivets. When installing a new gasket, it is not necessary to install new oil pan gasket rivets.**
- **DO NOT use the oil pan gasket again. When installing the oil pan, install a NEW oil pan gasket.**

1. Remove the left closeout cover and bolt.

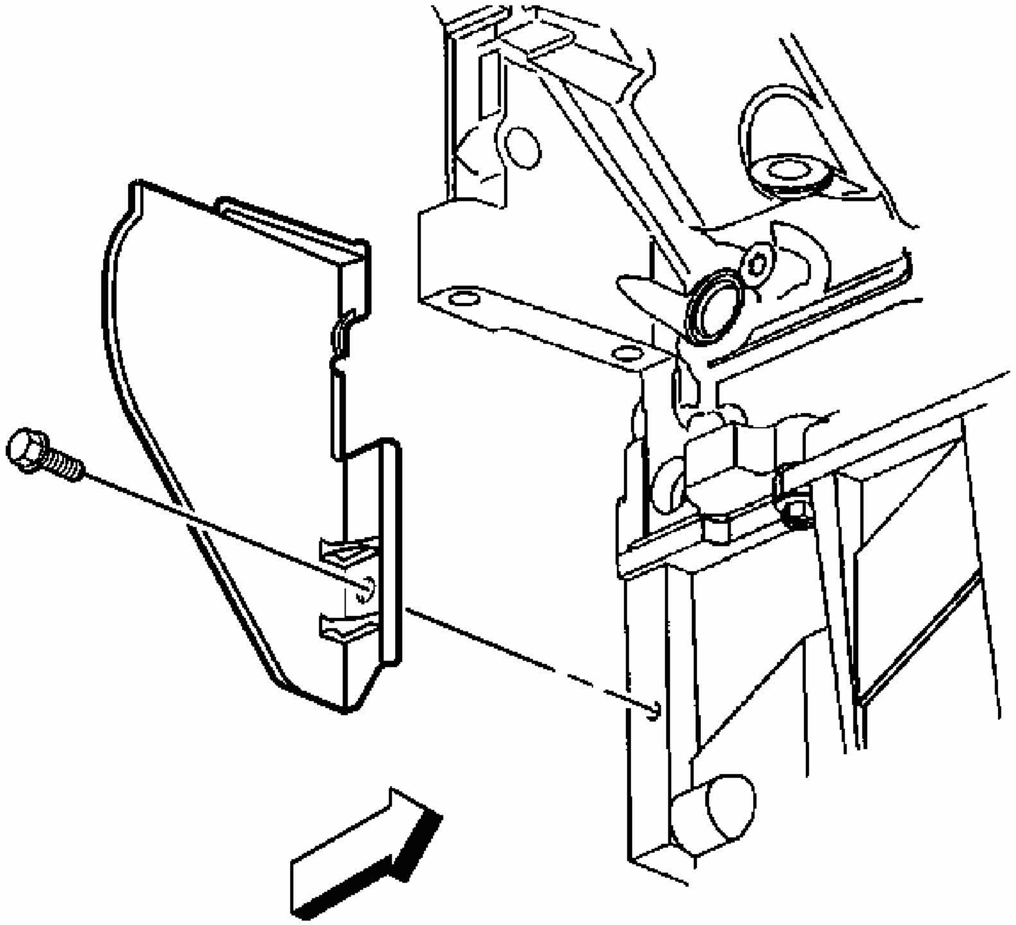


Fig. 381: View Of Right Closeout Cover & Bolt
Courtesy of GENERAL MOTORS CORP.

2. Remove the right closeout cover and bolt.

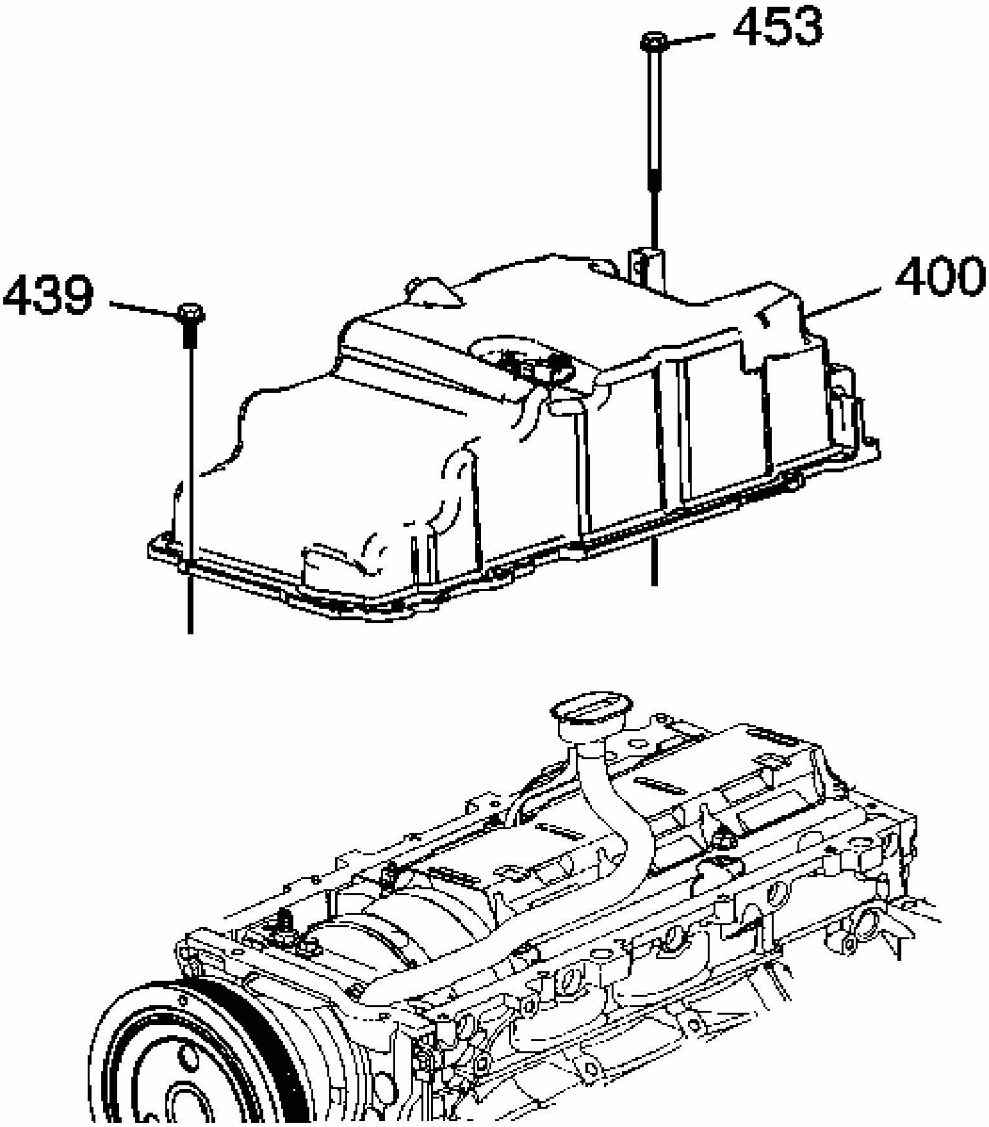


Fig. 382: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil pan bolts (439, 453).
4. Remove the oil pan (400).

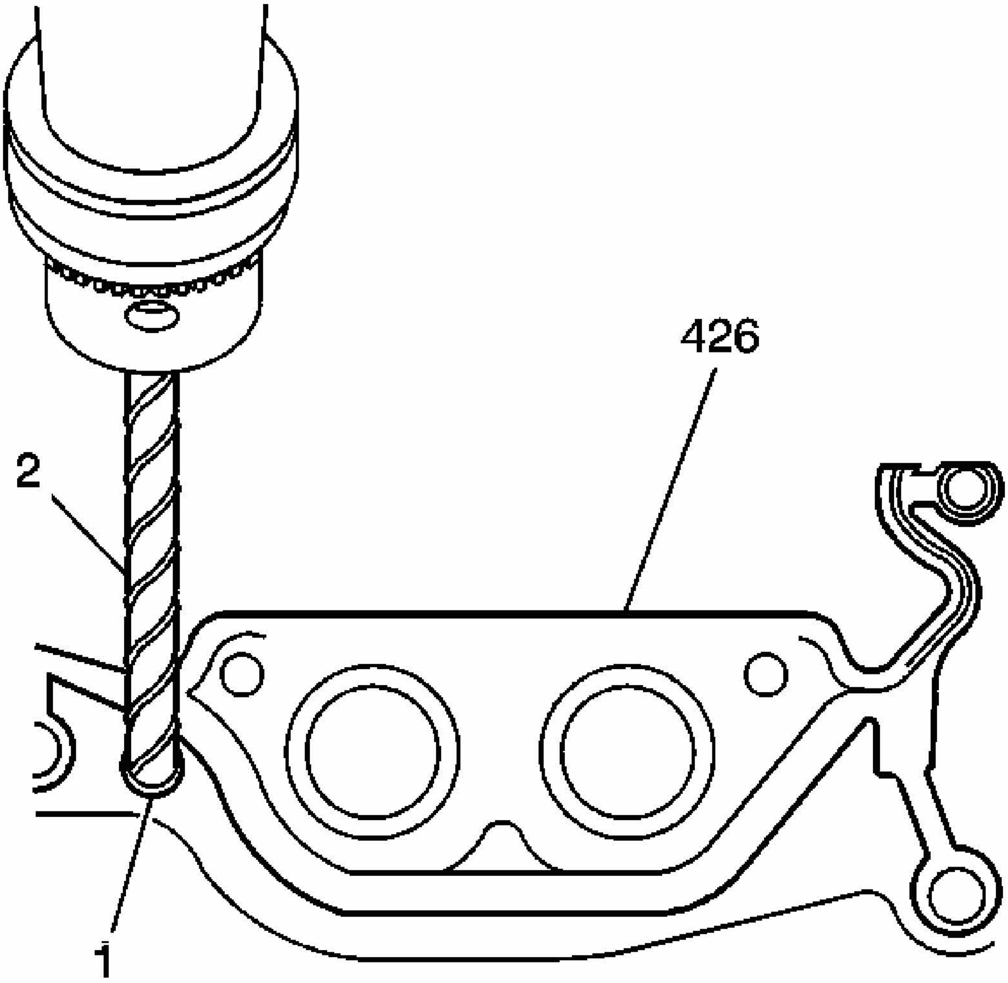


Fig. 383: Drilling Out Oil Pan Gasket Retaining Rivets
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **DO NOT allow foreign material to enter the oil passages of the oil pan. Cap or cover the openings, as required.**
- **Use care not to gouge, score, or damage the oil pan sealing surface.**

5. Drill (2) out the oil pan gasket retaining rivets (1), if required.
6. Remove the gasket (426) from the pan.
7. Discard the gasket and rivets.
8. Remove the baffle and other components, as required. Refer to **Oil Pan Cleaning and**

Inspection.

ENGINE FRONT COVER REMOVAL

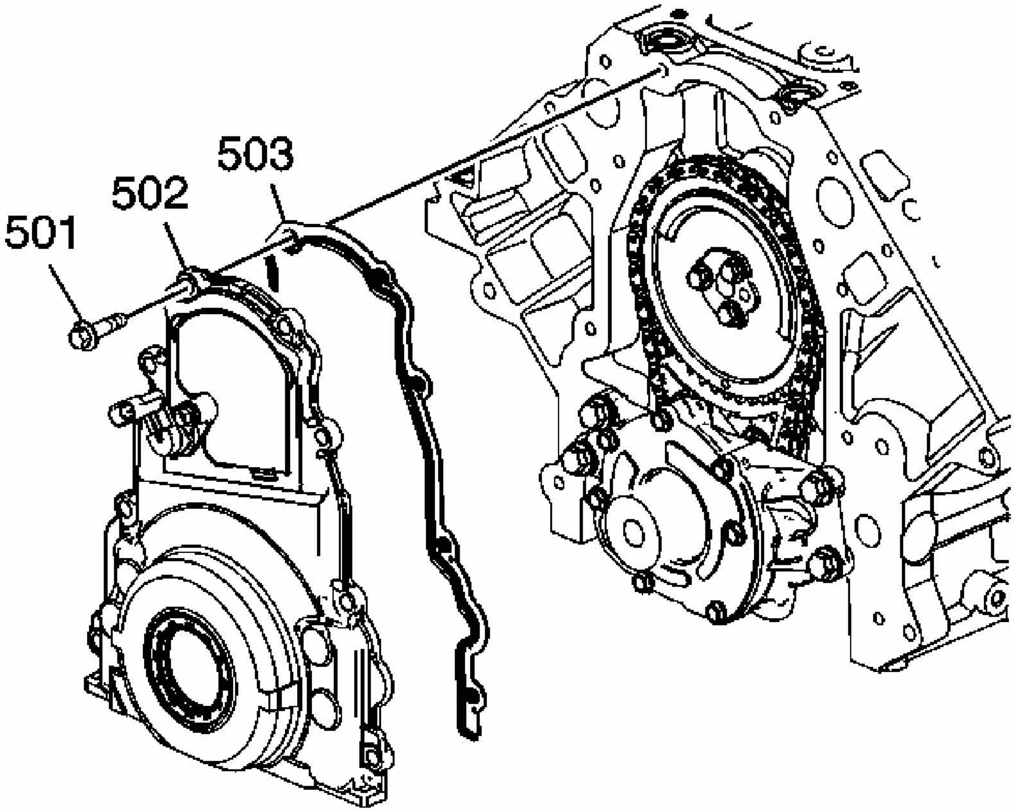


Fig. 384: View Of Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Remove the front cover bolts (501).
2. Remove the front cover (502) and gasket (503).
3. Discard the front cover gasket.

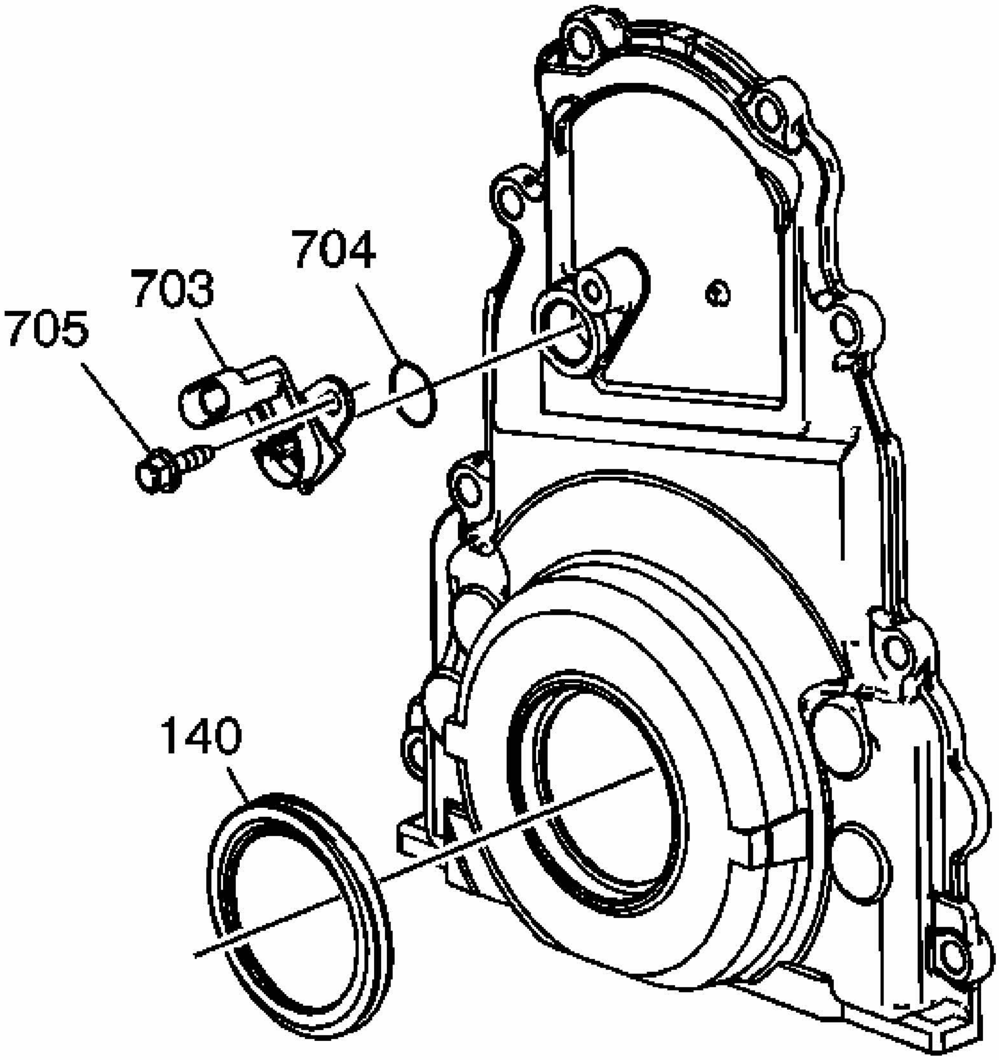


Fig. 385: View Of Crankshaft Oil Seal & Camshaft Position (CMP) Sensor
Courtesy of GENERAL MOTORS CORP.

4. Remove the oil seal (140).
5. Remove the bolt (705) and camshaft position (CMP) sensor (703).
6. Remove the O-ring (704) from the sensor, as required.

CRANKSHAFT REAR OIL SEAL HOUSING REMOVAL

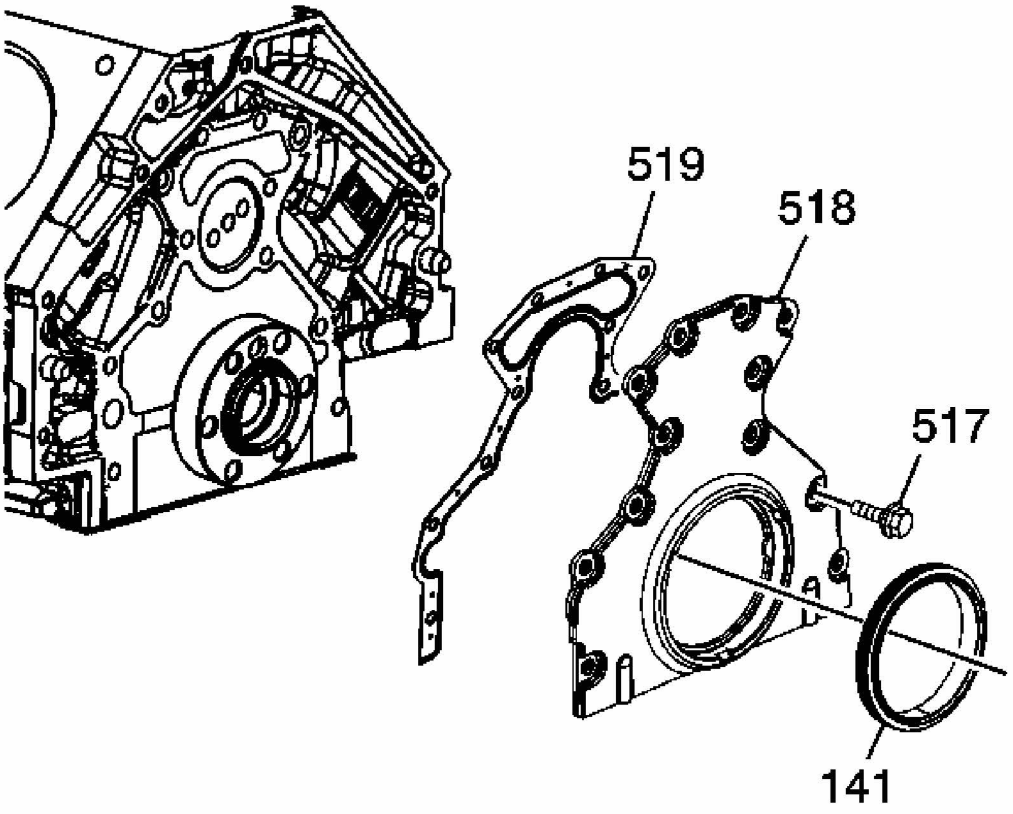


Fig. 386: View of Rear Housing, Gasket and Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the rear housing bolts (517).
2. Remove the rear housing (518) and gasket (519).
3. Remove the rear oil seal (141).

OIL PUMP, SCREEN AND CRANKSHAFT OIL DEFLECTOR REMOVAL

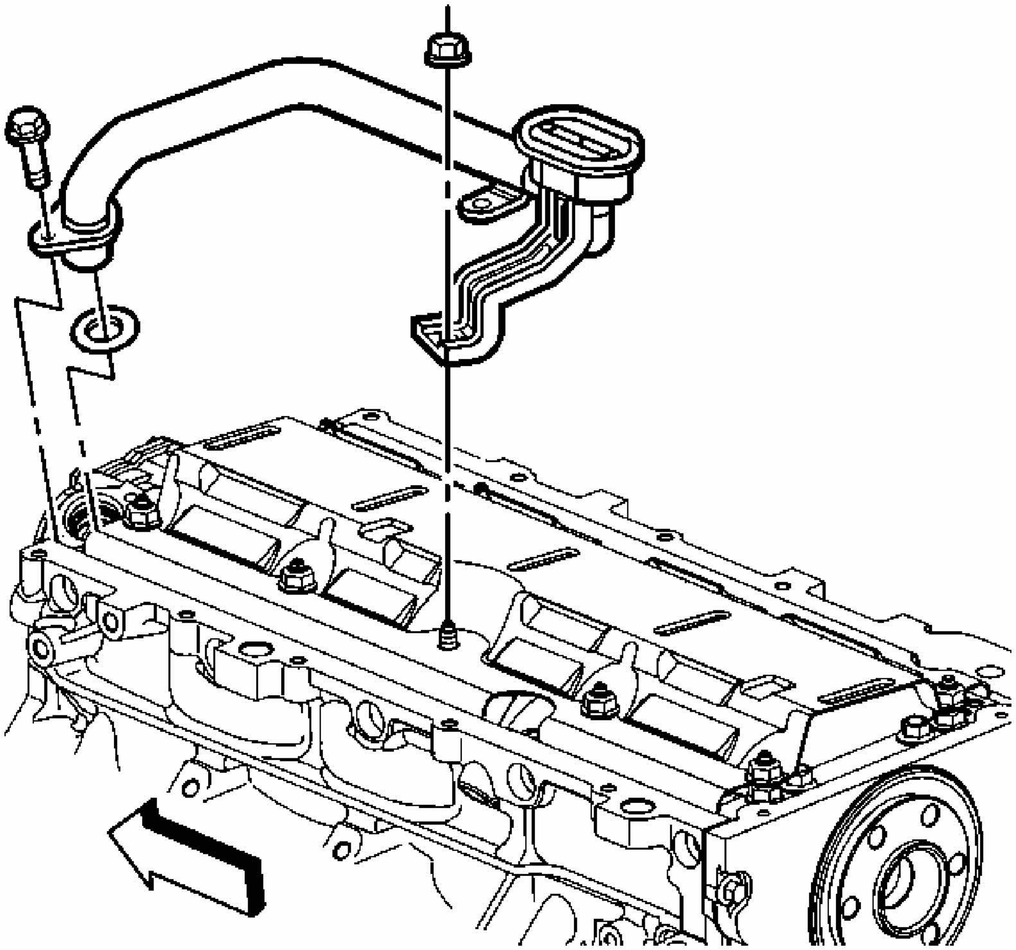


Fig. 387: View Of Oil Pump Screen
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pump screen bolt and nuts.
2. Remove the oil pump screen with O-ring seal.
3. Remove the O-ring seal from the pump screen.
4. Discard the O-ring seal.

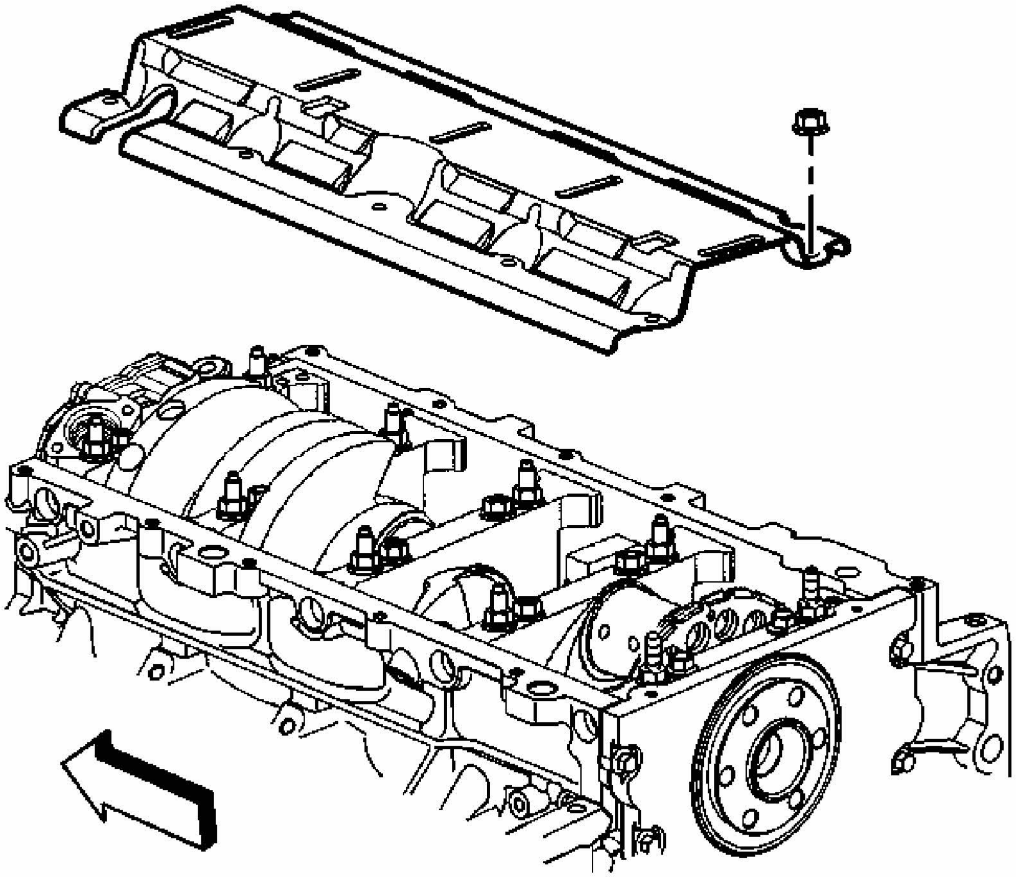


Fig. 388: View Of Crankshaft Oil Deflector
Courtesy of GENERAL MOTORS CORP.

5. Remove the crankshaft oil deflector nuts.
6. Remove the crankshaft oil deflector.

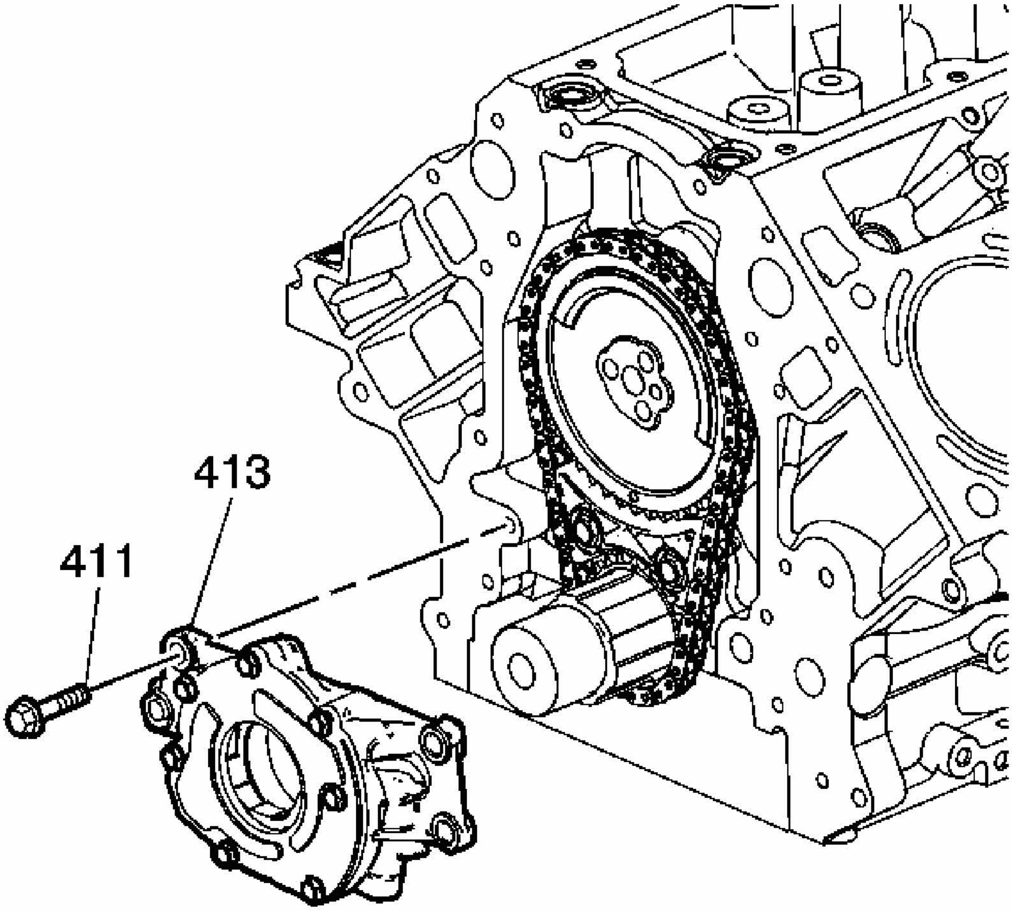


Fig. 389: Removing/Installing Oil Pump Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the oil pump bolts (411).

IMPORTANT: Do not allow dirt or debris to enter the oil pump assembly. Cap ends, as necessary.

8. Remove the oil pump (413).

TIMING CHAIN AND SPROCKETS REMOVAL

Tools Required

- **J 8433** Two Jaw Puller. See **Special Tools**.
- **J 41558** Crankshaft Sprocket Remover. See **Special Tools**.

- **J 41816-2** Crankshaft End Protector. See **Special Tools**.

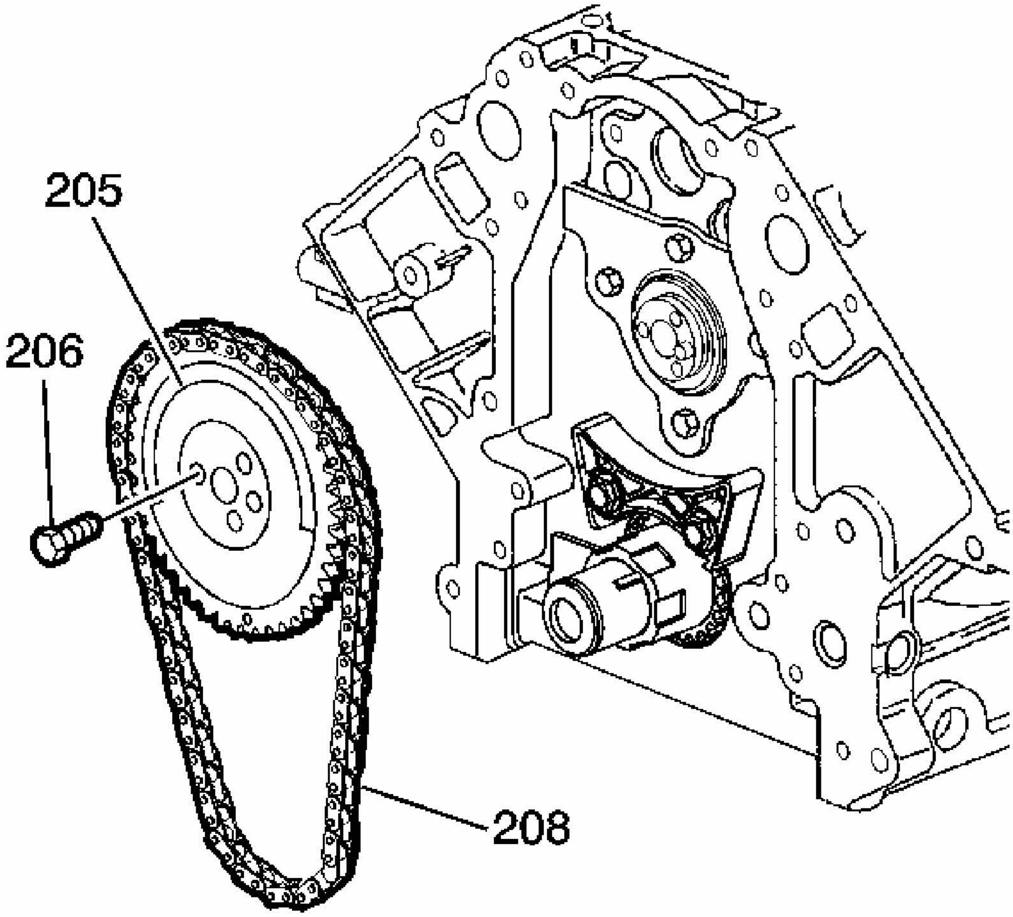


Fig. 390: View Of Camshaft Sprocket, Bolts & Timing Chain
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not turn the crankshaft assembly after the timing chain has been removed in order to prevent damage to the piston assemblies or the valves.

1. Remove the camshaft sprocket bolts (206).
2. Remove the camshaft sprocket (205) and timing chain (208).

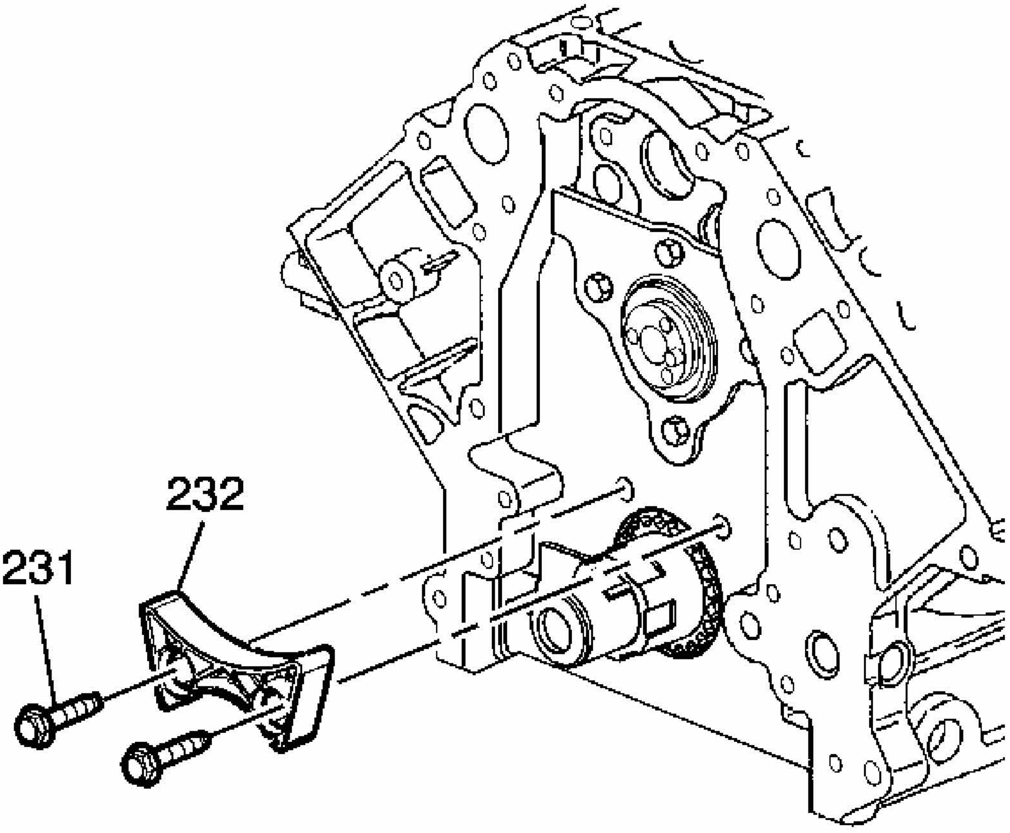


Fig. 391: Timing Chain Dampener & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the bolts (231) and chain dampener (232).

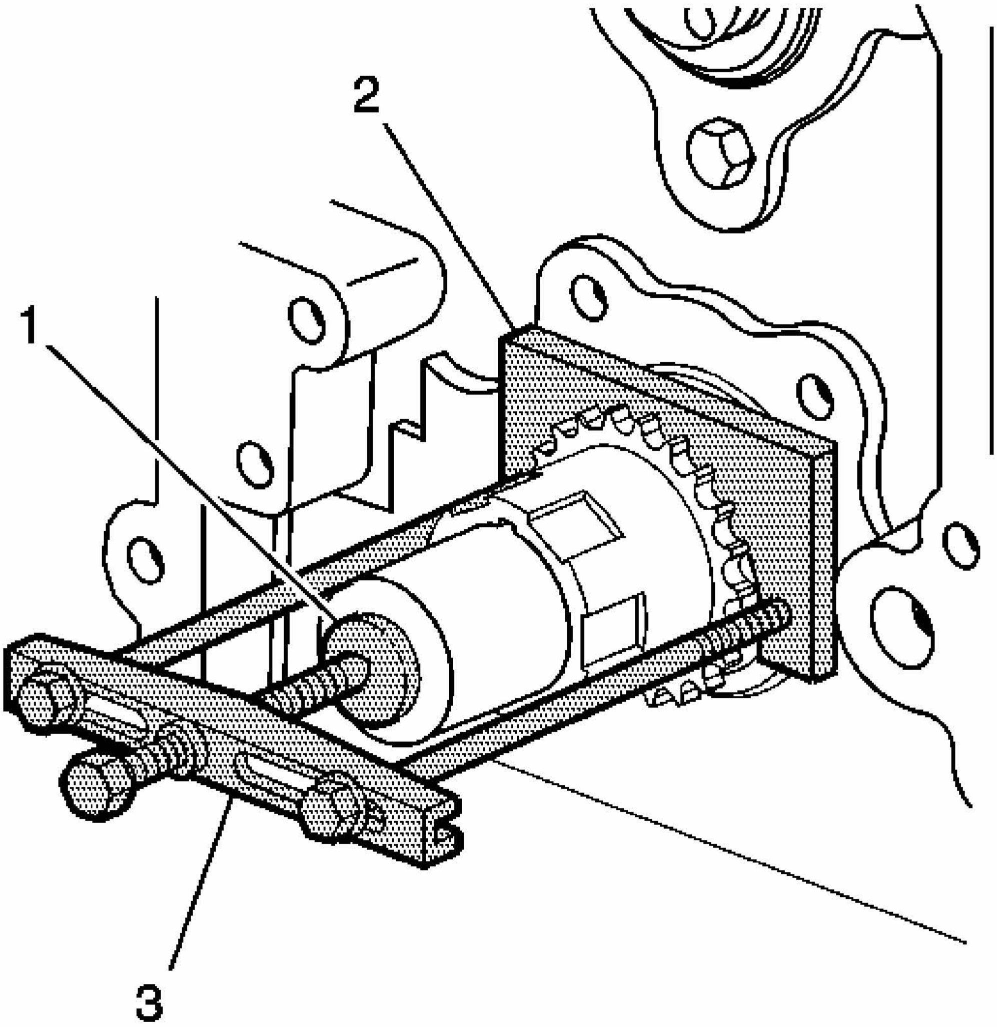


Fig. 392: Removing Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

4. Use the **J 41816-2** (1), the **J 41558** (2), and the **J 8433** (3) in order to remove the crankshaft sprocket. See **Special Tools**.

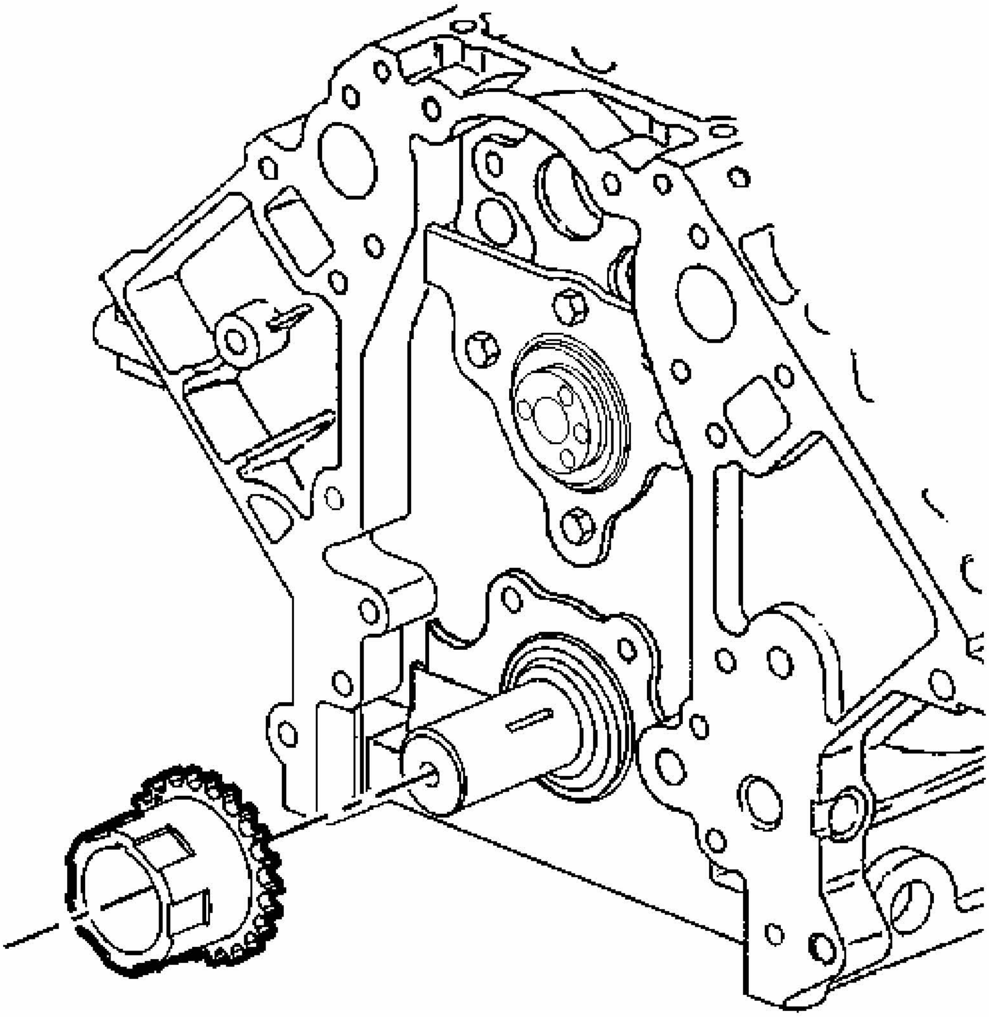


Fig. 393: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

5. Remove the crankshaft sprocket.

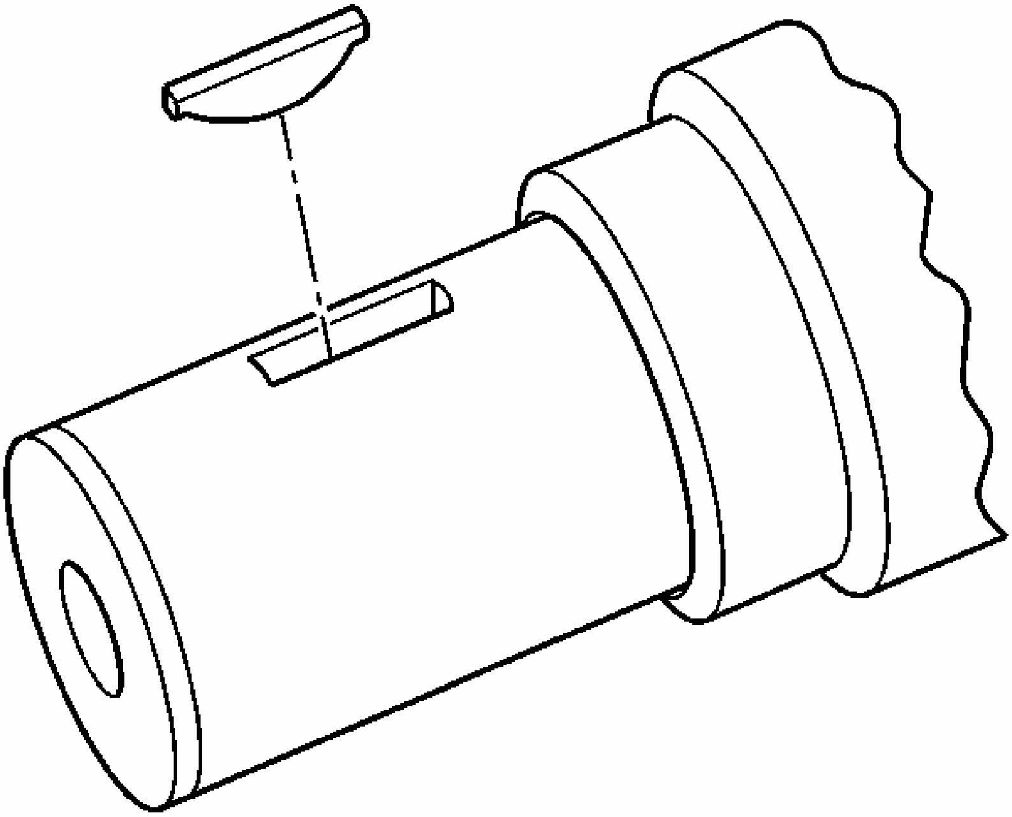


Fig. 394: View Of Crankshaft Key & Keyway
Courtesy of GENERAL MOTORS CORP.

6. Remove the crankshaft sprocket key, as required.

CAMSHAFT REMOVAL

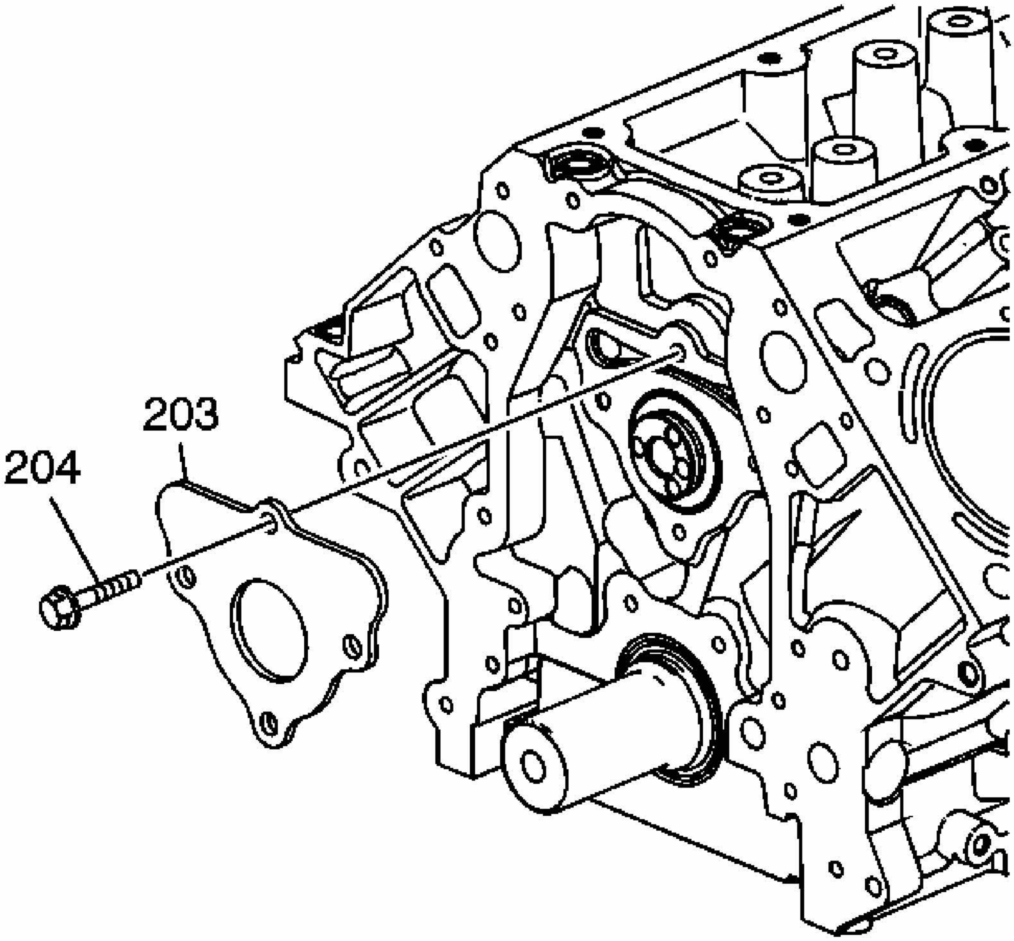


Fig. 395: Camshaft Retainer & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the camshaft retainer bolts (204) and retainer (203).

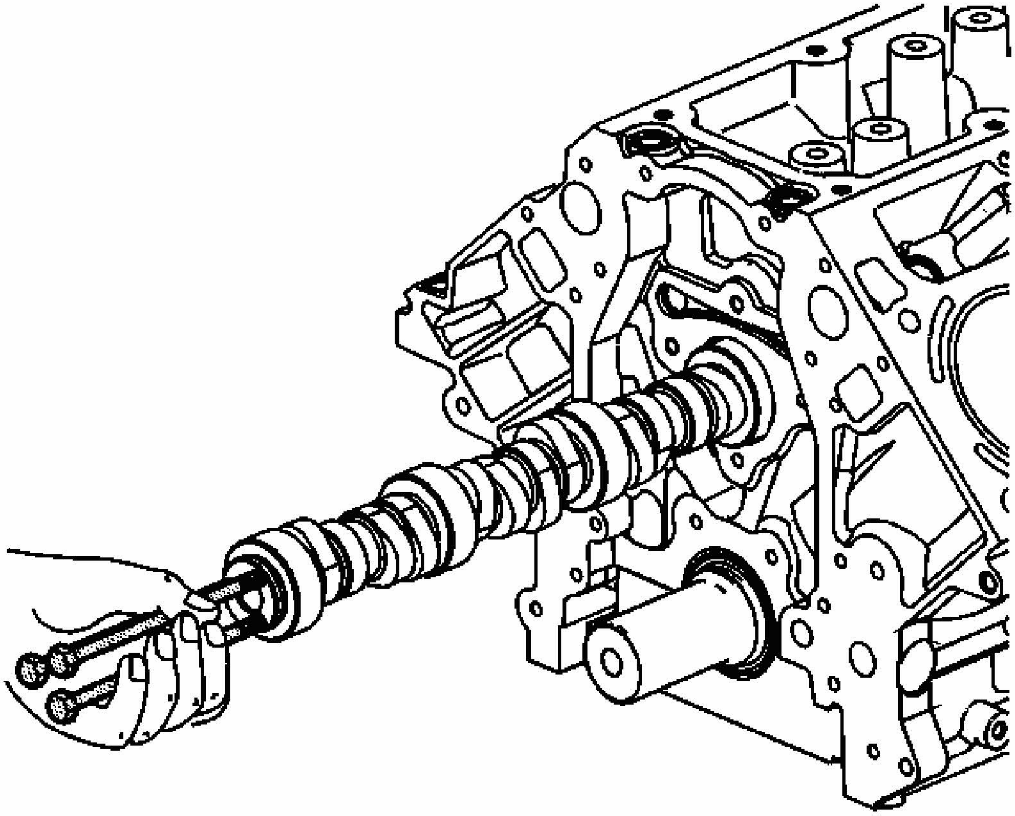


Fig. 396: Camshaft Installation
Courtesy of GENERAL MOTORS CORP.

NOTE: All camshaft journals are the same diameter, so care must be used in removing or installing the camshaft to avoid damage to the camshaft bearings.

2. Remove the camshaft.
    1. Install the 3 M8-1.25 x 100 mm bolts into the camshaft front bolt holes.
    2. Using the bolts as a handle, carefully rotate and pull the camshaft out of the engine block.
    3. Remove the bolts from the front of the camshaft.

PISTON, CONNECTING ROD, AND BEARING REMOVAL

Tools Required

- **J 24270** Cylinder Bore Ridge Reamer

- **J 41556** Connecting Rod Guide

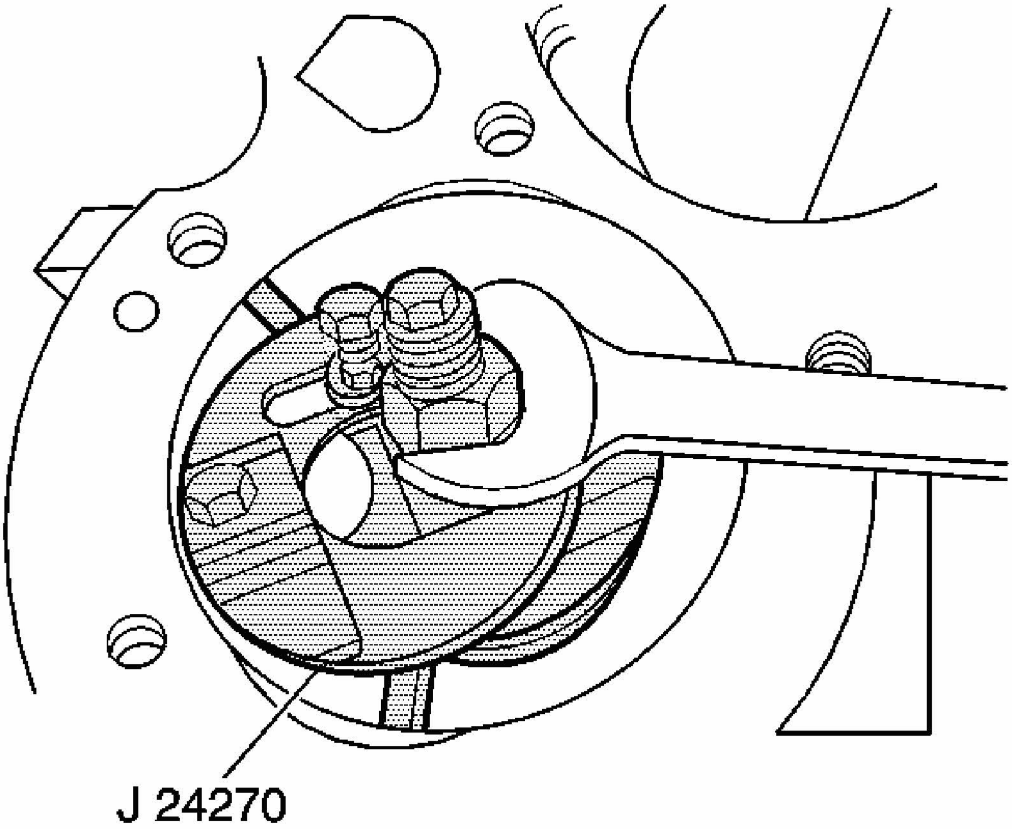


Fig. 397: Removing Cylinder Bore Ring Ridge
Courtesy of GENERAL MOTORS CORP.

1. Use the **J 24270** in order to remove the cylinder bore ring ridge, if required.
    1. Turn the crankshaft until the piston is at the bottom of the stroke.
    2. Place a cloth on top of the piston.
    3. Use the **J 24270** , or equivalent, in order to remove a cylinder ring ridge.
    4. Turn the crankshaft so the piston is at the top of the stroke.
    5. Remove the cloth.
    6. Remove the cutting debris from the cylinder and piston.

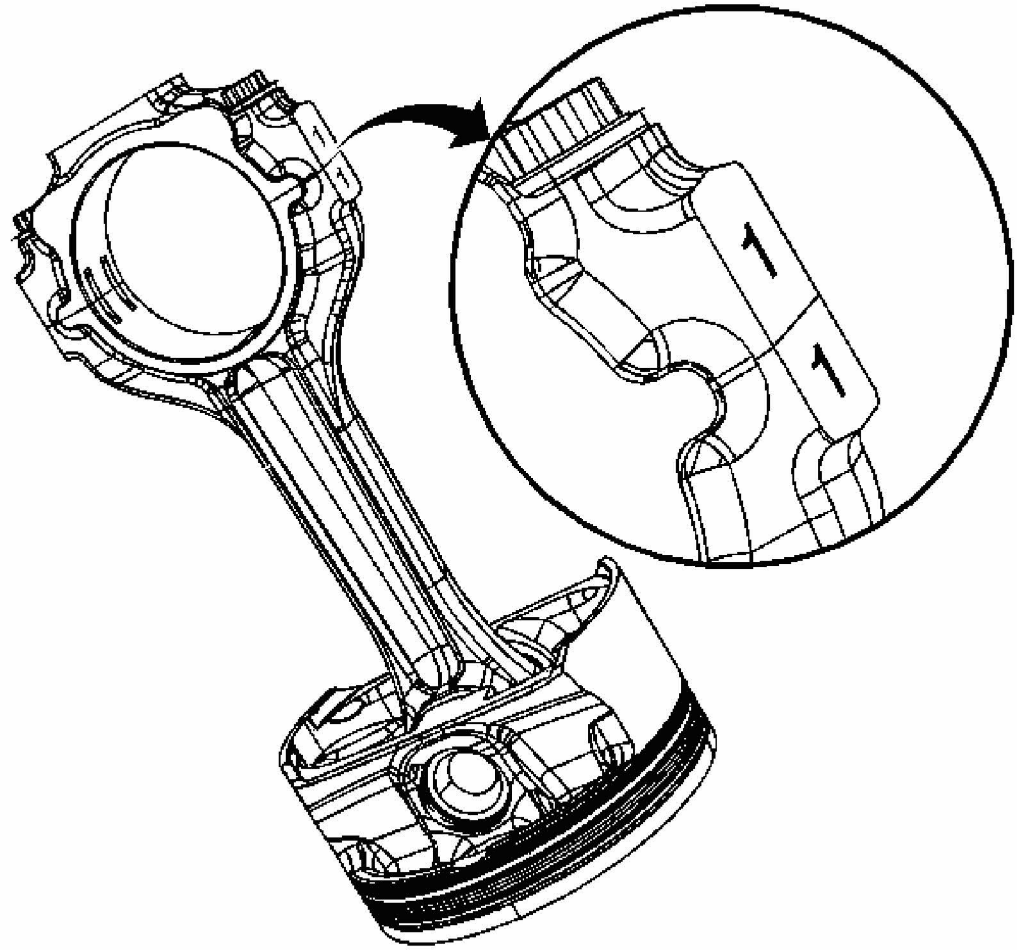


Fig. 398: Matchmarks On Connecting Rods & Caps
Courtesy of GENERAL MOTORS CORP.

2. Using a paint stick or etching tool, place matchmarks or numbers on the connecting rods and the connecting rod caps. The connecting rods and caps MUST be assembled to their original position and direction.
   - A stamping mark on the side of the connecting rod, at the crankshaft journal, may affect component geometry.
   - Mark the top of the piston to the specific cylinder bore.

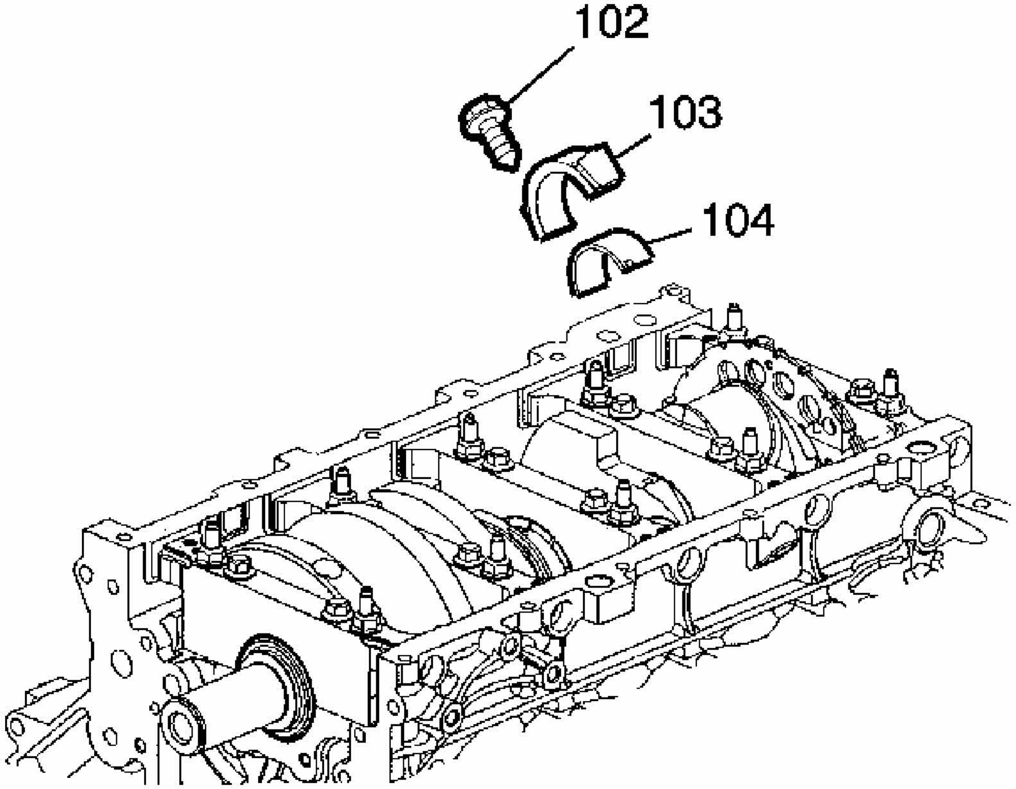


Fig. 399: Connecting Rod Bolt, Cap & Bearing
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Mark, sort, or organize the connecting rod bearings so they may be installed to their original position and location. The connecting rods and the bearing caps are NOT interchangeable. Refer to Separating Parts.

3. Remove the connecting rod bolt (102), cap (103) and bearing (104).

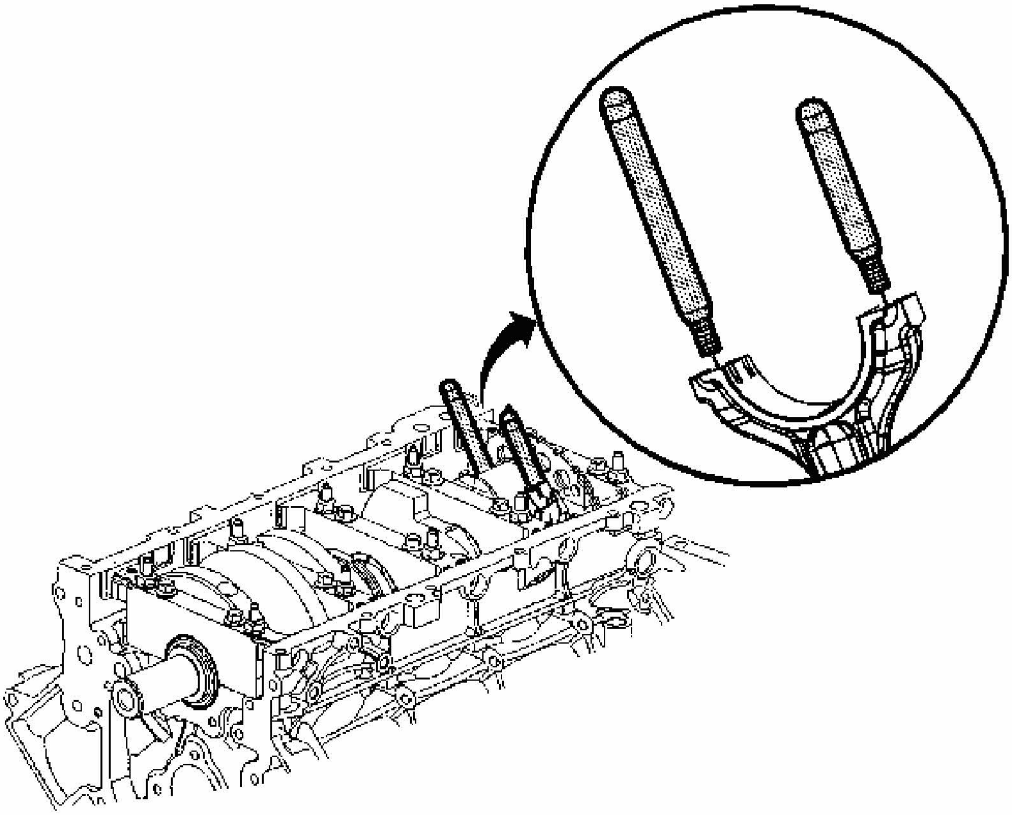


Fig. 400: Installing Piston & Connecting Rod Assembly
Courtesy of GENERAL MOTORS CORP.

4. Install the **J 41556** to the connecting rod.

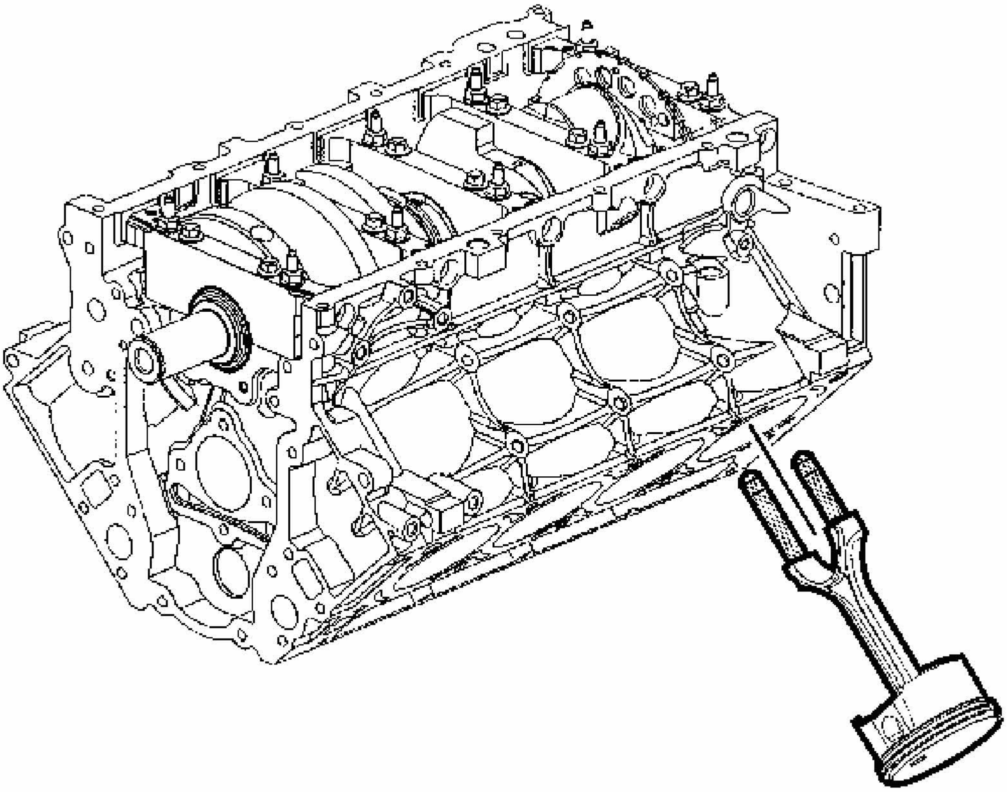


Fig. 401: Piston, Connecting Rod & Cylinder Bore
Courtesy of GENERAL MOTORS CORP.

5. Using a hammer, tap lightly on the end of the **J 41556** in order to remove the piston and connecting rod assembly from the cylinder bore.

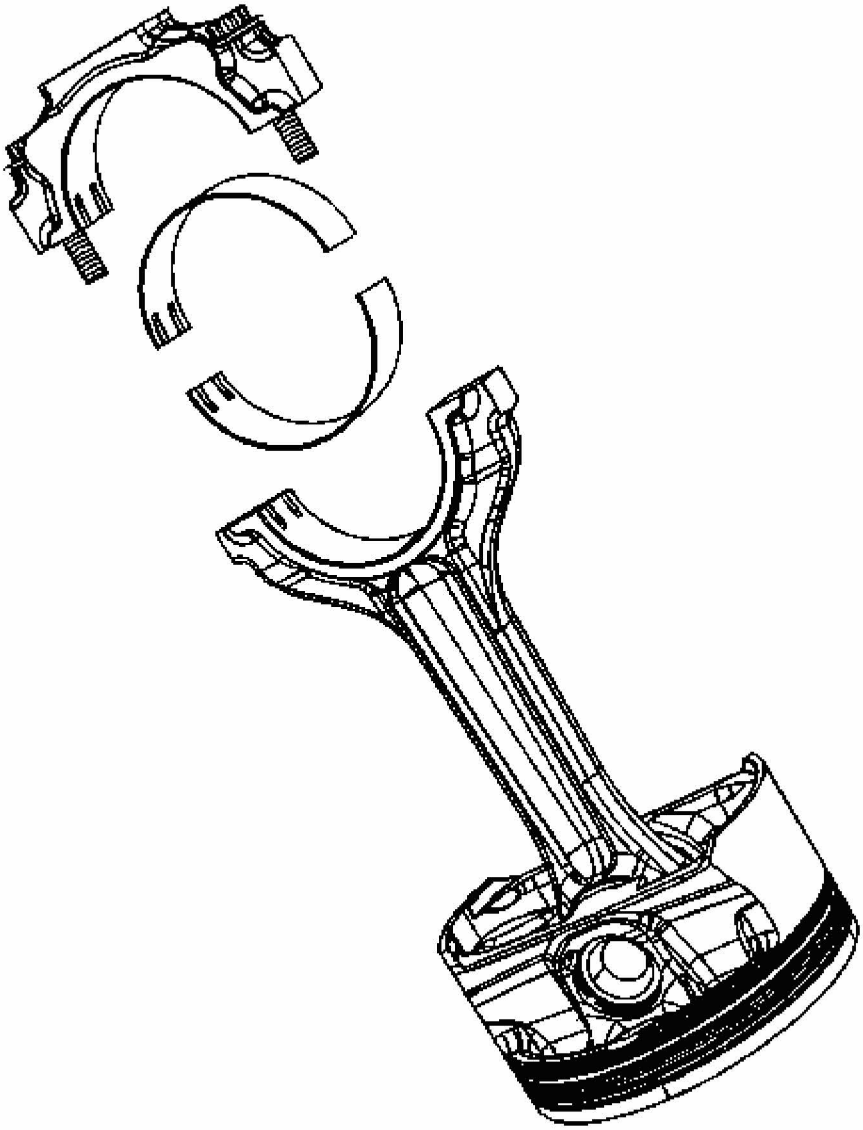


Fig. 402: View Of Piston, Connecting Rod & Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

6. Upon removal of the piston and connecting rod assembly, assemble the connecting rod cap and bolt onto the matching connecting rod.

CRANKSHAFT AND BEARINGS REMOVAL

Tools Required

- **J 6125-1B** Slide Hammer with Adapter
- **J 41818** Crankshaft Bearing Cap Remover. See **Special Tools**.

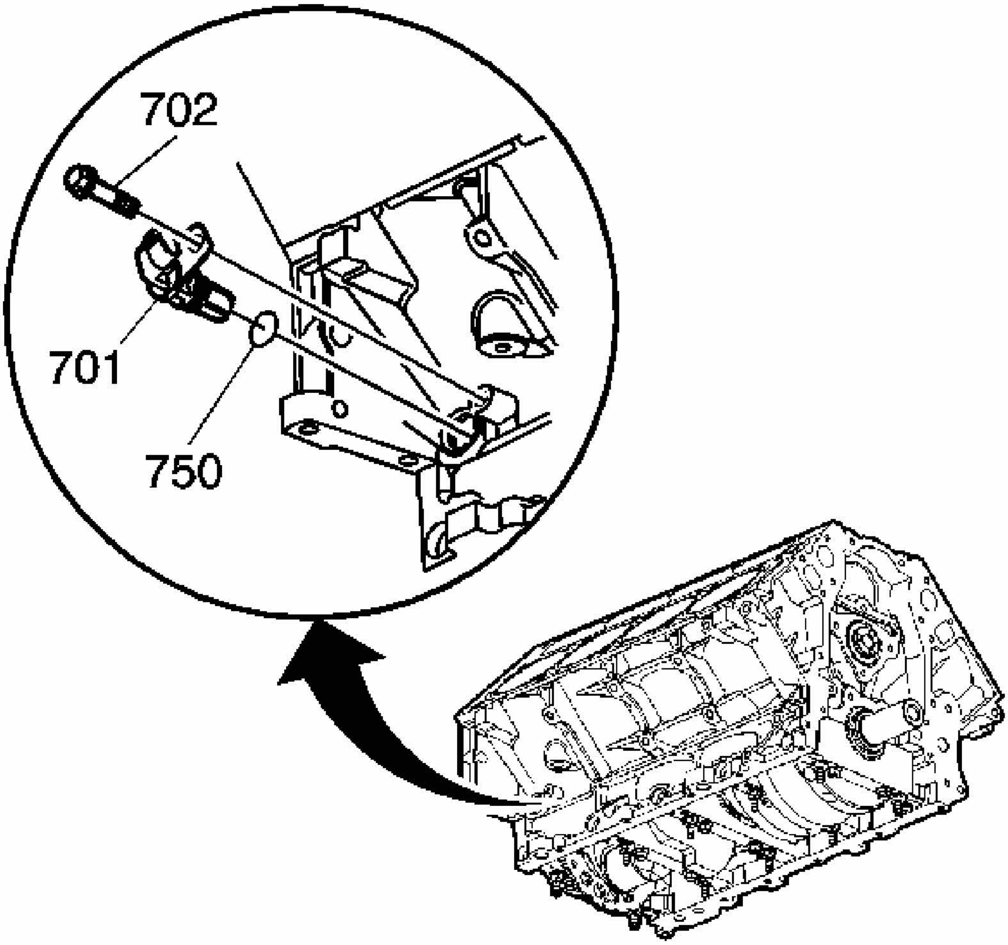


Fig. 403: CKP Sensor, Bolt & O-Ring
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **The crankshaft bearing caps are machined with the engine block for the proper clearances. Mark or identify each crankshaft bearing cap location and direction before removal. The crankshaft bearing caps MUST be installed to their original position and direction.**
- **Do not use the bearing cap M8 side bolts again.**

1. Remove the crankshaft position (CKP) sensor bolt (702).

2. Remove the CKP sensor (701).
3. Remove the O-ring (750) from the sensor, as required.

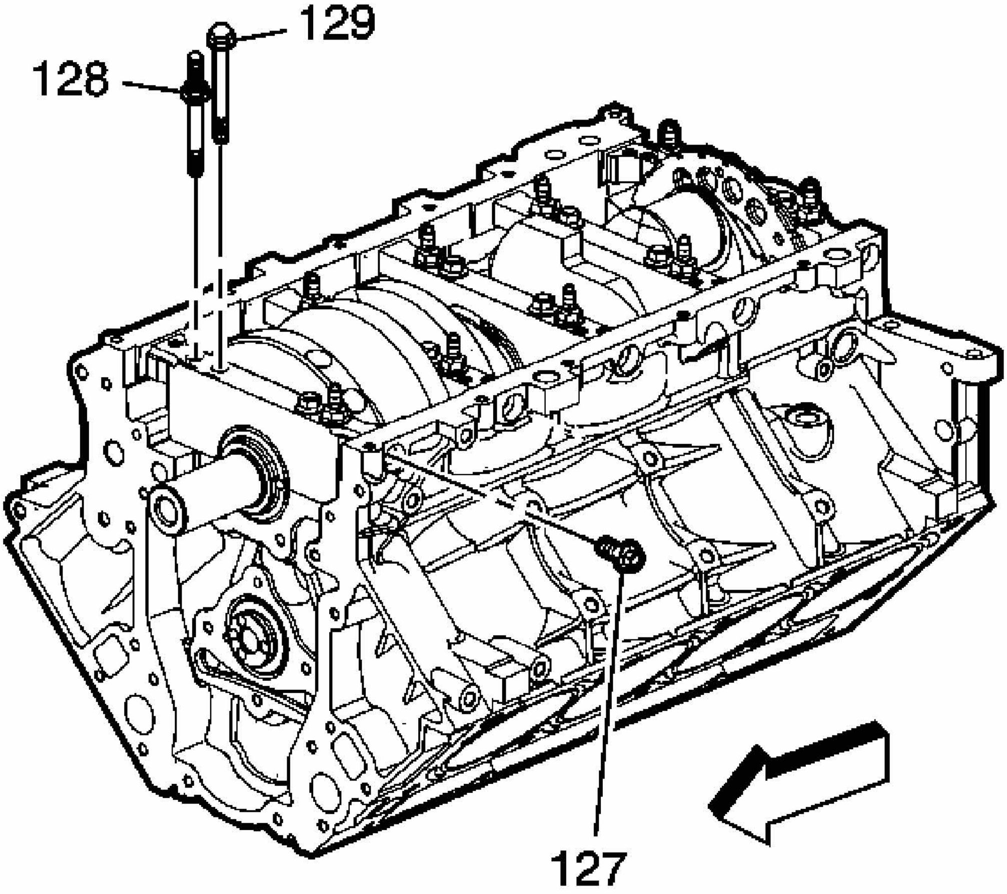


Fig. 404: Crankshaft Bearing Caps & Studs
Courtesy of GENERAL MOTORS CORP.

4. Remove the crankshaft bearing cap M8 bolts (127).
5. Remove the crankshaft bearing cap M10 bolts (129) and studs (128).

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

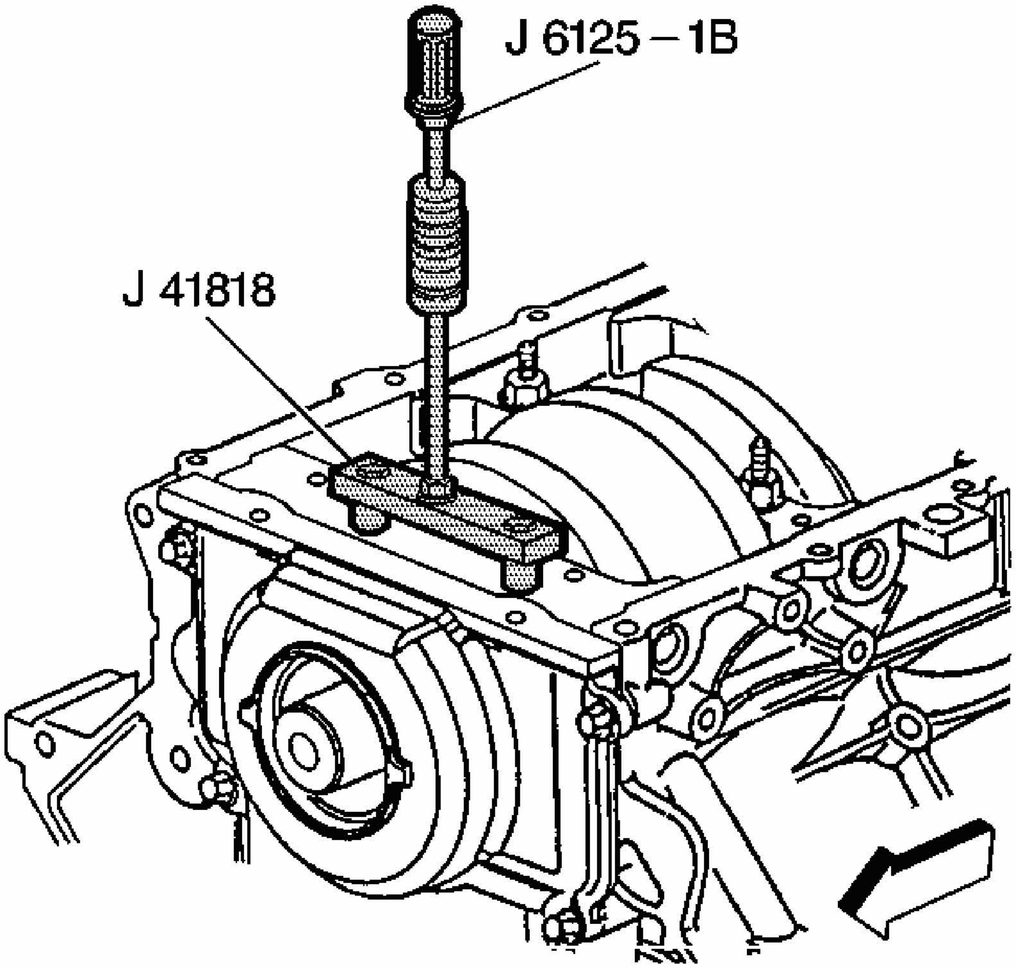


Fig. 405: View Of J 6125-1B & J 41818 Removing Main Bearing Cap
Courtesy of GENERAL MOTORS CORP.

6. Install the **J 41818** . See Special Tools.

   Tighten: Tighten the **J 41818** bolts to 11 N. See Special Tools.m (100 lb in).

7. Install the **J 6125-1B** to the **J 41818** in order to remove the crankshaft bearing caps. See Special Tools.

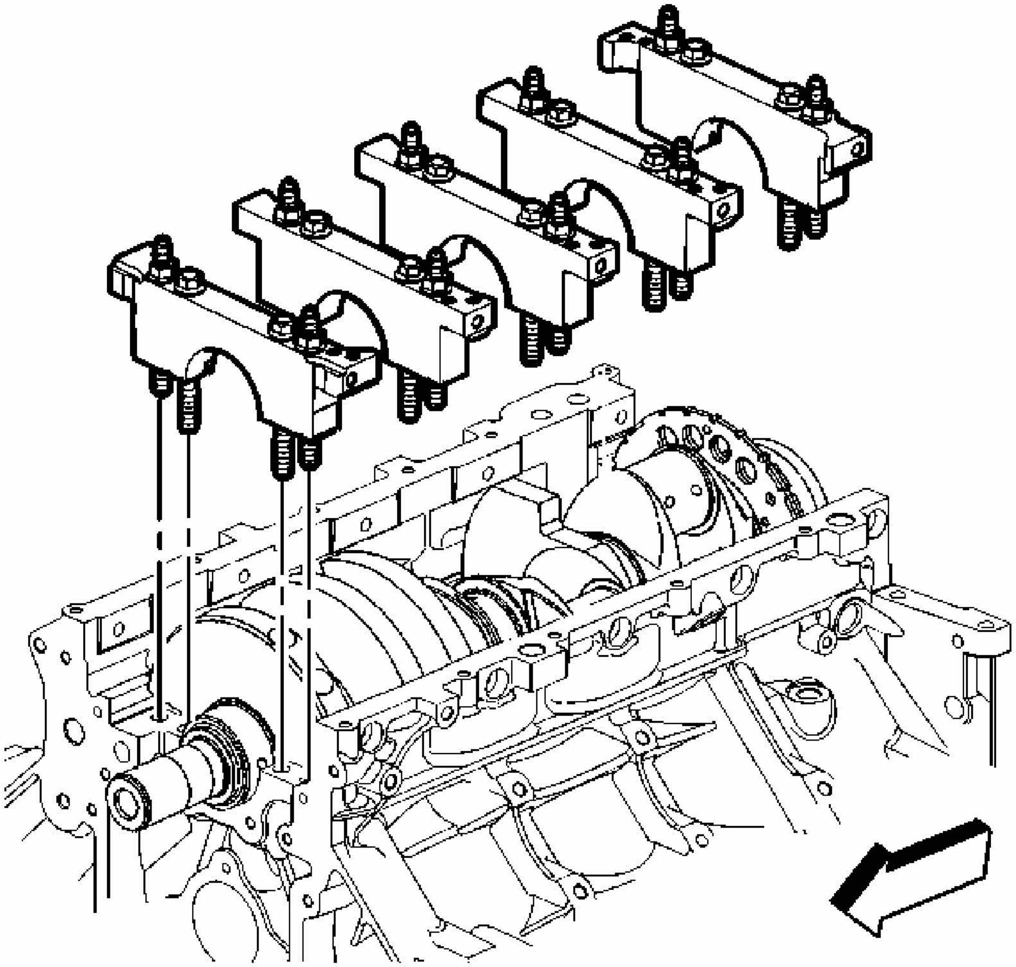


Fig. 406: View Of Crankshaft Main Bearing Caps
Courtesy of GENERAL MOTORS CORP.

8. Remove the bearing caps.

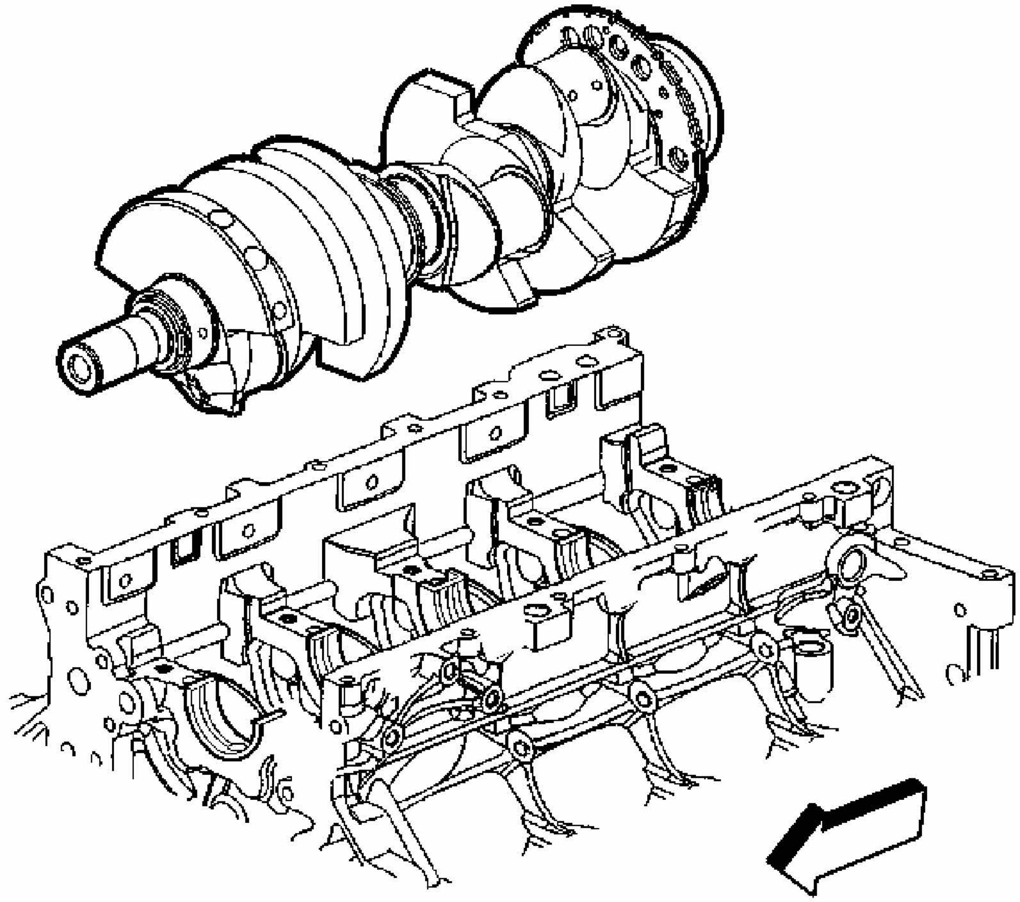


Fig. 407: View Of Crankshaft & Engine Block
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **Use care when handling the crankshaft. Avoid damage to the CKP sensor reluctor ring teeth. Nicks, burrs, or other damage to the teeth may effect on-board diagnostics (OBD) II system performance.**

9. Remove the crankshaft.

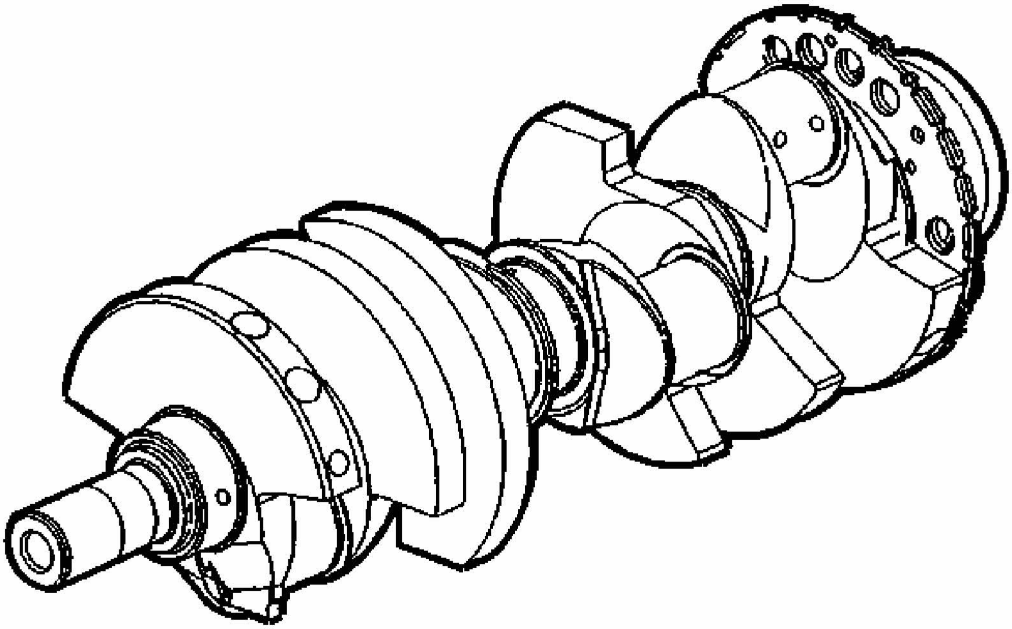


Fig. 408: View Of Camshaft
Courtesy of GENERAL MOTORS CORP.

10. Lay the crankshaft onto wooden V-blocks or other protective surface.

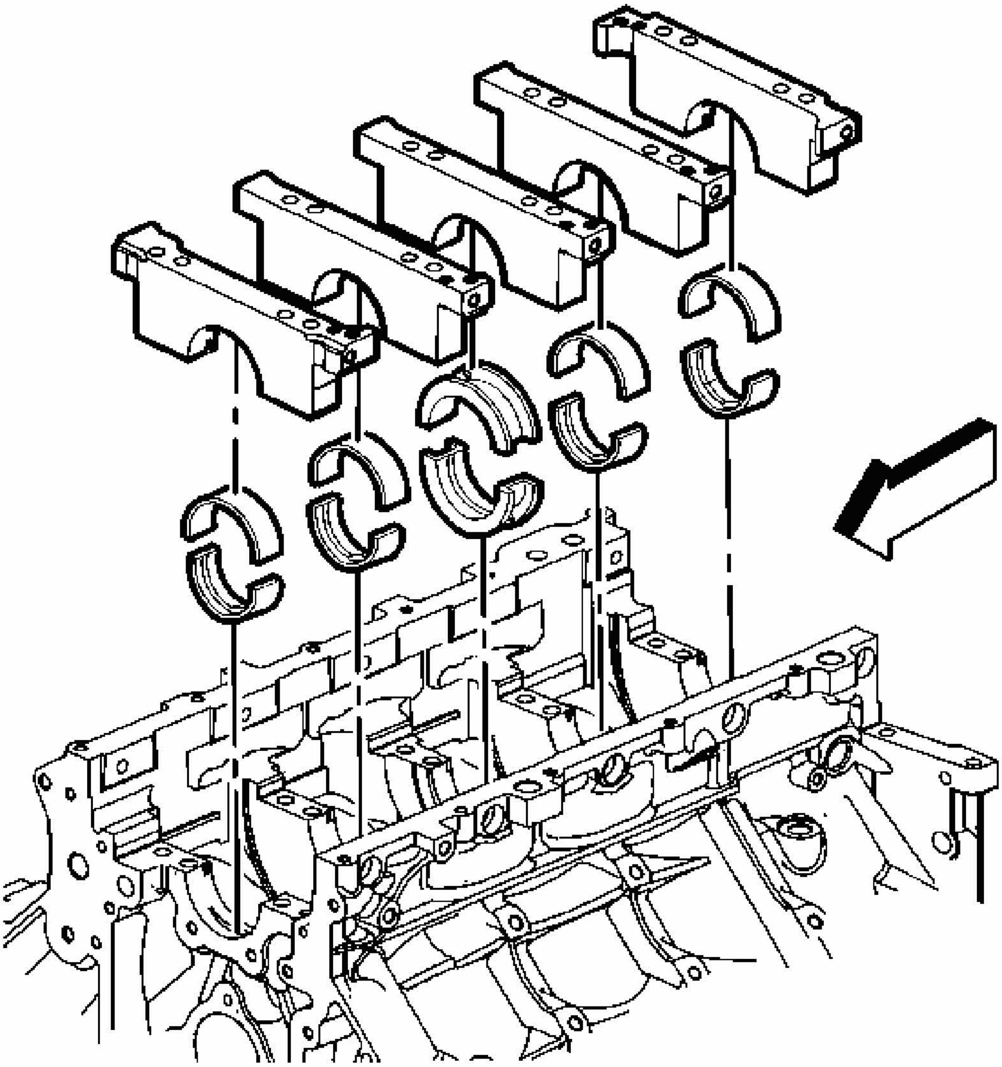


Fig. 409: View Of Crankshaft Bearings & Bearing Caps
Courtesy of GENERAL MOTORS CORP.

11. Remove the crankshaft bearings from the bearing caps and the engine block.
12. Mark, sort, or organize the crankshaft bearings so they may be installed to their original position and location. Refer to **Separating Parts**.

ENGINE BLOCK PLUG REMOVAL

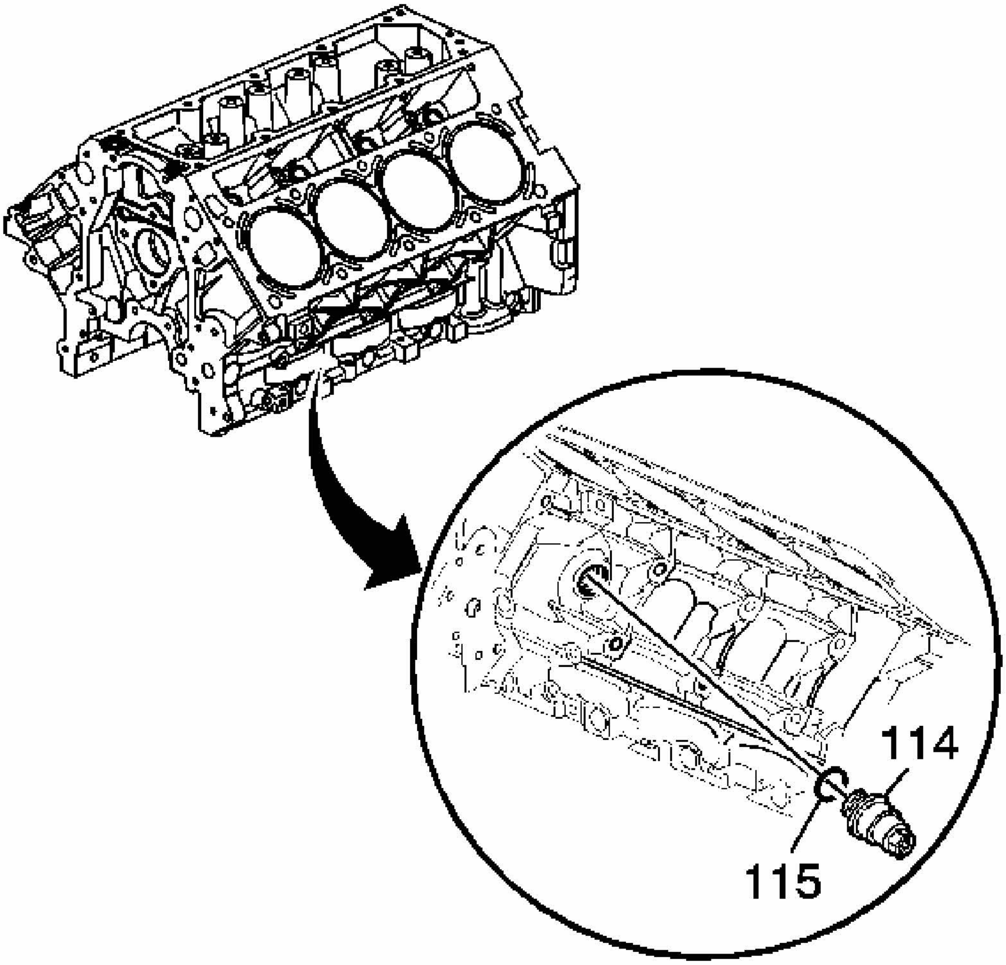


Fig. 410: Engine Block Coolant Heater
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine block coolant heater (114).

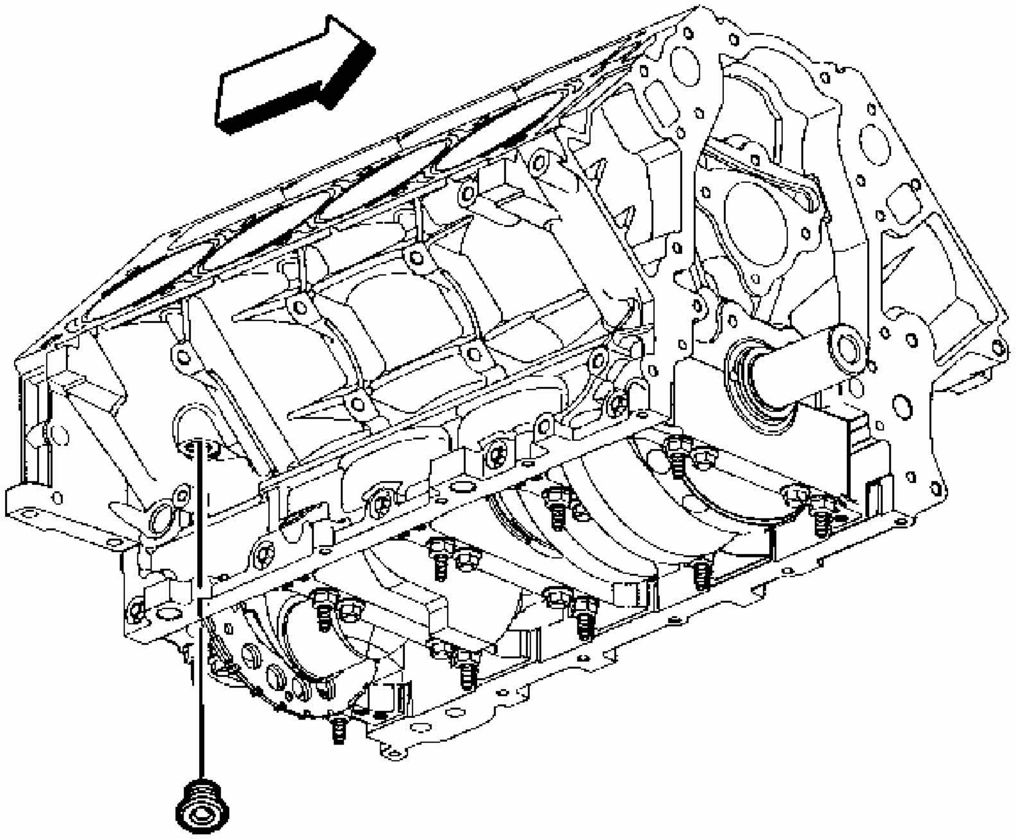


Fig. 411: Identifying Plug Location On Underside Of Block
Courtesy of GENERAL MOTORS CORP.

2. Remove the engine block coolant drain hole plug.

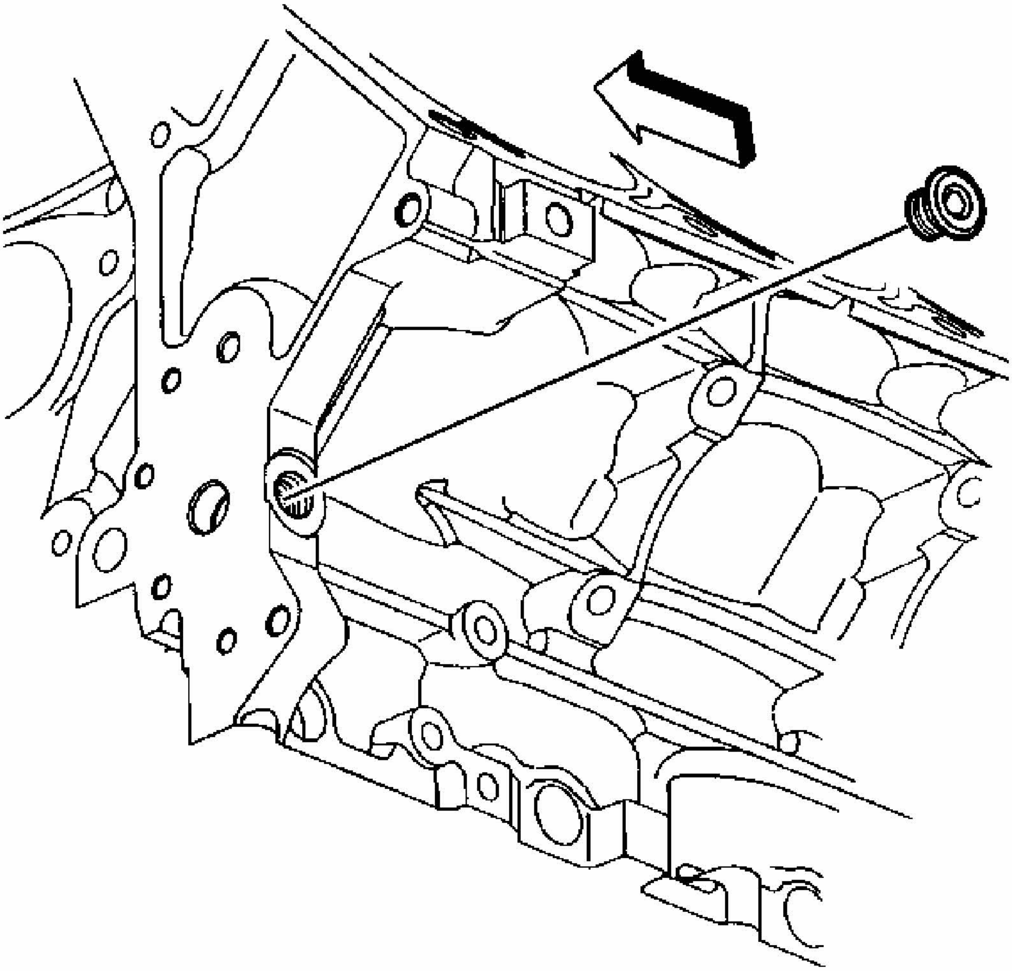


Fig. 412: Engine Block Left Front Oil Gallery Plug
Courtesy of GENERAL MOTORS CORP.

3. Remove the engine block left front oil gallery plug.

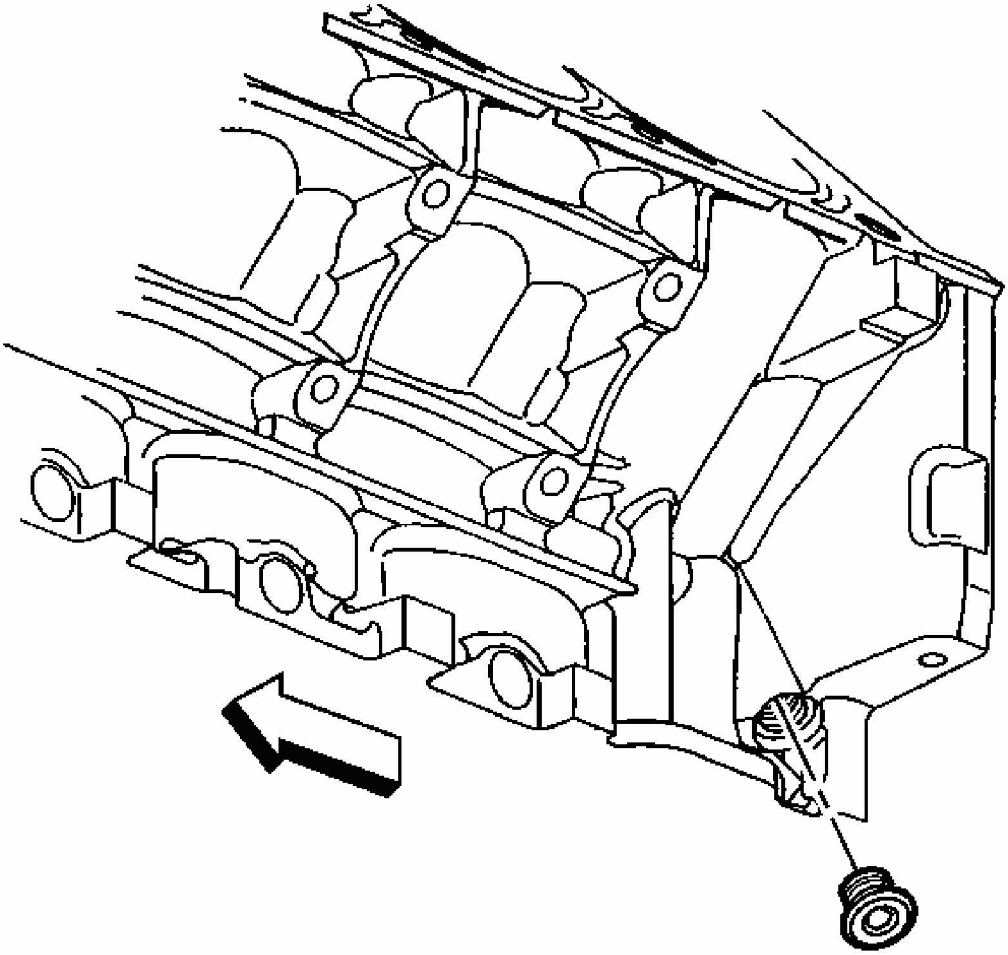


Fig. 413: View Of Engine Block Left Rear Oil Gallery Plug
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine block left rear oil gallery plug.
5. Inspect the block plug sealing washers.

   If the block plug and heater sealing washers are not damaged, they may be used during assembly.

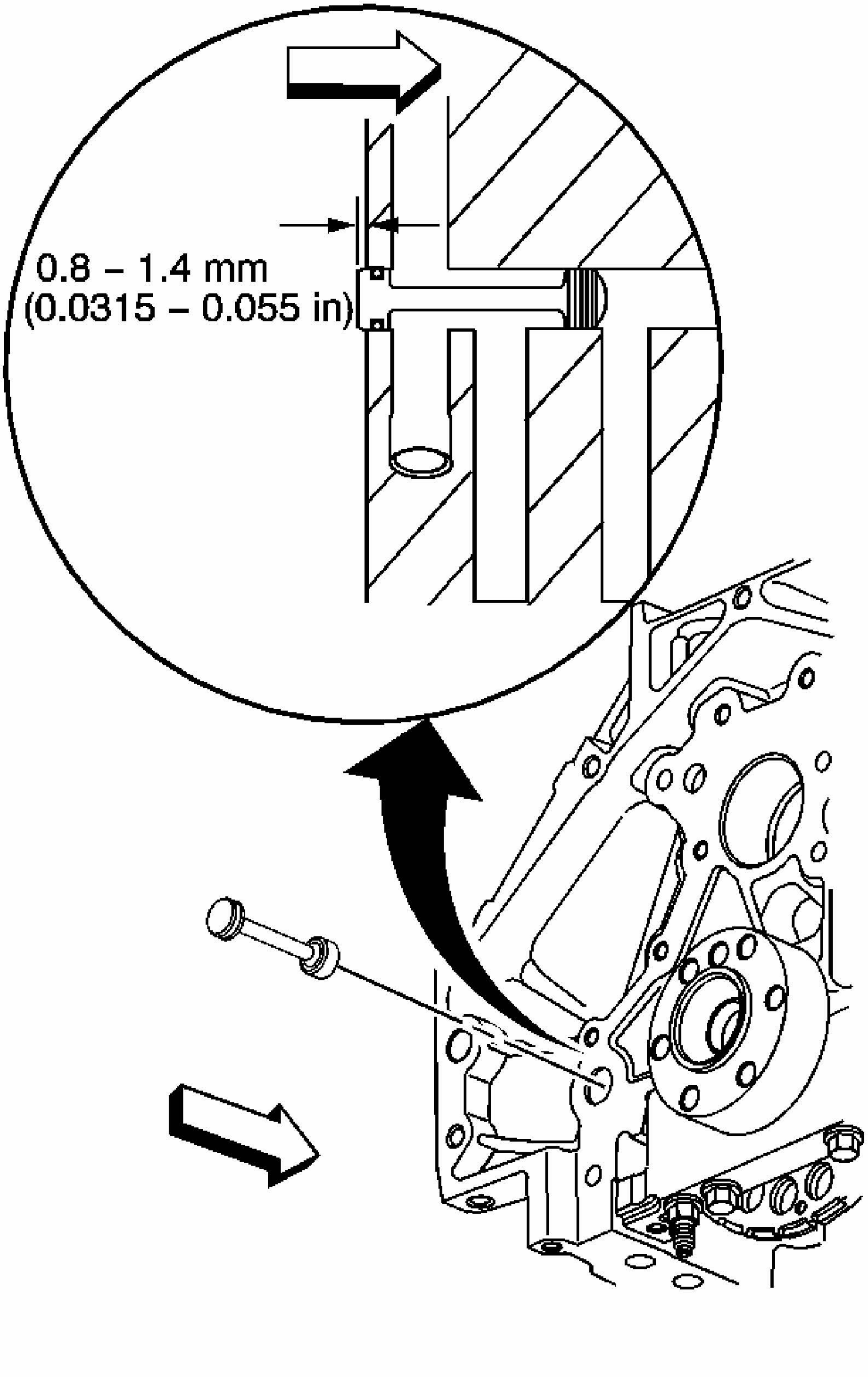

0.8 – 1.4 mm
(0.0315 – 0.055 in)

Fig. 414: View Of Engine Block Rear Oil Gallery Plug

Courtesy of GENERAL MOTORS CORP.

6. Remove the engine block rear oil gallery plug.
7. Inspect the O-ring seal of the rear oil gallery plug.

   If the O-ring seal is not cut or damaged, the plug and O-ring seal may be used during assembly.

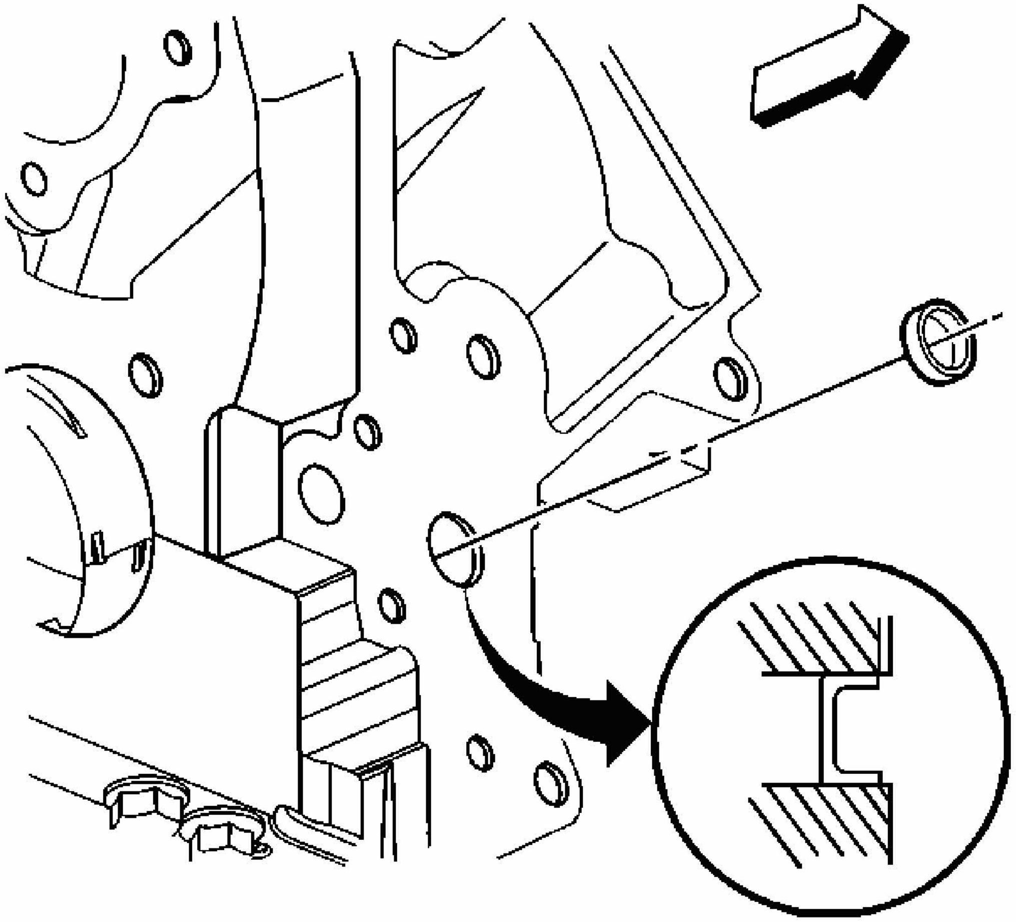


Fig. 415: View Of Engine Block Front Oil Gallery Plug
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Remove the front oil gallery plug only if service is required. If the front oil gallery plug is removed, a NEW oil gallery plug must be installed.

8. Remove the engine block front oil gallery plug.

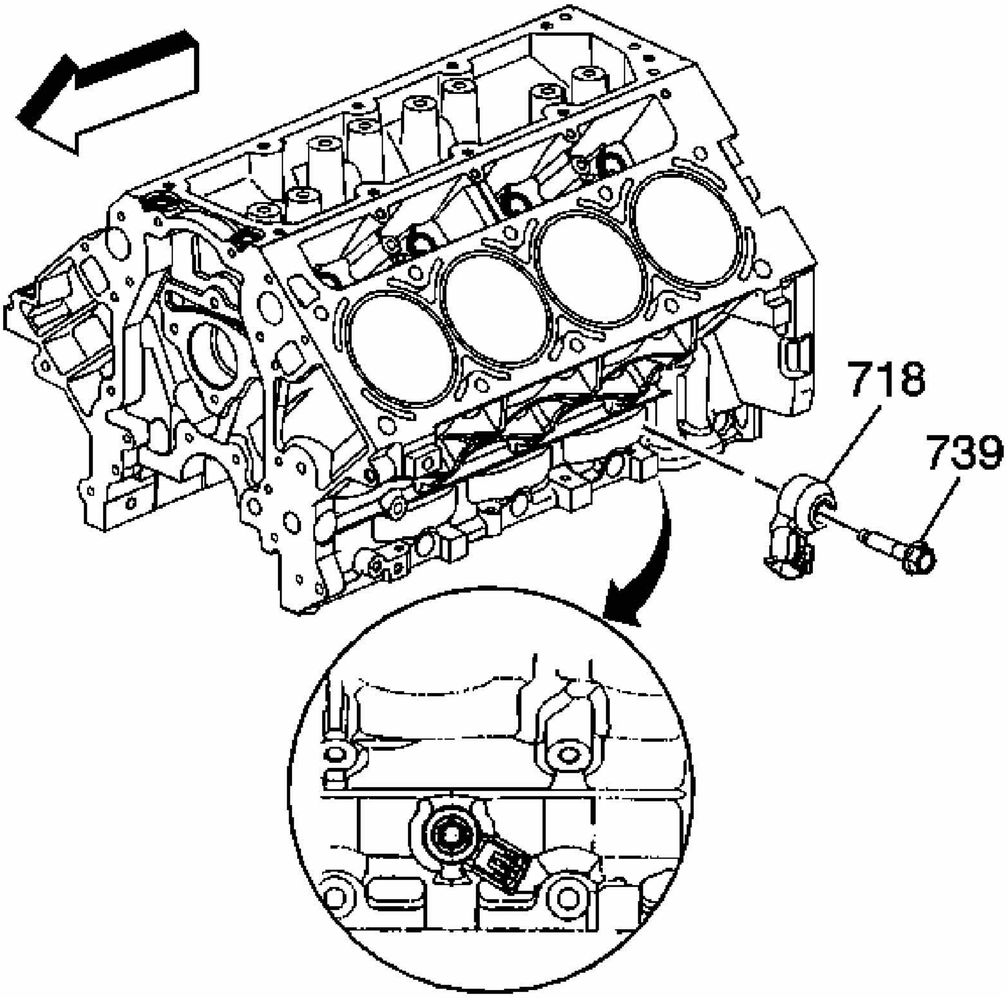


Fig. 416: Left Side Knock Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

9. Remove the left side knock sensor (718) and bolt (739).

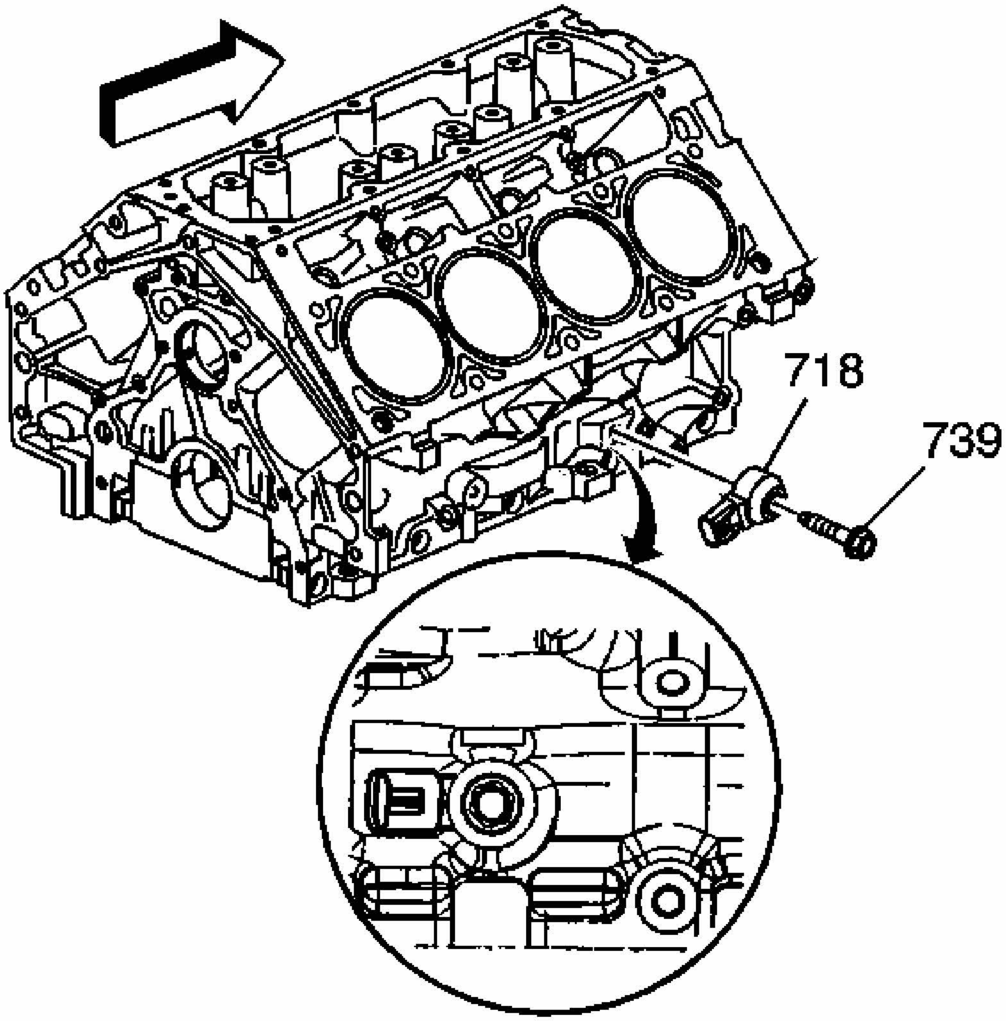


Fig. 417: Locating Knock Sensor
Courtesy of GENERAL MOTORS CORP.

10. Remove the right side knock sensor (718) and bolt (739).

ENGINE BLOCK CLEANING AND INSPECTION

Tools Required

- **J 8087** Cylinder Bore Gage
- **J 42385-100** Head/Main Bolt Thread Repair Kit. See Special Tools.

Cleaning Procedure

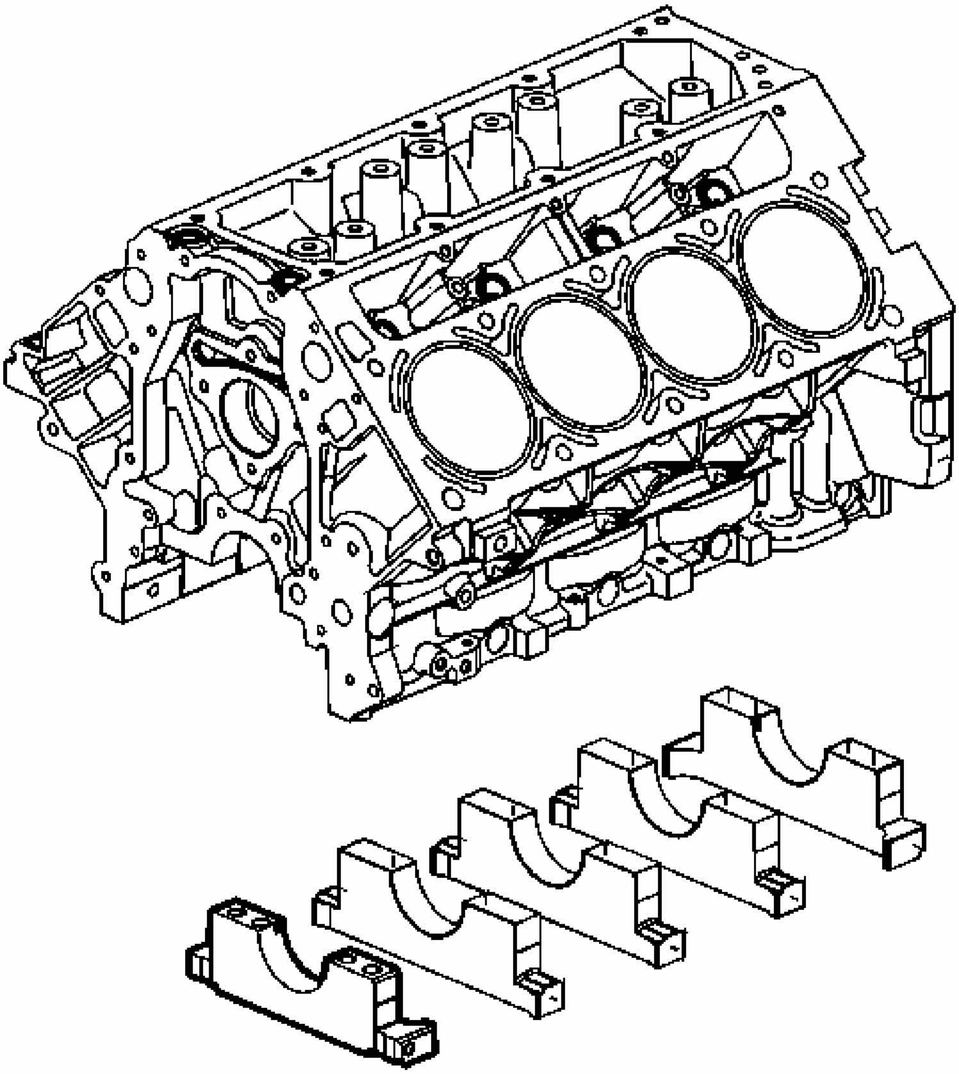


Fig. 418: Main Bearing Caps
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not use a caustic solution to clean the aluminum engine block.

IMPORTANT: When cleaning the engine block in a thermal type oven, do not exceed 232°C (450°F).

Clean the following components:

- Remove all sludge, dirt, or debris using a cleaning solvent or thermal type oven. Refer to **Cleanliness and Care**.
- Gasket surfaces

  Refer to **Replacing Engine Gaskets**.

- Coolant passages
- Oil galleries
- Main bearing caps
- Cylinder head bolt holes to remove threadlocking material

  Thread repair driver tool J 42385-107 may be used to clean the threads of old threadlocking material.

Inspection Procedure

1. Inspect the following components:
    - Cylinder walls for excessive scratches, gouging, or ring ridge
    - Cylinder bores for excessive ring ridge at the top of the cylinder
    - Coolant jacket for cracks
    - Valve lifter bores for excessive scoring or wear
    - Crankshaft bearing webs for cracks
    - Gasket sealing surfaces for excessive scratches or gouging

      Refer to **Replacing Engine Gaskets**.

    - Oil galleries for restrictions
    - Threaded bolt holes for damaged threads
    - Scoring or damage to the displacement on demand oil passages or sealing surfaces
2. Measure the cylinder bores for excessive ring ridge at the top of the cylinder.

Measuring the Cylinder for Oversize

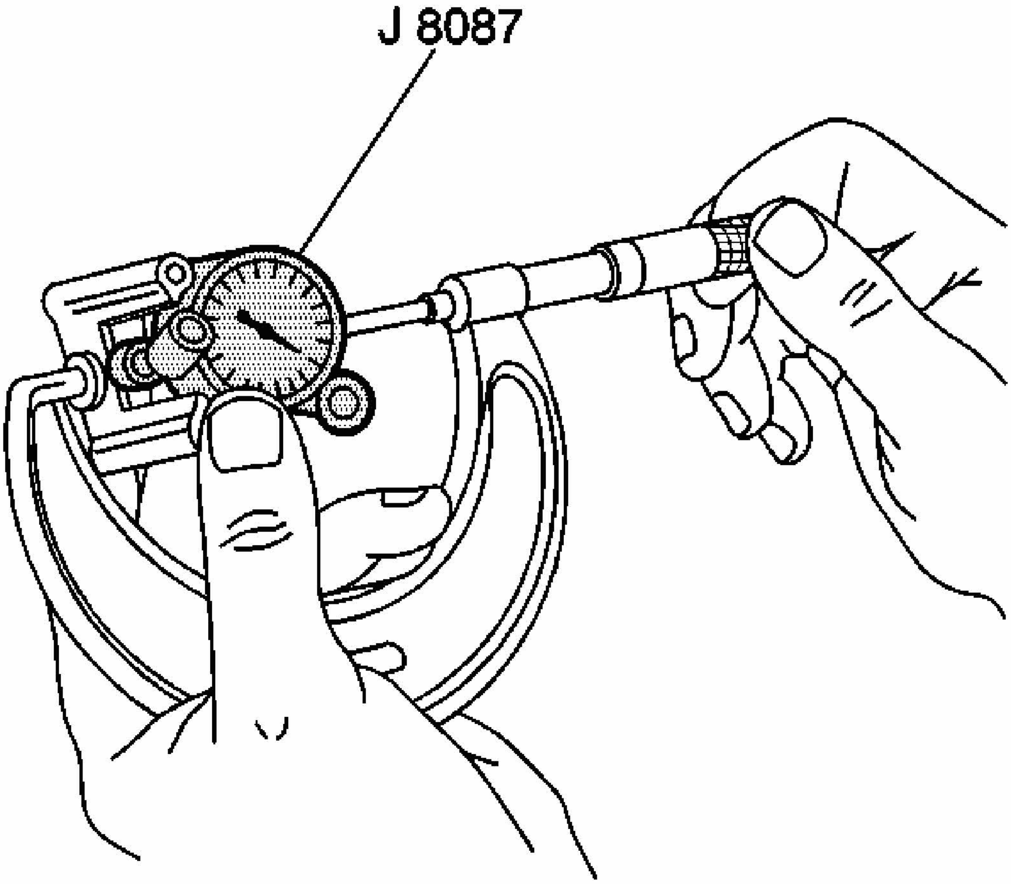


Fig. 419: Measuring Bore Gauge With Micrometer
Courtesy of GENERAL MOTORS CORP.

1. Adjust the micrometer to a dimension slightly smaller than the bore size. Refer to **Engine Mechanical Specifications**.
2. Insert the **J 8087** bore gage into the micrometer and zero the bore gage dial.

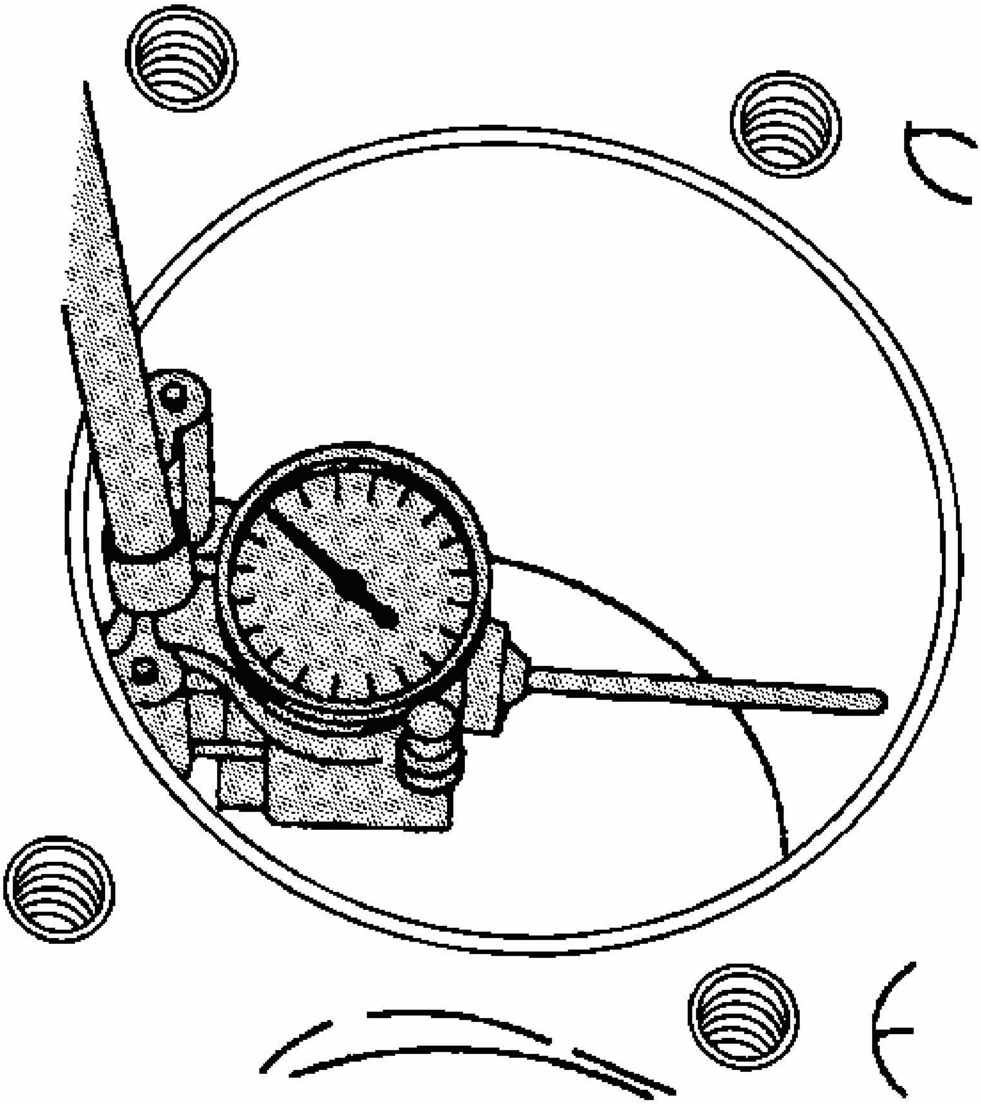


Fig. 420: Measuring Cylinder Bore
Courtesy of GENERAL MOTORS CORP.

3. Using the **J 8087** , measure the cylinder bore for oversize.

   Slide the bore gage up and down throughout the length of the cylinder bore. Measure the bore both parallel and perpendicular to the centerline of the crankshaft at the top, center, and bottom of the bore. A cylinder bore that exceeds the maximum diameter must be serviced with an oversized piston. Refer to **Engine Mechanical Specifications**.

CYLINDER BORING AND HONING

Boring Procedure

IMPORTANT: A 0.5 mm (0.02 in) oversize service piston and a piston ring set are available.

1. Measure all pistons with a micrometer to determine the cylinder bore diameter.
2. Before you use any type of boring bar, use a fine file and clean the top of the cylinder block, removing any dirt or burrs. If you do not check the cylinder block, the boring bar may be improperly positioned or tilted and the cylinder bore could be bored at an incorrect angle.
3. Carefully follow the instructions furnished by the manufacturer regarding use of the equipment.
4. When you bore the cylinders, ensure all the crankshaft bearing caps are in place. Tighten the crankshaft bearing caps to the proper torque in order to avoid distortion of the cylinder bores during final assembly.
5. When you take the final cut with a boring bar, leave 0.03 mm (0.001 in) on the cylinder bore diameter for the finish honing and fit of the piston.

Honing Procedure

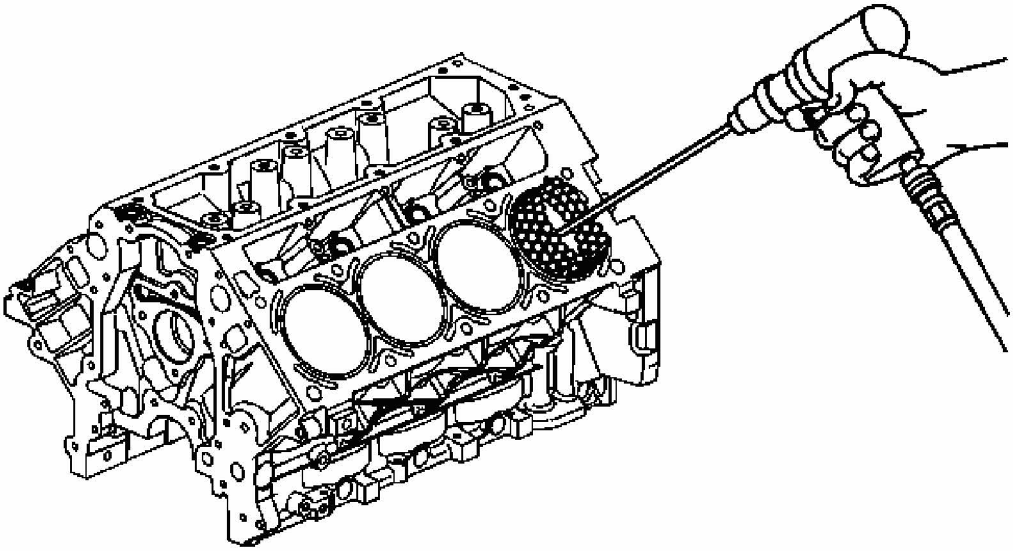


Fig. 421: Honing The Cylinders
Courtesy of GENERAL MOTORS CORP.

1. When honing the cylinders, follow the manufacturer's recommendations for equipment use, cleaning, and lubrication. Use only clean, sharp stones of the proper grade for the amount of material you remove. Dull, dirty stones cut unevenly and generate excessive heat. Do not hone to final clearance with a coarse or medium-grade stone. Leave sufficient metal so that all stone marks may be removed with fine-grade stones. Perform final honing with a fine-grade stone, honing the cylinder to the proper clearance.
2. During the honing operation, thoroughly clean the cylinder bore. Repeatedly check the cylinder bore for fit with the selected piston.

   All measurements of the piston or the cylinder bore should be made with the components at normal room temperature.

3. When honing a cylinder for fit to an oversize piston, first perform the preliminary honing with a 100 grit stone.
4. Perform final cylinder honing with a 240 grit stone and obtain a 45 degree cross hatch pattern.

   A 240 grit stone is preferred for final honing. If a 240 grit stone is not available, a 220 grit stone may be used as a substitute.

5. The finish marks should be clean but not sharp. The finish marks should also be free from imbedded particles and torn or folded metal.
6. By measuring the selected piston at the sizing point and by adding the average of the clearance specification, you can determine the final cylinder honing dimension required.
7. After final honing and before the piston is checked for fit, clean the cylinder bores with hot water and detergent. Scrub the bores with a stiff bristle brush and rinse the bores thoroughly with hot water. Do not allow any abrasive material to remain in the cylinder bores. This abrasive material may cause premature wear of the new piston rings and the cylinder bores. Abrasive material will also contaminate the engine oil and may cause premature wear of the bearings. After washing the cylinder bore, dry the bore with a clean rag.
8. Perform final measurements of the piston and the cylinder bore.
9. Permanently mark the top of the piston for the specific cylinder to which it has been fitted.
10. Apply clean engine oil to each cylinder bore in order to prevent rusting.

Deglazing Procedure

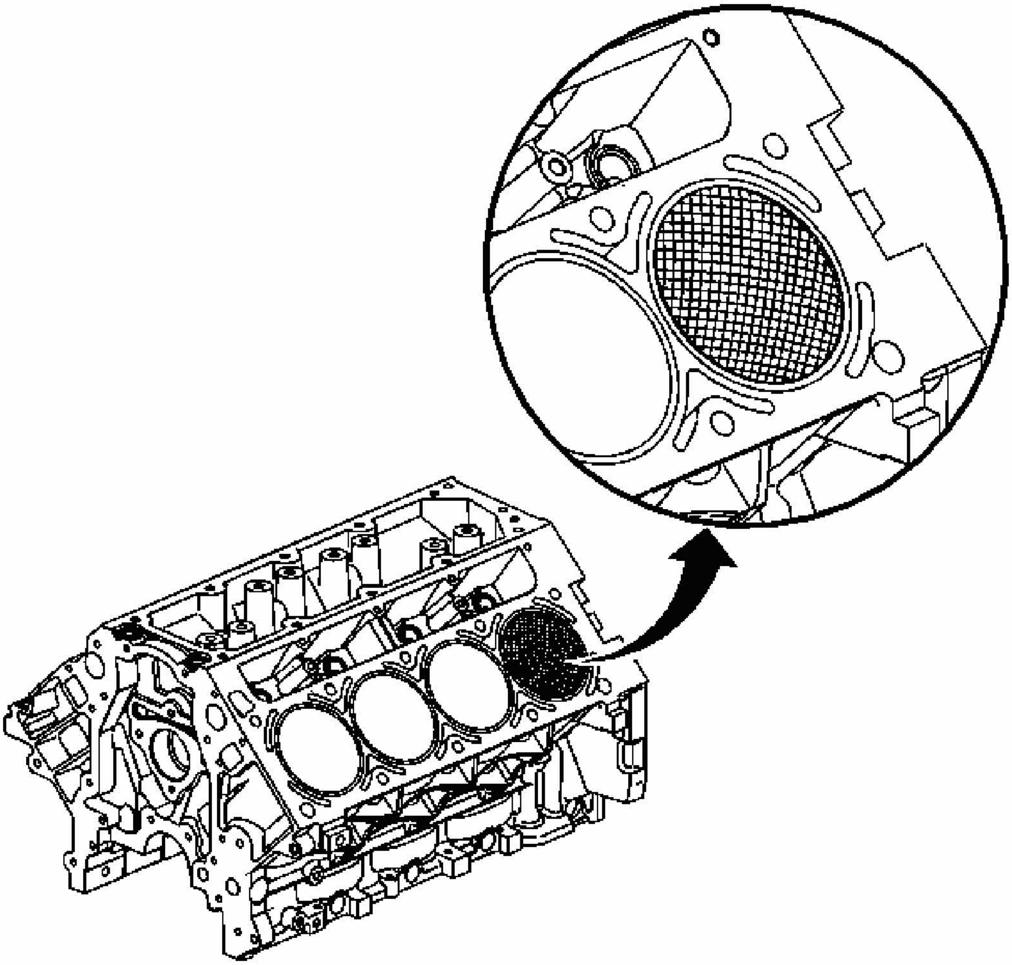


Fig. 422: Deglazing The Cylinder Bore Lightly
Courtesy of GENERAL MOTORS CORP.

Using a ball type or self centering honing tool, deglaze the cylinder bore lightly. Deglazing should be done only to remove any deposits that may have formed. Use a 240 grit stone of silicone carbide, or equivalent, material when preforming the deglazing procedure.

A 240 grit stone is preferred for final honing. If a 240 grit stone is not available, a 220 grit stone may be used as a substitute.

CRANKSHAFT AND BEARINGS CLEANING AND INSPECTION

Tools Required

- **J 7872** Magnetic Base Dial Indicator Set

- **J 43690** Rod Bearing Checking Tool
- **J 43690-100** Rod Bearing Checking Tool - Adapter Kit

Cleaning Procedure

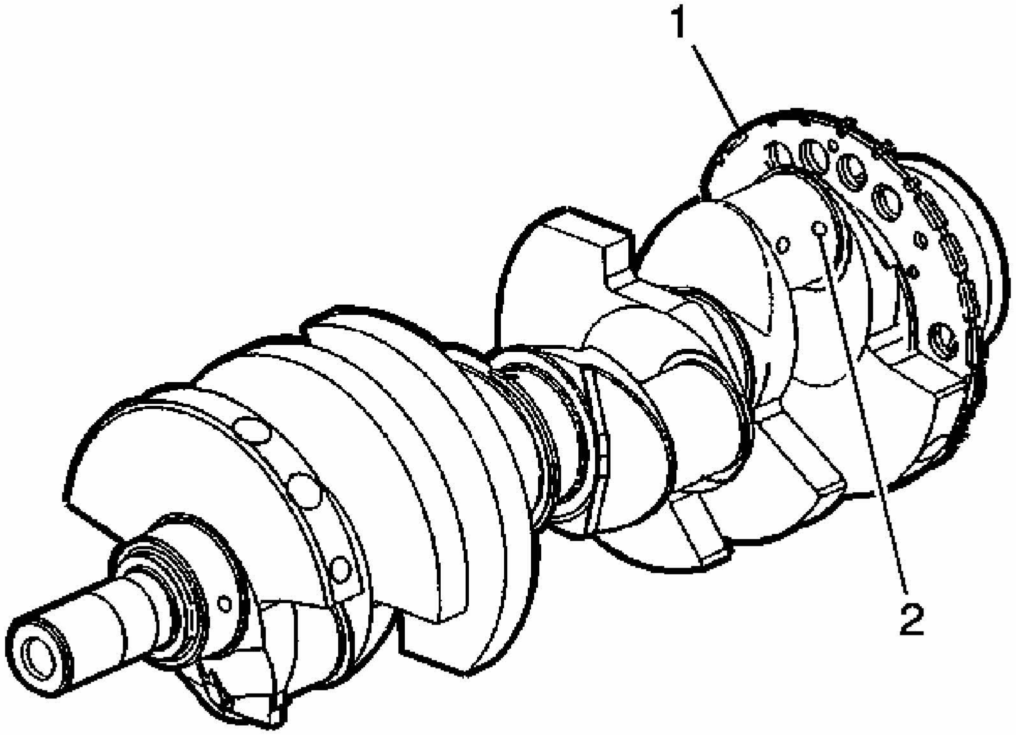


Fig. 423: Oil Passages & CKP Reluctor Ring Teeth
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use care when handling the crankshaft. Avoid damage to the crankshaft position (CKP) sensor reluctor ring teeth. Nicks, burrs, or other damage to the teeth may effect on-board diagnostics (OBD) II system performance.

1. Clean the crankshaft with solvent.
2. Thoroughly clean all oil passages (2) and inspect for restrictions or burrs.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

3. Dry the crankshaft with compressed air.

Inspection Procedure

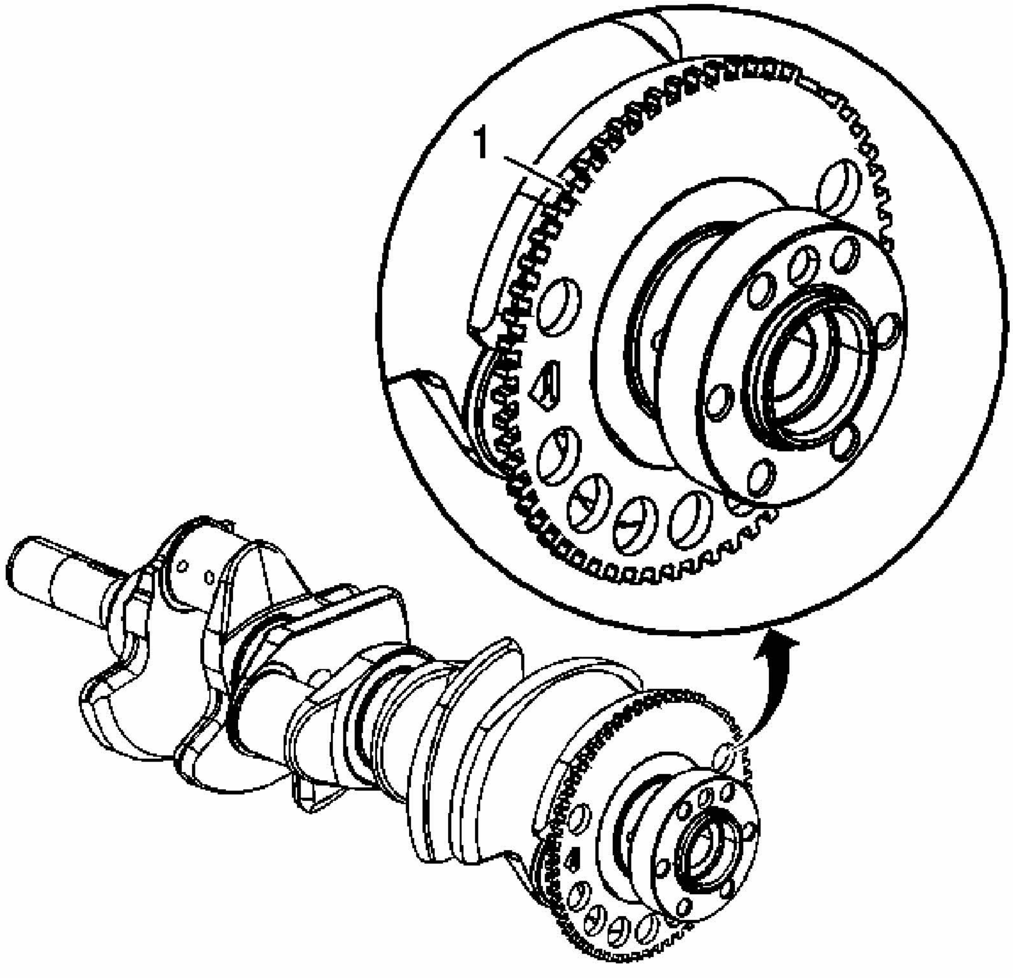


Fig. 424: CKP Reluctor Ring
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The reluctor ring teeth should not have imperfections on the rising or falling edges. Imperfections of the reluctor ring teeth may effect OBD II system performance.

1. Perform a visual inspection of the crankshaft for damage.
2. Inspect the CKP reluctor ring teeth (1) for damage.

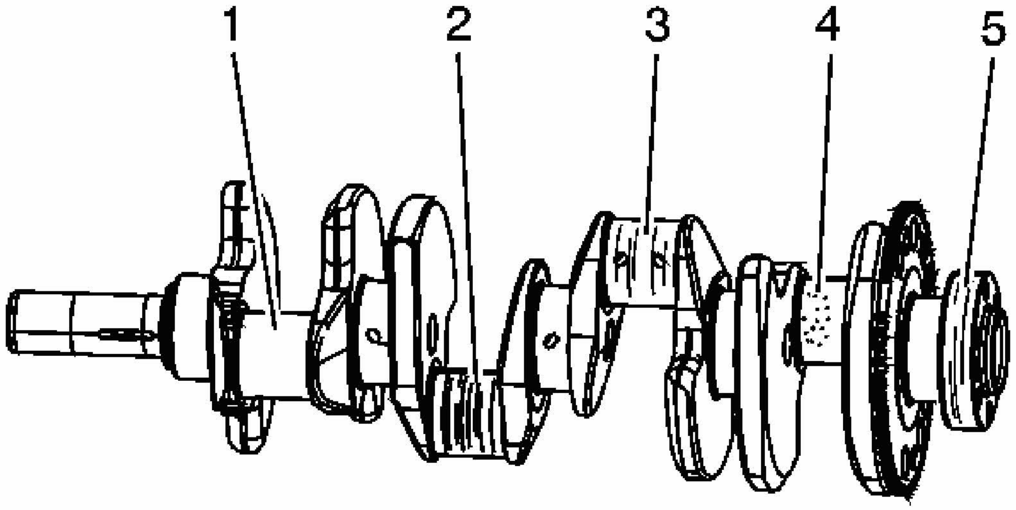


Fig. 425: Inspecting Crankshaft Journals For Wear
Courtesy of GENERAL MOTORS CORP.

3. Inspect the crankshaft journals for wear (1).

   Journals should be smooth with no signs of scoring, wear, or damage.

4. Inspect the crankshaft journals for grooves or scoring (2).
5. Inspect the crankshaft journals for scratches or wear (3).
6. Inspect the crankshaft journals for pitting or imbedded bearing material (4).
7. Inspect the crankshaft rear oil seal surface (5) for grooves or scoring.

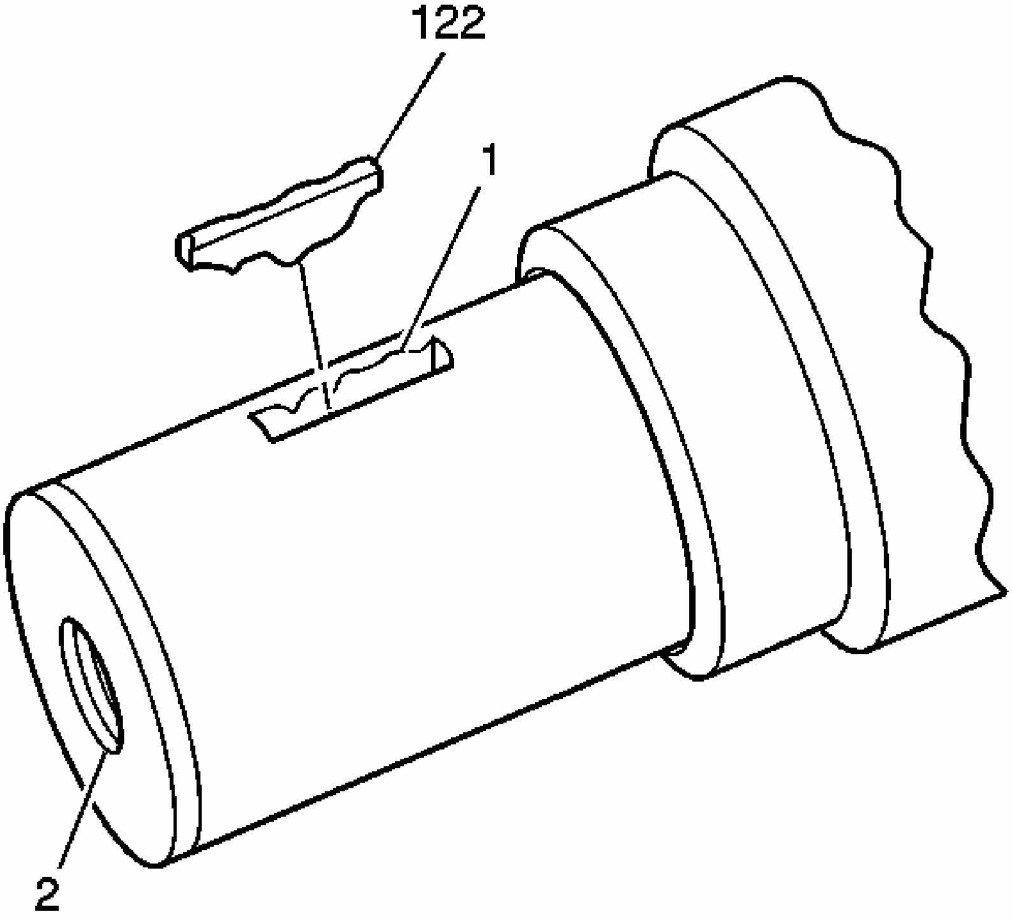


Fig. 426: View Of Crankshaft Key, Keyway & Threaded Hole
Courtesy of GENERAL MOTORS CORP.

8. Inspect the crankshaft key (122), keyway (1), and threaded hole (2) for damage.

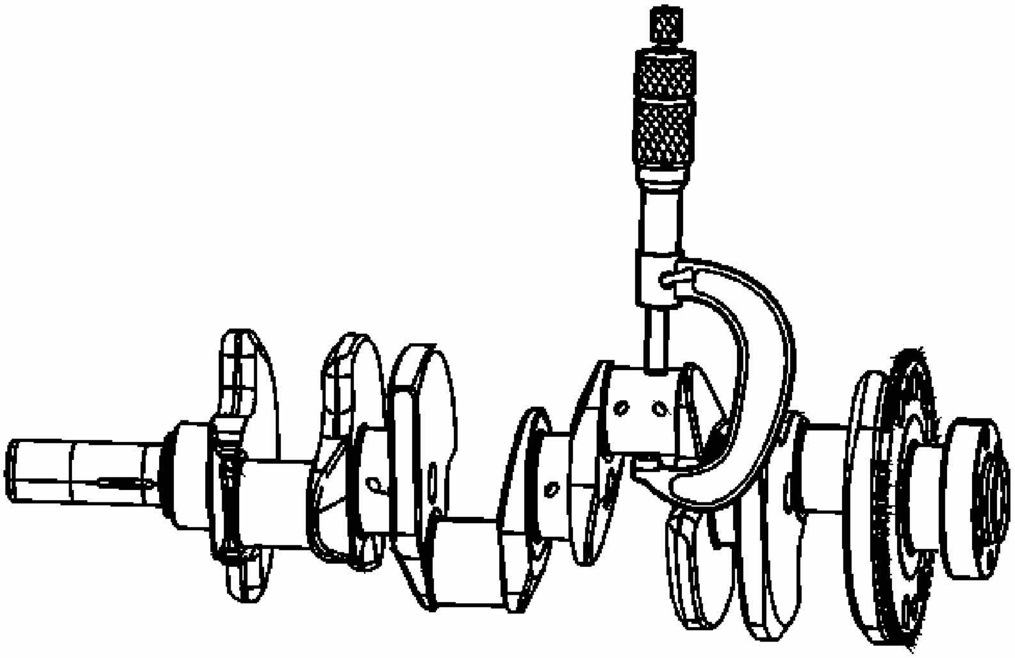


Fig. 427: Measuring Crank Pins For Out-Of-Round
Courtesy of GENERAL MOTORS CORP.

9. Measure the crankpins for the out-of-round.
10. Measure the crankpins for taper.

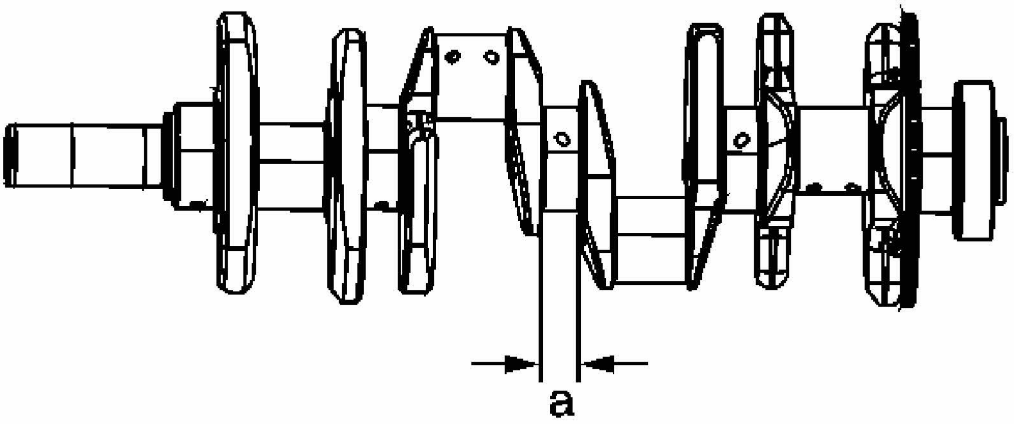


Fig. 428: Measuring The Crankshaft Thrust Wall Width
Courtesy of GENERAL MOTORS CORP.

11. Measure the crankshaft thrust wall width (a).

    A crankshaft with a thrust wall width in excess of 26.2 mm (1.0315 in) must be replaced.

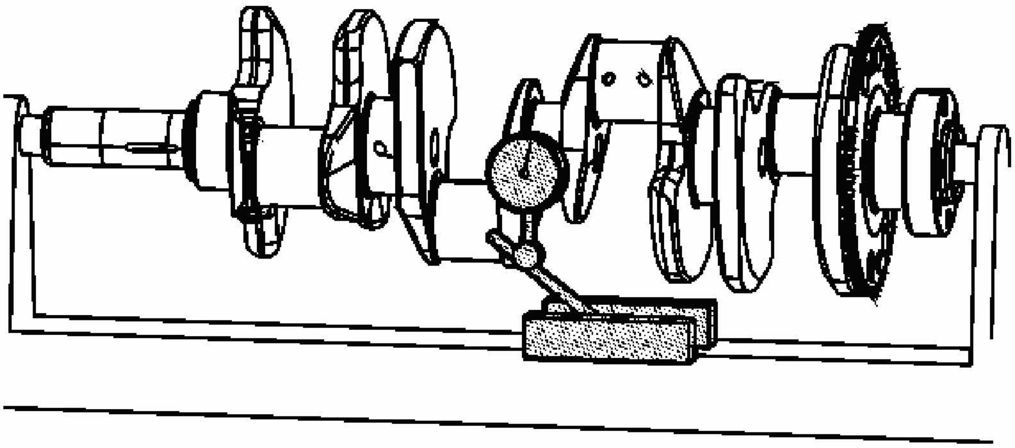


Fig. 429: Measuring The Crankshaft Runout
Courtesy of GENERAL MOTORS CORP.

12. Measure the crankshaft runout.

    Use wooden V-blocks or a fixture to support the crankshaft on the front and rear journals.

13. Use the **J 7872** in order to measure the crankshaft runout at the front and rear intermediate journals.
14. Use the **J 7872** in order to measure the runout of the crankshaft rear flange.
15. Use the **J 7872** in order to measure the runout of the crankshaft position reluctor ring. Reluctor ring runout should be measured 1.0 mm (0.04 in) below the ring teeth.

    If the reluctor ring has runout in excess of 0.7 mm (0.028 in), replace the crankshaft.

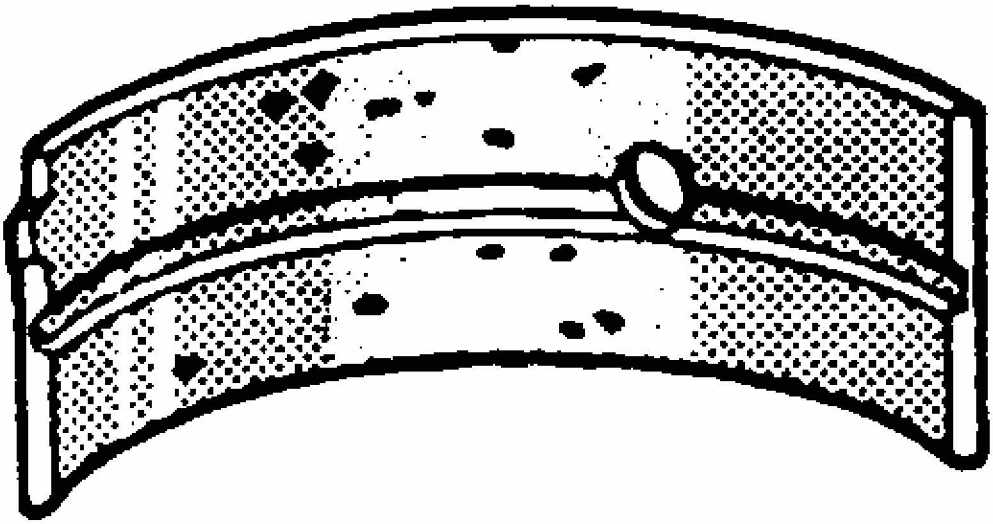


Fig. 430: Identifying Crankshaft Bearing Craters Or Pockets
Courtesy of GENERAL MOTORS CORP.

16. Inspect crankshaft bearings for craters or pockets. Flattened sections on the bearing halves also indicate fatigue.

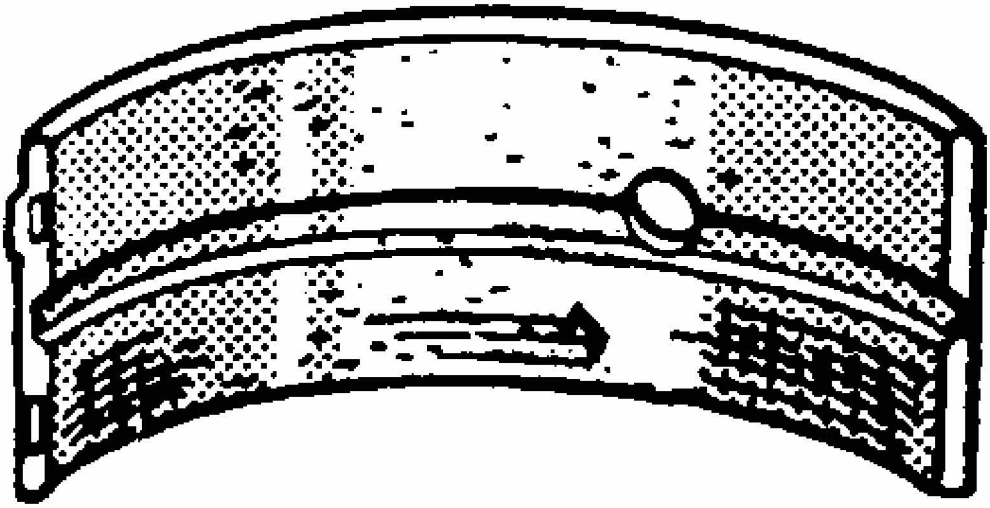


Fig. 431: Identifying Connecting Rod Bearing Scoring Or Discoloration
Courtesy of GENERAL MOTORS CORP.

17. Inspect the crankshaft bearings for excessive scoring or discoloration.
18. Inspect the crankshaft bearings for dirt or debris imbedded into the bearing material.

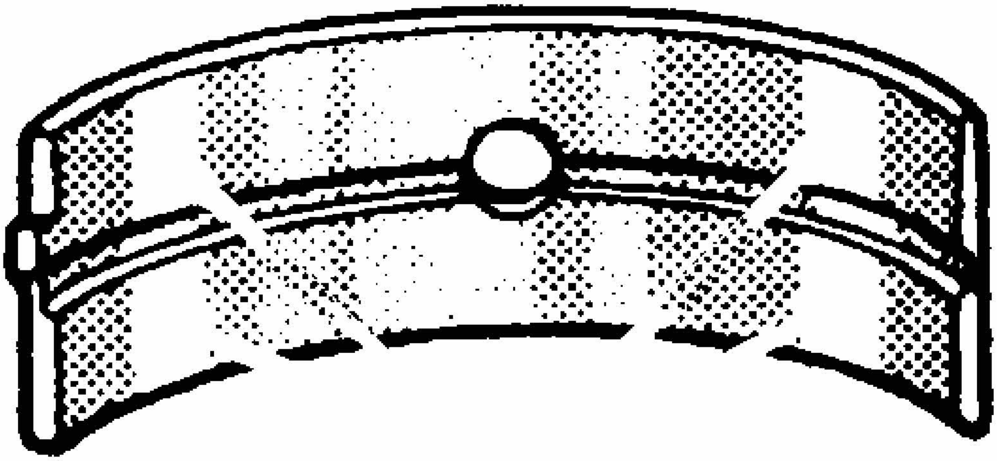


Fig. 432: Crankshaft Bearing Polished Sections (Improper Seating)

Courtesy of GENERAL MOTORS CORP.

19. Inspect the crankshaft bearings for improper seating indicated by bright, polished sections of the bearing.

    If the lower half of the bearing is worn or damaged, both upper and lower halves should be replaced.

    Generally, if the lower half is suitable for use, the upper half should also be suitable for use.

Measuring Main Bearing Clearance - Gaging Plastic Method

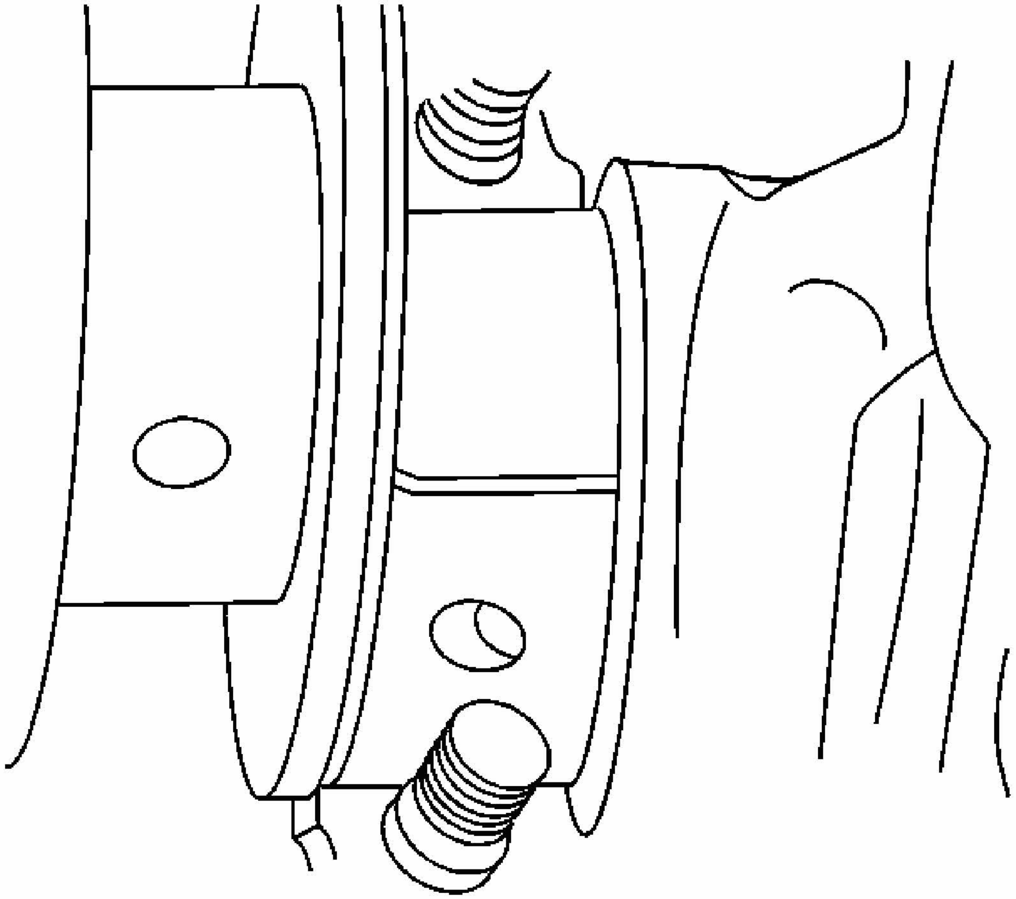


Fig. 433: View Of Gaging Plastic Installed On Crankshaft Journal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:
- **The crankshaft main bearings are a precision insert type.**

Main bearing caps are machined with the engine block for proper clearance and cannot be shimmed or filed for bearing fit. If the clearances are found to be excessive, new bearings and/or engine block and cap repair or replacement may be required.

- **Do not rotate the crankshaft while gaging plastic is between the crankshaft journal and the bearing surface.**
- **The crankshaft bearing clearances are critical. Excessive bearing clearance may effect CKP sensor signals and may effect on-board diagnostics (OBD) II system operation.**
- **Remove the bearing cap side bolts prior to cap removal.**

1. Remove the bearing caps, bearing half, and bolts. Refer to **Crankshaft and Bearings Removal**.
2. Install gaging plastic onto the crankshaft journal. Install the gaging plastic the full width of the crankshaft bearing journal.
3. Install the bearing caps, bearing half, and bolts. Refer to **Crankshaft and Bearings Installation**.
4. Remove the bearing caps, bearing half, and bolts. Refer to **Crankshaft and Bearings Removal**.

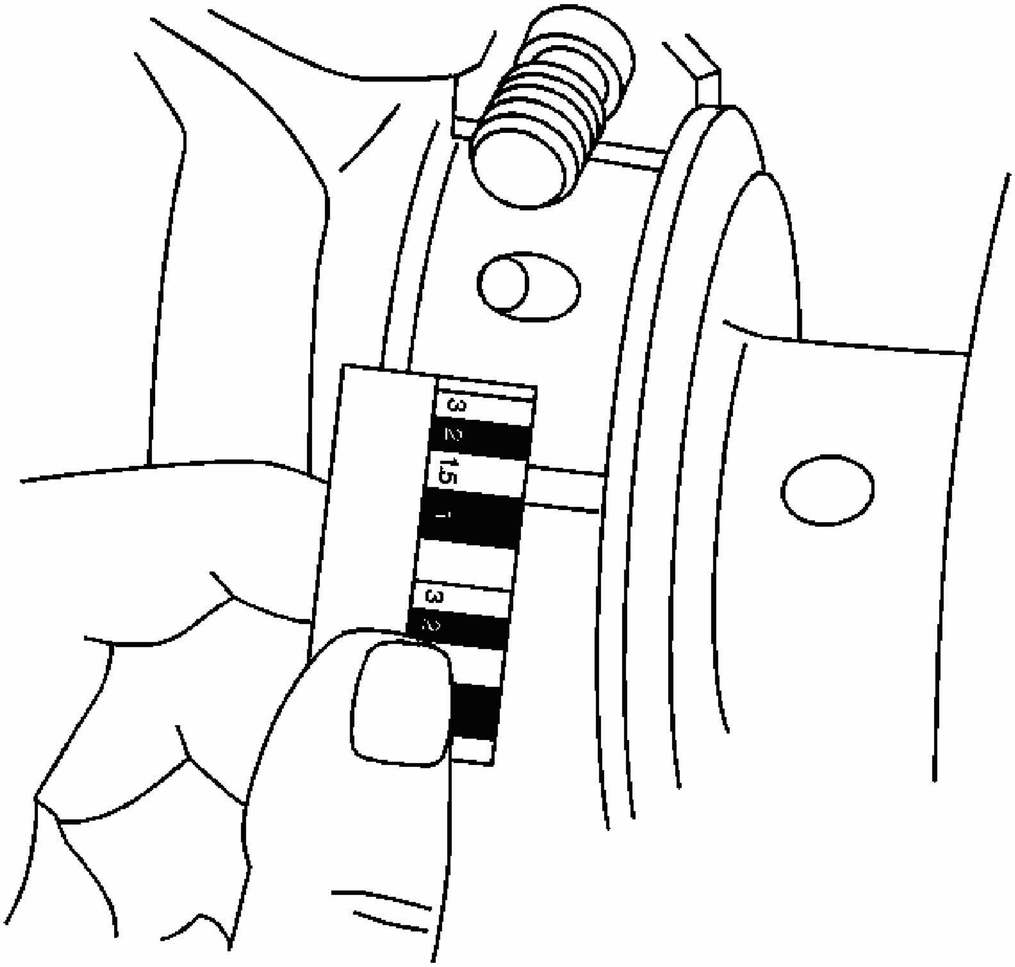


Fig. 434: Measuring Gaging Plastic
Courtesy of GENERAL MOTORS CORP.

5. Measure the gaging plastic at its widest area using the scale supplied with the plastic gaging kit.
    - If the gaging plastic shows irregularity in the journal exceeding 0.025 mm (0.001 in), remove the crankshaft and measure the journal with a micrometer.
    - If clearance cannot be brought to specifications, replace the crankshaft or engine block, as required. Refer to **Engine Mechanical Specifications**.

Measuring Connecting Rod Bearing Clearance - Gaging Plastic Method

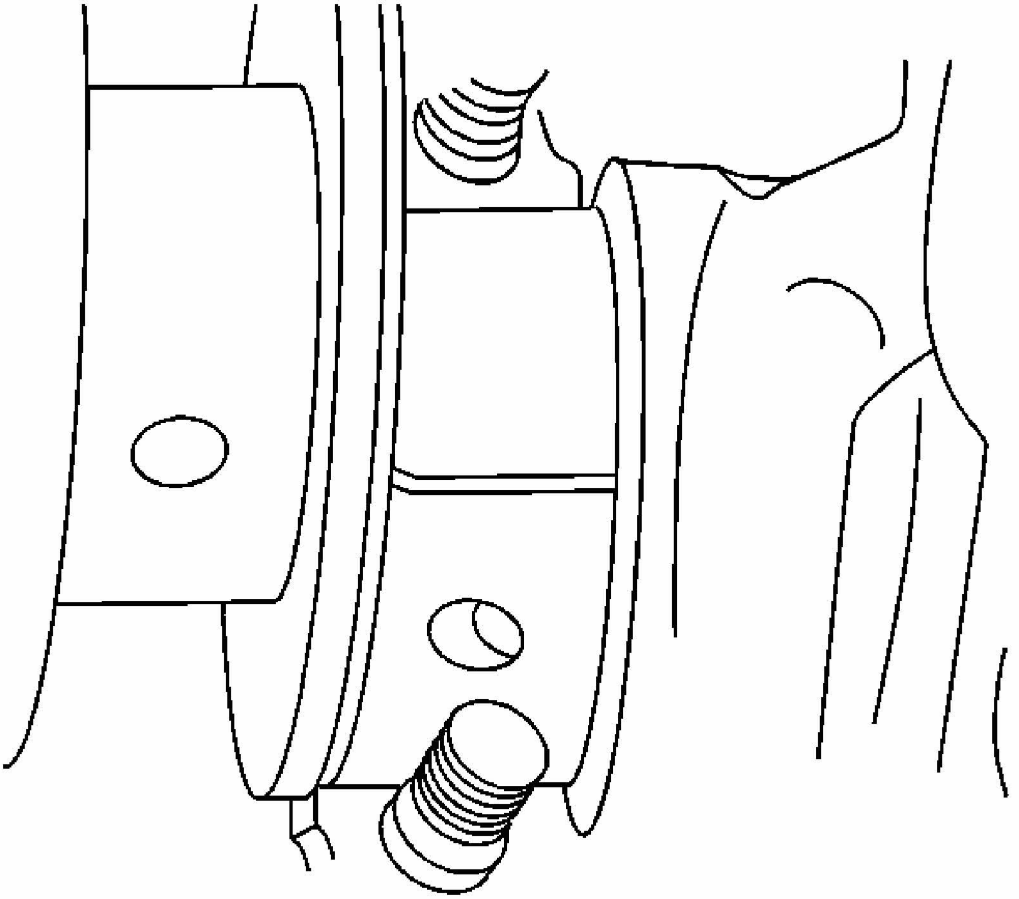


Fig. 435: View Of Gaging Plastic Installed On Crankshaft Journal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Connecting rod bearings are a precision insert type. Connecting rods are of a powdered metal design and cannot be shimmed or filed for bearing fit. If clearances are found to be excessive, a new bearing and/or connecting rod are required.**
- **Do not rotate the crankshaft while gaging plastic is between the crankshaft journal and the bearing surface.**

1. Remove the bearing cap, bearing half and bolts. Refer to **Piston, Connecting Rod, and Bearing Removal**.
2. Install the gaging plastic onto the connecting rod bearing journal. Install the gaging plastic the full width of the journal.

3. Install the bearing cap, bearing half, and bolts. Refer to **Piston, Connecting Rod, and Bearing Installation**.
4. Remove the bearing cap, bearing half and bolts. Refer to **Piston, Connecting Rod, and Bearing Removal**.

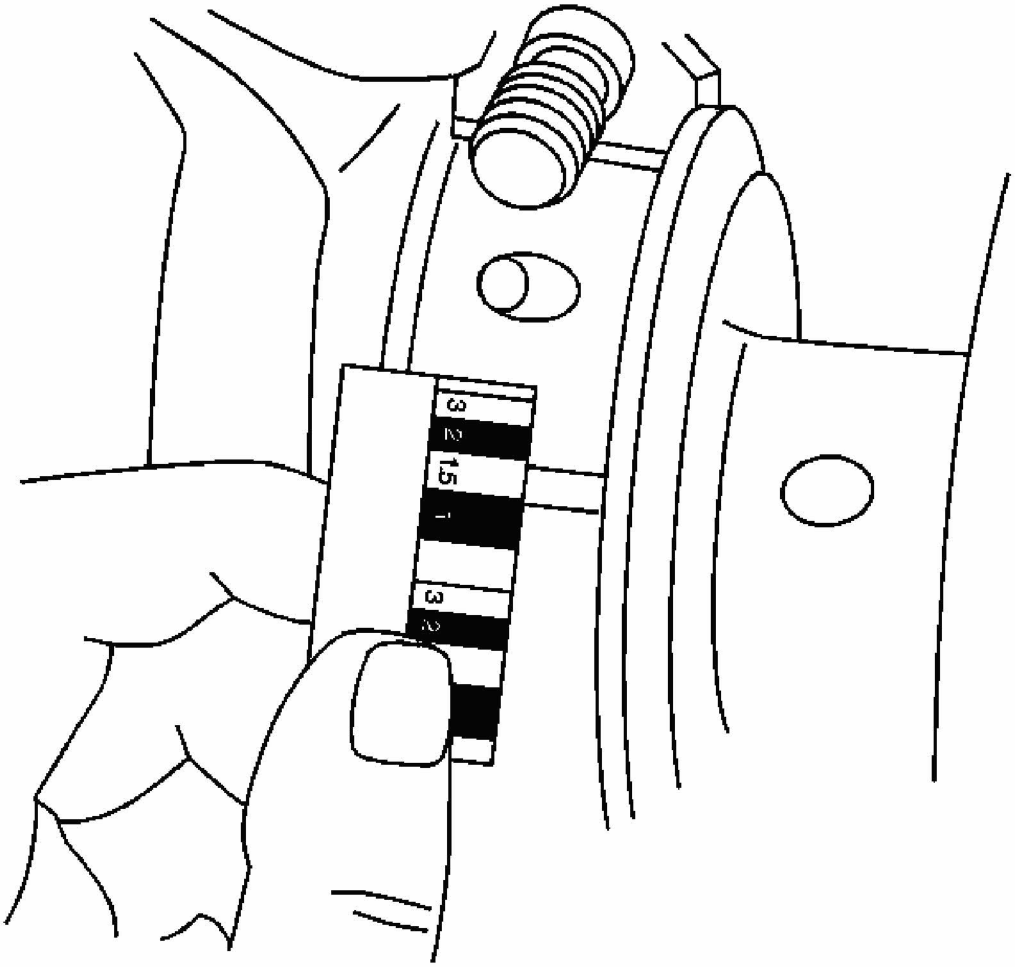


Fig. 436: Measuring Gaging Plastic
Courtesy of GENERAL MOTORS CORP.

5. Measure the gaging plastic at its widest area using the scale supplied with the plastic gaging kit. Refer to **Engine Mechanical Specifications**.

Measuring Connecting Rod Bearing Clearance - Using J 43690/J 43690-100

J 43690 and **J 43690-100** have been developed as a more accurate method to measure connecting rod bearing clearances. The instructions below provide an overview of tool setup and usage. For more detailed information, refer to the tool instruction sheets as supplied by the tool manufacturer.

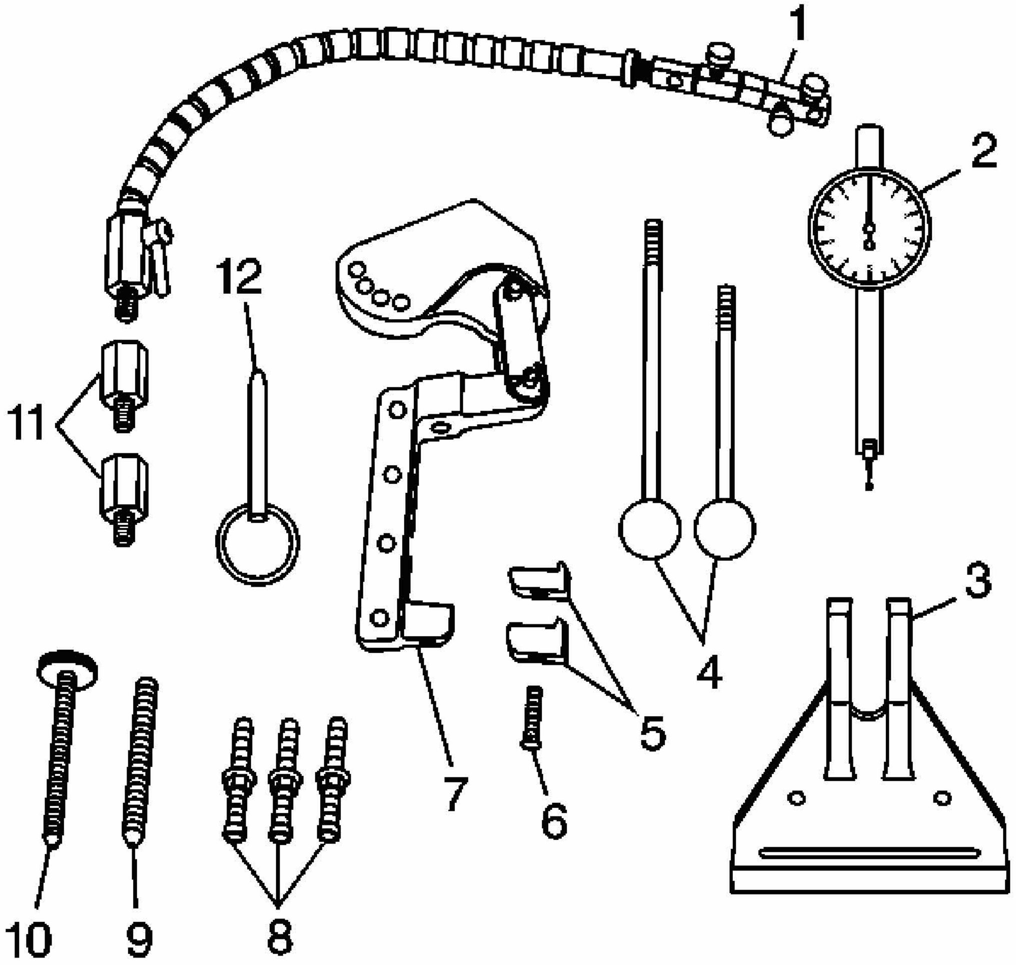


Fig. 437: Identifying Rod Bearing Clearance Checking Tool
Courtesy of GENERAL MOTORS CORP.

Rod Bearing Checking Tool

- J 43690-20 Swivel Base (1)
- J 43690-19 Dial Indicator (2)
- J 43690-2 Base (3)
- J 43690-5, -6 Handle (4)
- J 43690-10, -11 Foot (5)
- 280307 Screw (6)

- J 43690-1 Pivot Arm Assembly (7)
- J 43690-3, -7, -8 Screws (8)
- 280319 Screw (9)
- 280311 Screw (10)
- J 43690-17, -18 Adapter (11)
- 280310 Pin (12)

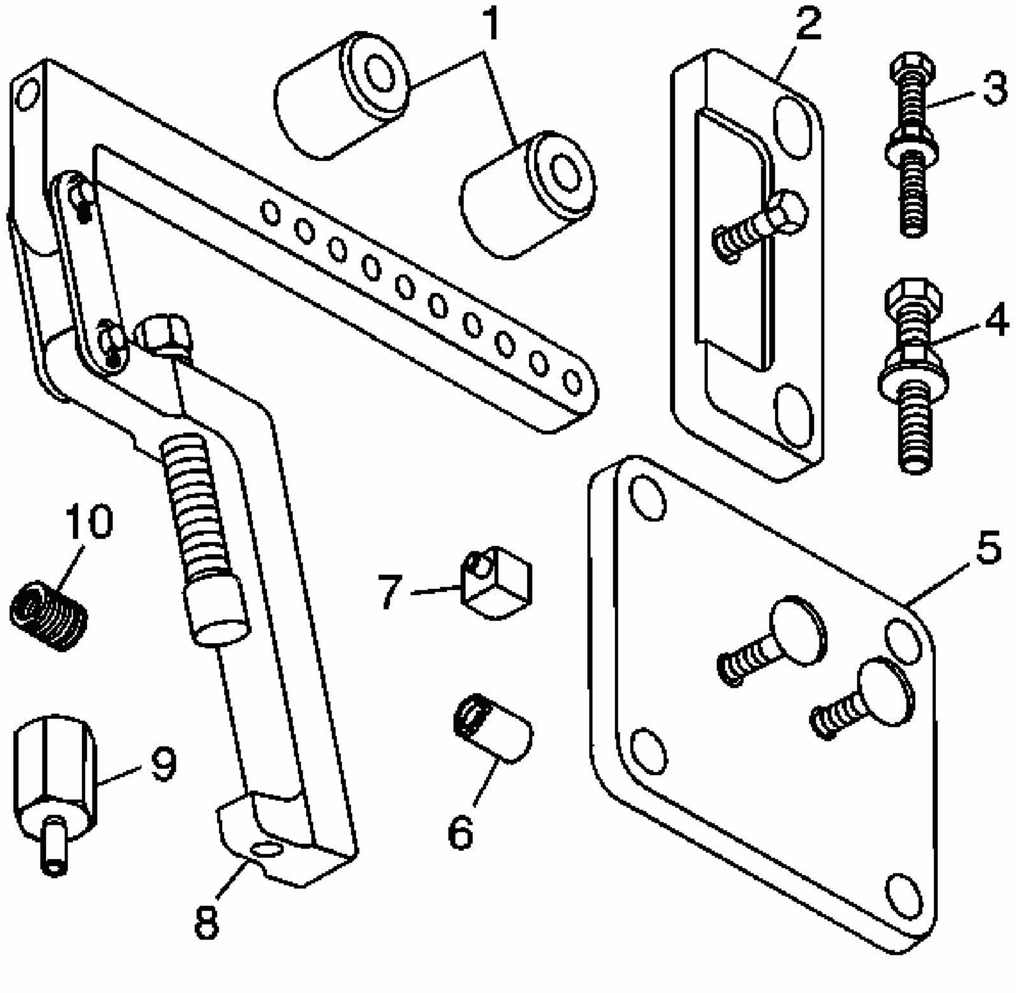


Fig. 438: Identifying Rod Bearing Clearance Tool - Adapter Kit
Courtesy of GENERAL MOTORS CORP.

Rod Bearing Checking Tool - Adapter Kit

- J 43690-104 Spacer (1)

- J 43690-105 Retainer Plate (2)
- 505478 Bolt (3)
- 511341 Bolt (4)
- J 43690-106 Retainer Plate (5)
- J 43690-107 Cap (6)
- J 43690-102 Foot (7)
- J 43690-101 Pivot Arm Assembly (8)
- J 43690-103 Adapter (9)
- 505439 Adapter (10)

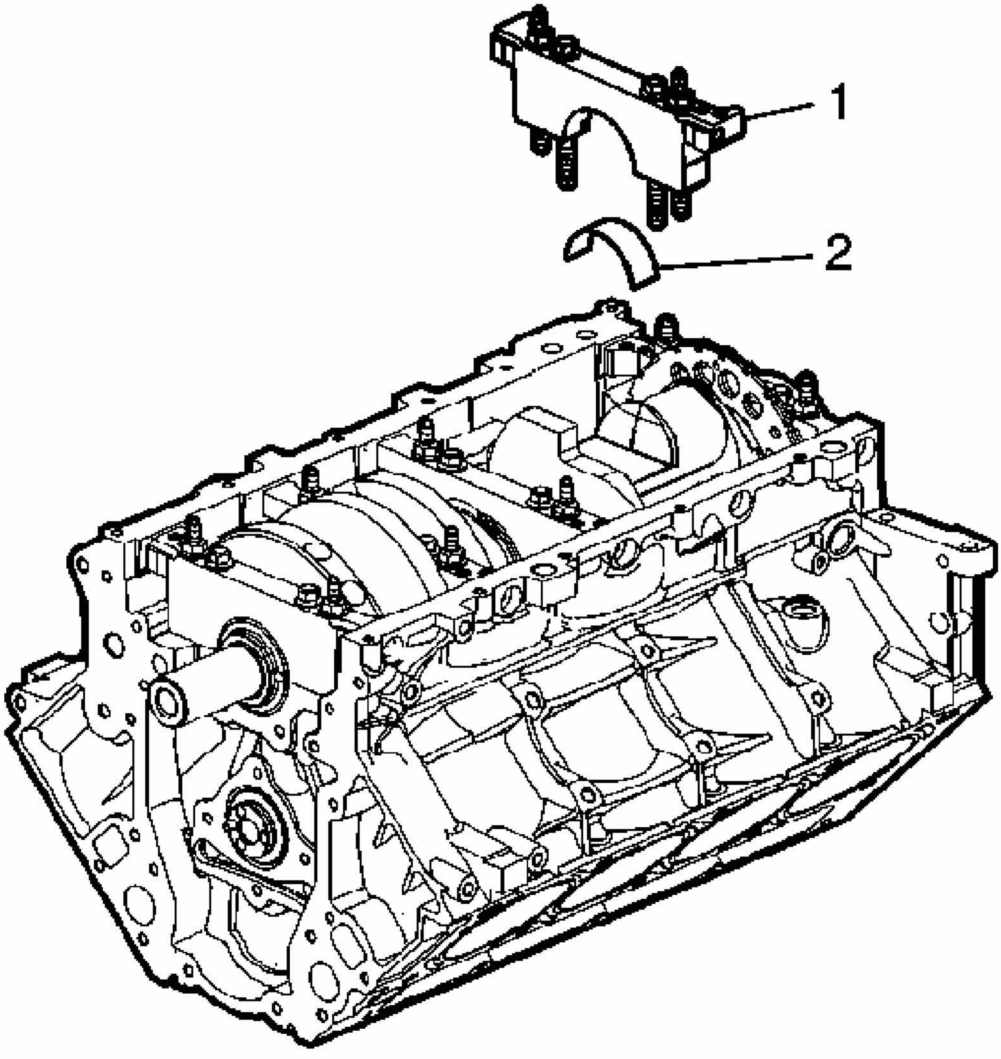


Fig. 439: View Of Bearing Cap, Bolt & Bearing Half
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The crankshaft must be secure with no movement or rotation in order to obtain an accurate reading.

1. Rotate the crankshaft until the journal/connecting rod to be measured is in the 12 o'clock position.
2. Remove a bearing cap and bolts (1).
3. Remove the bearing half (2).
4. Insert a piece of paper card stock onto the crankshaft journal.
5. Install the bearing half (2) and cap and bolts (1). Refer to **Fastener Tightening Specifications**.

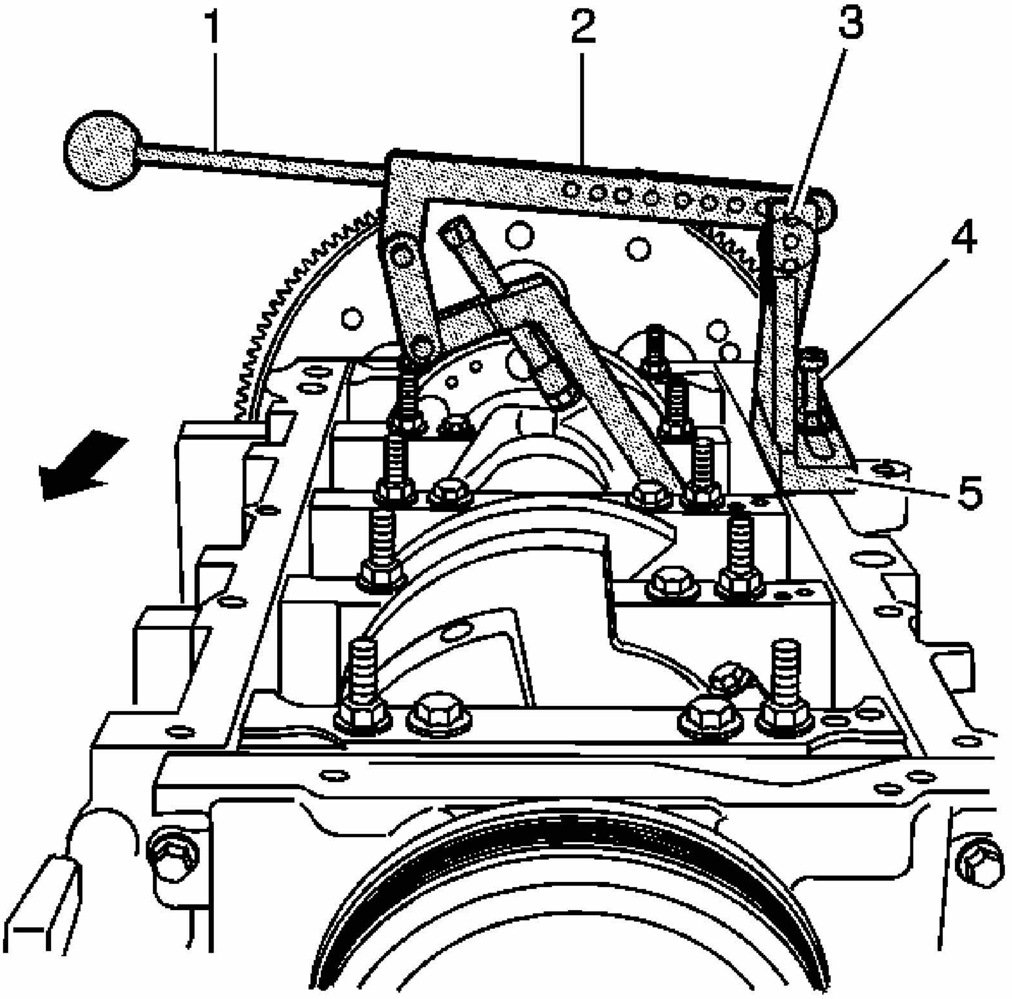


Fig. 440: View Of Special Tool Installed On Engine Block
Courtesy of GENERAL MOTORS CORP.

6. Install the following:
    1. J 43690-2 (5)
    2. J 43690-3 (4)
    3. J 43690-101 (2)
    4. 280310 (3)
    5. J 43690-5 (1)

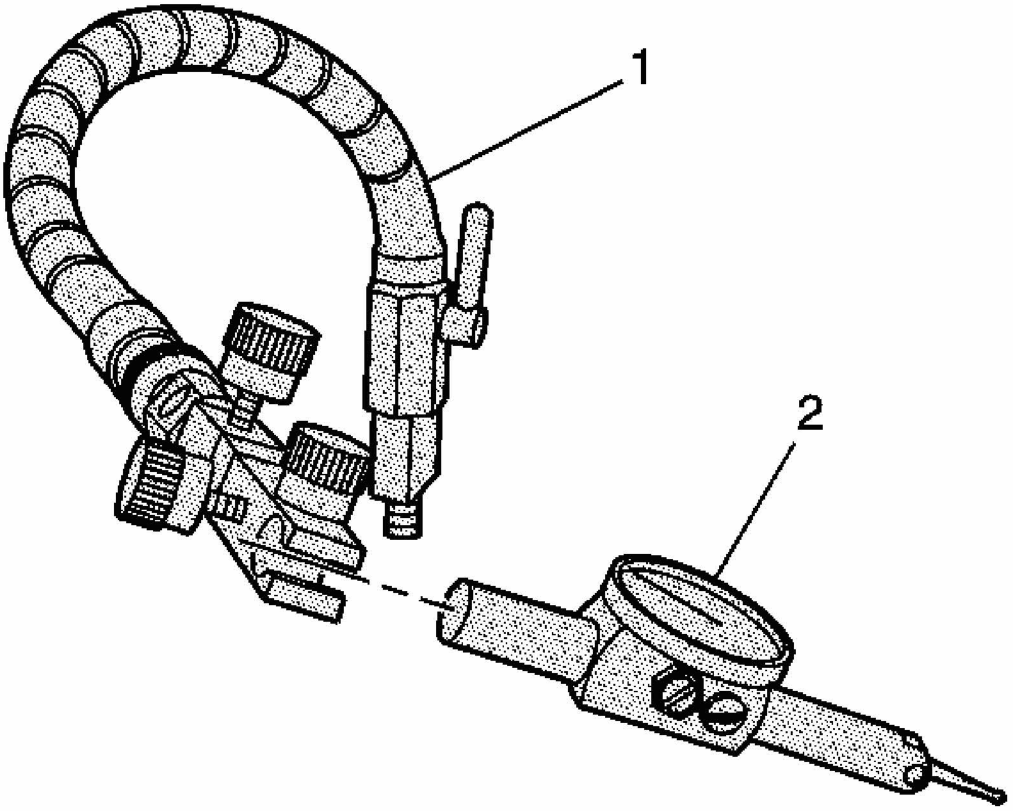


Fig. 441: View Of Swivel Base & Dial Indicator
Courtesy of GENERAL MOTORS CORP.

7. Install the swivel base (1) and dial indicator (2).
8. Adjust per the manufacturers instructions and measure the connecting rod bearing clearance.

   A connecting rod with a clearance in excess of 0.076 mm (0.003 in) is considered excessive. Service components, as required.

CRANKSHAFT BALANCER CLEANING AND INSPECTION

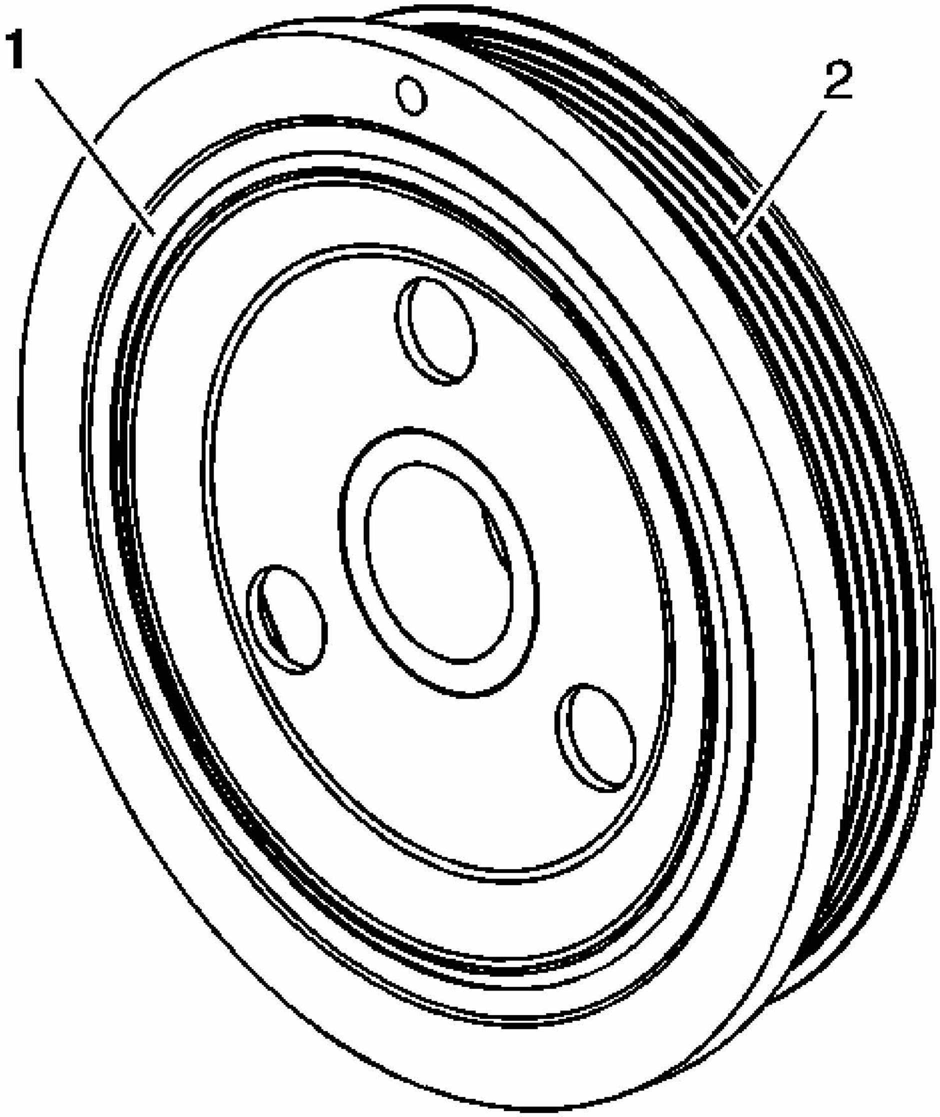


Fig. 442: View Of Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

1. Clean the crankshaft balancer in solvent.
2. Clean the belt grooves of all dirt or debris with a wire brush.
3. Dry the crankshaft balancer with compressed air.
4. Inspect the crankshaft balancer for the following conditions:
    - Worn, grooved, or damaged hub seal surface
    - A crankshaft balancer hub seal surface with excessive scoring, grooves, rust or

other damage must be replaced.

- Minor imperfections on the hub seal surface may be removed with polishing compound or fine grade emery cloth.

IMPORTANT: In order for the belt to track properly, the belt grooves should be free of all dirt or debris.

- Dirty or damaged belt grooves (2)
- The balancer belt grooves should be free of any nicks, gouges, or other damage that may not allow the belt to track properly.
- Minor imperfections may be removed with a fine file.
- Worn, chunking, or deteriorated rubber (1) between the hub and pulley

ENGINE FLYWHEEL CLEANING AND INSPECTION

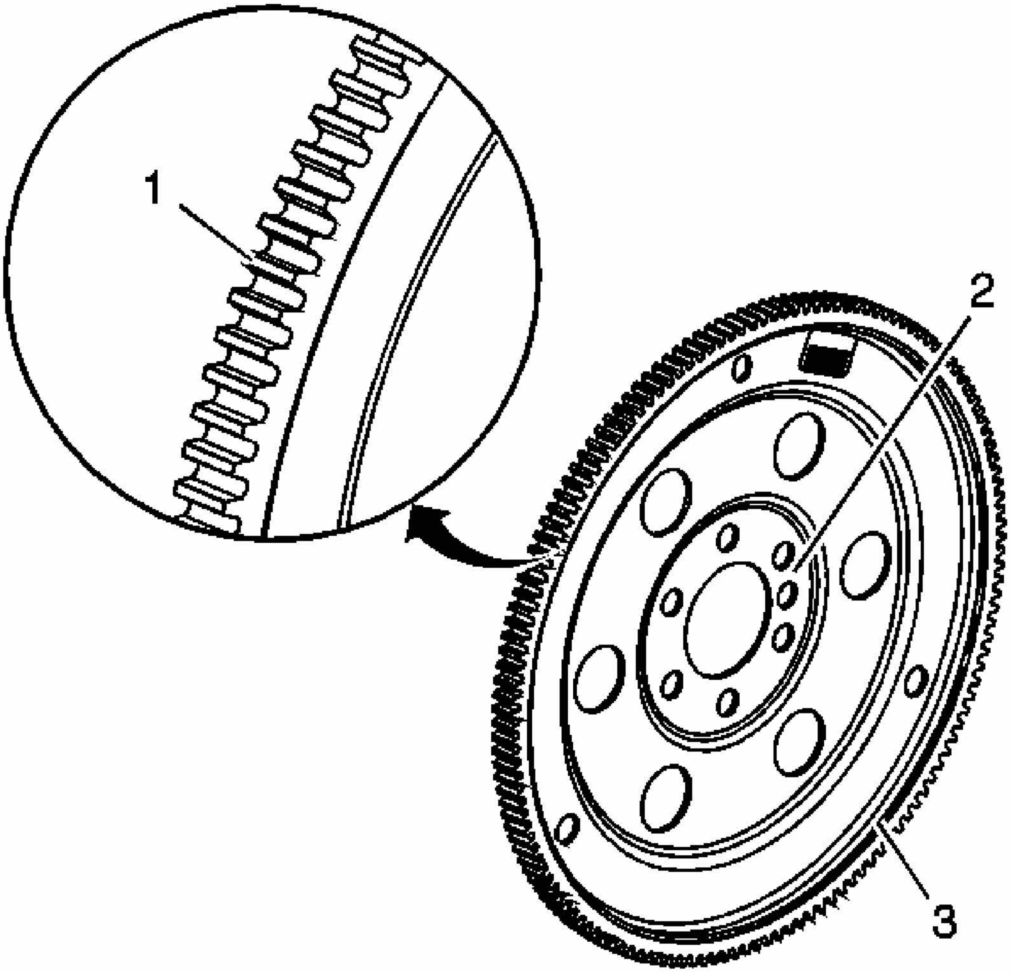


Fig. 443: Identifying Flex Plate
Courtesy of GENERAL MOTORS CORP.

1. Clean the flex plate in solvent.
2. Dry the flex plate with compressed air.
3. Inspect the flex plate for the following conditions:
    - Damaged ring gear teeth (1)
    - Stress cracks around the flex plate-to-crankshaft bolt hole locations (2)

IMPORTANT: Do not attempt to repair the welded areas that retain the ring gear to the flex plate plate. Install a new flex plate.

- Welded areas (3) that retain the ring gear onto the flex plate for cracking

PISTON AND CONNECTING ROD DISASSEMBLE

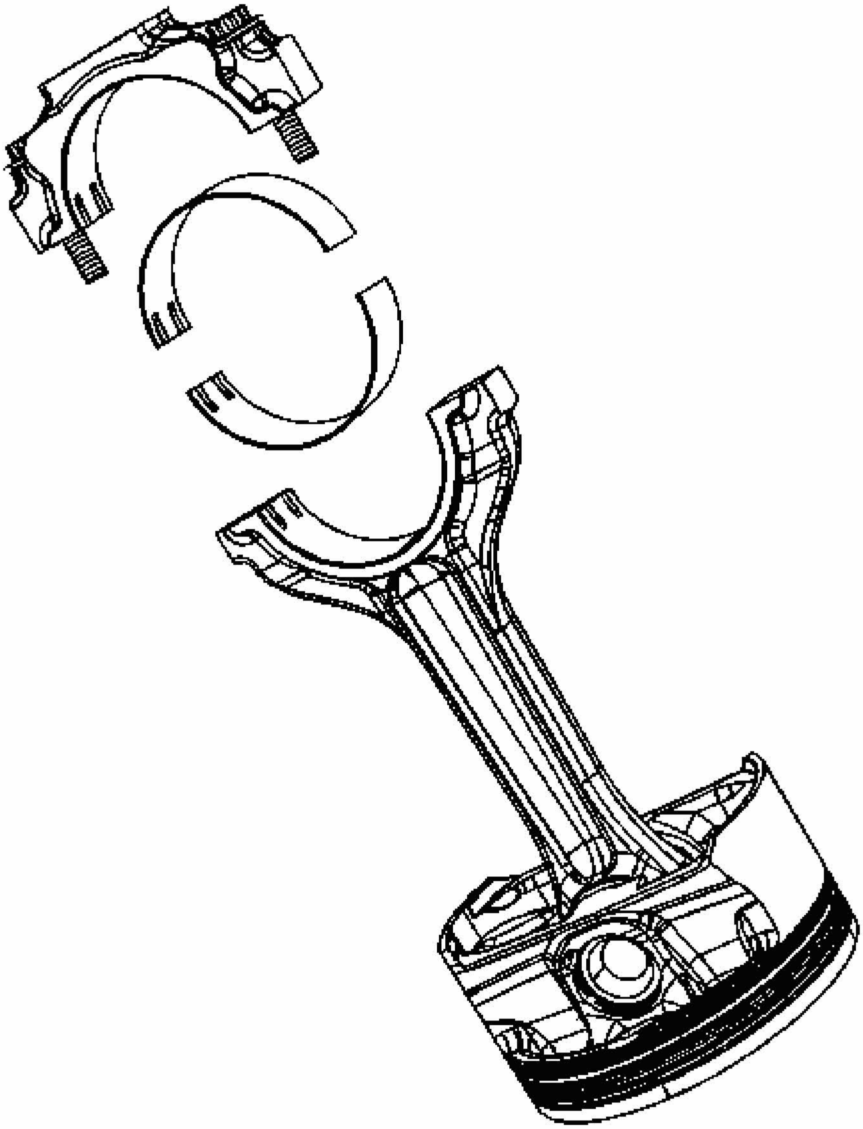


Fig. 444: View Of Piston, Connecting Rod & Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the connecting rod bearings from the rod and cap.

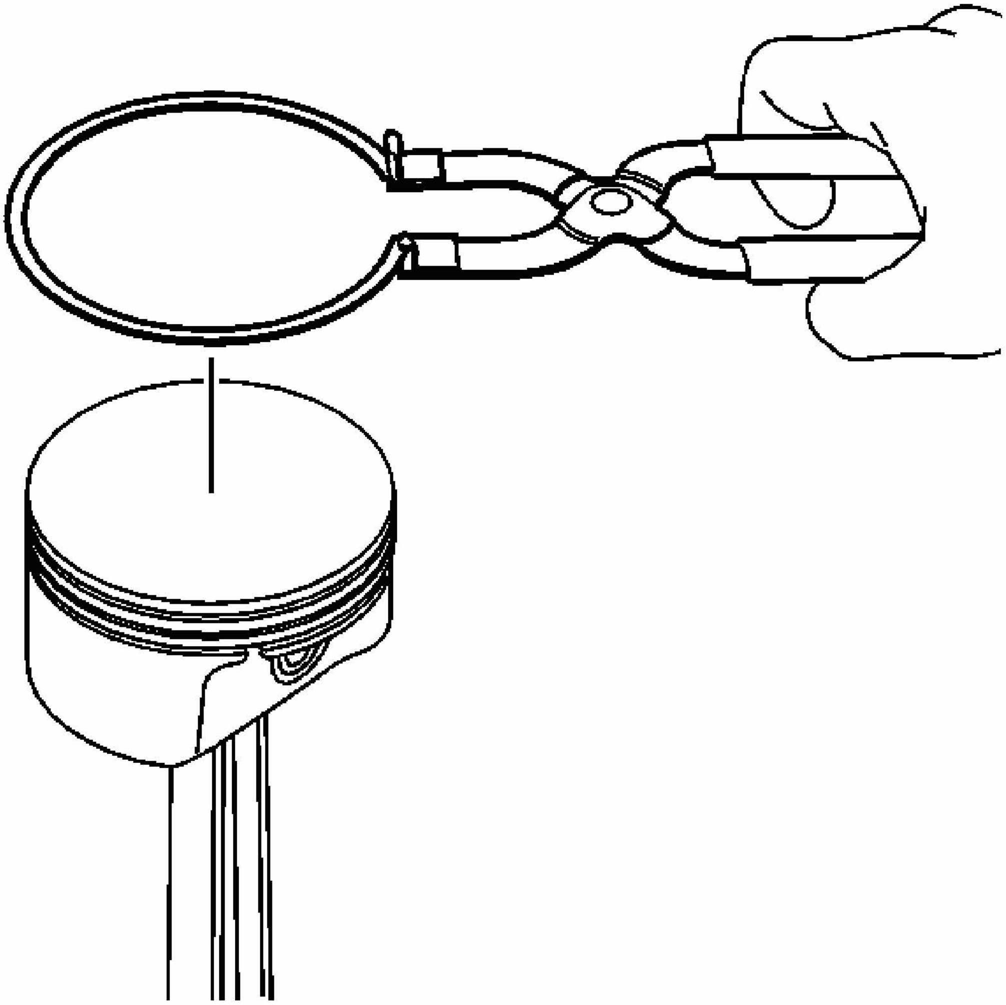


Fig. 445: Removing/Installing Piston Rings
Courtesy of GENERAL MOTORS CORP.

2. Using piston ring pliers, remove the piston rings from the piston.

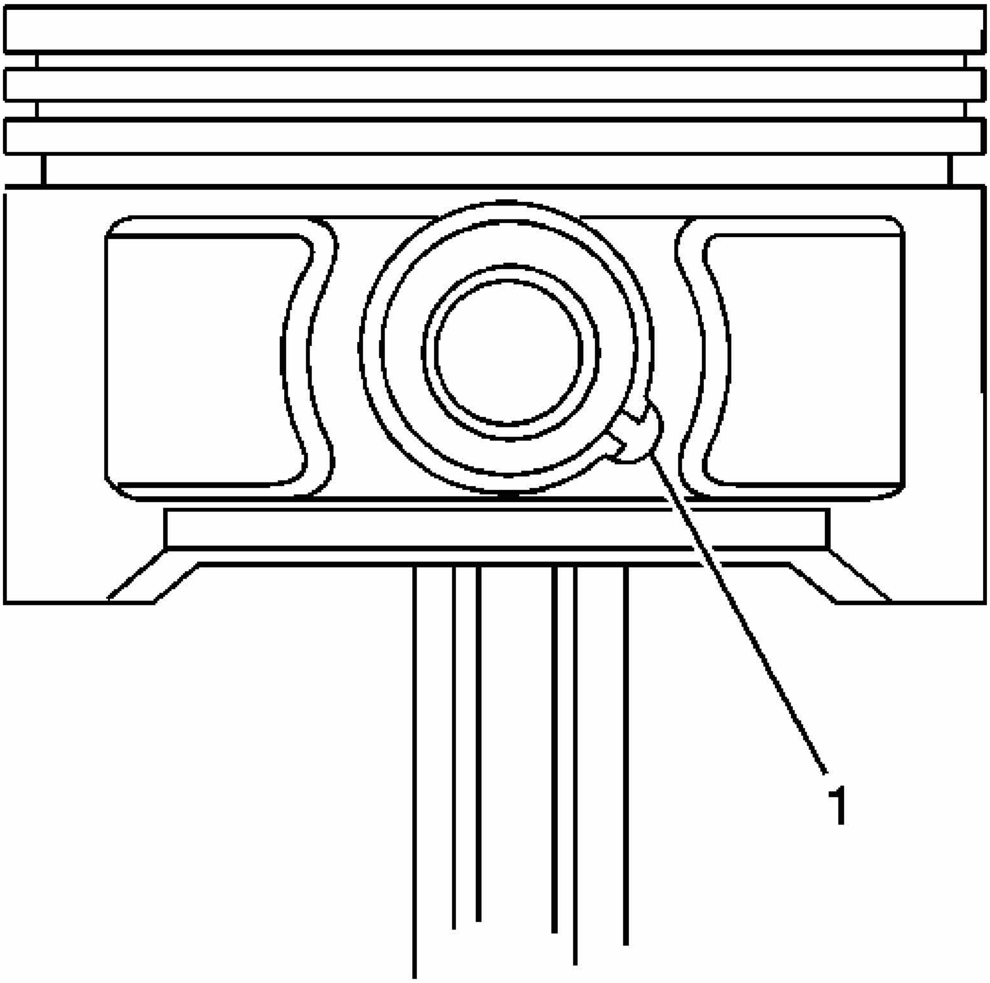


Fig. 446: View Of Piston Pin Retaining Clip & Cutout Area Of Pin Bore
Courtesy of GENERAL MOTORS CORP.

3. Rotate the piston pin retainers until the ring end gaps are positioned in the cutout area (1) of the pin bore.

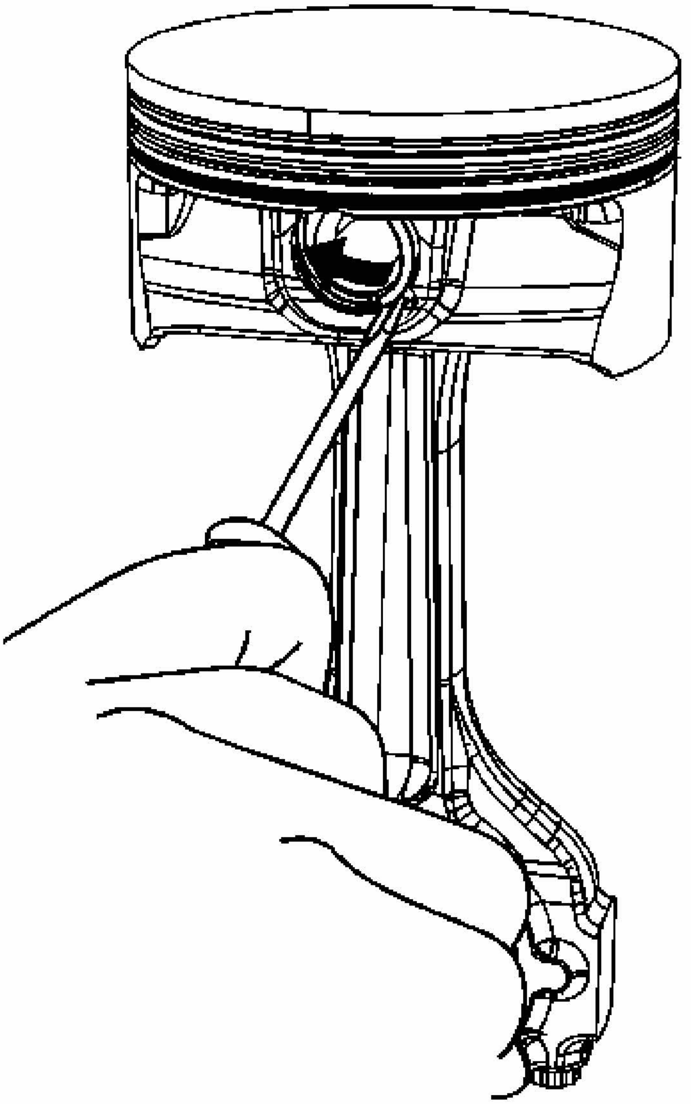


Fig. 447: Removing Piston Retainers
Courtesy of GENERAL MOTORS CORP.

4. Remove the retainers starting in the cutout area of the pin bore.

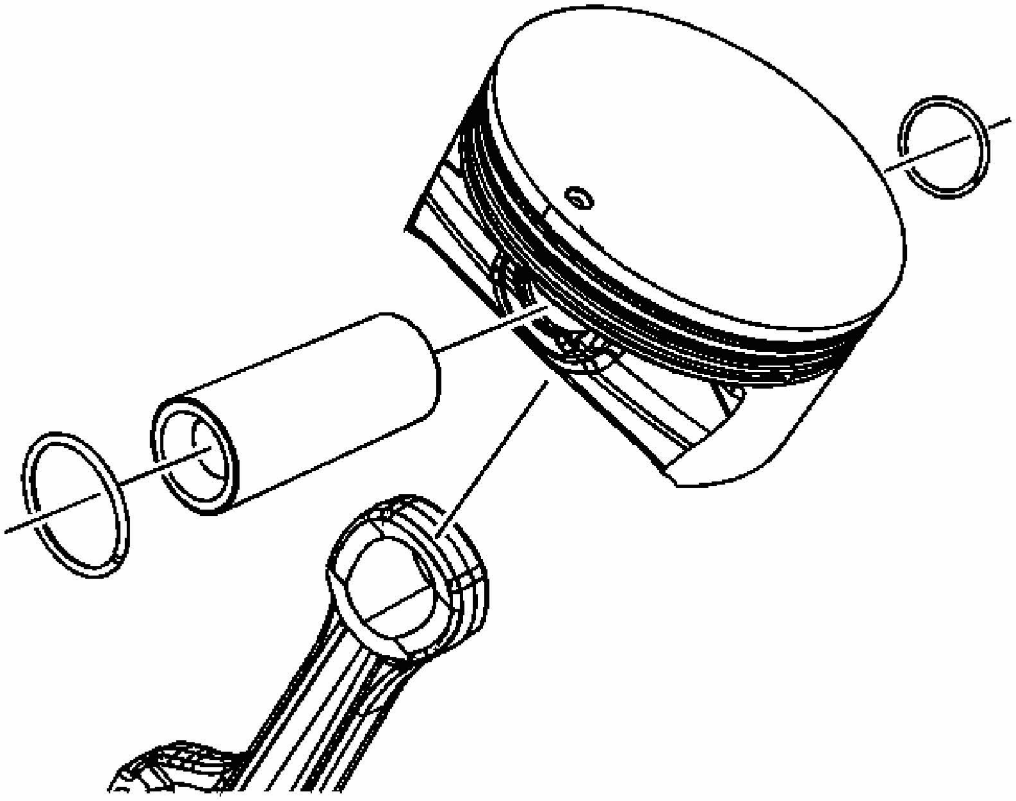


Fig. 448: Piston Pin, Piston & Connecting Rod
Courtesy of GENERAL MOTORS CORP.

5. Remove the pin from the piston and connecting rod.
6. The piston and pin are a matched set and are not to be serviced separately.

   Mark, sort, or organize the piston and the matching piston pin.

PISTON, CONNECTING ROD, AND BEARINGS CLEANING AND INSPECTION

Piston, Pin, and Piston Rings

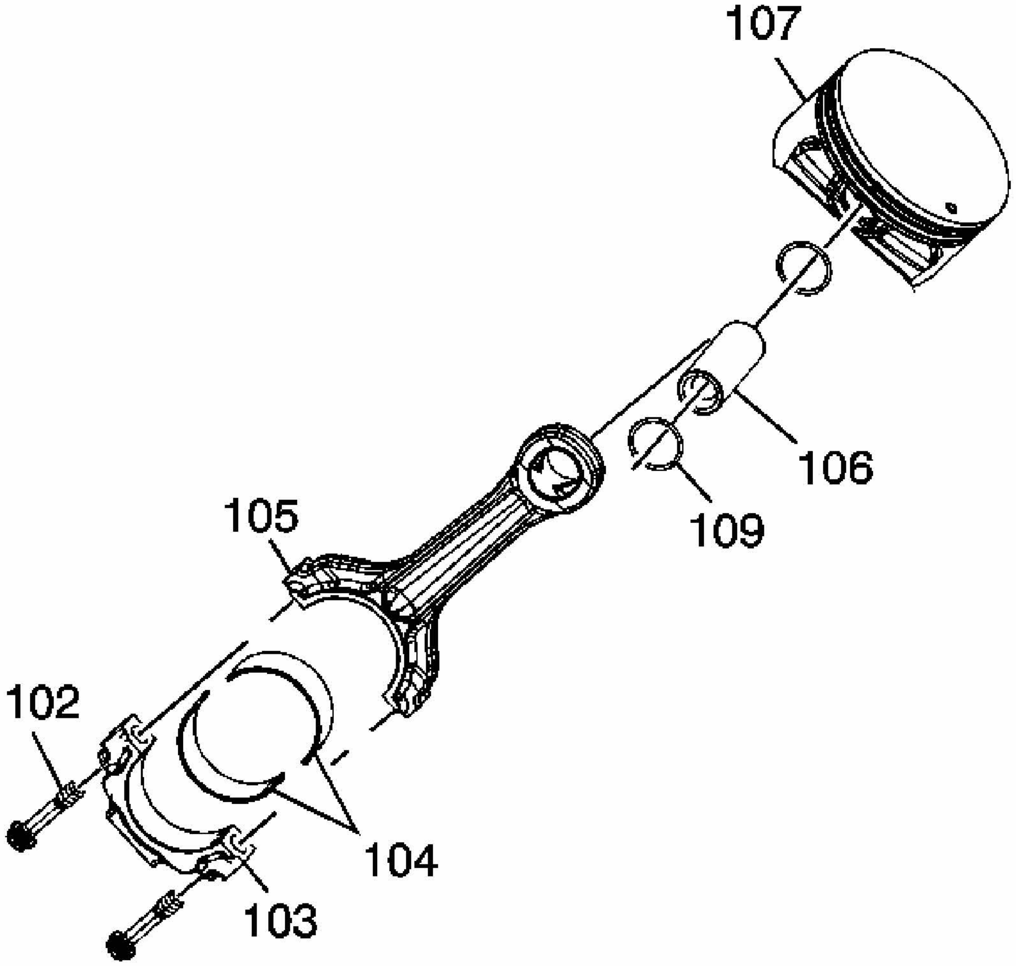


Fig. 449: Piston, Connecting Rod & Bearings
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Replace pistons, pins, and connecting rods that are damaged or show signs of excessive wear.**
- **The piston and pin are to be serviced as an assembly.**
- **Do not wire brush any part of the piston.**
- **Measurement of the components should be taken with the components at normal room temperature.**

1. Clean the varnish and carbon from the piston (107) using cleaning solvent.

CAUTION: Refer to Safety Glasses

Caution .

2. Dry the components with compressed air.

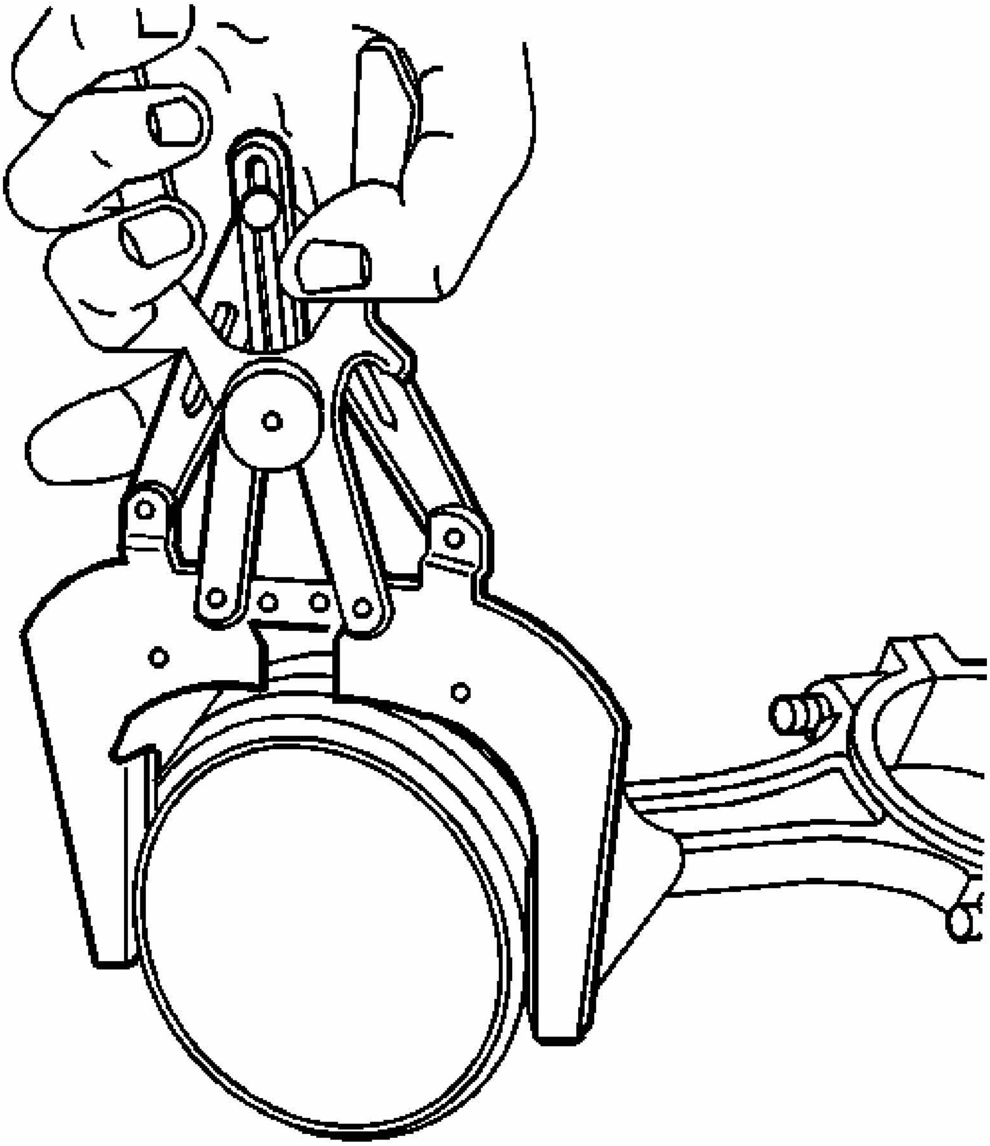


Fig. 450: Cleaning The Piston Ring Grooves With Suitable Ring Groove Cleaning Tool
Courtesy of GENERAL MOTORS CORP.

3. Clean the piston ring grooves with a suitable ring groove cleaning tool.

4. Clean the oil lubrication holes and slots.

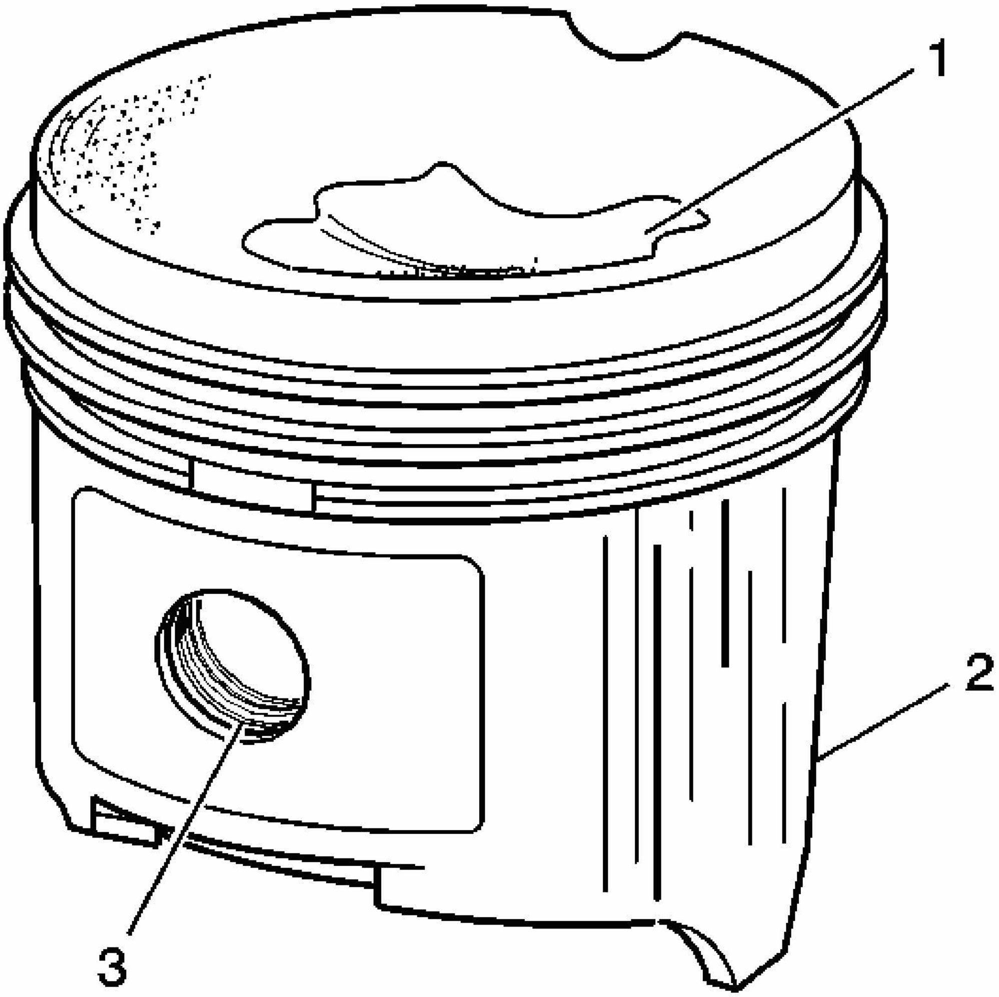


Fig. 451: Identifying Piston Damage Inspection Areas
Courtesy of GENERAL MOTORS CORP.

5. Inspect the piston for the following conditions:
   - Cracks in the piston ring lands, the piston skirt, or pin bosses
   - Piston ring grooves for nicks, burrs, or warpage which may cause the piston ring to bind

     MINOR imperfections may be removed from the piston with a fine file.

   - Scuffed or damaged skirts (2)

- Eroded areas at the top of the piston (1)
- Scoring to the full-floating design piston pin bore (3) or piston pin

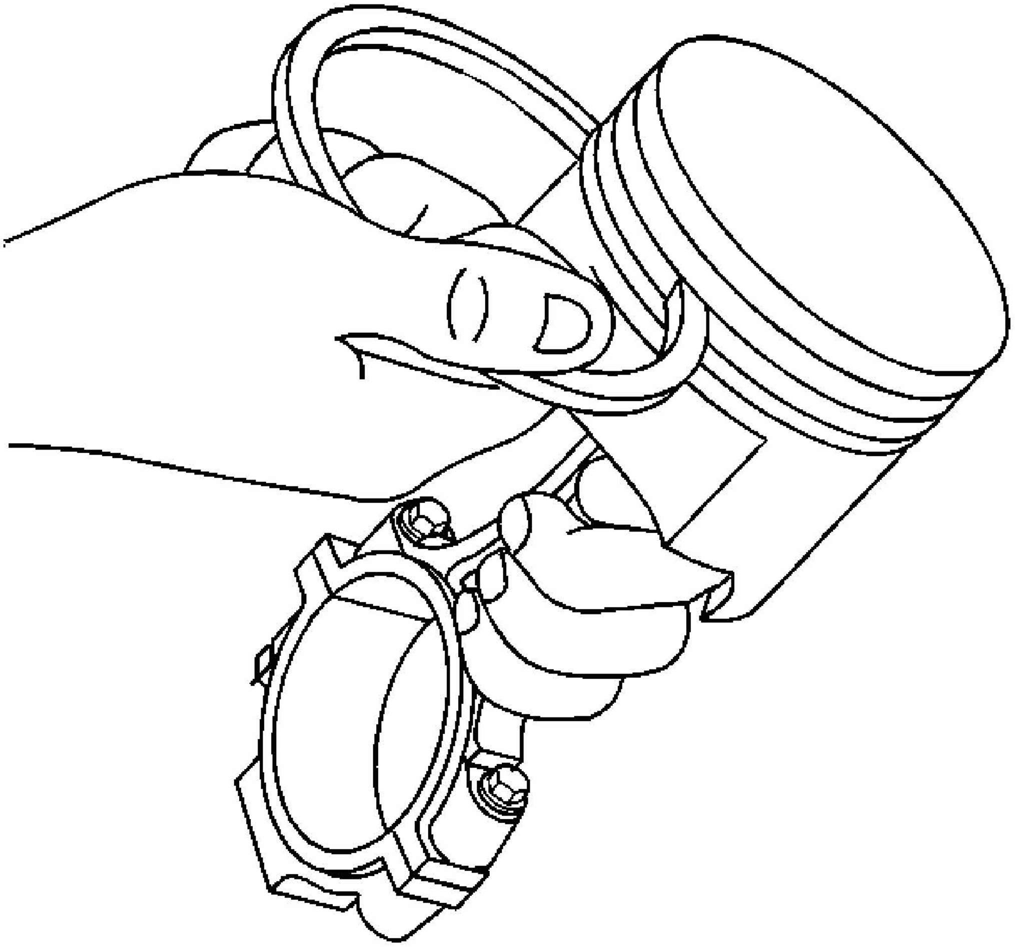


Fig. 452: Inserting Piston Ring Into Ring Groove
Courtesy of GENERAL MOTORS CORP.

6. Insert the edge of the piston ring into the piston ring groove.

   Roll the piston ring completely around the piston. If binding is caused by distorted ring groove, MINOR imperfections may be removed with a fine file. If binding is caused by a distorted piston ring, replace the rings, as required.

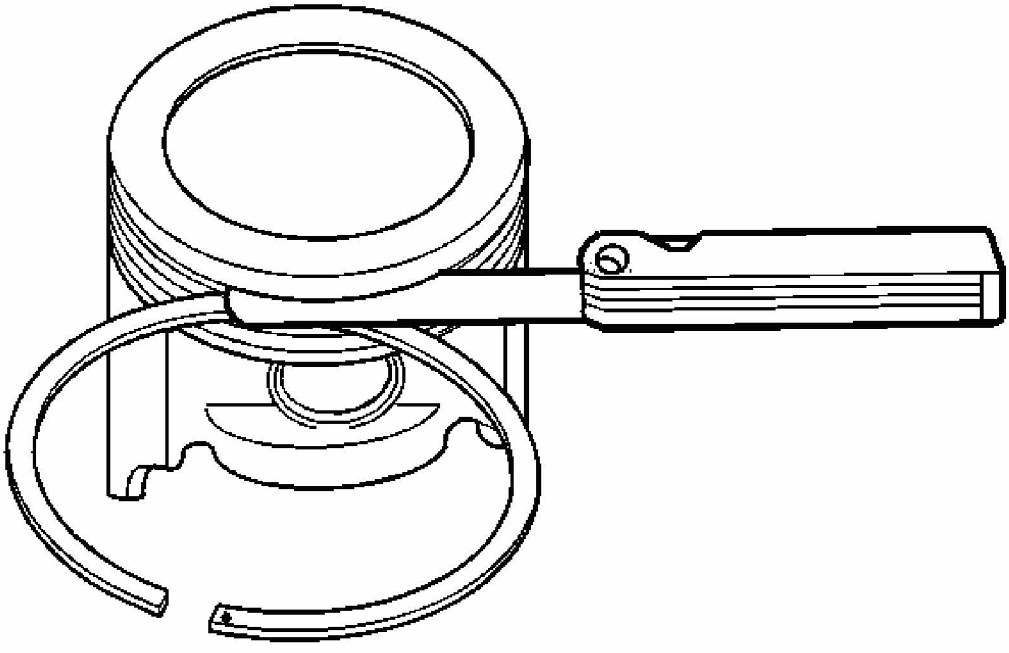


Fig. 453: Measuring Piston Ring Side Clearance
Courtesy of GENERAL MOTORS CORP.

7. Measure the piston ring side clearance with a feeler gauge. If side clearance is not within specifications, try another piston ring. If the proper ring-to- groove clearance cannot be obtained, replace the piston, pin, and connecting rod assembly. Refer to **Engine Mechanical Specifications**.

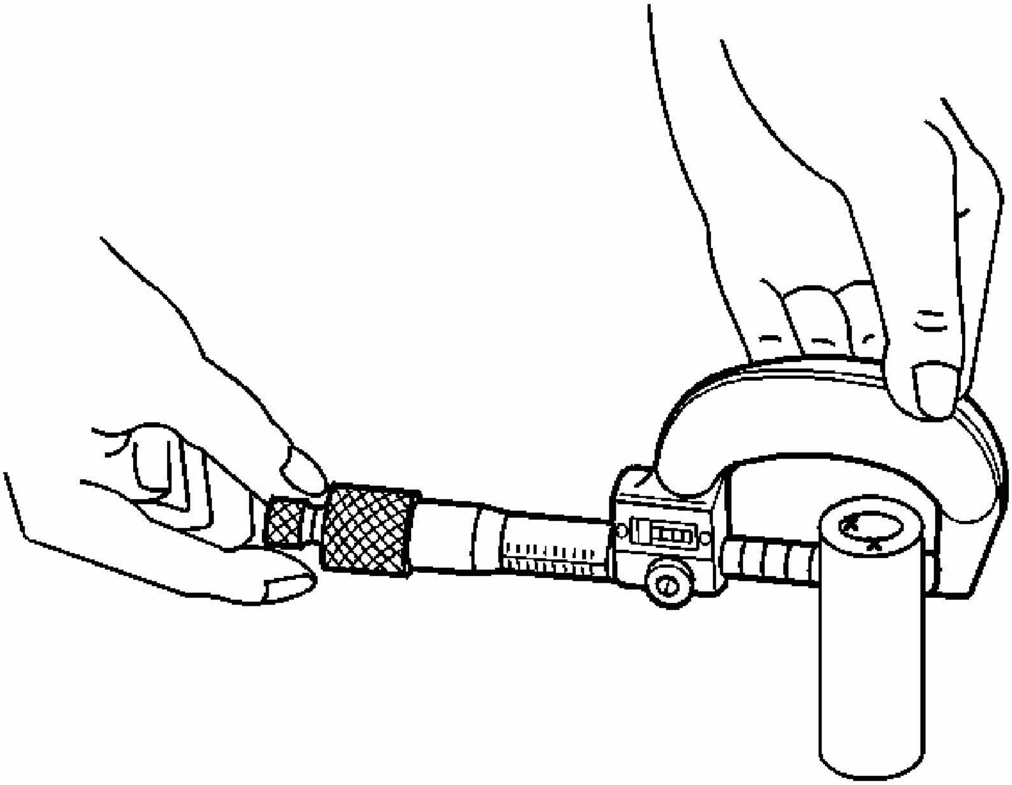


Fig. 454: Measuring Piston Pin Diameter
Courtesy of GENERAL MOTORS CORP.

8. To determine piston pin-to-bore clearance, use a micrometer and measure the piston pin outside diameter (OD).

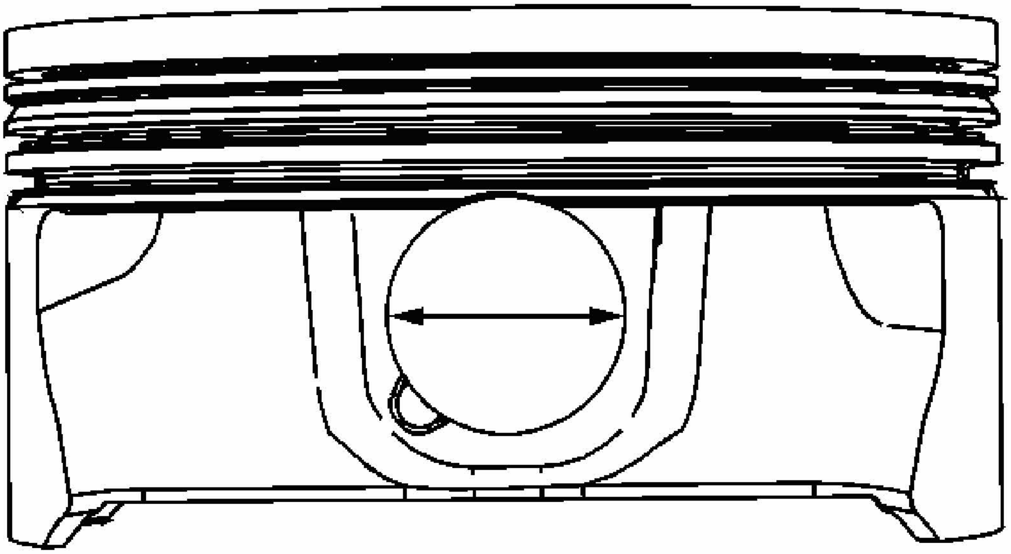


Fig. 455: Measuring Piston Pin-To-Bore Clearance
Courtesy of GENERAL MOTORS CORP.

9. To determine the piston pin-to-bore clearance, use an inside micrometer and measure the piston pin bore inside diameter (ID).
10. Subtract the piston pin OD measurement from the piston pin bore ID measurement to determine pin-to-bore clearance.

    Refer to **Engine Mechanical Specifications**.

Measuring Piston Ring End Gap

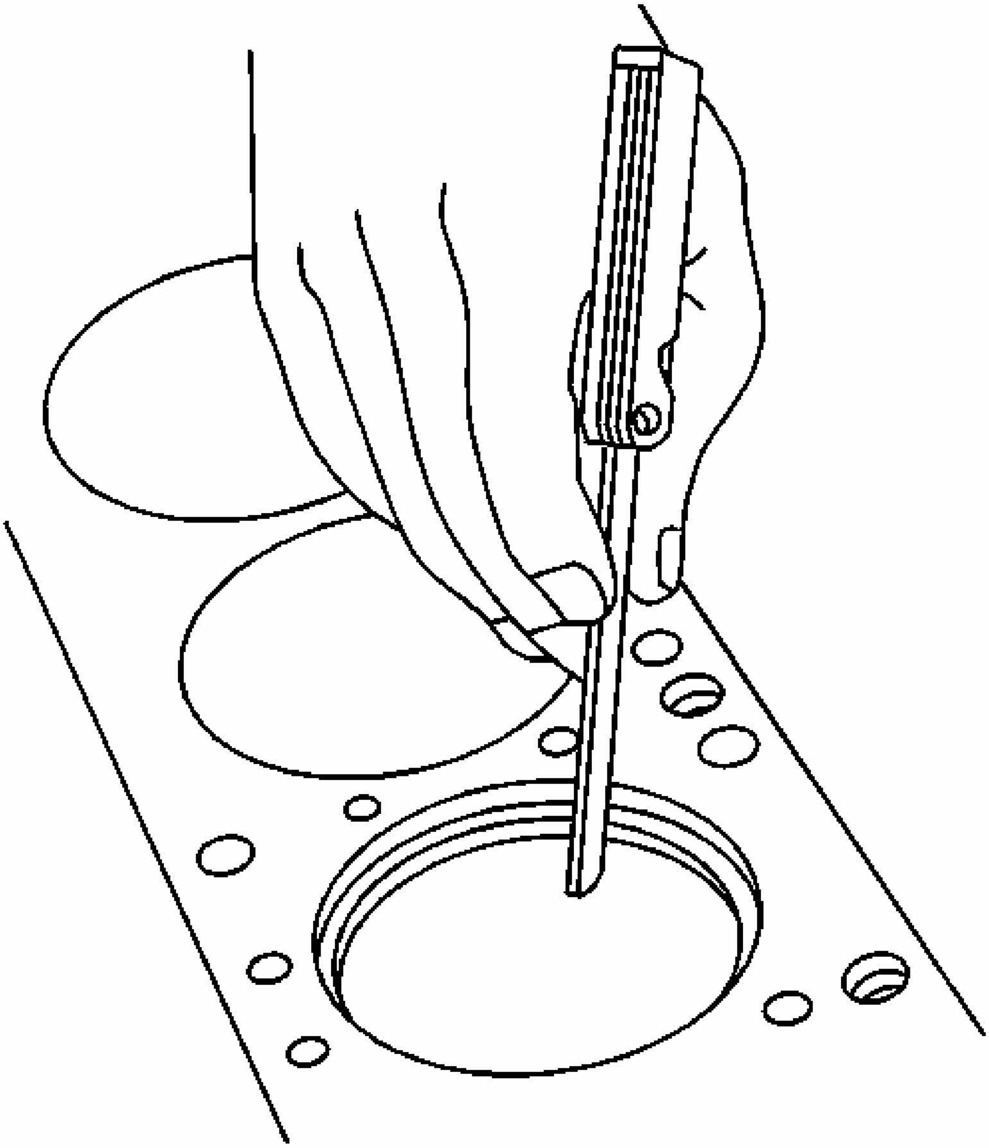


Fig. 456: Measuring Piston Ring End Gap
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Do not attempt to file the end of the piston ring to achieve the proper end gap clearance.**
- **Measure the piston ring in the cylinder in which it will be used.**

1. Place the piston ring into the cylinder bore 6.5 mm (0.25 in) below the top of the ring travel area.
2. Insert a feeler gage and measure the piston ring end gap. Refer to **Engine Mechanical Specifications**.

Connecting Rod and Bearings

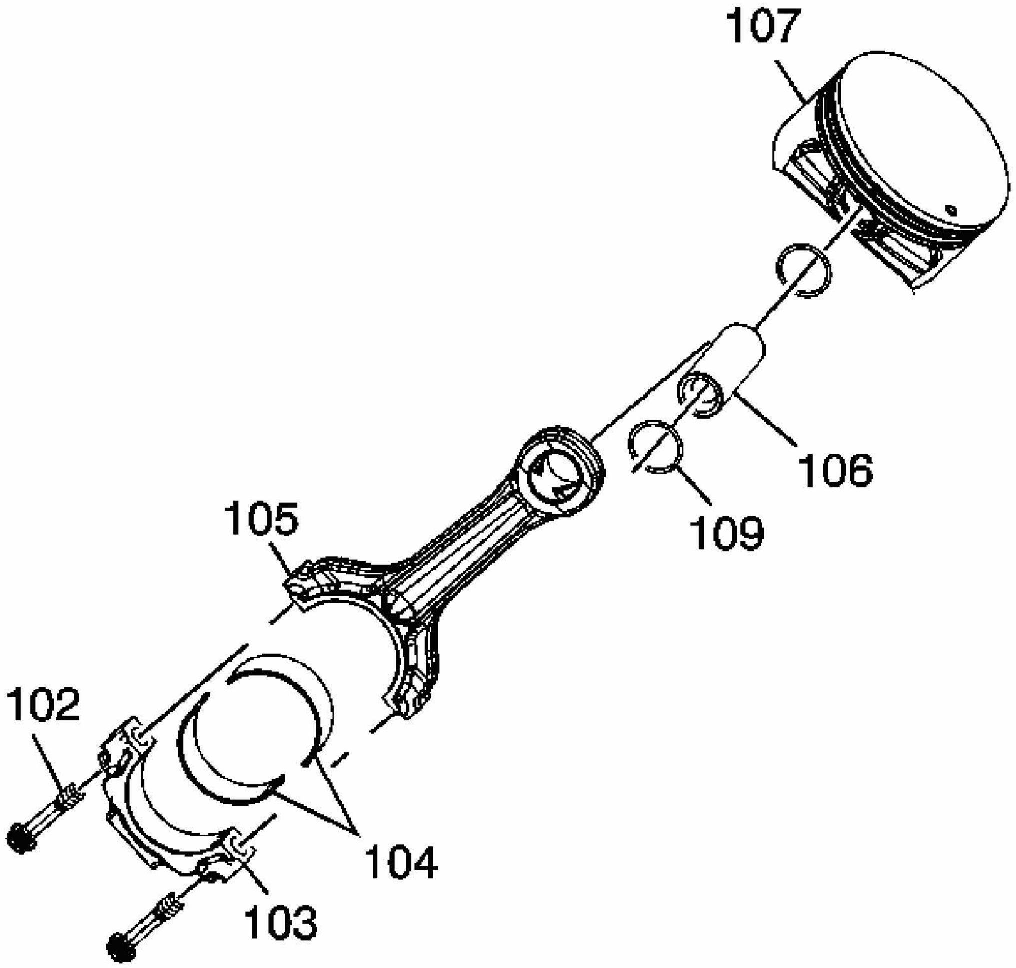


Fig. 457: Piston, Connecting Rod & Bearings
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **The powdered metal connecting rod and cap are machined for proper clearances. The connecting rod and cap must be used as an assembly with no repair or modifications to either mating surface. Do not attempt to repair the rod or**

cap. If service is required, replace the piston, pin, and connecting rod as an assembly.

- **Do not attempt to repair the bolt hole threads of the connecting rod.**

1. Clean the connecting rod (105) and cap (103) in solvent.

CAUTION: Refer to Safety Glasses Caution .

2. Dry the components with compressed air.

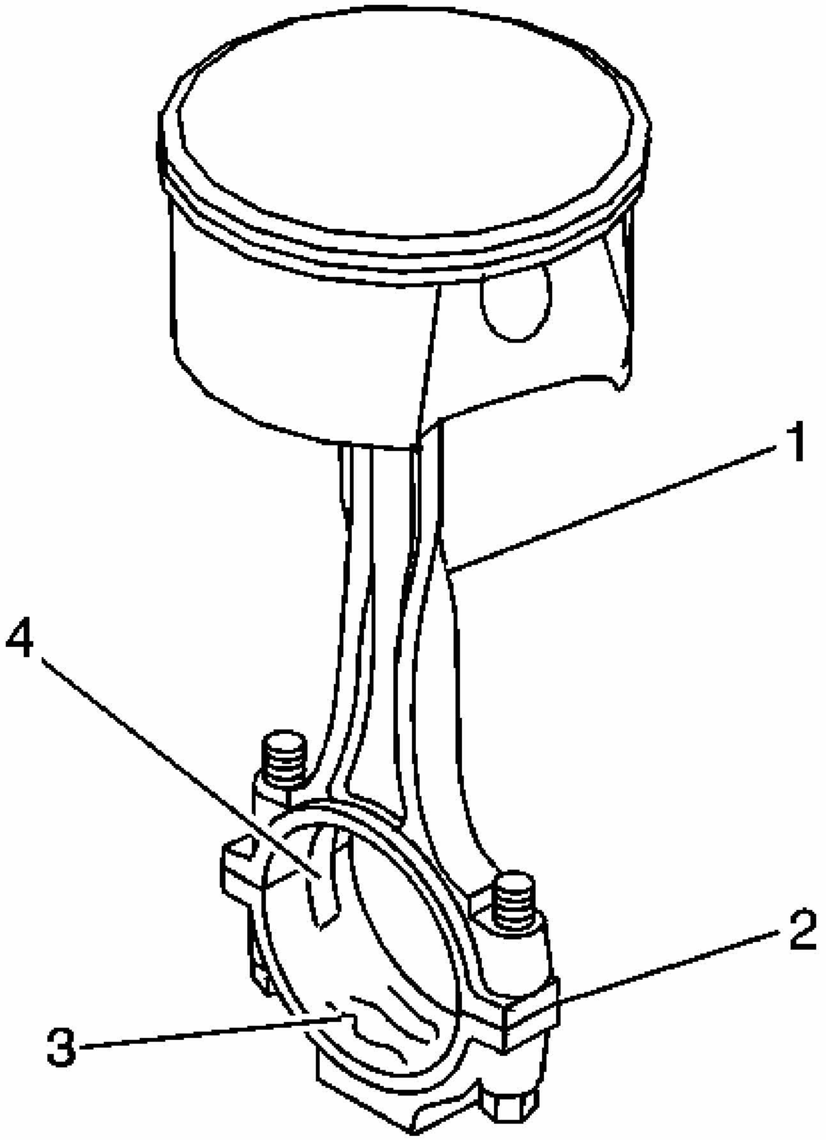


Fig. 458: Identifying Connecting Rod Inspection Areas
Courtesy of GENERAL MOTORS CORP.

3. Inspect the connecting rod for the following conditions:
    - Twisting (1)
    - Proper fit of the connecting rod and cap mating surfaces (2)
    - Nicks or gouges in the bearing bore (3)
    - Damage to the bearing locating slots (4)

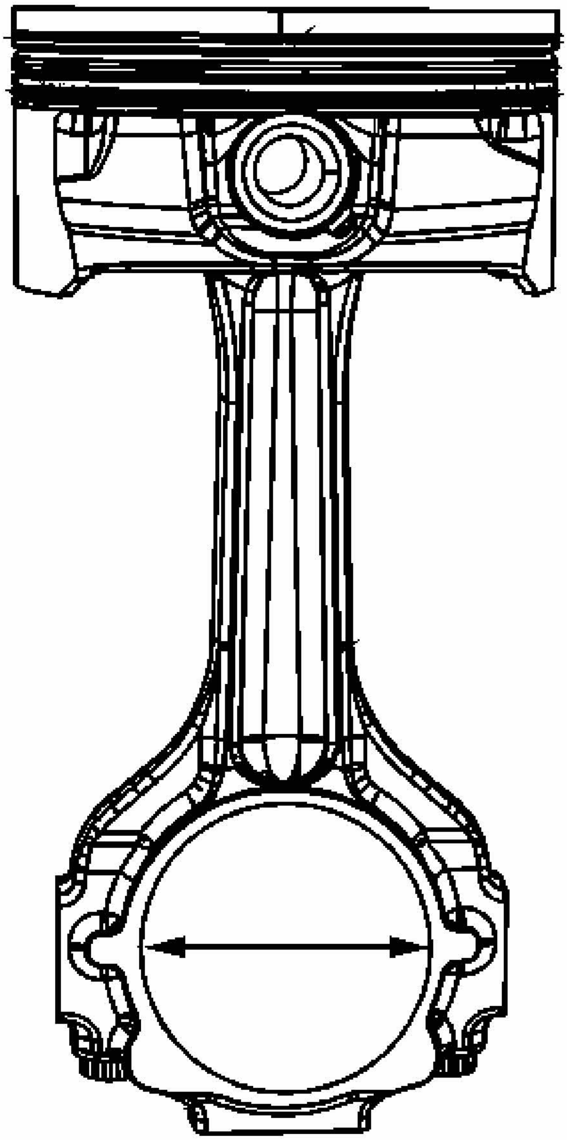


Fig. 459: Measuring Connecting Rod Bearing Bore For An Out-Of-Round
Courtesy of GENERAL MOTORS CORP.

4. Measure the connecting rod bearing bore for an out-of-round condition. Refer to **Engine Mechanical Specifications**.

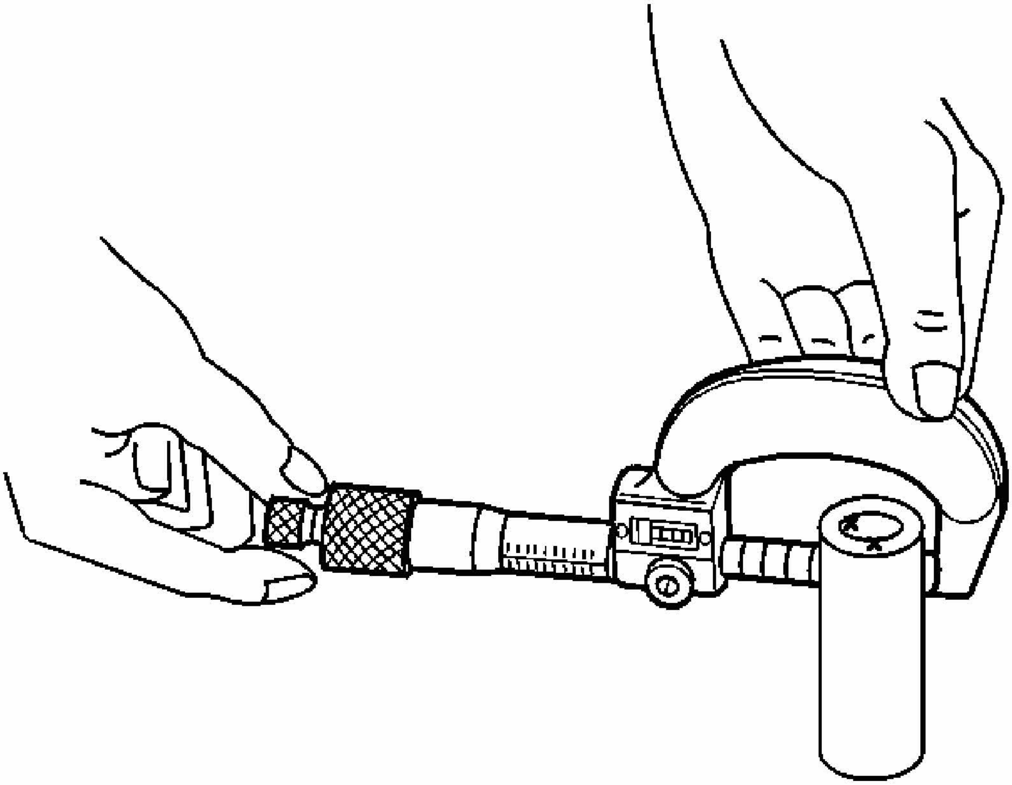


Fig. 460: Measuring Piston Pin Diameter
Courtesy of GENERAL MOTORS CORP.

5. To determine full-floating piston pin-to-connecting rod bore clearance, use a micrometer and measure the piston pin outside diameter (OD).

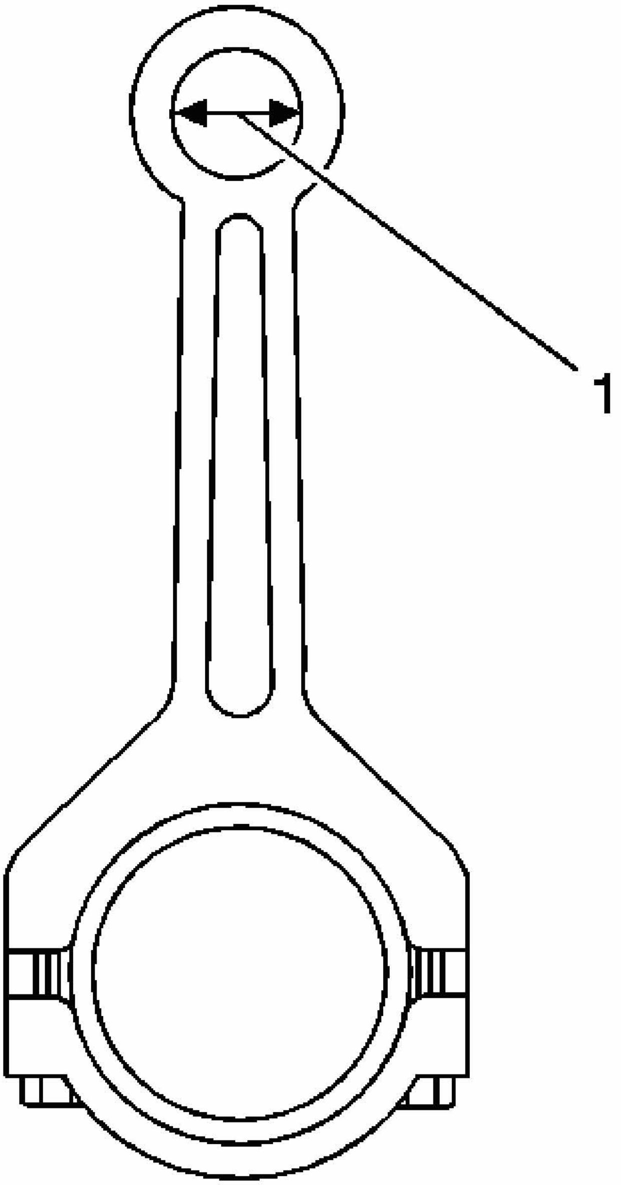


Fig. 461: Measuring Connecting Rod Pin Bore Inside Diameter
Courtesy of GENERAL MOTORS CORP.

6. To determine the full-floating piston pin-to-connecting rod bore clearance, use a micrometer and measure the connecting rod pin bore (1) inside diameter (ID).
7. Subtract the piston pin OD measurement from the connecting rod pin bore ID measurement to determine pin-to-bore clearance. Refer to **Engine Mechanical Specifications**.

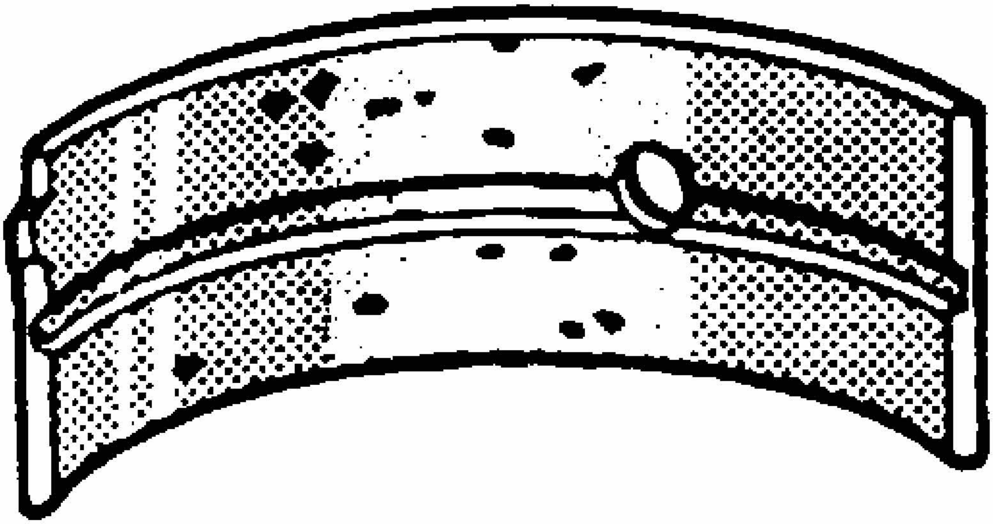


Fig. 462: Identifying Crankshaft Bearing Craters Or Pockets
Courtesy of GENERAL MOTORS CORP.

8. Inspect the connecting rod bearings for craters or pockets. Flattened sections on the bearing halves indicate fatigue.

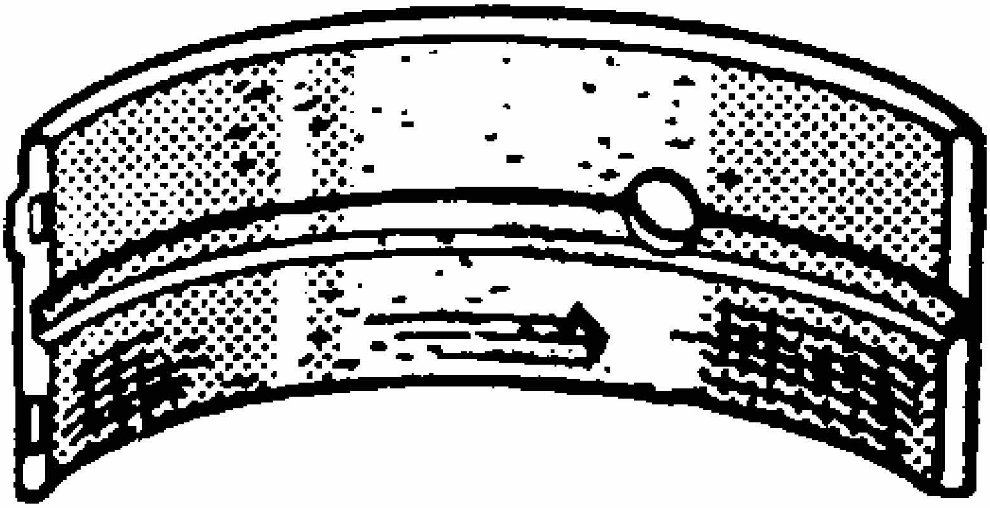


Fig. 463: Identifying Connecting Rod Bearing Scoring Or Discoloration
Courtesy of GENERAL MOTORS CORP.

9. Inspect the connecting rod bearings for excessive scoring or discoloration.
10. Inspect the connecting rod bearings for dirt or debris imbedded into the bearing material.

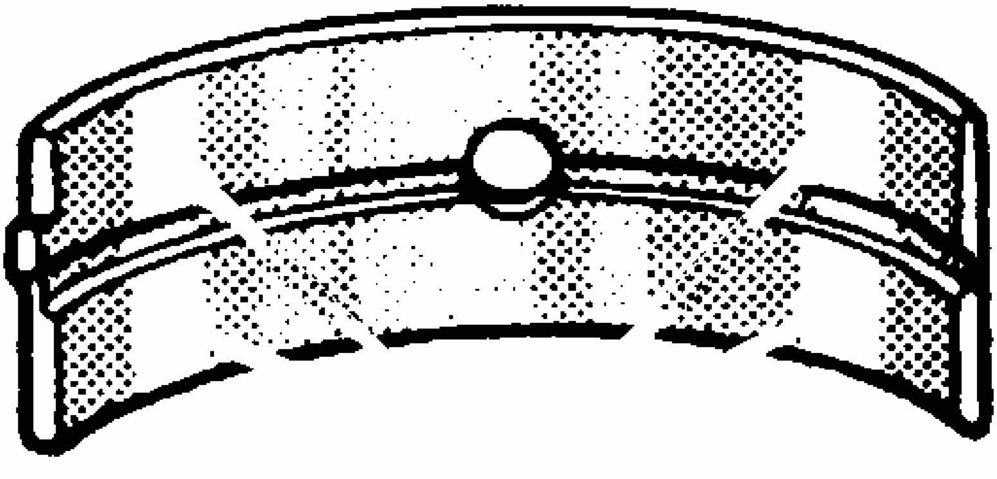


Fig. 464: Crankshaft Bearing Polished Sections (Improper Seating)
Courtesy of GENERAL MOTORS CORP.

11. Inspect the connecting rod bearings for improper seating indicated by bright, polished sections of the bearing surface.

PISTON AND CONNECTING ROD ASSEMBLE

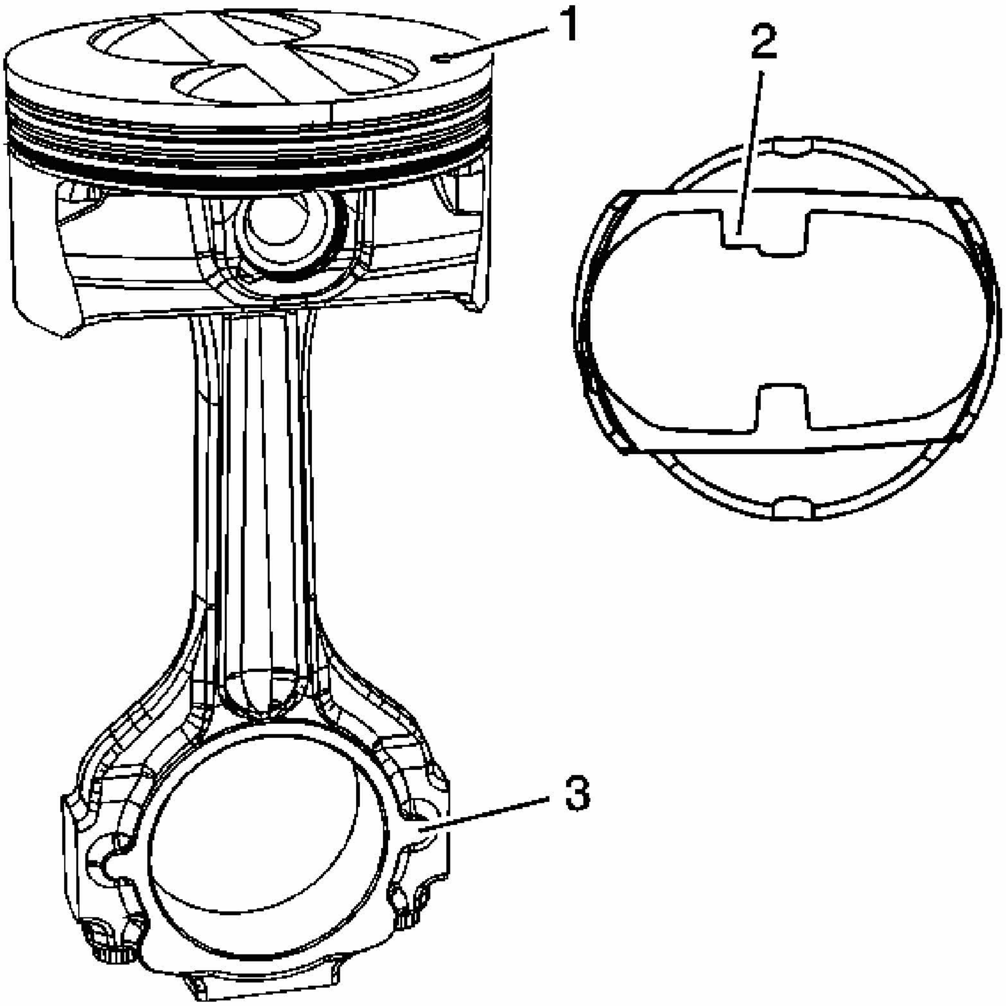


Fig. 465: Locating Piston Lug & Tab
Courtesy of GENERAL MOTORS CORP.

1. Assemble the piston and connecting rod with the lug (1) on the bottom of the piston and the tab (2) on the side of the connecting rod facing the same direction.

When installing the piston and connecting rod assembly, the mark on the top of the piston and the tab (2) on the side of the connecting rod should face the front of the engine.

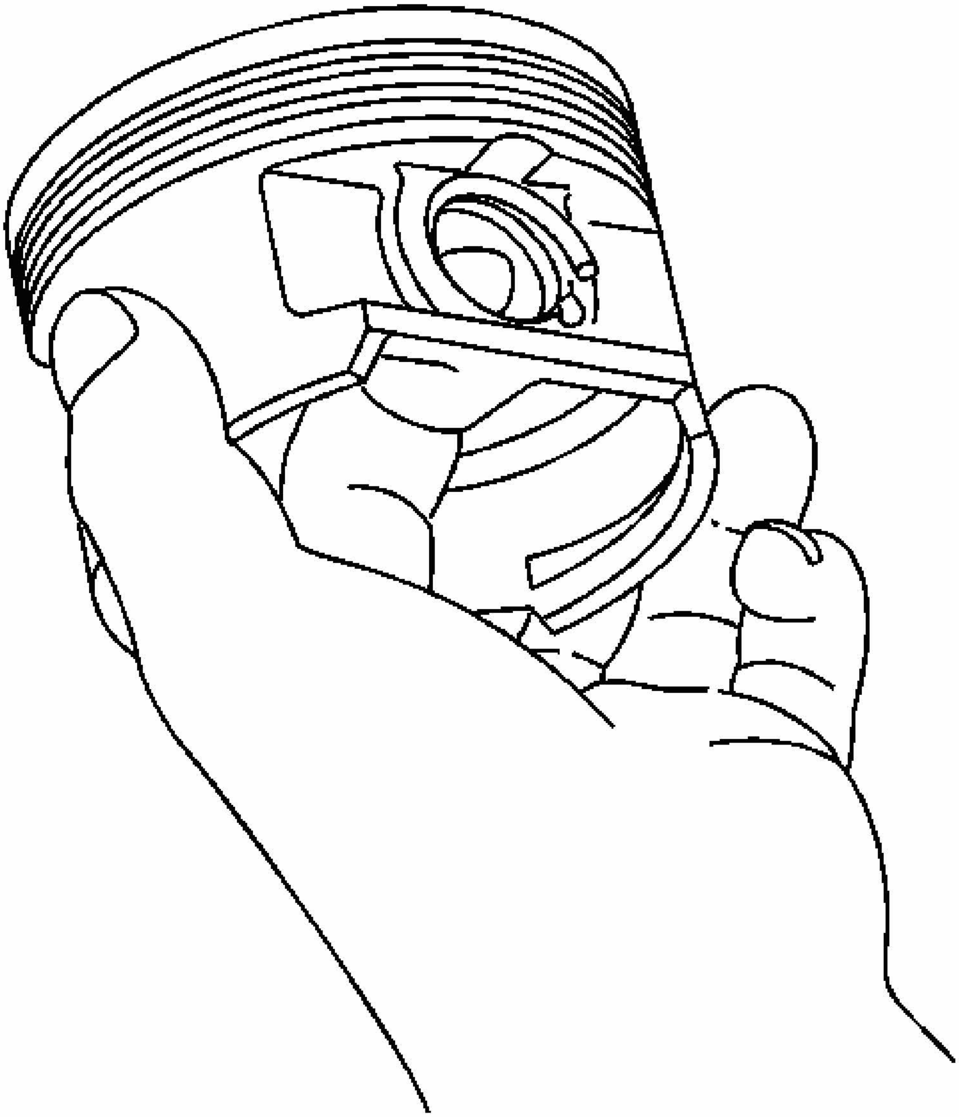


Fig. 466: View Of Retaining Clip In Pin Bore Groove
Courtesy of GENERAL MOTORS CORP.

2. Install the retainer. The retainer should be seated in the groove of the pin bore.

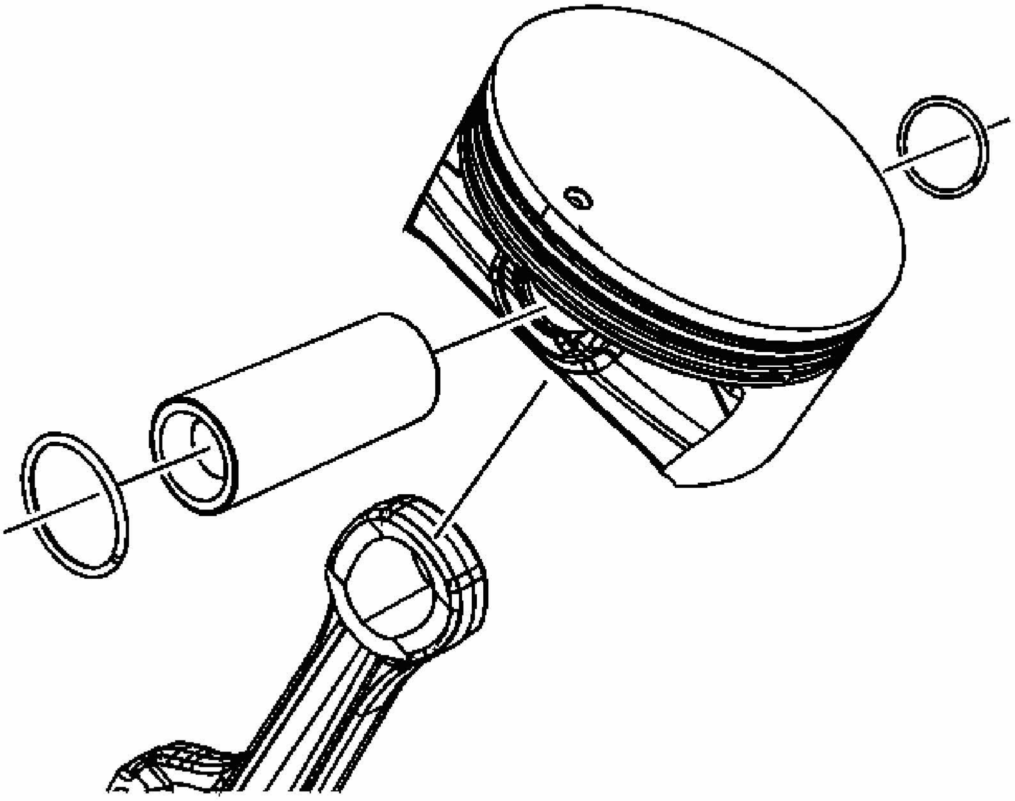


Fig. 467: Piston Pin, Piston & Connecting Rod
Courtesy of GENERAL MOTORS CORP.

3. Install the piston pin to the piston and connecting rod.
4. Install the retainer. The retainer should be seated in the groove of the pin bore.

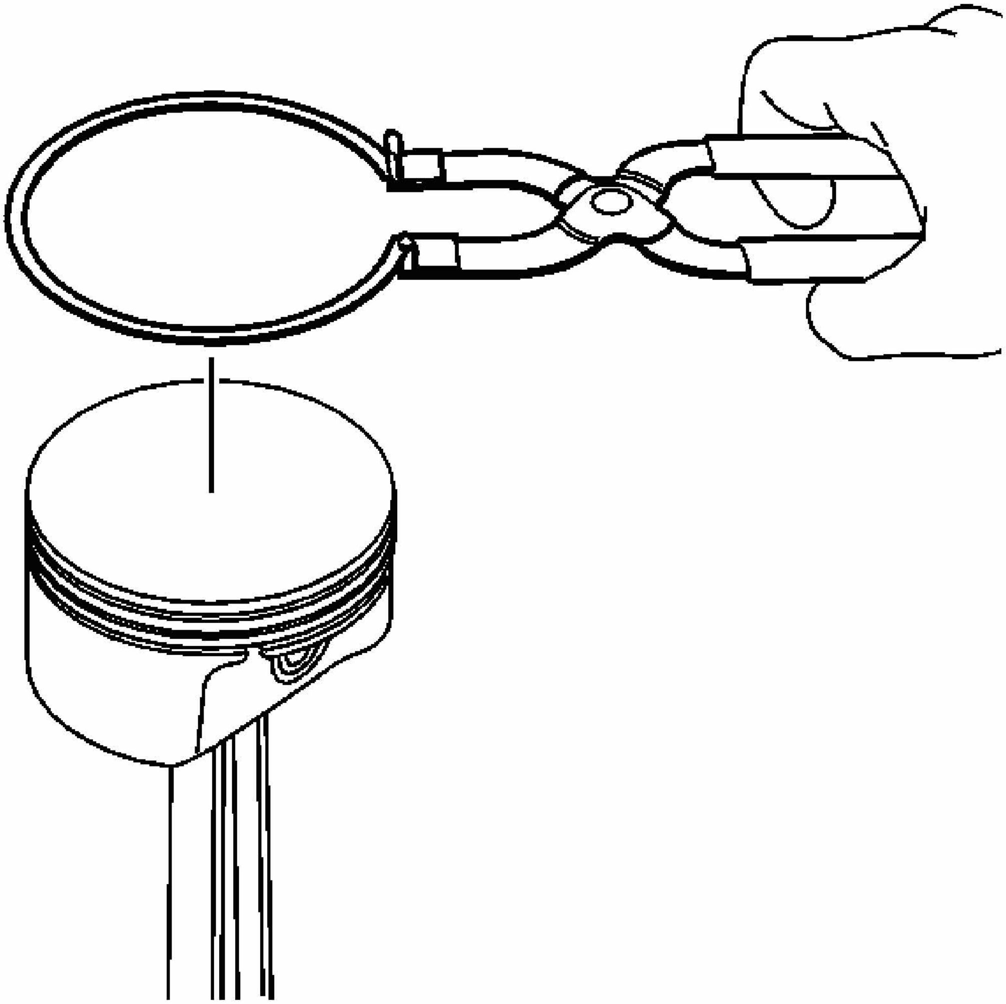


Fig. 468: Removing/Installing Piston Rings
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When installing piston rings, use a ring expander plier type tool. Do not roll the rings into the grooves of the piston. Use caution and care to expand the rings only slightly larger than the outside diameter (OD) of the piston.

5. Using piston ring pliers, install the piston rings onto the piston. Install the compression rings with the orientation mark facing the top of the piston.
6. Position the oil control ring end gaps a minimum of 25 mm (1.0 in) from each other.
7. Position the compression ring end gaps 180 degrees opposite each other.

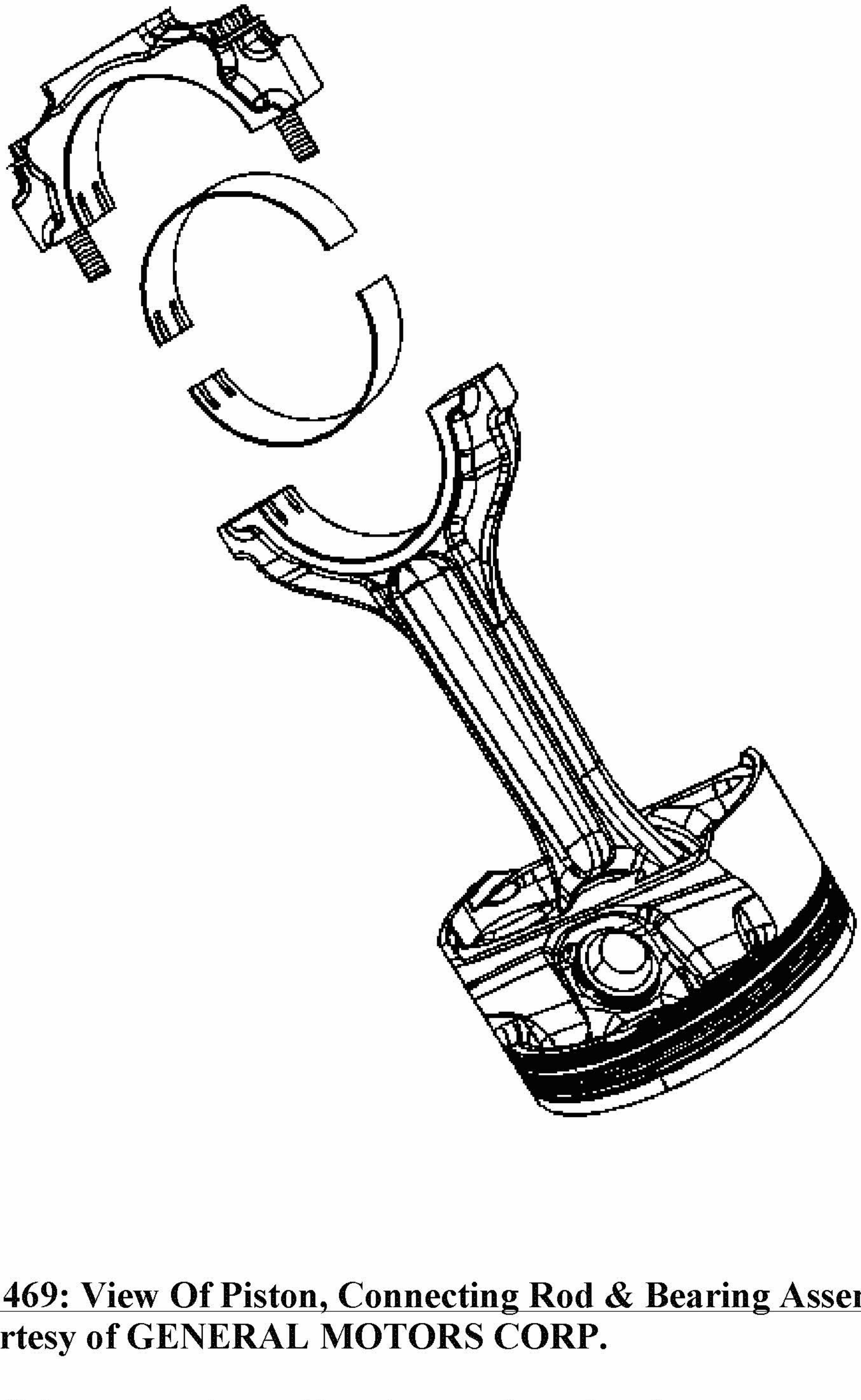


Fig. 469: View Of Piston, Connecting Rod & Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

8. Install the connecting rod bearings to the rod and cap.

CAMSHAFT BEARING REMOVAL

Tools Required

J 33049 Camshaft Bearing Service Set

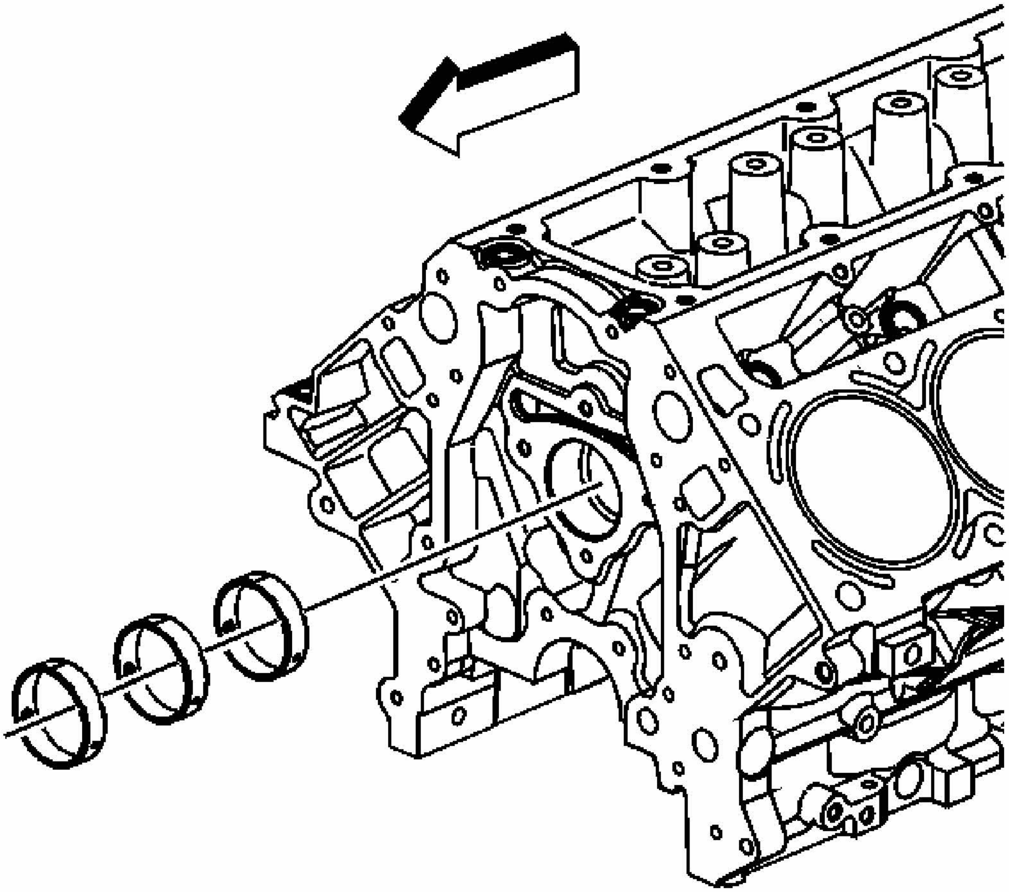


Fig. 470: Camshaft Bearings
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: A loose camshaft bearing may be caused by an enlarged, out of round, or damaged engine block bearing bore.

1. Prior to bearing removal, inspect the camshaft bearings for loose fit in the engine block bearing bores. Refer to **Camshaft and Bearings Cleaning and Inspection**.
2. Repair or replace the components, as required.

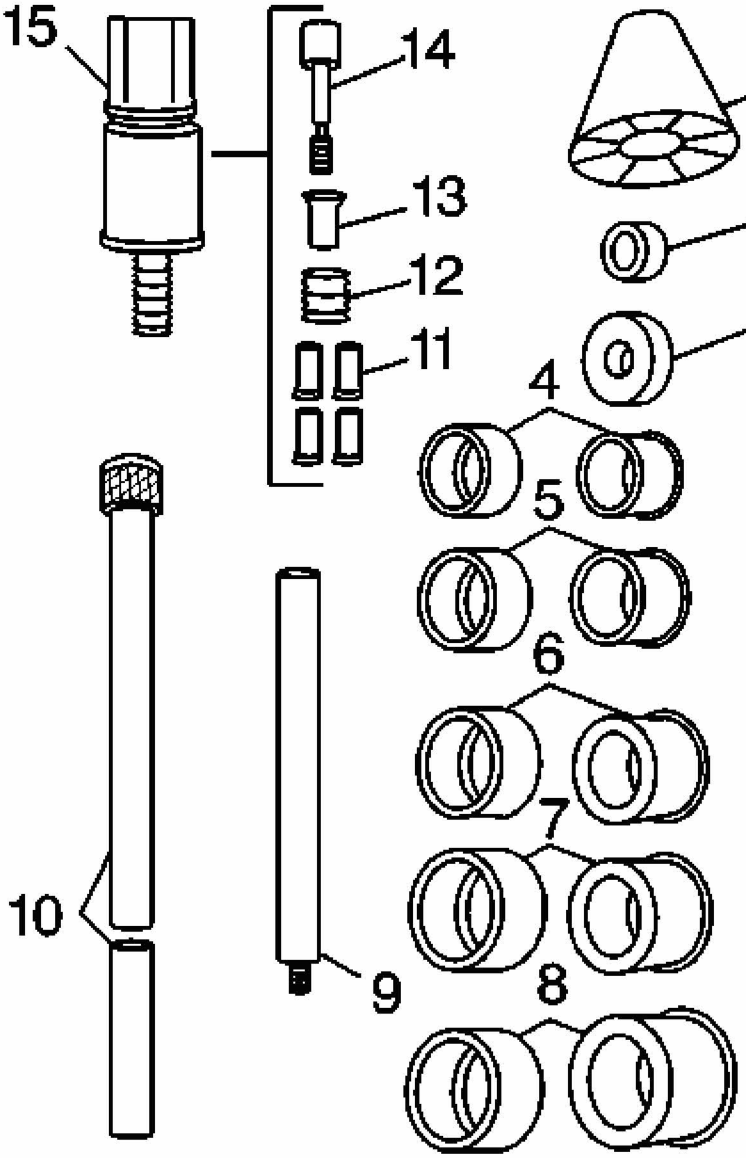


Fig. 471: View Of J 33049 Camshaft Bearing Service Kit Components
Courtesy of GENERAL MOTORS CORP.

3. Select the expanding driver (4-8) and washer (2 or 3) from the **J 33049** .
4. Assemble the tool.
5. Insert the tool through the front of the engine block and into the bearing.
6. Tighten the expander assembly (15) nut until snug.
7. Push the guide cone (1) into the front camshaft bearing location in order to align the

tool.

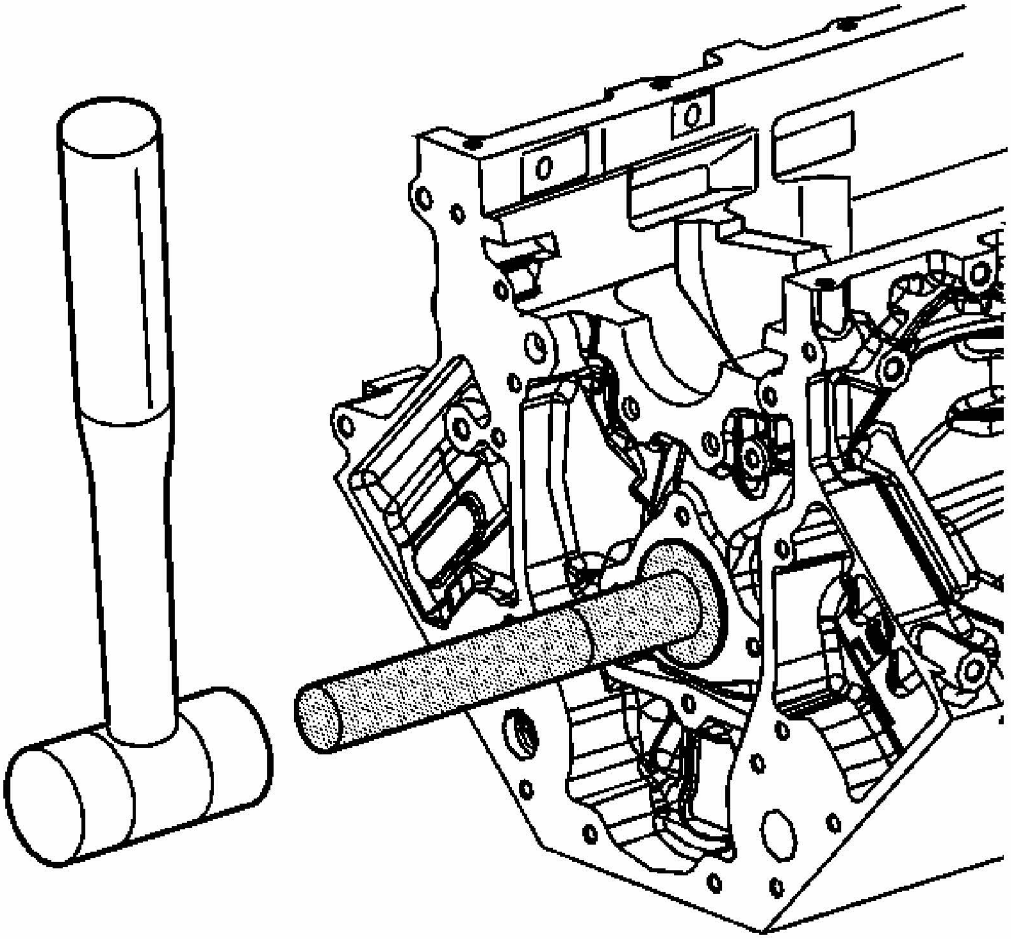


Fig. 472: Driving Bearing Out Of Or Into Engine Block
Courtesy of GENERAL MOTORS CORP.

8. Drive the bearing from the block bore.

IMPORTANT: In order to remove the front camshaft bearing, operate the tool from the rear of the block, using the guide cone in the rear camshaft bearing bore location.

9. Repeat the above procedures in order to remove the remaining bearings.

Tool Usage Information

Bearing, Expander, and Expander Driver Information

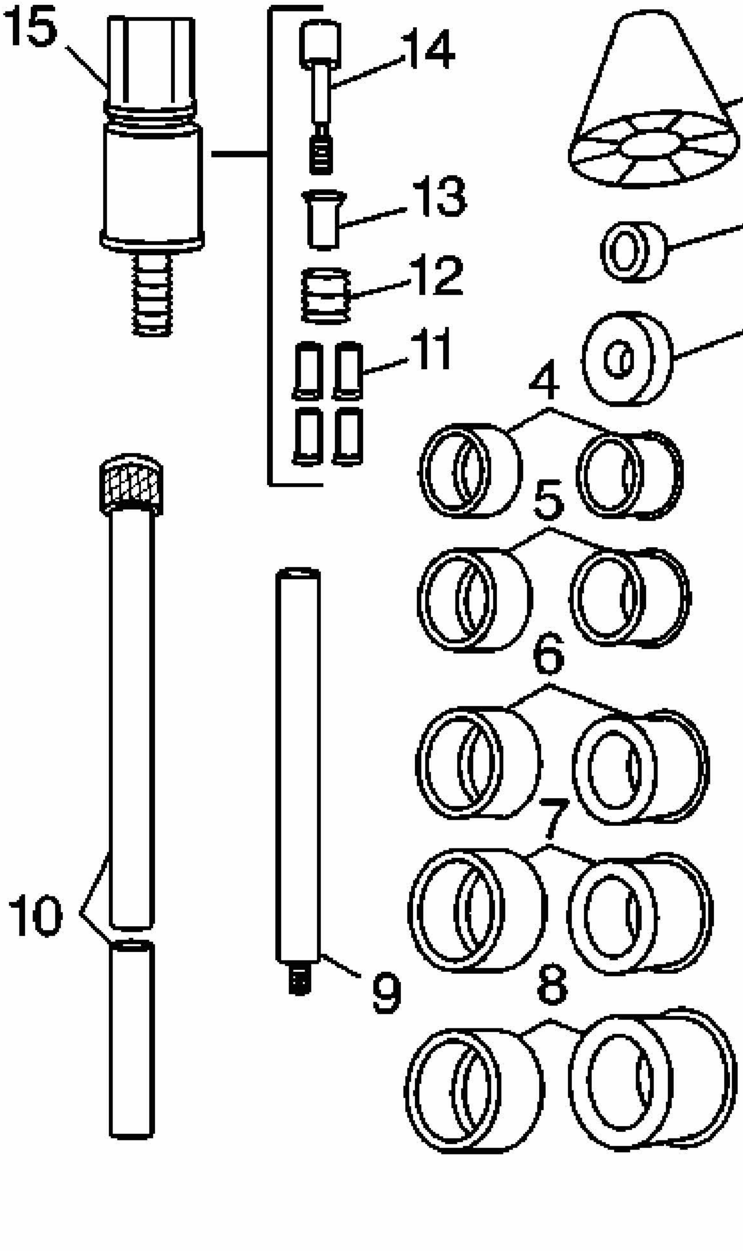


Fig. 473: View Of J 33049 Camshaft Bearing Service Kit Components
Courtesy of GENERAL MOTORS CORP.

- The tool consists of a guide cone (1), driving washers (2 or 3), expander bearing drivers (4-8), driver bars (9 or 10), expander jaws (11), expander sleeve (12), expander cone (13), expander shaft (14), and expander assembly (15).
- Expander bearing driver number 1 inside diameter is 28.575-37.465 mm (1.125-1.475 in) and is used with the expander assembly and the small washer.

- Expander bearing driver number 2 inside diameter is 37.465-43.18 mm (1.475-1.7 in) and is used with number 1 expanding driver and the small washer.
- Expander bearing driver number 3 inside diameter is 43.18-48.895 mm (1.7-1.925 in) and is used with number 2 expanding driver and the large washer.
- Expander bearing driver number 4 inside diameter is 48.895-54.61 mm (1.925-2.15 in) and is used with number 3 expanding driver and the large washer.
- Expander bearing driver number 5 inside diameter is 54.61-60.325 mm (2.150-2.375 in) and is used with number 4 expanding driver and the large washer.
- Expander bearing driver number 6 inside diameter is 60.325-68.326 mm (2.375-2.69 in) and is used with number 5 expanding driver and the large washer.

Tool Assembly and Operation

1. Select the proper expanding driver and washer from the expanding driver and washer information.

    **IMPORTANT: To install or remove the expanding driver, always push on or pull from the ends.
    Pressure on the outside diameter may cause a bind against the rubber expanding sleeve.**

2. Place the expanding driver onto the expander assembly.
3. Ensure the separation lines between the segments of the expanding driver align with the separation lines of the expander assembly.
4. With the small end of the cone (2) facing the driver assembly, place the guide cone over the driving bar.
5. Place the driving washer over the threaded portion of the expander assembly.
6. Screw the expander assembly, with driving washer, onto the driving bar.

    For removal of the inner bearings, it may be necessary to install the driver bar extension.

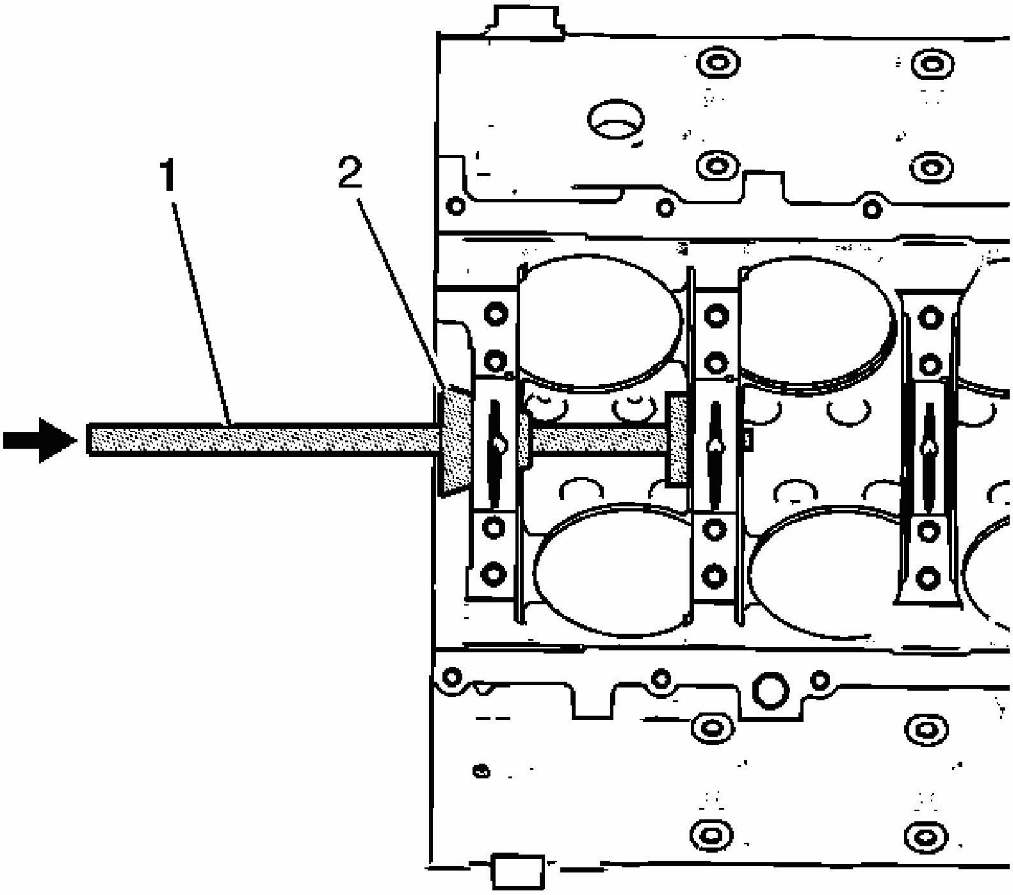


Fig. 474: Driving Bearing Out Of Or Into Engine Block
Courtesy of GENERAL MOTORS CORP.

7. Insert the tool into an inner camshaft bearing and tighten until snug.

   Operate the tool from the front or rear of the engine block.

   On some engine blocks, the nut on the expander assembly is inaccessible, except from either end. In this case, you must use a socket and extension to enlarge and reduce the expander assembly.

8. Slide the cone (2) into the front or rear camshaft bearing location. This will properly align the tool.
9. Drive the bearing out of the engine block.
10. Repeat the procedure for the additional inner bearings.

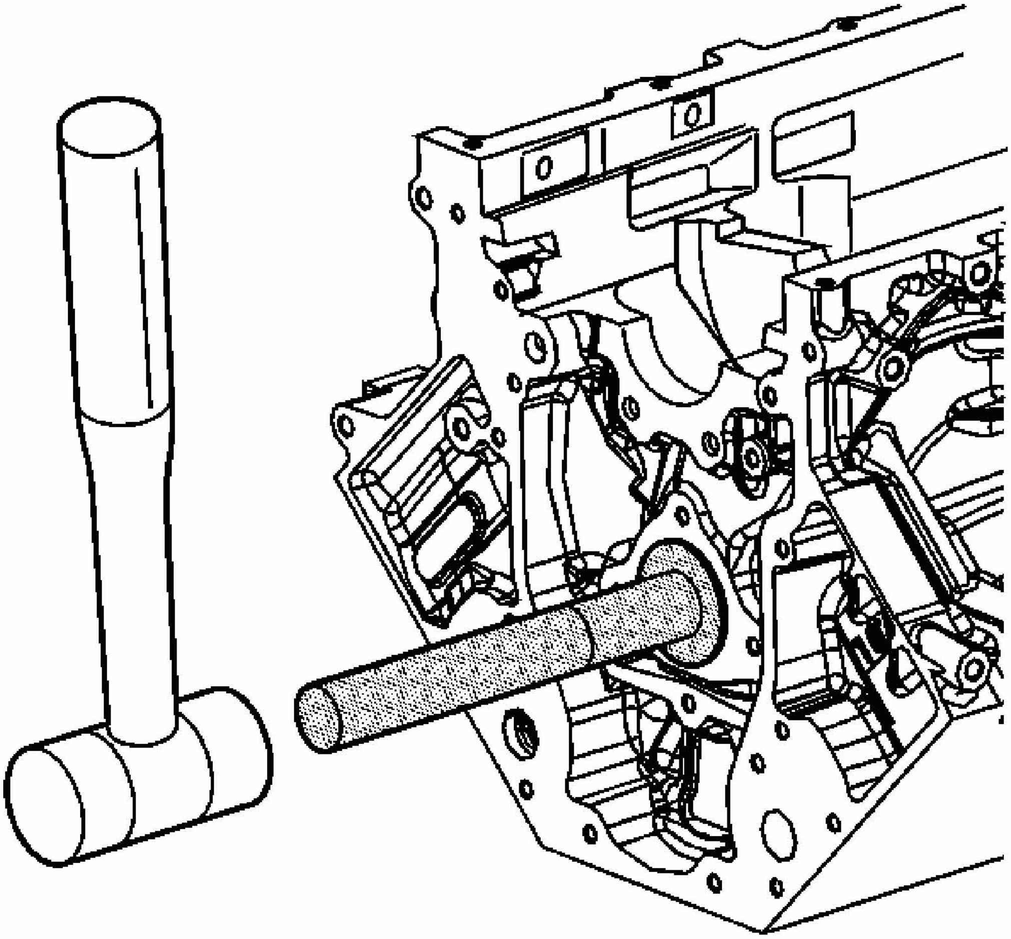


Fig. 475: Driving Bearing Out Of Or Into Engine Block
Courtesy of GENERAL MOTORS CORP.

11. For the 2 end bearings, front and rear, remove the nylon cone and driver bar extension.
12. Drive the bearings out of or into the engine block.

CAMSHAFT AND BEARINGS CLEANING AND INSPECTION

Tools Required

- **J 7872** Magnetic Base Dial Indicator Set
- **J 8520** Camshaft Lobe Lift Indicator

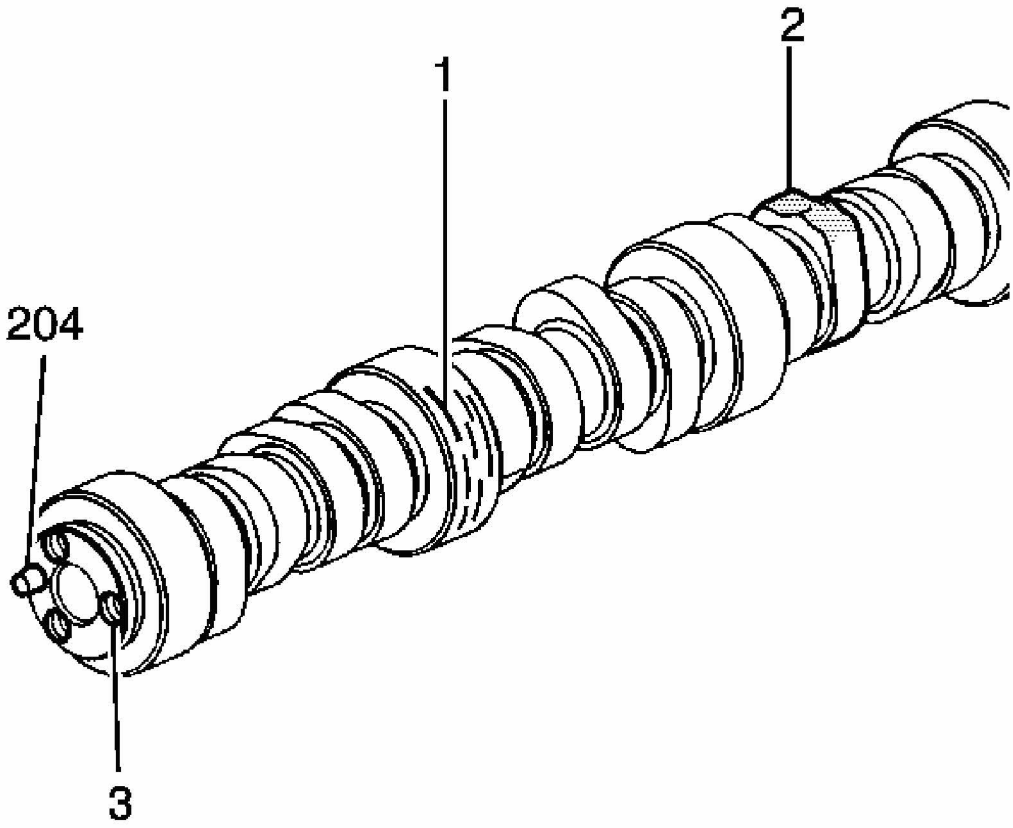


Fig. 476: Identifying Camshaft & Bearing Inspection Areas
Courtesy of GENERAL MOTORS CORP.

1. Clean the components in solvent.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

2. Dry the components with compressed air.
3. Inspect the camshaft bearing journals (1) for scoring or excessive wear.
4. Inspect the camshaft valve lifter lobes (2) for scoring or excessive wear.
5. Inspect the threaded bolt holes (3) in the front of the camshaft for damaged threads or debris.
6. Inspect the camshaft sprocket pin (204) for damage.

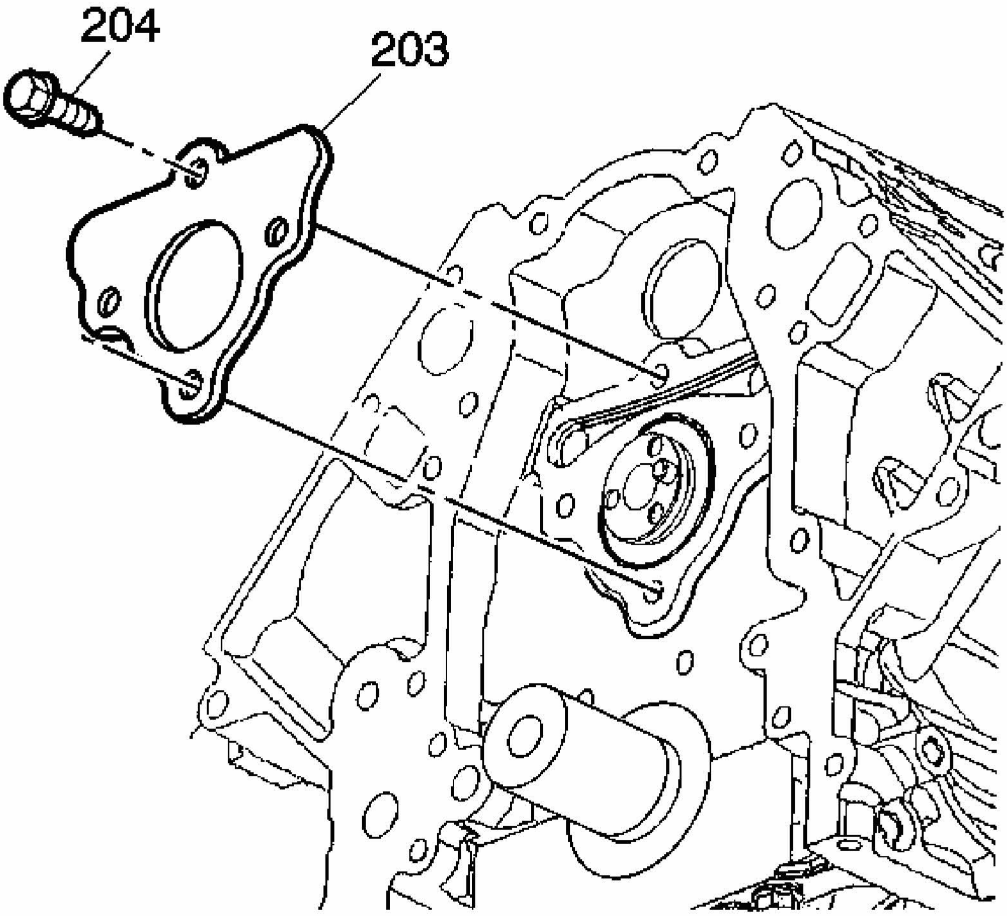


Fig. 477: Camshaft Retainer & Bolts
Courtesy of GENERAL MOTORS CORP.

7. Inspect the camshaft retainer plate (203) for wear or a damaged sealing gasket.

   If the camshaft retainer plate sealing gasket is not cut or damaged, it may be used again.

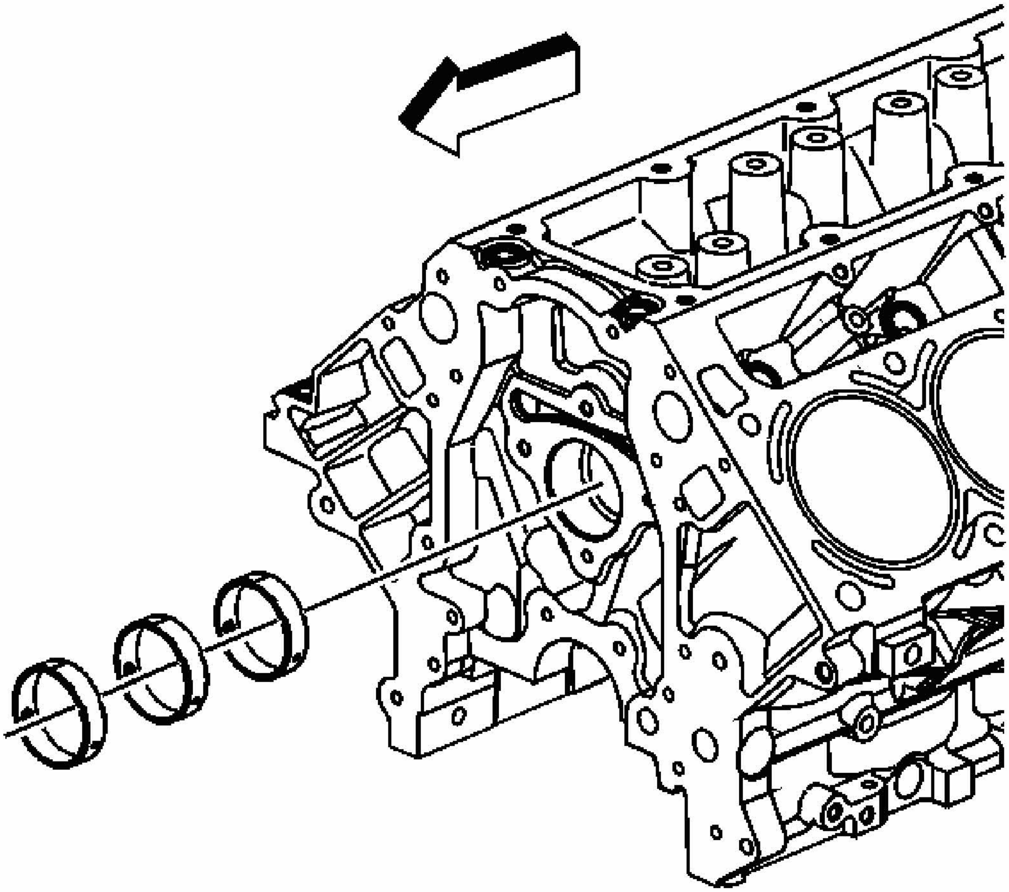


Fig. 478: Camshaft Bearings
Courtesy of GENERAL MOTORS CORP.

8. Inspect the camshaft bearings for proper fit in the engine block. Camshaft bearings have an interference fit to the engine block and should not be loose in their engine block bearing bores.
9. Inspect the camshaft bearings for excessive wear or scoring.

   Bearings with excessive scoring or wear must be replaced.

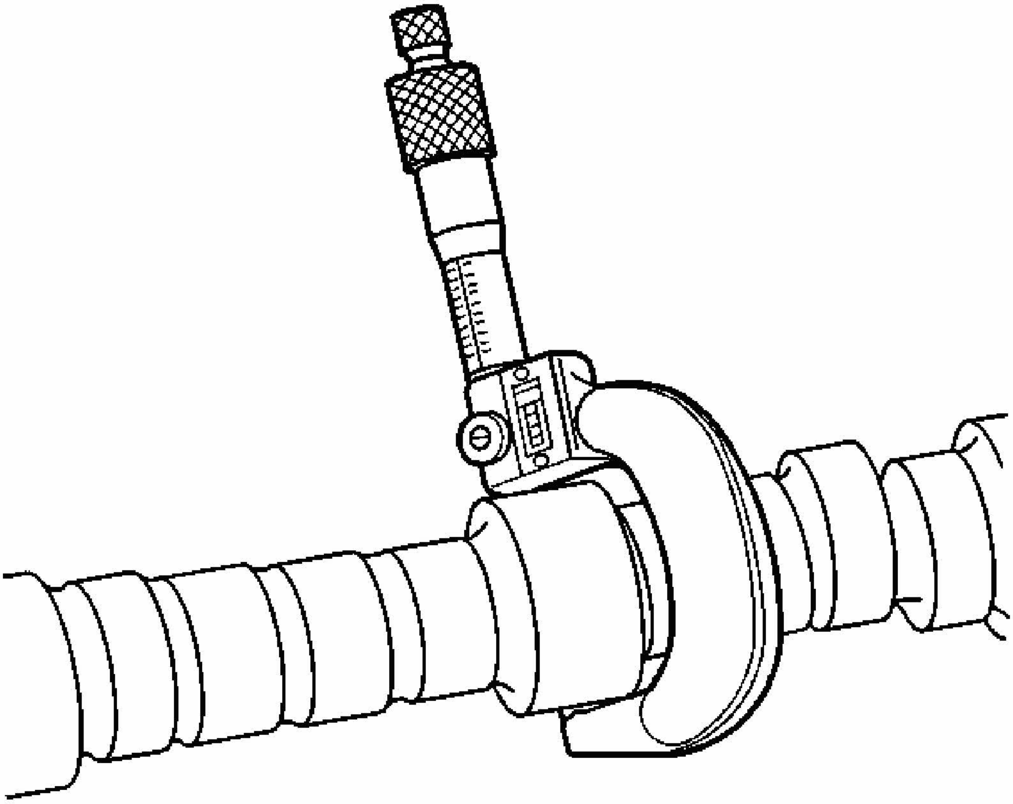


Fig. 479: Measure Camshaft Journals With Micrometer
Courtesy of GENERAL MOTORS CORP.

10. Measure the camshaft journals for wear and out-of-round with a micrometer.
    - If the camshaft bearing journals measure greater than 0.025 mm (0.001 in) out-of-round, replace the camshaft.
    - If the camshaft bearing journal diameter measures less than 54.99 mm (2.164 in), replace the camshaft.

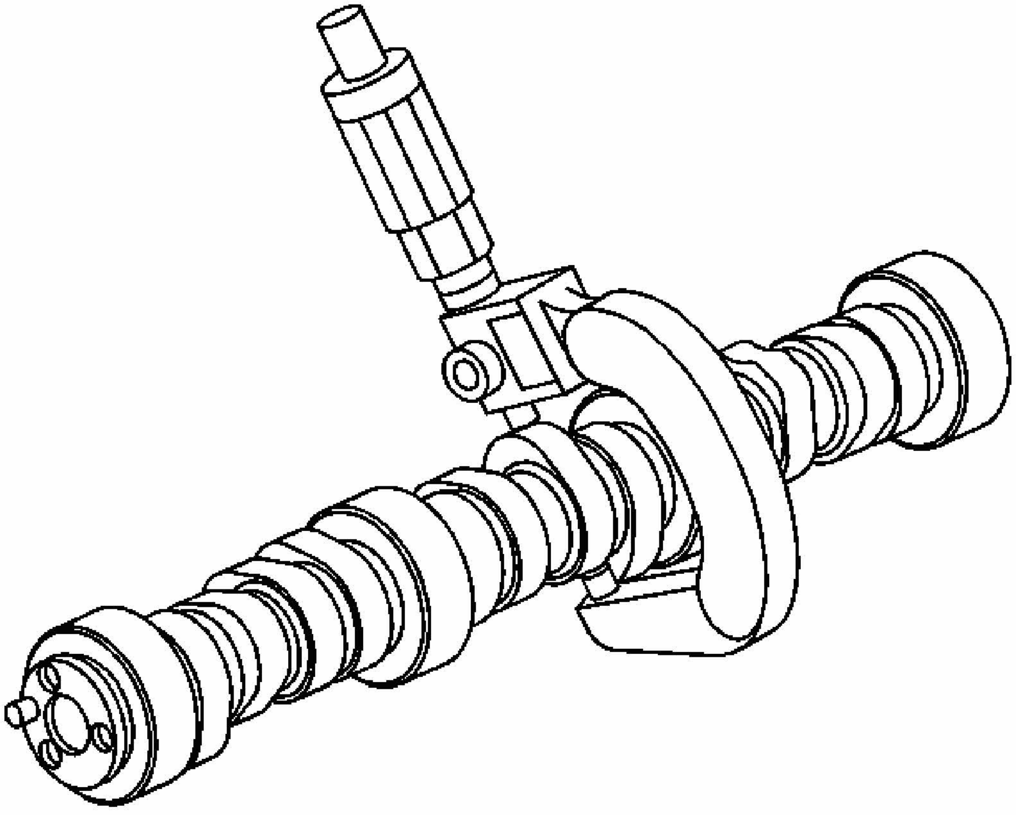


Fig. 480: Measuring Camshaft Lobes
Courtesy of GENERAL MOTORS CORP.

11. Using a micrometer, measure the camshaft lobes for wear. Refer to **Engine Mechanical Specifications**.

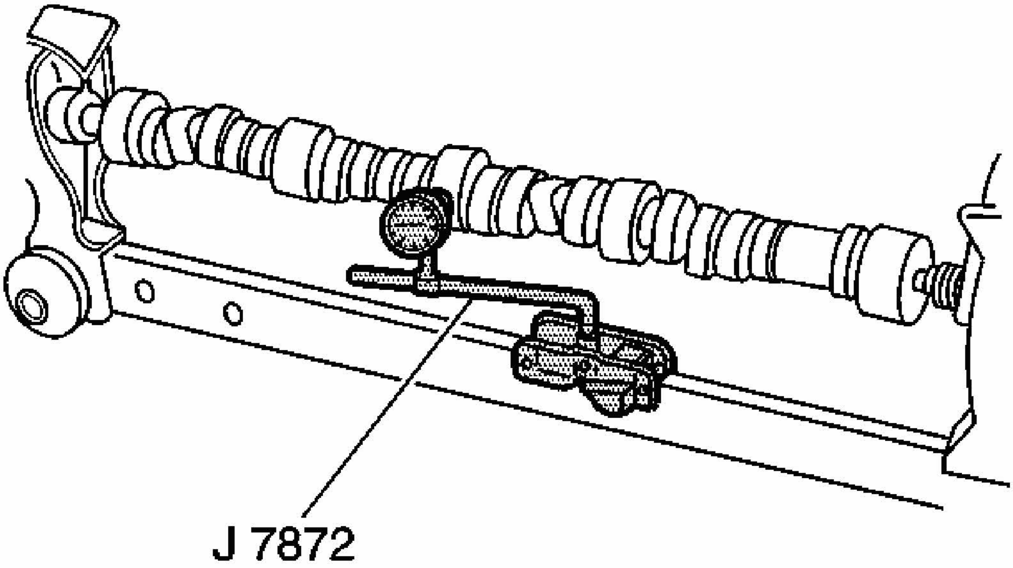


Fig. 481: Measuring Camshaft Runout
Courtesy of GENERAL MOTORS CORP.

12. Measure the camshaft runout.
    1. Mount the camshaft in wooden V-blocks or between centers on a fixture.
    2. Using the **J 7872** , measure the runout of the intermediate camshaft bearing journals.
    3. If camshaft runout exceeds 0.05 mm (0.002 in), the camshaft is bent and should be replaced.

Measuring Camshaft Lobe Lift

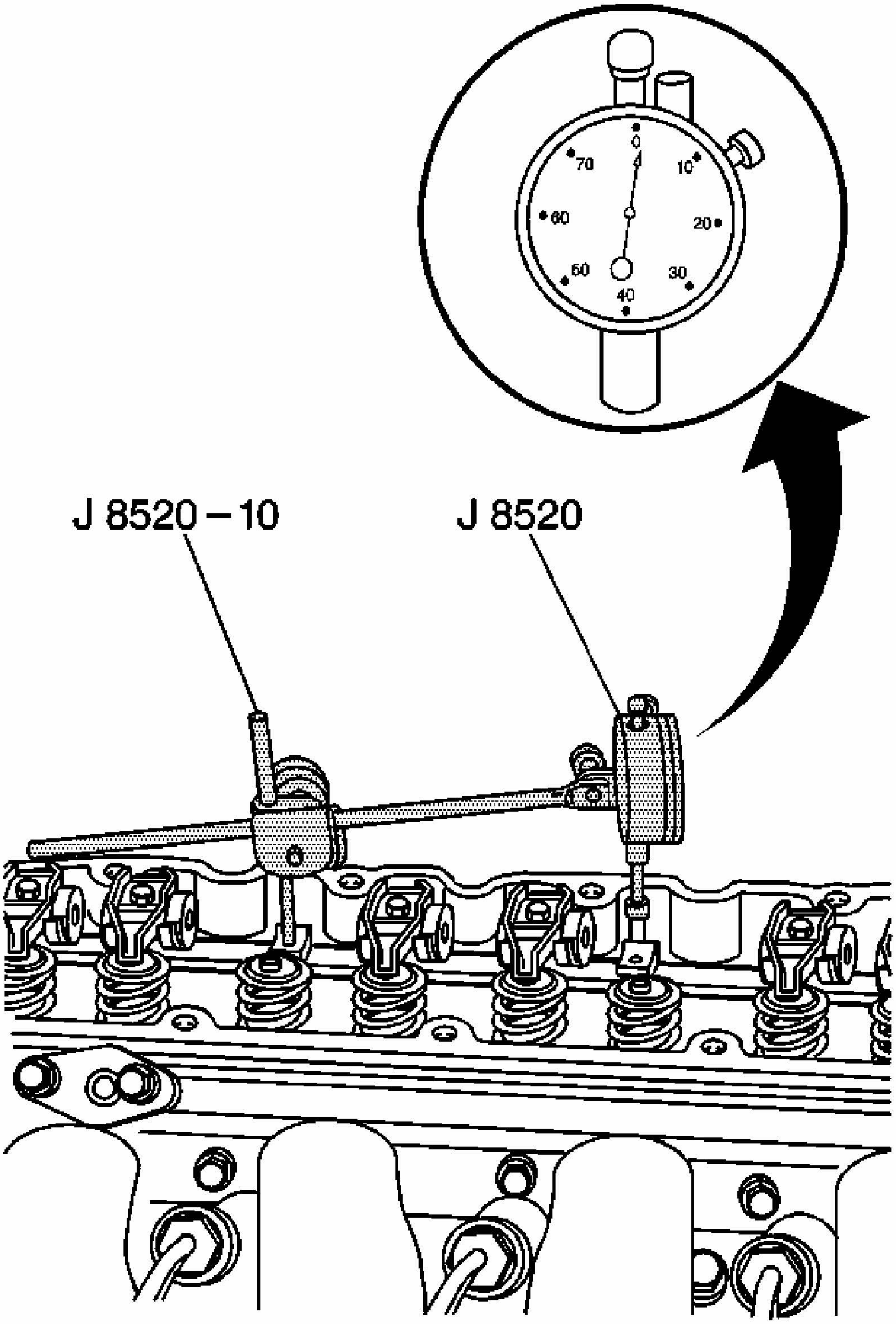

0
10
20
30
40
50
60
70
J 8520 – 10
J 8520

Fig. 482: Measuring Camshaft Lobe Lift
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Measuring camshaft lobe lift is a procedure used to determine if the camshaft lobes are worn. This test is to be performed prior to engine disassembly and with the camshaft and valve train components installed in the engine.

1. Measure camshaft lobe lift using **J 8520** .
2. Remove the valve rocker arms and bolts.
3. Install the dial indicator mounting stud into the valve rocker arm bolt hole.
4. Assemble the components of the **J 8520** and position onto the stud.
5. Position the shaft of the dial indicator onto the end of the pushrod.
6. Rotate the face of the dial indicator to zero.
7. Slowly rotate the crankshaft clockwise until the dial indicator obtains its highest and lowest readings.
8. Compare the total to specifications. Refer to **Engine Mechanical Specifications**.

CAMSHAFT BEARING INSTALLATION

Tools Required

J 33049 Camshaft Bearing Service Set

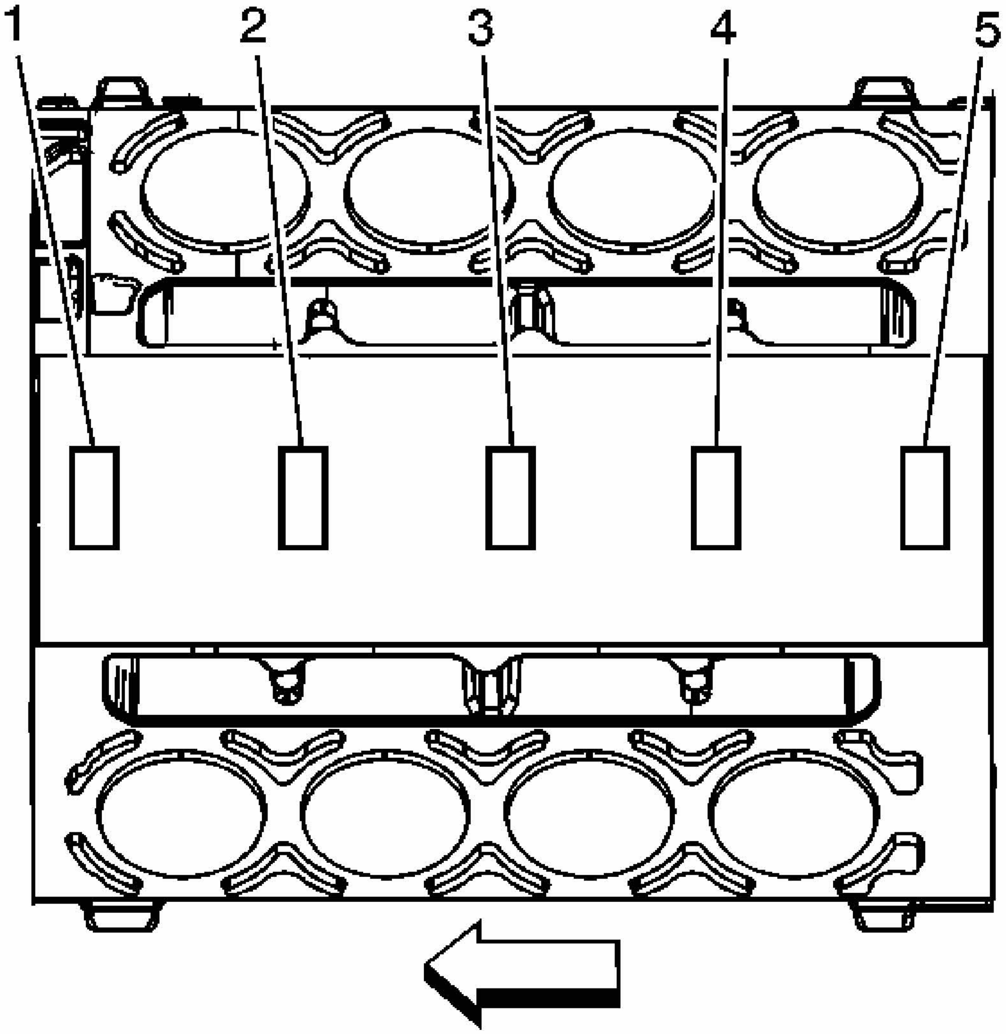


Fig. 483: Identifying Engine Block Camshaft Bearing Bores
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The engine block camshaft bearing bores are machined for 3 different outside diameter (OD) size bearings. Position 1 and 5 are the largest diameter bores. Position 3 is the smallest diameter bore. Position 2 and 4 are the intermediate size bores. The inside diameter (ID) for all camshaft bearings is the same size.

1. Measure the engine block camshaft bearing bores (1-5) in order to identify the correct OD size bearing for each position. Refer to **Engine Mechanical Specifications**.

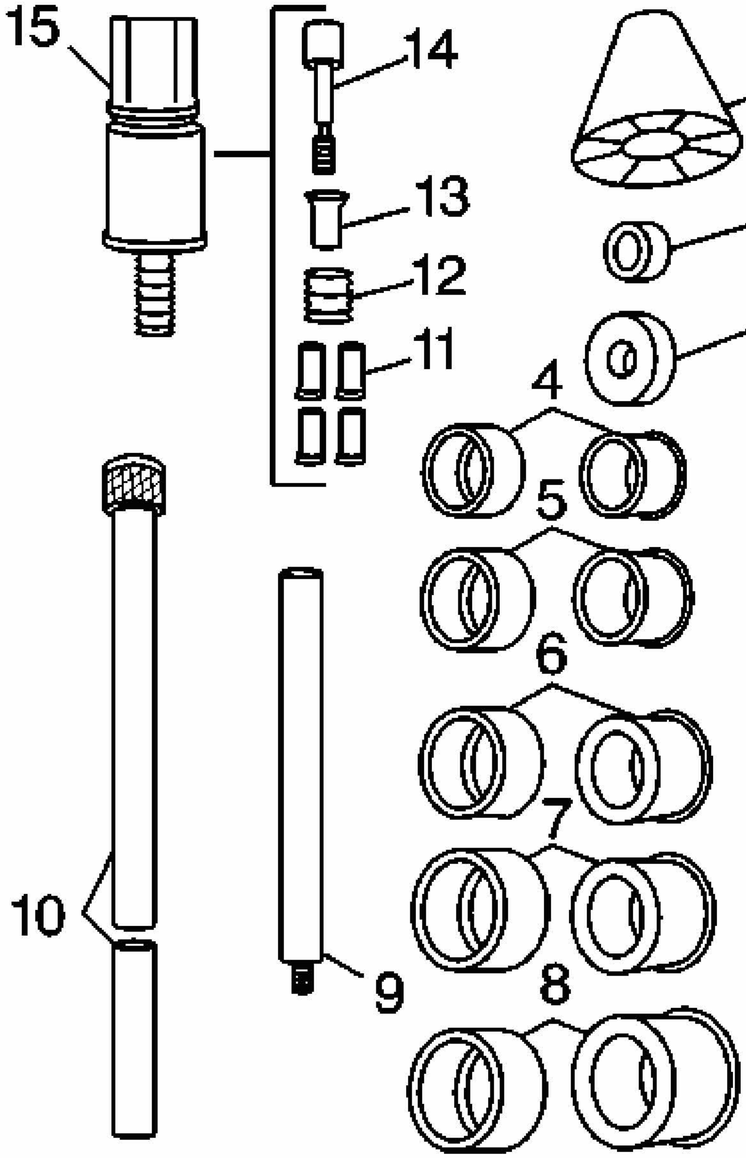


Fig. 484: View Of J 33049 Camshaft Bearing Service Kit Components
Courtesy of GENERAL MOTORS CORP.

2. Select the expanding driver (4-8) and washer (2 or 3) from the **J 33049** . Refer to **Piston and Connecting Rod Assemble**.
3. Assemble the tool.

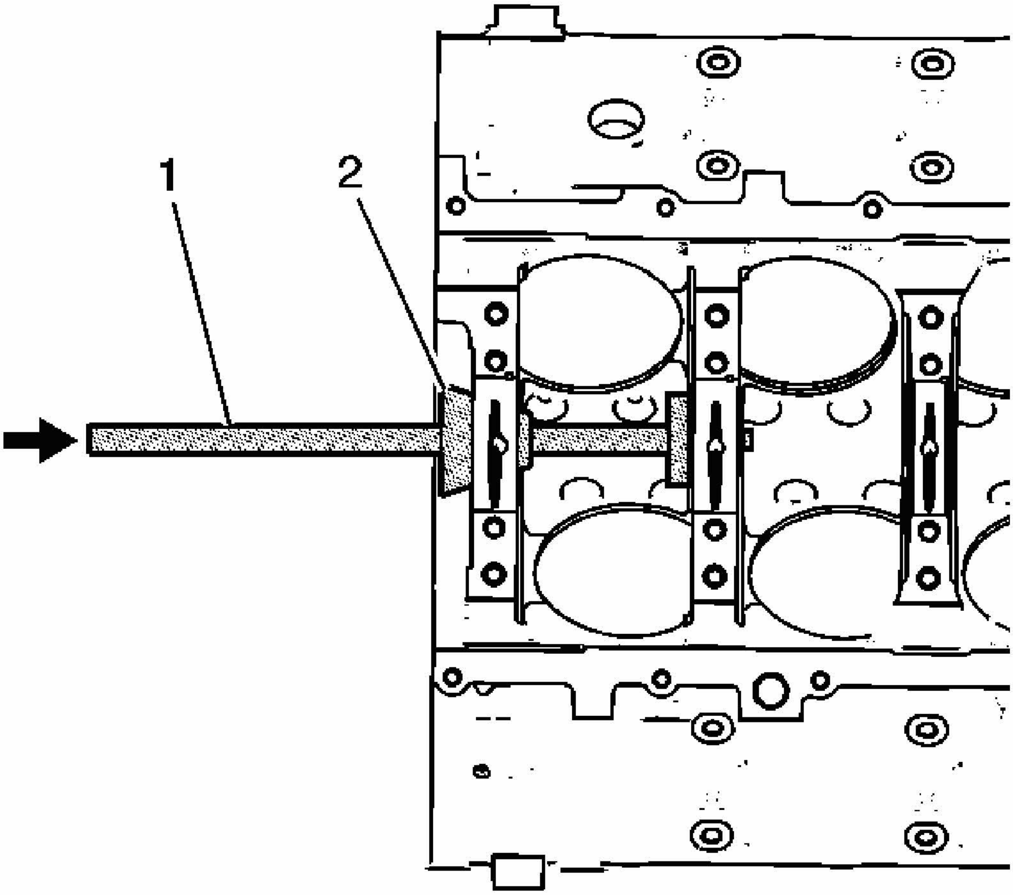


Fig. 485: Driving Bearing Out Of Or Into Engine Block
Courtesy of GENERAL MOTORS CORP.

4. Insert the tool through the front of the engine block and into the bearing.
5. Tighten the expander assembly nut until snug.
6. Push the cone (2) into the front camshaft bearing location in order to align the tool.
7. Drive the bearing into the block bore.

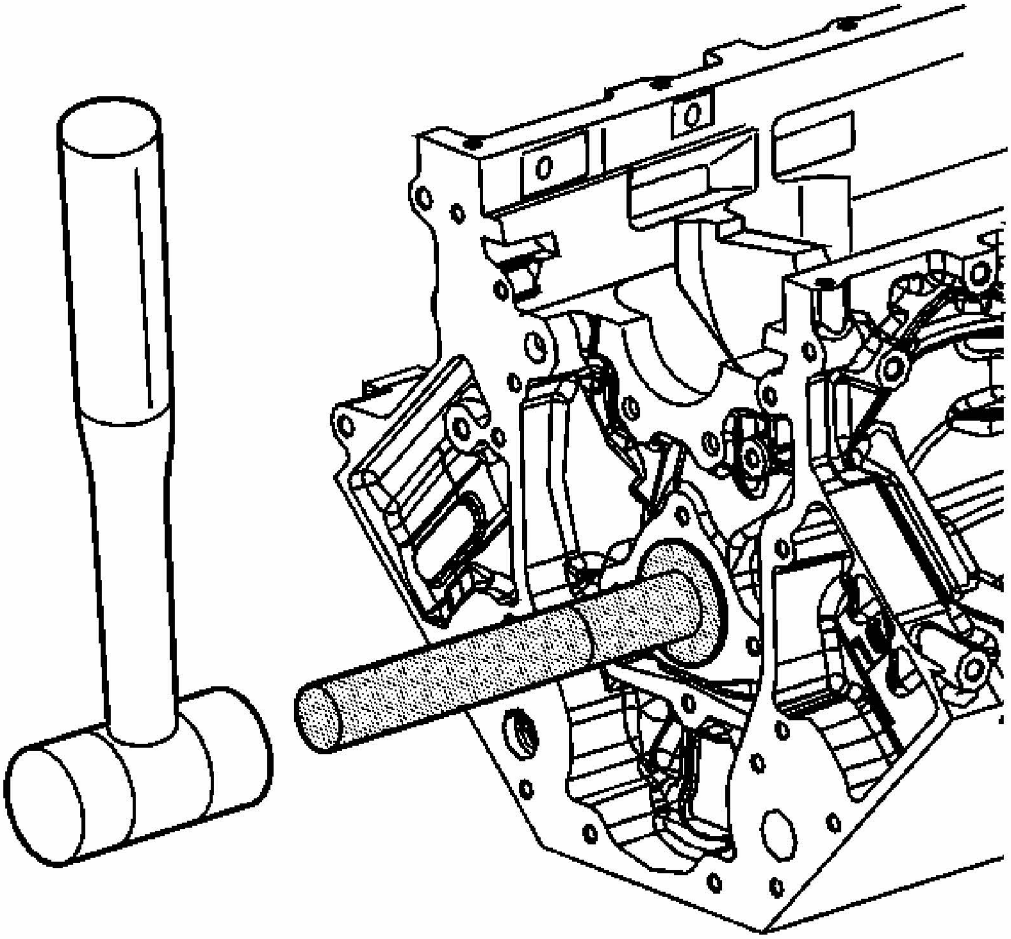


Fig. 486: Driving Bearing Out Of Or Into Engine Block
Courtesy of GENERAL MOTORS CORP.

8. Install the front and rear bearings to the block.

TIMING CHAIN AND SPROCKETS CLEANING AND INSPECTION

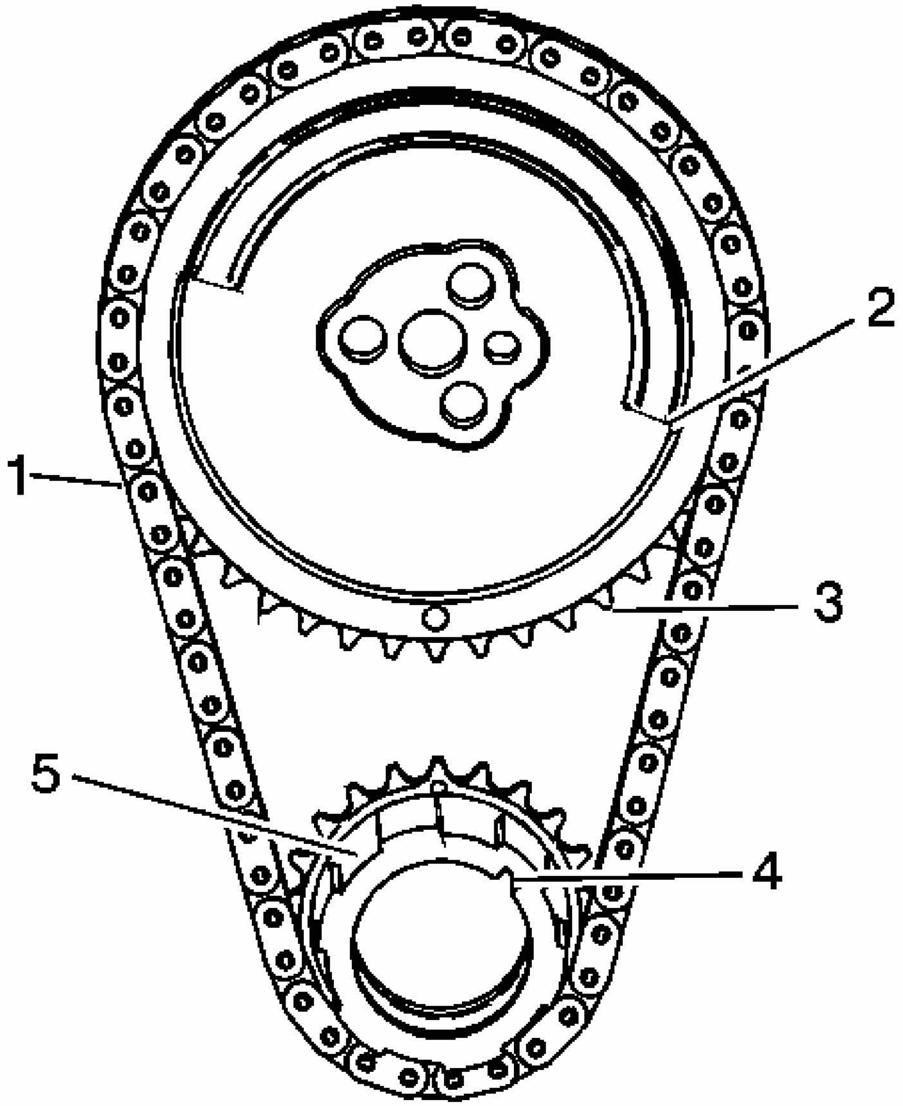


Fig. 487: Timing Chain & Sprockets Assembly
Courtesy of GENERAL MOTORS CORP.

1. Clean the components with cleaning solvent.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

2. Dry the components with compressed air.
3. Inspect the timing chain (1) for binding or wear.

4. Inspect the camshaft position (CMP) sensor raised area (2) for nicks or damage.
5. Inspect for worn, damaged, or chipped teeth (3).
6. Inspect for a damaged keyway (4).
7. Inspect for worn oil pump drive splines (5).

VALVE ROCKER ARM AND PUSH RODS CLEANING AND INSPECTION

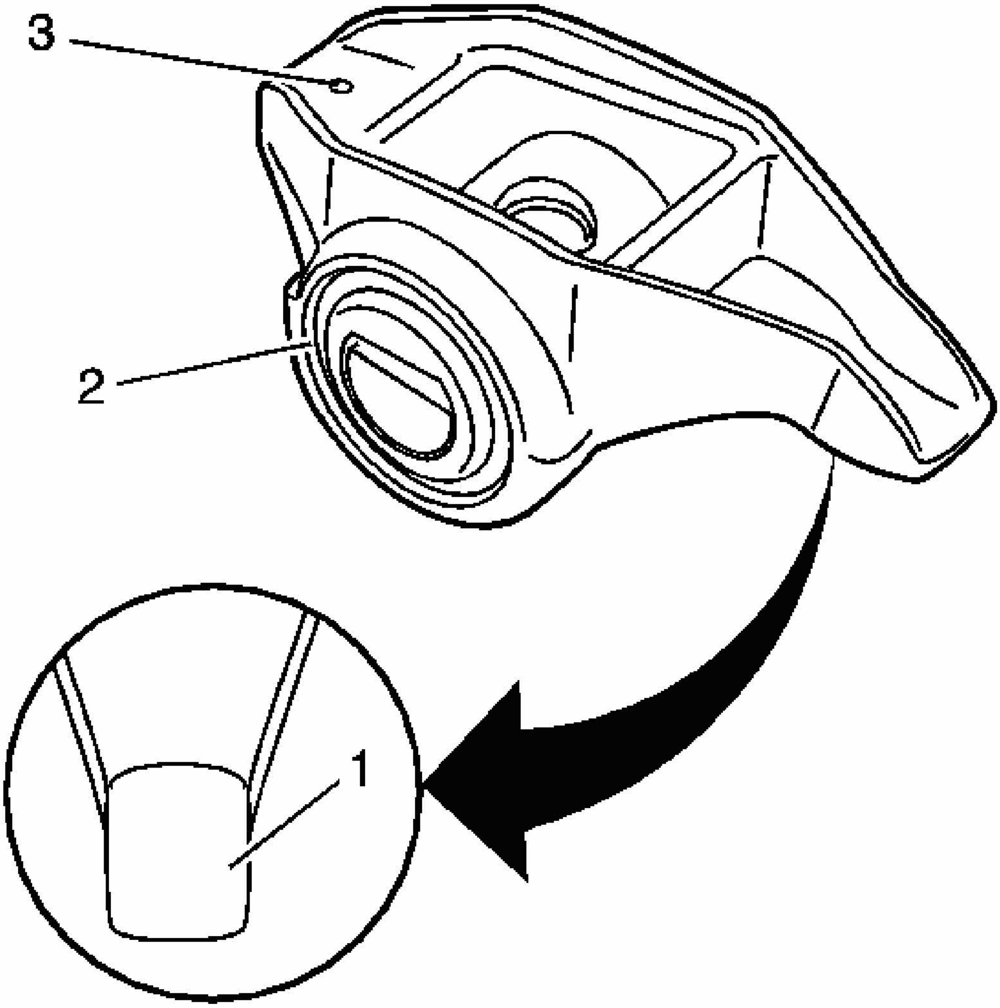


Fig. 488: Identifying Valve Rocker Arm Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Parts that are to be used again must be marked, sorted or organized for assembly.

1. Mark, sort, or organize the components for assembly. Refer to **Separating Parts**.
2. Clean the components with cleaning solvent.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

3. Dry the components with compressed air.
4. Inspect the valve rocker arms bearings (2) for binding or roughness.
5. Inspect the valve rocker arm pushrod sockets (3) and valve stem mating surfaces (1). These surfaces should be smooth with no scoring or exceptional wear.
6. Inspect the pushrods for worn or scored ends. These surfaces should be smooth with no scoring or exceptional wear.
7. Inspect the pushrods for bends. Roll the pushrod on a flat surface to determine if the pushrod is bent.
8. Inspect the pushrod oil passages for restrictions.
9. Inspect the rocker arm pivot supports for cracks, wear, or other damage.

VALVE LIFTERS AND GUIDES CLEANING AND INSPECTION

Non Displacement on Demand Valve Lifters

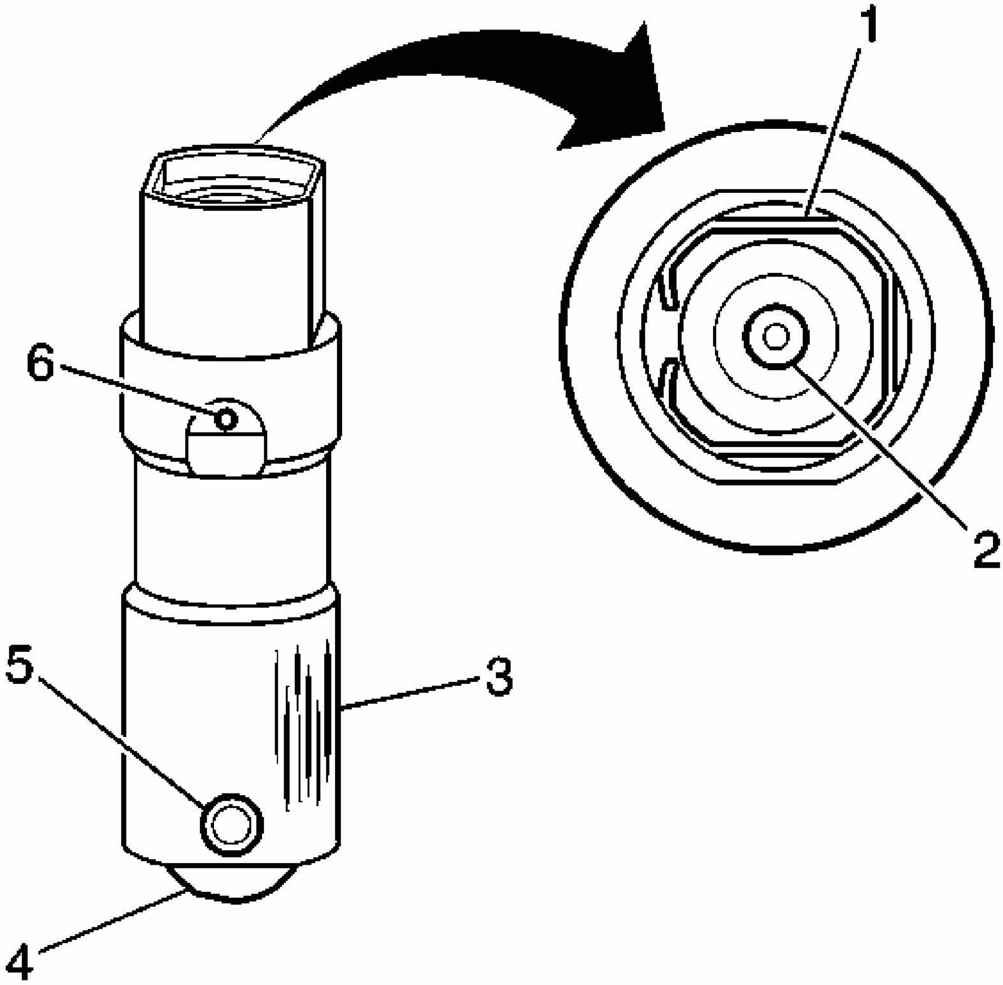


Fig. 489: Inspecting Areas Of Valve Lifters
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Components that are to be used again must be marked, sorted or organized for assembly.

1. Clean the components in cleaning solvent.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

2. Dry the components with compressed air.
3. Inspect the valve lifters for the following conditions:

- Bent or broken clip (1)
- Worn pushrod socket (2)
- Scuffed or worn sides (3)

  If the valve lifter shows wear, inspect the engine block lifter bores for wear or damage.

- Flat spots on the roller (4)
- Loose or damaged pin (5)
- Plugged oil hole (6)
- Worn or damaged roller bearing

  The roller should rotate freely with no binding or roughness.

Displacement on Demand Valve Lifters

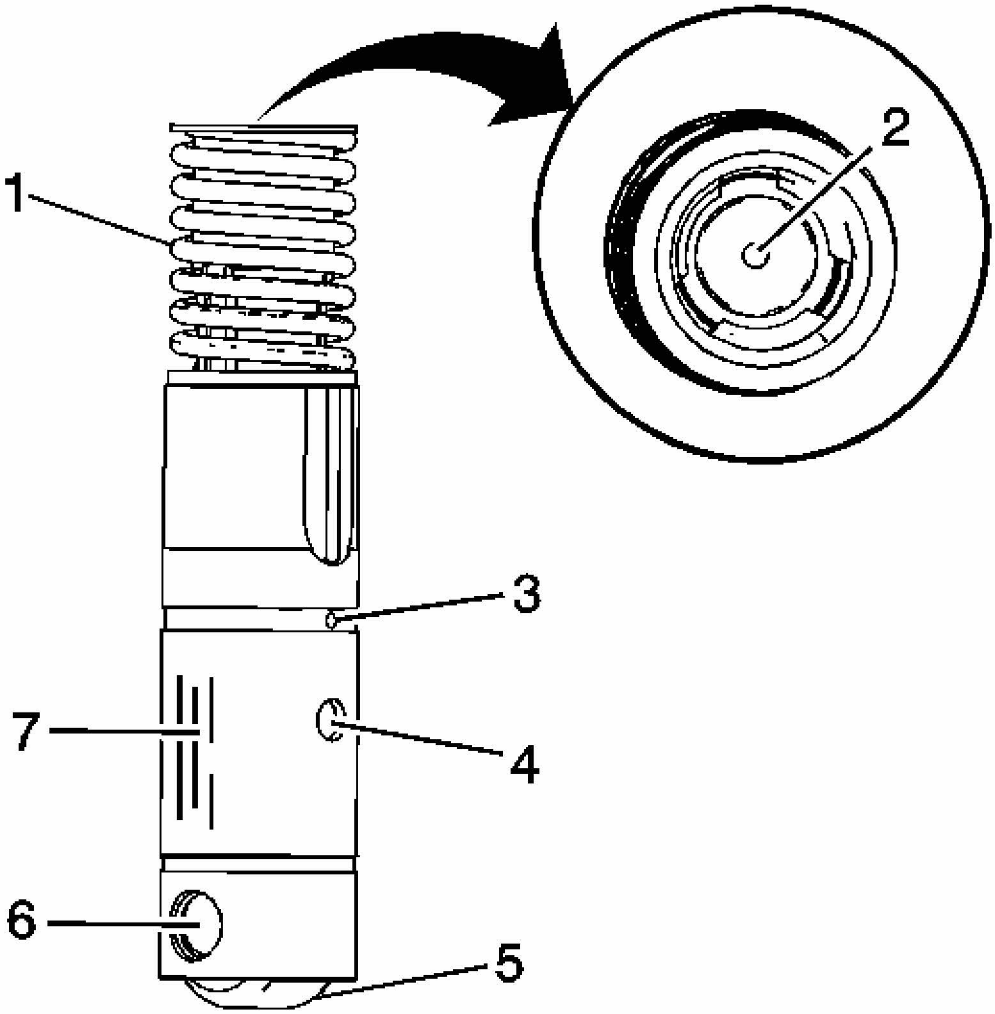


Fig. 490: Displacement On Demand Valve Lifters Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Components that are to be used again must be marked, sorted or organized for assembly.

1. Clean the components in cleaning solvent.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

2. Dry the components with compressed air.

3. Inspect the valve lifters for the following conditions:
    - Broken or collapsed spring (1)
    - Worn pushrod socket (2)
    - Plugged lubrication hole (3)
    - Plugged lifter oil-switching hole (4)
    - Flat spots on the roller (5)
    - Worn or damaged roller bearing (6)

      The roller should rotate freely with no binding or roughness.

    - Scuffed or worn sides (7)

Valve Guides

Inspect the valve lifter guides for the following conditions:

- Cracks or damage
- Excessive wear in the lifter mounting bores

CYLINDER HEAD DISASSEMBLE

Tools Required

J 8062 Valve Spring Compressor - Head Off. See **Special Tools**.

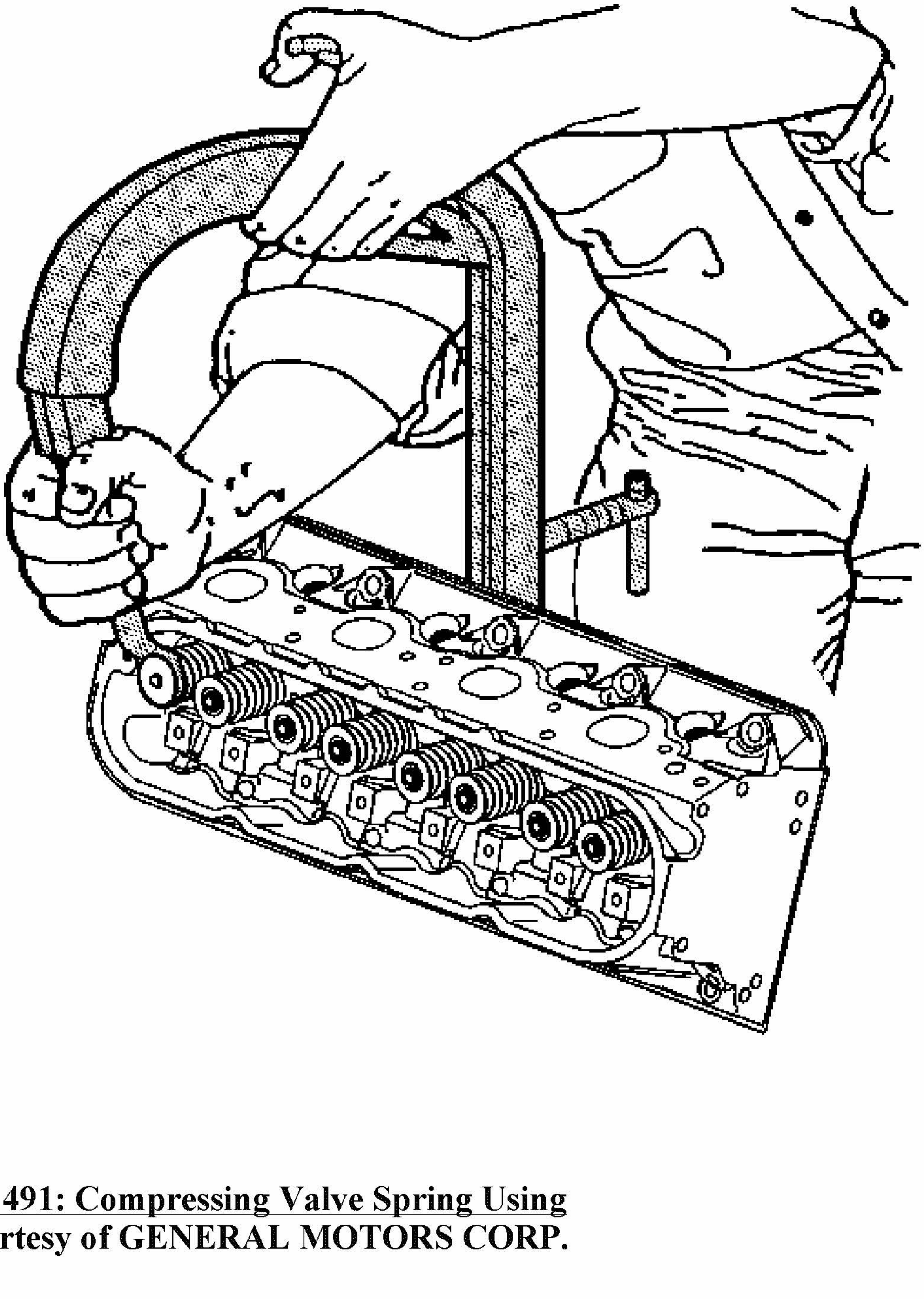


Fig. 491: Compressing Valve Spring Using
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **With the components at room temperature, remove the spark plugs from the cylinder head.**
- **Mark, organize, or sort the cylinder head components for assembly. Return the components to their original location during assembly.**

1. Remove the spark plugs from the cylinder heads.
2. Use the **J 8062** in order to compress the valve spring. See **Special Tools**.

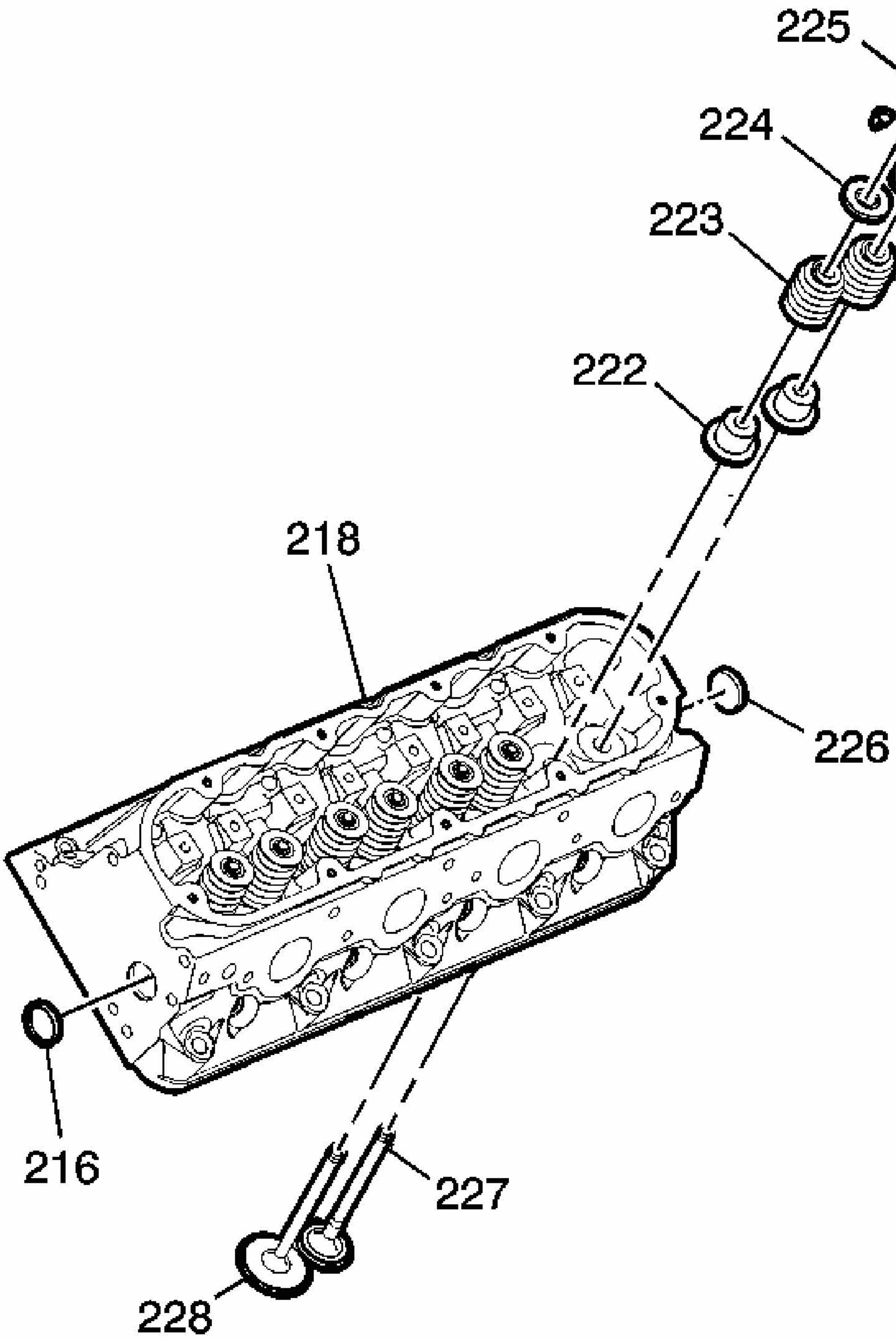

225
224
223
222
218
226
216
227
228

Fig. 492: View Of Cylinder Head Components
Courtesy of GENERAL MOTORS CORP.

3. Remove the valve stem keys (225).
4. Remove the valve spring cap (224).
5. Remove the valve spring (223).
6. Remove the valves (227 and 228).
7. Remove the valve stem oil seal (222). Refer to **Separating Parts**.

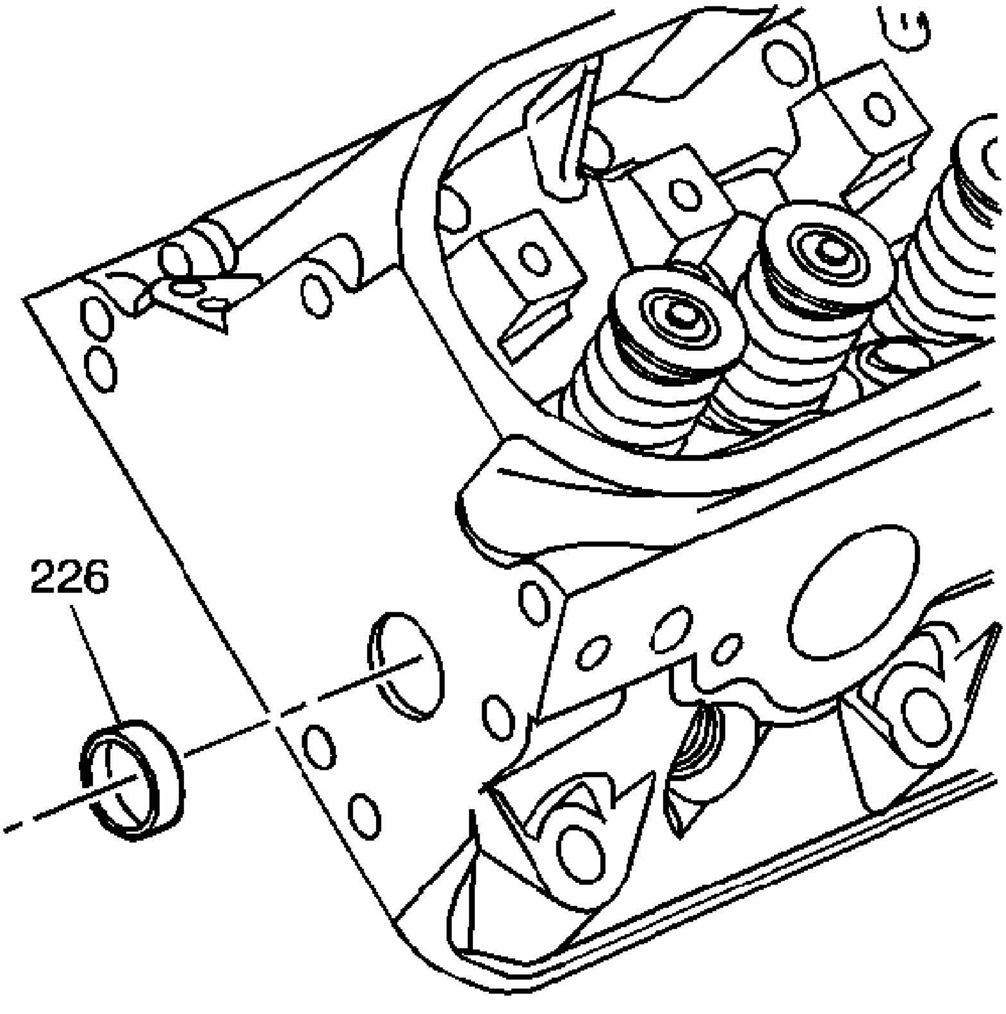


Fig. 493: View Of Cylinder Head Expansion Plugs
Courtesy of GENERAL MOTORS CORP.

8. Remove the cylinder head core hole plugs (226) as required.

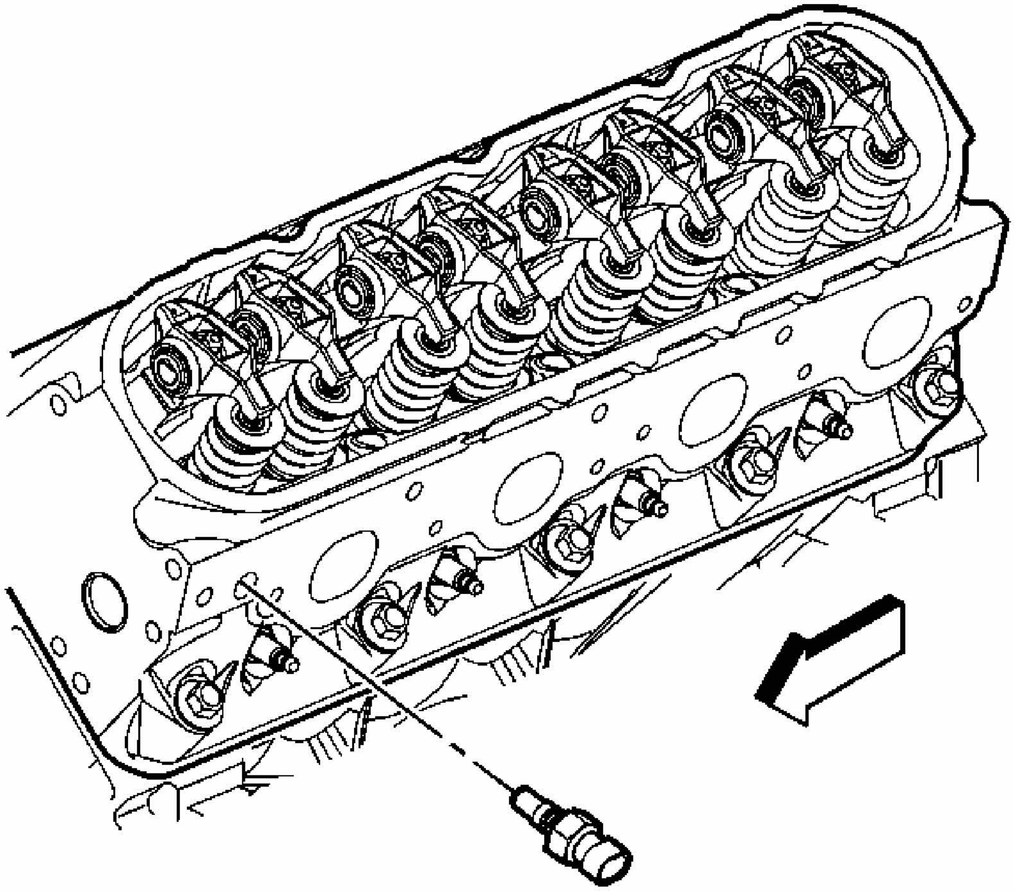


Fig. 494: View Of Coolant Temperature Sensor (Left Cylinder Head)
Courtesy of GENERAL MOTORS CORP.

9. Remove the coolant temperature sensor from the left cylinder head.

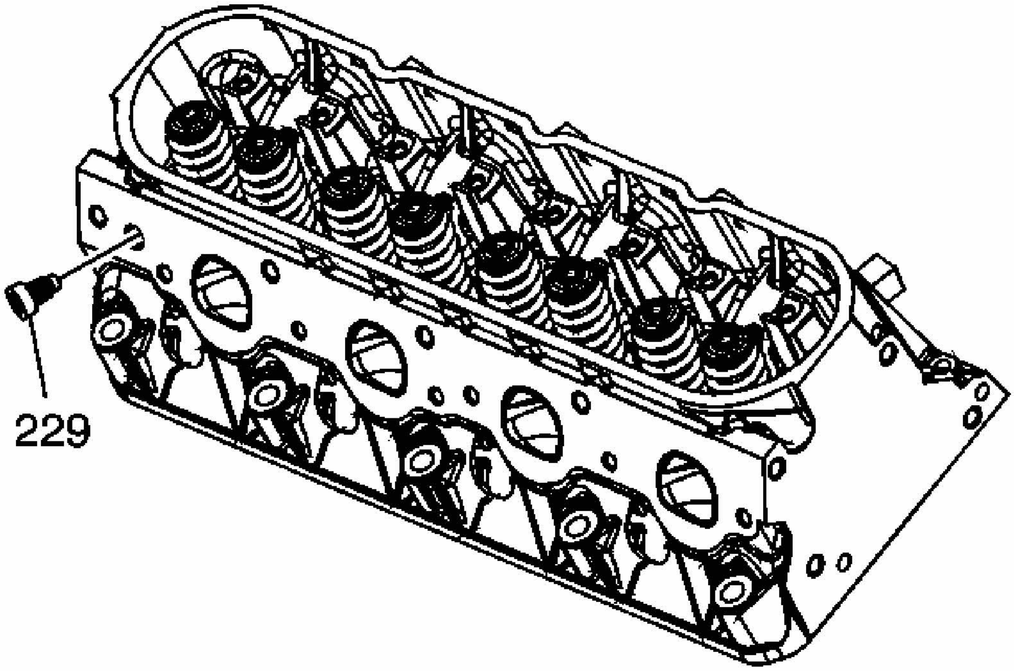


Fig. 495: Identifying Right Cylinder Head Coolant Plug
Courtesy of GENERAL MOTORS CORP.

10. Remove the coolant plug (229) from the right cylinder head.

CYLINDER HEAD CLEANING AND INSPECTION

Tools Required

- **J 8089** Carbon Removal Brush
- **J 9666** Valve Spring Tester

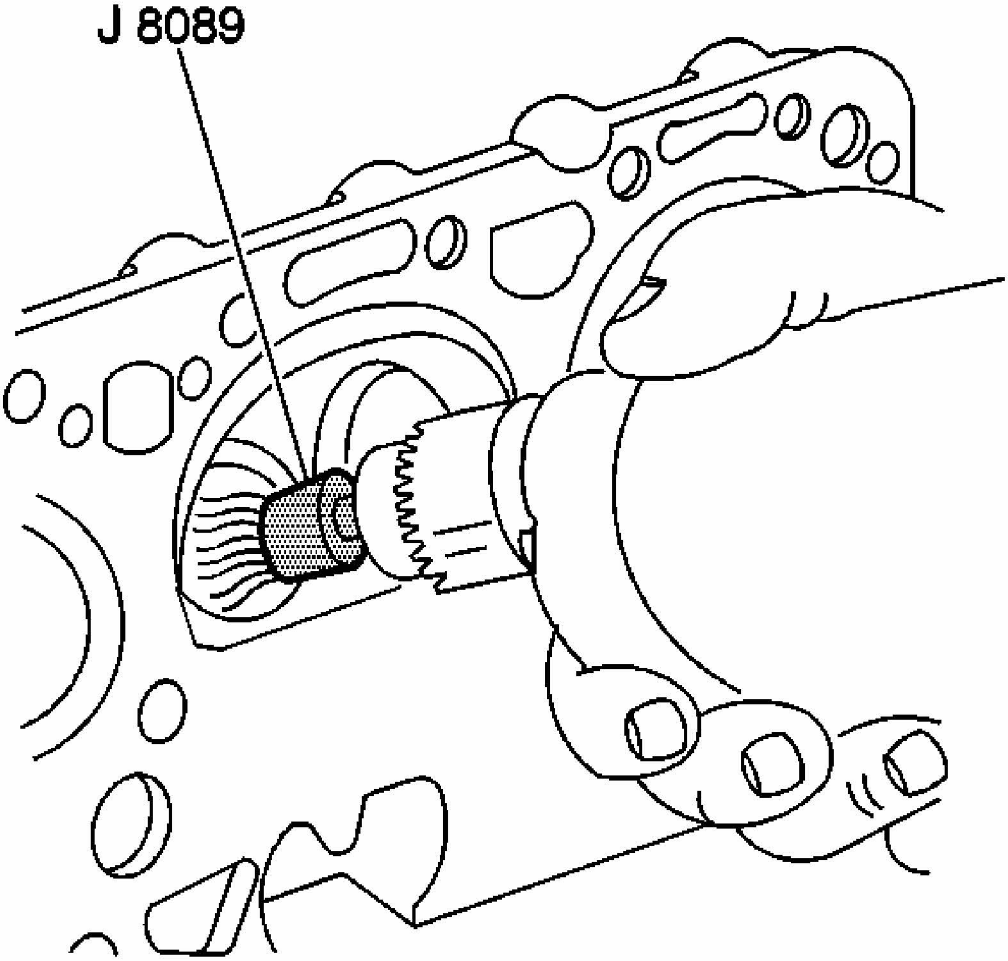


Fig. 496: Removing Carbon From Combustion Chambers
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

IMPORTANT:

- **When cleaning a cylinder head in a thermal type oven, do not exceed 204°C (400°F).**
- **Be careful not to scuff the chamber.**

1. Clean the following components:
    - Use the **J 8089** in order to remove the carbon from the combustion chambers.
    - Gasket surfaces

Refer to **Replacing Engine Gaskets** .

- Valve stems and heads on a buffing wheel
- Bolt hole threads

  Remove all dirt, debris, or threadlocking material from the bolt holes.

2. Inspect the cylinder head for the following conditions:
   1. Cracks in the exhaust ports and combustion chambers
   2. External cracks in the water chambers
   3. Gasket surfaces for excessive scratches or gouging

      Refer to **Replacing Engine Gaskets** .

   4. Bolt hole threads for debris or damaged threads

      Refer to **Thread Repair** or **Thread Repair Specifications** .

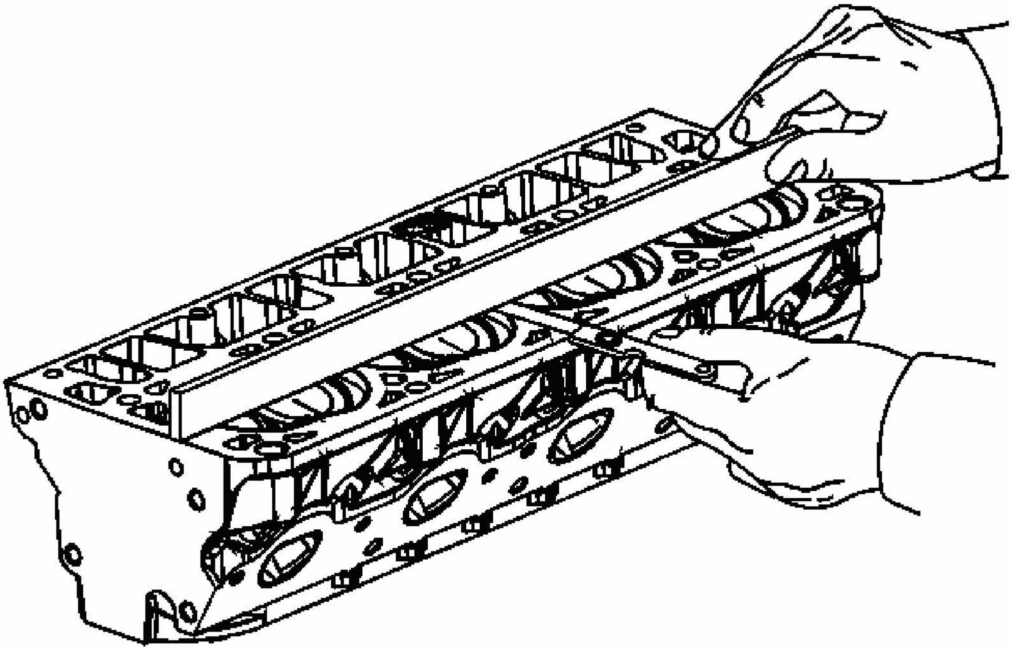


Fig. 497: Inspecting The Cylinder Head For Warpage
Courtesy of GENERAL MOTORS CORP.

3. Inspect the cylinder head for warpage. Refer to **Engine Mechanical Specifications**.

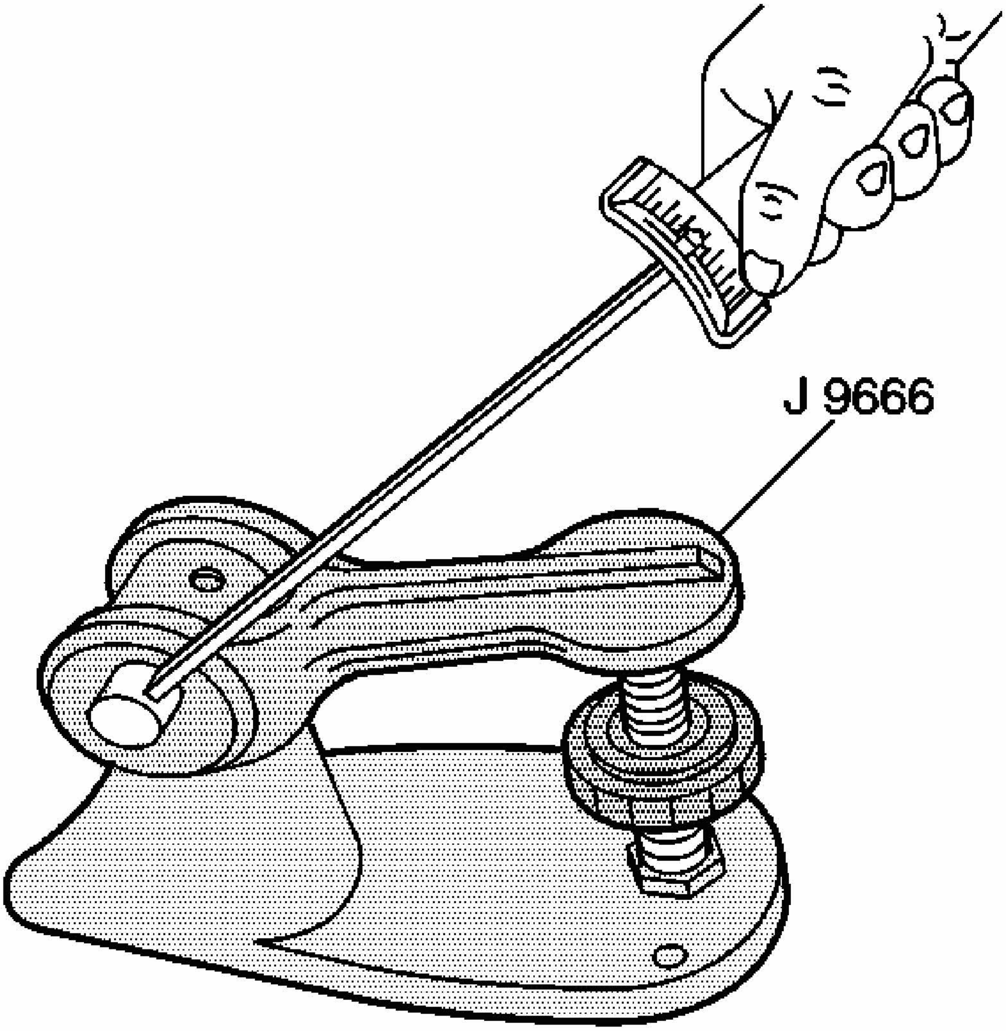


Fig. 498: Measuring Valve Spring Tension
Courtesy of GENERAL MOTORS CORP.

4. Use the **J 9666** in order to measure the valve spring tension. Refer to **Engine Mechanical Specifications**.

VALVE GUIDE REAMING/VALVE AND SEAT GRINDING

Tools Required

J 37378-1 Valve Guide Reamer. See **Special Tools**.

Valve Guide Reaming

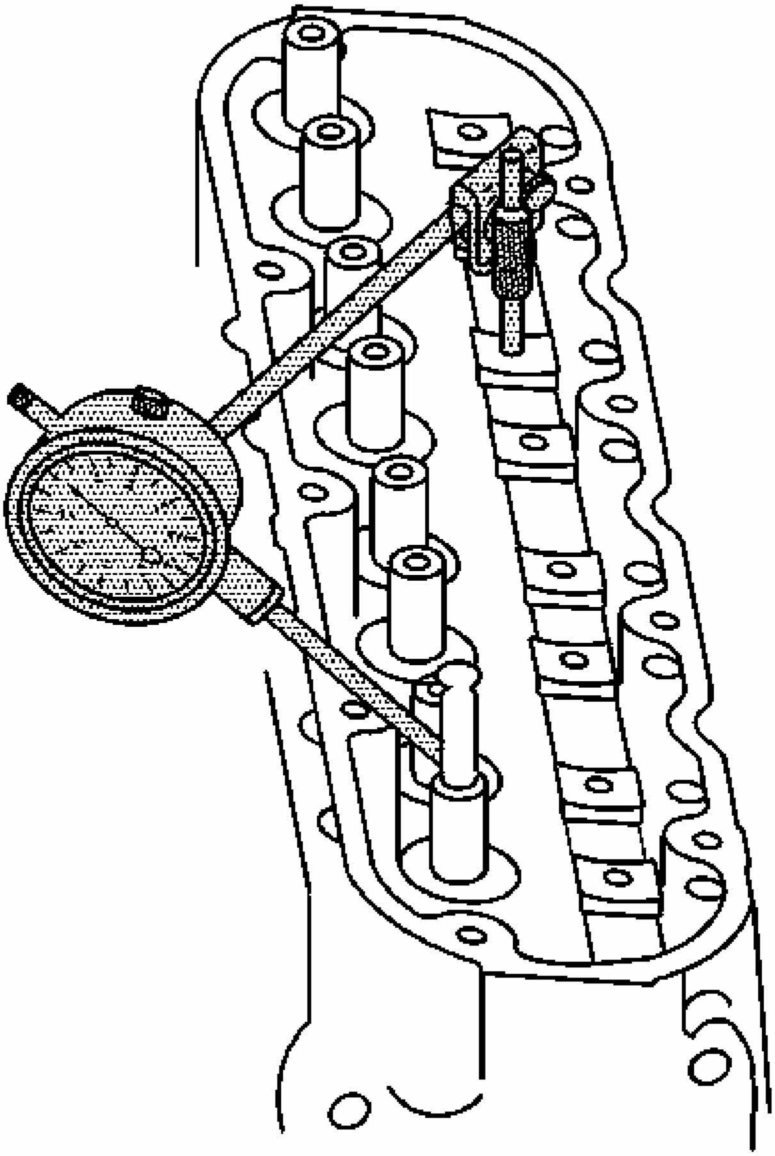


Fig. 499: Measuring Valve Stem-To-Guide Clearance
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Excessive valve stem-to-guide clearance may cause a noisy valve train, premature valve stem oil seal wear, component damage, and/or excessive engine oil consumption.**
- **Insufficient valve stem-to-guide clearance will result in**

noisy or sticking valves. Valves that are too tight may disturb engine smoothness or lead to component damage.

1. Measure the valve stem-to-guide clearance using a dial indicator. Position the tip of the dial indicator at the top of the valve guide.

   Valve stem-to-guide clearance may also be obtained by using a micrometer to measure the valve stem diameter and a ball type measuring gage to measure the guide bore.

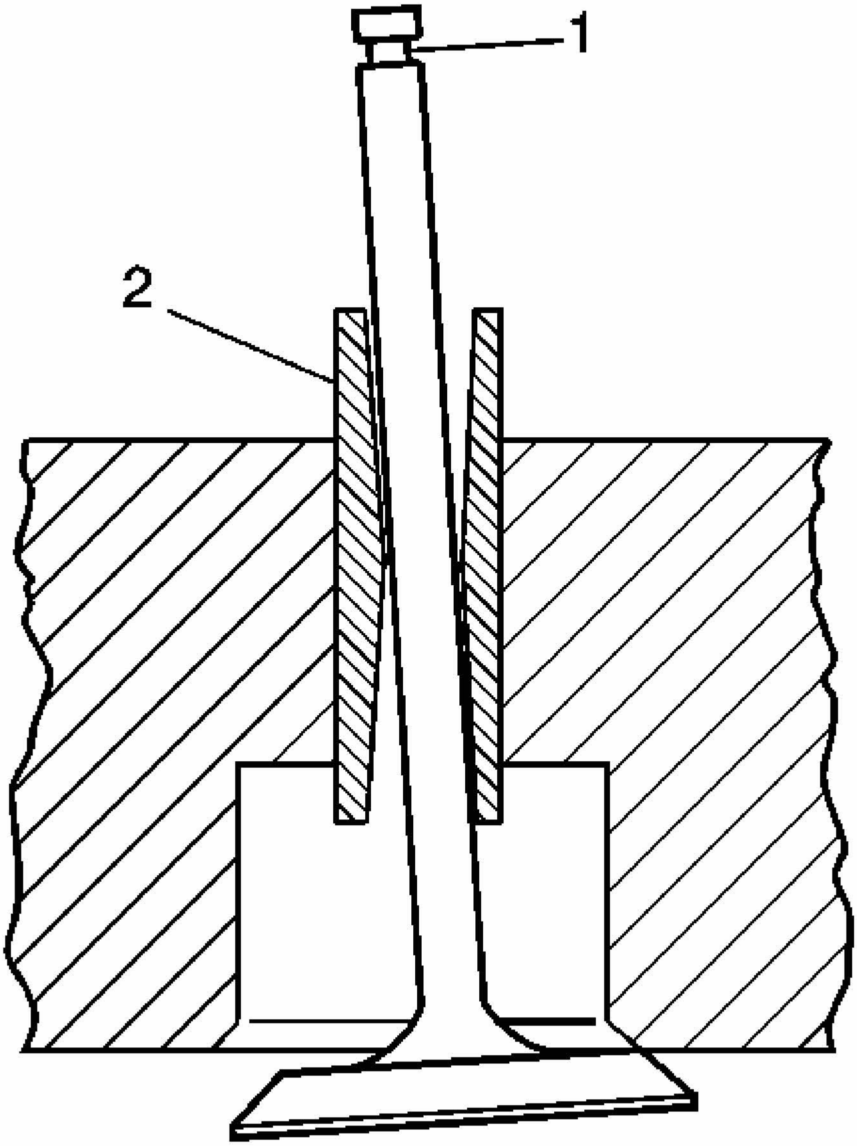


Fig. 500: Inspecting For Excessive Valve Stem To Guide Clearance
Courtesy of GENERAL MOTORS CORP.

2. A valve stem (1) and guide (2) with excessive clearance must be replaced or the components replaced. Refer to **Engine Mechanical Specifications**.

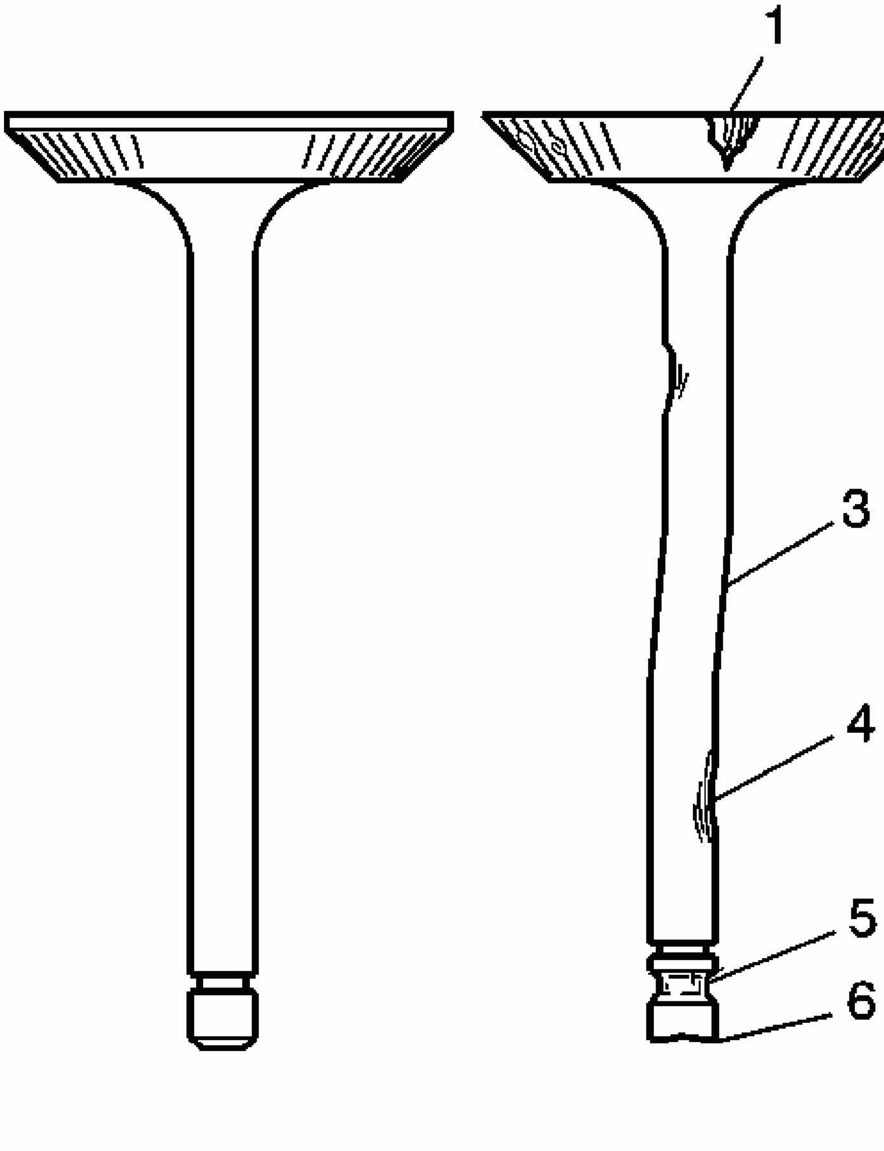


Fig. 501: Identifying Inspection Points For Valves Damage
Courtesy of GENERAL MOTORS CORP.

3. Inspect the valve stems for excessive scoring, wear, or warpage.
   - A valve stem that has excessive scoring (3 or 4) or wear (4 or 6) must be replaced.
   - A valve guide that is worn and has excessive stem-to-guide clearance should be

reamed and valves with oversize stems installed.

4. Measure the valve stem diameter. A valve stem with a diameter less than 7.95 mm (0.313 in) must be replaced.

   If the valve stem diameter is within specifications, and the stem-to-guide clearance is excessive, the cylinder head must be replaced.

Valve and Seat Grinding

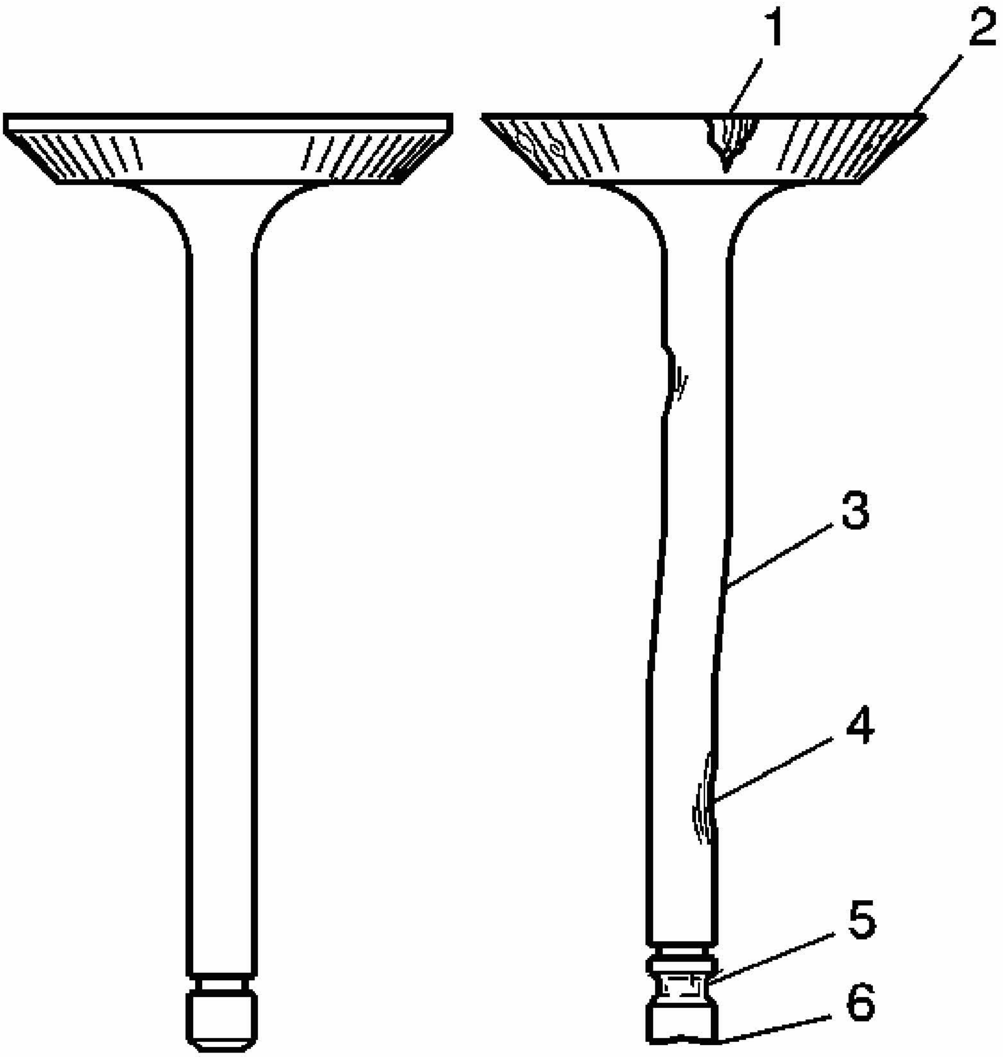


Fig. 502: Identifying Inspection Points For Valves Damage
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Reconditioning the valve seats is very important. The seating of the valves must be perfect for the engine to deliver optimum power and performance. Several different types of equipment are available for grinding valve seats.**
- **Another important factor is the cooling of the valve head. Good contact between the valve and the seat will ensure that heat will be properly dissipated.**
- **The recommendations of the manufacturer of the equipment should be followed carefully to obtain the proper results. Regardless of what type of equipment is used, it is essential that valve guide bores be free from carbon or dirt to ensure proper centering of the tool pilot in the guide.**
- **Valves that are pitted must be refaced to the proper angle. Valve stems that show excessive wear, or valves that are warped excessively must be replaced. When a valve head that is warped excessively is refaced, a knife edge may be ground on part or all of the valve head due to the amount of metal that must be removed. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1.25 mm (0.05 in) after grinding, replace the valve.**
- **Several different types of equipment are available for refacing valves. The recommendation of the manufacturer of the equipment should be carefully followed to obtain the proper results.**
- **DO NOT reface intake valves. Intake valves with excessive wear or damage MUST be replaced.**

1. Inspect the valve for the following conditions:
   - Burnt or eroded areas (1)
   - A worn margin (2)
   - A bent stem (3)
   - A worn or scored stem (4)
   - A worn key groove (5)
   - A worn stem tip (6)

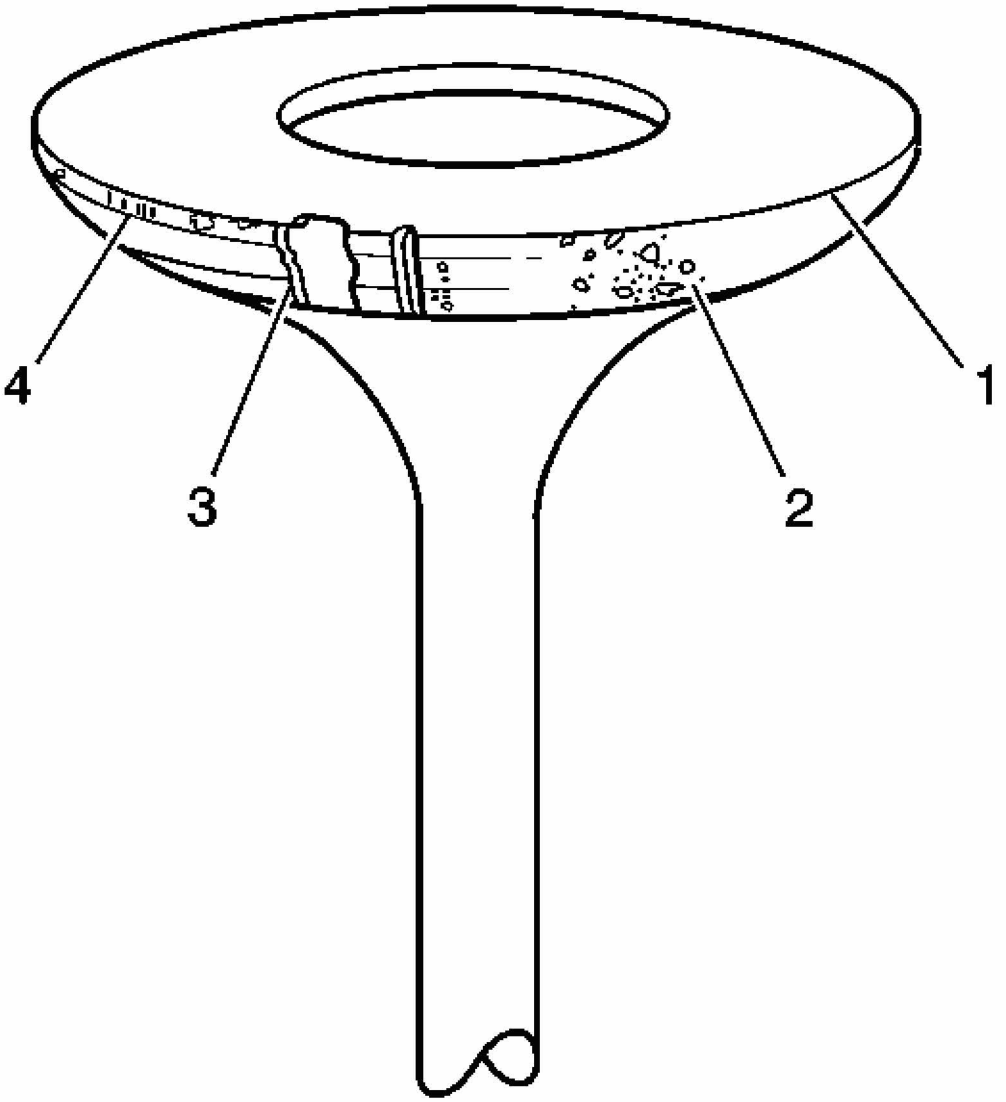


Fig. 503: Inspecting Valve Face For Burning, Pitting & Cracking
Courtesy of GENERAL MOTORS CORP.

2. Inspect the valve face for the following conditions:
    - Worn or no margin (1 or 4)
    - Pitted surfaces (2)
    - Burnt or eroded areas (3)

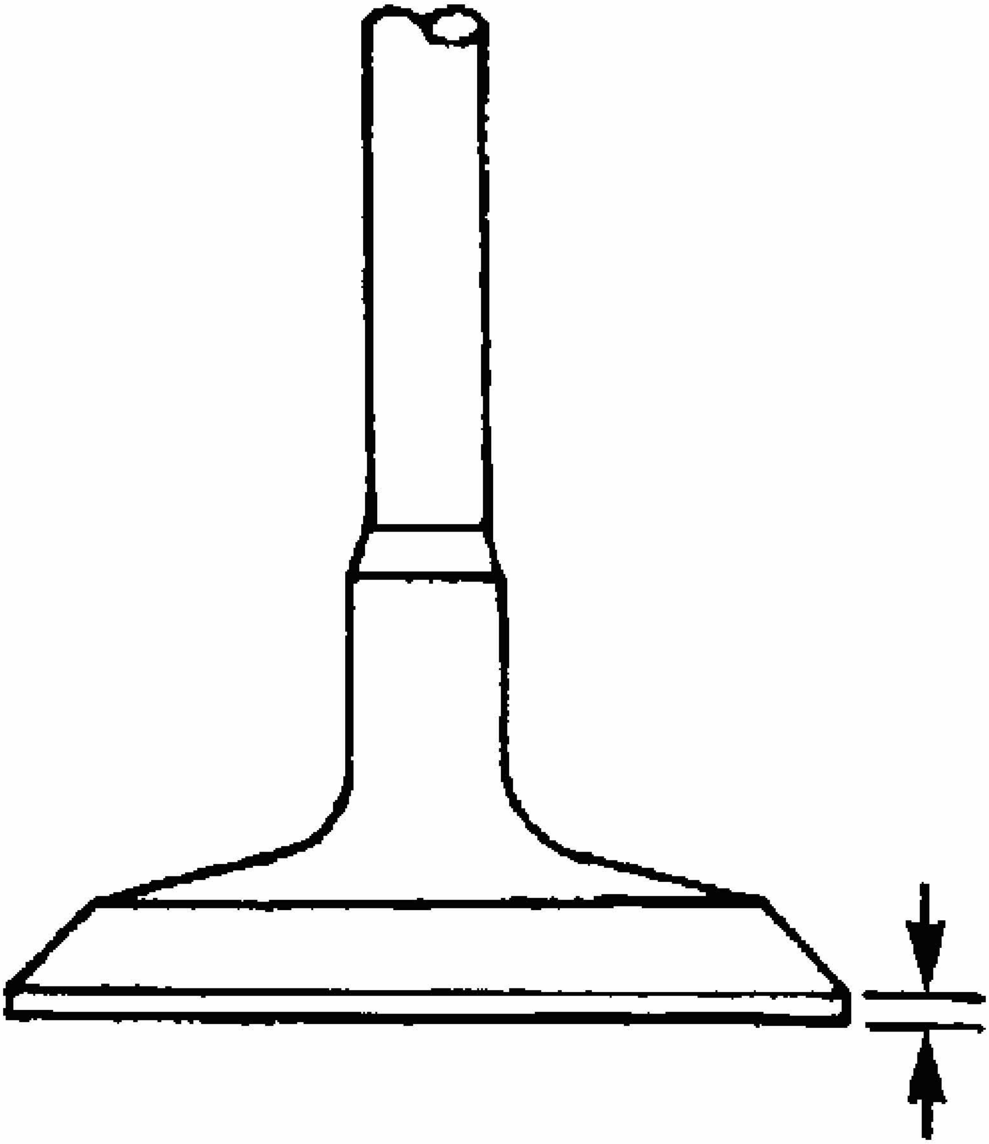


Fig. 504: Inspecting Valve Margin
Courtesy of GENERAL MOTORS CORP.

3. Inspect the valve margin.

   The exhaust valve may be refaced if the margin is greater than 1.25 mm (0.05 in) thick before grinding.

4. Reface pitted exhaust valves on a suitable valve refacing machine.

5. Replace the valve if the margin is less than 1.25 mm (0.05 in) thick after grinding.
6. If the valve face has been ground, it may be necessary to shim the valve spring to obtain the proper spring installed height. Refer to **Cylinder Head Disassemble**.
7. Inspect for a loose valve seat in the cylinder head. The valve seat has an interference fit to the cylinder head.
8. Clean the valve guide bores with a suitable tool. Remove all carbon or dirt from the bores.

   The valve guide must be clean for the seat grinding tool to obtain proper results.

9. Grind the valve seat.

   The recommendations of the manufacturer of the equipment should be followed carefully to obtain the proper results. Regardless of what type of equipment is used, it is essential that valve guide bores be free from carbon or dirt to ensure proper centering of the tool pilot in the guide.

10. Inspect the valve seats.
    - The valve seats should be concentric to within 0.05 mm (0.0021 in) total indicator reading.
    - If the valve seat has been ground, it may be necessary to shim the valve spring to attain the proper spring installed height. Refer to **Cylinder Head Disassemble**.

CYLINDER HEAD ASSEMBLE

Tools Required

J 8062 Valve Spring Compressor - Head Off. See **Special Tools**.

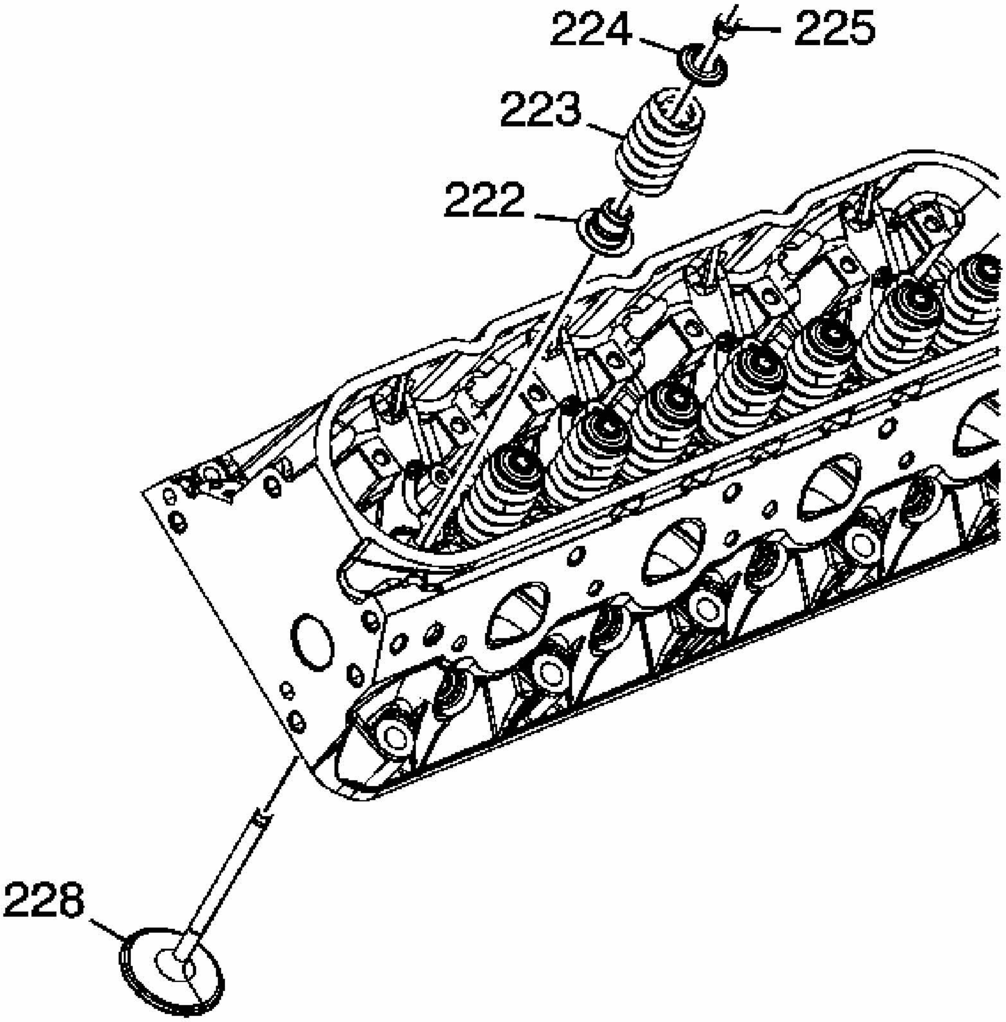


Fig. 505: Valve & Related Components
Courtesy of GENERAL MOTORS CORP.

1. Clean the cylinder head valve spring shim area.

IMPORTANT: When using the valves and related components again, install the parts to their original location.

2. Install the valves (228) into the proper location. Refer to Separating Parts.

IMPORTANT: The valve stem oil seal alignment and position on the valve guide is critical.
An improperly installed valve stem oil seal may lead to

excessive oil consumption, increased vehicle emissions, or component damage.

3. Install the valve stem oil seal (222).
4. Install the valve spring (223).
5. Install the valve spring cap (224).

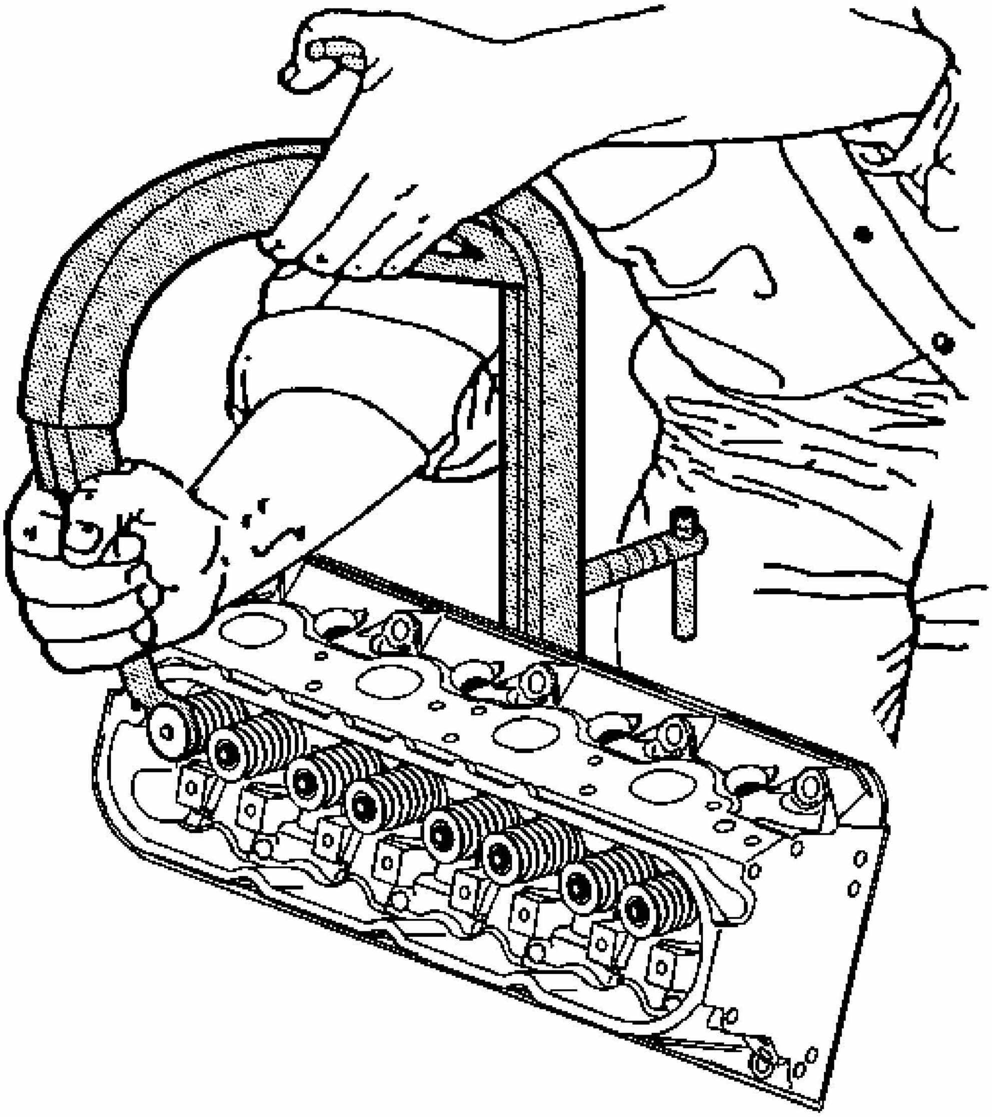


Fig. 506: Compressing Valve Spring Using
Courtesy of GENERAL MOTORS CORP.

6. Compress the valve spring using the **J 8062** . See **Special Tools**.
7. Install the valve stem keys.
    1. Use grease to hold the keys in place and remove the **J 8062** . See **Special Tools**.
    2. Ensure the keys seat properly in the groove of the valve stem.
    3. Tap the end to the valve stem with a plastic faced hammer to seat the keys, if necessary.

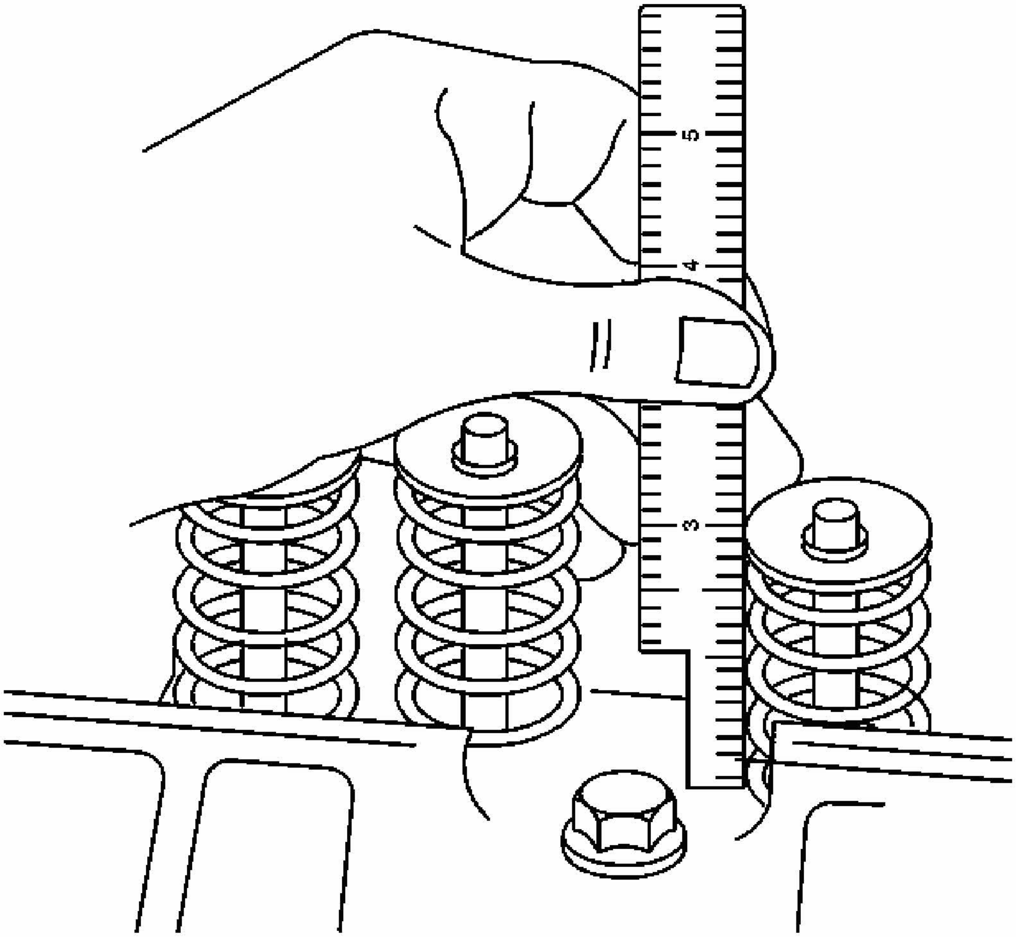


Fig. 507: Measuring Valve Spring Installed Height
Courtesy of GENERAL MOTORS CORP.

8. Measure the valve spring installed height using a ruler.

    Measure from the base of the valve spring to the top of the valve spring.

    Specification:

- If the installed height exceeds 46.25 mm (1.82 in), install a valve spring shim of approximately 0.5 mm (0.02 in) thick.
- Do not shim the valve spring to obtain less than the specified height.

  Do not assemble the components without a spring shim on the cylinder head.

9. Install the remaining valves, springs, and other components.

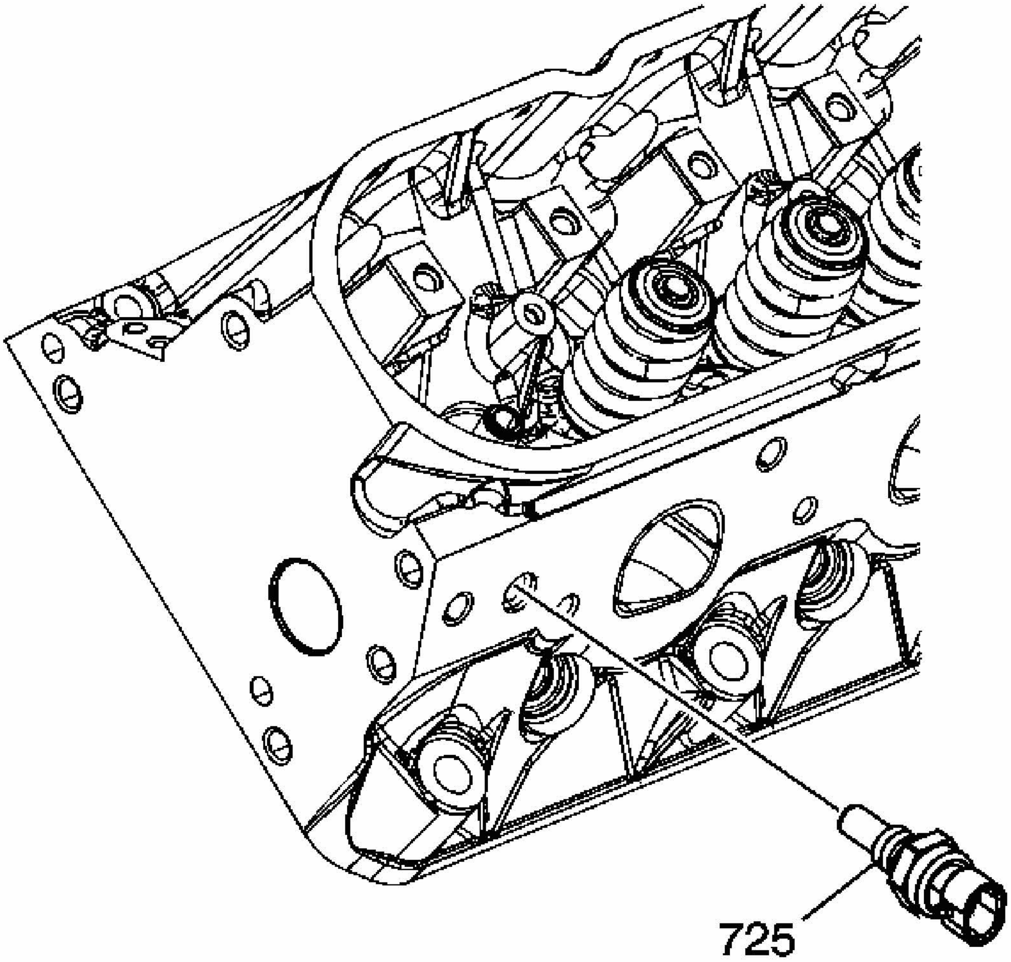


Fig. 508: Coolant Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

10. Install sealant GM P/N 12346004 (Canadian P/N 10953480), or equivalent, to the threads of the coolant sensor.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

11. Install the coolant temperature sensor (725) into the left cylinder head.

    Tighten: Tighten the coolant temperature sensor to 20 N.m (15 lb ft).

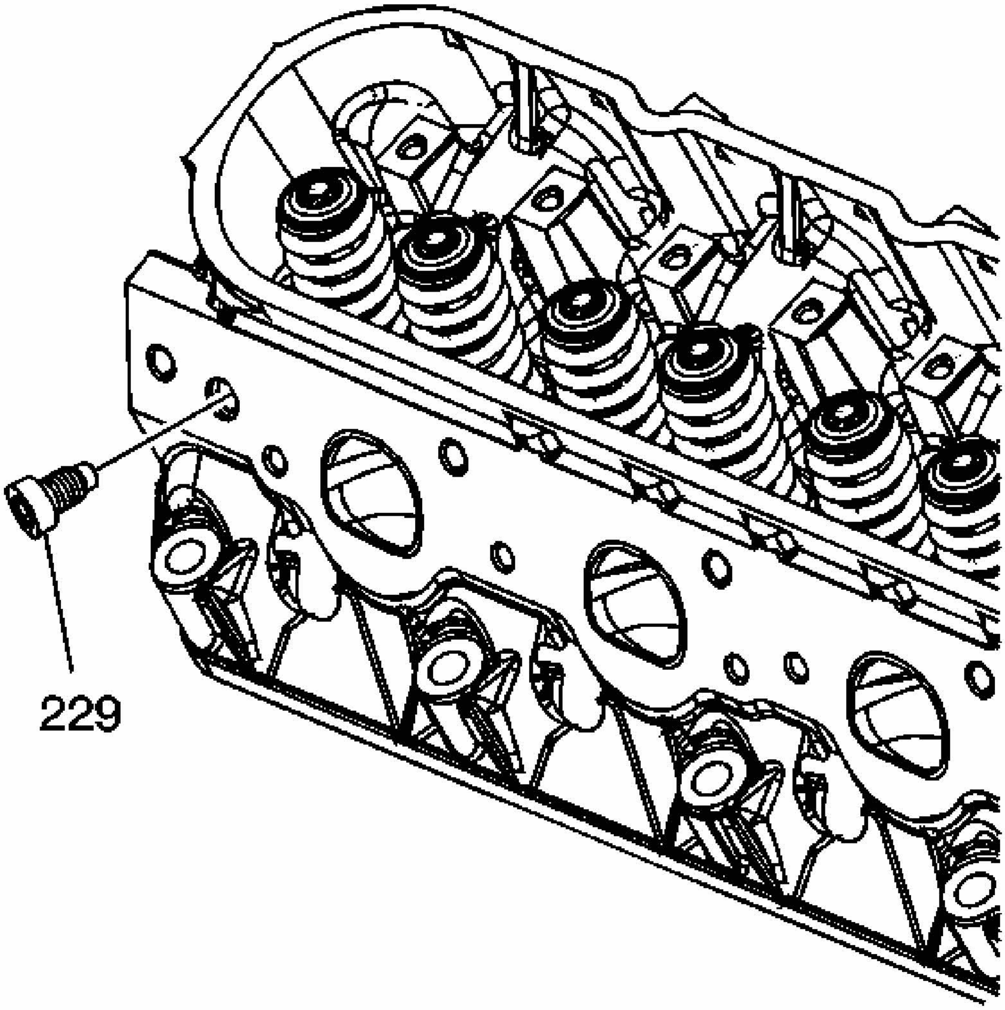


Fig. 509: Locating Coolant Plug
Courtesy of GENERAL MOTORS CORP.

12. Install threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the threads of the plug (229).
13. Install the coolant plug to the right cylinder head.

Tighten: Tighten the coolant plug to 20 N.m (15 lb ft).

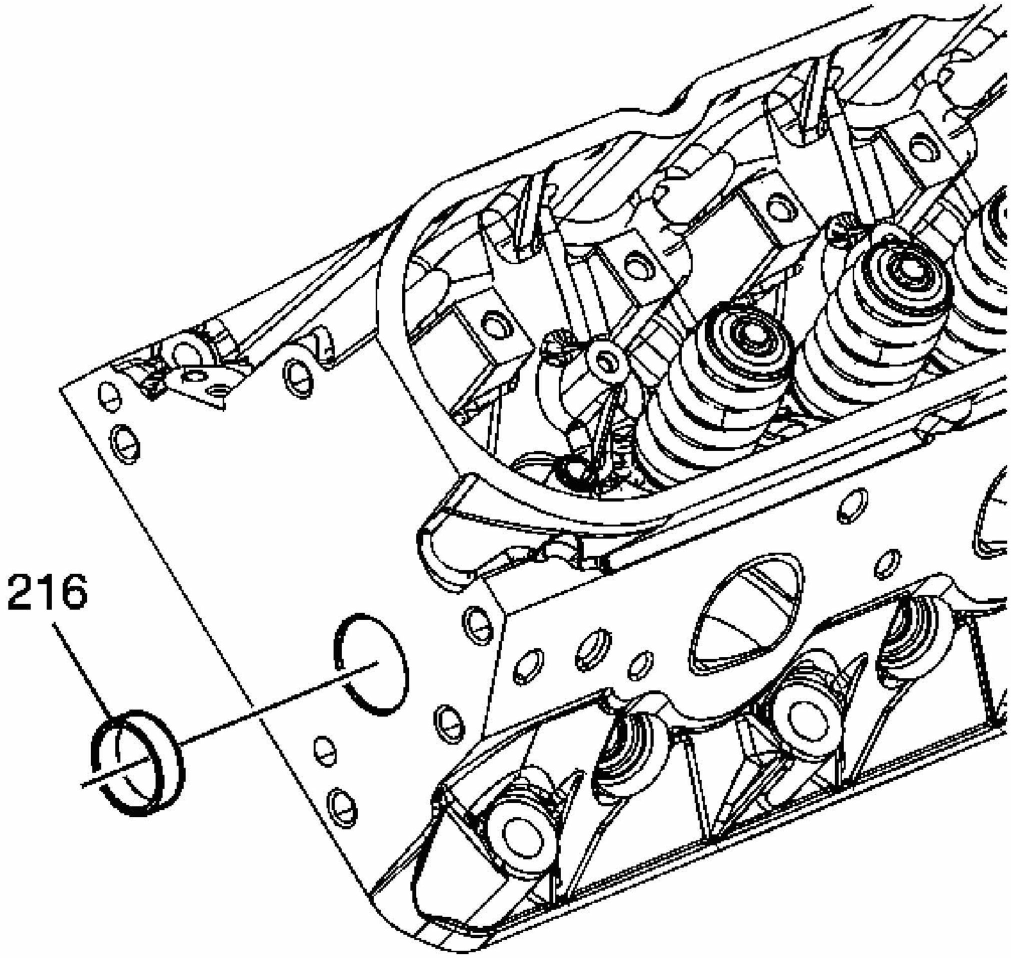


Fig. 510: Locating Cylinder Head Core Hole Plug
Courtesy of GENERAL MOTORS CORP.

14. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the sides of the cylinder head core hole plugs (216).
15. Install the core hole plugs into the cylinder head.

    A properly installed plug should be installed 2.5 mm (0.1 in) below the end face of the head.

OIL PUMP DISASSEMBLE

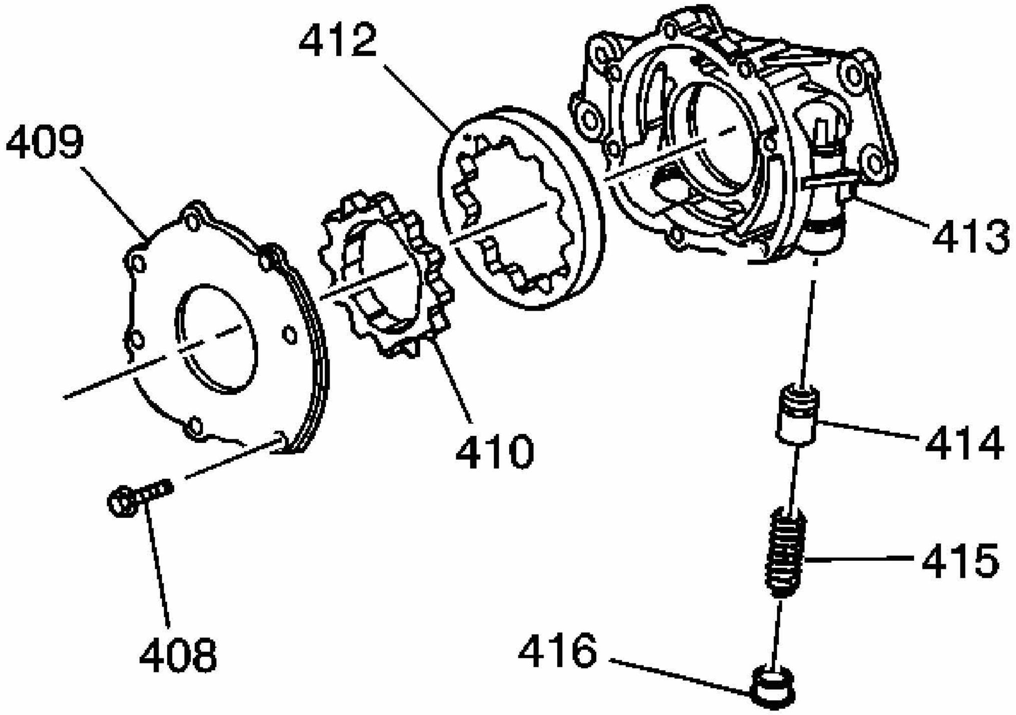


Fig. 511: Exploded View Of Oil Pump
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The internal parts of the oil pump assembly are not serviced separately, excluding the spring. If the oil pump components are worn or damaged, replace the oil pump as an assembly.

1. Remove the oil pump cover bolts (408).
2. Remove the oil pump cover (409).

IMPORTANT: Mark or identify the gears for assembly. Refer to Separating Parts.

3. Remove the drive gear (410).
4. Remove the driven gear (412).
5. Remove the pressure relief valve plug (416).
6. Remove the pressure relief valve spring (415).
7. Remove the pressure relief valve (414).
8. Inspect the oil pump components. Refer to **Oil Pump Cleaning and Inspection**.

OIL PUMP CLEANING AND INSPECTION

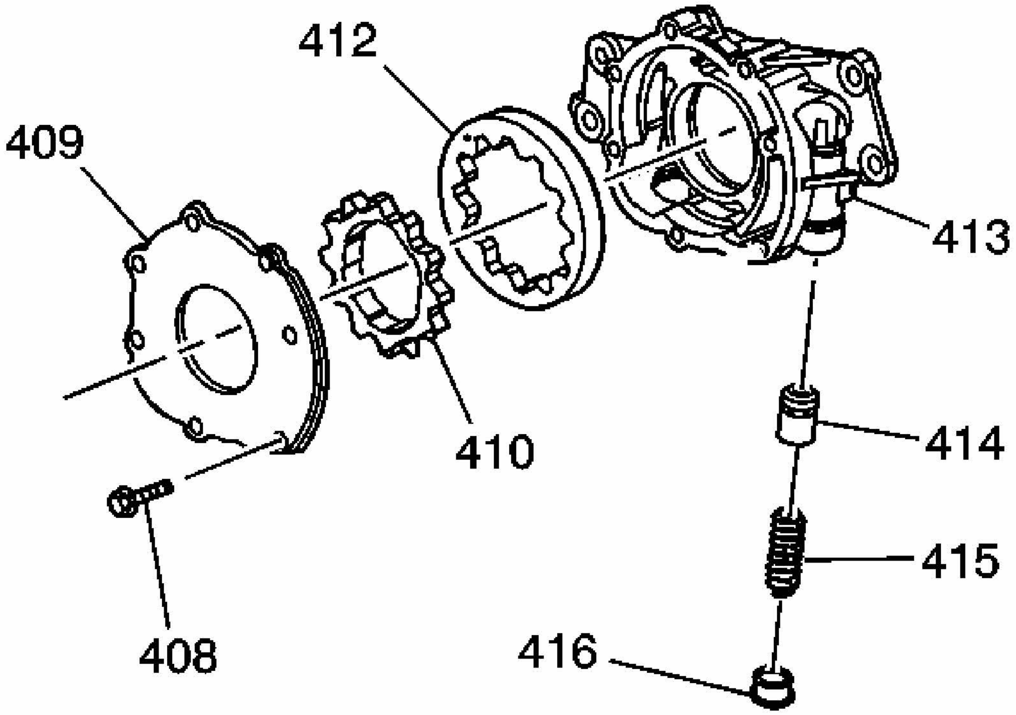


Fig. 512: Exploded View Of Oil Pump
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **The internal parts of the oil pump assembly are not serviced separately, excluding the spring. If the oil pump components are worn or damaged, replace the oil pump as an assembly.**
- **The oil pump pipe and screen are to be serviced as an assembly. Do not attempt to repair the wire mesh portion of the pump and screen assembly.**

1. Clean the parts in solvent.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

2. Dry the parts with compressed air.
3. Inspect the oil pump housing (413) and the cover (409) for cracks, excessive wear,

scoring, or casting imperfections.

4. Inspect the oil pump housing-to-engine block oil gallery surface for scratches or gouging.
5. Inspect the oil pump housing for damaged bolt hole threads.
6. Inspect the relief valve plug (416) and plug bore for damaged threads.
7. Inspect the oil pump internal oil passages for restrictions.
8. Inspect the drive gear (410) and driven gear (412) for chipping, galling or wear.

   Minor burrs or imperfections on the gears may be removed with a fine oil stone.

9. Inspect the drive gear splines for excessive wear.
10. Inspect the pressure relief valve (414) and bore for scoring or wear.

    The valve must move freely in the bore with no restrictions.

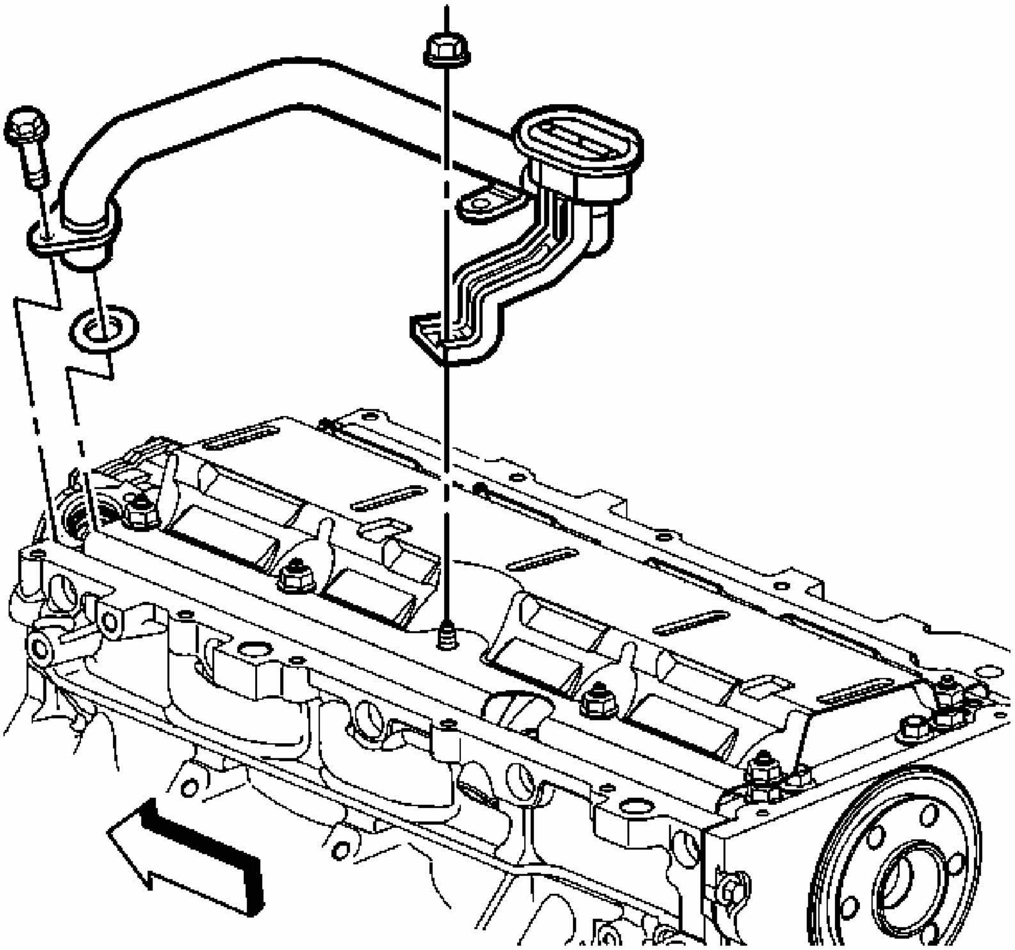


Fig. 513: View Of Oil Pump Screen
Courtesy of GENERAL MOTORS CORP.

11. Inspect the oil pump screen for debris or restrictions.
12. Inspect the oil pump screen for broken or loose wire mesh.

OIL PUMP ASSEMBLE

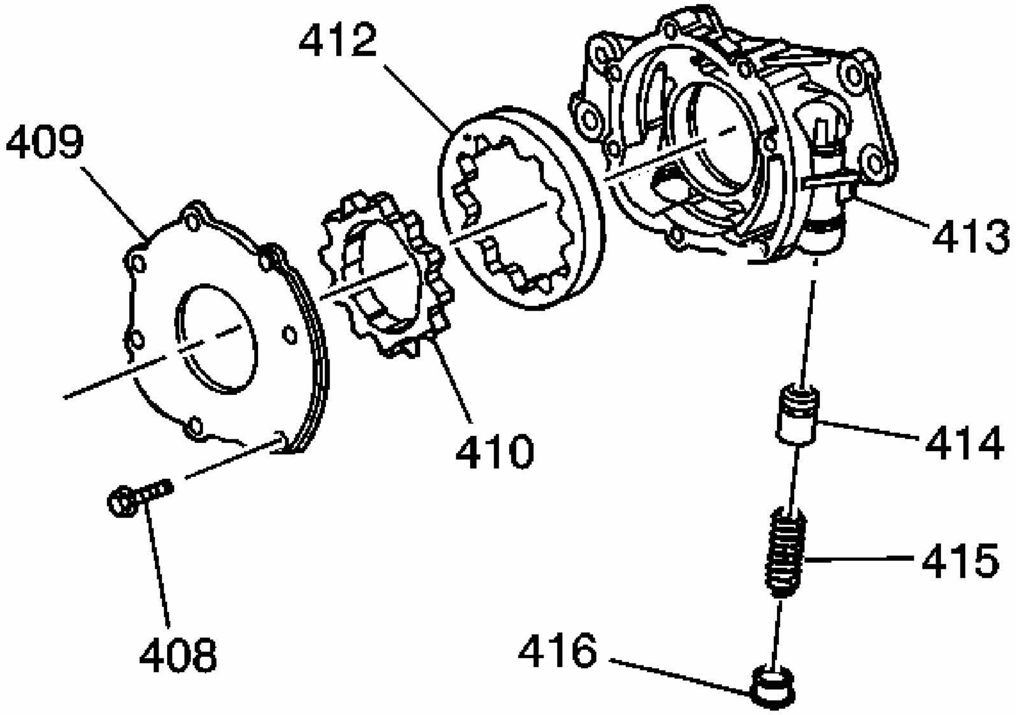


Fig. 514: Exploded View Of Oil Pump
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Prior to assembling the oil pump, coat all wear or internal surfaces with clean engine oil.

1. Install the driven gear (412) into the pump housing (413).

   Install the driven gear with the orientation mark facing the pump cover.

2. Install the drive gear (410) into the pump housing.
3. Install the oil pump cover (409).

   NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the pump cover bolts (408).

   Tighten: Tighten the oil pump cover bolts to 12 N.m (106 lb in).

5. Install the relief valve (414).

6. Install a NEW relief valve spring (415).
7. Install the pressure relief valve plug (416).

   Tighten: Tighten the pressure relief valve plug to 12 N.m (106 lb in).

8. Inspect the oil pump for smooth operation by rotating the drive gear.

ENGINE FRONT COVER CLEANING AND INSPECTION

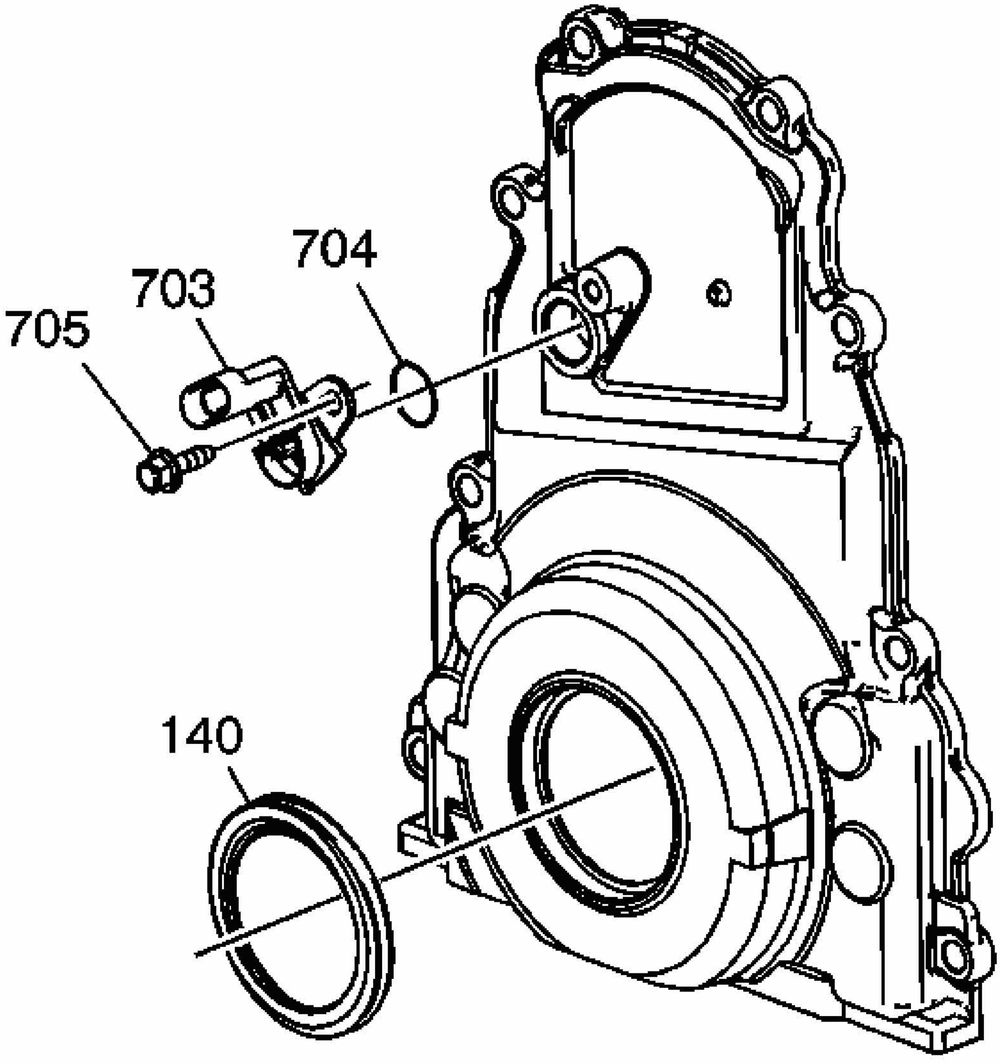


Fig. 515: View Of Crankshaft Oil Seal & Camshaft Position (CMP) Sensor
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Do not use the crankshaft oil seal again. Install a NEW crankshaft oil seal during assembly.**
- **Do not use the front cover-to-engine block gasket again. Install a NEW gasket during assembly.**

1. Remove the crankshaft oil seal (140) from the front cover.
2. Clean the cover in solvent. Remove the sealant from the cover oil pan surface. Refer to **Replacing Engine Gaskets**.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

3. Dry the cover with compressed air.
4. Inspect the gasket sealing surfaces for excessive scratches or gouging.
5. Inspect the threaded bolt holes for damaged threads or debris.
6. Inspect the crankshaft oil seal and camshaft position (CMP) sensor mounting bores for damage.

CRANKSHAFT REAR OIL SEAL HOUSING CLEANING AND INSPECTION

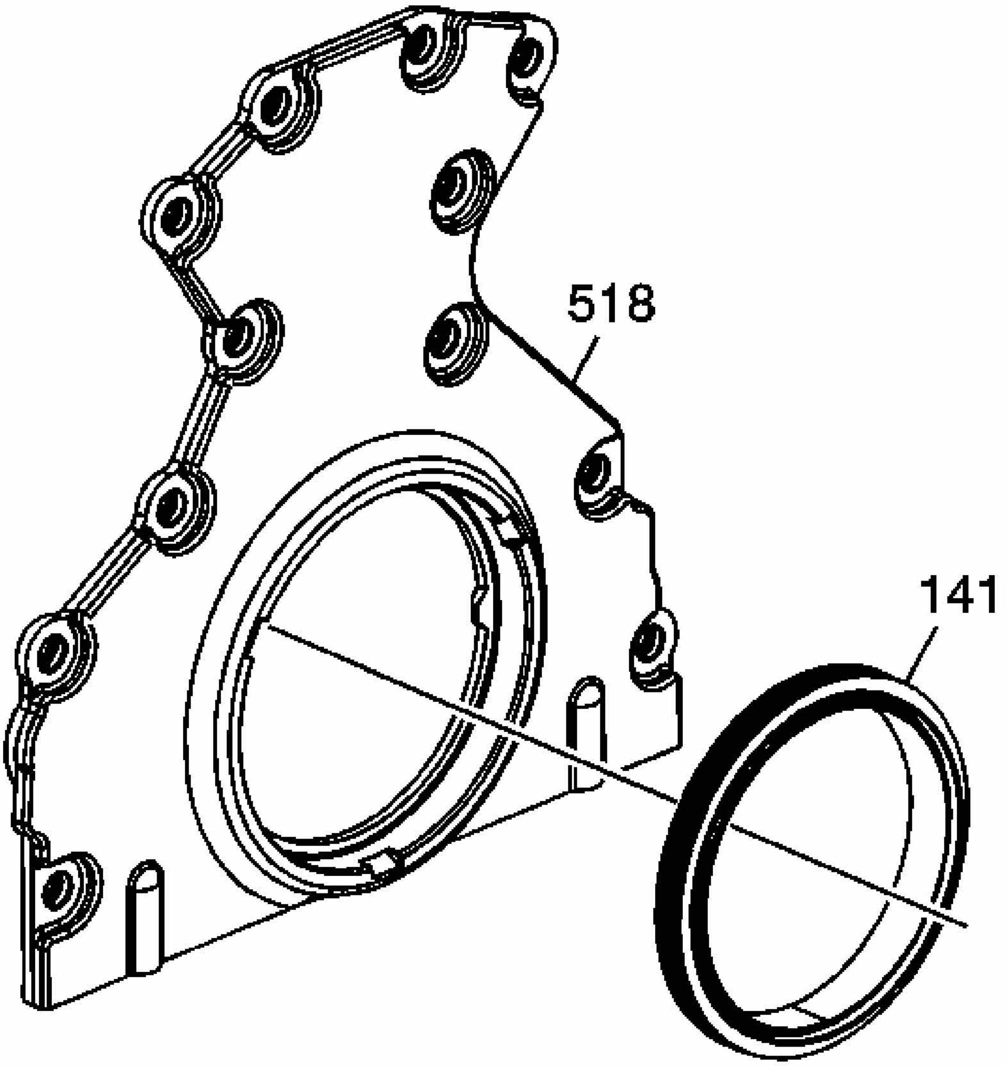


Fig. 516: Crankshaft Rear Oil Seal & Housing
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Do not use the crankshaft rear oil seal again. Install a NEW crankshaft oil seal during assembly.**
- **Do not use the rear housing-to-engine block gasket again. Install a NEW gasket during assembly.**

1. Remove the crankshaft oil seal (141) from the rear housing.
2. Clean the housing in solvent. Remove the sealant from the housing oil pan surface. Refer to **Replacing Engine Gaskets**.

CAUTION: Refer to Safety Glasses Caution .

3. Dry the housing with compressed air.
4. Inspect the gasket sealing surfaces for excessive scratches or gouging.
5. Inspect the housing-to-oil pan threaded bolt holes for damaged threads or debris.
6. Inspect the crankshaft oil seal mounting bore for damage.

VALVE LIFTER OIL MANIFOLD CLEANING AND INSPECTION

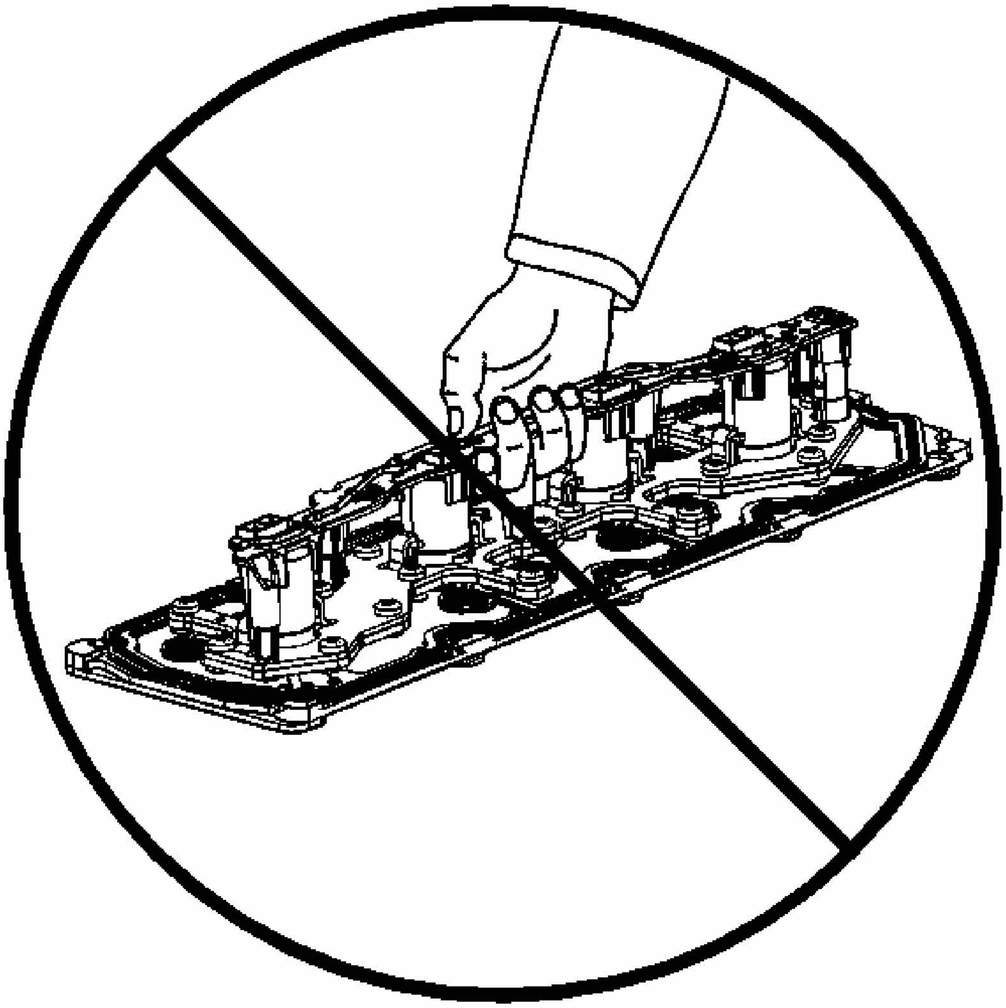


Fig. 517: Valve Lifter Oil Manifold
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Do not allow dirt or debris to enter the oil passages of the manifold. Plug as required.**
- **Do not disassemble the electrical components from the manifold.**
- **Do not submerge the electrical components in cleaning solvent.**
- **Do not use the manifold exterior gasket again. Remove the exterior gasket and install a NEW service gasket during assembly.**

1. Do not lift the manifold assembly by the electrical lead frame.

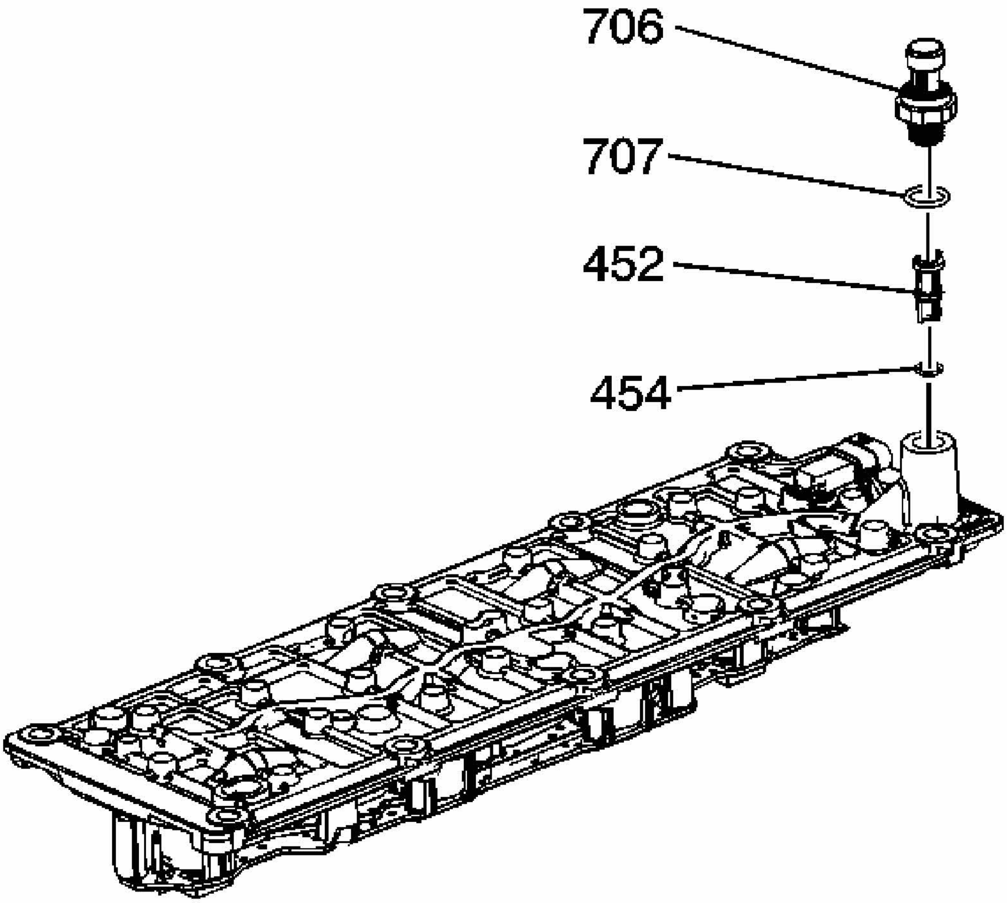


Fig. 518: View Of Oil Pressure Sensor, Washer And Valve Lifter Oil Filter
Courtesy of GENERAL MOTORS CORP.

2. Remove the oil pressure sensor (706) and washer (707).
3. Remove the oil screen (452) with O-ring (454).

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

4. Clean the manifold with compressed air.

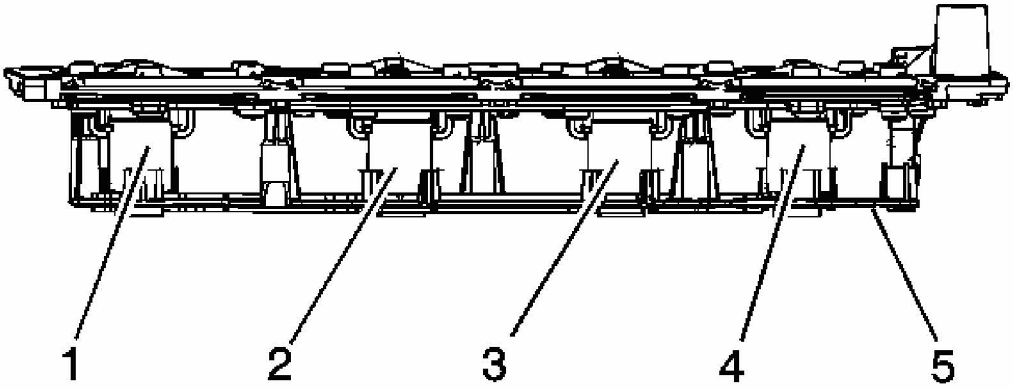


Fig. 519: Electrical Solenoids
Courtesy of GENERAL MOTORS CORP.

5. Inspect for loose electrical solenoids (1-4) or loose or missing bolts.
6. Inspect for damage to the electrical lead frame (5).
7. Inspect for a damaged electrical connector, for bent or corroded pins.

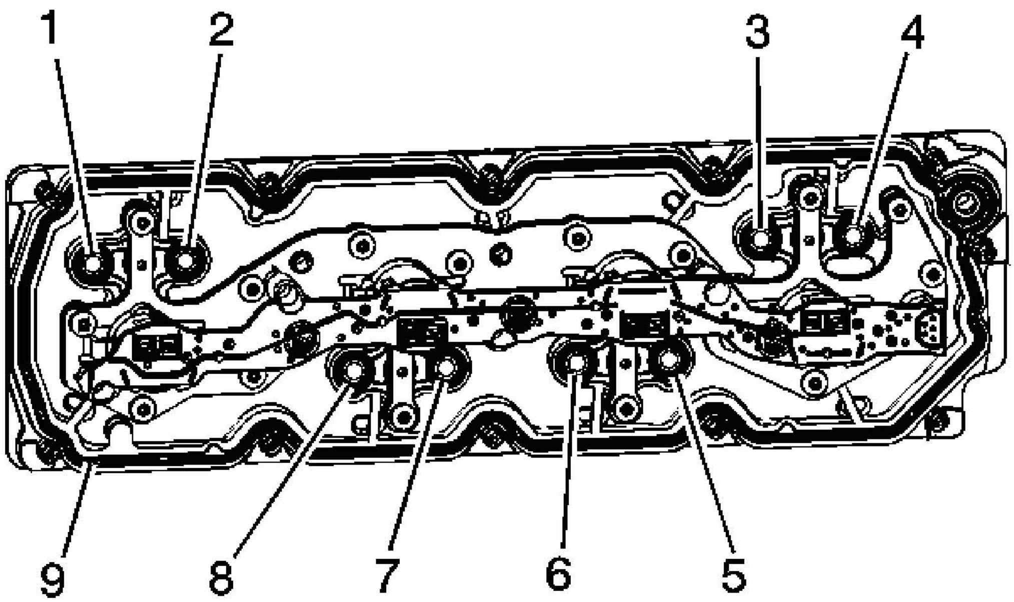


Fig. 520: View Of Sealing Gaskets
Courtesy of GENERAL MOTORS CORP.

8. Inspect for damaged interior sealing gaskets (1-8). If the interior sealing gaskets are damaged, the manifold must be replaced as an assembly.
9. Inspect for a damaged exterior sealing gasket (9) or scored gasket surfaces.
10. Inspect for debris or restrictions within the oil passages of the manifold.

VALVE ROCKER ARM COVER CLEANING AND INSPECTION

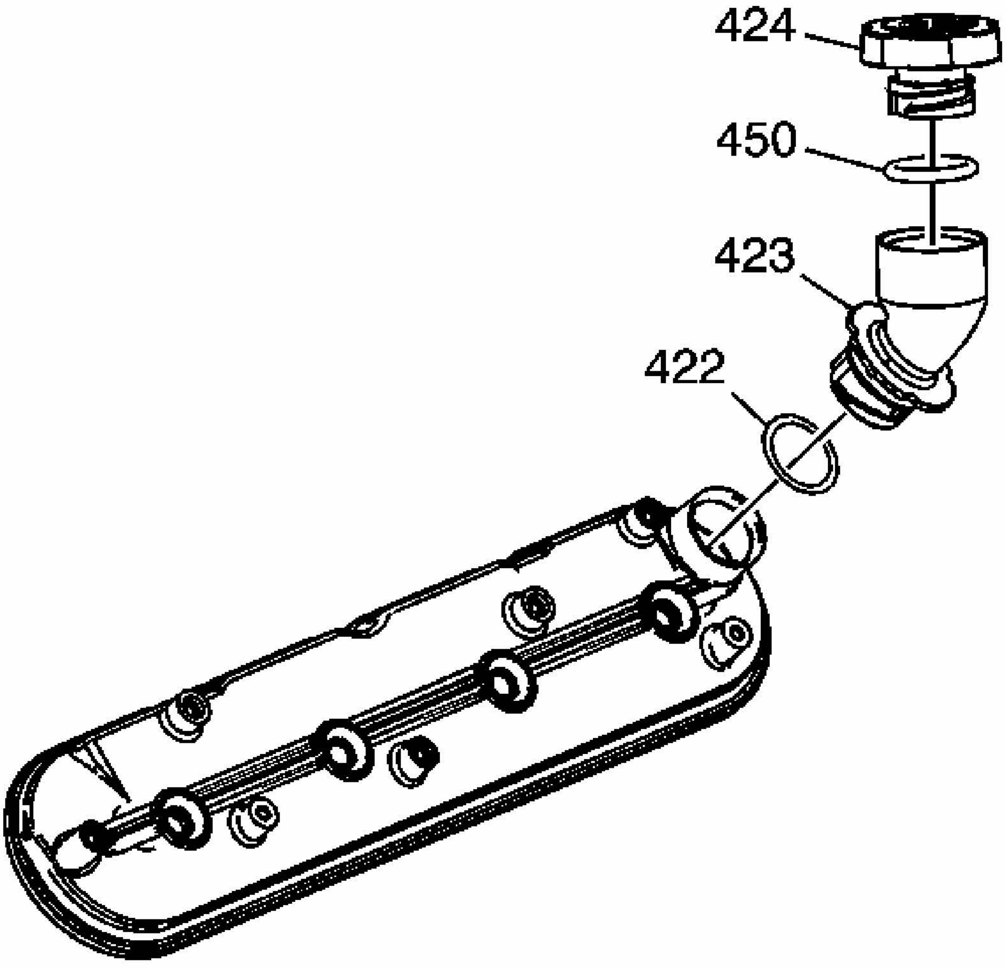


Fig. 521: Oil Fill Cap & Oil Fill Tube
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Do not use the valve rocker arm cover gasket again. Install a NEW gasket during assembly.**
- **Remove the ignition coils before cleaning the cover in solvent. Do not submerge the ignition coils in solvent.**
- **Do not remove the oil fill tube from the covers unless service is required.**
- **If the oil fill tube has been removed from the rocker arm cover, install a NEW tube during assembly.**

1. Inspect the oil fill tube (423) for a loose fit or damage.

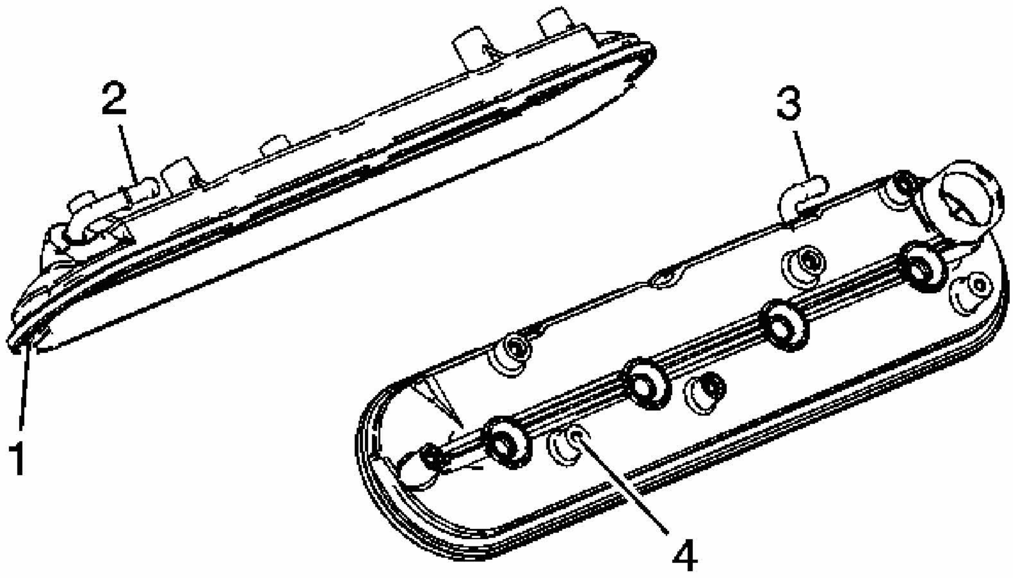


Fig. 522: Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

2. Inspect the covers for the following conditions:
    - Scoring or damage to the gasket surfaces (1)
    - Ventilation system passages (2, 3) for restrictions
    - Threaded bolt holes (4) for damage or debris

OIL PAN CLEANING AND INSPECTION

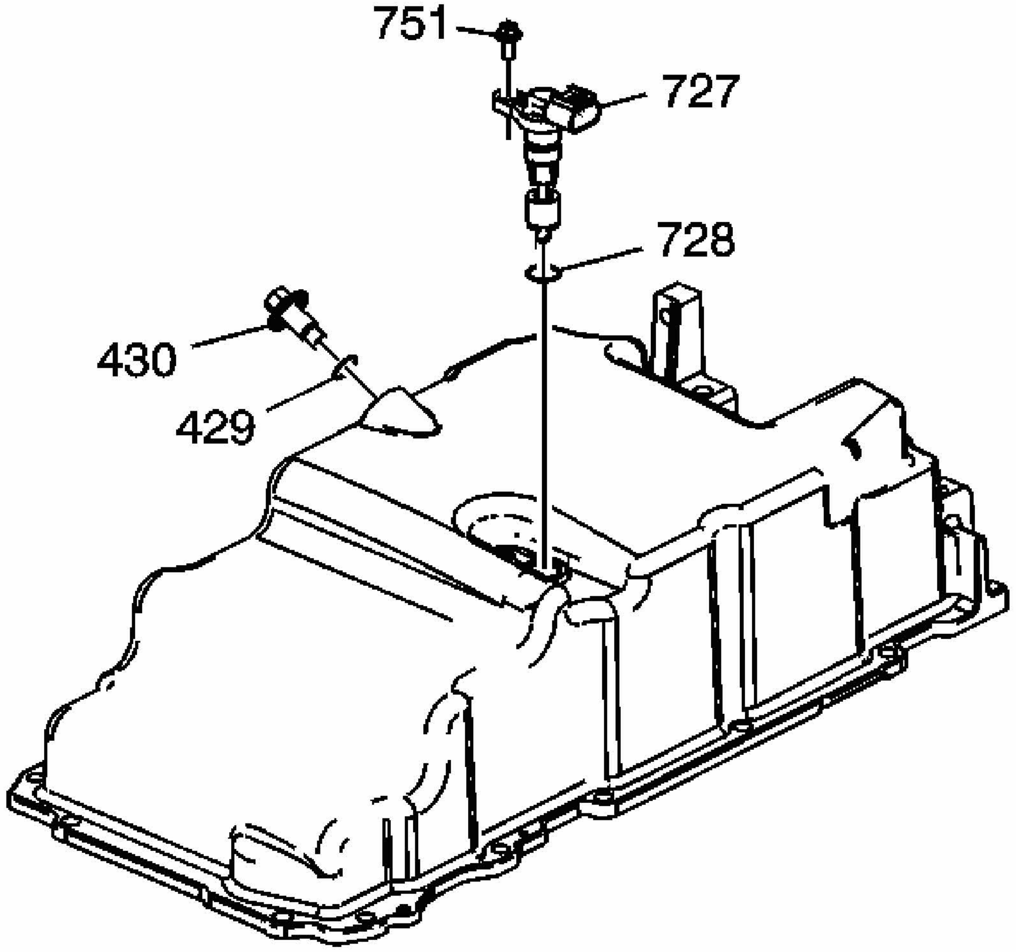


Fig. 523: View Of Oil Pan, Drain Plug & O-Ring, Oil Level Sensor, Bolt & O-Ring
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When installing a NEW oil pan gasket, it is not necessary to install the rivets that retain the NEW gasket to the pan.

1. Remove the oil filter fitting and bypass valve, as required. Refer to **Oil Filter and Adapter Removal**.
2. Remove the drain plug (430) and O-ring (429).
3. Remove the oil level sensor (727), bolt (751), and O-ring (728).

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

4. Clean the oil pan in solvent. Be sure to thoroughly clean all of the oil passages and recesses of the pan.
5. Dry the oil pan with compressed air.
6. Inspect the oil pan for the following conditions:
    - Damaged gasket surfaces
    - Restrictions within the oil passages of the pan
    - Threaded bolt holes for damage

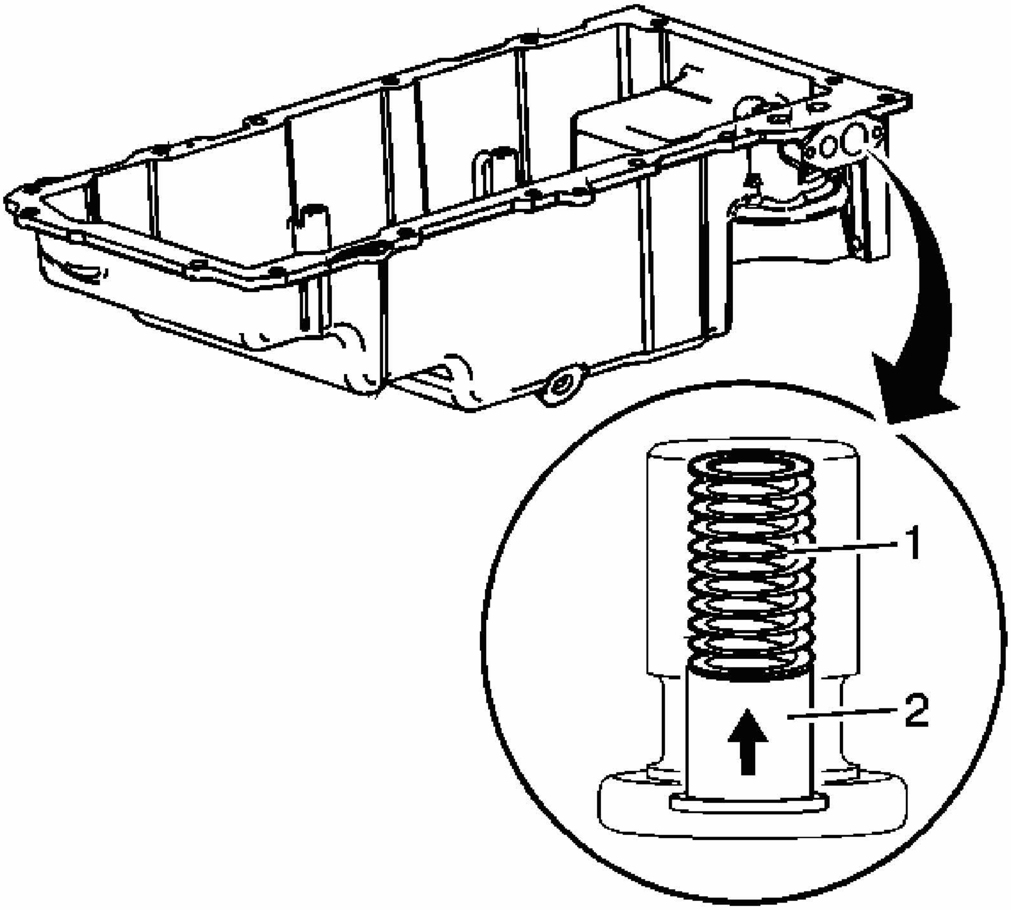


Fig. 524: View Of The Valve Lifter Oil Pressure Relief Valve
Courtesy of GENERAL MOTORS CORP.

7. Inspect the displacement on demand oil pressure relief valve for proper operation.

    Lightly depress the valve (2). The valve spring (1) should seat the valve to the proper closed position.

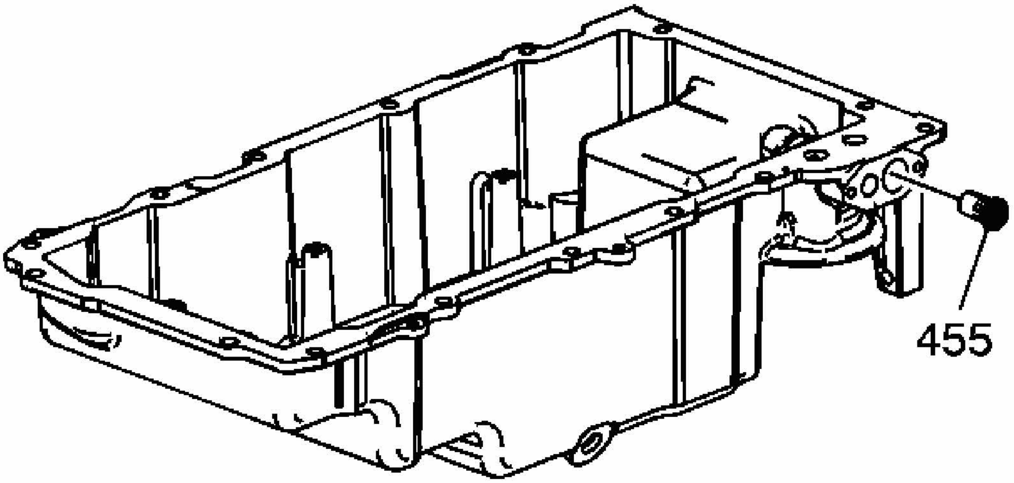


Fig. 525: Valve Lifter Oil Pressure Relief Valve
Courtesy of GENERAL MOTORS CORP.

8. The valve (455) is press-fit in the oil pan and is serviceable separately.

INTAKE MANIFOLD CLEANING AND INSPECTION

Cleaning Procedure

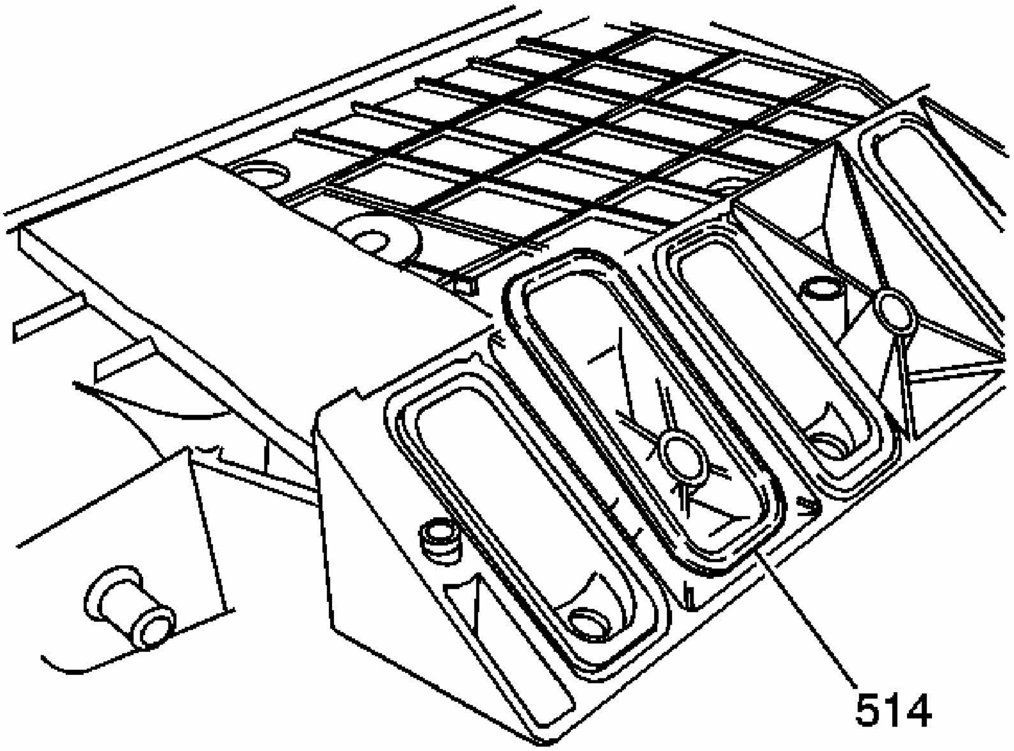


Fig. 526: View Of Intake Manifold-To-Cylinder Head Gaskets
Courtesy of GENERAL MOTORS CORP.

1. Remove and discard the intake manifold-to-cylinder head gaskets (514).

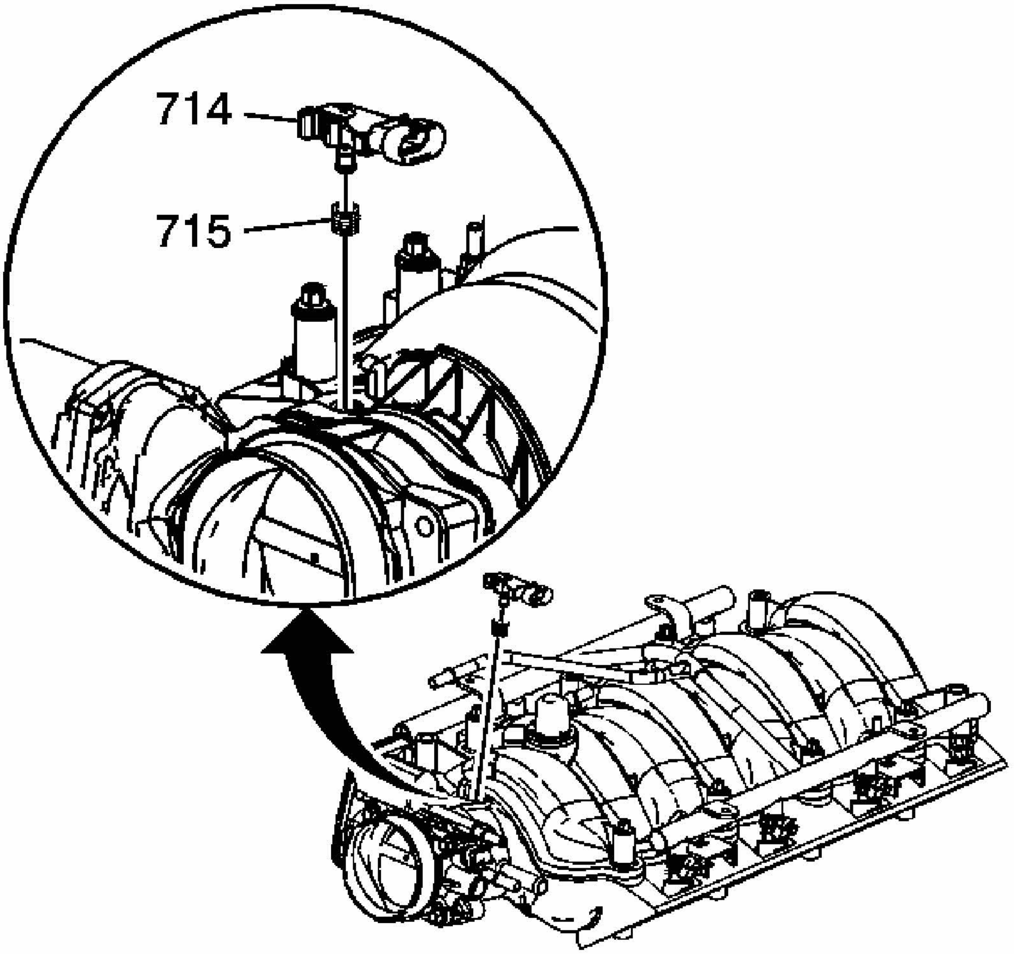


Fig. 527: View Of MAP Sensor
Courtesy of GENERAL MOTORS CORP.

2. Remove the manifold absolute pressure (MAP) sensor (714). Refer to **Intake Manifold Removal**.

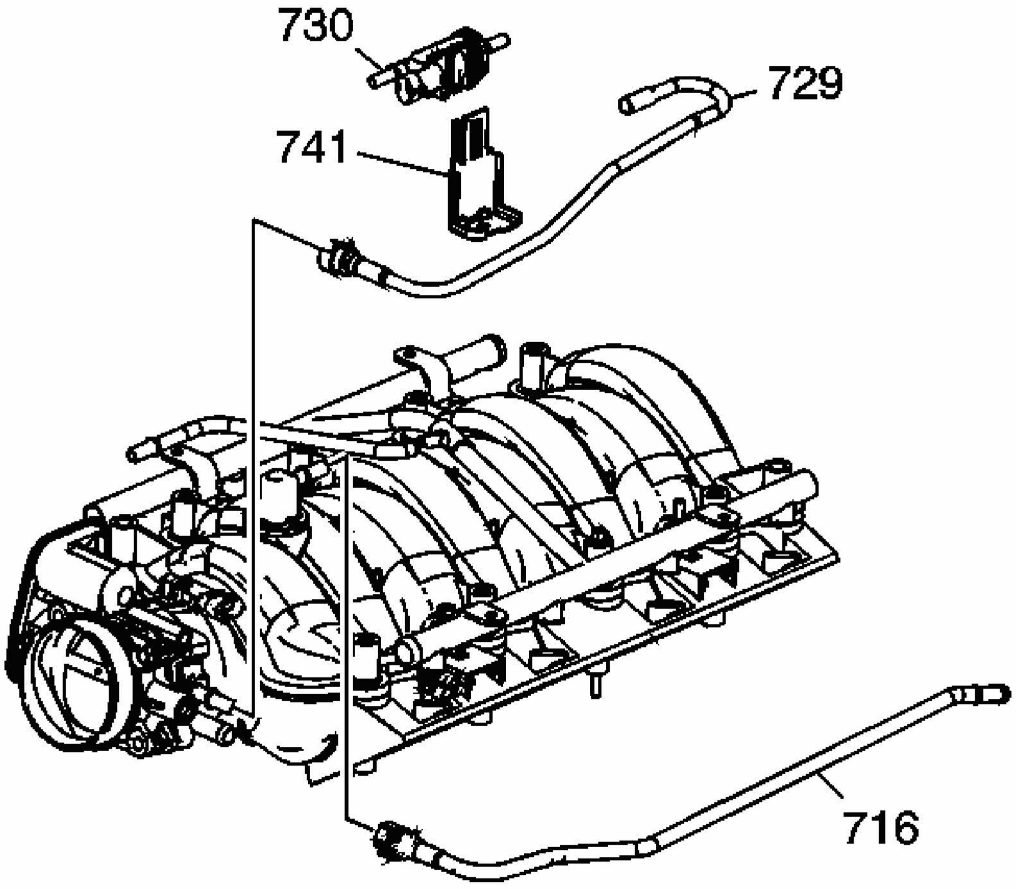


Fig. 528: View Of EVAP Purge Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

3. Remove the evaporative emission (EVAP) canister purge solenoid valve (730), EVAP tube (729), and fuel rail with injectors. Refer to **Fuel Rail and Injectors Removal**.
4. Remove the throttle body and gasket. Refer to **Throttle Body Removal**.
5. Clean the intake manifold in solvent.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

6. Dry the intake manifold with compressed air.

Inspection Procedure

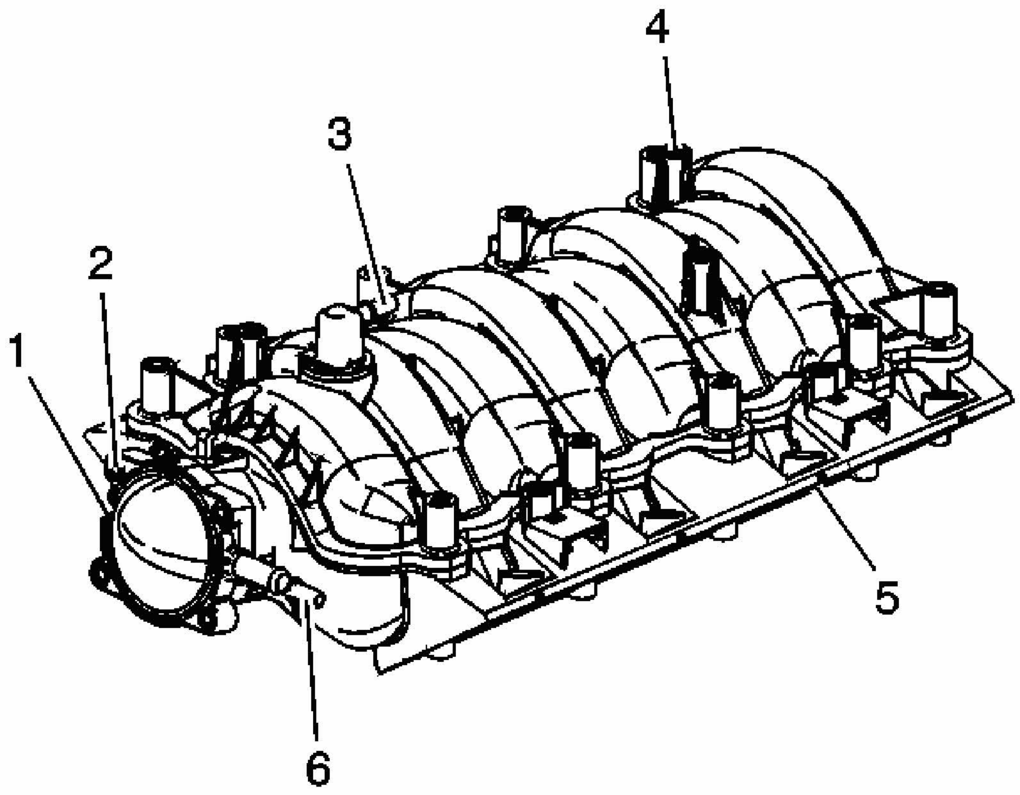


Fig. 529: Identifying Intake Manifold
Courtesy of GENERAL MOTORS CORP.

1. Inspect the manifold for the following conditions:
    - Damaged gasket or sealing surfaces (1, 5)
    - Loose threaded inserts or studs (2, 4)
    - Debris or restrictions within the passages of the manifold
    - Damaged or broken hose fittings (3, 6)
    - Inspect the composite intake manifold assembly for cracks or other damage.
2. Inspect the intake manifold cylinder head deck for warpage.
    1. Locate a straight edge across the intake manifold cylinder head deck surface.

       Position the straight edge across a minimum of 2 runner port openings.

    2. Insert a feeler gage between the intake manifold and the straight edge.

       An intake manifold with warpage in excess of 3 mm (0.118 in) over a 200 mm (7.87 in) area is warped and should be replaced.

EXHAUST MANIFOLD CLEANING AND INSPECTION

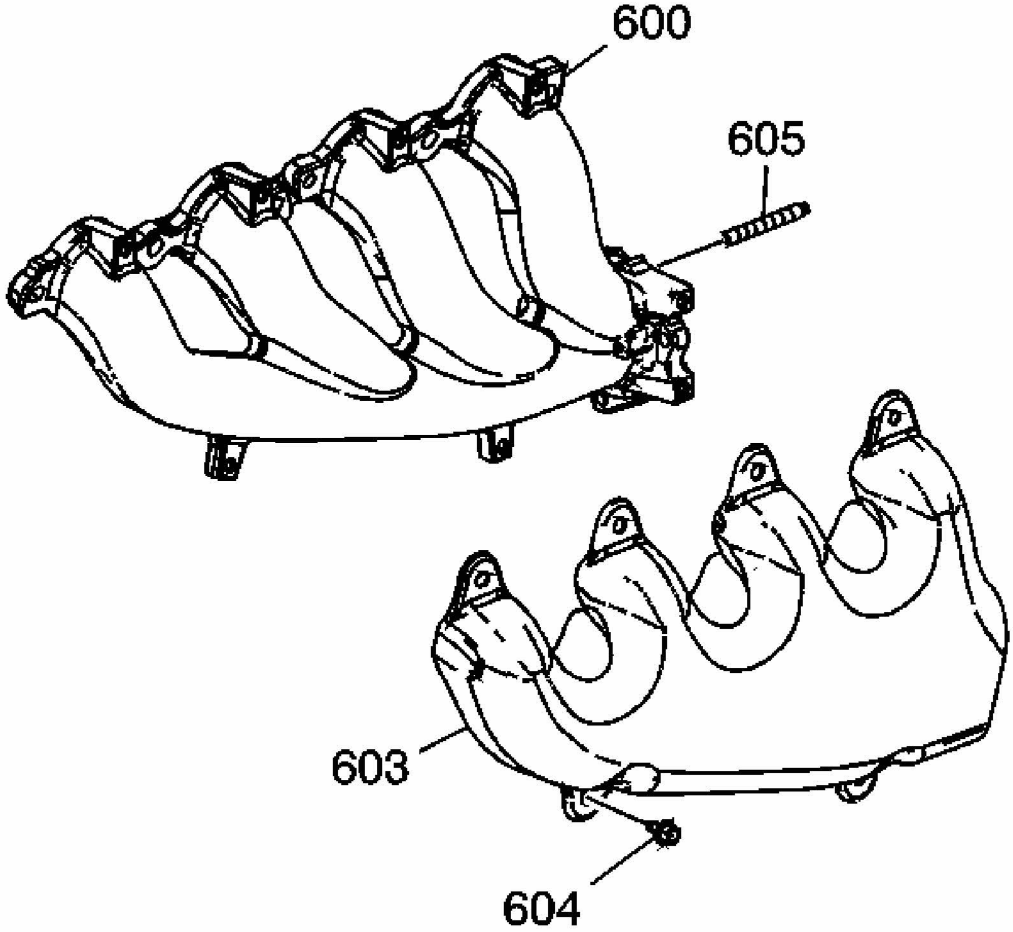


Fig. 530: View Of Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not use the exhaust manifold-to-cylinder head gaskets again. Upon installation of the exhaust manifold, install a NEW gasket. An improperly installed gasket or leaking exhaust system may effect on-board diagnostics (OBD) II system performance.

1. Clean the exhaust manifold (600) and heat shield (603) in solvent.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

2. Dry the exhaust manifold with compressed air.
3. Inspect the exhaust manifold-to-cylinder head gasket surface for excessive scratches or gouging.
4. Inspect for a loose, damaged, or cracked heat shield (603).
5. Inspect the studs (605) for damaged threads.

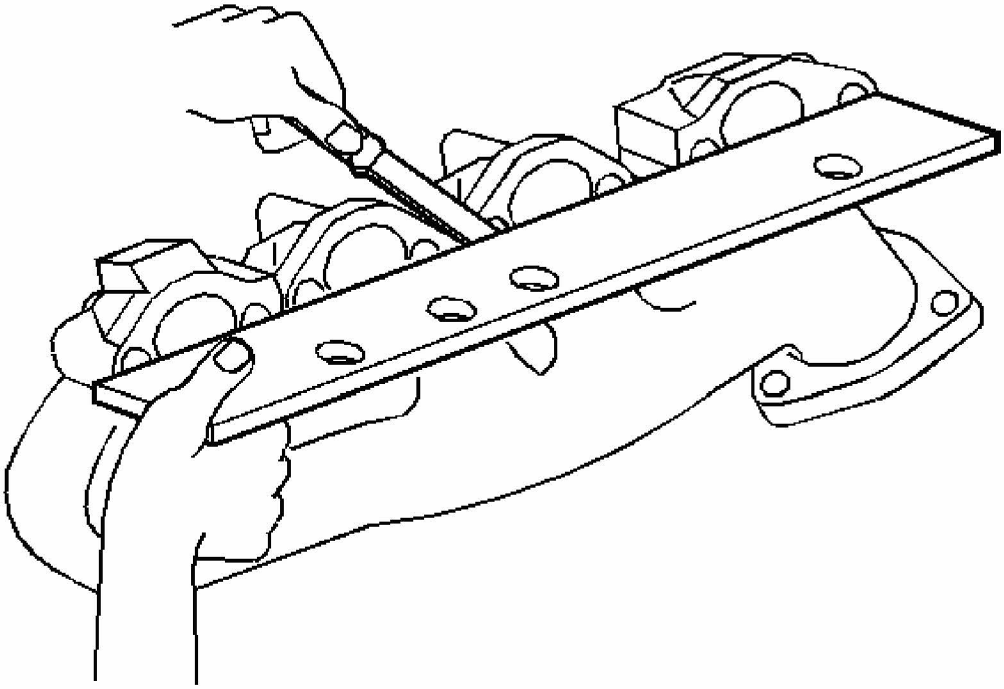


Fig. 531: Measuring Exhaust Manifold To Cylinder Head Surface For Warpage
Courtesy of GENERAL MOTORS CORP.

6. Use a straight edge and a feeler gage and measure the exhaust manifold cylinder head deck for warpage.

   An exhaust manifold deck with warpage in excess of 0.25 mm (0.01 in) within the 2 front or 2 rear runners or 0.5 mm (0.02 in) overall, may cause an exhaust leak and may effect OBD II system performance. Exhaust manifolds not within specifications must be replaced.

COOLANT AIR BLEED PIPE CLEANING AND INSPECTION

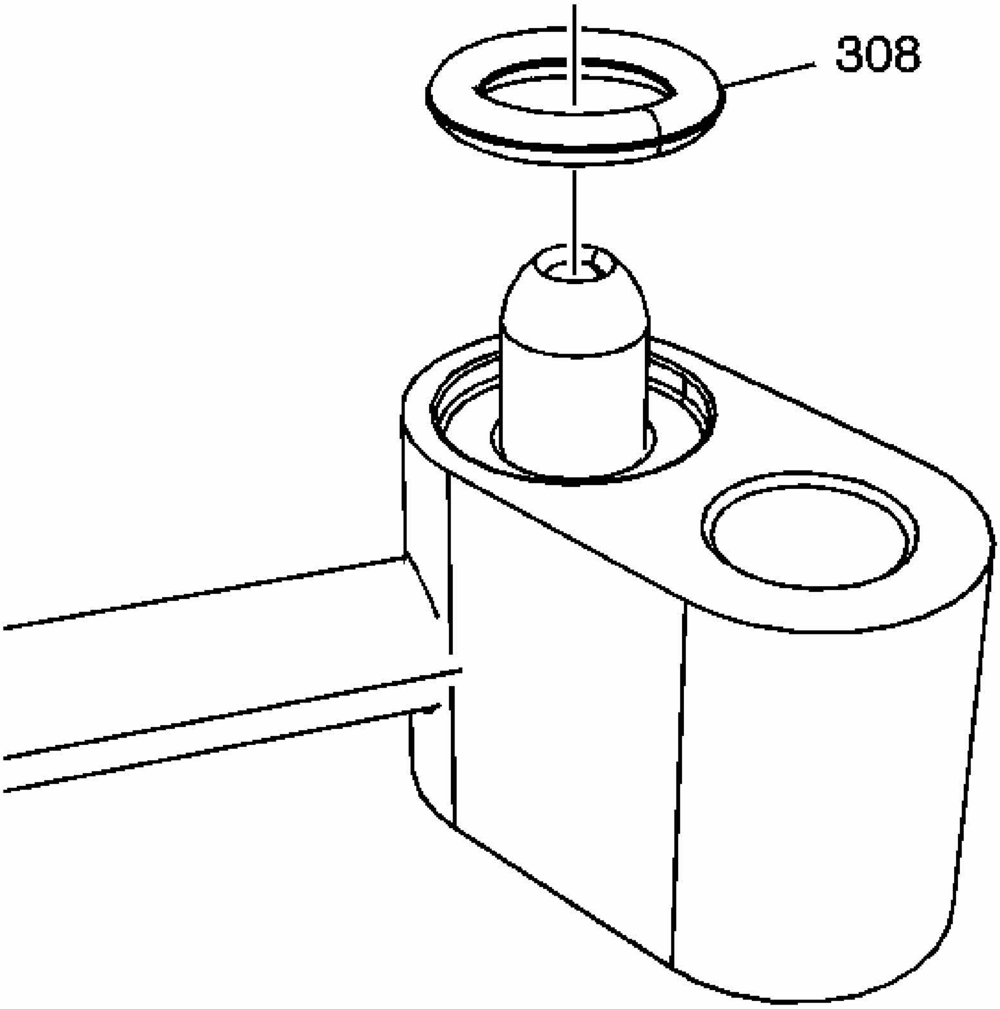


Fig. 532: View Of Coolant Air Bleed Pipe Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not use the engine coolant air bleed pipe and cover gaskets again. Upon installation of the pipe and covers, install NEW gaskets.

1. Remove the seals (308) from the pipe and covers.

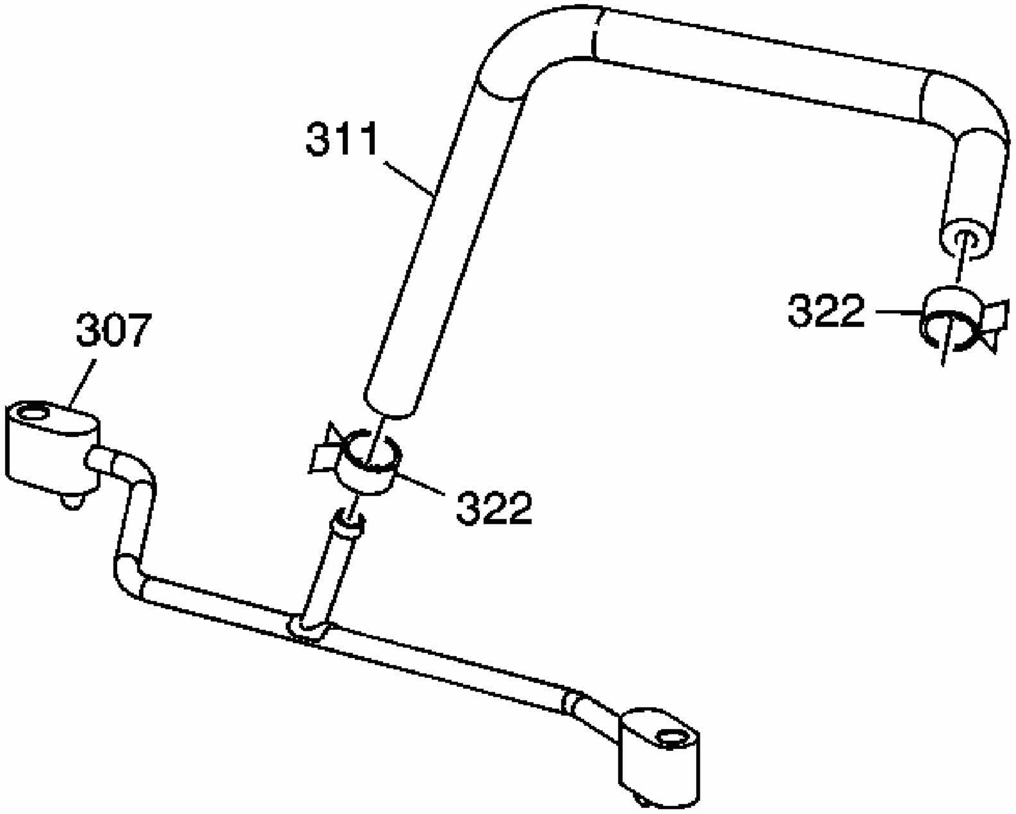


Fig. 533: View Of Coolant Air Bleed Pipe & Clamp
Courtesy of GENERAL MOTORS CORP.

2. Clean the pipe (307) and covers in solvent.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

3. Dry the pipe (307) and covers with compressed air.
4. Inspect the pipe and covers for damaged sealing surfaces or restrictions within the pipe.
5. Inspect the hose (311) for wear, restrictions, or damage.

WATER PUMP CLEANING AND INSPECTION

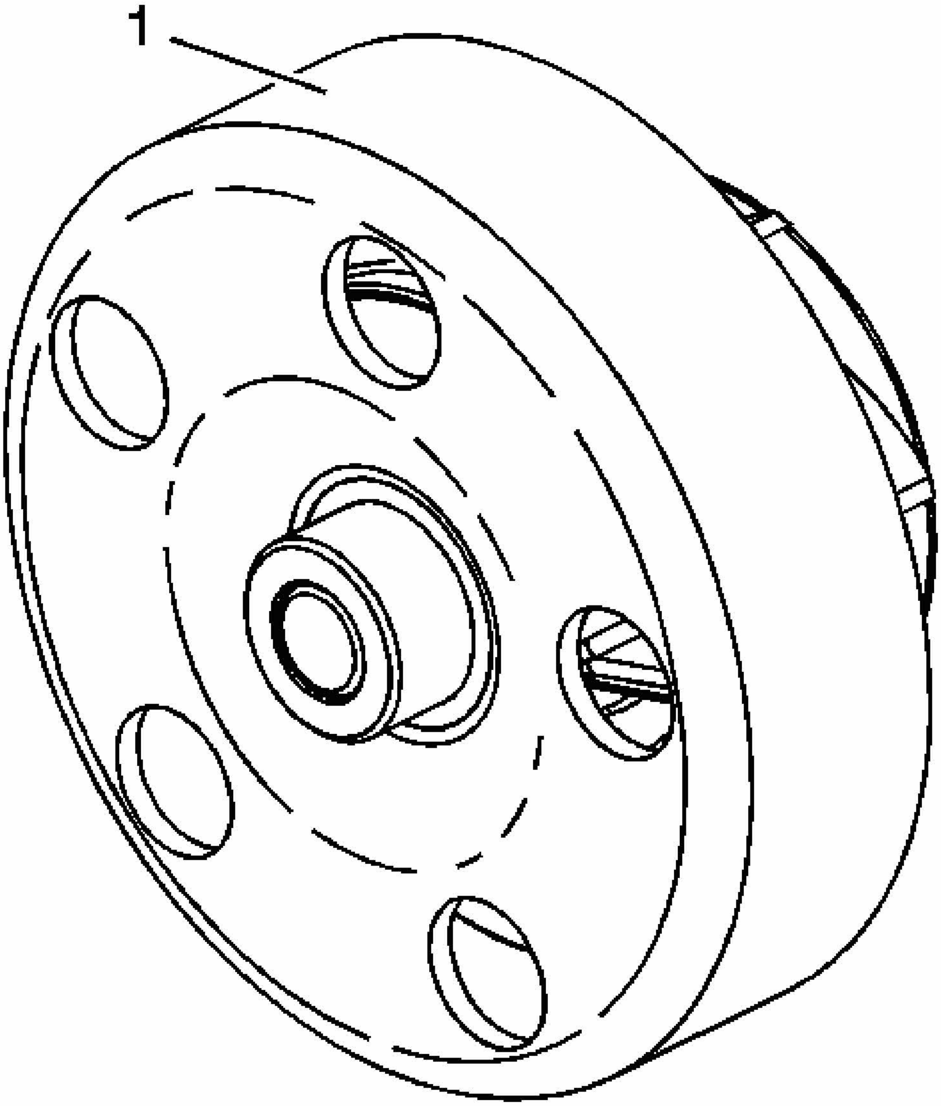


Fig. 534: Identifying Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

1. Clean all excess dirt and debris from the water pump housing.
2. Inspect the water pump for the following conditions:
    - Gasket sealing surfaces for excessive scratches or gouging
    - Excessive side-to-side play in the pulley shaft
    - Leakage at the water pump vent hole

A stain around the vent hole is acceptable. If leakage, dripping, occurs with the engine running and the cooling system pressurized, replace the water pump.

- Wear or damage in the belt tracking area of the pulley (1)

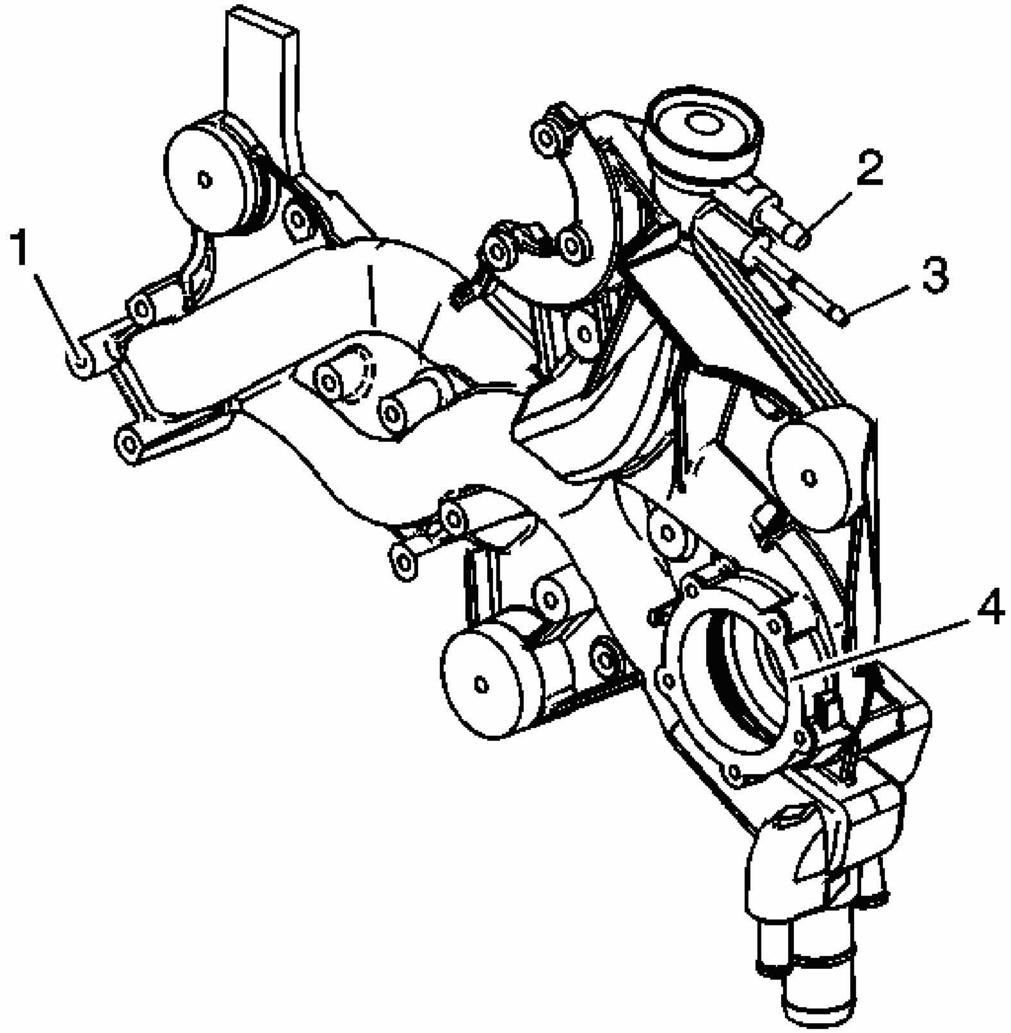


Fig. 535: Identifying Water Manifold
Courtesy of GENERAL MOTORS CORP.

3. Inspect the water manifold for the following conditions:
    - Damage to threaded bolt holes (1)
    - Restrictions within the internal passages (2, 3)
    - Gasket sealing surfaces (4) for excessive scratches or gouging

THREAD REPAIR

Tools Required

- **J 42385-100** Head/Main Bolt Thread Repair Kit. See **Special Tools**.
- **J 42385-200** Common Thread Repair Kit. See **Special Tools**.
- **J 42385-300** Fixtures and Hardware Kit. See **Special Tools**.

General Thread Repair

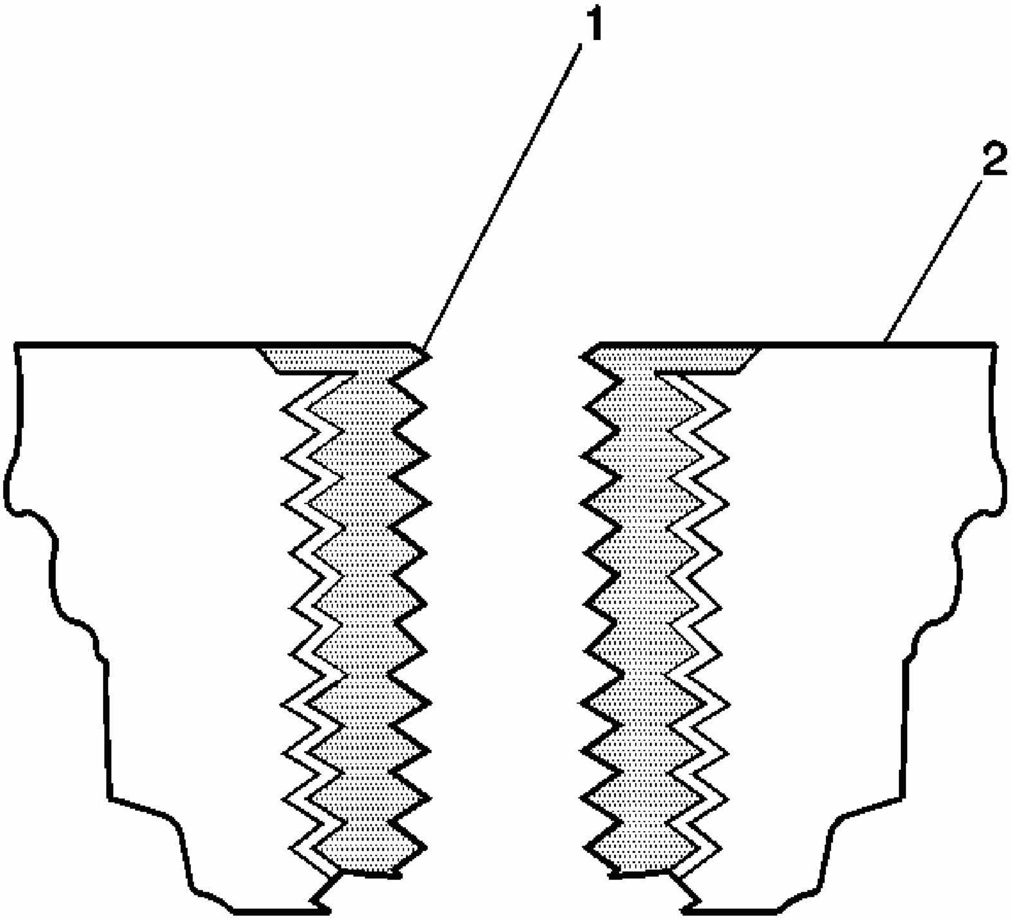


Fig. 536: View Of Bushing Type Insert & Base Material
Courtesy of GENERAL MOTORS CORP.

The thread repair process involves a solid, thin walled, self-locking, carbon steel, bushing type insert (1). During the bushing installation process, the driver tool expands the bottom external threads of the insert into the base material (2). This action mechanically locks the insert in place. Also, when installed to the proper depth, the flange of the insert will be seated against the counterbore of the repaired hole.

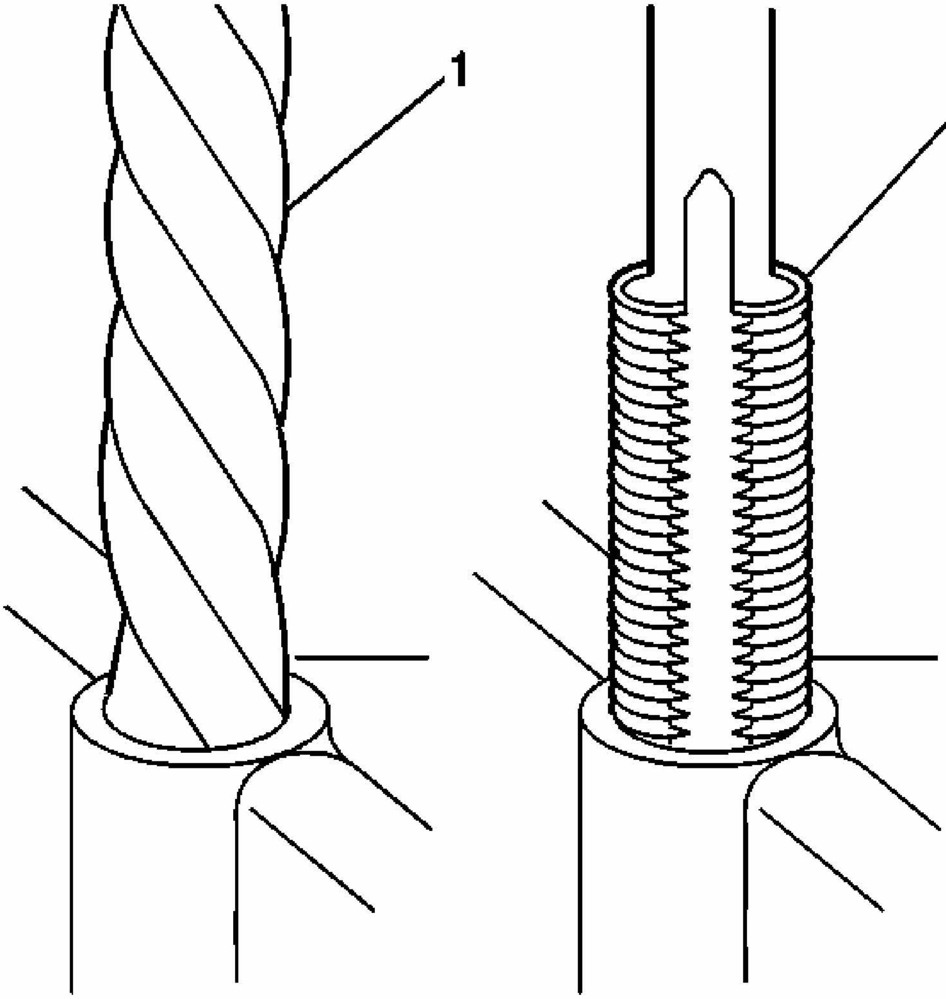


Fig. 537: Drilling & Tapping Threads
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.

IMPORTANT:

- **The use of a cutting type fluid GM P/N 1052864 (Canadian P/N 992881), WD 40®, or equivalent, is recommended when performing the drilling, counterboring, and tapping procedures.**

- **Driver oil MUST be used on the installer driver tool.**
- **The tool kits are designed for use with either a suitable tap wrench or drill motor.**

1. Drill out the threads of the damaged hole (1).
    - M6 inserts require a minimum drill depth of 15 mm (0.59 in).
    - M8 inserts require a minimum drill depth of 20 mm (0.79 in).
    - M10 inserts require a minimum drill depth of 23.5 mm (0.93 in).
2. Using compressed air, clean out any chips.

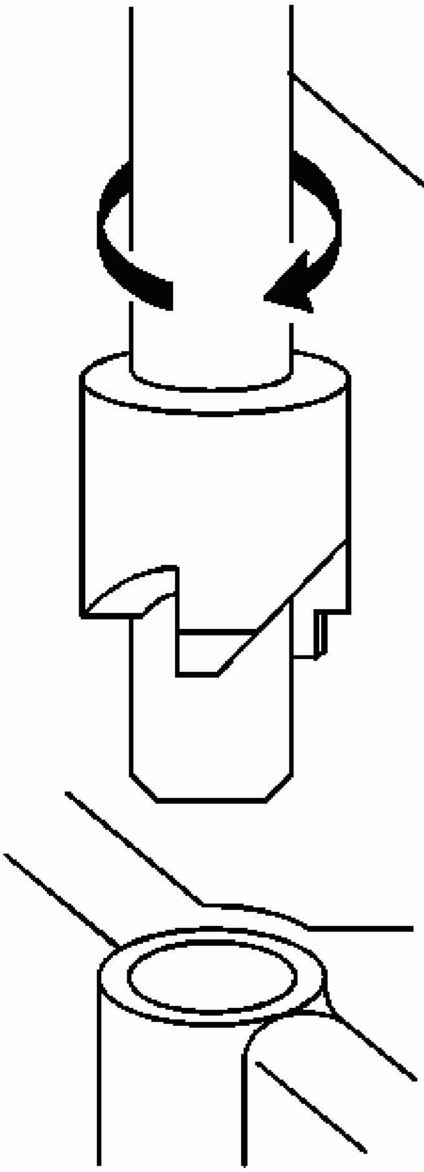


Fig. 538: View Of Counterbore Drill
Courtesy of GENERAL MOTORS CORP.

3. Counterbore the hole to the full depth permitted by the tool (1).
4. Using compressed air, clean out any chips.

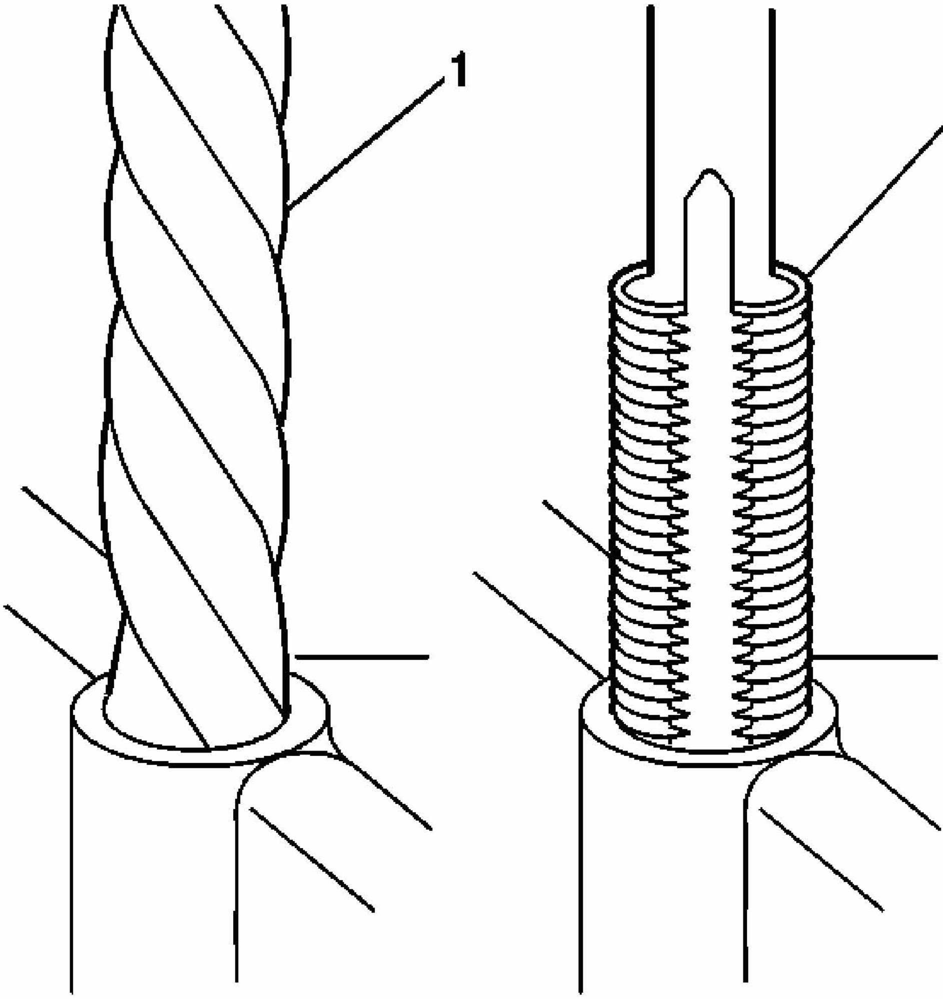


Fig. 539: Drilling & Tapping Threads
Courtesy of GENERAL MOTORS CORP.

5. Using a tap wrench (2), tap the threads of the drilled hole.
    - M6 inserts require a minimum tap depth of 15 mm (0.59 in).
    - M8 inserts require a minimum tap depth of 20 mm (0.79 in).
    - M10 inserts require a minimum tap depth of 23.5 mm (0.93 in).
6. Using compressed air, clean out any chips.
7. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463), or equivalent, into the hole.
8. Using compressed air, clean any cutting oil and chips out of the hole.

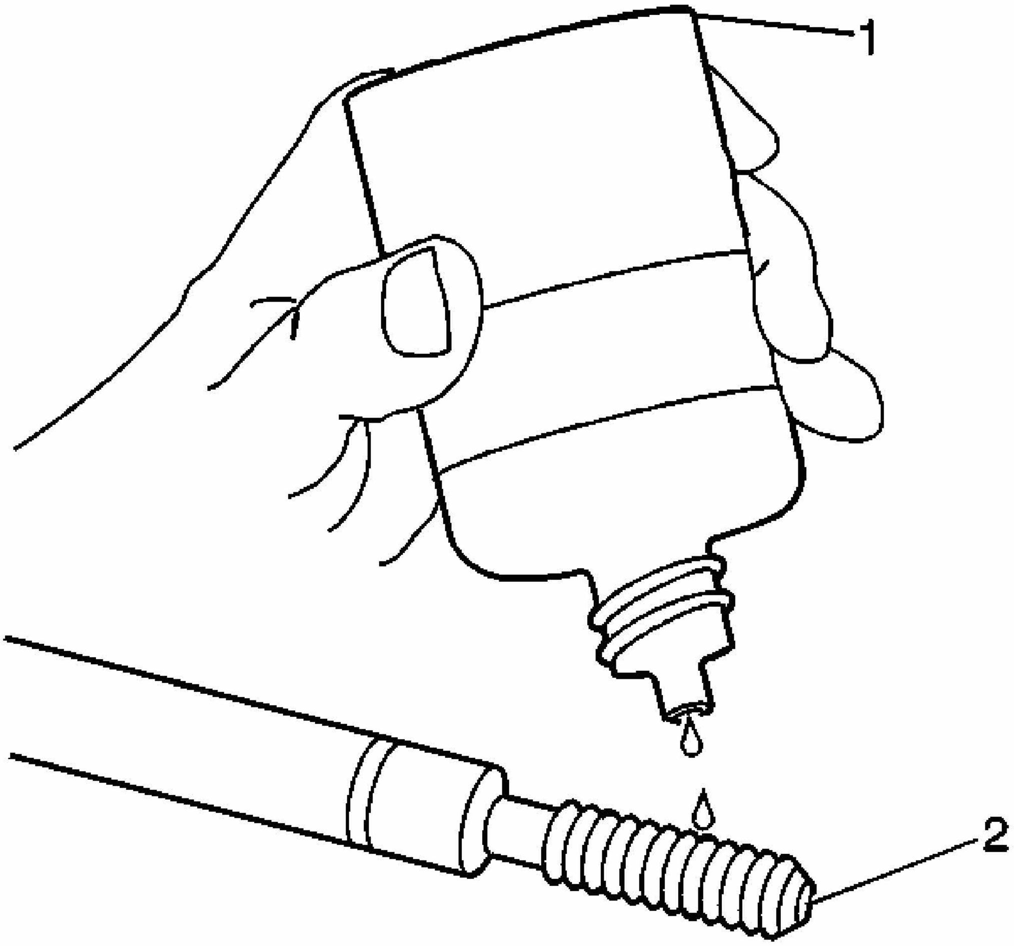


Fig. 540: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

9. Lubricate the threads of the installer tool (2) with the driver oil (1).

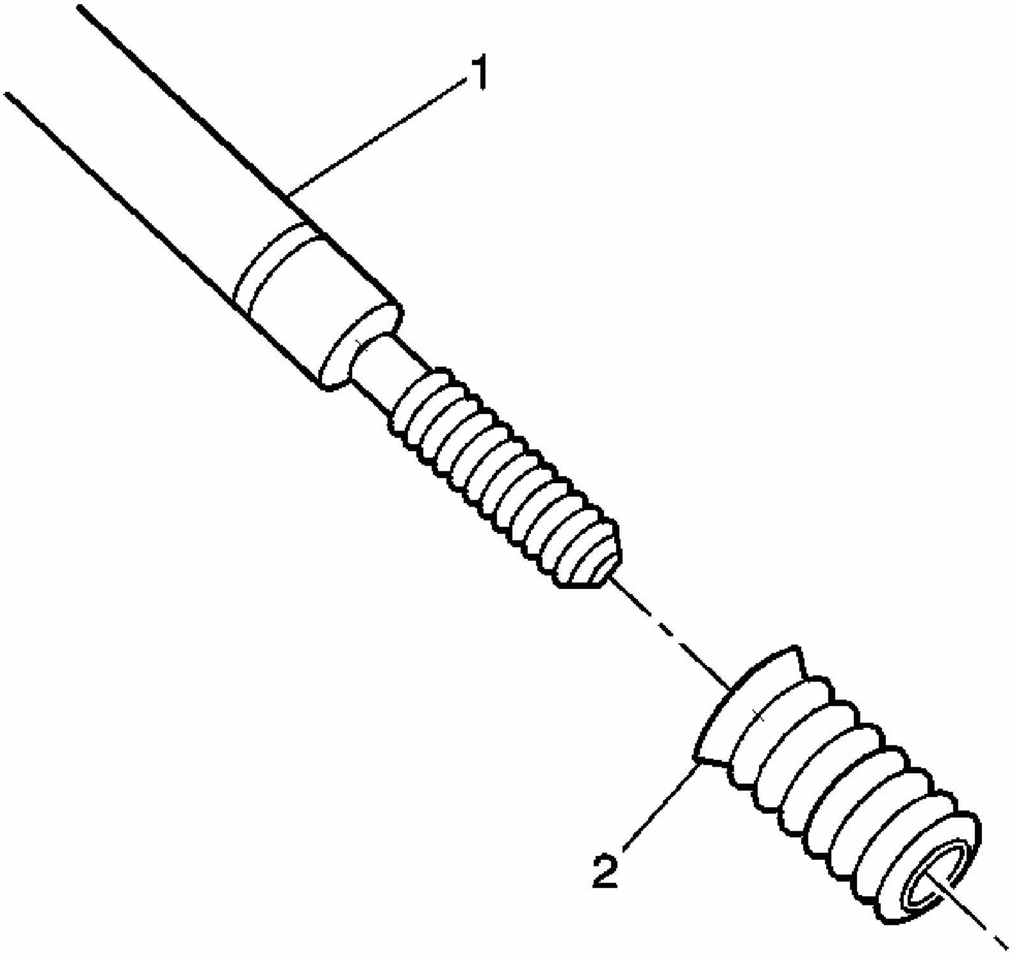


Fig. 541: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

10. Install the insert (2) onto the driver tool (1).

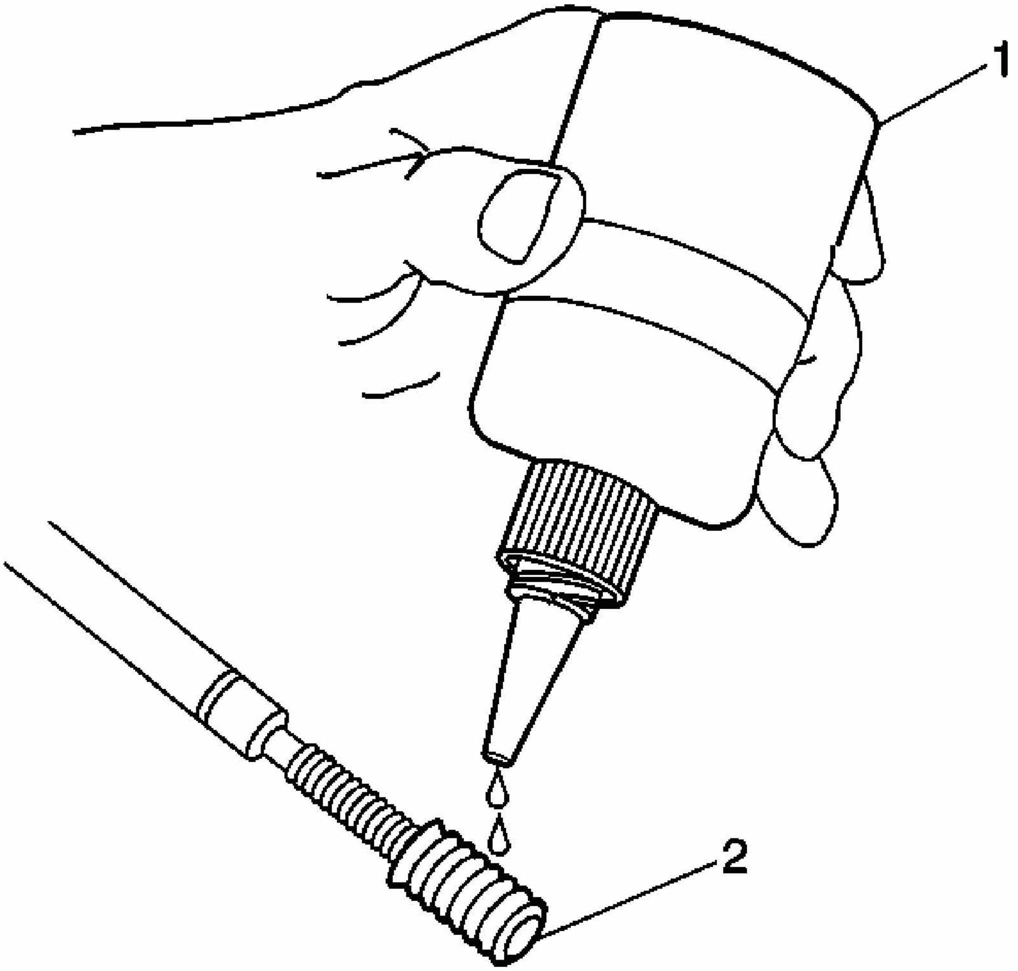


Fig. 542: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

11. Apply threadlock LOCTITE™ 277, J 42385-109 (1), or equivalent, to the insert OD threads (2).

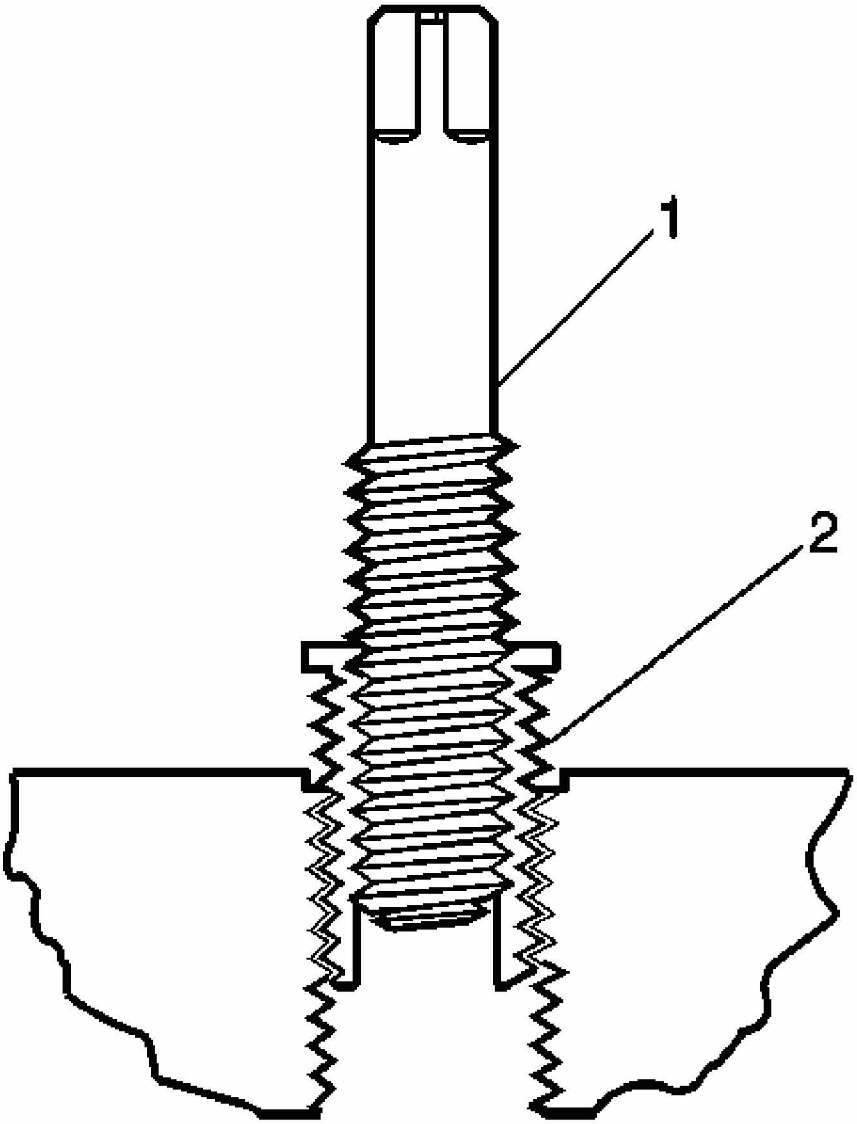


Fig. 543: Installing Insert Into Tapped Bolt Hole
Courtesy of GENERAL MOTORS CORP.

12. Install the insert (2) into the hole.

    Install the insert until the flange of the insert contacts the counterbored surface. Continue to rotate the installer tool (1) through the insert.

    The installer tool will tighten up before screwing completely through the insert. This is acceptable. You are forming the bottom threads of the insert and mechanically locking the insert to the base material threads.

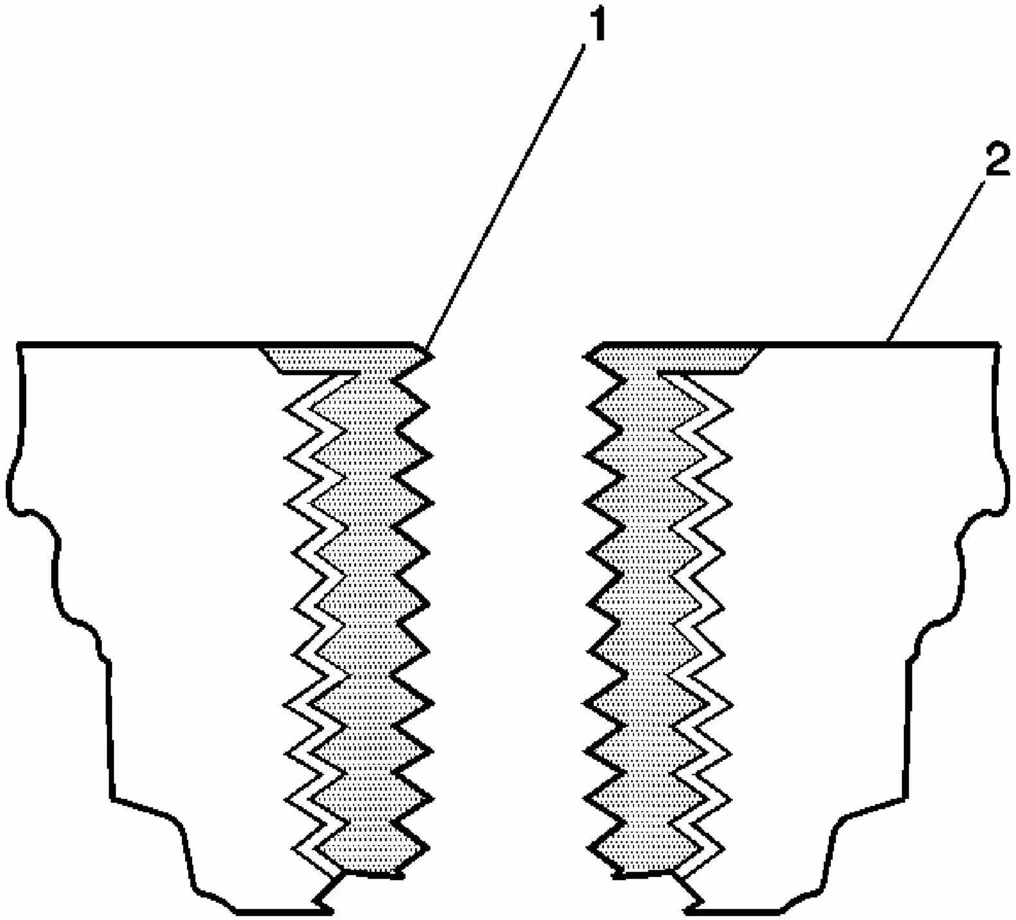


Fig. 544: View Of Bushing Type Insert & Base Material
Courtesy of GENERAL MOTORS CORP.

13. Inspect the insert for proper installation into the hole.

    A properly installed insert (1) will be either flush or slightly below flush with the surface of the base material (2).

Cylinder Head Bolt Hole Thread Repair

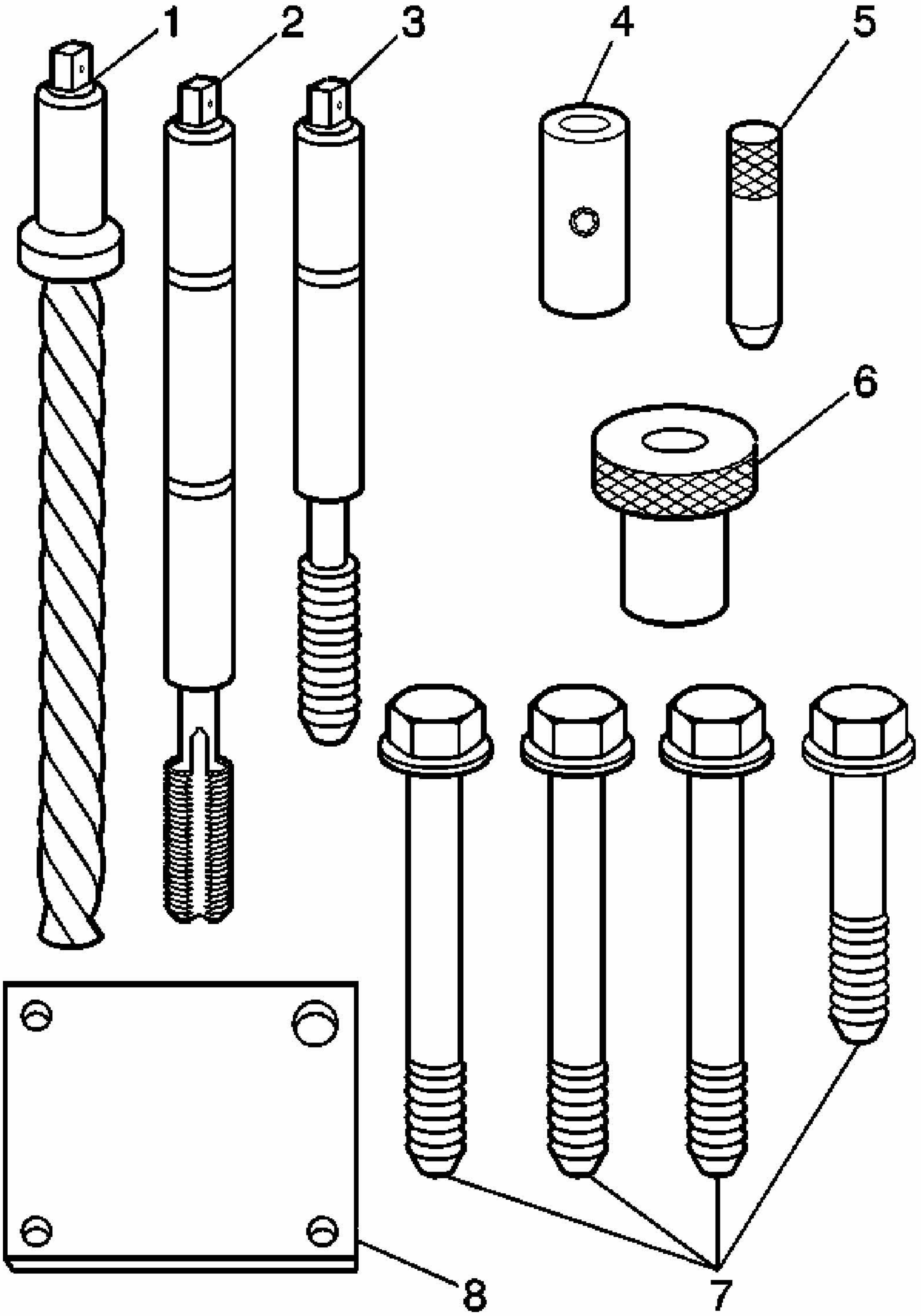


Fig. 545: Identifying Thread Repair Kit Components
Courtesy of GENERAL MOTORS CORP.

1. The cylinder head bolt hole thread repair kit consists of the following items:
    - The drill (1)
    - The tap (2)
    - The installer (3)
    - The sleeve (4)
    - The alignment pin (5)
    - The bushing (6)
    - The bolts (7)
    - The fixture plate (8)

CAUTION: Refer to SAFETY GLASSES CAUTION in Cautions and Notices.

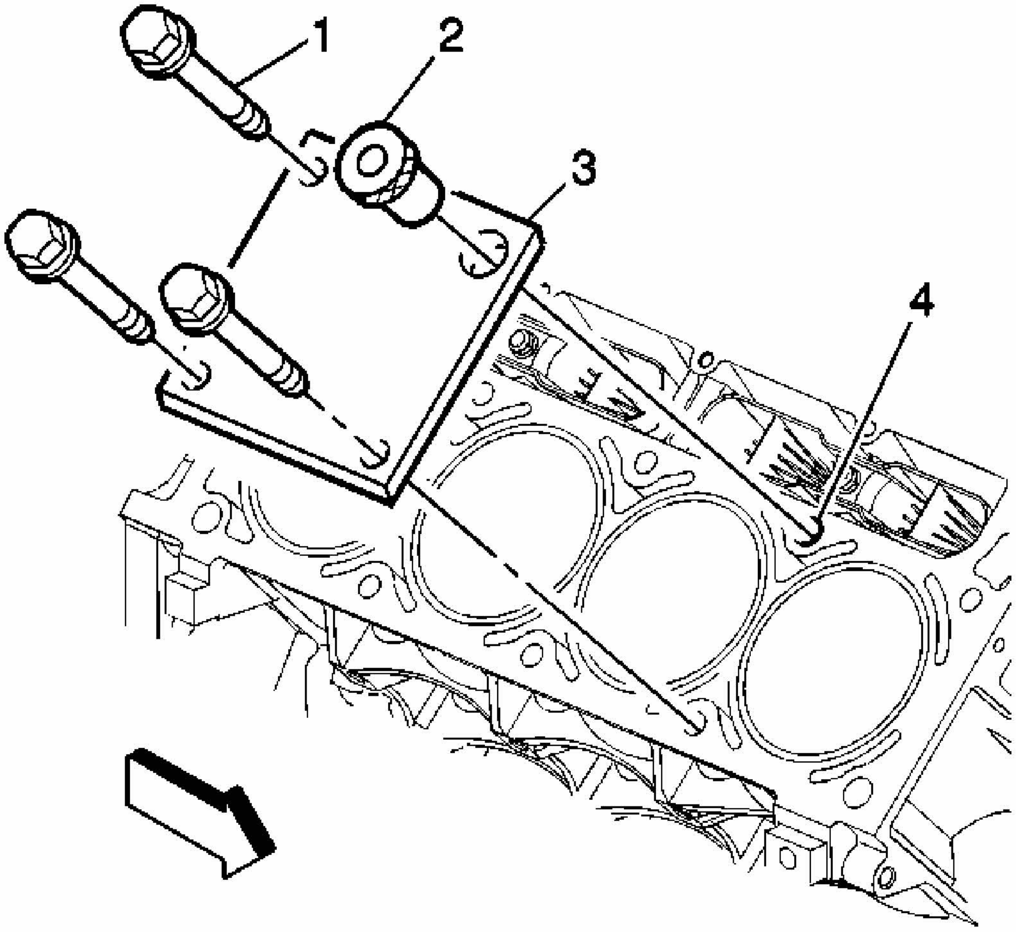


Fig. 546: View Of Fixture Plate, Bolts, Bushing & Cylinder Hole
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **The use of a cutting type fluid GM P/N 1052864 (Canadian P/N 992881), WD 40®, or equivalent, is recommended when performing the drilling and tapping procedures.**
- **Driver oil MUST be used on the installer driver tool.**
- **The tool kits are designed for use with either a suitable tap wrench or drill motor.**

2. Install the fixture plate (3), bolts (1), and bushing (2) onto the engine block deck.

   Position the fixture plate and bushing over the hole that is to be repaired (4).

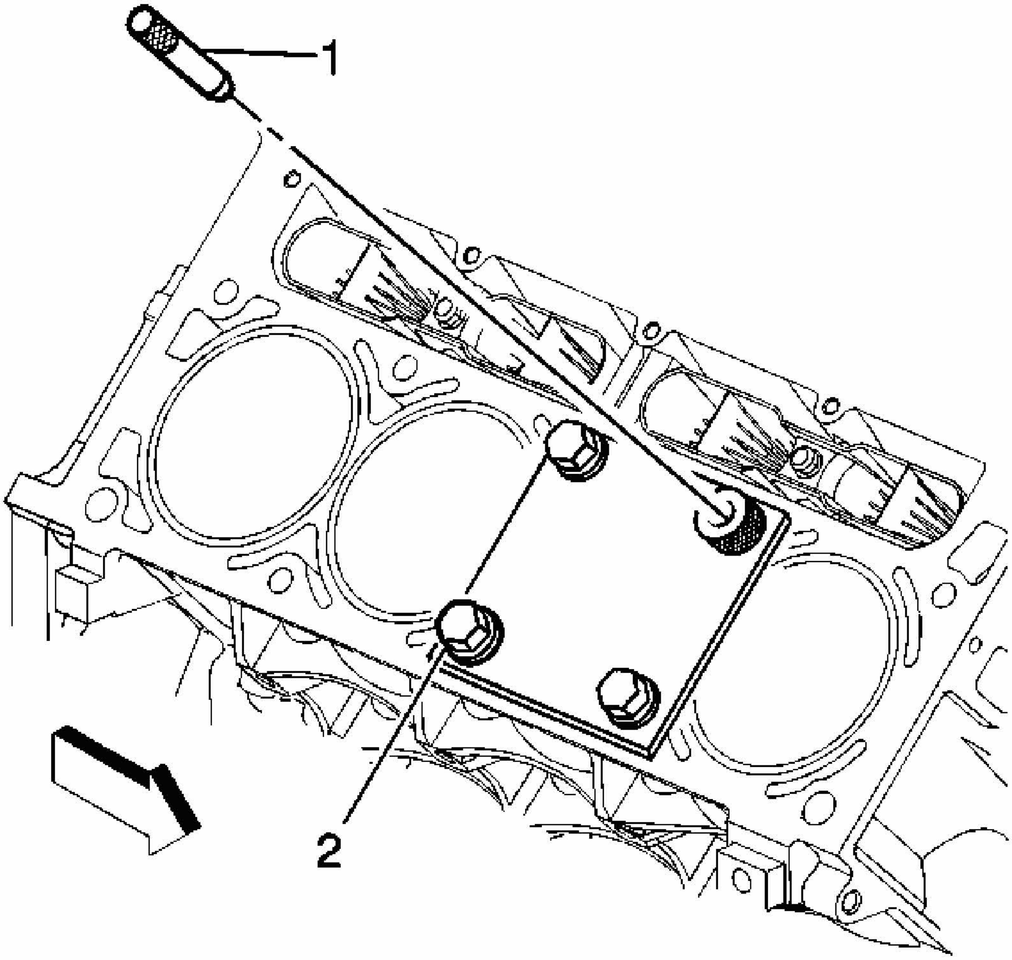


Fig. 547: View Of Alignment Pin & Fixture Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

3. Position the alignment pin (1) through the bushing and into the hole.
4. With the alignment pin in the desired hole, tighten the fixture retaining bolts (2).
5. Remove the alignment pin from the hole.

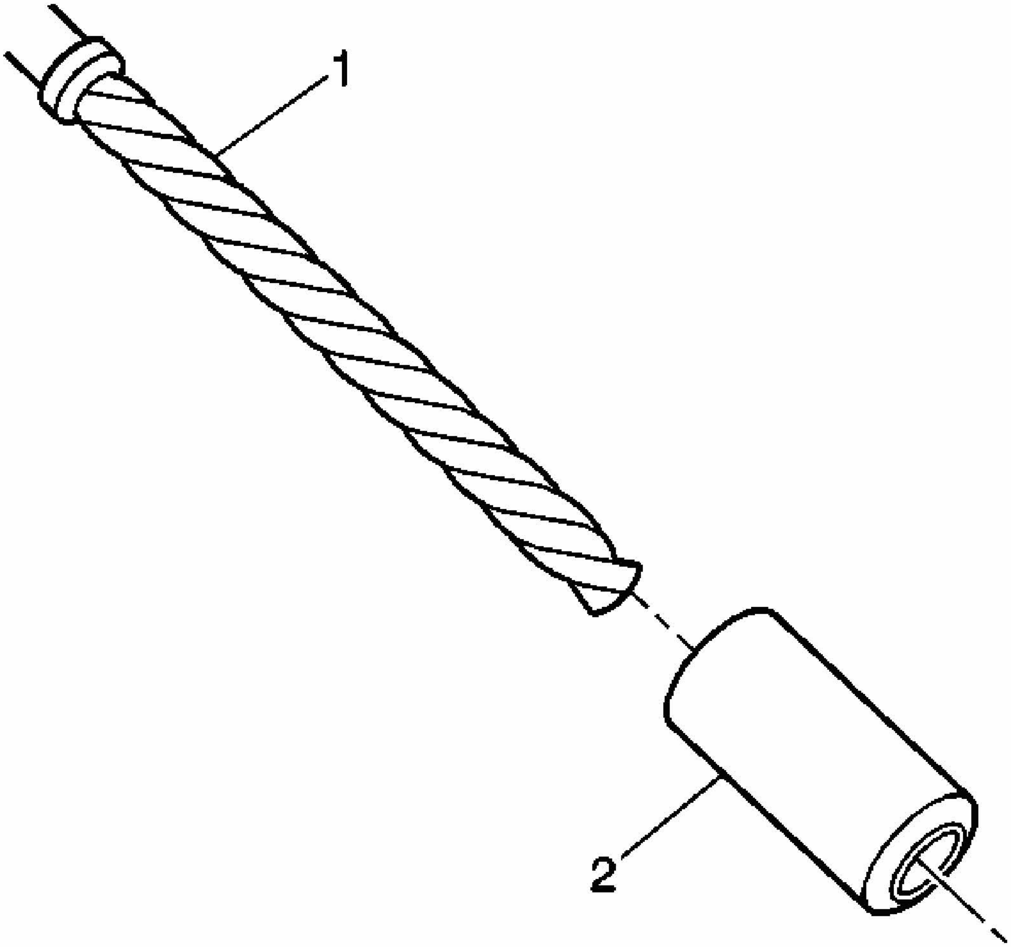


Fig. 548: View Of Stop Collar & Counterbore Drill
Courtesy of GENERAL MOTORS CORP.

6. Install the sleeve (2) onto the drill (1).

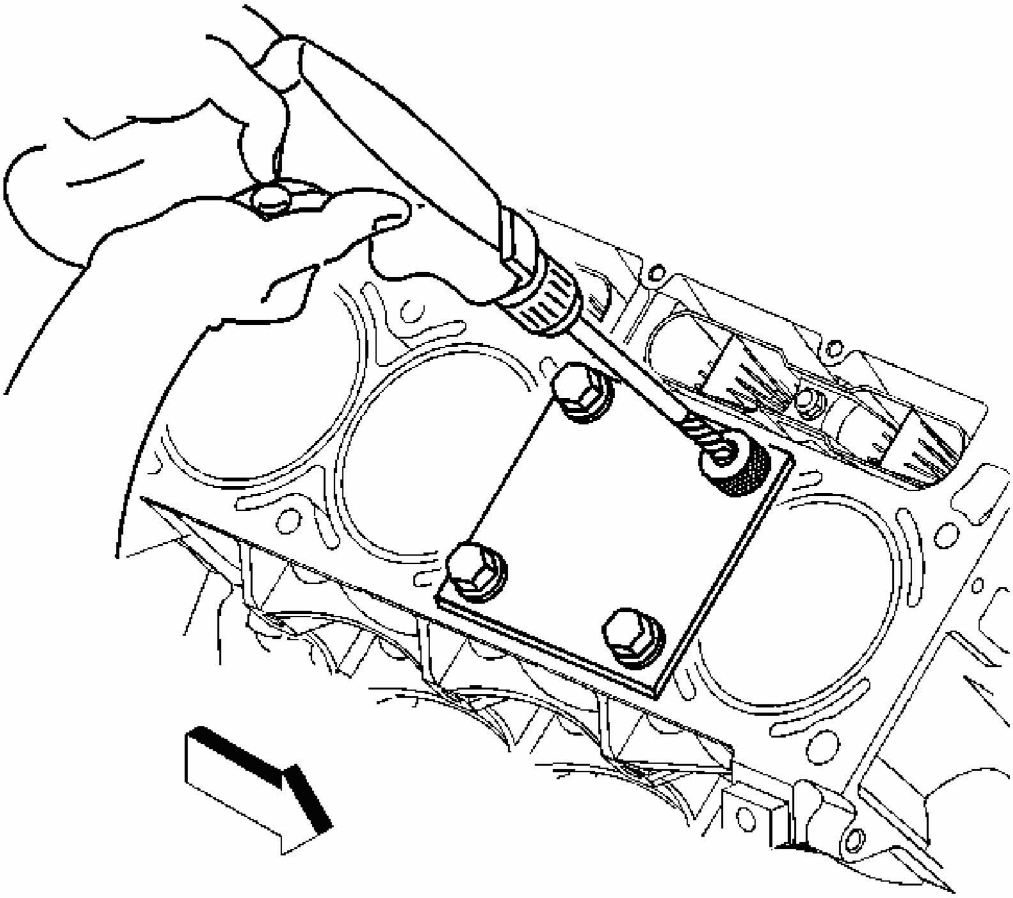


Fig. 549: Drilling Cylinder Head Bolt Hole
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: During the reaming process, it is necessary to repeatedly remove the drill and clean the chips from the hole.

7. Drill out the threads of the damaged hole.

   Drill the hole until the stop collar of the drill bit or the sleeve contacts the bushing.

8. Using compressed air, clean out any chips.

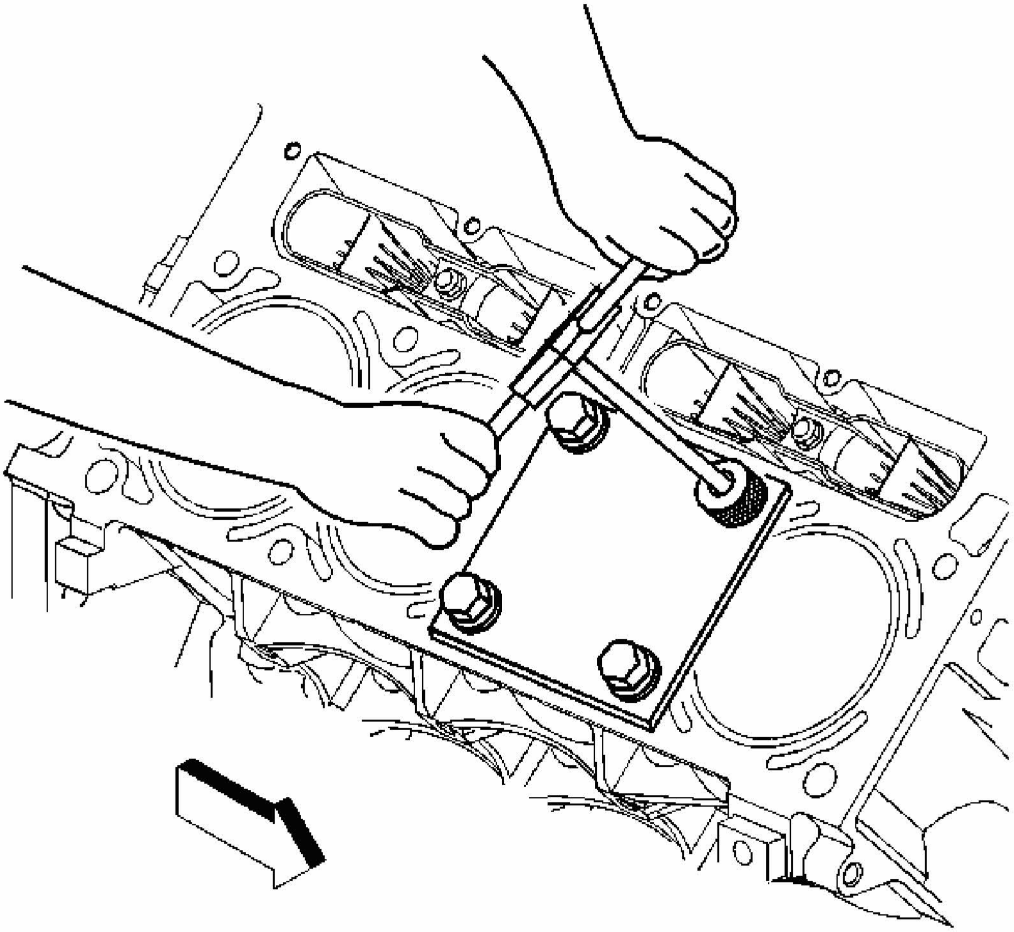


Fig. 550: Tapping Threads Of Drilled Hole Using Tapping Wrench
Courtesy of GENERAL MOTORS CORP.

9. Using a tap wrench, tap the threads of the drilled hole.

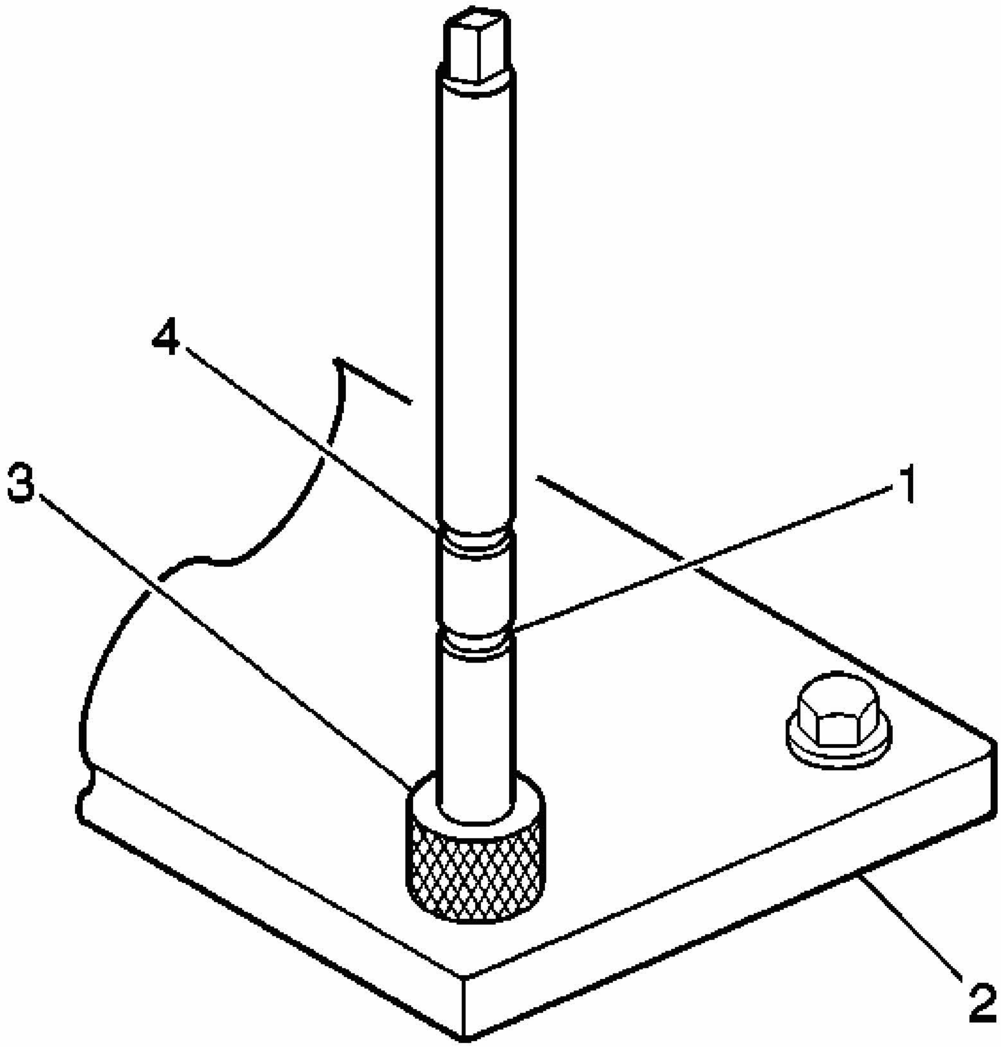


Fig. 551: View Of Tap Upper & Lower Marks, Fixture Plate & Bushing
Courtesy of GENERAL MOTORS CORP.

10. In order to tap the new threads to the proper depth, rotate the tap into the hole until the mark (1) on the tap aligns with the top of the drill bushing (3).
11. Remove the fixture plate (2), bushing (3), and bolts.
12. Using compressed air, clean out any chips.
13. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463), or equivalent, into the hole.
14. Using compressed air, clean any cutting oil and chips out of the hole.

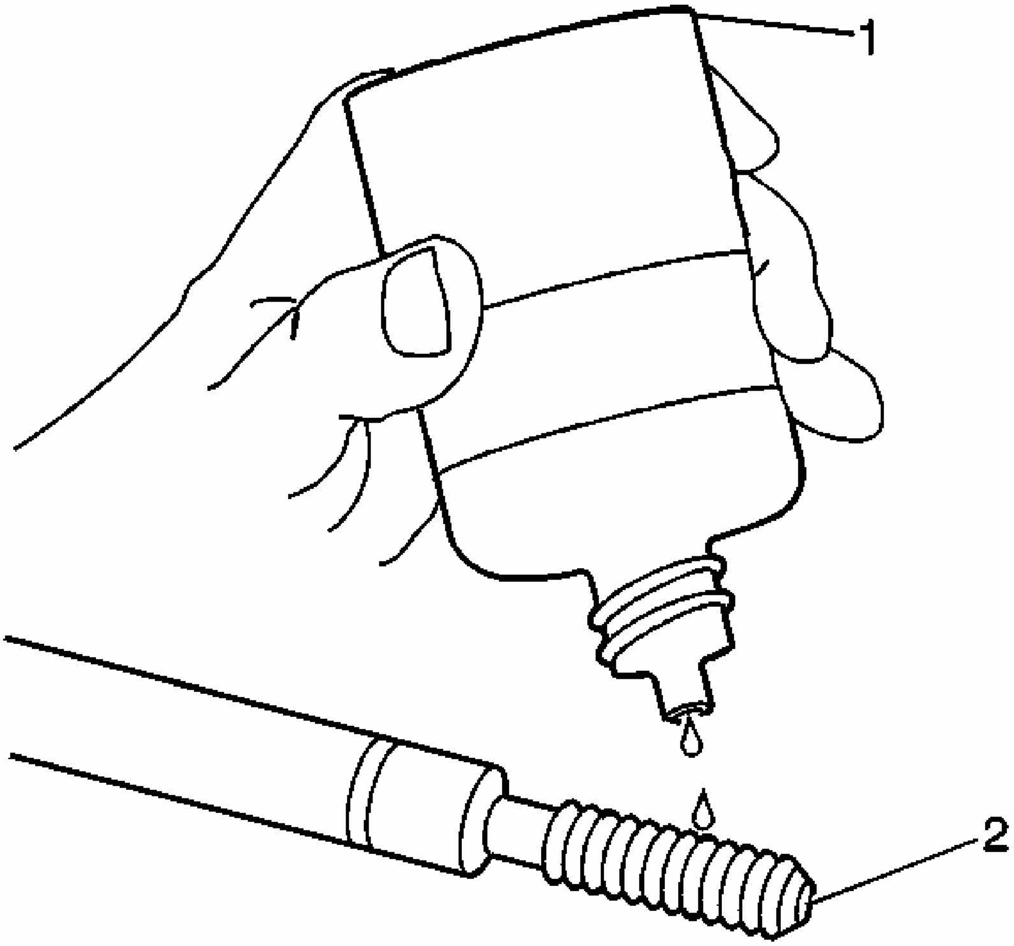


Fig. 552: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not allow oil or foreign material to contact the OD of the insert.

15. Lubricate the threads of the installer tool (2) with the driver oil (1).

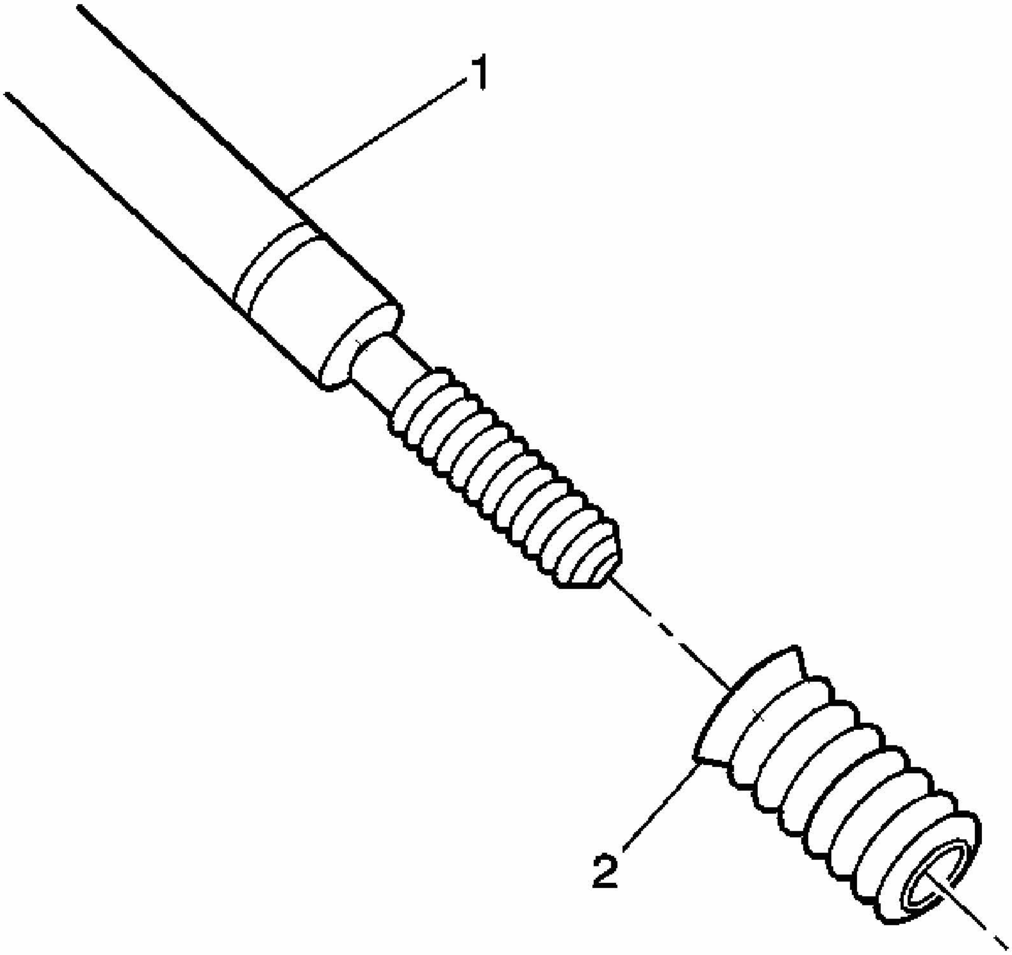


Fig. 553: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

16. Install the insert (2) onto the driver tool (1).

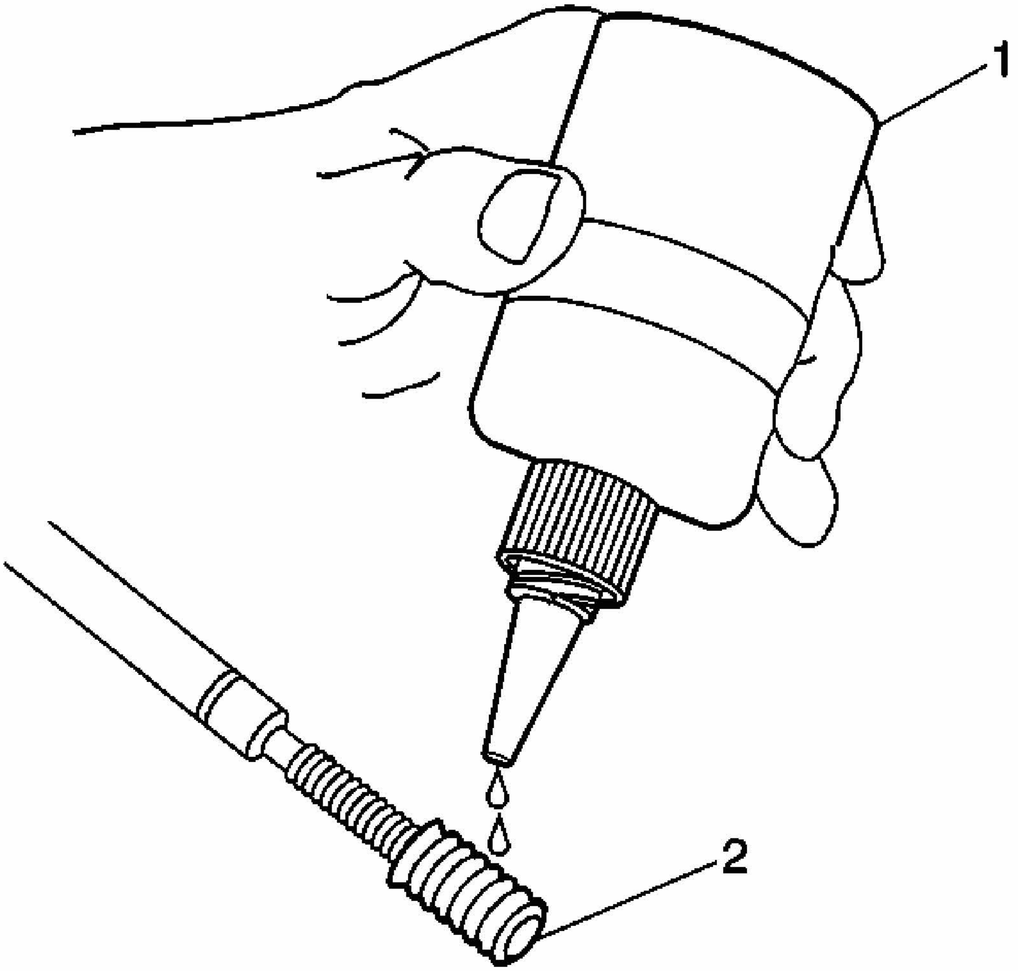


Fig. 554: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

17. Apply threadlock LOCTITE™ 277, J 42385-109 (1), or equivalent, to the insert OD threads (2).

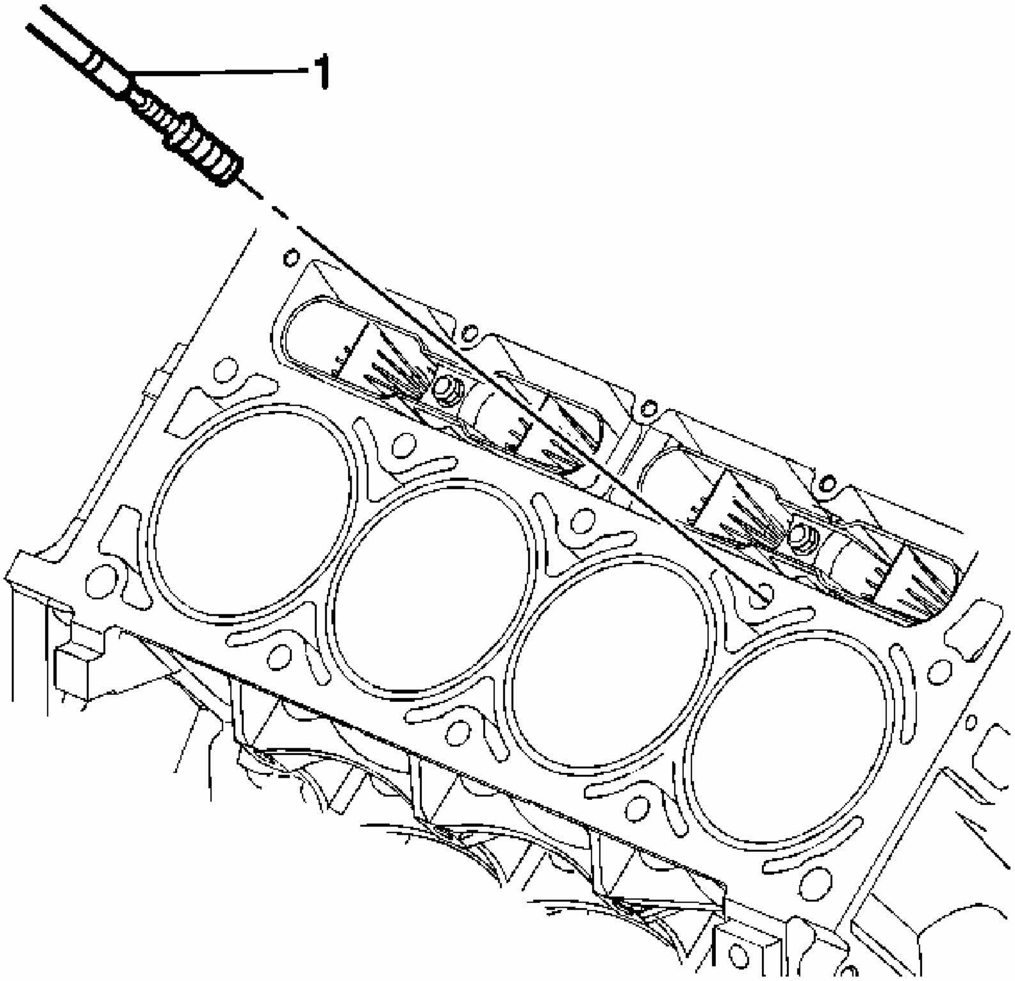


Fig. 555: Installing Insert & Driver Into Cylinder Bolt Hole
Courtesy of GENERAL MOTORS CORP.

18. Install the insert and driver (1) into the hole.

    Rotate the driver tool until the mark on the tool aligns with the deck surface of the engine block.

    The installer tool will tighten up before screwing completely through the insert. This is acceptable. You are forming the bottom threads of the insert and mechanically locking the insert to the base material threads.

Main Cap Bolt Hole Thread Repair

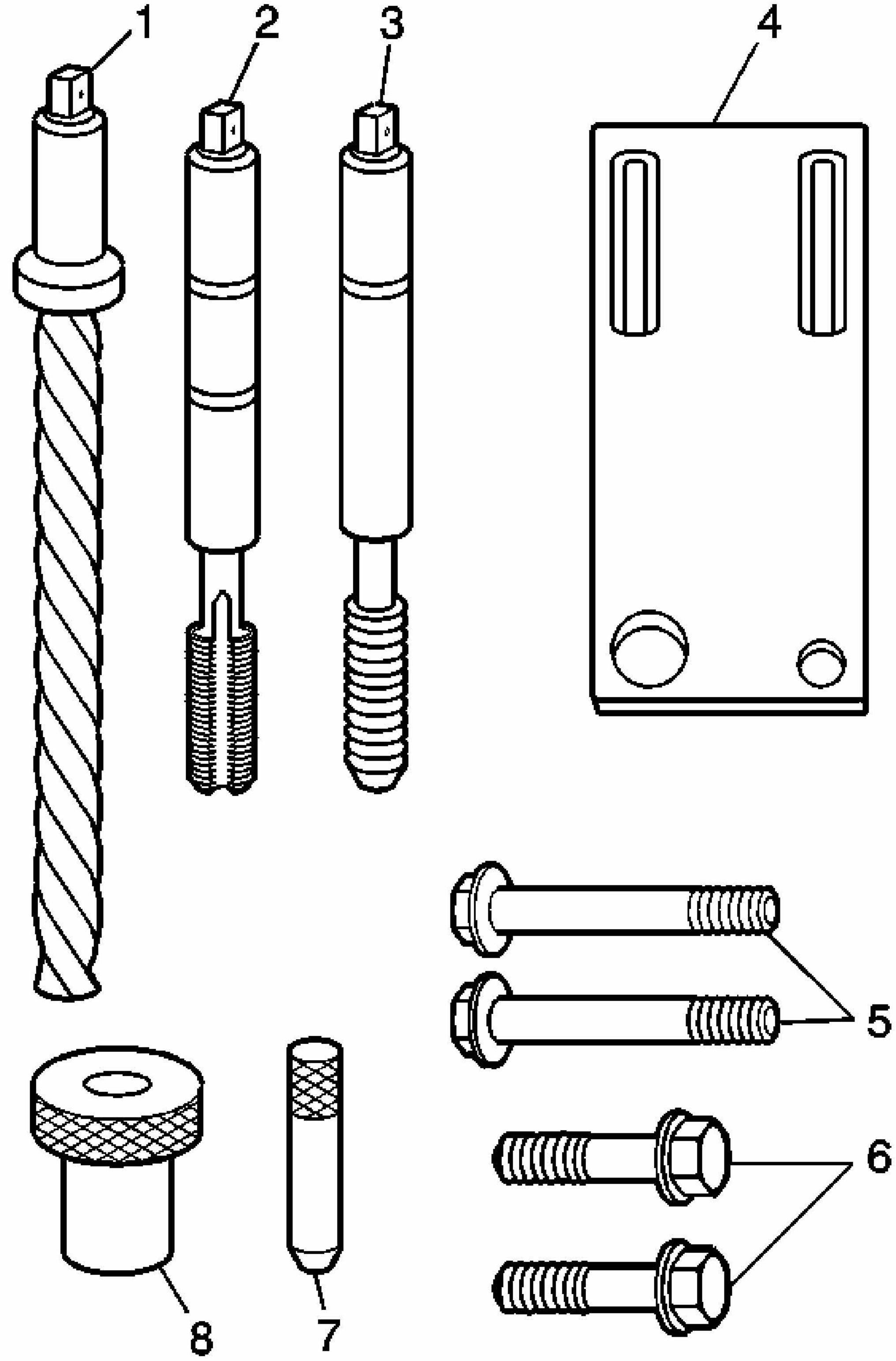


Fig. 556: Identifying Thread Repair Kit Components
Courtesy of GENERAL MOTORS CORP.

1. The main cap bolt hole thread repair kit consists of the following items:
   - The drill (1)
   - The tap (2)
   - The installer (3)
   - The fixture plate (4)
   - The long bolts (5)
   - The short bolts (6)
   - The alignment pin (7)
   - The bushing (8)

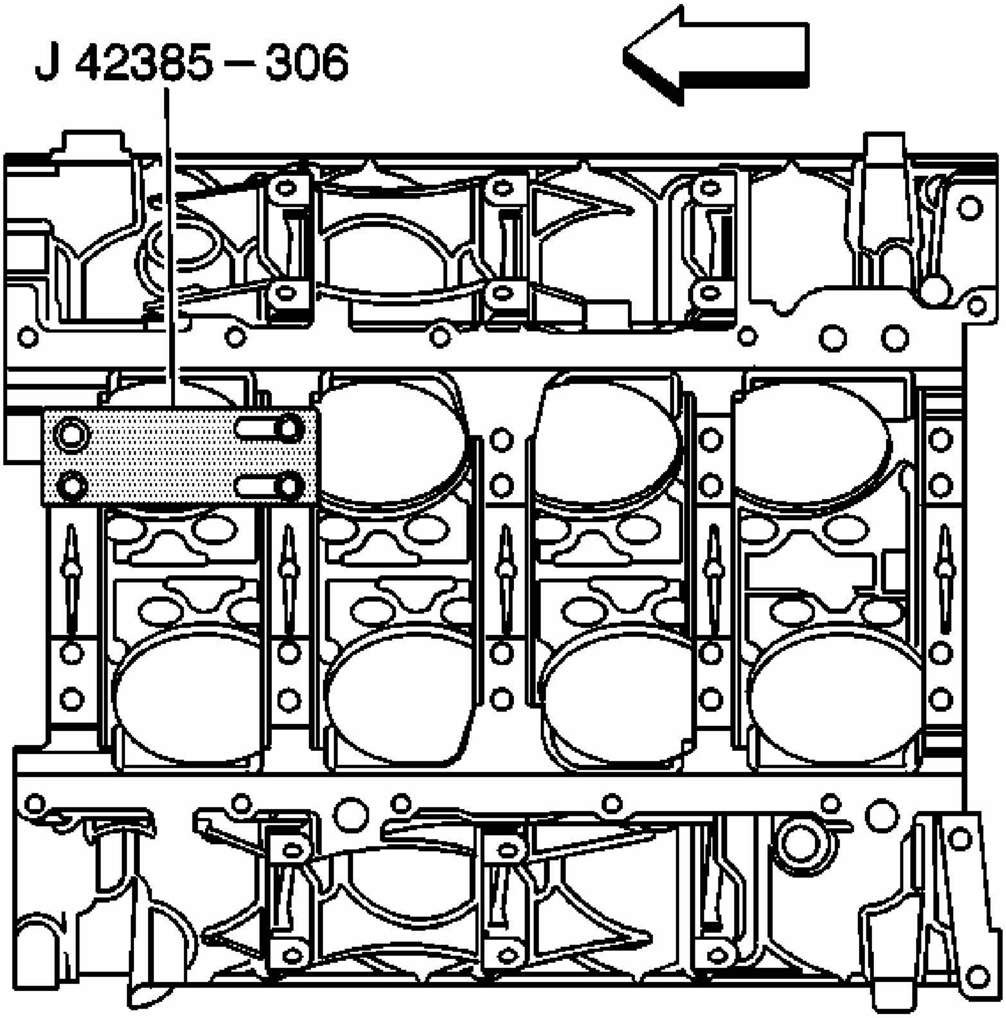


Fig. 557: View Of Fixture Plate, Bolt & Bushing
Courtesy of GENERAL MOTORS CORP.

2. Install the fixture plate, bolt, and bushing onto the engine block.

   Position the fixture plate and bushing over the hole that is to be repaired.

3. Position the alignment pin in the desired hole and tighten the fixture retaining bolts.

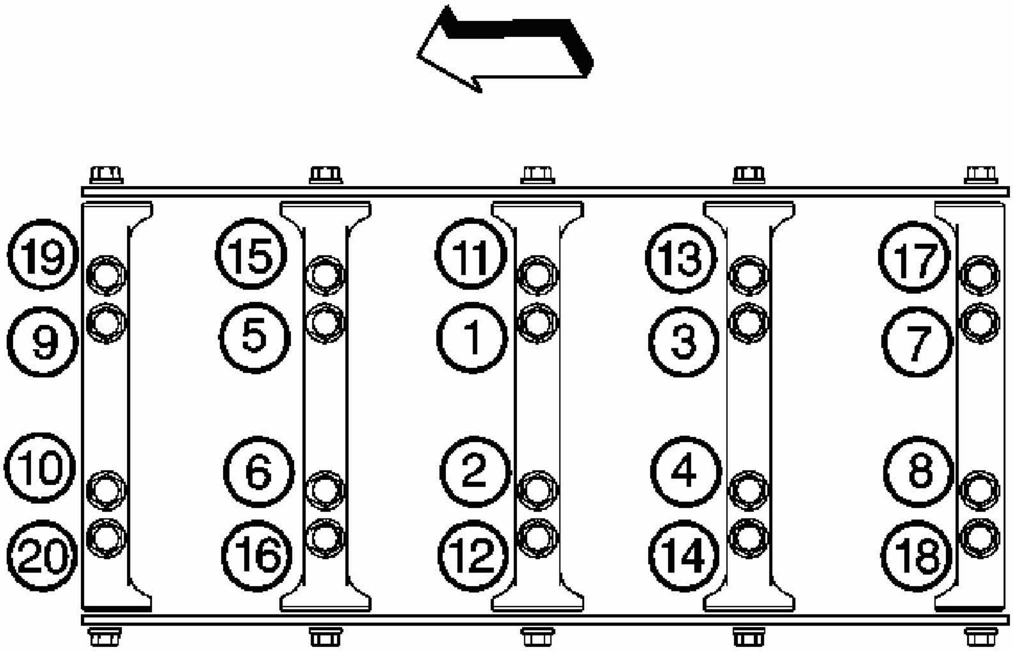


Fig. 558: Crankshaft Main Bearing Cap Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

4. Drill out the damaged hole.

   The outer bolt hole locations 11-20 have the shallower counterbores. Use sleeve J 42385-316 with the drill.

   Drill until the stop collar of the drill bit or the sleeve contacts the bushing.

5. Using compressed air, clean out any chips.

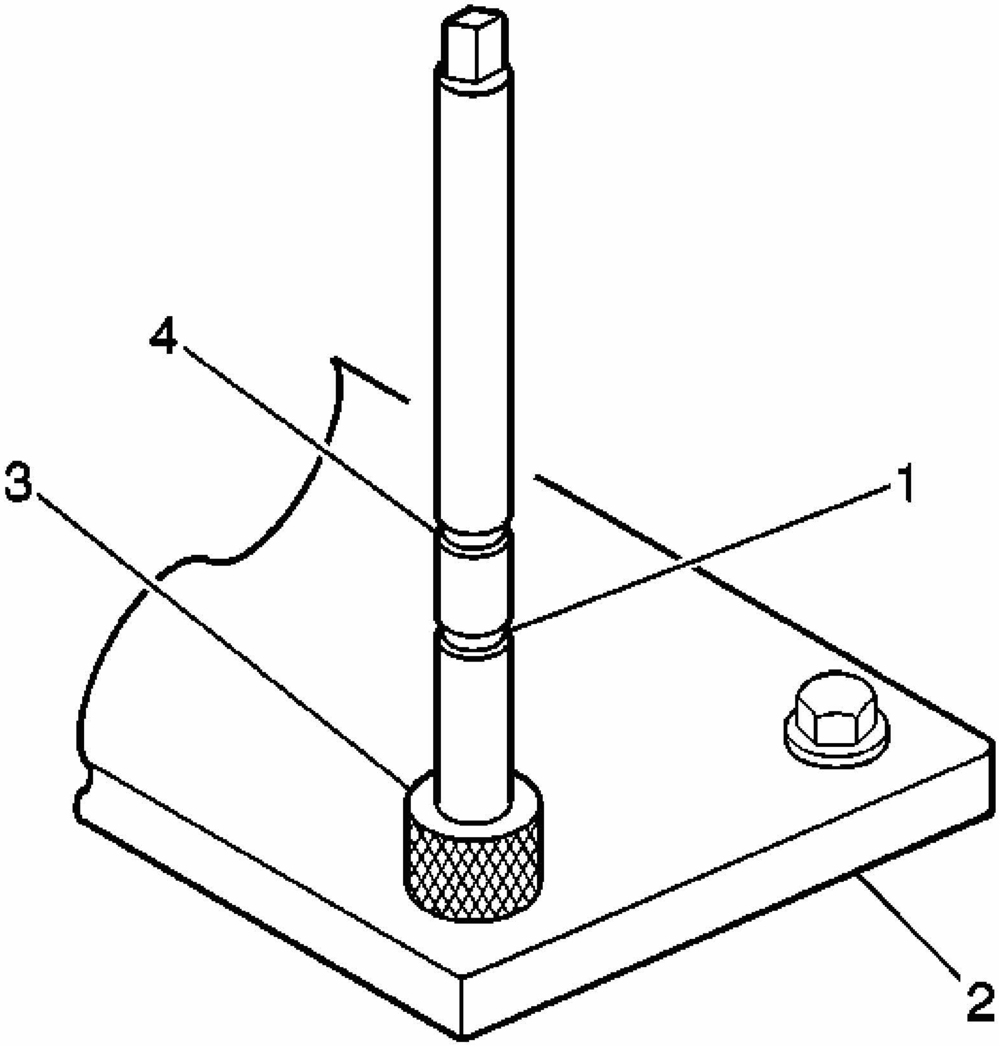


Fig. 559: View Of Tap Upper & Lower Marks, Fixture Plate & Bushing
Courtesy of GENERAL MOTORS CORP.

6. Using a tap wrench, tap the threads of the drilled hole.

   In order to tap the new threads to the proper depth, rotate the tap into the hole until the mark on the tap aligns with the top of the bushing.

   For the deeper main cap holes 1-10, rotate the tap until the upper mark (4) on the tap aligns with the top of the bushing (3).

   For the shallower main cap holes 11-20, rotate the tap until the lower mark (1) on the tap aligns with top of the bushing (3).

7. Using compressed air, clean out any chips.
8. Spray cleaner GM P/N 12346139 (Canadian P/N 10953463), or equivalent, into the hole.
9. Using compressed air, clean any cutting oil and chips out of the hole.

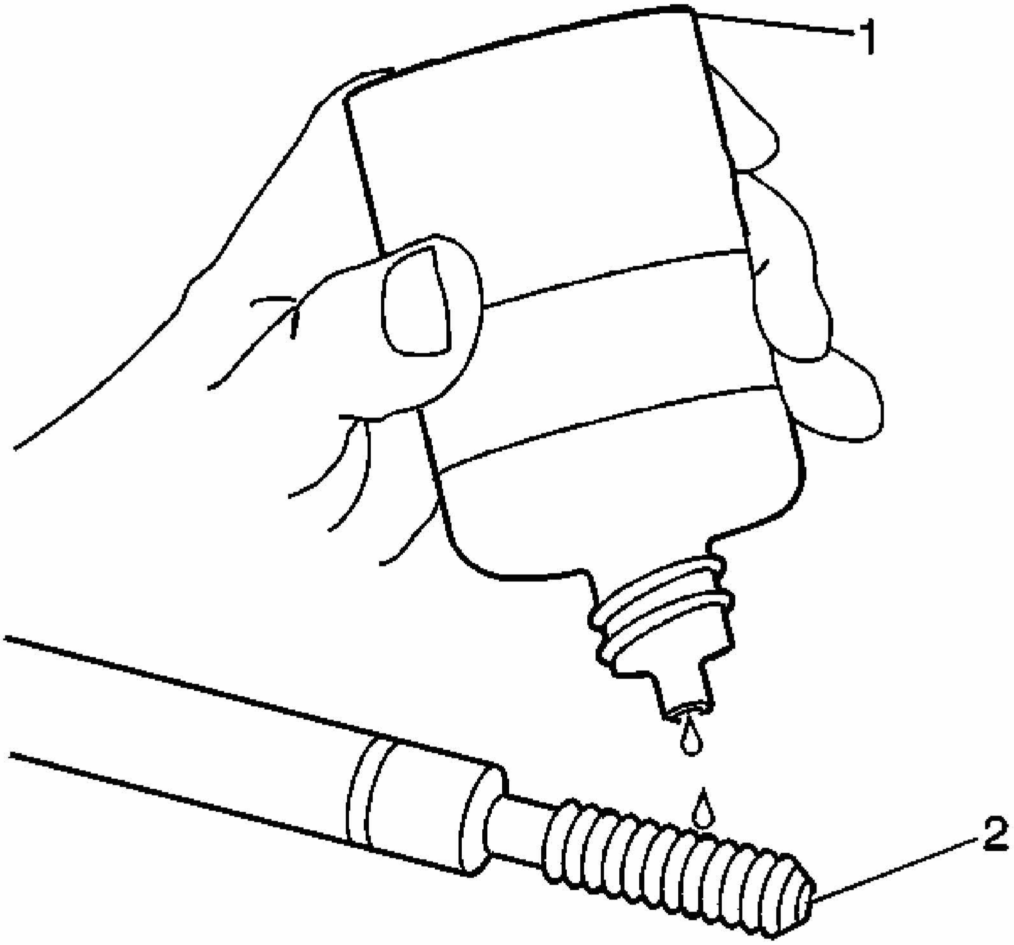


Fig. 560: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not allow oil or foreign material to contact the OD of the insert.

10. Lubricate the threads of the installer tool (2) with the driver oil (1).

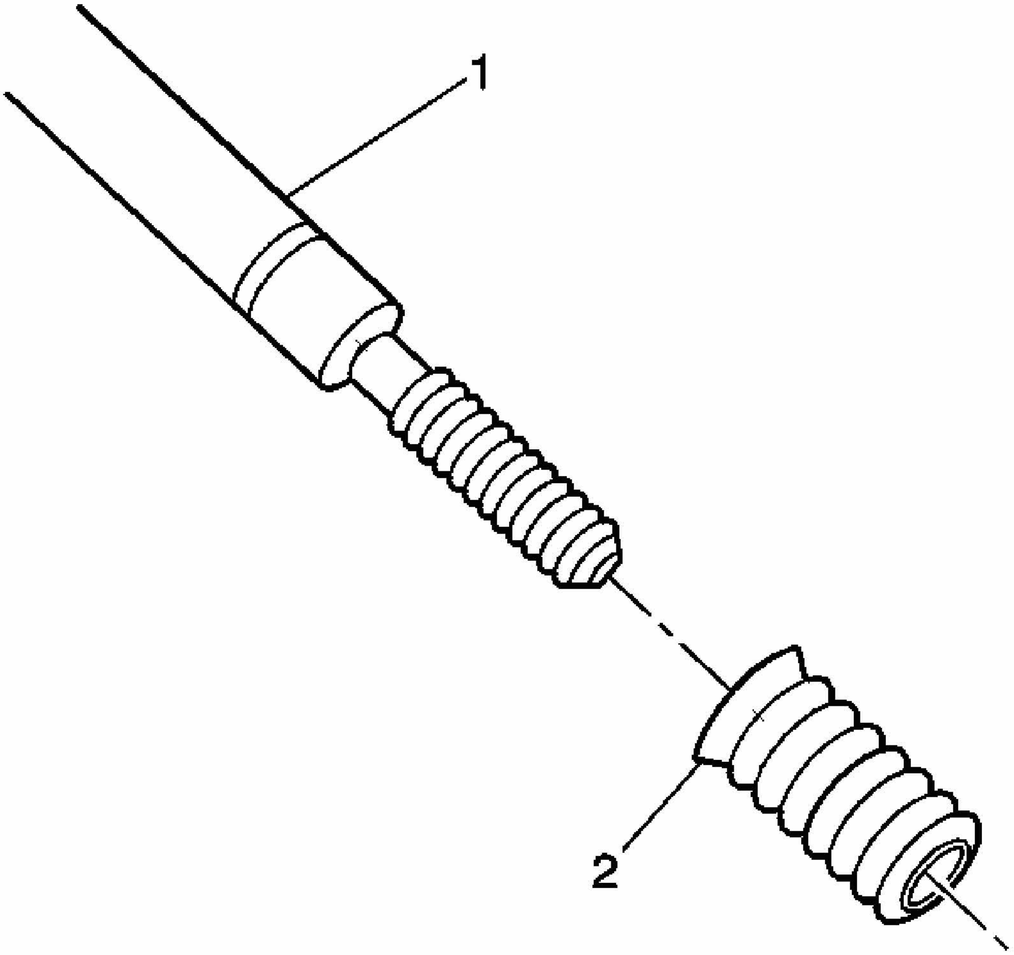


Fig. 561: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

11. Install the insert (2) onto the driver tool (1).

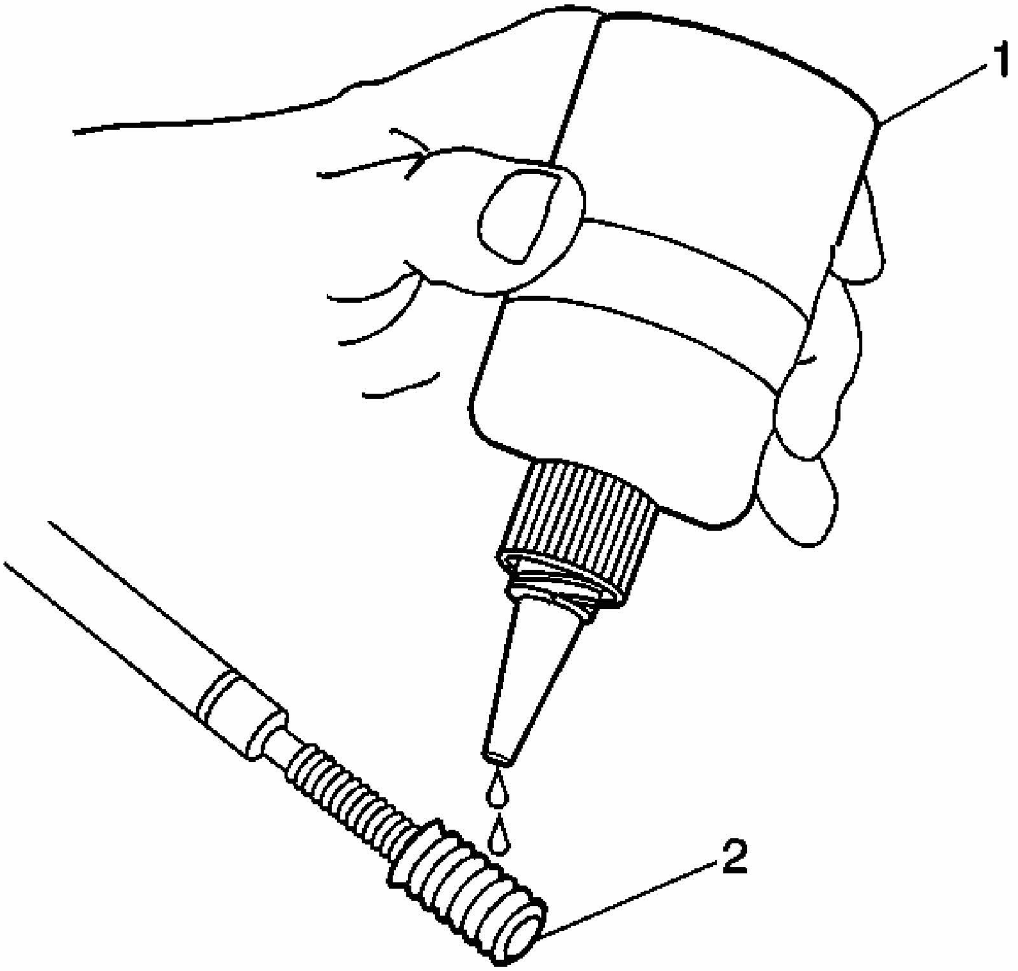


Fig. 562: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

12. Apply threadlock LOCTITE™ 277, J 42385-109 (1), or equivalent, to the insert OD threads (2).

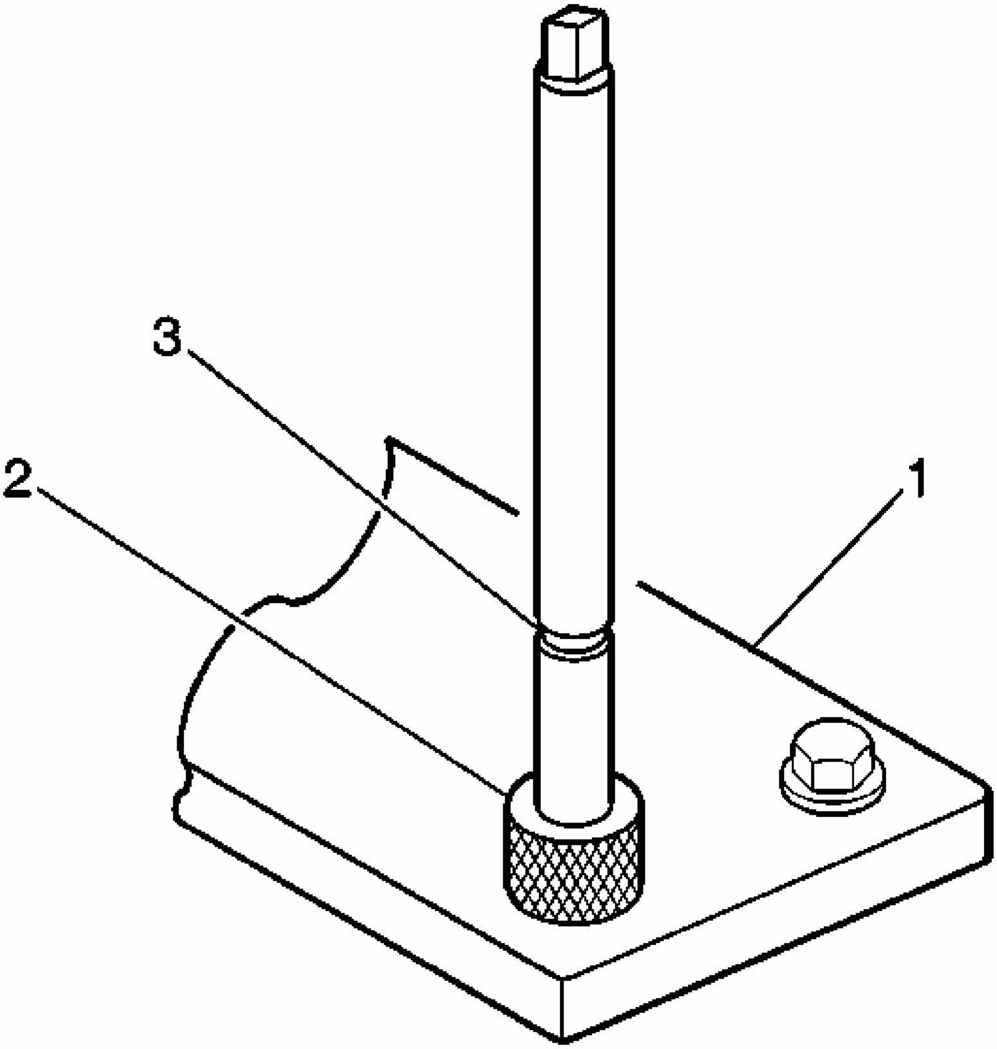


Fig. 563: View Of Fixture Plate, Drill Bushing & Tool Marking
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The fixture plate and bushing remains installed onto the engine block during the insert installation procedure.

13. Install the insert and driver (1) through the fixture plate and bushing and into the hole.

    Rotate the driver tool until the mark on the tool (3) aligns with the top of the bushing (2).

    The installer tool will tighten up before screwing completely through the insert. This is acceptable. You are forming the bottom threads of the insert and mechanically locking the insert to the base material threads.

SERVICE PRIOR TO ASSEMBLY

- Dirt or debris will cause premature wear of the rebuilt engine. Clean all components. Refer to **Cleanliness and Care**.
- Use the proper tools to measure components when inspecting for excessive wear. Components that are not within the manufacturers specifications must be repaired or replaced.
- When the components are installed into an engine, return the components to their original location, position and direction. Refer to **Separating Parts**.
- During assembly, lubricate all moving parts with clean engine oil. This provides initial lubrication when the engine is first started.

ENGINE BLOCK PLUG INSTALLATION

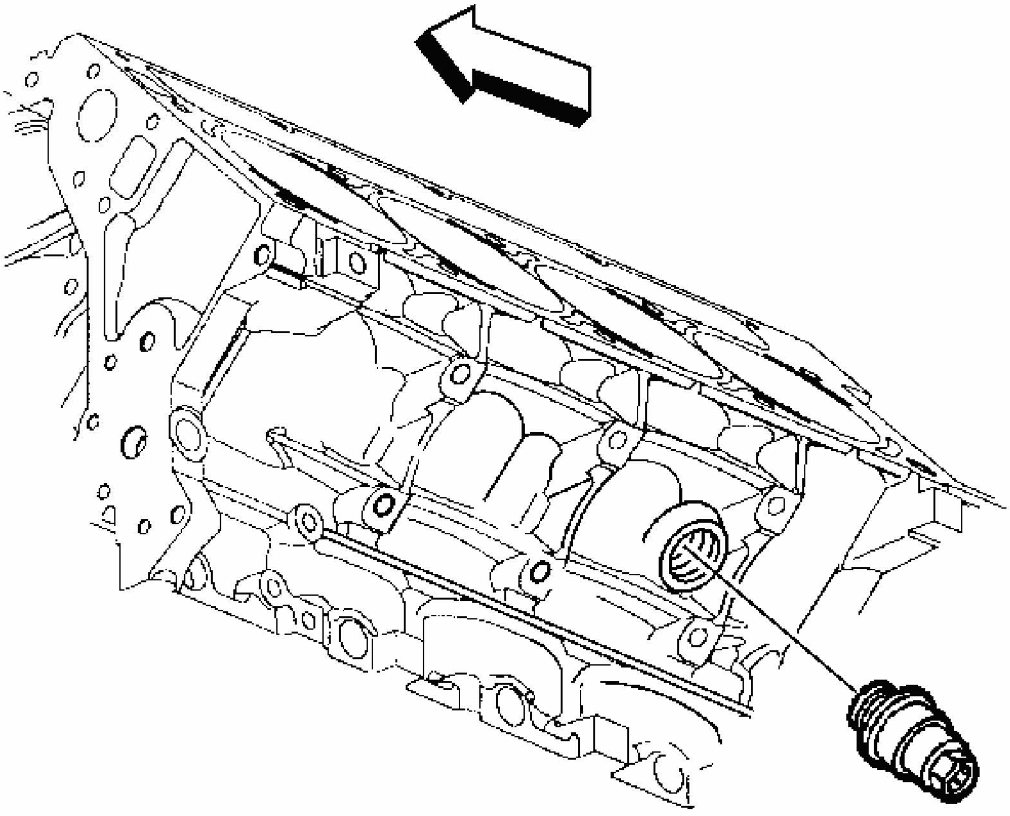


Fig. 564: Engine Block Coolant Heater

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Engine block plug, oil gallery, and coolant sealing washers may be used again if not bent, scored or otherwise damaged.

1. Apply a 3.175 mm (0.125 in) bead of sealant GM P/N 12346004 (Canadian P/N 10953480) to the engine block coolant heater sealing washer, if applicable. Refer to **Sealers, Adhesives, and Lubricants**.

   NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the engine block coolant heater to the engine block.

   Tighten: Tighten the block coolant heater to 50 N.m (37 lb ft).

3. Apply a 3.175 mm (0.125 in) bead of sealant GM P/N 12346004 (Canadian P/N 10953480) to the engine block coolant drain hole plug sealing washer.

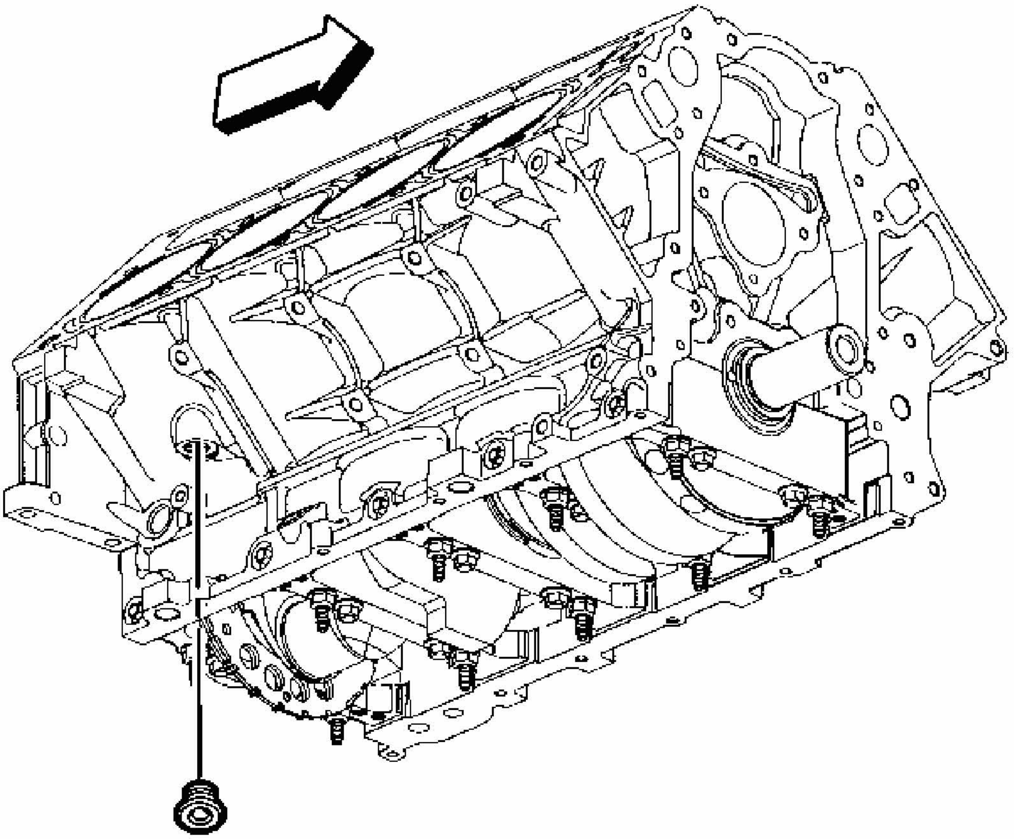


Fig. 565: Identifying Plug Location On Underside Of Block
Courtesy of GENERAL MOTORS CORP.

4. Install the engine block coolant drain hole plug.

   Tighten: Tighten the coolant drain hole plug to 60 N.m (44 lb ft).

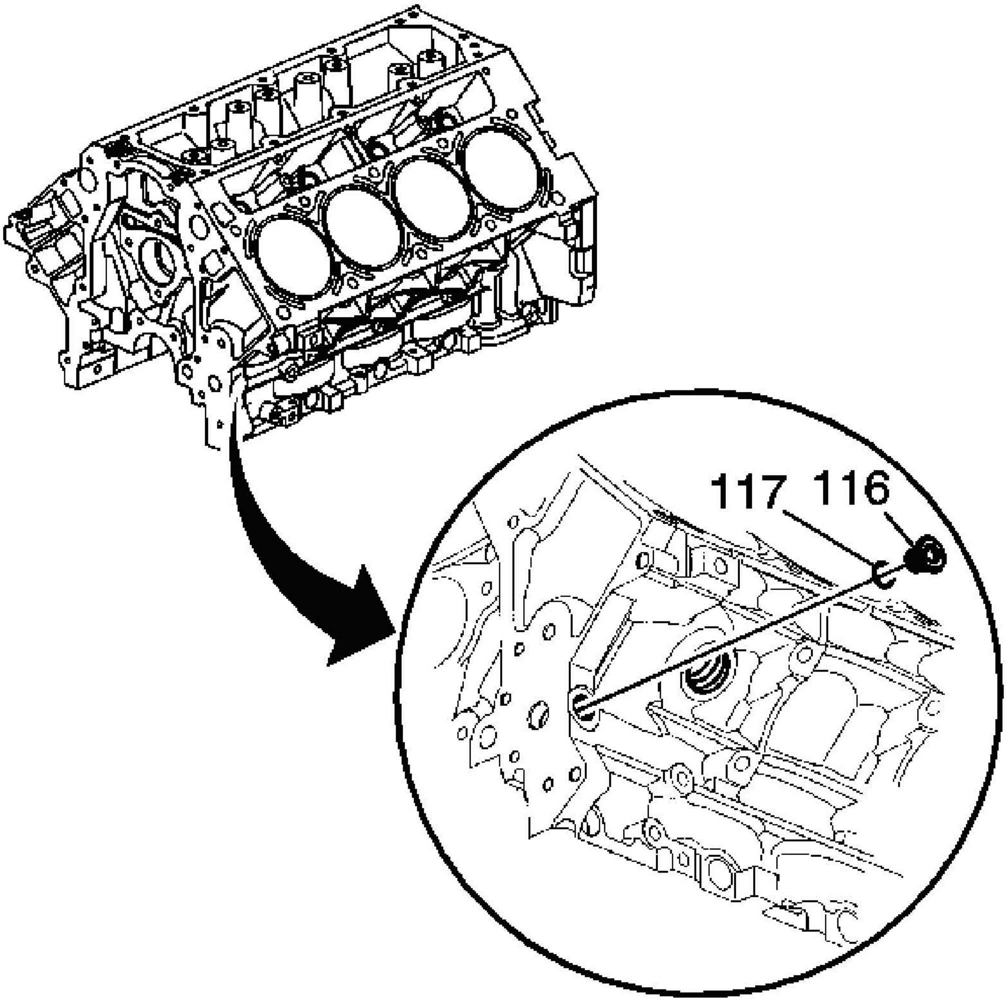


Fig. 566: Engine Block Left Front Oil Gallery Plug & Seal
Courtesy of GENERAL MOTORS CORP.

5. Apply a 3.175 mm (0.125 in) bead of sealant GM P/N 12346004 (Canadian P/N 10953480) to the engine block left front oil gallery plug sealing washer (117).
6. Install the engine block left front oil gallery plug (116).

   Tighten: Tighten the block left front oil gallery plug to 60 N.m (44 lb ft).

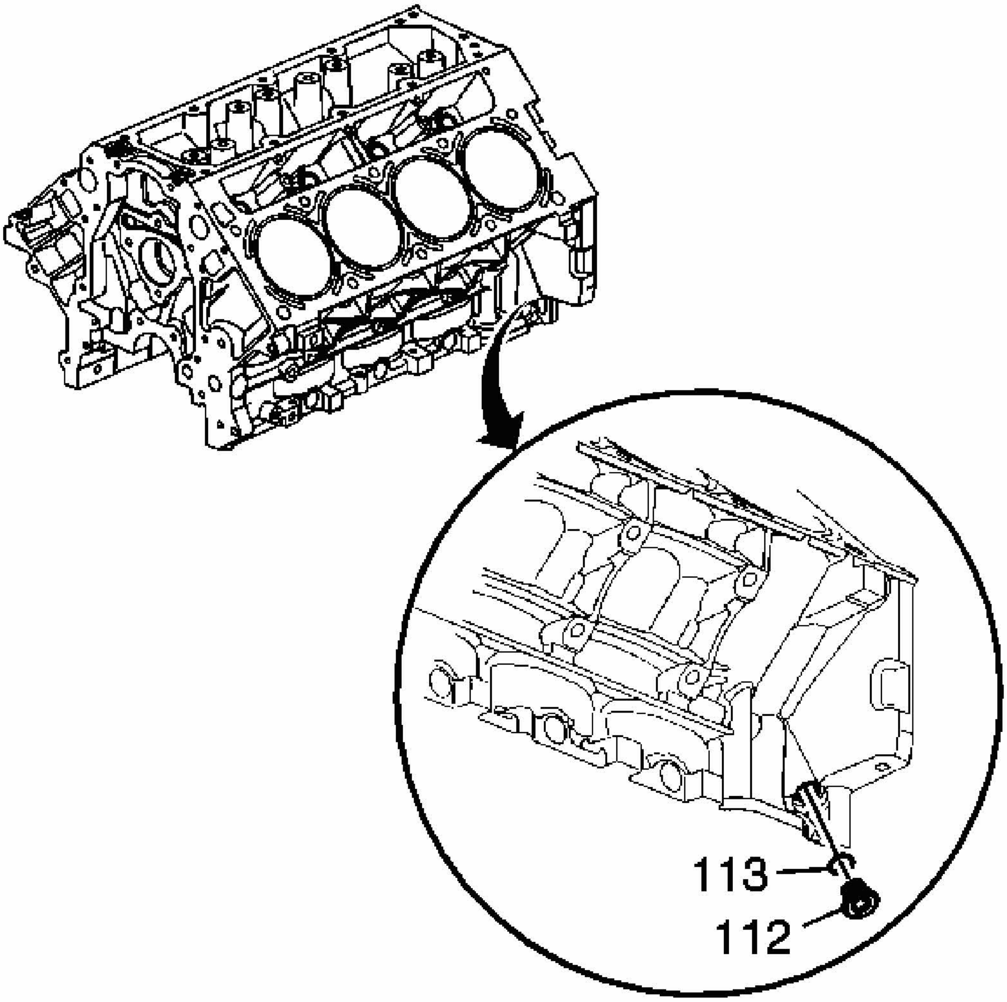


Fig. 567: Engine Block Left Rear Oil Gallery Plug & Seal
Courtesy of GENERAL MOTORS CORP.

7. Apply a 3.175 mm (0.125 in) bead of sealant GM P/N 12346004 (Canadian P/N 10953480) to the engine block left rear oil gallery plug sealing washer (113).
8. Install the engine block left rear oil gallery plug (112).

   Tighten: Tighten the block left rear oil gallery plug to 60 N.m (44 lb ft).

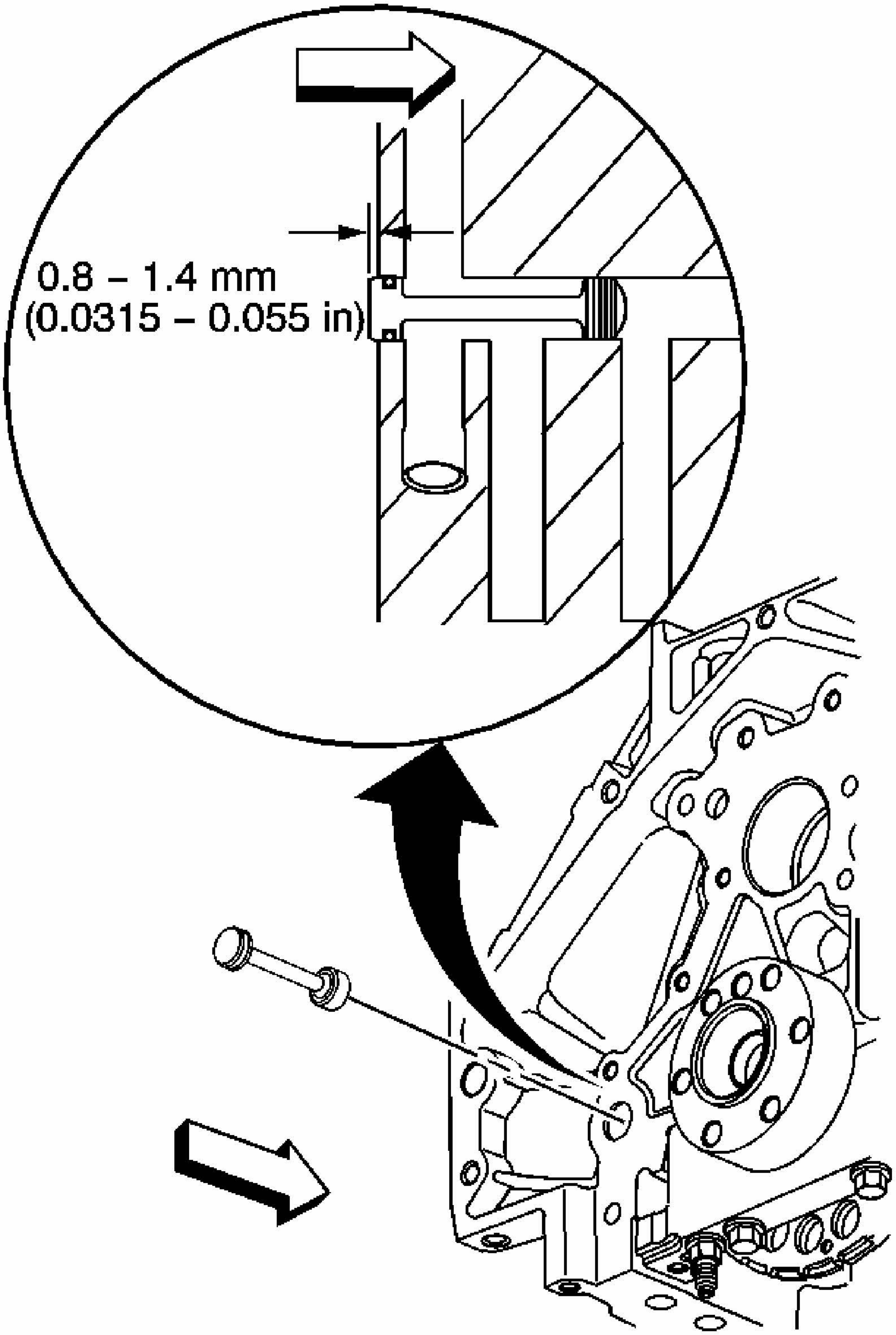

0.8 – 1.4 mm
(0.0315 – 0.055 in)

Fig. 568: View Of Engine Block Rear Oil Gallery Plug

Courtesy of GENERAL MOTORS CORP.

9. Inspect the engine block rear oil gallery plug and O-ring seal. If the O-ring seal on the plug is not cut or damaged, the rear oil gallery plug may be used again.
10. Lubricate the O-ring seal with clean engine oil.
11. Install the O-ring seal onto the plug.
12. Install the engine block rear oil gallery plug into the oil gallery bore. A properly installed block plug will protrude 0.8-1.4 mm (0.0315-0.055 in) beyond the rear face of the block.

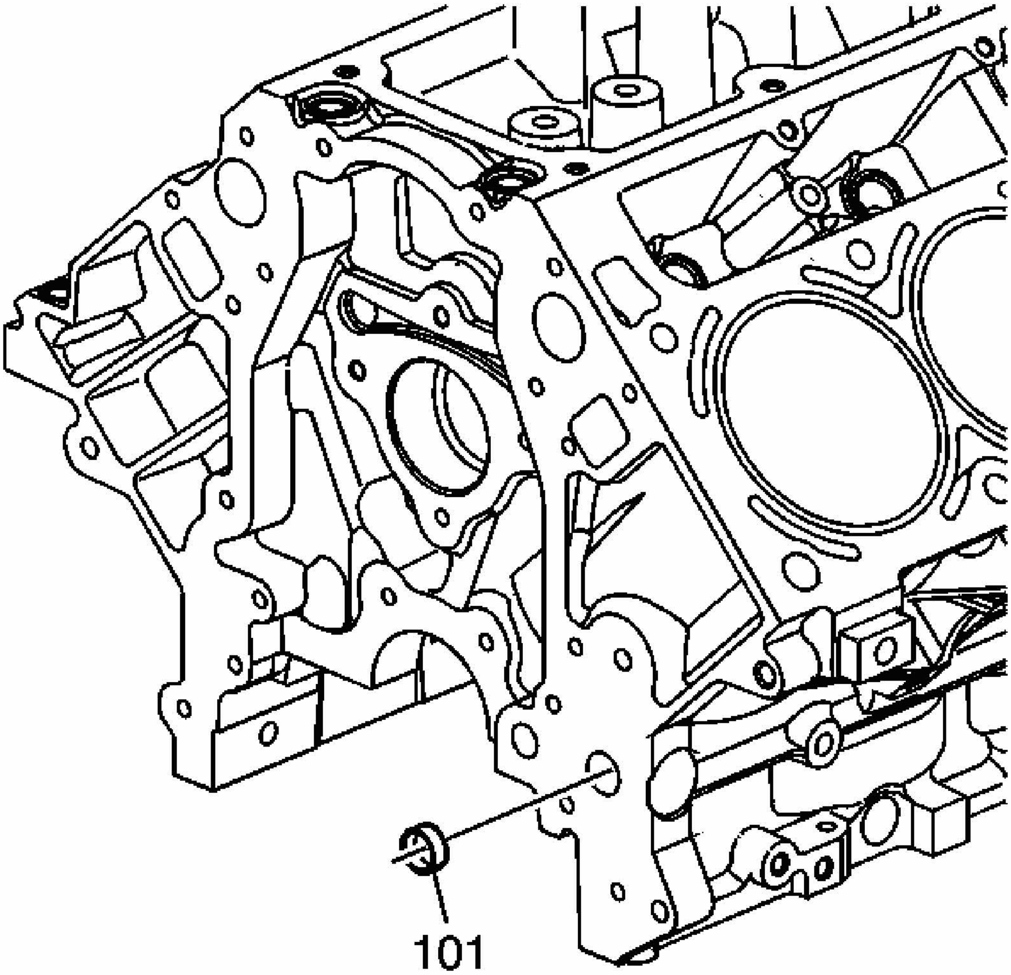


Fig. 569: Front Oil Gallery Plug
Courtesy of GENERAL MOTORS CORP.

13. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) to the sides of the

NEW front oil gallery plug (101).

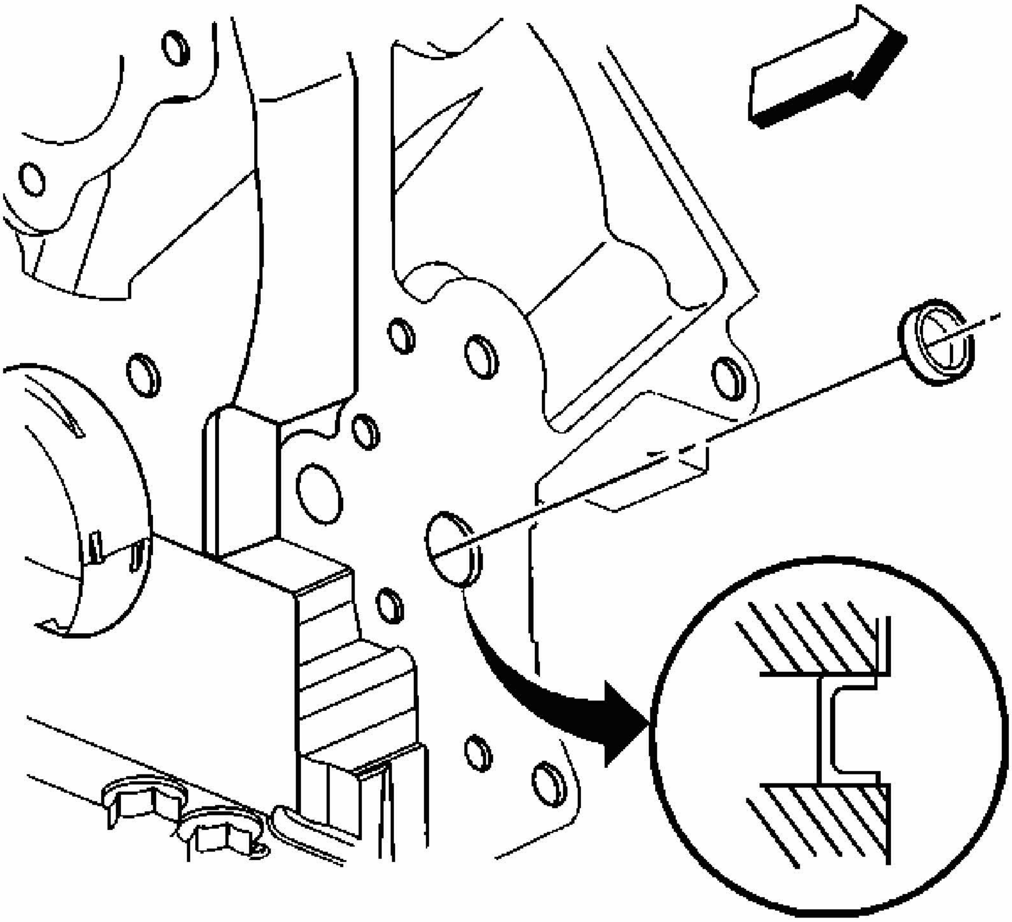


Fig. 570: View Of Engine Block Front Oil Gallery Plug
Courtesy of GENERAL MOTORS CORP.

14. Install a NEW engine block front oil gallery plug. Install the plug into the oil gallery bore 2.2-2.8 mm (0.0086-0.011 in) below flush.

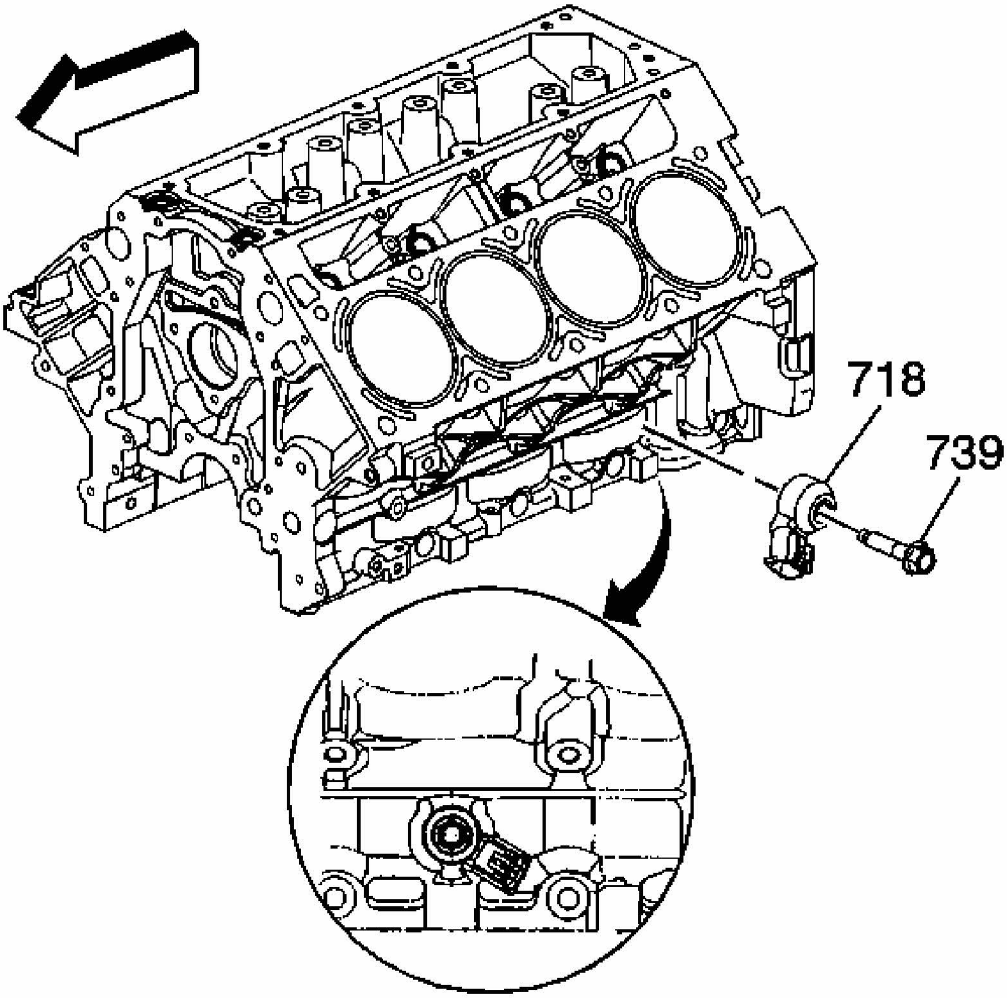


Fig. 571: Left Side Knock Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

15. Install the left side knock sensor (718) and bolt (739).

    Tighten: Tighten the bolt to 20 N.m (15 lb ft).

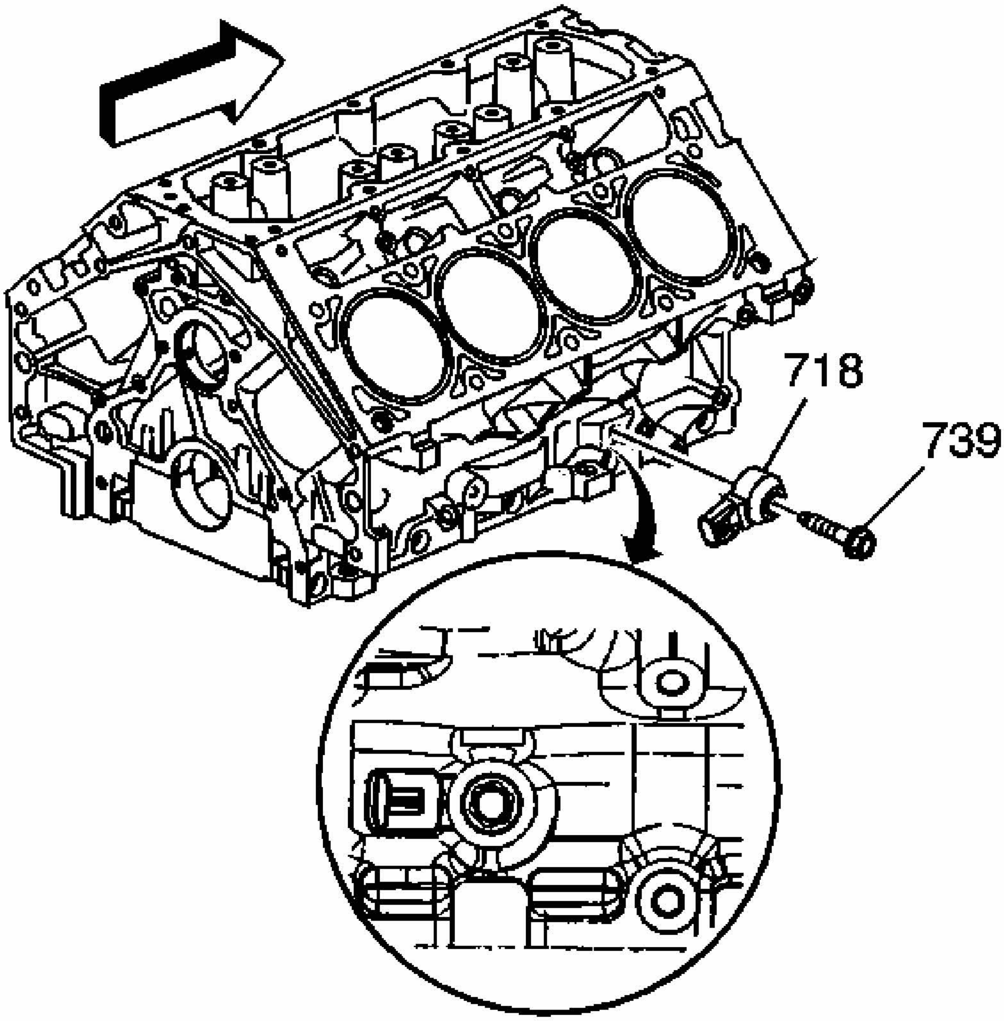


Fig. 572: Identifying Knock Sensor
Courtesy of GENERAL MOTORS CORP.

16. Install the right side knock sensor (718) and bolt (739).

    Tighten: Tighten the bolt to 20 N.m (15 lb ft).

CRANKSHAFT AND BEARINGS INSTALLATION

Tools Required

J 45059 Angle Meter

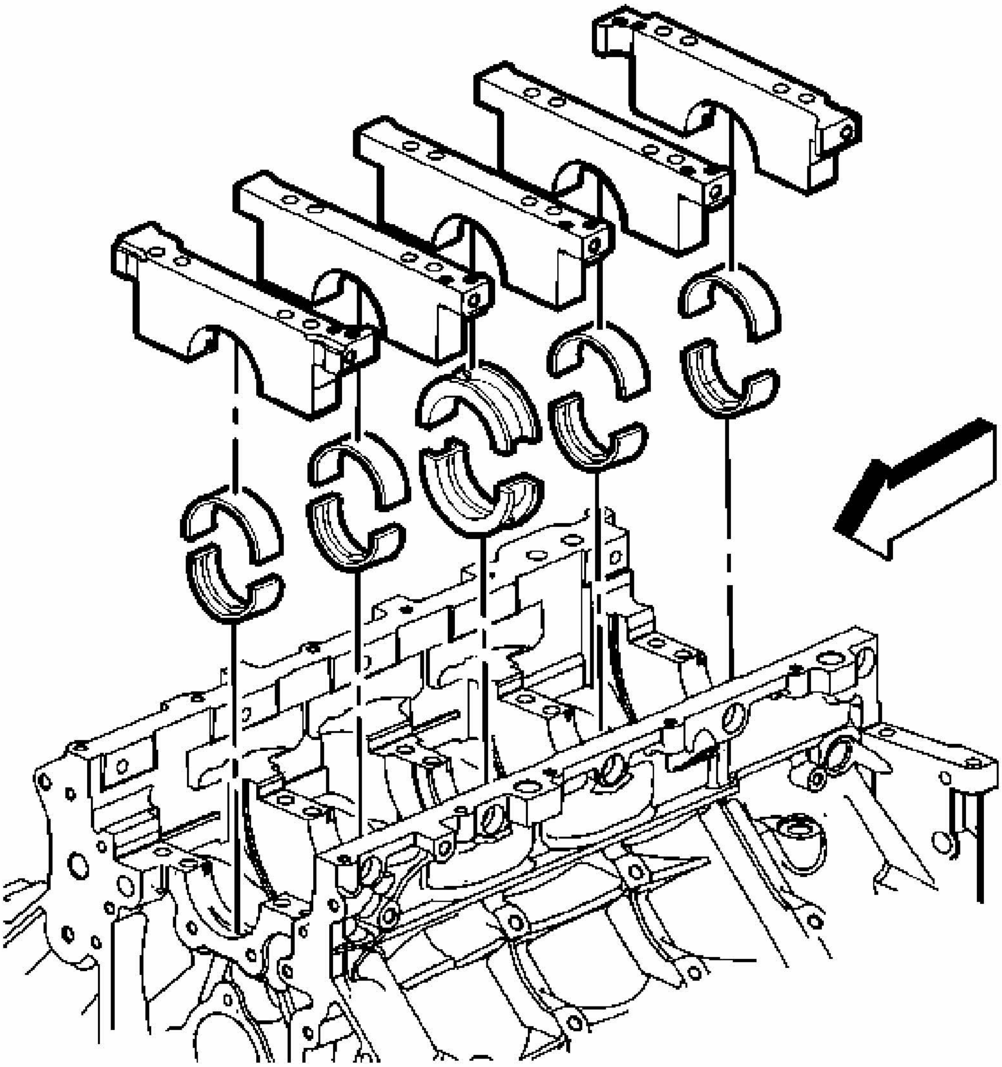


Fig. 573: View Of Crankshaft Bearings & Bearing Caps
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Crankshaft bearing clearances are critical. Excessive crankshaft bearing clearance may effect crankshaft position sensor signals and/or on-board diagnostics (OBD) II system performance.**
- **Crankshaft bearing caps must be installed to the proper location and direction.**
- **When installing the crankshaft bearings, align the locating tabs on the bearings with the locating notches in the**

engine block journal bore and the bearing cap.

- **Always install crankshaft bearings with their machined partner. Do not file bearings or mix bearing halves.**
- **To prevent engine block oil leakage, install NEW M8 crankshaft bearing cap side bolts.**

The crankshaft bearing cap M8 side bolts have a pre-applied sealant patch applied to the bolt flange.

1. Install the crankshaft bearings to the engine block and bearing caps. The thrust bearings are to be installed into center journal.
2. Lubricate the bearing surfaces and crankshaft journals with clean engine oil.

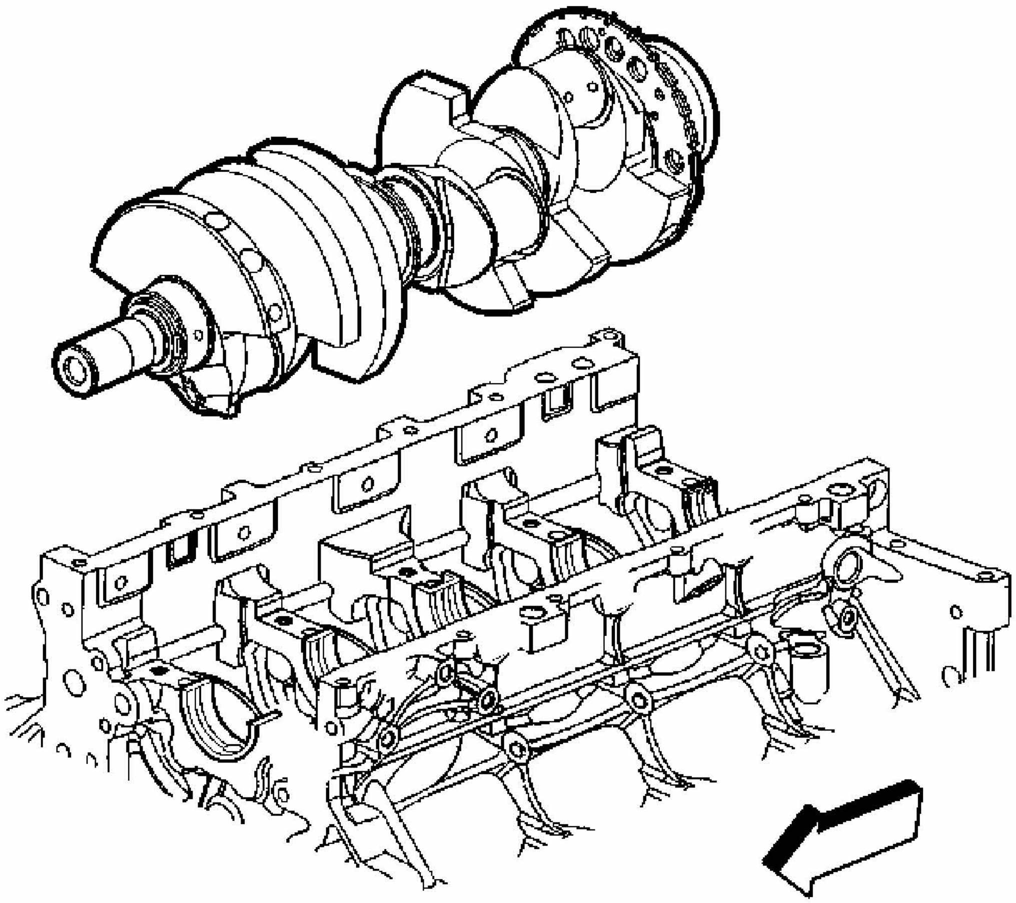


Fig. 574: View Of Crankshaft & Engine Block
Courtesy of GENERAL MOTORS CORP.

NOTE: To maintain proper crankshaft end play, use extreme care during crankshaft installation. Avoid scoring or damaging the thrust bearing.

3. Install the crankshaft.

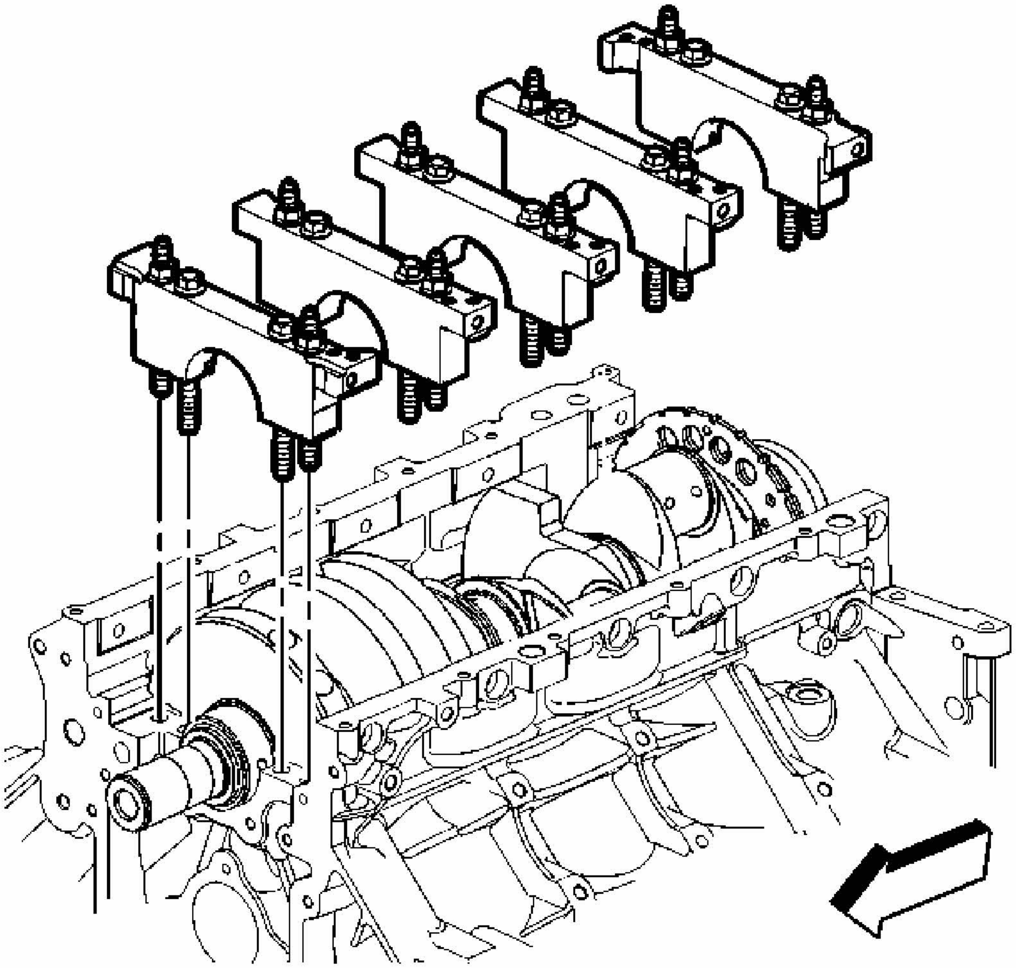


Fig. 575: View Of Crankshaft Main Bearing Caps
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The bearing caps must be installed in the proper location and direction.

4. Install the crankshaft bearing caps, with bearings, into the engine block.

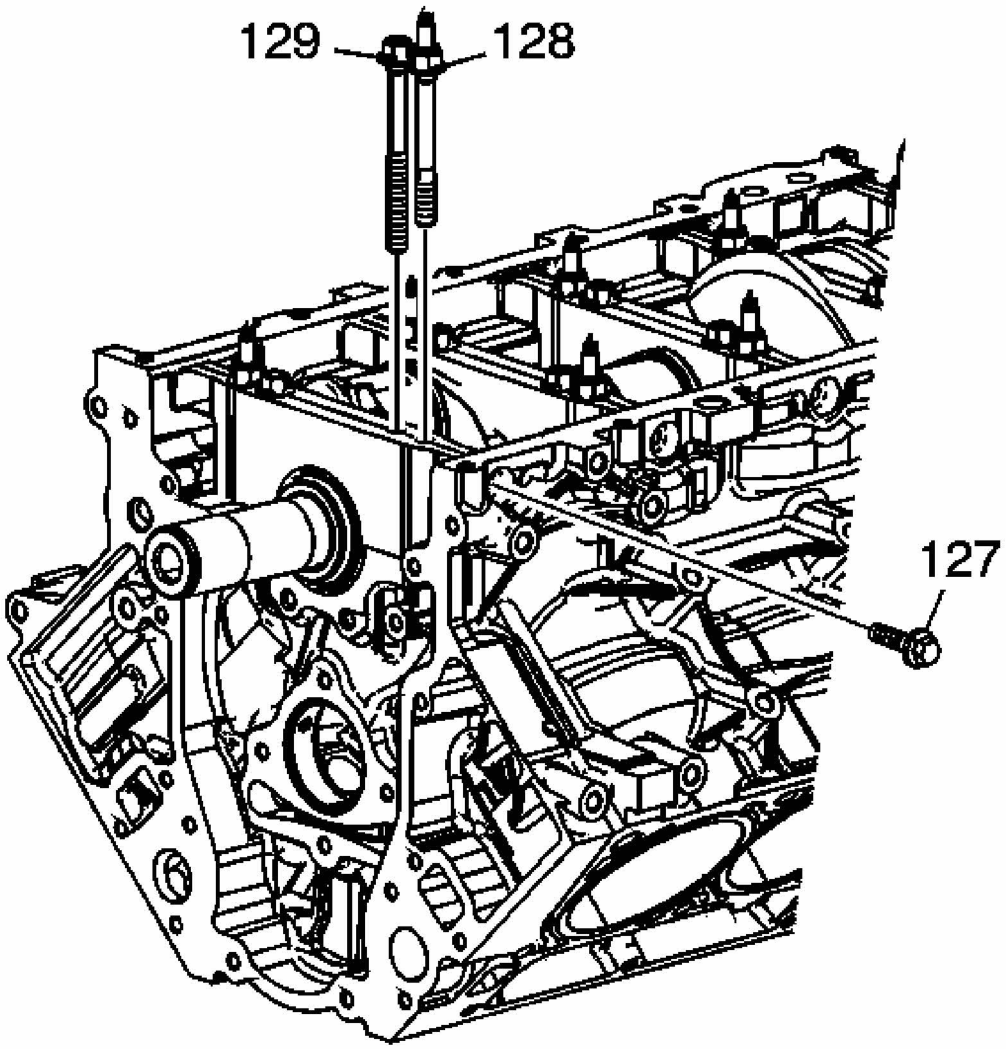


Fig. 576: Bearing Cap Bolts & Studs
Courtesy of GENERAL MOTORS CORP.

5. Install the M10 bolts (129) and M10 studs (128).
6. Tap the bearing caps into place with a plastic-face hammer.
7. Install the NEW M8 bearing cap side bolts (127).

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

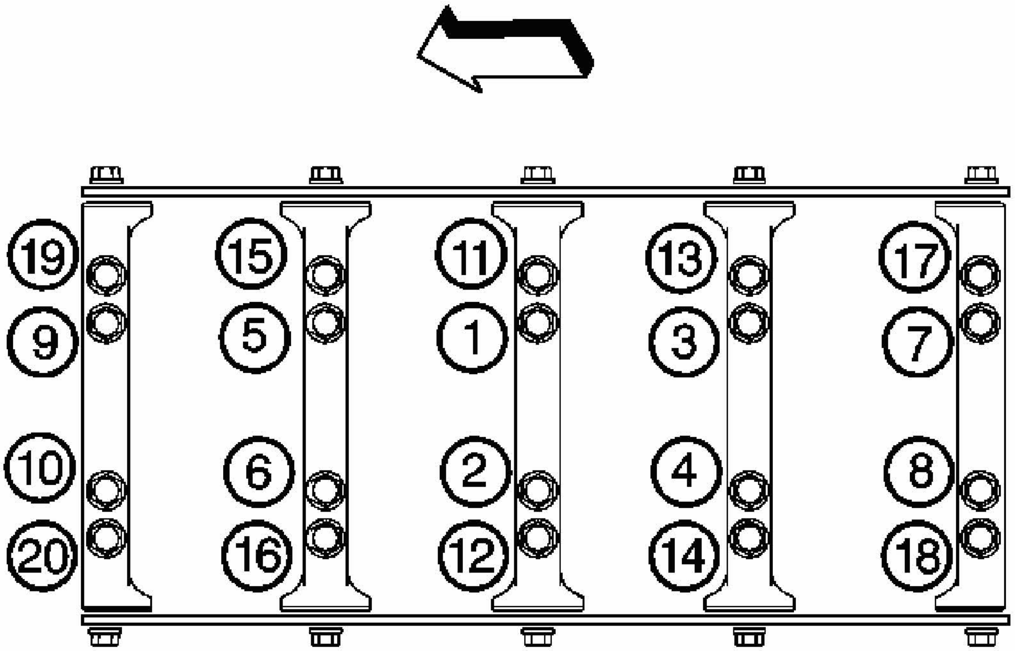


Fig. 577: Crankshaft Main Bearing Cap Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

8. Tighten the bearing cap M10 bolts (1-10).

   Tighten: Tighten the M10 bearing cap bolts (1-10) a first pass in sequence to 20 N.m (15 lb ft).

   IMPORTANT: To properly align the crankshaft thrust bearings, the final thrust of the crankshaft MUST be in the forward direction.

9. Using a plastic-face hammer, tap the crankshaft rearward, then forward to align the thrust bearings.

   Tighten:
   1. Tighten the M10 bolts (1-10) a final pass in sequence 80 degrees using the **J 45059** .
   2. Tighten the M10 studs (11-20) a first pass in sequence to 20 N.m (15 lb ft).
   3. Tighten the M10 studs (11-20) a final pass in sequence 51 degrees using the **J 45059** .
   4. Tighten the bearing cap M8 bolts to 25 N.m (18 lb ft).

Tighten the bolt on one side of the bearing cap and then tighten the bolt on the opposite side of the same bearing cap.

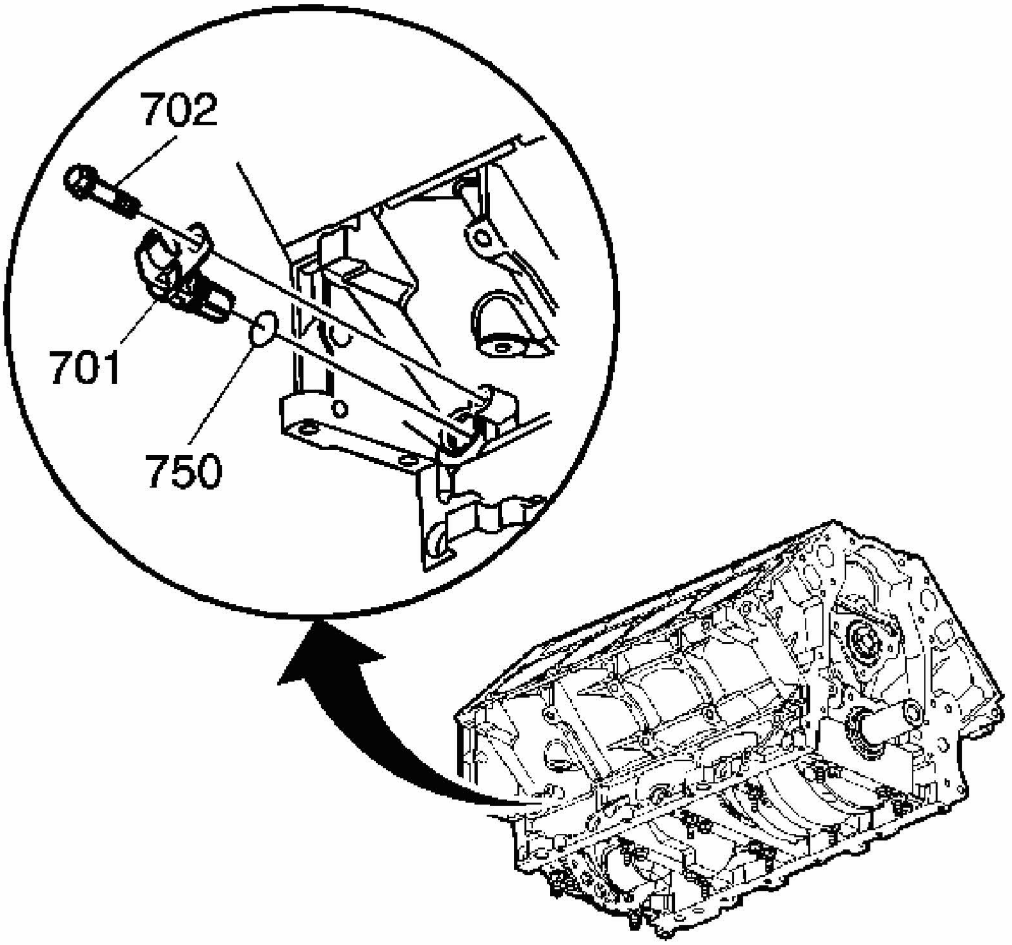


Fig. 578: CKP Sensor, Bolt & O-Ring
Courtesy of GENERAL MOTORS CORP.

10. Install the crankshaft position (CKP) sensor.
    1. Inspect the CKP sensor O-ring seal (750). If the O-ring seal is not cut or damaged, it may be used.
    2. Coat the O-ring seal with clean engine oil.
    3. Install the O-ring onto the sensor.
    4. Install the sensor (701). Rotate the sensor until the locating hole in the bracket aligns with the bolt hole in the block.
    5. Install the sensor bolt (702).

Tighten: Tighten the CKP sensor bolt to 25 N.m (18 lb ft).

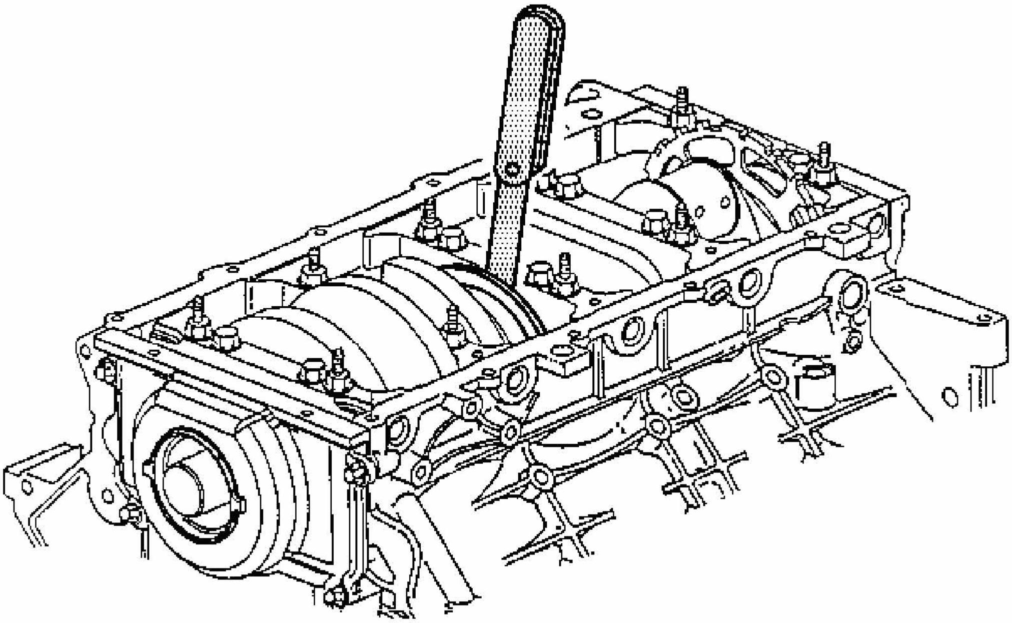


Fig. 579: Measuring Crankshaft End Play
Courtesy of GENERAL MOTORS CORP.

11. Measure the crankshaft end play.
    1. Thrust the crankshaft forward or rearward.
    2. Insert a feeler gage between the center crankshaft bearing and the bearing surface of the crankshaft and measure the bearing clearance.

       The proper crankshaft end play clearance is 0.04-0.2 mm (0.0015-0.0078 in).

    3. If the bearing clearance is not within specifications, inspect the thrust surfaces for nicks, gouges or raised metal. Minor imperfections may be removed with a fine stone.

PISTON, CONNECTING ROD, AND BEARING INSTALLATION

Tools Required

- **J 8037** Piston Ring Compressor
- **J 8087** Cylinder Bore Gage
- **J 41556** Connecting Rod Guide

- **J 45059** Angle Meter

Piston Selection

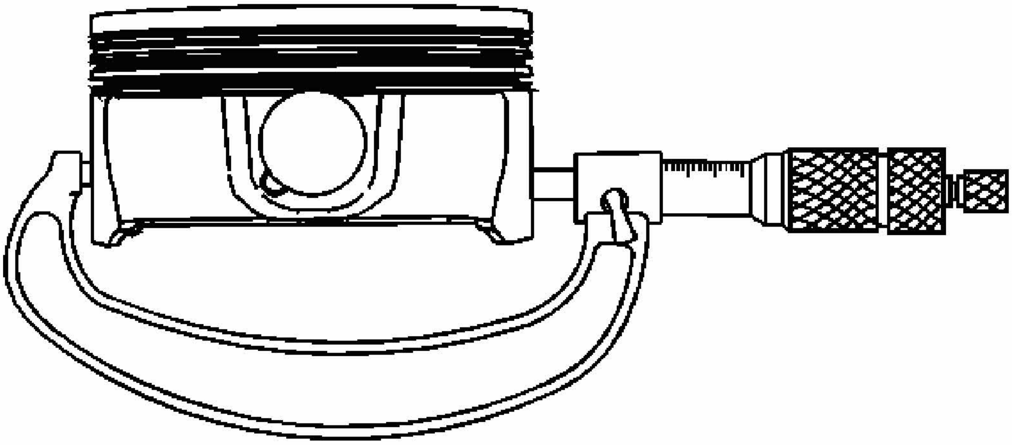


Fig. 580: Measuring The Piston Outside Diameter
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Measurements of all components should be taken with the components at normal room temperature. For proper piston fit, the engine block cylinder bores must not have excessive wear or taper. A used piston, pin, and connecting rod assembly may be installed if, after inspection is within specifications.

1. With a micrometer at a right angle, measure the piston outside diameter (OD). Measure the diameter 43 mm (1.69 in) from the top of the piston. Refer to **Engine Mechanical Specifications**.
2. Record the piston OD.

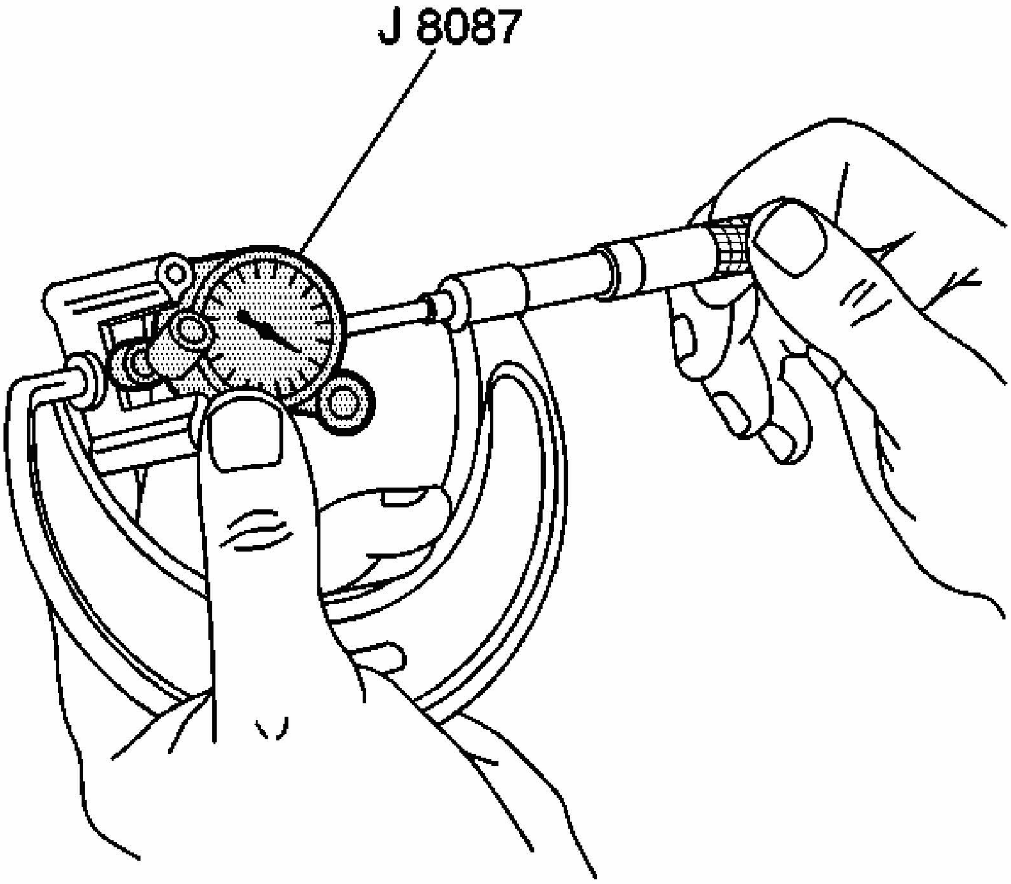


Fig. 581: Measuring Bore Gauge With Micrometer
Courtesy of GENERAL MOTORS CORP.

3. Adjust the micrometer to the recorded piston OD.
4. Insert the **J 8087** into the micrometer and zero the gage dial.

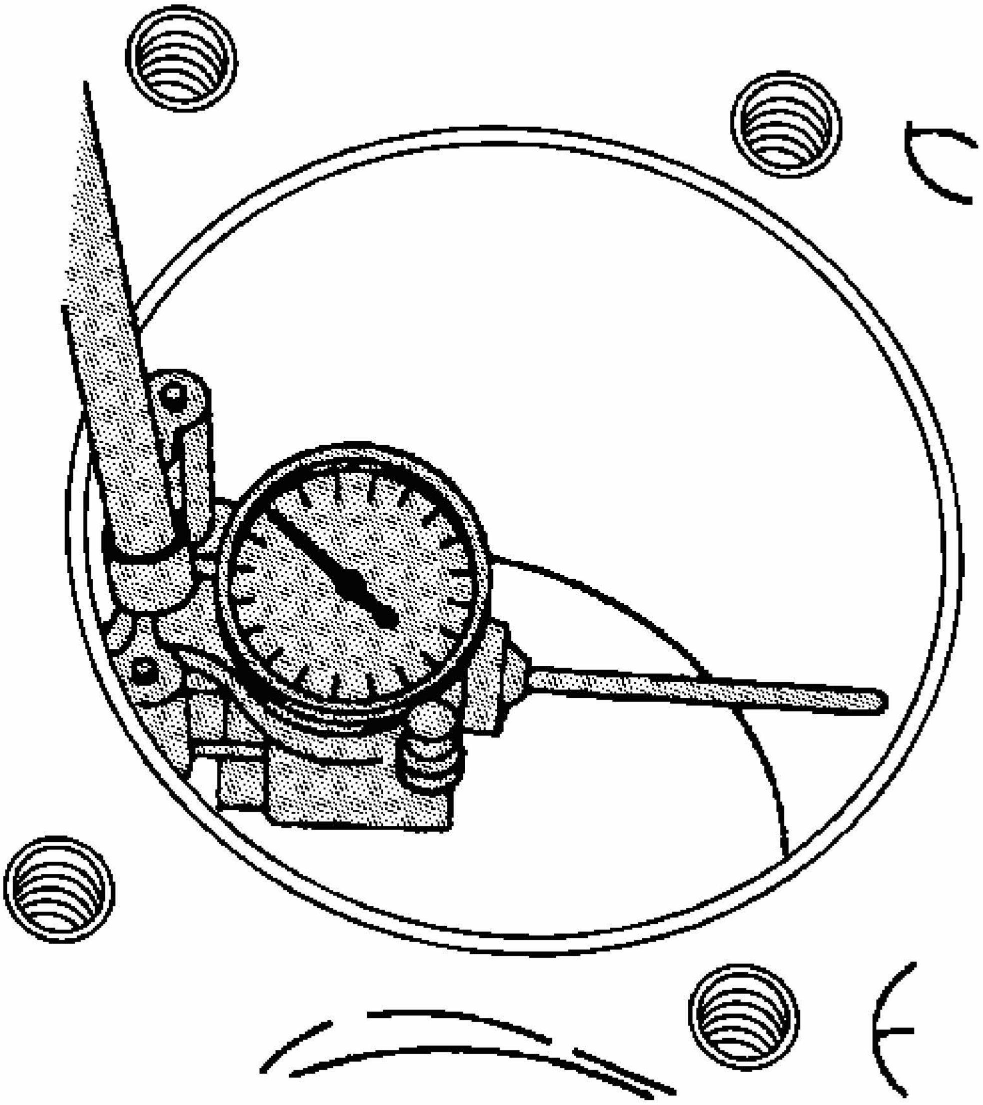


Fig. 582: Measuring Cylinder Bore
Courtesy of GENERAL MOTORS CORP.

5. Using the **J 8087** , measure the cylinder bore inside diameter (ID). Measure at a point 64 mm (2.5 in) from the top of the cylinder.
6. Record the cylinder bore ID.
7. Subtract the piston OD from the cylinder bore ID to determine the piston-to-bore clearance. Refer to **Engine Mechanical Specifications**.
8. If the proper clearance cannot be obtained, select another piston, pin, and connecting

rod assembly and again measure the clearances. If the proper fit cannot be obtained, the cylinder bore may require honing for an oversize piston.

Piston, Pin, and Connecting Rod Installation

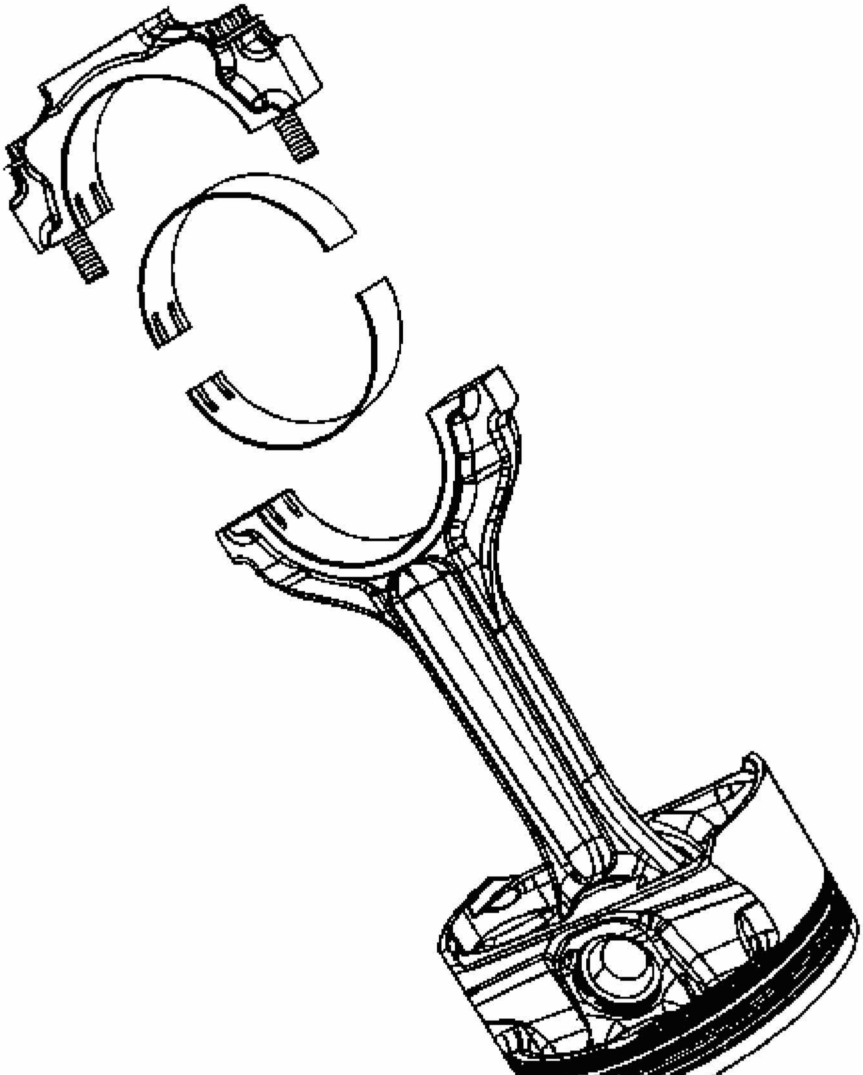


Fig. 583: View Of Piston, Connecting Rod & Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

1. Lightly lubricate the following components with clean engine oil:
   - Piston

- Piston rings
- Cylinder bore
- Bearings and bearing surfaces

2. Position the oil control ring end gaps a minimum of 25 mm (1.0 in) from each other.
3. Position the compression ring end gaps 180 degrees opposite each other.

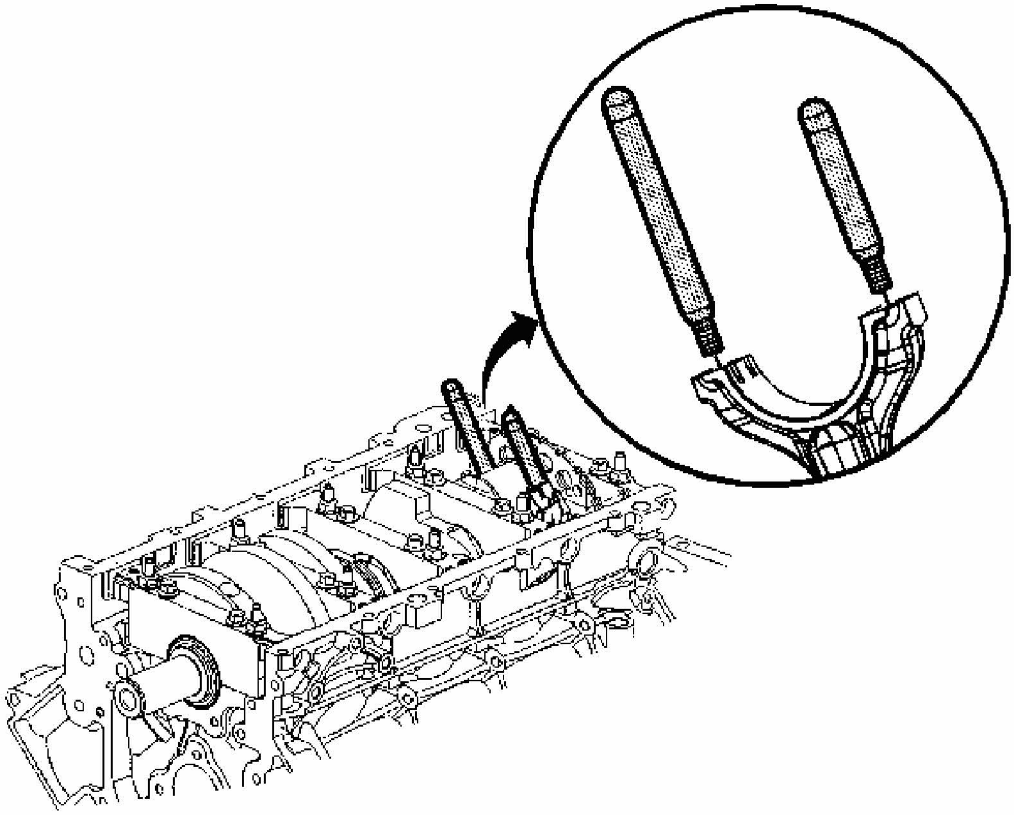


Fig. 584: Installing Piston & Connecting Rod Assembly
Courtesy of GENERAL MOTORS CORP.

4. Install the **J 41556** to the connecting rod.

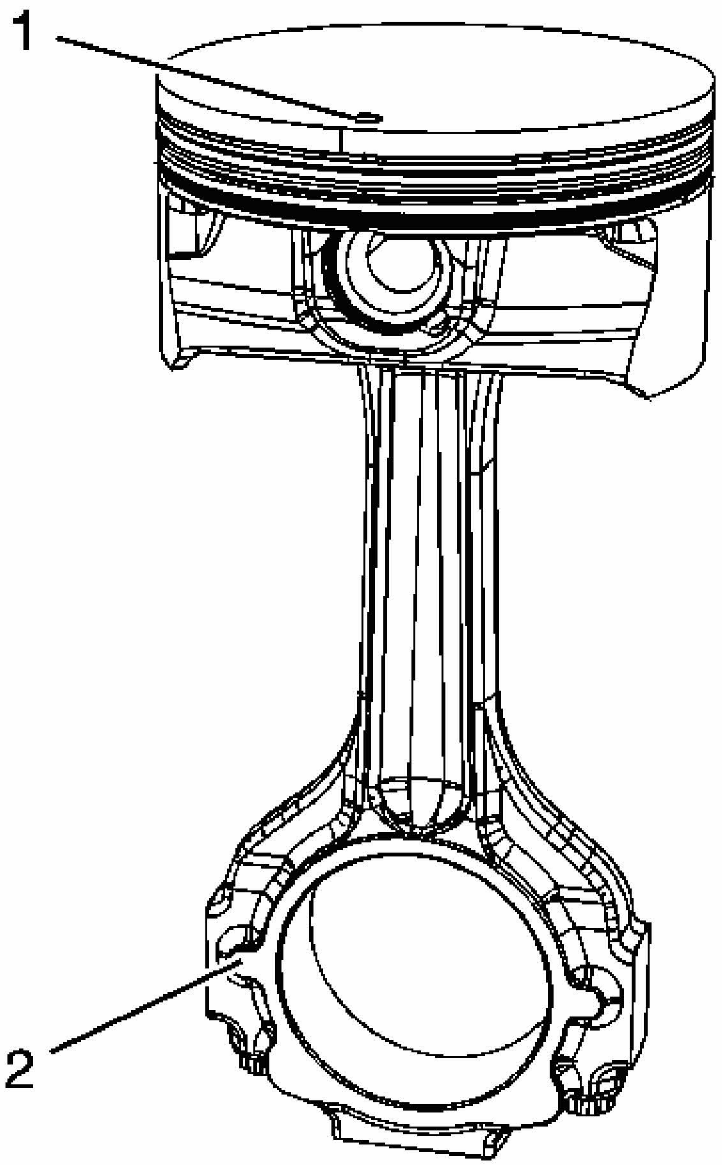


Fig. 585: Identifying Proper Piston Installation Direction
Courtesy of GENERAL MOTORS CORP.

5. Identify the proper installation direction of the piston and connecting rod assembly. When installing the piston and connecting rod assembly, the mark on the top of the piston (1) and the tab (2) on the side of the connecting rod should face the front of the engine.

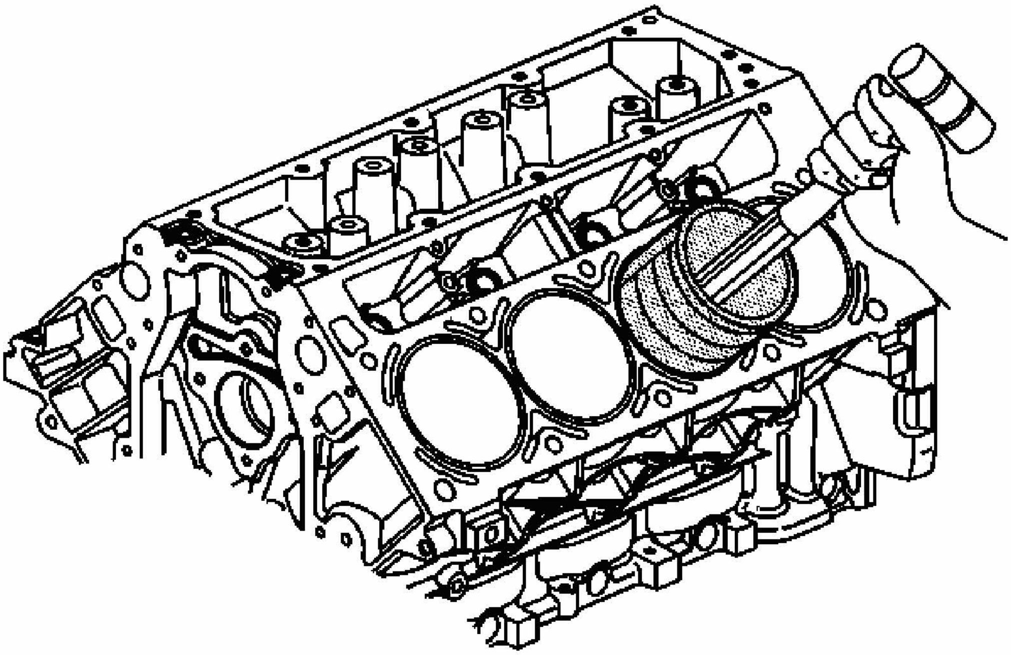


Fig. 586: Installing Piston
Courtesy of GENERAL MOTORS CORP.

6. Install the **J 8037** onto the piston and compress the piston rings.

IMPORTANT: The piston alignment mark MUST face the front of the engine block.

7. Install the piston, pin, and connecting rod assembly into the cylinder bore. Hold the piston ring compressor firmly against the engine block. Using a wooden hammer handle, lightly tap the top of the piston until all the piston rings have entered the cylinder bore.

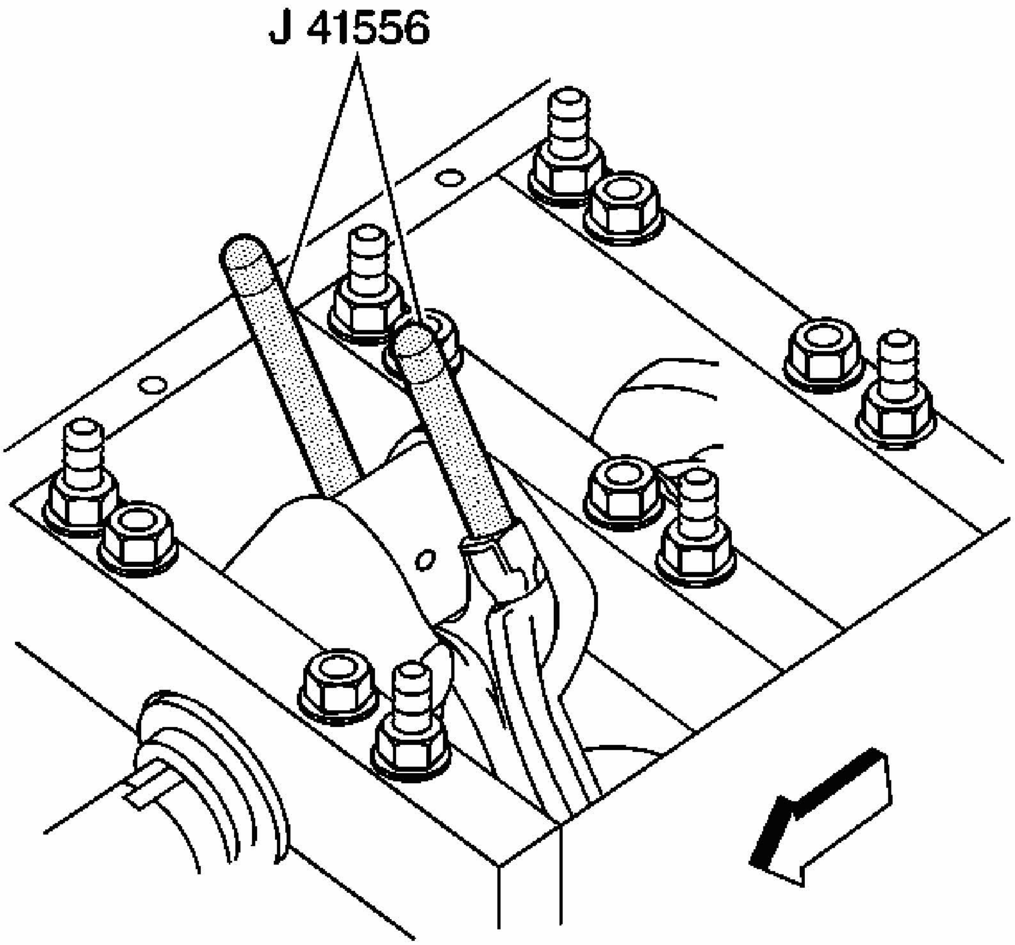


Fig. 587: View Of J 41556 & Connecting Rod
Courtesy of GENERAL MOTORS CORP.

8. Use the **J 41556** to guide the connecting rod onto the crankshaft journal.
9. Remove the **J 41556** from the connecting rod.

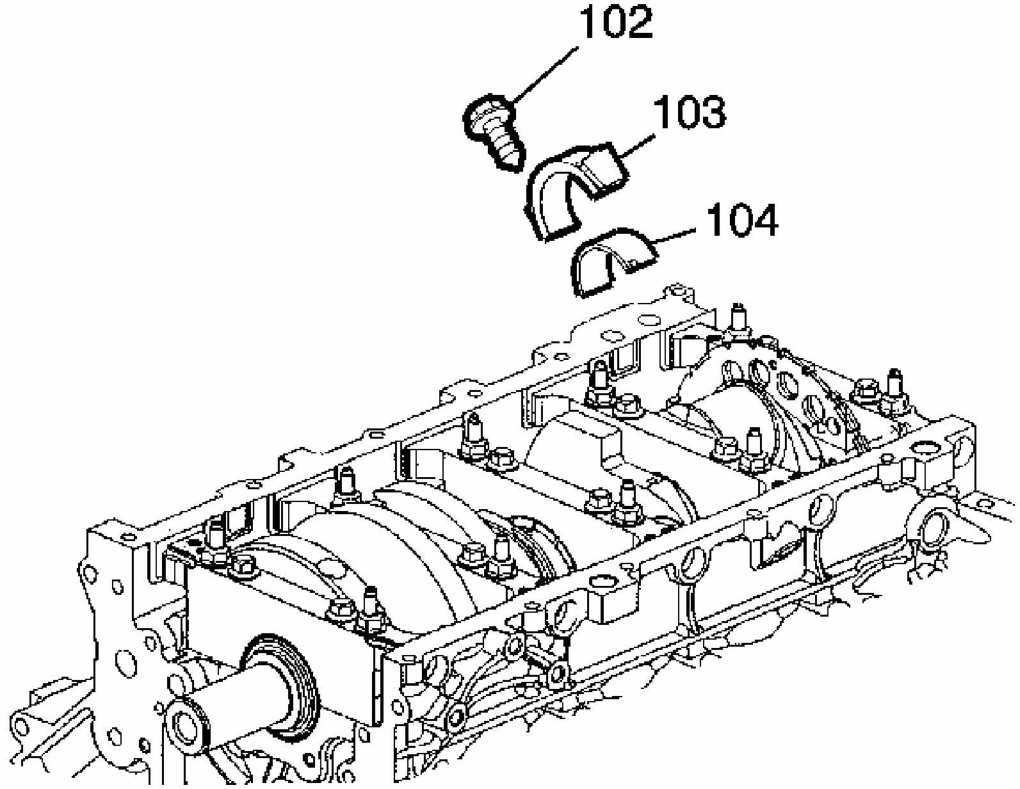


Fig. 588: Connecting Rod Bolt, Cap & Bearing
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

IMPORTANT: The connecting rod and cap must be assembled with the mating surfaces properly aligned.

10. Install the bearing cap (103), bearing (104), and bolts (102).

Tighten:

1. Tighten the bolts a first pass to 20 N.m (15 lb ft).
2. Tighten the bolts a final pass to 75 degrees using the **J 45059** .

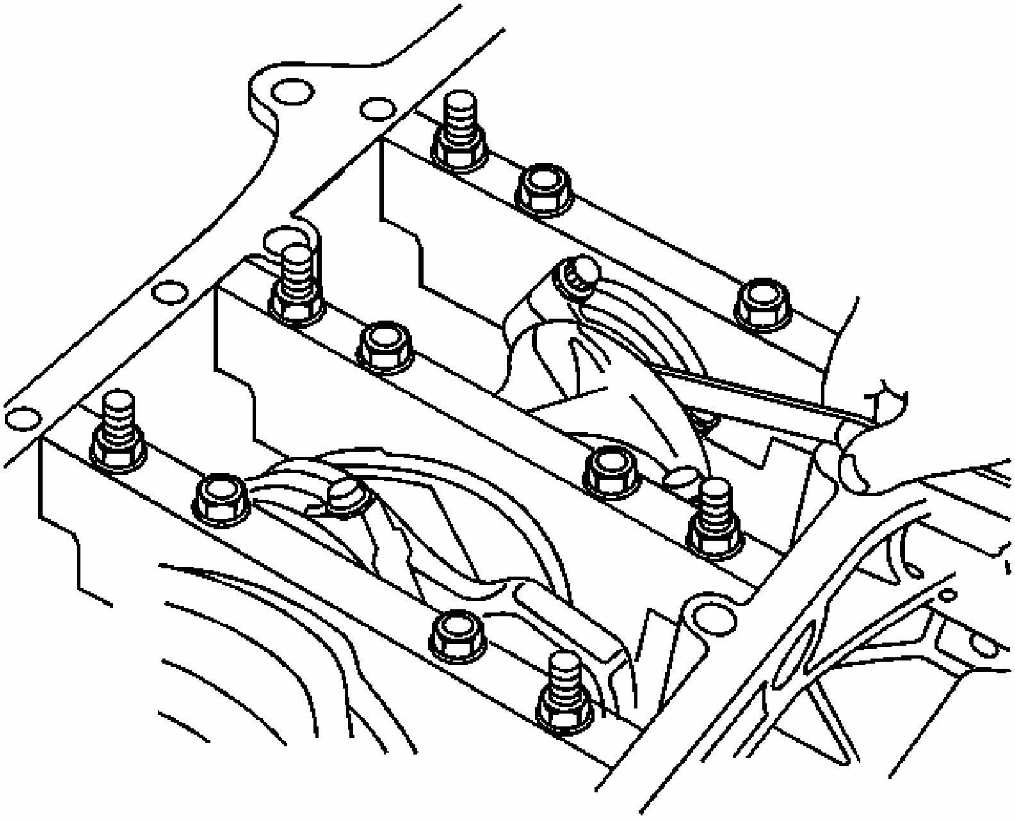


Fig. 589: Measuring Connecting Rod Side Clearance
Courtesy of GENERAL MOTORS CORP.

11. Measure the connecting rods for the proper side clearance. Refer to **Engine Mechanical Specifications**.

CAMSHAFT INSTALLATION

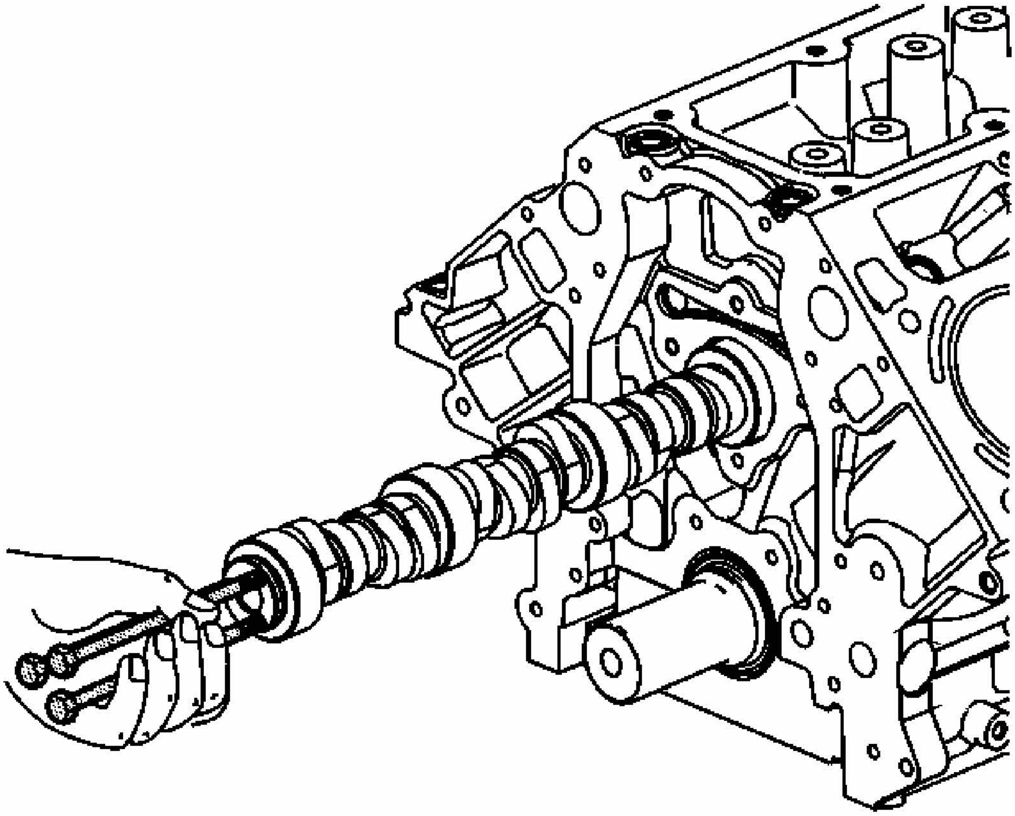


Fig. 590: Camshaft Installation
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If camshaft replacement is required, the valve lifters must also be replaced.

1. Lubricate the camshaft journals and the bearings with clean engine oil.
2. Install 3 M8 - 1.25 x 100 mm (M8 - 1.25 x 4.0 in) bolts into the camshaft front bolt holes.

NOTE: All camshaft journals are the same diameter, so care must be used in removing or installing the camshaft to avoid damage to the camshaft bearings.

3. Using the bolts as a handle, carefully install the camshaft into the engine block.
4. Remove the 3 bolts from the front of the camshaft.

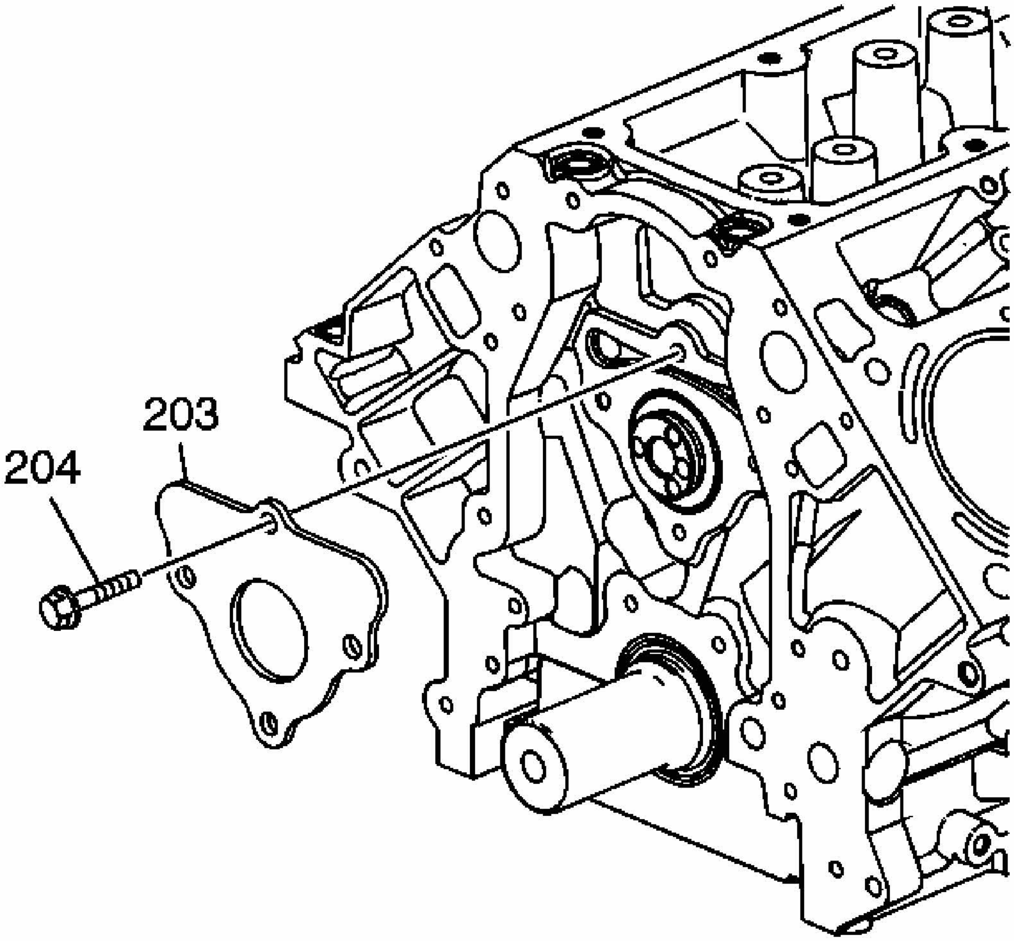


Fig. 591: Camshaft Retainer & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

IMPORTANT: The gasket surface on the engine block should be clean and free of dirt or debris.

5. Install the camshaft retainer (203) and the bolts (204). Install the retainer with the sealing gasket facing the front of the engine block.

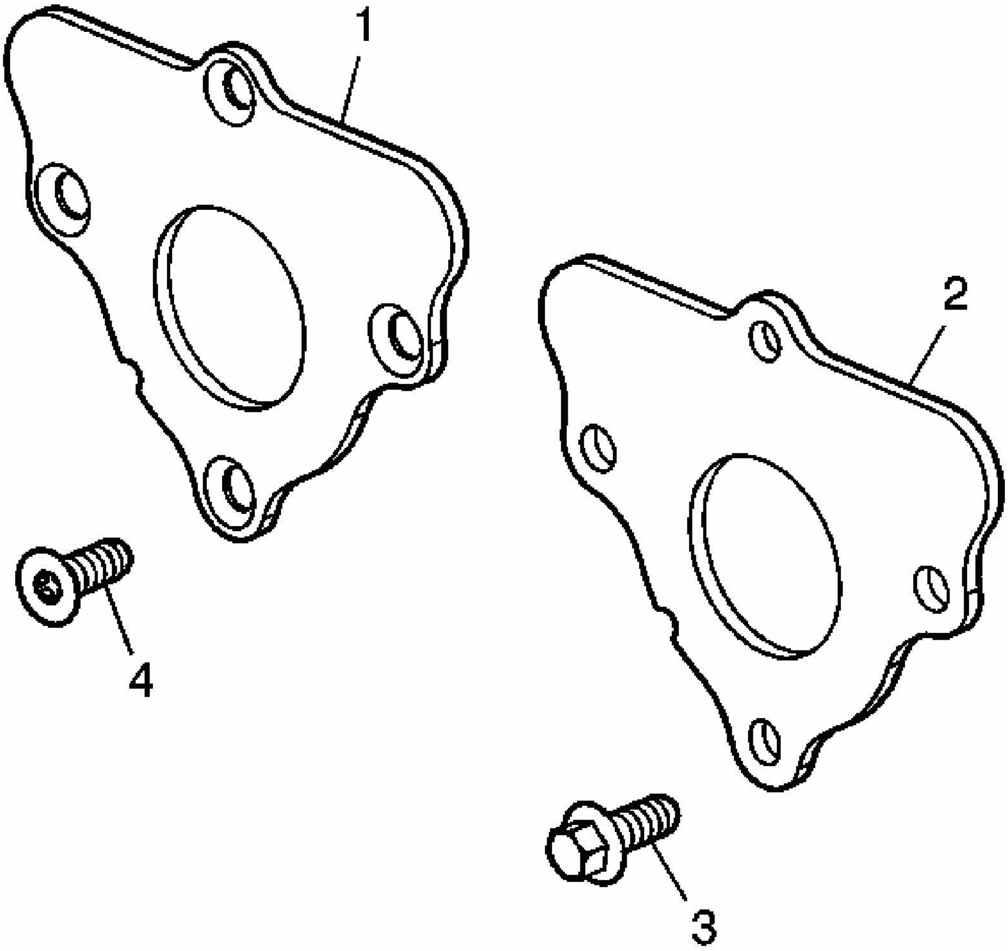


Fig. 592: First & Second Designs Of Head Bolts
Courtesy of GENERAL MOTORS CORP.

6. Tighten the camshaft retainer bolts.

   Tighten:

   - Tighten the first design hex head bolts (3) to 25 N.m (18 lb ft).
   - Tighten the second design TORX® head bolts (4) to 15 N.m (11 lb ft).

TIMING CHAIN AND SPROCKETS INSTALLATION

Tools Required

- **J 41478** Crankshaft Front Oil Seal Installer. See **Special Tools**.
- **J 41665** Crankshaft Balancer and Sprocket Installer. See **Special Tools**.

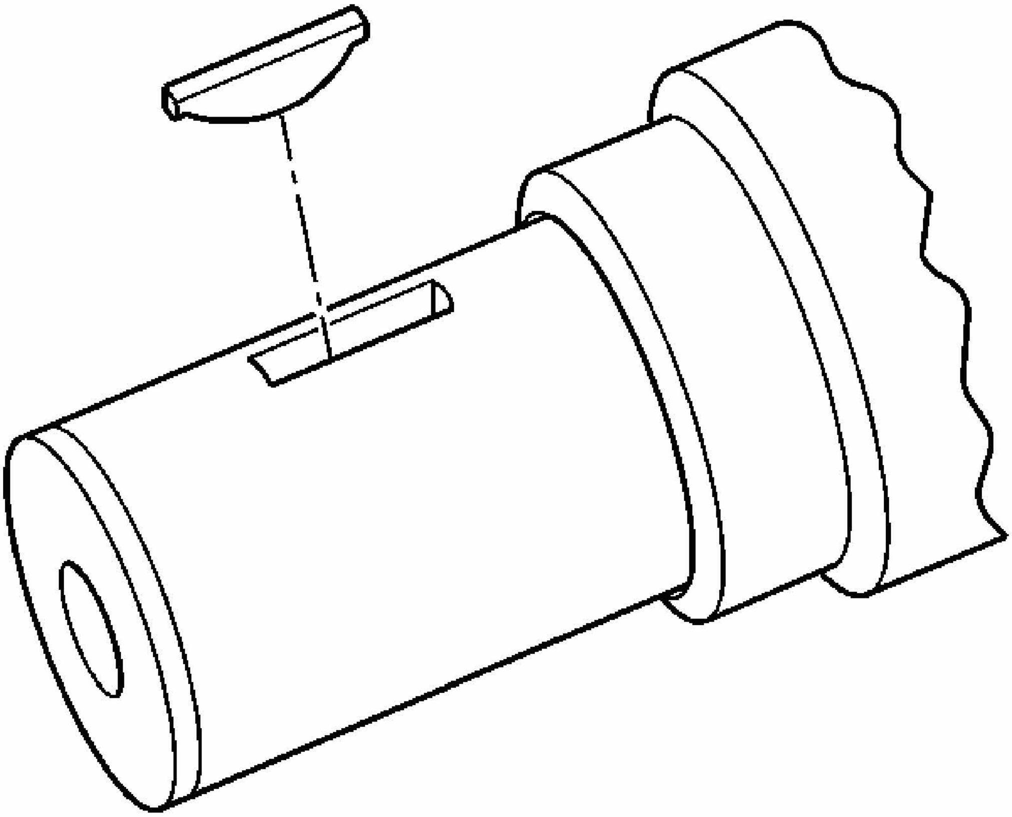


Fig. 593: View Of Crankshaft Key & Keyway
Courtesy of GENERAL MOTORS CORP.

1. Install the key into the crankshaft keyway, if previously removed.

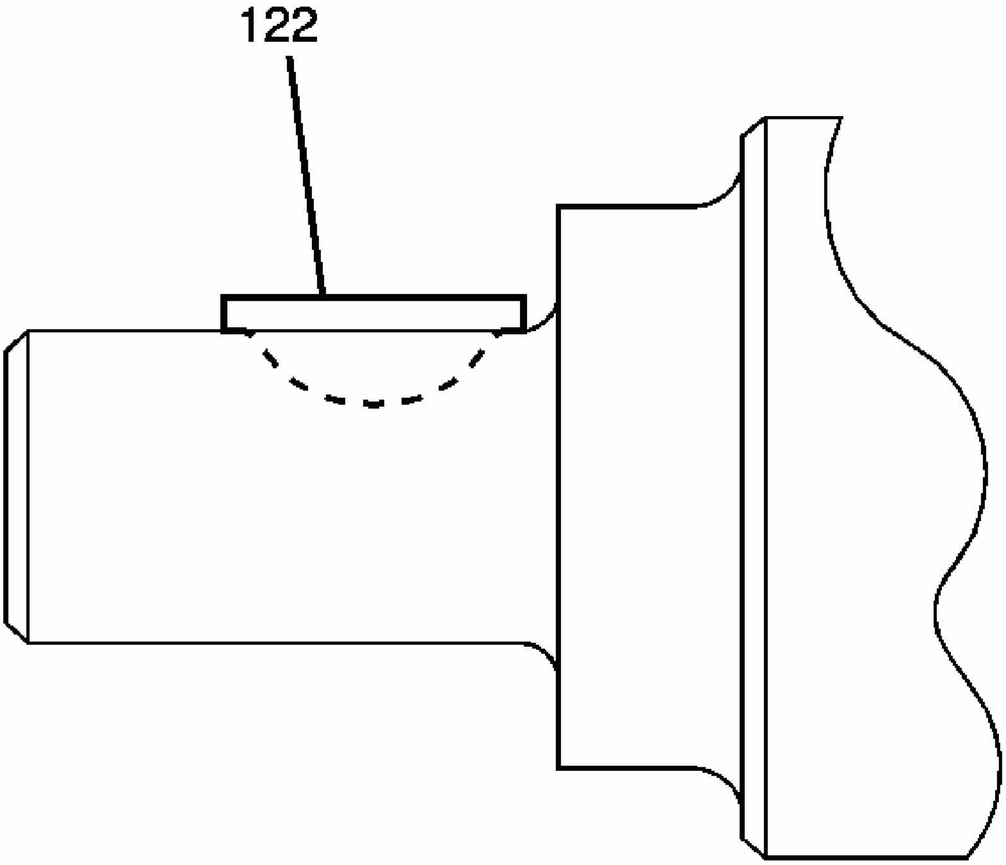


Fig. 594: View Of Installed Crankshaft Key
Courtesy of GENERAL MOTORS CORP.

2. Tap the key (122) into the keyway until both ends of the key bottom onto the crankshaft.

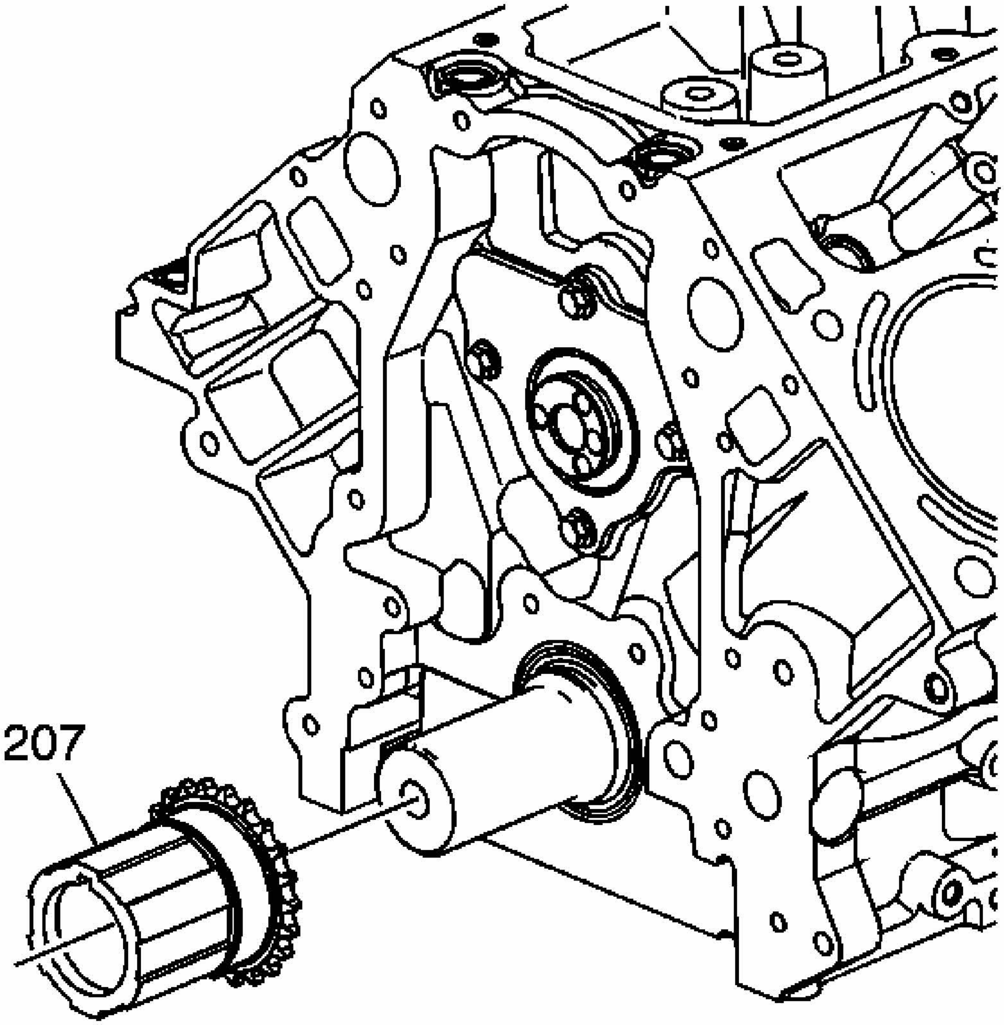


Fig. 595: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

3. Install the crankshaft sprocket (207) onto the front of the crankshaft. Align the crankshaft key with the crankshaft sprocket keyway.

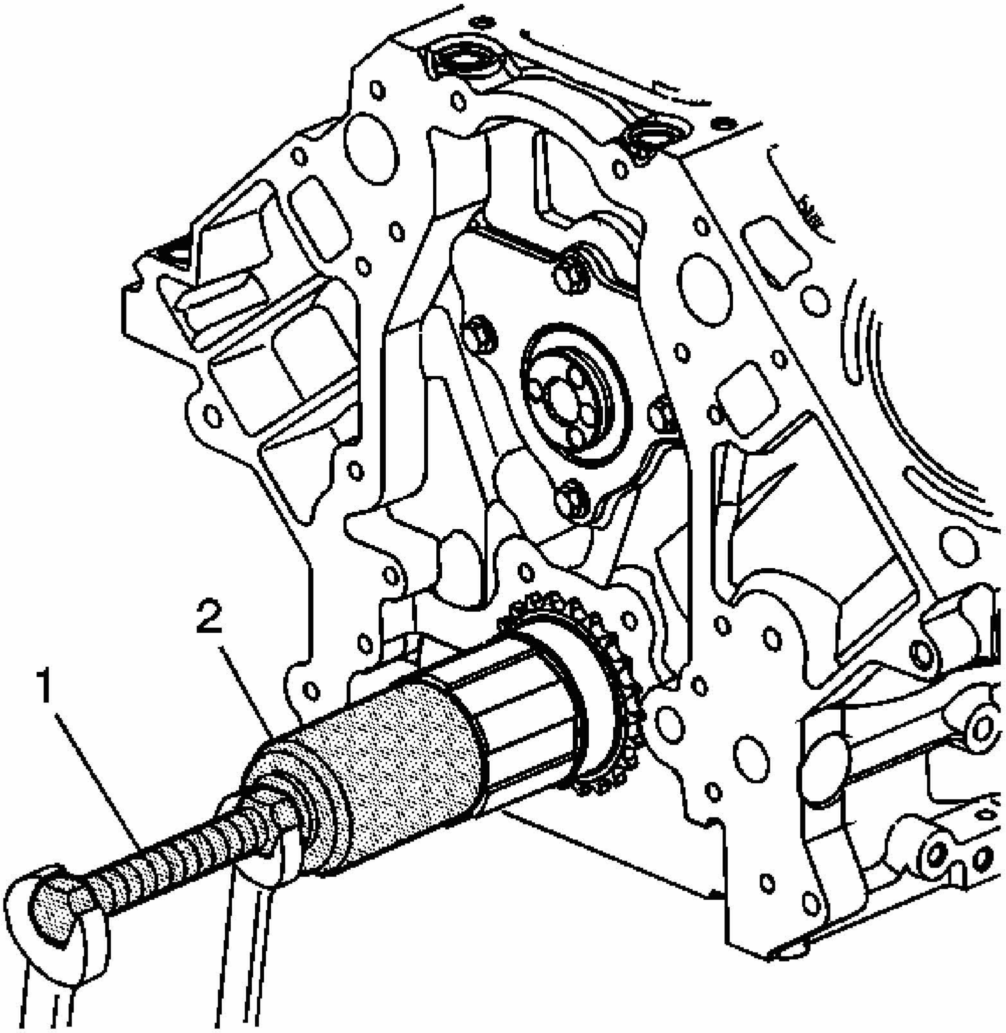


Fig. 596: Installing Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

4. Use the **J 41478** (1) and the **J 41665** (2) in order to install the crankshaft sprocket. See **Special Tools**.

   Install the sprocket onto the crankshaft until fully seated against the crankshaft flange.

5. Rotate the crankshaft sprocket until the alignment mark is in the 12 o'clock position.

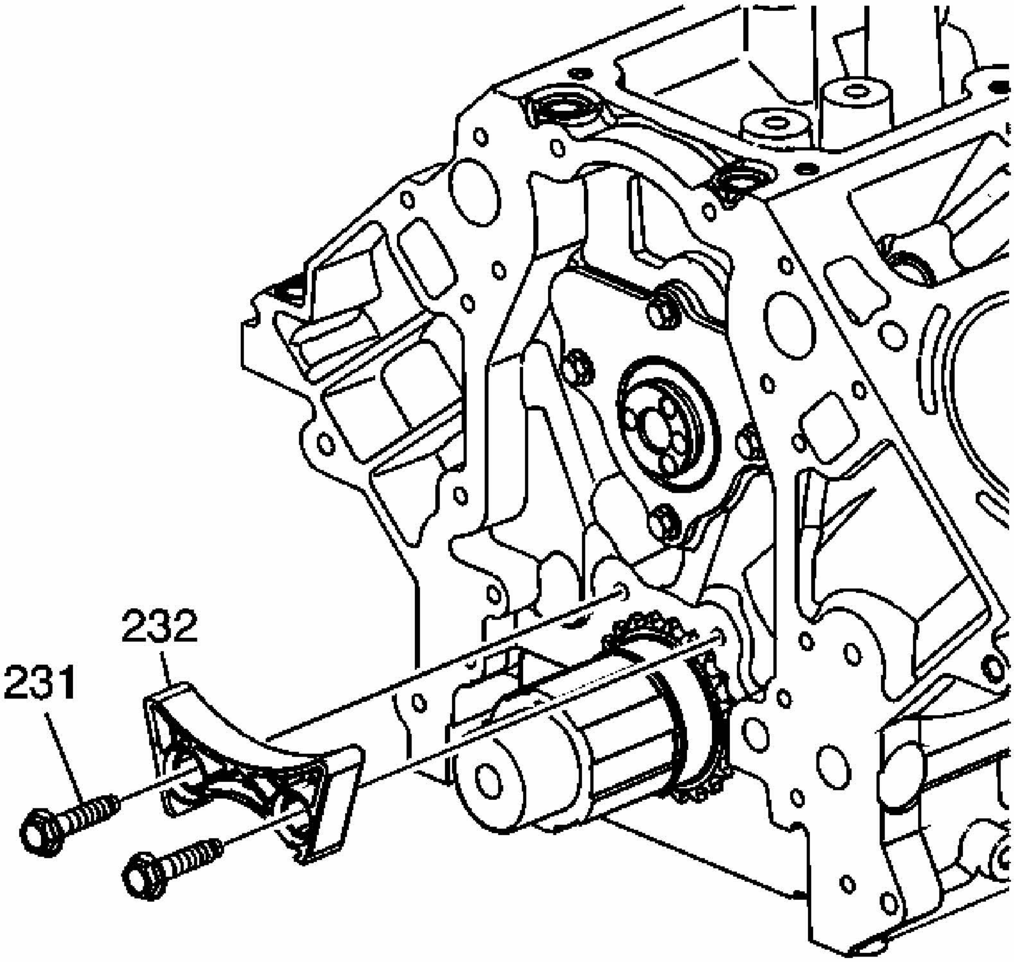


Fig. 597: Timing Chain Dampener & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

6. Install the timing chain dampener (232) and bolts (231).

   Tighten: Tighten the timing chain dampener bolts to 25 N.m (18 lb ft).

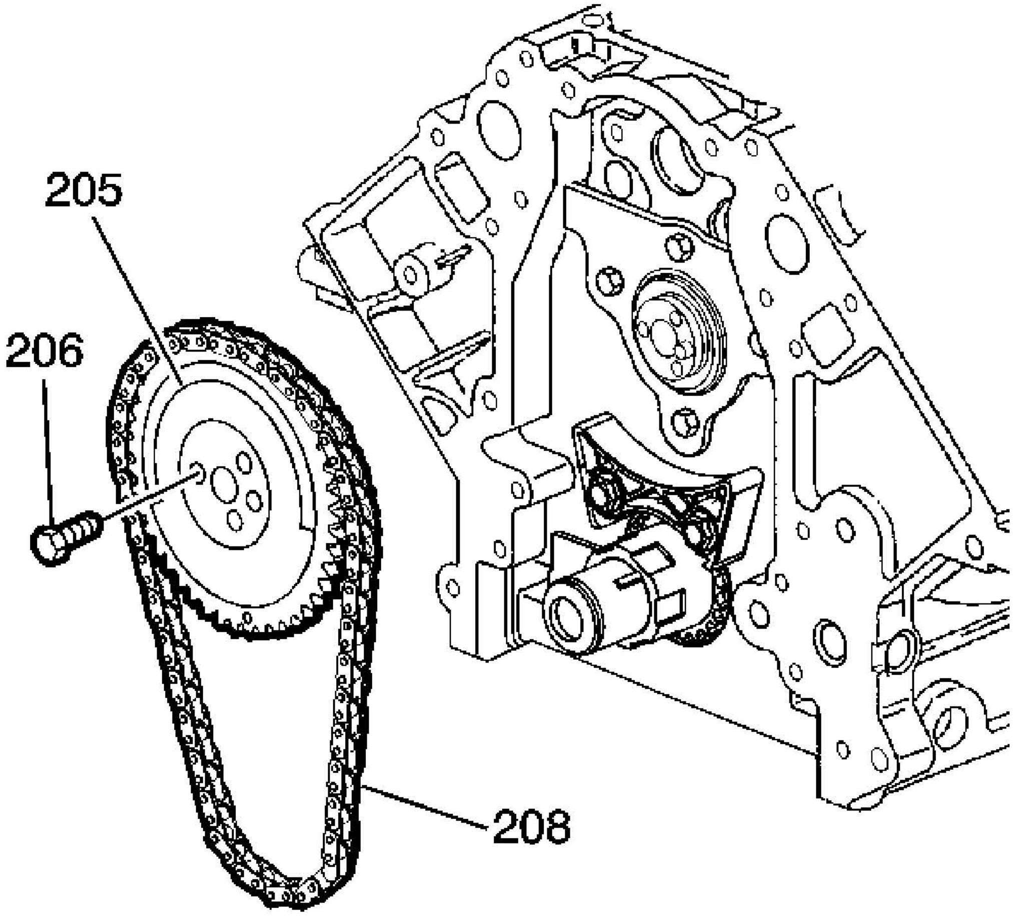


Fig. 598: View Of Camshaft Sprocket, Bolts & Timing Chain
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Properly locate the camshaft sprocket onto the locating pin of the camshaft.**
- **The sprocket teeth and timing chain must mesh.**
- **The camshaft and the crankshaft sprocket alignment marks MUST be aligned properly.**

  Position the camshaft sprocket alignment mark in the 6 o'clock position.

7. Install the camshaft sprocket (205) and timing chain (208). If necessary, rotate the camshaft or crankshaft sprockets in order to align the timing marks.
8. Install the camshaft sprocket bolts (206).

Tighten: Tighten the camshaft sprocket bolts to 25 N.m (18 lb ft).

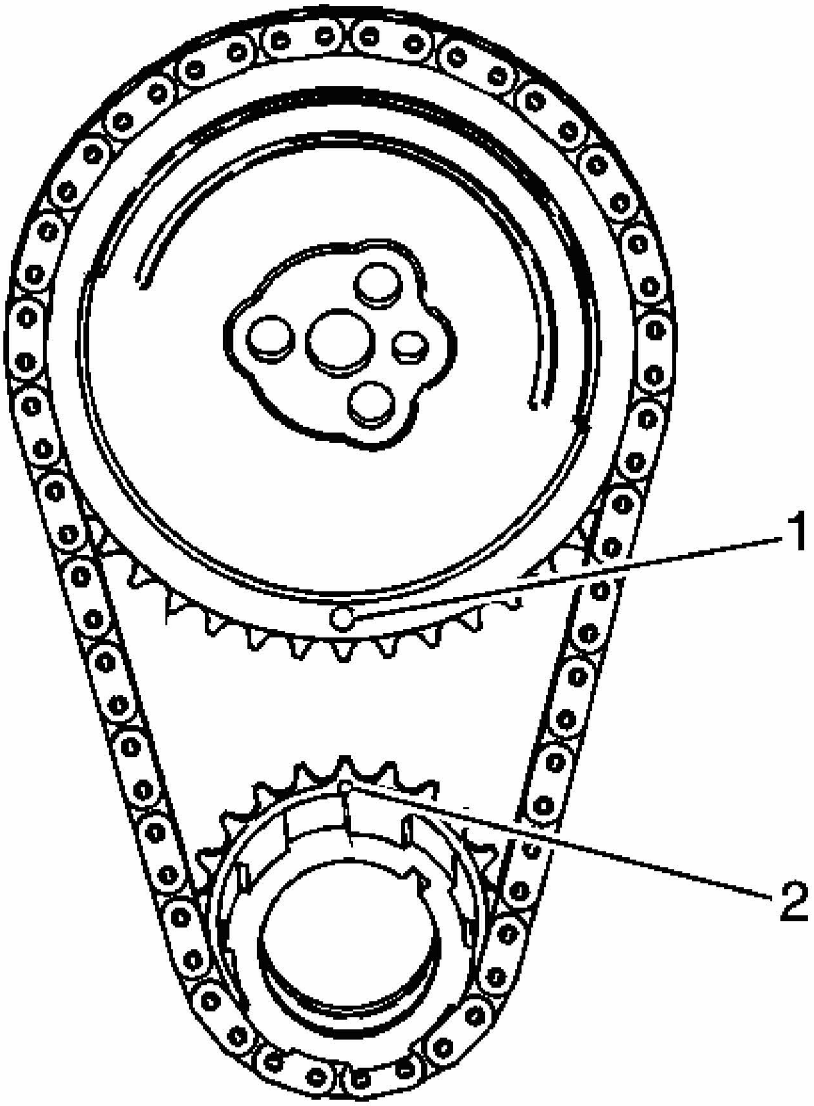


Fig. 599: View Of Camshaft And Crankshaft Timing Marks Aligned
Courtesy of GENERAL MOTORS CORP.

9. Inspect for proper alignment of the camshaft and crankshaft sprocket timing marks (1, 2).

OIL PUMP, SCREEN AND CRANKSHAFT OIL DEFLECTOR INSTALLATION

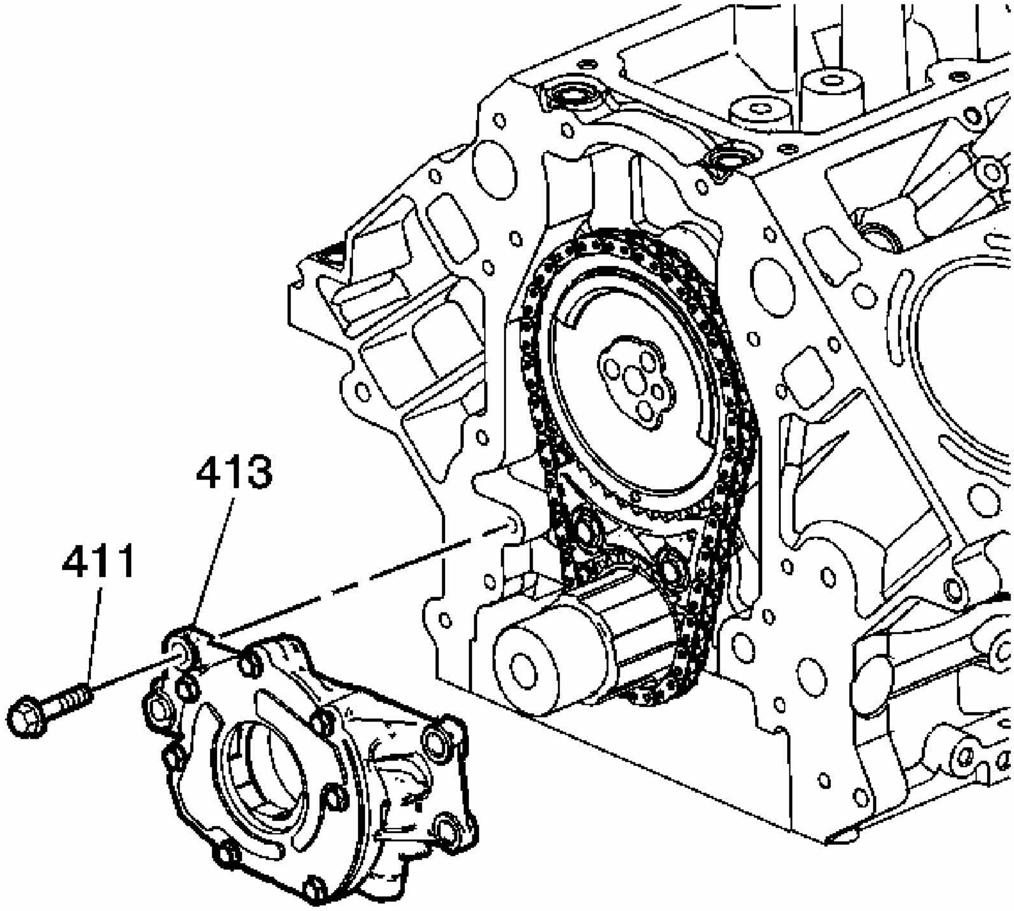


Fig. 600: Removing/Installing Oil Pump Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Inspect the oil pump and engine block oil gallery passages. These surfaces must be clear and free of debris or restrictions.

1. Align the splined surfaces of the crankshaft sprocket and the oil pump drive gear and install the oil pump (413).
2. Install the oil pump onto the crankshaft sprocket until the pump housing contacts the face of the engine block.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the oil pump bolts (411).

Tighten: Tighten the oil pump bolts to 25 N.m (18 lb ft).

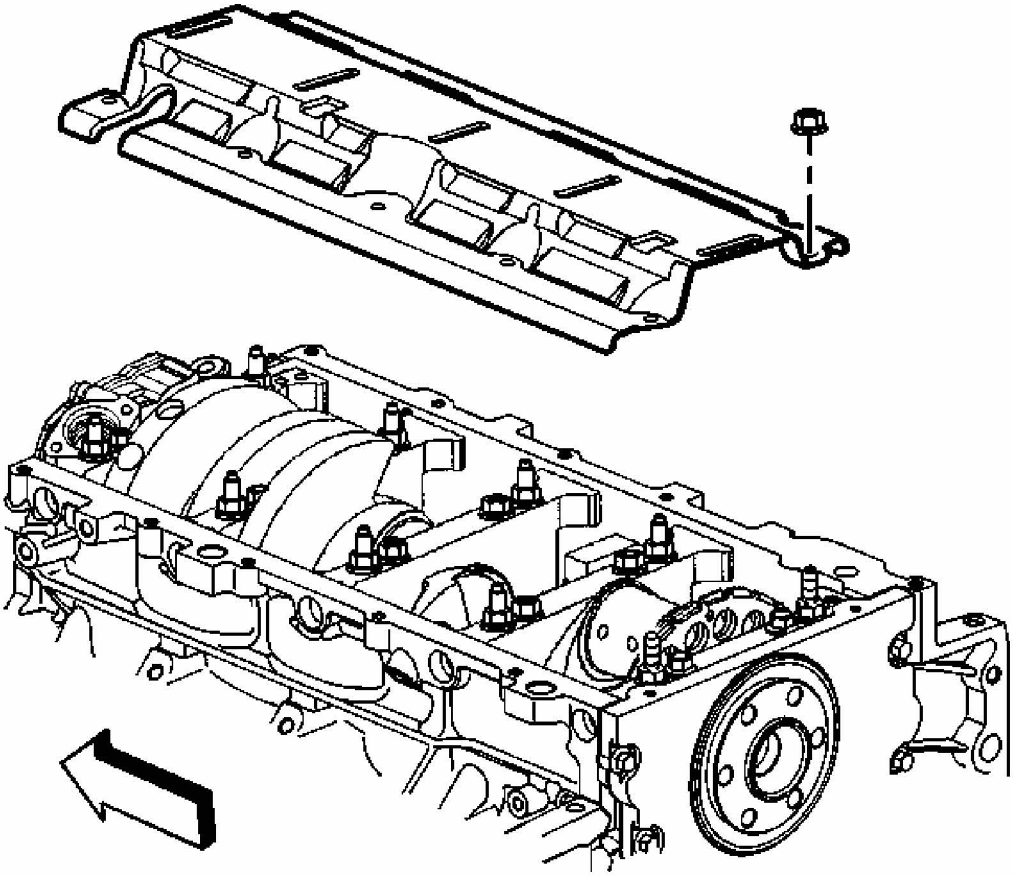


Fig. 601: View Of Crankshaft Oil Deflector
Courtesy of GENERAL MOTORS CORP.

4. Install the crankshaft oil deflector.

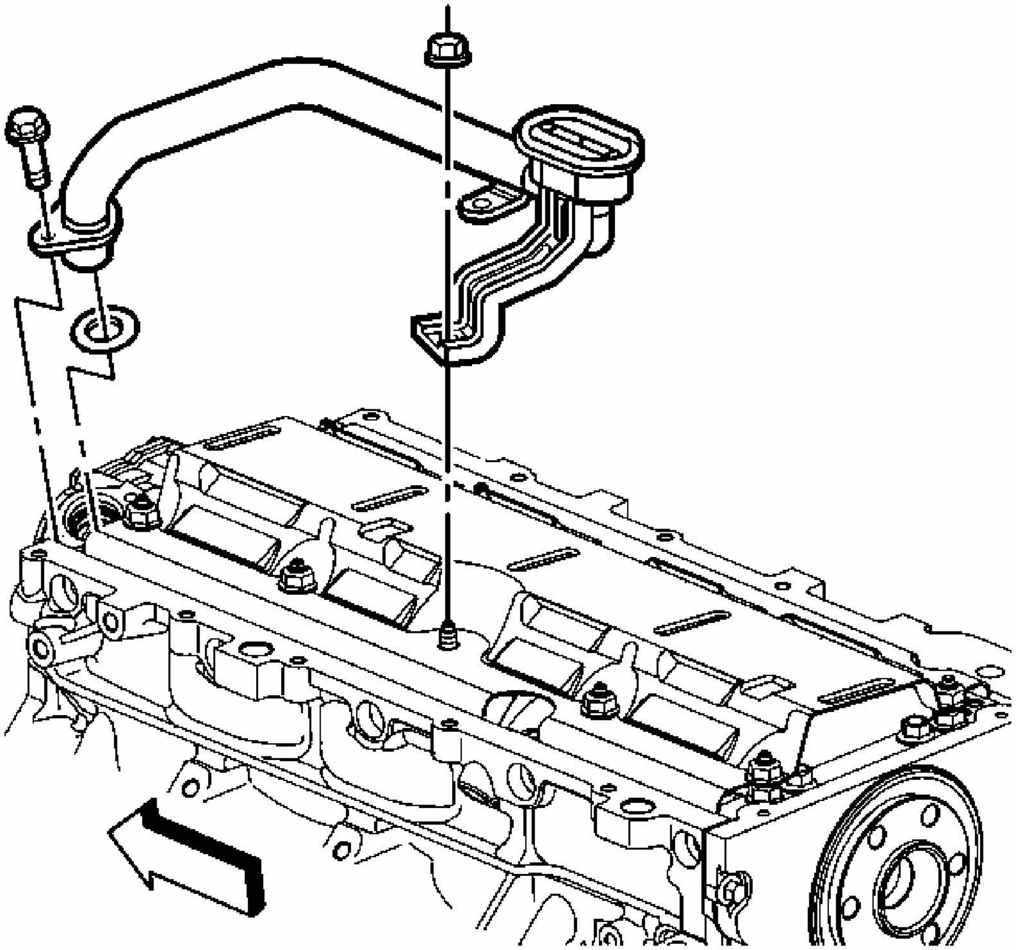


Fig. 602: View Of Oil Pump Screen
Courtesy of GENERAL MOTORS CORP.

5. Lubricate a NEW oil pump screen O-ring seal with clean engine oil.
6. Install the NEW O-ring seal onto the oil pump screen.

IMPORTANT:

- **Push the oil pump screen tube completely into the oil pump prior to tightening the bolt. Do not allow the bolt to pull the tube into the pump.**
- **Align the oil pump screen mounting brackets with the correct crankshaft bearing cap bolt/studs.**

7. Install the oil pump screen.
8. Install the oil pump screen bolt and the deflector nuts.

Tighten:

1. Tighten the oil pump screen bolt to 12 N.m (106 lb in).
2. Tighten the crankshaft oil deflector nut to 25 N.m (18 lb ft).

CRANKSHAFT REAR OIL SEAL HOUSING INSTALLATION

Tools Required

- **J 41476** Front and Rear Cover Alignment Tool. See **Special Tools**.
- **J 41480** Front and Rear Cover Alignment. See **Special Tools**.

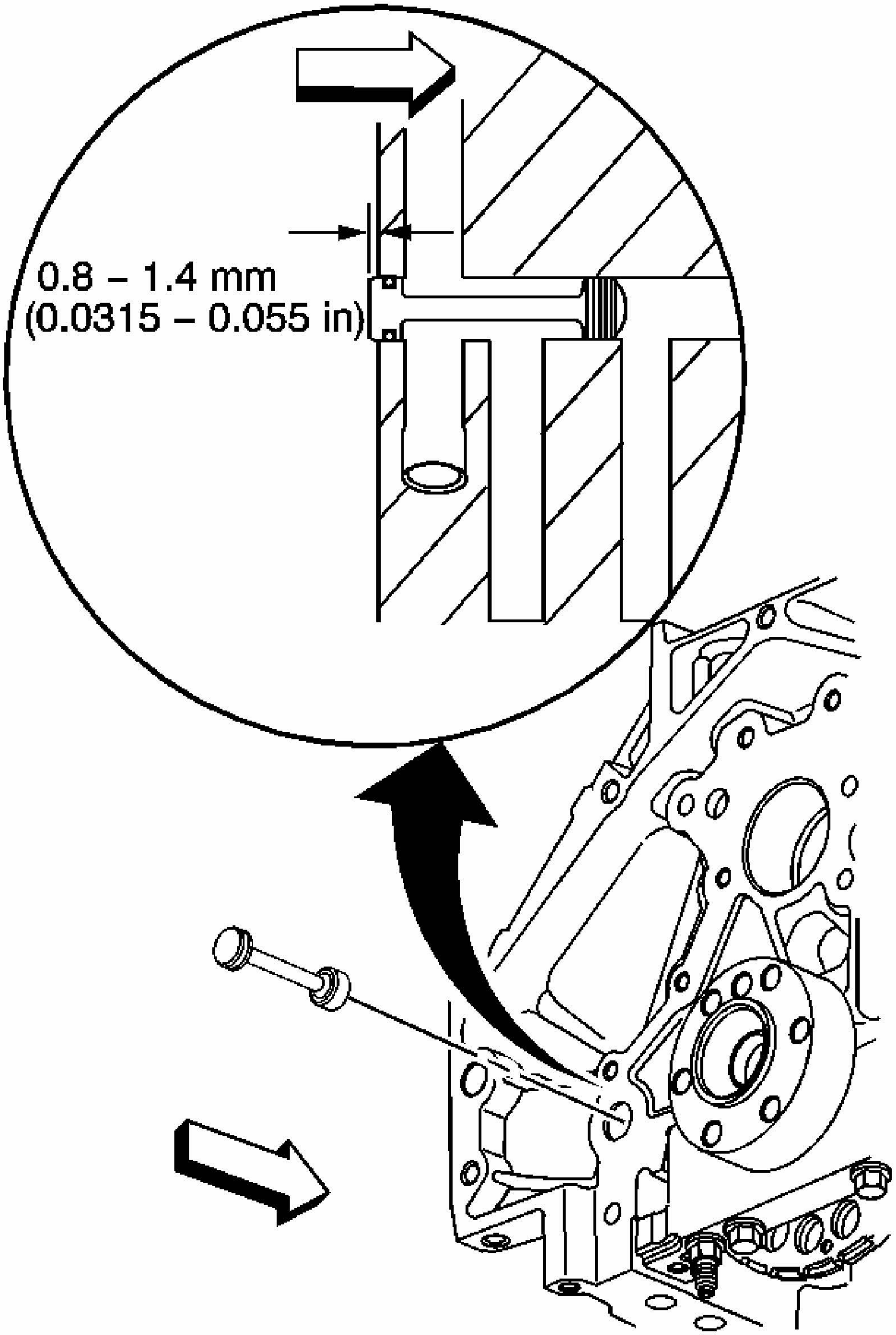

0.8 – 1.4 mm
(0.0315 – 0.055 in)

Fig. 603: View Of Engine Block Rear Oil Gallery Plug

Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Do not use the crankshaft rear oil seal or the engine rear housing gasket again.**
- **Do not apply any type of sealant to the rear housing gasket, unless specified.**
- **The special tools in this procedure are used to properly align the engine rear housing at the oil pan surface and to center the crankshaft rear oil seal.**
- **The crankshaft rear oil seal will be installed after the rear housing has been installed and aligned. Install the rear housing without the crankshaft oil seal.**
    - **The crankshaft rear oil seal MUST be centered in relation to the crankshaft.**
    - **The oil pan sealing surface at the rear housing and engine block MUST be aligned within specifications.**
    - **An improperly aligned rear housing may cause premature rear oil seal wear and/or engine assembly oil leaks.**

1. Inspect the rear oil gallery plug for proper installation.

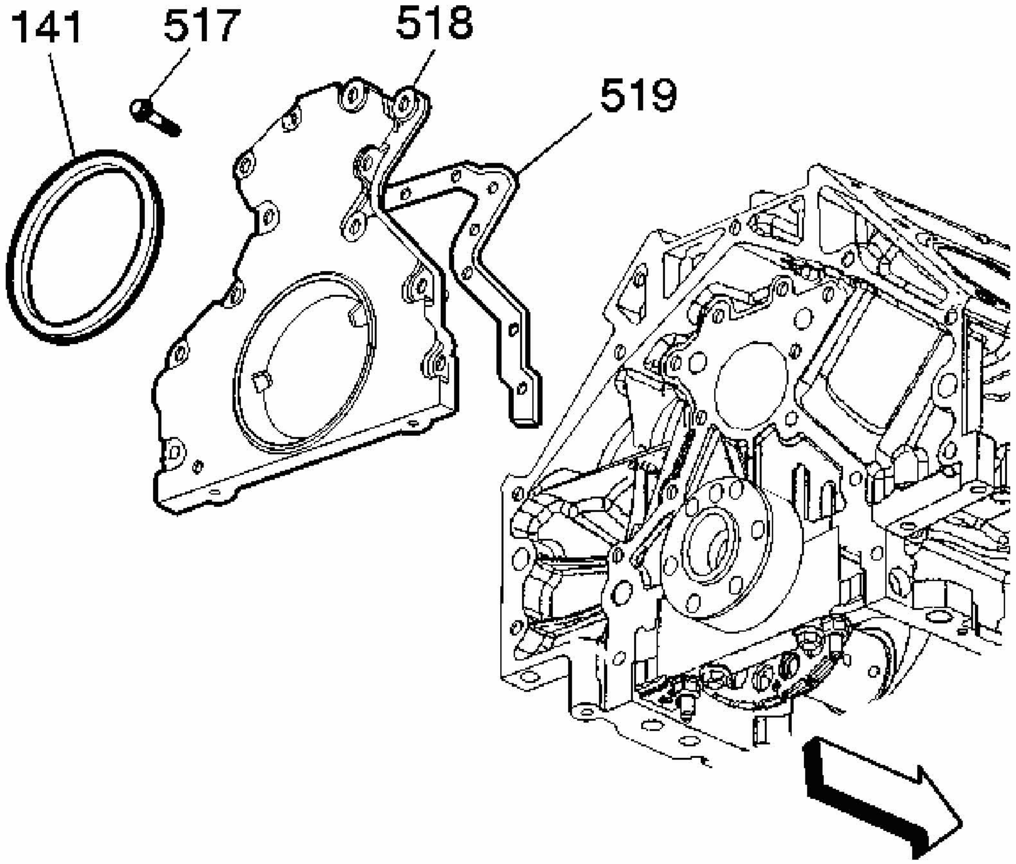


Fig. 604: Exploded View Of Engine Rear Cover
Courtesy of GENERAL MOTORS CORP.

2. Install the rear housing gasket (519), rear housing (518), and bolts (517).
3. Tighten the bolts finger tight. Do not overtighten.

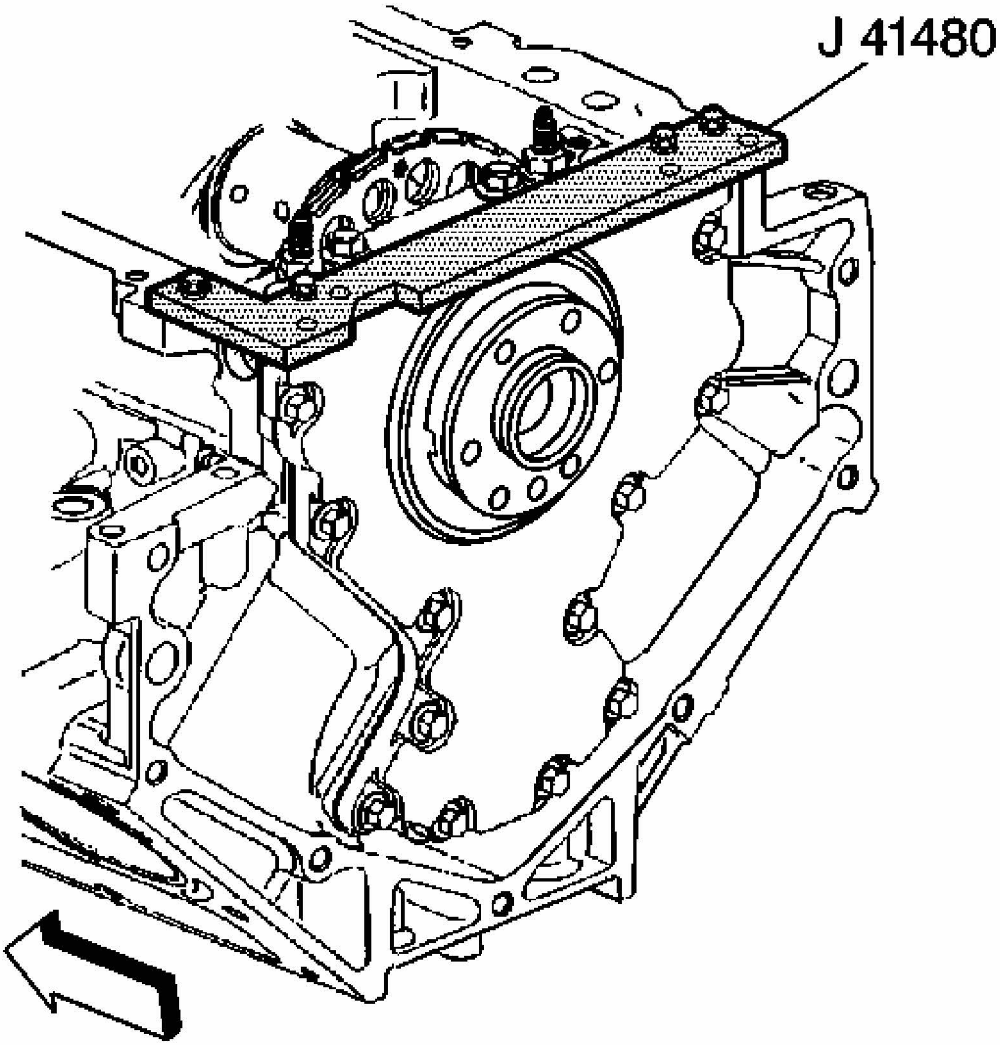


Fig. 605: View Of J 41480 Installed To Engine Block
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

IMPORTANT: **Start the J 41480 tool-to-rear housing bolts. See Special Tools. Do not tighten the bolts at this time.**

4. Install the **J 41480** and bolts. See **Special Tools**.

Tighten: Tighten the tool-to-engine block bolts to 25 N.m (18 lb ft).

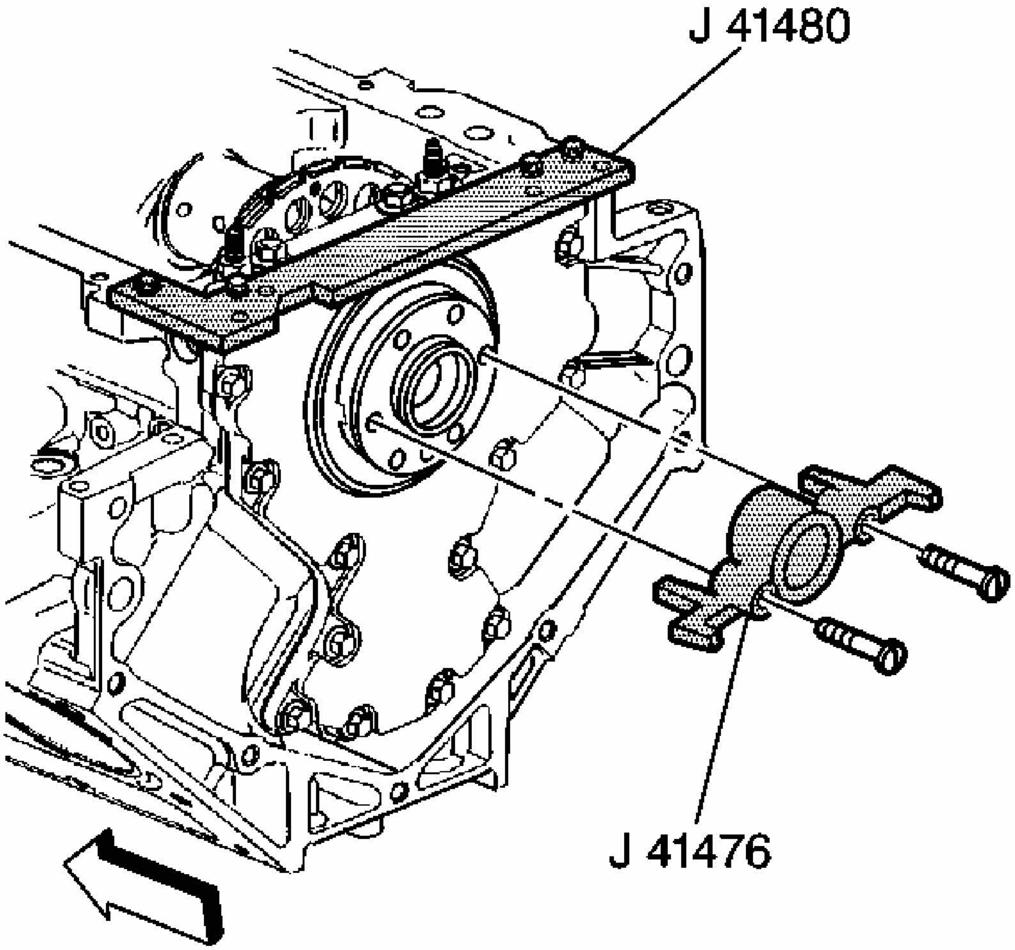


Fig. 606: View Of J 41480 & J 41476
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: To properly align the rear housing, the J 41476 must be installed onto the rear of the crankshaft with the tool mounting bolts parallel to the oil pan surface. See Special Tools.

5. Rotate the crankshaft until 2 opposing flywheel bolt holes are parallel to the oil pan surface.

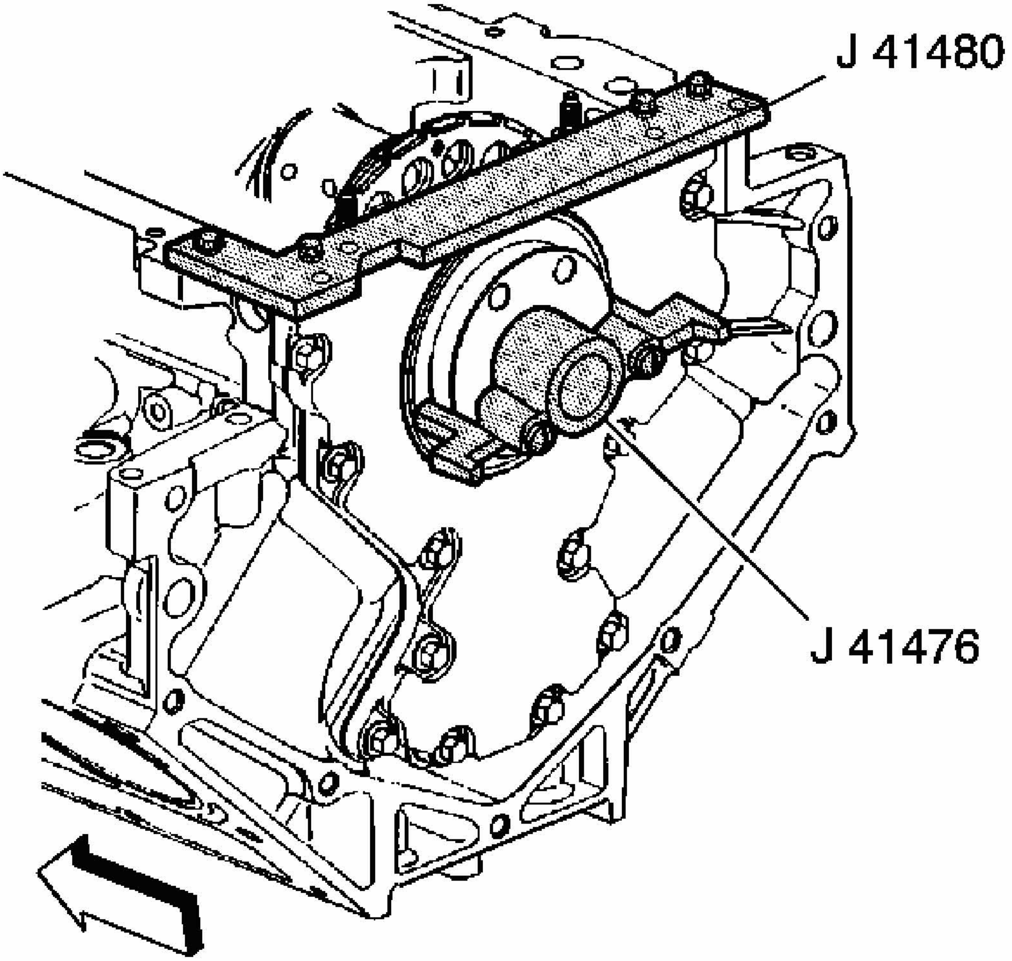


Fig. 607: View Of J 41480 & J 41476 Installed
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The tapered legs of the alignment tool must enter the rear housing oil seal bore.

6. Install the **J 41476** and bolts onto the rear of the crankshaft. See Special Tools.

Tighten:

1. Tighten the tool mounting bolts until snug. Do not overtighten.
2. Tighten the **J 41480** tool-to-rear housing bolts evenly to 12 N. See Special Tools.m (106 lb in).
3. Tighten the rear housing bolts to 25 N.m (18 lb ft).

7. Remove the tools.

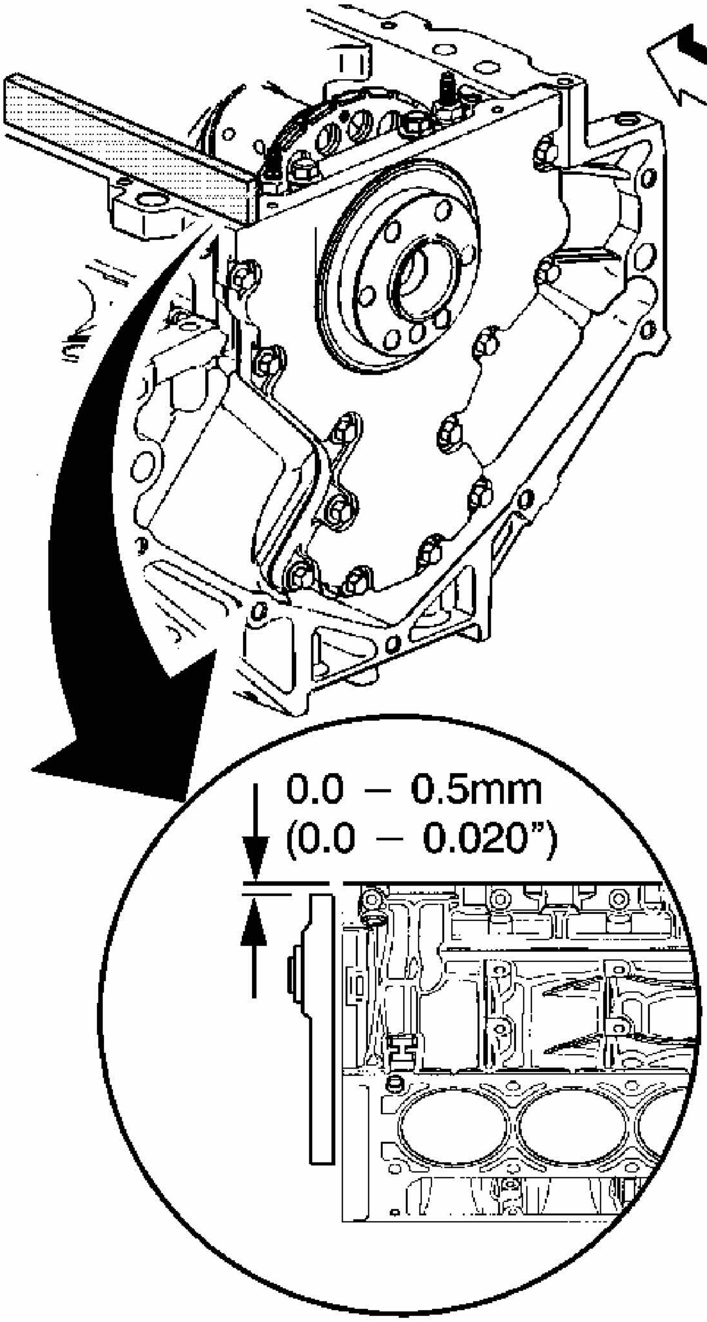


Fig. 608: Checking Rear Cover-To-Engine Block Proper Installation Position
Courtesy of GENERAL MOTORS CORP.

8. Measure the rear housing-to-engine block oil pan surface for flatness.

1. Place a straight edge onto the engine block and rear housing oil pan sealing surfaces.

   Avoid contact with the portion of the gasket that protrudes into the oil pan surface.

2. Insert a feeler gage between the rear housing and the straight edge. The housing must be flush with the oil pan or no more than 0.5 mm (0.02 in) below flush.

9. If the rear housing-to-engine block oil pan surface alignment is not within specifications, repeat the housing alignment procedure.
10. If the correct rear housing-to-engine block alignment at the oil pan surface cannot be obtained, replace the rear housing.

CRANKSHAFT REAR OIL SEAL INSTALLATION

Tools Required

J 41479 Crankshaft Rear Oil Seal Installer. See **Special Tools**.

J 41479-2A Crankshaft Rear Oil Seal Installation Guide. See **Special Tools**

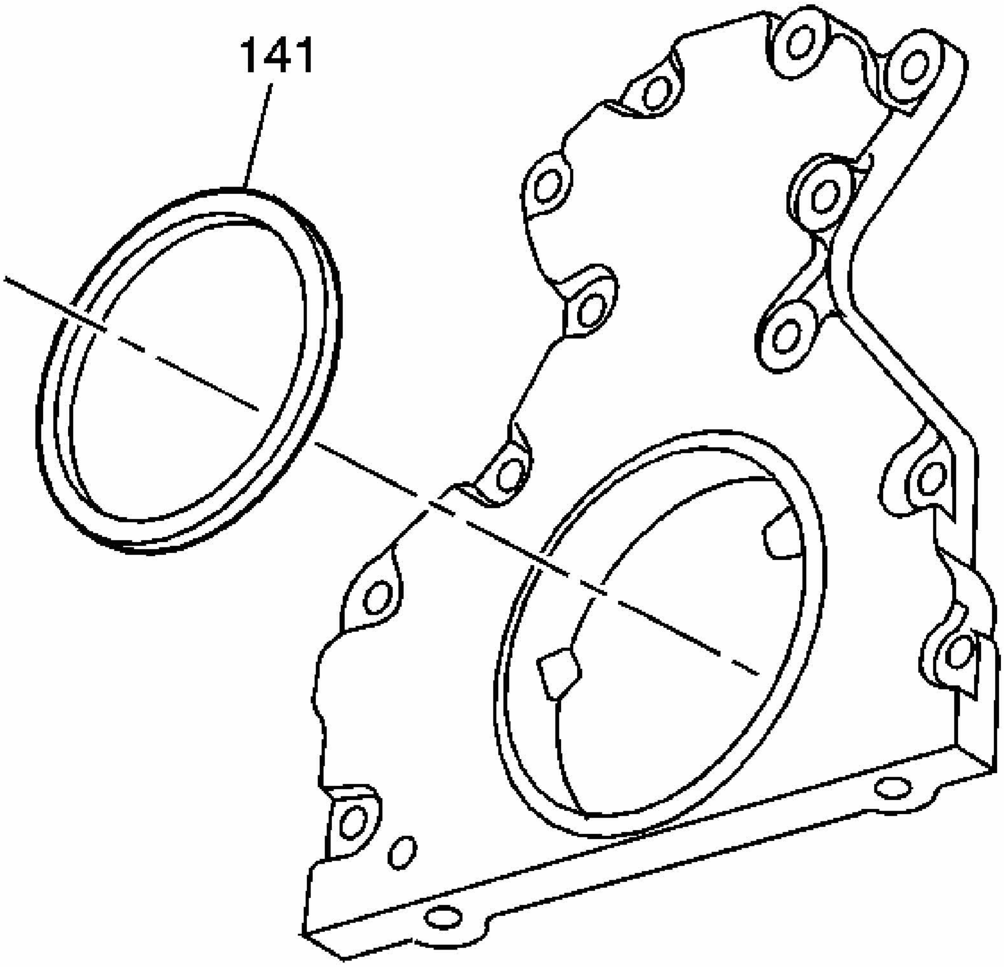


Fig. 609: View Of Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Do not lubricate the oil seal inside diameter (ID) or the crankshaft surface.**
- **Do not use the crankshaft rear oil seal again.**

1. Inspect the seal and identify the part number markings for proper orientation.

   DO NOT allow oil or other lubricants to contact the seal surface.

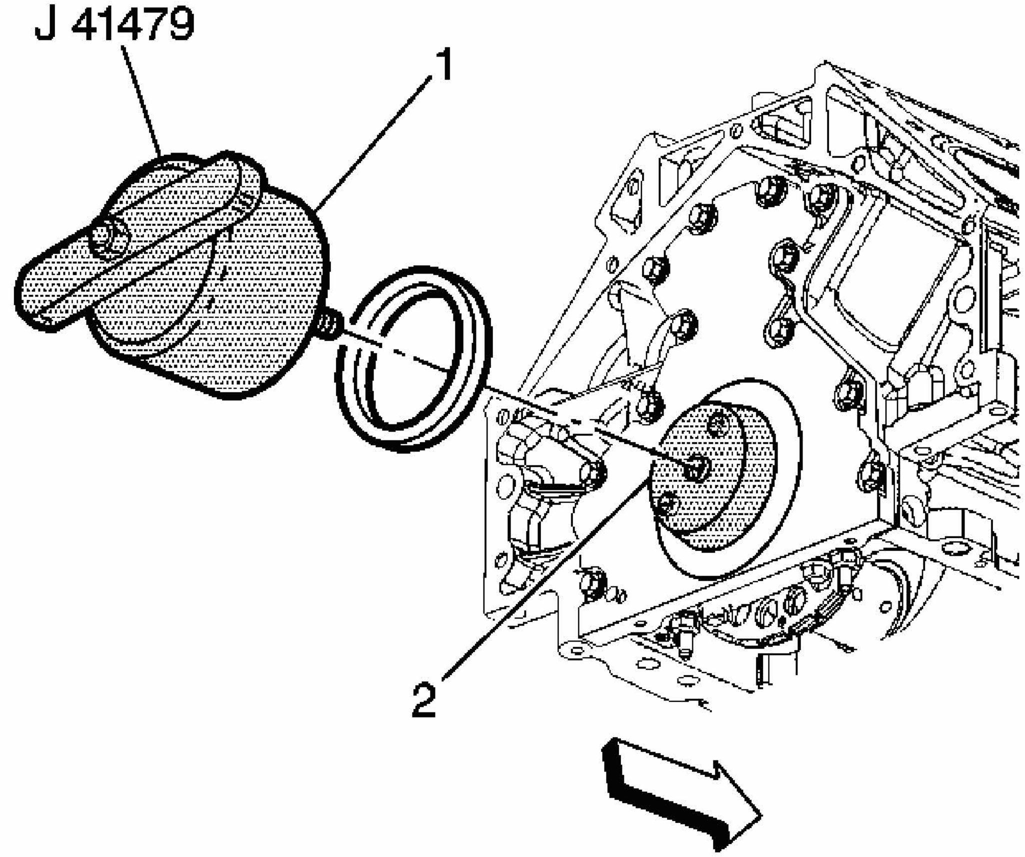


Fig. 610: Installing Crankshaft Rear Oil Seal Using J 41479
Courtesy of GENERAL MOTORS CORP.

2. Install the **J 41479** or **J 41479-2A** cone (2) and bolts onto the rear of the crankshaft. **J 41479-2A** may be required for manual transmission applications.

   DO NOT allow oil or other lubricants to contact the crankshaft surface.

3. Tighten the bolts until snug. Do not overtighten.
4. Install the rear oil seal onto the tapered cone (2) and push the seal to the rear seal bore. Install the oil seal with the part number markings facing away from the engine.
5. Thread the **J 41479** threaded rod into the tapered cone until the tool (1) contacts the oil seal.
6. Align the oil seal onto the tool (1).
7. Rotate the handle of the tool (1) clockwise until the seal enters the rear housing and bottoms into the housing bore.

8. Remove the tool.

ENGINE FRONT COVER INSTALLATION

Tools Required

- **J 41476** Front and Rear Cover Alignment Tool. See **Special Tools**.
- **J 41480** Front and Rear Cover Alignment. See **Special Tools**.

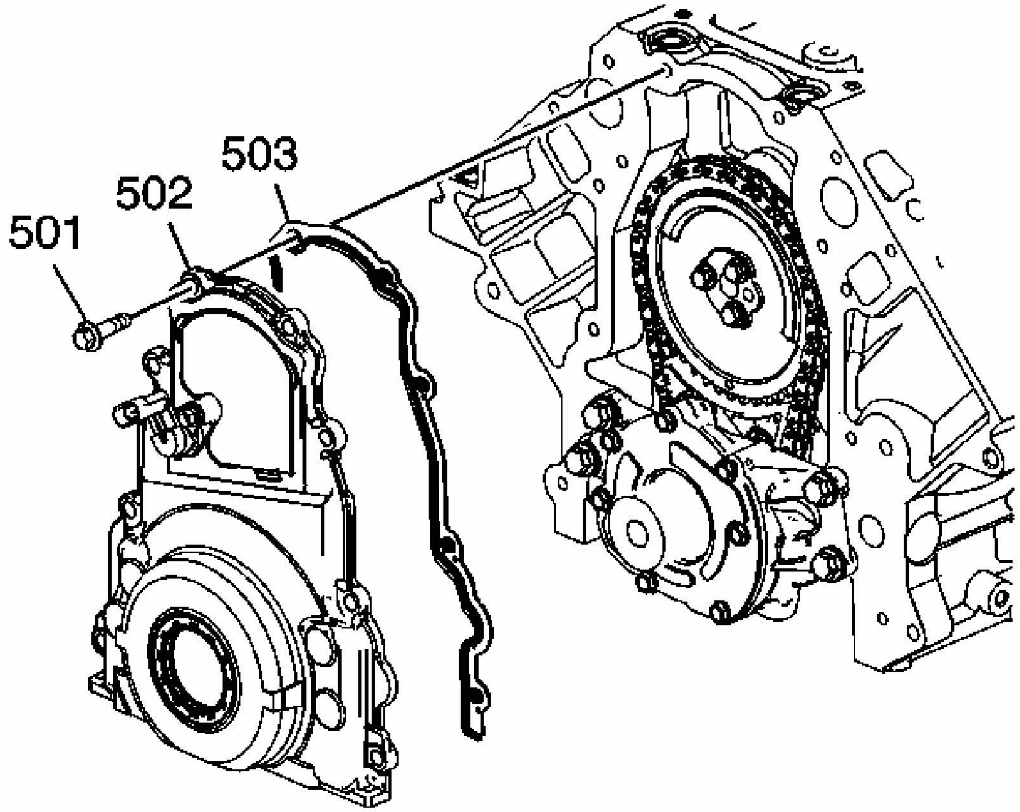


Fig. 611: View Of Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Do not use the crankshaft oil seal or the engine front cover gasket again.**
- **Do not apply any type of sealant to the front cover gasket, unless specified.**
- **The special tools in this procedure are used to properly**

align the engine front cover at the oil pan surface and to center the crankshaft front oil seal.

- **All gasket surfaces should be free of oil or other foreign material during assembly.**

  The crankshaft front oil seal MUST be centered in relation to the crankshaft.

- **The oil pan sealing surface at the front cover and engine block MUST be aligned within specifications.**
- **An improperly aligned front cover may cause premature front oil seal wear and/or engine assembly oil leaks.**

1. Install the front cover gasket (503), front cover (502), and bolts (501).
2. Tighten the cover bolts finger tight. Do not overtighten.

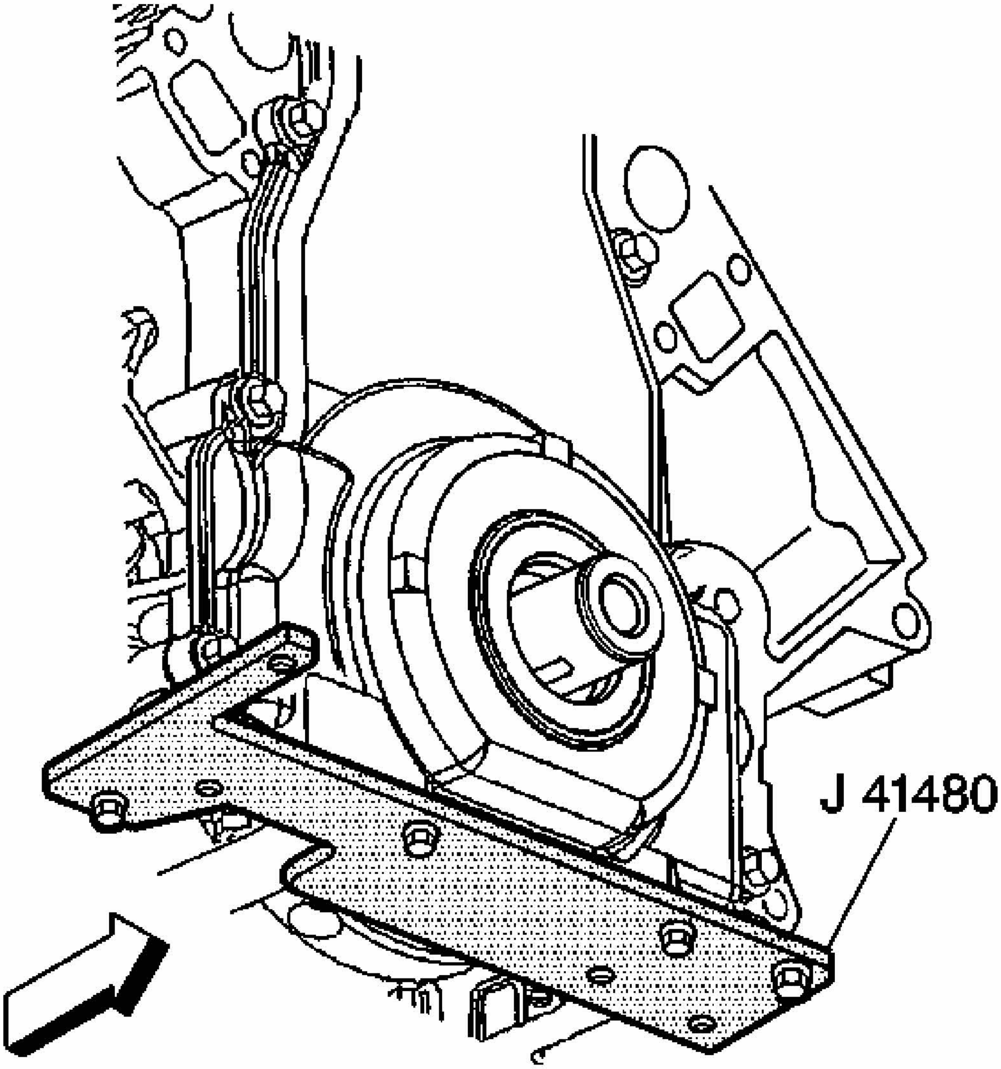


Fig. 612: View Of J 41480 Installed On Engine Block
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

IMPORTANT: **Start the tool-to-front cover bolts. Do not tighten the bolts at this time.**

3. Install the **J 41480** . See **Special Tools**.

Tighten: Tighten the tool-to-engine block bolts to 25 N.m (18 lb ft).

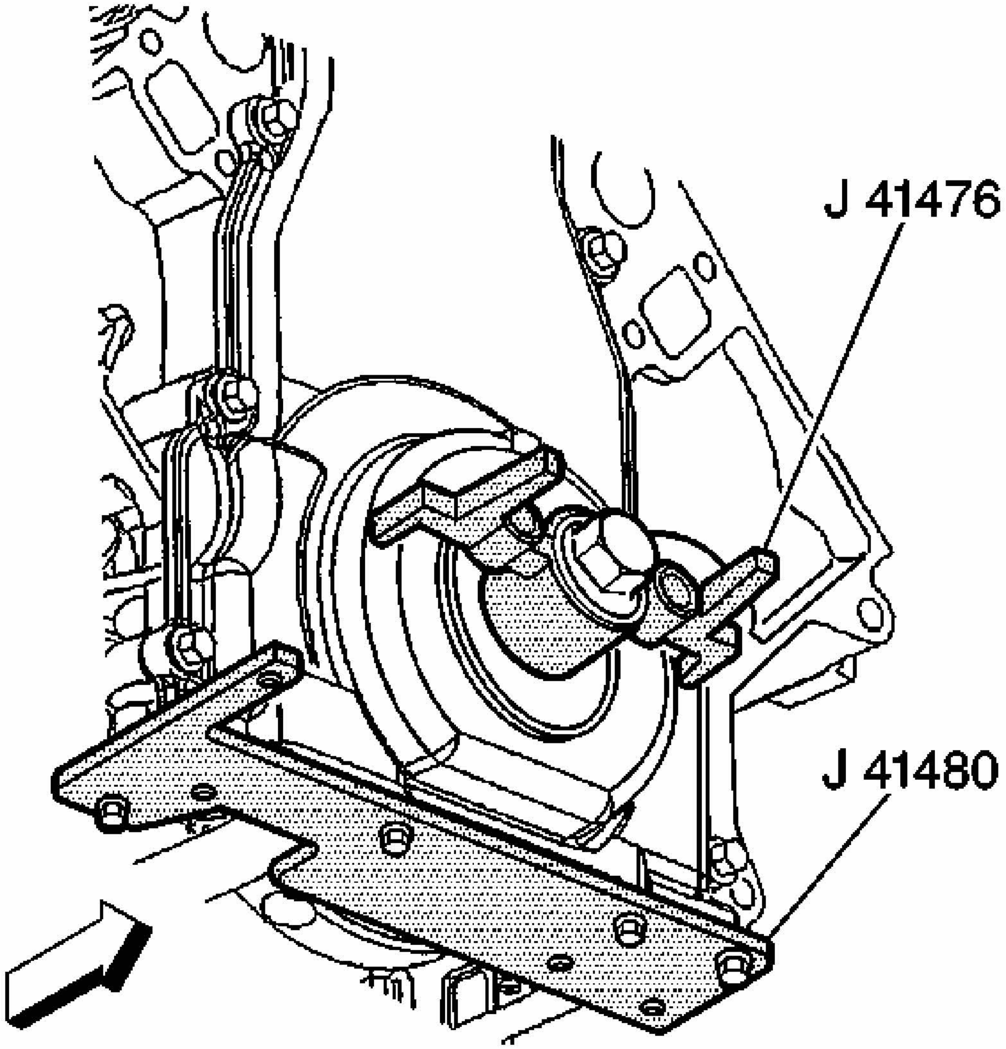


Fig. 613: View Of J 41476 & J 41480 Installed On Engine
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Align the tapered legs of the tool with the machined alignment surfaces on the front cover.

4. Install the **J 41476** . See Special Tools.
5. Install the crankshaft balancer bolt.

Tighten:

1. Tighten the crankshaft balancer bolt by hand until snug. Do not overtighten.
2. Tighten the **J 41480** . See **Special Tools**.
3. Tighten the engine front cover bolts to 25 N.m (18 lb ft).

6. Remove the tools.

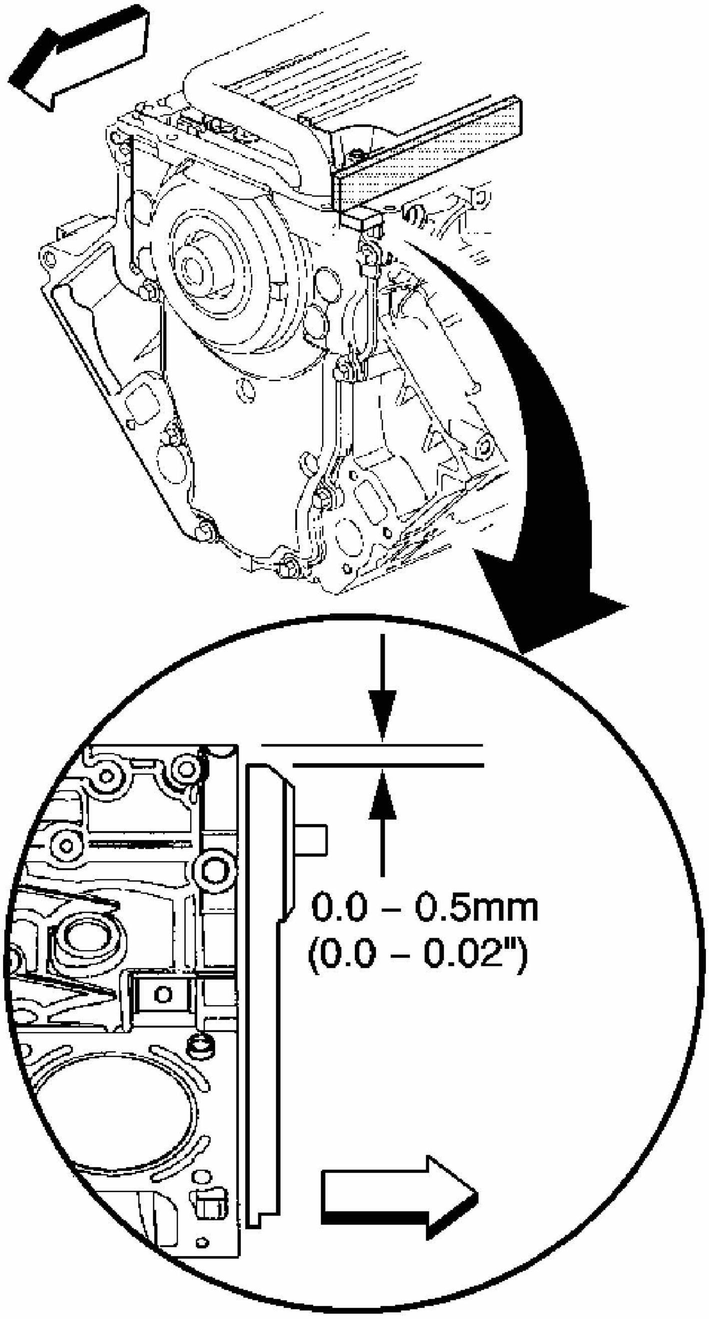


Fig. 614: View Of Front Cover-To-Engine Block Proper Installation Position
Courtesy of GENERAL MOTORS CORP.

7. Measure the oil pan surface flatness, front cover-to-engine block.
    1. Place a straight edge across the engine block and front cover oil pan sealing surfaces.

        Avoid contact with the portion of the gasket that protrudes into the oil pan surface.

    2. Insert a feeler gage between the front cover and the straight edge tool. The cover must be flush with the oil pan surface, or no greater than 0.5 mm (0.02 in) (a) below flush.
8. If the front cover-to-engine block oil pan surface alignment is not within specifications, repeat the cover alignment procedure.
9. If the correct front cover-to-engine block alignment cannot be obtained, replace the front cover.

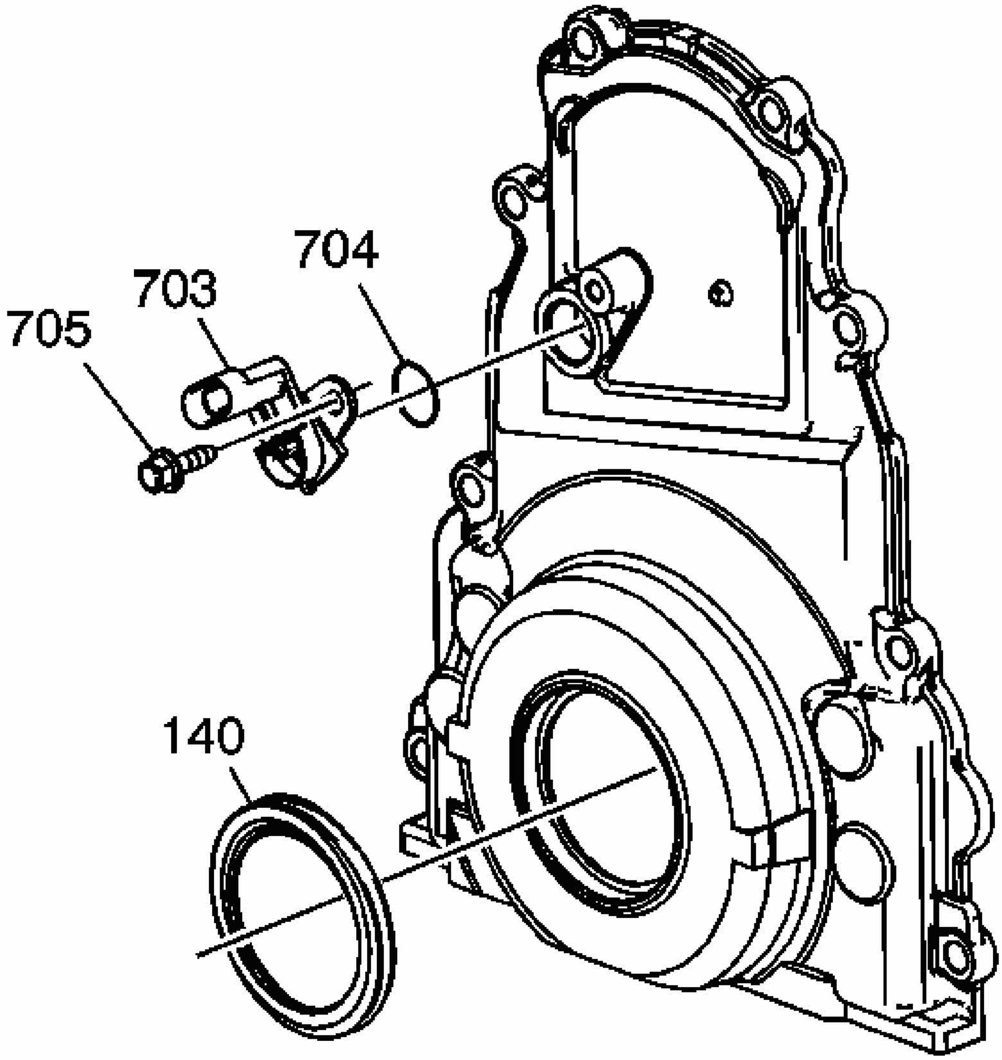


Fig. 615: View Of Crankshaft Oil Seal & Camshaft Position (CMP) Sensor
Courtesy of GENERAL MOTORS CORP.

10. Inspect the camshaft position (CMP) sensor O-ring seal (704) for cuts or damage. If the seal is not cut or damaged, it may be used again.
11. Lubricate the O-ring seal with clean engine oil.
12. Install the O-ring seal onto the sensor (703).
13. Install the sensor to the cover.
14. Install the bolt (705).

    Tighten: Tighten the bolt to 12 N.m (106 lb in).

CRANKSHAFT FRONT OIL SEAL INSTALLATION

Tools Required

J 41478 Crankshaft Front Oil Seal Installer. See **Special Tools**.

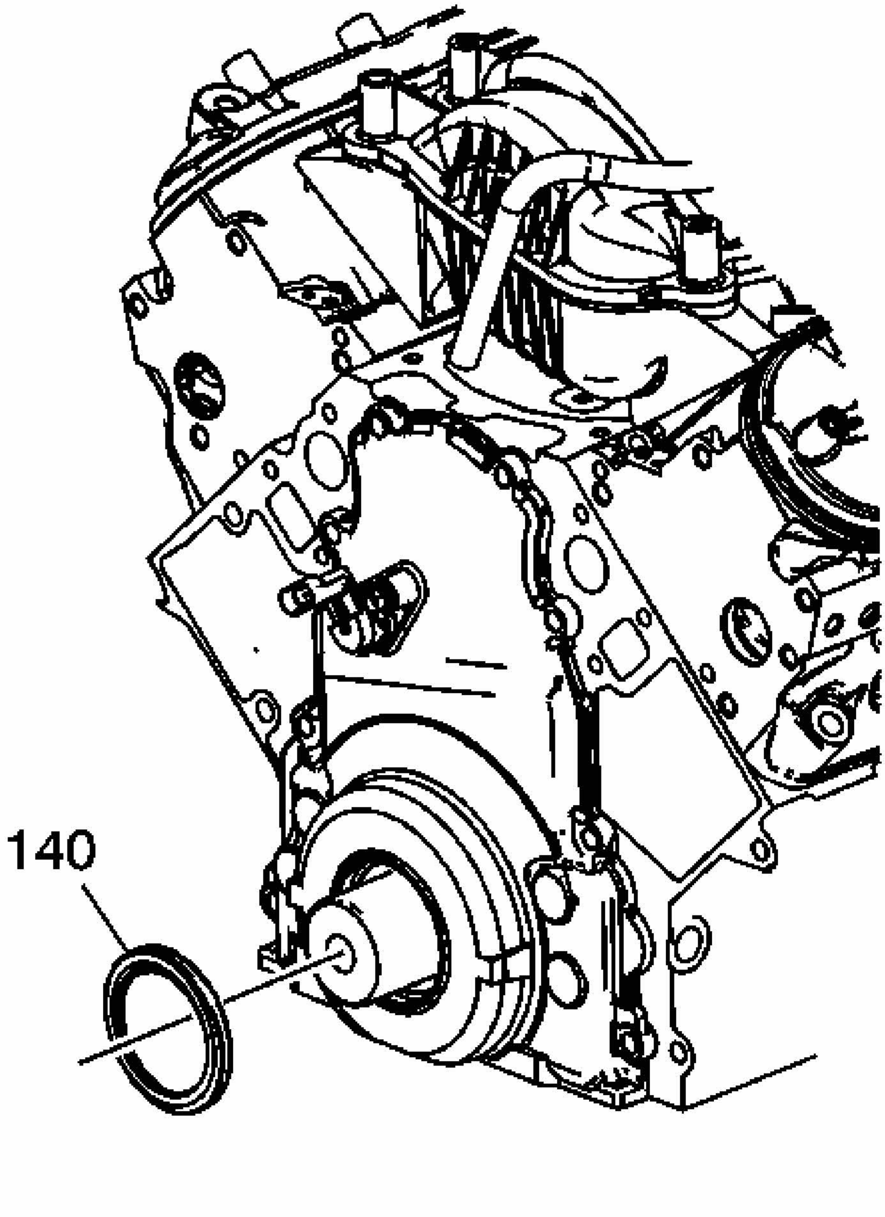


Fig. 616: Aligning The Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Do not lubricate the oil seal sealing surface.**

- **Do not use the crankshaft front oil seal again.**

1. Lubricate the outer edge of the oil seal (140) with clean engine oil.
2. Lubricate the front cover oil seal bore with clean engine oil.

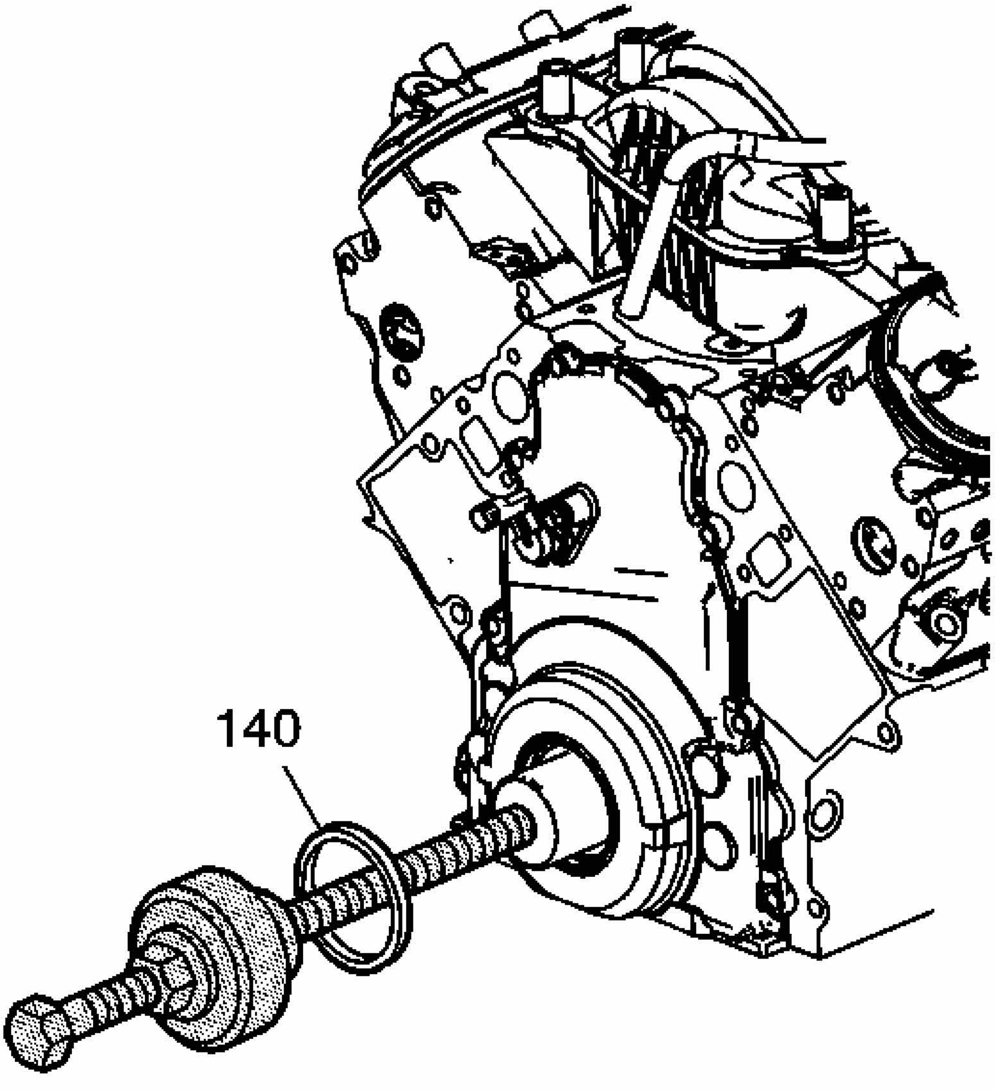


Fig. 617: Using Special Tools To Install Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

3. Install the crankshaft front oil seal (140) onto the **J 41478** . See **Special Tools**.

4. Install the **J 41478** threaded rod, with nut, washer, guide, and oil seal, into the end of the crankshaft. See **Special Tools**.
5. Use the **J 41478** in order to install the oil seal into the cover bore. See **Special Tools**.
    1. Use a wrench and hold the hex on the installer bolt.
    2. Use a second wrench and rotate the installer nut clockwise until the seal bottoms in the cover bore.
    3. Remove the tool.
    4. Inspect the oil seal for proper installation. The oil seal should be installed evenly and completely into the front cover bore.

OIL PAN INSTALLATION

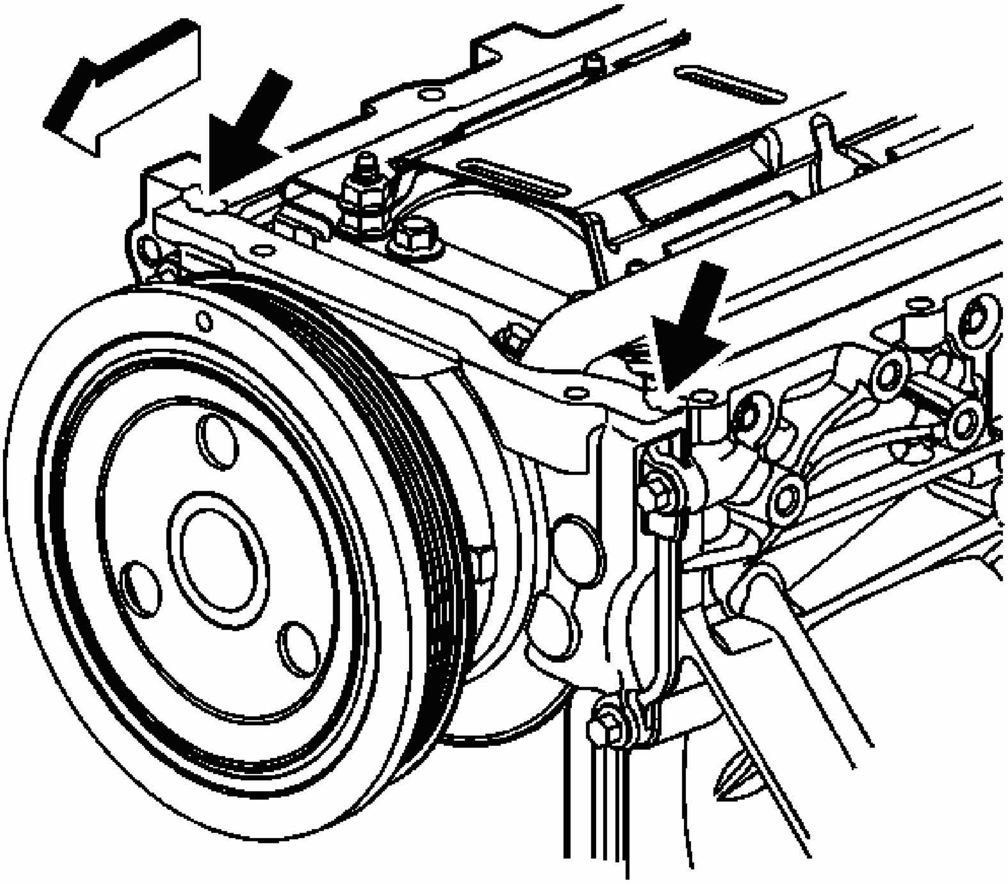


Fig. 618: Applying Bead Of Sealant
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **The alignment of the structural oil pan is critical. The rear bolt hole locations of the oil pan provide mounting points for the transmission housing. To ensure the rigidity of the powertrain and correct transmission alignment, it is important that the rear of the block and the rear of the oil pan are flush, or even. The rear of the oil pan must NEVER protrude beyond the engine block and transmission housing plane.**
- **Do not use the oil pan gasket again.**
- **It is not necessary to rivet the NEW gasket to the oil pan.**

1. Apply a 5 mm (0.2 in) bead of sealant GM P/N 12378190, or equivalent, 20 mm (0.8 in) long to the engine block. Apply the sealant directly onto the tabs of the front cover gasket that protrude into the oil pan surface. Refer to **Sealers, Adhesives, and Lubricants**.

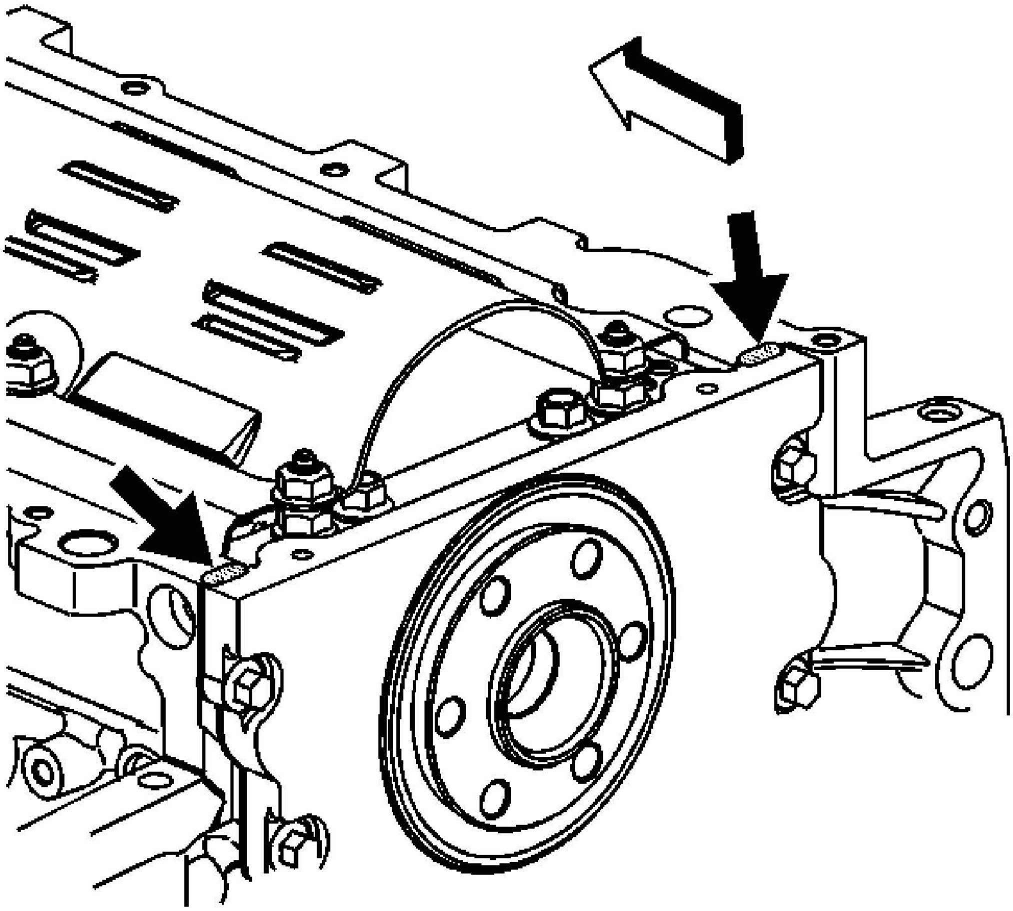


Fig. 619: View Of Sealant On Engine Rear Cover Gasket Tabs
Courtesy of GENERAL MOTORS CORP.

2. Apply a 5 mm (0.2 in) bead of sealant GM P/N 12378190, or equivalent, 20 mm (0.8 in) long to the engine block. Apply the sealant directly onto the tabs of the rear cover gasket that protrude into the oil pan surface.

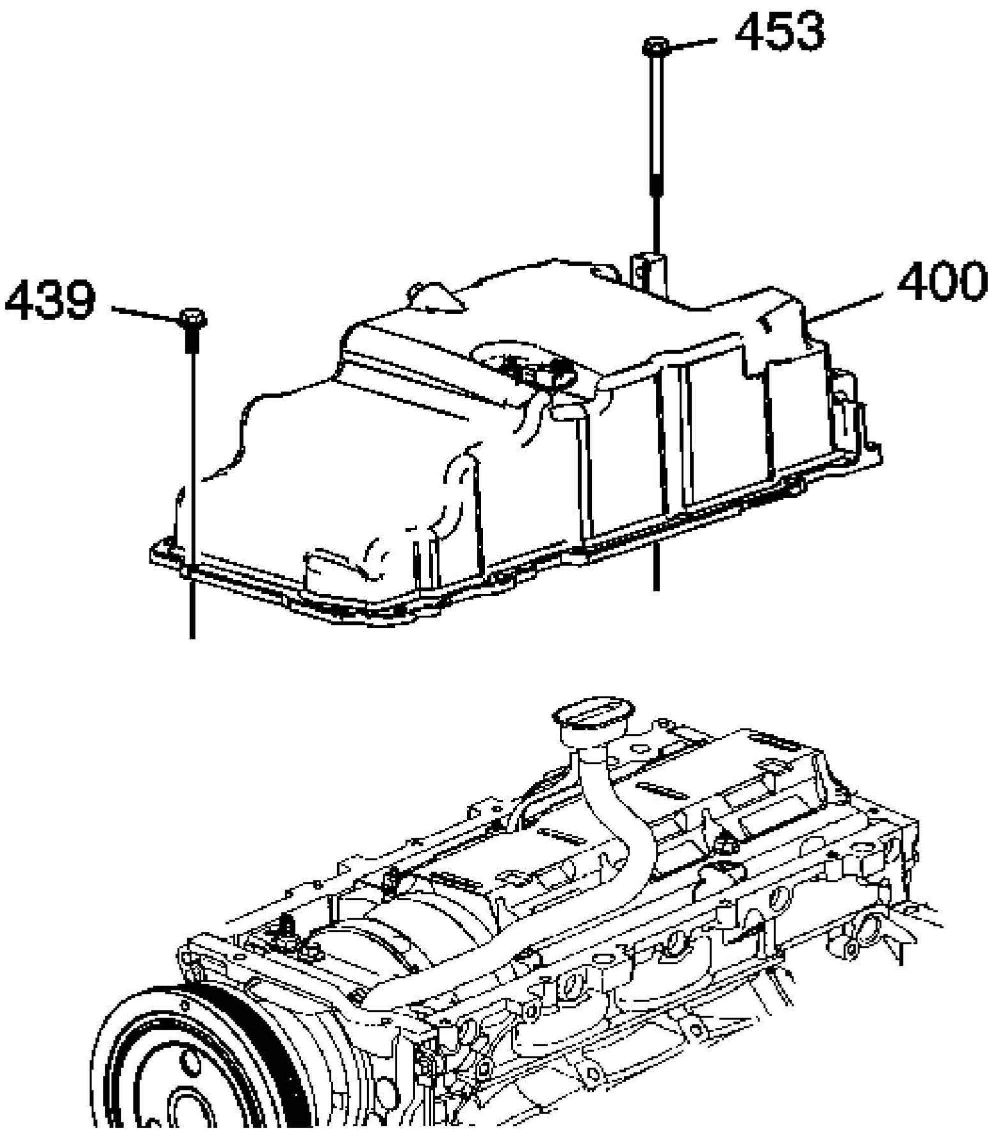


Fig. 620: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure the oil gallery passages in the oil pan and engine block properly align with the oil pan gasket.

3. Pre-assemble the oil pan gasket to the pan.
    1. Install the gasket onto the oil pan.
    2. Install the oil pan bolts (439, 453) to the pan and through the gasket.

4. Install the oil pan, gasket and bolts to the engine block.
5. Tighten bolts finger tight. Do not overtighten.

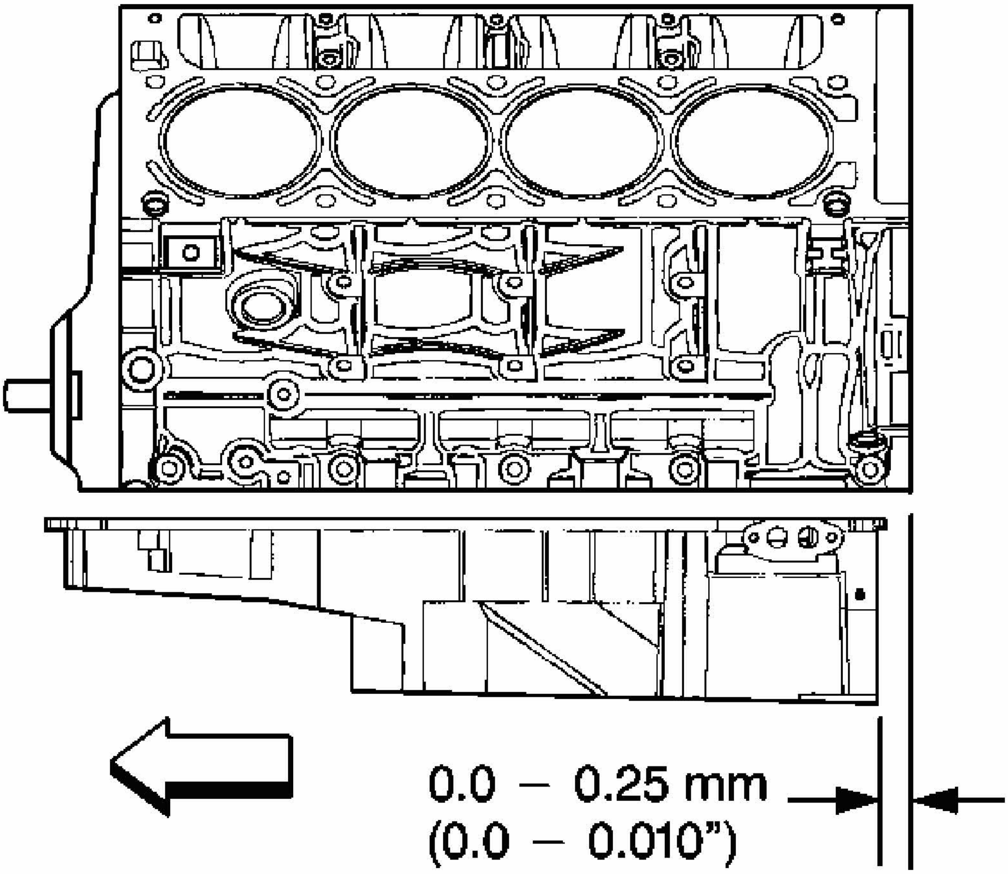


Fig. 621: Measuring The Oil Pan-To-Engine Block Alignment
Courtesy of GENERAL MOTORS CORP.

6. Place a straight edge across the rear of the engine block and the rear of the oil pan at the transmission housing mounting surfaces.

NOTE: Refer to Fastener Notice in Cautions and Notices.

7. Align the oil pan until the rear of engine block and rear of oil pan are flush or even.

Tighten:

1. Tighten the oil pan-to-block and oil pan-to-front cover bolts to 25 N.m (18 lb ft).

    2. Tighten the oil pan-to-rear cover bolts to 12 N.m (106 lb in).

8. Measure the oil pan-to-engine block alignment.
    1. Place a straight edge across the rear of the engine block and rear of oil pan at the transmission housing mounting surfaces.

       IMPORTANT: The rear of the oil pan must NEVER protrude beyond the engine block and transmission housing mounting surfaces.

    2. Insert a feeler gage between the straight edge and the oil pan transmission housing mounting surface, and inspect to ensure there is no more than a 0.25 mm (0.01 in) gap (a) between the pan and straight edge.
    3. If the oil pan alignment is not within specifications, remove the oil pan and repeat the above procedure.

OIL FILTER AND ADAPTER INSTALLATION

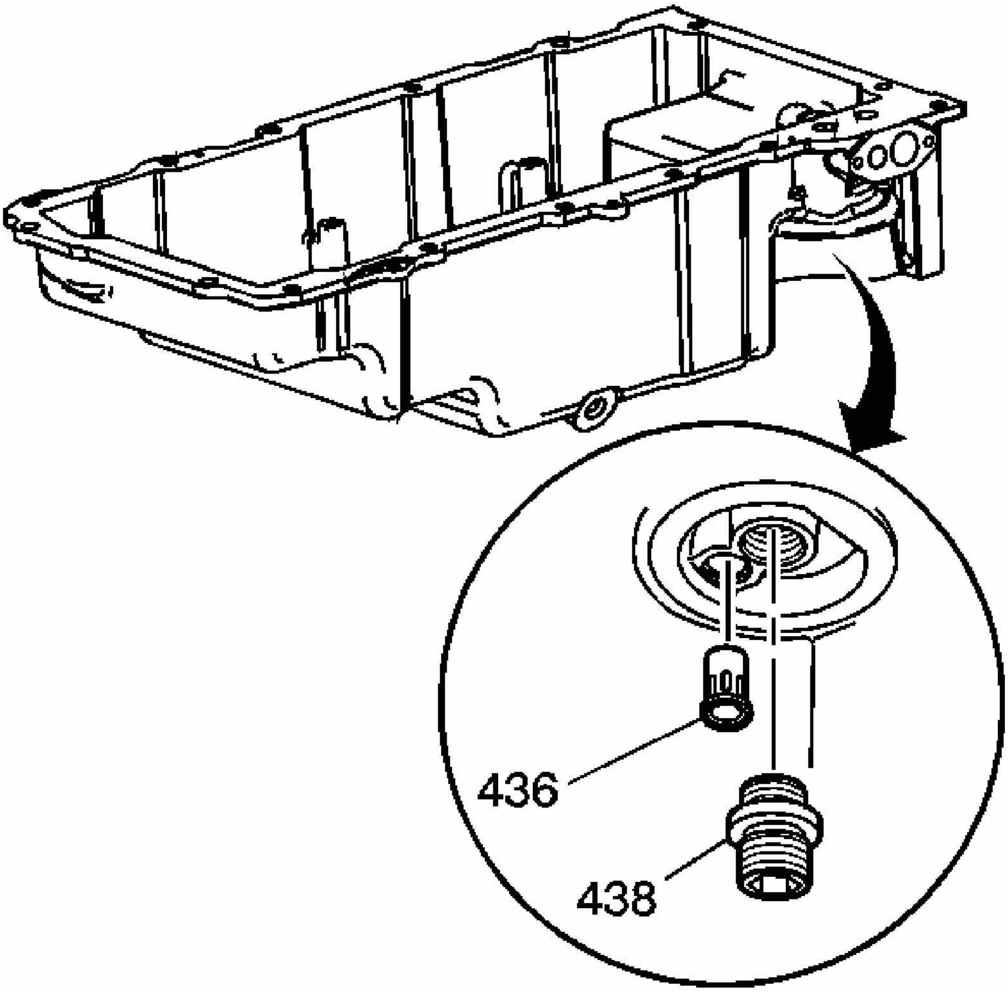


Fig. 622: View Of Oil Filter Adapter & Bypass Valve
Courtesy of GENERAL MOTORS CORP.

1. Install a new oil filter bypass valve (436) into the oil pan as required.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

2. Install the oil filter fitting (438).

Tighten: Tighten the oil filter fitting to 55 N.m (40 lb ft).

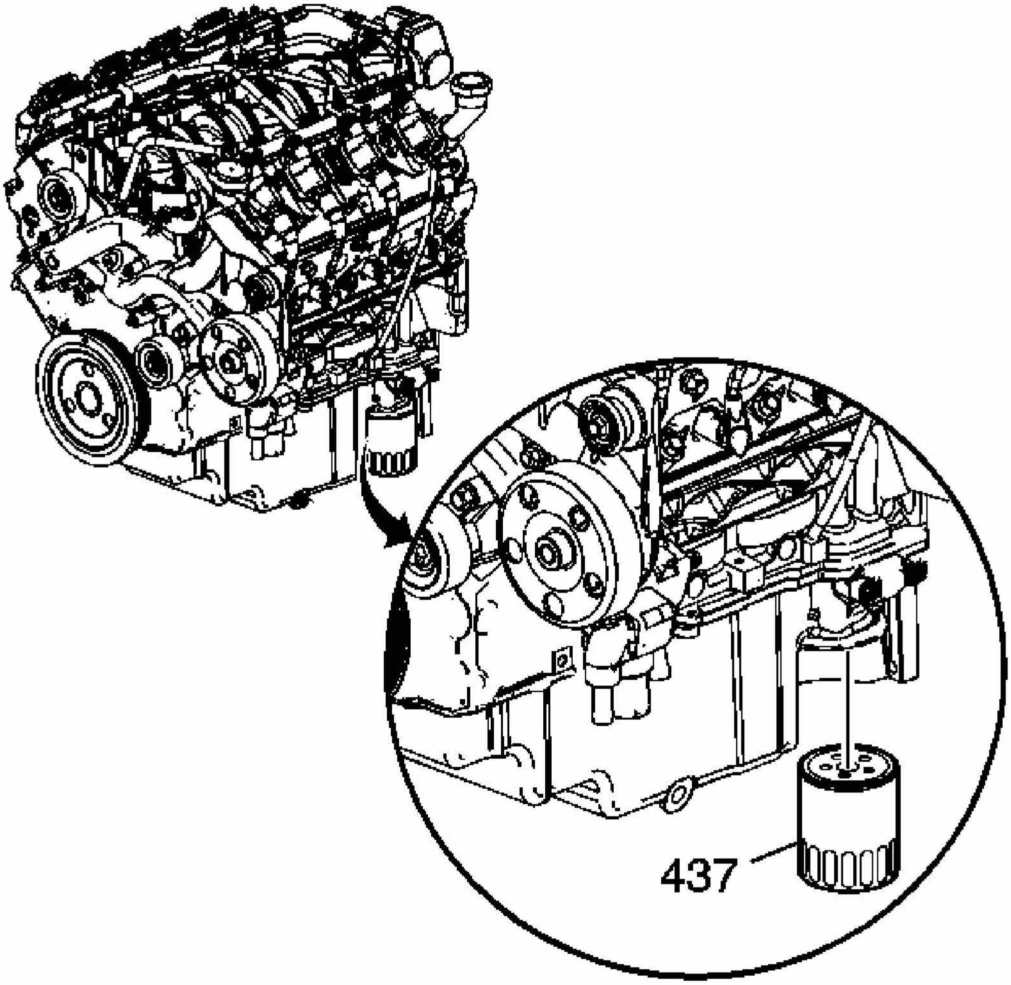


Fig. 623: View Of Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

3. Lubricate the oil filter seal with clean engine oil.
4. Install the oil filter (437).

Tighten: Tighten the oil filter to 30 N.m (22 lb ft).

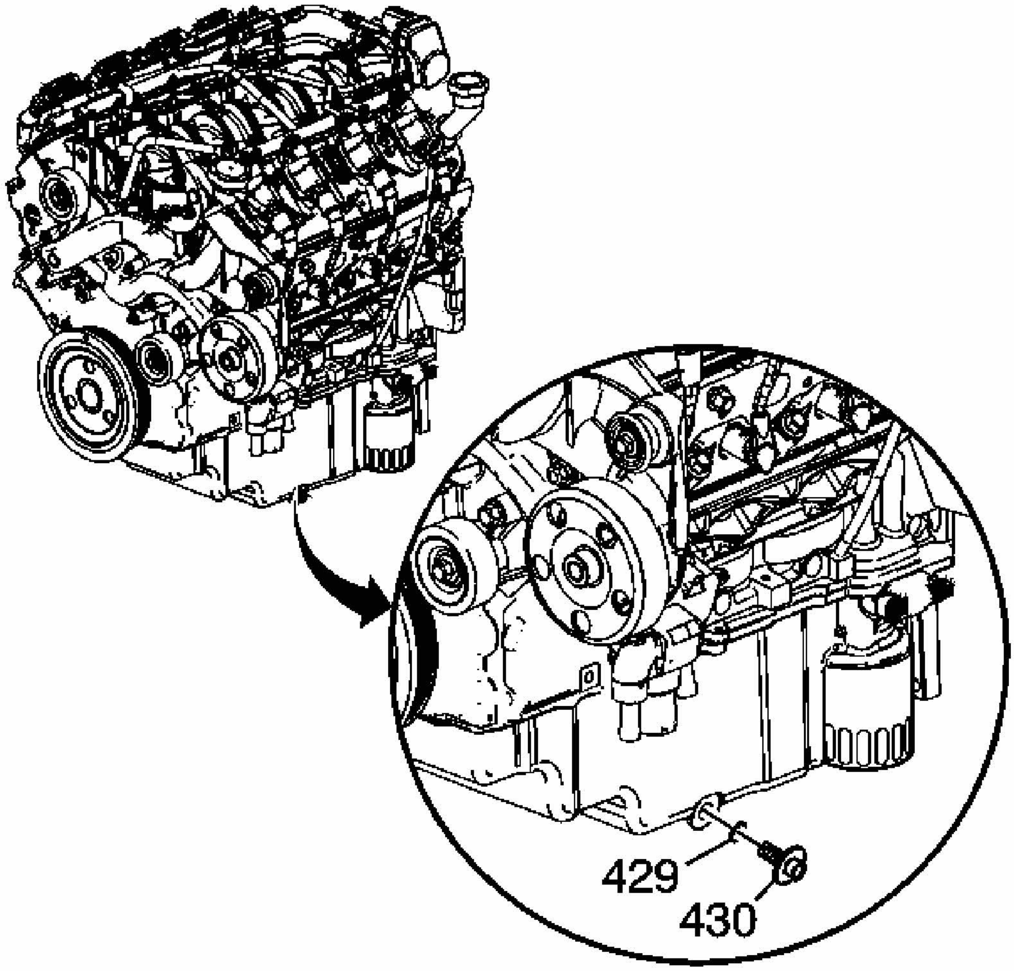


Fig. 624: View Of Oil Pan Drain Plug & O-Ring
Courtesy of GENERAL MOTORS CORP.

5. Install the oil pan drain plug (430) and O-ring (429).

   Tighten: Tighten the oil pan drain plug to 25 N.m (18 lb ft).

VALVE LIFTER INSTALLATION

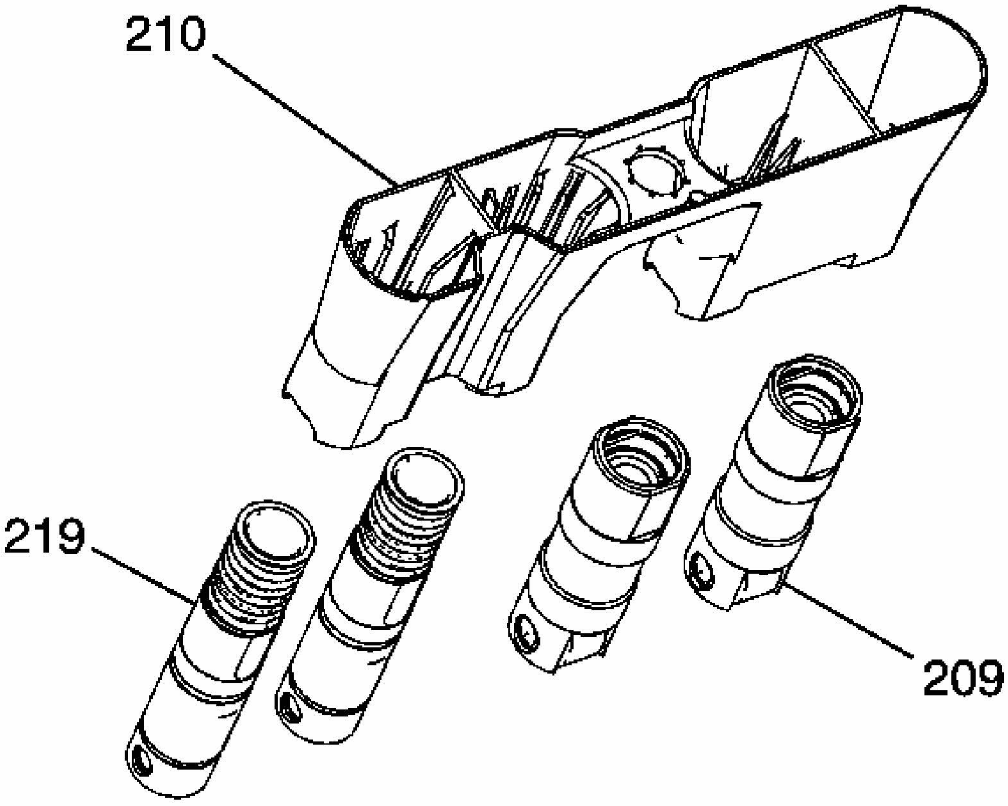


Fig. 625: Exploded View Of Lifter Guides & Lifters
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **When using the valve lifters again, install the lifters to their original locations.**
- **If camshaft replacement is required, the valve lifters must also be replaced.**
- **Each of the 4 valve guide assemblies will contain 2 displacement on demand valve lifters and 2 non-displacement on demand valve lifters.**
- **With the lifters and guides properly installed, cylinders 1, 4, 6, and 7 lifter bores will each contain 2 displacement on demand valve lifters.**

1. Lubricate the valve lifters (209, 219) and engine block valve lifter bores with clean engine oil.

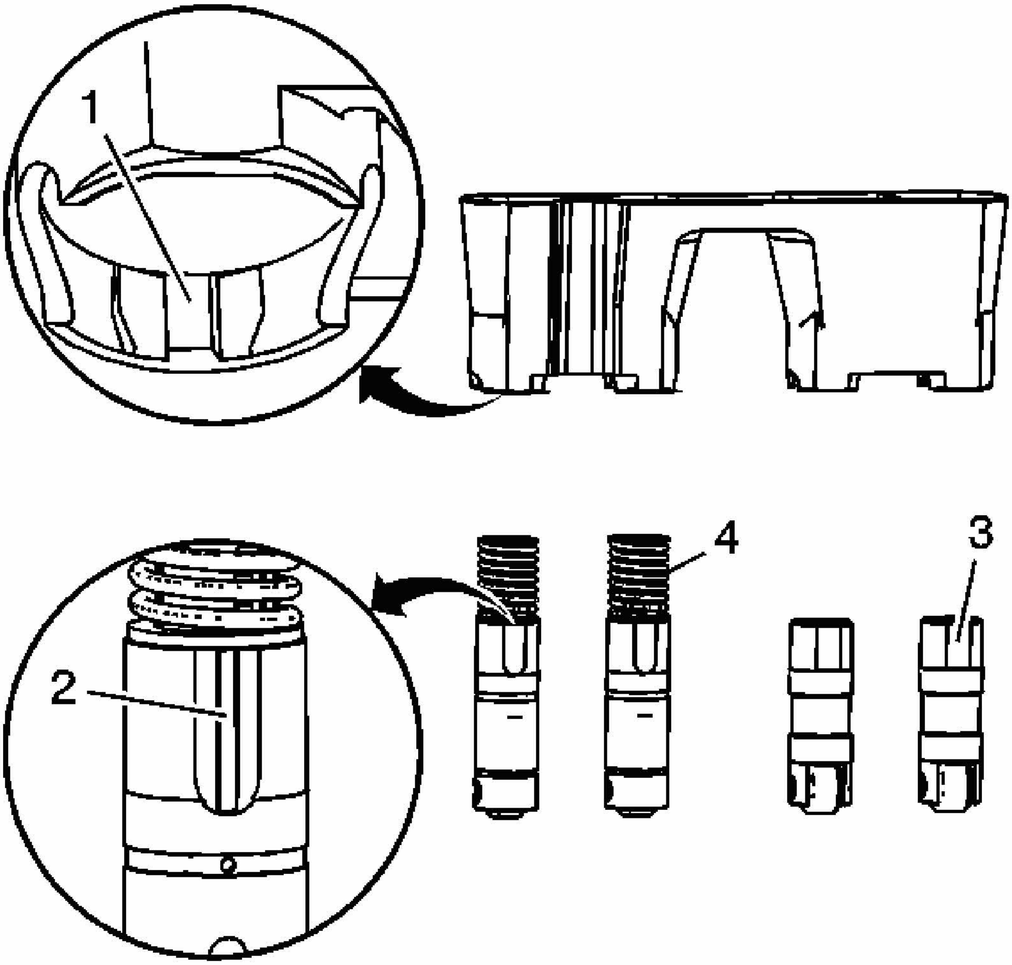


Fig. 626: Inserting Valve Lifters Into Lifter Guides
Courtesy of GENERAL MOTORS CORP.

2. Insert the valve lifters into the lifter guides.
    - Align the flat area (3) on the top of the non displacement on demand lifter with the flat area in the lifter guide bore. Push the lifter completely into the guide bore.
    - The displacement on demand lifters are to be installed into the guide, with the notch in the guide (1) aligned with the raised area (2) of the lifter.

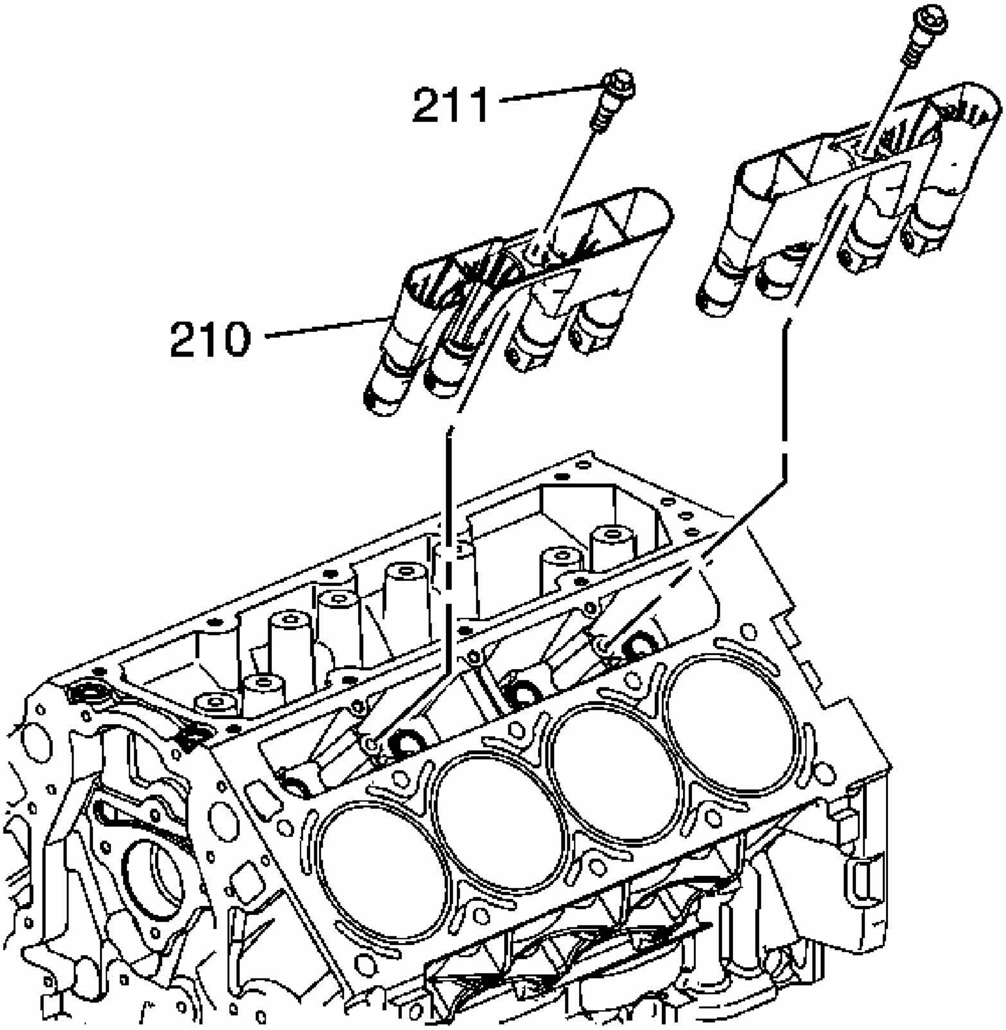


Fig. 627: View Of Lifter Guides & Lifters
Courtesy of GENERAL MOTORS CORP.

3. Install the valve lifters and guide assembly (210) to the engine block.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the valve lifter guide bolts (211).

Tighten: Tighten the valve lifter guide bolts to 12 N.m (106 lb in).

CYLINDER HEAD INSTALLATION - LEFT

Tools Required

- **J 42385-100** Thread Repair Kit. See Special Tools.
- **J 45059** Angle Meter

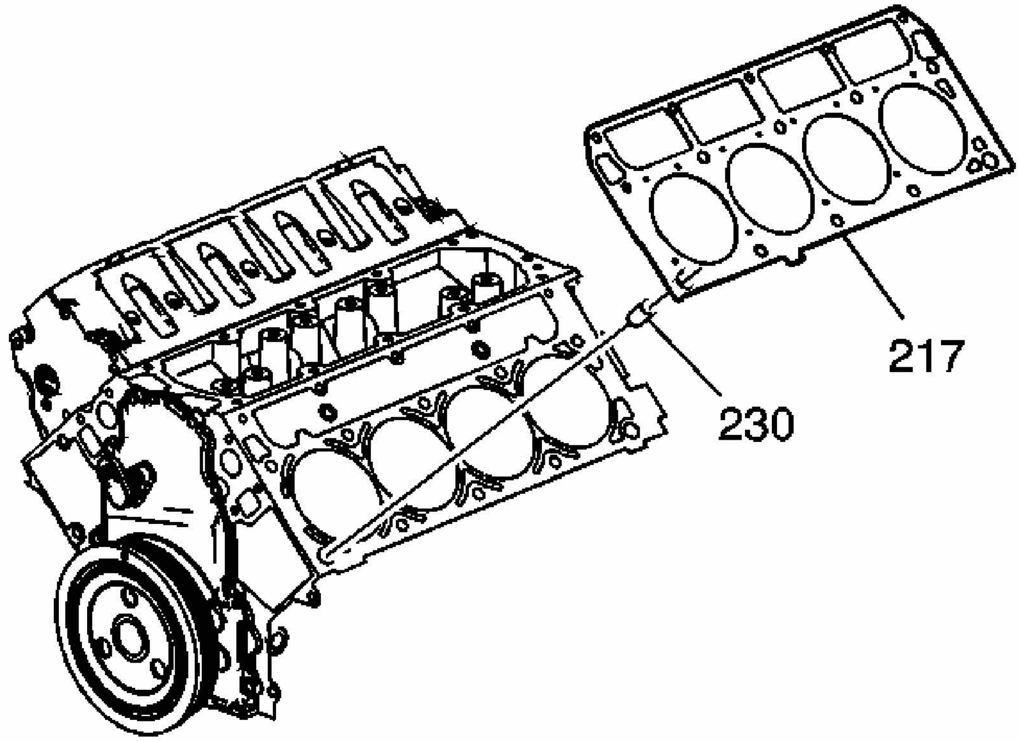


Fig. 628: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

NOTE: Clean all dirt, debris, and coolant from the engine block cylinder head bolt holes. Failure to remove all foreign material may result in damaged threads, improperly tightened fasteners or damage to components.

IMPORTANT:

- **Do not use the cylinder head bolts again. Install NEW cylinder head bolts during assembly.**
- **Do not use any type of sealant on the cylinder head**

gasket, unless specified.
- **The cylinder head gaskets must be installed in the proper direction and position.**

1. Clean the engine block cylinder head bolt holes, if required.

   Thread repair tool J 42385-107 may be used to clean the threads of old threadlocking material.

2. Spray cleaner GM P/N 12346139 (Canadian P/N 10953463), GM P/N 12377981 (Canadian P/N 10953463), or equivalent, into the hole.
3. Clean the cylinder head bolt holes with compressed air.
4. Install the cylinder head locating pins (230).

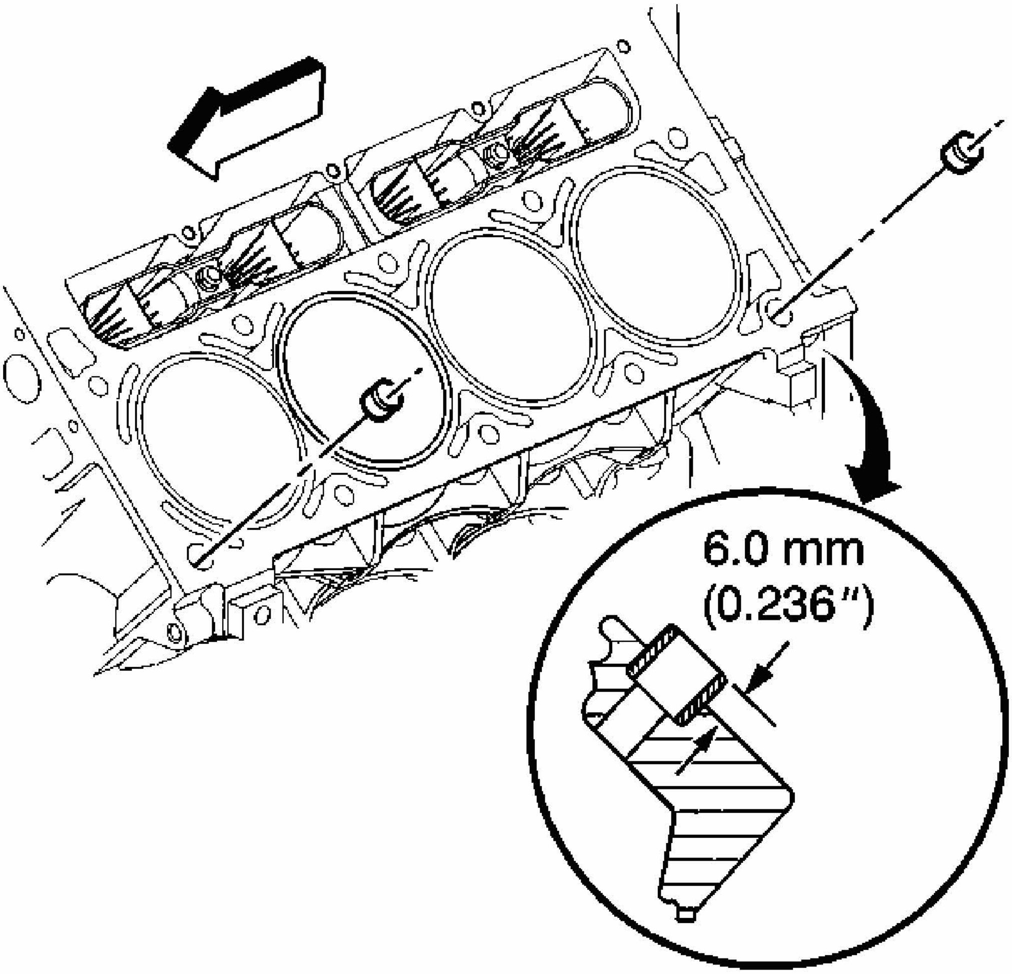


Fig. 629: Identifying Cylinder Head Locating Pins Installation Position
Courtesy of GENERAL MOTORS CORP.

5. Inspect the locating pins for proper installation.

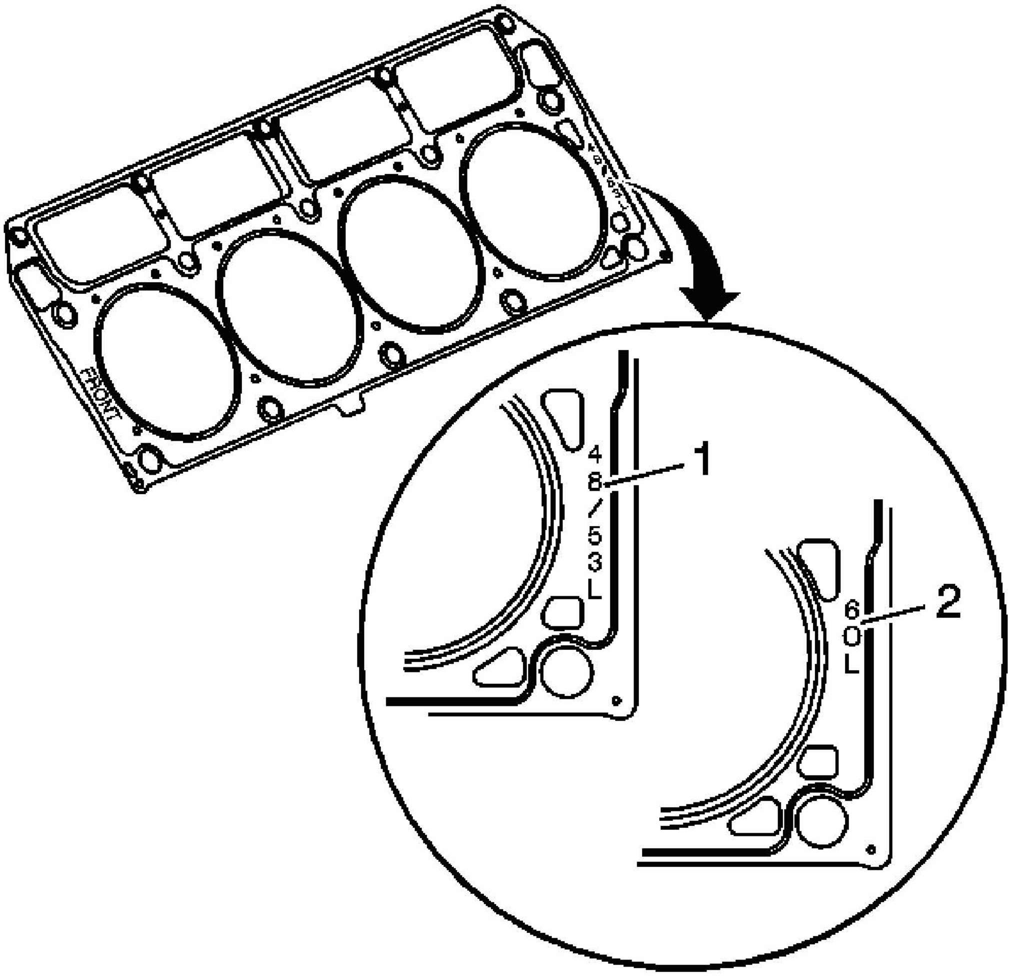


Fig. 630: View Of Cylinder Head Gasket Displacement Markings
Courtesy of GENERAL MOTORS CORP.

6. Inspect the displacement markings (1, 2) on the gasket for proper usage.

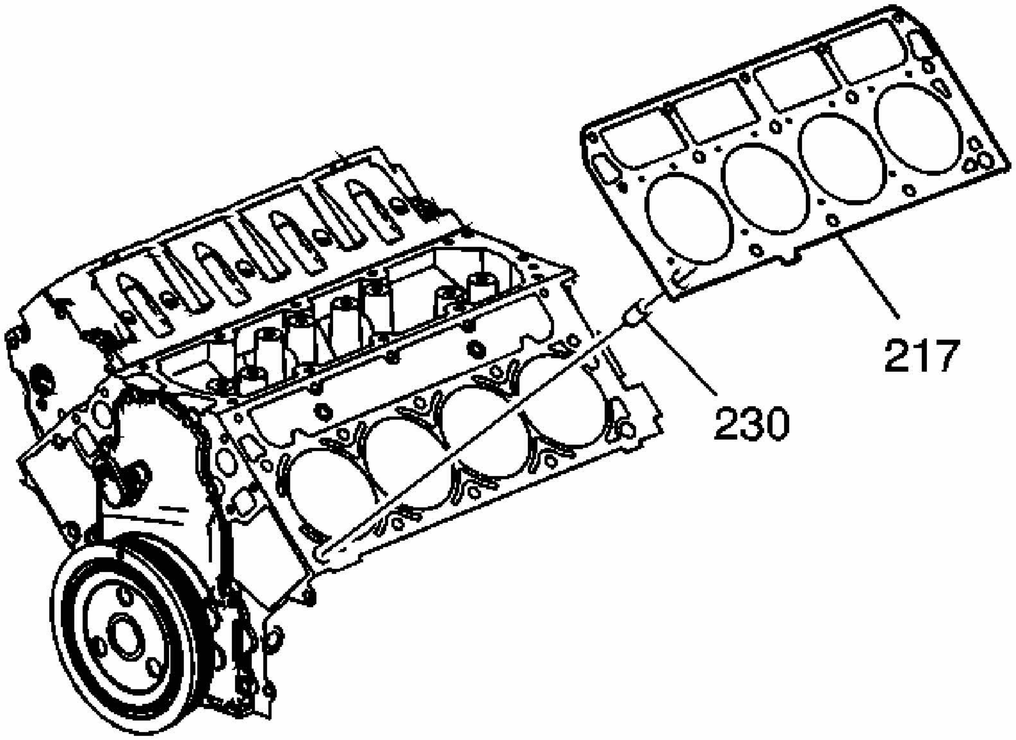


Fig. 631: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

7. Install the NEW cylinder head gasket (217) onto the locating pins.

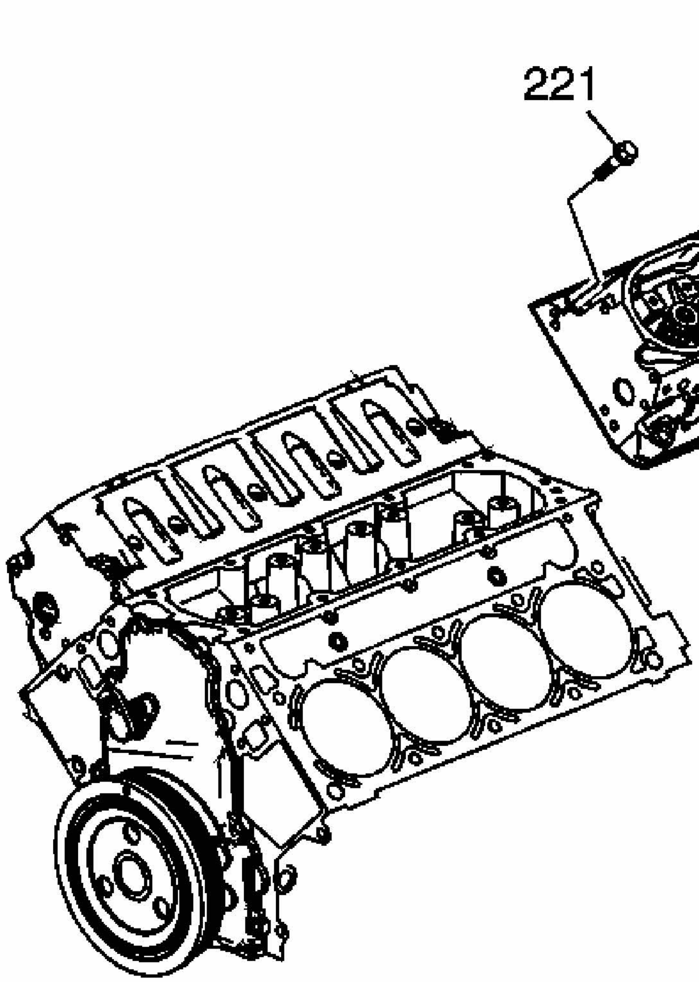


Fig. 632: View Of Cylinder Head & Bolts (Left)
Courtesy of GENERAL MOTORS CORP.

8. Install the cylinder head (218) onto the locating pins and the gasket.
9. Install the NEW cylinder head bolts (220, 221).

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

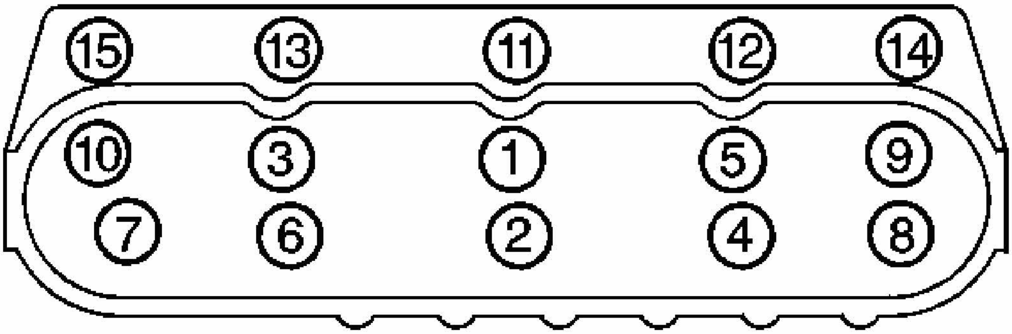


Fig. 633: Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

10. Tighten the cylinder head bolts.

    Tighten:

    1. Tighten the M11 cylinder head bolts (1-10) a first pass in sequence to 30 N.m (22 lb ft).
    2. Tighten the M11 cylinder head bolts (1-10) a second pass in sequence to 90 degrees using the **J 45059** .
    3. Tighten the M11 cylinder head bolts (1-10) a final pass in sequence to 70 degrees using the **J 45059** .
    4. Tighten the M8 cylinder head bolts (11-15) to 30 N.m (22 lb ft). Begin with the center bolt (11) and alternating side-to-side, work outward tightening all of the bolts.

CYLINDER HEAD INSTALLATION - RIGHT

Tools Required

- **J 42385-100** Thread Repair Kit. See Special Tools.
- **J 45059** Angle Meter

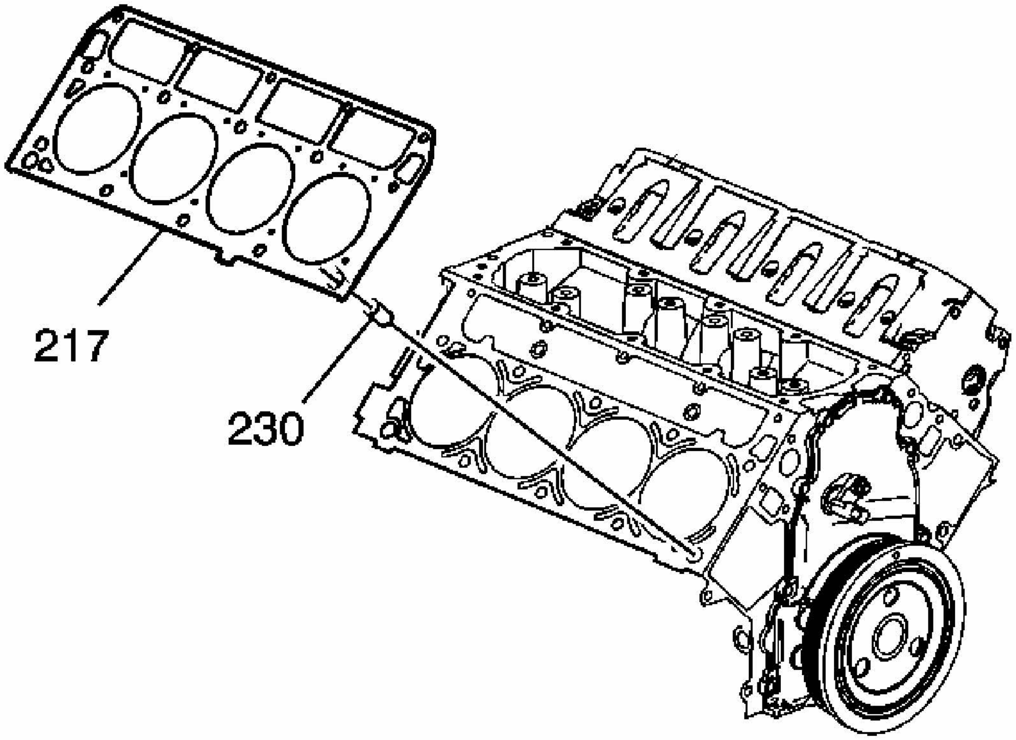


Fig. 634: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

NOTE: Clean all dirt, debris, and coolant from the engine block cylinder head bolt holes. Failure to remove all foreign material may result in damaged threads, improperly tightened fasteners or damage to components.

IMPORTANT:

- Do not use the cylinder head bolts again. Install NEW cylinder head bolts during assembly.
- Do not use any type of sealant on the cylinder head gasket, unless specified.
- The cylinder head gaskets must be installed in the proper direction and position.

1. Clean the engine block cylinder head bolt holes, if required.

Thread repair tool J 42385-107 may be used to clean the threads of old threadlocking material.

2. Spray cleaner GM P/N 12346139 (Canadian P/N 10953463), GM P/N 12377981 (Canadian P/N 10953463), or equivalent, into the hole.
3. Clean the cylinder head bolt holes with compressed air.
4. Install the cylinder head locating pins (230).

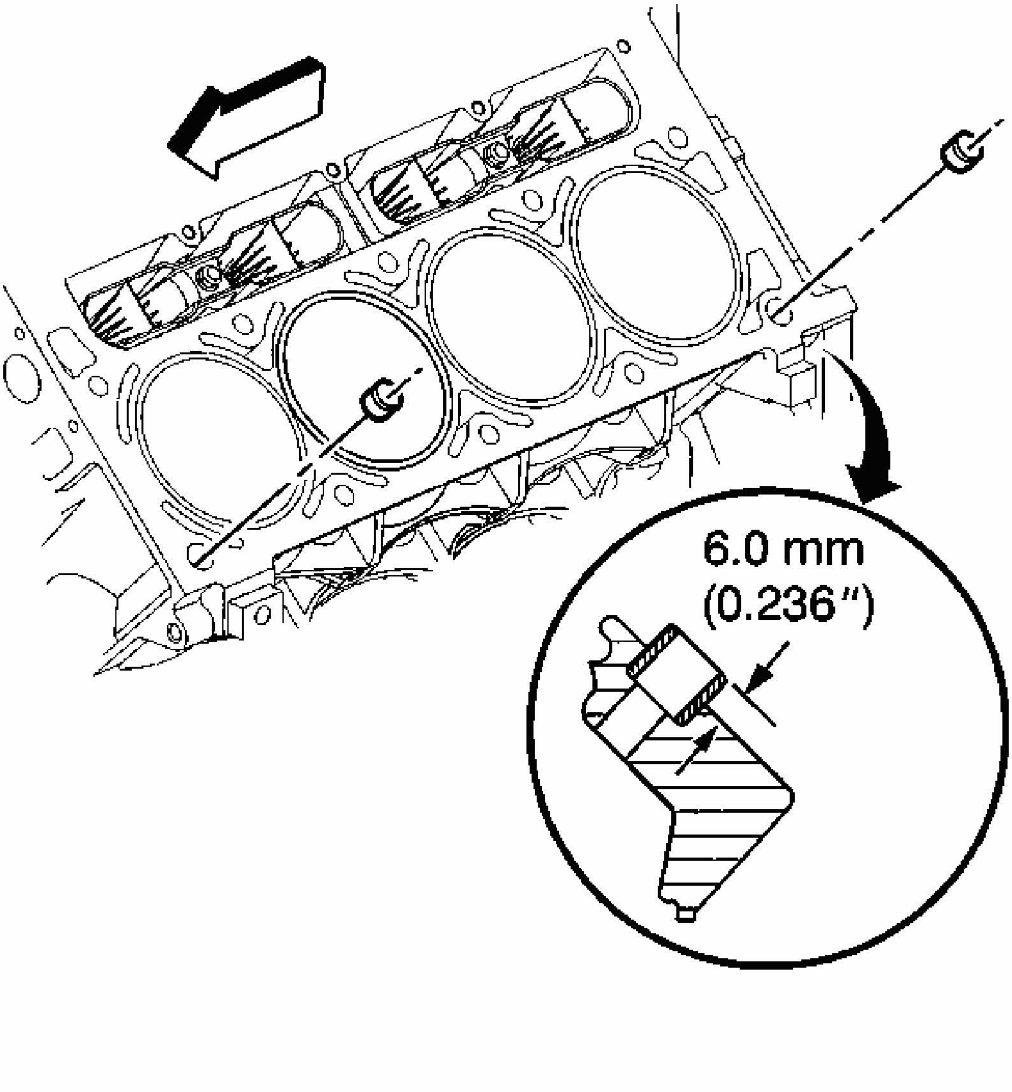


Fig. 635: Identifying Cylinder Head Locating Pins Installation Position
Courtesy of GENERAL MOTORS CORP.

5. Inspect the locating pins for proper installation.

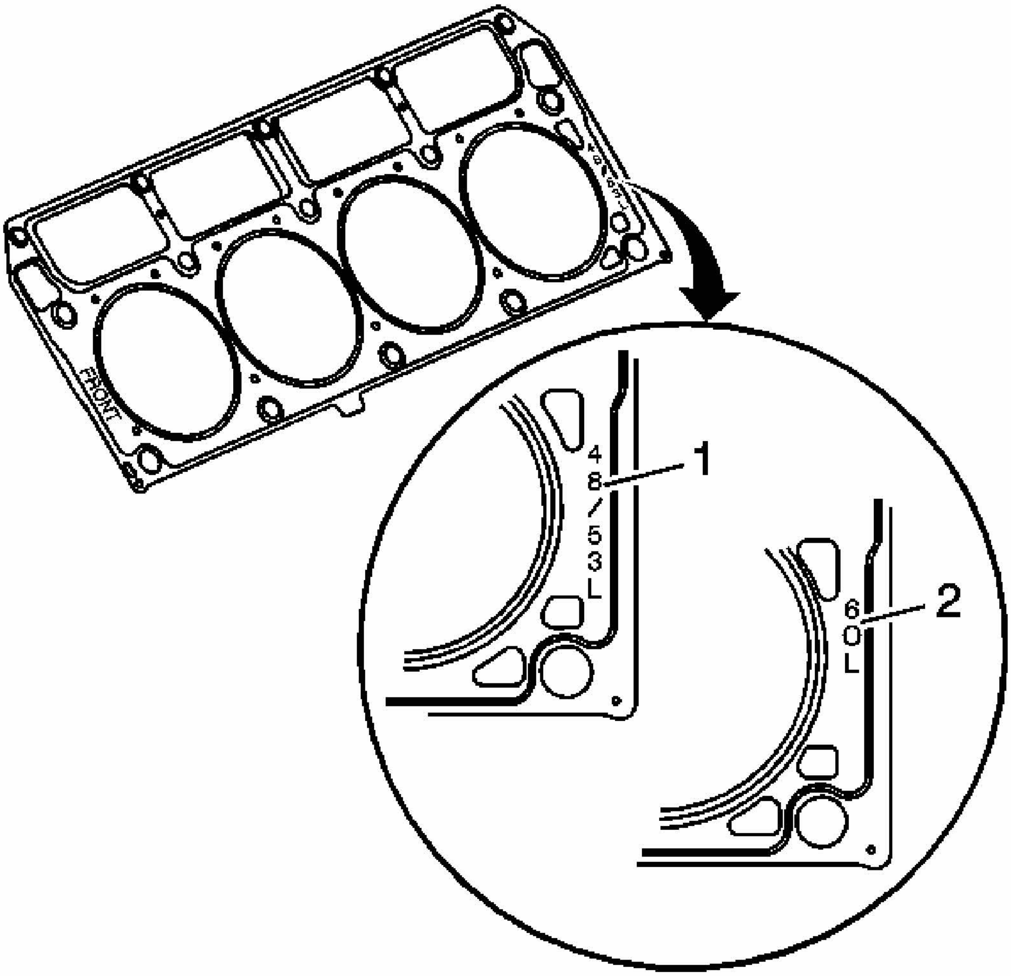


Fig. 636: View Of Cylinder Head Gasket Displacement Markings
Courtesy of GENERAL MOTORS CORP.

6. Inspect the displacement markings (1, 2) on the gasket for proper usage.

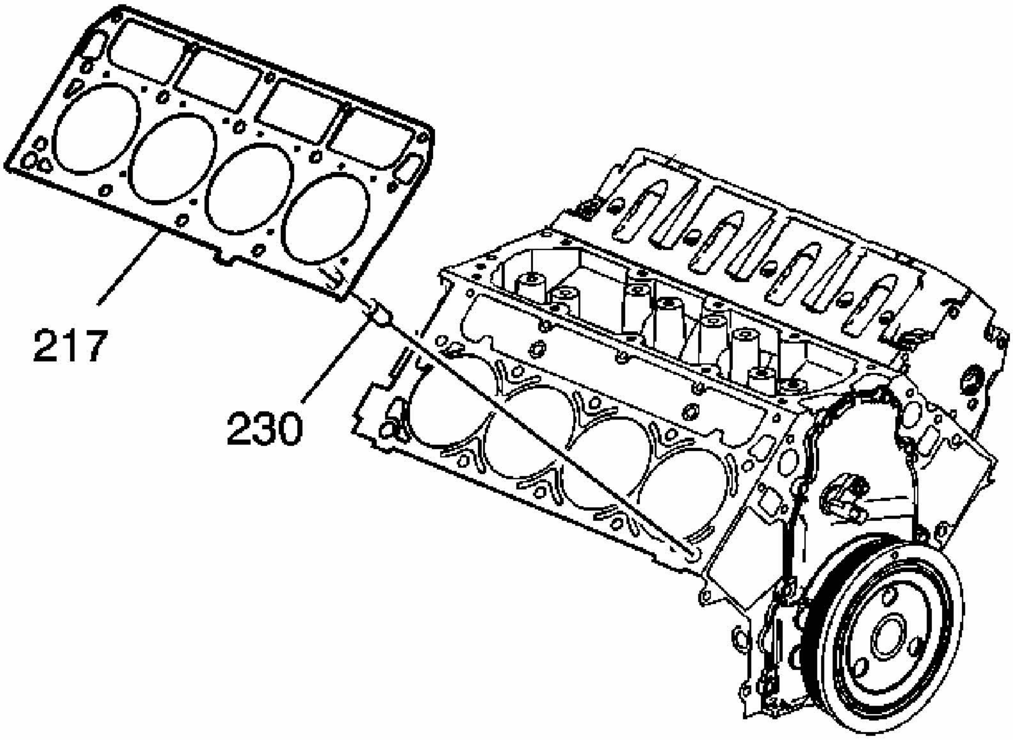


Fig. 637: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

7. Install the NEW cylinder head gasket (217) onto the locating pins.

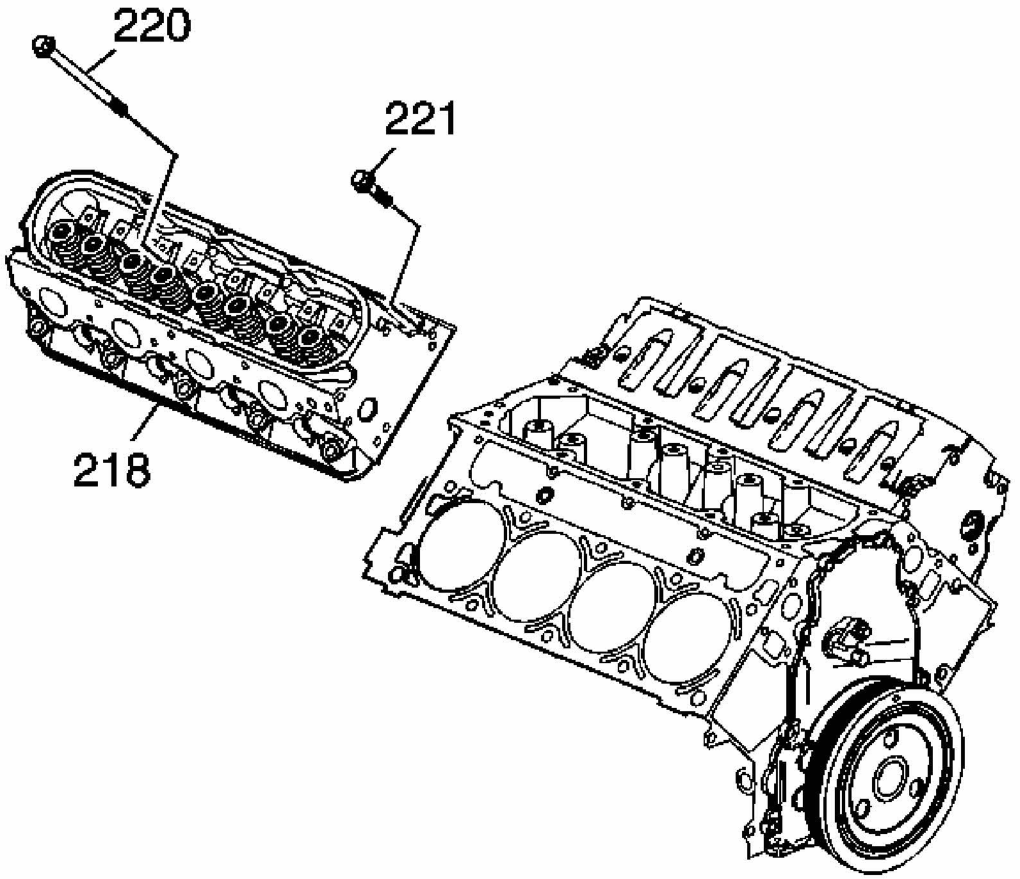


Fig. 638: View Of Cylinder Head & Bolt (Right)
Courtesy of GENERAL MOTORS CORP.

8. Install the cylinder head (218) onto the locating pins and the gasket.
9. Install the NEW cylinder head bolts (220, 221).

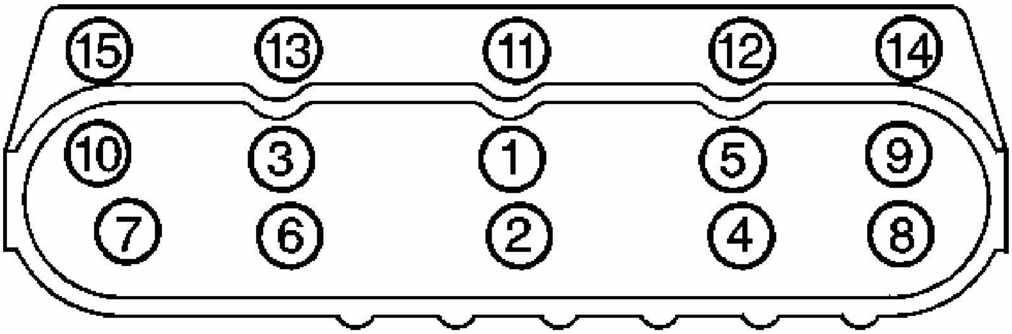


Fig. 639: Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

10. Tighten the cylinder head bolts.

Tighten:

1. Tighten the M11 cylinder head bolts (1-10) a first pass in sequence to 30 N.m (22 lb ft).
2. Tighten the M11 cylinder head bolts (1-10) a second pass in sequence to 90 degrees using the **J 45059** .
3. Tighten the M11 cylinder head bolts (1-10) a final pass in sequence to 70 degrees using the **J 45059** .
4. Tighten the M8 cylinder head bolts (11-15) to 30 N.m (22 lb ft). Begin with the center bolt (11) and alternating side-to-side, work outward tightening all of the bolts.

VALVE ROCKER ARM AND PUSH ROD INSTALLATION

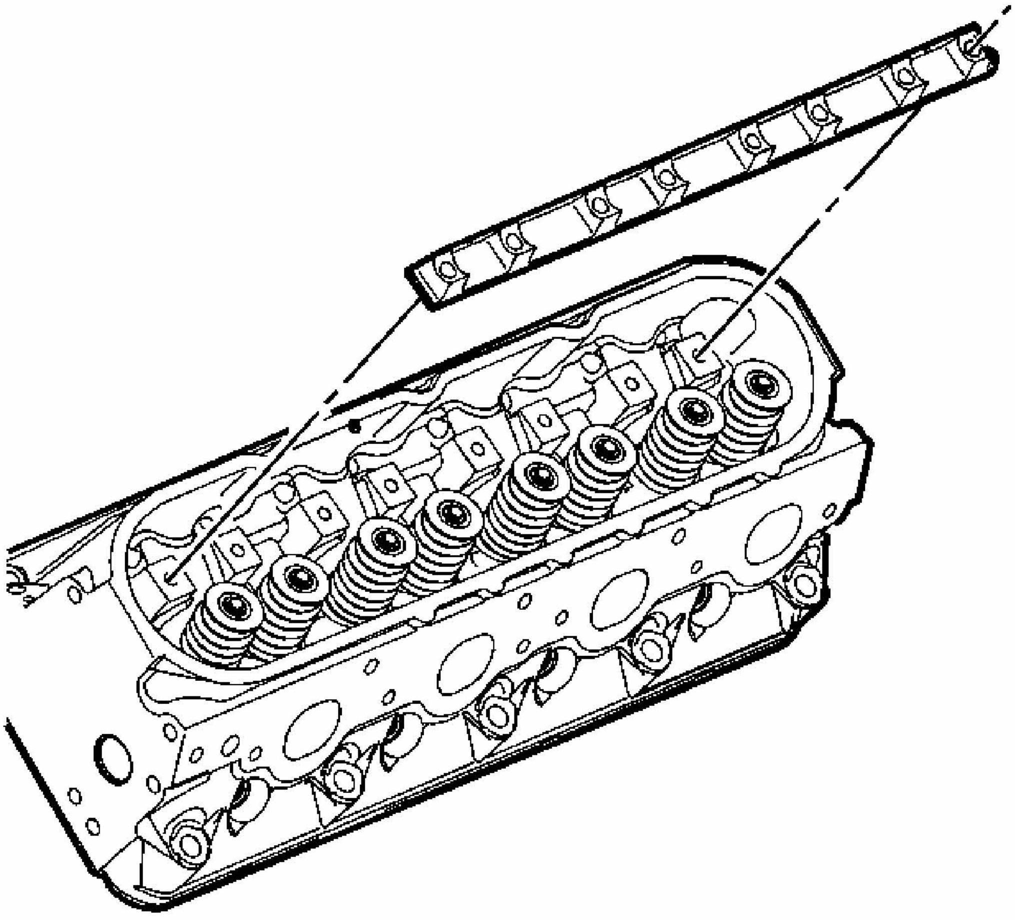


Fig. 640: View Of Valve Rocker Arm Pivot Support
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **When using the valve train components again, always install the components to the original location and position.**
- **Valve lash is net build, no valve adjustment is required.**

1. Lubricate the valve rocker arms and pushrods with clean engine oil.
2. Lubricate the flange of the valve rocker arm bolts with clean engine oil.
3. Install the valve rocker arm pivot support.

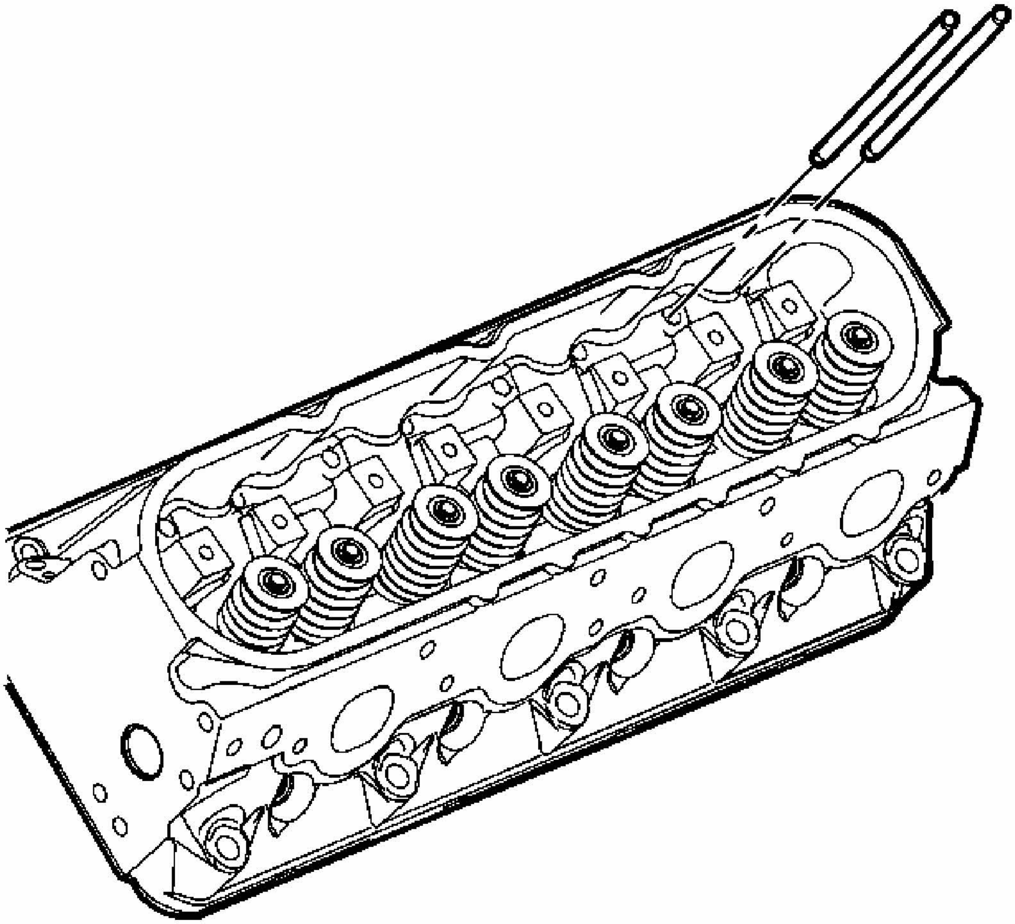


Fig. 641: View Of Pushrods
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure the pushrods seat properly to the valve lifter sockets.

4. Install the pushrods.

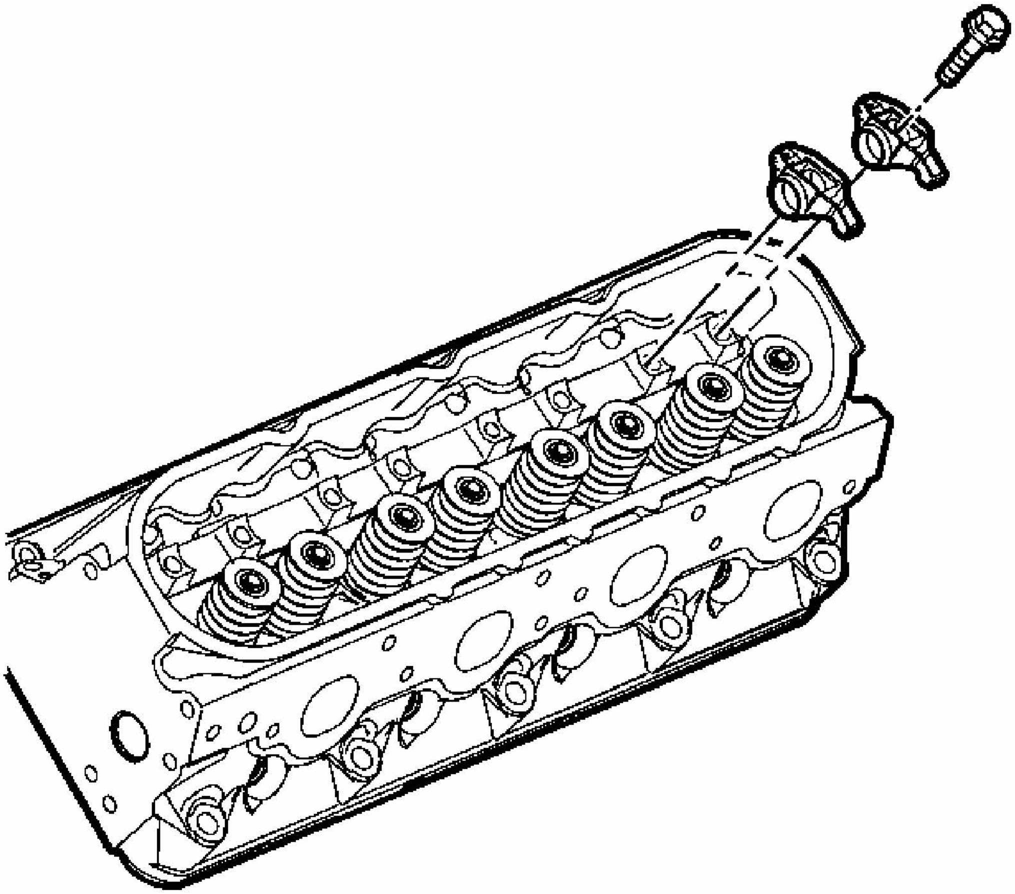


Fig. 642: View Of Rocker Arms & Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Ensure the pushrods seat properly to the ends of the rocker arms.**
- **DO NOT tighten the rocker arm bolts at this time.**

5. Install the rocker arms and bolts.

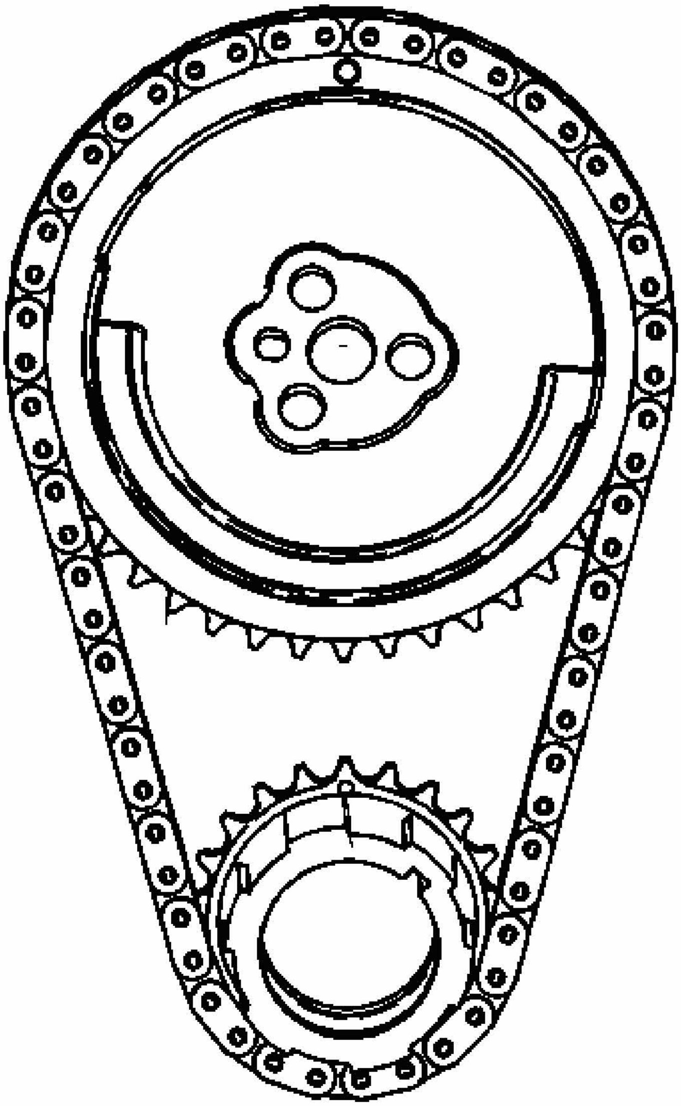


Fig. 643: Camshaft And Crankshaft Sprocket Alignment Marks
Courtesy of GENERAL MOTORS CORP.

6. Rotate the crankshaft until number one piston is at top dead center of compression stroke.

   In this position, cylinder number one rocker arms will be off lobe lift, and the crankshaft sprocket key will be at the 1:30 position. The camshaft and crankshaft sprocket alignment marks will be in the 12 o'clock positions. If viewing from the rear of the engine, the additional crankshaft pilot hole, non-threaded, will be in the 10:30

position.

The engine firing order is 1, 8, 7, 2, 6, 5, 4, 3.

Cylinders 1, 3, 5 and 7 are left bank.

Cylinders 2, 4, 6, and 8 are right bank.

NOTE: Refer to Fastener Notice in Cautions and Notices.

7. With the engine in the number one firing position, tighten the following valve rocker arm bolts:

   Tighten:

   - Tighten exhaust valve rocker arm bolts 1, 2, 7, and 8 to 30 N.m (22 lb ft).
   - Tighten intake valve rocker arm bolts 1, 3, 4, and 5 to 30 N.m (22 lb ft).

8. Rotate the crankshaft 360 degrees.
9. Tighten the following valve rocker arm bolts:

   Tighten:

   - Tighten exhaust valve rocker arm bolts 3, 4, 5, and 6 to 30 N.m (22 lb ft).
   - Tighten intake valve rocker arm bolts 2, 6, 7, and 8 to 30 N.m (22 lb ft).

VALVE ROCKER ARM COVER INSTALLATION - LEFT

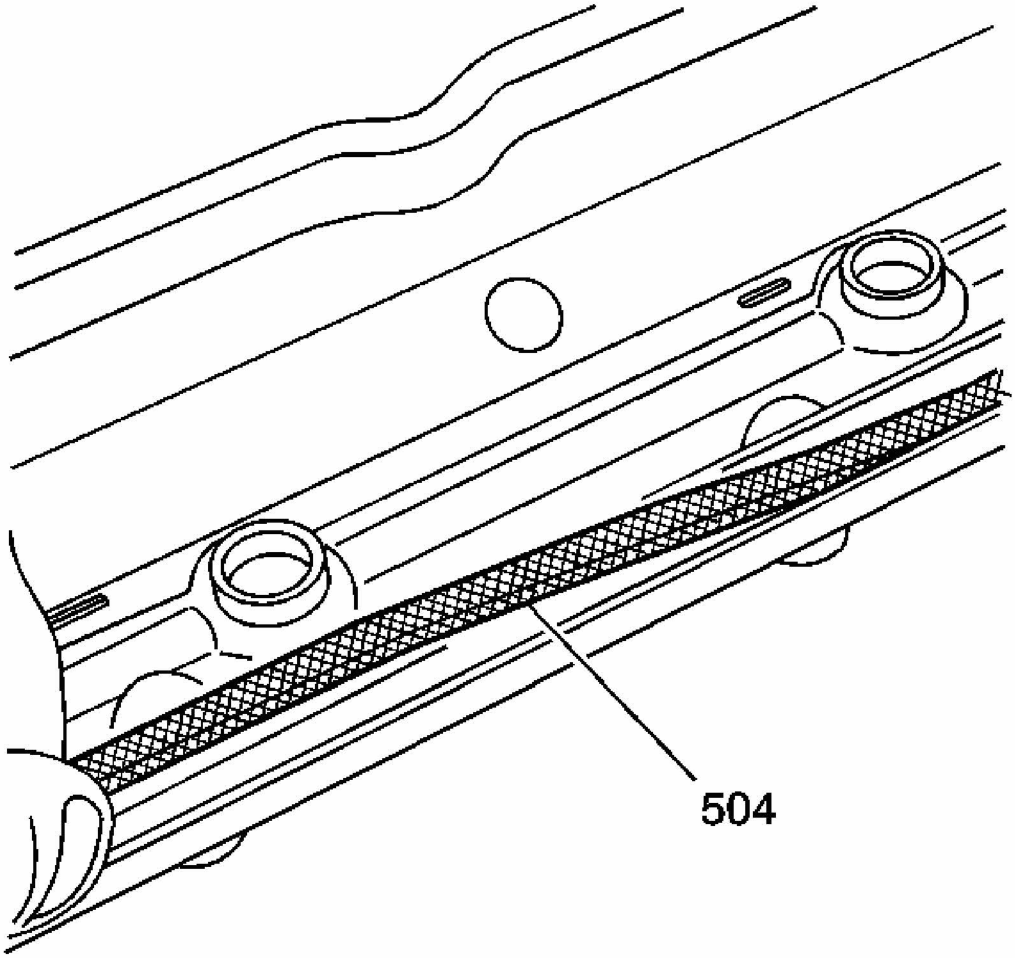


Fig. 644: View Of Valve Rocker Arm Cover Gasket
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:
- **All gasket surfaces should be free of oil or other foreign material during assembly.**
- **DO NOT use the valve rocker arm cover gasket again.**
- **The valve rocker arm cover bolt grommets may be used again if not damaged.**

1. Install a NEW gasket (504) into the valve rocker arm cover.

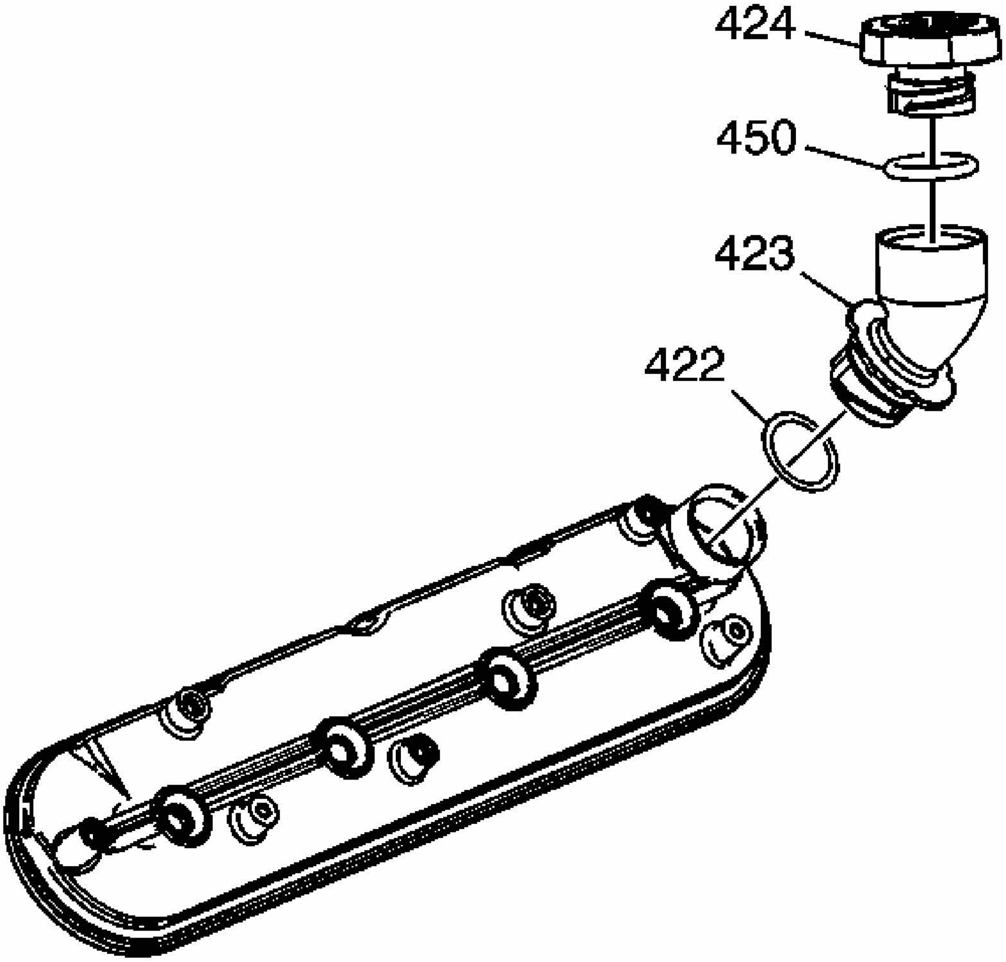


Fig. 645: Oil Fill Cap & Oil Fill Tube
Courtesy of GENERAL MOTORS CORP.

2. Install a new oil fill tube (423) and O-ring (422).
3. Install the oil fill cap (424) and O-ring (450).

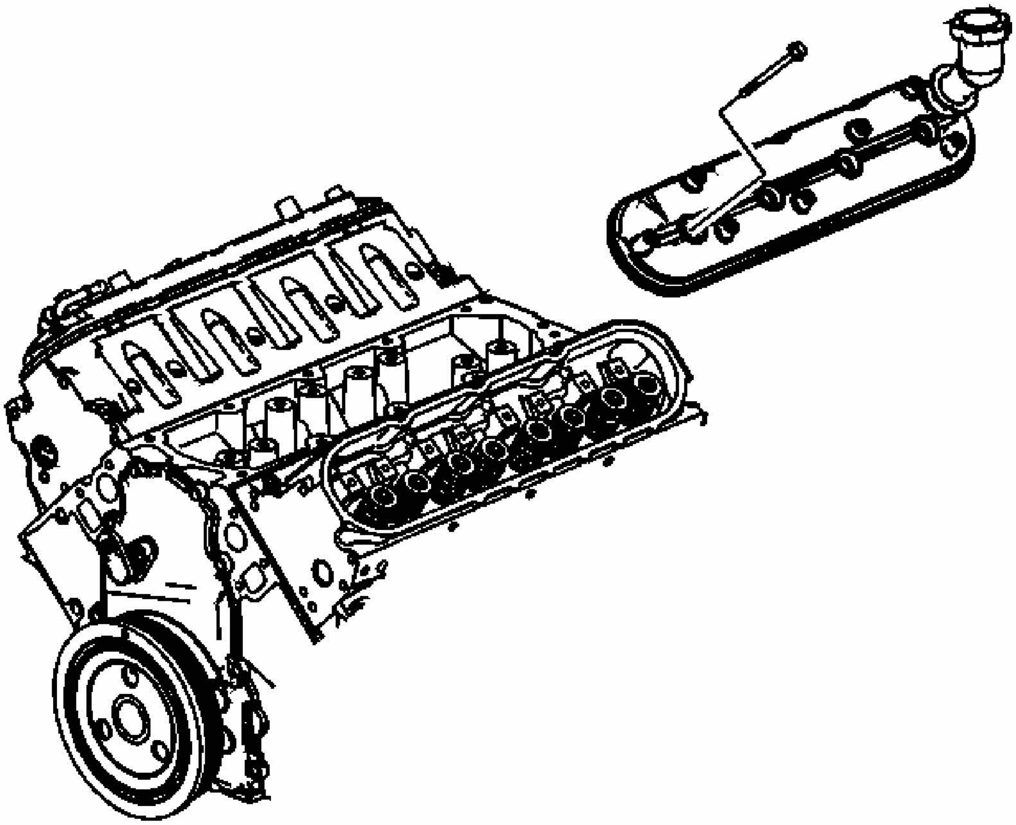


Fig. 646: View Of Valve Rocker Arm Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

4. Install the valve rocker arm cover onto the cylinder head.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the cover bolts with grommets.

Tighten: Tighten the valve rocker arm cover bolts to 12 N.m (106 lb in).

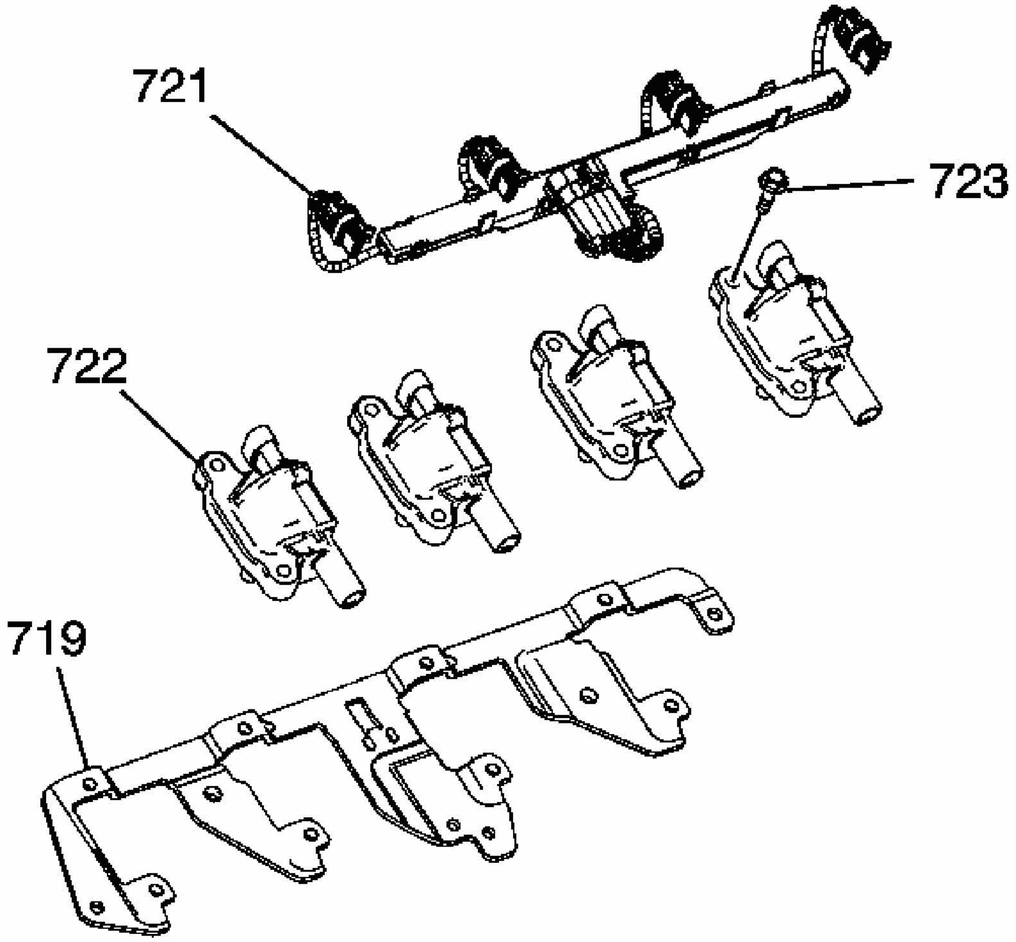


Fig. 647: View Of Bracket, Bolts, Coils & Wire Harness
Courtesy of GENERAL MOTORS CORP.

6. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the threads of the ignition coil bolts (723).
7. Install the ignition coils (722), wire harness (721), and bolts (723) to the bracket (719).

   Tighten: Tighten the ignition coil bolts to 8 N.m (71 lb in).

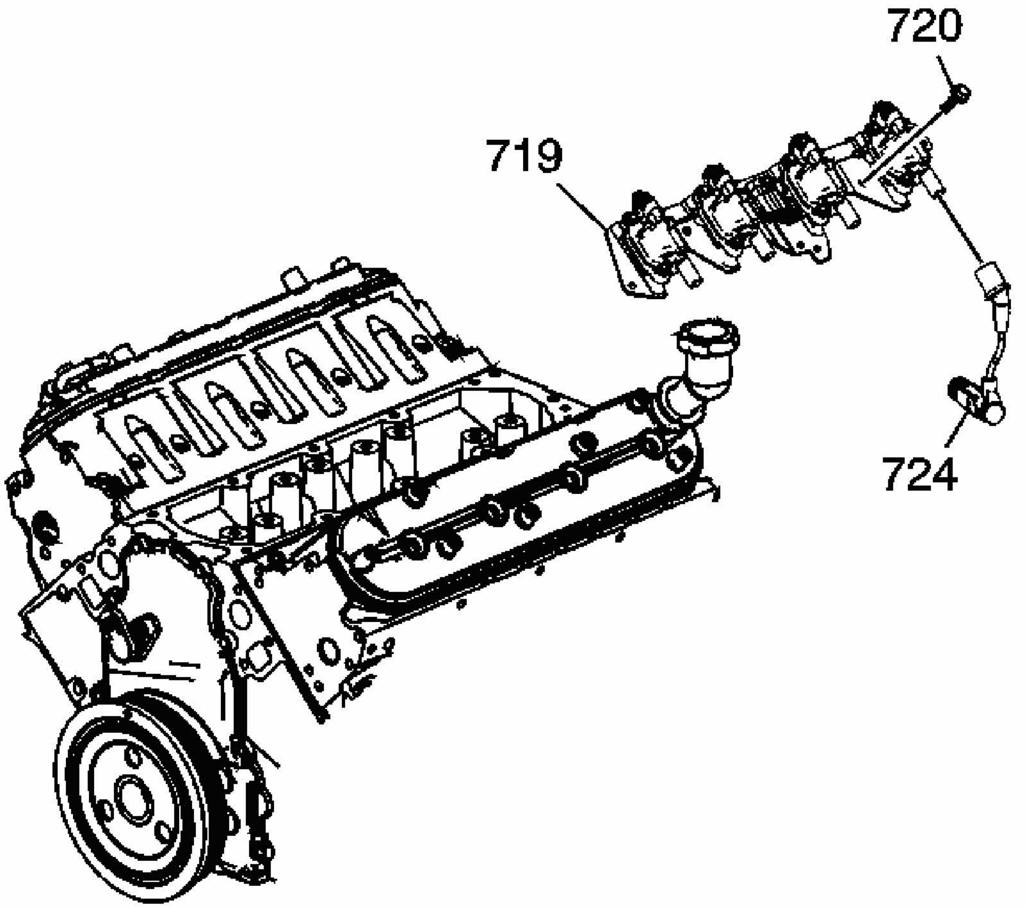


Fig. 648: View Of The Ignition Coil And Bracket Assembly
Courtesy of GENERAL MOTORS CORP.

8. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the threads of the ignition coil bracket studs (720).
9. Install the ignition coil and bracket assembly (719) and studs (720).

   Tighten: Tighten the bracket studs to 12 N.m (106 lb in).

VALVE ROCKER ARM COVER INSTALLATION - RIGHT

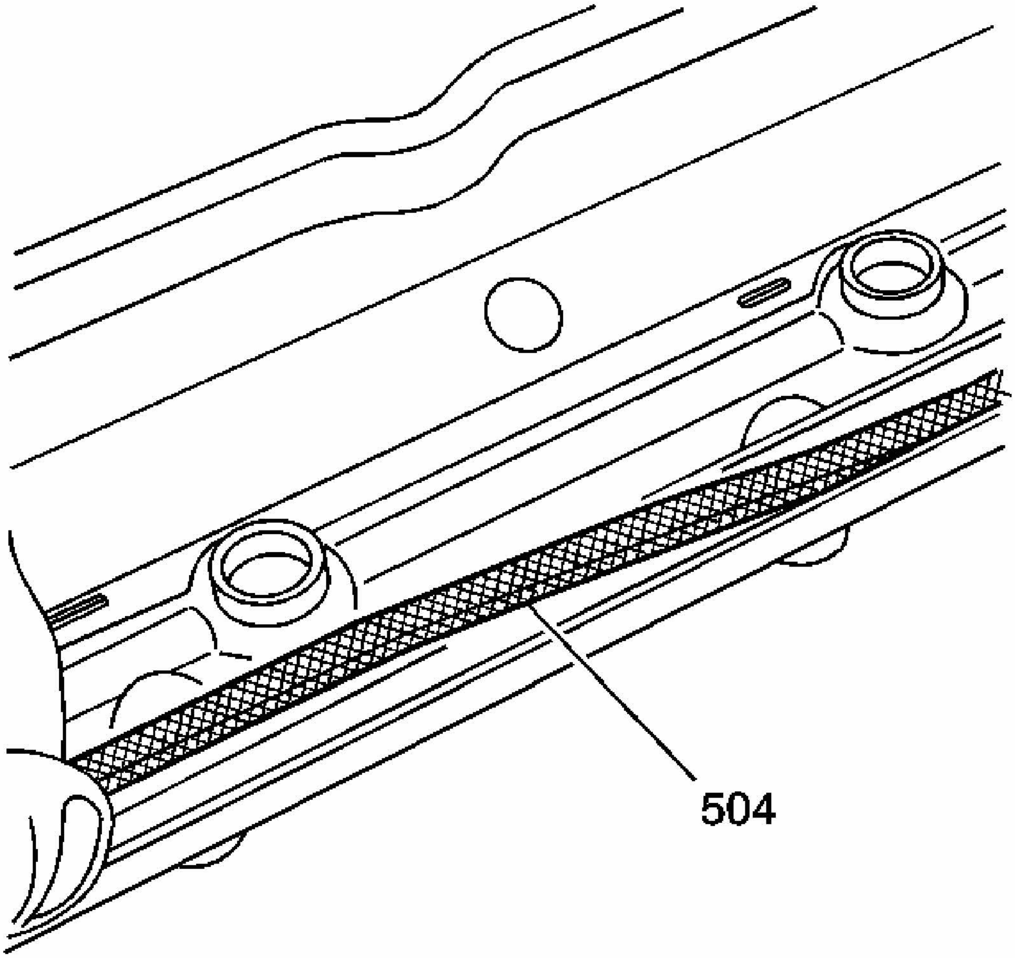


Fig. 649: View Of Valve Rocker Arm Cover Gasket
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **All gasket surfaces should be free of oil or other foreign material during assembly.**
- **DO NOT use the valve rocker arm cover gasket again.**
- **The valve rocker arm cover bolt grommets may be used again if not damaged.**

1. Install a NEW gasket (504) into the valve rocker arm cover.

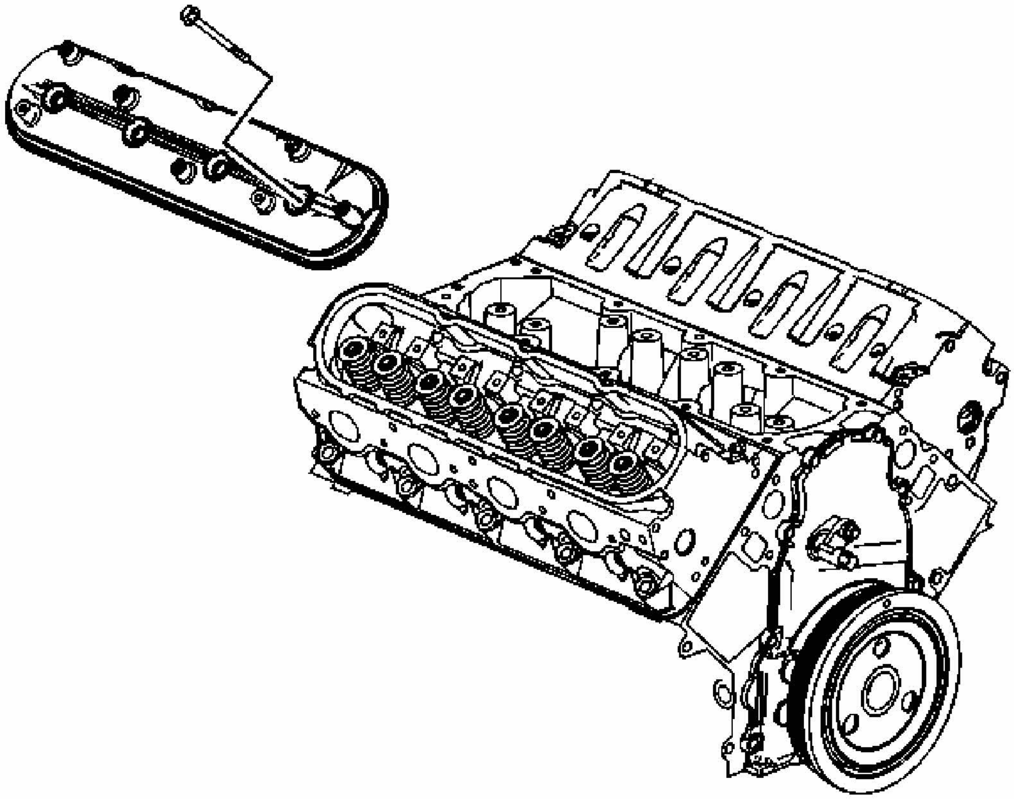


Fig. 650: View Of Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

2. Install the valve rocker arm cover onto the cylinder head.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the cover bolts with grommets.

Tighten: Tighten the valve rocker arm cover bolts to 12 N.m (106 lb in).

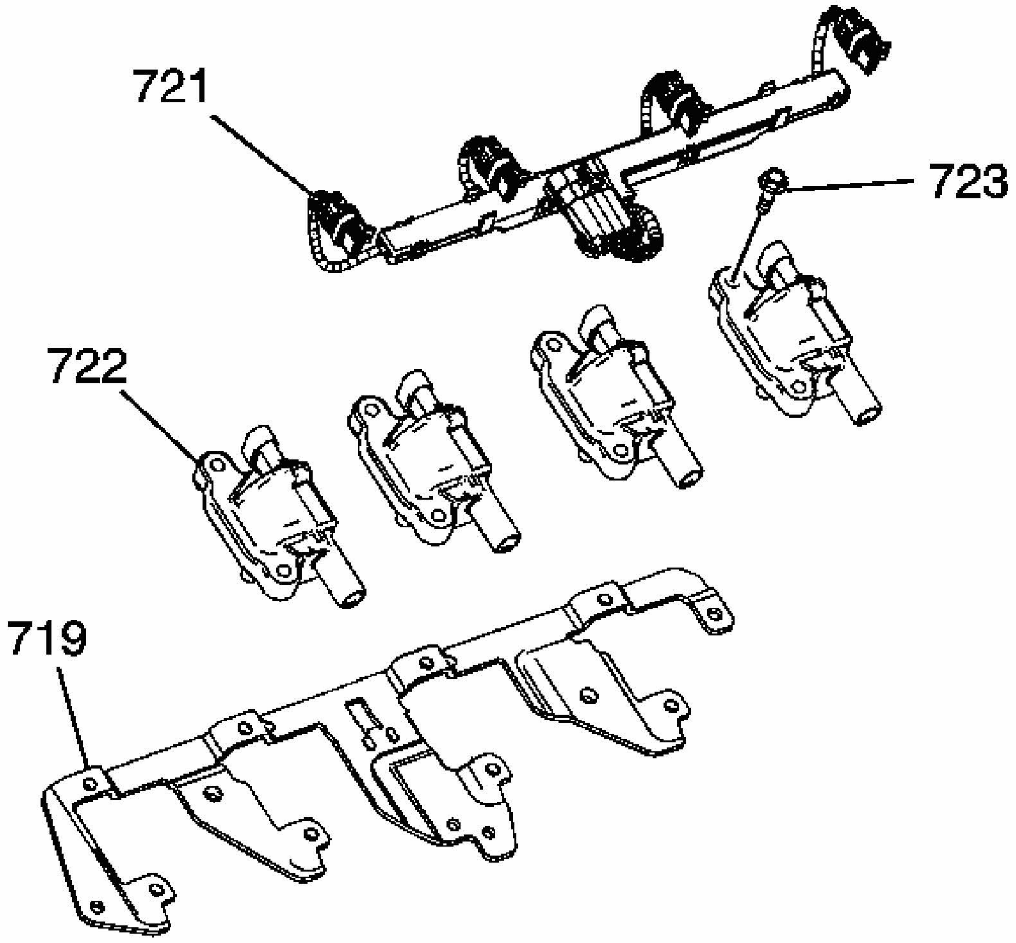


Fig. 651: View Of Bracket, Bolts, Coils & Wire Harness
Courtesy of GENERAL MOTORS CORP.

4. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the threads of the ignition coil bolts (723).
5. Install the ignition coils (722), wire harness (721), and bolts (723) to the bracket (719).

   Tighten: Tighten the ignition coil bolts to 8 N.m (71 lb in).

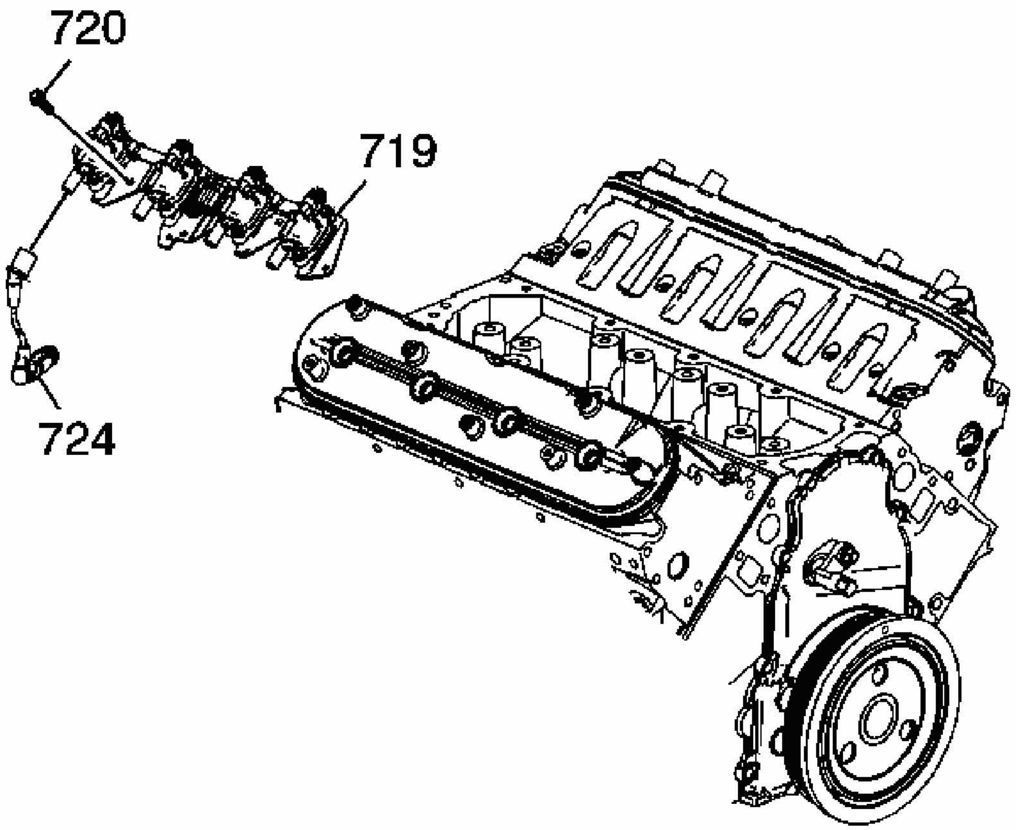


Fig. 652: View Of Ignition Coil And Bracket Assembly
Courtesy of GENERAL MOTORS CORP.

6. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the threads of the ignition coil bracket studs (720).
7. Install the ignition coil and bracket assembly (719) and studs (720).

   Tighten: Tighten the bracket studs to 12 N.m (106 lb in).

VALVE LIFTER OIL FILTER INSTALLATION

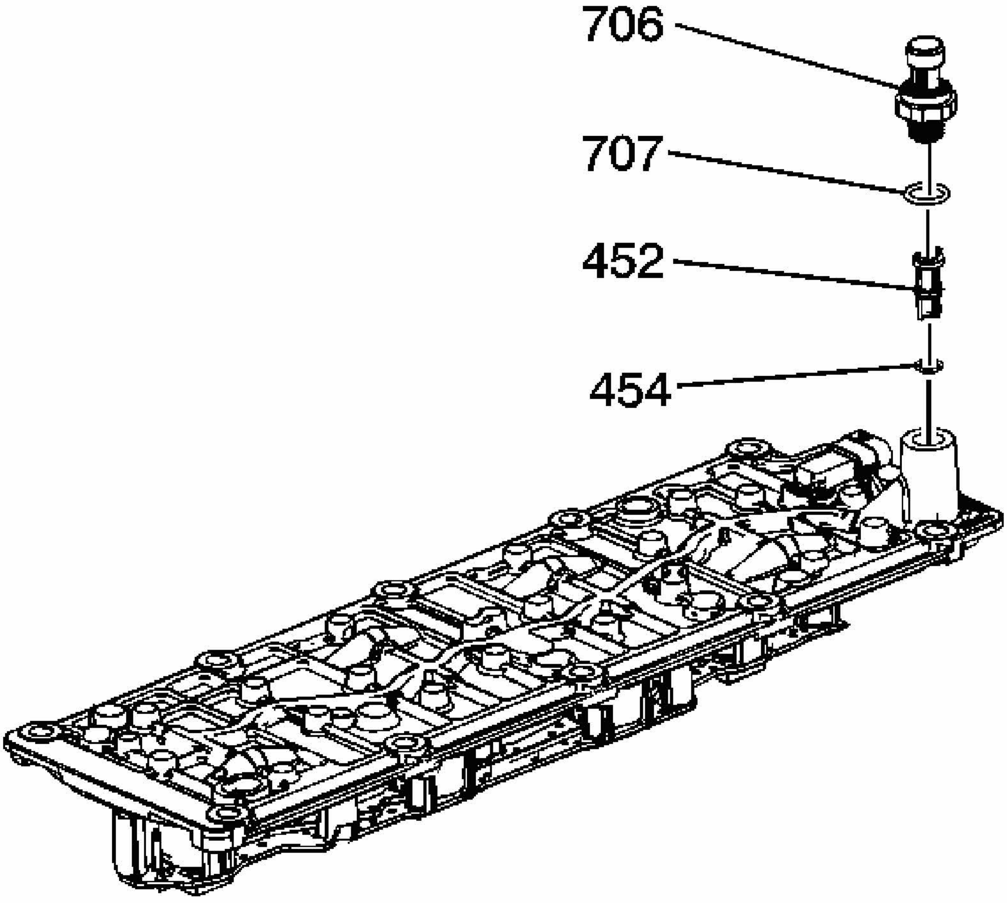


Fig. 653: View Of Oil Pressure Sensor, Washer And Valve Lifter Oil Filter
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not allow dirt or debris to enter the oil passages of the manifold. Plug as required.

1. Install a NEW oil filter (452) and O-ring (454) assembly.
2. Apply sealant GM P/N 12346004 (Canadian P/N 10953480) to the threads of the sensor.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the oil pressure sensor (706) and washer (707).

Tighten: Tighten the oil pressure sensor to 20 N.m (15 lb ft).

VALVE LIFTER OIL MANIFOLD INSTALLATION

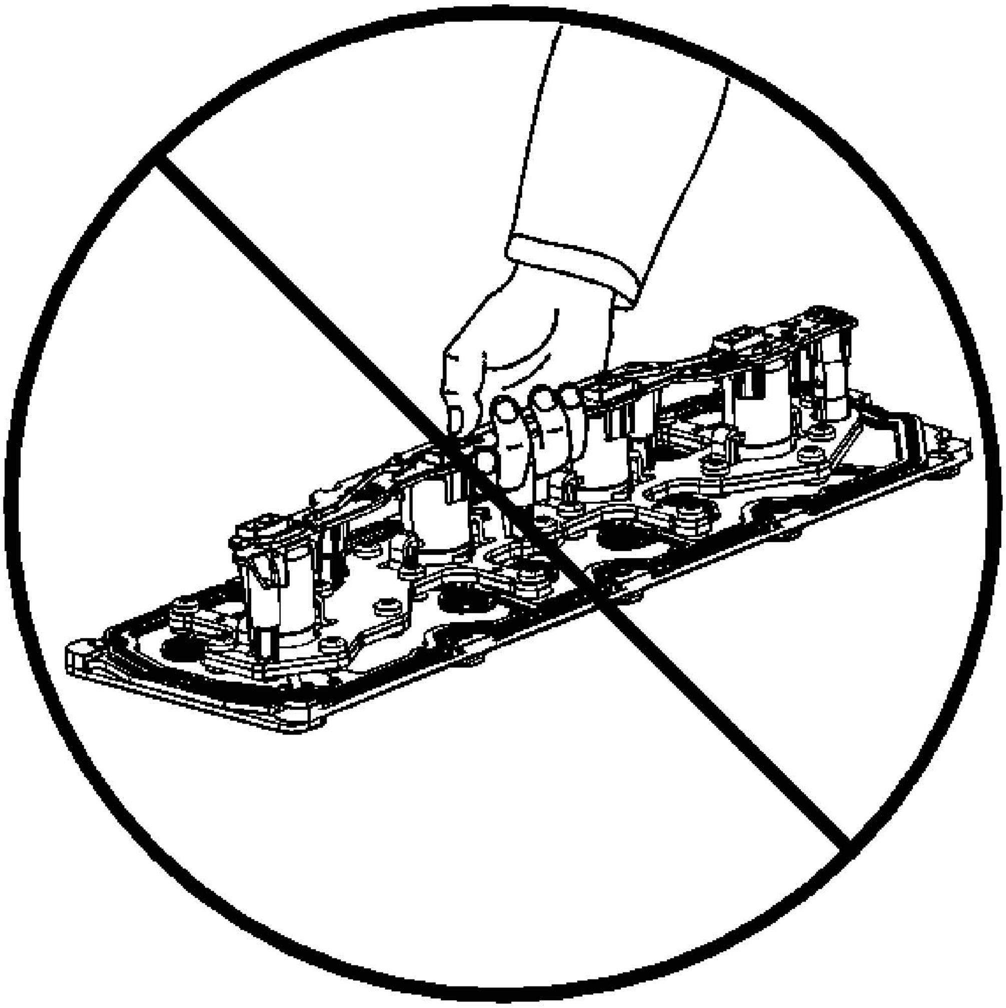


Fig. 654: Valve Lifter Oil Manifold
Courtesy of GENERAL MOTORS CORP.

1. Do not lift the manifold assembly by the electrical lead frame.

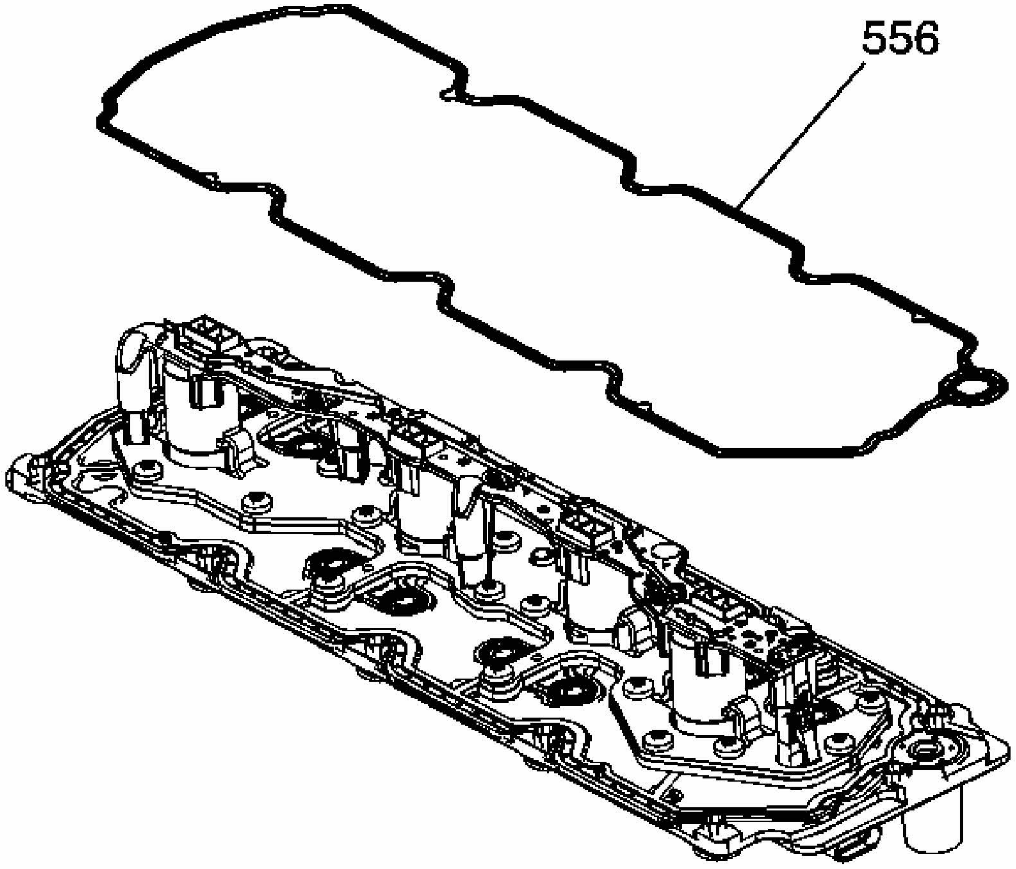


Fig. 655: View Of Outer Gasket
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **All gasket surfaces should be free of oil or other foreign material during assembly.**
- **Do not allow dirt or debris to enter the oil passages of the manifold. Plug as required.**

2. Install the service gasket (556) onto the manifold.

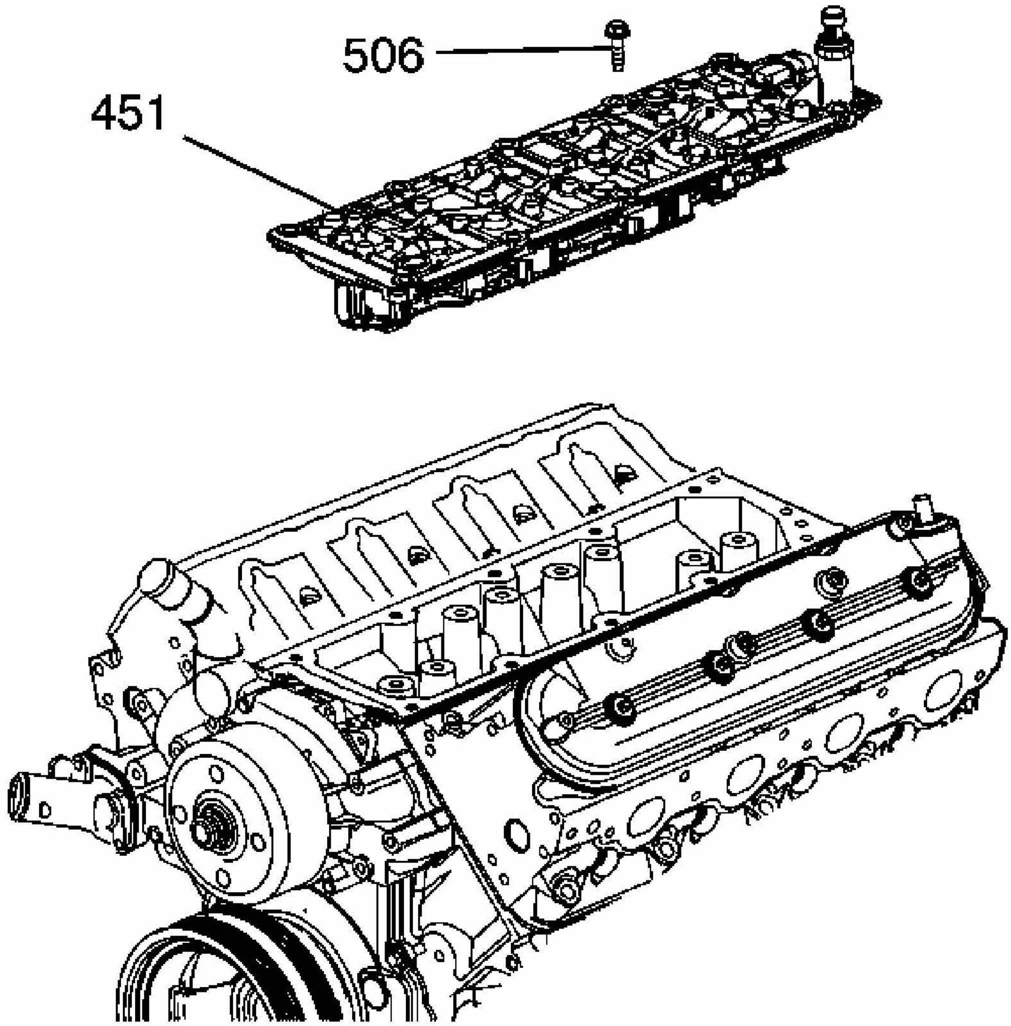


Fig. 656: View Of Valve Lifter Oil Manifold
Courtesy of GENERAL MOTORS CORP.

3. Install the manifold (451) with gasket.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

4. Install the manifold bolts (506).

Tighten: Tighten the manifold bolts to 25 N.m (18 lb ft).

COOLANT AIR BLEED PIPE INSTALLATION

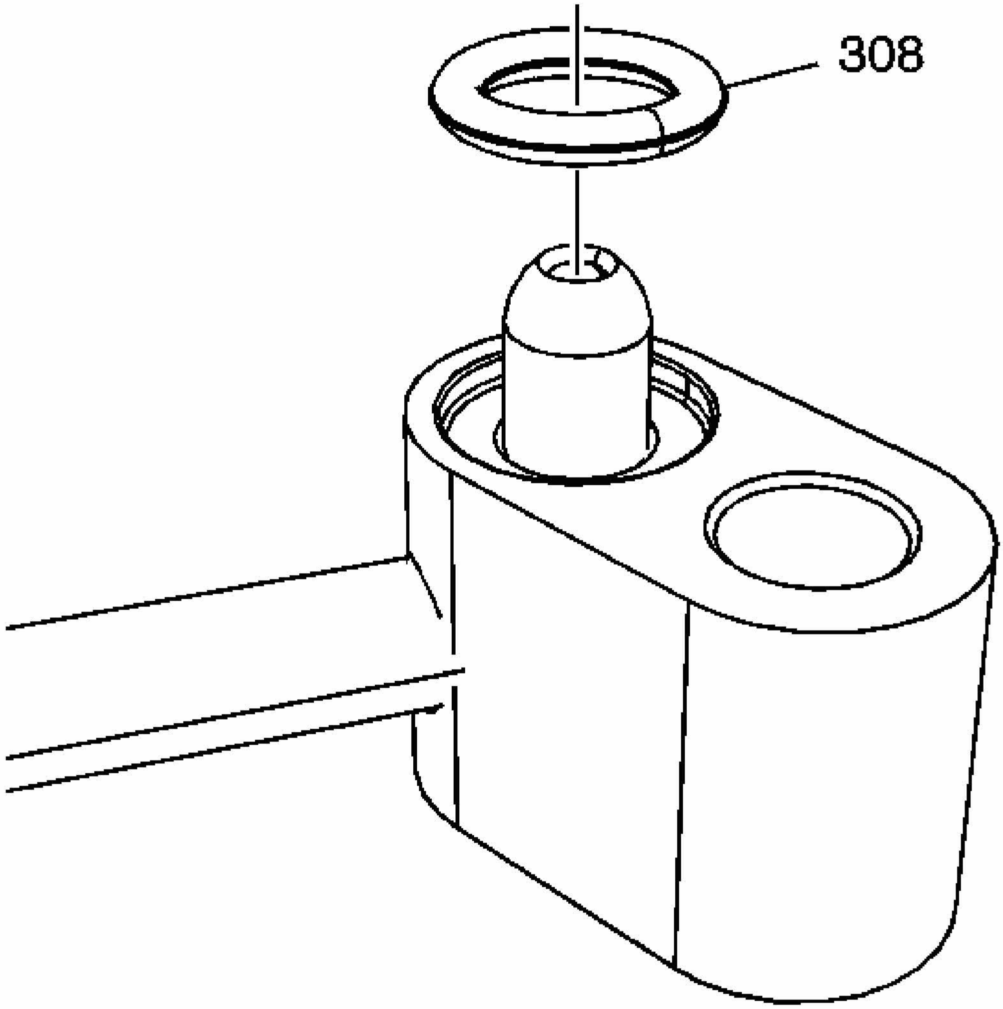


Fig. 657: View Of Coolant Air Bleed Pipe Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Position the gasket O-ring seal onto the nipple portion of the pipe.

1. Install the seals (308) onto the engine coolant air bleed pipe and covers.

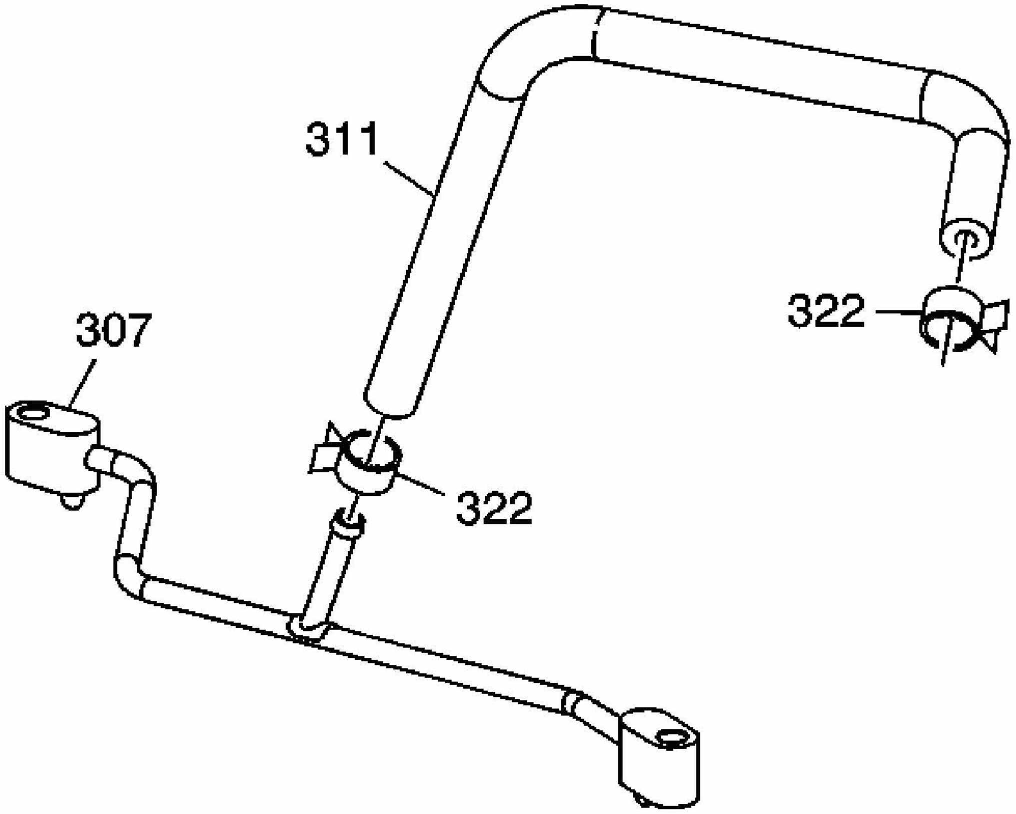


Fig. 658: View Of Coolant Air Bleed Pipe & Clamp
Courtesy of GENERAL MOTORS CORP.

2. Install the hose (311) and clamps (322) onto the pipe (307).

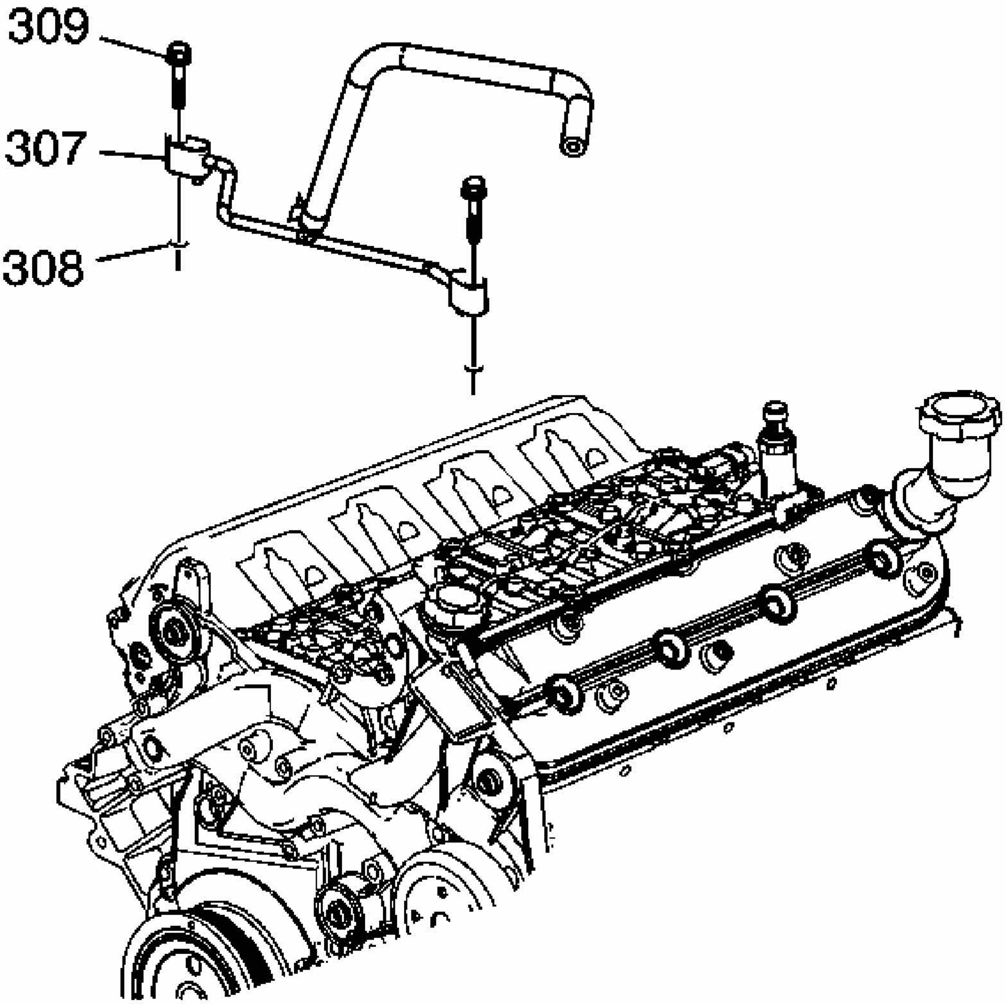


Fig. 659: View Of Coolant Air Bleed Pipe & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the pipe (307).

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

4. Install the bolts (309).

Tighten: Tighten the pipe bolts to 12 N.m (106 lb in).

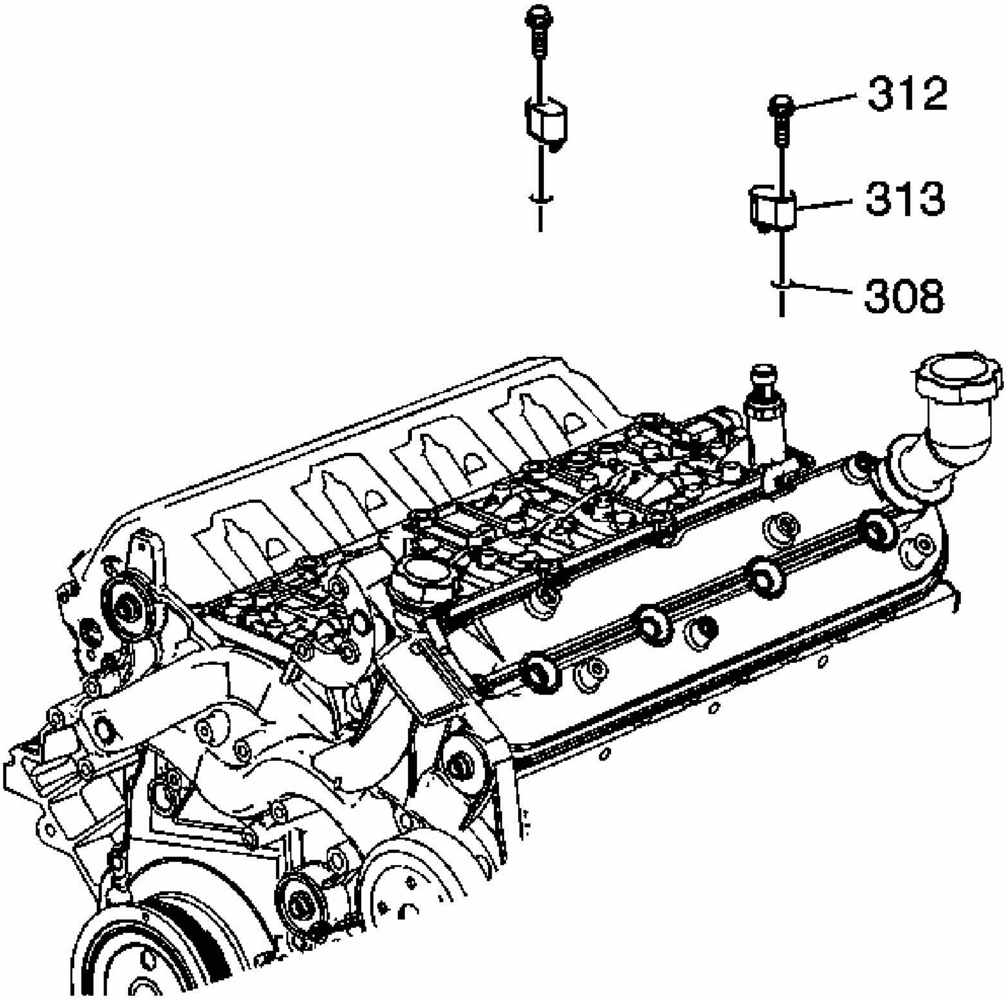


Fig. 660: View Of Engine Coolant Air Bleed Cover, Bolts & Gaskets
Courtesy of GENERAL MOTORS CORP.

5. Install the covers (313).
6. Install the bolts (312).

Tighten: Tighten the cover bolts to 12 N.m (106 lb in).

INTAKE MANIFOLD INSTALLATION

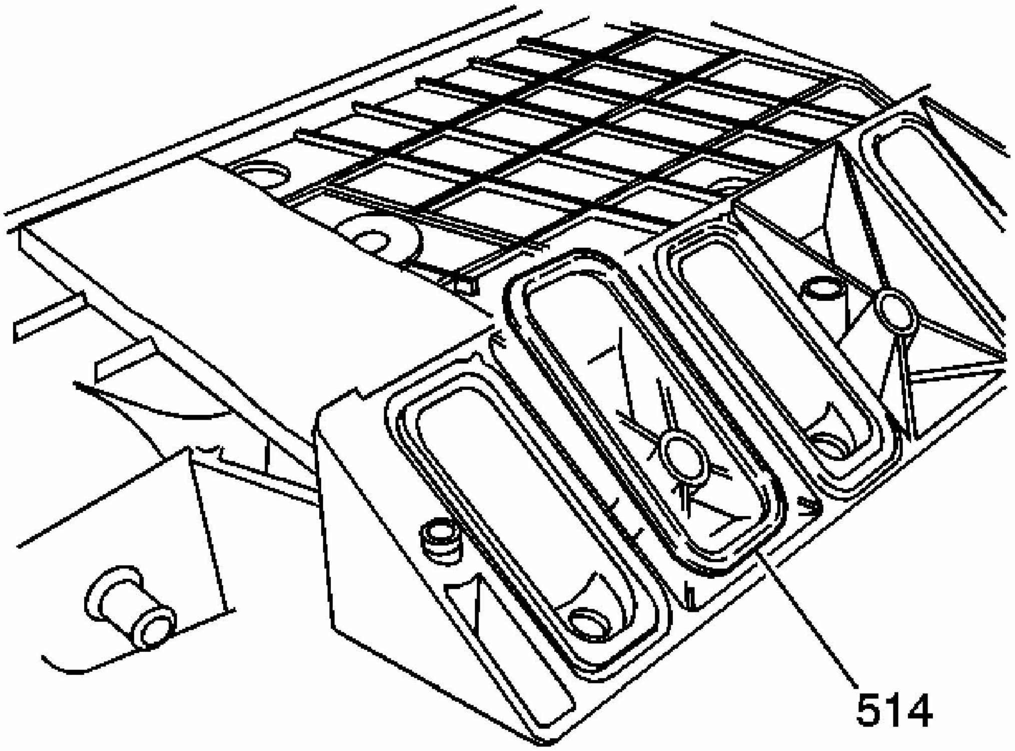


Fig. 661: View Of Intake Manifold-To-Cylinder Head Gaskets
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **The intake manifold, throttle body, fuel injection rail and fuel injectors may be removed as an assembly. If not servicing the individual components, install the intake manifold as a complete assembly.**
- **DO NOT use the intake manifold gaskets again. Install NEW intake manifold-to-cylinder head gaskets.**

1. Install NEW intake manifold-to-cylinder head gaskets (514).

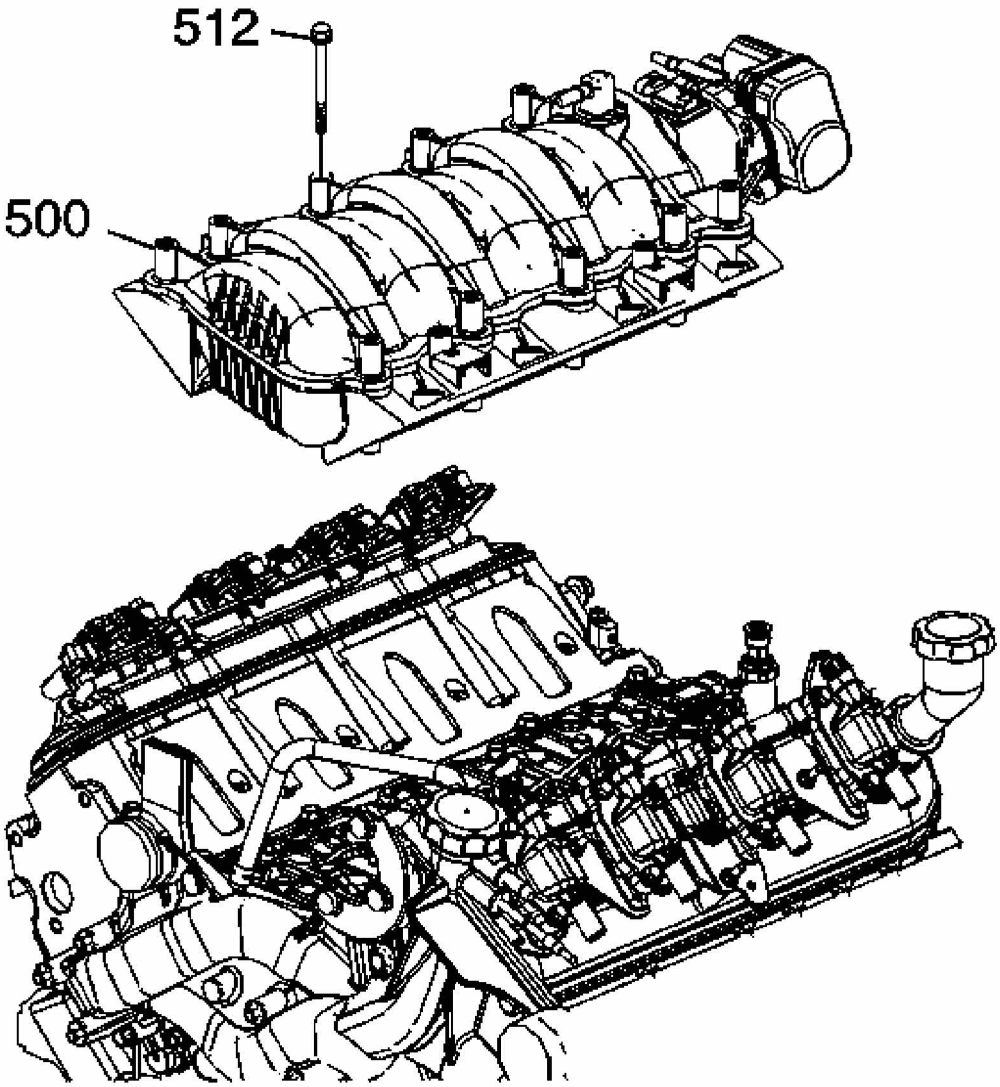


Fig. 662: View Of The Intake Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the intake manifold (500).
3. Apply a 5 mm (0.20 in) band of threadlock GM P/N 12345382 (Canadian P/N 10953489) to the threads of the intake manifold bolts (512). Refer to **Sealers, Adhesives, and Lubricants**.

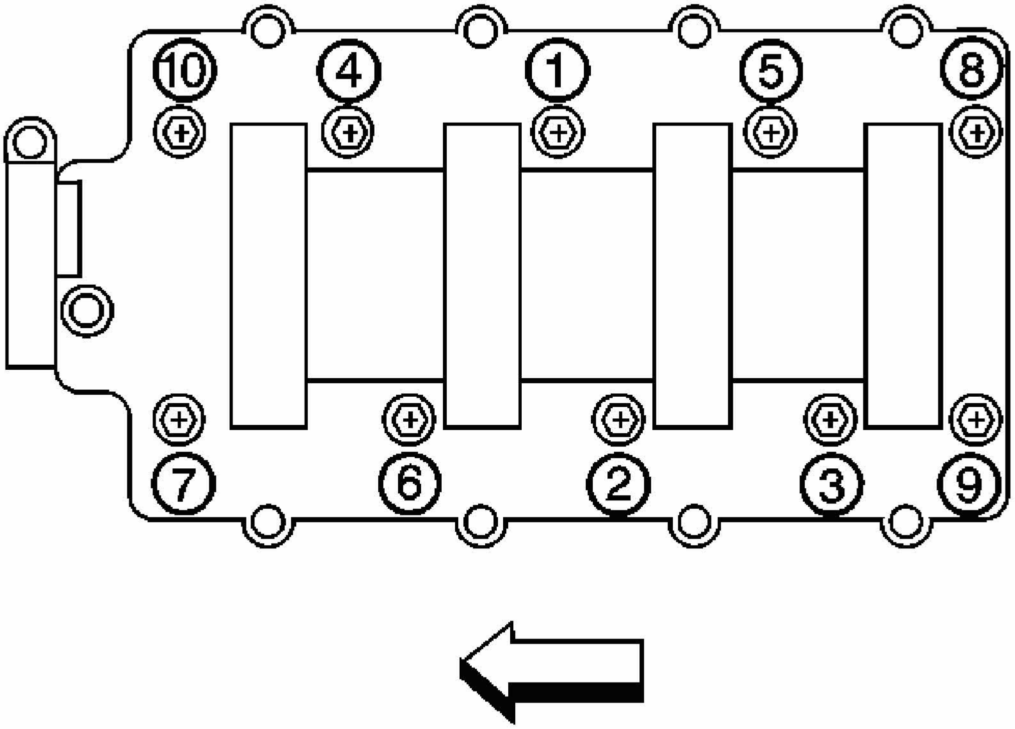


Fig. 663: Identifying Intake Manifold Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the intake manifold bolts.

Tighten:

1. Tighten the intake manifold bolts (1-10) a first pass in sequence to 5 N.m (44 lb in).
2. Tighten the intake manifold bolts (1-10) a final pass in sequence to 10 N.m (89 lb in).

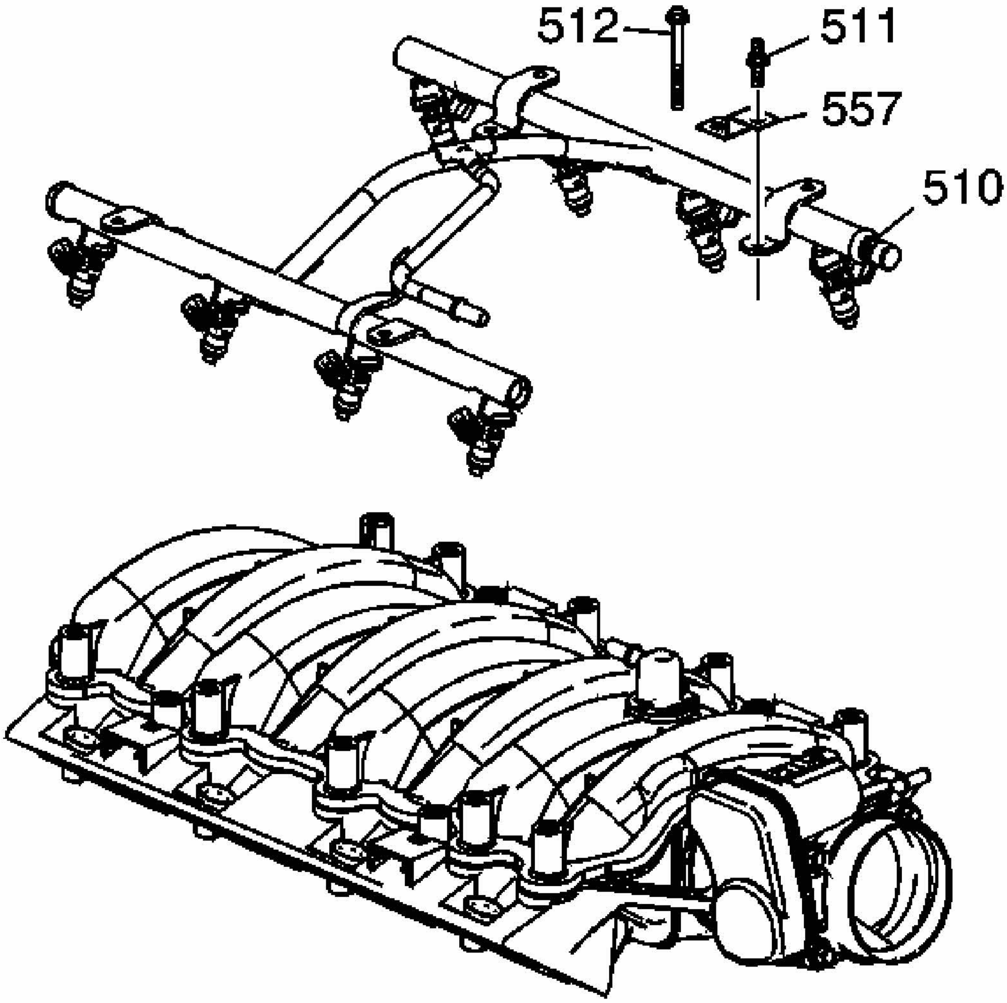


Fig. 664: View Of Fuel Rail Bolts, Ground Strap & Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the fuel rail. Refer to **Fuel Rail and Injectors Installation**.

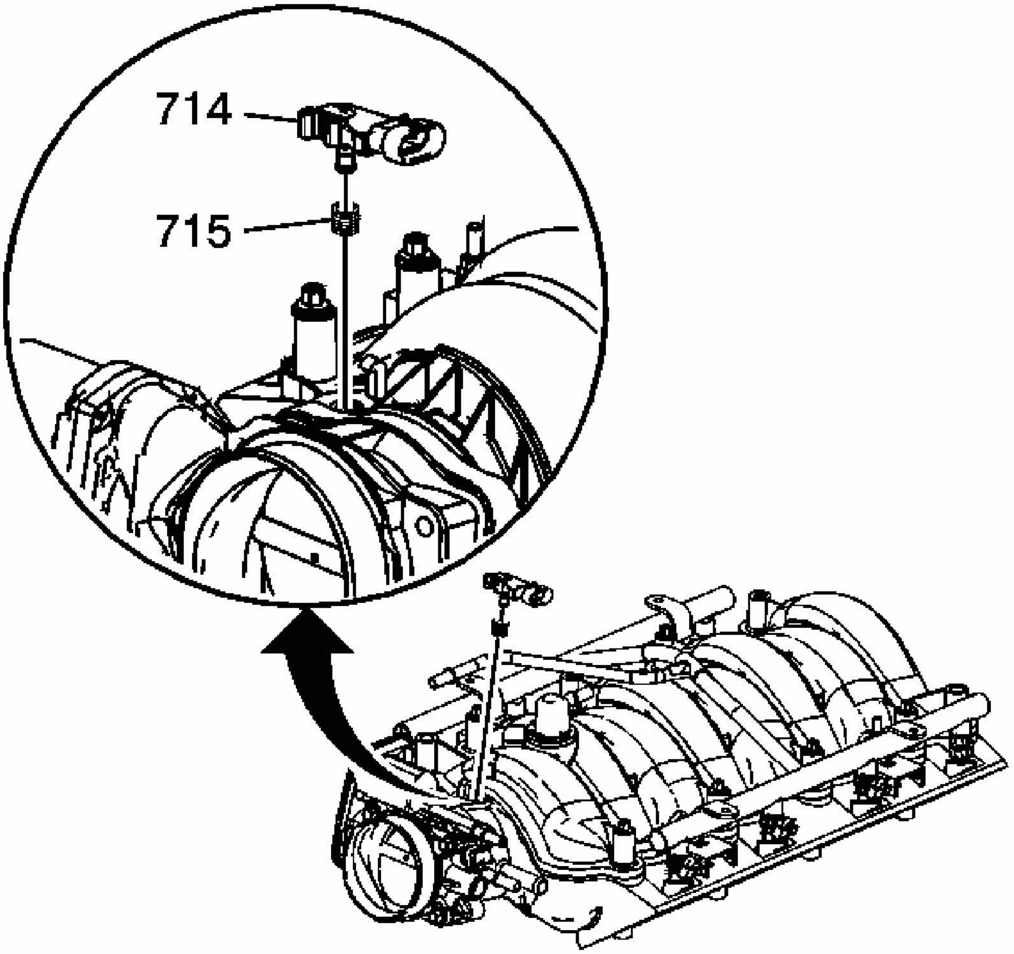


Fig. 665: View Of MAP Sensor
Courtesy of GENERAL MOTORS CORP.

6. Lubricate the manifold absolute pressure (MAP) sensor grommet (715) with clean engine oil.
7. Install the grommet onto the MAP sensor (714).
8. Install the MAP sensor.

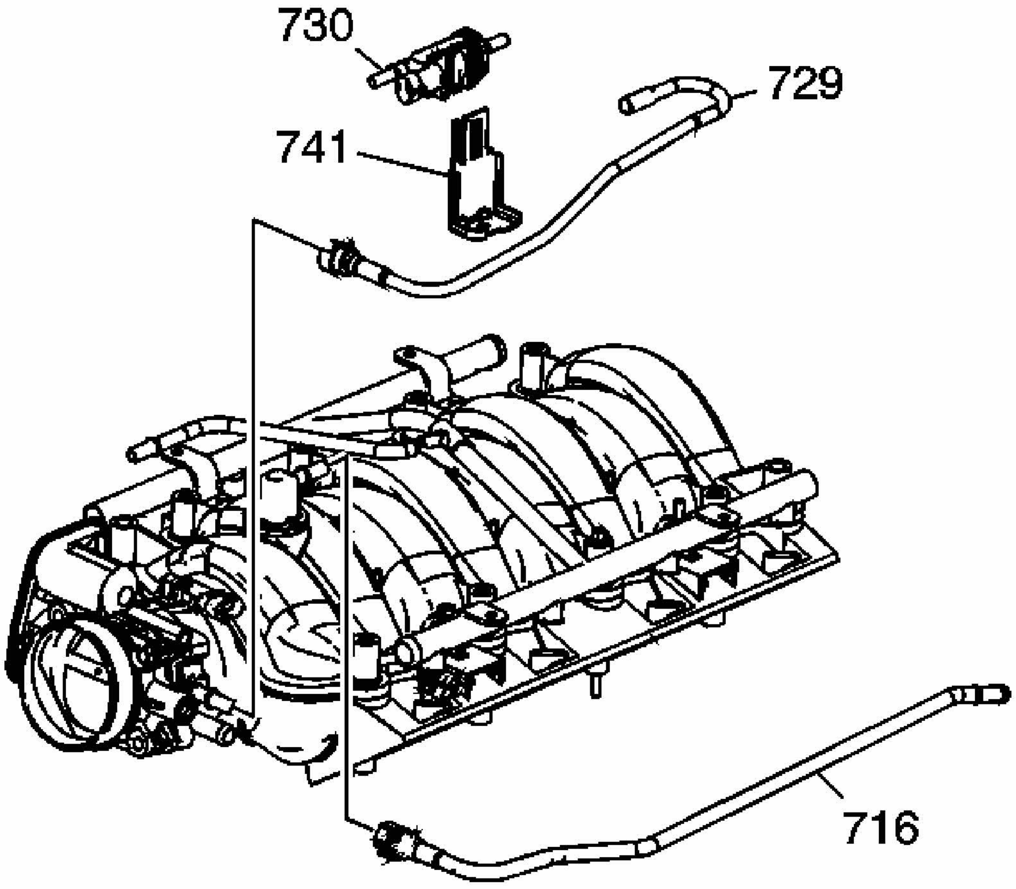


Fig. 666: View Of EVAP Purge Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

9. Install the positive crankcase ventilation (PCV) hose - dirty air (716).

FUEL RAIL AND INJECTORS INSTALLATION

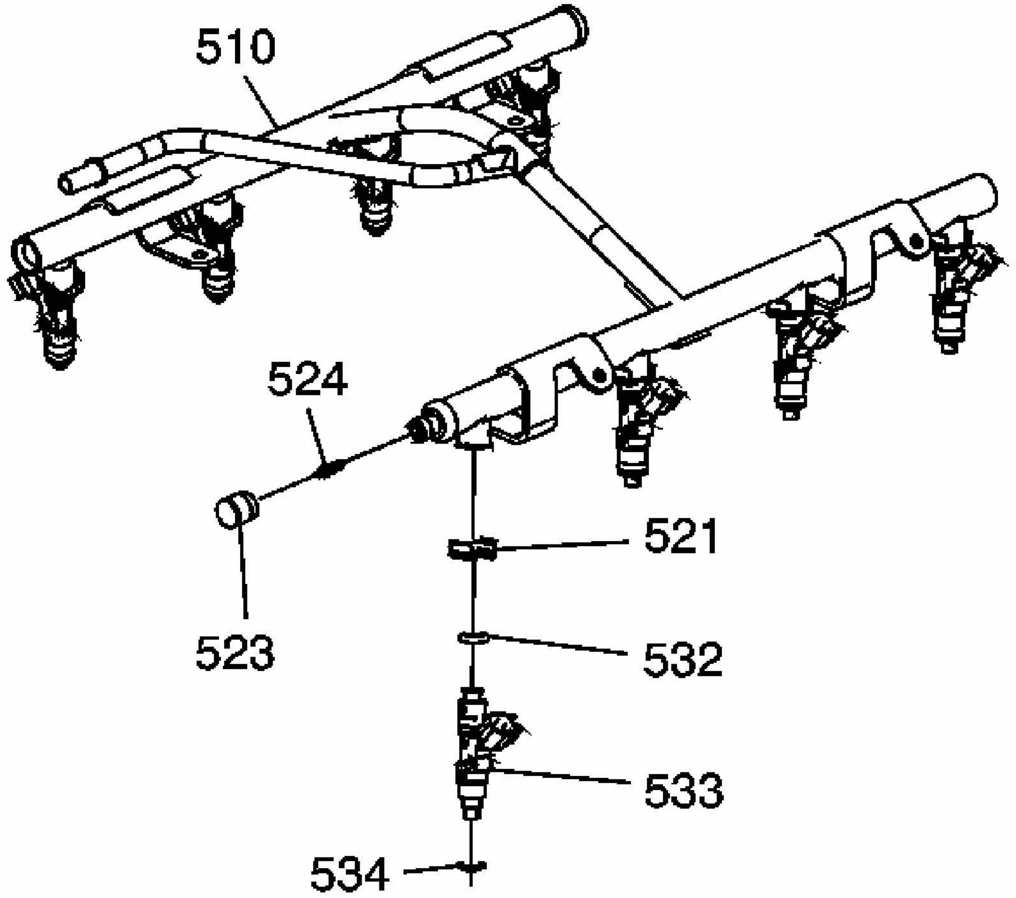


Fig. 667: View Of Fuel Rail With Injectors
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fuel Rail Stop Bracket Installation Caution in Cautions and Notices.

IMPORTANT: DO NOT use the fuel injector O-ring seals again. Install NEW fuel injector O-ring seals during assembly.

1. Lubricate the NEW fuel injector O-ring seals (532, 534) with clean engine oil.
2. Install the O-ring seals to the fuel injectors.
3. Install the fuel injectors (533) and retainers (521).

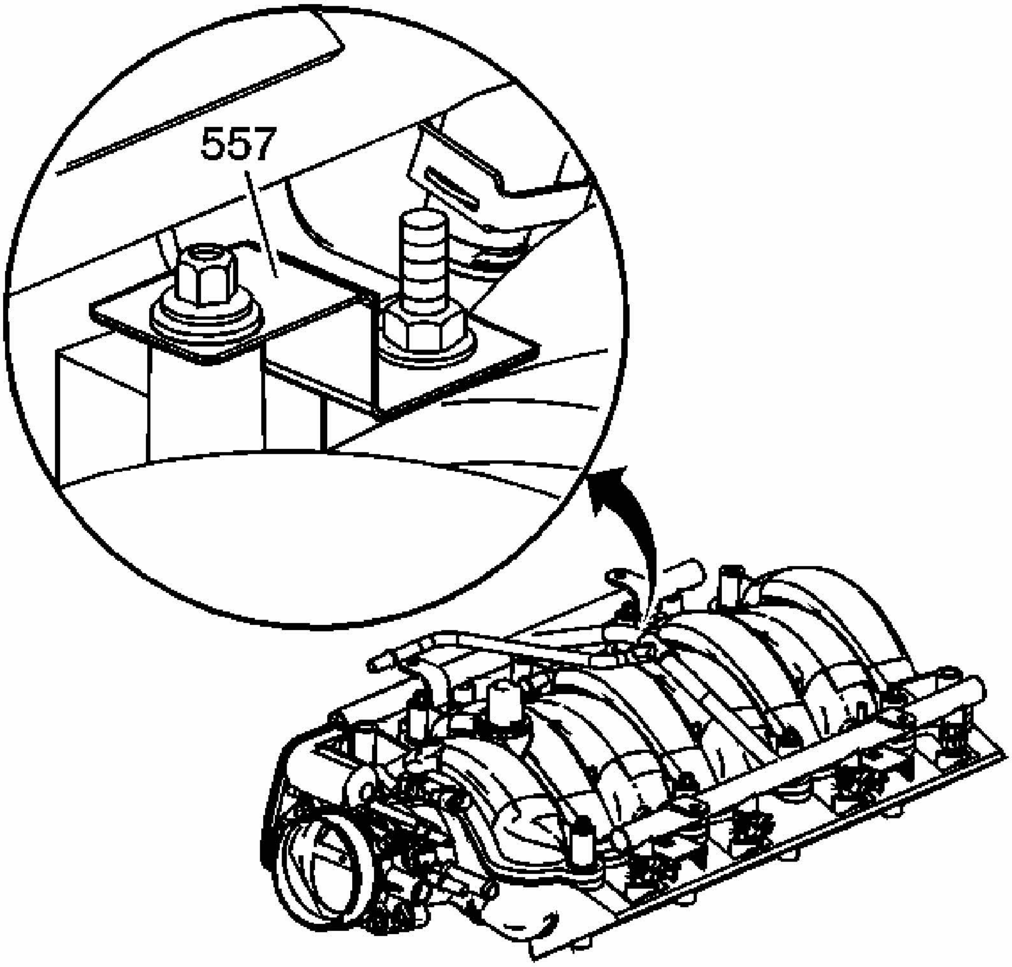


Fig. 668: View Of Fuel Rail Ground Strap
Courtesy of GENERAL MOTORS CORP.

4. Note the installed location of the fuel rail ground strap (557).

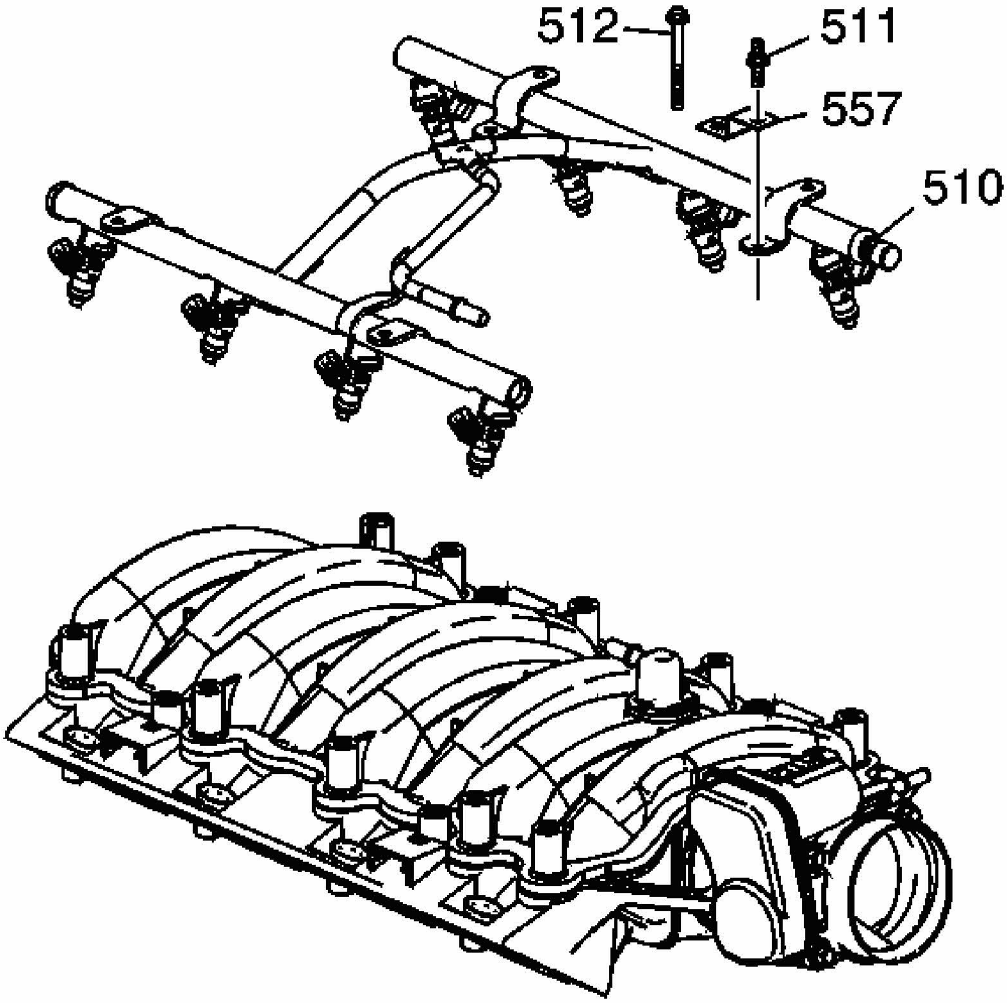


Fig. 669: View Of Fuel Rail Bolts, Ground Strap & Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the fuel rail assembly (510) to the manifold. Push firmly on both sides of the rail until all injectors have entered their bores.
6. Apply a 5 mm (0.2 in) band of threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the threads of the fuel rail bolts. Refer to **Sealers, Adhesives, and Lubricants**.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

7. Install the fuel rail bolts (511) and ground strap (557).

Tighten: Tighten the fuel rail bolts to 10 N.m (89 lb in).

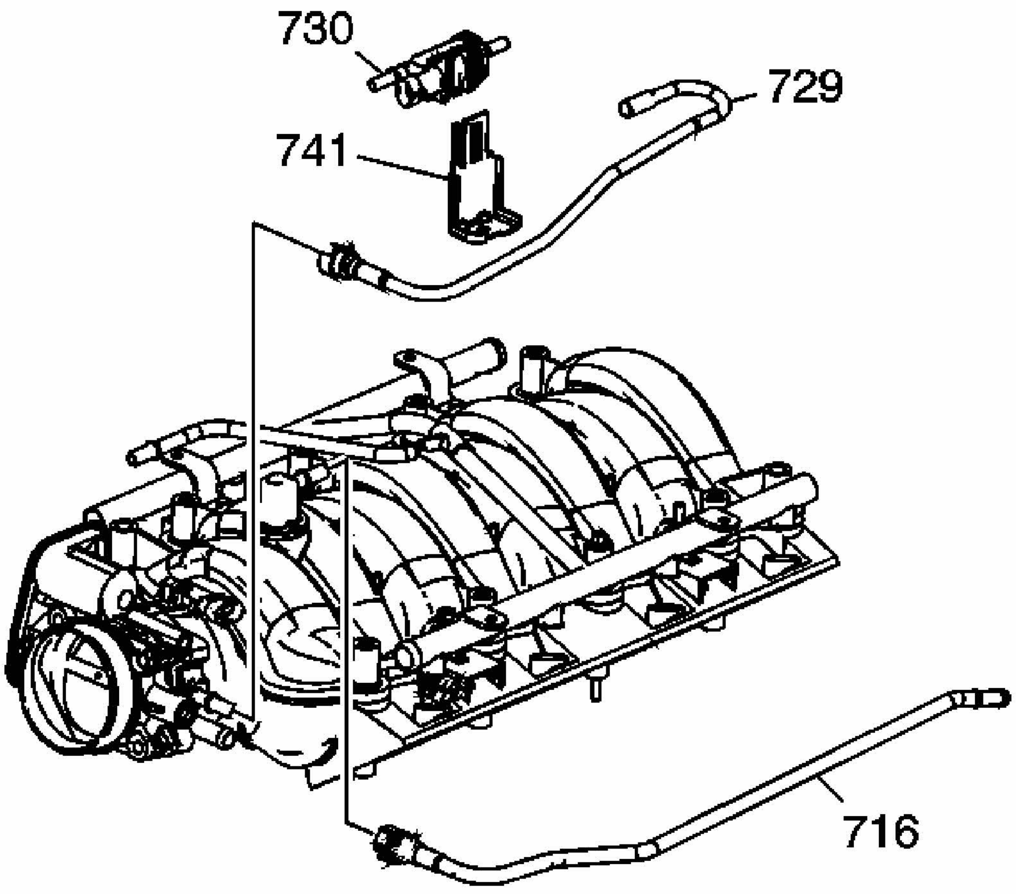


Fig. 670: View Of EVAP Purge Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

8. Install the evaporative emission (EVAP) canister purge solenoid valve (730), bracket (741), and tube (729).

THROTTLE BODY INSTALLATION

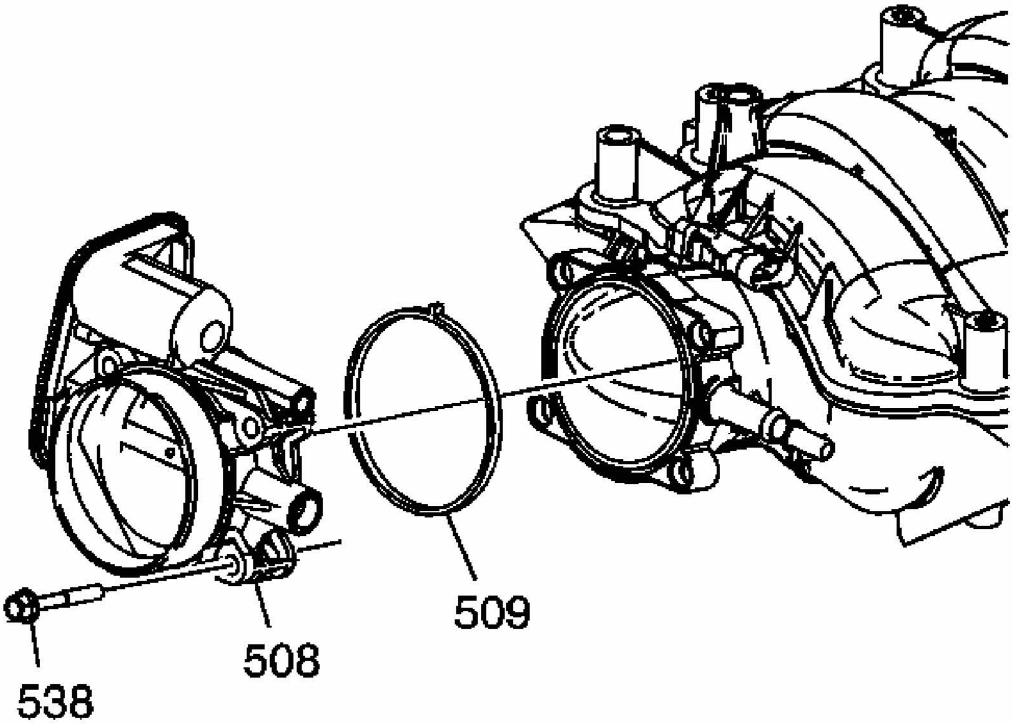


Fig. 671: Exploded View Of Throttle Body
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: DO NOT use the throttle body gasket again. Install a NEW gasket during assembly.

1. Install the throttle body gasket (509) to the intake manifold. Align the locating tab of the gasket with the notch in the manifold.

   NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the throttle body (508) and bolts (538).

   Tighten: Tighten the throttle body bolts to 10 N.m (89 lb in).

WATER PUMP INSTALLATION

NOTE: Refer to Fastener Notice in Cautions and Notices.

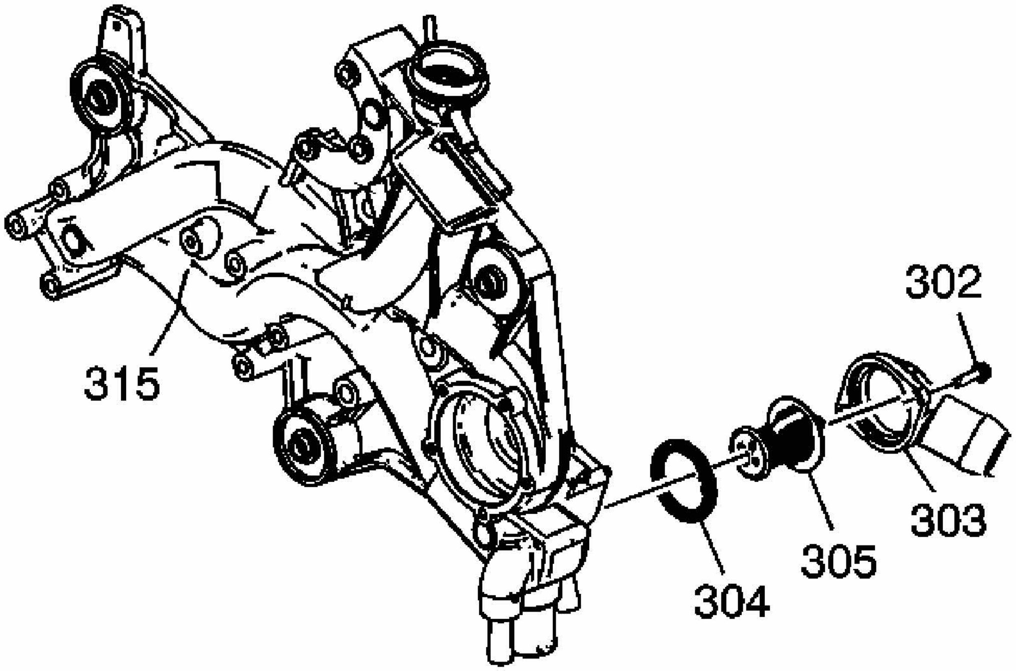


Fig. 672: View Of Thermostat Housing, Bolts, Thermostat, & O-Ring
Courtesy of GENERAL MOTORS CORP.

NOTE: **DO NOT use cooling system seal tabs, or similar compounds, unless otherwise instructed. The use of cooling system seal tabs, or similar compounds, may restrict coolant flow through the passages of the cooling system or the engine components. Restricted coolant flow may cause engine overheating and/or damage to the cooling system or the engine components/assembly.**

IMPORTANT: **All gasket surfaces are to be free of oil or other foreign material during assembly.**

1. Install the thermostat (305), O-ring (304), inlet housing (303), and bolts (302).

   Tighten: Tighten the bolts to 15 N.m (11 lb ft).

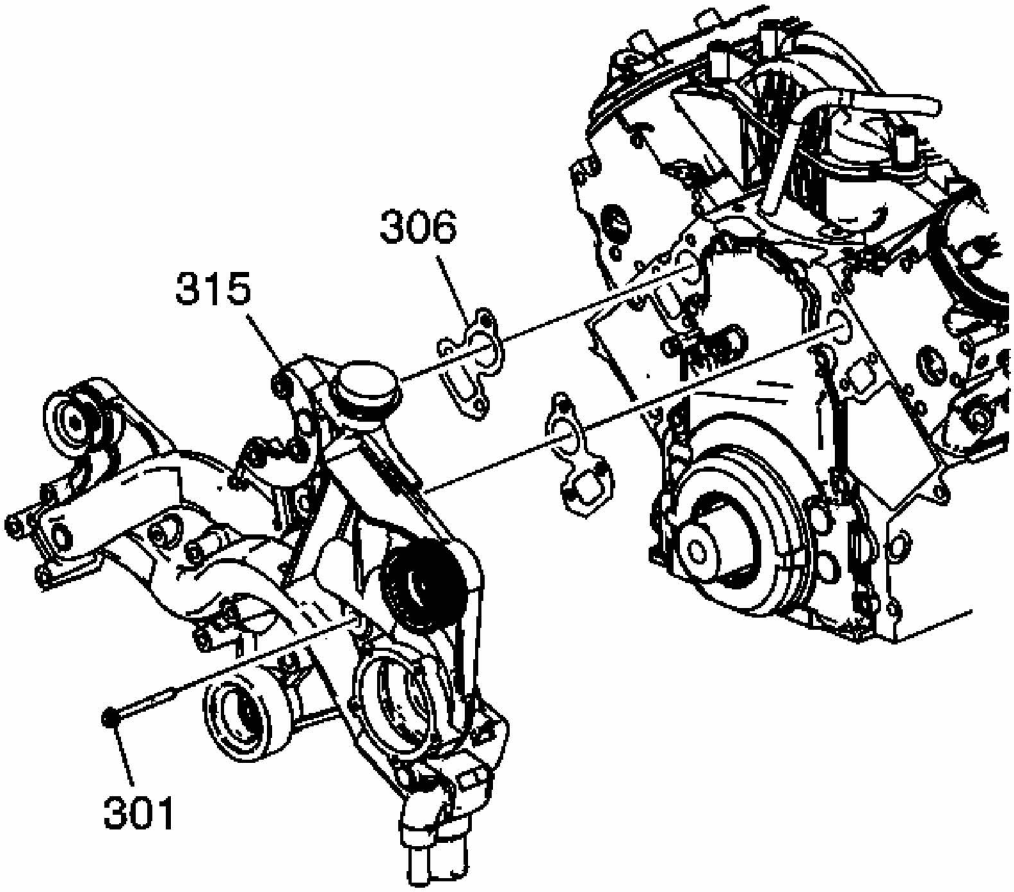


Fig. 673: Water Manifold, Bolts & Gaskets
Courtesy of GENERAL MOTORS CORP.

2. Install the water manifold (315), gaskets (306), and bolts (301).

   Tighten:

   1. Tighten the water manifold M8 bolts to 30 N.m (22 lb ft).
   2. Tighten the water manifold M10 bolts to 60 N.m (44 lb ft).

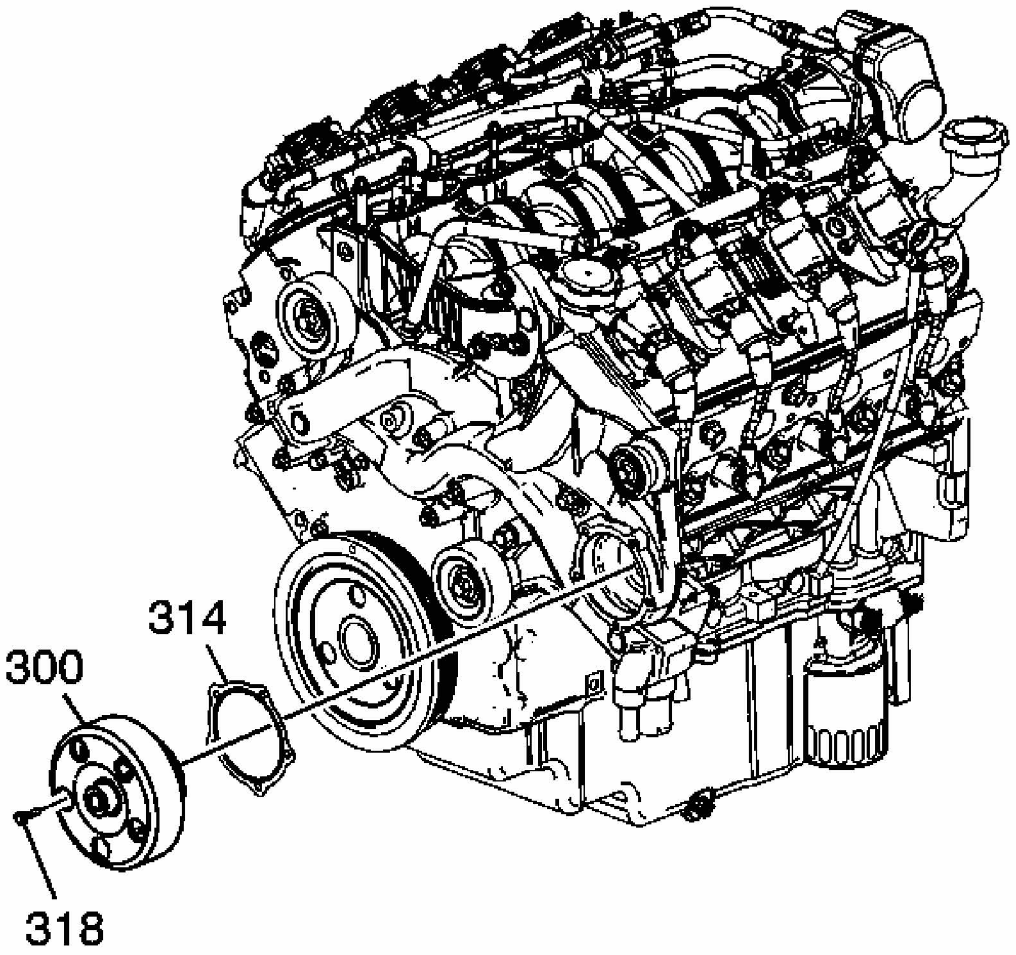


Fig. 674: Water Pump, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

3. Install the water pump (300) and NEW gasket (314).
4. Install the water pump bolts (318).

   Tighten: Tighten the water pump bolts to 12 N.m (106 lb in).

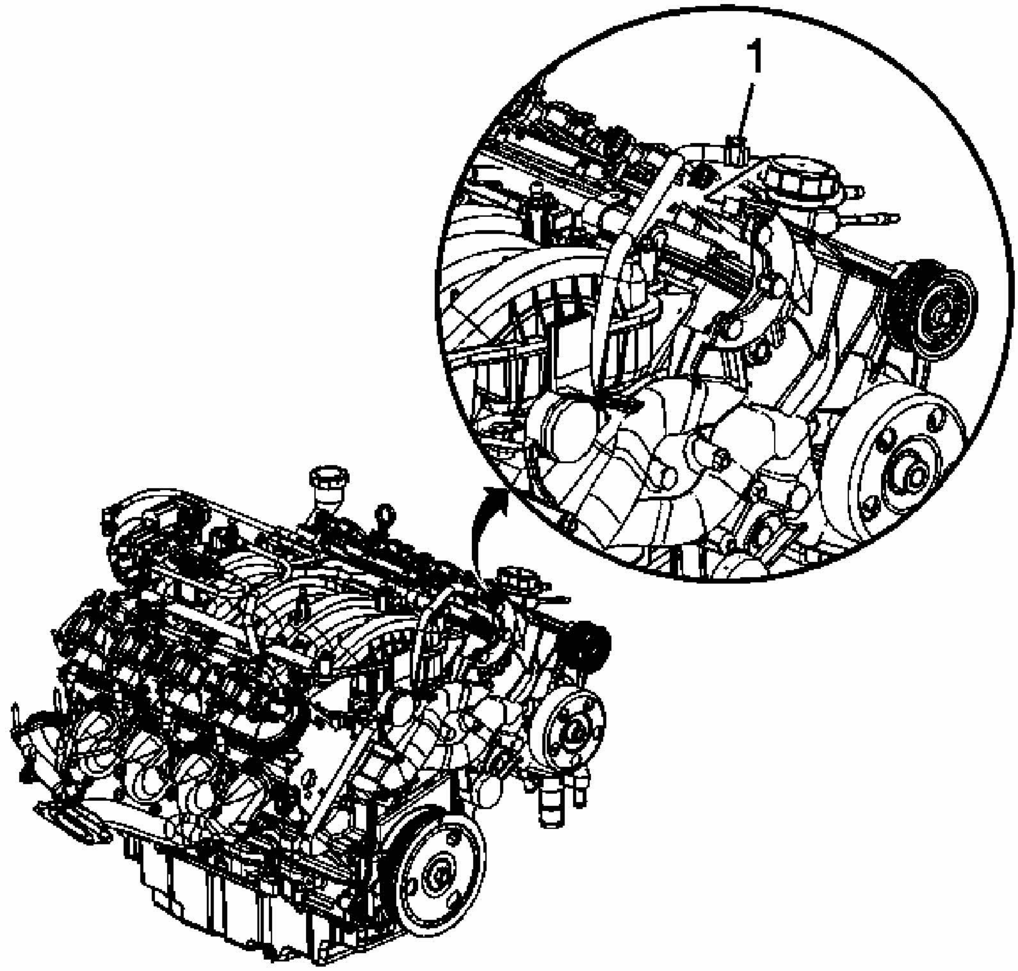


Fig. 675: Engine Coolant Air Bleed Hose And Clamp
Courtesy of GENERAL MOTORS CORP.

5. Install the coolant air bleed hose and clamp (1) to the manifold.

EXHAUST MANIFOLD INSTALLATION - LEFT

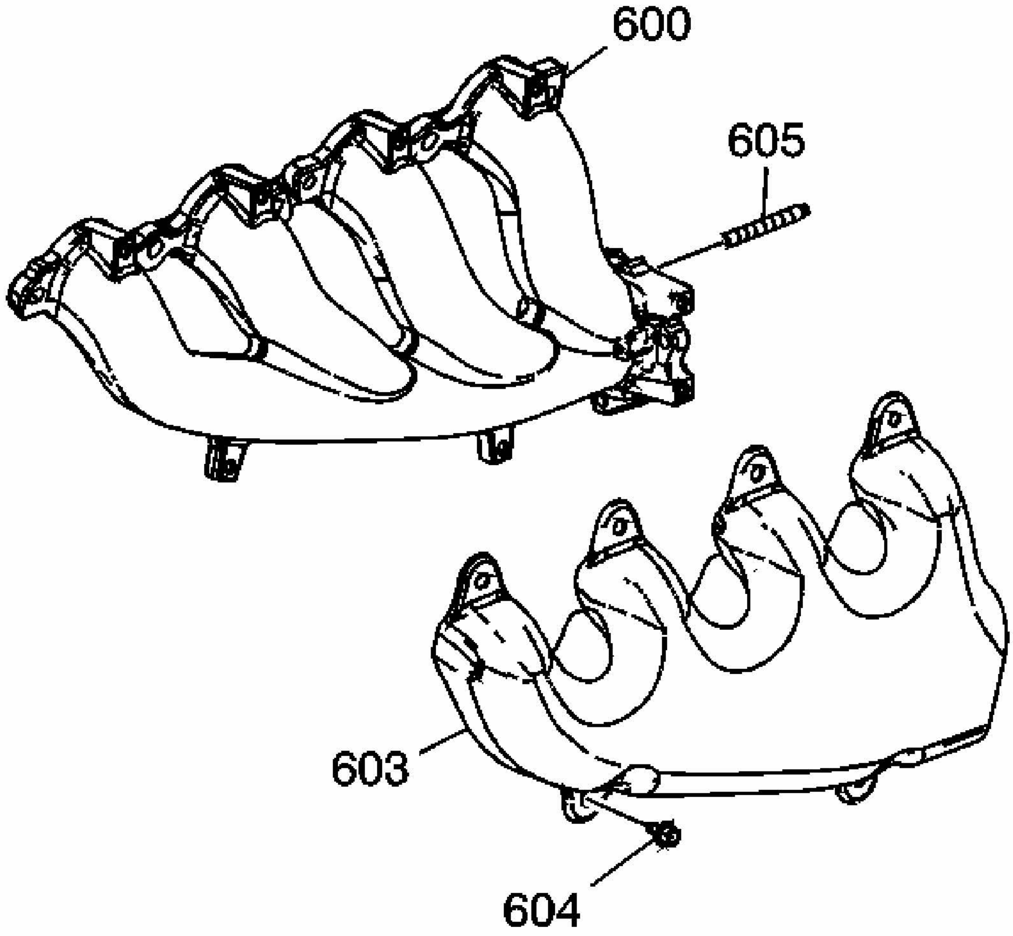


Fig. 676: View Of Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

IMPORTANT:

- **Tighten the exhaust manifold bolts as specified in the service procedure. Improperly installed and/or leaking exhaust manifold gaskets may affect vehicle emissions and/or on-board diagnostic (OBD) II system performance.**
- **The cylinder head exhaust manifold bolt hole threads must be clean and free of debris or threadlocking material.**
- **Do not apply sealant to the first 3 threads of the bolt.**

1. Install the heat shield (603) and bolts (604).

   Tighten: Tighten the bolts to 9 N.m (80 lb in).

2. Install the exhaust pipe studs (605).

   Tighten: Tighten the studs to 20 N.m (15 lb ft).

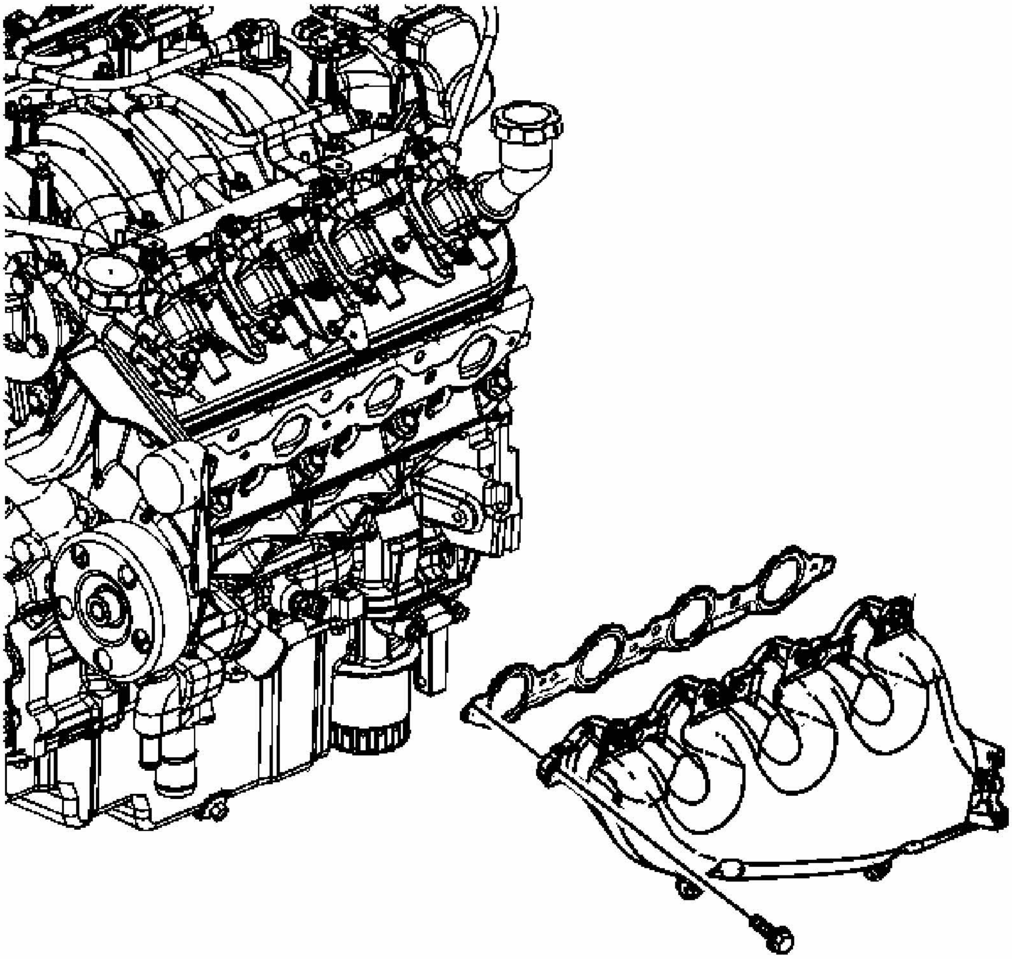


Fig. 677: View Of Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

3. Apply a 5 mm (0.2 in) wide band of threadlock GM P/N 12345493 (Canadian P/N 10953488), or equivalent, to the threads of the exhaust manifold bolts. Refer to **Sealers, Adhesives, and Lubricants**.
4. Install the exhaust manifold, NEW gasket, and bolts.

Tighten:

1. Tighten the exhaust manifold bolts a first pass to 15 N.m (11 lb ft). Tighten the exhaust manifold bolts beginning with the center 2 bolts. Alternate from side-to-side, and work toward the outside bolts.
2. Tighten the exhaust manifold bolts a final pass to 25 N.m (18 lb ft). Tighten the exhaust manifold bolts beginning with the center 2 bolts. Alternate from side-to-side, and work toward the outside bolts.

5. Using a flat punch, bend over the exposed edge of the exhaust manifold gasket at the rear of the left cylinder head.

EXHAUST MANIFOLD INSTALLATION - RIGHT

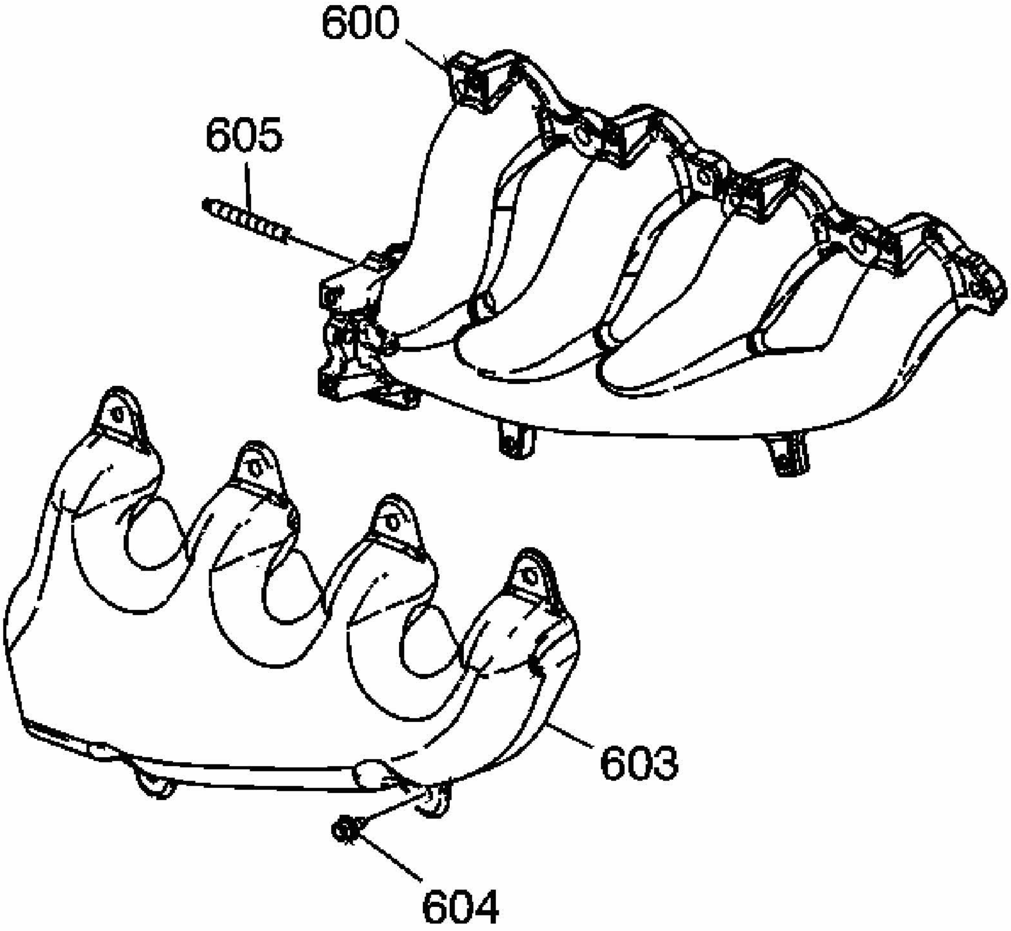


Fig. 678: View Of Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

IMPORTANT:

- **Tighten the exhaust manifold bolts as specified in the service procedure. Improperly installed and/or leaking exhaust manifold gaskets may affect vehicle emissions and/or on-board diagnostic (OBD) II system performance.**
- **The cylinder head exhaust manifold bolt hole threads must be clean and free of debris or threadlocking material.**
- **Do not apply sealant to the first 3 threads of the bolt.**

1. Install the heat shield (603) and bolts (604).

   Tighten: Tighten the bolts to 9 N.m (80 lb in).

2. Install the exhaust pipe studs (605).

   Tighten: Tighten the studs to 20 N.m (15 lb ft).

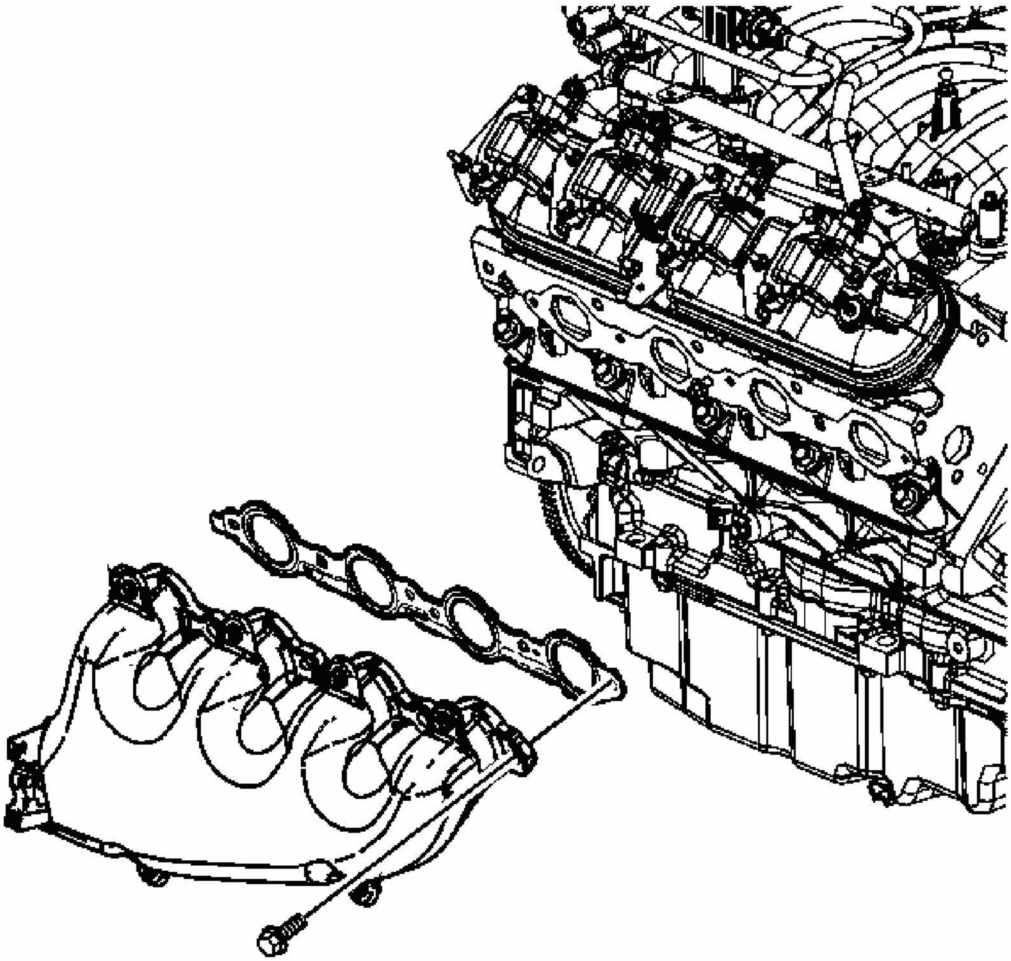


Fig. 679: View Of Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

3. Apply a 5 mm (0.2 in) wide band of threadlock GM P/N 12345493 (Canadian P/N 10953488), or equivalent, to the threads of the exhaust manifold bolts. Refer to **Sealers, Adhesives, and Lubricants**.
4. Install the exhaust manifold, NEW gasket, and bolts.

Tighten:

1. Tighten the exhaust manifold bolts a first pass to 15 N.m (11 lb ft). Tighten the exhaust manifold bolts beginning with the center 2 bolts. Alternate from side-to-side, and work toward the outside bolts.
2. Tighten the exhaust manifold bolts a final pass to 25 N.m (18 lb ft). Tighten the exhaust manifold bolts beginning with the center 2 bolts. Alternate from side-to-

side, and work toward the outside bolts.

5. Using a flat punch, bend over the exposed edge of the exhaust manifold gasket at the rear of the left cylinder head.

OIL LEVEL INDICATOR AND TUBE INSTALLATION

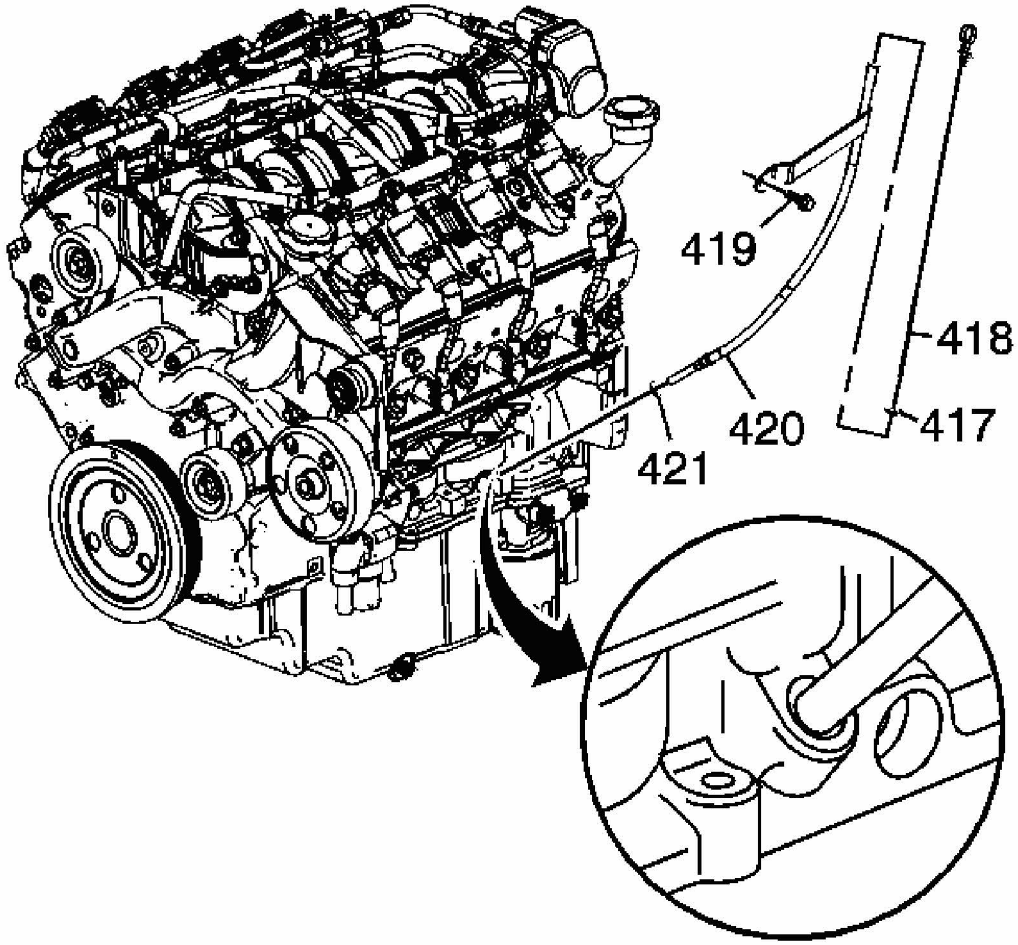


Fig. 680: View Of Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Inspect the O-ring seal (421) for cuts or damage. If the oil level indicator tube O-ring seal is not cut or damaged, it may be used again.
2. Lubricate the O-ring seal with clean engine oil.
3. Install the O-ring seal onto the oil level indicator tube (420).
4. Install the oil level indicator tube into the engine and rotate into proper position.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

5. Install the tube bolt (419).

   Tighten: Tighten the oil level indicator tube bolt to 25 N.m (18 lb ft).

6. Install the oil level indicator (418) into the tube.

ENGINE FLYWHEEL INSTALLATION

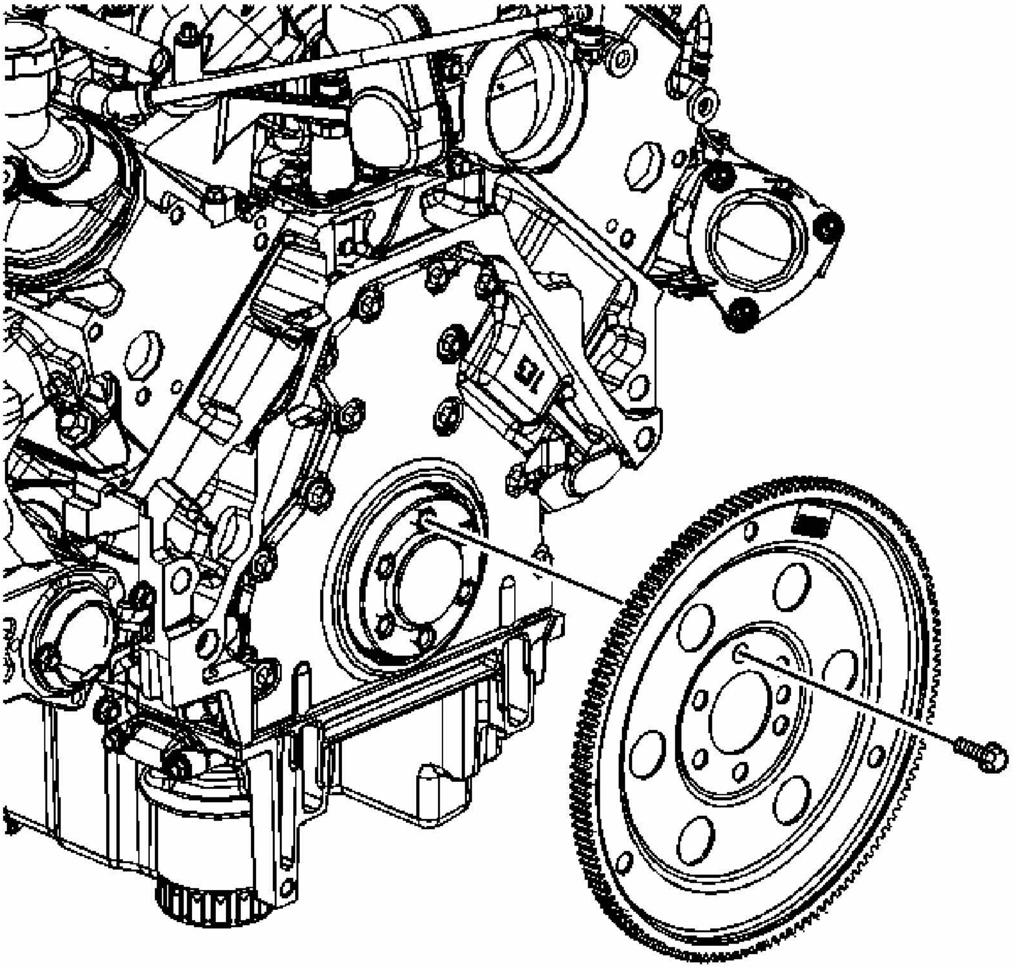


Fig. 681: Identifying Flywheel
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The flex plate does not use a locating pin for alignment and will

not initially seat against the crankshaft flange, but will be pulled onto the crankshaft by the engine flex plate bolts. This procedure requires a 3 stage tightening process.

1. Install the flex plate to the crankshaft.
2. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the threads of the flex plate bolts.

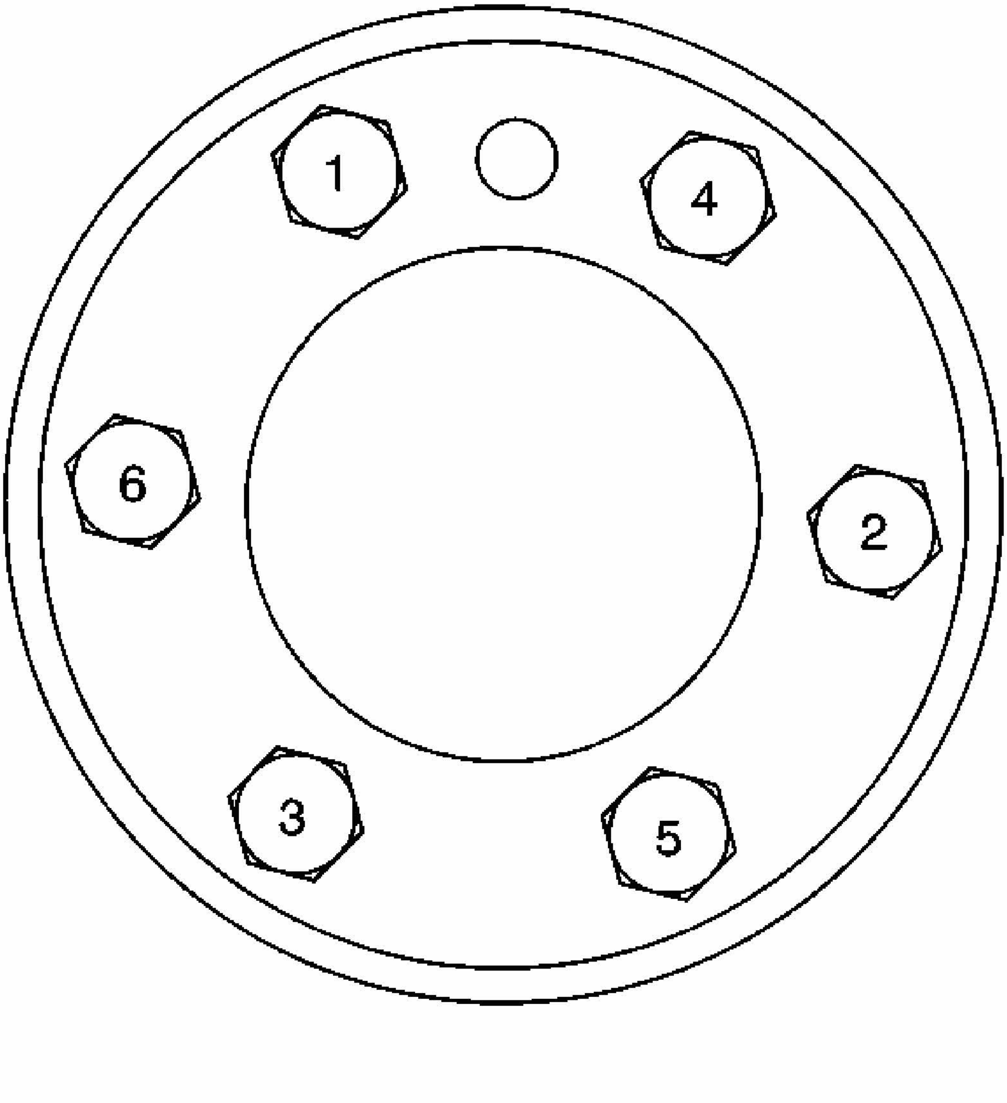


Fig. 682: Identifying Flywheel Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

3. Install the engine flex plate bolts.

   Tighten:

   1. Tighten the engine flex plate bolts (1-6) a first pass in sequence to 20 N.m (15 lb ft).
   2. Tighten the engine flex plate bolts (1-6) a second pass in sequence to 50 N.m (37 lb ft).
   3. Tighten the engine flex plate bolts (1-6) a final pass in sequence to 100 N.m (74 lb ft).

CRANKSHAFT BALANCER INSTALLATION

Tools Required

- **EN 47699** Flywheel Holding Tool. See **Special Tools**.
- **J 41478** Crankshaft Front Oil Seal Installer. See **Special Tools**.
- **J 41665** Crankshaft Balancer and Sprocket Installer. See **Special Tools**.
- **J 45059** Angle Meter

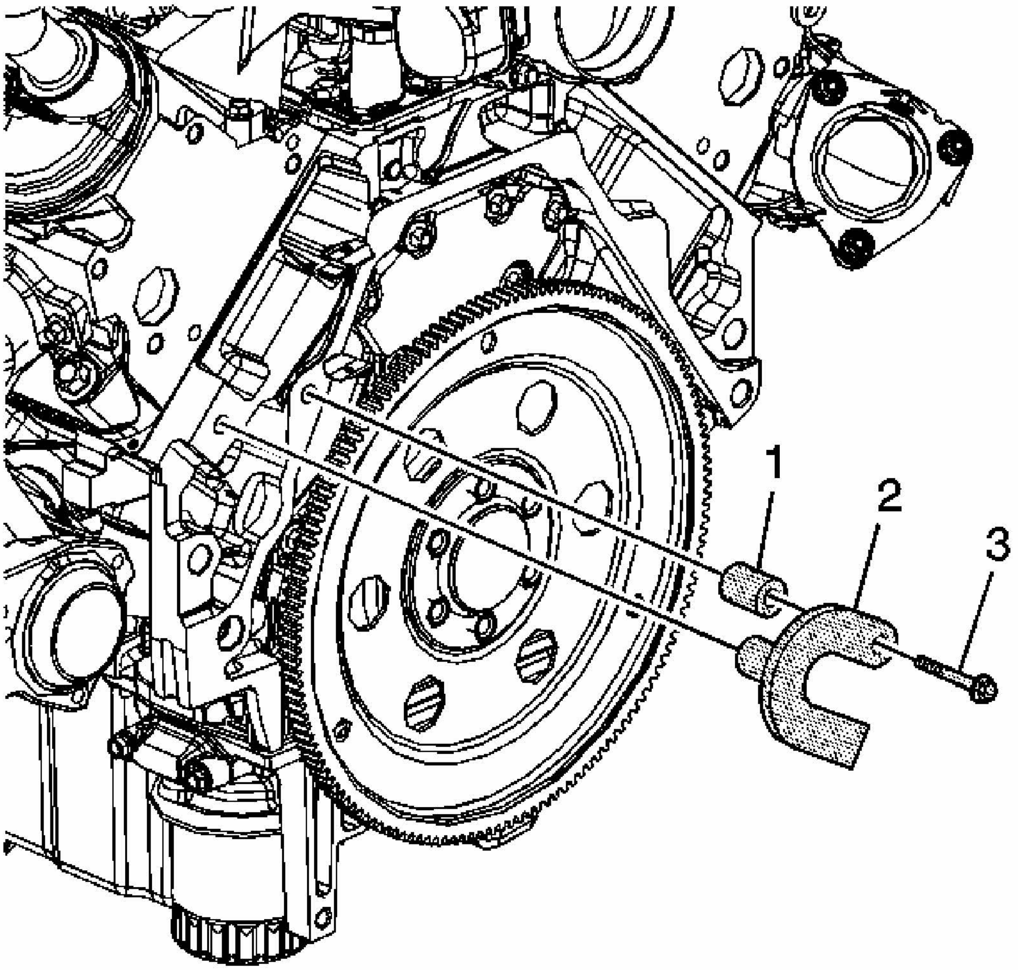


Fig. 683: Identifying Flywheel Holding Tool
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT:

- **The crankshaft balancer is balanced as an individual component. It is not necessary to mark the balancer prior to removal.**
- **The crankshaft balancer installation and bolt tightening involves a 4 stage tightening process. The first pass ensures that the balancer is installed completely onto the crankshaft. The second, third and fourth passes tighten the NEW bolt to the proper torque.**

- **The used crankshaft balancer bolt is used only during the first pass of the balancer installation procedure. Install a NEW crankshaft balancer bolt and tighten as described in the second, third and fourth passes of the balancer bolt tightening procedure.**
- **Ensure the teeth of the tool engage the engine flywheel teeth.**

1. Install the **EN 47699** (2), spacer (1), and bolt (3) to the block and flywheel. See **Special Tools**.

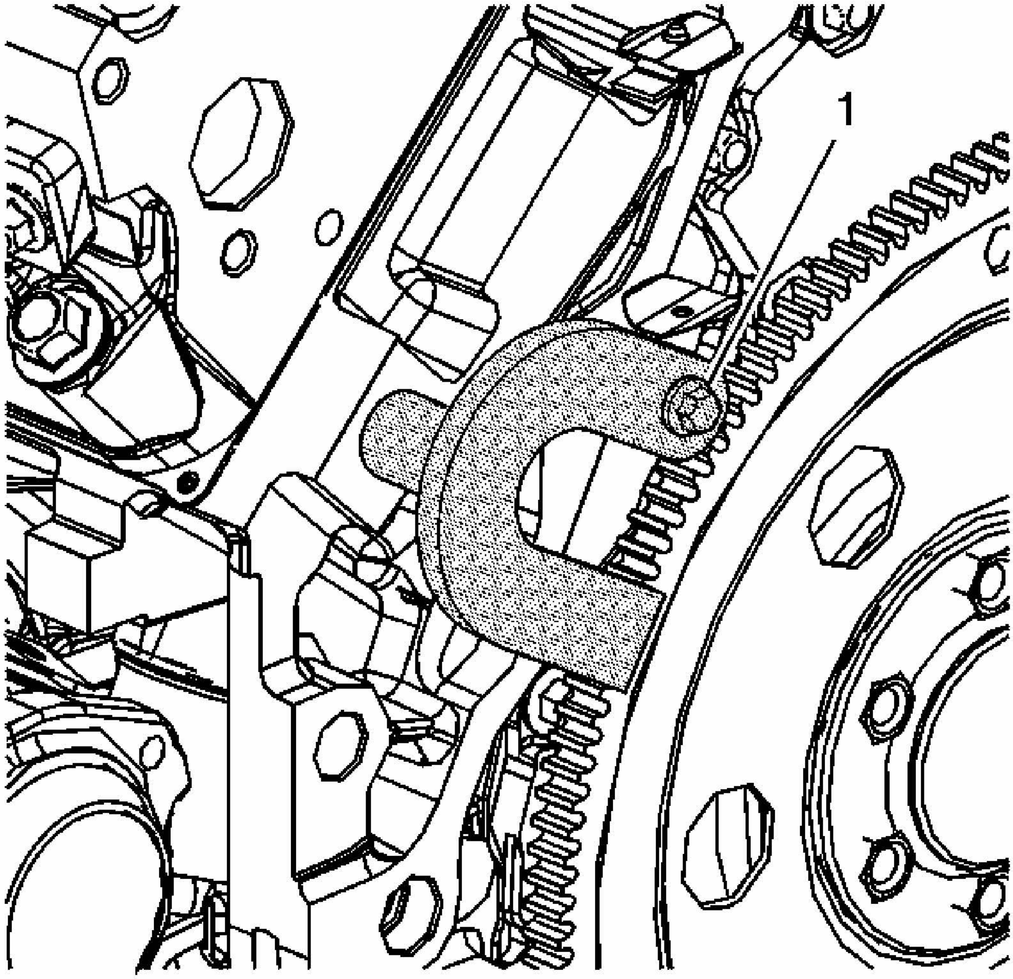


Fig. 684: Identifying Flywheel Holding Tool
Courtesy of GENERAL MOTORS CORP.

2. Tighten the **EN 47699** bolt (1). See **Special Tools**.

   Tighten: Tighten the bolt to 60 N.m (44 lb ft).

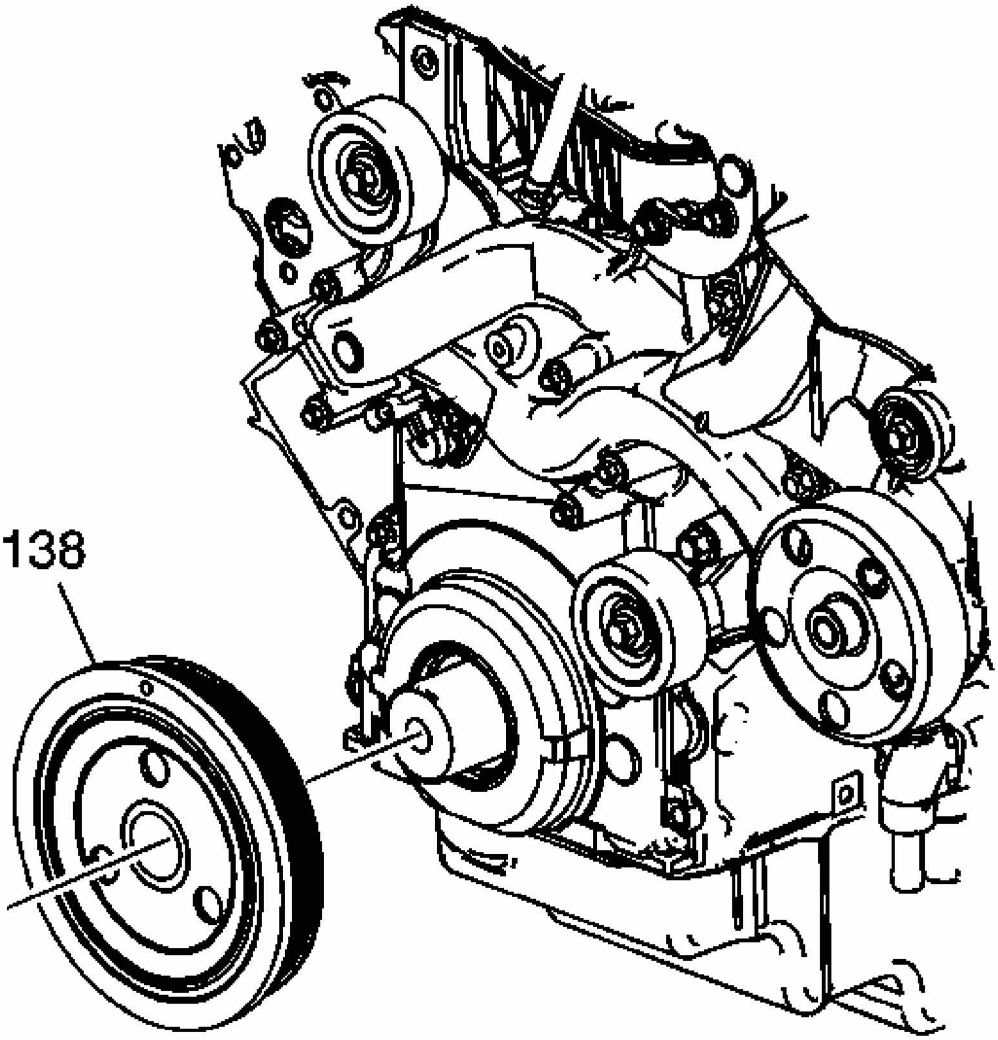


Fig. 685: View Of Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The balancer should be positioned onto the end of the crankshaft as straight as possible prior to tool installation.

3. Position the balancer (138) onto the end of the crankshaft.

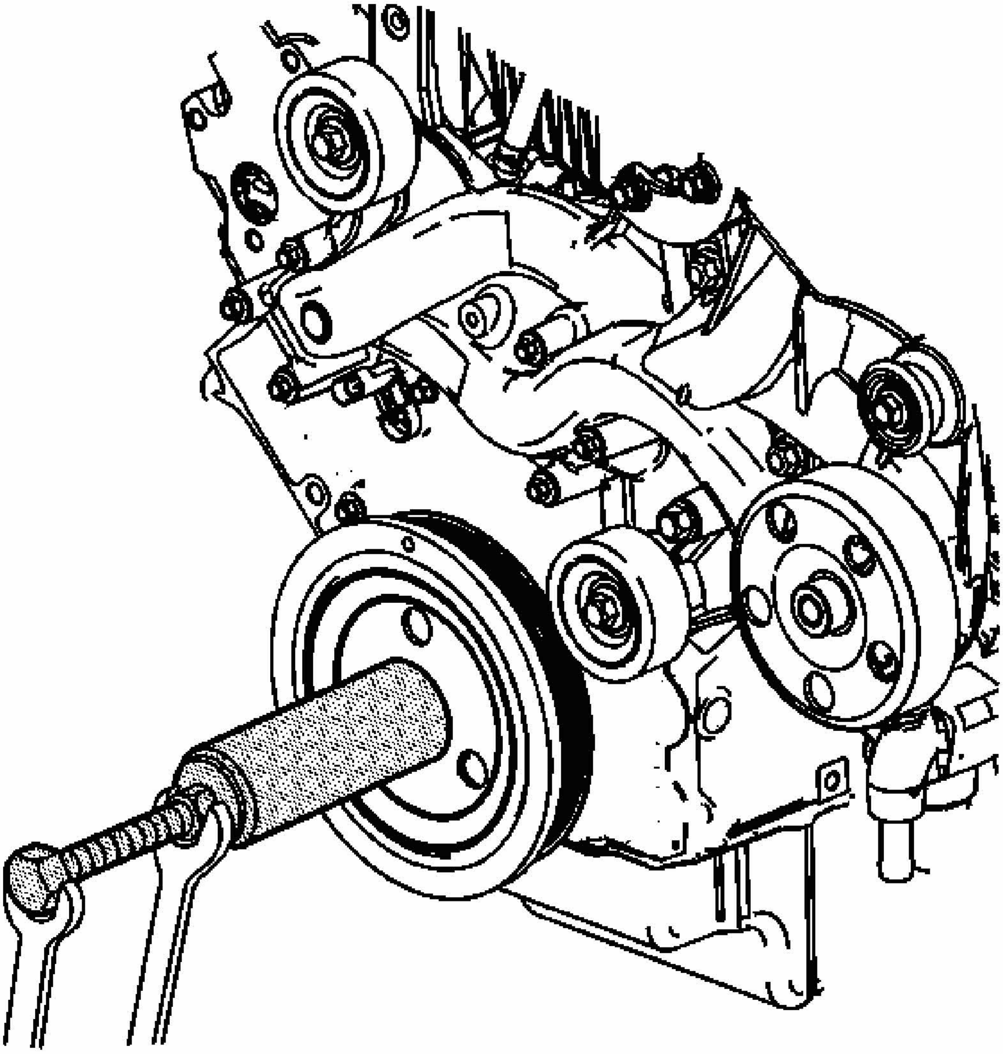


Fig. 686: Using Special Tools To Install Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

4. Use the **J 41478** and the **J 41665** in order to install the balancer. See **Special Tools**.
    1. Assemble the **J 41478** threaded rod, nut, washer and **J 41665** installer. See **Special Tools**.

        Insert the smaller end of the installer into the front of the balancer.

    2. Use a wrench and hold the hex end of the threaded rod.
    3. Use a second wrench and rotate the installation tool nut clockwise until the balancer is started onto the crankshaft.

4. Remove the tool and reverse the installation tool.

   Position the larger end of the installer against the front of the balancer.

5. Use a wrench and hold the hex end of the threaded rod.
6. Use a second wrench and rotate the installation tool nut clockwise until the balancer is installed onto the crankshaft.
7. Remove the balancer installation tools.

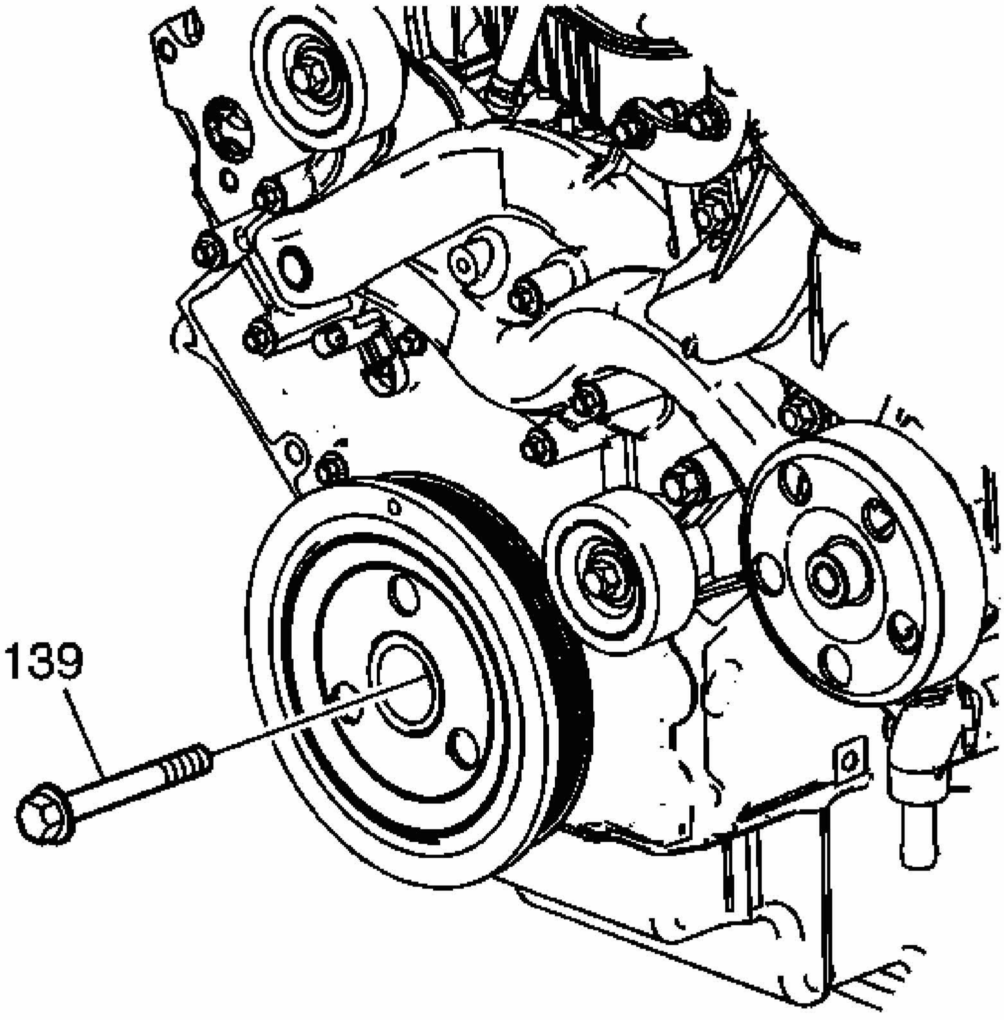


Fig. 687: View Of Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

5. Install the used crankshaft balancer bolt (139).

Tighten: Tighten the crankshaft balancer bolt to 330 N.m (240 lb ft).

6. Remove the used crankshaft balancer bolt (139).

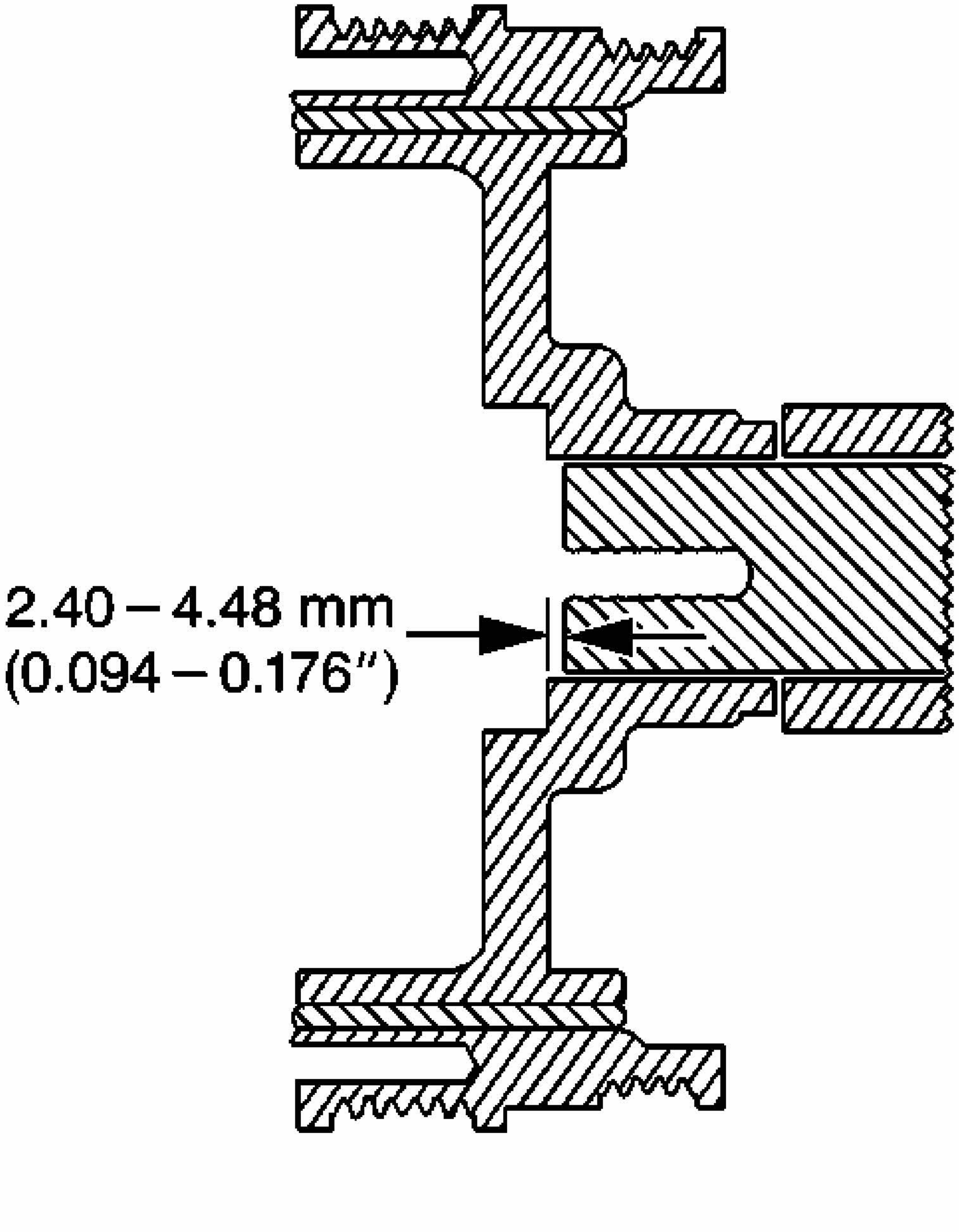


Fig. 688: Identifying Hub To Crankshaft Distance
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The nose of the crankshaft should be recessed 2.4-4.48 mm (0.094-0.176 in) into the balancer bore.

7. Measure for a correctly installed balancer.

   If the balancer is not installed to the proper dimensions, install the **J 41665** and repeat the installation procedure. See **Special Tools**.

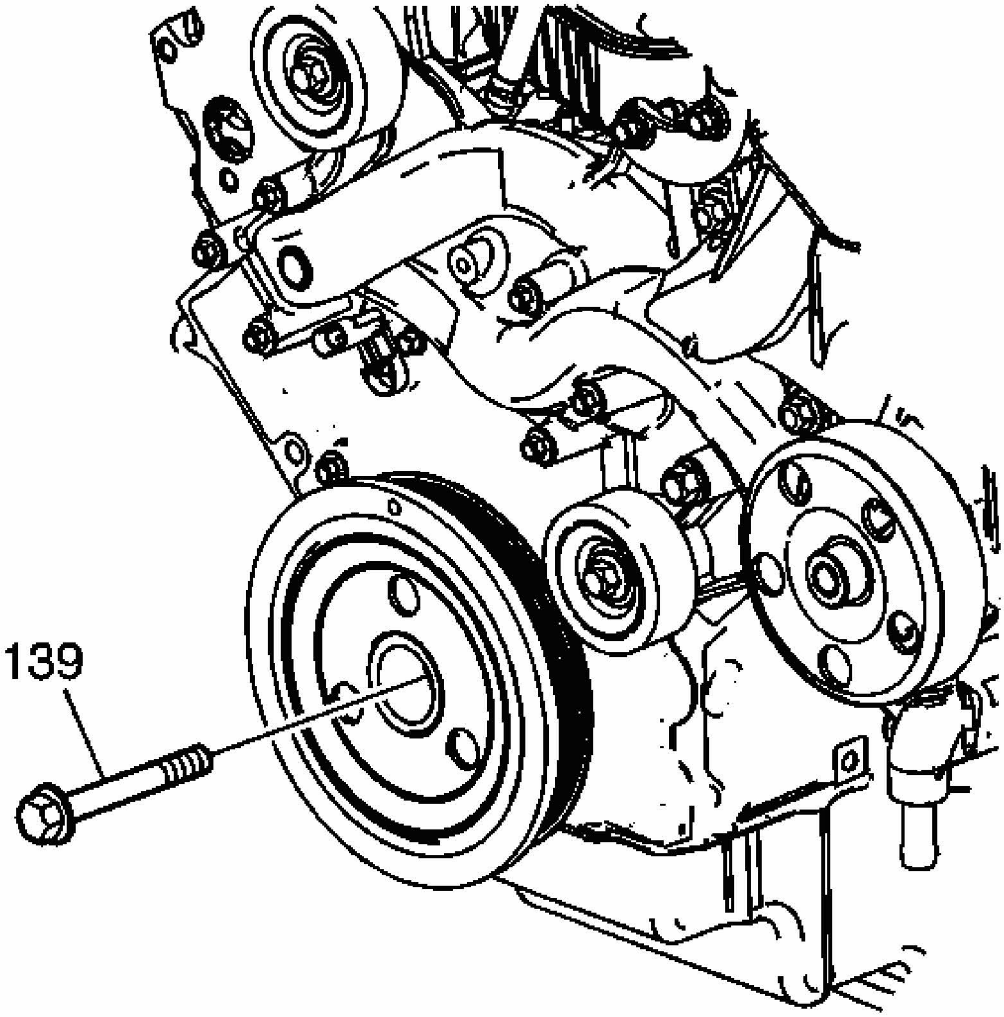


Fig. 689: View Of Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

8. Install the NEW crankshaft balancer bolt.

   Tighten:

   1. Tighten the crankshaft balancer bolt a first pass to 50 N.m (37 lb ft).
   2. Tighten the crankshaft balancer bolt a second pass to 140 degrees using the **J**

45059 .

9. Remove the **EN 47699** , spacer, and bolt. See **Special Tools**.

ENGINE PRELUBING

Tools Required

J 45299 Engine Preluber

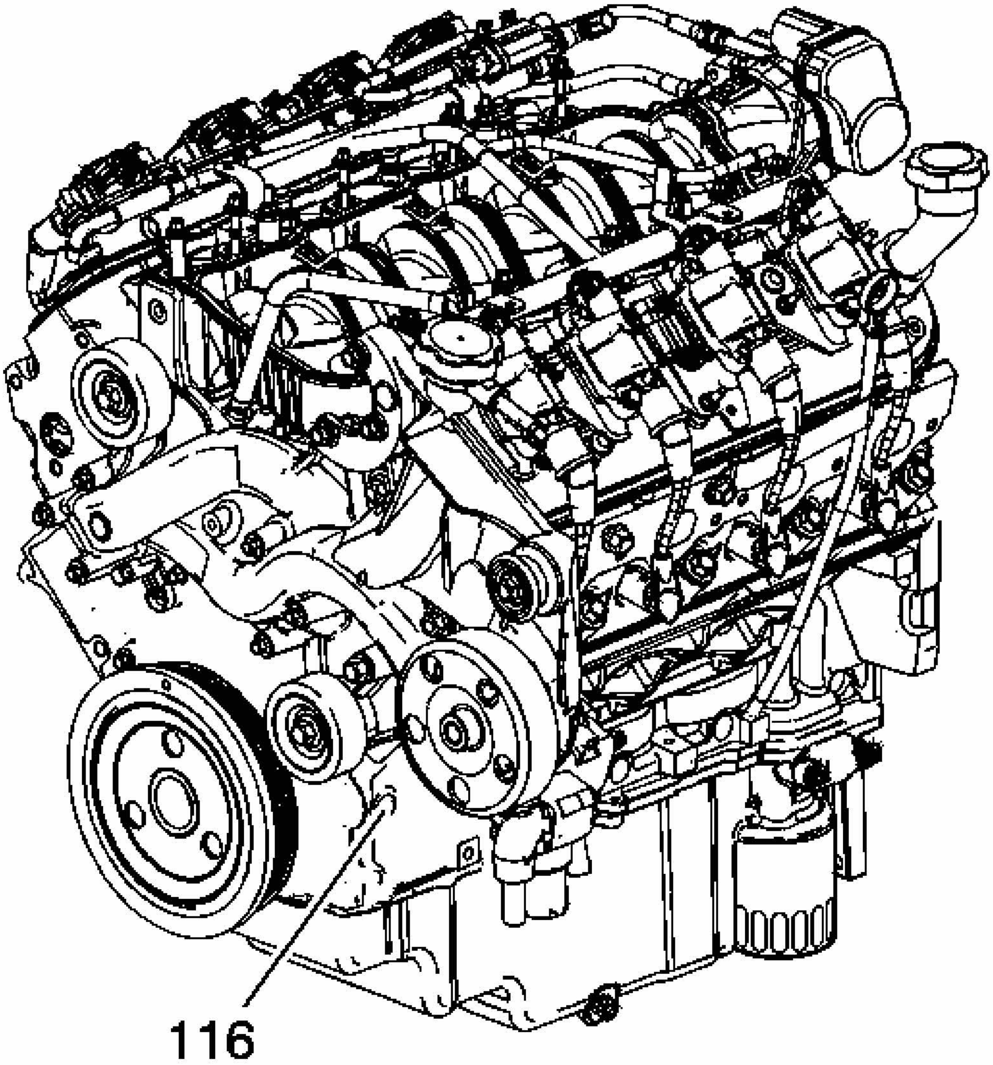


Fig. 690: Locating Engine Block Left Front Oil Gallery Plug
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: A constant and continuous flow of clean engine oil is required in order to properly prime the engine. Be sure to use an approved engine oil as specified in the owners manual.

1. Remove the engine oil filter and fill with clean engine oil.

   NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the oil filter.

   Tighten: Tighten the oil filter to 30 N.m (22 lb ft).

3. Locate the engine block left front oil gallery plug (116).
4. Install the M16 x 1.5 adapter P/N 509375.

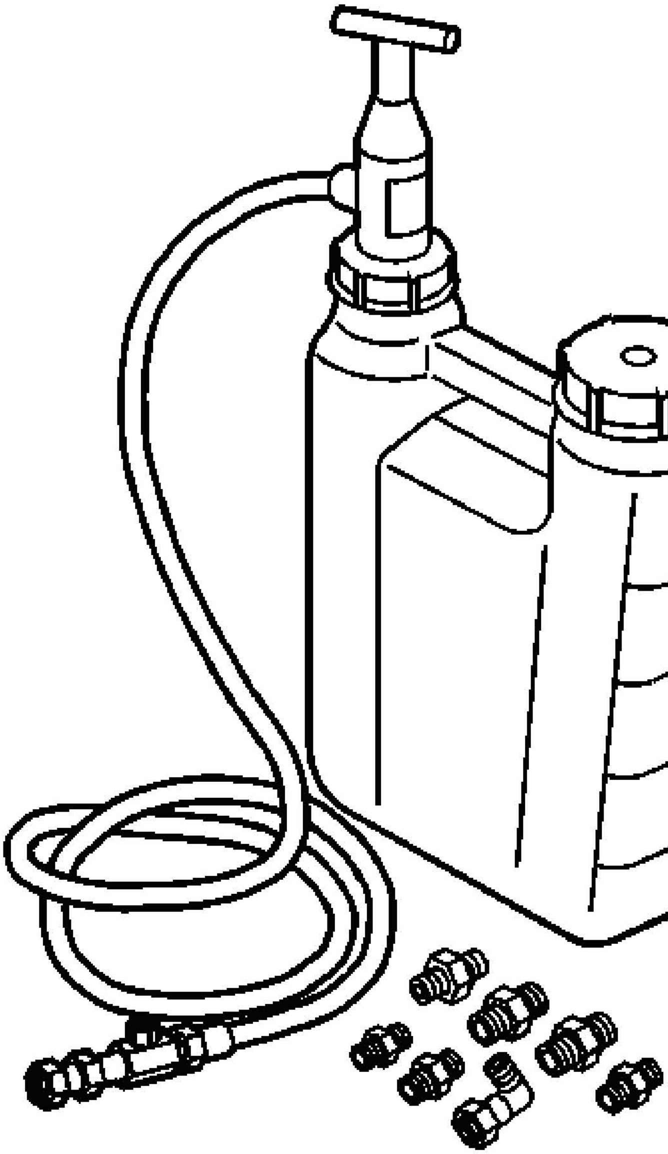


Fig. 691: Identifying Engine Preluber J 45299
Courtesy of GENERAL MOTORS CORP.

5. Install the flexible hose to the adapter and open the valve.
6. Pump the handle on the **J 45299** in order to flow a minimum of 1-1.9 liters (1-2 quarts) engine oil. Observe the flow of engine oil through the flexible hose and into the engine assembly.
7. Close the valve and remove the flexible hose and adapter from the engine.

8. Install the gallery plug to the engine.

   Tighten: Tighten the oil gallery plug to 60 N.m (44 lb ft).

9. Top-off the engine oil to the proper level.

DESCRIPTION AND OPERATION

CRANKCASE VENTILATION SYSTEM DESCRIPTION

A closed crankcase ventilation system is used in order to provide a more complete scavenging of crankcase vapors. Fresh air from the throttle body is supplied to the crankcase, mixed with blow-by gases, and then passed through a crankcase ventilation pipe/passage into the intake manifold.

Results of Incorrect Operation

A plugged PCV Pipe/passage way may cause:

- Rough idle
- Stalling or slow idle speed
- Oil leaks
- Sludge in engine

DRIVE BELT SYSTEM DESCRIPTION

The drive belt system consists of the following components:

- The drive belt
- The drive belt tensioner
- The drive belt idler pulley
- The crankshaft balancer pulley
- The accessory drive component mounting brackets
- The accessory drive components
  - The power steering pump, if belt driven
  - The generator
  - The A/C compressor, if equipped
  - The engine cooling fan, if belt driven
  - The water pump, if belt driven
  - The vacuum pump, if equipped
  - The air compressor, if equipped

The drive belt system may use 1 belt or 2 belts. The drive belt is thin so that it can bend backwards and has several ribs to match the grooves in the pulleys. The drive belts are made of different types of rubbers, chloroprene or EPDM, and have different layers or plys containing either fiber cloth or cords for reinforcement.

Both sides of the drive belt may be used to drive the different accessory drive components. When the back side of the drive belt is used to drive a pulley, the pulley is smooth.

The drive belt is pulled by the crankshaft balancer pulley across the accessory drive component pulleys. The spring loaded drive belt tensioner keeps constant tension on the drive belt to prevent the drive belt from slipping. The drive belt tensioner arm will move when loads are applied to the drive belt by the accessory drive components and the crankshaft.

The drive belt system may have an idler pulley, which is used to add wrap to the adjacent pulleys. Some systems use an idler pulley in place of an accessory drive component when the vehicle is not equipped with the accessory.

ENGINE COMPONENT DESCRIPTION

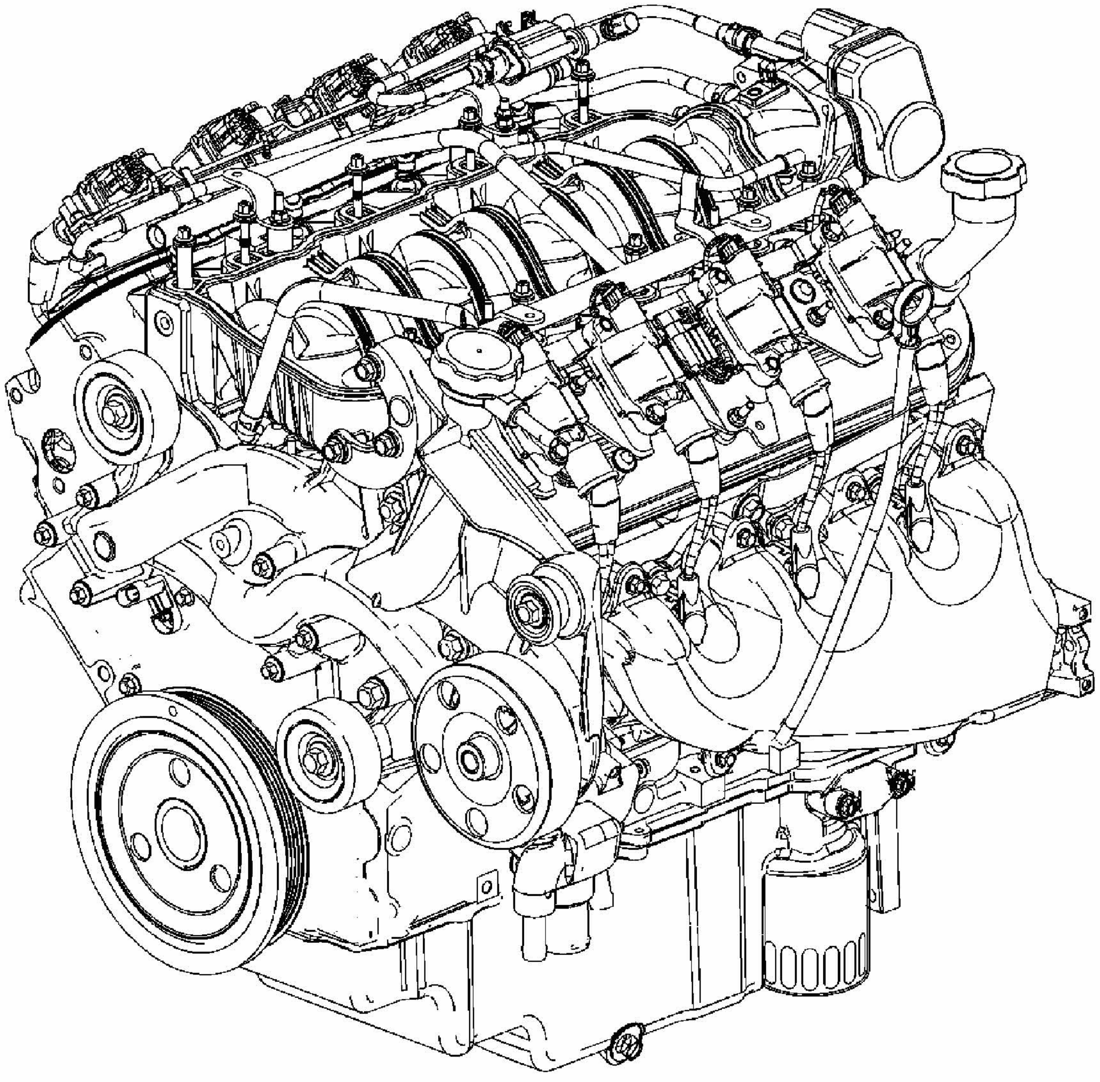


Fig. 692: The 5.3 Liter V8 Engine
Courtesy of GENERAL MOTORS CORP.

The 5.3 Liter V8 engine is identified as RPO LS4 VIN C.

Camshaft and Drive System

A billet steel 1 piece camshaft is supported by 5 bearings pressed into the engine block. The camshaft timing sprocket is mounted to the front of the camshaft and is driven by the crankshaft sprocket through the camshaft timing chain. The camshaft position (CMP) sensor lobes are incorporated into the front face of the camshaft sprocket with the CMP sensor mounted in the engine front cover. A timing chain dampener is mounted to the front of the engine block above the crankshaft sprocket. The externally splined crankshaft sprocket is positioned to the crankshaft by a key and keyway. The crankshaft sprocket external splines drive the oil pump drive gear. A retaining plate mounted to the front of the engine block maintains camshaft location.

Crankshaft

The crankshaft is cast nodular iron. The crankshaft is supported by 5 crankshaft bearings. The bearings are retained by crankshaft bearing caps which are machined with the engine block for proper alignment and clearance. The crankshaft journals are undercut and rolled. The center main journal is the thrust journal. A crankshaft position (CKP) reluctor ring is press fit mounted at the rear of the crankshaft. The reluctor ring is not serviceable separately.

Cylinder Heads

The cylinder heads are cast aluminum and have pressed in place powdered metal valve guides and valve seats. Passages for the engine coolant air bleed system are at the front of each cylinder head. The valve rocker arm covers are retained to the cylinder heads by 4 center mounted rocker arm cover bolts.

Engine Block

The engine block is a cam-in-block deep skirt 90 degree V configuration with 5 crankshaft bearing caps. The engine block is cast aluminum. The 5 crankshaft bearing caps each have 4 vertical M10 and 2 horizontal M8 mounting bolts. The camshaft is supported by 5 camshaft bearings pressed into the block.

Exhaust Manifolds

The exhaust manifolds are a 1 piece cast iron design. The exhaust manifolds direct exhaust gasses from the combustion chambers to the exhaust system. Each manifold also has an externally mounted heat shield that is retained by bolts.

Intake Manifold

The intake manifold is a 1 piece composite design that incorporates brass threaded inserts for mounting the fuel rail and throttle body. Each side of the intake manifold is sealed to the cylinder head by 8 non-reusable silicone sealing gaskets. The electronically actuated throttle body bolts to the front of the intake manifold. The throttle body is sealed by a 1 piece push in place silicone gasket. The fuel rail assembly, with 8 separate fuel injectors, is retained to the intake by 4 bolts. The injectors are seated into their individual manifold bores with O-ring seals to provide sealing. The manifold absolute pressure (MAP) sensor is installed and retained to the top of the intake manifold and sealed by an O-ring seal. The evaporative emission (EVAP) canister purge solenoid valve is retained to the manifold by a mounting bracket. There are no coolant passages within the intake manifold. The manifold is installed with the throttle body facing the rear of the engine.

Oil Pan

The structural rear-sump oil pan is cast aluminum. Incorporated into the design is the oil filter mounting boss, the displacement on demand (DoD) oil pressure relief valve and the drain plug opening. Filtered oil is returned to the engine block through the oil filter to the engine block upper oil galleries. The press-fit oil pressure relief valve is located at the left rear of the oil pan and can be inspected by removing the oil pan cover. The alignment of the structural oil pan to the rear of the engine block and transmission bell housing is critical.

Piston and Connecting Rod Assembly

The pistons are cast aluminum. The pistons use 2 compression rings and 1 oil control ring assembly. The piston is a low friction, lightweight design with a flat or recessed top and barrel shaped skirt. The piston pins are chromium steel and are a full-floating design. The connecting rods are powdered metal. The connecting rods are fractured at the connecting rod journal and then machined for the proper clearance. All applications use a piston with a graphite coated skirt. The piston and pin are to be serviced as an assembly.

Valve Rocker Arm Cover Assemblies

The valve rocker arm covers are cast aluminum and use a pre-molded silicon gasket for sealing. Mounted to each rocker cover are the coil and bracket assemblies. Incorporated into the left cover is the oil fill tube and the positive crankcase ventilation (PCV) fresh air passage. Incorporated into the right cover is the PCV system dirty air passage.

Valve Train

Motion is transmitted from the camshaft through the hydraulic roller valve lifters and tubular pushrods to the roller type rocker arms. The nylon valve lifter guides position and retain the valve lifters. The valve rocker arms for each bank of cylinders are mounted on pedestals or pivot supports. Each rocker arm is retained on the pivot support and cylinder head by a bolt. Valve lash is net build. Cylinders 1, 4, 6, and 7 are displacement on demand. Refer to **Displacement on Demand (DoD) System Description**.

DISPLACEMENT ON DEMAND (DOD) SYSTEM DESCRIPTION

System Operation

General Motors Displacement on Demand® (DoD) engine control system has the ability, under certain light load driving conditions, to provide maximum fuel economy by deactivating 4 of the engines 8 cylinders. The engine will normally operate on 8 cylinders in V8 mode during, starting, idling, and medium or heavy throttle conditions. When commanded ON, the powertrain control module (PCM) will direct the DoD system and deactivate cylinders 1 and 7 on the left bank and cylinders 4 and 6 on the right bank, forcing V4 mode. Refer to **Lubrication Description (Main Pressure Below 65 psi - DoD Off)** or **Lubrication Description (Main Pressure Above 65 psi - DoD Off)** or **Lubrication Description (Main Pressure Below 65 psi - DoD On)** or **Lubrication Description (Main Pressure Above 65 psi - DoD On)** and **Displacement on Demand (DoD) System Description** in Engine Controls - 5.3L.

Valve Lifter Oil Manifold Assembly

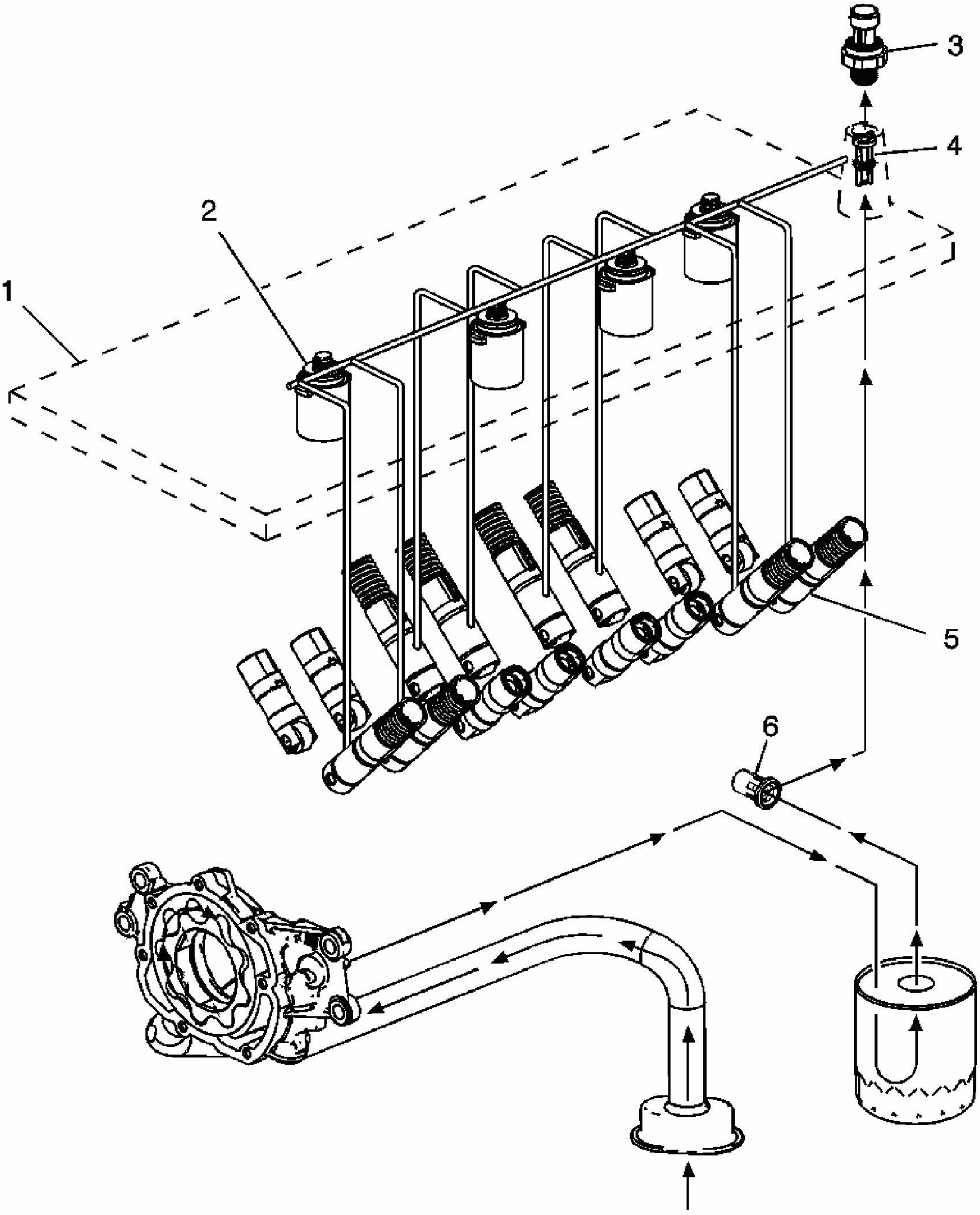


Fig. 693: View Of Valve Lifter Oil Manifold Assembly
Courtesy of GENERAL MOTORS CORP.

The valve lifter oil manifold (VLOM) assembly (1) is bolted to the top of the engine block beneath the intake manifold assembly. The oil manifold consists of 4 electrically operated and normally-closed solenoids (2). Each solenoid directs the flow of pressurized engine oil to the DoD intake and exhaust valve lifters (5). The oil pressure relief valve (6), located in the left rear area of the oil pan, regulates engine oil pressure to the lubrication system and the oil manifold.

When enabling conditions are met for DoD operation, the ECM will ground each solenoid control circuit in firing order sequence, allowing current to flow through the solenoid windings. With the windings energized, the solenoid valves open and direct pressurized engine oil through the manifold into 8 vertical passages in the engine block lifter valley. The 8 vertical passages, 2 per cylinder, direct pressurized oil to the valve lifter bores of the cylinders to be deactivated. When vehicle operating conditions require a return to V8 mode, the ECM will turn OFF the ground circuit for the solenoids, allowing the solenoid valves to close. When the solenoid valves are closed, remaining oil pressure is exhausted through the bleed passages of the manifold into the engine block lifter valley. The housing of the oil manifold incorporates several oil bleed passages that continually purge trapped air from the manifold and engine block.

To help control contamination within the DoD hydraulic system, a small replaceable oil filter (4) is located in the manifold oil inlet passage. The oil pressure sensor (3) monitors engine oil pressure and provides information to the ECM.

Displacement on Demand Valve Lifters

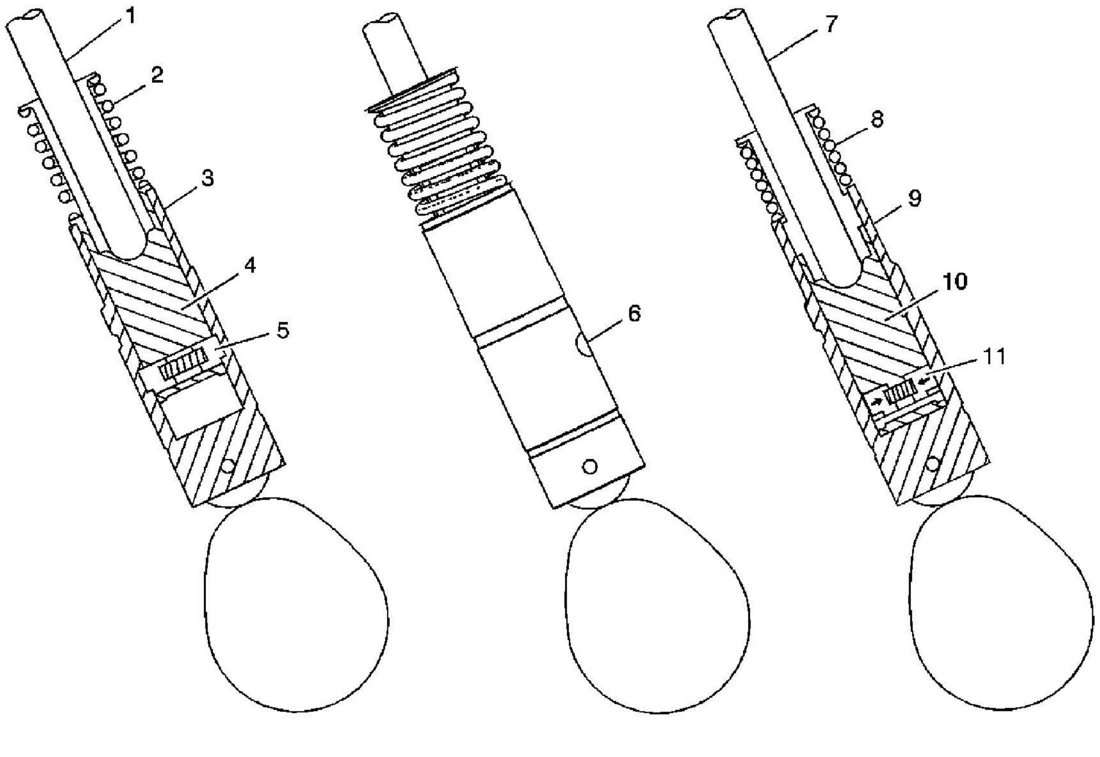


Fig. 694: Displacement On Demand Valve Lifters
Courtesy of GENERAL MOTORS CORP.

When operating in V8 mode, the DoD valve lifters function similar to the non-DoD valve lifters. The DoD oil manifold solenoids are in the closed position with no pressurized oil directed to the valve lifters. The pushrod (1) travels upward and downward to actuate the rocker arm and valve. The spring loaded locking pins (5) of the lifter are extended outward and mechanically lock the pin housing (4) to the outer body of the valve lifter (3).

When the DoD system is commanded ON, the ECM will direct the solenoids of the oil manifold to open and direct pressurized oil to the valve lifters. Oil travels through the manifold and engine block oil galleries and enters the inlet port (6) of the valve lifter.

When operating in V4 mode, pressurized oil forces the locking pins (11) inward. The pushrod (7) remains in a constant position and does not travel upward and downward. The outer body of the lifter (9) moves upward and downward independently from the pin housing (10). The valve lifter spring (8) retains tension on the valve train components to eliminate valve train noise.

When the DoD system is commanded OFF, the ECM directs the solenoids of the oil manifold to close, stopping the flow of pressurized oil to the valve lifters. The oil pressure within the lifter will decrease and the locking pins will move outward to mechanically lock the pin housing and outer body.

Engine Block

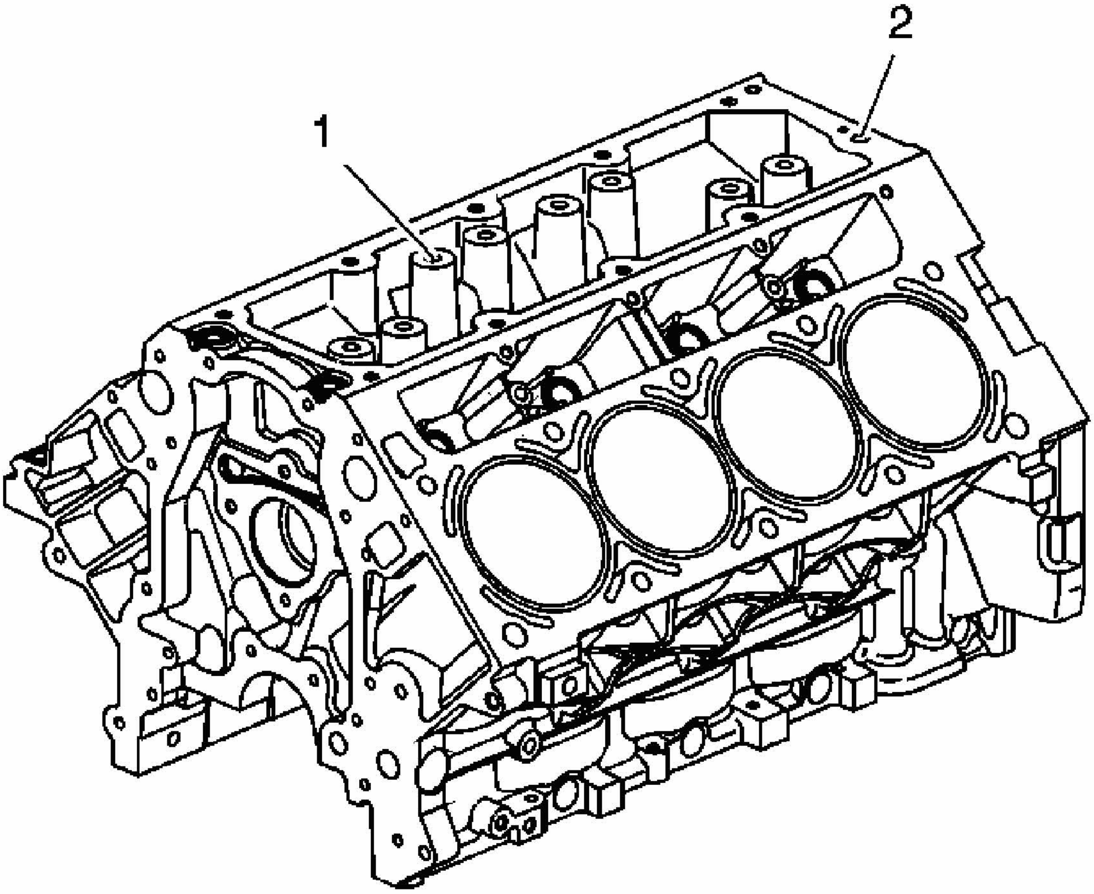


Fig. 695: DOD Engine Block
Courtesy of GENERAL MOTORS CORP.

The DoD engine block incorporates additional features to support DoD system operation. Engine oil pressure is routed to the manifold assembly from an oil gallery (2) in the rear of the cylinder block. Cylinders 1, 4, 6, and 7 each have 2 vertical, cast-in-block oil passages (1). The vertical oil passages permit oil flow from the manifold assembly to the valve lifter bores.

Powertrain Control Module (PCM)

Refer to **Displacement on Demand (DoD) System Description** in Engine Controls - 5.3L.

LUBRICATION DESCRIPTION (MAIN PRESSURE BELOW 65 PSI - DOD OFF)

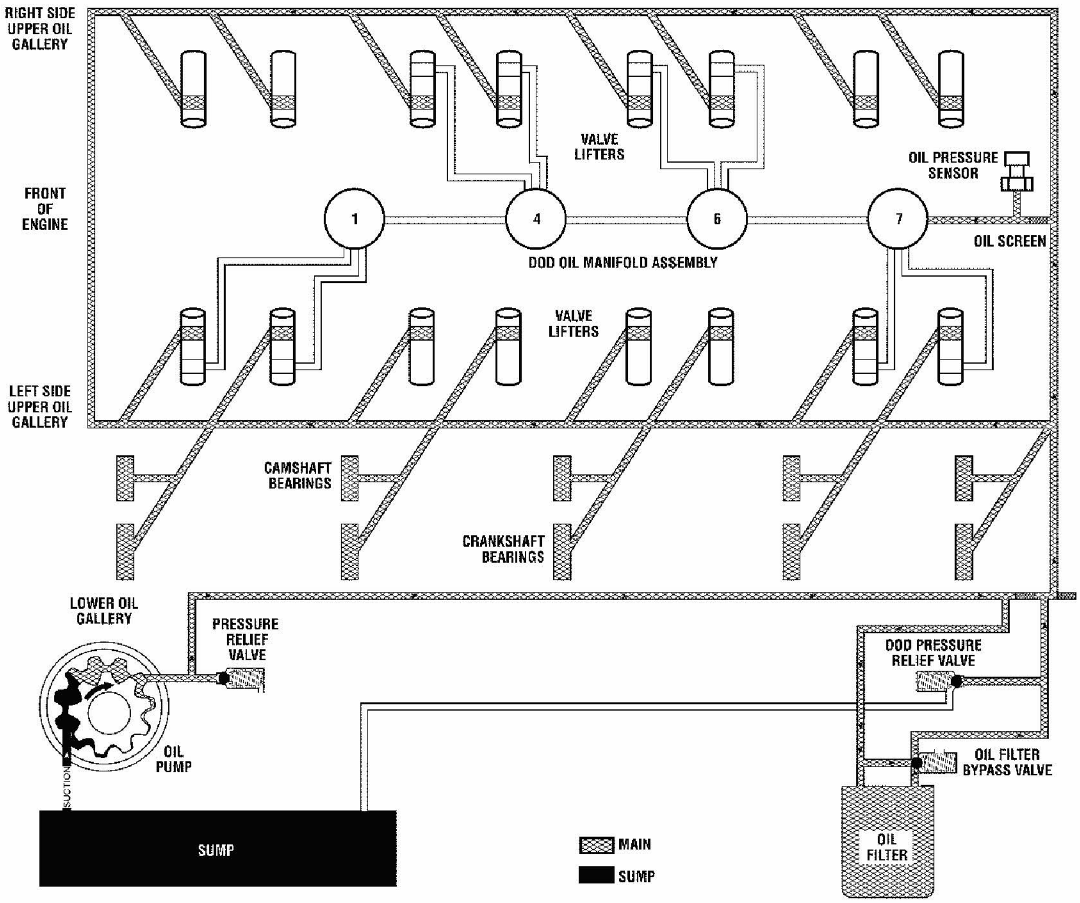

RIGHT SIDE UPPER OIL GALLERY
VALVE LIFTERS
OIL PRESSURE SENSOR
FRONT OF ENGINE
1
4
6
7
DOD OIL MANIFOLD ASSEMBLY
OIL SCREEN
VALVE LIFTERS
LEFT SIDE UPPER OIL GALLERY
CAMSHAFT BEARINGS
CRANKSHAFT BEARINGS
LOWER OIL GALLERY
PRESSURE RELIEF VALVE
DOD PRESSURE RELIEF VALVE
OIL PUMP
SUCTION
OIL FILTER BYPASS VALVE
SUMP
▨ MAIN
■ SUMP
OIL FILTER

Fig. 696: Lubrication Description (Main Pressure Below 65 psi - DoD Off)
Courtesy of GENERAL MOTORS CORP.

Engine lubrication is supplied by a gerotor type oil pump assembly. The pump is mounted on the front of the engine block and driven directly by the crankshaft sprocket. The pump gears rotate and draw oil from the oil pan sump through a pick-up screen and pipe. The oil is pressurized as it passes through the pump and is sent through the engine block lower oil gallery. Contained within the oil pump assembly is a pressure relief valve that maintains oil pressure within a specified range.

Pressurized oil is directed through the engine block lower oil gallery to the full flow oil filter where harmful contaminants are removed. A bypass valve is incorporated into the oil pan at the oil filter boss, which permits oil flow in the event the filter becomes restricted. A second valve, the displacement on demand (DoD) oil pressure relief valve is incorporated into the left rear side of the oil pan. The DoD oil pressure relief valve limits oil pressure directed to the upper oil galleries and oil manifold assembly to 448 kPa (65 psi) at 3,000 RPM and 21°C (70°F).

Oil is then directed from the filter to the upper main oil galleries and the DoD manifold assembly. Oil from the left upper oil gallery is directed to the crankshaft and camshaft bearings. Oil that has entered both the upper main oil galleries also pressurizes the valve lifter assemblies and is then pumped through the pushrods to lubricate the valve rocker arms and valve stems. Oil returning to the pan is directed by the crankshaft oil deflector. The oil pressure sensor is located at the top rear of the engine. Refer to **Displacement on Demand (DoD) System Description**.

LUBRICATION DESCRIPTION (MAIN PRESSURE ABOVE 65 PSI - DOD OFF)

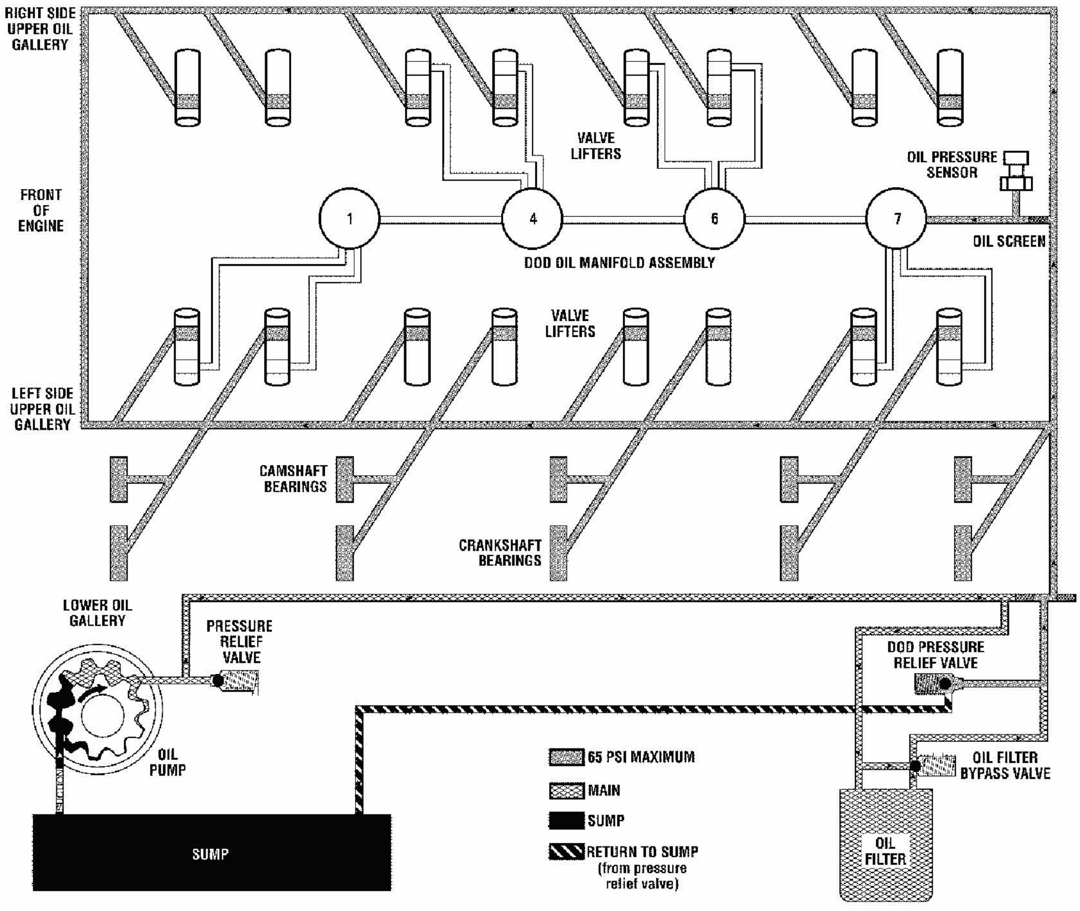

RIGHT SIDE UPPER OIL GALLERY
VALVE LIFTERS
OIL PRESSURE SENSOR
FRONT OF ENGINE
1
4
6
7
OIL SCREEN
DOD OIL MANIFOLD ASSEMBLY
VALVE LIFTERS
LEFT SIDE UPPER OIL GALLERY
CAMSHAFT BEARINGS
CRANKSHAFT BEARINGS
LOWER OIL GALLERY
PRESSURE RELIEF VALVE
DOD PRESSURE RELIEF VALVE
OIL PUMP
SUCTION
OIL FILTER BYPASS VALVE
65 PSI MAXIMUM
MAIN
SUMP
RETURN TO SUMP (from pressure relief valve)
SUMP
OIL FILTER

Fig. 697: Lubrication Description (Main Pressure Above 65 psi - DoD Off)
Courtesy of GENERAL MOTORS CORP.

Engine lubrication is supplied by a gerotor type oil pump assembly. The pump is mounted on the front of the engine block and driven directly by the crankshaft sprocket. The pump gears rotate and draw oil from the oil pan sump through a pick-up screen and pipe. The oil is pressurized as it passes through the pump and is sent through the engine block lower oil gallery. Contained within the oil pump assembly is a pressure relief valve that maintains oil pressure within a specified range.

Pressurized oil is directed through the engine block lower oil gallery to the full flow oil filter where harmful contaminants are removed. A bypass valve is incorporated into the oil pan at the oil filter boss, which permits oil flow in the event the filter becomes restricted. A second valve, the displacement on demand (DoD) oil pressure relief valve is incorporated into the left rear side of the oil pan. The DoD oil pressure relief valve limits oil pressure directed to the upper oil galleries and oil manifold assembly to 448 kPa (65 psi) at 3,000 RPM and 21°C (70°F). When main oil pressure exceeds 448 kPa (65 psi), the DoD oil pressure relief valve exhausts excess oil to the sump.

Oil is then directed from the filter to the upper main oil galleries and the DoD manifold assembly. Oil from the left upper oil gallery is directed to the crankshaft and camshaft bearings. Oil that has entered both the upper main oil galleries also pressurizes the valve lifter assemblies and is then pumped through the pushrods to lubricate the valve rocker arms and valve stems. Oil returning to the pan is directed by the crankshaft oil deflector. The oil pressure sensor is located at the top rear of the engine. Refer to **Displacement on Demand (DoD) System Description**.

LUBRICATION DESCRIPTION (MAIN PRESSURE BELOW 65 PSI - DOD ON)

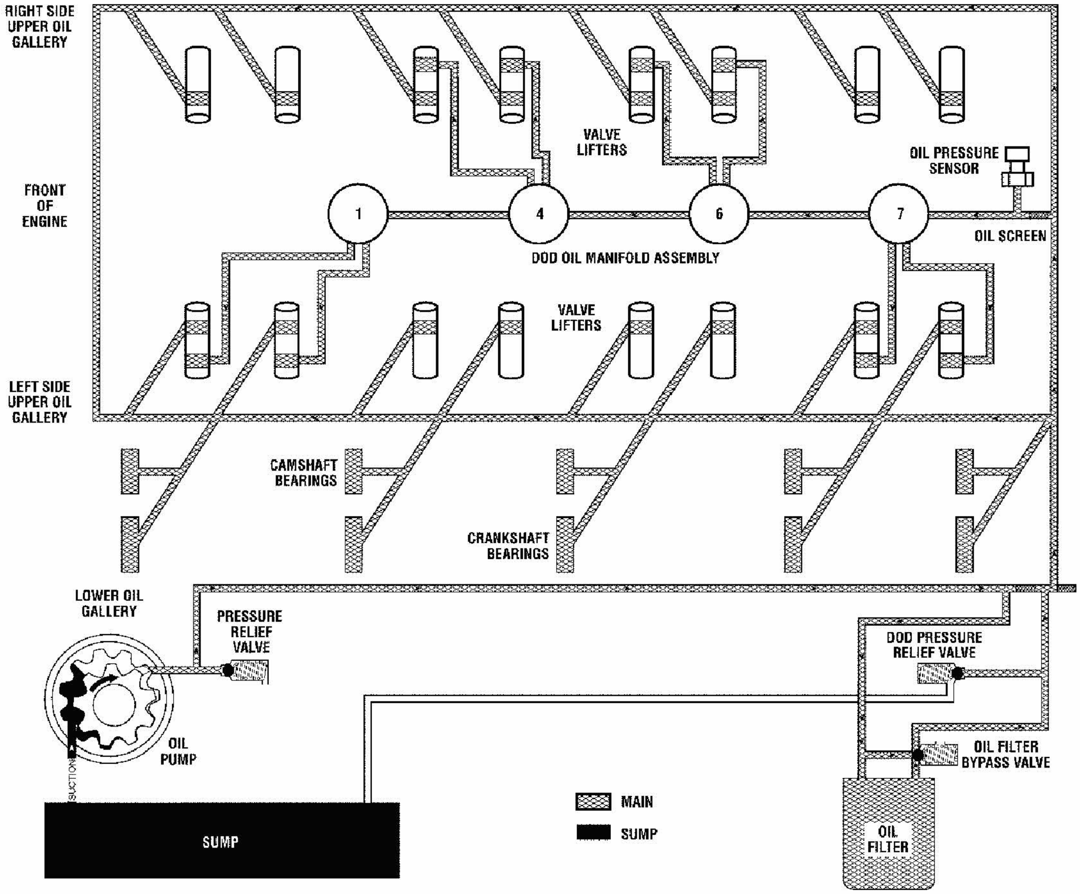

RIGHT SIDE UPPER OIL GALLERY
VALVE LIFTERS
OIL PRESSURE SENSOR
FRONT OF ENGINE
1
4
6
7
OIL SCREEN
DOD OIL MANIFOLD ASSEMBLY
VALVE LIFTERS
LEFT SIDE UPPER OIL GALLERY
CAMSHAFT BEARINGS
CRANKSHAFT BEARINGS
LOWER OIL GALLERY
PRESSURE RELIEF VALVE
DOD PRESSURE RELIEF VALVE
OIL FILTER BYPASS VALVE
OIL PUMP
SUCTION
SUMP
MAIN
SUMP
OIL FILTER

Fig. 698: Lubrication Description (Main Pressure Below 65 psi - DoD On)
Courtesy of GENERAL MOTORS CORP.

Engine lubrication is supplied by a gerotor type oil pump assembly. The pump is mounted on the front of the engine block and driven directly by the crankshaft sprocket. The pump gears rotate and draw oil from the oil pan sump through a pick-up screen and pipe. The oil is pressurized as it passes through the pump and is sent through the engine block lower oil gallery. Contained within the oil pump assembly is a pressure relief valve that maintains oil pressure within a specified range.

Pressurized oil is directed through the engine block lower oil gallery to the full flow oil filter where harmful contaminants are removed. A bypass valve is incorporated into the oil pan at the oil filter boss, which permits oil flow in the event the filter becomes restricted. A second valve, the displacement on demand (DoD) oil pressure relief valve is incorporated into the left rear side of the oil pan. The DoD oil pressure relief valve limits oil pressure directed to the upper oil galleries and oil manifold assembly to 448 kPa (65 psi) at 3,000 RPM and 21°C (70°F).

Oil is then directed from the filter to the upper main oil galleries and the DoD manifold assembly. Oil from the left upper oil gallery is directed to the crankshaft and camshaft bearings. Oil that has entered both the upper main oil galleries also pressurizes the valve lifter assemblies and is then pumped through the pushrods to lubricate the valve rocker arms and valve stems. Oil returning to the pan is directed by the crankshaft oil deflector. The oil pressure sensor is located at the top rear of the engine.

With DoD activated, the ECM commands the 4 solenoids to open, directing oil through the engine block oil galleries to the intake and exhaust valve lifters for cylinders 1, 4, 6, and 7. Refer to **Displacement on Demand (DoD) System Description**.

LUBRICATION DESCRIPTION (MAIN PRESSURE ABOVE 65 PSI - DOD ON)

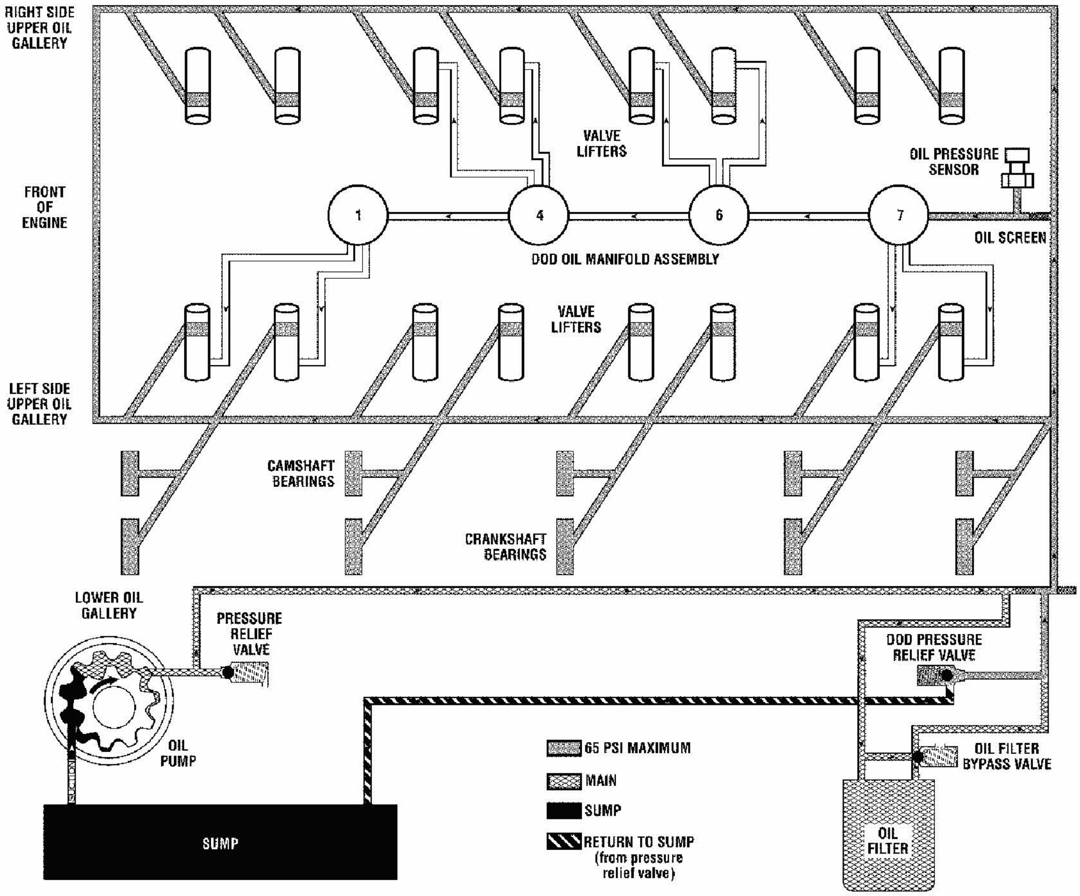

RIGHT SIDE UPPER OIL GALLERY
VALVE LIFTERS
OIL PRESSURE SENSOR
FRONT OF ENGINE
1
4
6
7
OIL SCREEN
DOD OIL MANIFOLD ASSEMBLY
VALVE LIFTERS
LEFT SIDE UPPER OIL GALLERY
CAMSHAFT BEARINGS
CRANKSHAFT BEARINGS
LOWER OIL GALLERY
PRESSURE RELIEF VALVE
DOD PRESSURE RELIEF VALVE
OIL PUMP
65 PSI MAXIMUM
MAIN
SUMP
RETURN TO SUMP (from pressure relief valve)
OIL FILTER BYPASS VALVE
SUMP
OIL FILTER

Fig. 699: Lubrication Description (Main Pressure Above 65 psi - DoD On)
Courtesy of GENERAL MOTORS CORP.

Engine lubrication is supplied by a gerotor type oil pump assembly. The pump is mounted on the front of the engine block and driven directly by the crankshaft sprocket. The pump gears rotate and draw oil from the oil pan sump through a pick-up screen and pipe. The oil is pressurized as it passes through the pump and is sent through the engine block lower oil gallery. Contained within the oil pump assembly is a pressure relief valve that maintains oil pressure within a specified range.

Pressurized oil is directed through the engine block lower oil gallery to the full flow oil filter where harmful contaminants are removed. A bypass valve is incorporated into the oil pan at the oil filter boss, which permits oil flow in the event the filter becomes restricted. A second valve, the displacement on demand (DoD) oil pressure relief valve is incorporated into the left rear side of the oil pan. The DoD oil pressure relief valve limits oil pressure directed to the upper oil galleries and oil manifold assembly to 448 kPa (65 psi) at 3,000 RPM and 21°C (70°F). When main oil pressure exceeds 448 kPa (65 psi), the DoD oil pressure relief valve exhausts excess oil to the sump.

Oil is then directed from the filter to the upper main oil galleries and the DoD manifold assembly. Oil from the left upper oil gallery is directed to the crankshaft and camshaft bearings. Oil that has entered both the upper main oil galleries also pressurizes the valve lifter assemblies and is then pumped through the pushrods to lubricate the valve rocker arms and valve stems. Oil returning to the pan is directed by the crankshaft oil deflector. The oil pressure sensor is located at the top rear of the engine.

With DoD activated, the ECM commands the 4 solenoids to open, directing oil through the engine block oil galleries to the intake and exhaust valve lifters for cylinders 1, 4, 6, and 7. Refer to **Displacement on Demand (DoD) System Description**.

CLEANLINESS AND CARE

- Throughout this information, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.
- When any internal engine parts are serviced, care and cleanliness is important.
- When components are removed for service, they should be marked, organized or retained in a specific order for assembly. Refer to **Separating Parts**.
- At the time of installation, components should be installed in the same location and with the same mating surface as when removed.
- An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in millimeters or thousandths of an inch. These surfaces should be covered or protected to avoid component damage.
- A liberal coating of clean engine oil should be applied to friction areas during assembly.
- Proper lubrication will protect and lubricate friction surfaces during initial operation.

SEPARATING PARTS

IMPORTANT:

- **Many internal engine components will develop specific wear patterns on their friction surfaces.**
- **When disassembling the engine, internal components MUST be separated, marked, or organized in a way to**

ensure installation to their original location and position.

Separate, mark, or organize the following components:

- Piston and the piston pin
- Piston to the specific cylinder bore
- Piston rings to the piston
- Connecting rod location and orientation to the crankshaft journal
- Connecting rod to the bearing cap

  A paint stick or etching/engraving type tool are recommended. Stamping the connecting rod or cap near the bearing bore may affect component geometry.

- Crankshaft main and connecting rod bearings
- Camshaft and valve lifters
- Valve lifters, lifter guides, pushrods and rocker arm assemblies
- Valve to the valve guide
- Valve spring to the cylinder head location
- Engine block main bearing cap location and direction
- Oil pump drive and driven gears

REPLACING ENGINE GASKETS

Tools Required

J 28410 Gasket Remover

Gasket Use and Applying Sealants

- Do not use any gasket again unless specified.
- Gaskets that can be used again will be identified in the service procedure.
- Do not apply sealant to any gasket or sealing surface unless called out in the service information.

Separating Components

- Use a rubber mallet to separate components.
- Bump the part sideways to loosen the components.
- Bumping should be done at bends or reinforced areas to prevent distortion of parts.

Cleaning Gasket Surfaces

- Remove all gasket and sealing material from the part using the **J 28410** or equivalent.

- Care must be used to avoid gouging or scraping the sealing surfaces.
- Do not use any other method or technique to remove sealant or gasket material from a part.
- Do not use abrasive pads, sand paper, or power tools to clean the gasket surfaces.
    - These methods of cleaning can cause damage to the component sealing surfaces.
    - Abrasive pads also produce a fine grit that the oil filter cannot remove from the oil.
    - This grit is abrasive and has been known to cause internal engine damage.

Assembling Components

NOTE: Refer to Sealant Notice in Cautions and Notices.

- When assembling components, use only the sealant specified or equivalent in the service procedure.
- Sealing surfaces should be clean and free of debris or oil.
- Specific components such as crankshaft oil seals or valve stem oil seals may require lubrication during assembly.
- Components requiring lubrication will be identified in the service procedure.
- When applying sealant to a component, apply the amount specified in the service procedure.
- Tighten bolts to specifications. Do not overtighten.

USE OF ROOM TEMPERATURE VULCANIZING (RTV) AND ANAEROBIC SEALER

Pipe Joint Compound

IMPORTANT: 3 types of sealer are commonly used in engines. These are room temperature vulcanizing (RTV) sealer, anaerobic gasket eliminator sealer, and pipe joint compound. The correct sealer and amount must be used in the proper location to prevent oil leaks. DO NOT interchange the 3 types of sealers. Use only the specific sealer, or the equivalent as recommended in the service procedure.

- Pipe joint compound is a pliable sealer that does not completely harden. This type of sealer is used where 2 non-rigid parts, such as the oil pan and the engine block, are assembled together.
- Do not use pipe joint compound in areas where extreme temperatures are expected. These areas include: exhaust manifold, head gasket, or other surfaces where gasket eliminator is specified.

- Follow all safety recommendations and directions that are on the container.

  To remove the sealant or the gasket material, refer to **Replacing Engine Gaskets**.

NOTE: Refer to Sealant Notice in Cautions and Notices.

- Apply the pipe joint compound to a clean surface. Use a bead size or quantity as specified in the procedure. Run the bead to the inside of any bolt holes.
- Apply a continuous bead of pipe joint compound to 1 sealing surface. Sealing surfaces to be resealed must be clean and dry.
- Tighten the bolts to specifications. Do not overtighten.

RTV Sealer

- RTV sealant hardens when exposed to air. This type of sealer is used where 2 non-rigid parts, such as the intake manifold and the engine block, are assembled together.
- Do not use RTV sealant in areas where extreme temperatures are expected. These areas include: exhaust manifold, head gasket, or other surfaces where a gasket eliminator is specified.
- Follow all safety recommendations and directions that are on the container.

  To remove the sealant or the gasket material, refer to **Replacing Engine Gaskets**.

NOTE: Refer to Sealant Notice in Cautions and Notices.

- Apply RTV sealant to a clean surface. Use a bead size as specified in the procedure. Run the bead to the inside of any bolt holes.
- Assemble components while the RTV sealant is still wet, within 3 minutes. Do not wait for the RTV sealant to skin over.
- Tighten bolts to specifications. Do not overtighten.

Anaerobic Sealer

- Anaerobic gasket eliminator hardens in the absence of air. This type of sealer is used where 2 rigid parts, such as castings, are assembled together. When 2 rigid parts are disassembled and no sealer or gasket is readily noticeable, the parts were probably assembled using a gasket eliminator.
- Follow all safety recommendations and directions that are on the container.

  To remove the sealant or the gasket material, refer to **Replacing Engine Gaskets**.

- Apply a continuous bead of gasket eliminator to 1 flange. Surfaces to be sealed must be clean and dry.

NOTE: Refer to Sealant Notice in Cautions and Notices.

- Spread the sealer evenly with your finger to get a uniform coating on the sealing surface.

IMPORTANT: Anaerobic sealed joints that are partially torqued and allowed to cure more than 5 minutes may result in incorrect shimming and sealing of the joint.

- Tighten bolts to specifications. Do not overtighten.
- After properly tightening the fasteners, remove the excess sealer from the outside of the joint.

TOOLS AND EQUIPMENT

Special tools are listed and illustrated throughout this information, with a complete listing at the end of the information. These tools, or their equivalents, are specially designed to quickly and safely accomplish the operations for which they are intended. The use of these special tools also minimize possible damage to engine components. Some precision measuring tools are required for inspection of certain critical components. Torque wrenches and a torque angle meter are necessary for the proper tightening of various fasteners.

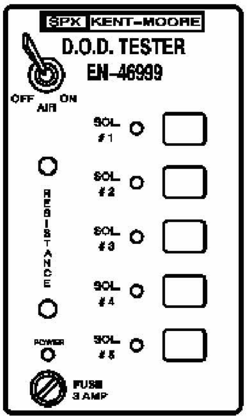
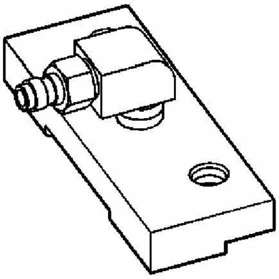
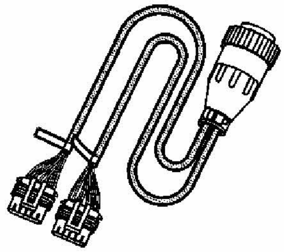
To properly service the engine assembly, the following items should be readily available:

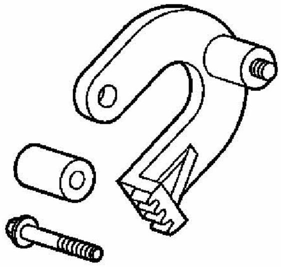
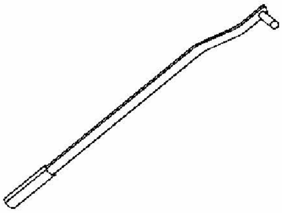
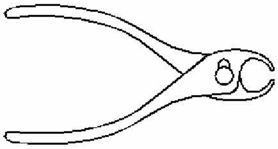
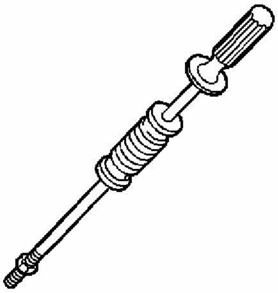
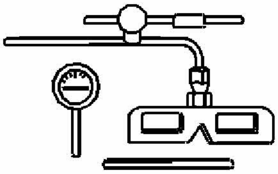
- Approved eye protection and safety gloves
- A clean, well lit, work area
- A suitable parts cleaning tank
- A compressed air supply
- Trays or storage containers to keep parts and fasteners organized
- An adequate set of hand tools
- Approved engine repair stand
- An approved engine lifting device that will adequately support the weight of the components

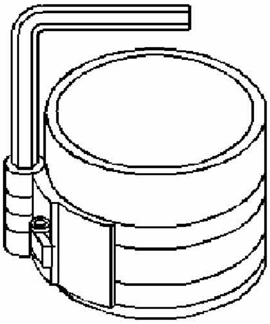
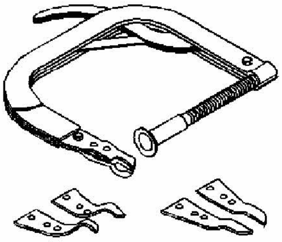
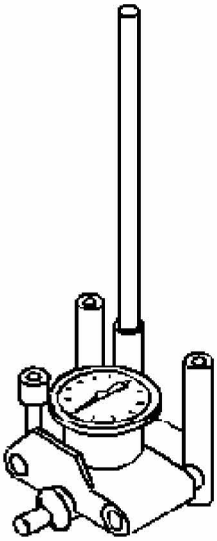
SPECIAL TOOLS AND EQUIPMENT

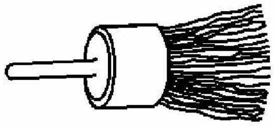
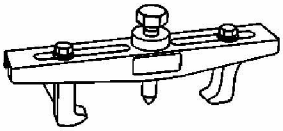
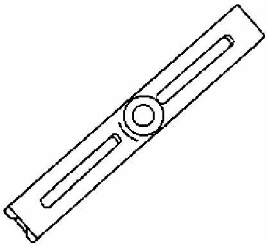
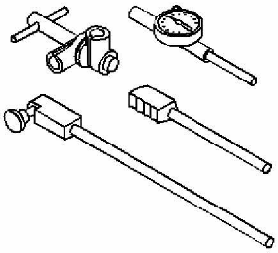
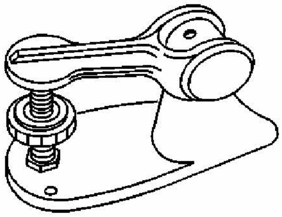
SPECIAL TOOLS

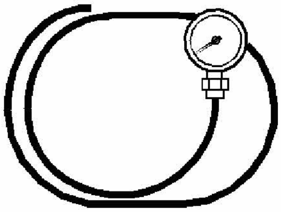
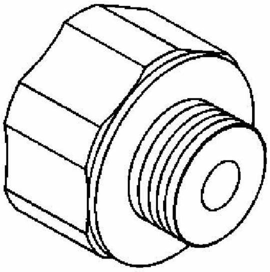
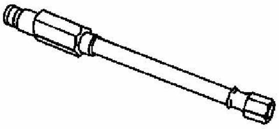
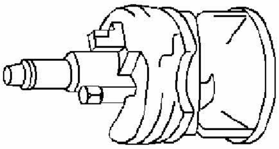
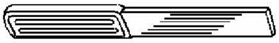
Special Tools

Illustration	Tool Number/Description
 SPX KENT-MOORE D.O.D. TESTER EN-46999 OFF AIR ON SOL #1 SOL #2 SOL #3 SOL #4 SOL #5 RESISTANCE POWER FUSE 3 AMP	EN-46999 Displacement on Demand Tester
	EN-46999-1 Displacement on Demand Tester Air Adapter
	EN-46999-5 Displacement on Demand Tester Harness - Small Block V8
	EN-47699 Flywheel Holding Tool

	
	EN-47988 Serpentine Belt Tension Unloader
	J 3049-A Valve Lifter Remover
	J 6125-1B Slide Hammer Adapter
	J 7872 Magnetic Base Dial Indicator

	J 8037 Ring Compressor
	J 8062 Valve Spring Compressor - Head Off
	J 8087 Cylinder Bore Gage
	J 8089

	Carbon Removal Brush
	J 8433 Two Jaw Puller
	J 8433-1 Puller Bar
	J 8520 Cam Lobe Lift Indicator
	J 9666 Valve Spring Tester

	J 21867 Pressure Gage
	J 21867-16 Oil Pressure Adapter
	J 22794 Spark Plug Port Adapter
	J 24270 Cylinder Bore Ridge Reamer
	J 28410 Gasket Remover
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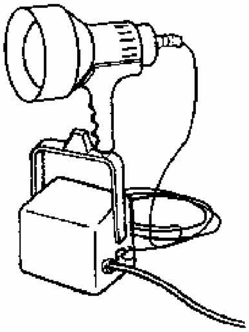
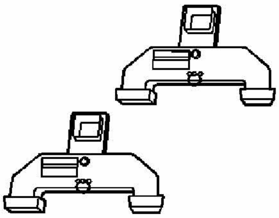
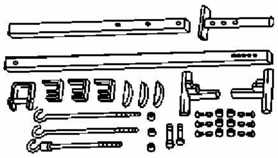
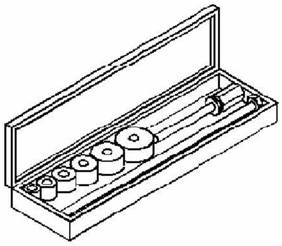
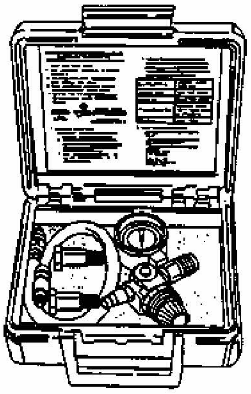
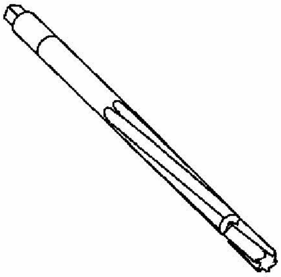
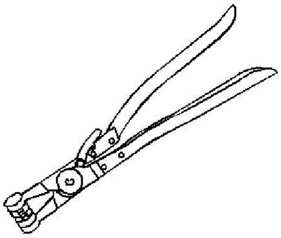
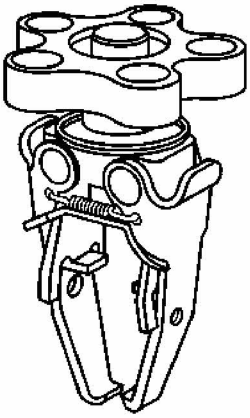
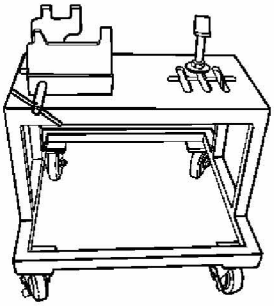
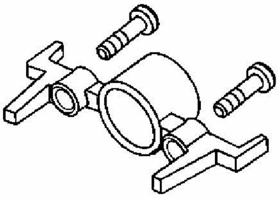
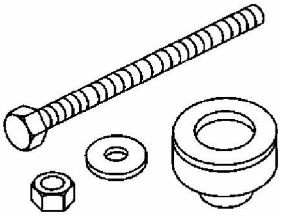
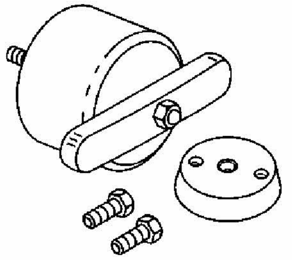
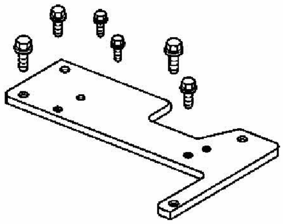
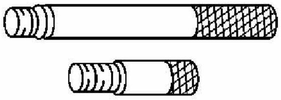
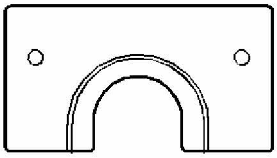
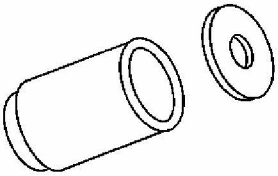
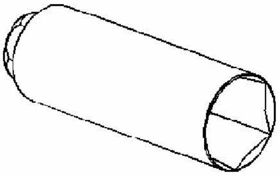
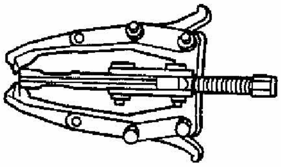
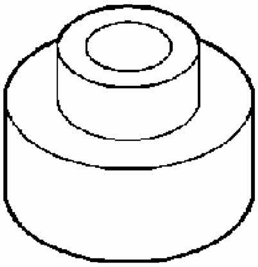
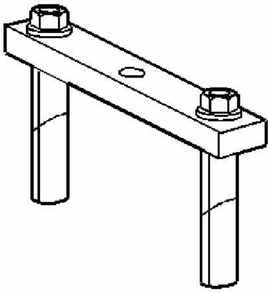
	
	J 28467-501 Engine Support Fixture Adapters
	J 28467-B Universal Engine Support Fixture
	J 33049 Camshaft Bearing Service Set

	J 35667-A Cylinder Head Leakdown Tester
	J 37378-1 Valve Guide Reamer
	J 38185 Hose Clamp Pliers
	J 38606 Valve Spring Compressor

	
	J 39580 Power Pack Stand Engine and Transaxle Assembly Support
	J 41476 Front and Rear Cover Alignment Tool
	J 41478 Crankshaft Front Oil Seal Installer

	J 41479 Crankshaft Rear Oil Seal Installer
	J 41480 Front and Rear Cover Alignment
	J 41556 Connecting Rod Guide
	J 41558 Crankshaft Sprocket Remover
	J 41665 Crankshaft Balancer and Sprocket Installer
	J 41712 Oil Pressure Switch Socket

	
	J 41816 Crankshaft Balancer Remover
	J 41816-2 Crankshaft End Protector
	J 41818 Crankshaft Bearing Cap Remover
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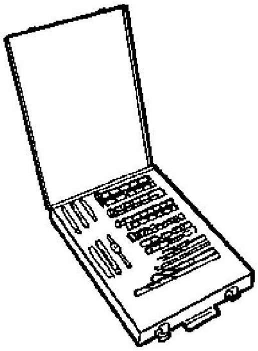
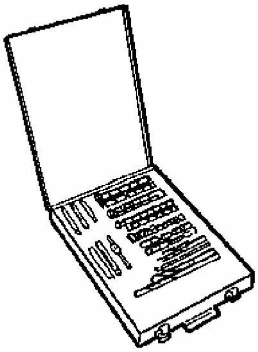
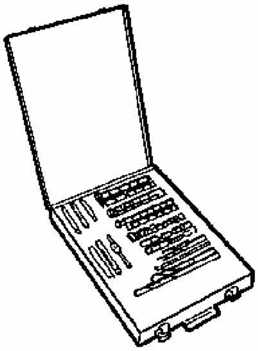
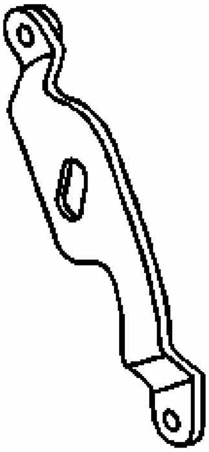
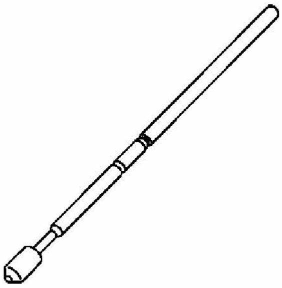
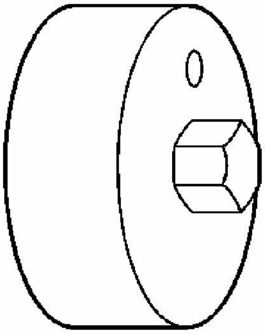
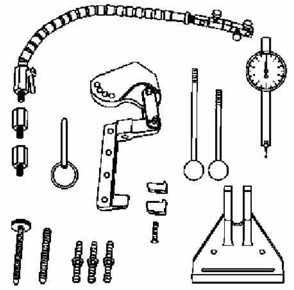
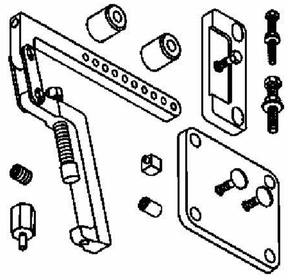
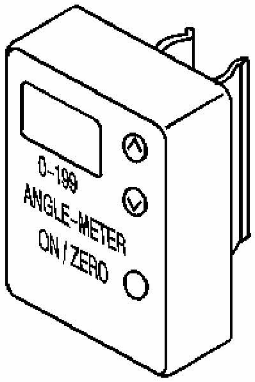
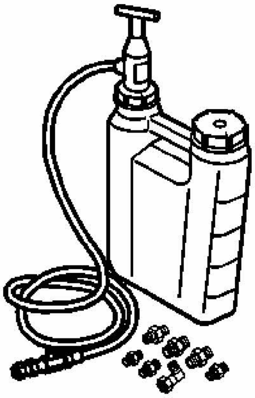
	
	J 42385-200 Common Threads Repair Kit
	J 42385-300 Fixtures and Hardware Kit

	J 42504 Engine Lift Bracket
	J 42640 Steering Column Anti-rotation Pin
	J 42907 Oil Pressure Tester

	J 43690 Rod Bearing Clearance Checking Tool
	J 43690-100 Rod Bearing Checking Tool - Adapter Kit
 0-199 ANGLE-METER ON / ZERO	J 45059 Angle Meter
	J 45299 Engine Preluber



2006 ENGINE

Engine Cooling - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Condenser-to-Radiator Bolt	6 N.m	53 lb in
Coolant Crossover Pipe Bolt (RPO's LZE/LZ9)	50 N.m	37 lb ft
Coolant Heater (RPO LS4)	50 N.m	37 lb ft
Coolant Heater (RPO's LZE/LZ9)	60 N.m	44 lb ft
Engine Coolant Air Bleed Pipe/Cover Bolt (RPO LS4)	12 N.m	106 lb in
Lower Radiator Support Bracket Bolt	60 N.m	44 lb ft
Thermostat Bypass Pipe-to-Engine Front Cover Bolt (RPO's LZE/LZ9)	11 N.m	98 lb in
Thermostat Bypass Pipe-to-Throttle Body Nut (RPO's LZE/LZ9)	25 N.m	18 lb ft
Thermostat Housing Bolt/Stud (RPO's LZE/LZ9)	25 N.m	18 lb ft
Transmission Oil Cooler Pipe Attachment Nut	7 N.m	62 lb in
Upper Radiator Support Bracket Bolt	10 N.m	89 lb in
Water Outlet Housing Bolt (RPO LS4)	15 N.m	11 lb ft
Water Pump Bolt (RPO LS4)	10 N.m	89 lb in
Water Pump Bolt (RPO's LZE/LZ9)	10 N.m	89 lb in
Water Pump Manifold Bolt (M8) (RPO LS4)	30 N.m	22 lb ft
Water Pump Manifold Bolt (M10) (RPO LS4)	60 N.m	44 lb ft
Water Pump Pulley Bolt (RPO's LZE/LZ9)	25 N.m	18 lb ft

SCHEMATIC AND ROUTING DIAGRAMS

ENGINE COOLING SCHEMATICS

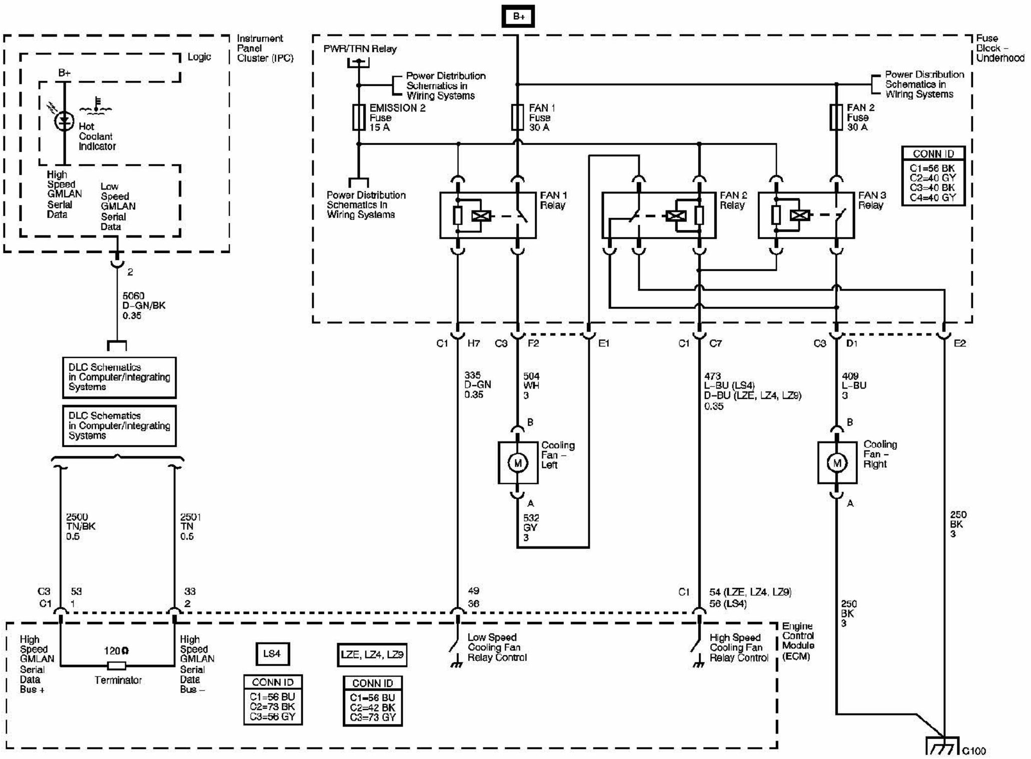

B+
Instrument Panel Cluster (IPC)
Logic
B+
Hot Coolant Indicator
High Speed GMLAN Serial Data
Low Speed GMLAN Serial Data
2
5060
D-GN/BK
0.35
DLC Schematics in Computer/Integrating Systems
DLC Schematics in Computer/Integrating Systems
2500
TN/BK
0.5
2501
TN
0.5
PWR/TRN Relay
Power Distribution Schematics in Wiring Systems
EMISSION 2 Fuse 15 A
FAN 1 Fuse 30 A
FAN 2 Fuse 30 A
Power Distribution Schematics in Wiring Systems
Power Distribution Schematics in Wiring Systems
Fuse Block - Underhood
FAN 1 Relay
FAN 2 Relay
FAN 3 Relay
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
C1
H7
C3
F2
E1
C1
C7
C3
D1
E2
335
D-GN
0.35
504
WH
3
473
L-BU (LS4)
D-BU (LZE, LZ4, LZ9)
0.35
409
L-BU
3
B
Cooling Fan - Left
A
532
GY
3
B
Cooling Fan - Right
A
250
BK
3
250
BK
3
C3
C1
53
1
33
2
49
36
C1
54 (LZE, LZ4, LZ9)
56 (LS4)
High Speed GMLAN Serial Data Bus +
120 Ω
Terminator
High Speed GMLAN Serial Data Bus –
LS4
CONN ID
C1=56 BU
C2=73 BK
C3=56 GY
LZE, LZ4, LZ9
CONN ID
C1=56 BU
C2=42 BK
C3=73 GY
Low Speed Cooling Fan Relay Control
High Speed Cooling Fan Relay Control
Engine Control Module (ECM)
C100

Fig. 1: Engine Cooling Schematics - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

COOLING SYSTEM COMPONENT VIEWS

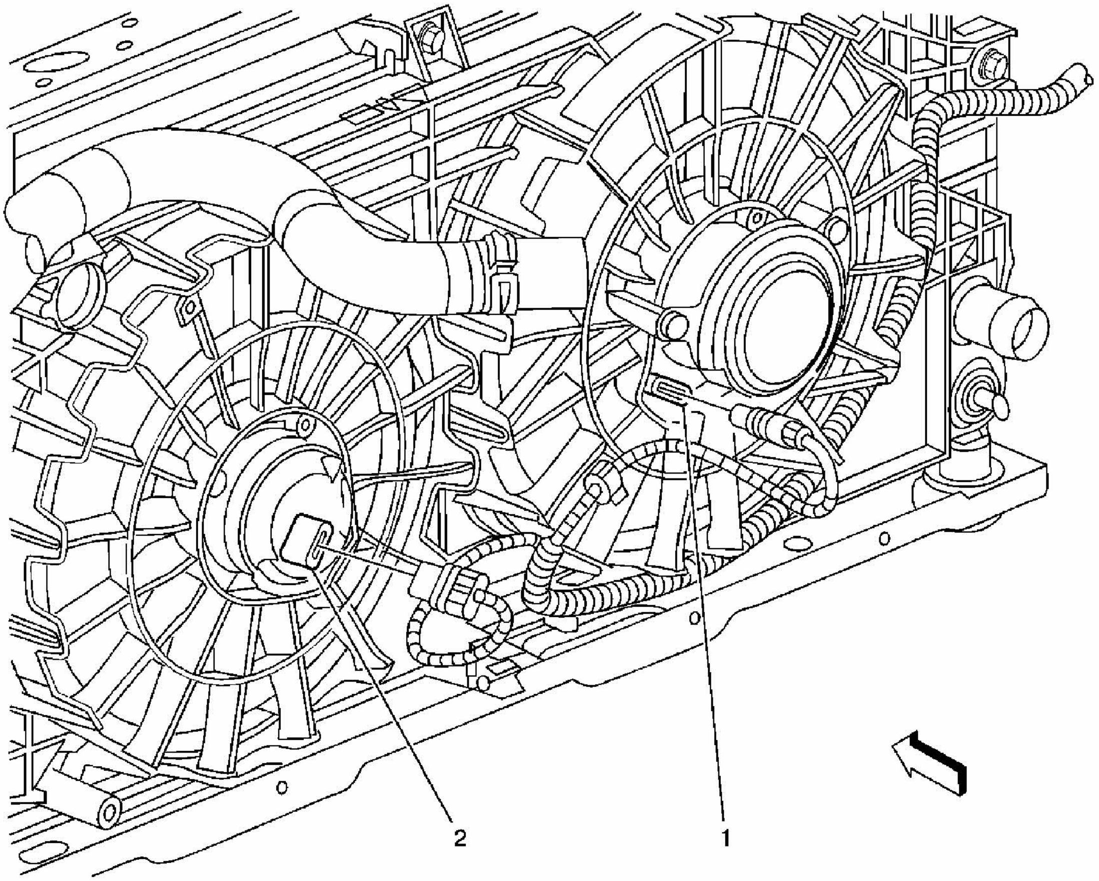


Fig. 2: Behind Radiator Component View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	Cooling Fan - Right
2	Cooling Fan - Left

COOLING SYSTEM CONNECTOR END VIEWS

Cooling Fan - Left

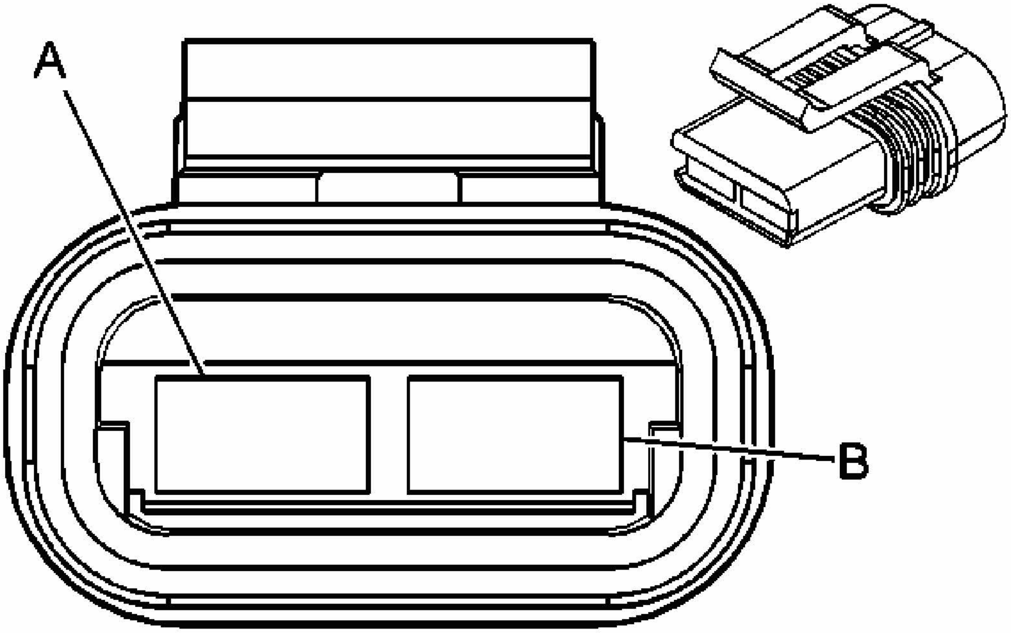


Fig. 3: Connector End View
Courtesy of GENERAL MOTORS CORP.

Cooling System Connector End Views

Connector Part Information - OEM: 12033769 - Service: 12101917 - Description: 2-Way F Metri-Pack 630 Sealed
Terminal Part Information - Terminal/Tray: 12033997/8 - Core/Insulation Crimp: D/B - Release Tool/Test Probe: 12094430/J-35616-42 (RD)

Cooling Fan - Left

Pin	Wire Color	Circuit No.	Function
A	GY	532	Cooling Fan Motor Supply Voltage
B	WH	504	Cooling Fan Low Reference

Cooling Fan - Right

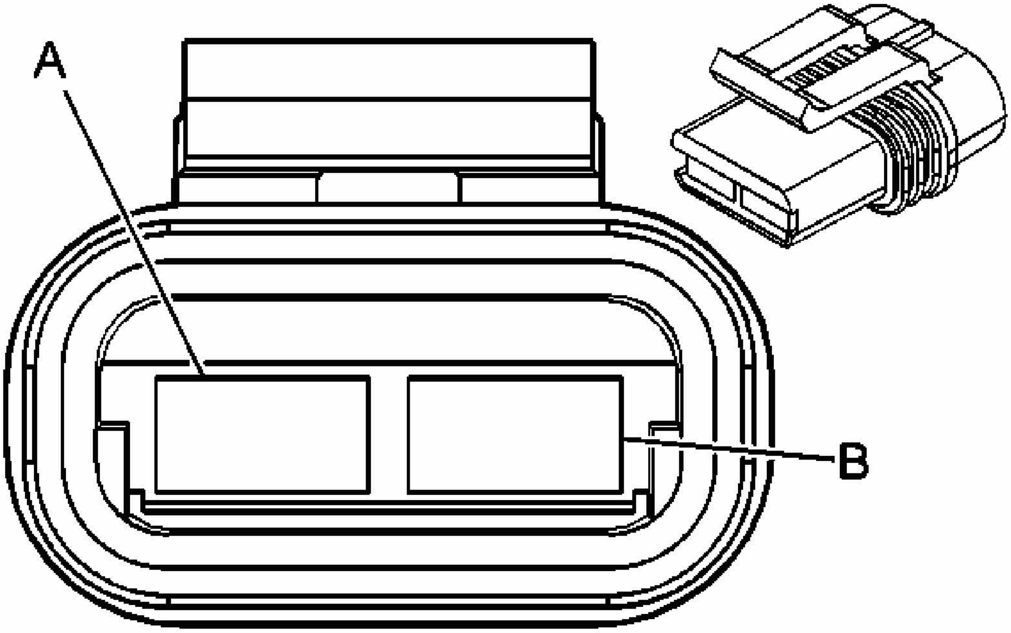


Fig. 4: Connector End View
Courtesy of GENERAL MOTORS CORP.

Cooling System Connector End Views

Connector Part Information

- OEM: 12033769
- Service: 12101917
- Description: 2-Way F Metri-Pack 630 Sealed

Terminal Part Information

- Terminal/Tray: 12033997/8
- Core/Insulation Crimp: D/B
- Release Tool/Test Probe: 12094430/J-35616-42 (RD)

Cooling Fan - Right

Pin	Wire Color	Circuit No.	Function
A	BK	250	Ground
B	L-BU	409	Cooling Fan Motor Supply Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC P0480 or P0481	Cooling Fan Relay 1 Control Circuit, Cooling Fan Relays 2 and 3 Control Circuit
DTC P1258	Engine Coolant Over Temperature - Fuel Disabled

DIAGNOSTIC STARTING POINT - ENGINE COOLING

Begin the system diagnosis with the **Diagnostic System Check - Vehicle** . The Diagnostic System Check in Vehicle DTC Information will provide the following information:

- The identification of the control modules which command the system.
- The ability of the control modules to communicate through the serial data circuit.
- The identification of any stored diagnostic trouble codes (DTCs) and their status.

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL OUTPUT CONTROLS

Powertrain Control Module (PCM) Scan Tool Output Controls LX9/3.5L only

Scan Tool Output Control	Additional Menu Selection(s)	Description
Fans Low Speed	Fan Relays	The scan tool displays a Commanded State of Off or On. This allows you to communicate with the powertrain control module (PCM) and activate or deactivate the cooling fan 1 relay, manually turning the low speed fans On and Off.
Fans High Speed	Fan Relays	The scan tool displays a Commanded State of Off or On. This allows you to communicate with the PCM to activate or deactivate the cooling fan 1 relay, manually turning the low speed fans On. After a 3 second delay the PCM will activate the cooling fan S/P relay and the cooling fan 2 relay. This turns the high speed fans On and Off.

SCAN TOOL DATA LIST

Powertrain Control Module (PCM) 3.5L/LX9

			Typical Data

Scan Tool Parameter	Data List	Units Displayed	Value
Ignition Switch in RUN/Engine running/Automatic Transmission in PARK/Air Conditioner is OFF			
ECT	Inputs/Outputs	°C/°F	Varies
FC Relay 1 Command	Outputs	ON/OFF	OFF
FC Relays 2 and 3 Command	Outputs	ON/OFF	OFF

Powertrain Control Module (PCM) 2.2L/L61

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition Switch in RUN/Engine running/Automatic Transmission in PARK/Air Conditioner is OFF			
ECT	Inputs/Outputs	°C/°F	Varies

SCAN TOOL DATA DEFINITIONS

ECT

The scan tool displays -40 to +151°C (-40 to +304°F). The engine coolant temperature (ECT) sensor is mounted in the coolant stream. The powertrain control module (PCM) applies 5 volts to the ECT sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold (internal resistance high), the PCM monitors a high signal voltage and interprets it as a cold engine. As the sensor warms and internal resistance decreases, the voltage signal decreases and the PCM interprets the lower voltage as a warm engine.

Engine Coolant Fan LX9/3.5L only

The scan tool displays OFF and ON. When the scan tool displays FC Relay 1 Commanded, the PCM is commanding the cool fan 1 relay ON. When the PCM commands the cool fan 1 relay ON, the left cooling fan is enabled in low speed. When the scan tool displays FC Relay 2 and 3 Commanded, the PCM is commanding the cool fan 1, cool fan 2, and S/P fan relays ON. When the cool fan 1, cool fan 2, and S/P fan relays are ON, the left and right cooling fans are enabled in high speed. When all fan relays are activated, the left and right cooling fans are enabled in high speed.

DTC P0480 OR P0481

Circuit Description

The powertrain control module (PCM) controls the low speed cooling fan operation by grounding the low speed fan relay control circuit with an internal solid state device called a driver. For high speed cooling fan operation, the PCM grounds the high speed and S/P relay control circuit at the same time the low speed control circuit is grounded. Battery positive voltage is supplied to the low speed, high speed and S/P fan relays. When the PCM is commanding a fan relay ON, the voltage of the control circuit should be low, near 0 volts. When the PCM is commanding a fan relay OFF, the voltage potential of the control circuit should be high, near battery voltage. If the fault detection circuit senses a voltage other than what is expected, the DTC will set.

If the PCM detects an improper voltage level on the low or high speed driver circuits, then code P0480 or P0481 will set and the effected driver will be disabled.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

DTC P0480

Cooling Fan Relay 1 Control Circuit

DTC P0481

Cooling Fan Relays 2 and 3 Control Circuit

The P0694 condition is present for 1 second.

Conditions for Running the DTC

- The ignition voltage is between 9-18 volts.
- The engine speed is more than 40 RPM.
- The PCM driver transitions from ON to OFF or from OFF to ON.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) during the second consecutive trip in which the diagnostic test has been run and failed.
- The PCM will store conditions which were present when the DTC set as Freeze Frame and Failure Records data.

Conditions for Clearing the MIL/DTC

- The PCM will turn OFF the MIL during the third consecutive trip in which the diagnostic has been run and passed.
- The History DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- Use the scan tool Clear DTC Information function.

Diagnostic Aids

- If the condition is not present, refer to **Testing for Intermittent Conditions and Poor Connections** .
- Review the Freeze/Failure Records vehicle mileage since the diagnostic test failed. This may help determine how often the condition that caused the DTC to be set occurs.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

> **2:** Listen for an audible click when the cool fan relay 1 operates. Command both the ON and OFF states. Repeat the commands as necessary.
>
> **3:** Listen for an audible click when the S/P and cool fan 2 relays operate. Command both the ON and OFF states. Repeat the commands as necessary.

DTC P0480 or P0481

Step	Action	Yes	No
Schematic Reference: Engine Cooling Schematics **Connector End View Reference: Cooling System Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fan Control Relay 1 ON and OFF. Does the cool fan 1 relay turn ON and OFF with each command?	Go to **Step 3**	Go to **Step 4**
3	With a scan tool, command the Fan Control Relay 2 and 3 ON and OFF. Do the S/P and the cool fan 2 relays turn ON and OFF with each command?	Go to Diagnostic Aids	Go to **Step 6**
4	1. Turn the ignition OFF. 2. Disconnect the cool fan 1 relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery voltage circuit of the cool fan 1 relay with a test lamp that is connected to a good ground.		

	Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 16**
5	1. Connect a test lamp between the control circuit of the cool fan 1 relay and the battery voltage circuit of the cool fan 1 relay. 2. With a scan tool, command the Fan Control Relay 1 ON and OFF. Does the test lamp turn ON and OFF with each command?	Go to **Step 12**	Go to **Step 9**
6	1. Turn OFF the ignition. 2. Disconnect the cool fan 2 relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery voltage circuit of the cool fan 2 relay with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 16**
7	1. Connect a test lamp between the control circuit of the cool fan 2 relay and the battery voltage circuit of the cool fan 2 relay. 2. With a scan tool, command the Fan Control Relay 2 and 3 ON and OFF. Does the test lamp turn ON and OFF with each command?	Go to **Step 14**	Go to **Step 8**
8	1. Turn OFF the ignition. 2. Disconnect the S/P fan relay. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the control circuit of the S/P fan relay and the battery voltage circuit of the S/P fan relay. 5. With a scan tool, command the Fan Control Relay 2 and 3 ON and OFF. Does the test lamp turn ON and OFF with		

	each command?	Go to **Step 13**	Go to **Step 9**
9	Does the test lamp remain illuminated with each command?	Go to **Step 11**	Go to **Step 10**
10	Test the control circuit of the appropriate relay for a short to voltage or an open. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 15**
11	Test the control circuit of the appropriate relay for a short to ground. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 15**
12	Inspect for poor connections at the cool fan 1 relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 17**
13	Inspect for poor connections at the S/P fan relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 18**
14	Inspect for poor connections at the cool fan 2 relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 19**
15	Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 20**
16	Repair the battery voltage circuit for an open or high resistance. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 21**	-
17	Replace the cool fan 1 relay. Did you complete the repair?	Go to **Step 21**	-
18	Replace the S/P fan relay.		

	Did you complete the repair?	Go to **Step 21**	-
19	Replace the cool fan 2 relay. Did you complete the repair?	Go to **Step 21**	-
20	Replace the PCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 21**	-
21	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

DTC P1258

Circuit Description

The powertrain control module (PCM) uses the engine coolant temperature (ECT) sensor to monitor the engine for an over temperature condition. This condition occurs when the coolant temperature is above 128°C (262°F). When an over temperature condition is present, DTC P1258 will set. The PCM will disable two groups of cylinders by turning OFF the fuel injectors. By switching between the two groups of cylinders, the PCM is able to reduce the temperature of the coolant.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P1258

Engine Coolant Over Temperature - Fuel Disabled

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

- The PCM detects an engine metal over temperature.
- The above condition is present for at least 8 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator Lamp (MIL) during the first trip in which the diagnostic test has been run and failed.
- The PCM will signal the instrument panel cluster (IPC) to turn ON the Service Engine Soon indicator.
- The PCM will alternately disable two groups of cylinders by turning OFF the fuel injectors.
- The PCM will store conditions which were present when the DTC set as Freeze Frame and File Records data.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL OFF after three consecutive trips that the diagnostic has been run and passed.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using the scan tool Clear DTC Information function.

DTC P1258

Step	Action	Yes	No
Connector End View Reference: Cooling System Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Check the engine cooling fans for proper operation. Are the engine cooling fans operative?	Go to **Engine Overheating**	Go to **Symptoms - Engine Cooling**

SYMPTOMS - ENGINE COOLING

IMPORTANT: The following steps need to be completed before using the symptom tables.

1. **Perform the Vehicle Control System Diagnostic System Check. Refer to Diagnostic System Check - Vehicle in order to verify that all of the following are true:**
   - **There are no DTCs set.**
   - **The control modules can communicate via the serial data link.**
2. **Review the system operation in order to become familiar with the system functions. Refer to Cooling System**

Description and Operation.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Cooling System. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the surge tank reservoir for the proper coolant level.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Engine Coolant Temperature Indicator Always On**
- **Cooling Fan Always On**
- **Cooling Fan Inoperative**
- **Engine Overheating**
- **Loss of Coolant**
- **Thermostat Diagnosis**
- **Coolant Heater Inoperative**
- **Engine Fails To Reach Normal Operating Temperature**

ENGINE COOLANT TEMPERATURE INDICATOR ALWAYS ON

Engine Coolant Temperature Indicator Always On

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Start the engine. Does the engine coolant temperature indicator illuminate?	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections**
	With the scan tool, observe the engine coolant temperature parameter in the		

3	powertrain control module (PCM) data list. Does the scan tool indicate that the coolant temperature is within the temperature range shown on the temperature gage?	Go to **Engine Overheating**	Go to **Step 4**
4	Replace the instrument panel cluster (IPC). Refer to **Control Module References** for replacement, setup, and programming. Did you complete the repair?	Go to **Step 5**	-
5	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

COOLING FAN ALWAYS ON

Cooling Fan Always On

Step	Action	Yes	No
Schematic Reference: Engine Cooling Schematics, (49327), **HVAC Schematics** **Connector End View Reference: Cooling System Connector End Views** DEFINITION: The engine cooling fan motor runs continuously in high or low speed.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Turn ON the ignition, with the engine OFF. Are one or both cooling fans ON?	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections**
3	Are both cooling fans running continuously?	Go to **Step 4**	Go to **Step 6**
4	Are both fans running continuously in high speed?	Go to **Step 5**	Go to **Step 7**
5	Test the low reference circuit of the A/C refrigerant pressure sensor for an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 18**	Go to **Step 14**
6	Remove the cooling fan S/P relay. Did the right cooling fan turn OFF?	Go to **Step 10**	Go to **Step 8**
7	Remove the cooling fan 1 relay.		

	Did the cooling fans turn OFF?	Go to **Step 12**	Go to **Step 9**
8	Remove the cooling fan 2 relay. Did the right cooling fan turn OFF?	Go to **Step 13**	Go to **Step 11**
9	Repair the short to voltage in the left cooling fan motor supply voltage circuit. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 18**	-
10	Repair the short to voltage in the left cooling fan motor low reference circuit. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 18**	-
11	Repair the short to voltage in the right cooling fan motor supply voltage circuit. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 18**	-
12	Inspect for poor connections at the cool fan 1 relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 18**	Go to **Step 15**
13	Inspect for poor connections at the cool fan 2 relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 18**	Go to **Step 16**
14	Inspect for poor connections at the A/C refrigerant pressure sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 18**	Go to **Step 17**
15	Replace the cool fan 1 relay. Did you complete the replacement?	Go to **Step 18**	-
16	Replace the cool fan 2 relay. Did you complete the replacement?	Go to **Step 18**	-
17	Replace the A/C refrigerant pressure sensor. Refer to **Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement** . Did you complete the replacement?	Go to **Step 18**	-
18	Operate the system in order to verify the repair.		

	Did you correct the condition?	System OK	Go to **Step 2**

COOLING FAN INOPERATIVE

Cooling Fan Inoperative

Step	Action	Yes	No
Schematic Reference: Engine Cooling Schematics **Connector End View Reference: Cooling System Connector End Views** DEFINITION: One or both cooling fan motors are inoperative in either high, low, or both speeds.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fan Control Relay 1 ON and OFF. Do the low speed engine cooling fans turn ON and OFF with each command?	Go to **Step 3**	Go to **Step 4**
3	**IMPORTANT:** **A 3 second delay occurs before the powertrain control module (PCM) changes the cooling fan speed.** With a scan tool, command the Fan Control Relay 2 and 3 ON and OFF.Do the high speed engine cooling fans turn ON and OFF with each command?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 6**
4	**IMPORTANT:** **Do NOT remove the jumper wire that you will be connecting until your testing is completed. If the cool fan 1 fuse opens when you connect the jumper wire, repair the cooling fan motor supply voltage circuit of the left cooling fan motor for a short to ground.** 1. Disconnect the cool fan 1 relay. 2. Connect a jumper wire between the battery positive voltage circuit and the cooling fan motor supply voltage		

	circuit of the cool fan 1 relay. Do both cooling fans operate in low speed?	Go to **Step 14**	Go to **Step 5**
5	1. Disconnect the S/P fan relay. 2. With a test lamp connected to a good ground, probe the cooling fan low reference circuit at the S/P fan relay. Does the test lamp illuminate?	Go to **Step 9**	Go to **Step 8**
6	Does the left cooling fan operate at high speed?	Go to **Step 16**	Go to **Step 7**
7	Inspect the ground circuit of the S/P fan relay for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 25**	Go to **Step 15**
8	1. Install the S/P fan relay. 2. Disconnect the left cooling fan electrical connector. 3. With a test lamp connected to a good ground, probe the cooling fan motor supply voltage circuit at the left cooling fan motor connector. Does the test lamp illuminate?	Go to **Step 12**	Go to **Step 13**
9	1. Install the S/P fan relay. 2. Disconnect the right cooling fan motor connector. 3. With a test lamp connected to a good ground, probe the cooling fan motor supply voltage circuit at the right cooling fan connector. Does the test lamp illuminate?	Go to **Step 11**	Go to **Step 10**
10	Inspect the cooling fan motor supply voltage circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 25**	Go to **Step 15**
11	Inspect the ground circuit of the right cooling fan for an open or high resistance. Refer to **Circuit Testing** and **Wiring**		

	Repairs . Did you find and correct the condition?	Go to **Step 25**	Go to **Step 18**
12	Inspect the cooling fan low reference circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 25**	Go to **Step 17**
13	Inspect the cooling fan motor supply voltage circuit of the left cooling fan for an open or high resistance. Refer to **Circuit Testing** **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 25**	Go to **Step 19**
14	Inspect for poor connections at the cool fan 1 relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 25**	Go to **Step 20**
15	Inspect for poor connections at the S/P fan relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 25**	Go to **Step 21**
16	Inspect for poor connections at the cool fan 2 relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 25**	Go to **Step 22**
17	Inspect for poor connections at the harness connector of the left cooling fan. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 25**	Go to **Step 23**
18	Inspect for poor connections at the harness connector of the right cooling fan. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 25**	Go to **Step 24**
19	Repair the battery positive voltage circuit for an open or high resistance. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 25**	-

20	Replace the cool fan 1 relay. Did you complete the replacement?	Go to **Step 25**	-
21	Replace the S/P fan relay. Did you complete the replacement?	Go to **Step 25**	-
22	Replace the cool fan 2 relay. Did you complete the replacement?	Go to **Step 25**	-
23	Replace the left cooling fan. Refer to **Electric Cooling Fan Motor Replacement**. Did you complete the replacement?	Go to **Step 25**	-
24	Replace the right cooling fan. Refer to **Electric Cooling Fan Motor Replacement**. Did you complete the replacement?	Go to **Step 25**	-
25	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

ENGINE OVERHEATING

Engine Overheating

Step	Action	Yes	No
DEFINITION: The engine temperature lamp comes on and stays on, or temperature gage shows hot, or coolant overflows from the surge tank onto the ground while the engine is running.			
1	Check for a loss of coolant. Refer to **Loss of Coolant**. Is there a loss of coolant?	Go to **Step 2**	Go to **Step 3**
2	Fill the system to the specified level. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**. Does the engine still overheat?	Go to **Step 3**	System OK
3	Check for kinked or pinched surge tank hoses, especially at the radiator. Are any surge tank hoses kinked or pinched?	Go to **Step 4**	Go to **Step 5**
	1. Relieve any kinks by rerouting the		

4	hoses. 2. Replace the hoses, if necessary. Does the engine still overheat?	Go to **Step 5**	System OK
5	Check for loose, missing, or damaged radiator air seals or deflectors. Are there any loose, missing, or damaged radiator air seals or deflectors?	Go to **Step 6**	Go to **Step 7**
6	Repair or replace any loose, missing, or damaged radiator air seals or deflectors. Does the engine still overheat?	Go to **Step 7**	System OK
7	Check the coolant concentration. Does the coolant concentration test correctly?	Go to **Step 9**	Go to **Step 8**
8	Replace the coolant, if necessary. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**. Does the engine still overheat?	Go to **Step 9**	System OK
9	**IMPORTANT:** **Use the correct pressure cap.** Check the system for loss of pressure.Is there a loss of pressure?	Go to **Step 10**	Go to **Step 11**
10	Repair any leaks, as necessary. Does the engine still overheat?	Go to **Step 11**	System OK
11	Check for a faulty engine coolant temperature (ECT) sensor. Is the ECT sensor faulty?	Go to **Step 12**	Go to **Step 13**
12	Replace the ECT sensor. Refer to one of the following: • **Engine Coolant Temperature (ECT) Sensor Replacement** • **Engine Coolant Temperature (ECT) Sensor Replacement** • **Engine Coolant Temperature (ECT)**		

	Sensor Replacement Does the engine still overheat?	Go to **Step 13**	System OK
13	Check the radiator for any air flow obstructions or bent fins. Is there any airflow obstruction or bent fins?	Go to **Step 14**	Go to **Step 15**
14	1. Remove or relocate add-on parts that block air flow to the radiator. 2. Clean any debris from the radiator core. Does the engine still overheat?	Go to **Step 15**	System OK
15	Check for any blocked cooling system passages. Are there any blocked cooling system passages?	Go to **Step 16**	Go to **Step 17**
16	1. Remove any obstruction. 2. Flush the cooling system as required. Refer to **Flushing**. 3. Refill the coolant. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**. Does the engine still overheat?	Go to **Step 17**	System OK
17	Check for an inoperative cooling fan. Is the cooling fan inoperative?	Go to **Step 18**	Go to **Step 19**
18	Replace the cooling fan. Refer to **Cooling Fan Motor Replacement - Electric**. Does the engine still overheat?	Go to **Step 19**	System OK
19	Check for a thermostat that is stuck closed. Is the thermostat stuck closed?	Go to **Step 20**	Go to **Step 21**
20	Replace the thermostat. Refer to **Thermostat Replacement (RPOs LZE/LZ4/LZ9)** or **Thermostat Replacement (RPO LS4)**.		

	Does the engine still overheat?	Go to **Step 21**	System OK
21	Check for a faulty water pump. The impeller blades may be eroded or broken. Is the water pump faulty?	Go to **Step 22**	-
22	Replace the water pump. Refer to **Water Pump Replacement (RPOs LZE/LZ4/LZ9)** or **Water Pump Replacement (RPO LS4)**. Does the engine still overheat?	-	System OK

LOSS OF COOLANT

Loss of Coolant

Step	Action	Yes	No
DEFINITION: The cooling system is loosing coolant either internally or externally.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Symptoms - Engine Cooling**
2	Repair any present DTCs. Refer to **Diagnostic Starting Point - Engine Cooling**. Is the action complete?	Go to **Step 3**	-
3	Inspect the coolant level. Is the coolant at the proper level?	Go to **Step 6**	Go to **Step 4**
4	Fill the cooling system to the proper level. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**. Is the action complete?	Go to **Step 5**	-
5	If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to **Step 6**	Go to **Step 26**
6	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to **Step 27**	Go to **Step 7**
	Extended operation with a low coolant level		

7	can cause engine internal component failure. Is the engine knocking?	Go to **Step 29**	Go to **Step 8**
8	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to **Step 9**	Go to **Step 10**
9	Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to **Step 28**	Go to **Step 10**
10	With the engine idling, inspect the coolant recovery system. Does the coolant recovery system discharge coolant while the engine is idling?	Go to **Step 15**	Go to **Step 11**
11	Visually inspect the hoses, pipes and hose clamps at the following locations: • Coolant bypass • Coolant reservoir • Heater core • Radiator Are any of the hoses, clamps or pipes leaking?	Go to **Step 20**	Go to **Step 12**
12	Visually inspect the following components: • Block heater • Coolant pressure cap • Core plugs • Cylinder head gaskets • Engine block • Intake manifold • Radiator		

	- Thermostat housing - Water pump Are any of the listed components leaking?	Go to **Step 20**	Go to **Step 13**
13	1. Pressure test the cooling system. Refer to **Cooling System Leak Testing**. 2. With the cooling system pressurized, visually inspect the components listed in steps 11 and 12. Are any leaks present?	Go to **Step 20**	Go to **Step 14**
14	Pressure test the coolant pressure cap. Refer to **Pressure Cap Testing**. Does the coolant pressure cap hold pressure?	Go to **Step 16**	Go to **Step 21**
15	Pressure test the coolant pressure cap. Refer to **Pressure Cap Testing**. Does the coolant pressure cap hold pressure?	Go to **Step 30**	Go to **Step 21**
16	Inspect for the following conditions: - A coolant smell inside of the vehicle - Coolant in the HVAC module drain tube - Coolant on the vehicles floor covering near the HVAC module Is coolant present?	Go to **Step 22**	Go to **Step 17**
17	Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is there a milky substance on under the oil fill cap?	Go to **Step 18**	Go to **Step 19**
18	Inspect the engine oil fluid level indicator for a gray/white milky substance. Is there a milky substance on the engine fluid level indicator?	Go to **Step 28**	Go to **Step 19**
19	Inspect the automatic transmission oil fluid level indicator for a gray/white milky substance. Is there a milky substance on the automatic transmission fluid level indicator?	Go to **Step 23**	Go to **Step 31**
	Repair or replace the leaking component.		

20	Is the repair complete?	Go to **Step 31**	-
21	Replace the coolant pressure cap. Is the repair complete?	Go to **Step 31**	-
22	Replace the heater core. Refer to **Heater Core Replacement** in Heating, Ventilation and Air Conditioning. Is the repair complete?	Go to **Step 31**	-
23	1. Remove the transmission oil cooler lines from the radiator. 2. Pressure test the cooling system. Refer to **Cooling System Leak Testing**. 3. Inspect the transmission oil cooler for coolant. Is coolant present?	Go to **Step 24**	Go to **Step 25**
24	1. Replace the radiator. Refer to **Radiator Replacement**. 2. Service the automatic transmission. Refer to **Engine Coolant/Water in Transmission** in Automatic Transaxle - 4T65-E. Is the repair complete?	Go to **Step 31**	-
25	Install the cooler lines to the radiator. Is the repair complete?	Go to **Step 31**	
26	Repair the engine no crank condition. Refer to **Engine Will Not Crank - Crankshaft Will Not Rotate** in Engine Mechanical - 3.5L or to **Engine Will Not Crank - Crankshaft Will Not Rotate** in Engine Mechanical - 3.9L or to **Engine Will Not Crank - Crankshaft Will Not Rotate** in Engine Mechanical - 5.3L. Is the repair complete?	Go to **Step 31**	-
27	Repair the engine overheating condition. Refer to **Engine Overheating**. Is the repair complete?	Go to **Step 31**	-
	Repair the engine internal coolant leak. Refer to **Coolant in Combustion Chamber** or to **Coolant in Engine Oil** in Engine Mechanical - 3.5L or to **Coolant in Combustion Chamber** or to **Coolant in**		

28	**Engine Oil** in Engine Mechanical - 3.9L or to **Coolant in Combustion Chamber** or to **Coolant in Engine Oil** in Engine Mechanical - 5.3L. Is the repair complete?	Go to **Step 31**	-
29	Repair the engine knock. Refer to **Lower Engine Noise, Regardless of Engine Speed** in Engine Mechanical - 3.5L or to **Lower Engine Noise, Regardless of Engine Speed** in Engine Mechanical - 3.9L or to **Lower Engine Noise, Regardless of Engine Speed** in Engine Mechanical - 5.3L. Is the repair complete?	Go to **Step 31**	-
30	Repair the combustion pressure in the cooling system problem. Refer to **Cylinder Leakage Test** in Engine Mechanical - 3.5L or to **Cylinder Leakage Test** in Engine Mechanical - 3.9L or to **Cylinder Leakage Test** in Engine Mechanical - 5.3L. Is the repair complete?	Go to **Step 31**	-
31	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

THERMOSTAT DIAGNOSIS

Thermostat Test Procedure Using Glycol

Inspect the operation of the thermostat by hanging the thermostat on a hook in a 33 percent glycol solution.

In order to inspect if the thermostat valve is opening properly, perform the following test:

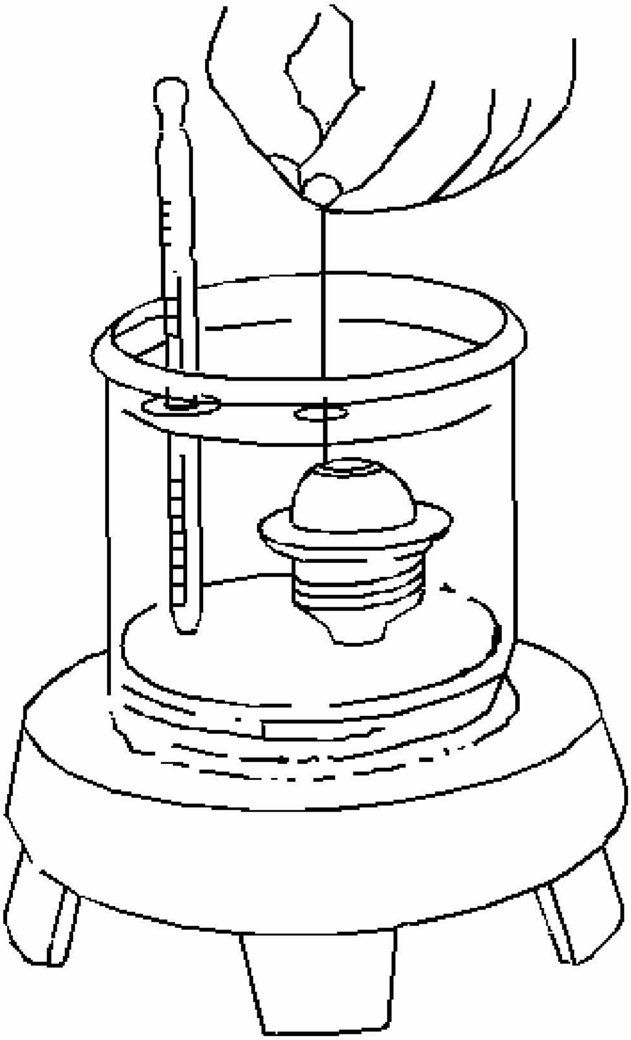


Fig. 5: View Of Thermostat Test Procedure Using Glycol
Courtesy of GENERAL MOTORS CORP.

1. Completely submerge the thermostat in a glycol solution. The solution should be 11°C (22°F) above the temperature indicated on the thermostat valve.
2. Thoroughly agitate the solution. Under these conditions, the thermostat valve should open.

In order to inspect if the thermostat valve is closing properly, perform the following test:

1. Completely submerge the thermostat in a glycol solution. The solution should be 6°C (10°F) below the temperature indicated on the thermostat valve.

2. Thoroughly agitate the solution. Under these conditions, the thermostat valve should close completely.

COOLANT HEATER INOPERATIVE

Coolant Heater Inoperative

Step	Action	Yes	No
DEFINITION: The coolant heater does not warm the engine coolant properly.			
1	Did you perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Cooling**
2	Test the engine coolant heater power supply cord for an open or short to ground. Refer to **Circuit Testing** . Did you find a condition?	Go to **Step 3**	Go to **Step 4**
3	Replace the engine coolant heater power supply cord. Refer to **Coolant Heater Cord Replacement (RPOs LZE/LZ4/LZ9)** or **Coolant Heater Cord Replacement (RPO LS4)**. Did you complete the replacement?	Go to **Step 6**	-
4	Inspect for poor connections at the harness connector of the engine coolant heater. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 6**	Go to **Step 5**
5	Replace the engine coolant heater. Refer to **Coolant Heater Replacement (RPOs LZE/LZ4/LZ9)** or **Coolant Heater Replacement (RPO LS4)**. Did you complete the replacement?	Go to **Step 6**	-
6	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

Engine Fails To Reach Normal Operating Temperature

Step	Action	Value(s)	Yes	No
	Check the coolant level in the radiator surge tank. Refer to **Draining and Filling Cooling System (LS4 Static**			

1	**Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**. Is the coolant at the proper level?	-	Go to **Step 3**	Go to **Step 2**
2	Add coolant to the radiator surge tank as necessary. Does the engine still fail to reach normal operating temperatures?	-	Go to **Step 3**	System OK
3	Check for a blockage in the coolant passages. Are there any blockages in the coolant passages?	-	Go to **Step 4**	Go to **Step 5**
4	Flush the cooling system or flow check the radiator. Refer to **Flushing**. Does the engine still fail to reach normal operating temperatures?	-	Go to **Step 5**	System OK
5	Check to see if the incorrect thermostat was installed or if it is stuck or sticks in the open position. Was the incorrect thermostat installed, or is it stuck or does it stick in the open position?	-	Go to **Step 6**	-
6	Replace the thermostat. Refer to **Thermostat Replacement (RPOs LZE/LZ4/LZ9)** or **Thermostat Replacement (RPO LS4)**. Does the engine still fail to reach normal operating temperature?	-	-	System OK

PRESSURE CAP TESTING

Tools Required

- **J 24460-01** Cooling System Pressure Tester. See **Special Tools**.
- **J 42401** Radiator Cap/Surge Tank Test Adapter. See **Special Tools**.

CAUTION: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system

will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

1. Remove the pressure cap.
2. Wash the pressure cap sealing surface with water.

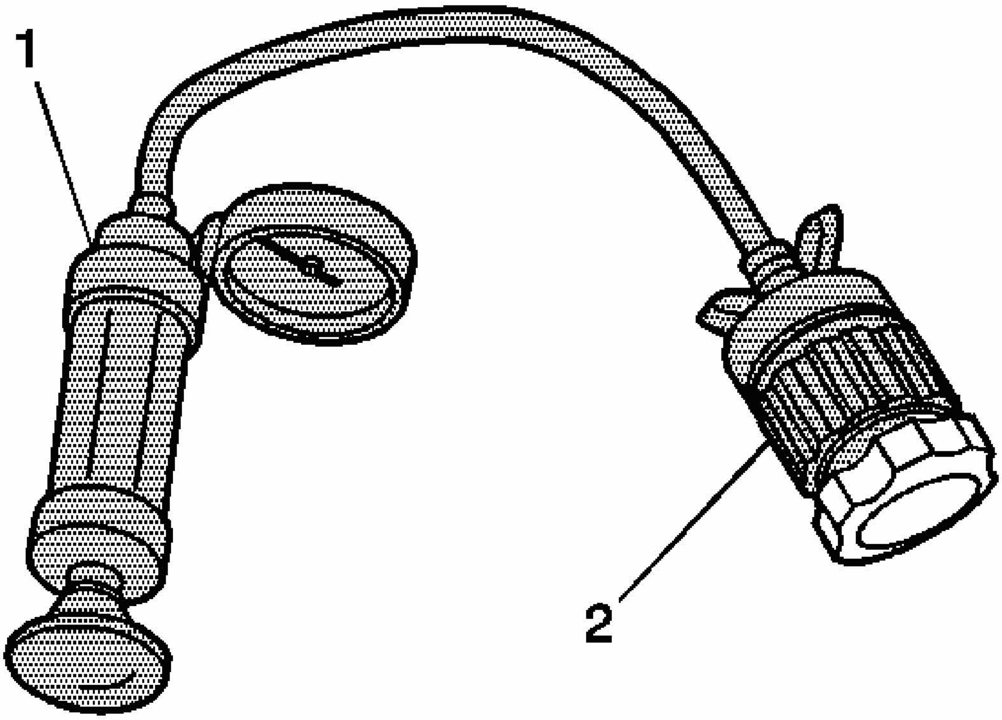


Fig. 6: Pressure Testing Radiator Cap
Courtesy of GENERAL MOTORS CORP.

3. Use the **J 24460-01** (1) with **J 42401** (2) in order to test the pressure cap. See **Special Tools**.
4. Test the pressure cap for the following conditions:
    - Pressure release when the **J 24460-01** exceeds the pressure rating of the pressure cap. See **Special Tools**.
    - Maintain the rated pressure for at least 10 seconds.

      Note the rate of pressure loss.

5. Replace the pressure cap under the following conditions:
    - The pressure cap does not release pressure which exceeds the rated pressure of the cap.
    - The pressure cap does not hold the rated pressure.

COOLING SYSTEM LEAK TESTING

Tools Required

- **J 24460-01** Cooling System Pressure Tester. See **Special Tools**.
- **J 42401** Radiator Cap/Surge Tank Test Adapter. See **Special Tools**.

CAUTION: Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine, fenders, and the person removing the cap. Serious bodily injury may result. Flammable antifreeze, such as alcohol, is not recommended for use at any time. Flammable antifreeze could cause a serious fire.

CAUTION: In order to help avoid being burned, do not remove the radiator cap while the engine and the radiator are hot. Scalding fluid and steam can be blown out under pressure if the cap is removed too soon.

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to **Pressure Cap Testing**.
3. Wash the pressure cap mating surface with water.

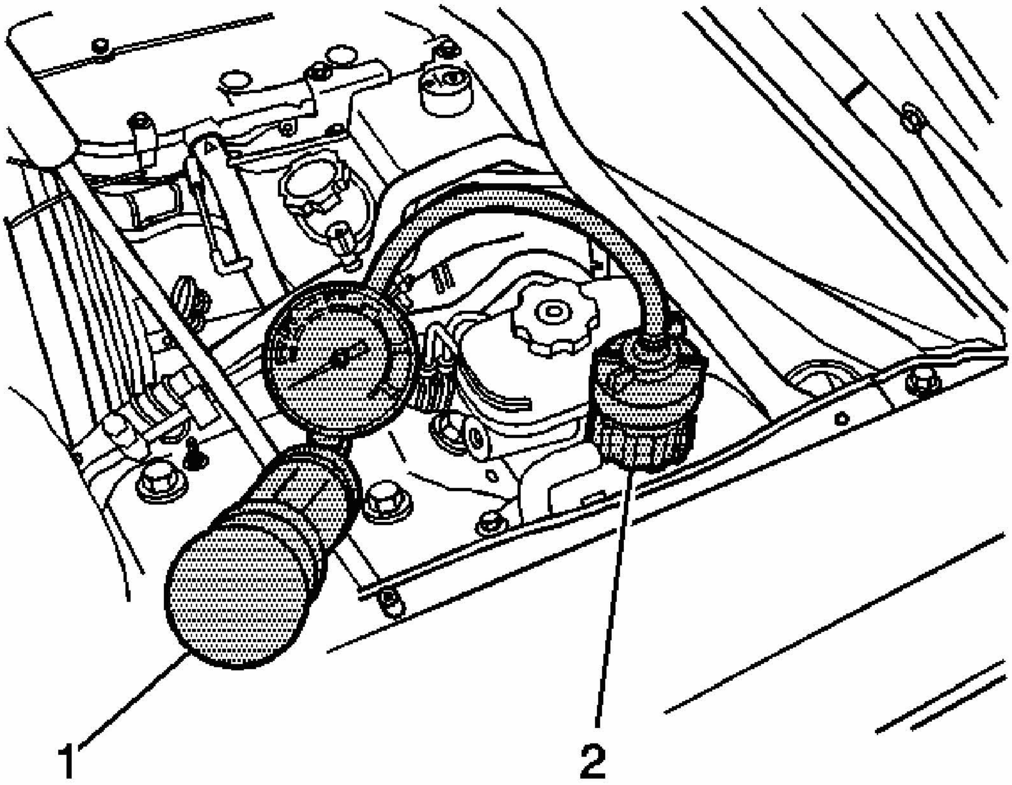


Fig. 7: Applying Pressure To Cooling System
Courtesy of GENERAL MOTORS CORP.

4. Use the **J 24460-01** (1) with **J 42401** (2) in order to apply pressure to the cooling system. See **Special Tools**.

   Do not exceed the pressure cap rating.

5. The cooling system should hold the rated pressure for at least 2 minutes.

   Observe the gage for any pressure loss.

6. Repair any leaks as required.

REPAIR INSTRUCTIONS

DRAINING AND FILLING COOLING SYSTEM (LS4 STATIC FILL)

Draining Procedure

Tools Required

J 26568 Coolant and Battery Tester. See **Special Tools**.

CAUTION: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

IMPORTANT: Draining the cooling system with the pressure cap installed will siphon the coolant from the overflow tank.

1. Remove the coolant pressure cap.
2. Place a drain pan under the drain cock.
3. Open the radiator drain cock.
4. Drain the cooling system.
5. If a complete engine block drain is required, remove the coolant drain plugs from the engine block. Refer to **Draining Fluids and Oil Filter Removal** in Engine Mechanical - 5.3L.
6. Inspect the coolant.
7. Follow the appropriate procedure based on the condition of the coolant.
    - Normal in appearance-Follow the filling procedure.
    - Discolored-Follow the flush procedure. Refer to **Flushing** .

Filling Procedure

NOTE: The procedure below must be followed. Improper coolant level could result in a low or high coolant level condition, causing engine damage.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

1. Close the radiator drain cock.
2. If a complete engine block drain was required, install the coolant drain plugs to the engine block. Refer to **Draining Fluids and Oil Filter Removal** in Engine Mechanical - 5.3L.

IMPORTANT: Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water.

3. Slowly fill the cooling system with a 50/50 coolant mixture until the coolant level is

visible and stable. Refer to **Capacities - Approximate Fluid** .

4. Install the pressure cap loosely (threaded on about one turn).
5. Start the engine and raise the engine speed to 2,500 RPM and hold it there for 40 seconds, then shut engine off.
6. Remove the pressure cap and fill the coolant system until the level is visible and stable.
7. Install the pressure cap loosely (threaded on about one turn).
8. Start the engine and raise the engine speed to 2,500 RPM and hold it there for 30 seconds, then shut engine off.
9. Remove the pressure cap and fill the coolant system until the level is visible and stable.
10. Install the pressure cap loosely (threaded on about one turn).
11. Start the engine and raise the engine speed to 2,500 RPM and hold it there for 20 seconds, then shut engine off.
12. Remove the pressure cap and fill the coolant system until the level is visible and stable.
13. Install the pressure cap, fully threaded on.
14. Fill the coolant recovery bottle to the indicator line, then add 400 milliliters (13.5 ounces) more.
15. Start the engine and run it above 2500 RPM until it is hot enough to open the thermostat, this will allow the trapped air to be purged from the engine.
16. Complete a series of three, four-second-duration idles with four-second-duration 3000 RPM cycles.
17. Turn the engine off and allow it to cool down.
18. Fill the coolant recovery bottle to the indicator line.
19. Inspect the concentration of the engine coolant using the **J 26568** . See **Special Tools**.
20. Rinse away any excess coolant from the engine and the engine compartment.

DRAINING AND FILLING COOLING SYSTEM (LZE, LZ4, LZ9 STATIC FILL)

Draining Procedure

Tools Required

J 26568 Coolant and Battery Tester. See **Special Tools**.

CAUTION: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

IMPORTANT: Draining the cooling system with the pressure cap installed will siphon the coolant from the overflow tank.

1. Remove the coolant pressure cap.
2. Place a drain pan under the drain cock.
3. Open the radiator drain cock.
4. Drain the cooling system.
5. If a complete engine block drain is required, remove the coolant drain plugs from the engine block. Refer to **Draining Fluids and Oil Filter Removal** in Engine Mechanical - 3.5L engine or to **Draining Fluids and Oil Filter Removal** in Engine Mechanical - 3.9L engine.
6. Inspect the coolant.
7. Follow the appropriate procedure based on the condition of the coolant.
    - Normal in appearance-Follow the filling procedure.
    - Discolored-Follow the flush procedure. Refer to **Flushing** .

Filling Procedure

NOTE: The procedure below must be followed. Improper coolant level could result in a low or high coolant level condition, causing engine damage.

NOTE: Refer to FASTENER NOTICE .

1. Close the radiator drain cock.
2. If a complete engine block drain was required, install the coolant drain plugs to the engine block. Refer to **Draining Fluids and Oil Filter Removal** in Engine Mechanical - 3.5L engine or to **Draining Fluids and Oil Filter Removal** in Engine Mechanical - 3.9L engine.

IMPORTANT: Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water.

3. Slowly fill the cooling system with a 50/50 coolant mixture until the coolant level is visible and stable. Refer to **Capacities - Approximate Fluid** .
4. Install the pressure cap loosely (threaded on about one turn).
5. Start the engine and raise the engine speed to 2500 RPM and hold it there for 40 seconds, then shut engine off.
6. Remove the pressure cap and fill the coolant system until the level is visible and stable.
7. Install the pressure cap loosely (threaded on about one turn).
8. Start the engine and raise the engine speed to 2500 RPM and hold it there for 30 seconds, then shut engine off.

9. Remove the pressure cap and fill the coolant system until the level is visible and stable.
10. Install the pressure cap loosely (threaded on about one turn).
11. Start the engine and raise the engine speed to 2500 RPM and hold it there for 20 seconds, then shut engine off.
12. Remove the pressure cap and fill the coolant system until the level is visible and stable.
13. Install the pressure cap, fully threaded on.
14. Fill the coolant recovery bottle to the indicator line, then add 400 milliliters (13.5 ounces) more.
15. Start the engine and run it above 2500 RPM until it is hot enough to open the thermostat, this will allow the trapped air to be purged from the engine.
16. Complete a series of three, four-second-duration idles with four-second-duration 3000 RPM cycles.
17. Turn the engine off and allow it to cool down to room temperature.
18. Repeat steps 15 through 17 two times.
19. Fill the coolant recovery bottle to the indicator line.
20. Inspect the concentration of the engine coolant using the **J 26568** . See **Special Tools**.
21. Rinse away any excess coolant from the engine and the engine compartment.

DRAINING AND FILLING COOLING SYSTEM (9C1, 9C3 STATIC FILL)

Draining Procedure

Tools Required

J 26568 Coolant and Battery Tester. See **Special Tools**.

CAUTION: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

IMPORTANT: Draining the cooling system with the pressure cap installed will siphon the coolant from the overflow tank.

1. Remove the coolant pressure cap.
2. Place a drain pan under the drain cock.
3. Open the radiator drain cock.
4. Drain the cooling system.
5. If a complete engine block drain is required, remove the coolant drain plugs from the engine block. Refer to **Draining Fluids and Oil Filter Removal** in Engine Mechanical

- 3.5L engine or to **Draining Fluids and Oil Filter Removal** in Engine Mechanical - 3.9L engine.

6. Inspect the coolant.
7. Follow the appropriate procedure based on the condition of the coolant.
   - Normal in appearance-Follow the filling procedure.
   - Discolored-Follow the flush procedure. Refer to **Flushing** .

Filling Procedure

NOTE: The procedure below must be followed. Improper coolant level could result in a low or high coolant level condition, causing engine damage.

NOTE: Refer to FASTENER NOTICE .

1. Close the radiator drain cock.
2. If a complete engine block drain was required, install the coolant drain plugs to the engine block. Refer to **Draining Fluids and Oil Filter Removal** in Engine Mechanical - 3.5L engine or to **Draining Fluids and Oil Filter Removal** in Engine Mechanical - 3.9L engine.

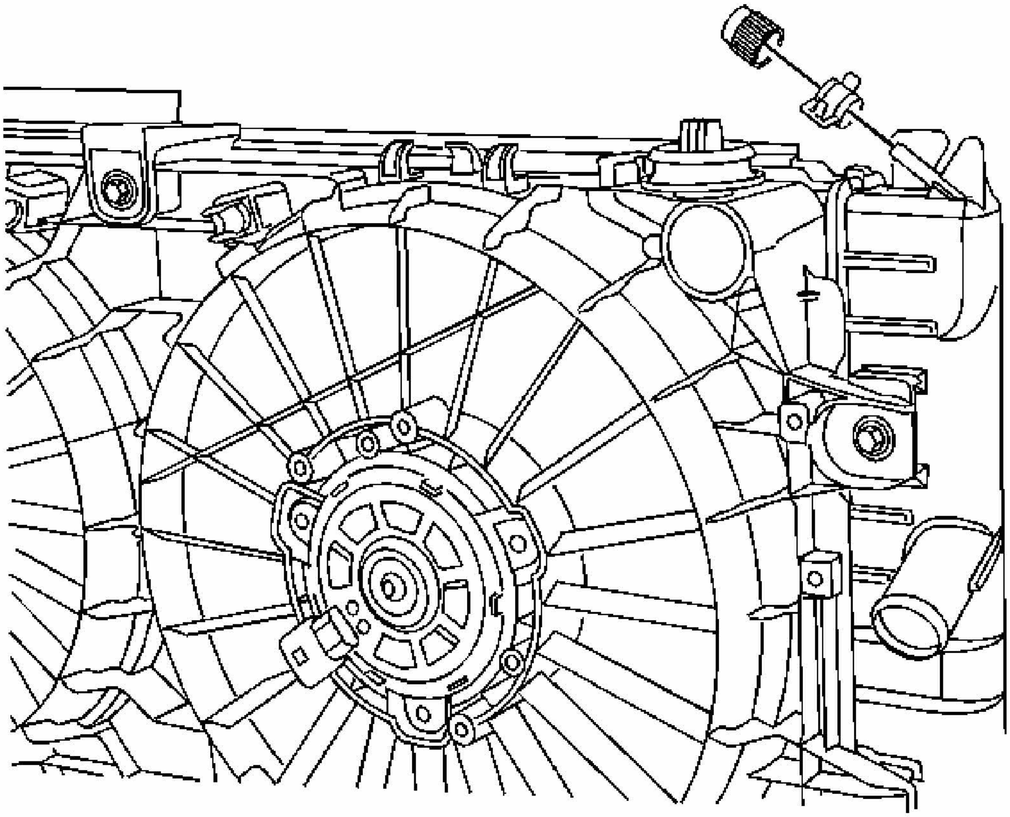


Fig. 8: Locating Vent Cap From The Top Right Side Of The Radiator
Courtesy of GENERAL MOTORS CORP.

3. Remove the vent cap from the top right side of the radiator.

IMPORTANT: Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water.

4. Slowly fill the cooling system with a 50/50 coolant mixture until the coolant comes out of the radiator vent. Refer to **Capacities - Approximate Fluid** .

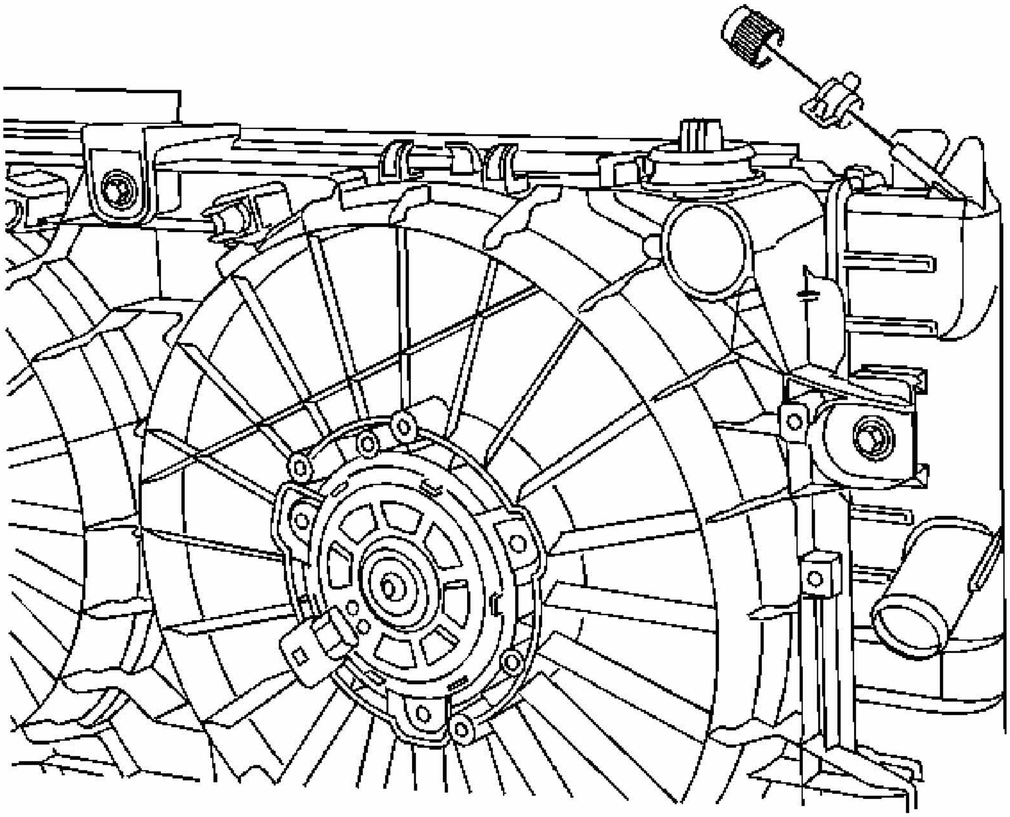


Fig. 9: Locating Vent Cap To The Top Right Side Of The Radiator
Courtesy of GENERAL MOTORS CORP.

5. Install the vent cap to the top right side of the radiator.
6. Slowly fill the cooling system with a 50/50 coolant mixture until the coolant level is visible and stable at the fill neck.
7. Install the pressure cap loosely (threaded on about one turn).
8. Start the engine and raise the engine speed to 2500 RPM and hold it there for 40 seconds, then shut engine off.
9. Remove the pressure cap and fill the coolant system until the level is visible and stable.
10. Install the pressure cap loosely (threaded on about one turn).
11. Start the engine and raise the engine speed to 2500 RPM and hold it there for 30 seconds, then shut engine off.
12. Remove the pressure cap and fill the coolant system until the level is visible and stable.
13. Install the pressure cap loosely (threaded on about one turn).
14. Start the engine and raise the engine speed to 2500 RPM and hold it there for 20

seconds, then shut engine off.

15. Remove the pressure cap and fill the coolant system until the level is visible and stable.
16. Install the pressure cap, fully threaded on.
17. Fill the coolant recovery bottle to the indicator line, then add 400 milliliters (13.5 ounces) more.
18. Start the engine and run it above 2500 RPM until it is hot enough to open the thermostat, this will allow the trapped air to be purged from the engine.
19. Complete a series of three, four-second-duration idles with four-second-duration 3000 RPM cycles.
20. Turn the engine off and allow it to cool down to room temperature.
21. Repeat steps 18 through 20 two times.
22. Fill the coolant recovery bottle to the indicator line.
23. Inspect the concentration of the engine coolant using the **J 26568** . See **Special Tools**.
24. Rinse away any excess coolant from the engine and the engine compartment.

DRAINING AND FILLING COOLING SYSTEM (LS4 GE 47716 FILL)

Tools Required

- **J 26568** Coolant and Battery Tester. See **Special Tools**.
- **J 42401** Radiator Cap/Surge Tank Test Adapter. See **Special Tools**.
- **GE-47716** Vac N Fill Coolant Refill Tool. See **Special Tools**.

Draining Procedure

CAUTION: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

IMPORTANT: Draining the cooling system with the pressure cap installed will siphon the coolant from the overflow tank.

1. Remove the coolant pressure cap.
2. Place a drain pan under the drain cock.
3. Open the radiator drain cock.
4. Drain the cooling system.
5. If a complete engine block drain is required, remove the engine block drain plugs. Refer to **Draining Fluids and Oil Filter Removal** .
6. Inspect the coolant.

7. Follow the appropriate procedure based on the condition of the coolant.
    - Normal in appearance-Follow the filling procedure.
    - Discolored-Follow the flush procedure. Refer to **Flushing** .

Vac-N-Fill Procedure

1. If a complete engine block drain was required, install the engine block drain plugs. Refer to **Draining Fluids and Oil Filter Removal** .

IMPORTANT: To prevent boiling of the coolant/water mixture in the vehicle's cooling system, do not apply vacuum to a cooling system above 49°C (120°F). The tool will not operate properly when the coolant is boiling.

2. Install the **J 42401** to the coolant fill port. See **Special Tools**.

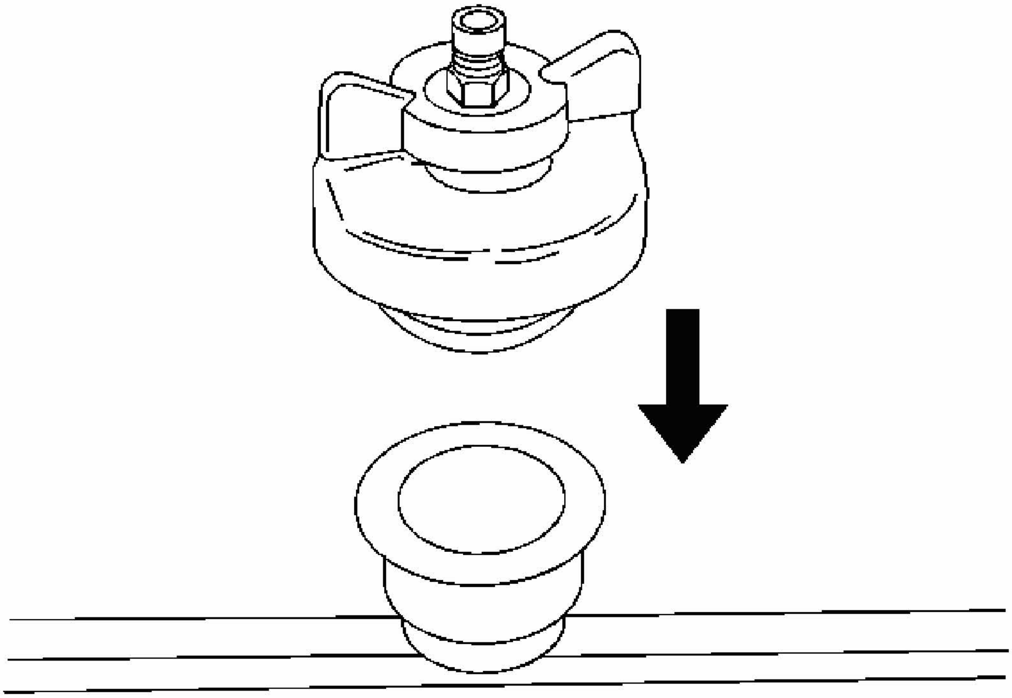


Fig. 10: Attaching The Vac N Fill Cap To The J 42401
Courtesy of GENERAL MOTORS CORP.

Attach the Vac N Fill cap to the **J 42401** . See **Special Tools**.

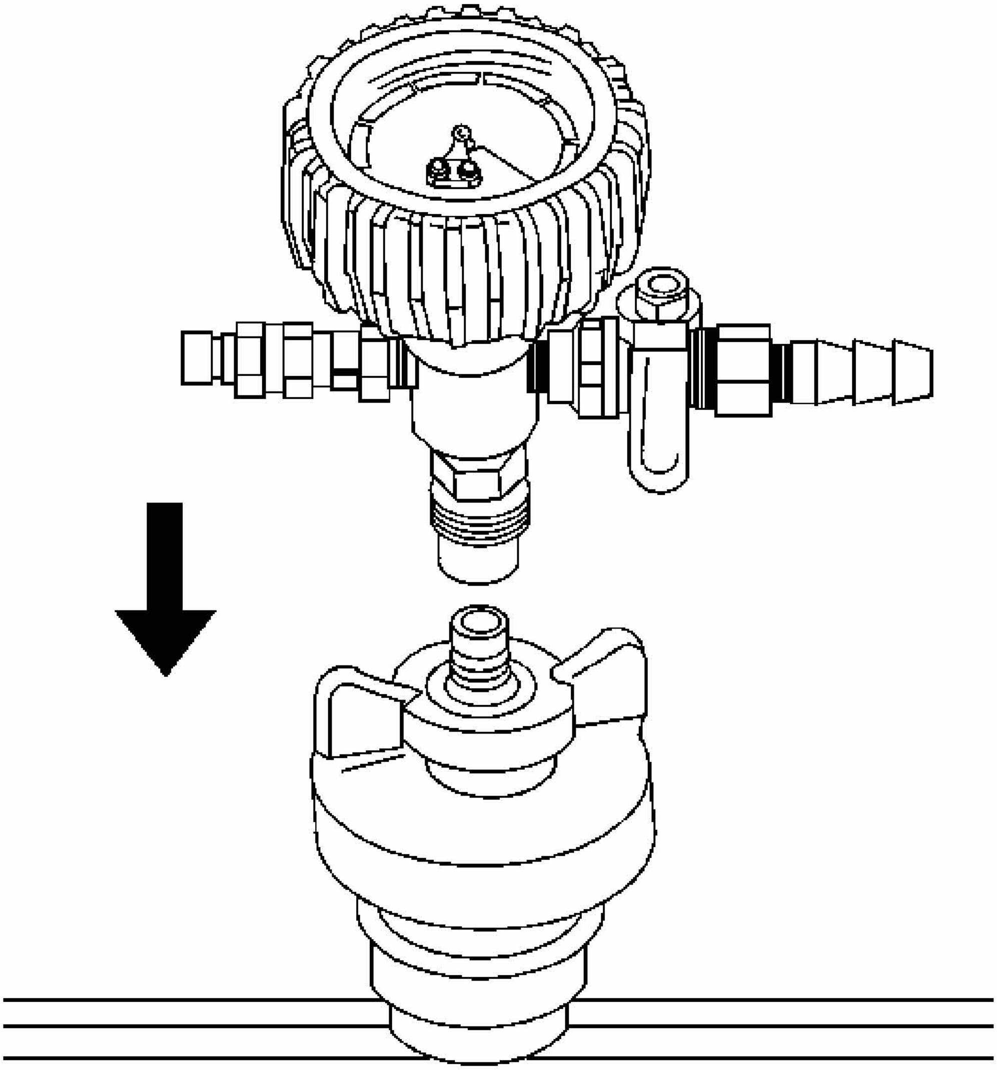


Fig. 11: Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

3. Attach the vacuum gage assembly to the Vac N Fill cap.

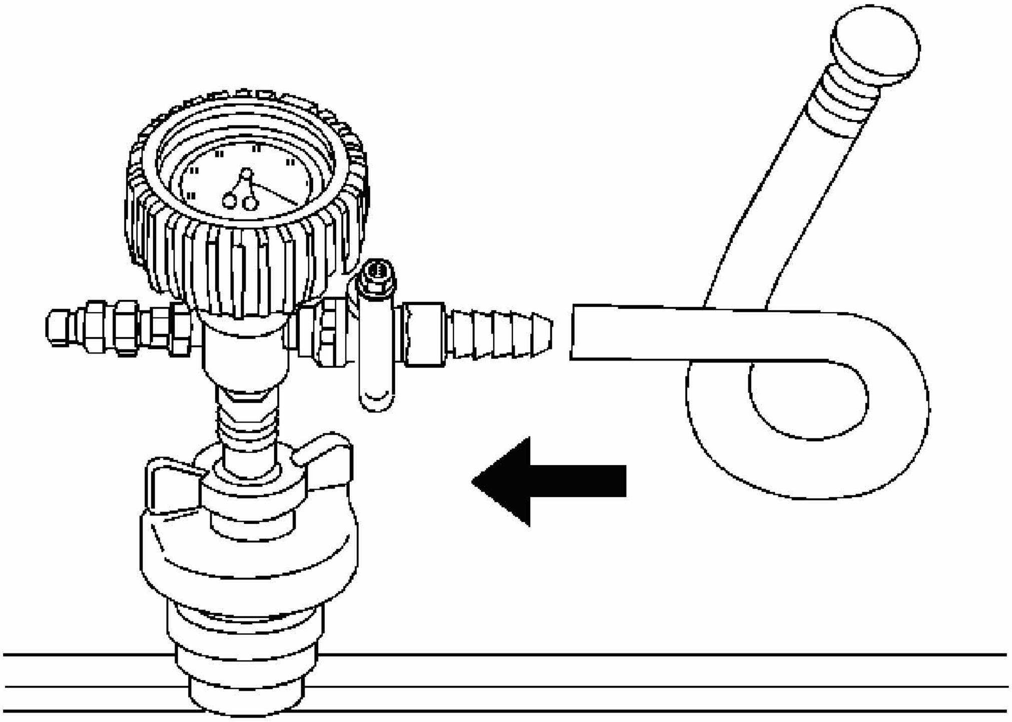


Fig. 12: Identifying Fill Hose
Courtesy of GENERAL MOTORS CORP.

4. Attach the fill hose to the barb fitting on the vacuum gage assembly.

   Ensure that the valve is closed.

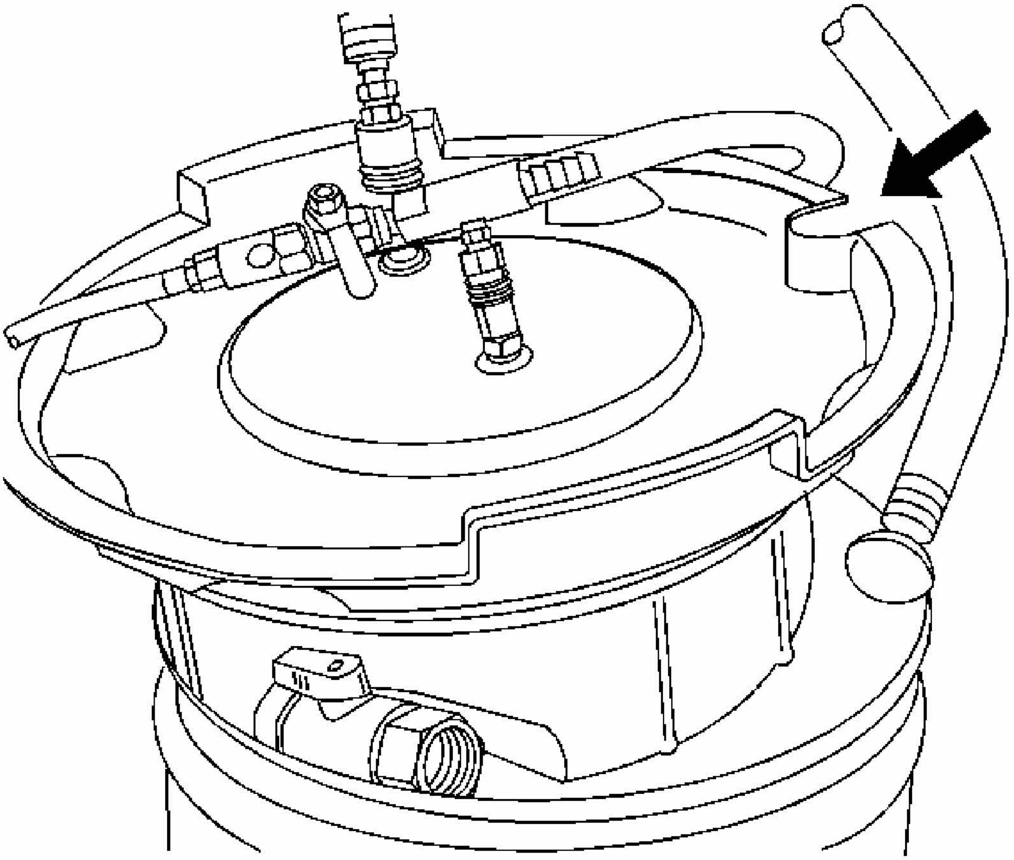


Fig. 13: Identifying Graduated Reservoir
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water. Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.

5. Pour the coolant mixture into the graduated reservoir.
6. Place the fill hose in the graduated reservoir.

IMPORTANT: Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.

7. Install the vacuum tank on the graduated reservoir with the fill hose routed through the cut-out area in the vacuum tank.

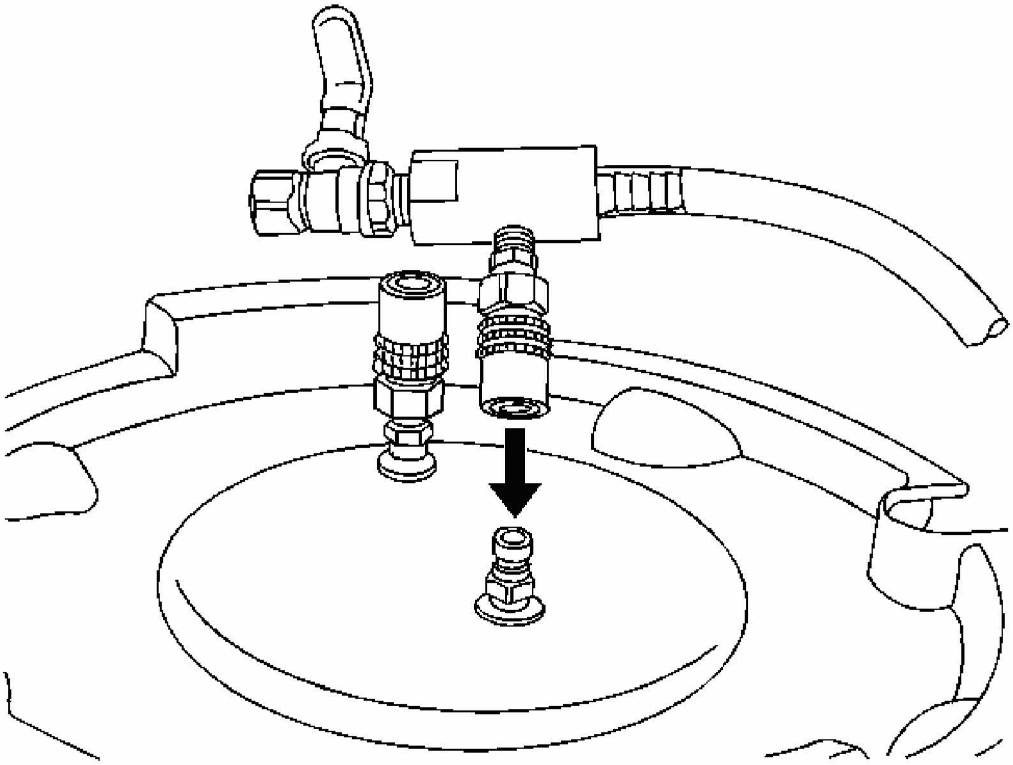


Fig. 14: Identifying Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

8. Attach the venturi assembly to the vacuum tank.

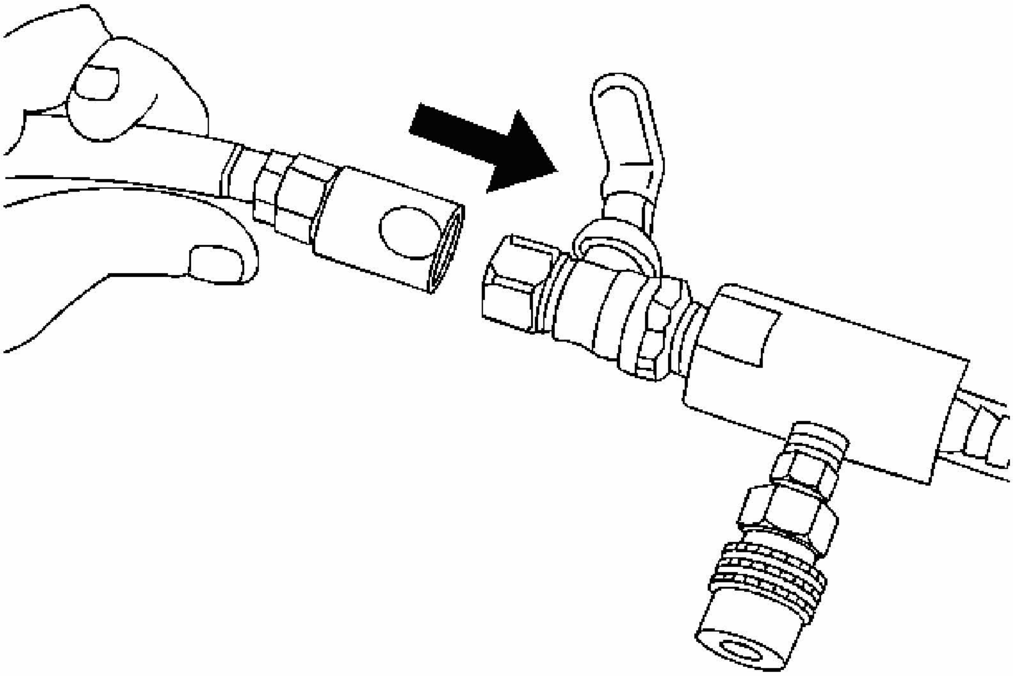


Fig. 15: Attaching A Shop Air Hose To The Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

9. Attach a shop air hose to the venturi assembly.

   Ensure the valve on the venturi assembly is closed.

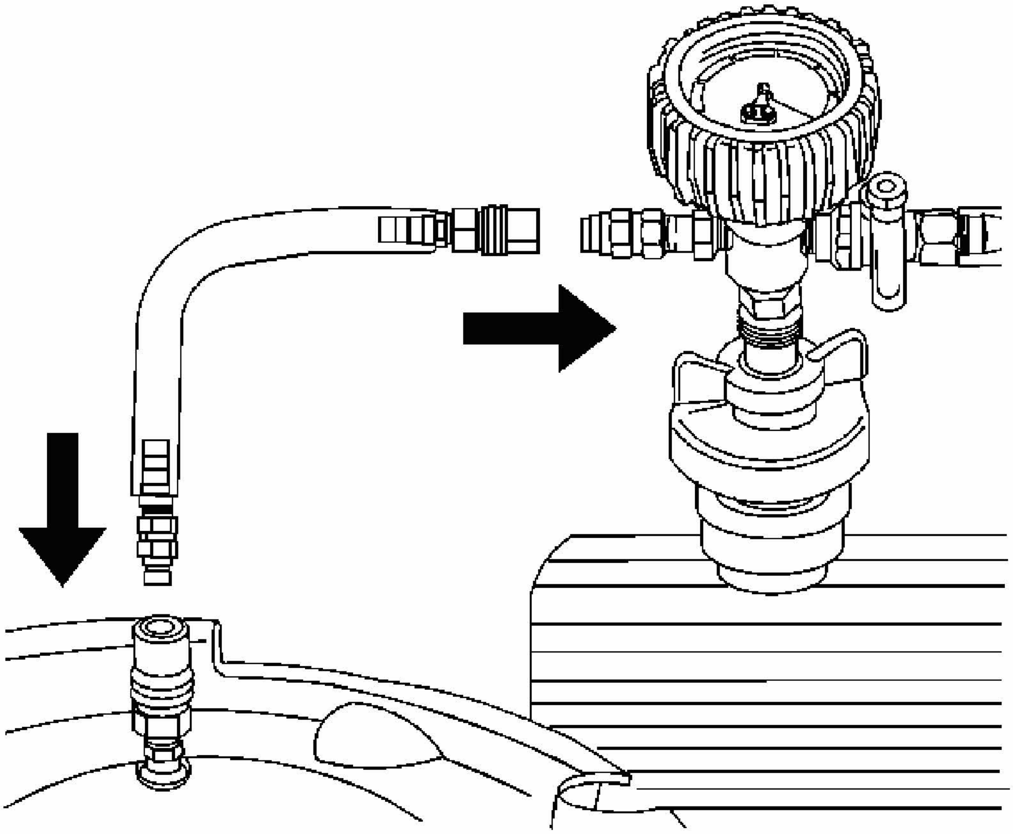


Fig. 16: Identifying Vacuum Hose To Vacuum Gage Assembly And Vacuum Tank
Courtesy of GENERAL MOTORS CORP.

10. Attach the vacuum hose to the vacuum gage assembly and the vacuum tank.

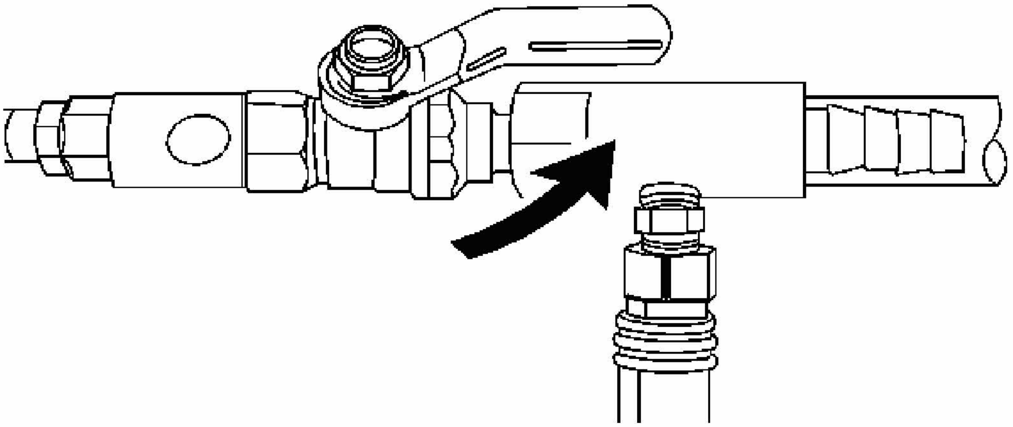


Fig. 17: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

11. Open the valve on the venturi assembly. The vacuum gage will begin to rise and a hissing noise will be present.

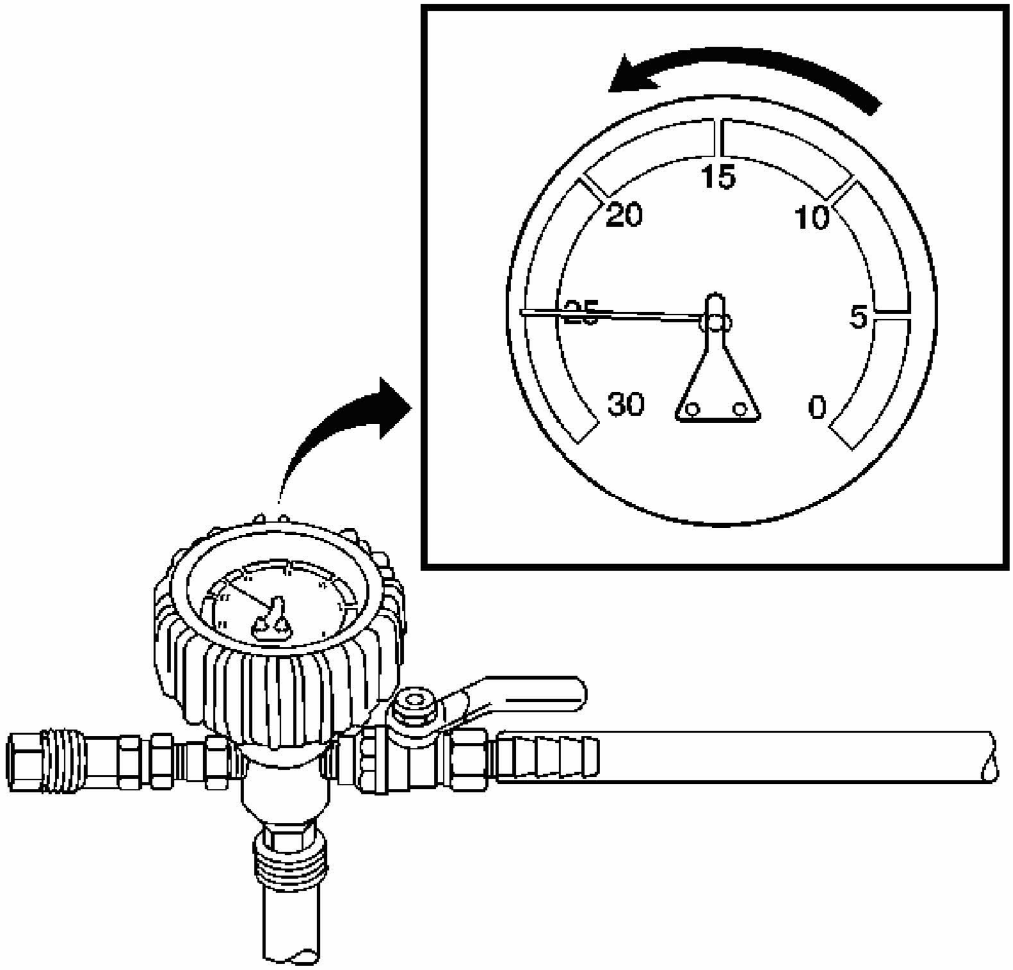


Fig. 18: View Of Vacuum Gauge
Courtesy of GENERAL MOTORS CORP.

12. Continue to draw vacuum until the needle stops rising. This should be 610-660 mm Hg (24-26 in Hg).

    Cooling hoses may start to collapse. This is normal due to vacuum draw.

13. To aid in the fill process, position the graduated reservoir above the coolant fill port.

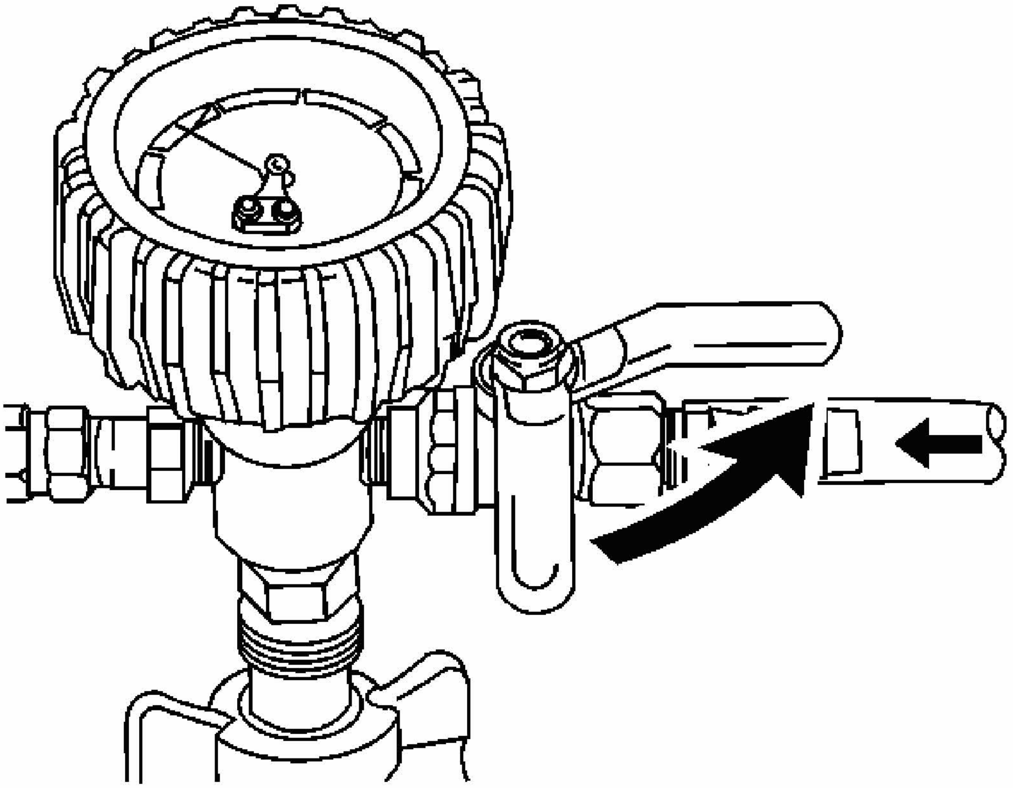


Fig. 19: Identifying Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

14. Slowly open the valve on the vacuum gage assembly. When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.
15. Close the valve on the venturi assembly.
16. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss.

    If vacuum loss is observed. Refer to **Loss of Coolant**.

17. Open the valve on the vacuum gage assembly. The vacuum gage will drop as coolant is drawn into the system.

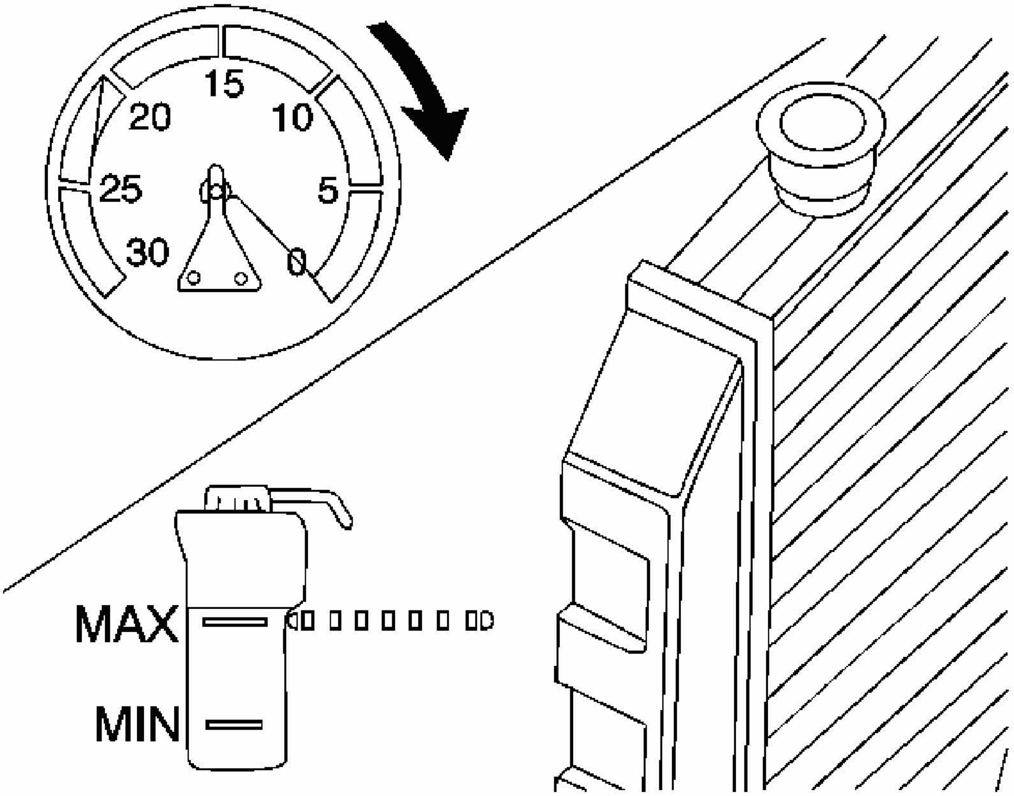


Fig. 20: View Of Vacuum Gauge & Radiator
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Complete 2 vacuum pulls to sufficiently fill the cooling system.

18. Once the vacuum gage reaches zero, close the valve on the vacuum gage assembly and repeat steps 11-17.
19. Detach the Vac N Fill cap from the **J 42401** . See **Special Tools**.
20. Remove the **J 42401** from the coolant fill port. See **Special Tools**.
21. Add coolant to the system as necessary.
22. Inspect the concentration of the coolant mixture using the **J 26568** . See **Special Tools**.

IMPORTANT: After filling the cooling system, the extraction hose can be used to remove excess coolant to achieve the proper coolant level.

23. Detach the vacuum hose from the vacuum gage assembly.

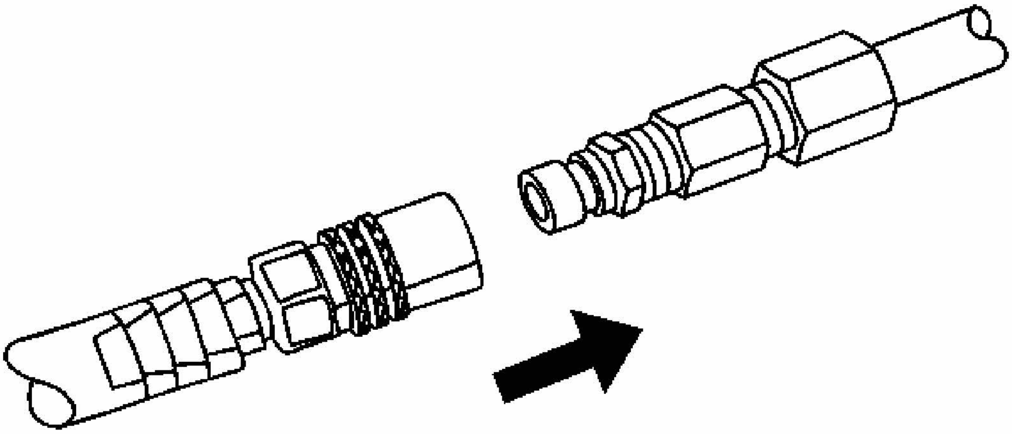


Fig. 21: Identifying Extraction Hose
Courtesy of GENERAL MOTORS CORP.

24. Attach the extraction hose to the vacuum hose.

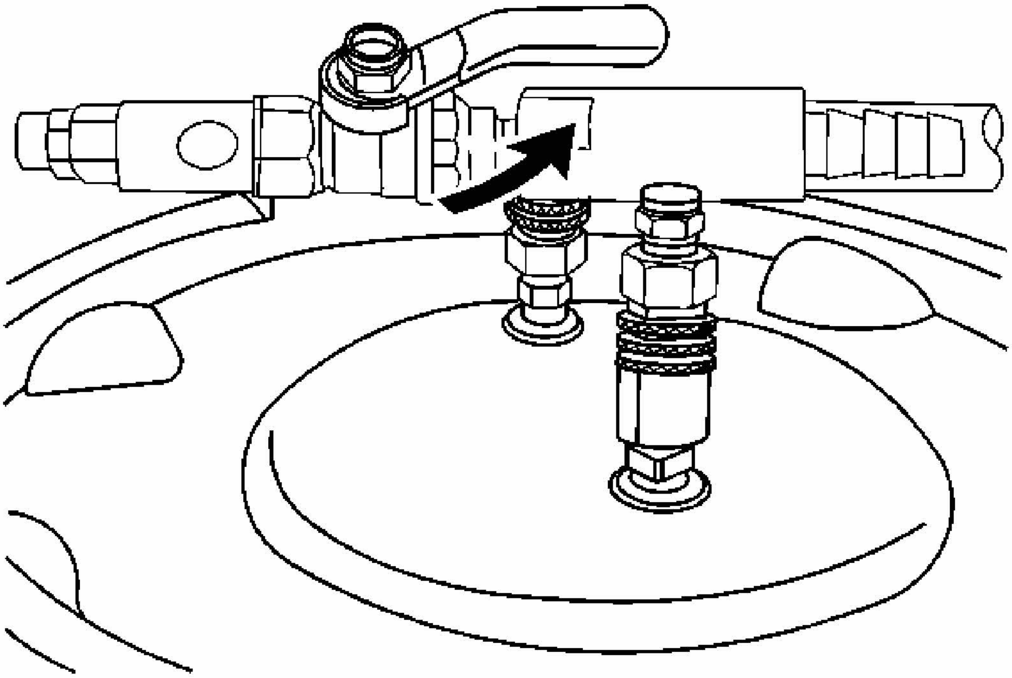


Fig. 22: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

25. Open the valve on the venturi assembly to start a vacuum draw.

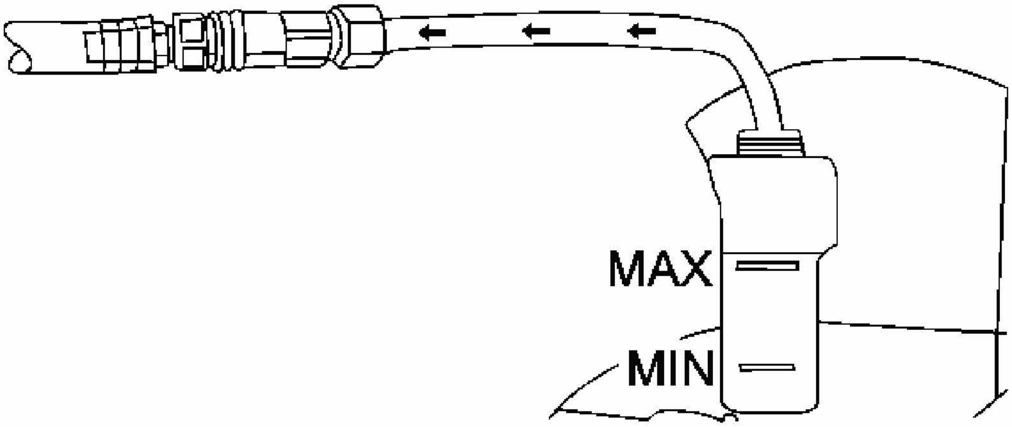


Fig. 23: Identifying Extraction Hose
Courtesy of GENERAL MOTORS CORP.

26. Use the extraction hose to draw out coolant to the proper level.
27. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.
28. Fill the coolant recovery bottle to the indicator line, then add 400 milliliters (13.5 ounces) more.
29. Start the engine and run it above 2500 RPM until it is hot enough to open the thermostat.
30. Complete a series of 3, 4-second-duration idles with 4-second-duration 3,000 RPM cycles.
31. Turn the engine OFF and allow it to cool down to room temperature.
32. Fill the coolant recovery bottle to the indicator line.

DRAINING AND FILLING COOLING SYSTEM (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 FILL)

Tools Required

- **J 26568** Coolant and Battery Tester. See **Special Tools**.
- **J 42401** Radiator Cap/Surge Tank Test Adapter. See **Special Tools**.
- **GE-47716** Vac N Fill Coolant Refill Tool. See **Special Tools**.

Draining Procedure

CAUTION: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

IMPORTANT: Draining the cooling system with the pressure cap installed will siphon the coolant from the overflow tank.

1. Remove the coolant pressure cap.
2. Place a drain pan under the drain cock.
3. Open the radiator drain cock.
4. Drain the cooling system.
5. If a complete engine block drain is required, remove the coolant drain plugs from the engine block. Refer to **Draining Fluids and Oil Filter Removal** for the 3.5L engine or to **Draining Fluids and Oil Filter Removal** for the 3.9L engine.
6. Inspect the coolant.
7. Follow the appropriate procedure based on the condition of the coolant.
    - Normal in appearance-Follow the filling procedure.
    - Discolored-Follow the flush procedure. Refer to **Flushing** .

Vac-N-Fill Procedure

1. If a complete engine block drain was required, install the coolant drain plugs to the engine block. Refer to **Draining Fluids and Oil Filter Removal** for the 3.5L engine or to **Draining Fluids and Oil Filter Removal** for the 3.9L engine.

IMPORTANT: To prevent boiling of the coolant/water mixture in the vehicle's cooling system, do not apply vacuum to a cooling system above 49°C (120°F). The tool will not operate properly when the coolant is boiling.

2. Install the **J 42401** to the coolant fill port. See **Special Tools**.

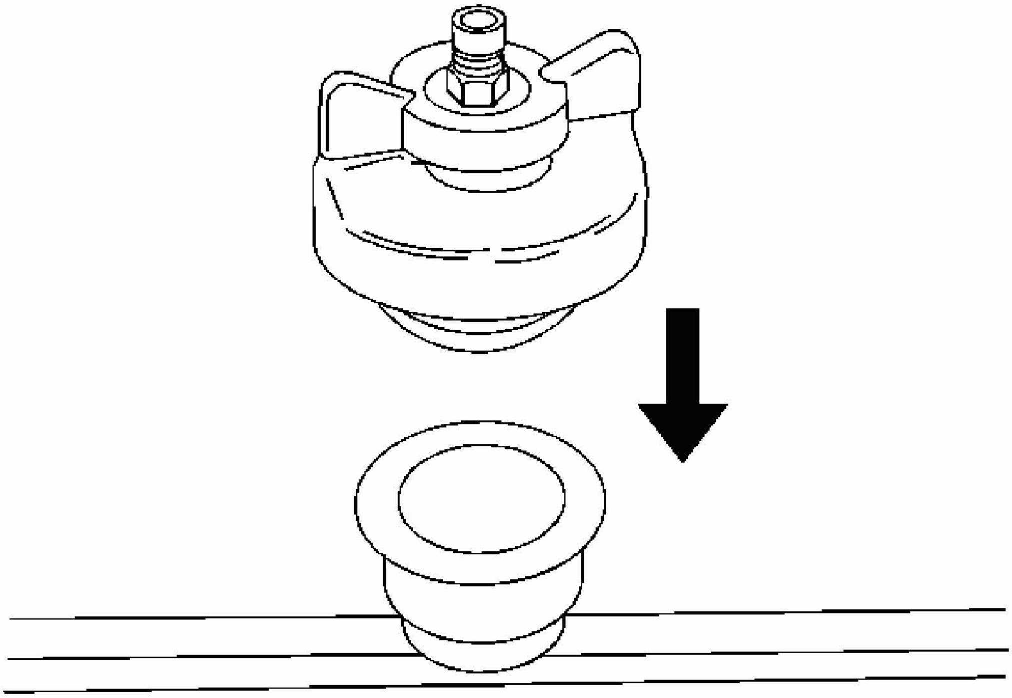


Fig. 24: Attach The Vac N Fill Cap To The J 42401
Courtesy of GENERAL MOTORS CORP.

Attach the Vac N Fill cap to the **J 42401** . See **Special Tools**.

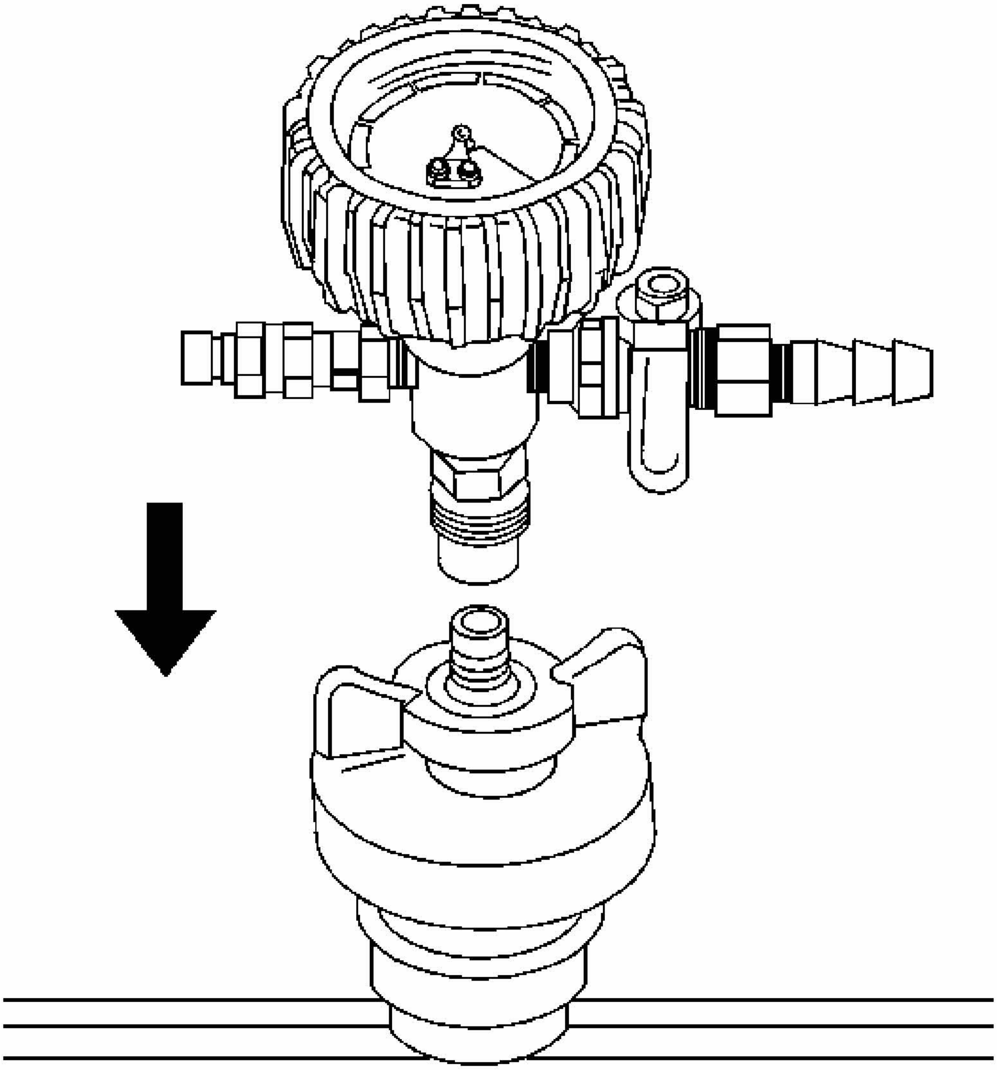


Fig. 25: Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

3. Attach the vacuum gage assembly to the Vac N Fill cap.

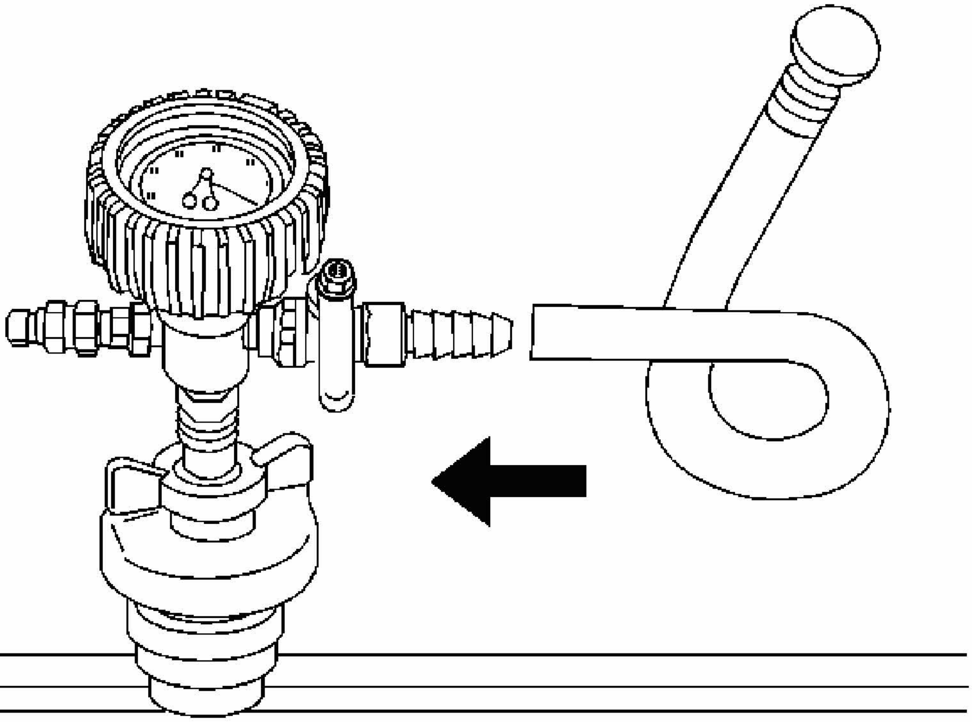


Fig. 26: Identifying Fill Hose
Courtesy of GENERAL MOTORS CORP.

4. Attach the fill hose to the barb fitting on the vacuum gage assembly.

   Ensure that the valve is closed.

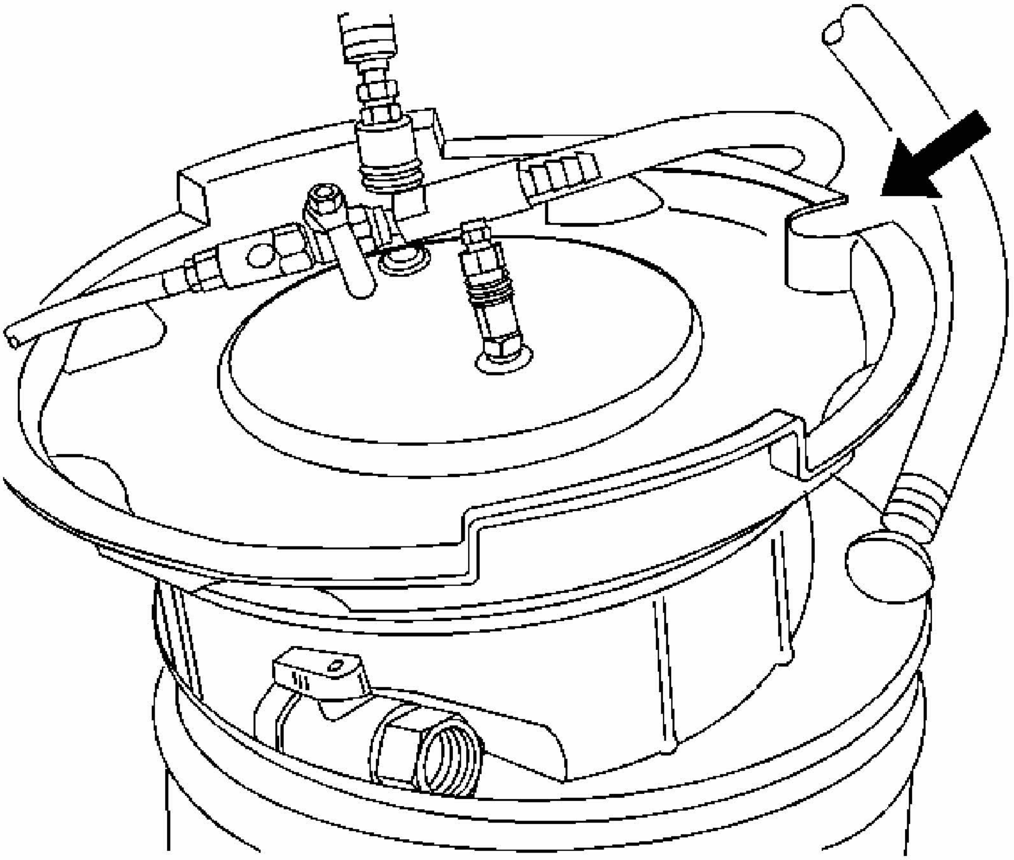


Fig. 27: Identifying Graduated Reservoir
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT: Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water.
Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.**

5. Pour the coolant mixture into the graduated reservoir.
6. Place the fill hose in the graduated reservoir.

IMPORTANT: Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.

7. Install the vacuum tank on the graduated reservoir with the fill hose routed through the cut-out area in the vacuum tank.

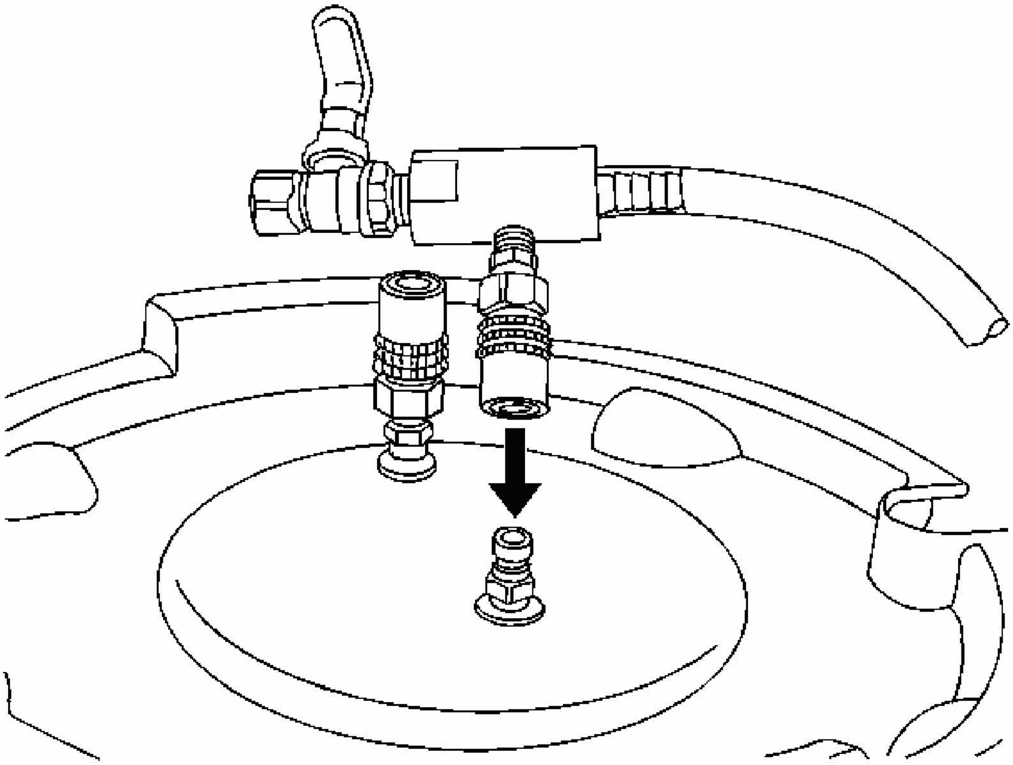


Fig. 28: Identifying Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

8. Attach the venturi assembly to the vacuum tank.

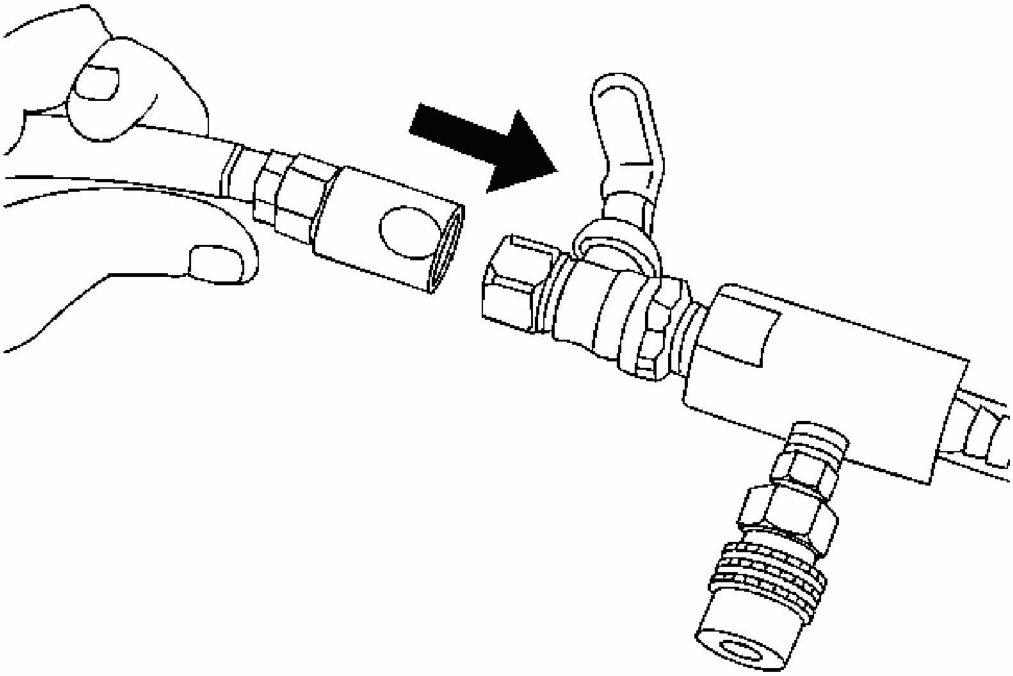


Fig. 29: Attaching A Shop Air Hose To The Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

9. Attach a shop air hose to the venturi assembly.

   Ensure the valve on the venturi assembly is closed.

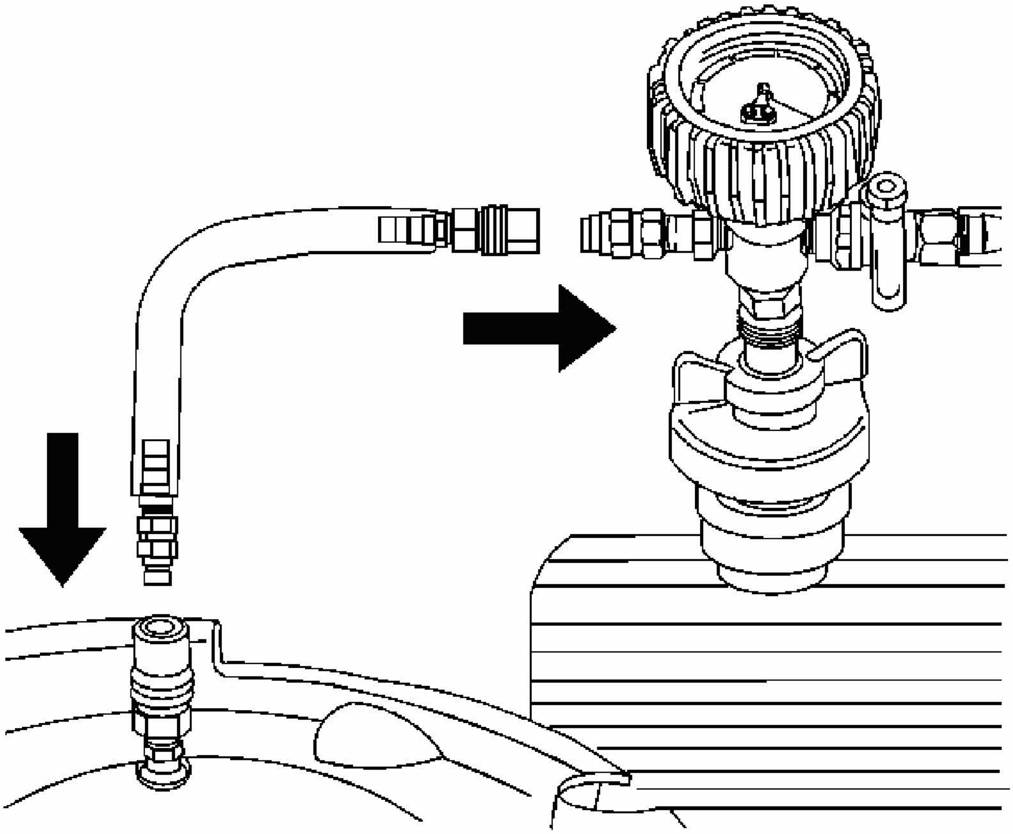


Fig. 30: Identifying Vacuum Hose To Vacuum Gage Assembly And Vacuum Tank
Courtesy of GENERAL MOTORS CORP.

10. Attach the vacuum hose to the vacuum gage assembly and the vacuum tank.

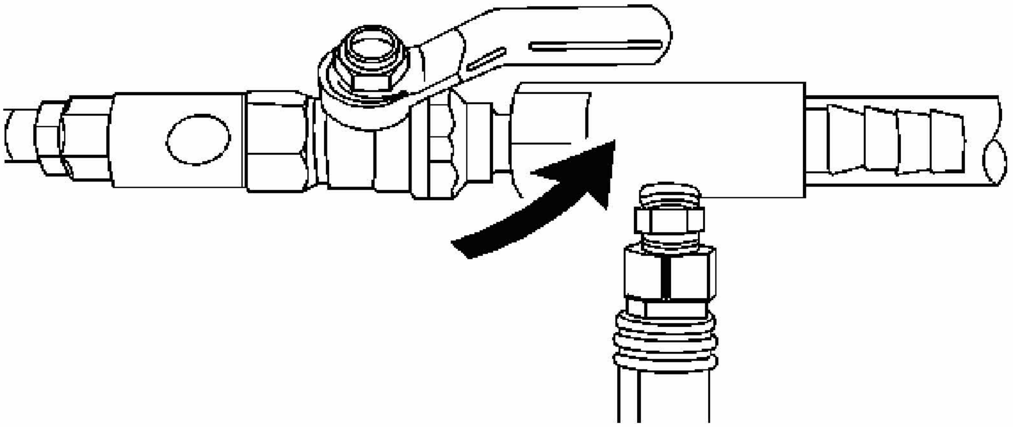


Fig. 31: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

11. Open the valve on the venturi assembly. The vacuum gage will begin to rise and a hissing noise will be present.

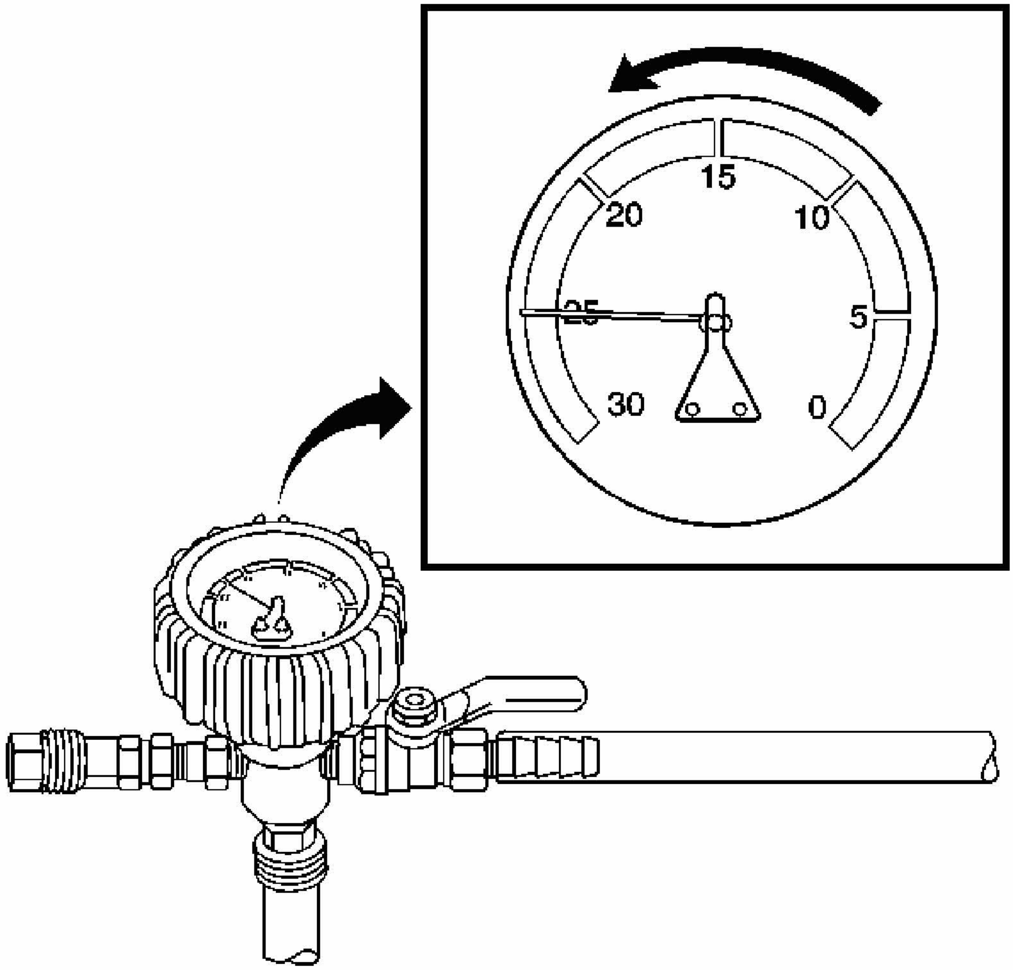


Fig. 32: View Of Vacuum Gauge
Courtesy of GENERAL MOTORS CORP.

12. Continue to draw vacuum until the needle stops rising. This should be 610-660 mm Hg (24-26 in Hg).

    Cooling hoses may start to collapse. This is normal due to vacuum draw.

13. To aid in the fill process, position the graduated reservoir above the coolant fill port.

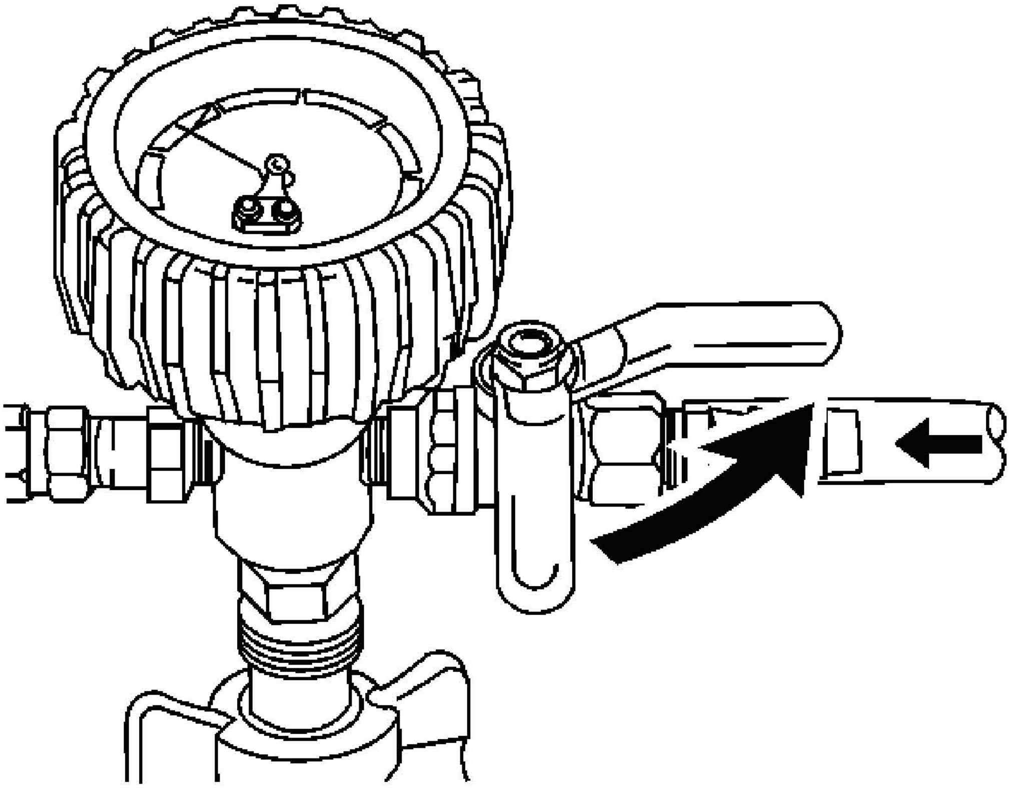


Fig. 33: Identifying Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

14. Slowly open the valve on the vacuum gage assembly. When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.
15. Close the valve on the venturi assembly.
16. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss.

    If vacuum loss is observed. Refer to **Loss of Coolant**.

17. Open the valve on the vacuum gage assembly. The vacuum gage will drop as coolant is drawn into the system.

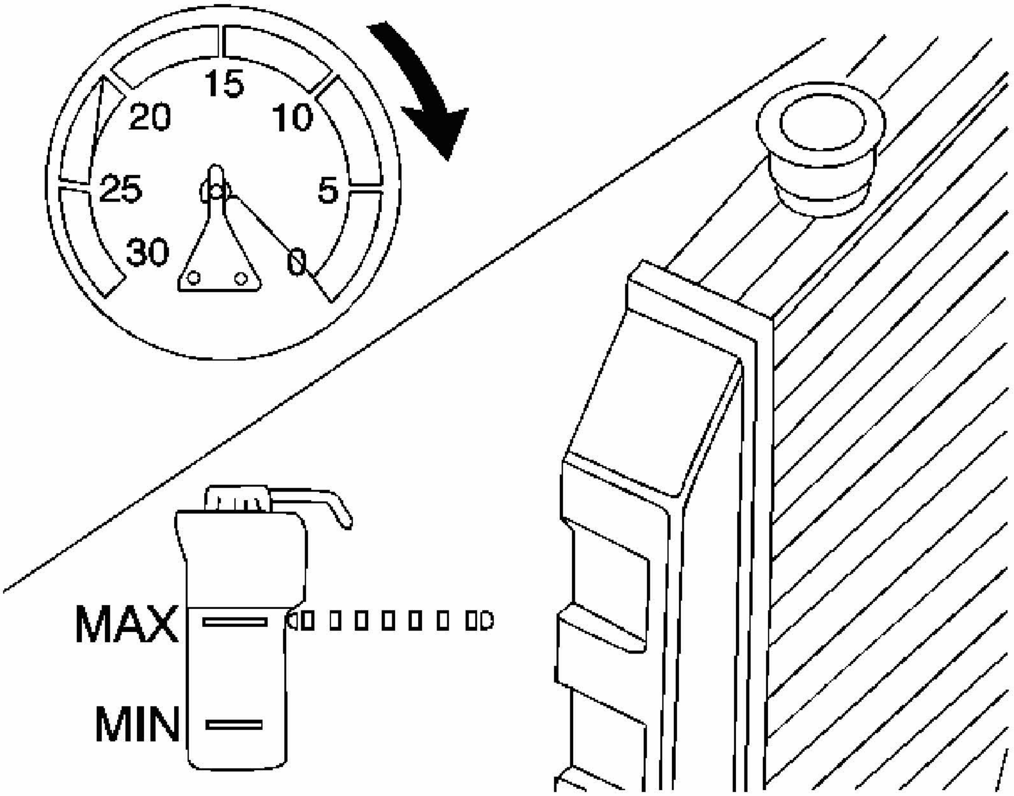


Fig. 34: View Of Vacuum Gauge & Radiator
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Complete 2 vacuum pulls to sufficiently fill the cooling system.

18. Once the vacuum gage reaches zero, close the valve on the vacuum gage assembly and repeat steps 11-17.
19. Detach the Vac N Fill cap from the **J 42401** . See **Special Tools**.
20. Remove the **J 42401** from the coolant fill port. See **Special Tools**.
21. Add coolant to the system as necessary.
22. Inspect the concentration of the coolant mixture using the **J 26568** . See **Special Tools**.

IMPORTANT: After filling the cooling system, the extraction hose can be used to remove excess coolant to achieve the proper coolant level.

23. Detach the vacuum hose from the vacuum gage assembly.

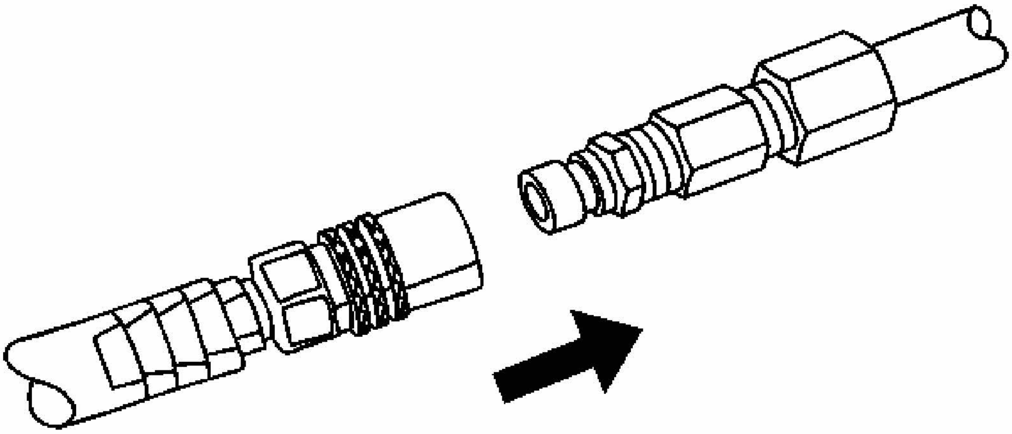


Fig. 35: Identifying Extraction Hose
Courtesy of GENERAL MOTORS CORP.

24. Attach the extraction hose to the vacuum hose.

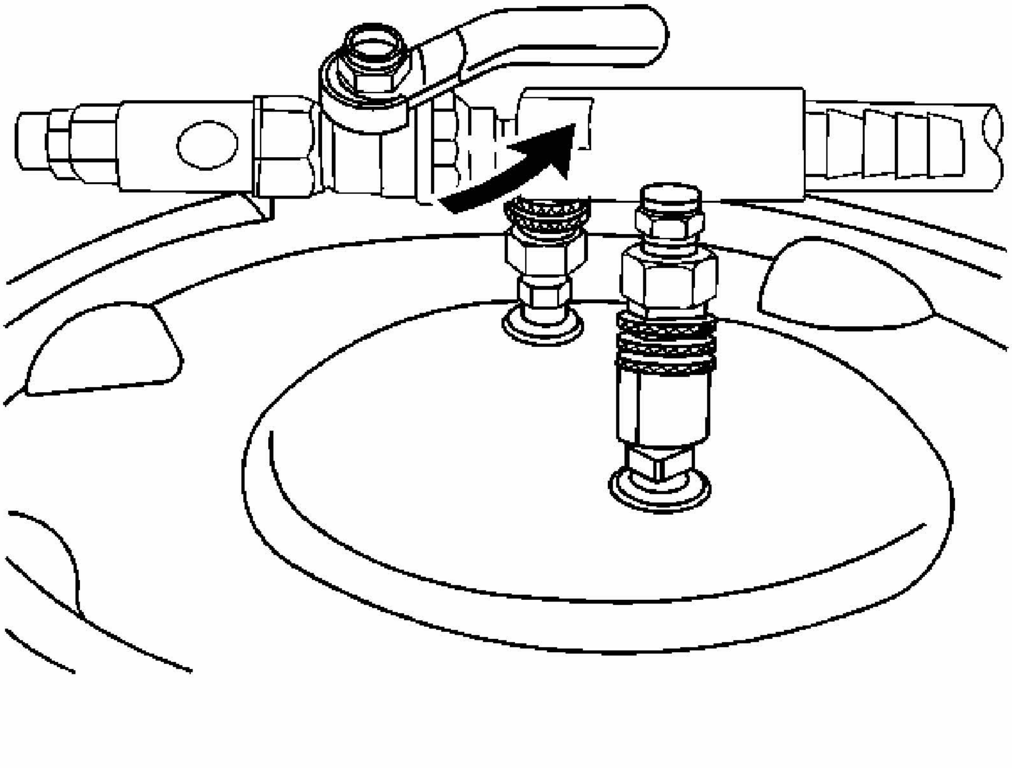


Fig. 36: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

25. Open the valve on the venturi assembly to start a vacuum draw.

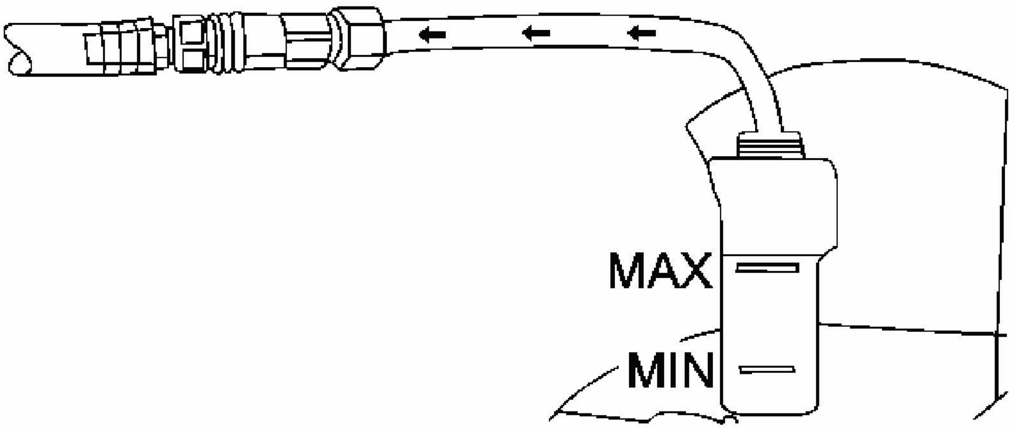


Fig. 37: Identifying Extraction Hose
Courtesy of GENERAL MOTORS CORP.

26. Use the extraction hose to draw out coolant to the proper level.
27. Fill the coolant recovery bottle to the indicator line, then add 400 milliliters (13.5 ounces) more.
28. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.

FLUSHING

IMPORTANT: Do not use a chemical flush.

Store used coolant in a properly labeled container. Do not pour used coolant down a drain. Ethylene glycol antifreeze is a very toxic chemical. Do not dispose of coolant into the sewer system or ground water. This is illegal and ecologically unsound.

Various methods and equipment can be used to flush the cooling system. If special equipment is used, such as a back flusher, follow the manufacturer's instruction.

When the cooling system becomes contaminated, the cooling system should be flushed thoroughly to remove the contaminants before the engine is seriously damaged.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
2. Remove the coolant recovery reservoir. Refer to **Coolant Recovery Reservoir Replacement (RPOs LZE, LZ4, LZ9)** or **Coolant Recovery Reservoir Replacement (RPO LS4)**.
3. Clean and flush the coolant recovery reservoir with clean, drinkable water.
4. Install the coolant recovery reservoir. Refer to **Coolant Recovery Reservoir Replacement (RPOs LZE, LZ4, LZ9)** or **Coolant Recovery Reservoir Replacement (RPO LS4)**.
5. Follow the drain and fill procedure using only clean, drinkable water. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
6. Run the engine for 20 minutes.
7. Stop the engine.
8. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
9. Repeat the procedure if necessary, until the fluid is nearly colorless.
10. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.

RADIATOR CLEANING

CAUTION: NEVER spray water on a hot radiator. The resulting steam could cause personal injury.

NOTE: The radiator fins are necessary for good heat transfer. Do not brush the fins. This may cause damage to the fins, reducing heat transfer.

IMPORTANT: Remove bugs, leaves, dirt and other debris by blowing compressed air through the engine side of the radiator.

- Some conditions may require the use of warm water and a mild detergent.
- Clean the A/C condenser fins.
- Clean between the A/C condenser and radiator.
- Clean the radiator cooling fins.
- Straighten any damaged cooling fins.

COOLANT RECOVERY RESERVOIR REPLACEMENT (RPOS LZE, LZ4, LZ9)

Removal Procedure

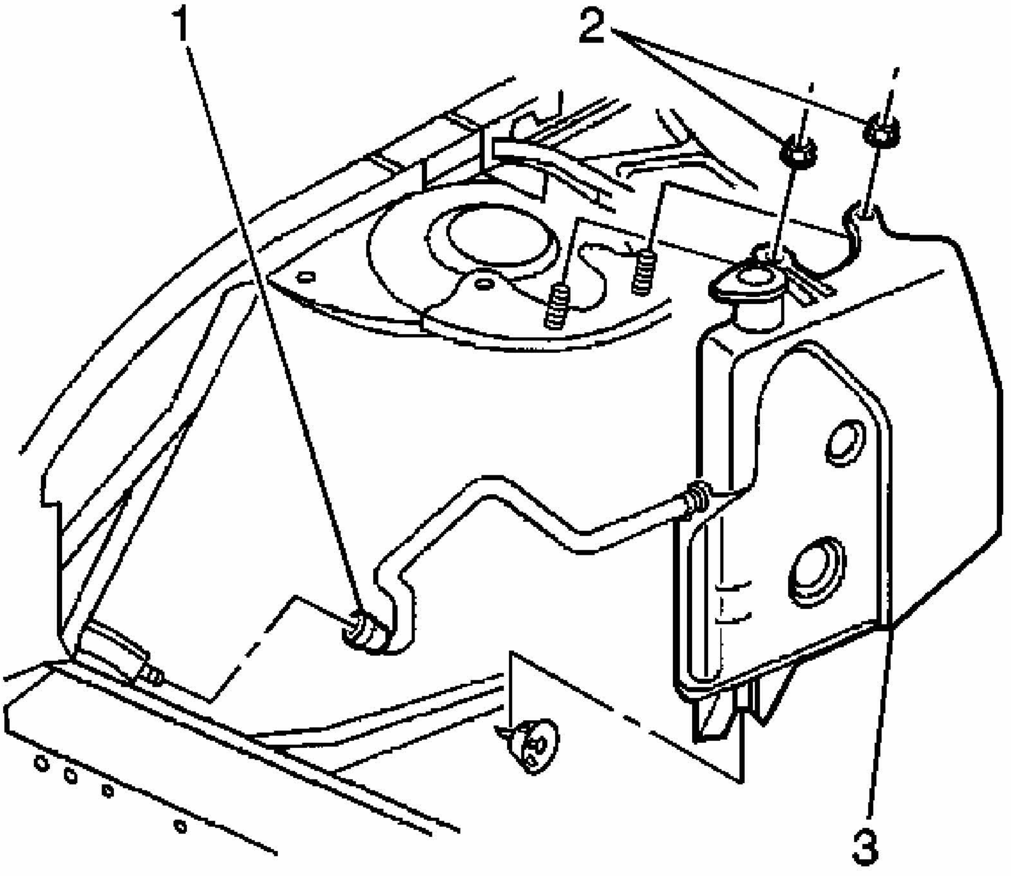


Fig. 38: Coolant Recovery Reservoir, Nuts & Hose Clamp
Courtesy of GENERAL MOTORS CORP.

1. Reposition the reservoir hose clamp (1).
2. Remove the reservoir hose from the radiator overflow neck.
3. Remove the coolant recovery reservoir nuts (2) from the shock tower studs.
4. Remove the coolant recovery reservoir (3) from the lower retainer and the shock tower studs.
5. Drain the coolant from the recovery reservoir in to a clean container.

Installation Procedure

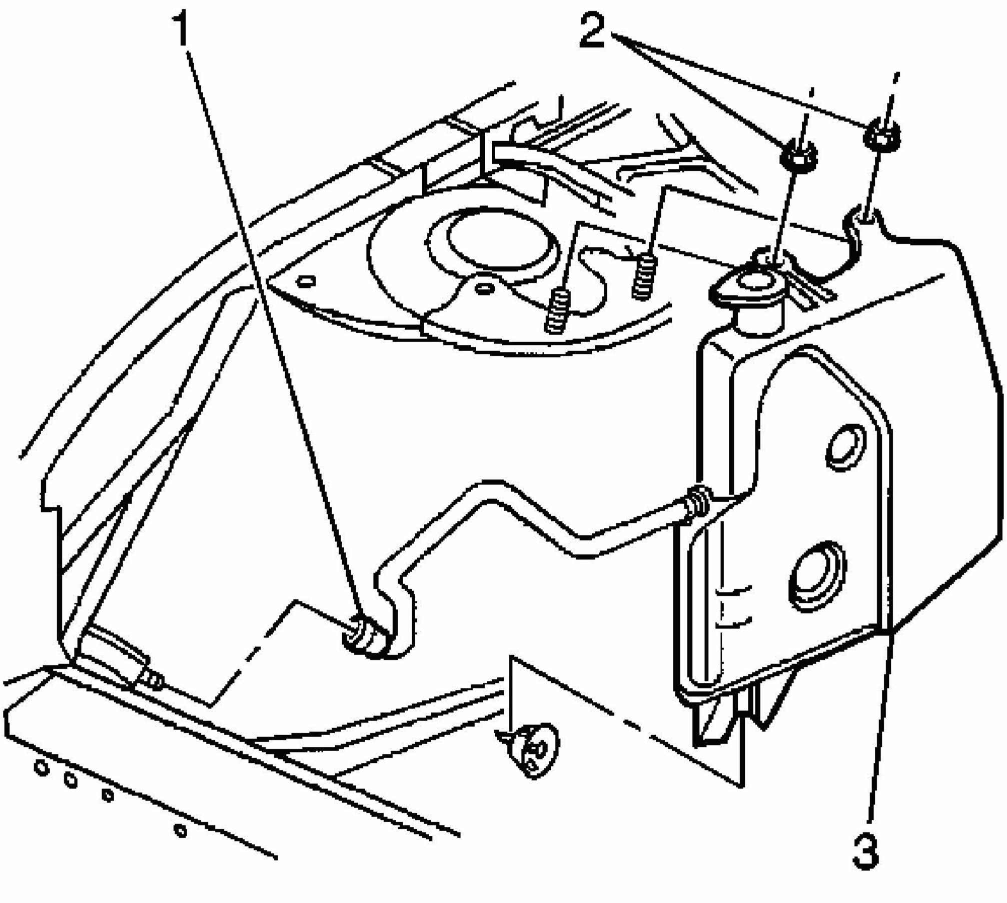


Fig. 39: Coolant Recovery Reservoir, Nuts & Hose Clamp
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant recovery reservoir (3) onto the lower retainer and the shock tower studs.

NOTE: **Refer to FASTENER**

NOTICE

2. Install the coolant recovery reservoir nuts (2) to the shock tower studs.

   Tighten: Tighten the nuts to 3.3 N.m (29 lb in).

3. Lubricate the reservoir hose with clean water. Route the hose to the radiator overflow neck fitting.
4. Install the coolant reservoir hose (1) to the overflow neck fitting.
5. Install the reservoir hose and clamp (1), with the clamp tabs at the 11 o'clock position, to the radiator overflow fitting on the radiator filler neck. The hose end must be flush against the radiator filler neck. Seat the clamp squarely between the radiator filler neck and the flared end of the fitting.
6. Fill the coolant recovery reservoir to the proper level.

COOLANT RECOVERY RESERVOIR REPLACEMENT (RPO LS4)

Removal Procedure

1. Remove the front fender upper diagonal brace. Refer to **Brace Replacement - Front Fender Upper Diagonal** in Body Front End.

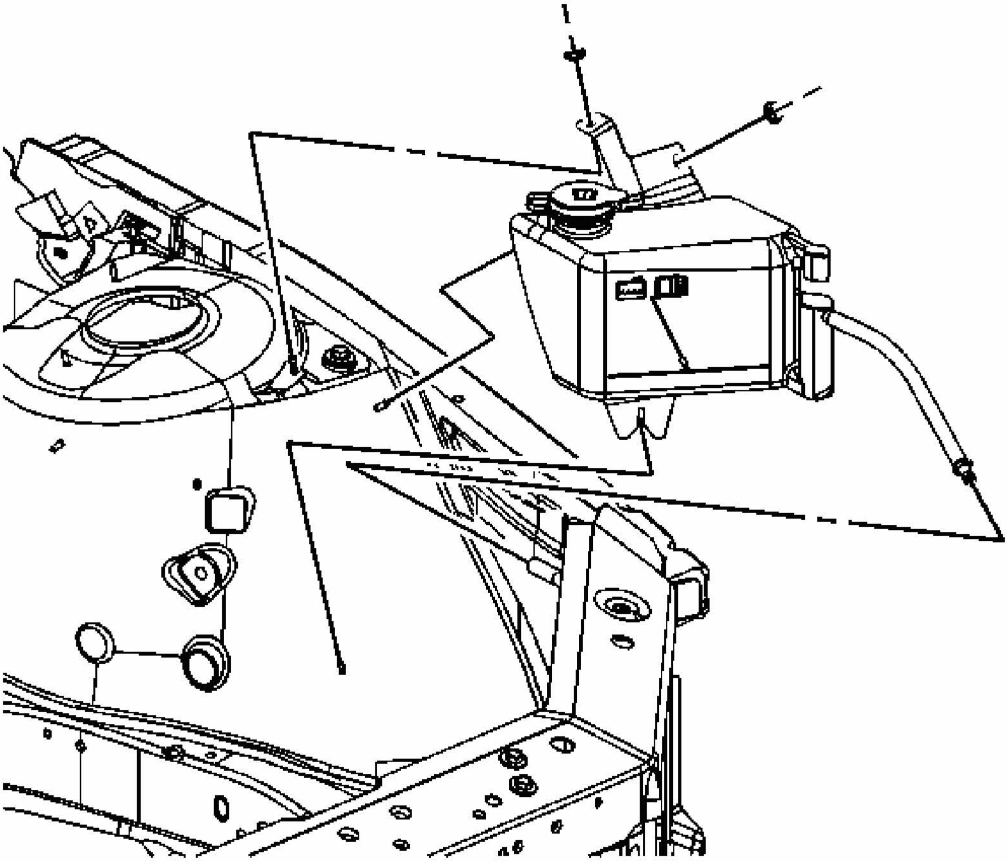


Fig. 40: Coolant Recovery Reservoir
Courtesy of GENERAL MOTORS CORP.

2. Reposition the coolant recovery reservoir hose clamp aside at the radiator overflow fitting.
3. Disconnect the coolant recovery reservoir hose from the radiator overflow hose.
4. Remove the coolant recovery reservoir nuts from the shock tower studs.
5. Remove the coolant recovery reservoir from the lower retainer and the shock tower studs.
6. Drain the coolant from the coolant recovery reservoir into a clean container.

Installation Procedure

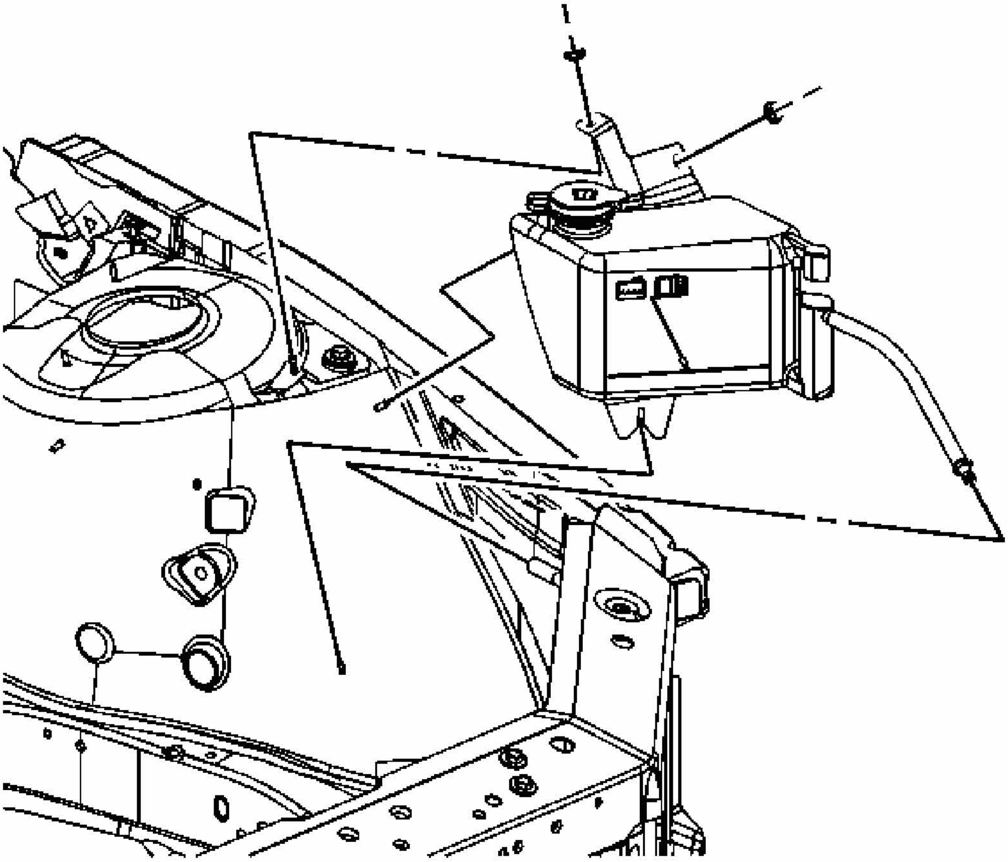


Fig. 41: Coolant Recovery Reservoir
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant recovery reservoir to the lower retainer and the shock tower studs.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the nuts to the shock tower studs.

   Tighten: Tighten the nuts to 3.3 N.m (29 lb in).

3. Lubricate the reservoir hose with clean water. Install the coolant reservoir hose to the radiator overflow hose.
4. Position the coolant reservoir hose clamp to the radiator overflow hose fitting.
5. Install the front fender upper diagonal brace. Refer to **Brace Replacement - Front Fender Upper Diagonal** in Body Front End.

6. Fill the coolant recovery reservoir to the proper level. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.

INLET RADIATOR HOSE REPLACEMENT - (RPO LS4)

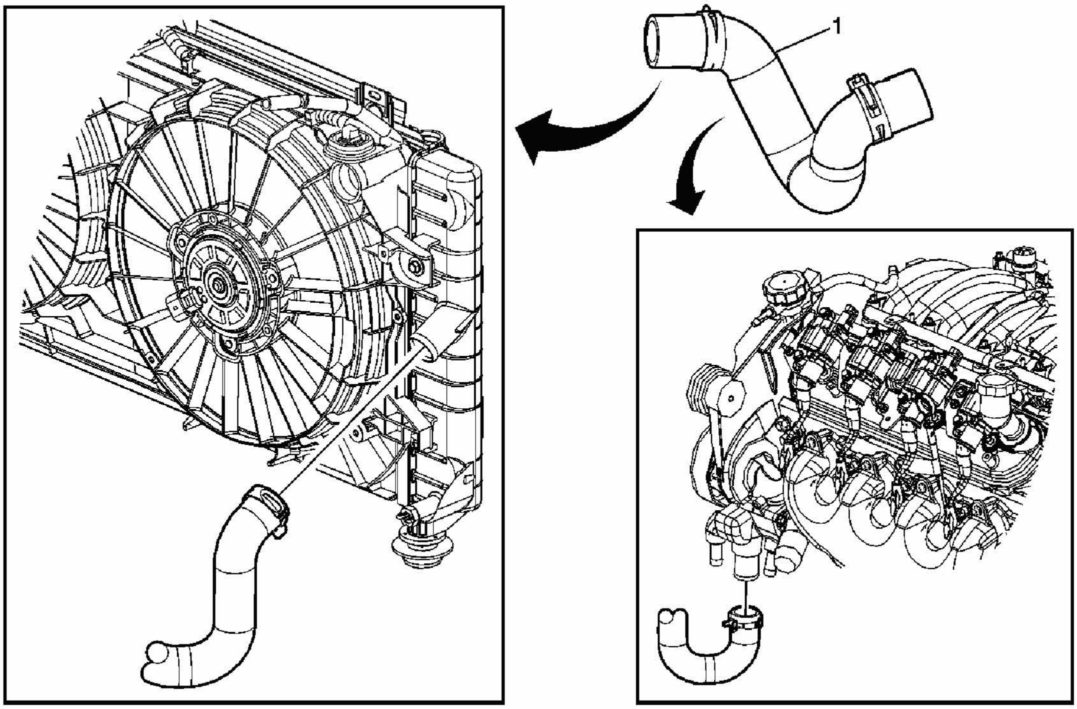


Fig. 42: View Of Radiator Hose
Courtesy of GENERAL MOTORS CORP.

Radiator Hose Replacement - Inlet (RPO LS4)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.	
1	Hose, Radiator Inlet **Tip:** Using **J 38185** reposition the radiator inlet hose clamps.

INLET RADIATOR HOSE REPLACEMENT - (RPOS LZE, LZ4, LZ9)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.

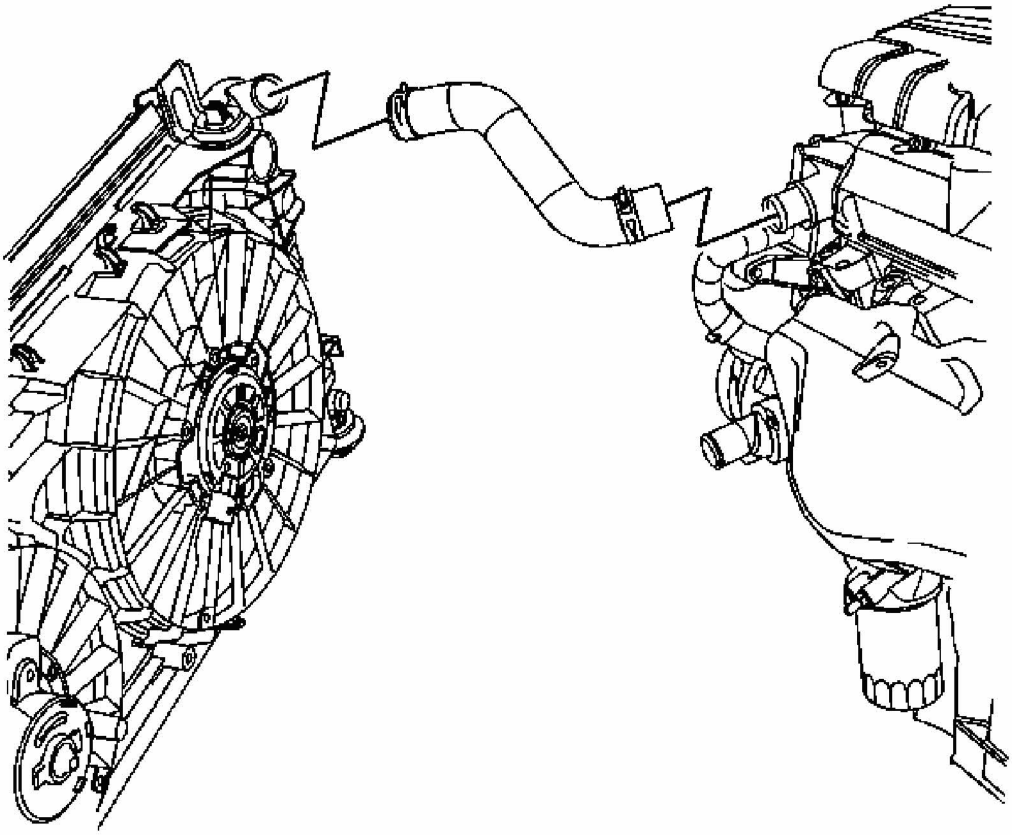


Fig. 43: Identifying Inlet Hose & Radiator
Courtesy of GENERAL MOTORS CORP.

2. Use **J 38185** in order to reposition the hose clamp from the radiator.
3. Remove the inlet hose from the radiator.
4. Use **J 38185** in order to reposition the hose clamp from the engine outlet pipe.

5. Remove the radiator inlet hose from the engine outlet pipe and the vehicle.

Installation Procedure

1. Install the radiator inlet hose to the engine outlet pipe.
2. Use **J 38185** in order to reposition and install the hose clamp to the engine outlet pipe.

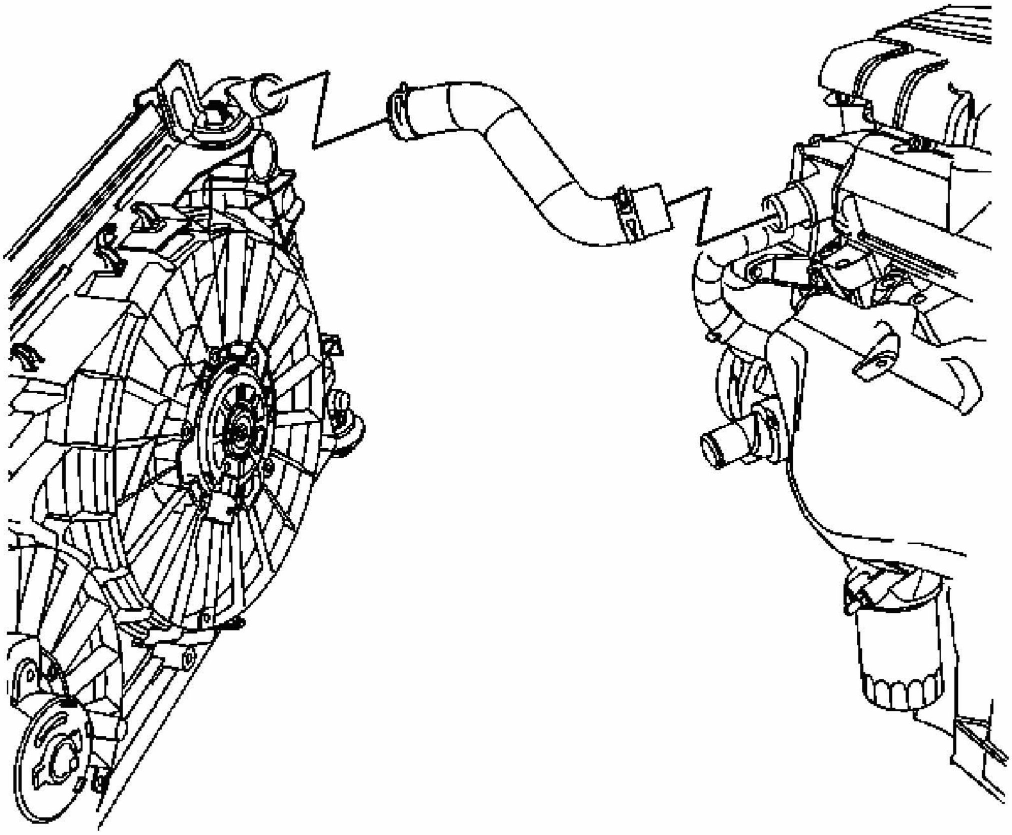


Fig. 44: Identifying Inlet Hose & Radiator
Courtesy of GENERAL MOTORS CORP.

3. Install the inlet hose to the radiator.
4. Use **J 38185** in order to reposition and install the hose clamp to the radiator.
5. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.

OUTLET RADIATOR HOSE REPLACEMENT - (RPO LS4)

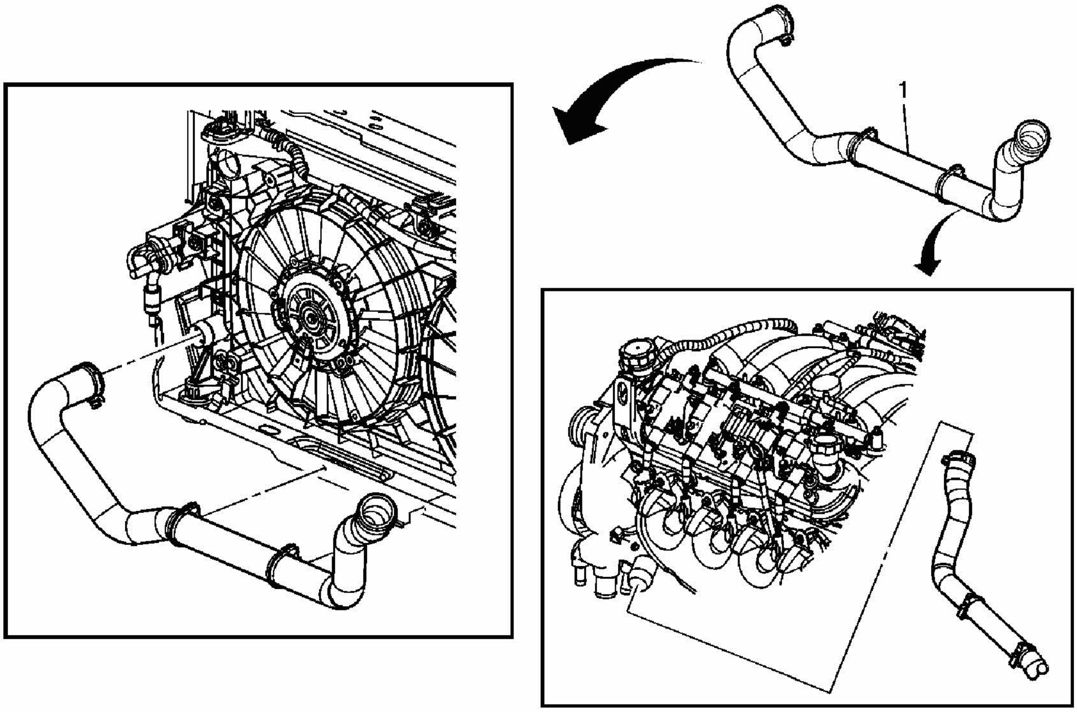


Fig. 45: View Of Outlet Radiator Hose
Courtesy of GENERAL MOTORS CORP.

Radiator Hose Replacement - Outlet (RPO LS4)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.	
1	Hose, Radiator Outlet **Tip:** Using **J 38185** reposition the radiator outlet hose clamps.

OUTLET RADIATOR HOSE REPLACEMENT - (RPOS LZE, LZ4, LZ9)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.

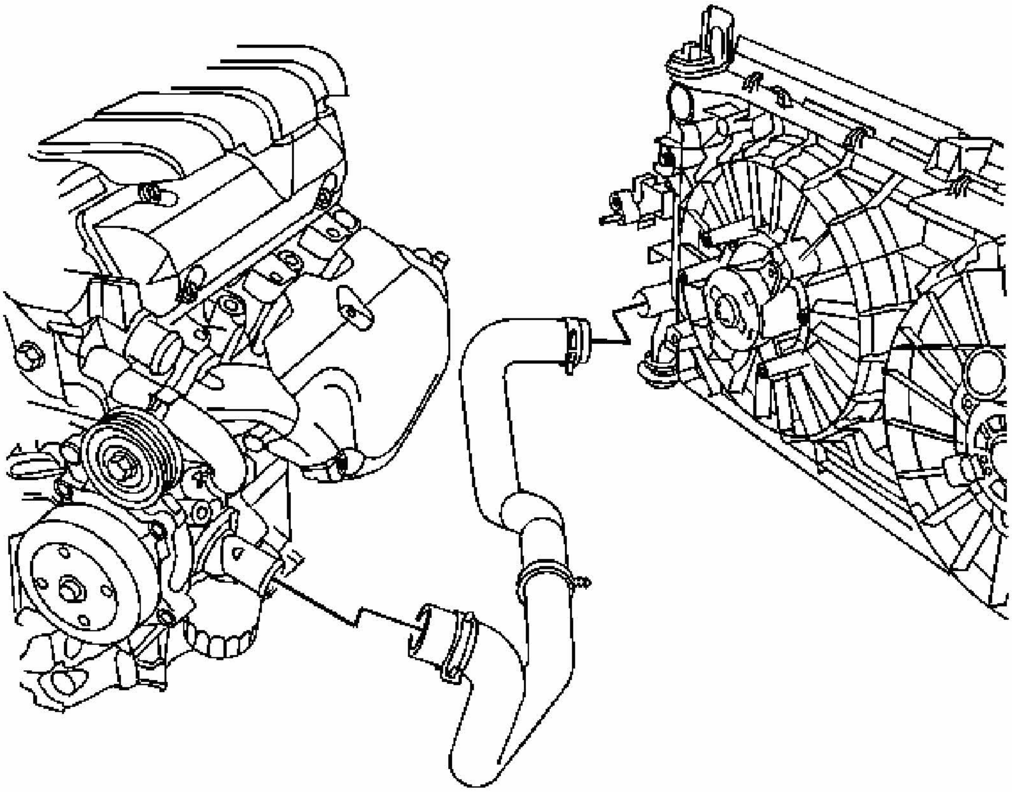


Fig. 46: View Of Outlet Hose & Radiator
Courtesy of GENERAL MOTORS CORP.

2. Use **J 38185** in order to reposition the hose clamp from the radiator.
3. Remove the outlet hose from the radiator.
4. Use **J 38185** in order to reposition the hose clamp from the thermostat housing.
5. Remove the radiator outlet hose from the thermostat housing and the vehicle.

Installation Procedure

1. Install the radiator outlet hose to the thermostat housing.

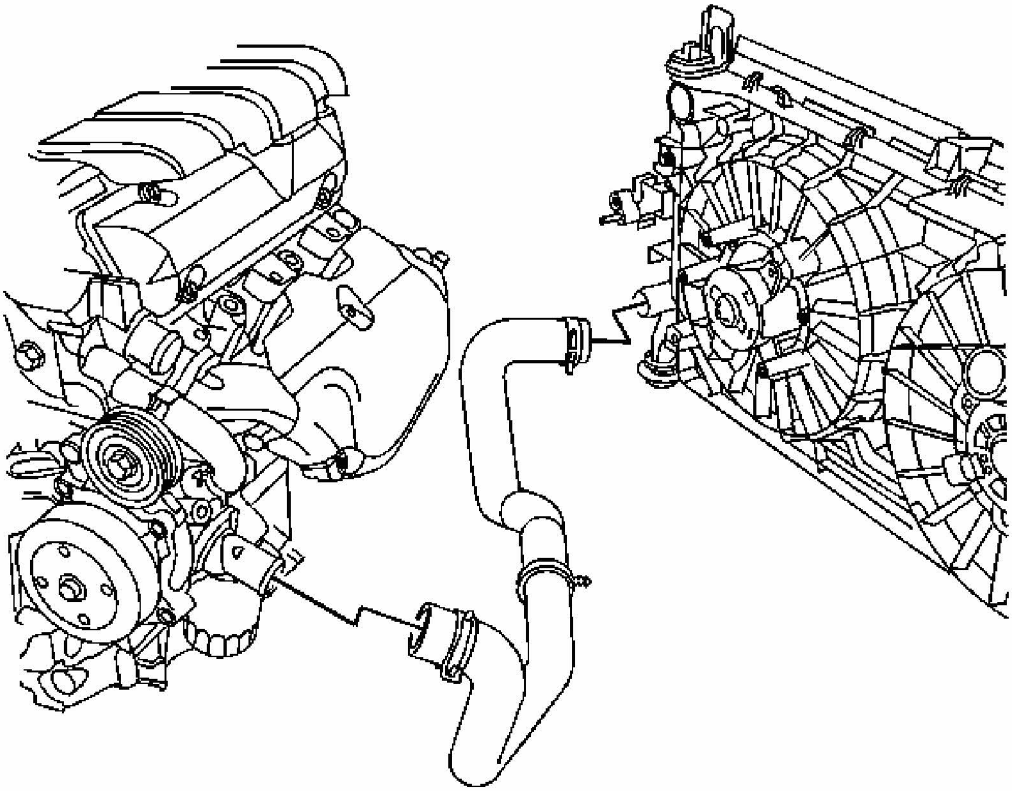


Fig. 47: View Of Outlet Hose & Radiator
Courtesy of GENERAL MOTORS CORP.

2. Use **J 38185** in order to reposition and install the hose clamp to the thermostat housing.
3. Install the outlet hose to the radiator.
4. Use **J 38185** in order to reposition and install the hose clamp to the radiator.
5. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.

ENGINE OIL COOLER PIPE/HOSE QUICK CONNECT FITTING

Removal Procedure

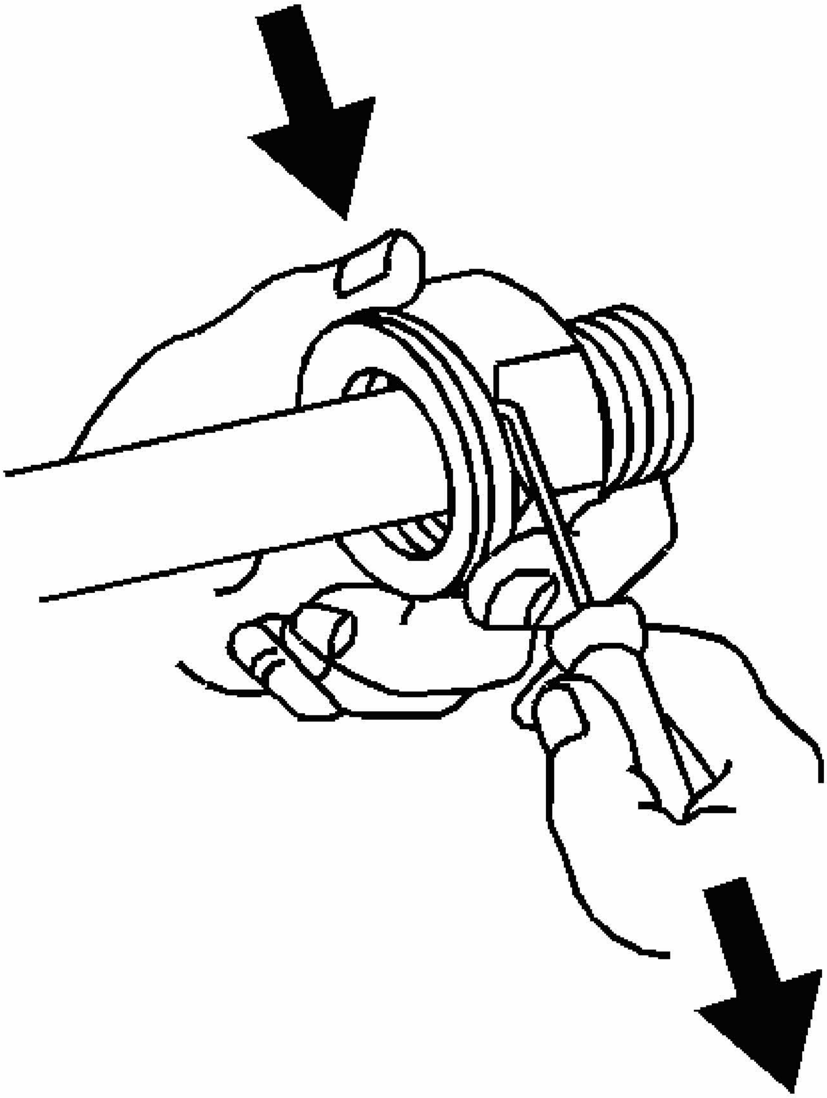


Fig. 48: Rotating Retaining Ring Using Screwdriver
Courtesy of GENERAL MOTORS CORP.

1. Using a bent-tip screwdriver or equivalent, pull on one of the open ends of the retaining ring in order to rotate the retaining ring.
2. Rotate the retaining ring around the quick connector until the retaining ring is out of position and can be completely removed.
3. Remove the engine oil cooler line from the quick connector fitting.

   Pull the lines straight out from the connector.

4. Clean all of the components in a suitable solvent, and dry them with compressed air.
5. Inspect the fittings, the connectors, the cooler lines, and the cooler for damage, distortion, or restriction. Replace parts as necessary.

Installation Procedure

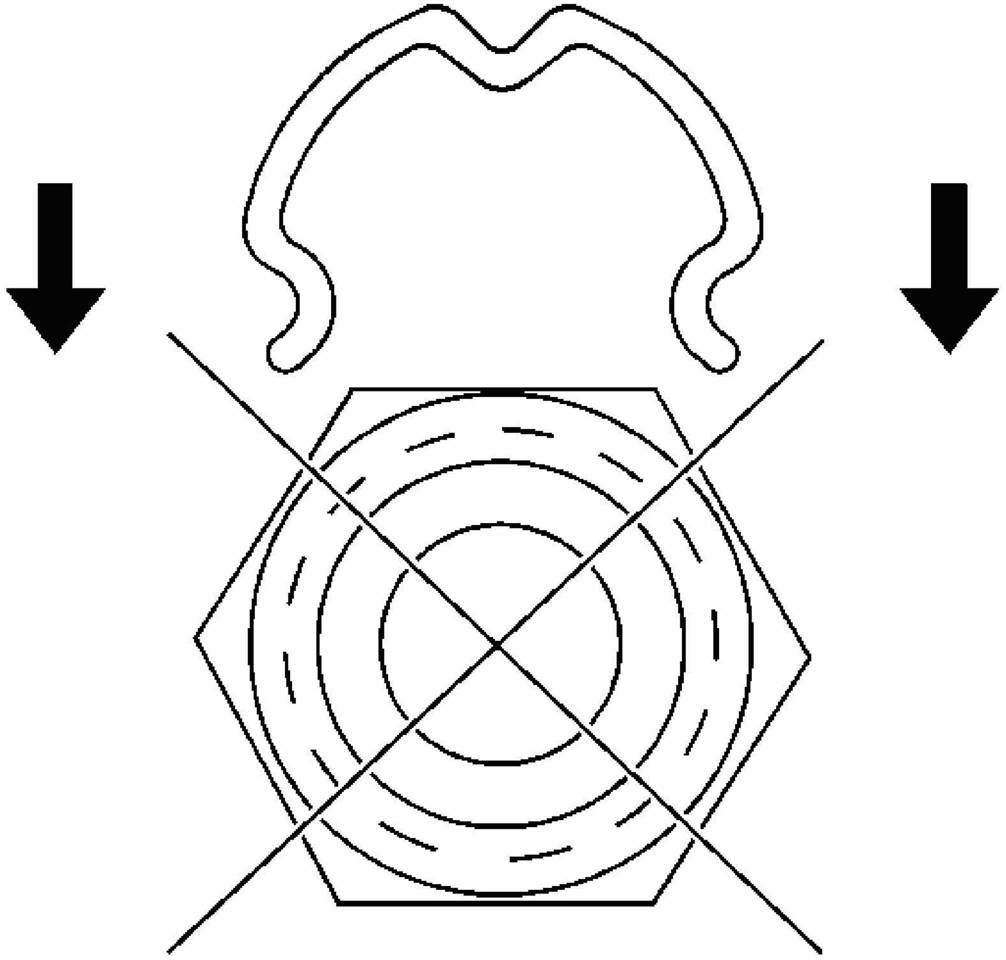


Fig. 49: View Of Retaining Ring & Quick Connector
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not install the new retaining ring onto the fitting by pushing the retaining ring down over the fitting.

1. Install the retaining ring into each quick connector fitting.

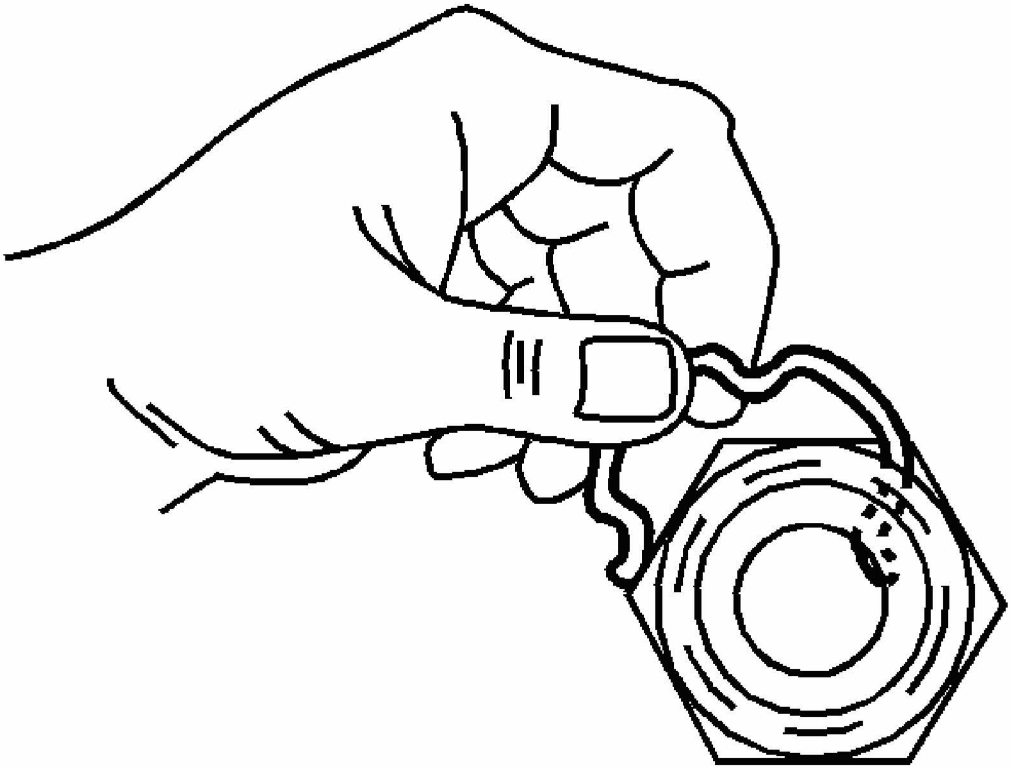


Fig. 50: Hooking Retaining Ring
Courtesy of GENERAL MOTORS CORP.

2. Hook one of the open ends of the retaining ring in one of the slots in the quick connector.

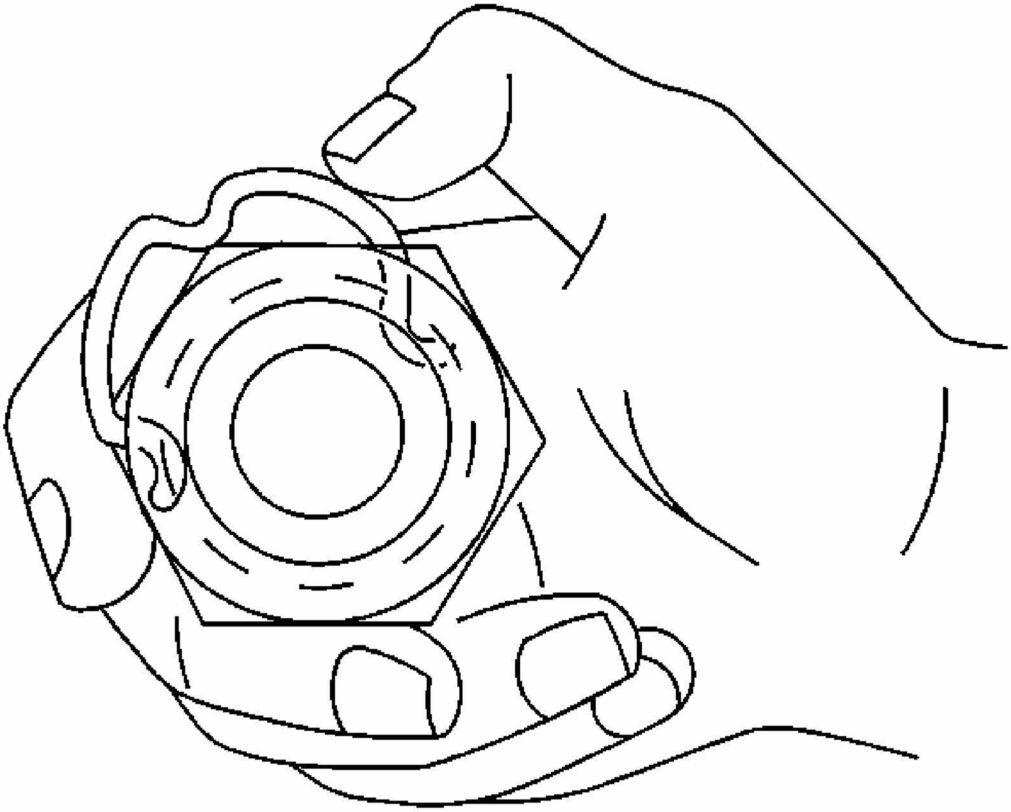


Fig. 51: View Of Retaining Ring & Connector
Courtesy of GENERAL MOTORS CORP.

3. Rotate the retaining ring around the connector until the retaining ring is positioned with all 3 ears through the 3 slots.

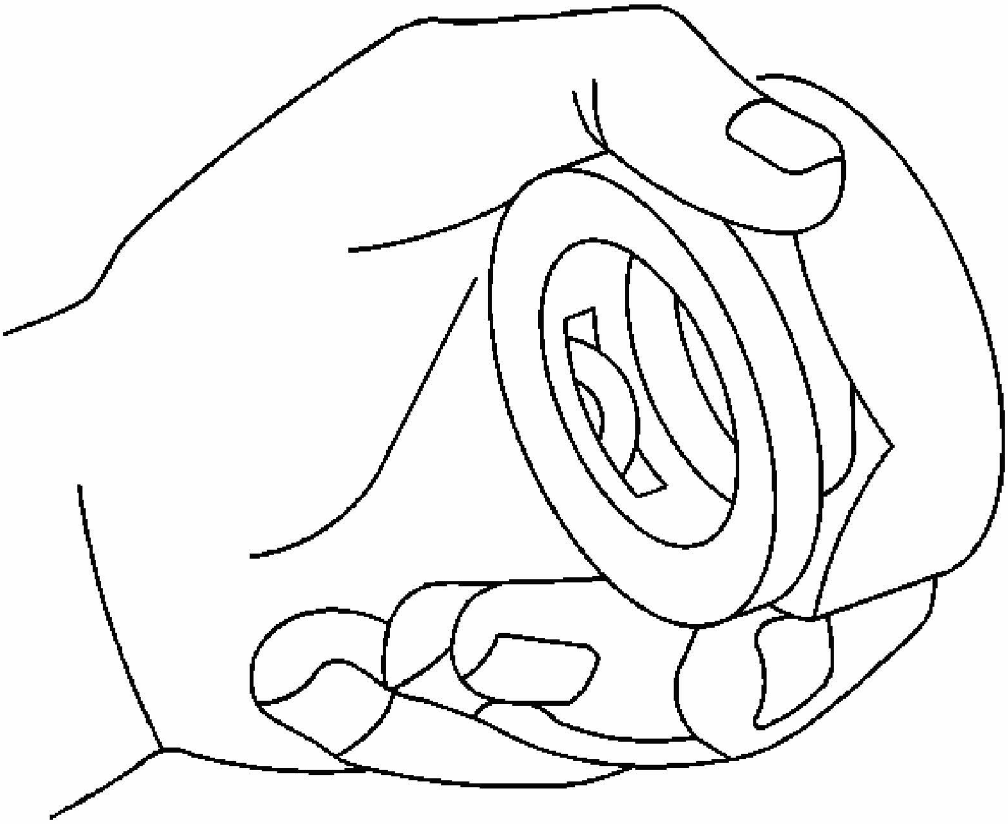


Fig. 52: View Of Retaining Ring Ears From Inside Of Connector
Courtesy of GENERAL MOTORS CORP.

4. Ensure the 3 retaining ring ears can be seen from the inside of the connector and the retaining ring can move freely in the slots.
5. Install the engine oil cooler line into the quick connector fitting.

   Pull back on the engine oil cooler lines to ensure a proper connection.

6. Inspect and fill the engine oil to the proper level.

ENGINE OIL COOLER HOSE/PIPE REPLACEMENT

Removal Procedure

1. Remove the right engine splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
2. Remove the lower air baffle. Refer to **Radiator Air Baffle and Deflector**

Replacement - Lower.

3. Remove the support clip from the engine oil cooler lines.

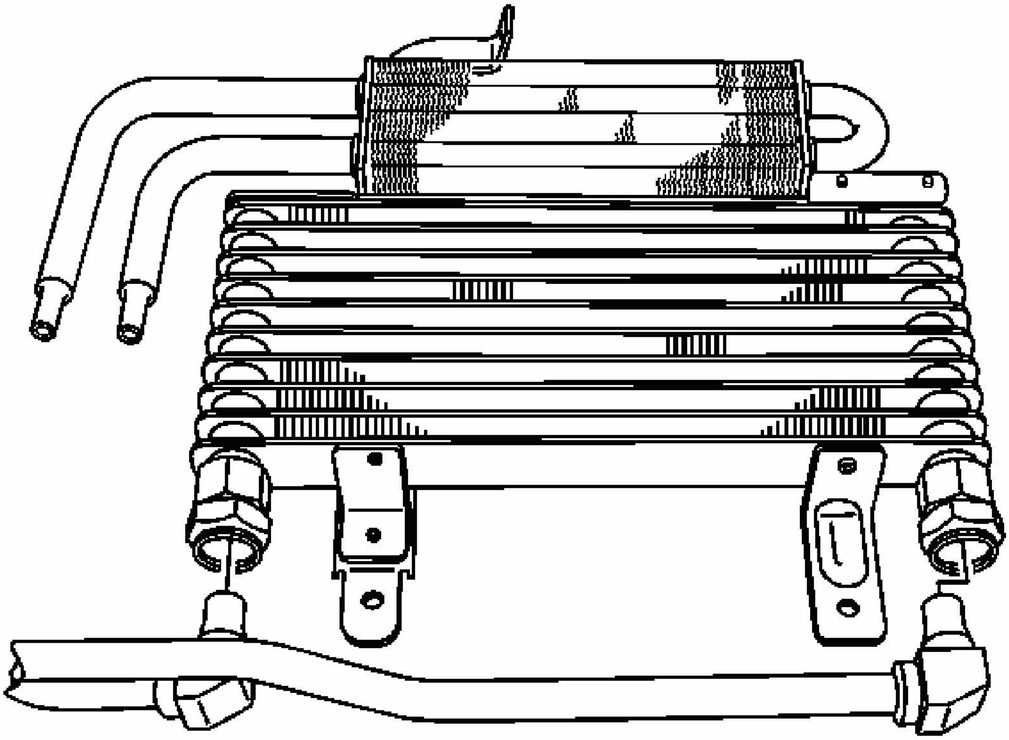


Fig. 53: View Of Engine Oil Cooler Lines
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine oil cooler lines from the engine oil cooler. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.
5. Remove the engine oil cooler lines from the engine oil filter adapter. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.
6. Remove the engine oil cooler lines from the vehicle.

Installation Procedure

1. Install the engine oil cooler lines to the vehicle.

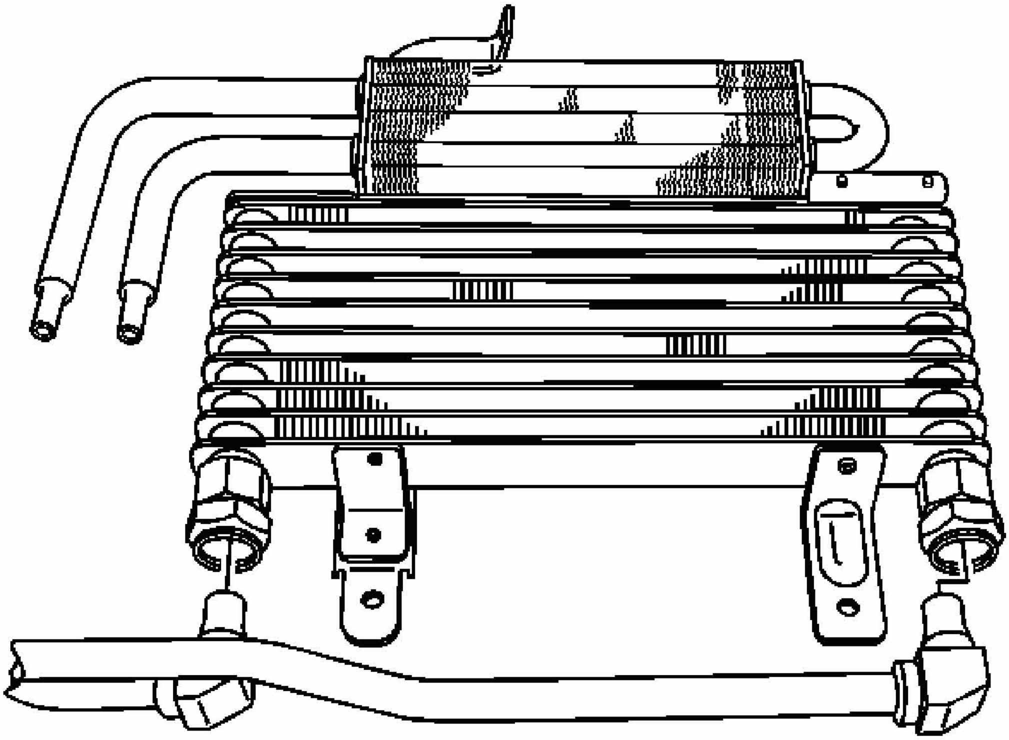


Fig. 54: View Of Engine Oil Cooler Lines
Courtesy of GENERAL MOTORS CORP.

2. Install the engine oil cooler lines to the engine oil cooler. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.
3. Install the engine oil cooler lines to the engine oil filter adapter. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.
4. Install the engine oil cooler line support clip to the engine oil cooler lines.
5. Install the right engine splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
6. Install the lower air baffle. Refer to **Radiator Air Baffle and Deflector Replacement - Lower**.
7. Add the proper amount of engine oil.

AUXILIARY ENGINE OIL COOLER REPLACEMENT

Removal Procedure

1. Remove the upper air baffle. Refer to **Radiator Air Baffle and Deflector Replacement - Upper**.

2. Remove the right engine splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
3. Remove the lower air baffle. Refer to **Radiator Air Baffle and Deflector Replacement - Lower**.
4. Remove the support clip from the engine oil cooler lines
5. Reposition the hose clamps on the power steering cooler lines.
6. Remove the power steering oil cooler lines from the power steering cooler.
7. Remove the engine oil cooler lines from the engine oil cooler. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.

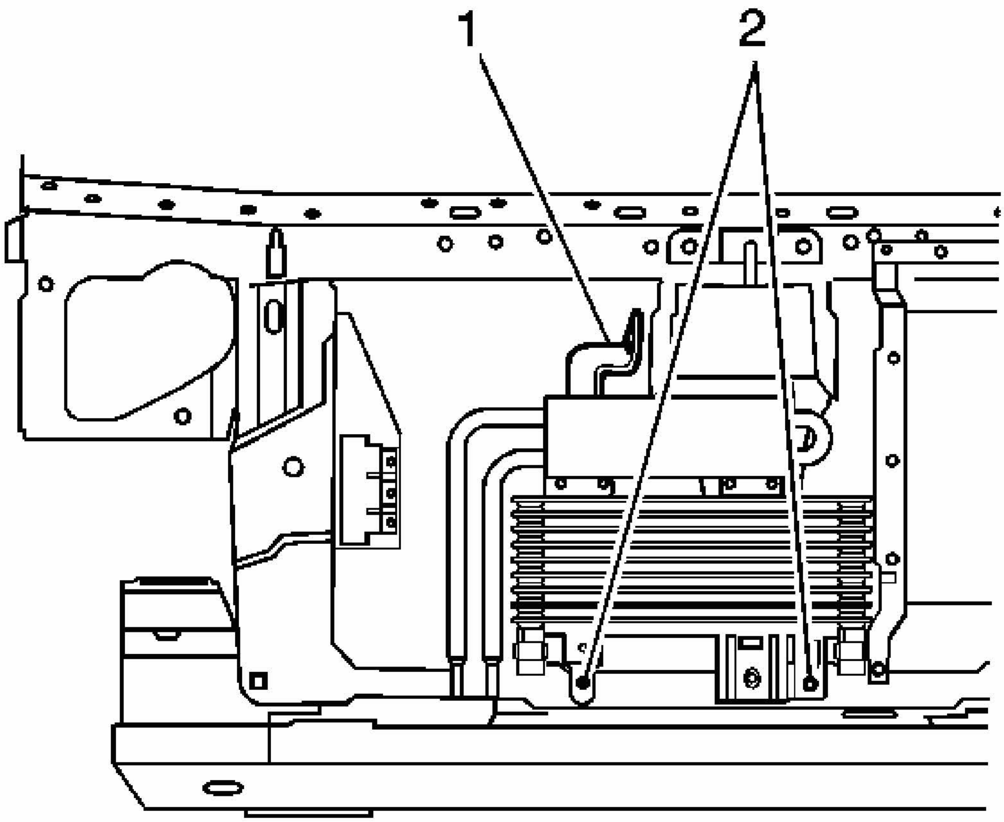


Fig. 55: Locating Engine Oil Cooler/Power Steering Cooler Bolts
Courtesy of GENERAL MOTORS CORP.

8. Remove the upper bolt (1) from the engine oil cooler/power steering cooler.
9. Remove the lower bolts (2) from the engine oil cooler/power steering cooler.
10. Remove the engine oil cooler/power steering cooler from the vehicle.

Installation Procedure

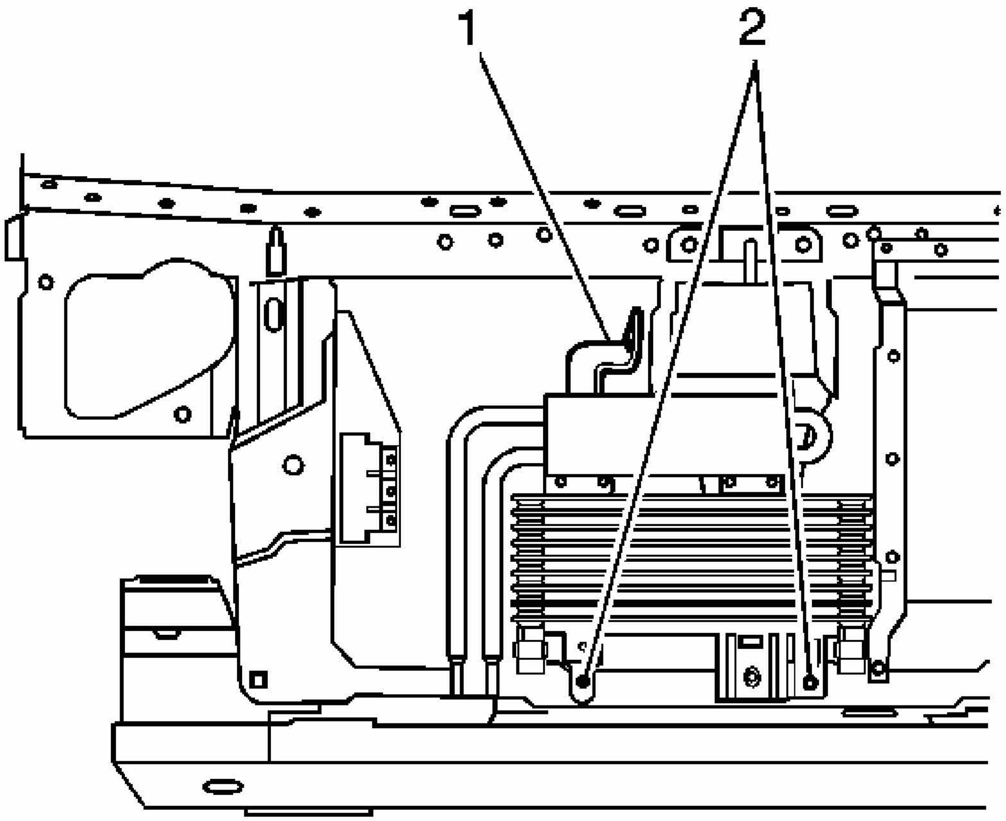


Fig. 56: Locating Engine Oil Cooler/Power Steering Cooler Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine oil cooler/power steering cooler to the vehicle.

   NOTE: **Refer to FASTENER NOTICE .**

2. Install the upper bolt (1) to the engine oil cooler/power steering cooler bracket.

   Tighten: Tighten the bolt to 2 N.m (18 lb in).

3. Install the lower bolts (2) to the engine oil cooler/power steering cooler bracket.

   Tighten: Tighten the bolts to 2 N.m (18 lb in).

4. Install the engine oil cooler lines to the engine oil cooler. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.
5. Install the power steering oil cooler lines to the power steering cooler.
6. Reposition the hose clamps on the power steering cooler lines.
7. Install the support clip to the engine oil cooler lines.
8. Install the right engine splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
9. Install the lower air baffle. Refer to **Radiator Air Baffle and Deflector Replacement - Lower**.
10. Install the upper air baffle. Refer to **Radiator Air Baffle and Deflector Replacement - Upper**.
11. Add the proper amount of engine oil and power steering fluid.

ELECTRIC COOLING FAN MOTOR REPLACEMENT

Tools Required

GE-47827 Socket. See **Special Tools**.

Removal Procedure

CAUTION: An electric fan under the hood can start up even when the engine is not running and can injure you. Keep hands, clothing and tools away from any underhood electric fan.

CAUTION: To help avoid personal injury or damage to the vehicle, a bent, cracked, or damaged fan blade or housing should always be replaced.

CAUTION: Before servicing any electrical component, the ignition key must be in the OFF or LOCK position and all electrical loads must be OFF, unless instructed otherwise in these procedures. If a tool or equipment could easily come in contact with a live exposed electrical terminal, also disconnect the negative battery cable. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.

1. Remove the fan shroud assembly from the vehicle. Refer to **Fan Shroud Replacement**.

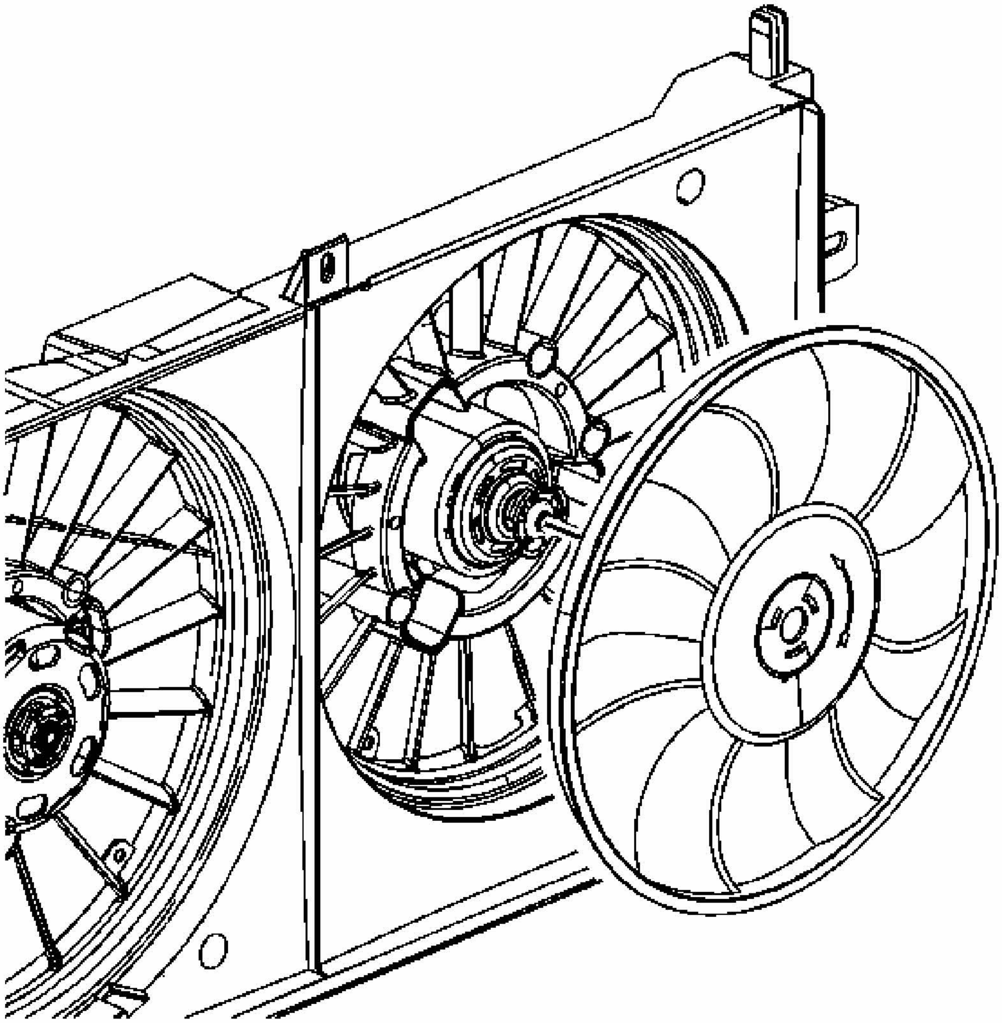


Fig. 57: Identifying Fan Shroud Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Hold the fan blade to prevent rotation.

2. Using **GE-47827** turn the fan motor drive plate in the opposite direction of the arrow on the fan blade until the motor drive plate disengages from the fan blade. See **Special Tools**.
3. Remove and discard the fan blade.

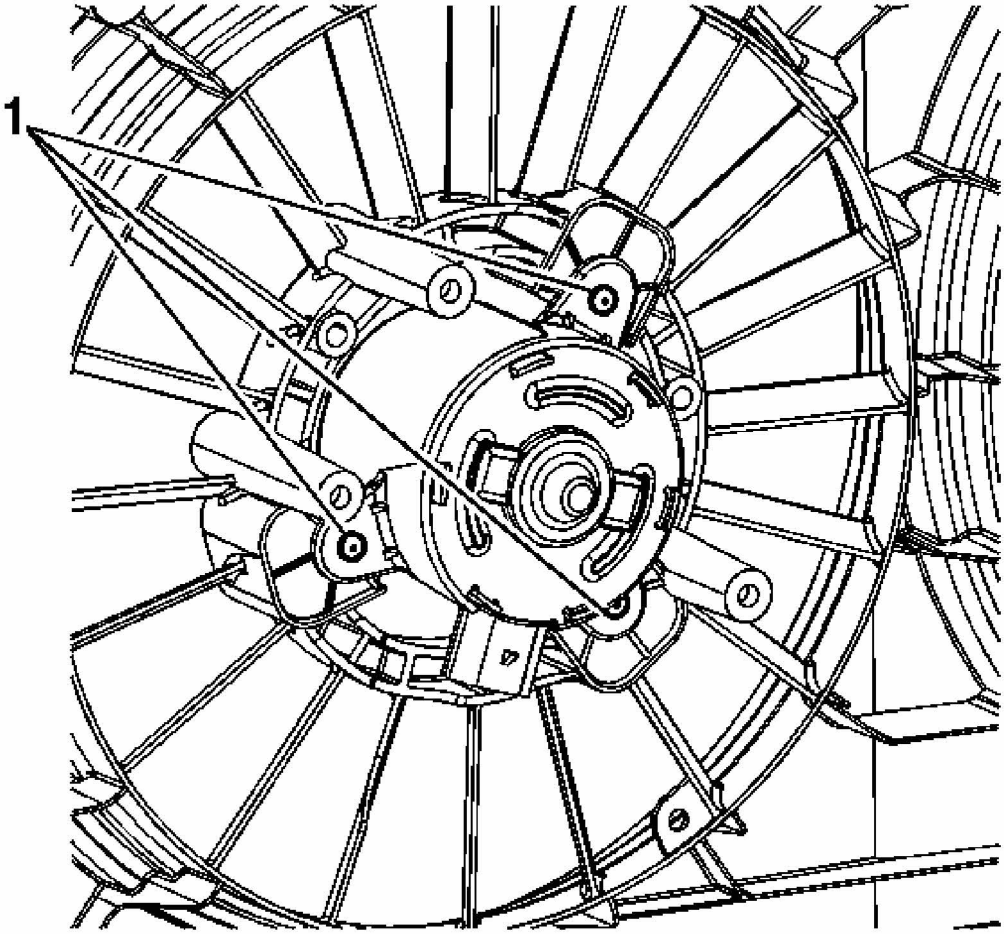


Fig. 58: Identifying Rivets On Rear Of The Motor
Courtesy of GENERAL MOTORS CORP.

NOTE: **Failure to tape off all of the entry points to the cooling fan motor will allow debris to enter and damage the motor.**

IMPORTANT: **When reusing the fan motor tape off the front and rear entry points of the fan motor before drilling the rivets.**

4. Center punch each of the rivets (1) from the rear of the motor.
5. Drill the head of the rivets (1) from the fan motor using a 6.35 mm (0.25 in) drill bit.

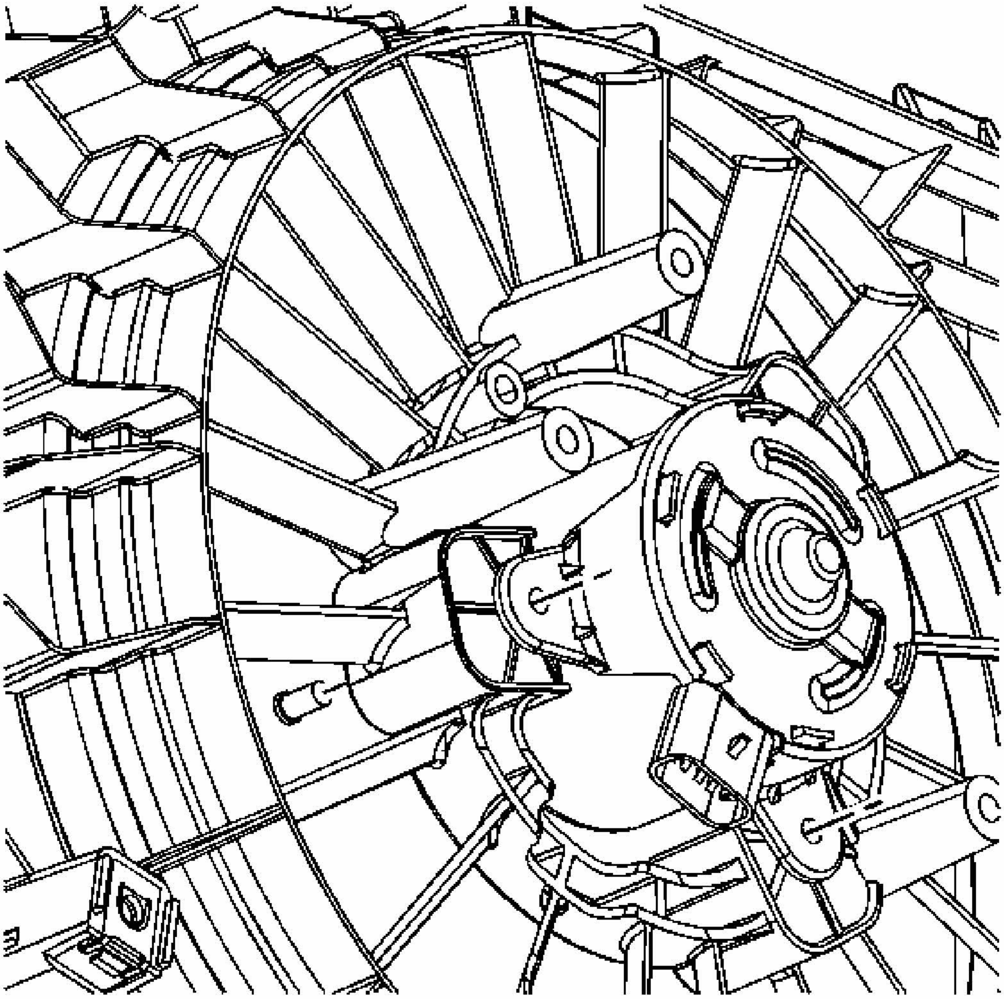


Fig. 59: Identifying Fan Rivets
Courtesy of GENERAL MOTORS CORP.

6. Tap the rivets out of the fan shroud.

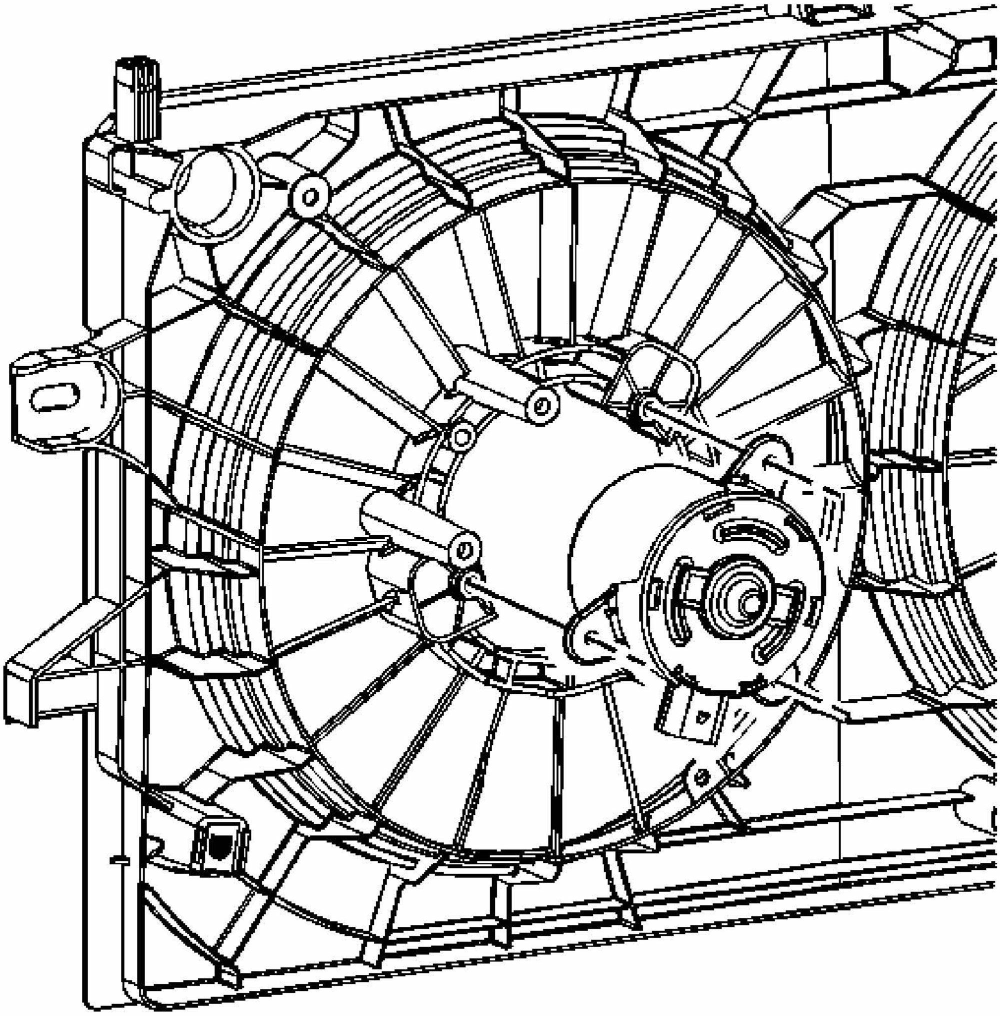


Fig. 60: View Of Fan Motor & Fan Shroud
Courtesy of GENERAL MOTORS CORP.

7. Remove the fan motor from the fan shroud.

IMPORTANT: Blow off any excess debris from the fan motor.

8. Remove the tape covering the entry points from the fan motor.

Installation Procedure

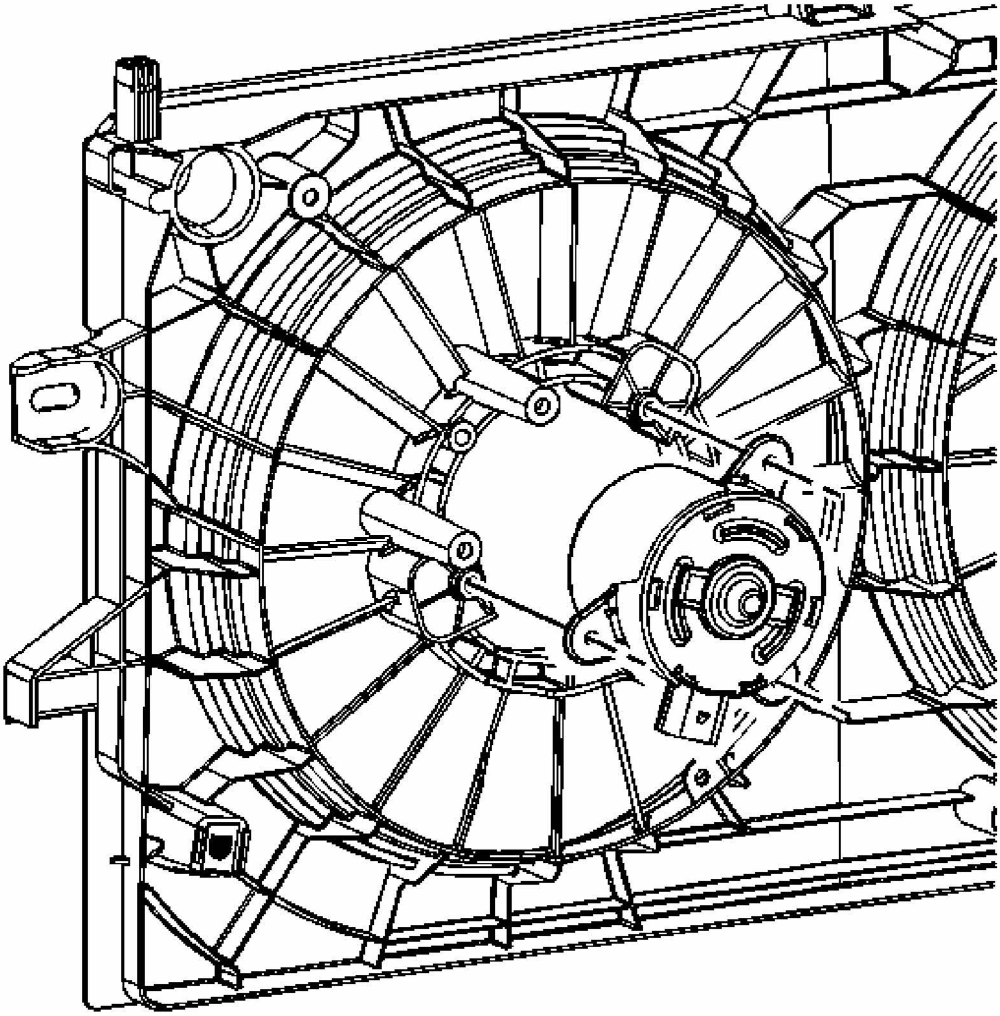


Fig. 61: View Of Fan Motor & Fan Shroud
Courtesy of GENERAL MOTORS CORP.

1. Install the engine cooling fan motor to the fan shroud.

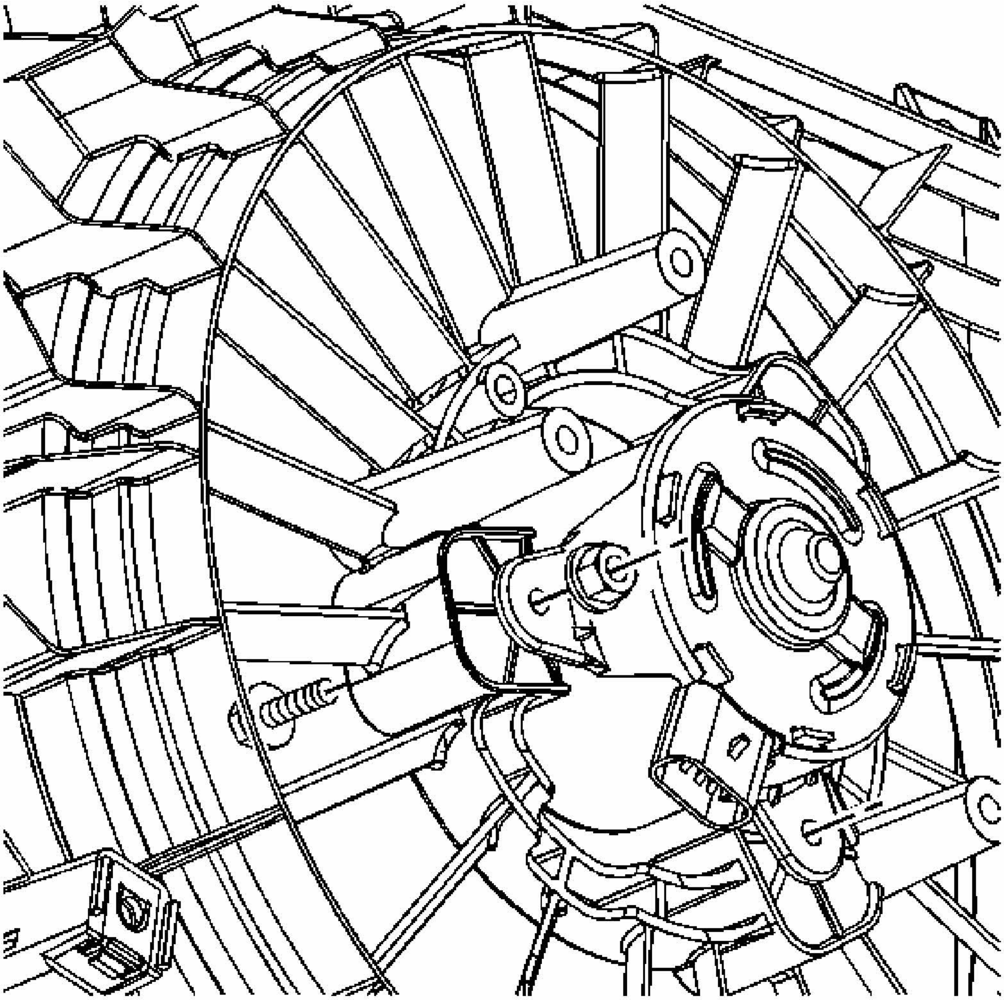


Fig. 62: Locating Cooling Fan Motor Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **Position the fan motor to the fan shroud and insert the bolts from the front side.**

2. Install the cooling fan motor bolts.

NOTE: **Refer to Fastener Notice .**

3. Install the cooling fan motor nuts.

Tighten: Tighten the nuts to 6 N.m (53 lb in).

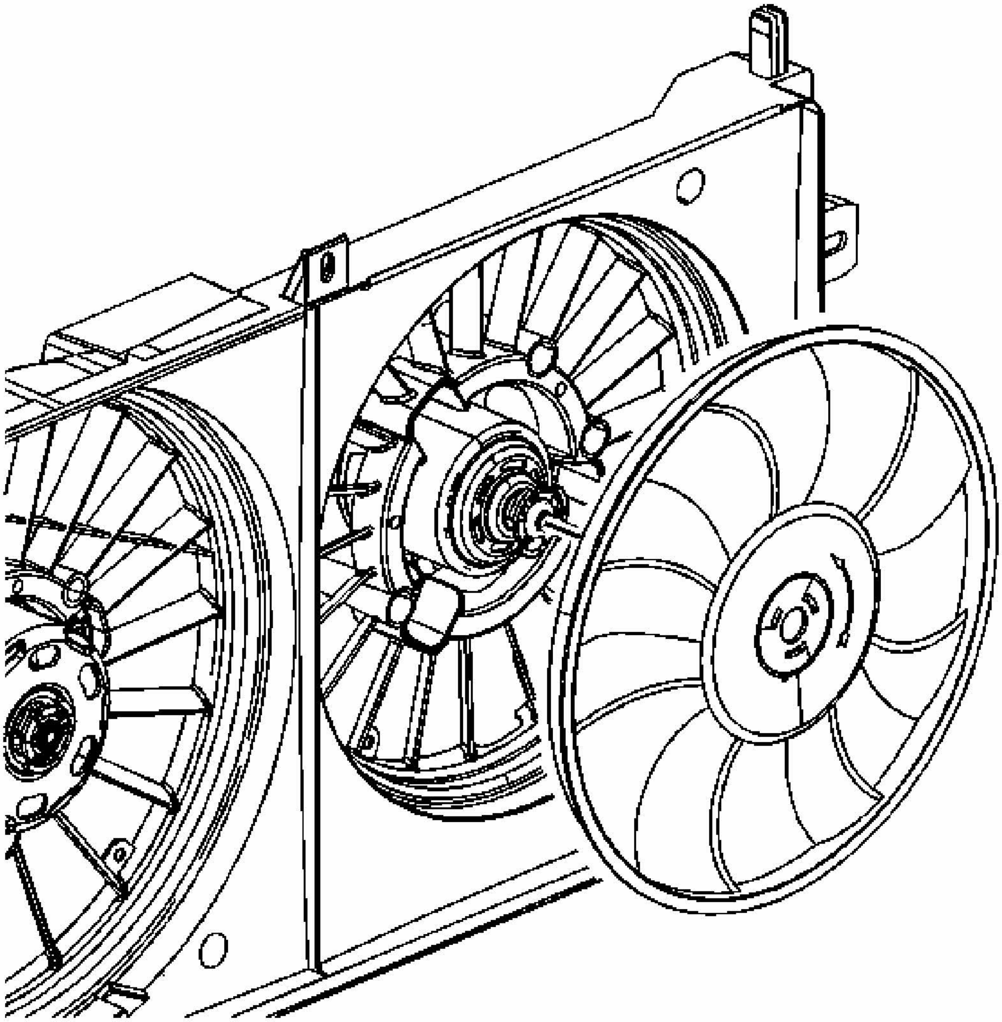


Fig. 63: Identifying Fan Shroud Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: **Failure to heat the fan hub in hot tap water before installation will result in cooling fan failure due to cracking. Allowing the heated fan to cool for more than one minute prior to installation will also result in failure due to cracking.**

IMPORTANT: **Using hot tap water at a minimum of 49°C (120°F), hold the new fan blade hub under the running water for a minimum**

of 60 seconds to hear the fan blade to the temperature of the water.
Immediately after heating, position the fan blade on the fan motor drive plate.

4. Install the new engine cooling fan blade.

IMPORTANT: Hold the fan blade to prevent rotation.

5. Using the **GE-47827** turn the fan motor drive plate in the same direction of the arrow on the fan blade until the fan motor drive plate engages to the fan blade. See **Special Tools**. Full engagement is attained when the motor drive plate fully occupies the three slots in the face of the fan blade.
6. Rotate the cooling fan blade to ensure proper rotation.
7. Install the fan shroud assembly to the vehicle. Refer to **Fan Shroud Replacement**.

THERMOSTAT HOUSING REPLACEMENT (RPOS LZE/LZ4/LZ9)

Removal Procedure

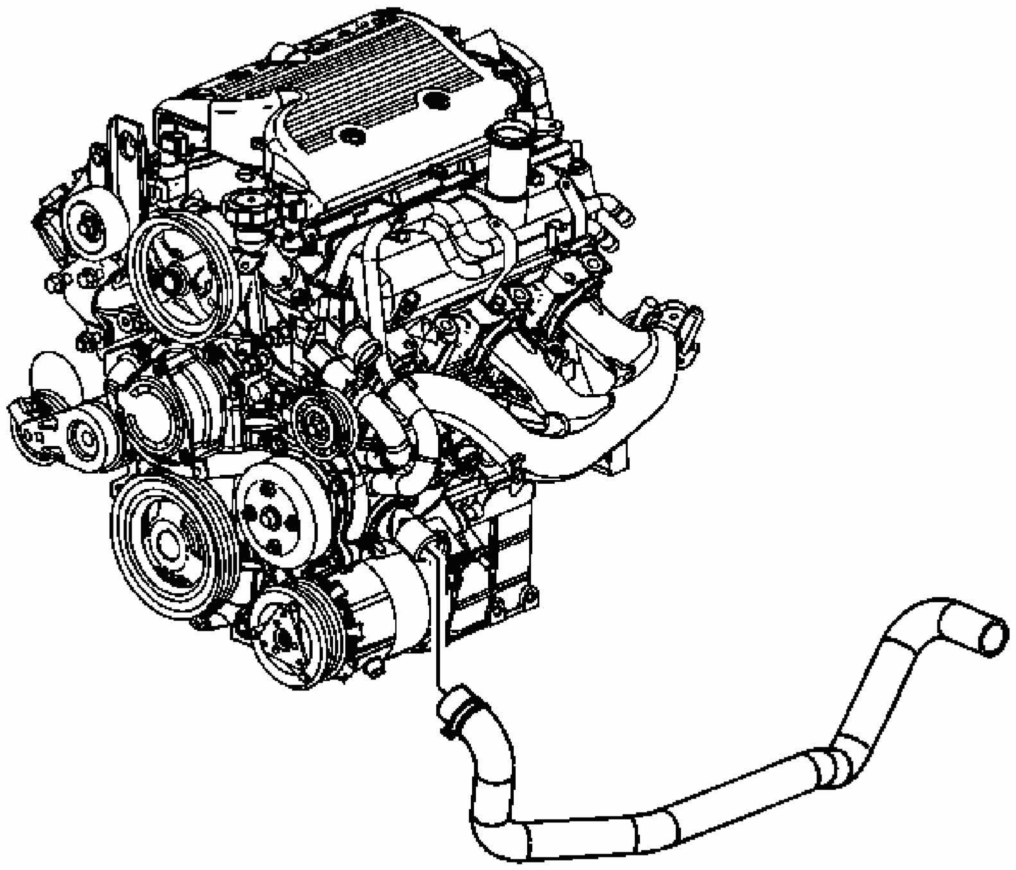


Fig. 64: Identifying Radiator Outlet Hose Clamp & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** or **Air Cleaner Outlet Duct Replacement** .
3. Reposition the radiator outlet hose clamp at the thermostat housing.
4. Remove the radiator outlet hose from the thermostat housing (3.5L shown, 3.9L similar).

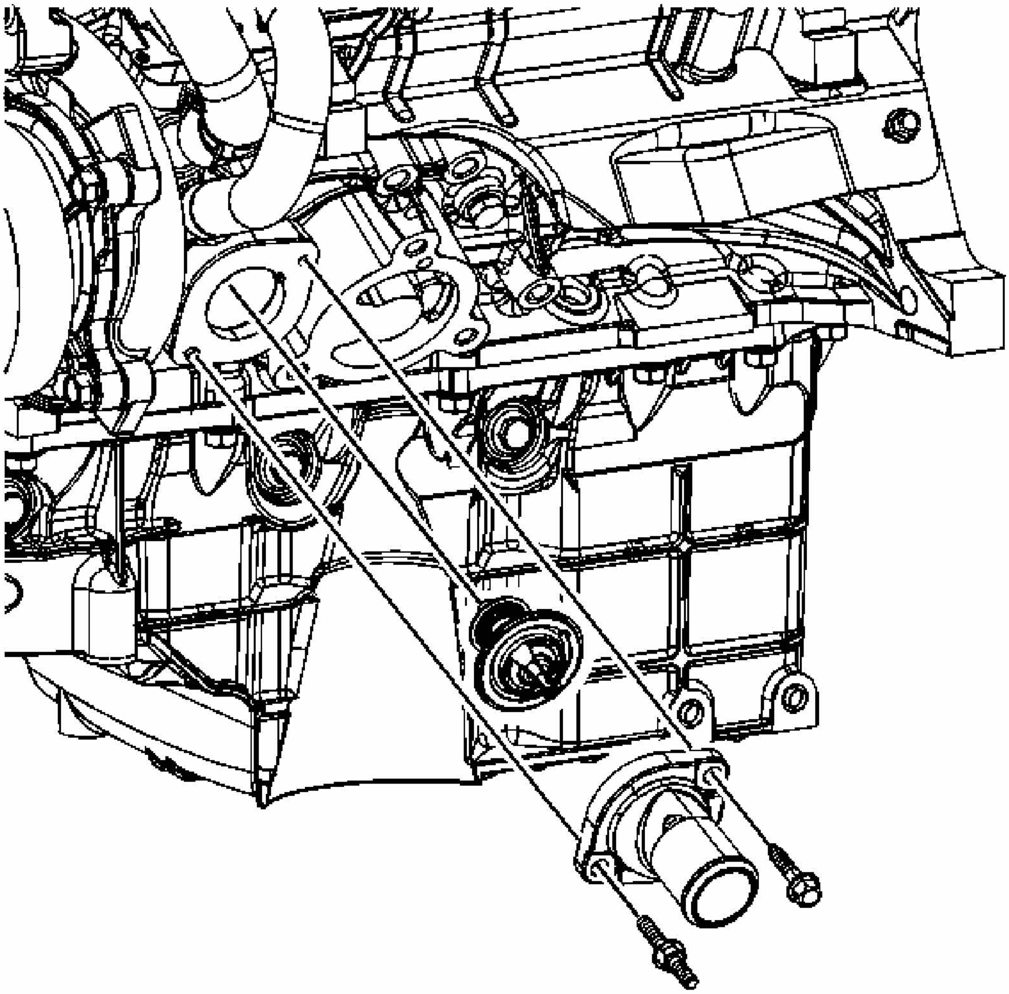


Fig. 65: Identifying Thermostat Housing Bolt/Stud
Courtesy of GENERAL MOTORS CORP.

5. Remove the thermostat housing bolt/stud.
6. Remove the thermostat housing and gasket.
7. Clean the gasket surfaces.

Installation Procedure

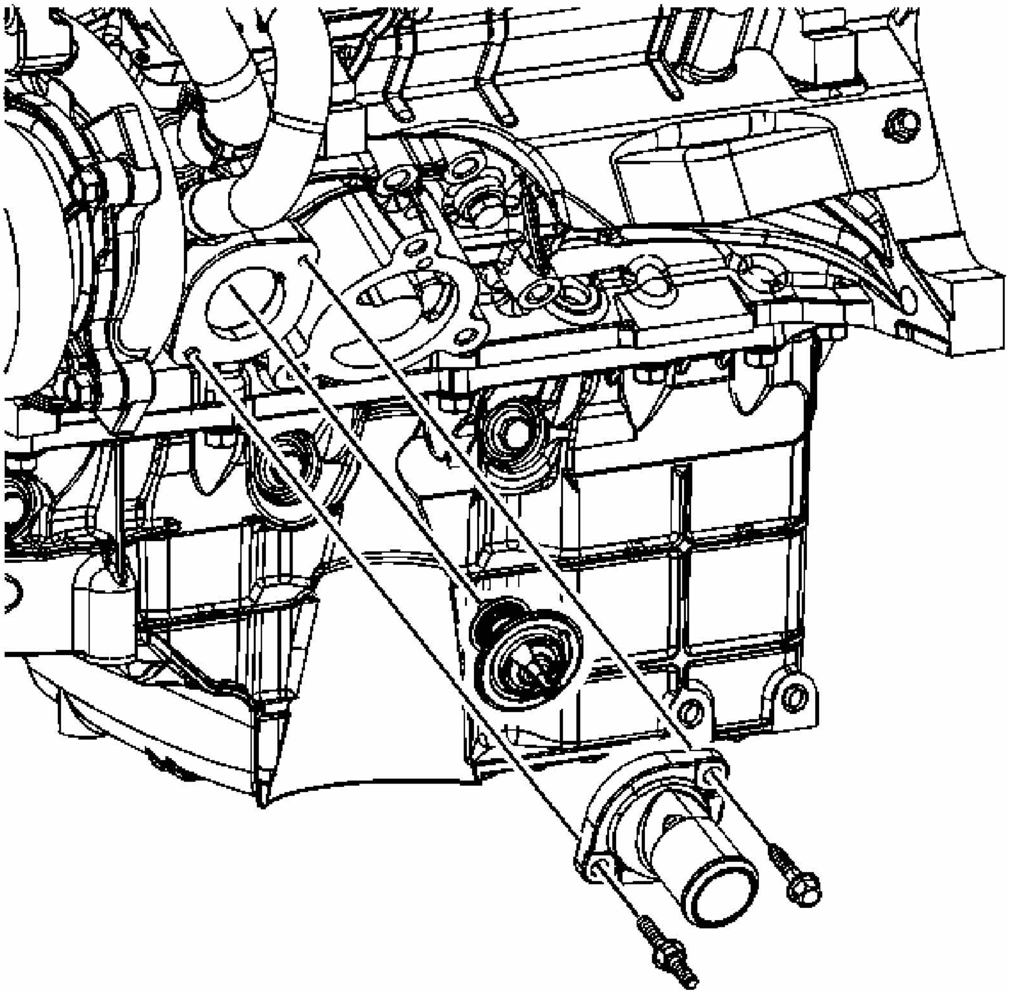


Fig. 66: Identifying Thermostat Housing Bolt/Stud
Courtesy of GENERAL MOTORS CORP.

1. Position a NEW gasket and the thermostat housing to the engine block.

NOTE: **Refer to FASTENER NOTICE .**

2. Install the thermostat housing bolt/stud.

Tighten: Tighten the bolt/stud to 25 N.m (18 lb ft).

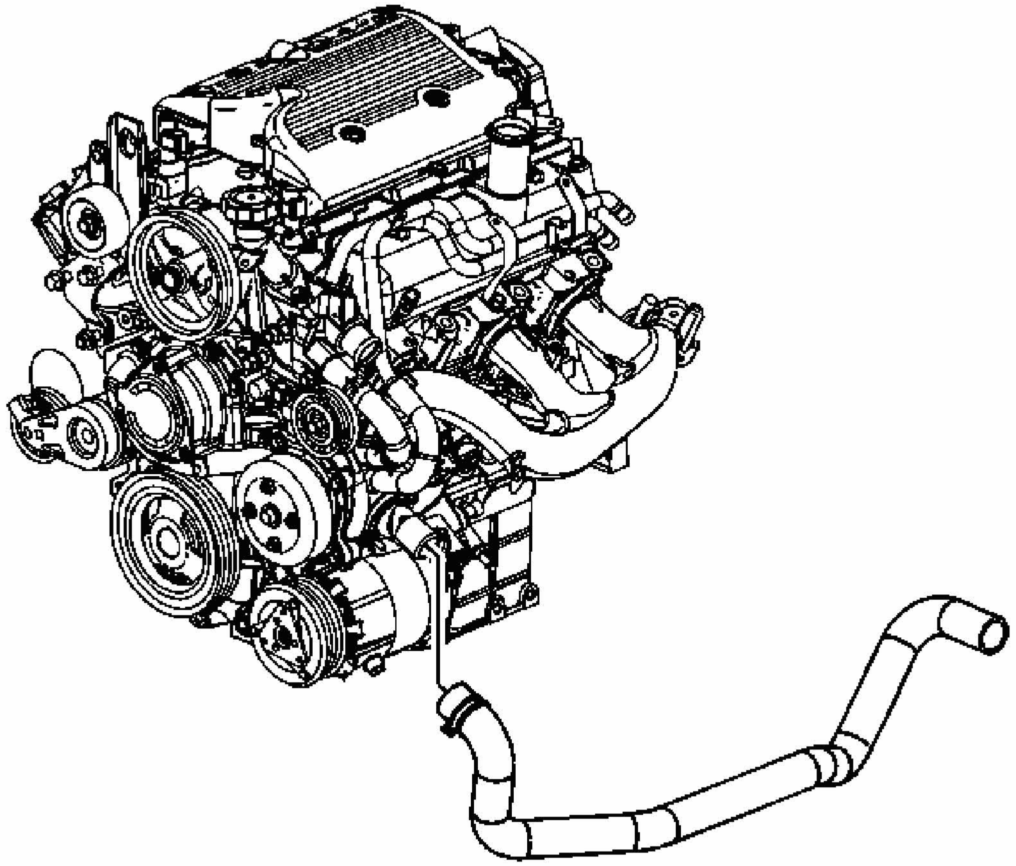


Fig. 67: Identifying Radiator Outlet Hose Clamp & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

3. Install the radiator outlet hose to the thermostat housing (3.5L shown, 3.9L similar).
4. Position the radiator outlet hose clamp at the thermostat housing.
5. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** or **Air Cleaner Outlet Duct Replacement** .
6. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
7. Inspect the system for leaks.

THERMOSTAT HOUSING REPLACEMENT (RPO LS4)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

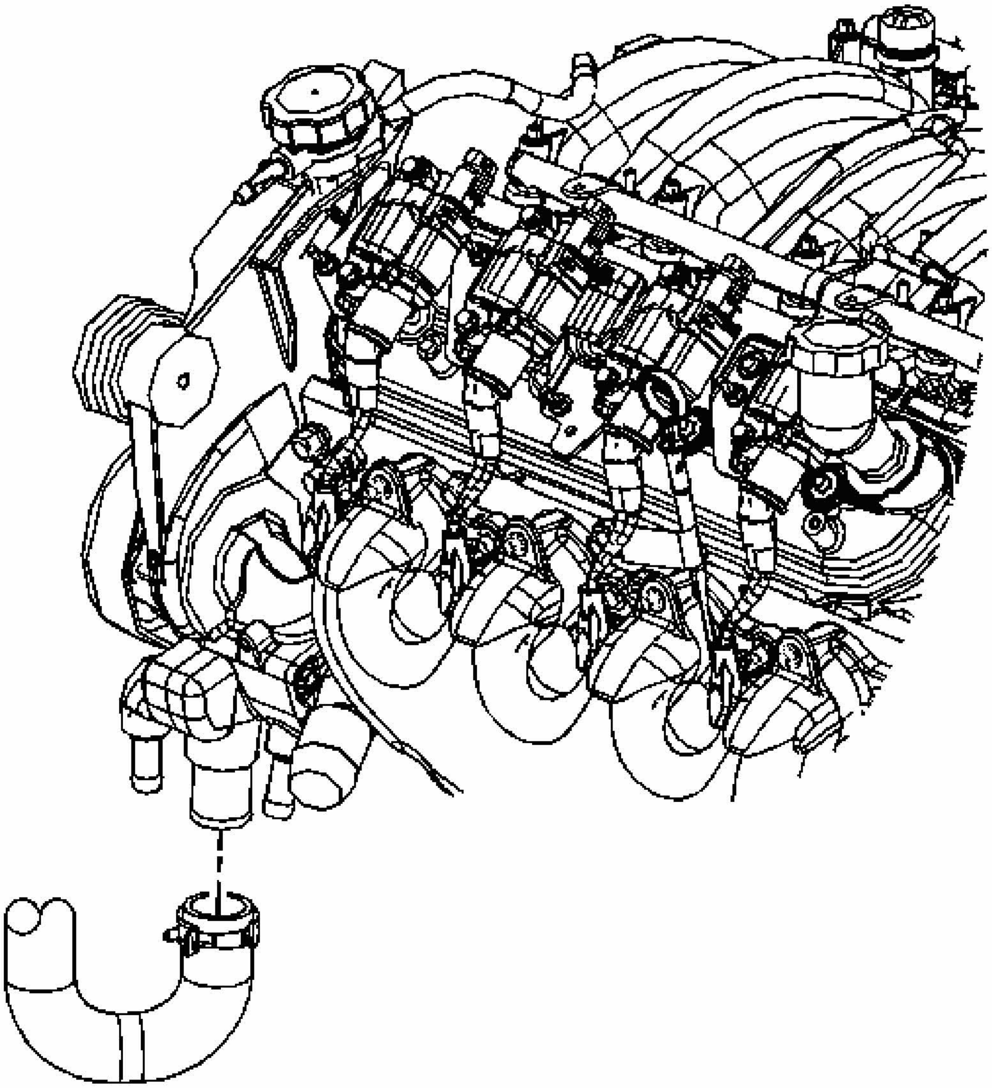


Fig. 68: Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling**

System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill).

2. Use the **J 38185** in order to reposition the hose clamp from the water outlet housing.
3. Remove the radiator inlet hose from the water outlet housing.

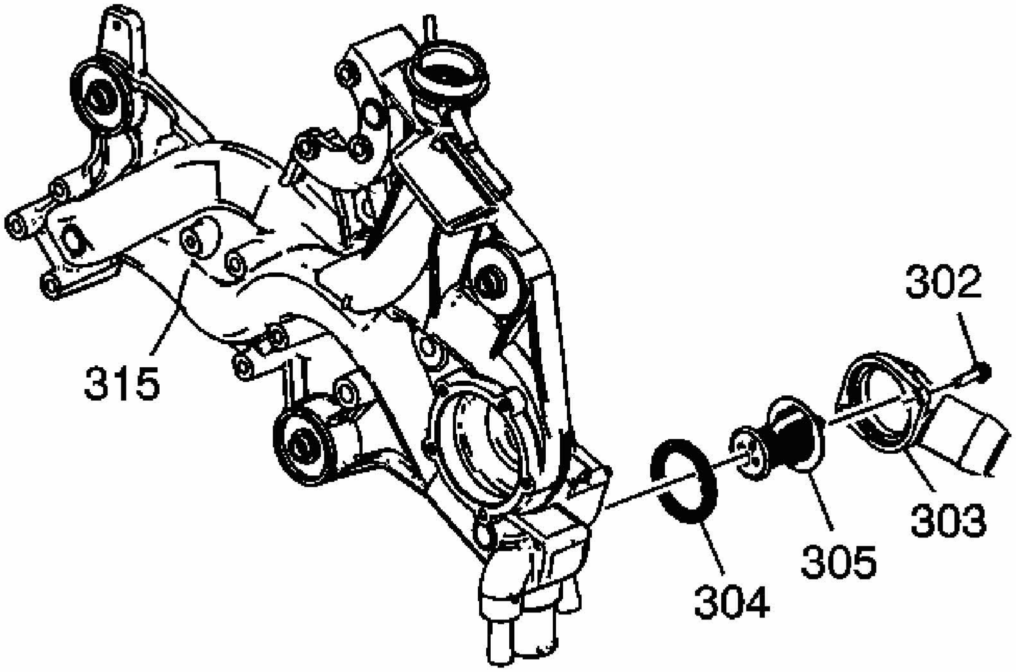


Fig. 69: View Of Thermostat Housing, Bolts, Thermostat, & O-Ring
Courtesy of GENERAL MOTORS CORP.

4. Remove the water outlet housing bolts (302).
5. Remove the water outlet housing (303) and O-ring seal (304).
6. Remove the thermostat (305).
7. Clean and inspect the water outlet housing O-ring seal mating surfaces.

Installation Procedure

NOTE: DO NOT use cooling system seal tabs, or similar compounds, unless otherwise instructed. The use of cooling system seal tabs, or similar compounds, may restrict coolant flow through the passages of the cooling system or the engine components. Restricted coolant flow may cause engine overheating and/or damage to the cooling system or the engine components/assembly.

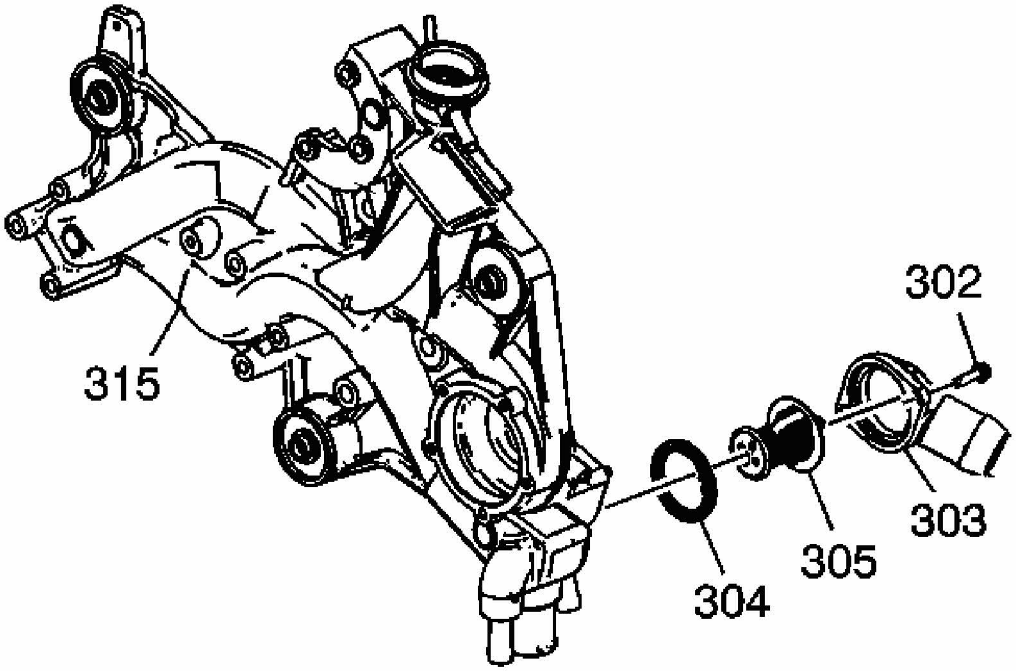


Fig. 70: View Of Thermostat Housing, Bolts, Thermostat, & O-Ring
Courtesy of GENERAL MOTORS CORP.

1. Install the thermostat (305).
2. Install the O-ring seal (304) and water outlet housing (303).

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the water outlet housing bolts (302).

   Tighten: Tighten the bolts to 15 N.m (11 lb ft).

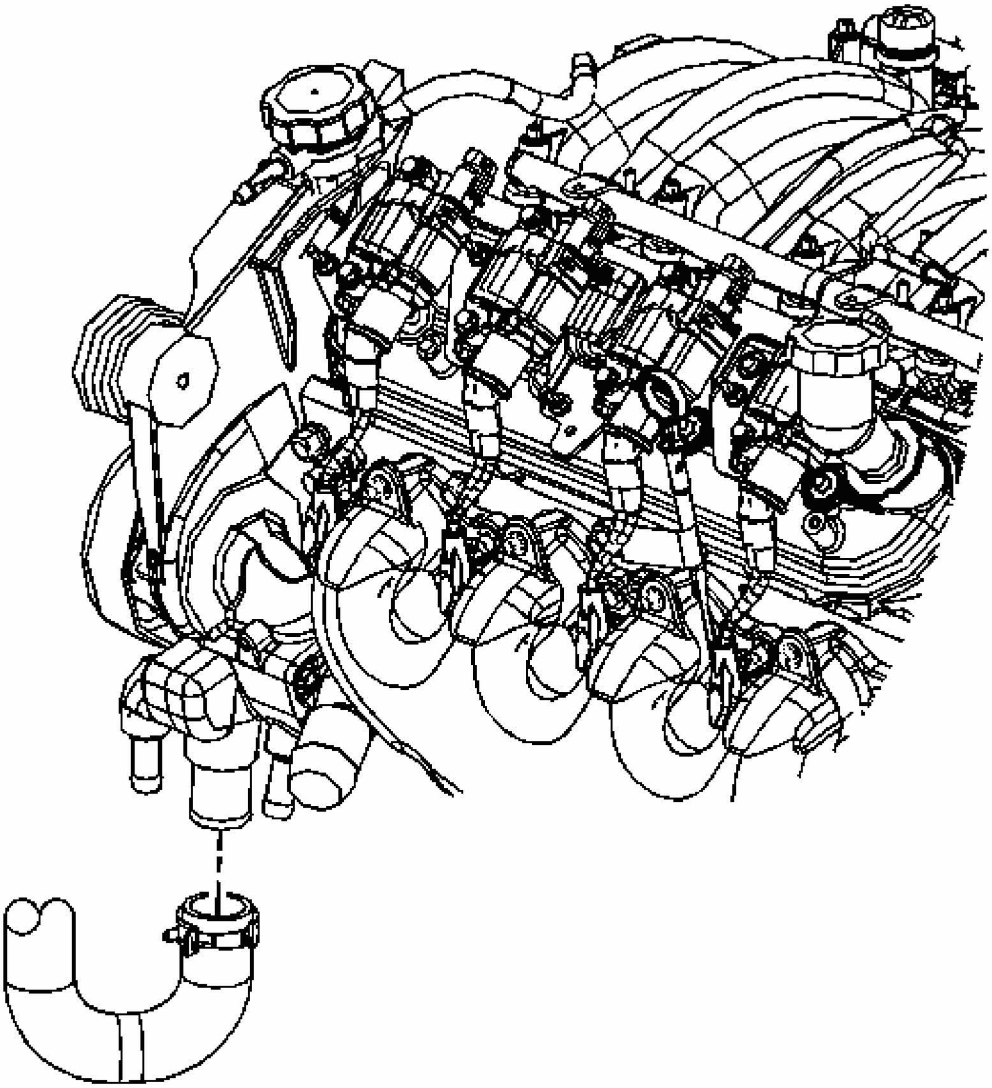


Fig. 71: Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Install the radiator inlet hose to the water outlet housing.
5. Use the **J 38185** in order to reposition and install the hose clamp to the water outlet housing.
6. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System**

(LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill).

THERMOSTAT REPLACEMENT (RPOS LZE/LZ4/LZ9)

Removal Procedure

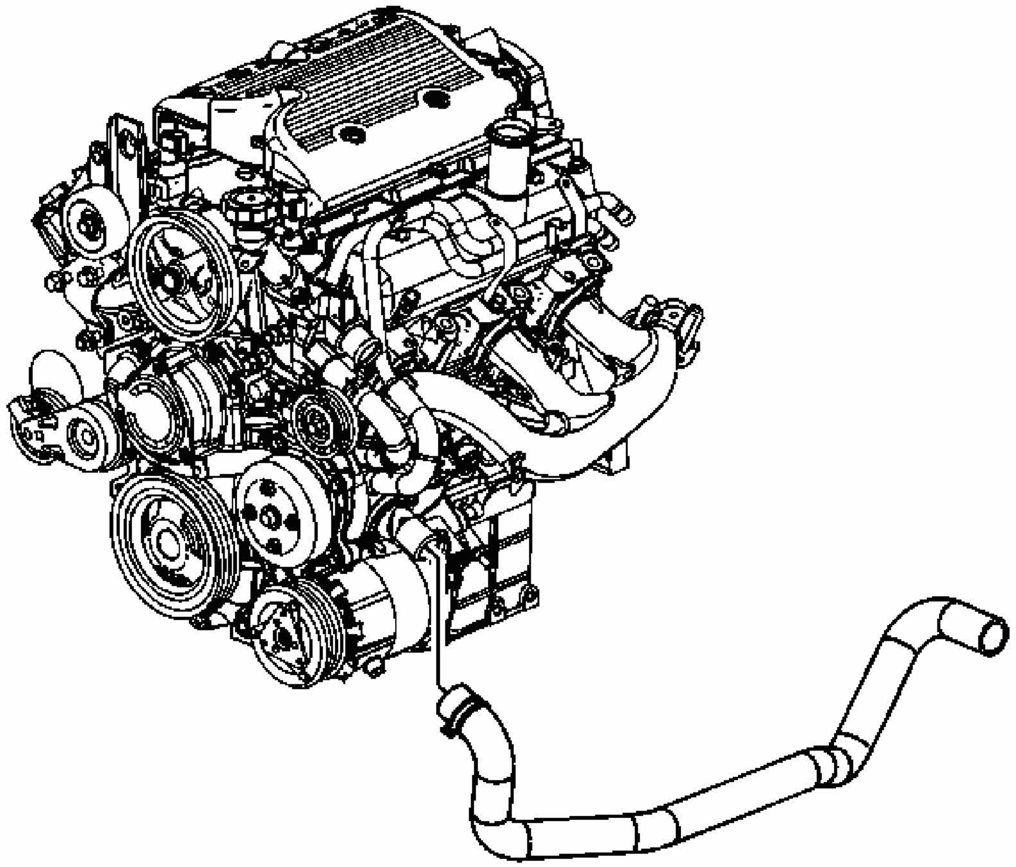


Fig. 72: Identifying Radiator Outlet Hose Clamp & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** or **Air Cleaner Outlet Duct Replacement** .
3. Reposition the radiator outlet hose clamp at the thermostat housing.

4. Remove the radiator outlet hose from the thermostat housing (3.5L shown, 3.9L similar).

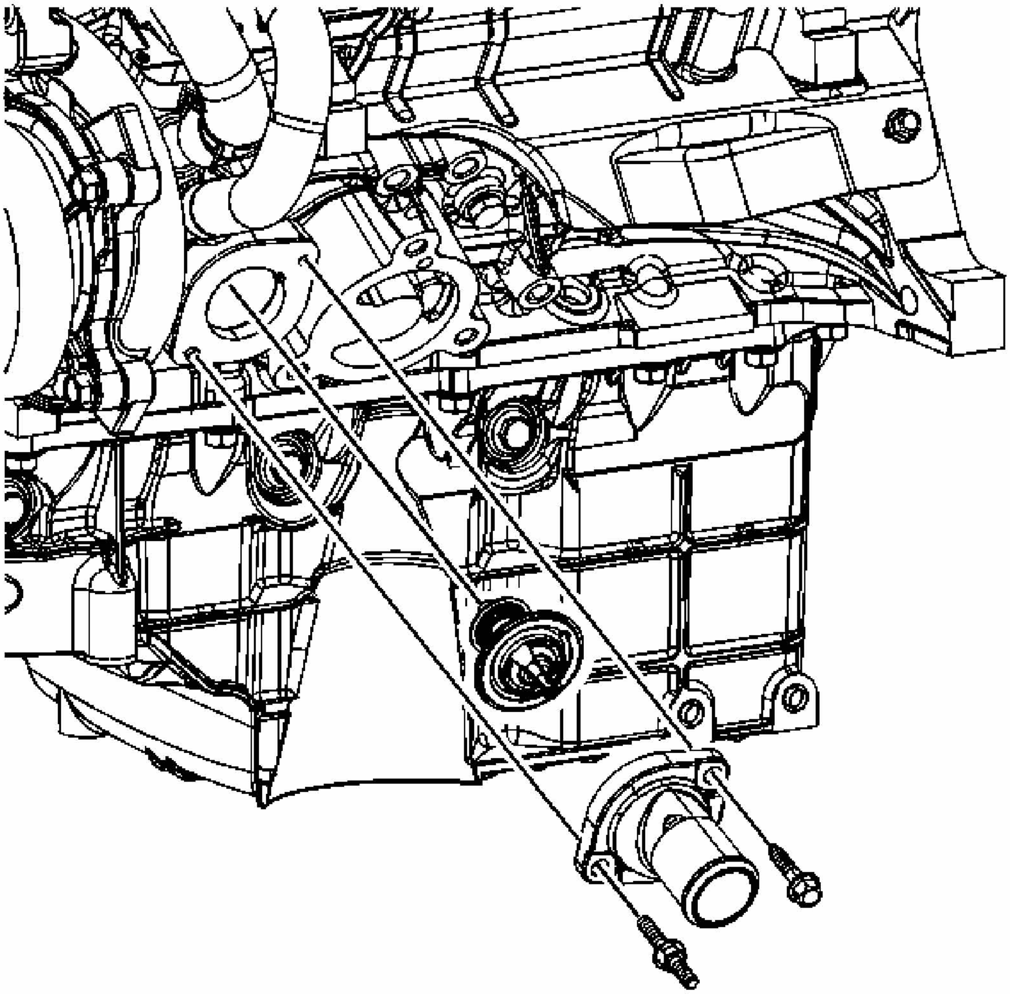


Fig. 73: Identifying Thermostat Housing Bolt/Stud
Courtesy of GENERAL MOTORS CORP.

5. Remove the thermostat housing bolt/stud.
6. Remove the thermostat housing and gasket.
7. Remove the thermostat.
8. Clean the gasket surfaces.

Installation Procedure

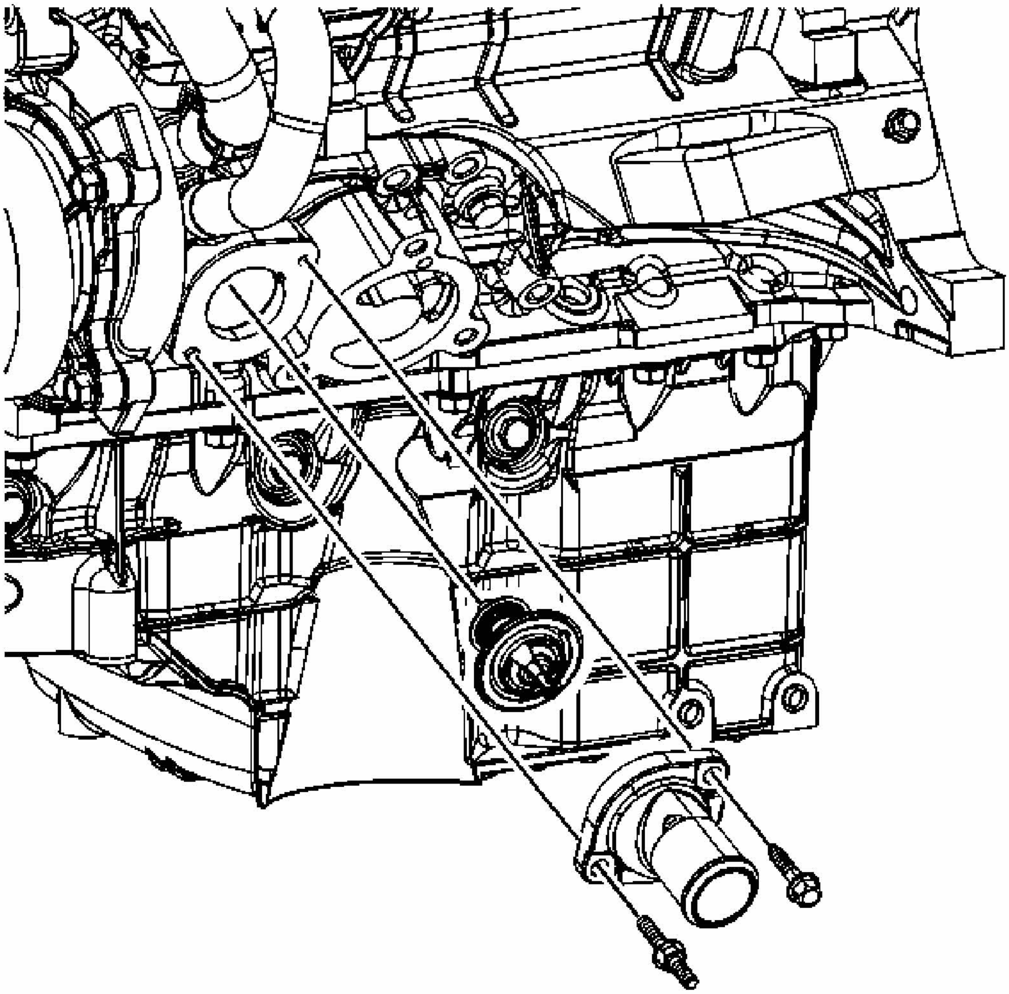


Fig. 74: Identifying Thermostat Housing Bolt/Stud
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW thermostat.
2. Position a NEW gasket and the thermostat housing to the engine block.

NOTE: **Refer to FASTENER NOTICE .**

3. Install the thermostat housing bolt/stud.

   Tighten: Tighten the bolt/stud to 25 N.m (18 lb ft).

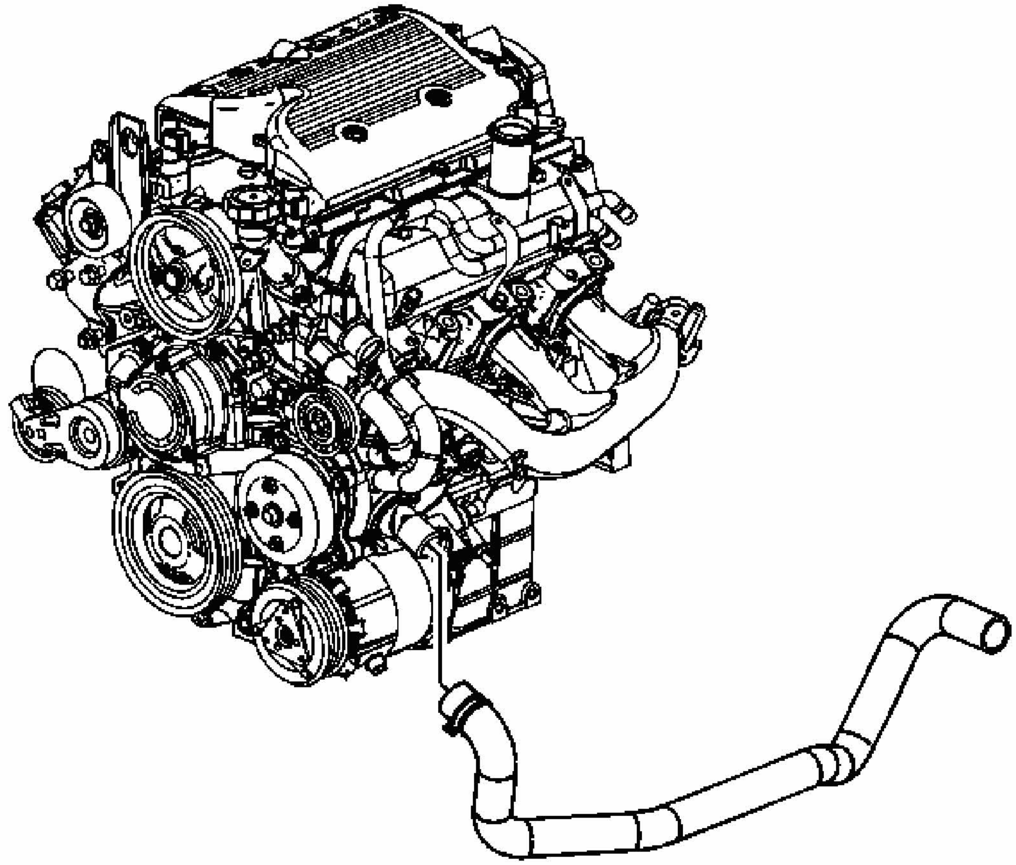


Fig. 75: Identifying Radiator Outlet Hose Clamp & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

4. Install the radiator outlet hose to the thermostat housing (3.5L shown, 3.9L similar).
5. Position the radiator outlet hose clamp at the thermostat housing.
6. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** or **Air Cleaner Outlet Duct Replacement** .
7. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
8. Inspect the system for leaks.

THERMOSTAT REPLACEMENT (RPO LS4)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

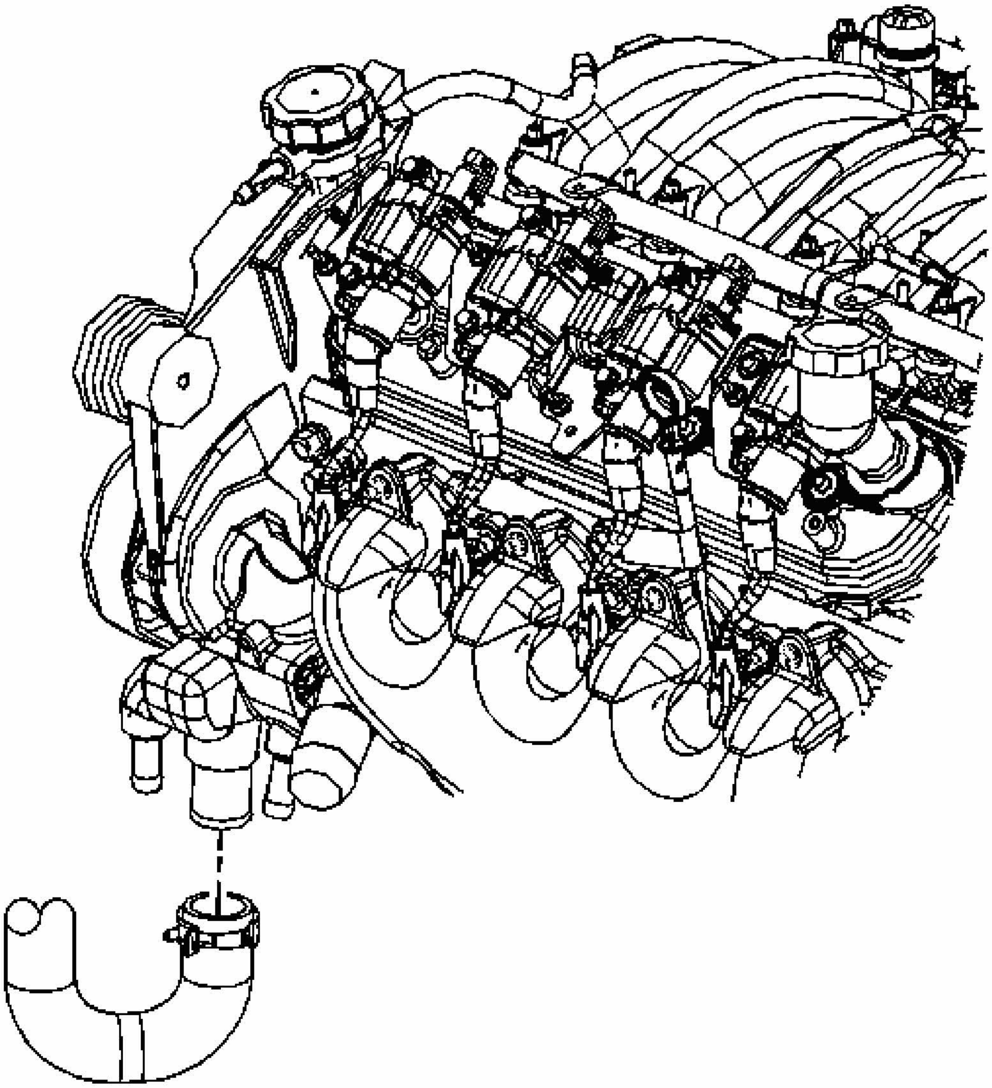


Fig. 76: Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling**

System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill).

2. Use the **J 38185** in order to reposition the hose clamp from the water outlet housing.
3. Remove the radiator inlet hose from the water outlet housing.

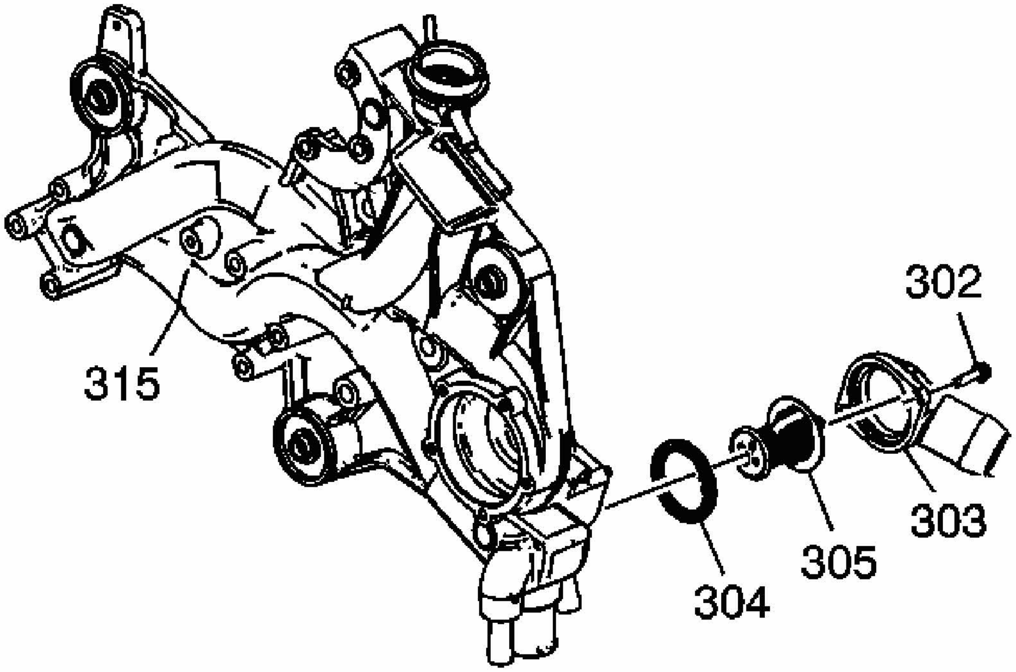


Fig. 77: View Of Thermostat Housing, Bolts, Thermostat, & O-Ring
Courtesy of GENERAL MOTORS CORP.

4. Remove the water outlet housing bolts (302).
5. Remove the water outlet housing (303) and O-ring seal (304).
6. Remove the thermostat (305).
7. Clean and inspect the water outlet housing O-ring seal mating surfaces.

Installation Procedure

NOTE: **DO NOT use cooling system seal tabs, or similar compounds, unless otherwise instructed. The use of cooling system seal tabs, or similar compounds, may restrict coolant flow through the passages of the cooling system or the engine components. Restricted coolant flow may cause engine overheating and/or damage to the cooling system or the engine components/assembly.**

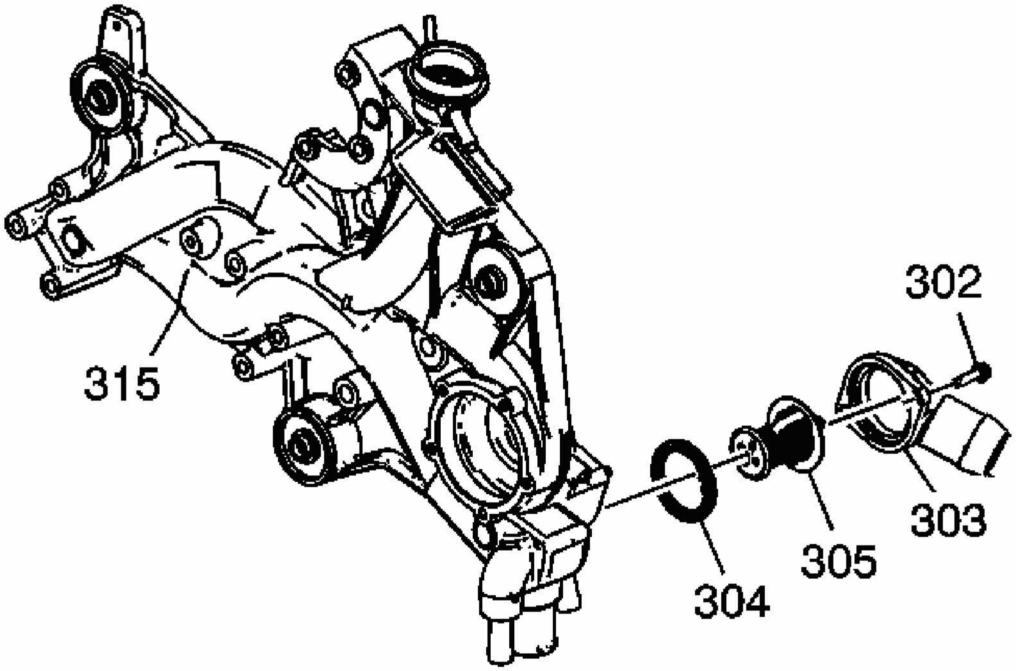


Fig. 78: View Of Thermostat Housing, Bolts, Thermostat, & O-Ring
Courtesy of GENERAL MOTORS CORP.

1. Install the thermostat (305).
2. Install the O-ring seal (304) and water outlet housing (303).

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

3. Install the water outlet housing bolts (302).

   Tighten: Tighten the bolts to 15 N.m (11 lb ft).

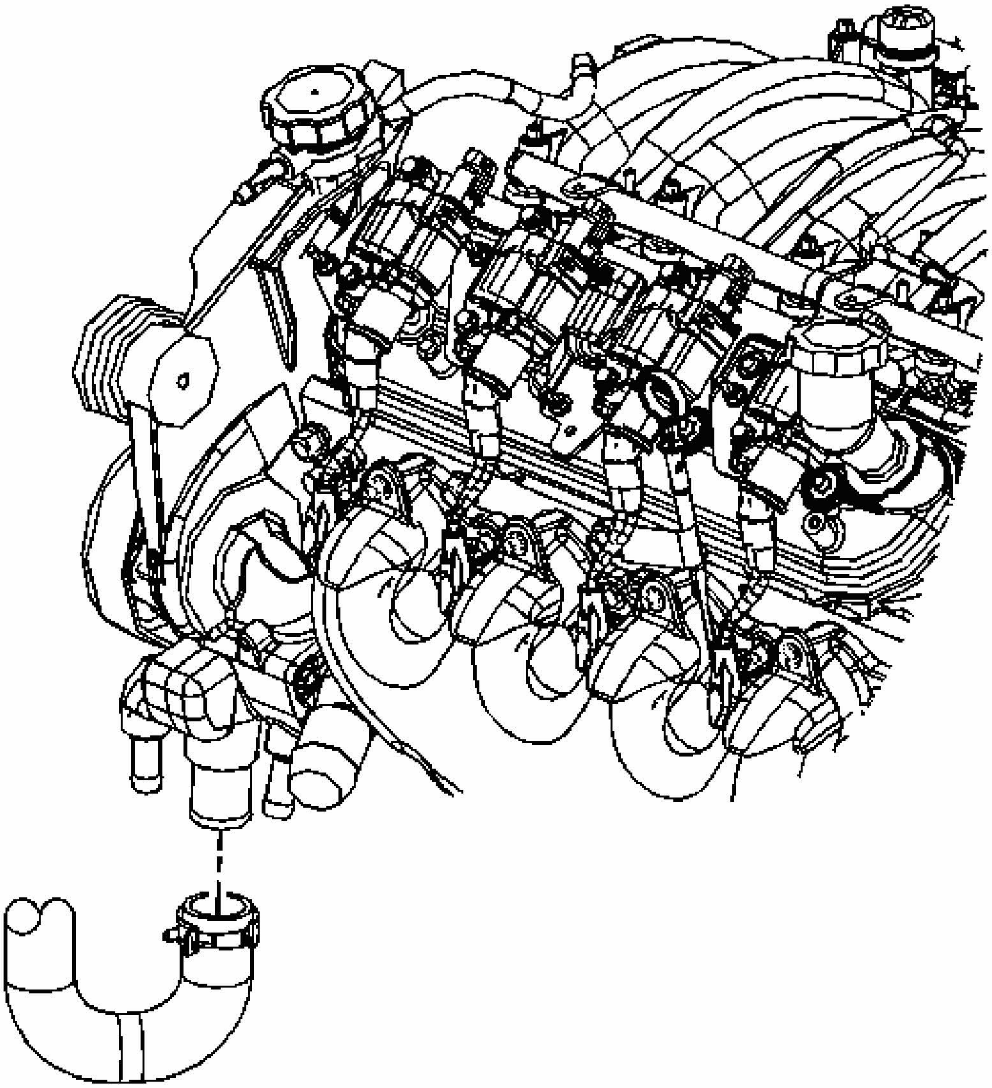


Fig. 79: Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Install the radiator inlet hose to the water outlet housing.
5. Use the **J 38185** in order to reposition and install the hose clamp to the water outlet housing.
6. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System**

(LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill).

COOLANT CROSSOVER PIPE REPLACEMENT (RPOS LZE/LZ9)

Removal Procedure

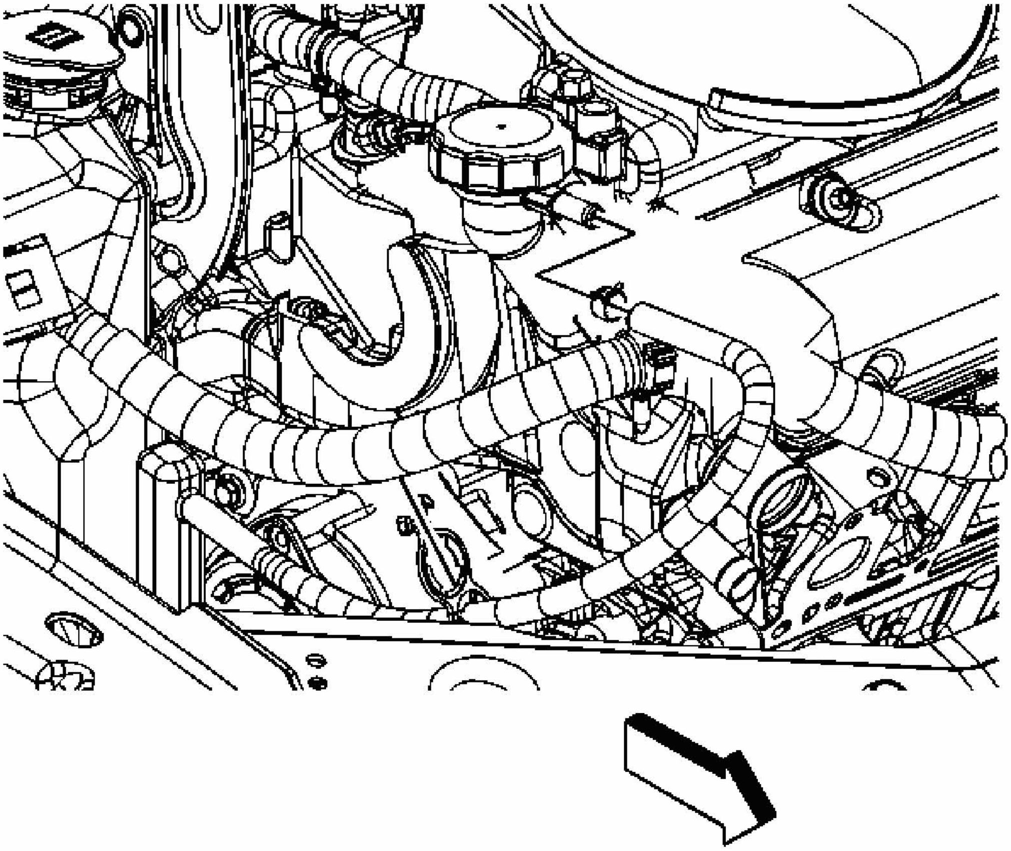


Fig. 80: Locating Coolant Recovery Reservoir Hose & Fill Tube Fitting
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement** or **Intake Manifold Cover Replacement** .
2. Remove the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** .
3. Remove the drive belt idler pulleys. Refer to **Drive Belt Idler Pulley Replacement** or **Drive Belt Idler Pulley Replacement** .
4. Remove the power steering pump. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)** .

5. Reposition the coolant recovery reservoir hose clamp at the fill tube fitting.
6. Remove the coolant recovery reservoir hose from the fill tube fitting. Position the hose out of the way.

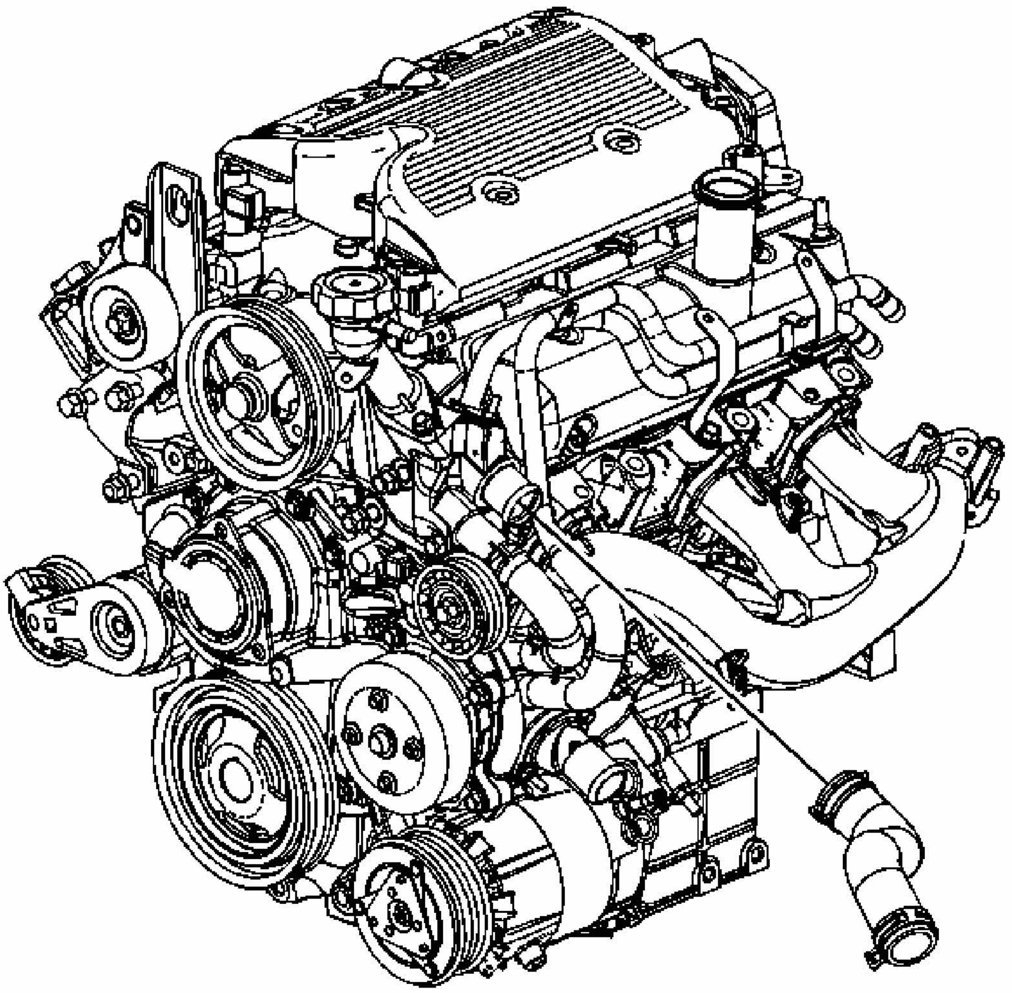


Fig. 81: View Of Radiator Inlet Hose & Crossover Pipe
Courtesy of GENERAL MOTORS CORP.

7. Reposition the radiator inlet hose clamp at the crossover pipe (3.5L shown, 3.9L similar).
8. Remove the radiator inlet hose from the crossover pipe.

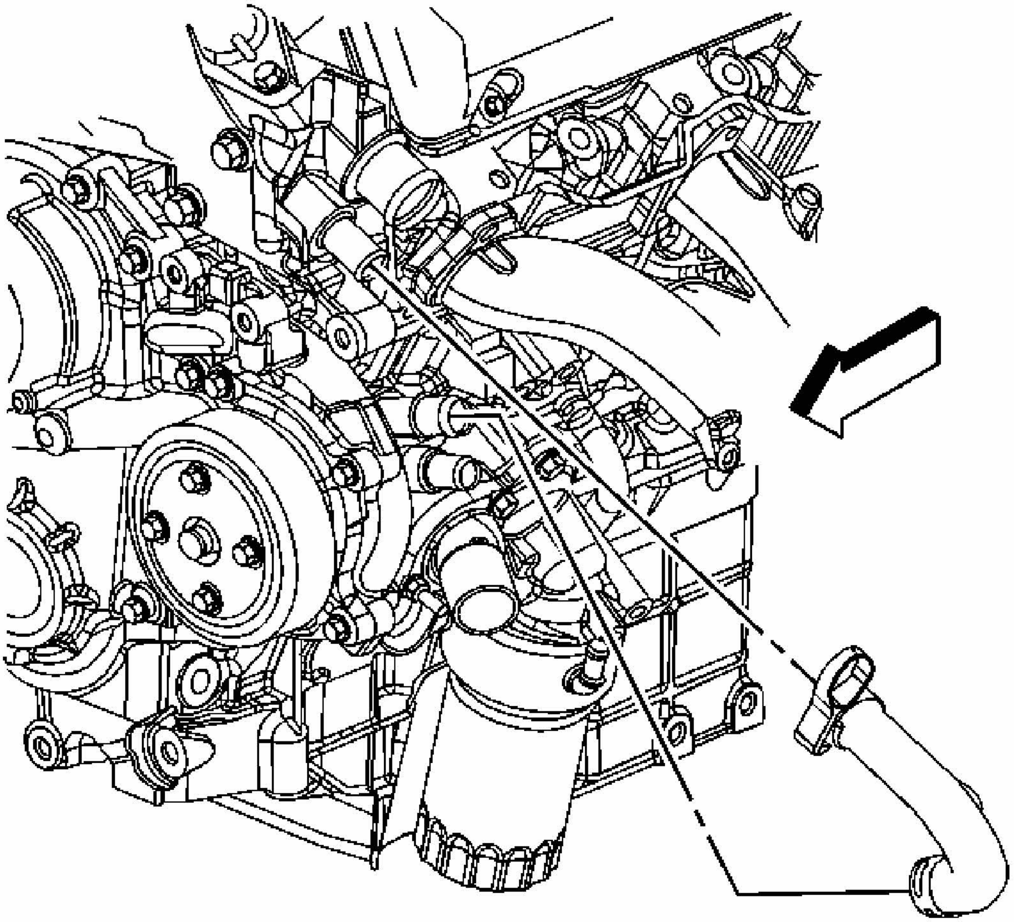


Fig. 82: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

9. Reposition the thermal bypass hose clamp at the crossover pipe.
10. Remove the thermal bypass hose from the crossover pipe.

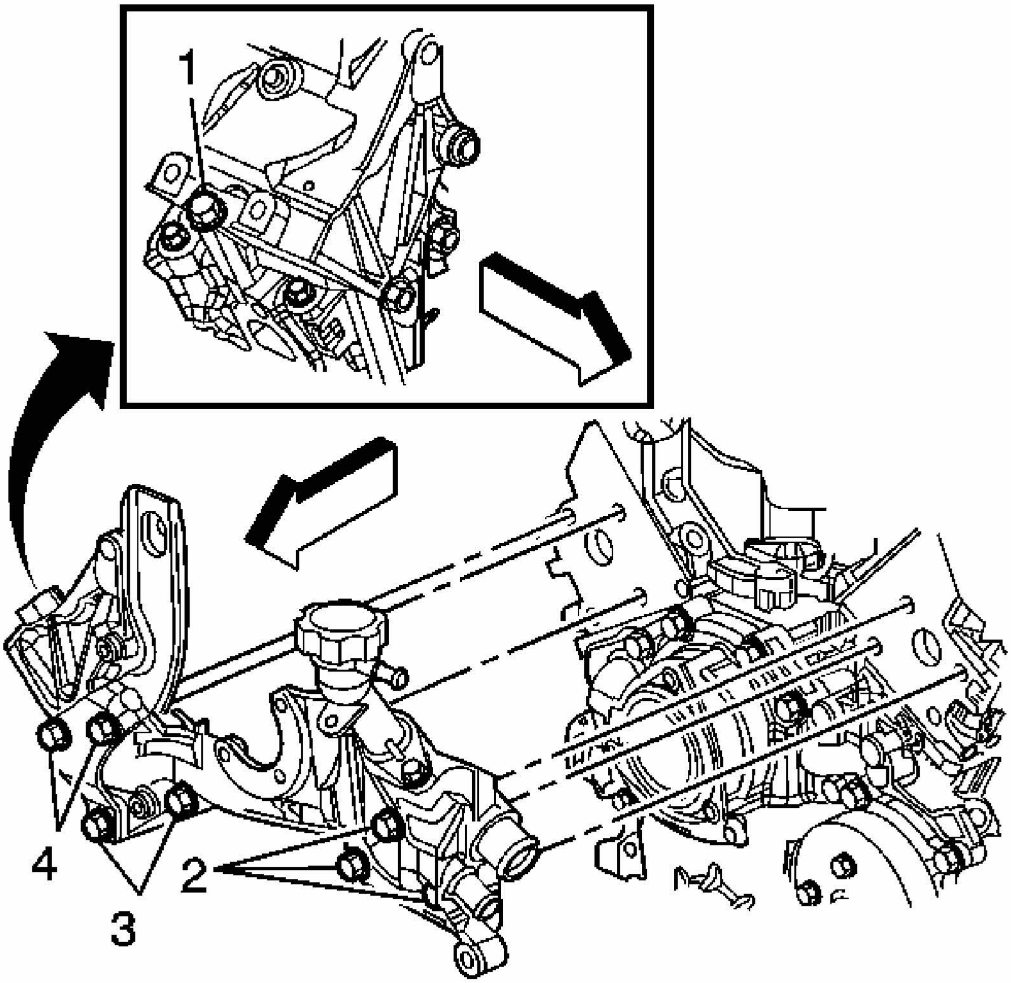


Fig. 83: Identifying Coolant Crossover Pipe Bolts (1-4)
Courtesy of GENERAL MOTORS CORP.

11. Remove the coolant crossover pipe bolts.
12. Remove the coolant crossover pipe.

Installation Procedure

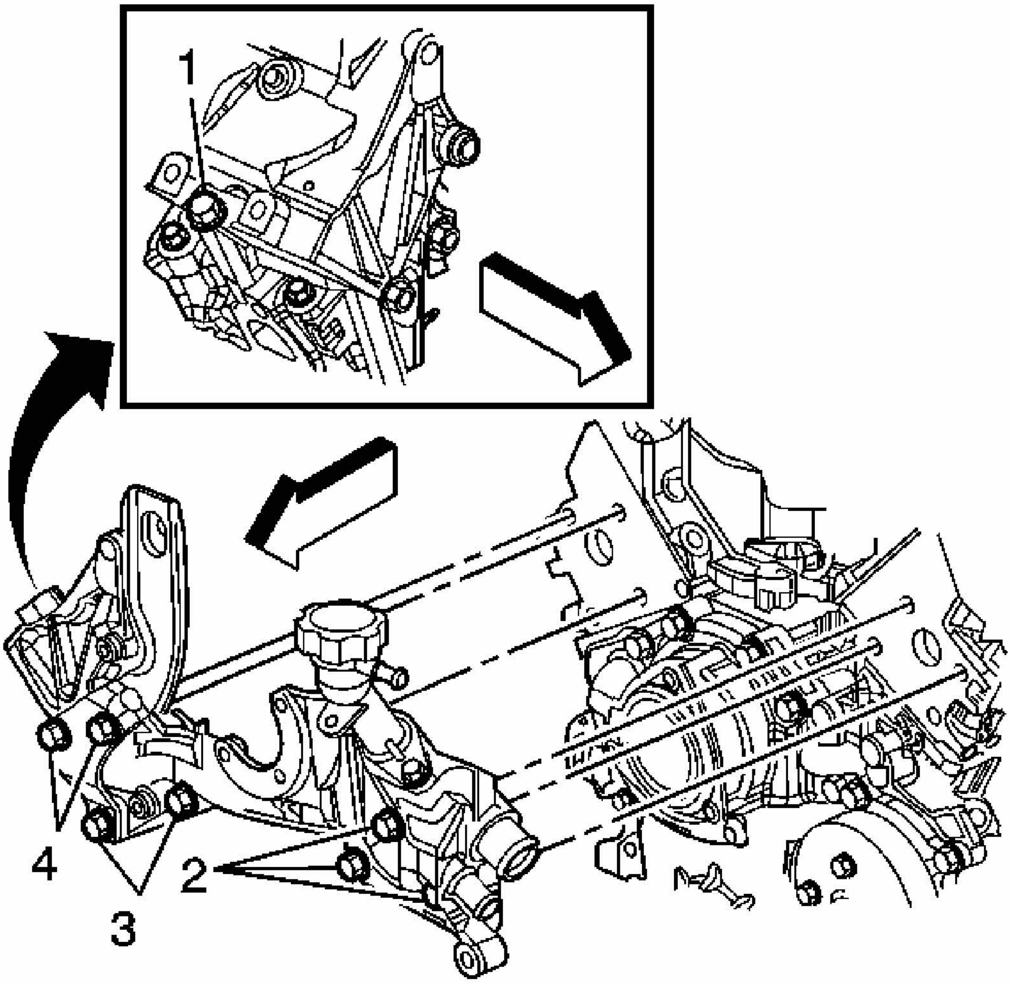


Fig. 84: Identifying Coolant Crossover Pipe Bolts (1-4)
Courtesy of GENERAL MOTORS CORP.

1. Position the coolant crossover pipe to the cylinder heads.

   NOTE: **Refer to Fastener Notice .**

2. Install the coolant crossover pipe bolts.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

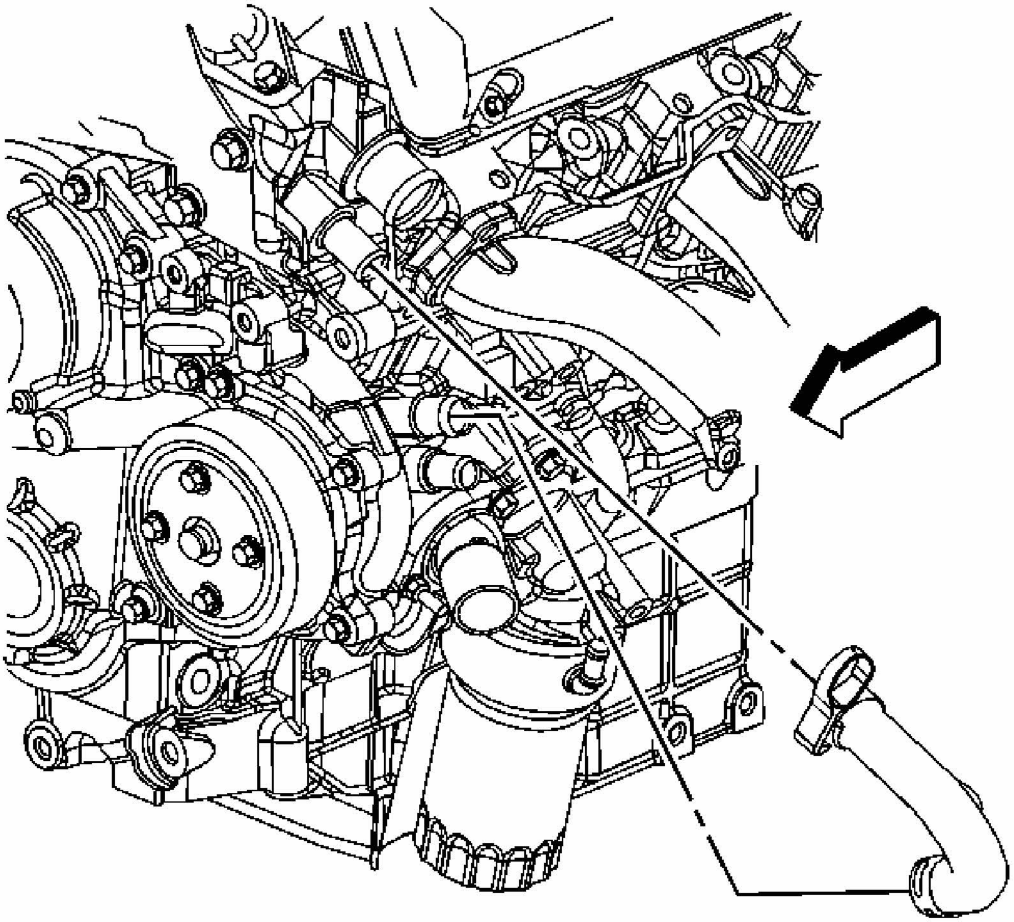


Fig. 85: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

3. Install the thermal bypass hose to the crossover pipe.
4. Position the thermal bypass hose clamp at the crossover pipe.

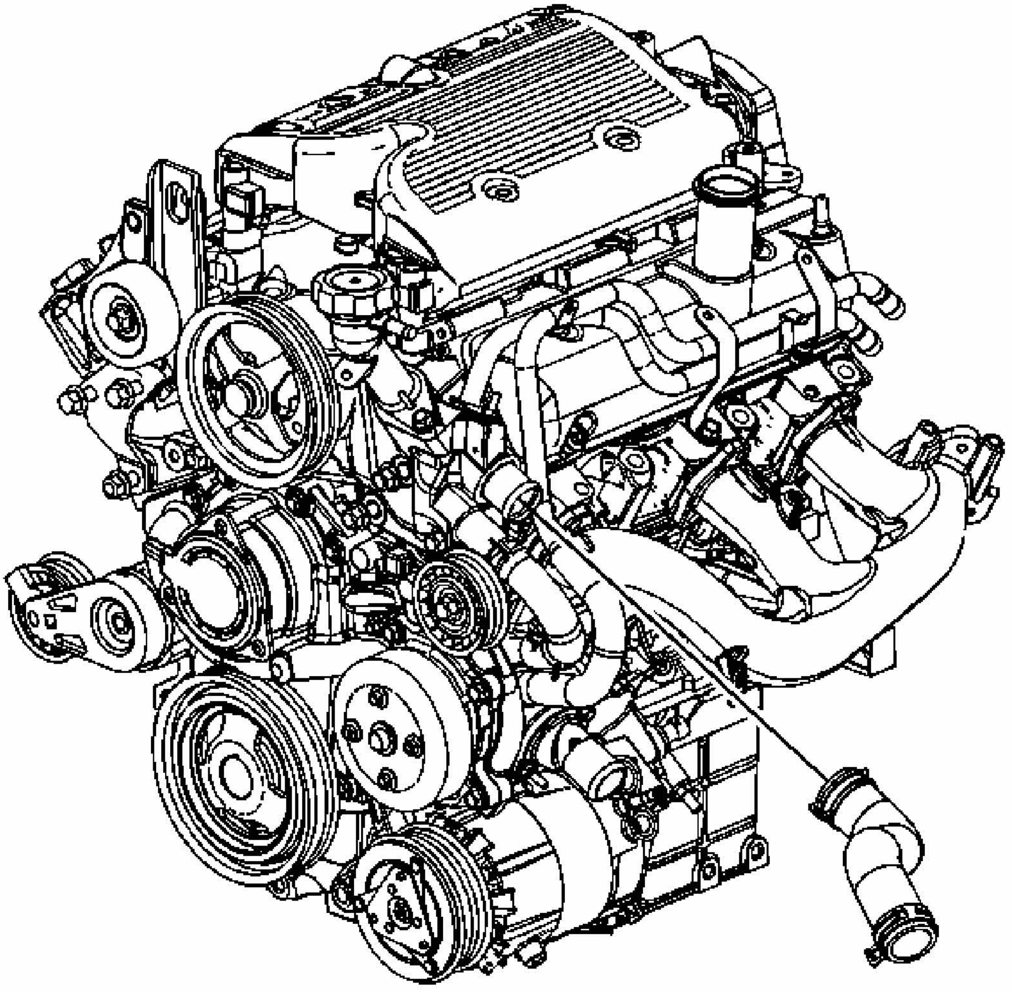


Fig. 86: View Of Radiator Inlet Hose & Crossover Pipe
Courtesy of GENERAL MOTORS CORP.

5. Install the radiator inlet hose to the crossover pipe (3.5L shown, 3.9L similar).
6. Position the radiator inlet hose clamp at the crossover pipe.

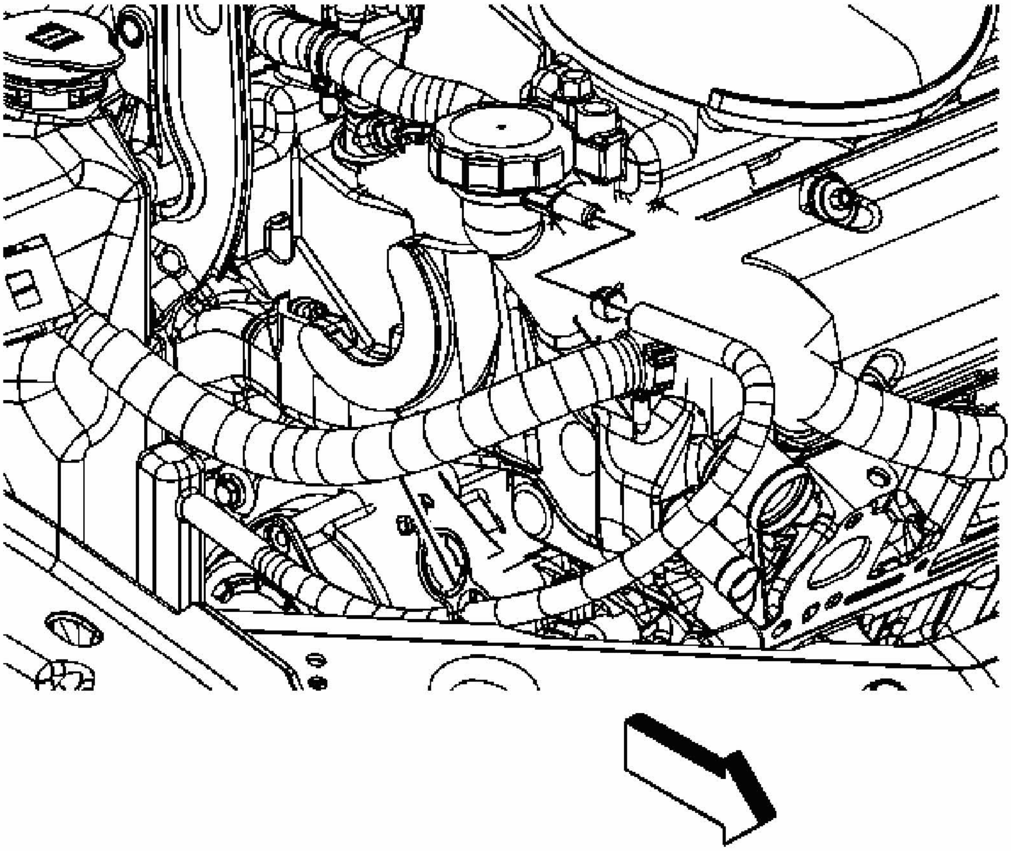


Fig. 87: Locating Coolant Recovery Reservoir Hose & Fill Tube Fitting
Courtesy of GENERAL MOTORS CORP.

7. Install the coolant recovery reservoir hose to the fill tube fitting.
8. Position the coolant recovery reservoir hose clamp at the fill tube fitting.
9. Install the power steering pump. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)** .
10. Install the drive belt idler pulleys. Refer to **Drive Belt Idler Pulley Replacement** or **Drive Belt Idler Pulley Replacement** .
11. Install the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** .
12. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement** or **Intake Manifold Cover Replacement** .

COOLANT AIR BLEED PIPE ASSEMBLY REPLACEMENT (RPO LS4)

Removal Procedure

IMPORTANT: Removal of the intake manifold is NOT required to service the coolant air bleed pipe, but is required to service the coolant air bleed pipe covers and/or gaskets.

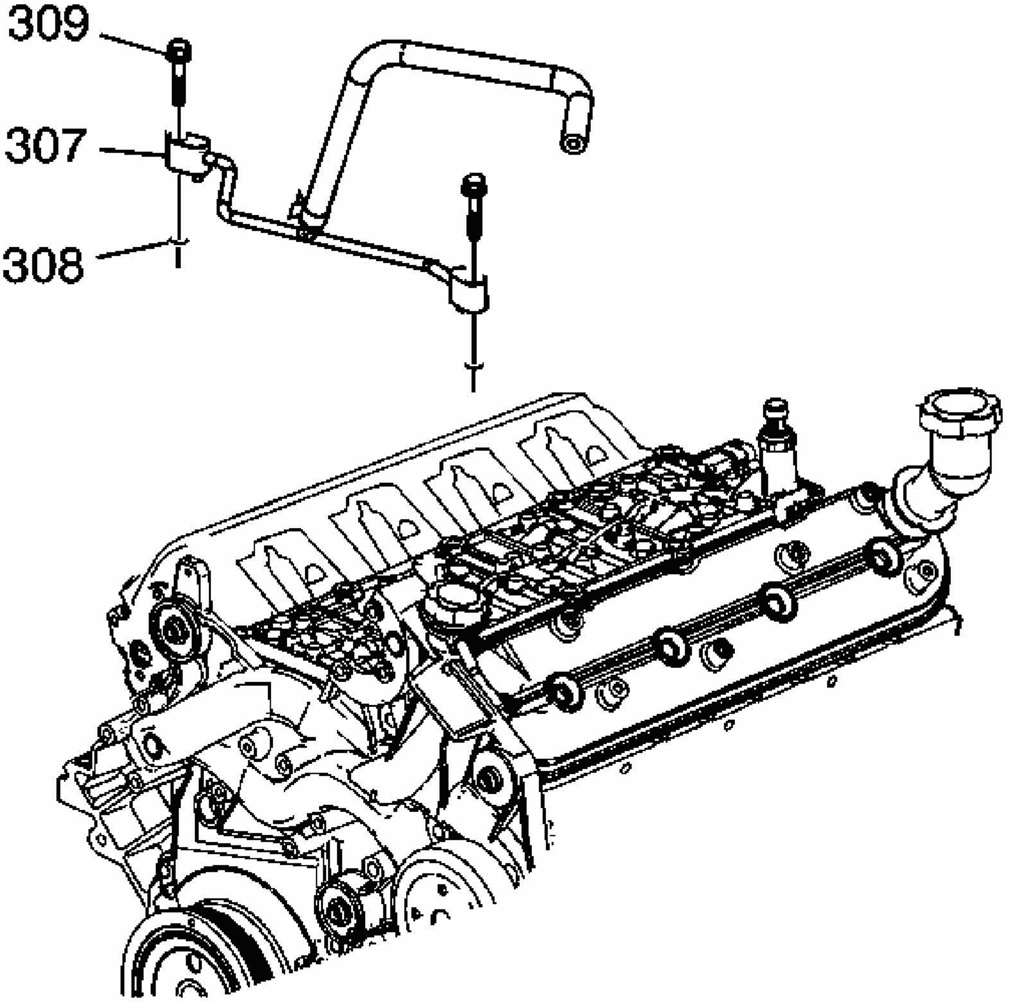


Fig. 88: View Of Coolant Air Bleed Pipe & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
2. Remove the intake manifold. Refer to **Intake Manifold Replacement** .

3. Disconnect the hose clamp and hose from the coolant fill neck.
4. Remove the coolant air bleed pipe bolts (309).
5. Remove the coolant air bleed pipe (307) with hose and seals (308).

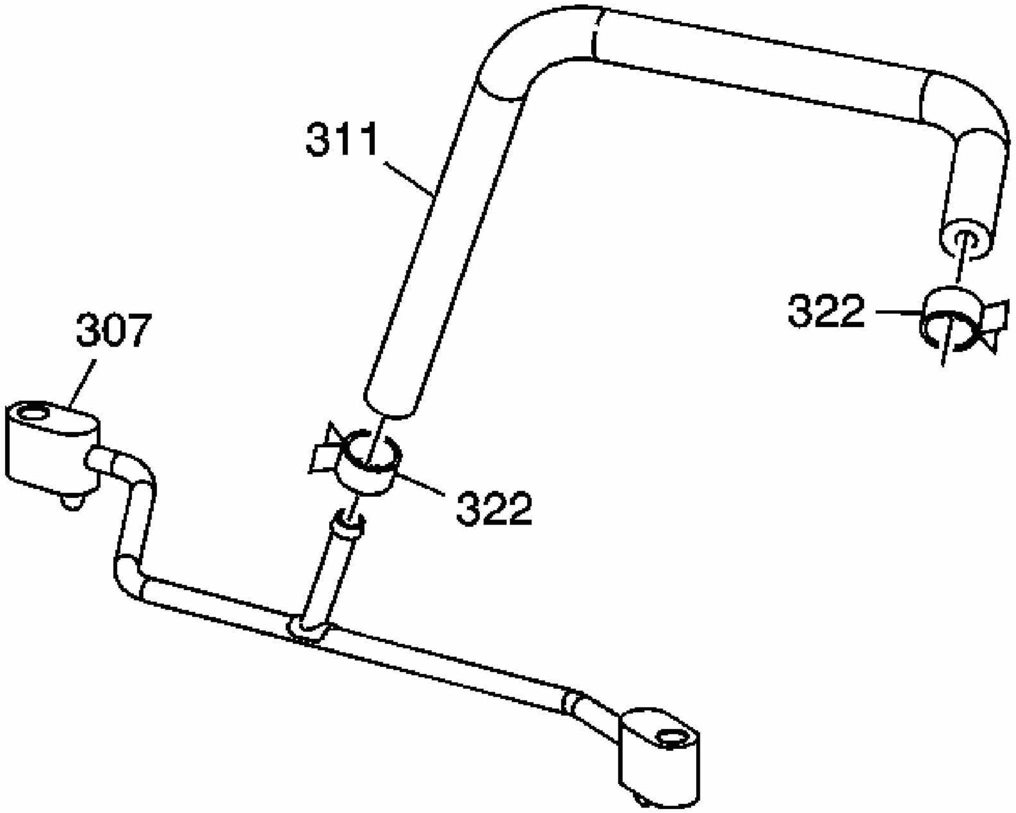


Fig. 89: View Of Coolant Air Bleed Pipe & Clamp
Courtesy of GENERAL MOTORS CORP.

6. Remove the hose (311) and clamps (322) from the coolant air bleed pipe (307) as required.

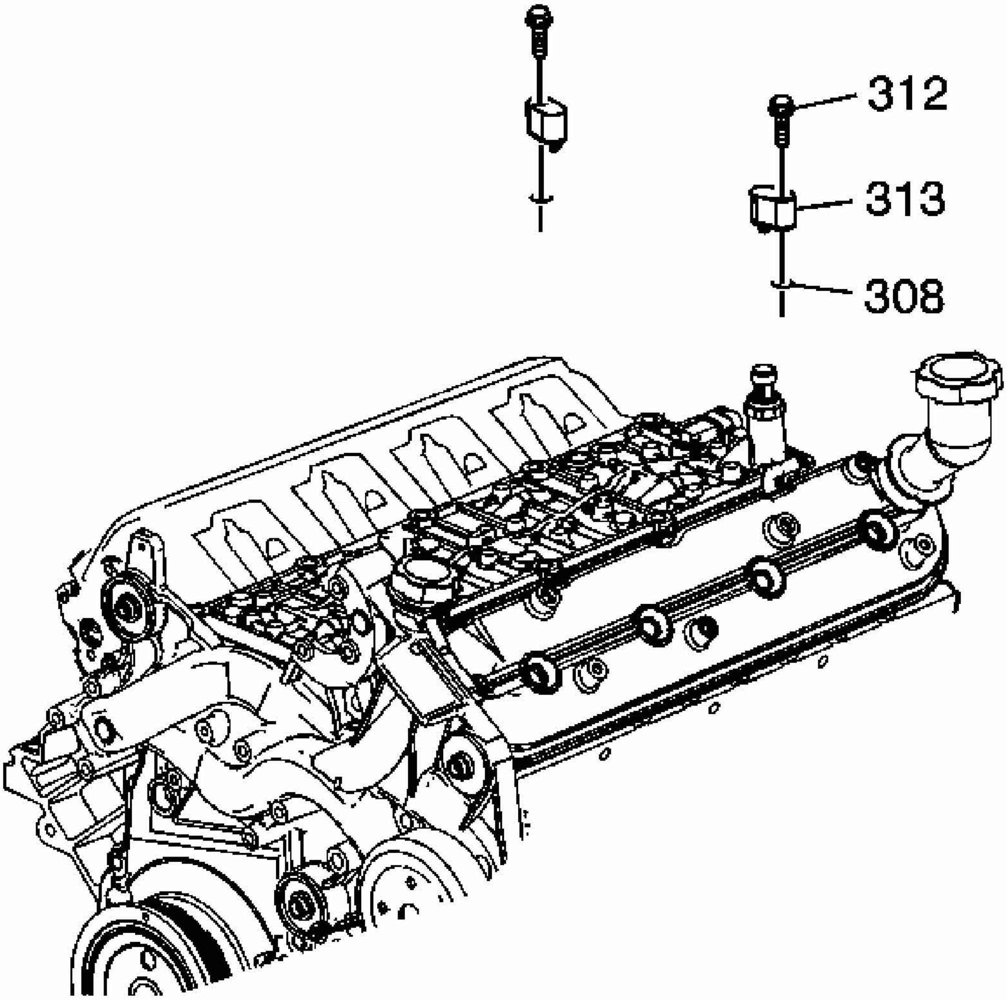


Fig. 90: View Of Engine Coolant Air Bleed Cover, Bolts & Gaskets
Courtesy of GENERAL MOTORS CORP.

7. Remove the engine coolant air bleed cover bolts (312).
8. Remove the covers (313) with seals (308).

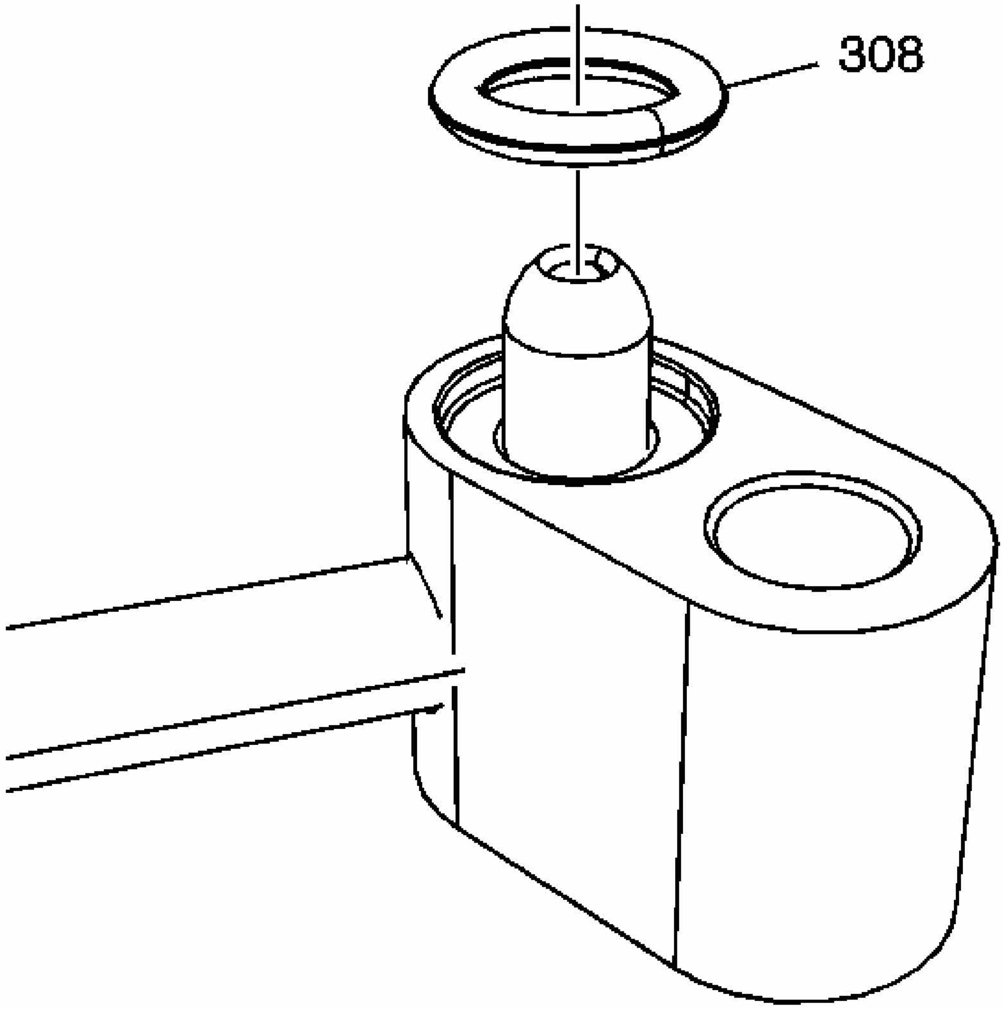


Fig. 91: View Of Coolant Air Bleed Pipe Seal
Courtesy of GENERAL MOTORS CORP.

9. Remove the seals (308) from the pipe and covers. Discard the seals.

Installation Procedure

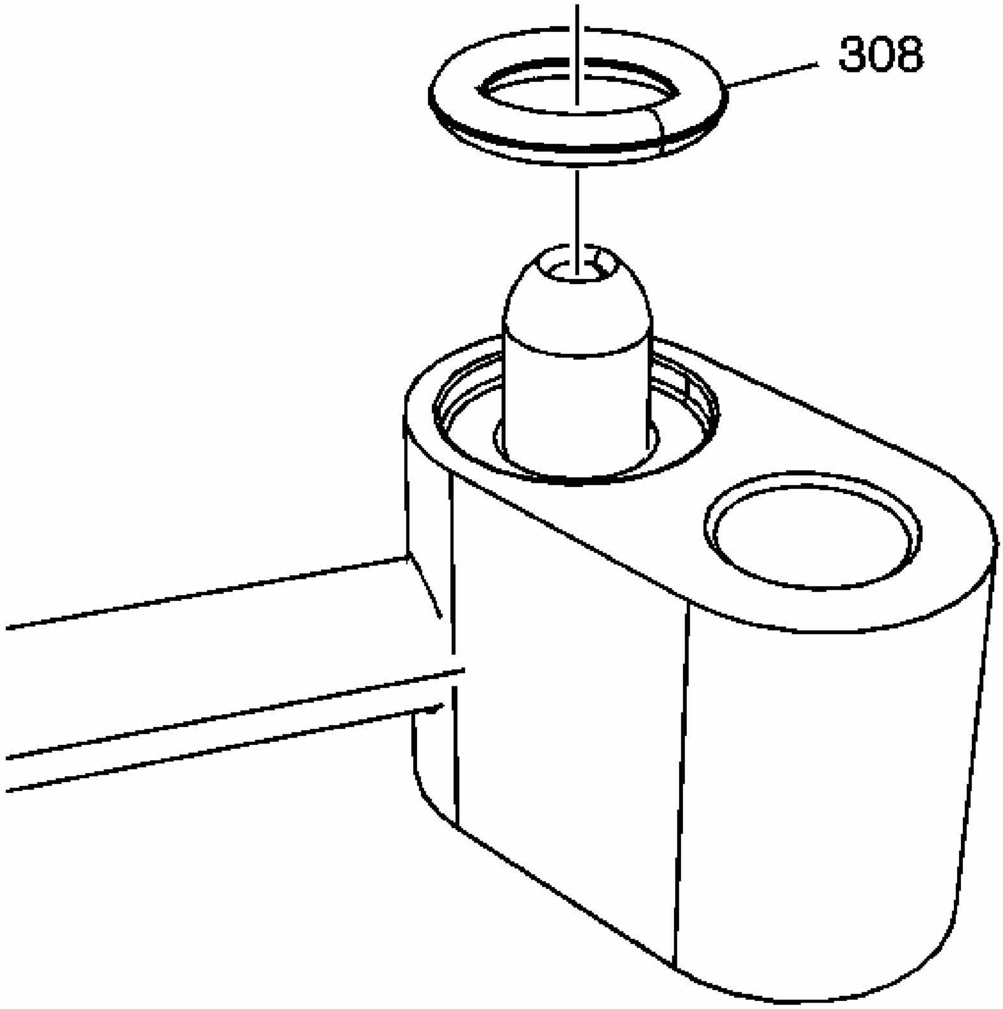


Fig. 92: View Of Coolant Air Bleed Pipe Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Position the O-ring seal onto the nipple portion of the pipe.

1. Install NEW seals (308) onto the engine coolant air bleed pipe and covers.

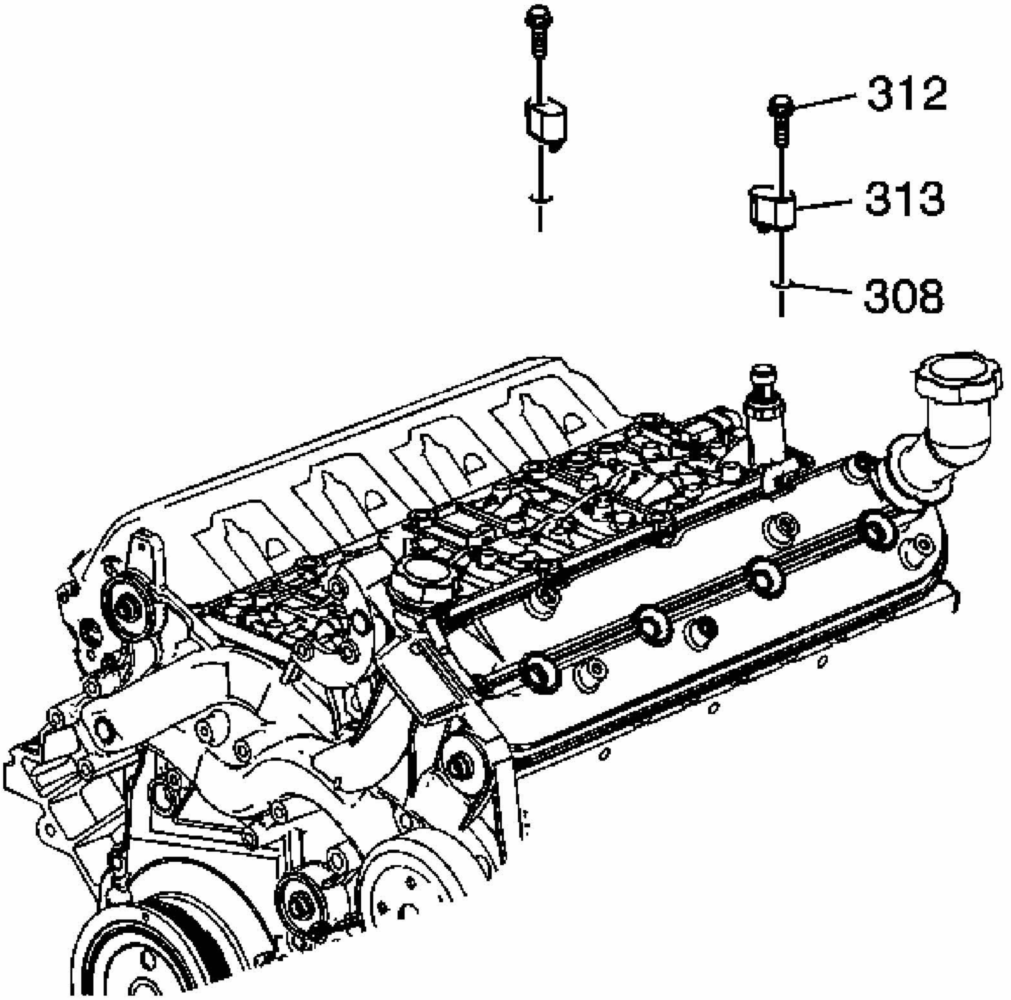


Fig. 93: View Of Engine Coolant Air Bleed Cover, Bolts & Gaskets
Courtesy of GENERAL MOTORS CORP.

2. Install the covers (313) with seals (308).

NOTE: **Refer to Fastener Notice .**

3. Install the engine coolant air bleed cover bolts (312).

Tighten: Tighten the bolts to 12 N.m (106 lb in).

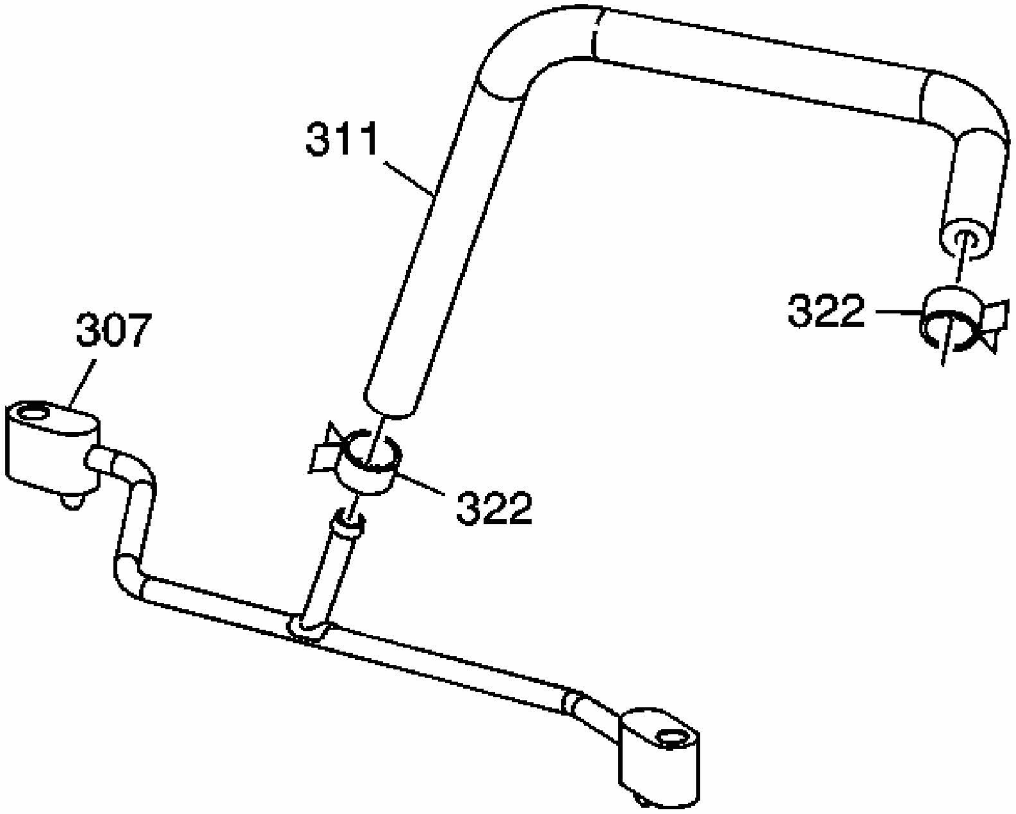


Fig. 94: View Of Coolant Air Bleed Pipe & Clamp
Courtesy of GENERAL MOTORS CORP.

4. Install the hose (311) and clamps (322) to the coolant air bleed pipe (307) as required.

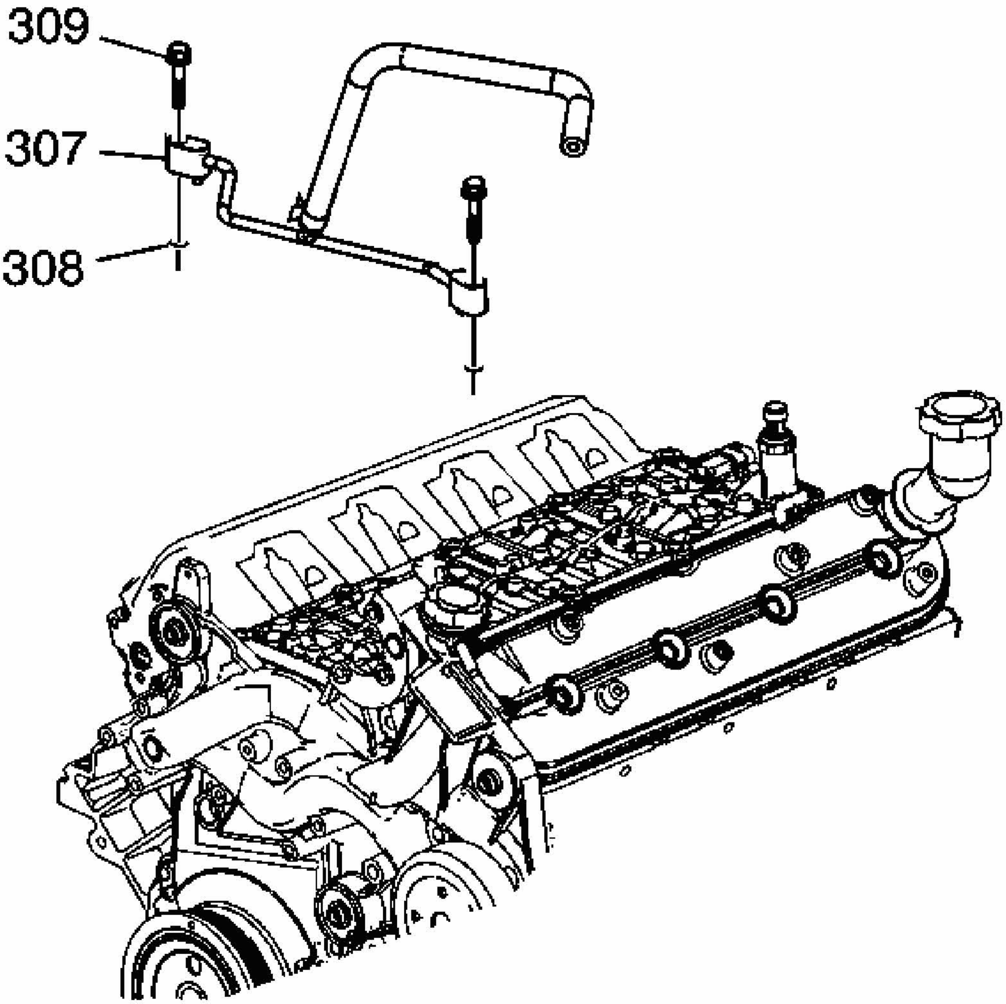


Fig. 95: View Of Coolant Air Bleed Pipe & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the coolant air bleed pipe (307) with hose and seals (308).
6. Install the coolant air bleed pipe bolts (309).

   Tighten: Tighten the bolts to 12 N.m (106 lb in).

7. Install the intake manifold. Refer to **Intake Manifold Replacement** .
8. Connect the clamp and hose to coolant fill neck.
9. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling**

Cooling System (LS4 GE 47716 Fill) or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.

COOLANT AIR BLEED HOSE REPLACEMENT (RPO LS4)

Removal Procedure

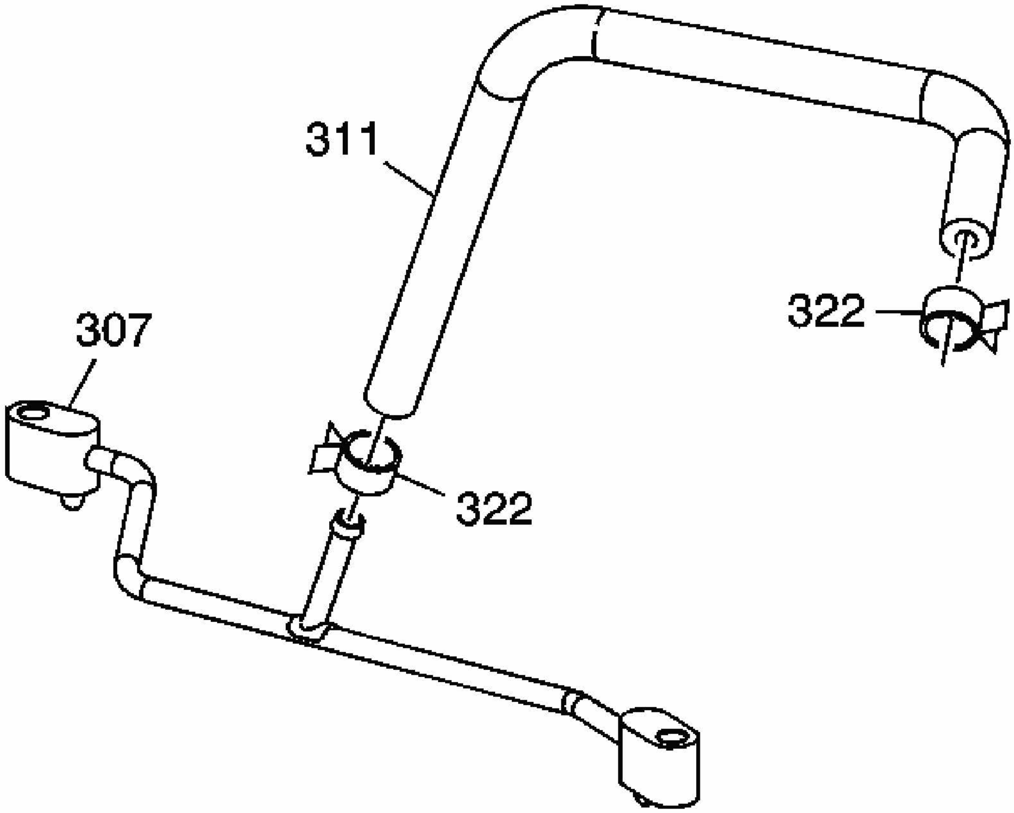


Fig. 96: View Of Coolant Air Bleed Pipe & Clamp
Courtesy of GENERAL MOTORS CORP.

1. Drain a small amount of coolant from the radiator. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
2. Reposition the coolant air bleed hose clamp (322) at the coolant air bleed pipe (307).
3. Reposition the coolant air bleed hose clamp (322) at the water manifold.
4. Remove the coolant air bleed hose from the water manifold.

5. Remove the coolant air bleed hose from the coolant air bleed pipe.
6. Remove the clamps from the coolant air bleed hose, if necessary.

Installation Procedure

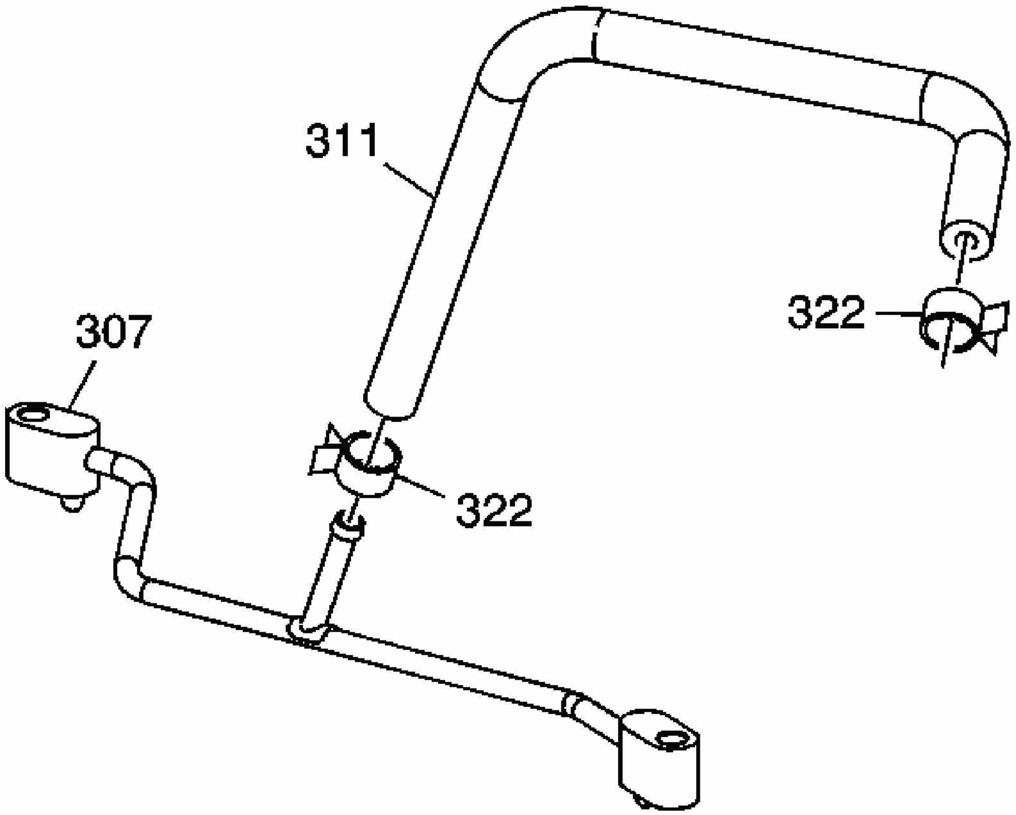


Fig. 97: View Of Coolant Air Bleed Pipe & Clamp
Courtesy of GENERAL MOTORS CORP.

1. Install the clamps onto the coolant air bleed hose, if necessary.
2. Install the coolant air bleed hose onto the coolant air bleed pipe.
3. Install the coolant air bleed hose onto the water manifold.
4. Position the coolant air bleed hose clamp (322) at the water manifold.
5. Position the coolant air bleed hose clamp (322) at the coolant air bleed pipe (307).
6. Refill the coolant system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System**

(LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill), as necessary.

WATER PUMP REPLACEMENT (RPOS LZE/LZ4/LZ9)

Removal Procedure

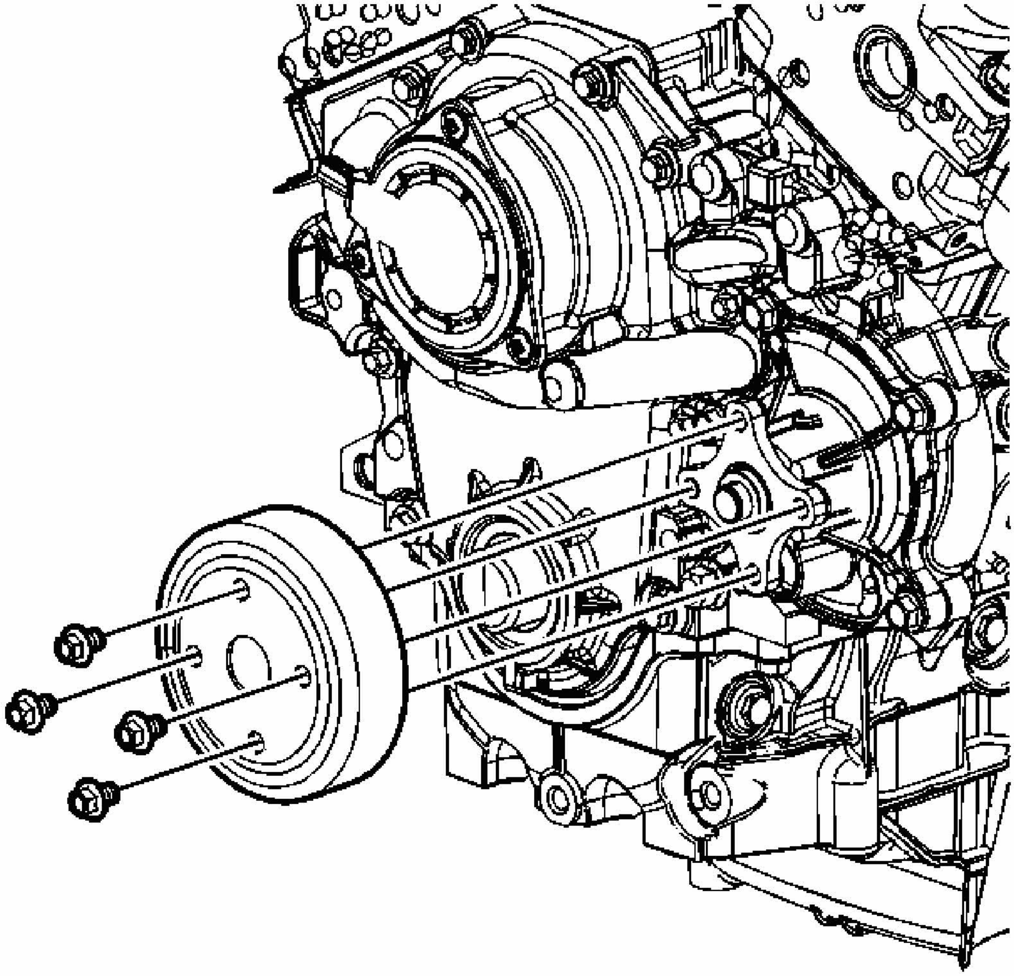


Fig. 98: View Of Water Pump Pulley & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
2. Loosen the water pump pulley bolts.

3. Remove the drive belt. Refer to **Drive Belt Replacement** or **Drive Belt Replacement** .
4. Remove the water pump pulley bolts and pulley.

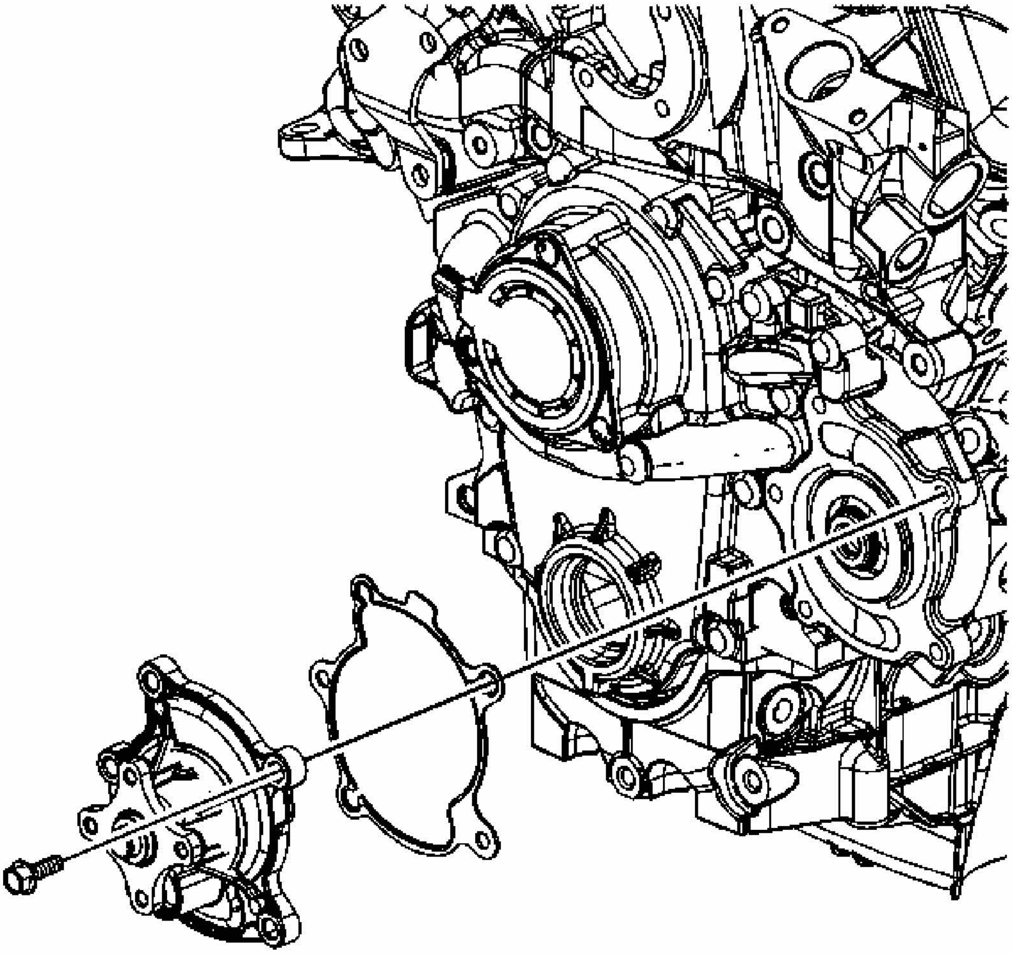


Fig. 99: Identifying Water Pump & Gasket
Courtesy of GENERAL MOTORS CORP.

5. Remove the water pump bolts.
6. Remove the water pump and gasket.
7. Clean the water pump mating surfaces.

Installation Procedure

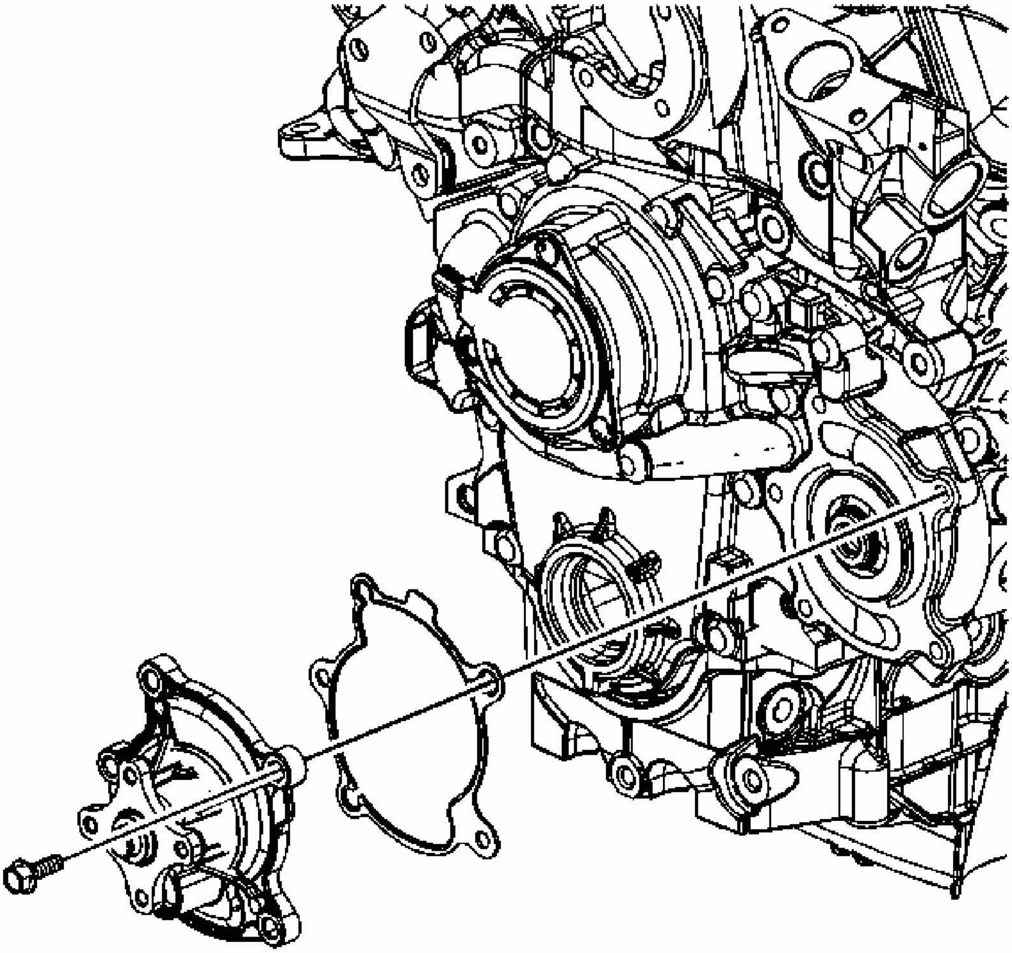


Fig. 100: Identifying Water Pump & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Position a NEW water pump gasket and the water pump to the engine front cover.

   NOTE: **Refer to Fastener Notice .**

2. Install the water pump bolts.

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

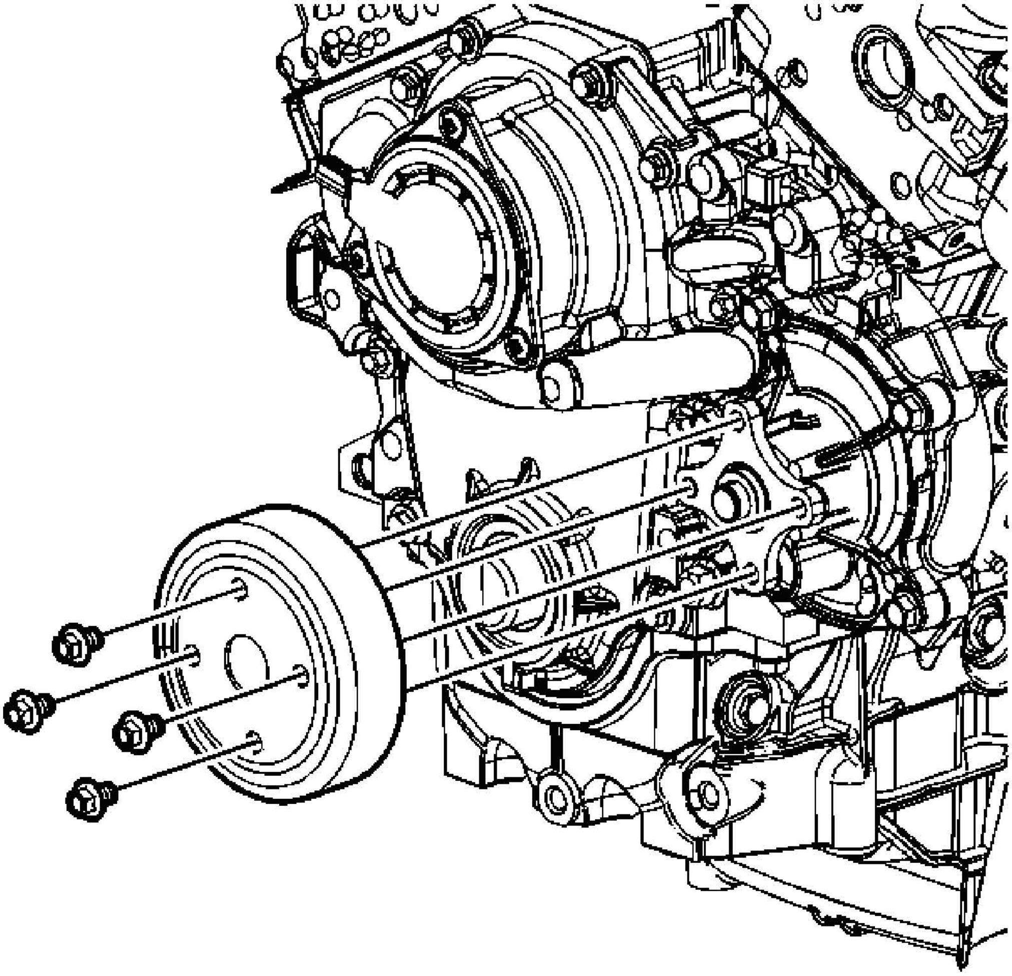


Fig. 101: View Of Water Pump Pulley & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the water pump pulley and bolts.
4. Install the drive belt. Refer to **Drive Belt Replacement** or **Drive Belt Replacement** .
5. Tighten the water pump pulley bolts.

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

6. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.

7. Inspect for leaks.

WATER PUMP REPLACEMENT (RPO LS4)

Removal Procedure

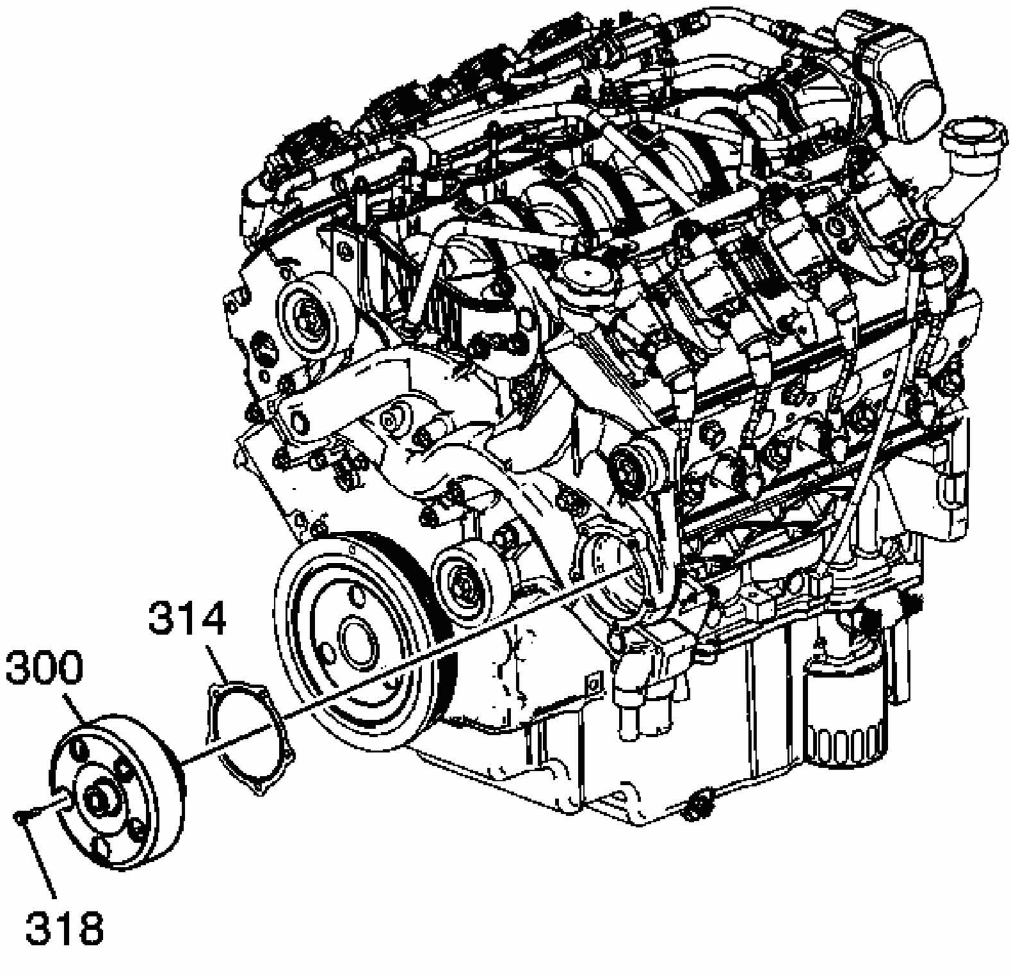


Fig. 102: Water Pump, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
2. Remove the battery and battery tray. Refer to **Battery Tray Replacement (RPOs**

LZE/LZ4/LZ9) or **Battery Tray Replacement (RPO LS4)** .

3. Remove the drive belt. Refer to **Drive Belt Replacement - Accessory** .
4. Remove the water pump bolts (318).
5. Remove the water pump (300) and gasket (314). Discard the gasket.
6. Clean and inspect the water pump gasket mating surfaces.

Installation Procedure

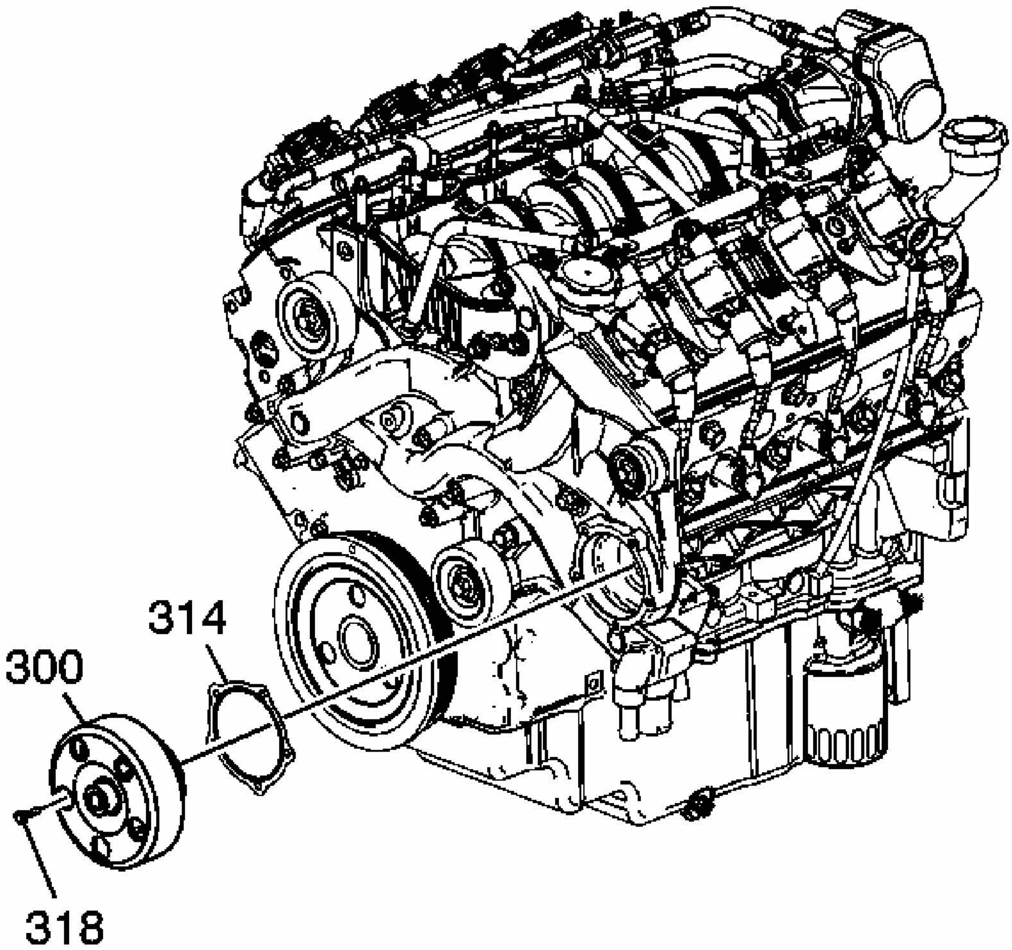


Fig. 103: Water Pump, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the water pump (300) and a NEW gasket (314).

NOTE: **Refer to Fastener Notice in Cautions and**

Notices.

2. Tighten the water pump bolts (318).

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

3. Install the drive belt. Refer to **Drive Belt Replacement - Accessory** .
4. Install the battery tray and battery. Refer to **Battery Tray Replacement (RPOs LZE/LZ4/LZ9)** or **Battery Tray Replacement (RPO LS4)** .
5. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.

COOLANT PUMP MANIFOLD REPLACEMENT (RPO LS4)

Removal Procedure

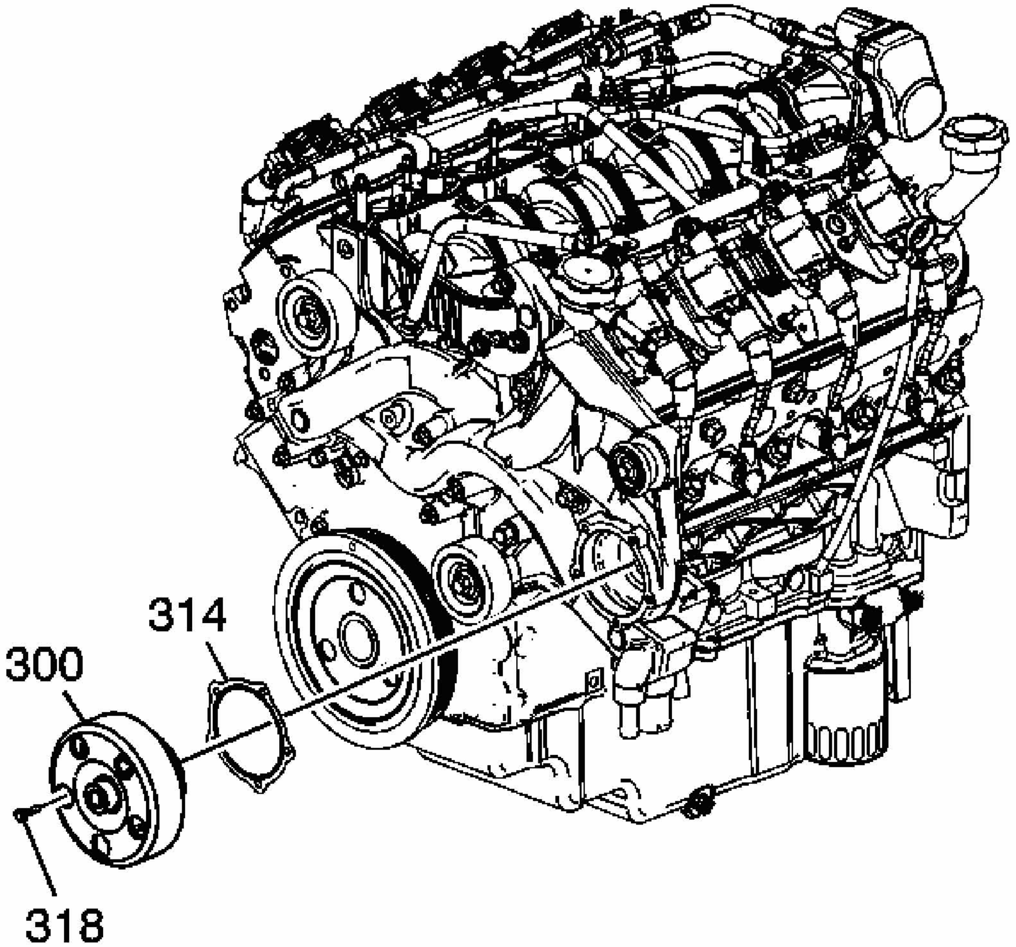


Fig. 104: Water Pump, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
2. Loosen the water pump bolts (318).
3. Remove the drive belt. Refer to **Drive Belt Replacement - Accessory** .
4. Remove fluid from the power steering pump reservoir.
5. Remove the power steering pump pulley. Refer to **Power Steering Pulley Replacement (LS4)** or **Power Steering Pulley Replacement (LZ4/LZE/LZ9)** .
6. Disconnect the power steering hoses and pipes from the power steering pump and

reservoir. Refer to **Power Steering Cooler Pipe/Hose Replacement** , **Power Steering Pressure Pipe/Hose Replacement (LS4)** or **Power Steering Pressure Pipe/Hose Replacement (LZ4/LZE/LZ9)** , and **Power Steering Return Hose Replacement (LS4)** or **Power Steering Return Hose Replacement (LZ4/LZE/LZ9)** .

7. Remove the bolt that retains a clip that retains the pressure pipe to the front of the engine.
8. Remove the water pump bolts (318).
9. Remove the water pump (300) and gasket (314). Discard the gasket.
10. Remove the camshaft position sensor. Refer to **Spark Plug Replacement** .
11. Unclip the wiring harness from the front of the engine.

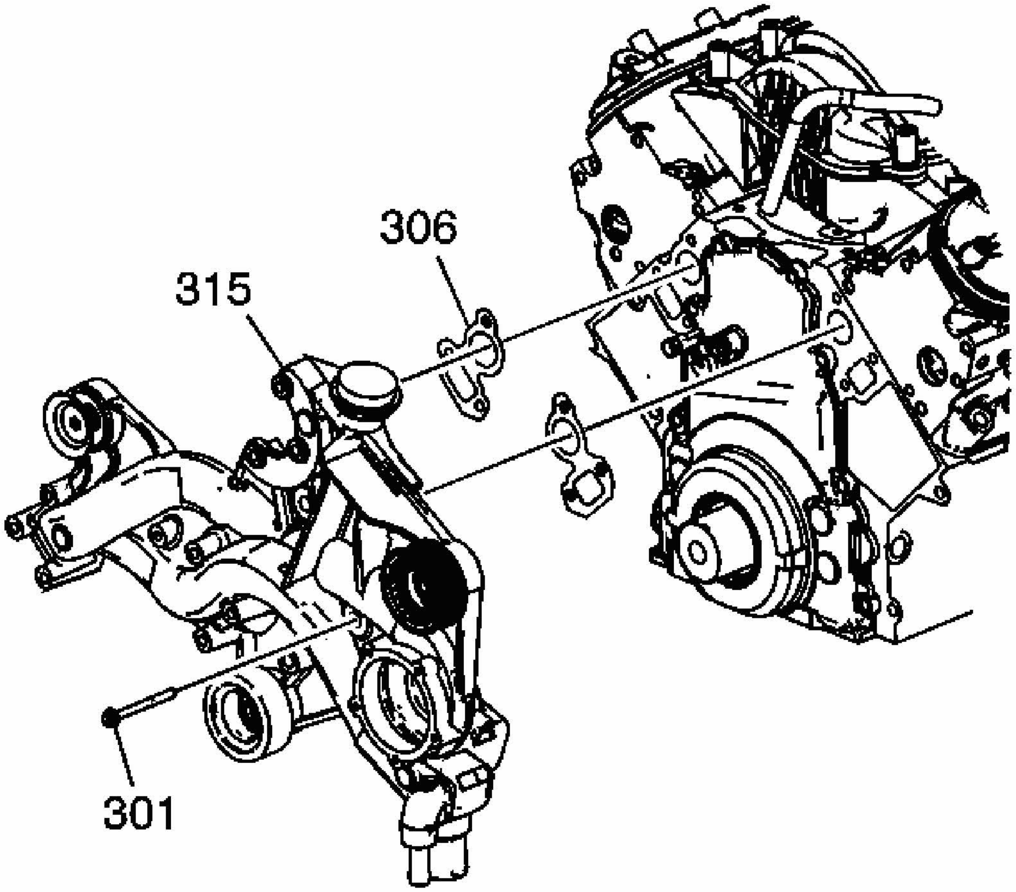


Fig. 105: Water Manifold, Bolts & Gaskets
Courtesy of GENERAL MOTORS CORP.

12. Disconnect the engine coolant air bleed pipe hoses and clamps. Refer to **Coolant Air**

Bleed Hose Replacement (RPO LS4).

13. Remove the three coolant pump manifold to cylinder head bolts.
14. Disconnect the heater hoses at the coolant pump manifold. Refer to **Heater Pipes Replacement (RPO LS4)** or **Heater Pipes Replacement (RPOs LZE, LZ4, LZ9)** .
15. Disconnect the radiator hoses from the coolant pump manifold. Refer to **Radiator Hose Replacement - Inlet (RPO LS4)** or **Radiator Hose Replacement - Inlet (RPOs LZE, LZ4, LZ9)** and **Radiator Hose Replacement - Outlet (RPO LS4)** or **Radiator Hose Replacement - Outlet (RPOs LZE, LZ4, LZ9)**.
16. Remove the coolant pump manifold bolts (301).
17. Remove the coolant pump manifold (315) and gaskets (306). Discard the gaskets.
18. Clean and inspect the water pump manifold mounting surfaces.

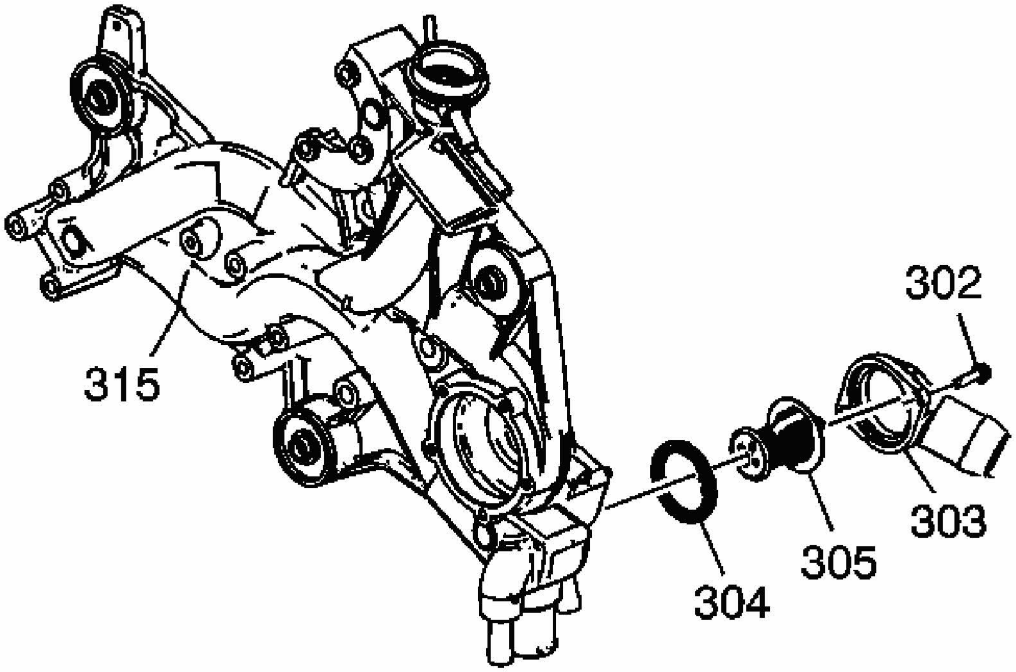


Fig. 106: View Of Thermostat Housing, Bolts, Thermostat, & O-Ring
Courtesy of GENERAL MOTORS CORP.

19. Remove the thermostat housing bolts (302), if necessary.
20. Remove the thermostat housing (303) and O-ring seal (304), if necessary.
21. Remove the thermostat (305), if necessary.
22. Remove the power steering pump and reservoir from the coolant pump manifold.
23. Remove the drive belt idler pulleys from the coolant pump manifold.

Installation Procedure

NOTE: DO NOT use cooling system seal tabs, or similar compounds, unless otherwise instructed. The use of cooling system seal tabs, or similar compounds, may restrict coolant flow through the passages of the cooling system or the engine components. Restricted coolant flow may cause engine overheating and/or damage to the cooling system or the engine components/assembly.

IMPORTANT: All gasket surfaces are to be free of oil and other foreign material during assembly.

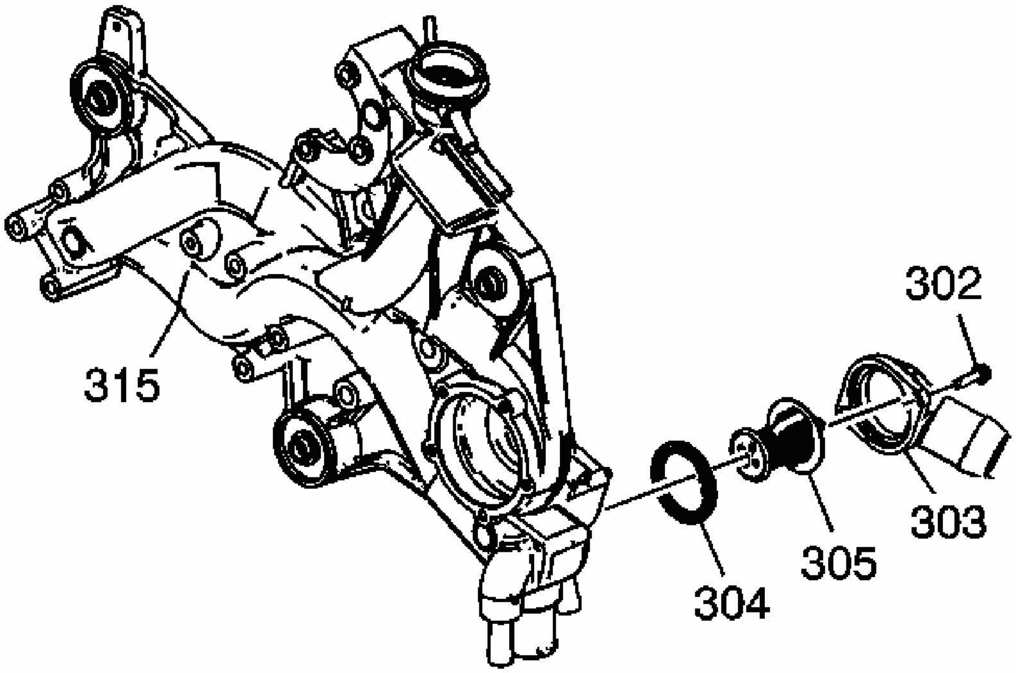


Fig. 107: View Of Thermostat Housing, Bolts, Thermostat, & O-Ring
Courtesy of GENERAL MOTORS CORP.

1. Install the drive belt idler pulleys to the coolant pump manifold. Refer to **Drive Belt Idler Pulley Replacement** .
2. Install the power steering pump and reservoir to the coolant pump manifold. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)** and **Remote Power Steering Fluid Reservoir Replacement** .

3. Install the thermostat (305), if necessary.
4. Install the thermostat housing (303) and O-ring seal (304), if necessary.

NOTE: **Refer to Fastener Notice .**

5. Install the thermostat housing bolts (302), if necessary.

   Tighten: Tighten the bolts to 15 N.m (11 lb ft).

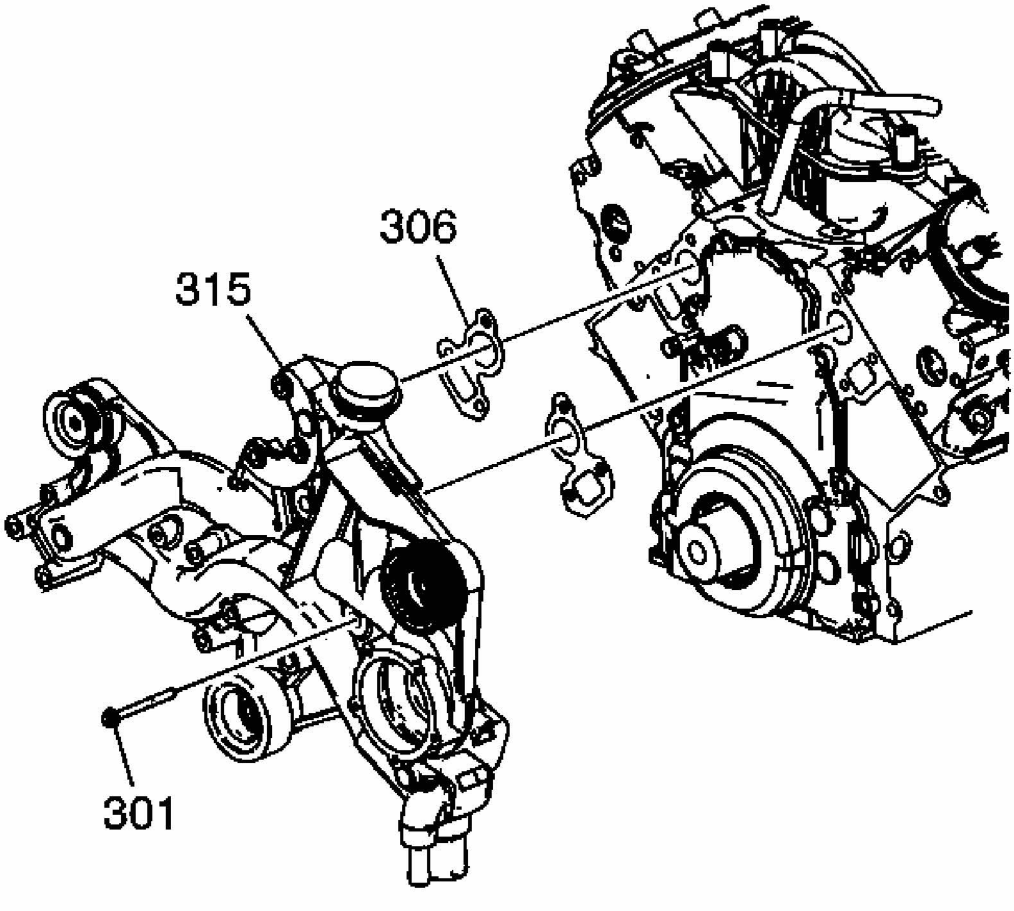


Fig. 108: Water Manifold, Bolts & Gaskets
Courtesy of GENERAL MOTORS CORP.

6. Install the water pump manifold (315) and NEW gaskets (306).

   Tighten:

1. Tighten the M10 bolts to 60 N.m (44 lb ft).
2. Tighten the M8 bolts to 30 N.m (22 lb ft).

7. Install the water pump manifold bolts (301).
8. Install the camshaft position sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** .
9. Install the cylinder head to coolant pump manifold bolts.
10. Connect the engine coolant air bleed pipe hose and clamp.

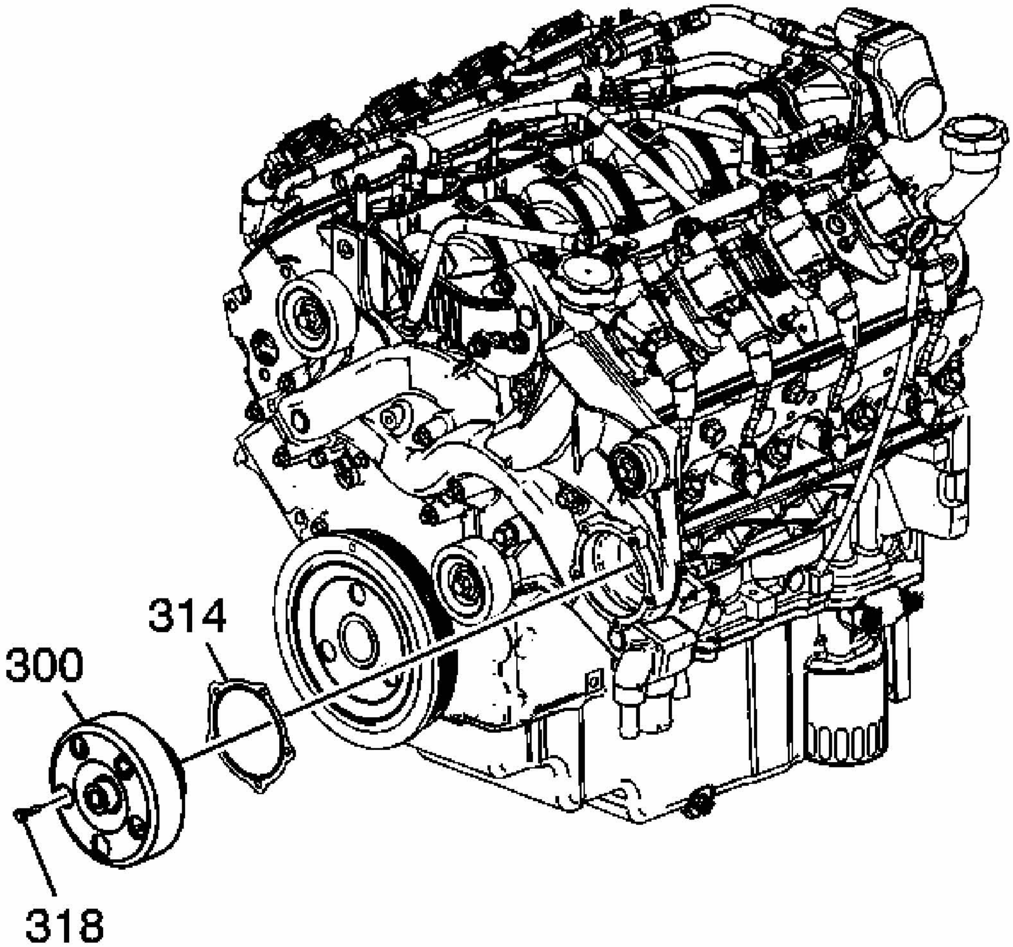


Fig. 109: Water Pump, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

11. Install the water pump (300) and a NEW gasket (314).
12. Install the water pump bolts (318) until sung.

13. Connect the power steering pipes and hoses to the pump and reservoir. Refer to **Power Steering Cooler Pipe/Hose Replacement** , **Power Steering Pressure Pipe/Hose Replacement (LS4)** or **Power Steering Pressure Pipe/Hose Replacement (LZ4/LZE/LZ9)** , and **Power Steering Return Hose Replacement (LS4)** or **Power Steering Return Hose Replacement (LZ4/LZE/LZ9)** .
14. Install the power steering pump pulley. Refer to **Power Steering Pulley Replacement (LS4)** or **Power Steering Pulley Replacement (LZ4/LZE/LZ9)** .
15. Install the bolt that retains the power steering pipe to the front of the engine.
16. Install the wiring harness to the clips on the front of the engine.
17. Install the drive belt. Refer to **Drive Belt Replacement - Accessory** .
18. Tighten the water pump bolts (318).

    Tighten: Tighten the bolts to 10 N.m (89 lb in).

19. Connect the heater hoses to the coolant pump manifold. Refer to **Heater Pipes Replacement (RPO LS4)** or **Heater Pipes Replacement (RPOs LZE, LZ4, LZ9)** .
20. Connect the radiator hoses to the coolant pump manifold. Refer to **Radiator Hose Replacement - Inlet (RPO LS4)** or **Radiator Hose Replacement - Inlet (RPOs LZE, LZ4, LZ9)** and **Radiator Hose Replacement - Outlet (RPO LS4)** or **Radiator Hose Replacement - Outlet (RPOs LZE, LZ4, LZ9)**.
21. Fill and bleed the power steering system. Refer to **Checking and Adding Power Steering Fluid** and **Bleeding the Power Steering System** .
22. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.

DRAIN COCK REPLACEMENT

Removal Procedure

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.

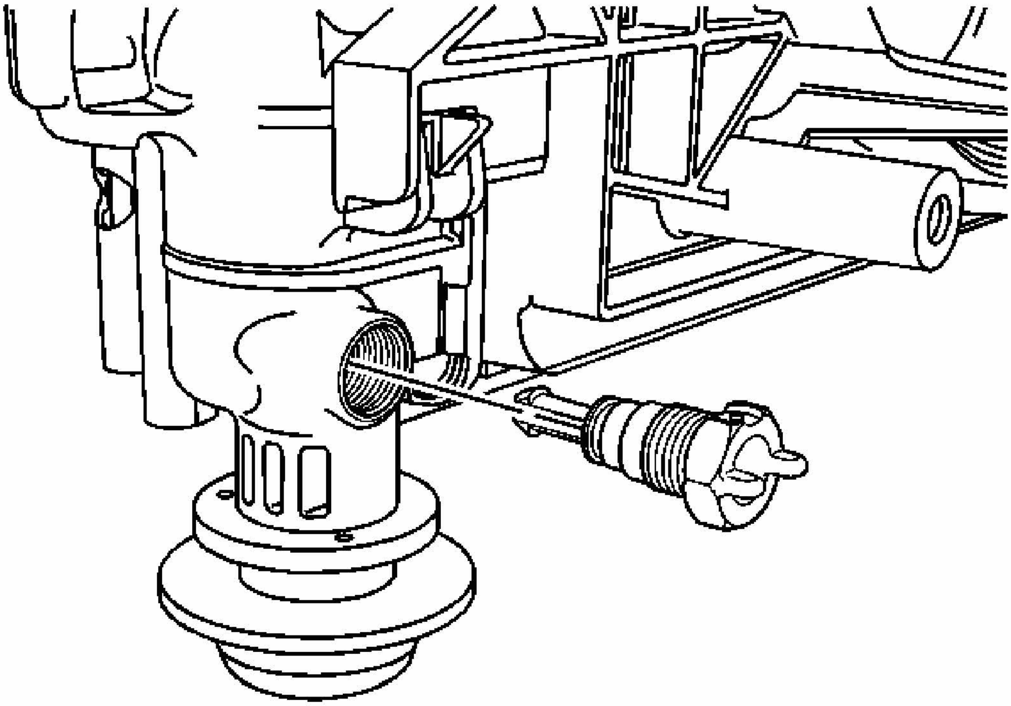


Fig. 110: Drain Cock
Courtesy of GENERAL MOTORS CORP.

2. Unscrew the radiator drain cock from the radiator.
3. Remove the drain cock from the radiator side tank with a firm tug.
4. Remove the drain cock seal from the drain cock.

Installation Procedure

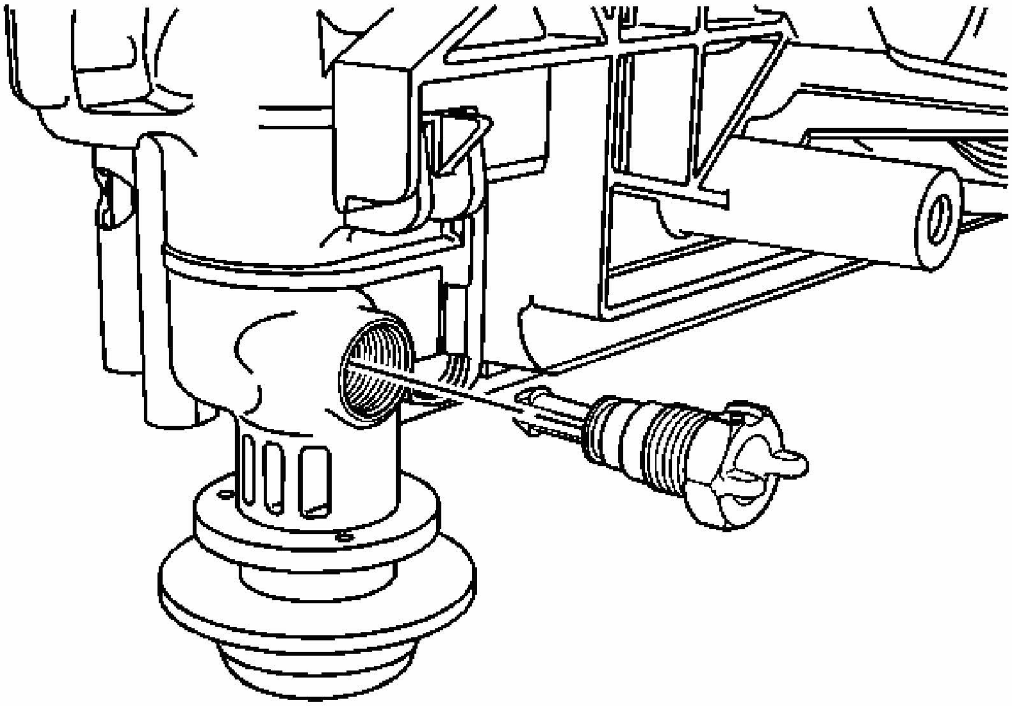


Fig. 111: Drain Cock
Courtesy of GENERAL MOTORS CORP.

1. Install the seal on the drain cock stem.
2. Install the drain cock. Make sure that the body is fully seated in the side tank of the radiator.
3. Screw the radiator drain cock in to the radiator.
4. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.

FAN SHROUD REPLACEMENT

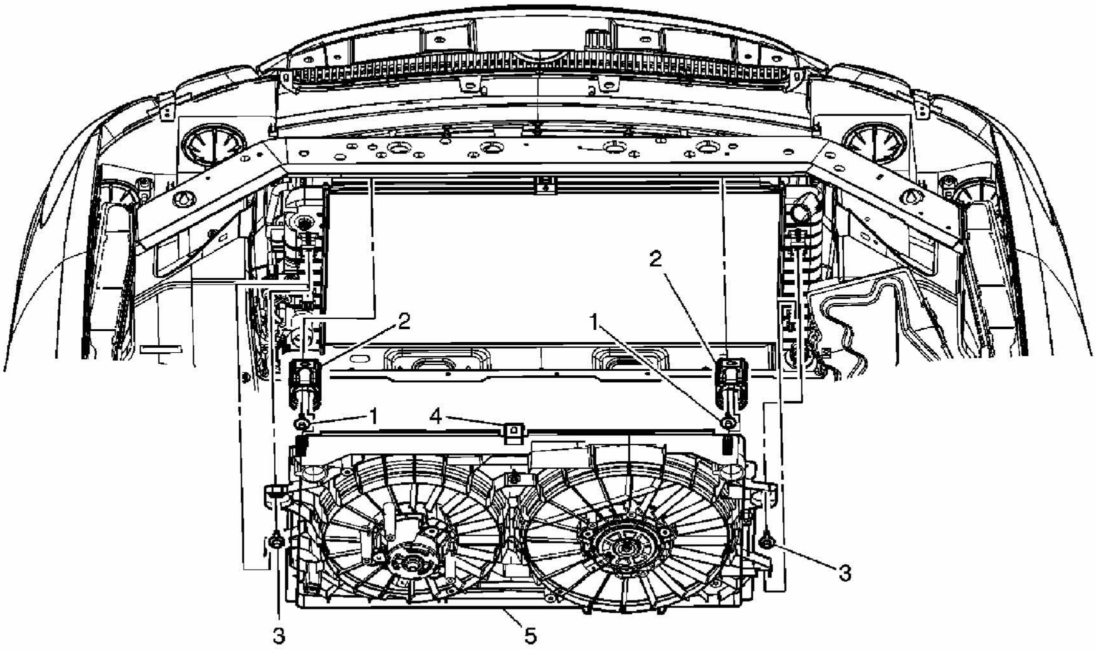


Fig. 112: Identifying Fan Shroud & Components
Courtesy of GENERAL MOTORS CORP.

Fan Shroud Replacement

Callout	Component Name

NOTE:

Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to Fastener Tightening Specifications .

Preliminary Procedure

CAUTION:

Keep hands, tools, and clothing away from the electric engine coolant fans in order to help prevent personal injury. These fans are electric and can turn on whether or not the engine is running. The fans can start automatically with the ignition in the ON position.

CAUTION:

An electric fan under the hood can start up even when the engine is not running and can injure you. Keep hands, clothing and tools away from any underhood electric fan.

CAUTION:

To help avoid personal injury or damage to the vehicle, a bent, cracked, or damaged fan blade or housing should always be replaced.

CAUTION:

Before servicing any electrical component, the ignition key must be in the OFF or LOCK

position and all electrical loads must be OFF, unless instructed otherwise in these procedures. If a tool or equipment could easily come in contact with a live exposed electrical terminal, also disconnect the negative battery cable. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** for the 3.5L engine or to **Air Cleaner Assembly Replacement** for the 3.9L engine or to **Air Cleaner Assembly Replacement** for the 5.3L engine.
3. Remove the engine mount struts. Refer to **Engine Mount Strut Replacement** for the 3.5L engine or to **Engine Mount Strut Replacement** for the 3.9L engine or to **Engine Mount Strut Replacement** for the 5.3L engine.
4. Remove the coolant reservoir hose from the fan shroud LS4 only.
5. Disconnect the upper transaxle oil cooler pipe from the radiator. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .

1	Bolt, Radiator Bracket Upper Support **Tighten:** 10 N.m (89 lb in)
2	Bracket, Radiator Upper Support **CAUTION:** **If a fan blade is bent or damaged in any way, do not repair or reuse the damaged part. Always replace a bent or damaged fan blade. Fan blades that have been damaged can not be assured of proper balance and could fail and fly apart during subsequent use. This creates an extremely dangerous situation.** **The fan blades must remain in proper balance. You cannot assure fan blade balance once a fan blade has been bent or damaged. A fan blade that is not in proper balance could fail and fly apart during use, creating an extremely dangerous situation.**
3	Bolt, Fan Shroud **Tighten:** 6 N.m (53 lb in)
4	Remove the bolt that connects the fan shroud to the condenser hold down bracket. **Tighten:** 6 N.m (53 lb in).
5	Shroud, Fan **Tip:** When replacing the fan shroud, remove the cooling fan motors. Refer to **Cooling Fan Motor Replacement - Electric**.

RADIATOR REPLACEMENT

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

CAUTION: Before servicing any electrical component, the ignition key must be in the OFF or LOCK position and all electrical loads must be OFF, unless instructed otherwise in these procedures. If a tool or equipment could easily come in contact with a live exposed electrical terminal, also disconnect the negative battery cable. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** for the 3.5L engine or to **Air Cleaner Assembly Replacement** for the 3.9L engine or to **Air Cleaner Assembly Replacement** for the 5.3L engine.
3. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
4. Remove the engine mount struts. Refer to **Engine Mount Strut Replacement** for the 3.5L engine or to **Engine Mount Strut Replacement** for the 3.9L engine or to **Engine Mount Strut Replacement** for the 5.3L engine.
5. Use **J 38185** to reposition the upper radiator hose clamp from the radiator.
6. Remove the upper radiator hose from the radiator.
7. Remove the powertrain control module (PCM) harness clip from the fan shroud.
8. Remove the condenser tubes bracket bolt from the fan shroud.

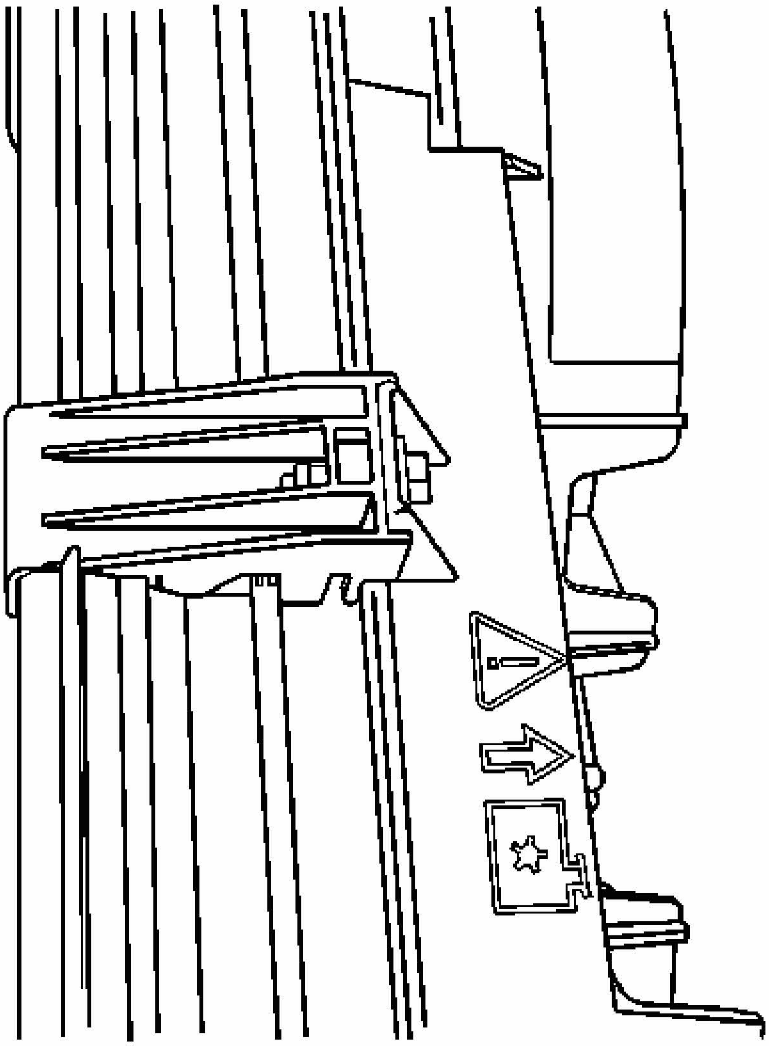


Fig. 113: Identifying Fan Shroud To Condenser Hold Down Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

9. Remove the bolt that connects the fan shroud to the condenser hold down bracket.
10. Remove the condenser hold down bracket from the radiator and condenser.

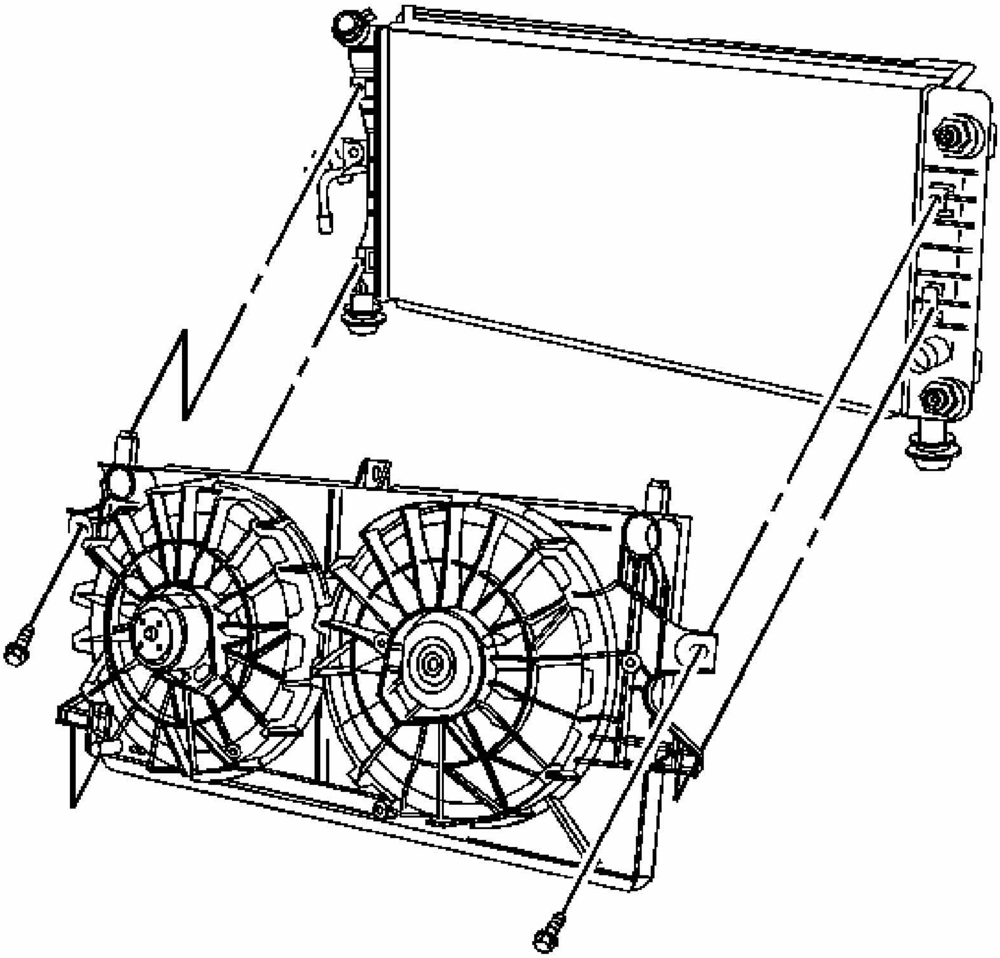


Fig. 114: Cooling Fan Shroud Bolts
Courtesy of GENERAL MOTORS CORP.

11. Remove the cooling fan shroud bolts.
12. Remove the coolant reservoir hose from the fan shroud LS4 only.
13. Remove the radiator vent hose from the right upper radiator tank LS4 only.

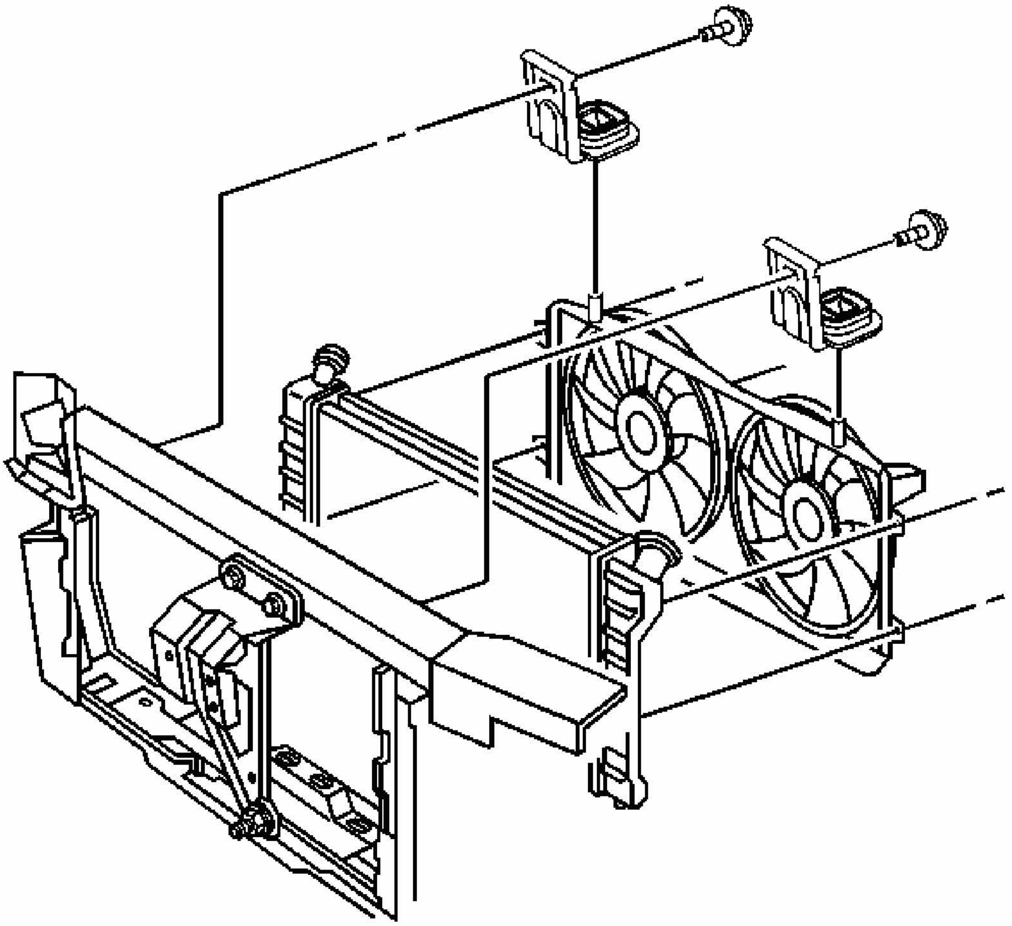


Fig. 115: View Of Fan Shroud To Radiator Upper Support Brackets
Courtesy of GENERAL MOTORS CORP.

14. Remove the radiator upper support brackets and bolts that connect to the fan shroud.
15. Disconnect the engine cooling fan motors electrical connectors.
16. Remove the cooling fan motors electrical harness from the fan shroud clips.
17. Remove the cooling fan shroud.
18. Use **J 38185** to reposition the lower radiator hose clamp from the radiator.
19. Remove the lower radiator hose from the radiator.
20. Disconnect the transaxle oil cooler pipes from the radiator. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .
21. Tilt the top of the radiator rearward.

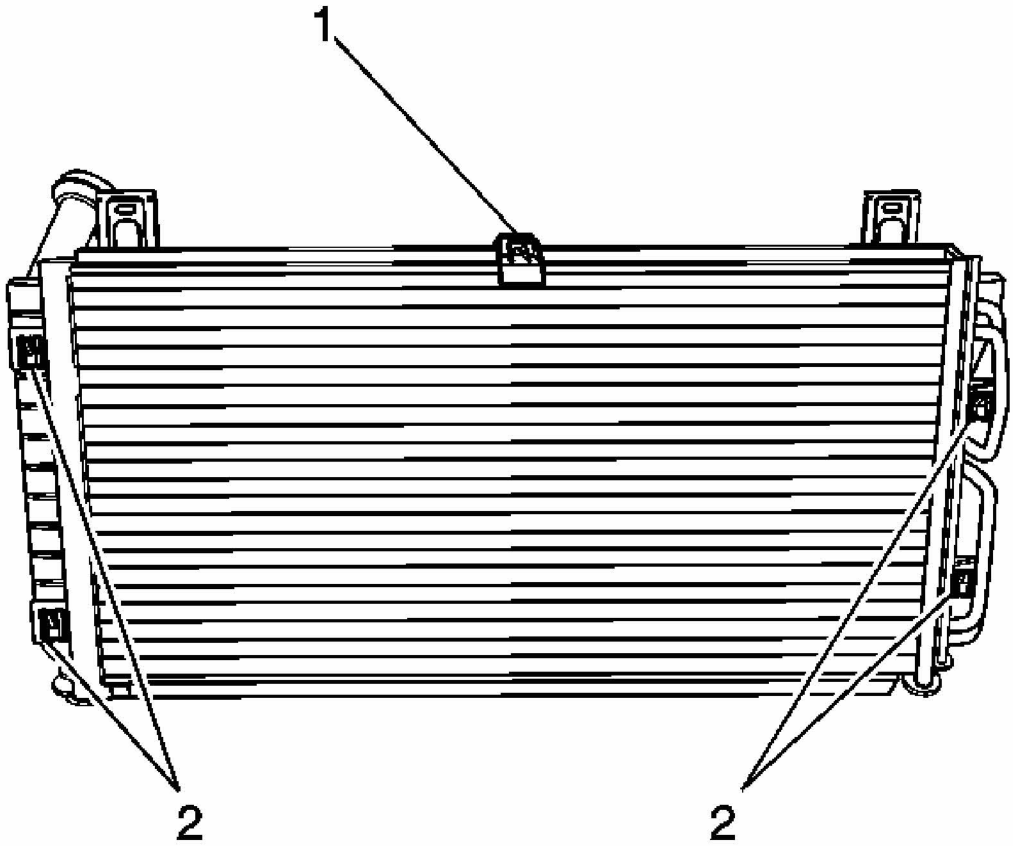


Fig. 116: Condenser Hold Down Bracket & Mount Tabs
Courtesy of GENERAL MOTORS CORP.

22. Lift the condenser from the mounting tabs on the radiator (2). Position the condenser aside.
23. Remove the radiator.

Installation Procedure

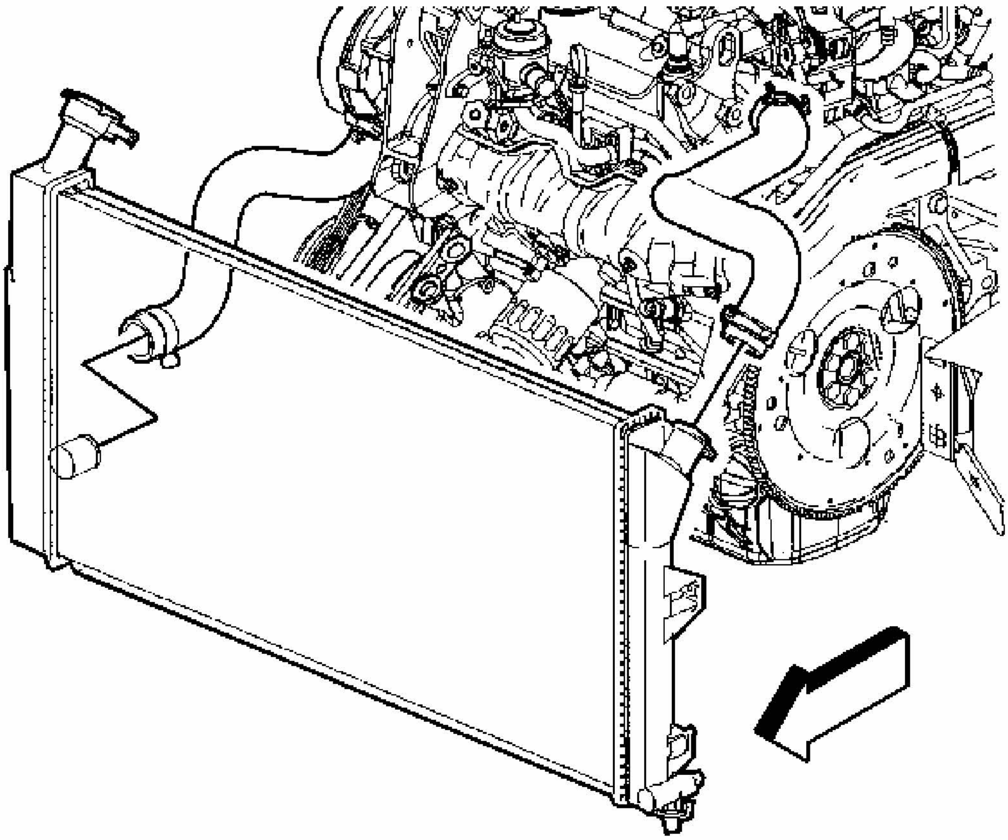


Fig. 117: Removing/Installing Radiator Hoses To/From Radiator
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator to the lower mounts.

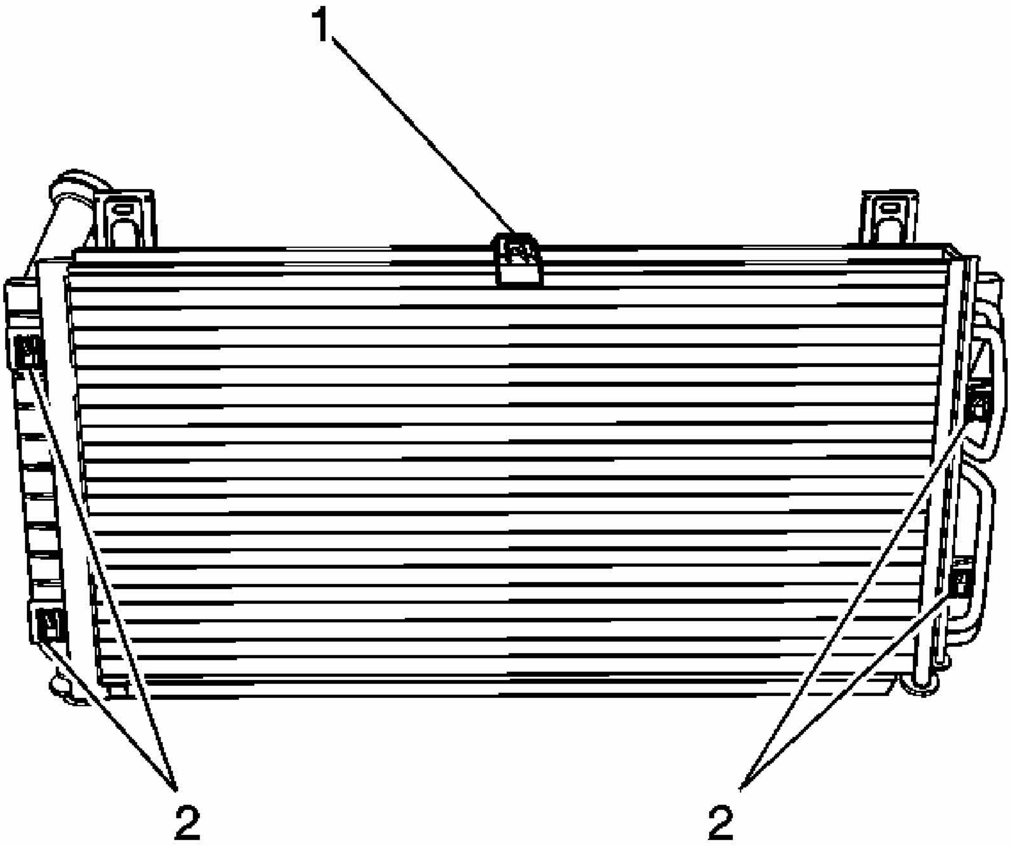


Fig. 118: Condenser Hold Down Bracket & Mount Tabs
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Verify that the condenser is fully seated in the radiator mounting tabs.

2. Install the condenser to the mounting tabs on the radiator (2).
3. Install the condenser hold down bracket (1) to the radiator and condenser.
4. Install the lower radiator hose to the radiator.
5. Use **J 38185** to install the lower radiator hose clamp to the radiator.

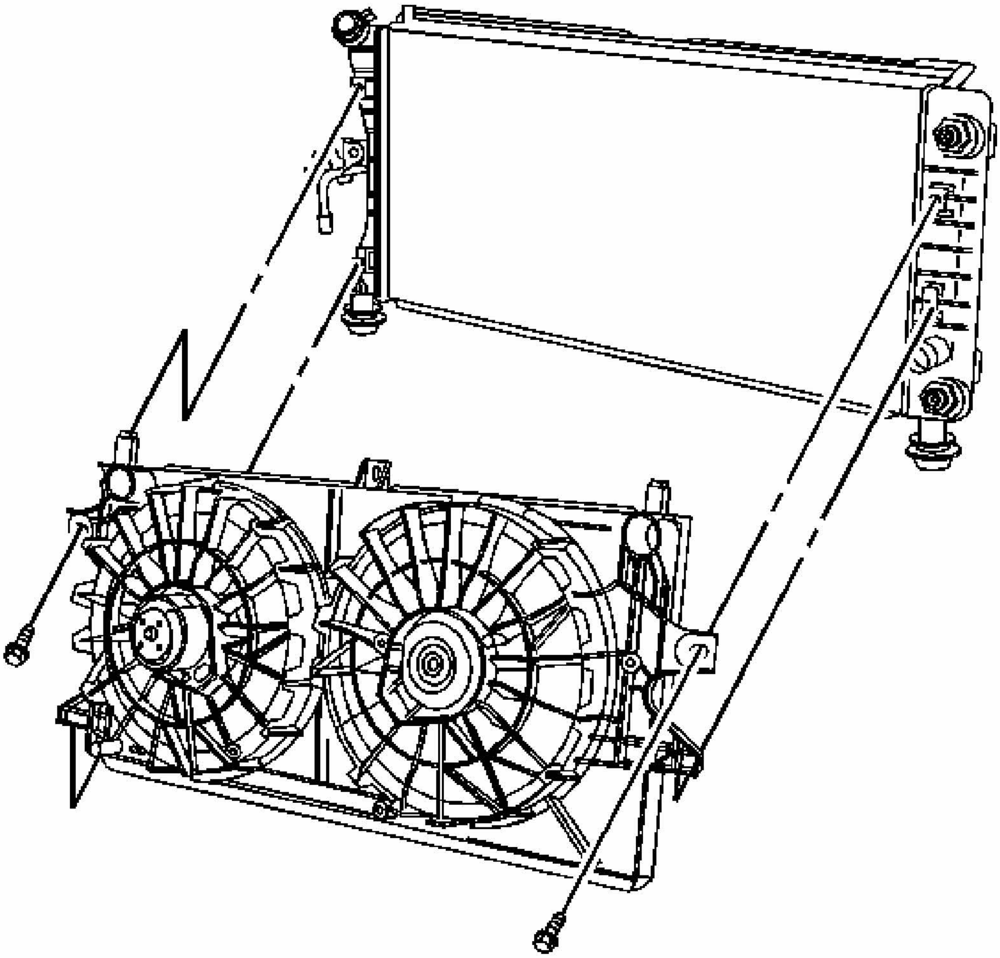


Fig. 119: Cooling Fan Shroud Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure the right and left edge of the fan shroud engages the radiator slots.

6. Install the cooling fan shroud.

NOTE: Refer to Fastener Notice .

7. Install the condenser tubes bracket bolt to the fan shroud.

Tighten: Tighten the bolts to 10 N.m (89 lb in).

8. Install the cooling fan motors electrical harness to the fan shroud clips.
9. Connect the engine cooling fan motors electrical connectors.
10. Install the cooling fan shroud bolts.

    Tighten: Tighten the bolts to 10 N.m (89 lb in).

11. Connect the transaxle oil cooler pipes to the radiator. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .

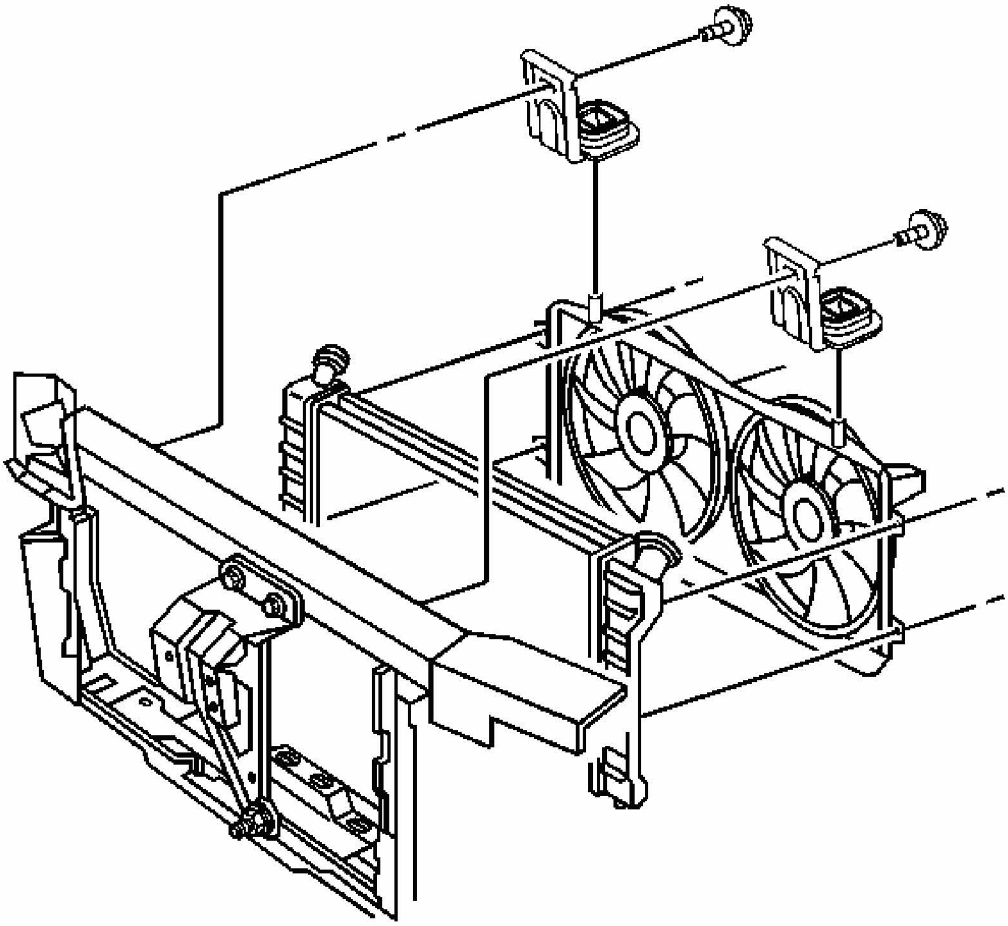


Fig. 120: View Of Fan Shroud To Radiator Upper Support Brackets
Courtesy of GENERAL MOTORS CORP.

12. Install the radiator upper support brackets and bolts that connect to the fan shroud.

    Tighten: Tighten the bolts to 6 N.m (53 lb in).

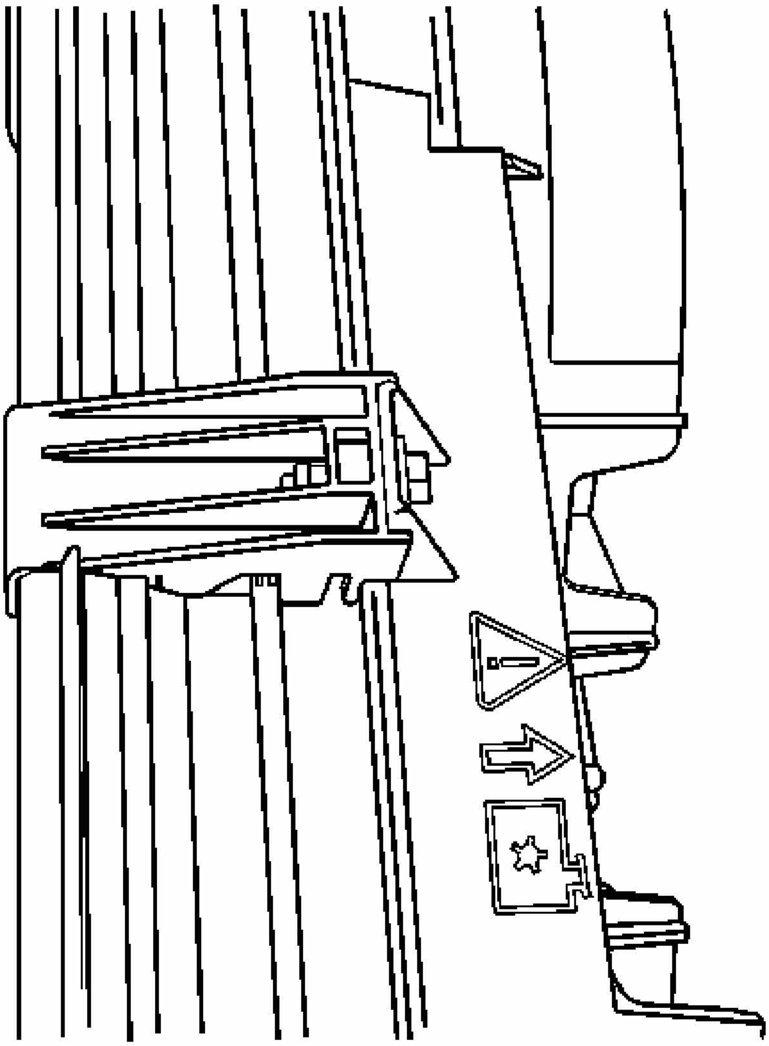


Fig. 121: Identifying Fan Shroud To Condenser Hold Down Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

13. Install the bolt that connects the fan shroud to the condenser hold down bracket.

    Tighten: Tighten the bolt to 6 N.m (53 lb in).

14. Install the PCM harness clip on to the fan shroud.
15. Install the upper radiator hose to the radiator.
16. Use **J 38185** to install the upper radiator hose clamp to the radiator.
17. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** for the

3.5L engine or to **Air Cleaner Assembly Replacement** for the 3.9L engine or to **Air Cleaner Assembly Replacement** for the 5.3L engine.

18. Install the coolant reservoir hose to the fan shroud.
19. Install the radiator vent hose to the right upper radiator tank and fill neck.
20. Install the engine mount struts. Refer to **Engine Mount Strut Replacement** for the 3.5L engine or to **Engine Mount Strut Replacement** for the 3.9L engine or to **Engine Mount Strut Replacement** for the 5.3L engine.
21. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
22. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .

NOTE: Do NOT overfill the transaxle. The overfilling of the transaxle causes foaming, loss of fluid, shift complaints, and possible damage to the transaxle.

23. Adjust the transaxle fluid level.

LOWER RADIATOR AIR BAFFLE AND DEFLECTOR REPLACEMENT

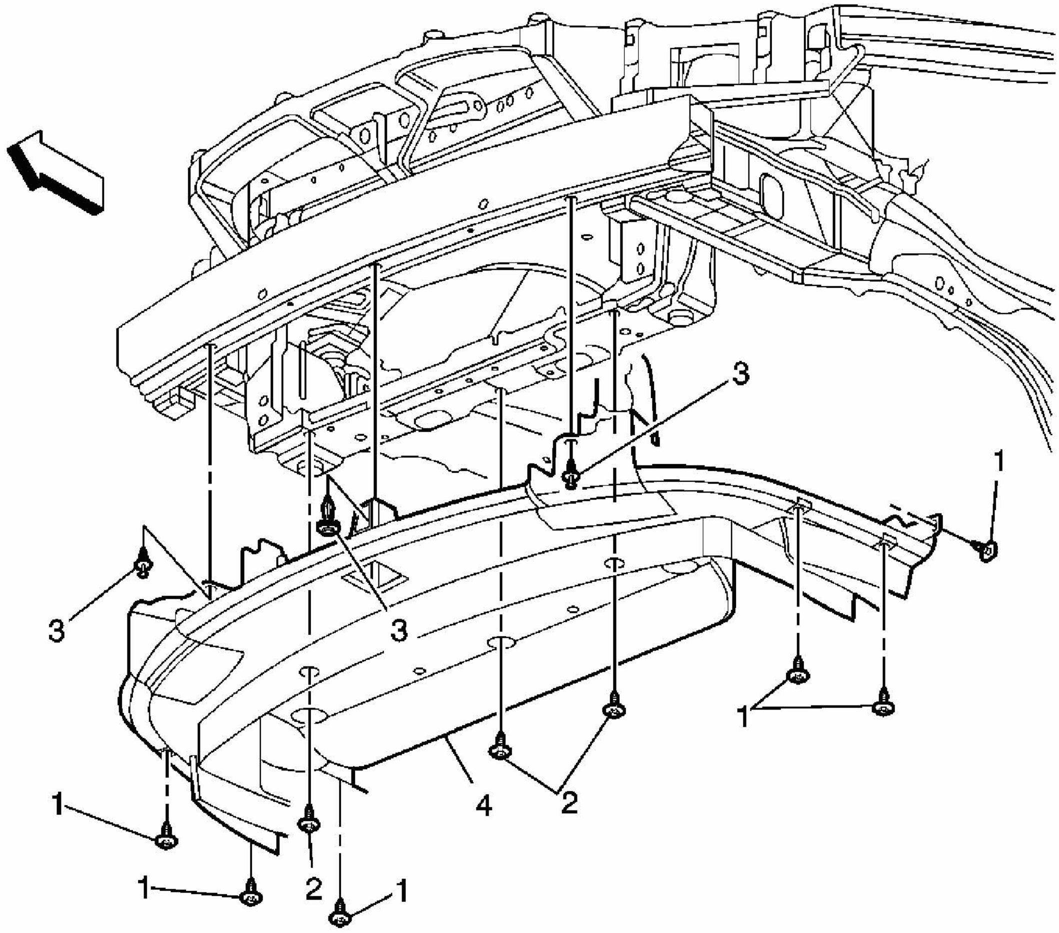


Fig. 122: Identifying Lower Radiator Air Baffle and Deflector
Courtesy of GENERAL MOTORS CORP.

Radiator Air Baffle and Deflector Replacement - Lower

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications** .**Preliminary Procedure:** Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .	
1	Screw, Radiator Air Deflector - Lower (Qty: 6) **Tighten:** 10 N.m (89 lb in)
2	Screw, Radiator Air Deflector - Lower (Qty: 3)

	Tighten: 10 N.m (89 lb in)
3	Retainer, Push (Qty: 3)
4	Deflector, Radiator Front End Panel

UPPER RADIATOR AIR BAFFLE AND DEFLECTOR REPLACEMENT

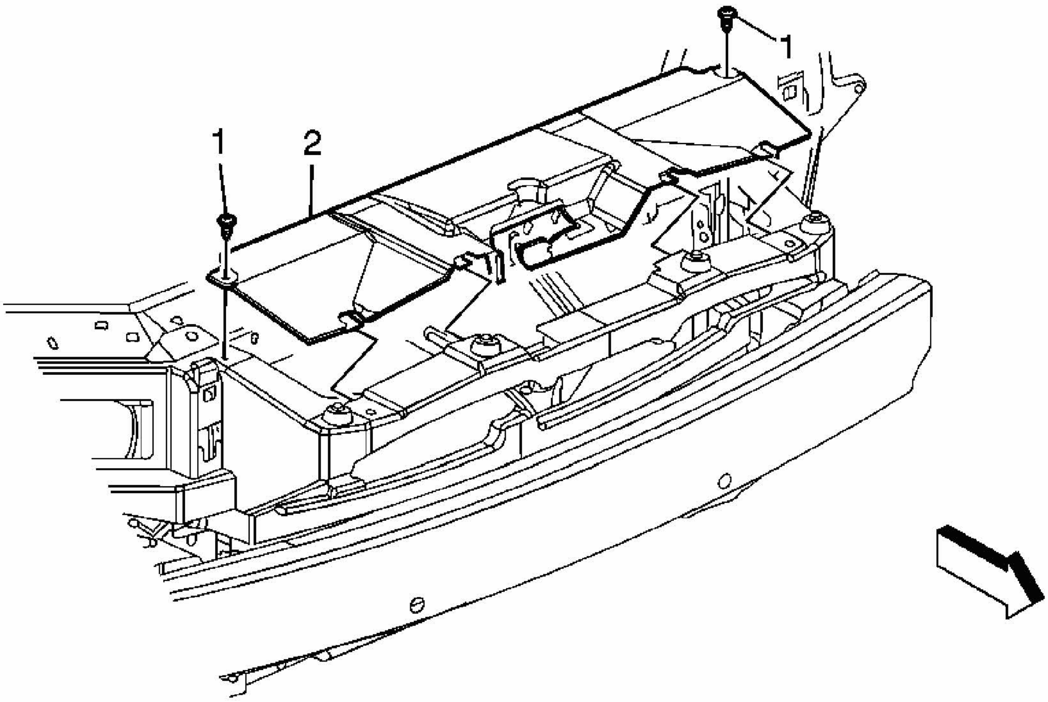


Fig. 123: Identifying Upper Radiator Air Baffle and Deflector
Courtesy of GENERAL MOTORS CORP.

Radiator Air Baffle and Deflector Replacement - Upper

Callout	Component Name
NOTE: Refer to Fastener Notice . **Fastener Tightening Specifications:** Refer to Fastener Tightening Specifications .	
1	Screw, Radiator Air Deflector - Upper (Qty: 2) **Tighten:** 5 N.m (44 lb in)
2	Baffle, Radiator Air - Upper

COOLANT HEATER REPLACEMENT (RPOS LZE/LZ4/LZ9)

Removal Procedure

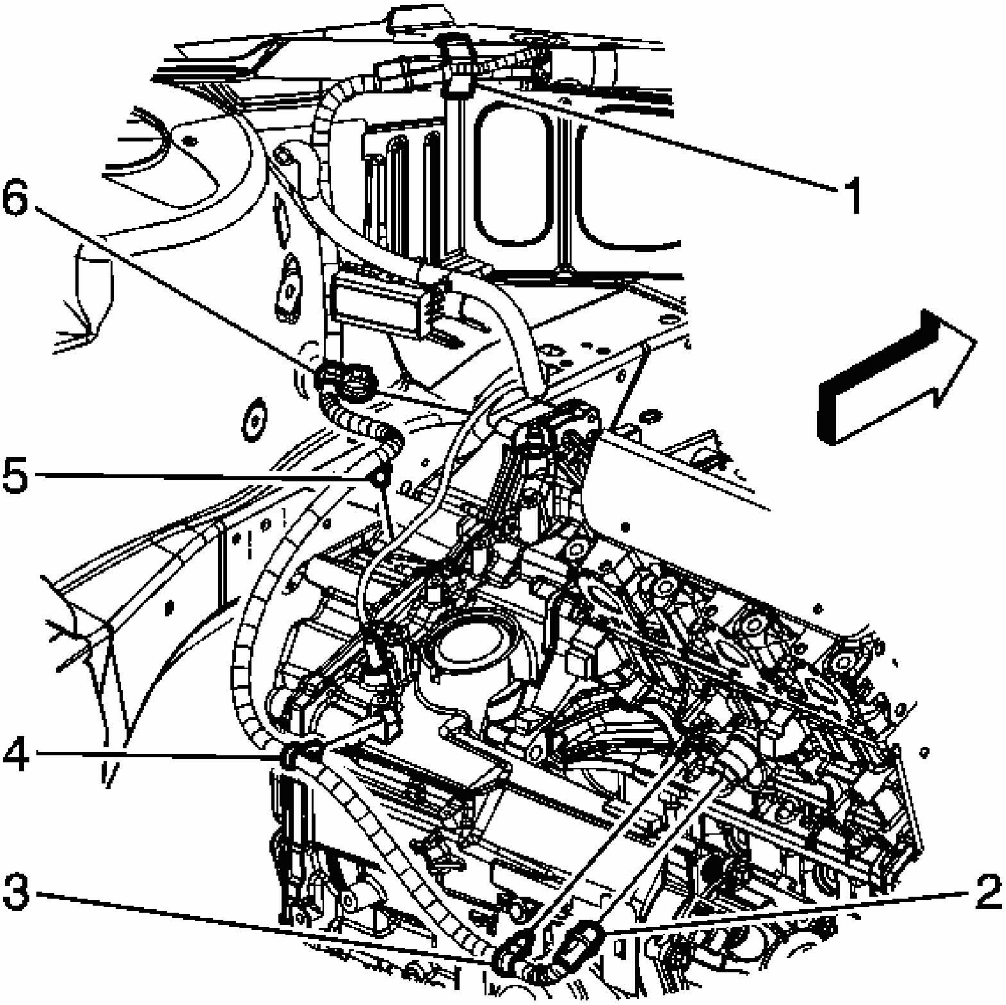


Fig. 124: Locating Engine Coolant Heater Cord & Engine Coolant Heater
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
2. Disconnect the engine coolant heater cord (2) from the engine coolant heater.

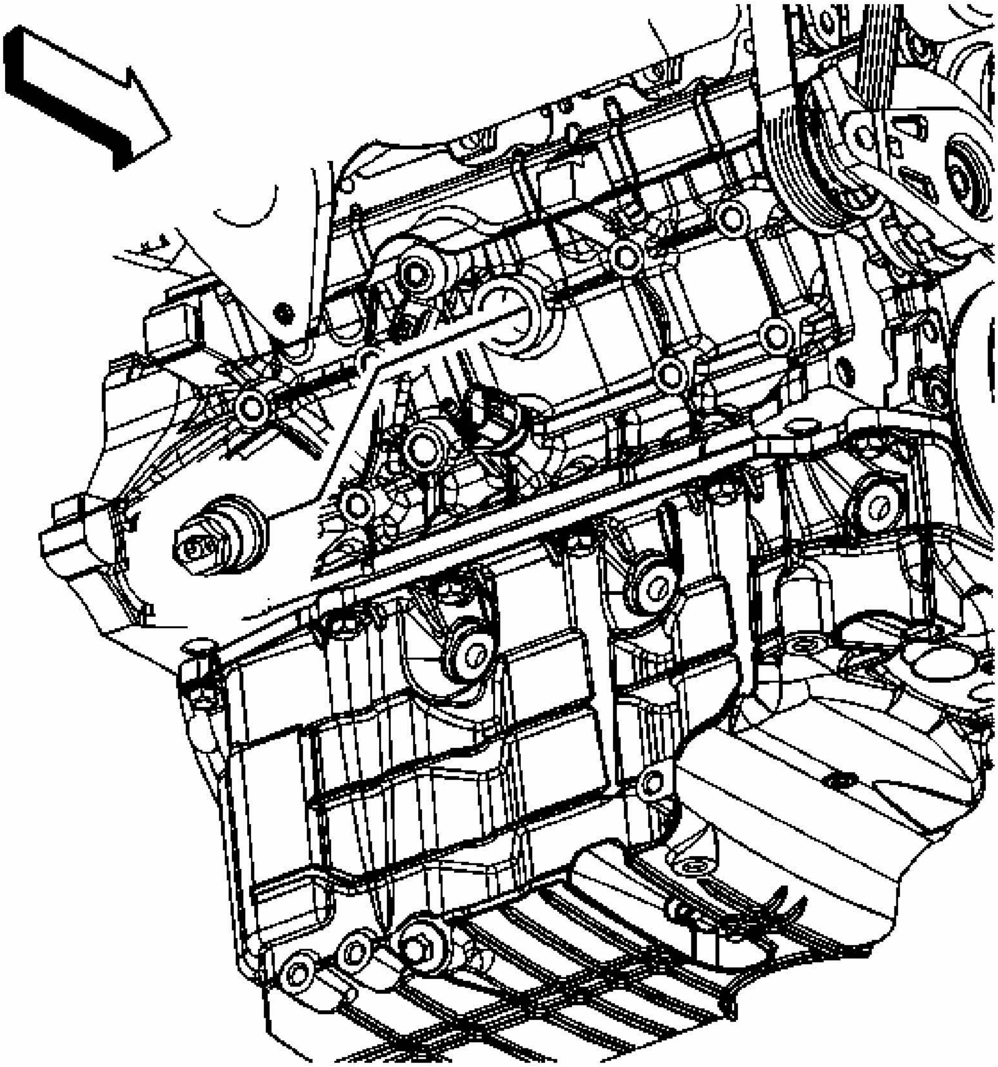


Fig. 125: Identifying Engine Coolant Heater
Courtesy of GENERAL MOTORS CORP.

3. Remove the engine coolant heater.
4. Clean the engine coolant heater opening.

Installation Procedure

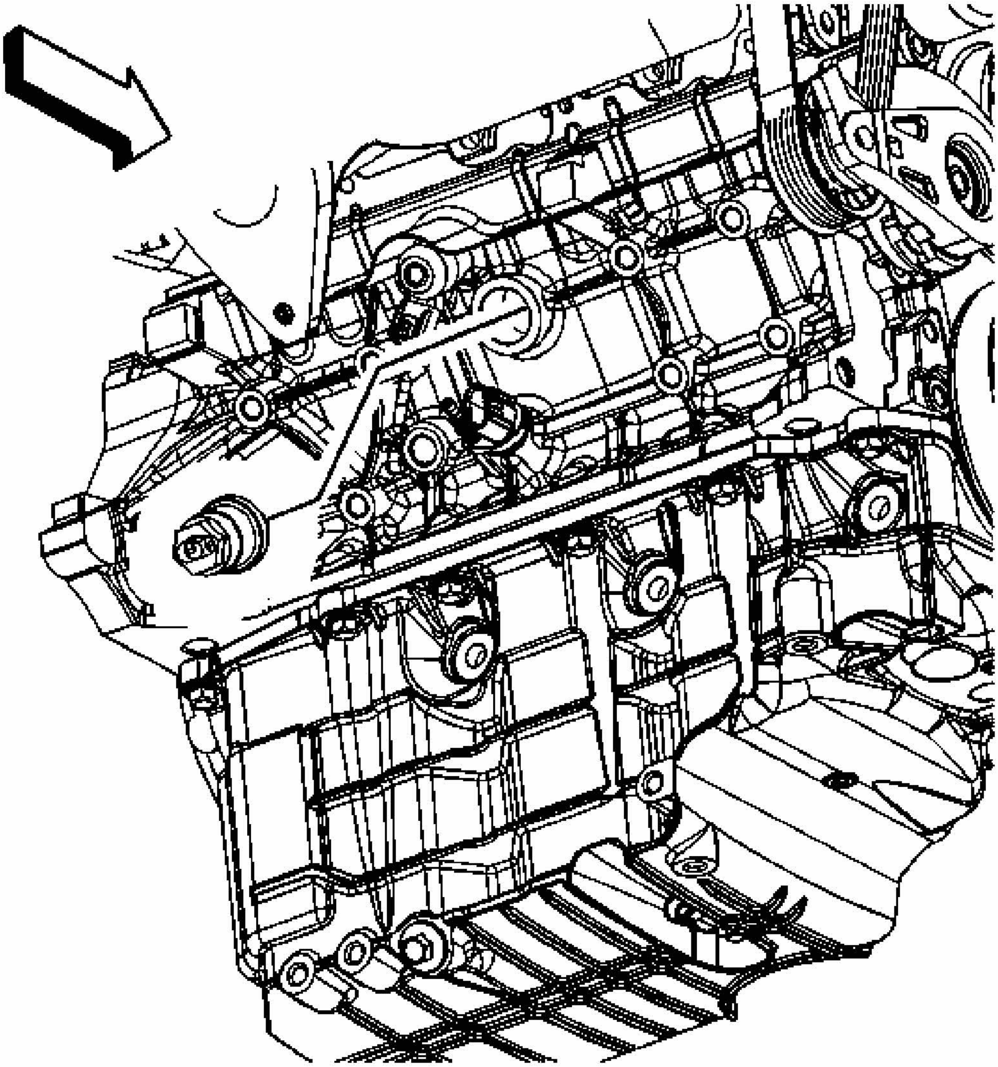


Fig. 126: Identifying Engine Coolant Heater
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer GM P/N 12346004 (Canadian P/N 10953480) or equivalent to the threads of the engine coolant heater, if necessary.

   NOTE: **Refer to Fastener Notice .**

2. Install the engine coolant heater.

   Tighten: Tighten the coolant heater to 60 N.m (44 lb ft).

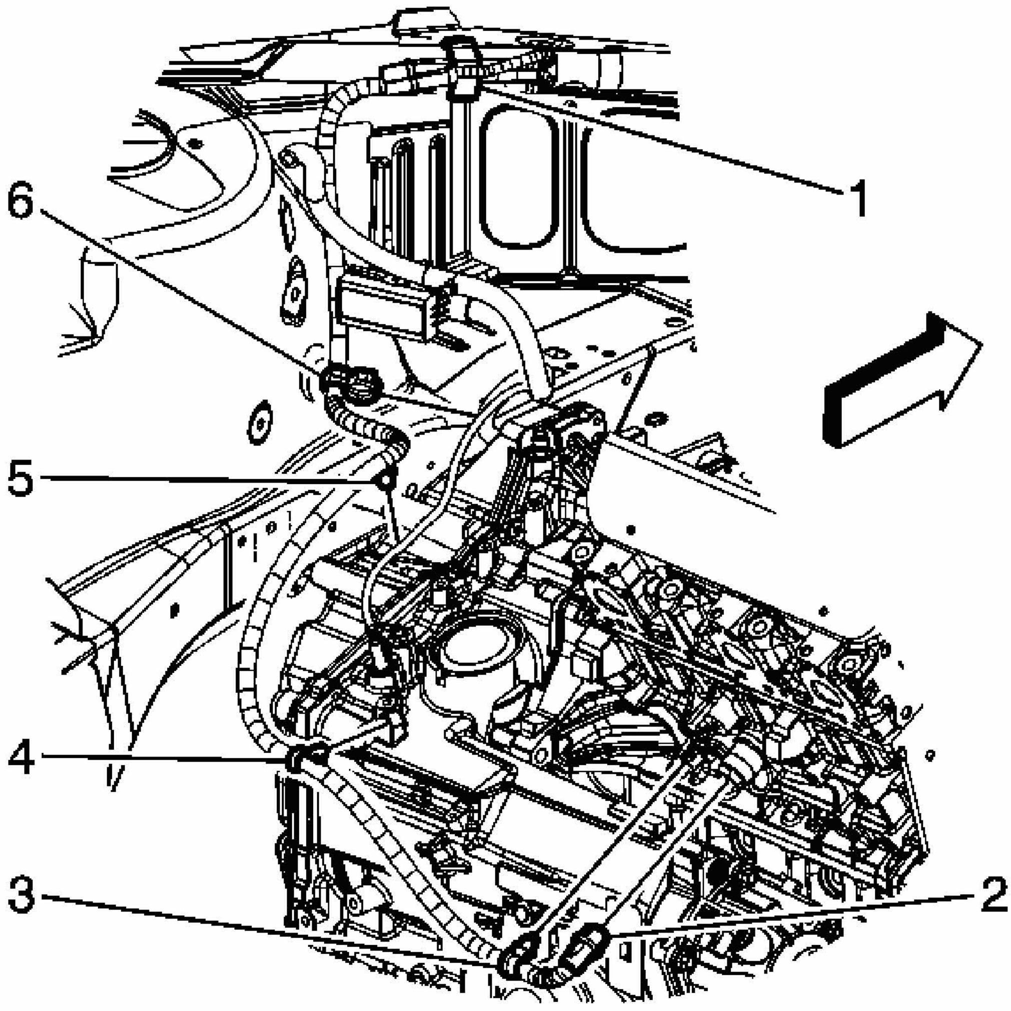


Fig. 127: Locating Engine Coolant Heater Cord & Engine Coolant Heater
Courtesy of GENERAL MOTORS CORP.

3. Connect the engine coolant heater cord (2) to the engine coolant heater.
4. Lower the vehicle.
5. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
6. Inspect for leaks.

COOLANT HEATER REPLACEMENT (RPO LS4)

Removal Procedure

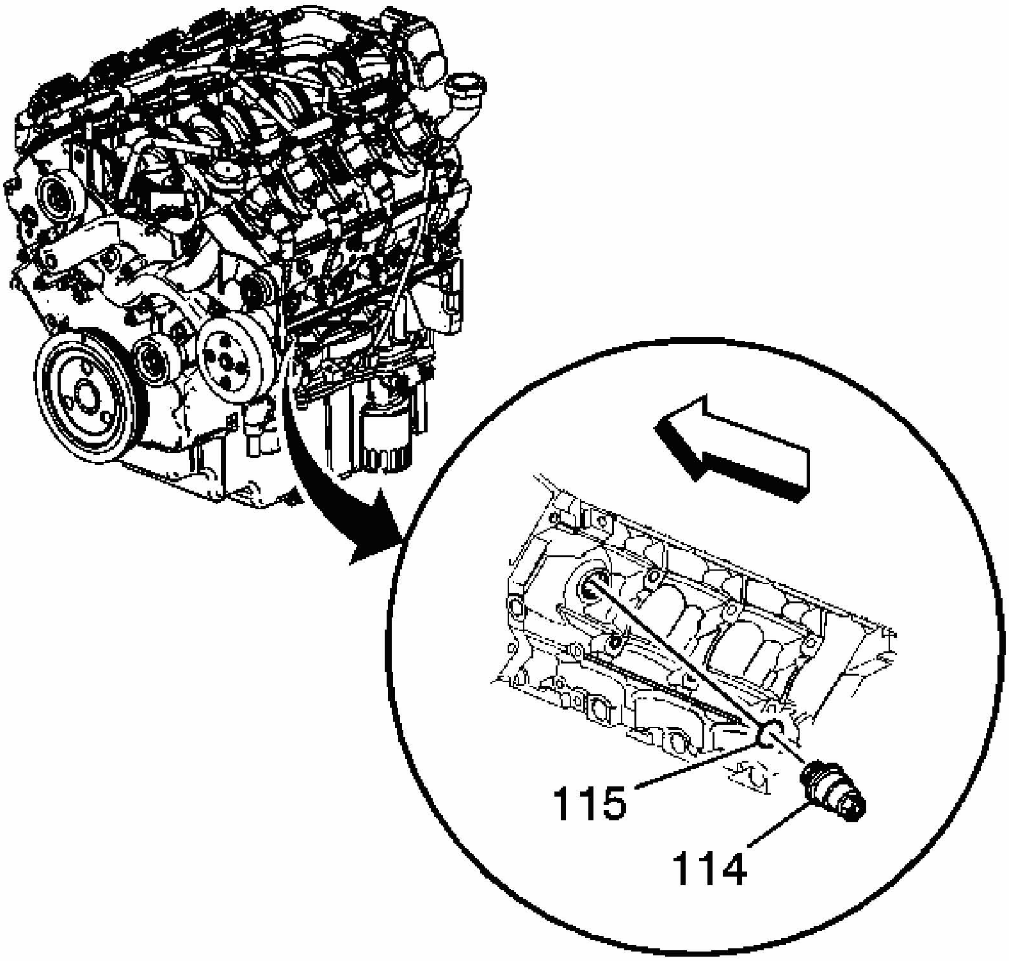


Fig. 128: Engine Block Coolant Heater & Washer
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Disconnect the coolant heater cord from the coolant heater.
4. Remove the coolant heater (114) and washer (115).

5. Remove and clean any burrs, compound, paint, or rough spots from the core plug hole.

Installation Procedure

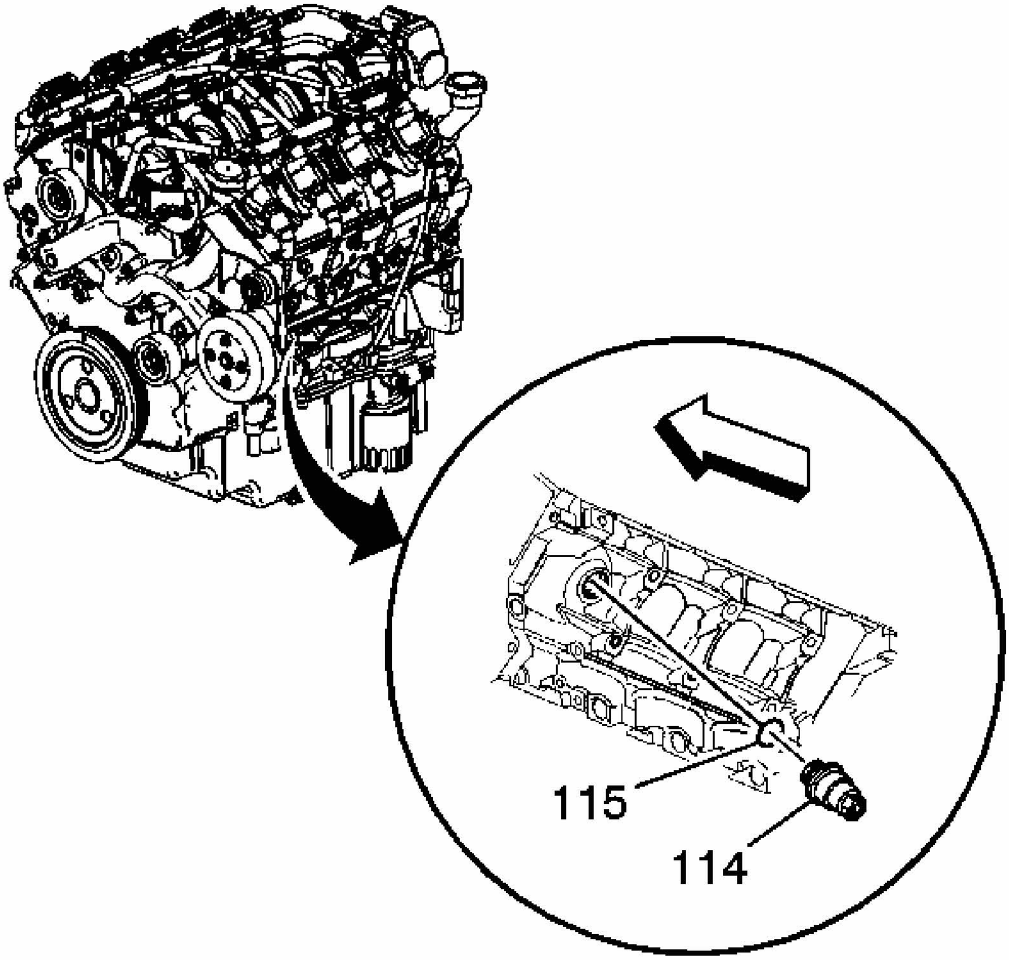


Fig. 129: Engine Block Coolant Heater & Washer
Courtesy of GENERAL MOTORS CORP.

1. Apply a 3.175 mm (0.125 in) bead of sealant, GM P/N 12346004 (Canadian P/N 10953480) or equivalent to the coolant heater.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the coolant heater (114) and washer (115).

Tighten: Tighten the coolant heater to 50 N.m (37 lb ft).

3. Connect the coolant heater cord to the coolant heater.
4. Lower the vehicle.
5. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)**.

COOLANT HEATER CORD REPLACEMENT (RPOS LZE/LZ4/LZ9)

Removal Procedure

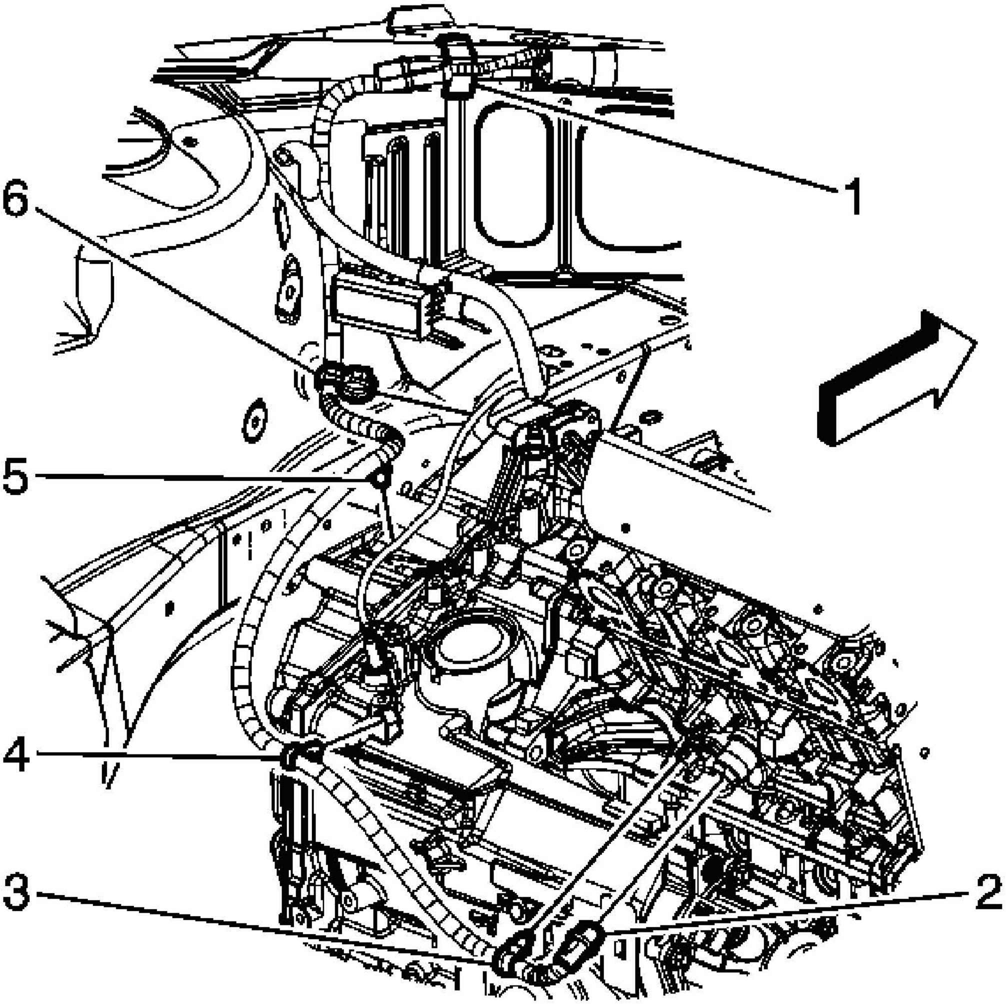


Fig. 130: Locating Heater Cord Clip On Engine Block
Courtesy of GENERAL MOTORS CORP.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Disconnect the engine coolant heater cord (2) from the engine coolant heater.
3. Remove the heater cord clip (3) from the engine block.
4. Lower the vehicle.
5. Remove the heater cord clips (4, 5) from the transaxle.
6. Remove the heater cord clamp from the engine harness.
7. Cut the heater cord tape (1) at the diagonal brace and remove the cord.

Installation Procedure

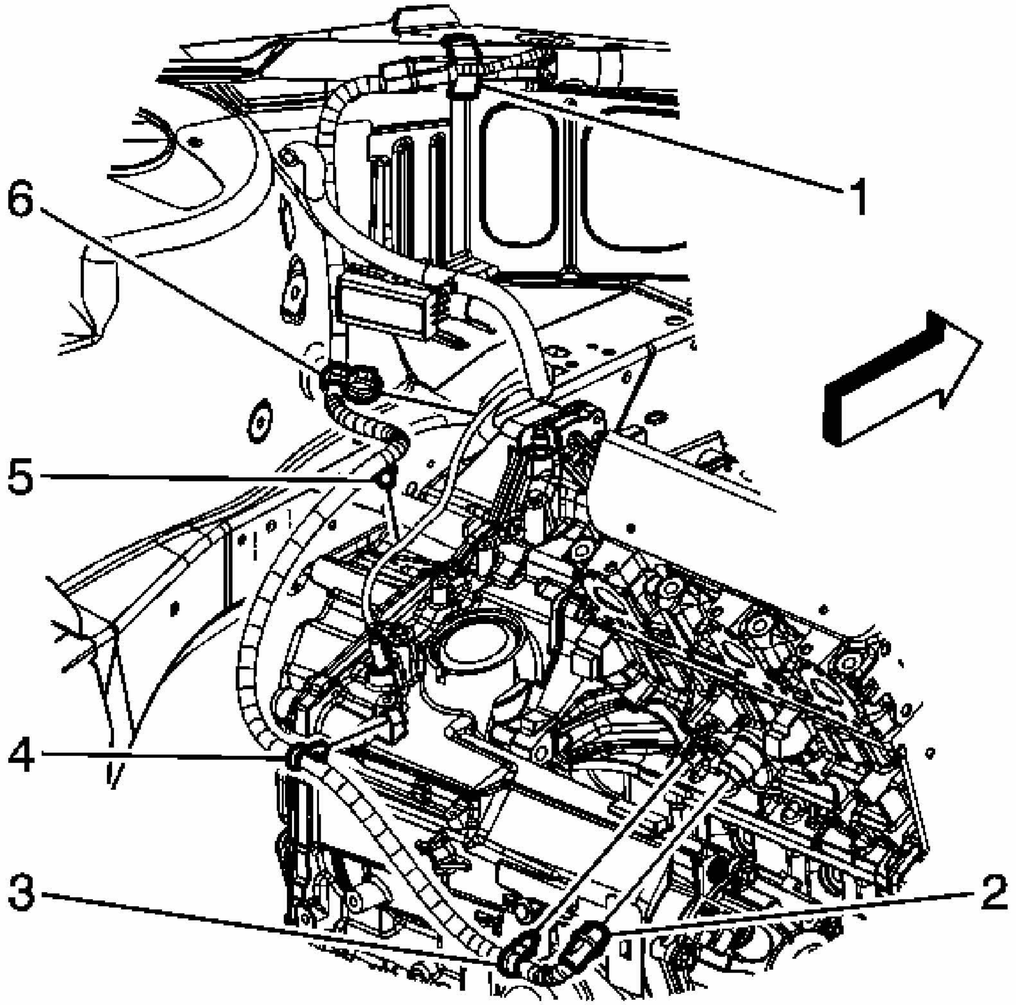


Fig. 131: Identifying Heater Cord Clips & Transaxle
Courtesy of GENERAL MOTORS CORP.

1. Lay the heater cord into place.
2. Install the heater cord clamp to the engine harness.
3. Install the heater cord clips (4, 5) to the transaxle.
4. Raise and support the vehicle.
5. Install the heater cord clip (3) to the engine block.
6. Connect the engine coolant heater cord (2) to the engine coolant heater.
7. Lower the vehicle.
8. Gather any slack and install the heater cord tape (1) at the diagonal brace.

COOLANT HEATER CORD REPLACEMENT (RPO LS4)

Removal Procedure

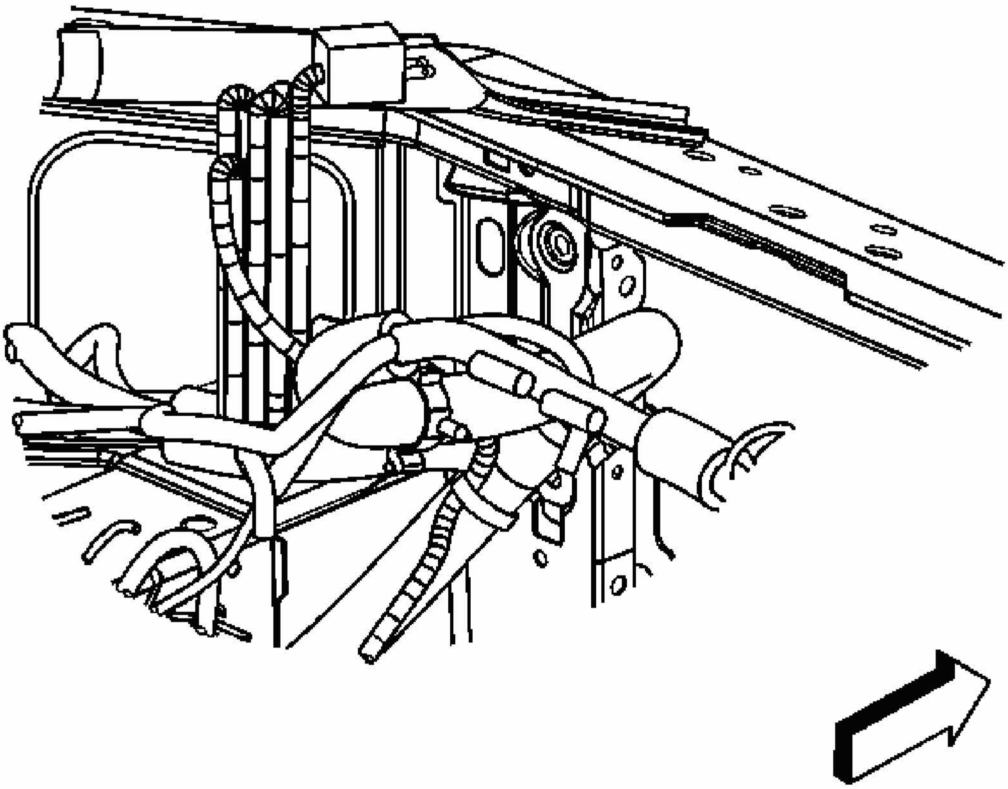


Fig. 132: Locating Tie Strap Attaching The Coolant Heater Cord To The Diagonal Brace

Courtesy of GENERAL MOTORS CORP.

1. Cut the tie strap attaching the coolant heater cord to the diagonal brace.

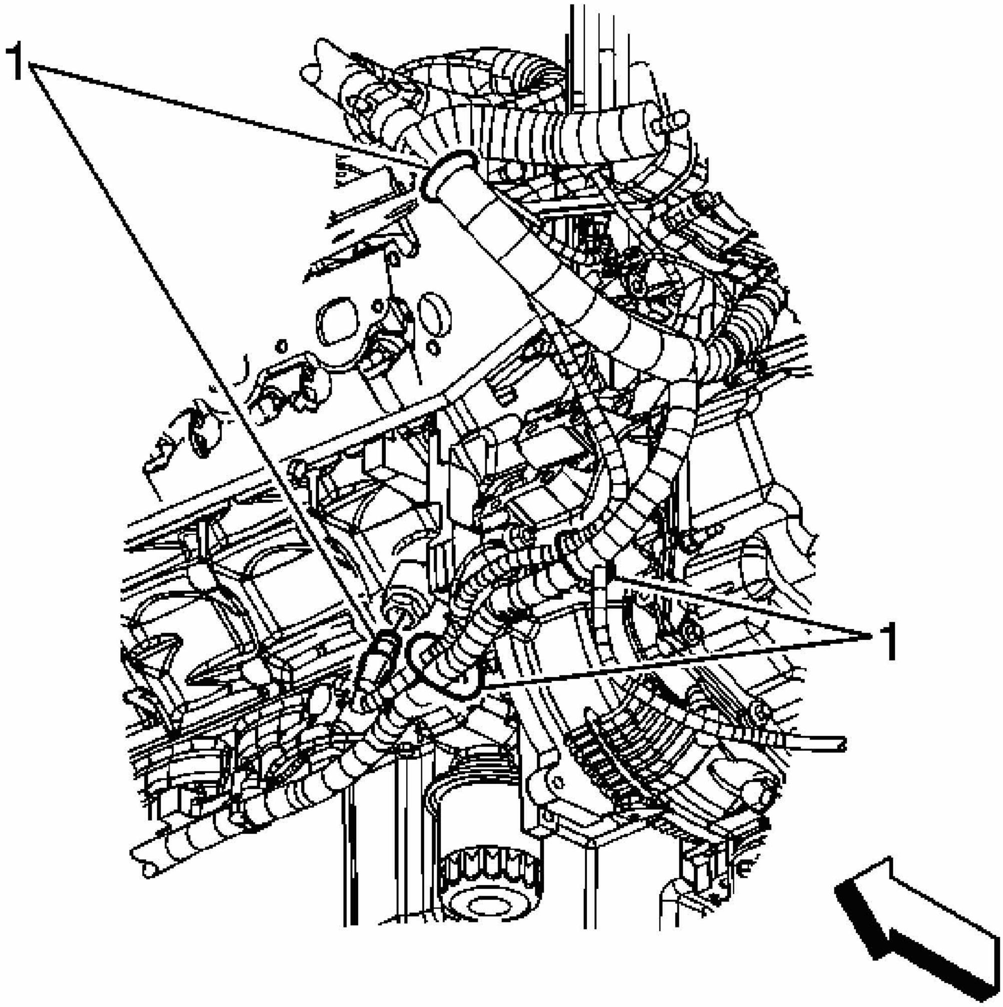


Fig. 133: Locating Tie Straps Attaching The Coolant Heater Cord To The Engine Wiring Harness
Courtesy of GENERAL MOTORS CORP.

2. Cut the tie straps (1) attaching the coolant heater cord to the engine wiring harness.
3. Disconnect the coolant heater cord connection from the coolant heater.
4. Remove the coolant heater cord.

Installation Procedure

NOTE: The heater cord must not touch the engine, hot pipes, manifold, or any moving parts. Route the cord to the left front of the engine compartment securing with tie straps as necessary to prevent damage.

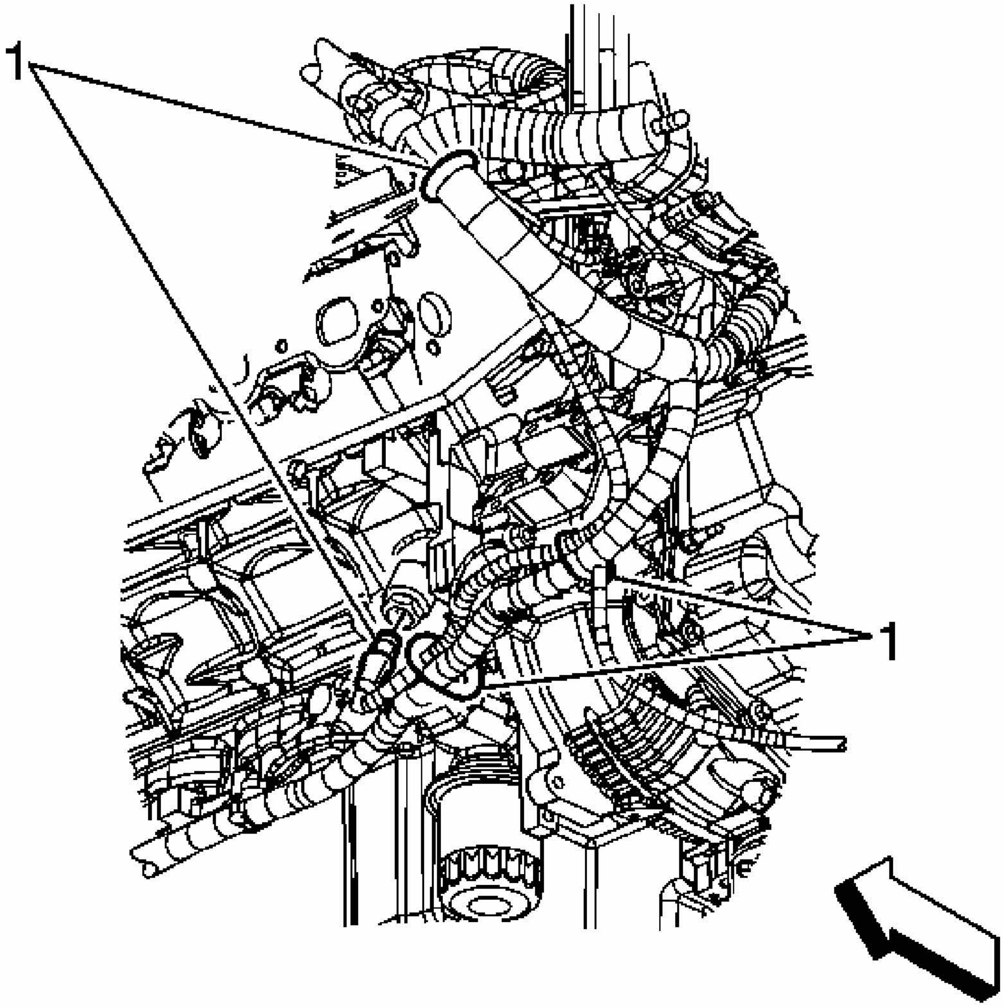


Fig. 134: Locating Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant heater cord.
2. Connect the coolant heater cord connection to the coolant heater.
3. Install NEW tie straps (1) attaching the coolant heater cord to the engine wiring harness.

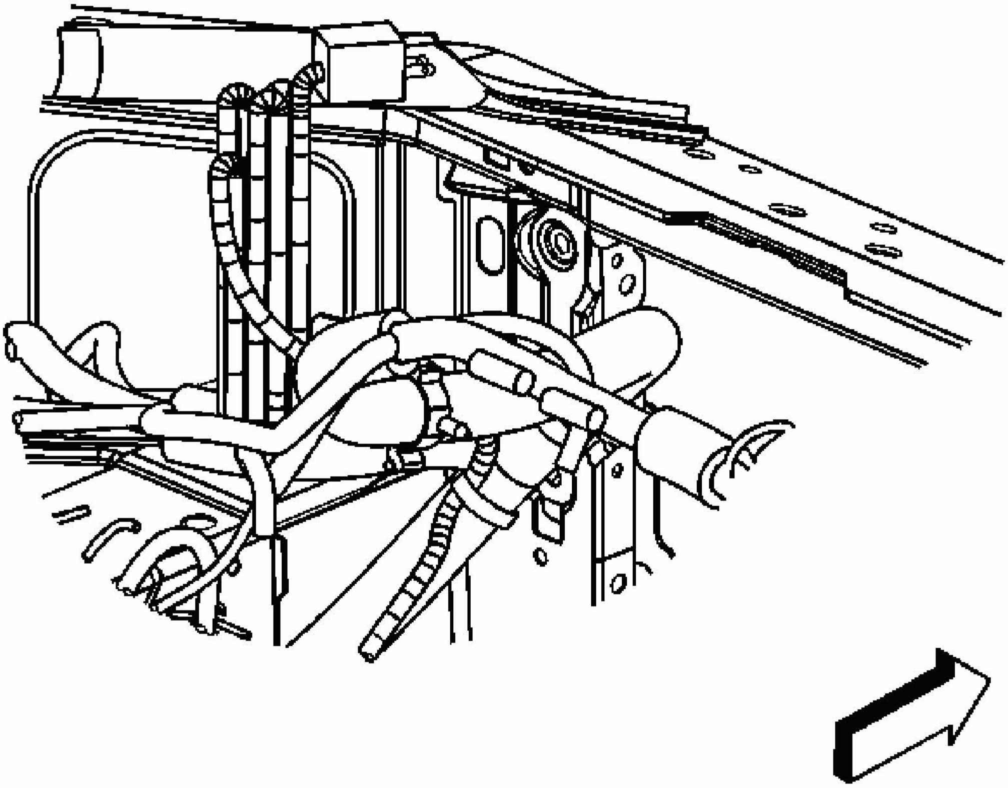


Fig. 135: View Of Coolant Heater Cord At The Diagonal Brace
Courtesy of GENERAL MOTORS CORP.

4. Install a NEW tie strap attaching the coolant heater cord to the diagonal brace.

DESCRIPTION AND OPERATION

COOLING SYSTEM DESCRIPTION AND OPERATION

Cooling Fan Control

The engine cooling fan system consists of 2 electrical cooling fans and 3 fan relays. The relays are arranged in a series/parallel configuration that allows the powertrain control module (PCM) to operate both fans together at low or high speeds. The cooling fans and fan relays receive battery positive voltage from the underhood fuse block. The ground path is provided at G106.

During low speed operation, the PCM supplies the ground path for the low speed fan relay through the low speed cooling fan relay control circuit. This energizes the cooling fan 1 relay coil, closes the relay contacts, and supplies battery positive voltage from the cool fan 1 fuse through the cooling fan motor supply voltage circuit to the left cooling fan. The ground path for the left cooling fan is through the cooling fan S/P relay and the right cooling fan. The result is a series circuit with both fans running at low speed.

During high speed operation the PCM supplies the ground path for the cooling fan 1 relay through the low speed cooling fan relay control circuit. After a 3 second delay, the PCM supplies a ground path for the cooling fan 2 relay and the cooling fan S/P relay through the high speed cooling fan relay control circuit. This energizes the cooling fan 2 relay coil, closes the relay contacts, and provides a ground path for the left cooling fan. At the same time the cooling fan S/P relay coil is energized closing the relay contacts and provides battery positive voltage from the cool fan 2 fuse on the cooling fan motor supply voltage circuit to the right cooling fan. During high speed fan operation, both engine cooling fans have their own ground path. The result is a parallel circuit with both fans running at high speed.

The PCM commands Low Speed Fans on under the following conditions:

- Engine coolant temperature exceeds approximately 106°C (223°F).
- When A/C is requested and the ambient temperature is more than 50°C (122°F).
- A/C refrigerant pressure exceeds 1 310 kPa (190 psi).
- After the vehicle is shut off if the engine coolant temperature at key-off is more than 140°C (284°F) and system voltage is more than 12 volts. The fans will stay on for approximately 3 minutes.

The PCM commands High Speed Fans on under the following conditions:

- Engine coolant temperature reaches 110°C (230°F).
- A/C refrigerant pressure exceeds 1 655 kPa (240 psi).
- When certain DTCs set

Engine Coolant Indicators

TEMP

- The instrument panel cluster (IPC) illuminates the TEMP indicator when the powertrain control module (PCM) determines that the coolant temperature is more than 128°C (262°F). The IPC receives a discrete input from the PCM requesting illumination.
- The IPC performs the display test at the start of each ignition cycle. The IPC illuminates the TEMP indicator.

Coolant Level Control

The engine cooling system contains an engine coolant level switch to alert the driver in the event of a low coolant level. When the engine coolant level in the coolant recovery reservoir falls below a certain level, the coolant level switch opens. When the IBCM detects an open or a high voltage level on the coolant level indicator control circuit, for at least 10 seconds, it will send a GM LAN message to the driver information center (DIC) requesting display of the low coolant level message. There is approximately a 10 second delay before the IBCM sends the GM LAN message to prevent the message from being displayed, due to coolant sloshing in the surge tank.

Coolant Heater

The optional engine coolant heater (RPO K05) operates using AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather -29°C (-20°F). The coolant heater helps reduce fuel consumption when a cold engine is warming up. The unit is equipped with a detachable AC power cord. A weather shield on the cord is provided to protect the plug when not in use.

Cooling System

The cooling systems function is to maintain an efficient engine operating temperature during all engine speeds and operating conditions. The cooling system is designed to remove approximately one-third of the heat produced by the burning of the air-fuel mixture. When the engine is cold, the coolant does not flow to the radiator until the thermostat opens. This allows the engine to warm quickly.

Cooling Cycle

Coolant flows from the radiator outlet and into the water pump inlet. Some coolant flows from the water pump, to the heater core, then back to the water pump. This provides the passenger compartment with heat and defrost capability as the coolant warms up.

Coolant also flows from the water pump outlet and into the engine block. In the engine block, the coolant circulates through the water jackets surrounding the cylinders where the coolant absorbs heat.

The coolant then flows through the cylinder head gasket openings and into the cylinder heads. In the cylinder heads, the coolant flows through the water jackets surrounding the combustion chambers and valve seats, where the coolant absorbs additional heat.

From the cylinder heads, the coolant flows to the thermostat. The flow of coolant will either be stopped at the thermostat until the engine reaches normal operating temperature, or the coolant will flow through the thermostat and into the radiator where the coolant is cooled. At this point, the coolant flow cycle is completed.

Efficient operation of the cooling system requires proper functioning of all cooling system components. The cooling system consists of the following components.

Coolant

The engine coolant is a solution made up of a 50/50 mixture of DEX-COOL and suitable drinking water. The coolant solution carries excess heat away from the engine to the radiator, where the heat is dissipated to the atmosphere.

Radiator

The radiator is a heat exchanger consisting of a core and 2 tanks. The aluminum core is a tube and fin crossflow design that extends from the inlet tank to the outlet tank. Fins are placed around the outside of the tubes to improve heat transfer to the atmosphere.

The inlet and outlet tanks are a molded, high temperature, nylon reinforced plastic material. A high temperature rubber gasket seals the tank flange edge to the aluminum core. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core.

The radiator also has a drain cock located in the bottom of the end tank. The drain cock unit includes the drain cock and drain cock seal.

Heat is removed from the coolant as the coolant passes through the radiator. The fins on the core transfer heat from the coolant passing through the tubes. Air passing between the fins absorbs the heat and cools the coolant.

Pressure Cap

The pressure cap seals and pressurizes the cooling system. The cap contains a blow off, or pressure valve and a vacuum, or an atmospheric valve:

- The pressure valve is held against the seat by a spring that protects the radiator by relieving pressure that exceeds 15 psi.
- The vacuum valve is held against the seat by a spring that permits opening of the valve to relieve vacuum created when the cooling system cools. The vacuum, if not relieved, might cause the radiator to collapse.

The pressure cap allows the cooling system pressure to build up when the temperature increases. As the pressure builds, the boiling point of the coolant increases. Therefore, the engine coolant can be safely run at a temperature much higher than the boiling point of the coolant at atmospheric pressure. The hotter the coolant becomes, the faster the heat transfers from the radiator into the cooler air.

The pressure in the cooling system can get too high. When the pressure exceeds the strength of the spring, the pressure valve rises, venting the excess pressure.

As the engine cools, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum causes the vacuum valve to open. This equalizes the pressure in the cooling system with the atmospheric pressure, preventing the radiator from collapsing.

Coolant Recovery System

The coolant recovery system consists of a plastic coolant recovery reservoir and overflow tube. The recovery reservoir is also called a recovery tank or expansion tank. This tank is partially filled with coolant and is connected to the radiator fill neck with the overflow tube. Coolant can flow back and forth between the radiator and the reservoir.

In effect, a cooling system with a coolant recovery reservoir is a closed system. When the pressure within the cooling system gets too high, the pressure valve in the pressure cap will open. This allows the coolant, which has expanded due to heat, to flow through the overflow tube and into the recovery reservoir. As the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum opens the vacuum valve in the pressure cap, allowing some of the coolant in the reservoir to be siphoned back into the radiator. Under normal operating conditions, no coolant is lost. Although the coolant level in the recovery reservoir goes up and down, the radiator and cooling system are kept full. An advantage to using a coolant recovery reservoir is the elimination of almost all air bubbles from the cooling system. Coolant without bubbles absorbs heat much better than coolant with bubbles.

Air Baffles and Seals

The cooling system uses deflectors, air baffles and air seals to increase cooling system capability. Deflectors are installed under the vehicle to redirect airflow beneath the vehicle and through the radiator to increase engine cooling. Air baffles are also used to direct airflow through the radiator and increase cooling capability. Air seals prevent air from bypassing the radiator and A/C condenser, and prevent recirculation of hot air for better hot weather cooling and A/C condenser performance.

Water Pump

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing with coolant inlet and outlet passages and an impeller. The impeller is a flat plate mounted on the pump shaft with a series of flat or curved blades or vanes. When the impeller rotates, the coolant between the vanes is thrown outward by centrifugal force. The impeller shaft is supported by one or more sealed bearings, which never need to be lubricated. With a sealed bearing, grease cannot leak out, and dirt and water cannot get in.

The water pump circulates coolant throughout the cooling system. The pump is driven by the crankshaft from the drive belt.

Thermostat

The thermostat is a coolant flow control component, whose purpose is to regulate the operating temperature of the engine. The thermostat utilizes a temperature sensitive waxpellet element, which connects to a valve through a piston. Heating causing the element to expand and exert pressure against a rubber diaphragm. This pressure forces the valve to open. Cooling causes the element to contract. This contraction allows a spring to push the valve closed.

When the coolant temperature is below 91°C (195°F), the thermostat valve remains closed. This prevents circulation of the coolant to the radiator and allows the engine to warm up quickly. After the coolant temperature reaches 91°C (195°F), the thermostat valve will open. The coolant is then allowed to circulate through the thermostat to the radiator where the engine heat is dissipated to the atmosphere. The thermostat also provides a restriction in the cooling system, even after opening. This restriction creates a pressure difference which prevents cavitation at the water pump and forces coolant to circulate through the engine block.

Engine Oil Cooler

The engine oil cooler is a heat exchanger which is located external to the radiator. The oil temperature is cooled by the air passing through the oil cooler fins. The oil pump pumps the oil through the feed line to the oil cooler. The oil flows through the cooler where the air absorbs heat from the oil. The oil is then pumped through the cooler return line to the oil filter and returns to the main oil passage.

Transmission Oil Cooler - Internal

The transmission oil cooler is a heat exchanger that is located inside one of the radiator end tanks. The transmission fluid temperature is regulated by the temperature of the engine coolant in the radiator. The oil pump pumps the fluid through the transmission oil cooler feed line to the oil cooler. The fluid flows through the cooler where the engine coolant absorbs heat from the fluid. The fluid is then pumped through the oil cooler return line back to the transmission.

Transmission Oil Cooler - External

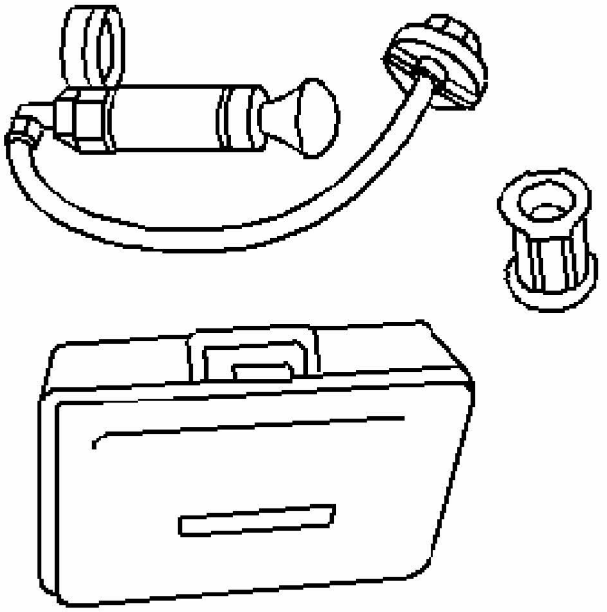
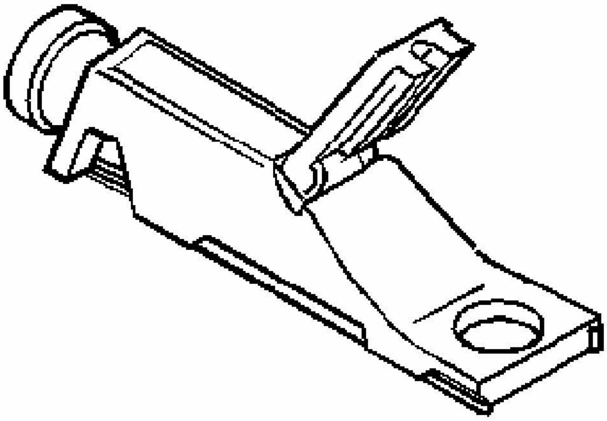
The transmission oil cooler is a heat exchanger that is located external to the radiator. Air passing through the oil cooler fins cools the transmission fluid temperature. Within the transmission system, the oil pump pumps the fluid through the feed line to the oil cooler. The fluid then flows through the cooler where air absorbs heat from the fluid. The fluid is then pumped through the oil cooler return line back to the transmission.

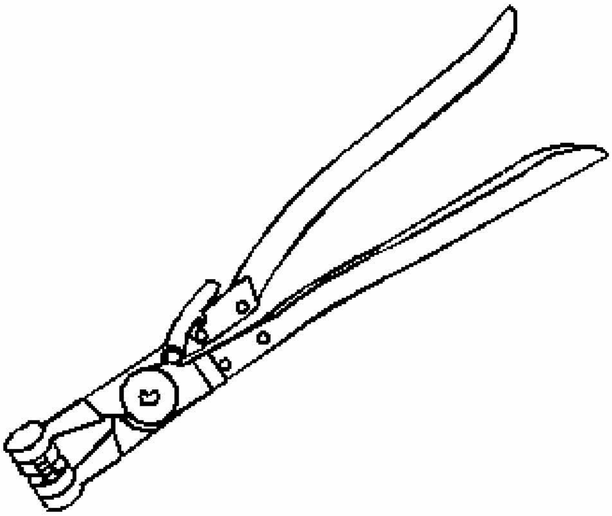
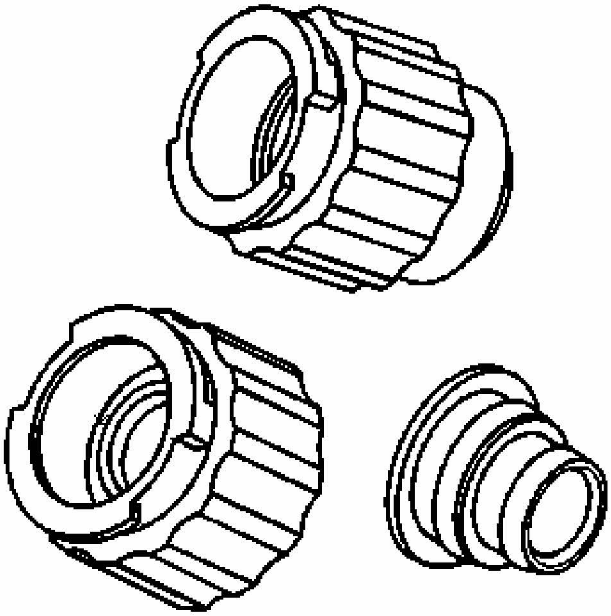
SPECIAL TOOLS AND EQUIPMENT

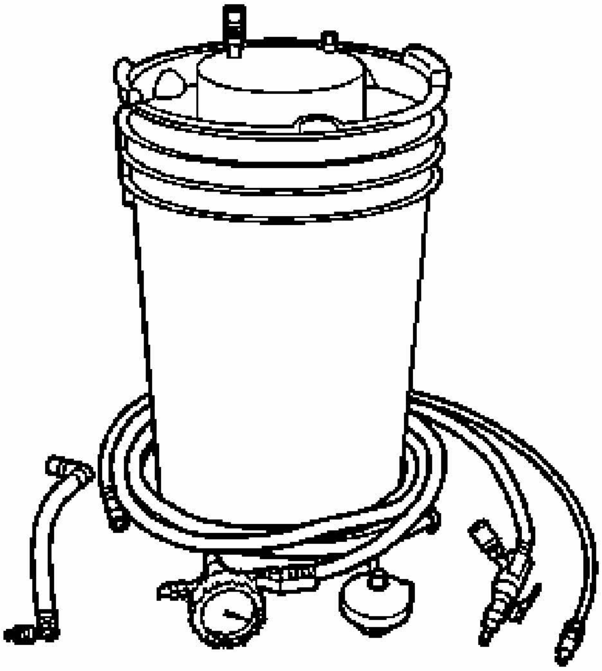
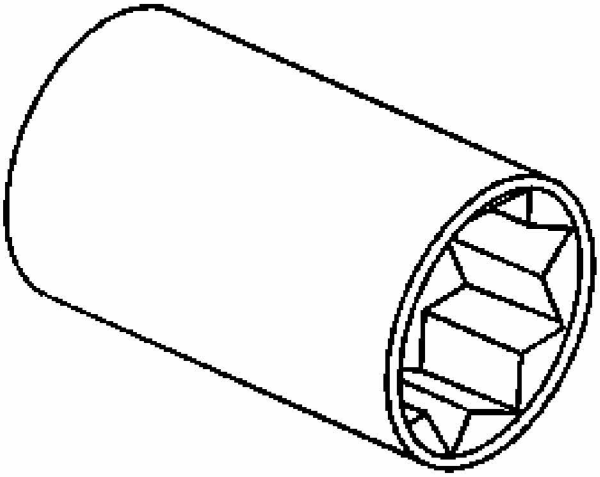
SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description

	J 24460-01 Cooling System Pressure Tester
	J 26568 Coolant and Battery Fluid Tester

	J 38185 Hose Clamp Pliers
	J 42401 Radiator Cap/Surge Tank Test Adapter

	GE 47716 Vac N Fill Coolant Refill Tool
	GE 47827 Socket

2006 ENGINE

Engine Electrical - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Battery Hold Down Bolt (RPOs LZE/LZ9)	18 N.m	13 lb ft
Battery Retainer Bolt (LS4)	18 N.m	13 lb ft
Battery Tray Bolt	5 N.m	44 lb in
Generator Bolt/Stud	50 N.m	37 lb ft
Generator Bracket Bolt (RPO LS4)	50 N.m	37 lb ft
Generator Output BAT Terminal Nut	30 N.m	22 lb ft
Ground Wire Bolt	10 N.m	89 lb in
Negative Battery Cable Terminal Nut	15 N.m	11 lb ft
Positive Battery Cable Junction Block Lead Nut	10 N.m	89 lb in
Positive Battery Cable Terminal Nut	15 N.m	11 lb ft
Starter Bolt	43 N.m	32 lb ft
Starter Solenoid "BAT" Terminal Nut	10 N.m	89 lb in
Transaxle Stud Nut	30 N.m	22 lb ft

BATTERY USAGE

Battery Usage

Application	Specification
3.5L LZ4/LZE	
Cold Cranking Amperage	600 A
Amp Hour Rating	70 AH
Reserve Capacity Rating	115 Minutes
Replacement Battery Number	34-7YR
3.9L LZ9	
Cold Cranking Amperage	750 A
Amp Hour Rating	70 AH
Reserve Capacity Rating	115 Minutes
Replacement Battery Number	34-7YR
5.3L LS4	
Cold Cranking Amperage	625 A

Amp Hour Rating	66 AH
Reserve Capacity Rating	110 Minutes
Replacement Battery Number	85H - 7YR

GENERATOR USAGE

Generator Usage

Application	Specification
LZ4, LZE, LZ9	
Generator Model	Bosch
Rated Output	125 A
Load Test Output	87 A
LS4	
Generator Model	Denso SC1
Rated Output	135 A
Load Test Output	94 A

SCHEMATIC AND ROUTING DIAGRAMS

STARTING AND CHARGING SCHEMATICS

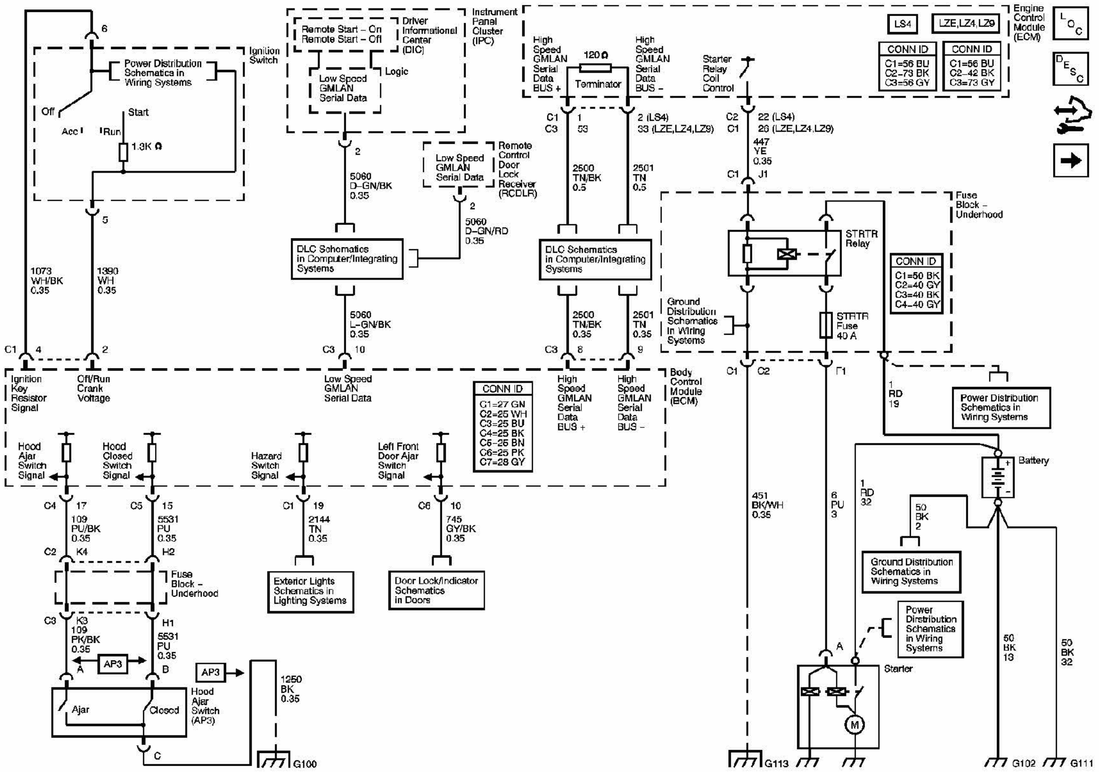

6
Power Distribution Schematics in Wiring Systems
Ignition Switch
Off
Acc
Run
Start
1.3K Ω
5
1073 WH/BK 0.35
1390 WH 0.35
C1 4
2
Ignition Key Resistor Signal
Off/Run Crank Voltage
Remote Start – On
Remote Start – Off
Driver Informational Center (DIC)
Instrument Panel Cluster (IPC)
Logic
Low Speed GMLAN Serial Data
2
5060 D-GN/BK 0.35
Low Speed GMLAN Serial Data
Remote Control Door Lock Receiver (RCDLR)
2
5060 D-GN/RD 0.35
DLC Schematics in Computer/Integrating Systems
5060 L-GN/BK 0.35
C3 10
Low Speed GMLAN Serial Data
High Speed GMLAN Serial Data BUS +
120 Ω
Terminator
High Speed GMLAN Serial Data BUS –
Starter Relay Coil Control
LS4
LZE,LZ4,LZ9
CONN ID
C1=56 BU
C2–73 BK
C3=56 GY
CONN ID
C1=56 BU
C2–42 BK
C3=73 GY
Engine Control Module (ECM)
C1 1
C3 53
2 (LS4)
33 (LZE,LZ4,LZ9)
C2 22 (LS4)
C1 26 (LZE,LZ4,LZ9)
447 YE 0.35
C1 J1
2500 TN/BK 0.5
2501 TN 0.5
DLC Schematics in Computer/Integrating Systems
2500 TN/BK 0.35
2501 TN 0.35
C3 8
9
High Speed GMLAN Serial Data BUS +
High Speed GMLAN Serial Data BUS –
Body Control Module (BCM)
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5–25 BN
C6=25 PK
C7=28 GY
Fuse Block – Underhood
STRTR Relay
CONN ID
C1=50 BK
C2=40 GY
C3=40 BK
C4–40 GY
Ground Distribution Schematics in Wiring Systems
STRTR Fuse 40 A
C1
C2
F1
1 RD 19
Power Distribution Schematics in Wiring Systems
Battery
451 BK/WH 0.35
6 PU 3
1 RD 32
50 BK 2
Ground Distribution Schematics in Wiring Systems
Power Dirstribution Schematics in Wiring Systems
A
Starter
M
50 BK 13
50 BK 32
G113
G102
G111
Hood Ajar Switch Signal
Hood Closed Switch Signal
Hazard Switch Signal
Left Front Door Ajar Switch Signal
C4 17
109 PU/BK 0.35
C5 15
5531 PU 0.35
C1 19
2144 TN 0.35
C6 10
745 GY/BK 0.35
C2 K4
H2
Fuse Block – Underhood
C3 K3
109 PK/BK 0.35
H1
5531 PU 0.35
A
AP3
B
AP3
1250 BK 0.35
Ajar
Closed
Hood Ajar Switch (AP3)
C
G100
Exterior Lights Schematics in Lighting Systems
Door Lock/Indicator Schematics in Doors

Fig. 1: Starter - Wiring Diagram

Courtesy of GENERAL MOTORS CORP.

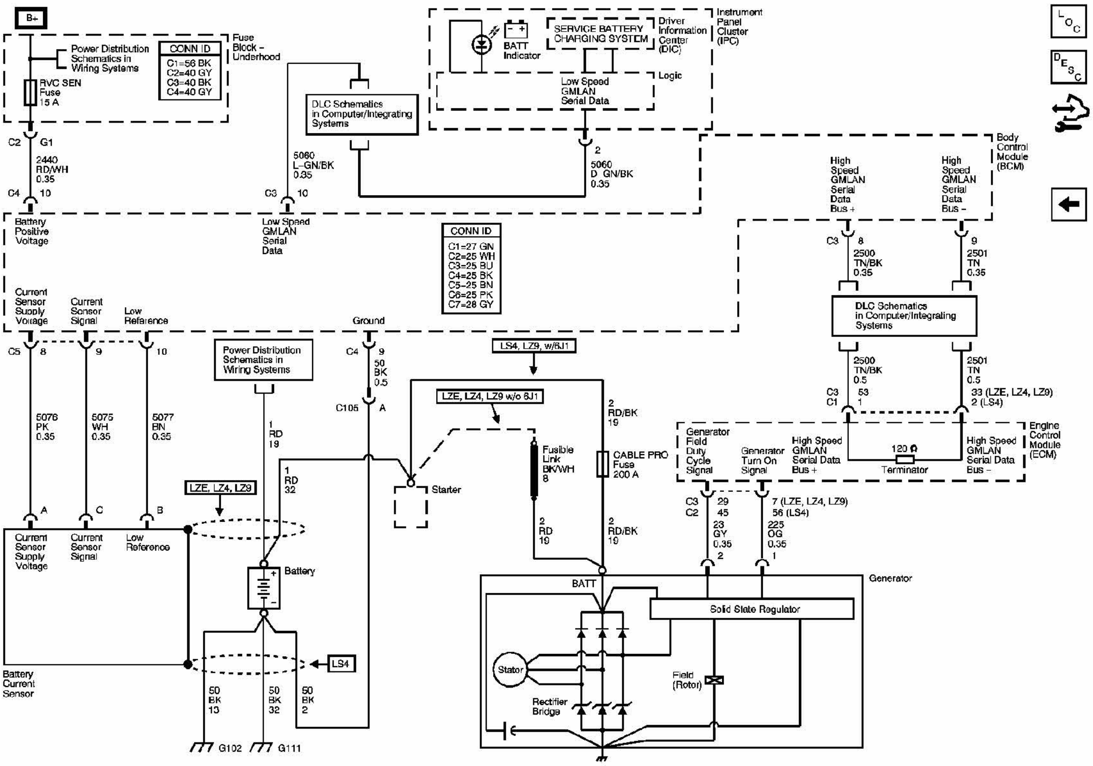

B+
Power Distribution Schematics in Wiring Systems
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
Fuse Block - Underhood
RVC SEN Fuse 15 A
C2 G1
2440 RD/WH 0.35
C4 10
Battery Positive Voltage
DLC Schematics in Computer/Integrating Systems
5060 L-GN/BK 0.35
C3 10
Low Speed GMLAN Serial Data
BATT Indicator
SERVICE BATTERY CHARGING SYSTEM
Driver Information Center (DIC)
Instrument Panel Cluster (IPC)
Logic
Low Speed GMLAN Serial Data
2
5060 D GN/BK 0.35
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
High Speed GMLAN Serial Data Bus +
High Speed GMLAN Serial Data Bus –
Body Control Module (BCM)
C3 8
2500 TN/BK 0.35
9
2501 TN 0.35
DLC Schematics in Computer/Integrating Systems
2500 TN/BK 0.5
2501 TN 0.5
C3 C1 53 1
33 (LZE, LZ4, LZ9) 2 (LS4)
Current Sensor Supply Voltage
Current Sensor Signal
Low Reference
Ground
C5 8
9
10
5076 PK 0.35
5075 WH 0.35
5077 BN 0.35
Power Distribution Schematics in Wiring Systems
1 RD 19
1 RD 32
C4 9
50 BK 0.5
C105 A
LS4, LZ9, w/6J1
LZE, LZ4, LZ9 w/o 6J1
Starter
Fusible Link BK/WH 8
2 RD/BK 19
CABLE PRO Fuse 200 A
2 RD 19
2 RD/BK 19
LZE, LZ4, LZ9
A
C
B
Current Sensor Supply Voltage
Current Sensor Signal
Low Reference
Battery
LS4
Battery Current Sensor
50 BK 13
50 BK 32
50 BK 2
G102
G111
Generator Field Duty Cycle Signal
Generator Turn On Signal
High Speed GMLAN Serial Data Bus +
120 Ω
Terminator
High Speed GMLAN Serial Data Bus –
Engine Control Module (ECM)
C3 C2 29 45
23 GY 0.35
2
7 (LZE, LZ4, LZ9) 56 (LS4)
225 OG 0.35
1
Generator
BATT
Solid State Regulator
Stator
Field (Rotor)
Rectifier Bridge

Fig. 2: Generator - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

ENGINE ELECTRICAL COMPONENT VIEWS

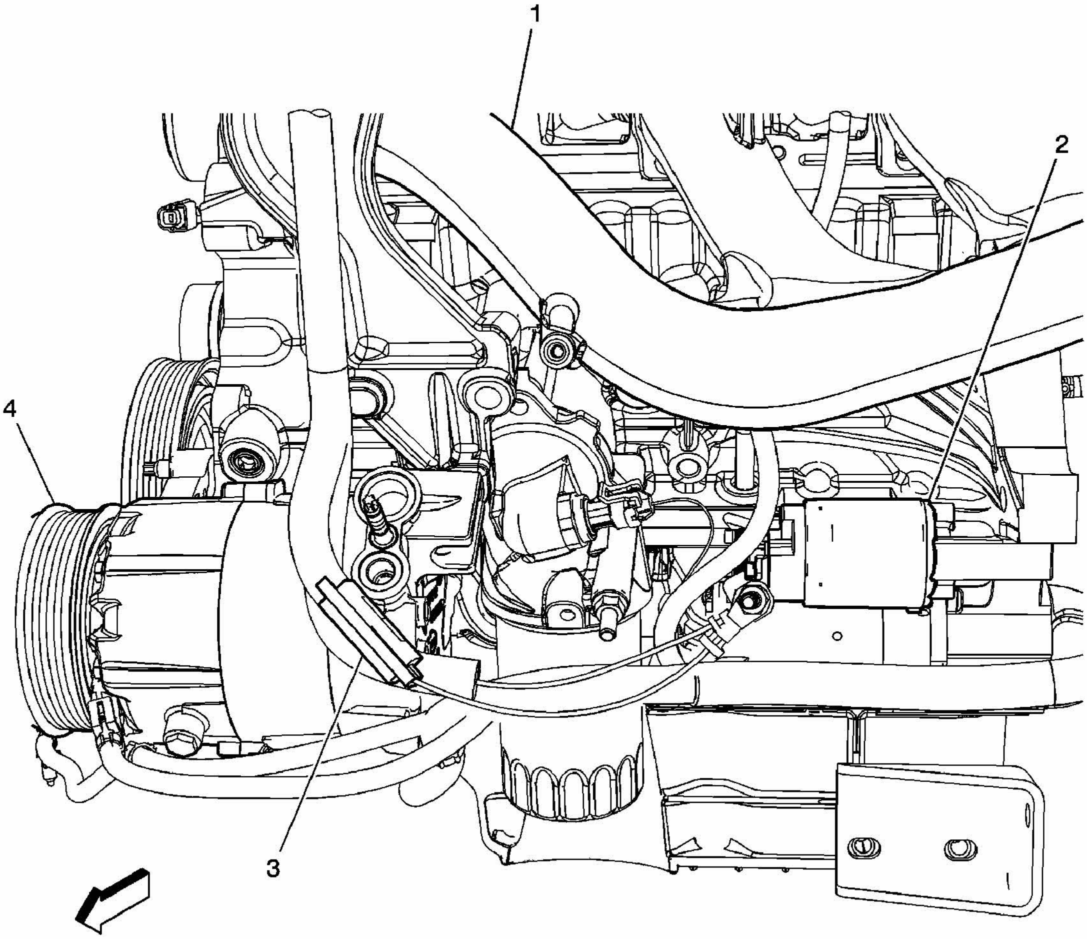


Fig. 3: Lower Front Of The Engine (LZE, LZ4, LZ4)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Exhaust Manifold
2	Starter
3	Cable Pro Fuse (6J1)
4	A/C Compressor Clutch

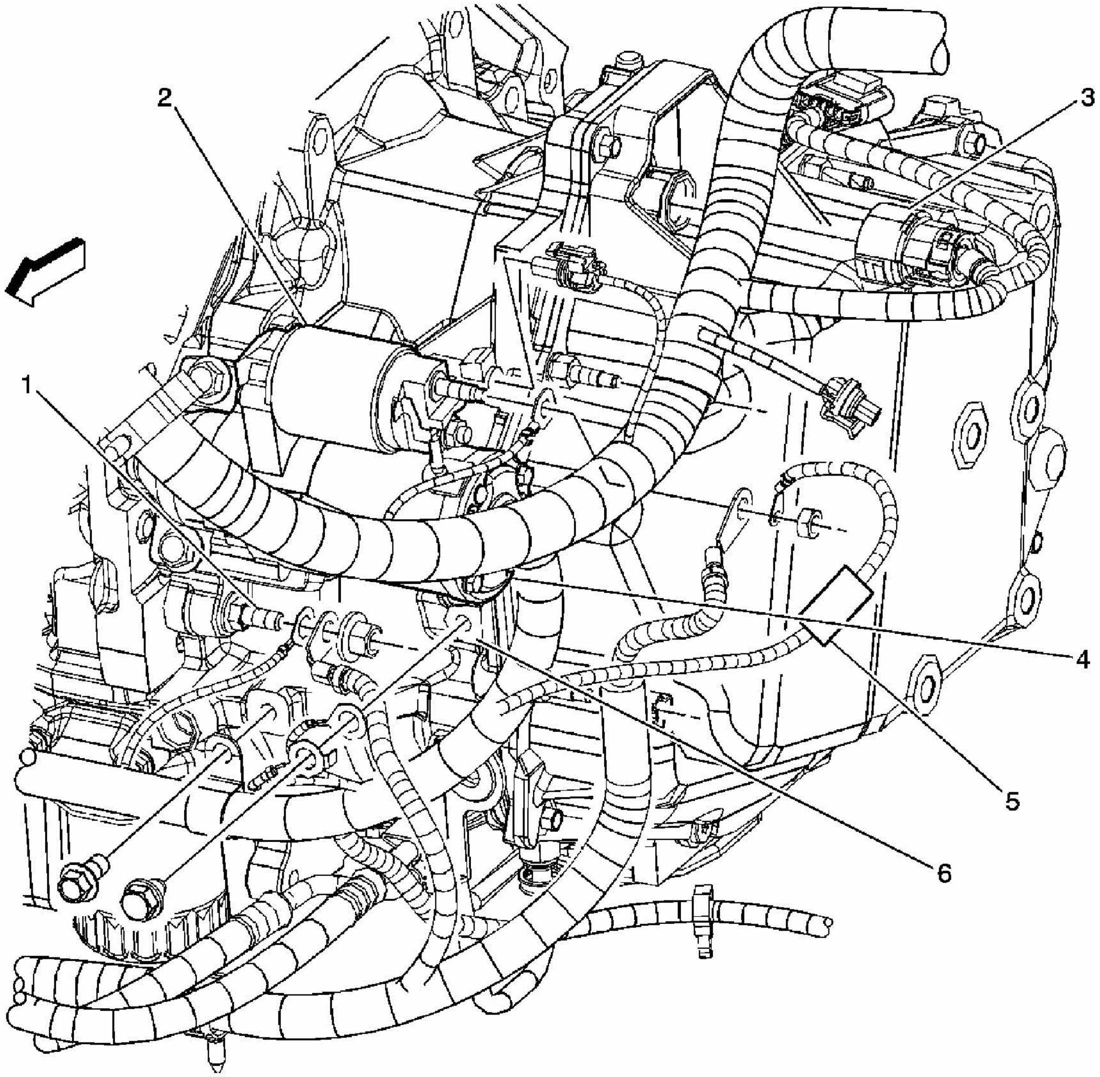


Fig. 4: Front of the Engine (LS4)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	G111
2	Starter Solenoid
3	C100
4	Starter
5	Cable Pro fuse
6	G113

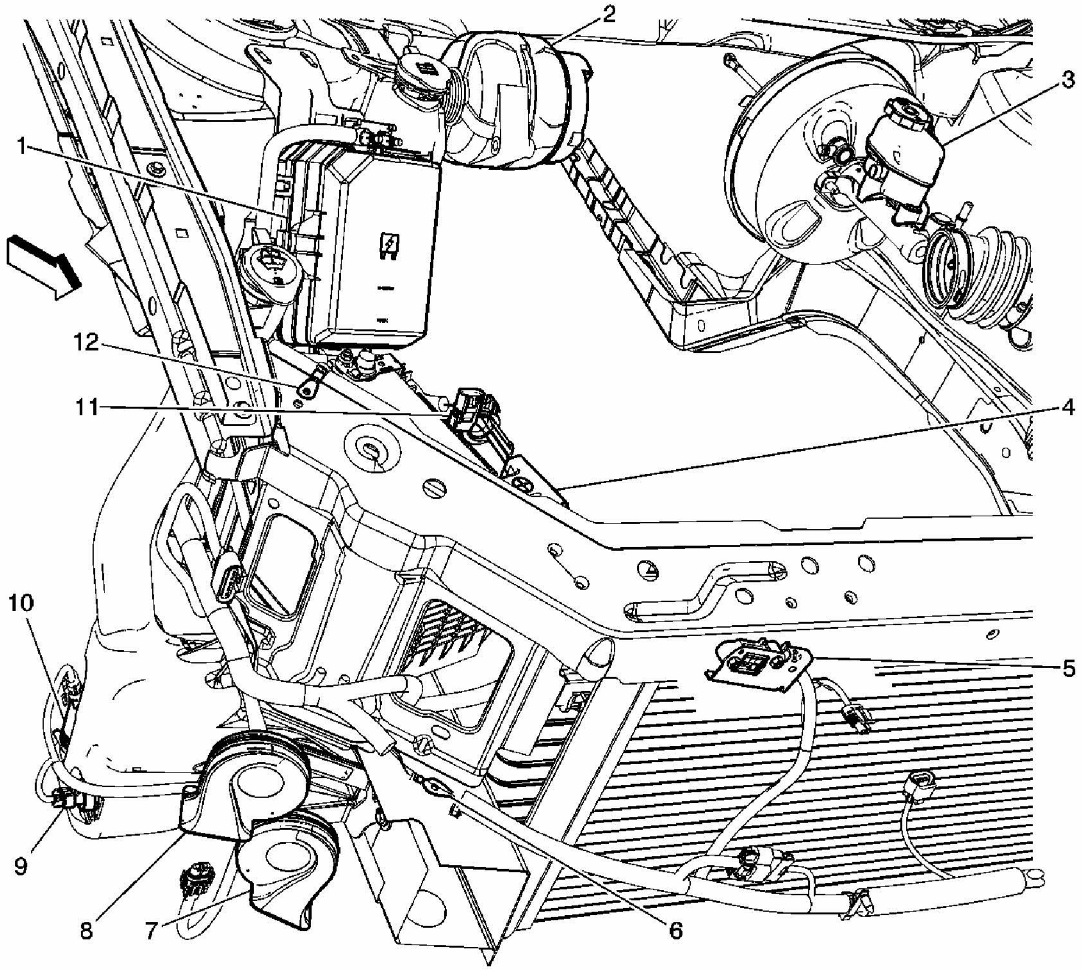


Fig. 5: RF Of The Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
1	Fuse Block - Underhood
2	Generator
3	Brake Fluid Level Switch
4	Battery
5	Inflatable Restraint Front end Sensor - Right
6	G100
7	Horn Assembly
8	Windshield Washer Fluid Container
9	Windshield Washer Fluid Level Switch
10	Windshield Washer Fluid Pump
11	Battery Current Sensor

12	G102

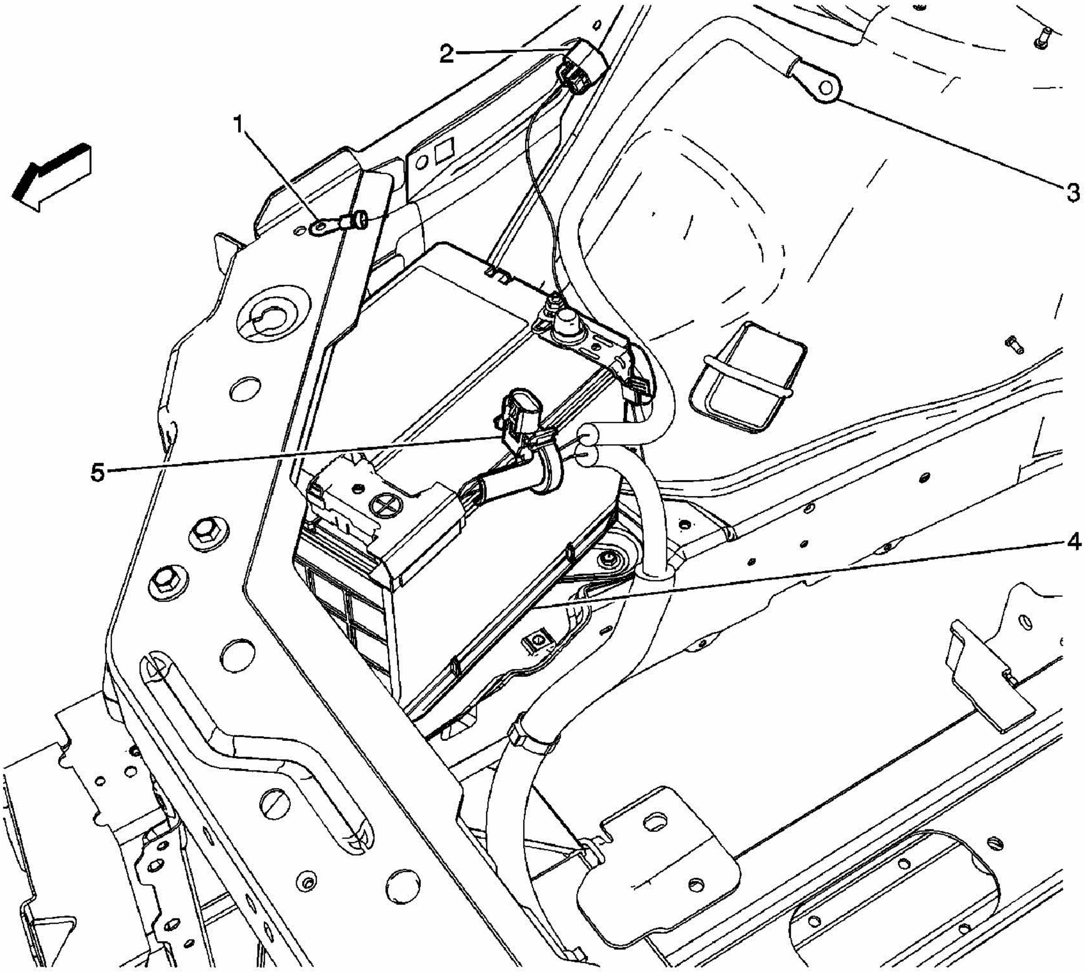


Fig. 6: Battery Attachments (LZE, LZ4, LZ9)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 6

Callout	Component Name
1	G102
2	C105
3	Fuse Block - Underhood Positive Battery Cable Terminal
4	Battery
5	Battery Current Sensor

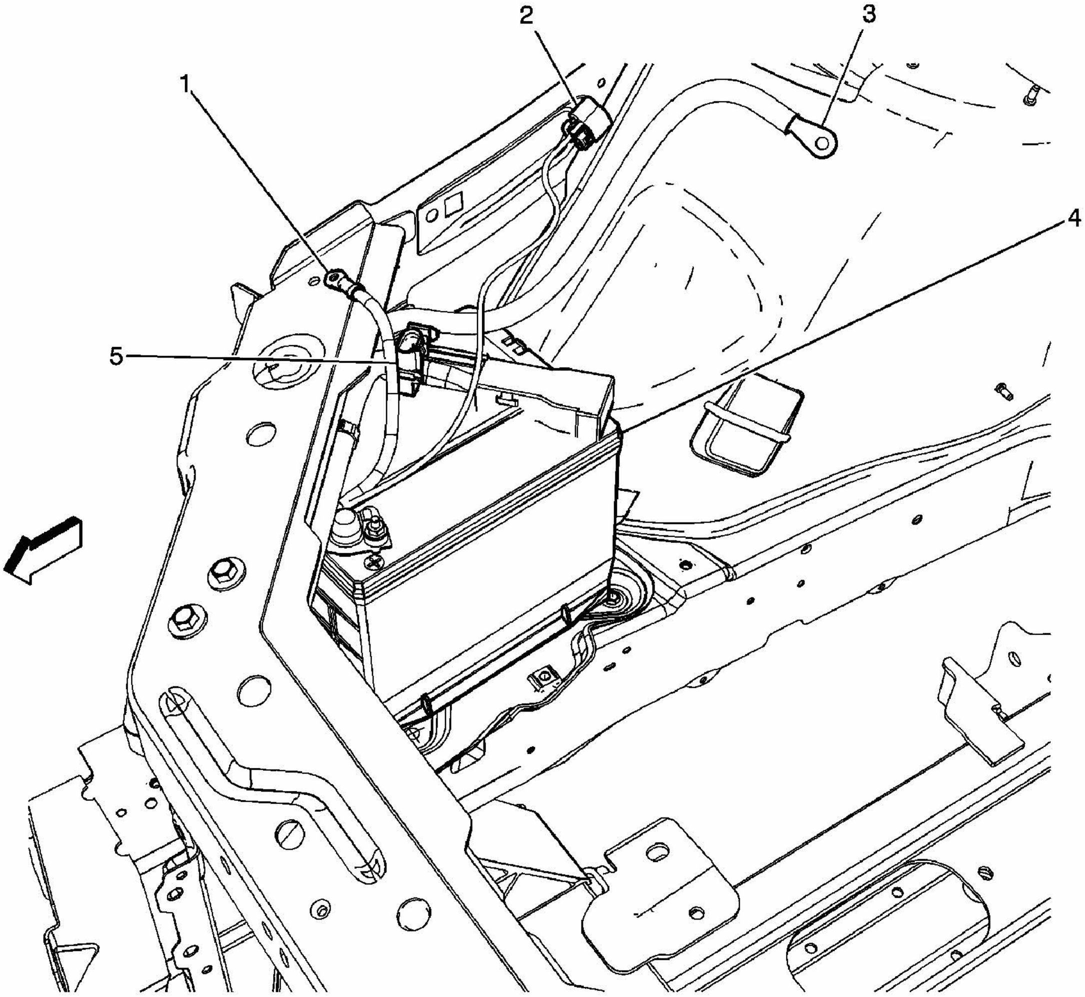


Fig. 7: Battery Attachments (LS4)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 7

Callout	Component Name
1	G102
2	C105
3	Fuse Block - Underhood Positive Battery Cable Terminal
4	Battery
5	Battery Current Sensor

ENGINE ELECTRICAL CONNECTOR END VIEWS

Battery Current Sensor

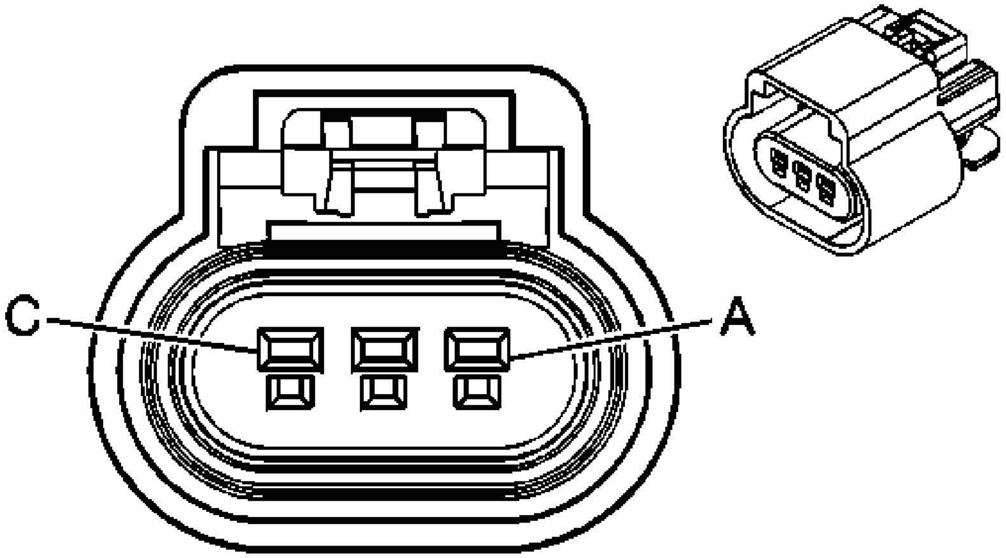


Fig. 8: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Engine Electrical Connector End Views

Connector Part Information

- OEM: 15326808
- Service: See Catalog
- Description: 3-Way F GT 150 Sealed (BK)

Terminal Part Information

- Terminal/Tray: 12191819/8
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Battery Current Sensor

Pin	Wire Color	Circuit No.	Function
A	PK	5076	Current Sensor Supply Voltage
B	BN	5077	Low Reference
C	WH	5075	Current Sensor Signal

Generator

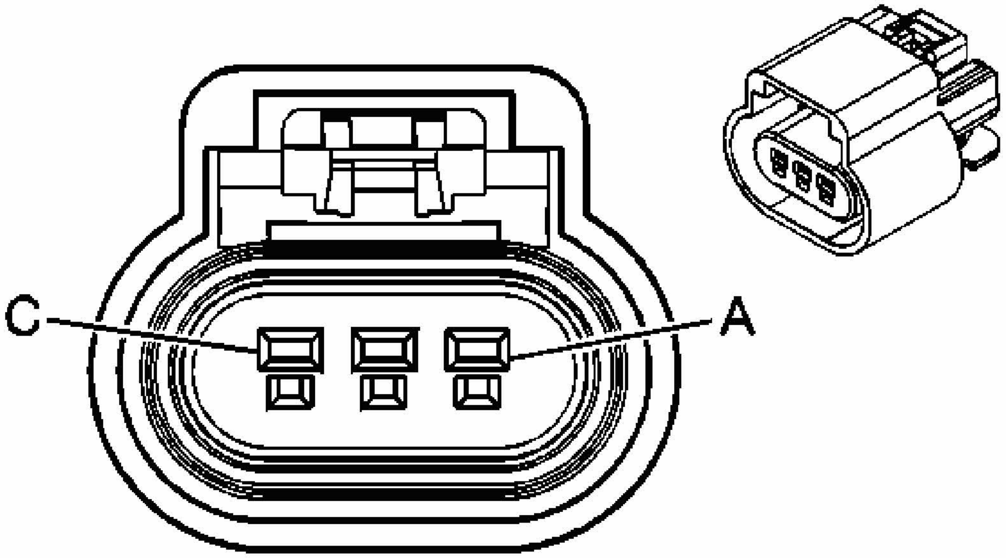


Fig. 9: Connector End View
Courtesy of GENERAL MOTORS CORP.

Engine Electrical Connector End Views

Connector Part Information

- OEM: 15397337
- Service: See Catalog
- Description: 2-Way F Timer JR-Power Sealed (BK)

Terminal Part Information

- Terminal/Tray: 4-964286-1/16
- Core/Insulation Crimp: E/1
- Release Tool/Test Probe: 12093647/J-35616-4A (PU)

Generator

Pin	Wire Color	Circuit No.	Function
C	OG	225	Generator Turn On Signal
A	GY	23	Generator Field Duty Cycle Signal

Starter

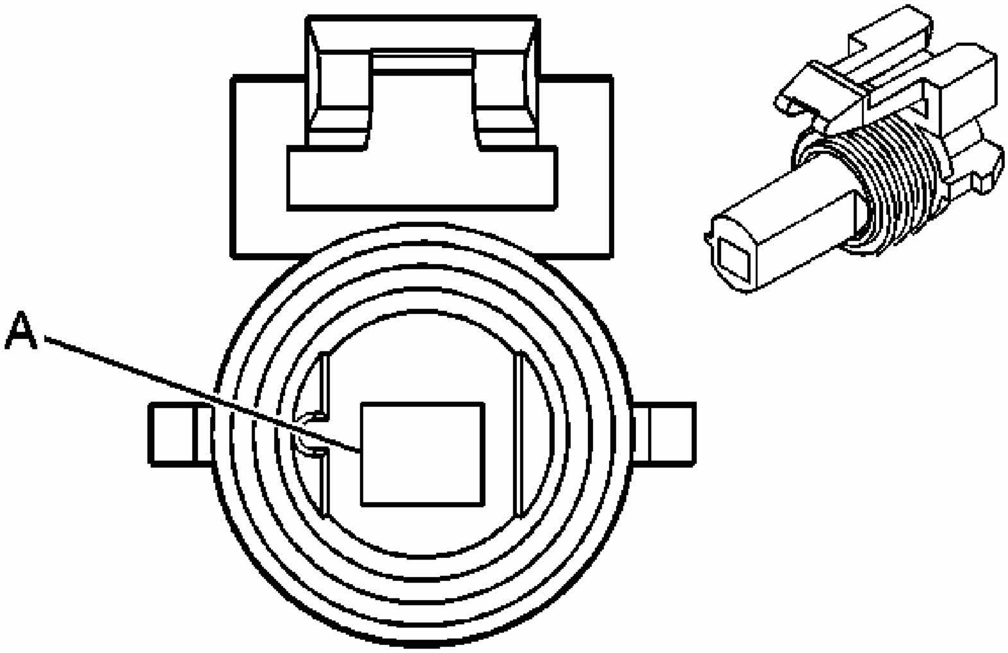


Fig. 10: Connector End View
Courtesy of GENERAL MOTORS CORP.

Engine Electrical Connector End Views

Connector Part Information
- OEM: 12089916   - Service: 12101763   - Description: 1-Way F Metri-Pack 280 Sealed (GY)
Terminal Part Information
- Terminal/Tray: 12077413/4   - Core/Insulation Crimp: F/5   - Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Starter

Pin	Wire Color	Circuit No.	Function
A	PU	6	Starter Solenoid Crank Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B1325	Device Power Circuit
DTC B1516	Refer to**DTC B1516**
DTC B1517	Battery Voltage
DTC P0562	System Voltage Low
DTC P0563	System Voltage High
DTC P0615	Starter Relay Control Circuit
DTC P0621	Generator L-Terminal Circuit
DTC P0622	Generator F-Terminal Circuit
DTC P1668	Generator L-Terminal Control Circuit

DIAGNOSTIC STARTING POINT - ENGINE ELECTRICAL

Begin the system diagnosis with **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check - Vehicle will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check - Vehicle will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL OUTPUT CONTROLS

Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection(s)	Description
Engine Output Controls	GEN L-Terminal	The engine control module (ECM) commands the generator OFF by removing the 5 V reference signal from the L terminal of the voltage regulator when you select Off. The generator will then stop generating an output voltage.
Engine Output Controls	Starter Relay Control	The ECM commands the Crank Relay OFF by removing the 12 volts from the control circuit of Crank Relay when you select OFF. Voltage will then stop flowing through the switch of the Crank Relay.

SCAN TOOL DATA LIST

Amplifier (AMP)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine Running			
Battery Voltage Signal	Data	Volts	13.9 Volts

Body Control Module (BCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine Running			
Battery Low at Start	Data Display/ Charging Info	Yes/No	No
Batt. Open Ckt. Tested	Data Display/ Charging Info	Yes/No	No
Batt. Open Ckt. Voltage	Data Display/ Charging Info	Volts	13.03 Volts
Battery Voltage	Data Display/ Charging Info	Volts	13.9 Volts
Batt. Voltage High Res.	Data Display/ Charging Info	Volts	12.417 Volts
Parasitic Current	Data Display/ Charging Info	Amps	0.0 Amps
Prev. State of Charge	Data Display/ Charging Info	%	90%
Start Up State of Charge	Data Display/ Charging Info	%	80%
State of Charge	Data Display/ Charging Info	%	85%
State of Charge Low	Data Display/ Charging Info	Yes/No	No

Engine Control Module (ECM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF			
Crank Request Signal	Engine Electrical	Yes / No	No
GEN F-Terminal Signal	Engine Electrical	%	0%
GEN L-Terminal Signal Command	Engine Electrical	%	0%

GEN L-Terminal Signal Command	Engine Electrical	On / Off	Off
GEN L-Terminal Circuit Status	Engine Electrical	Incomplete / Short Gnd / Open / Short to B+ / OK	OK
Ignition 1 Signal	Engine Electrical	Volts	Varies
PNP Switch	Engine Electrical	Park / Neutral / In Gear	Park
Starter Relay Command	Engine Electrical	On/Off	Off
Starter Relay Circuit Status	Engine Electrical	Incomplete / Short Gnd / Open / Short to B+ / OK	OK

Instrument Panel Cluster (IPC)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine Running			
Battery Voltage Signal	Data Display	Volts	13.9 Volts

Vehicle Theft Deterrent (VTD)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON, Engine Off			
Battery Voltage Signal	Data Display	Volts	12.0 Volts
Ignition Voltage Signal	Data Display	Not Present / Present	Present
Start Disabled	Data Display	Yes/No	Yes

Sensing Diagnostic Module (SDM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine Running			
Battery Voltage Signal	Data Display	Volts	13.9 Volts

Transmission Control Module (TCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Transmission in Park			
Ignition Voltage	Data Display	Volts	12.8 Volts

IMS	Data Display	Park, Park/Reverse, Reverse, Reverse/Neutral, Neutral, Neutral/Drive 4, Drive 4, Drive 4/Drive 3, Drive 3, Drive 3/Drive 2, Drive 2, Drive 2/Drive 1, Drive 1, INVALID, OPEN	Park

SCAN TOOL DATA DEFINITIONS

Battery Voltage Signal

The scan tool displays 0-20 Volts. The scan tool displays the voltage as received by the Module or the 72-08 battery voltage message from the BCM over class 2 lines.

Crank Request Signal

The scan tool displays Yes/No. The scan tool displays No until the ignition is placed into the START position then Yes is displayed.

GEN F-Terminal Signal

The scan tool displays 0%-100%. The scan tool displays 0%-10% until the engine is started and the ECM receives a signal from the generator then OK is displayed.

GEN L-Terminal Signal Command

The scan tool displays On/Off. The scan tool displays Off until the engine is running, then the ECM supplies the percentage value varies depending on electrical loads

Ignition 1 Signal

The scan tool displays 0-20 Volts. The scan tool displays the voltage as received on the Ignition 1 circuit to the ECM.

IMS

The scan tool displays Park, Park/Reverse, Reverse, Reverse/Neutral, Neutral, Neutral/Drive 4, Drive 4, Drive 4/Drive 3, Drive 3, Drive 3/Drive 2, Drive 2, Drive 2/Drive 1, Drive 1, INVALID, and OPEN. The scan tool displays the physical position of the Internal Mode Switch (IMS) of the transmission.

Starter Relay Command

The scan tool displays ON/OFF. The scan tool displays Off until engine start has been requested, then it reads On.

Starter Relay Control Circuit

The scan tool displays Fault/OK/Invalid State. The scan tool displays Fault until the starter relay control circuit is grounded then OK is displayed.

DTC B1325

Circuit Description

The control modules on this vehicle monitor the battery voltage through the battery positive voltage circuits. This vehicle has multiple modules that will set this DTC. For more information on which modules, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B1325

Device Power Circuit

This vehicle has DTCs which include DTC Symptoms. For more information on DTC Symptoms, refer to **DTC Symptom Description** .

DTC B1325

DTC Symptom	DTC Symptom Descriptor
03	Voltage Below Threshold
07	Voltage Above Threshold

Conditions for Running the DTC

The voltage supplied to the control modules are in the range of 7-26 volts.

Conditions for Setting the DTC

DTC B1325 03

- The control module detects a system voltage below the calibrated value usually 9 volts.
- The above condition is present at least 5 seconds.

DTC B1325 07

- The control module detects a system voltage above the calibrated value usually 18 volts.
- The above condition is present at least 5 seconds.

Action Taken When the DTC Sets

- The control module immediately disables all outputs when an out of range voltage condition has been detected, with the exception of GMLAN and Run/Crank relay that are disabled after a 3 minute delay.
- The setting of other DTCs is inhibited.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

DTC B1325

Step	Action	Values	Yes	No
Schematic Reference: Body Control System Schematics **Connector End View Reference: Computer/Integrating Systems Connector End Views**				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the Battery Voltage Signal parameter in the data list of the module setting the DTC Is the Battery Voltage Signal parameter displayed in the specified range?	9-18 V	Go to **Step 3**	Go to **Step 4**
3	Is the DTC set as a current DTC?	-	Go to **Step 7**	Go to **Testing for Intermittent Conditions and Poor Connections**
4	1. Disconnect the harness connector of the module setting the DTC. 2. Measure the voltage between the battery positive voltage	9-18 V		

	circuit at the module harness connector and a good ground. Is the measured value in the specified range?		Go to **Step 6**	Go to **Step 5**
5	Test the battery positive voltage circuit for the following conditions: • A short to ground • An open • A high resistance Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 9**	Go to **Battery Inspection/Test**
6	Test the all of ground circuits of the module for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 7**
7	Inspect for poor connections at the harness connector of the affected module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 8**
8	Replace the affected module Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 9**	-
9	Operate the system in order to verify the repair. Did you find and correct the condition?	-	System OK	Go to **Step 2**

DTC B1516

DTC Descriptor

DTC B1516 08

Battery Current Sensor Signal Invalid

DTC B1516 66

Battery Current Sensor Wrong Mounting Position

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC B1516

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Battery Current Sensor Supply Voltage	B1516	B1516	-	B1516
Battery Current Sensor Signal Circuit	B1516	B1516	-	B1516
Battery Current Sensor Low Reference Circuit	-	B1516	-	B1516

Circuit/System Description

The battery current sensor is a 3-wire hall effect current sensor. The battery current sensor monitors the battery current. It directly inputs to the body control module (BCM). It creates a 5-volt pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-95 percent. Between 0-5 percent and 95-100 percent are for diagnostic purposes.

Conditions for Running the DTC

- The ignition is ON.
- The engine is running.

Conditions for Setting the DTC

B1516 08

The BCM detects a duty cycle of PWM input signal is less than 4 percent or more than 96 percent for more 33 seconds.

B1516 66

The BCM detects the battery current sensor is improperly installed.

Action Taken When the DTC Sets

The SERVICE VEHICLE SOON warning message will be illuminated in the driver information center (DIC).

Conditions for Clearing the DTC

- The DTC clears as current status when the battery sensed current returns to normal range for more than 5 seconds.
- Using the scan tool Clear DTC Information function can clear the DTC.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Engine Electrical Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the battery current sensor.
2. Ignition ON, test for 5 volts between the battery current sensor supply voltage circuit, harness side and ground.
    - If the voltage is less than 5 volts, test the battery current sensor supply voltage circuit for a short to ground, a high resistance, an open circuit, or replace the BCM.
3. Ignition ON, test for 5 volts between the battery current sensor supply voltage circuit and current sensor low reference circuit, harness side.
    - If the voltage is less than 5 volts, test the current sensor low reference circuit for a high resistance, an open circuit, or replace the BCM.
4. Ignition ON, test for 5 volts between the battery current sensor signal circuit, harness side and ground.

    - If the voltage is less than 5 volts, test the battery current sensor signal circuit for a short to ground, a high resistance, an open circuit, or replace the BCM.

5. If all 3 circuits test normal, replace the battery current sensor.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for BCM replacement, setup, and programming

Battery Current Sensor Replacement (RPOs LZE/LZ4/LZ9) or **Battery Current Sensor Replacement (RPO LS4)**

DTC B1517

Circuit Description

The body control module (BCM) has designated circuits for monitoring vehicle system voltage. The BCM monitors the system voltage to ensure that the voltage stays within the proper range. Damage to components, and incorrect data may occur when the voltage is out of range. The BCM monitors the system voltage over an extended length of time. If the BCM detects the system voltage is outside an expected range for the calibrated length of time, or the BCM battery sense circuits differ by 3 volts DTC B1517 will set. Other modules also monitor system voltage the system voltage message is sent to the other modules and will default to 12.9 volts.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B1517

Battery Voltage

This vehicle has DTCs which include DTC symptoms. For more information, refer to **DTC Symptom Description** in Vehicle DTC Information.

DTC B1517

DTC Symptom	DTC Symptom Descriptor
03	Voltage Below Threshold
07	Voltage Above Threshold
52	Compare Failure

Conditions for Running the DTC

This DTC shall run only if the BCM has power, ground, and the ignition is not in START mode. This DTC shall execute regardless of the battery voltage.

Conditions for Setting the DTC

- The battery voltage falls below 11 volts, engine speed greater than 1,100 RPM for 15 seconds.
- The battery voltage is greater 16 volts, engine speed greater than 1,100 RPM for 15 seconds.
- The battery voltage differs by 3 volts on the BCM battery sense circuits for 15 seconds.

Action Taken When the DTC Sets

B1517 03

The driver information center (DIC) displays the BATTERY VOLTAGE LOW Message.

B1517 07

The DIC displays the BATTERY VOLTAGE HIGH Message.

B1517 52

The DIC displays the SERVICE VEHICLE SOON Message.

Conditions for Clearing the DTC

- The DTC will clear current status when the fault is no longer present.
- A history DTC will clear after 50 consecutive ignition cycles if the condition for the malfunction is no longer present.
- Use the scan tool Clear DTC function to clear the DTC.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

> **3:** This step tests for the proper voltage at battery positive voltage sense circuits of the BCM. If voltages are not within the proper operating range, the voltage sense circuits needs to be tested.
>
> **4:** This step tests the ground sense circuit of the BCM.
>
> **5:** This step tests for the proper voltage of the battery sense circuits to the BCM. If voltage is not within the proper operating range, the battery positive voltage and ground circuits of the BCM need to be tested.

DTC B1517

Step	Action	Value(s)	Yes	No

Schematic Reference: Starting and Charging Schematics or **Power Distribution Schematics** and **Body Control System Schematics**
Connector End View Reference: Master Electrical Component List

1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the Battery Voltage parameters in the body control module (BCM) data list. Do any of the voltages differ more than the specified value?	3 V	Go to **Step 5**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the BCM harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the battery positive voltage circuits of the BCM and the ground circuits of the BCM. Do the voltages differ more than the specified value?	3 V	Go to **Step 9**	Go to **Step 4**
4	Measure the voltage from the battery positive voltage circuits of the BCM and a good ground. Do the voltages differ more than the specified value?	3 V	Go to **Step 8**	Go to **Step 7**
5	1. Turn ON the ignition. 2. Measure the voltage between the battery positive voltage circuits of the BCM and the ground circuits of the BCM.	10.5-15.5 V		

	Does the voltage measure within the specified range?		Go to **Step 9**	Go to **Step 6**
6	Measure the voltage between the battery positive voltage circuits of BCM and a good ground. Does the voltage measure within the specified range?	10.5-15.5 V	Go to **Step 8**	Go to **Step 7**
7	Test the battery positive voltage circuits of BCM for a high resistance or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 9**
8	Test the ground circuits of the BCM for a high resistance or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 9**
9	Inspect for poor connections at the harness connector of the BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 10**
10	Replace the module BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 11**	-
11	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	-	Go to **Step 2**	System OK

DTC P0562

DTC Descriptor

DTC P0562

System Voltage Low

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0562

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition 1 Signal	P0562	P0562	-	-

Circuit/System Description

The engine control module (ECM) monitors the system voltage to ensure that the voltage stays within the proper range. Damage to components, and incorrect data may occur when the voltage is out of range.

Conditions for Running the DTC

- The vehicle speed is above 8 km/h (5 mph).
- The system voltage is between 9.5-18 volts.

Conditions for Setting the DTC

The ECM detects a system voltage below 10 volts for 5 seconds.

Action Taken When the DTC Sets

- The ECM will command the charge indicator and or warning message to be illuminated on the instrument panel cluster (IPC) and the driver information center (DIC), if equipped.
- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store conditions, which were present when the DTC set as Failure Records data only.

Conditions for Clearing the DTC

- The ECM will command the message OFF after one trip in which the diagnostic test has been run and passed.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- Using the scan tool Clear DTC Information function can clear the DTC.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Engine Electrical Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List** for ECM
- **Scan Tool Data Definitions** for ECM

Circuit/System Verification

With the scan tool installed, ignition ON and the engine OFF, observe the Ignition 1 Signal parameter in the ECM data list. The Ignition 1 Signal parameter should read 10.5 volts or greater.

Circuit/System Testing

1. Measure the voltage at the battery terminals and compare it with the Ignition 1 Signal parameter in the ECM data list. Verify that battery and ignition 1 signal readings do not differ more than 0.5 volt.
    - If greater than 0.5 volt, test the ignition 1 ground circuits of the ECM for high resistance or replace the ECM.
2. Go to **Charging System Test**.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for ECM replacement, setup, and programming

DTC P0563

DTC Descriptor

DTC P0563

System Voltage High

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0563

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition 1 Signal	P0562	P0562	-	-

Circuit/System Description

The engine control module (ECM) monitors the system voltage to ensure that the voltage stays within the proper range. Damage to components, and incorrect data may occur when the voltage is out of range.

Conditions for Running the DTC

- The vehicle speed is above 8 km/h (5 mph).
- The system voltage is between 9.5-18 volts.

Conditions for Setting the DTC

The ECM detects a system voltage above 16 volts for less than 1 second.

Action Taken When the DTC Sets

- The ECM will command the charge indicator and or warning message to be illuminated on the instrument panel cluster (IPC) and the driver information center (DIC), if equipped.
- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store conditions, which were present when the DTC set as Failure Records data only.

Conditions for Clearing the DTC

- The ECM will command the message OFF after one trip in which the diagnostic test has been run and passed.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- Using the scan tool Clear DTC Information function can clear the DTC.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Engine Electrical Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List** for ECM
- **Scan Tool Data Definitions** for ECM

Circuit/System Verification

With the scan tool installed, ignition ON and the engine OFF, observe the Ignition 1 Signal parameter in the ECM data list. The Ignition 1 Signal parameter should read 16 volts or less.

Circuit/System Testing

1. Measure the voltage at the battery terminals and compare it with the Ignition 1 Signal parameter in the ECM data list. Verify that battery and ignition 1 signal readings do not differ more than 0.5 volt.
   - If greater than 0.5 volt, test the ignition 1 ground circuits of the ECM for high resistance or replace the ECM.
2. Go to **Charging System Test**.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for ECM replacement, setup, and programming

DTC P0615

Circuit Description

The engine control module (ECM) supplies 12 volts to the control circuit of the crank relay when start enable has been requested. The ECM monitors this circuit for conditions that are incorrect for the commanded state. If the ECM detects an improper circuit condition, crank relay DTC P0615 will set.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0615

Starter Relay Control Circuit

Conditions for Running the DTC

System voltage is between 9-16 volts.

Conditions for Setting the DTC

- The ECM detects an improper voltage level on the control circuit that controls the crank relay.
- The condition exists for at least 2 seconds.

Action Taken When the DTC Sets

- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store the conditions present when the DTC set as Failure Records data only.

Conditions for Clearing the MIL/DTC

- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using the scan tool Clear DTC Information function.

Diagnostic Aids

Ignition system DTCs set with the ignition switch in the START position if the crank relay or the starter is inoperative. When the ECM enables starter operation, the ECM also initiates the diagnostic test routines for other DTCs. If a condition exists which prevents the engine from cranking, the ECM will not receive signal input from the crankshaft position (CKP) and camshaft position (CMP) sensors, and the DTCs will set.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may assist in diagnosing the condition. The information may help determine how often the condition that set the DTC occurs.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: Listen for an audible click when the crank relay operates. Turn the ignition switch back and forth from the ON to START positions. Repeat this as necessary.

3: This step tests the ground circuit of the crank relay.

4: This step verifies that the ECM is providing 12 volts to the control circuit of crank relay.

5: This step tests for an open in the control circuit to the crank relay.

DTC P0615

Step	Action	Yes	No
Schematic Reference: **Starting and Charging Schematics** **Connector End View Reference: Power and Grounding Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Turn the ignition back and forth from the ON to START positions. Does the crank relay click with each command?	Go to **Step 3**	Go to **Starter Solenoid Does Not Click**
3	1. Turn OFF the ignition. 2. Remove the crank relay. 3. Turn ON the ignition, with the engine OFF. 4. Test the ground circuit of the crank relay with a test lamp that is connected to battery positive. Does the test lamp illuminate?	Go to **Step 4**	Go to **Step 8**
4	1. Connect a test lamp between the crank relay control circuit and the crank relay ground circuit of the crank relay. 2. Turn the ignition back and forth from the ON to START positions. Does the test lamp turn ON and OFF with		

	each command?	Go to **Step 6**	Go to **Step 5**
5	Test the control circuit of the crank relay for an open or a high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 7**
6	Inspect for poor connections at the starter relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 9**
7	Inspect for poor connections at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 10**
8	Repair the ground circuit of the crank relay. Refer to **Connector Repairs** . Did you complete the repair?	Go to **Step 11**	-
9	Replace the crank relay. Did you complete the replacement?	Go to **Step 11**	-
10	Replace the ECM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 11**	-
11	1. Review and record the scan tool Failure Records data. 2. Clear the DTCs. 3. Operate the vehicle within the Failure Records conditions as noted. 4. Using a scan tool, monitor the Specific DTC Information for DTC P0615. Does the scan tool indicate DTC P0615 failed this ignition?	Go to **Step 2**	System OK

DTC P0621

DTC Descriptor

DTC P0621

Generator L-Terminal Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0621

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Generator L-Terminal Circuit	P0621	P0621	P0621

Circuit/System Description

The engine control module (ECM) uses the generator turn on signal circuit to control the load of the generator on the engine. A high side driver in the ECM applies a voltage to the voltage regulator. This signals the voltage regulator to turn ON the field circuit ON and OFF. The ECM monitors the state of the generator turn on signal circuit. The ECM should detect low voltage on generator turn on signal circuit when the ignition is ON and the engine is OFF, or when the charging system malfunctions. With the engine running, the ECM should detect high voltage on the generator turn on signal circuit. The ECM performs key ON and RUN tests to determine the status of the generator turn on signal circuit.

Conditions for Running the DTC

Key ON Test

- No generator, crankshaft position (CKP) sensors, or camshaft position (CMP) sensor DTCs are set.
- The ignition is in RUN position.
- The engine is not running.

Run Test

- No generator, CKP sensors, CMP sensor DTCs are set.
- The engine is running.

Conditions for Setting the DTC

- During the key ON test, the ECM detects high voltage on the generator turn on signal circuit for at least 5 seconds.

  OR

- During the RUN test, the ECM detects low voltage on the generator turn on signal circuit for at least 15 seconds.

Action Taken When the DTC Sets

- The ECM will command the charge indicator and or warning message to be illuminated on the instrument panel cluster (IPC) and the driver information center (DIC), if equipped.
- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store conditions, which were present when the DTC set as Failure Records data only.

Conditions for Clearing the DTC

- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- Using the scan tool Clear DTC Information function can clear the DTC.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Engine Electrical Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List** for ECM
- **Scan Tool Data Definitions** for ECM

Circuit/System Testing

1. With ignition ON, and the engine OFF.
2. Disconnect the generator harness and measure the voltage of the generator turn on signal circuit, should read near 0 volt.
    - If greater than 0 volt, test the generator turn on signal circuit for a short to voltage, or replace the ECM.
3. With ignition ON, and the engine running, the voltage of the generator turn on signal

circuit, should read near 5 volts.

  - If no voltage is measured, test the generator turn on signal circuit for a short to ground, an open or a high resistance or replace the ECM.

4. Go to **Charging System Test**.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for ECM replacement, setup, and programming

DTC P0622

DTC Descriptor

DTC P0622

Generator F-Terminal Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0622

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Generator F-Terminal Circuit	P0622	P0622	P0622	P0622

Circuit/System Description

The engine control module (ECM) uses the generator field duty cycle signal circuit to monitor the duty cycle of the generator. The generator field duty cycle signal circuit connects to high side of the field windings in the generator. A pulse width modulated (PWM) high side driver in the voltage regulator turns the field windings ON and OFF. The ECM uses the PWM signal input to determine the generator load on the engine. This allows the ECM to adjust the idle speed to compensate for high electrical loads. The ECM monitors the status of the generator field duty cycle signal circuit. When the key is in the RUN position and the engine is OFF, the ECM should detect a duty cycle near 0 percent. However, when the engine is running, the duty cycle should be between 5-95 percent.

Conditions for Running the DTC

- The vehicle speed is above 8 km/h (5 mph).
- The system voltage is between 9.5-18 volts.

Conditions for Setting the DTC

- The ECM detects an out of range PWM signal during the KEY ON test.
- The ECM detects a PWM signal greater than 65 percent for at least 5 seconds
- The ECM detects a PWM signal less than 5 percent for at least 15 seconds during the RUN test.

Action Taken When the DTC Sets

- The ECM will command the charge indicator and or warning message to be illuminated on the instrument panel cluster (IPC) and the driver information center (DIC), if equipped.
- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store conditions, which were present when the DTC set as Failure Records data only.

Conditions for Clearing the DTC

- The ECM will command the message OFF after one trip in which the diagnostic test has been run and passed.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- Using the scan tool Clear DTC Information function can clear the DTC.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Engine Electrical Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List** for ECM
- **Scan Tool Data Definitions** for ECM

Circuit/System Verification

With the scan tool installed, ignition ON and the engine running, observe the GEN-F Terminal Signal parameter in the ECM data list. The GEN-F Terminal Signal parameter should read between 5-95 percent.

Circuit/System Testing

1. Ignition OFF, disconnect the generator harness connector.
2. With the ignition ON, and the engine OFF, connect a test lamp to battery positive voltage and repeatedly probe the generator field duty cycle circuit, harness side while monitoring the GEN-F Terminal Signal Parameter in the ECM data list. It should change from 0 percent to above 95 percent.
    - If the GEN-F Terminal Signal parameter was not affected by the test lamp, test the GEN-F Terminal Signal circuit for a short to ground, a high resistance, an open circuit, or replace the ECM.
3. Go to **Charging System Test**.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for ECM replacement, setup, and programming

DTC P1668

DTC Descriptor

DTC P1668

Generator L-Terminal Control Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P1668

	Short to	Open/High	Short to

Circuit	Ground	Resistance	Voltage
Generator L-Terminal Control Circuit	P1668	P1668	P1668

Circuit/System Description

The engine control module (ECM) uses the generator turn on signal circuit to control the load of the generator on the engine. A high side driver in the ECM applies a voltage to the voltage regulator. This signals the voltage regulator to turn ON the field circuit ON and OFF. The ECM monitors the state of the generator turn on signal circuit. The ECM should detect low voltage on generator turn on signal circuit voltage when the ignition is ON and the engine is OFF, or when the charging system malfunctions. With the engine running, the ECM should detect high voltage on the generator turn on signal circuit. The ECM performs key ON and RUN tests to determine the status of the generator turn on signal circuit.

Conditions for Running the DTC

Key ON Test

- No generator, crankshaft position (CKP) sensors, or camshaft position (CMP) sensor DTCs are set.
- The ignition is in RUN position.
- The engine is not running.

RUN Test

- No generator, CKP sensors, CMP sensor DTCs are set.
- The engine is running.

Conditions for Setting the DTC

- During the Key ON test, the ECM detects a high signal voltage on the generator turn on signal circuit for at least 5 seconds.

  OR

- During the RUN test, the ECM detects a low signal voltage on the generator turn on signal circuit for at least 15 seconds.

Action Taken When the DTC Sets

- The ECM will command the charge indicator and or warning message to be illuminated on the instrument panel cluster (IPC) and the driver information center (DIC), if equipped.
- The ECM will not illuminate the malfunction indicator lamp (MIL).

- The ECM will store conditions, which were present when the DTC set as Failure Records data only.

Conditions for Clearing the DTC

- The ECM will command the message OFF after one trip in which the diagnostic test has been run and passed.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- Using the scan tool Clear DTC Information function can clear the DTC.

Reference Information

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Starting and Charging Schematics

Connector End View Reference

Engine Electrical Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List** for ECM
- **Scan Tool Data Definitions** for ECM

Circuit/System Testing

1. With ignition ON, and the engine OFF.
2. Disconnect the generator harness and measure the voltage of the generator turn on signal circuit, should read near 0 volts.
   - If greater than 0 volts, test the generator turn on signal circuit for a short to voltage, or replace the ECM.
3. With ignition ON, and the engine running, the voltage of the generator turn on signal circuit, should read near 5 volts.
   - If no voltage is measured, test the generator turn on signal circuit for a short to ground, an open, or a high resistance, or replace the ECM.

4. Go to **Charging System Test**.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for ECM replacement, setup, and programming

SYMPTOMS - ENGINE ELECTRICAL

IMPORTANT: The following steps must be completed before using the symptom tables.

- Perform **Diagnostic System Check - Vehicle** in Vehicle DTC Information, before using the Symptom Tables in order to verify that all of the following are true:
  - There are no DTCs set.
  - The control modules can communicate via the serial data link.
- Review the system descriptions and operations in order to familiarize yourself with the system functions. Refer to one of the following system operations:
  - **Battery Description and Operation**
  - **Starting System Description and Operation**
  - **Charging System Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the starting and charging systems. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Starter Solenoid Does Not Click**
- **Starter Solenoid Clicks, Engine Does Not Crank**

- **Engine Cranks Slowly**
- **Charge Indicator Always On**
- **Charge Indicator Inoperative**
- **Battery Inspection/Test**
- **Battery Electrical Drain/Parasitic Load Test**
- **Battery Common Causes of Failure**
- **Starter Motor Noise Diagnosis**
- **Charging System Test**
- **Generator Noise Diagnosis**

BATTERY INSPECTION/TEST

Tools Required

J 42000 Battery Tester. See Special Tools.

Diagnostic Aids

IMPORTANT:	- **Failure to properly understand the battery and its function could lead to a misdiagnosis and unneeded repairs. Refer to Battery Description and Operation and Battery Common Causes of Failure for more information.** - **If testing an AGM battery with the J 42000 , add 100 to the CCA rating of the battery and enter that amount into the tester when prompted for the CCA rating. See Special Tools. For instance, if the AGM batteries CCA rating is 500 amps, enter 600 into the J 42000 . See Special Tools. Perform this modification only if the J 42000 does not ask if you are testing an AGM battery. See Special Tools. If these instructions are not followed when testing an AGM battery, an invalid test result and invalid test code will be obtained on the J 42000 . See Special Tools.** - **The battery test using the J 42000 requires correct connections to the battery terminals. See Special Tools. A failure to obtain the correct connections during the test may result in a failed test on a good battery.**

Follow these instructions in order to avoid an incorrect diagnosis because of connections:

- If testing the vehicle with the battery cables still connected, wiggle the **J 42000** clips on the terminal bolt. See **Special Tools**. This may cut through any coating or through any oxidation that may be present on the bolt.

Even new bolts contain a protective coating that may insulate or cause a resistance in the test circuit.

- If correct connections to the battery terminal bolts in the vehicle are in doubt, perform the following steps:
  1. Disconnect the negative battery cable.
  2. Disconnect the positive battery cable.
  3. Install the test adapters on the terminals.
  4. Follow the instructions for an Out-of-Vehicle test.
- If the tester displays a REPLACE BATTERY or BAD CELL-REPLACE result for a battery tested in the vehicle with the battery cables connected, perform the following steps:
  1. Disconnect the negative battery cable.
  2. Disconnect the positive battery cable.
  3. Install the tester adapters.
  4. Follow the instructions for an Out-of-Vehicle test.
  5. Replace the battery only if the Out-of-Vehicle test shows a REPLACE BATTERY or BAD CELL-REPLACE result. This prevents battery replacements that are due only to faulty battery cable connections.
- Use the correct terminal adapters.

  Do not use any common bolts or a combination of bolts, nuts, and or washers as adapters when testing the battery.

  Use the test adapters that are provided with the **J 42000** or P/N 12303040 terminal adapters. See **Special Tools**. If the adapters that are provided with the **J 42000** require replacement, use P/N 12303040. See **Special Tools**. Any other adapter may not contact the correct areas of the battery terminal, causing a resistance that may result in an invalid battery test result.

Battery Inspection/Test

Step	Action	Values	Yes	No
CAUTION: **Refer to Battery Disconnect Caution .** **IMPORTANT:** **Always write the test code displayed by the tester on the repair order for any warranty purposes. The number is a unique code that describes the test data for a particular battery at a particular time. The test code may occasionally repeat when you retest the same battery. More often, each test will result in a different code. If the battery is replaced due to failing the test, only an Out-of-Vehicle test code is valid for warranty purposes.**				
	Inspect the battery for a cracked,			

1	broken, or damaged case, which may be indicated by battery acid leakage. Is the battery OK?	-	Go to **Step 2**	Go to **Step 15**
2	Compare the cold cranking amperage (CCA), and reserve capacity (RC) and/or amp hour (AH) rating of the battery to the original battery or original equipment (OE) specification. Refer to **Battery Usage**. Does the battery meet or exceed the specifications?	-	Go to **Step 3**	Go to **Step 15**
3	1. Turn OFF the ignition. 2. Attempt to rotate the negative battery cable connector clockwise with light finger pressure. Does the negative connector rotate?	-	Go to **Step 4**	Go to **Step 5**
4	Use a torque wrench in order to verify the torque to loosen the negative battery terminal bolt. Is the torque above the specified value?	10 N.m (88 lb in)	Go to **Step 9**	Go to **Step 8**
5	Attempt to rotate the positive battery cable connector clockwise with light finger pressure. Does the positive connector rotate?	-	Go to **Step 7**	Go to **Step 6**
6	**IMPORTANT:** **Ensure that all of the electrical loads are turned OFF.** 1. Install the **J 42000** Battery Tester. See **Special Tools**. 2. Follow the directions supplied with the tester for an In-Vehicle test. 3. Follow any directions displayed on the tester. 4. If the tester calls for charging the battery, refer to **Battery Charging (Non-HP2)**.	-		

	Did the tester pass the battery?		Go to **Step 14**	Go to **Step 8**
7	Use a torque wrench in order to verify the torque to loosen the positive battery terminal bolt. Is the torque above the specified value?	10 N.m (88 lb in)	Go to **Step 10**	Go to **Step 8**
8	1. Disconnect the negative battery cable. 2. Disconnect the positive battery cable. 3. Clean and wire brush the lead face of both battery terminals and the metal contact rings in both cable connectors. 4. Remove the bolts from the cable connectors in order to provide access to the connector rings as needed. 5. If either of the battery terminals or the cable rings are excessively damaged or corroded, replace as needed. Did you complete the repair?	-	Go to **Step 11**	-
9	1. Disconnect the negative battery cable. 2. Inspect for the following conditions and repair as needed: • The cable bolt is too long or deformed at the end. • There is foreign material present inside the nut in the battery terminal. • Damage to the battery terminal face or cable connector ring Did you complete the repair?		Go to **Step 10**	-
	1. Disconnect the positive battery cable.			

10	2. Inspect for the following conditions and repair as needed: - The cable bolt is too long or deformed at the end. - There is foreign material present inside the nut in the battery terminal. - Damage to the battery terminal face or cable connector ring Did you complete the repair?	-	Go to **Step 11**	-	
11	**IMPORTANT:** **Ensure that both battery cables are disconnected and proper adapters are installed in the battery terminals.** 1. Install the **J 42000** . See **Special Tools**. 2. Follow the directions supplied with the tester for an Out-of-Vehicle test. 3. Follow any directions displayed on the tester. 4. If the tester calls for charging the battery, refer to **Battery Charging (Non-HP2)**. Did the tester pass the battery?	-	Go to **Step 12**	Go to **Step 15**	
12	1. Press the CODE button on the **J 42000** . See **Special Tools**. 2. For warranty purposes, write the displayed code on the repair order. Did you complete this action?		Go to **Step 13**		-
	1. Connect the positive battery cable to the batteries positive terminal. **NOTE:** **Refer to Fastener**				

13	**Notice** . 2. Tighten the positive battery cable bolt to the specified value. 3. Connect the negative battery cable to the battery negative terminal. 4. Tighten the negative battery cable bolt to the specified value. Are the cable bolts properly tightened?	17 N.m (13 lb ft)	Battery OK	-	
14	1. Press the CODE button on the **J 42000** . See **Special Tools**. 2. For warranty purposes, write the displayed code on the repair order. Did you complete the replacement?		Battery OK		-
15	Replace the battery. Refer to **Battery Replacement (RPOs LZE/LZ4/LZ9)** or **Battery Replacement (RPO LS4)**. Did you complete the replacement?	-	Battery OK	-	

BATTERY CHARGING (NON-HP2)

Tools Required

J 42000 Battery Tester. See **Special Tools**.

- For best results, use an automatic taper-rate battery charger with a voltage capability of 16 volts.
- The charging area should be well ventilated.
- Do not charge a battery that appears to be frozen; allow the battery to warm to room temperature and test it using the **J 42000** before charging. See **Special Tools**.

Charging Time Required

The time required to charge a battery will vary depending upon the following factors:

- The battery charger capacity-The higher the charger's amperage, the less time it will take to charge the battery.

- The state-of-charge of the battery-A completely discharged battery requires more than twice as much charging time as a half charged battery. In a discharged battery with a voltage below 11 volts, the battery has a very high internal resistance and may only accept a very low current at first. Later, as the charging current causes the acid content to increase in the electrolyte, the charging current will increase. Extremely discharged batteries may not activate the reversed voltage protection in some chargers. Refer to the manufacturers instructions for operating this circuitry.
- The temperature of the battery-The colder the battery is, the more time it takes to recharge the battery. The charging current accepted by a cold battery is very low at first. As the battery warms, the charging current will increase.

Charging Procedure

NOTE: Turn OFF the ignition when connecting or disconnecting the battery cables, the battery charger or the jumper cables. Failure to do so may damage the PCM or other electronic components.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

When charging side-terminal batteries with the battery cables connected, connect the charger to the positive cable bolt and to a ground located away from the battery. When charging side-terminal batteries with the battery cables disconnected, install the battery side terminal adapters and connect the charger to the adapters.

Tighten: Tighten the battery side terminal adapters to 15 N.m (11 lb ft).

Use the following procedure to charge the battery:

1. Turn OFF the charger.
2. Ensure that all of the battery terminal connections are clean and tight.
3. Connect the charger positive lead to the battery positive terminal on the Battery or Fuse Block - Underhood.

   NOTE: Do not connect the negative charger lead to the housings of other vehicle electrical accessories or equipment. The action of the battery charger may damage such equipment.

4. Connect the negative charger lead to a solid engine ground or to a ground stud in the engine compartment that is connected directly to the battery negative terminal, but away from the battery. If the negative battery cable is disconnected and a terminal adapter is being used, connect directly to the adapter.

5. Turn ON the charger and set to the highest setting for normal charging.
6. Inspect the battery every half hour after starting the battery charger.
    - Charge the battery until the taper-rate charger indicates that the battery is fully charged.
    - Estimate the battery temperature by feeling the side of the battery. If it feels hot to the touch or its temperature is over 45°C (125°F), discontinue charging and allow the battery to cool before resuming charging.
7. After charging, test the battery. Refer to **Battery Inspection/Test**.

BATTERY ELECTRICAL DRAIN/PARASITIC LOAD TEST

Tools Required

J 38758 Parasitic Draw Test Switch. See **Special Tools**.

Diagnostic Aids

- Be sure to rule out any possible obvious influences, such as customer error or aftermarket equipment.
- Customer driving habits, such as regular short trips. This does not allow enough time to properly charge the battery. Refer to **Battery Description and Operation**.
- Verify that the battery and charging system are in proper working order. Refer to **Battery Charging (Non-HP2)** and **Charging System Test**.
- A battery discharging for no apparent reason while the vehicle is parked can be caused by an intermittent draw, such as a module waking up, or a continuous draw, such as a dome light or stuck relay.
- Some systems and modules such as OnStar®, and regulated voltage control (RVC), if equipped, are designed to wake-up, perform a task, and go back asleep at regular intervals. Refer to **Body Control System Description and Operation** in Computer/Integrating Systems for the system or modules description and operation.
- Remote keyless entry (RKE) will wake up due to an outside input. Refer to **Keyless Entry System Description and Operation** in Keyless Entry.
- The graph below indicates roughly how many days a 690 CCA battery with at 110 min. RC (60.5 AH) starting at 80 percent state of charge will last with a constant current draw until it reaches 50 percent state of charge. Differences in battery temperature and ratings will affect the results:

Battery Electrical Drain/Parasitic Load Test

Current Drain	Days
25 mA	30.5
50 mA	16.5
75 mA	11

100 mA	8.25
250 mA	3.3
500 mA	1.65
750 mA	1
1 A	0.8
2 A	0.4

NOTE: Do not turn the parasitic draw test switch to the OFF position with the engine running. Damage will occur to the vehicle's electrical system.

NOTE: The test switch must be in the ON position when removing the fuses in order to maintain continuity in the electrical system. This avoids damaging the digital multimeter due to accidental overloading, such as a door being opened to change a fuse.

IMPORTANT: The switch knob (1) on the J 38758 is marked ON and OFF. See Special Tools. When the switch knob is in the ON position, the circuit is closed and electrical current will pass through the switch. When the switch knob is in the OFF position, the circuit is open and electrical current will not pass through the switch.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the battery negative cable from the battery negative terminal.
2. Install the male end of the **J 38758** to the battery ground terminal. See **Special Tools**.
3. Turn the **J 38758** knob to the OFF position. See **Special Tools**.
4. Install the battery negative cable to the female end of the **J 38758** . See **Special Tools**.
5. Turn the **J 38758** knob to the ON position. See **Special Tools**.
6. Road test the vehicle and activate ALL of the accessories, including the radio and air conditioning. This may take up to 30 minutes.
7. Park the vehicle. Turn the ignition switch to the OFF position and remove the ignition switch key.
8. Connect a 10A fused jumper wire to the test switch tool terminals.
9. Turn the **J 38758** knob to the OFF position. See **Special Tools**. The current now flows through the jumper wire.
10. Wait 1 minute. If the fuse blows, install an inductive ammeter and go to step 20.
11. Remove the fused jumper wire.
12. Set a digital multimeter to the 10A scale.

13. Connect the digital multimeter to the test switch tool terminals.
14. Turn the **J 38758** knob to the OFF position. See **Special Tools**. The current flows now through the digital multimeter.
15. Wait 1 minute. Check and record the current reading.
    1. When there is a current reading on 2A or less, turn the **J 38758** knob to the ON position. See **Special Tools**. The electrical current will now pass through the switch.
    2. Then switch the digital multimeter down to the 2A scale for a more accurate reading when the **J 38758** knob is turned OFF. See **Special Tools**.
16. Turn the **J 38758** knob to the OFF position. See **Special Tools**. Wait 15 minutes for most vehicles.
17. Check and record the current reading.
18. Note the battery Reserve Capacity (Amp Hour rating). Refer to **Battery Usage**.
    1. Divide the reserve capacity by 4 (Amp hour rating by 2.4).
    2. Compare this to the multimeter milliampere reading taken in the previous step. The parasitic current drain should not exceed this number. Example: If a battery has a reserve capacity of 100 minutes, (60 A/H) the current drain should not exceed 25 mA.
19. If excessive current drain is not found at this time and there are no other apparent causes, complete the following:
    1. Using the MIN/MAX function of the digital multimeter, monitor the parasitic drain overnight or during the day. This will determine if something has been activated during that time frame.

       NOTE: The test switch must be in the ON position when removing the fuses in order to maintain continuity in the electrical system. This avoids damaging the digital multimeter due to accidental overloading, such as a door being opened to change a fuse.

       IMPORTANT: Removing fuses, relays, and connectors to determine the failure area may wake up modules. You must wait for these modules to go to sleep or use the sleep function on the scan tool.

    2. When the vehicle has an unacceptable amount of parasitic current drain, remove each fuse one at a time until the current drain falls to an acceptable level. This will indicate which circuit is causing the drain. Refer to **Power Distribution Schematics** in Wiring Systems to diagnose exactly which part of the suspect circuit is causing the parasitic drain. In some cases a non-fused circuit or component, such as a relay, is the cause of excessive parasitic current drain.

    3. Repeat the parasitic current drain test procedure after any repair has been completed to make sure that the parasitic current drain is at an acceptable level.
    4. When the cause of the excessive current drain has been located and repaired, remove the **J 38758** . See **Special Tools**.
20. Connect the battery negative cable to the battery negative terminal.

BATTERY COMMON CAUSES OF FAILURE

A battery is not designed to last forever. With proper care, however, the battery will provide years of good service. If the battery tests good but still fails to perform well, the following are some of the more common causes:

- A vehicle accessory was left on overnight.
- The driving speeds have been slow with frequent stops, stop-and-go driving, with many electrical accessories in use, particularly air conditioning, headlights, wipers, heated rear window, cellular telephone, etc.
- The electrical load has exceeded the generator output, particularly with the addition of aftermarket equipment.
- Existing conditions in the charging system, including the following possibilities:
    - A slipping belt
    - A bad generator
- The battery has not been properly maintained, including a loose battery hold down or missing battery insulator if used.
- There are mechanical conditions in the electrical system, such as a short or a pinched wire, attributing to power failure. Refer to **General Electrical Diagnosis Procedures** in Wiring Systems.

Electrolyte Freezing

The freezing point of electrolyte depends on its specific gravity. A fully charged battery will not freeze until the ambient temperature gets below -54°C (-65°F). However, a battery with a low state of charge may freeze at temperatures as high as -7°C (20°F). Since freezing may ruin a battery, the battery should be protected against freezing by keeping it properly charged. As long as the green eye is visible in the hydrometer, the freezing point of the battery will be somewhere below -32°C (-25°F).

Battery Protection During Vehicle Storage

Certain devices on the vehicle maintain a small continuous current drain, parasitic load, on the battery. A battery that is not used for an extended period of time will discharge. Eventually permanent damage will result. Discharged batteries will also freeze in cold weather. Refer to **Battery Inspection/Test**.

In order to maintain the battery state of charge while storing the vehicle for more than 30 days:

1. Ensure that the green dot is visible in the built-in hydrometer.

CAUTION: Refer to BATTERY DISCONNECT CAUTION in Cautions and Notices.

2. Disconnect the battery ground cable to protect the battery from discharge by parasitic current drains.

When the battery cannot be disconnected:

1. Maintain a high state of charge.
2. Establish a regular schedule for recharging the battery every 20-45 days.

A battery that has remained in a discharged state for a long period of time is difficult to recharge or may be permanently damaged.

JUMP STARTING IN CASE OF EMERGENCY

CAUTION: Batteries produce explosive gases. Batteries contain corrosive acid. Batteries supply levels of electrical current high enough to cause burns. Therefore, in order to reduce the risk of personal injury while working near a battery, observe the following guidelines:

- **Always shield your eyes.**
- **Avoid leaning over the battery whenever possible.**
- **Do not expose the battery to open flames or sparks.**
- **Do not allow battery acid to contact the eyes or the skin.**
  - **Flush any contacted areas with water immediately and thoroughly.**
  - **Get medical help.**

NOTE: This vehicle has a 12 volt, negative ground electrical system. Make sure the vehicle or equipment being used to jump start the engine is also 12 volt, negative ground. Use of any other type of system will damage the vehicle's electrical components.

1. Position the vehicle with the booster battery so that the jumper cables will reach.

  - Do not let the 2 vehicles touch.
  - Make sure that the jumper cables do not have loose ends, or missing insulation.

2. Place an automatic transmission in PARK. If equipped with a manual transmission, place in NEUTRAL and block the wheels.
3. Turn OFF all electrical loads on both vehicles that are not needed.
4. Turn OFF the ignition on both vehicles.

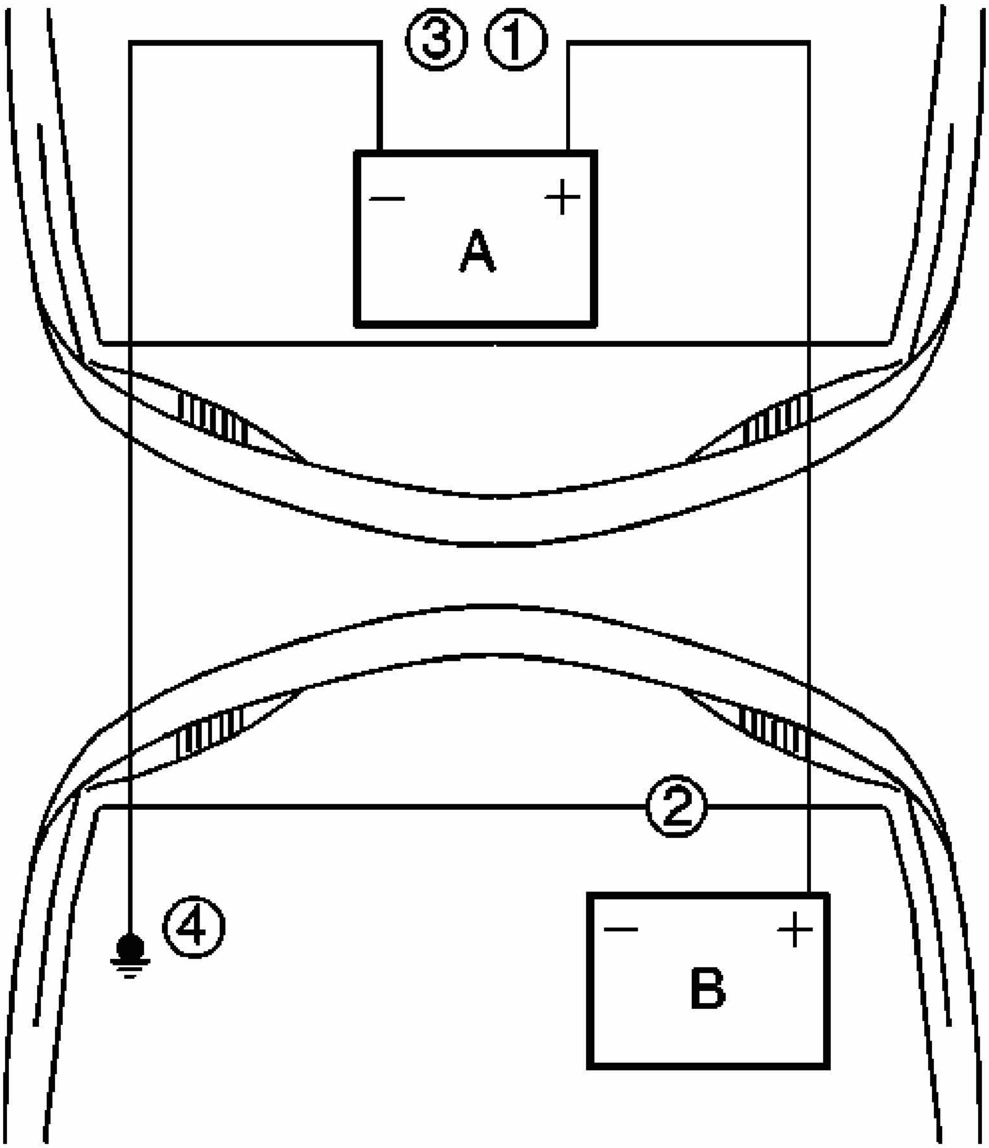


Fig. 11: Identifying Proper Jumper Cable Connection

Courtesy of GENERAL MOTORS CORP.

5. Connect the red positive (+) cable to the battery positive (+) terminal (2) of the vehicle with the discharged battery.

   Use a remote positive (+) terminal if the vehicle has one.

6. Connect the red positive (+) cable to the positive (+) terminal (1) of the booster battery.

   Use a remote positive (+) terminal if the vehicle has one.

7. Connect the black negative (-) cable to the negative (-) terminal (3) of the booster battery.

   CAUTION: Do not connect a jumper cable directly to the negative terminal of a discharged battery to prevent sparking and possible explosion of battery gases.

8. The final connection is made to a heavy, unpainted metal engine part (4) of the vehicle with the discharged battery.

   This final attachment must be at least 46 cm (18 in) away from the dead battery.

9. Start the engine of the vehicle that is providing the boost.

   NOTE: Never operate the starter motor more than 15 seconds at a time without pausing in order to allow it to cool for at least 2 minutes. Overheating will damage the starter motor.

10. Crank the engine of the vehicle with the discharged battery.
11. The black negative (-) cable must be first disconnected from the vehicle that was boosted (4).
12. Disconnect the black negative (-) cable from the negative (-) terminal (3) of the booster battery.

    NOTE: Do not let the cable end touch any metal. Damage to the battery and other components may result.

13. Disconnect the red positive (+) cable from the positive (+) terminal (1) of the booster battery.
14. Disconnect the red positive (+) cable from the remote positive (+) terminal (2) of the vehicle with the discharged battery.

CHARGING SYSTEM TEST

Charging System Test

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	**IMPORTANT:** **The battery must be above a 70 percent state of charge. Refer to Battery Charging (Non-HP2).** Did you perform the Battery/Inspection Test?	-	Go to **Step 3**	Go to **Battery Inspection/Test**
3	1. Install a scan tool. 2. Start the engine. 3. With a scan tool, command the GEN-L Terminal OFF and ON. 4. Observe the Ignition 1 Signal parameter. Does the voltage change with each command?	-	Go to **Step 4**	Go to **Step 8**
4	1. Turn ON the following accessories: • Headlights (high beams) • A/C on Max • Blower fan (on high) • Heated seats (if equipped) 2. With a scan tool, observe the Ignition 1 Signal parameter in the engine data list. 3. Increase engine speed to 2,500 RPM. Is the voltage within the specified value?	12.0-15.5 V	Go to **Step 5**	Go to **Step 6**
	1. Turn OFF all accessories. 2. Turn OFF the ignition.			

5	**CAUTION:** **Make sure that the load is completely turned off before connecting or disconnecting a carbon pile load tester to the battery. Otherwise, sparking could ignite battery gasses which are extremely flammable and may explode violently.** 3. Connect a carbon pile tester to the vehicle. **IMPORTANT:** **When measuring generator output current, be sure the inductive probe encircles the generator output wire.** 4. Connect an inductive ammeter probe to the output circuit of the generator. 5. Start the engine. 6. With a scan tool, command the GEN-L Terminal ON. 7. Increase engine speed to 2,500 RPM. 8. Adjust the carbon pile as necessary in order to obtain the maximum current output. Is the generator output greater than or equal to the load test value as specified in **Generator Usage** ?	-	Generator OK	Go to **Step 7**
6	Is the voltage measured greater than 15.5 volts?	-	Go to **Step 12**	Go to **Step 7**
7	1. Leave the vehicle accessories ON or maintain load test value. 2. Maintain engine speed at 2,500 RPM. 3. Measure the voltage of the battery. 4. Measure the voltage between the generator output terminal	-		

	and the generator metal housing. Is the voltage measured of the generator within 0.2 volts of the battery voltage?		Go to **Step 14**	Go to **Step 9**
8	1. Turn the engine OFF. disconnect the generator harness connector 2. Start the engine. 3. Measure the voltage between the generator turn on signal circuit and ground. 4. With a scan tool, command the GEN-L Terminal ON and OFF. Does the voltage measure greater than the first value ON and near the second value OFF?	4.7 V 0 V	Go to **Step 14**	Go to **Step 11**
9	1. Maintain the engine speed at 2,500 RPM and continue to operate the generator at the load test value. 2. Measure the voltage drop from the battery negative terminal to the metal housing of the generator. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Is the voltage measured less than the specified value?	0.5 V	Go to **Step 10**	Go to **Step 15**
10	1. Maintain the engine speed at 2,500 RPM and continue to operate the generator at the load test value. 2. Measure the voltage drop from the output terminal of the generator to the positive terminal on the battery. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	0.2 V		

	Is the voltage measured less than the specified value?		Go to **Step 14**	Go to **Step 16**
11	Test the generator turn on signal circuit for a short or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 13**
12	Test the generator battery voltage sense circuit, if equipped, for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 14**
13	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 17**
14	Inspect for poor connections at the generator. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 18**
15	Repair the high resistance or open in the ground circuit of the generator. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 19**	-
16	Repair the high resistance or open in the generator output circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 19**	-
	Replace the ECM. Refer to **Control Module References** in			

17	Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 19**	-
18	Replace the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)**. Did you complete the replacement?	-	Go to **Step 19**	-
19	Operate the vehicle in order to verify the repair. Did you correct the condition?	-	Generator OK	Go to **Step 2**

CHARGE INDICATOR ALWAYS ON

Charge Indicator Always On

Step	Action	Values	Yes	No
Schematic Reference: Starting and Charging Schematics **Connector End View Reference: Engine Electrical Connector End Views**				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Start the engine. 2. Turn OFF all accessories. Does the battery charge indicator remain illuminated?	-	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections**
3	1. Install a scan tool. 2. Start the engine. 3. Turn OFF all accessories. 4. Increase engine speed to 1,500 RPM. 5. With a scan tool, observe the Battery Voltage parameter in the body control module (BCM) data list, engine control module (ECM) and the instrument panel cluster (IPC) data list.	0.9-1.1 V		

	6. Compare the voltages. Are all of the voltages within the specified range?		Go to **Step 4**	Go to **Step 5**
4	Are the voltages displayed within the specified range?	11-16 V	Go to **Step 5**	Go to **Charging System Test**
5	Test the battery positive voltage and ground circuits of the affected module for a high resistance or open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 6**
6	Inspect for poor connections at the harness connector of the affected module. Refer to **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 7**
7	Replace the affected module. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 8**	-
8	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 2**

CHARGE INDICATOR INOPERATIVE

Charge Indicator Inoperative

Step	Action	Yes	No
Schematic Reference: Starting and Charging Schematics			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Disconnect the generator harness connector. 2. Start the engine. Does the charge indicator illuminate?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**

3	Test the generator L-terminal signal circuit a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 6**	Go to **Step 4**
4	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 6**	Go to **Step 5**
5	**IMPORTANT:** **Perform the set up procedures for the ECM.** Replace the ECM. Refer to **Control Module References** for replacement, setup, and programming.Did you complete the replacement?	Go to **Step 6**	-
6	Operate the system for which the symptom occurred. Did you correct the condition?	System OK	Go to **Step 2**

GENERATOR NOISE DIAGNOSIS

Diagnostic Aids

Noise from a generator may be due to electrical or mechanical noise. Electrical noise or magnetic whine usually varies with the electrical load placed on the generator and is a normal operating characteristic of all generators. When diagnosing a noisy generator, it is important to remember that loose or misaligned components around the generator may transmit the noise into the passenger compartment and that replacing the generator may not solve the problem.

Generator Noise Diagnosis

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Test the generator for proper operation using the Generator Tester. Refer to **Charging System Test**. Is the generator operating properly?	Go to **Step 3**	Go to **Step 12**

3	1. Start the engine. Verify that the noise can be heard. 2. Turn OFF the engine. 3. Disconnect the harness connector from the generator. 4. Start the engine. 5. Listen for the noise. Has the noise stopped?	Go to **Step 12**	Go to **Step 4**
4	1. Turn OFF the engine. 2. Remove the drive belt. Refer to **Drive Belt Replacement** for the 3.5L (LZE) engine, **Drive Belt Replacement** for the 3.9L (LZ9) engine, or **Drive Belt Replacement - Accessory** for the 5.3L (LS4) engine. 3. Spin the generator pulley by hand. Does the generator shaft spin smoothly and without any roughness or grinding noise?	Go to **Step 5**	Go to **Step 12**
5	Inspect the generator for a loose pulley and/or pulley nut. Is the generator pulley or pulley nut loose?	Go to **Step 12**	Go to **Step 6**
6	1. Loosen all of the generator mounting bolts. 2. Tighten the generator mounting bolts to specifications and in the proper sequence, if necessary. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)**. 3. Install the drive belt. Refer to **Drive Belt Replacement** for the 3.5L (LZE) engine, **Drive Belt Replacement** for the 3.9L (LZ9) engine, or **Drive Belt Replacement - Accessory** for the 5.3L (LS4) engine. 4. Start the engine. Has the noise decreased or stopped?	System OK	Go to **Step 7**
	Inspect the generator for the following		

7	conditions: - Strained or stretched electrical connections - Hoses or other vehicle equipment resting on the generator, which may cause the noise to be transmitted into the passenger compartment Are any electrical connections pulling on the generator or are any hoses, etc. resting on the generator?	Go to **Step 8**	Go to **Step 9**
8	1. Reroute the electrical connections to relieve the tension. 2. Reroute the hoses, etc. away from the generator. 3. Start the engine. Has the noise decreased or stopped?	System OK	Go to **Step 9**
9	Inspect the drive belt for proper tension. Refer to **Drive Belt Tensioner Diagnosis** for the 3.5L (LZE) engine, **Drive Belt Tensioner Diagnosis** for the 3.9L (LZ9) engine, or**Drive Belt Tensioner Diagnosis** for the 5.3L (LS4) engine. Is the drive belt loose?	Go to **Step 10**	Go to **Step 11**
10	1. Replace the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** for the 3.5L (LZE) engine, **Drive Belt Tensioner Replacement** for the 3.9L (LZ9) engine, or **Drive Belt Tensioner Replacement - Accessory** for the 5.3L (LS4) engine. 2. Start the engine. Has the noise decreased or stopped?	System OK	Go to **Step 12**
11	Compare the vehicle with a known good vehicle. Do both vehicles make the same noise?	System OK	Go to **Step 12**
	IMPORTANT: **If no definite generator problems were found, be**		

12	**sure that all other possible sources of objectionable noise are eliminated before replacing the generator. Replacing the generator may not change the noise level if the noise is a normal characteristic of the generator or the generator mounting.** Replace the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)**.Did you complete the replacement?	Go to **Step 13**	-
13	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

STARTER SOLENOID DOES NOT CLICK

Starter Solenoid Does Not Click

Step	Action	Yes	No
Schematic Reference: Starting and Charging Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Turn the ignition switch to the start position. Does the engine crank?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the Starter Relay Command parameter in the engine control module (ECM) data list. 4. Turn the ignition switch to the start position. Does the scan tool display ON?	Go to **Step 5**	Go to **Step 4**
	1. Turn ON the ignition, with the engine OFF.		

4	2. Verify that the transmission is in Park or Neutral. 3. With a scan tool, observe the IMS parameter in the transmission control module (TCM) data list. Does the scan tool display Park or Neutral?	Go to **Step 6**	Go to **Range Selector Displays Incorrect Range**
5	Turn the ignition switch to the start position. Did the crank relay click?	Go to **Step 8**	Go to **Step 6**
6	1. Turn OFF the ignition. 2. Remove the crank relay. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the control circuit of the crank relay coil and a good ground. 5. Turn the ignition switch to the start position. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 15**
7	1. Connect a test lamp between the control circuit of the crank relay coil and the ground circuit of the crank relay. 2. Turn the ignition switch to the start position. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 12**
8	1. Turn ON the ignition. 2. Connect a test lamp between the battery positive voltage circuit of the crank relay switch circuit and a good ground. 3. Turn the ignition switch to the start position. Does the test lamp illuminate?	Go to **Step 9**	Go to **Step 17**
	IMPORTANT: **Ensure the parking brake is applied and the transmission is in park equipped with an**		

	automatic transmission or neutral on a manual transmission.		
9	Connect a 30-amp fused jumper between the battery positive voltage circuit of the crank relay switch circuit and the supply voltage circuit of the starter solenoid.Does the engine crank?	Go to **Step 13**	Go to **Step 10**
10	Does the fuse in the jumper open?	Go to **Step 18**	Go to **Step 11**
11	Test the supply voltage circuit of the starter solenoid for a high resistance or open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 22**	Go to **Step 14**
12	Repair the ground circuit of the crank relay. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 22**	-
13	Inspect for poor connections at the crank relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 22**	Go to **Step 19**
14	Inspect for poor connections at the starter solenoid. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 22**	Go to **Step 20**
15	Repair an open or high resistance in the control circuit of the crank relay coil. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 22**	Go to **Step 16**
16	Inspect for poor connections at the harness connector of the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 22**	**Step 21**
17	Repair the open or high resistance in the battery positive voltage circuit of the crank relay switch. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 22**	-
18	Repair the short to ground in the supply voltage circuit of the starter solenoid. Refer to **Wiring Repairs** .		

	Did you complete the repair?	Go to **Step 22**	-
19	Replace the crank relay. Did you complete the replacement?	Go to **Step 22**	-
20	Replace the starter motor. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)**. Did you complete the replacement?	Go to **Step 22**	-
21	Replace the ECM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 22**	-
22	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

STARTER SOLENOID CLICKS, ENGINE DOES NOT CRANK

Starter Solenoid Clicks, Engine Does Not Crank

Step	Action	Yes	No
Schematic Reference: Starting and Charging Schematics			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Turn the ignition to the START position. Did the starter solenoid click?	Go to **Step 3**	Go to **Starter Solenoid Does Not Click**
3	Inspect the engine and belt drive system for mechanical binding, seized engine, or seized generator. Does the engine move freely?		Go to **Engine Will Not Crank - Crankshaft Will Not Rotate** for the 3.5L (LZE) engine, **Engine Will Not Crank - Crankshaft Will Not Rotate** for the 3.9L (LZ9) engine, or **Engine Will Not Crank - Crankshaft Will Not Rotate** for

		Go to **Step 4**	the 5.3L (LS4) engine
4	Test the battery positive cable between the battery and the starter solenoid for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 8**	Go to **Step 5**
5	Test the ground circuit between the battery and the starter motor for a high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 8**	Go to **Step 6**
6	Inspect for poor connections at the starter. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 8**	Go to **Step 7**
7	Replace the starter. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)**. Did you complete the replacement?	Go to **Step 8**	-
8	Operate the system for which the symptom occurred. Did you correct the condition?	System OK	Go to **Step 2**

ENGINE CRANKS SLOWLY

Inspect the following items:

- Battery - Perform the Battery Inspection/Test. Refer to **Battery Inspection/Test**.
- Wiring - Inspect the wiring for damage. Inspect all connections to the starter motor, the solenoid, the battery, and all ground connections. Refer to **Circuit Testing** , **Wiring Repairs** , **Testing for Intermittent Conditions and Poor Connections** , and **Connector Repairs** in Wiring Systems.
- Engine - Verify that the engine is not seized.

If the battery, the wiring, and the engine are functioning properly, and the engine continues to crank slowly, replace the starter motor. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)**.

STARTER MOTOR NOISE DIAGNOSIS

Diagnostic Aids

- Inspect the flywheel ring gear for damage or unusual wear.
- Shim the starter as required.
- In order to add pinion to ring gear clearance a full size shim must be used. Do not shim only one starter mounting bolt. There are 3 shims available in different shapes, for clearance, all are 1 mm (0.039 in) thick.

Starter Motor Noise Diagnosis

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Start the engine. Does the starter operate normally?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Start the engine while listening to the starter motor turn. Is there a loud whoop, it may sound like a siren if the engine is revved while the starter is engaged after the engine starts, but while the starter is still held in the engaged position?	Go to **Step 6**	Go to **Step 4**
4	Do you hear a rumble, a growl, or, in some cases, a knock as the starter is coasting down to a stop after starting the engine?	Go to **Step 7**	Go to **Step 5**
5	**IMPORTANT:** **This is often diagnosed as a starter drive gear hang-in or a weak solenoid.** When the engine is cranked, do you hear a high-pitched whine after the engine cranks and starts normally?	Go to **Step 8**	Go to **Step 7**
6	Inspect the flywheel ring gear for the following conditions: • Chipped gear teeth • Missing gear teeth • Milled teeth		

	Is the flywheel bent, or does it have damaged teeth?	Go to **Step 9**	Go to **Step 10**
7	1. Remove the starter motor. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)**. 2. Inspect the starter motor bushings and clutch gear. Does the clutch gear have chipped or milled teeth or worn bushings?	Go to **Step 10**	Go to **Step 9**
8	Shim the starter motor away from the flywheel by adding shims between the starter motor and the engine block one at a time. Flywheel runout may make this noise appear to be intermittent. Did you complete the repair?	Go to **Step 11**	-
9	Replace the flywheel. Refer to **Engine Flywheel Replacement** for the 3.5L (LZE) engine, **Engine Flywheel Replacement** for the 3.9L (LZ9) engine, or **Engine Flywheel Replacement** for the 5.3L (LS4) engine. Did you complete the replacement?	Go to **Step 11**	-
10	Replace the starter motor. Refer to **Starter Motor Replacement (RPOs LZE/LZ4/LZ9)** or **Starter Motor Replacement (RPO LS4)**. Did you complete the replacement?	Go to **Step 11**	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

REPAIR INSTRUCTIONS

BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE (RPOS LZE/LZ4/LZ9)

Removal Procedure

CAUTION: Refer to SIR Caution .

CAUTION: Refer to Battery Disconnect

Caution .

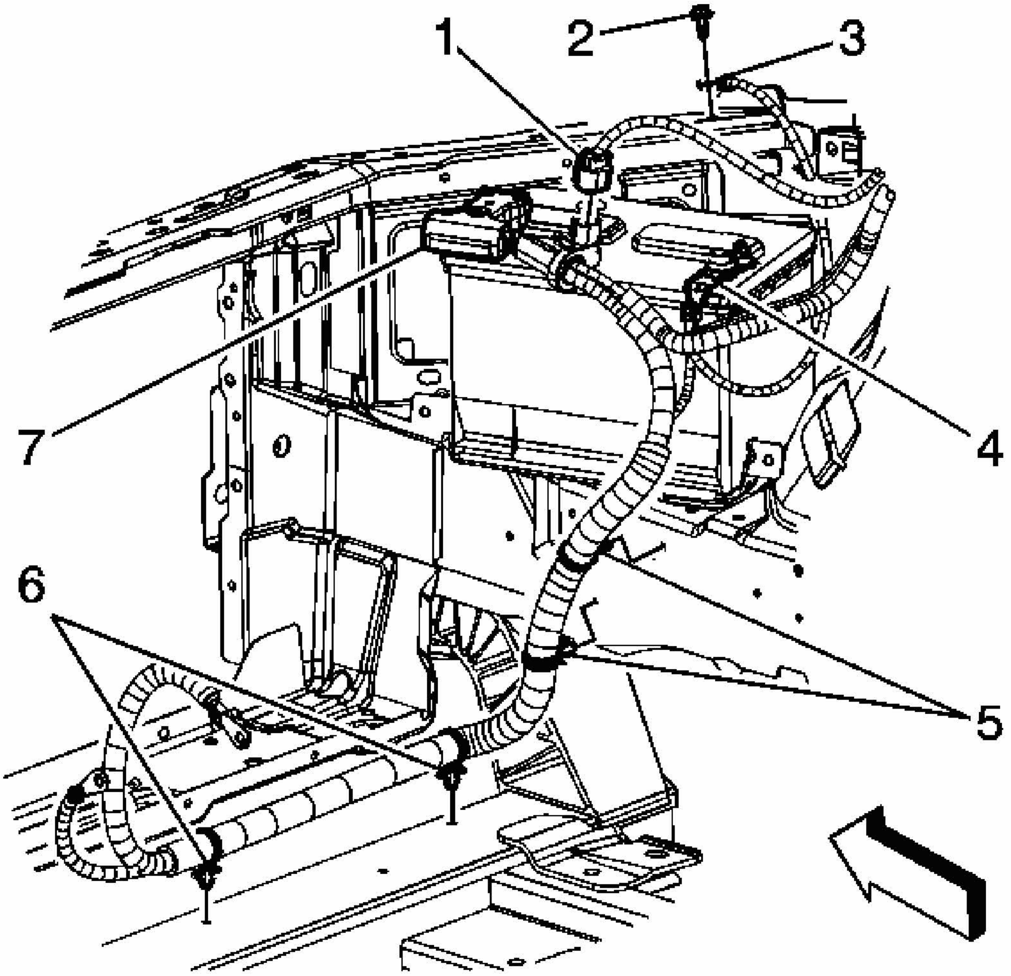


Fig. 12: View Of Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

1. Record all of the vehicle's preset radio stations.
2. Turn OFF all lamps and accessories.
3. Turn the ignition switch to the OFF position.
4. Loosen the negative battery cable terminal nut.
5. Remove the negative battery cable terminal (4) from the battery.

Installation Procedure

IMPORTANT: Clean any existing oxidation from the contact face of the battery terminal and battery cable using a wire brush before installing the battery cable to the battery terminal.

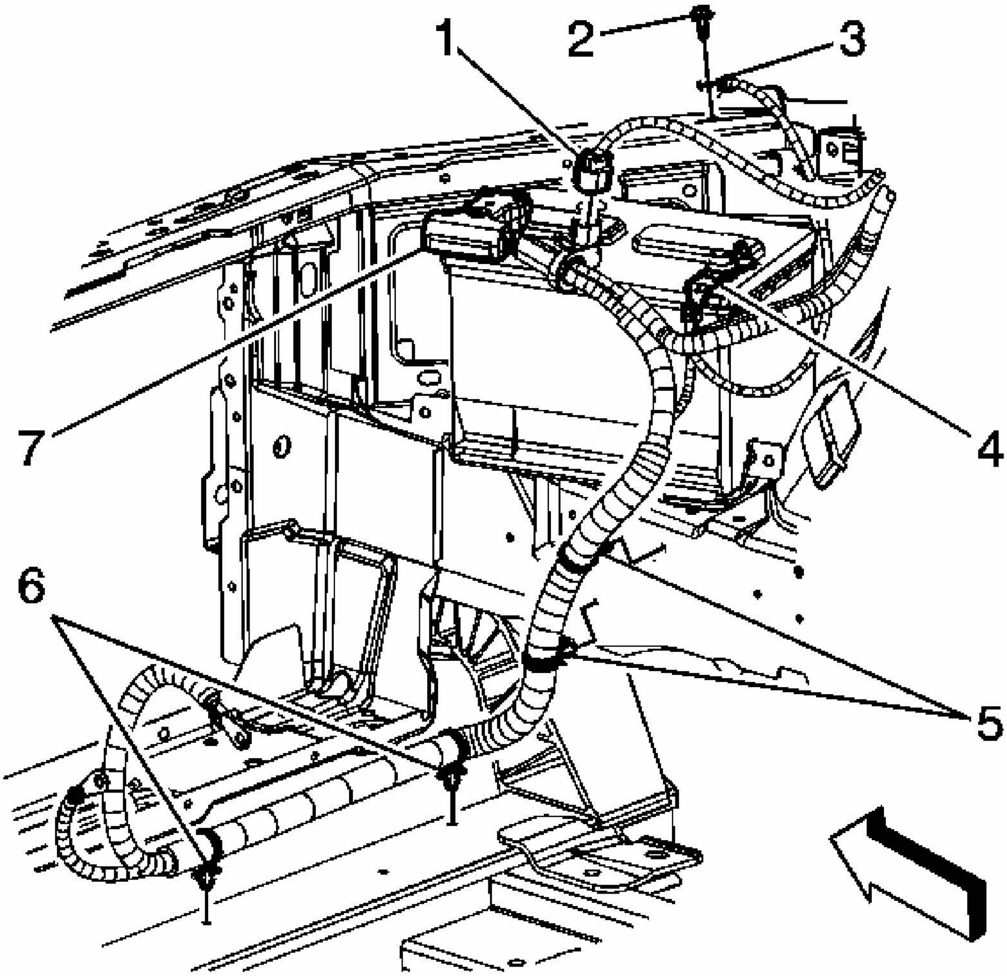


Fig. 13: View Of Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

1. Install the negative battery cable terminal (4) to the battery.

   NOTE: Refer to Fastener Notice .

2. Tighten the negative battery cable terminal nut.

Tighten: Tighten the nut to 15 N.m (11 lb ft).

3. Set the clock and program the radio stations back into the radio as recorded at the beginning of the procedure. Refer to **Radio/Audio System Description and Operation** .

BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE (RPO LS4)

Removal Procedure

CAUTION: Refer to SIR Caution .

CAUTION: Refer to Battery Disconnect Caution .

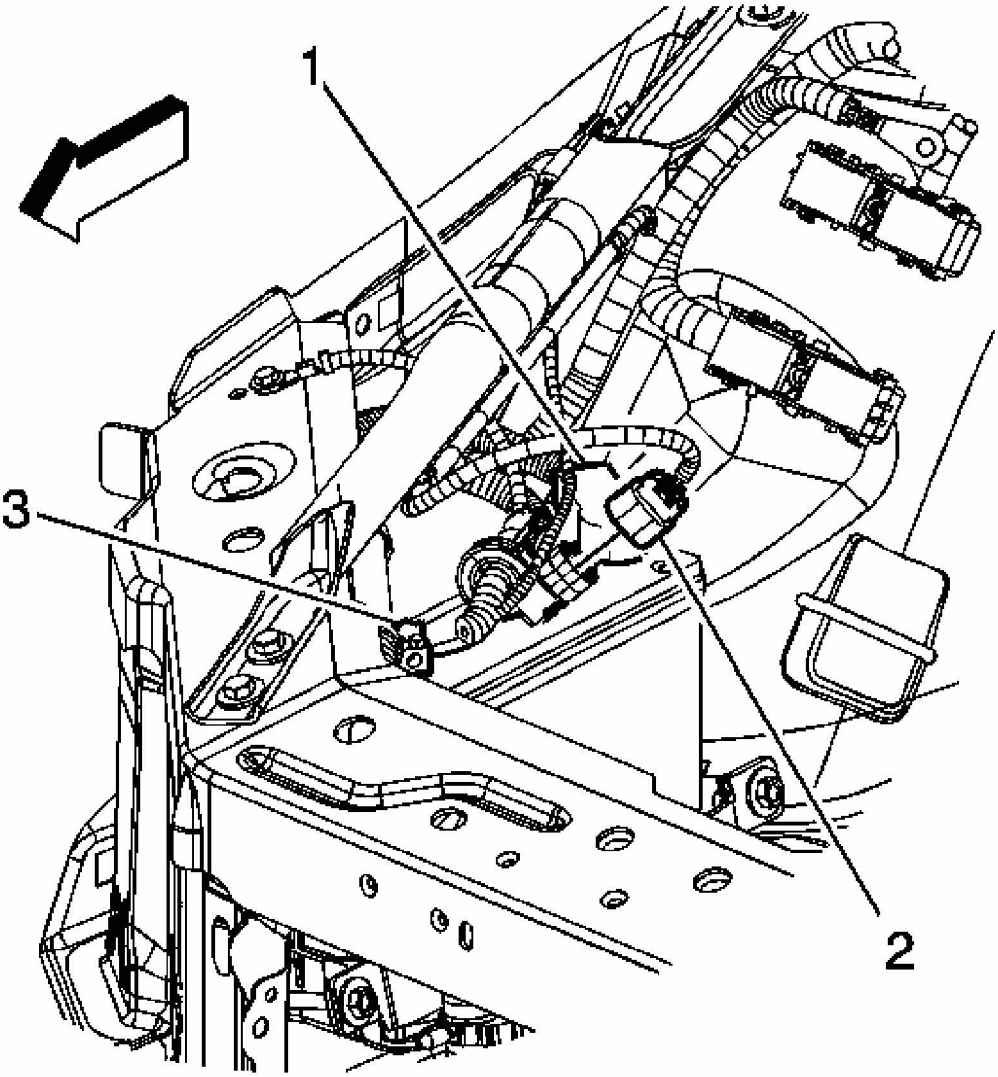


Fig. 14: Identifying Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

1. Record all of the vehicle's preset radio stations.
2. Turn OFF all lamps and accessories.
3. Turn the ignition switch to the OFF position.
4. Loosen the negative battery cable terminal nut.
5. Remove the negative battery cable terminal (3) from the battery.

Installation Procedure

IMPORTANT: Clean any existing oxidation from the contact face of the battery terminal and battery cable using a wire brush before installing the battery cable to the battery terminal.

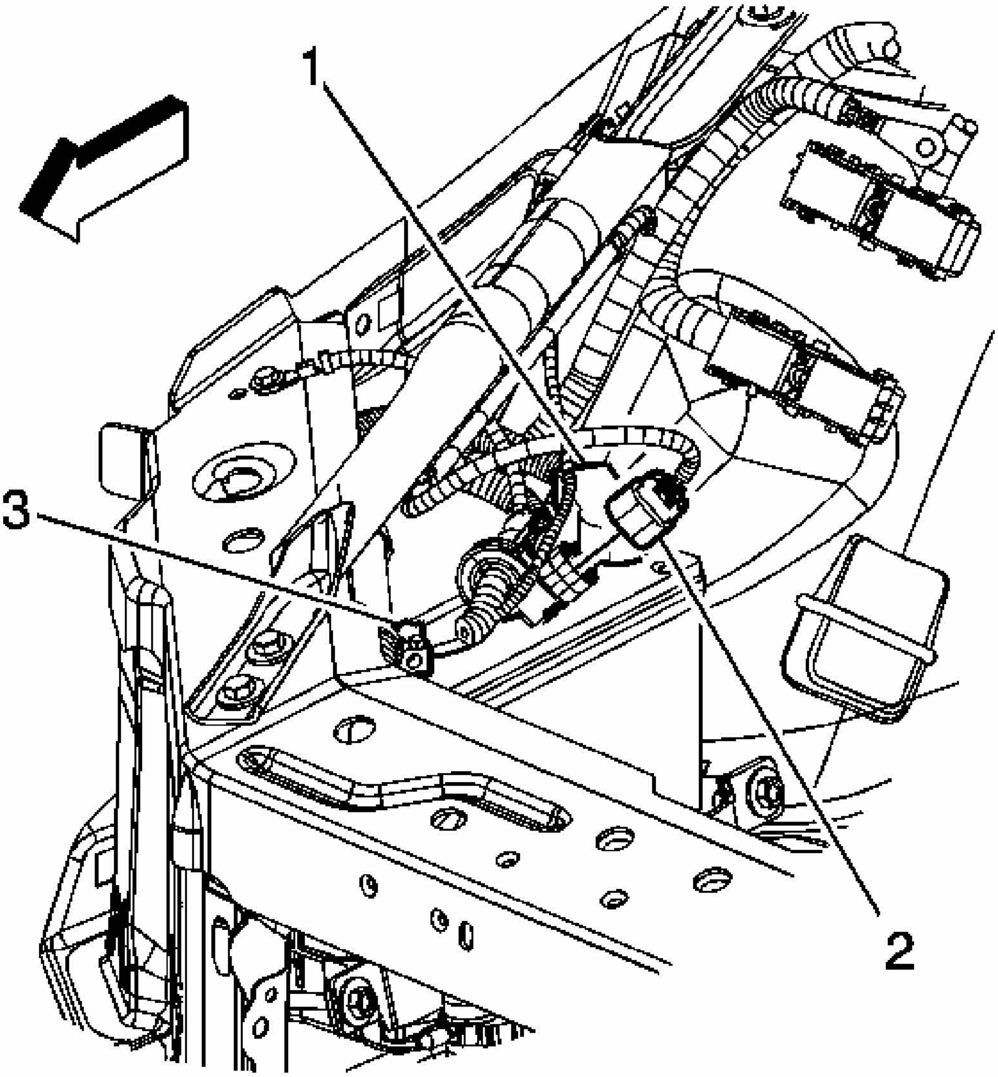


Fig. 15: Identifying Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

1. Install the negative battery cable terminal (2) to the battery.

NOTE: **Refer to Fastener Notice .**

2. Tighten the negative battery cable terminal nut.

   Tighten: Tighten the nut to 15 N.m (11 lb ft).

3. Set the clock and program the radio stations back into the radio as recorded at the beginning of the procedure. Refer to **Radio/Audio System Description and Operation** .

BATTERY CURRENT SENSOR REPLACEMENT (RPOS LZE/LZ4/LZ9)

Removal Procedure

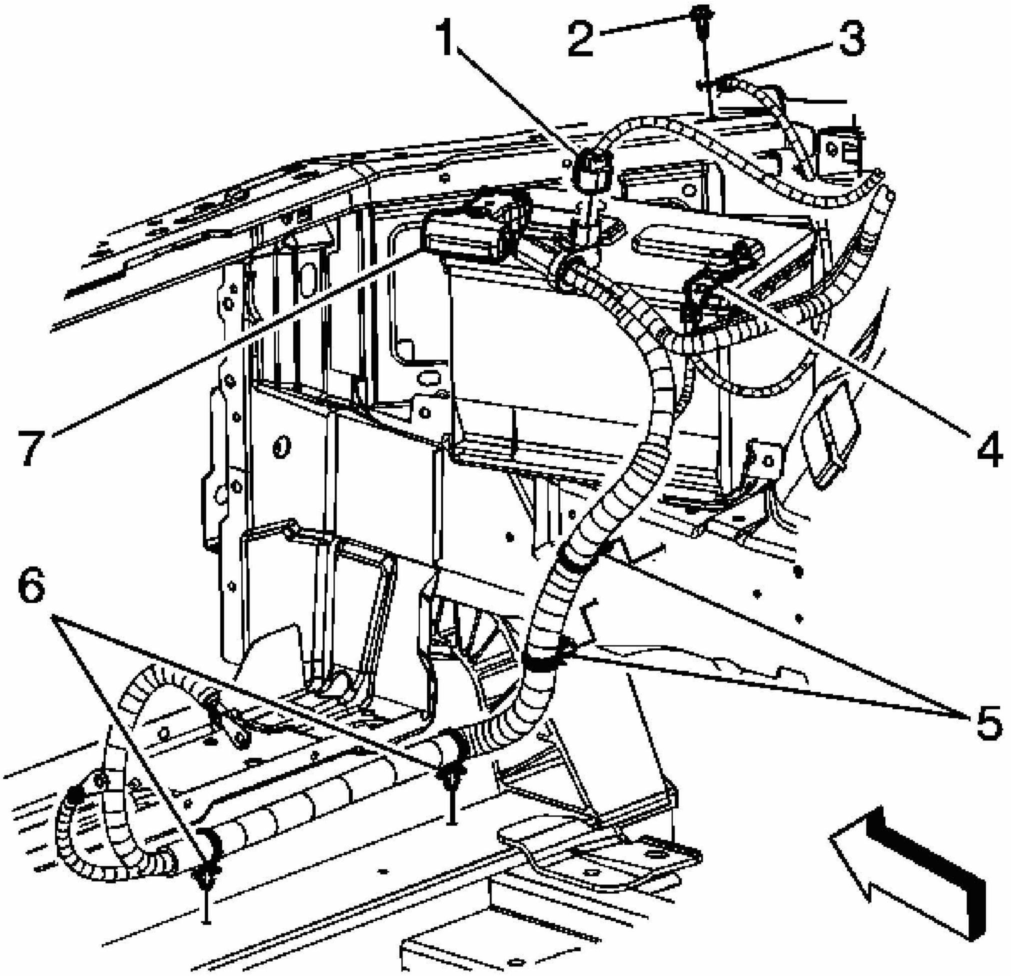


Fig. 16: View Of Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the instrument panel (I/P) harness electrical connector (1) from the battery current sensor.
2. Remove the positive and negative battery cable. Refer to **Battery Positive and Negative Cable Replacement (RPOs LZE/LZ4/LZ9)** or **Battery Positive and Negative Cable Replacement (RPO LS4)**.

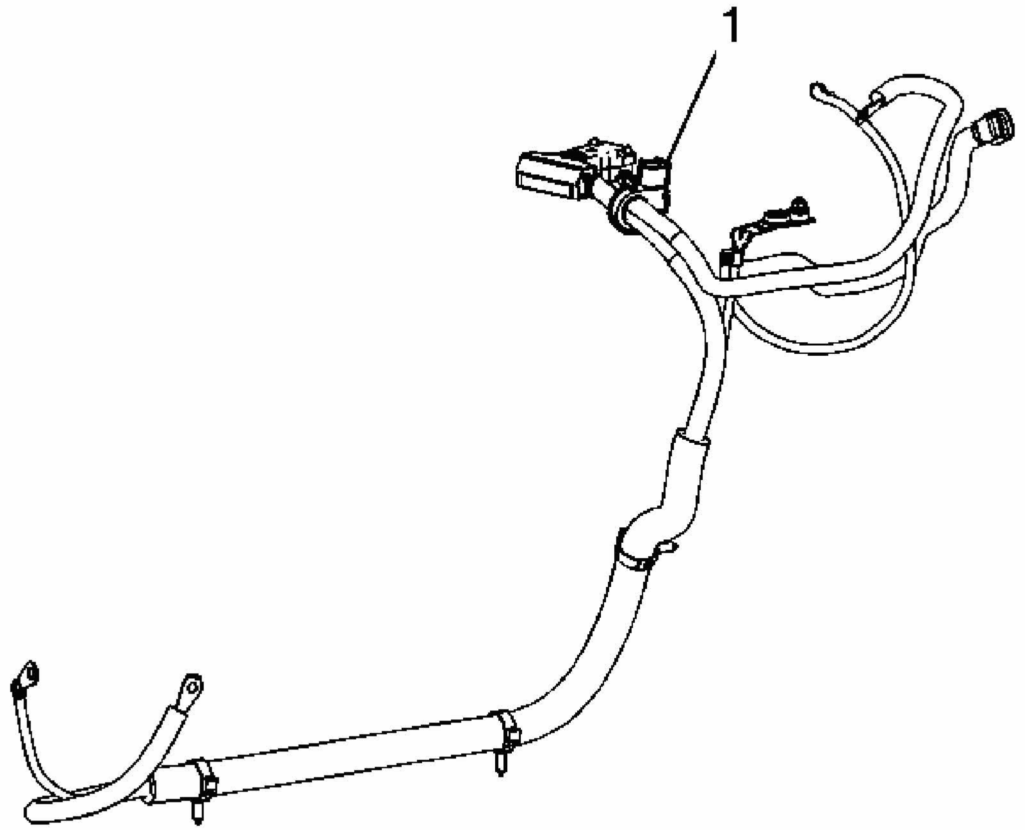


Fig. 17: View Of Battery Current Sensor & Battery Cable
Courtesy of GENERAL MOTORS CORP.

3. Cut the tie straps and electrical tape attaching the battery current sensor to the positive battery cable.
4. Squeeze the positive and negative battery cable branches together.

IMPORTANT: Note the position of the battery current sensor prior to removal.

5. Slide the battery current sensor (1) off of the battery cable.

Installation Procedure

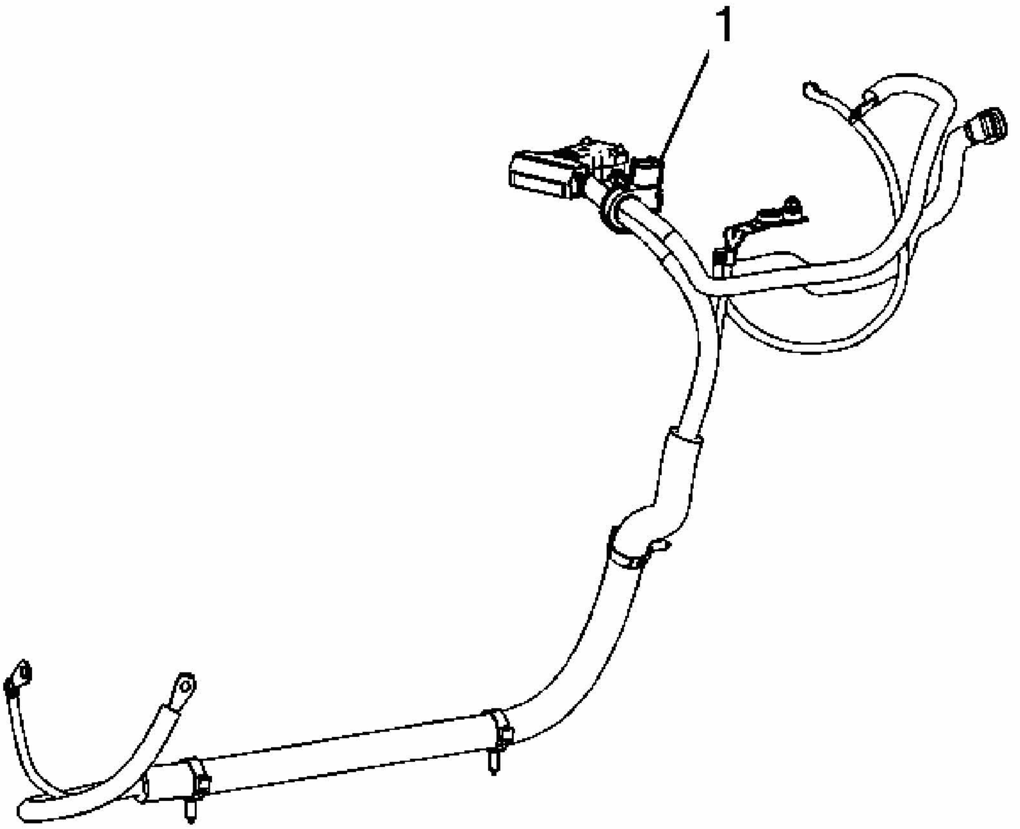


Fig. 18: View Of Battery Current Sensor & Battery Cable
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the tape tab is pointing towards the positive battery terminal prior to installation.

1. Slide the NEW battery current sensor (1) up onto the battery cable.
2. Using NEW tie straps and electrical tape, attach the battery current sensor to the positive battery cable.

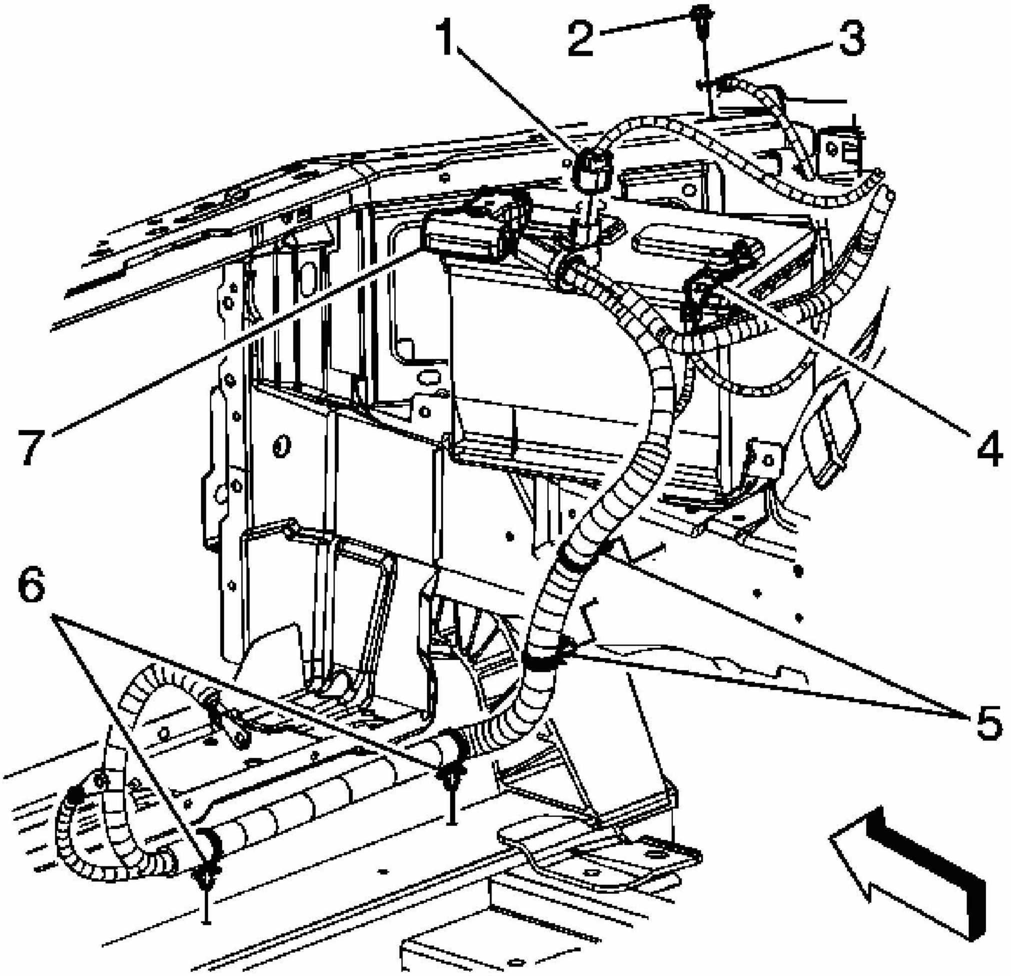


Fig. 19: View Of Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

3. Install the positive and negative battery cable. Refer to **Battery Positive and Negative Cable Replacement (RPOs LZE/LZ4/LZ9)** or **Battery Positive and Negative Cable Replacement (RPO LS4)**.
4. Connect the I/P harness electrical connector (1) to the battery current sensor.

BATTERY CURRENT SENSOR REPLACEMENT (RPO LS4)

Removal Procedure

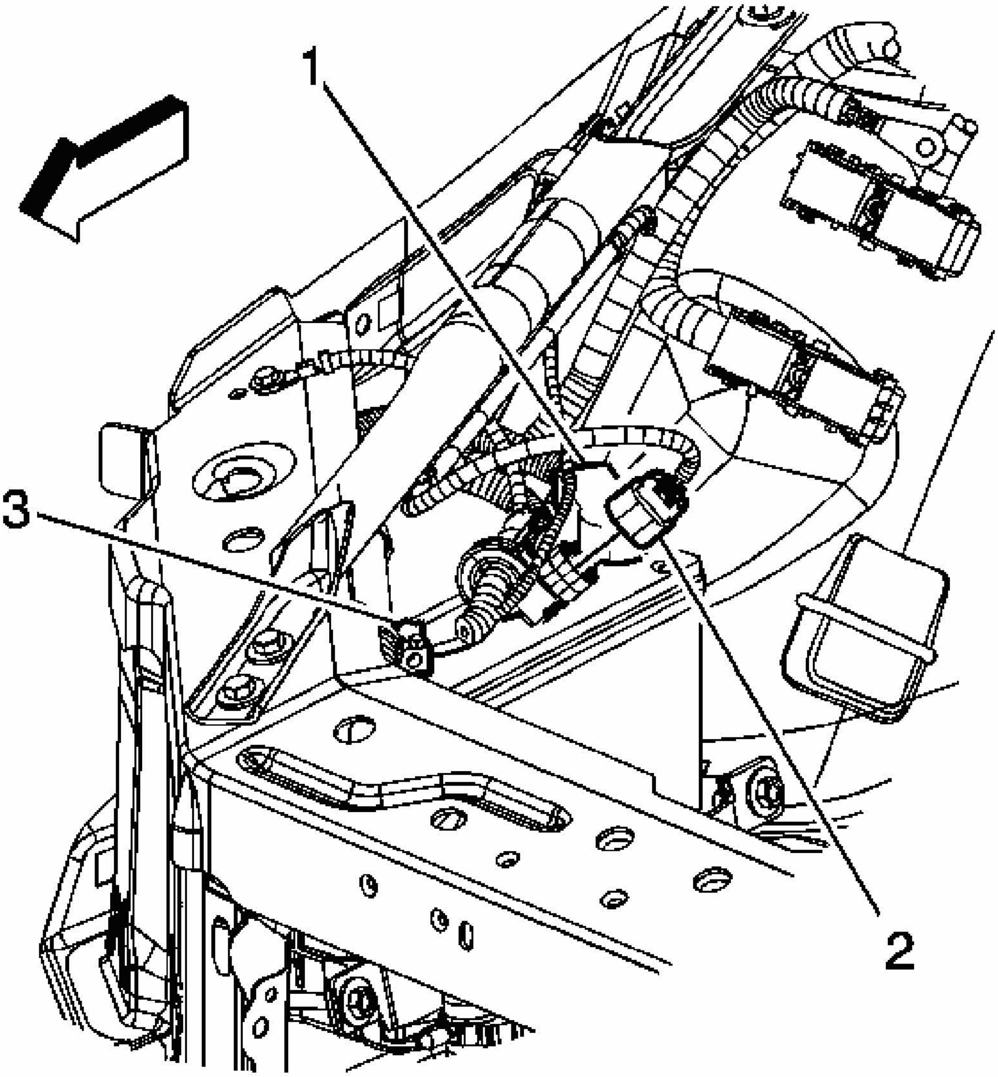


Fig. 20: Identifying Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the instrument panel (I/P) harness electrical connector (2) from the battery current sensor.
2. Remove the positive and negative battery cable. Refer to **Battery Positive and Negative Cable Replacement (RPOs LZE/LZ4/LZ9)** or **Battery Positive and Negative Cable Replacement (RPO LS4)**.

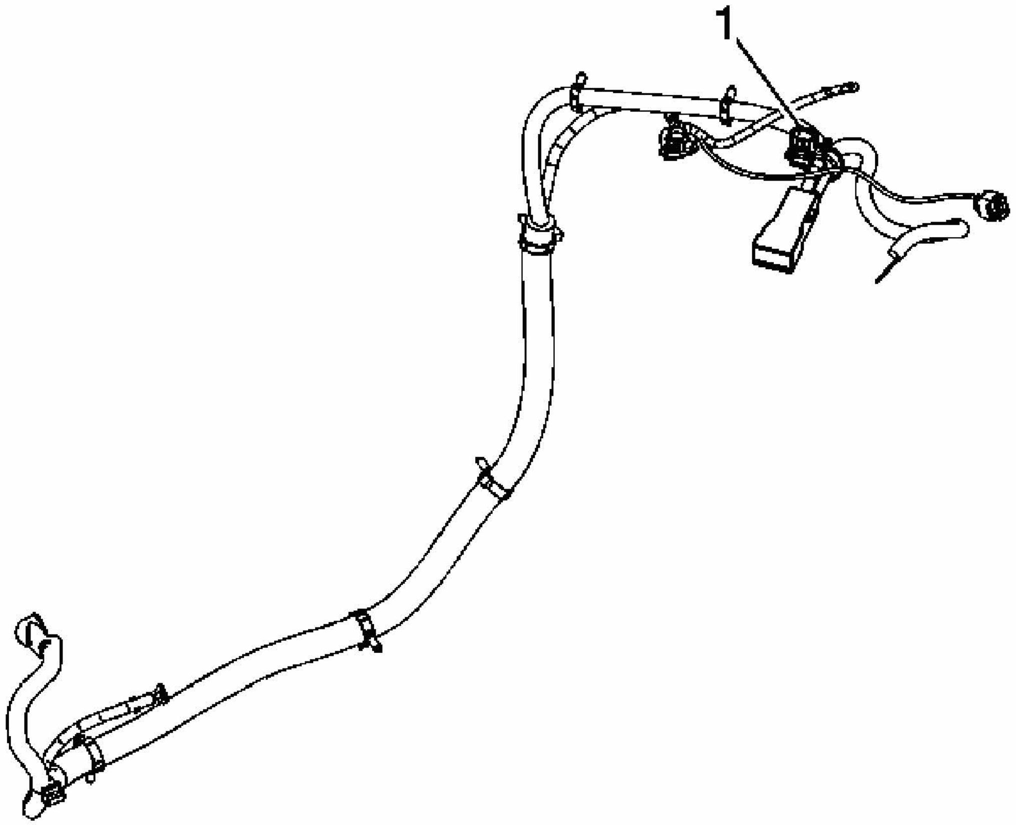


Fig. 21: Identifying Battery Current Sensor & Battery Cable
Courtesy of GENERAL MOTORS CORP.

3. Cut the tie straps and electrical tape attaching the battery current sensor to the negative battery cable.
4. Squeeze the battery cable branches together.

IMPORTANT: Note the position of the battery current sensor prior to removal.

5. Slide the battery current sensor (1) off of the battery cable.

Installation Procedure

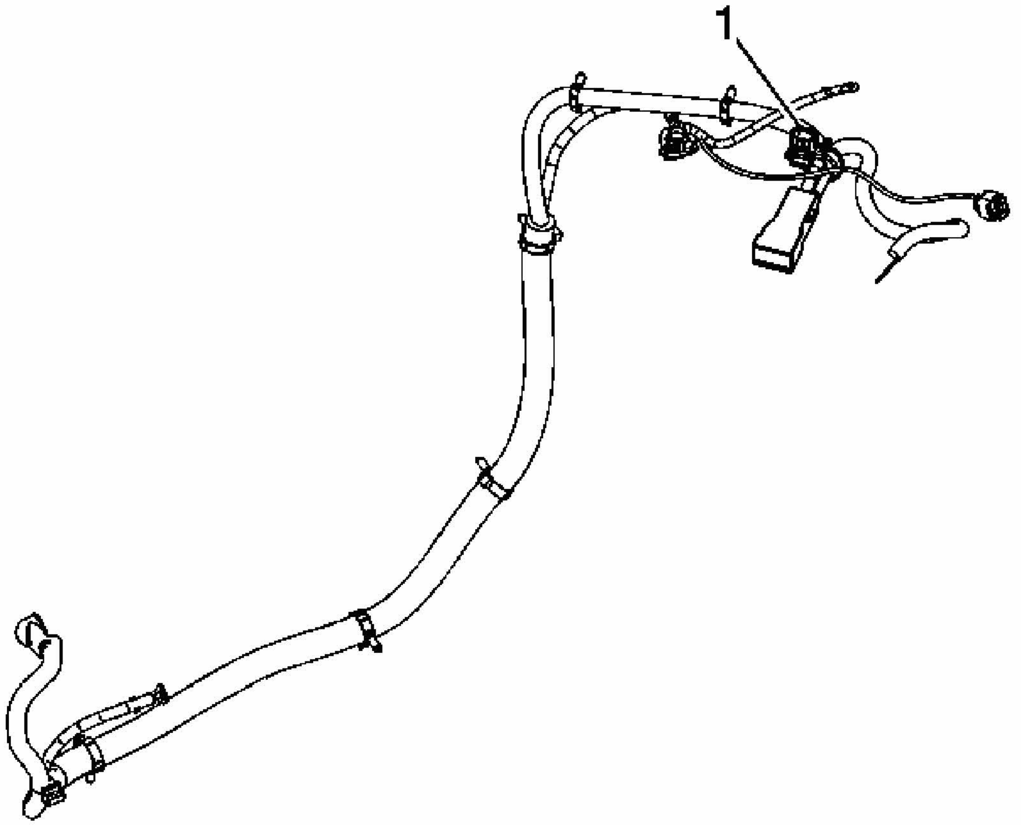


Fig. 22: Identifying Battery Current Sensor & Battery Cable
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the tape tab is pointing away from the battery prior to installation.

1. Slide the NEW battery current sensor (1) up onto the battery cable.
2. Using NEW tie straps and electrical tape, attach the battery current sensor to the negative battery cable.

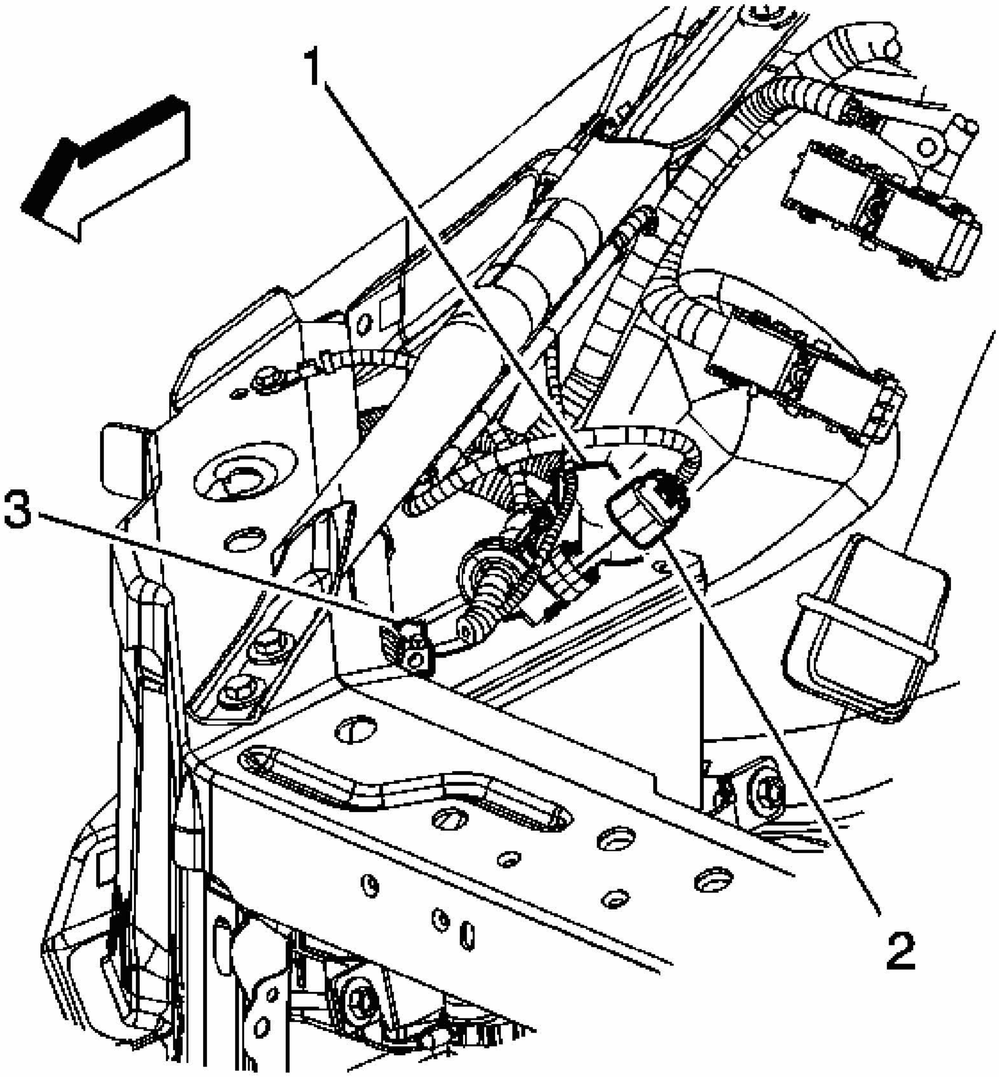


Fig. 23: Identifying Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

3. Install the positive and negative battery cable. Refer to **Battery Positive and Negative Cable Replacement (RPOs LZE/LZ4/LZ9)** or **Battery Positive and Negative Cable Replacement (RPO LS4)**.
4. Connect the I/P harness electrical connector (2) to the battery current sensor.

BATTERY POSITIVE AND NEGATIVE CABLE REPLACEMENT (RPOS LZE/LZ4/LZ9)

Removal Procedure

IMPORTANT: When replacing battery cables be sure to use replacement cables that are the same type, gage, and length.

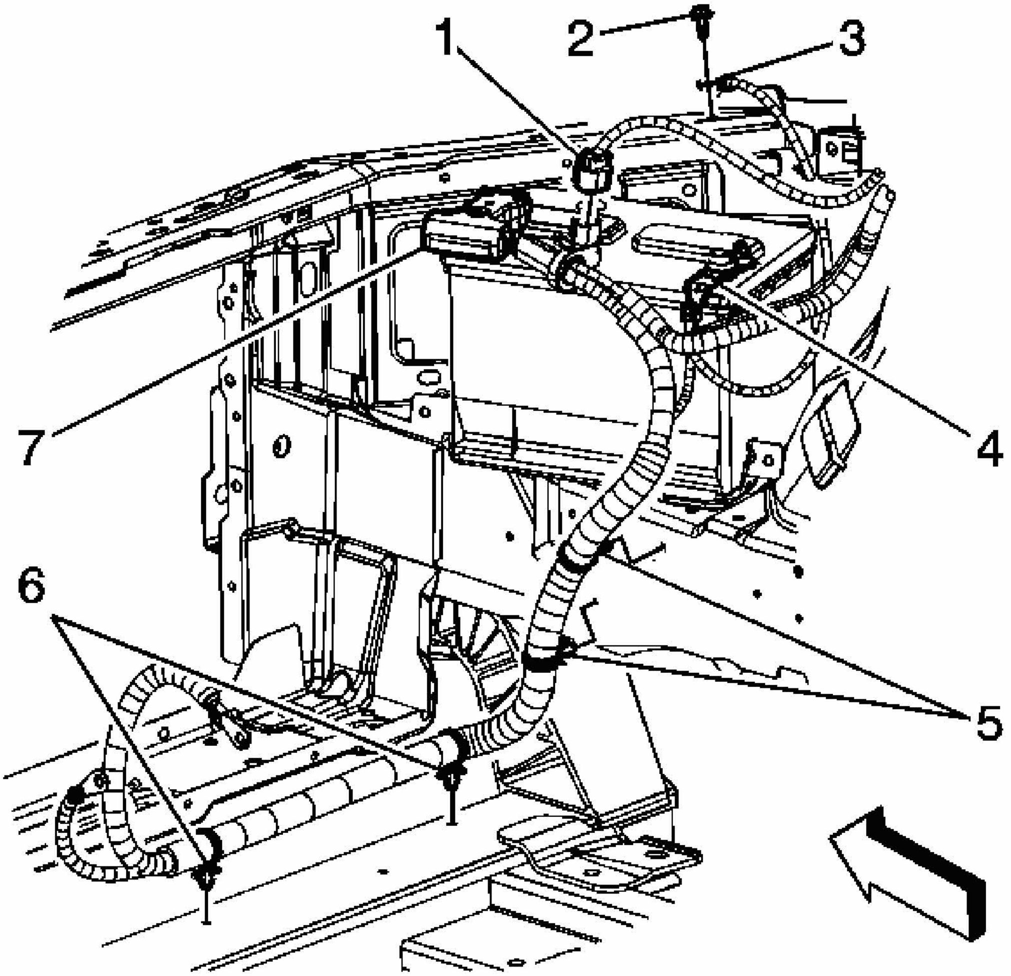


Fig. 24: View Of Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)**.
2. Open the positive battery cable terminal cover (7).
3. Loosen the positive battery cable terminal nut.
4. Remove the positive battery cable terminal (1) from the battery.
5. Remove the ground wire bolt (2) and wire (3) from the upper tie bar.

6. Disconnect the instrument panel (I/P) harness electrical connector (1) from the battery current sensor.

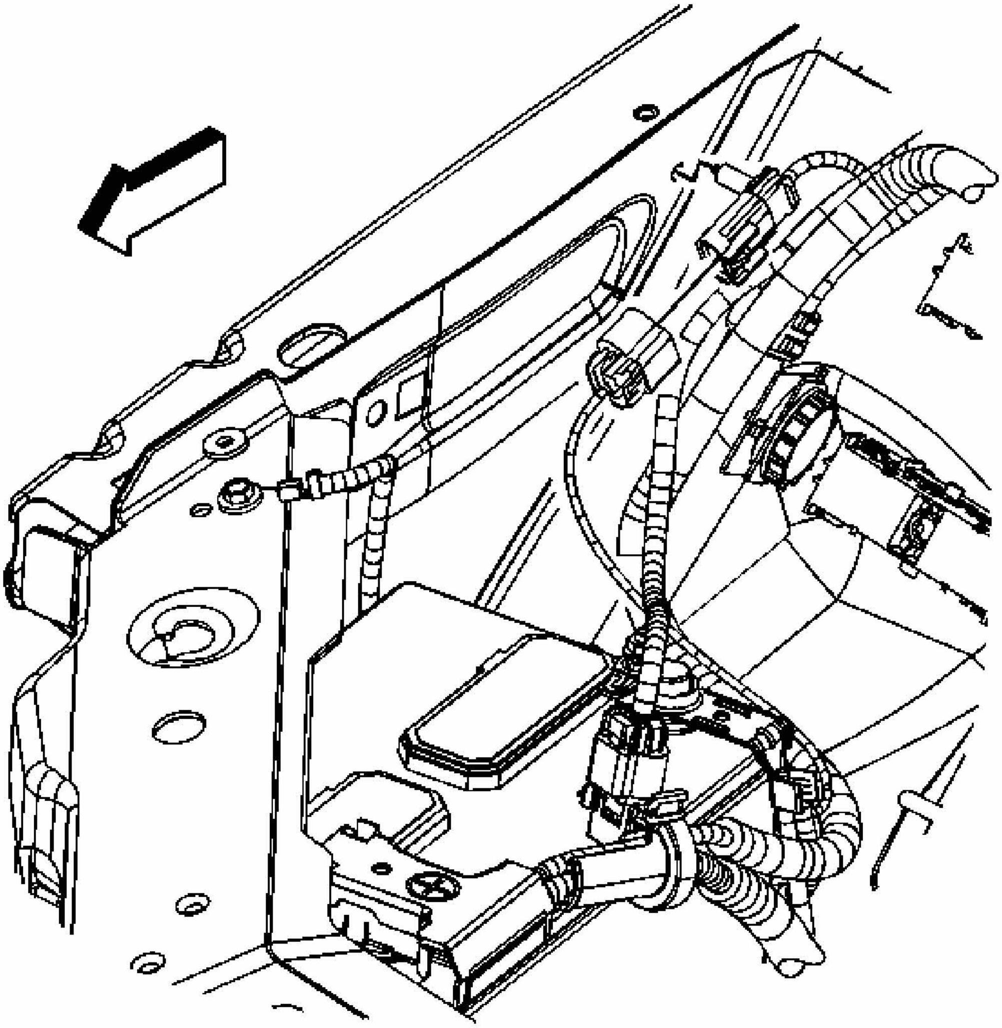


Fig. 25: Locating Battery Cable Connector & I/P Harness Connector
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the battery cable connector from the I/P harness connector.

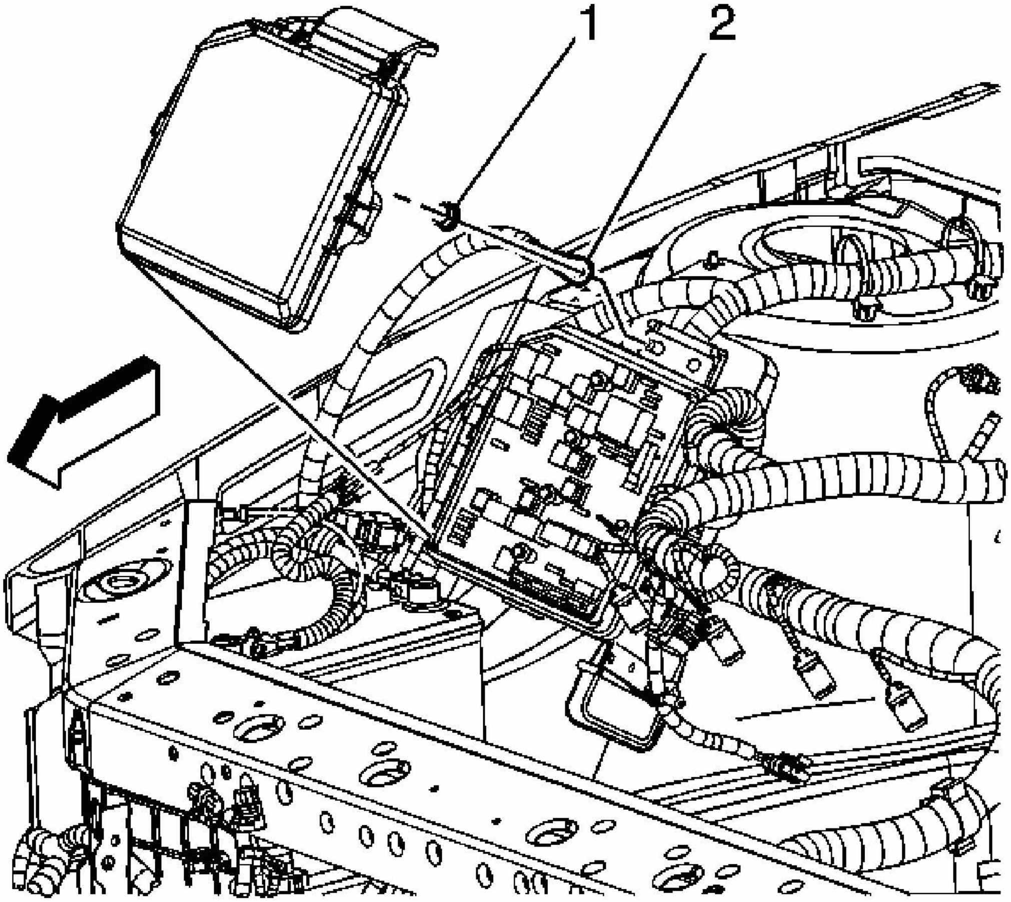


Fig. 26: View Of Bussed Electrical Center
Courtesy of GENERAL MOTORS CORP.

8. Remove the bussed electrical center (BEC) cover.
9. Remove the positive battery cable junction block lead nut (1).
10. Remove the positive battery cable (2) from the BEC.
11. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
12. Remove the front lower air deflector. Refer to **Radiator Air Baffle and Deflector Replacement - Lower** .

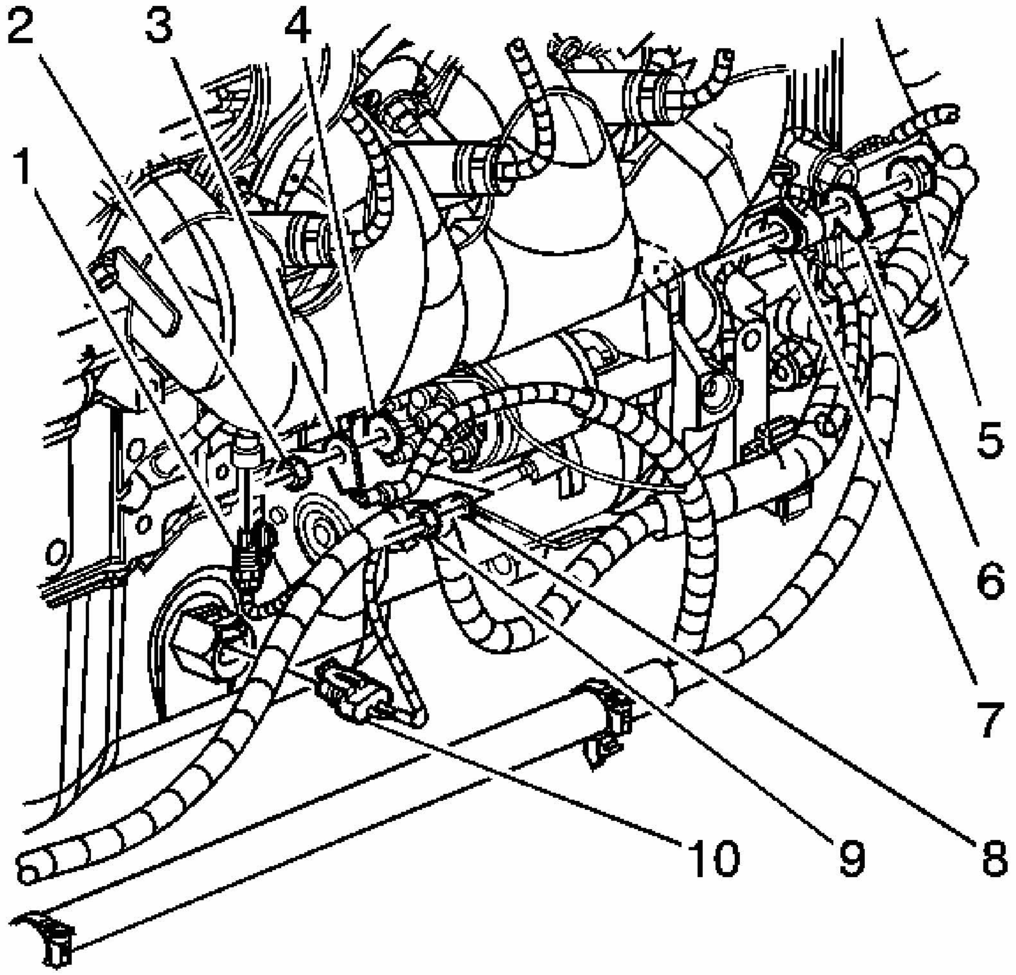


Fig. 27: View Of Engine Electrical Connectors (Left Side)
Courtesy of GENERAL MOTORS CORP.

13. Remove the starter solenoid BAT terminal nut (3) from the starter.
14. Remove the positive battery cable (2) from the starter motor.
15. Lower the vehicle.

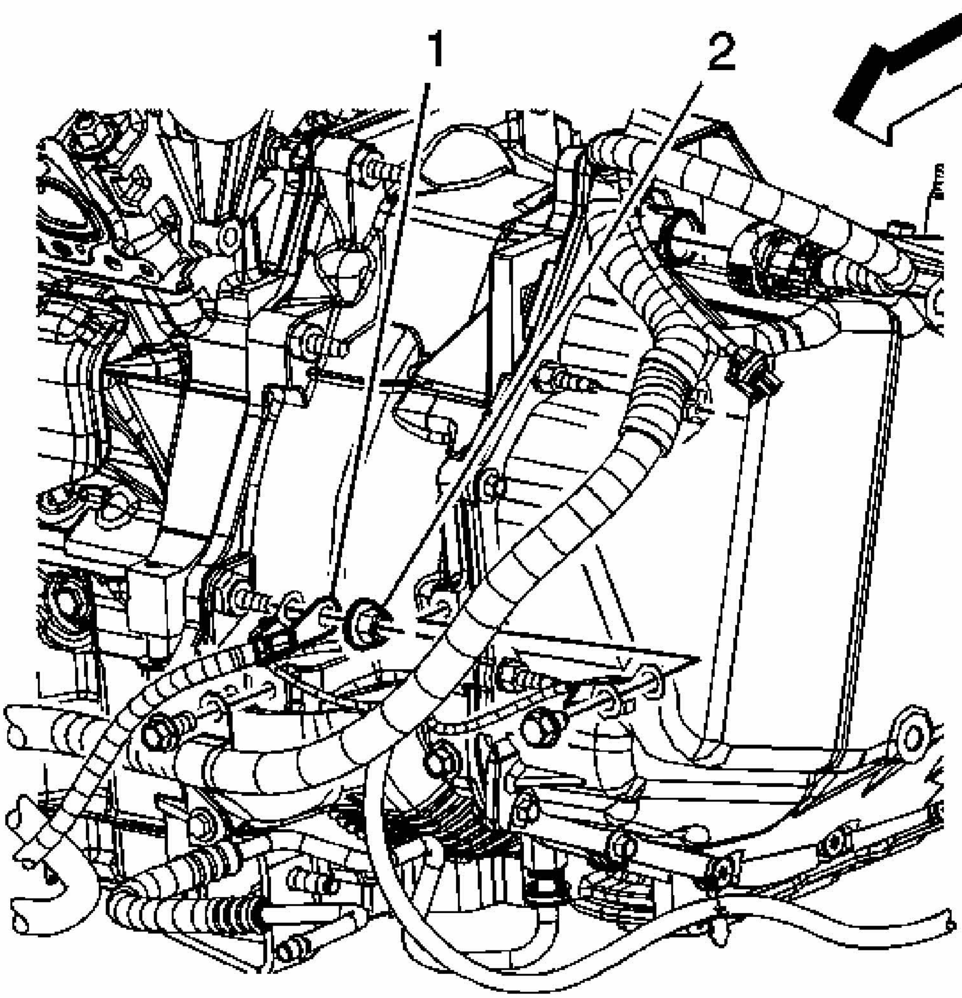


Fig. 28: Locating Transaxle Stud Nut
Courtesy of GENERAL MOTORS CORP.

16. Remove the transaxle stud nut (2).
17. Remove the battery cable ground (1) from the transaxle stud.

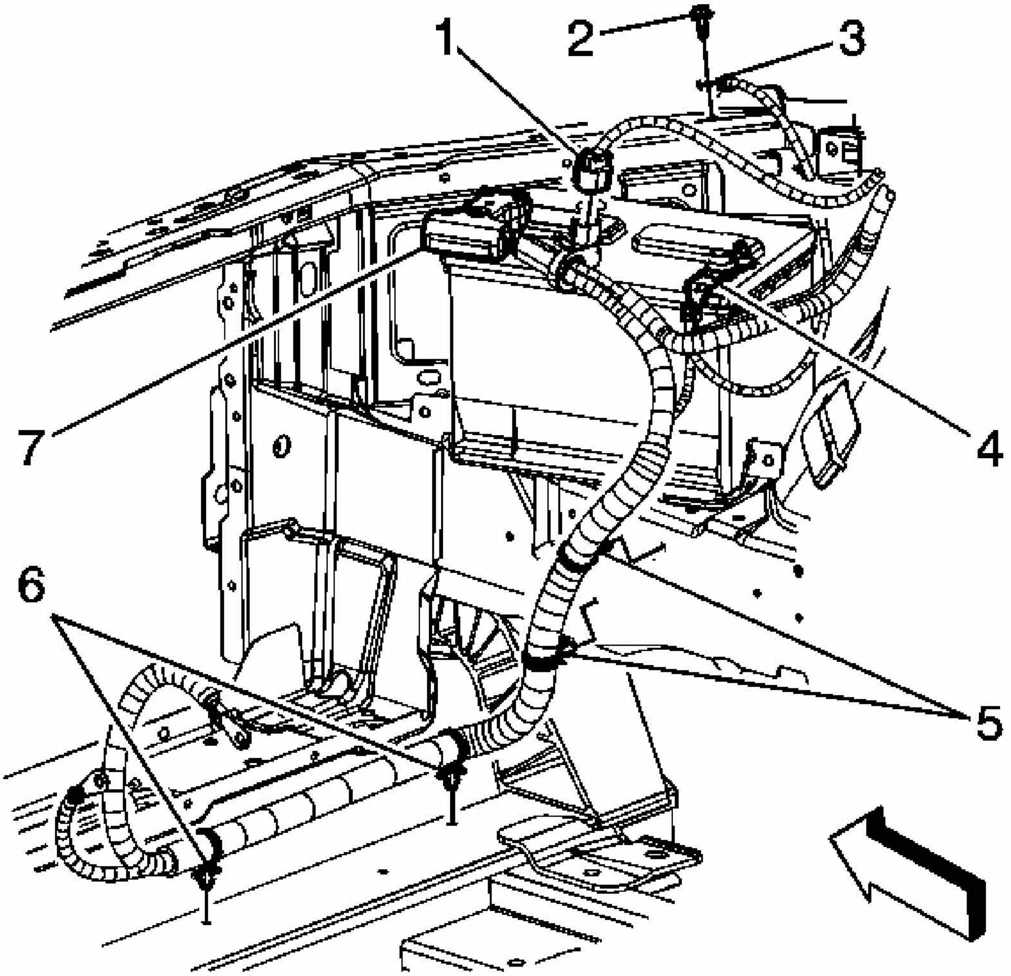


Fig. 29: View Of Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

18. Remove the positive and negative battery cable retainers (5) from the right hand rail.
19. Remove the positive and negative battery cable retainers (6) from the cradle.
20. Remove the positive and negative battery cable assembly from the vehicle.

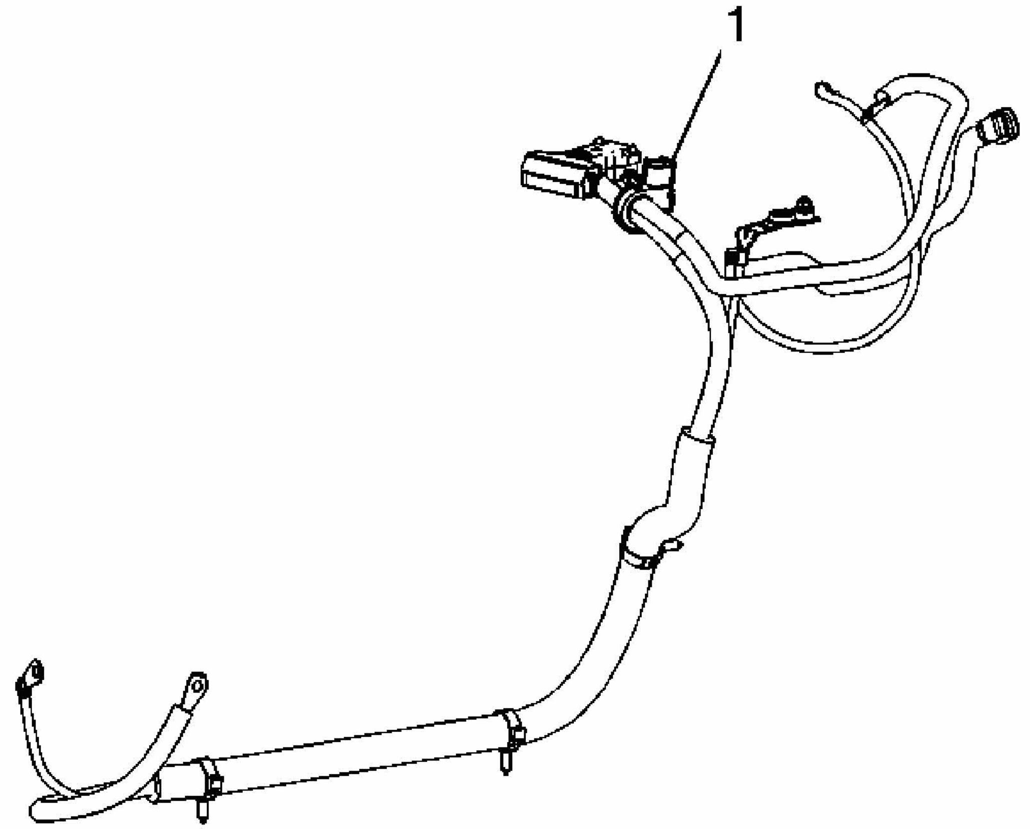


Fig. 30: View Of Battery Current Sensor & Battery Cable
Courtesy of GENERAL MOTORS CORP.

21. If replacing the cable assembly, perform the following:
    1. Cut the tie straps and electrical tape attaching the battery current sensor to the battery cable.
    2. Squeeze the cable branches together.

       IMPORTANT: Note the position of the battery current sensor prior to removal.

    3. Slide the battery current sensor (1) off of the battery cable.

Installation Procedure

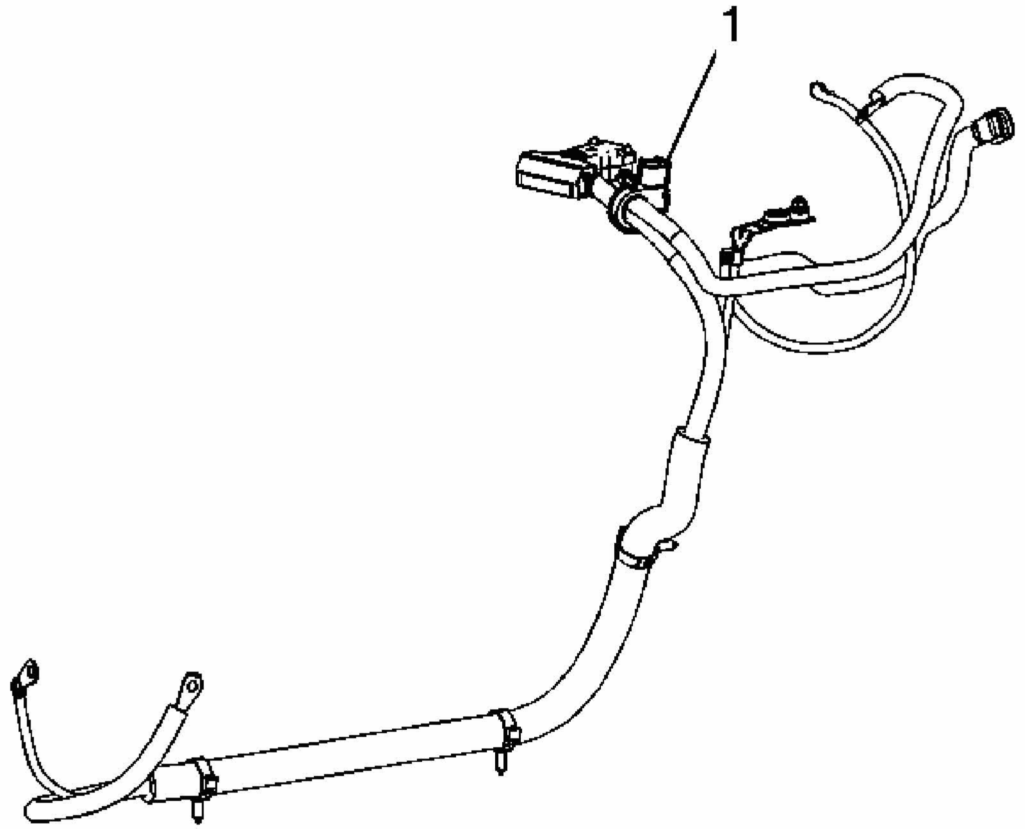


Fig. 31: View Of Battery Current Sensor & Battery Cable
Courtesy of GENERAL MOTORS CORP.

1. If the cable assembly was replaced, perform the following:
    1. Slide the battery current sensor (1) onto the battery cable.

       IMPORTANT: Ensure that the tape tab is pointing towards the positive cable terminal.

    2. Using NEW tie straps and electrical tape, attach the battery current sensor to the battery cable.

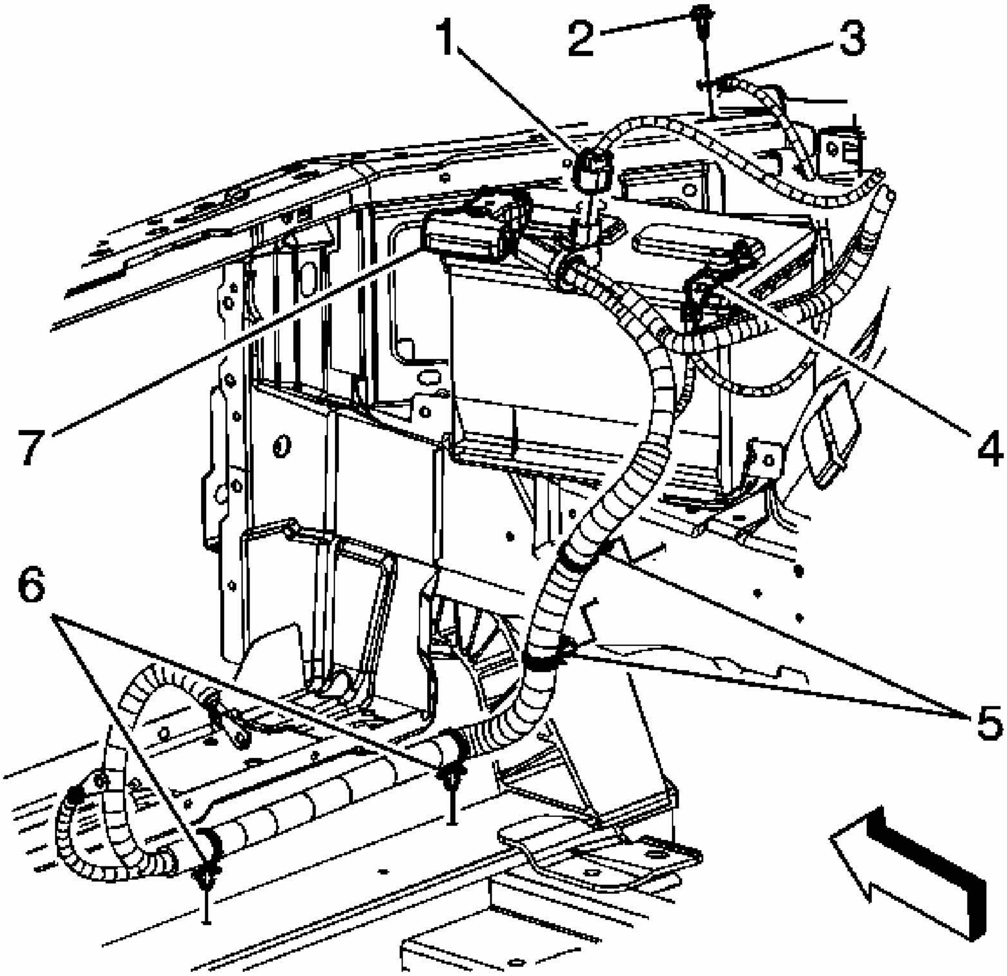


Fig. 32: View Of Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

2. Install the positive and negative battery cable assembly to the vehicle.
3. Install the positive and negative battery cable retainers (6) to the cradle.
4. Install the positive and negative battery cable retainers (5) to the right hand rail.

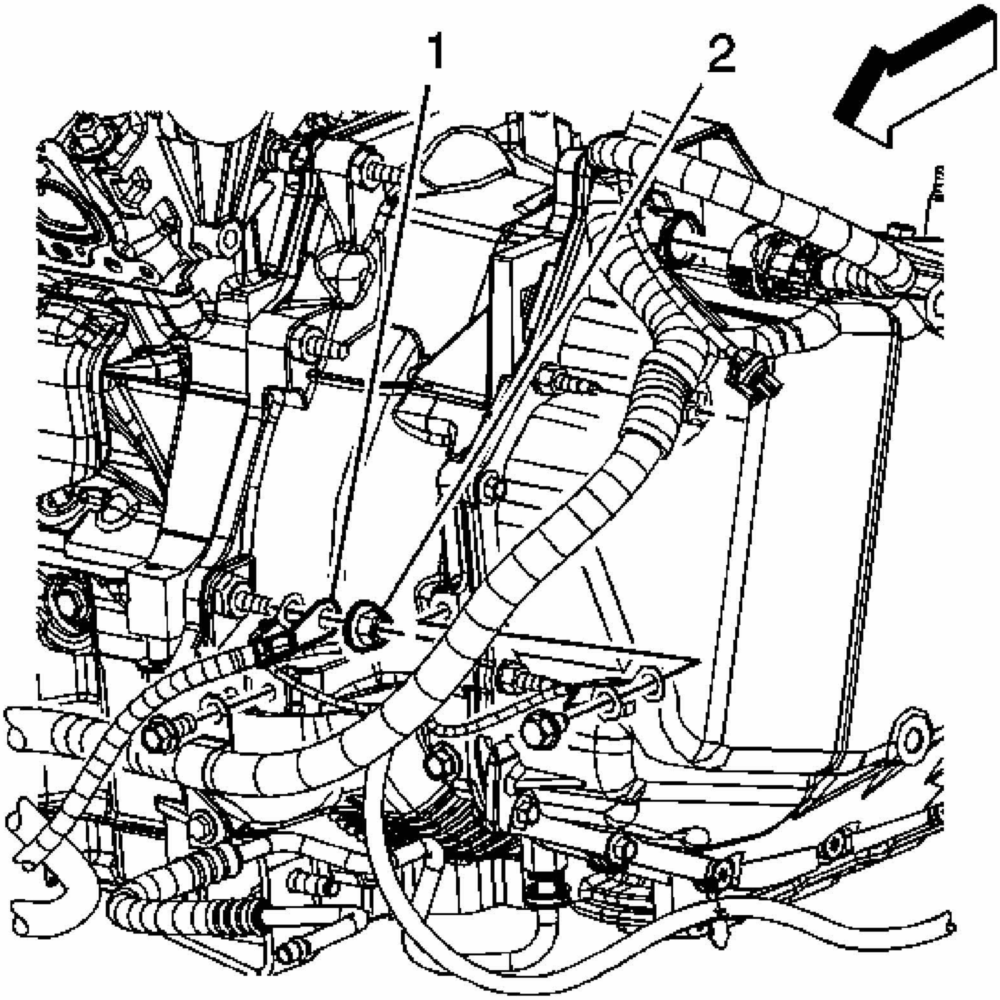


Fig. 33: View Of Battery Cable Ground & Transaxle Stud
Courtesy of GENERAL MOTORS CORP.

5. Install the battery cable ground (1) to the transaxle stud.

   NOTE: **Refer to Fastener Notice .**

6. Install the transaxle stud nut (2).

   Tighten: Tighten the nut to 30 N.m (22 lb ft).

7. Raise and support the vehicle.

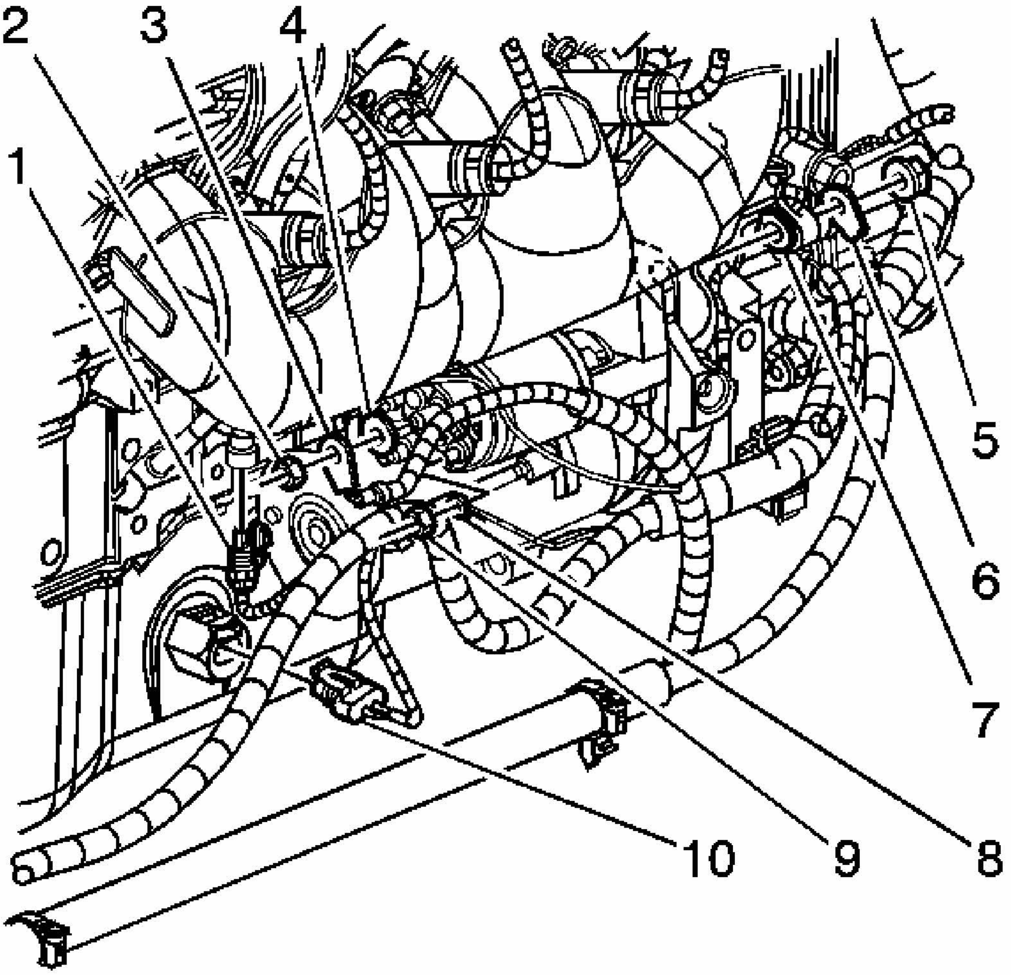


Fig. 34: View Of Engine Electrical Connectors (Left Side)
Courtesy of GENERAL MOTORS CORP.

8. Install the positive battery cable (2) to the starter motor.
9. Install the starter solenoid BAT terminal nut (3) to the starter.

   Tighten: Tighten the nut to 10 N.m (89 lb in).

10. Install the front lower air deflector. Refer to **Radiator Air Baffle and Deflector Replacement - Lower** .
11. Lower the vehicle.

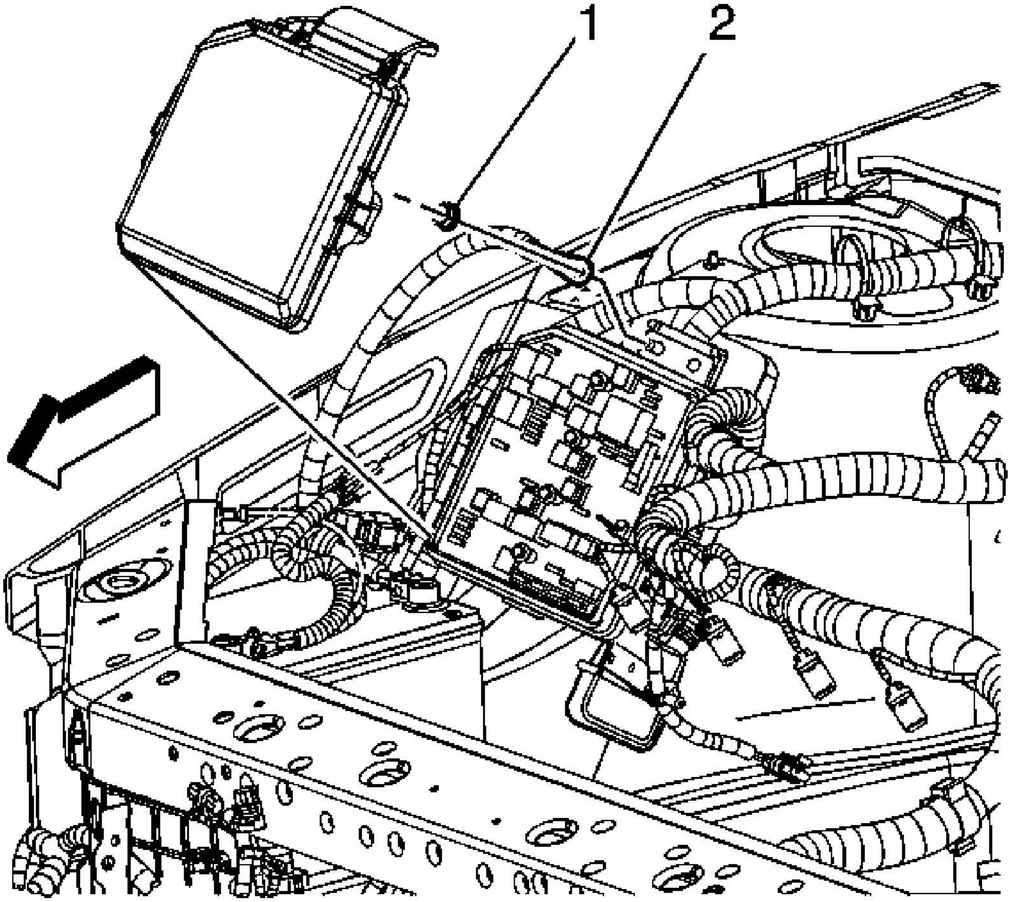


Fig. 35: View Of Bussed Electrical Center
Courtesy of GENERAL MOTORS CORP.

12. Install the positive battery cable (2) to the BEC.
13. Install the positive battery cable junction block lead nut (1).

    Tighten: Tighten the nut to 10 N.m (89 lb in).

14. Install the BEC cover.

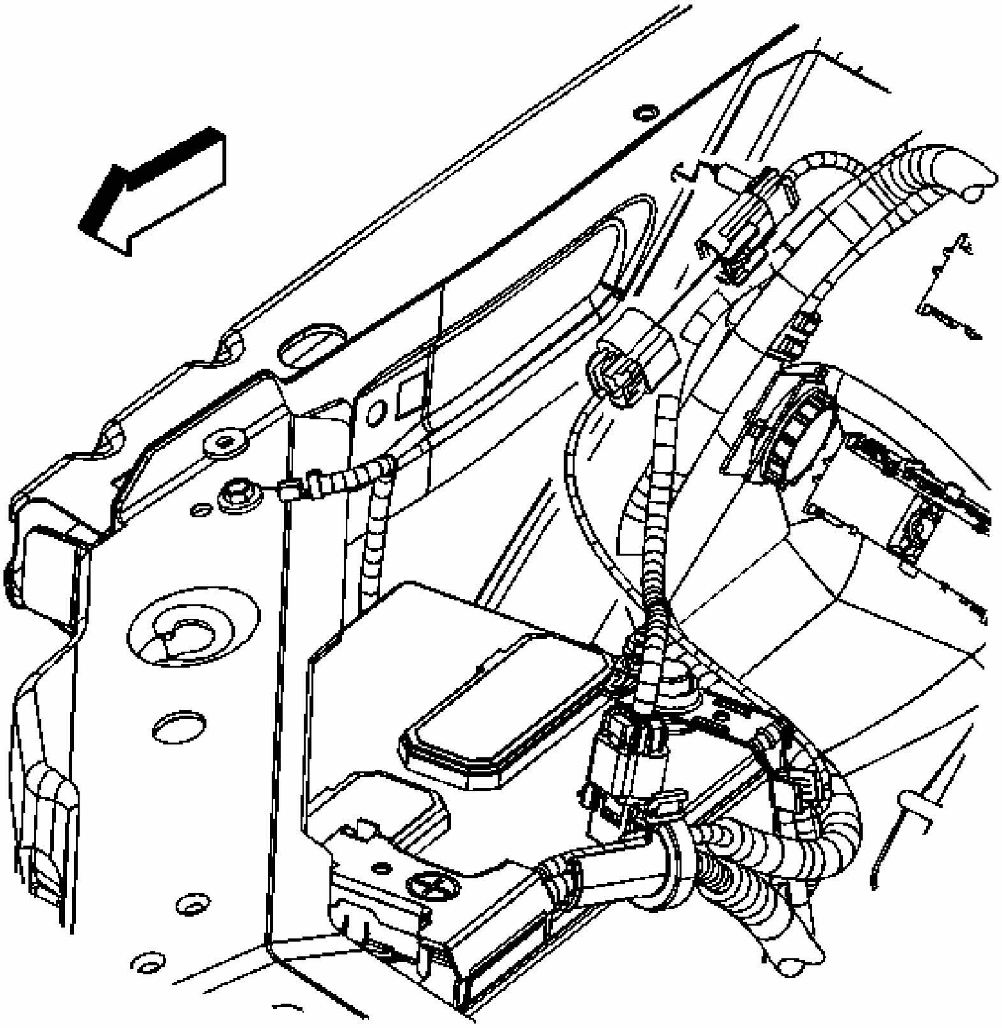


Fig. 36: View Of Battery Cable Connector & I/P Harness Connector
Courtesy of GENERAL MOTORS CORP.

15. Connect the battery cable connector to the I/P harness connector.

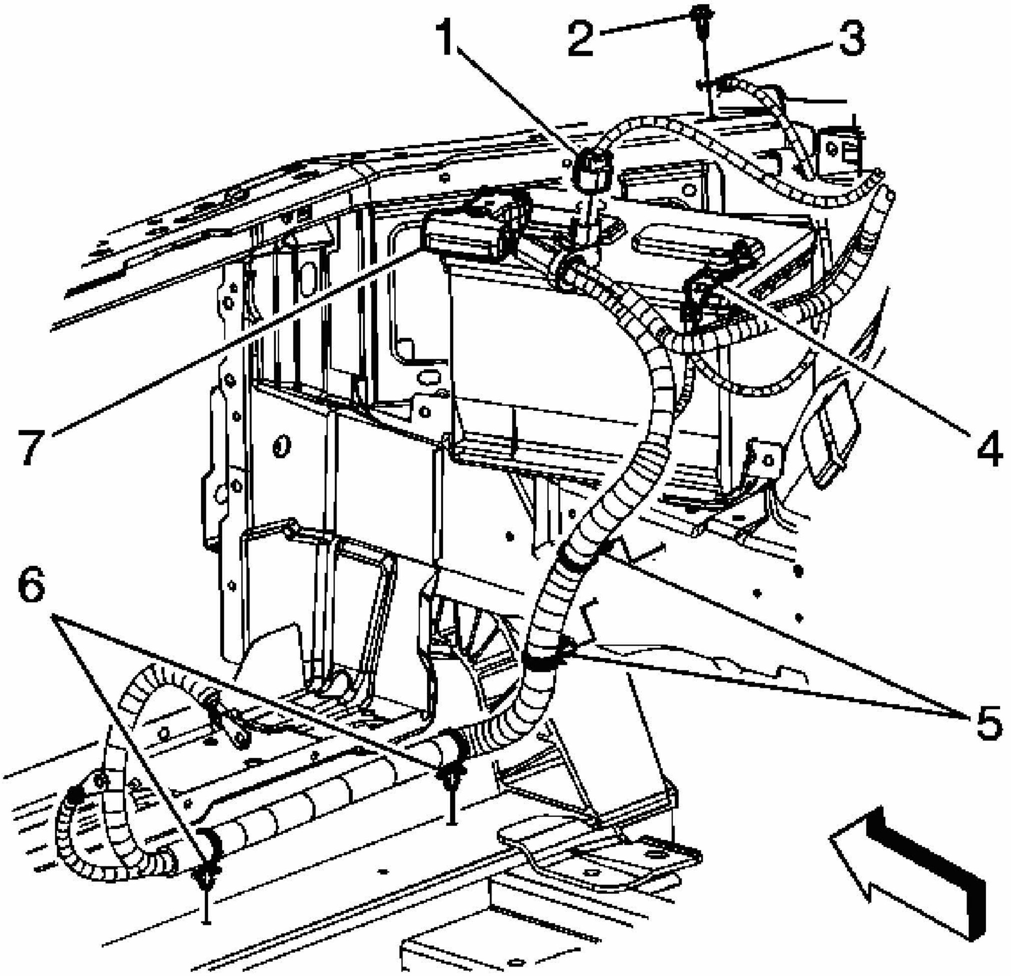


Fig. 37: View Of Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

16. Connect the I/P harness electrical connector (1) to the battery current sensor.
17. Install the ground wire (3) and bolt (2) to the upper tie bar.

    Tighten: Tighten the bolt to 10 N.m (89 lb in).

18. Install the positive battery cable terminal (1) to the battery.
19. Tighten the positive battery cable terminal nut.

    Tighten: Tighten the bolt to 15 N.m (11 lb ft).

20. Snap closed the positive battery cable terminal cover (7).

21. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)**.

BATTERY POSITIVE AND NEGATIVE CABLE REPLACEMENT (RPO LS4)

Removal Procedure

IMPORTANT: When replacing battery cables be sure to use replacement cables that are the same type, gage, and length.

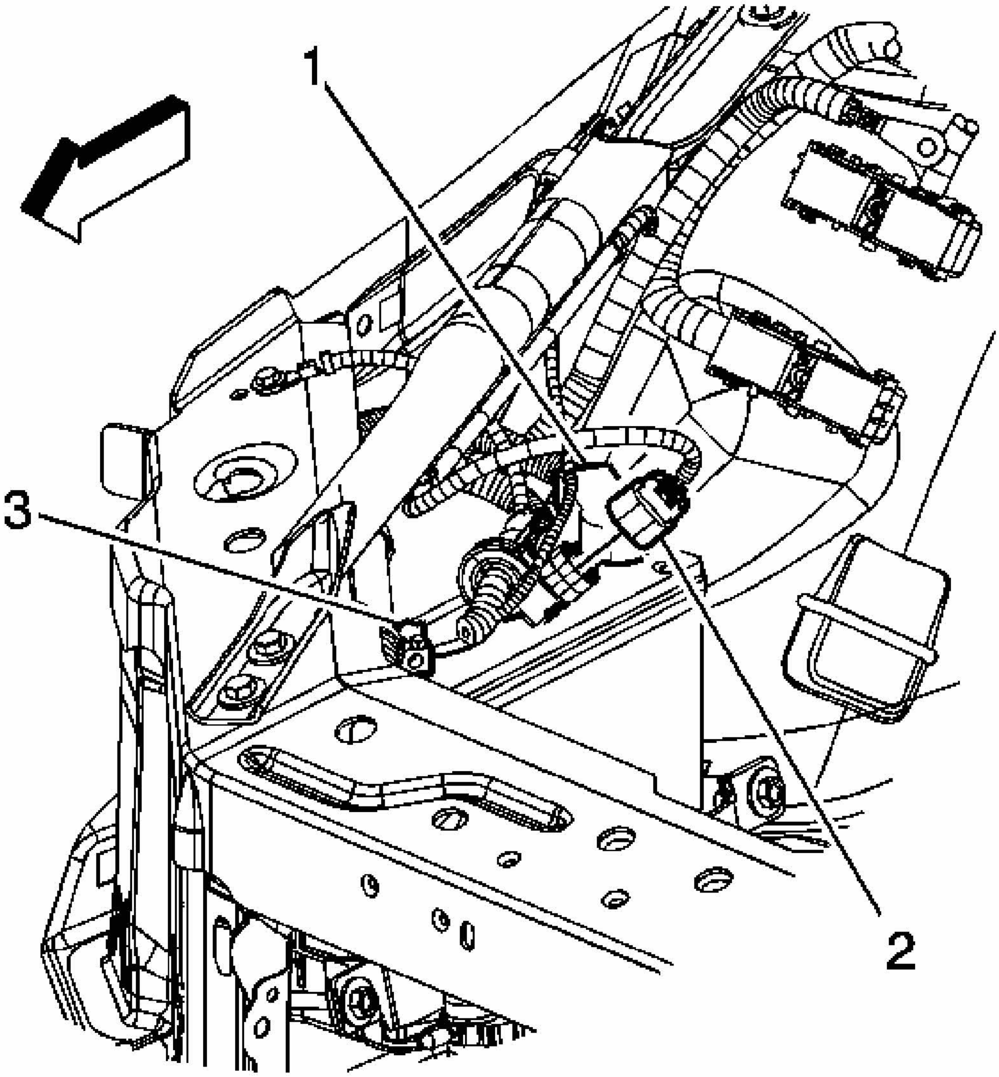


Fig. 38: Identifying Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable (3). Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)**.
2. Open the positive battery cable terminal lead cover (1).
3. Loosen the positive battery cable terminal lead nut
4. Remove the positive battery cable terminal from the battery.
5. Disconnect the instrument panel (I/P) harness electrical connector (2) from the battery current sensor.

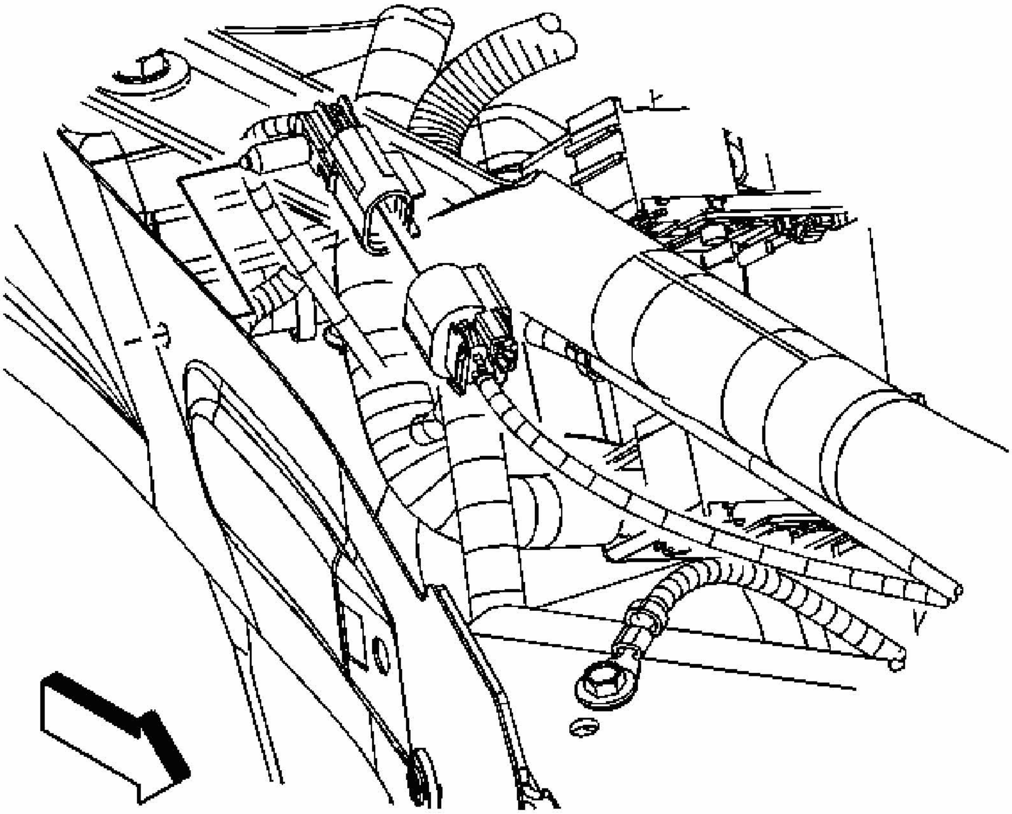


Fig. 39: View Of Battery Cable Connector & I/P Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the battery cable connector from the I/P harness electrical connector.

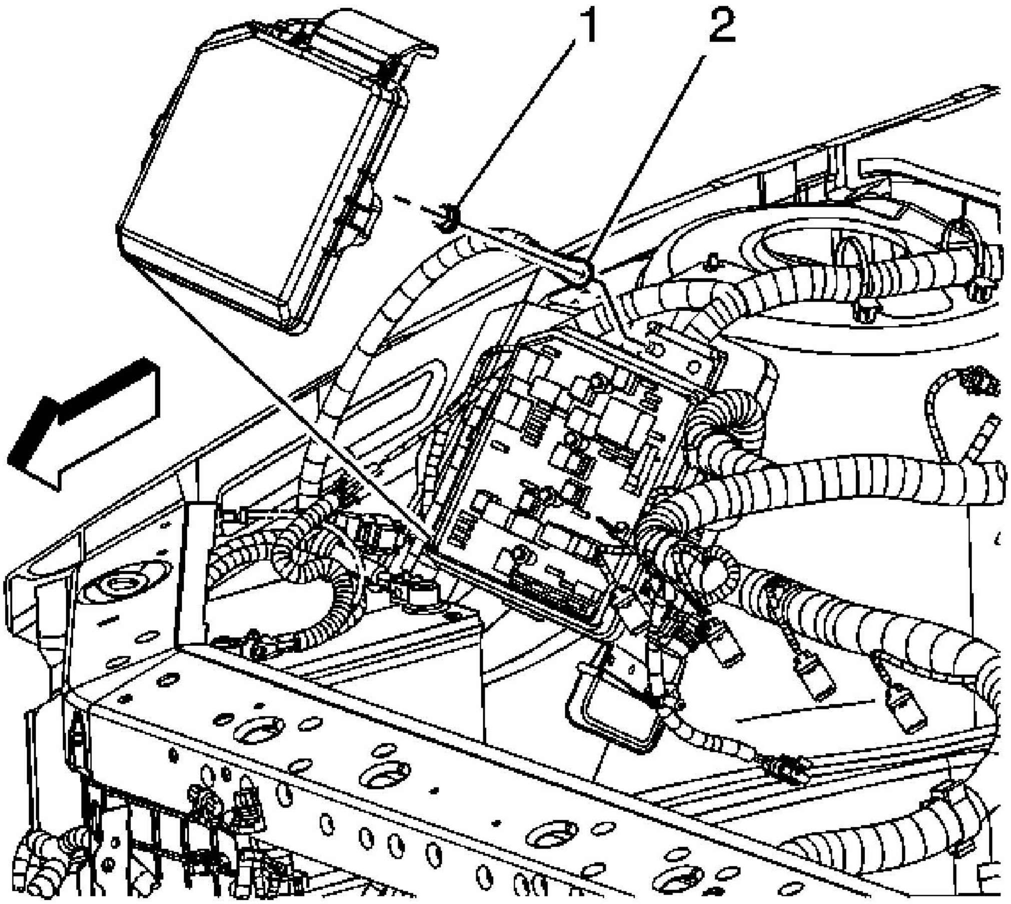


Fig. 40: View Of Bussed Electrical Center
Courtesy of GENERAL MOTORS CORP.

7. Remove the bussed electrical center (BEC) cover.
8. Remove the positive battery cable junction block lead nut (1).
9. Remove the positive battery cable terminal (2) from the BEC.

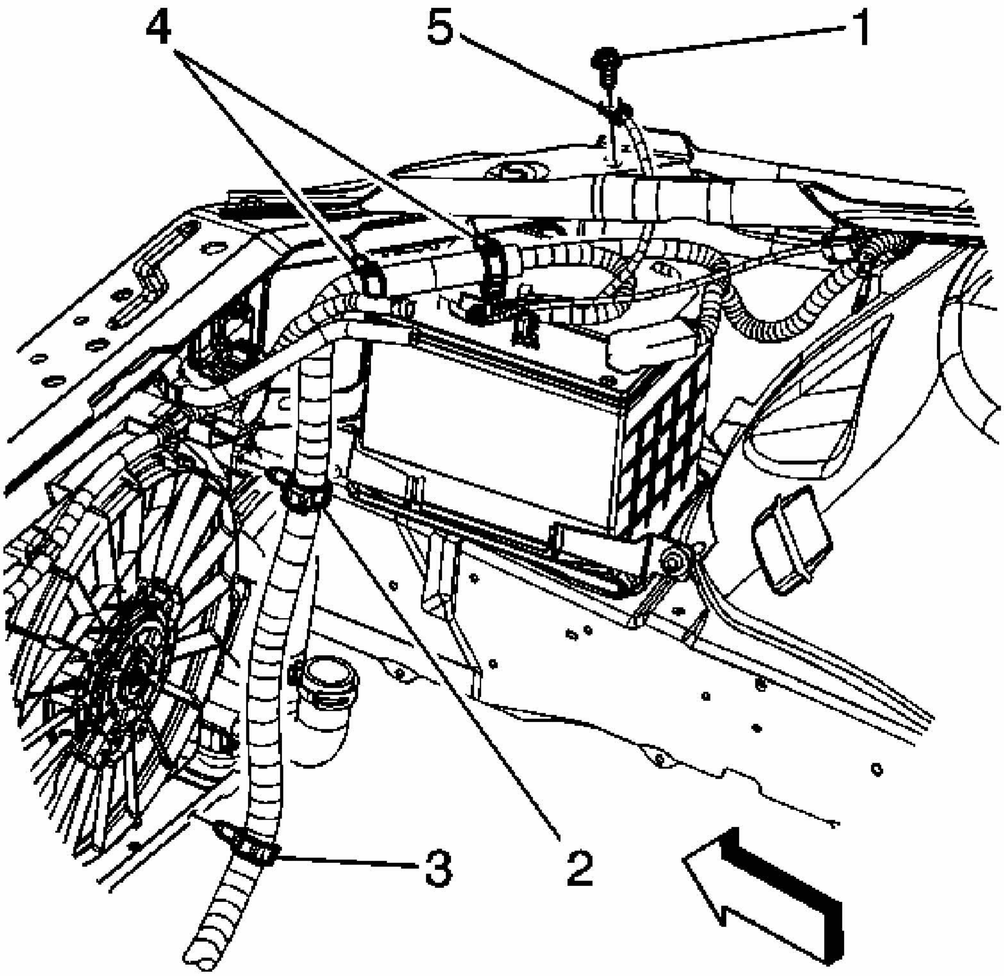


Fig. 41: View Of Ground Wire Bolt & Battery Cable Harness Retaining Clips
Courtesy of GENERAL MOTORS CORP.

10. Remove the ground wire bolt (1) and reposition the wire (5) from the top rail.
11. Remove the battery cable harness retaining clips (2, 3, and 4) from the front rail and fan shroud.
12. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

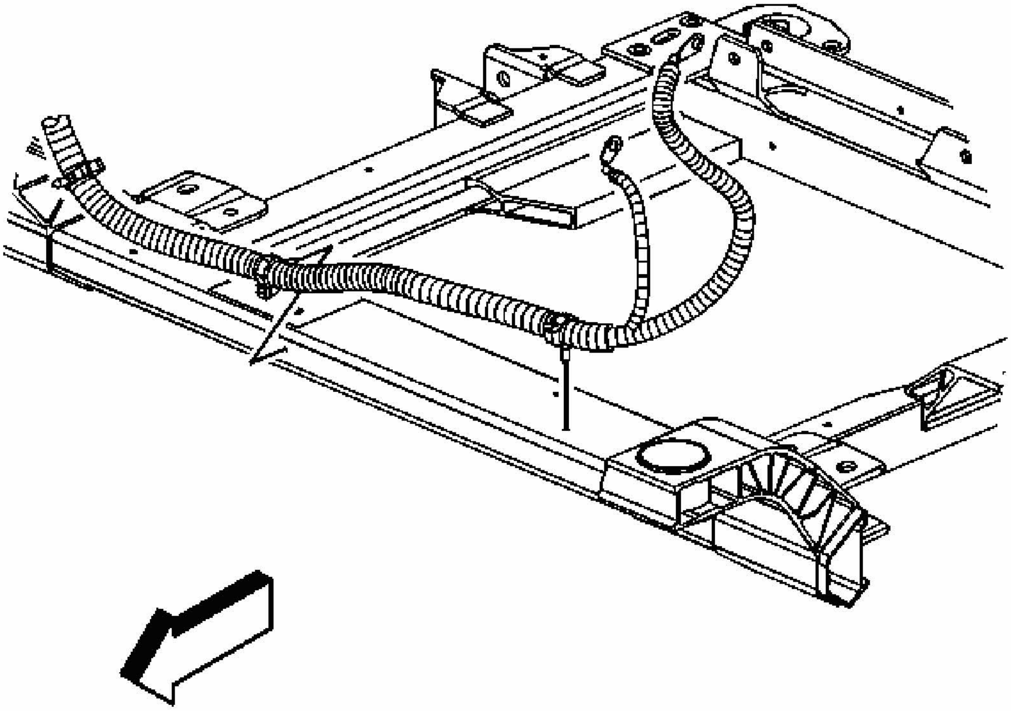


Fig. 42: View Of Battery Cable Harness Retainers
Courtesy of GENERAL MOTORS CORP.

13. Remove the battery cable harness retainers from the engine cradle.

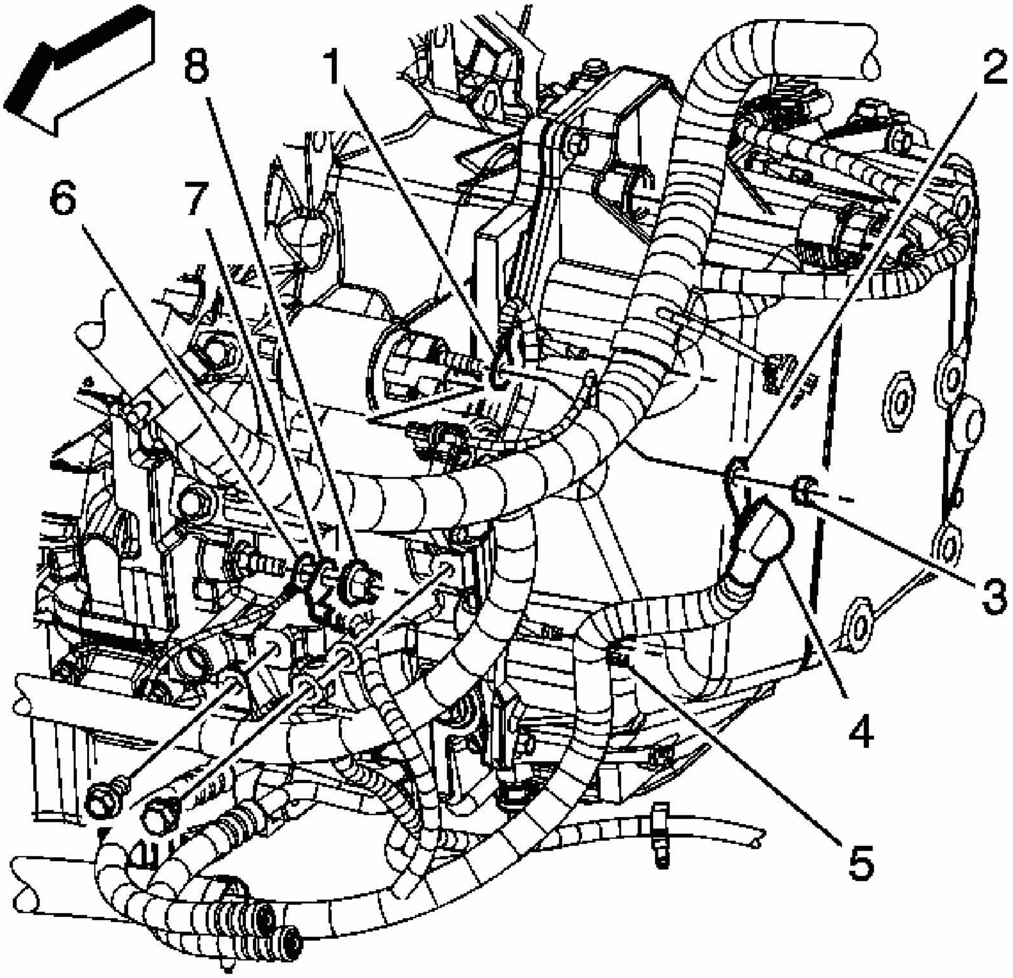


Fig. 43: Locating Transaxle Stud Nut
Courtesy of GENERAL MOTORS CORP.

14. Remove the transaxle stud nut (8).
15. Remove the battery cable ground (7) from the transaxle stud.
16. Reposition the positive battery cable boot (4) at the starter solenoid.
17. Remove the starter solenoid BAT terminal nut (3) from the starter.
18. Remove the positive battery cable (2) from the starter motor.
19. Remove the positive battery cable clip (5) from the transmission stud.
20. Lower the vehicle.
21. Remove the positive and negative battery cable from the vehicle.

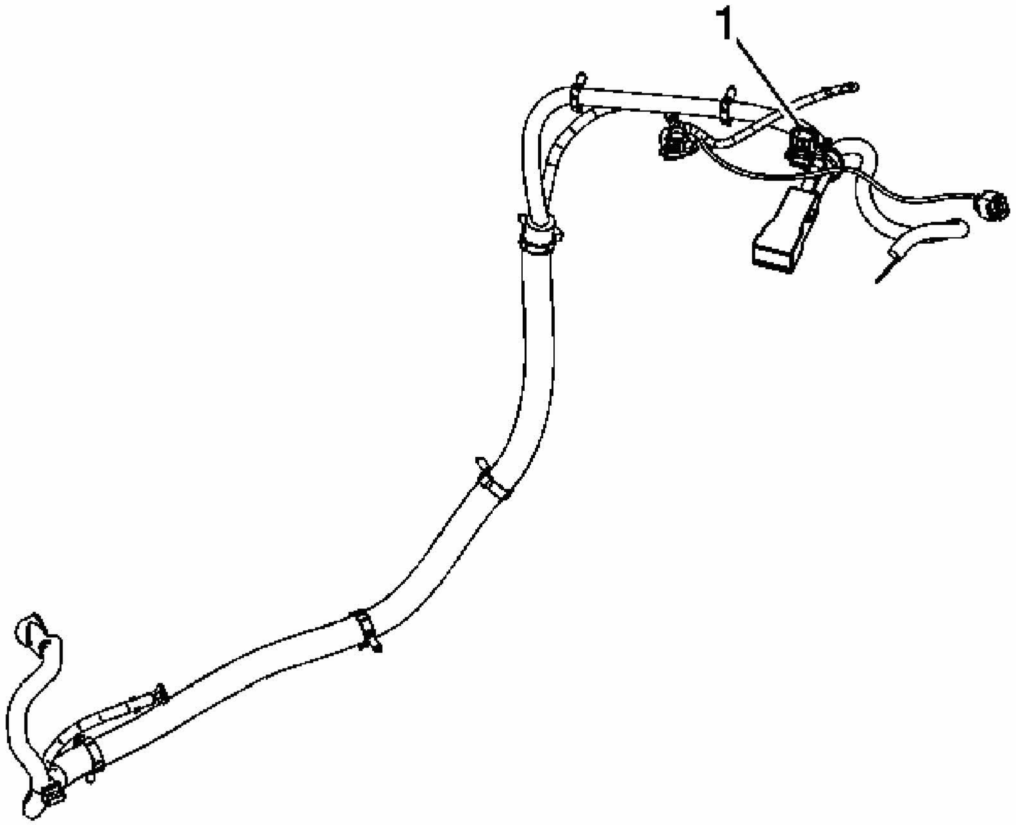


Fig. 44: Identifying Battery Current Sensor & Battery Cable
Courtesy of GENERAL MOTORS CORP.

22. If replacing the positive and negative battery cable, perform the following:
    1. Cut the tie straps and electrical tape attaching the battery current sensor to the battery cable.
    2. Squeeze the battery cable branches together.

       IMPORTANT: Note the position of the battery current sensor prior to removal.

    3. Slide the battery current sensor (1) off of the battery cable.

Installation Procedure

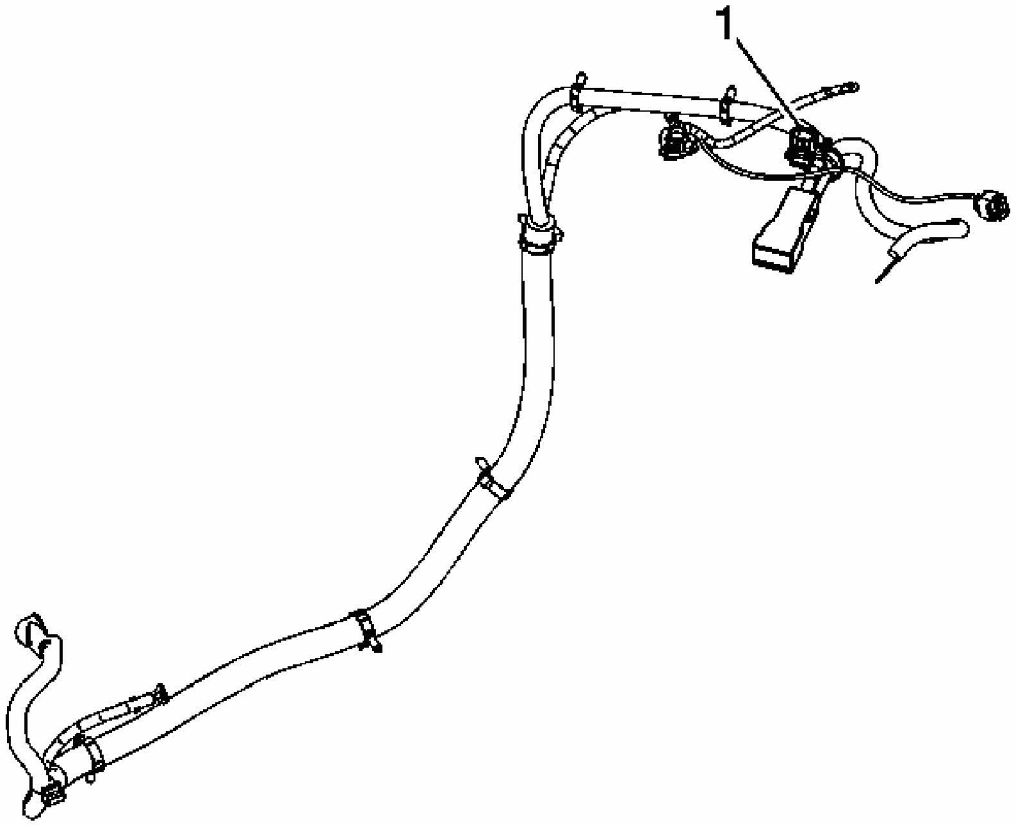


Fig. 45: Identifying Battery Current Sensor & Battery Cable
Courtesy of GENERAL MOTORS CORP.

1. If the positive and negative battery cable was replaced, perform the following:
    1. Slide the battery current sensor (1) onto the battery cable.

       IMPORTANT: Ensure that the tape tab is pointing away from the negative cable terminal.

    2. Using NEW tie straps and electrical tape, attach the battery current sensor to the battery cable.

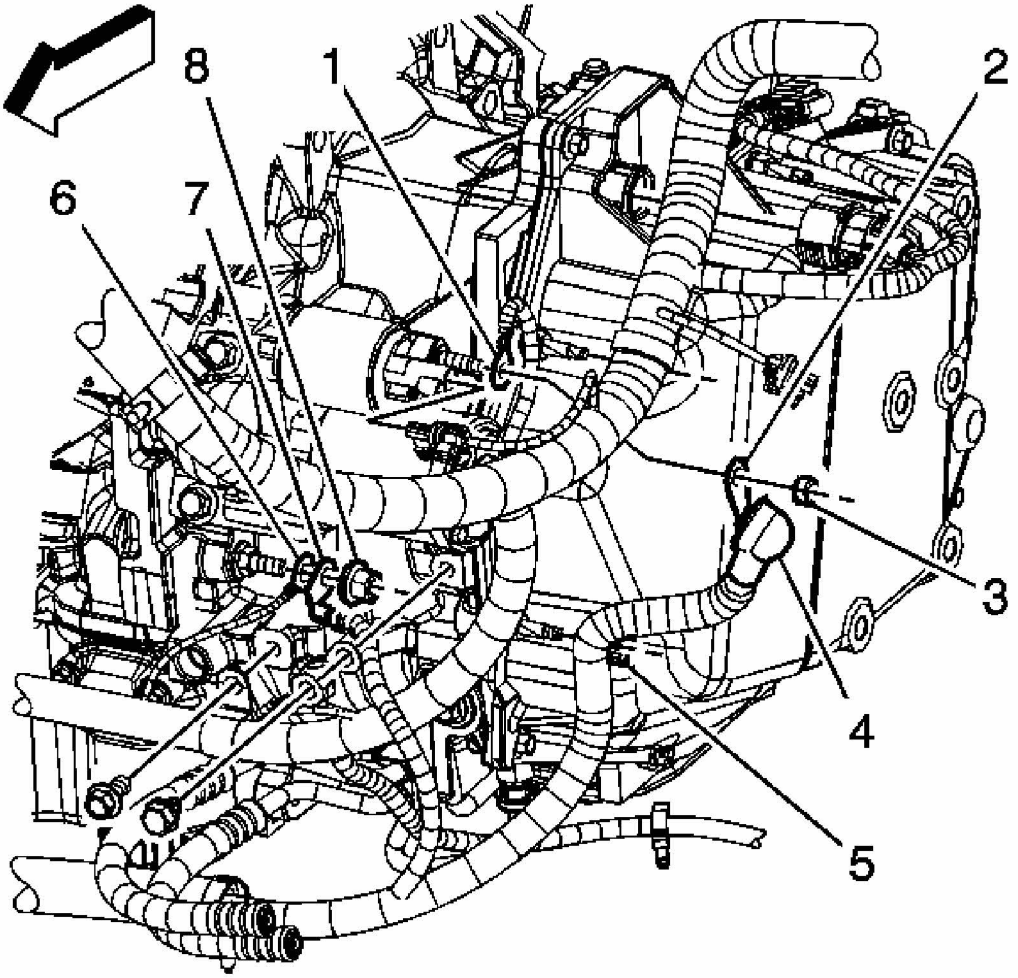


Fig. 46: View Of Battery Current Sensor, Bat Terminal Nut, Battery Cable Boot & Cable Clip
Courtesy of GENERAL MOTORS CORP.

2. Install the positive and negative battery cable to the vehicle.
3. Raise and support the vehicle.
4. Install the positive battery cable (2) to the starter motor.

NOTE: Refer to Fastener Notice .

5. Install the starter solenoid BAT terminal nut (3) to the starter.

Tighten: Tighten the nut to 10 N.m (89 lb in).

6. Position the positive battery cable boot (4) at the starter solenoid.
7. Install the positive battery cable clip (5) to the transmission stud.
8. Install the battery cable ground (7) to the transaxle stud.
9. Install the transaxle stud nut (8).

   Tighten: Tighten the nut to 30 N.m (22 lb ft).

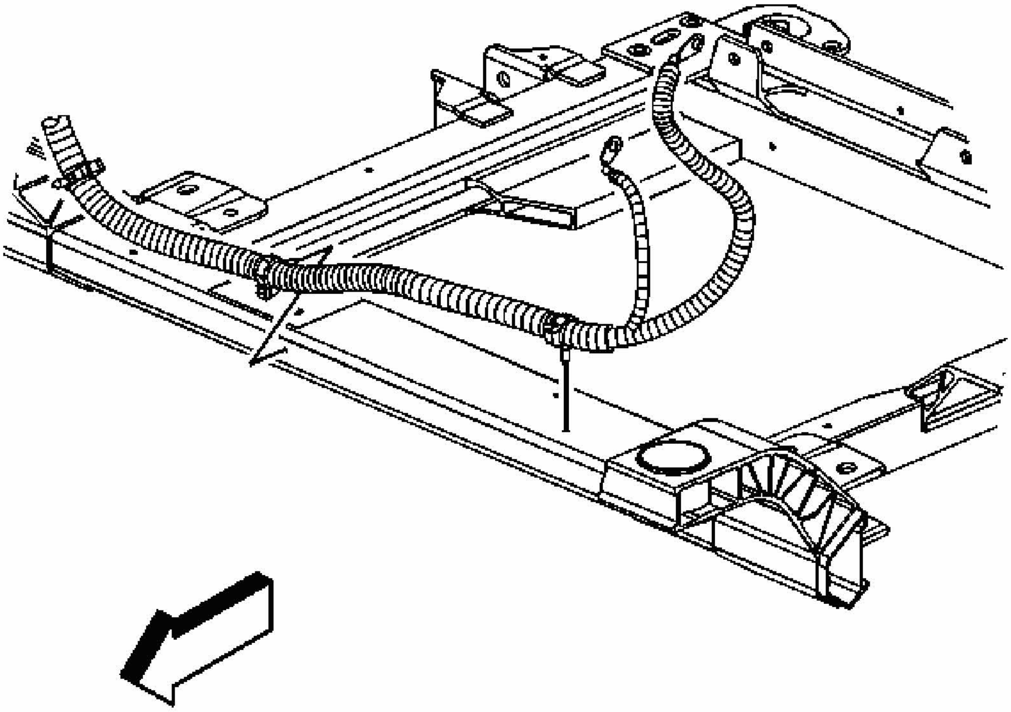


Fig. 47: View Of Battery Cable Harness Retainers
Courtesy of GENERAL MOTORS CORP.

10. Install the battery cable harness retainers from the engine cradle.
11. Lower the vehicle.

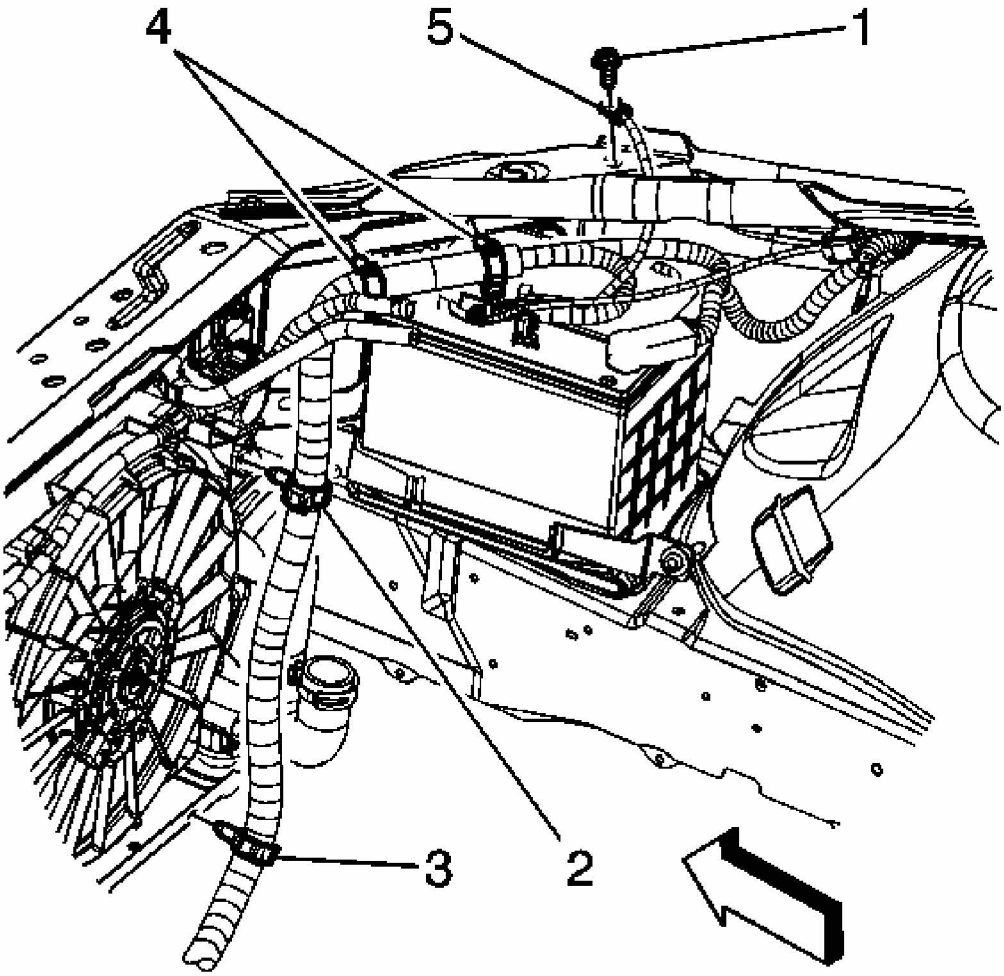


Fig. 48: Locating Ground Wire, Bolt, & Harness Retaining Clips
Courtesy of GENERAL MOTORS CORP.

12. Position the ground wire (5) and install the ground wire bolt (1) to the top rail.

    Tighten: Tighten the nut to 10 N.m (89 lb in).

13. Install the battery cable harness retaining clips (2, 3, and 4) to the front rail and fan shroud.

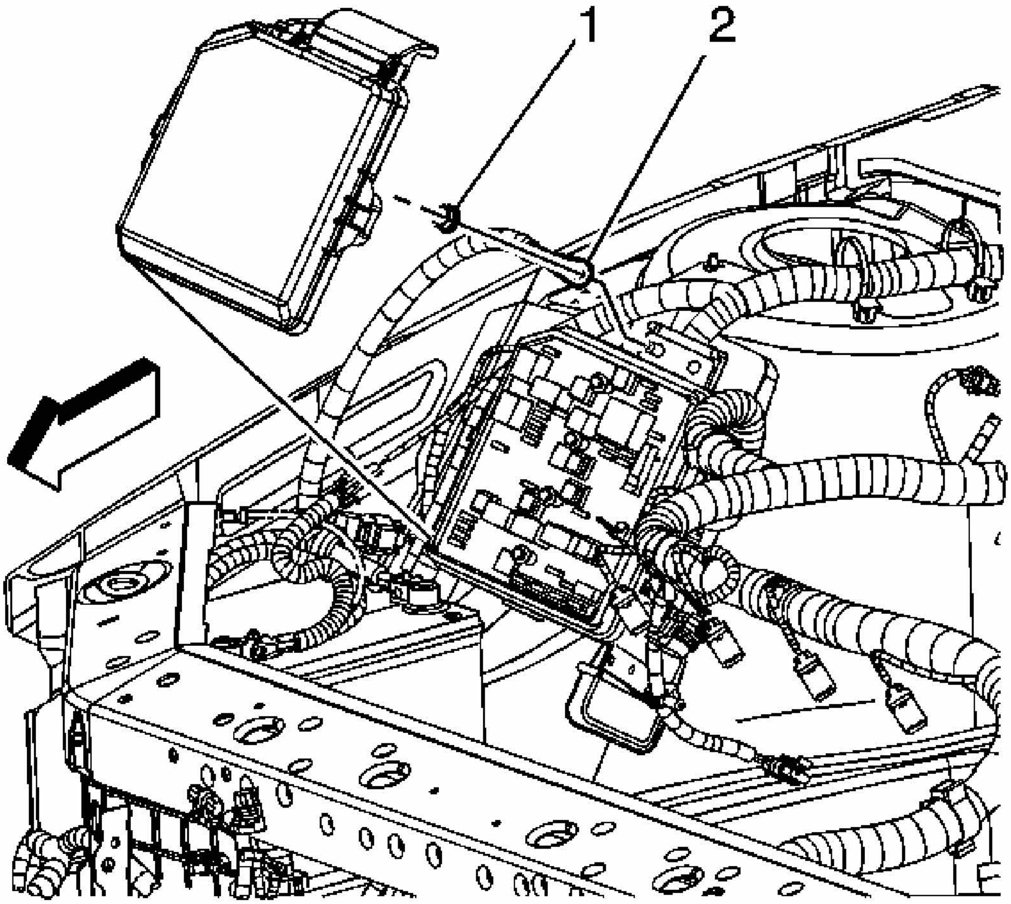


Fig. 49: View Of Bussed Electrical Center
Courtesy of GENERAL MOTORS CORP.

14. Install the positive battery cable terminal (2) to the BEC.
15. Install the positive battery cable junction block lead nut (1).

    Tighten: Tighten the nut to 10 N.m (89 lb in).

16. Install the BEC cover.

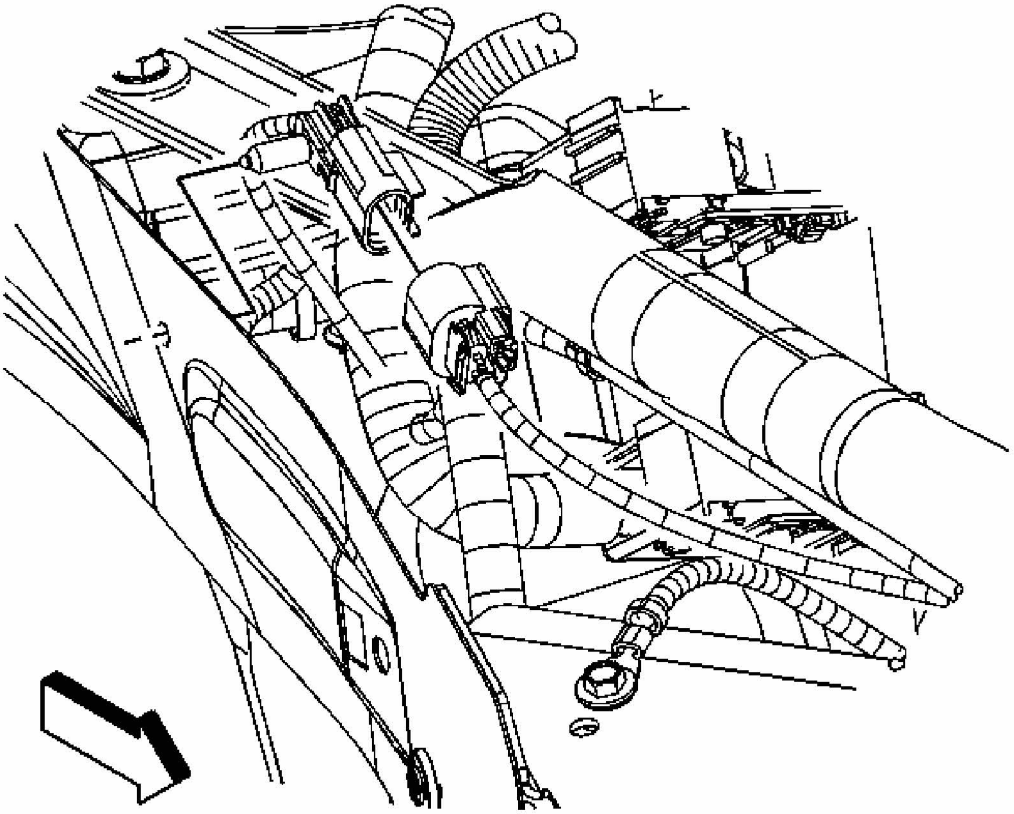


Fig. 50: View Of Battery Cable Connector & I/P Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

17. Connect the battery cable connector to the I/P harness electrical connector.

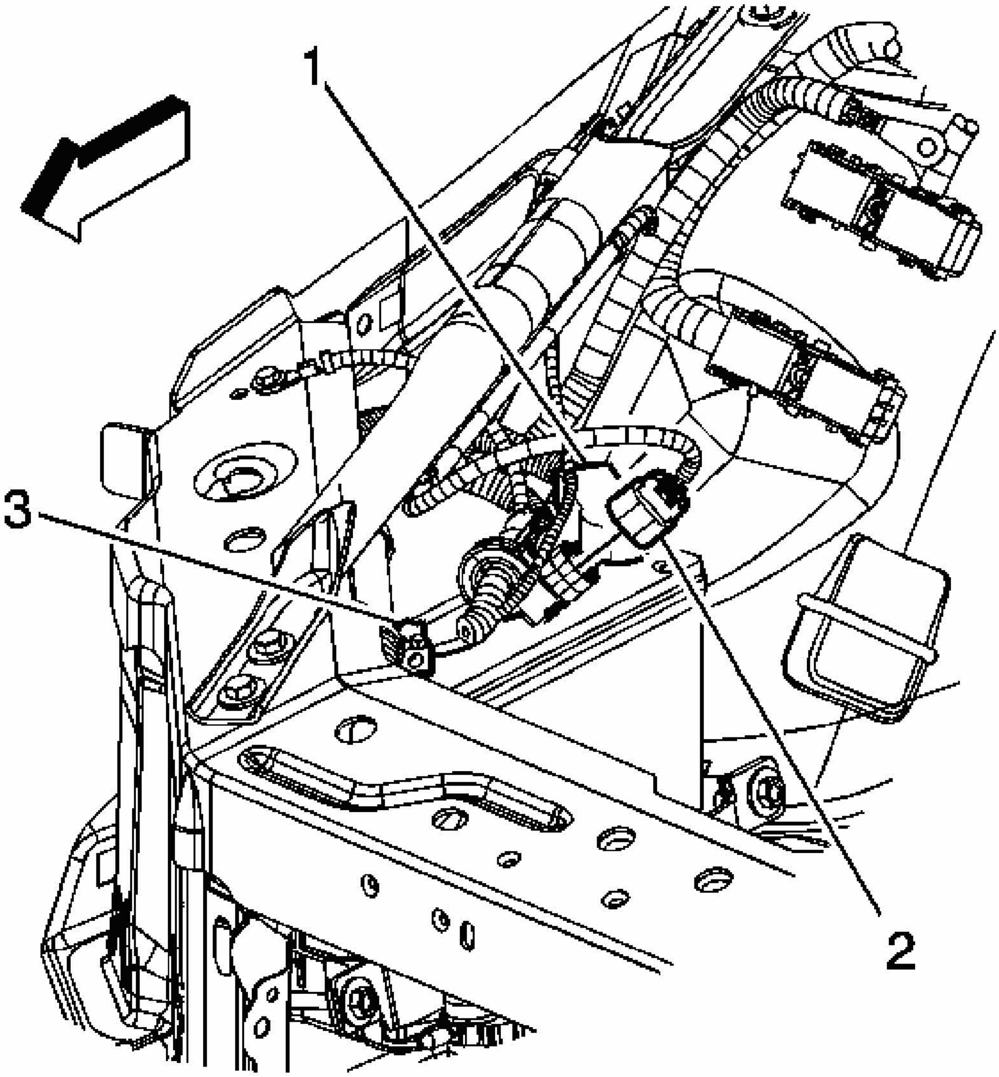


Fig. 51: Identifying Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

18. Connect the I/P harness electrical connector (2) to the battery current sensor.
19. Install the positive battery cable terminal to the battery.
20. Tighten the positive battery cable terminal lead nut.

    Tighten: Tighten the nut to 15 N.m (11 lb ft).

21. Snap closed the positive battery cable terminal lead cover (1).
22. Connect the negative battery cable (3). Refer to **Battery Negative Cable**

Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9) or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)**.

BATTERY REPLACEMENT (RPOS LZE/LZ4/LZ9)

Removal Procedure

IMPORTANT: Do not tip the battery more than 40 degrees during removal.

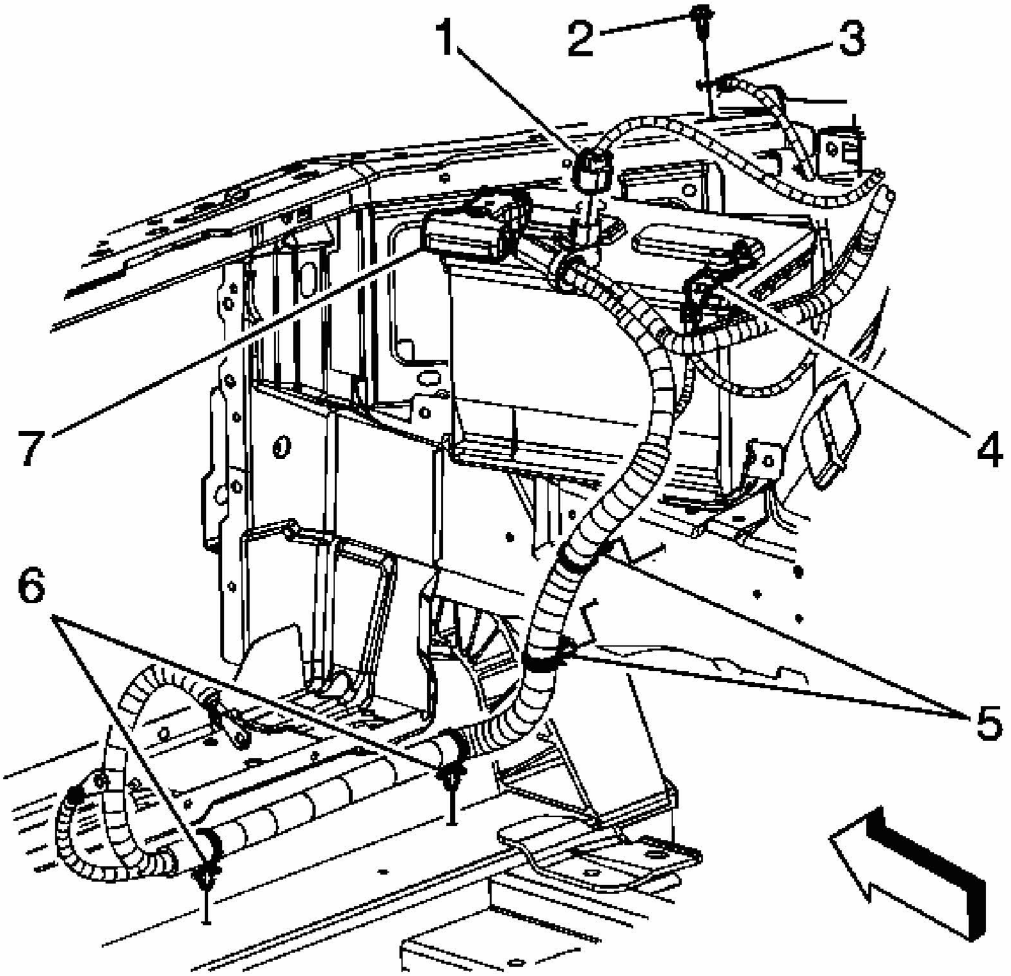


Fig. 52: View Of Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable**

Disconnect/Connect Procedure (RPO LS4).

2. Remove the right front diagonal brace. Refer to **Brace Replacement - Front Fender Upper Diagonal** .
3. Open the positive battery cable terminal cover (7).
4. Loosen the positive battery cable terminal nut.
5. Remove the positive battery cable terminal from the battery.

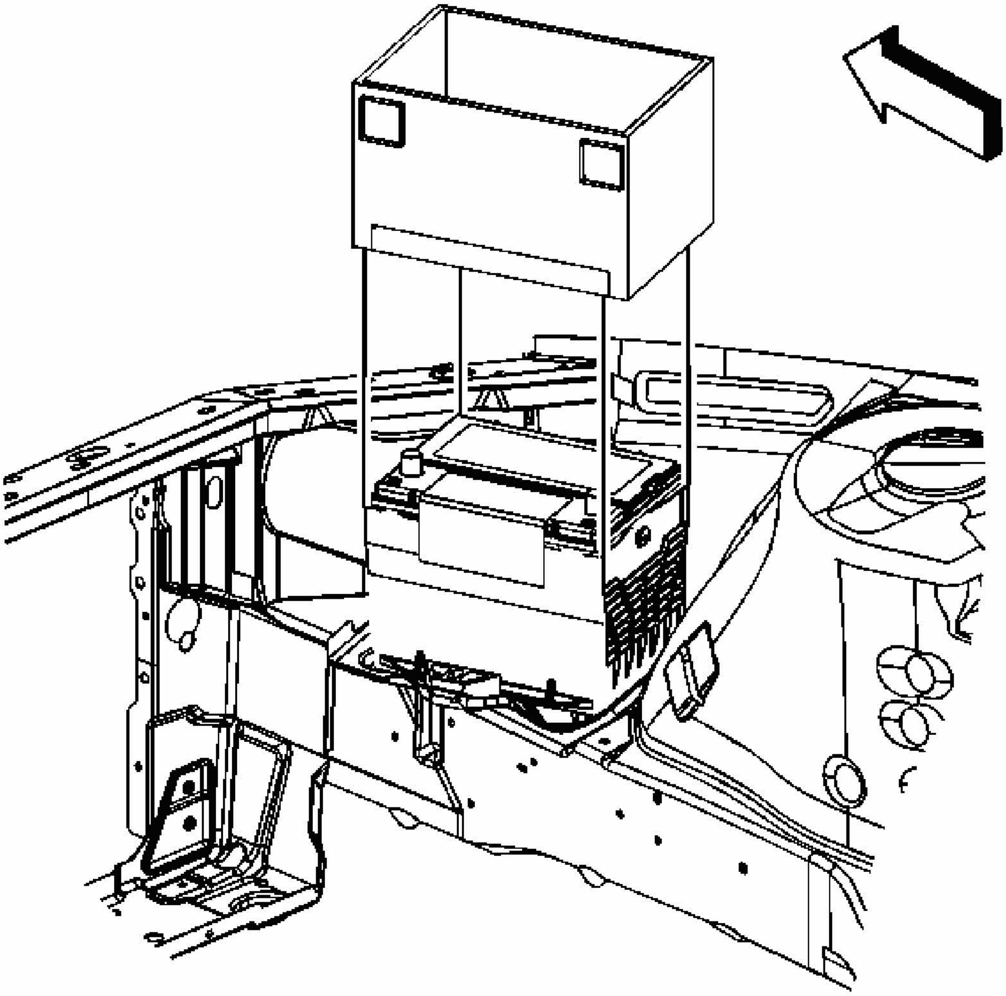


Fig. 53: View Of Battery Insulator
Courtesy of GENERAL MOTORS CORP.

6. Remove the battery insulator.

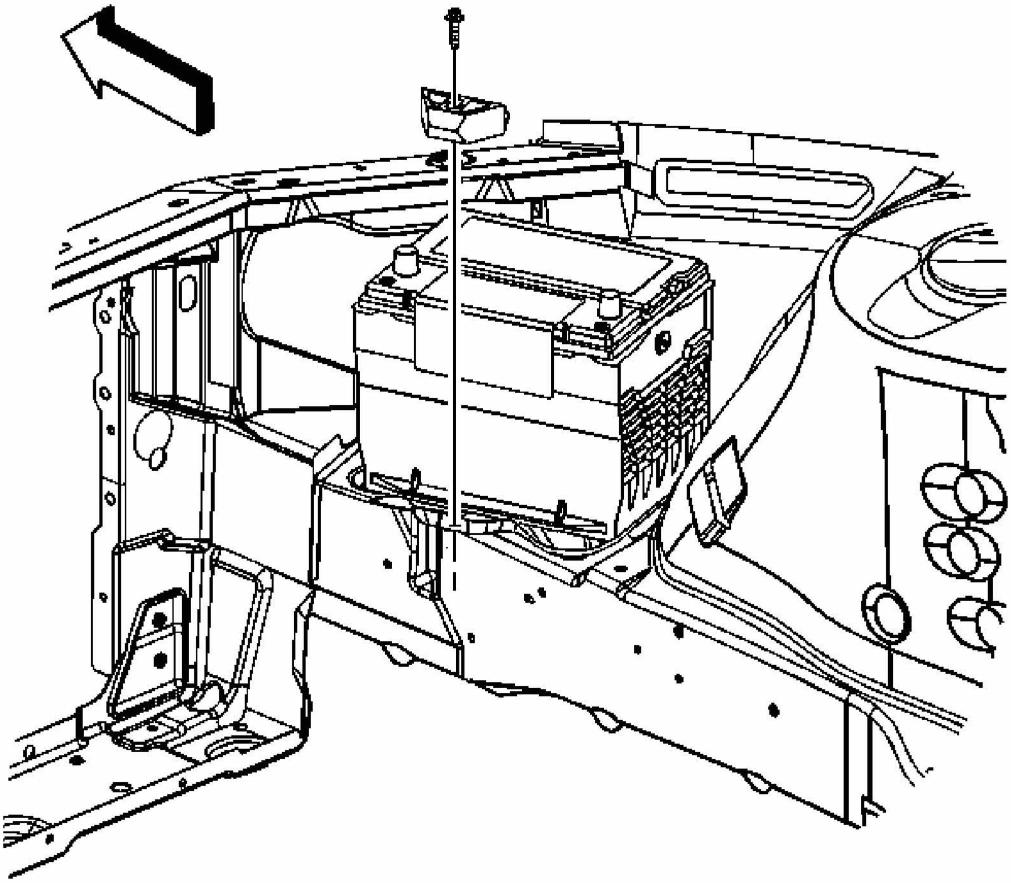


Fig. 54: View Of Battery Hold Down & Bolt
Courtesy of GENERAL MOTORS CORP.

7. Remove the battery hold down bolt and hold down.
8. Remove the battery.

Installation Procedure

IMPORTANT: Do not tip the battery more than 40 degrees during installation.

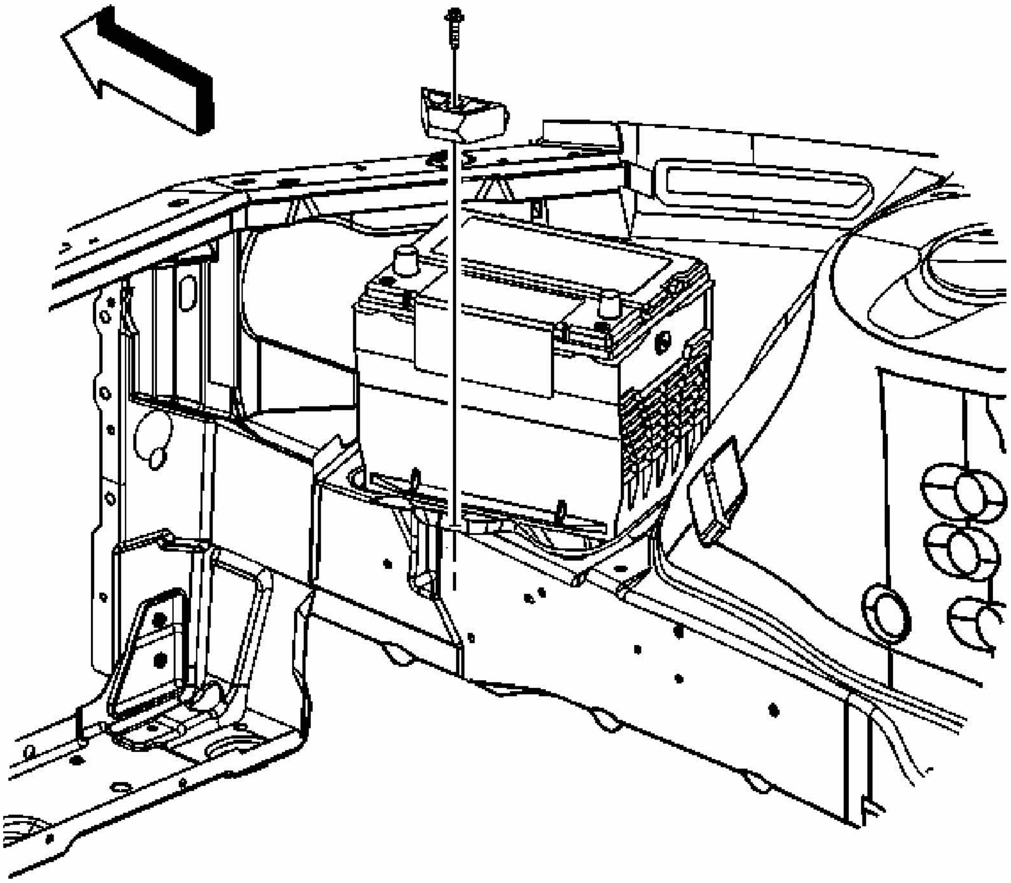


Fig. 55: View Of Battery Hold Down & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the battery.

NOTE: **Refer to Fastener Notice .**

2. Install the battery hold down and bolt.

Tighten: Tighten the bolt to 18 N.m (13 lb ft).

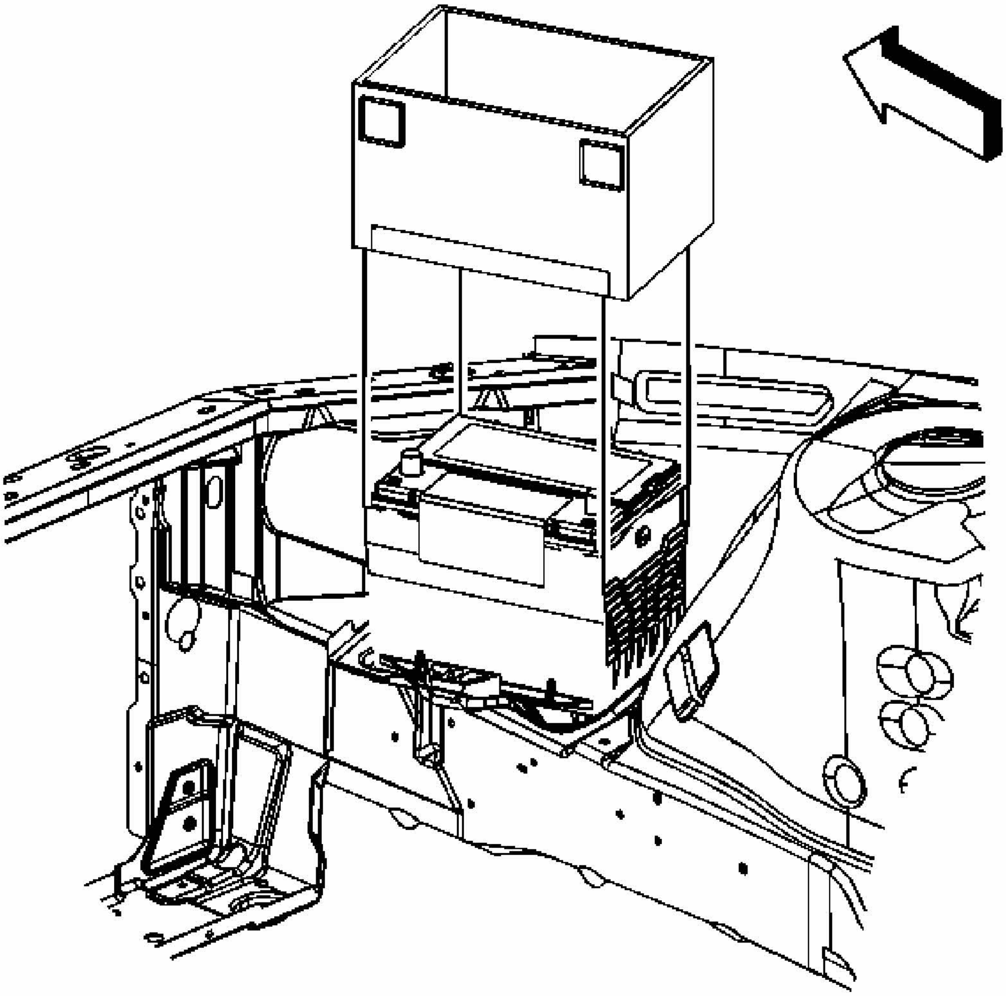


Fig. 56: View Of Battery Insulator
Courtesy of GENERAL MOTORS CORP.

3. Install the battery insulator.

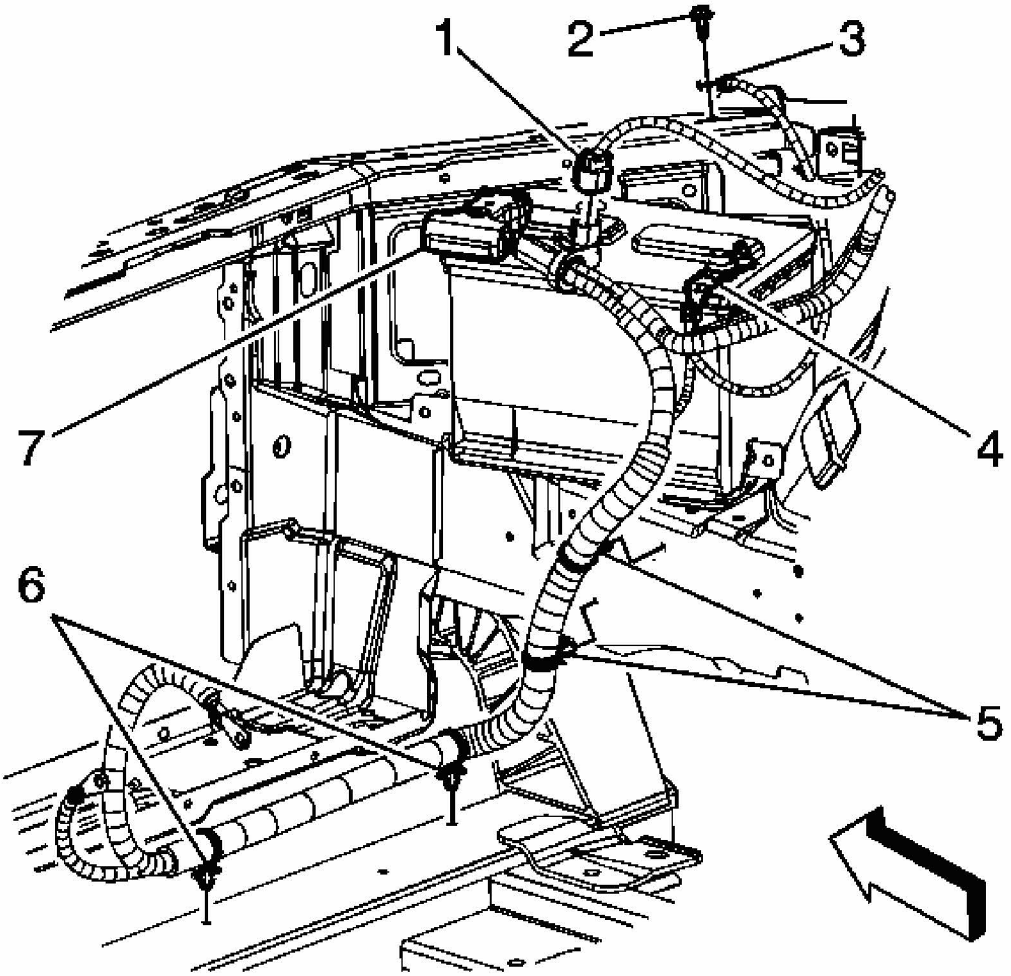


Fig. 57: View Of Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

4. Install the positive battery cable terminal to the battery.
5. Tighten the positive battery cable terminal nut.

   Tighten: Tighten the nut to 15 N.m (11 lb ft).

6. Snap closed the positive battery cable terminal cover (7).
7. Install the right front diagonal brace. Refer to **Brace Replacement - Front Fender Upper Diagonal** .
8. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)**.

BATTERY REPLACEMENT (RPO LS4)

Removal Procedure

IMPORTANT: Do not tip the battery more than 40 degrees during removal.

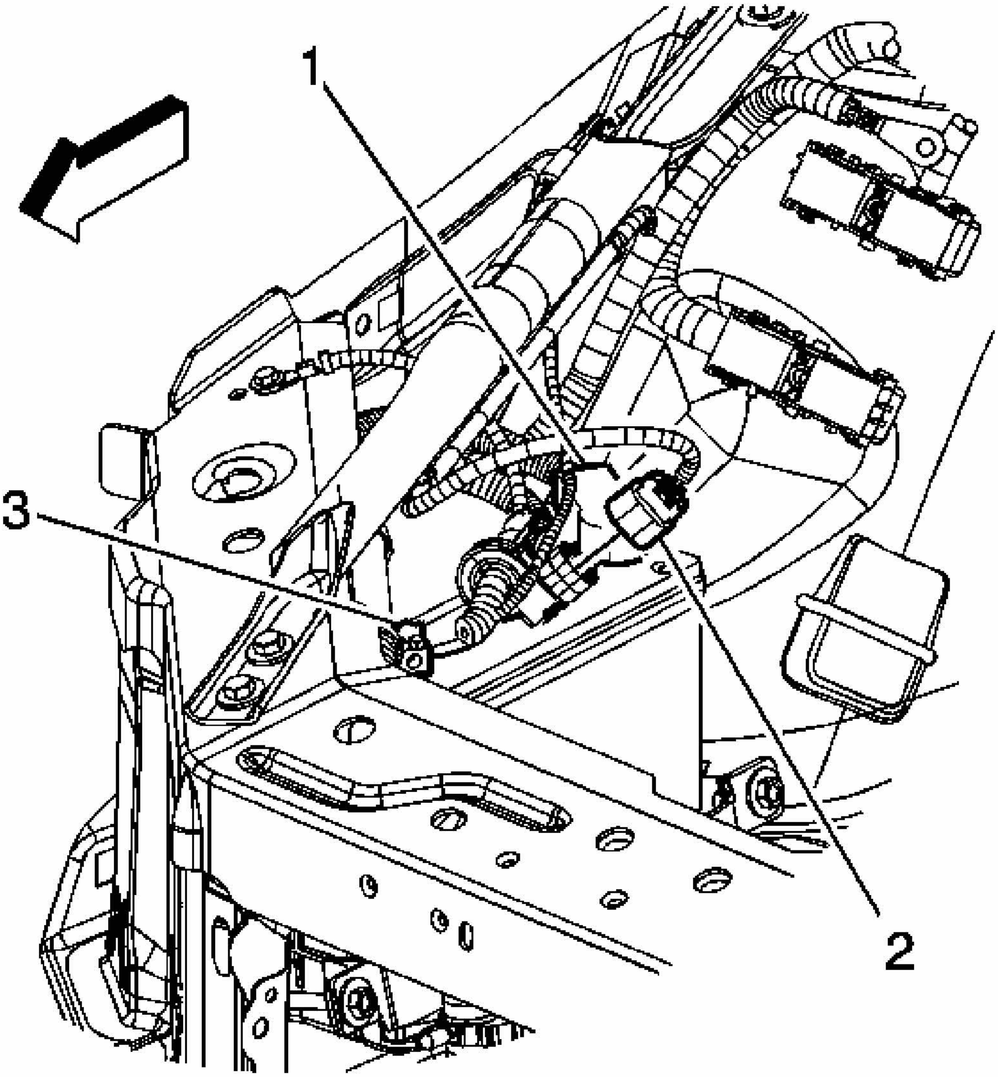


Fig. 58: Identifying Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable**

Disconnect/Connect Procedure (RPO LS4).

2. Remove the right front diagonal brace. Refer to **Brace Replacement - Front Fender Upper Diagonal** .
3. Reposition the positive battery cable terminal cover (1).
4. Loosen the positive battery cable terminal nut.
5. Remove the positive battery cable terminal from the battery.

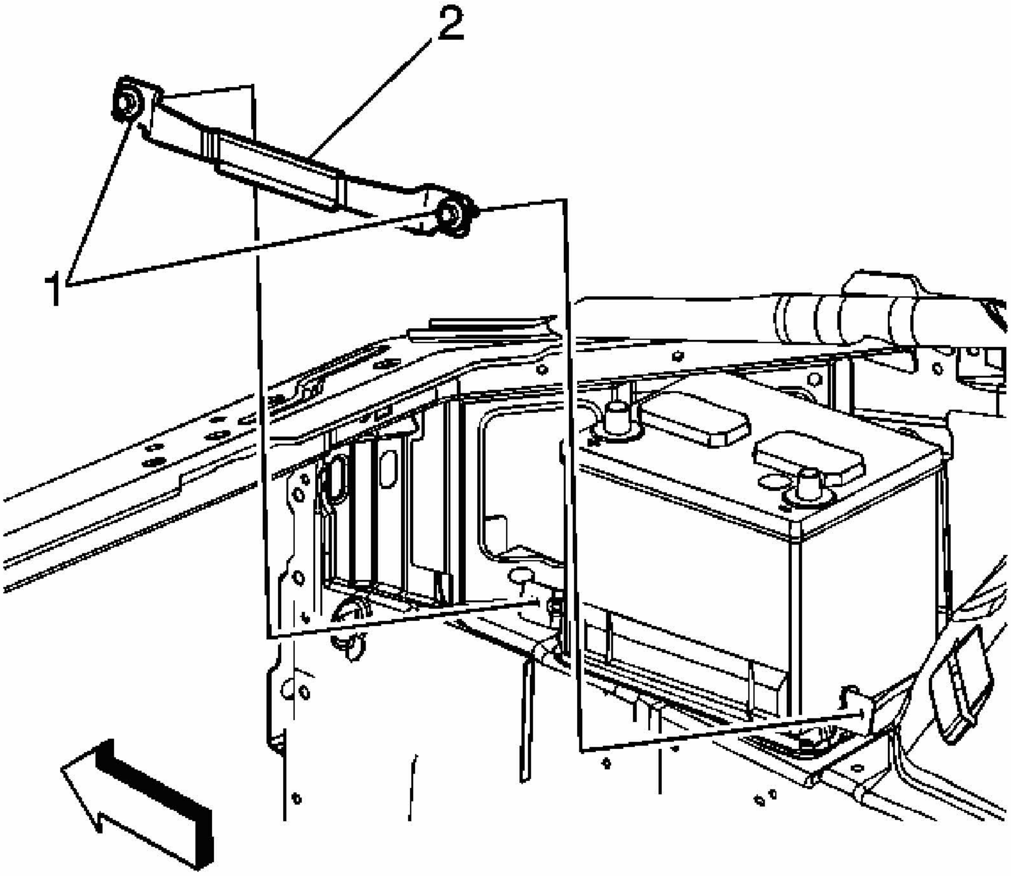


Fig. 59: View Of Battery Retainer & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the battery retainer bolts (1) and retainer (2).
7. Remove the battery.

Installation Procedure

IMPORTANT: Do not tip the battery more than 40 degrees during

installation.

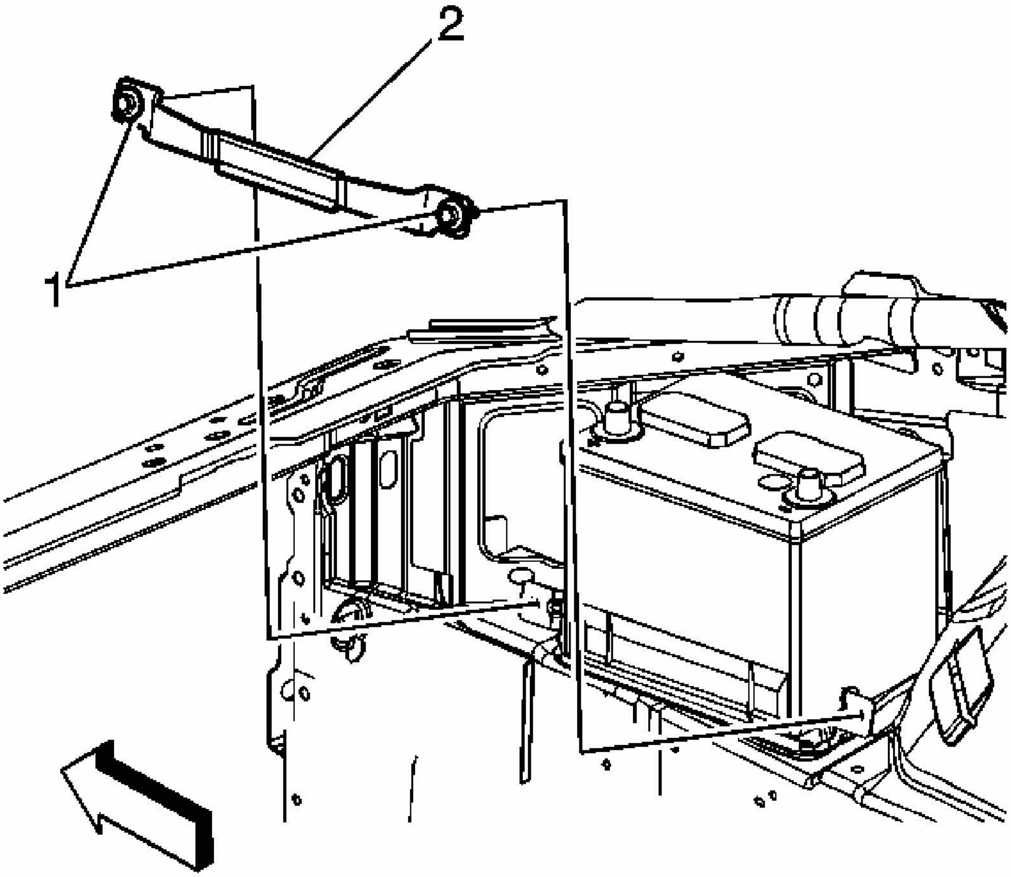


Fig. 60: View Of Battery Retainer & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the battery.

NOTE: **Refer to Fastener Notice .**

2. Install the battery retainer (2) and bolts (1).

Tighten: Tighten the bolts to 18 N.m (13 lb ft).

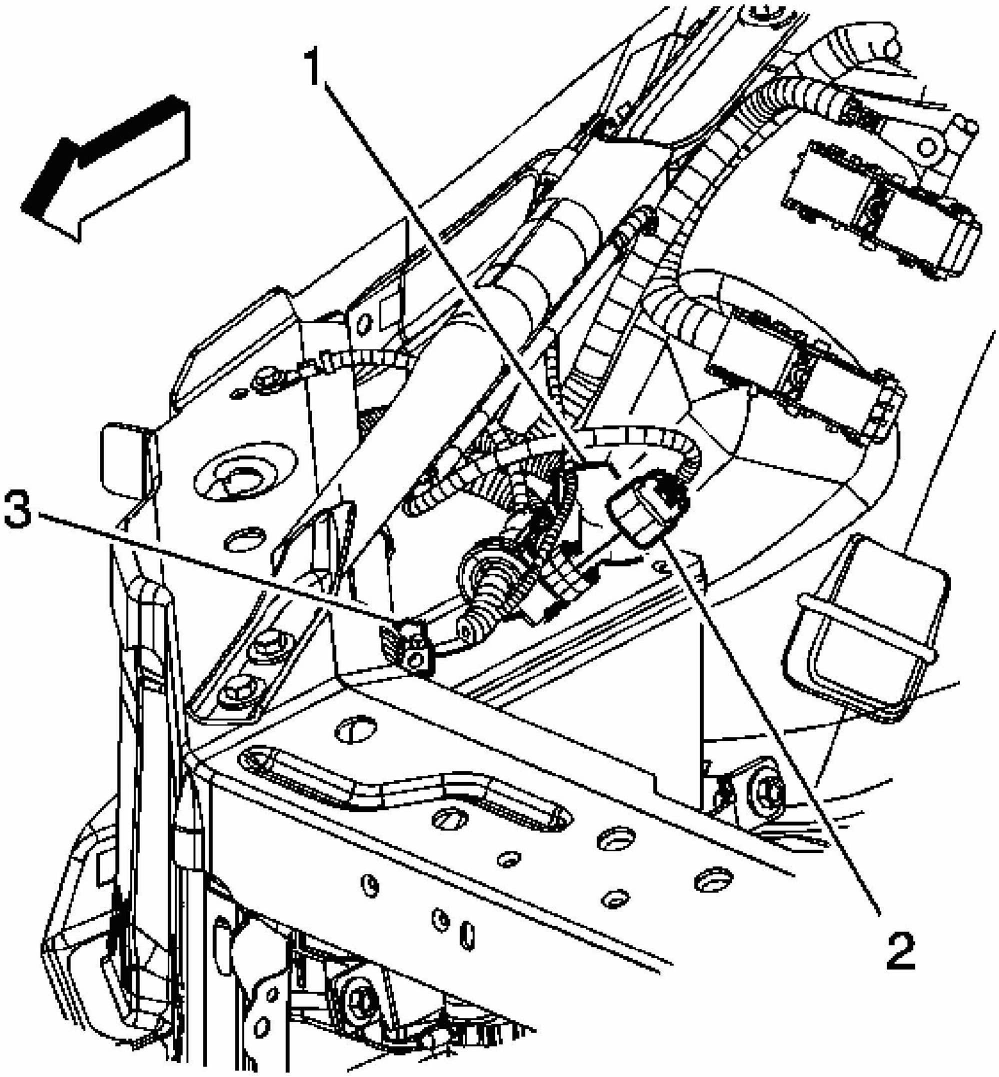


Fig. 61: Identifying Negative Battery Cable Terminal & Battery
Courtesy of GENERAL MOTORS CORP.

3. Install the positive battery cable terminal to the battery.
4. Tighten the positive battery cable terminal nut.

   Tighten: Tighten the nut to 15 N.m (11 lb ft).

5. Position the positive battery cable terminal cover (2).
6. Install the right front diagonal brace. Refer to **Brace Replacement - Front Fender Upper Diagonal** .

7. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)**.

BATTERY TRAY REPLACEMENT (RPOS LZE/LZ4/LZ9)

Removal Procedure

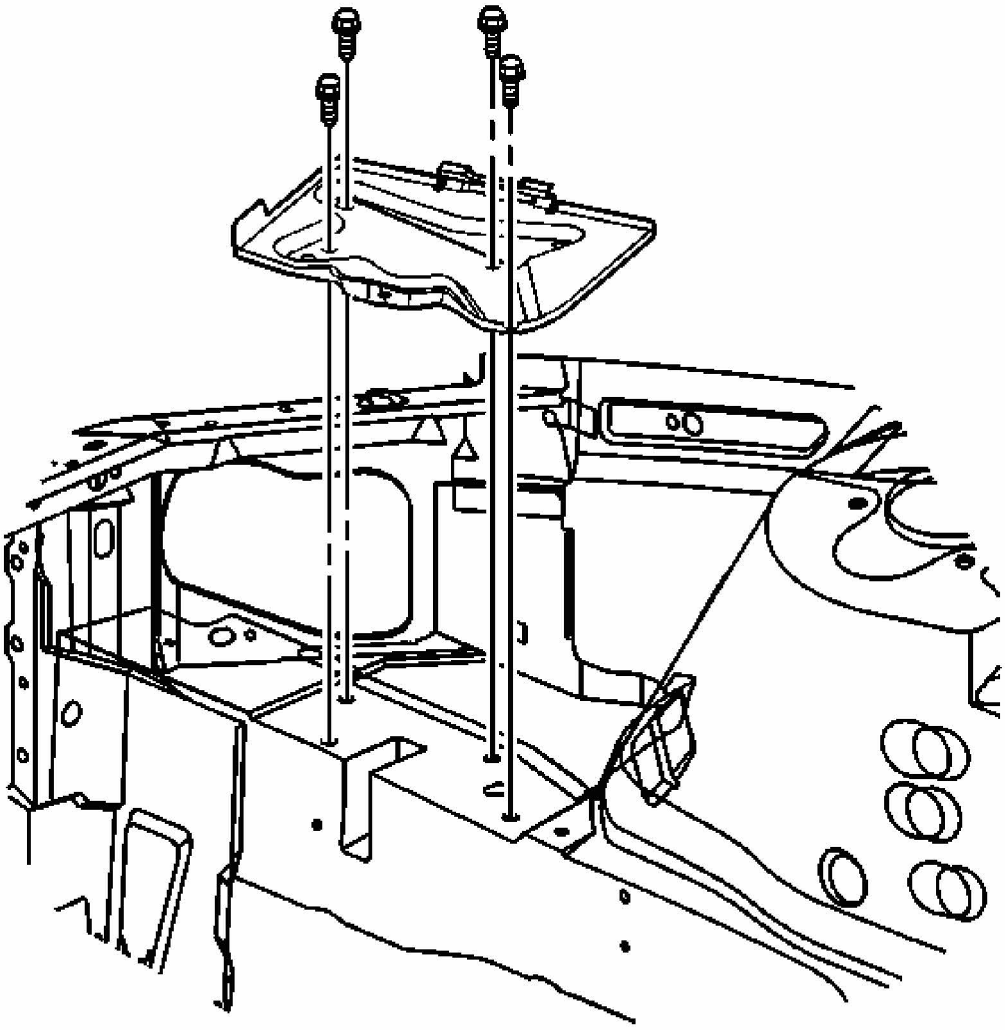


Fig. 62: Battery Tray & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the battery. Refer to **Battery Replacement (RPOs LZE/LZ4/LZ9)** or **Battery Replacement (RPO LS4)**.

2. Remove the battery tray bolts.
3. Remove the battery tray.

Installation Procedure

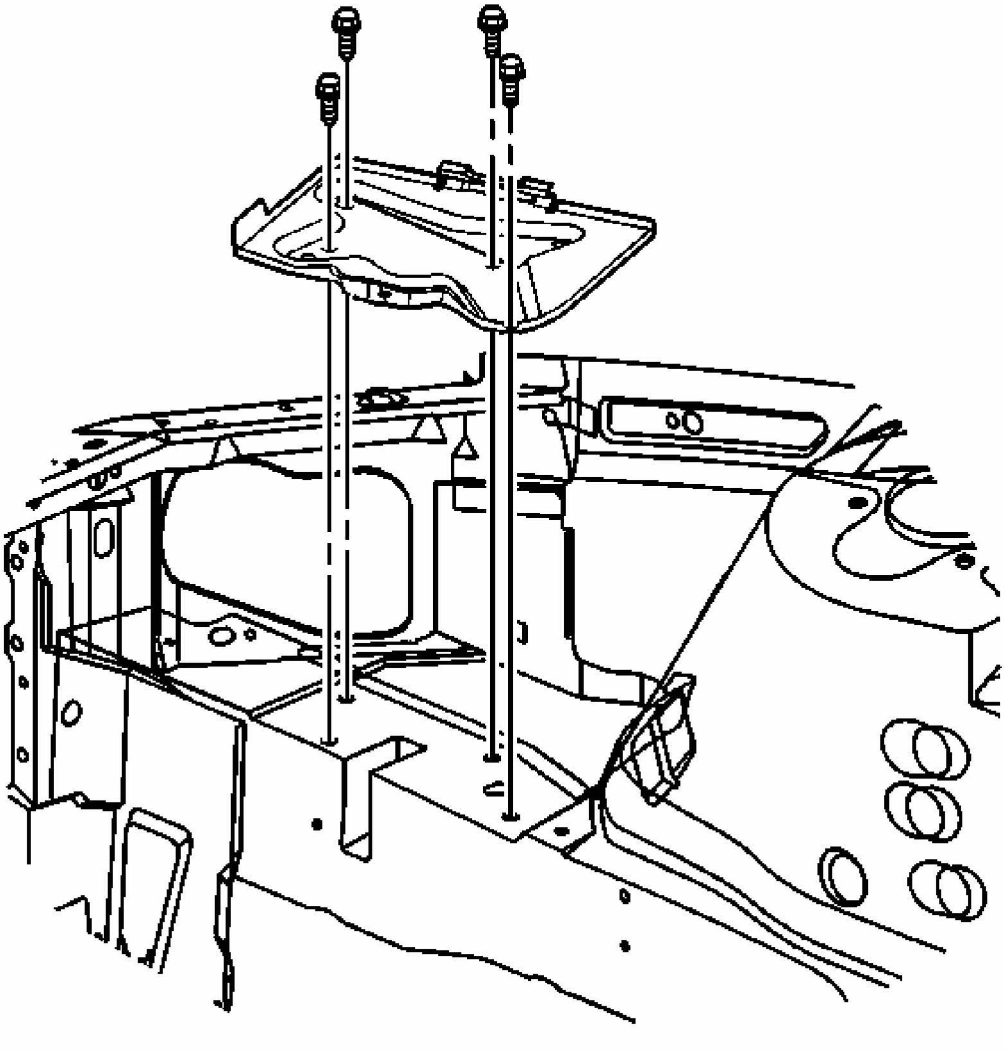


Fig. 63: Battery Tray & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the battery tray.

NOTE: **Refer to Fastener Notice .**

2. Install the battery tray bolts.

   Tighten: Tighten the bolts to 5 N.m (44 lb in).

3. Install the battery. Refer to **Battery Replacement (RPOs LZE/LZ4/LZ9)** or **Battery Replacement (RPO LS4)**.

BATTERY TRAY REPLACEMENT (RPO LS4)

Removal Procedure

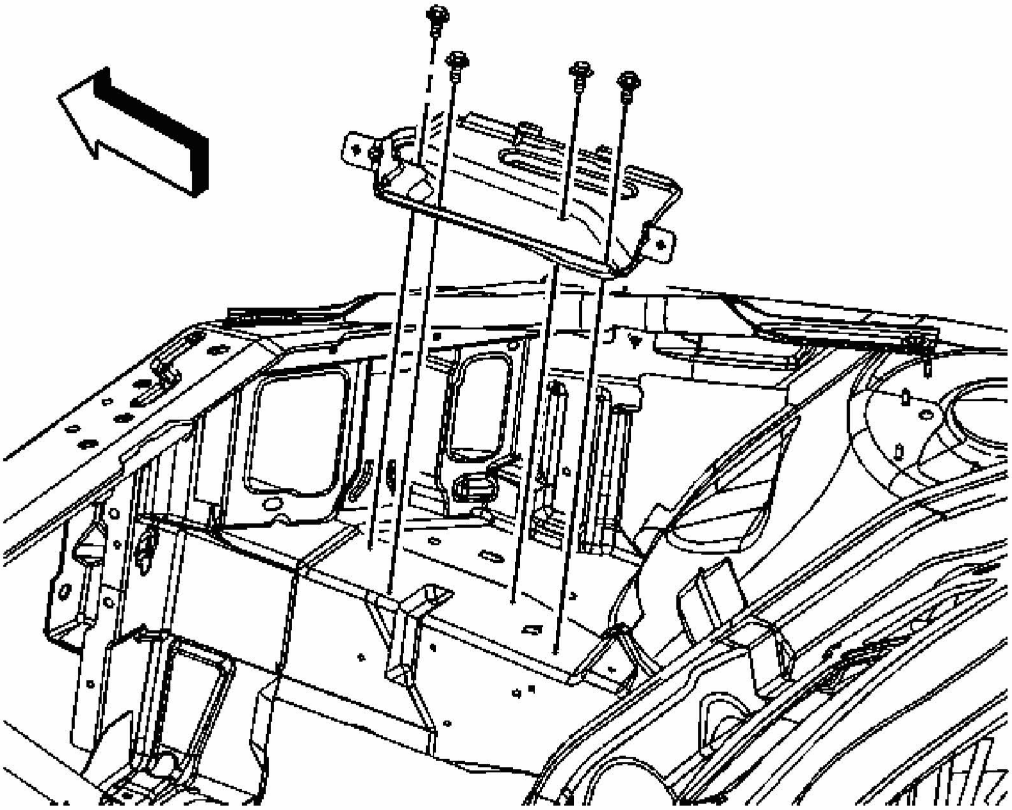


Fig. 64: Battery Tray & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the battery. Refer to **Battery Replacement (RPOs LZE/LZ4/LZ9)** or **Battery Replacement (RPO LS4)**.
2. Remove the battery tray bolts.
3. Remove the battery tray.

Installation Procedure

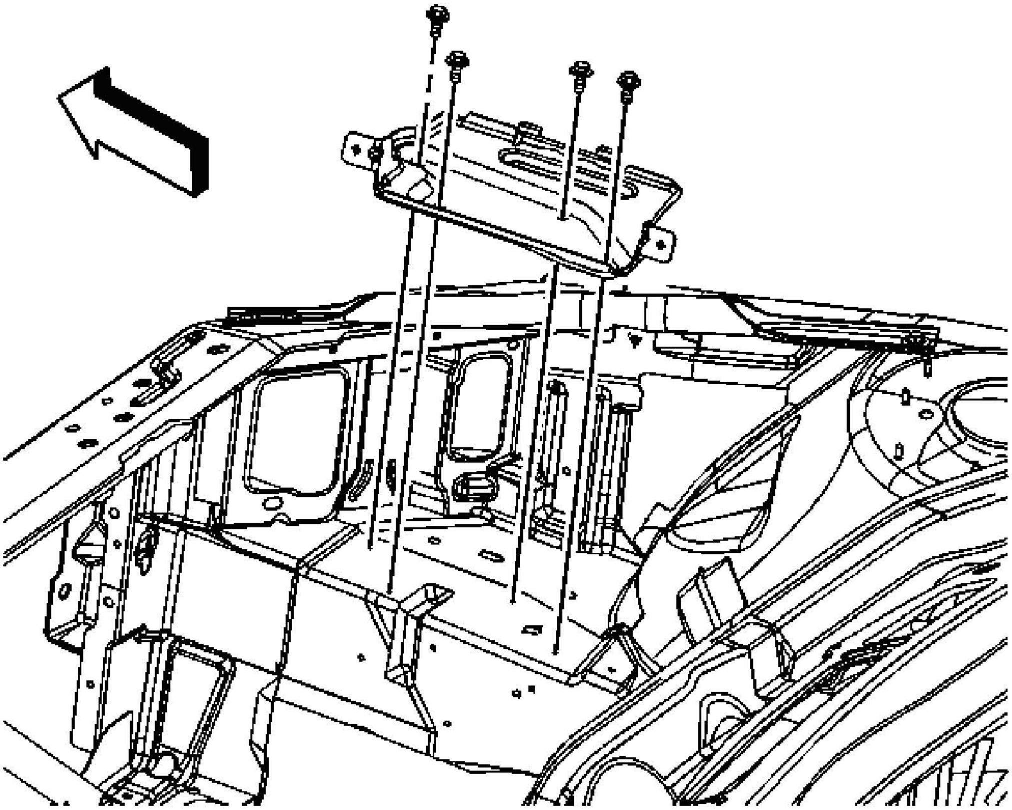


Fig. 65: Battery Tray & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the battery tray.

   NOTE: Refer to Fastener Notice .

2. Install the battery tray bolts.

   Tighten: Tighten the bolts to 5 N.m (44 lb in).

3. Install the battery. Refer to **Battery Replacement (RPOs LZE/LZ4/LZ9)** or **Battery Replacement (RPO LS4)**.

STARTER MOTOR REPLACEMENT (RPOS LZE/LZ4/LZ9)

Removal Procedure

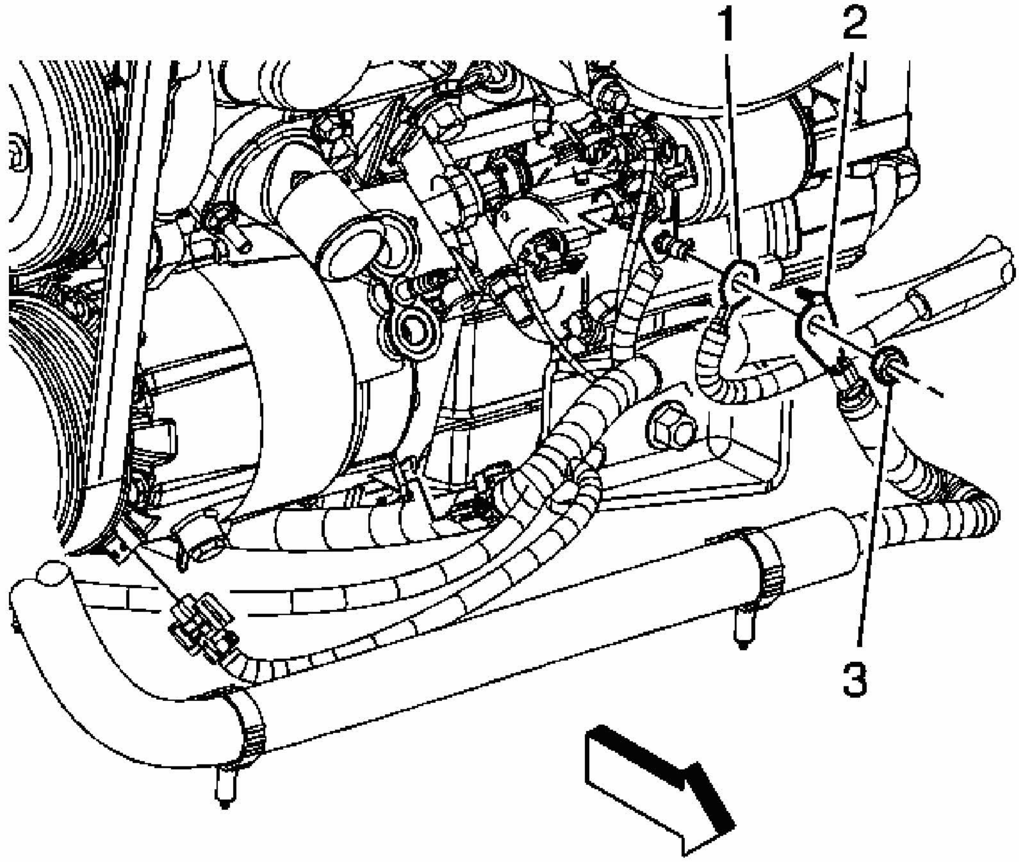


Fig. 66: View Of Bat Terminal Nut, Battery Cable Terminal & Engine Harness Terminal
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)**.
2. Remove the front lower air deflector panel. Refer to **Radiator Air Baffle and Deflector Replacement - Lower** .
3. Remove the torque converter cover. Refer to **Torque Converter Cover Replacement** .
4. Remove the starter solenoid BAT terminal nut (1) from the starter motor.
5. Remove the positive battery cable terminal (2) and engine harness terminal (3) from the starter.

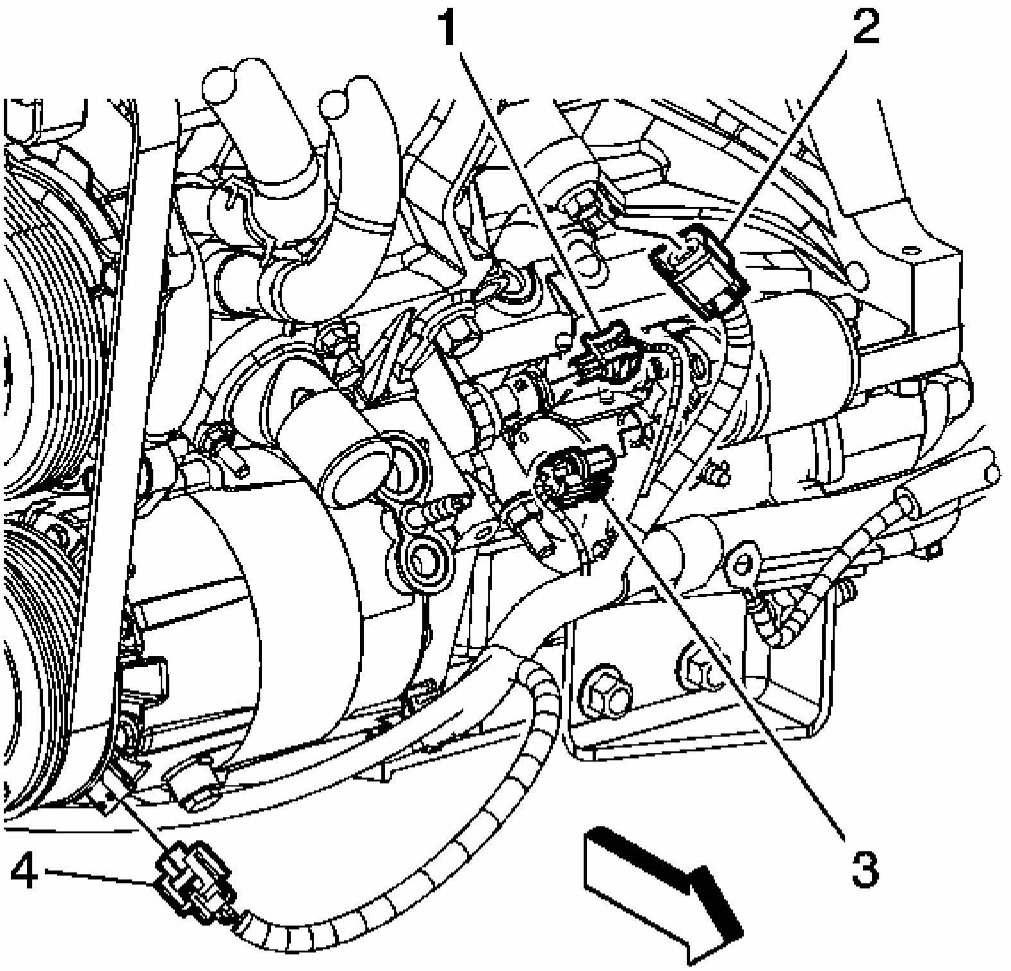


Fig. 67: Identifying Starter Motor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the starter motor electrical connector (3).

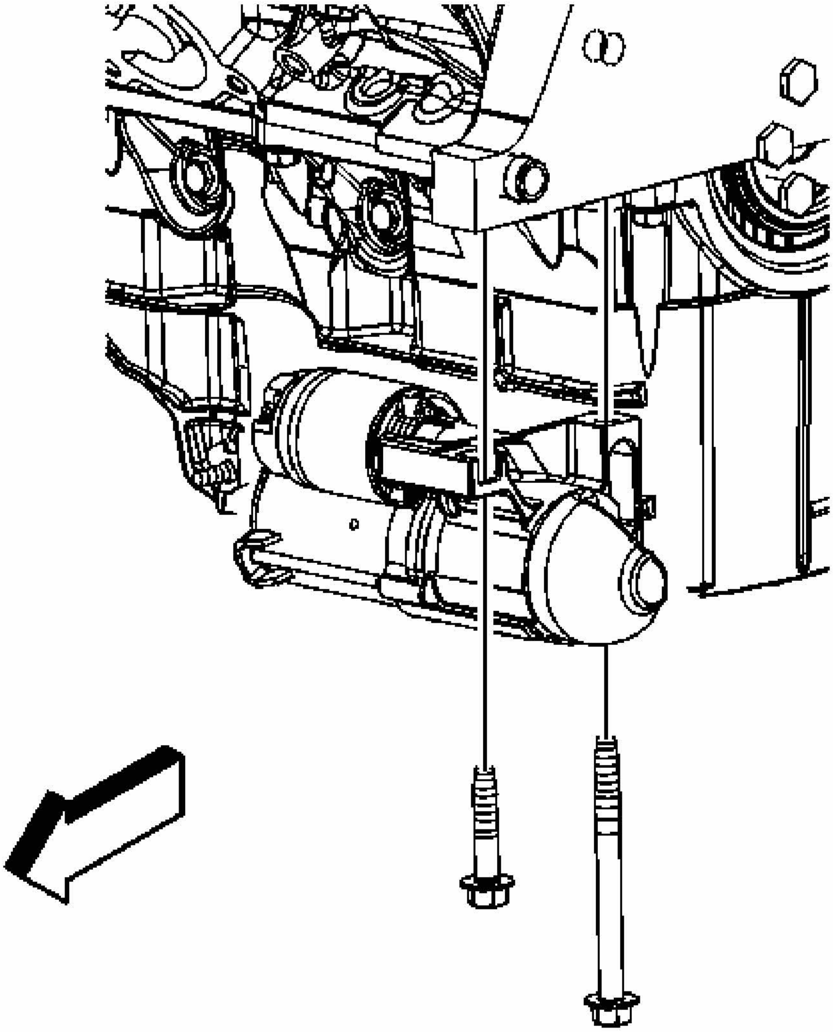


Fig. 68: View Of Starter Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the starter bolts.
8. Remove the starter.

Installation Procedure

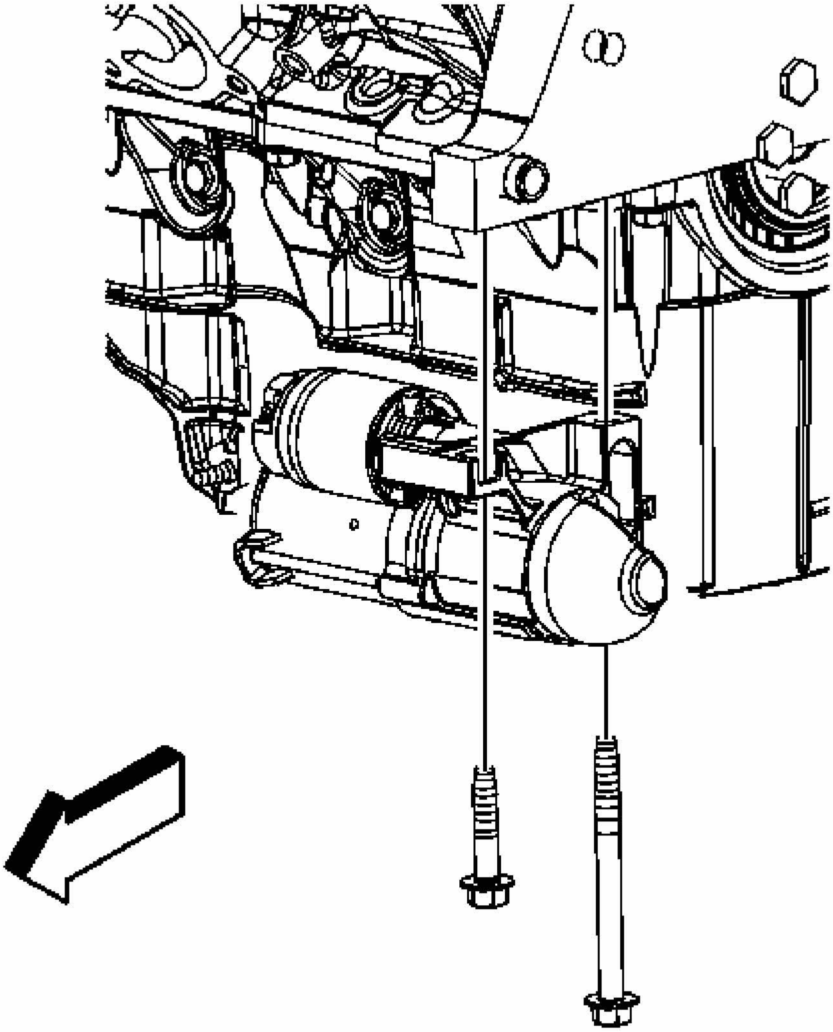


Fig. 69: View Of Starter Bolts
Courtesy of GENERAL MOTORS CORP.

1. Position the starter motor to the engine.

NOTE: Refer to Fastener Notice .

2. Install the starter bolts.

Tighten: Tighten the bolts to 43 N.m (32 lb ft).

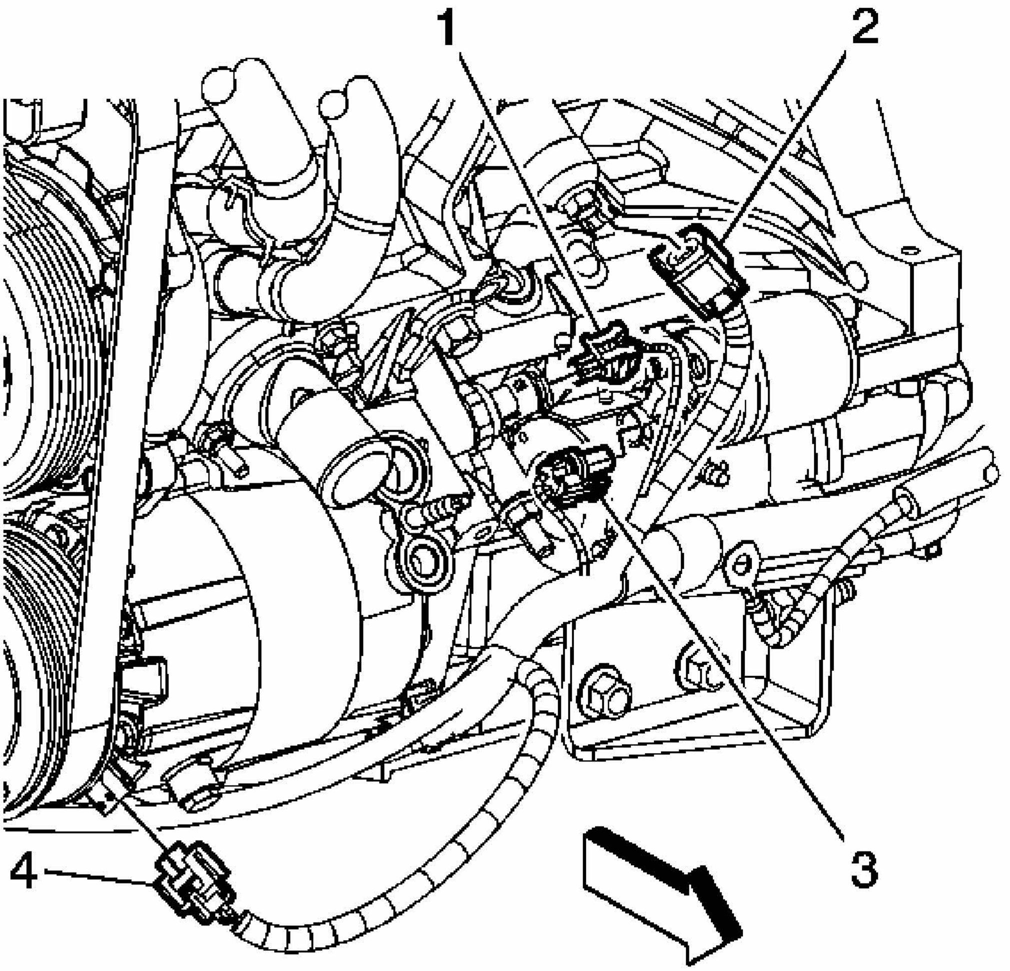


Fig. 70: Locating Starter Motor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the starter motor electrical connector (3).

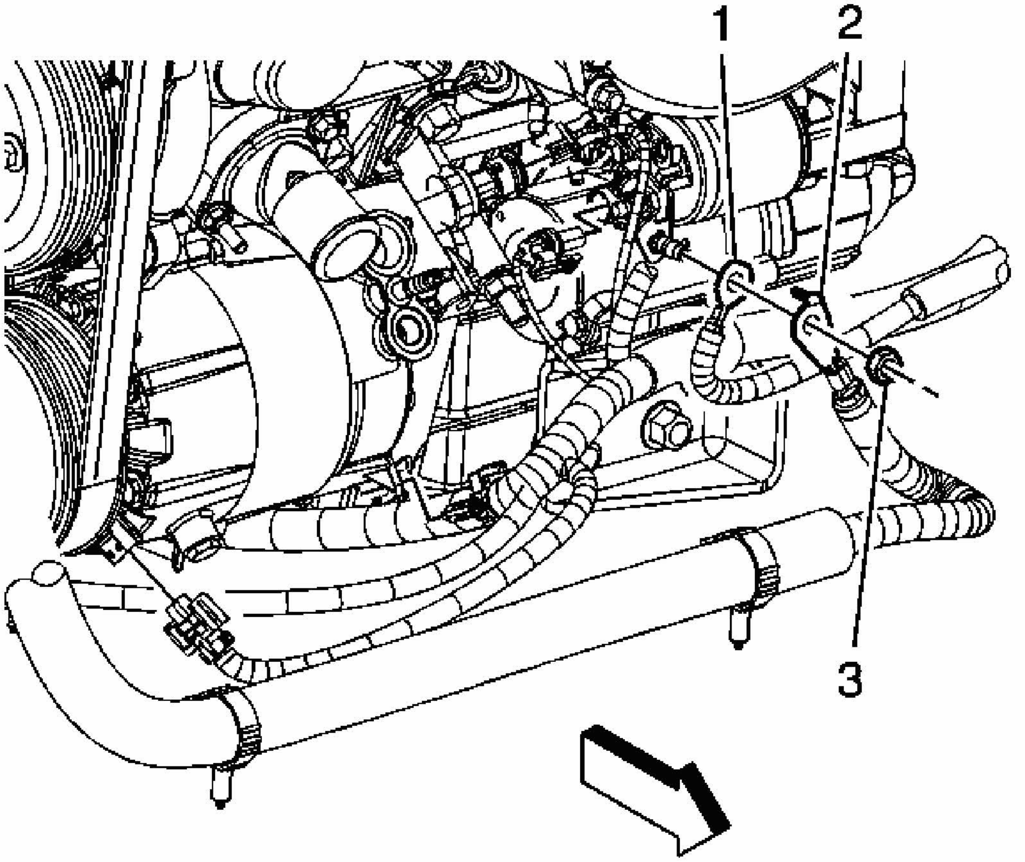


Fig. 71: View Of Engine Harness Terminal, Positive Battery Terminal & BAT Terminal Nut
Courtesy of GENERAL MOTORS CORP.

4. Install the engine harness terminal (1) and positive battery cable terminal (2) to the starter. Ensure that the positive battery cable terminal anti-rotation feature is aligned correctly.
5. Install the starter solenoid BAT terminal nut (3) to the starter motor.

   Tighten: Tighten the nut to 10 N.m (89 lb in).

6. Install the torque converter covers. Refer to **Torque Converter Cover Replacement** .
7. Install the front lower air deflector panel. Refer to **Radiator Air Baffle and Deflector Replacement - Lower** .
8. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)**.

STARTER MOTOR REPLACEMENT (RPO LS4)

Removal Procedure

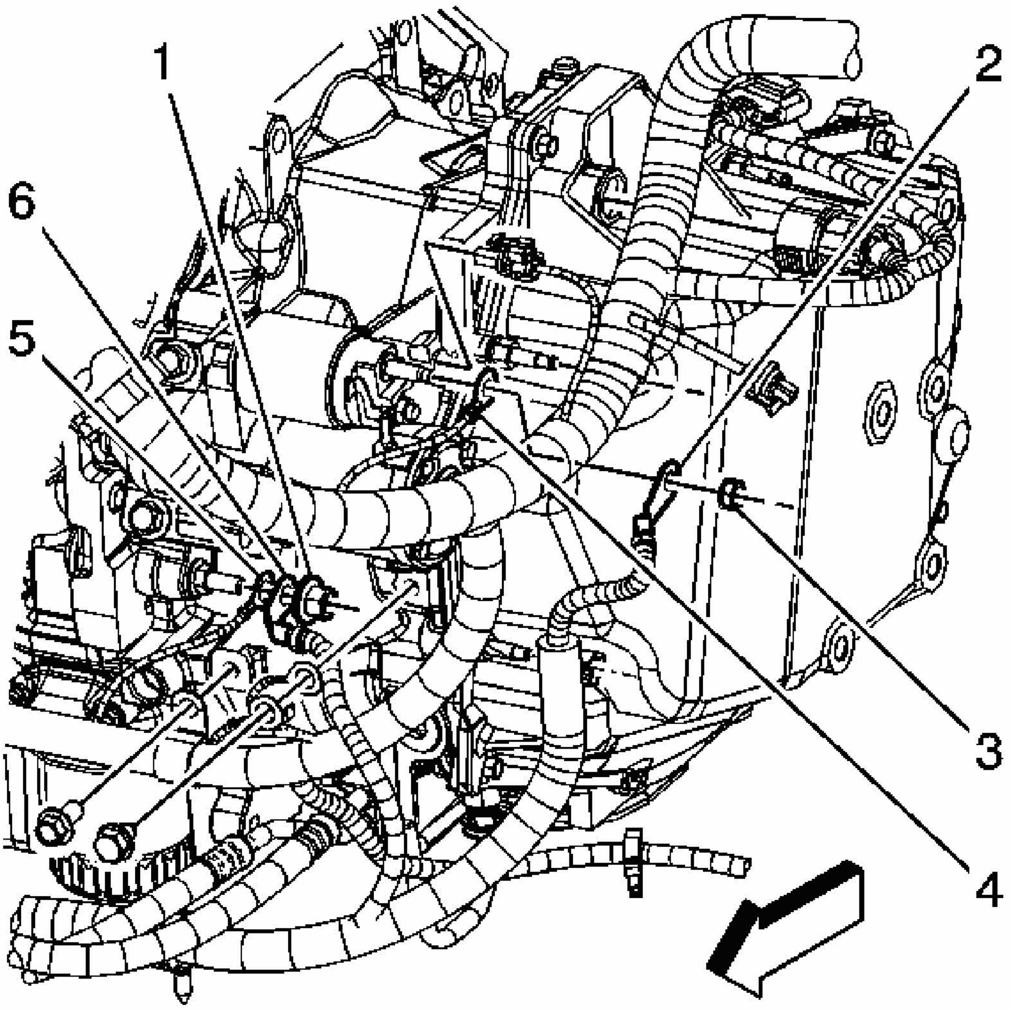


Fig. 72: Battery Positive & Negative Cables
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)**.
2. Remove the starter solenoid BAT terminal nut (3) and remove the positive battery cable (2) from the starter motor.
3. Remove the engine harness terminal (4) from the starter motor.

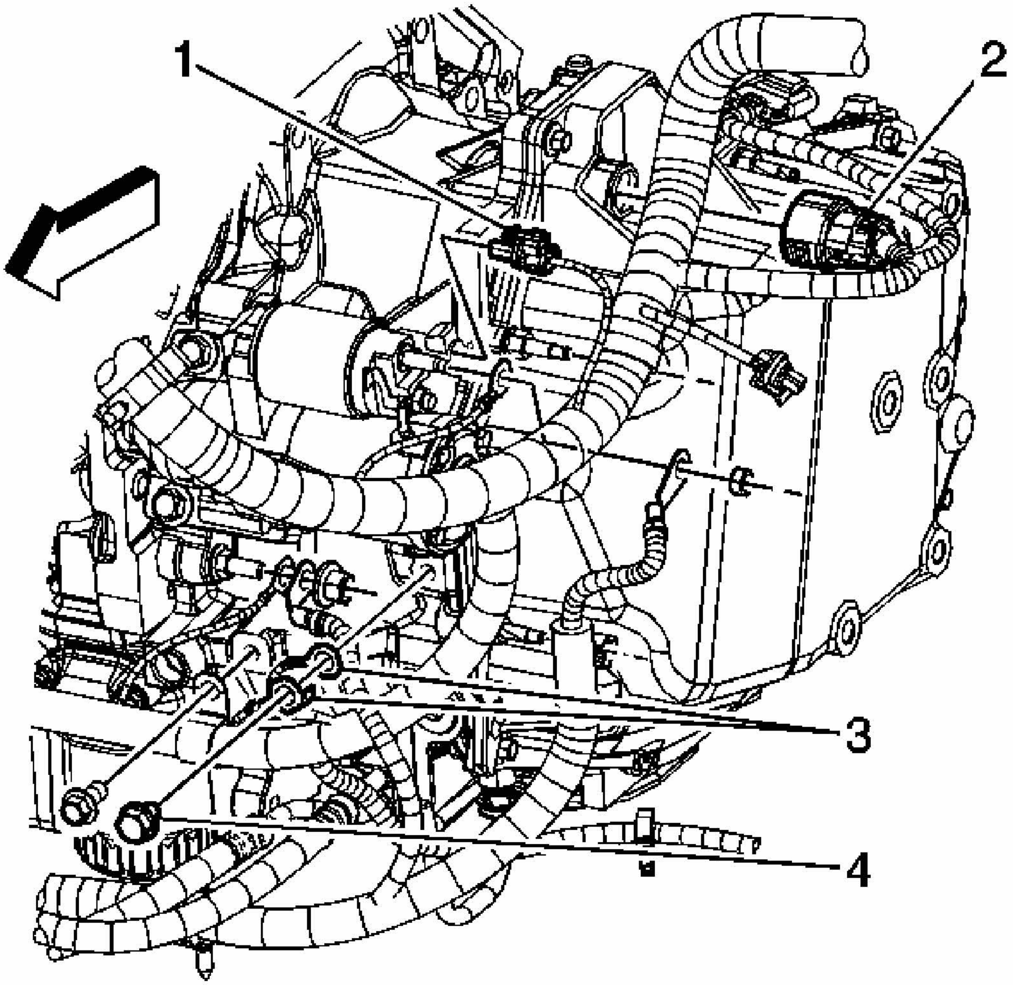


Fig. 73: View Of Engine Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the starter motor electrical connector (1).
5. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

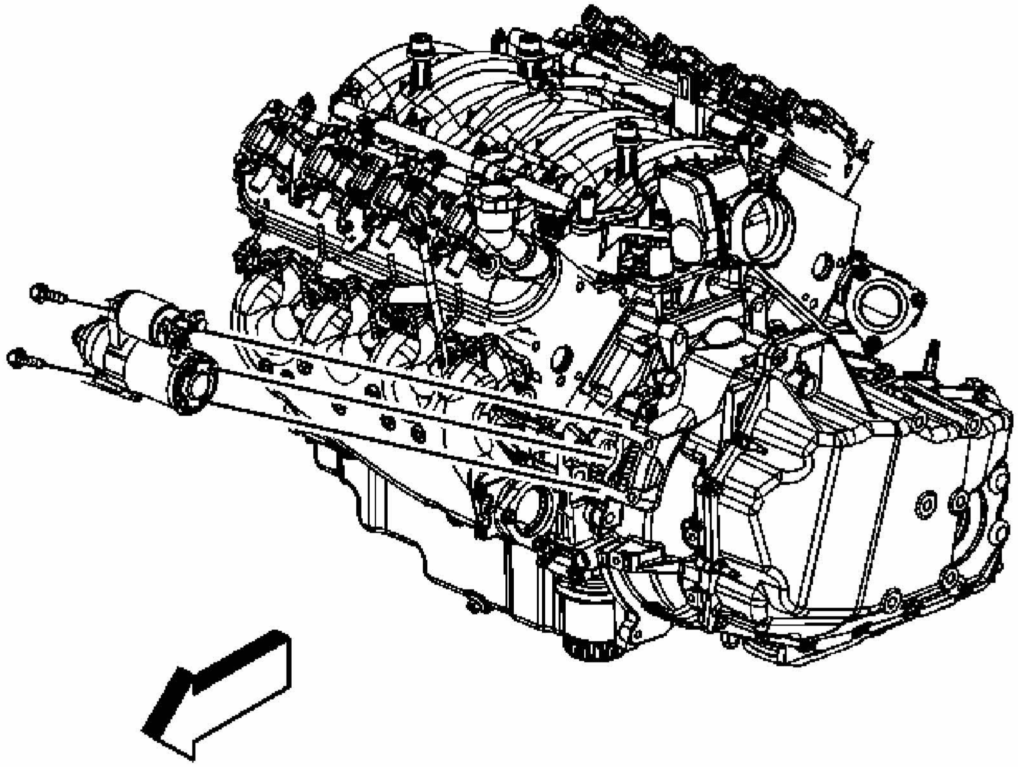


Fig. 74: View Of Starter Motor
Courtesy of GENERAL MOTORS CORP.

6. Remove the starter motor bolts and starter motor.

Installation Procedure

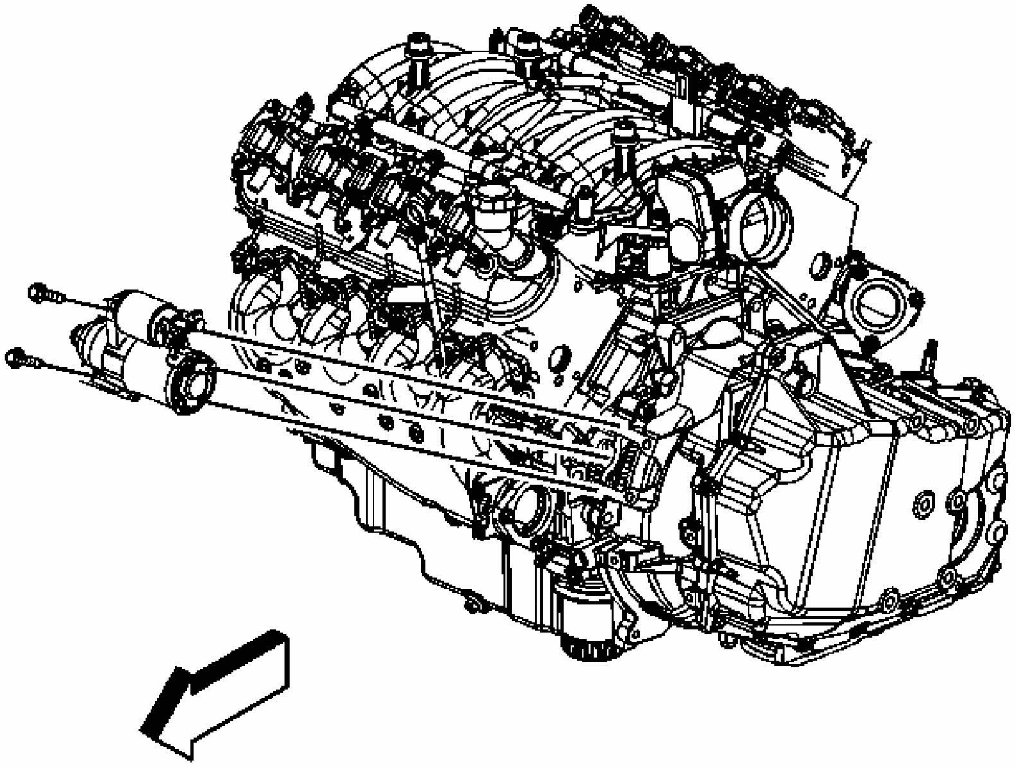


Fig. 75: View Of Starter Motor
Courtesy of GENERAL MOTORS CORP.

1. Position the starter motor to the engine.

   NOTE: **Refer to Fastener Notice .**

2. Install the starter bolts.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

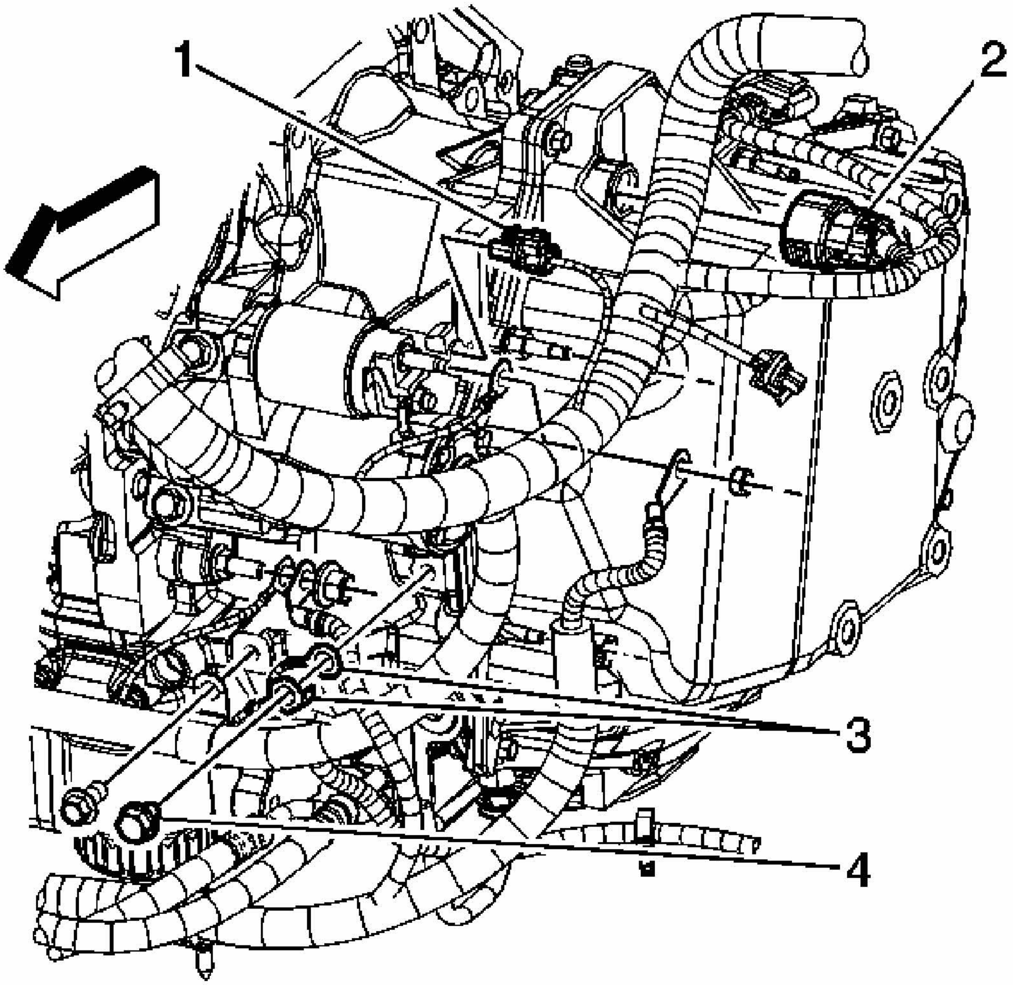


Fig. 76: View Of Engine Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

3. Connect the starter motor electrical connector (1).

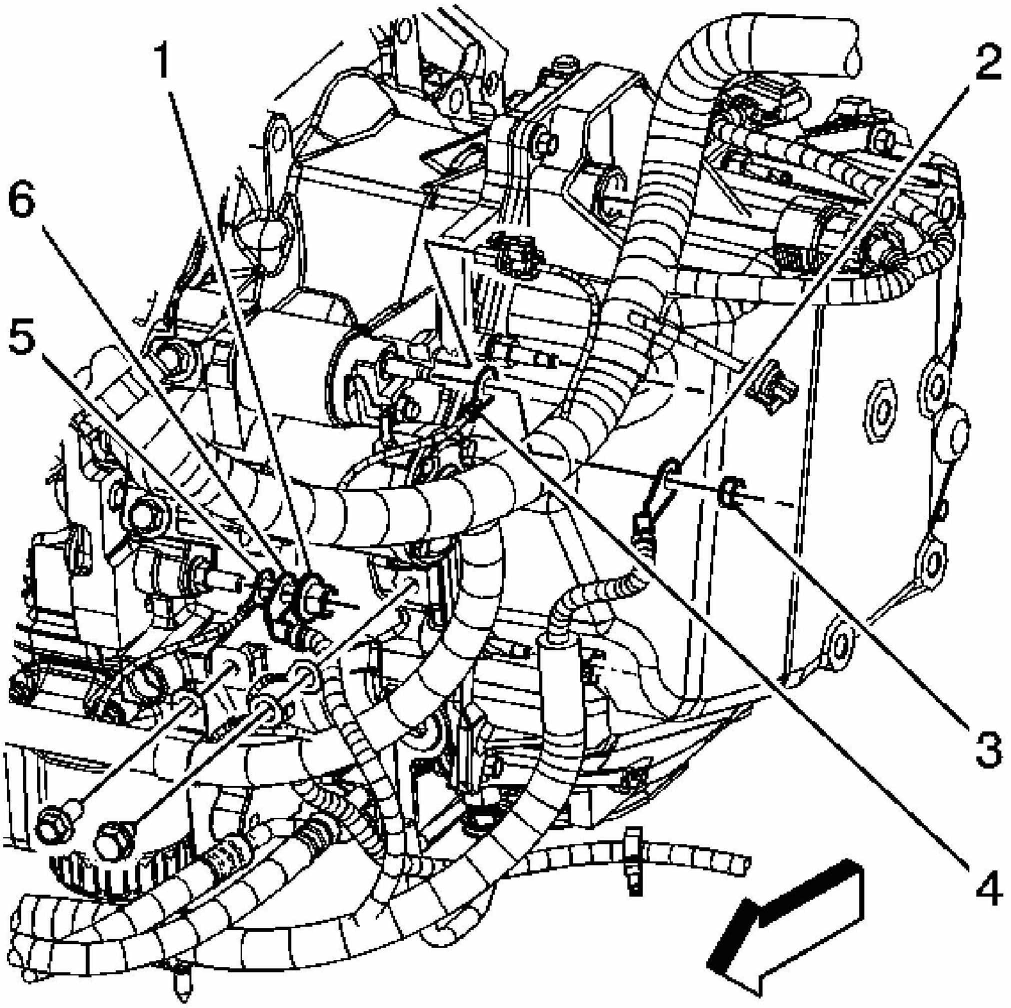


Fig. 77: Battery Positive & Negative Cables
Courtesy of GENERAL MOTORS CORP.

4. Install the engine harness terminal (4) to the starter motor.
5. Install the positive battery cable (2) and the starter solenoid BAT terminal nut (3) to the starter motor.

   Tighten: Tighten the solenoid BAT terminal nut to 10 N.m (89 lb in).

6. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
7. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)**.

GENERATOR BRACKET REPLACEMENT (RPO LS4)

Removal Procedure

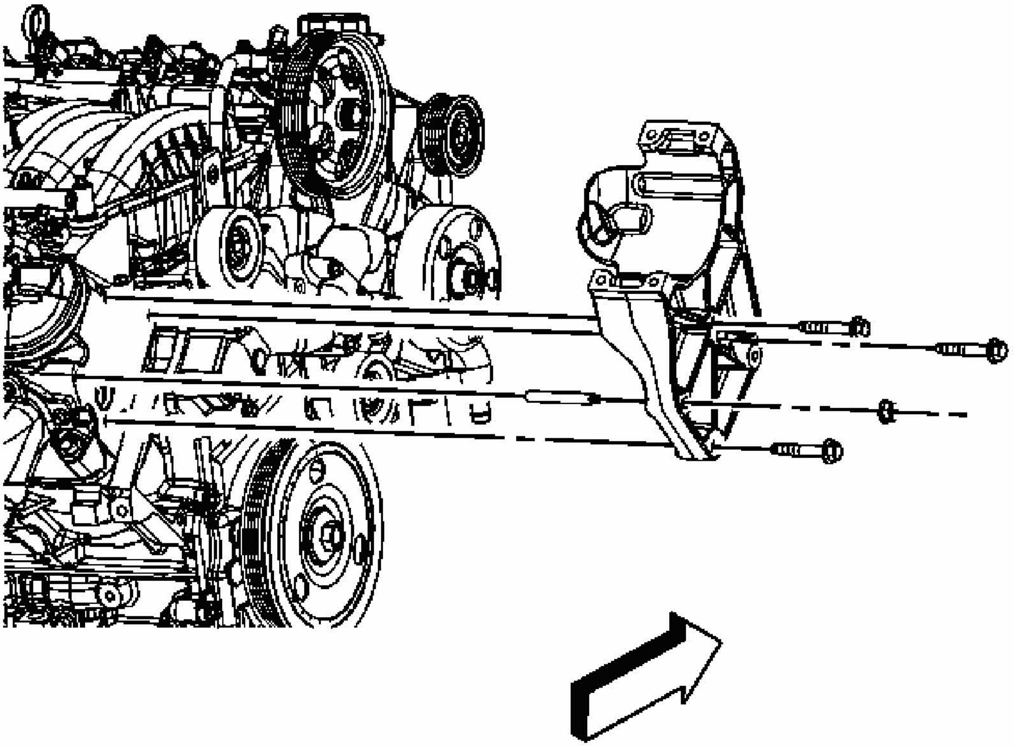


Fig. 78: View Of Generator Bracket
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)**.
2. Remove the idle pulley. Refer to **Drive Belt Idler Pulley Replacement** .
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Remove the lower tensioner bolt and rotate the tensioner to access the generator bracket bolt.
5. Lower the vehicle.
6. Remove the generator bracket bolts.
7. Remove the generator bracket from the stud.

Installation Procedure

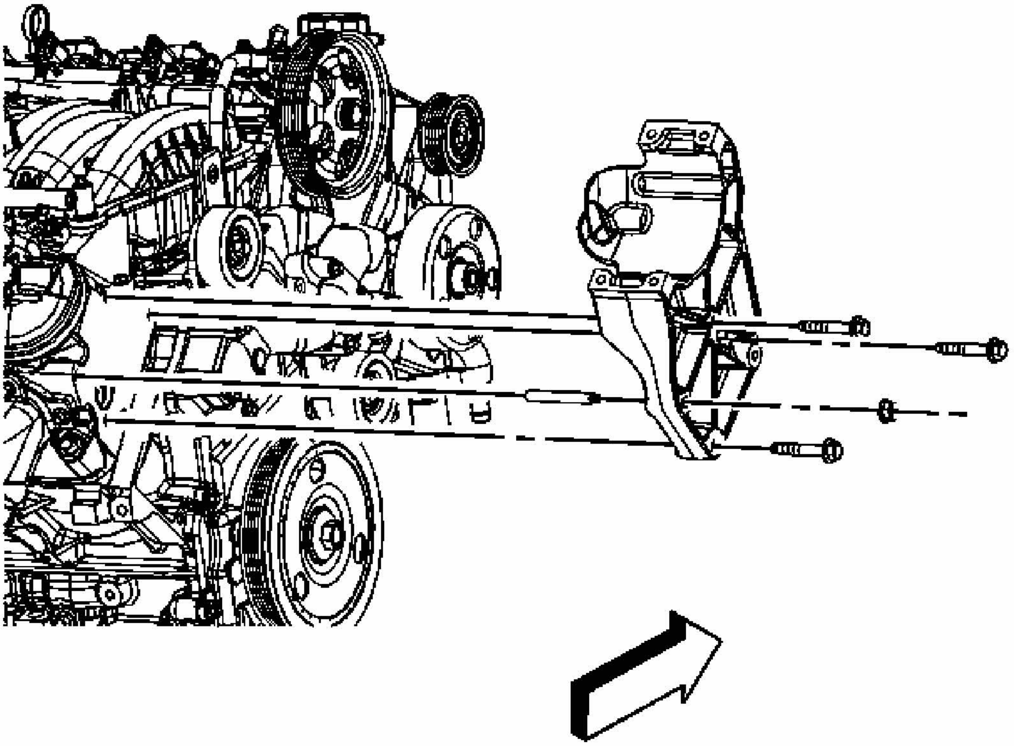


Fig. 79: View Of Generator Bracket
Courtesy of GENERAL MOTORS CORP.

1. Install the generator bracket to the stud.

   NOTE: **Refer to Fastener Notice .**

2. Install the generator bracket bolts.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

3. Raise the vehicle.
4. Install the lower generator bracket bolt.

   Tighten: Tighten the bolt to 50 N.m (37 lb ft).

5. Install the lower tensioner bolt.

   Tighten: Tighten the bolt to 50 N.m (37 lb ft).

6. Lower the vehicle.
7. Install the idler pulley. Refer to **Drive Belt Idler Pulley Replacement** .
8. Install the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)**.

GENERATOR REPLACEMENT (RPOS LZE/LZ4/LZ9)

Removal Procedure

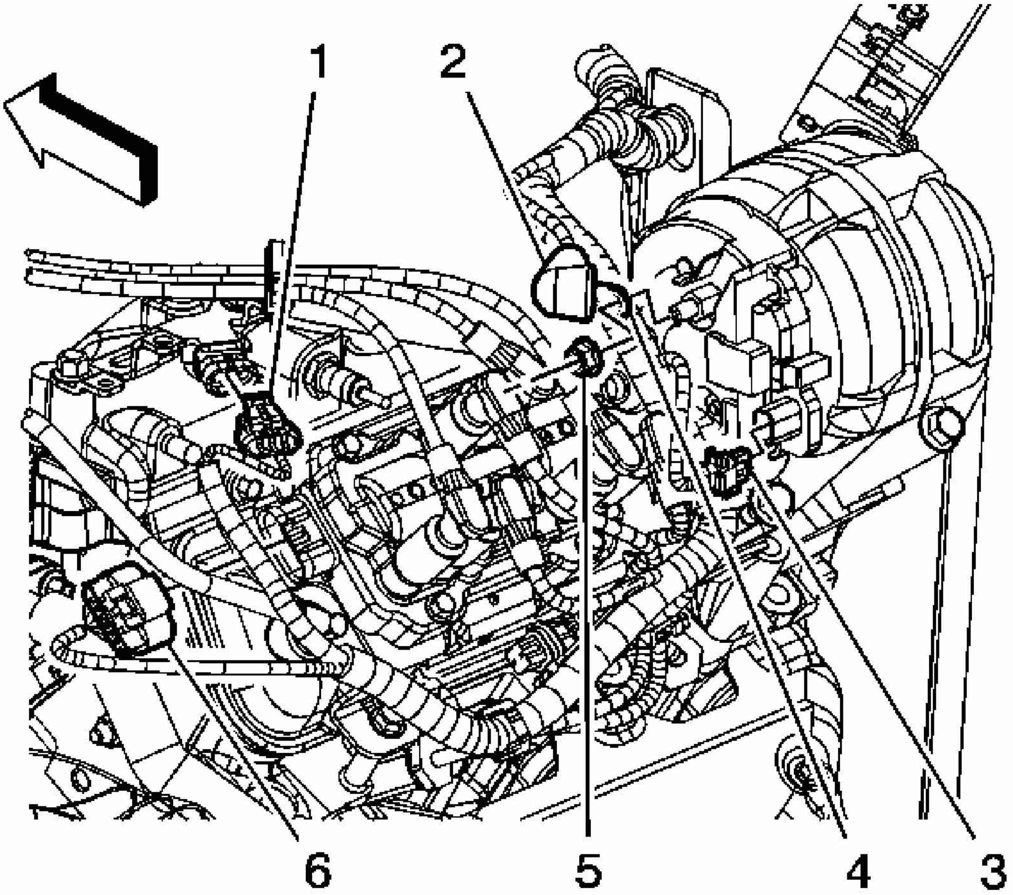


Fig. 80: Negative Battery Cable, Protective Boot, Generator Electrical Connector,Harness Terminal & BAT Terminal Nut
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)**.

2. Remove the drive belt. Refer to **Drive Belt Replacement** or **Drive Belt Replacement** .
3. Reposition the protective boot (2) from the generator output BAT terminal.
4. Remove the generator output BAT terminal nut (5).
5. Remove the engine harness terminal (4) from the generator.
6. Disconnect the generator electrical connector (3).

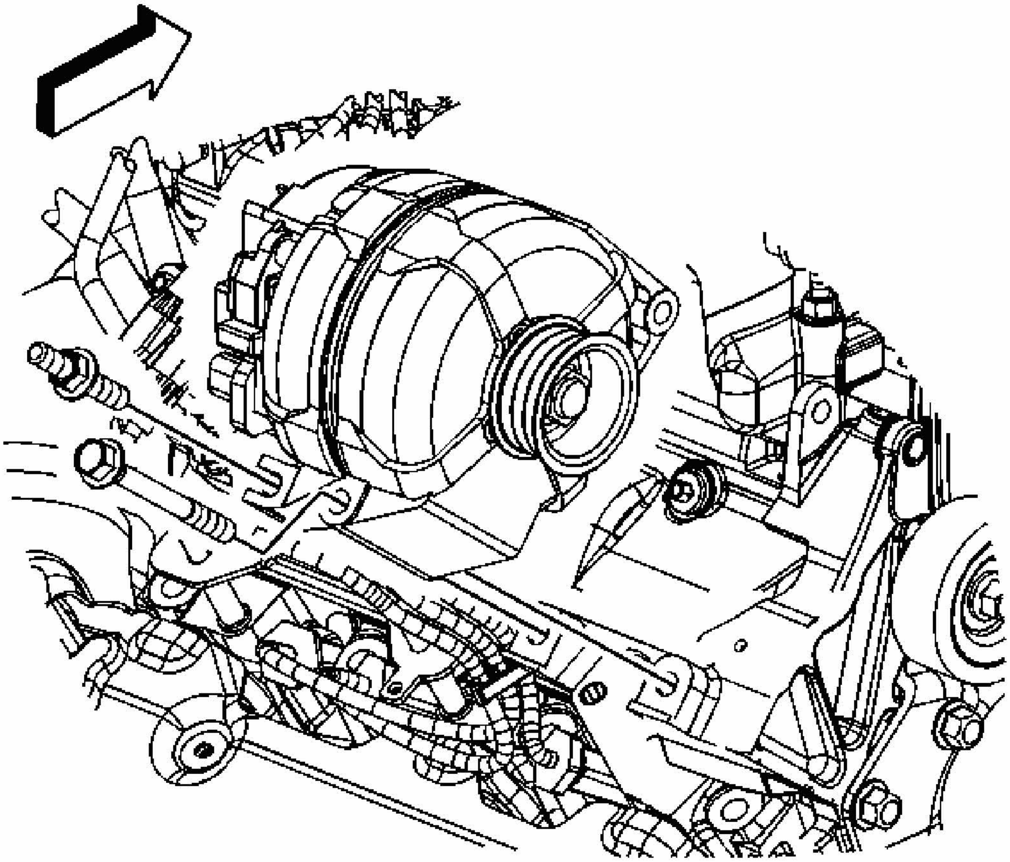


Fig. 81: View Of Generator Bolt And Stud
Courtesy of GENERAL MOTORS CORP.

7. Remove the generator bolt and stud.

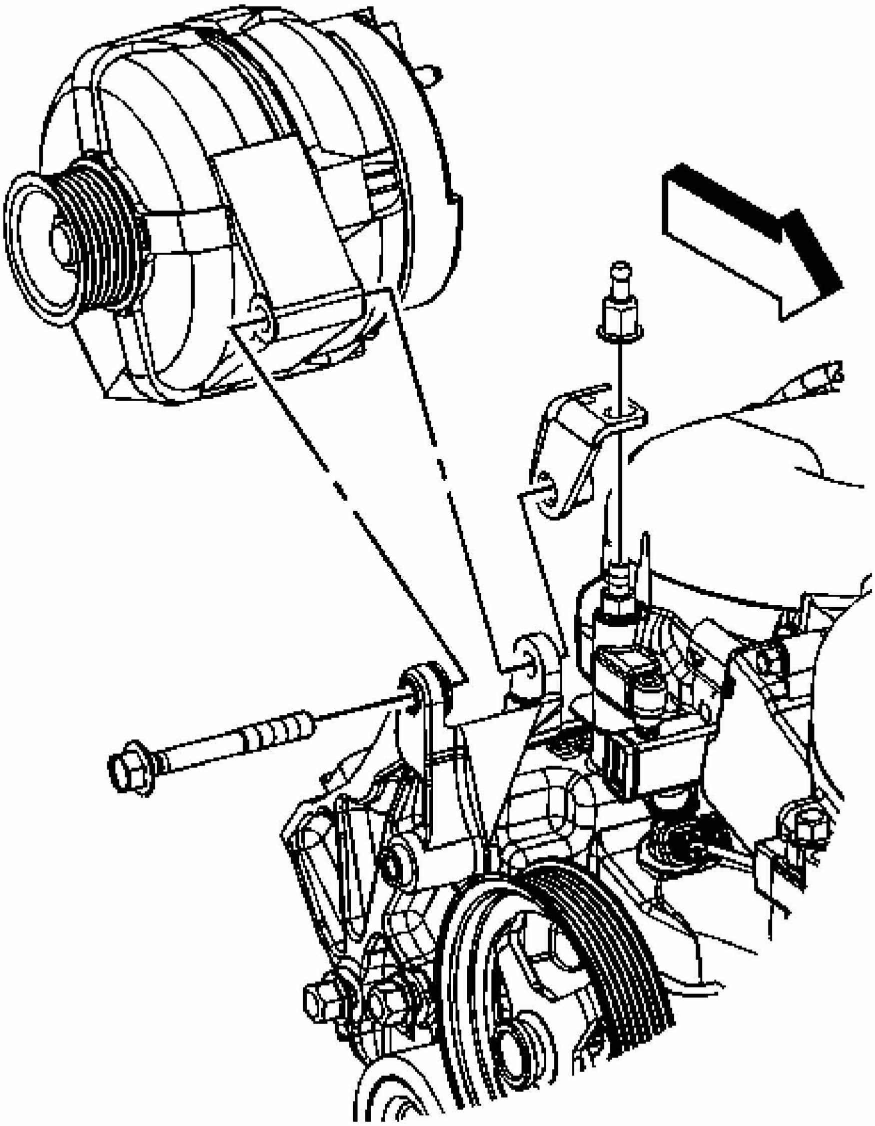


Fig. 82: View Of The Generator
Courtesy of GENERAL MOTORS CORP.

8. Remove the generator bolt.
9. Remove the generator.

Installation Procedure

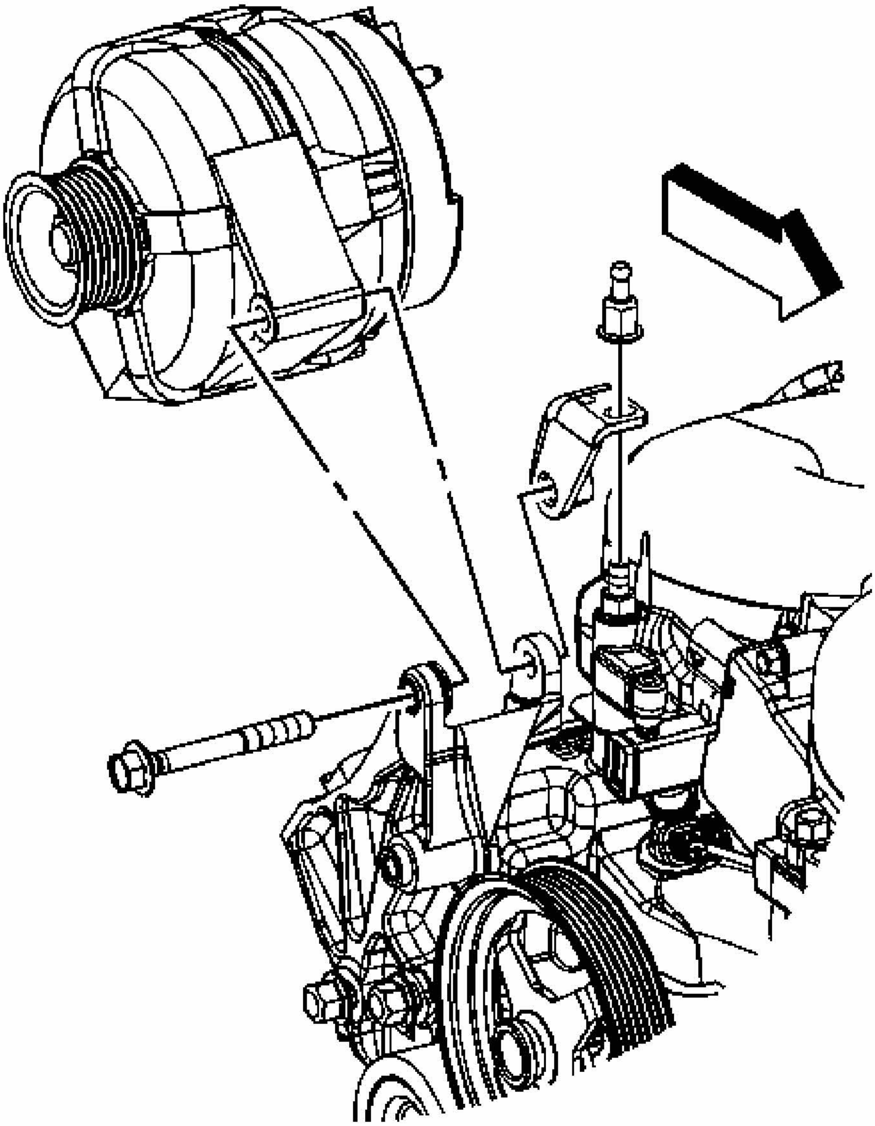


Fig. 83: View Of The Generator
Courtesy of GENERAL MOTORS CORP.

1. Install the generator.
2. Install the generator bolt until snug.

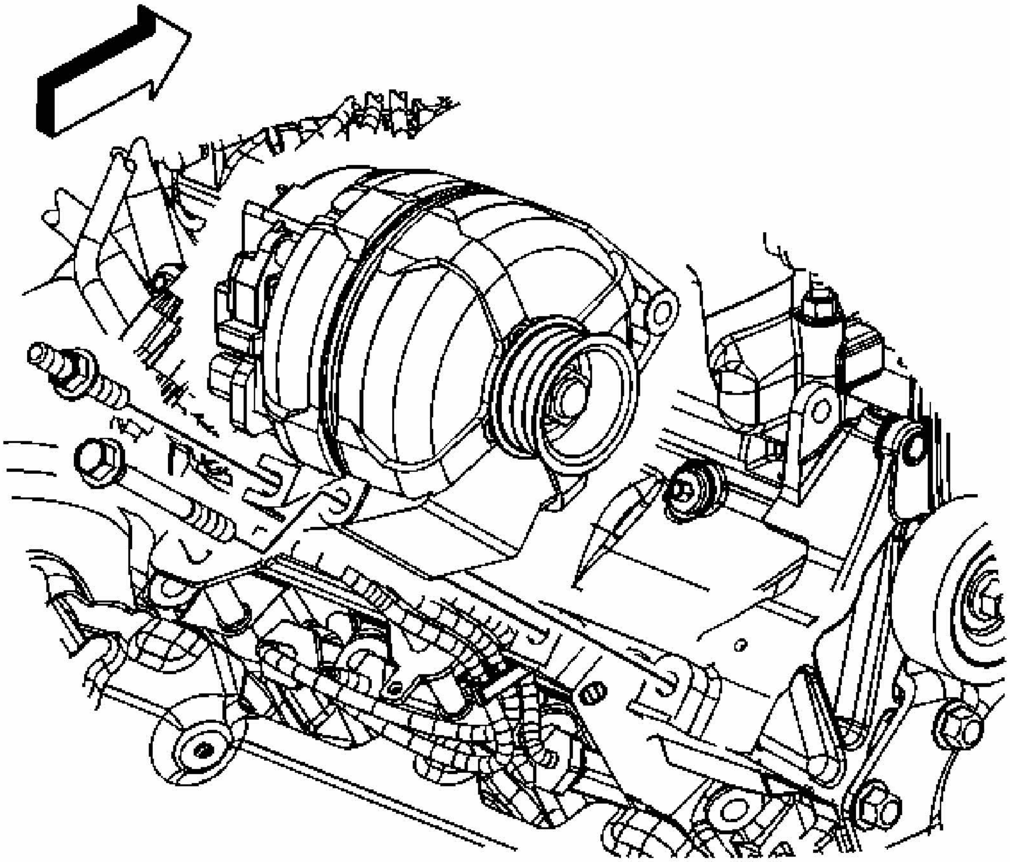


Fig. 84: View Of Generator Bolt And Stud
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

3. Install the generator bolt and stud.

   Tighten: Tighten the bolts/stud to 50 N.m (37 lb ft).

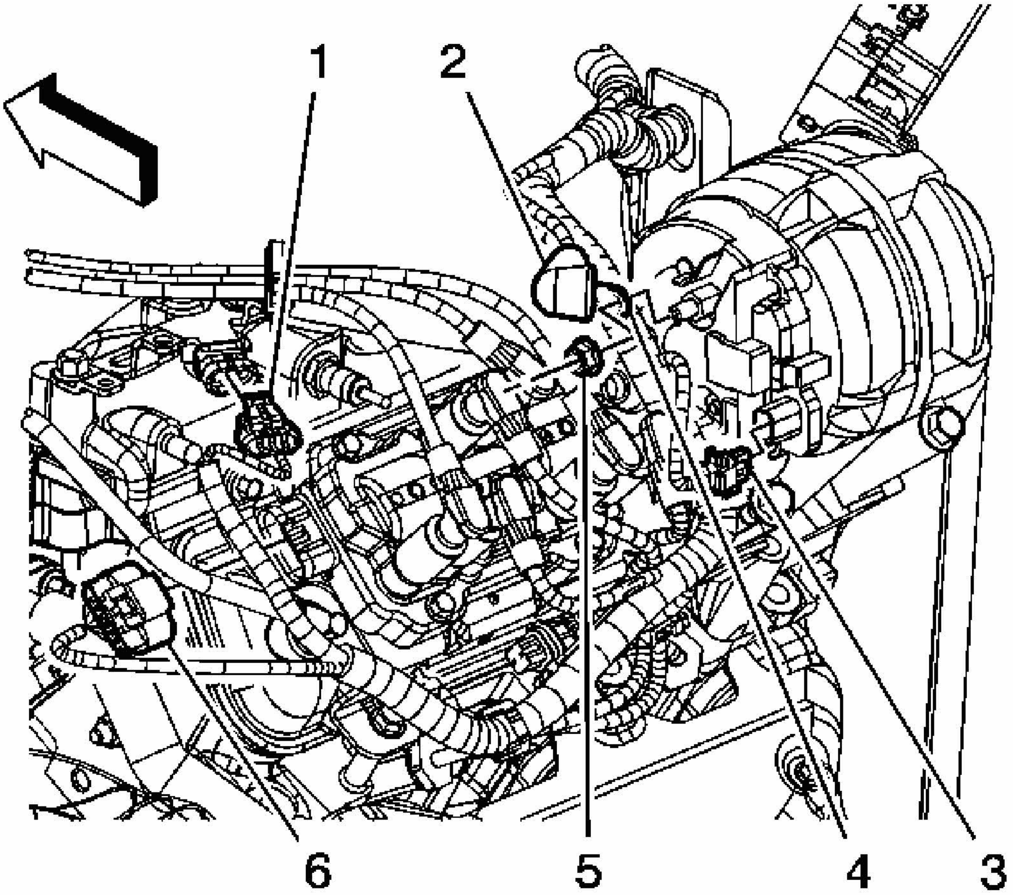


Fig. 85: Locating Generator Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Connect the generator electrical connector (3).
5. Install the engine harness terminal (4) to the generator.
6. Install the generator output BAT terminal nut (5).

   Tighten: Tighten the nut to 30 N.m (22 lb ft).

7. Position the protective boot (2) to the generator output BAT terminal.
8. Install the drive belt. Refer to **Drive Belt Replacement** or **Drive Belt Replacement** .
9. Connect the negative battery negative cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)**.

GENERATOR REPLACEMENT (RPO LS4)

Removal Procedure

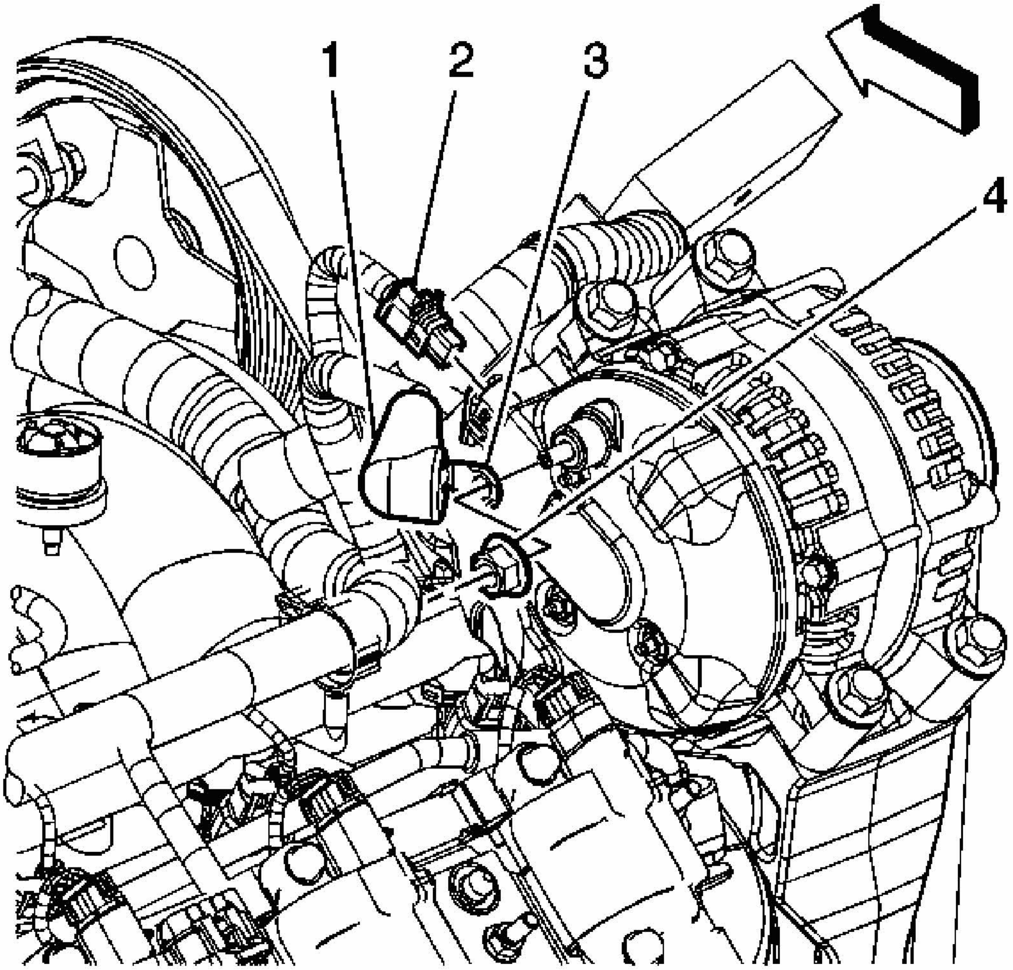


Fig. 86: View Of Generator Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)**.
2. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement** .
3. Remove the drive belt. Refer to **Drive Belt Replacement - Accessory** .
4. Disconnect the generator electrical connector (2).
5. Position aside the protective boot (1) from the generator output BAT terminal for access.
6. Remove the generator output BAT terminal nut (4) and remove the positive battery lead

(3) from the generator.

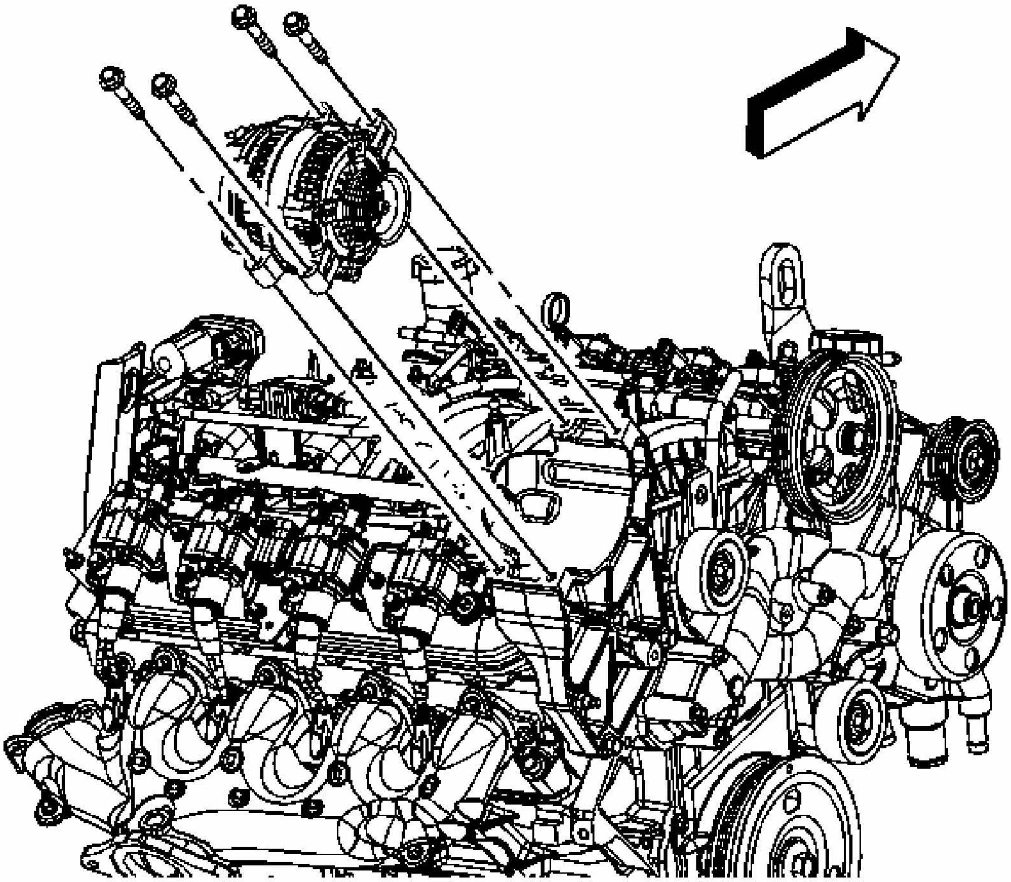


Fig. 87: View Of Generator & Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the generator bolts and generator.

Installation Procedure

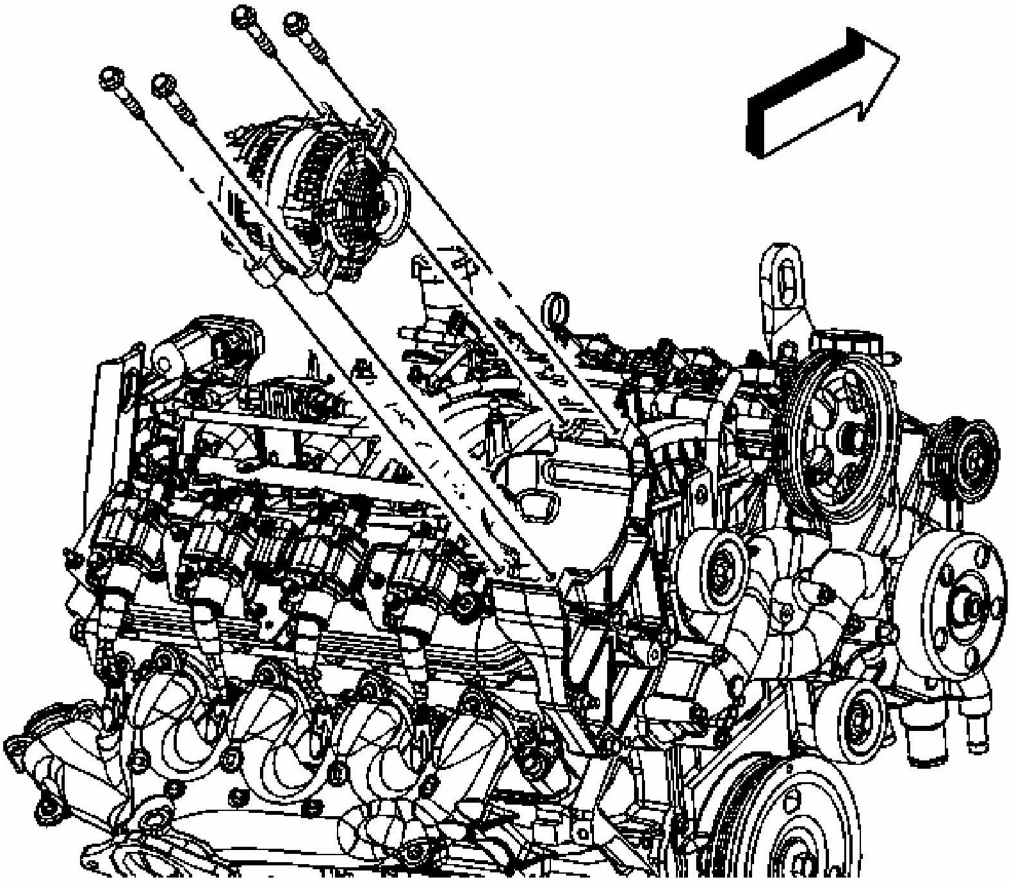


Fig. 88: View Of Generator & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

1. Install the generator and bolts.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

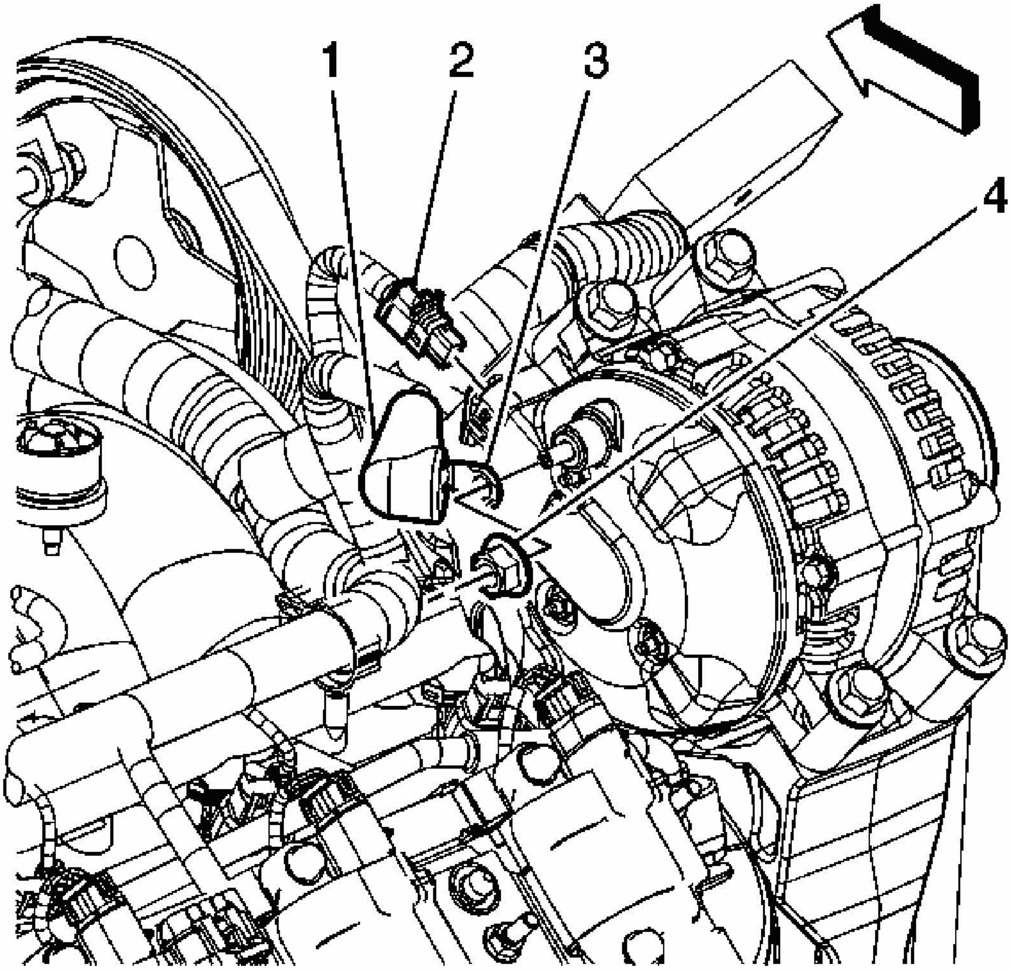


Fig. 89: View Of Generator Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

2. Install the positive battery lead (3) and generator output BAT terminal nut (4) to the generator.

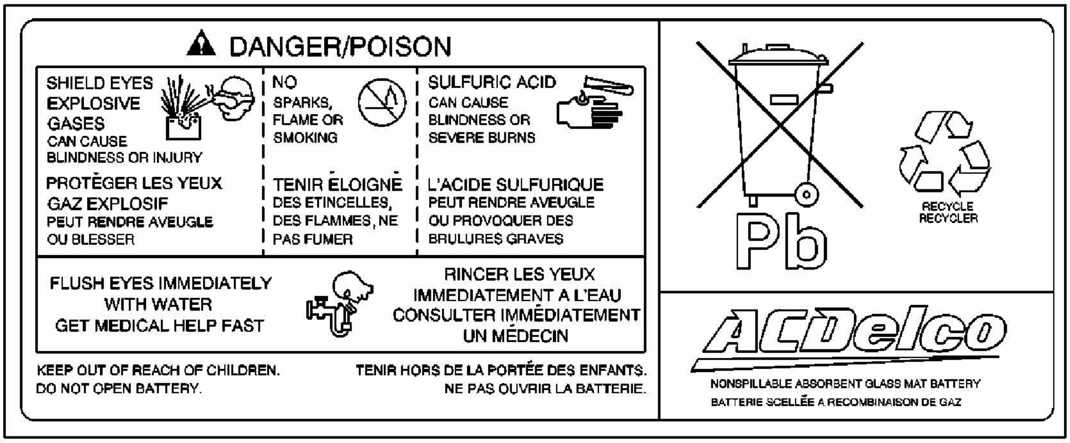
   Tighten: Tighten the nut to 20 N.m (15 lb ft).

3. Position the protective boot (1) to the generator output BAT terminal.
4. Connect the generator electrical connector (2).
5. Install the drive belt. Refer to **Drive Belt Replacement - Accessory** .
6. Install the engine sight shield. Refer to **Engine Sight Shield Replacement** .
7. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable**

Disconnect/Connect Procedure (RPO LS4).

DESCRIPTION AND OPERATION

BATTERY DESCRIPTION AND OPERATION



DANGER/POISON

SHIELD EYES EXPLOSIVE GASES CAN CAUSE BLINDNESS OR INJURY

PROTÈGER LES YEUX GAZ EXPLOSIF PEUT RENDRE AVEUGLE OU BLESSER

NO SPARKS, FLAME OR SMOKING

TENIR ÉLOIGNÉ DES ETINCELLES, DES FLAMMES, NE PAS FUMER

SULFURIC ACID CAN CAUSE BLINDNESS OR SEVERE BURNS

L'ACIDE SULFURIQUE PEUT RENDRE AVEUGLE OU PROVOQUER DES BRULURES GRAVES

FLUSH EYES IMMEDIATELY WITH WATER GET MEDICAL HELP FAST

RINCER LES YEUX IMMEDIATEMENT A L'EAU CONSULTER IMMÉDIATEMENT UN MÉDECIN

KEEP OUT OF REACH OF CHILDREN. DO NOT OPEN BATTERY.

TENIR HORS DE LA PORTÉE DES ENFANTS. NE PAS OUVRIR LA BATTERIE.

NONSPILLABLE ABSORBENT GLASS MAT BATTERY

BATTERIE SCELLÉE A RECOMBINAISON DE GAZ

Fig. 90: Battery Warning Label
Courtesy of GENERAL MOTORS CORP.

CAUTION: **Batteries produce explosive gases, contain corrosive acid, and supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury when working near a battery:**

- **Always shield your eyes and avoid leaning over the battery whenever possible.**
- **Do not expose the battery to open flames or sparks.**
- **Do not allow the battery electrolyte to contact the eyes or the skin. Flush immediately and thoroughly any contacted areas with water and get medical help.**
- **Follow each step of the jump starting procedure in order.**
- **Treat both the booster and the discharged batteries carefully when using the jumper cables.**

IMPORTANT: **Because of the materials used in the manufacture of automotive lead-acid batteries, dealers and service shops that handle them are subject to various regulations issued by OSHA, EPA, DOT, and various state or local agencies. Other**

regulations may also apply in other locations. Always know and follow these regulations when handling batteries.

Batteries that are no longer wanted must be disposed of by an approved battery recycler and must never be thrown in the trash or sent to a landfill.

Batteries that are not part of the vehicle itself, not the battery under the hood, must only be transported on public streets for business purposes via approved hazardous material transportation procedures.

Battery storage, charging, and testing facilities in repair shops must meet various requirements for ventilation, safety equipment, material segregation, etc.

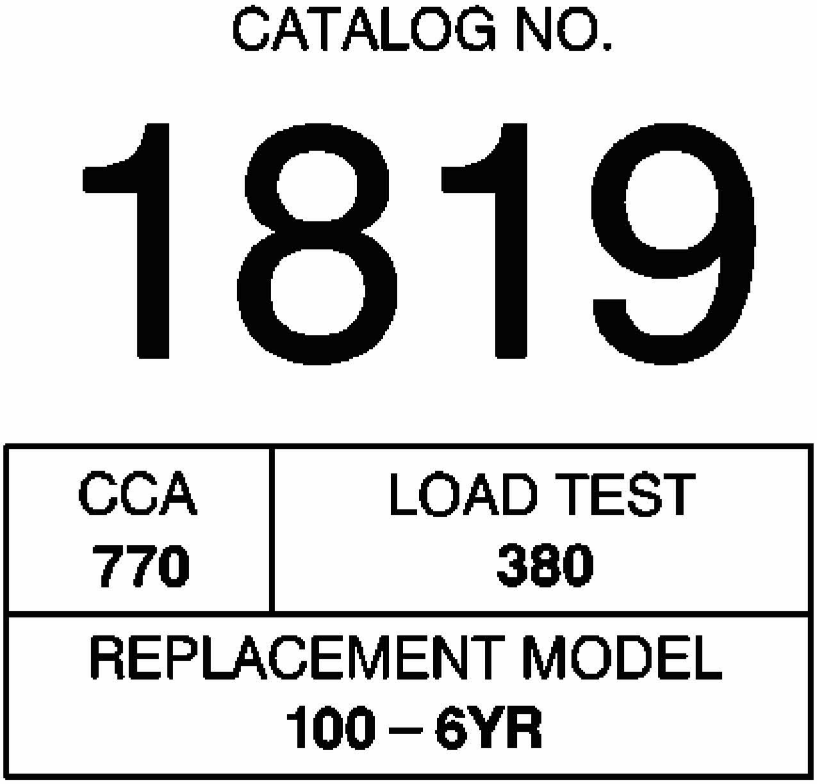
The maintenance-free battery is standard. There are no vent plugs in the cover. The battery is completely sealed except for 2 small vent holes in the side. These vent holes allow the small amount of gas that is produced in the battery to escape.

The battery has 3 functions as a major source of energy:

- Engine cranking
- Voltage stabilizer
- Alternate source of energy with generator overload

The battery specification label, example below, contains information about the following:

- The test ratings
- The original equipment catalog number
- The recommended replacement model number



CATALOG NO.

1819

CCA	LOAD TEST
770	380
REPLACEMENT MODEL 100 – 6YR	

Fig. 91: View Of Battery Specification Label
Courtesy of GENERAL MOTORS CORP.

Battery Ratings

A battery may have 3 ratings:

- Amp hour
- Reserve capacity
- Cold cranking amperage

When a battery is replaced, use a battery with similar ratings. Refer to the battery specification label on the original battery or refer to **Battery Usage**.

Amp Hour

The amp hour rating of a battery is the amount of time it takes a fully charged battery, being discharged at a constant rate of 1 amperes and a constant temperature of 27°C (80°F), to reach a terminal voltage of 10.5 volts. Refer to **Battery Usage** for the amp hour rating of the original equipment battery.

Reserve Capacity

Reserve capacity is the amount of time in minutes it takes a fully charged battery, being discharged at a constant rate of 25 amperes and a constant temperature of 27°C (80°F), to reach a terminal voltage of 10.5 volts. Refer to **Battery Usage** for the reserve capacity rating of the original equipment battery.

Cold Cranking Amperage

The cold cranking amperage is an indication of the ability of the battery to crank the engine at cold temperatures. The cold cranking amperage rating is the minimum amperage the battery must maintain for 30 seconds at -18°C (0°F) while maintaining at least 7.2 volts. Refer to **Battery Usage** for the cold cranking amperage rating for this vehicle.

CHARGING SYSTEM DESCRIPTION AND OPERATION

Electrical Power Management (EPM) Overview

The electrical power management (EPM) system is designed to monitor and control the charging system and send diagnostic messages to alert the driver of possible problems with the battery and generator. This EPM system primarily utilizes existing on-board computer capability to maximize the effectiveness of the generator, to manage the load, improve battery state-of-charge and life, and minimize the system's impact on fuel economy. The EPM system performs 3 functions:

- It monitors the battery voltage and estimates the battery condition.
- It takes corrective actions by boosting idle speeds, managing the loads, and adjusting the regulated voltage.
- It performs diagnostics and driver notification.

The battery condition is estimated during ignition-off and during ignition-on. During ignition-off, the state-of-charge (SOC) of the battery is determined by measuring the open-circuit voltage. The SOC is a function of the acid concentration and the internal resistance of the battery, and is estimated by reading the battery open circuit voltage when the battery has been at rest for several hours.

The SOC can be used as a diagnostic tool to tell the customer or the dealer the condition of the battery. Throughout ignition-on, the algorithm continuously estimates SOC based on adjusted net amp hours, battery capacity, initial SOC, and temperature.

While running, the battery degree of discharge is primarily determined by a battery current sensor, which is integrated to obtain net amp hours.

In addition, the EPM function is designed to perform regulated voltage control (RVC) to improve battery SOC, battery life, and fuel economy. This is accomplished by using knowledge of the battery SOC and temperature to set the charging voltage to an optimum battery voltage level for recharging without detriment to battery life.

The Charging System Description and Operation is divided into 3 sections. The first section describes the charging system components and their integration into the EPM. The second section describes charging system operation. The third section describes the instrument panel cluster (IPC) operation of the charge indicator, driver information center (DIC) messages, and voltmeter operation.

Charging System Components

Generator

The generator is a serviceable component. If there is a diagnosed failure of the generator it must be replaced as an assembly. The engine drive belt drives the generator. When the rotor is spun it induces an alternating current (AC) into the stator windings. The AC voltage is then sent through a series of diodes for rectification. The rectified voltage has been converted into a direct current (DC) for use by the vehicles electrical system to maintain electrical loads and the battery charge. The voltage regulator integral to the generator controls the output of the generator. It is not serviceable. The voltage regulator controls the amount of current provided to the rotor. If the generator has field control circuit failure, the generator defaults to an output voltage of 13.8 volts.

Body Control Module (BCM)

The body control module (BCM) is a GMLAN device. It communicates with the engine control module (ECM) and the instrument panel cluster (IPC) for EPM operation. The BCM determines the output of the generator and sends the information to the ECM for control of the generator field control circuit. It monitors the generator field duty cycle signal circuit information sent from the ECM for control of the generator. It monitors a battery current sensor, the battery positive voltage circuit, and estimated battery temperature to determine battery state of charge (SOC). The BCM performs idle boost and load management operations.

Battery Current Sensor

The battery current sensor is a serviceable component that is connected to the negative battery cable at the battery. The battery current sensor is a 3-wire hall effect current sensor. The battery current sensor monitors the battery current. It directly inputs to the BCM. It creates a 5-volt pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-95 percent. Between 0-5 percent and 95-100 percent are for diagnostic purposes.

Engine Control Module (ECM)

The ECM directly controls the generator field control circuit input to the generator. The ECM receives control decisions based on messages from the BCM. It monitors the generators generator field duty cycle signal circuit and sends the information to the BCM.

Instrument Panel Cluster (IPC)

The IPC provides a means of customer notification in case of a failure and a voltmeter. There are 2 means of notification, a charge indicator and a driver information center (DIC) message of SEVICE BATTERY CHARGING SYSTEM

Charging System Operation

The purpose of the charging system is to maintain the battery charge and vehicle loads. There are 2 modes of operation and they include:

- Charge Mode
- Voltage Reduction Mode

The engine control module (ECM) controls the generator through the generator field control circuit. It monitors the generator performance though the generator field duty cycle signal circuit. The ECM controls the generator through the generator field control circuit. The signal is a pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-95 percent. Between 0-5 percent and 95-100 percent are for diagnostic purposes. The following table shows the commanded duty cycle and output voltage of the generator:

Charging System Description and Operation

Commanded Duty Cycle	Generator Output Voltage
10%	11 V
20%	11.56 V
30%	12.12 V
40%	12.68 V
50%	13.25 V
60%	13.81 V
70%	14.37 V
80%	14.94 V
90%	15.5 V

The generator provides a feedback signal of the generator voltage output through the generator field duty cycle signal circuit to the ECM. This information is sent to the body control module (BCM). The signal is a 5-volt PWM signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-99 percent. Between 0-5 percent and 100 percent are for diagnostic purposes.

Charge Mode

The BCM will enter Charge Mode when the headlamps are ON, low or high beams. The voltage is controlled to 13.4 volts if the system is below 13.3 volts or to 14.5 volts if the system voltage is above 14.6 volts.

Voltage Reduction Mode

The BCM will enter Voltage Reduction Mode when the calculated ambient air temperature is above 0°C (32°F). The calculated battery current is less than 2 amps and greater than -7 amps, and the generator field duty cycle is less than 99 percent. Its targeted generator output voltage is 12.9 volts. The BCM will exit this mode once the criteria are met for Charge Mode.

Instrument Panel Cluster (IPC) Operation

Charge Indicator Operation

The instrument panel cluster (IPC) illuminates the charge indicator and displays a warning message in the driver information center (DIC) when the one or more of the following occurs:

- The engine control module (ECM) detects that the generator output is less than 11 volts or greater than 16 volts. The IPC receives a GMLAN message from the ECM requesting illumination.
- The IPC determines that the system voltage is less than 11 volts or greater than 16 volts for more than 30 seconds. The IPC receives a GMLAN message from the body control module (BCM) indicating there is a system voltage range concern.
- The IPC performs the displays test at the start of each ignition cycle. The indicator illuminates for approximately 3 seconds.
- The ignition is ON, with the engine OFF.

Battery Voltage

The IPC displays the system voltage as received from the BCM over the GMLAN serial data circuit. If there is no communication with the BCM, then the display will read all dashes until communication is restored.

SERVICE BATTERY CHARGING SYSTEM

The BCM and the ECM will send a GMLAN message to the DIC for the SEVICE BATTERY CHARGING SYSTEM message to be displayed. It is commanded ON when a charging system DTC is a current DTC. The message is turned OFF when the conditions for clearing the DTC have been met.

BATTERY SAVER ACTIVE

The BATTERY SAVER ACTIVE message will display on the DIC when the vehicle enters a load shed 2 event or a load shed 3 event. Refer to **Load Shed System Description and Operation** for load shed 2 or 3 setting criteria.

STARTING SYSTEM DESCRIPTION AND OPERATION

The starter motors are non-repairable starter motors. They have pole pieces that are arranged around the armature. Both solenoid windings are energized. The pull-in winding circuit is completed to the ground through the starter motor. The windings work together magnetically to pull and hold in the plunger. The plunger moves the shift lever. This action causes the starter drive assembly to rotate on the armature shaft spline as it engages with the flywheel ring gear on the engine. Moving at the same time, the plunger also closes the solenoid switch contacts in the starter solenoid. Full battery voltage is applied directly to the starter motor and it cranks the engine.

As soon as the solenoid switch contacts close, current stops flowing thorough the pull-in winding because battery voltage is applied to both ends of the windings. The hold-in winding remains energized. Its magnetic field is strong enough to hold the plunger, shift lever, starter drive assembly, and solenoid switch contacts in place to continue cranking the engine. When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened.

When the ignition switch is released from the START position, the START relay opens and battery voltage is removed from the starter solenoid S terminal. Current flows from the motor contacts through both windings to the ground at the end of the hold-in winding. However, the direction of the current flow through the pull-in winding is now opposite the direction of the current flow when the winding was first energized.

The magnetic fields of the pull-in and hold-in windings now oppose one another. This action of the windings, along with the help of the return spring, causes the starter drive assembly to disengage and the solenoid switch contacts to open simultaneously. As soon as the contacts open, the starter circuit is turned off.

Circuit Description (Key Start)

When the ignition switch is placed in the Start position, a discrete 12-volt signal is supplied to the body control module (BCM) notifying it that the ignition is in the Start position. The BCM then sends a message to the engine control module (ECM) notifying it that CRANK has been requested. The ECM verifies that the transmission is in Park or Neutral. If it is, the ECM then supplies 12 volts to the control circuit of the crank relay. When this occurs, battery positive voltage is supplied through the switch side of the crank relay to the S terminal of the starter solenoid.

LOAD SHED SYSTEM DESCRIPTION AND OPERATION

Electrical Power Management

The electrical power management (EPM) is used to monitor and control the charging system and alert the driver of possible problems within the charging system. The EPM system makes the most efficient use of the generator output, improves the battery state of charge (SOC), extends battery life, and manages system electrical loads.

The load shed operation is a means of reducing electrical loads during a low voltage or low battery SOC condition.

The idle boost operation is a means of improving generator performance during a low voltage or low battery SOC condition.

Each EPM function, either idle boost or load-shed, is discrete. No 2 functions are active at the same time. Idle boost is activated in incremental steps, idle boost 1 must be active before idle boost 2 can be active. The criteria used by the body control module (BCM) to regulate EPM are outlined below:

Load Shed System Description and Operation

Function	Battery Temperature Calculation	Battery Voltage Calculation	Amp-hour Calculation	Action Taken
Idle Boost 1 Start	Less Than -15°C (5°F)	Less Than 13 V	-	First level Idle boost requested
Idle Boost 1 Start	-	-	Battery has a net loss greater than 0.6 AH	First level Idle boost requested
Idle Boost 1 Start	-	Less Than 11 V	-	First level Idle boost requested
Idle Boost 1 End	Greater Than -15°C (5°F)	Greater Than 12 V	Battery has a net loss less than 0.2 AH	First level Idle boost request cancelled
Load Shed 1 Start	-	-	Battery has a net loss of 4 AH	Front HVAC Blowers cycled OFF for 20% of their cycle
Load Shed 1 Start	-	Less Than 11 V	-	Front HVAC Blowers cycled OFF for 20% of their cycle
Load Shed 1 End	-	Greater Than 12 V	Battery has a net loss of less than 2 AH	Clear Load Shed 1
Idle Boost 2	-	-	Battery has a net loss greater than	Second level Idle boost

Start			1.6 AH	requested
Idle Boost 2 Start	-	Less Than 11 V	-	Second level Idle boost requested
Idle Boost 2 End	-	Greater Than 12 V	Battery has a net loss less than 0.8 AH	Second level Idle boost request cancelled
Idle Boost 3 Start	-	-	Battery has a net loss of 10 AH	Third level Idle boost requested
Idle Boost 3 Start	-	Less Than 11 V	-	Third level Idle boost requested
Idle Boost 3 End	-	Greater Than 12 V	Battery has a net loss of less than 6 AH	Third level Idle boost request cancelled
Load Shed 2 Start	-	-	Battery has a net loss greater than 12 AH	Rear Defrost, Heated Seats, Front HVAC Blowers cycled OFF for 100% of their cycle. The BATTERY SAVER ACTIVE message will be displayed on the DIC
Load Shed 2 Start	-	Less Than 11 V	-	Rear Defrost, Heated Seats, Front HVAC Blowers cycled OFF for 100% of their cycle. The BATTERY SAVER ACTIVE message will be displayed on the DIC
Load Shed 2 End	-	Greater Than 12 V	Battery has a net loss of less than 8 AH	Clear Load Shed 2

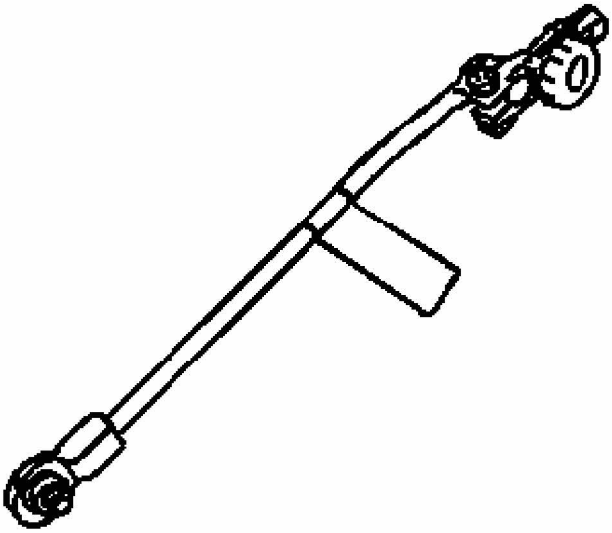
Load Shed 3 Start	-	Less Than 11.9 V	Battery has a net loss greater than 12 AH	Rear Defrost, Heated Seats, Front HVAC Blowers cycled OFF for 100% of their cycle. The BATTERY SAVER ACTIVE message will be displayed on the DIC
Load Shed 3 Start	-	Less Than 11 V	-	Rear Defrost, Heated Seats, Front HVAC Blowers cycled OFF for 100% of their cycle. The BATTERY SAVER ACTIVE message will be displayed on the DIC
Load Shed 3 End	-	Greater Than 12.6 V	Battery has a net loss of less than 8 AH	Clear Load Shed 3

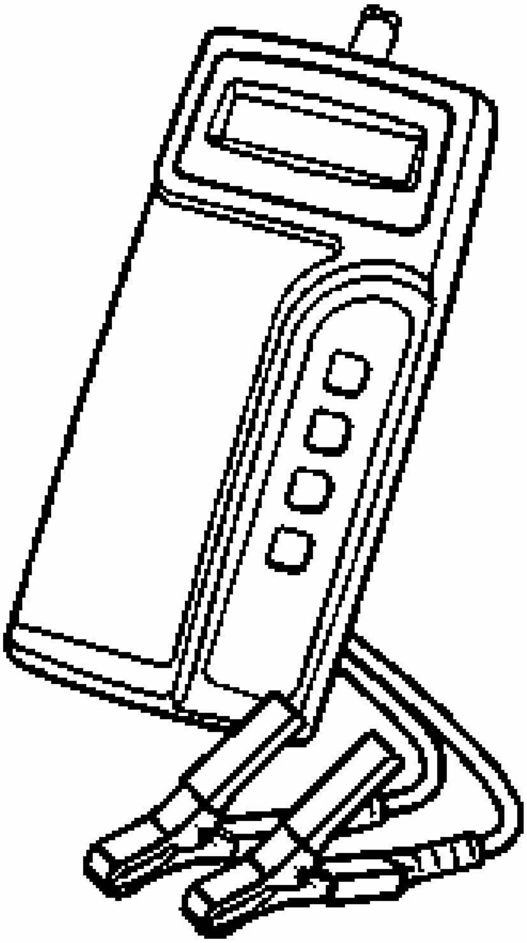
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/Description

	J 38758 Parasitic Draw Test Switch
	J 42000 Battery Tester



2006 ENGINE

Engine Exhaust - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Catalytic Converter Nut	60 N.m	44 lb ft
Catalytic Converter Pipe Stud Nut	35 N.m	26 lb ft
Exhaust Crossover Pipe Nut (LS4)	25 N.m	18 lb ft
Exhaust Hanger Bracket Bolt	25 N.m	18 lb ft
Exhaust Manifold Bolt (LS4)		
• First Pass	15 N.m	11 lb ft
• Final Pass	20 N.m	15 lb ft
Exhaust Manifold Heat Shield Bolt (LS4)	9 N.m	80 lb in
Exhaust Pipe Rear Hanger Bolt	25 N.m	18 lb ft
Rear Bumper Impact Bar Bolt	25 N.m	18 lb ft
Tail Pipe Extension Clamp	68 N.m	50 lb ft

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - ENGINE EXHAUST

Begin the system diagnosis by reviewing the system Description and Operation. Reviewing the information will help you determine the correct symptom diagnostic procedure when a malfunction exists. It will also help you determine if the condition described by the customer is normal operation. Refer to **Symptoms - Engine Exhaust** in order to identify the correct procedure for diagnosing the system.

SYMPTOMS - ENGINE EXHAUST

- Review the Exhaust System Description and Operation in order to familiarize yourself with the system functions. Refer to **Exhaust System Description**.
- All diagnostics on a vehicle should follow a logical process. Strategy Based Diagnostics is a uniform approach for repairing all systems. The diagnostic flow is the place to start when repairs are necessary and may always be used in order to resolve a system problem. For a detailed explanation, refer to **Strategy Based Diagnosis** in General Information.

Visual/Physical Inspection

- Inspect for aftermarket or non-OEM devices such as, but not including; tailpipe extensions, headers, and exhaust cutouts. This could affect the operation and proper performance of the exhaust system.
- Verify the exact operating conditions under which the concern exists. Note factors such as engine RPM, engine temperature, engine load, and frequency of concern.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause any symptom.

Intermittent

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating as designed.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Loss of Power

  Refer to **Restricted Exhaust**.

- Poor acceleration

  Refer to **Restricted Exhaust**.

- Poor fuel economy

  Refer to **Restricted Exhaust**.

- Excessive smoke-diesel

  Refer to **Restricted Exhaust**.

- Exhaust hissing noise

  Refer to **Exhaust Leakage**.

- Exhaust popping noise

  Refer to **Exhaust Leakage**.

- Exhaust rattle noise

Refer to **Exhaust Noise**.

- Loud exhaust noise

  Refer to **Exhaust Noise**.

- Exhaust buzz, groan, hum noise

  Refer to **Exhaust Noise**.

RESTRICTED EXHAUST

Diagnostic Aids

For dual exhaust systems a quick check of exhaust flow will help determine which side of the exhaust system is restricted. The side that has less exhaust flow is the side that will be suspect, and the diagnosis should begin there.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: The exhaust system has very low back pressure under normal conditions. If the exhaust system is restricted, a significant increase in the exhaust pressure is noticed on the **J 35314-A** Exhaust Back Pressure Gage. See **Special Tools**. Removing the heated oxygen sensor (HO2S) may set a DTC. When finishing this diagnostic table, be sure to clear all codes.

5: This step will isolate the catalytic converter from the remainder of the exhaust system.

8: Confirming that the condition has been fixed is essential. If the symptom still exists and the vehicle has a dual exhaust system, proceed to Step 2 and repeat diagnostic procedure on the opposite exhaust pipe.

9: Confirming that the condition has been fixed is essential. If the symptom still exists, proceed to Step 2 and repeat the diagnostic procedure.

Restricted Exhaust

Step	Action	Value(s)	Yes	No
1	Did you verify the customers complaint?	-	Go to **Step 2**	-
2	Did you review the exhaust symptoms diagnostic information and perform the necessary inspections?	-	Go to **Step 3**	Go to **Symptoms - Engine Exhaust**
	Is the system equipped with dual		Go to	

3	exhaust?	-	Diagnostic Aids	Go to **Step 4**
4	**CAUTION:** **While engine is operating, the exhaust system will become extremely hot. To prevent burns avoid contacting a hot exhaust system.** 1. Remove the pre-catalyst heated oxygen sensor (HO2S). Refer to one of the following: - **Heated Oxygen Sensor Replacement - Position 1** - **Heated Oxygen Sensor Replacement - Position 1** - **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** 2. Install the **J 35314-A** in place of the HO2S sensor. See **Special Tools**. 3. Start and run the engine. 4. Increase and monitor the engine speed at 2,500 RPM. 5. Observe the exhaust system back pressure reading on the gage. Does the reading exceed the specified value?	9 kPa (1.25 psi)	Go to **Step 5**	Go to **Step 9**
	1. Turn the engine OFF and place the ignition in the lock position. 2. Remove the **J 35314-A** . See **Special Tools**. 3. Install the pre-catalyst HO2S. Refer to one of the following: - **Heated Oxygen Sensor Replacement - Position 1** - **Heated Oxygen Sensor Replacement - Position 1** - **Heated Oxygen Sensor (HO2S) Replacement Bank**			

5	**1 Sensor 1** 4. Remove the post-catalyst HO2S. Refer to one of the following: • **Heated Oxygen Sensor Replacement - Position 2** • **Heated Oxygen Sensor Replacement - Position 2** • **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2** 5. Install the **J 35314-A** in place of the post HO2S sensor. See **Special Tools**. 6. Start and run the engine. 7. Increase and monitor the engine speed at 2,500 RPM. 8. Observe the exhaust system back pressure reading on the gage. Does the reading exceed the specified value?	9 kPa (1.25 psi)	Go to **Step 6**	Go to **Step 7**
6	Inspect the exhaust system for the following conditions: • Damage in the exhaust pipe • Debris in the exhaust pipe • Muffler or resonator internal failure • Two-layer exhaust pipe separation Did you find and correct the condition?	-	Go to **Step 8**	-
7	Replace the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)**. Did you find and correct the condition?	-	Go to **Step 8**	-
	1. Remove the **J 35314-A** . See **Special Tools**. 2. Install the post-catalyst HO2S.			

8	Refer to one of the following: - **Heated Oxygen Sensor Replacement - Position 2** - **Heated Oxygen Sensor Replacement - Position 2** - **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2** 3. Clear any codes. 4. Road test the vehicle in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 2**
9	1. Remove the **J 35314-A** . See **Special Tools**. 2. Install the pre-catalyst HO2S. Refer to one of the following: - **Heated Oxygen Sensor Replacement - Position 1** - **Heated Oxygen Sensor Replacement - Position 1** - **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** 3. Clear any codes. 4. Road test the vehicle in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 2**

EXHAUST LEAKAGE

Exhaust Leakage

Problem	Action
CAUTION: **Refer to Hot Exhaust System Caution in Cautions and Notices.** **IMPORTANT:** **Refer to Symptoms - Engine Exhaust prior to beginning this table.**	

DEFINITION: An exhaust leak may show stains at the area of the leak. The leak may be felt by holding a hand close to the suspected areas or using a smoke pencil. The leak may make a popping or hissing noise.	
Misaligned or improperly installed exhaust system components	**NOTE:** **Refer to FASTENER NOTICE in Cautions and Notices.** Align and tighten the components to the specifications. Refer to **Fastener Tightening Specifications**.
Exhaust leaks at the following connections: - Exhaust manifold to pipe - Flanges - Pipe clamps	Tighten the components to the specifications. Refer to **Fastener Tightening Specifications**.
Seals or gaskets leaking: - Exhaust manifold to cylinder head - Exhaust pipes to exhaust manifold - Catalytic converter connection - EGR connections - AIR connections to the exhaust manifold or cylinder head	Replace the leaking seal or gasket. Refer to the affected components procedure for service.
Exhaust manifold cracked or broken	Replace the exhaust manifold. Refer to **Exhaust Manifold Replacement - Left (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Left (RPO LS4)** or **Exhaust Manifold Replacement - Right (RPOs LZE/LZ4/LZ9)** or **Exhaust Manifold Replacement - Right (RPO LS4)**.
Exhaust system component connection welds leaking	Replace the leaking component. Refer to the affected component's procedure for service.
Muffler is damaged or leaking at the seams	Replace the affected muffler. Refer to **Muffler Replacement (Single Outlet)** or **Muffler Replacement (Dual Outlet)**.

EXHAUST NOISE

Exhaust Noise

Condition	Action
CAUTION: **Refer to Hot Exhaust System Caution in Cautions and Notices.** **IMPORTANT:** **Refer to Symptoms - Engine Exhaust prior to beginning this table.** DEFINITION: An audible or physical noise due to a faulty component or damaged components causing a loose or misaligned exhaust system resulting in a rattle or vibration noise.	
Popping or hissing noise	Exhaust leak. Refer to **Exhaust Leakage**.
Loud exhaust	1. Compare to a known good vehicle. 2. Inspect for a damaged or failed muffler. 3. Replace the faulty muffler. Refer to **Muffler Replacement (Single Outlet)** or **Muffler Replacement (Dual Outlet)**.
External rattle or vibration noise	1. Inspect for a bent or loose hanger, loose heat shield, or loose clamp. 2. Inspect for a exhaust pipe causing interference. 3. Repair or replace the affected component. Refer to the affected component's service procedure.
Internal rattle	1. Test the components by tapping with a rubber mallet to confirm a rattle. 2. Replace the faulty catalytic converter, resonator, or muffler. Refer to one of the following procedures: - **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)Catalytic Converter Replacement (RPO LS4)** - **Muffler Replacement (Single Outlet) Muffler Replacement (Dual Outlet)**

REPAIR INSTRUCTIONS

EXHAUST MANIFOLD REPLACEMENT - LEFT (RPOS LZE/LZ4/LZ9)

Removal Procedure

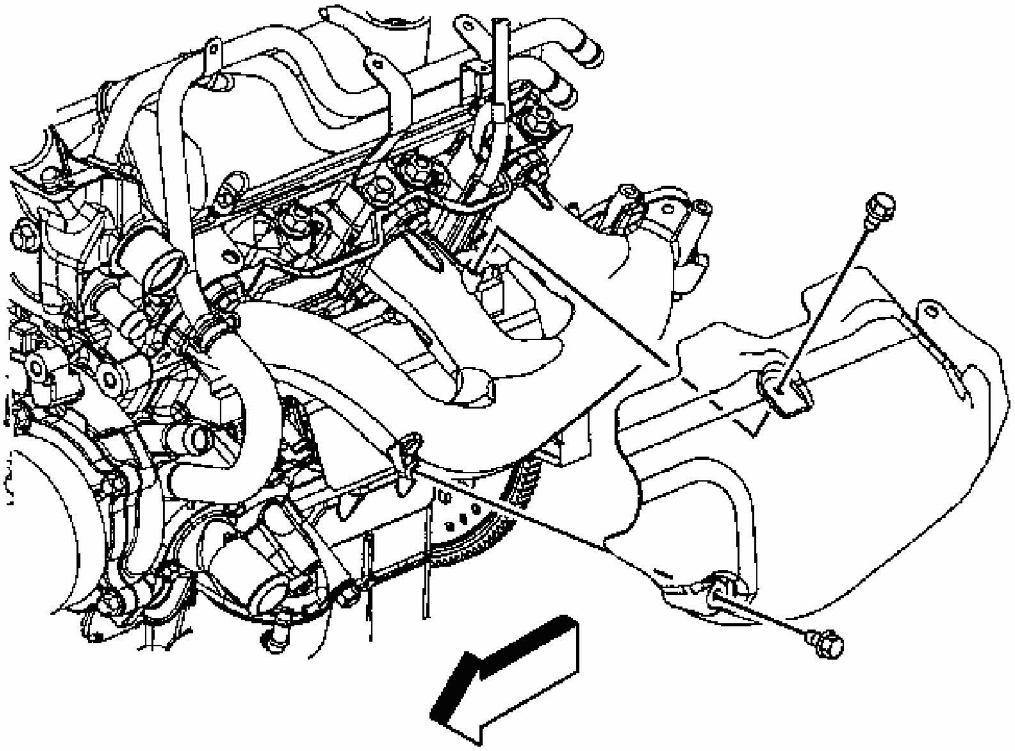


Fig. 1: Identifying Exhaust Manifold Heat Shield - Left
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount strut bracket. Refer to **Engine Mount Strut Bracket Replacement - Left** .
2. Remove the exhaust manifold heat shield bolts.
3. Remove the exhaust manifold heat shield.

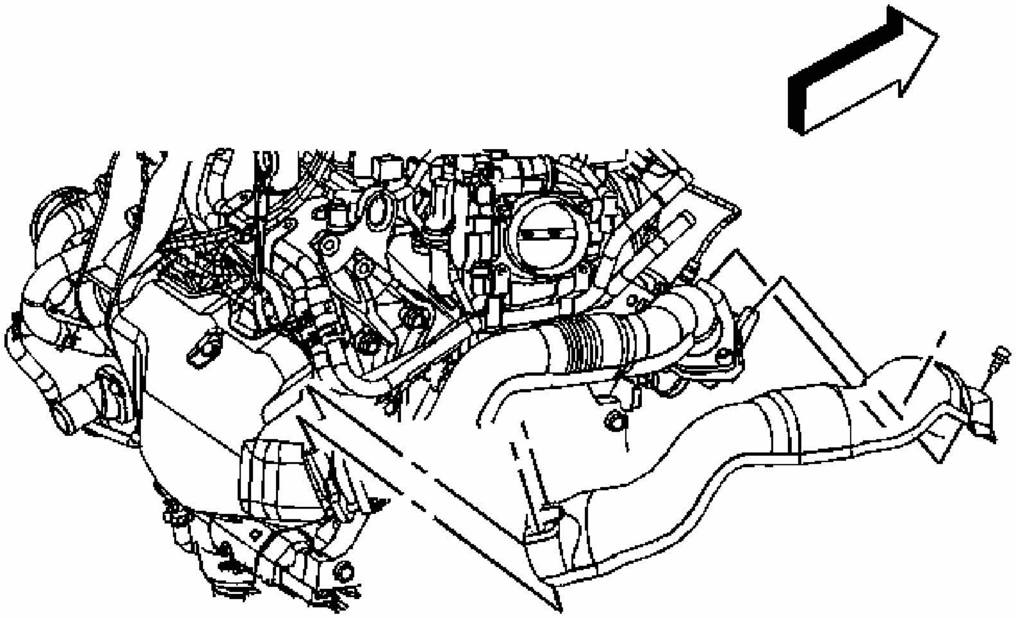


Fig. 2: Identifying Exhaust Crossover Pipe Heat Shield
Courtesy of GENERAL MOTORS CORP.

4. Remove the exhaust crossover pipe heat shield bolts.
5. Remove the exhaust crossover pipe heat shield.

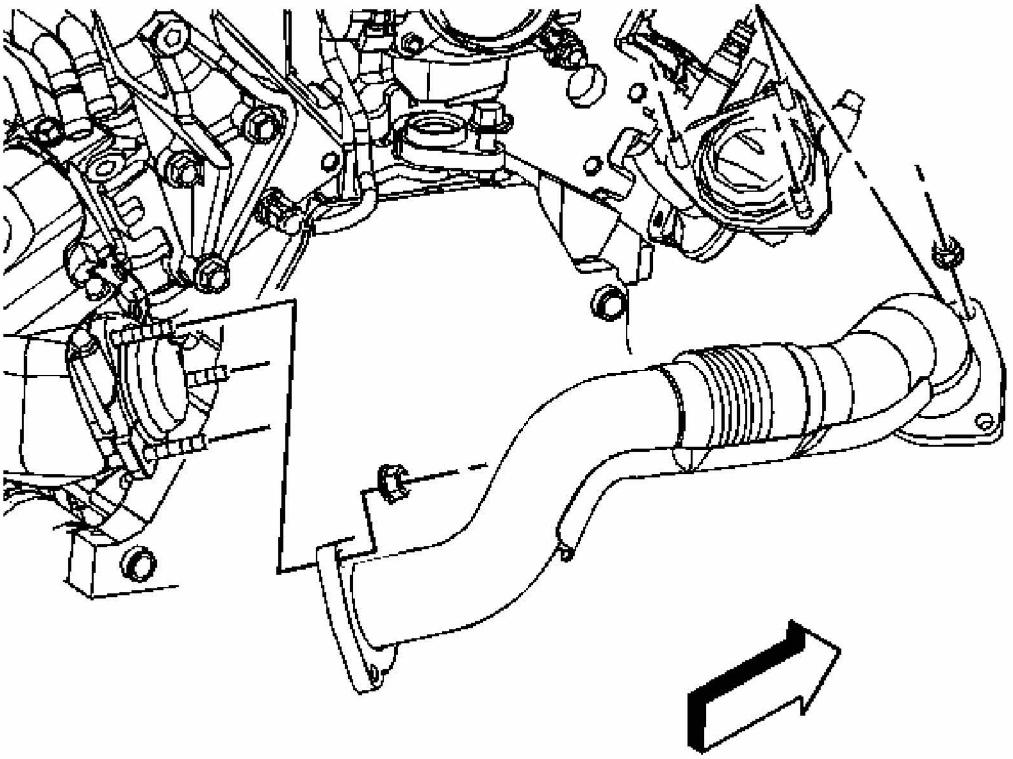


Fig. 3: Locating Exhaust Crossover Pipe & Left Exhaust Manifold Nuts
Courtesy of GENERAL MOTORS CORP.

6. Remove the exhaust crossover pipe to left exhaust manifold nuts.

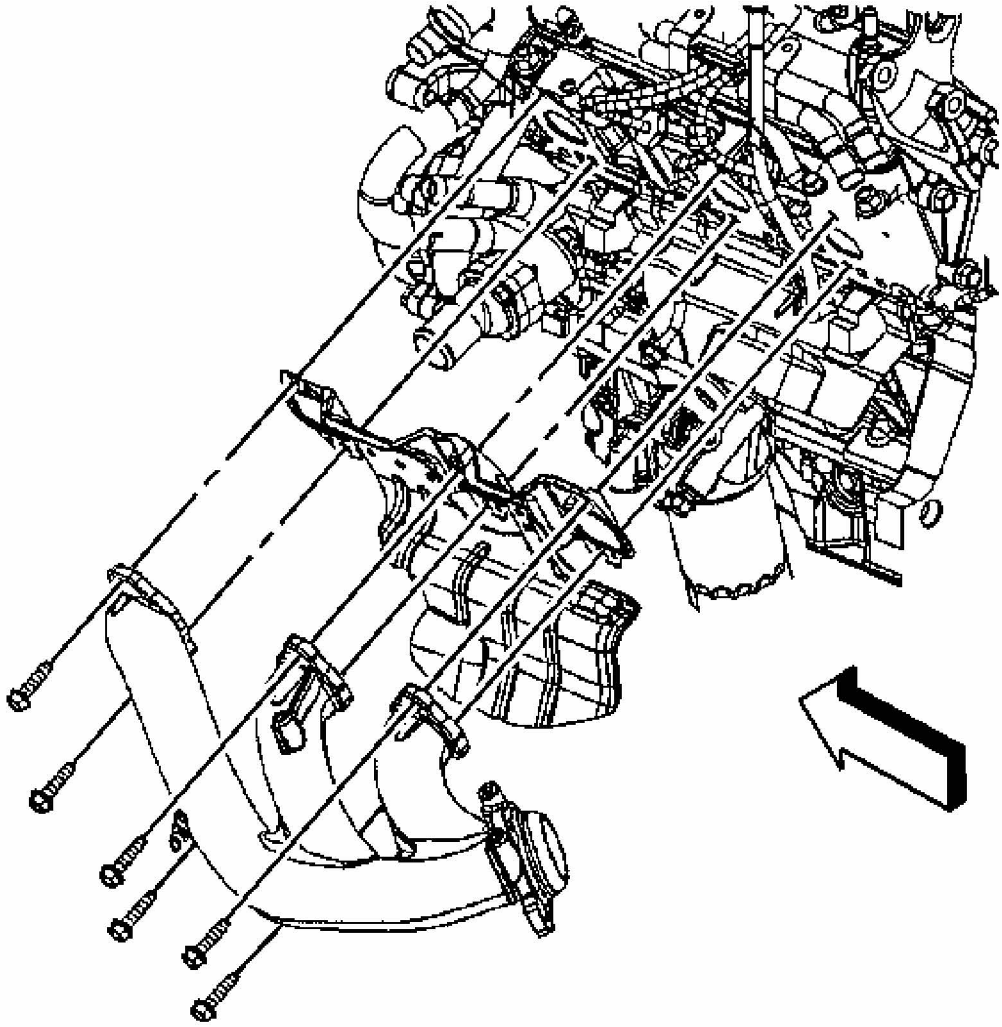


Fig. 4: Identifying Exhaust Manifold Bolts - Left
Courtesy of GENERAL MOTORS CORP.

7. Remove the exhaust manifold bolts.
8. Remove the exhaust manifold bolts.
9. Remove the exhaust manifold.
10. Remove and discard the exhaust manifold gasket.

Installation Procedure

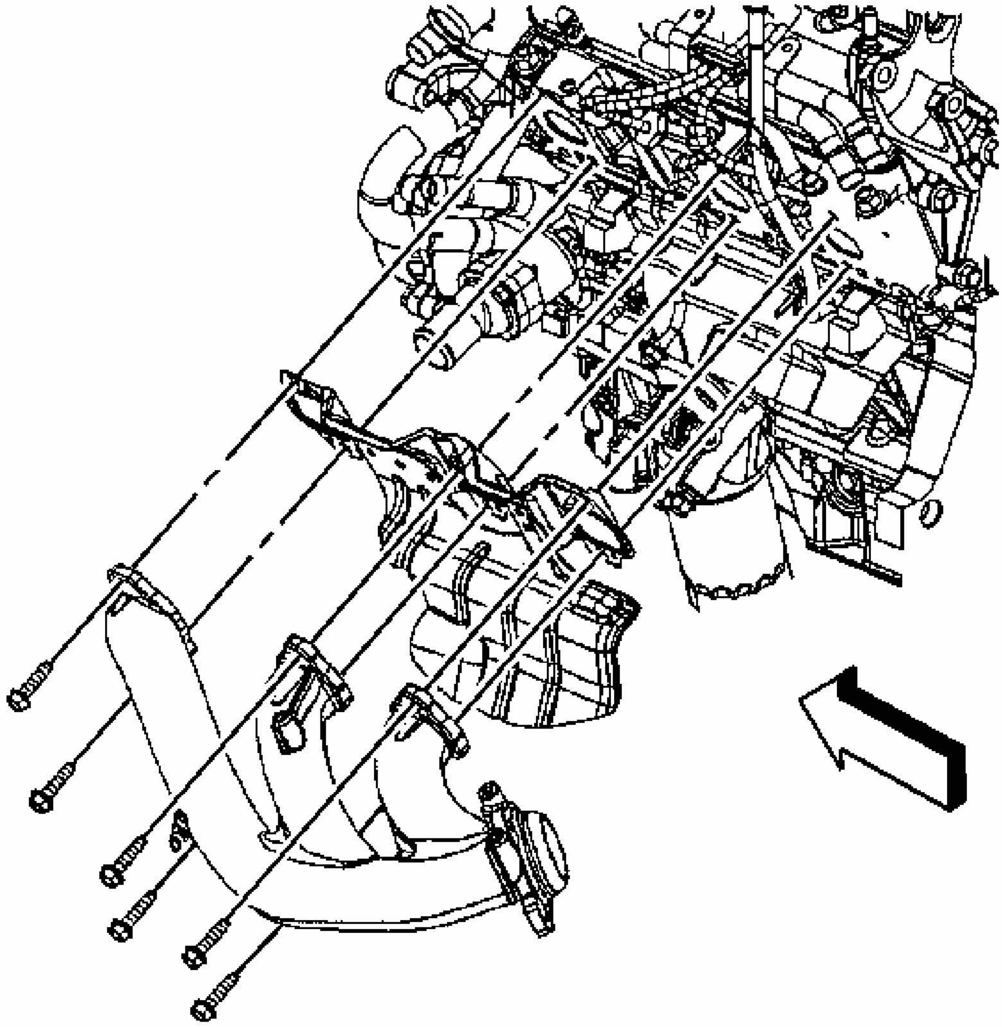


Fig. 5: Identifying Exhaust Manifold Bolts - Left
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW exhaust manifold gasket onto the cylinder head studs.
2. Install the exhaust manifold.

NOTE: **Refer to Fastener Notice .**

3. Install the exhaust manifold bolts.

Tighten: Tighten the bolts to 20 N.m (15 lb ft).

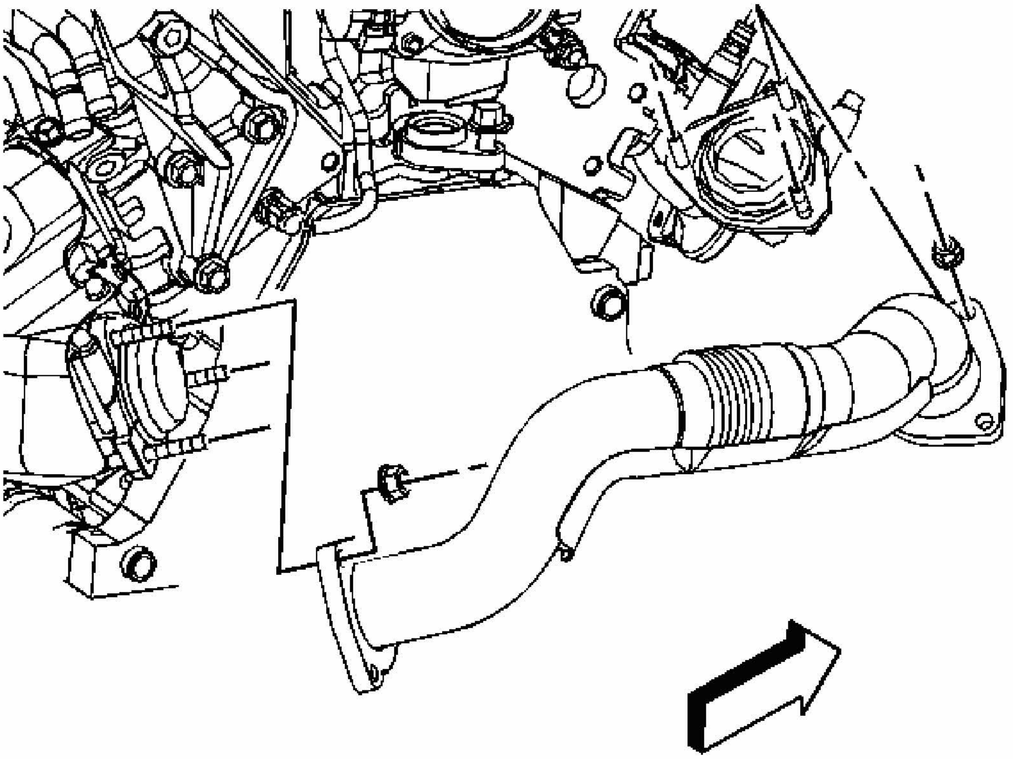


Fig. 6: Locating Exhaust Crossover Pipe & Left Exhaust Manifold Nuts
Courtesy of GENERAL MOTORS CORP.

4. Install the exhaust crossover pipe to left exhaust manifold nuts.

   Tighten: Tighten the nuts to 20 N.m (15 lb ft).

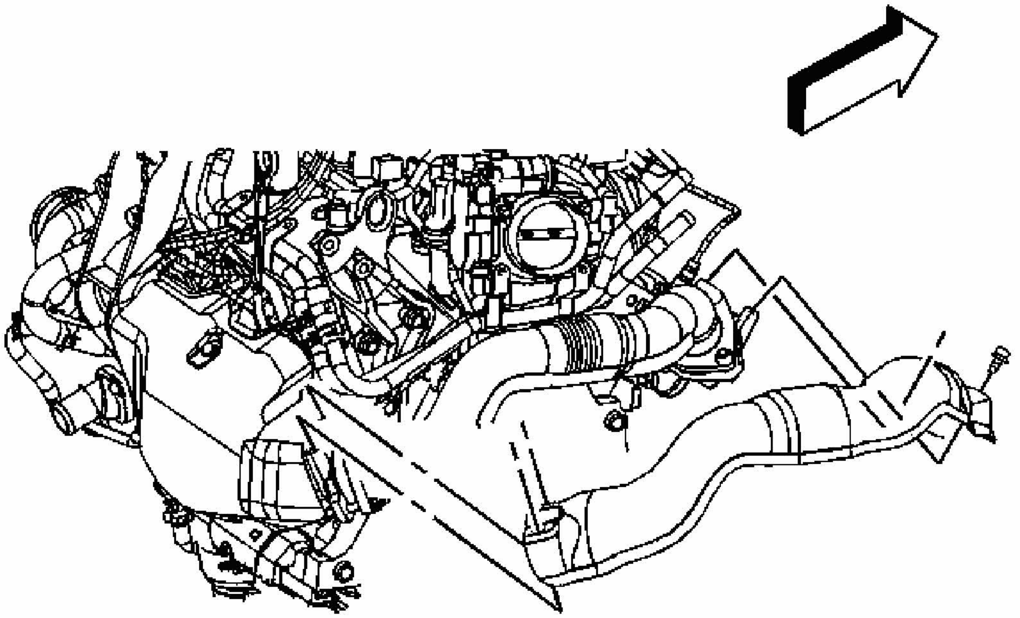


Fig. 7: Identifying Exhaust Crossover Pipe Heat Shield
Courtesy of GENERAL MOTORS CORP.

5. Install the exhaust crossover pipe heat shield.
6. Install the exhaust crossover pipe heat shield bolts.

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

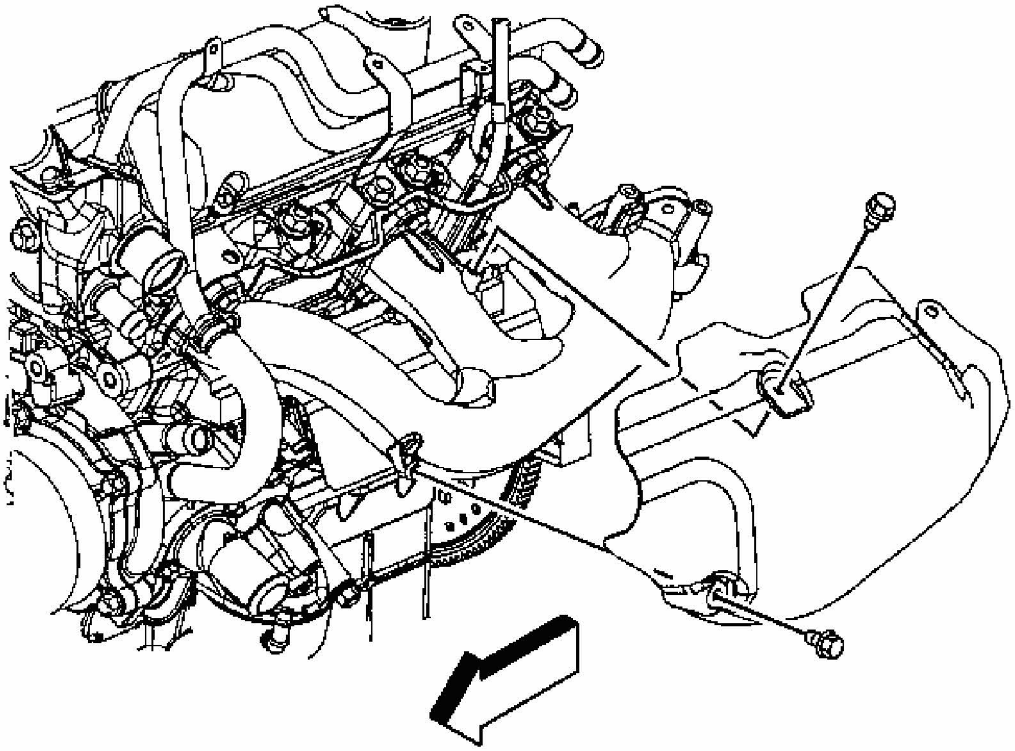


Fig. 8: Identifying Exhaust Manifold Heat Shield - Left
Courtesy of GENERAL MOTORS CORP.

7. Install the exhaust manifold heat shield.
8. Install the exhaust manifold heat shield bolts.

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

9. Install the engine mount strut bracket. Refer to **Engine Mount Strut Bracket Replacement - Left** .

EXHAUST MANIFOLD REPLACEMENT - LEFT (RPO LS4)

Removal Procedure

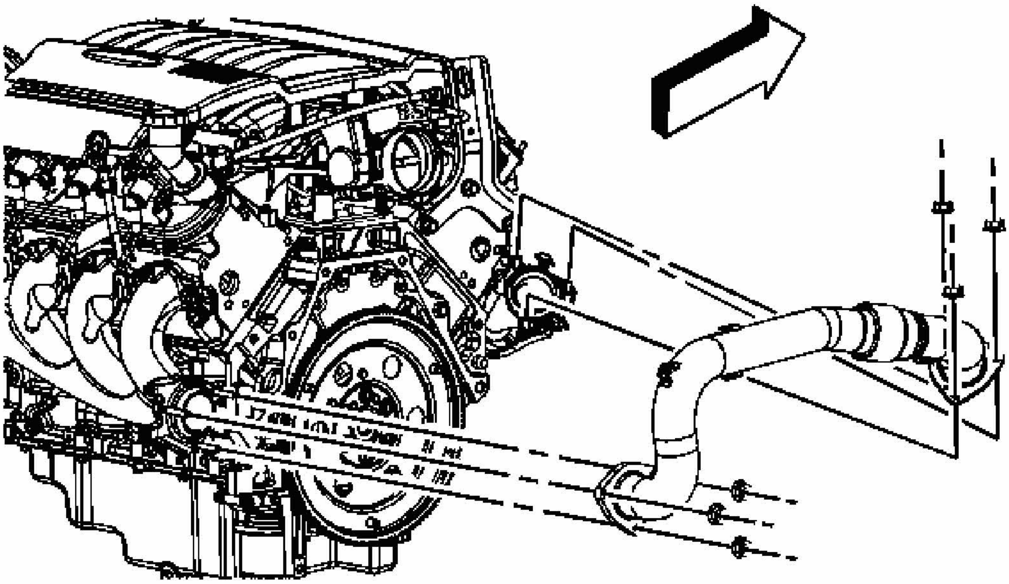


Fig. 9: Exhaust Crossover Pipe & Nuts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement** .
2. Remove the exhaust crossover pipe heat shield in order to access the cross pipe to the exhaust manifold nuts.
3. Remove the exhaust crossover pipe nuts from the left exhaust manifold.
4. Remove the left side spark plugs. Refer to **Spark Plug Replacement** .
5. Remove the oil level indicator tube. Refer to **Oil Level Indicator and Tube Replacement** .

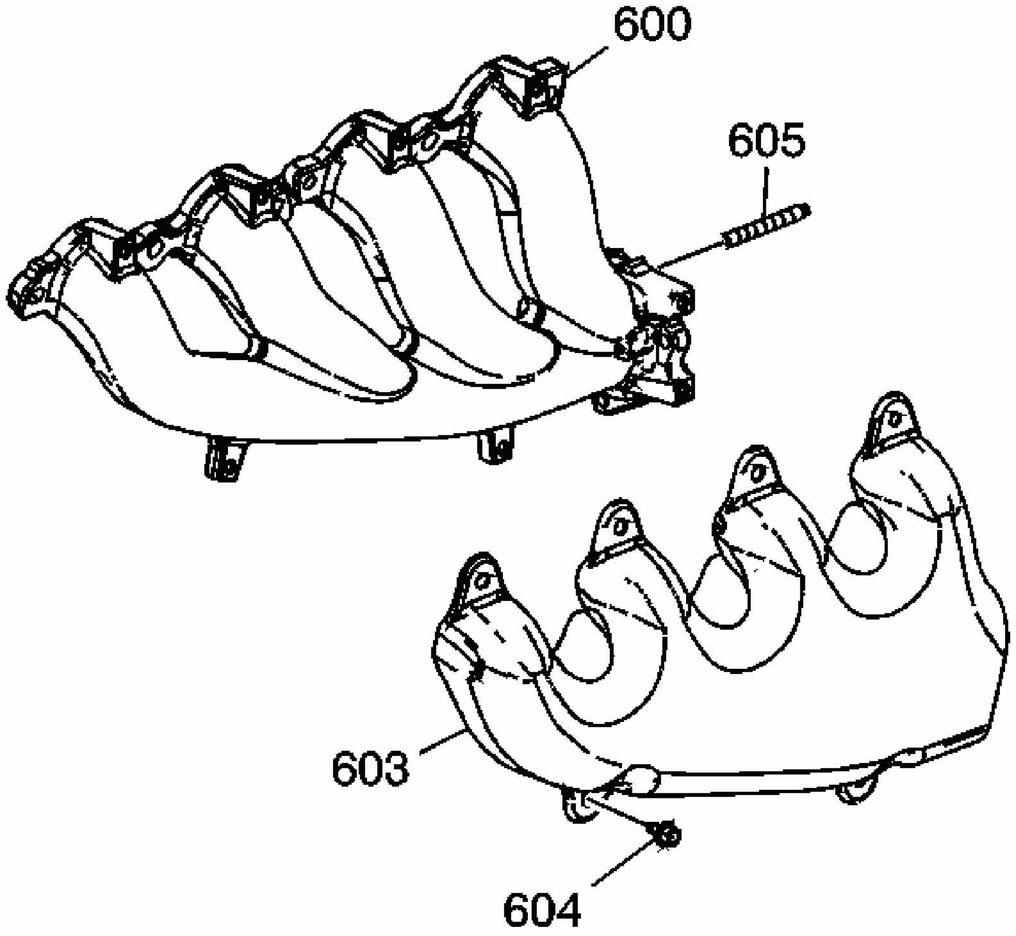


Fig. 10: Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the exhaust manifold heat shield bolts (604).
7. Remove the exhaust manifold heat shield (603).
8. Remove the heater hose retainer bolts in order to be able to remove the manifold.

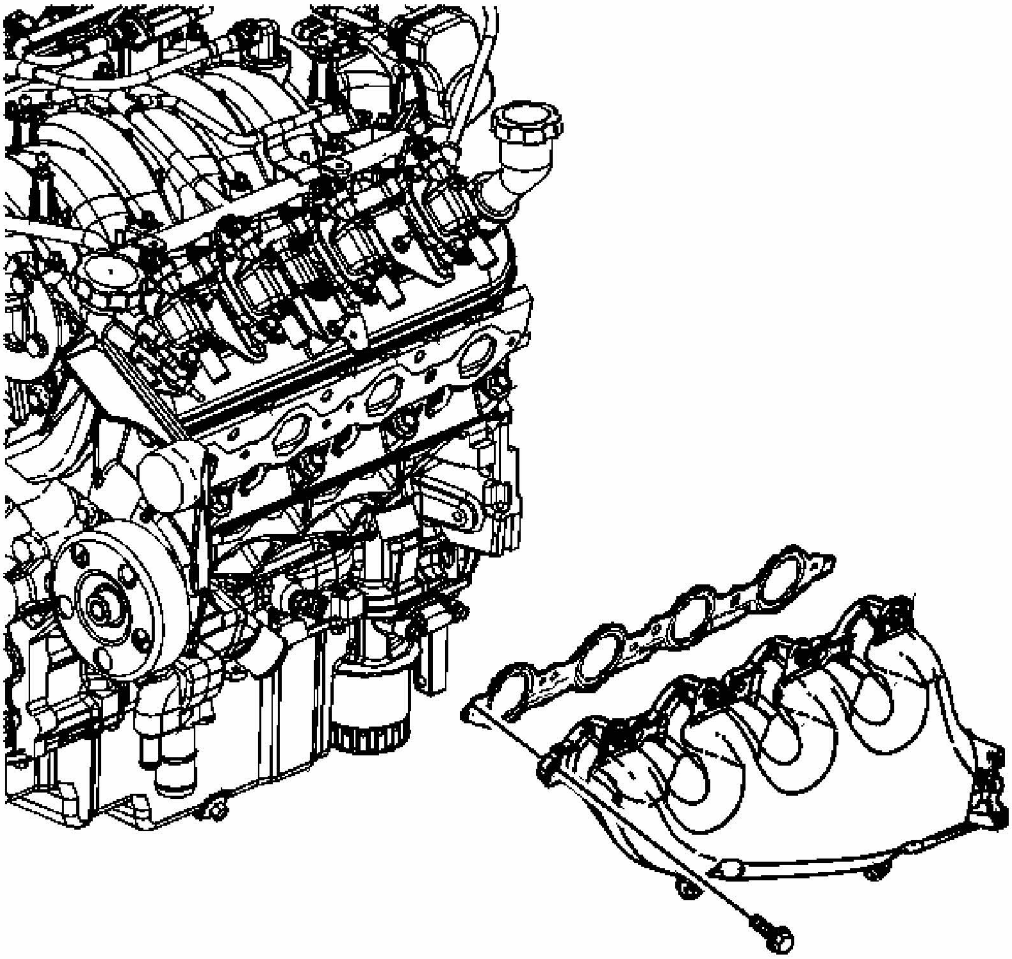


Fig. 11: Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

9. Remove the exhaust manifold bolts.
10. Remove the exhaust manifold.
11. Remove and discard the exhaust manifold gasket.
12. Clean and inspect the left exhaust manifold. Refer to **Exhaust Manifold Cleaning and Inspection** .

Installation Procedure

IMPORTANT:

- **Tighten the exhaust manifold bolts as specified in the service procedure. Improperly installed and/or leaking exhaust manifold gaskets my affect vehicle emissions**

and/or On Board Diagnostic (OBD) II system performance.

- **The cylinder head exhaust manifold bolt hole threads must be clean and free of debris or threadlocking material.**
- **DO NOT apply threadlock to the first three thread of the bolts.**

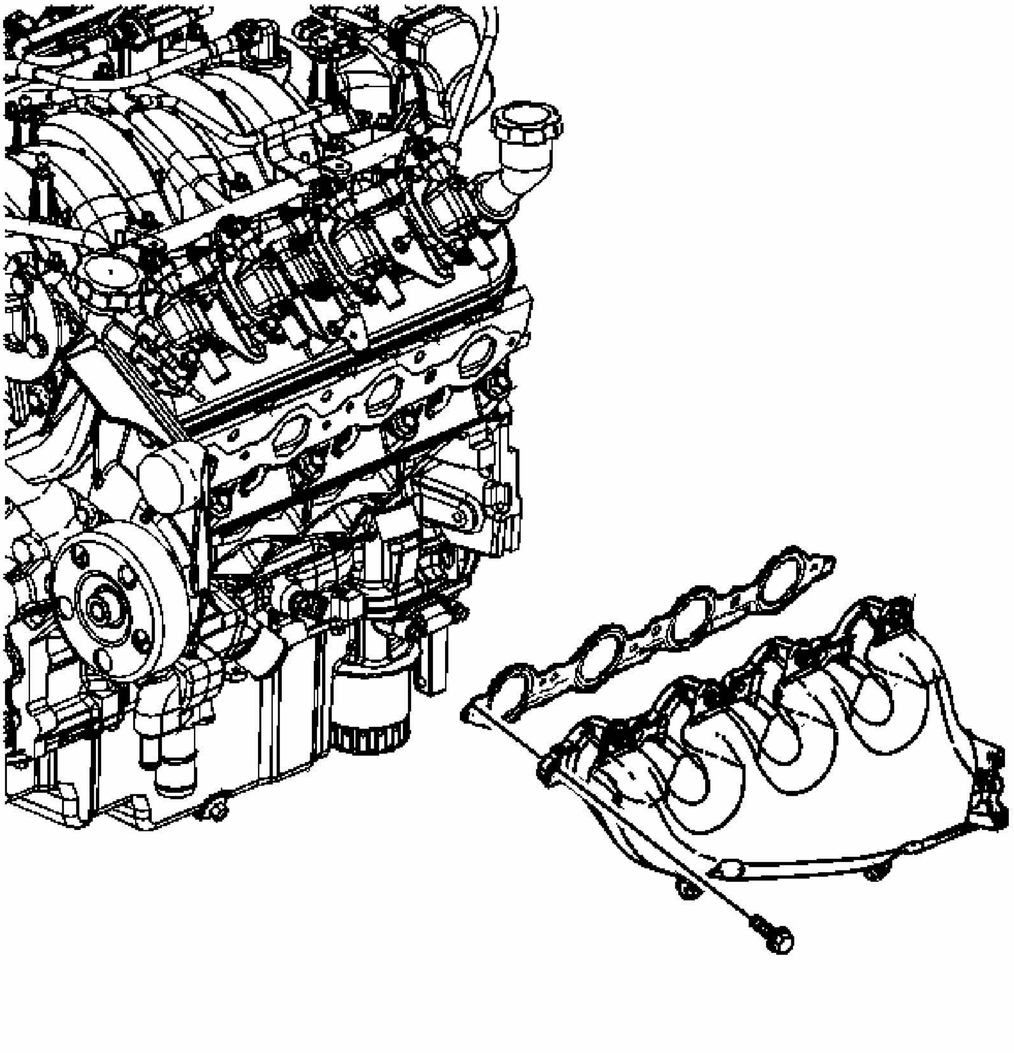


Fig. 12: Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

1. Apply a 5 mm (0.2 in) wide band of threadlock GM P/N 12345493 (Canadian P/N 10953488) or equivalent to the threads of the exhaust manifold bolts.

NOTE: **Refer to Fastener Notice .**

2. Install a NEW exhaust manifold gasket, the exhaust manifold and bolts.

   Tighten:

   - Tighten the bolts a first pass to 15 N.m (11 lb ft). Tighten the bolts beginning with the center 2 bolts. Alternate from side to side, and work toward the outside.
   - Tighten the bolts a final pass to 20 N.m (15 lb ft). Tighten the bolts beginning with the center 2 bolts. Alternate from side to side, and work toward the outside.

3. Using a flat punch, bend over the exposed edge of the exhaust manifold gasket at the rear of the left cylinder head.

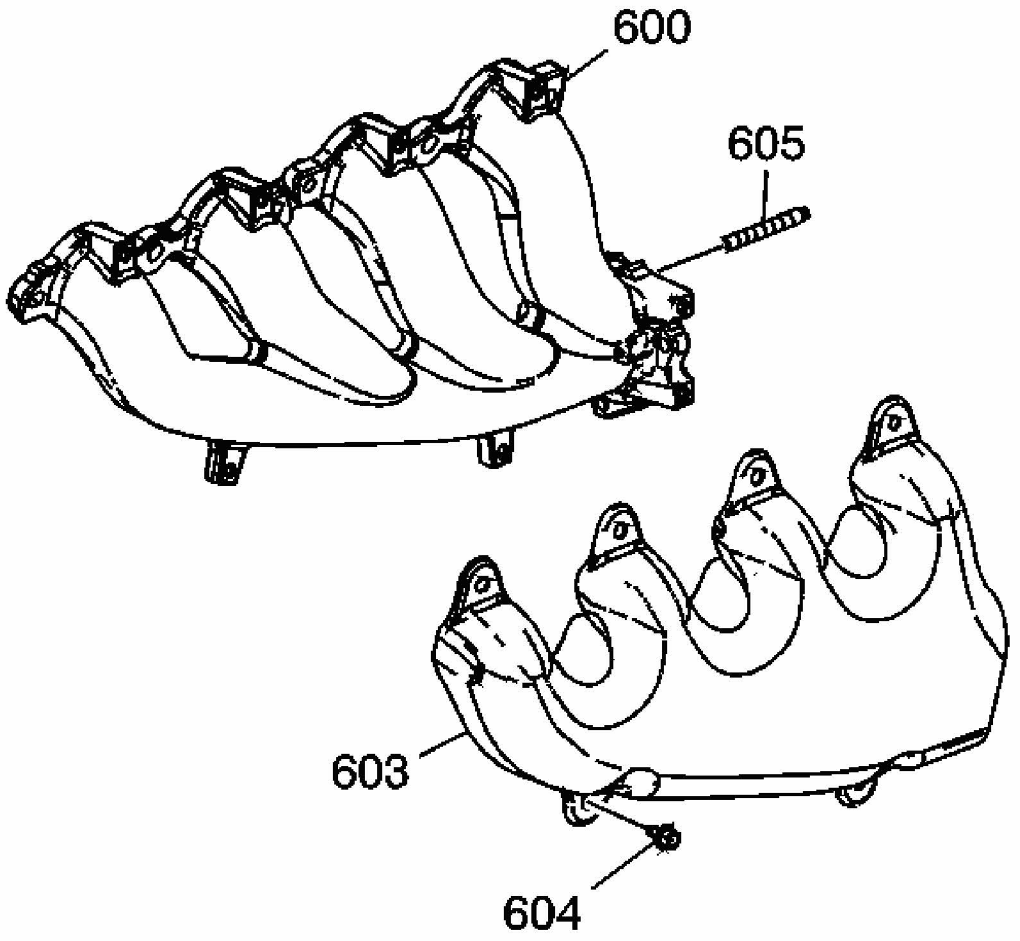


Fig. 13: Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the exhaust manifold heat shield (603).

5. Install the exhaust manifold heat shield bolts (604).

   Tighten: Tighten the bolts to 9 N.m (80 lb in).

6. Install the oil level indicator tube. Refer to **Oil Level Indicator and Tube Replacement** .
7. Install the left side spark plugs. Refer to **Spark Plug Replacement** .

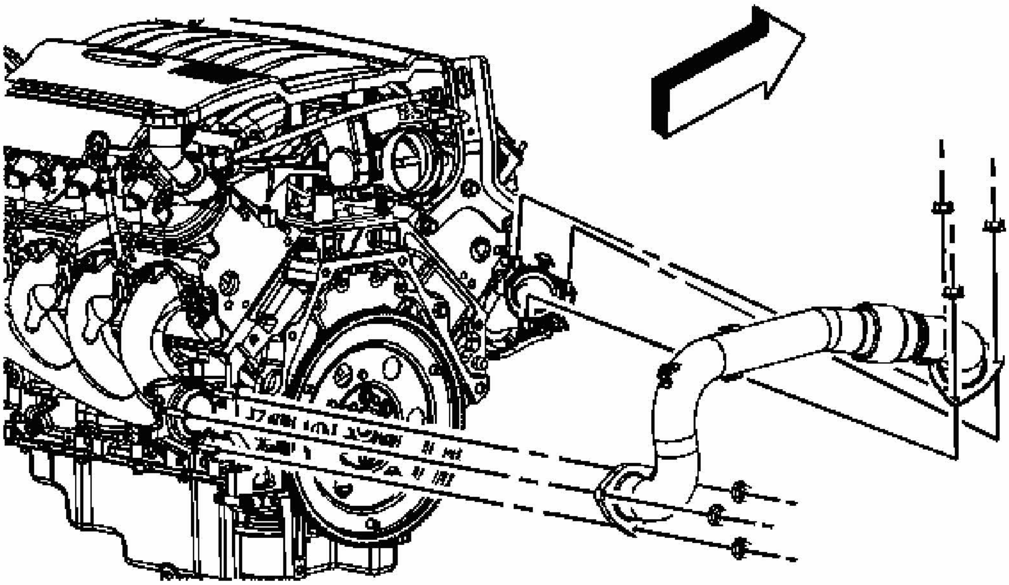


Fig. 14: Exhaust Crossover Pipe & Nuts
Courtesy of GENERAL MOTORS CORP.

8. Install the exhaust crossover pipe nuts from the left exhaust manifold.

   Tighten: Tighten the nuts to 25 N.m (18 lb ft).

9. Install the exhaust crossover pipe heat shield.
10. Install the heater pipe retainer bolts.

    Tighten: Tighten the bolts to 16 N.m (12 lb ft).

11. Install the engine sight shield. Refer to **Engine Sight Shield Replacement** .

EXHAUST MANIFOLD REPLACEMENT - RIGHT (RPOS LZE/LZ4/LZ9)

Tools Required

J 39194-B Heated Oxygen Sensor Socket. See **Special Tools**.

Removal Procedure

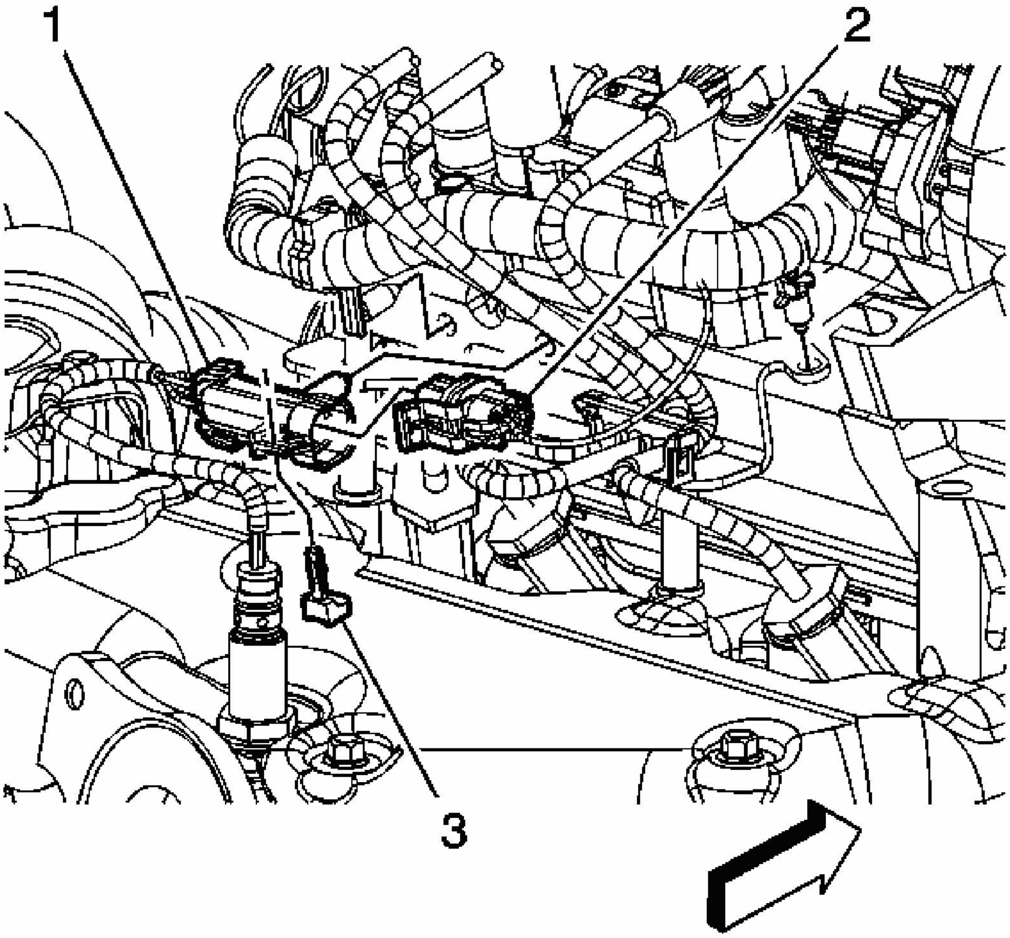


Fig. 15: Identifying The HO2S Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** .
2. Remove the connector position assurance (CPA) retainer (3).
3. Disconnect the heated oxygen sensor (HO2S) electrical connector (2).
4. Remove the HO2S clip (1) from the ignition coil bracket.

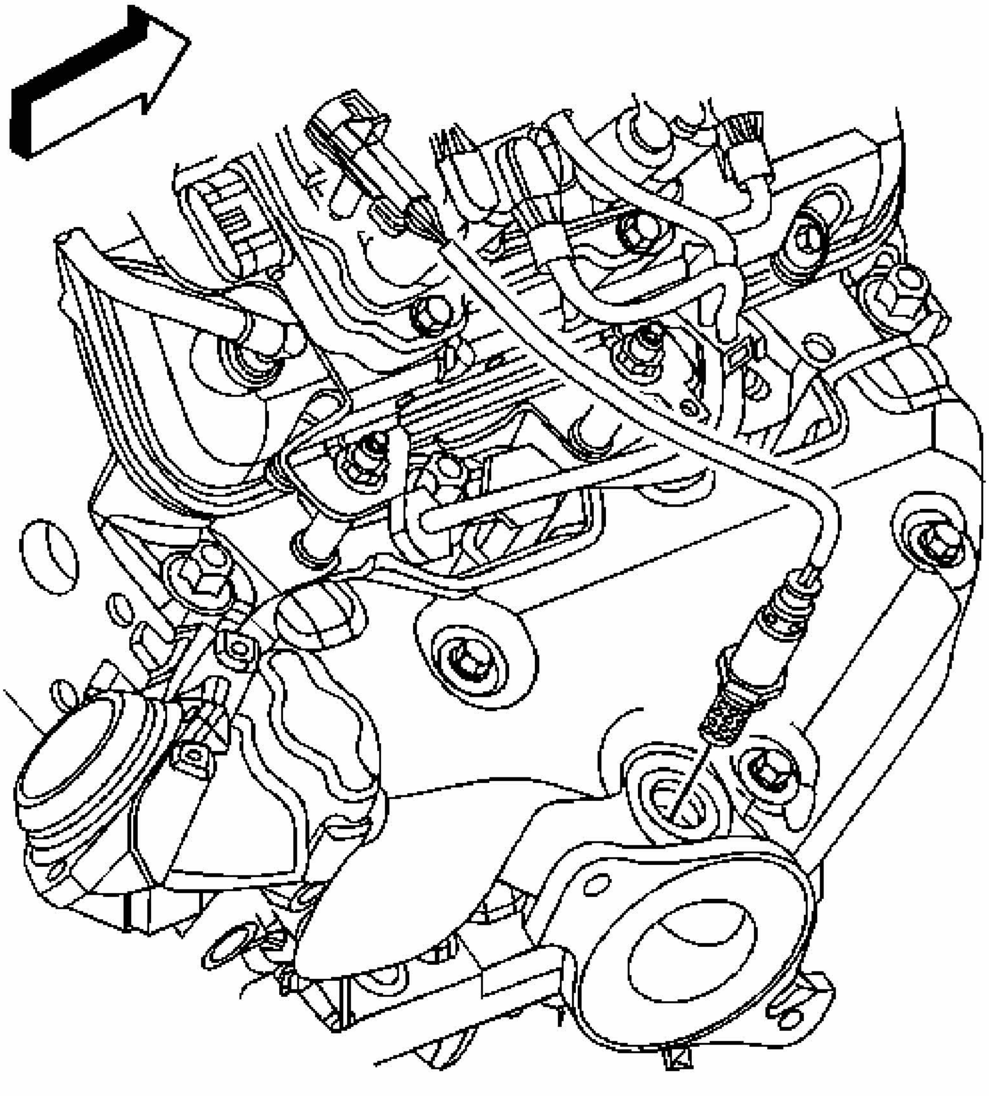


Fig. 16: View Of HO2S & J 39194-B
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The HO2S uses a permanently attached pigtail and connector. This pigtail should not be removed from the sensor. Damage or removal of the pigtail or connector will affect proper operation of the sensor.

5. Remove the HO2S using the **J 39194-B** . See **Special Tools**.

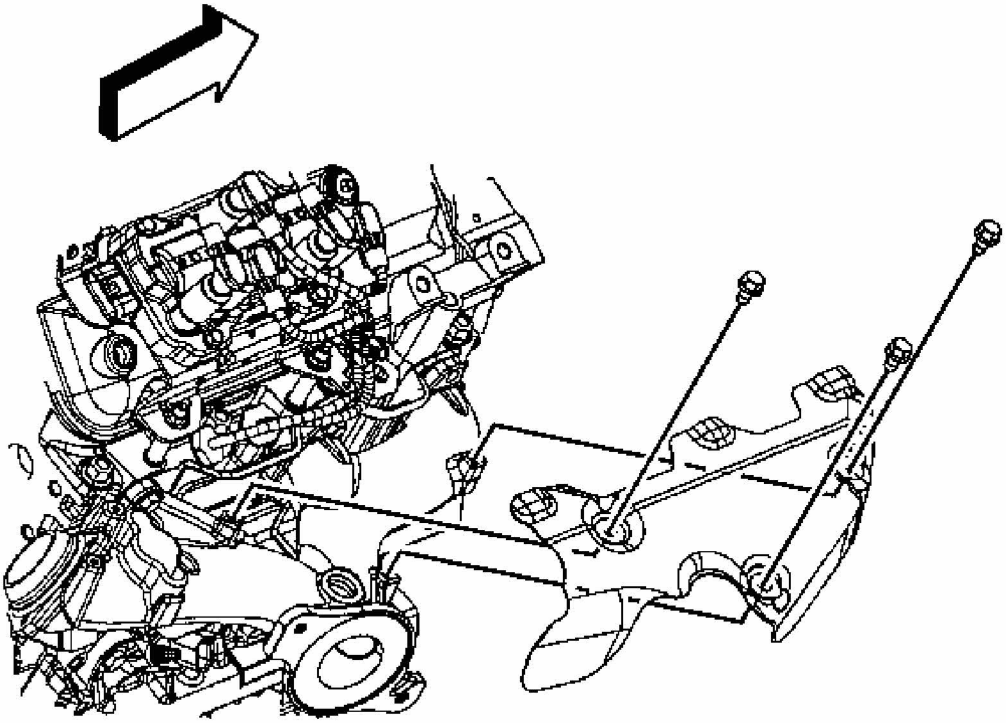


Fig. 17: Identifying Exhaust Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the exhaust manifold shield bolts.
7. Remove the exhaust manifold shield.

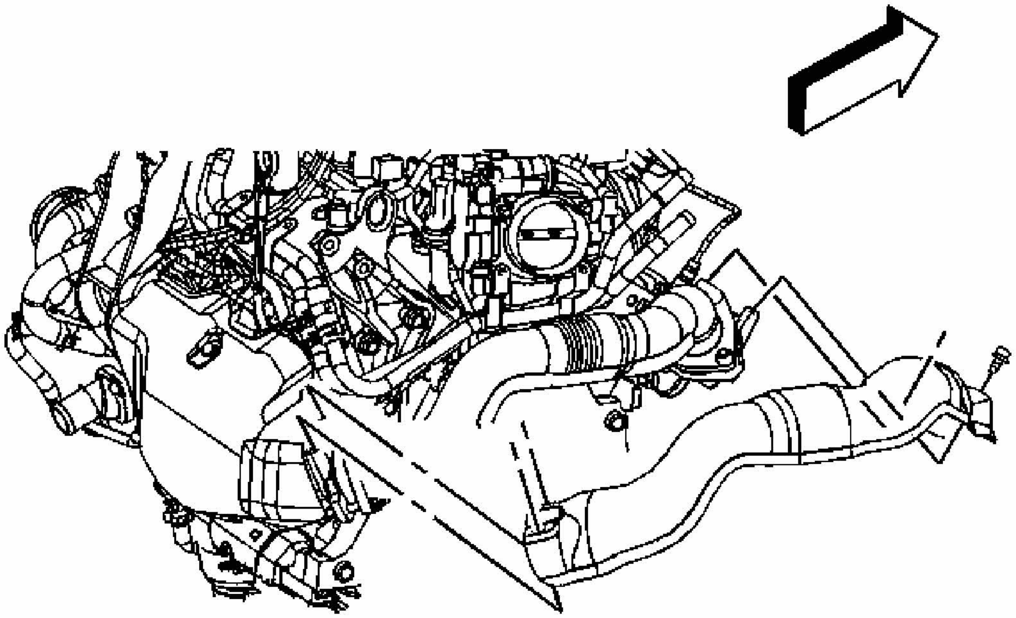


Fig. 18: Identifying Exhaust Crossover Pipe Heat Shield
Courtesy of GENERAL MOTORS CORP.

8. Remove the exhaust crossover pipe heat shield bolts.
9. Remove the exhaust crossover pipe heat shield.

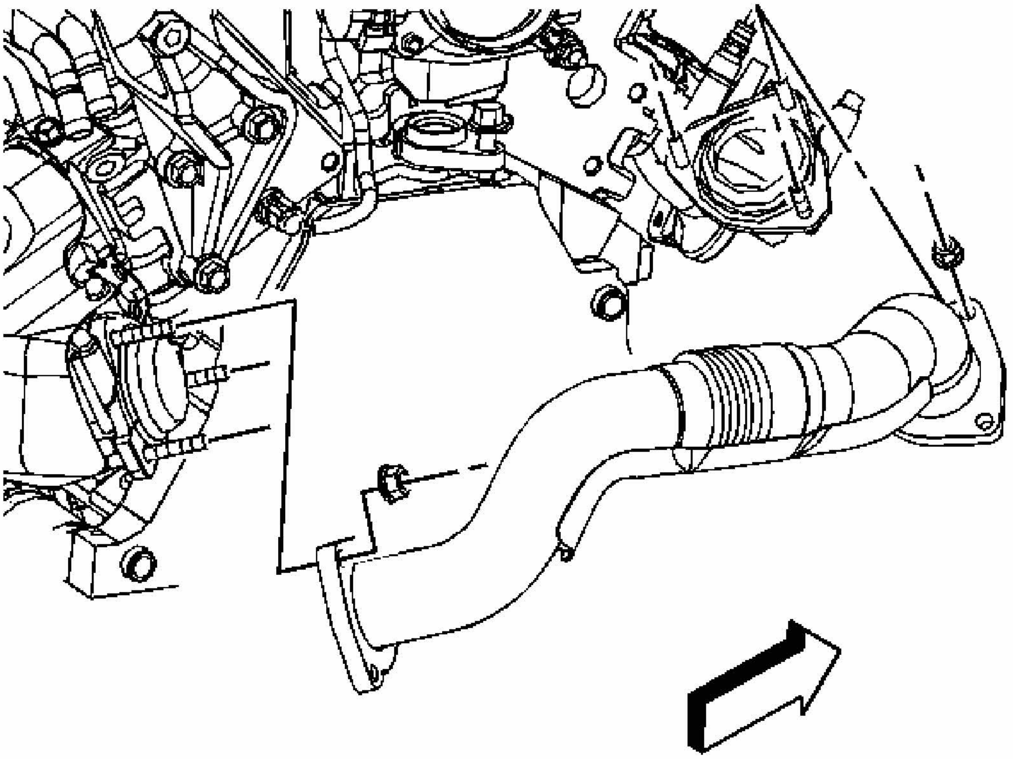


Fig. 19: Locating Exhaust Crossover Pipe & Left Exhaust Manifold Nuts
Courtesy of GENERAL MOTORS CORP.

10. Remove the exhaust crossover pipe to right exhaust manifold nuts.

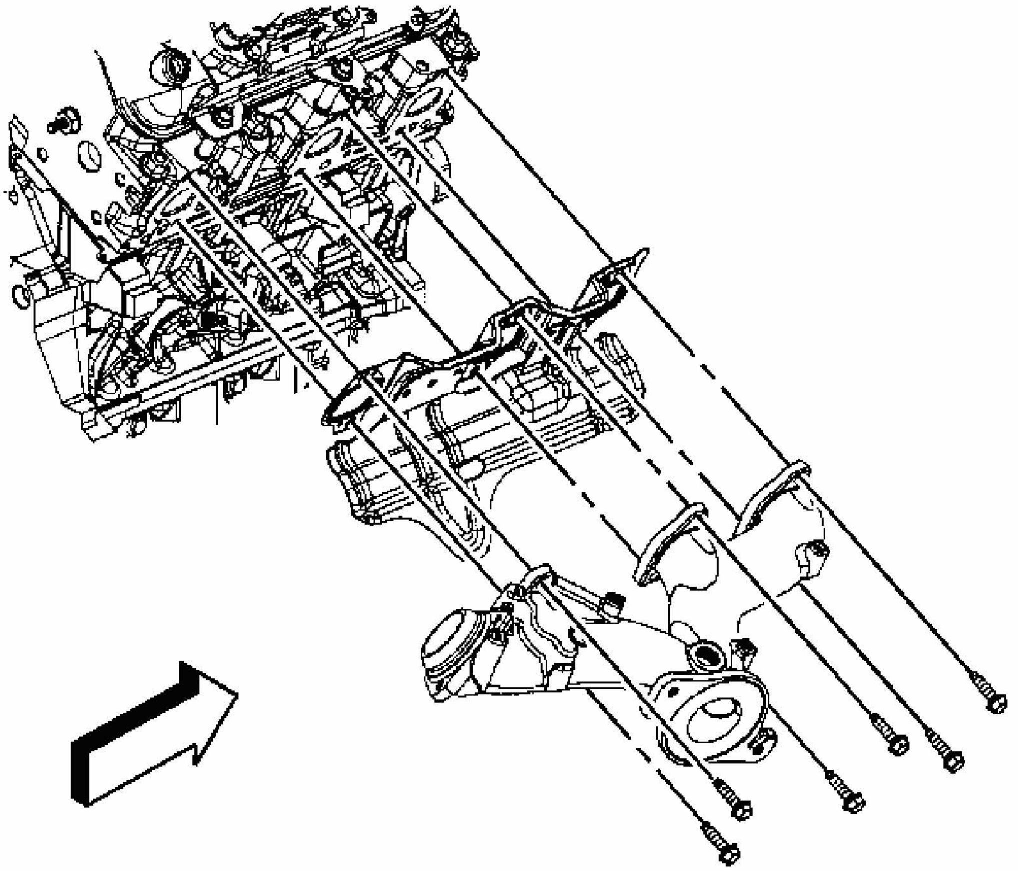


Fig. 20: Identifying Exhaust Manifold & Heat Shield Bolts
Courtesy of GENERAL MOTORS CORP.

11. Remove the upper exhaust manifold bolts.
12. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)**.
13. Remove the lower exhaust manifold bolts.
14. Remove the exhaust manifold.
15. Remove and discard the exhaust manifold gasket.

Installation Procedure

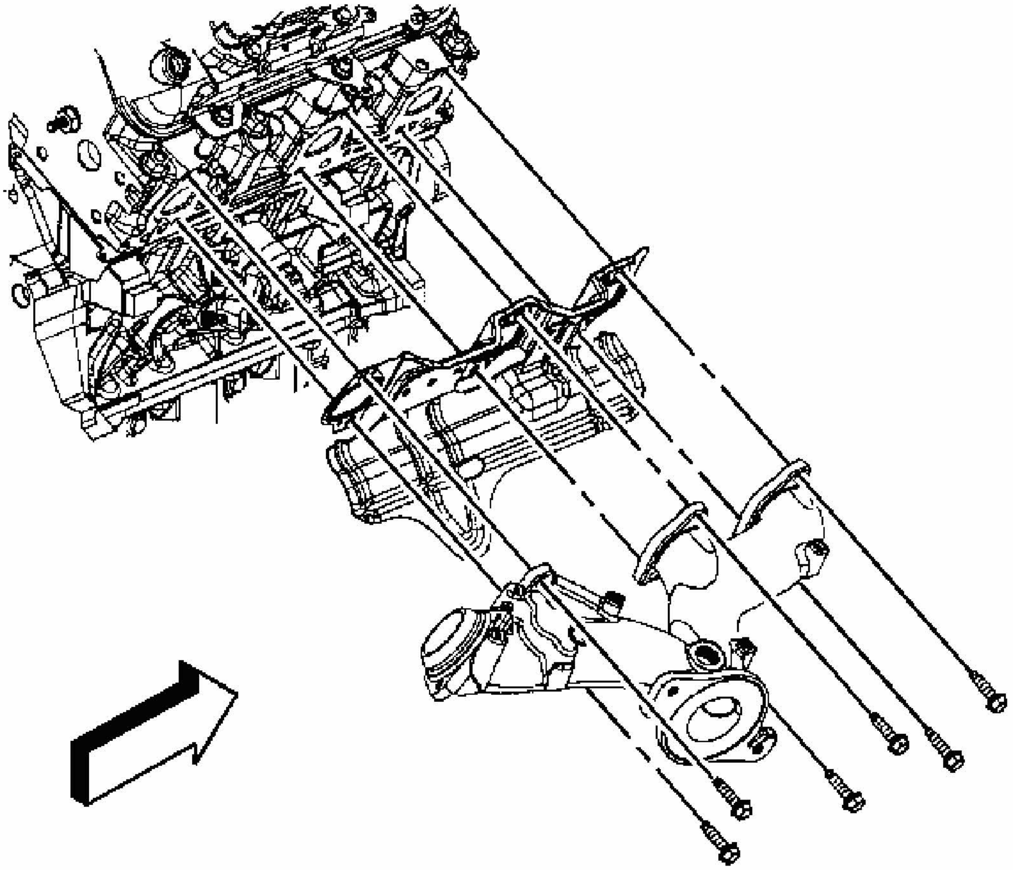


Fig. 21: Identifying Exhaust Manifold & Heat Shield Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW exhaust manifold gasket onto the cylinder head studs.
2. Install the exhaust manifold.

NOTE: **Refer to Fastener Notice .**

3. Install the lower exhaust manifold bolts.

   Tighten: Tighten the bolts to 20 N.m (15 lb ft).

4. Install the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)**.
5. Lower the vehicle.

6. Install the upper exhaust manifold bolts.

   Tighten: Tighten the bolts to 20 N.m (15 lb ft).

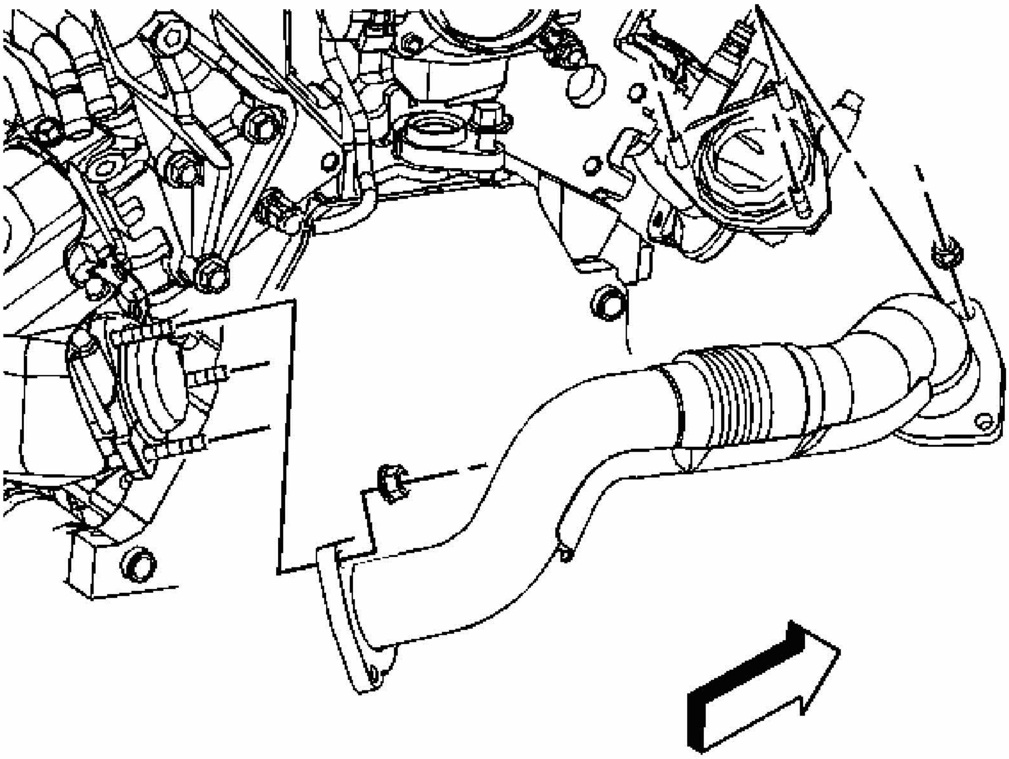


Fig. 22: Locating Exhaust Crossover Pipe & Left Exhaust Manifold Nuts
Courtesy of GENERAL MOTORS CORP.

7. Install the exhaust crossover pipe to right exhaust manifold nuts.

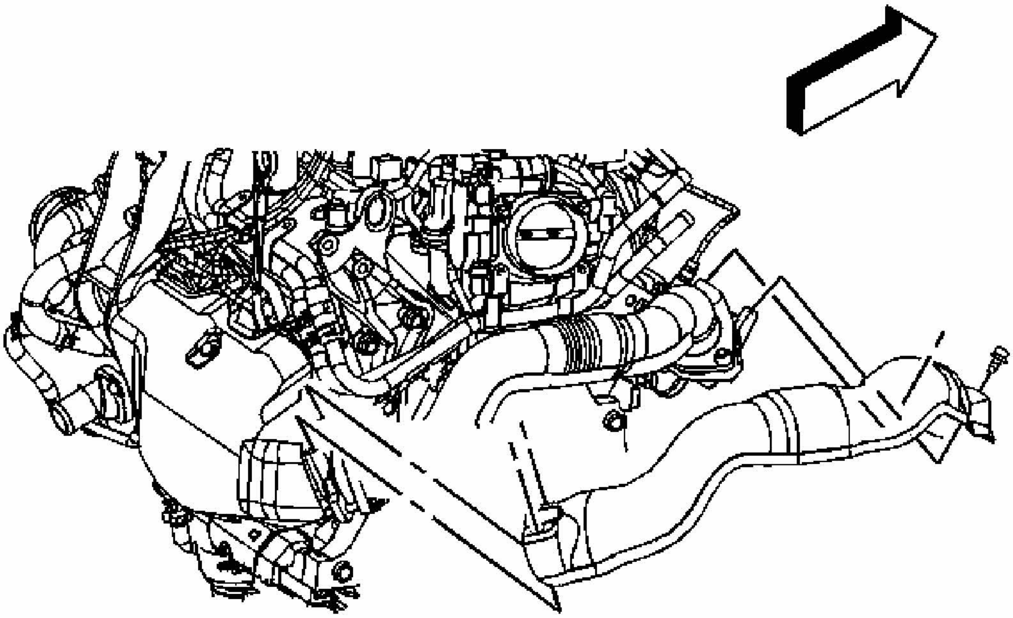


Fig. 23: Identifying Exhaust Crossover Pipe Heat Shield
Courtesy of GENERAL MOTORS CORP.

8. Install the exhaust crossover pipe heat shield.
9. Install the exhaust crossover pipe heat shield bolts.

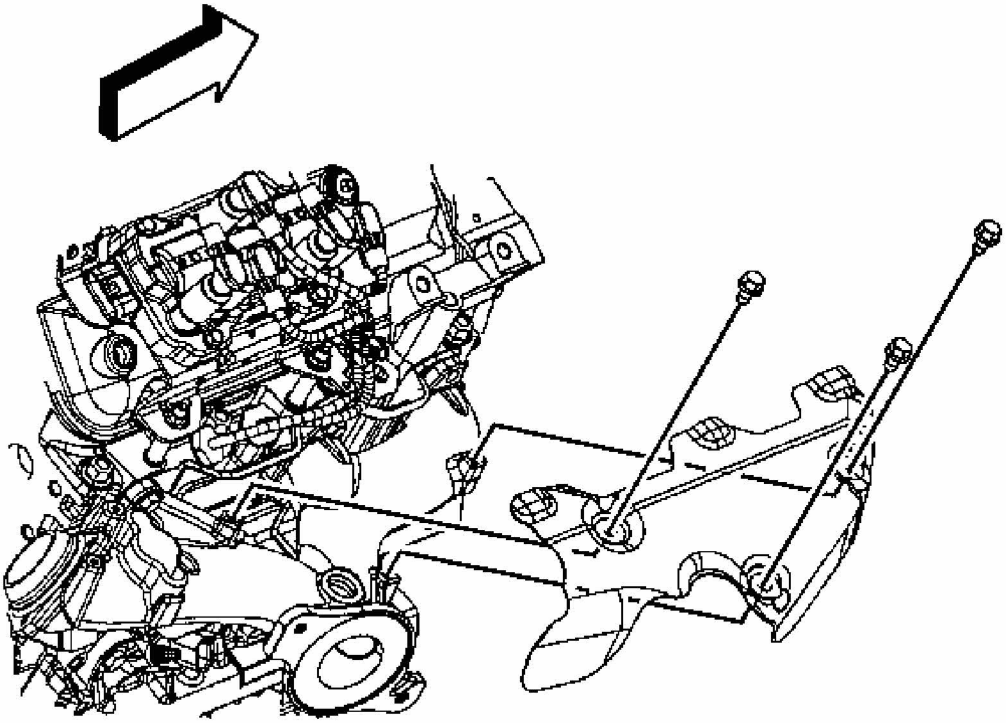


Fig. 24: Identifying Exhaust Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

10. Install the exhaust manifold shield.
11. Install the exhaust manifold shield bolts.

    Tighten: Tighten the bolts to 10 N.m (89 lb in).

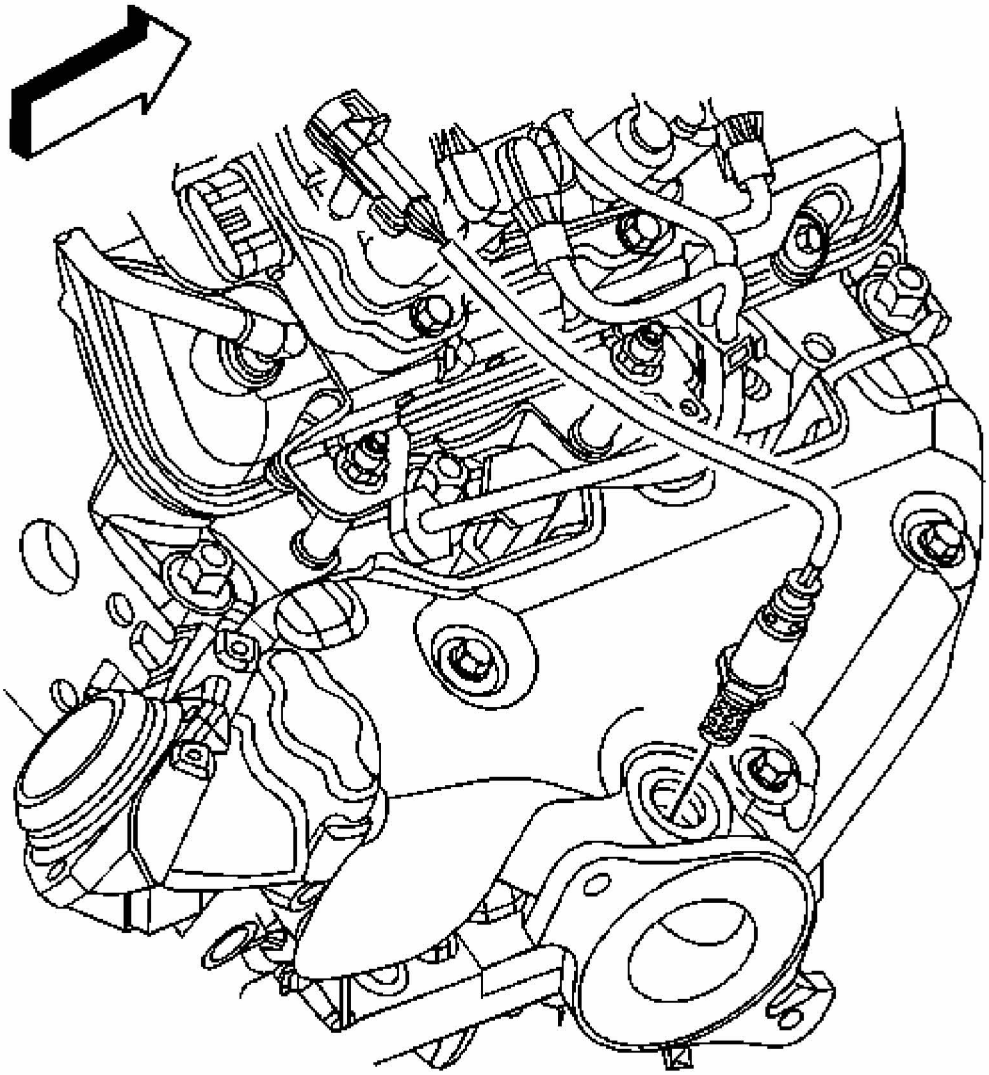


Fig. 25: Locating HO2S & J 39194-B
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Whenever the oxygen sensor is removed, coat the threads with nickel-based anti-seize compound such as GM P/N 5613695 (or equivalent).

12. Install the HO2S using **J 39194-B** . See **Special Tools**.

    Tighten: Tighten the sensor to 42 N.m (31 lb ft).

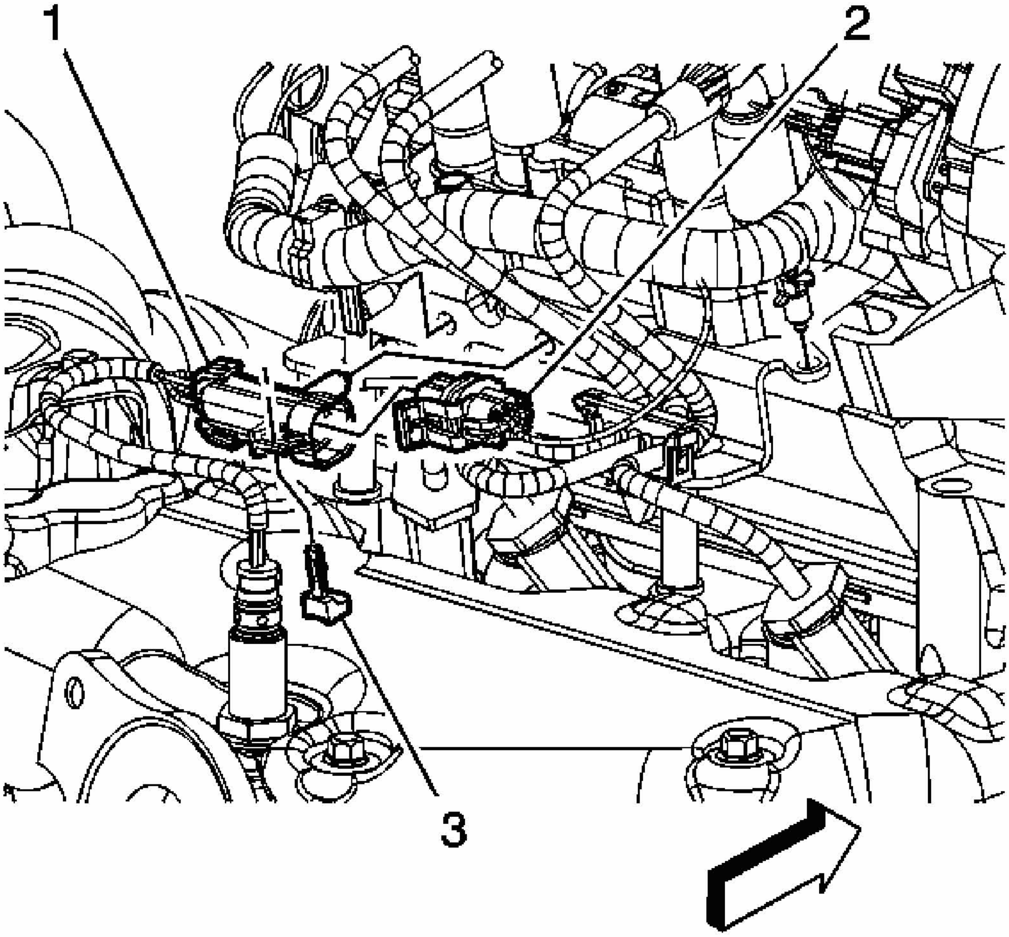


Fig. 26: Identifying The HO2S Electrical Connector
Courtesy of GENERAL MOTORS CORP.

13. Connect the HO2S electrical connector (2).
14. Install the CPA retainer (3).
15. Install the HO2S clip (1) to the ignition coil bracket.
16. Install the generator. Refer to **Generator Replacement (RPOs LZE/LZ4/LZ9)** or **Generator Replacement (RPO LS4)** .

EXHAUST MANIFOLD REPLACEMENT - RIGHT (RPO LS4)

Removal Procedure

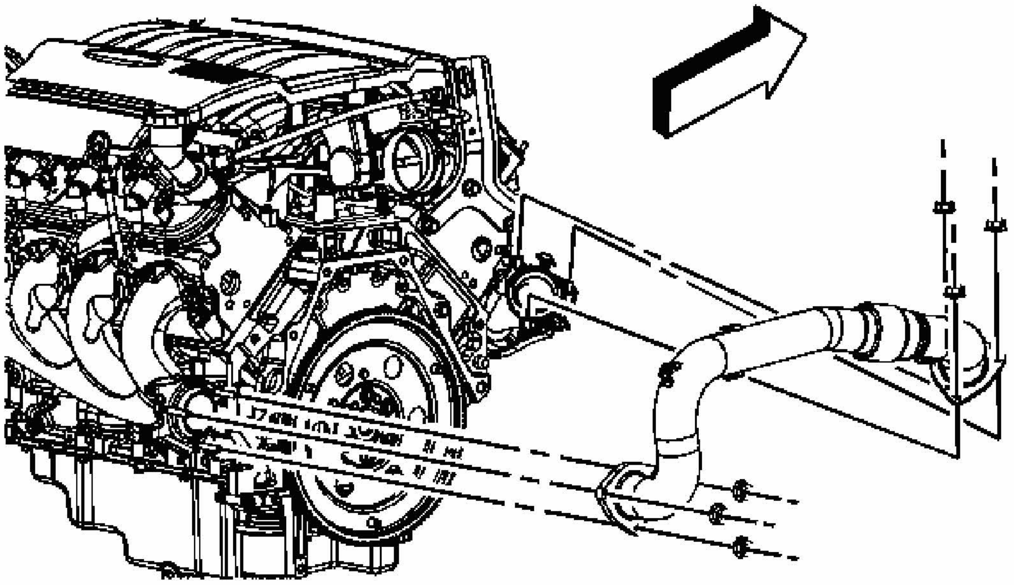


Fig. 27: Exhaust Crossover Pipe & Nuts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement** .
2. Remove the spark plugs. Refer to **Spark Plug Replacement** .
3. Remove the exhaust crossover pipe nuts from the right exhaust manifold.
4. Disconnect the catalytic converter from the exhaust manifold. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)**.
5. Support the catalytic convertor and exhaust system with the mechanics wire.
6. Lower the vehicle.
7. Remove the ignition coil. Refer to **Ignition Coil(s) Replacement** .
8. Remove the O2 sensors. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** .

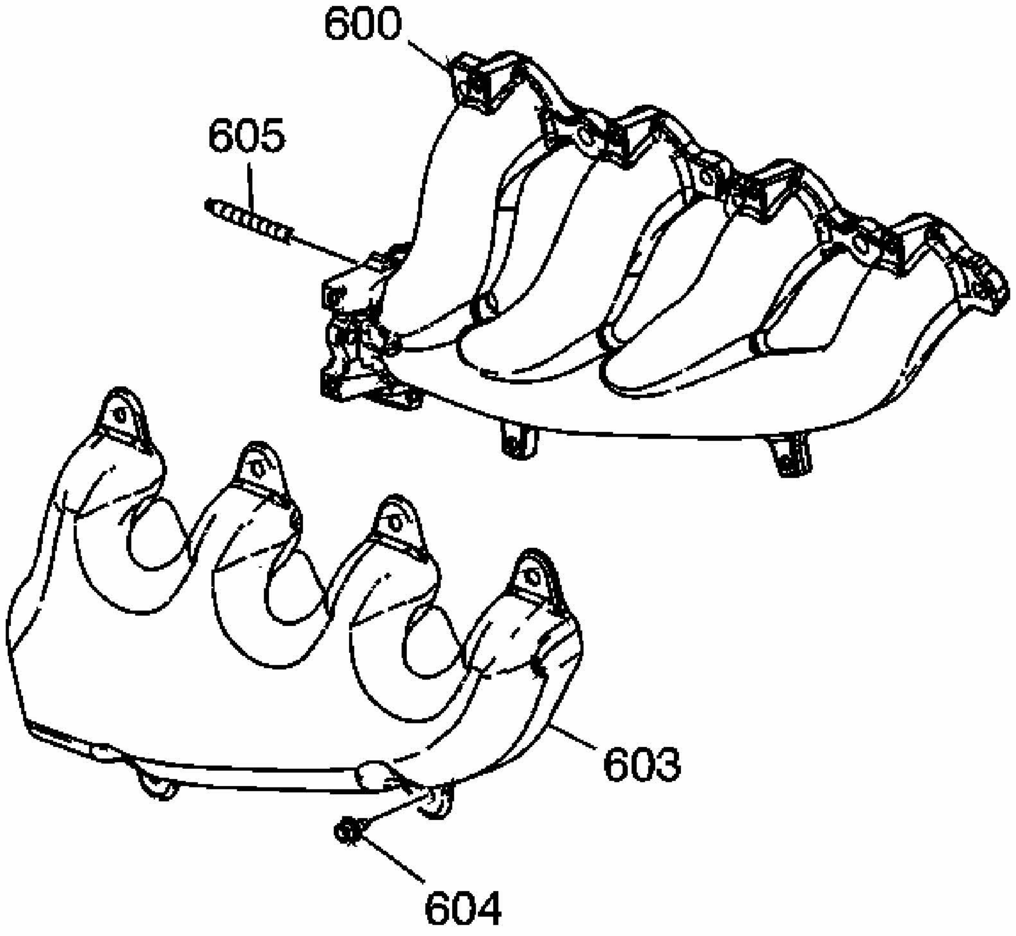


Fig. 28: Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

9. Remove the exhaust manifold heat shield bolts (604).
10. Remove the exhaust manifold heat shield (603).

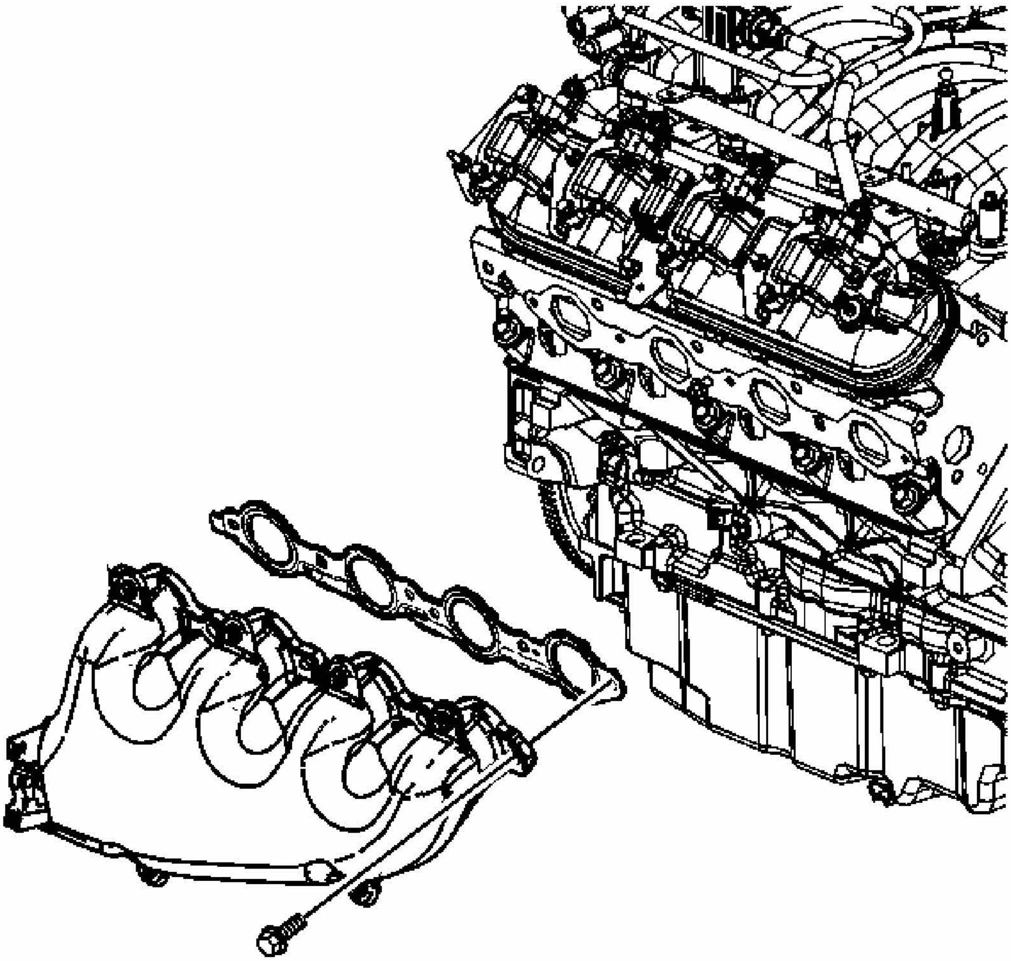


Fig. 29: Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

11. Remove the exhaust manifold bolts.
12. Remove the exhaust manifold.
13. Remove and discard the exhaust manifold gasket.
14. Clean and inspect the left exhaust manifold. Refer to **Exhaust Manifold Cleaning and Inspection** .

Installation Procedure

IMPORTANT:

- **Tighten the exhaust manifold bolts as specified in the service procedure. Improperly installed and/or leaking exhaust manifold gaskets my affect vehicle emissions**

and/or On Board Diagnostic (OBD) II system performance.

- **The cylinder head exhaust manifold bolt hole threads must be clean and free of debris or threadlocking material.**
- **DO NOT apply threadlock to the first three thread of the bolts.**

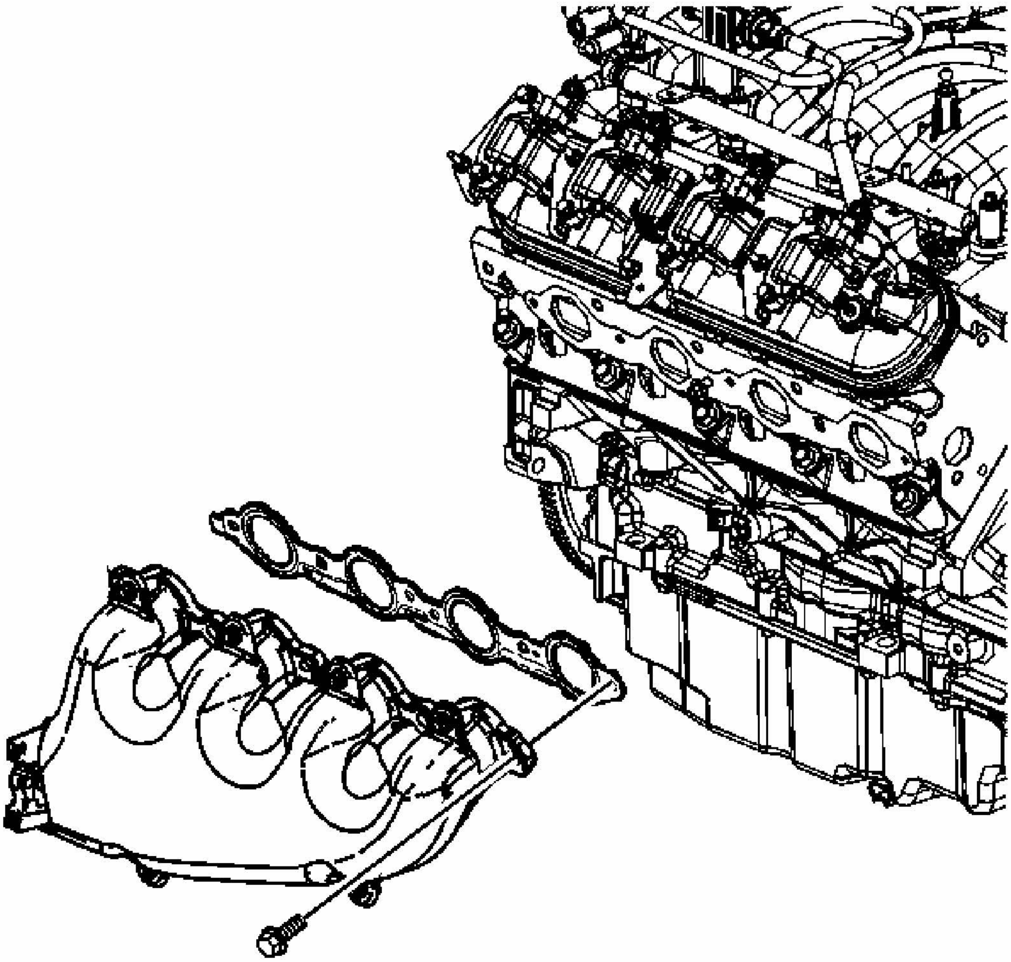


Fig. 30: Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

1. Apply a 5 mm (0.2 in) wide band of threadlock GM P/N 12345493 (Canadian P/N 10953488) or equivalent to the threads of the exhaust manifold bolts.

NOTE: **Refer to Fastener Notice .**

2. Install a NEW exhaust manifold gasket, the exhaust manifold and bolts.

   Tighten:

   - Tighten the bolts a first pass to 15 N.m (11 lb ft). Tighten the bolts beginning with the center 2 bolts. Alternate from side to side, and work toward the outside.
   - Tighten the bolts a final pass to 20 N.m (15 lb ft). Tighten the bolts beginning with the center 2 bolts. Alternate from side to side, and work toward the outside.

3. Using a flat punch, bend over the exposed edge of the exhaust manifold gasket at the rear of the right cylinder head.

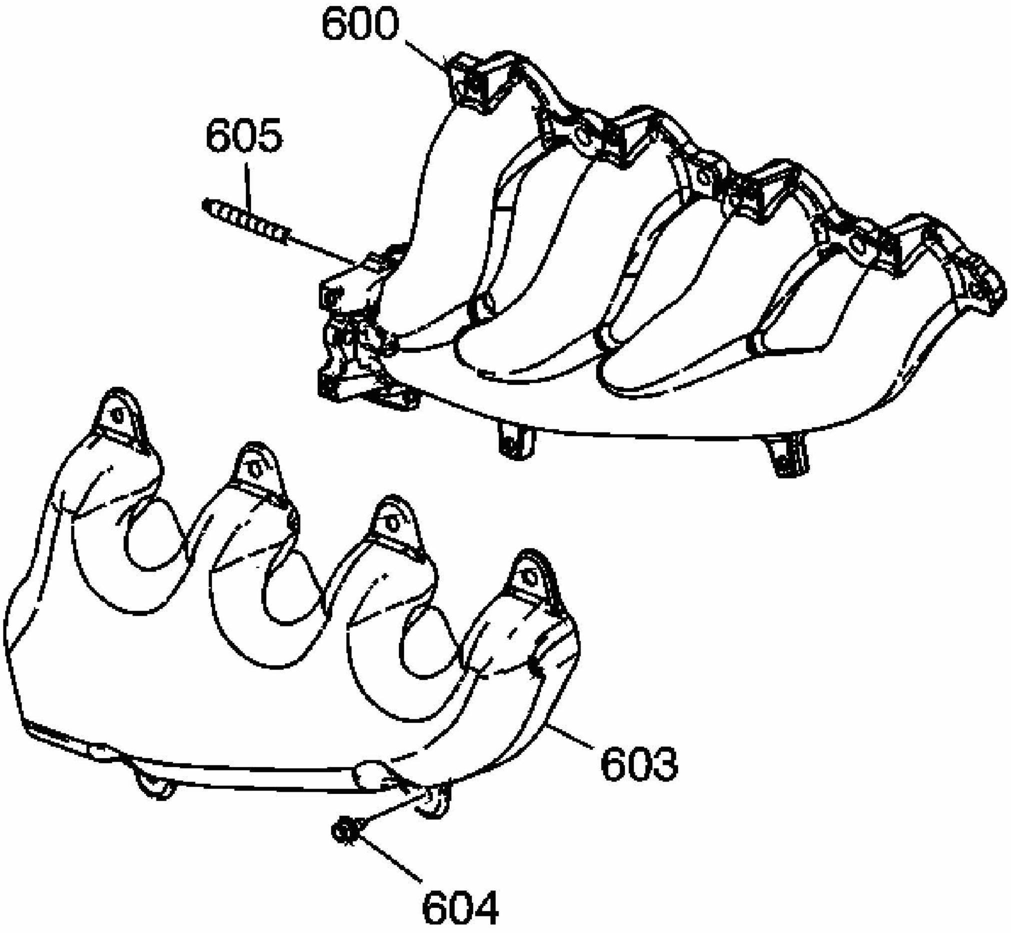


Fig. 31: Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the exhaust manifold heat shield (603).

5. Install the exhaust manifold heat shield bolts (604).

   Tighten: Tighten the bolts to 9 N.m (80 lb in).

6. Install the O2 sensor. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** .
7. Raise the vehicle.
8. Remove the mechanics wire from the exhaust system and connect the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)**.

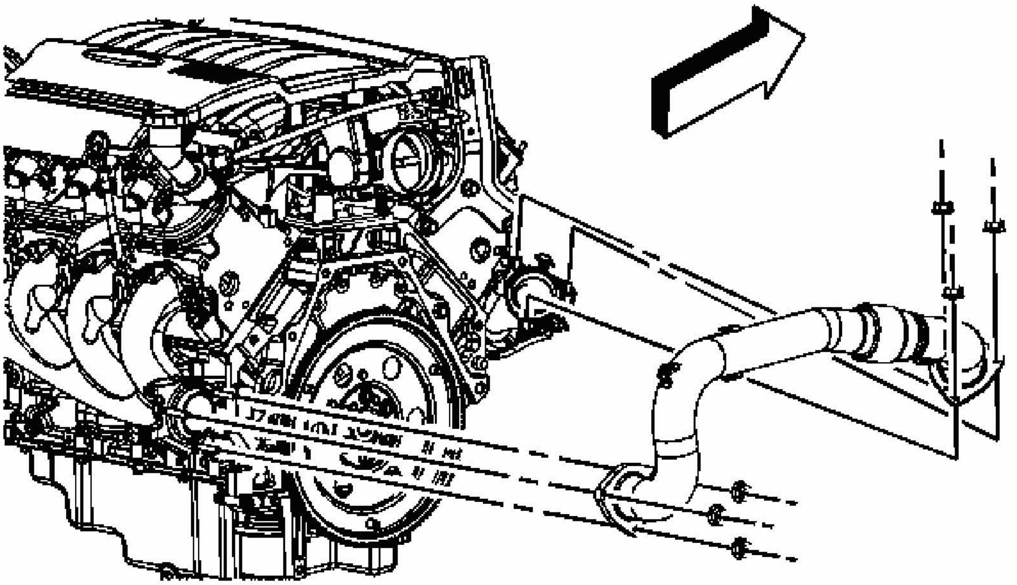


Fig. 32: Exhaust Crossover Pipe & Nuts
Courtesy of GENERAL MOTORS CORP.

9. Install the exhaust crossover pipe nuts to the right exhaust manifold.

   Tighten: Tighten the nuts to 25 N.m (18 lb ft).

10. Install the ignition coil. Refer to **Ignition Coil(s) Replacement** .
11. Install the spark plugs. Refer to **Spark Plug Replacement** .
12. Install the fuel injector sight shield. Refer to **Engine Sight Shield Replacement** .

EXHAUST CROSSOVER PIPE REPLACEMENT (RPOS LZE/LZ4/LZ9)

Removal Procedure

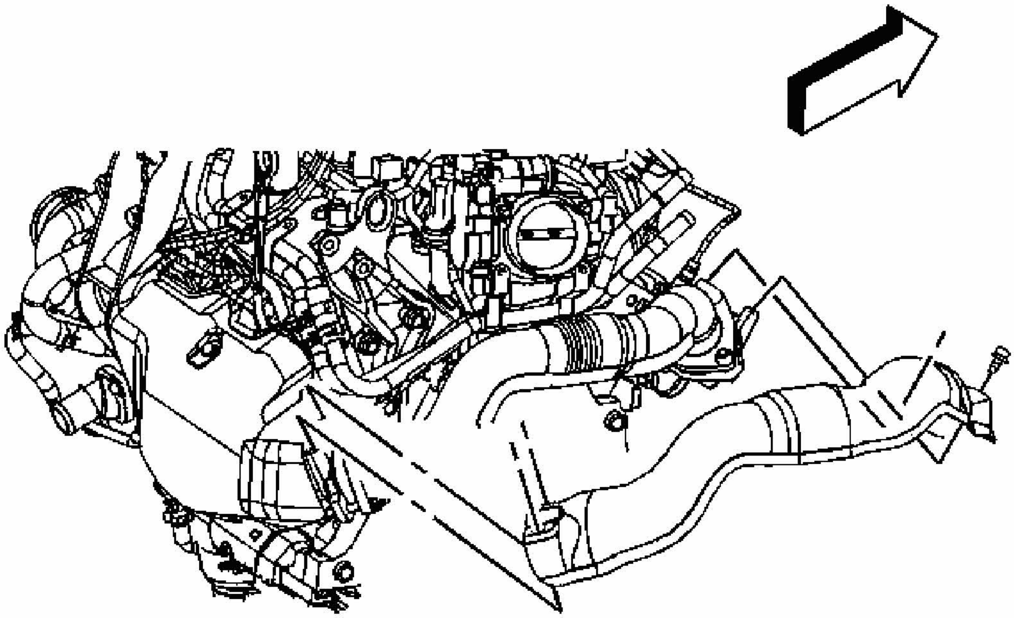


Fig. 33: Identifying Exhaust Crossover Pipe Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner intake duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
2. Remove the exhaust crossover pipe heat shield bolts.
3. Remove the exhaust crossover pipe heat shield.

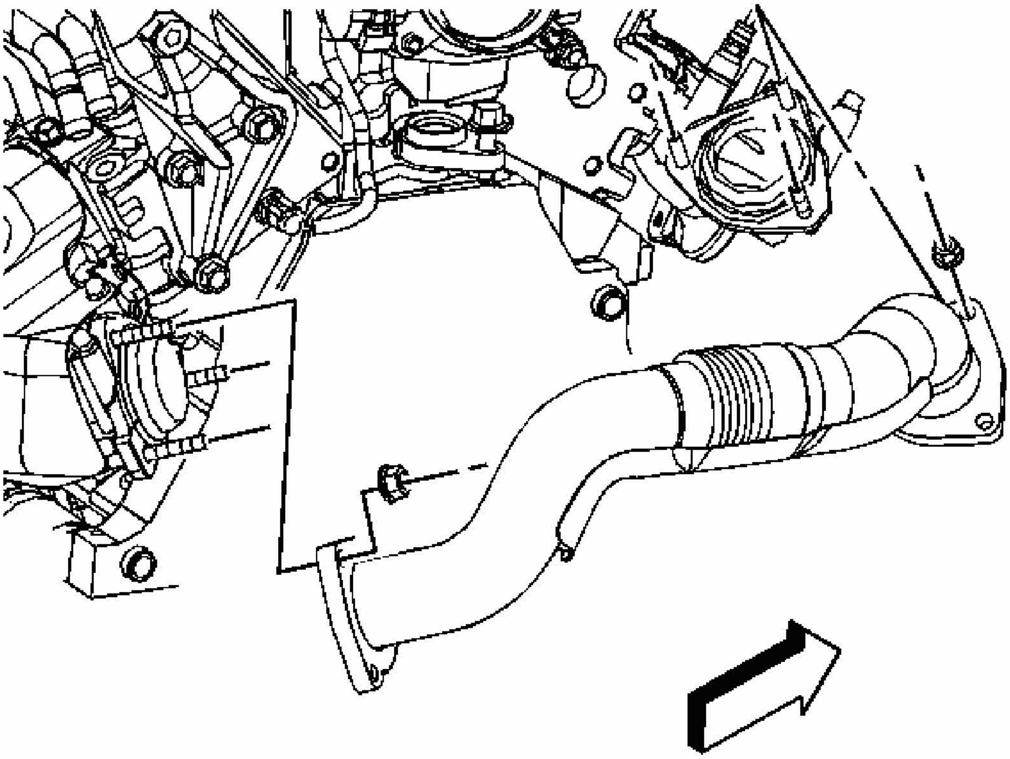


Fig. 34: Locating Exhaust Crossover Pipe & Left Exhaust Manifold Nuts
Courtesy of GENERAL MOTORS CORP.

4. Remove the exhaust crossover pipe nuts.
5. Remove the exhaust crossover pipe.
6. Remove the exhaust crossover pipe seals.

Installation Procedure

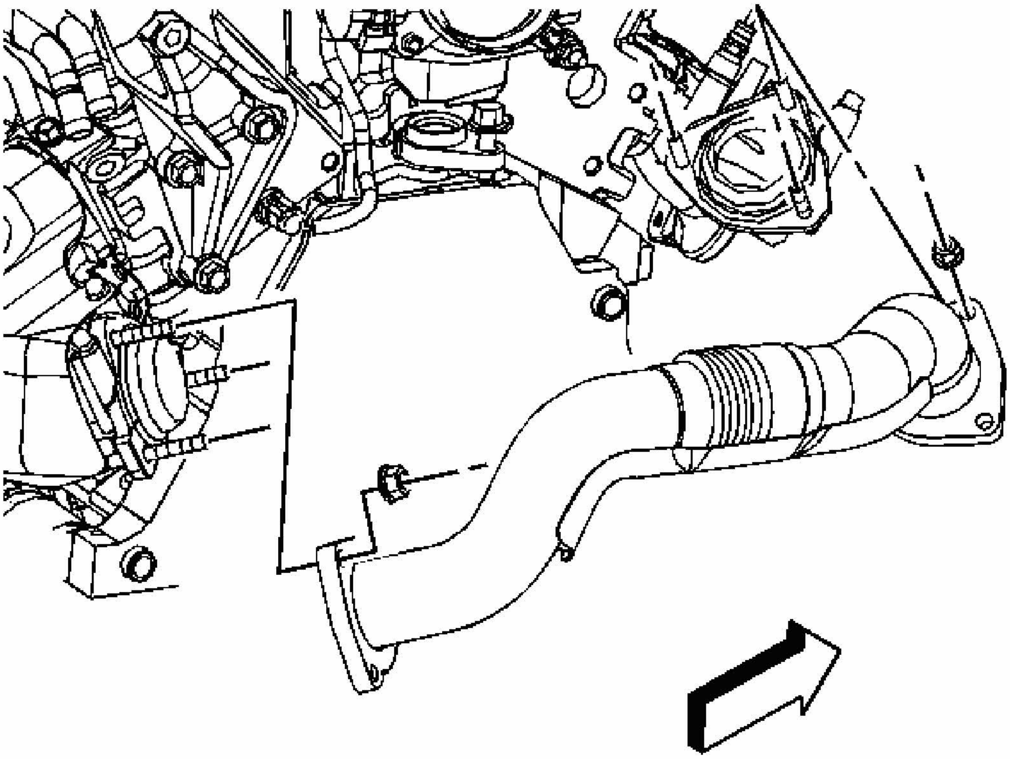


Fig. 35: Locating Exhaust Crossover Pipe & Left Exhaust Manifold Nuts
Courtesy of GENERAL MOTORS CORP.

1. Install the exhaust crossover pipe seals to the exhaust manifolds.
2. Install the exhaust crossover pipe.

NOTE: **Refer to Fastener Notice .**

3. Install the exhaust crossover pipe nuts.

   Tighten: Tighten the nuts to 20 N.m (15 lb ft).

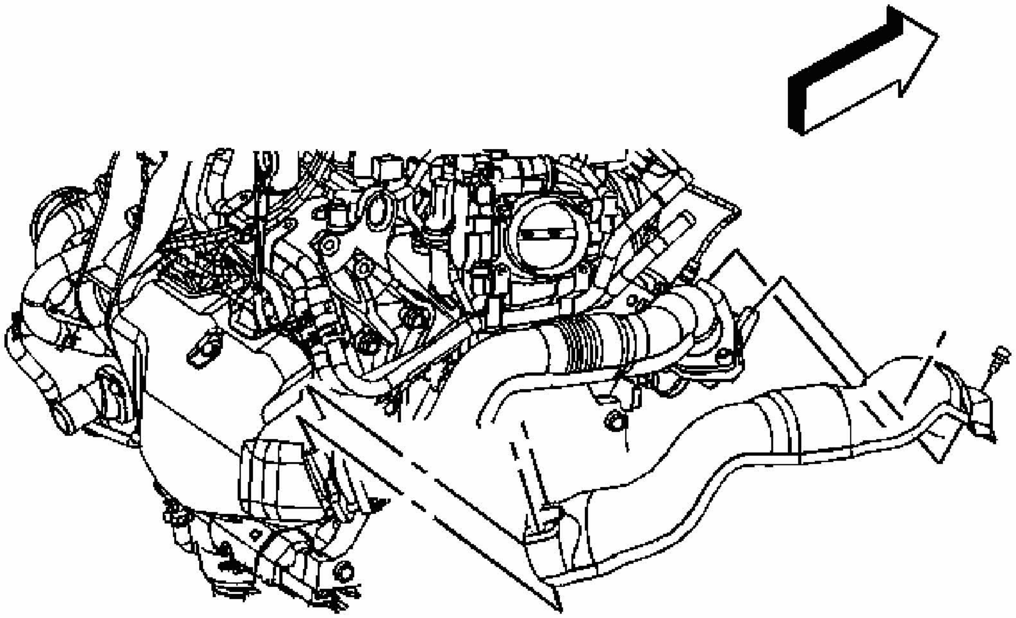


Fig. 36: Identifying Exhaust Crossover Pipe Heat Shield
Courtesy of GENERAL MOTORS CORP.

4. Install the exhaust crossover pipe heat shield.
5. Install the exhaust crossover pipe heat shield bolts.

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

6. Install the air cleaner intake duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .

EXHAUST CROSSOVER PIPE REPLACEMENT (RPO LS4)

Removal Procedure

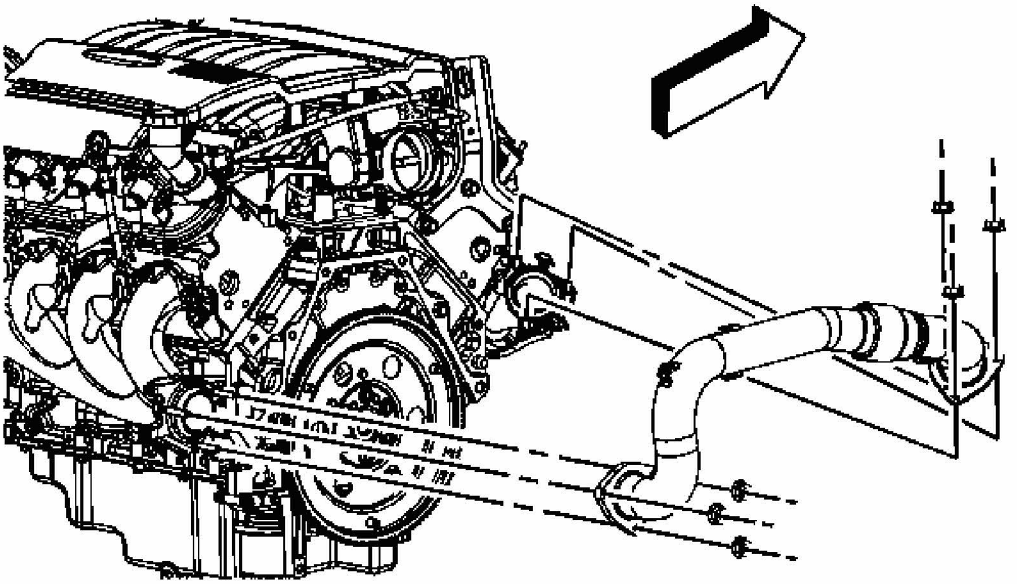


Fig. 37: Exhaust Crossover Pipe & Nuts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement** .
2. Remove the air cleaner intake duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
3. Remove the exhaust crossover pipe heat shield.
4. Remove the exhaust crossover pipe nuts.
5. Remove the exhaust crossover pipe.
6. Remove the exhaust crossover pipe seal.

Installation Procedure

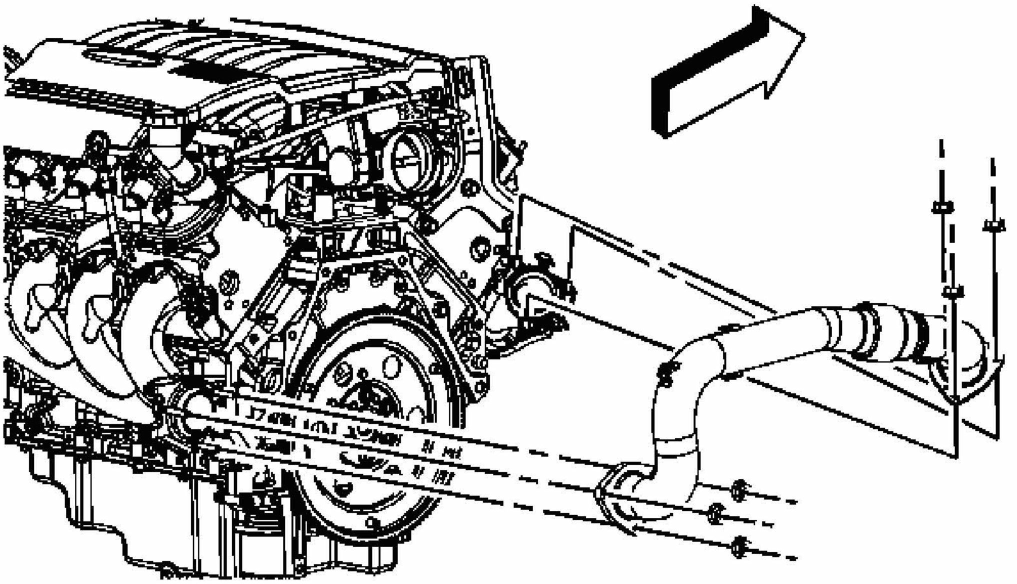


Fig. 38: Exhaust Crossover Pipe & Nuts
Courtesy of GENERAL MOTORS CORP.

1. Install the exhaust crossover pipe seal to the exhaust crossover pipe at the right exhaust manifold connection.
2. Install the exhaust crossover pipe.

NOTE: **Refer to Fastener Notice .**

3. Install the exhaust crossover pipe nuts.

   Tighten: Tighten the nuts to 25 N.m (18 lb ft).

4. Install the exhaust crossover pipe heat shield.
5. Install the air cleaner intake duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
6. Install the engine sight shield. Refer to **Engine Sight Shield Replacement** .

EXHAUST SEAL REPLACEMENT

Removal Procedure

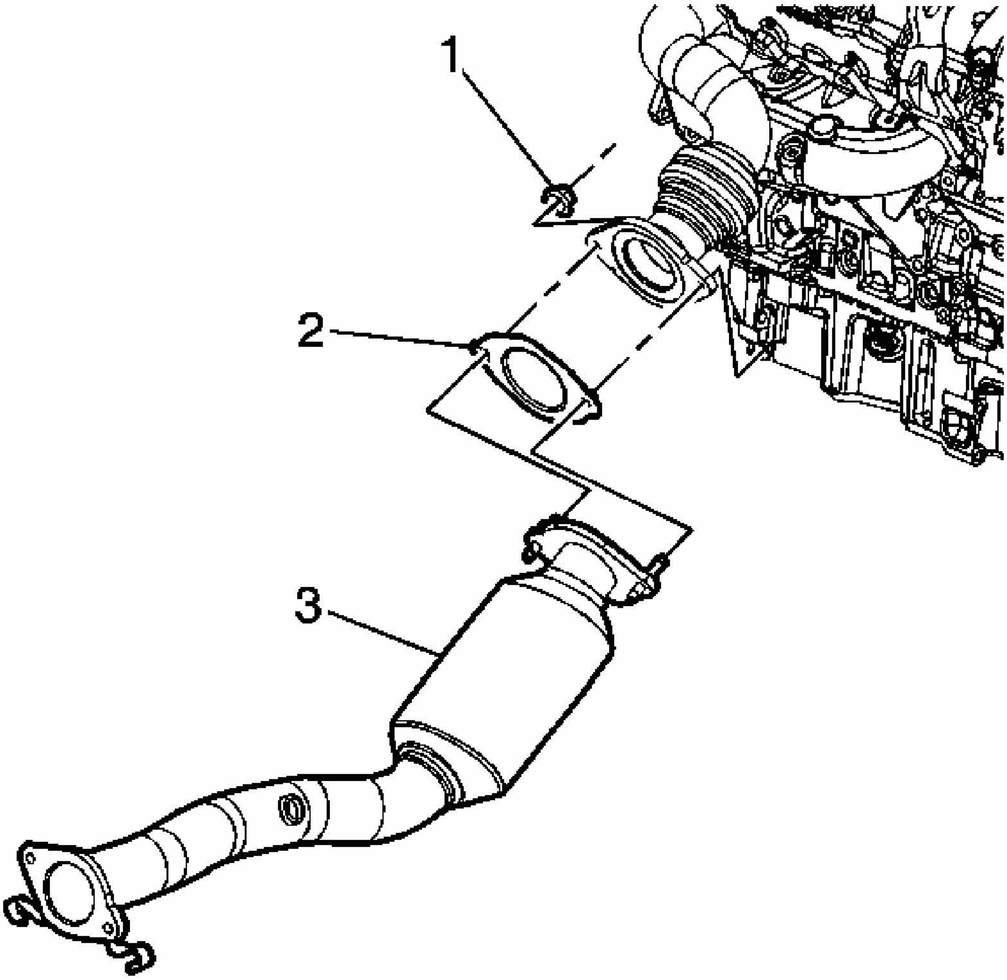


Fig. 39: Identifying The Catalytic Converter
Courtesy of GENERAL MOTORS CORP.

1. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)**.
2. Remove and discard the exhaust manifold pipe gasket (2), if equipped with regular production options (RPOs) LZE/LZ9.

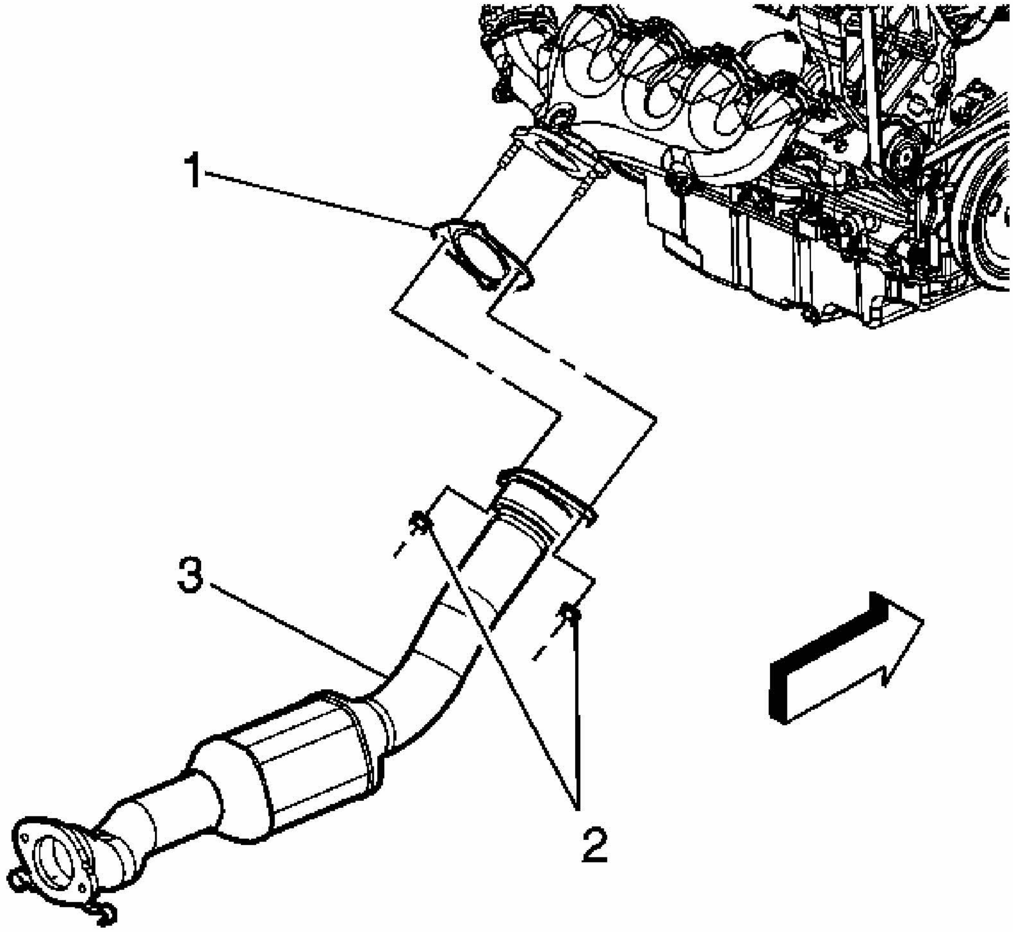


Fig. 40: Exhaust Manifold Pipe & Gasket
Courtesy of GENERAL MOTORS CORP.

3. Remove and discard the exhaust manifold pipe gasket (1), if equipped with RPO LS4.

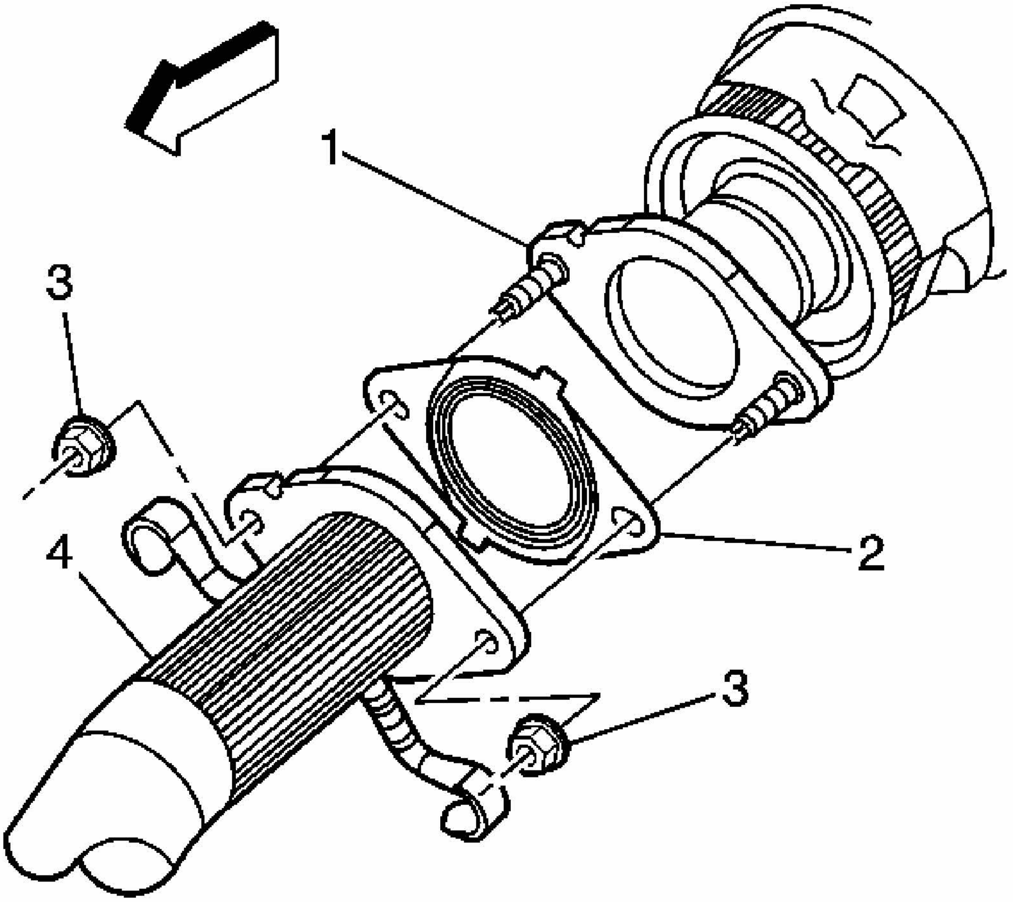


Fig. 41: Catalytic Converter To Muffler Components
Courtesy of GENERAL MOTORS CORP.

4. Remove and discard the catalytic converter to muffler gasket (2), if equipped with RPO LZE.

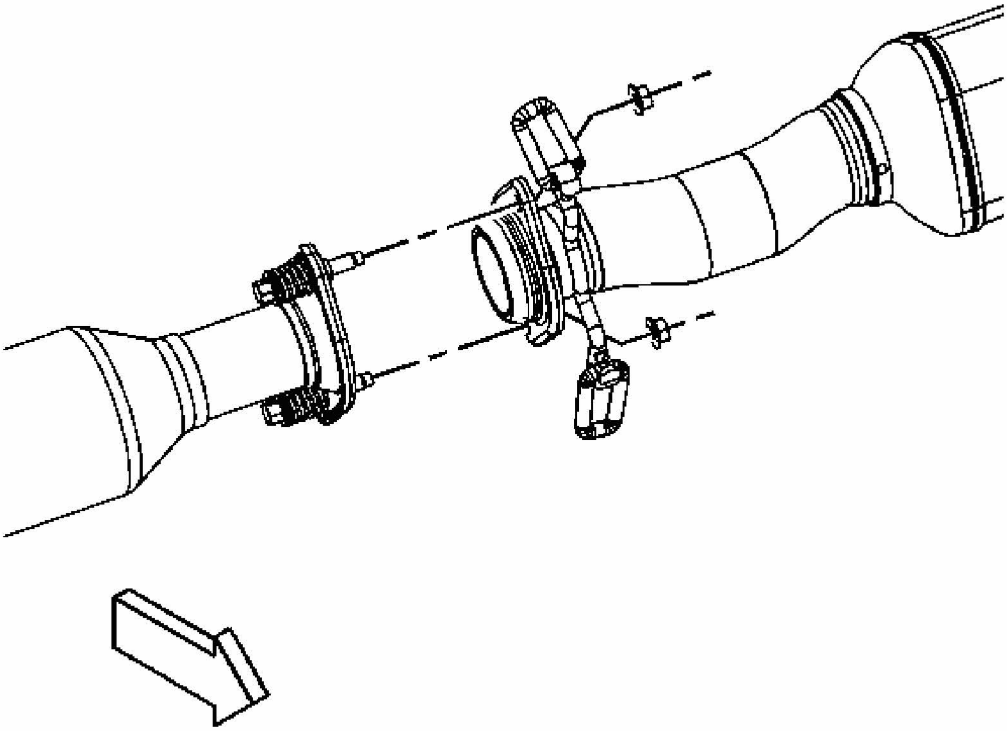


Fig. 42: View Of Catalytic Converter To Muffler Seal
Courtesy of GENERAL MOTORS CORP.

5. Remove and discard the catalytic converter to muffler seal, if equipped with RPOs LS4/LZ9.

Installation Procedure

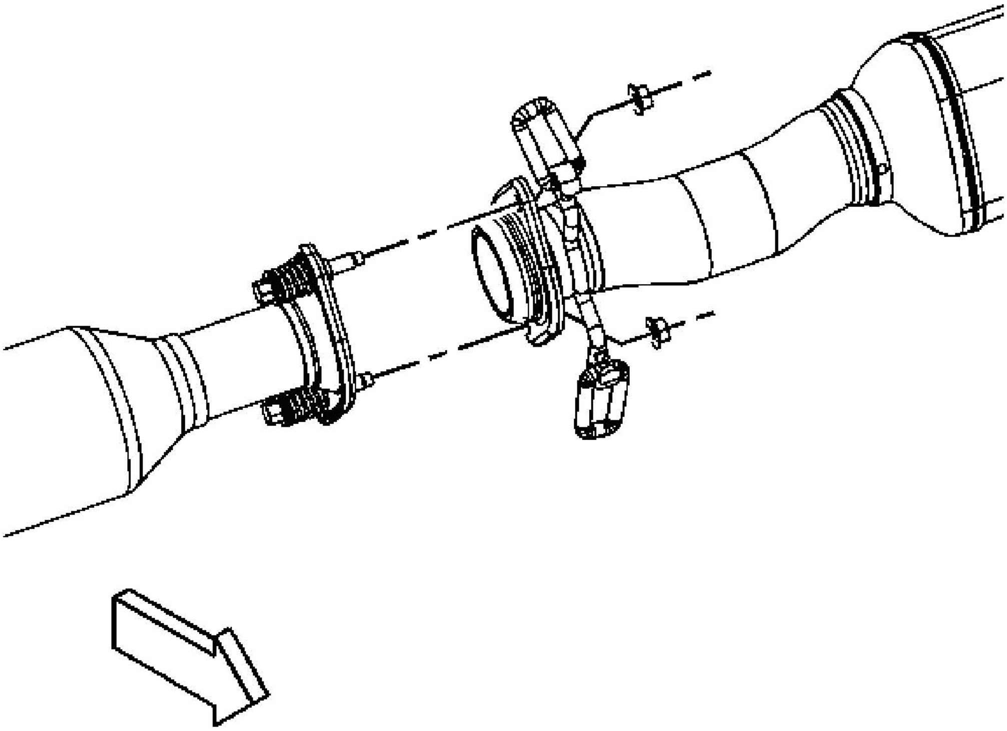


Fig. 43: View Of Catalytic Converter To Muffler Seal
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW catalytic converter to muffler seal, if equipped with RPOs LS4/LZ9.

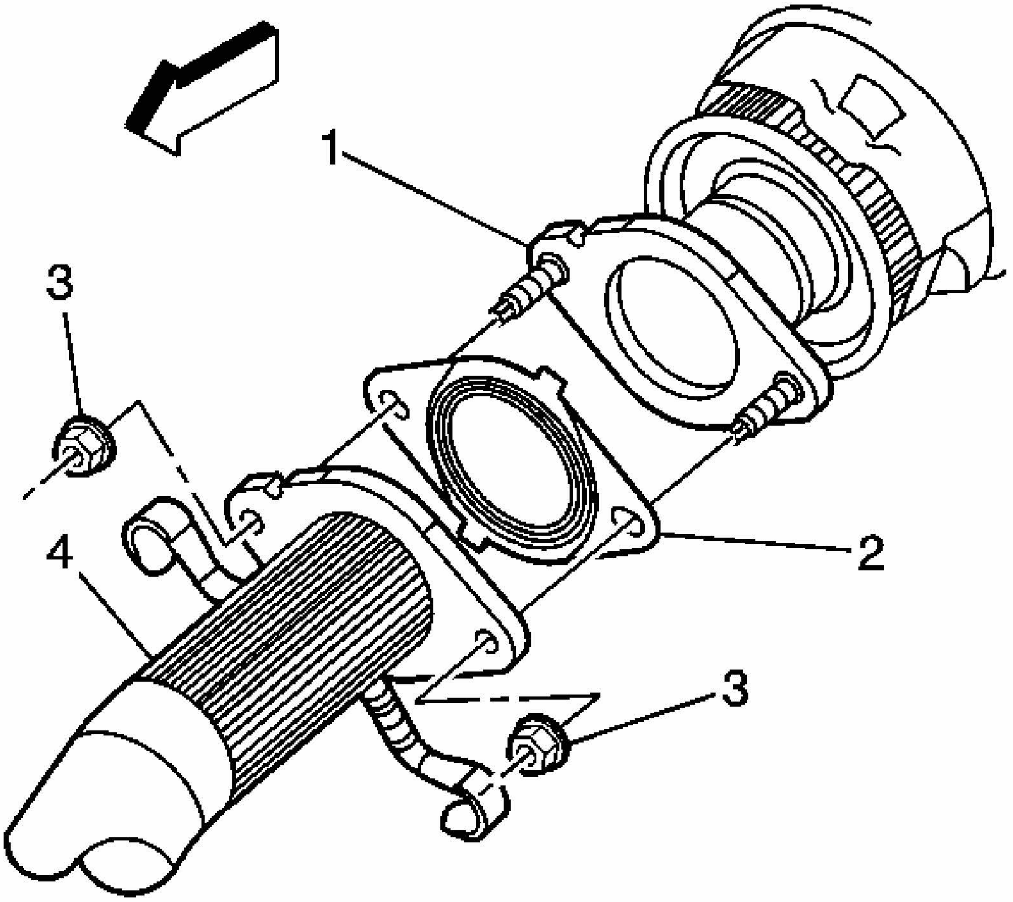


Fig. 44: Catalytic Converter To Muffler Components
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW catalytic converter to muffler gasket (2), if equipped with RPO LZE.

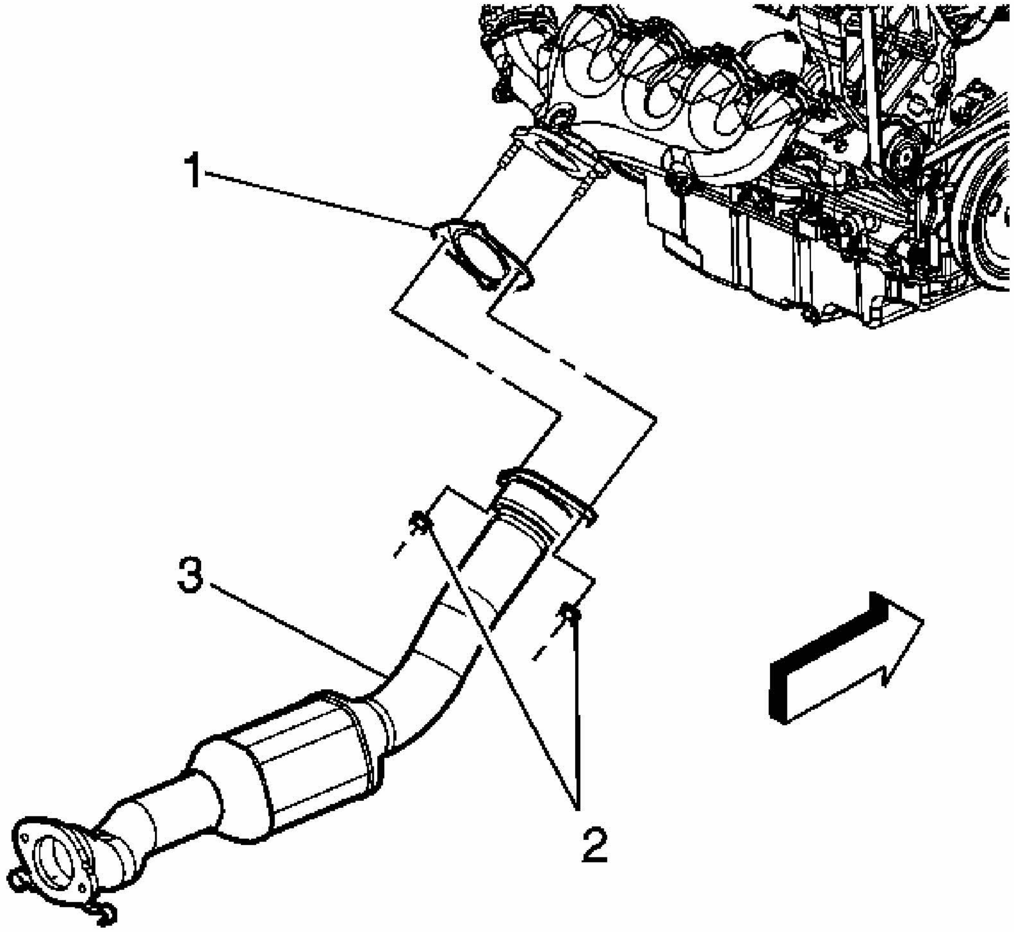


Fig. 45: Exhaust Manifold Pipe & Gasket
Courtesy of GENERAL MOTORS CORP.

3. Install a NEW exhaust manifold pipe gasket (1), if equipped with RPO LS4.

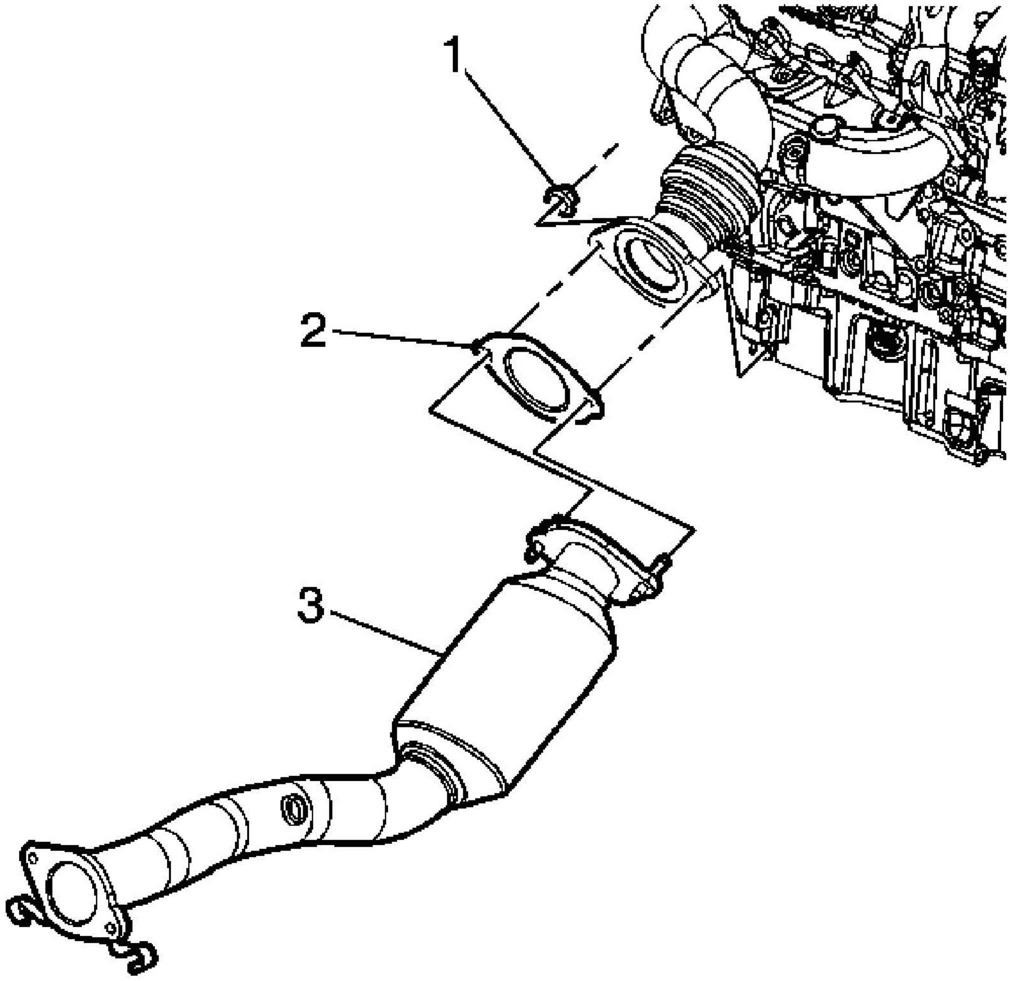


Fig. 46: View Of Exhaust Manifold Pipe Gasket
Courtesy of GENERAL MOTORS CORP.

4. Install a NEW exhaust manifold pipe gasket (2), if equipped with RPOs LZE/LZ9.
5. Install the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)**.

CATALYTIC CONVERTER REPLACEMENT (RPOS LZE/LZ4/LZ9)

Removal Procedure

IMPORTANT: The catalytic converter is serviced by replacing the entire assembly. Always replace the gaskets at the front and rear flanges when servicing the catalytic converter. Never install the

original gasket.

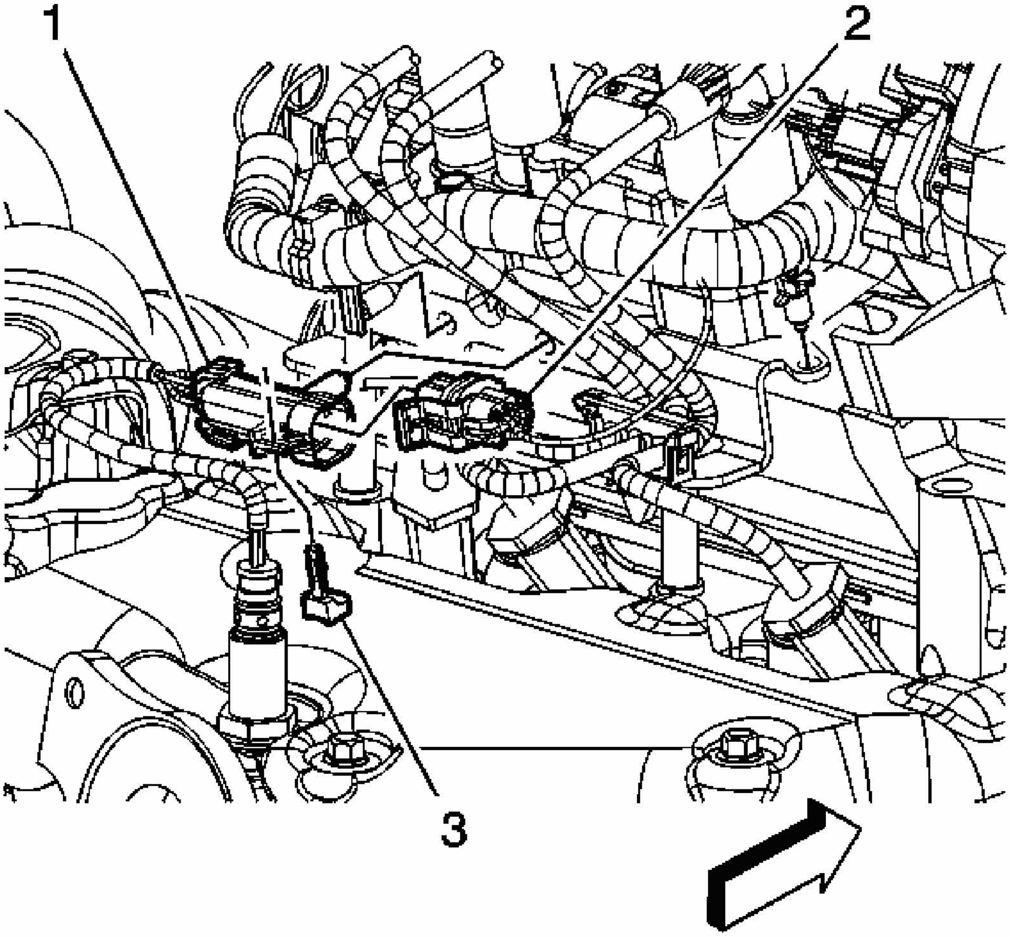


Fig. 47: Identifying The HO2S Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement** or **Intake Manifold Cover Replacement** .
2. Remove the connector position assurance (CPA) retainer (3).
3. Remove the heated oxygen sensor (HO2S) electrical connector clip (1) from the ignition coil bracket.
4. Disconnect the HO2S electrical connector (2).

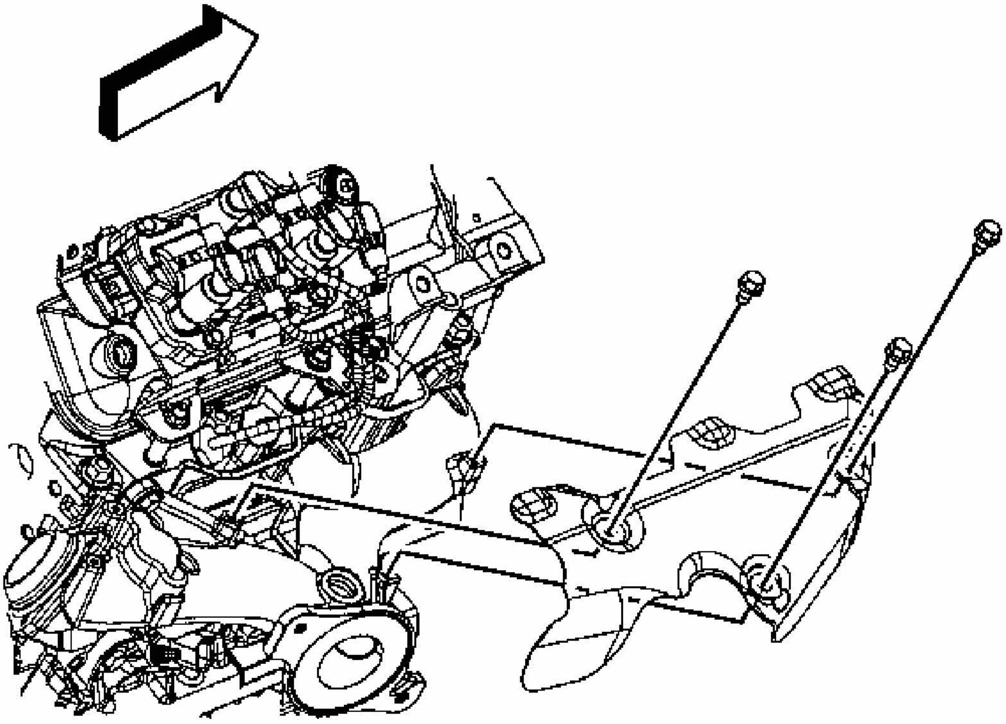


Fig. 48: Identifying Exhaust Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the exhaust manifold heat shield bolts.
6. Remove the exhaust manifold heat shield.

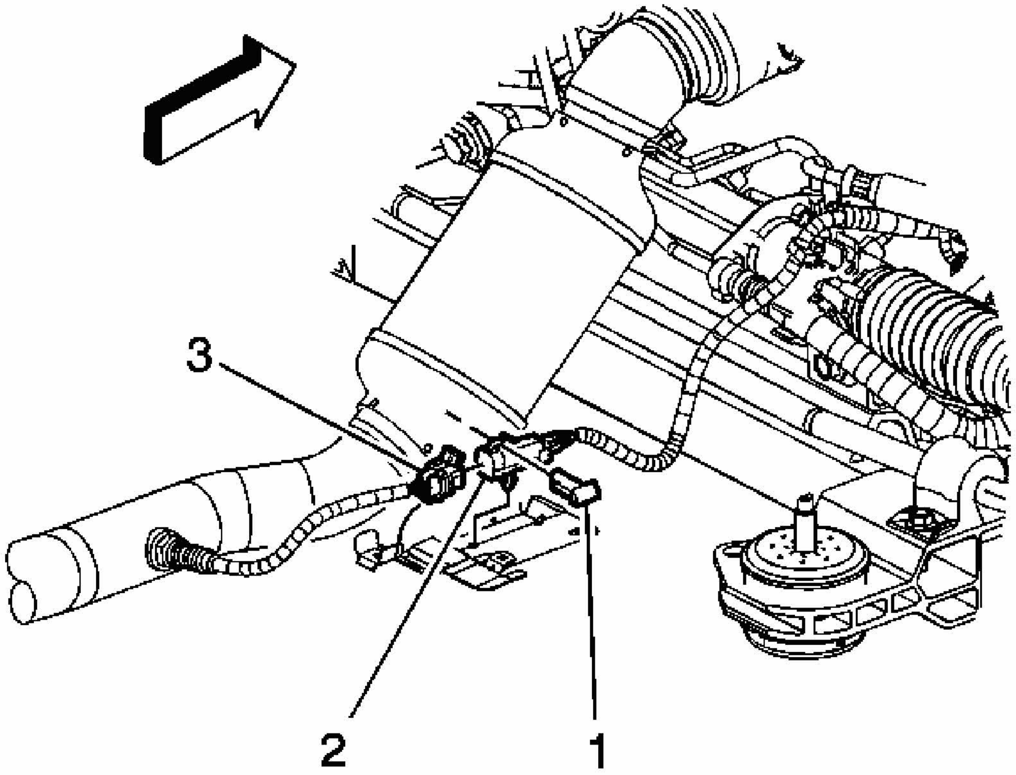


Fig. 49: Locating Upper Catalytic Converter & Exhaust Manifold Nut
Courtesy of GENERAL MOTORS CORP.

7. Remove the upper catalytic converter to exhaust manifold nut (1).

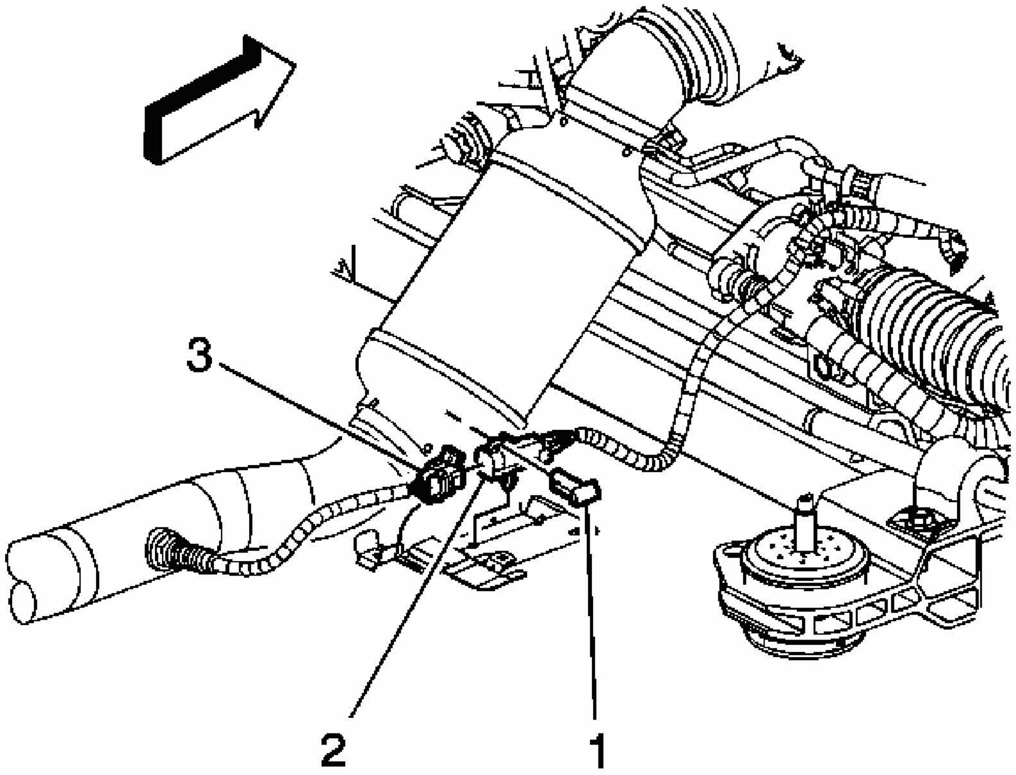


Fig. 50: Locating CPA Retainer
Courtesy of GENERAL MOTORS CORP.

8. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
9. Remove the CPA retainer (1).
10. Disconnect the HO2S electrical connector (3).

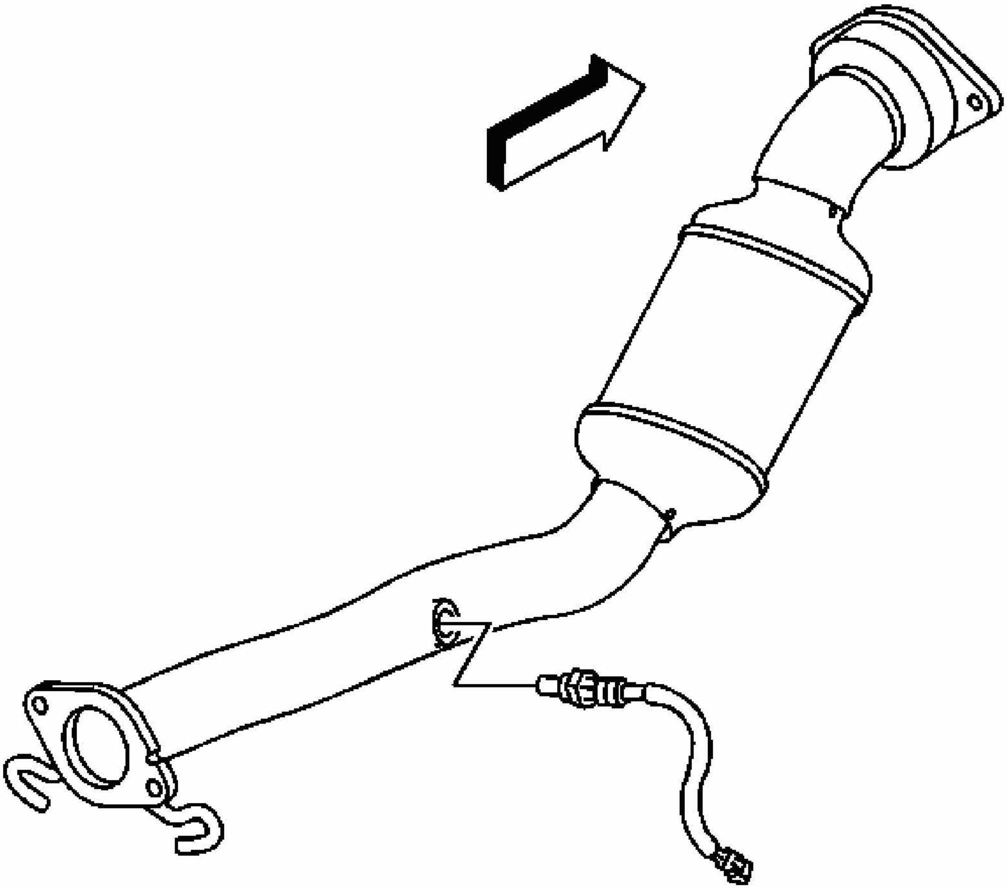


Fig. 51: Locating The HO2S
Courtesy of GENERAL MOTORS CORP.

11. Remove the HO2S. Refer to **Heated Oxygen Sensor Replacement - Position 2** or **Heated Oxygen Sensor Replacement - Position 2** .
12. Support the exhaust system.

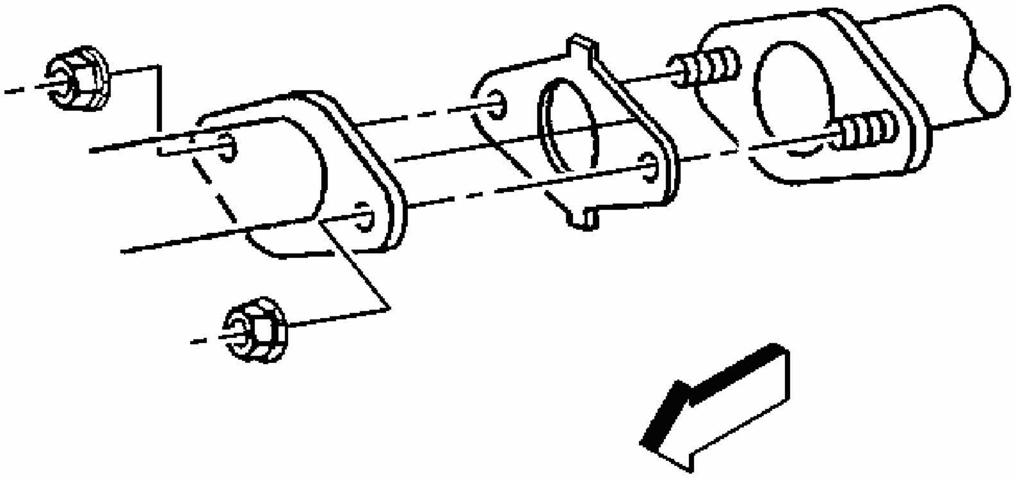


Fig. 52: View Of Catalytic Converter Mounting Nuts
Courtesy of GENERAL MOTORS CORP.

13. Remove the catalytic converter to muffler nuts.

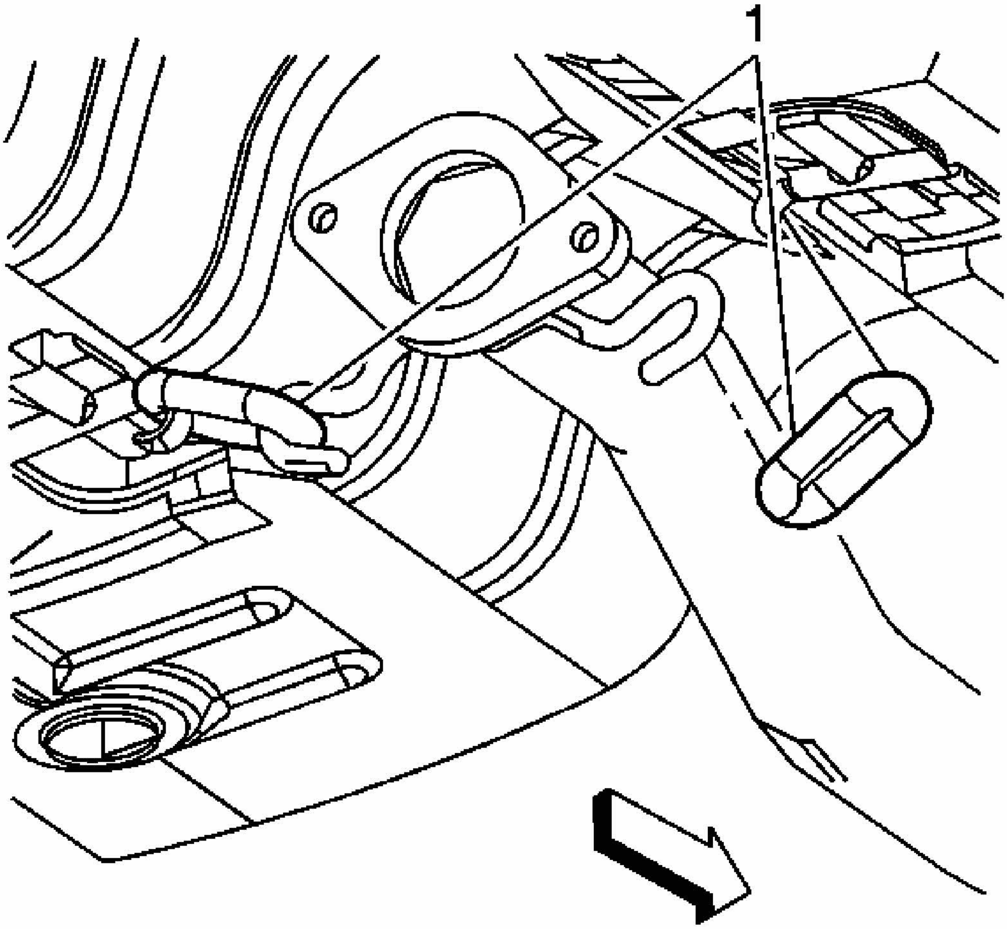


Fig. 53: Catalytic Converter Hangers
Courtesy of GENERAL MOTORS CORP.

14. Remove the catalytic converter insulators (1).

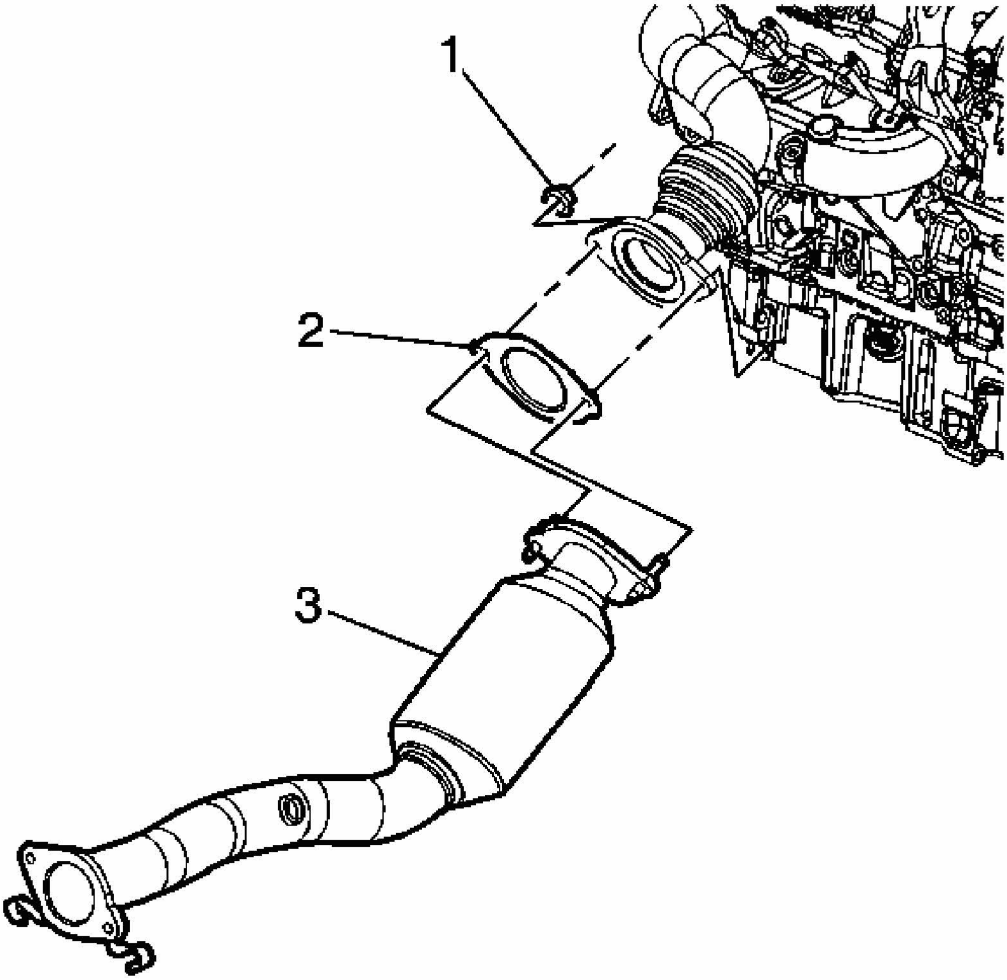


Fig. 54: Locating Catalytic Converter Lower Nut
Courtesy of GENERAL MOTORS CORP.

15. Remove the catalytic converter lower nut (3).
16. Reposition the muffler assembly rearward until the catalytic converter can be removed.
17. Remove the catalytic converter (3).
18. Remove the catalytic converter gasket (2).
19. Clean and inspect the exhaust manifold and the exhaust pipe gasket mating surfaces.

Installation Procedure

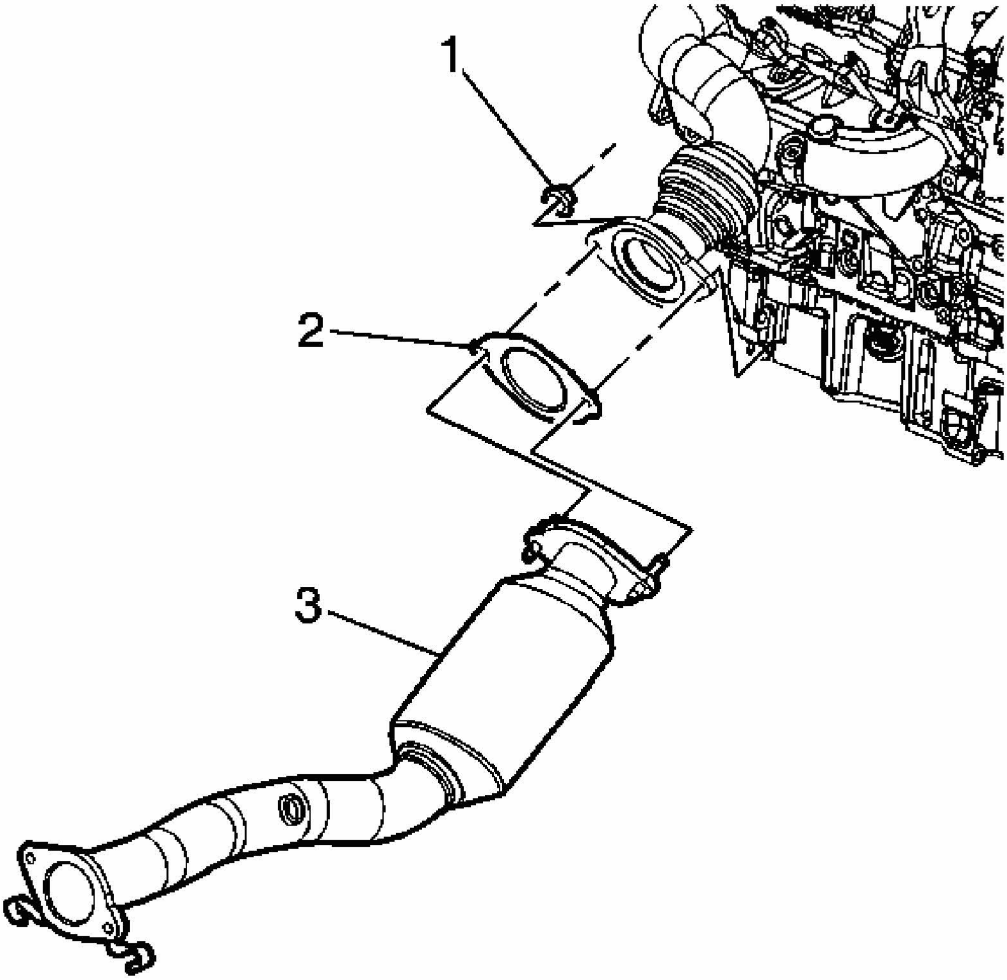


Fig. 55: Identifying Catalytic Converter Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the catalytic converter gasket (2) onto the catalytic converter.
2. Reposition the muffler assembly rearward until the catalytic converter can be installed.
3. Install the catalytic converter (3).

NOTE:	**Refer to Fastener Notice .**

4. Install the catalytic converter lower nut (3).

Tighten: Tighten the nut to 35 N.m (26 lb ft).

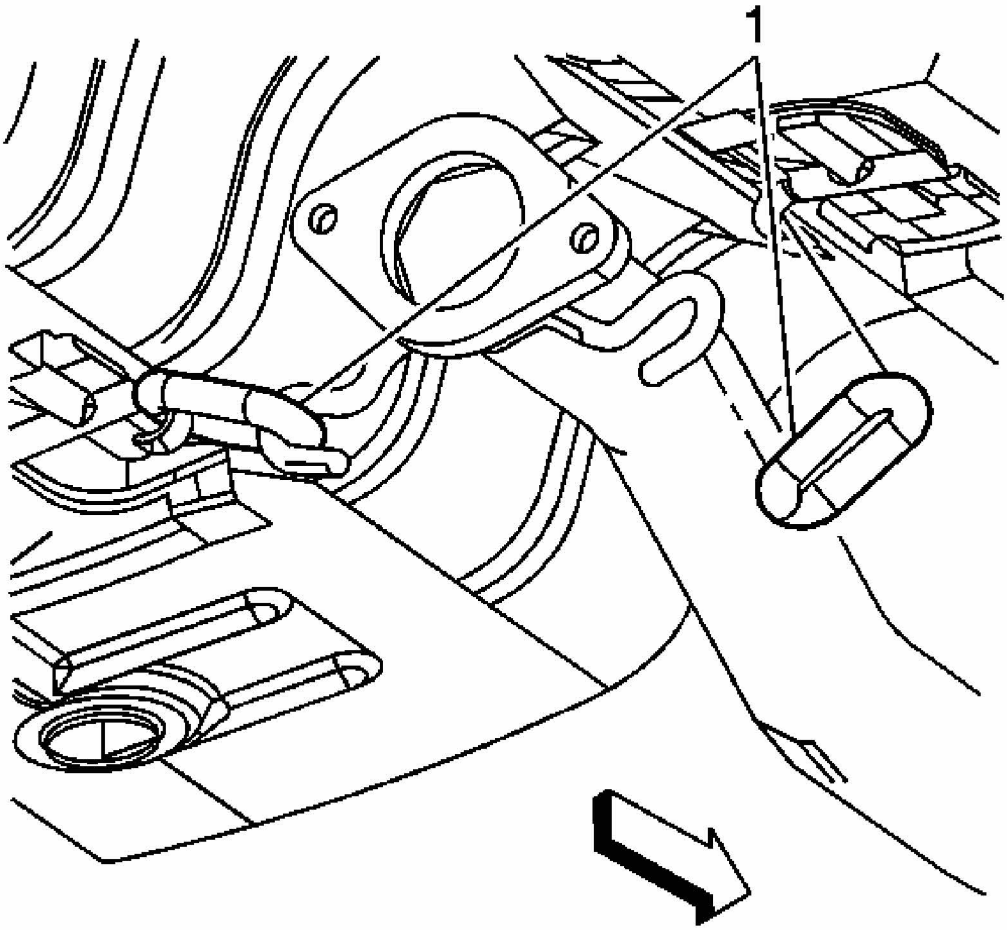


Fig. 56: Catalytic Converter Hangers
Courtesy of GENERAL MOTORS CORP.

5. Install the catalytic converter insulators (1).

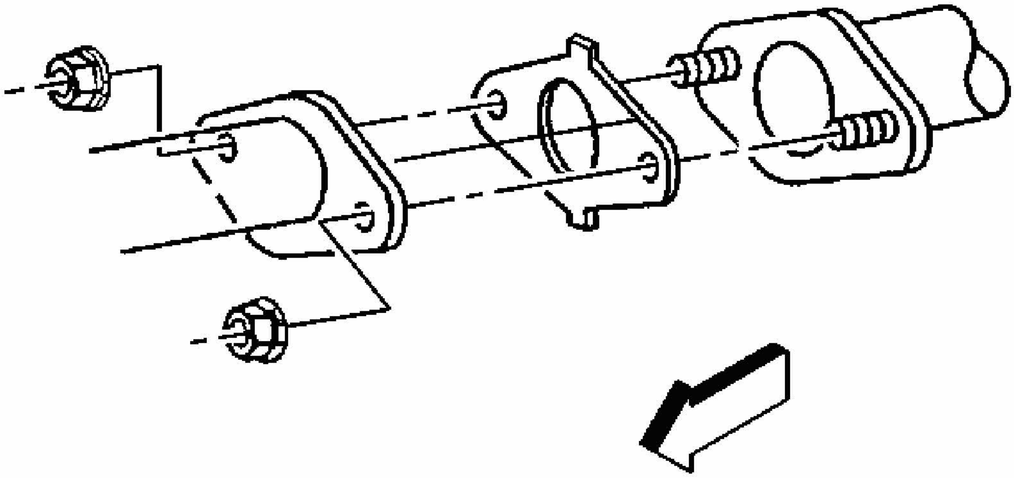


Fig. 57: View Of Catalytic Converter Mounting Nuts
Courtesy of GENERAL MOTORS CORP.

6. Install the catalytic converter to muffler nuts (3).

   Tighten: Tighten the nuts to 60 N.m (44 lb ft).

7. Remove the support from the exhaust system.

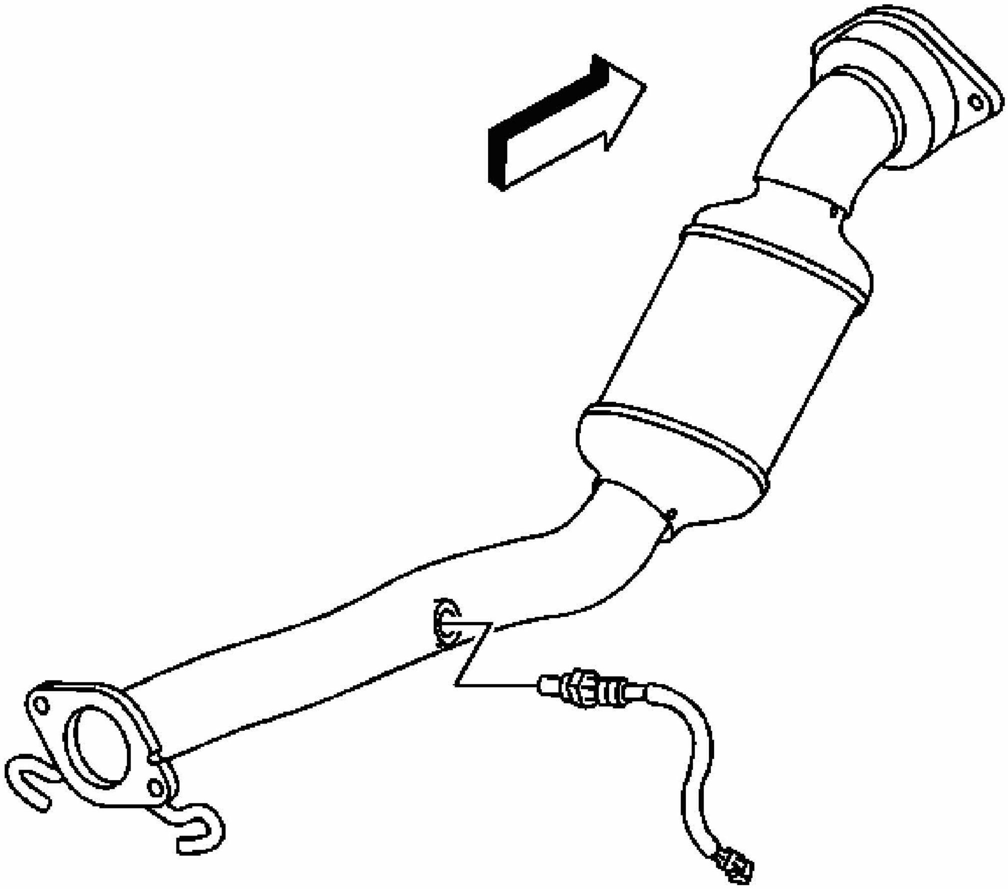


Fig. 58: Locating The HO2S
Courtesy of GENERAL MOTORS CORP.

8. Install the HO2S. Refer to **Heated Oxygen Sensor Replacement - Position 2** or **Heated Oxygen Sensor Replacement - Position 2** .

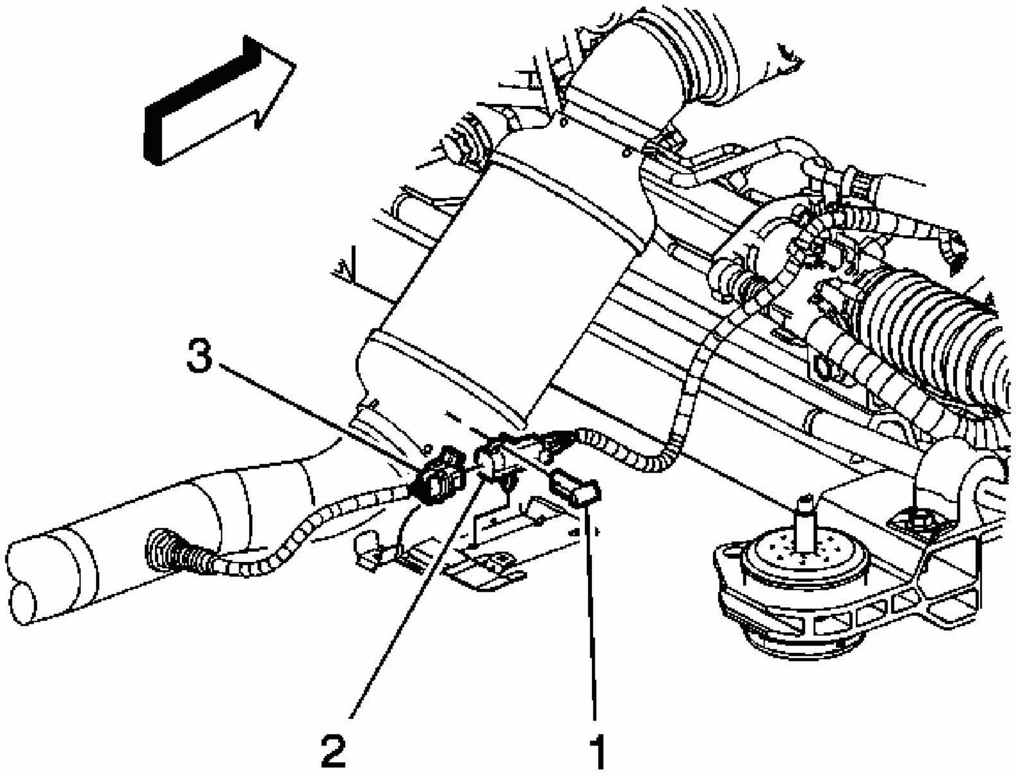


Fig. 59: View Of HO2S Electrical Connector
Courtesy of GENERAL MOTORS CORP.

9. Connect the HO2S electrical connector (3).
10. Install the CPA retainer (1).
11. Lower the vehicle.
12. Install the upper catalytic converter to exhaust manifold nut (1).

    Tighten: Tighten the nut to 35 N.m (26 lb ft).

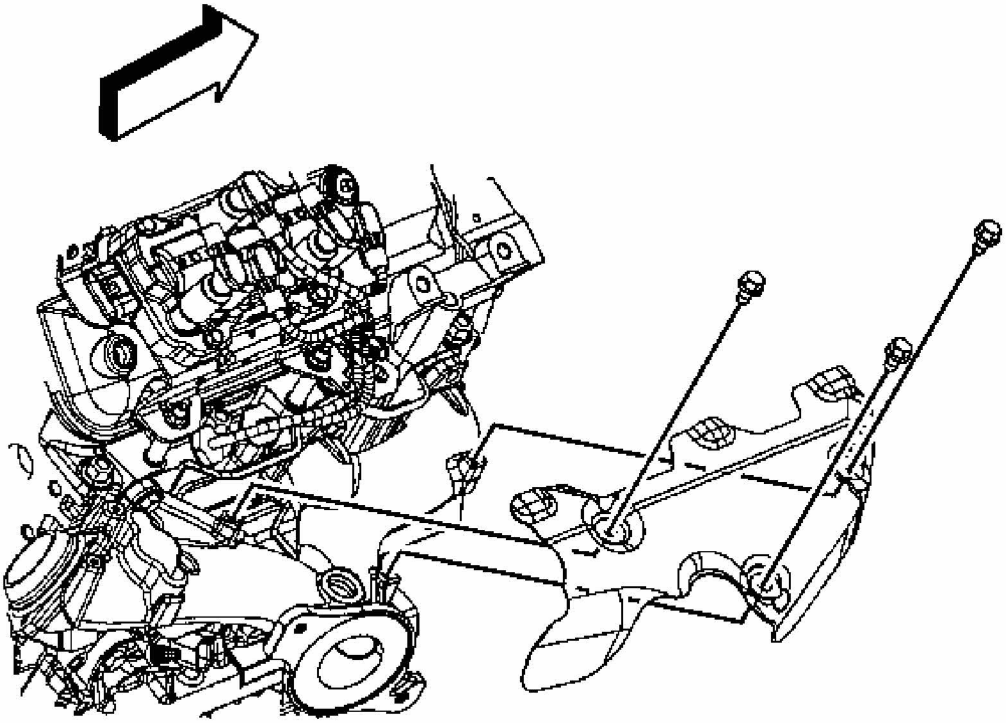


Fig. 60: Identifying Exhaust Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

13. Install the exhaust manifold heat shield.
14. Install the exhaust manifold heat shield bolts.

    Tighten: Tighten the nuts to 10 N.m (89 lb in).

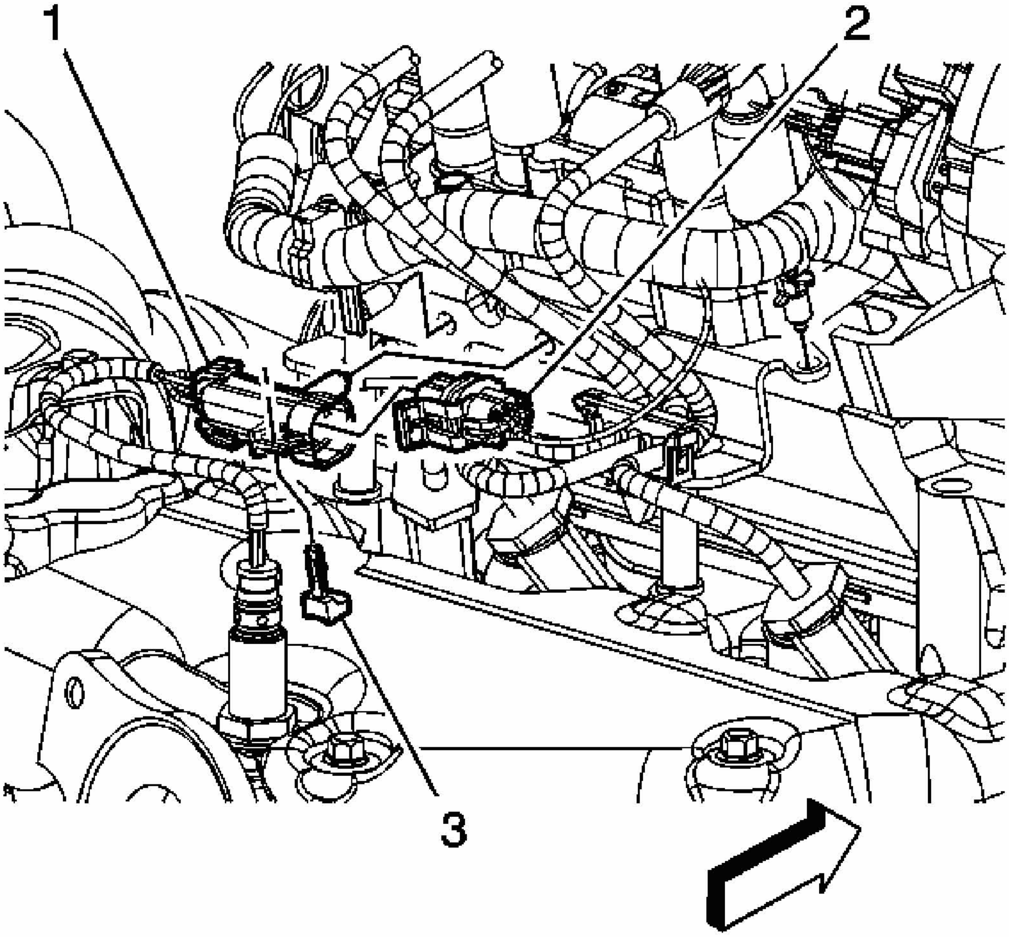


Fig. 61: Identifying The HO2S Electrical Connector
Courtesy of GENERAL MOTORS CORP.

15. Connect the HO2S electrical connector (2).
16. Install the connector position assurance (CPA) retainer (3).
17. Install the heated oxygen sensor (HO2S) electrical connector clip (1) to the ignition coil bracket.
18. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement** or **Intake Manifold Cover Replacement** .

CATALYTIC CONVERTER REPLACEMENT (RPO LS4)

Removal Procedure

IMPORTANT: The catalytic converter is serviced by replacing the entire

assembly. Always replace the gaskets at the front and rear flanges when servicing the catalytic converter. Never install the original gaskets.

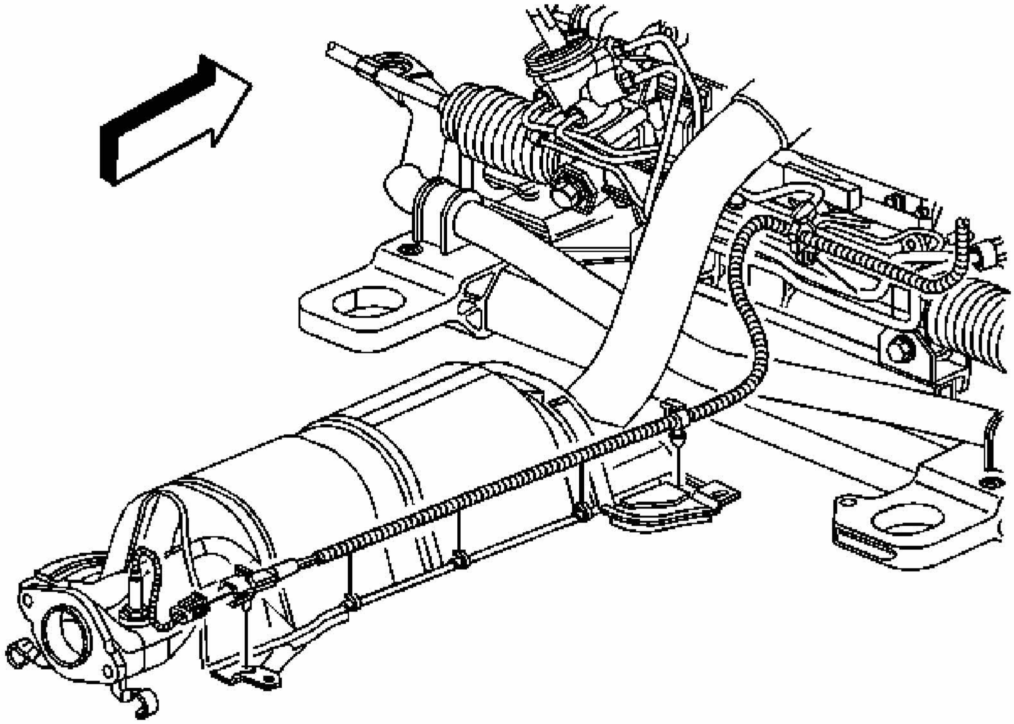


Fig. 62: Bank 2 Sensor 2 Electrical Harness Connector
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Disconnect the heated oxygen sensor (HO2S) electrical connector.

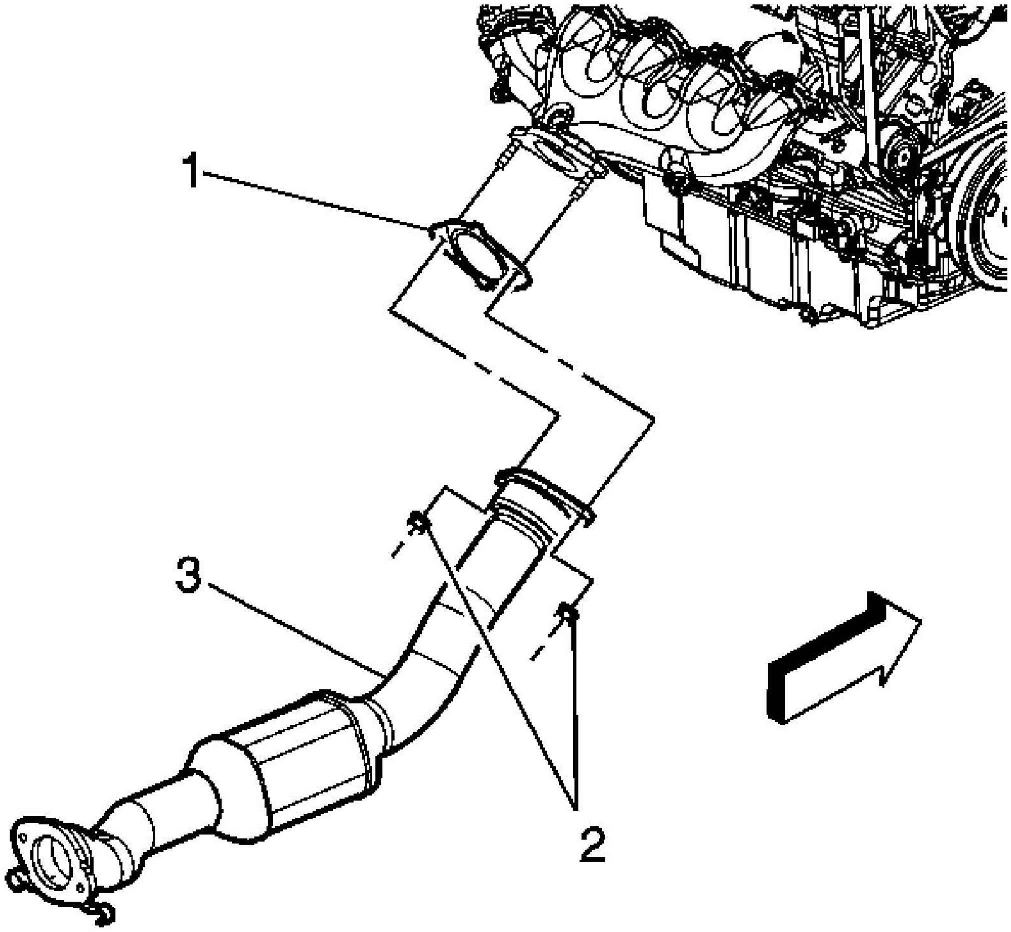


Fig. 63: Exhaust Manifold Pipe & Gasket
Courtesy of GENERAL MOTORS CORP.

3. Remove the catalytic converter pipe stud nuts (2).

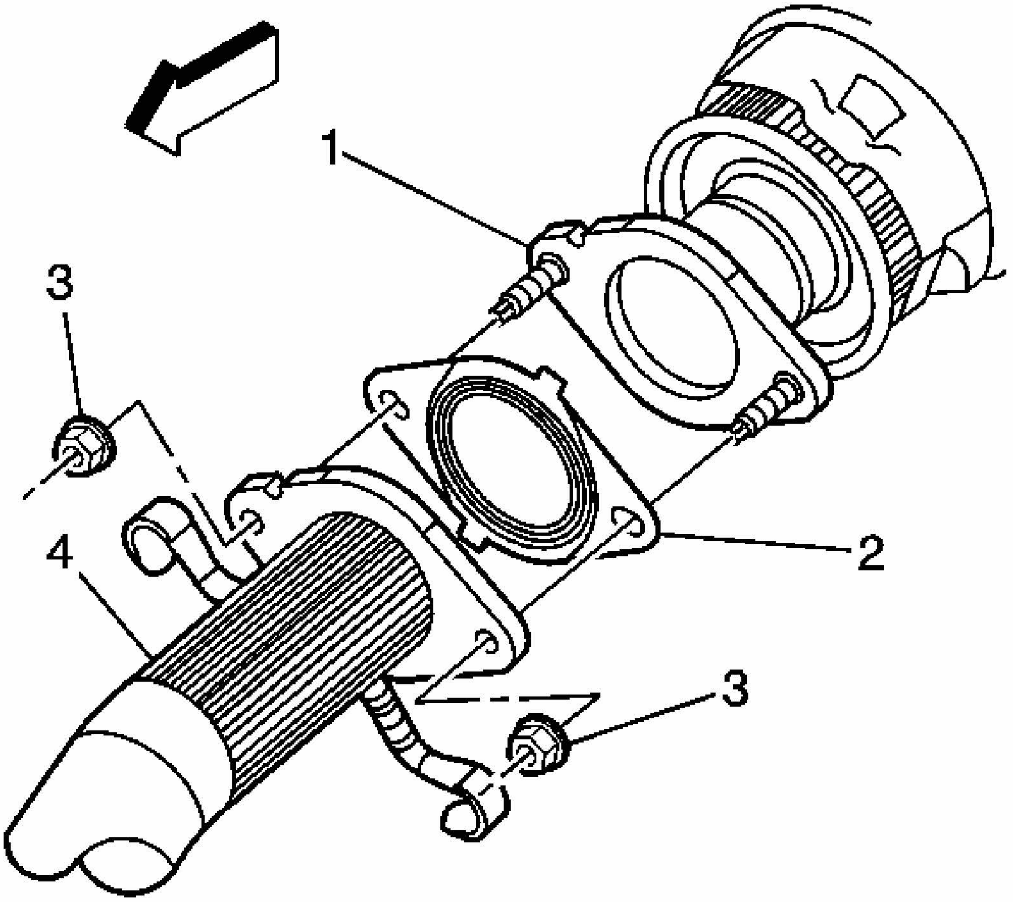


Fig. 64: Catalytic Converter To Muffler Components
Courtesy of GENERAL MOTORS CORP.

4. Remove the catalytic converter nuts (3).
5. Using a suitable adjustable jack, loosely support the exhaust system.

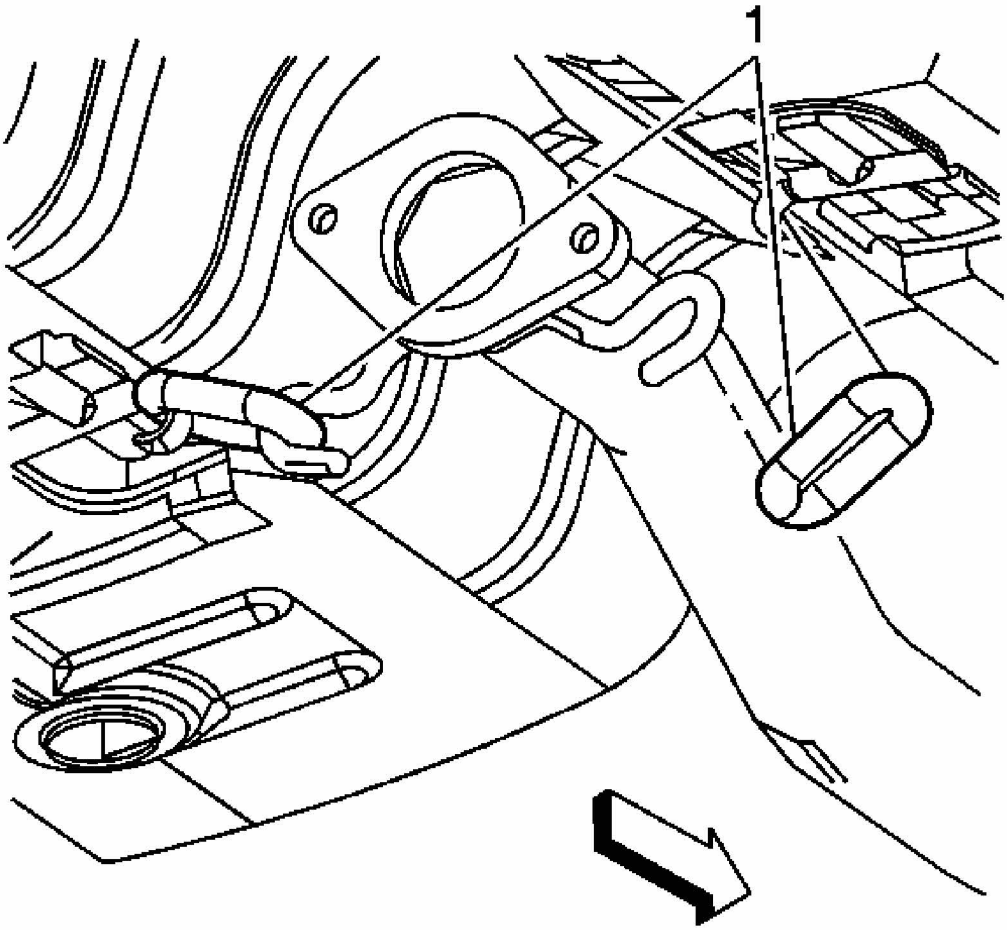


Fig. 65: Catalytic Converter Hangers
Courtesy of GENERAL MOTORS CORP.

6. Remove the catalytic converter hangers (1) from the converter.
7. Remove the catalytic converter.
8. Remove and discard the catalytic converter gaskets.

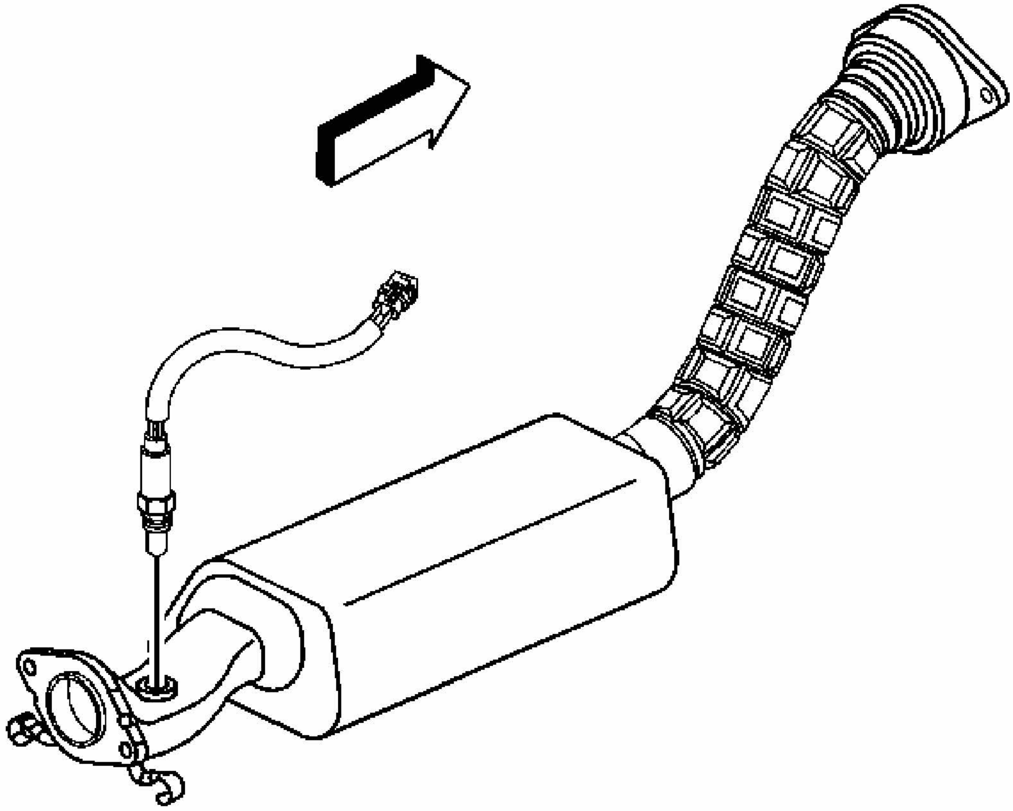


Fig. 66: Identifying The HO2S
Courtesy of GENERAL MOTORS CORP.

9. Remove the HO2S, if required.
10. Clean and inspect the exhaust manifold and the exhaust pipe mating surfaces.

Installation Procedure

NOTE: To prevent internal damage to the flexible coupling of the catalytic converter assembly, the converter must be supported. The vertical movement at the rear of the catalytic converter assembly must not exceed 6 degrees up or down.

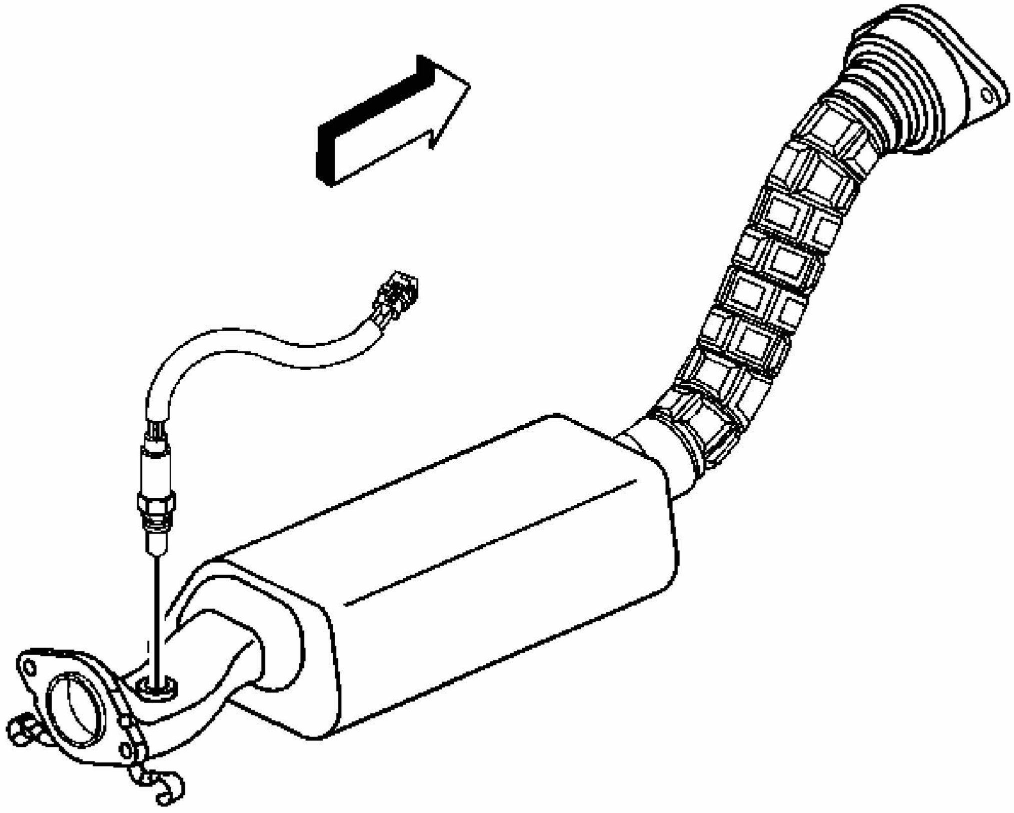


Fig. 67: Identifying The HO2S
Courtesy of GENERAL MOTORS CORP.

1. Install the HO2S, if required.

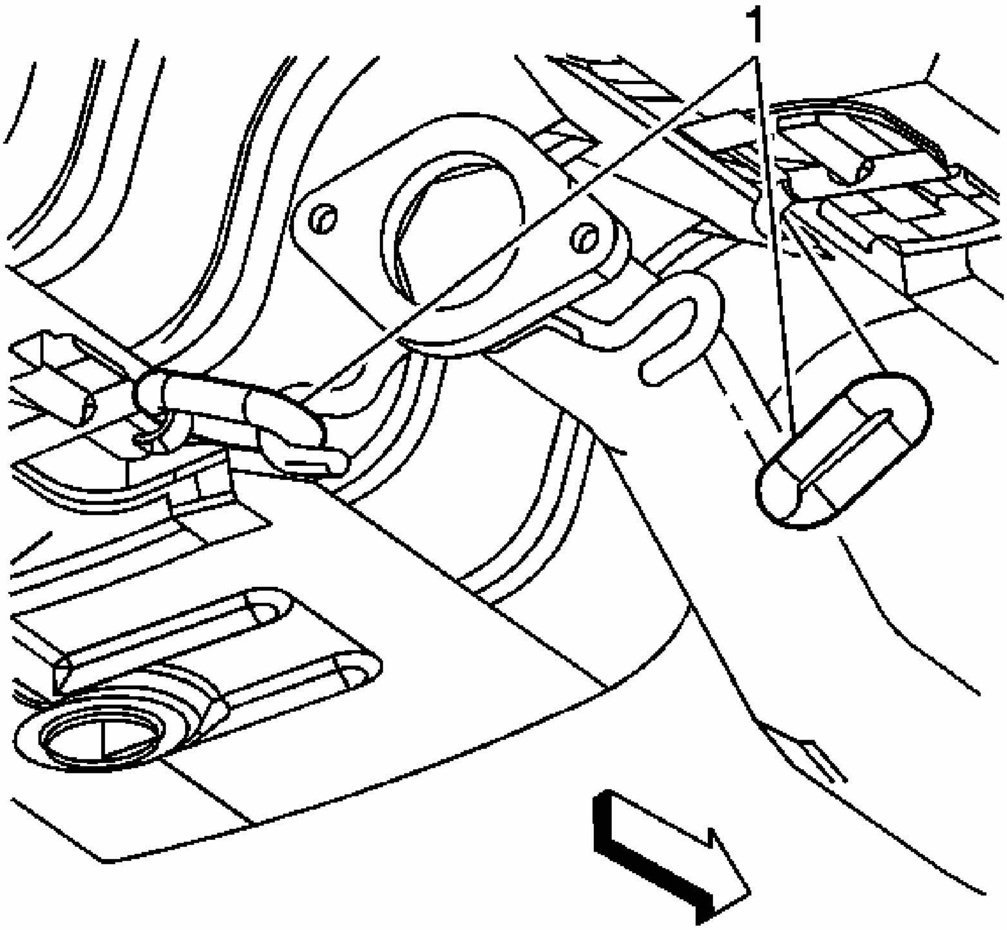


Fig. 68: Catalytic Converter Hangers
Courtesy of GENERAL MOTORS CORP.

2. Install NEW gaskets to the exhaust manifold and muffler studs.
3. Position the catalytic converter into place.
4. Install the catalytic converter hangers (1) to the converter.

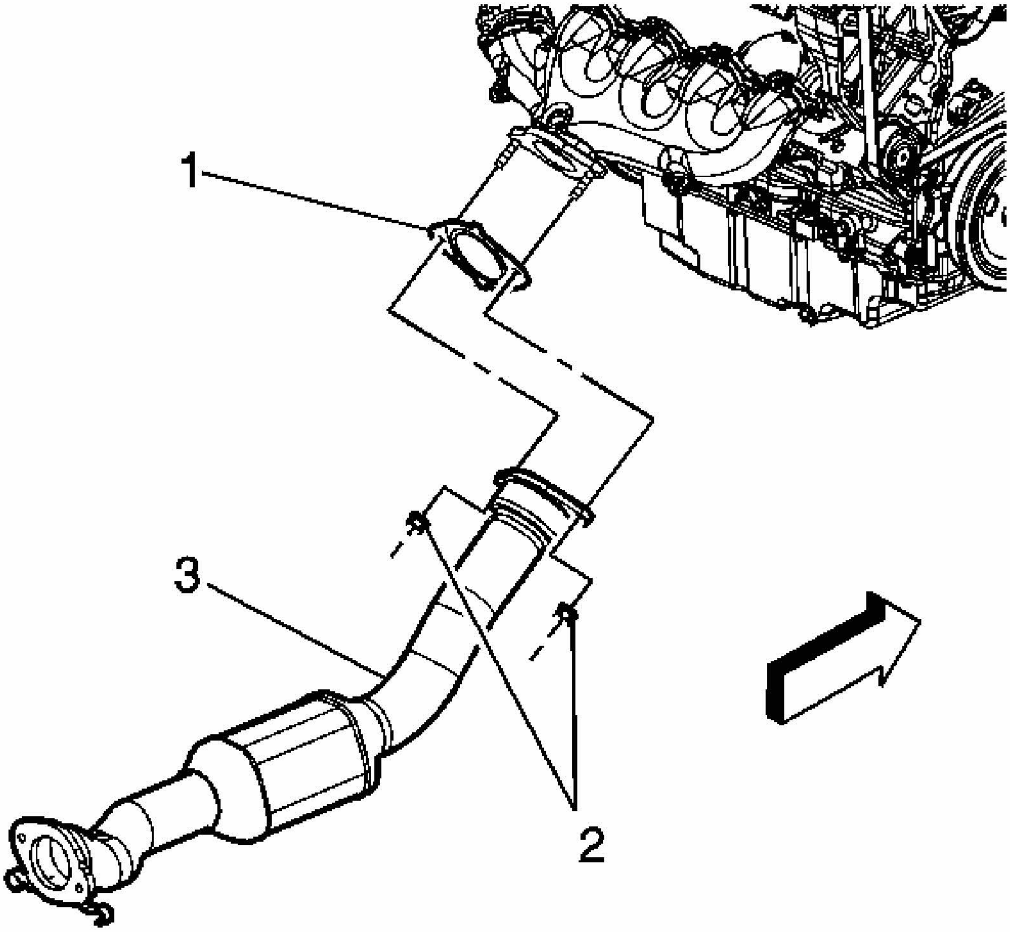


Fig. 69: Exhaust Manifold Pipe & Gasket
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

5. Install the catalytic converter pipe stud nuts (2).

   Tighten: Tighten the nuts to 35 N.m (26 lb ft).

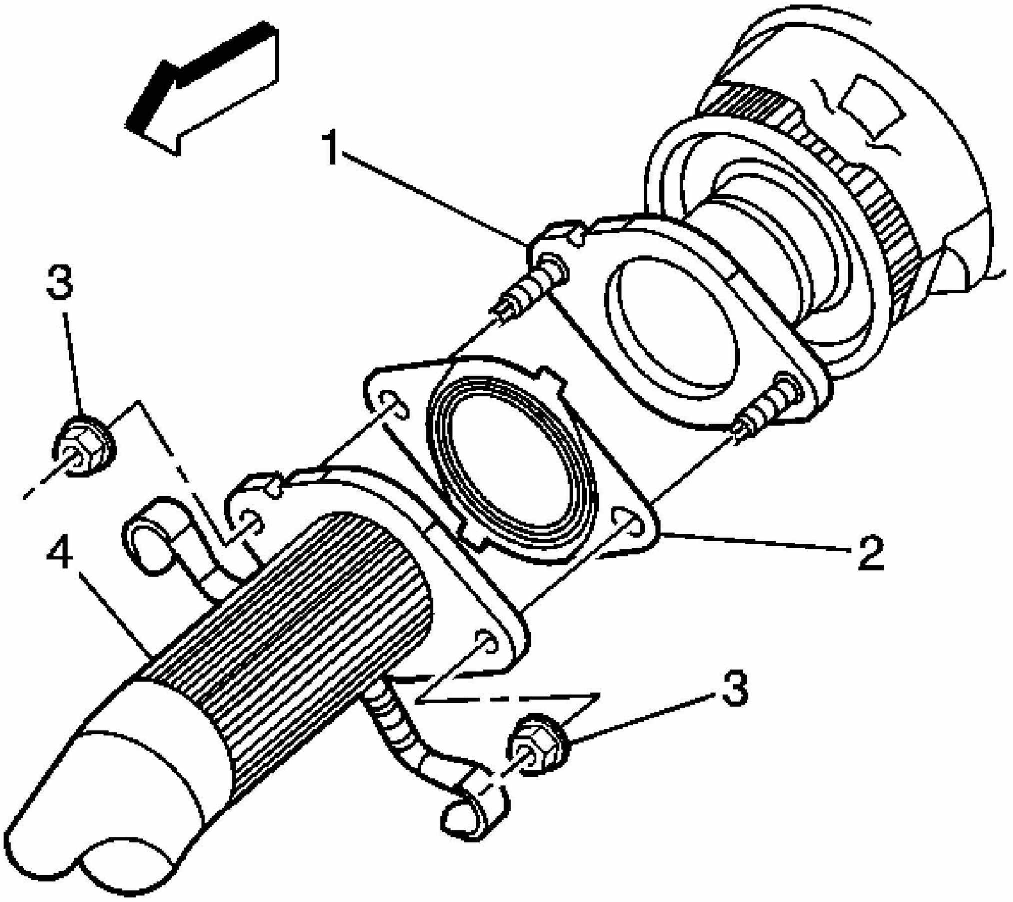


Fig. 70: Catalytic Converter To Muffler Components
Courtesy of GENERAL MOTORS CORP.

6. Install the catalytic converter nuts (3).

   Tighten: Tighten the nuts to 60 N.m (44 lb ft).

7. Remove the exhaust system support.

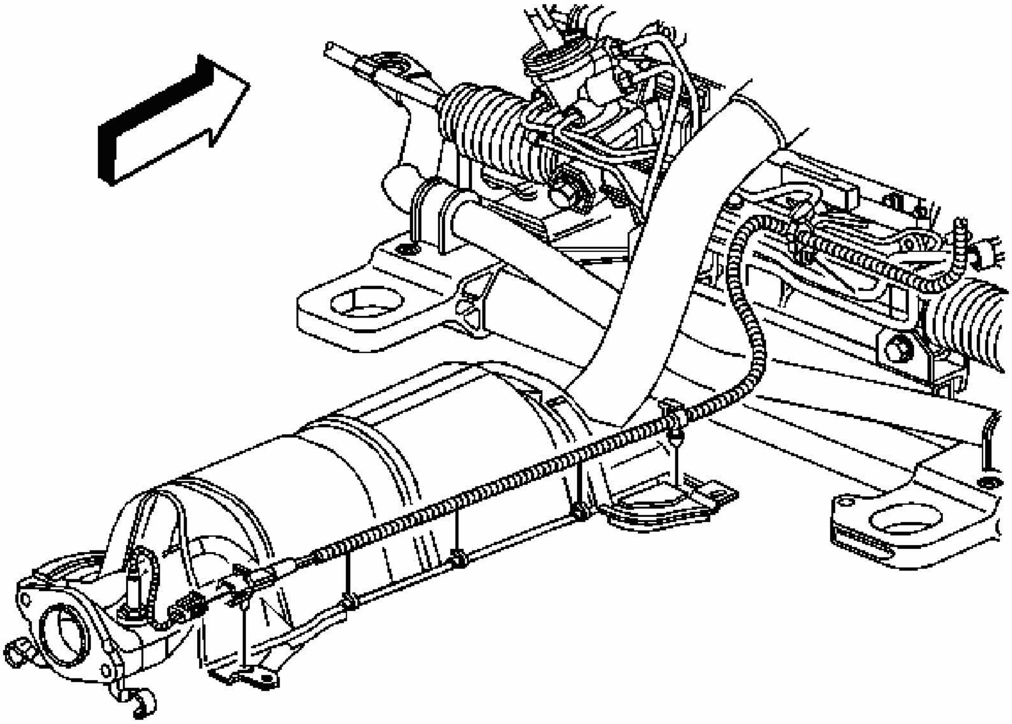


Fig. 71: Bank 2 Sensor 2 Electrical Harness Connector
Courtesy of GENERAL MOTORS CORP.

8. Connect the HO2S electrical connector.
9. Lower the vehicle.
10. Run the vehicle and inspect the exhaust system for leaks and underbody contact.

MUFFLER REPLACEMENT (SINGLE OUTLET)

Removal Procedure

IMPORTANT: The muffler is serviced as a complete assembly and cannot be serviced separately.

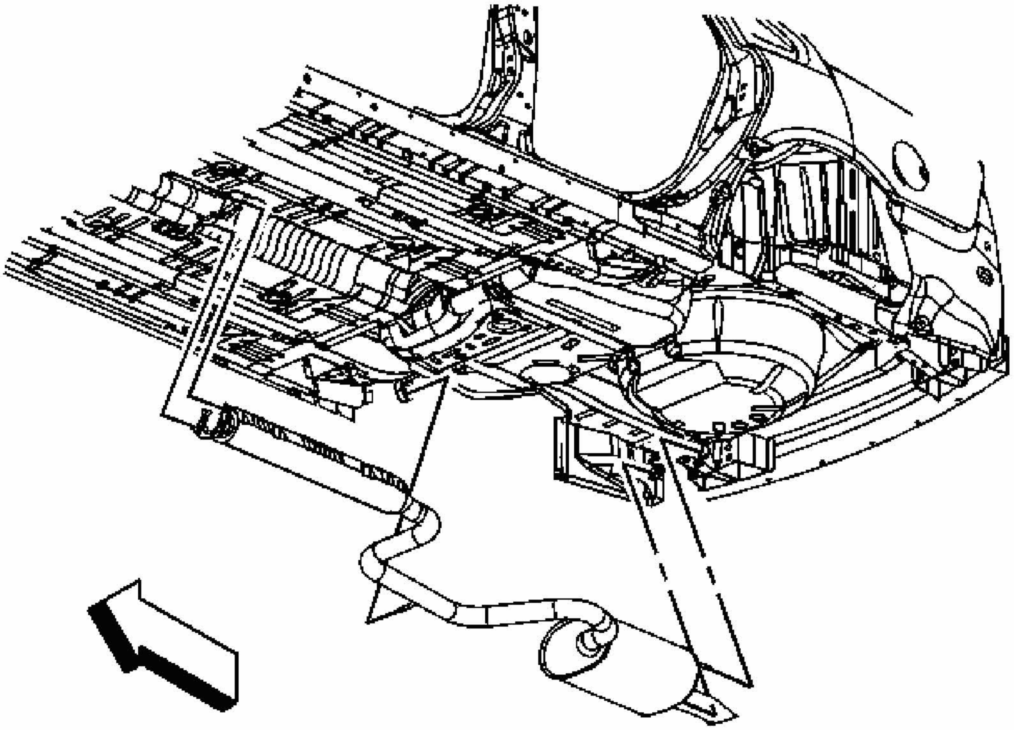


Fig. 72: View Of Muffler Assembly & Exhaust Insulators
Courtesy of GENERAL MOTORS CORP.

1. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)**.
2. Have an assistant support the muffler assembly.
3. Remove the muffler assembly from the exhaust insulators.
4. Clean the catalytic converter to muffler mating surfaces.

Installation Procedure

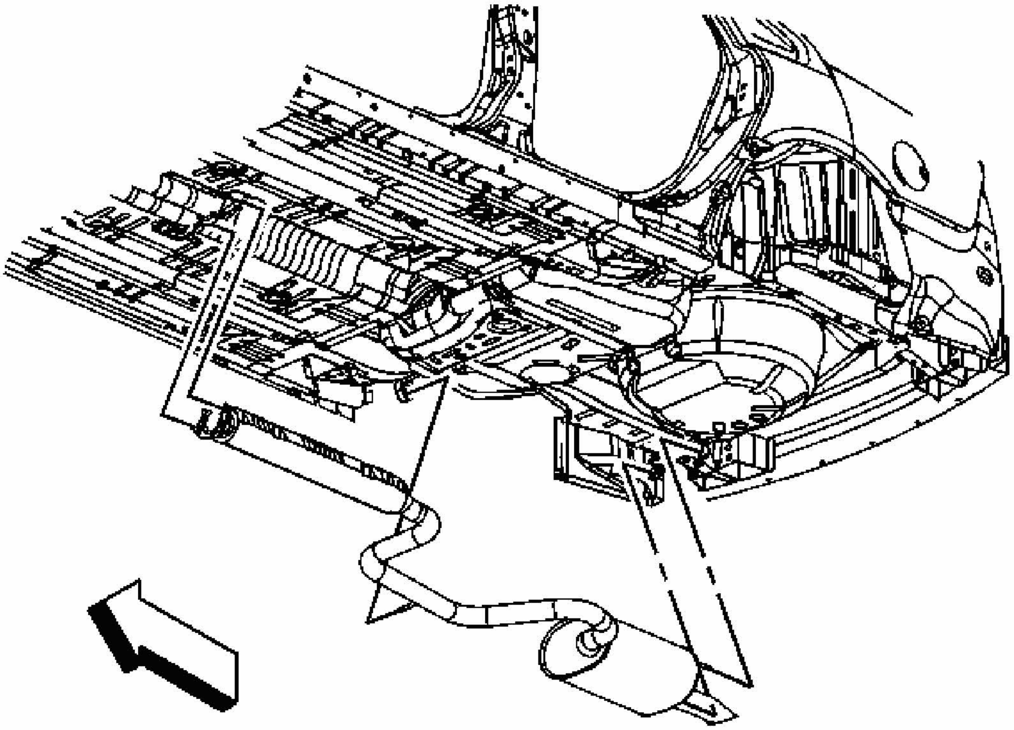


Fig. 73: View Of Muffler Assembly & Exhaust Insulators
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the insulators with spray lubricant.
2. With the aid of an assistant, install the muffler assembly to the exhaust insulators.
3. Install the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)**.

MUFFLER REPLACEMENT (DUAL OUTLET)

Removal Procedure

IMPORTANT: The muffler is serviced as a complete assembly and cannot be serviced separately.

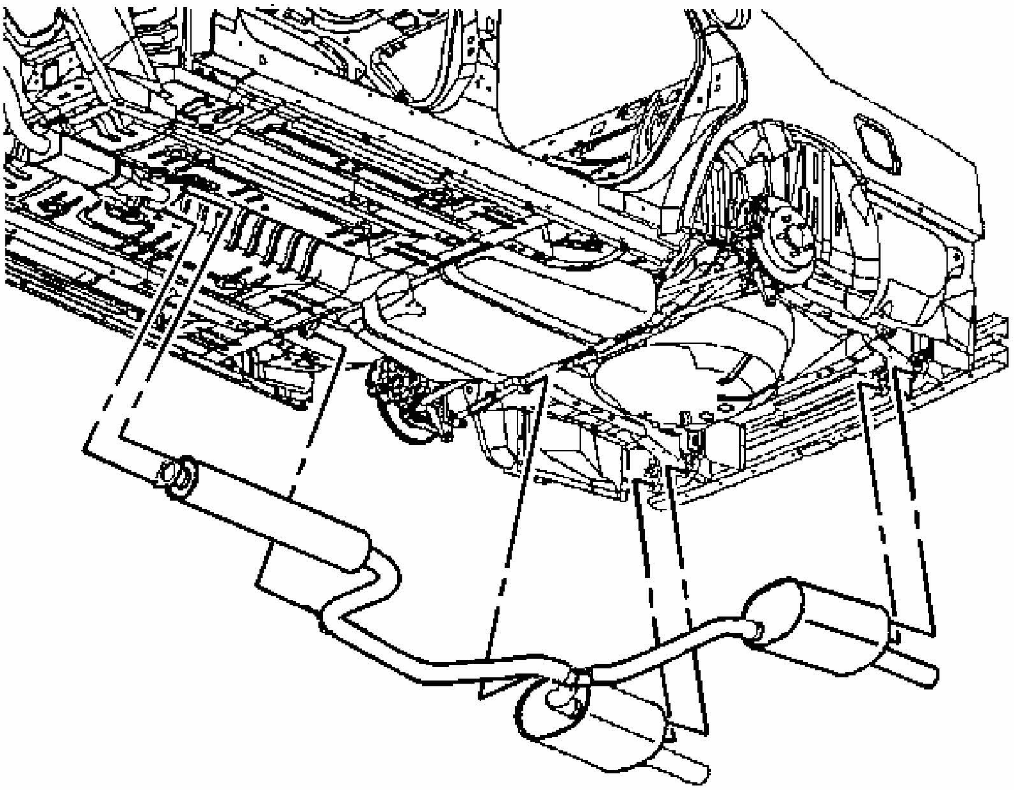


Fig. 74: Identifying Muffler (Dual)
Courtesy of GENERAL MOTORS CORP.

1. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)**.
2. Support the exhaust system.
3. With the aid of an assistant, remove the exhaust system from the exhaust hangers.
4. Clean the catalytic converter and the muffler mating surfaces.

Installation Procedure

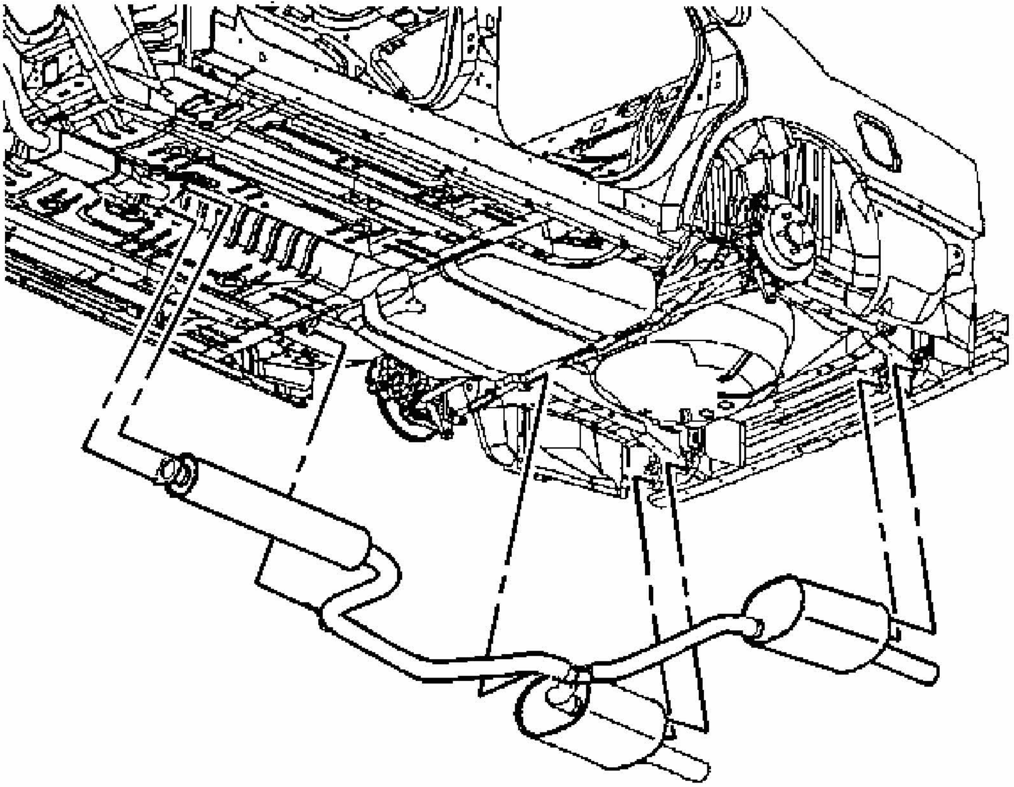


Fig. 75: Identifying Muffler (Dual)
Courtesy of GENERAL MOTORS CORP.

1. With the aid of an assistant, install the muffler to the exhaust hangers.
2. Remove the support from the exhaust system.
3. Install the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)**.

CONVERTER HANGER ASSEMBLY REPLACEMENT

Removal Procedure

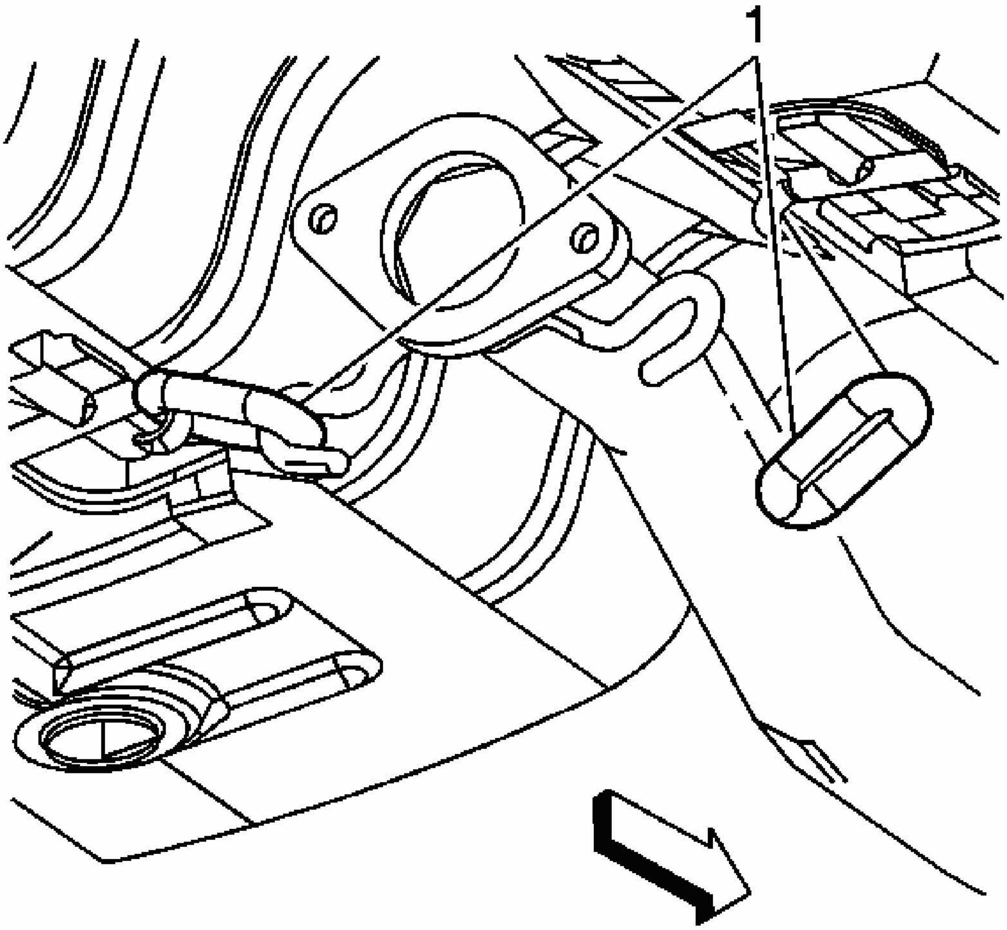


Fig. 76: Catalytic Converter Hangers
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Using a suitable jack, support the exhaust system, if necessary.
3. Remove and discard the catalytic converter pipe hangers (1), if necessary.

Installation Procedure

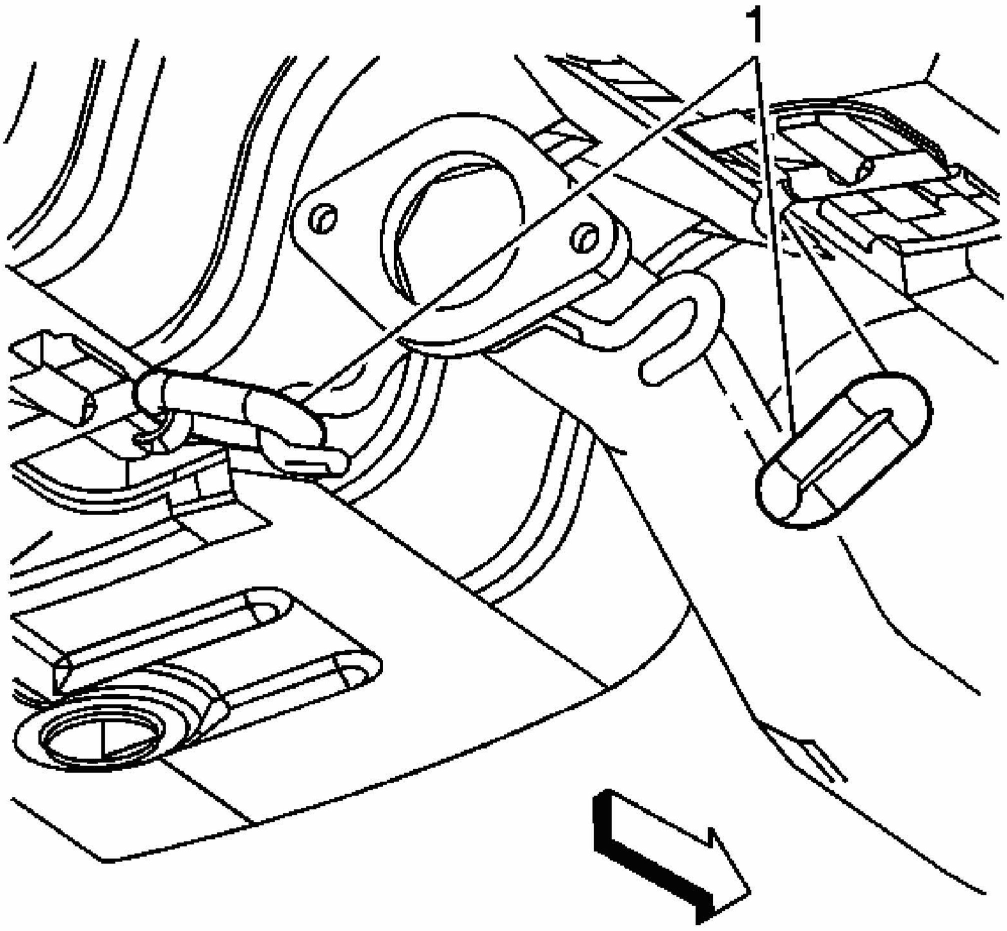


Fig. 77: Catalytic Converter Hangers
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW catalytic converter pipe hangers (1), if necessary.
2. Remove the support from the exhaust system, if necessary.
3. Lower the vehicle.

CATALYTIC CONVERTER HEAT SHIELD REPLACEMENT

Removal Procedure

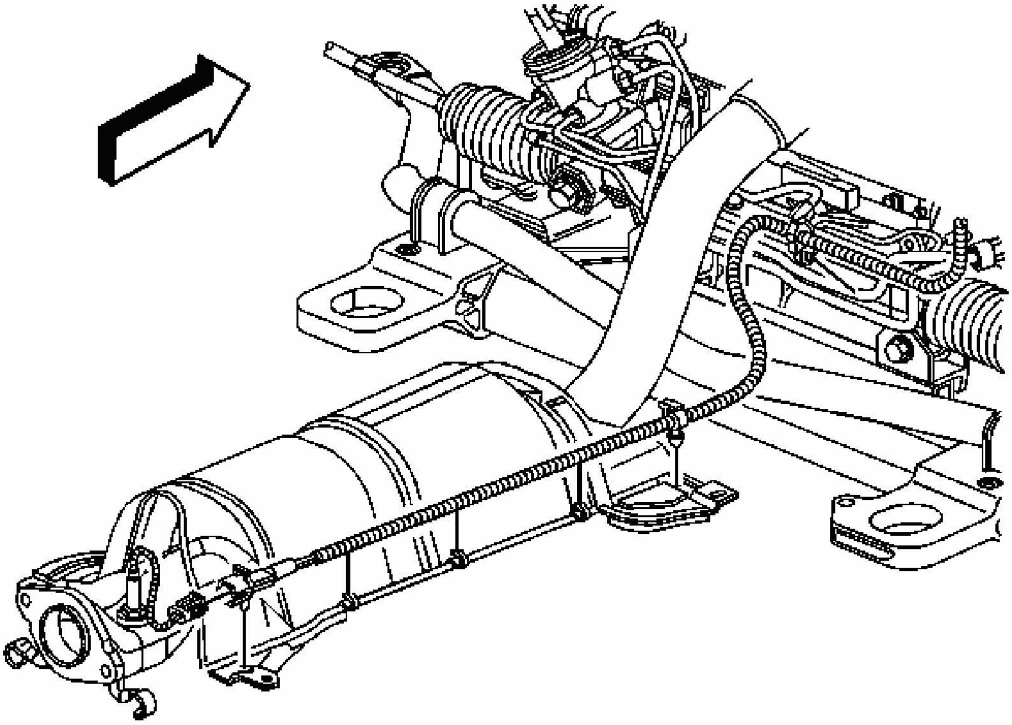


Fig. 78: Bank 2 Sensor 2 Electrical Harness Connector
Courtesy of GENERAL MOTORS CORP.

1. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)**.
2. Remove the heated oxygen sensor (HO2S) wiring harness from the clips on the catalytic converter heat shield.

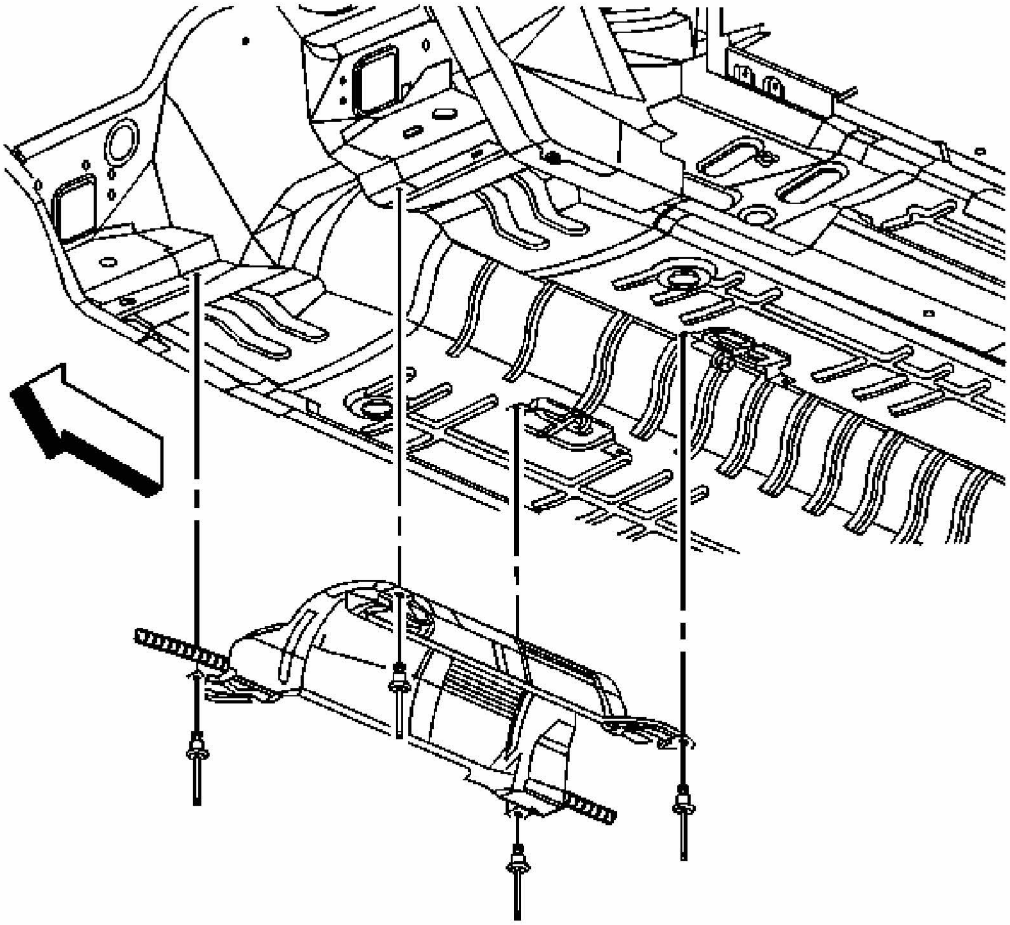


Fig. 79: Catalytic Converter Heat Shield
Courtesy of GENERAL MOTORS CORP.

3. Drill out the catalytic converter heat shield rivets.
4. Remove the catalytic converter heat shield.

Installation Procedure

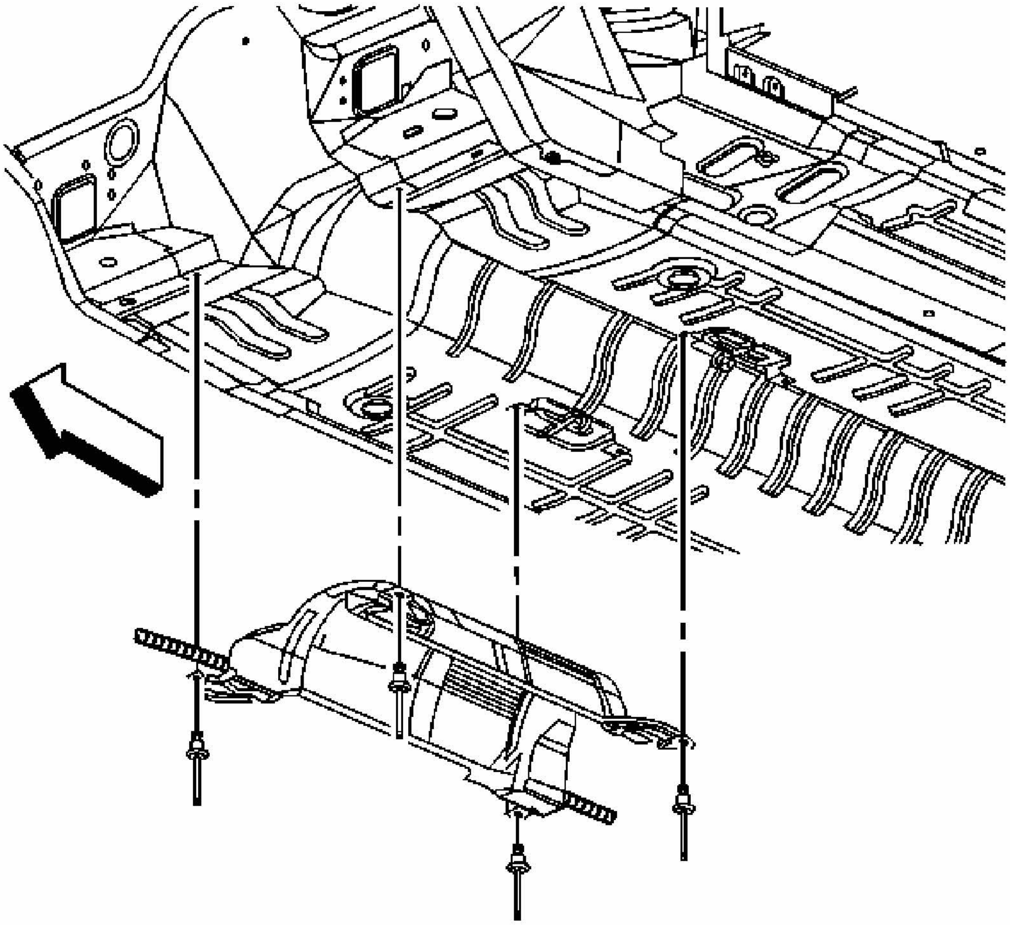


Fig. 80: Catalytic Converter Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Position the catalytic converter heat shield to the underbody.
2. Install NEW catalytic converter heat shield rivets.

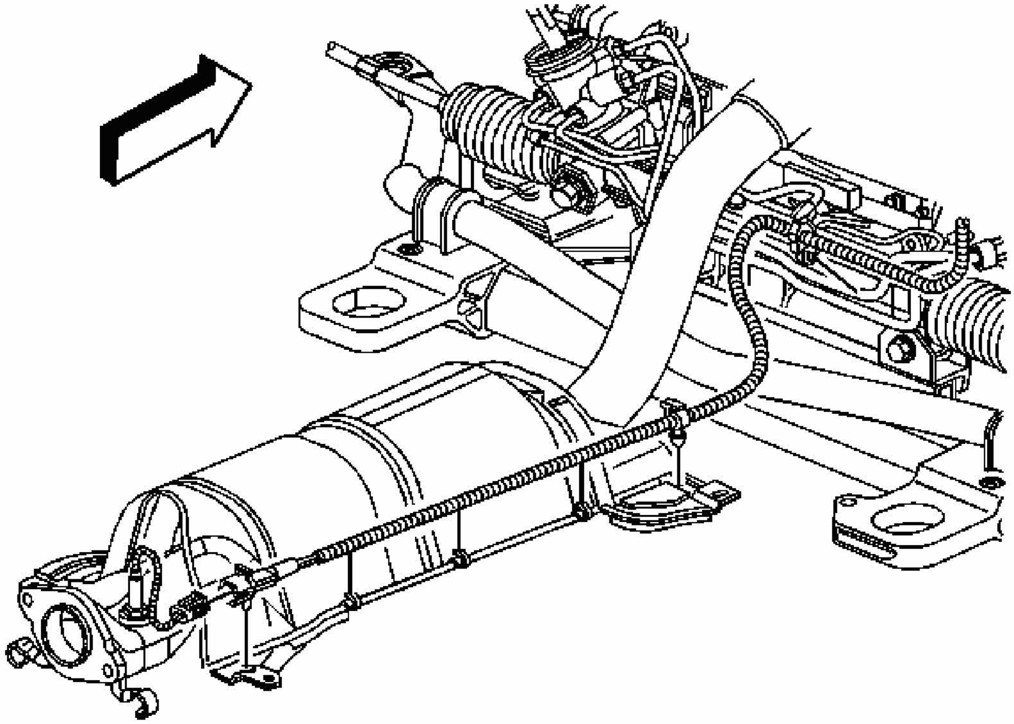


Fig. 81: Bank 2 Sensor 2 Electrical Harness Connector
Courtesy of GENERAL MOTORS CORP.

3. Install the HO2S wiring harness from the clips on the catalytic converter heat shield.
4. Install the catalytic converter. Refer to **Catalytic Converter Replacement (RPOs LZE/LZ4/LZ9)** or **Catalytic Converter Replacement (RPO LS4)**.

DESCRIPTION AND OPERATION

EXHAUST SYSTEM DESCRIPTION

IMPORTANT: Use of non-OEM parts may cause driveability concerns.

The exhaust system carries exhaust gases, treated by the catalytic converter, through a resonator, if applicable and into the exhaust muffler where exhaust noise is lessened.

In order to secure the exhaust pipe to the exhaust manifold, a flange and seal-joint coupling is utilized. The exhaust system may utilize a slip-joint coupling design with a clamp and a U-bolt or a flange connection with a gasket.

Exhaust hangers and rubber insulators help to support the weight of the exhaust pipe along with insulating any exhaust system vibration, rattle, or noise.

Exhaust hangers also space the exhaust system away from the underbody of the vehicle and allows the exhaust system to expand as the exhaust system warms up.

Exhaust heat shields are used to protect the body and other components from damage due to the heat from the exhaust system.

The exhaust system may be comprised of the following components:

- Exhaust manifold
- Exhaust pipes
- Catalytic converters
- Exhaust muffler
- Exhaust resonator, if equipped
- Exhaust tail pipe, if equipped
- Exhaust hangers
- Exhaust heat shields

Resonator

Some exhaust systems are equipped with a resonator. The resonator, located either before or after the muffler, allows the use of mufflers with less back pressure. Resonators are used when vehicle characteristics require specific exhaust tuning.

Catalytic Converter

The catalytic converter is an emission control device added to the engine exhaust system in order to reduce hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) pollutants from the exhaust gas.

The catalytic converter is comprised of a ceramic monolith substrate, supported in insulation and housed within a sheet metal shell. The substrate may be washcoated with 3 noble metals:

- Platium (Pt)
- Palladium (Pd)
- Rhodium (Rh)

The catalyst in the converter is not serviceable.

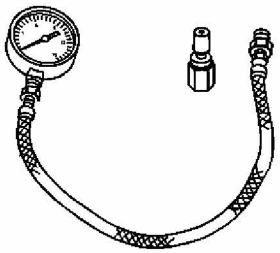
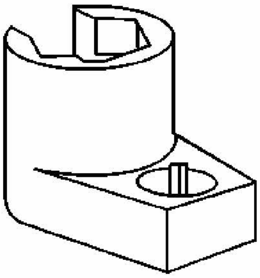
Muffler

The exhaust muffler reduces the noise levels of the engine exhaust by the use of tuning tubes. The tuning tubes create channels inside the exhaust muffler that lower the sound levels created by the combustion of the engine.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description
	J 35314-A Exhaust Back Pressure Gage
	J 39194-B Heated Oxygen Sensor Wrench

2006 ACCESSORIES & EQUIPMENT

Entertainment - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Antenna Amplifier Fastener	3 N.m	27 lb in
Audio Amplifier Fasteners	2.5 N.m	22 lb in
Digital Radio Receiver Mounting Bracket to Body Fasteners	5 N.m	44 lb in
Digital Radio Receiver to Mounting Bracket Fasteners	3.5 N.m	31 lb in
Radio Fasteners	2 N.m	18 lb in
Speaker Grille Fasteners	2 N.m	18 lb in

SCHEMATIC AND ROUTING DIAGRAMS

ENTERTAINMENT SCHEMATIC ICONS

Entertainment Schematic Icons

Icon	Icon Definition
	IMPORTANT: **Twisted-pair wires provide an effective "shield" that helps protect sensitive electronic components from electrical interference.** **In order to prevent electrical interference from degrading the performance of the connected components, you must maintain the proper specification when making any repairs to the twisted-pair wires shown :** • **The wires must be twisted a minimum of 9 turns per 31 cm (12 in) as measured anywhere along the length of the wires.** • **The outside diameter of the twisted wires must not exceed 6.0 mm (0.2 in).**

⚠	

RADIO/AUDIO SYSTEM SCHEMATICS

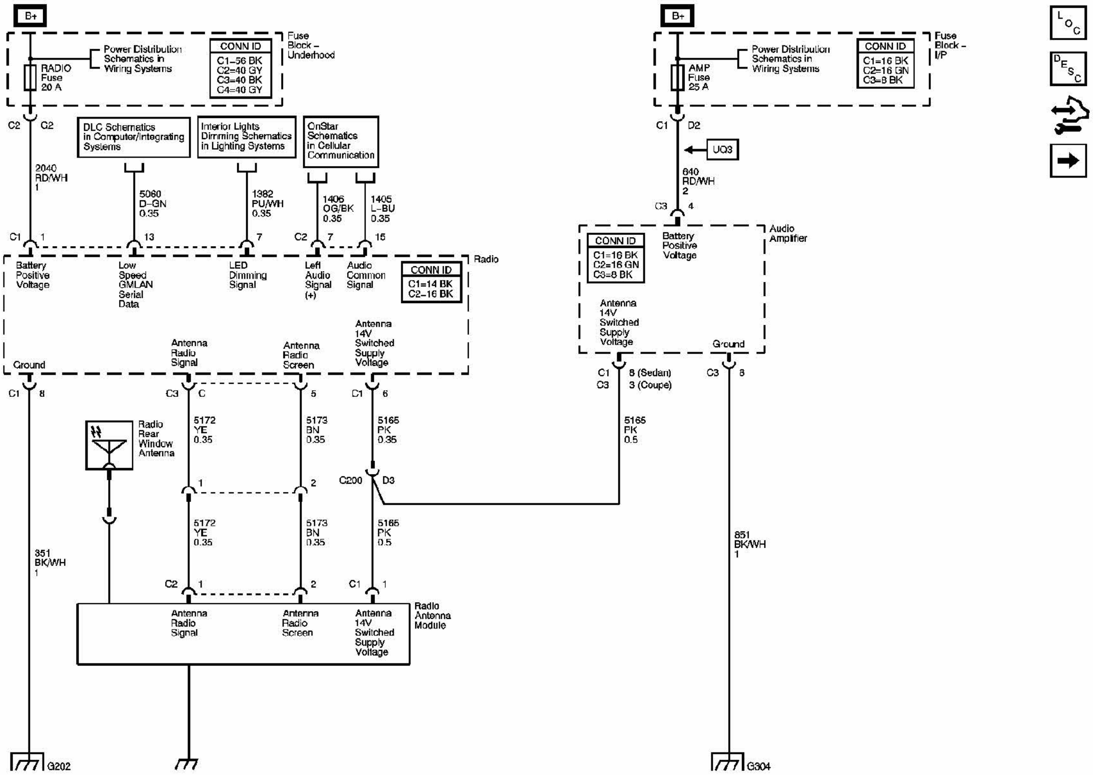

B+
RADIO Fuse 20 A
Power Distribution Schematics in Wiring Systems
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
Fuse Block – Underhood
C2
2040 RD/WH 1
DLC Schematics in Computer/Integrating Systems
Interior Lights Dimming Schematics in Lighting Systems
OnStar Schematics in Cellular Communication
5060 D-GN 0.35
1382 PU/WH 0.35
1406 OG/BK 0.35
1405 L-BU 0.35
C1 1 13 7 C2 7 15
Battery Positive Voltage
Low Speed GMLAN Serial Data
LED Dimming Signal
Left Audio Signal (+)
Audio Common Signal
CONN ID
C1=14 BK
C2=16 BK
Radio
Ground
Antenna Radio Signal
Antenna Radio Screen
Antenna 14V Switched Supply Voltage
C1 8
C3 C 5
C1 6
Radio Rear Window Antenna
5172 YE 0.35
5173 BN 0.35
5165 PK 0.35
C200 D3
1 2
5172 YE 0.35
5173 BN 0.35
5165 PK 0.5
351 BK/WH 1
C2 1 2
C1 1
Antenna Radio Signal
Antenna Radio Screen
Antenna 14V Switched Supply Voltage
Radio Antenna Module
G202
B+
AMP Fuse 25 A
Power Distribution Schematics in Wiring Systems
CONN ID
C1=16 BK
C2=16 GN
C3=8 BK
Fuse Block – I/P
C1 D2
UQ3
640 RD/WH 2
C3 4
CONN ID
C1=16 BK
C2=16 GN
C3=8 BK
Battery Positive Voltage
Audio Amplifier
Antenna 14V Switched Supply Voltage
Ground
C1 C3 8 (Sedan) 3 (Coupe)
C3 8
5165 PK 0.5
851 BK/WH 1
G304
LOC
DESC

Fig. 1: Power, Ground, and References - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

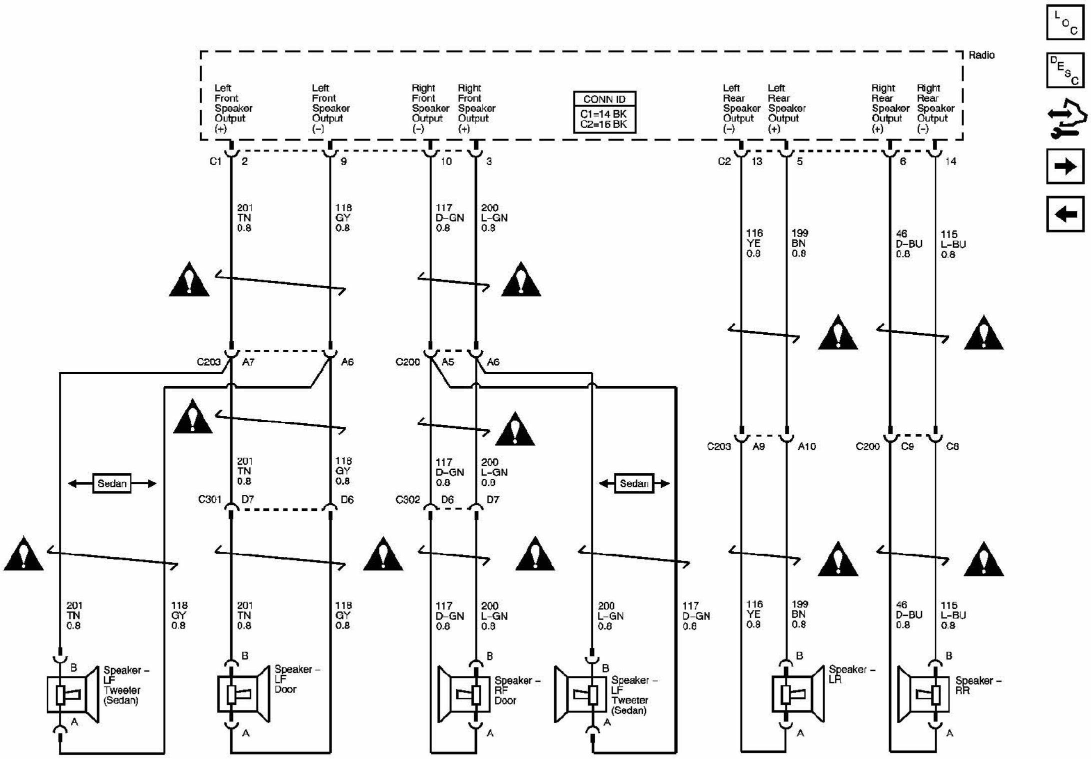

Radio
Left Front Speaker Output (+)
Left Front Speaker Output (–)
Right Front Speaker Output (–)
Right Front Speaker Output (+)
CONN ID
C1=14 BK
C2=16 BK
Left Rear Speaker Output (–)
Left Rear Speaker Output (+)
Right Rear Speaker Output (+)
Right Rear Speaker Output (–)
C1 2 9 10 3
C2 13 5 6 14
201 TN 0.8
118 GY 0.8
117 D-GN 0.8
200 L-GN 0.8
116 YE 0.8
199 BN 0.8
46 D-BU 0.8
115 L-BU 0.8
C203 A7 A6
C200 A5 A6
C203 A9 A10
C200 C9 C8
Sedan
C301 D7 D6
C302 D6 D7
Sedan
B
A
Speaker – LF Tweeter (Sedan)
Speaker – LF Door
Speaker – RF Door
Speaker – LF Tweeter (Sedan)
Speaker – LR
Speaker – RR
LOC
DESC

Fig. 2: Radio to Speakers - UW6 - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

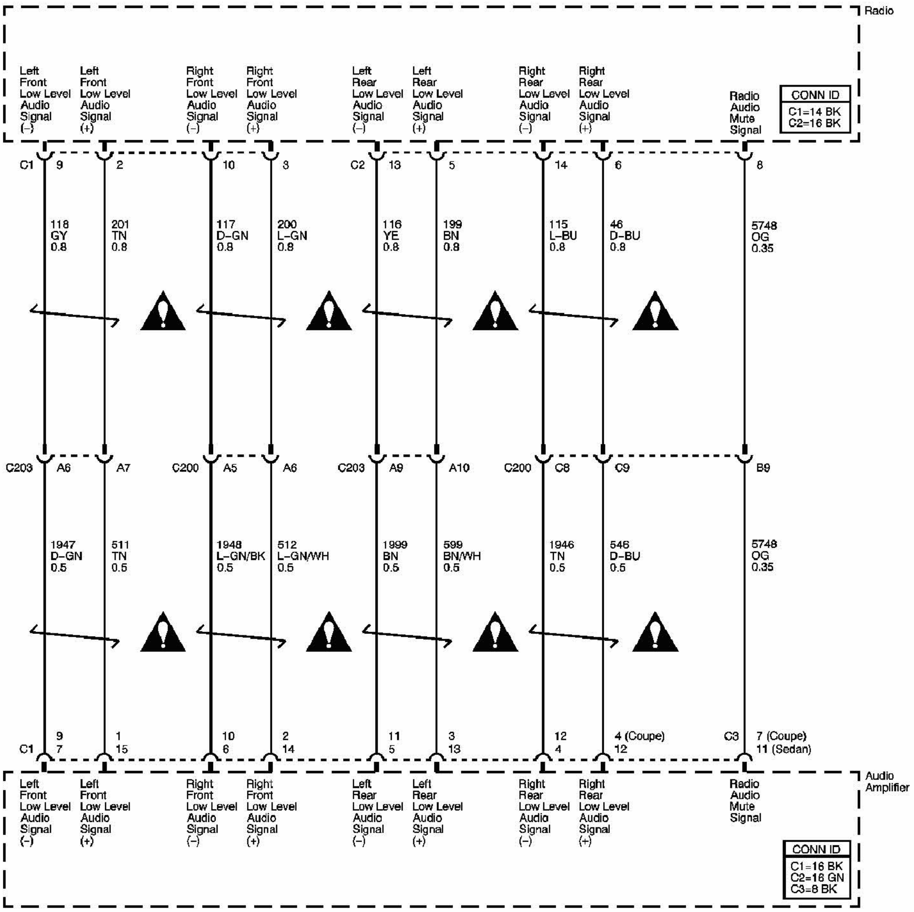

Radio
Left Front Low Level Audio Signal (–)
Left Front Low Level Audio Signal (+)
Right Front Low Level Audio Signal (–)
Right Front Low Level Audio Signal (+)
Left Rear Low Level Audio Signal (–)
Left Rear Low Level Audio Signal (+)
Right Rear Low Level Audio Signal (–)
Right Rear Low Level Audio Signal (+)
Radio Audio Mute Signal
CONN ID
C1=14 BK
C2=16 BK
C1 9
2
10
3
C2 13
5
14
6
8
118 GY 0.8
201 TN 0.8
117 D-GN 0.8
200 L-GN 0.8
116 YE 0.8
199 BN 0.8
115 L-BU 0.8
46 D-BU 0.8
5748 OG 0.35
C203 A6
A7
C200 A5
A6
C203 A9
A10
C200 C8
C9
B9
1947 D-GN 0.5
511 TN 0.5
1948 L-GN/BK 0.5
512 L-GN/WH 0.5
1999 BN 0.5
599 BN/WH 0.5
1946 TN 0.5
546 D-BU 0.5
5748 OG 0.35
C1 9 7
1 15
10 6
2 14
11 5
3 13
12 4
4 (Coupe) 12
C3 7 (Coupe) 11 (Sedan)
Audio Amplifier
Left Front Low Level Audio Signal (–)
Left Front Low Level Audio Signal (+)
Right Front Low Level Audio Signal (–)
Right Front Low Level Audio Signal (+)
Left Rear Low Level Audio Signal (–)
Left Rear Low Level Audio Signal (+)
Right Rear Low Level Audio Signal (–)
Right Rear Low Level Audio Signal (+)
Radio Audio Mute Signal
CONN ID
C1=16 BK
C2=16 GN
C3=8 BK

Fig. 3: Audio Signal Communication - UQ3 - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

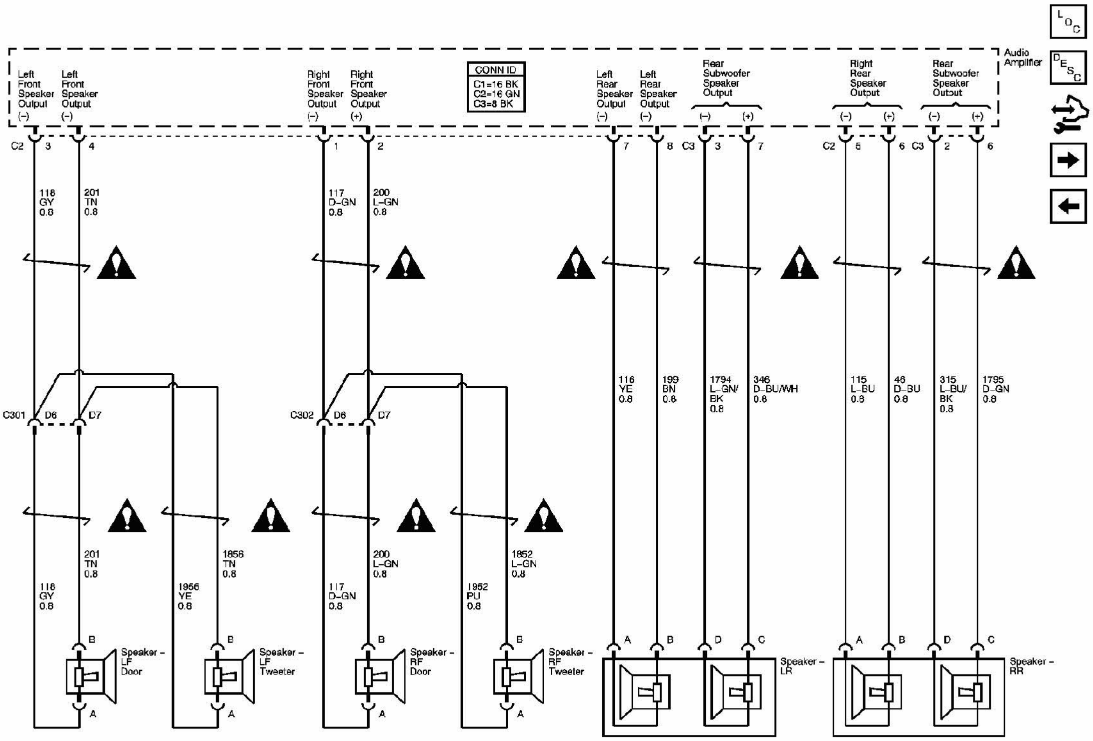

Left Front Speaker Output (–)
Left Front Speaker Output (–)
Right Front Speaker Output (–)
Right Front Speaker Output (+)
CONN ID
C1=16 BK
C2=16 GN
C3=8 BK
Left Rear Speaker Output (–)
Left Rear Speaker Output (–)
Rear Subwoofer Speaker Output (–) (+)
Right Rear Speaker Output (–) (+)
Rear Subwoofer Speaker Output (–) (+)
Audio Amplifier
C2 3 4 1 2 7 8
C3 3 7
C2 5 6
C3 2 6
118 GY 0.8
201 TN 0.8
117 D-GN 0.8
200 L-GN 0.8
116 YE 0.8
199 BN 0.8
1794 L-GN/BK 0.8
346 D-BU/WH 0.8
115 L-BU 0.8
46 D-BU 0.8
315 L-BU/BK 0.8
1795 D-GN 0.8
C301 D6 D7
C302 D6 D7
201 TN 0.8
118 GY 0.8
1956 YE 0.8
1856 TN 0.8
200 L-GN 0.8
117 D-GN 0.8
1952 PU 0.8
1852 L-GN 0.8
B A
Speaker – LF Door
Speaker – LF Tweeter
Speaker – RF Door
Speaker – RF Tweeter
A B D C
Speaker – LR
A B D C
Speaker – RR

Fig. 4: Audio Amplifier to Speakers - UQ3, Sedan - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

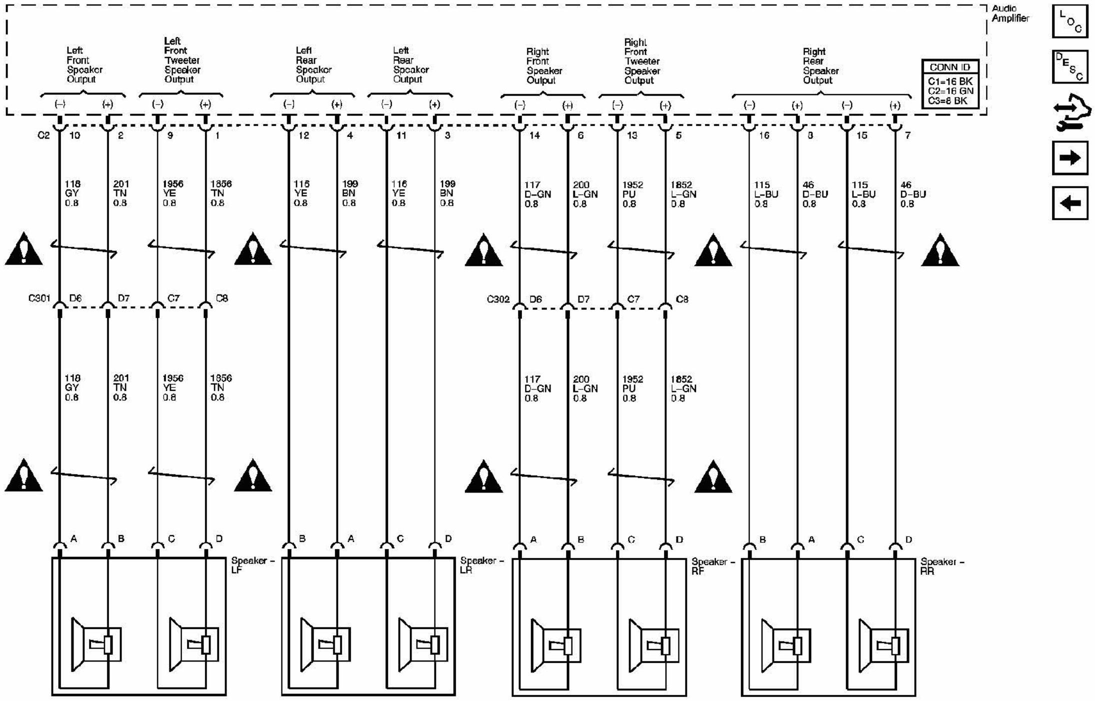

Left Front Speaker Output (–) (+)
Left Front Tweeter Speaker Output (–) (+)
Left Rear Speaker Output (–) (+)
Left Rear Speaker Output (–) (+)
Right Front Speaker Output (–) (+)
Right Front Tweeter Speaker Output (–) (+)
Right Rear Speaker Output (–) (+) (–) (+)
CONN ID
C1=16 BK
C2=16 GN
C3=8 BK
Audio Amplifier
C2 10 2 9 1 12 4 11 3 14 6 13 5 16 8 15 7
118 GY 0.8
201 TN 0.8
1956 YE 0.8
1856 TN 0.8
116 YE 0.8
199 BN 0.8
116 YE 0.8
199 BN 0.8
117 D-GN 0.8
200 L-GN 0.8
1952 PU 0.8
1852 L-GN 0.8
115 L-BU 0.8
46 D-BU 0.8
115 L-BU 0.8
46 D-BU 0.8
C301 D6 D7 C7 C8
C302 D6 D7 C7 C8
118 GY 0.8
201 TN 0.8
1956 YE 0.8
1856 TN 0.8
117 D-GN 0.8
200 L-GN 0.8
1952 PU 0.8
1852 L-GN 0.8
A B C D
Speaker – LF
B A C D
Speaker – LR
A B C D
Speaker – RF
B A C D
Speaker – RR

Fig. 5: Amplifier to Speakers - UQ3, Coupe - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

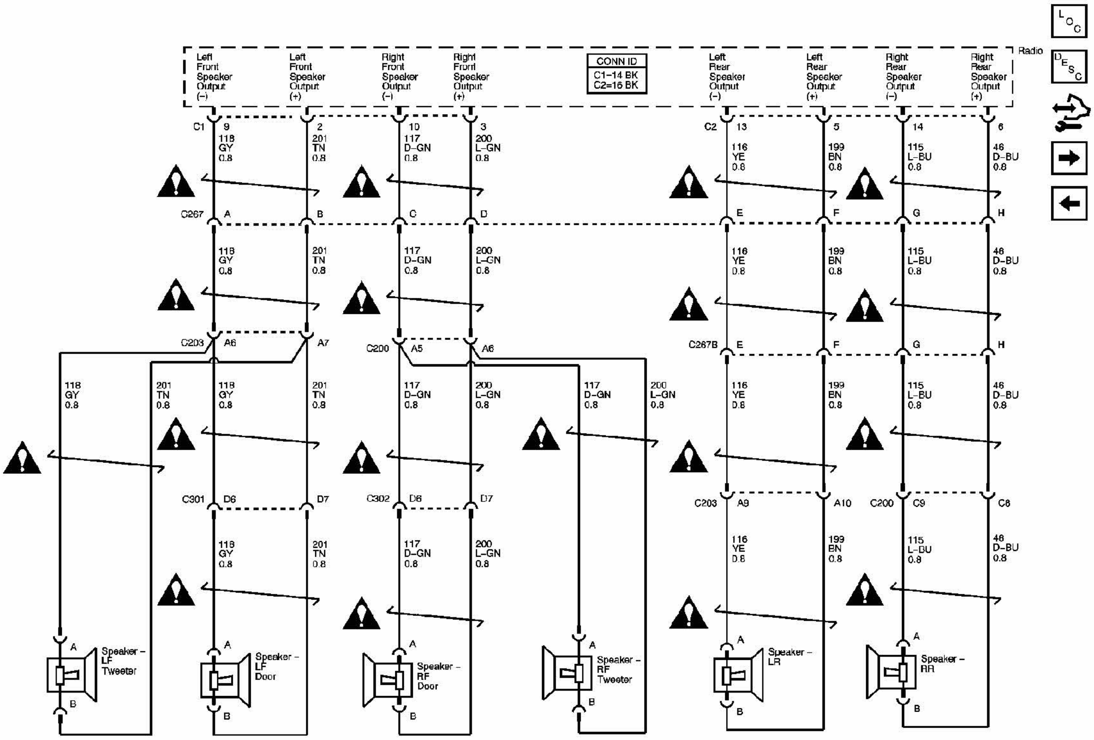

Radio
CONN ID
C1=14 BK
C2=16 BK
Left Front Speaker Output (–)
Left Front Speaker Output (+)
Right Front Speaker Output (–)
Right Front Speaker Output (+)
Left Rear Speaker Output (–)
Left Rear Speaker Output (+)
Right Rear Speaker Output (–)
Right Rear Speaker Output (+)
C1
C2
C267
C267B
C203
C200
C301
C302
118 GY 0.8
201 TN 0.8
117 D-GN 0.8
200 L-GN 0.8
116 YE 0.8
199 BN 0.8
115 L-BU 0.8
46 D-BU 0.8
Speaker – LF Tweeter
Speaker – LF Door
Speaker – RF Door
Speaker – RF Tweeter
Speaker – LR
Speaker – RR

Fig. 6: Radio to Speakers - 9C1, 9C3, w/o WX7 - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

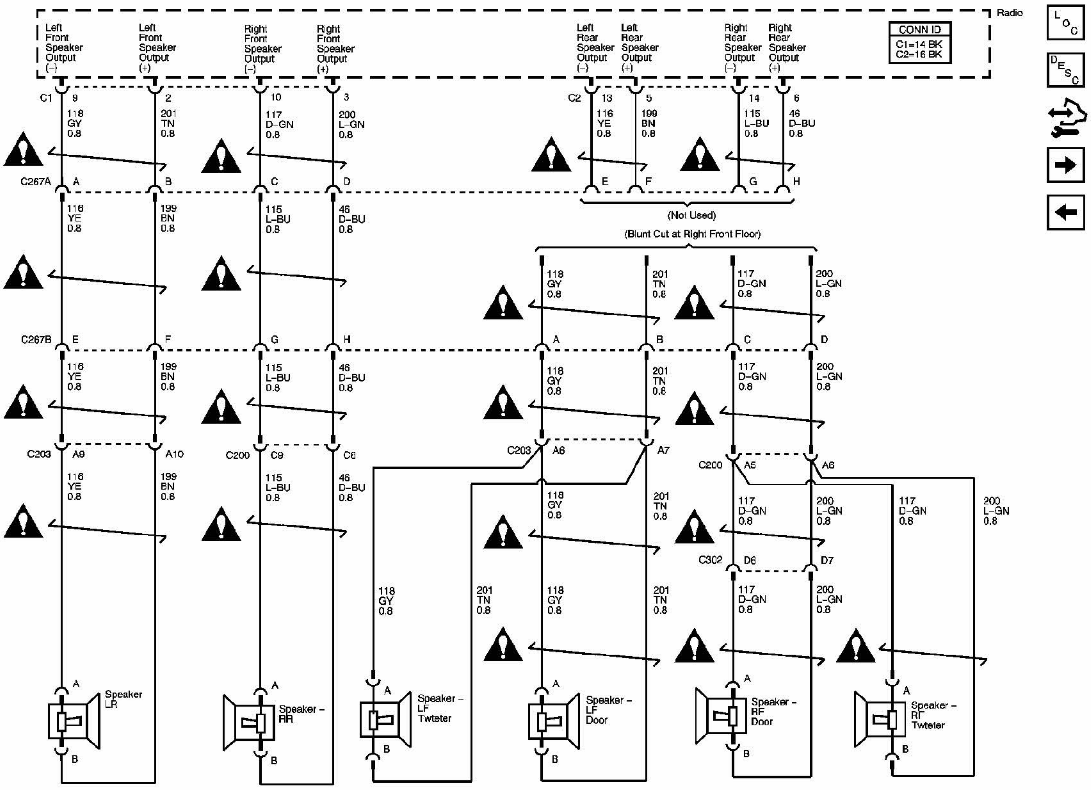

Radio
CONN ID
C1=14 BK
C2=16 BK
Left Front Speaker Output (–)
Left Front Speaker Output (+)
Right Front Speaker Output (–)
Right Front Speaker Output (+)
Left Rear Speaker Output (–)
Left Rear Speaker Output (+)
Right Rear Speaker Output (–)
Right Rear Speaker Output (+)
C1
C2
C267A
C267B
C203
C200
C302
(Not Used)
(Blunt Cut at Right Front Floor)
116 YE 0.8
199 BN 0.8
115 L-BU 0.8
46 D-BU 0.8
118 GY 0.8
201 TN 0.8
117 D-GN 0.8
200 L-GN 0.8
Speaker LR
Speaker – RR
Speaker – LF Tweeter
Speaker – LF Door
Speaker – RF Door
Speaker – RF Tweeter

Fig. 7: Radio to Speakers - 9C1, 9C3, and WX7 - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

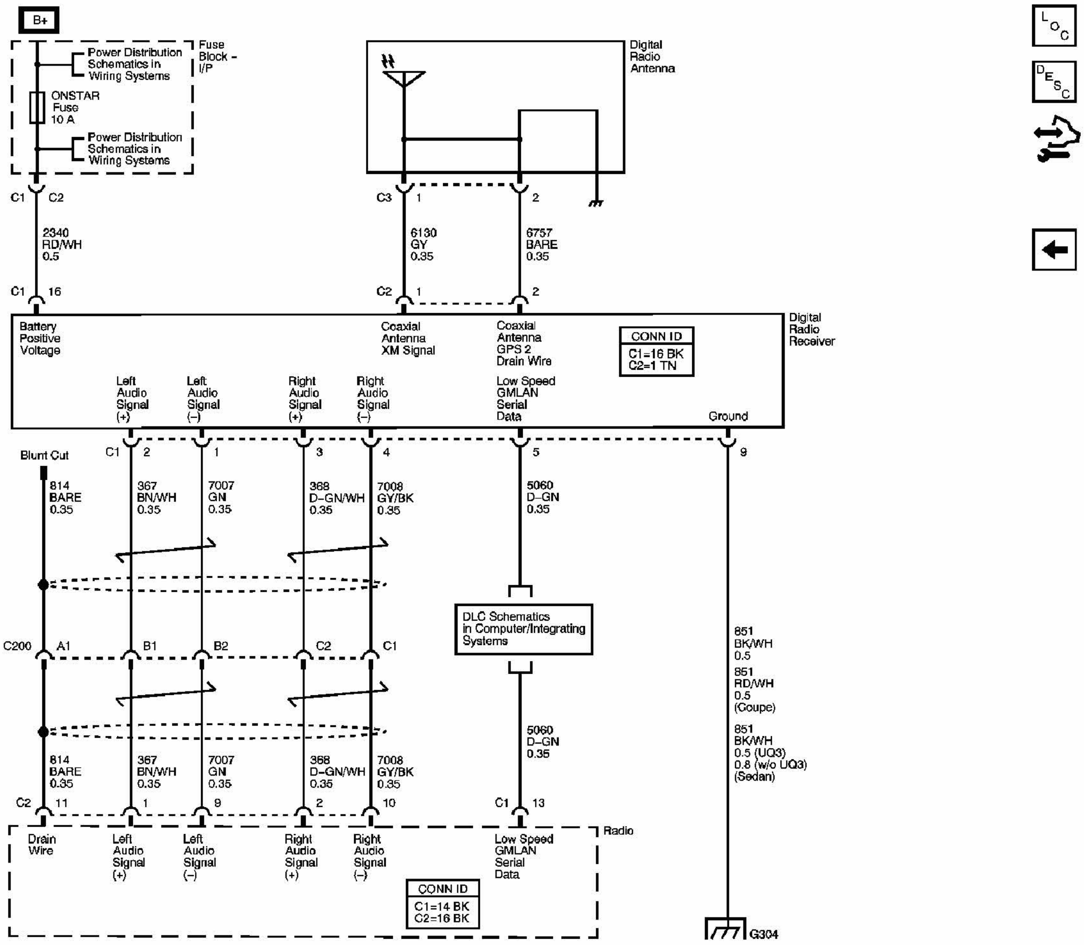

B+
Power Distribution Schematics in Wiring Systems
Fuse Block - I/P
ONSTAR Fuse 10 A
Power Distribution Schematics in Wiring Systems
C1 C2
2340 RD/WH 0.5
C1 16
Digital Radio Antenna
C3 1 2
6130 GY 0.35
6757 BARE 0.35
C2 1 2
Battery Positive Voltage
Coaxial Antenna XM Signal
Coaxial Antenna GPS 2 Drain Wire
CONN ID
C1=16 BK
C2=1 TN
Digital Radio Receiver
Left Audio Signal (+)
Left Audio Signal (–)
Right Audio Signal (+)
Right Audio Signal (–)
Low Speed GMLAN Serial Data
Ground
Blunt Cut
C1 2 1 3 4 5 9
814 BARE 0.35
367 BN/WH 0.35
7007 GN 0.35
368 D-GN/WH 0.35
7008 GY/BK 0.35
5060 D-GN 0.35
DLC Schematics in Computer/Integrating Systems
C200 A1 B1 B2 C2 C1
851 BK/WH 0.5
851 RD/WH 0.5 (Coupe)
851 BK/WH 0.5 (UQ3) 0.8 (w/o UQ3) (Sedan)
5060 D-GN 0.35
814 BARE 0.35
367 BN/WH 0.35
7007 GN 0.35
368 D-GN/WH 0.35
7008 GY/BK 0.35
C2 11 1 9 2 10
C1 13
Radio
Drain Wire
Left Audio Signal (+)
Left Audio Signal (–)
Right Audio Signal (+)
Right Audio Signal (–)
Low Speed GMLAN Serial Data
CONN ID
C1=14 BK
C2=16 BK
G304
LOC
DESC

Fig. 8: Satellite Radio - U2K - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

ENTERTAINMENT COMPONENT VIEWS

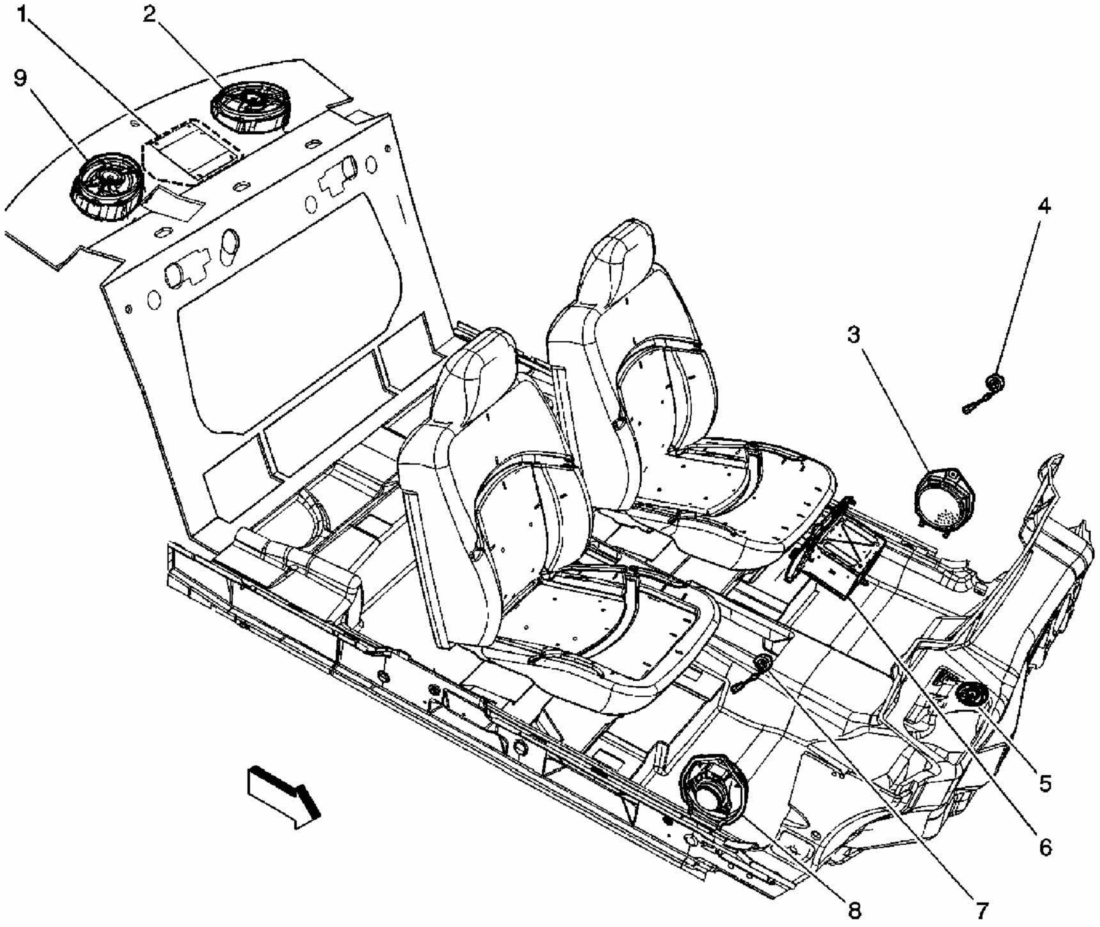


Fig. 9: Radio and Speaker Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 9

Callout	Component Name
1	Radio Amplifier (U88)
2	Speaker - LR
3	Speaker - LF Door
4	Speaker - LF Tweeter
5	Speaker - Center (U88)
6	Radio
7	Speaker - RF Tweeter
8	Speaker - RF Door
9	Speaker - RR

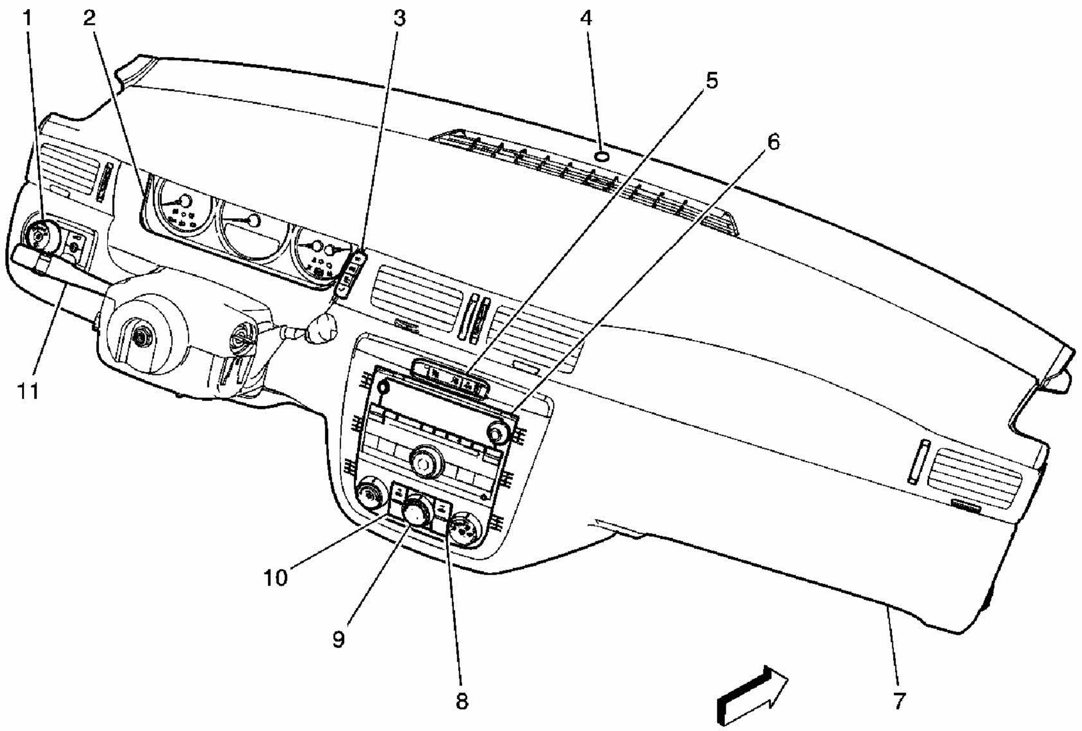


Fig. 10: I/P Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 10

Callout	Component Name
1	Headlamp Switch
2	Instrument Panel Cluster (IPC)
3	Driver Information Center (DIC) Switch
4	Ambient Light Sensor
5	Inflatable Restraint Passenger Air Bag On/Off Indicator (Sedan w/o 9C1, 9C3)
6	Radio
7	I/P Trim Panel
8	Heated Seat Switch-Passenger (KA7)
9	HVAC Control Module
10	Heated Seat Switch-Driver (KA7)
11	Turn Signal / Multifunction Switch

ENTERTAINMENT CONNECTOR END VIEWS

Audio Amplifier C1 (U87)

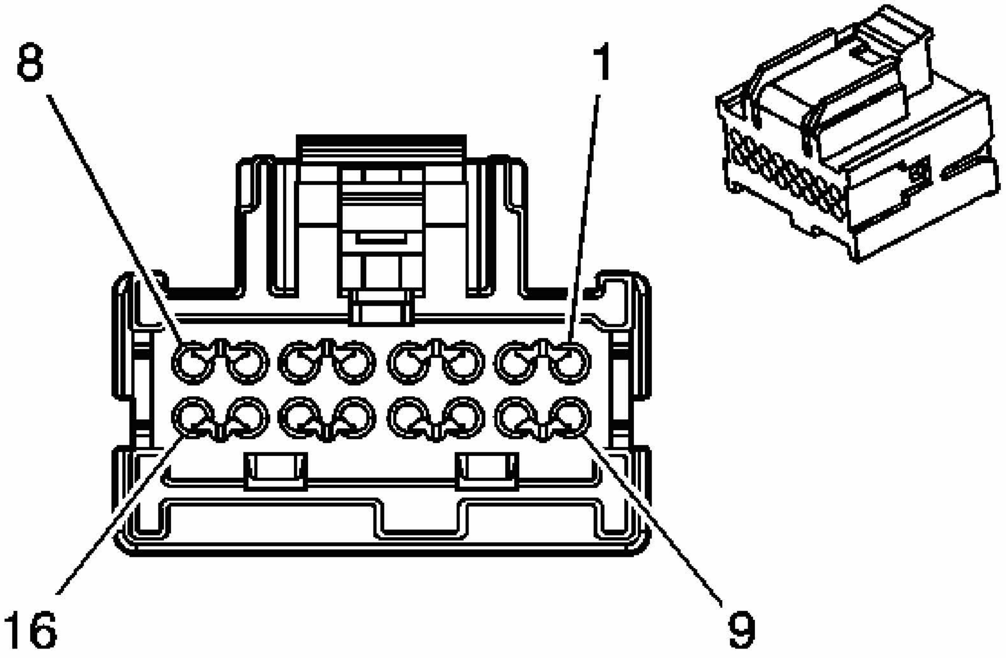


Fig. 11: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 15394150
- Service: See Catalog
- Description: 16-Way F Micro 64 Modular (BK)

Terminal Part Information

- Pins: 1, 2, 9, 10, 3, 4, 11, 12
- Terminal/Tray: 15359541/4
- Core/Insulation Crimp: Pins 1, 2, 9, 10 - See Terminal Repair Kit
- Core/Insulation Crimp: Pins 3, 4, 11, 12 - M/M
- Release Tool/Test Probe: 15381651-2/J-35616-64A (L-BU)

Audio Amplifier C1 (U87)

Pin	Wire Color	Circuit No.	Function
1	TN	201	Left Front Speaker Output (+)

2	L-GN	200	Right Front Speaker Output (+)
3	BN/WH	599	Left Rear Low Level Audio Signal (+)
4	D-BU	546	Right Rear Low Level Audio Signal (+)
5-8	-	-	Not Used
9	GY	118	Left Front Speaker Output (-)
10	D-GN	117	Right Front Speaker Output (-)
11	BN	1999	Left Rear Low Level Audio Signal (-)
12	TN	1946	Right Rear Low Level Audio Signal (-)
13-16	-	-	Not Used

Audio Amplifier C1 (UQ3)

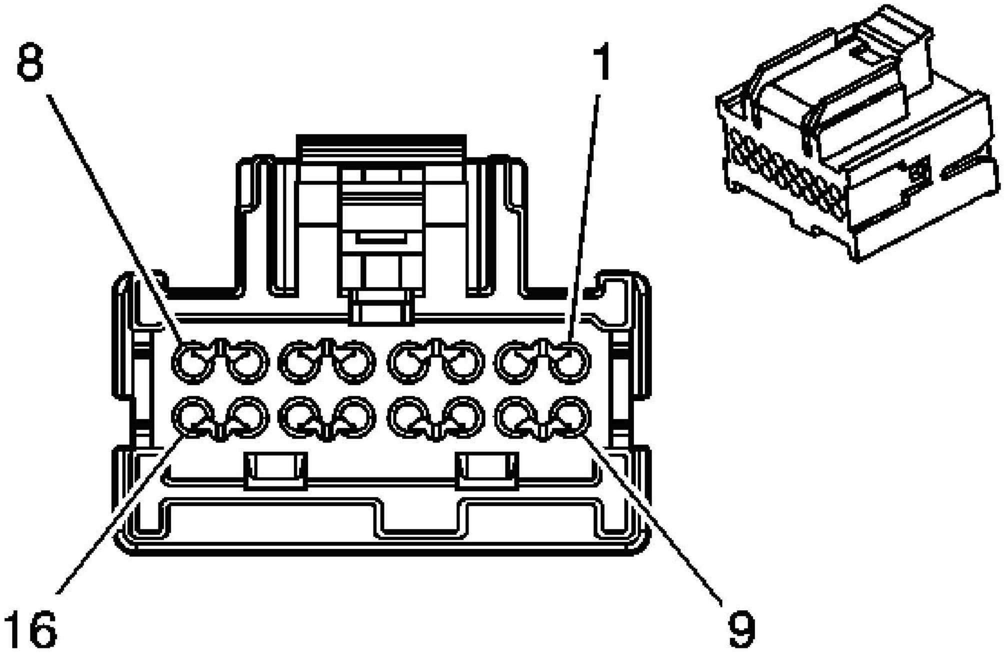


Fig. 12: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 15394150
- Service: See Catalog
- Description: 16-Way F Micro 64 Modular (BK)

Terminal Part Information

- Pins: 4, 5, 6, 7, 8, 11, 12, 13, 14, 15
- Terminal/Tray: 15359541/4
- Core/Insulation Crimp: M/M
- Release Tool/Test Probe: 15381651-2/J-35616-64A (L-BU)

Audio Amplifier C1 (UQ3)

Pin	Wire Color	Circuit No.	Function
1-3	-	-	Not Used
4	TN	1946	Right Rear Low Level Audio Signal (-)
5	BN	1999	Left Rear Low Level Audio Signal (-)
6	L-GN/BK	1948	Right Front Low Level Audio Signal (-)
7	D-GN	1947	Left Front Low Level Audio Signal (-)
8	PK	5165	TBD
9--10	-	-	Not Used
11	OG	5748	TBD
12	D-BU	546	Right Rear Low Level Audio Signal (+)
13	BN/WH	599	Left Rear Low Level Audio Signal (+)
14	L-GN	512	Right Front Low Level Audio Signal (+)
15	TN	511	Left Front Low Level Audio Signal (+)
16	-	-	Not Used

Audio Amplifier C2 (U87)

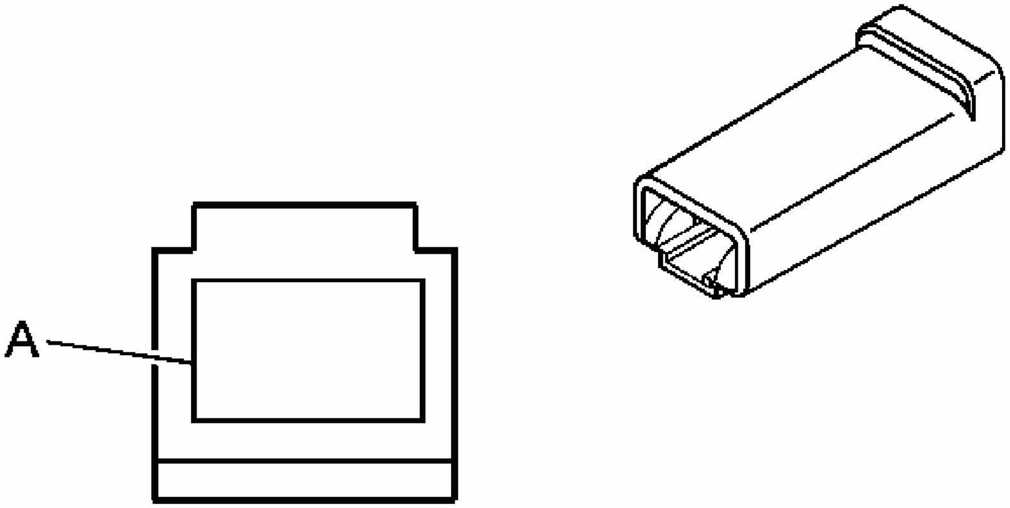


Fig. 13: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 10734461
- Service: See Catalog
- Description: 16-Way F 1.5 (GN)

Terminal Part Information

- Terminal/Tray: 33012-0002/26
- Core/Insulation Crimp: 2/C
- Release Tool/Test Probe: 12094429/J-35616-66 (YE)

Audio Amplifier C2 (U87)

Pin	Wire Color	Circuit No.	Function
1	TN	1856	Left Front Tweeter Speaker Output (+)
2	TN	201	Left Front Speaker Output (+)
3	BN	199	Left Rear Speaker Output (+)
4	BN	199	Left Rear Speaker Output (+)
5	L-GN	1852	Right Front Tweeter Speaker Output

			(+)
6	L-GN	200	Right Front Speaker Output (+)
7	D-BU	46	Right Rear Speaker Output (+)
8	D-BU	46	Right Rear Speaker Output (+)
9	YE	1956	Left Front Tweeter Speaker Output (-)
10	GY	118	Left Front Speaker Output (-)
11	YE	116	Left Rear Speaker Output (-)
12	YE	116	Left Rear Speaker Output (-)
13	PU	1952	Right Front Tweeter Speaker Output (-)
14	D-GN	117	Right Front Speaker Output (-)
15	L-BU	115	Right Rear Speaker Output (-)
16	L-BU	115	Right Rear Speaker Output (-)

Audio Amplifier C2 (UQ3)

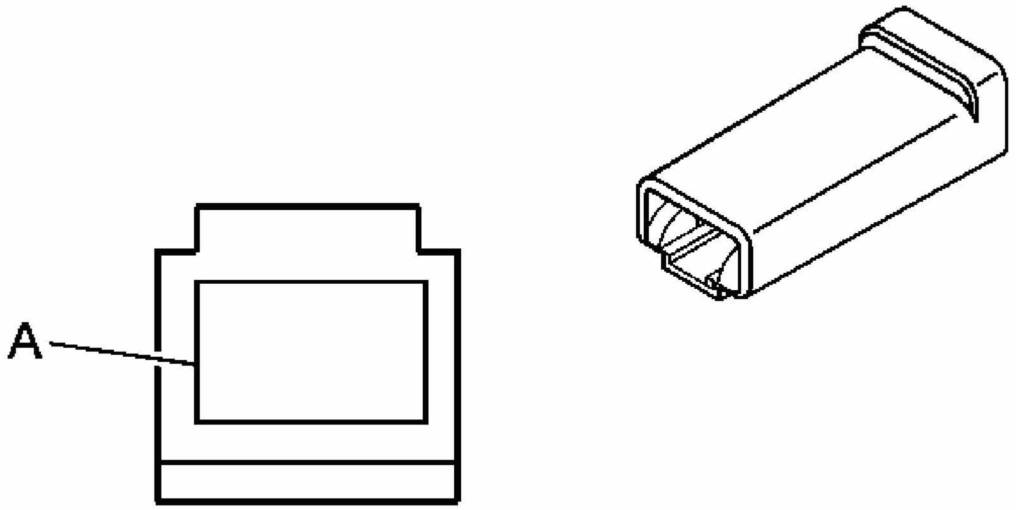


Fig. 14: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 10734461

- Service: See Catalog
- Description: 16-Way F 1.5 (GN)

Terminal Part Information

- Pins: 1, 2, 3, 4, 5, 6, 7, 8
- Terminal/Tray: 33012-0002/26
- Core/Insulation Crimp: 2/C
- Release Tool/Test Probe: 12094429/J-35616-66 (YE)

Audio Amplifier C2 (UQ3)

Pin	Wire Color	Circuit No.	Function
1	D-GN	117	Right Front Speaker Output (-)
2	L-GN	200	Right Front Speaker Output (+)
3	GY	118	Left Front Speaker Output (-)
4	TN	201	Left Front Speaker Output (+)
5	L-BU	115	Right Rear Speaker Output (-)
6	D-BU	46	Right Rear Speaker Output (+)
7	YE	116	Left Rear Speaker Output (-)
8	BN	199	Left Rear Speaker Output (+)
9-16	-	-	Not Used

Audio Amplifier C3 (U87)

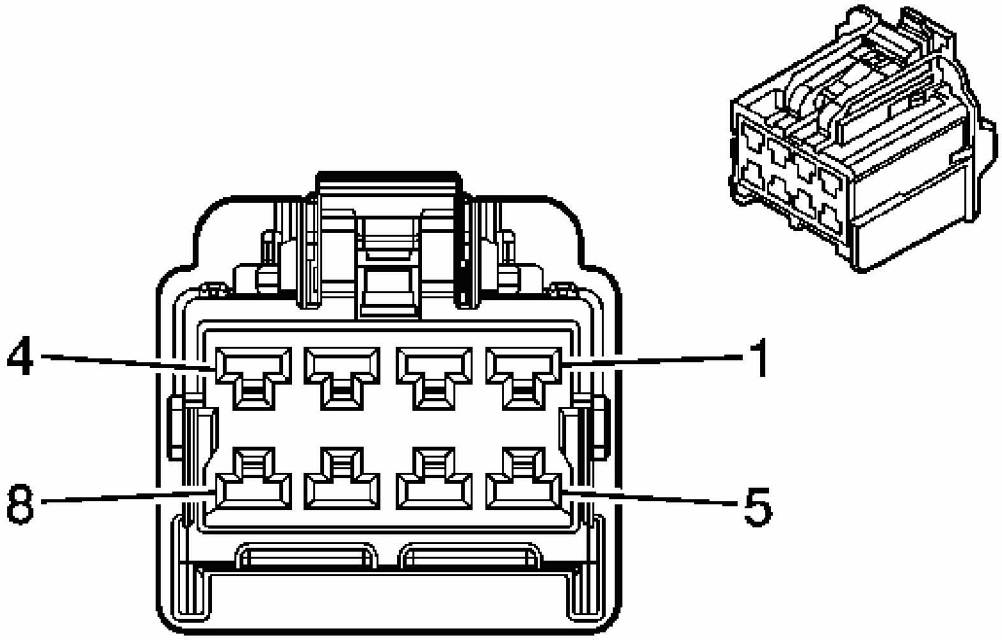


Fig. 15: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 15465056
- Service: See Catalog
- Description: 8-Way F GT 280 (BK)

Terminal Part Information

- Pins: 4
- Terminal/Tray: 15304713/19
- Core/Insulation Crimp: 4/4
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

- Pins: 3, 7, 8
- Terminal/Tray: 15304711/8
- Core/Insulation Crimp: Pins 3, 7 - See Terminal Repair Kit
- Core/Insulation Crimp: Pins 8 - 2/A

- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Audio Amplifier C3 (U87)

Pin	Wire Color	Circuit No.	Function
1-2	-	-	Not Used
3	PK	5165	TBD
4	RD/WH	640	Battery Positive Voltage
5-6	-	-	Not Used
7	OG	5748	TBD
8	BK/WH	351	Ground

Audio Amplifier C3 (UQ3)

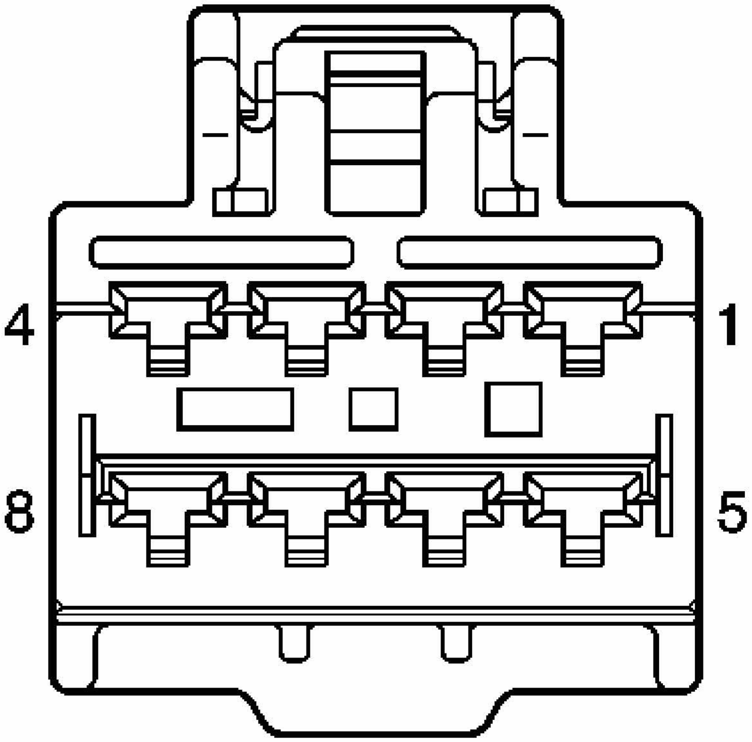


Fig. 16: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 15491286
- Service: See Catalog
- Description: 8-Way F Receptacle 2.8 (BK)

Terminal Part Information

- Pins: 2, 3, 6, 7
- Terminal/Tray: 8100-4444/22
- Core/Insulation Crimp: 2/A
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

- Pins: 4, 8
- Terminal/Tray: 8100-4445/22
- Core/Insulation Crimp: 4/4
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Audio Amplifier C3 (UQ3)

Pin	Wire Color	Circuit No.	Function
1	-	-	Not Used
2	L-BU/BK	315	Right Subwoofer Speaker Output (-)
3	L-GN/BK	1794	[Left or Rear] Subwoofer Speaker Output (-)
4	RD/WH	640	Battery Positive Voltage
5	-	-	Not Used
6	D-GN	1795	Right Subwoofer Speaker Output (+)
7	D-BU/WH	346	Left or Rear Subwoofer Speaker Output (+)
8	BK/WH	851	Ground

Digital Radio Receiver C1 (U2K)

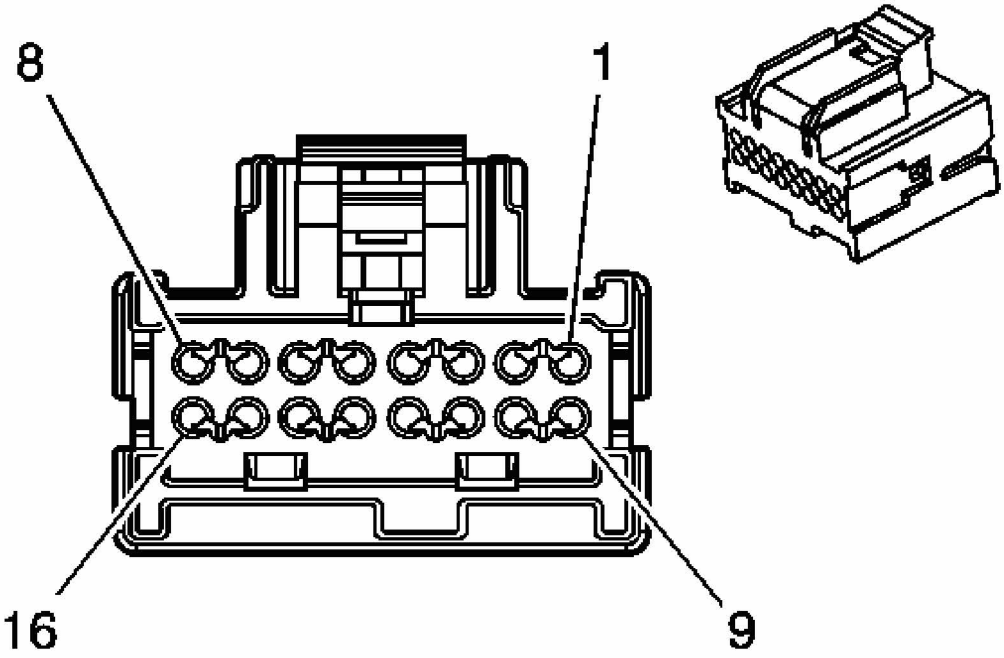


Fig. 17: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 15394150
- Service: See Catalog
- Description: 16-Way F Micro 64 Modular (BK)

Terminal Part Information

- Pins: 1, 2, 3, 4, 5, 9, 16, 9
- Terminal/Tray: 15359541/4
- Core/Insulation Crimp: M/M
- Release Tool/Test Probe: 15381651-2/J-35616-64A (L-BU)

Digital Radio Receiver C1 (U2K)

Pin	Wire Color	Circuit No.	Function
1	D-GN	7007	TBD
2	BN/WH	367	Remote Radio Left Audio Signal

3	D-GN/WH	368	Remote Radio Right Audio Signal
4	GY/BK	7008	TBD
5	D-GN	5060	Low Speed GMLAN Serial Data
6-8	-	-	Not Used
9	BK/WH	851	Ground
10-15	-	-	Not Used
16	RD/WH	2340	Battery Positive Voltage
9	BK/WH	351	Ground

Radio Antenna Module

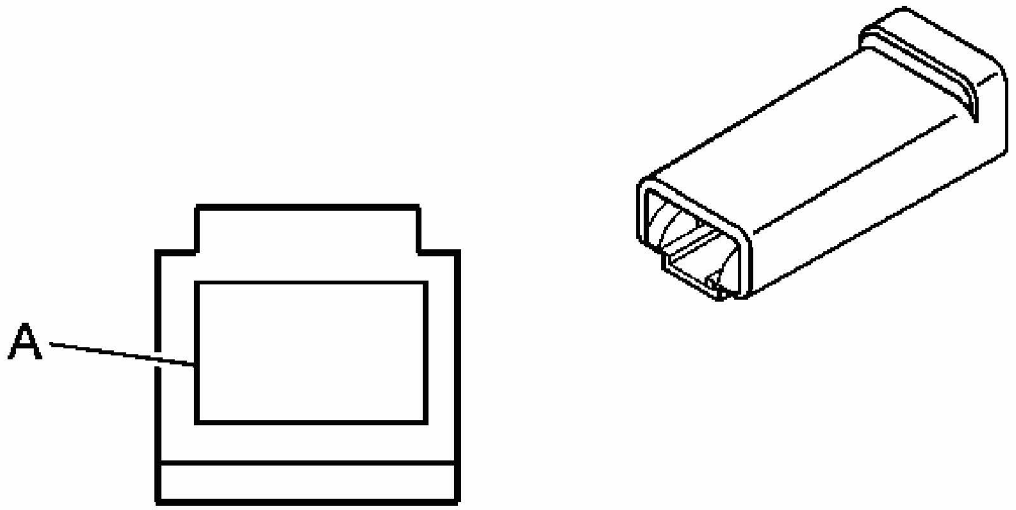


Fig. 18: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 15418109
- Service: Not Serviced
- Description: 1-Way F

Terminal Part Information

- Pins: 1
- Terminal/Tray: See Terminal Repair Kit

- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: See Terminal Repair Kit

- Pins: A, B
- Terminal/Tray: Not Serviced in Kit
- Core/Insulation Crimp: Not Serviced in Kit
- Release Tool/Test Probe: Not Serviced in Kit

Radio Antenna Module

Pin	Wire Color	Circuit No.	Function
1	PK	5165	TBD
A	PK	5165	TBD
B	BK/WH	1351	Ground

Radio C1

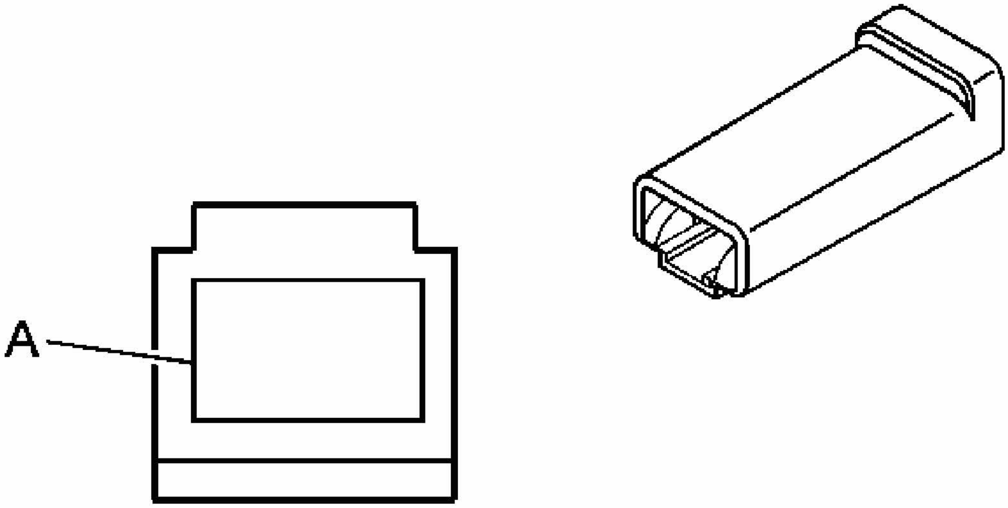


Fig. 19: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 15488568
- Service: See Catalog

- Description: 14-Way F GT 150 Micro 64 Modular

Terminal Part Information

- Pins: 1, 2, 3, 8, 9, 10, 6, 7, 13
- Terminal/Tray: 15359541/4
- Core/Insulation Crimp: Pins 1, 2, 3, 8, 9, 10 - See Terminal Repair Kit
- Core/Insulation Crimp: Pins 6, 7, 13 - M/M
- Release Tool/Test Probe: 15381651-2/J-35616-64A (L-BU)

Radio C1

Pin	Wire Color	Circuit No.	Function
1	RD/WH	2040	Battery Positive Voltage
2	TN	201	Left Front Speaker Output (+)
3	L-GN	200	Right Front Speaker Output (+)
4-5	-	-	Not Used
6	PK	5165	TBD
7	PU/WH	1382	LED Dimming Signal/LED Dimming Supply
8	BK/WH	351	Ground
9	GY	118	Left Front Speaker Output (-)
10	D-GN	117	Right Front Speaker Output (-)
11-12	-	-	Not Used
13	D-GN	5060	Low Speed GMLAN Serial Data
14	-	-	Not Used

Radio C1 (9C1/9C3)

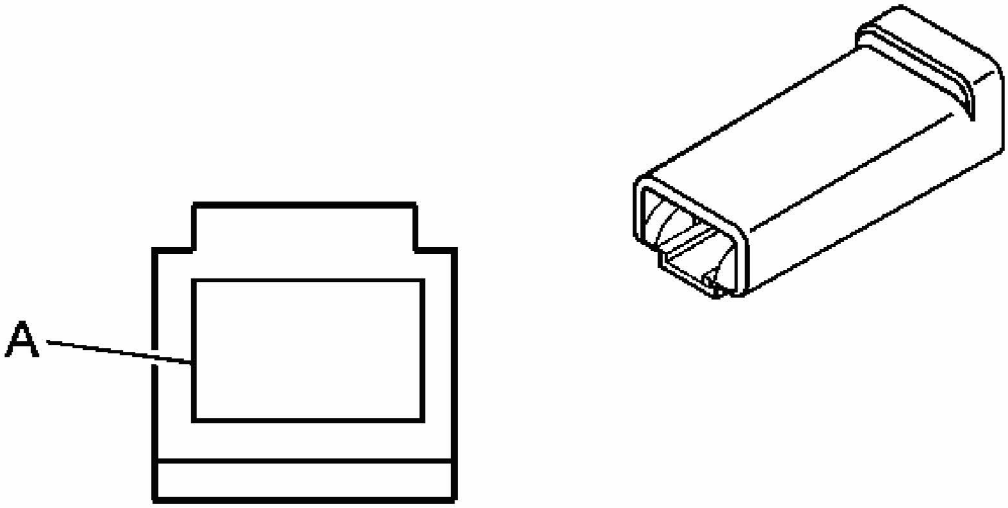


Fig. 20: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 15488568
- Service: See Catalog
- Description: 14-Way F GT 150 Micro 64 Modular

Terminal Part Information

- Pins: 1, 2, 3, 8, 9, 10, 6, 7, 13
- Terminal/Tray: 15359541/4
- Core/Insulation Crimp: Pins 1, 2, 3, 8, 9, 10 - See Terminal Repair Kit
- Core/Insulation Crimp: Pins 6, 7, 13 - M/M
- Release Tool/Test Probe: 15381651-2/J-35616-64A (L-BU)

Radio C1 (9C1/9C3)

Pin	Wire Color	Circuit No.	Function
1	RD/WH	2040	Battery Positive Voltage
2	TN	201	Left Front Speaker Output (+)
3	L-GN	200	Right Front Speaker Output (+)
4-5	-	-	Not Used

6	PK	5165	TBD
7	PU/WH	1382	LED Dimming Signal/LED Dimming Supply
8	BK/WH	351	Ground
9	GY	118	Left Front Speaker Output (-)
10	D-GN	117	Right Front Speaker Output (-)
11-12	-	-	Not Used
13	D-GN	5060	Low Speed GMLAN Serial Data
14	-	-	Not Used

Radio C2

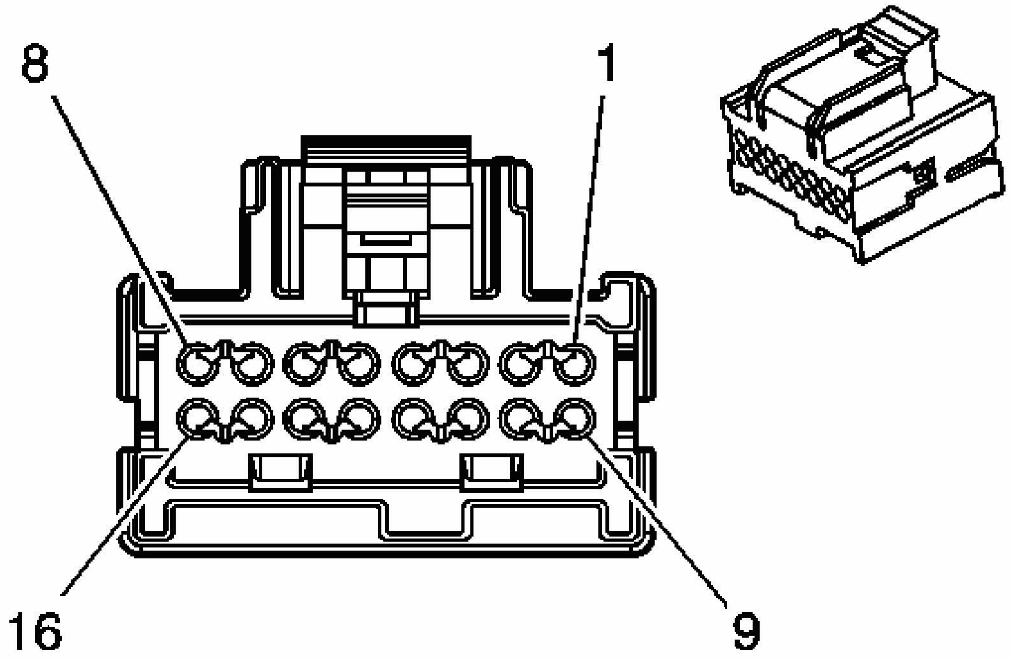


Fig. 21: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 15416970
- Service: See Catalog

- Description: 16-Way F Micro 64 Modular (BK)

Terminal Part Information

- Pins: 1, 2, 7, 8, 9, 10, 11, 15, 5, 6, 13, 14
- Terminal/Tray: 15359541/4
- Core/Insulation Crimp: Pins 1, 2, 7, 8, 9, 10, 11, 15 - M/M
- Core/Insulation Crimp: Pins 5, 6, 13, 14 - See Terminal Repair Kit
- Release Tool/Test Probe: 15381651-2/J-35616-64A (L-BU)

Radio C2

Pin	Wire Color	Circuit No.	Function
1	BN/WH	367	Remote Radio Left Audio Signal
2	D-GN/WH	368	Remote Radio Right Audio Signal
3-4	-	-	Not Used
5	BN	199	Left Rear Speaker Output (+)
6	D-BU	46	Right Rear Speaker Output (+)
7	OG/BK	1406	Remote Playback Device Left Audio Signal
8	OG	5748	TBD
9	L-GN	7007	TBD
10	GY/BK	7008	TBD
11	-	814	Drain Wire
12	-	-	Not Used
13	YE	116	Left Rear Speaker Output (-)
14	L-BU	115	Right Rear Speaker Output (-)
15	L-BU	1405	Remote Playback Device Audio Common Signal
16	-	-	Not Used

Radio C2 (9C1/9C3)

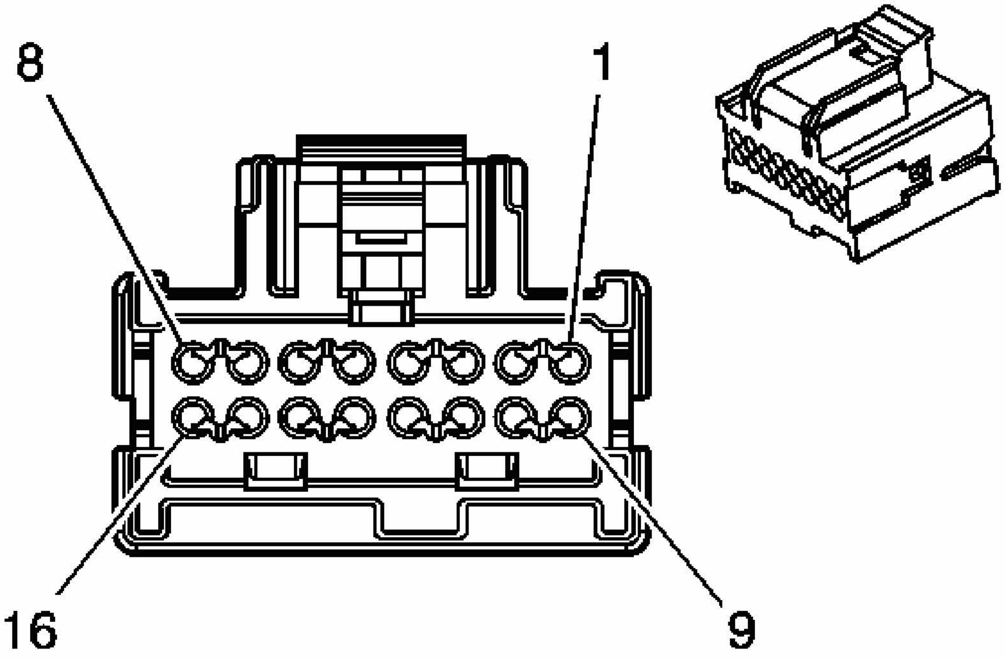


Fig. 22: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 15416970
- Service: See Catalog
- Description: 16-Way F Micro 64 Modular (BK)

Terminal Part Information

- Pins: 5, 6, 13, 14
- Terminal/Tray: 15359541/4
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: 15381651-2/J-35616-64A (L-BU)

Radio C2 (9C1/9C3)

Pin	Wire Color	Circuit No.	Function
1-4	-	-	Not Used
5	BN	199	Left Rear Speaker Output (+)

6	D-BU	46	Right Rear Speaker Output (+)
7-12	-	-	Not Used
13	YE	116	Left Rear Speaker Output (-)
14	L-BU	115	Right Rear Speaker Output (-)
15-16	-	-	Not Used

Speaker - LF Door

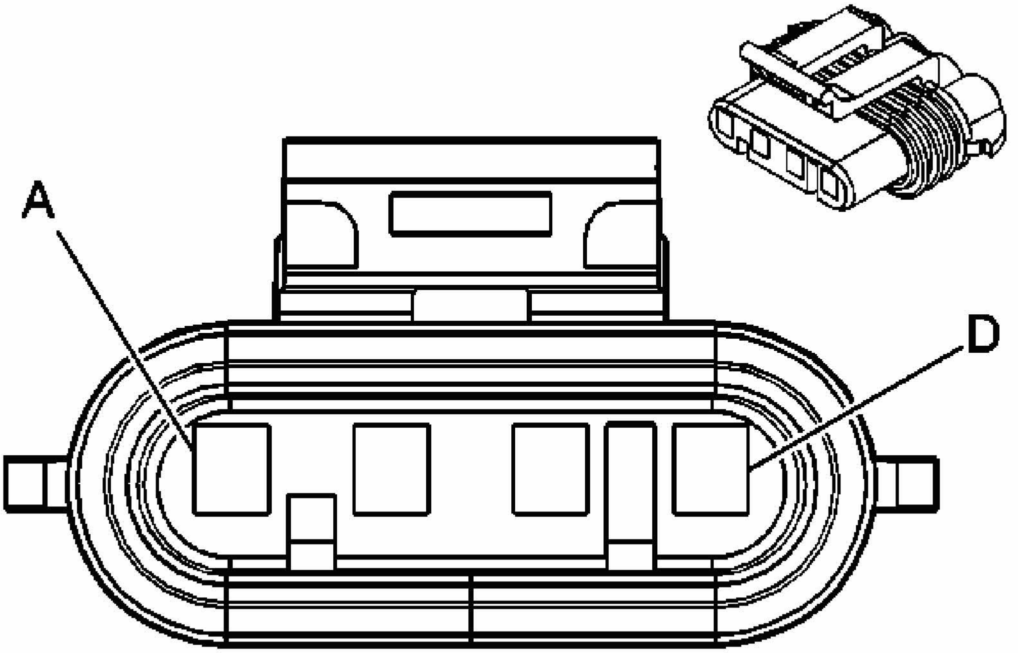


Fig. 23: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 12186568
- Service: See Catalog
- Description: 4-Way F Metri-Pack 150 Sealed (BK)

Terminal Part Information

- Terminal/Tray: 12048074/2
- Core/Insulation Crimp: E/1

- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Speaker - LF Door

Pin	Wire Color	Circuit No.	Function
A	GY	118	Left Front Speaker Output (-)
B	TN	201	Left Front Speaker Output (+)
C	YE	1956	Left Front Tweeter Speaker Output (-)
D	TN	1856	Left Front Tweeter Speaker Output (+)

Speaker - LF Door (UW6)

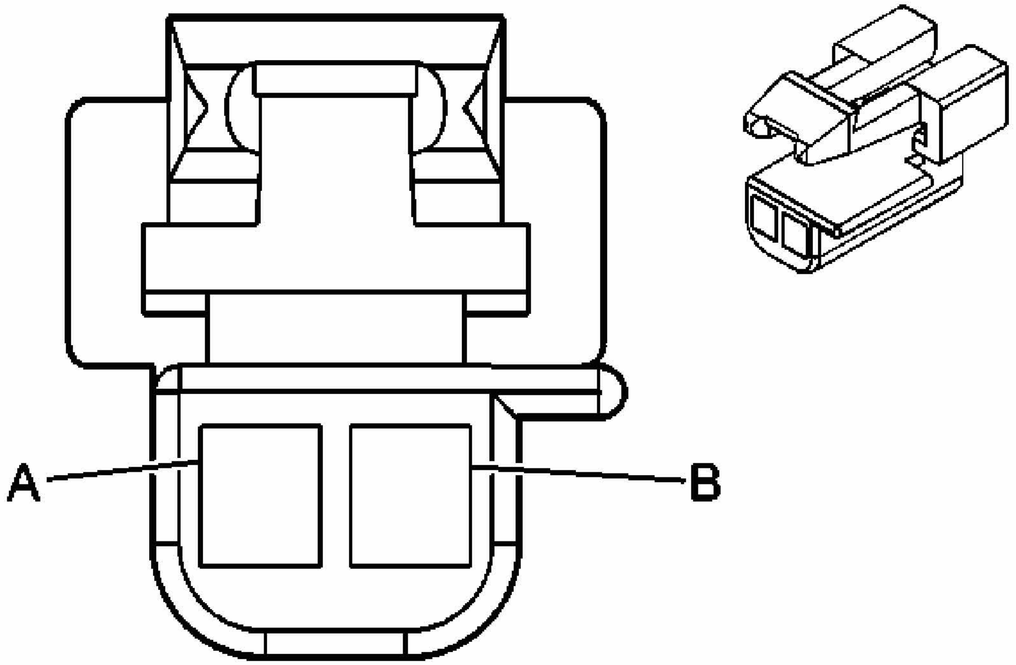


Fig. 24: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 12064867
- Service: 88987981

- Description: 2-Way F Metri-Pack 150 (NA)

Terminal Part Information

- Terminal/Tray: 12047767/2
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Speaker - LF Door (UW6)

Pin	Wire Color	Circuit No.	Function
A	GY	118	Left Front Speaker Output (-)
B	TN	201	Left Front Speaker Output (+)

Speaker - LF Tweeter

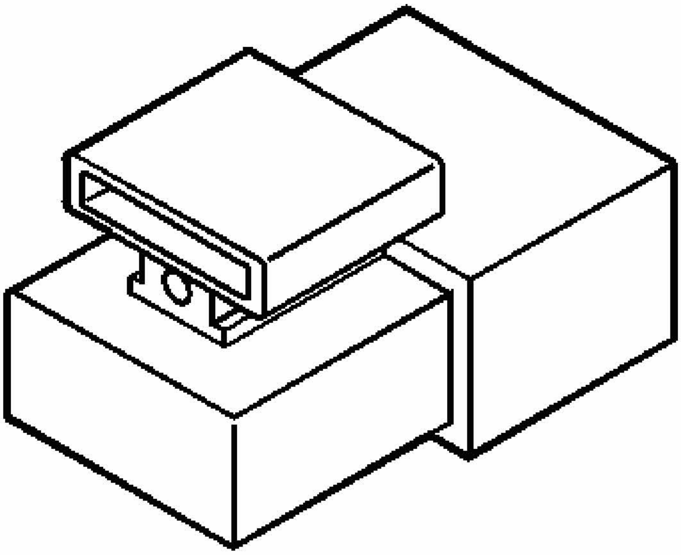


Fig. 25: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 15393225
- Service: 12117275

- Description: 2-Way M Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Speaker - LF Tweeter

Pin	Wire Color	Circuit No.	Function
A	YE	1956	Left Front Tweeter Speaker Output (-)
B	TN	1856	Left Front Tweeter Speaker Output (+)
A	GY	118	Left Front Speaker Output (-)
B	TN	201	Left Front Speaker Output (+)

Speaker - LR (U87)

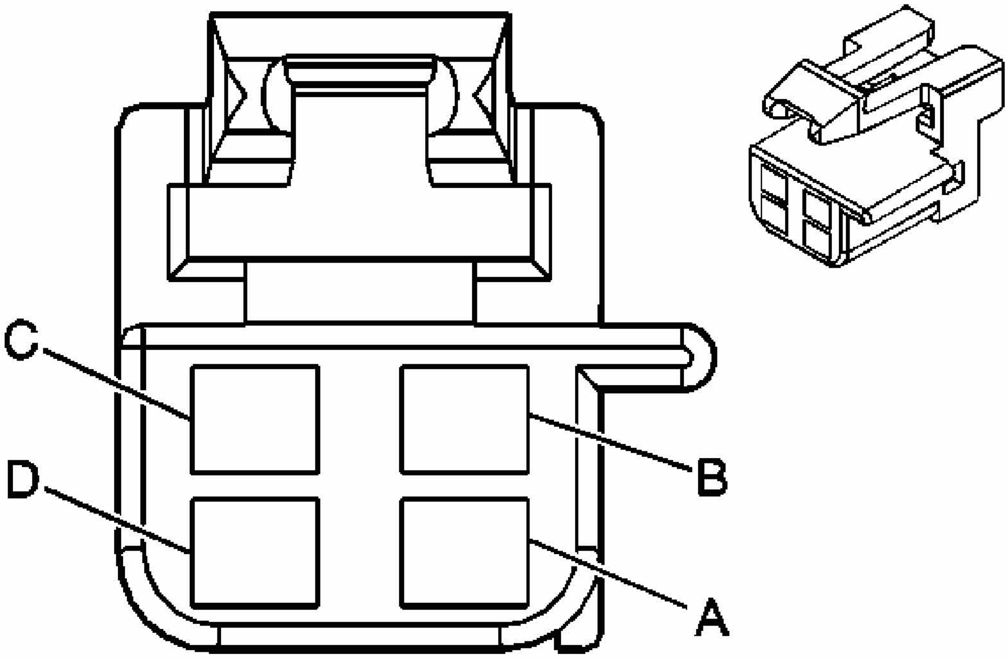


Fig. 26: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 12064760
- Service: 12085208
- Description: 4-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12047767/2
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Speaker - LR (U87)

Pin	Wire Color	Circuit No.	Function
A	YE	116	Left Rear Speaker Output (-)
B	BN	199	Left Rear Speaker Output (+)
C	YE	116	Left Rear Speaker Output (-)
D	BN	199	Left Rear Speaker Output (+)

Speaker - LR (UQ3)

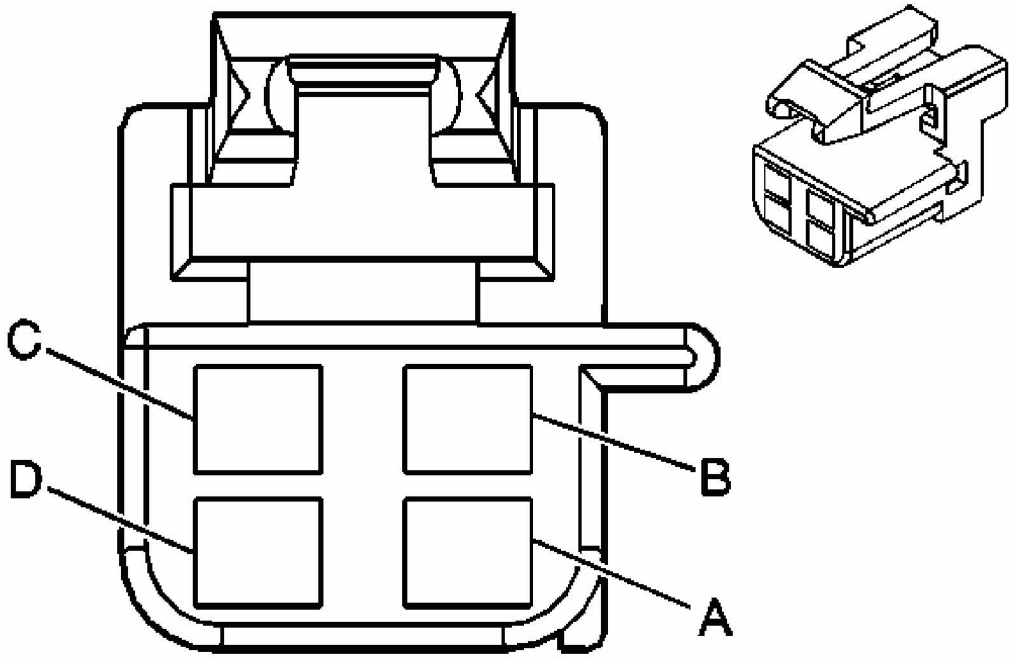


Fig. 27: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 12064760
- Service: 12085208
- Description: 4-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12047767/2
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Speaker - LR (UQ3)

Pin	Wire Color	Circuit No.	Function
A	YE	116	Left Rear Speaker Output (-)
B	BN	199	Left Rear Speaker Output (+)
C	D-BU/WH	346	Left or Rear Subwoofer Speaker Output (+)
D	L-GN/BK	1794	[Left or Rear] Subwoofer Speaker Output (-)

Speaker - LR (UW6)

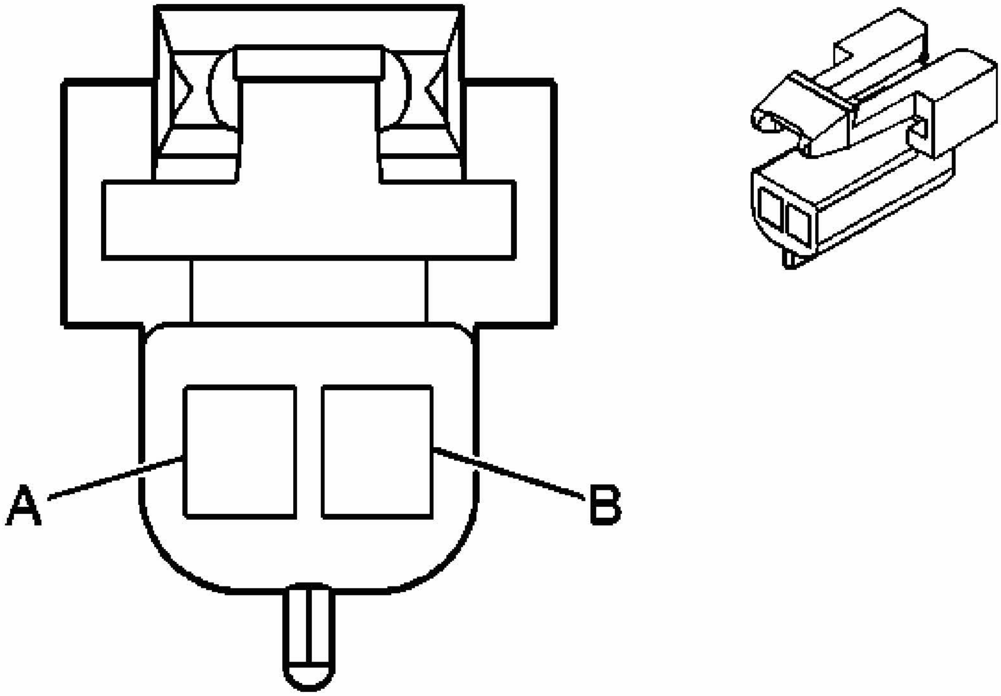


Fig. 28: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 12052832
- Service: 12101825
- Description: 2-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12047767/2
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Speaker - LR (UW6)

Pin	Wire Color	Circuit No.	Function
A	YE	116	Left Rear Speaker Output (-)
B	BN	199	Left Rear Speaker Output (+)

Speaker - RF Door

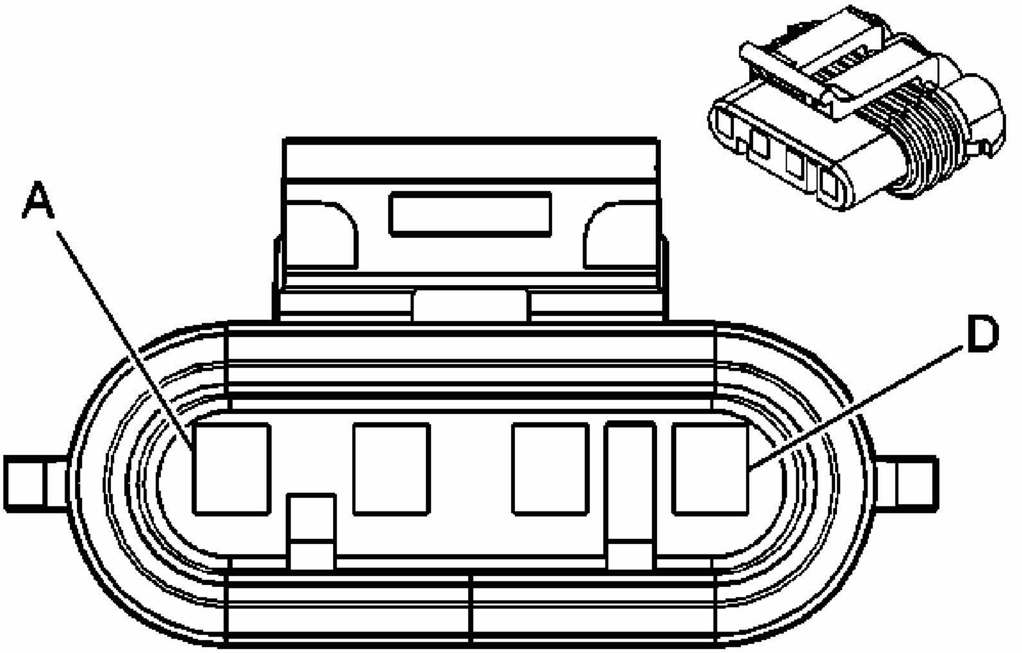


Fig. 29: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 12186568
- Service: See Catalog
- Description: 4-Way F Metri-Pack 150 Sealed (BK)

Terminal Part Information

- Terminal/Tray: 12048074/2
- Core/Insulation Crimp: E/1
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Speaker - RF Door

Pin	Wire Color	Circuit No.	Function
A	D-GN	117	Right Front Speaker Output (-)
B	L-GN	200	Right Front Speaker Output (+)

C	PU	1952	Right Front Tweeter Speaker Output (-)
D	L-GN	1852	Right Front Tweeter Speaker Output (+)

Speaker - RF Door (UW6)

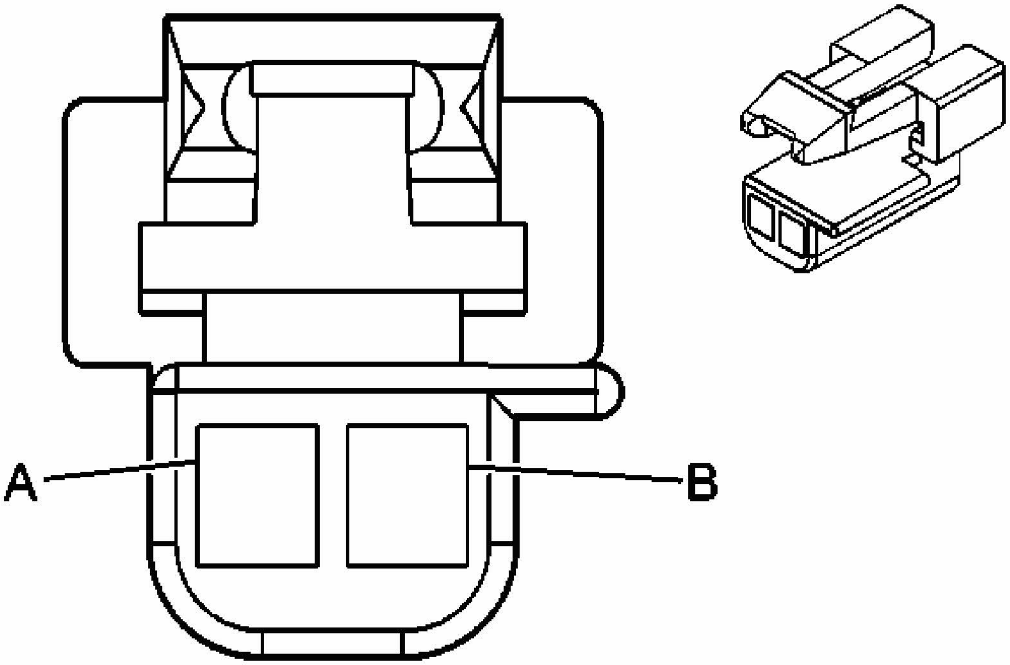


Fig. 30: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 12064867
- Service: 88987981
- Description: 2-Way F Metri-Pack 150 (NA)

Terminal Part Information

- Terminal/Tray: 12047767/2
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Speaker - RF Door (UW6)

Pin	Wire Color	Circuit No.	Function
A	D-GN	117	Right Front Speaker Output (-)
B	L-GN	200	Right Front Speaker Output (+)

Speaker - RF Tweeter

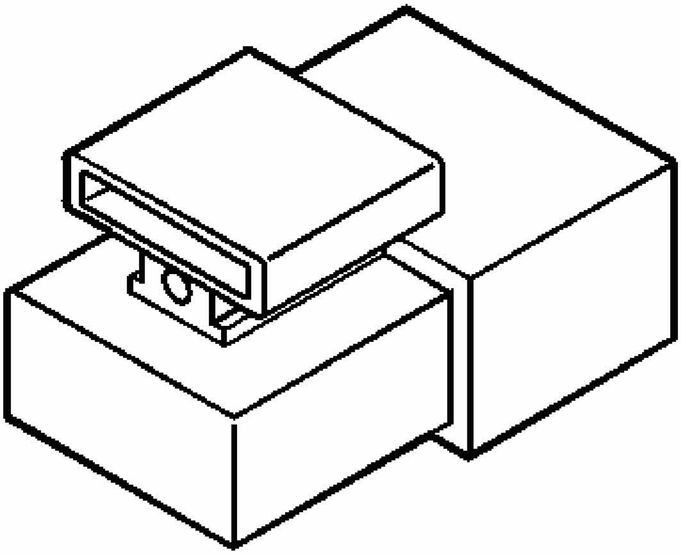


Fig. 31: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 15393225
- Service: 12117275
- Description: 2-Way M Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Speaker - RF Tweeter

Pin	Wire Color	Circuit No.	Function
A	PU	1952	Right Front Tweeter Speaker Output (-)
B	L-GN	1852	Right Front Tweeter Speaker Output (+)
A	D-GN	117	Right Front Speaker Output (-)
B	L-GN	200	Right Front Speaker Output (+)

Speaker - RR (U87)

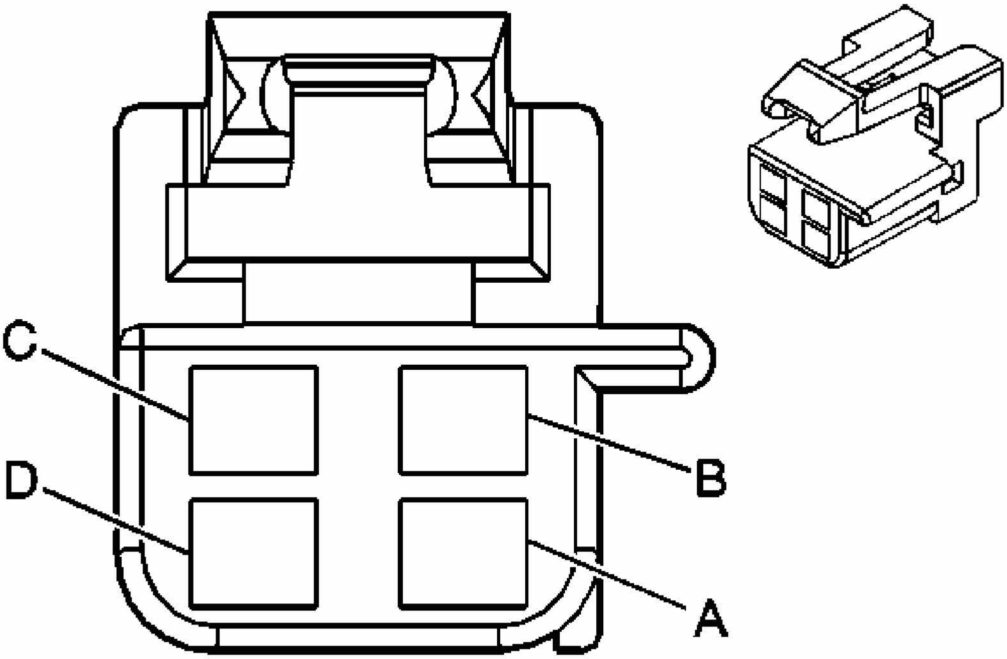


Fig. 32: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 12064760
- Service: 12085208
- Description: 4-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12047767/2
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Speaker - RR (U87)

Pin	Wire Color	Circuit No.	Function
A	L-BU	115	Right Rear Speaker Output (-)
B	D-BU	46	Right Rear Speaker Output (+)
C	L-BU	115	Right Rear Speaker Output (-)
D	D-BU	46	Right Rear Speaker Output (+)

Speaker - RR (UQ3)

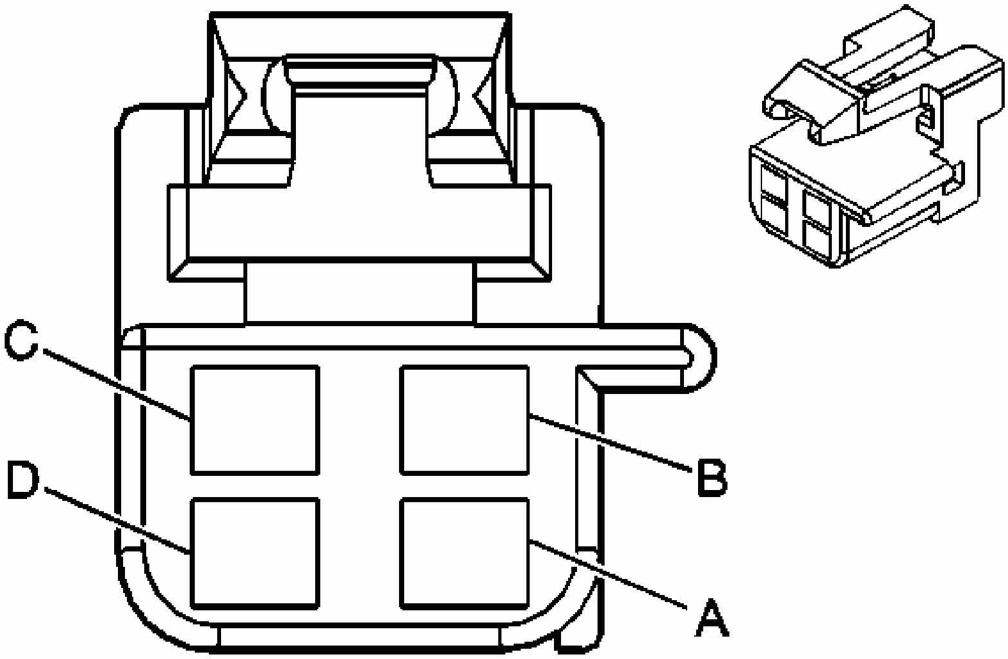


Fig. 33: Connector End View
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information

- OEM: 12064760

- Service: 12085208
- Description: 4-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12047767/2
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Speaker - RR (UQ3)

Pin	Wire Color	Circuit No.	Function
A	L-BU	115	Right Rear Speaker Output (-)
B	D-BU	46	Right Rear Speaker Output (+)
C	D-GN	1795	Right Subwoofer Speaker Output (+)
D	L-BU/BK	315	Right Subwoofer Speaker Output (-)

Speaker - RR (UW6)

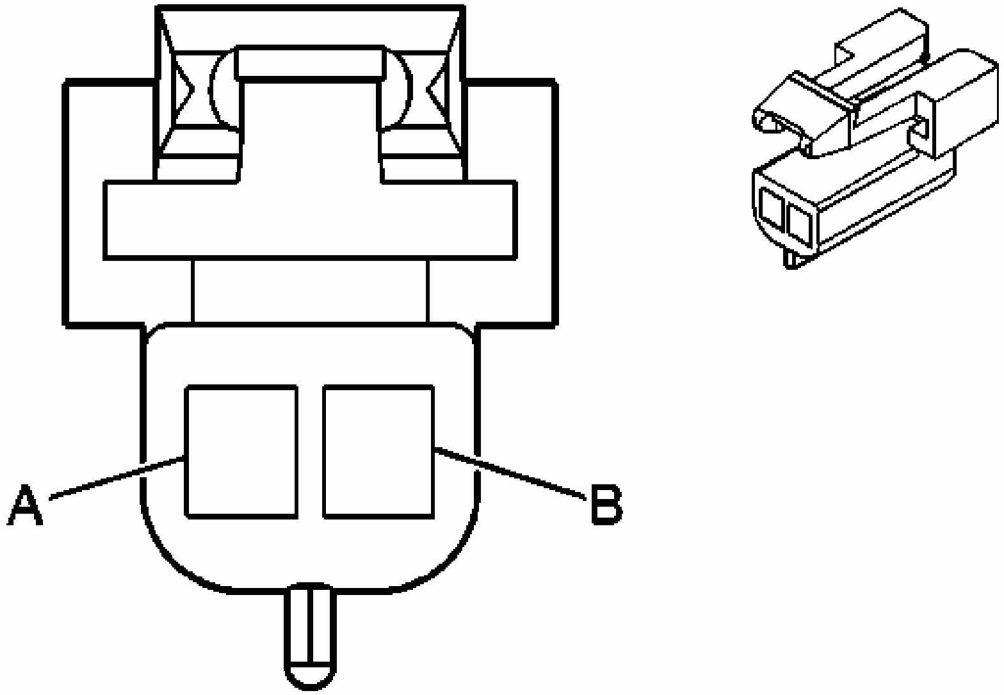


Fig. 34: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Entertainment Connector End Views

Connector Part Information - OEM: 12052832 - Service: 12101825 - Description: 2-Way F Metri-Pack 150 (BK) **Terminal Part Information** - Terminal/Tray: 12047767/2 - Core/Insulation Crimp: E/A - Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Speaker - RR (UW6)

Pin	Wire Color	Circuit No.	Function
A	L-BU	115	Right Rear Speaker Output (-)
B	D-BU	46	Right Rear Speaker Output (+)

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B1001	B1001 Option Configuration Error
DTC B1025, B1035, B1045, or B1055	MULTIPLE VALUES see link in column to the left
DTC B1259	Antenna Ground Circuit
DTC B1780	Theftlock Enabled

DIAGNOSTIC STARTING POINT - ENTERTAINMENT

Begin the system diagnosis with **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL OUTPUT CONTROLS

Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selections	Description
Left Front Speaker	Front Speakers	Commanding the speaker ON will turn OFF all speakers except this speaker. Commanding the speaker OFF will turn OFF all speakers.
Left Rear Speaker	Rear Speakers	Commanding the speaker ON will turn OFF all speakers except this speaker. Commanding the speaker OFF will turn OFF all speakers.
Right Front Speaker	Front Speakers	Commanding the speaker ON will turn OFF all speakers except this speaker. Commanding the speaker OFF will turn OFF all speakers.
Right Rear Speaker	Rear Speakers	Commanding the speaker ON will turn OFF all speakers except this speaker. Commanding the speaker OFF will turn OFF all speakers.

SCAN TOOL DATA LIST

Radio

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON/Engine OFF/Radio ON			
Antenna Module	Data	Enabled/Disabled	Enabled
Auxiliary Video Input	Data	Present/Not Present	Not Present
Battery Voltage Signal	Data	Volts	11.8 Volts
CD H/W Level	CD/DVD/MAP Information	Numeric	Varies
CD S/W Level	CD/DVD/MAP Information	Numeric	Varies
DVD H/W Part Number	CD/DVD/MAP Information	Numeric	Varies
DVD S/W Part Number	CD/DVD/MAP Information	Numeric	Varies
Navigation Software Version	CD/DVD/MAP Information	Numeric	Varies
Navigation Hardware Level	CD/DVD/MAP Information	Numeric	Varies
Component Serial No. 13 -	Module		

16	Information	Numeric	Varies
End Model Part Number	Module Information	Numeric	Varies
Base Model Part Number	Module Information	Numeric	Varies
DRR	Data	Present/Not Present	Present
Ign. Cycles Since Last DTC	Data	Numeric	Varies
Software Part Number	Module Information	Numeric	Varies
Year Module Built	Module Information	Numeric	Varies
Julian Date of Build	Module Information	Numeric	Varies
Phone Signal	Data	Present/Not Present	Present
Power Mode	Data	Off/Accessory/Run/Crank Request	Varies
Power Mode Config.	Data	Normal Mode/Bench Mode	Normal Mode
Signal Strength	Data	dBuV	19 dBuv
Video Display	Data	Present/Not Present	Not Present
Theft Armed	Data	Learned VIN/No VIN	Learned VIN
Theft Lock Status	Data	Active/Inactive	Inactive

Digital Radio Receiver

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON/Engine OFF/Radio ON			
Battery Voltage	Data	Volts	12.2 Volts
Digital Radio Antenna	Data	mV	1400 mV
Ignition Counter	Data	Numeric	98
Julian Date of Build	Module Information	Numeric	043
Power Mode	Data	Run/Crank/ Accessory/ RAP/Off Awake	Run
Year Module Built	Module Information	Numeric	varies

SCAN TOOL DATA DEFINITIONS

Base Model Part Number

Information used during SPS programming to identify a unique combination of ECU hardware and all non-reprogrammable software (e.g. Boot software).

Battery Voltage Signal

The scan tool displays 0-25.5 volts. The displayed value is calculated from a circuit connected to source voltage.

CD H/W Level

The scan tool displays a numeric value that represents the hardware level the internal CD Changer contains.

CD S/W Level

The scan tool displays a numeric value that represents the software level the internal CD Changer contains.

Component Serial No. 13-16

The scan tool displays a numeric value that represents the modules serial number.

Digital Radio Antenna

The scan tool displays millivolts. This parameter indicates the amount of current being used by the digital radio antenna by measuring the voltage drop across an internal resistor. Typical value is 1,200-1,800 mV.

DRR

The scan tool displays Present/Not Present. The scan tool displays Present when the digital radio receiver (DRR) is connected to the radio.

End Model Part Number

Part number used in service to uniquely identify the combination of hardware/software/calibrations programmed into the ECU at the time the part is ordered.

Julian Date of Build

The scan tool displays 0-999. This represents the day of year the module was manufactured.

Phone Signal

The scan tool displays Present/Not Present. The scan tool displays Present when a phone is connected.

Power Mode

The scan tool displays what power mode the module is in.

Power Mode Config

The diagnostic state the radio is in.

Radio Signal Strength

The scan tool displays 0-300. The signal from the antenna is measured in dBuV.

Theft Armed

The scan tool displays Learned VIN/No VIN. The scan tool displays Learned VIN indicating the radio received a valid VIN.

Theft Lock Status

The scan tool displays Active/Inactive. The scan tool displays Inactive, indicating the radio received the correct VIN and the Theft Lock Mode is not enabled.

DTC B1001

Circuit Description

The radio receives GMLAN messages, containing VIN digits 3 and 4, when the ignition cycles from OFF to ON and the radio is active. The specific VIN data is sent from another module on the GMLAN serial data circuit. The VIN data needs to match the calibration platform ID stored in the radio memory in order for the radio to operate normally.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B1001

Option Configuration Error

This vehicle has DTCs which include DTC Symptoms. For more information on DTC Symptoms, refer to **DTC Symptom Description** .

DTC B1001

DTC Symptom	DTC Symptom Descriptor
00	No Additional Information

Conditions for Running the DTC

The following conditions must be present in order for the radio to enable the diagnostics:

- The radio transitions from OFF to ON. This may be in response to the radio power switch or an ignition key cycle.
- The system voltage is at least 9 volts and no more than 16 volts.

Conditions for Setting the DTC

The radio detects the calibration platform ID does not match the VIN data sent to the radio with GMLAN messages.

Action Taken When the DTC Sets

The radio does not function properly. The radio displays "CALIBRATE".

Conditions for Clearing the DTC

- The conditions for setting the DTC are no longer present.
- A history DTC clears after 100 malfunction-free ignition cycles.
- The radio receives the clear code command from the scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: Clear all DTCs and cycle the ignition to verify that the DTC did not falsely set.

3: Clear all DTCs after the repair procedure is complete.

DTC B1001

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With the scan tool, perform the VIN		

2	relearn procedure. On the scan tool, go to Module Replacement/Setup and select Radio. 4. Turn OFF the ignition. 5. Turn ON the ignition, with the engine OFF. Does the DTC reset?	Go to **Step 3**	System OK
3	1. Replace the radio. Refer to **Radio Replacement** for service procedure. 2. Perform the VIN Relearn procedure with a scan tool. On the scan tool, go to Module Replacement/Setup and select Radio. Did you complete the replacement?	Go to **Step 4**	-
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

DTC B1025, B1035, B1045, OR B1055

Circuit Description

When the radio is powered up, the radio supplies low level audio signals to the speakers. If the vehicle is equipped with an audio amplifier, the amplifier will boost the signal sent to the speakers.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B1025

Audio Output Circuit

Conditions for Running the DTC

The test is performed when the radio switches from OFF to ON. The radio will continue to test for the fault once every 0.5 seconds.

Conditions for Setting the DTC

The radio sets a current status for this DTC when a short to ground or voltage is detected on any of the speaker channels for 1.5 seconds.

Action Taken When the DTC Sets

No sound is present from one or more of the speakers.

Conditions for Clearing the DTC

The fault condition is not present for 5 seconds.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

- **2:** This step verifies that the DTC is still present.
- **3:** This step isolates the fault condition.

DTC B1025

Step	Action	Yes	No
Schematic Reference: Radio/Audio System Schematics **Connector End View Reference: Entertainment Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With the scan tool, monitor the DTC Information for DTC B1025. Does the scan tool indicate that DTC B1025 is current?	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems
3	Test the speaker outputs from the radio for a short to ground or voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 6**	Go to **Step 4**
4	Inspect for poor connections at the harness connector of the radio. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 6**	Go to **Step 5**

5	Replace the Radio. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 6**	-
6	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

DTC B1259

Circuit Description

The digital radio antenna is connected to the digital radio receiver by 2 coax cables. One coax carries the satellite signal, the other coax carries the terrestrial signal. The antenna cable for the satellite antenna also provides a path for DC current for powering the antenna.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B1259

Antenna Ground Circuit

Conditions for Running the DTC

This test is run every 300 milliseconds.

Conditions for Setting the DTC

The digital radio receiver detects an antenna fault.

Action Taken When the DTC Sets

The radio displays "No XM Signal."

Conditions for Clearing the DTC

- The condition must be corrected.
- The DTC clears after 100 malfunction free ignition cycles.

Test Description

The number below refers to the step number on the diagnostic table.

2: Early design modules support the mV reading while later design modules support the mA reading.

3: Due to current limiting capabilities in the module, an antenna cable shorted to ground could still show 1200-1800 mV.

DTC B1259

Step	Action	Values	Yes	No
Schematic Reference: Radio/Audio System Schematics **Connector End Views Reference: Entertainment Connector End Views**				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	With a scan tool, observe the digital radio antenna in the digital radio receiver data list. Does the scan tool indicate that the digital radio antenna is within the specified range?	1200-1800 mV or 42-118 mA	Go to **Step 3**	Go to **Step 4**
3	Test the antenna cables for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 8**
4	1. Disconnect the antenna cables from the digital radio receiver. 2. Measure the voltage from the center conductor of the inboard antenna connector on the digital radio receiver to one of the case screws. Does the voltage measure within the specified range?	4.5-5.5 V	Go to **Step 5**	Go to **Step 6**
5	Test the antenna cables for an open or a high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 8**
6	Inspect for poor connections at the digital radio receiver. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 7**

7	Replace the digital radio receiver. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 10**	-
8	Inspect for poor connections at the digital radio antenna. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 9**
9	Replace the digital radio antenna. Refer to **Antenna Replacement - Cellular Communications/Digital Radio** . Did you complete the replacement?	-	Go to **Step 10**	-
10	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	-	Go to **Step 2**	System OK

DTC B1780

Circuit Description

Each time the ignition cycles from OFF to ON, the radio receives VIN data over the class 2 communication circuit. If the VIN data in the radio memory matches the VIN data the radio receives over the class 2 communication circuit, the radio will operate normally.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B1780

Theftlock Enabled

Conditions for Running the DTC

- The DTC is run when the radio is turned from OFF to ON.
- Battery voltage is between 9-16 volts.

Conditions for Setting the DTC

Installing a radio from another vehicle or installing a new body control module (BCM) and not entering the correct VIN information with the scan tool.

Action Taken When the DTC Sets

The radio does not function. The radio displays "LOC" or "LOCKED".

Conditions for Clearing the DTC

- When installing a radio from another vehicle of the same platform, clear the VIN data using the scan tool.
- Installing a new BCM setup properly with the correct VIN for that vehicle.

The DTC status will turn to history when the above criteria is met. The scan tool can now clear the history DTC, or the DTC will clear automatically after 100 consecutive fault free ignition cycles.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: After clearing the DTCs and theft information, the radio relearns the VIN upon cycling the ignition switch.

3: After completing the repair procedure, clear all DTCs.

DTC B1780

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Install a scan tool. 2. Use the scan tool to clear the DTCs. 3. Perform radio setup procedure. Refer to **Radio Setup**. Does the DTC Reset?	Go to **Step 3**	System OK
3	Replace the Radio. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	System OK	-

SYMPTOMS - ENTERTAINMENT

IMPORTANT:

1. **Perform the Diagnostic System Check - Vehicle before using the Symptom Tables in order to verify that all of the following conditions are true:**
    - **There are no DTCs set.**
    - **The control modules can communicate via the serial data link.**
2. **Review the system operation in order to familiarize yourself with the system functions. Refer to Radio/Audio System Description and Operation.**

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the Radio/Audio System. Refer to **Checking Aftermarket Accessories** .
- Inspect for easily accessible or visible system components for obvious damage or conditions which may cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Audio System Troubleshooting Hints**
- **Radio Poor Reception**
- **Digital Radio Poor or No Reception**
- **Audio Distortion - One or More Speakers**
- **Speakers Inoperative - One or More**

AUDIO SYSTEM TROUBLESHOOTING HINTS

Tools Required

J 39916-A CD and Cassette Diagnostic Audio Kit

Many conditions that affect radio operation may be corrected without removing the radio from the car. Verify the condition, and follow the diagnostic procedures in order to isolate and correct the condition. In order to properly diagnose any audio system problems, ensure that you have a fully charged battery.

Preliminary Inspections

IMPORTANT: When testing the audio system for poor reception or noise, the vehicle should be outside away from metal buildings and utility lines, with the hood and rear compartment closed.

- Inspect for any aftermarket equipment that may have been installed on the vehicle. If aftermarket equipment is found, disconnect the equipment and verify that the audio noise is still present.

  Verify that the antenna connector and the antenna coaxial cable are clean and tight.

- For reception concerns, first determine if the customer is within the listening area of the stations they are attempting to receive.
- Stations at the lower end of the FM band are more susceptible to audio noises than stations at the higher end.
- If the noise is only from one speaker, inspect for the following items before speaker replacement:
  - Isolate the noise using the **J 39916-A** .
  - Inspect the speaker connections in order to ensure they are clean and tight. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.
  - Inspect for a loose or incorrectly installed speaker or surrounding trim. Loose trim may cause a buzz or flutter which sounds like a malfunctioning speaker.
- Ignition noise on the FM band may be an indication of an ignition system problem.
- Verify that all vehicle grounds are clean, tight, and free of corrosion.
- Inspect the rear defogger grid lines for large breaks or dark spots.
- Inspect the connections at the radio antenna module, if equipped, in order to ensure that they are clean and tight.
- Compare the customers vehicle to another of similar model and audio system in order to determine if the condition is abnormal.

Identifying Concerns

1. In order to isolate the source of the noise/poor reception, identify the ignition switch position that the concern is most noticeable:
   1. Turn the ignition switch to the ACCESSORY position.
   2. Turn ON the radio.
   3. Seek up 88 to 108 FM then 550 to 1600 AM.
   4. Record the number of valid radio stations where the tuner stops.

    5. Repeat these steps with the ignition ON, and the engine OFF, then repeat the steps again with the engine running.
2. Return the ignition switch to the position that the concern was most noticeable.
3. Remove the fuses or circuit breakers, one at a time, until the noise has been eliminated.
4. Identify what systems or components are powered by the fuse.
5. Reinstall all fuses and circuit breakers.
6. Disconnect the components powered by the fuse, one at a time, until the concern has been eliminated.

Corrective Action

- Inspect the ground integrity of the component or system causing the noise.
- Malfunctioning and marginal components such as relays and solenoids may cause noise and/or poor reception.
- Always use a braided ground strap when applying additional grounds and keep the ground strap as short as possible.
- If the noise source is found to be coming from the vehicle harness:
    - Route the antenna cable separately from the wire harness that is emitting the noise.
    - Use aluminum or nickel tape in order to shield the antenna cable. Try variations of the following repairs:
        - Try adding only aluminum or nickel tape before adding a ground strap to the tape.
        - Wrap a ground strap 360 degrees around the tape, securing the other end of the strap to chassis ground.

IMPORTANT: When installing suppression devices, signal wires such as sensor and communication circuits should not be suppressed. Battery and ignition voltage circuits are the best choices for suppressing.

- Capacitors work best on switch pops and low frequency noise.
- Filters work best on high frequency whines and static.
- After adding any suppression device, inspect all of the vehicle systems, including those not related to the audio system, for proper operation and function.
- Whenever possible, make a test harness that includes filters or capacitors. Always inspect the effectiveness and operation before permanent installation.
- If an audible pop is caused due to operating a switch, perform the following repairs as necessary:
    - Add a capacitor across the contacts of the switch.

  - Add a capacitor from the battery positive voltage (B+) side of the switch to chassis ground.
  - Add a capacitor from the ground side of the switch to chassis ground.
- Use the following available noise suppression devices:
  - 220 micro farad (50V) capacitor GM P/N 1227895

    This works well for ignition system related noise.

  - 0.47 micro farad capacitor GM P/N 1227894

    This works well for switches and relays.

  - Feed through capacitor GM P/N 477371

    This works well for high current situations.

  - Filter package GM P/N 1224205

    This works well for low current situations.

  - Fuel pump suppressor GM P/N 25027405
  - 21 inch braided ground strap GM P/N 8910791
  - 19 inch braided ground strap GM P/N 6286800
  - 10.5 inch braided ground strap GM P/N 6287160
  - 8.5 inch braided ground strap GM P/N 12091511

Generator Whine Concerns

1. Inspect the ground terminal and cable for high resistance.
2. Inspect the generator and brackets for loose or coated mounting bolts.
3. Verify that the ground straps between the engine and the frame are clean and tight.
4. If the noise is still present, inspect the charging system for proper operation. Refer to **Diagnostic Starting Point - Engine Electrical** in Engine Electrical.
5. Install a filter GM P/N 1224205 in the battery voltage feed circuit to the radio.
6. If the noise is not eliminated, install the filter in each following variation:
   - Install the filter with the single wire side toward the radio and the ground wire attached to chassis ground.
   - Remove the ground to the filter.
   - Reverse the filter so that the 2-wire side is toward the radio with the ground wire attached to chassis ground.
   - Remove the ground from the filter.

7. If the filter GM P/N 1224205 causes a delay when turning the radio ON or OFF, or other problems, remove the filter and Install a 0.47 micro farad capacitor to chassis ground.
8. Before reassembling the vehicle, remove any unneeded filters.
9. Test the functionality of all the vehicle systems, including those not related to the audio system, for proper operation and function.

RADIO POOR RECEPTION

Schematic Reference: Radio/Audio System Schematics

Antenna System Test

The length of the antenna coax cable lead-in and antenna body determines the total system ground measurement.

IMPORTANT: Always zero out the DMM before taking a resistance measurement in order to ensure an accurate reading.

1. Disconnect the antenna lead-in connector from the radio receiver.
2. Measure the resistance from the negative battery post to the coax outer conductor connector.
3. The resistance measured should be as follows:
   - Cable less than 5 ft-No more than 0.035 ohms
   - Cable 5-13 ft-No more than 0.060 ohms
   - Cable 13-20 ft-No more than 0.085 ohms
4. Test the following when the resistance is greater than specified:
   - Base of the antenna for a poor connection to body ground.
   - The coaxial cable interconnects for a poor connection or corrosion.
   - Test for an open or high resistance from the battery negative cable to the body. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.
   - Do not use black (phosphate-coated) hardware for antenna mounting purposes. This type of fastener is unreliable in making good connections.
5. After finding and correcting the condition, operate the system in order to verify the repair.

Perform the Antenna Checking Procedures after confirming the integrity of the antenna ground.

Antenna Checking Procedures

Perform the following tests for the type of antenna on the vehicle.

Using a Test Antenna

Use a test mast antenna to check for poor vehicle antenna operation. Unplug antenna lead-in connector from radio receiver and plug the test antenna into radio. Make sure the test antenna base is grounded to the vehicle chassis and keep hands off the mast. Check radio reception in an area away from electrical interferences. Tune to several weak and strong AM and FM stations. If the radio reception improved, the problem exists with the vehicle antenna and/or lead-in cable. If the reception is still poor, refer to **Audio System Troubleshooting Hints**.

Antenna Coaxial Cable Testing

Disconnect the antenna coax cable connector from the radio receiver and perform the following measurements.

IMPORTANT: Always zero out the DMM before taking a resistance measurement in order to ensure an accurate reading.

1. Measure the resistance from the coax cable center conductor to center conductor or antenna mast.
2. Total resistance from end to end of center conductor:
    - RG-58/RG-59 type cable-Less than 0.20 ohms
    - RG-62/RG-62M type cable-Less than 3.5 ohms
3. When checking the resistance, cautiously wiggle the lead-in tip and cable. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.
4. Measure the resistance from the cable center conductor to metal case. Reading should be infinite.
5. Replace the antenna and/or lead-in cable when the above readings are not obtained.

Radio Antenna Module System

IMPORTANT: The following information lists the most probable cause of the concern to the least probable cause followed by the appropriate test for that condition. If the test leads to the replacement of a component, always inspect for a poor connection before proceeding with the replacement. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.

This antenna system consists of an antenna module and a grid separate from the heated grid element.

Perform the Antenna System Test and test the antenna coax cable prior to performing the following tests:

- The radio antenna module is not grounded properly. The module grounding screws should be clean and tight. Measure the resistance from the antenna module base plate to a good ground. Resistance should be 0.020 ohms or less. Find and correct the condition if the resistance is out of specification.
- The antenna module supply voltage circuit to the radio antenna module is open or shorted to ground. Test the antenna module supply voltage circuit for an open or short to ground. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems.
- No antenna module supply voltage output from the radio. Disconnect the radio antenna module connector. Turn ON the radio and measure the voltage from the antenna module supply voltage circuit of the radio to a good ground. Voltage measured should be near 12 volts. If no voltage is measured, replace the radio. Refer to **Radio Replacement** for service procedure. Perform the VIN Relearn procedure after replacing the radio. On the scan tool, go to Module Replacement/Setup in Vehicle Control Systems and select Radio.
- Defective radio antenna module. Replace the radio antenna module.
- After finding and correcting the condition, operate the system in order to verify the repair.

DIGITAL RADIO POOR OR NO RECEPTION

Digital Radio Poor or No Reception

Step	Action	Values	Yes	No
Schematic Reference: Radio/Audio System Schematics **Connector End View Reference: Entertainment Connector End Views**				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Make sure the vehicle is outside in an area with an unobstructed view of the southern sky. 2. Turn ON the ignition, with the engine OFF. 3. Turn ON the radio. 4. Tune the radio to satellite channel 1. Is the reception clear?	-	Go to **Step 3**	Go to **Step 5**

3	Tune the radio to several other satellite channels. Is the reception clear?	-	Go to **Audio System Troubleshooting Hints**	Go to **Step 4**
4	Contact XM at 1-800-556-3600 to verify customer account status or possible network problems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 10**
5	Contact XM at 1-800-556-3600 to verify possible network problems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 6**
6	With a scan tool, observe the digital radio antenna in the digital radio receiver data list. Does the scan tool indicate that the digital radio antenna is within the specified range?	1200-1800 mV or 42-118 mA	Go to **Step 10**	Go to **Step 7**
7	1. Disconnect the antenna cables from the digital radio receiver. 2. Measure the voltage from the center conductor of the inboard antenna connector on the digital radio receiver to one of the case screws. Does the voltage measure within the specified range?	4.5-5.5 V	Go to **Step 8**	Go to **Step 10**
8	Test the antenna cables for an open, short, or high resistance. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. Did you find the condition?	-	Go to **Step 9**	Go to **Step 11**
9	Replace the antenna cable. Refer to **Coaxial Cable Replacement - Digital Radio**. Did you complete the replacement?	-	Go to **Step 14**	-
	Inspect for poor connections at the digital radio receiver. Refer to **Testing for Intermittent**			

10	**Conditions and Poor Connections** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 12**
11	Inspect for poor connections at the digital radio antenna. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 13**
12	Replace the digital radio receiver. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 14**	-
13	Replace the digital radio antenna. Refer to **Antenna Replacement - Digital Radio**. Did you complete the replacement?	-	Go to **Step 14**	-
14	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 2**

AUDIO DISTORTION - ONE OR MORE SPEAKERS

Audio Distortion - One or More Speakers

Step	Action	Yes	No
Schematic Reference : Radio/Audio System Schematics **Connector End View Reference: Entertainment Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Play the radio or CD player. Can audio distortion be heard from any speakers?	Go to **Step 3**	Go to **Audio System Troubleshooting Hints**
3	Can audio distortion be heard from all speakers?	Go to **Step 4**	Go to **Step 6**
4	Is the vehicle equipped with an audio		

	amplifier?	Go to **Step 5**	Go to **Step 8**
5	Test the appropriate speaker outputs from the radio to the audio amplifier for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 12**	Go to **Step 6**
6	Test the battery positive voltage circuit to the audio amplifier for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 12**	Go to **Step 7**
7	Test the audio amplifier ground circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 12**	Go to **Step 8**
8	Test the appropriate speaker outputs from the radio for a short to ground or a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 12**	Go to **Step 9**
9	Inspect for poor connections at the harness connector of the speaker. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 12**	Go to **Step 10**
10	Replace the speaker. Refer to **Speaker Replacement - Rear (UW6)** or **Speaker Replacement - Rear (UQ3)** or **Speaker Replacement - Front Door**. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 11**
11	Replace the radio. Refer to **Control Module References** for replacement, setup, and programming. Did you find and correct the condition?	Go to **Step 12**	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

REDUCED VOLUME - ONE OR MORE SPEAKERS

Schematic Reference: Radio/Audio System Schematics

Connector End View Reference: Entertainment Connector End Views

Speakers - Reduced Volume

IMPORTANT: The following information lists the most probable cause of the concern to the least probable cause. If the list leads to the replacement of a component, always inspect for a poor connection before proceeding with replacement. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs .

With RPO UW6

1. Speaker output circuit high resistance-Test the appropriate speaker output circuits for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** .
2. Defective speaker-Replace the appropriate speaker. Refer to **Speaker Replacement Reference**.

With RPO UQ3

1. Speaker output circuit high resistance-Test the appropriate speaker output circuits from the audio amplifier for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** .
2. Defective speaker-Replace the appropriate speaker. Refer to **Speaker Replacement Reference**.

IMPORTANT: The following procedure assumes all speakers are operative for all modes of operation except digital radio.

With RPO U2K or U2L

1. Audio common circuit open-Test the audio common circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** .
2. Audio left or right circuit open-Audio common circuit open. Test the audio common circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** .

SPEAKERS INOPERATIVE - ONE OR MORE

Schematic Reference: Radio/Audio System Schematics

Connector End View Reference: Entertainment Connector End Views

One Speaker Inoperative

IMPORTANT: The following information lists the most probable cause of the concern to the least probable cause. If the list leads to the replacement of a component, always inspect for a poor

connection before proceeding with replacement. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs .

With RPO UW6

1. Speaker output open-Test the appropriate speaker output circuits for an open. Refer to **Circuit Testing** and **Wiring Repairs** .
2. No audio output from the radio-Test for any AC voltage between the appropriate speaker output circuits at the speaker harness connector, disconnected with the radio volume adjusted to 50 percent. If AC voltage is present, replace the speaker. Refer to **Speaker Replacement Reference**. If no AC voltage is present, replace the radio. Refer to **Control Module References** for replacement, setup, and programming.

With RPO UQ3

1. Speaker output circuit from amplifier open-Test the appropriate speaker output circuits for an open. Refer to **Circuit Testing** and **Wiring Repairs** .
2. No audio output from the amplifier-Test for any AC voltage between the appropriate speaker output circuits at the speaker harness connector, disconnected with the radio volume adjusted to 50 percent. If AC voltage is present, replace the speaker. Refer to **Speaker Replacement Reference**. If no AC voltage is present, replace the amplifier. Refer to **Control Module References** for replacement, setup, and programming.

Speakers - One Channel Inoperative

IMPORTANT: The following information lists the most probable cause of the concern to the least probable cause. If the list leads to the replacement of a component, always inspect for a poor connection before proceeding with replacement. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs .

With RPO UQ3

1. Speaker output circuit from amplifier shorted-Test the appropriate speaker output circuits for a short. Refer to **Circuit Testing** and **Wiring Repairs** .
2. No audio output from the amplifier-Test for any AC voltage between the appropriate speaker output circuits at the speaker harness connector, disconnected with the radio volume adjusted to 50 percent. If AC voltage is present, replace the speaker. Refer to **Speaker Replacement Reference**. If no AC voltage is present, replace the amplifier. Refer to **Control Module References** for replacement, setup, and programming.

IMPORTANT: The following procedure assumes all speakers are operative for all modes of operation except digital radio.

With RPO U2K or U2L

1. Remote radio audio signal circuit open-Test the appropriate remote radio audio signal circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** .
2. No audio output from the digital radio receiver-Replace the digital radio receiver. Refer to **Control Module References** for replacement, setup, and programming.
3. No digital radio audio output from the radio-Replace the radio. Refer to **Control Module References** for replacement, setup, and programming.

SPEAKERS INOPERATIVE - ALL

Schematic Reference: Radio/Audio System Schematics

Connector End View Reference: Entertainment Connector End Views

All Speakers Inoperative

IMPORTANT: The following information lists the most probable cause of the concern to the least probable cause followed by the appropriate test for that condition. If the list leads to the replacement of a component, always inspect for a poor connection before proceeding with the replacement. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs .

With RPO UW6

1. Speaker output shorted-Test all speaker outputs for a short. Refer to **Circuit Testing** and **Wiring Repairs** .
2. Defective radio-Replace the radio. Refer to **Control Module References** for replacement, setup, and programming.

With RPO UQ3

1. Battery positive voltage circuit to the amplifier open-Test the battery positive voltage circuit to the amplifier for an open. Refer to **Circuit Testing** and **Wiring Repairs** .
2. Ground circuit to the amplifier open-Test the ground circuit to the amplifier for an open. Refer to **Circuit Testing** and **Wiring Repairs** .
3. Antenna enable signal circuit to the amplifier open or shorted to ground-Test the antenna enable signal circuit for an open or short to ground. Refer to **Circuit Testing** and **Wiring Repairs** .

4. No audio output from the amplifier-Replace the amplifier. Refer to **Control Module References** for replacement, setup, and programming.

IMPORTANT: The following procedure assumes all speakers are operative for all modes of operation except digital radio.

With RPO U2K or U2L

1. Remote radio audio signal circuit shorted-Test the remote radio audio signal circuits for a short. Refer to **Circuit Testing** and **Wiring Repairs** .
2. No audio output from the digital radio receiver-Refer to **Control Module References** for replacement, setup, and programming.
3. No digital radio audio output from the radio-Replace the radio. Refer to **Control Module References** for replacement, setup, and programming.

RADIO SETUP

Radio setup completed using Service Programming System (SPS).

DIGITAL RADIO RECEIVER SETUP

IMPORTANT: The digital radio receiver setup option does not contain a submenu. Digital radio receiver setup will configure the following systems:

- **DTCs**
- **GMLAN and class 2 radio messages**

To setup the digital radio receiver, complete the setup procedure under the Special Functions menu of the scan tool, then cycle ignition.

XM Activation

IMPORTANT: After replacement of an XM receiver, call XM radio to deactivate the receiver that has been removed from the vehicle and activate the new XM radio receiver. The vehicle must be parked in view of a satellite within 24 hours after an activation call.

1. Turn the radio ON, tune to the XM channel 0, and record the radio ID. The radio ID will be needed for activation of the new receiver.
2. Call XM radio at 1-800-556-3600 to deactivate the faulty receiver and activate the new receiver.
3. Park the vehicle outside in an area with an unobstructed view of the southern sky.

4. Leave the vehicle outside with the ignition switch in the ACC position and the radio on for 30 minutes to activate XM service.
5. Once activated, the radio will receive the remaining XM channels.

SPEAKER REPLACEMENT REFERENCE

Speaker Replacement Reference

Component	Repair Instruction
Front Door Speaker	Refer to **Speaker Replacement - Front Door**
Rear Speaker	Refer to **Speaker Replacement - Rear (UW6)** or **Speaker Replacement - Rear (UQ3)**

REPAIR INSTRUCTIONS

RADIO REPLACEMENT

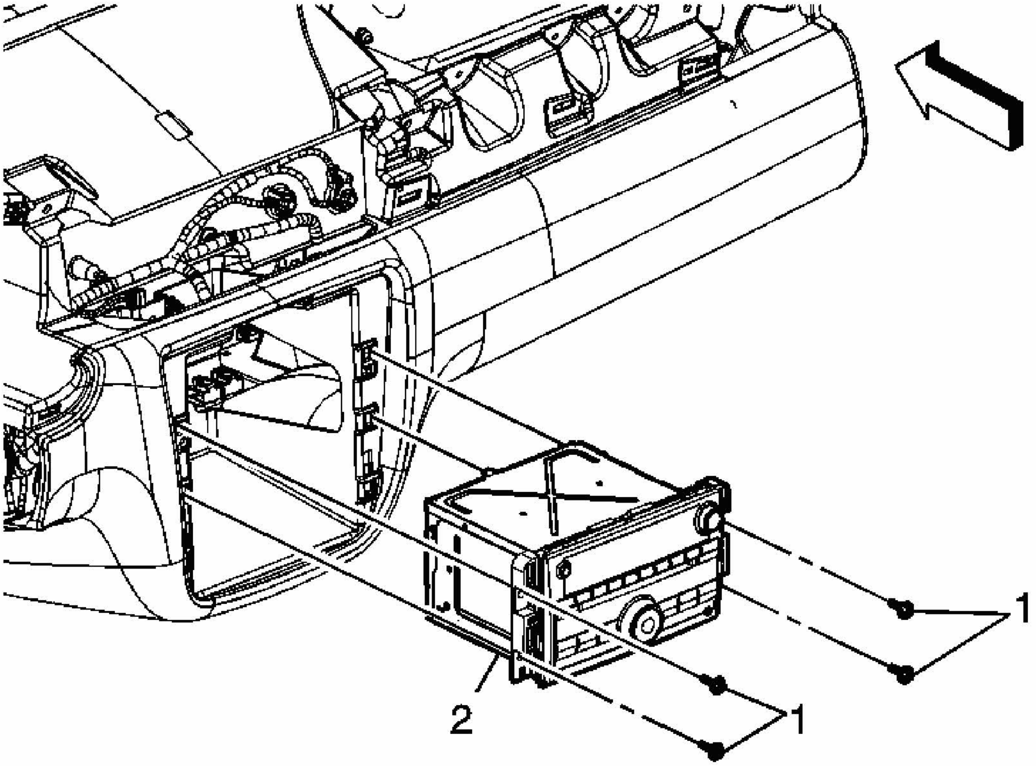


Fig. 35: Replacing Radio
Courtesy of GENERAL MOTORS CORP.

Radio Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the Instrument panel accessory trim plate. Refer to **Trim Plate Replacement - Instrument Panel (I/P) Accessory (Impala)** or **Trim Plate Replacement - Instrument Panel (I/P) Accessory (Monte Carlo)** . 2. Program the radio after replacement. Refer to **Control Module References** .	
1	Bolt/Screw, Radio (Qty: 4) **Tighten:** 2 N.m (18 lb in)
2	Radio, AM/FM Stereo

DIGITAL RADIO RECEIVER REPLACEMENT

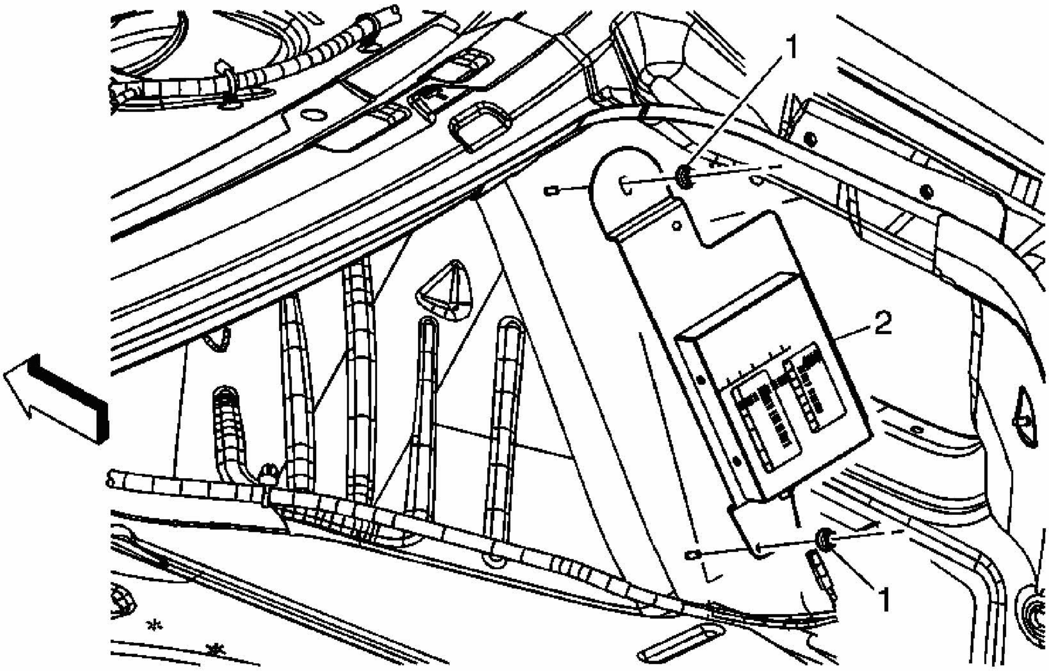


Fig. 36: Replacing Digital Radio Receiver
Courtesy of GENERAL MOTORS CORP.

Receiver Replacement - Digital Radio

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.

IMPORTANT:
Do not swap digital radio receivers between vehicles. Swapping digital receivers between vehicles will activate the digital radio Theftlock. "XM Theftlock" will be displayed.

Preliminary Procedure

1. Remove the right rear compartment trim. Refer to Compartment Side Trim Replacement - RH Rear .
2. After replacement, perform the digital radio setup procedure. Refer to Digital Radio Receiver Setup.
3. Program the digital radio receiver after replacement. Refer to Control Module References .</td></tr>
<tr><td>1</td><td>Nuts, Digital Radio Receiver Bracket (Qty: 2)
Tip: Disconnect the antenna and electrical connectors from the module.

Tighten: 3.5 N.m (31 lb in)</td></tr>
<tr><td>2</td><td>Receiver Assembly, Digital Radio</td></tr>
</table>

AMPLIFIER REPLACEMENT

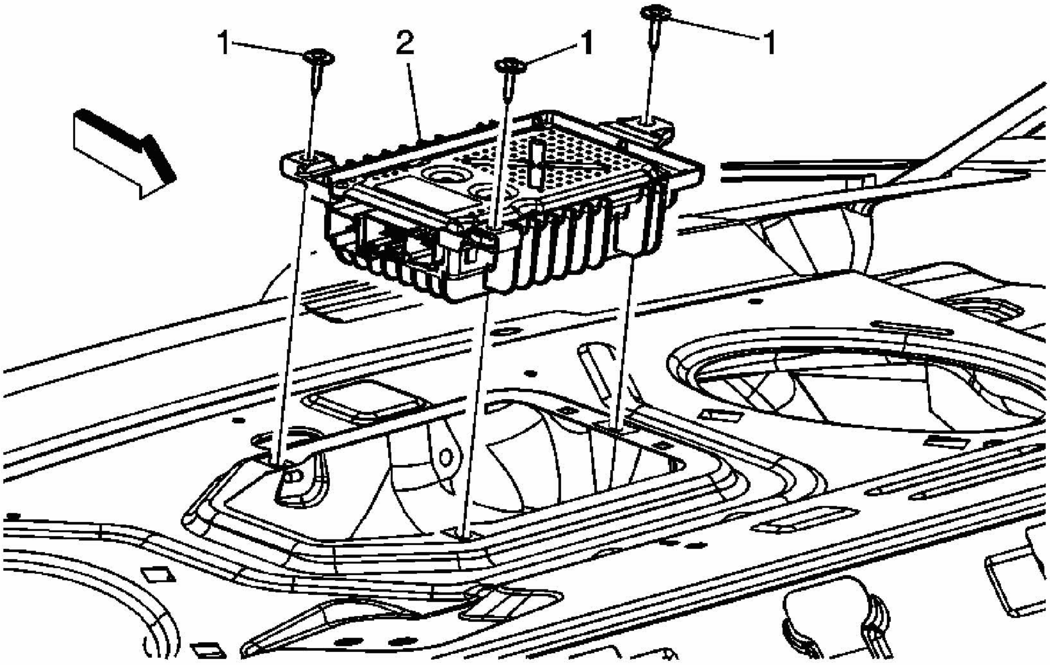


Fig. 37: Replacing Amplifier
Courtesy of GENERAL MOTORS CORP.

Amplifier Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the rear window shelf trim panel. Refer to **Trim Panel Replacement - Rear Window Shelf** .	
1	Bolt, Low Frequency Audio Amplifier (Qty: 3) **Tighten:** 2.5 N.m (22 lb in)
2	Amplifier Assembly, Low Frequency Audio

COMPACT DISC CARE AND CLEANING

Care of CDs

Handle CDs carefully. Store them in their original cases or other protective cases and away from direct sunlight and dust. The CD player scans the bottom surface of the disc. If the surface of a CD is damaged, such as cracked, broken, scratched, or wrinkled labeling, the

CD will not play properly or not at all. If the surface of a CD is soiled, take a soft, lint free cloth or dampen a clean, soft cloth in a mild, neutral detergent solution mixed with water, and clean it. Make sure the wiping process starts from the center to the edge. Do not touch the bottom side of a CD while handling it. This could damage the surface. Pick up CDs by grasping the outer edges or the edge of the hole and the outer edge.

Care of the CD Player

The use of CD lens cleaners for CD players is not advised, due to the risk of contaminating the internal lens of the CD optics with lubricants.

Stuck CDs

Interrupting the battery power by pulling the fuse will sometimes release a stuck CD. If a CD is stuck, and removed, inspect it for warps, cracks, etc. If the CD is damaged, do not replace the radio.

Labeling CDs

Paper labels can eventually warp and wrinkle, and this will cause the disc to jam inside the CD player. Try labeling the top of the discs with a soft magic marker instead.

ANTENNA MODULE REPLACEMENT

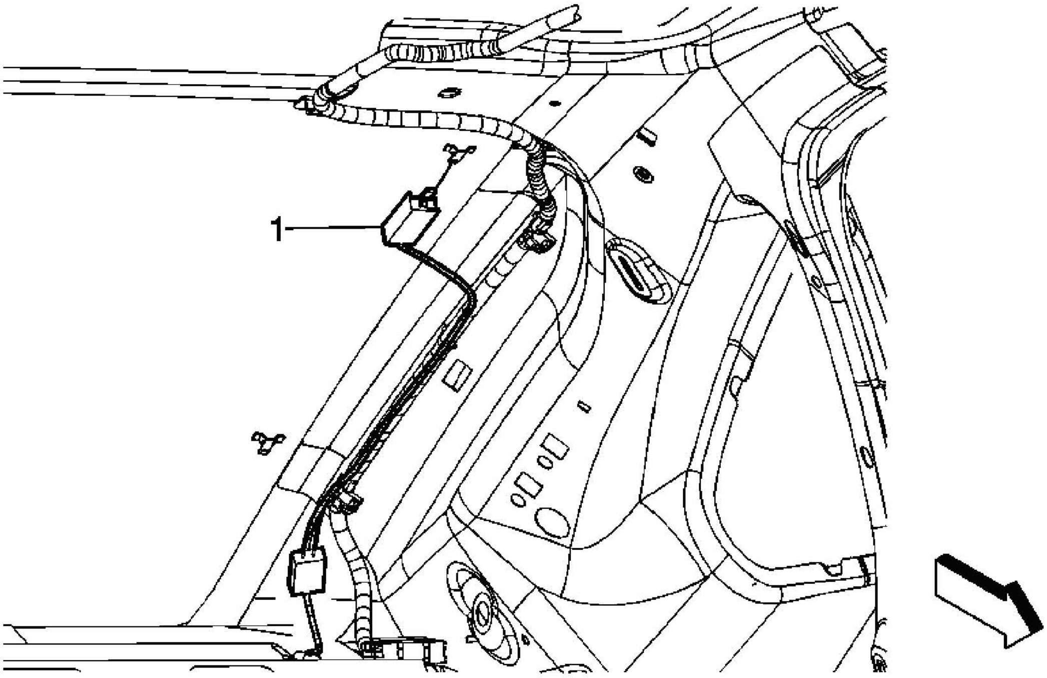


Fig. 38: Replacing Antenna Module

Courtesy of GENERAL MOTORS CORP.

Antenna Module Replacement

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the rear quarter upper trim panel. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** . 2. Remove the rear window shelf trim panel. Refer to **Trim Panel Replacement - Rear Window Shelf** .	
1	Module Assembly, Radio Antenna

DIGITAL RADIO ANTENNA REPLACEMENT

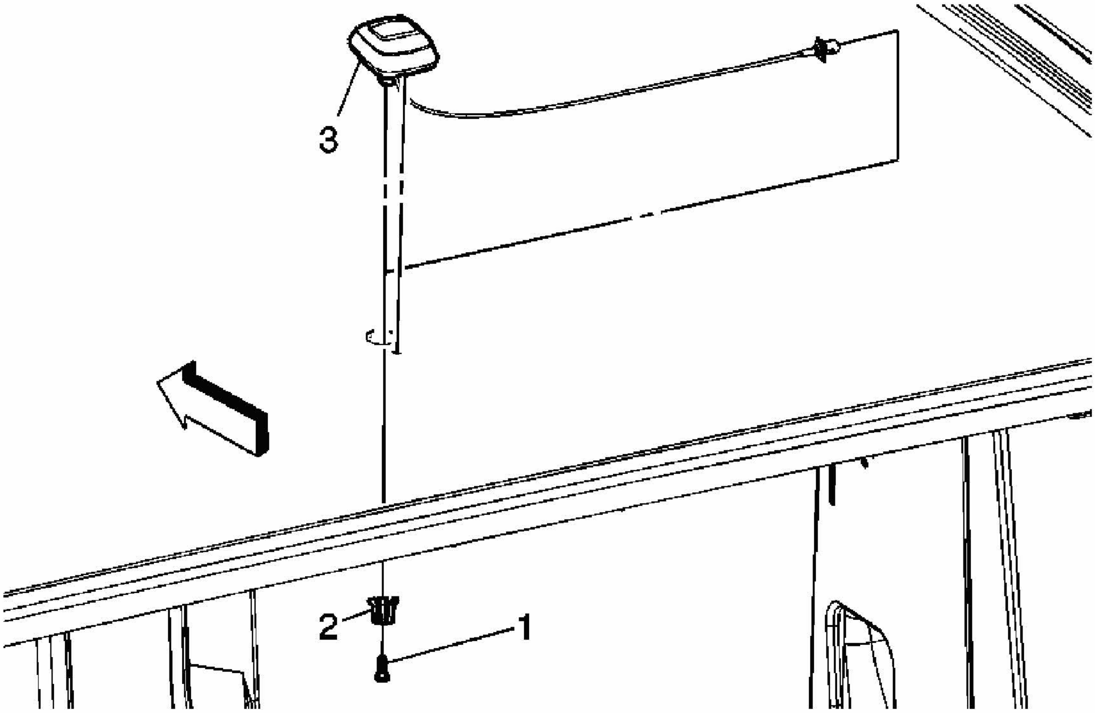


Fig. 39: Replacing Digital Radio Antenna
Courtesy of GENERAL MOTORS CORP.

Antenna Replacement - Digital Radio

Callout	Component Name
NOTE: **Refer to Fastener Notice .**	

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .**Preliminary Procedure:** Lower the rear of the headliner. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** .	
1	Bolt, Digital Radio Antenna Assembly **Tip:** Disconnect the electrical connections. **Tighten:** 9 N.m (80 lb in)
2	Expansion Sleeve, Digital Radio Antenna
3	Antenna Assembly, Digital Radio

ANTENNA EXTENSION CABLE REPLACEMENT

Removal Procedure

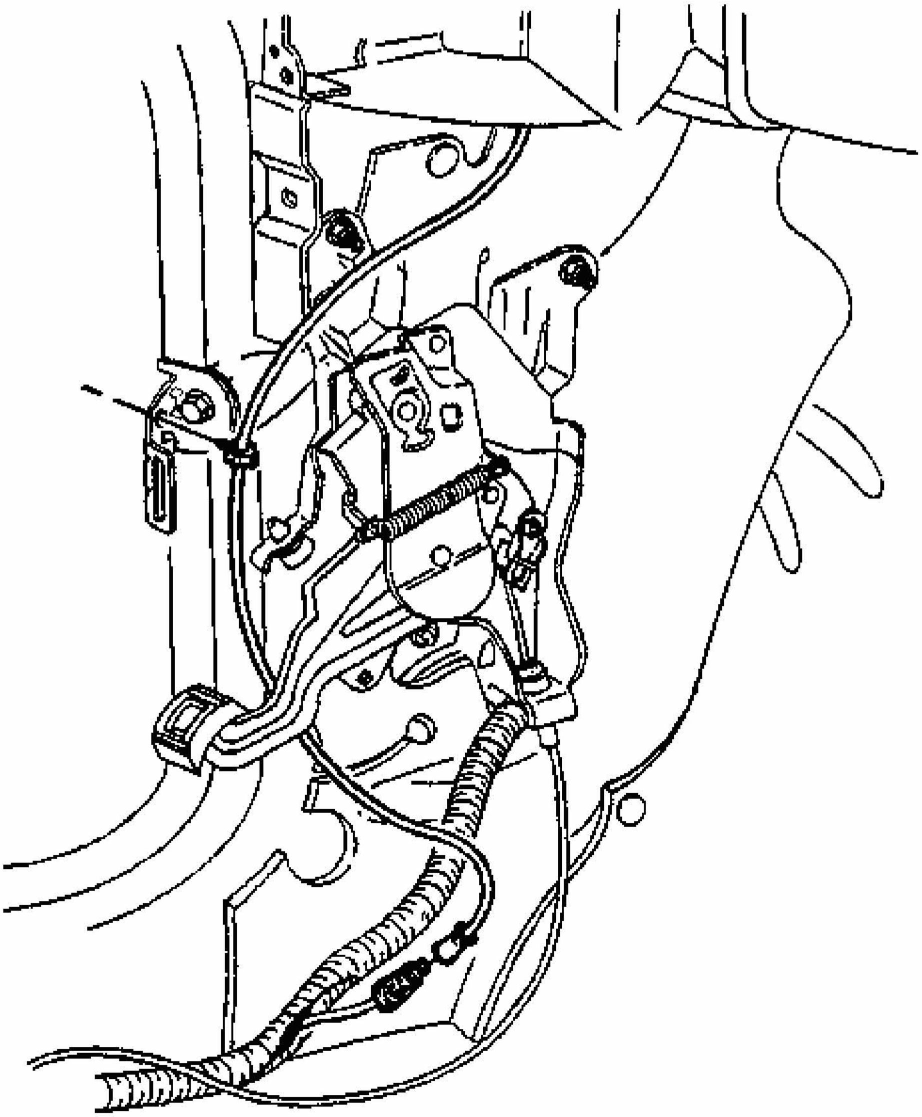


Fig. 40: Antenna Extension Cable
Courtesy of GENERAL MOTORS CORP.

1. Remove the left carpet retainer. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** in Interior Trim.
2. Adjust the carpet for access.
3. Disconnect the antenna extension cable from the antenna cable.
4. Remove the left instrument panel insulator. Refer to **Closeout/Insulator Panel Replacement - Left** in Instrument Panel, Gages and Console.

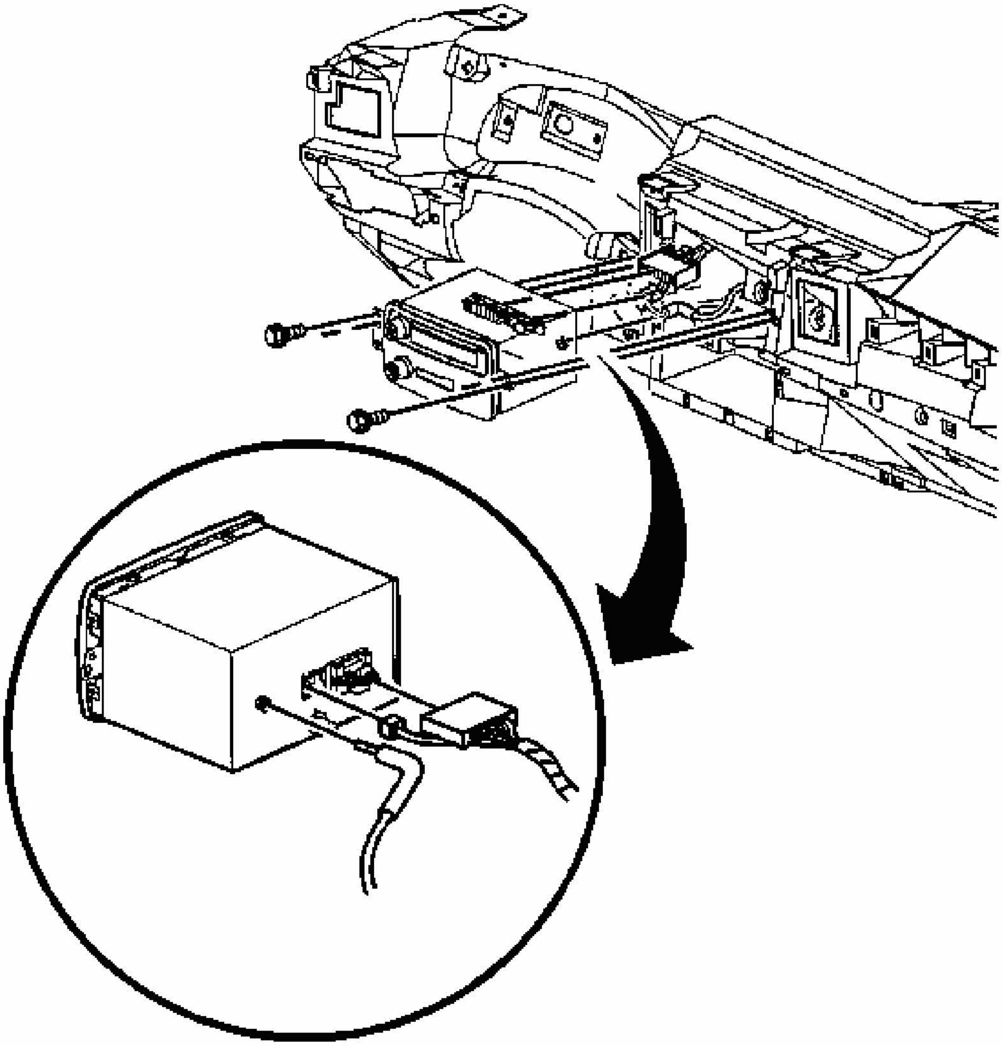


Fig. 41: Instrument Panel Wiring Harness Connector & Antenna Cable
Courtesy of GENERAL MOTORS CORP.

5. Adjust the radio for access. Disconnect the antenna extension cable from the radio. Refer to **Radio Replacement**.
6. Cut off the visible ends of the antenna extension cable.

Installation Procedure

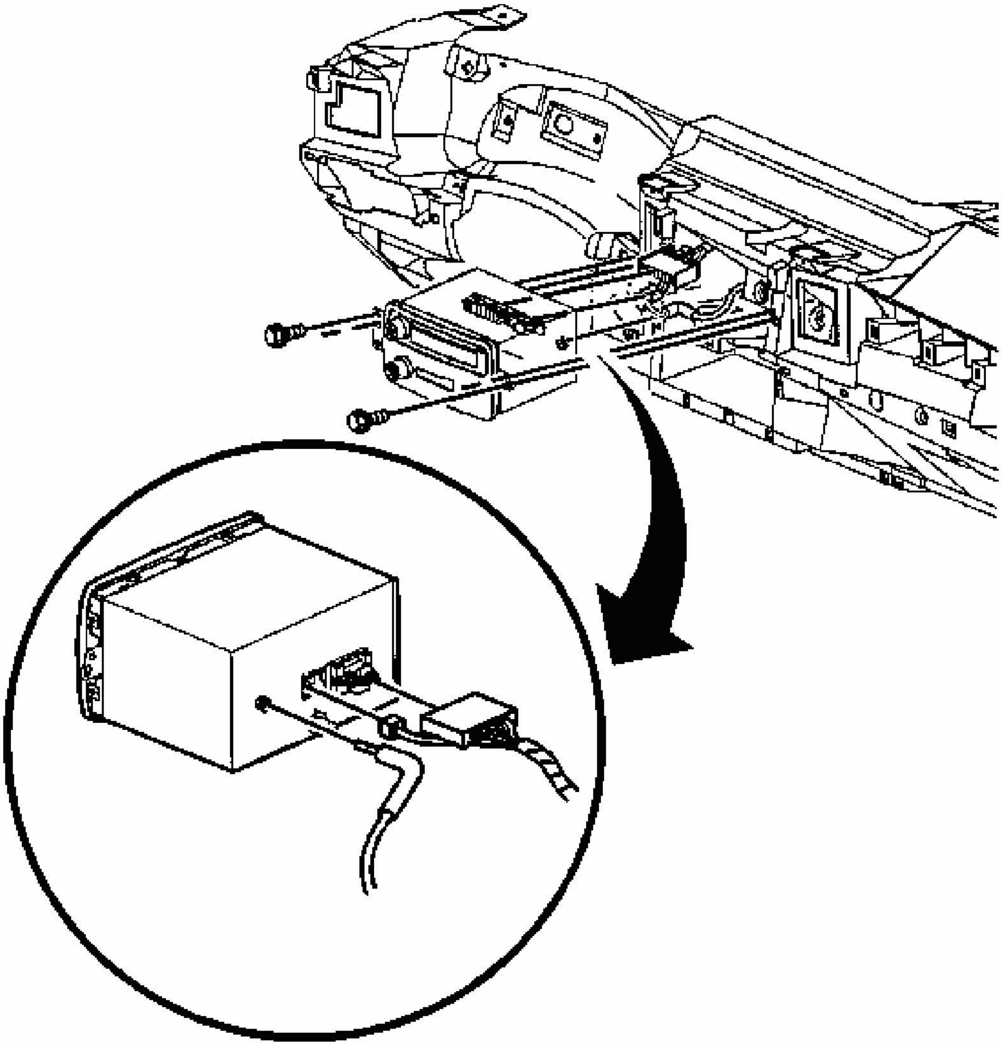


Fig. 42: Instrument Panel Wiring Harness Connector & Antenna Cable
Courtesy of GENERAL MOTORS CORP.

1. Route the antenna extension cable. Secure the cable.
2. Connect the antenna extension cable to the radio. Install the radio. Refer to **Radio Replacement**.

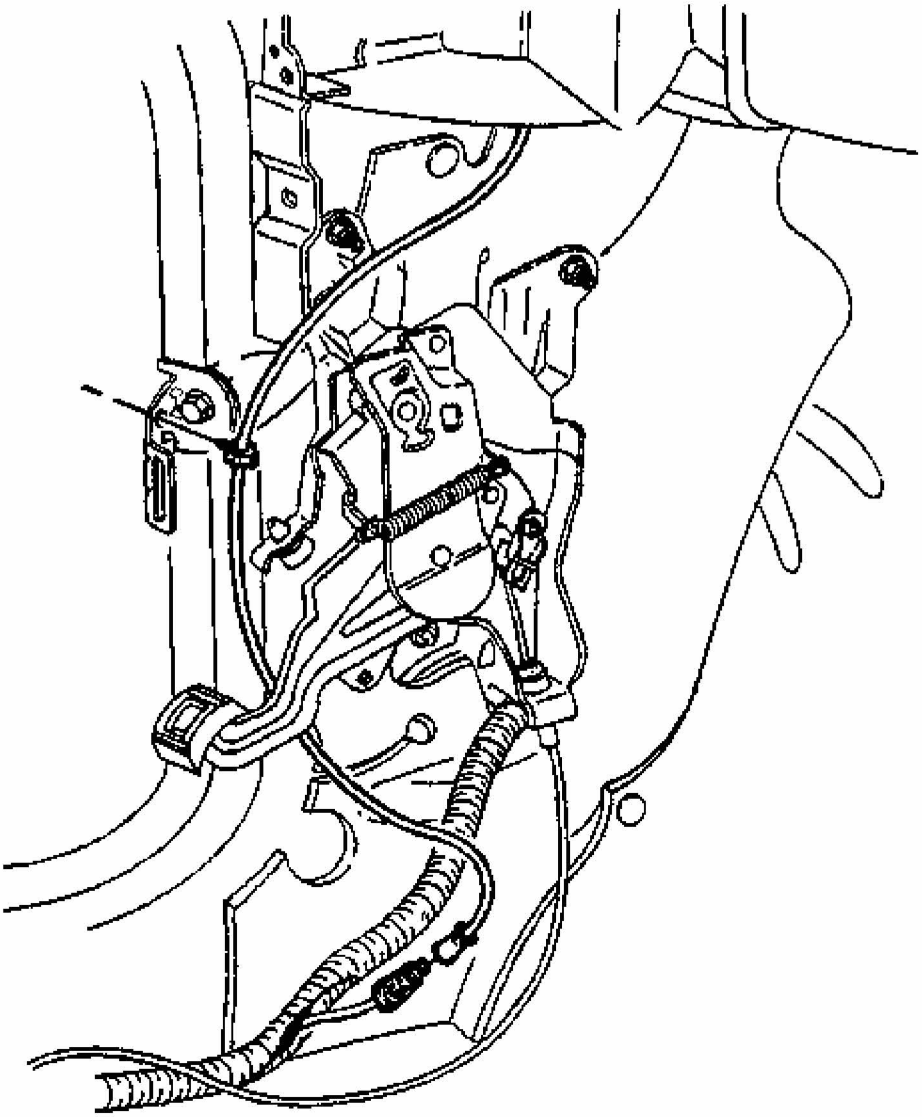


Fig. 43: Antenna Extension Cable
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The antenna cable uses a sliding snap-lock. Holding the sliding lock feature will prevent installation.

3. Connect the antenna extension cable from the radio to the antenna cable near the kick panel:
    1. Position the antenna extension cable behind the sliding lock feature.

   2. Install the antenna extension cable to the sliding lock feature.

4. Install the left instrument panel insulator. Refer to **Closeout/Insulator Panel Replacement - Left** in Instrument Panel, Gages and Console.
5. Install the carpet.
6. Install the left carpet retainer. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** in Interior Trim.

ANTENNA CABLE REPLACEMENT

Removal Procedure

1. Remove the rear upper quarter trim panel. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** in Interior Trim.
2. Disconnect the antenna cable from the radio antenna module.

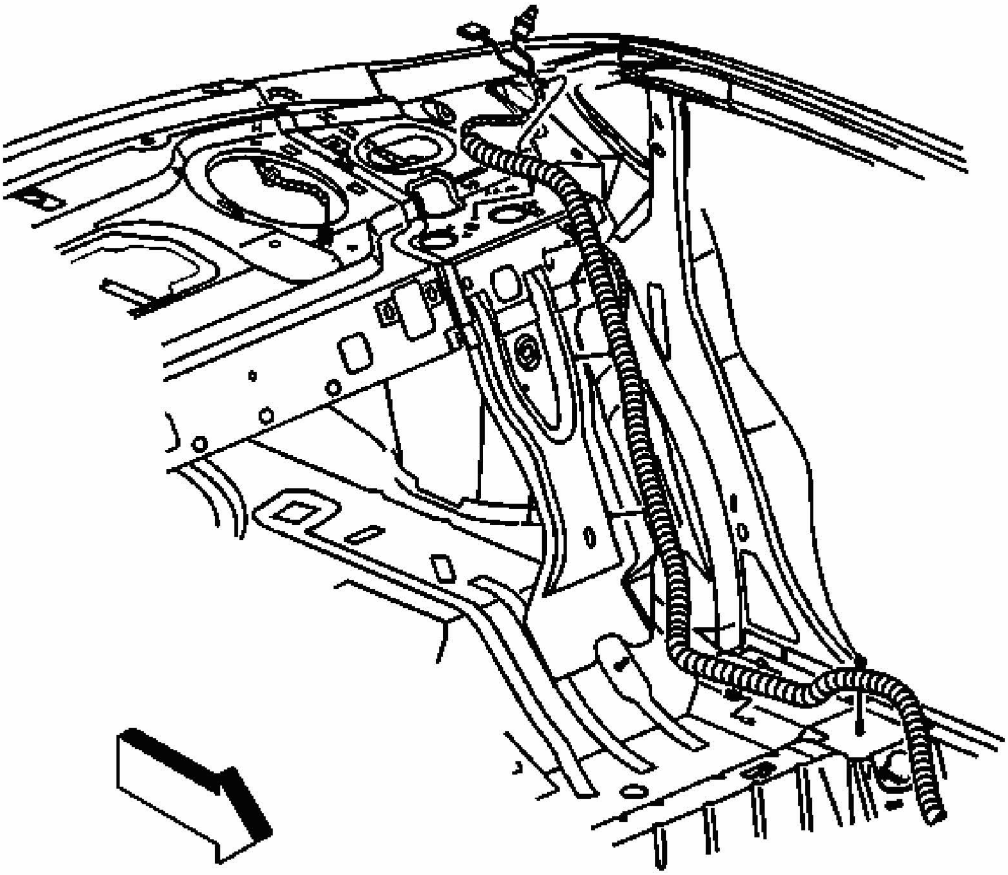


Fig. 44: Antenna Cable
Courtesy of GENERAL MOTORS CORP.

3. Remove the rear seat cushion. Refer to **Seat Cushion Replacement - Rear (Impala)** or **Seat Cushion Replacement - Rear (Monte Carlo)** in Seats.
4. Remove the rear seat back. Refer to **Seat Back Replacement - Rear (Impala)** or **Seat Back Replacement - Rear (Monte Carlo)** in Seats.

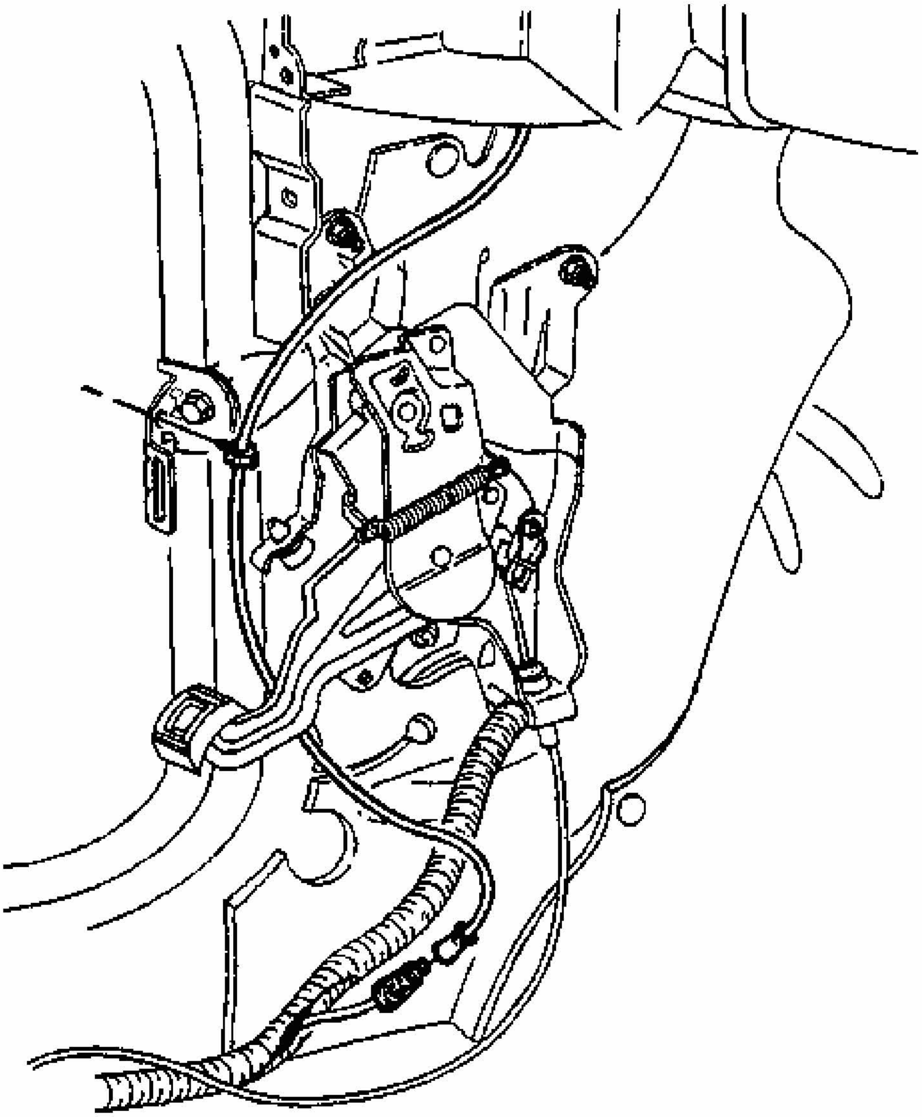


Fig. 45: Antenna Extension Cable
Courtesy of GENERAL MOTORS CORP.

5. Remove the left carpet retainers. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** in Interior Trim.
6. Remove the lower center pillar trim panel. Refer to **Trim Panel Replacement - Lower Center Pillar** in Interior Trim.
7. Adjust the carpet for access to the antenna cable as required.
8. Disconnect the antenna cable from the antenna extension cable.
9. Cut off the visible end of the antenna cable from the wiring harness in the following locations:
   - The kick panel area
   - The rear shelf area

Installation Procedure

1. Install the antenna cable to the vehicle. Use electrical tape in order to secure the antenna extension cable to the top of the wiring harness. Secure the cable to the harness at least every 150 mm (6 in).

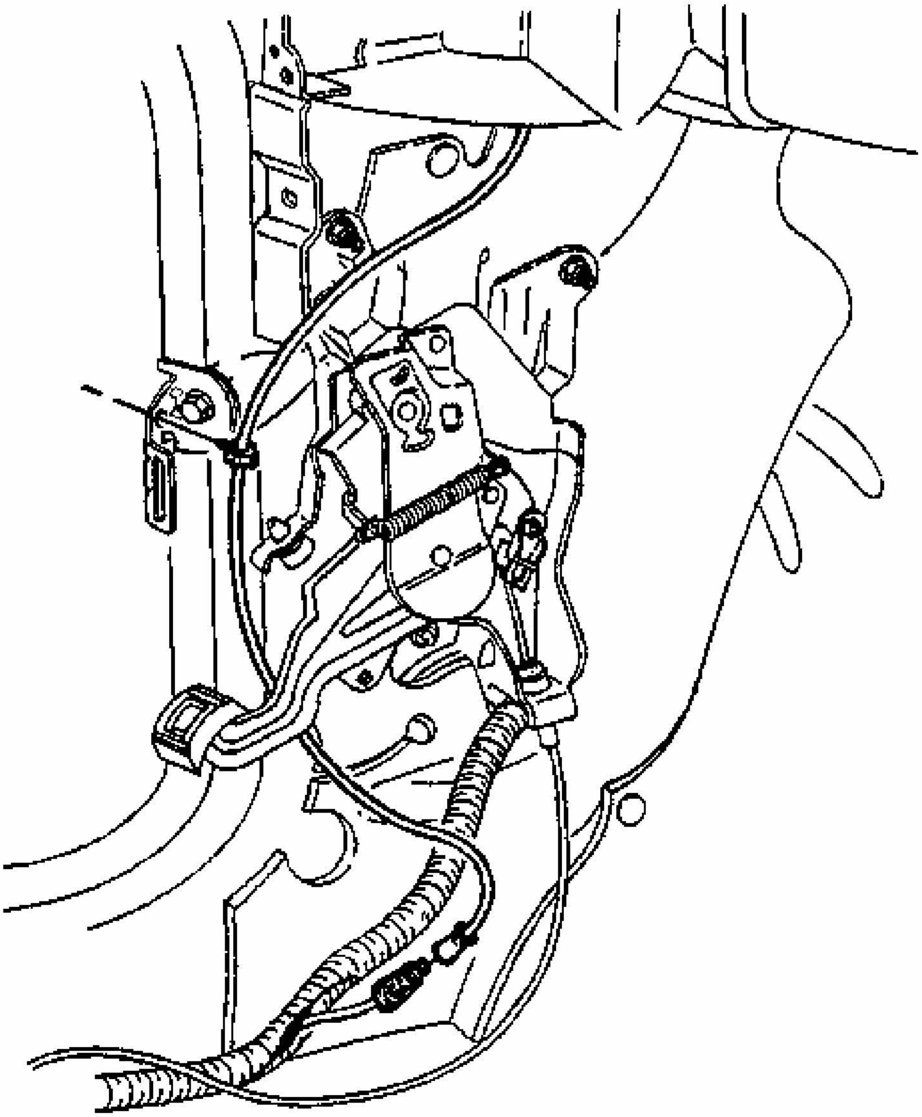


Fig. 46: Antenna Extension Cable
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The antenna cable uses a sliding snap-lock. Holding the sliding lock feature will prevent installation.

2. Connect the antenna extension cable from the radio to the antenna cable near the kick panel:
    1. Position the antenna extension cable behind the sliding lock feature.

   2. Install the antenna extension cable to the sliding lock feature.
3. Install the carpet.
4. Install the lower center pillar trim panel. Refer to **Trim Panel Replacement - Lower Center Pillar** in Interior Trim.
5. Install the left carpet retainers. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** in Interior Trim.

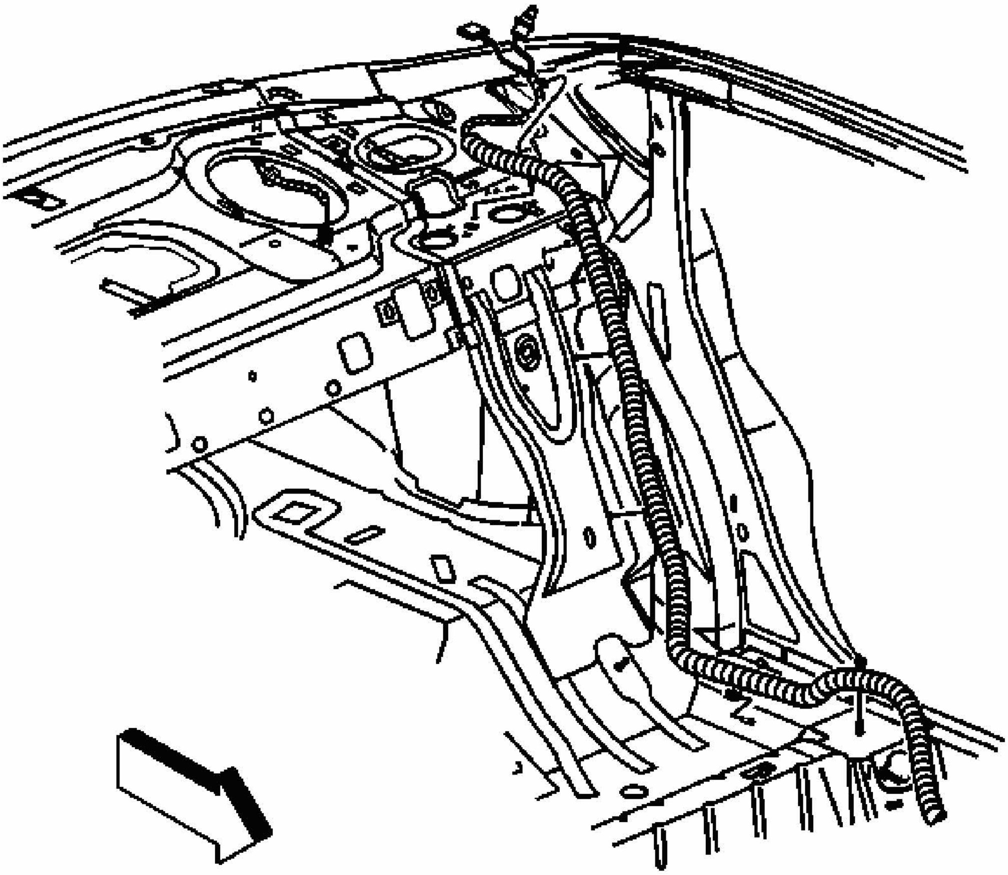


Fig. 47: Antenna Cable
Courtesy of GENERAL MOTORS CORP.

6. Install the rear seat back. Refer to **Seat Back Replacement - Rear (Impala)** or **Seat Back Replacement - Rear (Monte Carlo)** in Seats.
7. Install the rear seat cushion. Refer to **Seat Cushion Replacement - Rear (Impala)** or **Seat Cushion Replacement - Rear (Monte Carlo)** in Seats.

IMPORTANT: The antenna cable uses a sliding snap-lock. Holding the sliding lock feature will prevent installation.

8. Connect the antenna cable to the radio antenna module:
    1. Position the antenna cable behind the sliding lock feature.
    2. Install the antenna cable to the sliding lock feature.
9. Install the rear upper quarter trim panel. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** in Interior Trim.

COAXIAL CABLE REPLACEMENT - DIGITAL RADIO

Removal Procedure

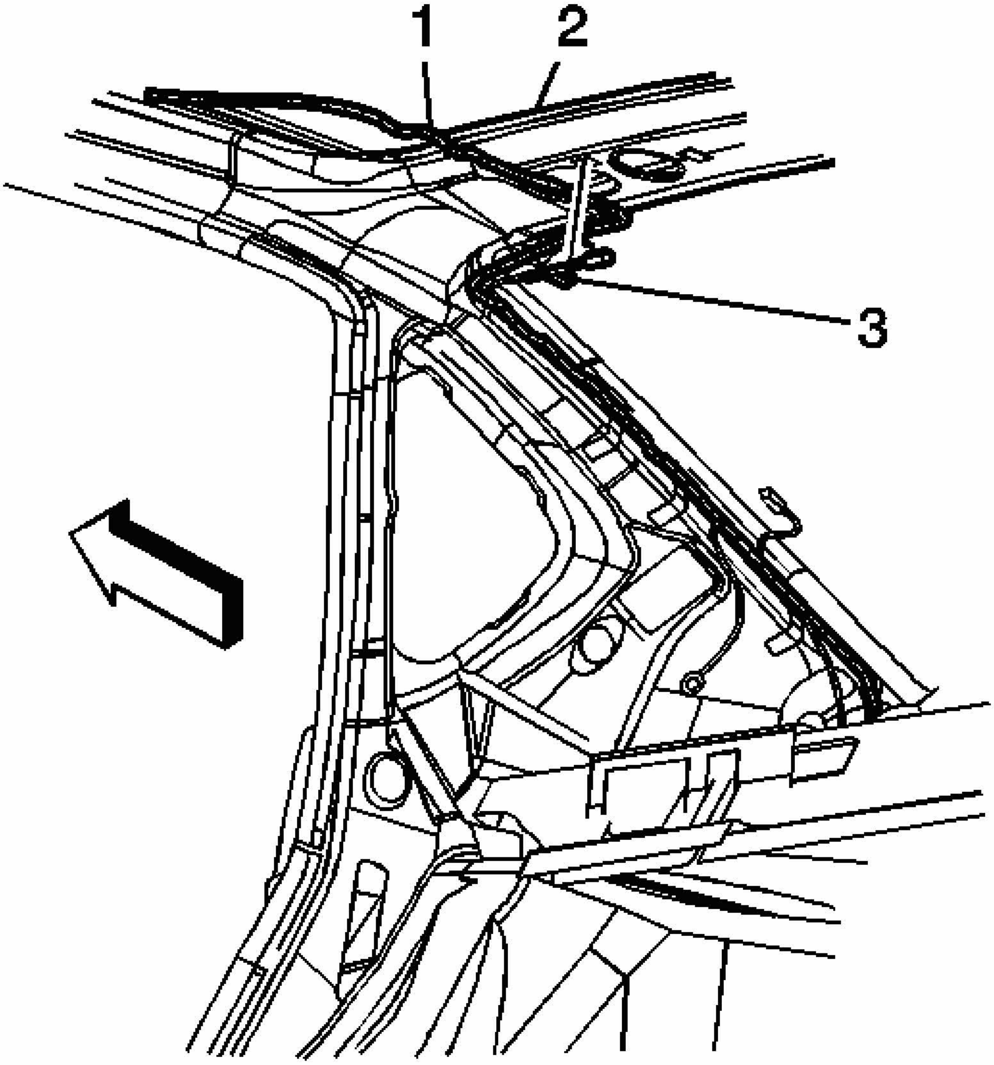


Fig. 48: Removing Antenna Cable
Courtesy of GENERAL MOTORS CORP.

1. Remove the right rear upper quarter trim panel. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** in Interior Trim.
2. Lower the rear of the headliner for access to the antenna/cable attachment. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** in Interior Trim.
3. Adjust the antenna cable mastic patch/tape at the roof.
4. Disconnect the antenna cable from the antenna base cable connector.

5. Remove the antenna cable retainer (3) from the rear header (2).

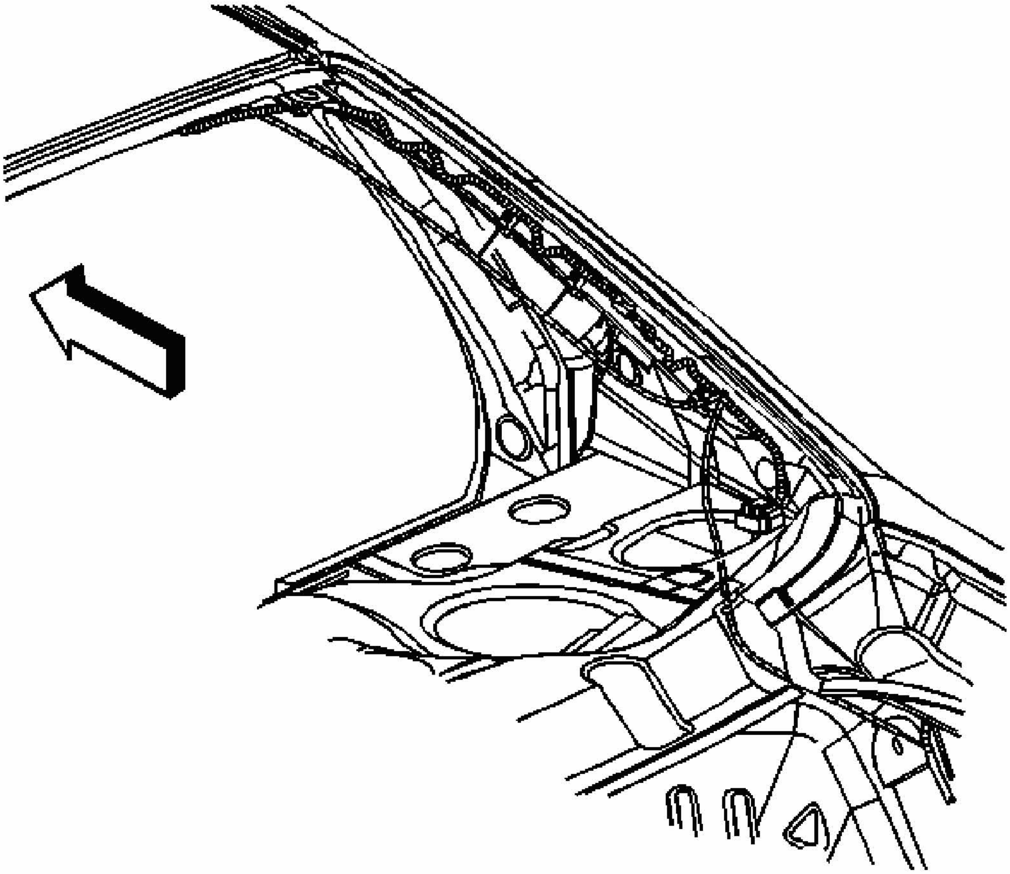


Fig. 49: Routing Antenna Cable
Courtesy of GENERAL MOTORS CORP.

6. Remove the antenna cable from the dome lamp harness clips.
7. Remove the antenna cable from between the dome lamp harness and the upper quarter panel.
8. Attach a piece of wire or string to the end of the antenna cable.
9. Route the antenna cable through the rear shelf and along the rear wheel house.
10. Adjust the right rear compartment trim panel.
11. Disconnect the antenna cable from the digital radio receiver.
12. Remove the antenna cable retainers from the receiver bracket.
13. Remove the wire or string from the antenna cable.
14. Remove the antenna cable.

Installation Procedure

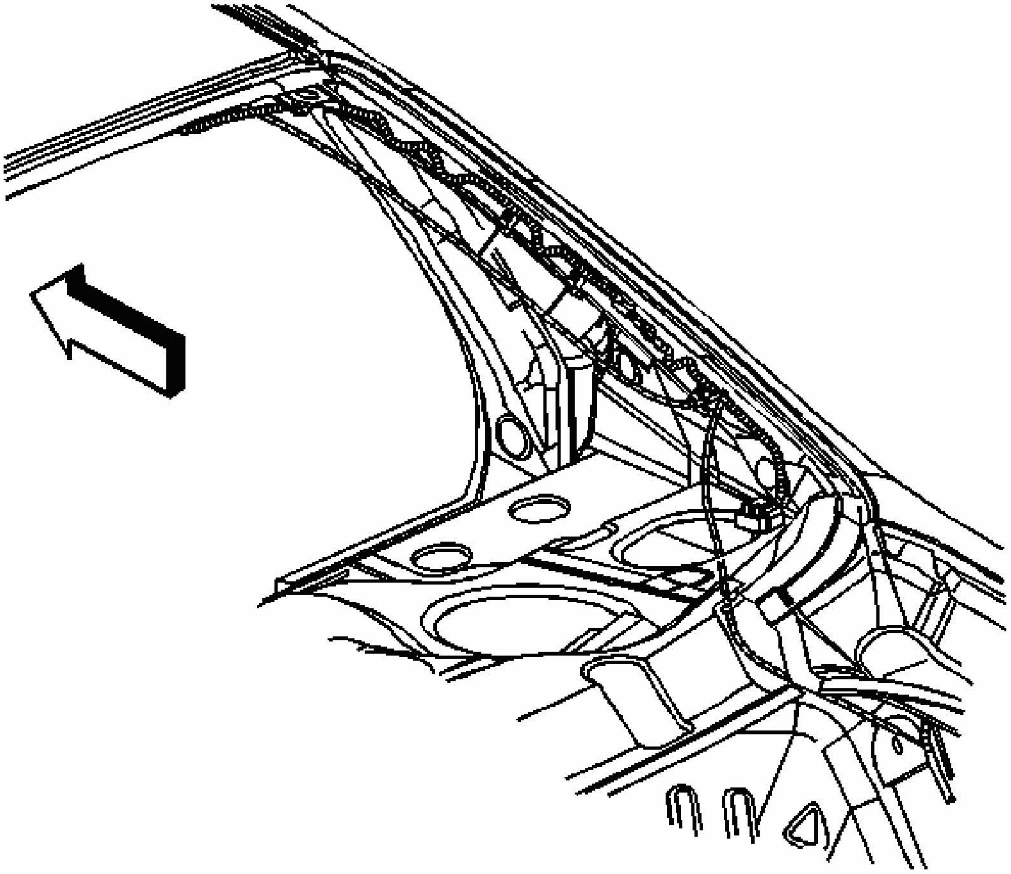


Fig. 50: Routing Antenna Cable
Courtesy of GENERAL MOTORS CORP.

1. Install the antenna cable retainers to the receiver bracket.
2. Connect the antenna cable to the digital radio receiver.
3. Attach the wire or string used in the removal procedure to the cable being installed.
4. Carefully pull the antenna cable through the rear shelf into the passenger compartment.
5. Install the right rear compartment trim panel.
6. Remove the wire or string from the antenna cable.
7. Route the antenna cable between the dome lamp harness and the upper quarter panel.
8. Install the antenna cable to the dome lamp harness clips.

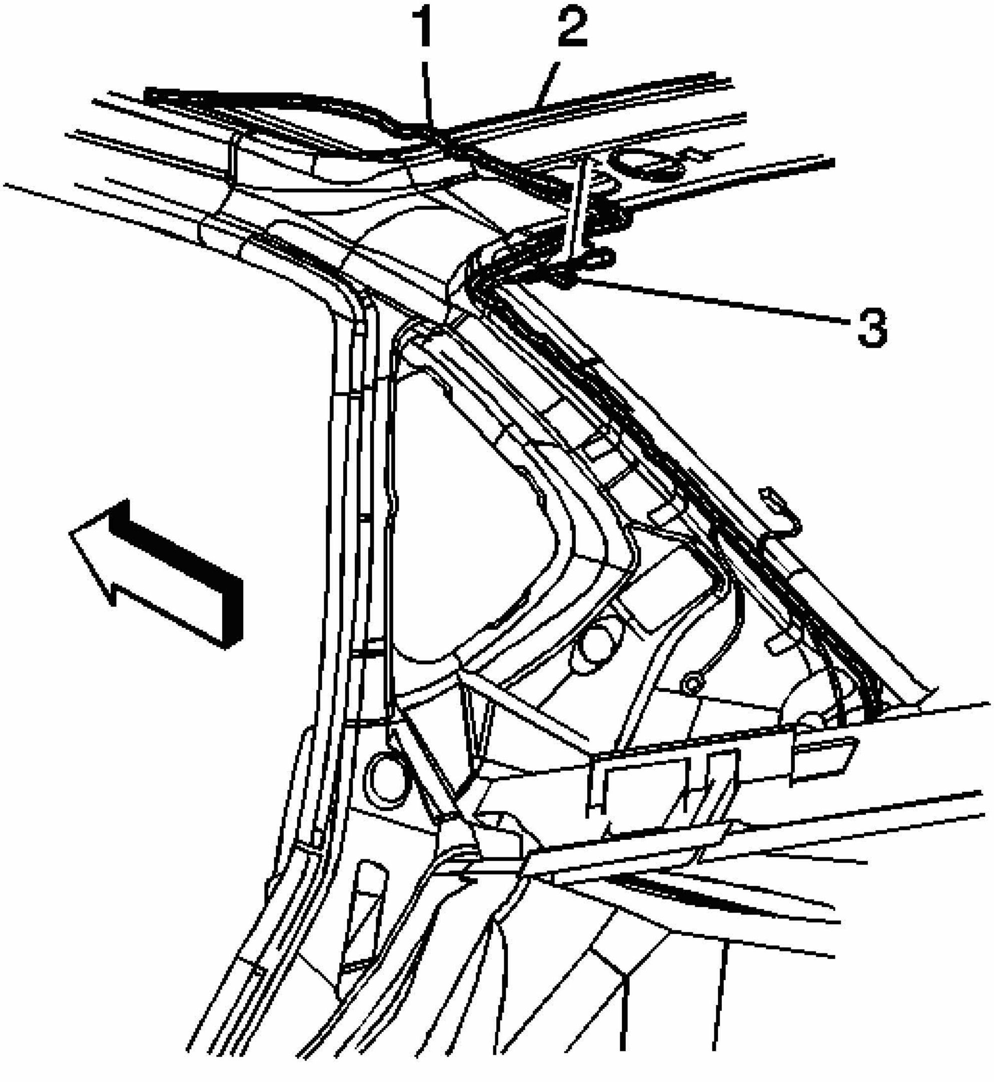


Fig. 51: Removing Antenna Cable
Courtesy of GENERAL MOTORS CORP.

9. Install the antenna cable retainer (3) to the rear header (2).
10. Connect the antenna cable to the antenna base cable connector.
11. Install the antenna cable mastic patch/tape at the roof.
12. Install the rear of the headliner. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** in Interior Trim.
13. Install the right rear upper quarter trim panel. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper**

(Monte Carlo) in Interior Trim.

FRONT DOOR SPEAKER REPLACEMENT

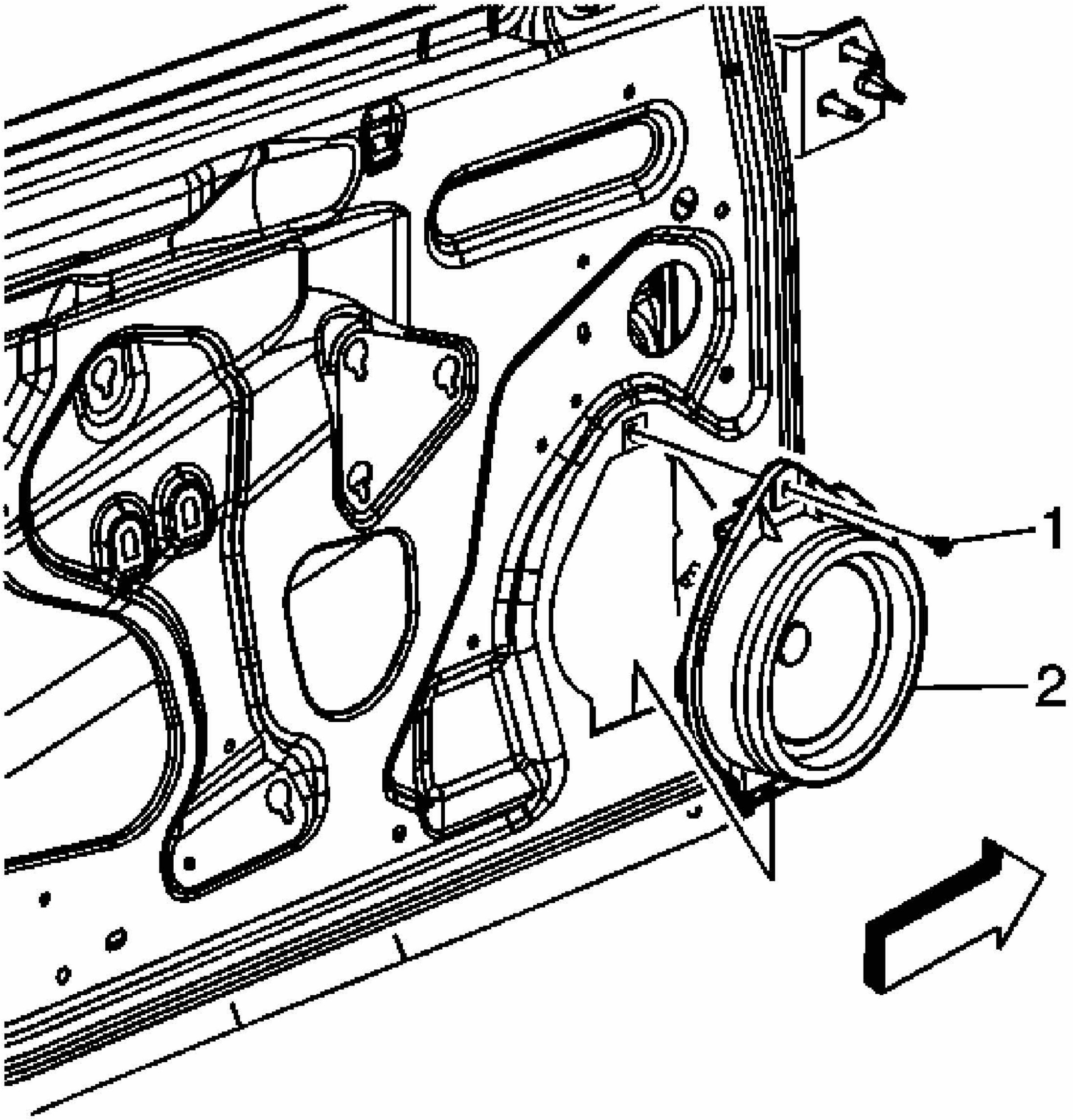


Fig. 52: Replacing Front Door Speaker
Courtesy of GENERAL MOTORS CORP.

Speaker Replacement - Front Door

Callout	Component Name
NOTE: Refer to Fastener Notice . **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the front door trim panel. Refer to	

Trim Panel Replacement - Side Front Door (Impala) .	
1	Bolt/Screw, Radio Front Side Door Speaker Housing **Tighten:** 2 N.m (18 lb in)
2	Speaker Assembly, Radio Front Side Door

FRONT UPPER SPEAKER REPLACEMENT

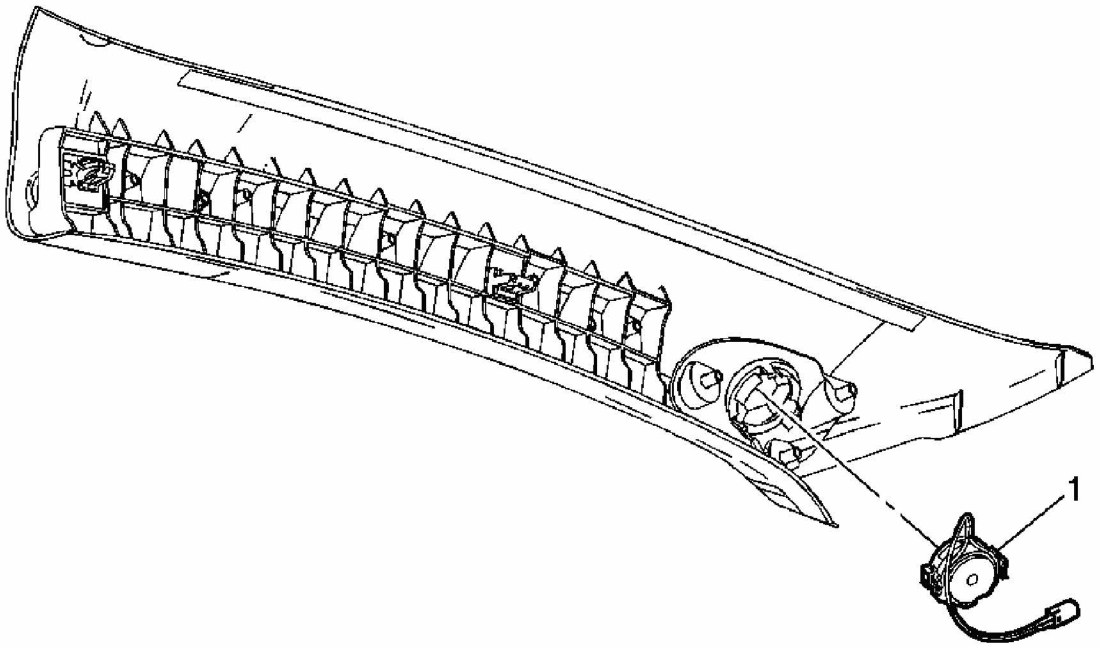


Fig. 53: Replacing Front Upper Speaker
Courtesy of GENERAL MOTORS CORP.

Speaker Replacement - Front Upper

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the windshield pillar garnish molding. Refer to **Garnish Molding Replacement - Windshield Pillar (Impala)** or **Garnish Molding Replacement - Windshield Pillar (Monte Carlo)** .	
1	Speaker Assembly, Radio Windshield Side Garnish Molding **Tip:** Release the tabs on the windshield pillar speaker carrier to remove the speaker from the molding.

REAR (UW6) SPEAKER REPLACEMENT

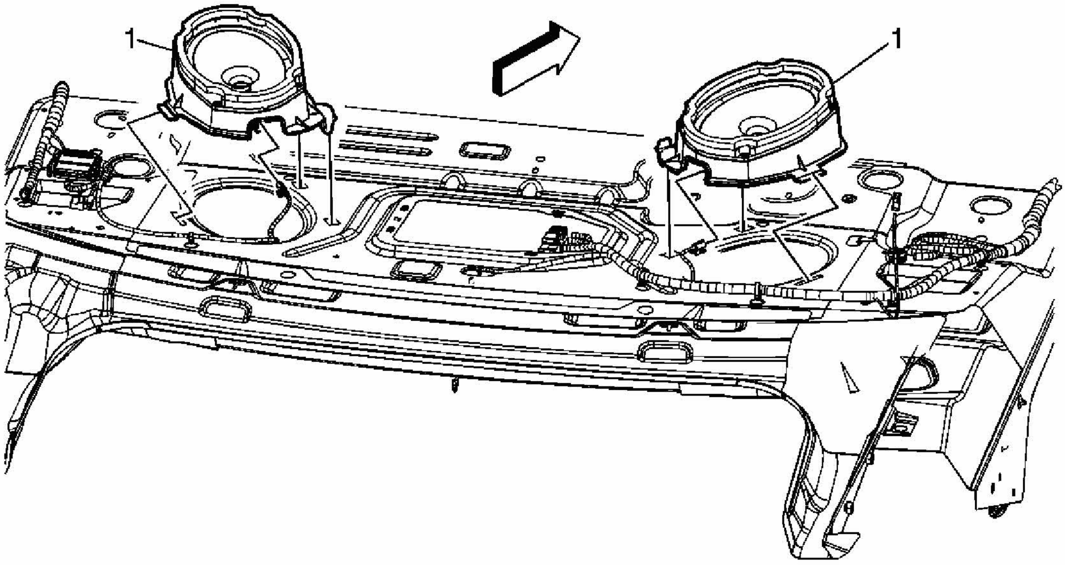


Fig. 54: Replacing Rear (UW6) Speaker
Courtesy of GENERAL MOTORS CORP.

Speaker Replacement - Rear (UW6)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the rear window shelf trim panel. Refer to **Trim Panel Replacement - Rear Window Shelf** .	
1	Speaker Assembly, Radio Rear (Qty: 2) **Tip:** • Push in on the tabs on the speaker in order to release. • Disconnect the electrical connector.

REAR (UQ3) SPEAKER REPLACEMENT

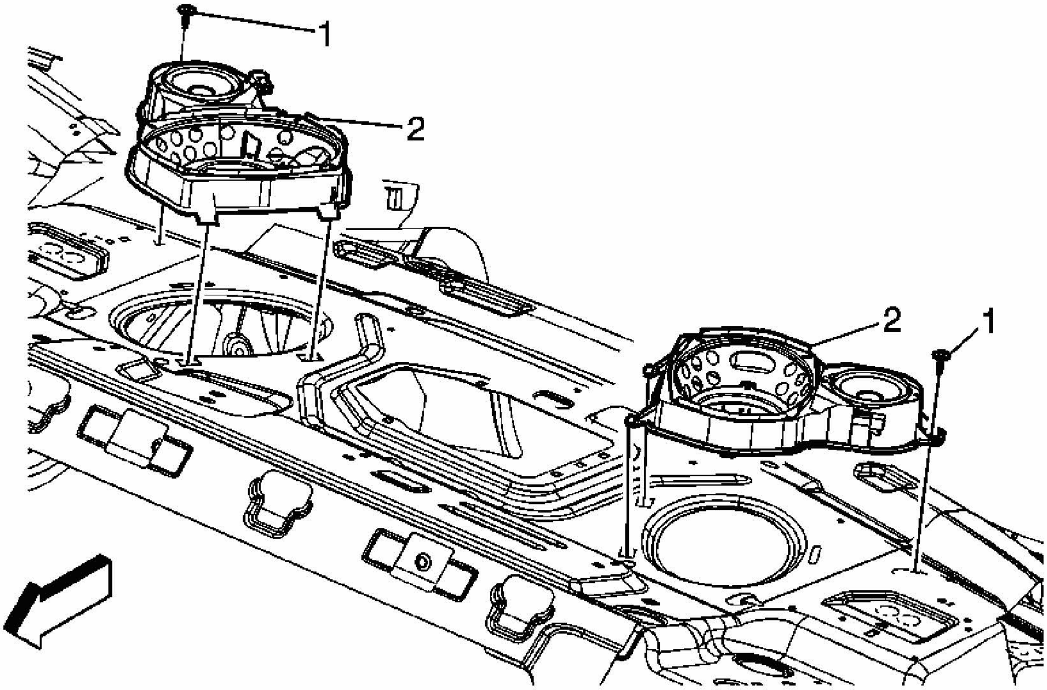


Fig. 55: Replacing Rear (UQ3) Speaker
Courtesy of GENERAL MOTORS CORP.

Speaker Replacement - Rear (UQ3)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the rear window shelf trim panel. Refer to **Trim Panel Replacement - Rear Window Shelf** .	
1	Bolt/Screw, Radio Rear Speaker **Tip:** Disconnect the electrical connector. **Tighten:** 2.5 N.m (22 lb in)
2	Speaker Assembly, Radio Rear

REAR SPEAKER GRILLE REPLACEMENT

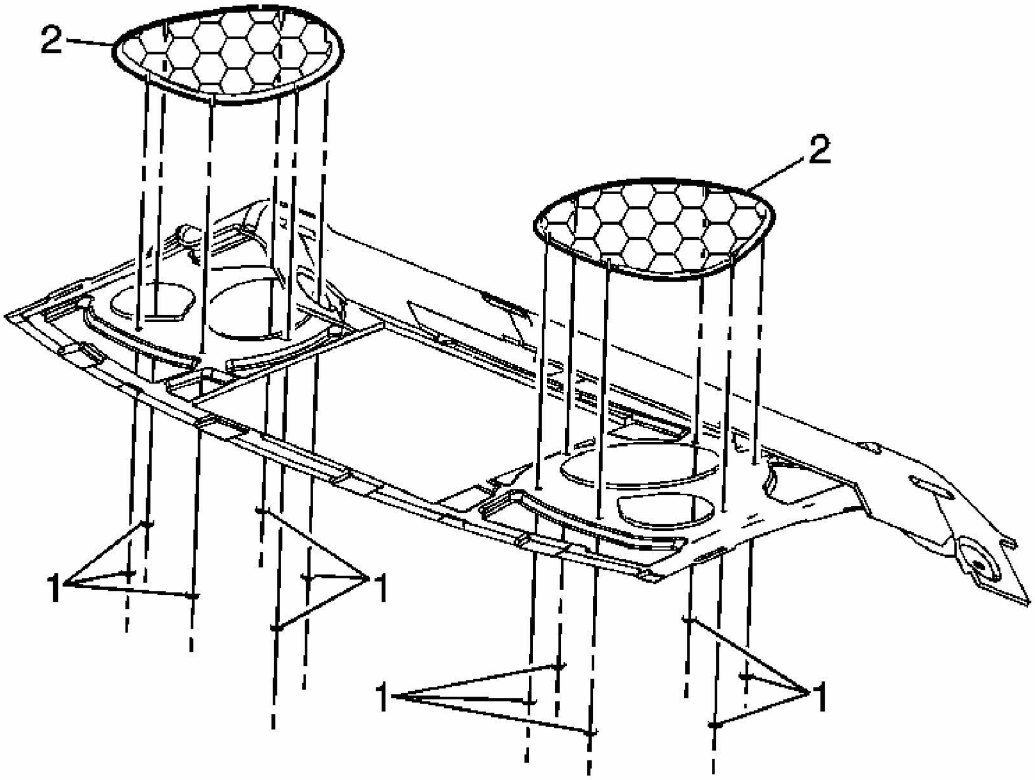


Fig. 56: Replacing Rear Speaker Grille
Courtesy of GENERAL MOTORS CORP.

Speaker Grille Replacement - Rear

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the rear window shelf trim panel. Refer to **Trim Panel Replacement - Rear Window Shelf** .	
1	Nut, Radio Rear Speaker Grille **Tighten:** 2 N.m (18 lb in)
2	Grille, Radio Rear Speaker

DESCRIPTION AND OPERATION

RADIO/AUDIO SYSTEM DESCRIPTION AND OPERATION

Contents

- RPO options
- Circuit description
- Component description
- Theft deterrent feature

RPO Options

The entertainment system on this vehicle is configured with either a base or uplevel audio system. Both the base and uplevel audio systems contain a radio, antenna, and speakers. The following shows the Entertainment RPOs that are available for this vehicle:

- (U1C) AM/FM Stereo CD
- (US8) AM/FM Stereo, CD, MP3, RDS, EQ
- (US9) AM/FM Stereo, 6-Disc CD, MP3, RDS, EQ
- (UW5) Base Six Speaker
- (UQ3) Uplevel Six Speaker
- (U2K) Digital Radio

Circuit Operation

Radio Power

The main radio power is supplied by a 15A RADIO fuse located in the body control module (BCM). The radio does not require a discrete ignition feed circuit for power moding. The power moding is accomplished using a structure of Virtual Networks (VN). The Power Mode Master (PMM) transmits the GMLAN power mode signals.

The radio supports the following signals:

- System Power Mode
- Infotainment Operation Allowed

The radio also supports the following GMLAN Vehicle Power Modes:

- OFF
- ACCESSORY
- RUN
- CRANK REQUEST

Radio Ground

A wire in the main radio connector that is connected to battery negative at all times provides the main radio ground. Resistance between the ground pin and the vehicle battery negative terminal must not exceed 0.05 ohm.

Radio Speaker Outputs

At low volume, the plus (+) and minus (-) speaker outputs circuits measure approximately 7-8 volts. If a plus or minus circuit for any speaker output is shorted to ground or voltage, the radio disables the circuit for component protection and sets a diagnostic trouble code (DTC). The radio sets the speaker circuit DTC on non - amplified systems only. As the radio volume increases the voltage on the plus and minus circuits change to create a voltage difference between each other. The difference in voltage is what drives the voice coil of the speaker producing sound.

Radio Head Unit Dimming

GMLAN signal data received by the radio determines the radio dimming and backlighting levels. The radio sets the backlight and VF display dimming to the value indicated by the interior dimming level and interior dimming display level signals in the GMLAN dimming information frame. The radio provides faceplate and control/graphics backlighting in the OFF (RAP inactive) when the exterior lighting virtual network (VN) is activated. The radio display is consistent then with the surrounding devices that use analog PWM dimming to backlight their control/graphics when the power mode is OFF and the park lights are ON.

Amplifier Interface

The main amplifier power is provided by a 20A RADIO AMP fuse located in the body control module (BCM). A discrete switched 12 volt output is used to control the power - state of the amplifier. To respond quickly to audio input and control signals, the amplifier is ON in all vehicle power modes except OFF and CRANK Request. However, when the amplifier is asleep it still must allow chime functionality. The internal amplifier bridges are fully powered and unmuted when the amplifier receives the switched 12-volt input.

The radio provides a remote amp mute output circuit to control overall muting of remote non-GMLAN amplifiers with rear seat audio (RSA) applications. The amplifier receives PWM signals on the circuit at varying duty cycle percentages for controlling the muted and unmuted functions of the amplifier. The RSA Enable circuit in the radio enables the rear seat channel muting of the amplifier. A Diag Sense circuit internal to the radio monitors the remote amp mute circuit for faults and sets the appropriate DTC when detected.

The function table below shows the four possible amplifier mute functions.

Radio/Audio System Description and Operation

% Duty Cycle Out	Function
0 % (Vlow Vdc)	FOUR_CHANNEL_UNMUTE
50 %	REAR_MUTE (input must be 2-channel)

75 %	SIX_CHANNEL_UNMUTE
100% (Vhigh Vdc	ALL_MUTE

Amplifier Radio Speaker Inputs

The low-level audio signals (LF, RF, LR, and RR) from the radio are the inputs to the amplifier. The amplifier boosts these inputs and outputs them to the vehicle speakers. If one speaker plus or minus low level audio signal circuit is open between the radio and the amplifier, the input to the amplifier is approximately half. The speakers for that channel then operate at approximately half the normal volume or in some cases no volume.

The low level audio signals from the radio to the amplifier typically measure in the 4-5 V range.

Amplifier Speaker Outputs

At a low volume, the plus (+) and minus (-) speaker outputs circuits measure approximately 2-7 V AC or 7-8 V DC at the speaker connector when testing a normal working system. If a plus or minus for any speaker output is shorted to ground or voltage, the amplifier circuitry will turn OFF the front outputs or rear outputs for component protection.

Repeat speaker failure can be caused by a damaged amplifier. Test for a damaged quad bridge output in the amplifier if the wiring between the amplifier and speaker test negative for a short to voltage. Prolonged exposure to DC voltage can cause a speaker coil to short. An early indication of a shorted speaker coil is distortion/noise and eventual failure.

Remote Radio Audio Signal Inputs (UE1 only)

Audio output from the OnStar(R) communications module connects to the remote audio signal inputs of the radio. When the cellular telephone mute signal goes to 0 volts, the radio over-rides any other audio signal and uses these inputs as the source for the output to the speakers.

Cellular Telephone Mute (UE1 only)

The OnStar(R) communications module uses the cellular telephone mute signal circuit to over-ride the radio for OnStar(R) communication. When cellular telephone mute is not active, this circuit is held at 1-volt by the radio. When the cellular telephone mute signal is pulled to ground, the radio over-rides any other audio signal and uses the remote audio signals as the source for output to the speakers. If the radio was OFF when this circuit is pulled low, the radio will turn ON. Additionally, the radio fades the speakers to full front, adjusts the volume to an initial audible level, and sets an Auto Tone designed for optimal use with OnStar(R). When the mute signal is no longer pulled to ground, the radio returns to the mode it was in previously.

Component Description

Antenna System

The antenna system receives broadcast AM or FM stereo signals from free space and sends the signals to the radio receiver for processing via a coaxial antenna cable. Good antenna grounding is important for good radio reception.

Radio

The operator interfaces with the radio system through the radio display and controls. Through these controls the operator is able to control system power, volume, fade, balance, bass, and treble equalizations. Control on the integrated CD, MP3, or XM Satellite Radio system is also available when equipped with these options. A VFD (vacuum florescent display) provides system feedback to the operator.

The radio processes the AM and FM signals from the antenna system or the information from the CD media, amplifies that information and sends the output to the speaker system.

The radio is located in the instrument panel center stack area and is fastened to the instrument panel by fasteners. A rear bullet type guide pin is provided to aid in aligning the radio. An electrical connection to the radio is a 30-way connector that is part of the I/P harness, antenna lead connector, and an additional 16-way harness connector is present on OnStar(R) equipped vehicles. Additional service length is provided in the radio harnesses to allow connection prior to radio installation.

Radio amplifier outputs to the speakers are protected from damage should speaker leads become shorted to ground or shorted to vehicle power. The radio will sense these conditions and shut down the amplifier outputs in a non-destructive manner. After the short condition is removed, the radio will return to normal operation.

Speakers

The speaker system consists of six speakers, two 6 inch speakers mounted in the doors. Two 3.5 inch speakers mounted in the back panels. Two one-inch tweeter speakers mounted in the A-pillars. The amplified speaker system adds a subwoofer and amplifier.

Subwoofer

The premium audio system includes a subwoofer that is mounted in the rear of the vehicle. The subwoofer is a single speaker designed for low frequency response. The subwoofer speaker is a dual coil design. The amplifier, which is included with the premium audio package amplifies the low frequency and outputs it to the subwoofer.

Auxiliary Jack Socket

The AM/FM Stereo CD radio shall provide a 3.5 mm Auxiliary stereo jack that will allow playback of audio signals from remote devices (e.g., portable tape player, IPOD, MP3 playback device, etc.).

OnStar(R)

OnStar(R) equipped (RPO UE1) vehicles use the radio amplifier and speaker system for voice communication from the OnStar(R) operator to the vehicle. Voice communication from the vehicle to the OnStar(R) operator is through the OnStar(R) microphone and module, which is not a part of the radio system.

When OnStar(R) begins operation, the radio volume is set to a preset level, auto tone preset for OnStar(R) becomes active and the fade control is adjusted to the full front speakers. The radio volume control can then be used to adjust the volume to a desired level.

The radio system and OnStar(R) system are connected through the 16-way connector at the back of the radio. Left and right channel OnStar(R) audio, mute control of radio functions by OnStar(R) and the audio signal ground are the circuits provided in the 16-way connector. Disconnecting the 16-way connector from the radio will isolate the radio system from the OnStar(R) system.

Voice communication from the vehicle to the OnStar(R) operator could be possible under this condition. However, the vehicle occupant will not be able to hear the OnStar(R) operator.

For more information regarding radio operation problems, refer to **Symptoms - Entertainment** and **Diagnostic System Check - Vehicle** .

Theft Deterrent

The radio theft deterrent system is intended to disable radio functionality if incorrect vehicle information is received by the radio. The radio disables functionality if the VIN information received by the radio does not match the VIN information that has been learned by the radio. A VIN sequence is the last 6 digits of the VIN. The radio receives this information in a GMLAN frame form.

The radio shall provide the following theft operating modes as part of the radio theft deterrent system:

- No VIN Mode - A radio that has not received or learned a VIN. In this mode the radio has limited functionality.
- Normal Mode - A radio has received a VIN sequence. The radio only learns the VIN sequence if the VIN sequence contained all 6 digits. In this mode the radio has full functionality.
- Theft Detected Mode - A radio that had previously learned a VIN sequence and subsequently received a VIN sequence not matching the learned sequence. In this mode the radio has limited functionality.

AM/FM Reception

Radio Signal

The radio signal is sent from a broadcast station and is then received by an antenna. The strength of the signal received depends on the following:

- The power output, or wattage, of the broadcasting station
- The location of the vehicle, or receiver, relative to the broadcast tower.
- Obstacles between the tower and the receiver
- Atmospheric conditions
- Which band, AM or FM, the station is broadcasting
- Type of antenna and the ground plane

AM Reception

The AM band has a lower frequency range than the FM band. These longer wavelengths:

- Bend around obstacles
- Follow the curvature of the earth
- May reflect, or skip, off of the ionosphere

The AM frequencies have longer range due to the ground wave. The ground wave follows the curvature of the earth and is affected by its conductivity. Greater conductivity equates to less signal loss, thus transmission over water is better than over land. The AM band has a range of 80-320 km (50-200 mi).

FM Reception

The shorter wavelengths of the higher frequency FM band:

- Reflect off obstacles
- Are absorbed by the ground
- Penetrate the ionosphere

Broadcasts in the FM band are limited to "line of sight" reception which is typically 40 km (25 mi). Even when out of a direct line of sight, the signal may be reflected into areas that would be in a "shadow" otherwise. Factors which affect the line of sight include:

- Height of the broadcast antenna
- Height of the receiving antenna
- Terrain and buildings in the broadcast path

XM Reception

XM satellite radio provides digital radio reception. The XM signal is broadcast from two satellites and, where necessary, terrestrial repeaters. The high power satellites allow the antenna to receive the XM signal even when foliage and other partial obstructions block the antennas view of the satellite. Terrestrial repeaters are used in dense urban areas. These repeaters will receive the satellite signal and re-broadcast them at much higher power levels in order to ensure reception in areas with densely packed tall buildings.

XM Satellite Radio

XM is a national satellite radio service that offers up to 100 coast to coast channels including music, news, sports, talk and children's programming. XM provides digital quality audio and text information, including song title and artist name. A service fee is required in order to receive the XM service. For more information, contact XM at www.xmradio.com or call 1-800-852-9696.

Digital Radio Receiver

The radio controls communicate with the digital radio receiver via the class 2 communication circuit. The digital radio receiver sends remote radio audio signals to the radio.

2006 ACCESSORIES & EQUIPMENT

Lighting Systems - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

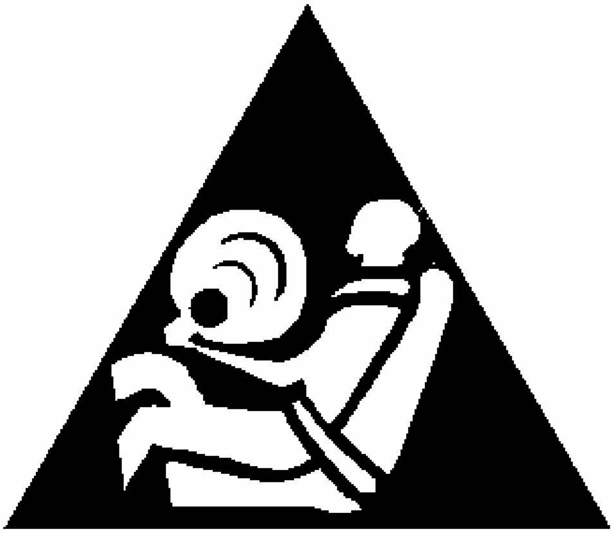
Application	Specification	
	Metric	English
Brake Pedal Position Sensor Bolt	2 N.m	18 lb in
Fog Lamp Nuts	2.5 N.m	22 lb in
Headlamp Bolts	2 N.m	18 lb in
High Mounted Stop Lamp Bolts	2 N.m	18 lb in
HVAC Control Screws	2.5 N.m	22 lb in
License Lamp Screws	2 N.m	18 lb in
Tail Lamp Screws	2 N.m	18 lb in

SCHEMATIC AND ROUTING DIAGRAMS

LIGHTING SYSTEMS SCHEMATIC ICONS

Lighting Systems Schematic Icons

Icon	Icon Definition
	CAUTION: **When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Refer to SIR DISABLING AND ENABLING ZONES . Failure to observe the correct procedure could cause deployment of the SIR components, personal injury, or unnecessary SIR system repairs.**

HEADLIGHTS/DAYTIME RUNNING LIGHTS (DRL) SCHEMATICS

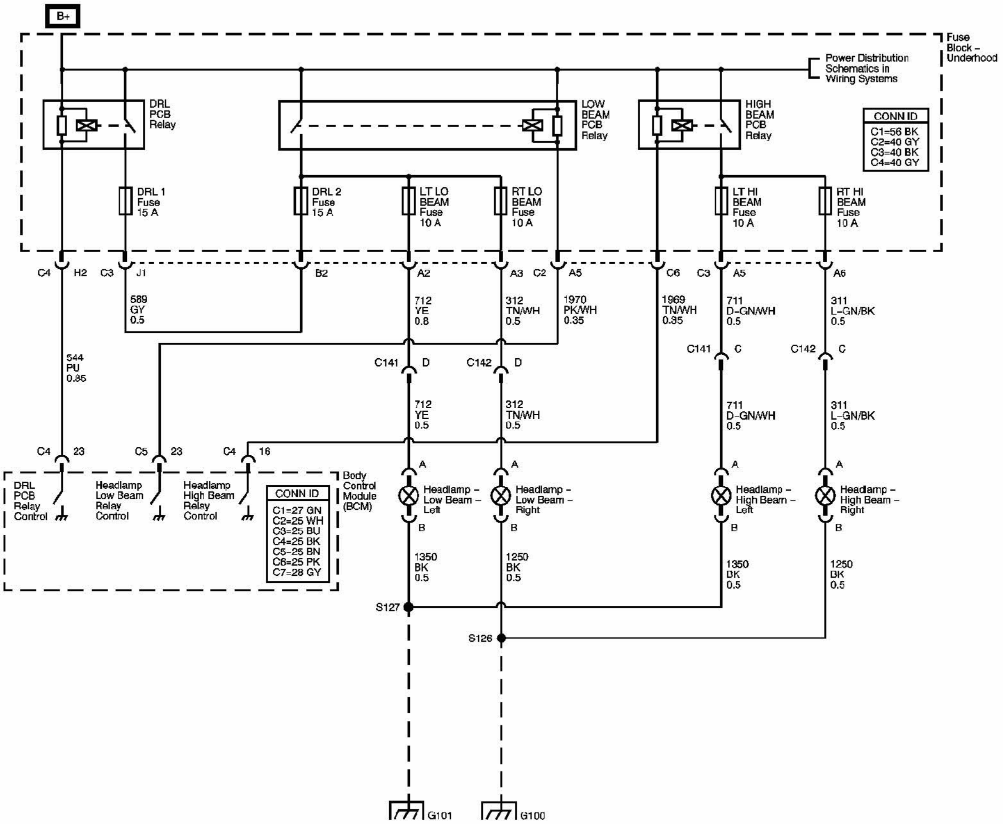

B+
Fuse Block – Underhood
Power Distribution Schematics in Wiring Systems
DRL PCB Relay
LOW BEAM PCB Relay
HIGH BEAM PCB Relay
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
DRL 1 Fuse 15 A
DRL 2 Fuse 15 A
LT LO BEAM Fuse 10 A
RT LO BEAM Fuse 10 A
LT HI BEAM Fuse 10 A
RT HI BEAM Fuse 10 A
C4 H2
C3 J1
B2
A2
A3
C2 A5
C6
C3 A5
A6
589 GY 0.5
712 YE 0.8
312 TN/WH 0.5
1970 PK/WH 0.35
1969 TN/WH 0.35
711 D-GN/WH 0.5
311 L-GN/BK 0.5
544 PU 0.35
C141 D
C142 D
C141 C
C142 C
712 YE 0.5
312 TN/WH 0.5
711 D-GN/WH 0.5
311 L-GN/BK 0.5
C4 23
C5 23
C4 16
DRL PCB Relay Control
Headlamp Low Beam Relay Control
Headlamp High Beam Relay Control
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Body Control Module (BCM)
A
Headlamp – Low Beam – Left
Headlamp – Low Beam – Right
Headlamp – High Beam – Left
Headlamp – High Beam – Right
B
1350 BK 0.5
1250 BK 0.5
1350 BK 0.5
1250 BK 0.5
S127
S126
G101
G100

Fig. 1: DRL Relay, Headlamps, And Power - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

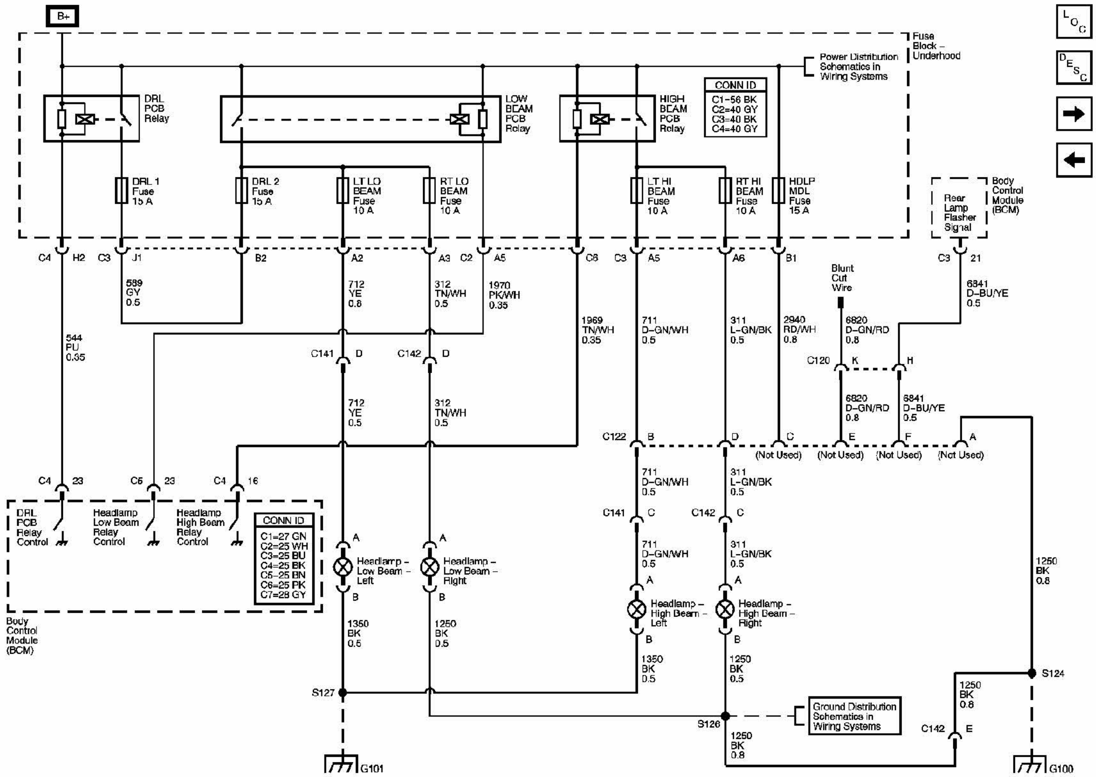

B+
Fuse Block - Underhood
Power Distribution Schematics in Wiring Systems
DRL PCB Relay
LOW BEAM PCB Relay
HIGH BEAM PCB Relay
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
DRL 1 Fuse 15 A
DRL 2 Fuse 15 A
LT LO BEAM Fuse 10 A
RT LO BEAM Fuse 10 A
LT HI BEAM Fuse 10 A
RT HI BEAM Fuse 10 A
HDLP MDL Fuse 15 A
Rear Lamp Flasher Signal
Body Control Module (BCM)
C4 H2
C3 J1
B2
A2
A3
C2 A5
C6
C3 A5
A6
B1
C3 21
589 GY 0.5
712 YE 0.8
312 TN/WH 0.5
1970 PK/WH 0.35
1969 TN/WH 0.35
711 D-GN/WH 0.5
311 L-GN/BK 0.5
2940 RD/WH 0.8
Blunt Cut Wire
6820 D-GN/RD 0.8
6841 D-BU/YE 0.5
544 PU 0.35
C141 D
C142 D
712 YE 0.5
312 TN/WH 0.5
C120 K H
6820 D-GN/RD 0.8
6841 D-BU/YE 0.5
C122 B D C E F A
(Not Used) (Not Used) (Not Used) (Not Used)
C4 23
C5 23
C4 16
DRL PCB Relay Control
Headlamp Low Beam Relay Control
Headlamp High Beam Relay Control
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Body Control Module (BCM)
711 D-GN/WH 0.5
311 L-GN/BK 0.5
C141 C
C142 C
711 D-GN/WH 0.5
311 L-GN/BK 0.5
A
Headlamp - Low Beam - Left
Headlamp - Low Beam - Right
Headlamp - High Beam - Left
Headlamp - High Beam - Right
B
1350 BK 0.5
1250 BK 0.5
1250 BK 0.8
S127
S124
S126
Ground Distribution Schematics in Wiring Systems
1250 BK 0.8
C142 E
G101
G100

Fig. 2: DRL Relay, Headlamps, And Power (9C1, 9C3) - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

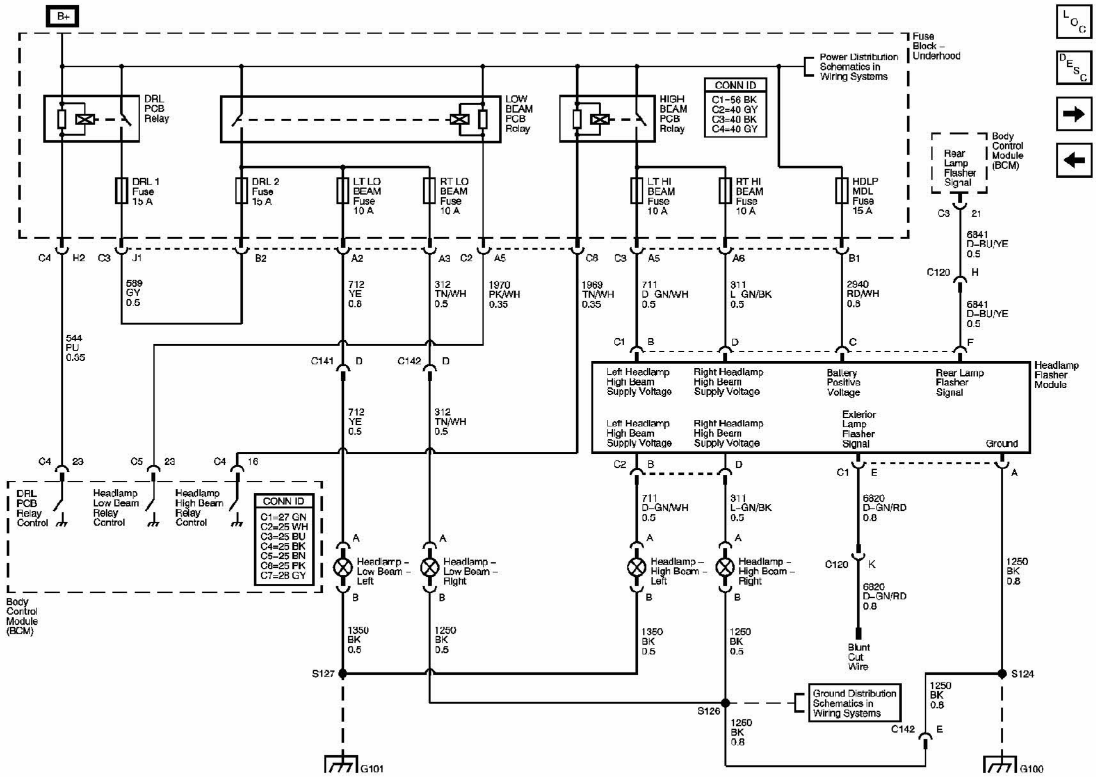

B+
Fuse Block - Underhood
Power Distribution Schematics in Wiring Systems
DRL PCB Relay
LOW BEAM PCB Relay
HIGH BEAM PCB Relay
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
DRL 1 Fuse 15 A
DRL 2 Fuse 15 A
LT LO BEAM Fuse 10 A
RT LO BEAM Fuse 10 A
LT HI BEAM Fuse 10 A
RT HI BEAM Fuse 10 A
HDLP MDL Fuse 15 A
Rear Lamp Flasher Signal
Body Control Module (BCM)
C3 21
C4 H2
C3 J1
B2
A2
A3
C2 A5
C6
C3 A5
A6
B1
589 GY 0.5
712 YE 0.8
312 TN/WH 0.5
1970 PK/WH 0.35
1969 TN/WH 0.35
711 D GN/WH 0.5
311 L GN/BK 0.5
2940 RD/WH 0.8
6841 D-BU/YE 0.5
C120 H
6841 D-BU/YE 0.5
544 PU 0.35
C1 B D C F
C141 D
C142 D
Left Headlamp High Beam Supply Voltage
Right Headlamp High Beam Supply Voltage
Battery Positive Voltage
Rear Lamp Flasher Signal
Headlamp Flasher Module
Left Headlamp High Beam Supply Voltage
Right Headlamp High Beam Supply Voltage
Exterior Lamp Flasher Signal
Ground
712 YE 0.5
312 TN/WH 0.5
C4 23
C5 23
C4 16
C2 B D
C1 E
A
DRL PCB Relay Control
Headlamp Low Beam Relay Control
Headlamp High Beam Relay Control
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Body Control Module (BCM)
711 D-GN/WH 0.5
311 L-GN/BK 0.5
6820 D-GN/RD 0.8
C120 K
6820 D-GN/RD 0.8
Blunt Cut Wire
1250 BK 0.8
A
Headlamp - Low Beam - Left
Headlamp - Low Beam - Right
Headlamp - High Beam - Left
Headlamp - High Beam - Right
B
1350 BK 0.5
1250 BK 0.5
S127
S124
S126
Ground Distribution Schematics in Wiring Systems
1250 BK 0.8
C142 E
G101
G100

Fig. 3: DRL Relay, Flasher, Headlamps, And Power (6J7) - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

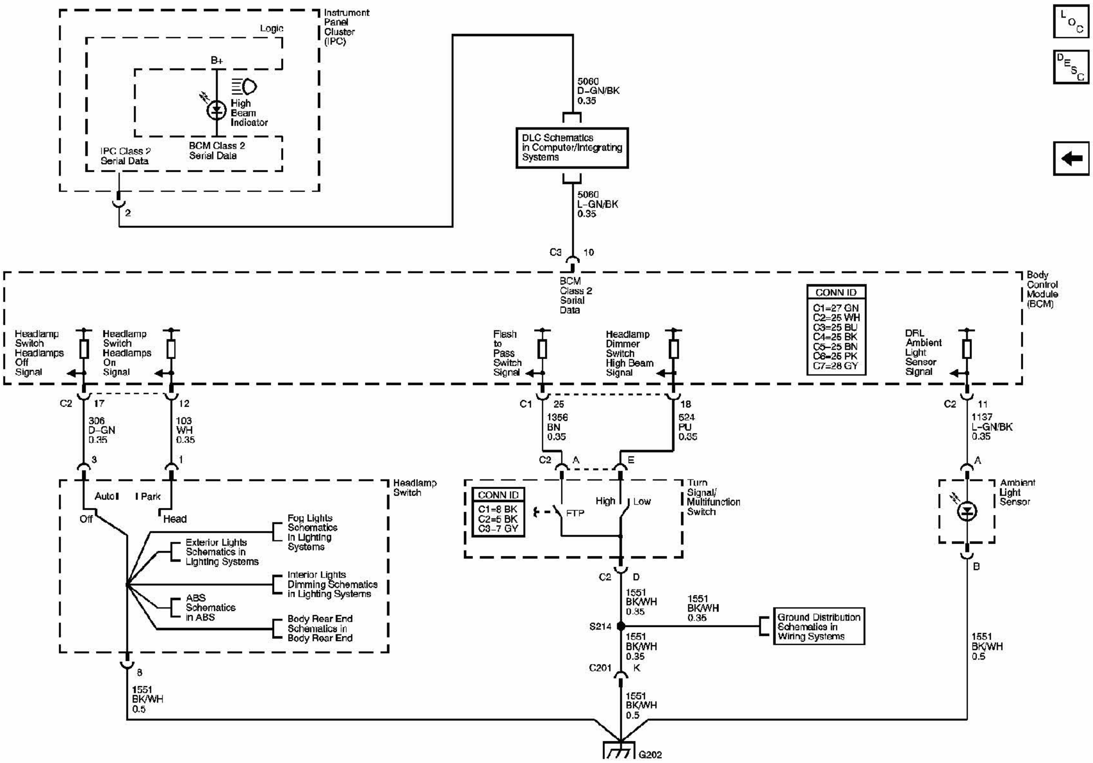

Instrument Panel Cluster (IPC)
Logic
B+
High Beam Indicator
IPC Class 2 Serial Data
BCM Class 2 Serial Data
2
5060 D-GN/BK 0.35
DLC Schematics in Computer/Integrating Systems
5060 L-GN/BK 0.35
C3 10
BCM Class 2 Serial Data
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Body Control Module (BCM)
Headlamp Switch Headlamps Off Signal
Headlamp Switch Headlamps On Signal
Flash to Pass Switch Signal
Headlamp Dimmer Switch High Beam Signal
DRL Ambient Light Sensor Signal
C2 17
306 D-GN 0.35
12
103 WH 0.35
C1 25
1356 BN 0.35
18
524 PU 0.35
C2 11
1137 L-GN/BK 0.35
3
1
C2 A
E
A
Headlamp Switch
Auto
Park
Off
Head
Fog Lights Schematics in Lighting Systems
Exterior Lights Schematics in Lighting Systems
Interior Lights Dimming Schematics in Lighting Systems
ABS Schematics in ABS
Body Rear End Schematics in Body Rear End
8
1551 BK/WH 0.5
CONN ID
C1=8 BK
C2=5 BK
C3-7 GY
FTP
High
Low
Turn Signal/ Multifunction Switch
Ambient Light Sensor
B
C2 D
1551 BK/WH 0.35
1551 BK/WH 0.35
Ground Distribution Schematics in Wiring Systems
S214
1551 BK/WH 0.35
C201 K
1551 BK/WH 0.5
1551 BK/WH 0.5
G202

Fig. 4: Switches - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

FOG LIGHTS SCHEMATICS

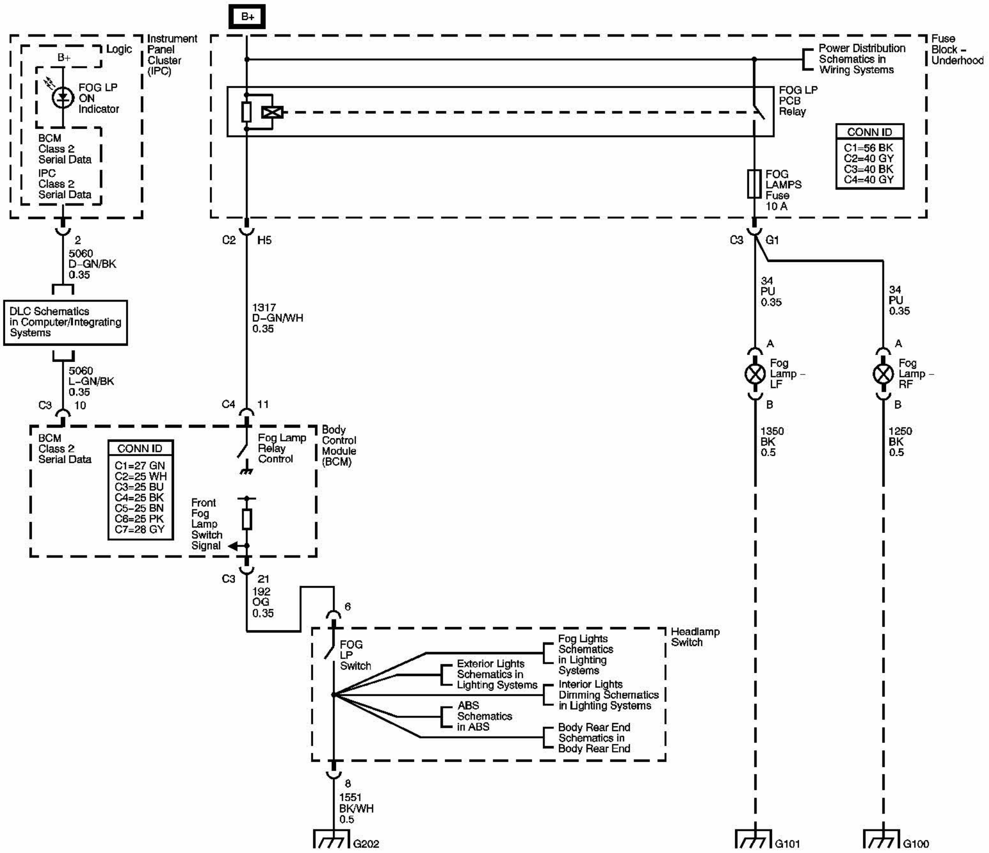

B+
Logic
B+
FOG LP ON Indicator
BCM Class 2 Serial Data
IPC Class 2 Serial Data
Instrument Panel Cluster (IPC)
Power Distribution Schematics in Wiring Systems
Fuse Block - Underhood
FOG LP PCB Relay
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
FOG LAMPS Fuse 10 A
2
5060
D-GN/BK
0.35
DLC Schematics in Computer/Integrating Systems
5060
L-GN/BK
0.35
C3
10
C2
H5
1317
D-GN/WH
0.35
C4
11
C3
G1
34
PU
0.35
34
PU
0.35
A
Fog Lamp - LF
B
A
Fog Lamp - RF
B
1350
BK
0.5
1250
BK
0.5
BCM Class 2 Serial Data
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Fog Lamp Relay Control
Body Control Module (BCM)
Front Fog Lamp Switch Signal
C3
21
192
OG
0.35
6
FOG LP Switch
Exterior Lights Schematics in Lighting Systems
Fog Lights Schematics in Lighting Systems
Interior Lights Dimming Schematics in Lighting Systems
ABS Schematics in ABS
Body Rear End Schematics in Body Rear End
Headlamp Switch
8
1551
BK/WH
0.5
G202
G101
G100

Fig. 5: Fog Lights - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

EXTERIOR LIGHTS SCHEMATICS

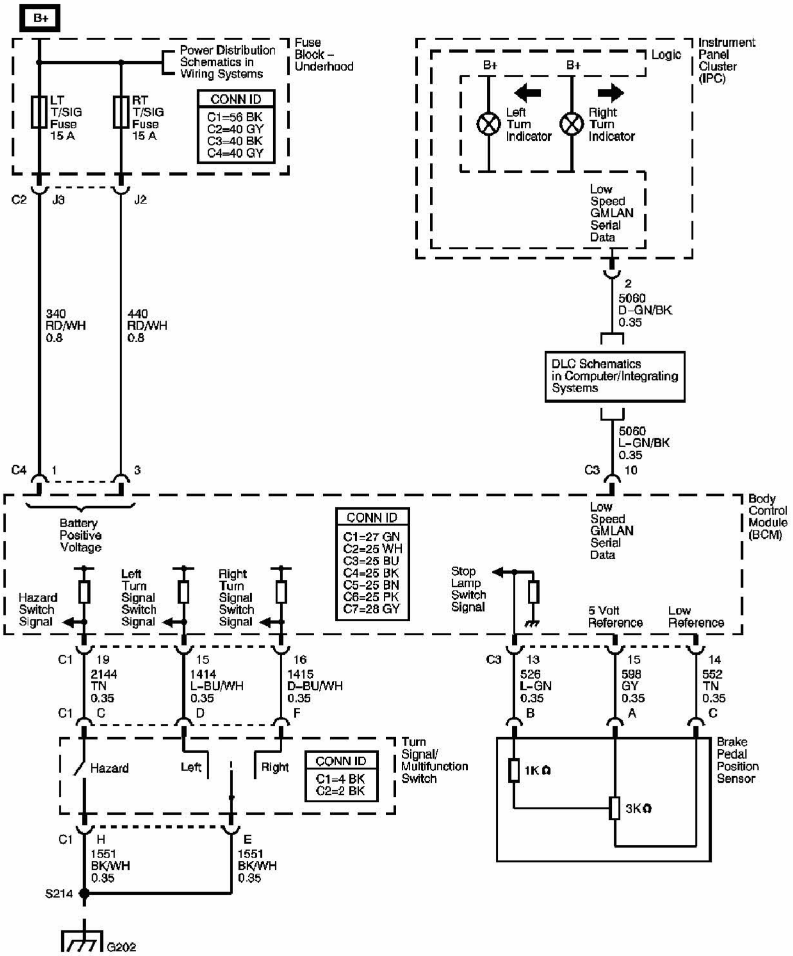

B+
Power Distribution Schematics in Wiring Systems
Fuse Block - Underhood
LT T/SIG Fuse 15 A
RT T/SIG Fuse 15 A
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
C2
J3
J2
340
RD/WH
0.8
440
RD/WH
0.8
C4
1
3
Instrument Panel Cluster (IPC)
Logic
B+
B+
Left Turn Indicator
Right Turn Indicator
Low Speed GMLAN Serial Data
2
5060
D-GN/BK
0.35
DLC Schematics in Computer/Integrating Systems
5060
L-GN/BK
0.35
C3
10
Body Control Module (BCM)
Battery Positive Voltage
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Low Speed GMLAN Serial Data
Hazard Switch Signal
Left Turn Signal Switch Signal
Right Turn Signal Switch Signal
Stop Lamp Switch Signal
5 Volt Reference
Low Reference
C1
19
2144
TN
0.35
15
1414
L-BU/WH
0.35
16
1415
D-BU/WH
0.35
C3
13
526
L-GN
0.35
15
598
GY
0.35
14
552
TN
0.35
C1
C
D
F
B
A
C
Hazard
Left
Right
CONN ID
C1=4 BK
C2=2 BK
Turn Signal/ Multifunction Switch
1K Ω
3K Ω
Brake Pedal Position Sensor
C1
H
1551
BK/WH
0.35
E
1551
BK/WH
0.35
S214
G202

Fig. 6: Turn Signal, Hazard, And Stop Lamps Inputs - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

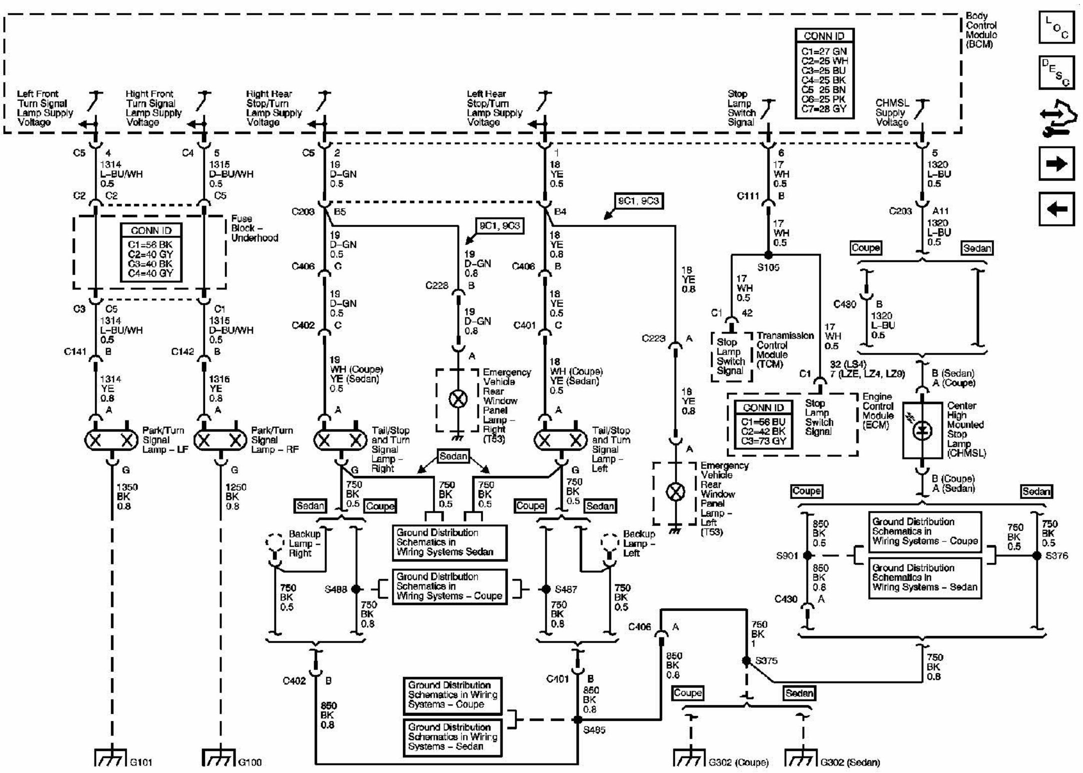

Body Control Module (BCM)
CONN ID C1=27 GN C2=25 WH C3=25 BU C4=25 BK C5 25 BN C6=25 PK C7=28 GY
Left Front Turn Signal Lamp Supply Voltage
Right Front Turn Signal Lamp Supply Voltage
Right Rear Stop/Turn Lamp Supply Voltage
Left Rear Stop/Turn Lamp Supply Voltage
Stop Lamp Switch Signal
CHMSL Supply Voltage
Fuse Block – Underhood
CONN ID C1=56 BK C2=40 GY C3=40 BK C4=40 GY
1314 L-BU/WH 0.5
1315 D-BU/WH 0.5
19 D-GN 0.5
18 YE 0.5
17 WH 0.5
1320 L-BU 0.5
Park/Turn Signal Lamp – LF
Park/Turn Signal Lamp – RF
Tail/Stop and Turn Signal Lamp – Right
Tail/Stop and Turn Signal Lamp – Left
Emergency Vehicle Rear Window Panel Lamp – Right (T53)
Emergency Vehicle Rear Window Panel Lamp – Left (T53)
Transmission Control Module (TCM)
Stop Lamp Switch Signal
Engine Control Module (ECM)
CONN ID C1=56 BU C2=42 BK C3=73 GY
Center High Mounted Stop Lamp (CHMSL)
Backup Lamp – Right
Backup Lamp – Left
Ground Distribution Schematics in Wiring Systems Sedan
Ground Distribution Schematics in Wiring Systems – Coupe
Coupe
Sedan
G101
G100
G302 (Coupe)
G302 (Sedan)

Fig. 7: Turn Signal, Hazard, And Stop Lamps Outputs - Wiring Diagram
Courtesy of GENERAL NOTORS CORP.

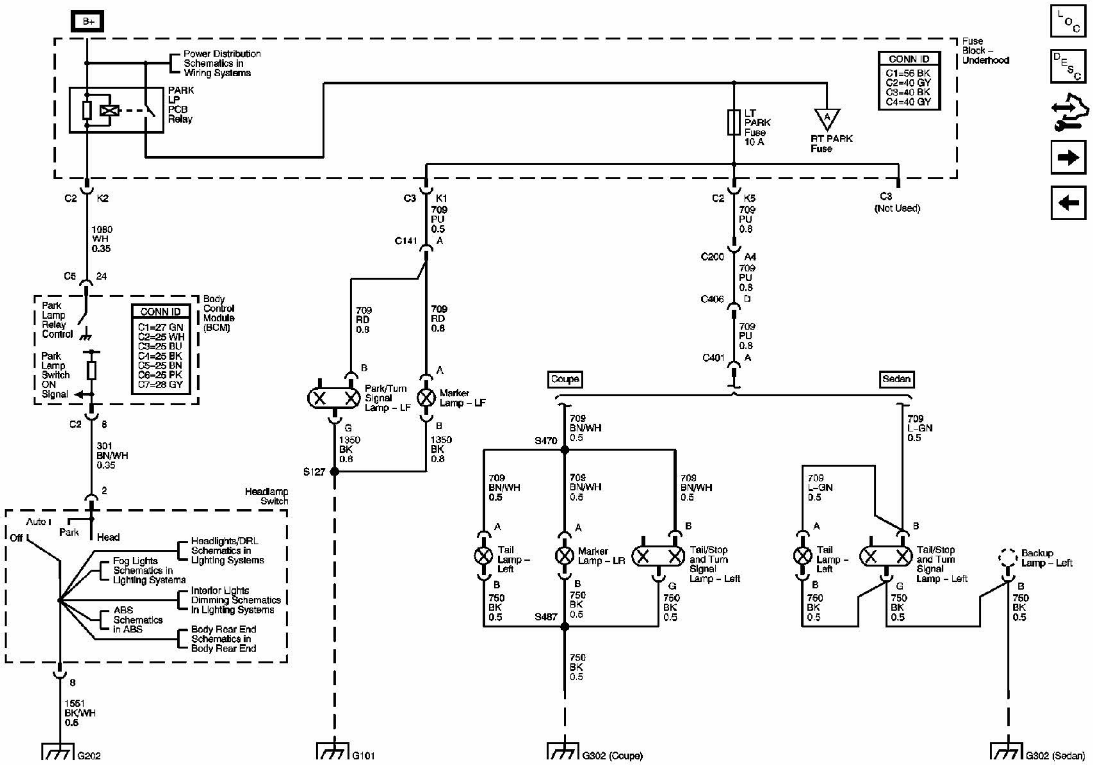

B+
Power Distribution Schematics in Wiring Systems
PARK LP PCB Relay
LT PARK Fuse 10 A
RT PARK Fuse
Fuse Block – Underhood
CONN ID C1=56 BK C2=40 GY C3=40 BK C4=40 GY
C3 (Not Used)
1060 WH 0.35
Park Lamp Relay Control
Park Lamp Switch ON Signal
Body Control Module (BCM)
CONN ID C1=27 GN C2=25 WH C3=25 BU C4=25 BK C5=25 BN C6=25 PK C7=28 GY
301 BN/WH 0.35
Headlamp Switch
Auto
Off
Park
Head
Headlights/DRL Schematics in Lighting Systems
Fog Lights Schematics in Lighting Systems
Interior Lights Dimming Schematics in Lighting Systems
ABS Schematics in ABS
Body Rear End Schematics in Body Rear End
1551 BK/WH 0.5
709 PU 0.5
709 RD 0.8
Park/Turn Signal Lamp – LF
Marker Lamp – LF
1350 BK 0.8
Coupe
Sedan
709 BN/WH 0.5
709 L-GN 0.5
Tail Lamp – Left
Marker Lamp – LR
Tail/Stop and Turn Signal Lamp – Left
Backup Lamp – Left
750 BK 0.5
G202
G101
G302 (Coupe)
G302 (Sedan)

Fig. 8: Park Lamps - Wiring Diagram (1 of 2)
Courtesy of GENERAL MOTORS CORP.

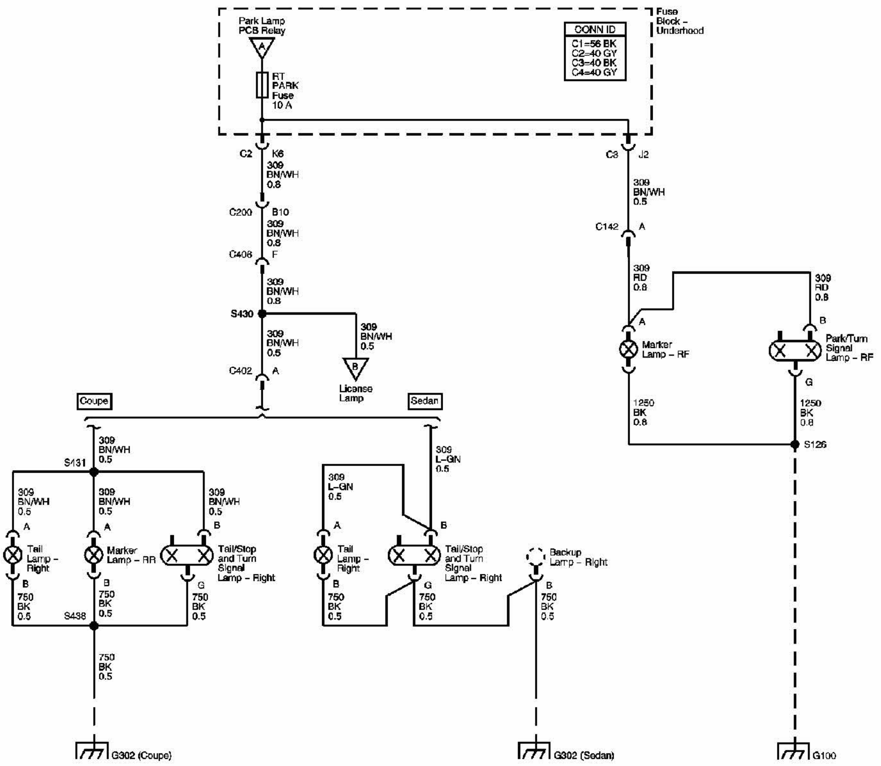

Park Lamp PCB Relay
A
RT PARK Fuse 10 A
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
Fuse Block - Underhood
C2
K6
309 BN/WH 0.8
C200
B10
309 BN/WH 0.8
C406
F
309 BN/WH 0.8
S430
309 BN/WH 0.5
C402
A
309 BN/WH 0.5
B
License Lamp
Coupe
Sedan
309 BN/WH 0.5
S431
309 BN/WH 0.5
A
Tail Lamp - Right
B
750 BK 0.5
309 BN/WH 0.5
A
Marker Lamp - RR
B
750 BK 0.5
S438
309 BN/WH 0.5
B
Tail/Stop and Turn Signal Lamp - Right
G
750 BK 0.5
750 BK 0.5
G302 (Coupe)
309 L-GN 0.5
309 L-GN 0.5
A
Tail Lamp - Right
B
750 BK 0.5
B
Tail/Stop and Turn Signal Lamp - Right
G
750 BK 0.5
Backup Lamp - Right
B
750 BK 0.5
G302 (Sedan)
C3
J2
309 BN/WH 0.5
C142
A
309 RD 0.8
A
Marker Lamp - RF
1250 BK 0.8
309 RD 0.8
B
Park/Turn Signal Lamp - RF
G
1250 BK 0.8
S126
G100

Fig. 9: Park Lamps - Wiring Diagram (2 of 2)
Courtesy of GENERAL MOTORS CORP.

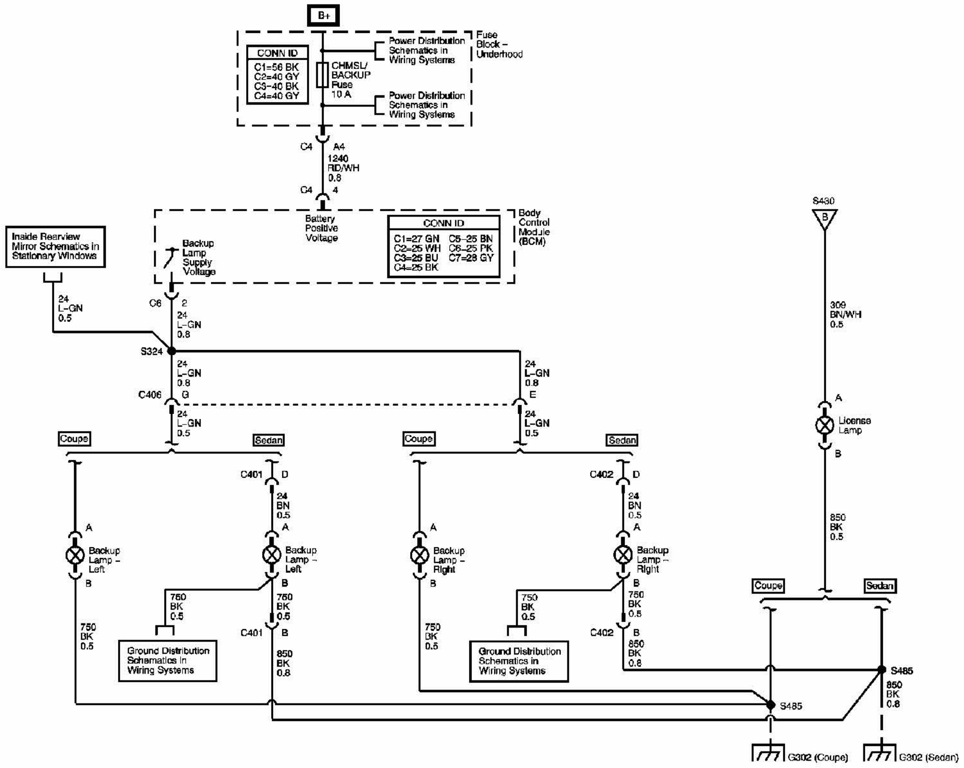

B+
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
Power Distribution Schematics in Wiring Systems
CHMSL/ BACKUP Fuse 10 A
Power Distribution Schematics in Wiring Systems
Fuse Block – Underhood
C4
A4
1240
RD/WH
0.8
C4
4
Battery Positive Voltage
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Body Control Module (BCM)
Inside Rearview Mirror Schematics in Stationary Windows
Backup Lamp Supply Voltage
24
L-GN
0.5
C6
2
24
L-GN
0.8
S324
24
L-GN
0.8
C406
G
24
L-GN
0.5
24
L-GN
0.8
E
24
L-GN
0.5
Coupe
Sedan
Coupe
Sedan
C401
D
24
BN
0.5
A
Backup Lamp – Left
A
Backup Lamp – Left
B
B
750
BK
0.5
750
BK
0.5
C401
B
850
BK
0.8
750
BK
0.5
Ground Distribution Schematics in Wiring Systems
C402
D
24
BN
0.5
A
Backup Lamp – Right
A
Backup Lamp – Right
B
B
750
BK
0.5
750
BK
0.5
C402
B
850
BK
0.8
750
BK
0.5
Ground Distribution Schematics in Wiring Systems
S430
B
309
BN/WH
0.5
A
License Lamp
B
850
BK
0.5
Coupe
Sedan
S485
850
BK
0.8
S485
G302 (Coupe)
G302 (Sedan)

Fig. 10: Backup, And License Lamps - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

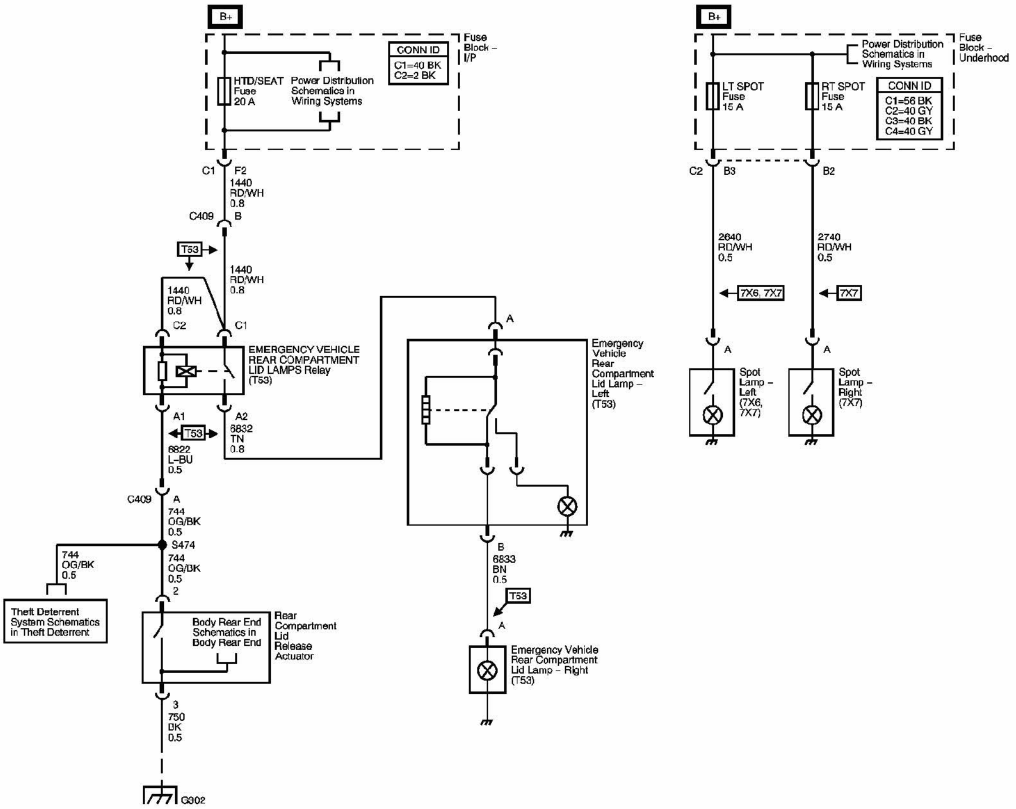

B+
Fuse Block – I/P
CONN ID
C1=40 BK
C2=2 BK
HTD/SEAT Fuse 20 A
Power Distribution Schematics in Wiring Systems
C1 F2
1440 RD/WH 0.8
C409 B
T53
1440 RD/WH 0.8
1440 RD/WH 0.8
C2
C1
EMERGENCY VEHICLE REAR COMPARTMENT LID LAMPS Relay (T53)
A1
A2
T53
6822 L-BU 0.5
6832 TN 0.8
C409 A
744 OG/BK 0.5
S474
744 OG/BK 0.5
744 OG/BK 0.5
2
Theft Deterrent System Schematics in Theft Deterrent
Body Rear End Schematics in Body Rear End
Rear Compartment Lid Release Actuator
3
750 BK 0.5
G302
A
Emergency Vehicle Rear Compartment Lid Lamp – Left (T53)
B
6833 BN 0.5
T53
A
Emergency Vehicle Rear Compartment Lid Lamp – Right (T53)
B+
Power Distribution Schematics in Wiring Systems
Fuse Block – Underhood
LT SPOT Fuse 15 A
RT SPOT Fuse 15 A
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
C2 B3
B2
2640 RD/WH 0.5
2740 RD/WH 0.5
7X6, 7X7
7X7
A
A
Spot Lamp – Left (7X6, 7X7)
Spot Lamp – Right (7X7)

Fig. 11: Emergency Vehicle Rear Compartment Lid Lamps, And Spot Lamps - T53, 7X6, 7X7 - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

INTERIOR LIGHTS SCHEMATICS

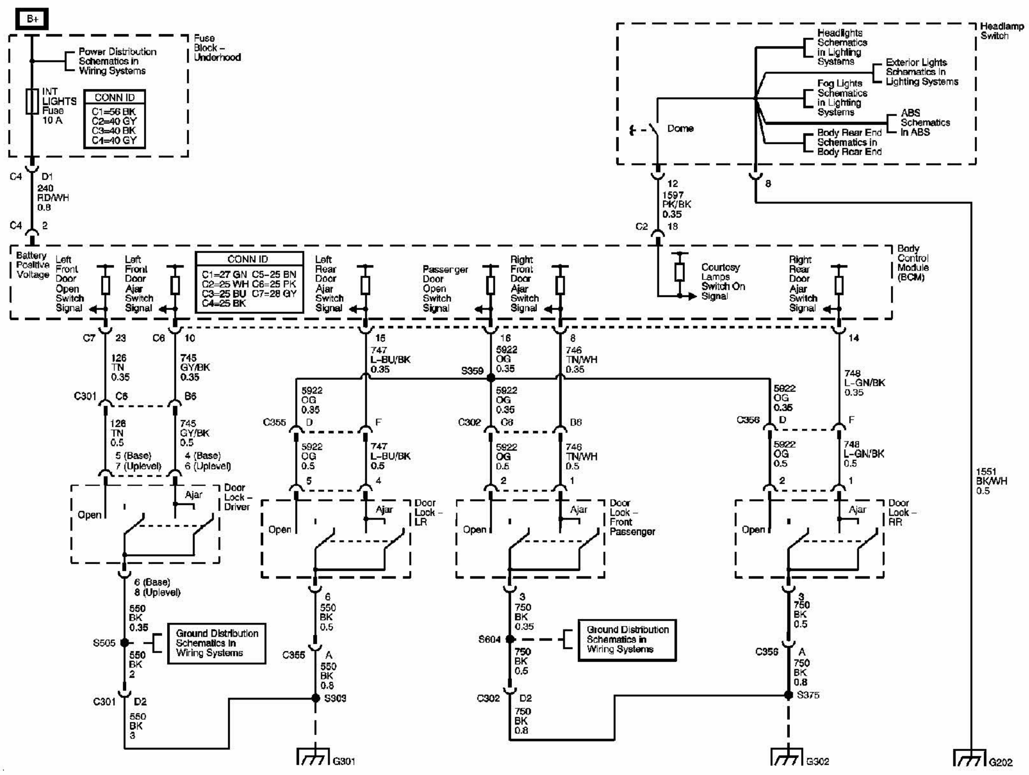

B+
Power Distribution Schematics in Wiring Systems
Fuse Block – Underhood
INT LIGHTS Fuse 10 A
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
C4 D1
240 RD/WH 0.8
C4 2
Battery Positive Voltage
Left Front Door Open Switch Signal
Left Front Door Ajar Switch Signal
CONN ID
C1=27 GN C5=25 BN
C2=25 WH C6=25 PK
C3=25 BU C7=28 GY
C4=25 BK
Left Rear Door Ajar Switch Signal
Passenger Door Open Switch Signal
Right Front Door Ajar Switch Signal
Courtesy Lamps Switch On Signal
Right Rear Door Ajar Switch Signal
Body Control Module (BCM)
Headlamp Switch
Headlights Schematics in Lighting Systems
Exterior Lights Schematics in Lighting Systems
Fog Lights Schematics in Lighting Systems
ABS Schematics in ABS
Body Rear End Schematics in Body Rear End
Dome
12
1597 PK/BK 0.35
C2 18
8
1551 BK/WH 0.5
C7 23
126 TN 0.35
C6 10
745 GY/BK 0.35
15
747 L-BU/BK 0.35
16
5922 OG 0.35
S359
8
746 TN/WH 0.35
14
748 L-GN/BK 0.35
C301 C5
B6
126 TN 0.5
745 GY/BK 0.5
5 (Base) 7 (Uplevel)
4 (Base) 6 (Uplevel)
Open
Ajar
Door Lock – Driver
5922 OG 0.35
C355 D
F
5922 OG 0.5
747 L-BU/BK 0.5
5
4
Door Lock – LR
C302 C8
B8
5922 OG 0.5
746 TN/WH 0.5
2
1
Door Lock – Front Passenger
C356 D
F
5922 OG 0.5
748 L-GN/BK 0.5
Door Lock – RR
6 (Base) 8 (Uplevel)
550 BK 0.35
S505
Ground Distribution Schematics in Wiring Systems
550 BK 2
C301 D2
550 BK 3
6
550 BK 0.5
C355 A
550 BK 0.8
S303
G301
3
750 BK 0.35
S604
750 BK 0.5
C302 D2
750 BK 0.8
3
750 BK 0.5
C356 A
750 BK 0.8
S375
G302
G202

Fig. 12: Switches (Sedan) - Wiring Diagram

Courtesy of GENERAL MOTORS CORP.

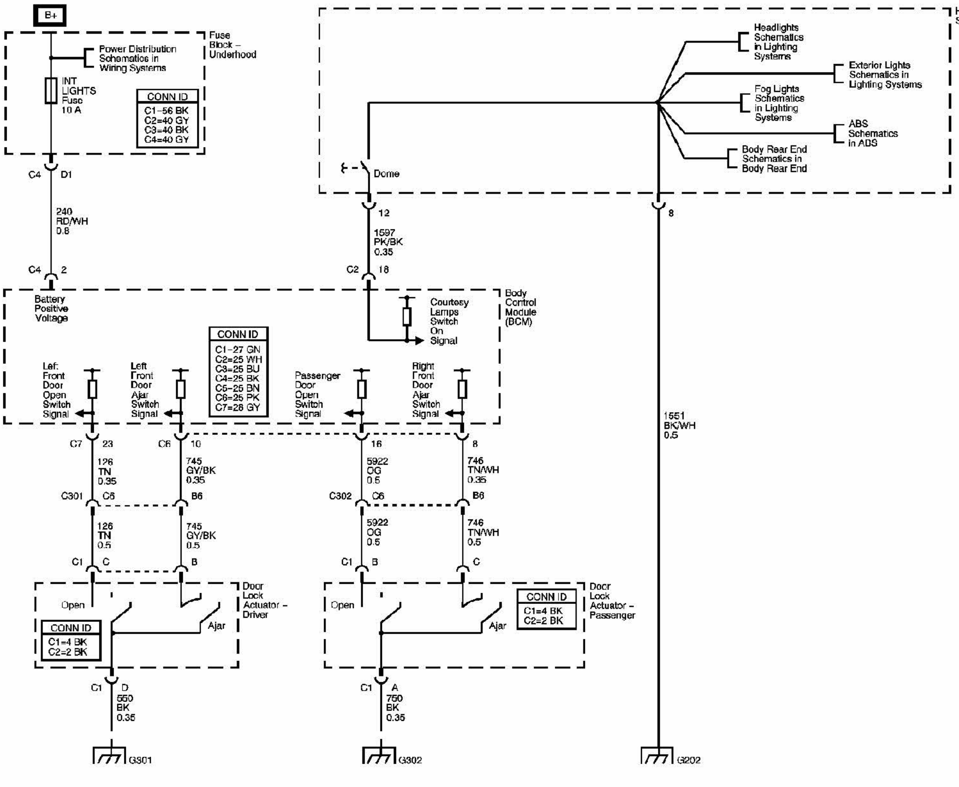

B+
Power Distribution Schematics in Wiring Systems
Fuse Block – Underhood
INT LIGHTS Fuse 10 A
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
C4 D1
240 RD/WH 0.8
C4 2
Headlamp Switch
Headlights Schematics in Lighting Systems
Exterior Lights Schematics in Lighting Systems
Fog Lights Schematics in Lighting Systems
ABS Schematics in ABS
Body Rear End Schematics in Body Rear End
Dome
12
8
1597 PK/BK 0.35
C2 18
Battery Positive Voltage
Courtesy Lamps Switch On Signal
Body Control Module (BCM)
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Left Front Door Open Switch Signal
Left Front Door Ajar Switch Signal
Passenger Door Open Switch Signal
Right Front Door Ajar Switch Signal
1551 BK/WH 0.5
C7 23
126 TN 0.35
C6 10
745 GY/BK 0.35
16
5922 OG 0.5
8
746 TN/WH 0.35
C301 C5
B6
C302 C6
B6
126 TN 0.5
745 GY/BK 0.5
5922 OG 0.5
746 TN/WH 0.5
C1 C
B
C1 B
C
Open
Ajar
Door Lock Actuator – Driver
CONN ID
C1=4 BK
C2=2 BK
Door Lock Actuator – Passenger
CONN ID
C1=4 BK
C2=2 BK
C1 D
550 BK 0.35
C1 A
750 BK 0.35
G301
G302
G202

Fig. 13: Switches (Coupe) - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

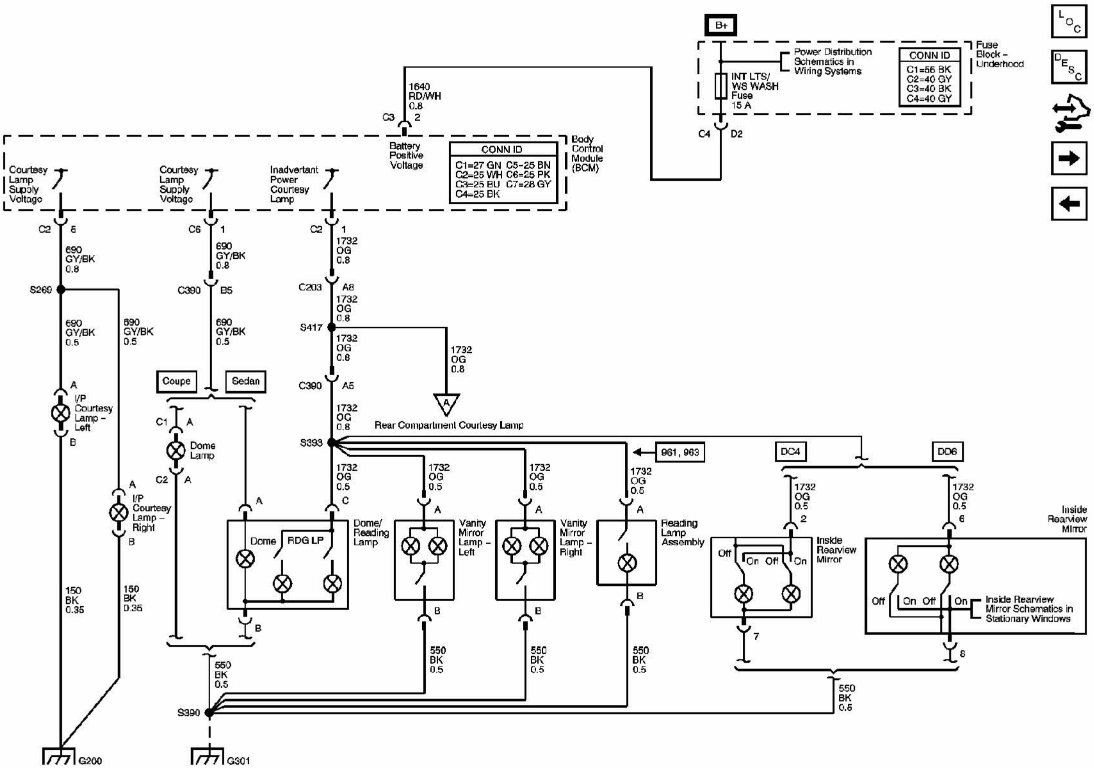

B+
Power Distribution Schematics in Wiring Systems
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
Fuse Block - Underhood
INT LTS/ WS WASH Fuse 15 A
C4
D2
1640 RD/WH 0.8
C3
2
Battery Positive Voltage
CONN ID
C1=27 GN C5=25 BN
C2=25 WH C6=25 PK
C3=25 BU C7=28 GY
C4=25 BK
Body Control Module (BCM)
Courtesy Lamp Supply Voltage
Courtesy Lamp Supply Voltage
Inadvertant Power Courtesy Lamp
C2
6
690 GY/BK 0.8
C6
1
690 GY/BK 0.8
C2
1
1732 OG 0.8
S269
690 GY/BK 0.5
690 GY/BK 0.5
C390
B5
690 GY/BK 0.5
C203
A8
1732 OG 0.8
S417
1732 OG 0.8
1732 OG 0.8
C390
A5
Rear Compartment Courtesy Lamp
A
I/P Courtesy Lamp - Left
B
Coupe
Sedan
C1
A
Dome Lamp
C2
A
I/P Courtesy Lamp - Right
B
S393
1732 OG 0.5
961, 963
DC4
DD6
Dome
RDG LP
Dome/ Reading Lamp
C
Vanity Mirror Lamp - Left
Vanity Mirror Lamp - Right
Reading Lamp Assembly
Off
On
Off
On
Inside Rearview Mirror
Inside Rearview Mirror
Off
On
Off
On
Inside Rearview Mirror Schematics in Stationary Windows
150 BK 0.35
150 BK 0.35
550 BK 0.5
S390
550 BK 0.5
7
8
G200
G301

Fig. 14: Interior Lights - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

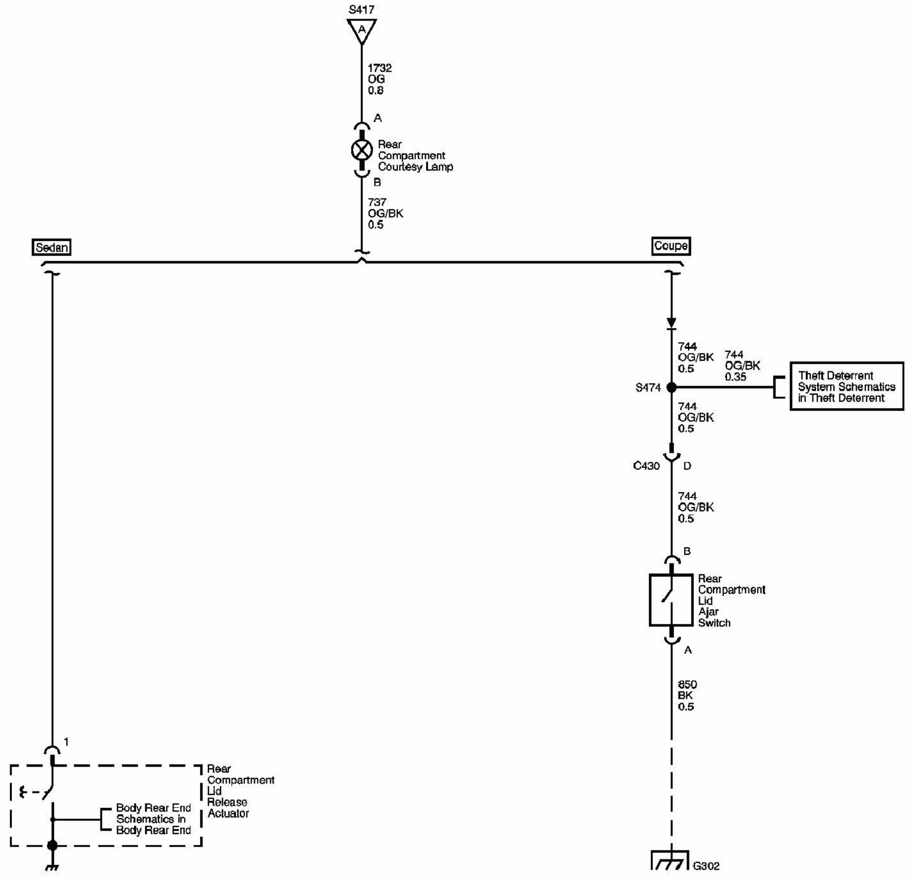

S417
A
1732
OG
0.8
A
Rear
Compartment
Courtesy Lamp
B
737
OG/BK
0.5
Sedan
Coupe
744
OG/BK
0.5
744
OG/BK
0.35
S474
Theft Deterrent
System Schematics
in Theft Deterrent
744
OG/BK
0.5
C430
D
744
OG/BK
0.5
B
Rear
Compartment
Lid
Ajar
Switch
A
850
BK
0.5
G302
1
Rear
Compartment
Lid
Release
Actuator
Body Rear End
Schematics in
Body Rear End

Fig. 15: Rear Compartment Lights - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

INTERIOR LIGHTS DIMMING SCHEMATICS

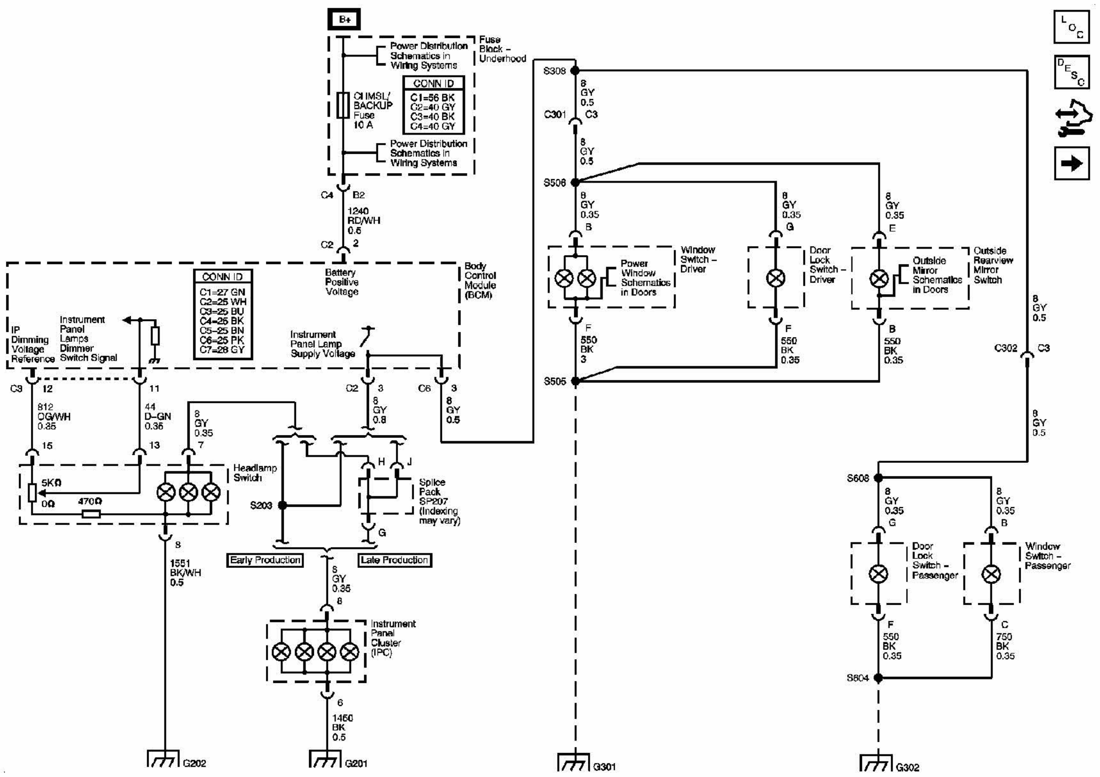

B+
Power Distribution Schematics in Wiring Systems
Fuse Block - Underhood
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
CHMSL/ BACKUP Fuse 10 A
C4 B2
1240 RD/WH 0.5
C2 2
Battery Positive Voltage
Body Control Module (BCM)
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
IP Dimming Voltage Reference
Instrument Panel Lamps Dimmer Switch Signal
Instrument Panel Lamp Supply Voltage
C3 12
812 OG/WH 0.35
15
11
44 D-GN 0.35
13
8 GY 0.35 7
C2 3
8 GY 0.8
C6 3
8 GY 0.5
Headlamp Switch
5KΩ
0Ω
470Ω
8
1551 BK/WH 0.5
S203
Splice Pack SP207 (Indexing may vary)
H J G
Early Production
Late Production
8 GY 0.35 8
Instrument Panel Cluster (IPC)
6
1450 BK 0.5
G202
G201
S308
8 GY 0.5
C301 C3
8 GY 0.5
S506
8 GY 0.35 B
Window Switch - Driver
Power Window Schematics in Doors
F
550 BK 3
8 GY 0.35 G
Door Lock Switch - Driver
F
550 BK 0.35
8 GY 0.35 E
Outside Rearview Mirror Switch
Outside Mirror Schematics in Doors
B
550 BK 0.35
S505
G301
8 GY 0.5
C302 C3
8 GY 0.5
S608
8 GY 0.35 G
Door Lock Switch - Passenger
F
550 BK 0.35
8 GY 0.35 B
Window Switch - Passenger
C
750 BK 0.35
S604
G302
L O C
D E S C

Fig. 16: Coupe - Wiring Diagram
Courtesy of GENERAL MOTORS CORP

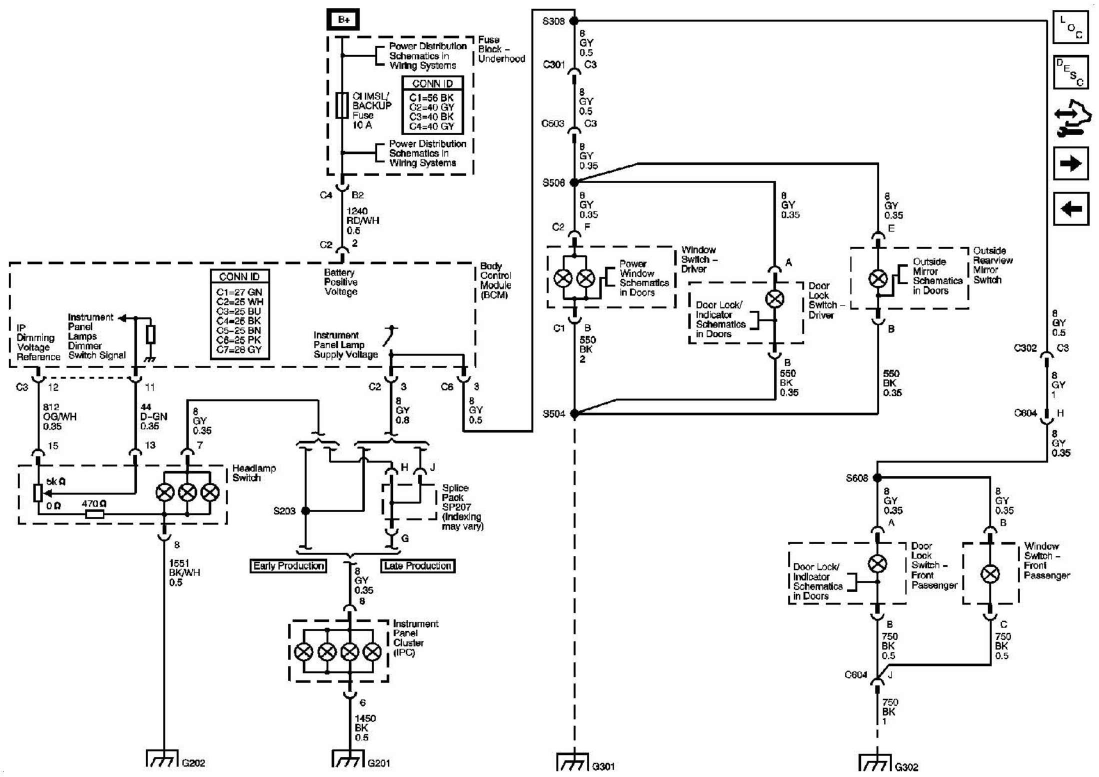

B+
Power Distribution Schematics in Wiring Systems
Fuse Block - Underhood
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
CHMSL/ BACKUP Fuse 10 A
C4 B2
1240 RD/WH 0.5
C2 2
Battery Positive Voltage
Body Control Module (BCM)
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
IP Dimming Voltage Reference
Instrument Panel Lamps Dimmer Switch Signal
Instrument Panel Lamp Supply Voltage
C3 12
812 OG/WH 0.35
15
11
44 D-GN 0.35
13
8 GY 0.35 7
C2 3
8 GY 0.8
C6 3
8 GY 0.5
Headlamp Switch
5kΩ
0Ω
470Ω
8
1551 BK/WH 0.5
S203
Splice Pack SP207 (Indexing may vary)
H J G
Early Production
Late Production
8 GY 0.35 8
Instrument Panel Cluster (IPC)
6
1450 BK 0.5
G202
G201
S308
8 GY 0.5
C301 C3
8 GY 0.5
C503 C3
8 GY 0.35
S506
8 GY 0.35
C2 F
Window Switch - Driver
Power Window Schematics in Doors
C1 B
550 BK 2
8 GY 0.35 A
Door Lock/ Indicator Schematics in Doors
Door Lock Switch - Driver
B
550 BK 0.35
8 GY 0.35 E
Outside Rearview Mirror Switch
Outside Mirror Schematics in Doors
B
550 BK 0.35
S504
G301
8 GY 0.5
C302 C3
8 GY 1
C604 H
8 GY 0.35
S608
8 GY 0.35 A
Door Lock Switch - Front Passenger
Door Lock/ Indicator Schematics in Doors
B
750 BK 0.5
8 GY 0.35 B
Window Switch - Front Passenger
C
750 BK 0.5
C604 J
750 BK 1
G302
L O C
D E S C

Fig. 17: Sedan - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

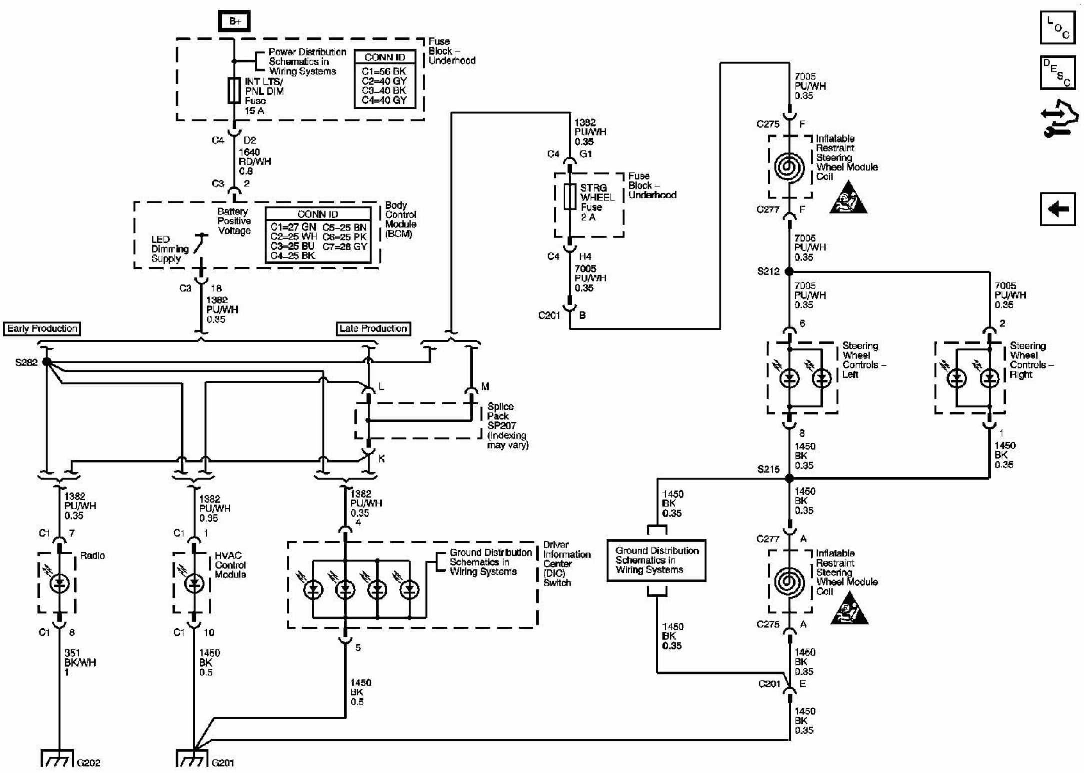

B+
Power Distribution Schematics in Wiring Systems
INT LTS/ PNL DIM Fuse 15 A
CONN ID
C1=56 BK
C2=40 GY
C3-40 BK
C4=40 GY
Fuse Block – Underhood
C4
D2
1640 RD/WH 0.8
C3
2
Battery Positive Voltage
LED Dimming Supply
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4-25 BK
C5-25 BN
C6=25 PK
C7=28 GY
Body Control Module (BCM)
C3
18
1382 PU/WH 0.35
Early Production
Late Production
S282
L
M
Splice Pack SP207 (Indexing may vary)
K
1382 PU/WH 0.35
C1
7
Radio
C1
8
351 BK/WH 1
G202
1382 PU/WH 0.35
C1
1
HVAC Control Module
C1
10
1450 BK 0.5
G201
1382 PU/WH 0.35
4
Ground Distribution Schematics in Wiring Systems
Driver Information Center (DIC) Switch
5
1450 BK 0.5
1382 PU/WH 0.35
C4
G1
STRG WHEEL Fuse 2 A
Fuse Block – Underhood
C4
H4
7005 PU/WH 0.35
C201
B
7005 PU/WH 0.35
C275
F
Inflatable Restraint Steering Wheel Module Coil
C277
F
7005 PU/WH 0.35
S212
7005 PU/WH 0.35
6
Steering Wheel Controls – Left
8
1450 BK 0.35
7005 PU/WH 0.35
2
Steering Wheel Controls – Right
1
1450 BK 0.35
S215
1450 BK 0.35
1450 BK 0.35
Ground Distribution Schematics in Wiring Systems
1450 BK 0.35
C277
A
Inflatable Restraint Steering Wheel Module Coil
C275
A
1450 BK 0.35
C201
E
1450 BK 0.35
LOC
DESC

Fig. 18: Radio, HVAC Control Module, Driver Information Center (DIC) Switch, and Steering Wheel Controls - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

LIGHTING SYSTEMS COMPONENT VIEWS

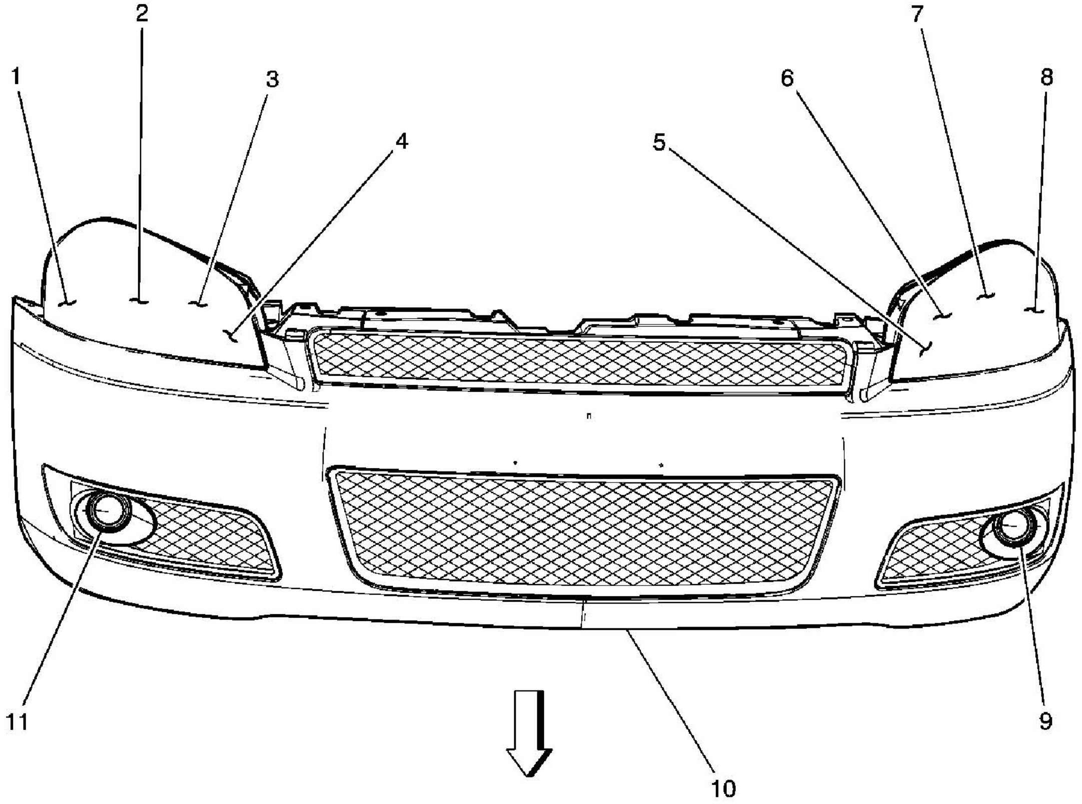


Fig. 19: Front Of The Vehicle
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 20

Callout	Component Name
1	Marker Lamp - RF
2	Headlamp - Low Beam - Right
3	Headlamp - High Beam - Right
4	Park/Turn Signal Lamp - RF
5	Park/Turn Signal Lamp - LF
6	Headlamp - High Beam - Left
7	Headlamp - Low Beam - Left
8	Marker Lamp - LF
9	Fog Lamp - LF
10	Front Fascia
11	Fog Lamp - RF

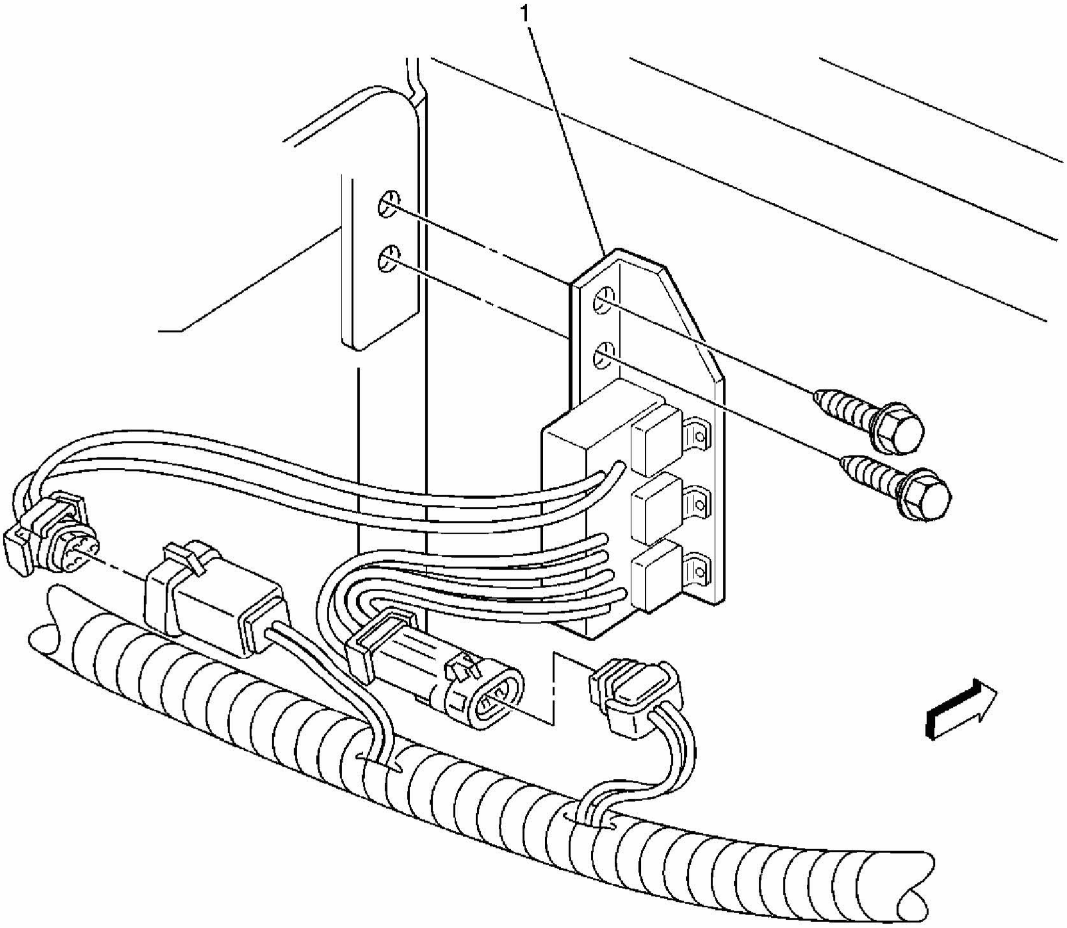


Fig. 20: Left Side Of The Right Headlamp Assembly (9C1, 9C3)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 21

Callout	Component Name
1	Headlamp Flasher Module (6J7)

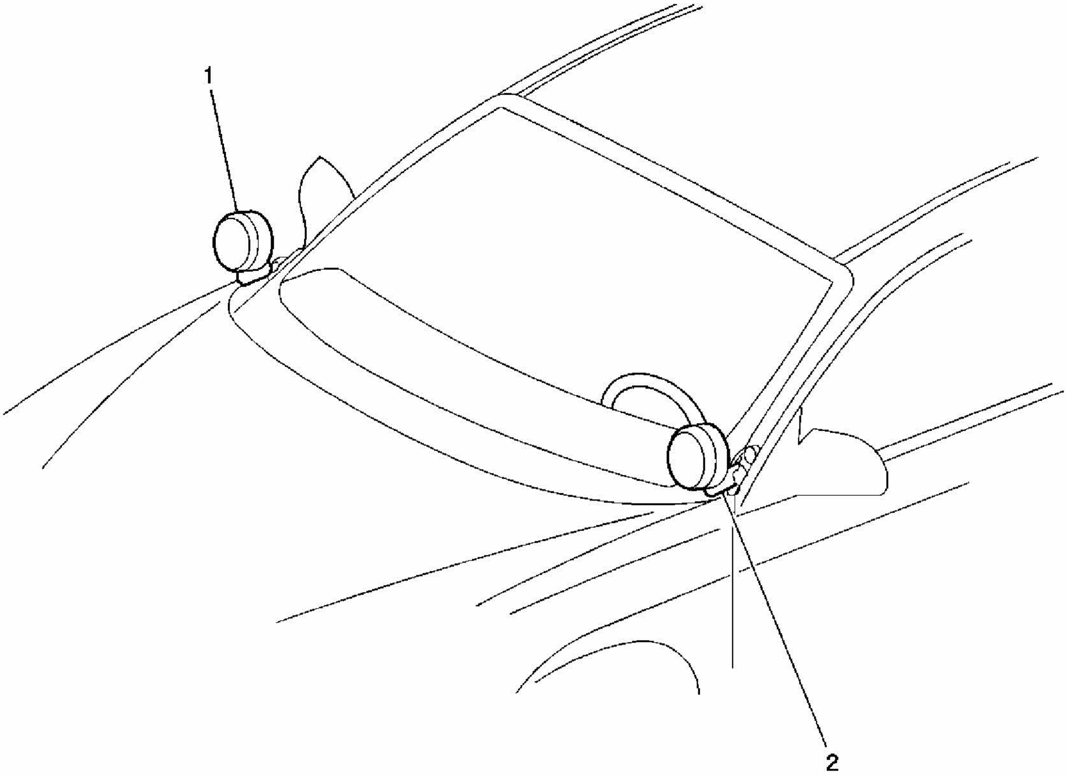


Fig. 21: Base Of A-Pillars (9C1, 9C3)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 22

Callout	Component Name
1	Spot Lamp - Left (7X6, 7X7)
2	Spot Lamp - Right (7X7)

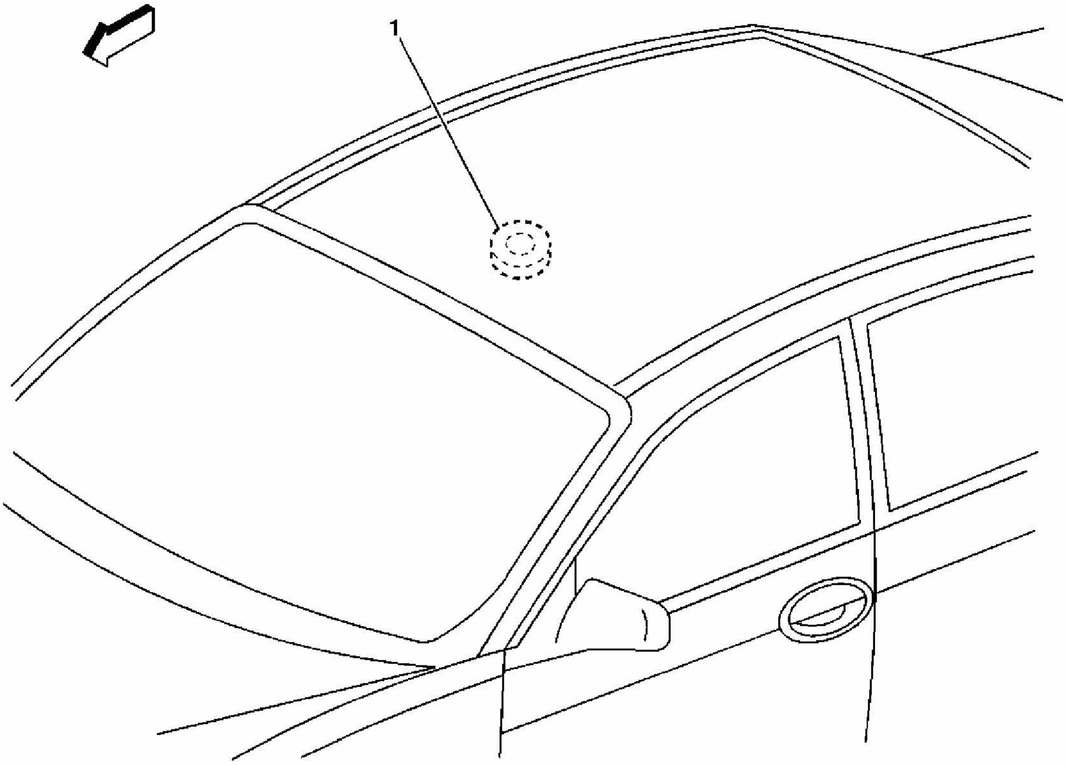


Fig. 22: Forward Headliner (9C1, 9C3)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 23

Callout	Component Name
1	Headlamp Flasher Module (6J7)

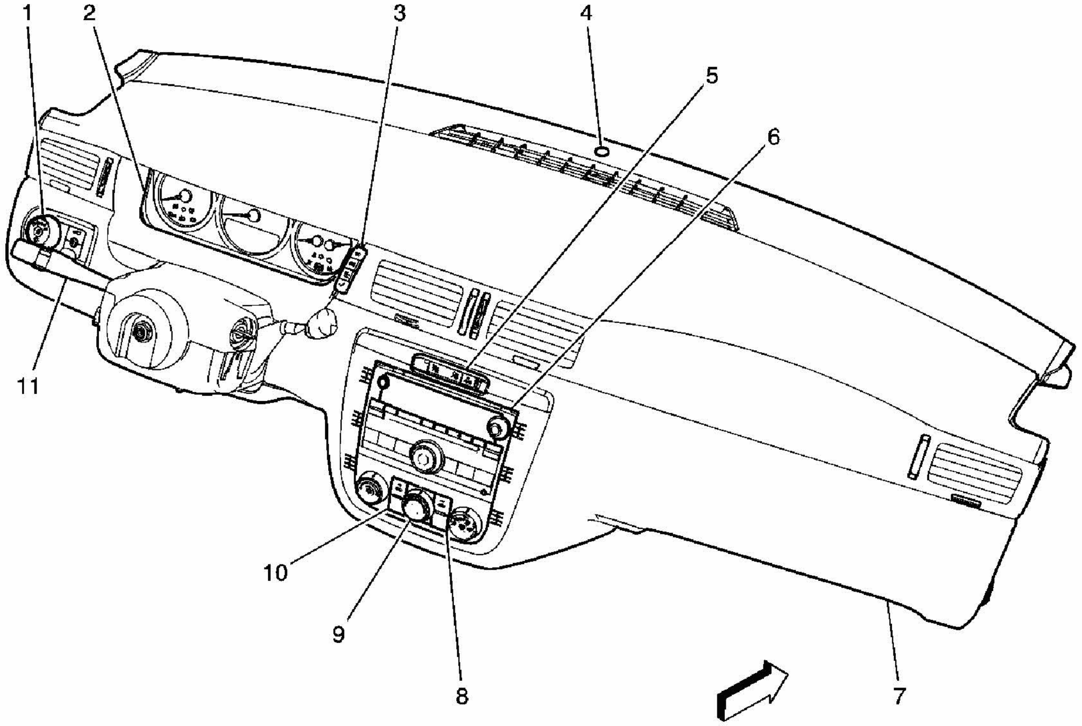


Fig. 23: I/P Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 24

Callout	Component Name
1	Headlamp Switch
2	Instrument Panel Cluster (IPC)
3	Driver Information Center (DIC) Switch
4	Ambient Light Sensor
5	Inflatable Restraint Passenger Air Bag On/Off Indicator (Sedan w/o 9C1, 9C3)
6	Radio
7	I/P Trim Panel
8	Heated Seat Switch-Passenger (KA7)
9	HVAC Control Module
10	Heated Seat Switch-Driver (KA7)
11	Turn Signal / Multifunction Switch

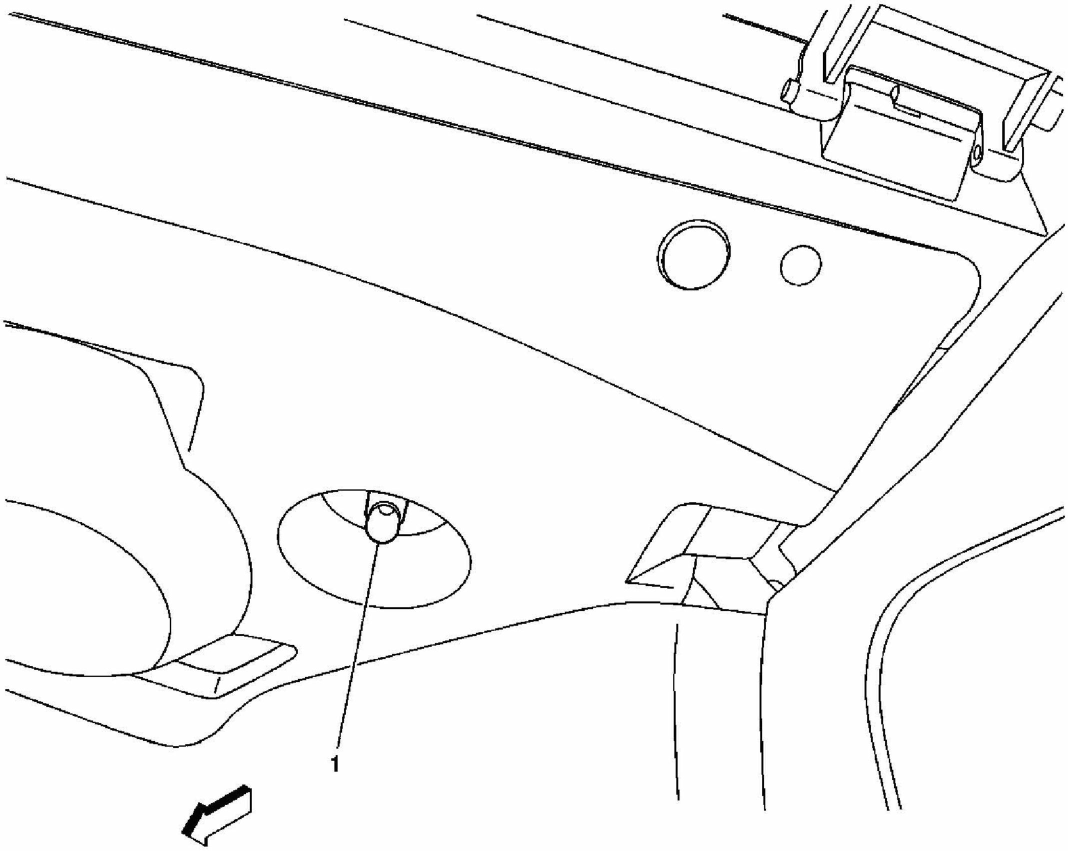


Fig. 24: In Left Front Footwell
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 25

Callout	Component Name
1	I/P Courtesy Lamp - Left

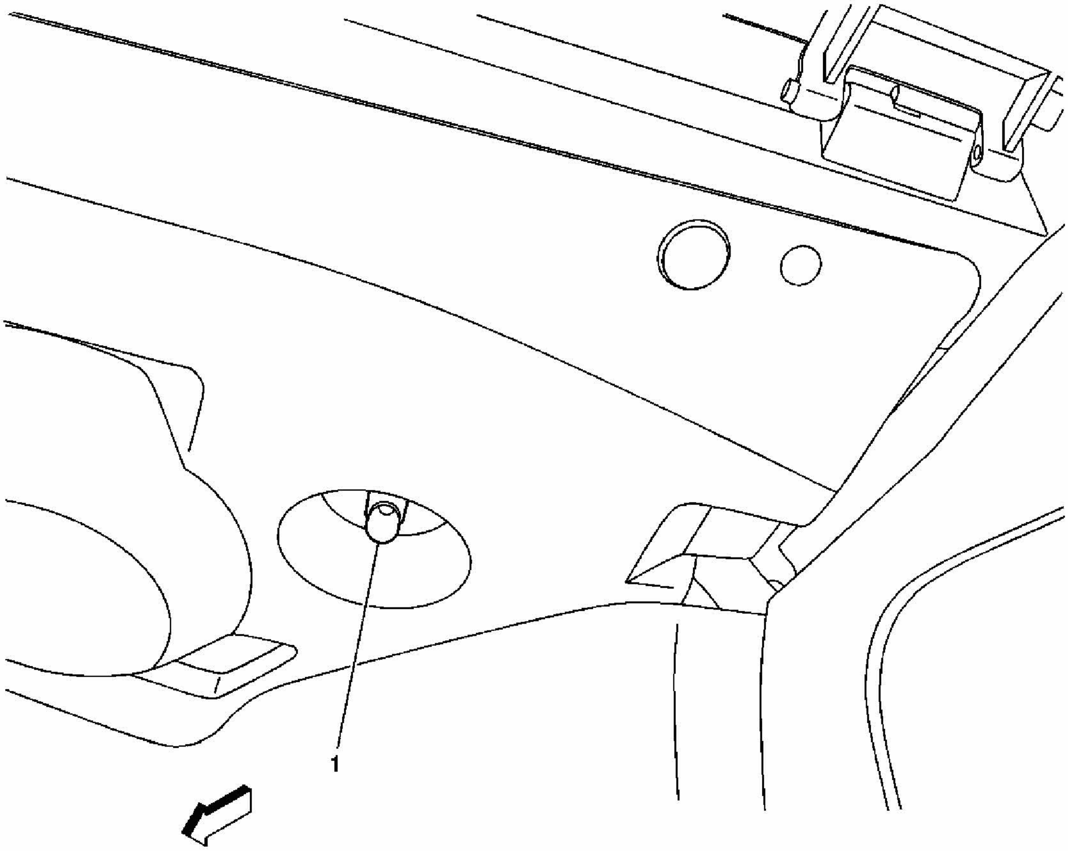


Fig. 25: In Right Front Footwell
Courtesy of GENREAL MOTORS CORP.

Callouts For Fig. 26

Callout	Component Name
1	I/P Courtesy Lamp - Right

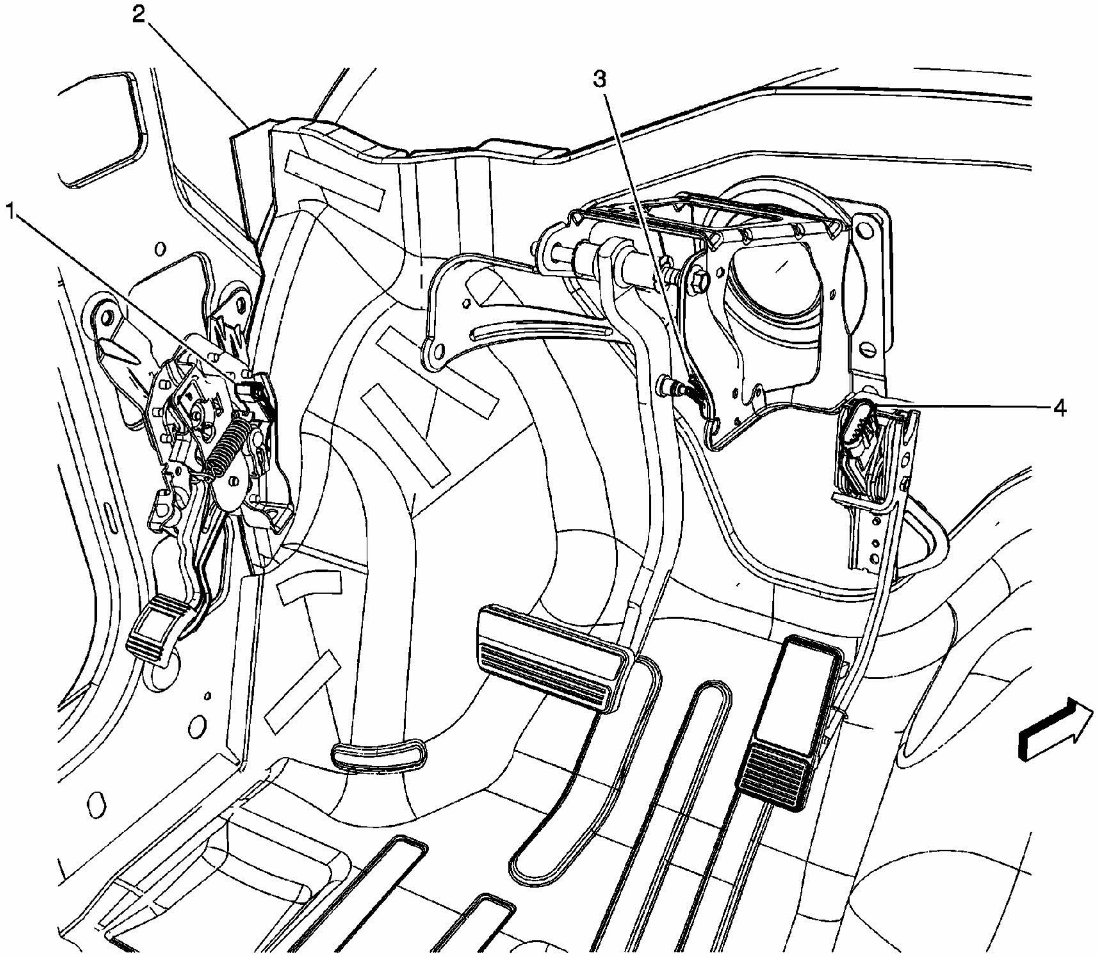


Fig. 26: Pedal Assemblies
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 27

Callout	Component Name
1	Park Brake Switch
2	Dash Panel
3	Brake Pedal Position Sensor
4	Accelerator Pedal Position (APP) Sensor

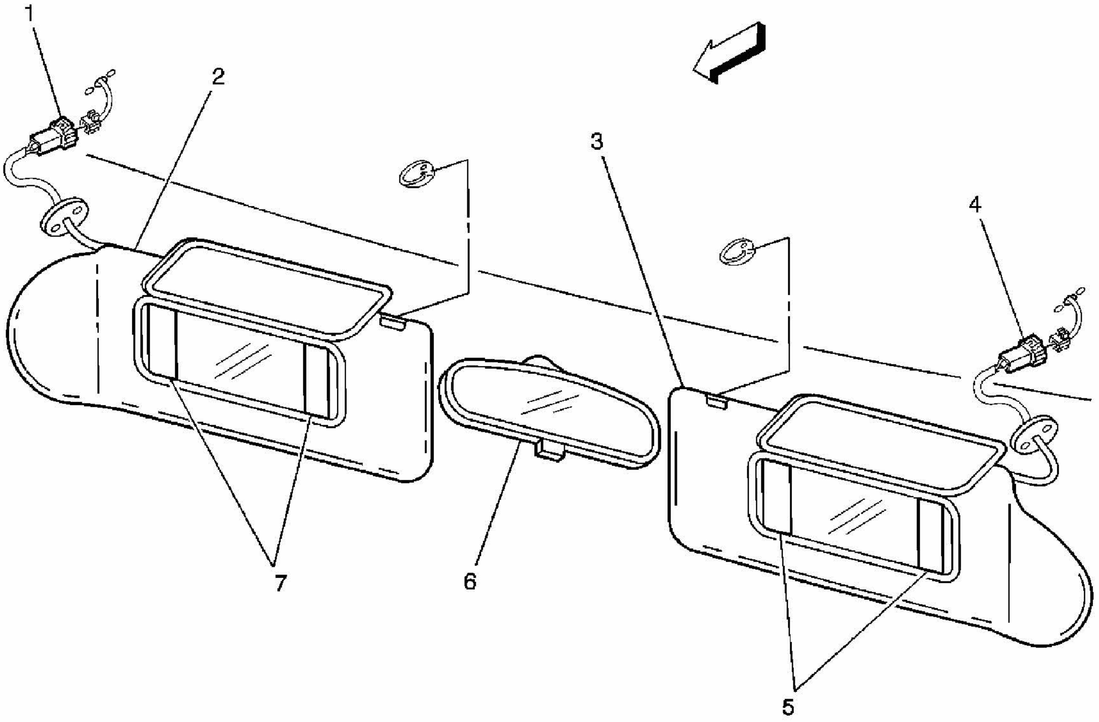


Fig. 27: Above Front Windshield
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 28

Callout	Component Name
1	Vanity Mirror Lamp - Left Connector
2	Left Sunshade
3	Right Sunshade
4	Vanity Mirror Lamp - Right Connector
5	Vanity Mirror Lamp - Right
6	Inside Rearview Mirror
7	Vanity Mirror Lamp - Left

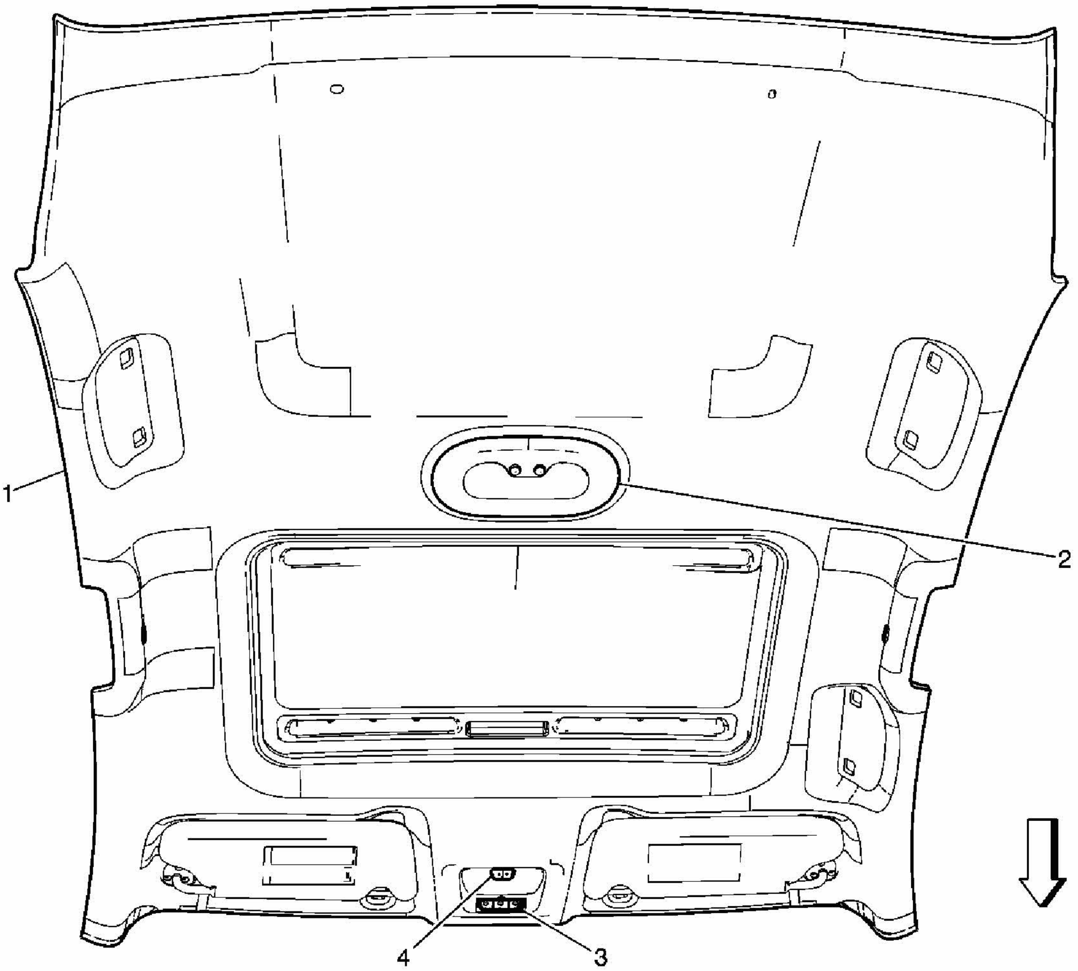


Fig. 28: Headliner Components - Bottom View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 29

Callout	Component Name
1	Headliner
2	Dome Lamp
3	Home Link Buttons
4	Sunroof Switch

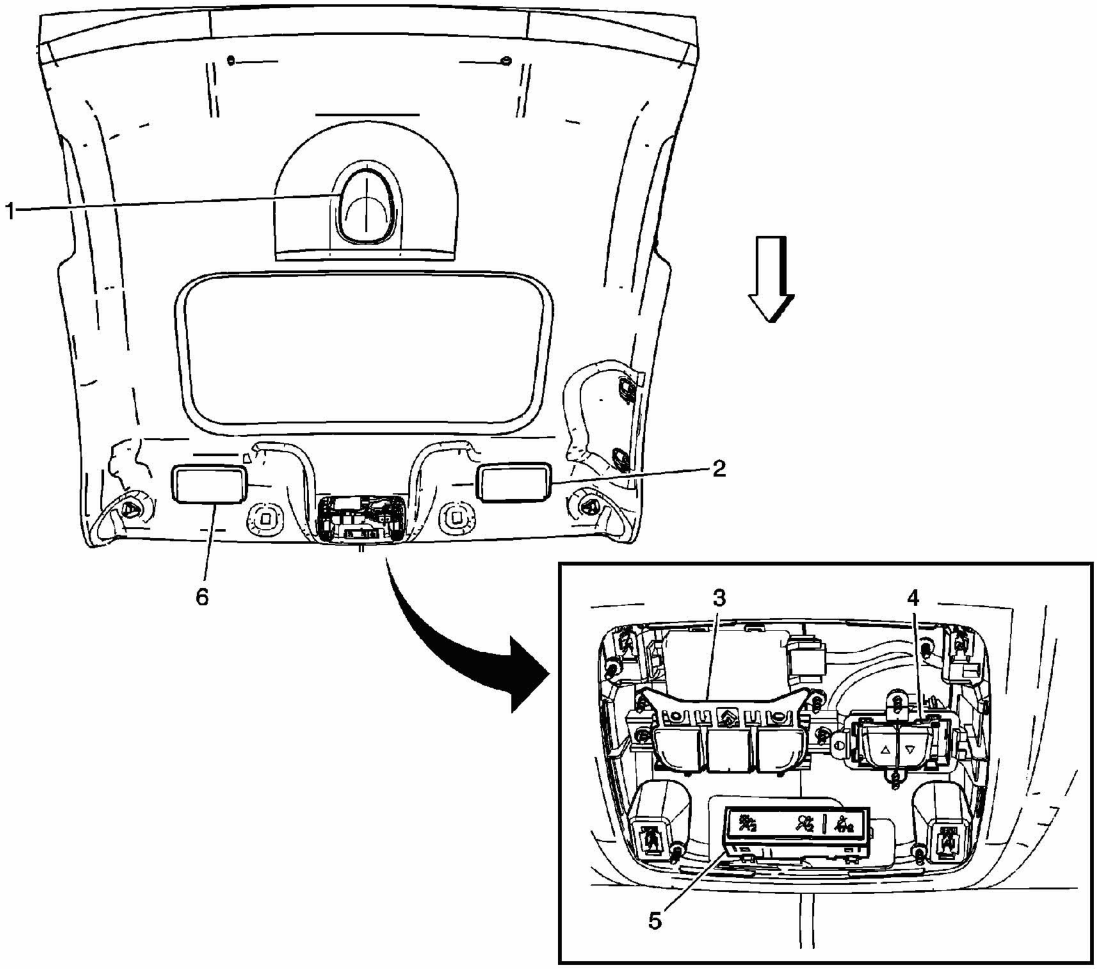


Fig. 29: Headliner Components (Coupe)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 30

Callout	Component Name
1	Dome Lamp
2	Vanity Mirror Lamp - Right (DH6)
3	Garage Door Opener (UG1)
4	Sunroof Switch (CF5)
5	Inflatable Restraint Passenger Air Bag On/Off Indicator
6	Vanity Mirror Lamp - Left (DH6)

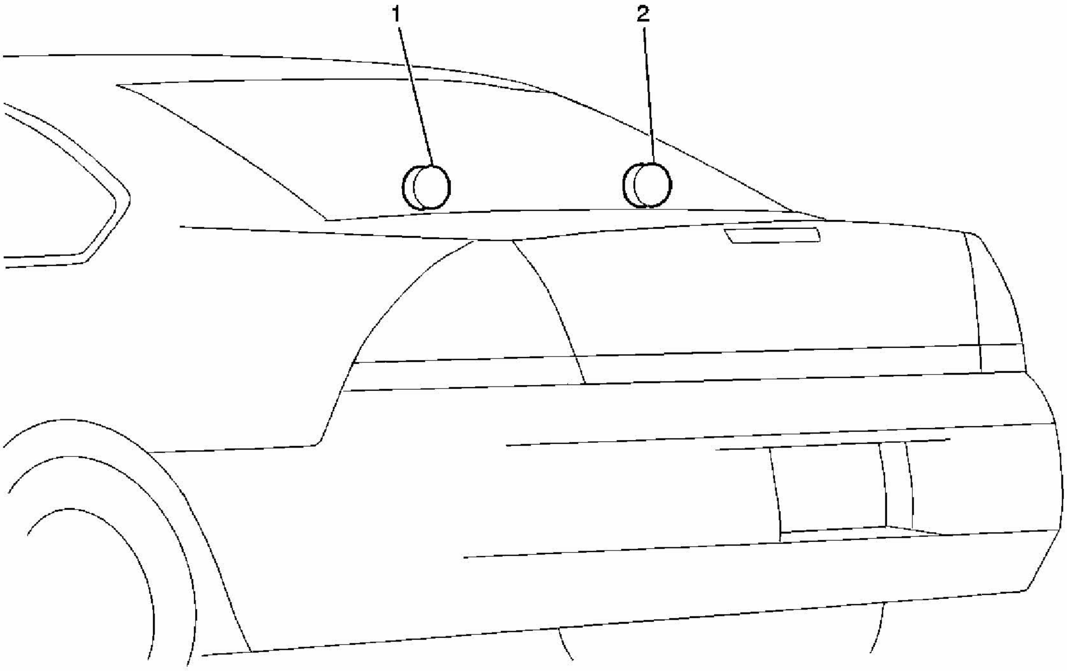


Fig. 30: On Package Shelf (9C1, 9C3)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 31

Callout	Component Name
1	Emergency Vehicle Rear Window Panel Lamp - Left (9C1, 9C3)
2	Emergency Vehicle Rear Window Panel Lamp - Right (9C1, 9C3)

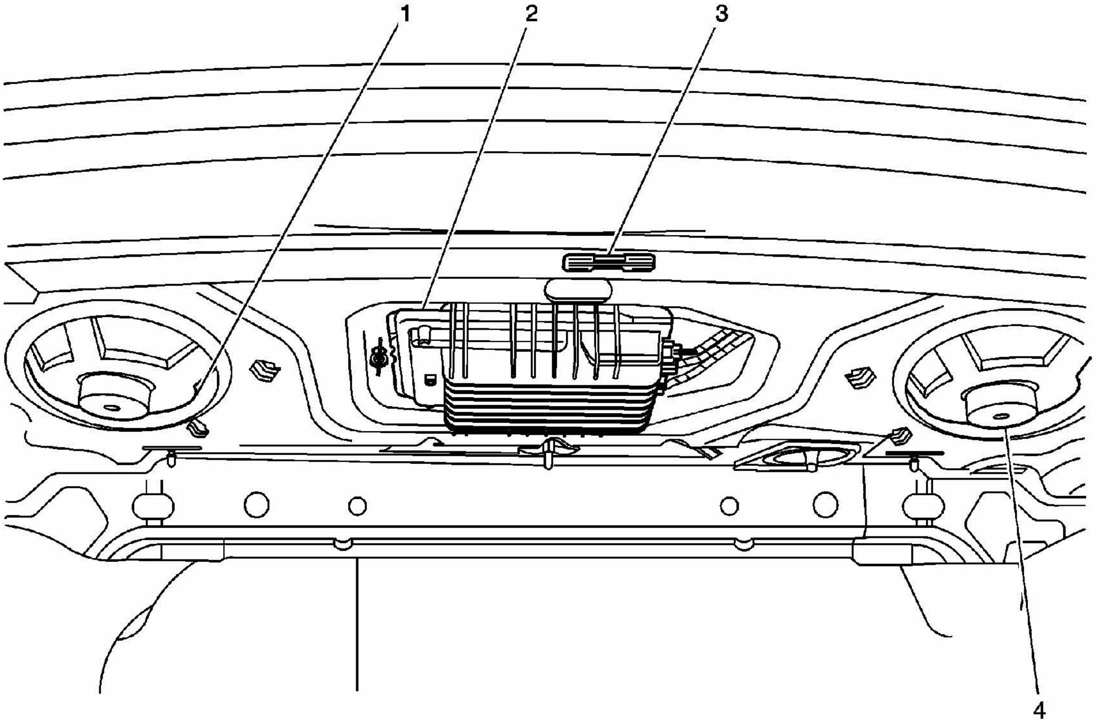


Fig. 31: Under Rear Package Shelf
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 32

Callout	Component Name
1	Speaker - LR
2	Audio Amplifier
3	Rear Compartment Courtesy Lamp
4	Speaker - RR

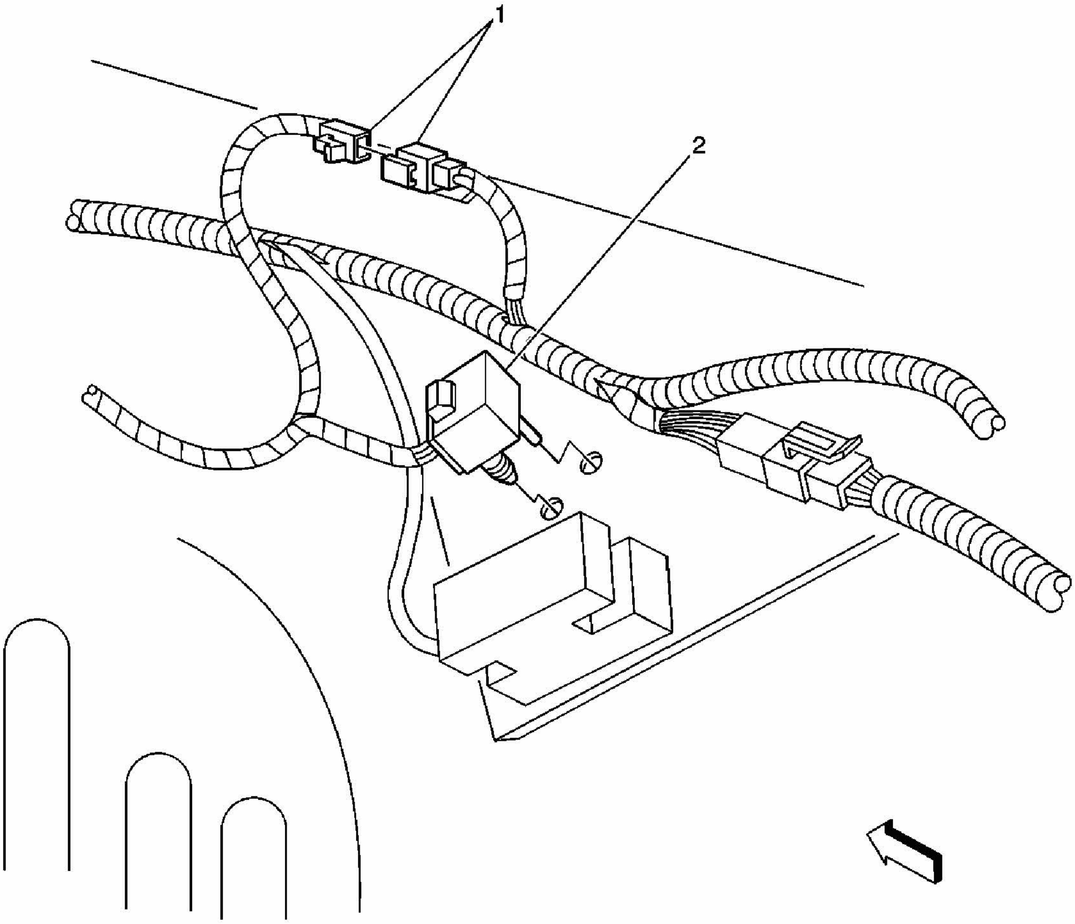


Fig. 32: Right Front Of Rear Compartment Component View (w/ T53)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 33

Callout	Component Name
1	C409
2	Emergency Vehicle Rear Compartment Lid Lamps Relay

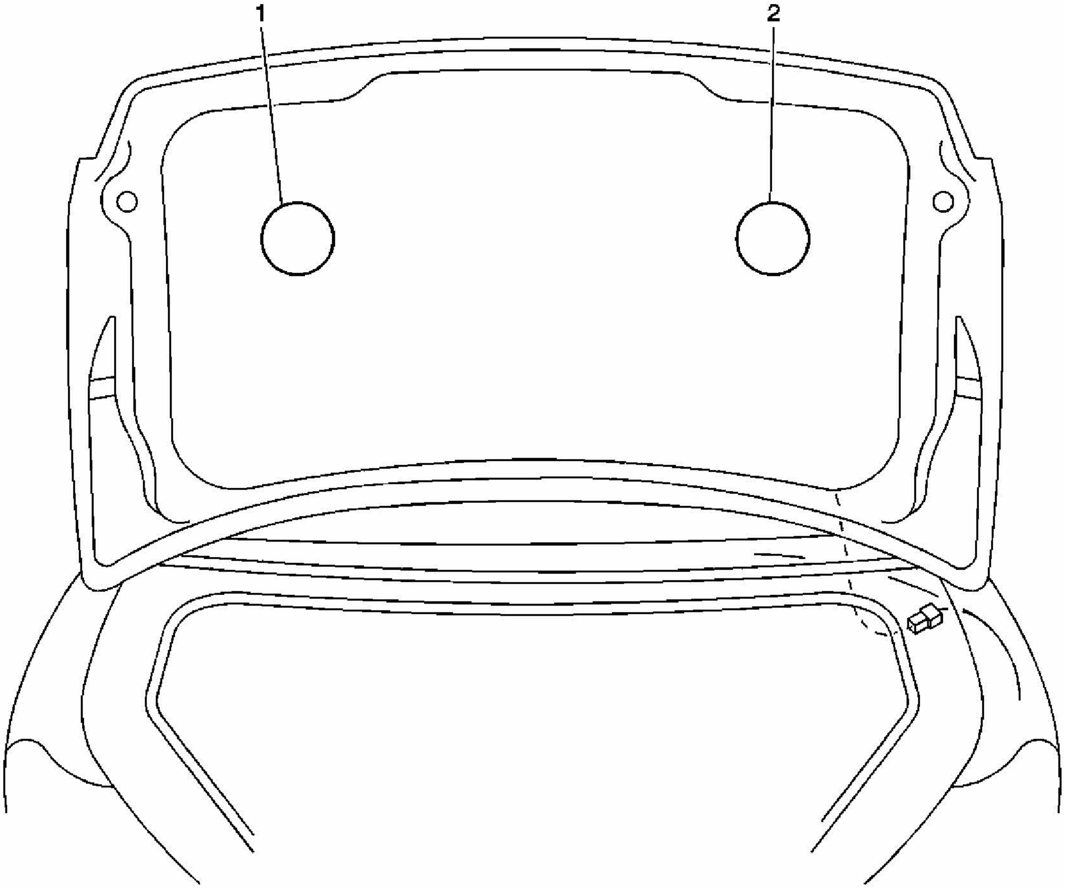


Fig. 33: Rear Compartment Lid (9C1, 9C3)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 34

Callout	Component Name
1	Emergency Vehicle Rear Compartment Lid Lamp - Left (T53)
2	Emergency Vehicle Rear Compartment Lid Lamp - Right (T53)

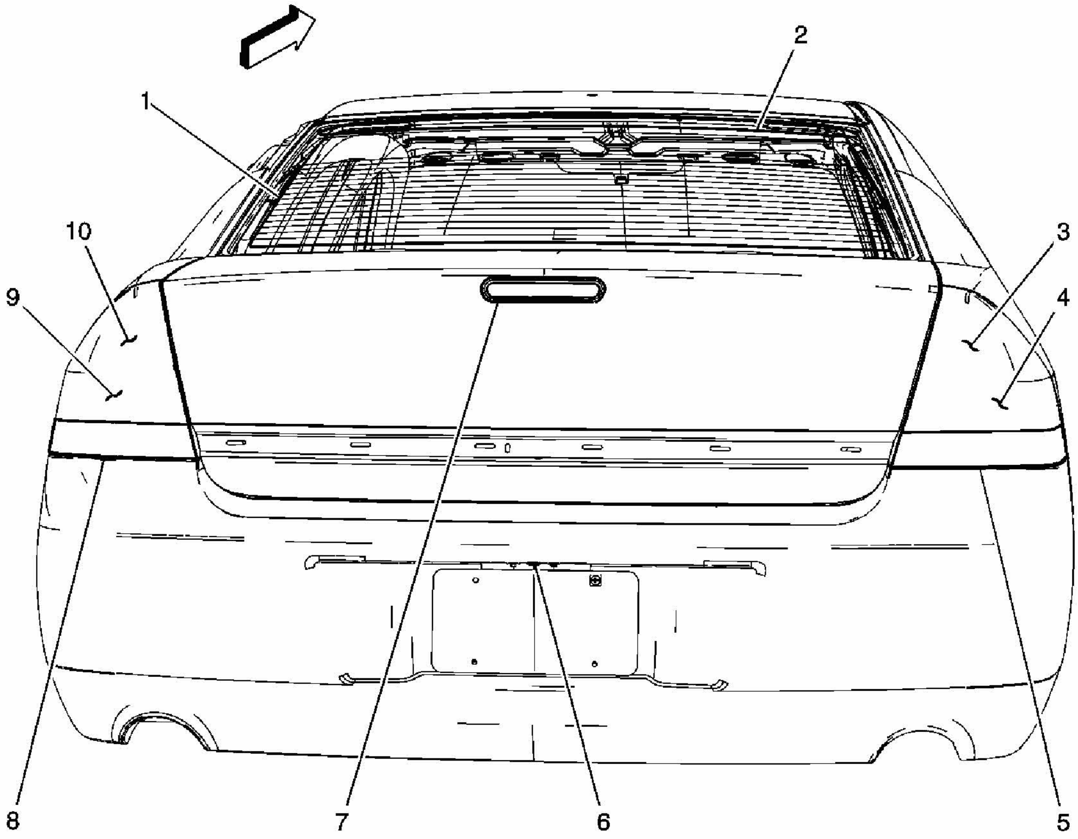


Fig. 34: Rear Of The Vehicle
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 35

Callout	Component Name
1	Rear Window Defogger Grid
2	Cellular and Navigation Antenna
3	Stop Lamp - Right
4	Tail/Stop and Turn Signal - Right
5	Backup Lamp - Right
6	License Lamp
7	Center High Mounted Stop Lamp (CHMSL)
8	Backup Lamp - Left
9	Tail/Stop and Turn Signal - Left
10	Stop Lamp - Left

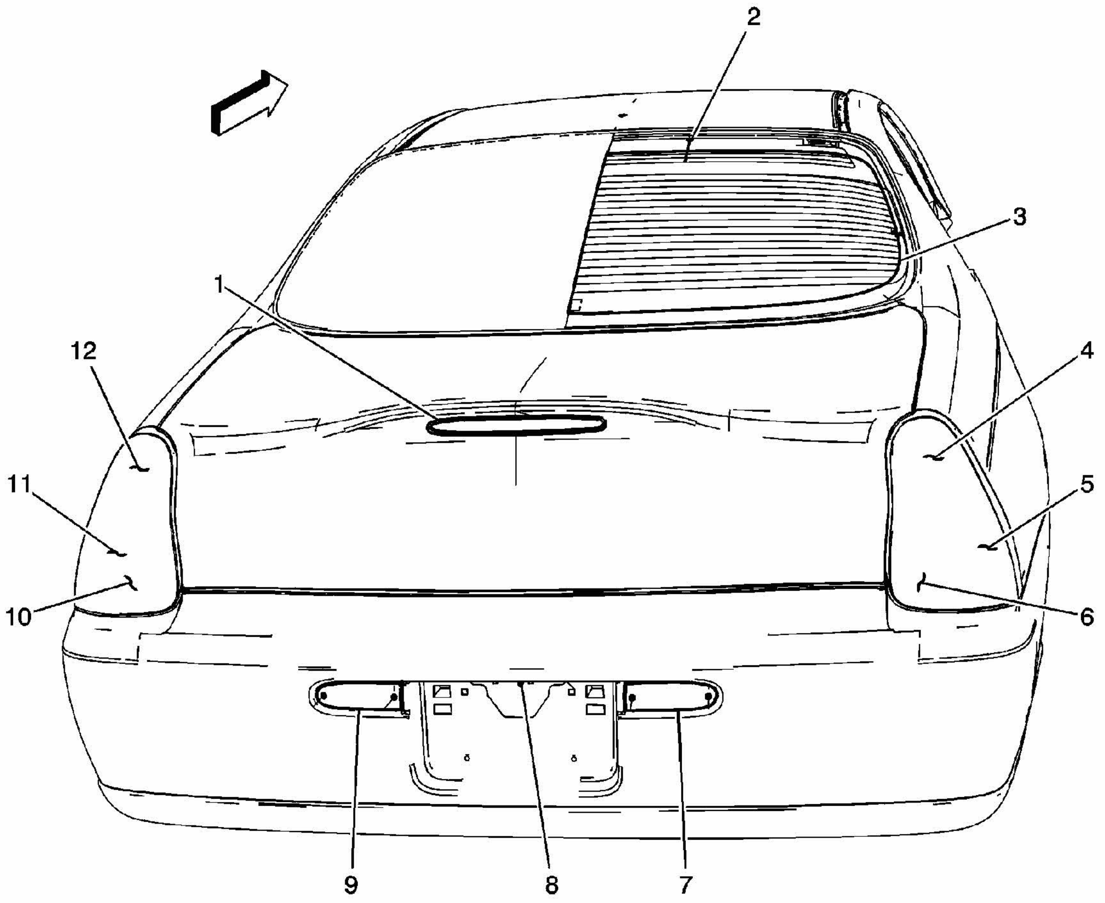


Fig. 35: Rear Of The Vehicle (Coupe)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 36

Callout	Component Name
1	Center High Mounted Stop Lamp (CHMSL)
2	Radio Rear Window Antenna
3	Rear Window Defogger Grid
4	Tail Lamp - Right
5	Marker Lamp - RR
6	Tail/Stop and Turn Signal Lamp - Left
7	Backup Lamp - Right
8	License Lamp
9	Backup Lamp - Left
10	Tail/Stop and Turn Signal Lamp - Right
11	Marker Lamp - LR
12	Tail Lamp - Left

LIGHTING SYSTEMS CONNECTOR END VIEWS

Ambient Light Sensor

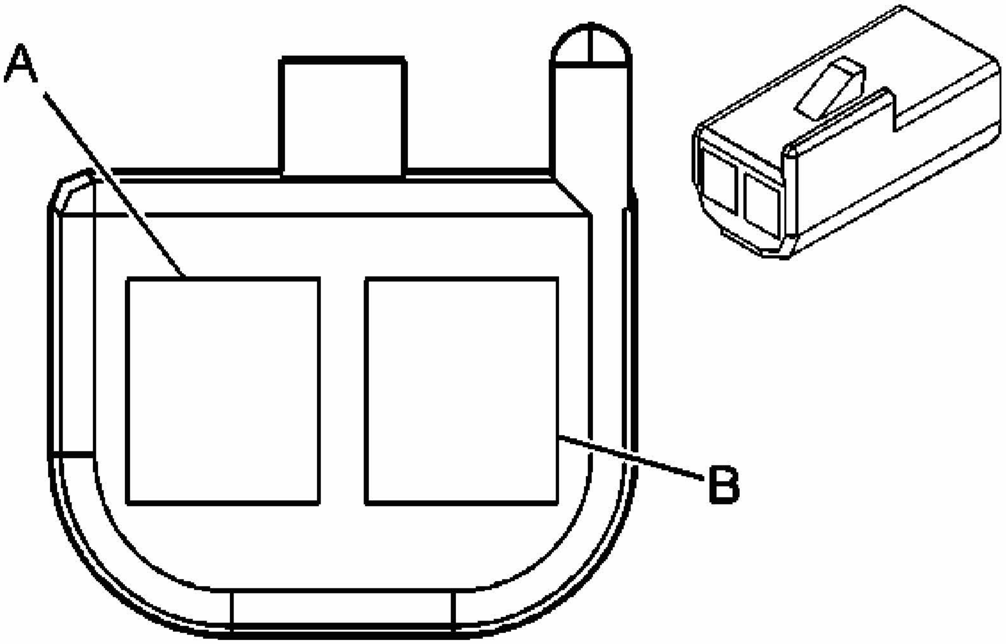


Fig. 36: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information
- OEM: 12047662 - Service: 12085535 - Description: 2-Way F Metri-Pack 150 (BK)
Terminal Part Information
- Terminal/Tray: 12064971/5 - Core/Insulation Crimp: E/C - Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Ambient Light Sensor

Pin	Wire Color	Circuit No.	Function
A	L-GN/BK	1137	DRL Ambient Light Sensor Signal
B	BK/WH	1551	Ground

Backup Lamp - Left

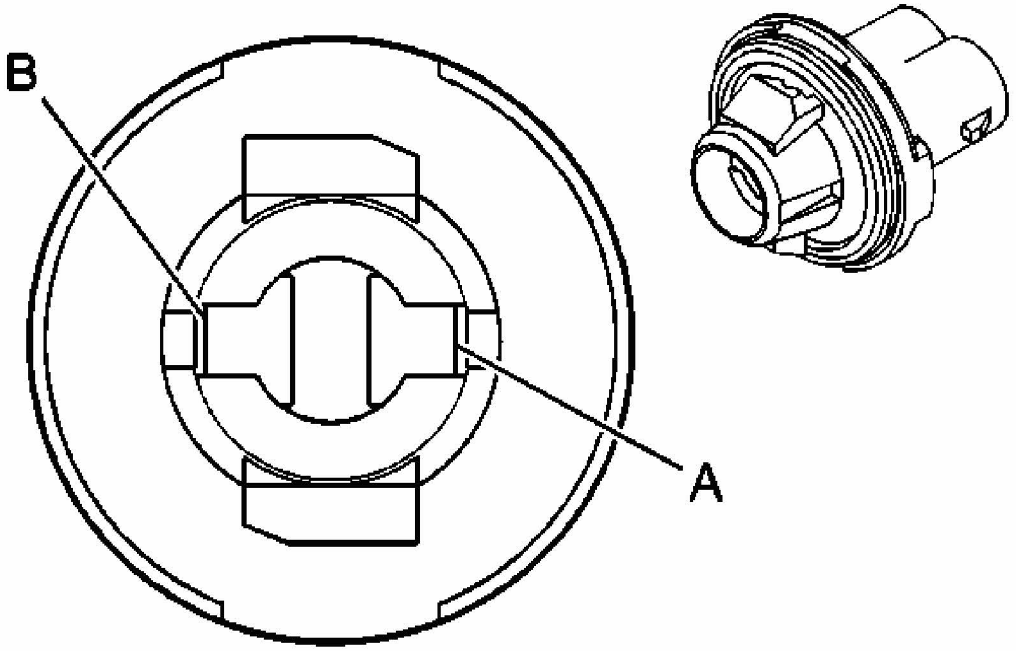


Fig. 37: Connector End View
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 15324946
- Service: See Catalog
- Description: 2-Way F Lamp Socket Wedge Sealed W2 (D-GY)

Terminal Part Information

- Terminal/Tray: 12124471/5
- Core/Insulation Crimp: 2/3
- Release Tool/Test Probe: 12094430

Backup Lamp - Left

Pin	Wire Color	Circuit No.	Function
A	L-GN	24	Backup Lamp Supply Voltage
B	BK	850	Ground

Backup Lamp - Right

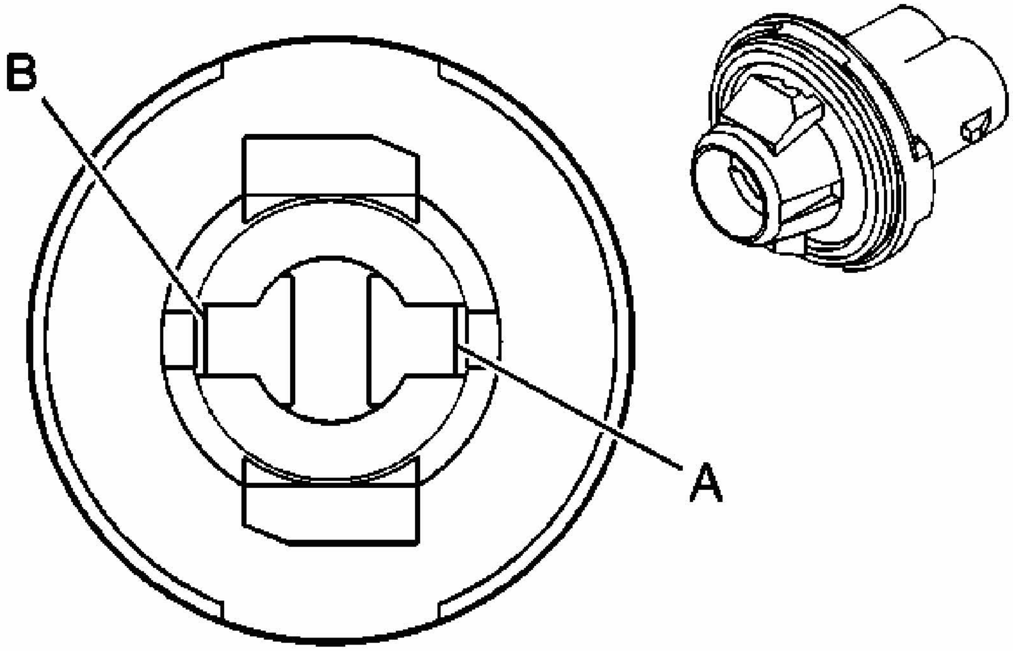


Fig. 38: Connector End View
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 15324946
- Service: See Catalog
- Description: 2-Way F Lamp Socket Wedge Sealed W2 (D-GY)

Terminal Part Information

- Terminal/Tray: 12124471/5
- Core/Insulation Crimp: 2/3
- Release Tool/Test Probe: 12094430

Backup Lamp - Right

Pin	Wire Color	Circuit No.	Function
A	L-GN	24	Backup Lamp Supply Voltage (Coupe)

A	BN	24	Backup Lamp Supply Voltage (Sedan)
B	BK	850	Ground

Brake Pedal Position Sensor

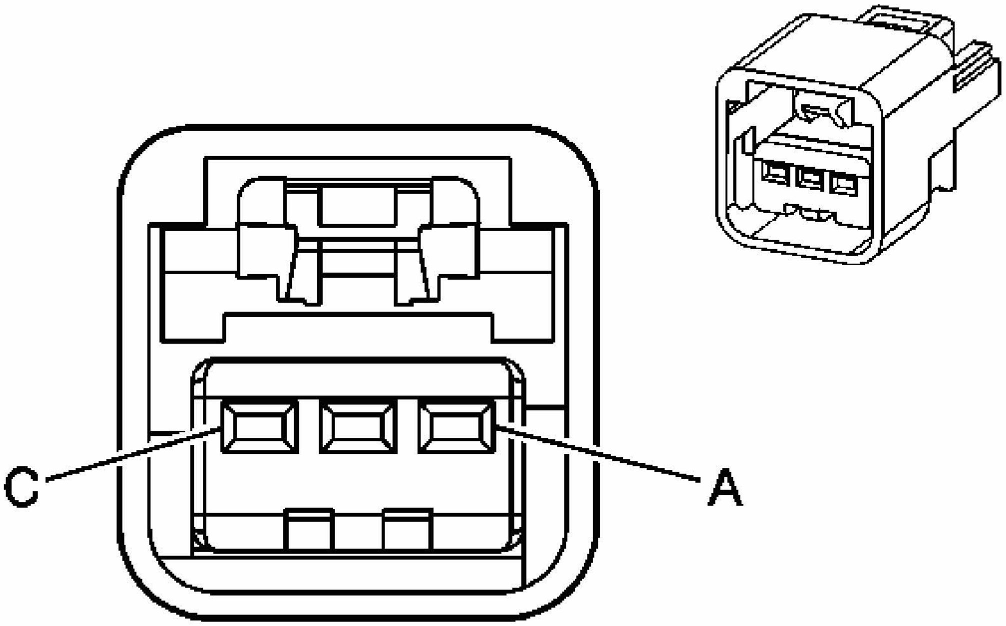


Fig. 39: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 15332132
- Service: 88953364
- Description: 3-Way F GT 150 (BK)

Terminal Part Information

- Terminal/Tray: 12191812/19
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Brake Pedal Position Sensor

Pin	Wire Color	Circuit No.	Function
A	GY	598	5-Volt Reference
B	L-GN	526	Stop Lamp Switch Signal
C	TN	552	Low Reference

Center High Mounted Stop Lamp (CHMSL)

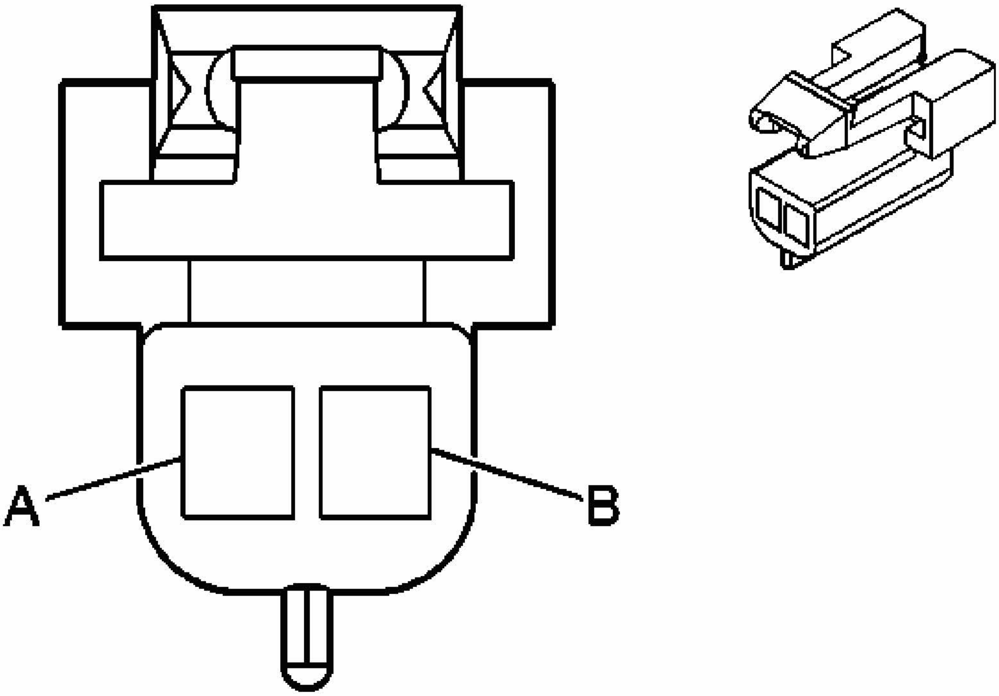


Fig. 40: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12052832
- Service: 12101825
- Description: 2-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12064971/5

- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Center High Mounted Stop Lamp (CHMSL)

Pin	Wire Color	Circuit No.	Function
A	L-BU	1320	CHMSL Supply Voltage (Coupe)
A	BK	750	Ground (Sedan)
B	L-BU	850	Ground (Coupe)
B	L-BU	1320	CHMSL Supply Voltage (Sedan)

Dome/Reading Lamp

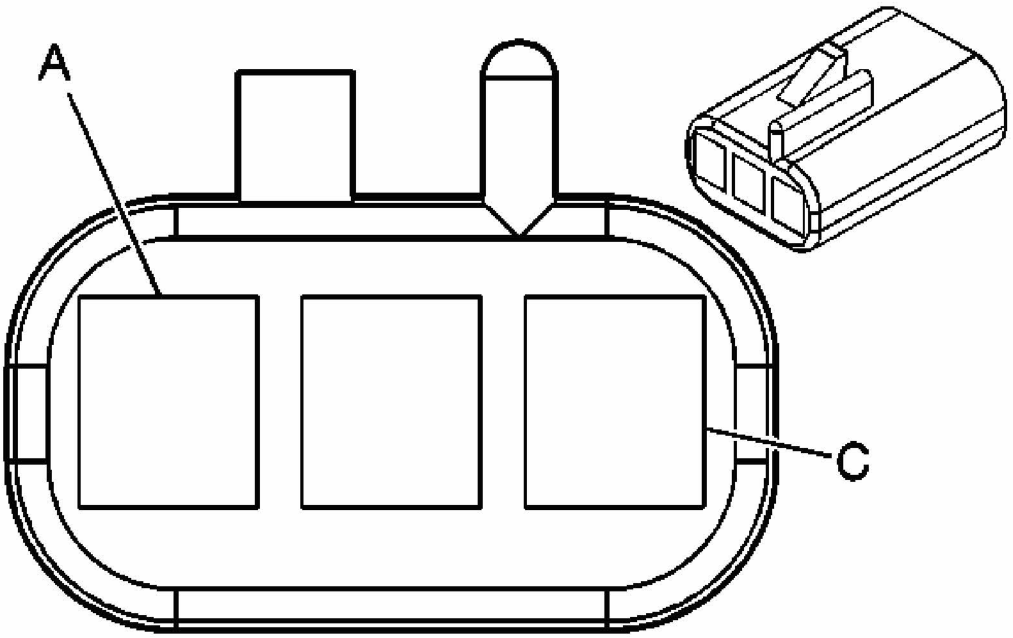


Fig. 41: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12047781
- Service: 12101864
- Description: 3-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12047767/2
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Dome/Reading Lamp

Pin	Wire Color	Circuit No.	Function
A	GY/BK	690	Courtesy Lamp Low Control
B	BK	550	Ground
C	OG	1732	Courtesy Lamps Supply Voltage

Emergency Vehicle Rear Window Panel Lamp - Left (9C1/9C3)

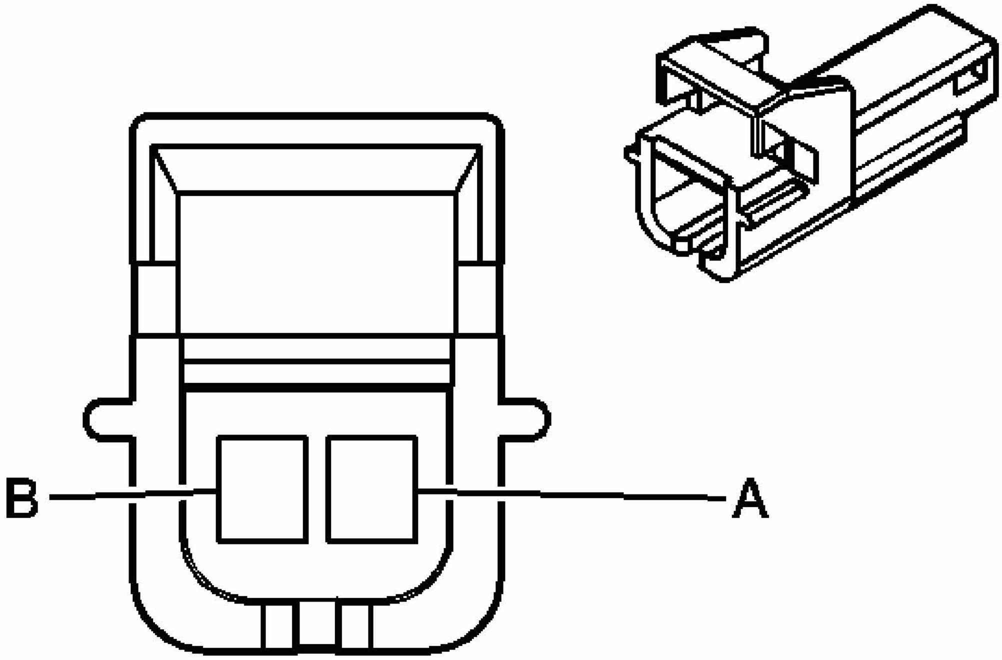


Fig. 42: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12065651
- Service: 12117275
- Description: 2-Way M Metri-Pack 150 (BK)

Terminal Part Information

- Pins: A
- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Emergency Vehicle Rear Window Panel Lamp - Left (9C1/9C3)

Pin	Wire Color	Circuit No.	Function
A	YE	18	Left Rear Stop/Turn Lamp Supply Voltage
B	-	-	Not Used

Emergency Vehicle Rear Window Panel Lamp - Right (9C1/9C3)

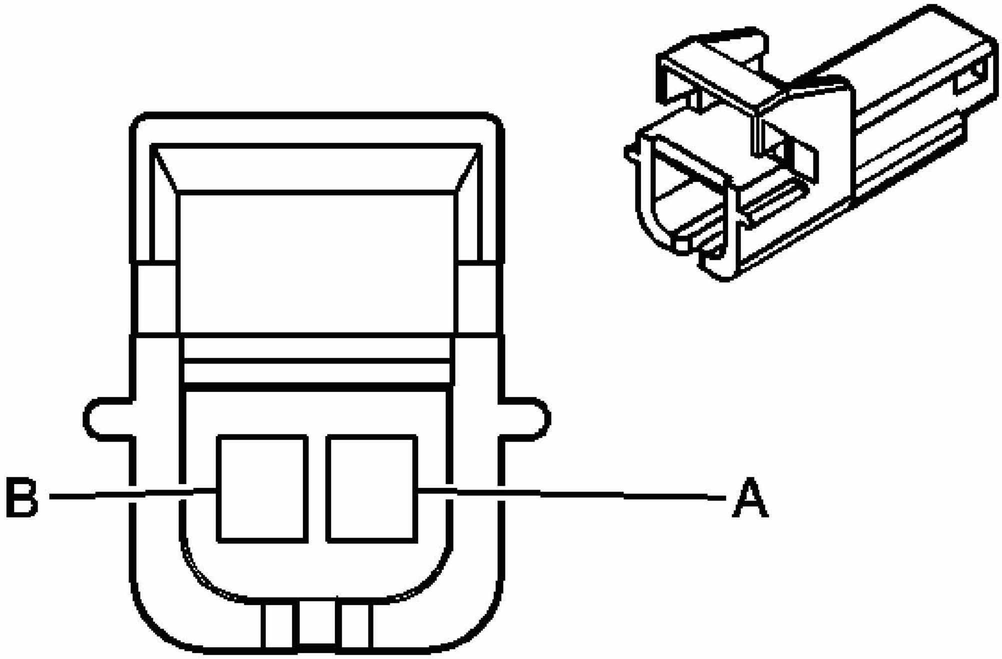


Fig. 43: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12065651
- Service: 12117275
- Description: 2-Way M Metri-Pack 150 (BK)

Terminal Part Information

- Pins: A
- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Emergency Vehicle Rear Window Panel Lamp - Right (9C1/9C3)

Pin	Wire Color	Circuit No.	Function
A	D-GN	19	Right Rear Stop/Turn Lamp Supply Voltage
B	-	-	Not Used

Fog Lamp - LF (T96)

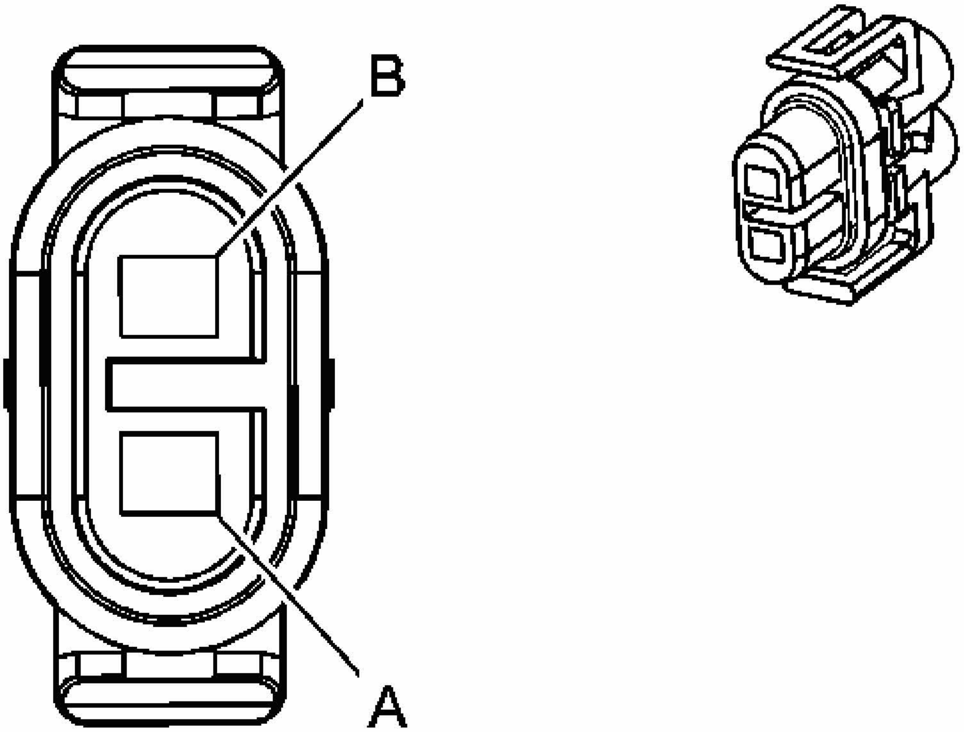


Fig. 44: Connector End View
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12124819
- Service: 12085498
- Description: 2-Way F Metri-Pack 280 Sealed (BU)

Terminal Part Information

- Pins: A, B
- Terminal/Tray: 12077411/2
- Core/Insulation Crimp: Pins B - 2/5
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Fog Lamp - LF (T96)

Pin	Wire Color	Circuit No.	Function

A	PU	34	Front Fog Lamp Supply Voltage
B	BK	1350	Ground

Fog Lamp - RF (T96)

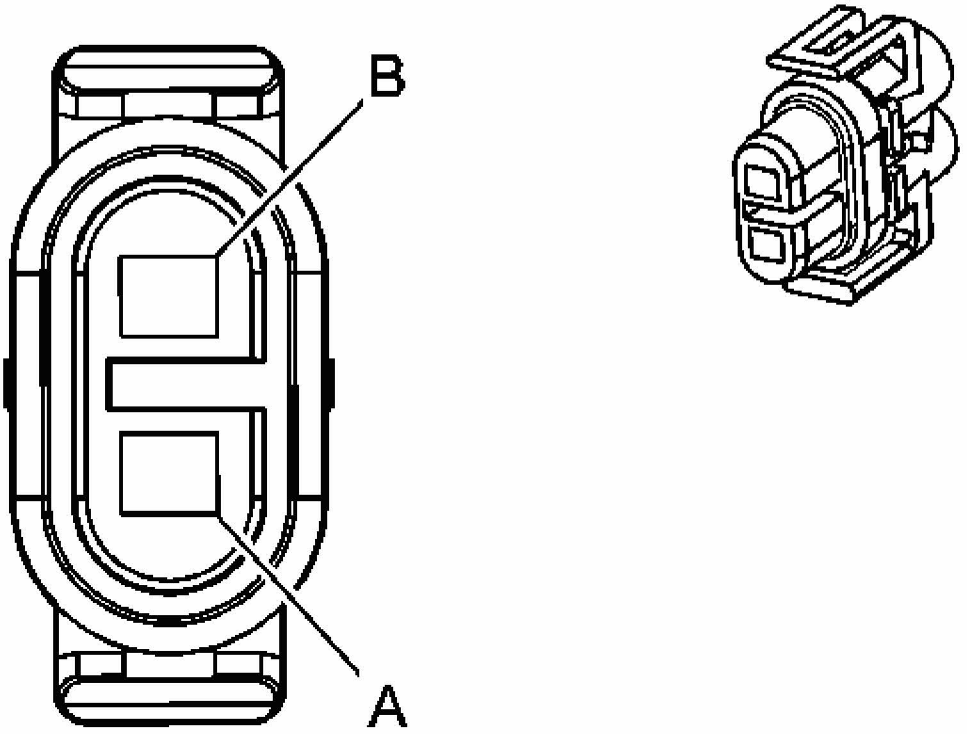


Fig. 45: Connector End View
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12124819
- Service: 12085498
- Description: 2-Way F Metri-Pack 280 Sealed (BU)

Terminal Part Information

- Pins: A, B
- Terminal/Tray: 12077411/2

- Core/Insulation Crimp: Pins B - 2/5
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Fog Lamp - RF (T96)

Pin	Wire Color	Circuit No.	Function
A	PU	34	Front Fog Lamp Supply Voltage
B	BK	1250	Ground

Headlamp - High Beam - Left

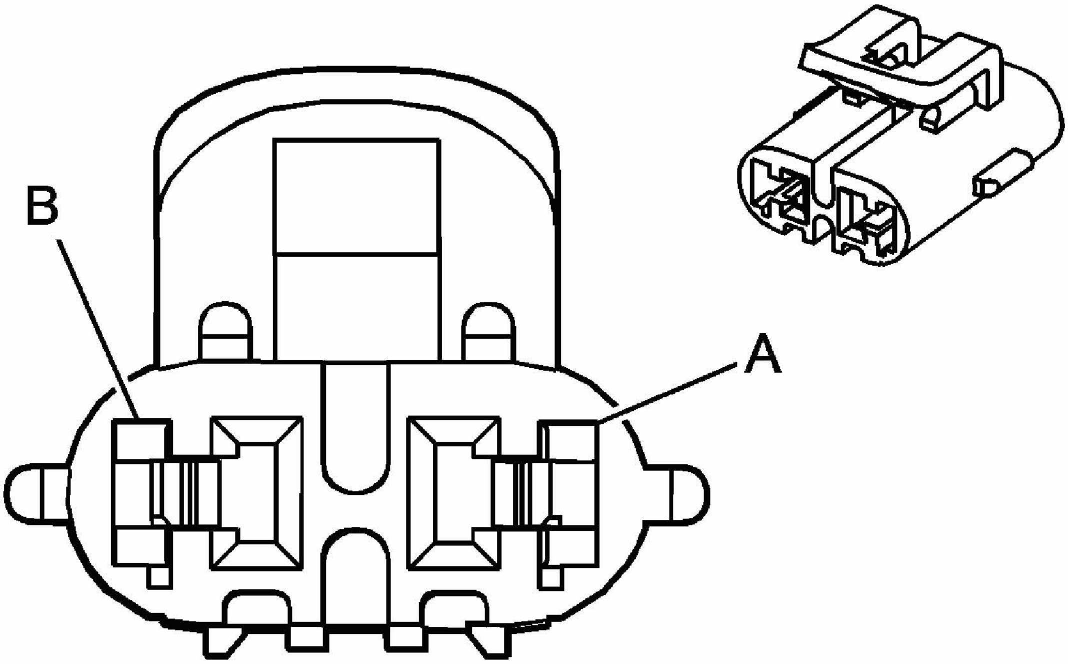


Fig. 46: Connector End Views
Courtesy of GENREAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: H9
- Service: See Catalog
- Description: 2-Way F (BK)

Terminal Part Information

- Terminal/Tray: See Terminal Repair Kit
- Core/Insulation Crimp: See Terminal Repair Kit

- Release Tool/Test Probe: See Terminal Repair Kit

Headlamp - High Beam - Left

Pin	Wire Color	Circuit No.	Function
A	BU	711	Left Headlamp High Beam Supply Voltage
B	BK	1350	Ground

Headlamp - High Beam - Right

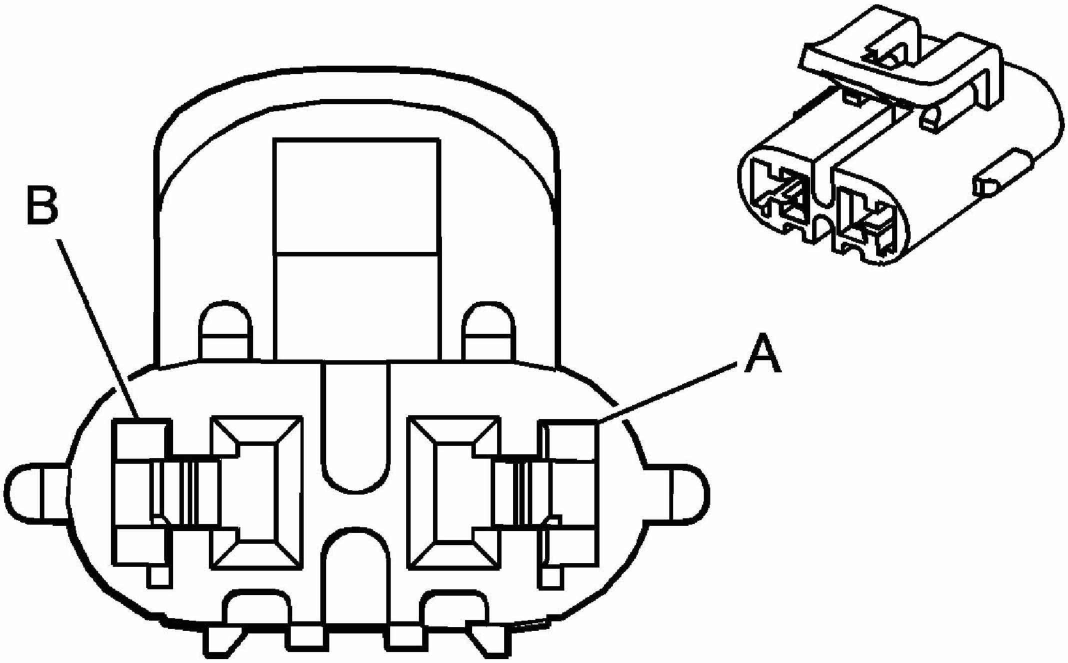


Fig. 47: Connector End Views
Courtesy of GENREAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: H9
- Service: See Catalog
- Description: 2-Way F (BK)

Terminal Part Information

- Terminal/Tray: See Terminal Repair Kit
- Core/Insulation Crimp: See Terminal Repair Kit

- Release Tool/Test Probe: See Terminal Repair Kit

Headlamp - High Beam - Right

Pin	Wire Color	Circuit No.	Function
A	BU	311	Right Headlamp High Beam Supply Voltage
B	BK	1250	Ground

Headlamp - Low Beam - Left

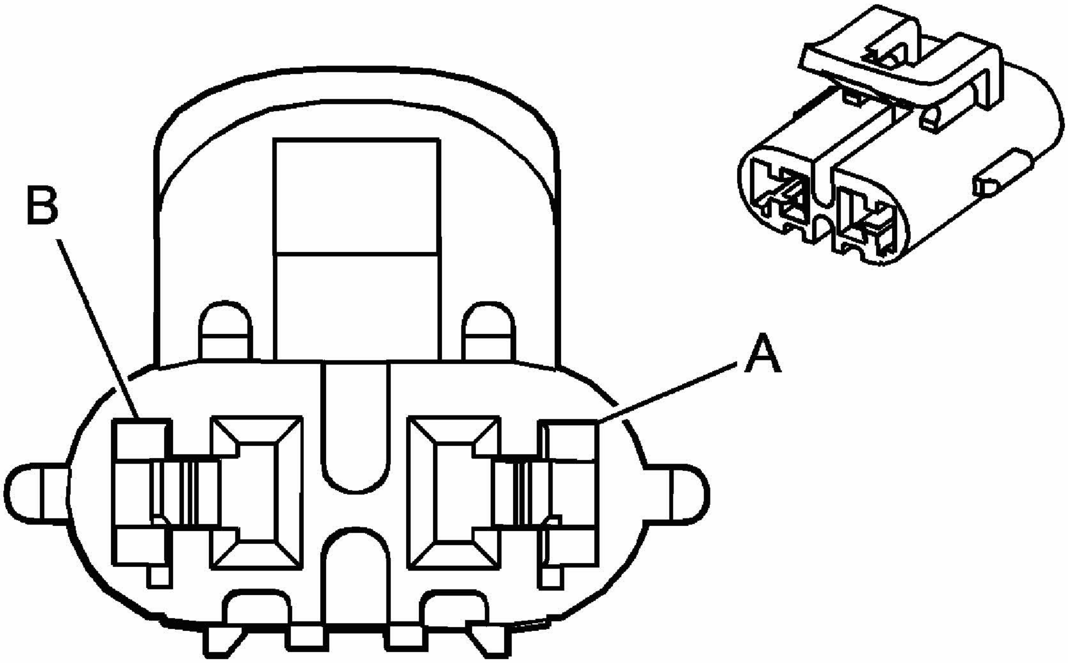


Fig. 48: Connector End Views
Courtesy of GENREAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: H11
- Service: See Catalog
- Description: 2-Way F (WH)

Terminal Part Information

- Terminal/Tray: See Terminal Repair Kit
- Core/Insulation Crimp: See Terminal Repair Kit

- Release Tool/Test Probe: See Terminal Repair Kit

Headlamp - Low Beam - Left

Pin	Wire Color	Circuit No.	Function
A	GN	712	Left Headlamp Low Beam Supply Voltage
B	BK	1350	Ground

Headlamp - Low Beam - Right

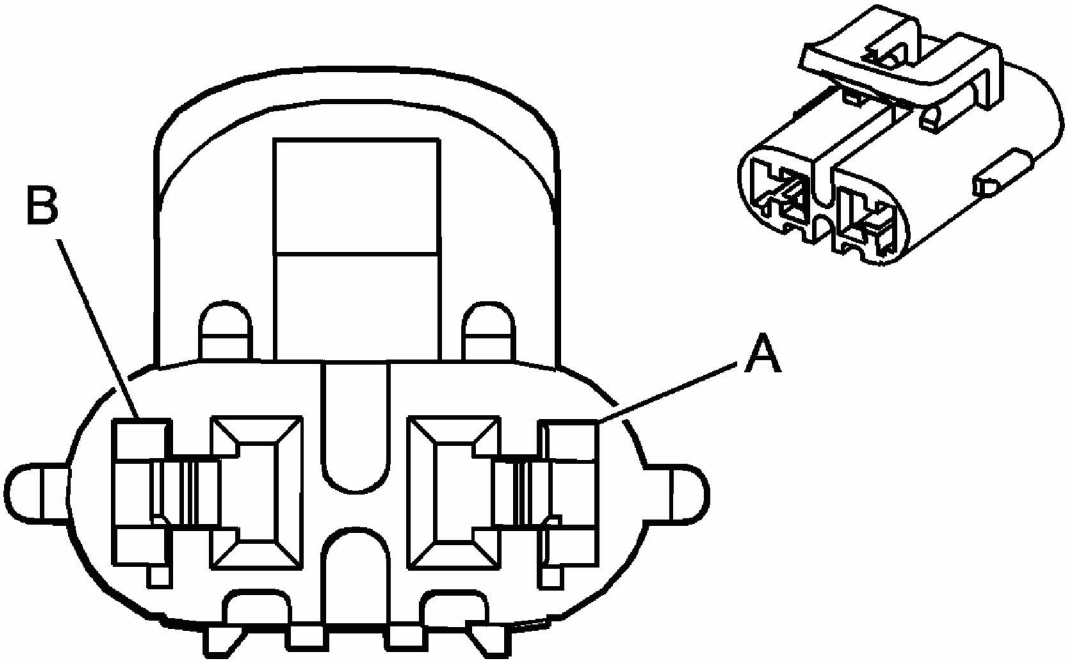


Fig. 49: Connector End Views
Courtesy of GENREAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: H11
- Service: See Catalog
- Description: 2-Way F (WH)

Terminal Part Information

- Terminal/Tray: See Terminal Repair Kit
- Core/Insulation Crimp: See Terminal Repair Kit

- Release Tool/Test Probe: See Terminal Repair Kit

Headlamp - Low Beam - Right

Pin	Wire Color	Circuit No.	Function
A	GN	312	Right Headlamp Low Beam Supply Voltage
B	BK	1250	Ground

Headlamp Switch

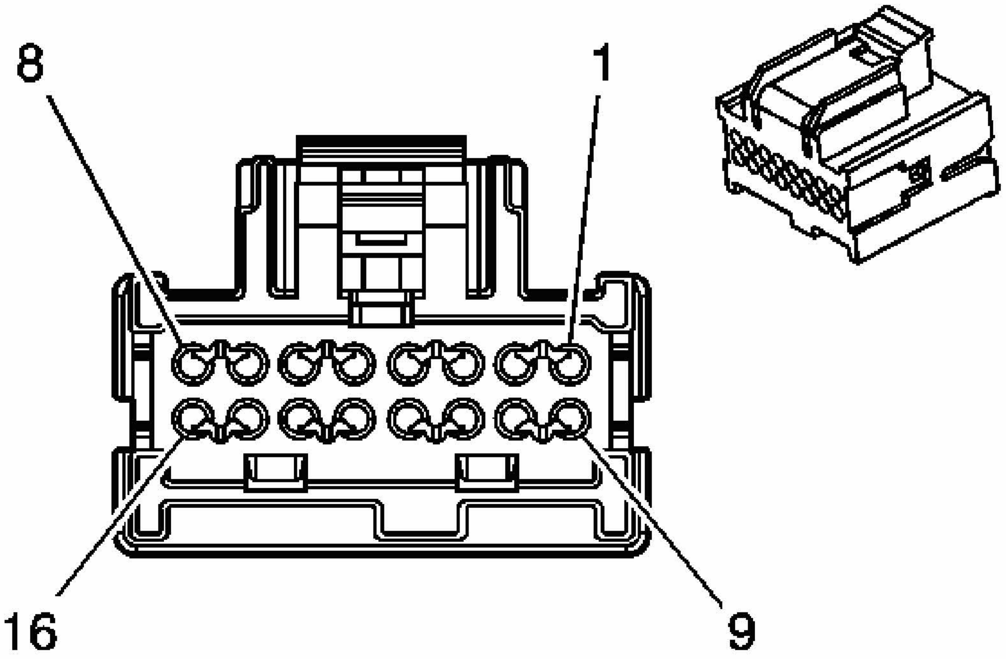


Fig. 50: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 15416970
- Service: 22715969
- Description: 16-Way F Micro 64 Modular (BK)

Terminal Part Information

- Terminal/Tray: 15359541/4
- Core/Insulation Crimp: M/M
- Release Tool/Test Probe: 15381651-2/J-35616-64A (L-BU)

Headlamp Switch

Pin	Wire Color	Circuit No.	Function
1	WH	103	Headlamp Switch On Signal
2	BN/WH	301	Park Lamp Switch On Signal
3	D-GN	306	Headlamp Switch Headlamps Off Signal
4-5	-	-	Not Used
6	OG	192	Front Fog Lamp Switch Signal
7	GY	8	Instrument Panel Lamp Supply Voltage
8	BK/WH	1551	Ground
9	L-BU	383	Trunk Release Control
10	BN/WH	1571	Traction Control Switch Signal
11	-	-	Not Used
12	PK/BK	1597	Interior Lamp Switch On Signal
13	D-GN	44	Instrument Panel Lamps Dimmer Switch Signal
14	-	-	Not Used
15	OG/WH	812	12-Volt Reference or IP Dimming Voltage Reference
16	-	-	Not Used

I/P Courtesy Lamp - Left

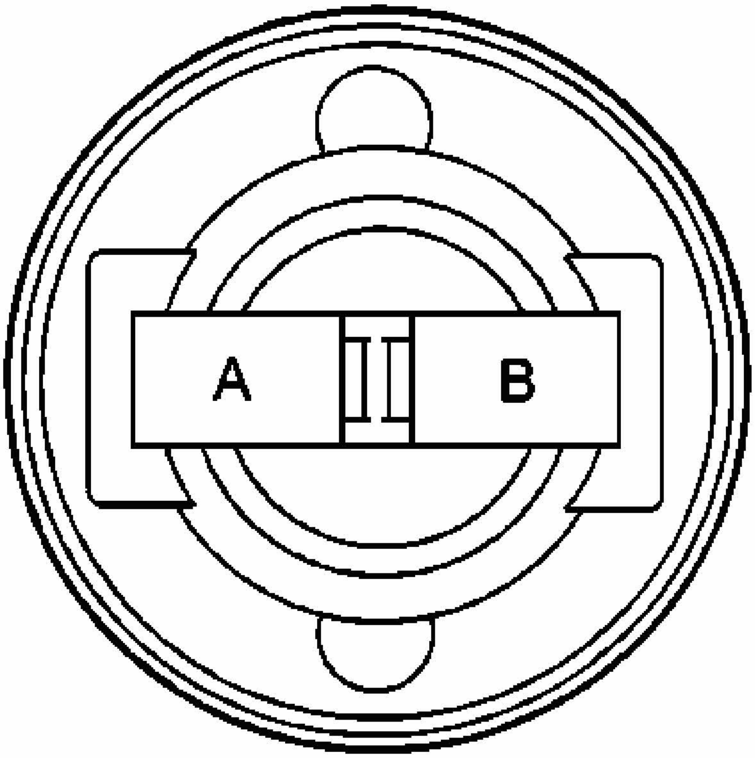


Fig. 51: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12084388
- Service: See Catalog
- Description: 2-Way F Lamp Socket Hardshell W2 (BK)

Terminal Part Information

- Terminal/Tray: Not Serviced in Kit
- Core/Insulation Crimp: Not Serviced in Kit
- Release Tool/Test Probe: Not Serviced in Kit

I/P Courtesy Lamp - Left

Pin	Wire Color	Circuit No.	Function

A	GY/BK	690	Courtesy Lamp Low Control
B	BK	150	Ground

I/P Courtesy Lamp - Right

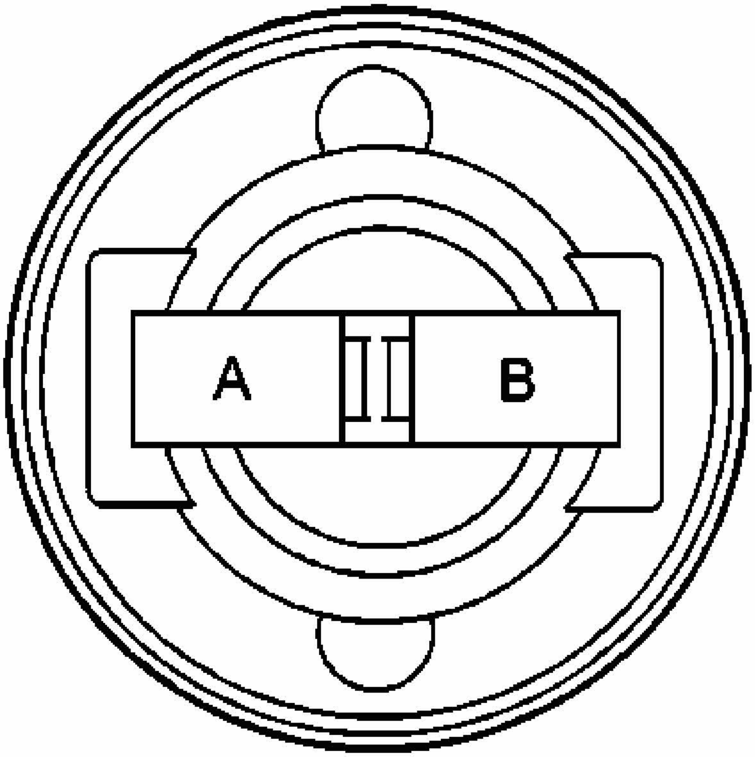


Fig. 52: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12084388
- Service: See Catalog
- Description: 2-Way F Lamp Socket Hardshell W2 (BK)

Terminal Part Information

- Terminal/Tray: Not Serviced in Kit
- Core/Insulation Crimp: Not Serviced in Kit

- Release Tool/Test Probe: Not Serviced in Kit

I/P Courtesy Lamp - Right

Pin	Wire Color	Circuit No.	Function
A	GY/BK	690	Courtesy Lamp Low Control
B	BK	150	Ground

License Lamp

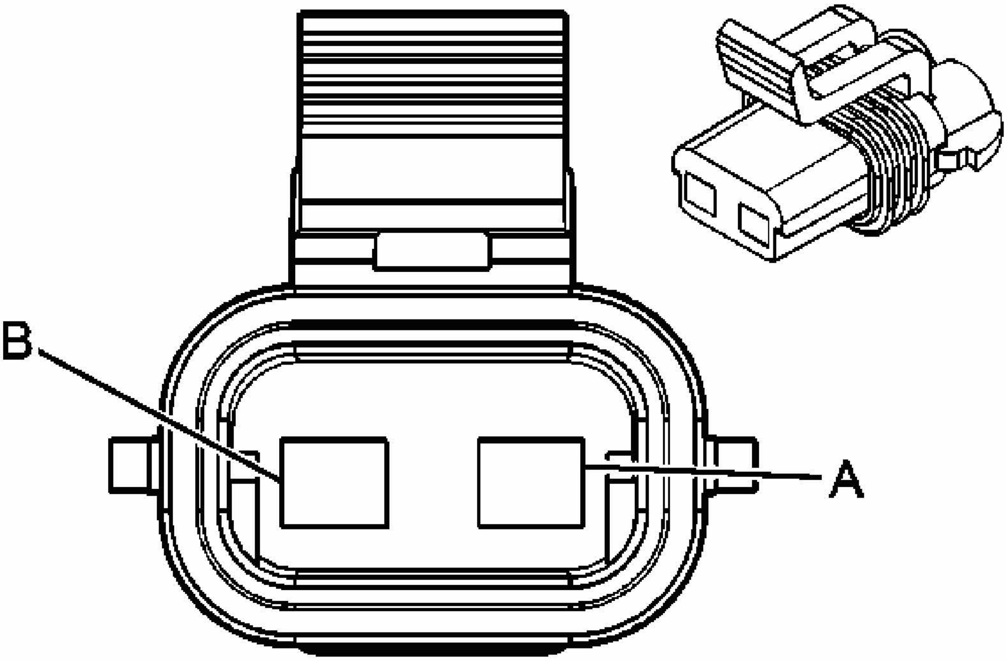


Fig. 53: Door Connectors - End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 15300027
- Service: 12101855
- Description: 2-Way F Metri-Pack 280 Sealed (BK)

Terminal Part Information

- Terminal/Tray: 12077411/2

- Core/Insulation Crimp: 2/5
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

License Lamp

Pin	Wire Color	Circuit No.	Function
A	BN/WH	309	Right Park Lamp Supply Voltage
B	BK	850	Ground

Marker Lamp - LF

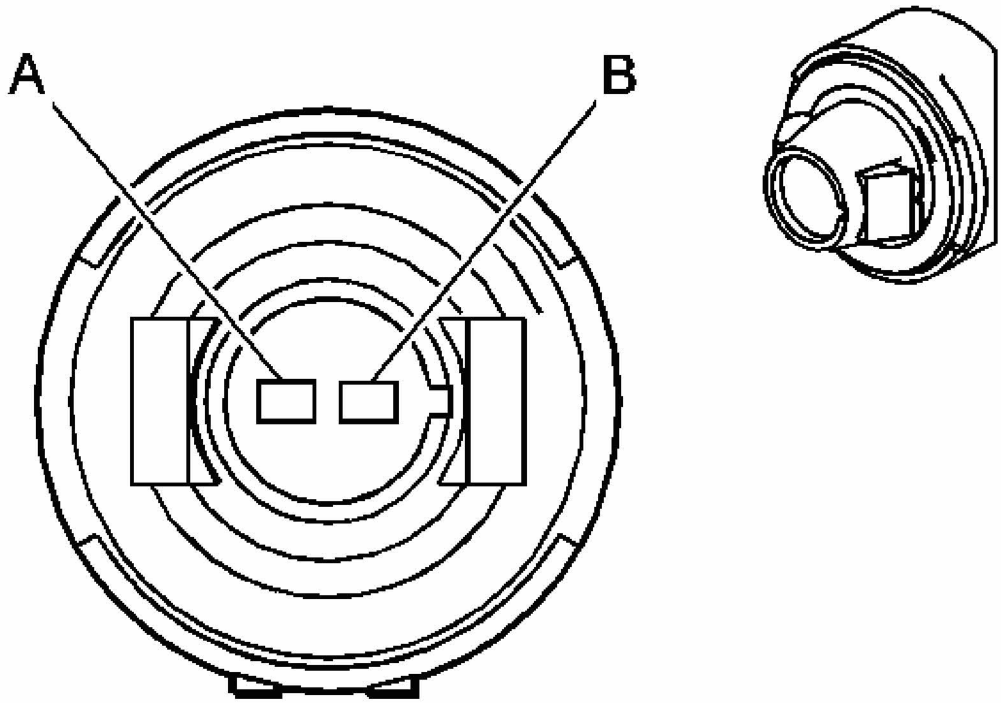


Fig. 54: Connector End View
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 16530674
- Service: See Catalog
- Description: 2-Way F Socket (GY)

Terminal Part Information

- Terminal/Tray: See Terminal Repair Kit
- Core/Insulation See Terminal Repair Kit
- Release Tool/Test Probe: See Terminal Repair Kit

Marker Lamp - LF

Pin	Wire Color	Circuit No.	Function
A	RD	709	Left Park Lamp Supply Voltage
A	RD	709	Left Park Lamp Supply Voltage
B	BK	1350	Ground

Marker Lamp - LR (Coupe)

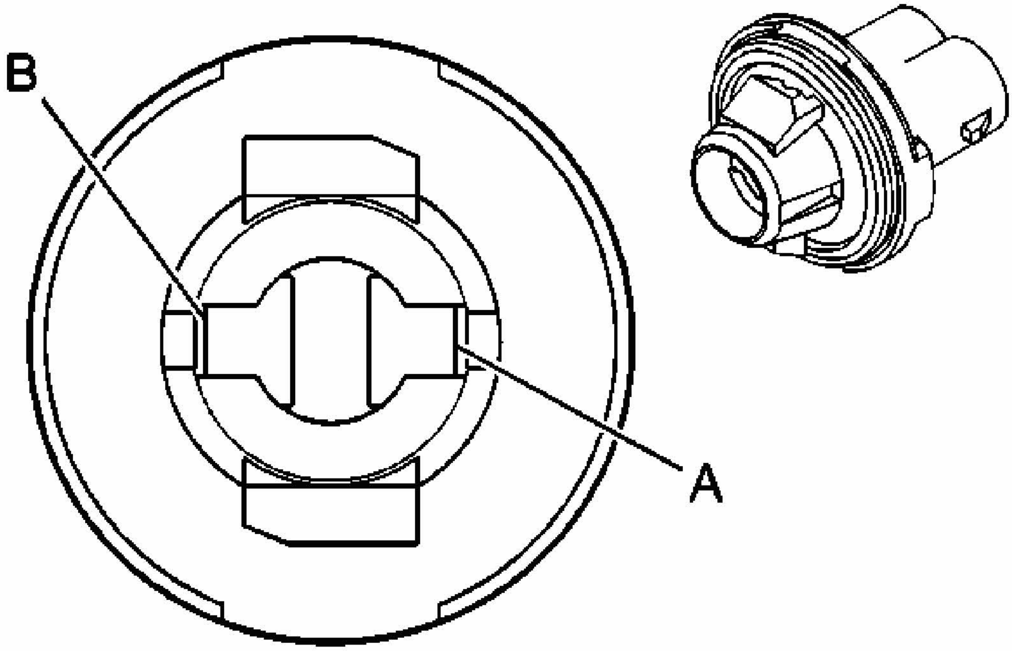


Fig. 55: Connector End View
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 15324946

- Service: See Catalog
- Description: 2-Way F Lamp Socket Wedge Sealed W2 (D-GY)

Terminal Part Information

- Terminal/Tray: 12124471/5
- Core/Insulation Crimp: 2/3
- Release Tool/Test Probe: 12094430/ N/A

Marker Lamp - LR (Coupe)

Pin	Wire Color	Circuit No.	Function
A	BN/WH	709	Left Park Lamp Supply Voltage
B	BK	750	Ground

Marker Lamp - RF

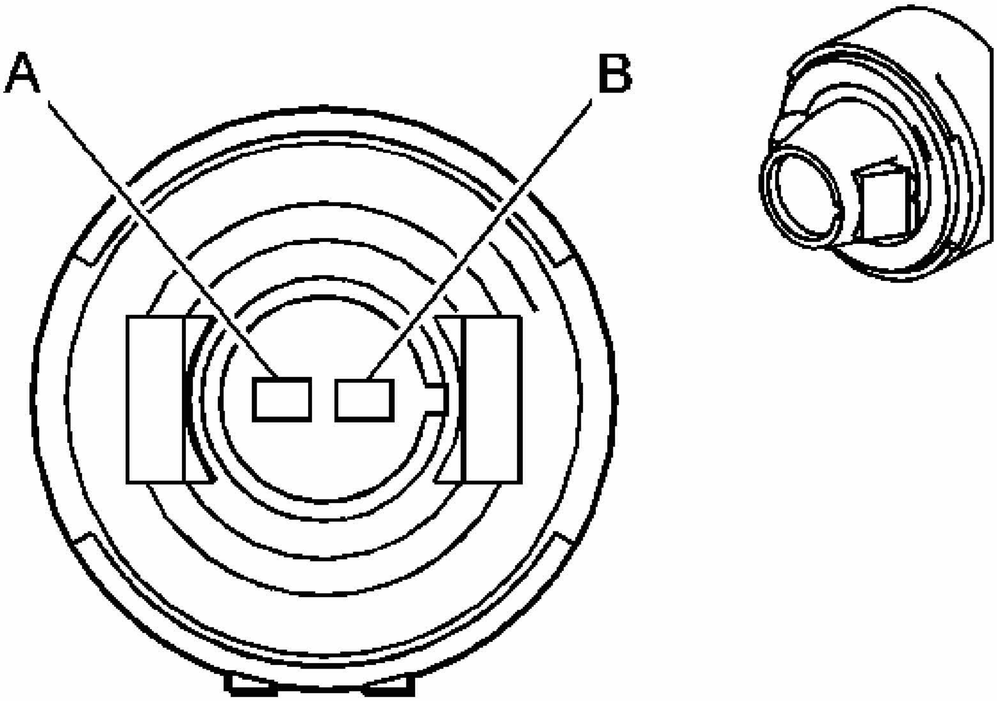


Fig. 56: Connector End View

Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 16530674
- Service: See Catalog
- Description: 2-Way F Socket (GY)

Terminal Part Information

- Terminal/Tray: See Terminal Repair Kit
- Core/Insulation See Terminal Repair Kit
- Release Tool/Test Probe: See Terminal Repair Kit

Marker Lamp - RF

Pin	Wire Color	Circuit No.	Function
A	RD	309	Right Park Lamp Supply Voltage
B	BK	1250	Ground

Marker Lamp - RR (Coupe)

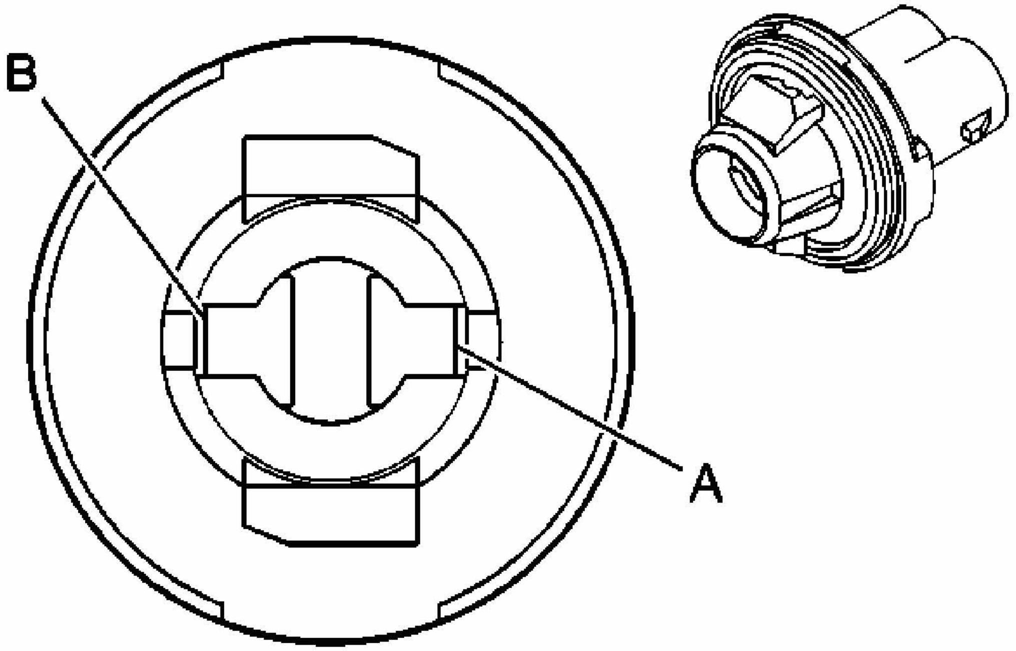


Fig. 57: Connector End View
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 15324946
- Service: See Catalog
- Description: 2-Way F Lamp Socket Wedge Sealed W2 (D-GY)

Terminal Part Information

- Terminal/Tray: 12124471/5
- Core/Insulation Crimp: 2/3
- Release Tool/Test Probe: 12094430/ N/A

Marker Lamp - RR (Coupe)

Pin	Wire Color	Circuit No.	Function
A	BN/WH	309	Right Park Lamp Supply Voltage
B	BK	750	Ground

Park/Turn Signal Lamp - LF

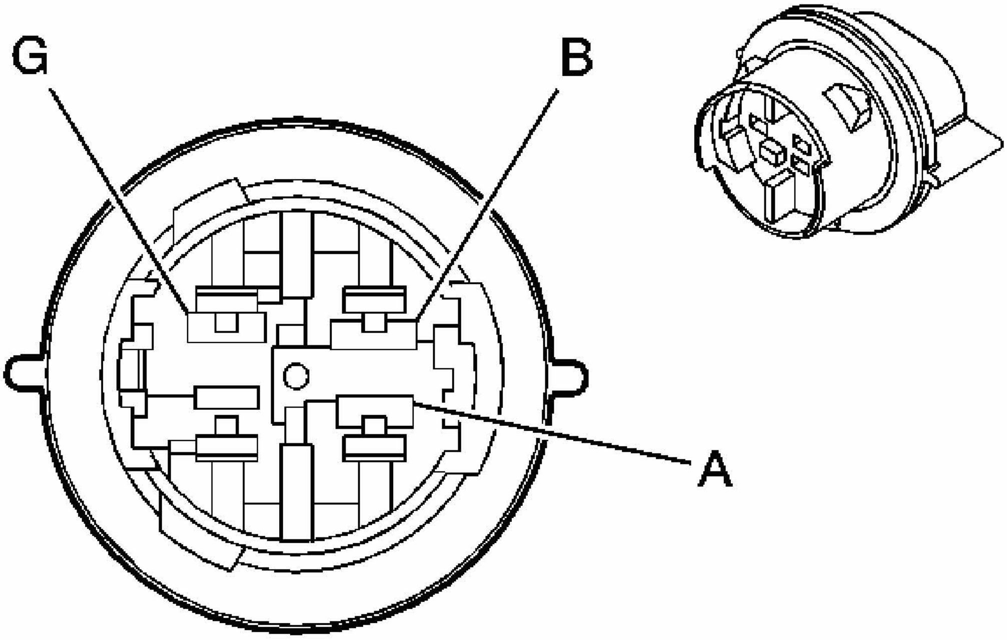


Fig. 58: Connector End Views

Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 16530873
- Service: See Catalog
- Description: 3-Way F Lamp Socket (WH)

Terminal Part Information

- Terminal/Tray: See Terminal Repair Kit
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: See Terminal Repair Kit

Park/Turn Signal Lamp - LF

Pin	Wire Color	Circuit No.	Function
A	YE	1314	Left Front Turn Signal Lamp Supply Voltage
B	RD	709	Left Park Lamp Supply Voltage
G	BK	1350	Ground

Park/Turn Signal Lamp - RF

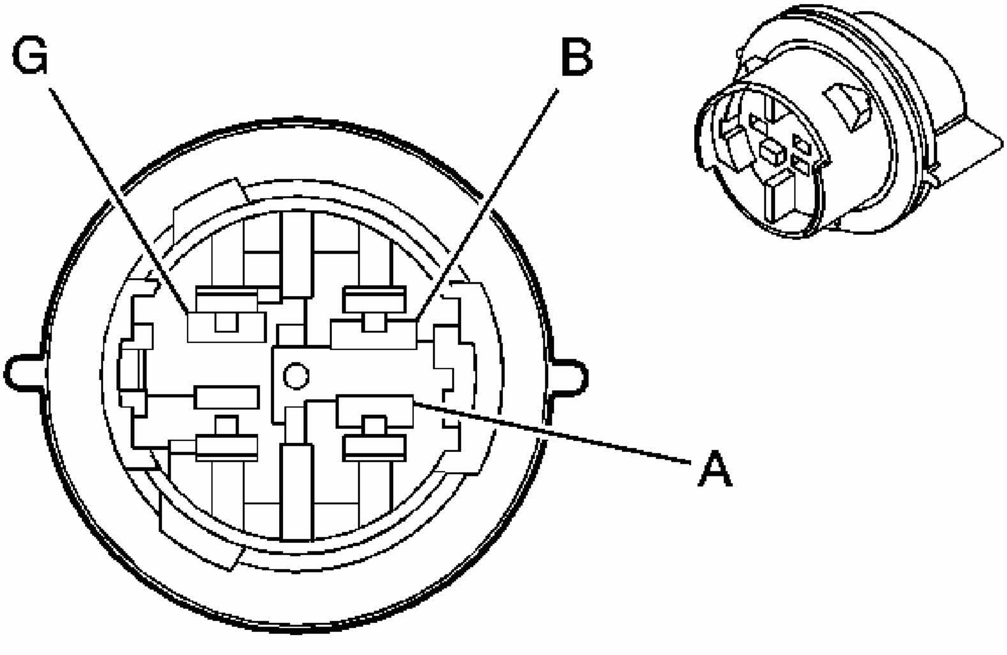


Fig. 59: Connector End Views

Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 16530873
- Service: See Catalog
- Description: 3-Way F Lamp Socket (WH)

Terminal Part Information

- Terminal/Tray: See Terminal Repair Kit
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: See Terminal Repair Kit

Park/Turn Signal Lamp - RF

Pin	Wire Color	Circuit No.	Function
A	YE	1315	Right Front Turn Signal Lamp Supply Voltage
B	RD	309	Right Park Lamp Supply Voltage
G	BK	1350	Ground

Reading Lamp Assembly (9C1/9C3)

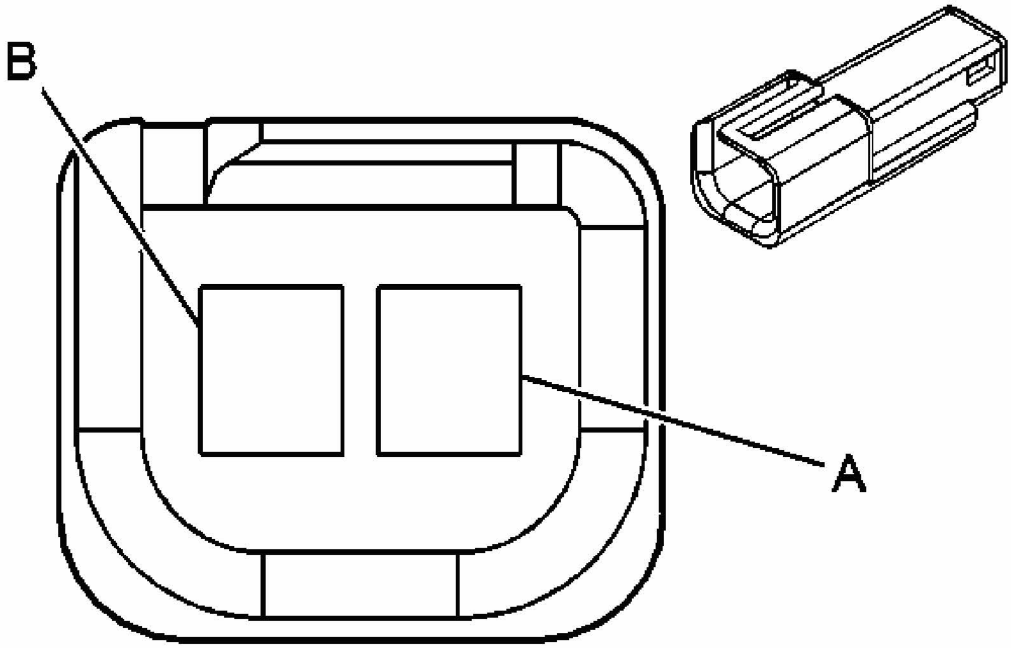


Fig. 60: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12047663
- Service: 12085481
- Description: 2-Way M Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Reading Lamp Assembly (9C1/9C3)

Pin	Wire Color	Circuit No.	Function
A	OG	1732	Inadvertent Power Courtesy Lamp
B	BK	550	Ground

Rear Compartment Courtesy Lamp

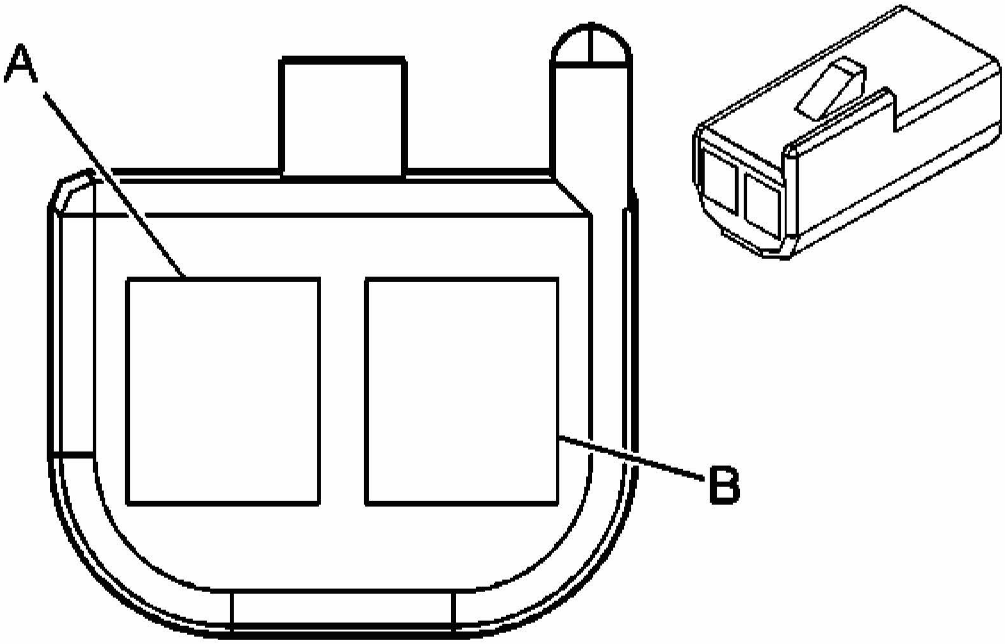


Fig. 61: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12047662
- Service: 12085535
- Description: 2-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Pins: A
- Terminal/Tray: 12047767/2
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

- Pins: B
- Terminal/Tray: 12064971/5
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Rear Compartment Courtesy Lamp

Pin	Wire Color	Circuit No.	Function
A	OG	1732	Inadvertent Power Courtesy Lamp
B	OG/BK	737	Rear Compartment Lamp Control

Spot Lamp - Left (7X6, 7X7)

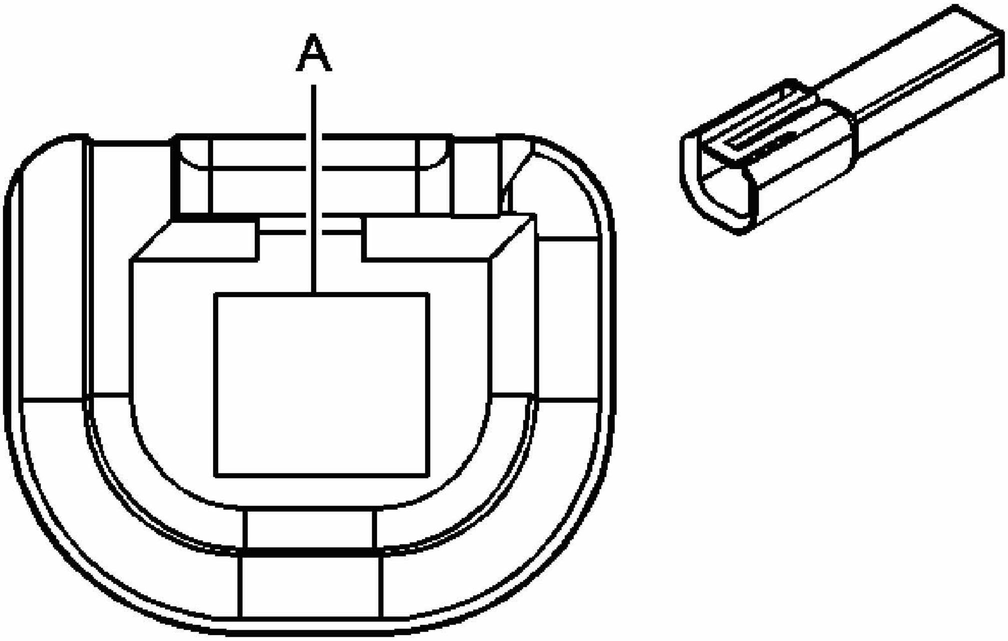


Fig. 62: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12047683
- Service: 12101828
- Description: 1-Way M Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Spot Lamp - Left (9C1/9C3)

Pin	Wire Color	Circuit No.	Function
A	RD/WH	2640	Battery Positive Voltage

Spot Lamp - Right (7X6, 7X7)

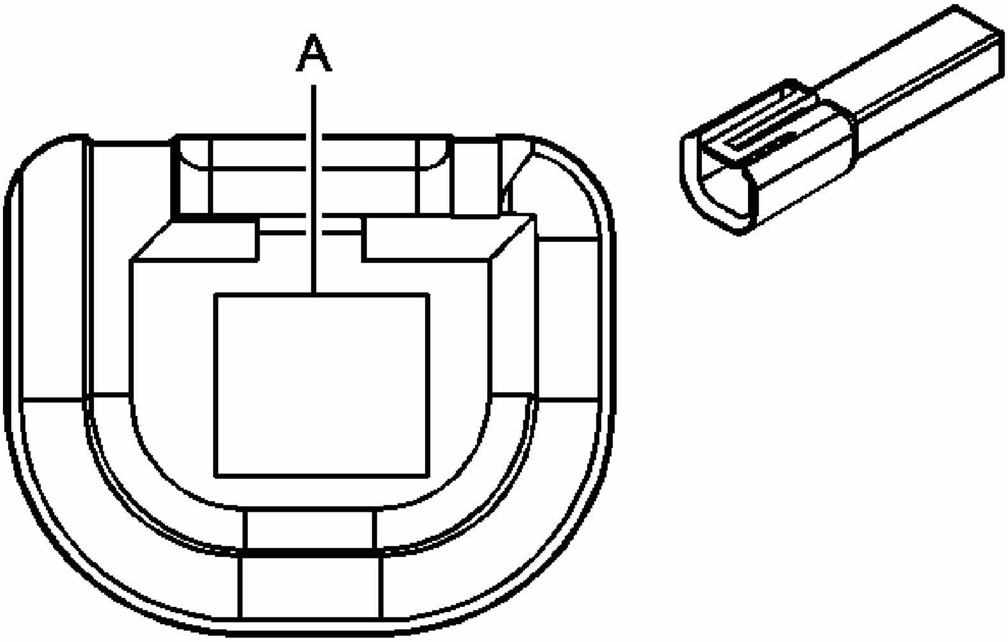


Fig. 63: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12047683
- Service: 12101828
- Description: 1-Way M Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Spot Lamp - Right (9C1/9C3)

Pin	Wire Color	Circuit No.	Function
A	RD/WH	2740	Battery Positive Voltage

Tail Lamp - Left

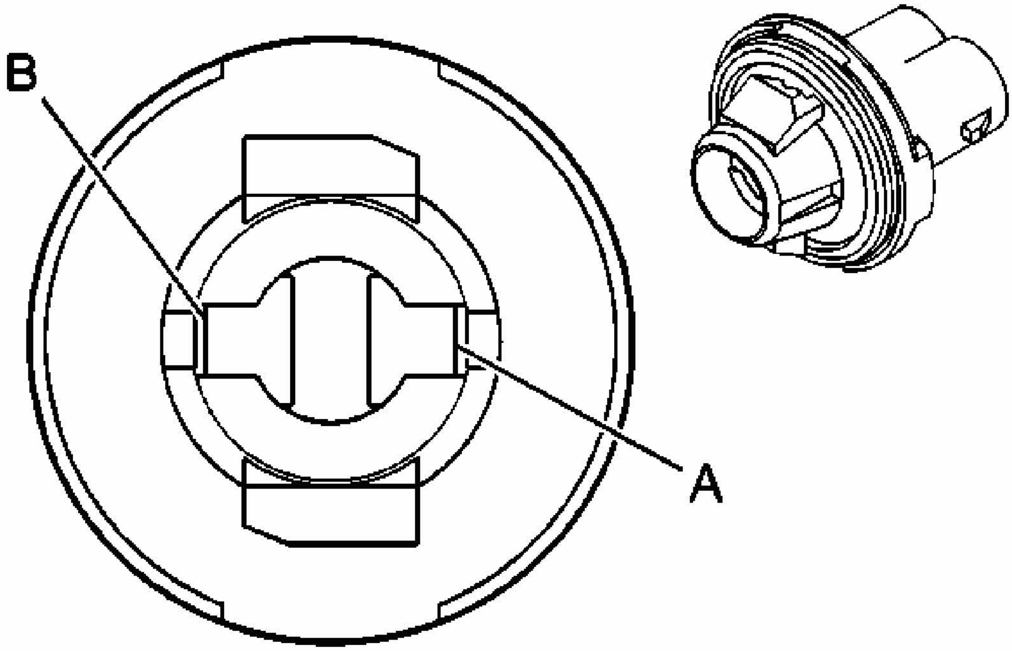


Fig. 64: Connector End View
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 15324946
- Service: See Catalog
- Description: 2-Way F Lamp Socket Wedge Sealed W2 (D-GY)

Terminal Part Information

- Terminal/Tray: 12124471/5
- Core/Insulation Crimp: 2/3
- Release Tool/Test Probe: 12094430/ N/A

Tail Lamp - Left

Pin	Wire Color	Circuit No.	Function
A	BN/WH	709	Left Park Lamp Supply Voltage (Coupe)
A	L-GN	709	Left Park Lamp Supply Voltage (Sedan)
B	BK	750	Ground

Tail Lamp - Right

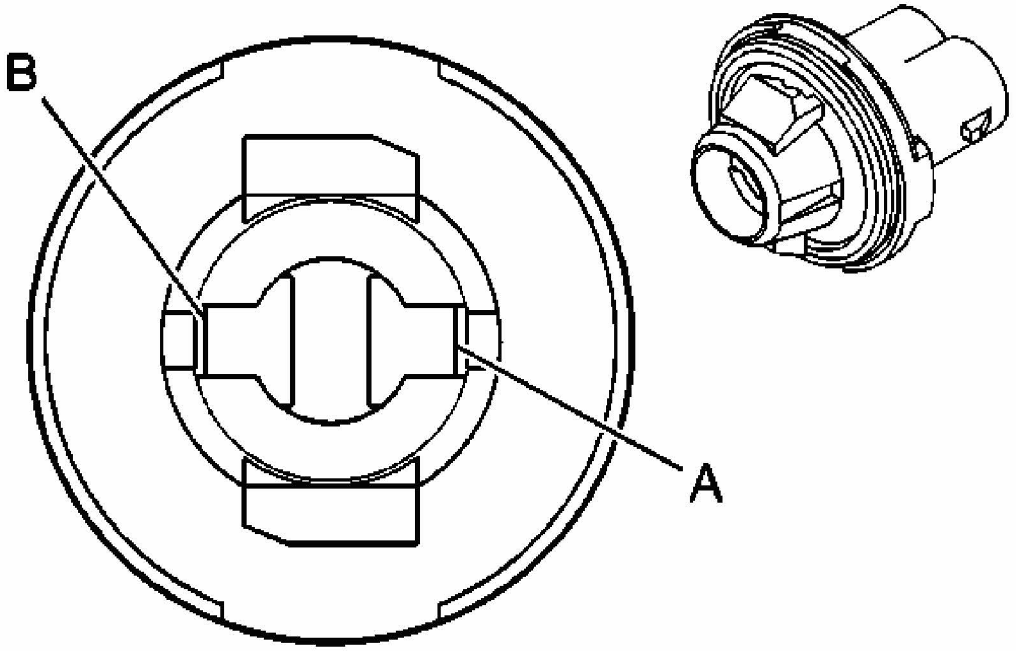


Fig. 65: Connector End View
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 15324946
- Service: See Catalog
- Description: 2-Way F Lamp Socket Wedge Sealed W2 (D-GY)

Terminal Part Information

- Terminal/Tray: 12124471/5
- Core/Insulation Crimp: 2/3
- Release Tool/Test Probe: 12094430/ N/A

Tail Lamp - Right

Pin	Wire Color	Circuit No.	Function
A	BN/WH	309	Right Park Lamp Supply Voltage (Coupe)
A	L-GN	309	Right Park Lamp Supply Voltage (Sedan)
B	BK	750	Ground

Tail/Stop and Turn Signal Lamp - Left

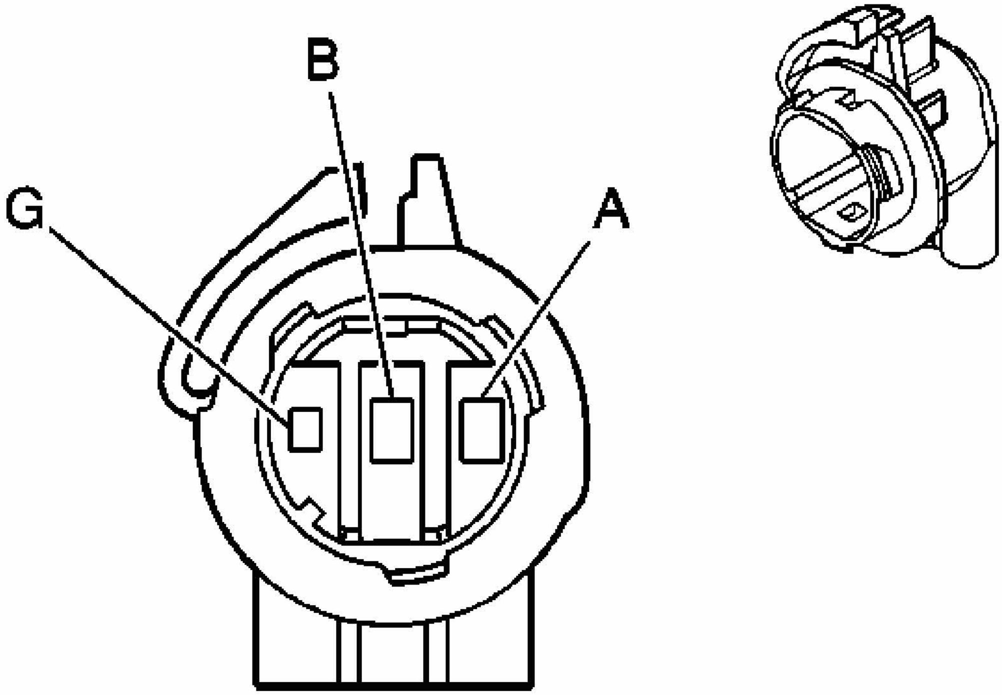


Fig. 66: Connector End View
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12160394
- Service: See Catalog
- Description: 3-Way Socket (GY)

Terminal Part Information

- Terminal/Tray: 12066638/5
- Core/Insulation Crimp: 2/5
- Release Tool/Test Probe: 12180559-1/J-35616-4A (PU)

Tail/Stop and Turn Signal Lamp - Left

Pin	Wire Color	Circuit No.	Function
A	WH	18	Left Rear Stop/Turn Lamp Supply Voltage (Coupe)
A	YE	18	Left Rear Stop/Turn Lamp Supply Voltage (Sedan)
B	BN/WH	709	Left Park Lamp Supply Voltage (Coupe)
B	L-GN	709	Left Park Lamp Supply Voltage (Sedan)
B	L-GN	709	Left Park Lamp Supply Voltage (Sedan)
G	BK	750	Ground
G	BK	750	Ground (Sedan)

Tail/Stop and Turn Signal Lamp - Right

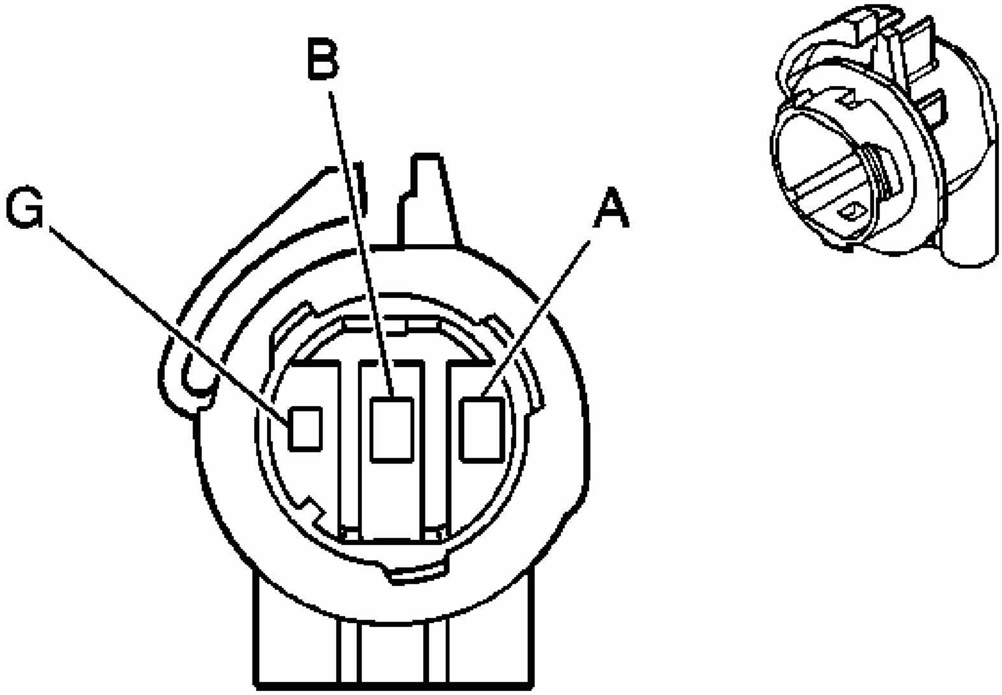


Fig. 67: Connector End View
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12160394
- Service: See Catalog
- Description: 3-Way Socket (GY)

Terminal Part Information

- Terminal/Tray: 12066638/5
- Core/Insulation Crimp: 2/5
- Release Tool/Test Probe: 12180559-1/J-35616-4A (PU)

Tail/Stop and Turn Signal Lamp - Right

Pin	Wire Color	Circuit No.	Function
A	WH	19	Right Rear Stop/Turn Lamp Supply Voltage (Coupe)

A	YE	19	Right Rear Stop/Turn Lamp Supply Voltage (Sedan)
B	BN/WH	309	Right Park Lamp Supply Voltage (Coupe)
B	L-GN	309	Right Park Lamp Supply Voltage (Sedan)
B	L-GN	309	Right Front Turn Signal Switch Signal
G	BK	750	Ground
G	BK	750	Ground (Sedan)

Turn Signal/Multifunction Switch C1

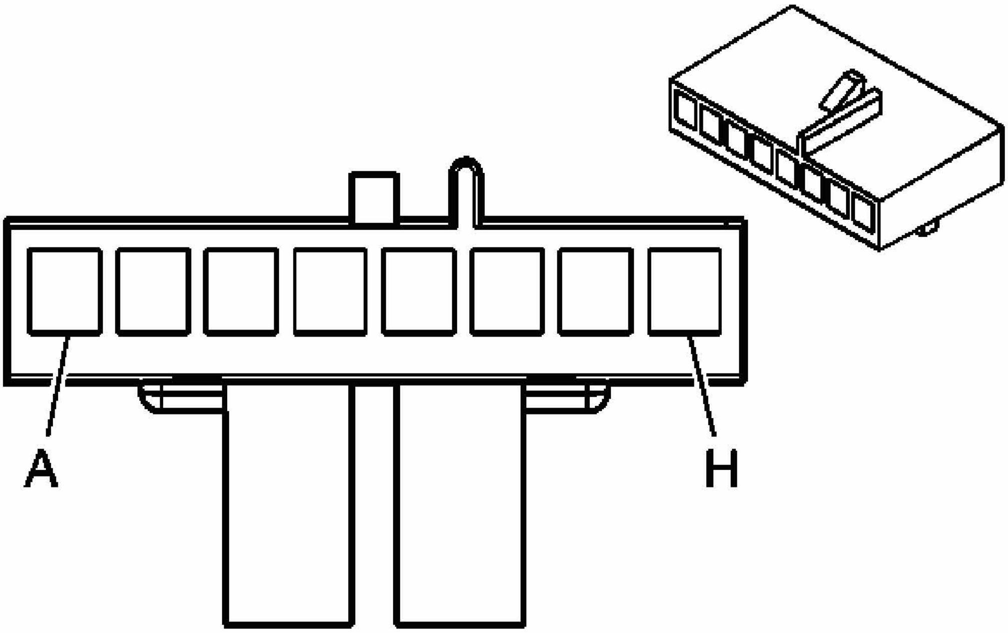


Fig. 68: Connector End View
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12064862
- Service: 12126438

- Description: 8-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12064971/5
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Turn Signal/Multifunction Switch C1

Pin	Wire Color	Circuit No.	Function
A-B	-	-	Not Used
C	TN	2144	Hazard Switch Signal
D	L-BU/WH	1414	Left Front Turn Signal Switch Signal
E	BK/WH	1551	Ground
F	D-BU/WH	1415	Right Front Turn Signal Switch Signal
G	-	-	Not Used
H	BK/WH	1551	Ground

Turn Signal/Multifunction Switch C2

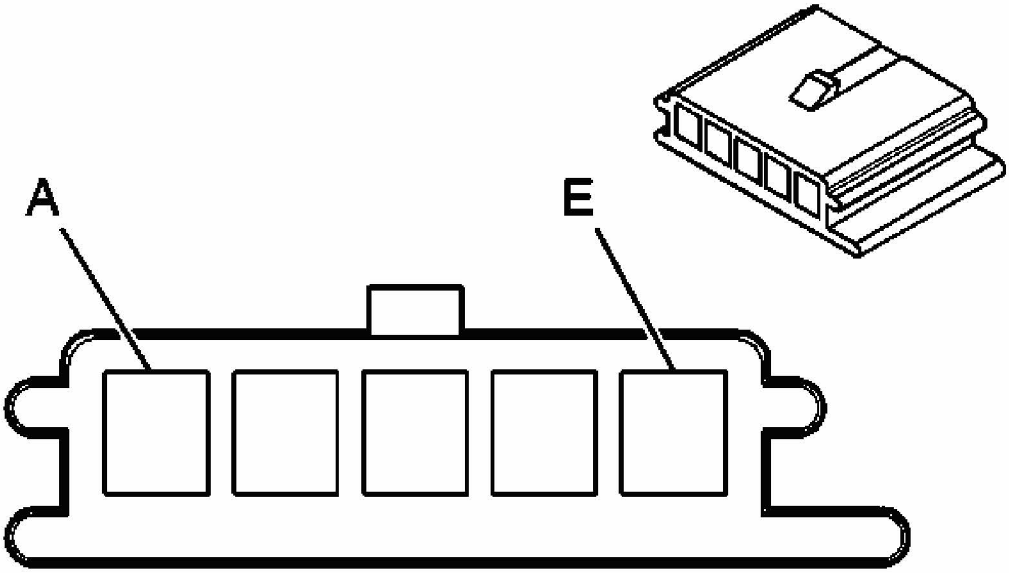


Fig. 69: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12059800
- Service: 15306169
- Description: 5-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Pins: A, D, E
- Terminal/Tray: 12064971/5
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Turn Signal/Multifunction Switch C2

Pin	Wire Color	Circuit No.	Function
A	BN	1356	Flash To Pass Switch Signal
B-C	-	-	Not Used
D	BK/WH	1551	Ground
E	PU	524	Headlamp Dimmer Switch High Beam Signal

Turn Signal/Multifunction Switch C3

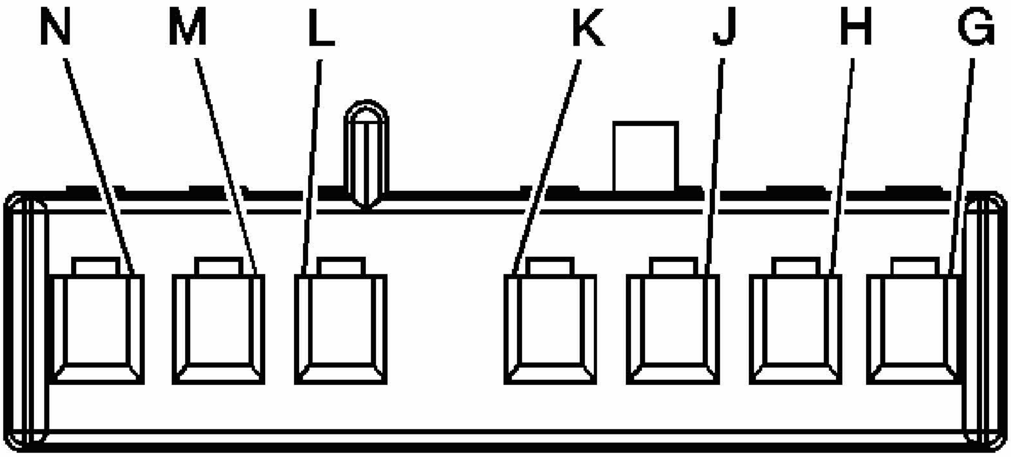


Fig. 70: Connector End View

Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 15339058
- Service: See Catalog
- Description: 7-Way F Metri-Pack 150 (GY)

Terminal Part Information

- Terminal/Tray: 12064971/5
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Turn Signal/Multifunction Switch C3

Pin	Wire Color	Circuit No.	Function
G	-	-	Not Used
H	BK/WH	1251	Ground
J	PK	94	Windshield Washer Switch Signal
K	L-GN	1715	Windshield Wiper Switch High Signal
L	L-BU	1714	Windshield Wiper Switch Low Signal
M-N	-	-	Not Used

Vanity Mirror Lamp - Left (DH6)

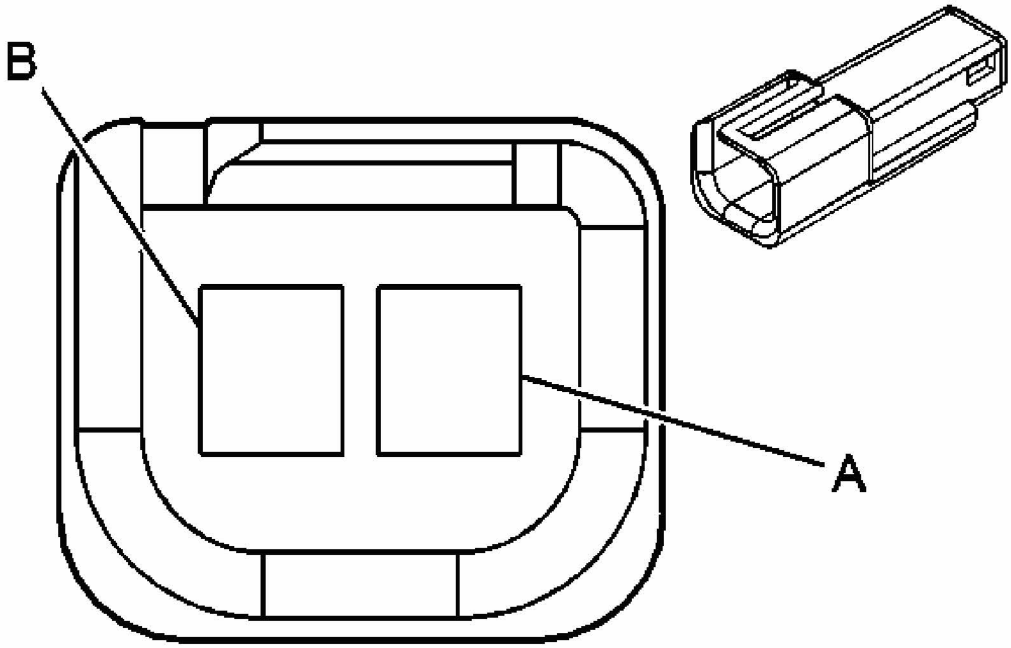


Fig. 71: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12047663
- Service: 12085481
- Description: 2-Way M Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Vanity Mirror Lamp - Left (DH6)

Pin	Wire Color	Circuit No.	Function
A	OG	1732	Inadvertent Power Courtesy Lamp
B	BK	550	Ground

Vanity Mirror Lamp - Right (DH6)

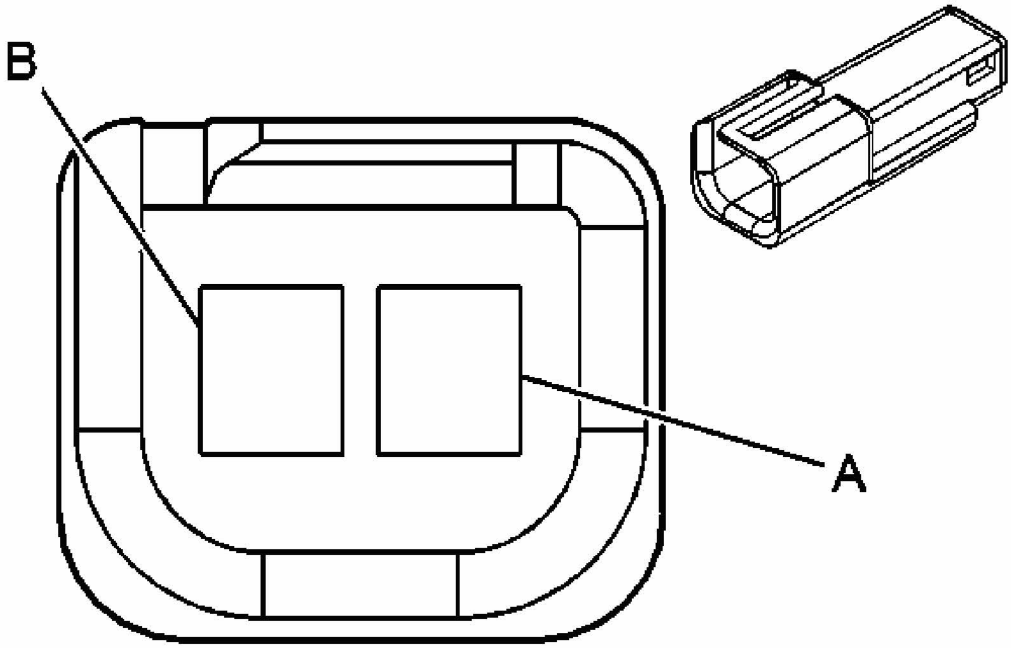


Fig. 72: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Lighting Systems Connector End Views

Connector Part Information

- OEM: 12047663
- Service: 12085481
- Description: 2-Way M Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Vanity Mirror Lamp - Right (DH6)

Pin	Wire Color	Circuit No.	Function
A	OG	1732	Inadvertent Power Courtesy Lamp
B	BK	550	Ground

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC PROCEDURE INSTRUCTIONS

The following is an overview of instructions for all 16 categories which may be included in a diagnostic procedure.

Diagnostic Instructions

A link to the **Diagnostic System Check - Vehicle** Diagnostic System Check - Vehicle is provided here. This procedure should be performed prior to performing other diagnostic procedures, as this prevents misdiagnosis where there are integrated system dependencies.

A link to the **STRATEGY BASED DIAGNOSIS** is provided here. This provides an overview on how a technician should diagnose a vehicle.

A link to the **Diagnostic Procedure Instructions** is provided here. This information is an overview of instructions for all 16 categories which may be included in a diagnostic procedure.

DTC Descriptor

Describes what DTCs are diagnosed in this procedure. The DTC number, with Symptom Description when applicable, and descriptor are written out.

Diagnostic Fault Information

The diagnostic Fault Information table identifies each circuit that makes up an electrical subsystem and the associated circuit faults. DTCs and symptoms are listed in the table for all circuit fault modes. This information can be used to diagnose an electrical fault, or as a quick visual aid showing how the different symptoms and DTCs apply for the subsystem being diagnosed.

Even though all the DTCs and symptoms are shown in this table it does not mean they will all be diagnosed in the same procedure.

An example table from an engine coolant temperature (ECT) procedure:

Example Table From An Engine Coolant Temperature (ECT) Procedure

Circuit	Short to Ground	Open/High Resistance	Short to Voltage Open/High Resistance	Signal Performance Short to Voltage
ECT Sensor Signal	P0117	P0118	P0118	P0125 P0128
	ECT Low Reference	P0118	P0118	P0125 P0128

Typical Scan Tool Data

The Typical Scan Tool Data table identifies a scan tool data parameter and its value in reference to potential circuit faults.

An example table from an ECT procedure:

ECT Sensor Temperature - PCM

ECT Sensor Temperature Circuit

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: -32 to +130°C (-26 to +275°F)			
ECT Signal	-40°C (-40°F)	140°C (284°F)	-40°C (-40°F)
Low Reference	--	-40°C (-40°F)	-40°C (-40°F)
Internal ECM damage may occur if shorted to B+			

Circuit/System Description

Circuit/System Description identifies how a circuit/system normally functions.

Conditions for Running the DTC

Conditions for Running the DTC, identifies what conditions must be present to allow the diagnostic to run.

Conditions for Setting the DTC

Conditions for Setting the DTC, identifies the condition(s) that must be present in order to fail the diagnostic and when to set the DTC.

Action Taken When the DTC Sets

Actions Taken When the DTC sets, identifies the default actions taken when a control module sets a DTC.

Conditions for Clearing the DTC

Conditions for Clearing the DTC, identifies the conditions that must be met in order to clear the DTC.

Diagnostic Aids

Diagnostic Aids are suggestions which explain other methods to diagnose the condition. It also provides unique information about the system used to assist the technician in finding and repairing a vehicle condition.

Reference Information

Reference Information includes links providing additional information for the diagnostic procedure.

For example:

- Schematic Reference
- Connector End View Reference
- Description and Operation
- Electrical Information Reference
- DTC Type Reference
- Scan Tool Reference
- Special Tools Required

Circuit/System Verification

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, performing the Circuit/System Verification category first, aids in determining if a vehicle condition is current. This category also serves to route the technician to another diagnostic procedure which should be performed first; for example, a DTC with a higher priority.

Circuit/System Verification is a non-intrusive procedure outlining how to verify that a system or a portion of a system is functioning correctly. During the verification process, the vehicle is kept intact and tested as a complete system. This verification is used to assist the technician in determining whether a condition is current or intermittent. When a condition is determined to be intermittent, a technician can use the link in Electrical Information Reference: **Testing for Intermittent Conditions and Poor Connections** .

The technician should be able to identify if the fault is occurring on the input circuit - signal or on the output circuit - control when applicable. The technician will need to decide from the verification results if the system is working correctly or if further diagnosis needs to be performed in either Circuit/System Testing and/or Component Testing.

Circuit/System Testing

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, beginning with the Circuit/System Verification category aids in determining if a vehicle condition is current.

Circuit/System Testing is a step by step, positive-flow, testing sequence which allows the technician to perform each test step, in sequence, until a fault is detected. If the result of a test step is achieved, the normal flow is to proceed to the next step. If the result is NOT achieved, the repair arrow bullet will identify what actions need to take place.

Intrusive diagnostics are performed to locate the system fault. System harness connections are disconnected from the module or component to test individual circuit functions. The module or component will be used to assist in verifying the circuit function. When a test does not pass, the repair steps will indicate what circuit faults to test. For example, short to voltage, short to ground or open/high resistance.

When testing for individual circuit faults, the technician is expected to include terminal inspections such as connection surfaces and terminal tension at both the harness and component/module. Additionally, a technician can use the links in Electrical Information Reference: **Testing for Intermittent Conditions and Poor Connections**

or**Circuit Testing** .

The control modules and components will also be diagnosed during these test steps. A retest of a control module or component should always be performed before replacement. For example, re-connect all components and modules and retest the system to verify the condition still exists before replacing modules or components.

Component Testing

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, beginning with the Circuit/System Verification category aids in determining if a vehicle condition is current.

Component Testing can offer static and/or dynamic component tests. These tests can be used to verify if a component is operating correctly to avoid unnecessary replacement.

Testing modules in this category will not be offered. In most cases, the module is used to verify the harness circuits in the Circuit/System Testing category and a retest of the module should always be performed before replacement.

Repair Instructions

Repair Instructions provides a link to**Diagnostic Repair Verification** . This link describes how to verify the vehicle is repaired.

Repair Verification

Repair Verification describes how to verify the vehicle is repaired when additional instructions are needed beyond what is in Diagnostic Repair Verification.

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description

DTC B257A	Headlamp Switch Input Signal Mismatch
DTC B1395 03	Voltage Below Threshold
DTC B1395 07	Voltage Above Threshold
DTC B1480	Battery Rundown Protection Circuit
DTC B2530	Front Fog Lamps Control Circuit
DTC B2545	Backup Lamps Circuit
DTC B2575	Headlamp Control Circuit
DTC B2580	Headlamp High Beam Control Circuit
DTC B2585	Park Lamp Control Circuit
DTC B2600	Daytime Running Lamp Control System Circuit
DTC B2610	Passenger Compartment Dimming 1 Circuit
DTC B2615	Passenger Compartment Dimming 2 (courtesy lamps, etc.) Circuit
DTC B2645	Ambient Light Circuit
DTC B2652	Passenger Compartment Dimming 3
DTC B3445	Stop Lamp Circuit
DTC B3600	Passenger Compartment Dimming Request Signal Circuit
DTC C0277 06	Brake Pedal Position Sensor Circuit Short to Ground or Open
DTC C0277 07	Brake Pedal Position Sensor Circuit Voltage Above Threshold
DTC C0277 09	Brake Pedal Position Sensor Circuit Rate of Change Above Threshold
DTC C0277 4B	Brake Pedal Position Sensor Calibration Not Learned
DTC C0297	Powertrain Configuration Data Not Received
DTC C0890 03	Voltage Below Threshold
DTC C0890 07	Voltage Above Threshold
DTC P0572	Brake Switch Circuit 1 Low Voltage
DTC P0573	Brake Switch Circuit 1 High Voltage

DIAGNOSTIC STARTING POINT - LIGHTING SYSTEMS

Begin the system diagnosis with the **Diagnostic System Check - Vehicle** . The Diagnostic System Check-Vehicle will provide the following information:

- The identification of the control module(s) which command the system.
- The ability of the control module(s) to communicate through the serial data circuit.
- The identification of any stored diagnostic trouble codes (DTCs) and their status.

The use of the Diagnostic System Check-Vehicle will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL OUTPUT CONTROLS

Body Control Module (BCM)

Scan Tool Output Control	Additional Menu Selection(s)	Description
Backup Lamps	Light Test	The BCM activates the backup lamp relay when you select ON. The backup lamps illuminate until commanded OFF.
LF Turn/DRL Lamp	Light Test	The BCM activates the left front turn signal lamps when you select ON. The turn signal lamps illuminate until commanded OFF.
Parking Lamp	Light Test	The BCM activates the park lamp relay when you select ON. The park lamps illuminate until commanded OFF.
RF Turn/DRL Lamp	Light Test	The BCM activates the right front turn signal lamps when you select ON. The turn signal lamps illuminate until commanded OFF.
Interior Lamps	Light Test	The BCM activates the interior lamps outputs for 5 seconds when you select ON. The dome, footwell, and courtesy lamps illuminate for 5 seconds.
Fog Lamps	Light Test	The BCM activates the fog lamps relay when you select ON. the fog lamps illuminate until commanded OFF.
High Beam Relay	Light Test	The BCM activates the high beam relay when you select ON. The high beam headlamps illuminate until commanded OFF.
Low Beam Relay	Light Test	The BCM activates the low beam relay when you select ON. The low beam headlamps illuminate until commanded OFF.
LR Stop/Turn Signal Lamp	Light Test	The BCM activates the left rear stop/turn signal lamp when you select ON. The lamp illuminates until commanded OFF.
RR Stop/Turn Signal Lamp	Light Test	The BCM activates the right rear stop/turn signal lamp when you select ON. The lamp illuminates until commanded OFF.
Instrumentation Backlight Dimming	Light Test	The BCM commands the IPC to dim the instruments from full dim to full bright.

SCAN TOOL DATA LIST

Scan Tool Data List

Scan Tool Parameter	Data Display	Units Displayed	Typical Data Value
Operating Conditions: Ignition in the ON position. Bright Light Applied to the DRL ambient light sensor. Park brake not set. Headlamp Switch in the OFF position. I/P lamp switch in the OFF position. Fog lamp switch in the OFF position.			
Ambient Light Sensor	Exterior Lighting	Volts	Volts
Ambient Light States	Exterior Lighting	Night/Day Unknown/Invalid	-
Auto Hdlp. Disable Sw.	Exterior Lighting	Inactive/Active	-
Backup Lamps	Exterior Lighting	On/Off	Off
Bass High During Learn	Bass Data	No/Yes	No
Bass Learned	Bass Data	No/Yes	Yes
Bass Low During Learn	Bass Data	No/Yes	No
Bass Moved During Learn	Bass Data	No/Yes	No
Bass Valid	Bass Data	No/Yes	Yes
Brake Applied Output Signal	Outputs	On/Off	Off
Brake Apply Sensor	BCM Data	Volts	0 volts
Brake Lamp	Bass Data	On/Off	Off
Center Stop Lamp	Exterior Lighting	On/Off	-
Courtesy Lamp PWM Command	Interior Lighting	%	%
Courtesy Lamp Active Reason	Interior Lighting	On/Off	Off
Current Position	Bass Data	Counts	0
Dimming Control Reference	Interior Lighting	Volts	Volts
Dimming Control Signal	Interior Lighting	%	%
Dimming Control Signal	Interior Lighting	Volts	Volts
Flash to Pass Switch	Exterior Lighting	Inactive/Active	Inactive
Front Fog Lamp Relay	Outputs	On/Off	Off
Front Fog Lamp Relay Command	Exterior Lighting	On/Off	Off
Front Fog Lamp Switch	Exterior Lighting	Inactive/Active	Inactive
Hazard Lamp Switch	Exterior	Inactive/Active	Inactive

	Lighting		
Headlamp Switch	Exterior Lighting	Inactive/Active	Inactive
High Beam Select Switch	Exterior Lighting	Inactive/Active	Inactive
Incandescent Dimming	Interior Lighting	%	%
Instrumentation Backlight	Outputs	On/Off	Off
Interior Lamp Output	Outputs	On/Off	Off
Interior Light Switch	Inputs	On/Off	Off
Interior Lights Power	Outputs	On/Off	Off
Interior Lights Power	Inputs	On/Off	Off
Learned Home Position	Bass Data	Counts	0
Learn in Progress	Bass Data	No/Yes	No
LED Dimming PWM Command	Interior Lighting	%	%
Left Turn Signal Switch	Exterior Lighting	Inactive/Active	Inactive
LF Turn Signal	Exterior Lighting	On/Off	Off
Low Beam Relay Command	Exterior Lighting	Inactive/Active	Inactive
Low Beam Switch	Inputs	On/Off	Off
LR Door Open Switch	Inputs	On/Off	Off
LR Turn Signal	Exterior Lighting	On/Off	Off
Park Brake Switch	Inputs	Applied/Released	Released
Park Lamp Relay Command	Exterior Lighting	On/Off	Off
Park Lamp Switch	Exterior Lighting	Inactive/Active	Inactive
Park Lamp Switch	Inputs	On/Off	Off
RF Door Lock Switch	Inputs	On/Off	Off
RF Turn Signal	Exterior Lighting	On/Off	Off
Right Corner Lamp	Exterior Lighting	Inactive/Active	Inactive
Right Turn Signal Switch	Exterior Lighting	On/Off	Off
RR Door Open Switch	Inputs	On/Off	Off
RR Turn Signal	Outputs	On/Off	Off

Stop Lamp Signal	Cruise Control Data	On/Off	Off

SCAN TOOL DATA DEFINITIONS

BCM Scan Tool Data Definitions

The BCM Scan Tool Data Definitions contains a brief description of all Lighting System related BCM parameters available on the scan tool.

Cruise Control Data List

Stop Lamp Signal

The scan tool displays ON/OFF. When the PCM detects the stop lamps are applied, the scan tool will display ON.

BCM Data List

Brake Apply Sensor

The scan tool displays volts. The voltage level varies as the brakes are applied.

BCM Inputs

Flash to Pass

The scan tool displays ON/OFF. When the multifunction switch is placed on the FTP position, the scan tool will display ON.

Front Fog Lamp Switch

The scan tool displays ON/OFF. When the fog lamp switch is placed in the ON position, the scan tool will display ON.

Hazard Switch Signal

The scan tool displays ON/OFF. When the hazard switch is placed in the ON position, the scan tool will display ON.

Headlamp OFF Switch

The scan tool displays ON/OFF. When the headlamp switch is placed in the OFF position, the scan tool will display ON.

High Beam Switch

The scan tool displays ON/OFF. When the headlamp dimmer switch is placed in the HIGH position, the scan tool will display ON.

Interior Light Switch

The scan tool displays ON/OFF. When the interior light switch is placed in the DOME position, the scan tool will display ON.

Interior Lights Power

The scan tool displays ON/OFF. When the interior lamps switch has voltage applied, the scan tool will display ON.

Left Turn Signal

The scan tool displays ON/OFF. When the turn signal switch is placed in the LEFT turn position, the scan tool will display ON.

Low Beam Switch

The scan tool displays ON/OFF. When the headlamp dimmer switch is placed in the LOW position, the scan tool will display ON.

LR Door Open Switch

The scan tool displays ON/OFF. When the LR door is open, the scan tool will display ON.

Park Brake Switch

The scan tool display ON/OFF. When the park brake is applied, the scan tool will display ON.

Park Lamp Switch

The scan tool displays ON/OFF. When the headlamp switch is in the PARK position, the scan tool will display ON.

RF Door Lock Switch

The scan tool displays ON/OFF. When the RF door is open, the scan tool will display ON.

RR Door Open Switch

The scan tool displays ON/OFF. When the RR door is open, the scan tool will display

ON.

Right Turn Signal

The scan tool displays ON/OFF. When the turn signal switch is placed in the right turn position, the scan tool will display ON.

BCM Outputs

Backup Lamps

The scan tool displays ON/OFF. This output of the BCM is displayed as ON when the backup lamps are turned ON.

Brake Applied Outputs

The scan tool displays ON/OFF. This output of the BCM is displayed as ON when the brake pedal is applied.

Front Fog Lamp Relay

The scan tool displays ON/OFF. This output of the BCM is displayed as ON when the fog lamps are turned ON.

Instrumentation Backlight

The scan tool displays ON/OFF. This output of the BCM is displayed as ON when the I/P lamps are commanded ON by the BCM.

Interior Lamp Output

The scan tool displays ON/OFF. This output of the BCM is displayed as ON when the interior lamps are turned ON.

LF Turn/DRL Lamp Status

The scan tool displays ON/OFF. This output of the BCM is displayed as ON when the left turn signal is turned ON or when the BCM turns ON the DRL lamps.

LR Stop/Turn Signal Lamp

The scan tool displays ON/OFF. This output of the BCM is displayed as ON when the left turn signal is turned ON or when the brakes are applied.

Low Beam Relay Command

The scan tool displays ON/OFF. This output of the BCM is displayed as ON when the low beam headlamps are turned ON.

Park Lamp Relay

The scan tool displays ON/OFF. This output of the BCM is displayed as ON when the park lamps are turned ON.

RF Turn/DRL lamp Status

The scan tool displays ON/OFF. This output of the BCM is displayed as ON when the right turn signal is turned ON or when the BCM turns ON the DRL lamps.

RR Stop/Turn Signal Lamp

The scan tool displays ON/OFF. This output of the BCM is displayed as ON when the right turn signal is turned ON or when the brakes are applied.

BASS Data List

BASS High During Learn

The scan tool displays NO/YES. If a short to battery positive voltage is detected in the stop lamp switch signal circuit during calibration, then the scan tool will display YES.

BASS Learned

The scan tool displays NO/YES. When the brake pedal position sensor has been calibrated correctly, the scan tool will display YES.

BASS Low During Learn

The scan tool displays NO/YES. If a short to ground is detected in the stop lamp switch signal circuit during calibration, then the scan tool will display YES.

BASS Moved During Learn

If the brake pedal is moved during calibration, the scan tool will display YES.

BASS Valid

The scan tool displays NO/YES. When the brake pedal position sensor has been calibrated correctly, the scan tool will display YES.

Brake Lamp

The scan tool displays ON/OFF. When the brake is applied the scan tool will display ON.

Current Position

The scan tool displays COUNTS. The brake pedal position sensor applies a varying voltage to the BCM. The BCM then calculates the current position of the brake pedal.

Learned Home Position

The scan tool displays COUNTS. The BCM displays the home position of the brake pedal position sensor.

Learn in Progress

The scan tool displays NO/YES. When the brake pedal position sensor is being calibrated, the scan tool will display YES.

DTC B257A

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

DTC B257A 00

Headlamp Switch Input Signal Mismatch

Diagnostic Fault Information

DTC B257A

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch Off	B257A 00	2, 3	B257A 00	-
Park Lamp Switch On	B257A 00	B257A 00	B257A 00	-
Headlamp Switch On	B257A 00	1	B2575 00	-
Headlamp Ground	-	3, 4	-	-

1. Headlamps Inoperative Low or High Beams
2. Headlamps Always On - Low or High Beam
3. Park/Tail Lamps Inoperative

4. Daytime Running Lamps (DRL) Defeat Inoperative

Circuit/System Description

When the headlamp switch is in the OFF position, the body control module (BCM) receives a ground signal through the headlamp switch OFF circuit and an open signal on the park lamp ON circuit. When the headlamp switch is in the PARK or HEAD position, the BCM receives an open signal through the headlamp switch OFF circuit and a ground signal through the park lamp ON circuit.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The BCM receives an unexpected signal along either the headlamp switch OFF circuit or the park lamp ON circuit.

Action Taken When the DTC Sets

The BCM disregards the headlamp switch input and defaults to automatic headlamp function.

Conditions for Clearing the DTC

The BCM clears this code from current when the fault is removed from the system.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, headlamp switch to PARK, just the park lamps should illuminate.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the headlamp switch.
2. Ignition ON, test for B+ between the signal circuits listed below and ground.
    - Headlamp switch headlamps ON signal terminal 1
    - Park lamp switch ON signal terminal 2
    - Headlamp switch OFF signal terminal 3
    - If less than the specified value, test the signal circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
3. Install a 3A fused jumper wire between the headlamp OFF signal circuit terminal 3 and ground. Verify the scan tool Auto Hdlp. Disable Sw. parameter is Active.
    - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
4. Install a 3A fused jumper wire between the park lamp ON signal circuit terminal 2 and ground. Verify the scan tool Parklamp Switch parameter is Active.
    - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
5. Connect a 3A fused jumper wire between the park lamp ON signal circuit terminal 2 and the headlamps ON signal circuit terminal 1 to ground. Verify the scan tool Headlamp Switch parameter is Active.
    - If not the specified value, test the headlamps On signal circuit for a short to voltage or an open/high resistance. If the circuits test normal replace the BCM.
6. If all circuits test normal, replace the headlamp switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**
- **Control Module References** for BCM replacement, setup, and programming.

DTC B1395

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

DTC B1395 03

Voltage Below Threshold

DTC B1395 07

Voltage Above Threshold

Diagnostic Fault Information

DTC B1395

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
I/P Dimming Voltage Reference	B1395 03, B3600 03	B1395 03	-	B1395 03, B1395 07
I/P Dimming Control Circuit	B3600 03	B3600 03	1	-
1. Interior Backlighting Inoperative				

Circuit/System Description

The BCM supplies a voltage reference through the instrument panel (I/P) dimming voltage reference circuit to the interior lamp dimmer switch, which is part of the headlamp switch. When the dimmer switch is placed in a desired brightness position, reference voltage is applied through the dimmer switch rheostat and the I/P lamps dimmer switch signal circuit to the BCM. The BCM interprets this voltage signal, then applies a pulse width modulated (PWM) voltage through the I/P lamps supply voltage circuit and the LED dimming supply circuit to all related interior lamps, illuminating them to the desired level of brightness.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

B1395 03

The BCM detects a voltage that is lower than 9 volts on the I/P dimming voltage reference circuit.

B1395 07

The BCM detects a voltage that is greater than 12 volts on I/P dimming voltage reference circuit.

Action Taken When the DTC Sets

The I/P lamps are not illuminated.

Conditions for Clearing the DTC

The BCM clears this code from current when the fault is removed from the system.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, cover the ambient light sensor, vary the interior lamp dimming switch from dim to full bright. The I/P lamps should dim and then become full bright.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the headlamp switch.
2. Ignition ON, test for B+ between the reference voltage circuit terminal 15 and ground.
    - If less than the specified value, test the voltage reference circuit for a short to

ground or an open/high resistance. If the circuit test normal, replace the BCM.

3. Ignition OFF, disconnect the (C3) harness connector at the BCM.
4. Ignition ON, test the 12 volt reference circuit terminal 12 for a short to voltage.
5. If all circuits test normal, replace the headlamp switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**
- **Control Module References** for BCM replacement, setup, and programming

DTC B1480

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Circuit Description

The body control module (BCM) supplies battery positive voltage to the courtesy lamps, underhood lamp, instrument panel (I/P) compartment lamp, console lamp and both visor vanity mirror lamps. In the event that any of these lamps were to remain illuminated for more than 20 minutes with the ignition switch in the OFF position, the BCM will deactivate the inadvertent power courtesy lamps supply voltage circuit to prevent a total battery discharge condition.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B1480

Battery Rundown Protection Circuit

Diagnostic Fault Information

DTC B1480

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Inadvertent Power Courtesy				

Lamp	B1480 00	1	-	-
	Ground	1	-	-
1. Inadvertent courtesy lamps inoperative				

Battery voltage is supplied at all times to the body control module (BCM) from the 10A INT LIGHTS fuse located in the underhood fuse block. The BCM then applies this voltage to the following lamps:

- Dome/Reading Lamp
- Vanity Mirror Lamps
- Reading Lamp Assembly
- Inside Rearview Mirror
- Rear Compartment Courtesy Lamp

In the event that any of these lamps were to remain illuminated for more than 20 minutes with the ignition switch in the OFF position, the BCM will deactivate the inadvertent power courtesy lamps supply voltage circuit to prevent a total battery discharge condition.

Conditions for Running the DTC

The battery voltage must be between 9-16 volts.

Conditions for Setting the DTC

DTC B1480 00

The BCM detects a short ground on the inadvertent power courtesy lamp circuit.

Action Taken When the DTC Sets

The BCM will deactivate inadvertent power to the courtesy lamps.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

Perform a visual inspection for loose or poor connections at all related components. Refer to **Testing for Intermittent Conditions and Poor Connections** .

DTC B1480

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition. Is DTC B1480 present?	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections**
3	Test the inadvertent power courtesy lamps supply voltage circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 5**	Go to **Step 4**
4	Replace the body control module (BCM). Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 5**	-
5	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the headlamp switch.
2. Ignition ON, test for B+ between the reference voltage circuit terminal 15 and ground.
    - If less than the specified value, test the voltage reference circuit for a short to ground or an open/high resistance. If the circuit test normal, replace the BCM.
3. Ignition OFF, disconnect the (C3) harness connector at the BCM.
4. Ignition ON, test the 12 volt reference circuit terminal 12 for a short to voltage.
5. If all circuits test normal, replace the headlamp switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**
- **Vanity Mirror Lamp Bulb Replacement**
- **Instrument Panel Courtesy Lamp Replacement**
- **Dome Lamp Replacement (Impala)** or **Dome Lamp Replacement (Monte Carlo)**
- **Rear Compartment Lamp Replacement**
- **Control Module References** for BCM replacement, setup, and programming

DTC B2530

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Circuit Description

The front fog lamp switch signal circuit is grounded momentarily by pressing the front fog lamp switch. The body control module (BCM) energizes the front fog lamp relay by applying battery positive voltage to the front fog lamps relay control circuit when the front fog lamp relay is energized, battery positive voltage is applied to the front fog lamps supply voltage circuit which illuminates the front fog lamps.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B2530

Front Fog Lamps Control Circuit

Diagnostic Fault Information

DTC B2530

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Front Fog Lamp Control Circuit	2	1	B2530 00	-
1. Inadvertent courtesy lamps inoperative 2. Fog Lamps Always On				

Circuit/System Description

The fog lamps are controlled by the body control module (BCM) by inputs from the for lamp switch. When the BCM receives a fog lamps ON signal, it grounds the fog lamp relay control circuit in order to energize the FOG LAMP PCB Relay. With the relay energized, battery voltage is applied through the switch side of the relay, the FOG LAMPS Fuse, and the fog lamps supply voltage circuits to the fog lamps.

Conditions for Running the DTC

The ignition is ON. Park lamps must be ON and the fog lamps must be commanded ON.

Conditions for Setting the DTC

The BCM detects a short to voltage on the front fog lamp control circuit while trying to apply a ground to the circuit.

Action Taken When the DTC Sets

The BCM will deactivate the fog lamp relay for the remainder of the ignition cycle.

Conditions for Clearing the DTC

- The conditions for setting the DTC are no longer present.
- A history DTC clears after 100 malfunction-free ignition cycles.

Diagnostic Aids

- The fog lamps will only illuminate under the following conditions:
  - The park lamps or low beam headlamps are ON.
  - The high beam headlamps are OFF.
  - The fog lamp switch is the ON position.
- If the DTC is a history DTC, the problem may be intermittent. Refer to **Testing for Intermittent Conditions and Poor Connections** .

DTC B2530

Step	Action	Yes	No
Schematic Reference: Fog Lights Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn ON the ignition. 2. Turn ON the park lamps. 3. Turn ON the front fog lamps. 4. Turn OFF the front fog lamps. Do the front fog lamps turn ON and OFF?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Is DTC B2530 02 present?	Go to **Step 4**	Go to **Step 6**
4	1. Disconnect the underhood electrical center. 2. Connect a test lamp between battery positive voltage and the front fog lamp relay control circuit. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 13**
5	Test for a short to ground in the front fog lamp relay control circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 8**
	1. Disconnect the body control module (BCM) connector C1.		

6	2. Connect a test lamp between the front fog lamp relay control circuit and ground. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 10**
7	Test for a short to battery positive voltage in the front fog lamp relay control circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 9**
8	1. Remove the front fog lamp relay. 2. Disconnect the underhood electrical center. 3. Using a test lamp connected to battery positive voltage, probe the front fog lamp relay control circuit at the underhood electrical center. Does the test lamp illuminate?	Go to **Step 12**	Go to **Step 11**
9	1. Remove the front fog lamp relay. 2. Disconnect the underhood electrical center connector C2. 3. Using a test lamp connected to ground, probe the front fog lamp relay control circuit at the underhood electrical center. Does the test lamp illuminate?	Go to **Step 12**	Go to **Step 11**
10	Test for a poor connection or an open in the front fog lamp relay control circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
11	Replace the front fog lamp relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	Go to **Step 14**	-
12	Replace the underhood electrical center. Refer to **Underhood Electrical Center or Junction Block Replacement** .		

	Did you complete the replacement?	Go to **Step 14**	-
13	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 14**	-
14	1. Use a scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

Reference Information

Schematic Reference

Fog Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, turn the park lamps ON. Press the front fog lamp switch. The front fog lamps should illuminate.

Circuit/System Testing

1. Ignition OFF, disconnect the (C2) harness connector at the underhood fuse block.

2. Connect a test lamp between the control circuit terminal H5 and B+.
3. Ignition ON, command the Fog Lamps ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
   - If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the BCM.
   - If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
4. If all circuits test normal, replace the underhood fuse block.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **UNDERHOOD ELECTRICAL CENTER OR JUNCTION BLOCK REPLACEMENT**
- **Control Module References** for BCM replacement, setup, and programming

DTC B2545

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B2545

Backup Lamps Circuit

Diagnostic Fault Information

DTC B2545

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+, BCM C4 Terminal 4	B2545 00	B2545 00	-	-
Backup Lamps Voltage Supply	B2545 00	1	2	-
1. Backup lamps inoperative				

2. Backup lamps always on

Circuit Description

When the PRNDL is placed in the REVERSE position, a signal is sent to the body control module (BCM). The message indicates that the gear selector is in the REVERSE position. The BCM then applies voltage through the backup lamps supply voltage circuit illuminating the left and right backup lamps.

Conditions for Running the DTC

- The ignition is ON
- The backup lamps must be commanded ON.

Conditions for Setting the DTC

The BCM detects a short to ground on the backup lamp supply voltage circuit.

Action Taken When the DTC Sets

The BCM will deactivate the backup lamps for the remainder of the ignition cycle.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

Perform a visual inspection for loose or poor connections at all related components. Refer to **Testing for Intermittent Conditions and Poor Connections** .

DTC B2545

Step	Action	Yes	No
Schematic Reference: Exterior Lights Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
	1. Install a scan tool. 2. Turn the ignition to the ON position, with the engine OFF. 3. With a scan tool, select light test and		

2	command the backup lamps ON and OFF. Do the backup lamps turn ON and OFF with each command?	Go to Diagnostic Aids	Go to **Step 3**
3	Test the backup lamps voltage supply circuit for a short to ground or an open. Refer to **Circuit Testing** and to **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 6**	Go to **Step 4**
4	Test the CHMSL/Bkup fused voltage supply circuit to the body control module (BCM) for a short ground or an open. Refer to **Circuit Testing** and **Wiring Repairs** .	Go to **Step 6**	Go to **Step 5**
5	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 6**	-
6	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC. Does the DTC reset?	Go to **Step 2**	System OK

Reference Information

Schematic Reference

Fog Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, place the PRNDL to the REVERSE position. The backup lamps should illuminate.

Circuit/System Testing

1. Ignition OFF, disconnect the (C4) harness connector at the BCM.
2. Ignition ON, verify that a test lamp illuminates between the B+ circuit terminal 4 and ground.

   If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the B+ circuit fuse is open, test the backup lamp supply voltage circuit terminal 2 C6 for a short to ground.

3. Ignition OFF, disconnect the harness connectors at the components listed below.
   - Inside rearview mirror
   - Left backup lamp
   - Right backup lamp
4. Connect a test lamp between the left backup lamp supply voltage circuit terminal A and ground.
5. Ignition ON, command the Backup Lamps ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.

   If the test lamp is always ON, test the supply voltage circuit for a short to voltage. If the circuit tests normal, replace the BCM.

   If the test lamp is always OFF, test the supply voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.

6. Clear the DTC with a scan tool.
7. Reconnect each component one at a time and operate the system under the Conditions for Running the DTC. Verify the DTC does not reset as current.

   If the DTC resets as current, test or replace the component responsible for setting the DTC.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Backup Lamp Bulb Replacement**
- **Control Module References** for BCM replacement, setup, and programming

DTC B2575

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Circuit Description

The body control module (BCM) turns on the LOW BEAM relay when the ambient light sensor senses a dark condition or the low beam headlamps are requested ON. Battery positive voltage is supplied to the LOW BEAM relay at all times. The BCM grounds the LOW BEAM relay control circuit in order to activate the relay.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B2575

Headlamp Control Circuit

Diagnostic Fault Information

DTC B2575

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Low Beam Relay Control	2	1	B2575 00	-
1. Headlamps Inoperative - Low Beams 2. Headlamps Always On - Low or High				

Circuit/System Description

The low beam headlamps are controlled by two different inputs to the body control module (BCM), the headlamp switch, or when in the Auto mode, the ambient light sensor. When the BCM receives a low beam headlamps ON command, it grounds the headlamp low beam relay control circuit in order to energize the low beam PCB relay. With the relay energized, battery voltage is applied through switch side of the relay, both LO BEAM fuses, and the low beam supply voltage circuits to the low beam headlamps.

Conditions for Running the DTC

- The low beam headlamps are commanded ON.
- The headlamp dimmer switch must be in the low beam position.

Conditions for Setting the DTC

The BCM detects a short to voltage on the headlamp low beam relay control circuit.

Action Taken When the DTC Sets

The BCM will deactivate the headlamp low beam PCB relay for the remainder of the ignition cycle.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

- Turn the ignition switch to the OFF position, cover the ambient light sensor on the dash, wait for 15 seconds, and then return the ignition to the ON position. The low beam headlamps should illuminate.
- If the DTC is a history DTC, the problem may be intermittent. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: Listen for an audible click when the LOW BEAM relay operates. Command both the ON and OFF states. Repeat the commands as necessary.

4: This step tests for voltage at the coil side of the LOW BEAM relay.

DTC B2575

Step	Action	Yes	No
Schematic Reference: Headlights/Daytime Running Lights (DRL) Schematics **Connector End View Reference: Master Electrical Component List**			
	Did you perform the Diagnostic System		Go to

1	Check - Vehicle?	Go to **Step 2**	**Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the LOW BEAM relay ON and OFF. Does the LOW BEAM relay turn ON and OFF with each command?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Is DTC B2575.01 set?	Go to **Step 6**	Go to **Step 4**
4	1. Turn OFF the ignition. 2. Disconnect the LOW BEAM relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the coil side battery positive voltage circuit of the LOW BEAM relay with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 10**
5	1. Connect a test lamp between the control circuit of the LOW BEAM relay and the coil side battery positive voltage circuit of the LOW BEAM relay. 2. With a scan tool, command the LOW BEAM relay ON and OFF. Does the test lamp turn ON and OFF with each command?	Go to **Step 8**	Go to **Step 7**
6	Test the control circuit of the LOW BEAM relay for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**
7	Test the control circuit of the LOW BEAM relay for a high resistance or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**

8	Inspect for poor connections at the LOW BEAM relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 11**
9	Inspect for poor connections at the harness connector of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 12**
10	Repair the open in the coil side battery positive voltage circuit of the LOW BEAM relay. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 13**	-
11	Replace the LOW BEAM relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	Go to **Step 13**	-
12	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 13**	-
13	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, turn the headlamps ON. The headlamps should illuminate.

Circuit/System Testing

1. Ignition OFF, disconnect the (C2) harness connector at the underhood fuse block.
2. Connect a test lamp between the control circuit terminal A5 and B+.

   If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the B+ circuit fuse is open, test the backup lamp supply voltage circuit terminal 2 C6 for a short to ground.

3. Ignition ON, command the Low Beams ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
   - If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the BCM.
   - If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
4. If the circuit tests normal, replace the underhood fuse block.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **UNDERHOOD ELECTRICAL CENTER OR JUNCTION BLOCK REPLACEMENT**
- **Control Module References** for BCM replacement, setup, and programming

DTC B2580

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Circuit Description

When the body control module (BCM) receives a ground signal from the headlamp dimmer switch high beam signal or flash to pass (FTP) switch signal commanding to illuminate the high beam headlamps, the BCM will energize the high beam relay by grounding the high beam relay control circuit.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B2580

Headlamp High Beam Control Circuit

Diagnostic Fault Information

DTC B2580

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Low Beam Relay Control	2	1	B2580 00	-
1. Headlamps Inoperative - High Beams 2. Headlamps Always On - Low or High				

Circuit/System Description

The high beam headlamps can be controlled by two different inputs to the body control module (BCM), the dimmer switch and the flash to pass switch. When the BCM receives a high beam headlamps ON command, it grounds the headlamp high beam relay control circuit in order to energize the high beam PCB relay. With the relay energized, battery voltage is applied through switch side of the relay, both HI BEAM fuses, and the high beam supply voltage circuits to the high beam headlamps.

Conditions for Running the DTC

The high beam headlamps must be commanded ON by the BCM.

Conditions for Setting the DTC

The BCM detects a short to voltage on the headlamp high beam relay control circuit.

Action Taken When the DTC Sets

The BCM will deactivate the headlamp high beam PCM relay for the remainder of the ignition cycle.

Conditions for Clearing the MIL/DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

DTC B2580

Step	Action	Yes	No
Schematic Reference: Headlights/Daytime Running Lights (DRL) Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the high beam relay ON and OFF. Does the high beam relay turn ON and OFF with each command?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the high beam relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery positive voltage circuit of the high beam relay with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to **Step 4**	Go to **Step 10**
	1. Connect a test lamp between the control circuit of the high beam relay and the battery positive voltage		

4	circuit of the high beam relay. 2. With a scan tool, command the high beam relay ON and OFF. Does the test lamp turn ON and OFF with each command?	Go to **Step 8**	Go to **Step 5**
5	Does the test lamp remain illuminated with each command?	Go to **Step 7**	Go to **Step 6**
6	Test the control circuit of the high beam relay for a short to battery positive voltage or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 9**
7	Test for a short to ground in the high beam headlamp relay control circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 9**
8	Inspect for a high resistance or a poor connection at the high beam headlamp relay in the underhood fuse block. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
9	Inspect for a high resistance or a poor connection at the harness connector of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
10	Inspect for a high resistance or a poor connection at the harness connectors of the underhood fuse block. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 11**
11	Replace the underhood electrical center. Refer to **Underhood Electrical Center or Junction Block Replacement** . Did you complete the repairs?	Go to **Step 14**	-
	Replace the high beam headlamp relay in		

12	the underhood fuse block. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the repair?	Go to **Step 14**	-
13	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 14**	-
14	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, turn the headlamps ON. Turn the high beams ON. The headlamps should illuminate.

Circuit/System Testing

1. Ignition OFF, disconnect the (C2) harness connector at the underhood fuse block.
2. Connect a test lamp between the control circuit terminal C6 and B+.
3. Ignition ON, command the High Beams ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
    - If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the BCM.
    - If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
4. If the circuit tests normal, replace the underhood fuse block.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **UNDERHOOD ELECTRICAL CENTER OR JUNCTION BLOCK REPLACEMENT**
- **Control Module References** for BCM replacement, setup, and programming

DTC B2585

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B2585

Park Lamp Control Circuit

Diagnostic Fault Information

DTC B2585

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Park Lamp Relay Control Circuit	2	1	B2585 00	-

1. Park Lamps Inoperative
2. Park Lamps Always On

Circuit Description

Battery positive voltage is applied at all times to both the coil and switched sides of the PARK LP PCB Relay. The park lamps are controlled by the body control module (BCM) by inputs from park lamp switch. When the BCM receives a park lamps ON command, it grounds the park lamps relay control circuit in order to energize the PARK LP PCB Relay. With the relay energized, battery voltage is applied through switch side of the relay, both PARK Fuses, the and the park lamp supply voltage circuits to all park, tail, and marker lamps.

Conditions for Running the DTC

The park lamps must be commanded on by the BCM.

Conditions for Setting the DTC

The BCM detect a short to voltage on the park lamp relay control circuit.

Action Taken When the DTC Sets

The BCM will deactivate the park lamp relay for the remainder of the ignition cycle.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

If the DTC is a history DTC, the problem may be intermittent. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: Listen for an audible click when the PARK LAMP relay operates. Command both the ON and OFF states. Repeat the commands as necessary.

4: This step tests for voltage at the coil side of the PARK LAMP relay.

5: This step verifies that the BCM is providing ground to the PARK LAMP relay.

DTC B2585

Step	Action	Yes	No
Schematic Reference: Exterior Lights Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the PARK LAMP relay ON and OFF. Does the PARK LAMP relay turn ON and OFF with each command?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Is DTC B2585.01 set?	Go to **Step 6**	Go to **Step 4**
4	1. Turn OFF the ignition. 2. Disconnect the PARK LAMP relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the coil side battery positive voltage circuit of the PARK LAMP relay with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 11**
5	1. Connect a test lamp between the control circuit of the PARK LAMP relay and the coil side battery positive voltage circuit of the PARK LAMP relay. 2. With a scan tool, command the PARK LAMP relay ON and OFF. Does the test lamp turn ON and OFF with each command?	Go to **Step 7**	Go to **Step 8**
6	Test the control circuit of the PARK LAMP relay for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**

7	Test for an open or high resistance in the park lamp supply voltage circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 9**
8	Test for an open, high resistance, or short to voltage in the control circuit of the PARK LAMP relay. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
9	Inspect for poor connection at the PARK LAMP relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
10	Inspect for poor connections at the harness connector of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
11	Repair an open, high resistance, or short to ground in the coil side battery positive voltage circuit of the PARK LAMP relay. Refer to **Circuit Testing** and **Wiring Repairs** . Did you complete the repair?	Go to **Step 14**	-
12	Replace the PARK LAMP relay. Did you complete the replacement?	Go to **Step 14**	-
13	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 14**	-
14	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	-

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, turn the park lamps on. The park lamps should illuminate.

Circuit/System Testing

1. Ignition OFF, disconnect the (C2) harness connector at the underhood fuse block.
2. Connect a test lamp between the control circuit terminal K2 and B+.
3. Ignition ON, command the Parking Lamps ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
    - If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the BCM.
    - If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
4. If the circuit tests normal, replace the underhood fuse block.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **UNDERHOOD ELECTRICAL CENTER OR JUNCTION BLOCK REPLACEMENT**
- **Control Module References** for BCM replacement, setup, and programming

DTC B2600

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B2600

Daytime Running Lamp Control System Circuit

Diagnostic Fault Information

DTC B2600

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
DRL Relay Control	2	1	B2600 00	-
DRL Ambient Light Sensor Signal	B2645 03	B2645 07	B2645 07	-
DRL Ambient Light Sensor Low Reference	-	B2645 07, 1	-	-
Headlamp - Low Beam Voltage Supply - Right	1, 3	1, 3	3	-
Headlamp - Low Beam Voltage Supply - Left	1, 3	1, 3	3	-
Headlamp - Low Beam Ground - Right	-	3	3	-
Headlamp - Low Beam ground - Left	-	3	3	-
1. Daytime Running Lamps (DRL) Inoperative 2. Daytime Running Lamps (DRL) Always ON 3. Headlamps Malfunction				

Circuit Description

Battery positive voltage is applied at all times to both the coil and switched sides of the DRL PCB Relay. The daytime running lamps (DRL) are controlled by the body control module

(BCM). The BCM grounds the DRL relay control circuit in order to energize the DRL PCB relay coil. With the relay energized, voltage is applied through the switch side of the relay, both LOW BEAM Fuses, and the headlamp low beam supply voltage circuits to the low beam headlamps.

Conditions for Running the DTCs

- The headlamp switch is in the AUTO position.
- The park brake is unapplied.
- The engine is running.

Conditions for Setting the DTC

The BCM detect a short to voltage in the DRL relay control circuit.

Action Taken When the DTC Sets

The BCM will deactivate the DRL relay for the remainder of the ignition cycle.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

- Check both the LH and RH headlamps for proper operation.
- Check both the LH and RH HDLP fuses.
- Diagnose all other DRL DTCs before DTC B2600.
- If the DTC is a history DTC, the problem may be intermittent. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Test Description

The number below refers to the step number on the diagnostic table.

> **2:** Listen for an audible click when the DRL relay operates. Command both the ON and OFF states. Repeat the commands as necessary.

DTC B2600

Step	Action	Yes	No
Schematic Reference: Headlights/Daytime Running Lights (DRL) Schematics **Connector End View Reference: Master Electrical Component List**			
	Did you perform the Diagnostic System		Go to

1	Check - Vehicle?	Go to **Step 2**	**Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the daytime running lamps (DRL) relay ON and OFF. Does the DRL relay turn ON and OFF with each command?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Remove the DRL relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition positive voltage circuit of the DRL relay with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to **Step 4**	Go to **Step 8**
4	1. Connect a test lamp between the ignition positive voltage circuit of the DRL relay and the control circuit of the DRL relay. 2. With a scan tool, command the DRL relay ON. Does the test lamp illuminate?	Go to **Step 6**	Go to **Step 5**
5	Test the control circuit of the DRL relay for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 7**
6	Inspect for poor connections at the DRL relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 9**
	Inspect for poor connections at the harness connector of the body control module		

7	(BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 10**
8	Repair an open, high resistance, or short to ground in the ignition positive voltage circuit of the DRL relay. Refer to **Circuit Testing** and **Wiring Repairs** . Did you complete the repair?	Go to **Step 11**	-
9	Replace the DRL relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	Go to **Step 11**	-
10	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 11**	-
11	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Carefully supply sufficient light to simulate daylight conditions to the ambient light sensor. With the engine running, headlamp switch in AUTO position, and the park brake released, the day time running lamps should illuminate.

Circuit/System Testing

1. Ignition OFF, disconnect the (C4) harness connector at the underhood fuse block.
2. Connect a test lamp between the DRL PCB relay control circuit terminal H2 and B+.
3. Ignition ON and headlamps OFF, command the DRL ON and OFF with a scan tool. The test lamp should turn ON and OFF between commanded states.
    - If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the BCM.
    - If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
4. If all circuits test normal, replace underhood fuse block.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **UNDERHOOD ELECTRICAL CENTER OR JUNCTION BLOCK REPLACEMENT**
- **Control Module References** for BCM replacement, setup, and programming

DTC B2610

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

DTC B2610 00

Passenger Compartment Dimming 1 Circuit

Diagnostic Fault Information

DTC B2610

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
LED Dimming Supply	B2610 00	2	1	-
1. Interior Backlighting Does Not Dim 2. Interior Backlighting Inoperative				

Circuit/System Description

The BCM supplies a voltage reference through the instrument panel (I/P) dimming voltage reference circuit to the interior lamp dimmer switch, which is part of the headlamp switch. When the dimmer switch is placed in a desired brightness position, reference voltage is applied through the dimmer switch rheostat and the I/P lamps dimmer switch signal circuit to the BCM. The BCM interprets this voltage signal, then applies a pulse width modulated (PWM) voltage through the LED dimming supply circuit illuminating the components listed below:

- Radio
- HVAC control module
- Driver information center (DIC) switch
- Steering wheel controls

Conditions for Running the DTC

- The ignition is ON.
- The headlamps or park lamps ON.

Conditions for Setting the DTC

The BCM detects a short to ground on the LED dimming supply circuit.

Action Taken When the DTC Sets

The BCM does not attempt to illuminate the LED lamps.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- A history DTC clears after 100 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

- Scan Tool Output Controls
- Scan Tool Data List
- Scan Tool Data Definitions

Circuit/System Verification

Ignition ON, cover the ambient light sensor, adjust the interior lamp dimming switch from dim to full bright. The LED lamps in the HVAC control head, radio, DIC switch, and the steering wheel controls should dim and then become full bright.

Circuit/System Testing

1. Ignition OFF, disconnect all of the LED dimming components on the LED dimming supply circuit.
2. Ignition ON, with a scan tool clear the DTC.
3. Operate the vehicle within the conditions for running the DTC and verify the DTC does not reset.
    - If the DTC resets, test the LED dimming supply circuit for a short to ground. If the circuit test normal, replace the BCM.
4. Reconnect each component one at a time and verify that the DTC does not reset as current.
    - If the DTC resets as current, test or replace the component responsible for setting the DTC.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Driver Information Center Switch Replacement (Impala)** or **Driver Information Center Switch Replacement (Monte Carlo)**
- **HVAC Module Assembly Replacement**
- **Radio Replacement**
- **Steering Wheel Control Switch Assembly Replacement**
- **Control Module References** for BCM replacement, setup, and programming

DTC B2615

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B2615

Passenger Compartment Dimming 2 (courtesy lamps, etc.) Circuit

Diagnostic Fault Information

DTC B2615

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
BCM B+ C4 Pin-2	B2615 00	B2615 00	-	-
Courtesy Lamp Voltage Supply	B2615 00	1	1	-
1. Courtesy lamps malfunction				

Circuit Description

Battery voltage for the courtesy lamps is supplied at all times, from the INT LIGHTS Fuse located in the underhood fuse block, to the body control module (BCM). When the BCM receives a signal to command the courtesy lamps ON, it applies voltage through the courtesy lamps supply voltage circuits to the courtesy lamps listed below.

- The left and right I/P courtesy lamps
- Dome lamp

Conditions for Running the DTC

- The ignition is ON
- The courtesy lamps must be commanded ON.

Conditions for Setting the DTC

The BCM detects a short to ground on the courtesy lamp supply voltage circuit.

Action Taken When the DTC Sets

The BCM will deactivate the courtesy lamps.

Conditions for Clearing the MIL/DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

Perform a visual inspection for loose or poor connections at all related components. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines if an open or short to ground exists.

3: This step determines if a short to ground exists in the lamp wiring or internally within the BCM.

4: This test determines if an open exists in the TBC 3 battery positive voltage circuit, the courtesy lamp supply voltage circuit, or internally within the BCM.

6: After replacement of the BCM you must calibrate the new module for proper operation.

DTC B2615

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Lighting Systems Connector End Views** or **Computer/Integrating Systems Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Inspect the TBC 3 fuse in the rear fuse block.		

	Is the fuse good?	Go to **Step 4**	Go to **Step 3**
3	Test the TBC 3 battery positive voltage and courtesy lamp supply voltage circuits for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 7**	Go to **Step 5**
4	Test the TBC 3 battery positive voltage and courtesy lamp supply voltage circuits for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 7**	Go to **Step 5**
5	Inspect for poor connections at the harness connectors of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 7**	Go to **Step 6**
6	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 7**	-
7	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, command the Courtesy Lamps ON and OFF with the scan tool. The interior courtesy lamps should turn ON and OFF when changing between commanded states.

Circuit/System Testing

1. Ignition OFF, disconnect the (C4) harness connector at the BCM.
2. Verify that a test lamp illuminates between the B+ circuit terminal 2 and ground.
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the B+ circuit fuse is open, test the supply voltage circuits listed below for a short to ground.
        - Courtesy lamp supply voltage terminal 5 C2
        - Courtesy lamp supply voltage terminal 1 C6
3. Ignition OFF, connect the (C4) harness connector at the BCM.
4. Disconnect the harness connectors at all components fed by the courtesy lamp supply voltage circuits listed below.
    - Courtesy lamp supply voltage terminal 5 C2
    - Courtesy lamp supply voltage terminal 1 C6
5. Ignition ON, clear the DTC with a scan tool.
6. Operate the vehicle within the conditions for running the DTC and verify the DTC does not reset.
    - If the DTC resets, test the supply voltage circuits for a short to ground. If the circuits test normal, replace the BCM.
7. Reconnect each component one at a time and verify that the DTC does not reset.
    - If the DTC resets, test or replace the component responsible for setting the DTC.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Dome Lamp Replacement (Impala)** or **Dome Lamp Replacement (Monte Carlo)**

- **Instrument Panel Courtesy Lamp Replacement**
- **Control Module References** for BCM replacement, setup, and programming

DTC B2645

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B2645 03

Ambient Light Sensor Circuit Below Threshold

DTC B2645 07

Ambient Light Sensor Circuit Above Threshold

Diagnostic Fault Information

DTC B2645

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
BCM B+ C4 Pin-2	B2645 03	B2645 07	B2645 07	-
Courtesy Lamp Voltage Supply	-	B2645 07	-	-
1. Interior Backlighting Does Not Dim 2. Interior Backlighting Inoperative				

Circuit Description

The ambient light sensor is used to monitor outside lighting conditions. The body control module (BCM) provides a 5-volt reference signal to the ambient light sensor. The sensor is a variable resistor, it's resistance changes as outside lighting conditions change. With the headlamp switch in the AUTO position, the BCM monitors the sensor signal circuit to determine if the outside lighting conditions are correct for either daytime running lamps (DRL) or headlamp low beam operation. In daylight conditions, the BCM will command the DRLs ON. In low light conditions, the BCM will command the low beam headlamps ON.

Conditions for Running the DTC

- The ignition is ON.
- The headlamp switch in the AUTO position.

Conditions for Setting the DTC

- The DTC will set when the BCM detects the ambient light sensor signal voltage is below 0.196 volt.

  Or

- The DTC will set when the BCM detects the ambient light sensor signal voltage is above 4.9 volts.

Action Taken When the DTC Sets

The BCM defaults to low light status and commands the low beam headlamps ON.

Conditions for Clearing the MIL/DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

DTC B2645

Step	Action	Yes	No
Schematic Reference: Headlights/Daytime Running Lights (DRL) Schematics **Connector End View Reference: Lighting Systems Connector End Views** or **Computer/Integrating Systems Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Test for a short to battery positive voltage or a short to ground on the 10-volt reference circuit of the brake pedal position sensor (BPPS). Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 3**
3	1. Disconnect the body control module (BCM) connector C1. 2. Using a test lamp connected to battery positive voltage, probe the ambient light sensor signal circuit. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 4**

4	Test for a poor connection or an open in the ground circuit of the ambient light sensor. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 6**
5	Test the ambient light sensor circuit of the ambient light sensor for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 10**	Go to **Step 8**
6	Test the ambient light sensor signal circuit of the ambient light sensor for a short to battery positive voltage or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 7**
7	Inspect for poor connections at the harness connector of the ambient light sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 9**
8	Inspect for poor connections at the harness connector of the BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 10**
9	Replace the ambient light sensor. Refer to **Daytime Running Lamps (DRL) Ambient Light Sensor Replacement**. Did you complete the replacement?	Go to **Step 11**	-
10	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 11**	-
11	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

- Scan Tool Output Controls
- Scan Tool Data List
- Scan Tool Data Definitions

Circuit/System Verification

Ignition ON, headlamp switch in the AUTO position, observe the scan tool Ambient Light Sensor parameter. The reading should be between 1.96-4.8 volts and change between day and night time conditions.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the ambient light sensor.
2. Ignition OFF, test for less than 5 ohms of resistance between the low reference circuit terminal B and ground.
    - If greater than the specified range, test the low reference circuit for an open/high resistance.
3. Ignition ON, verify the scan tool Ambient Light Sensor parameter is greater than 4.65 volts.
    - If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the BCM.
4. Install a 3A fused jumper wire between the signal circuit terminal A and the low reference circuit terminal B. Verify the scan tool Ambient Light Sensor parameter is less than 1.96 volts.
    - If greater than the specified range, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.

5. If all circuits test normal, test or replace the ambient light sensor.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Daytime Running Lamps (DRL) Ambient Light Sensor Replacement**
- **Control Module References** for BCM replacement, setup, and programming

DTC B2652

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

DTC B2652 00

Passenger Compartment Dimming 3

Diagnostic Fault Information

DTC B2652

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+, BCM C2 Terminal 2	B2652 00	B2652 00	-	-
Instrument Panel Lamp Supply Voltage	B2652 00	2	1	-

1. Interior Backlighting Does Not Dim
2. Interior Backlighting Inoperative

Circuit/System Description

The BCM supplies a voltage reference through the instrument panel (I/P) dimming voltage reference circuit to the interior lamp dimmer switch, which is part of the headlamp switch. When the dimmer switch is placed in a desired position, reference voltage is applied through the dimmer switch rheostat and the I/P lamps dimmer switch signal circuit to the BCM. The BCM interprets this voltage signal, then applies a pulse width modulated (PWM) voltage through the instrument panel lamp supply voltage circuit illuminating the components listed below:

- Headlamp switch
- Instrument panel cluster (IPC)
- Driver and passenger window switches
- Driver and passenger door lock switches
- Outside rearview mirror switch

Conditions for Running the DTC

- The ignition is ON.
- The headlamps or park lamps ON.

Conditions for Setting the DTC

The BCM detects a short to ground on the instrument panel lamps supply voltage circuit.

Action Taken When the DTC Sets

The BCM does not attempt to illuminate the instrument panel lamps.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, park lamps ON, adjust the dimmer switch from dim to full bright. The I/P lamps should dim and then become full bright.

Circuit/System Testing

1. Ignition OFF, disconnect the (C2) harness connector at the BCM.
2. Verify that a test lamp illuminates between the B+ circuit terminal 2 and ground.
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the B+ circuit fuse is open, test the supply voltage circuits listed below for a short to ground.

    Scan Tool Reference

    - Instrument panel lamp supply voltage circuit terminal 3 C2
    - Instrument panel lamp supply voltage circuit terminal 3 C6
3. Ignition OFF, disconnect all of the instrument panel lamp components fed by the BCM supply voltage circuits listed below.
    - Instrument panel supply voltage circuit -terminal 3 C2
    - Instrument panel supply voltage circuit -terminal 3 C6
4. Ignition ON, with a scan tool clear the DTC.
5. Operate the vehicle within the conditions for running the DTC and verify the DTC does not reset.
    - If the DTC resets, test the instrument panel lamp supply voltage circuit for a short to ground. If the circuit test normal, replace the BCM.
6. Reconnect each component one at a time and verify that the DTC does not reset as current.
    - If the DTC resets as current, test or replace the component responsible for setting the DTC.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**
- **Instrument Panel Cluster (IPC) Replacement (Impala)** or **Instrument Panel**

Cluster (IPC) Replacement (Monte Carlo)
- **Power Window Switch Replacement - Rear Door**
- **Power Door Lock Switch Replacement (Impala)** or **Power Door Lock Switch Replacement (Monte Carlo)**
- **Power Window Switch Replacement (Impala)**
- **Power Mirror Switch Replacement (Impala)** or **Power Mirror Switch Replacement (Monte Carlo)**
- **Control Module References** for BCM replacement, setup, and programming

DTC B3445

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B3445

Stop Lamp Circuit

Diagnostic Fault Information

DTC B3445

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
CHMSL Supply Voltage	B3445 00	1	2	-
Ground	-	1	-	-

1. High Mounted Stop Lamp Inoperative
2. High Mounted Stop Lamp Always ON

Battery voltage is applied at all times to the body control module (BCM) from the CHMSL/BCK-UP Fuse located in the underhood fuse block. When the brake pedal is applied and the BCM receives a brake applied signal from the brake pedal position sensor (BPPS). It then applies battery voltage from the CHMSL/BCK-UP fuse through the CHMSL voltage supply circuit to the CHMSL.

Conditions for Running the DTC

The ignition is ON. The stop lamps must be commanded ON.

Conditions for Setting the DTC

The BCM detects a short to ground on the CHMSL voltage supply circuit when the stop lamps are commanded ON.

Action Taken When the DTC Sets

The BCM will deactivate power to the CHMSL.

Conditions for Clearing the MIL/DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

Perform a visual inspection for loose or poor connections at all related components. Refer to **Testing for Intermittent Conditions and Poor Connections** .

DTC B3445

Step	Action	Yes	No
Schematic Reference: Exterior Lights Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn the ignition to the ON position. 2. Apply the brake pedal. Does the center high-mounted stop lamp (CHMSL) illuminate?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	1. Turn the ignition to the OFF position. 2. Disconnect the CHMSL. 3. Using a test lamp connected to battery positive voltage, probe the stop lamp voltage supply circuit. Does the test lamp illuminate?	Go to **Step 4**	Go to **Step 5**
	Test for a short to ground in the stop lamp voltage supply circuits. Refer to **Circuit**		

4	**Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 7**	Go to **Step 6**
5	Test for a poor connection or an open in the stop lamp voltage supply circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 7**	Go to **Step 6**
6	Replace the body control module (BCM). Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 7**	-
7	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the CHMSL.

2. Ignition OFF, test for less than 5.0 ohm of resistance between the appropriate ground circuit listed below and ground.
    - Sedan terminal A
    - Coupe terminal B
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Connect a test lamp between the appropriate supply voltage circuit terminal listed below and ground.
    - Sedan terminal B
    - Coupe terminal A
4. Ignition ON, press and release the brake pedal. The test lamp should turn ON and OFF when changing between the commanded states.
    - If the DTC resets, test the instrument panel lamp supply voltage circuit for a short to ground. If the circuit test normal, replace the BCM.
    - If the test lamp is always OFF, test the supply voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
5. If all circuits test normal, test or replace the CHMSL.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **High Mounted Stop Lamp Replacement (Monte Carlo)** or **High Mounted Stop Lamp Replacement (Impala)**
- **Control Module References** for BCM replacement, setup, and programming

DTC B3600

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B3600

Passenger Compartment Dimming Request Signal Circuit

This vehicle has DTCs which include DTC Symptoms. For more information on DTC Symptoms, refer to **DTC Symptom Description** .

DTC B3600

DTC Symptom	DTC Symptom Descriptor
08	Signal Invalid

Diagnostic Fault Information

DTC B3600

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
I/P Dimming Voltage Reference	B1395 03, B3600 03	B3600 03	-	B1395 07
Instrument Panel Lamps Dimmer Switch Signal	B3600 03	B3600 03	1	-
1. Interior backlighting will not dim				

Circuit Description

The instrument panel (I/P) dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The BCM supplies a voltage reference through the instrument panel (I/P) dimming voltage reference circuit to the interior lamp dimmer switch, which is part of the headlamp switch. When the dimmer switch is placed in a desired brightness position, reference voltage is applied through the dimmer switch rheostat and the I/P lamps dimmer switch signal circuit to the BCM. The BCM interprets this voltage signal, then applies a pulse width modulated (PWM) voltage through the I/P lamps supply voltage circuit and the LED dimming supply circuit to all related interior lamps, illuminating them to the desired level of brightness.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

- The BCM detects a short to ground or open in the I/P dimming voltage reference circuit.
- The BCM detects a short to ground or open in the instrument panel lamps dimming signal circuit.

Action Taken When the DTC Sets

The I/P lamps are not illuminated.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

Thoroughly inspect the wiring and connectors. An incomplete inspection of the wiring and connectors may result in misdiagnosis causing part replacement with the reappearance of the malfunction. If an intermittent malfunction exists, refer to **Testing for Intermittent Conditions and Poor Connections** .

DTC B3600

Step	Action	Values	Yes	No
Schematic Reference: Interior Lights Dimming Schematics **Connector End View Reference: Master Electrical Component List**				
1	Did you perform the Diagnostic System Check - Vehicle?		Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Place the headlamp switch in the PARK position. 4. With a scan tool observe the Dimming Pot A/D parameter in the instrument panel module (IPM) inputs list. 5. Turn the instrument panel (I/P) dimmer switch from minimum to maximum intensity. Does the scan tool indicate the dimming pot A/D parameter is within the specified range as the I/P dimmer switch is changed from minimum to maximum intensity?	25-145 Counts	Go to **Step 6**	Go to **Step 3**

3	Test the I/P lamp dimmer switch signal circuit for an open, short to ground, or short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?		Go to **Step 9**	Go to **Step 4**
4	Test the I/P dimmer switch low reference circuit for an open or short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?		Go to **Step 9**	Go to **Step 5**
5	Inspect for poor connections at the harness connector of the I/P dimmer switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?		Go to **Step 9**	Go to **Step 7**
6	Inspect for poor connections at the harness connector of the IPM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?		Go to **Step 9**	Go to **Step 8**
7	Replace the I/P dimmer switch. Did you complete the replacement?		Go to **Step 9**	-
8	Replace the IPM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 9**	-
	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within			

9	the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

Reference Information

Schematic Reference

Interior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the headlamp switch.
2. Ignition ON, test for B+ between the reference voltage circuit terminal 15 and ground.
    - If less than the specified value, test the voltage reference circuit for a short to ground or an open/high resistance. If the circuit test normal, replace the BCM.
3. Verify the scan tool Dimming Control Signal parameter is less than 0.2 volts.
    - If greater than the specified range, test the signal circuit for a short to voltage. If the circuit tests normal, replace the BCM
4. Install a 3A fused jumper wire between the signal circuit terminal 13 and the voltage reference circuit terminal 15. Verify the scan tool Dimming Control Signal parameter is greater than 2.75 volts.
    - If less than the specified value, test the signal circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.

5. If all circuits test normal, replace the headlamp switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**
- **Control Module References** for BCM replacement, setup, and programming

DTC C0277

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

DTC C0277 06

Brake Pedal Position Sensor Circuit Short to Ground or Open

DTC C0277 07

Brake Pedal Position Sensor Circuit Voltage Above Threshold

DTC C0277 09

Brake Pedal Position Sensor Circuit Rate of Change Above Threshold

DTC C0277 4B

Brake Pedal Position Sensor Calibration Not Learned

Diagnostic Fault Information

DTC C0277

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Position Sensor Signal	C0277 06	C0277 06	C0277 07	C0277 09, C0277 4B
	C0277 06,			

5-Volt Reference	C0890 03	C0277 06	C0277 06, 1	-
Low Reference	-	C0277 06, 1	-	-

1. Stop lamps are always ON

Circuit/System Description

The body control module (BCM) provides a 5-volt reference voltage and a low reference signal to the brake pedal position sensor (BPPS). When the brake pedal is applied, the BPPS sends a variable voltage signal, that will increase as the brake pedal is applied, through the stop lamp switch signal circuit to the BCM. In response to this signal, the BCM applies battery positive voltage to the stop lamps, center high mounted stop lamp (CHMSL), transmission control module (TCM), and engine control module (ECM). The stop lamps will not operate unless the ignition is in the ON position.

Conditions for Running the DTC

Battery voltage must be between 9-16 volts.

Conditions for Setting the DTC

- DTC C0277 06-The BCM detects a short to ground or an open on the brake pedal position sensor signal circuit for 0.5 second or greater.
- DTC C0277 07-The BCM detects a short to battery voltage in the brake pedal position sensor signal or low reference circuits for 0.5 second or greater.
- C0277 09-The BCM detects the BPPS reading is erroneous.
- C0277 4B-The BCM detect that the BPPS is not calibrated.

Action Taken When the DTC Sets

- The Service Vehicle Soon indicator is commanded ON.
- When DTC C0277 is set as current, the vehicle will not start.
- If the DTC sets while the vehicle is running, the BCM will activate the brake lights when the vehicles transmission is not in the PARK position and the vehicle is not accelerating.

Conditions for Clearing the MIL/DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

IMPORTANT: The stop lamps will not illuminate unless the ignition is in the ON position. For more detailed information concerning stop

lamp operation, refer to Exterior Lighting Systems Description and Operation.

If DTC C0277 09 is set, replace the brake pedal position sensor. If the DTC resets, replace the BCM.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

C0277 6 and C0277 07

1. Ignition OFF, disconnect the harness connector at the brake pedal position sensor.
2. Ignition OFF, verify that a test lamp illuminates between the low reference circuit terminal C and B+.
    - If the test lamp does not illuminate, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the BCM.
3. Ignition ON, test for 4.8-5.2 volts between the 5-volt reference circuit terminal A and ground.
    - If less than the specified range, test the 5-volt reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
    - If greater than the specified range, test the 5-volt reference circuit for a short to voltage. If the circuit tests normal, replace the BCM.

4. Verify the scan tool BPP Sensor parameter is less than 2 counts.
    - If greater than the specified range, test the signal circuit terminal B for a short to voltage. If the circuit tests normal, replace the BCM.
5. Install a 3A fused jumper wire between the signal circuit terminal B and the 5-volt reference circuit terminal A. Verify the scan tool BPP Sensor parameter is greater than 800 counts.
    - If less than the specified range, test the signal circuit for short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
6. If all circuits test normal, test or replace the brake pedal position sensor.

C0277 09

1. Replace the brake pedal position sensor.
2. Perform the scan tool BPP Sensor Calibration procedure.
3. Operate the vehicle within the Conditions for Running and Setting the DTC and verify the DTC does not reset.
    - If the DTC resets, replace the BCM.

C0277 4B

1. Ignition ON, verify that no other brake pedal position sensor DTCs are set.
    - If other brake pedal sensor DTCs are set, diagnosis those DTCs first.
2. Ignition ON, perform the scan tool BPP Sensor Calibration procedure. Refer to **Brake Pedal Position Sensor Calibration**.
3. Observe the scan tool BPPS Status parameter. The reading should be Learned.
    - If not the specified value, replace the brake pedal position sensor. If the DTC resets, replace the BCM.

Repair Procedures

IMPORTANT: Perform the Brake Pedal Position Sensor Calibration after replacement of the brake pedal position sensor.

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Brake Pedal Position Sensor Replacement**
- **Control Module References** for BCM replacement, setup, and programming

DTC C0297

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**

- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC C0297

Powertrain Configuration Data Not Received

Diagnostic Fault Information

DTC C0297

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Stop Lamp Switch Signal	C0297 00	-	-	-

Circuit Description

The body control module (BCM) provides a 5-volt reference voltage and a low reference signal to the brake pedal position sensor (BPPS). When the brake pedal is applied, the BPPS sends a variable voltage signal, that will increase as the brake pedal is applied, through the stop lamp switch signal circuit to the BCM. The BCM then applies a signal through the stop lamp switch signal circuit to the engine control module (ECM) and transmission control module (TCM).

Conditions for Running the DTC

- The engine must be ON.
- The brake must be applied.

Conditions for Setting the DTC

The BCM detects a short to ground in the stop lamp switch signal circuit to the ECM and TCM.

Action Taken When the DTC Sets

- The BCM stores the DTC to memory.
- The Service Vehicle Soon indicator is commanded ON.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have

occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, observe the scan tool Brake Applied Output Signal parameter. The reading should be On, with the brakes applied.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the TCM and the (C1) harness connector at the ECM.
2. Connect a test lamp between the signal circuit terminal 42 of the TCM and ground.
3. Engine ON, press and release the brake pedal. The test lamp should turn ON and OFF when pressing and releasing the brake pedal.
   - If the test lamp is always ON, test the signal circuit for a short to voltage. If the circuit test normal, replace the BCM.
   - If the test lamp is always OFF, test the signal circuit for a short to ground or an open/high resistance. If the circuit test normal, replace the BCM.
4. Ignition OFF, connect the harness connector at the TCM.
5. If all circuits test normal, replace the headlamp switch.
   - With LS4 -- terminal 7

    - With LZE, LZ4, or LZ8 -- terminal 9

6. Engine ON, press and release the brake pedal. The test lamp should turn ON and OFF when pressing and releasing the brake pedal.
    - If the test lamp is always OFF, test the signal circuit for an open/high resistance. If the circuit tests normal, replace the TCM.
7. If all circuits test normal, replace the ECM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Control Module References** for BCM replacement, setup, and programming

DTC C0890

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

DTC C0890 03

Voltage Below Threshold

DTC C0890 07

Voltage Above Threshold

Diagnostic Fault Information

DTC C0890

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Position Sensor Signal	C0277 06	C0277 06	C0277 07	C0277 09, C0277 4B
5-Volt Reference	C0277 06, C0890 03	C0277 06	C0277 06, 1	-
Low Reference	-	C0277 06, 1	-	-
1. Stop lamps are always ON				

Circuit/System Description

The body control module (BCM) provides a 5-volt reference voltage and a low reference signal to the brake pedal position sensor (BPPS). When the brake pedal is applied, the BPPS sends a variable voltage signal, that will increase as the brake pedal is applied, through the stop lamp switch signal circuit to the BCM. In response to this signal, the BCM applies battery positive voltage to the stop lamps, center high mounted stop lamp (CHMSL), transmission control module (TCM), and engine control module (ECM). The stop lamps will not operate unless the ignition is in the ON position.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

C0890 03

This DTC will set when the BCM detects a short to ground in the brake pedal position sensor voltage reference circuit for 0.5 second or greater.

C0890 07

This DTC will set when the BCM detects a short to battery voltage in the brake pedal position sensor voltage reference circuits for 0.5 second or greater.

Action Taken When the DTC Sets

- The Service Vehicle Soon indicator is commanded ON.
- If the DTC sets while the vehicle is running, the BCM will activate the brake lights when the vehicles transmission is not in the PARK position and the vehicle is not accelerating.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

- Scan Tool Output Controls
- Scan Tool Data List
- Scan Tool Data Definitions

Circuit/System Verification

Ignition ON, press and release the brake pedal. The stop lamps should turn ON and OFF when pressing and releasing the brake pedal.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the brake pedal position sensor.
2. Verify that a test lamp illuminates between the low reference circuit terminal C and B+.
    - If the test lamp does not illuminate, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the BCM.
3. Ignition ON, test for 4.8-5.2 volts between the 5-volt reference circuit terminal A and ground.
    - If less than the specified range, test the 5-volt reference circuit for a short to ground or an open/high resistance. If the circuit/connections test normal, replace the BCM.
    - If greater than the specified range, test the 5-volt reference circuit for a short to voltage. If the circuit test normal, replace the BCM.
4. If all circuits test normal, replace the brake pedal position sensor.

Repair Procedures

IMPORTANT: Perform the Brake Pedal Position Sensor Calibration after replacement of the brake pedal position sensor.

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Brake Pedal Position Sensor Replacement

- **Control Module References** for BCM replacement, setup, and programming

DTC P0572

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0572

Brake Switch Circuit 1 Low Voltage

Diagnostic Fault Information

DTC P0572

Circuit	Short to Ground	Open or High Resistance	Short to Voltage	Signal Performance
Stop Lamp Switch Signal	P0572	P0573	P0573	-

Circuit/System Description

The brake pedal position sensor is used to sense the action of the driver application of the brake pedal. The brake pedal position sensor provides an analog voltage signal that will increase as the brake pedal is applied. The brake pedal position sensor receives a low reference signal and a 5-volt reference voltage from the body control module (BCM) when the driver applies the brakes. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the stop/turn signal voltage supply circuit to illuminate the stop lamps and the center high mounted stop lamp (CHMSL). The BCM also sends a brake pedal position sensor signal to the engine control module (ECM) as well as a serial data message to indicate the application of the brake pedal.

Conditions for Running the DTC

- The ignition is ON.
- Battery voltage is greater than 11.5 volts.

Conditions for Setting the DTC

The ECM detects a short to ground on the stop lamp switch signal circuit when the serial data message from the BCM indicates the brakes are applied.

Action Taken When the DTC Sets

- The ECM stores the DTC to memory.
- The ECM will record the operating conditions at the time the diagnostic failed. The ECM stores this information in Failure Records.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- You issue a scan tool CLEAR DTCs command.
- A history DTC will clear once 40 malfunction-free ignition cycles have occurred.

Diagnostic Aids

IMPORTANT: Verify that the brake pedal position sensor is properly calibrated.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

1. With a scan tool recalibrate the brake pedal position sensor, clear all DTCs, and operate the vehicle within the Conditions for Running the DTC.
    - If DTC P0572 resets as current, test the stop lamp switch signal circuit for a short

to ground.

2. If circuits test OK, replace the ECM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Control Module References** for ECM replacement, setup, and programming
- **Brake Pedal Position Sensor Calibration**

DTC P0573

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0573

Brake Switch Circuit 1 High Voltage

Diagnostic Fault Information

DTC P0573

Circuit	Short to Ground	Open or High Resistance	Short to Voltage	Signal Performance
Stop Lamp Switch Signal	P0572	P0573	P0573	-

Circuit/System Description

The brake pedal position sensor is used to sense the action of the driver application of the brake pedal. The brake pedal position sensor provides an analog voltage signal that will increase as the brake pedal is applied. The brake pedal position sensor receives a low reference signal and a 5-volt reference voltage from the body control module (BCM) when the driver applies the brakes. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the stop/turn signal voltage supply circuit to illuminate the stop lamps and the center high mounted stop lamp (CHMSL). The BCM also sends a brake pedal position sensor signal to the engine control module (ECM) as well as a serial data message to indicate the application of the brake pedal.

Conditions for Running the DTC

- The ignition is ON.
- Battery voltage is greater than 11.5 volts.

Conditions for Setting the DTC

The ECM detects an open or short to voltage on the stop lamp switch signal circuit when the serial data message from the BCM indicates the brakes are applied.

Action Taken When the DTC Sets

- The ECM stores the DTC to memory.
- The ECM will record the operating conditions at the time the diagnostic failed. The ECM stores this information in Failure Records.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- You issue a scan tool CLEAR DTCs command.
- A history DTC will clear once 40 malfunction-free ignition cycles have occurred.

Diagnostic Aids

IMPORTANT: Verify that the brake pedal position sensor is properly calibrated.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

1. With a scan tool recalibrate the brake pedal position sensor, clear all DTCs, and operate the vehicle within the Conditions for Running the DTC.
    - If DTC P0573 resets as current, test the stop lamp switch signal circuit for an open or short to voltage.
2. If circuits test OK, replace the ECM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Control Module References** for ECM replacement, setup, and programming
- **Brake Pedal Position Sensor Calibration**

SYMPTOMS - LIGHTING SYSTEMS

IMPORTANT: The following steps must be completed before doing the Symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** in Vehicle DTC Information.
    - No DTCs are set.
    - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Exterior Lighting Systems Description and Operation** or **Interior Lighting Systems Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the lighting system. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Backup Lamps Always On
- Backup Lamps Inoperative
- Courtesy Lamps Always On
- Courtesy Lamps Inoperative
- Daytime Running Lamps (DRL) Inoperative
- Fog Lamps Always On
- Fog Lamps Inoperative
- Hazard Lamps Always On
- Hazard Lamps Inoperative
- Headlamps Always On - Low or High Beam
- Headlamps Inoperative - High Beams
- Headlamps Inoperative - Low Beams
- Headlamps Inoperative - Flash to Pass
- Illuminated Entry Lamps Inoperative
- Interior Backlighting Does Not Dim
- Interior Backlighting Inoperative
- Instrument Panel (I/P) Compartment Lamp Inoperative
- Instrument Panel (I/P) Compartment Lamp Always On
- Park, License, and Tail Lamps Always On
- Park, License, and Tail Lamps Inoperative
- Reading Lamp(s) Always On
- Reading Lamp(s) Inoperative
- Rear Compartment Lamp(s) Always On
- Rear Compartment Lamp(s) Inoperative
- Stop Lamps Always On
- Stop Lamps Inoperative
- Turn Signal Lamps and/or Indicators Always On or Flashing
- Turn Signal Lamps and/or Indicators Inoperative
- Vanity Mirror Lamp(s) Always On
- Vanity Mirror Lamp(s) Inoperative

BACKUP LAMPS ALWAYS ON

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Diagnostic Fault Information

DTC B2545

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Backup Lamps Voltage Supply	B2545 00	1	2	-

1. Backup Lamps Inoperative
2. Backup Lamps Always ON

Circuit/System Description

When the PRNDL is placed in the REVERSE position, a GMLAN signal is sent from the transmission control module (TCM) to the body control module (BCM). The BCM then applies voltage through the backup lamps voltage supply circuit to the tail lamp assemblies illuminating the backup lamps.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**

- **Scan Tool Data Definitions**

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the appropriate tail lamp assembly.
2. Test for less than 5.0 ohm of resistance between the ground circuit terminal B and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Connect a test lamp between the supply voltage circuit terminal A for Coupe or terminal D for Sedan and the ground circuit terminal B.
4. Ignition ON, cycle the PRNDL between the PARK and REVERSE positions. The test lamp should turn ON and OFF when changing between park and reverse.
    - If the test lamp is always ON, test the supply voltage circuit for a short to voltage. If the circuit tests normal, replace the body control module.
    - If the test lamp is always OFF, test the supply voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the body control module.
5. If all circuits test normal, test or replace the appropriate backup lamp bulb.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Backup Lamp Bulb Replacement**
- **Tail Lamp Replacement (Monte Carlo)** or **Tail Lamp Replacement (Impala)**
- **REARVIEW MIRROR REPLACEMENT**
- **Control Module References** for ECM replacement, setup, and programming

BACKUP LAMPS INOPERATIVE

Backup Lamps Inoperative

Step	Action	Yes	No
Schematic Reference: Exterior Lights Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?		Go to **Diagnostic System Check - Vehicle** in Vehicle DTC

		Go to **Step 2**	Information
2	1. Turn the ignition to the ON position. 2. Place the gear selector lever to the REVERSE position. Do both backup lamps illuminate?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	Is only one lamp inoperative?	Go to **Step 9**	Go to **Step 4**
4	Do the backup lamps operate normally?	Go to **Step 6**	Go to **Step 5**
5	1. Disconnect the body control module (BCM) connector C1. 2. Using a test lamp connected to ground, probe the CHMSL/Bkup fuse voltage supply circuit. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 7**
6	Test the backup lamps supply voltage circuit for a short to ground or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 10**	Go to **Step 8**
7	Repair the CHMSL/Bkup Fuse voltage supply circuit for a poor connection open or an short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 10**	-
8	Replace the BCM. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the repair?	Go to **Step 10**	-
9	Repair the open or the high resistance in the inoperative backup lamp voltage supply or the ground circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 10**	-
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

COURTESY LAMPS MALFUNCTION

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Diagnostic Fault Information

DTC's

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Courtesy Lamp Supply Voltage	B2615 00	1	-	-
I/P Dimming Voltage Reference	B1395 00	7	-	-
Instrument Panel Lamps Dimmer Switch Signal	B3600 03	B3600 03	2	-
Left Front Door Open Switch Signal	4	4	3	-
Passenger Door Open Switch Signal	5	5	4	-
Inadvertent Power Courtesy Lamp	B1480 00	6	1	-
Dome Lamp Ground	-	1	-	-
Door Lock Ground - Driver	-	4	-	-
Door Lock Ground - Front Passenger	-	5	-	-
Door Lock Ground - LR	-	5	-	-
Door Lock Ground - RR	-	5	-	-
Inadvertent Courtesy Lamp Ground	-	6	-	-
I/P Courtesy Lamp Ground - Left	-	2	-	-
I/P Courtesy Lamp Ground - Right	-	2	-	-

1. Dome Lamps Malfunction
2. IP Courtesy Lamps Malfunction
3. Dome Lamp Switch Malfunction
4. Door Open Switch Malfunction-Driver

5. Door Open Switch Malfunction-Passenger
6. Inadvertent Power Courtesy Lamps Malfunction
7. Interior Backlighting Malfunction

Circuit/System Description

The INT LIGHTS fuse supplies battery voltage to the body control module (BCM). The BCM applies battery voltage to the courtesy lamps through the courtesy lamp supply voltage circuit. When any door is opened, the door open switch contacts close and the BCM receives a door-open input. If the BCM receives a door lock or unlock input, the BCM will activate the courtesy lamp supply voltage circuit, providing battery voltage to the dome lamp and instrument panel (I/P) courtesy lamps. The courtesy lamps can be manually activated by placing the interior lamp switch in the DOME position. For more detailed information concerning courtesy lamp operation refer to **Interior Lighting Systems Description and Operation**.

Inadvertent power courtesy lamp feature provides a similar function for the interior lamps as a retained accessory power feature. The BCM will energize the courtesy lamps supply voltage circuit when the BCM is in the active state (awake). When the inadvertent power courtesy lamps supply voltage circuit is energized, it supplies voltage to all the interior lights listed below. The BCM will continue to supply voltage to the interior lamps after the ignition is turned OFF so that the interior lamps may be operated.

- Dome/Reading Lamp
- Vanity Mirror Lamps
- Reading Lamp Assembly
- Inside Rearview Mirror
- Rear Compartment Courtesy Lamp

In the event that any of these lamps were to remain illuminated for a period of more than 20 minutes with the ignition switch in the OFF position and no BCM input activity, the BCM will deactivate the inadvertent power supply voltage circuit to prevent a total battery discharge condition.

Reference Information

Schematic Reference

Interior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

1. Ignition ON, observe the scan tool Driver Door Open Sw. parameter while opening and closing the driver door. The reading should change between Open and Closed.
   - If the Driver Door Open Sw. parameter does not change between Open and Closed, refer to **Door Open Switch Circuit Test -- Driver**.
2. Observe the scan tool Passenger Door Open Sw. parameter while opening and closing the front passenger door. The reading should change between Open and Closed.
   - If the Passenger Door Open Sw. parameter does not change between Open and Closed, refer to **Door Open Switch Circuit Test -- Passenger**.
3. Observe the scan tool Passenger Door Open Sw. parameter while opening and closing the left and right rear passenger doors. The reading should change between Open and Closed.
   - If the Passenger Door Open Sw. parameter does not change between Open and Closed, refer to **Door Open Switch Circuit Test -- Passenger**.
4. Ignition ON and all doors closed, observe the scan tool Ctsy. Lamp Actv. Reason parameter while turning the dome lamp switch ON and OFF. The reading should change between OFF and MANUAL.
   - If the Ctsy. Lamp Actv. Reason parameter does not change between OFF and MANUAL, refer to **Dome Lamp Switch Circuit Test**.
5. If all scan tool parameters test normal, refer to the appropriate circuit test listed below:
   - Dome Lamp Circuit Test
   - I/P Courtesy Lamp Circuit Test
   - Inadvertent Power Courtesy Lamps Circuit Test

Circuit/System Testing

Door Open Switch Circuit Test -- Driver

1. Ignition OFF, disconnect the (C1 for Coupe) harness connector at the driver door lock.
2. Test for less than 10 ohms of resistance between the appropriate ground circuit terminal listed below and ground.
    - Base Level Sedan terminal 6
    - Uplevel Sedan terminal 8
    - Coupe terminal D C1
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool Driver Door Open Sw. parameter is Closed.
    - If not the specified value, test the appropriate signal circuit terminal listed below for a short to ground. If the circuit tests normal, replace the BCM.
    - Base Level Sedan terminal 5
    - Uplevel Sedan terminal 7
    - Coupe terminal C C1
4. Install a 3A fused jumper wire between the appropriate signal circuit terminal listed and ground. Verify the scan tool Driver Door Open Sw. parameter is Open.
    - Base Level Sedan terminal 5
    - Uplevel Sedan terminal 7
    - Coupe terminal C C1
    - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
5. If all circuits test normal, test or replace the door lock.

Door Open Switch Circuit Test -- Passenger

1. Ignition OFF, disconnect the (C1 for Coupe) harness connector at the inoperative passenger door lock.
2. Test for less than 10 ohms of resistance between the appropriate ground circuit terminal listed below and ground.
    - Sedan -- Front Passenger Door Lock terminal 3
    - Coupe -- Front Passenger Door Lock terminal A C1
    - Left Rear Door Lock terminal 6
    - Right Rear Door Lock terminal 3
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool Passenger Door Open Sw. parameter is Closed.
    - If not the specified value, test the signal circuit for a short to ground. If the circuit tests normal, replace the BCM.

4. Install a 3A fused jumper wire between the appropriate signal circuit terminal listed below and ground. Verify the scan tool Passenger Door Open Sw. parameter is Open.
    - Sedan -- Front Passenger Door Lock terminal 2
    - Coupe -- Front Passenger Door Lock terminal B C1
    - Left Rear Door Lock terminal 5
    - Right Rear Door Lock terminal 2
    - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
5. If all circuits test normal, test or replace the appropriate door lock.

Dome Lamp Switch Circuit Test

1. Ignition OFF, disconnect the harness connector at the headlamp switch.
2. Verify that a test lamp illuminates between the ground circuit terminal 8 and B+.
    - If the test lamp does not illuminate, test the ground circuit for an open/high resistance. If the circuit tests normal.
3. Ignition ON, verify the scan tool Ctsy. Lamp Actv. Reason parameter is OFF.
    - If not the specified value, test the signal circuit terminal 12 for a short to ground. If the circuit tests normal, replace the BCM.
4. Install a 3A fused jumper wire between the signal circuit terminal 12 and ground. Verify the scan tool Ctsy. Lamp Actv. Reason parameter is MANUAL.
    - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
5. If all circuits test normal, test or replace the headlamp switch.

Dome Lamp Circuit Test

1. Ignition OFF, disconnect the (C1 Sedan, C2 Coupe) harness connector at the dome lamp.
2. Ignition OFF, test for less than 5.0 ohms of resistance between the appropriate ground circuit terminal listed below and ground.
    - Sedan terminal B
    - Coupe terminal A C2
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Connect a test lamp between the appropriate supply voltage circuit terminal listed below and ground.
    - Sedan terminal A
    - Coupe terminal A C1
4. Command the Courtesy Lamp ON and OFF with a scan tool. The test lamp should turn

ON and OFF when changing between the commanded states.

- If the test lamp is always ON, test the supply voltage circuit for a short to voltage. If the circuit tests normal, replace the BCM.
- If the test lamp is always OFF, test the supply voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.

5. If all circuits test normal, test or replace the dome lamp.

I/P Courtesy Lamp Circuit Test

1. Ignition OFF, disconnect the harness connector at the I/P courtesy lamp.
2. Test for less than 5.0 ohms of resistance between the ground circuit terminal B and ground.
    - If greater than the specified range, test the ground for an open/high resistance.
3. Door Open, verify that a test lamp illuminates between the supply voltage circuit terminal A and ground.
    - If the test lamp does not illuminate, test the supply voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
4. If all circuits test normal, replace the inoperative I/P courtesy lamp.

Inadvertent Power Courtesy Lamps Circuit Test

1. Ignition OFF, disconnect the harness connector at the inoperative lamp.
2. Test for less than 5.0 ohms of resistance between the appropriate ground circuit terminal listed below and ground.
    - Dome/Reading Lamp terminal B -- Sedan
    - Left or Right Vanity Mirror terminal B
    - Reading Lamp Assembly terminal B with 9C1 or 9C3
    - Inside Rearview Mirror terminal 7 w/o UE1
    - Inside Rearview Mirror terminal 8 with UE1
    - Rear Compartment Courtesy Lamp terminal B
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify that a test lamp illuminates between the appropriate inadvertent power courtesy lamp circuit terminal listed below and ground.
    - Dome/Reading Lamp terminal B -- Sedan
    - Left or Right Vanity Mirror terminal B
    - Reading Lamp Assembly terminal A with 9C1 or 9C3
    - Inside Rearview Mirror terminal 2 w/o UE1
    - Inside Rearview Mirror terminal 6 with UE1

    - Rear Compartment Courtesy Lamp terminal A
    - If the test lamp does not illuminate, test the inadvertent power courtesy lamp circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
4. If all circuits test normal, replace the inoperative lamp.

Component Test

Door Open Switch Test

1. Ignition OFF, remove the appropriate door lock.
2. Test for infinite resistance between the appropriate signal and ground terminals listed below with the switch in the open position.
    - Driver door coupe -- signal terminal C and ground terminal D
    - Driver door base sedan -- signal terminal 5 and ground terminal 6
    - Driver door uplevel sedan -- signal terminal 7 and ground terminal 8
    - Front passenger coupe -- signal terminal B and ground terminal A
    - Front passenger sedan -- signal terminal 2 and ground terminal 3
    - Left rear door -- signal terminal 5 and ground terminal 6
    - Right rear door -- signal terminal 2 and ground terminal 3
    - If not the specified value, replace the appropriate door lock
3. Test for less than 2 ohms between the appropriate signal and ground terminals listed below with the switch in the closed position.
    - Driver door coupe -- signal terminal C and ground terminal D
    - Driver door base sedan -- signal terminal 5 and ground terminal 6
    - Driver door uplevel sedan -- signal terminal 7 and ground terminal 8
    - Front passenger coupe -- signal terminal B and ground terminal A
    - Front passenger sedan -- signal terminal 2 and ground terminal 3
    - Left rear door -- signal terminal 5 and ground terminal 6
    - Right rear door -- signal terminal 2 and ground terminal 3
    - If greater than the specified range, replace the appropriate door lock.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**
- **Reading Lamp Bulb Replacement**

- **Instrument Panel Courtesy Lamp Replacement**
- **Vanity Mirror Lamp Bulb Replacement**
- **Dome Lamp Replacement (Impala)** or **Dome Lamp Replacement (Monte Carlo)**
- **Dome Lamp Bulb Replacement (Impala)** or **Dome Lamp Bulb Replacement (Monte Carlo)**
- **Rear Compartment Lamp Replacement**
- **FRONT DOOR LOCK REPLACEMENT - (MONTE CARLO)** or **FRONT DOOR LOCK REPLACEMENT - (IMPALA)**
- **REAR DOOR LOCK REPLACEMENT**
- **REARVIEW MIRROR REPLACEMENT**
- **Control Module References** for ECM replacement, setup, and programming

COURTESY LAMPS ALWAYS ON

Courtesy Lamps Always On

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Master Electrical Component List** DEFINITION: The instrument panel (I/P) courtesy dome and roof rail courtesy lamps are ON at all times.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Ensure the instrument panel dimmer switch is not in the DOME position. 2. Close all of the vehicle doors. 3. Wait 20 seconds. Are the courtesy lamps illuminated?	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections**
3	Use the scan tool in order to command the courtesy lamps OFF. Do the courtesy lamps turn OFF?	Go to **Step 4**	Go to **Step 6**
4	1. Close all of the vehicle doors. 2. With a scan tool, observe the Driver Door Open Sw. and the Passenger Door Open Sw. parameters in the Lamp Status data list. Does the scan tool indicate that all parameters are OFF?	Go to **Step 14**	Go to **Step 5**

5	Does the scan tool indicate that the Driver Door Open Sw. parameter is ON?	Go to **Step 9**	Go to **Step 10**
6	Disconnect the lamp switch assembly. Are the courtesy lamps illuminated?	Go to **Step 7**	Go to **Step 13**
7	Test for a short to ground in the courtesy lamp switch ON signal circuit of the body control module (BCM). Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 18**	Go to **Step 8**
8	1. Disconnect the BCM connector C1. 2. Test the courtesy lamp supply voltage circuit for a short to battery positive voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 18**	Go to **Step 14**
9	1. Disconnect the driver door lock switch. 2. Observe the Driver Door Open Sw. parameter as you disconnect the switch. Does the scan tool indicate that the Driver Door Open Sw. parameter is OFF when the driver door lock switch is disconnected?	Go to **Step 16**	Go to **Step 11**
10	1. Disconnect the passenger door lock switches one at a time. 2. Observe the Passenger Door Open Sw. parameter as you disconnect each switch. Does the scan tool indicate that the Passenger Door Open Sw. parameter is OFF when one of the passenger door lock switches is disconnected?	Go to **Step 16**	Go to **Step 12**
11	Test the driver door open switch signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 18**	Go to **Step 14**
12	Test the passenger door open switch signal circuits for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** .		

	Did you find and correct the condition?	Go to **Step 18**	Go to **Step 14**
13	Inspect for poor connections at the harness connector of the lamp switch assembly. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 18**	Go to **Step 15**
14	Inspect for poor connections at the harness connector of the BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 18**	Go to **Step 17**
15	Replace the lamp switch assembly. Refer to **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**. Did you complete the replacement?	Go to **Step 18**	-
16	Replace the inoperative door lock switch. Refer to **Lock Replacement - Front Door (Monte Carlo)** or **Lock Replacement - Front Door (Impala)** or to **Lock Replacement - Rear Door** . Did you complete the replacement?	Go to **Step 18**	-
17	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 18**	-
18	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

COURTESY LAMPS INOPERATIVE

Courtesy Lamps Inoperative

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Master Electrical Component List** DEFINITION: All instrument panel (I/P) courtesy dome and roof rail courtesy lamps are inoperative from any door or the I/P dimmer switch.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**

2	1. Turn ON the ignition, with the engine OFF. 2. Open and close all of the vehicle doors. 3. Observe the courtesy lamps. Do the courtesy lamps illuminate when each door is opened?	Go to **Step 4**	Go to **Step 3**
3	Are the courtesy lamps inoperative from the lamp switch assembly also?	Go to **Step 4**	Go to **Step 7**
4	1. Disconnect the lamp switch assembly. 2. Install a jumper between the courtesy lamp switch on signal circuit and ground. Do the courtesy lamps illuminate?	Go to **Step 15**	Go to **Step 5**
5	Test for a poor connection, open or a short to ground in the INT LIGHT fuse voltage supply circuit of the body control module (BCM). Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 6**
6	Test for short to ground or an open in the courtesy lamp supply voltage circuit of the BCM. Refer to **Circuit Testing** and**Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 9**
7	Are the courtesy lamps inoperative from all the doors?	Go to **Step 13**	Go to **Step 8**
8	1. Close all of the vehicle doors, except the inoperative door. 2. Disconnect the inoperative door lock switch. 3. Connect a 3-amp fused jumper wire between the door open switch signal wire and ground. Do the courtesy lamps illuminate?	Go to **Step 11**	Go to **Step 12**
9	Test for a poor connection, an open, or a short to battery positive voltage in the courtesy lamp switch on signal circuit.		

	Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 10**
10	Test for a short to battery positive voltage or a open in the I/P dimming return circuit of the BCM. Refer to **Circuit Testing** and**Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 17**
11	Test the ground circuit of the inoperative door lock switch for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 16**
12	Test the inoperative door lock switch open circuit for the following: • An open • A high resistance • A short to voltage Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 17**
13	1. Disconnect the lamp switch assembly. 2. Open and close the driver door. Do the courtesy lamps illuminate?	Go to **Step 17**	Go to **Step 14**
14	Test for a short to ground in the courtesy defeat circuit of the BCM. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	-
15	Test for a poor connection or an open in the ground circuit of the lamp switch assembly. Did you find and correct the condition?	Go to **Step 21**	Go to **Step 19**
16	Inspect for a poor connections at the harness connector of the inoperative door lock switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 18**
	Inspect for poor connections at the harness		

17	connector of the BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 20**
18	Replace the inoperative door lock switch. Refer to **Lock Replacement - Front Door (Monte Carlo)** or **Lock Replacement - Front Door (Impala)** or **Lock Replacement - Rear Door** . Did you complete the replacement?	Go to **Step 21**	-
19	Replace the lamp switch assembly. Refer to **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**. Did you complete the repair?	Go to **Step 21**	-
20	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 21**	-
21	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

DAYTIME RUNNING LAMPS MALFUNCTION

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Diagnostic Fault Information

DTC's

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
DRL Ambient Light Sensor Signal	B2645 03	B2645 07	B2645 07	-
DRL Ambient Light Sensor Low Reference	-	B2645 07	-	-
DRL Resistor Supply Voltage	1, 3	1	2	-
Left Headlamp Low Beam				

Voltage Supply	1, 3	1, 3	4	-
Right Headlamp Low Beam Voltage Supply	1, 3	1, 3	4	-
DRL Relay Control	2	1	B2600 00	-
Left Headlamp Low Beam Ground	-	3	-	-
Right Headlam Low Beam ground	-	3	-	-

1. Daytime Running Lamps (DRL) Inoperative
2. Daytime Running Lamps (DRL) Always ON
3. Headlamp Inoperative
4. Headlamp Always ON

Circuit/System Description

The ambient light sensor is a light sensitive transistor that varies the voltage signal to the body control module (BCM) based on outside lighting conditions. When the ambient light sensor indicates daytime conditions with engine running, the body control module (BCM) grounds the DRL relay control circuit, energizing the DRL relay. With the DRL relay energized, voltage is applied through the relay switch contacts, the DRL 1 fuse, and the DRL 2 fuse to the left and right low beam headlamps. Any function or condition that turns the headlamps ON will cancel DRL operation.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, observe the scan tool Ambient Light Sensor parameter voltage while carefully supplying sufficient light to simulate daylight conditions to the ambient light sensor. The voltage reading should change approximately 2-3.5 volts.

Circuit/System Testing

Ignition ON and headlamps OFF, with a test lamp connected to ground, probe each of the test points on the DRL 1 fuse while commanding the DRL ON and OFF with a scan tool. The test lamp should illuminate at one or both of the fuse test points.

- If the test lamp does not illuminate at either test point, refer to **DRL Relay Circuit Test**.
- If the test lamp illuminates, refer to **DRL Circuit Test**.

DRL Relay Circuit Test

1. Ignition OFF, disconnect the (C4) harness connector at the underhood fuse block.
2. Connect a test lamp between the DRL PCB relay control circuit terminal H2 and B+.
3. Ignition ON and headlamps OFF, command the DRL ON and OFF with a scan tool. The test lamp should turn ON and OFF between commanded states.
    - If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the BCM.
    - If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
4. If all circuits nest normal, replace underhood fuse block.

DRL Circuit Test

1. Turn the ignition ON and the headlamps OFF.
2. With a test lamp connected to ground, probe each of the test points on the DRL 2 fuse while commanding the DRL ON and OFF with a scan tool. The test lamp should turn ON and OFF between commanded states at one or both of the fuse test points.
    - If the test lamp is always ON, test the supply voltage circuit between the DRL 1 fuse and the DRL 2 fuse for a short to voltage. If the circuit tests normal, replace the underhood fuse block.
    - If the test lamp is always OFF, test the supply voltage circuit between the DRL 1 fuse and the DRL 2 fuse for a short to ground or an open/high resistance. If the circuit tests normal, replace the underhood fuse block.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **UNDERHOOD ELECTRICAL CENTER OR JUNCTION BLOCK REPLACEMENT**
- **Control Module References** for ECM replacement, setup, and programming

DAYTIME RUNNING LAMPS (DRL) INOPERATIVE

Daytime Running Lamps (DRL) Inoperative

Step	Action	Yes	No
Schematic Reference: Headlights/Daytime Running Lights (DRL) Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Place the ignition in the ON position. 2. Disengage the park brake. 3. Expose the ambient light sensor to a bright incandescent lamp. Do the low beam headlamps illuminate at reduced intensity?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	1. Install a scan tool. 2. Expose the ambient light sensor to a bright incandescent lamp. 3. With a scan tool, observe the Headlamp/DRL Output parameter in the body control module (BCM) data list. Does the scan tool display DRL?	Go to **Step 4**	Go to **Step 5**
4	Replace the headlamp module in the underhood fuse block. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached**		

	to Wire Harness) in Wiring Systems. Did you complete the repair?	Go to **Step 6**	-
5	Replace the BCM. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 6**	-
6	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

FOG LAMPS ALWAYS ON

Fog Lamps Always On

Step	Action	Yes	No
Schematic Reference: Fog Lights Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn ON the ignition, with the engine OFF. 2. Place the fog lamp switch in the OFF position. 3. Place the headlamp switch in the OFF position. Do the fog lamps remain illuminated?	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections**
3	Disconnect the FOG LP relay. Did the fog lamps turn OFF?	Go to **Step 4**	Go to **Step 8**
4	1. Reinstall the FOG LP relay. 2. Disconnect the lamp switch assembly. Do the fog lamps remain illuminated?	Go to **Step 5**	Go to **Step 10**
5	Disconnect the body control module (BCM) connector C3. Do the fog lamps remain illuminated?	Go to **Step 6**	Go to **Step 9**
6	Disconnect the BCM connector C1. Do the fog lamps remain illuminated?	Go to **Step 7**	Go to **Step 12**
7	Test for a short to ground in the fog lamp relay control circuit. Refer to **Circuit**		

	Testing and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 11**
8	Repair a short to battery positive voltage in the fog lamp voltage supply circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you complete the repair?	Go to **Step 13**	-
9	Repair a short to ground in the fog lamp switch signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you complete the repair?	Go to **Step 13**	-
10	Replace the lamp switch assembly. Refer to **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**. Did you complete the repair?	Go to **Step 13**	-
11	Replace the FOG LP relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	Go to **Step 13**	-
12	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 13**	-
13	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

FRONT FOG LAMPS MALFUNCTION

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Diagnostic Fault Information

DTC's

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Fog Lamp Supply Voltage	2	2	1	-

Right Front Fog Lamp Supply Voltage	4	4	3	-
Front Fog Lamp Switch Signal	2, 4	2, 4	1, 3	-
Fog Lamp Relay Control	1, 3	2, 4	B2530 00, 1, 3	-
Headlamp Switch Ground	-	1, 3	-	-
Left Front Left Fog Lamp Ground	-	2	-	-
Right Front Fog Lamp Ground	-	4	-	-

1. Left Fog Lamp Always ON
2. Left Front Fog Lamp Inoperative
3. Right Fog Lamps Always ON
4. Right Front Fog Lamp Inoperative

Circuit/System Description

The body control module (BCM) controls the fog lamps based on inputs from the fog lamp switch. When the fog lamp switch is pressed, a ground path is provided on the front fog lamp switch signal circuit to the BCM, indicating the front fog lamps ON command. In response to this signal, the BCM grounds the fog lamp relay control circuit energizing the FOG LAMP PCB Relay. With the fog lamp relay energized, battery voltage is applied through the FOG LAMPS Fuse and the fog lamp supply voltage circuits illuminating the front fog lamps.

When a fog lamp request is seen by the BCM, a serial data message is sent to the instrument panel cluster (IPC) requesting the fog lamp indicator be illuminated.

Reference Information

Schematic Reference

Fog Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

- **Connector Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

1. Observe the scan tool Front Fog Lamps Switch parameter while pressing and releasing the fog lamp switch. The parameter should change between Active and Inactive.
   - If the parameter does not change between the specified values, refer to **Fog Lamp Switch Circuit Test**.
2. With a test lamp connected to ground, probe each of the test points on the FOG Fuse while commanding the Fog Lamps ON and OFF with a scan tool. The test lamp should turn ON and OFF at one or both of the fuse test points when changing between commanded states.
   - If the test lamp is always OFF, or remains always ON, refer to **Fog Lamp PCB Relay Circuit Test**.
   - If the test lamp turns ON and OFF, refer to **Fog Lamps Circuit Test**.
3. With the fog lamps ON, verify the fog lamp indicator is illuminated on the IPC.
   - If the indicator does not illuminate, refer to **Front Fog Lamp Indicator Test**.

Circuit/System Testing

Fog Lamp Switch Circuit Test

1. Ignition OFF, disconnect the harness connector at the headlamp switch.
2. Verify that a test lamp illuminates between the ground circuit terminal 8 and B+.
   - If the test lamp does not illuminate, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool Front Fog Lamp Switch parameter is Inactive.
   - If not the specified value, test the signal circuit terminal 6 for a short to ground. If the circuit tests normal, replace the BCM.
4. Install a 3A fused jumper wire between the signal circuit terminal 6 and the ground circuit terminal 8. Verify the scan tool Front Fog Lamp Switch parameter is Active.
   - If not the specified value, test the signal circuit for a short to voltage or and open/high resistance. If the circuit tests normal, replace the BCM.
5. If all circuits test normal, test or replace the headlamp switch.

Fog Lamp PCB Relay Circuit Test

1. Ignition OFF, disconnect the (C2) harness connector at the underhood fuse block.
2. Connect a test lamp between the control circuit terminal H5 and B+.
3. Ignition ON, command the Fog Lamps ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
    - If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the BCM.
    - If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
4. If all circuits test normal, replace the underhood fuse block.

Fog Lamps Circuit Test

1. Ignition OFF, disconnect the harness connector at the inoperative fog lamp.
2. Test for less than 5.0 ohms of resistance between the ground circuit terminal B and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Connect a test lamp between the supply voltage circuit terminal A and ground.
4. Ignition ON, command the Fog Lamps ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
    - If the test lamp is always ON, test the supply voltage circuit for a short to voltage. If the circuit tests normal, replace the underhood fuse block.
    - If the test lamp is always OFF, test the supply voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the underhood fuse block.
5. If all circuits test normal, test or replace the inoperative fog lamp bulb.

Front Fog Lamp Indicator Test

1. Ignition ON, with a scan tool perform the display test for the instrument panel cluster (IPC) and observe the front fog lamp indicator.
    - If the front fog lamp indicator illuminates during the test, replace the BCM.
    - If the front fog lamp indicator does not illuminate during the test or remains illuminated at all times, replace the IPC.

Component Test

Headlamp Switch

1. Ignition OFF, disconnect the harness connector at the headlamp switch.
2. Test for infinite resistance between the signal circuit terminal 6 and the ground circuit terminal 8 with the switch in the open position. ? If not the specified value, replace the

headlamp switch.

   - If not the specified value, replace the headlamp switch.

3. Test for less than 2.0 ohms of resistance between the signal circuit terminal 6 and the ground circuit terminal 8 with the switch in the closed position.
   - If greater than the specified range, replace the headlamp switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**
- **Fog Lamp Replacement - Front**
- **UNDERHOOD ELECTRICAL CENTER OR JUNCTION BLOCK REPLACEMENT**
- **Control Module References** for ECM replacement, setup, and programming

FOG LAMPS INOPERATIVE

Fog Lamps Inoperative

Step	Action	Yes	No
Schematic Reference: Fog Lights Schematics **Connector End View Reference: Power and Grounding Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn the ignition to the ON position. 2. Turn the headlamp switch to the PARK position. 3. Place the fog lamp switch in the ON position. Are both of the fog lamps ON?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Is only one fog lamp inoperative?	Go to **Step 4**	Go to **Step 6**
4	1. Disconnect the inoperative fog lamp. 2. Using a test lamp connected to ground, probe the fog lamps supply voltage circuit of the inoperative fog lamp.		

	Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 22**
5	Using a test lamp, probe between the ground circuit and supply voltage circuit of the inoperative fog lamp. Does the test lamp illuminate?	Go to **Step 18**	Go to **Step 24**
6	1. Place the headlamp switch in the HEAD position. 2. Place the headlamp dimmer switch in the HIGH beam position. Do the high beam headlamps operate properly?	Go to **Step 7**	Go to **Headlamps Inoperative - High Beams**
7	Check the FOG LP fuse for an open. Is the FOG LP fuse open?	Go to **Step 16**	Go to **Step 8**
8	1. Disconnect the FOG LP relay. 2. Turn the ignition to the ON position. 3. Connect a test lamp between the switch side supply of the FOG LP relay and a ground. Does the test lamp illuminate?	Go to **Step 9**	Go to **Step 20**
9	1. Turn the headlamp switch to the PARK position. 2. Place the headlamp dimmer switch in the LOW beam position. 3. Connect a test lamp between the coil side supply of the FOG LP relay and a ground. Does the test lamp illuminate?	Go to **Step 10**	Go to **Step 20**
10	1. Place the fog lamp switch in the ON position. 2. Connect a test lamp between the coil side supply of the FOG LP relay and the control circuit of the FOG LP relay. Does the test lamp illuminate?	Go to **Step 12**	Go to **Step 11**
	1. Disconnect the lamp switch assembly connector.		

11	2. Connect a jumper between the fog lamp switch signal circuit of the fog lamp switch and ground circuit. Do the fog lamps illuminate?	Go to **Step 17**	Go to **Step 13**
12	Connect a fused jumper between the switch side supply of the FOG LP relay and the fog lamps supply voltage circuit of the fog lamp relay. Do the fog lamps illuminate?	Go to **Step 19**	Go to **Step 16**
13	Connect a fused jumper between the fog lamp switch signal circuit and ground. Do the fog lamps illuminate?	Go to **Step 23**	Go to **Step 14**
14	Test for an open high resistance short to battery positive voltage or a short to ground in the fog lamps switch signal circuit of the fog lamp switch. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 30**	Go to **Step 15**
15	Test for an open, high resistance, or short to battery positive voltage in the control circuit of the FOG LP relay. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 30**	Go to **Step 21**
16	Test for a short to ground in the fog lamp supply voltage circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 30**	Go to **Step 20**
17	Inspect for poor connections at the harness connector of the lamp switch assembly. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 30**	Go to **Step 26**
18	Inspect for poor connections at the harness connector of the inoperative fog lamp. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 30**	Go to **Step 25**
	Inspect for poor connections at the harness connector of the FOG LP relay. Refer to		

19	**Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 30**	Go to **Step 27**
20	Inspect for poor connections at the harness connector of the fuse block - underhood. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 30**	Go to **Step 28**
21	Inspect for poor connections at the harness connector of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 30**	Go to **Step 29**
22	Repair an open or high resistance in the fog lamp supply voltage circuit of the inoperative fog lamp. Refer to **Circuit Testing** and **Wiring Repairs** . Has the repair been made?	Go to **Step 30**	-
23	Repair a poor connection or an open in the ground circuit of the fog lamp switch. Refer to **Circuit Testing** and **Wiring Repairs** . Has the repair been made?	Go to **Step 30**	-
24	Repair an open or high resistance in the ground circuit of the inoperative fog lamp. Refer to **Circuit Testing** and **Wiring Repairs** . Has the repair been made?	Go to **Step 30**	-
25	Replace the inoperative fog lamp. Refer to **Fog Lamp Bulb Replacement - Front**. Has the repair been made?	Go to **Step 30**	-
26	Replace the lamp switch assembly. Refer to **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**. Has the repair been made?	Go to **Step 30**	-
27	Replace the FOG LP relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** .		

	Has the repair been made?	Go to **Step 30**	-
28	Replace the fuse block - underhood. Refer to **Underhood Electrical Center or Junction Block Replacement** . Has the repair been made?	Go to **Step 30**	-
29	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Has the repair been made?	Go to **Step 30**	-
30	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

HAZARD LAMPS MALFUNCTION

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Diagnostic Fault Information

DTC's

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Hazard Switch Signal	2	1	1	-
Hazard Switch Ground	-	1	1	-

1. Hazard Lamps Inoperative
2. Hazard Lamps Always On

Circuit/System Description

The body control module (BCM) controls the hazard lamps based on inputs from the hazard switch. With the hazard switch closed, a ground path is provided on the hazards switch signal circuit, indicating a hazard lamp request. When this request is seen, the BCM will pulse the turn signal lamp supply voltage circuits, illuminating the turn signal lamps.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

1. Ignition ON, individually operate both the left and right turn signals. All applicable lamps should flash when in each turn signal position.
   - If any of the lamps do not flash, refer to **Turn Signal Lamps**.
2. Observe the scan tool Hazard Lamp Switch parameter while cycling the hazard switch. The parameter should change between Active and Inactive.
   - If the parameter does not cycle between the specified values, refer to **Hazard Switch Circuit Malfunction**.
3. Press the hazard switch. All applicable lamps should flash.
   - If one or more lamps do not flash, replace the BCM.

Circuit/System Testing

Hazard Switch Circuit Malfunction

1. Ignition OFF, disconnect the harness connector C1 at the turn signal/multifunction switch.
2. Test for less than 5.0 ohms of resistance between the ground circuit terminal H and ground.
   - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool Hazard Lamp Switch parameter is Inactive.
   - If not the specified value, test the signal circuit terminal C for a short to ground. If the circuit tests normal, replace the BCM.

4. Install a 3A fused jumper wire between the signal circuit terminal C and the ground circuit terminal E. Verify the scan tool Hazard Lamp Switch parameter is Active.
    - If not the specified value, test the signal circuit for a short to voltage or and open/high resistance. If the circuit tests normal, replace the BCM.
5. If all circuits test normal, test or replace the turn signal/multifunction switch.

Component Testing

Turn Signal/Multifunction Switch

1. Ignition OFF, disconnect the harness connector C1 at the turn signal/multifunction switch.
2. Test for infinite resistance between the signal circuit terminal C and the ground circuit terminal H with the switch in the open position.
    - If not the specified value, replace the turn signal/multifunction switch.
3. Test for less than 2.0 ohms of resistance between the signal circuit terminal C and the ground circuit terminal H with the switch in the closed position.
    - If greater than the specified range, replace the turn signal/multifunction switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Control Module References** for ECM replacement, setup, and programming

HAZARD LAMPS ALWAYS ON

Hazard Lamps Always On

Step	Action	Yes	No
Schematic Reference: Exterior Lights Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Place the hazard switch in the OFF position. Do the hazard lamp remain ON continuously?		Go to **Testing for Intermittent Conditions and Poor Connections** in

		Go to **Step 3**	Wiring Systems
3	Disconnect the driver information center (DIC). Do the hazard lamps turn OFF?	Go to **Step 6**	Go to **Step 4**
4	Test for a short to ground in the hazard switch signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 7**	Go to **Step 5**
5	Replace the body control module (BCM). Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 7**	-
6	Replace the DIC. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the repair?	Go to **Step 7**	-
7	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

HAZARD LAMPS INOPERATIVE

Hazard Lamps Inoperative

Step	Action	Yes	No
Schematic Reference: Exterior Lights Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Place the hazard switch to the ON position. Do the hazard lamps turn ON?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**

3	1. Disconnect the driver information center (DIC)/ hazard switch. 2. Install a fused jumper between the hazard switch signal circuit and the ground circuit. Do the hazard lamps illuminate?	Go to **Step 8**	Go to **Step 4**
4	Using a test lamp connected to battery positive voltage, probe the ground circuit of the hazard switch. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 6**
5	Test the hazard warning switch signal circuit for an open, a poor connection, or a short to battery positive voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 7**
6	Repair a poor connection, an open, or a short to battery positive voltage in the hazard warning switch ground circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 9**	-
7	Replace the body control module (BCM). Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 9**	-
8	Replace the DIC/hazard switch. Refer to **Driver Information Center Switch Replacement (Impala)** or **Driver Information Center Switch Replacement (Monte Carlo)** in Instrument Panel, Gages and Console. Is the repair complete?	Go to **Step 6**	-
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

HEADLAMPS MALFUNCTION

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Diagnostic Fault Information

DTC's

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Beam Headlamp Supply Voltage	1	1	3	-
High Beam Headlamp Supply Voltage	2	2	4	-
Headlamp Low Beam Relay Control	3	1	B2575 00	-
Headlamp High Beam Relay Control	4	2	B2580 00	-
Headlamp Switch Headlamps Off Signal	B257A 00	6	6*	-
Headlamp Switch Headlamps On Signal	B257A 00	1	1*	-
Park Lamp Switch On Signal	B257A 00	B257A 00	B257A 00*	-
Flash to Pass Switch Signal	4	5	5	-
Headlamp Dimmer Switch High Beam Signal	4	2	2	-
Low Beam Headlamp Ground	-	1	-	-
High Beam Headlamp Ground	-	2	-	-
Headlamp Switch Ground	-	1, 2	-	-
Turn Signal/Multifunction Switch Ground	-	2, 5	-	-

* Internal damage to the headlamp switch may occur if shorted to B+

1. Low Beam Headlamp(s) Inoperative
2. High Beam Headlamp(s) Inoperative
3. Low Beam Headlamp(s) Always On
4. High Beam Headlamp(s) Always On
5. Flash to Pass Inoperative
6. Headlamp Defeat Inoperative

Circuit/System Description

The vehicle headlamps are controlled by the body control module (BCM) based on inputs from the headlamp switch and the turn signal/multifunction switch. The headlamp switch has four positions: Off, Auto, Park, and Headlamps. The default headlamp switch position is Auto, in which the BCM uses the ambient light sensor to determine when headlamps are needed. The Off portion of the headlamp switch is a momentary switch which overrides the automatic headlamps and will turn off the vehicle headlamps. When in the Off position, the headlamp switch grounds the headlamp switch headlamps off signal circuit, prompting the BCM to turn off the headlamps. The Park position of the headlamp switch will only illuminate the vehicle parking lamps. The Headlamp position of the headlamp switch will illuminate both the parking lamps, as well has the headlamps. With the headlamp switch in the Headlamp position, the headlamp switch headlamps on signal circuit is grounded, prompting the BCM to turn on the headlamps, regardless of other factors such as ambient light.

The headlamp high beams are controlled through the flash to pass switch and the headlamp dimmer switch, both located in the turn signal/multifunction switch. The flash to pass switch is a momentary type switch, designed to illuminate the high beams as long as the switch is held. With the switch closed, the flash to pass switch signal circuit is grounded, prompting the BCM to turn on the high beam lamps. The headlamp dimmer switch allows the operator to select between full time high or low beam operation. Unlike the flash to pass switch, it is not a momentary switch. When the headlamp dimmer switch is in the high beam position, the headlamp dimmer switch high beam signal circuit is grounded. This prompts the BCM to turn on the high beam lamps.

The BCM controls the headlamps based on the inputs explained above. When a low beam request is received, the BCM grounds the headlamp low beam relay control circuit. This energizes the coil in the LOW BEAM PCB relay, causing the relay switch to close. This then applies B+ to both low beam headlamps through the LT LO BEAM and RT LO BEAM fuses, illuminating the low beam headlamps. When a high beam request is received, the BCM grounds the headlamp high beam relay control circuit. This energizes the coil in the HIGH BEAM PCB relay, causing the relay switch to close. This then applies B+ to both high beam headlamps through the LT HI BEAM and RT HI BEAM fuses, illuminating the high beam headlamps.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

1. Ignition ON, observe the scan tool Auto Hdlp. Disable Sw. parameter while cycling the headlamp switch between the Auto and Off positions. The parameter should cycle between Active and Inactive.
    - If the parameter does not cycle between the specified values, refer to **Headlamp Switch Malfunction**.
2. Observe the scan tool Headlamp Switch parameter while cycling the headlamp switch between the Auto and Head position. The parameter should cycle between Active and Inactive.
    - If the parameter does not cycle between the specified values, refer to **Headlamp Switch Malfunction**.
3. With the headlamps ON, observe the scan tool Flash to Pass Switch parameter while pulling and releasing the flash to pass switch. The parameter should cycle between Active and Inactive.
    - If the parameter does not cycle between the specified values, refer to **Turn Signal/Multifunction Switch Malfunction**.
4. With the headlamps ON, observe the scan tool High Beam Select Switch parameter while switching the headlamp dimmer switch between the low and high beam positions. The parameter should cycle between Active and Inactive.
    - If the parameter does not cycle between the specified values, refer to **Turn Signal/Multifunction Switch Malfunction**.
5. Command the Low Beams ON and OFF with a scan tool. Verify the low beam headlamps turn ON and OFF.
    - If the low beam headlamps do not cycle between the commanded states, refer to **Low Beam Headlamp Malfunction**.
6. Command the High Beams ON and OFF with a scan tool. Verify the low beam headlamps turn ON and OFF.
    - If the high beam headlamps do not cycle between the commanded states, refer to **High Beam Headlamp Malfunction**.

Circuit/System Testing

Headlamp Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the headlamp switch.
2. Verify that a test lamp illuminates between the ground circuit terminal 8 and B+.
   - If the test lamp does not illuminate, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool Headlamp Switch parameter is Inactive.
   - If not the specified value, test the signal circuit terminal 1 for a short to ground. If the circuit tests normal, replace the BCM.
4. Verify the scan tool Auto Hdlp. Disable Sw. parameter is Inactive.
   - If not the specified value, test the signal circuit terminal 3 for a short to ground. If the circuit tests normal, replace the BCM.
5. Install a 3A fused jumper wire between the signal circuit terminal 1 and ground. Verify the scan tool Headlamp Switch parameter is Active.
   - If not the specified value, test the signal circuit for a short to voltage or and open/high resistance. If the circuit tests normal, replace the BCM.
6. Install a 3A fused jumper wire between the signal circuit terminal 3 and ground. Verify the scan tool Auto Hdlp. Disable Sw. parameter is Active.
   - If not the specified value, test the signal circuit for a short to voltage or and open/high resistance. If the circuit tests normal, replace the BCM.
7. If all circuits test normal, test or replace the headlamp switch.

Turn Signal/Multifunction Switch Malfunction

1. Ignition OFF, disconnect the (C2) harness connector at the turn signal/multifunction switch.
2. Ignition OFF, test for less than 5.0 ohms of resistance between the ground circuit terminal D and ground.
   - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool Flash to Pass Switch parameter is Inactive.
   - If not the specified value, test the signal circuit terminal A for a short to ground. If the circuit tests normal, replace the BCM.
4. Verify the scan tool High Beam Select Switch parameter is Inactive.
   - If not the specified value, test the signal circuit terminal E for a short to ground. If the circuit tests normal, replace the BCM.
5. Install a 3A fused jumper wire between the signal circuit terminal A and ground. Verify the scan tool Flash to Pass Switch parameter is Active.
   - If not the specified value, test the signal circuit for a short to voltage or and

open/high resistance. If the circuit tests normal, replace the BCM.

6. Install a 3A fused jumper wire between the signal circuit terminal E and ground. Verify the scan tool High Beam Select Switch parameter is Active.
    - If not the specified value, test the signal circuit for a short to voltage or and open/high resistance. If the circuit tests normal, replace the BCM.
7. If all circuits test normal, test or replace the turn signal/multifunction switch.

Low Beam Headlamp Malfunction

1. Ignition OFF, disconnect the (C4) harness connector at the underhood fuse block.
2. Ignition ON, headlamps off, verify a test lamp does not illuminate between the control circuit terminal H2 and B+.
    - If the test lamp illuminates, test the control circuit for a short to ground. If the circuit tests normal, replace the BCM.
3. Ignition OFF, connect the (C4) harness connector at the underhood fuse block.
4. Disconnect the (C3) harness connector at the underhood fuse block.
5. Ignition ON, verify a test lamp does not illuminate between the control circuit terminal B2 and ground.
    - If the test lamp illuminates, test the supply voltage circuit for a short to B+. If the circuit tests normal, replace the underhood fuse block.
6. Ignition OFF, disconnect the (C2) harness connector at the underhood fuse block.
7. Connect a test lamp between the control circuit terminal A5 and B+.
8. Ignition ON, command the Low Beams ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
    - If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the BCM.
    - If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
9. Ignition OFF, connect the harness connectors at the underhood fuse block. Disconnect the harness connector at the affected low beam headlamp bulb.
10. Ignition OFF, test for less than 1.0 ohm of resistance between the ground circuit terminal B and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
11. Connect a test lamp between the supply voltage circuit terminal A and ground.
12. Ignition ON, command the Low Beams ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
    - If the test lamp is always ON, test the supply voltage circuit for a short to voltage. If the circuit tests normal, replace the underhood fuse block.

   - If the test lamp is always OFF, test the supply voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the underhood fuse block.
13. If all circuits test normal, test or replace the affected low beam headlamp bulb.

High Beam Headlamp Malfunction

1. Ignition OFF, disconnect the (C2) harness connector at the underhood fuse block.
2. Connect a test lamp between the control circuit terminal C6 and B+.
3. Ignition ON, command the High Beams ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
   - If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the BCM.
   - If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.
4. Ignition OFF, connect the harness connector at the underhood fuse block. Disconnect the harness connector at the affected high beam headlamp bulb.
5. Ignition OFF, test for less than 1.0 ohm of resistance between the ground circuit terminal B and ground,
   - If greater than the specified range, test the ground circuit for an open/high resistance.
6. Connect a test lamp between the supply voltage circuit terminal A ground ground.
7. Ignition ON, Command the High Beams ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
   - If the test lamp is always ON, test the supply voltage circuit for a short to voltage. If the circuit tests normal, replace the underhood fuse block.
   - If the test lamp is always OFF, test the supply voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the underhood fuse block.
8. If all circuits test normal, test or replace the affected high beam headlamp bulb.

Component Test

Headlamp Switch

1. Ignition OFF, disconnect the harness connector at the headlamp switch.
2. Test for infinite resistance between the signal terminal 3 and the ground terminal 8 with the switch in the Auto position.
   - If not the specified value, replace the headlamp switch.
3. Test for infinite resistance between the signal terminal 1 and the ground terminal 8 with the switch in the Auto position.

   - If not the specified value, replace the headlamp switch.
4. Test for less than 2.0 ohms of resistance between the signal terminal 3 and the ground terminal 8 with the switch in the Off position.
   - If not the specified value, replace the headlamp switch.
5. Test for less than 2.0 ohms of resistance between the signal terminal 1 and the ground terminal 8 with the switch in the Headlamp position.
   - If not the specified value, replace the headlamp switch.

Turn Signal/Multifunction Switch

1. Ignition OFF, disconnect the harness connector C2 at the turn signal/multifunction switch.
2. Test for infinite resistance between the signal terminal A and the ground terminal D with the flash to pass switch in the open position.
   - If not the specified value, replace the turn signal/multifunction switch.
3. Test for infinite resistance between the signal terminal E and the ground terminal D with the headlamp dimmer switch in the low beam position.
   - If not the specified value, replace the turn signal/multifunction switch.
4. Test for less than 2.0 ohms of resistance between the signal terminal A and the ground terminal D with the flash to pass switch in the closed position.
   - If not the specified value, replace the turn signal/multifunction switch.
5. Test for less than 2.0 ohms of resistance between the signal terminal E and the ground terminal D with the headlamp dimmer switch in the high beam position.
   - If not the specified value, replace the turn signal/multifunction switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**
- **Headlamp Bulb Replacement**
- **MULTIFUNCTION, TURN SIGNAL SWITCH REPLACEMENT**
- **UNDERHOOD ELECTRICAL CENTER OR JUNCTION BLOCK REPLACEMENT**
- **Control Module References** for ECM replacement, setup, and programming

HEADLAMPS ALWAYS ON - LOW OR HIGH BEAM

Headlamps Always On - Low or High Beam

Step	Action	Yes	No
Schematic Reference: Headlights/Daytime Running Lights (DRL) Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Turn the headlamp switch to the OFF position. Do the low and high beam headlamps remain OFF?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Remove the appropriate component either the headlamp module for low beams or HI BEAM relay for high beams. Do the lamps turn OFF?	Go to **Step 5**	Go to **Step 4**
4	Repair a short to battery positive voltage in the supply circuit of the affected headlamps. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 13**	-
5	1. Reinstall the appropriate component. 2. Disconnect the lamp switch assembly. Do the headlamps turn OFF?	Go to **Step 12**	Go to **Step 6**
6	Are the high beam headlamps on at all times?	Go to **Step 7**	Go to **Step 8**
7	Test for a short to ground in FTP circuit and the headlamp dimmer switch high beam signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**
8	Test for a short to ground in the headlamp switch ON signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**
9	Disconnect the body control module (BCM) connector C1. Do the headlamps turn OFF?	Go to **Step 14**	Go to **Step 10**
10	Test for a short to ground in the affected low or high beam relay control circuit. Refer to **Circuit Testing** and **Wiring**		

	Repairs . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 11**
11	Replace the appropriate headlamp module or HI BEAM relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	Go to **Step 14**	-
12	Replace the lamp switch assembly. Refer to **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**. Did you complete the replacement?	Go to **Step 14**	-
13	Replace the BCM. Refer to **Control Module References** for replacement, setup and programming. Did you complete the replacement?	Go to **Step 14**	-
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

HEADLAMPS INOPERATIVE - HIGH BEAMS

Headlamps Inoperative - High Beams

Step	Action	Yes	No
Schematic Reference: Headlights/Daytime Running Lights (DRL) Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn ON the headlamps. 2. Ensure that the headlamp dimmer switch is in the HIGH position. Do the high beams illuminate?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Is only one high beam headlamp inoperative?	Go to **Step 15**	Go to **Step 4**
4	Place the headlamp dimmer switch in to the FTP position. Do the high beam headlamps illuminate?	Go to **Step 7**	Go to **Step 5**
	1. Disconnect the body control module		

5	(BCM) connector C1. 2. Connect a jumper between the headlamp high beam relay control circuit and ground. Do the high beam headlamps illuminate?	Go to **Step 9**	Go to **Step 6**
6	1. Remove the HI BEAM relay. 2. Install a fused jumper between the battery positive voltage supply circuit and the switched high beam voltage supply circuit. Do the high beam headlamps illuminate?	Go to **Step 10**	Go to **Step 14**
7	1. Disconnect the multifunction switch. 2. Connect a jumper between the headlamp dimmer switch high beam signal circuit and ground. Do the high beam headlamps illuminate?	Go to **Step 12**	Go to **Step 8**
8	Test for poor connection, short to battery positive voltage or an open in the headlamp dimmer switch high beam signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 20**
9	1. Reconnect the BCM connector C1. 2. Disconnect the multifunction switch. 3. Connect a jumper between the headlamp dimmer switch high beam signal circuit and ground. Do the headlamps illuminate?	Go to **Step 11**	Go to **Step 20**
10	Test for a short to battery positive voltage, a poor connection or an open in the headlamp high beam relay control circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 13**
11	Test for a poor connection or an open in the ground circuit of the turn signal/multifunction switch. Refer to		

	Circuit Testing and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 12**
12	Inspect for a poor connection at the harness connector of the multifunction turn signal switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 16**
13	Inspect for a poor connection at the harness connector of the HI BEAM relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 17**
14	Inspect for a poor connection at the harness connectors of the underhood fuse block. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 18**
15	Inspect the inoperative high beam headlamp battery positive voltage supply and ground circuit for the following: • An open • A high resistance • A short to ground Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 19**
16	Replace the multifunction turn signal switch. Refer to **Multifunction, Turn Signal Switch Replacement** . Did you complete the replacement?	Go to **Step 21**	-
17	Replace the HI BEAM relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	Go to **Step 21**	-
	Replace the underhood fuse block. Refer to		

18	**Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the repair?	Go to **Step 21**	-
19	Replace the inoperative high beam headlamp. Refer to **Headlamp Replacement (Impala)** or **Headlamp Bulb Replacement**. Did you complete the replacement?	Go to **Step 21**	-
20	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming.	Go to **Step 21**	-
21	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

HEADLAMPS INOPERATIVE - LOW BEAMS

Headlamps Inoperative - Low Beams

Step	Action	Yes	No
Schematic Reference: Headlights/Daytime Running Lights (DRL) Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn ON the headlamps. 2. Ensure that the headlamp dimmer switch is in the LOW position. Do both low beam headlamps illuminate?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Is only one low beam headlamp inoperative?	Go to **Step 13**	Go to **Step 4**
4	1. Disconnect the lamps switch assembly. 2. Install a jumper between the headlamp switch headlamps ON signal circuit and ground. Do the low beam headlamps illuminate?	Go to **Step 9**	Go to **Step 5**
	Test for a poor connection, an open, or a short to battery positive voltage in the		

5	headlamp switch headlamps ON signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 6**
6	- Reconnect the lamp switch assembly. - Disconnect the body control module (BCM) connector C1. - Install a jumper between the headlamp module control circuit and ground. Do the low beam headlamps illuminate?	Go to **Step 18**	Go to **Step 7**
7	1. Remove the headlamp module. 2. Install a fused jumper between battery positive voltage and the switched low beam voltage supply circuit. Do the low beam headlamps illuminate?	Go to **Step 8**	Go to **Step 11**
8	Test for the following in the headlamp module control circuit: - An open - A poor connection - A short to ground Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 10**
9	Inspect for a poor connection at the harness connector of the lamp switch assembly. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 14**
10	Inspect for a poor connection at the headlamp module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 15**
	Test for a short to ground in the low beam		

11	voltage supply circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 12**
12	Inspect for a poor connection at the harness connector of the underhood fuse block. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 17**
13	Inspect the inoperative low beam headlamp voltage supply and ground circuit for a high resistance, a short to ground, or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 16**
14	Replace the lamp switch assembly. Refer to **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**. Did you complete the replacement?	Go to **Step 19**	-
15	Replace the headlamp module. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	Go to **Step 19**	-
16	Replace the inoperative low beam headlamp. Refer to **Headlamp Replacement (Impala)** or **Headlamp Bulb Replacement**. Did you complete the replacement?	Go to **Step 19**	-
17	Replace the underhood fuse block. Refer to **Testing for Intermittent Conditions and Poor Connections** . Did you complete the replacement?	Go to **Step 19**	-
18	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 19**	-
19	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

HEADLAMPS INOPERATIVE - FLASH TO PASS

Headlamps Inoperative - Flash to Pass

Step	Action	Yes	No
Schematic Reference: Headlights/Daytime Running Lights (DRL) Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Turn the ignition to the ON position. 2. Turn the headlamp switch to the OFF position. 3. Place the headlamp dimmer switch in the flash to pass position. Do the high beam headlamps illuminated during flash to pass operation?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	1. Turn the headlamp switch to the HEAD position. 2. Place the headlamp dimmer switch in the high beam position. Are the high beam headlamps operating properly?	Go to **Step 4**	Go to **Headlamps Inoperative - High Beams**
4	1. Disconnect the multifunction turn signal switch. 2. Connect a jumper between the flash to pass switch signal circuit and ground. Do the high beam headlamps illuminate?	Go to **Step 5**	Go to **Step 6**
5	Inspect for poor connections at the harness connector of the multifunction switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 8**	Go to **Step 7**
6	Repair a high resistance, open, or a short to battery positive voltage in the flash to pass switch signal circuit of the headlamp		

	dimmer switch. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 8**	-
7	Replace the multifunction turn signal switch. Refer to **Multifunction, Turn Signal Switch Replacement** in Steering Wheel and Column. Did you complete the repair?	Go to **Step 8**	-
8	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

ILLUMINATED ENTRY LAMPS INOPERATIVE

Illuminated Entry Lamps Inoperative

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems DEFINITION: Courtesy lamps are inoperative from the key fob.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Turn OFF the ignition. 2. Lock all of the vehicle doors. 3. Close all of the vehicle doors. 4. Wait 20 seconds. 5. Press the unlock button on the remote keyless entry transmitter. Do the courtesy lamps illuminate?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	Does the driver door unlock?	Go to **Step 4**	Go to **Symptoms - Keyless Entry** in Keyless Entry
4	Replace the body control module (BCM). Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming.		-

	Did you complete the replacement?	Go to **Step 5**	
5	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

INTERIOR BACKLIGHTING MALFUNCTION

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Diagnostic Fault Information

DTC's

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
I/P Dimming Voltage Reference	B1395 03, B3600 03	B1395 03	1, 2	-
Instrument Panel Lamps Dimmer Switch Signal	B3600 03	B3600 03	1, 2	-
Instrument Panel Lamp Supply Voltage	B2652 00	1	1	-
Headlamp Switch Ground	B2610 00	2	2	-
Turn Signal/Multifunction Switch Ground	-	3	-	-

1. Instrument Panel Lamps Malfunction
2. LED Malfunction
3. Headlamps and Dimmer Switch Malfunction

Circuit/System Description

The BCM supplies a voltage reference through the instrument panel (I/P) dimming voltage reference circuit to the interior lamp dimmer switch, which is part of the headlamp switch. When the dimmer switch is placed in a desired brightness position, reference voltage is applied through the dimmer switch rheostat and the I/P lamps dimmer switch signal circuit to the BCM. The BCM interprets this voltage signal, then applies a pulse width modulated (PWM) voltage through the instrument panel lamp supply voltage circuit, the backlight lamp control circuit, and the LED dimming supply circuit illuminating the LED and I/P panel lamps. For more detailed information concerning interior lamp operation refer to **Interior Lighting Systems Description and Operation**.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

1. Ignition ON, observe the scan tool Dimming Control Signal parameter while operating the dimmer switch from high to low. The reading should change from a high percent to a low percent as the switch is rotated.
    - If the reading does not change, refer to **Dimmer Switch Circuit Test**.
    - If the scan tool dimmer control operates normal, refer to **Interior Backlighting Circuit Test**.

Circuit/System Testing

Dimmer Switch Circuit Test

1. Ignition OFF, disconnect the harness connector at the headlamp switch.
2. Ignition OFF, verify that a test lamp illuminates between the ground circuit terminal 8 and B+.
    - If the test lamp does not illuminate, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool Dimming Control Signal parameter is less than 0.1 volts.
    - If greater than the specified range, test the signal circuit terminal 13 for a short to

voltage. If the circuit tests normal, replace the BCM.

4. Ignition ON, test for B+ between the voltage reference circuit terminal 15 and ground.
    - If less than the specified value, test the voltage reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
5. Install a 3A fused jumper wire between the signal circuit terminal 13 and the voltage reference circuit terminal 15. Verify the scan tool Dimming Control Signal parameter is greater than 2.6 volts.
    - If less than the specified range, test the signal circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
6. If all circuits test normal, test or replace the headlamp switch.

Interior Backlighting Circuit Test

1. Ignition OFF, disconnect the harness connector at the component with the inoperative backlighting.
2. Test for less than 5.0 ohms of resistance between the appropriate ground circuit terminal listed below and ground.
    - Headlamp Switch terminal 8
    - Instrument Panel Cluster (IPC) terminal 6
    - Driver Window Switch terminal F
    - Driver Door Lock Switch terminal F
    - Outside Rearview Mirror Switch terminal B
    - Passenger Window Switch terminal C
    - Passenger Door Lock Switch terminal F
    - Radio terminal 8 C1
    - HVAC Control Module terminal 10 C1
    - Driver Information Display Switch terminal 5
    - Left Steering Wheel Controls terminal 8
    - Right Steering Wheel Controls terminal 1
        - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Connect a test lamp between the appropriate supply voltage circuit terminal listed below and ground.
    - Headlamp Switch terminal 7
    - Instrument Panel Cluster (IPC) terminal 8
    - Driver Window Switch terminal B
    - Driver Door Lock Switch terminal G
    - Outside Rearview Mirror Switch terminal E

  - Passenger Window Switch terminal B
  - Passenger Door Lock Switch terminal G
  - Radio terminal 7 C1
  - HVAC Control Module terminal 1 C1
  - Driver Information Display Switch terminal 4
  - Left Steering Wheel Controls terminal 6
  - Right Steering Wheel Controls terminal 2

4. Ignition ON, command the appropriate Incandescent Dimming or LED Dimming ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
    - If not the specified value, test the signal circuit terminal E for a short to ground. If the circuit tests normal, replace the BCM.
    - If the test lamp is always ON, test the supply voltage circuit for a short to voltage. If the circuit tests normal, replace the BCM.
5. If all circuits test normal, test or replace the component with the inoperative backlighting.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**
- **POWER DOOR LOCK SWITCH REPLACEMENT (IMPALA)** or **POWER DOOR LOCK SWITCH REPLACEMENT (MONTE CARLO)**
- **POWER MIRROR SWITCH REPLACEMENT (IMPALA)** or **POWER MIRROR SWITCH REPLACEMENT (MONTE CARLO)**
- **Steering Wheel Control Switch Assembly Replacement**
- **Control Module References** for ECM replacement, setup, and programming

INTERIOR BACKLIGHTING DOES NOT DIM

Interior Backlighting Does Not Dim

Step	Action	Yes	No
Schematic Reference: Interior Lights Dimming Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?		Go to **Diagnostic System Check -**

		Go to **Step 2**	**Vehicle**
2	Verify that the interior backlighting does not dim. Does the interior backlighting operate normally?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Do the instrument panel (I/P) lamps dim?	Go to **Step 13**	Go to **Step 4**
4	Do the class 2 lamps dim?	Go to **Step 5**	Go to **Step 6**
5	Test for a short to battery positive voltage in the I/P lamps supply voltage circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
6	Disconnect the lamp switch assembly. Does all the illumination of the backlight components turn OFF?	Go to **Step 8**	Go to **Step 7**
7	Test for a short to battery positive voltage on the I/P dimming control circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 8**
8	Test for a poor connection, an open, or a short to ground in the I/P dimming control circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 9**
9	Test for a poor connection or an open in the I/P dimming return circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
10	1. Reconnect the lamp switch assembly. 2. Disconnect the body control module (BCM) connector C1. 3. Using a DMM, measure the resistance between the I/P dimming voltage reference circuit and the I/P dimming control circuit. 4. Vary the I/P dimming switch from full bright to full dim. Does the DMM, display change?	Go to **Step 13**	Go to **Step 11**
	Test for an open or a short to battery		

11	positive voltage in the I/P dimming voltage reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
12	Replace the lamp switch assembly. Refer to **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**. Did you complete the replacement?	Go to **Step 14**	-
13	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 14**	-
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

INTERIOR BACKLIGHTING INOPERATIVE

Interior Backlighting Inoperative

Step	Action	Yes	No
Schematic Reference: Interior Lights Dimming Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn the ignition to the ON position. 2. Turn the headlamp switch to the PARK position. 3. Turn the instrument panel (I/P) lamp dimmer switch to a high position. Are all of the interior backlighting lamps inoperative?	Go to **Step 3**	Go to **Step 5**
3	Are all of the class 2 dimming lamps inoperative?	Go to **Step 17**	Go to **Step 4**
4	Is one of the class 2 dimming lamp inoperative?	Go to **Step 19**	Go to **Testing for Intermittent Conditions and Poor Connections**
	Are all of the instrument panel lamps		

5	inoperative?	Go to **Step 13**	Go to **Step 6**
6	Are any of the steering wheel control lamps inoperative?	Go to **Step 7**	Go to **Step 15**
7	Is one steering wheel control switch illuminated?	Go to **Step 9**	Go to **Step 8**
8	1. Remove both steering wheel control switches. 2. Probe the I/P lamp supply voltage circuit of each switch with a test lamp connected to ground. Refer to **Circuit Testing** . Does the test lamp illuminate a each supply circuit?	Go to **Step 11**	Go to **Step 10**
9	1. Remove the inoperative switch. 2. Probe the I/P lamp supply voltage circuit of the inoperative switch with a test lamp connected to ground. Refer to **Circuit Testing** . Does the test lamp illuminate?	Go to **Step 11**	Go to **Step 10**
10	Repair a high resistance or an open in the I/P lamp supply voltage circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 22**	Go to **Step 16**
11	Test for a high resistance or an open in the I/P lamp ground circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 22**	Go to **Step 16**
12	1. Disconnect the lamp switch assembly. 2. Install a fused jumper between the I/P dimming voltage reference circuit and the instrument panel lamps dimming control circuit. Do the instrument panel lamps turn on?	Go to **Step 20**	Go to **Step 21**
13	Inspect the instrument panel lamps dimming control circuit for a short to battery positive voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 14**

14	Inspect the I/P dimming voltage reference circuit and the I/P dimming return circuit for a short to battery positive voltage. Refer to **Circuit Testing** and**Wiring Repairs** . Did you find and correct the condition?	Go to **Step 22**	Go to **Step 12**
15	Inspect for a high resistance or an open in the inoperative instrument panel lamp supply voltage circuit or the ground circuit. Refer to **Circuit Testing** and**Wiring Repairs** . Did you find and correct the condition?	Go to **Step 22**	Go to **Step 19**
16	Inspect for a poor connection at the harness connector of the steering wheel control switches. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 22**	Go to **Step 18**
17	Test for a short to ground in the I/P lamp supply voltage circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 22**	Go to **Step 21**
18	Replace the inoperative switch. Refer to **Steering Wheel Control Switch Assembly Replacement** . Did you complete the repair?	Go to **Step 22**	-
19	Replace the inoperative component or bulb. Did you complete the repair?	Go to **Step 22**	-
20	Replace the lamp switch assembly. Refer to **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**. Did you complete the repair?	Go to **Step 22**	-
21	Replace the body control module (BCM). Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 22**	-
22	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 5**

INSTRUMENT PANEL (I/P) COMPARTMENT LAMP INOPERATIVE

Instrument Panel (I/P) Compartment Lamp Inoperative

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn ON the ignition, with the engine OFF. 2. Disconnect the instrument panel (I/P) compartment lamp and switch. 3. Connect a test lamp between the courtesy lamps supply voltage circuit of the I/P compartment lamp and switch connector and a ground. Does the test lamp illuminate?	Go to **Step 3**	Go to **Step 4**
3	Connect a test lamp between battery positive voltage and the ground circuit of the I/P compartment lamp switch connector. Does the test lamp illuminate?	Go to **Step 6**	Go to **Step 5**
4	Repair the poor connection, open or short to ground in the courtesy lamps supply voltage circuit of the I/P compartment lamp. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 7**	-
5	Repair the poor connection, or an open in the ground circuit of the I/P compartment lamp. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 7**	-
6	Replace the I/P compartment lamp and switch. Did you complete the replacement?	Go to **Step 7**	-
7	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

INSTRUMENT PANEL (I/P) COMPARTMENT LAMP ALWAYS ON

Instrument Panel (I/P) Compartment Lamp Always On

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Master Electrical Component List**			

1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Verify that the instrument panel (I/P) compartment door closes properly. Does the I/P compartment door close properly?	Go to **Step 4**	Go to **Step 3**
3	Adjust or repair the I/P compartment door. Refer to **Latch Replacement - Instrument Panel (I/P) Compartment (Impala)** or **Latch Replacement - Instrument Panel (I/P) Compartment (Monte Carlo)** . Did you complete the repair?	Go to **Step 5**	-
4	Replace the I/P compartment lamp and switch. Did you complete the replacement?	Go to **Step 5**	-
5	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

PARK, LICENSE, AND/OR TAIL LAMPS MALFUNCTION

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Diagnostic Fault Information

DTC's

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Park Lamp Relay Control	B2585	B2585	B2585	-
Park Lamp Switch On Signal	B257A	B257A	B257A	-
Left Park Lamp Control	3	3	3	-
Right Park Lamp Control	4	4	4	-
Left Park Lamp Ground	-	3	3	-
	Right Park Lamp Ground	-	4	-
Headlamp Switch Ground	-	B257A	B257A	-

1. All Park Lamps Inoperative
2. All Park Lamps Always On
3. Left Park Lamps Malfunction
4. Right Park Lamps Malfunction

Circuit/System Description

The vehicle park, license, and tail lamps are controlled by the body control module (BCM) based on an input from the headlamp switch. The headlamp switch has four positions: Off, Auto, Park, and Headlamps. The default headlamp switch position is Auto, in which the BCM uses the ambient light sensor to determine when exterior lamps are needed. The Off portion of the headlamp switch is a momentary switch which overrides the automatic lamps and will turn off the vehicle lamps. The Park position of the headlamp switch will only illuminate the vehicle parking lamps. The Headlamp position of the headlamp switch will illuminate both the parking lamps, as well has the headlamps. With the headlamp switch in the Park position, the park lamp switch on signal circuit is grounded, prompting the BCM to turn on the exterior lamps, regardless of other factors such as ambient light.

When a park lamp request is received, the BCM grounds the park lamp relay control circuit. This energizes the coil in the PARK LP PCB relay, causing the relay switch to close. This then applies B+ to the left and right exterior lamps through the LT PARK and RT PARK fuses, illuminating the exterior lamps.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**

- **Scan Tool Data Definitions**

Circuit/System Verification

1. Ignition ON, observe the scan tool BCM Parklamp Switch parameter while cycling the headlamp switch between the Park and Off positions. The parameter should cycle between Active and Inactive.
    - If the parameter does not cycle between the specified values, refer to **Headlamp Switch Circuit Malfunction**.
2. Command the Parking Lamps ON and OFF with a scan tool. Verify the park, license, and tail lamps turn ON and OFF.
    - If any of the lamps do not cycle between the commanded states, refer to **Exterior Lamps Circuit Malfunction**.

Circuit/System Testing

Headlamp Switch Circuit Malfunction

1. Ignition OFF, disconnect the harness connector at the headlamp switch.
2. Ignition OFF, test for less than 1.0 ohm of resistance between the ground circuit terminal 8 and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool BCM Parklamp Switch parameter is Inactive.
    - If not the specified value, test the signal circuit terminal 2 for a short to ground. If the circuit tests normal, replace the BCM.
4. Install a 3A fused jumper wire between the signal circuit terminal 2 and ground. Verify the scan tool BCM Parklamp Switch parameter is Active.
    - If not the specified value, test the signal circuit for a short to voltage or and open/high resistance. If the circuit tests normal, replace the BCM.
5. If all circuits test normal, test or replace the headlamp switch.

Exterior Lamps Circuit Malfunction

1. Ignition OFF, disconnect the harness connector C2 at the underhood fuse block.
2. Connect a test lamp between the control circuit terminal K2 and B+.
3. Command the Park Lamps ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
    - If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the BCM.
    - If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the BCM.

4. Ignition OFF, disconnect the harness connector at the affected exterior lamp.
5. Ignition OFF, test for less than 1.0 ohm of resistance between the affected lamp ground circuit terminal and ground.
    - Marker Lamp, Tail Lamp, or License Lamp - Terminal B
    - Tail/Stop and Turn Signal Lamp or Park/Turn Signal Lamp - Terminal G
    - If greater than the specified range, test the ground circuit for an open/high resistance.
6. Connect a test lamp between the affected lamp control circuit terminal and ground.
    - Marker Lamp, Tail Lamp, or License Lamp - Terminal A
    - Tail/Stop and Turn Signal Lamp or Park/Turn Signal Lamp - Terminal B
7. Ignition ON, Command the Park Lamps ON and OFF with a scan tool. The scan tool should turn ON and OFF when changing between the commanded states.
    - If the test lamp is always ON, test the control circuit for a short to voltage. If the circuit tests normal, replace the underhood fuse block.
    - If the test lamp is always OFF, test the control circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the underhood fuse block.
    - If the test lamp is OFF and the circuit fuse is open, test the control circuit for a short to ground. If the circuit tests normal, replace the affected lamp bulb.
8. If all circuits test normal, test or replace the affected lamp bulb.

Component Testing

Headlamp Switch

1. Ignition OFF, disconnect the harness connector at the headlamp switch.
2. Test for less than 2.0 ohms of resistance between the signal terminal 2 and the ground terminal 8 with the switch in the Park position.
    - If not the specified value, replace the headlamp switch.
3. Test for less than 2.0 ohms of resistance between the signal terminal 2 and the ground terminal 8 with the switch in the Headlamp position.
    - If not the specified value, replace the headlamp switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**
- **Headlamp Bulb Replacement**
- **Tail Lamp Bulb Replacement**

- **Turn Signal Lamp Bulb Replacement - Rear**
- **License Lamp Replacement (Monte Carlo)** or **License Lamp Replacement (Impala)**
- **UNDERHOOD ELECTRICAL CENTER OR JUNCTION BLOCK REPLACEMENT**
- **Control Module References** for ECM replacement, setup, and programming

PARK, LICENSE, AND TAIL LAMPS ALWAYS ON

Park, License, and Tail Lamps Always On

Step	Action	Yes	No
Schematic Reference: Exterior Lights Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn OFF the ignition. 2. Turn the headlamp switch to the OFF position. Do the park lamps operate properly?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Disconnect the lamp switch assembly. Are the park lamps illuminated?	Go to **Step 4**	Go to **Step 11**
4	Test for a short to ground in the park lamp ON signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 5**
5	Test for the following in the exterior lamps OFF input circuit: • An open • A short to battery positive voltage • A short to ground Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 6**
6	The PK LP relay is located on the reverse side of the I/P fuse block.		

	Remove the PK LP relay. Do the park lamps turn OFF?	Go to **Step 7**	Go to **Step 10**
7	1. Reconnect the lamp switch assembly. 2. Turn the headlamp switch to the OFF position. 3. Using a test lamp connected to battery positive voltage, probe the park lamp relay control circuit at the I/P fuse block. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 9**
8	Test for a short to ground in the park lamp relay control circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 12**
9	Replace the PK LP relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	Go to **Step 13**	-
10	Repair a short to battery positive voltage in the park lamp voltage supply circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you complete the repair?	Go to **Step 13**	-
11	Replace the lamp switch assembly. Refer to **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**. Did you complete the repair?	Go to **Step 13**	-
12	Replace the body control module (BCM). Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 13**	-
13	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

PARK, LICENSE, AND TAIL LAMPS INOPERATIVE

Park, License, and Tail Lamps Inoperative

Step	Action	Yes	No
Schematic Reference: Exterior Lights Schematics			

Connector End View Reference: **Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Verify that the park, license, and tail lamps are inoperative. Do the park, license, and tail lamps operate normally?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Are all park, license, and tail lamps inoperative?	Go to **Step 6**	Go to **Step 4**
4	Test the voltage supply circuit of the inoperative lamp for high resistance or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 5**
5	Test the ground circuit of the inoperative lamp for high resistance or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 15**
6	The PK LP relay is located on the reverse side of the I/P fuse block. 1. Remove the PK LP relay. 2. Install a jumper between the coil side supply circuit and the switch side circuit of the PK LP relay. Do the park lamps illuminate?	Go to **Step 7**	Go to **Step 14**
7	1. Remove the jumper. 2. Reinstall the PK LP relay. 3. Disconnect the body control module (BCM) connector C1. 4. At the BCM connector, install a jumper between the park lamp relay control circuit and ground. Do the park lamps illuminate?	Go to **Step 9**	Go to **Step 8**
	Test for a poor connection or a short to battery positive voltage open in the park		

8	lamp relay control circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 16**
9	1. Reconnect the BCM connector C1. 2. Disconnect the lamp switch assembly. 3. At the lamp switch assembly connector, install a jumper between the park lamp switch ON signal circuit and ground. Do the park lamps illuminate?	Go to **Step 10**	Go to **Step 12**
10	Test for a short to ground in the exterior lamps OFF input circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 11**
11	Inspect for poor connections at the harness connector of the multifunction turn signal switch. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 17**
12	Test for a poor connection, an open, or a short to battery positive in the park lamp switch on the signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 13**
13	Inspect for poor connections at the harness connector of the BCM. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 19**	Go to **Step 18**
14	Repair a short to ground, an open, or a poor connection in the park lamp supply voltage circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you complete the repair?	Go to **Step 19**	-
15	Replace the inoperative bulb. Did you complete the replacement?	Go to **Step 19**	-
16	Replace the PK LP relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the repair?	Go to **Step 19**	-

17	Replace the lamp switch assembly. Refer to **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)**. Did you complete the repair?	Go to **Step 19**	-
18	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 19**	-
19	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

READING LAMP(S) ALWAYS ON

Reading Lamp(s) Always On

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Close all of the doors. 2. Turn ON the ignition, with the engine OFF. 3. Place the appropriate reading lamp switch in the OFF position. Does the reading lamp remain illuminated?	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems
3	Replace the appropriate reading lamp. Refer **Reading Lamp Bulb Replacement**. Did you complete the replacement?	Go to **Step 4**	-
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

READING LAMP(S) INOPERATIVE

Reading Lamp(s) Inoperative

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Place the inoperative reading lamp in the ON position. Does the reading lamp operate properly?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	Does the courtesy lamp function of the inoperative reading lamp operate properly?	Go to **Step 4**	Go to **Courtesy Lamps Inoperative**
4	1. Disconnect the inoperative reading switch. 2. Using a test lamp connected to battery positive voltage, probe the ground circuit of the reading lamp switch. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 7**
5	Test for a poor connection or an open in the reading lamp supply voltage circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 6**
6	Inspect for poor connections at the harness connector of the reading lamp. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 8**
7	Repair an open or high resistance in the ground circuit of the reading lamp switches. Refer to **Circuit Testing** and to **Wiring Repairs** in Wiring Systems. Did you correct the condition?	Go to **Step 9**	-

8	Replace the inoperative reading lamp. Refer to **Reading Lamp Bulb Replacement**. Did you complete the replacement?	Go to **Step 9**	-
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

REAR COMPARTMENT LAMP(S) ALWAYS ON

Rear Compartment Lamp(s) Always On

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Open and close the rear compartment. Does the courtesy lamp rear compartment operate properly?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Test the rear compartment lamp switch low control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 5**	Go to **Step 4**
4	Replace the rear compartment lid ajar switch. Did you complete the replacement?	Go to **Step 5**	-
5	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

REAR COMPARTMENT LAMP(S) INOPERATIVE

Rear Compartment Lamp(s) Inoperative

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
	Did you perform the Diagnostic System		Go to

1	Check - Vehicle?	Go to **Step 2**	**Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Open the rear compartment. Does the rear compartment courtesy lamp operate properly?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	Place the instrument panel (I/P) dimmer switch in the DOME position. Do the courtesy lamps operate properly?	Go to **Step 4**	Go to **Courtesy Lamps Inoperative**
4	1. Disconnect the rear compartment courtesy lamp. 2. Connect a test lamp between the supply voltage circuit and the rear compartment lamp low control circuit of the rear compartment courtesy lamp. Did the test lamp illuminate?	Go to **Step 8**	Go to **Step 5**
5	Connect a test lamp between the inadvertent power courtesy lamp circuit of the rear compartment courtesy lamp and ground. Did the test lamp illuminate?	Go to **Step 6**	Go to **Step 11**
6	1. Disconnect the rear compartment lid ajar switch. 2. Connect a test lamp between battery positive voltage and the ground circuit of the rear compartment lid ajar switch. Did the test lamp illuminate?	Go to **Step 7**	Go to **Step 12**
7	Connect a fused jumper between the ground circuit and the rear compartment courtesy lamp switch low control circuit of the rear compartment lid ajar switch. Does the rear compartment lamp illuminate?	Go to **Step 9**	Go to **Step 10**

8	Inspect for poor connections at the bulb of the rear compartment courtesy lamp. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 15**	Go to **Step 13**
9	Inspect for poor connections at the harness connector of the rear compartment lid ajar switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 15**	Go to **Step 14**
10	Repair the high resistance or an open in the rear compartment courtesy lamp switch low control circuit of the rear compartment ajar switch. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 15**	-
11	Repair the high resistance or an open in the inadvertent power courtesy lamp circuit of the rear compartment courtesy lamp. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 15**	-
12	Repair the high resistance or an open in the ground circuit of the rear compartment lid ajar switch. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 15**	-
13	Replace the rear compartment courtesy lamp bulb. Refer to **Rear Compartment Lamp Replacement**. Did you complete the repair?	Go to **Step 15**	-
14	Replace the rear compartment lid ajar switch. Refer to **Latch Replacement - Rear Compartment Lid** in Body Rear End. Did you complete the repair?	Go to **Step 15**	-
15	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

STOP LAMPS MALFUNCTION

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Diagnostic Fault Information

DTC's

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Position Sensor 5-Volt Reference	C0277 06, C0890 03	C0277 06	C0277 06	-
Stop Lamp Switch Signal	C0277 06	C0277 06	C0277 07	C0277 09, C0277 4B
Brake Position Sensor Low Reference	-	C0277 06		-
CHMSL Supply Voltage	B3445 00	5	6	-
Left Rear Stop/Turn Lamp Supply Voltage	B3950 00, 1	1	2	-
Right Rear Stop/Turn Lamp Supply Voltage	B3951 00, 3	3	4	-
Center High Mounted Stop Lamp (CHMSL) Ground	-	5	-	-
Left Rear Stop/Turn Lamp Ground	-	1	-	-
Right Rear Stop/Turn Lamp Ground	-	3	-	-

1. Left stop/turn lamp inoperative
2. Left stop/turn lamp always On
3. Right stop/turn lamp inoperative
4. Right stop/turn lamp always On
5. Center high mounted stop lamp (CHMSL) inoperative
6. Center high mounted stop lamp (CHMSL) always On

Circuit/System Description

The brake pedal position sensor is used to sense the action of the driver application of the brake pedal. The brake pedal position sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the brake pedal position sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery positive voltage to the stop lamps, center high mounted stop lamp (CHMSL), transmission control module (TCM), and engine control module (ECM). The stop lamps will not operate unless the ignition is in the ON position. Ground for both rear stop lamp/turn signals is provided by G302.

Diagnostic Aids

IMPORTANT: The stop lamps will not illuminate unless the ignition is in the ON position. For more detailed information concerning stop lamp operation, refer to Exterior Lighting Systems Description and Operation.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
- Connector Repairs

Scan Tool Reference

- Scan Tool Output Controls
- Scan Tool Data List
- Scan Tool Data Definitions

Circuit/System Verification

Ignition ON, observe the rear stop lamps while pressing and releasing the brake pedal. The stop lamps should turn ON and OFF.

Circuit/System Testing

Stop Lamps Circuit Test

1. Ignition OFF, disconnect the harness connector at the brake pedal position sensor.
2. Verify that a test lamp illuminates between the low reference circuit terminal C and B+.

- If the test lamp does not illuminate, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the BCM.

3. Ignition ON, test for 4.8-5.2 volts between the 5-volt reference circuit terminal A and ground.
    - If greater than the specified range, test the 5-volt reference circuit for a short to voltage. If the circuit tests normal, replace the BCM.
    - If less than the specified range, test the 5-volt reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
4. Ignition OFF, disconnect harness connector at the inoperative stop/turn lamp assembly.
5. Ignition OFF, test for less than 5.0 ohms of resistance between the ground circuit terminal G and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
6. Connect a test lamp between the supply voltage circuit terminal A and ground.
7. Ignition ON, command the appropriate LR or RR Turn Signal ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
    - If the test lamp is always ON, test the supply voltage circuit for a short to voltage. If the circuit tests normal, replace the BCM.
    - If the test lamp is always OFF, test the supply voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
8. If all circuits test normal, replace the inoperative stop/turn signal lamp assembly.

High Mounted Stop Lamp Circuit Test

1. Ignition OFF, disconnect the harness connector at the CHMSL.
2. Ignition OFF, test for less than 5.0 ohms of resistance between the ground circuit terminal listed below and ground.
    - Sedan - terminal A
    - Coupe - terminal B
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Connect a test lamp between the supply voltage circuit terminal listed below and the ground.
    - Sedan - terminal B
    - Coupe - terminal A
4. Ignition ON, apply and release the brake pedal. The test lamp should turn ON and OFF as the brake pedal is applied and released.
    - If the test lamp is always ON, test the supply voltage circuit for a short to voltage.

If the circuit tests normal, replace the BCM.

- If the test lamp is always OFF, test the supply voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.

5. If all circuits test normal, replace the CHMSL.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Brake Pedal Position Sensor Replacement**
- **High Mounted Stop Lamp Replacement (Monte Carlo)** or **High Mounted Stop Lamp Replacement (Impala)**
- **Tail Lamp Replacement (Monte Carlo)** or **Tail Lamp Replacement (Impala)**
- **Turn Signal Lamp Bulb Replacement - Rear**
- **Control Module References** for ECM replacement, setup, and programming

STOP LAMPS ALWAYS ON

Stop Lamps Always On

Step	Action	Yes	No
Schematic Reference: Exterior Lights Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems DEFINITION: The CHMSL lamps are on at all times.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Ensure that the brake pedal is not depressed. Are the stop lamps OFF?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	Disconnect the body control module (BCM) connector C2. Does CHMSL stay illuminated?	Go to **Step 5**	Go to **Step 4**
	Test for a poor connection or an open in the brake pedal position switch low reference		

4	circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 7**	Go to **Step 6**
5	Repair a short to battery positive voltage in the stop lamp voltage supply circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 7**	-
6	Replace the BCM. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 7**	-
7	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

STOP LAMPS INOPERATIVE

Stop Lamps Inoperative

Step	Action	Yes	No
Schematic Reference: Exterior Lights Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Depress the brake pedal. Do all of the stop lamps illuminate?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Is only one lamp inoperative?	Go to **Step 4**	Go to **Step 7**
4	1. Disconnect the imperative lamp. 2. Using a test lamp connected to ground, probe the stop lamp supply voltage circuit. 3. Depress the brake pedal. Does the test lamp illuminate?	Go to **Step 6**	Go to **Step 5**
	Test for a poor connection, open, or a short to ground in the stop lamp supply voltage		

5	circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 10**
6	Test for a poor connection or an open in the ground circuit of the inoperative stop lamp. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 9**
7	1. Disconnect the brake pedal position sensor. 2. Using a test lamp connected to the battery positive voltage, probe the brake pedal position sensor low reference circuit. Does the test lamp illuminate?	Go to **Step 10**	Go to **Step 8**
8	Test for a poor connection or an open in the low reference circuit of the brake pedal position sensor. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 11**	Go to **Step 10**
9	Replace the inoperative stop lamp. Refer to **High Mounted Stop Lamp Replacement (Monte Carlo)** or **High Mounted Stop Lamp Replacement (Impala)**. Did you complete the repair?	Go to **Step 11**	-
10	Replace the body control module (BCM). Refer to **Control Module References** for replacement, setup, and programming. Did you complete the repair?	Go to **Step 11**	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

TURN SIGNAL LAMPS AND/OR INDICATORS MALFUNCTION

Diagnostic Instructions

- **Diagnostic System Check - Vehicle**
- **STRATEGY BASED DIAGNOSIS**
- **Diagnostic Procedure Instructions**

Diagnostic Fault Information

DTC's

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Turn Signal B+	2	2	-	-
Right Turn Signal B+	3	3	-	-
Left Front Turn Signal Lamp Supply Voltage	4	C0277 06	4	-
Right Front Turn Signal Lamp Supply Voltage	5	5	5	-
Left Rear Stop/Turn Lamp Supply Voltage	6	1	6	-
Right Rear Stop/Turn Lamp Supply Voltage	7	3	7	-
Left Turn Signal Switch Signal	2	5	2	-
Right Turn Signal Switch Signal	3	1	3	-
Turn Signal/Multifunction Switch Ground	-	3	1	-
LF Park/Turn Signal Lamp Ground	-	4	4	-
RF Park/Turn Signal Lamp Ground	-	5	5	-
Left Tail/Stop and Turn Signal Lamp Ground	-	6	6	-
Right Tail/Stop and Turn Signal Lamp Ground	-	7	7	-

1. All Turn Signals Inoperative
2. Left Turn Signals Malfunction
3. Right Turn Signals Malfunction
4. Left Front Turn Signal Malfunction
5. Right Front Turn Signal Malfunction
6. Left Rear Turn Signal Malfunction
7. Right Rear turn Signal Malfunction

Circuit/System Description

The BCM controls the vehicle turn signals based on inputs from the turn signal/multifunction switch. With the turn signal/multifunction switch in the left turn position, a ground path is provided on the left turn signal switch signal circuit, indicating a left turn signal request. With the turn signal/multifunction switch in the right turn position, a ground path is provided on the right turn signal switch signal circuit, indicating a right turn signal request. When the specific request is seen, the BCM will pulse the respective turn signal lamp supply voltage circuits, illuminating the turn signal lamps.

When a turn signal request is seen by the BCM, a serial data message is sent to the instrument panel cluster (IPC) requesting the respective turn signal indicator be pulsed.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

Lighting Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

- **Scan Tool Output Controls**
- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

1. Ignition ON, view the scan tool Left Turn Signal Switch parameter while using the turn signal/multifunction switch to turn the left turn signal on and off. The parameter should cycle between Active and Inactive.
    - If the parameter does cycle between the specified values, refer to **Turn Signal/Multifunction Switch Circuit Malfunction**.
2. View the scan tool Right Turn Signal Switch parameter while using the turn signal/multifunction switch to turn the right turn signal on and off. The parameter should cycle between Active and Inactive.
    - If the parameter does cycle between the specified values, refer to **Turn Signal/Multifunction Switch Circuit Malfunction**.
3. Command the following ON and OFF with a scan tool. The respective turn signal

should illuminate.

- LF Turn Signal
- RF Turn Signal
- LR Turn Signal
- RR Turn Signal
  - If the turn signal does not illuminate, refer to **Turn Signal Circuit Malfunction**.

4. With the turn signal/multifunction switch in the left turn position, verify the left turn signal indicator is illuminated on the IPC.
    - If the indicator is not illuminated, replace the IPC.
5. With the turn signal/multifunction switch in the right turn position, verify the right turn signal indicator is illuminated on the IPC.
    - If the indicator is not illuminated, replace the IPC.

Circuit/System Testing

Turn Signal/Multifunction Switch Circuit Malfunction

1. Ignition OFF, disconnect the harness connector C1 at the turn signal/multifunction switch.
2. Test for less than 1.0 ohm of resistance between the ground circuit terminal E and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool Left Turn Signal Switch parameter is Inactive.
    - If not the specified value, test the signal circuit terminal D for a short to ground. If the circuit tests normal, replace the BCM.
4. Verify the scan tool Right Turn Signal Switch parameter is Inactive.
    - If not the specified value, test the signal circuit terminal F for a short to ground. If the circuit tests normal, replace the BCM.
5. Install a 3A fused jumper wire between the signal circuit terminal D and the ground circuit terminal E. Verify the scan tool Left Turn Signal Switch parameter is Active.
    - If not the specified value, test the signal circuit for a short to voltage or and open/high resistance. If the circuit tests normal, replace the BCM.
6. Install a 3A fused jumper wire between the signal circuit terminal F and the ground circuit terminal E. Verify the scan tool Right Turn Signal Switch parameter is Active.
    - If not the specified value, test the signal circuit for a short to voltage or and open/high resistance. If the circuit tests normal, replace the BCM.
7. If all circuits test normal, test or replace the turn signal/multifunction switch.

Turn Signal Circuit Malfunction

1. Ignition OFF, disconnect the harness connect C4 at the BCM.
2. Ignition ON, verify a test lamp illuminates between the following terminals and ground.
    - B+ terminal 1
    - B+ terminal 3
    - If the test lamp does not illuminate, test the B+ circuit for an open/high resistance. If the circuit fuse is open, test the B+ circuit and the respective turn signal circuits for a short to ground.
3. Ignition OFF, disconnect the harness connector at the affected turn signal lamp.
4. Test for less than 1.0 ohm of resistance between the ground circuit terminal G and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
5. Connect a test lamp between the control circuit terminal A and the ground circuit terminal G.
6. Ignition ON, command the affected turn signal ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
    - If the test lamp is always ON, test the control circuit for a short to voltage. If the circuit tests normal, replace the BCM.
    - If the test lamp is always OFF, test the control circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
7. If all circuits test normal, test or replace the affected turn signal lamp.

Component Testing

Turn Signal/Multifunction Switch

1. Ignition OFF, disconnect the harness connector C1 at the turn signal/multifunction switch.
2. Test for infinite resistance between the following terminals and the ground circuit terminal E with the switch in the neutral position.
    - Signal terminal D
    - Signal terminal F
    - If not the specified value, replace the turn signal/multifunction switch.
3. Test for less than 2.0 ohms of resistance between the signal circuit terminal D and the ground circuit terminal E with the switch in the left turn position.
    - If greater than the specified range, replace the turn signal/multifunction switch.
4. Test for less than 2.0 ohms of resistance between the signal circuit terminal F and the ground circuit terminal E with the switch in the left turn position.
    - If greater than the specified range, replace the turn signal/multifunction switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Headlamp Bulb Replacement**
- **Turn Signal Lamp Bulb Replacement - Rear**
- **Control Module References** for ECM replacement, setup, and programming

TURN SIGNAL LAMPS AND/OR INDICATORS ALWAYS ON OR FLASHING

Turn Signal Lamps and/or Indicators Always On or Flashing

Step	Action	Yes	No
Schematic Reference: Exterior Lights Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Turn the ignition to the ON position, with the engine OFF. 2. Observe the turn signal lamps and indicators. 3. Turn ON and OFF the right and left turn signal lamps. Do the turn signal lamps and indicators operate properly?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	1. Place the turn signal switch in the OFF position. 2. Place the hazard warning switch in the OFF position. Are only the turn signal indicators always ON?	Go to **Step 11**	Go to **Step 4**
4	Are all 4 of the turn signals lamps flashing?	Go to **Hazard Lamps Always On**	Go to **Step 5**
5	Is only one lamp on at all times?	Go to **Step 6**	Go to **Step 7**

6	Test for a short to battery positive voltage in the turn signal voltage circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 9**
7	Disconnect the multifunction turn signal switch. Do the turn signal lamps turn off?	Go to **Step 10**	Go to **Step 8**
8	Test for a short to ground in the illuminated turn signal switch circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 9**
9	Replace the body control module (BCM). Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 12**	-
10	Replace the multifunction turn signal switch. Refer to **Multifunction, Turn Signal Switch Replacement** in Steering Wheel and Column. Did you complete the replacement?	Go to **Step 12**	-
11	Replace the instrument panel cluster (IPC). Refer to **Instrument Panel Cluster (IPC) Replacement (Impala)** or **Instrument Panel Cluster (IPC) Replacement (Monte Carlo)** in Instrument Panel, Gages and Console. Did you complete the repair?	Go to **Step 12**	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

TURN SIGNAL LAMPS AND/OR INDICATORS INOPERATIVE

Turn Signal Lamps and/or Indicators Inoperative

Step	Action	Yes	No
Schematic Reference: Exterior Lights Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?		Go to **Diagnostic System Check -**

		Go to **Step 2**	**Vehicle**
2	1. Turn the ignition switch to the ON position. 2. Place the turn signal switch in the LH ON position. 3. Place the turn signal switch in the RH ON position. 4. Determine if any of the turn signals or turn signal indicators are inoperative. Are the turn signals and indicators operating properly?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Are all of the turn signals and indicators inoperative?	Go to **Step 4**	Go to **Step 5**
4	Press the hazard switch to the ON position. Do all of the hazard lamps operate?	Go to **Step 6**	Go to **Step 14**
5	Are only the instrument panel (I/P) turn signal indicators inoperative?	Go to **Step 12**	Go to **Step 8**
6	1. Disconnect the turn signal switch. 2. Install a jumper between the turn signal switch ground circuit and the left turn signal switch circuit. Do the left turn signal lamps illuminate?	Go to **Step 13**	Go to **Step 7**
7	Test for an open, poor connection, or a short to battery positive voltage in the ground circuit of the turn signal switch. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 16**	Go to **Step 15**
8	Are only the hazard lamps inoperative?	Go to **Hazard Lamps Inoperative**	Go to **Step 9**
9	Are both the front and rear turn signal lamps inoperative on one side?	Go to **Step 10**	Go to **Step 16**
10	1. Disconnect the multifunction turn signal switch connector C2. 2. Install a jumper between the turn signal switch ground circuit and the inoperative side turn signal switch circuit.		

	Do the turn signal lamps illuminate?	Go to **Step 13**	Go to **Step 11**
11	Test for a poor connection, an open, or a short to battery positive voltage in inoperative turn signal switch circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 15**
12	Replace the instrument panel cluster (IPC). Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 21**	-
13	Replace the multifunction turn signal switch. Refer to **Multifunction, Turn Signal Switch Replacement** . Is the replacement complete?	Go to **Step 21**	-
14	Test for a poor connection, an open, or a short to ground in the HAZRD Fuse circuit of the body control module (BCM). Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 15**
15	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the repair?	Go to **Step 21**	-
16	1. Disconnect the inoperative turn signal lamp. 2. Place the turn signal switch to the inoperative side. 3. Using a test lamp connected to ground, probe the turn signal supply voltage circuit. Does the test lamp flash?	Go to **Step 17**	Go to **Step 19**
17	Using a test lamp connected to the turn signal supply voltage circuit, probe the turn signal lamp ground circuit. Does the test lamp flash?	Go to **Step 20**	Go to **Step 18**
18	Repair a poor connection, an open, or a short to battery positive voltage in the ground circuit of the turn signal lamp. Refer to **Circuit Testing** and **Wiring Repairs** .		

	Did you complete the repair?	Go to **Step 21**	-
19	Test for a poor connection, an open, or a short to ground in the turn signal lamp voltage supply circuit. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 21**	Go to **Step 15**
20	Replace the inoperative turn signal lamp. Did you complete the repair?	Go to **Step 21**	-
21	1. Connect all connectors and components that were previously disconnected. 2. Verify that the turn signal lamps and indicators operate properly. Do the turn signal lamps and indicators operate properly?	System OK	Go to **Step 3**

VANITY MIRROR LAMP(S) ALWAYS ON

Vanity Mirror Lamp(s) Always On

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Close the vanity mirror cover. Are the vanity mirror lamps off?	Go to **Testing for Electrical Intermittents** in Wiring Systems	Go to **Step 3**
3	Replace the vanity mirror lamp. Refer to **Sunshade Replacement** in Interior Trim. Did you complete the repair?	Go to **Step 4**	-
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

VANITY MIRROR LAMP(S) INOPERATIVE

Vanity Mirror Lamp(s) Inoperative

Step	Action	Yes	No
Schematic Reference: Interior Lights Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn ON the courtesy lamps. 2. Open the vanity mirror cover. 3. Close the vanity mirror cover. Did the vanity mirror lamps operate properly?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Do the courtesy lamps operate properly?	Go to **Step 4**	Go to **Courtesy Lamps Inoperative**
4	1. Place the interior lamp switch in the ON position. 2. Open the vanity mirror. 3. Remove the inoperative bulb from the vanity mirror lamp. 4. Connect a test lamp between the courtesy lamp supply voltage circuit of the inoperative vanity mirror lamp bulb and the ground circuit of the inoperative vanity lamp bulb. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 5**
5	1. Disconnect the vanity mirror lamp connector. 2. Connect a test lamp between the courtesy lamp supply voltage circuit of the inoperative vanity mirror lamp connector and the ground circuit of the inoperative vanity lamp connector. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 6**
6	Test the inadvertent power courtesy lamp circuit for a high resistance or open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 12**	Go to **Step 9**

7	Inspect for poor connections at the inoperative vanity mirror lamp bulb. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 12**	Go to **Step 10**
8	Inspect for poor connections at the harness connector of the inoperative vanity mirror lamp. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 12**	Go to **Step 11**
9	Repair the high resistance or an open in the ground circuit of the inoperative vanity mirror lamp bulb. Refer to **Circuit Testing** and **Wiring Repairs** . Did you complete the repair?	Go to **Step 12**	-
10	Replace the inoperative vanity mirror lamp bulbs. Refer to **Vanity Mirror Lamp Bulb Replacement**. Did you complete the replacement?	Go to **Step 12**	-
11	Replace the inoperative vanity mirror lamp. Refer to **Sunshade Replacement** . Did you complete the replacement?	Go to **Step 12**	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

REPAIR INSTRUCTIONS

BRAKE PEDAL POSITION SENSOR CALIBRATION

Calibration Criteria

The brake pedal position sensor (BPPS) receives a low reference signal and a 10-volt reference signal from the body control module (BCM). Whenever the brake pedal is applied, the brake pedal position sensor applies a variable voltage signal to the BCM through the stop lamp switch signal circuit. Brake pedal position sensor calibration must be performed after the brake pedal position sensor or BCM have been serviced. The calibration procedure will set brake pedal position sensor home value. This value is used by the BCM to determine the action of the driver applying the brake system and to provide this information to the vehicle subsystems via the class 2 communication bus.

Calibration Procedure

IMPORTANT: If the master brake cylinder has been replaced, verify that the correct pushrod is installed before attempting to calibrate the brake pedal position sensor.

1. Turn ON the ignition, with the engine OFF.
2. Install a scan tool, select the proper vehicle and options.
3. Navigate to the BCM module setup menu, located in Vehicle Control Systems.
4. Select the BPP Sensor Calibration procedure and follow the directions displayed on the screen.

BRAKE PEDAL POSITION SENSOR REPLACEMENT

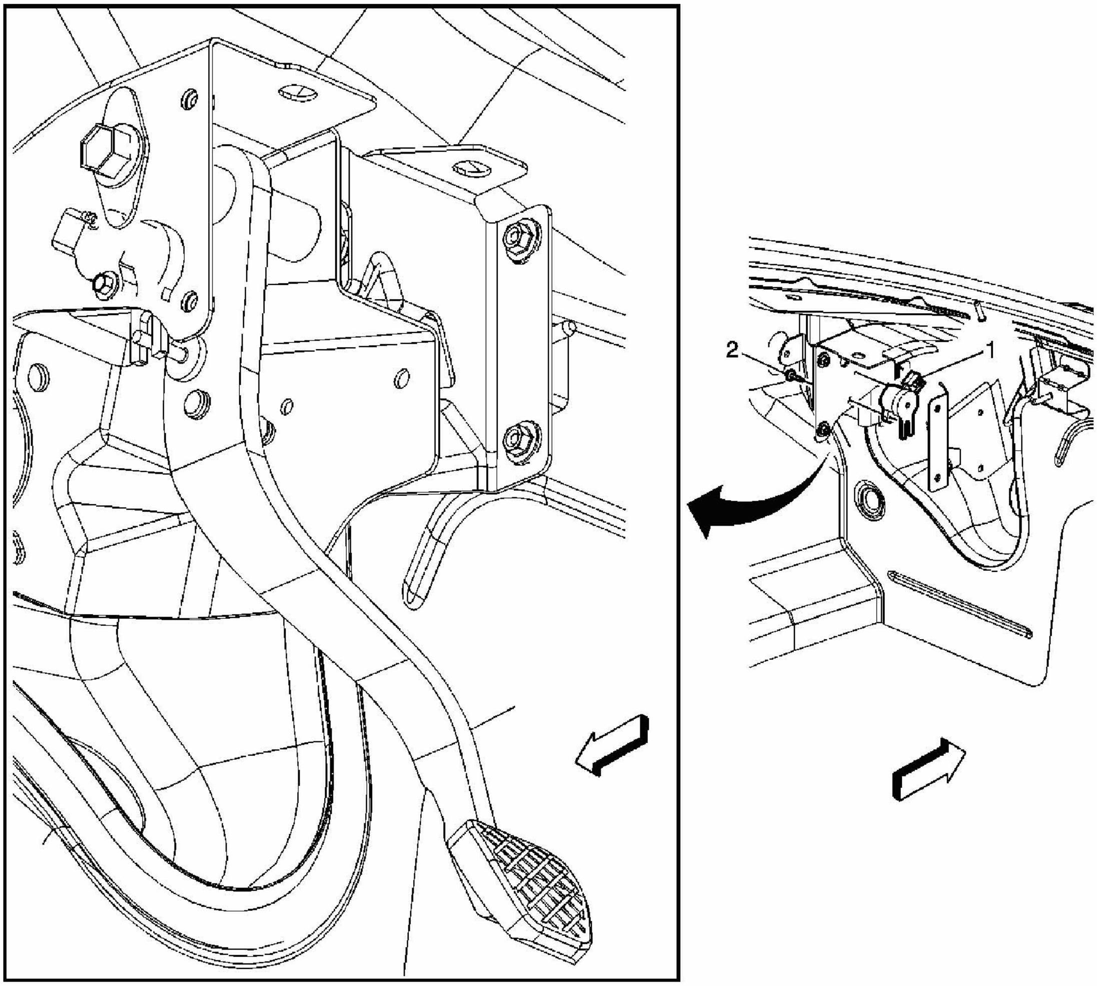


Fig. 73: Replacing Brake Pedal Position Sensor
Courtesy of GENERAL MOTORS CORP.

Brake Pedal Position Sensor Replacement

Callout	Component Name

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .

1	Sensor Assembly, Brake Pedal Position **Tip:** Disconnect the electrical connector.
2	Bolt, Brake Pedal Position Sensor **Tip:** • Calibrate the position sensor. Refer to **Brake Pedal Position Sensor Calibration**. • Do not reuse the position sensor bolt. Always use a new bolt when installing a brake pedal position sensor. **Tighten:** 2 N.m (18 lb in)

HEADLAMP SWITCH REPLACEMENT (IMPALA)

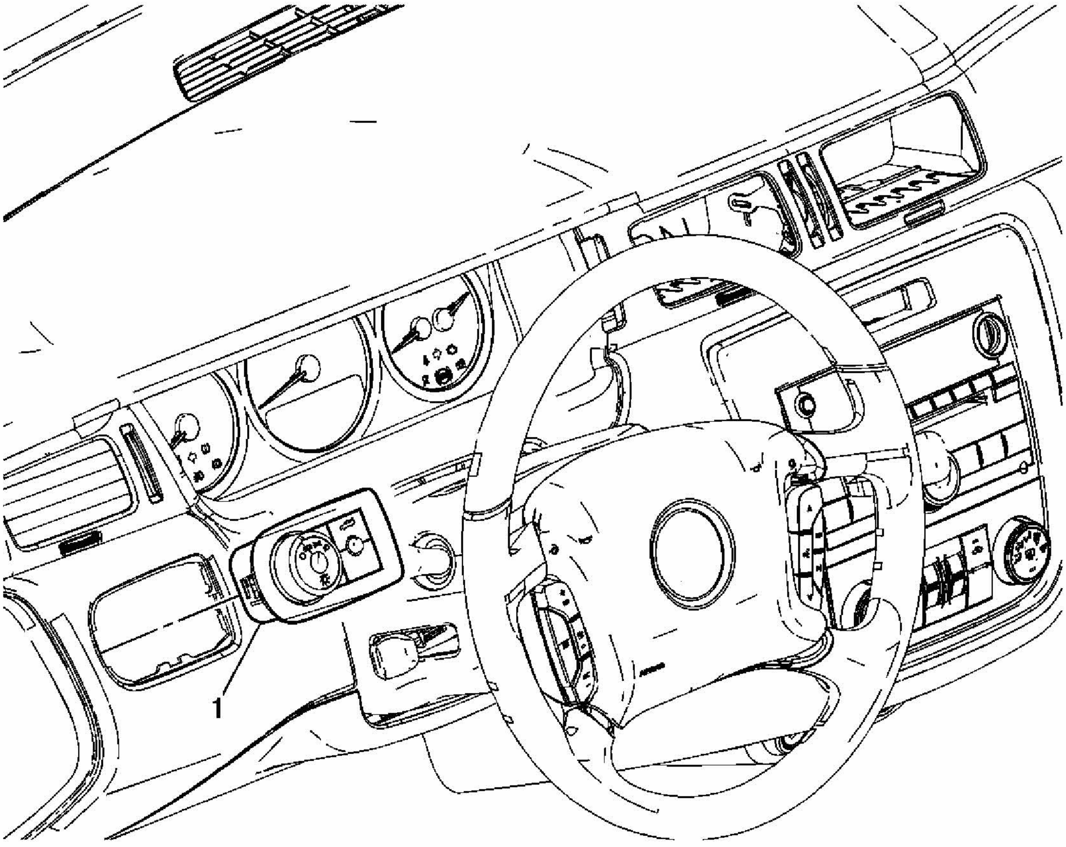


Fig. 74: Replacing Headlamp Switch

Courtesy of GENERAL MOTORS CORP.

Headlamp Switch Replacement (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Switch Assembly, Head lamp Instrument Panel Dimmer **Tip:** Disconnect the electrical connector.

HEADLAMP SWITCH REPLACEMENT (MONTE CARLO)

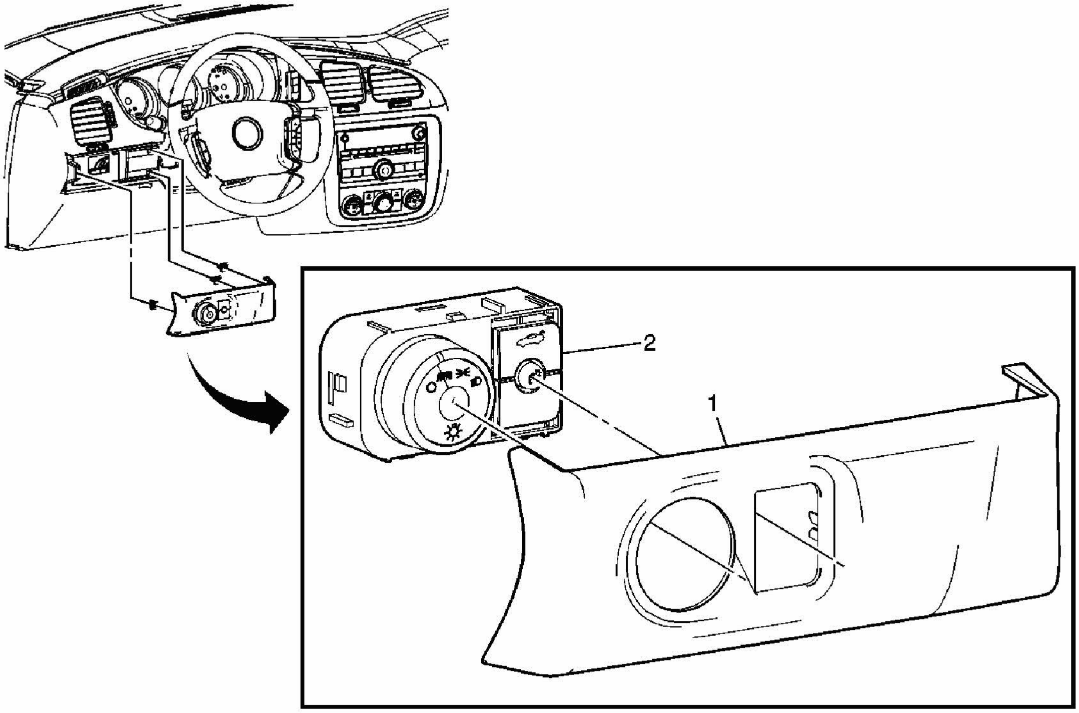


Fig. 75: Replacing Headlamp Switch
Courtesy of GENERAL MOTORS CORP.

Headlamp Switch Replacement (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Headlamp Switch Bezel
2	Headlamp Switch Assembly **Tip:** Disconnect the electrical connector.

DAYTIME RUNNING LAMPS (DRL) AMBIENT LIGHT SENSOR REPLACEMENT

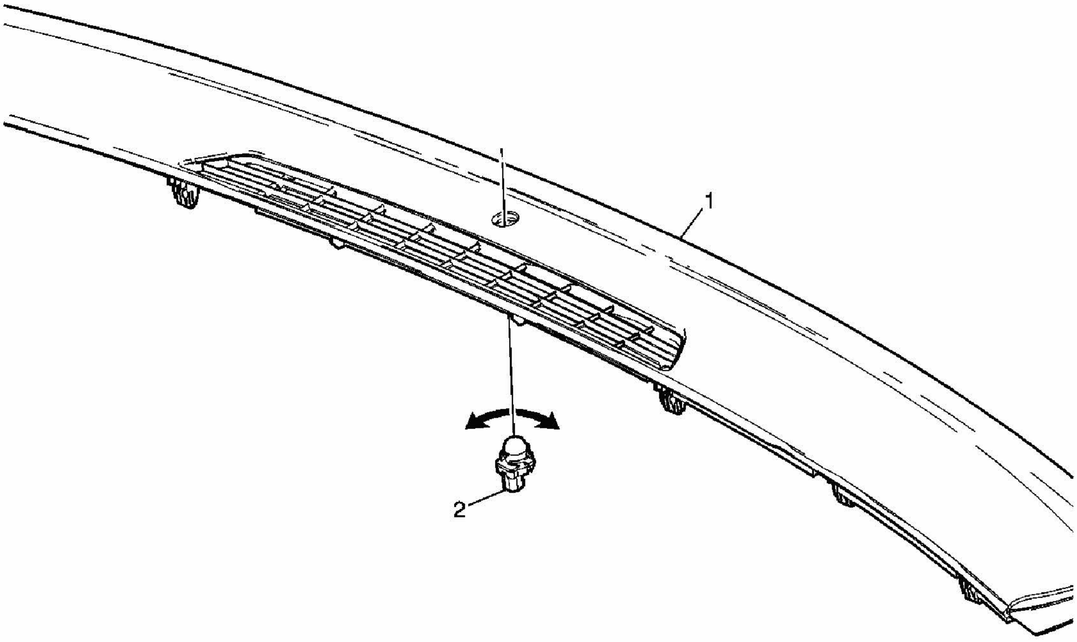


Fig. 76: Replacing Daytime Running Lamps (DRL) Ambient Light Sensor
Courtesy of GENERAL MOTORS CORP.

Daytime Running Lamps (DRL) Ambient Light Sensor Replacement

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .	
1	Trim Panel, Instrument Panel Upper Refer to **Trim Panel Replacement - Instrument Panel (I/P) Upper** .
2	Sensor Assembly, Ambient Light

EMERGENCY VEHICLE INTERIOR SWITCH REPLACEMENT (IMPALA)

Removal Procedure

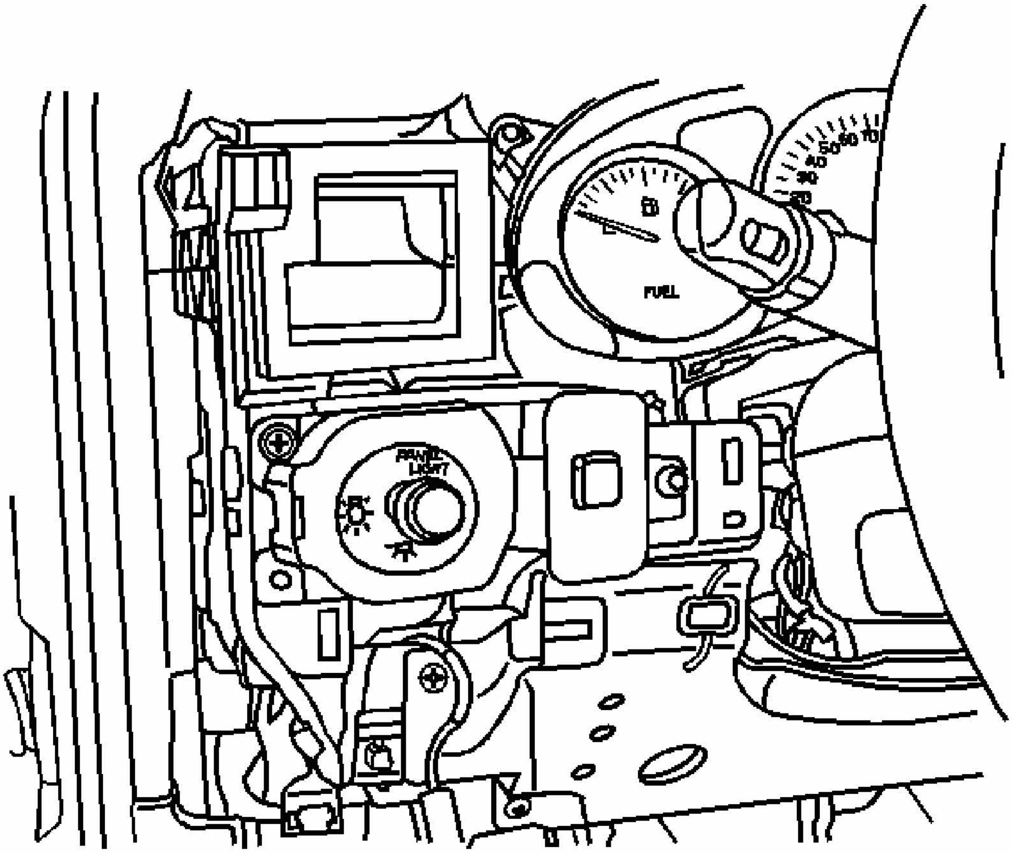


Fig. 77: Headlamp Switch Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the trim plate bezel from the instrument panel (I/P) cluster. Refer to **Trim Plate Replacement - Instrument Panel (I/P) (Impala)** or **Trim Plate Replacement - Instrument Panel (I/P) (Monte Carlo)** .
2. Remove the headlamp switch assembly screws.
3. Pull the headlamp switch assembly from the I/P.

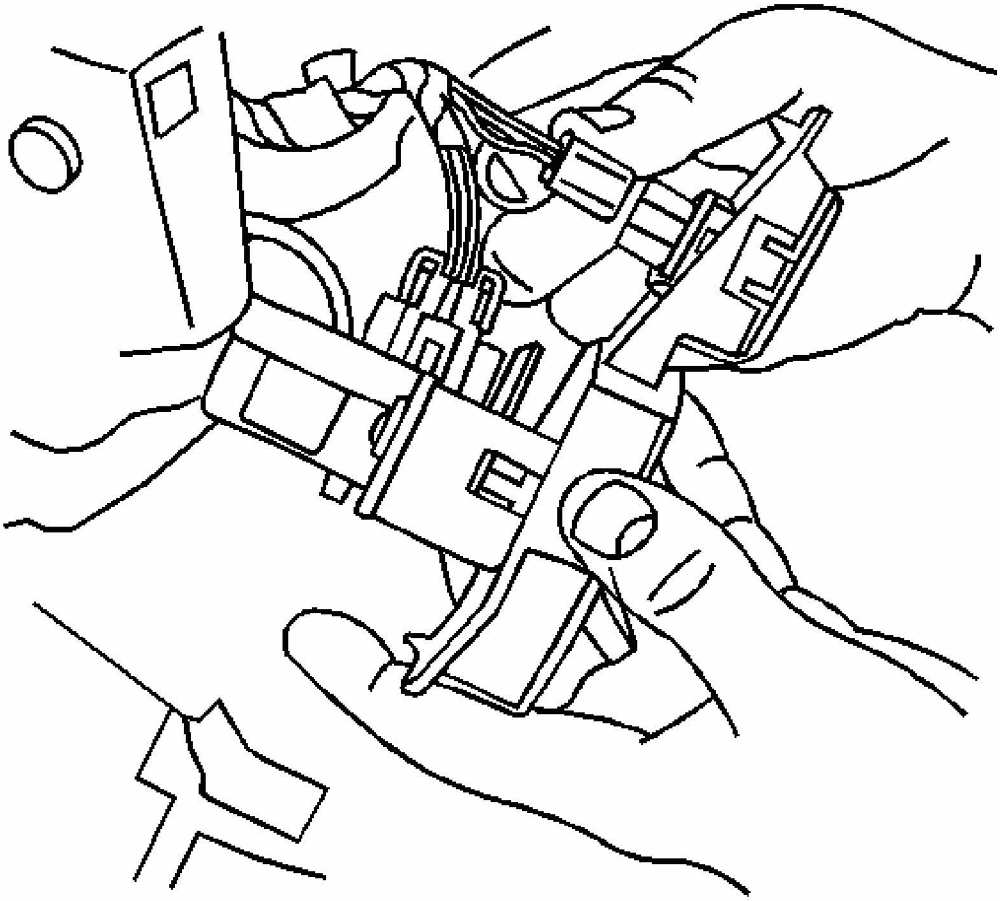


Fig. 78: Disconnecting Electrical Connector From Emergency Vehicle Interior Switch
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the electrical connector from the emergency vehicle interior switch.

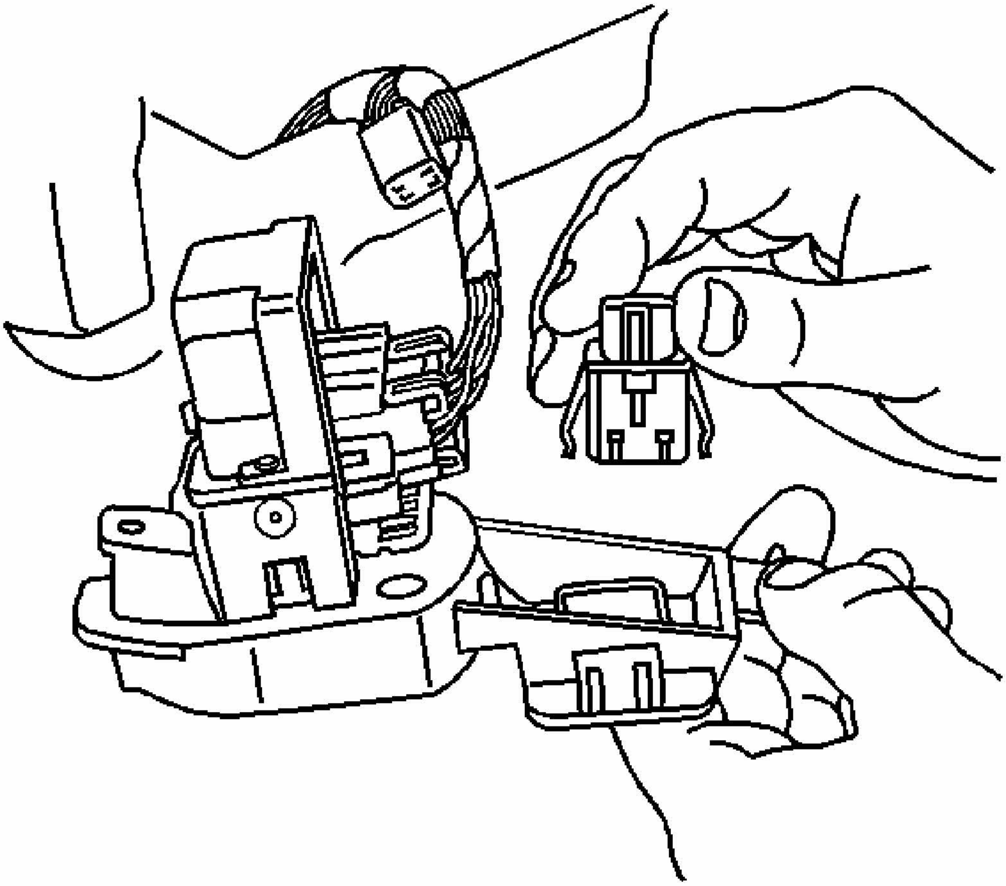


Fig. 79: Removing Emergency Vehicle Interior Switch
Courtesy of GENERAL MOTORS CORP.

5. Remove the emergency vehicle interior switch from the back of the headlamp switch assembly.

Installation Procedure

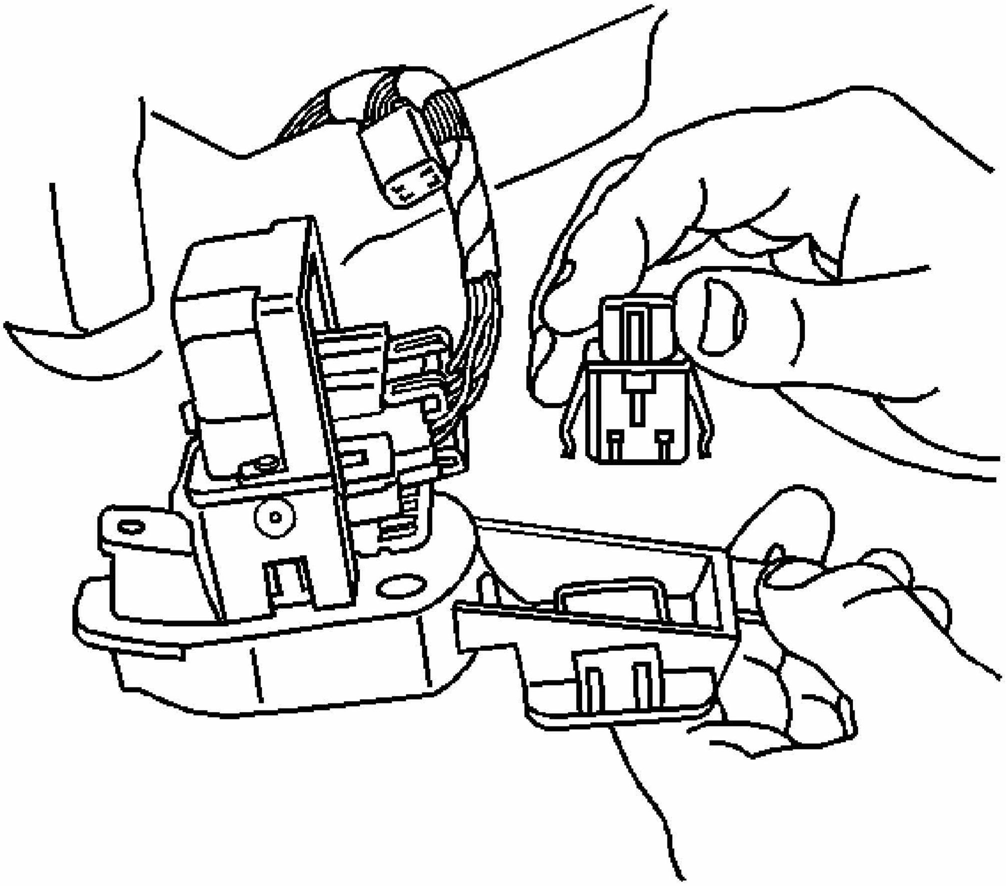


Fig. 80: Removing Emergency Vehicle Interior Switch
Courtesy of GENERAL MOTORS CORP.

1. Install the emergency vehicle interior switch through the back of the headlamp switch assembly by pressing the switch into place until fully seated.

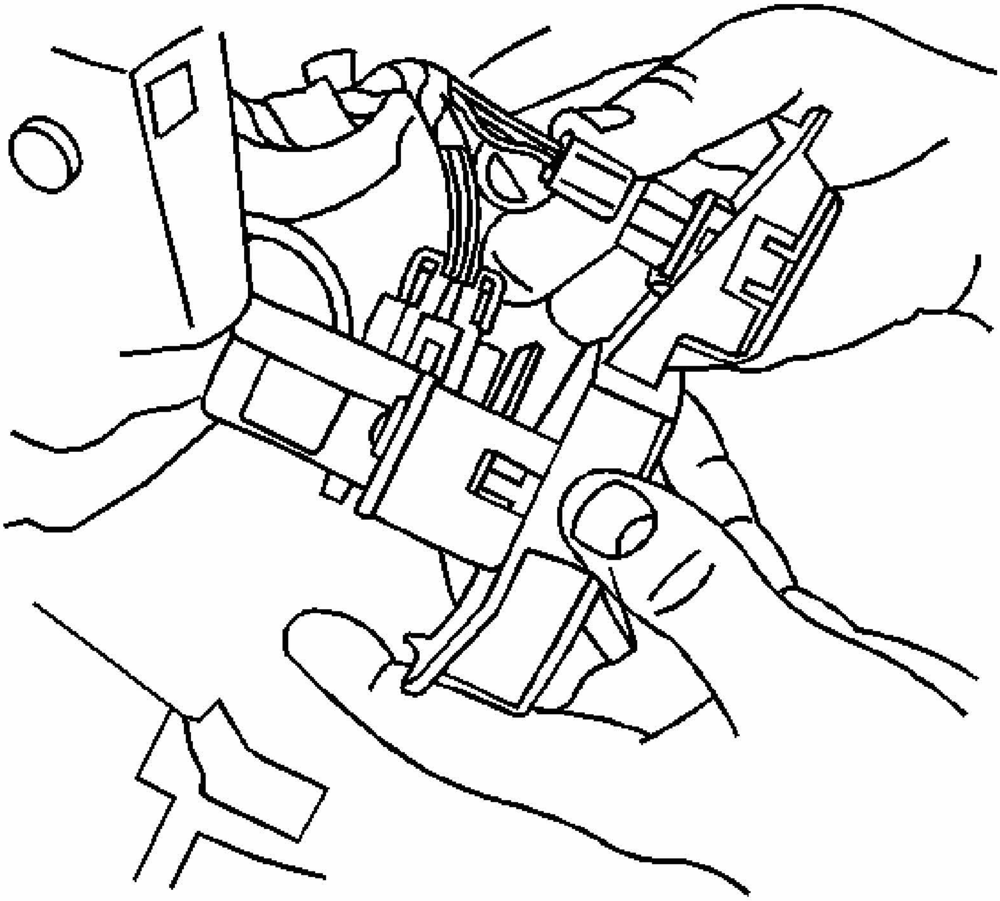


Fig. 81: Disconnecting Electrical Connector From Emergency Vehicle Interior Switch
Courtesy of GENERAL MOTORS CORP.

2. Connect the electrical connector to the emergency vehicle interior switch.

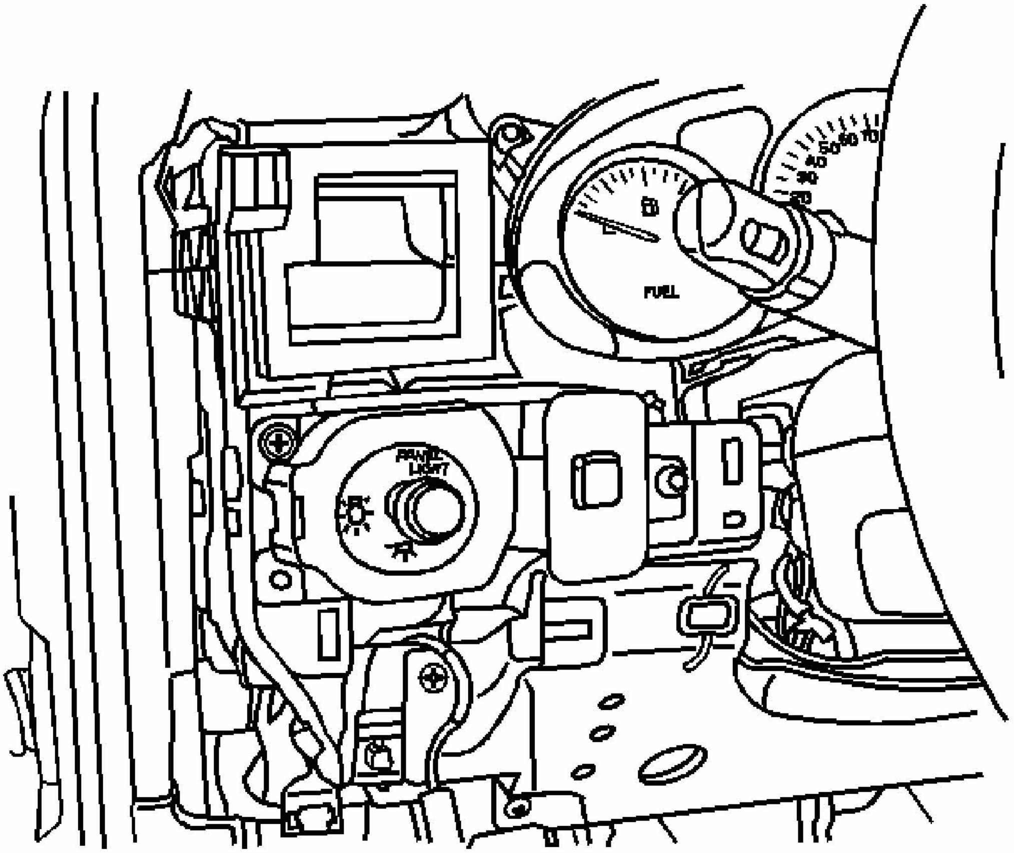


Fig. 82: Headlamp Switch Assembly
Courtesy of GENERAL MOTORS CORP.

3. Install the headlamp switch assembly to the I/P.

NOTE: **Refer to FASTENER NOTICE .**

4. Install the headlamp switch assembly screws.

   Tighten: Tighten the screws to 2 N.m (18 lb in).

5. Install the trim plate bezel. Refer to **Trim Plate Replacement - Instrument Panel (I/P) (Impala)** or **Trim Plate Replacement - Instrument Panel (I/P) (Monte Carlo)** .

EMERGENCY VEHICLE HEADLAMP FLASHER REPLACEMENT

Removal Procedure

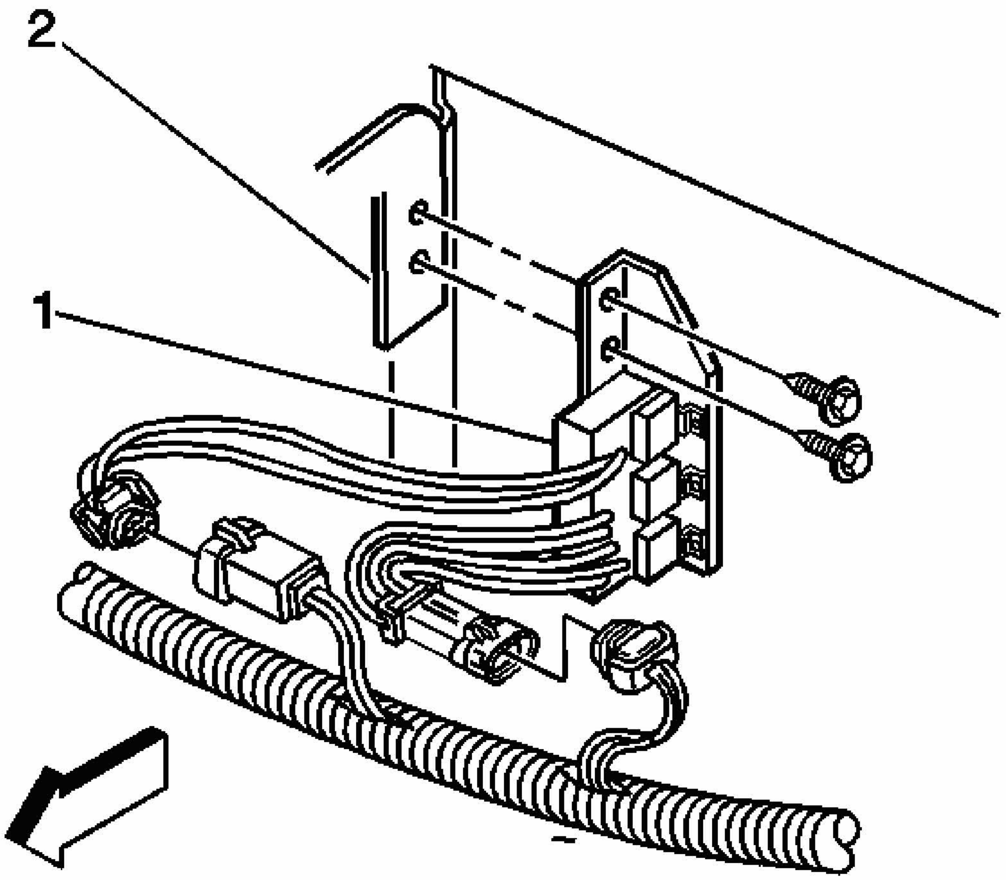


Fig. 83: Headlamp Flasher Components
Courtesy of GENERAL MOTORS CORP.

1. Remove the upper radiator baffle. Refer to **Radiator Air Baffle and Deflector Replacement - Upper** in Engine Cooling.
2. Disconnect the electrical connectors.
3. Remove the headlamp flasher bolts at the front radiator support (2).

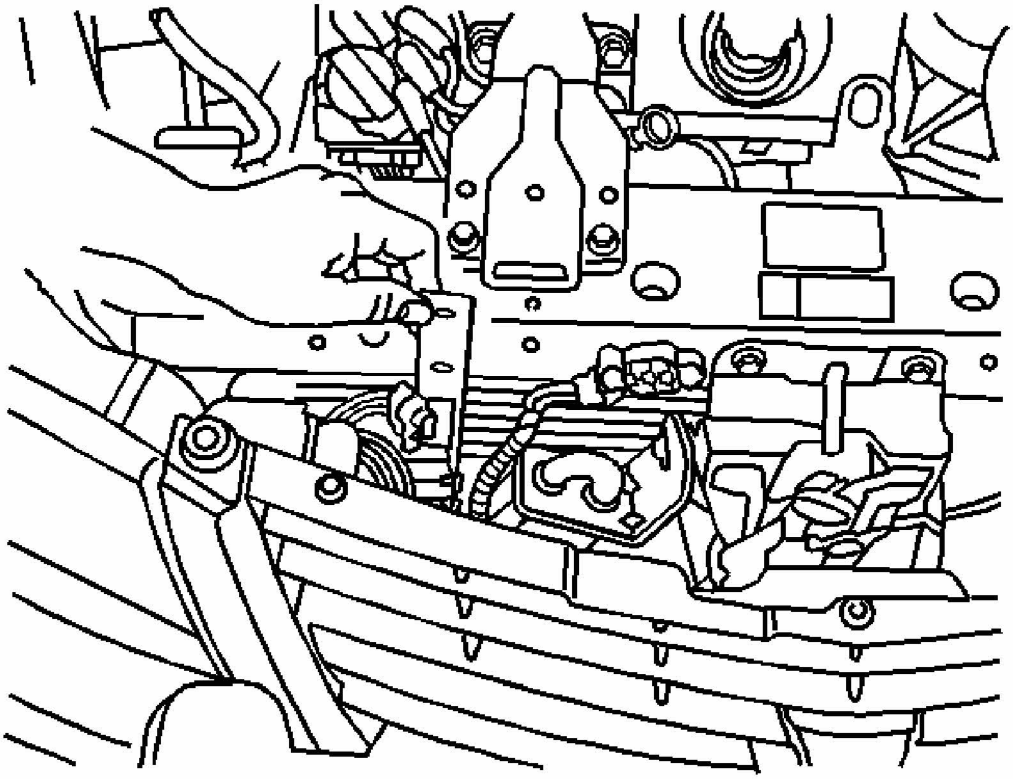


Fig. 84: Removing Headlight Flasher
Courtesy of GENERAL MOTORS CORP.

4. Remove the headlamp flasher.

Installation Procedure

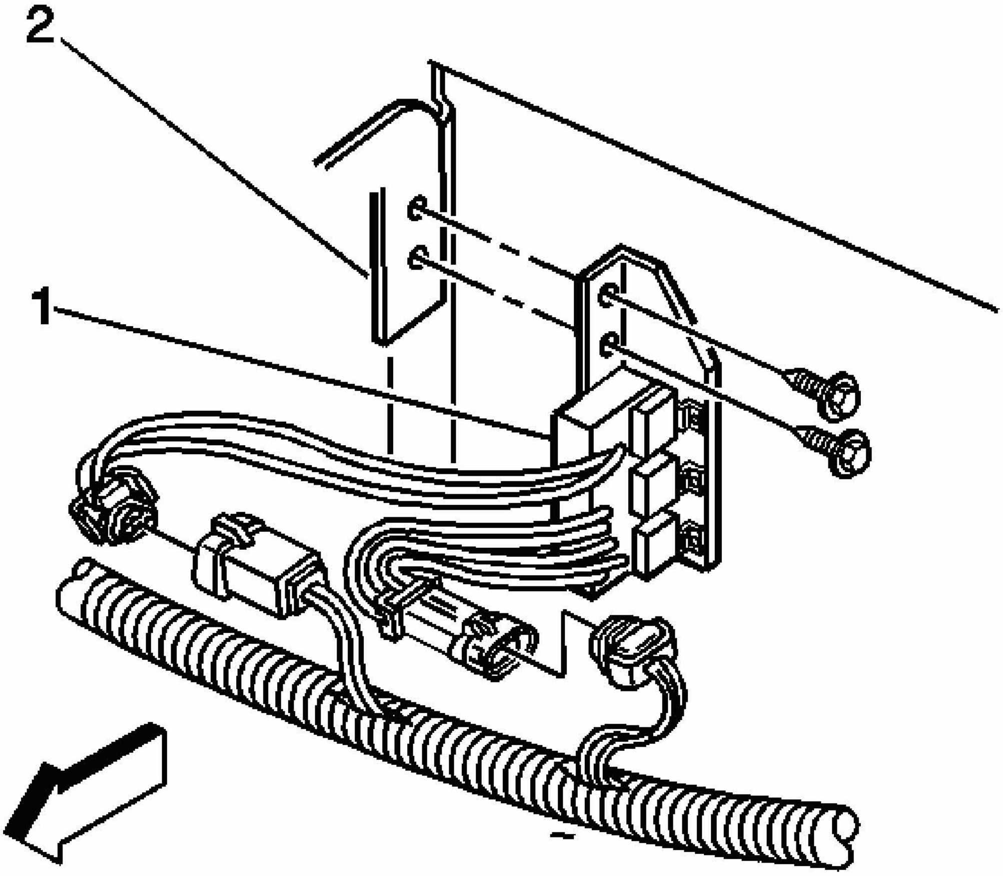


Fig. 85: Headlamp Flasher Components
Courtesy of GENERAL MOTORS CORP.

1. Position the headlamp flasher (1) to the front radiator support (2).

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the headlamp flasher bolts.

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

3. Connect the electrical connectors.
4. Install the upper radiator baffle. Refer to **Radiator Air Baffle and Deflector Replacement - Upper** in Engine Cooling.

EMERGENCY VEHICLE REAR FLASHER REPLACEMENT

Removal Procedure

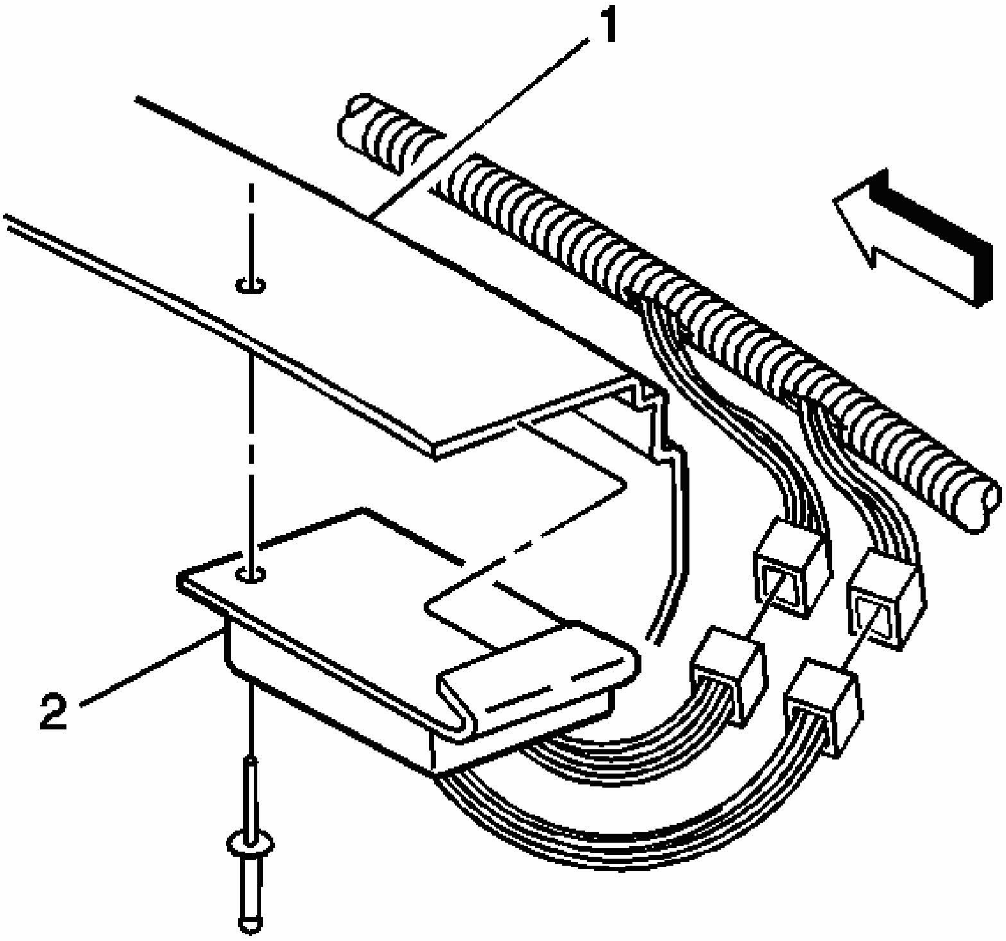


Fig. 86: Emergency Vehicle Rear Flasher & Components
Courtesy of GENERAL MOTORS CORP.

1. Adjust the right side rear compartment trim for access.
2. Disconnect the electrical connectors.
3. Remove the rivet from the rear window panel extension brace (1).
4. Remove the emergency vehicle rear flasher (2).

Installation Procedure

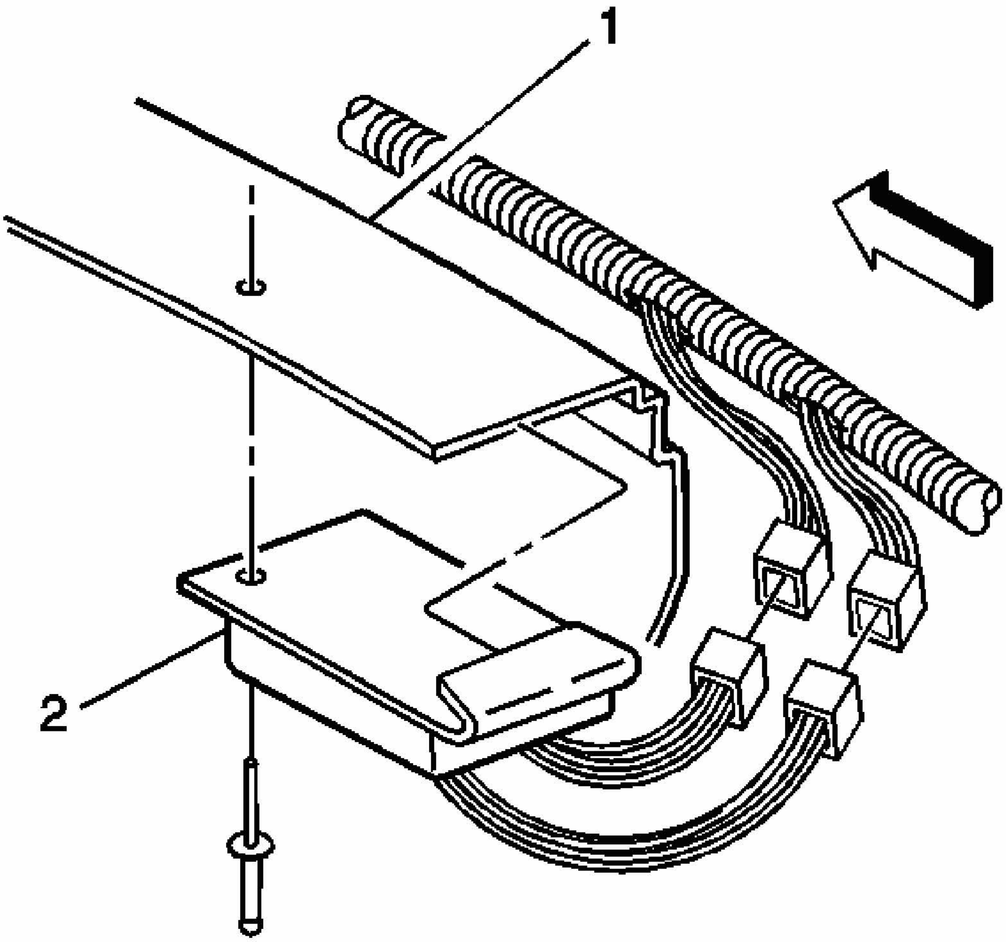


Fig. 87: Emergency Vehicle Rear Flasher & Components
Courtesy of GENERAL MOTORS CORP.

1. Position the emergency vehicle rear flasher (2) to the rear window panel extension brace (1).
2. Install a rivet to secure the flasher.
3. Connect the electrical connectors.
4. Install the rear compartment trim.

READING LAMP BULB REPLACEMENT

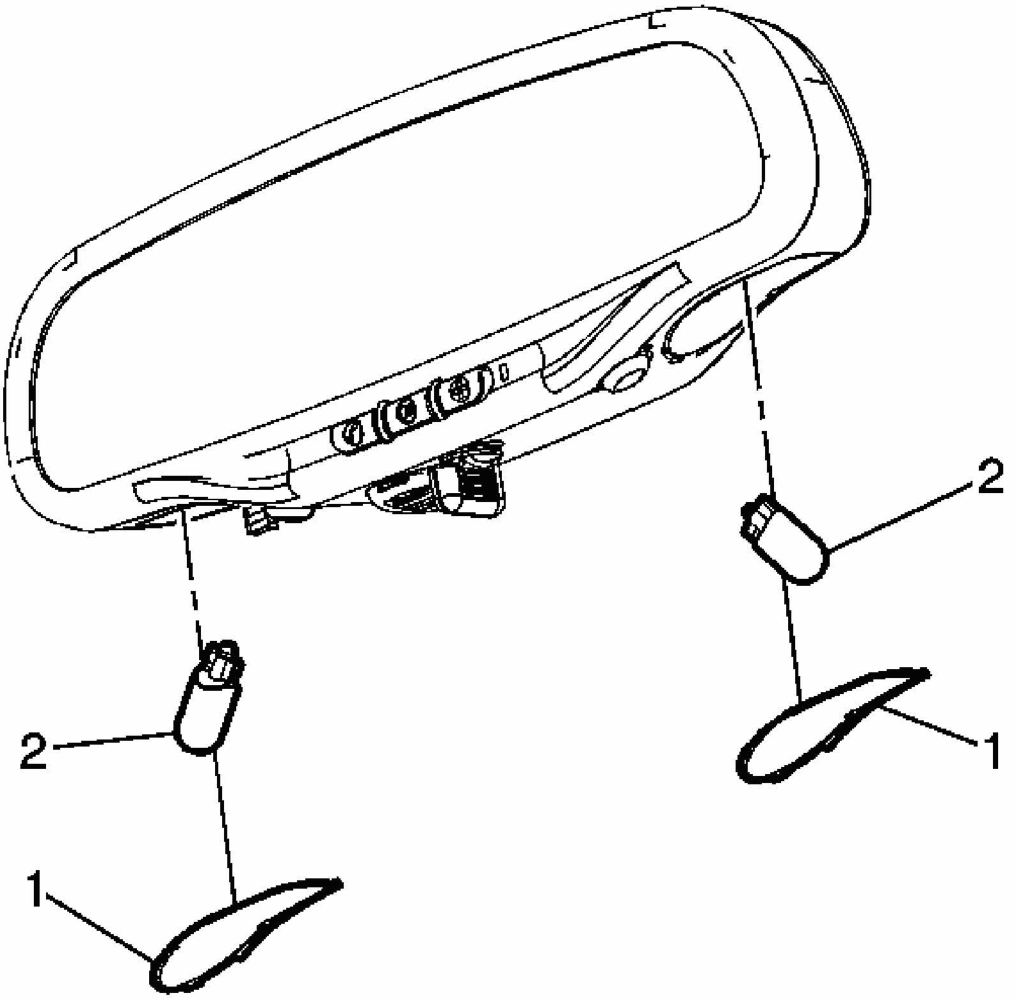


Fig. 88: Replacing Reading Lamp Bulb
Courtesy of GENERAL MOTORS CORP.

Reading Lamp Bulb Replacement

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Reading Lamp Lens (Qty: 2)
2	Reading Lamp Bulb (Qty: 2)

INSTRUMENT PANEL COURTESY LAMP REPLACEMENT

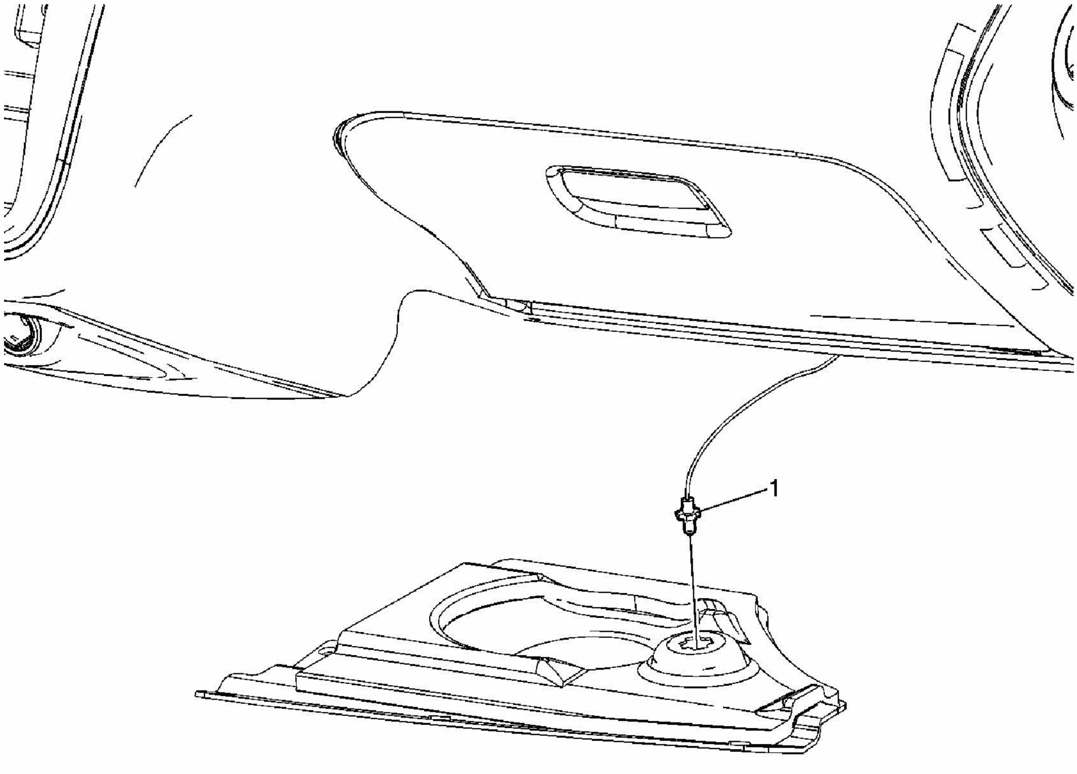


Fig. 89: Replacing Instrument Panel Courtesy Lamp
Courtesy of GENERAL MOTORS CORP.

Courtesy Lamp Replacement - Instrument Panel

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the instrument panel (I/P) insulator panel. Refer to **Closeout/Insulator Panel Replacement - Right** or **Closeout/Insulator Panel Replacement - Left** .	
1	Courtesy Lamp, Instrument Panel **Tip:** Disconnect the electrical connector.

VANITY MIRROR LAMP BULB REPLACEMENT

Removal Procedure

1. Lower the sunshade and open the illuminated mirror door.
2. Insert a small flat-bladed tool at the outer edge of the lamp lens in the slot. Carefully press down to remove the lens.

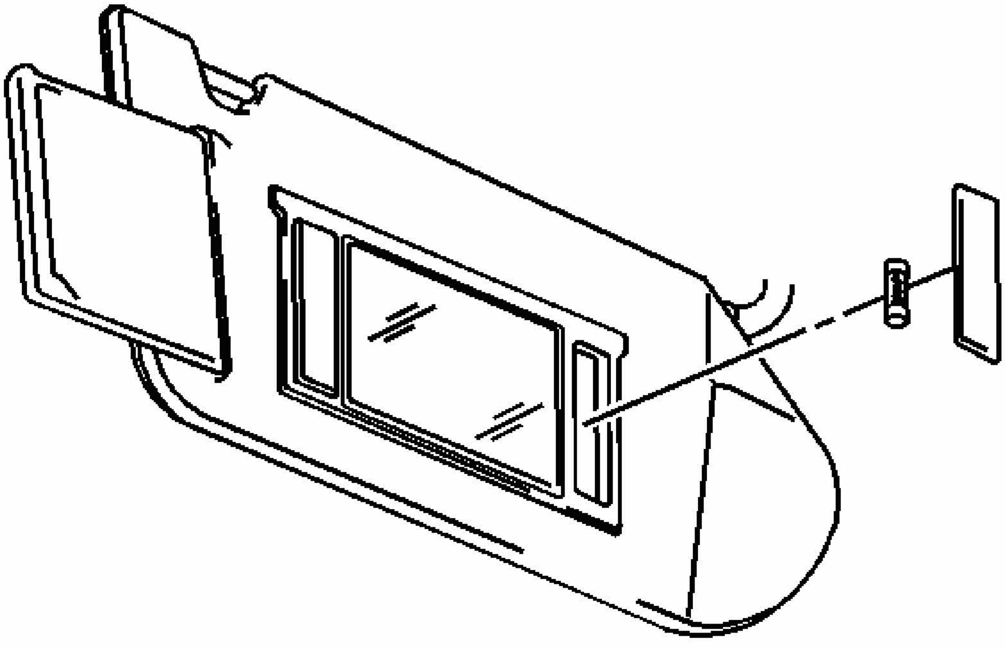


Fig. 90: Removing Lamp Bulb
Courtesy of GENERAL MOTORS CORP.

3. Remove the bulb.

Installation Procedure

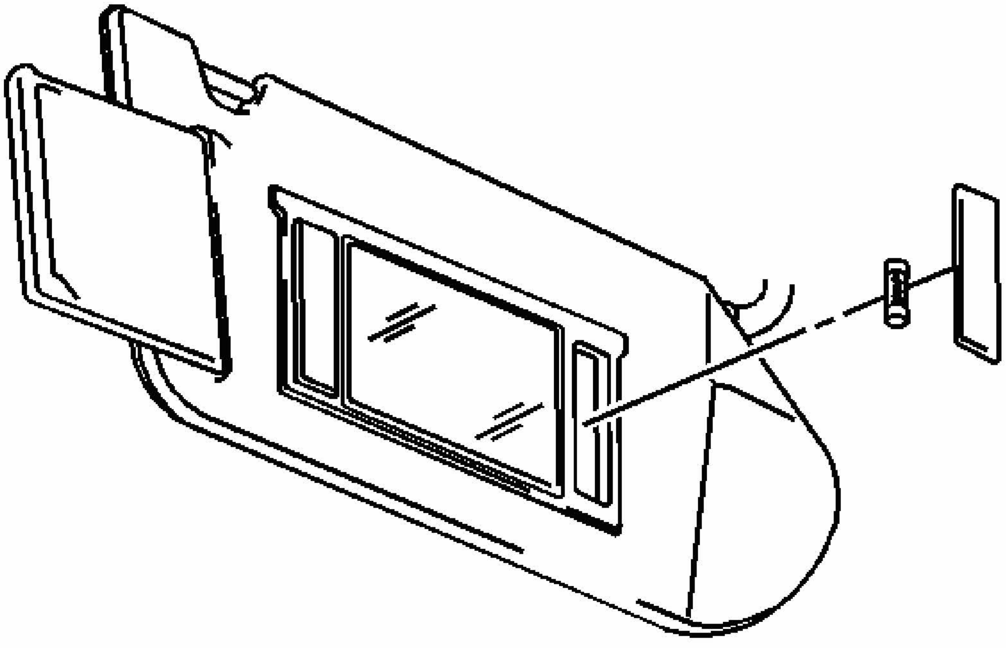


Fig. 91: Removing Lamp Bulb
Courtesy of GENERAL MOTORS CORP.

1. Install the bulb.
2. Align the upper lens tab to the opening. Insert the upper edge of the lens.
3. Insert a small flat-bladed tool at the outer edge of the lamp lens. Carefully press up to install the lens.
4. Close the illuminated mirror door and raise the sunshade.

DOME LAMP REPLACEMENT (IMPALA)

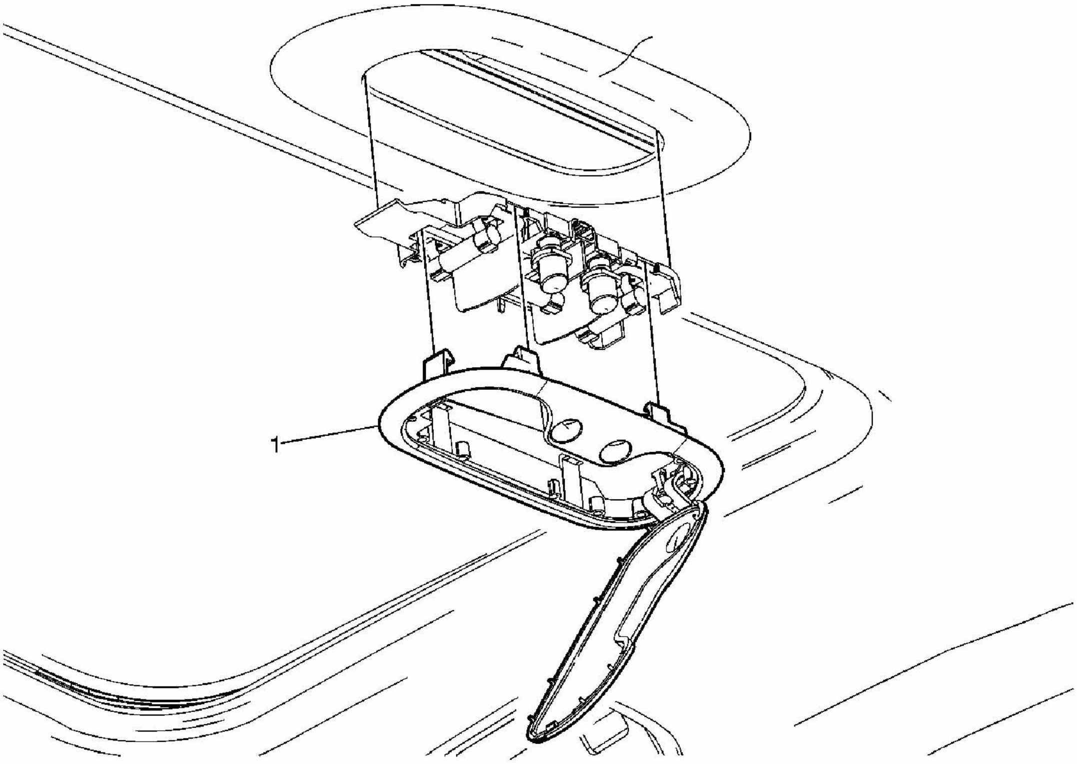


Fig. 92: Replacing Dome Lamp
Courtesy of GENERAL MOTORS CORP.

Dome Lamp Replacement (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Lamp Assembly, Dome Reading **Tip:** • Pry open the passenger side. • Disconnect the electrical connectors.

DOME LAMP REPLACEMENT (MONTE CARLO)

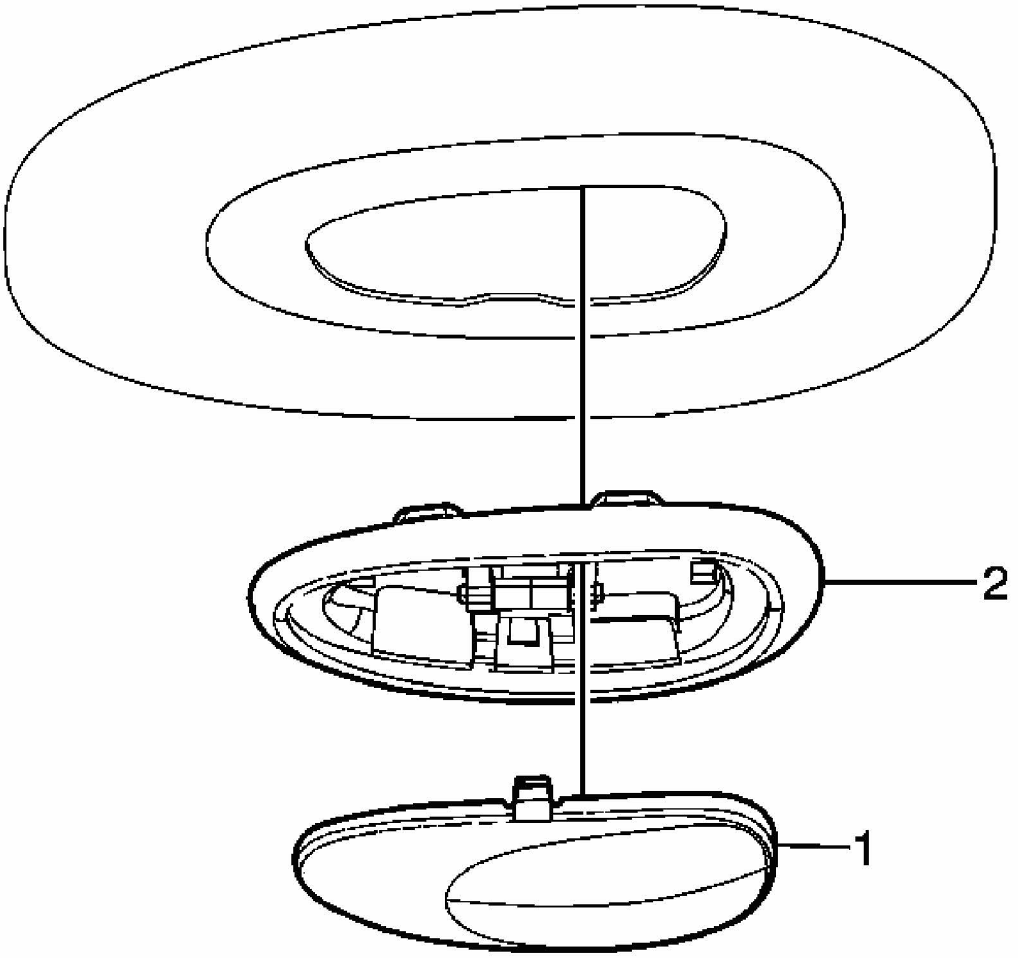


Fig. 93: Replacing Dome Lamp
Courtesy of GENERAL MOTORS CORP.

Dome Lamp Replacement (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Dome Lamp Lens
4	Dome Lamp Housing **Tip:** Disconnect the electrical connector.

DOME LAMP BULB REPLACEMENT (IMPALA)

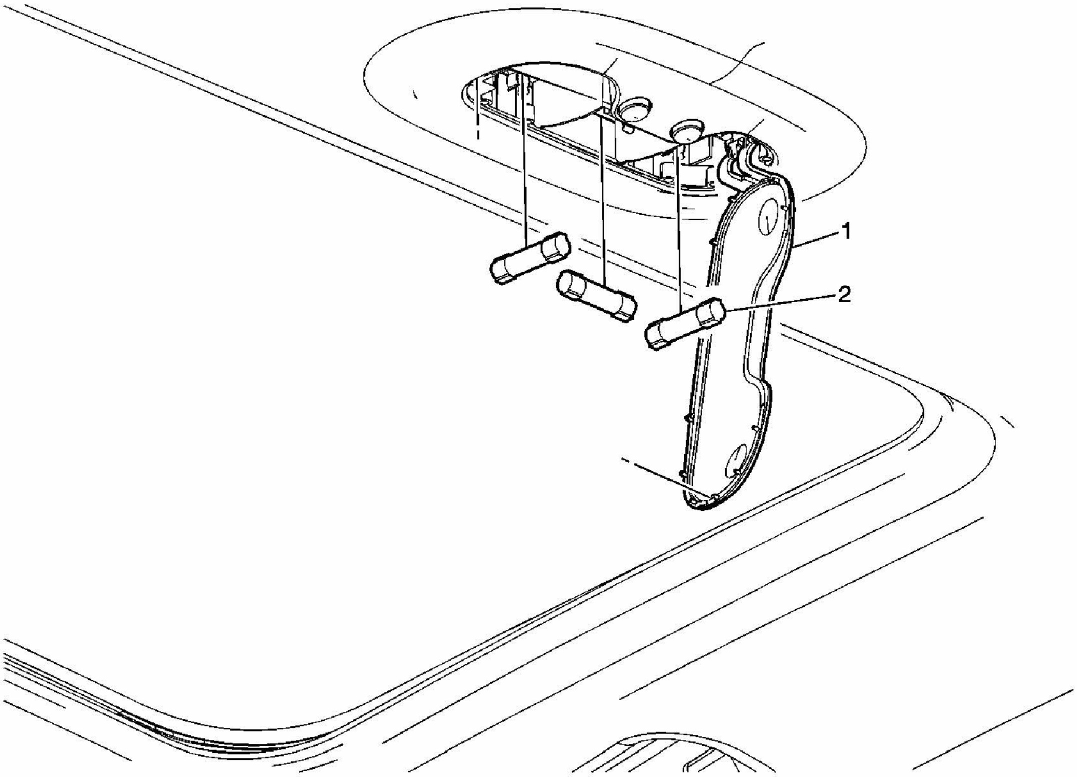


Fig. 94: Replacing Dome Lamp Bulb
Courtesy of GENERAL MOTORS CORP.

Dome Lamp Bulb Replacement (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Lens, Dome Lamp **Tip:** Pry open the driver side.
2	Bulb, Dome lamp

DOME LAMP BULB REPLACEMENT (MONTE CARLO)

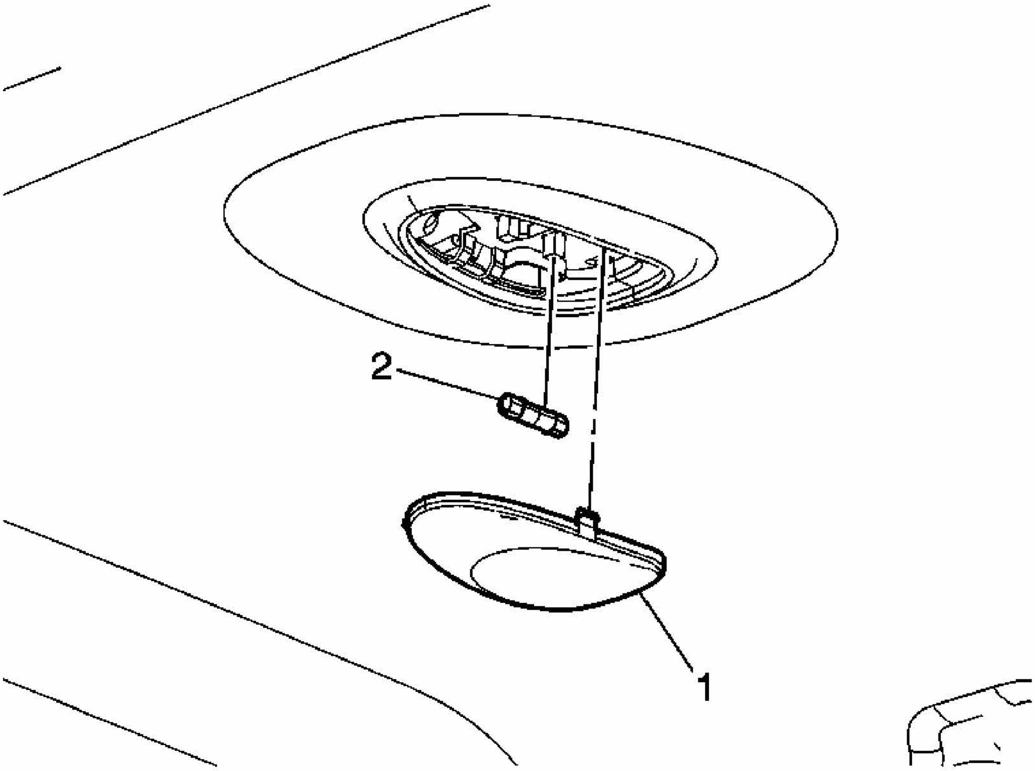


Fig. 95: Replacing Dome Lamp Bulb
Courtesy of GENERAL MOTORS CORP.

Dome Lamp Bulb Replacement (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Dome Lamp Lens
4	Dome Lamp Bulb

HEADLAMP REPLACEMENT (IMPALA)

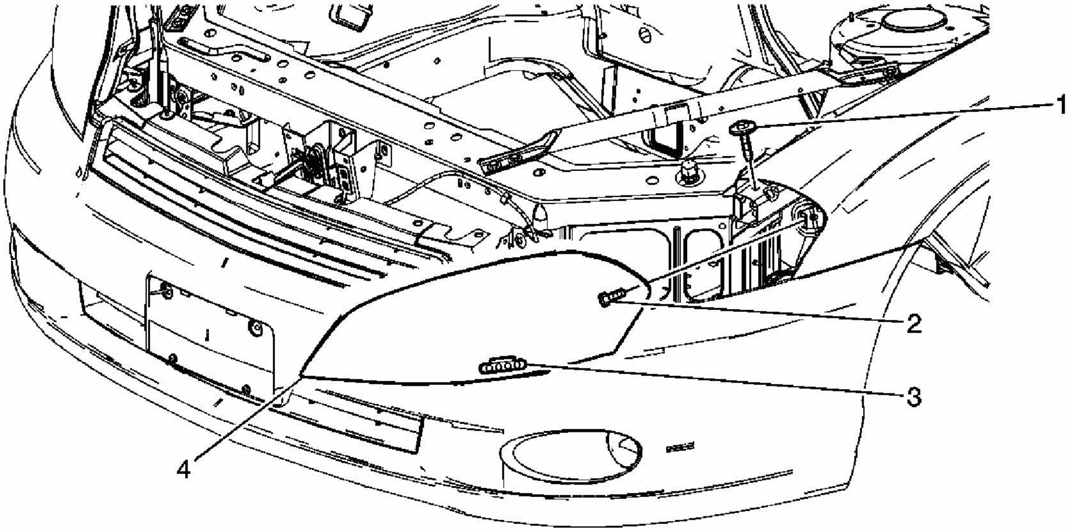


Fig. 96: Replacing Headlamp
Courtesy of GENERAL MOTORS CORP.

Headlamp Replacement (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Open the hood.	
1	Bolt, Headlamp Assembly **Tighten:** 6 N.m (53 lb in)
2	Pin, Headlamp Lock **Tip:** Pull headlamp from the outboard edge in order to release the lock pin from the fender flange retainer.
3	Connector, Forward Lamp Harness **Tip:** Disconnect the electrical connector before removing the headlamp from the vehicle.
4	Assembly, Headlamp **CAUTION:** **Refer to Halogen Bulb Caution .**

HEADLAMP REPLACEMENT (MONTE CARLO)

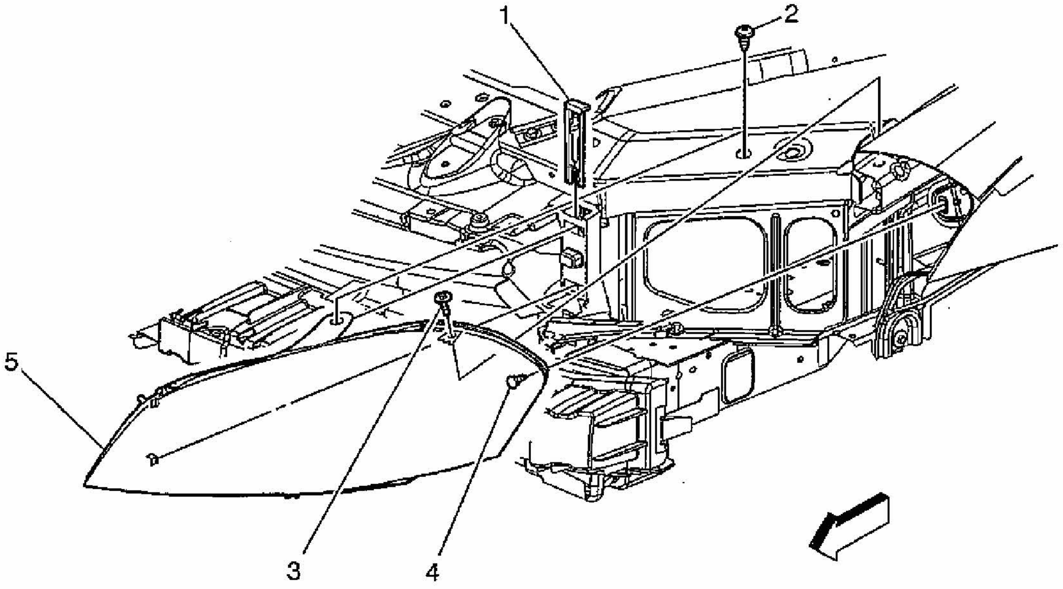


Fig. 97: Replacing Headlamp
Courtesy of GENERAL MOTORS CORP.

Headlamp Replacement (Impala)

Callout	Component Name
1	Headlamp Retainer **Tip** Lift upward on the retainer in order to release the headlamp from the radiator support.
2	Headlamp Screw Refer to **Fastener Notice** . **Tighten** Tighten the screw to 2 N.m (18 lb in)
3	Headlamp Retainer Screw **Tighten** Tighten the screw to 2 N.m (18 lb in)
4	Front Fender Upper Outer Rail Locator
5	Headlamp Assembly **Procedure:** 1. Pull the inside edge of the headlamp outward. 2. Pull and release the outer edge of the headlamp by grasping the outer edge and giving the headlamp a quick jerk. 3. Disconnect the forward lamp harness from the headlamp electrical connector.

	4. Remove the headlamp from the vehicle.

HEADLAMP BULB REPLACEMENT

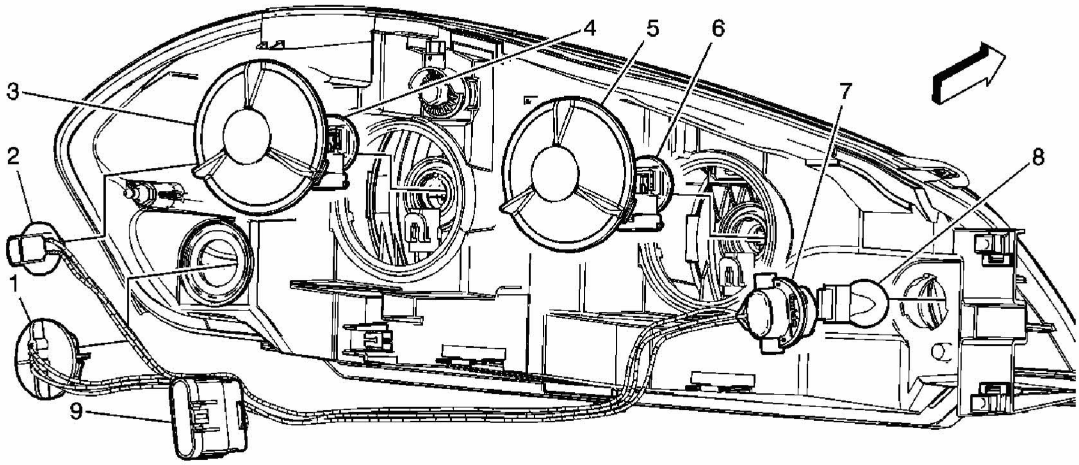


Fig. 98: Replacing Headlamp Bulb
Courtesy of GENERAL MOTORS CORP.

Headlamp Bulb Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Open the hood. 2. Remove either the LH of RH headlamp assembly. Refer to **Headlamp Replacement (Impala)**.	
1	Lamp Assembly, Daytime Running and Front Park and Turn Signal **CAUTION:** **Refer to Halogen Bulb Caution .**
2	Lamp Assembly, Park **Tip:** Pull outward on the housing in order to access the electrical connector.
3	Cover, Headlamp Bulb Accessory **Tip:** Turn the cover counterclockwise in order to remove.

4	Bulb, Headlamp (LO Beam) **CAUTION:** **Refer to Halogen Bulb Caution .** **Tip:** Disconnect the electrical connector from the headlamp bulb socket and turn bulb socket a quarter turn counterclockwise in order to remove.
5	Cover, Headlamp Bulb Accessory **Tip:** Turn the cover counterclockwise in order to remove.
6	Bulb, Headlamp (HI Beam) **CAUTION:** **Refer to Halogen Bulb Caution .** **Tip:** Disconnect the electrical connector from the headlamp bulb socket and turn bulb socket a quarter turn counterclockwise in order to remove.
7	Socket, Front Park and Turn Signal **Tip:** Turn lamp socket counterclockwise in order to remove from the headlamp assembly.
8	Bulb, Front Park and Turn Signal **Tip:** Pull the park and turn signal lamp bulb straight from the bulb socket.
9	Connector, Forward Lamp Harness

HEADLAMP AIMING

The vehicle has a visual optical headlamp aiming system. The aim has been preset at the factory and should need no further adjustment

However, If the vehicle is damaged in an accident, the headlamp aim may be affected and adjustment may be necessary.

If oncoming vehicles flash their high beams at you, this may also mean the vertical aim needs to be adjusted.

It is recommended that the vehicle is taken to your dealer for service if the headlamps need to be re-aimed. It is possible however, to re-aim the headlamps as described in the following procedure.

The vehicle should be properly prepared as follows:

- The vehicle should be placed so the headlamps are 7.6 m (25 ft) from a light colored wall or other flat surface.

- The vehicle must have all four tires on a perfectly level surface which is level all the way to the wall or other flat surface.
- The vehicle should be placed so it is perpendicular to the wall or other flat surface.
- The vehicle should not have any snow, ice or mud on it.
- The vehicle should be fully assembled and all other work stopped while headlamp aiming is being done.
- The vehicle should be normally loaded with a full tank of fuel and one person or 75 kg (160lbs) on the driver seat.
- Tires should be properly inflated.

Headlamp aiming is done with the vehicle's low-beam headlamps. The high-beam headlamps will be correctly aimed if the low-beam headlamps are aimed properly.

The vertical headlamp aiming screws are located under the hood near the headlamps.

The adjustment screw can be turned with a 6 mm male hex.

To adjust the vertical aim on the headlamps, do the following:

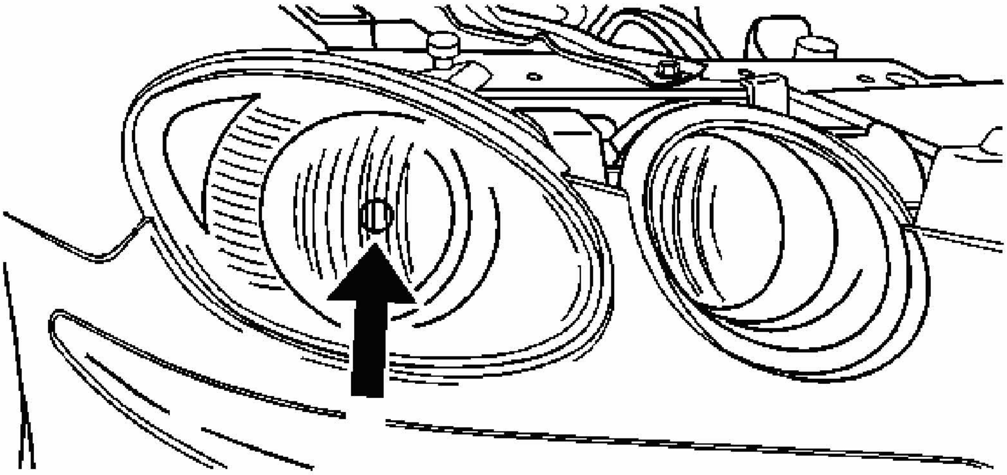


Fig. 99: Identifying Headlight Aiming Dot
Courtesy of GENERAL MOTORS CORP.

1. Find the aim dot on the lens of the low-beam lamp.
2. Measure the distance from the ground to the aim dot on the lamp. Record the distance.

3. At the wall or other flat surface, measure from the ground upward the recorded distance from Step 2 and draw or tape a horizontal line the width of the vehicle.

NOTE: Do not cover a headlamp to improve beam cut-off when aiming. Covering a headlamp may cause excessive heat build-up which may cause damage to the headlamp.

4. Turn on the low-beam headlamps and place a piece of cardboard or equivalent in front of the headlamp not being aimed. This should allow only the beam of light from the headlamp being aimed to be seen on the flat surface.

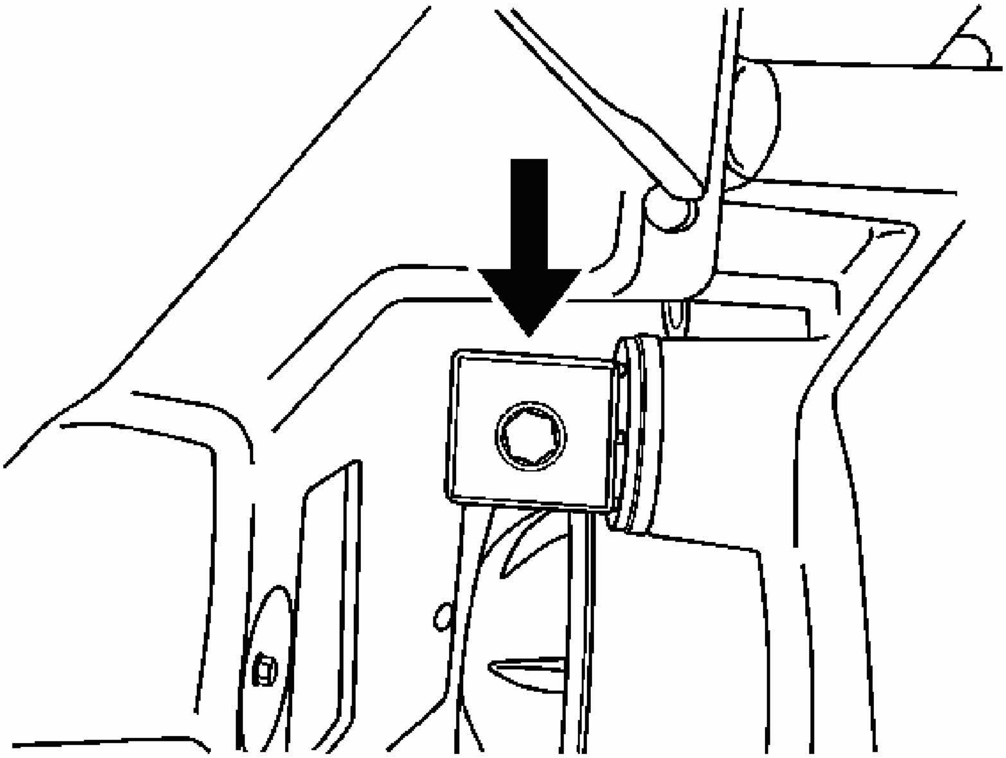


Fig. 100: Identifying Vertical Aiming Screw
Courtesy of GENERAL MOTORS CORP.

5. Turn the vertical aiming screw until the headlamp beam is aimed to the horizontal tape line. The top edge of the cut-off should be positioned at the bottom edge of the horizontal tape line.
6. Repeat Steps 6 and 7 for the opposite headlamp.

FOG LAMP REPLACEMENT - FRONT

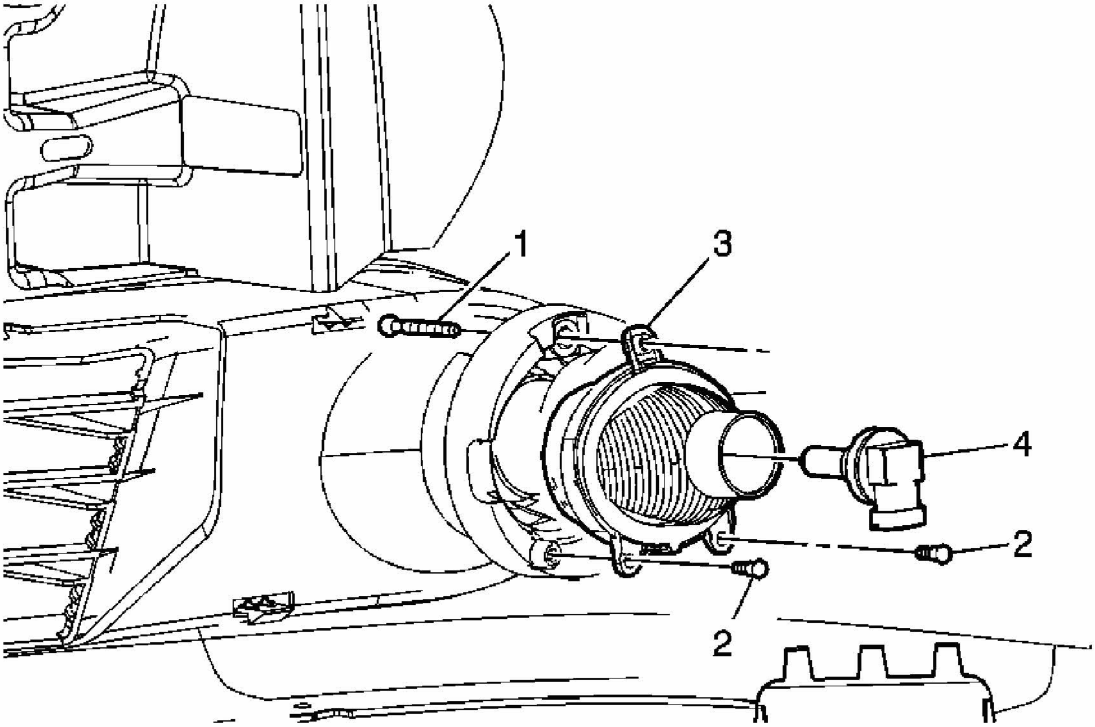


Fig. 101: Fog Lamp Replacement - Front (GXP)
Courtesy of GENERAL MOTORS CORP.

Fog Lamp Replacement - Front

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.

Preliminary Procedures
1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle
2. Remove either the LF or RF front fender liner. Refer to Front Fender Liner Replacement
3. Disconnect fog lamp bulb socket electrical connector.</td></tr>
<tr><td>1</td><td>Front Fog Lamp Adjuster Screw

1. Remove the adjuster screw from the fog lamp bracket and lamp assembly.
2. Count the number of turns when removing the adjuster screw for a</td></tr>
</table>

	reference upon installation. 3. Aim the fog lamp after installation. Refer to **Fog Lamp Aiming Procedure**.
2	Front Fog Lamp Screws (Qty: 2) **Tighten:** 2 N.m(18 lb in)
3	Front Fog Lamp Assembly **Tip:** Remove the lamp assembly from the fog lamp bracket.
4	**CAUTION:** **Refer to Halogen Bulb Caution .** Front Fog Lamp Bulb**Tip:** Turn the bulb socket counter clockwise and remove from lamp assembly.

FOG LAMP BULB REPLACEMENT - FRONT

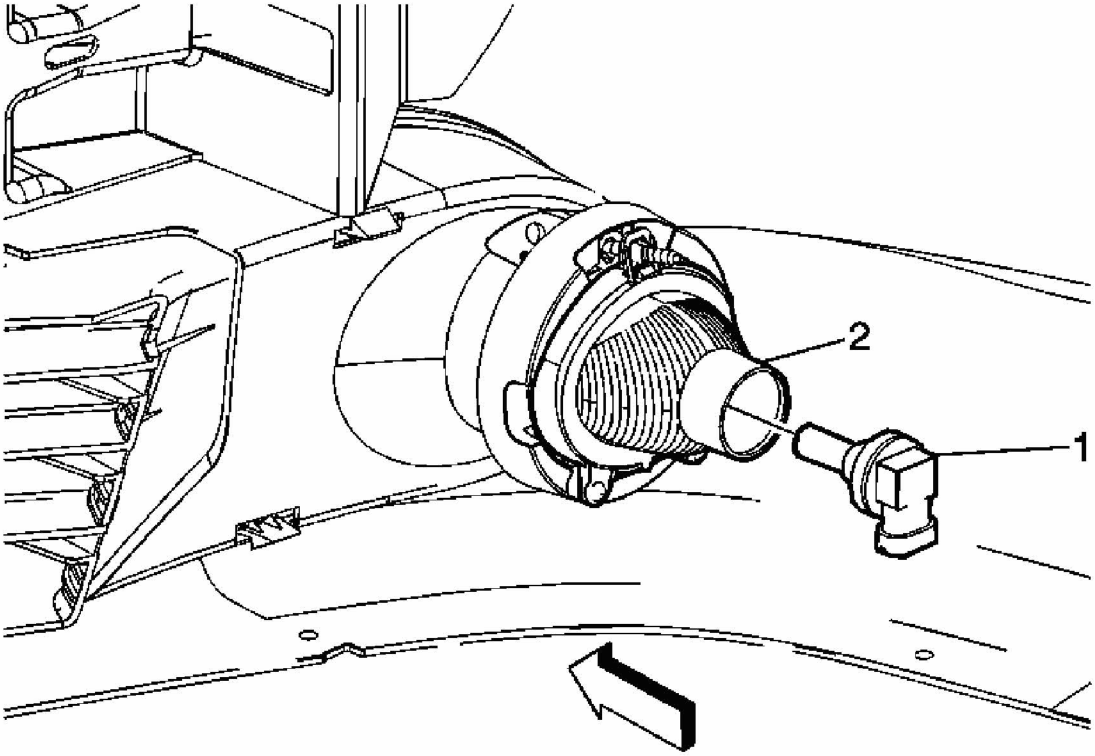


Fig. 102: Replacing Fog Lamp Bulb
Courtesy of GENERAL MOTORS CORP.

Fog Lamp Bulb Replacement - Front

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	

1. Remove either the LF or RF headlamp assembly. Refer to **Headlamp Replacement (Impala)**. 2. Disconnect the fog lamp electrical connector.	
1	Bulb, Front Fog Lamp Projector **CAUTION:** **Refer to Halogen Bulb Caution .** **Tip:** Twist the bulb socket counterclockwise to remove from the lamp housing.
2	Housing, Front Fog Lamp Projector

FOG LAMP AIMING PROCEDURE

The front fog lamps must be aimed for proper illumination of the road. The front fog lamp aim should be checked when a new front fog lamp assembly is installed, or if service or repairs in the front end area may have disturbed the front fog lamp mounting.

There is no horizontal adjustment for aiming the front fog lamp assemblies on this vehicle.

1. To ensure accurate vertical front fog lamp aiming, first perform the following steps to prepare the vehicle.
    - Ensure that all the components are in place on the vehicle, if other service has been performed on the vehicle.
    - Ensure the fuel level is full.
    - Place the vehicle on a level surface 1.52 m (5 ft) away from a target screen.
    - Stop all other operations of work on the vehicle.
    - Jounce the vehicle to settle the suspension.
    - Cover the headlamps while aiming the fog lamps.
2. Turn the front fog lamps ON.

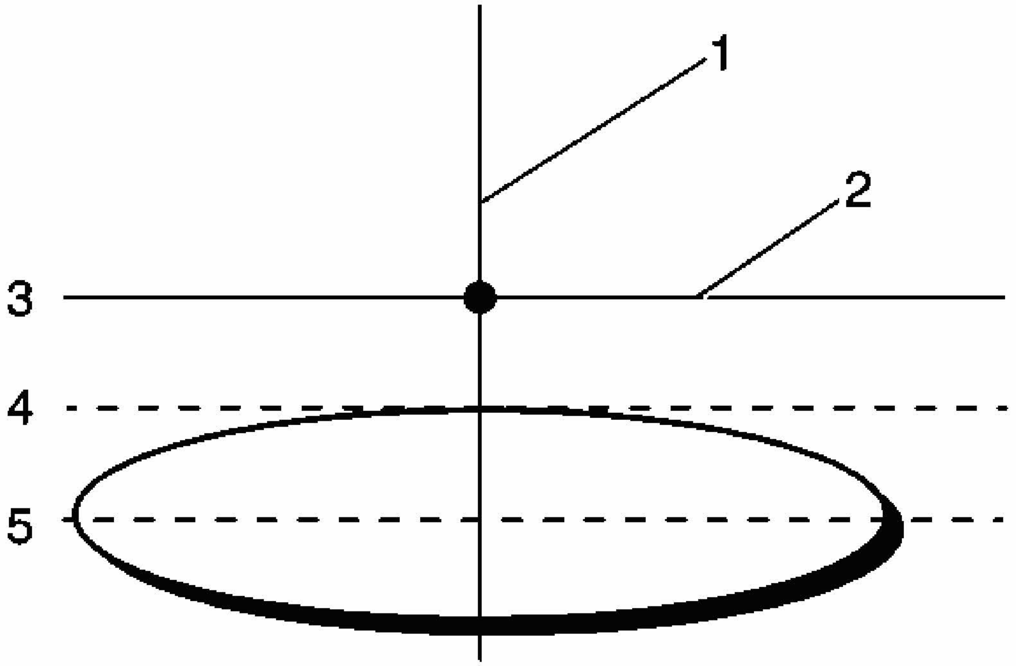


Fig. 103: Fog Lamp Aiming Pattern
Courtesy of GENERAL MOTORS CORP.

3. Adjust the fog lamp up or down until the top edge of the high intensity zone on the screen is 102 mm (4 in) below the horizontal centerline (2), within the range of 0 mm (0 in) (3) to 203 mm (8 in) (5), below the horizontal centerline, on the target screen.
4. Turn OFF the front fog lamps.

HIGH MOUNTED STOP LAMP REPLACEMENT (MONTE CARLO)

Removal Procedure

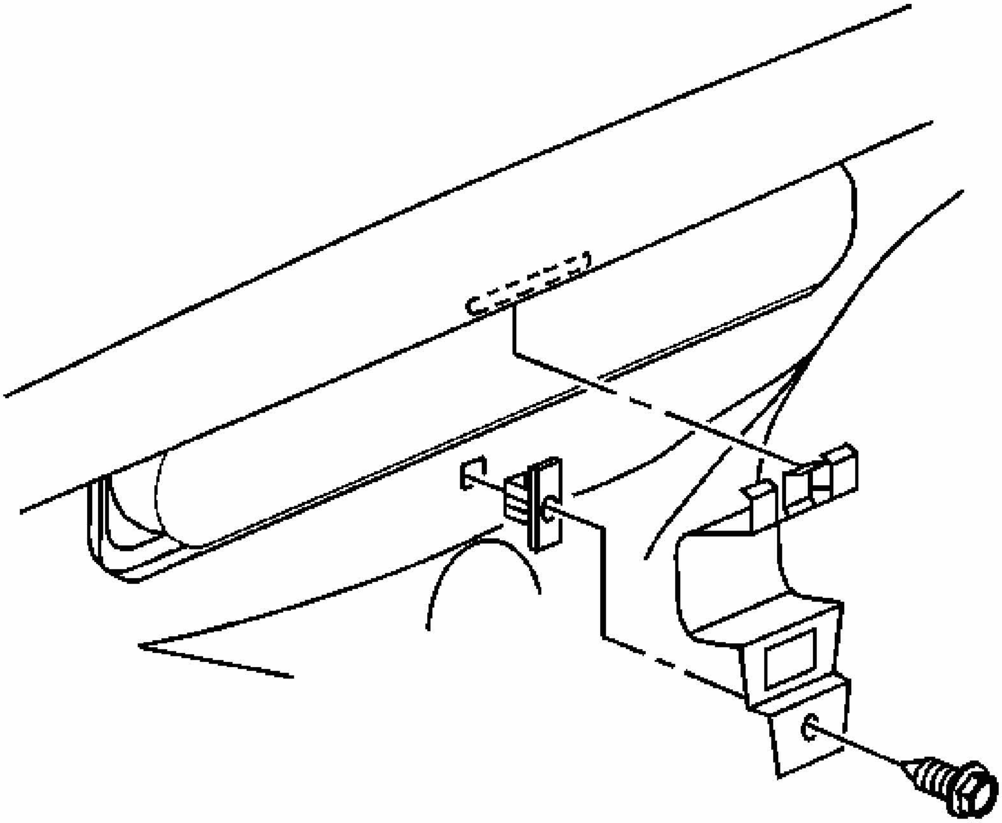


Fig. 104: High Mounted Stoplamp Bracket
Courtesy of GENERAL MOTORS CORP.

1. Open the rear compartment.
2. Remove the screw from the high mounted stoplamp bracket.
3. Remove the high mounted stoplamp bracket.

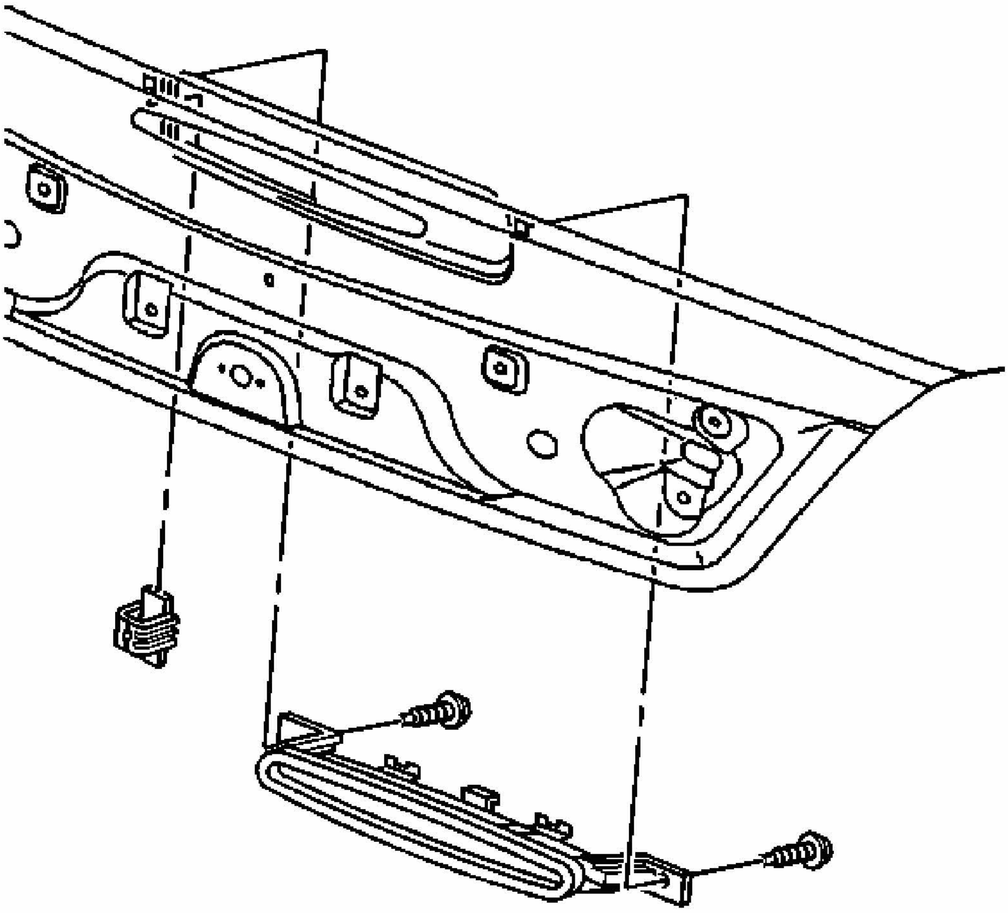


Fig. 105: High Mounted Stoplamp
Courtesy of GENERAL MOTORS CORP.

4. Remove the screws from the high mounted stoplamp.
5. Depress the retainers holding the high mounted stoplamp to the inner panel of the compartment lid.
6. Remove the high mounted stoplamp from the rear compartment lid inner panel.

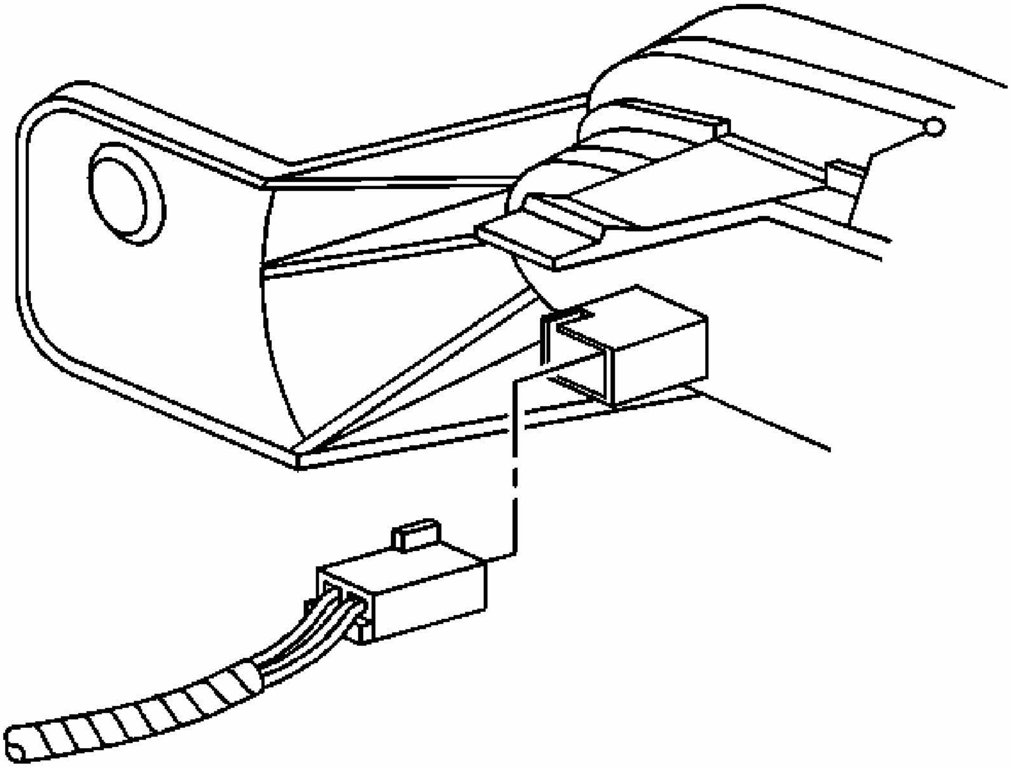


Fig. 106: High Mounted Stoplamp Electrical Connector
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the electrical connector from the high mounted stoplamp.

Installation Procedure

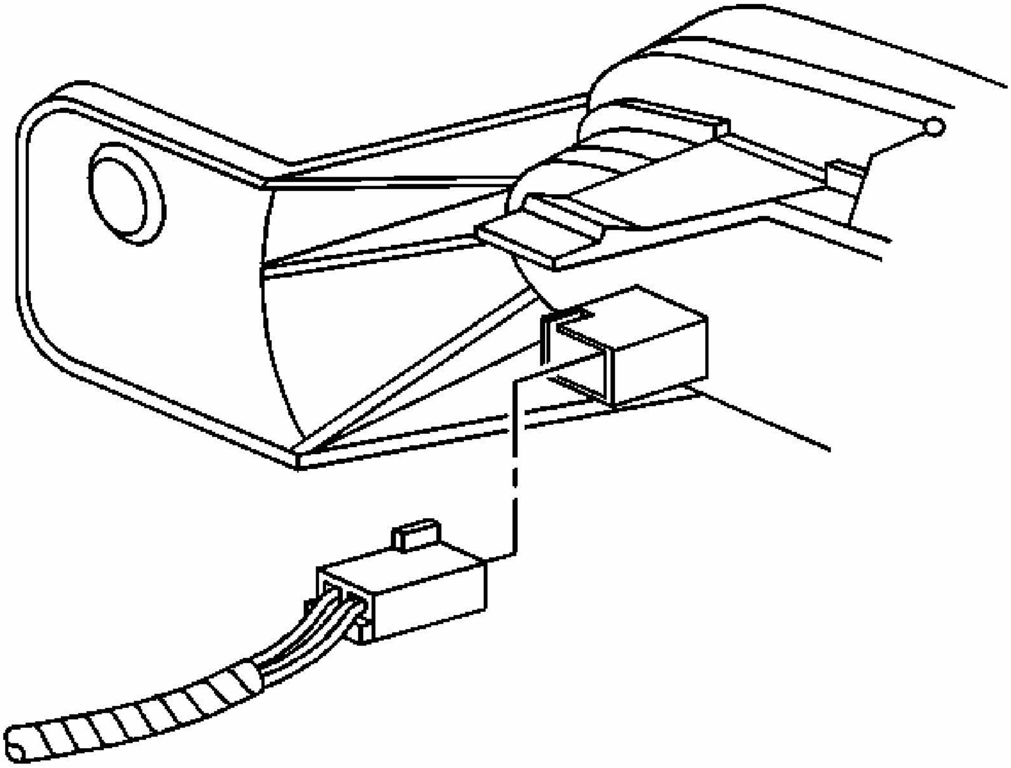


Fig. 107: High Mounted Stoplamp Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Connect the electrical connector to the high mounted stoplamp.

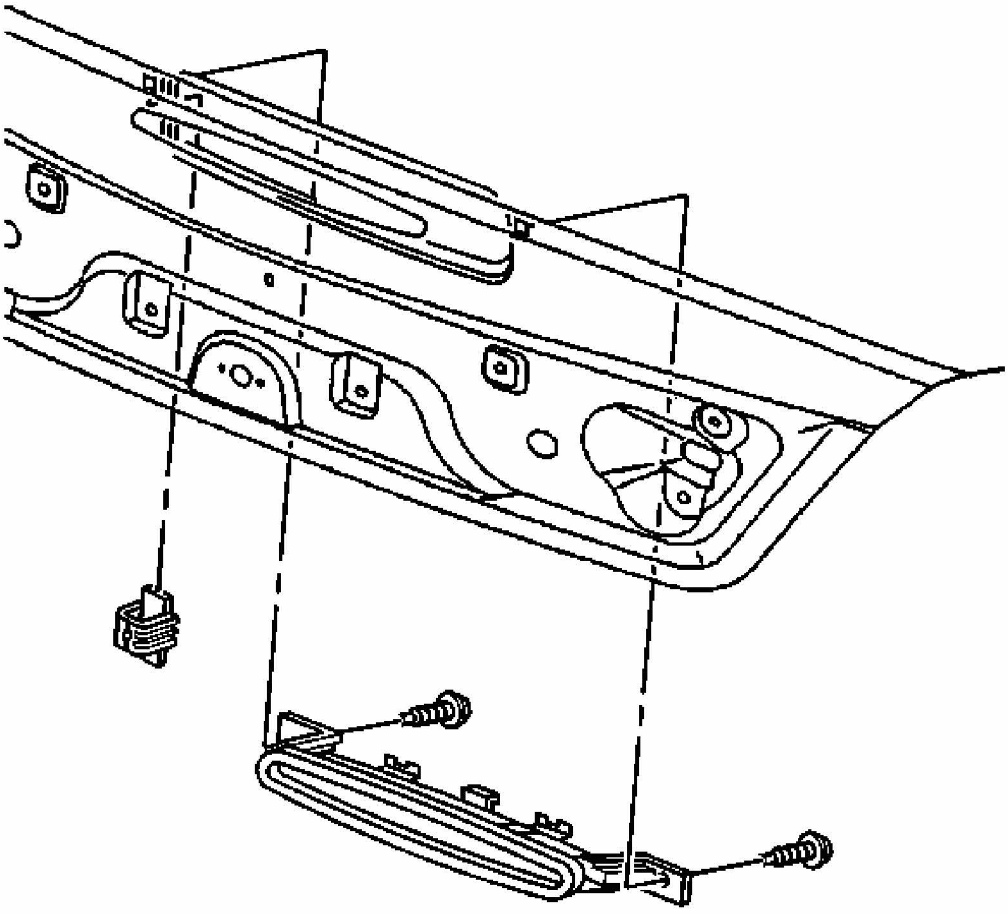


Fig. 108: High Mounted Stoplamp
Courtesy of GENERAL MOTORS CORP.

2. Install the high mounted stoplamp pressing in until the retainers are fully seated.

NOTE: **Refer to FASTENER NOTICE .**

3. Install the screws to the high mounted stoplamp.

Tighten: Tighten the high mounted stoplamp screws to 2 N.m (18 lb in).

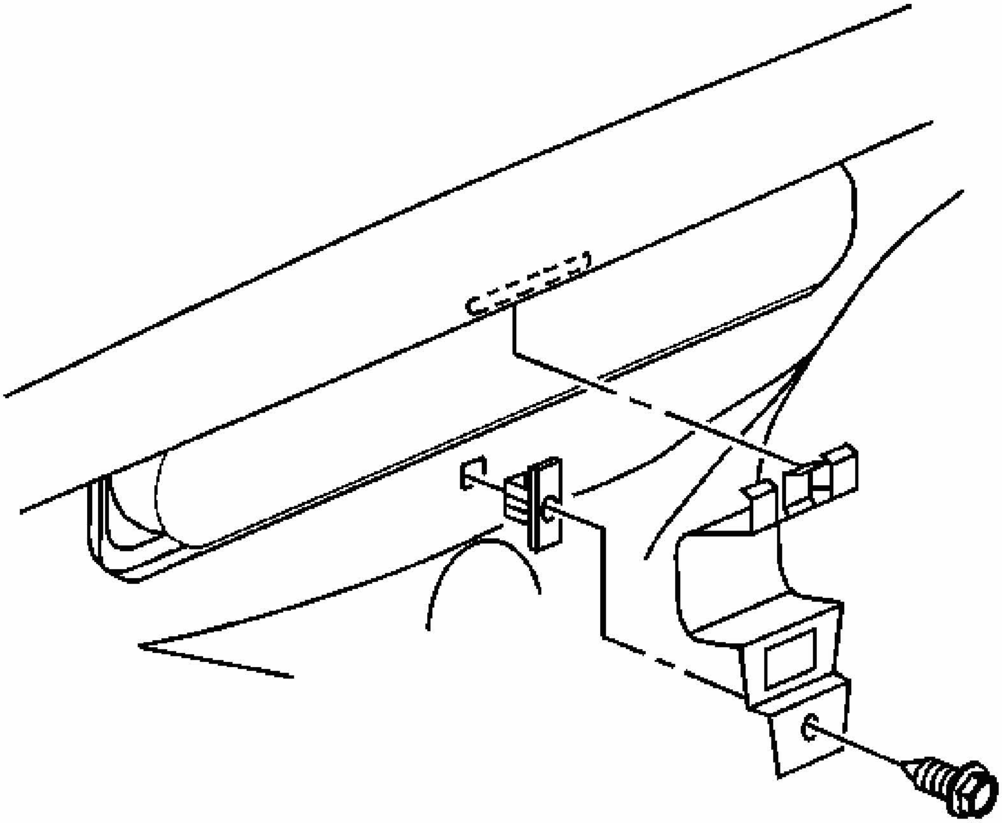


Fig. 109: High Mounted Stoplamp Bracket
Courtesy of GENERAL MOTORS CORP.

4. Install the high mounted stoplamp bracket.
5. Install the screw to the high mounted stoplamp bracket.

   Tighten: Tighten the high mounted stoplamp bracket screw to 2 N.m (18 lb in).

6. Close the rear compartment.

HIGH MOUNTED STOP LAMP REPLACEMENT (IMPALA)

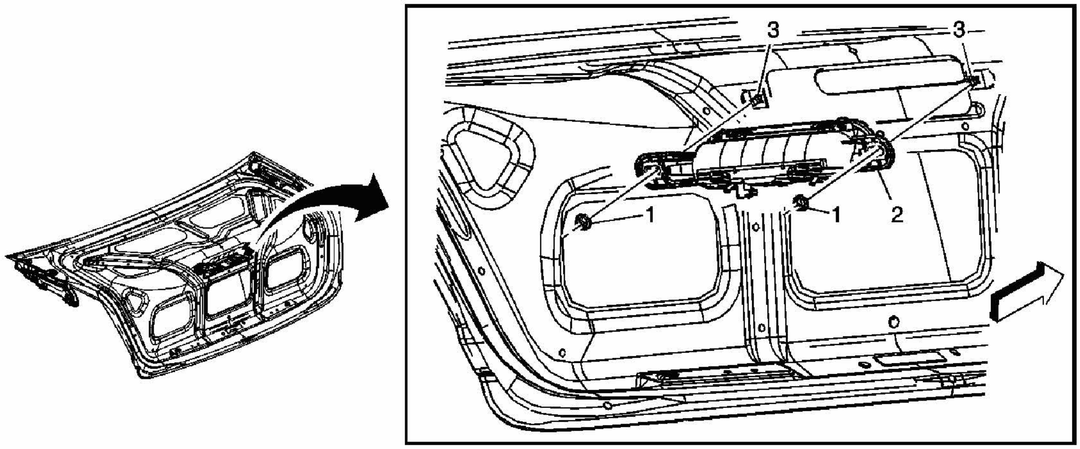


Fig. 110: Replacing High Mounted Stop Lamp
Courtesy of GENERAL MOTORS CORP.

High Mounted Stop Lamp Replacement (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the rear interior compartment lid trim. Refer to **Compartment Lid Trim Replacement - Rear** .	
1	Nuts, High Mounted Stop Lamp Assembly (Qty: 2) **Tighten:** 4 N.m (35 lb in)
2	Lamp Assembly, High Mounted Stop **Tip:** • Remove the high mounted stop lamp from the inside of the rear compartment lid mounting studs. • Disconnect the electrical connector to the high mounted stop lamp.
3	Studs, Rear Compartment Inner Panel **Tip:** Ensure the studs are secure to the inner compartment panel upon reassemble.

BACKUP LAMP BULB REPLACEMENT

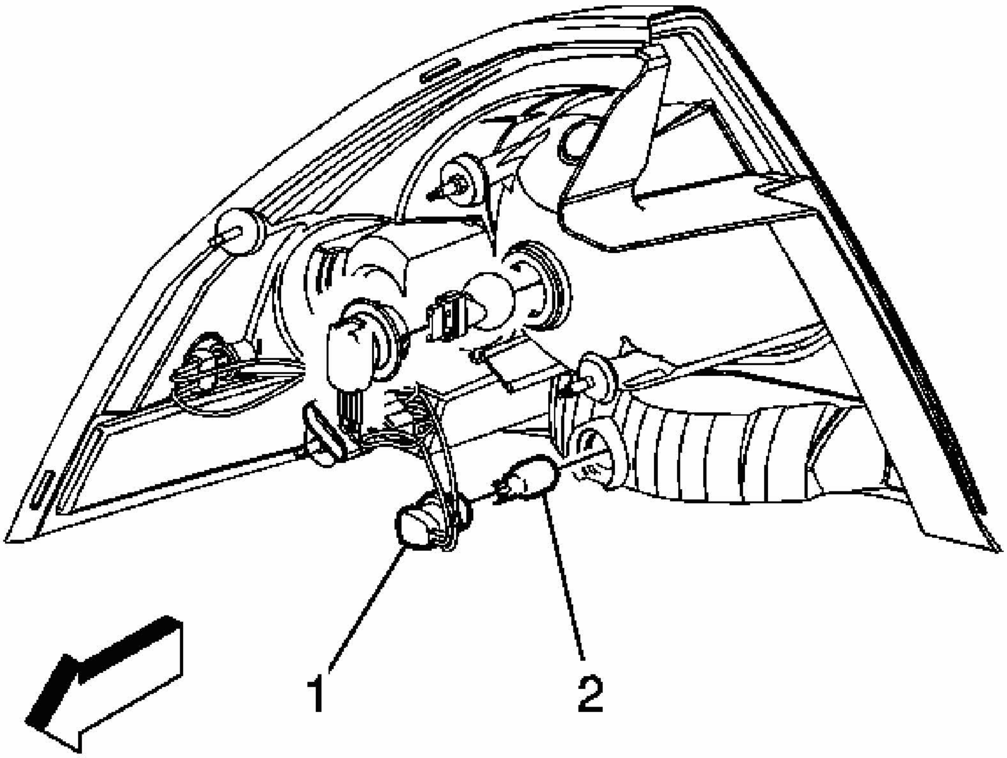


Fig. 111: Replacing Backup Lamp Bulb
Courtesy of GENERAL MOTORS CORP.

Backup Lamp Bulb Replacement

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove either the LR or RR tail lamp assembly. Refer to **Tail Lamp Replacement (Monte Carlo)** or **Tail Lamp Replacement (Impala)**.	
1	Socket, Reverse Lamp Bulb **Tip:** Twist the socket counterclockwise a quarter turn to remove.
2	Bulb, Reverse Lamp **Tip:** Pull outward on the bulb in order to replace.

REAR LICENSE LAMP REPLACEMENT (MONTE CARLO)

Removal Procedure

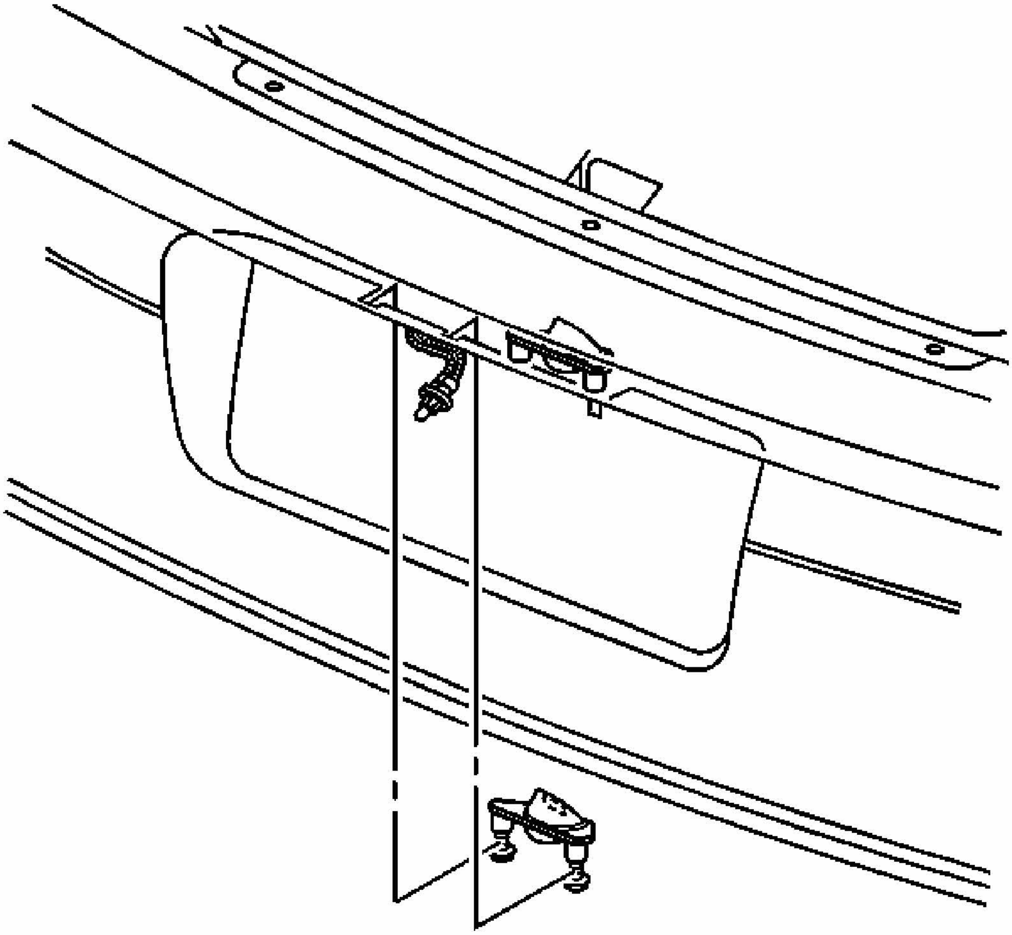


Fig. 112: License Plate Lamp (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Remove the screws from the license plate lamp.
2. Remove the license plate lamp from the rear bumper fascia.
3. Remove the license plate lamp socket, turning counterclockwise.
4. Remove the bulb from the license plate lamp socket.

Installation Procedure

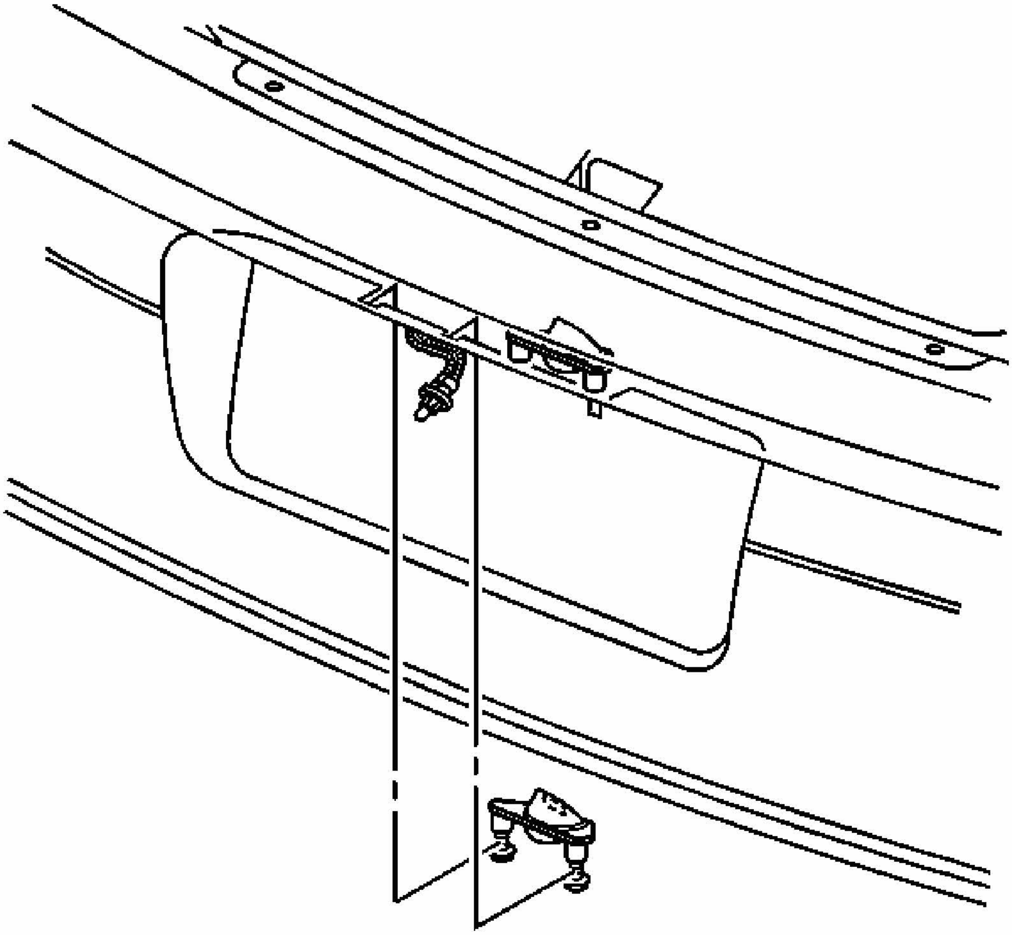


Fig. 113: License Plate Lamp (Impala)
Courtesy of GENERAL MOTORS CORP.

1. Install the bulb to the license plate lamp socket.
2. Install the license plate lamp socket, turning clockwise.
3. Install the license plate lamp to the rear bumper fascia.

NOTE: **Refer to FASTENER NOTICE .**

4. Install the screws to the license plate lamp.

Tighten: Tighten the license plate lamp screws to 2 N.m (18 lb in).

REAR LICENSE LAMP REPLACEMENT (IMPALA)

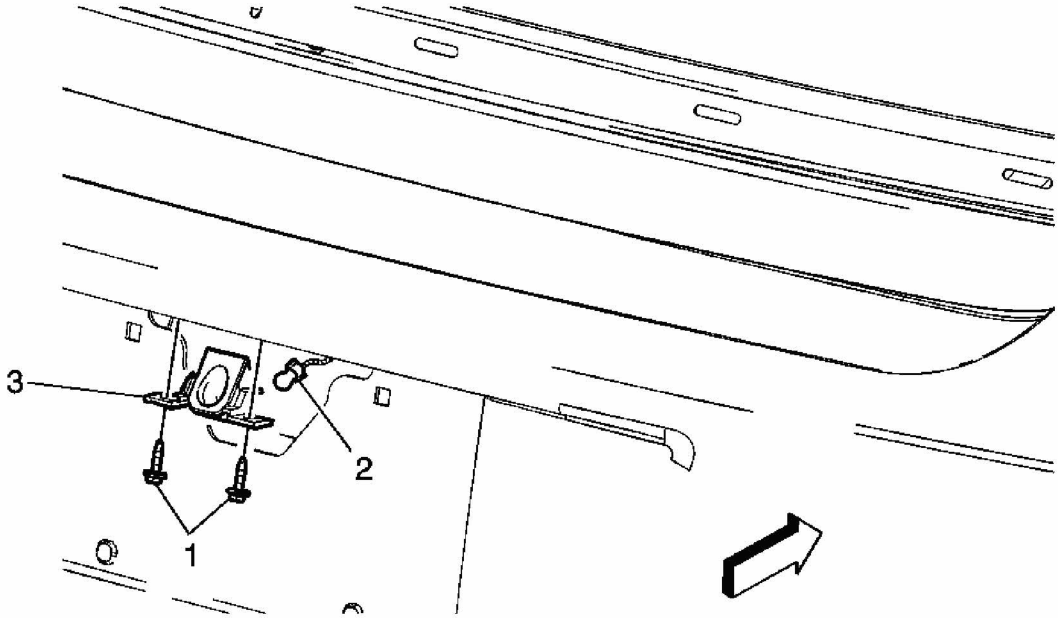


Fig. 114: Replacing Rear License Lamp
Courtesy of GENERAL MOTORS CORP.

License Lamp Replacement (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Screws, Rear License Plate Lamp (Qty: 2) **Tighten:** 2 N.m (18 lb in)
2	Lamp, Rear License **Tip** 1. Pull downward on the lamp in order to access the lamp electrical connector on the inside of the rear bumper fascia. 2. Twist the connector socket counterclockwise in order to remove from the lamp housing. 3. Pull the bulb outward to remove from the socket.
3	Lens, Rear License Plate **Tip:** Snap lens into outer rear compartment lid upon installation.

TAIL LAMP REPLACEMENT (MONTE CARLO)

Removal Procedure

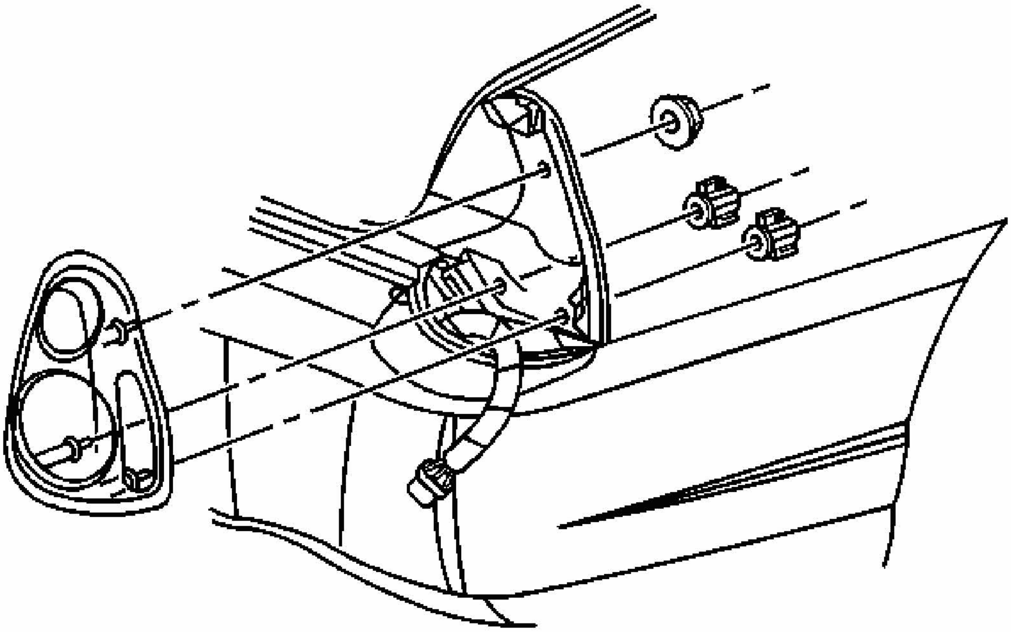


Fig. 115: Tail Lamp & Components (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

1. Open the rear compartment.
2. Remove the upper wingnut from the tail lamp.
3. Pull back the rear compartment trim panel from the tail lamp.
4. Remove the lower wingnuts from the tail lamp.
5. Remove the tail lamp from the rear body panel.

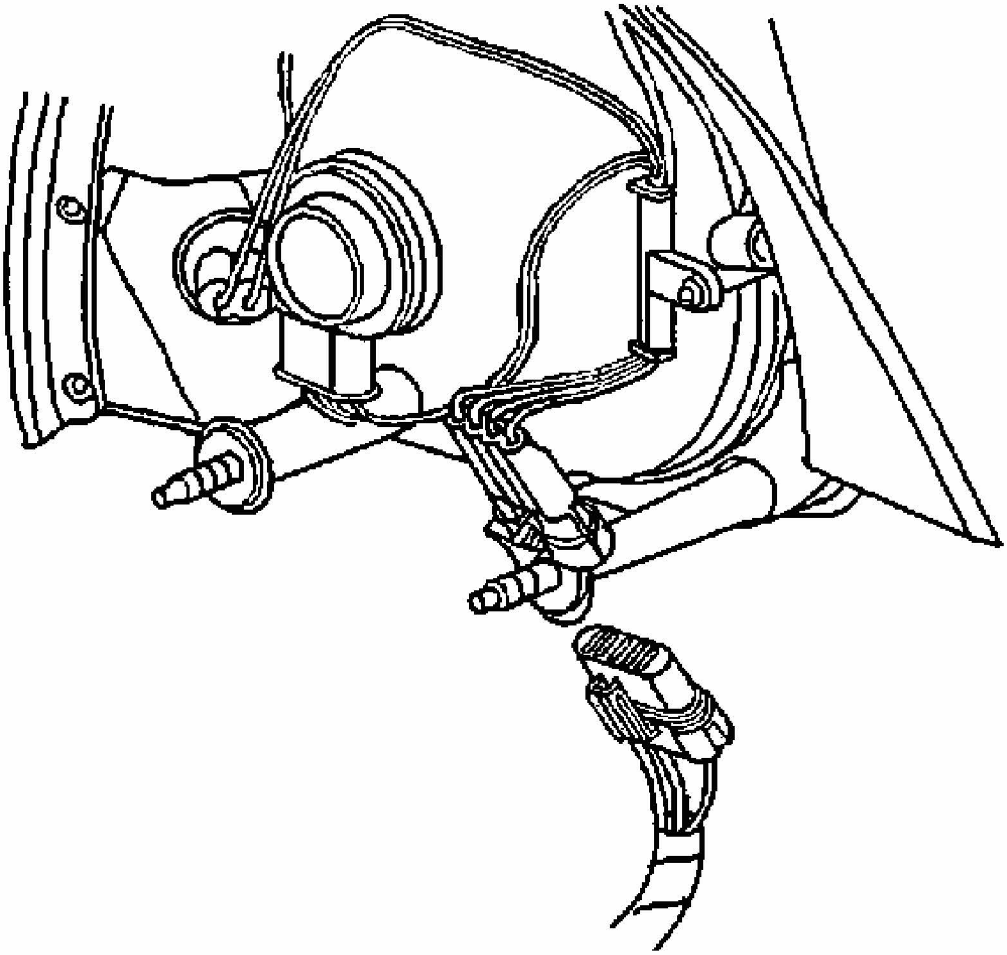


Fig. 116: Tail Lamp Electrical Connector (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the electrical connector to the tail lamp.

NOTE: Note the correct routing of the electrical wiring. Failure to reinstall the wiring properly could result in damage to the wiring.

7. Disconnect the electrical connector from the tail lamp.
8. Remove the tail lamp socket, turning counterclockwise.
9. Remove the bulb from the tail lamp socket.
10. Remove the sidemarker lamp socket, turning counterclockwise.
11. Remove the bulb from the sidemarker lamp socket.

Installation Procedure

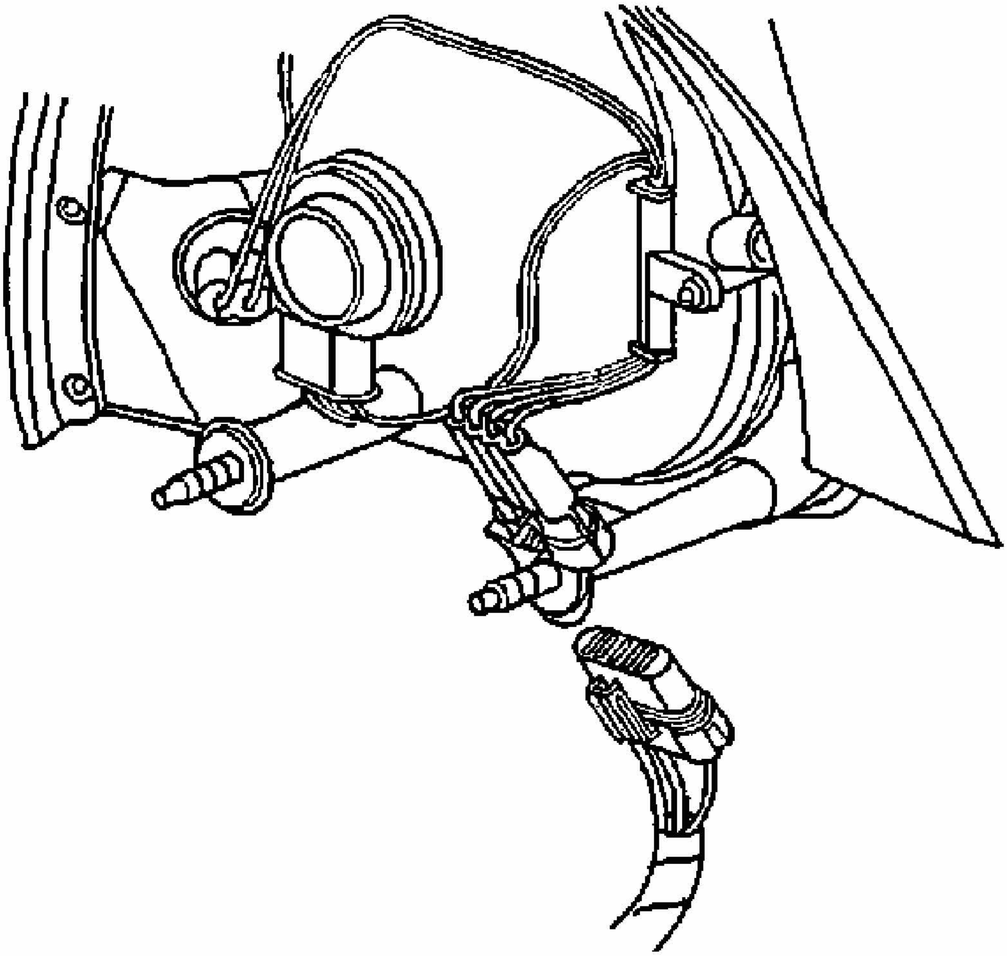


Fig. 117: Tail Lamp Electrical Connector (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

1. Install the bulb to the tail lamp socket.
2. Install the bulb to the sidemarker lamp socket.
3. Install the sidemarker lamp socket, turning clockwise.
4. Install the tail lamp socket, turning clockwise.

NOTE: Note the correct routing of the electrical wiring. Failure to reinstall the wiring properly could result in damage to the wiring.

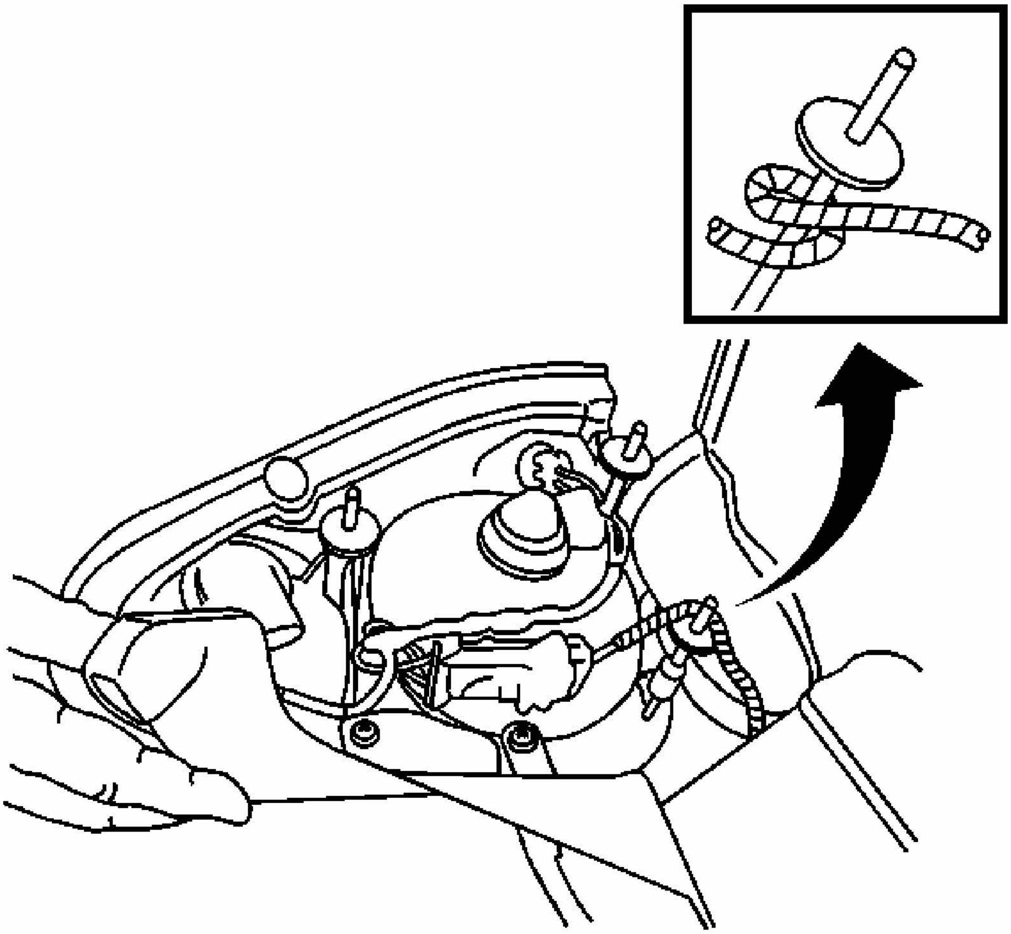


Fig. 118: Tail Lamp Electrical Wiring
Courtesy of GENERAL MOTORS CORP.

5. Connect the electrical connector to the tail lamp.

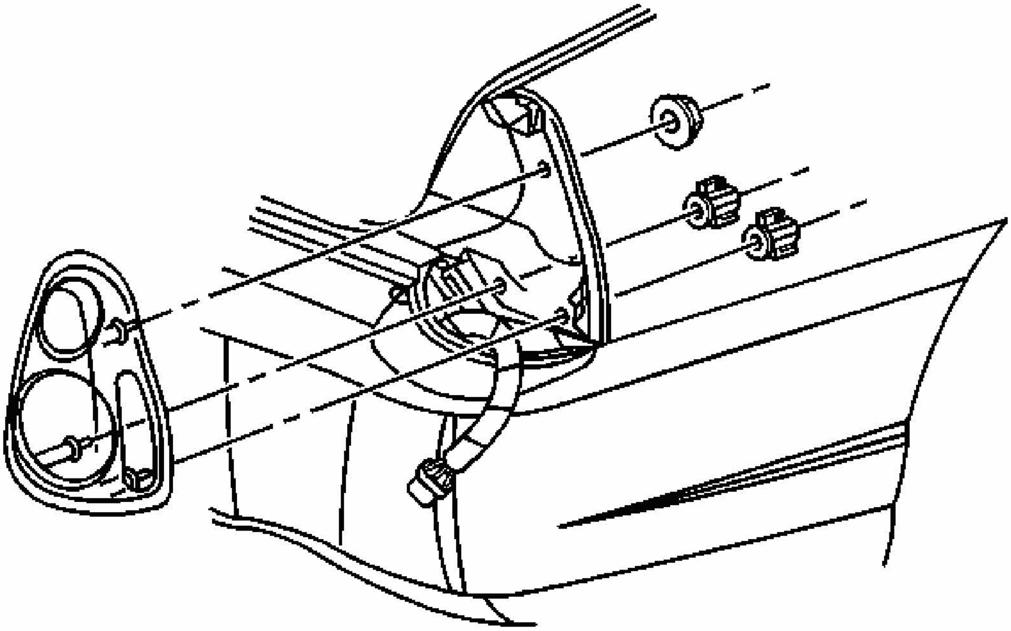


Fig. 119: Tail Lamp & Components (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

6. Install the tail lamp to the rear body panel
7. Install the lower wingnuts to the tail lamp.
8. Pull back the rear compartment trim panel to the tail lamp.
9. Install the upper wingnut to the tail lamp.
10. Close the rear compartment.

TAIL LAMP REPLACEMENT (IMPALA)

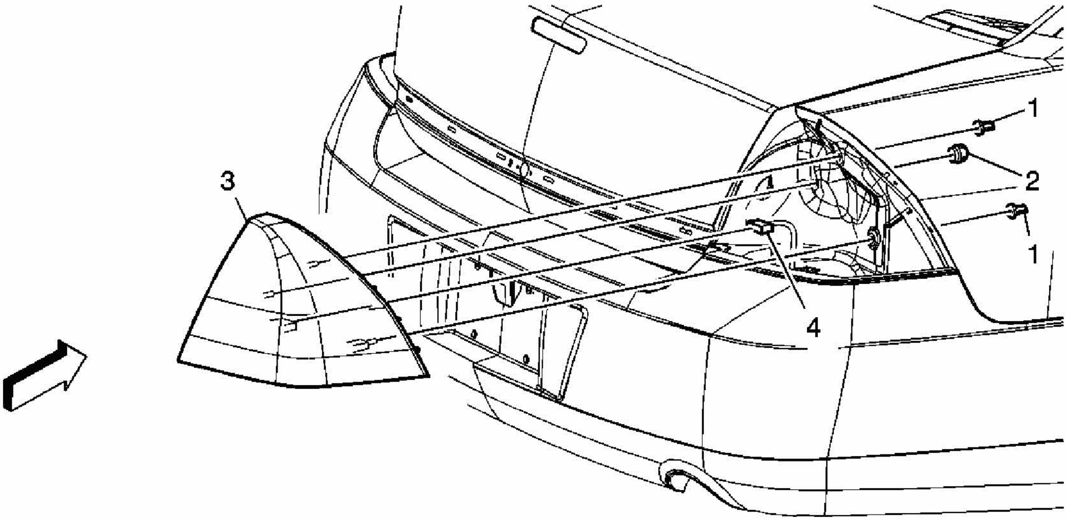


Fig. 120: Replacing Tail Lamp
Courtesy of GENERAL MOTORS CORP.

Tail Lamp Replacement (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedures** 1. Open the rear compartment lid. 2. Remove the nut securing the rear compartment trim the backside of the tail lamp assembly. 3. Pull down the rear compartment trim liner.	
1	Nuts, Tail Lamp Assembly (Qty: 2) **Tighten:** 2 N.m (18 lb in)
2	Nut, Trunk Trim Liner **Tip:** Ensure the trim liner nut is installed after the liner is repositioned in the rear compartment.
3	Lamp Assembly, Tail **Tip:** Pull rearward to remove and connect the electrical connector and push lamp inward in order to position the lamp to the body panel.
4	Connector, Rear Lamp Harness Ensure to connect the lamp harness connector before securing the lamp to

	the rear body panel.

TAIL LAMP BULB REPLACEMENT

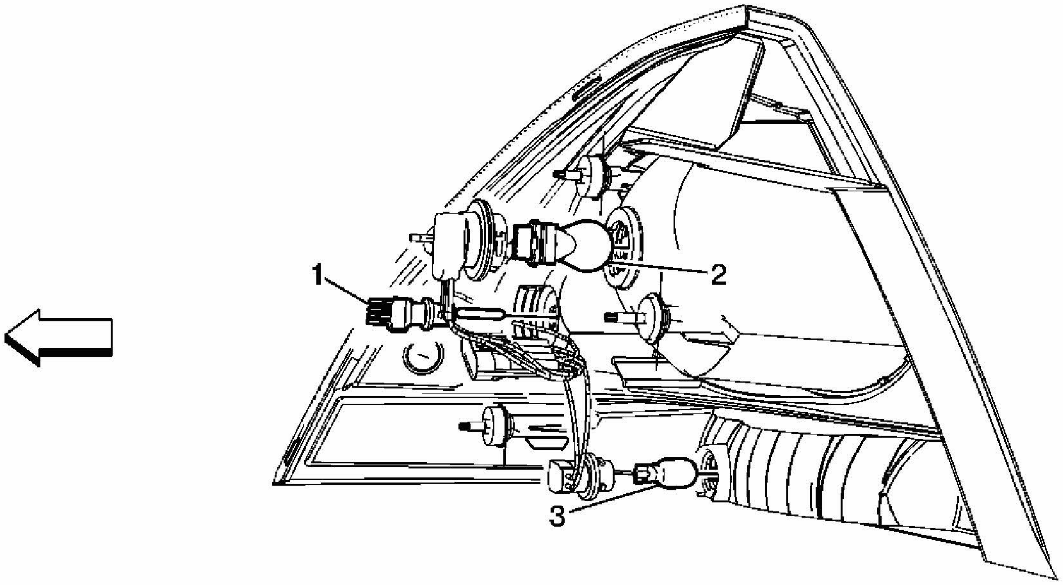


Fig. 121: Replacing Tail Lamp Bulb
Courtesy of GENERAL MOTORS CORP.

Tail Lamp Bulb Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure** Remove either the LR or RR tail lamp assembly. Refer to **Tail Lamp Replacement (Monte Carlo)** or **Tail Lamp Replacement (Impala)**.	
1	Bulb, Rear Park Lamp **Tip:** Turn the lamp socket counterclockwise in order to remove.
2	Bulb, Park and Turn Signal Assembly **Tip:** Pull the bulb straight out of the lamp socket.
3	Bulb, Rear Back Up Assembly **CAUTION:** **Refer to Halogen Bulb Caution .**

	Tip: Remove the bulb from the lamp socket by pulling the bulb straight outward from the socket.

TURN SIGNAL LAMP BULB REPLACEMENT - REAR

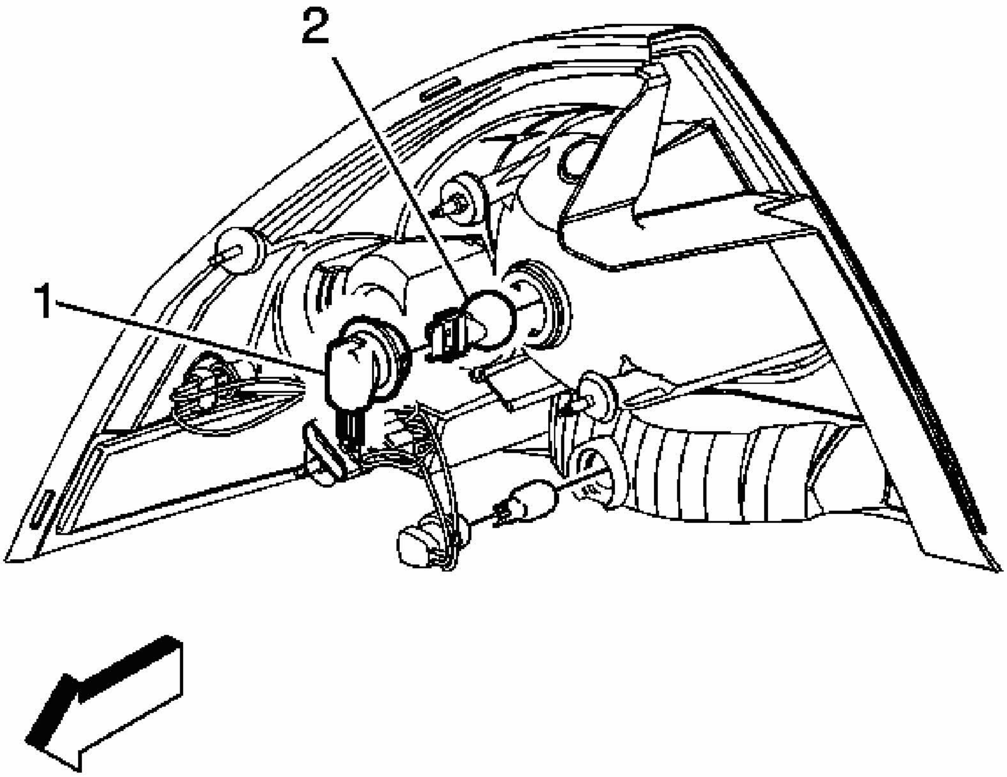


Fig. 122: Replacing Rear Turn Signal Lamp Bulb
Courtesy of GENERAL MOTORS CORP.

Turn Signal Lamp Bulb Replacement - Rear

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove either the LR or RR tail lamp assembly. Refer to **Tail Lamp Replacement (Monte Carlo)** or **Tail Lamp Replacement (Impala)**.	
1	Socket, Stop and Tail Lamp **Tip:** Twist the socket counterclockwise a quarter turn to remove.
2	Bulb, Stop and Tail Lamp

	Tip: Pull outward on the bulb in order to replace.

EMERGENCY VEHICLE REAR COMPARTMENT LID LAMP REPLACEMENT (IMPALA RPO T53)

Removal Procedure

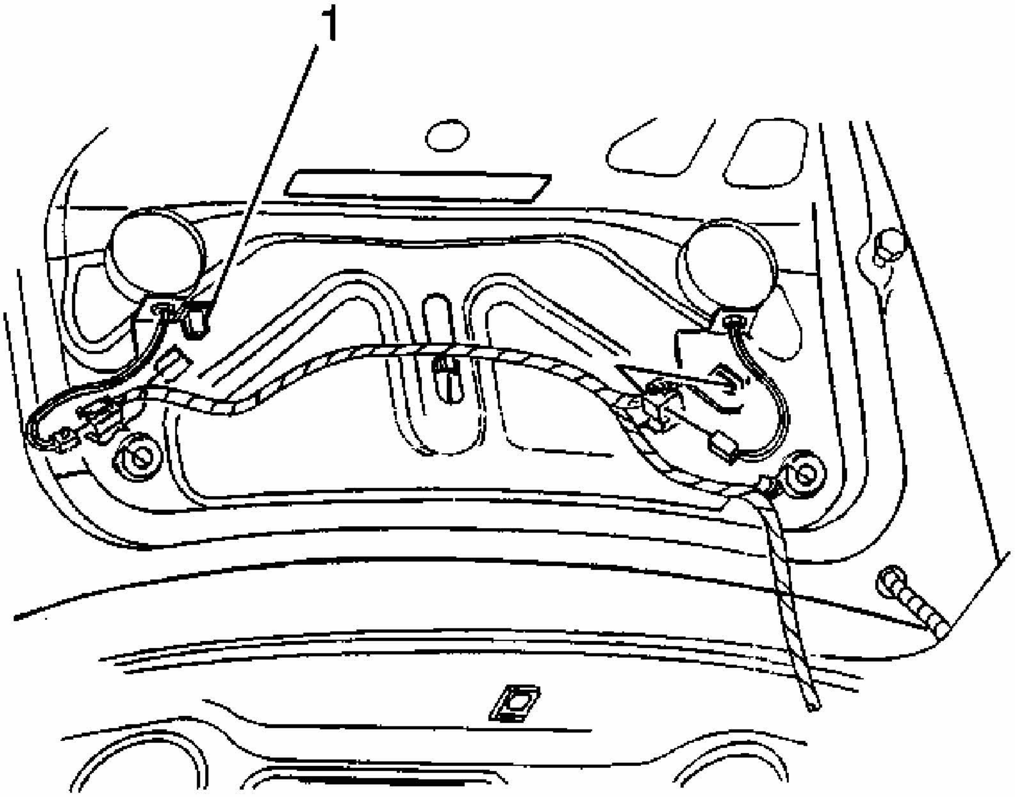


Fig. 123: Rear Compartment Lid Lamps & Flasher Fuse
Courtesy of GENERAL MOTORS CORP.

1. Open the rear compartment.
2. Disconnect the electrical connectors from the rear compartment lid lamp(s).
3. Disconnect the electrical connector from the flasher fuse (1).
4. Remove the flasher fuse (1) if required.

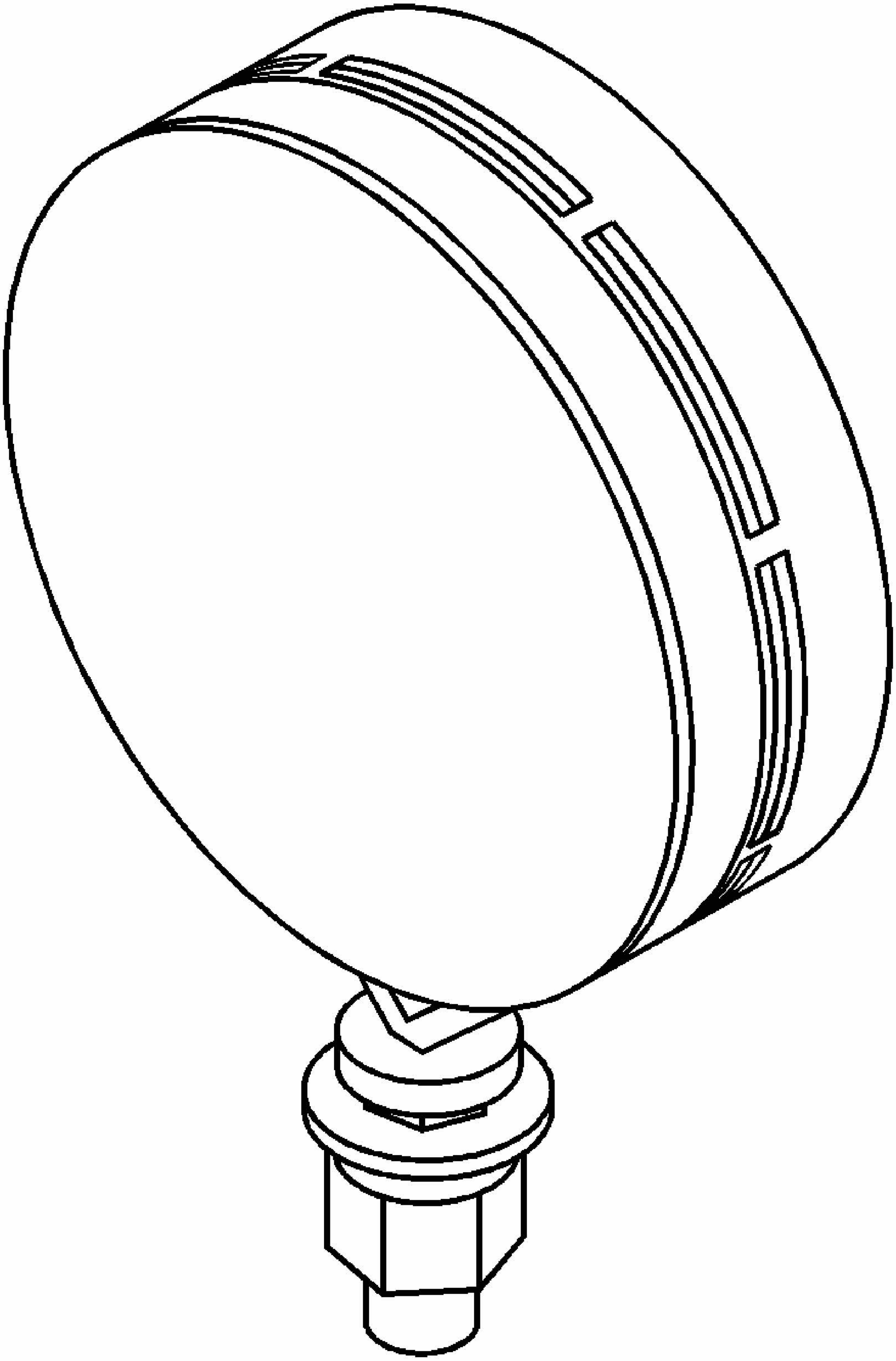


Fig. 124: Removing The Rear Compartment Lid Lamp From The Rear

Compartment Lid
Courtesy of GENERAL MOTORS CORP.

5. Remove the rear compartment lid lamp(s) from the rear compartment lid.

Installation Procedure

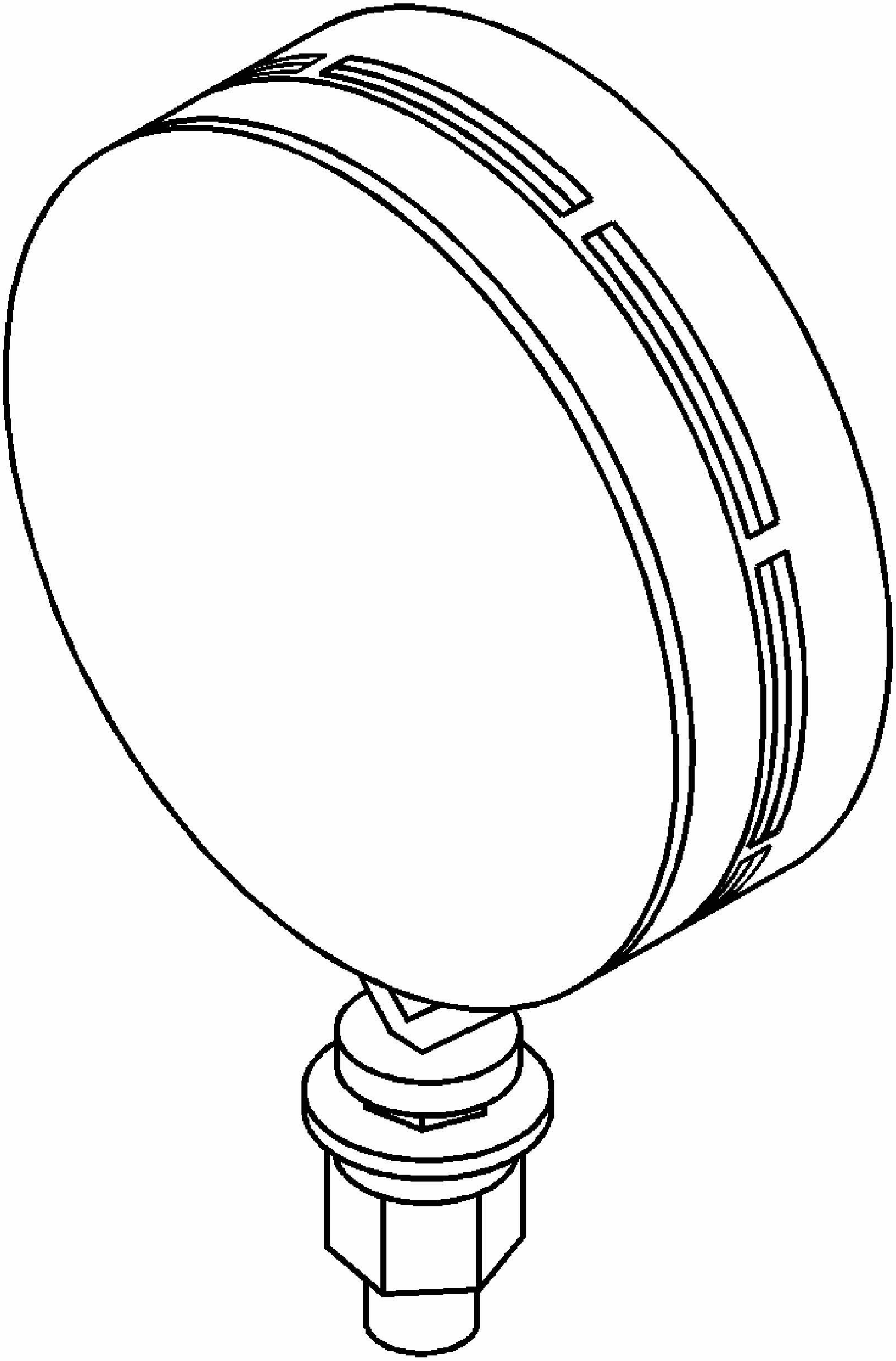


Fig. 125: Installing The Rear Compartment Lid Lamp From The Rear Compartment

Lid
Courtesy of GENERAL MOTORS CORP.

1. Position the rear compartment lid lamp(s) from the rear compartment lid.

NOTE: **Refer to FASTENER NOTICE .**

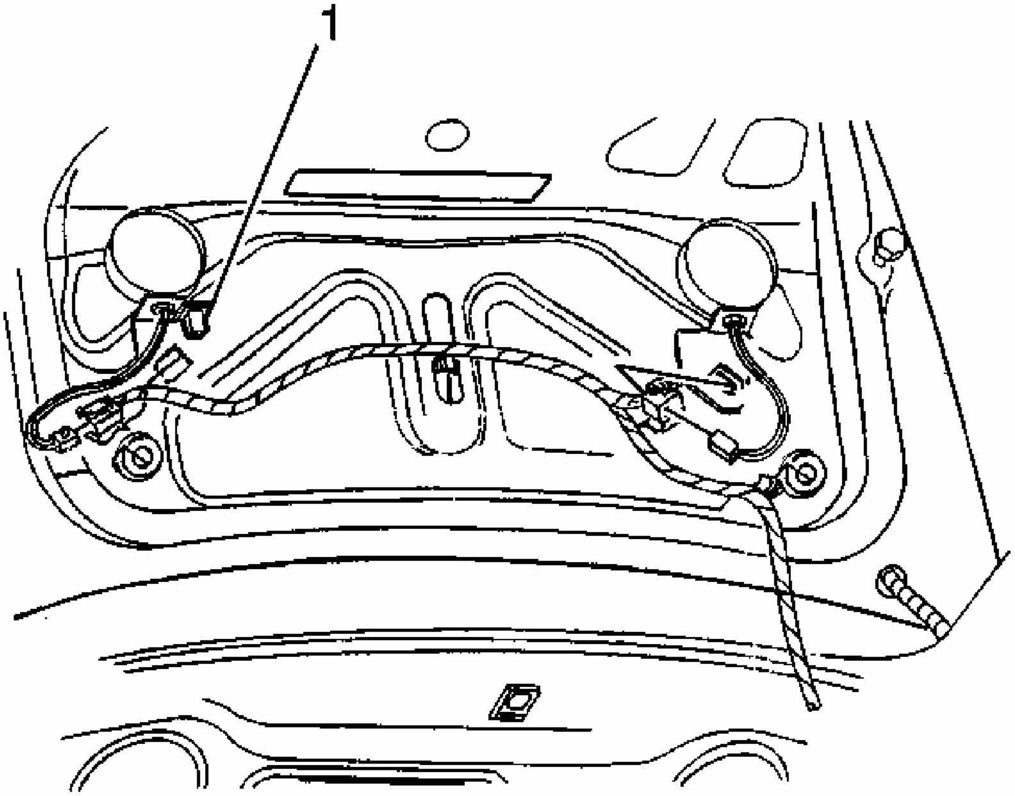


Fig. 126: Rear Compartment Lid Lamps & Flasher Fuse
Courtesy of GENERAL MOTORS CORP.

2. Install the flasher fuse (1) if required.
3. Connect the electrical connector to the flasher fuse (1).
4. Connect the electrical connectors to the rear compartment lid lamp(s).
5. Close the rear compartment.

REAR COMPARTMENT LAMP REPLACEMENT

Removal Procedure

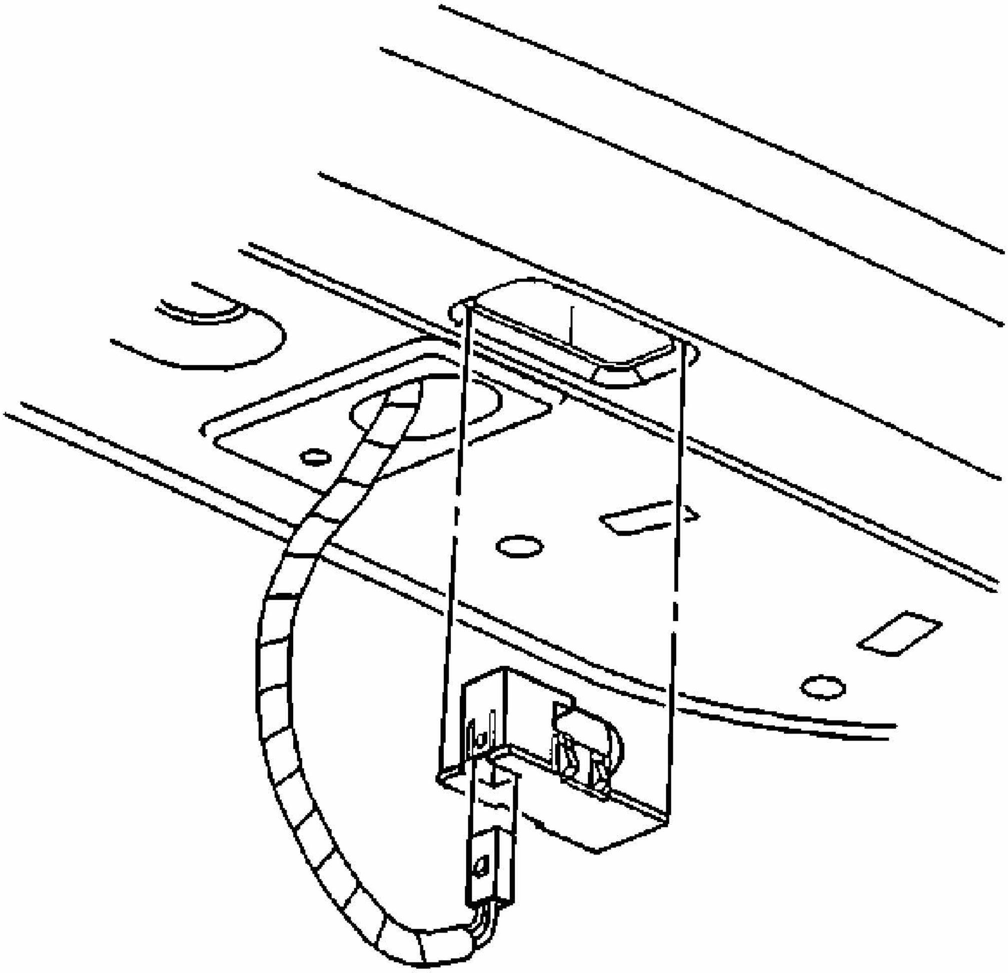


Fig. 127: Rear Compartment Lamp
Courtesy of GENERAL MOTORS CORP.

1. Open the rear compartment.
2. Remove the rear compartment lamp using a small flat-bladed tool to release the retaining tabs.
3. Remove the bulb from the rear compartment lamp socket.

Installation Procedure

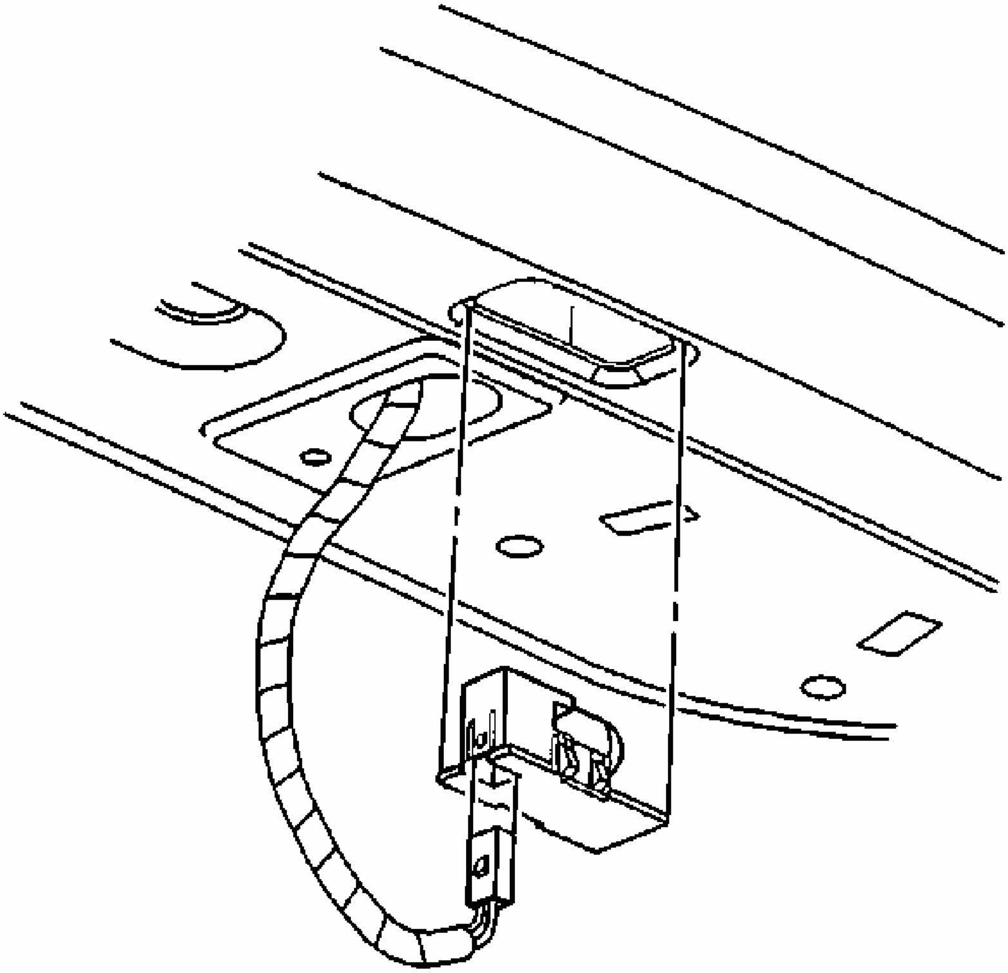


Fig. 128: Rear Compartment Lamp
Courtesy of GENERAL MOTORS CORP.

1. Install the bulb to the rear compartment lamp socket.
2. Install the rear compartment lamp, pressing into place until full seated.
3. Close the rear compartment.

DESCRIPTION AND OPERATION

EXTERIOR LIGHTING SYSTEMS DESCRIPTION AND OPERATION

Exterior Lamps

The exterior lighting consist of the following lamps:

- Headlamps
- Fog Lamps
- Park Lamps
- Tail Lamps
- License Lamps
- Marker Lamps
- Turn Signal Lamps
- Stop Lamps
- Backup Lamps

Headlamps

You can use the headlamps two different ways.

- Place the headlamp switch in the HEAD position for normal operations
- Place the headlamp switch in the OFF position for automatic lamp control (ALC) operation. During ALC the low beam headlamps are ON for daytime running lamp (DRL) operation in daylight conditions at reduced intensity or low beam headlamps ON at full intensity with exterior park lamps ON in low light conditions.

The body control module (BCM) applies a pulse width modulated (PWM) voltage to the headlamp module and high beam relay in the underhood fuse block. The ground for the headlamp module is supplied from G113 or G115. For normal manual low beam operation when the headlamp switch is place in the HEAD position, ground from G202 is applied through the headlamp switch and to the BCM through the headlamp switch headlamps ON signal circuit. The BCM then applies a PWM voltage to the headlamp module/high beam relay voltage supply circuit. The headlamp module then applies battery positive voltage through the left front (LF) and right front (RF) LO Beam fuses to the left and right low beam headlamps. The ground for the left headlamps is supplied by G101 and the ground for the right headlamp is supplied by G100.

For high beam operation, ground is applied at all times to the headlamp dimmer switch from G202. When the headlamp dimmer switch is placed in the HIGH position, ground is then applied through the headlamp dimmer switch signal circuit to the BCM. The BCM then applies a ground to the headlamp high beam relay control circuit. This energizes the HI Beam relay, the relay then applies battery positive voltage through the LF and RF HI BEAM fuses to the LF and RF high beam headlamps. The ground for the left headlamps is supplied by G101 and the ground for the right headlamp is supplied by G100.

The BCM then sends a class 2 message to the instrument cluster in order to illuminate the high beam indicator lamp. If the headlamp switch is left in the HEAD position, the inadvertent power control feature will turn OFF the headlamps after 10 minutes after you turn the ignition switch to the OFF position. If you place the headlamp switch in the head position after the ignition switch has been turned OFF, or if the ignition switch is in ACCY position, the headlamps will remain ON until you turn them OFF or until the battery runs dead.

HDLPS Suggested Indicator

If the park lamps are turned ON manually and the ambient light sensor detects a low light condition then the body control module (BCM) will send a class 2 message to the instrument panel cluster (IPC) to illuminate the HDLP suggested indicator.

Lights ON Warning

The body control module (BCM) activates the lights ON warning as requested by the headlamp dimmer switch. The lights ON warning sounds when the following occurs:

- The key is out of the ignition.
- The BCM determines that the drivers door is open, signal is low.
- The BCM determines that the headlamp switch is in the PARK or HEAD position.

Daytime Running Lamps (DRL)

The ambient light sensor is a light-sensitive transistor that varies its voltage signal to the body control module (BCM) in response to changes in the outside (ambient) light level. When the BCM receives this signal the BCM either turns ON the just the low beam headlamps at reduced intensity for the daytime running lamp (DRL) operation or turns ON the low beam headlamps and the exterior lamps for automatic lamp control (ALC). Any function or condition that turns ON the headlamps will cancel the DRL operation. Thirty seconds after you start the engine with the headlamp switch in the OFF position, the DRL will perform one of two actions:

- Illuminate the low beam headlamps at reduced intensity in daylight conditions
- Illuminate the low beam headlamps and exterior park lamps for low light conditions

The DRL operates when the ignition switch is in the RUN position, the parking brake is not set and the transmission is not in the PARK position When these conditions are met and the DRL ambient light sensor indicates daylight conditions the DRL will illuminate

Fog Lamps

The FOG LPS fuse in the underhood fuse block supplies battery positive voltage to both the coil and switch side of the FOG LP Relay. When the fog lamp switch is placed in the ON position, ground is applied from G202 through the fog lamp switch to the body control module (BCM). The BCM then applies a ground to the fog lamp relay control circuit. This energizes the FOG LP relay and applies battery positive voltage through the fog lamp voltage supply circuit to the left and right fog lamps. Ground is applied at all times to the left fog lamp from G101 and to the right fog lamp from G100. The park lamps are headlamps must be ON in order for the fog lamps to illuminate. Fog lamp operation will be cancelled whenever the park lamps are turned OFF or the high beams are turned ON. When the park lamps are turned ON, the BCM sends a class 2 message to the instrument panel cluster (IPC) to illuminate the fog lamp indicator.

Park, Tail, Marker and License Lamps

The PK LAMPS fuse in the instrument panel (I/P) fuse block applies battery positive voltage to both the coil and switch side of the PARK LAMP Relay. When the headlamp switch is placed in either the HEAD or PARK position, ground is applied from G202 to the headlamp switch. The headlamp switch then applies the ground through the park lamp ON signal circuit to the body control module (BCM). The BCM then applies a ground to the park lamp relay enable circuit. This energizes the PK LAMP relay, applying battery positive voltage to all the park, tail marker and license lamps. The park, tail marker and license lamps are also turned ON when the headlamps are commanded ON by the BCM for low light operation.

Remote Keyless Entry Exterior Lamp Illumination

When the remote function actuation (RFA) module receives a door unlock command from the remote function actuator transmitter, the RFA module will ground the door unlock signal to the body control module (BCM), then send a class 2 signal to the BCM indicating that an UNLOCK command has been received. The BCM then will flash the park lamps twice. With all the doors closed, and the remote keyless entry (RKE) transmitter is used to lock the doors the park lamps will flash twice. The park lamps will not flash if the rear compartment is opened using the RKE transmitter

Turn Signal Lamps

The TURN/HAZ fuse in the instrument panel (I/P) fuse block supplies battery positive voltage to the body control module (BCM) for the turn signal lamps and hazard lamps. When the turn signal switch is place in either the TURN LEFT or TURN RIGHT position, ground is applied from G202 through the turn signal switch to the BCM the BCM then applies battery positive voltage to the front and rear turn signal lamps supply voltage circuits. The left front turn signal lamp is grounded at G101 and the right front at G100. The left rear turn lamp is grounded at G301 and the right rear at G302.

Turn Signal Reminder

The body control module (BCM) activates the turn signal warning as requested by either turn signal switch. The turn signal warning sounds when the following occurs:

- The ignition is in the RUN position.
- The turn signal switch is in either turn position, sensing, within one second, an open to battery positive voltage transition in the turn signal control circuit, left or right turn.

- The vehicle has traveled a distance of 1.2 km (0.75 mi) by counting pulses ON the vehicle speed input circuit.

The BCM turns OFF the turn signal reminder when either the ignition switch is turned to the OFF position or the turn signal switch returns to the OFF position.

Hazard Lamps

The TURN/HAZ fuse in the instrument panel (I/P) fuse block supplies battery positive voltage to the body control module (BCM) for the turn signal lamps and hazard lamps. When the hazard switch is placed in to the ON position, the driver information center (DIC) sends a signal to the BCM through he hazard switch signal circuit. The BCM then flashes all of the turn signal lamps ON and OFF.

Stop Lamps

The rear turn signal lamps are also used as the stop lamps. The TURN/HAZ fuse in the instrument panel (I/P) fuse block supplies battery positive voltage to the body control module (BCM) for the turn signal/stop lamps and hazard lamps. The CHMSL/BKUP fuse in the I/P fuse block provides battery positive voltage to the center high mounted stop lamp (CHMSL). The brake pedal position sensor receives a low reference signal and a 10-volt reference signal from the BCM. Whenever the brake pedal is applied, the brake pedal position sensor applies a variable voltage signal to the BCM through the stop lamp switch signal circuit. The BCM then applies battery positive voltage to the rear turn/stop lamps and to the CHMSL, illuminating them. The left rear turn lamp is grounded at G301 and the right rear stop/turn lamp and CHMSL is grounded at G302.

Backup Lamps

The CHMSL/BKUP fuse in the instrument panel (I/P) fuse block supplies battery positive voltage to the body control module (BCM). When the driver places the gear selector in to the REVERSE position, the powertrain control module (PCM) sends a class 2 message to the BCM. The BCM then applies battery positive voltage to the backup lamp supply voltage circuit. The left backup lamp is grounded at G301 and the right backup lamp is grounded at G302.

Battery Rundown Protection/Inadvertent Power

The body control module (BCM) used in this vehicle controls the lighting system through circuits that enable both the exterior lamp functions of park, head and fog lamps as well as the interior lamps. The BCM opens these enabling circuits 20 minutes after the ignition switch is turned OFF with no lamp switch activity. If the ignition switch is turned to any position other than OFF, or if a lamp switch is activated, during this 20 minute period the timer will reset for another 20 minutes.

INTERIOR LIGHTING SYSTEMS DESCRIPTION AND OPERATION

Interior Lighting

The interior lighting consist of lamps that may not be dimmed (Interior Lamps) and lamps that may be dimmed (Interior Lamps Dimming).

Interior Lamps

The first group of lamps are the interior courtesy lamps that may not be dimmed manually, these include:

- The dome lamp
- The instrument panel (I/P) compartment lamp
- The I/P courtesy lamps
- The rear compartment lamp
- The roof rail courtesy/reading lamps
- The sunshade vanity mirror lamps

Interior Lamps Features

The interior lamps system features the following functions:

- An illuminated entry feature that illuminates the courtesy lamps when entering the vehicle or activating the remote keyless entry system.
- An illuminated exit feature that illuminates the courtesy lamps when the ignition key has been removed from the ignition.
- An inadvertent power feature that supplies voltage to all interior lamps after the ignition is turned OFF. The inadvertent power feature will deactivate all interior lamps after 20 minutes to prevent battery rundown.
- A theater dimming feature that will slowly dim the interior lamps from full brightness to OFF.
- An lamp switch assembly that illuminates the courtesy lamps.
- Individual switches for control of each interior lamp that is not illuminate with the interior lamp switch.

Courtesy/Illuminated Entry Lamps

When the body control module (BCM) is in an active state (awake) it energizes the courtesy lamps supply voltage circuit. The courtesy lamps supply voltage circuit supplies voltage to all of the interior lamps, including the illuminated entry lamps (courtesy lamps). The illuminated entry lamps are turned ON when they receive a battery positive voltage from the courtesy lamp supply voltage circuit of the BCM. When the ignition is in the LOCK position the BCM will apply the courtesy lamp supply voltage circuit under the following conditions:

- The door jamb input transitions to an active state (opening a door).

- The use of the remote keyless entry (RKE) to unlock the side doors.

When the courtesy lamps supply voltage circuit and the courtesy lamp low control circuit are active the courtesy/illuminated entry lamps will illuminate. The courtesy lamps/illuminated entry lamps include the following interior lamps :

- The dome lamp
- The roof rail courtesy lamps
- The I/P courtesy lamps

When the driver uses the remote function actuator transmitter to unlock the doors, the BCM will illuminate the courtesy lamps for approximately 40 seconds, unless another BCM function causes the lamps to remain active. If the ignition switch is turned to either the RUN or START position the courtesy lamps will turn OFF immediately.

When the door latch switch signal circuit is active with the ignition in the OFF position the BCM will illuminate the courtesy lamps. The courtesy lamps will remain illuminated for approximately 25 seconds, after the door latch switch signal circuit becomes inactive, unless another BCM function causes the lamps to remain active. If the ignition switch is turned to either the RUN or START position the courtesy lamps will turn OFF immediately.

Courtesy/Illuminated Exit

The illuminated exit feature will activate the courtesy lamps when the key IN input of the BCM transitions from an active state to an inactive state (removing the ignition key). When the key is removed from the ignition, the key IN input to the BCM becomes inactive. The BCM will illuminate the courtesy lamps for approximately 25 seconds, unless another BCM function causes the lamps to remain active.

Inadvertent Power Feature

Inadvertent power feature provides a similar function for the interior lamps as a retained accessory power feature. The BCM will energize the courtesy lamps supply voltage circuit when the BCM is in the active state (awake). When the courtesy lamps supply voltage circuit is energized, it supplies voltage to all the interior lights. The BCM will continue to supply voltage to the interior lamps after the ignition is turned OFF so that the interior lamps may be operated.

The inadvertent power feature will also act as battery run down protection by deactivate the courtesy lamps supply voltage circuit after 20 minutes once the BCM becomes inactive, ignition OFF and no BCM input activity.

Theater Dimming

The theater dimming feature that will slowly dim the interior lamps from full brightness to

OFF. The following actions will over ride the theater dimming feature causing the courtesy lamps to deactivate immediately if no other BCM function commands the courtesy lamps ON:

- A transition from active to inactive of the interior lamps switch, turning OFF the interior lamps switch
- A LOCK command from the remote keyless entry system
- A last door closed locking function, locking and closing all the doors

Courtesy Lamps Manual Operation

The courtesy lamps, may be manually operated by the lamp switch assembly. When the dimmer switch is placed in the DOME position the BCM receives a ground from the courtesy lamp switch signal circuit. Upon receiving the courtesy lamp switch signal the BCM then applies battery positive voltage to the courtesy lamp supply voltage circuit, which illuminates the courtesy lamps. The voltage for all interior lamps is supplied by the courtesy lamp supply voltage circuit of the BCM, whenever the BCM is active. The interior lamp switch will override any BCM operation of the interior lamps, such as entry illumination.

Dome Lamp

The dome lamp is turned ON by the lamp switch assembly or during illuminated entry.

During illuminated entry or when the lamp switch assembly is in the DOME position, the body control module (BCM) wakes up and then energizes the courtesy lamps supply voltage circuit, suppling voltage to all interior lamps.

I/P Compartment Lamp

When the I/P compartment is opened the I/P compartment lamp illuminates, if the courtesy lamps supply voltage circuit of the BCM is activated, BCM awake.

The I/P compartment lamp illuminates when the courtesy lamps supply circuit of the BCM supplies voltage to the I/P compartment lamp and the I/P compartment switch closes, providing a ground path.

I/P Courtesy Lamp

The I/P courtesy lamp is turned ON by the lamp switch assembly or during illuminated entry.

During illuminated entry or when the I/P dimmer switch is DOME the BCM wakes up and then energizes the courtesy lamps supply voltage circuit, suppling voltage to all interior lamps.

Rear Compartment Lamp

When the rear compartment is opened, the rear compartment lamp illuminates.

When the rear compartment is opened, the rear compartment courtesy lamp switch sends a ground signal to the BCM, waking the BCM. When the BCM wakes up it will then energize the courtesy lamps supply voltage circuit, suppling voltage to the rear compartment courtesy lamp. The rear compartment courtesy lamp switch will provide a ground path for the rear compartment courtesy lamp in order to illuminate the lamp.

Roof Rail Courtesy/Reading Lamps

The roof rail courtesy lamps are turned ON by the lamp switch assembly, the individual roof rail courtesy lamp switch, or during illuminated entry.

During illuminated entry or when the I/P dimmer switch is ON the BCM wakes up and then energizes the courtesy lamps supply voltage circuit, suppling voltage to all interior lamps.

The roof rail courtesy/reading lamps can be turned ON from the individual roof rail courtesy lamp switch. The BCM supplies voltage through the courtesy lamps supply voltage circuit when the BCM is awake. Manually turning ON the roof rail courtesy lamp switch provides a ground path.

Sunshade Vanity Mirror Lamps

When the vanity mirror cover on the sunshade is opened, the sunshade mirror lamp illuminates.

The sunshade mirror lamps receive voltage from the courtesy lamps supply voltage circuit anytime the BCM is awake. The sunshade illuminated mirror lamps receive ground from their individual switches when the sunshade is open.

Interior Lamps Dimming

The second group of lamps include lamps which may be dimmed. This group uses a combination of class 2 dimming and incandescent lamps.

- The PRNDL lamp
- The door switches and window switches
- The HVAC control head assembly
- The outside rearview mirror switches
- The driver information center (DIC)
- The radio
- The lamp switch assembly
- The steering wheel controls
- The instrument panel cluster (IPC)

- The traction control switch

When the headlamp switch is placed in the PARK position, ground is supplied through the headlamp switch to body control module (BCM). The BCM also applies a voltage reference and a low reference signal to the interior lamp dimmer switch. When the interior lamp switch is varied, the position of the switch is applied through the instrument panel (I/P) dimming control circuit to the BCM. The BCM then applies a voltage to the interior lamps.

The lamps become illuminated when the park lamps are ON. The brightness of all the incandescent lamps is determined by a variable voltage signal from the dimmer switch and sent through the instrument panel lamp supply voltage circuit. The lamps are located in various components (see **Schematic and Routing Diagrams**).

Incandescent Dimming

The incandescent lamps become illuminated when the park lamps are on. The brightness of all the incandescent lamps is determined by a variable voltage signal from the dimmer switch and sent through the instrument panel lamp supply voltage circuit. The incandescent lamps are located in various components (see **Schematic and Routing Diagrams**).

Driver Controls and Modules

The BCM module processes the inputs and the controls. The ambient light sensor supplies the BCM with a signal for daytime conditions or for low light conditions:

- The BCM
- The DIC
- The IPC

Driver controls include the following components:

- The I/P dimmer switch
- The door jamb switches
- The headlamp switch
- The rear compartment lid ajar switch
- The roof rail courtesy reading lamp switch
- The sunshade vanity mirror lamps switch
- The I/P compartment lamp switch

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Door Frame Screws	2 N·m	18 lb in
Rear Spoiler Nuts	10 N·m	89 lb in
Rocker Panel Molding Screws	2 N·m	18 lb in

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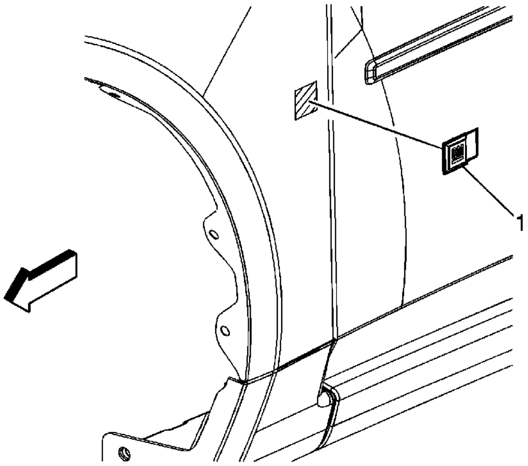
Front Fender Emblem / Nameplate Replacement



Callout	Component Name
1	Front Fender Nameplate **Tip** • When removing protective liners from adhesive backed nameplates, be careful not to touch the tape with hands and do not allow the tape to come in contact with dirt or any foreign matter prior to adhesion. • Use a J 25070 or equivalent to remove the old nameplate. Clean all the adhesive residue from the fender, wipe the surface dry with a clean lint-free towel prior to installing new nameplate. **Special Tools** J 25070 Heat Gun - 500-750F

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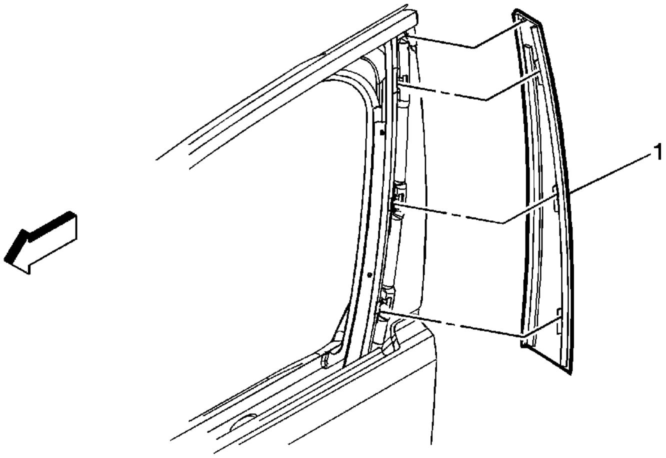
Front Side Door Window Frame Rear Applique and Outer Weatherstrip Replacement (Impala)



Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.	
1	Front Side Door Window Frame Applique **Tip** The applique is secured with 3 metal clips located in the glass run channel.

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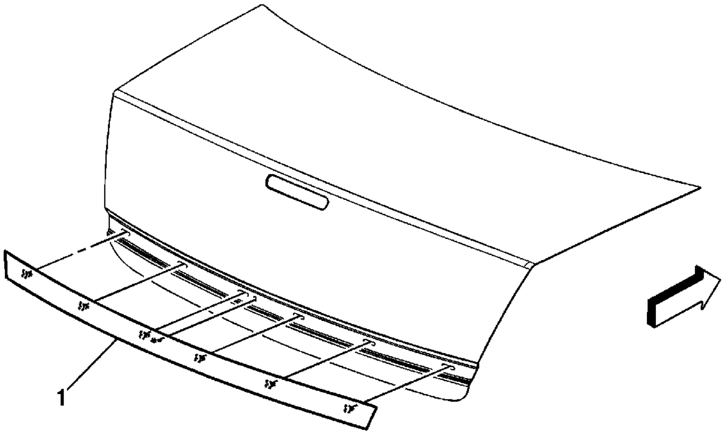
Rear Compartment Lid Applique Replacement



Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications .	
1	Applique, Rear Compartment **Tip** Use a flat-bladed tool and gently pry the applique from the compartment lid.

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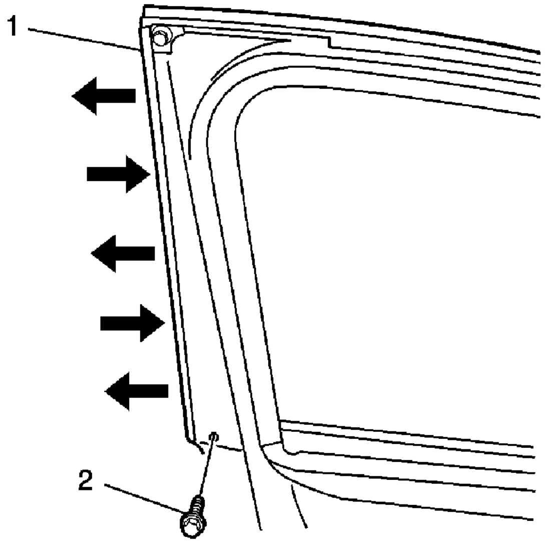
Rear Side Door Window Frame Front Applique and Front Channel Replacement

Removal Procedure



Caution: To avoid paint damage, protect the area surrounding the part which you are removing or installing.

1. Apply masking tape to the door frame and applique.
2. Lower the window to the full down position.
3. Remove the window channel retainer. Refer to Rear Side Door Window Channel Retainer Replacement.
4. Remove the screws (1, 2) from the upper and lower corners of the inside door frame.
5. Pull the window run channel weatherstrip out of the retainer and reposition it in order to access to the applique rivets.

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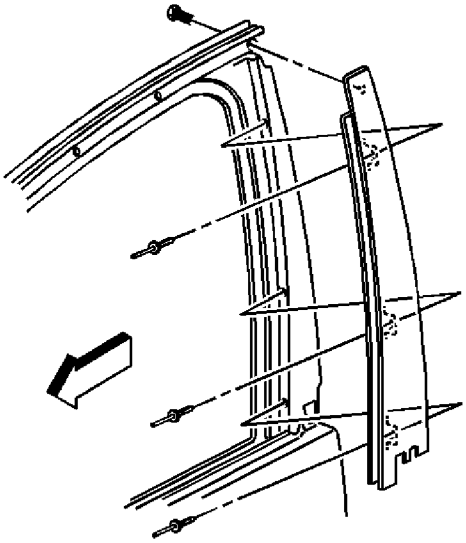
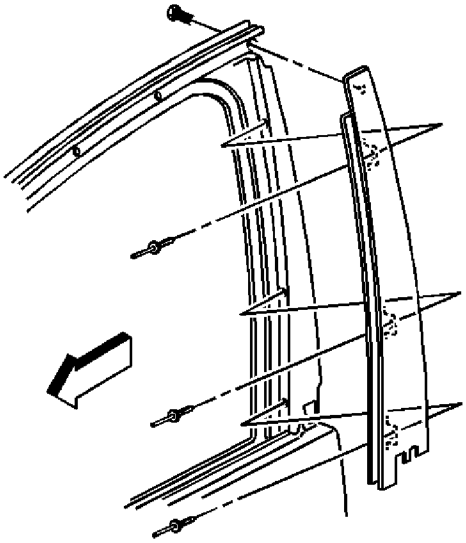


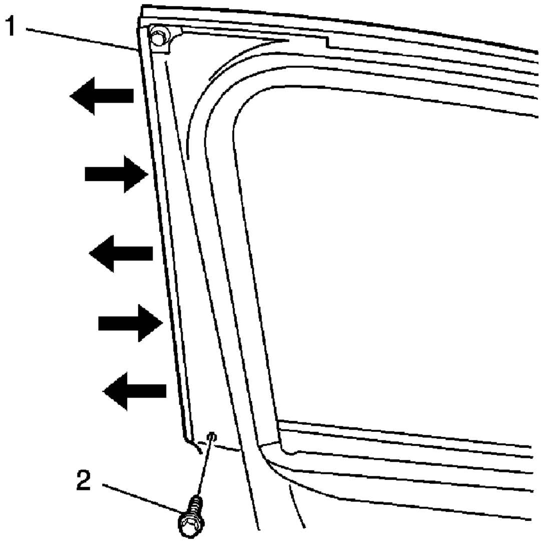
6. Drill out the 4 mm (5/32 in) rivets along the inside edge of the window channel retainer.
7. Pull upward to release the applique from the door frame.

Installation Procedure



1. Install the applique to the door frame.
2. Install the new 4 mm (5/32 in) rivets along the inside edge of the window channel retainer to secure the applique to the door frame.

Caution: Refer to Fastener Caution in the Preface section.



3. Install the screws (1, 2) to the upper and lower corners of the inside door frame.

   Tighten
   Tighten the screws to 2 N·m (18 lb in).

4. Install the window channel retainer. Refer to Rear Side Door Window Channel Retainer Replacement.
5. Install the window weatherstrip.
6. Remove masking tape.
7. Inspect the window for proper operation.

Decal or Stripe Replacement

A pressure sensitive adhesive adheres the stripes and decals to the painted surfaces.

Use a wetting solution in order to lift and position the stripe or decal during installation.

A wetting solution ensures a better bond between the stripe or decal and the panel assembly.

If the metal or underlying painted surfaces are damaged, repair and refinish the metal as needed before you install the stripes or decals.

Caution: Striping material highlights vehicle surface imperfection. All dings, rough metal, paint defects and uneven two-tone paint breaklines must be eliminated before stripe/decal application. Freshly painted surfaces must be allowed to dry thoroughly before installing stripe or decal. Residual solvents in fresh painted surfaces can lead to subsequent blistering problems if stripe or decal is applied before complete release of solvents.

Maintain body surface and decal temperature between 21-38°C (70 -100°F) during installation.

Note: DO NOT apply the decals when the body surface and the decal temperatures are below 21°C (70°F).

Use auxiliary heat sources to warm the body surface and decals if the temperature is less than 21°C (70°F).

Caution: Use of harsh chemicals when cleaning can damage exterior lamps. Suggested cleaners are a mild soap and water, or Varnish Makers and Painters (VM&P) Naptha. VM&P Naptha is a specific type of naptha and should not be substituted by any other naptha.

Note: When you apply stripes or decals on flexible surfaces (fascias, etc.), use the WET method. The WET method reduces the formation of bubbles under the decal due to the outgassing potential of the flexible materials.

You may apply stripes and decals dry. If the stripe or decal shows bubbles, use the "wet" method. Use the "wet" method for large graphics packages.

The following equipment and materials, or the equivalent, are necessary when making a quality stripe or decal installation:

- Wetting solution foaming type window cleaner that does not contain ammonia
- Silicone, wax and grease remover
- Varnish Makers and Painters (VM&P) naphtha
- Isopropyl alcohol
- Squeegee about 75-100 mm (3-4 in) wide, plastic or hard rubber. Deburr any sharp or rough edges in order to prevent scratching of the stripe or decal
- Water bucket and sponge or spray bottle
- Sandpaper 800 grit or finer, wet or dry type
- Heat gun

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- Clean, lint-free wiping cloth
- Sharp knife or razor blade
- Scissors
- Fine pin or needle
- Marking pencil

Removal Procedure

1. Remove the necessary molding and trim panel.
2. Wash and clean the following items using Liquid Wash and Wax GM P/N 1052870 or the equivalent:
   - The repair surfaces
   - The adjacent panel
   - The openings
3. Remove the following components:
   - The molding attaching clips
   - The handles
   - The sidemarker reflector
   - Other stripe or decal overlapping parts

   Caution: To avoid damaging the paint finish, do not use pointed or sharp instruments to remove the stripe or the decal.

4. Use heat in order to remove the stripe or decal. Start at one edge and peel the stripe or decal from the panel surface.
5. Remove all traces of adhesive residue from the painted surfaces using the following items:
   - Silicone, wax and grease remover
   - Varnish makers and painters (VM&P) naphtha

Installation Procedure

1. Prepare the surface.

   Caution: To prevent possible vehicle, stripe or decal damage, always refer to manufacturer's packaged instructions.

   Note: If the area where you apply the stripe or decal has been refinished, remove any imperfections that may show through the stripe or decal.

2. Clean the painted surface with the following items:
   - Silicone
   - Wax
   - Grease remover
3. Clean the area where you apply the stripe or decal. Use a 50/50 mixture of isopropyl alcohol and water.
4. Wipe the panel surface with a clean cloth while the solvent drys.
5. Apply the wetting solution to the area where you install the stripe or decal.

Note: DO NOT touch the adhesive backing of the stripes.

6. Use the wetting solution on the adhesive side of the stripe or decal.
7. Remove the backing material of the stripe or decal as needed.
8. Install the stripe or decal to the panel.
9. Working from the center if possible, squeegee the stripe or decal into position.
10. Apply additional wetting solution in order to ease installation of the stripe or decal.

    Apply a soapy wetting solution on the top side of the stripe or decal for the following reasons:

    - In order to ease the pull of the squeegee on the stripe or decal
    - In order to eliminate the possibility of damage
11. Apply heat to the stripe or decal at recessed areas.
12. Press the stripe or decal into recess in order to obtain a firm bond.
13. Use adequate light reflection in order to detect any irregularities in the stripe or decal that may have developed during installation.

    Note: DO NOT use a razor blade or a knife edge.
14. Use one of the following items in order to remove all bubbles by piercing:
    - A safety pin
    - A needle
    - A tool with the same size piercing tip
15. Pierce a bubble on the outer edge.
16. Force the air out from the opposite edge with the blade of the squeegee.
17. Install all previously removed components. Clean the components as needed.

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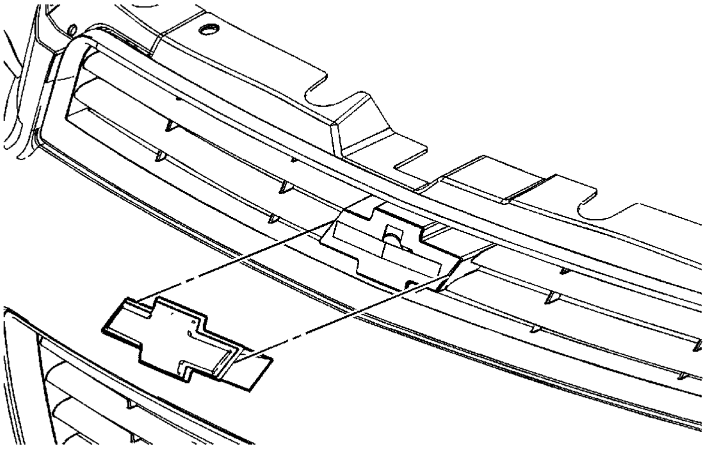
Document ID: 1609603

Front Bumper Fascia Emblem Replacement (Base)



Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications .	
1	Plate Assembly, Front Bumper Fascia Name **Important:** When removing protective liners from adhesive tape, be careful not to touch tape with hands and do not allow tape to come in contact with dirt or any foreign matter prior to adhesion. **Tip** Use a J 25070 or equivalent to remove the old nameplate. Clean all adhesive from front bumper fascia, wipe surface dry with a clean lint-free towel prior to installing new nameplate.

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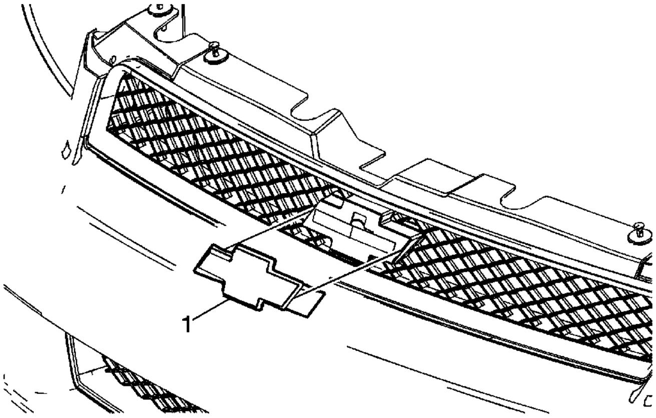
Front Bumper Fascia Emblem Replacement (Sport SS)



Callout	Component Name
1	Front Bumper Fascia Name Plate Assembly **Tip** - When removing protective liners from adhesive tape, be careful not to touch tape with hands and do not allow tape to come in contact with dirt or any foreign matter prior to adhesion. - Use a J 25070 Heat Gun or equivalent to remove the old nameplate. Clean all adhesive from front bumper fascia, wipe surface dry with a clean lint-free towel prior to installing new nameplate. **Special Tools** J 25070 Heat Gun - 500-750F

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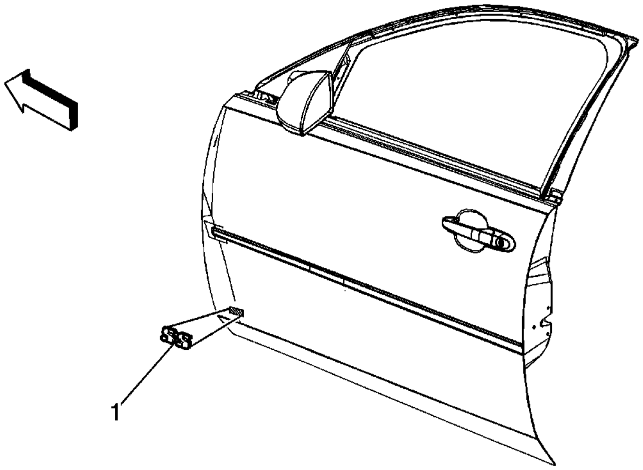
Front Side Door Emblem / Nameplate Replacement



Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.	
1	Emblem Assembly, Front Door **Important:** When removing protective liners from adhesive backed emblems, be careful not to touch tape with hands and do not allow tape to come in contact with dirt or any foreign matter prior to adhesion. **Tip** Use a J 25070 or equivalent to remove the old emblem. Clean all the adhesive residue from the door, wipe surface dry with a clean lint-free towel prior to installing new emblem.

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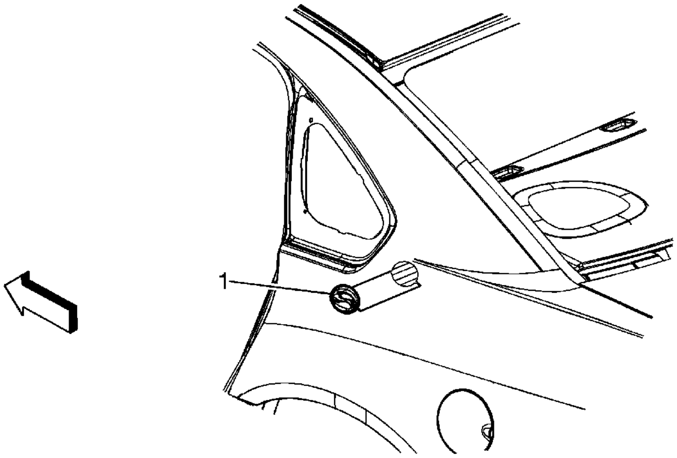
Quarter Window Rear Applique Emblem Replacement (Base)



Callout	Component Name
1	Quarter Window Rear Applique **Important:** When removing protective liners from adhesive tape backed nameplates, be careful not to touch tape with hands and do not allow tape to come in contact with dirt or any foreign matter prior to adhesion. **Procedure** 1. Use a J 25070 or equivalent to remove the old quarter window rear applique. Clean all adhesive from the quarter panel, wipe the surface dry with a clean lint-free towel prior to installing the new quarter window rear applique. 2. Apply the new quarter window rear applique in the same location as shown. 3. Apply pressure to the new quarter window rear applique to ensure full adhesion is made to the quarter panel.

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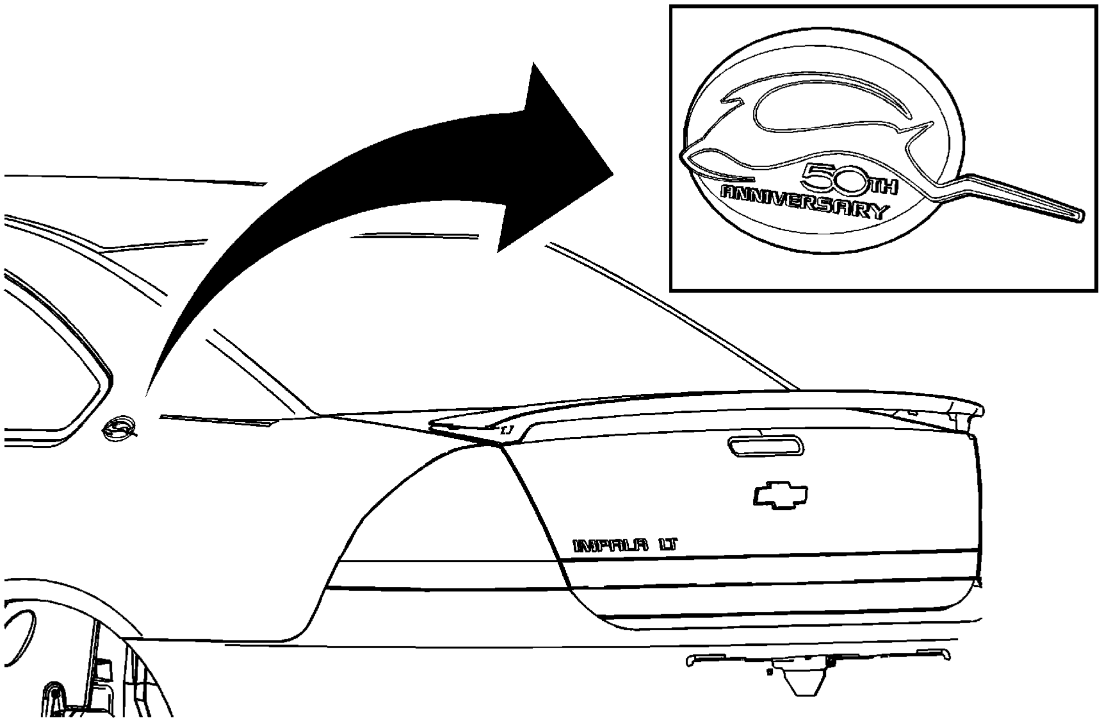
Quarter Window Rear Applique Emblem Replacement (50th Anniversary Edition)



Callout	Component Name
1	Quarter Window Rear Applique **Important:** When removing protective liners from adhesive tape backed nameplates, be careful not to touch tape with hands and do not allow tape to come in contact with dirt or any foreign matter prior to adhesion. **Procedure** 1. Use a J 25070 or equivalent to remove the old quarter window rear applique. Clean all adhesive from the quarter panel, wipe the surface dry with a clean lint-free towel prior to installing the new quarter window rear applique. 2. Apply the new quarter window rear applique in the same location as shown. 3. Apply pressure to the quarter window rear applique to ensure full adhesion is made to the quarter panel.

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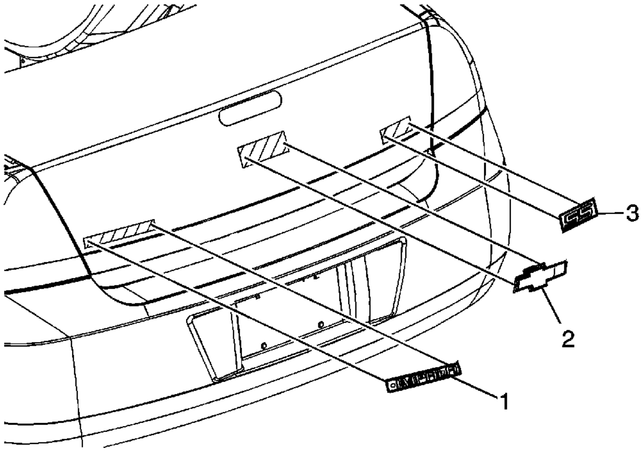
Rear Compartment Lid Emblem / Nameplate Replacement (Impala SS)



Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications .	
1	Nameplate, Rear Compartment Lid (IMPALA) **Tip** 1. When removing protective liners from adhesive tape backed nameplates, be careful not to touch the tape with hands and do not allow the tape to come in contact with dirt or any foreign matter prior to adhesion. 2. Use a J 25070 or equivalent to remove the old nameplate. Clean all adhesive from the rear compartment lid, wipe surface dry with a clean lint-free towel prior to installing the new nameplate. 3. Apply the new nameplate with the rear compartment lid in the closed position. 4. Apply pressure to the nameplate to ensure full adhesion is made to the compartment lid.
2	Nameplate, Rear Compartment Lid (Bowtie) **Tip** 1. When removing protective liners from adhesive tape backed nameplates, be careful not to touch the tape with hands and do not allow the tape to come in contact with dirt or any foreign matter prior to adhesion. 2. Use a J 25070 or equivalent to remove the old nameplate. Clean all adhesive from the rear compartment lid, wipe surface dry with a clean lint-free towel prior to installing the new nameplate. 3. Apply the new nameplate with the rear compartment lid in the closed position. 4. Apply pressure to the nameplate to ensure full adhesion is made to the compartment lid.

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3	Emblem, Rear Compartment Lid (SS) **Tip** 1. When removing protective liners from adhesive tape backed emblems, be careful not to touch the tape with hands and do not allow the tape to come in contact with dirt or any foreign matter prior to adhesion. 2. Use a J 25070 or equivalent to remove the old emblem. Clean all adhesive from the rear compartment lid, wipe surface dry with a clean lint-free towel prior to installing the new emblem. 3. Apply the new emblem with the rear compartment lid in the closed position. 4. Apply pressure to the emblem to ensure full adhesion is made to the compartment lid.

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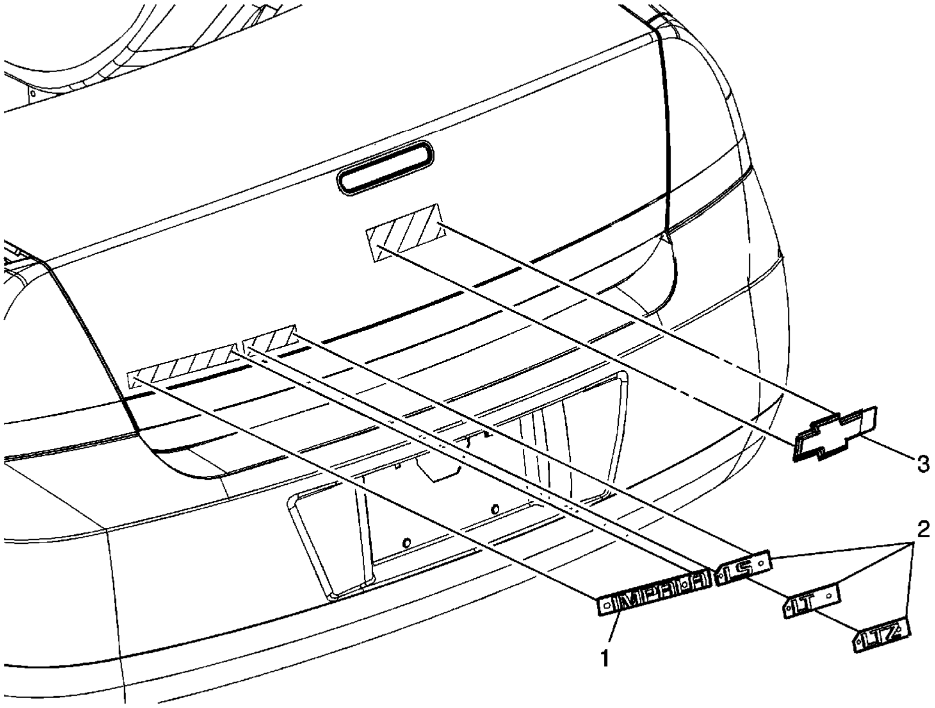
Rear Compartment Lid Emblem/Nameplate Replacement (Impala Base/Uplevel)



Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications .	
1	Nameplate, Rear Compartment Lid (IMPALA) **Tip** 1. When removing protective liners from adhesive tape backed nameplates, be careful not to touch the tape with hands and do not allow the tape to come in contact with dirt or any foreign matter prior to adhesion. 2. Use a J 25070 or equivalent to remove the old nameplate. Clean all adhesive from the rear compartment lid, wipe surface dry with a clean lint-free towel prior to installing the new nameplate. 3. Apply the new nameplate with the rear compartment lid in the closed position. 4. Apply pressure to the nameplate to ensure full adhesion is made to the compartment lid.
	Emblem, Rear Compartment Lid (LS LT LTZ) **Tip**

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2	1. When removing protective liners from adhesive tape backed emblems, be careful not to touch the tape with hands and do not allow the tape to come in contact with dirt or any foreign matter prior to adhesion. 2. Use a J 25070 or equivalent to remove the old emblem. Clean all adhesive from the rear compartment lid, wipe surface dry with a clean lint-free towel prior to installing the new emblem. 3. Apply the new emblem with the rear compartment lid in the closed position. 4. Apply pressure to the emblem to ensure full adhesion is made to the compartment lid.
3	Nameplate, Rear Compartment Lid (Bowtie) **Tip** 1. When removing protective liners from adhesive tape backed nameplates, be careful not to touch the tape with hands and do not allow the tape to come in contact with dirt or any foreign matter prior to adhesion. 2. Use a J 25070 or equivalent to remove the old nameplate. Clean all adhesive from the rear compartment lid, wipe surface dry with a clean lint-free towel prior to installing the new nameplate. 3. Apply the new nameplate with the rear compartment lid in the closed position. 4. Apply pressure to the nameplate to ensure full adhesion is made to the compartment lid.

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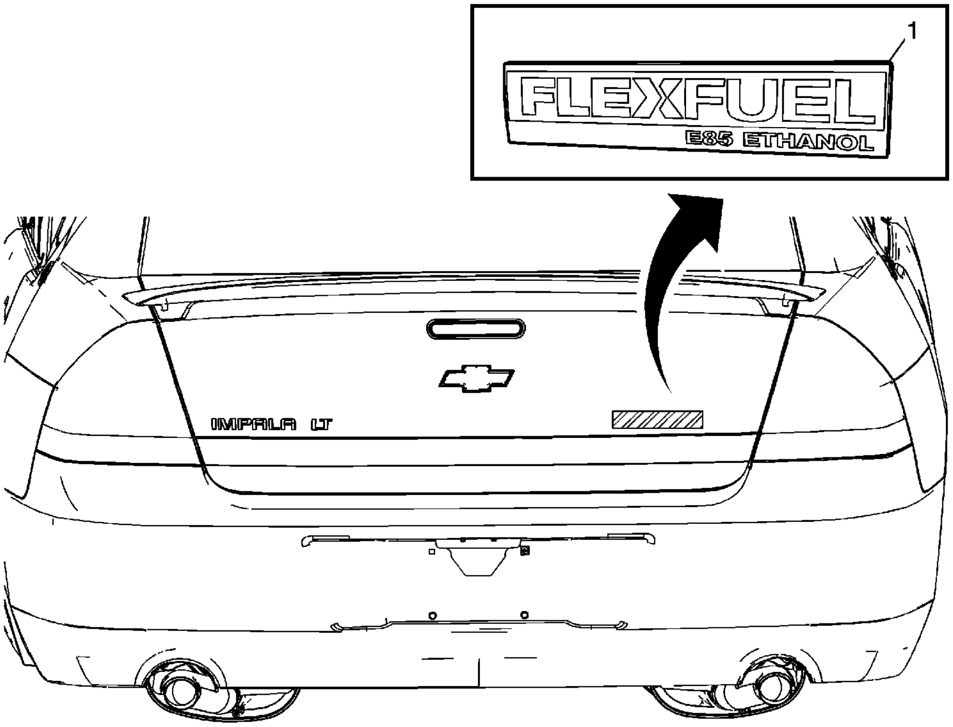
Rear Compartment Lid Emblem/Nameplate Replacement (FFU)



Callout	Component Name
1	Flex Fuel Badge **Caution:** Refer to Exterior Trim Emblem Removal Caution in the Preface section. **Procedure** 1. The part and surface should be 21°C (70°F) prior to installation. The vehicle should remain 21°C (70°F) for one hour after assembly to allow adhesive to develop sufficient bond strength. 2. Use a J 25070 Heat Gun or equivalent to remove the old nameplate. 3. Clean all adhesive from rear compartment lid panel and wipe the surface dry with a clean lint-free towel prior to installing the new name plate. 4. When removing protective liners from the adhesive tape, be careful not to touch tape with hands and do not allow tape to come in contact with dirt or any foreign matter prior to adhesion. 5. Close the rear compartment lid prior to installing the nameplate. 6. Using the palm of the hand, wet out the name plate to the rear compartment lid panel and ensure full adhesion of the name plate is made.

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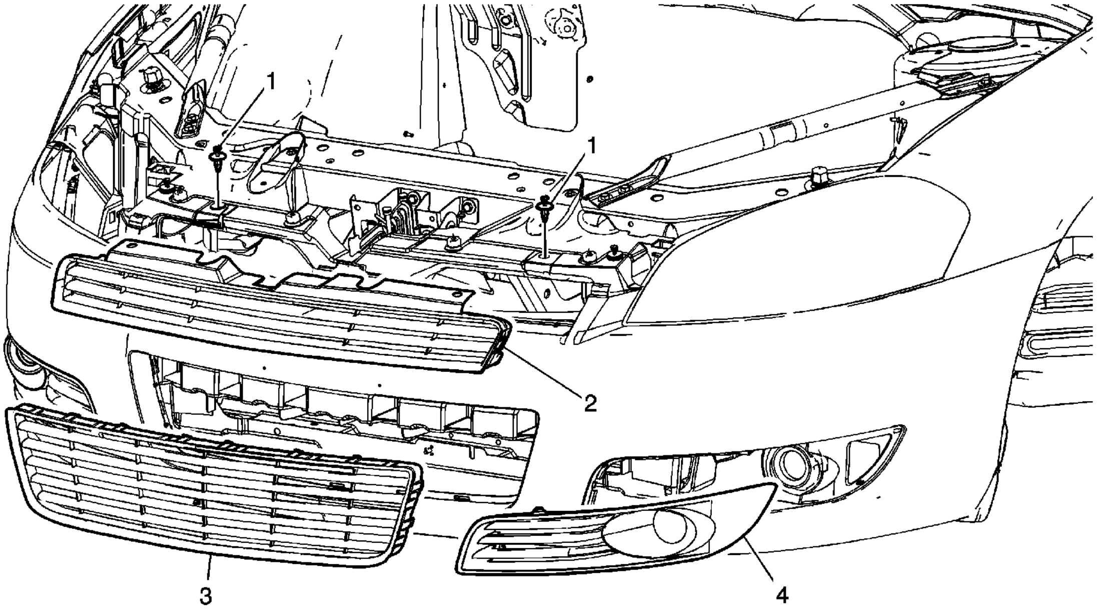
Special Tools

J 25070 Heat Gun

Fascia Grille Replacement (Impala)



Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications .	
1	Retainer, Front Fascia Grille (Qty: 2)
2	Grille, Upper Fascia
3	Grille, Center
4	Grille, Side

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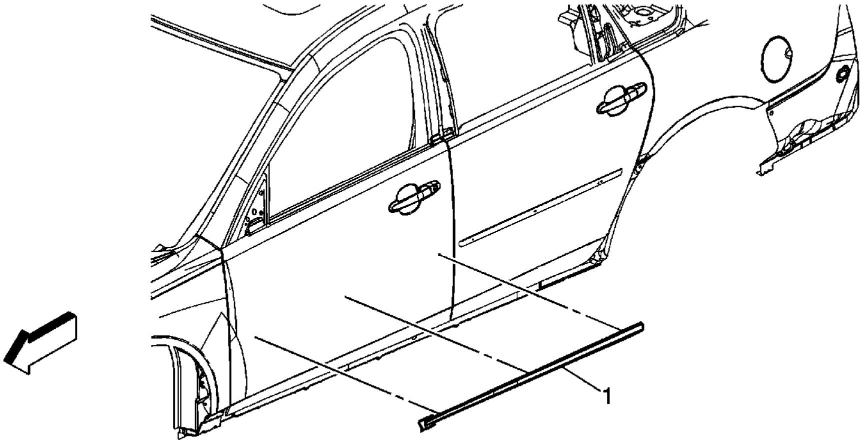
Front Side Door Molding Replacement (Impala)



Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications. **Preliminary Procedure** Using a J 25070 Heat Gun in a circular motion, warm the door bodyside molding prior to removal. Carefully clean the body panel thoroughly prior to bonding the new front bodyside molding to the door.	
1	Molding Asm, Bodyside Door **Tip** 1. Upon installation of the new front door bodyside molding, position the pin on the backside of the molding to the round hole at the front edge of the door first then to the oval holes. 2. Remove the protective liner from the backside of the molding adhesive tape. 3. Ensure full adhesion of the molding to the door using the palm of the hand with a dry towel working from the front edge of the door to the rear, down the entire molding.

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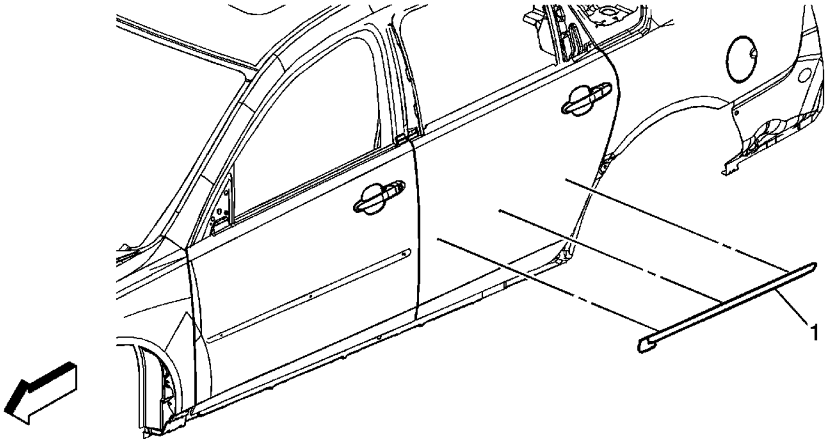
Rear Side Door Molding Replacement (Impala)



Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications. **Preliminary Procedure** Use a J 25070 Heat Gun in a circular motion to warm the door bodyside molding prior to removal. Carefully clean the body panel thoroughly prior to bonding the new bodyside molding to the door.	
1	Molding Asm, Bodyside Door **Tip:** 1. Upon installation of the new rear door molding, position the pin on the frontside of the molding to the round hole first at the front edge of the door then to the oval holes. 2. Remove the protective liner from the backside of the molding adhesive tape. 3. Ensure full adhesion of the molding to the door using the palm of the hand with a dry towel working from the rear edge of the door forward down the entire molding.

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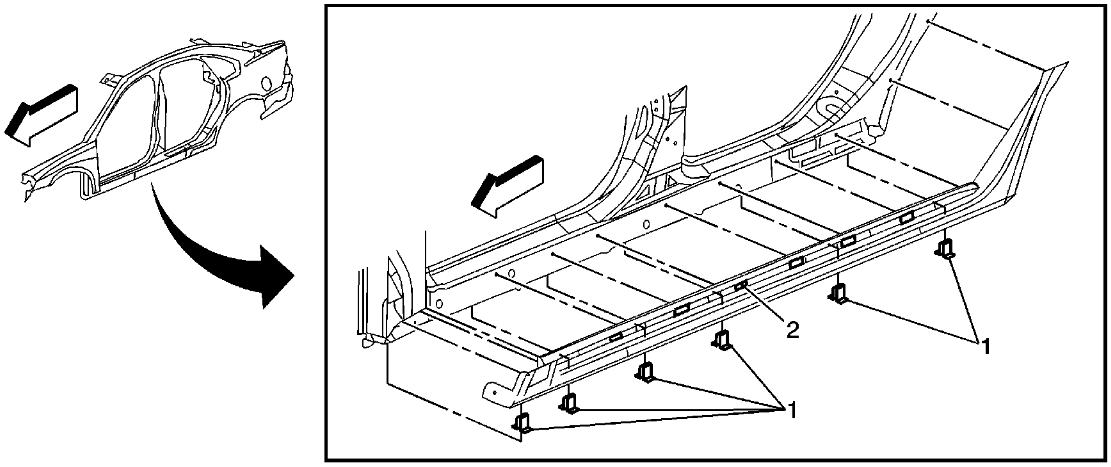
Document ID: 1602044

Rocker Panel Molding Replacement (Base)



Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications . **Preliminary Procedure** Open both doors on the side that the lower rocker panel molding is being removed from.	
1	Clips, Rocker Panel Integral (Qty: 6) Release the lower integral clips by pulling downward at each location prior to releasing the upper retainers from the lower rocker.
2	Retainers, Rocker Panel (Qty: 12) **Tip** Release the lower 12 retainers from the rocker by pulling panel outward and removing the lower rocker panel.

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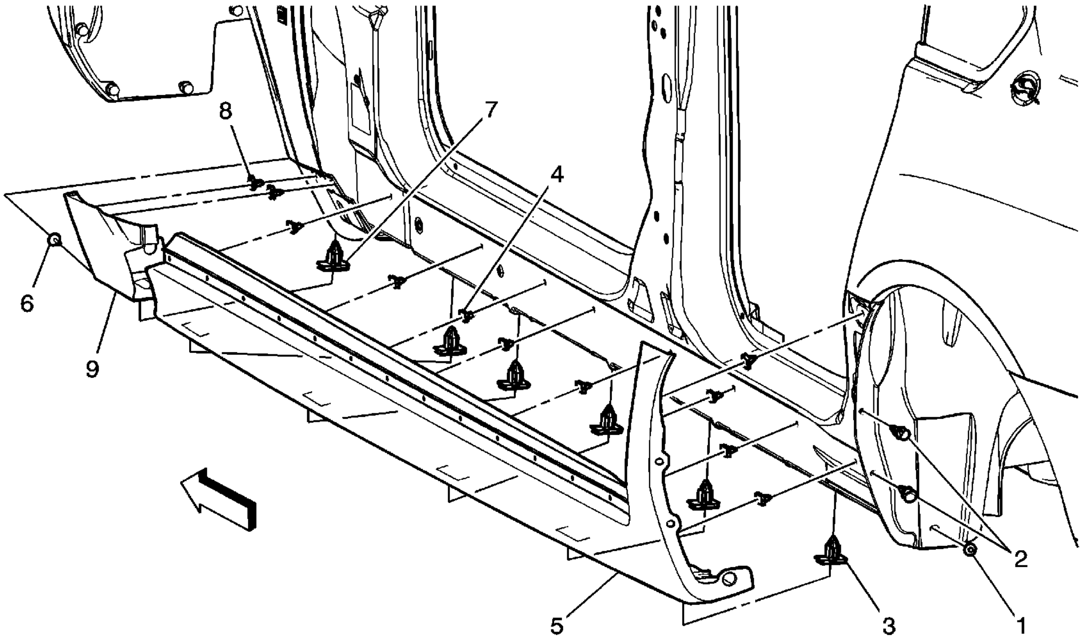
Document ID: 2151917

Rocker Panel Molding Replacement (50th Anniversary Edition)



Callout	Component Name
Preliminary Procedure Remove the front and rear side door lower weather-strip from the lower rocker panel. Refer to Front and Rear Side Door Lower Weatherstrip Replacement.	
1	Rear Wheelhouse Panel Screw **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 1.5 N·m (13 lb in)
2	Wheelhouse Panel Push-Type Retainer (Qty: 2) **Tip** Using a small flat-bladed tool, release the center of the retainer and remove.
3	Rocker Panel Molding Lower Retainer (Qty: 5) **Tip**

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	Release the lower retainers first, followed by the upper retainers.
4	Rocker Panel Molding Retainer (Qty: 10)
5	Rear Rocker Panel Molding Assembly **Tip** Lift the rear portion of the molding upward and pull rearward in order to release from the front rocker molding.
6	Front Wheelhouse Panel Screw **Tighten** 1.5 N·m (13 lb in)
7	Rocker Panel Molding Lower Retainer
8	Rocker Panel Molding Retainer (Qty: 2)
9	Front Rocker Panel Molding **Tip** Install the front rocker molding then the rear.

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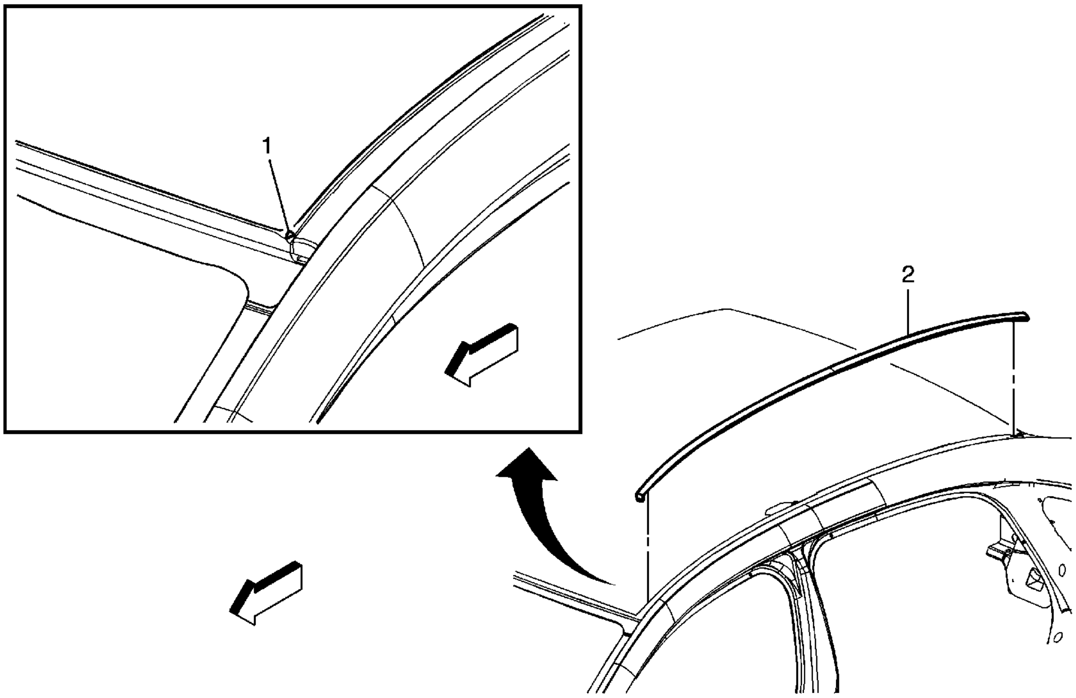
Document ID: 1602026

Roof Weld Joint Reveal Molding Replacement



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2"><i>Fastener Tightening Specifications:</i> Refer to Fastener Tightening Specifications .
Preliminary Procedure
Use a J 25070 Heat Gun in a circular motion to warm the roof ditch molding prior to removal. Carefully clean the roof panel ditch thoroughly prior to bonding the new ditch molding to the roof panel.</td></tr>
<tr><td>1</td><td>Molding Assembly, Roof Ditch
Tip
1. Upon installation of the new ditch molding, engage the front edge of the molding into the clip at the front roof header.
2. Remove the protective liner from the backside of the molding adhesive tape surface.
3. Ensure full adhesion of the ditch molding to the roof using the palm of the hand with a dry towel or a roller type tool working from the front of the vehicle to the rear.
4. Engage the rear end of the molding to the retainer clip in the roof ditch.</td></tr>
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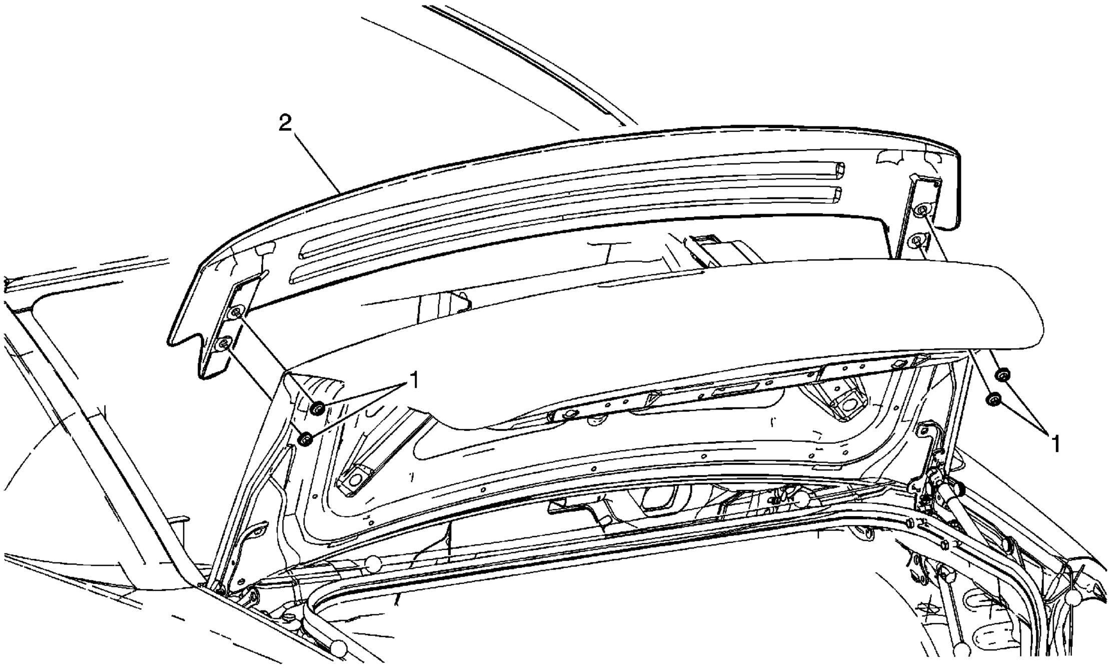
2	Molding Assembly, Roof Ditch

Rear Spoiler Replacement (T43)



Callout	Component Name
1	Rear Spoiler Nuts (Qty: 4) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 10 N·m (89 lb in)
2	Rear Spoiler

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Eliminating Unwanted Odors in Vehicles

GM Vehicle Care Odor Eliminator, GM P/N 12378554 (Canadian P/N 88901678), may control or eliminate odors in the interior and luggage compartment areas of GM vehicles. This non-toxic, biodegradable, odorless product has been shown to greatly reduce or remove the following types of odor:

- Objectionable smells of mold and mildew resulting from vehicle water leaks
- Customer created odors, such as smoke

You may safely use GM Vehicle Care Odor Eliminator on fabrics, vinyl, leather, carpet, and sound deadening materials. You may also induce this product into HVAC modules and instrument panel ducts for the control of non-bacterial related odors.

Important: This product leaves no residual scent and should not be used as an air freshener.

This product may result in the permanent elimination of an odor and may be preferable to customers whose allergies make them sensitive to perfumes. This product may effectively remove odors when directly contacting the odor source. In cases such as water leaks, use this product with diagnostic procedures to first eliminate the primary cause of the odor. Then use further applications on the residual odor to permanently correct the vehicle condition.

How to Use this Product

- Spray GM Vehicle Care Odor Eliminator directly or as an additive with carpet shampoo in steam cleaners.
- Do not use on any interior surface that plain water would deteriorate, because this product will have the same effect. Also avoid letting this product come into contact with vinegar or any acidic substance. Acid-based products will hamper the effectiveness of GM Vehicle Care Odor Eliminator.
- Complete eight page treatment sheets are enclosed within each case of GM Vehicle Care Odor Eliminator. These treatment instructions range from simple vehicle odor elimination to full step by step procedures for odor removal from water leaks. If lost, contact 800-977-4145 to get a replacement set faxed or e-mailed to your dealership.
- Instructions and cautions are printed on the bottle, but additional help is available. If you encounter a persistent or recurring odor, you may call to obtain additional information and usage suggestions.
  - In the USA, call 1-800-955-8591.
  - In Canada, call 1-800-977-4145.

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Floor Carpet Drying

If the carpet or the pad or insulator is wet, use the following criteria for drying or for replacing the components:

- For a 1-piece carpet assembly bonded to a cotton or a fiber padding, replace the entire assembly.
- For a 2-piece carpet assembly with a cotton or a fiber padding, replace the padding only. While the carpet is out of the vehicle, dry the carpet using the method described below.
- For a 1-piece carpet assembly bonded to a foam padding or attached to a synthetic padding, dry the carpet using the method described below.
- For a 2-piece carpet assembly with a synthetic padding, dry the assembly using the method described below.

Drying Method

1. If you observe puddles of liquid on the carpet face, use a wet vacuum to remove the excess moisture.
2. Blot the face of the carpet with a towel in order to absorb as much moisture as possible.
3. Point a fan at the affected area and air dry the carpet.

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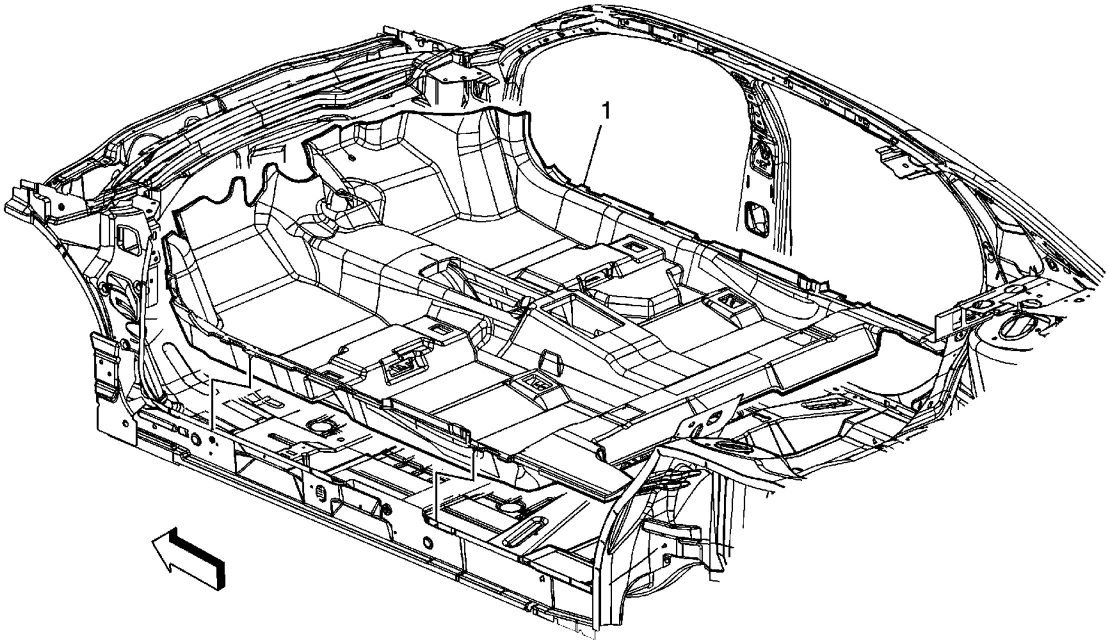
2009 Chevrolet Impala | Impala (VIN W) Service Manual | Body Hardware and Trim | Floor Coverings and Headlinings | Repair Instructions | Document ID: 1724446

Floor Panel Carpet Replacement (Impala)



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedures
1. Remove the front seats. Refer to Front Seat Replacement - Bucket .
2. Remove the rear seat. Refer to Rear Seat Cushion Replacement .
3. Remove the floor console. Refer to Front Floor Console Replacement .
4. Remove the carpet retainers. Refer to Front Carpet Retainer Replacement .
5. Loosen the center lower pillar garnish moldings. Refer to Center Pillar Lower Trim Panel Replacement .
6. Loosen the lower lock pillar garnish moldings. Refer to Quarter Lower Rear Trim Panel Replacement
7. Remove the lower front seat belt bolt.</td></tr>
<tr><td>1</td><td>Floor Panel Carpet Assembly</td></tr>
</table>

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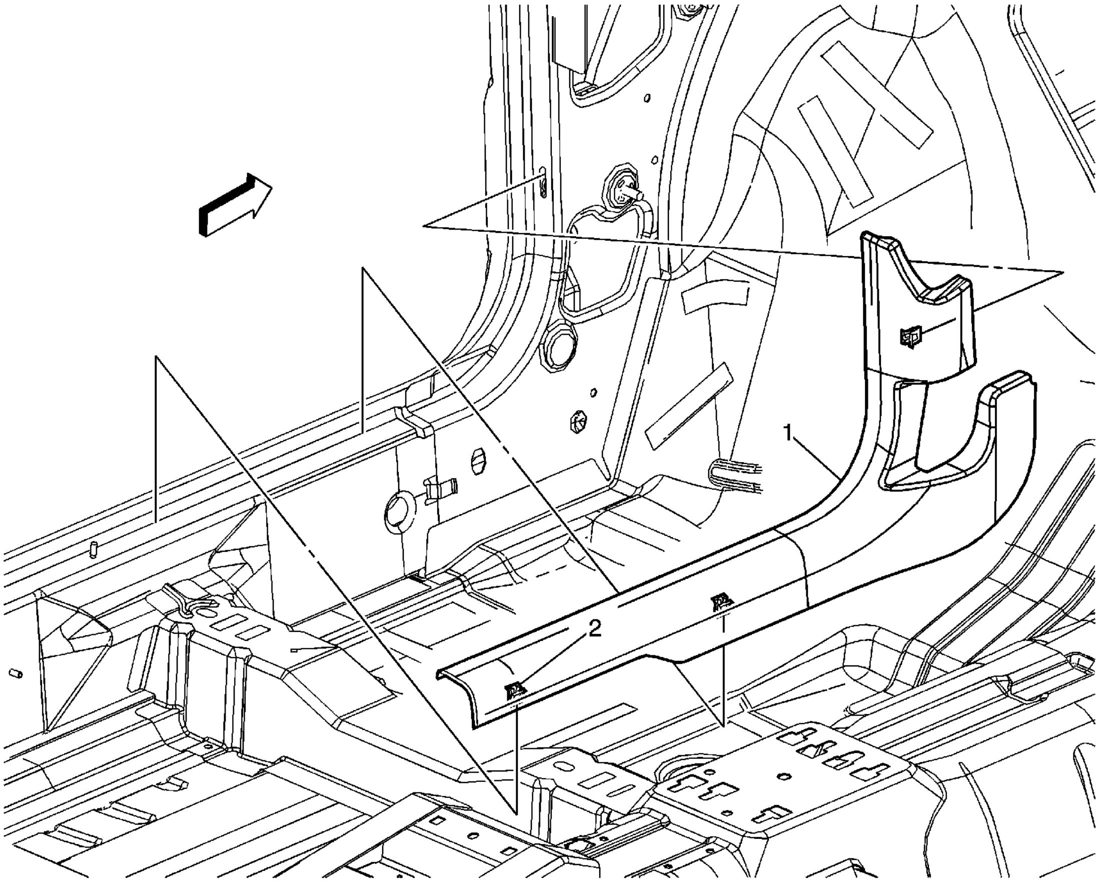
Front Side Door Opening Floor Carpet Retainer Replacement (Impala)



Callout	Component Name
1	Front Side Door Carpet Retainer Assembly
2	Front Side Door Carpet Retainer Assembly Clip

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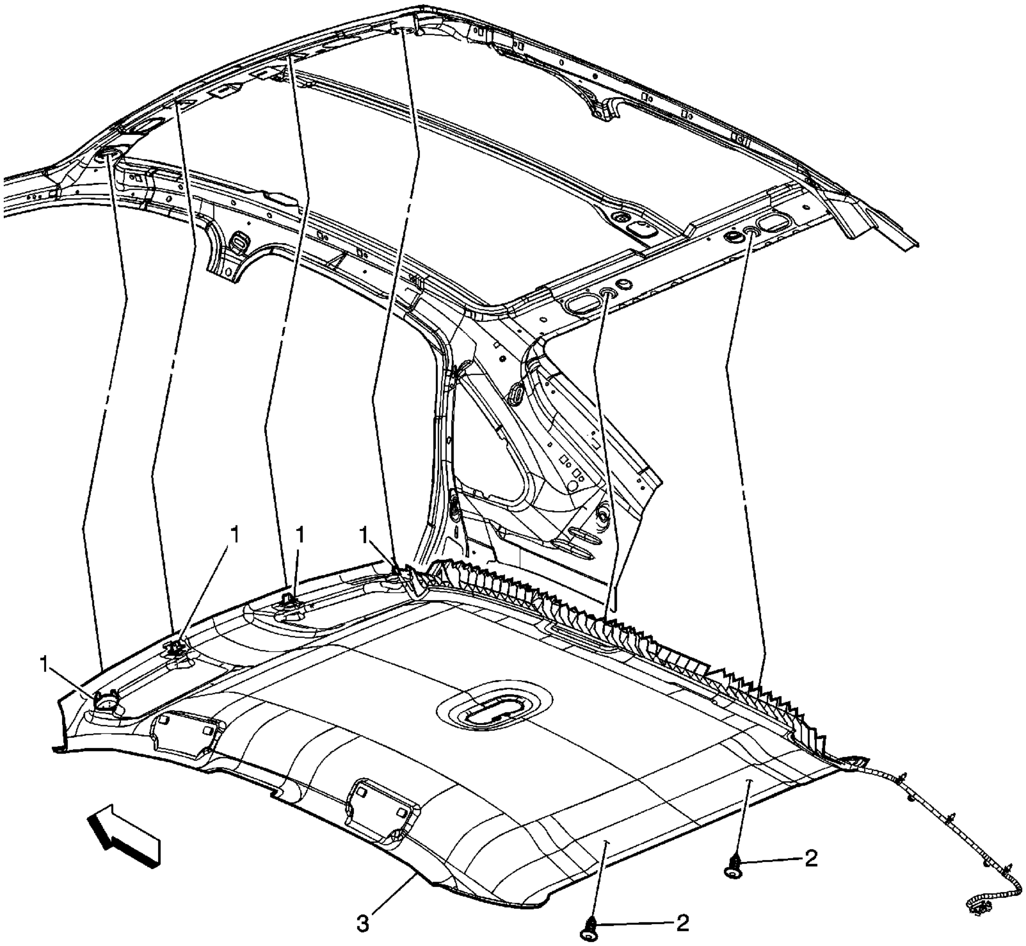
2009 Chevrolet Impala | Impala (VIN W) Service Manual | Body Hardware and Trim | Floor Coverings and Headlinings | Repair Instructions | **Document ID: 2151929**

Headlining Trim Panel Replacement



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Warning: Do not attempt to repair or alter the head impact energy-absorbing material glued to the headliner or to the garnish trims. If the material is damaged, replace the headliner and/or the garnish trim. Failure to do so could result in personal injury.
Caution: Use care when working around the head curtain inflator module. Sharp tools may puncture the curtain airbag. If the head curtain inflator module is damaged in any way, it must be replaced.
Caution: If a vehicle is equipped with a head curtain inflator module ensure that the inflator module and tether are undamaged. If tether or curtain airbag are damaged in any way, they must be replaced.</td></tr>
</table>

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Preliminary Procedure

1. Disable the SIR. Refer to SIR Disabling and Enabling.
2. Remove the rear quarter upper trim panel. Refer to Quarter Upper Trim Panel Replacement.
3. Remove the upper center pillar trim. Refer to Center Pillar Upper Trim Panel Replacement.
4. Remove the windshield pillar trim. Refer to Windshield Pillar Garnish Molding Replacement.
5. Remove the sunshades. Refer to Sunshade Replacement.
6. Remove the sunshade anchors. Refer to Sunshade Anchor Replacement.
7. Remove the assist handles. Refer to Assist Handle Replacement.

1	Headlining Trim Screw **Caution:** Refer to Fastener Caution in the Preface section. **Tip** The screws come off with the sunshade and sunshade anchors.
2	Headlining Trim Retainer (Qty: 2)
3	Headlining Trim **Procedure** 1. Disconnect the electrical connectors. 2. Fully recline the front seat backs. 3. Tilt the steering wheel fully upward. 4. Set the parking brake and put shifter in low gear. 5. Cover the instrument panel (I/P) to protect from damage. 6. Remove through the front passenger door opening.

2006 ACCESSORIES & EQUIPMENT

Frame and Underbody - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Frame Support Bolt	20 N.m	15 lb ft
Frame Support Nut	20 N.m	15 lb ft
Front Frame Bolt	145 N.m	107 lb ft
Rear Frame Bolt	160 N.m	118 lb ft

REPAIR INSTRUCTIONS

FRAME REPLACEMENT

Tools Required

J 39580 Universal Engine Support Table

Removal Procedure

1. Install the engine support fixture to support the engine/transaxle assembly. Refer to **Engine Support Fixture** for the 3.5L engine, **Engine Support Fixture** for the 3.9L engine, **Engine Support Fixture** for the 5.3L engine.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Remove the front tires and wheels. Refer to **Tire and Wheel Removal and Installation** .
4. Remove the lower radiator air deflector. Refer to **Radiator Air Baffle and Deflector Replacement - Lower** .
5. Remove the positive battery cable retainers. Position the positive battery cable aside. Refer to **Battery Positive and Negative Cable Replacement (RPOs LZE/LZ4/LZ9)** or **Battery Positive and Negative Cable Replacement (RPO LS4)** .
6. Disconnect the power steering cooler pipe from the frame. Refer to **Power Steering Cooler Pipe/Hose Replacement** .
7. Secure the power steering cooler to the exhaust pipe.
8. Remove the stabilizer shaft links. Rotate the stabilizer shaft up to gain access to the mounting bolts for the power steering gear. Refer to **Stabilizer Shaft Link Replacement** .

9. Remove the mounting bolts for the power steering gear. Refer to **Power Steering Gear Replacement** .

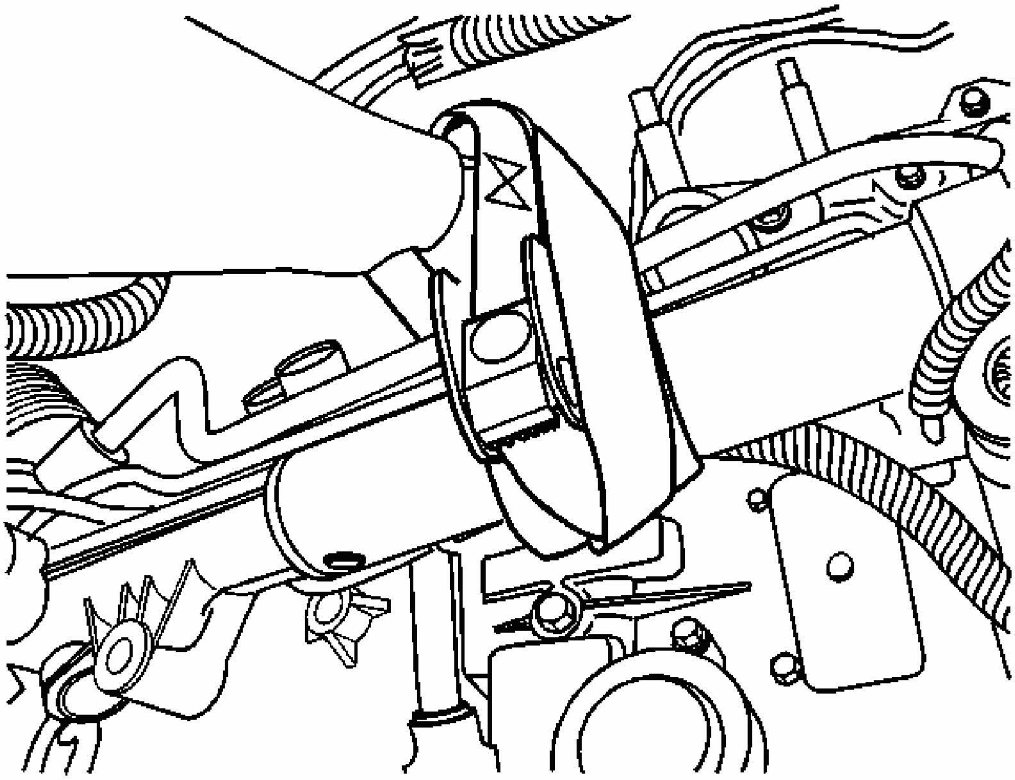


Fig. 1: Securing Power Steering Gear To Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

10. Secure the power steering gear.
11. Remove the nuts which secure the engine mount to the frame. Refer to **Engine Mount Replacement** for the 3.5L engine, **Engine Mount Replacement** for the 3.9L engine, **Engine Mount Replacement - Left** and **Engine Mount Replacement - Right** for the 5.3L engine.
12. Remove the nuts which secure the transaxle mount to the frame. Refer to **Transmission Mount Replacement - Left** for the 4T65-E transaxle.

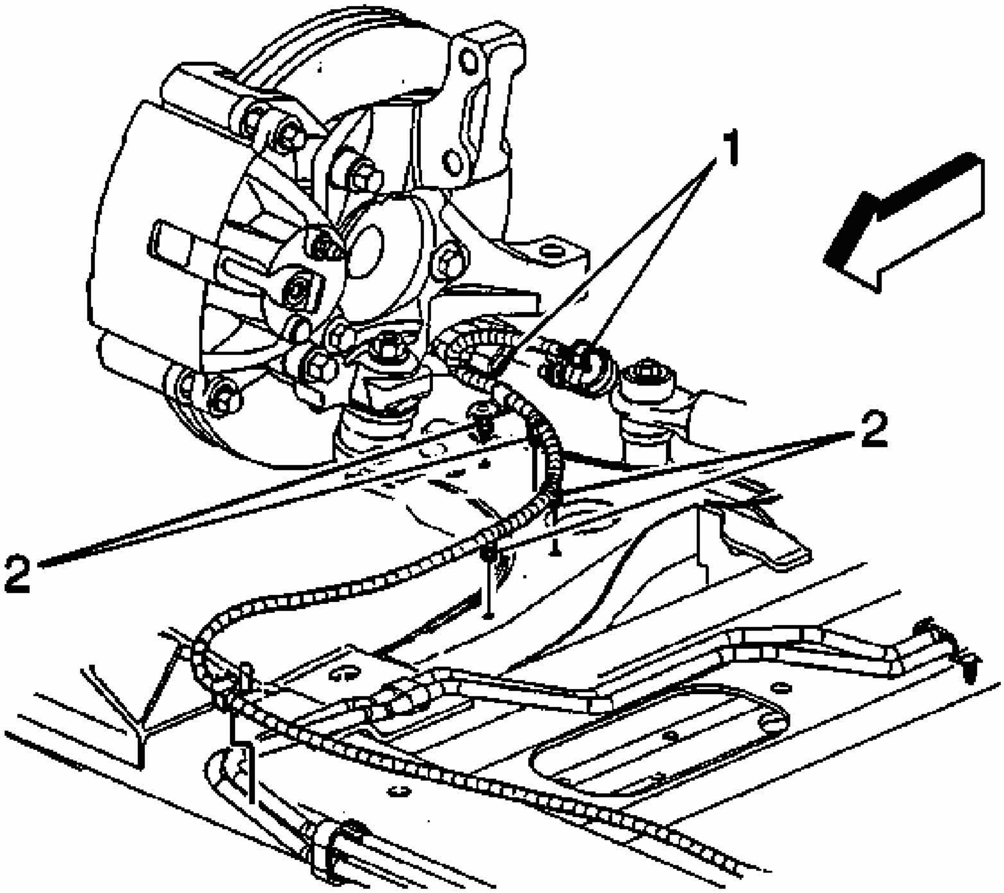


Fig. 2: Front Wheel Speed Sensor Connectors & Harness Retainers
Courtesy of GENERAL MOTORS CORP.

13. Disconnect both front wheel speed sensor connectors (1), if equipped.
14. Remove both front wheel speed harness retainers (2) from the frame and the lower control arms, if equipped.
15. Separate both of the lower ball joints from the steering knuckle. Refer to **Lower Ball Joint Replacement** .

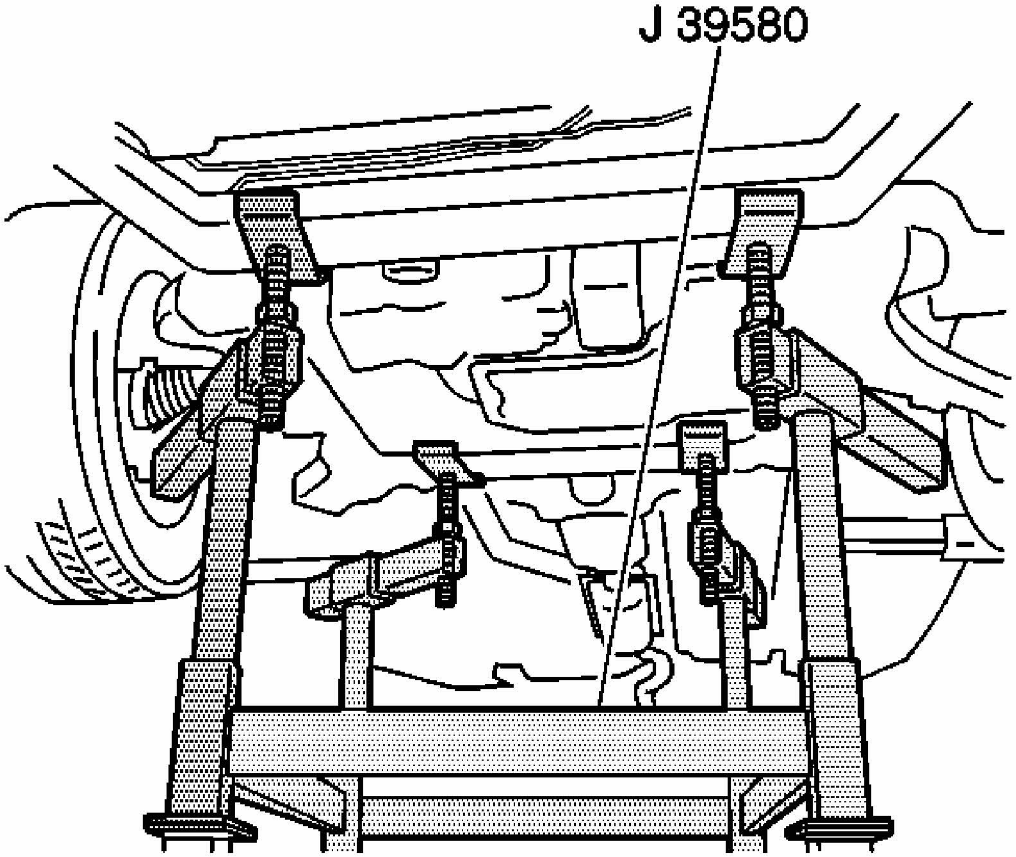


Fig. 3: Identifying Utility Stand
Courtesy of GENERAL MOTORS CORP.

16. Lower the vehicle until the frame contacts **J 39580** .

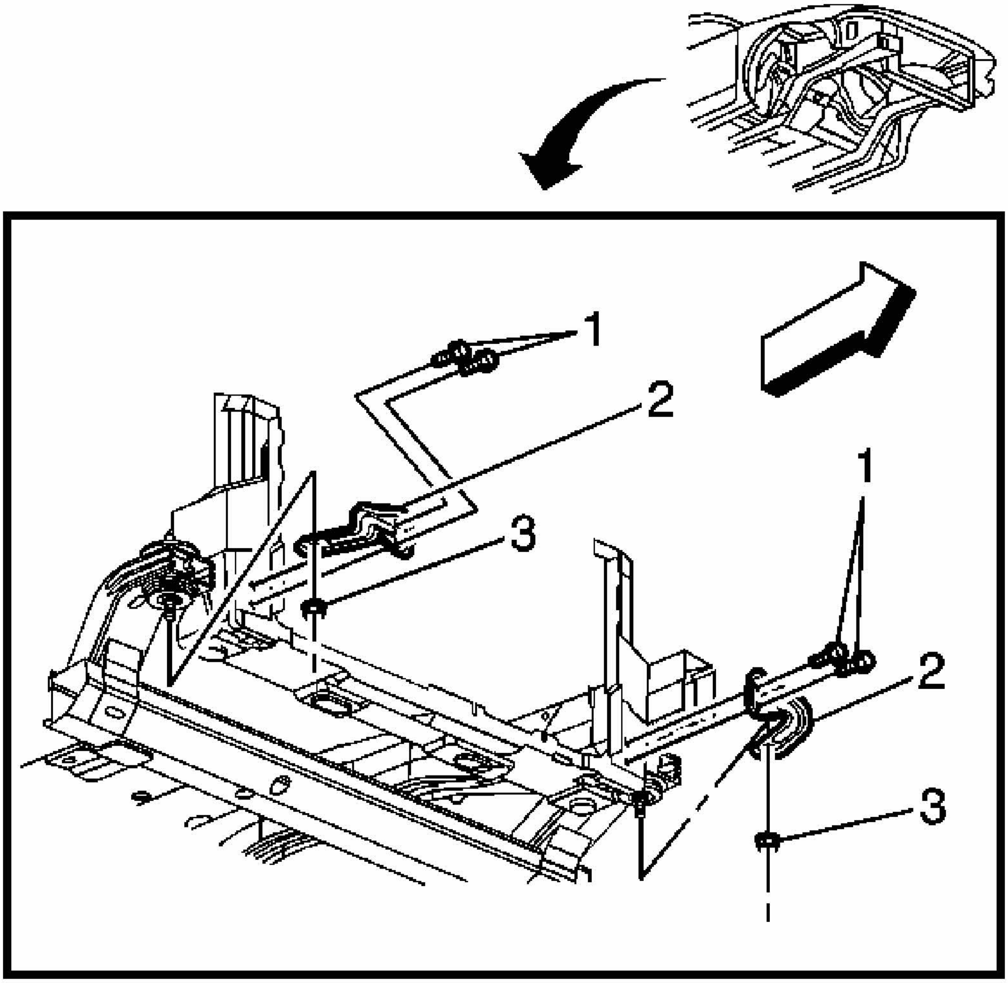


Fig. 4: Removing The Frame Reinforcement Nuts
Courtesy of GENERAL MOTORS CORP.

17. Remove the frame reinforcement nuts (3).
18. Remove the frame reinforcement bolts (1).
19. Remove the frame reinforcements (2).

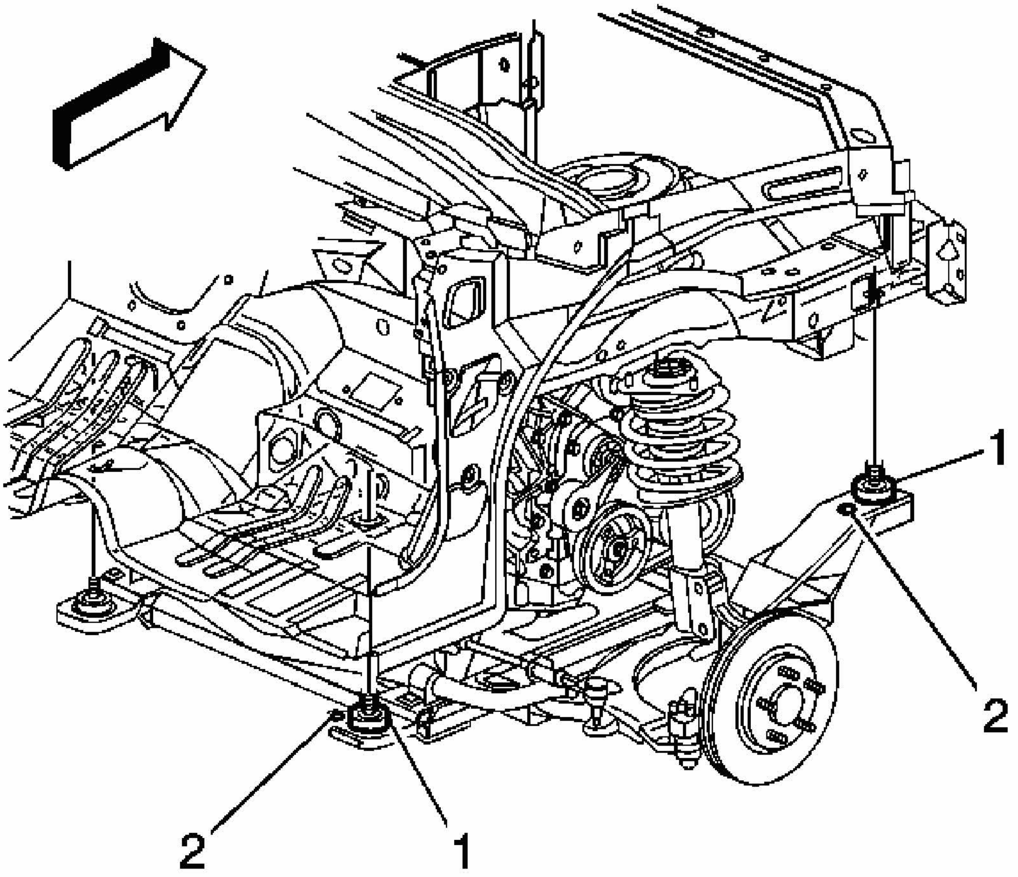


Fig. 5: Removing The Bolts Which Secure The Frame To The Body
Courtesy of GENERAL MOTORS CORP.

20. Remove the bolts (1) which secure the frame to the body.
21. Raise the vehicle in order to separate the frame from the body.
22. If you are replacing the frame, remove the following components:
    - Both of the lower control arms-Refer to **Lower Control Arm Replacement** .
    - The stabilizer shaft-Refer to **Stabilizer Shaft Replacement** .
    - The spacers, the upper insulator, the lower insulator, and the retainers-Refer to **Frame Cushion or Insulator Replacement - Front** and to **Frame Cushion or Insulator Replacement - Rear**.

Installation Procedure

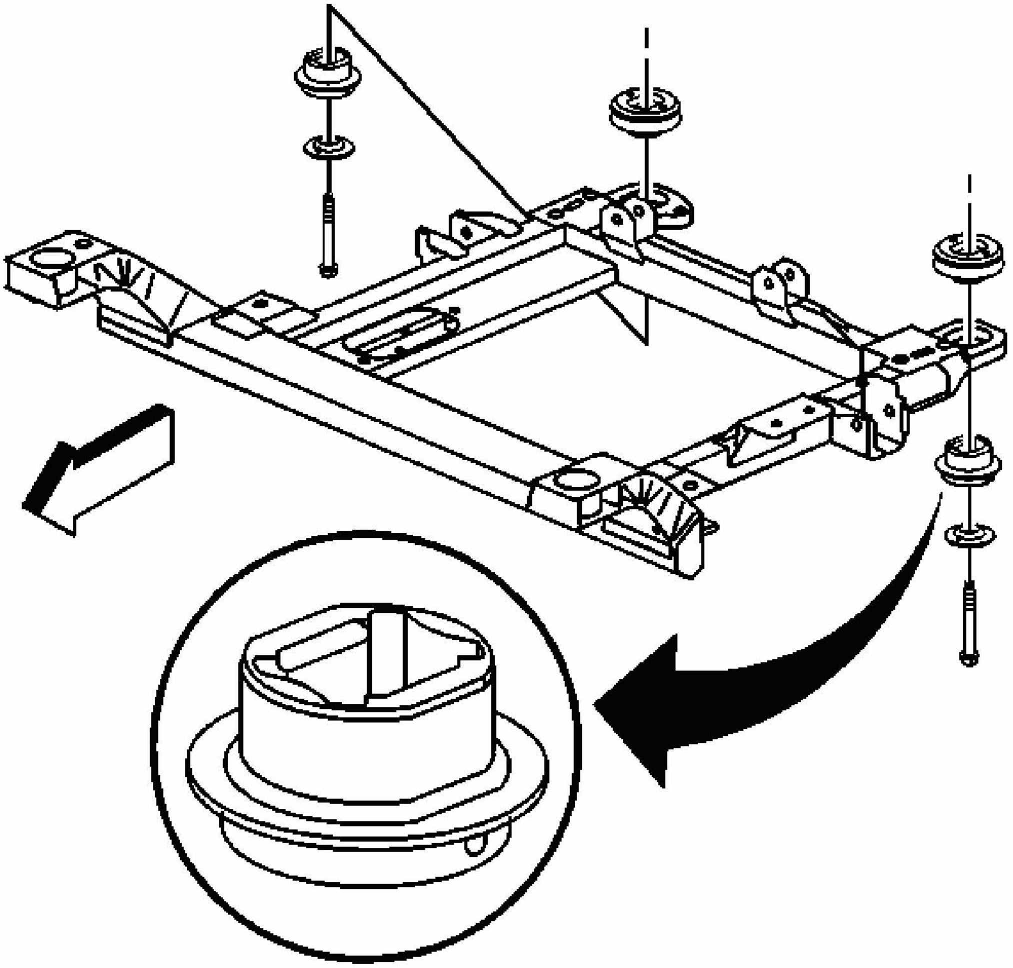


Fig. 6: Rear Frame To Body Bolts
Courtesy of GENERAL MOTORS CORP.

1. If you are replacing the frame, install the following components:
    - Both of the lower control arms-Refer to **Lower Control Arm Replacement** .
    - The stabilizer shaft-Refer to **Stabilizer Shaft Replacement** .
    - The spacers, the upper insulator, the lower insulator, and the retainers-Refer to **Frame Cushion or Insulator Replacement - Front** and to **Frame Cushion or Insulator Replacement - Rear**.

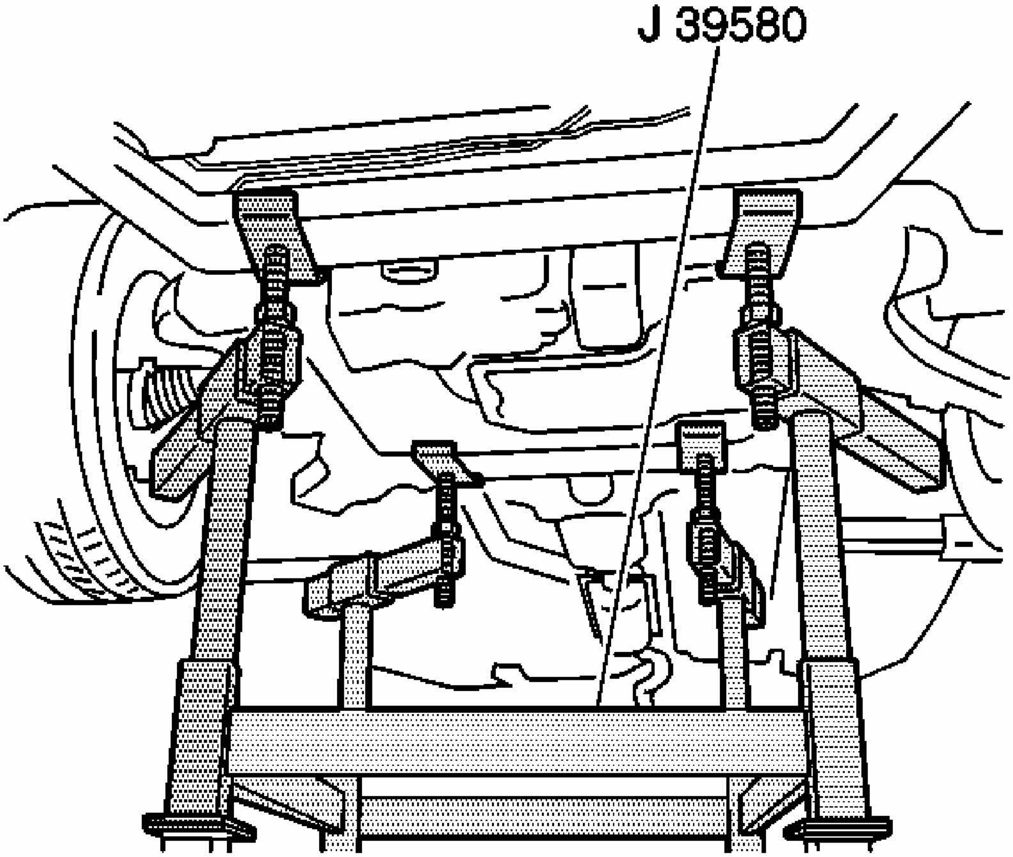


Fig. 7: Identifying Utility Stand
Courtesy of GENERAL MOTORS CORP.

2. Position the engine support table with the frame under the vehicle.
3. Lower the vehicle to the frame.

NOTE: **Refer to Fastener Notice .**

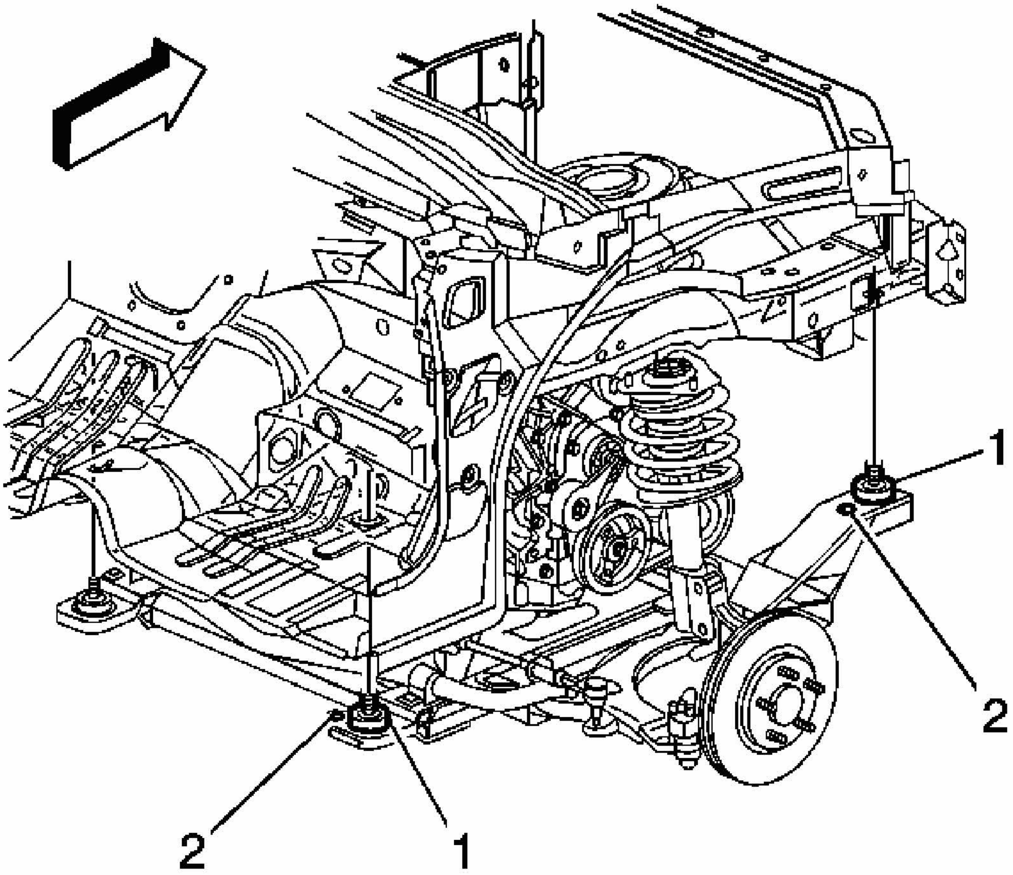


Fig. 8: Installing The Bolts To Secure The Frame To The Body
Courtesy of GENERAL MOTORS CORP.

4. Loosely install the bolts (1) to secure the frame to the body.
5. Align the frame to the body by inserting two 19X203 mm (0.74X8.0 in) pins in the alignment holes (2) on the right side of the frame.

Tighten:

- Tighten the new front frame bolts to 145 N.m (107 lb ft).
- Tighten the new rear frame bolts to 160 N.m (118 lb ft).

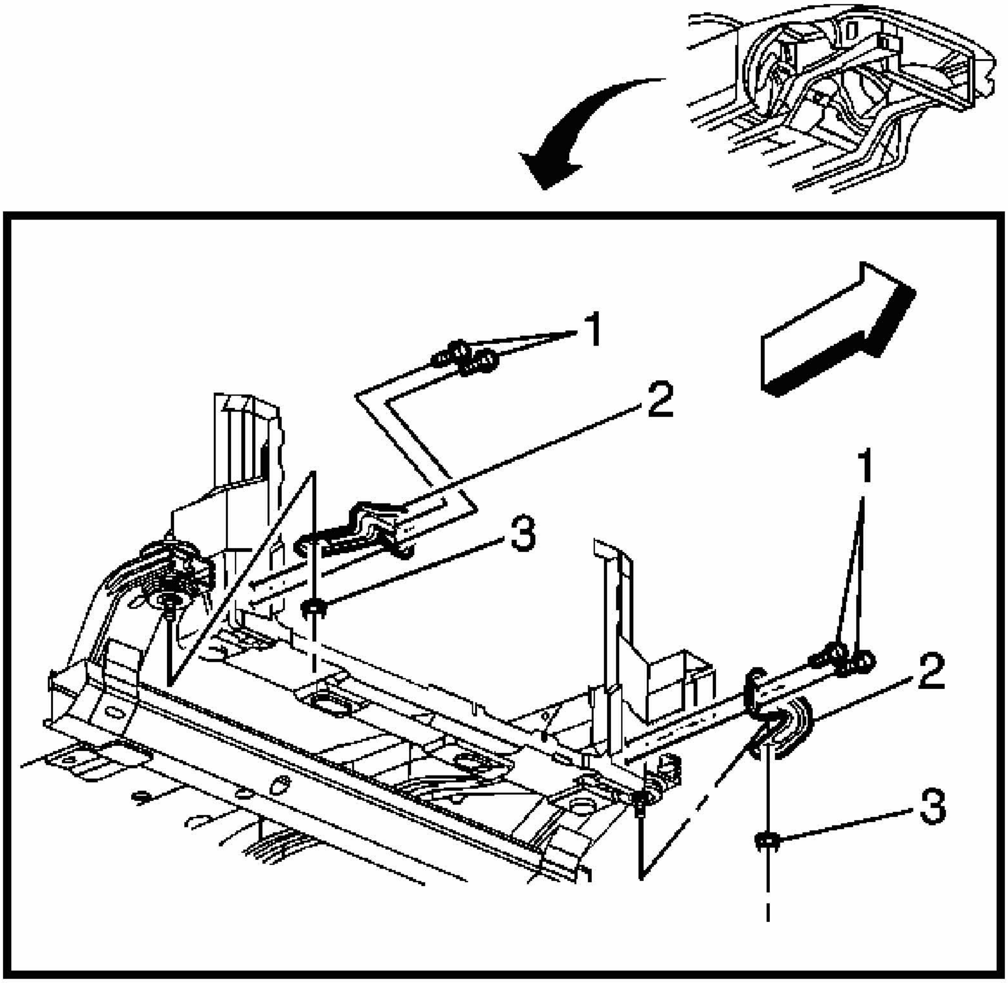


Fig. 9: Installing The Frame Reinforcements
Courtesy of GENERAL MOTORS CORP.

6. Install the frame reinforcements (2).
7. Install the frame reinforcement bolts (1).

   Tighten: Tighten the bolts to 20 N.m (15 lb ft).

8. Install the frame reinforcement nuts (3).

   Tighten: Tighten the nuts to 20 N.m (15 lb ft).

9. Connect both the lower ball joints to the steering knuckle. Refer to **Lower Ball Joint Replacement** .

10. Install the nuts which secure the engine mount to the frame. Refer to **Engine Mount Replacement** for the 3.5L engine, **Engine Mount Replacement** for the 3.9L engine, **Engine Mount Replacement - Left** and **Engine Mount Replacement - Right** for the 5.3L engine.
11. Install the nuts which secure the transaxle mount to the frame. Refer to **Transmission Mount Replacement - Left** for the 4T65-E transaxle.
12. Remove the power steering gear from the exhaust pipe. Position to the frame.
13. Install the steering gear mounting bolts. Refer to **Power Steering Gear Replacement** .
14. Install the stabilizer shaft links. Refer to **Stabilizer Shaft Link Replacement** .

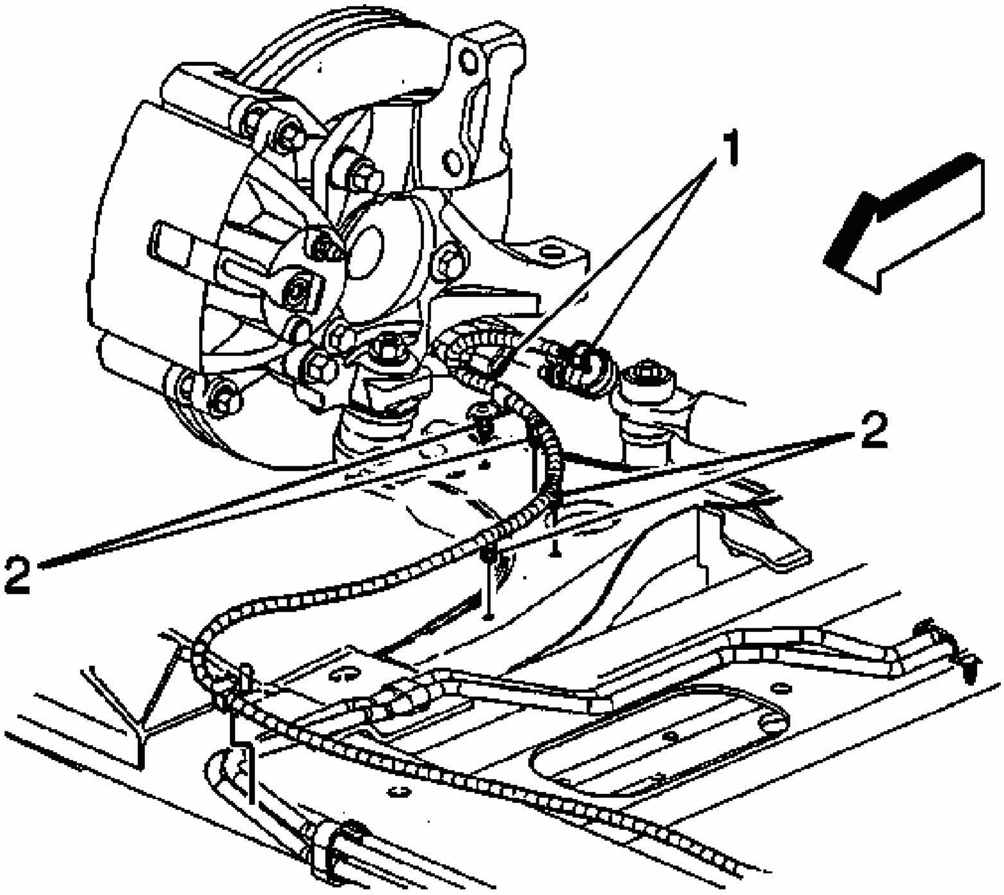


Fig. 10: Front Wheel Speed Sensor Connectors & Harness Retainers
Courtesy of GENERAL MOTORS CORP.

15. Connect both front wheel speed sensor connectors (1), if equipped.
16. Install both front wheel speed harness retainers (2) to the frame and to the lower control

arm, if equipped.

17. Install the positive battery cable. Refer to **Battery Positive and Negative Cable Replacement (RPOs LZE/LZ4/LZ9)** or **Battery Positive and Negative Cable Replacement (RPO LS4)** .
18. Install the power steering cooler pipe. Refer to **Power Steering Cooler Pipe/Hose Replacement** .
19. Install the radiator lower air deflector. Refer to **Radiator Air Baffle and Deflector Replacement - Lower** .
20. Install the front tires and wheels. Refer to **Tire and Wheel Removal and Installation** .
21. Lower the vehicle.
22. Remove the engine support fixture. Refer to **Engine Support Fixture** for the 3.5L engine, **Engine Support Fixture** for the 3.9L engine, **Engine Support Fixture** for the 5.3L engine.
23. Inspect the front wheel alignment. Refer to **Measuring Wheel Alignment** .

FRONT FRAME CUSHION OR INSULATOR REPLACEMENT

Tools Required

J 45296 Frame Insulator Remover/Installer. See **Special Tools**.

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Disconnect the steering intermediate shaft. Refer to **Intermediate Steering Shaft Replacement** .
3. Disconnect the fog lamp electrical connectors from the fog lamps.

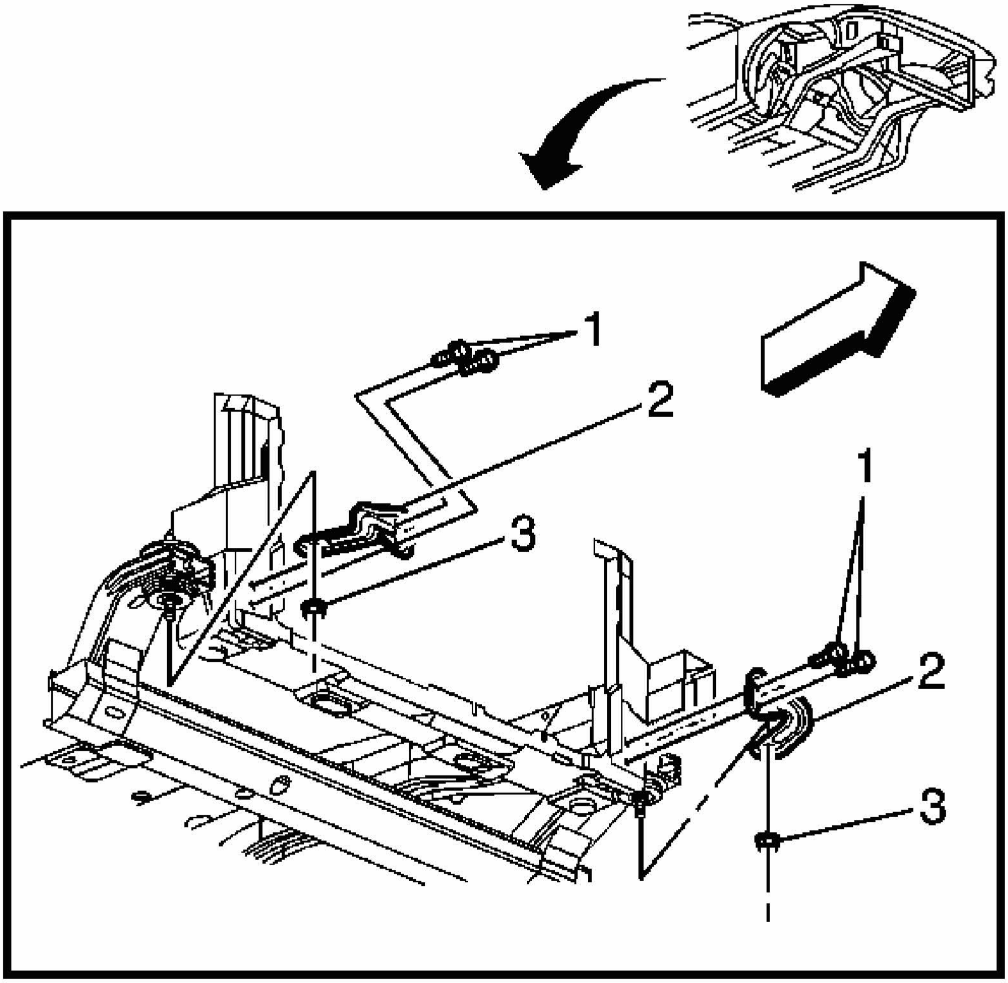


Fig. 11: Remove The Frame Reinforcement Nuts
Courtesy of GENERAL MOTORS CORP.

4. Remove the frame reinforcement nuts (3).
5. Remove the frame reinforcement bolts (1).
6. Remove the frame reinforcements (2).
7. Install a jackstand under the center of the frame, between the front frame insulators.

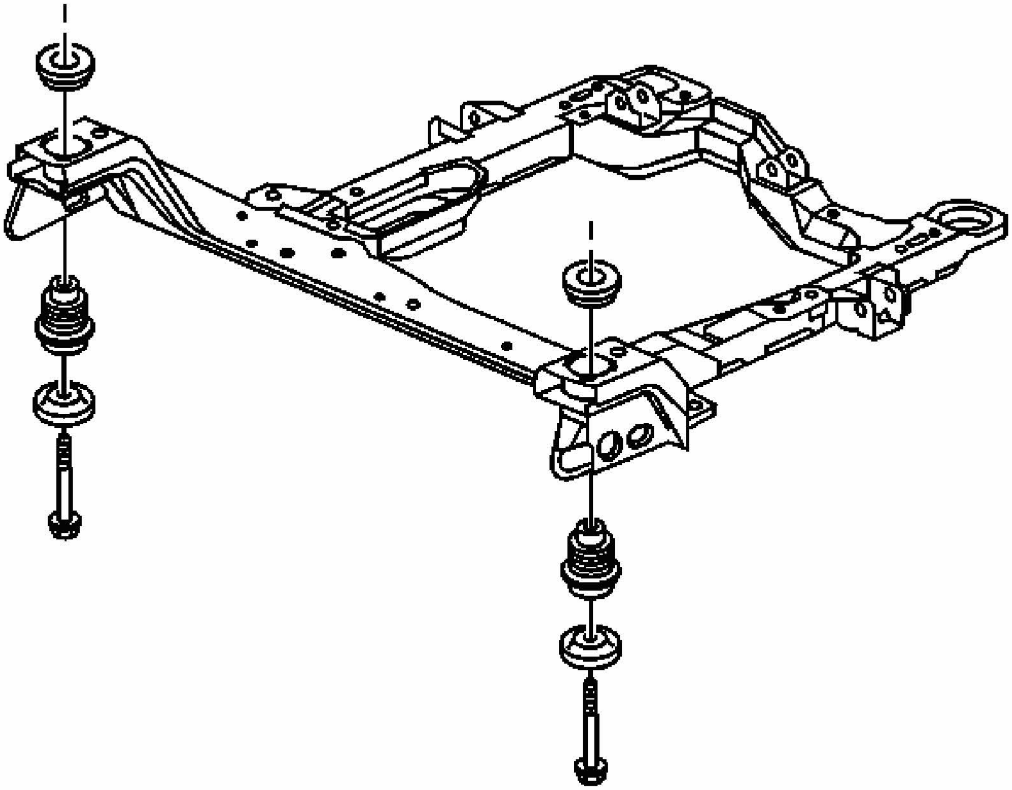


Fig. 12: View Of Front Frame Bolts And Retainers
Courtesy of GENERAL MOTORS CORP.

8. Remove the front frame bolts and retainers.
9. Lower the front of the frame.
10. Remove the frame front upper insulators.

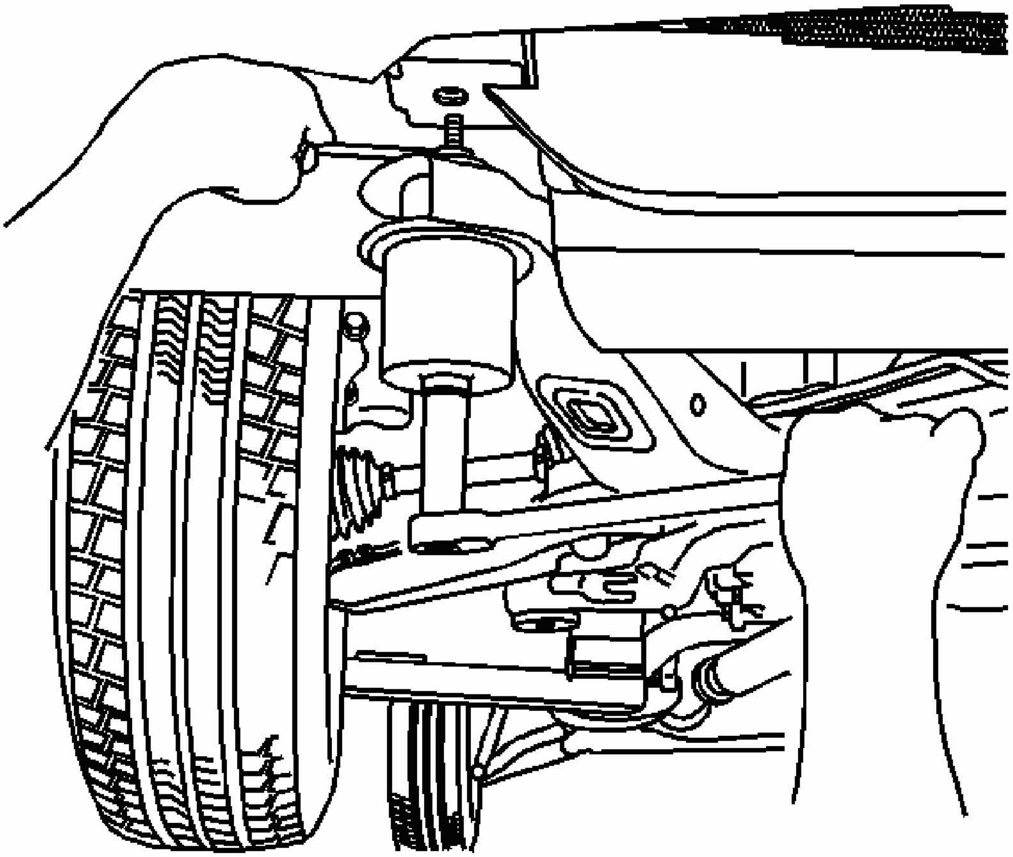


Fig. 13: View Of Frame Front Upper Insulators
Courtesy of GENERAL MOTORS CORP.

11. Install the **J 45296** , or equivalent to the front frame insulator you are removing. See **Special Tools**.
12. Using the **J 45296** , or equivalent remove the front frame insulator from the frame. See **Special Tools**.

Installation Procedure

1. Clean the front frame insulator opening.
2. Apply a thin coat of rubber lubricant GM P/N 01051717 (Canadian P/N 12345884) or equivalent to the inside of the front frame insulator opening.
3. Apply a thin coat of rubber lubricant GM P/N 01051717 (Canadian P/N 12345884) or equivalent to the front frame insulator.

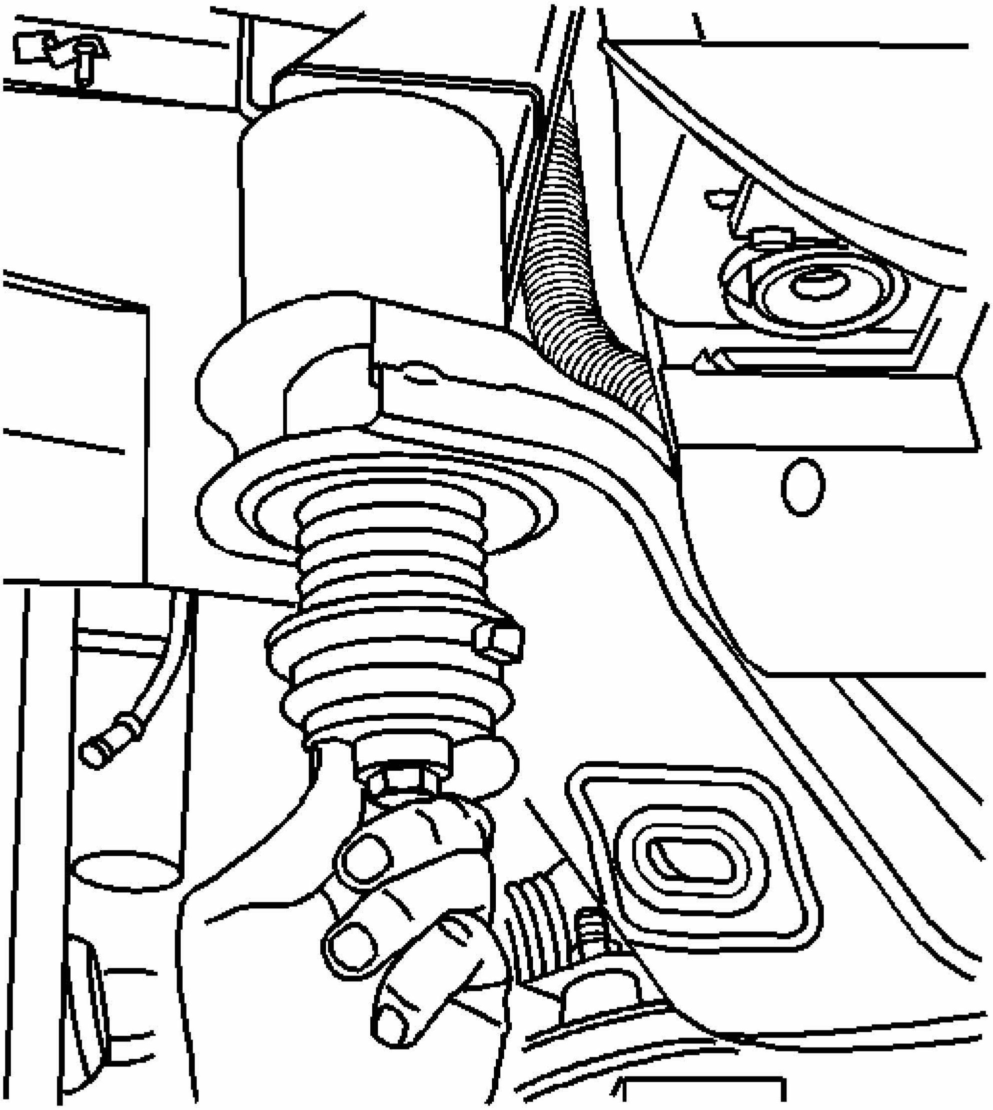


Fig. 14: Aligning The Front Frame Insulator
Courtesy of GENERAL MOTORS CORP.

4. Align the front frame insulator to the front frame opening with the front frame alignment tabs facing to the front.
5. Using the **J 45296** , or equivalent install the front frame insulator to the front frame. See **Special Tools**.

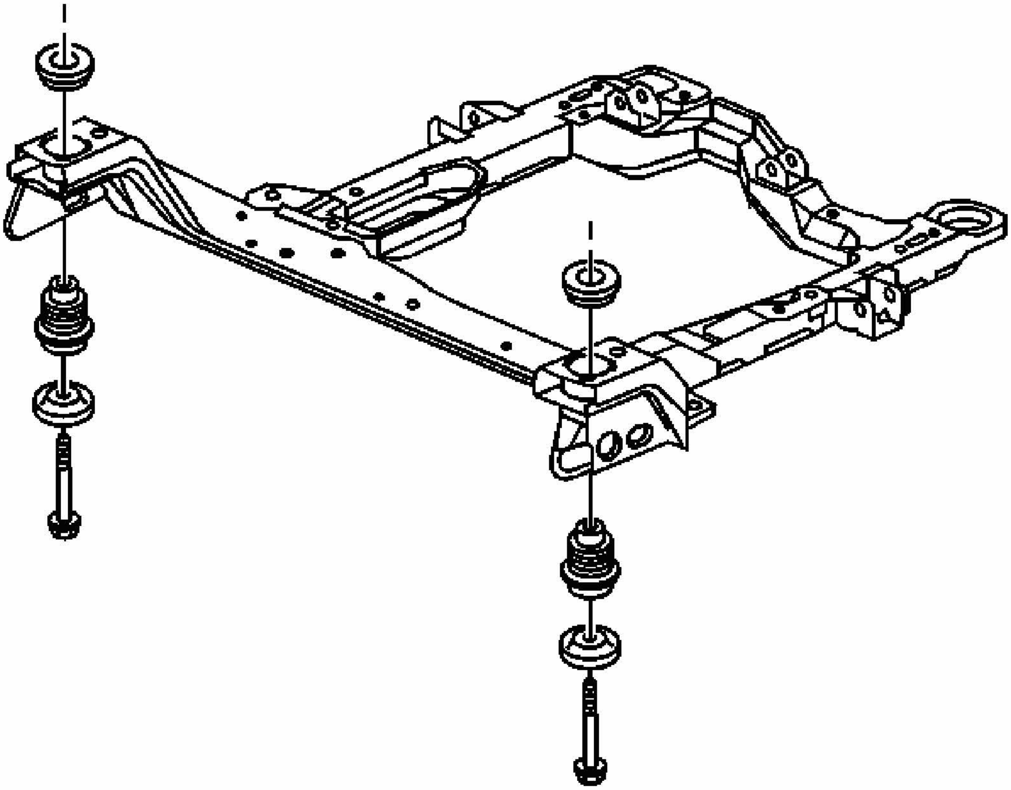


Fig. 15: View Of Front Frame Bolts And Retainers
Courtesy of GENERAL MOTORS CORP.

6. Install the frame front upper insulators.
7. Raise the front of the frame.

NOTE: **Refer to Fastener Notice .**

8. Install the front frame bolts and retainers.

   Tighten: Tighten the front frame bolts to 145 N.m (107 lb ft).

9. Remove the jackstand.

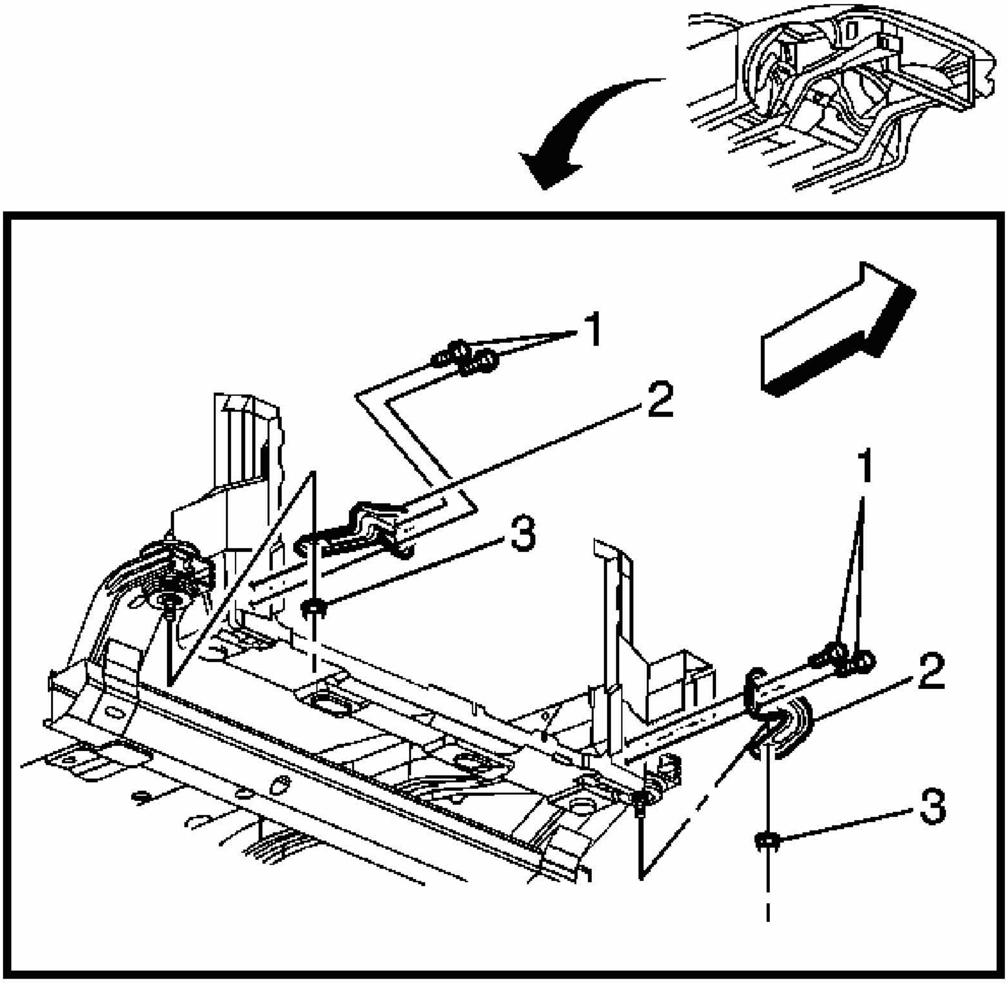


Fig. 16: Installing The Frame Reinforcements
Courtesy of GENERAL MOTORS CORP.

10. Install the frame reinforcements (2).
11. Install the frame reinforcement bolts (1).

    Tighten: Tighten the bolts to 20 N.m (15 lb ft).

12. Install the frame reinforcement nuts (3).

    Tighten: Tighten the nuts to 20 N.m (15 lb ft).

13. Connect the fog lamp electrical connectors to the fog lamps.
14. Connect the steering intermediate shaft. Refer to **Intermediate Steering Shaft**

Replacement .

15. Lower the vehicle.

REAR FRAME CUSHION OR INSULATOR REPLACEMENT

Removal Procedure

IMPORTANT: In order to remove any frame insulator, loosen the adjacent frame insulators to permit the frame to separate from the body. Do not break the fan shroud or damage the frame attachments, such as steering hoses and brake pipes during the replacement of body mounts.
When installing a body mount, ensure the lower insulator is seated into the frame. The lower insulator should not be loose. The spacer and the corresponding upper insulator is pressed into the lower insulator thus squeezing the frame. The bolt is then inserted through the mount, capturing the lower retainer. The body mount components prevent contact of the frame to the body.
Do not over tighten the body mount. Over tightening may collapse a spacer or strip a bolt. When the frame insulator bolts are removed, always discard the bolts and replace with new bolts.
When clamping by the mount, ensure the surfaces are clean and dry. If the frame insulator bolt does not screw in smoothly, run a tap through the frame crossmember nut in the body in order to remove foreign material. Ensure the tap does not punch through the underbody.
Whenever the body is moved in relation to the frame, disconnect the intermediate shaft from the rack and pinion steering gear and stub shaft.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

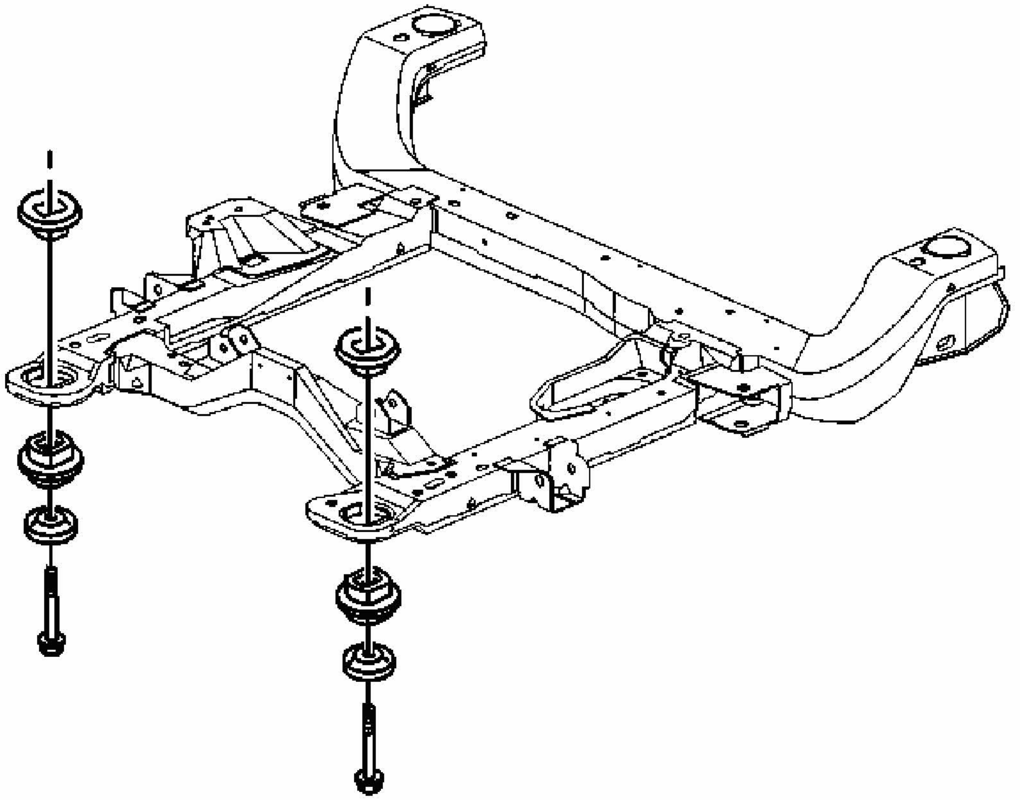


Fig. 17: View Of Rear Frame
Courtesy of GENERAL MOTORS CORP.

2. Remove the intermediate shaft from the steering gear stub shaft. Refer to **Intermediate Steering Shaft Replacement** .
3. Install a utility stand to the rear of the frame.
4. Remove the rear frame bolts.
5. Lower the rear of the frame.
6. Remove the upper and lower insulators from the rear of the frame as a set.

Installation Procedure

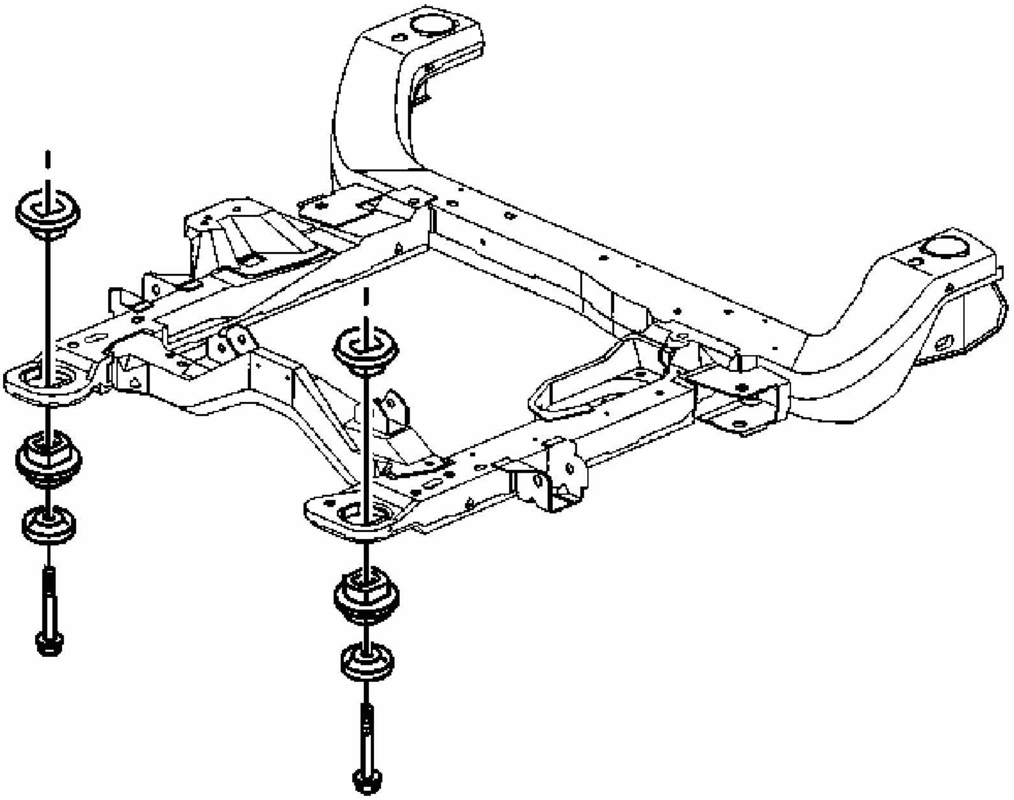


Fig. 18: View Of Rear Frame
Courtesy of GENERAL MOTORS CORP.

1. Apply lube to inside surface of lower insulator and to top surface of upper insulator.
2. Install the upper and lower insulators to the rear of the frame as a set.
3. Raise the rear of the frame.

NOTE: **Refer to Fastener Notice .**

4. Install the rear frame bolts.

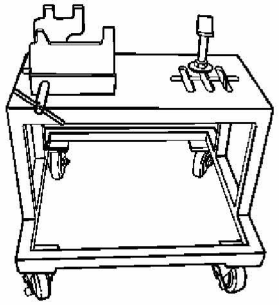
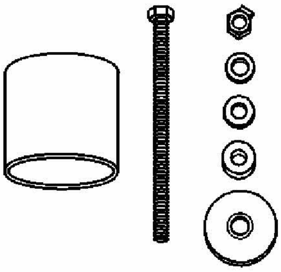
   Tighten: Tighten the rear frame bolts to 160 N.m (118 lb ft).

5. Remove the utility stand.
6. Install the intermediate shaft to the steering gear stub shaft. Refer to **Intermediate Steering Shaft Replacement** .
7. Lower the vehicle.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description
	J 39580 Power Pack Stand Engine And Transaxle Assembly Support Remove/Installer
	J 45296 Frame Insulator Remover/Installer

2006 SUSPENSION

Front Suspension - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
[1] Front Lower Control Arm Ball Stud to Steering Knuckle Nut	20 N.m + 120 degrees	15 lb ft + 120 degrees
Front Lower Control Ball Stud to Control Arm Nuts	68 N.m	50 lb ft
Front Lower Control Arm Mounting Nuts	125 N.m	92 lb ft
Front Stabilizer Shaft Bracket Bolt	42 N.m	31 lb ft
Front Stabilizer Shaft Link Nut	23 N.m	17 lb ft
Front Suspension Strut Mount to Body Nut	33 N.m	24 lb ft
Front Suspension Strut Rod to Strut Mount Nut	70 N.m	52 lb ft
Front Suspension Strut to Steering Knuckle Bolts	130 N.m	96 lb ft
Front Wheel Bearing/Hub Bolts	130 N.m	96 lb ft
Front Wheel Driveshaft Nut	190 N.m	140 lb ft
Powertrain Cradle to Body Bolts (Front)	145 N.m	107 lb ft
Powertrain Cradle to Body Bolts (Rear)	160 N.m	118 lb ft
[1] Tighten the nut to 20 N.m(15 lb ft) plus 2 nut flats (120°) to align the cotter pin hole with the front lower control arm ball stud. Turn the nut clockwise. DO NOT loosen the nut in order to align the cotter pin hole. Minimum torque is 55 N.m (41 lb ft).		

REPAIR INSTRUCTIONS

STABILIZER SHAFT REPLACEMENT

Removal Procedure

CAUTION: Failure to disconnect intermediate shaft from rack and pinion stub shaft can result in damage to steering gear and/or intermediate shaft. This damage can cause loss of steering control which could result in personal injury.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the left tire and wheel assembly. Refer to **Tire and Wheel Removal and**

Installation .

3. Remove the pinch bolt from the lower intermediate steering shaft. Refer to **Intermediate Steering Shaft Replacement** .
4. Loosen all insulator clamp attaching bolts.
5. Place a jackstand under the center of the rear frame crossmember.
6. Remove the rear frame-to-body bolts.
7. Lower the rear of the frame just enough to gain access to the stabilizer shaft.

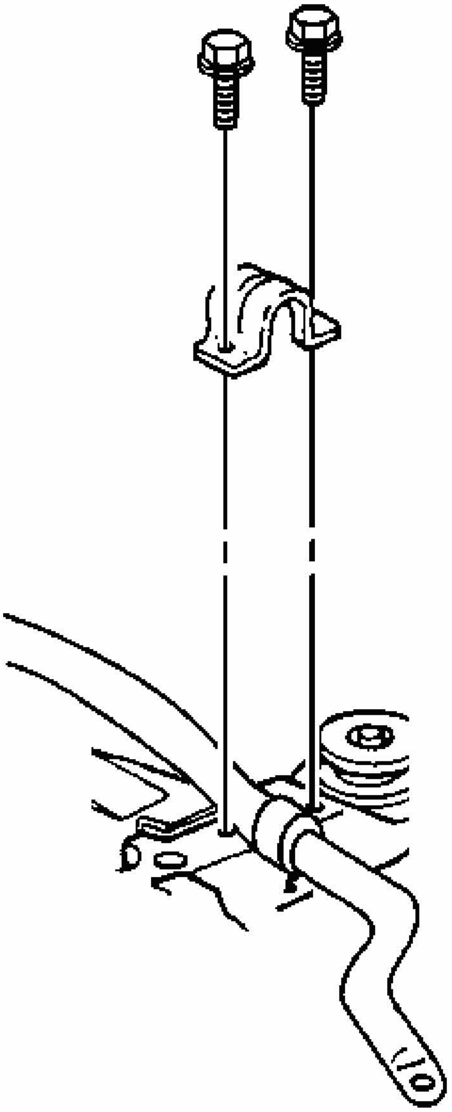


Fig. 1: View Of Insulator Brackets

Courtesy of GENERAL MOTORS CORP.

8. Remove the insulator clamp bolts and the clamps from the frame.

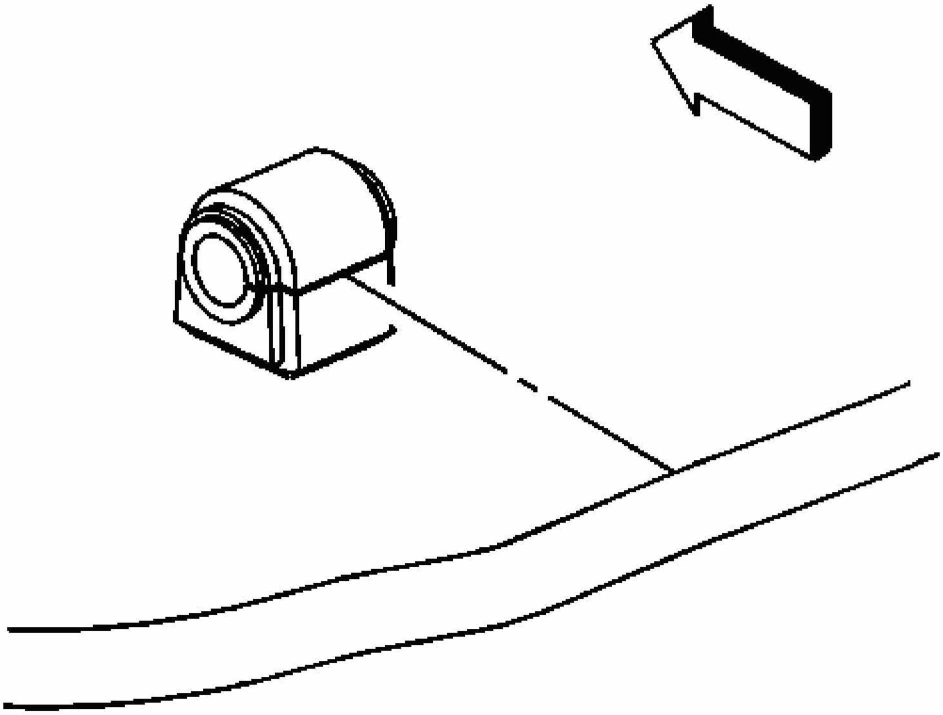


Fig. 2: View Of Insulator For Stabilizer Bar
Courtesy of GENERAL MOTORS CORP.

9. Remove the insulators from the stabilizer bar.

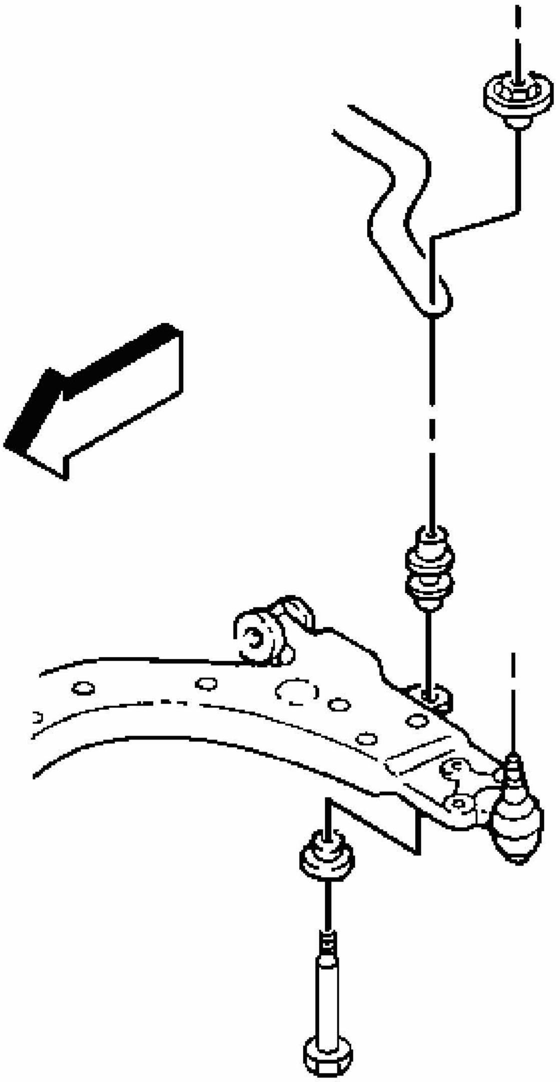


Fig. 3: View Of Stabilizer Shaft Link
Courtesy of GENERAL MOTORS CORP.

10. Remove the stabilizer bar links from the control arms. Refer to **Stabilizer Shaft Link Replacement**.
11. Pull the stabilizer shaft rearward.
12. Swing the stabilizer shaft down to remove the stabilizer shaft from the left side of the vehicle.

Installation Procedure

CAUTION: When installing the intermediate shaft make sure that the shaft is seated prior to pinch bolt installation. If the pinch bolt is inserted into the coupling before shaft installation, the two mating shafts may disengage. Disengagement of the two mating shafts will cause loss of steering control which could result in personal injury.

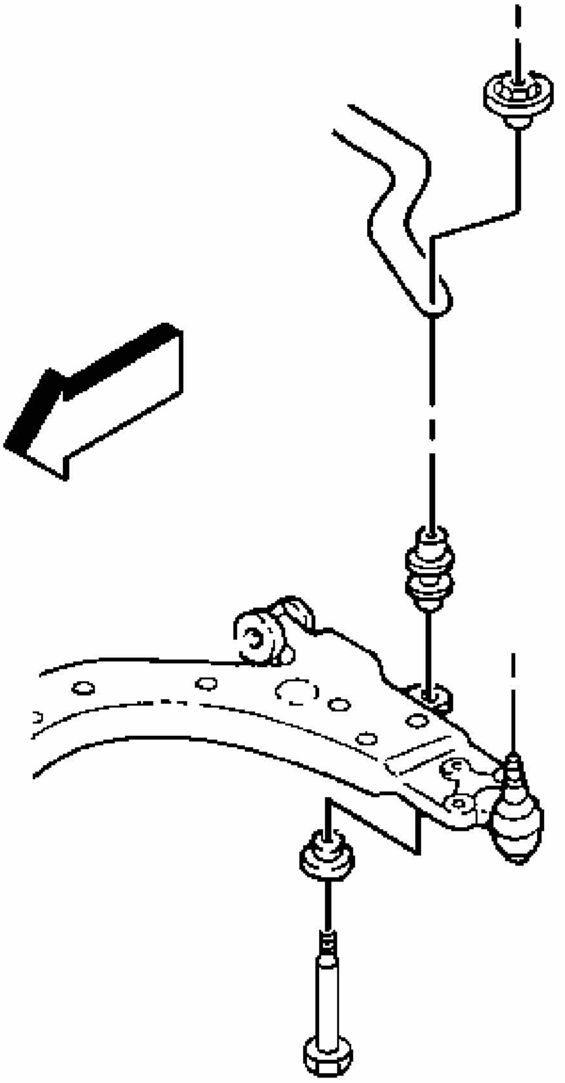


Fig. 4: View Of Stabilizer Shaft Link
Courtesy of GENERAL MOTORS CORP.

1. Insert the stabilizer shaft to the left side of the vehicle.

IMPORTANT: DO NOT tighten the stabilizer link nut at this time. The weight of the vehicle must be supported by the control arms such that you can obtain the vehicle design trim heights before tightening the link nut.

2. Loosely install the stabilizer shaft link at the control arm.

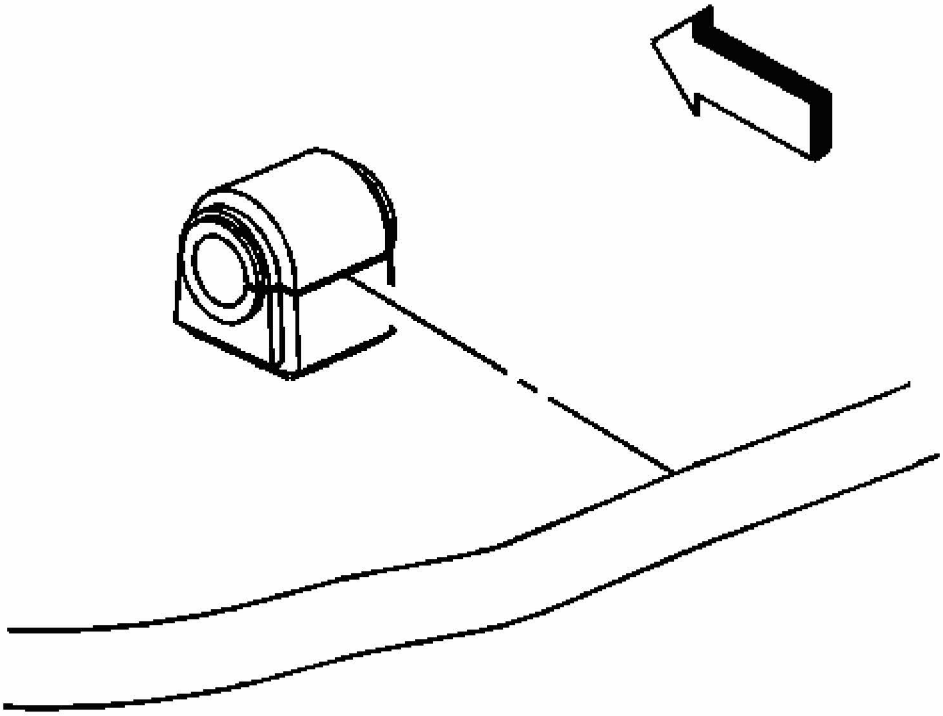


Fig. 5: View Of Insulator For Stabilizer Bar
Courtesy of GENERAL MOTORS CORP.

3. Install the insulators on to the stabilizer bar.

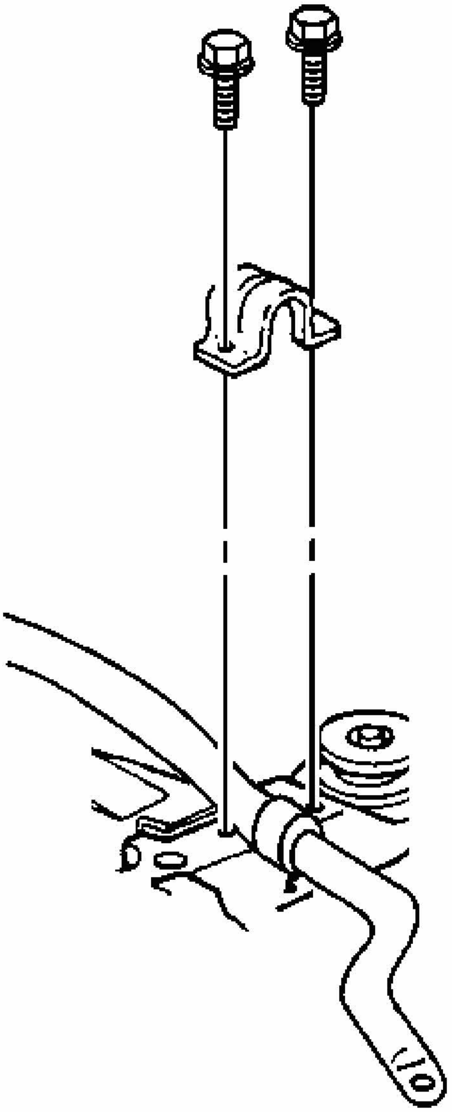


Fig. 6: View Of Insulator Brackets
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

4. Connect the insulator clamps to the frame.

Tighten: Tighten the stabilizer shaft bracket bolt to 42 N.m (31 lb ft).

5. Raise the frame into position while you guide the steering shaft onto the gear.
6. Install the rear frame-to-body attaching bolts.

   Tighten: Tighten the frame to body attaching bolts to 160 N.m (118 lb ft).

7. Remove the jackstand.
8. Install the pinch bolt and tighten. Refer to **Intermediate Steering Shaft Replacement** .
9. Install the left tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
10. Lower the vehicle.
11. Support the weight of the vehicle by the control arms.
12. Tighten the stabilizer link nut.

    Tighten: Tighten the stabilizer shaft link nut to 23 N.m (17 lb ft).

STABILIZER SHAFT LINK REPLACEMENT

Removal Procedure

1. Raise the vehicle and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

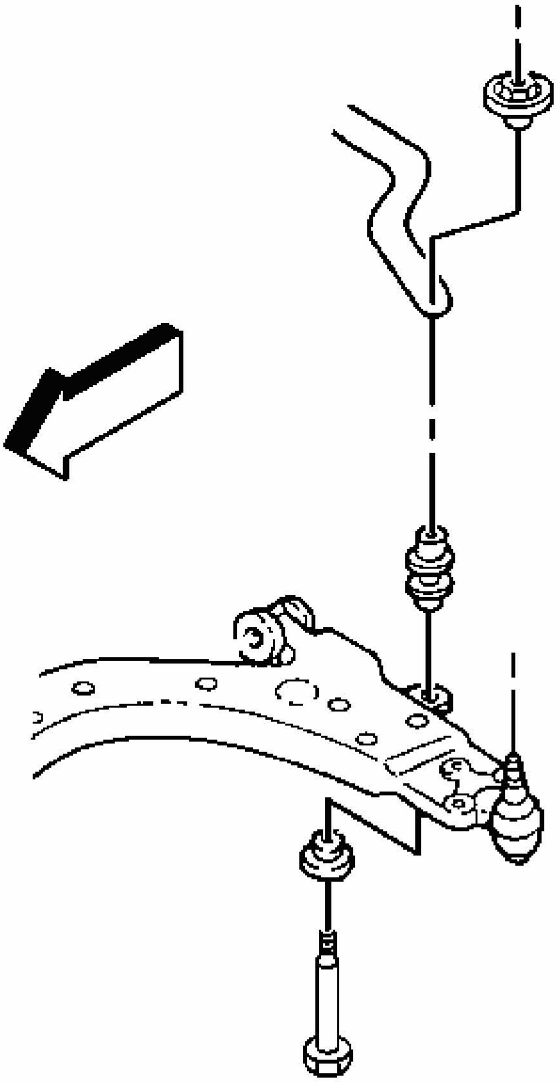


Fig. 7: View Of Stabilizer Shaft Link
Courtesy of GENERAL MOTORS CORP.

3. Remove the stabilizer shaft link bolt and nut.
4. Remove the stabilizer shaft link from the vehicle.

Installation Procedure

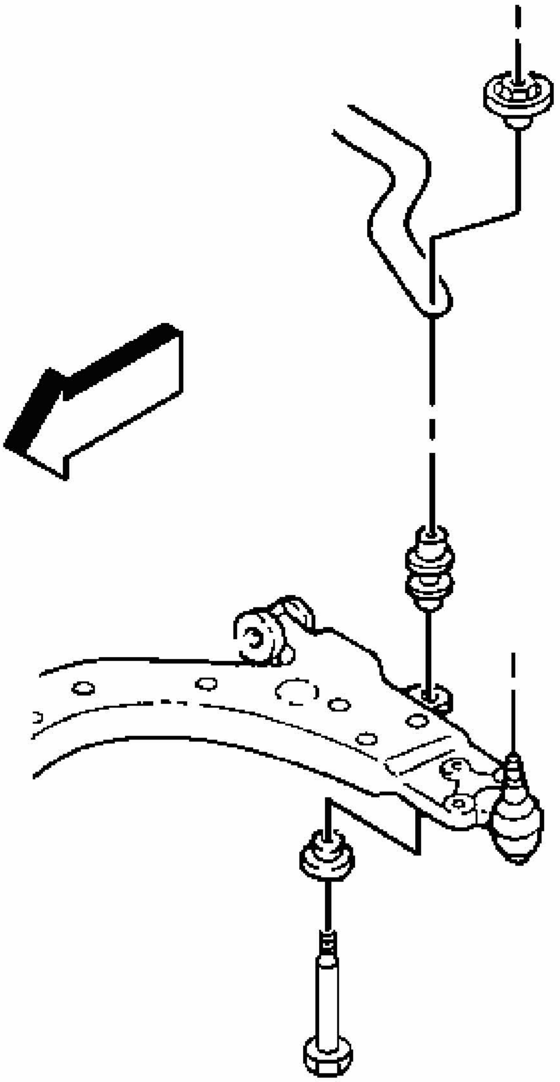


Fig. 8: View Of Stabilizer Shaft Link
Courtesy of GENERAL MOTORS CORP.

1. Install the stabilizer link into the vehicle.

NOTE: **Refer to Fastener Notice .**

2. Install the stabilizer shaft link bolt and nut.

Tighten: Tighten the stabilizer shaft link nut to 23 N.m (17 lb ft).

3. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
4. Lower the vehicle.

STABILIZER SHAFT INSULATOR REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

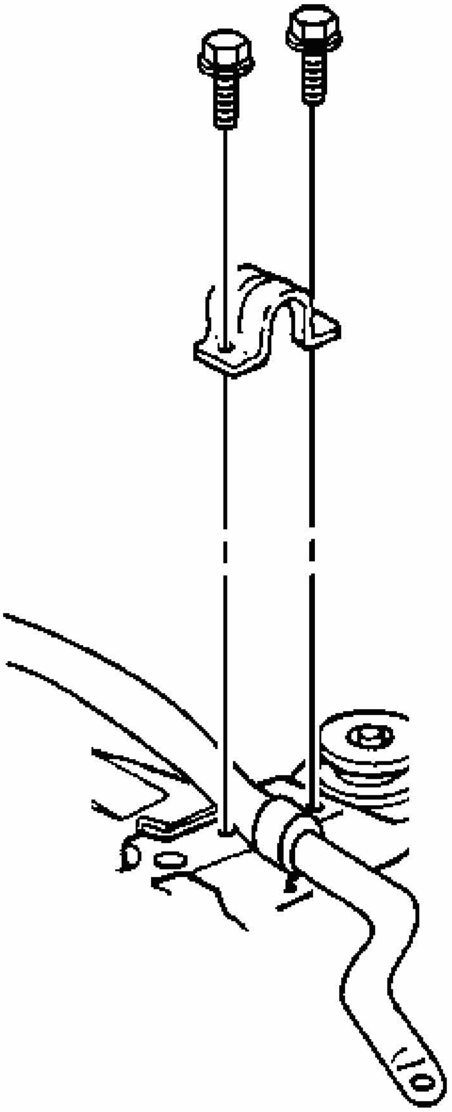


Fig. 9: View Of Insulator Brackets
Courtesy of GENERAL MOTORS CORP.

2. Remove the left and right side stabilizer shaft insulator bracket bolts.
3. Remove the left and right side stabilizer shaft insulator brackets.

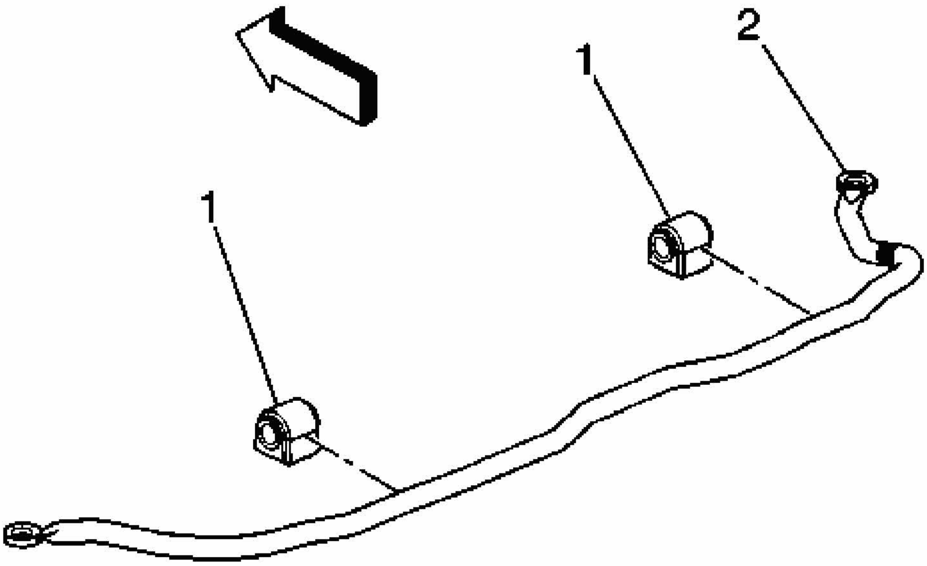


Fig. 10: Stabilizer Shaft Insulators
Courtesy of GENERAL MOTORS CORP.

4. Remove the left and right side stabilizer shaft insulators (1) from the stabilizer shaft (2).

Installation Procedure

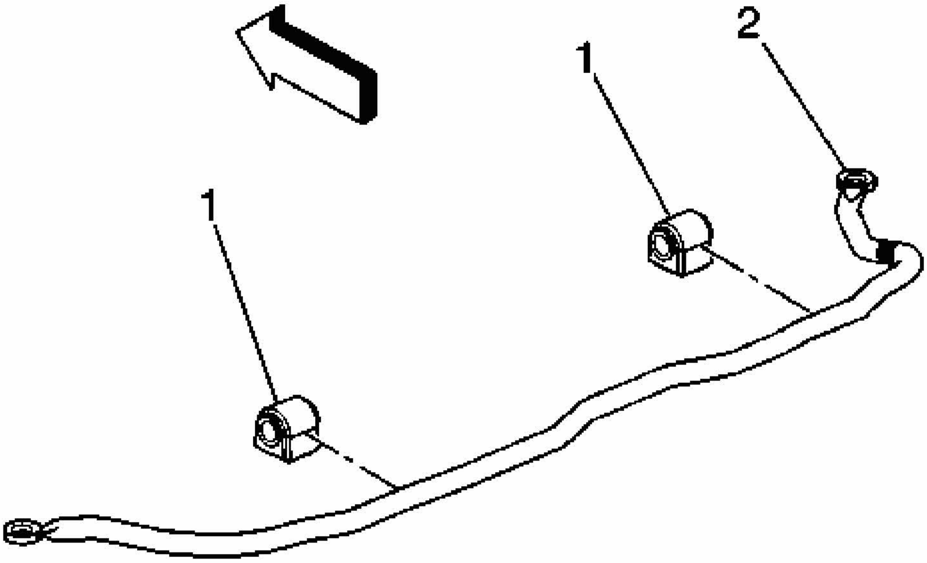


Fig. 11: Stabilizer Shaft Insulators
Courtesy of GENERAL MOTORS CORP.

1. Install the left and right side stabilizer shaft insulators (1) to the stabilizer shaft (2).

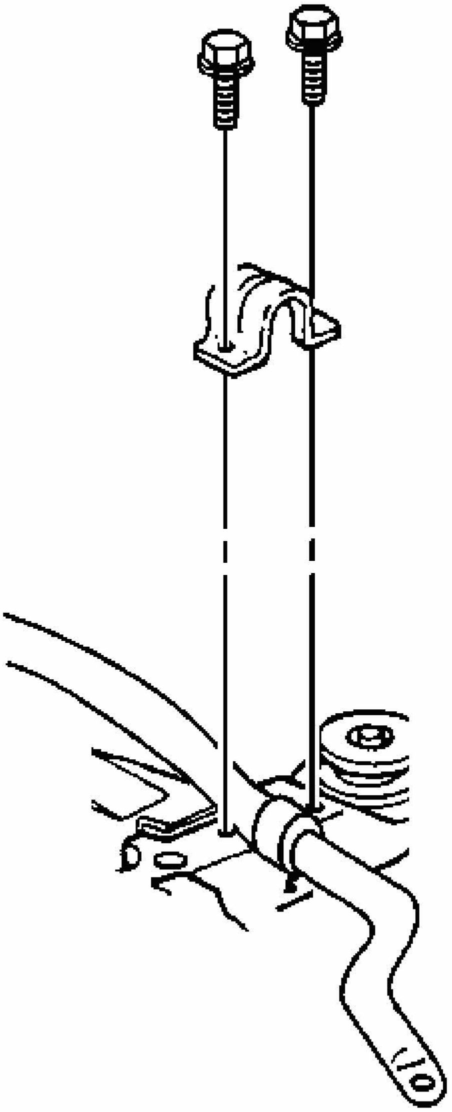


Fig. 12: View Of Insulator Brackets
Courtesy of GENERAL MOTORS CORP.

2. Install the left and right side stabilizer shaft insulator brackets.

NOTE: **Refer to Fastener Notice .**

3. Install the left and right side stabilizer shaft insulator bracket bolts.

Tighten: Tighten the stabilizer shaft insulator bracket bolts to 42 N.m (31 lb ft).

4. Lower the vehicle.

LOWER BALL JOINT REPLACEMENT

Tools Required

J 41820 Ball Joint/Stud Separator. See **Special Tools**.

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Drill a pilot hole through the rivets.
4. Drill the remainder of the rivets.
5. Use a hammer and a chisel in order to remove the remainder of the rivet heads.
6. Remove the cotter pin from the ball stud.
7. Loosen the ball stud nut.

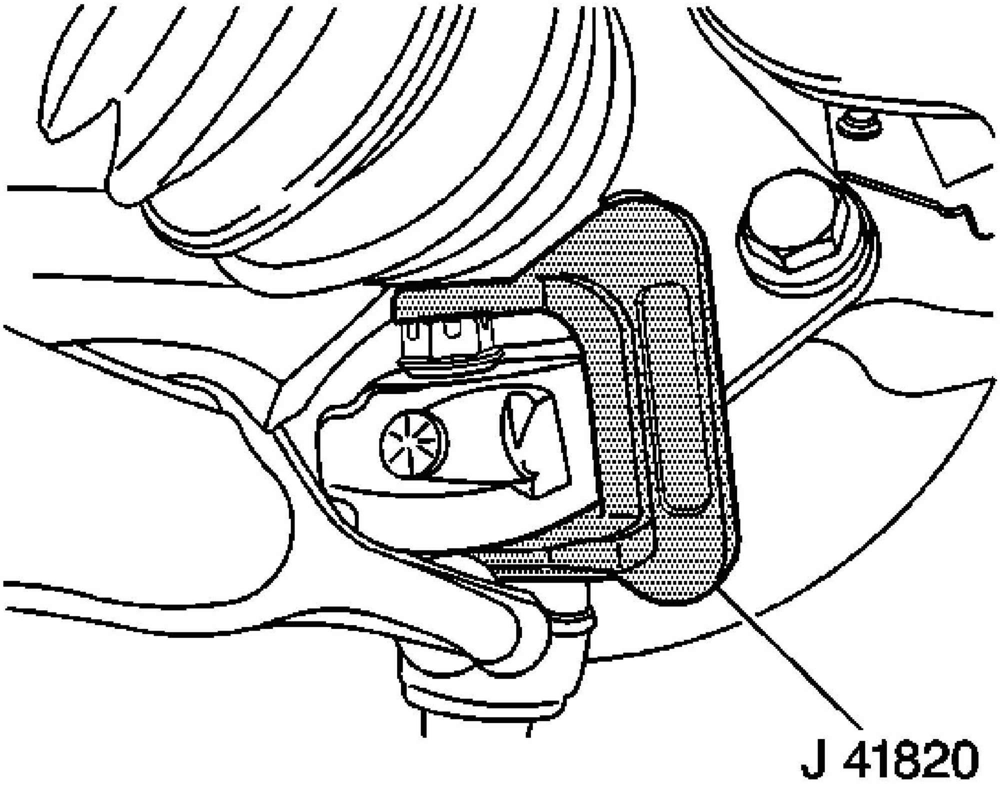


Fig. 13: Separating Ball Stud From Steering Knuckle
Courtesy of GENERAL MOTORS CORP.

8. Install the **J 41820** over the ball stud and lower control arm. See **Special Tools**.
9. Rotate the ball stud nut counterclockwise in order to separate the ball stud from the steering knuckle.
10. Remove the **J 41820** . See **Special Tools**.
11. Remove the ball stud nut.

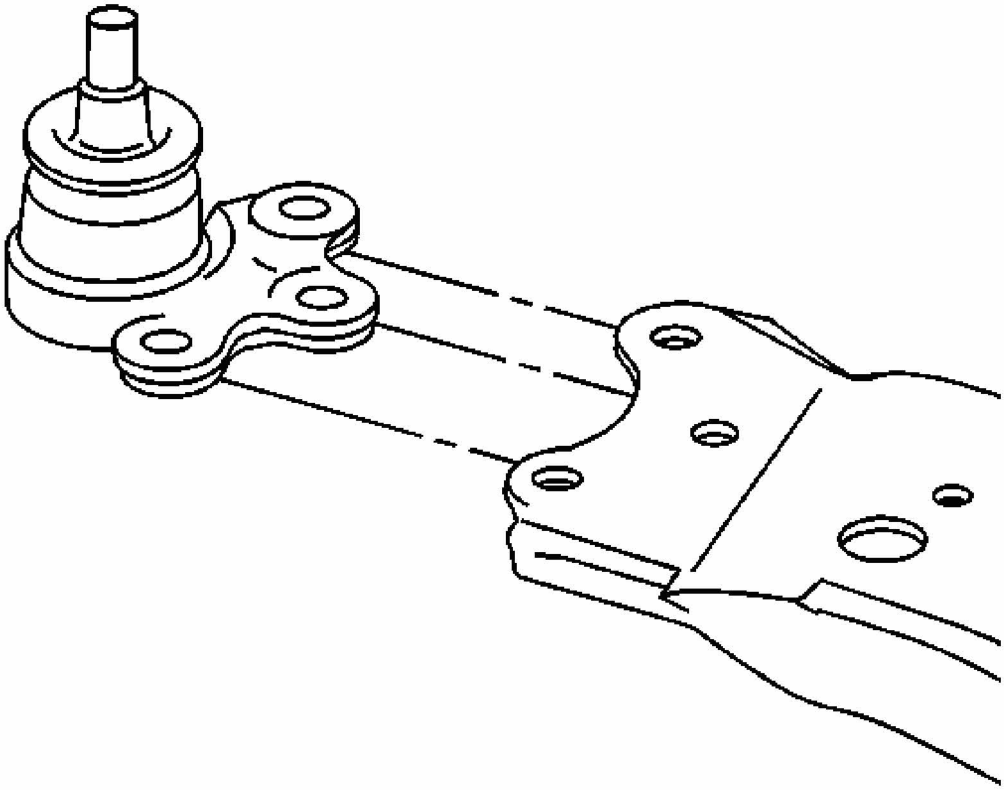


Fig. 14: Removing/Installing Lower Ball Joint
Courtesy of GENERAL MOTORS CORP.

12. Remove the ball stud from the lower control arm.

Installation Procedure

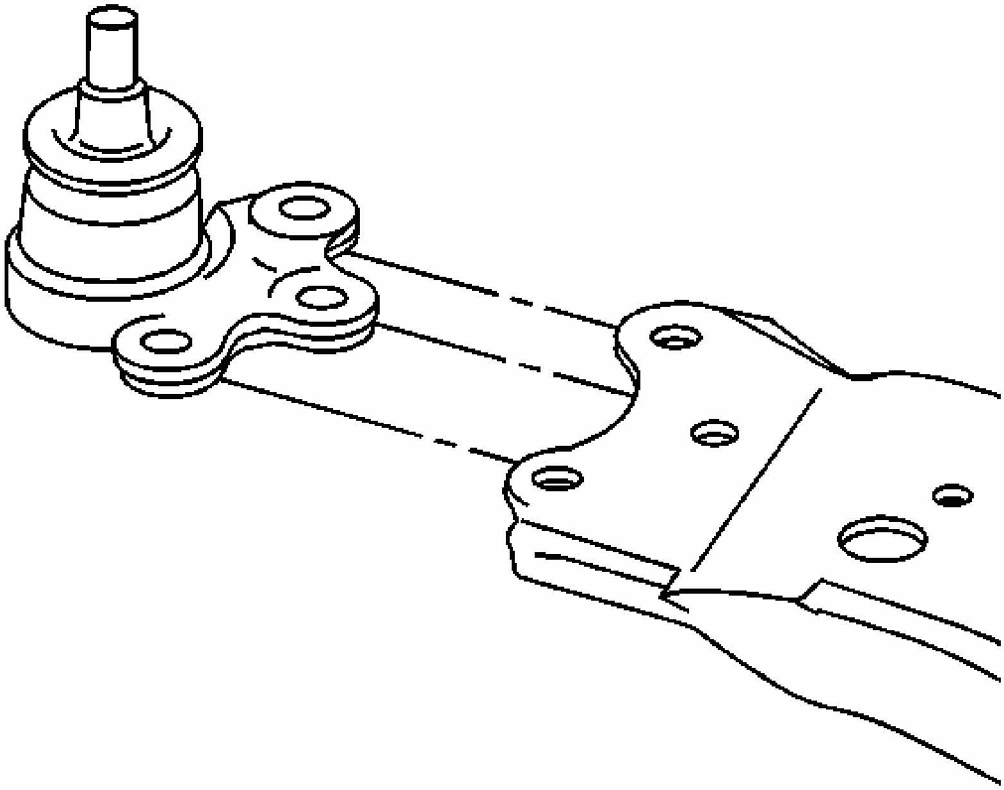


Fig. 15: Removing/Installing Lower Ball Joint
Courtesy of GENERAL MOTORS CORP.

1. Install the ball stud to the lower control arm.

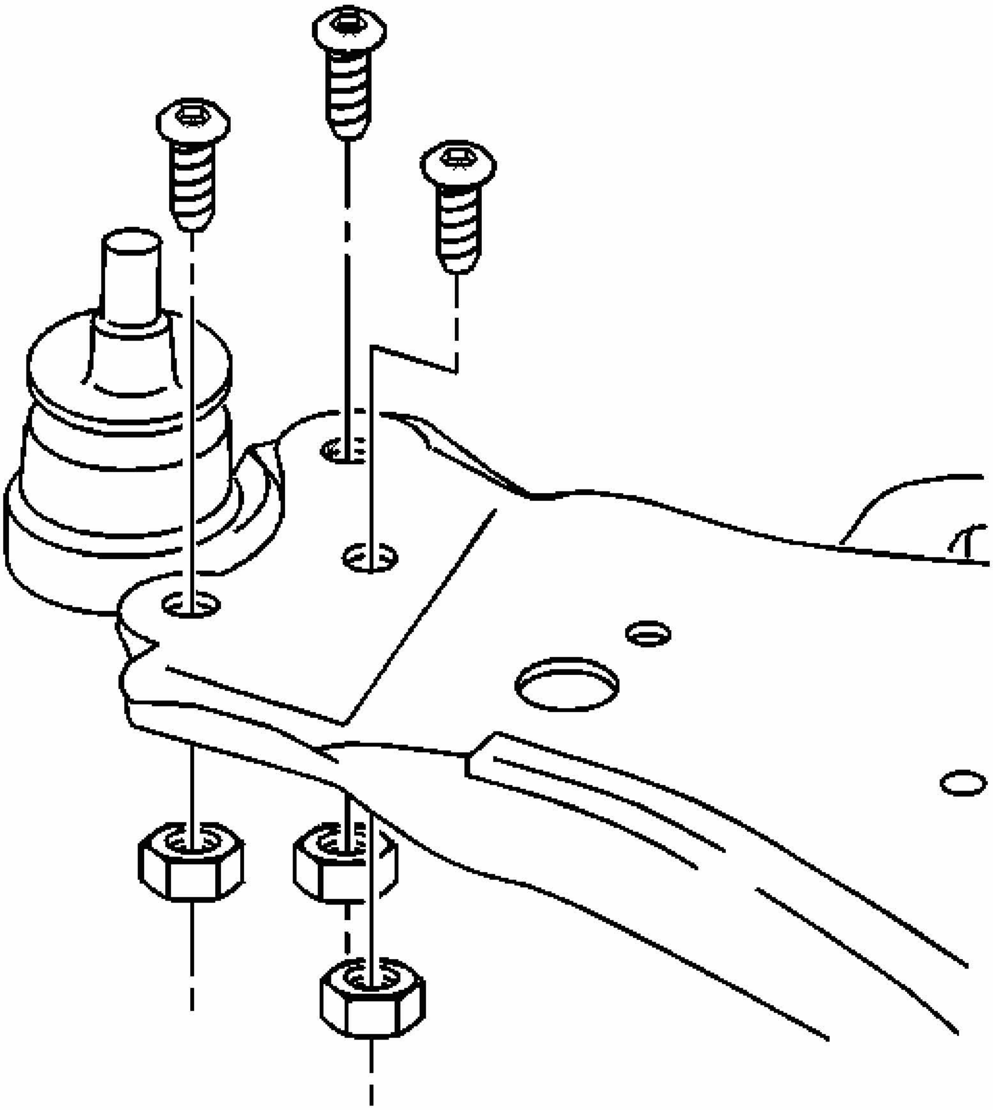


Fig. 16: Identifying Ball Joint Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

2. Install the NEW ball stud bolts facing down, away from the ball stud.

   NOTE: **Refer to Fastener Notice in Cautions and Notices.**

3. Install the NEW ball stud nuts.

Tighten: Tighten the NEW ball stud nuts to 68 N.m (50 lb ft).

4. Install the ball stud to the steering knuckle.

IMPORTANT: Verify the nut is torqued to a minimum of 55 N.m.

5. Install the ball stud castle nut.

Tighten: Tighten the nut to 20 N.m (15 lb ft) plus an additional 120 degrees

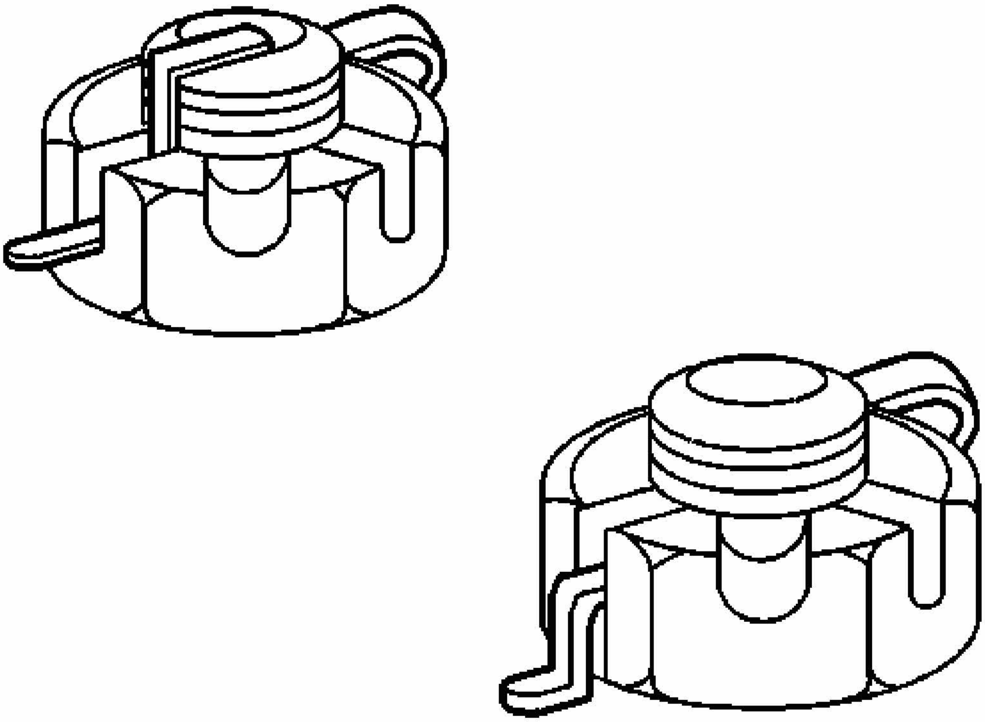


Fig. 17: Securing Cotter Pin In Ball Joint Castle Nut
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do NOT loosen the ball stud nut in order to align the ball stud nut slots to the ball stud cotter pin hole. If necessary, tighten the ball stud castle nut in order to align the ball stud castle nut slot to the ball stud cotter pin hole.

IMPORTANT: Ensure the cotter pin ends do NOT contact the ABS wheel speed sensor, the ABS sensor connector or the drive axle.

6. Install a new cotter pin and bend the ends.
7. Install the tire and wheels. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
8. Lower the vehicle.
9. Check the wheel alignment. Refer to **Measuring Wheel Alignment** in Wheel Alignment.

FRONT WHEEL BEARING/HUB REPLACEMENT

Tools Required

J 42129 Wheel Hub Remover. See **Special Tools**.

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

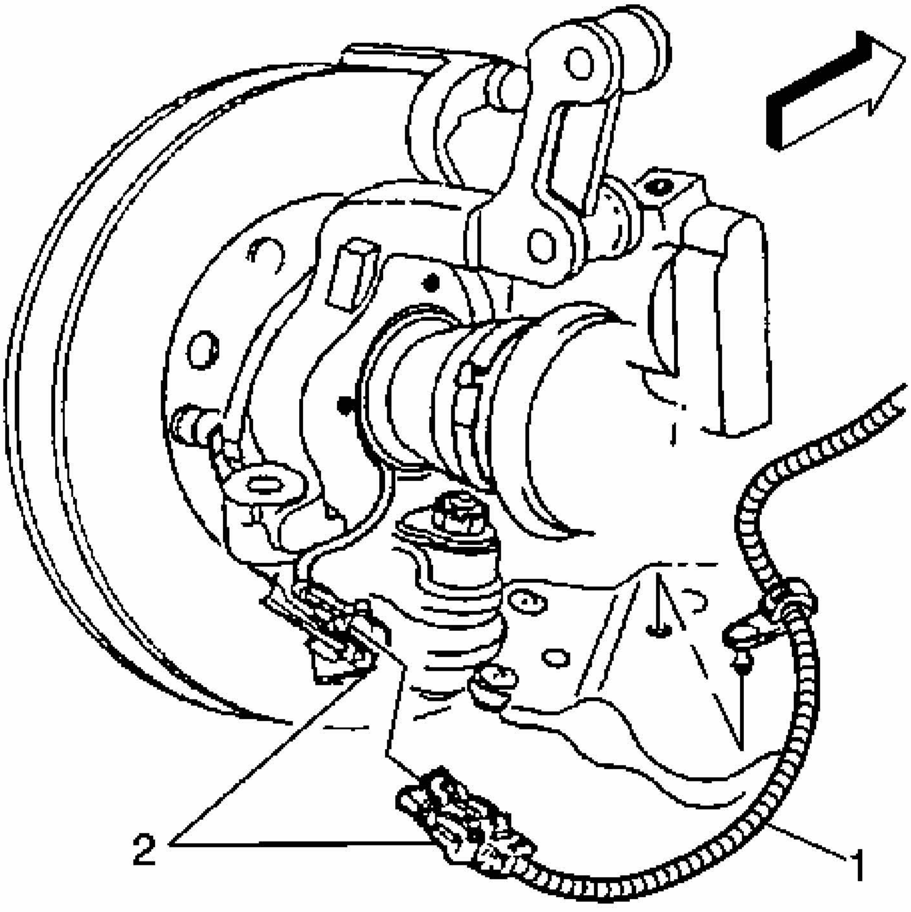


Fig. 18: View Of Wheel Speed Sensor, Connector And Harness
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the wheel speed sensor electrical connector (2), if equipped.

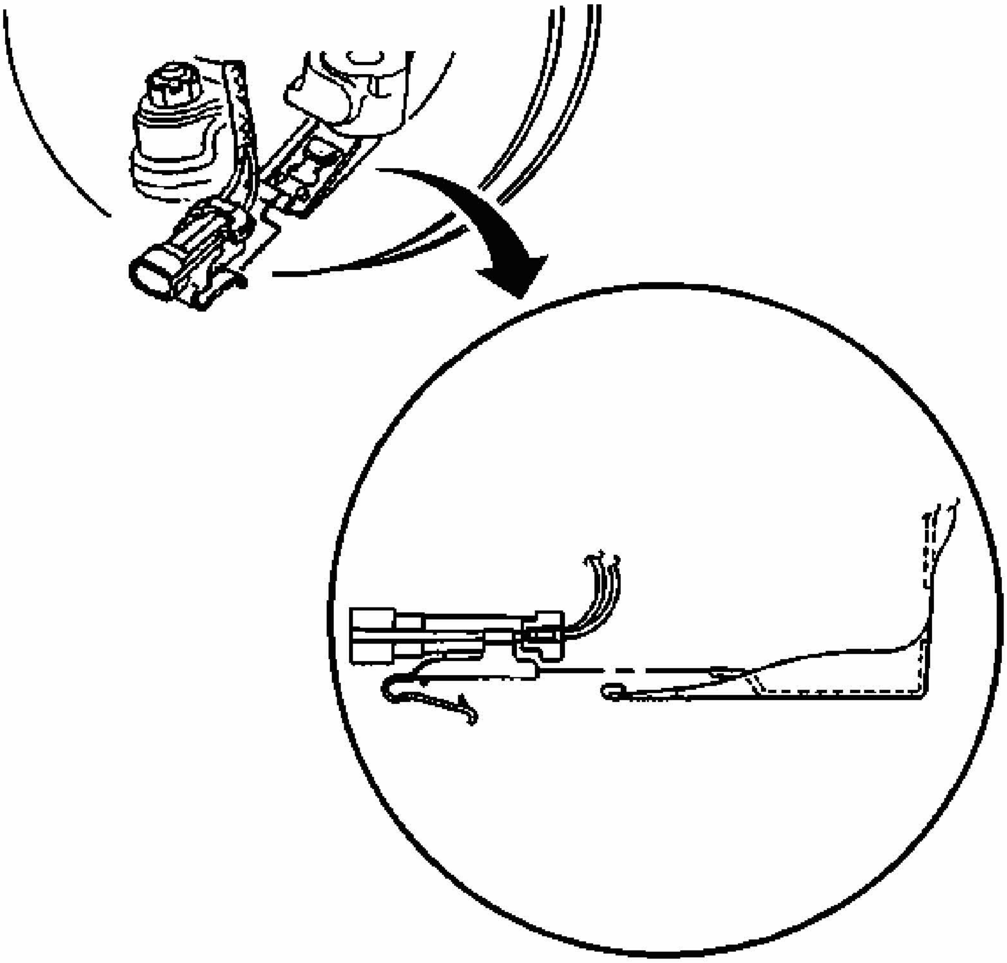


Fig. 19: View Of Wheel Speed Sensor Electrical Connector & Bracket
Courtesy of GENERAL MOTORS CORP.

4. Remove the wheel speed sensor electrical connector from the bracket, if equipped.

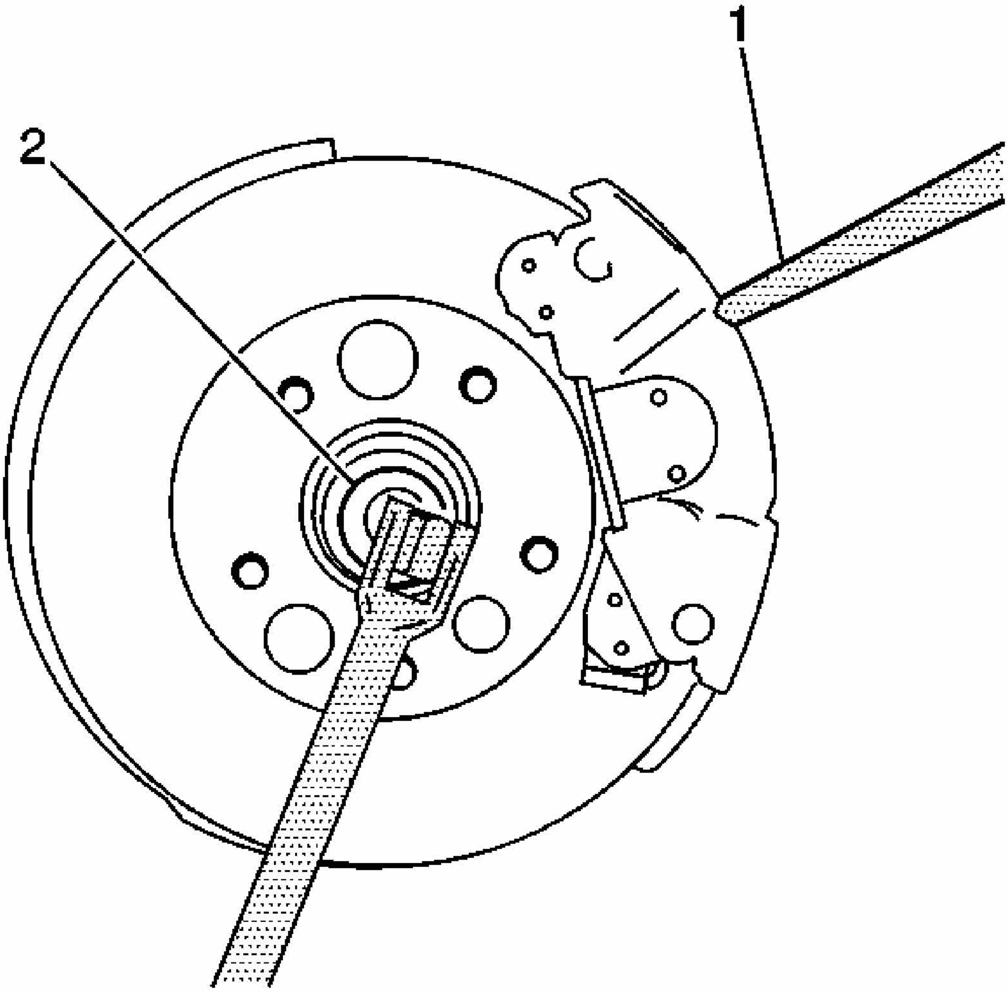


Fig. 20: Preventing Rotor Turning Using Drift Or Punch
Courtesy of GENERAL MOTORS CORP.

5. Remove the front wheel drive shaft nut (2). Insert a drift or flat bladed tool (1) into the caliper and rotor to prevent from turning.
6. Remove the brake rotor. Refer to **Brake Rotor Replacement - Front** in Disc Brakes.

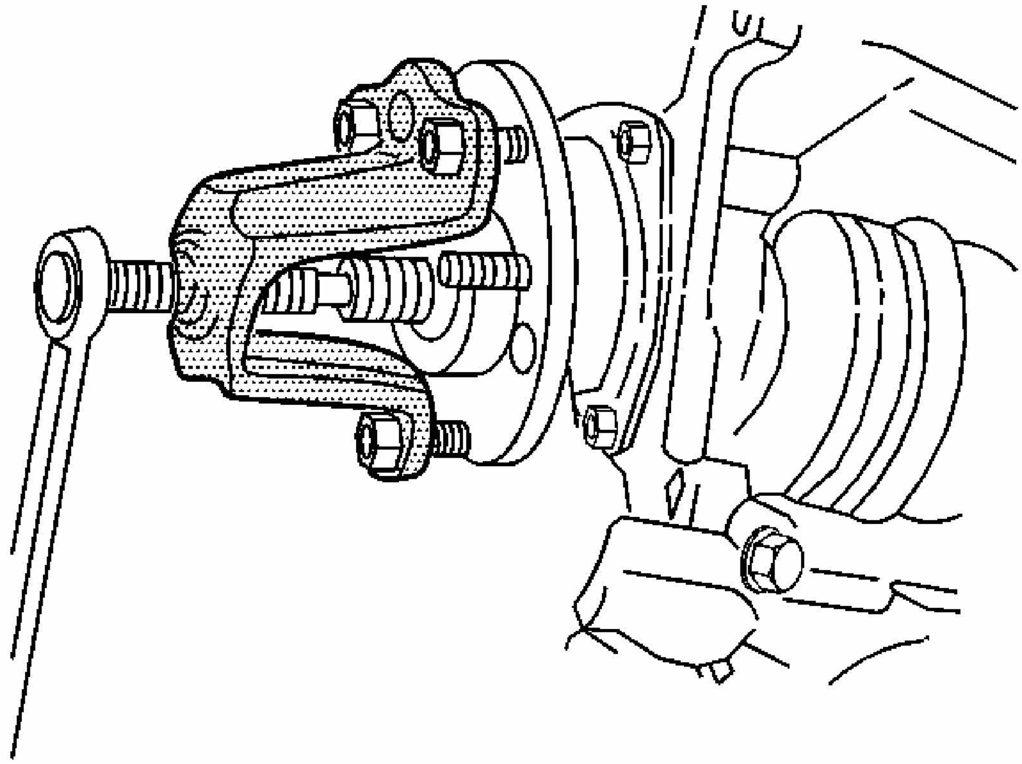


Fig. 21: Using J 28733-B To Push Wheel Drive Shaft Out Of Wheel Bearing/Hub
Courtesy of GENERAL MOTORS CORP.

7. Use 3 wheel nuts in order to attach the **J 42129** to the wheel bearing/hub. See **Special Tools**.
8. Use the **J 42129** in order to push the wheel drive shaft out of the wheel bearing/hub. See **Special Tools**.

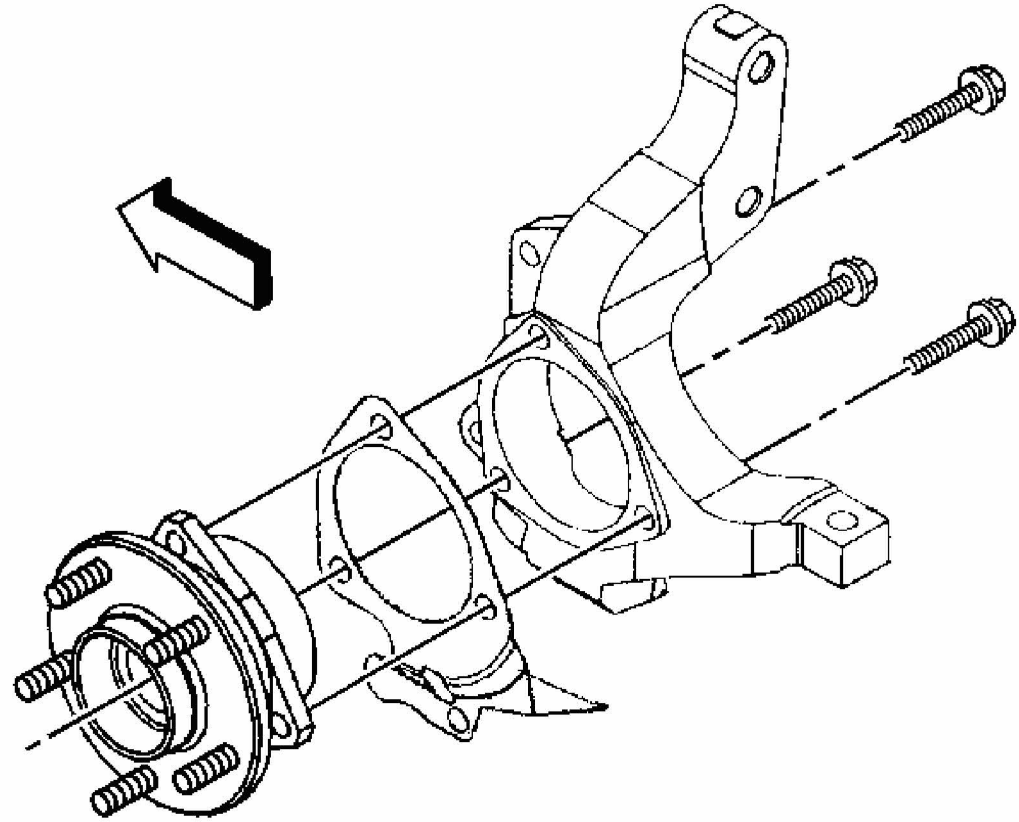


Fig. 22: View Of Wheel Bearing/Hub & Splash Shield
Courtesy of GENERAL MOTORS CORP.

9. Remove and DISCARD the wheel bearing/hub bolts. Remove the **J 42129** from the hub. See Special Tools.

IMPORTANT: Ensure that the wheel drive shaft outer seal/boot is not damaged.

10. Remove the wheel bearing/hub and splash shield-noting the position of the shield for re-installation.

Installation Procedure

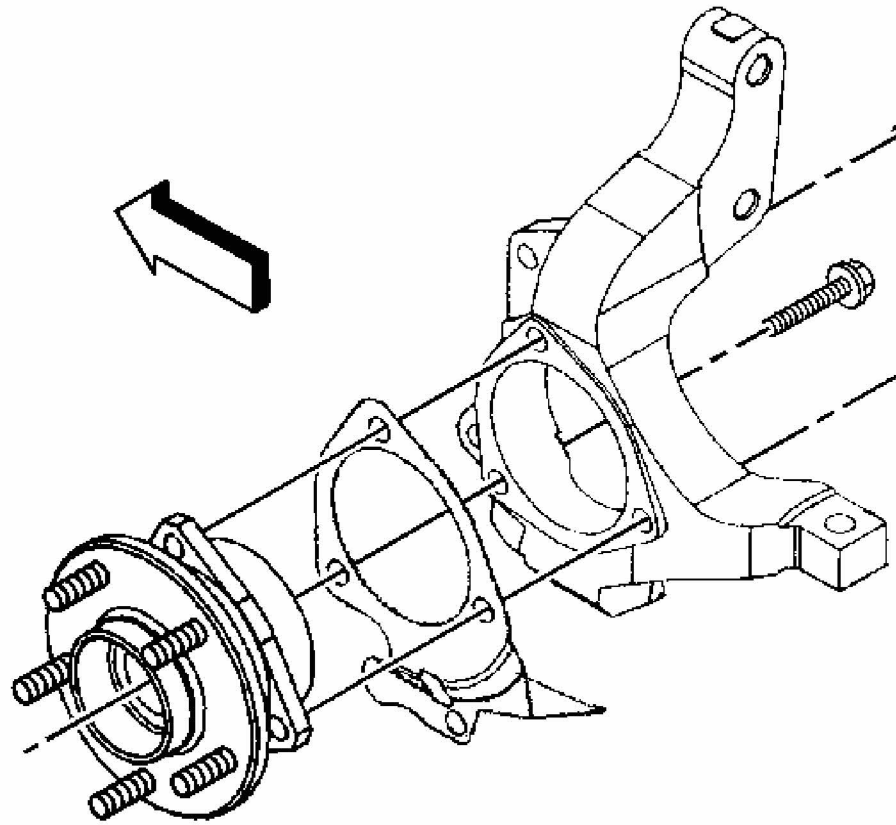


Fig. 23: View Of Wheel Bearing/Hub & Splash Shield
Courtesy of GENERAL MOTORS CORP.

1. Install the wheel bearing/hub with the splash shield as noted during removal.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

CAUTION: **These fasteners MUST be replaced with new fasteners anytime they become loose or are removed. Failure to replace these fasteners after they become loose or are removed may cause loss of vehicle control and personal injury.**

2. Install NEW wheel bearing/hub bolts.

Tighten: Tighten the NEW wheel bearing/hub bolts to 130 N.m (96 lb ft).

3. Install the brake rotor and caliper. Refer to **Brake Rotor Replacement - Front** in Disc Brakes.
4. Install the front wheel drive shaft nut. Insert a drift on a flat bladed tool into caliper and rotor to prevent the rotor from turning.

   Tighten: Tighten the front wheel drive shaft nut to 190 N.m (140 lb ft).

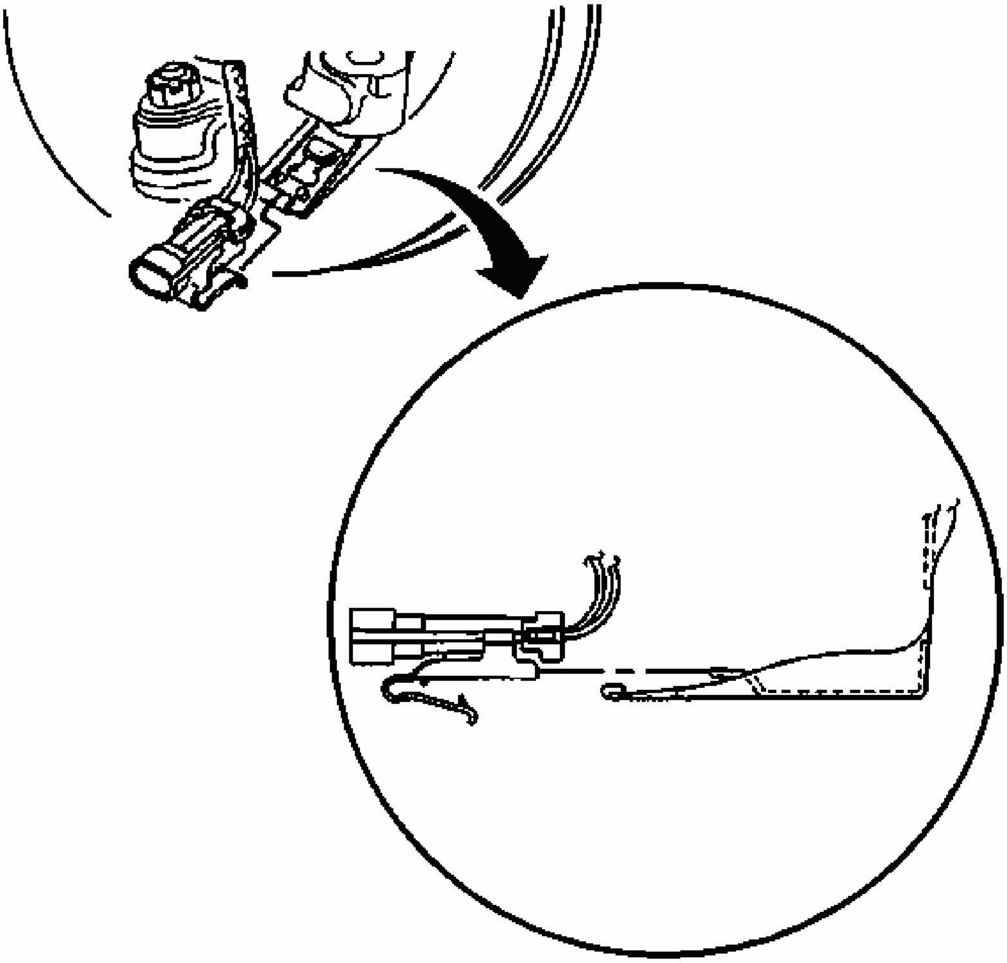


Fig. 24: View Of Wheel Speed Sensor Electrical Connector & Bracket
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the connector clip engages the bracket properly.

5. Install the wheel speed sensor electrical connector to the bracket, if equipped.

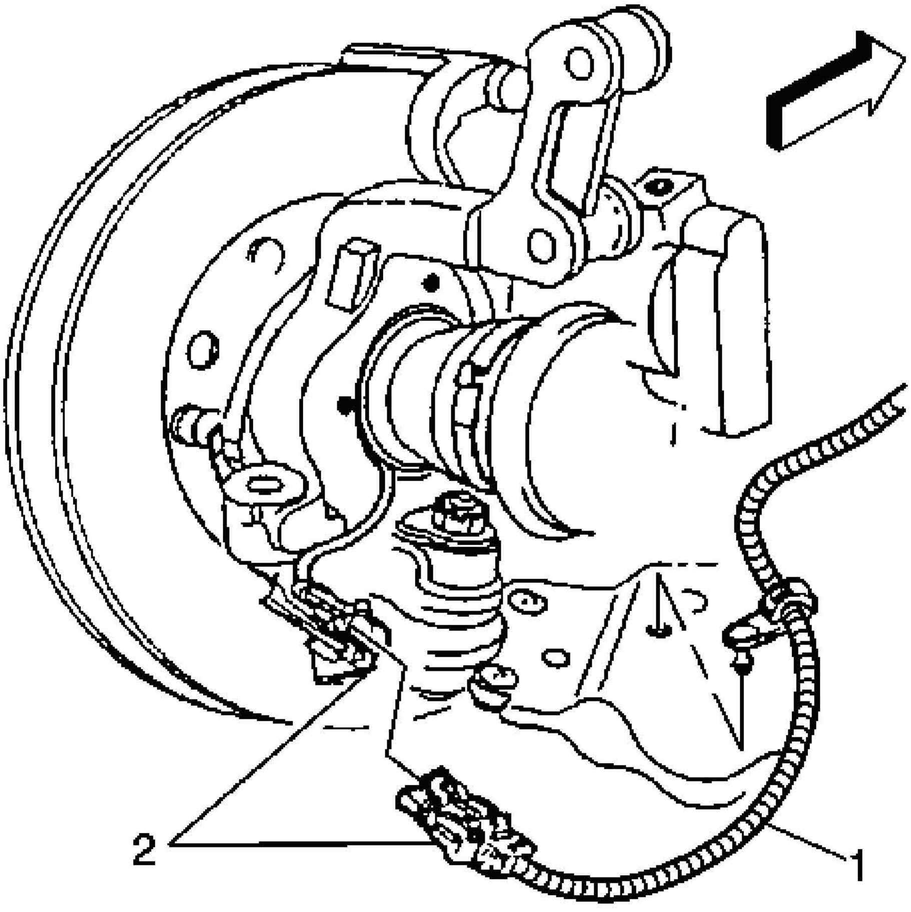


Fig. 25: View Of Wheel Speed Sensor, Connector And Harness
Courtesy of GENERAL MOTORS CORP.

6. Connect the wheel speed sensor electrical connector (2), if equipped.
7. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
8. Lower the vehicle.

STEERING KNUCKLE REPLACEMENT

Removal Procedure

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the bearing/hub assembly. Refer to **Wheel Bearing/Hub Replacement - Front**.

3. Remove the front lower control arm ball stud. Refer to **Lower Control Arm Replacement**.
4. Remove the outer tie rod end from the steering knuckle. Refer to **Rack and Pinion Outer Tie Rod End Replacement** .

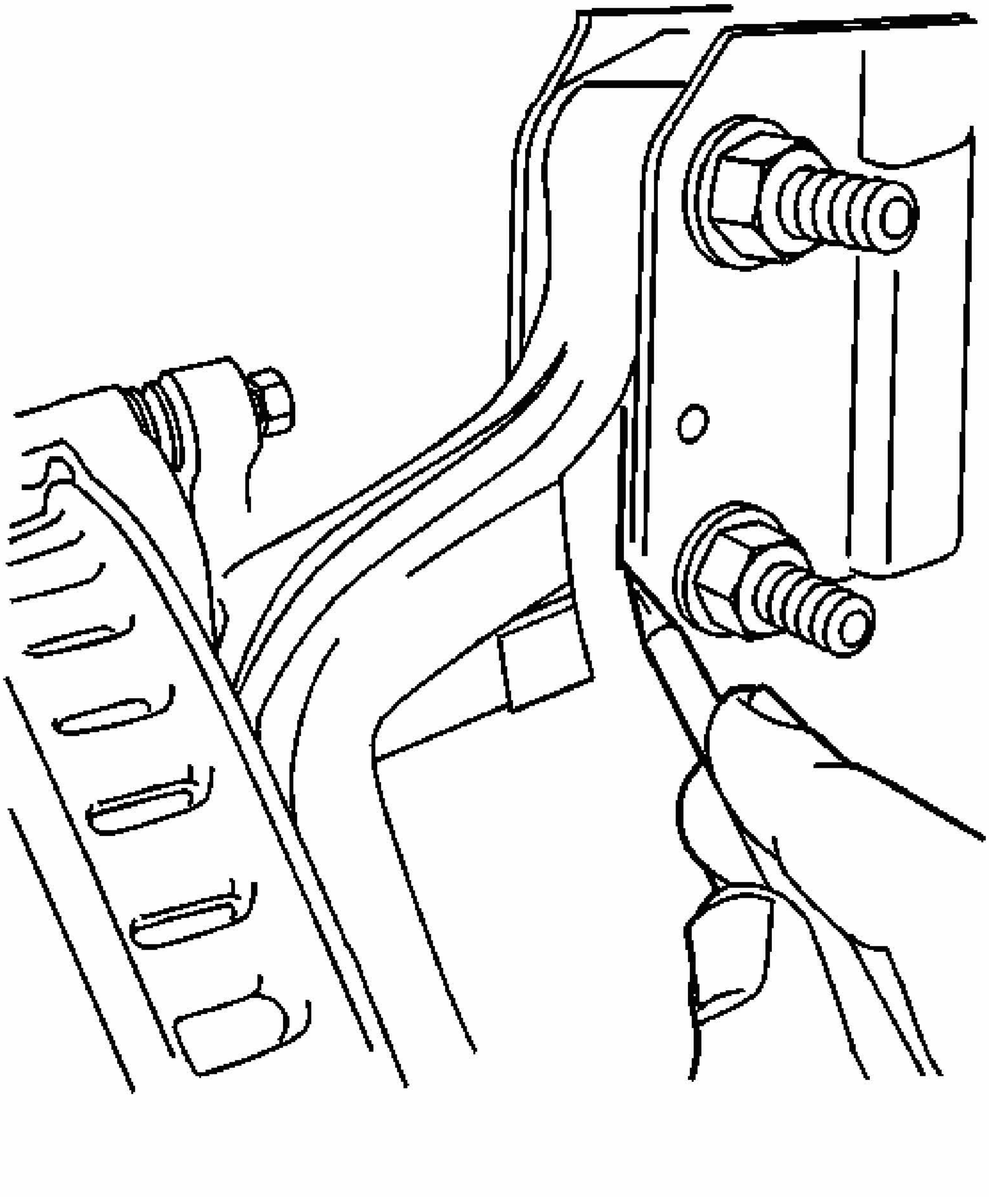


Fig. 26: Scribing Strut To Knuckle
Courtesy of GENERAL MOTORS CORP.

5. Scribe the strut to the knuckle.

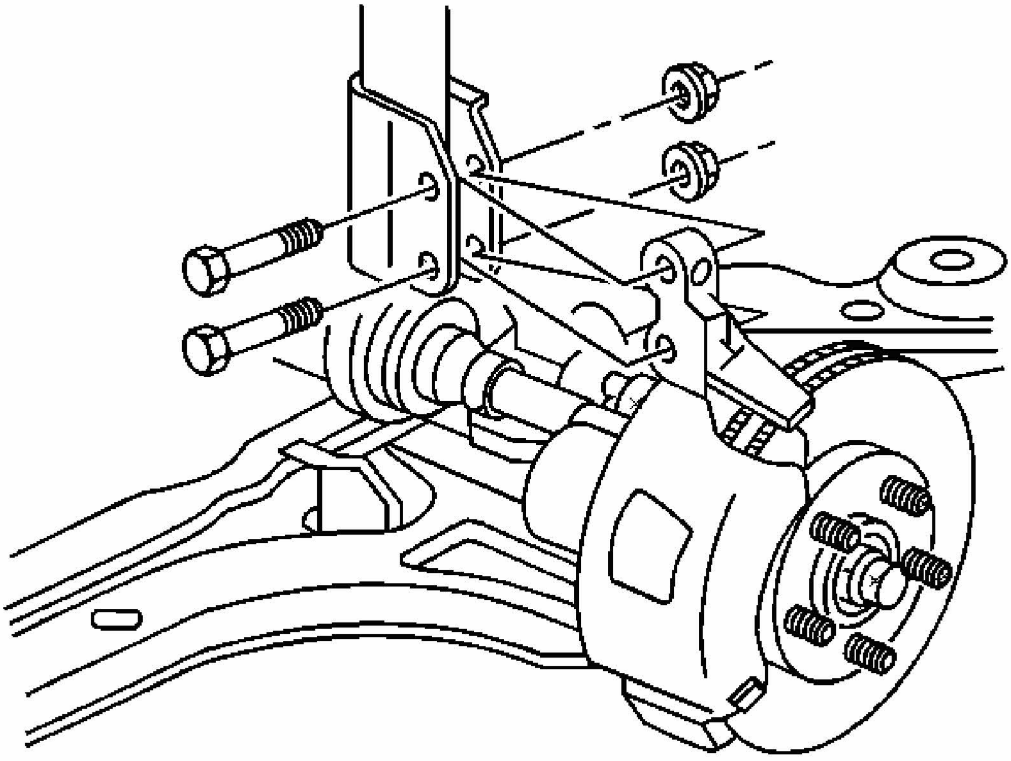


Fig. 27: View Of Steering Knuckle To Strut Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the bolts and nuts attaching the strut to the knuckle.
7. Remove the knuckle from the vehicle.

Installation Procedure

1. Install the knuckle to the vehicle.

NOTE: **Refer to Fastener Notice .**

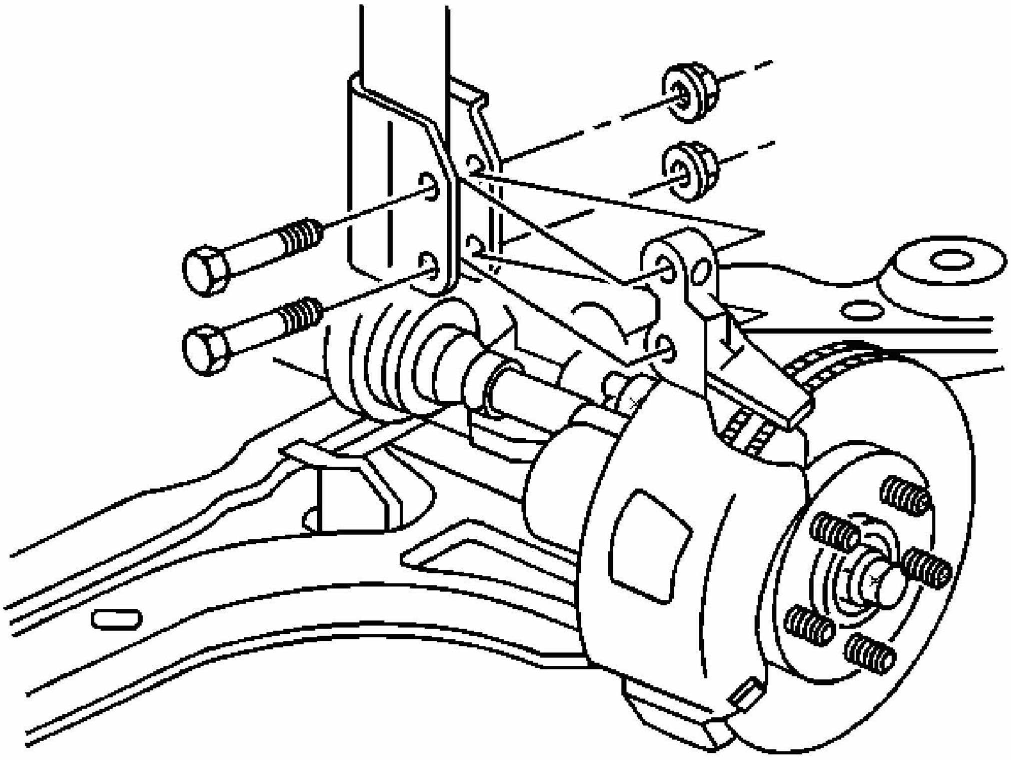


Fig. 28: View Of Steering Knuckle To Strut Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the bolts and nuts attaching the strut to the knuckle.

   Tighten: Tighten the strut to knuckle bolts to 130 N.m (96 lb ft).

3. Install the outer tie rod to the steering knuckle. Refer to **Rack and Pinion Outer Tie Rod End Replacement** .
4. Connect the front lower control arm ball stud to the knuckle. Refer to **Lower Control Arm Replacement**.
5. Install the front wheel drive shaft bearing. Refer to **Wheel Bearing/Hub Replacement - Front**.
6. Lower the vehicle.
7. Inspect the front wheel alignment and adjust, if necessary. Refer to **Measuring Wheel Alignment** .

LOWER CONTROL ARM REPLACEMENT

Tools Required

J 41820 Ball Joint/Stud Separator. See **Special Tools**.

Removal Procedure

NOTE: Use only the recommended tools for separating the ball joint from the knuckle. Do NOT hammer or pry the ball joint from the knuckle. Failure to use the recommended tools may cause damage to the ball joint and seal.

IMPORTANT: Use the ignition key in order to unlock the steering column.

1. Turn the steering wheel in order to move the front of the applicable wheel to the outboard most position.

   IMPORTANT: Use ONLY a frame-contact type vehicle lift or a floor jack at the recommended lift points. Do NOT use a suspension-contact type vehicle lift. Do NOT lift the vehicle by the lower control arms.

2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .

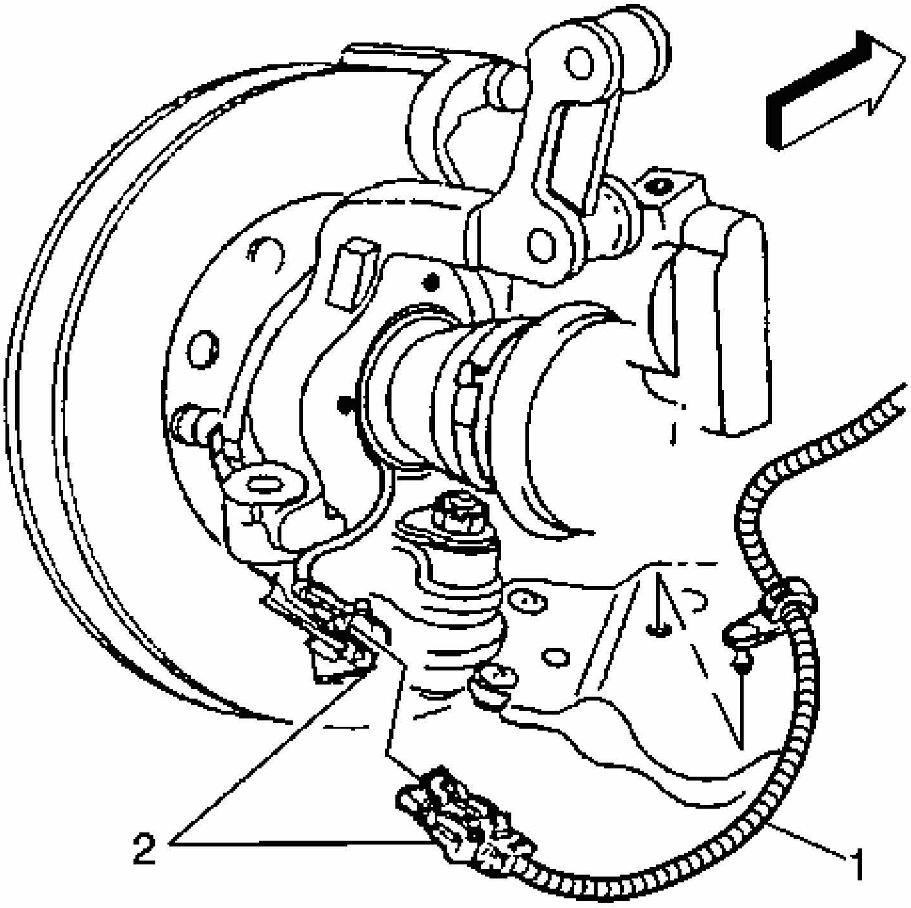


Fig. 29: View Of Wheel Speed Sensor, Connector And Harness
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the ABS wheel speed sensor connector (2), if equipped.
5. Disconnect the ABS wheel speed sensor jumper harness from the harness retainer clips, if equipped.
6. Remove the stabilizer shaft link. Refer to **Stabilizer Shaft Link Replacement**.

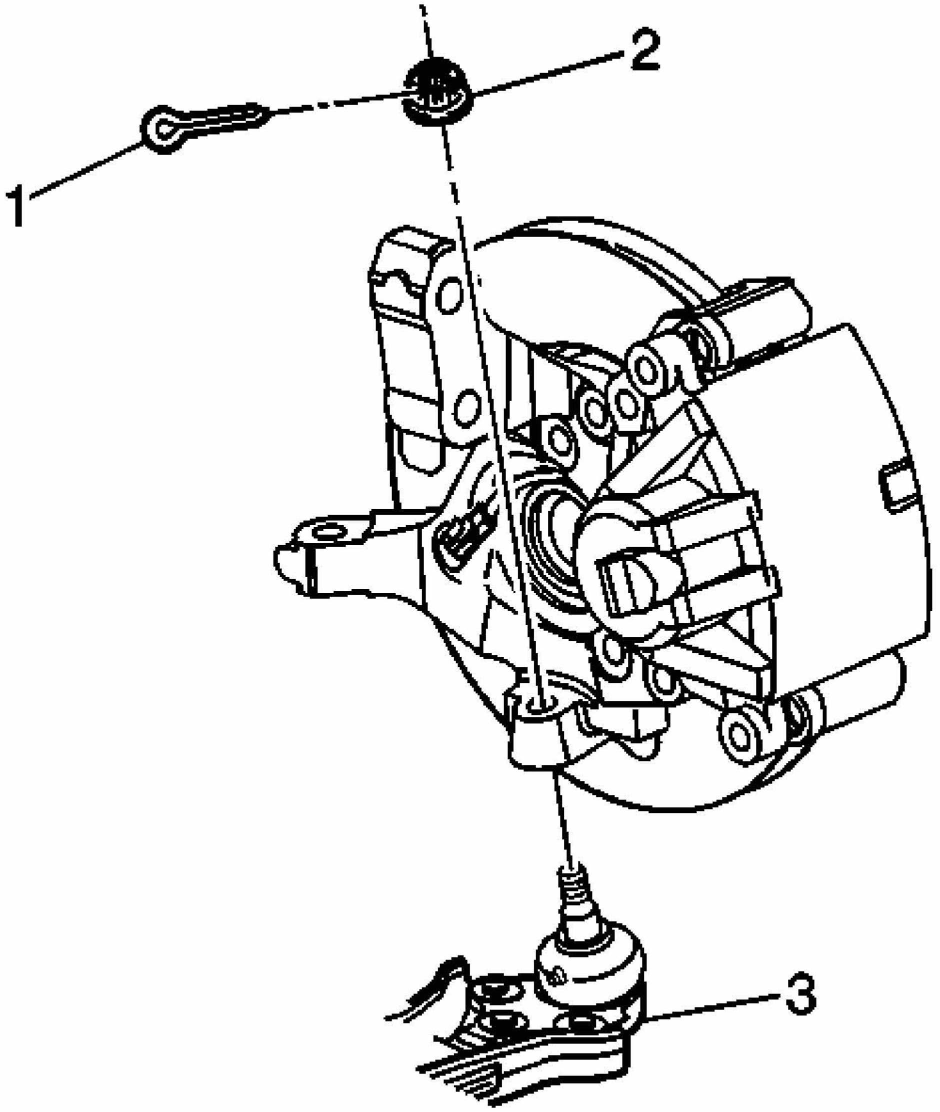


Fig. 30: Identifying Ball Stud Cotter Pin
Courtesy of GENERAL MOTORS CORP.

7. Remove the cotter pin (1) from the ball stud (3).
8. Loosen the ball stud nut (2).

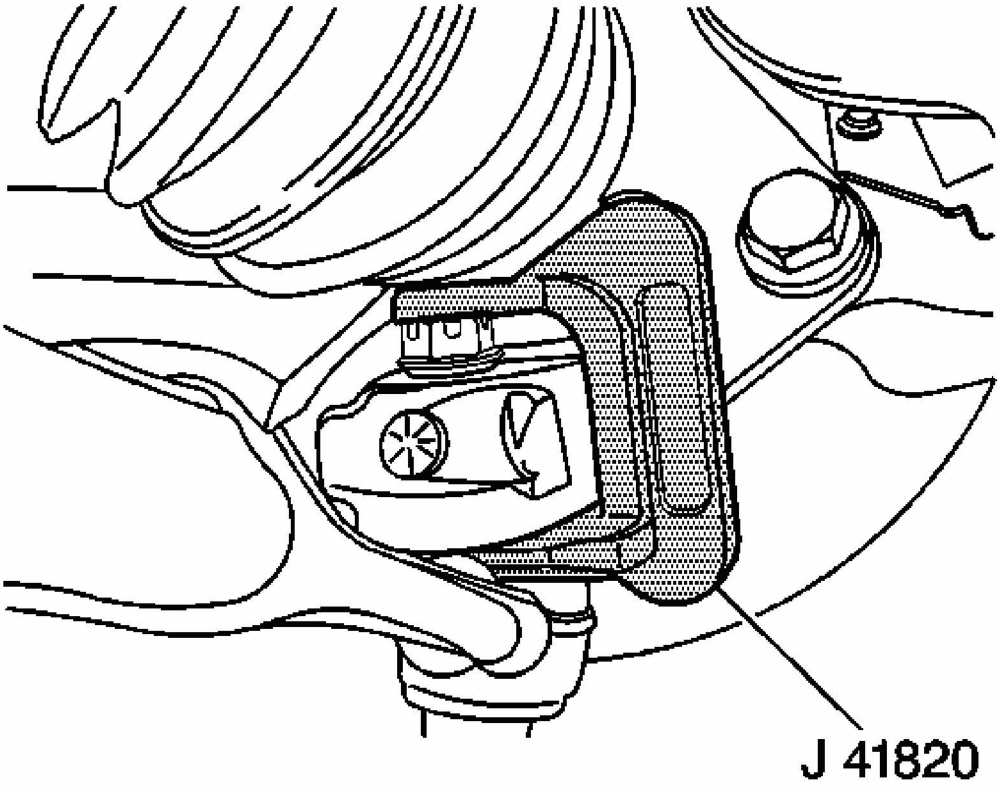


Fig. 31: Separating Ball Stud From Steering Knuckle
Courtesy of GENERAL MOTORS CORP.

9. Install the **J 41820** over the ball stud and lower control arm, as shown. See **Special Tools**.
10. Rotate the ball stud nut counterclockwise in order to separate the ball stud from the steering knuckle.
11. Remove the **J 41820** . See **Special Tools**.
12. Remove the ball stud nut.

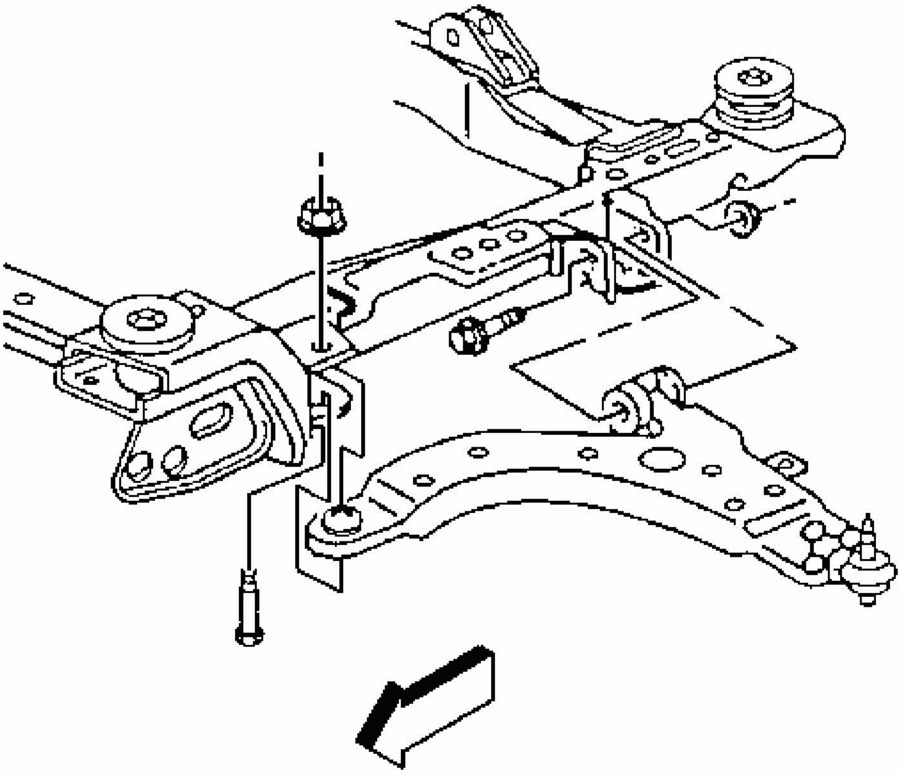


Fig. 32: View Of Lower Control Arm
Courtesy of GENERAL MOTORS CORP.

13. Remove the lower control arm bolts and nuts.
14. Remove the lower control arm.

Installation Procedure

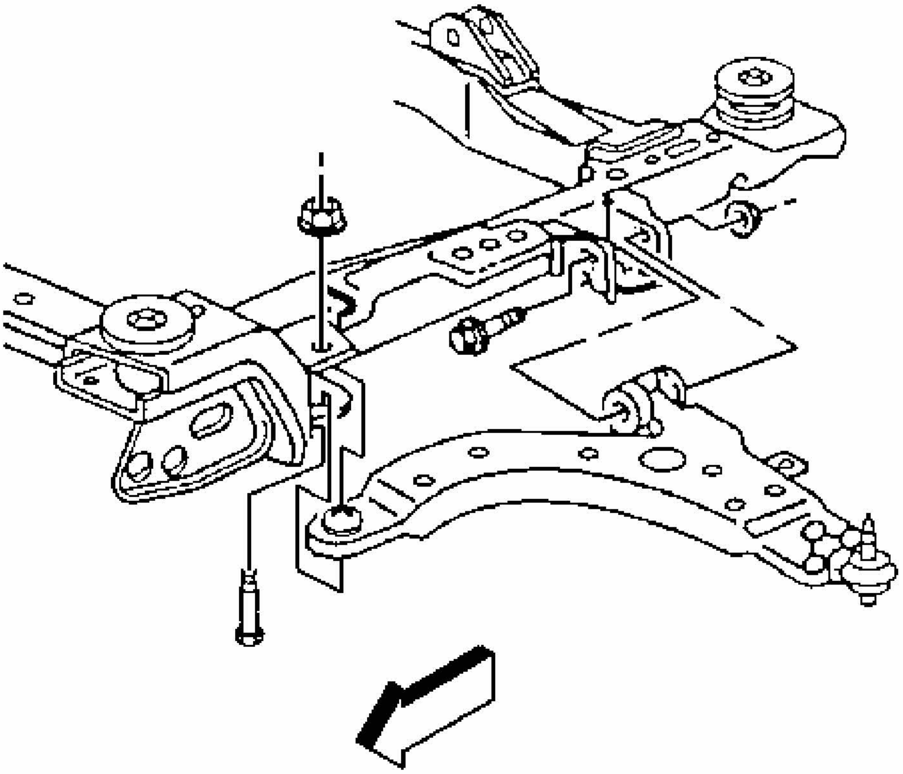


Fig. 33: View Of Lower Control Arm
Courtesy of GENERAL MOTORS CORP.

1. Install the lower control arm.
2. Install the control arm bolts and nuts. Do not tighten at this time.

IMPORTANT: Align the ball stud cotter pin hole parallel to the knuckle in order to ease the cotter pin installation.

3. Install the ball stud to the knuckle.

NOTE: Refer to Fastener Notice .

IMPORTANT: Verify the nut is torqued to a minimum of 55 N.m.

4. Install the ball stud castle nut.

Tighten: Tighten the ball stud castle nut to 20 N.m + 120 degrees (15 lb ft + 120 degrees).

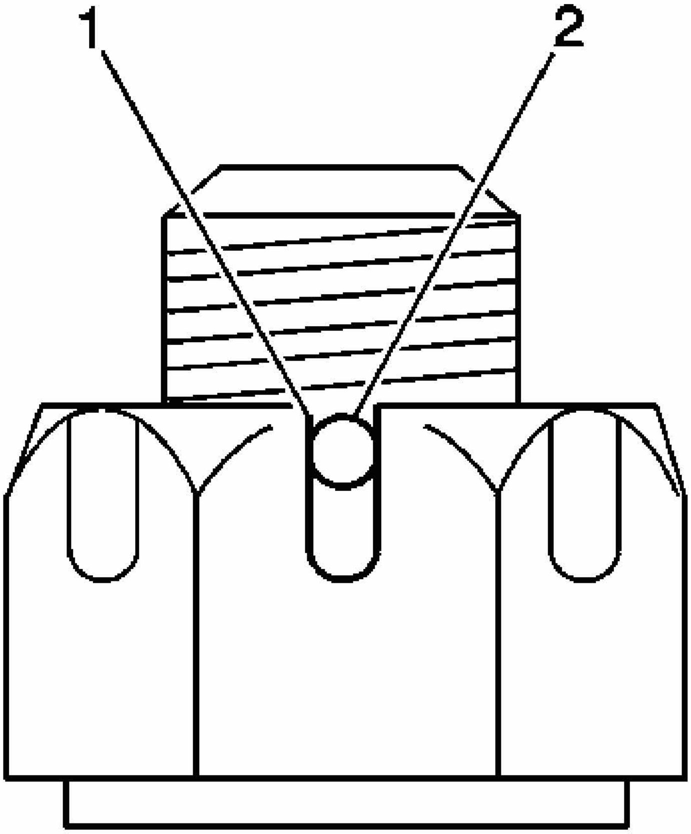


Fig. 34: Aligning Ball Stud Castle Nut Slot To The Ball Stud Cotter Pin Hole
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do NOT loosen the ball stud nut in order to align the ball stud nut slots to the ball stud cotter pin hole.

5. If necessary, tighten the ball stud castle nut in order to align the ball stud castle nut slot (1) to the ball stud cotter pin hole (2), as shown.

IMPORTANT: Ensure that the cotter pin ends do NOT contact the ABS wheel speed sensor, the ABS sensor connector, or the drive axle.

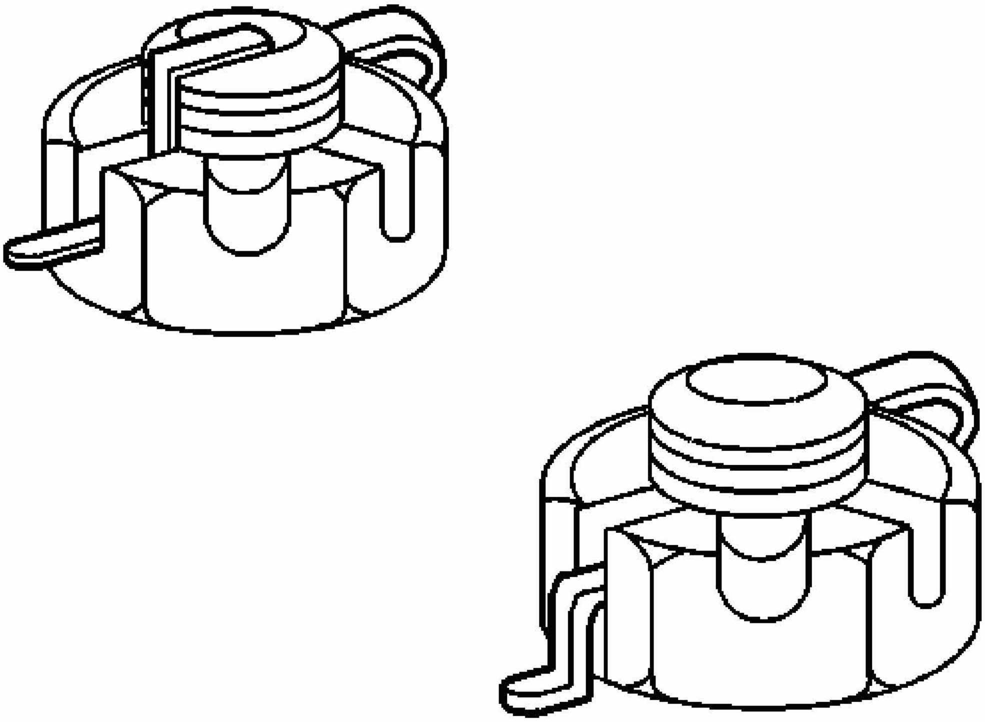


Fig. 35: Securing Cotter Pin In Ball Joint Castle Nut
Courtesy of GENERAL MOTORS CORP.

6. Install a NEW cotter pin and bend the ends as shown in either example.
7. Install the stabilizer shaft link. Refer to **Stabilizer Shaft Link Replacement**.
8. Install the ABS wheel speed sensor jumper harness to the harness retainer clips, if equipped.

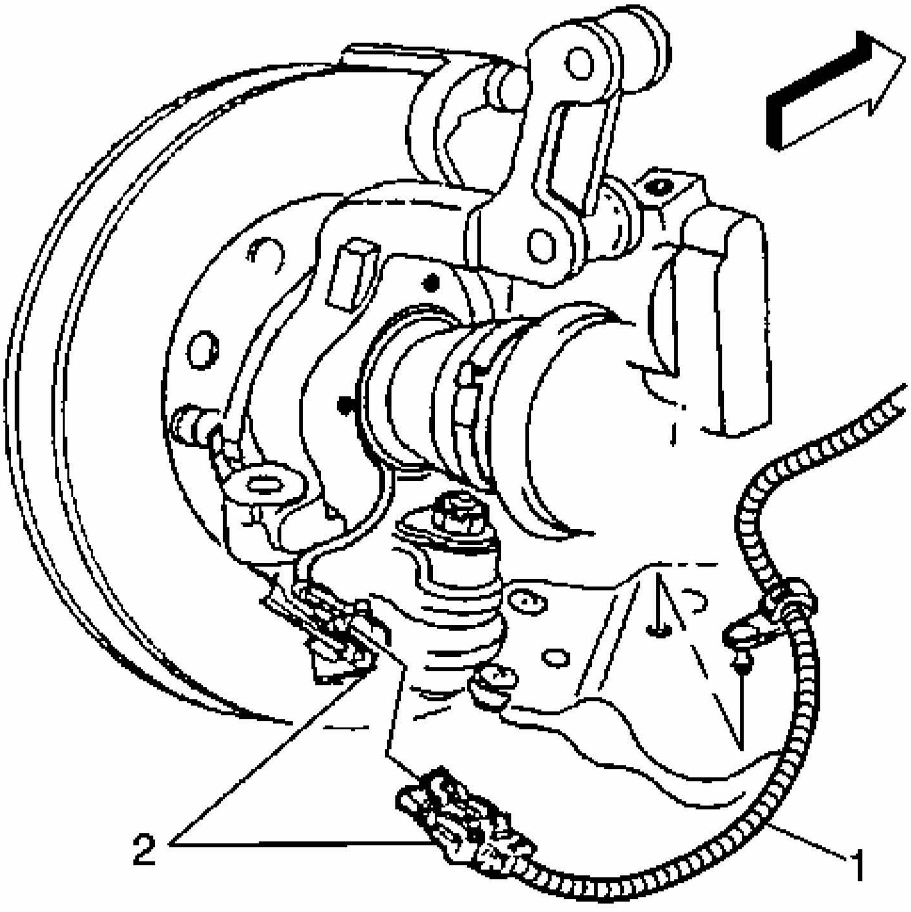


Fig. 36: View Of Wheel Speed Sensor, Connector And Harness
Courtesy of GENERAL MOTORS CORP.

9. Install the ABS wheel speed sensor connector (2), if equipped.

IMPORTANT: This is a prevailing torque type fastener. This fastener may be reused ONLY if:

- **The fastener and its counterpart are clean and free from rust.**
- **The fastener develops 3 N.m (27 lb in) of torque against its counterpart prior to the fastener seating.**

If the fastener does not meet these criteria, REPLACE the

fastener.

10. Install the lower control arm nuts.

    Tighten: Tighten the lower control arm nuts to 125 N.m (92 lb ft).

11. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
12. Lower the vehicle.

FRONT LOWER CONTROL ARM BUSHINGS REPLACEMENT (VERTICAL)

Tools Required

- **J 21474-01** Control Arm Bushing Set. See **Special Tools**.
  - **J 21474-27** 1/2 Inch Puller Bolt Thrust Bearing. See **Special Tools**.
  - **J 21474-2** Bushing Installer Remover. See **Special Tools**.
  - **J 21474-4** Nut
  - **J 21474-13** Control Arm Bushing Installer
- **J 23444-A** High Pressure Lubricant. See **Special Tools**.
- **J 34126** Driven Sprocket Support Bearing Installer. See **Special Tools**.
- **J 35379** Front Knuckle Support. See **Special Tools**.

Removal Procedure

1. Remove the lower control arm. Refer to **Lower Control Arm Replacement**.
2. Secure the lower control arm in a vice.

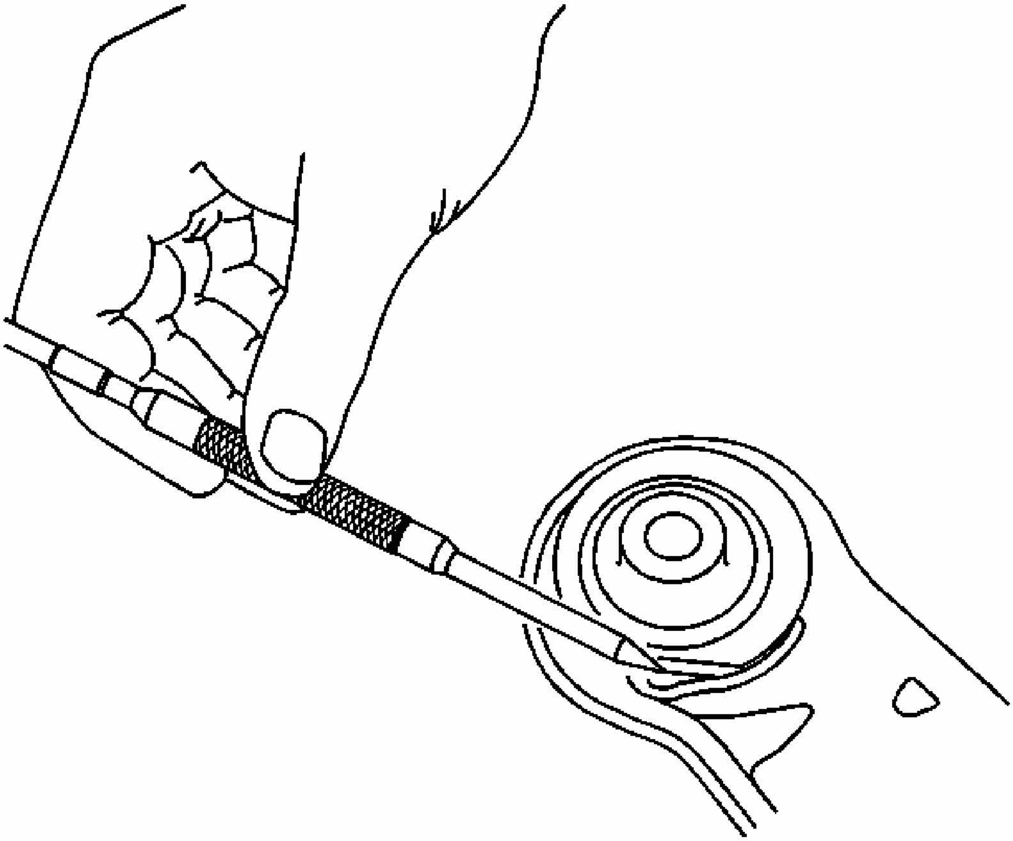


Fig. 37: Scribing Orientation Of Control Arm Bushing On Lower Control Arm
Courtesy of GENERAL MOTORS CORP.

3. Mark the lower control arm along the flat edge of the bushing flange.

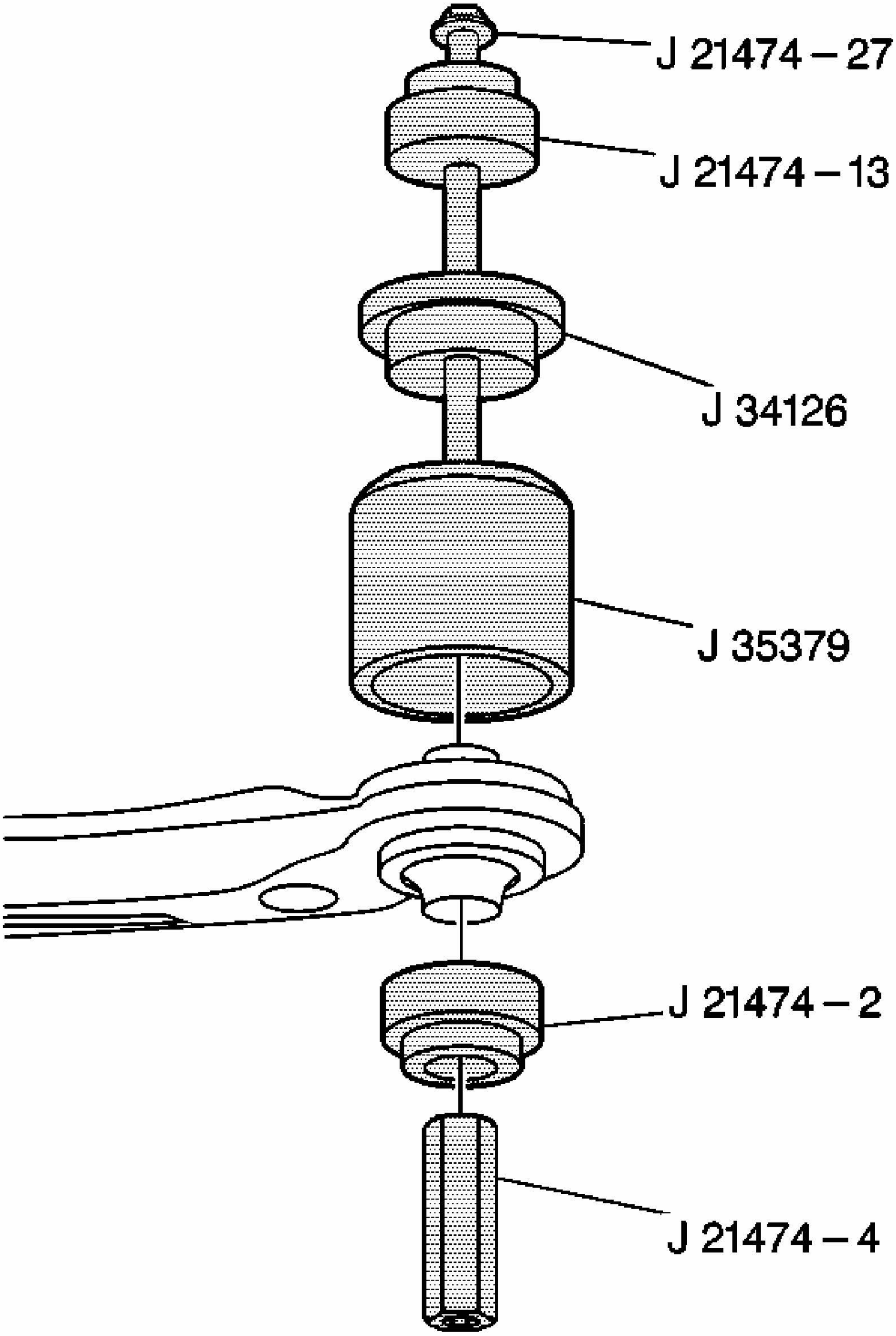

J 21474 – 27
J 21474 – 13
J 34126
J 35379
J 21474 – 2
J 21474 – 4

Fig. 38: View Of J 21474-01

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Apply J 23444-A or equivalent to the threads of J 21474-27 . See Special Tools.

4. Assemble the following bushing removal tools as shown:
    1. **J 21474-27** . See **Special Tools**.
    2. **J 21474-13**
    3. **J 34126** . See **Special Tools**.
    4. **J 35379** . See **Special Tools**.
    5. **J 21474-2** . See **Special Tools**.
    6. **J 21474-4**
5. Tighten **J 21474-4** .
6. Disassemble the bushing removal tools.

Installation Procedure

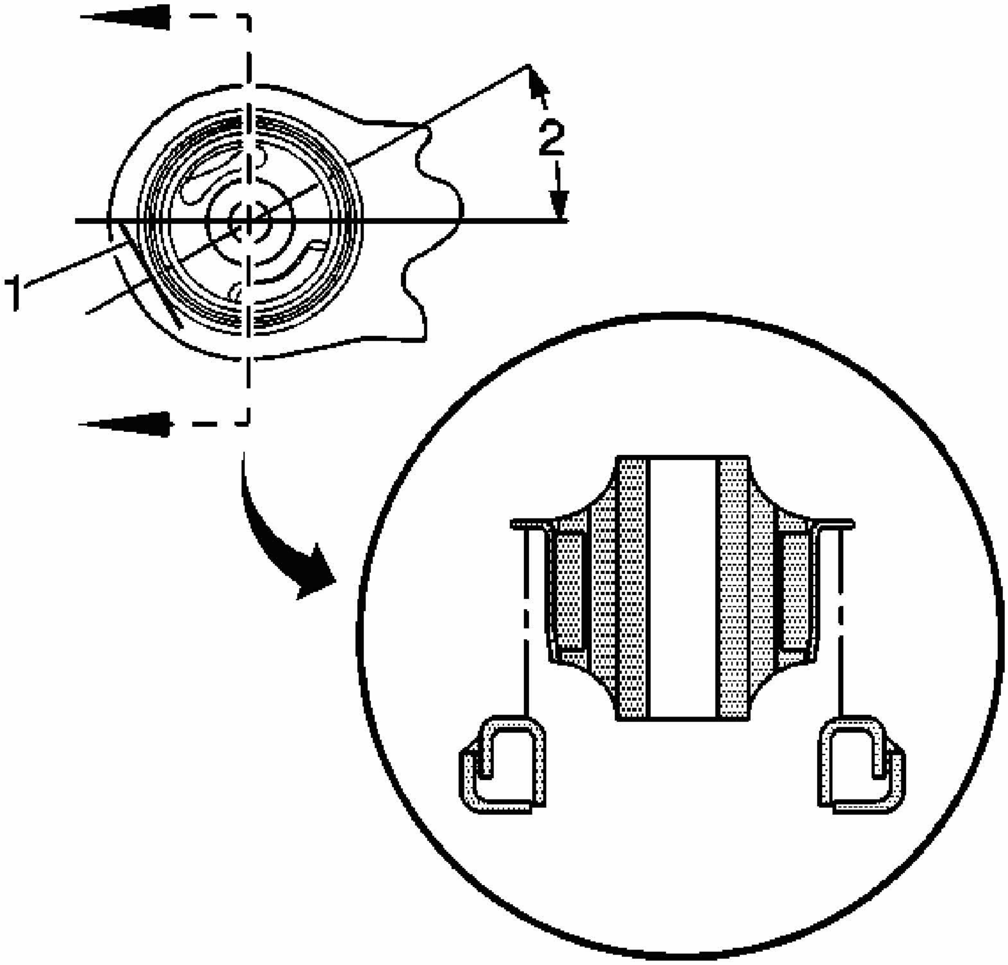


Fig. 39: Aligning Flat Edge Of Bushing Flange To Mark In Control Arm
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: You MUST install the lower control arm vertical bushing in the same position in order to maintain the original vehicle ride, handling, and road feel.

1. Align the flat edge of the bushing flange to the mark in the control arm (1). Ensure that the flat edge of the bushing flange is 30 degrees (2) from the centerline of the lower control arm. Ensure that the thin slot in the bushing is facing outboard.
2. Insert the bushing into the control arm.

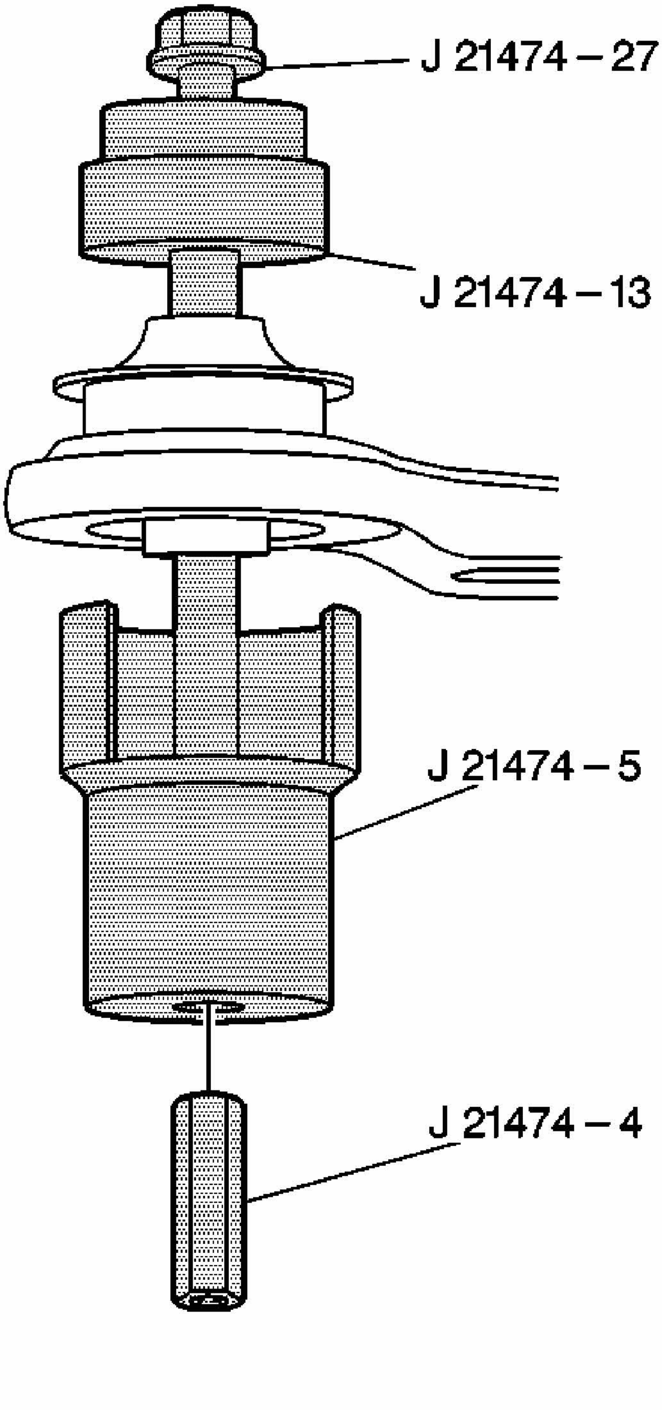

J 21474 – 27
J 21474 – 13
J 21474 – 5
J 21474 – 4

Fig. 40: Illustrating Proper Installation Of Bushing Tools
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Apply J 23444-A or equivalent to the threads of J 21474-27 . See Special Tools.

3. Assemble the following bushing installation tools as shown:

    1. **J 21474-27** . See **Special Tools**.
    2. **J 21474-13**
    3. **J 21474-5** . See **Special Tools**.
    4. **J 21474-4**
4. Tighten **J 21474-4** .
5. Disassemble the bushing installation tools.
6. Install the lower control arm. Refer to **Lower Control Arm Replacement**.

FRONT LOWER CONTROL ARM BUSHINGS REPLACEMENT (HORIZONTAL)

Tools Required

- **J 21474-01** Control Arm Bushing Service Set. See **Special Tools**.
- **J 21474-5** Control Arm Bushing Receiver. See **Special Tools**.

Removal Procedure

1. Remove the lower control arm. Refer to **Lower Control Arm Replacement**.
2. Secure the lower control arm in a vise.

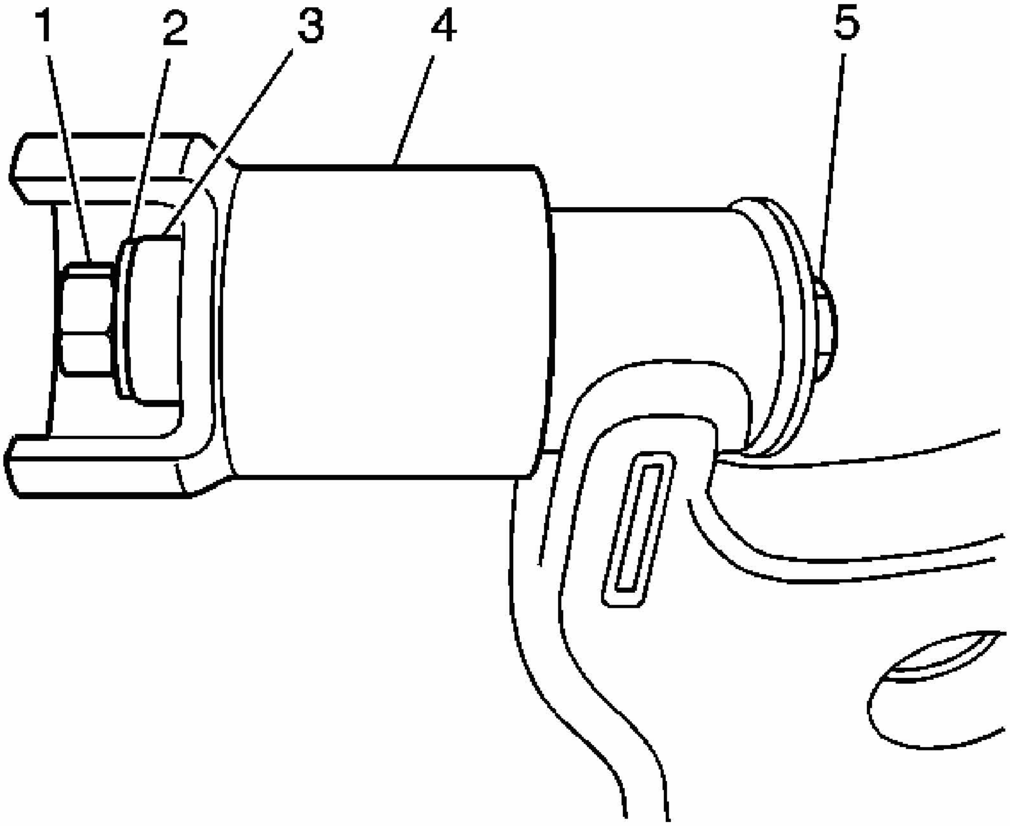


Fig. 41: Assembling Bushing Removal Tools
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use a 1/2 x 20 in standard thread nut with the puller bolt.

3. Assemble the bushing removal tools as indicated:
    1. The nut (1)
    2. The **J 21474-01** washer (2). See Special Tools.
    3. The **J 21474-01** bearing (3). See Special Tools.
    4. The **J 21474-5** (4). See Special Tools.
    5. The **J 21474-01** puller bolt (5). See Special Tools.
4. Tighten the puller bolt (5) until the bushing is removed.
5. Disassemble the **J 21474-01** and **J 21474-5** . See Special Tools.

Installation Procedure

1. Lubricate the bushing with liquid hand soap or equivalent.

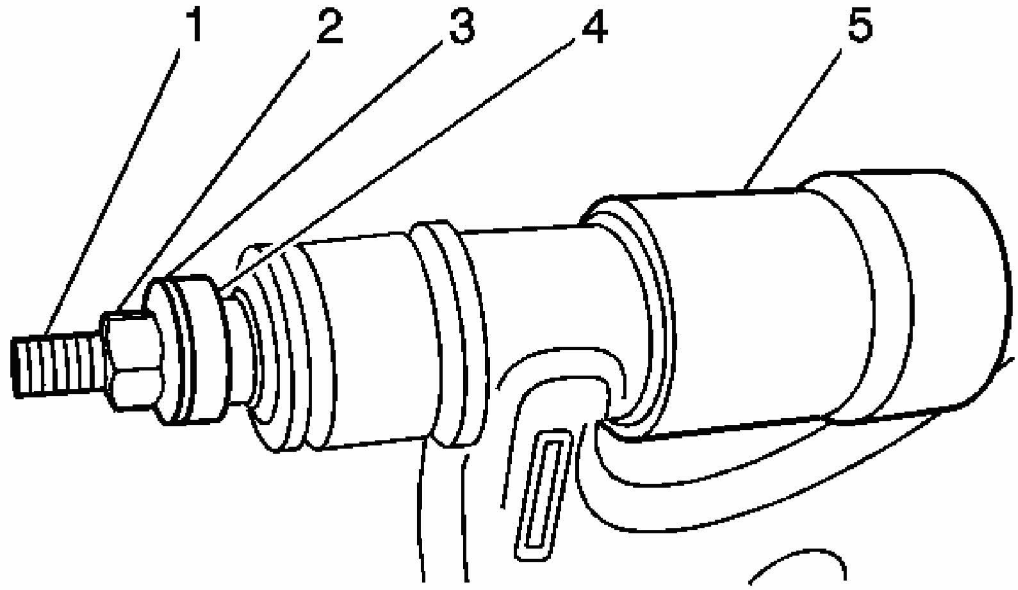


Fig. 42: Assembling Bushing Installation Tools
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use a 1/2 x 20 in standard thread nut with the puller bolt.

2. Assemble the following bushing installation tools as indicated :
    1. The nut (1)
    2. The **J 21474-01** washer (2). See **Special Tools**.
    3. The **J 21474-01** bearing (3). See **Special Tools**.
    4. The **J 21474-5** (4). See **Special Tools**.
    5. The **J 21474-01** puller bolt (5). See **Special Tools**.
3. Tighten the puller bolt (5) until the bushing is installed into the control arm.
4. Disassemble the **J 21474-01** and **J 21474-5** . See **Special Tools**.
5. Remove the control arm from the vice.
6. Install the lower control arm. Refer to **Lower Control Arm Replacement**.

WHEEL STUD REPLACEMENT

Tools Required

J 6627-A Tie Rod Puller. See **Special Tools**.

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Remove the brake caliper and bracket. Hang the caliper and the bracket from the vehicle. DO NOT allow the caliper and the bracket to hang by the brake hose. Refer to **Brake Caliper Replacement - Front** in Disc Brakes.
4. Remove the brake rotor. Refer to **Brake Rotor Replacement - Front** in Disc Brakes.

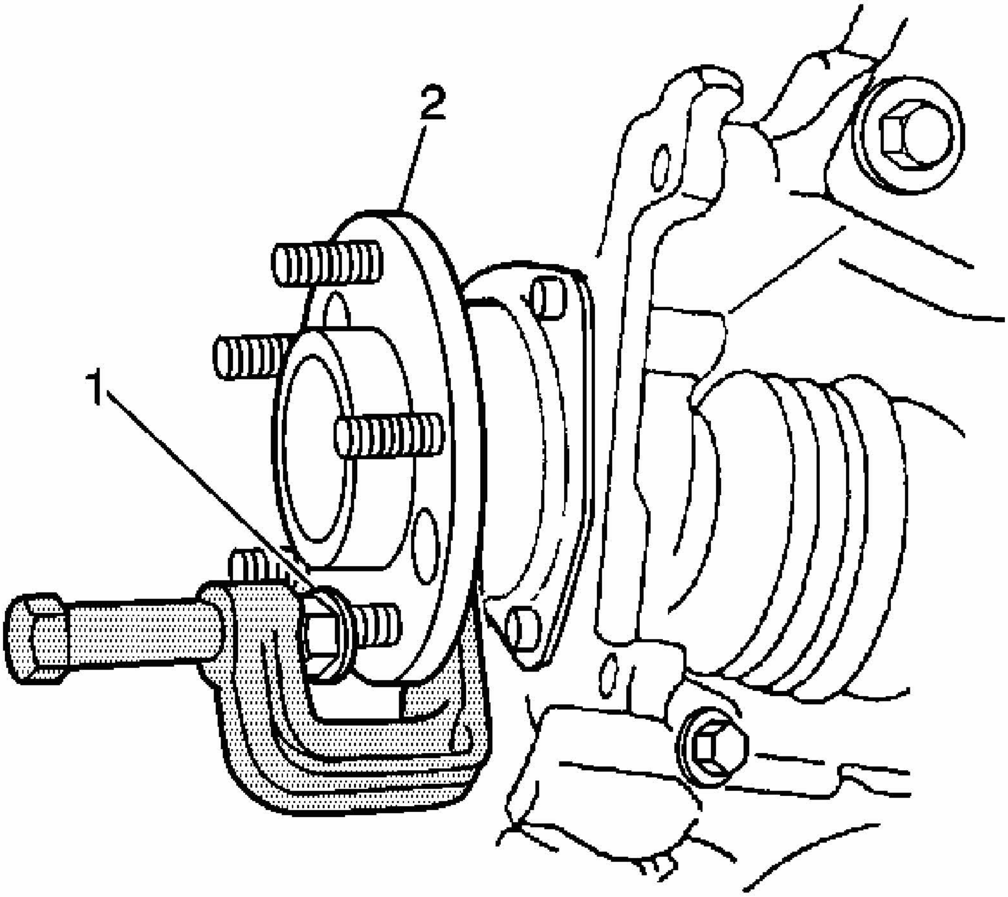


Fig. 43: Extracting Stud From Hub
Courtesy of GENERAL MOTORS CORP.

5. Use the **J 6627-A** in order to extract the stud (1) from the hub (2). See **Special Tools**.

Installation Procedure

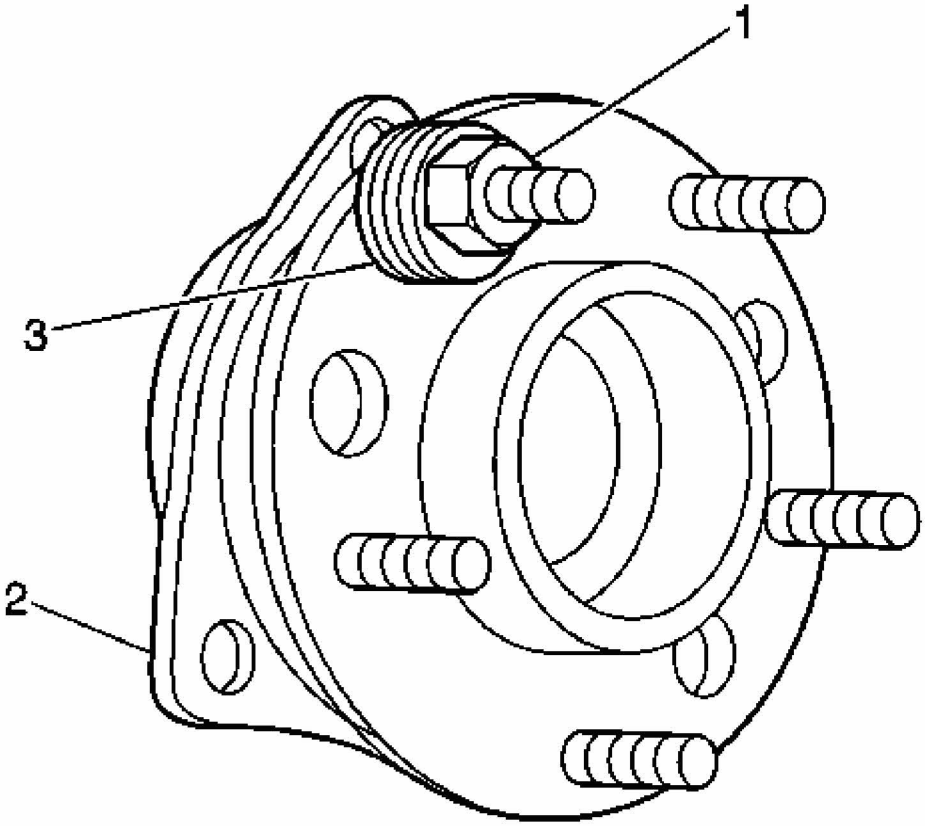


Fig. 44: Installing Wheel Stud
Courtesy of GENERAL MOTORS CORP.

1. Install a replacement stud in the wheel hub.
2. Add enough washers (3) in order to draw the stud into the hub (2).
3. Install the wheel nut (1) with the flat side against the washers (3).

IMPORTANT: Fully seat the wheel stud against the hub flange (2).

4. Tighten the wheel nut (1) until the wheel stud is fully seated against the hub flange.
5. Back off the wheel nut (1) and remove the washers (3).
6. Install the brake rotor. Refer to **Brake Rotor Replacement - Front** in Disc Brakes.
7. Install the brake caliper and bracket. Refer to **Brake Caliper Replacement - Front** in

Disc Brakes.

8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
9. Lower the vehicle.

STRUT ASSEMBLY REPLACEMENT

Removal Procedure

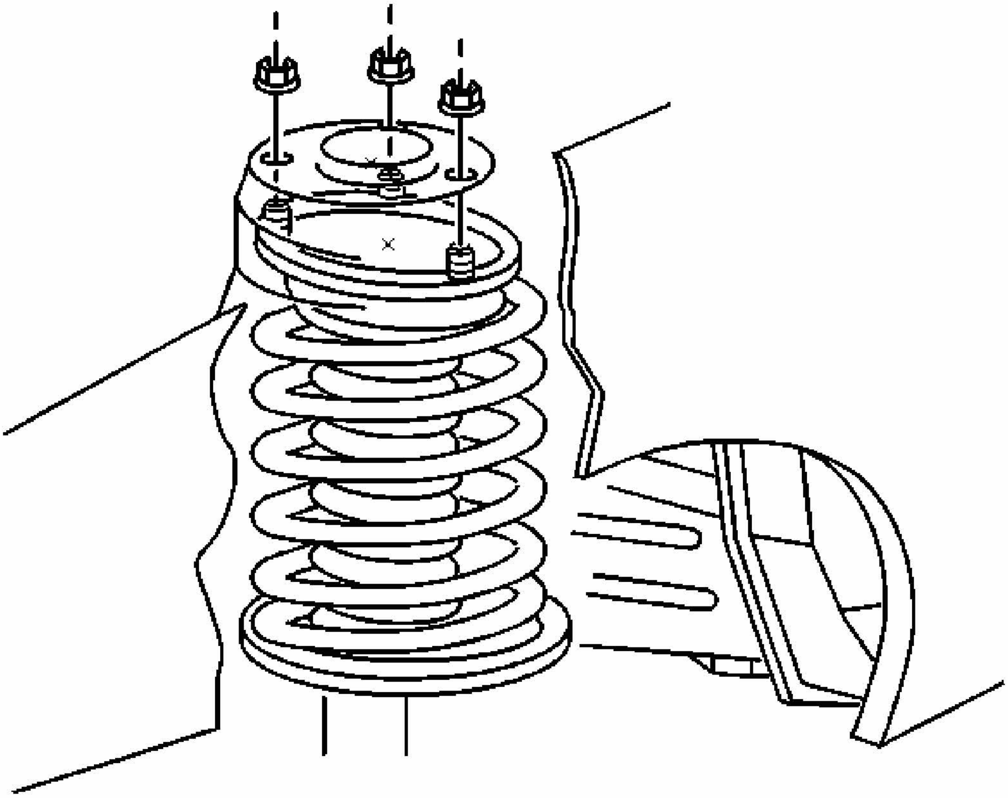


Fig. 45: Identifying Upper Strut Mounting Nuts
Courtesy of GENERAL MOTORS CORP.

1. Remove the strut upper nuts.

IMPORTANT: Lift the vehicle using ONLY a frame-contact vehicle lift. Do NOT lift the vehicle using a suspension-contact vehicle lift.

2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

3. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .

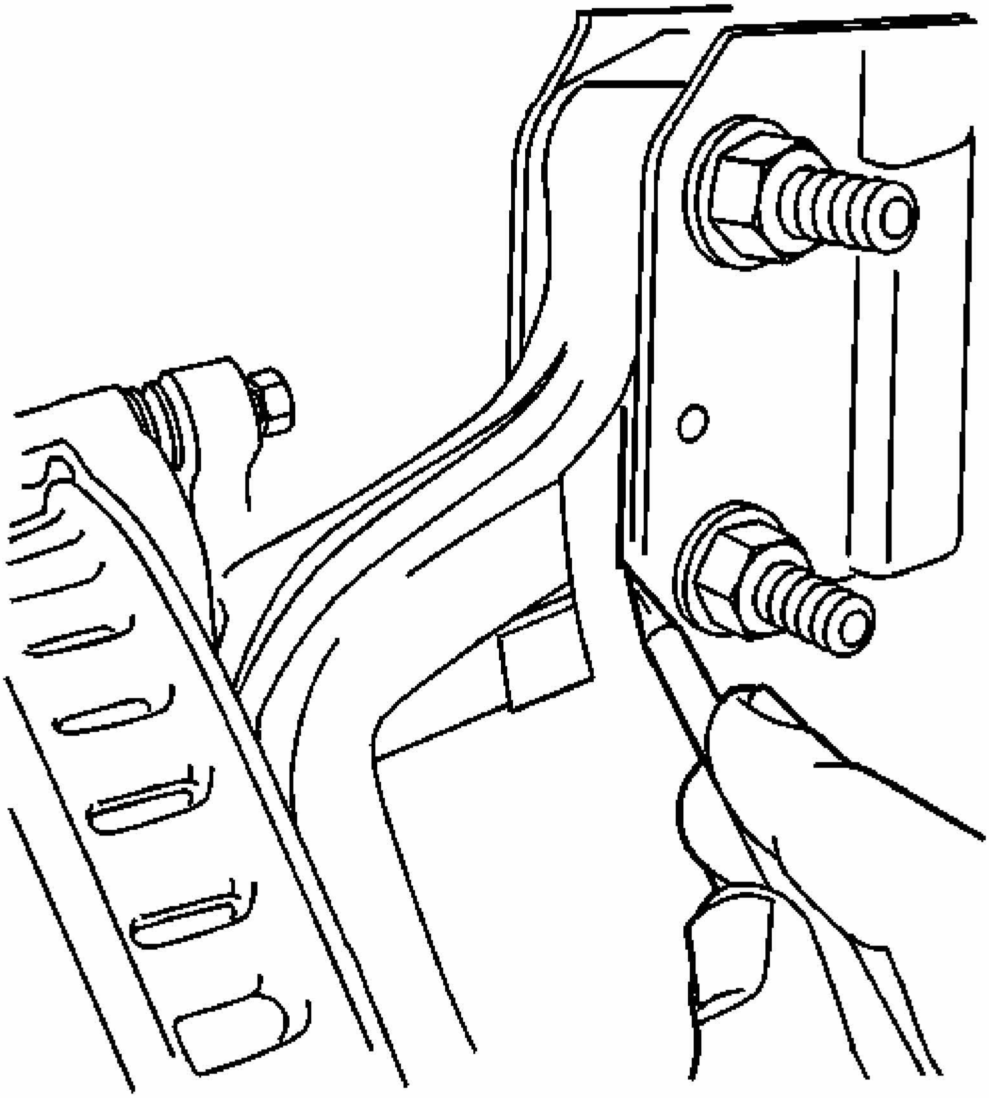


Fig. 46: Scribing Strut To Knuckle
Courtesy of GENERAL MOTORS CORP.

4. Scribe the strut to the knuckle.

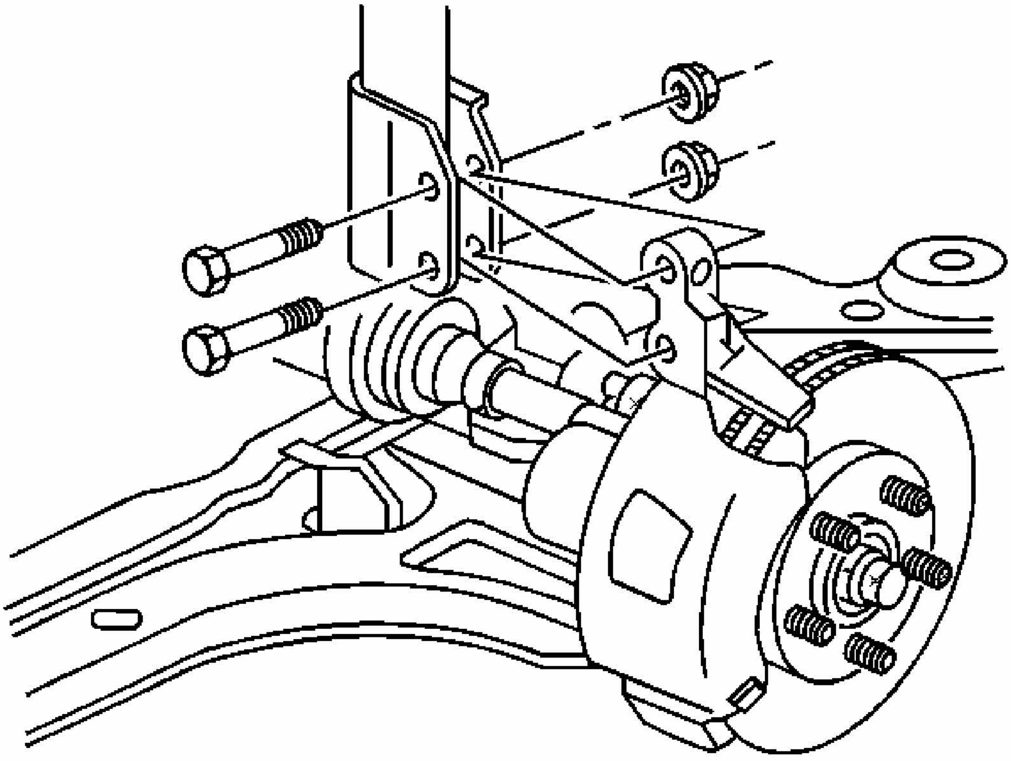


Fig. 47: View Of Steering Knuckle To Strut Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the strut lower bolts and nuts.
6. Remove the strut.

Installation Procedure

1. Install the strut.

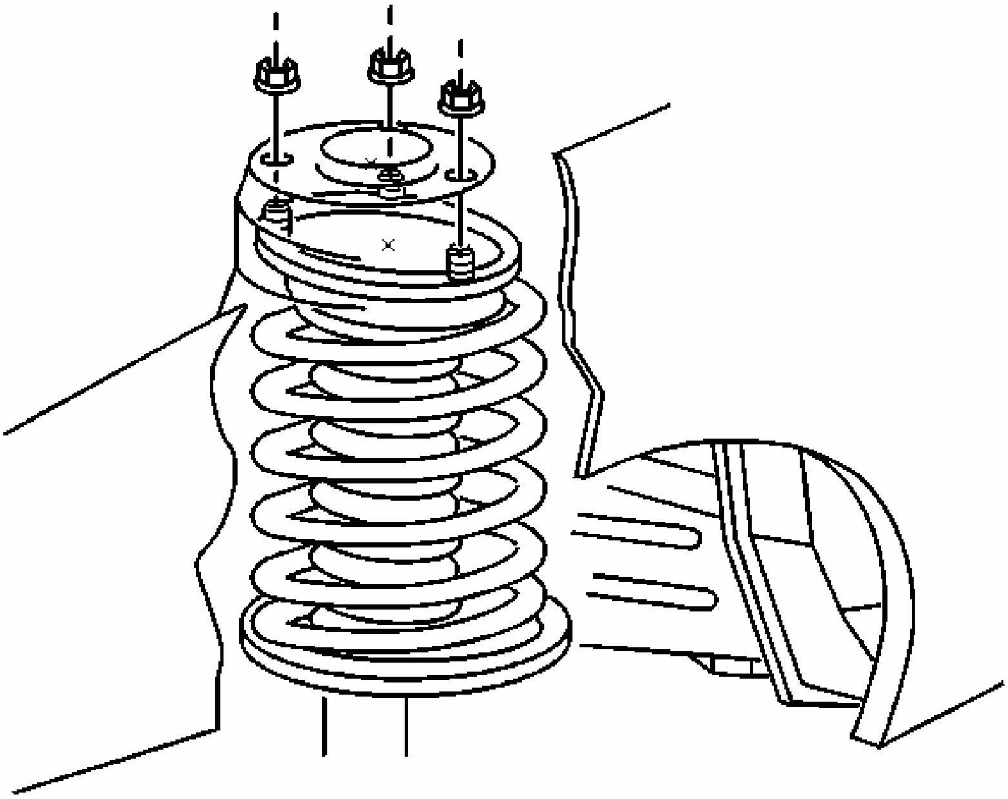


Fig. 48: Identifying Upper Strut Mounting Nuts
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE .**

2. Install the strut upper nuts.

   Tighten: Tighten the strut upper nuts to 33 N.m (24 lb ft).

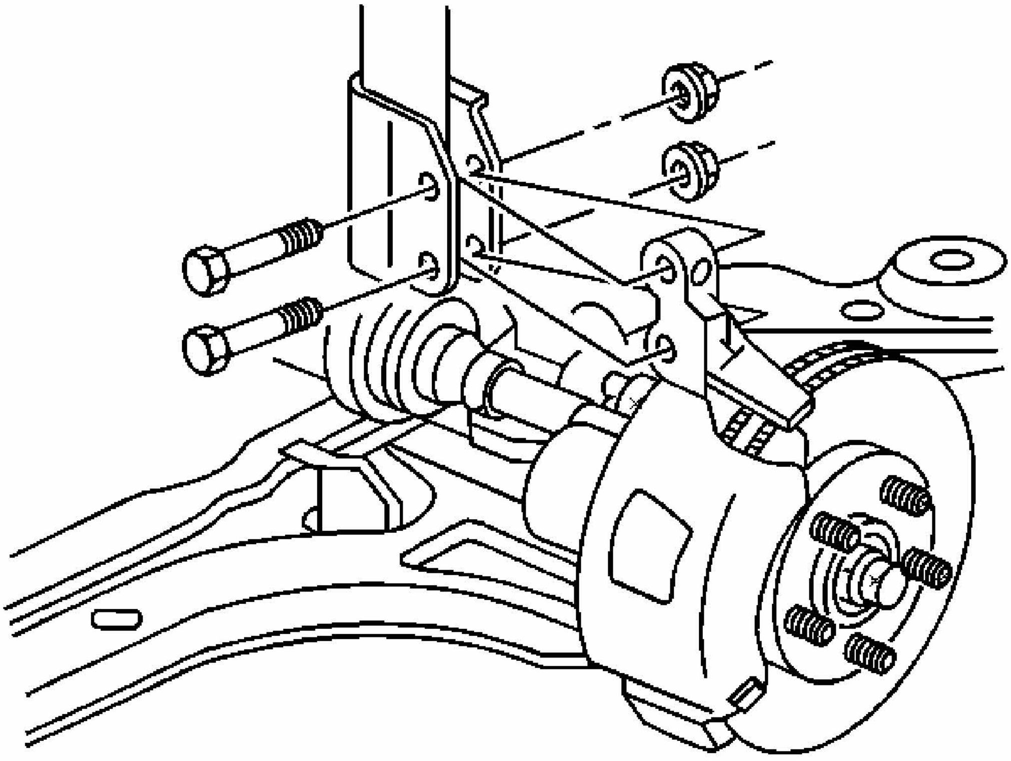


Fig. 49: View Of Steering Knuckle To Strut Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the strut lower bolts and nuts.

IMPORTANT: This is a prevailing torque type fastener. This fastener may be reused ONLY if:

- **The fastener and its counterpart are clean and free from rust.**
- **The fastener develops 3 N.m (27 lb in) of torque/drag against its counterpart prior to the fastener seating.**

If the fastener does not meet these criteria, REPLACE the fastener.

4. Align the strut to the mark on the knuckle.

Tighten: Tighten the strut lower nuts to 130 N.m (96 lb ft).

5. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
6. Lower the vehicle.
7. Align the front wheels. Refer to **Measuring Wheel Alignment** .

SUSPENSION SHOCK/STRUT DISPOSAL

CAUTION: Use the proper eye protection when drilling to prevent metal chips from causing physical injury.

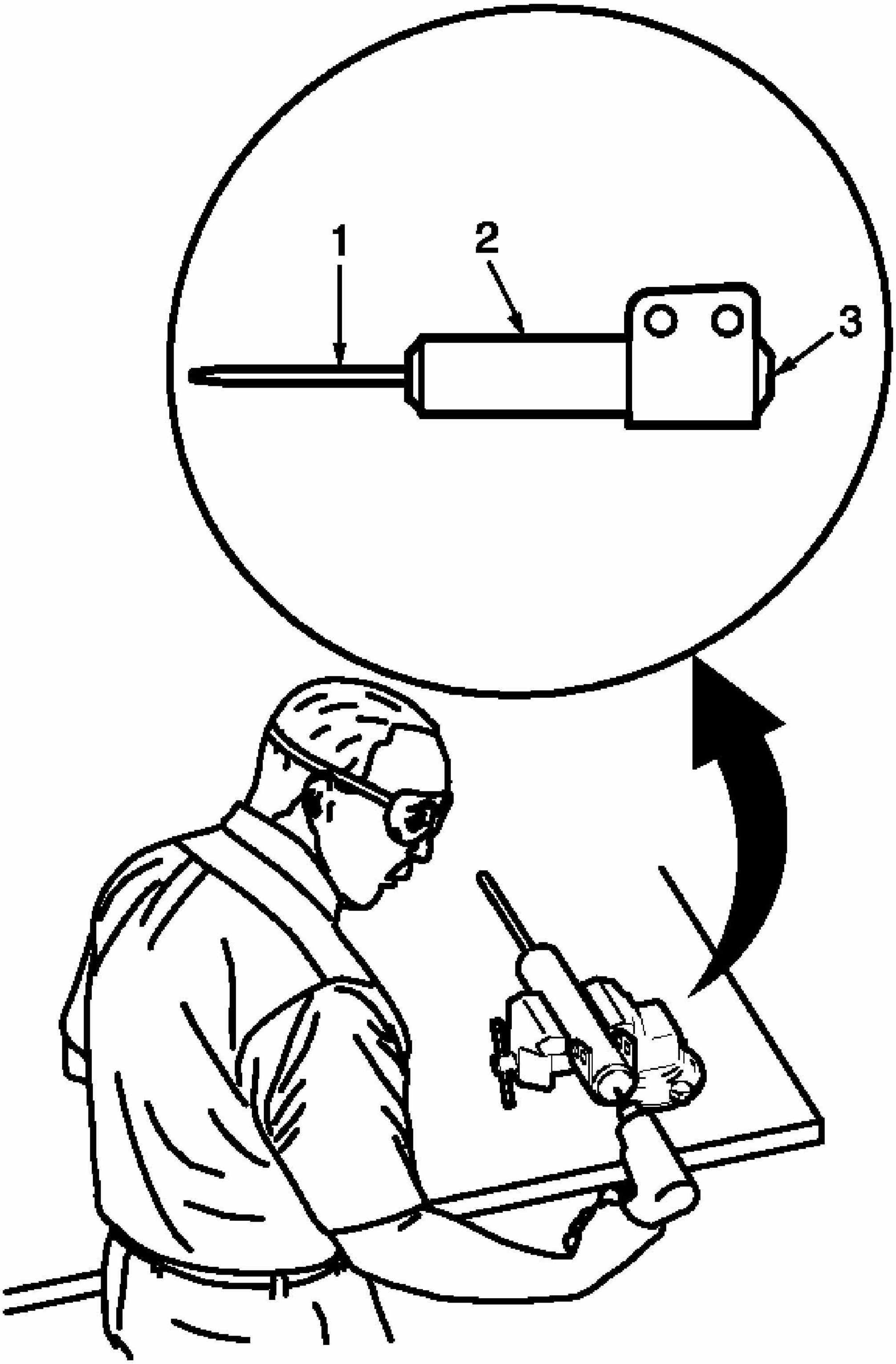


Fig. 50: Drilling Hole In Strut At Center Of End Cap

Courtesy of GENERAL MOTORS CORP.

1. Clamp the strut in a vise horizontally with the rod (1) completely extended.
2. Drill a hole in the strut at the center of the end cap (3) using a 5 mm (3/16 in) drill bit. Gas or a gas/oil mixture will exhaust when the drill bit penetrates the strut. Use shop towels in order to contain the escaping oil.
3. Remove the strut from the vise.
4. Hold the strut over a drain pan vertically with the hole down.
5. Move the rod (1) in and out of the tube (2) to completely drain the oil from the strut.

STRUT, STRUT COMPONENT AND/OR SPRING REPLACEMENT

Tools Required

- **J 42991** Strut Rod Nut Socket. See **Special Tools**.
- **J 45400** Strut Spring Compressor. See **Special Tools**.

Disassembly Procedure

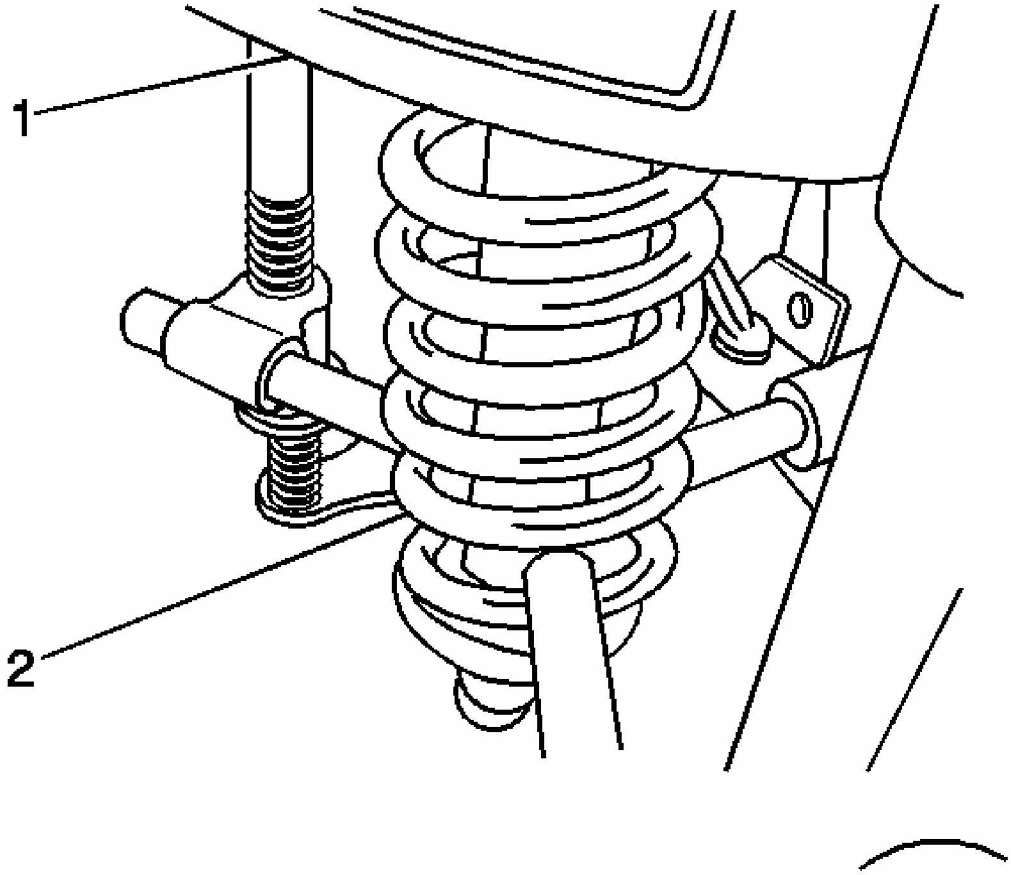


Fig. 51: Compressing/Releasing Lower Part Of Shock Spring
Courtesy of GENERAL MOTORS CORP.

1. Remove the strut from the vehicle. Refer to **Strut Assembly Replacement** .
2. Install the strut (2) in the **J 45400** (1). See **Special Tools**.

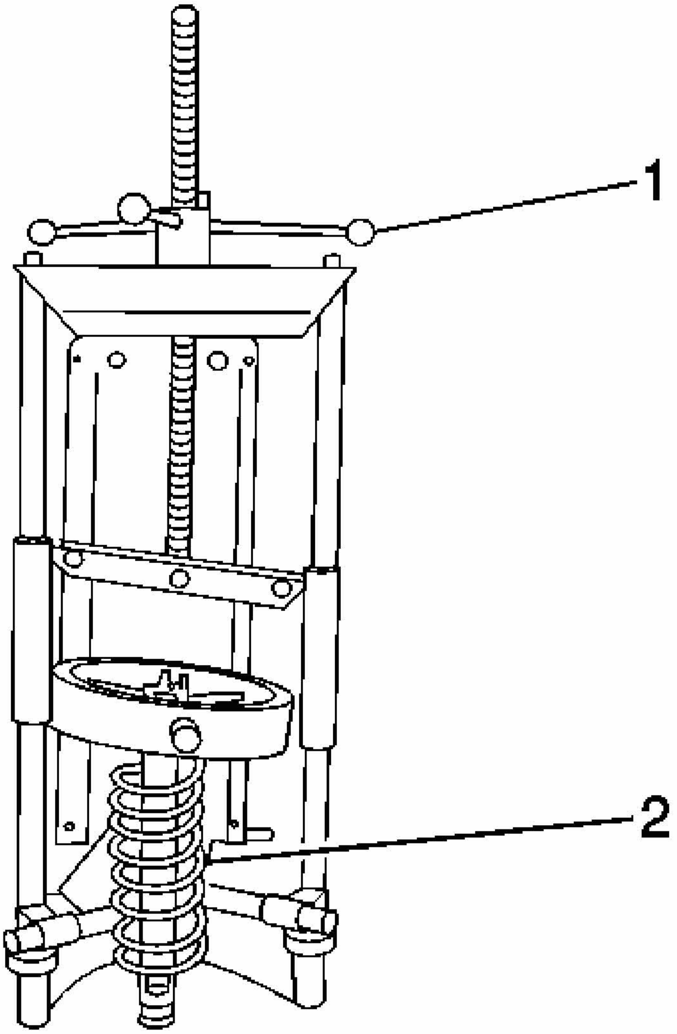


Fig. 52: View Of Compressor Forcing Screw & Coil Spring
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The spring is compressed when the strut moves freely.

3. Turn the spring compressor forcing screw (1) until the coil spring (2) is compressed.

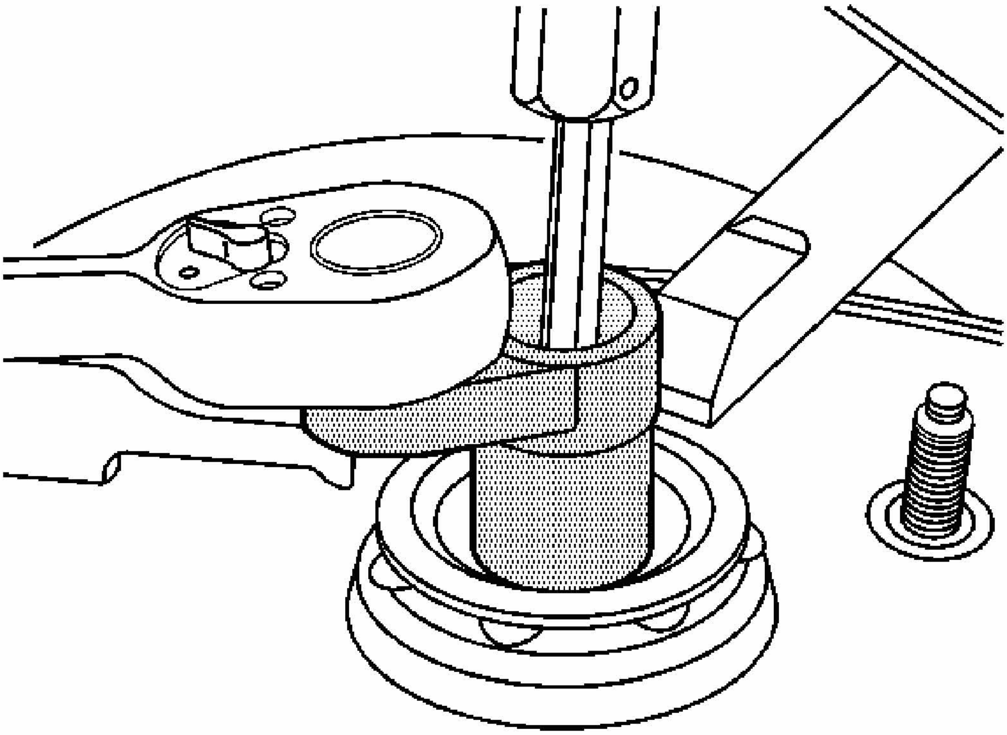


Fig. 53: Removing/Installing Strut Retaining Nut
Courtesy of GENERAL MOTORS CORP.

4. Use a 45 TORX® socket in order to hold the strut shaft. Remove the upper strut mount nut by turning with **J 42991** . See **Special Tools**.
5. Remove the strut from the **J 45400** . See **Special Tools**.

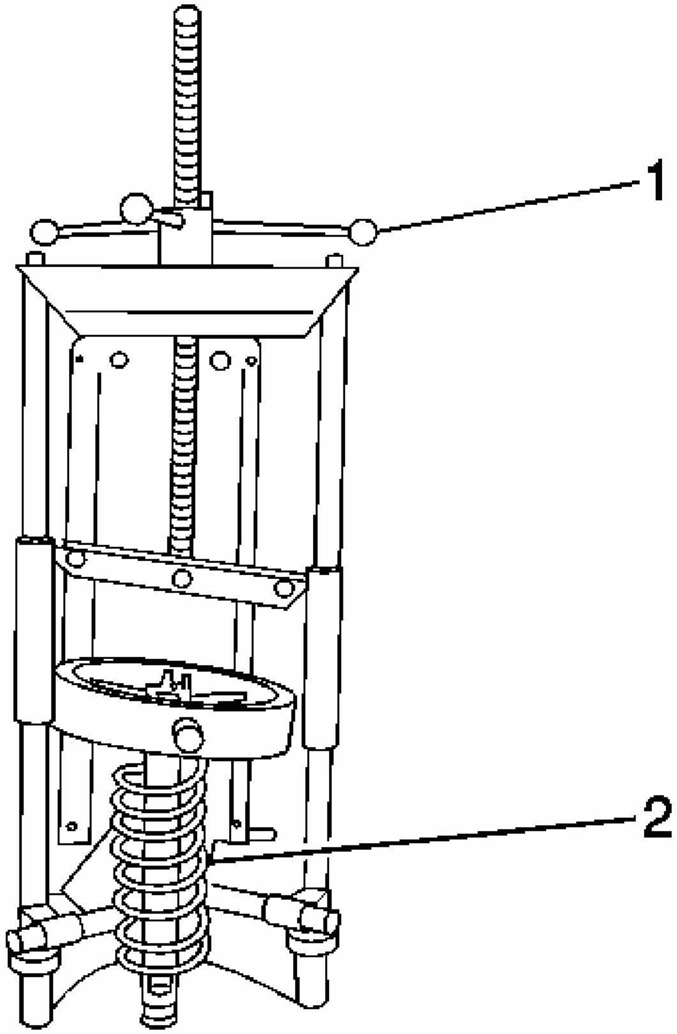


Fig. 54: View Of Compressor Forcing Screw & Coil Spring
Courtesy of GENERAL MOTORS CORP.

6. Loosen the compressor forcing screw (1) until the upper strut mount and coil spring (2) may be removed.
7. Remove the upper strut mount and the coil spring from the **J 45400** . See **Special Tools**.

Assembly Procedure

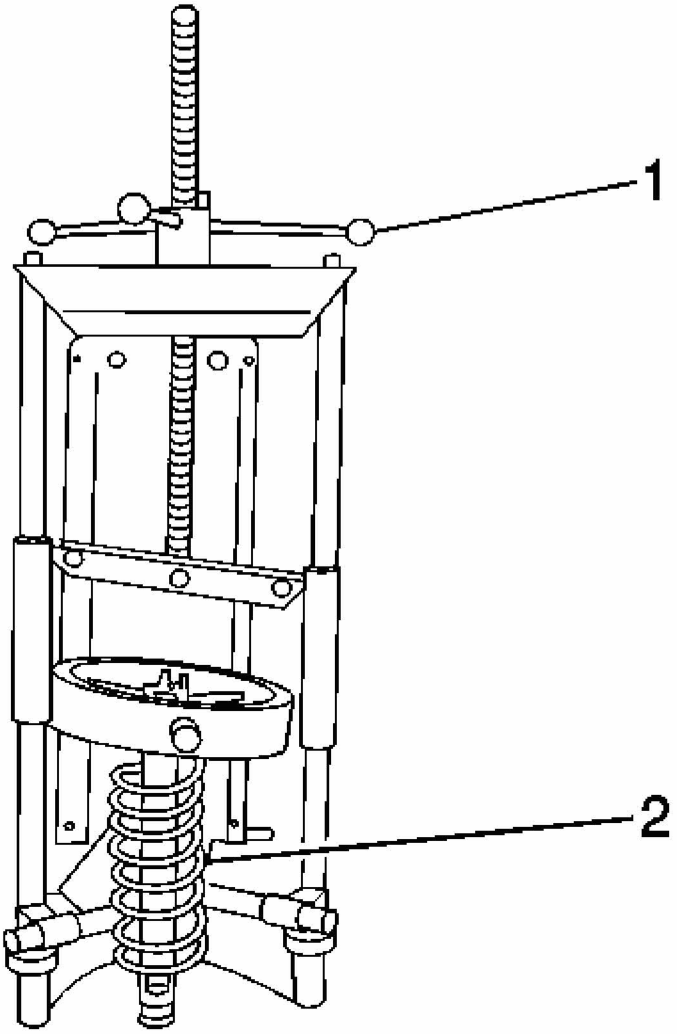


Fig. 55: View Of Compressor Forcing Screw & Coil Spring
Courtesy of GENERAL MOTORS CORP.

1. Install the coil spring and upper strut mount to the **J 45400** . See **Special Tools**.
2. Turn the spring compressor forcing screw (1) until the coil spring is compressed.
3. Install the strut to the coil spring and upper strut mount.

NOTE: **Refer to Fastener Notice .**

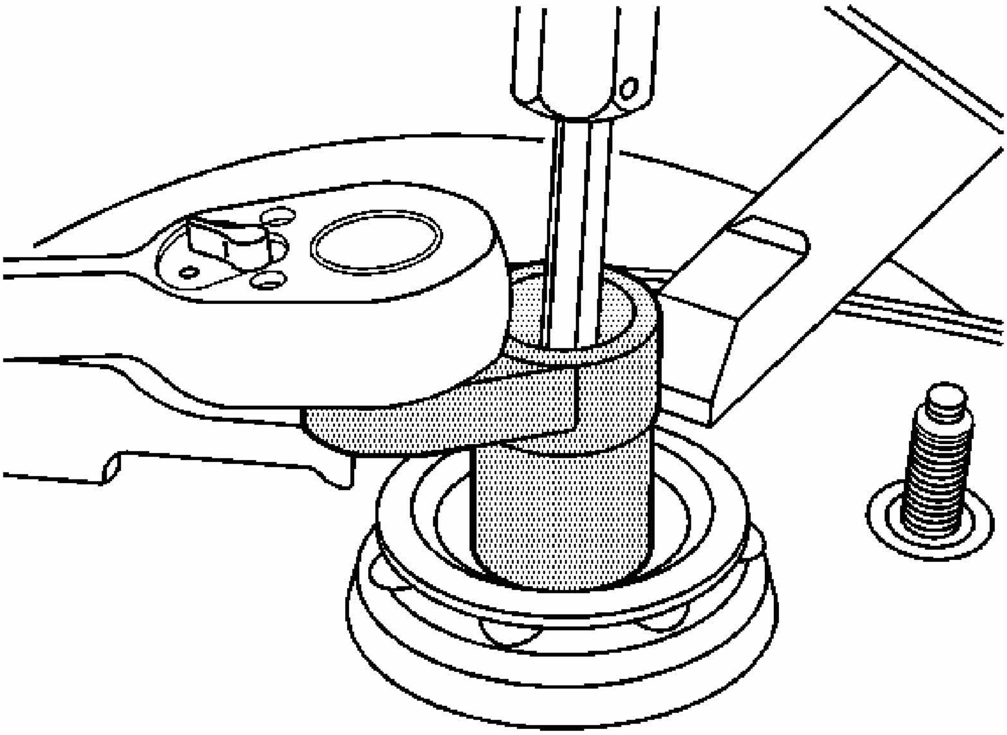


Fig. 56: Removing/Installing Strut Retaining Nut
Courtesy of GENERAL MOTORS CORP.

4. Install the strut retaining nut.

   Using the **J 42991** and a 45 TORX® socket, install the strut mount nut. See **Special Tools**.

   Tighten: Tighten the strut mount nut to 70 N.m (52 lb ft).

5. Remove the strut from the **J 45400** . See **Special Tools**.
6. Install the strut to the vehicle. Refer to **Strut Assembly Replacement** .

DESCRIPTION AND OPERATION

FRONT SUSPENSION DESCRIPTION AND OPERATION

The front suspension has 2 primary purposes:

- Isolate the driver from irregularities in the road surface.

- Define the ride and handling characteristics of the vehicle.

The front suspension absorbs the impact of the tires travelling over irregular road surfaces and dissipates this energy throughout the suspension system. This process isolates the vehicle occupants from the road surface. The rate at which the suspension dissipates the energy and the amount of energy that is absorbed is how the suspension defines the vehicles ride characteristics. Ride characteristics are designed into the suspension system and are not adjustable. The ride characteristics are mentioned in this description in order to aid in the understanding of the functions of the suspension system. The suspension system must allow for the vertical movement of the tire and wheel assembly as the vehicle travels over irregular road surfaces while maintaining the tire's horizontal relationship to the road.

This requires that the steering knuckle be suspended between a lower control arm and a strut assembly. The lower control arm attaches from the steering knuckle at the outermost point of the control arm. The attachment is through a ball and socket type joint. The innermost end of the control arm attached at 2 points to the vehicle frame through semi-rigid bushings. The upper portion of the steering knuckle is attached to a strut assembly. The strut assembly then connects to the vehicle body by way of an upper bearing. The steering knuckle is allowed to travel up and down independent of the vehicle body structure and frame.

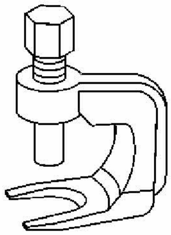
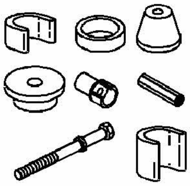
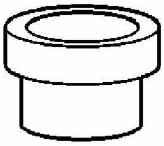
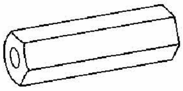
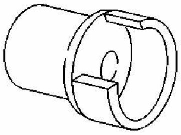
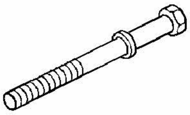
This up and down motion of the steering knuckle as the vehicle travels over bumps is absorbed predominantly by the coil spring. This spring is retained under tension over the strut assembly. A strut is used in conjunction with this system in order to dampen out the oscillations of the coil spring. A strut is a basic hydraulic cylinder. The strut is filled with oil and has a moveable shaft that connects to a piston inside the strut. Valves inside the shock absorber offer resistance to oil flow and consequently inhibit rapid movement of the piston and shaft. Each end of the shock absorber is connected in such a fashion to utilize this recoil action of a spring alone. Each end of the strut is designed as the connection point of the suspension system to the vehicle and acts as the coil spring seat. This allows the strut to utilize the dampening action to reduce the recoil of a spring alone. The lower control arm is allowed to pivot at the vehicle frame in a vertical fashion. The ball joint allows the steering knuckle to maintain the perpendicular relationship to the road surface.

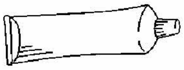
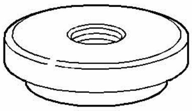
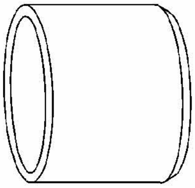
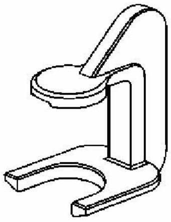
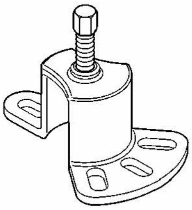
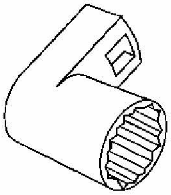
Front suspensions systems utilize a stabilizer shaft. The stabilizer bar connects between the left and right lower control arm assemblies through the stabilizer link and stabilizer shaft insulators. This bar controls the amount of independent movement of the suspension when the vehicle turns. Limiting the independent movement defines the vehicles handling characteristics on turns.

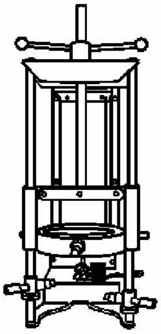
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description
	J 6627-A Tie Rod Puller
	J 21474-01 Control Arm Bushing Set
	J 21474-2 Bushing Installer Remover
	J 21474-4 1/2 Inch Nut
	J 21474-5 Control Arm Bushing Receiver
	J 21474-27 1/2 Inch Puller Bolt Thrust Bearing
	J 23444-A Extreme Press Lubricant - 1/4-Ounce Tube

	
	J 34126 Sprocket Bearing Remover
	J 35379 Front Knuckle Support
	J 41820 Ball Joint Separator
	J 42129 Wheel Hub Remover
	J 42991 Strut Rod Nut Socket

	J 45400 Strut Spring Compressor

2006 ACCESSORIES & EQUIPMENT

Instrument Panel, Gages, and Console - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Floor Console Armrest Screws (GMX211)	2 N.m	18 lb in
Front Floor Console Armrest Hinge Screws (GMX211)	2 N.m	18 lb in
Front Floor Console Armrest Inner Screws (GMX211)	2 N.m	18 lb in
Front Floor Console Bolts/Screws (GMX211)& (GMX231)	7 N.m	62 lb in
Front Floor Console Bracket Bolts (GMX211)& (GMX231)	10 N.m	89 lb in
Front Floor Console Cupholder Screws (GMX211)	2 N.m	18 lb in
Front Floor Console Door Hinge Screws (GMX231)	2 N.m	18 lb in
Front Floor Console Door Inner Screws (GMX231)	2 N.m	18 lb in
Front Floor Console Door Screws (GMX231)	2 N.m	18 lb in
Front Floor Console Front Trim Plate Screws (GMX211)	2 N.m	18 lb in
Instrument Panel Carrier to Body Bolts (GMX211)&(GMX231)	25 N.m	18 lb ft
Instrument Panel Carrier to HVAC Module Bolts (GMX211)&(GMX231)	4 N.m	35 lb in
Instrument Panel Center Support Bracket Bolts (GMX211)&(GMX231)	10 N.m	89 lb in
Instrument Panel Cluster Assembly Screws (GMX211)&(GMX231)	2 N.m	18 lb in
Instrument Panel Compartment Screws (GMX231)	2 N.m	18 lb in
Instrument Panel Compartment Dampener Screws (GMX211)	2 N.m	18 lb in
Instrument Panel Compartment Inner Panel		

Screws (GMX211)&(GMX231)	2 N.m	18 lb in
Instrument Panel Compartment Latch Screws (GMX211)&(GMX231)	2 N.m	18 lb in
Instrument Panel Compartment Striker Screws (GMX231)	2 N.m	18 lb in
Instrument Panel Lower Center Trim Panel Screws (GMX231)	2 N.m	18 lb in
Instrument Panel Lower Trim Panel Bolts/Screws (GMX211)	2 N.m	18 lb in
Instrument Panel Trim Plate Screws (GMX211)	2 N.m	18 lb in
Instrument Panel Upper Trim Pad Bolts/Screws (GMX211)&(GMX231)	2 N.m	18 lb in
Knee Bolster Bracket to Carrier Bolts (GMX211)&(GMX231)	10 N.m	89 lb in
Knee Bolster Bracket to HVAC Module Bolts (GMX211)&(GMX231)	4 N.m	35 lb in
Knee Bolster Reinforcement Bolts (GMX211)&(GMX231)	2 N.m	18 lb in

FUEL LEVEL SPECIFICATIONS

The information in this table is intended for use with the **J 33431-C** Signal Generator and Instrument Panel Tester. See **Special Tools**. The fuel level sensor values represent the test values to be used on the Signal Generator to drive the fuel gage display to the indicated positions. Vehicles that require more than one fuel level sensor calculate gage position from many possible resistance combinations of fuel levels between the two tanks. Therefore, the values in the table may not correlate directly to readings taken from the vehicle primary or secondary sending units.

The values in the table are approximate values based on information obtained from properly operating vehicles. Actual results may vary slightly.

Fuel Level Specifications

Fuel Gauge Display	Resistance	Fuel Level	Fuel Remaining
E	40-62ohm	0-9%	0-4.9 L (0-1.3 gal)
1/4	95ohm	29%	18.5 L (4.9 gal)
1/2	125ohm	49%	31.8 L (8.4 gal)
3/4	156ohm	70%	45.0 L (11.9 gal)
F	200-230ohm	90-100%	58.3-64.3 L (15.4-17.0 gal)
Low Fuel Indicator			

On	69ohm	13%	8.3 L (2.2 gal)
Low Fuel Indicator Off	87ohm	23%	15.1 L (4.0 gal)

SCHEMATIC AND ROUTING DIAGRAMS

INSTRUMENT CLUSTER SCHEMATICS

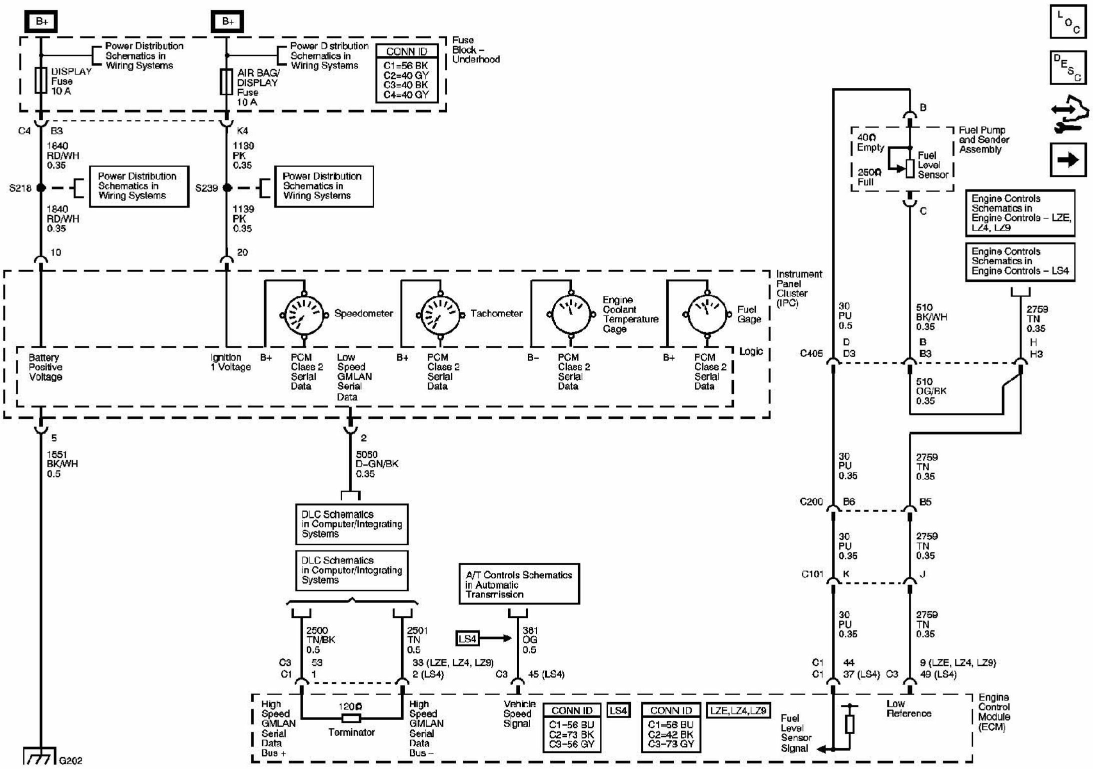

B+
B+
Power Distribution Schematics in Wiring Systems
DISPLAY Fuse 10 A
Power Distribution Schematics in Wiring Systems
AIR BAG/ DISPLAY Fuse 10 A
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
Fuse Block – Underhood
C4
B3
1840 RD/WH 0.35
K4
1139 PK 0.35
S218
Power Distribution Schematics in Wiring Systems
S239
Power Distribution Schematics in Wiring Systems
1840 RD/WH 0.35
1139 PK 0.35
10
20
Speedometer
Tachometer
Engine Coolant Temperature Gage
Fuel Gage
Instrument Panel Cluster (IPC)
Logic
Battery Positive Voltage
Ignition 1 Voltage
B+
PCM Class 2 Serial Data
Low Speed GMLAN Serial Data
B+
PCM Class 2 Serial Data
B–
PCM Class 2 Serial Data
B+
PCM Class 2 Serial Data
5
1551 BK/WH 0.5
2
5060 D–GN/BK 0.35
DLC Schematics in Computer/Integrating Systems
DLC Schematics in Computer/Integrating Systems
A/T Controls Schematics in Automatic Transmission
2500 TN/BK 0.5
2501 TN 0.5
LS4
381 OG 0.5
C3 53
C1 1
33 (LZE, LZ4, LZ9)
2 (LS4)
C3 45 (LS4)
High Speed GMLAN Serial Data Bus +
120Ω
Terminator
High Speed GMLAN Serial Data Bus –
Vehicle Speed Signal
CONN ID
C1–56 BU
C2=73 BK
C3–56 GY
LS4
CONN ID
C1=56 BU
C2=42 BK
C3–73 GY
LZE,LZ4,LZ9
Fuel Level Sensor Signal
Low Reference
Engine Control Module (ECM)
G202
B
40Ω Empty
250Ω Full
Fuel Level Sensor
Fuel Pump and Sender Assembly
C
Engine Controls Schematics in Engine Controls – LZE, LZ4, LZ9
Engine Controls Schematics in Engine Controls – LS4
30 PU 0.5
510 BK/WH 0.35
2759 TN 0.35
C405
D
D3
B
B3
H
H3
510 OG/BK 0.35
30 PU 0.35
2759 TN 0.35
C200
B6
B5
30 PU 0.35
2759 TN 0.35
C101
K
J
30 PU 0.35
2759 TN 0.35
C1 44
C1 37 (LS4)
C3
9 (LZE, LZ4, LZ9)
49 (LS4)
LOC
DESC

Fig. 1: Power, Ground, And Gages - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

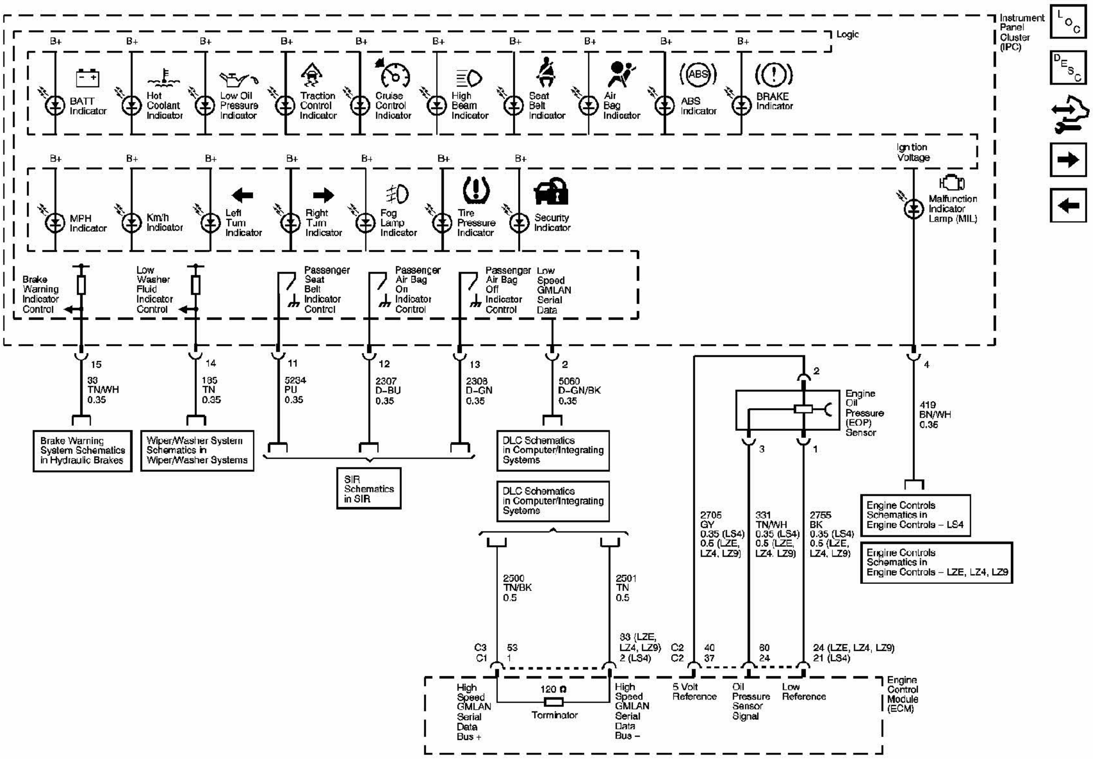

Instrument Panel Cluster (IPC)
Logic
B+
BATT Indicator
Hot Coolant Indicator
Low Oil Pressure Indicator
Traction Control Indicator
Cruise Control Indicator
High Beam Indicator
Seat Belt Indicator
Air Bag Indicator
ABS Indicator
BRAKE Indicator
Ignition Voltage
MPH Indicator
Km/h Indicator
Left Turn Indicator
Right Turn Indicator
Fog Lamp Indicator
Tire Pressure Indicator
Security Indicator
Malfunction Indicator Lamp (MIL)
Brake Warning Indicator Control
Low Washer Fluid Indicator Control
Passenger Seat Belt Indicator Control
Passenger Air Bag On Indicator Control
Passenger Air Bag Off Indicator Control
Low Speed GMLAN Serial Data
15 33 TN/WH 0.35
14 185 TN 0.35
11 5234 PU 0.35
12 2307 D-BU 0.35
13 2308 D-GN 0.35
2 5060 D-GN/BK 0.35
4 419 BN/WH 0.35
Brake Warning System Schematics in Hydraulic Brakes
Wiper/Washer System Schematics in Wiper/Washer Systems
SIR Schematics in SIR
DLC Schematics in Computer/Integrating Systems
Engine Oil Pressure (EOP) Sensor
2 3 1
Engine Controls Schematics in Engine Controls – LS4
Engine Controls Schematics in Engine Controls – LZE, LZ4, LZ9
2500 TN/BK 0.5
2501 TN 0.5
2705 GY 0.35 (LS4) 0.5 (LZE, LZ4, LZ9)
331 TN/WH 0.35 (LS4) 0.5 (LZE, LZ4, LZ9)
2755 BK 0.35 (LS4) 0.5 (LZE, LZ4, LZ9)
C3 53
C1 1
33 (LZE, LZ4, LZ9)
2 (LS4)
C2 40
C2 37
60 24
24 (LZE, LZ4, LZ9)
21 (LS4)
High Speed GMLAN Serial Data Bus +
120 Ω Terminator
High Speed GMLAN Serial Data Bus –
5 Volt Reference
Oil Pressure Sensor Signal
Low Reference
Engine Control Module (ECM)

Fig. 2: Indicators - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

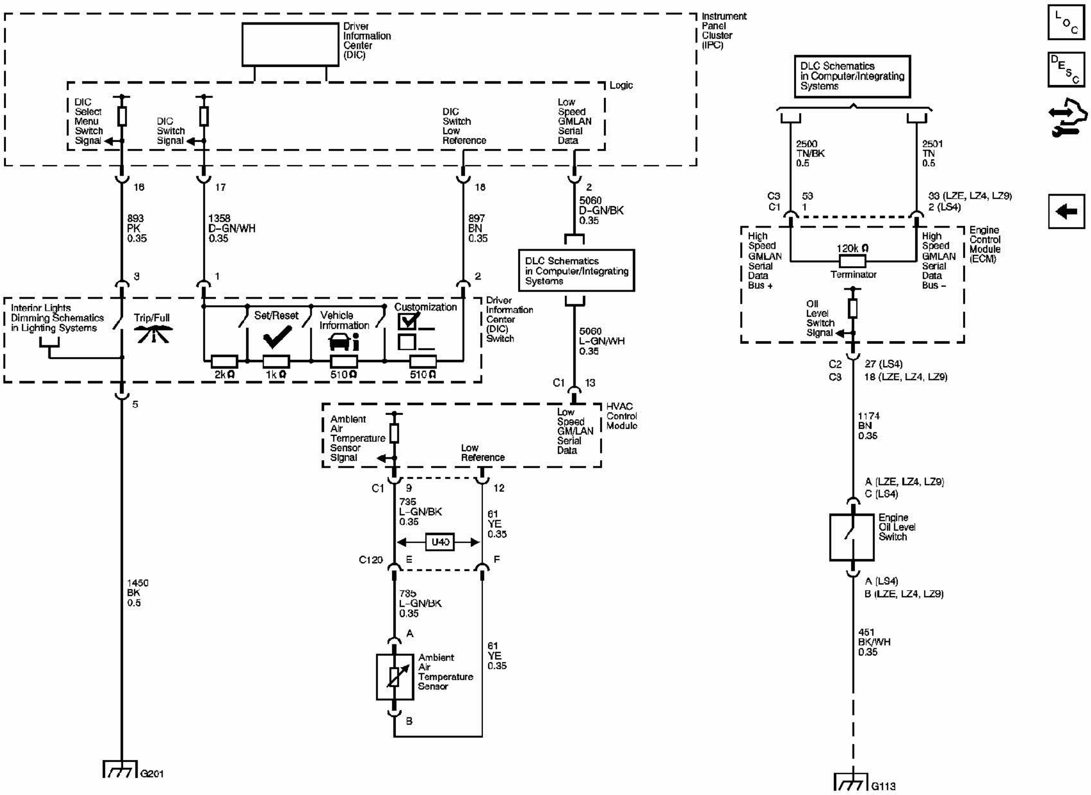

Driver Information Center (DIC)
Instrument Panel Cluster (IPC)
Logic
DIC Select Menu Switch Signal
DIC Switch Signal
DIC Switch Low Reference
Low Speed GMLAN Serial Data
16 893 PK 0.35
17 1358 D-GN/WH 0.35
18 897 BN 0.35
2 5060 D-GN/BK 0.35
3 1 2
Interior Lights Dimming Schematics in Lighting Systems
Trip/Full
Set/Reset
Vehicle Information
Customization
2k Ω
1k Ω
510 Ω
510 Ω
Driver Information Center (DIC) Switch
DLC Schematics in Computer/Integrating Systems
5060 L-GN/WH 0.35
C1 13
HVAC Control Module
Ambient Air Temperature Sensor Signal
Low Reference
Low Speed GMLAN Serial Data
5
C1 9 12
735 L-GN/BK 0.35
61 YE 0.35
U40
C120 E F
1450 BK 0.5
A
Ambient Air Temperature Sensor
B
G201
DLC Schematics in Computer/Integrating Systems
2500 TN/BK 0.5
2501 TN 0.5
C3 53
C1 1
33 (LZE, LZ4, LZ9)
2 (LS4)
High Speed GMLAN Serial Data Bus +
120k Ω Terminator
High Speed GMLAN Serial Data Bus –
Engine Control Module (ECM)
Oil Level Switch Signal
C2 27 (LS4)
C3 18 (LZE, LZ4, LZ9)
1174 BN 0.35
A (LZE, LZ4, LZ9)
C (LS4)
Engine Oil Level Switch
A (LS4)
B (LZE, LZ4, LZ9)
451 BK/WH 0.35
G113

Fig. 3: Driver Information Center - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

AUDIBLE WARNINGS SCHEMATICS

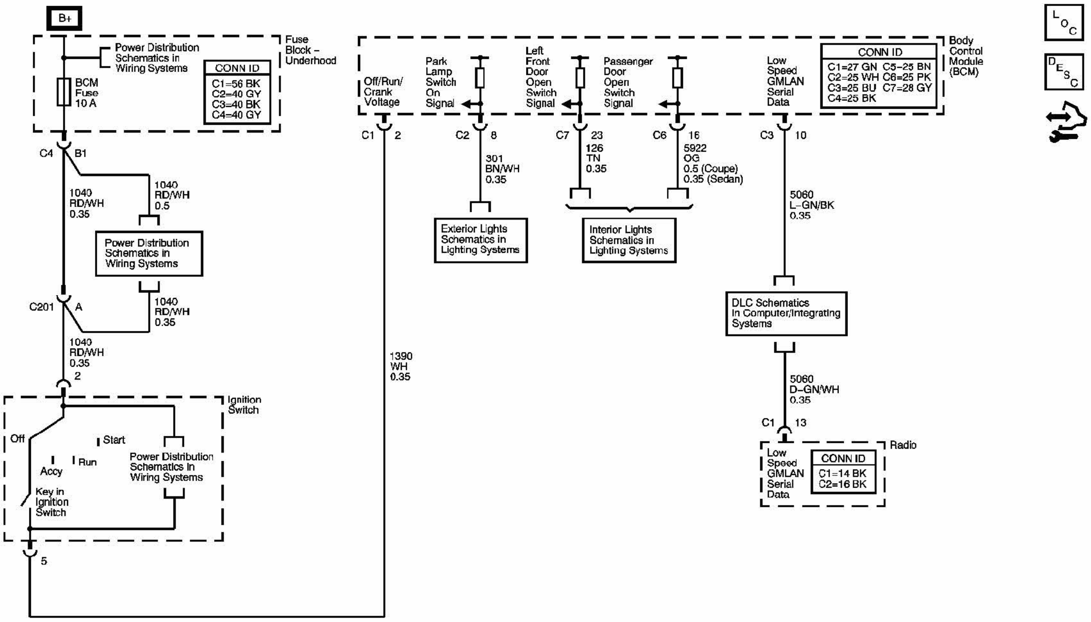

B+
Power Distribution Schematics in Wiring Systems
Fuse Block - Underhood
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
BCM Fuse 10 A
C4
B1
1040 RD/WH 0.35
1040 RD/WH 0.5
Power Distribution Schematics in Wiring Systems
1040 RD/WH 0.35
C201
A
1040 RD/WH 0.35
2
Ignition Switch
Off
Start
Accy
Run
Power Distribution Schematics In Wiring Systems
Key in Ignition Switch
5
1390 WH 0.35
Off/Run/ Crank Voltage
Park Lamp Switch On Signal
Left Front Door Open Switch Signal
Passenger Door Open Switch Signal
Low Speed GMLAN Serial Data
CONN ID
C1=27 GN C5-25 BN
C2=25 WH C6=25 PK
C3=25 BU C7=28 GY
C4=25 BK
Body Control Module (BCM)
C1
2
C2
8
C7
23
C6
16
C3
10
301 BN/WH 0.35
126 TN 0.35
5922 OG 0.5 (Coupe) 0.35 (Sedan)
Exterior Lights Schematics in Lighting Systems
Interior Lights Schematics in Lighting Systems
5060 L-GN/BK 0.35
DLC Schematics In Computer/Integrating Systems
5060 D-GN/WH 0.35
C1
13
Radio
Low Speed GMLAN Serial Data
CONN ID
C1=14 BK
C2=16 BK
LOC
DESC

Fig. 4: Audible Warnings - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

INSTRUMENT PANEL, GAGES, AND CONSOLE COMPONENT VIEWS

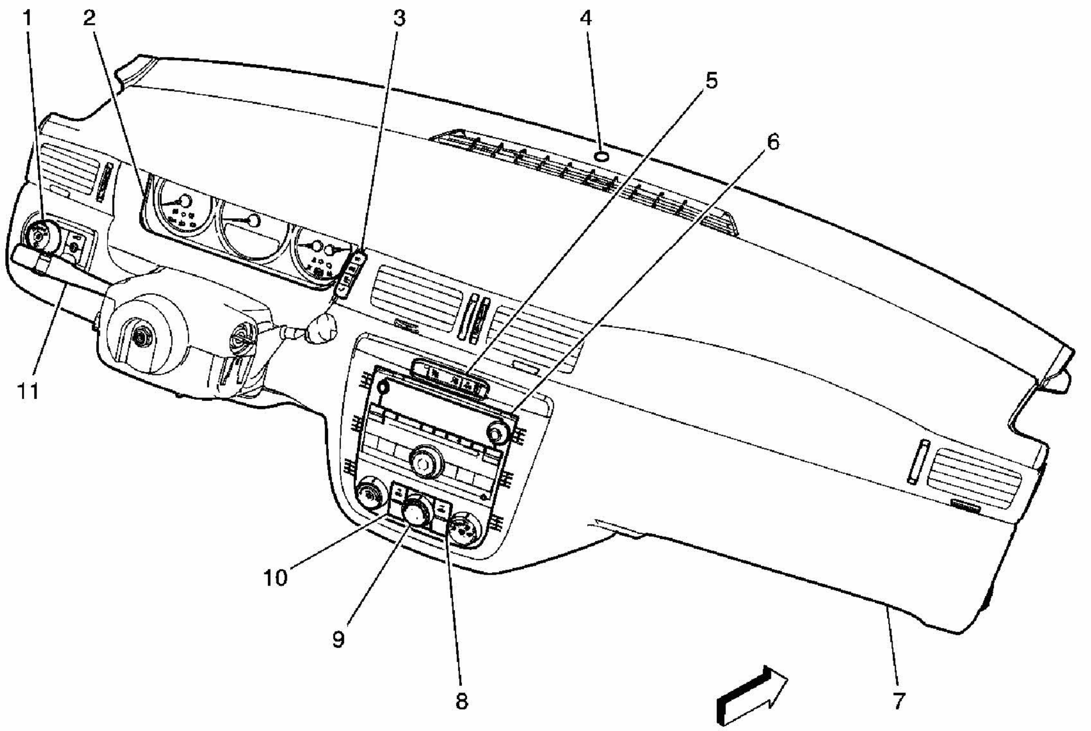


Fig. 5: I/P Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
1	Headlamp Switch
2	Instrument Panel Cluster (IPC)
3	Driver Information Center (DIC) Switch
4	Ambient Light Sensor
5	Inflatable Restraint Passenger Air Bag On/Off Indicator (Sedan w/o 9C1, 9C3)
6	Radio
7	I/P Trim Panel
8	Heated Seat Switch-Passenger (KA7)
9	HVAC Control Module
10	Heated Seat Switch-Driver (KA7)
11	Turn Signal / Multifunction Switch

INSTRUMENT PANEL, GAGES, AND CONSOLE CONNECTOR END VIEWS

Driver Information Center (DIC) Switch

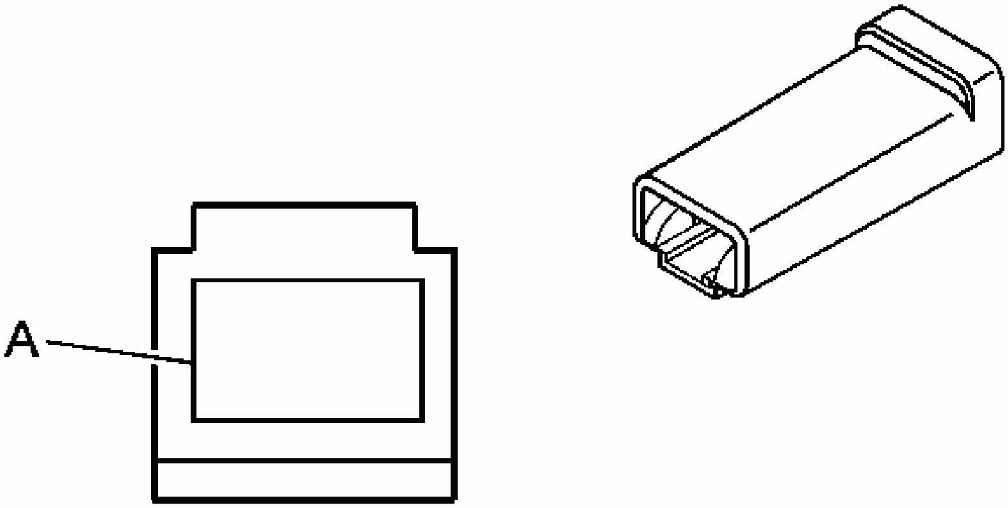


Fig. 6: Connector End View
Courtesy of GENERAL MOTORS CORP.

Instrument Panel, Gages, and Console Connector End Views

Connector Part Information

- OEM: 15491277
- Service: See Catalog
- Description: 5-Way F HCM (BK)

Terminal Part Information

- Terminal/Tray: SHCM-A03T-P025/20
- Core/Insulation Crimp: J/J
- Release Tool/Test Probe: 12094429/J-35616-64A (L-BU)

Driver Information Center (DIC) Switch

Pin	Wire Color	Circuit No.	Function
1	D-GN/WH	1358	DIC Switch Signal
2	BN	897	DIC Switch Low Reference
3	PK	893	DIC Select Menu Switch Signal
4	PU/WH	1382	LED Dimming Signal/LED Dimming Supply
5	BK	1450	Ground

Driver Information Center (DIC) Switch (9C1/9C3)

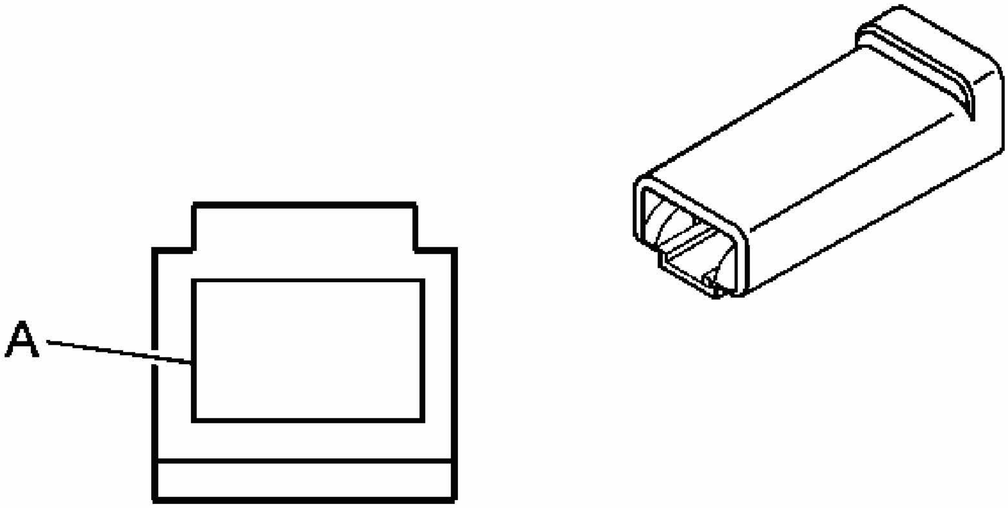


Fig. 7: Connector End View
Courtesy of GENERAL MOTORS CORP.

Instrument Panel, Gages, and Console Connector End Views

Connector Part Information

- OEM: 15491277
- Service: See Catalog
- Description: 5-Way F HCM (BK)

Terminal Part Information

- Terminal/Tray: SHCM-A03T-P025/20
- Core/Insulation Crimp: J/J
- Release Tool/Test Probe: 12094429/J-35616-64A (L-BU)

Driver Information Center (DIC) Switch (9C1/9C3)

Pin	Wire Color	Circuit No.	Function
1	D-GN/WH	1358	DIC Switch Signal
2	BN	897	DIC Switch Low Reference
3	PK	893	DIC Select Menu Switch Signal
4	PU/WH	1382	LED Dimming Signal/LED Dimming Supply

5	BK	1450	Ground

Engine Oil Level Switch

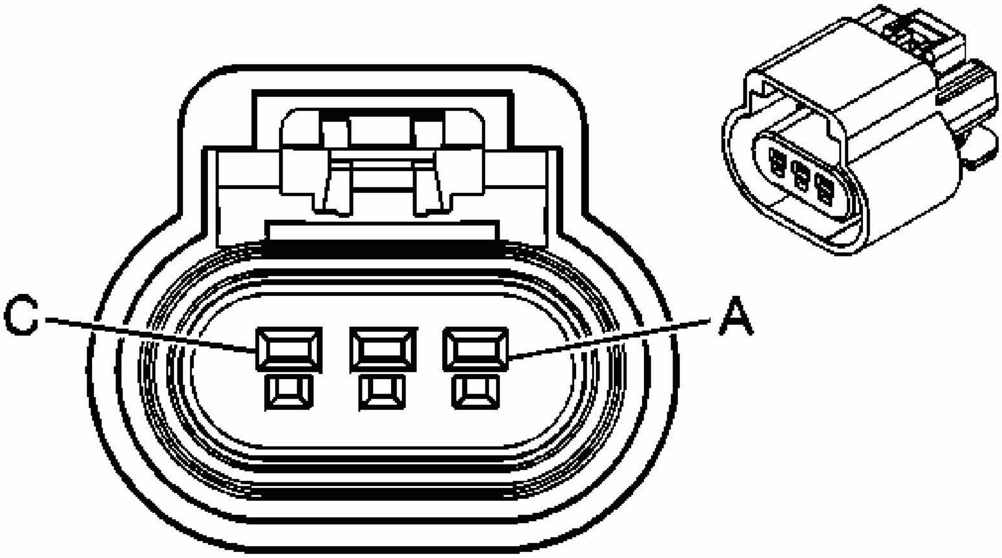


Fig. 8: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Instrument Panel, Gages, and Console Connector End Views

Connector Part Information

- OEM: 15326808
- Service: See Catalog
- Description: 3-Way F GT 150 Sealed (BK)

Terminal Part Information

- Pins: A, C, A, B
- Terminal/Tray: 12048074/2
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Engine Oil Level Switch

Pin	Wire Color	Circuit No.	Function
			Oil Level Switch Signal (LZE, LZ4,

A	BN	1174	LZ9)
	BK/WH	451	Ground (LS4)
B	BK/WH	451	Ground (LZE, LZ4, LZ9)
	-	-	Not Used (LS4)
C	-	-	Not Used (LZE, LZ4, LZ9)
	BN	1174	Oil Level Switch Signal (LS4)

Engine Oil Pressure (EOP) Sensor

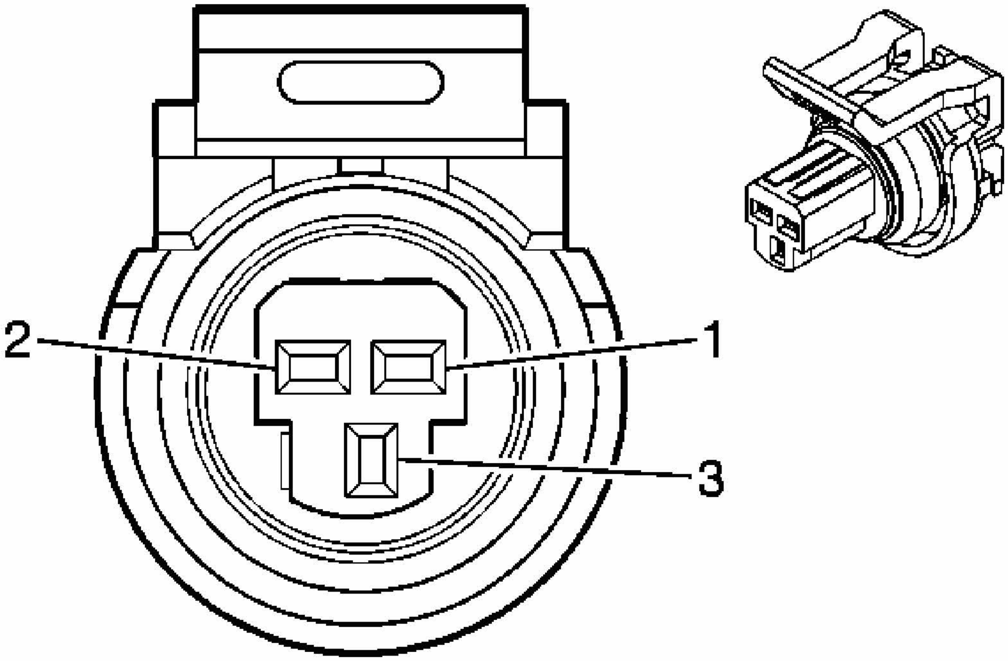


Fig. 9: Connector End View
Courtesy of GENERAL MOTORS CORP.

Instrument Panel, Gages, and Console Connector End Views

Connector Part Information

- OEM: 15477863
- Service: 88988301
- Description: 3-Way F GT 150 Sealed (BK)

Terminal Part Information

- Terminal/Tray: 15326267/19

- Core/Insulation Crimp: E/4
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Engine Oil Pressure (EOP) Sensor

Pin	Wire Color	Circuit No.	Function
1	BK	2755	Low Reference
2	GY	2705	5-Volt Reference
3	TN/WH	331	Oil Pressure Sensor Signal

Instrument Panel Cluster (IPC)

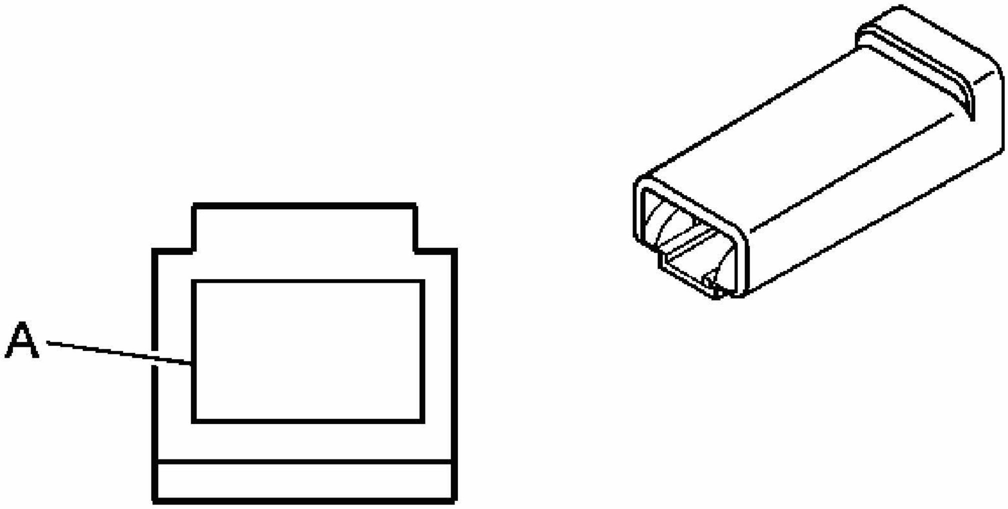


Fig. 10: Connector End View
Courtesy of GENERAL MOTORS CORP.

Instrument Panel, Gages, and Console Connector End Views

Connector Part Information

- OEM: 15489824
- Service: See Catalog
- Description: 20-Way F Receptacle 0.64 (BK)

Terminal Part Information

- Pins: 2, 4, 5, 6, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20
- Terminal/Tray: 7116-4618-02/14

- Core/Insulation Crimp: P/P
- Release Tool/Test Probe: J-38125-215/J-35616-64A (L-BU)

Instrument Panel Cluster (IPC)

Pin	Wire Color	Circuit No.	Function
1	-	-	Not Used
2	D-GN	5060	Low Speed GMLAN Serial Data
3	-	-	Not Used
4	BN/WH	419	MIL Control
5	BK/WH	1551	Ground
6	BK	1450	Ground
7	-	-	Not Used
8	GY	8	Instrument Panel Lamp Supply Voltage
9	-	-	Not Used
10	RD/WH	1840	Battery Positive Voltage
11	PU	5234	TBD
12	D-BU	2307	Passenger Air Bag On Indicator Control
13	D-GN	2308	Passenger Air Bag Off Indicator Control
14	TN	185	Low Washer Fluid Indicator Control
15	TN/WH	33	Brake Warning Indicator Control
16	PK	893	DIC Select Menu Switch Signal
17	D-GN/WH	1358	DIC Switch Signal
18	BN	897	DIC Switch Low Reference
19	-	-	Not Used
20	PK	1139	Ignition 1 Voltage

Instrument Panel Cluster (IPC) (9C1/9C3)

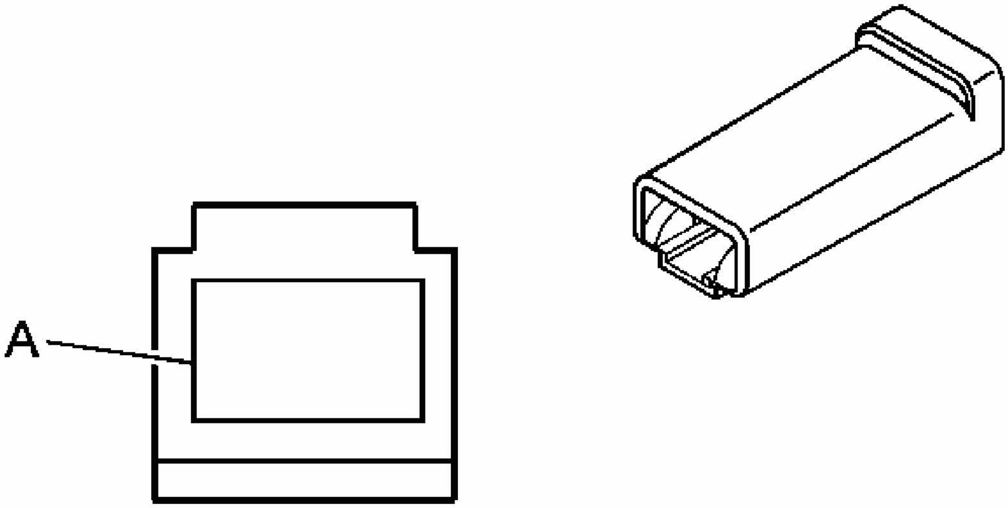


Fig. 11: Connector End View
Courtesy of GENERAL MOTORS CORP.

Instrument Panel, Gages, and Console Connector End Views

Connector Part Information

- OEM: 15489824
- Service: See Catalog
- Description: 20-Way F Receptacle 0.64 (BK)

Terminal Part Information

- Pins: 2, 4, 5, 6, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20
- Terminal/Tray: 7116-4618-02/14
- Core/Insulation Crimp: P/P
- Release Tool/Test Probe: J-38125-215/J-35616-64A (L-BU)

Instrument Panel Cluster (IPC) (9C1/9C3)

Pin	Wire Color	Circuit No.	Function
1	-	-	Not Used
2	D-GN	5060	Low Speed GMLAN Serial Data
3	-	-	Not Used
4	BN/WH	419	MIL Control
5	BK/WH	1551	Ground

6	BK	1450	Ground
7	-	-	Not Used
8	GY	8	Instrument Panel Lamp Supply Voltage
9	-	-	Not Used
10	RD/WH	1840	Battery Positive Voltage
11	PU	5234	TBD
12	D-BU	2307	Passenger Air Bag On Indicator Control
13	D-GN	2308	Passenger Air Bag Off Indicator Control
14	TN	185	Low Washer Fluid Indicator Control
15	TN/WH	33	Brake Warning Indicator Control
16	PK	893	DIC Select Menu Switch Signal
17	D-GN/WH	1358	DIC Switch Signal
18	BN	897	DIC Switch Low Reference
19	-	-	Not Used
20	PK	1139	Ignition 1 Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B0158	Outside Air Temperature (OAT) Sensor Open
DTC B3567	Driver Information Center Select Switch Circuit
DTC P0461	Fuel Level Sensor Circuit Performance
DTC P0462	Fuel Level Sensor Circuit Low Voltage
DTC P0463	Fuel Level Sensor Circuit High Voltage
DTC P0464	Fuel Level Sensor Circuit Intermittent
DTC P0521	Engine Oil Pressure (EOP) Sensor Performance
DTC P0522	Engine Oil Pressure (EOP) Sensor Circuit Low Voltage
DTC P0523	Engine Oil Pressure (EOP) Sensor Circuit High Voltage
DTC P0608	Vehicle Speed Output Circuit
DTC P0654	Engine Speed Output Circuit

DIAGNOSTIC STARTING POINT - INSTRUMENT PANEL, GAGES AND CONSOLE

Begin the instrument panel (I/P) system diagnosis with the appropriate Diagnostic System Check - Vehicle. Refer to **Diagnostic System Check - Vehicle** in Vehicle DTC Information.

The Diagnostic System Check - Vehicle will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored DTCs and their status

The use of the Diagnostic System Check - Vehicle will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL OUTPUT CONTROLS

Instrument Panel Cluster (IPC)

Scan Tool Output Control	Additional Menu Selections	Description
IPC Gauge Sweep Test	Special Functions	The instrument panel cluster (IPC) drives all of the gages at or below minimum for a few seconds when you select ON, then drives all of the gages at or above maximum for a few seconds. The IPC Display Test will end after one cycle of the gages sweep.
Displays Test	Special Functions	The IPC illuminates all of the indicators for 7 seconds when you select ON. The IPC turns off the indicators after the 7 seconds.
Dimming	Special Functions	The IPC increases or decreases the dimming intensity in increments of 20 percent between a range of 0-100 percent.

Engine Control Module (ECM)/Powertrain Control Module (PCM)

Scan Tool Output Control	Additional Menu Selections	Description
Special Functions	Malfunction Indicator Lamp (MIL)	The engine control module (ECM)/Powertrain Control Module (PCM) commands the MIL indicator ON and OFF.

SCAN TOOL DATA LIST

The scan tool data lists contain all the instrument panel, gages, and console related parameters that are available on the scan tool. The parameters in the list are arranged in alphabetical order. The data list column indicates the location of the parameter within the scan tool menu selections.

Use the scan tool data lists as directed by a diagnostic table or in order to supplement the diagnostic procedures. Begin all of the diagnostic procedures with the **Diagnostic System**

Check - Vehicle .

Use the scan tool data lists only after the following is determined:

- There is no published DTC procedure nor published symptom procedure for the customer concern.
- The DTC or symptom procedure indicated by the diagnostic system check does not resolve the customer concern.

The typical data values are obtained from a properly operating vehicle under the conditions specified in the first row of the scan tool data list table. Comparison of the parameter values from the suspect vehicle with the typical data values may reveal the source of the customer concern.

Body Control Module (BCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON/Engine OFF/Seat Belt Buckled/High Beams OFF/Park Brake Unapplied			
Cruise Control Switch	Cruise Control Data	Cancel/Off/On/Resume/Set/Error	Off
Driver Door Ajar Switch	Doors Data	Door Closed/Door Ajar	Door Closed
Key In Ignition Cylinder Status	Power Mode Data	Key Out/Key In	Key Out
Park Lamp Switch	Exterior Lighting Data	Active/Inactive	Inactive

Instrument Panel Cluster (IPC)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON/Engine OFF/Seat Belt Buckled/High Beams OFF/Park Brake Unapplied			
Battery Voltage	IPC	Volts	Varies
Brake Fluid	IPC	Ok/Low	Ok
Brake Fluid Switch	IPC	Volts	Off
DIC Fuel Info.	IPC	Active/Inactive	Inactive
DIC Information Switch	IPC	Active/Inactive	Inactive
DIC Personalization	IPC	Active/Inactive	Inactive
Heated Washer Fluid Indicator Signal	IPC	Active/Inactive	Inactive
Ignition 1 Input	IPC	Active/Inactive	Active

Ignition Cycle Counter	IPC	Counts	Varies
LCD Dimming	IPC	Percent (%)	Varies
Passenger Seatbelt Indicator Command	IPC	Off/On	Off
Passenger Seatbelt Indicator Status	IPC	Off/On	Off
Trip Reset Switch	IPC	Active/Inactive	Inactive
Washer Fluid Level	IPC	Ok/Low	Ok

Powertrain Control Module (PCM)/Engine Control Module (ECM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Engine Idling/Normal Operating Temperature			
Cruise Control Active	ECM IPC Data	Inactive/Active/Invalid	Inactive
Change Engine Oil Indicator Command	ECM IPC Data	Off/On	Off
ECT Sensor	PCM/ECM IPC Data	Celsius (Fahrenheit)	85-105°C (185-220°F)
Engine Oil Level Switch	ECM IPC Data	Ok/Off	Off
Engine Oil Life Remaining	ECM IPC Data	%	0-100% Varies
Engine Oil Pressure Sensor	ECM IPC Data	kPa (psi)	Varies w/oil pressure
Engine Oil Pressure Sensor	ECM IPC Data	0-5 Volts	Varies w/oil pressure
Engine Oil Temperature Calculated	ECM IPC Data	Celsius (Fahrenheit)	Varies w/oil temperature
Engine Speed	ECM IPC Data	RPM	+/-100 RPM from Desired Idle Speed
Fuel Level Sensor	ECM IPC Data	Volts	Varies
Fuel Tank Level Remaining	ECM IPC Data	%	0-100% Varies
Ignition 1 Signal	ECM IPC Data	Volts	Varies
Ignition Accessory Signal	ECM IPC Data	Off/On	Off
Low EOP Indicator Command	IPC Data	Off/On	Off
Low Engine Oil Level Indicator Command	ECM IPC Data	Off/On	Off
		Incomplete/Short	

MIL Circuit Status	ECM IPC Data	GND/Open/Short B+/Ok	Ok
MIL Command	ECM IPC Data	Off/On	Off
Vehicle Speed Sensor	ECM IPC Data	kph (mph)	0 kph (0 mph)

SCAN TOOL DATA DEFINITIONS

Battery Voltage

The scan tool displays the system voltage of the vehicle.

Brake Fluid

The scan tool displays Ok/Low. This is the state of the vehicle brake fluid as monitored by the IPC.

Brake Fluid Switch

The scan tool displays volts. This is the state of the brake fluid switch as monitored by the IPC.

Cruise Control Active

The scan tool displays Active/Inactive/Invalid. This is the status of the cruise control monitored by the by the engine control module (ECM).

Cruise Control Switch

The scan tool displays Cancel/Off/On/Resume/Set/Error. This is the state of the cruise control switch as monitored by the body control module (BCM).

Change Engine Oil Indicator Command

The scan tool displays Off or On. This is the state of the change engine oil indicator as commanded by the ECM.

DIC Fuel Info

The scan tool displays Active/Inactive. This is the status of the driver information center (DIC) fuel information switch as monitored by the IPC.

DIC Information Switch

The scan tool displays Active/Inactive. This is the status of the driver information center (DIC) information switch as monitored by the IPC.

DIC Personalization

The scan tool displays Active/Inactive. This is the status of the driver information center (DIC) personalization functions as monitored by the IPC.

Driver Door Ajar Switch

The scan tool displays Door Closed or Door Ajar. This is the status of the drivers door switch as commanded by the body control module (BCM).

ECT Sensor

The scan tool displays -40 to +151°C (-40 to +304°F). The ECM monitors the voltage at the signal circuit of the engine coolant temperature sensor. The voltage is inversely proportional to the engine coolant temperature.

Engine Oil Level Switch

The scan tool displays Ok or Low. This is the status of the engine oil level switch as monitored by the ECM.

Engine Oil Life Remaining

The scan tool displays 0-100%. The ECM calculates the amount of engine oil life remaining.

Engine Oil Pressure Sensor

The scan tool displays kPa (psi). This is the state of the engine oil pressure sensor as monitored by the ECM.

Engine Oil Pressure Sensor

The scan tool displays 0-5 volts. This is the state of the engine oil pressure sensor as monitored by the ECM.

Engine Oil Temperature Calculated

The scan tool displays Celsius/Fahrenheit. This is the temperature of the engine oil as calculated by the ECM.

Engine Speed

The scan tool displays 0-9999 RPM. Engine speed is computed by the ECM. It should remain close to desired idle under various engine loads with the engine idling.

Fuel Level Sensor

The scan tool displays 0-5 volts. The ECM monitors the signal circuit of the fuel level sensor and the scan tool displays the fuel level sensor voltage.

Fuel Tank Level Remaining

The scan tool displays 0-100%. The ECM calculates the amount of fuel remaining based on the signal circuit voltage of the fuel level sensor.

Heated Washer Fluid Indicator Signal

The scan tool displays Active/Inactive. This is the status of the heated washer fluid indicator signal as monitored by the IPC.

Ignition 1 Input

The scan tool displays Active/Inactive. This is the state of the ignition 1 input to the IPC.

Ignition 1 Signal

The scan tool displays the system voltage of the vehicle.

Ignition Accessory Signal

The scan tool displays On or Off. The scan tool displays On when there is voltage present at the ignition accessory signal circuit.

Key In Ignition Cylinder Status

The scan tool displays Yes or No. This is the status of the key in ignition switch as monitored by the BCM

Low EOP Indicator Command

The scan tool displays On or Off. This is the state of the low EOP indicator as monitored by the ECM.

LCD Dimming

The scan tool displays percent (%). This is the percentage of the LCD dimming as monitored by the IPC.

Low Engine Oil Level Indicator Command

The scan tool displays On or Off. This is the state of the low engine oil level indicator as monitored by the ECM.

MIL Circuit Status

The scan tool displays Incomplete/Short to GND/Open/Short to B+/Ok. This is the status of the MIL circuit as monitored by the ECM.

MIL Command

The scan tool displays On or Off. This is the status of the MIL indicator as commanded by the ECM.

MIL Command

The scan tool displays k/mh or MPH. This is the vehicle non-driven-wheel speed as calculated by the ECM.

Odometer

The scan tool displays k/mh or MPH. This is the accumulated vehicle odometer as calculated by the ECM.

Passenger Seatbelt Indicator Command

The scan tool displays On or Off. This is the state of the seatbelt indicator command as monitored by the IPC.

Passenger Seatbelt Indicator Status

The scan tool displays On or Off. This is the status of the seatbelt indicator status as monitored by the IPC.

Park Lamp Switch

The scan tool displays On or Off. This is the status of the park lamp switch as commanded by the BCM.

Key In Ignition Cylinder Switch

The scan tool displays Active/Inactive. The IPC monitors the signal circuit of the trip reset switch and the switch state is displayed by the scan tool.

Vehicle Speed Sensor

The scan tool displays 0-255 km/h (0-155 mph). The ECM monitors the signal circuit of the vehicle speed sensor and the vehicle speed is displayed by the scan tool.

Washer Fluid Level

The scan tool displays Ok or Low. This is the status of the washer fluid level as monitored by the IPC.

DTC B0158

DTC Descriptor

DTC B0158 04

Outside Air Temperature (OAT) Sensor Open

DTC B0158 05

Outside Air Temperature (OAT) Sensor Short to Battery or Open

DTC B0158 06

Outside Air Temperature (OAT) Sensor Short to Ground or Open

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC B0158

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Outside Air Temperature (OAT) Signal Circuit	B0158 1	B0158 1	B0158 1
Outside Air Temperature (OAT) Ground Reference Circuit	1	B0158 1	1
1. Outside Air Temperature (OAT) Display Inaccurate or Inoperative			

Circuit/System Description

The HVAC module monitors the signal circuit of the outside air temperature sensor. The outside air temperature (OAT) sensor is a thermistor which varies in resistance as the temperature changes. When the resistance of OAT sensor increases, the outside air temperature is cold. When the resistance of the OAT sensor decreases, the outside air temperature is high. The HVAC module interfaces with the ambient air temperature via two discreet circuits. The HVAC module applies 5 volts to an internal input resistor that is connected to the signal circuit of the outside air temperature sensor. The HVAC module provides ground through the low reference circuit. The HVAC module uses the outside air temperature resistance and voltage for automatic control calculations and conversion to temperature values. The HVAC module sends the temperature value to the instrument panel cluster (IPC) via GMLAN serial data circuits for display in the driver information center (DIC). If the OAT sensor is opened or shorted, the temperature display is either a cold or hot extreme. An open OAT sensor will display -40°F (-40°C) in the DIC and an OAT sensor shorted to battery displays +189.5°F (+87.5°C).

Conditions for Running the DTC

The ignition is in ACCESSORY or RUN

- The ignition is ON.
- The system voltage is between 9-16 volts.

Conditions for Setting the DTC

- The HVAC module detects that the outside air temperature is -40°F (-40°C).
- The HVAC module detects that the outside air temperature is +189.5°F (+87.5°C).

Action Taken When the DTC Sets

- "SC" is displayed in the DIC when the OAT sensor resistance value is less than the lowest OAT sensor resistance threshold.
- "OC" is displayed in the DIC when the OAT sensor resistance value is greater than the highest OAT sensor resistance threshold.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.
- The HVAC module receives a clear code command from the scan tool.

Reference Information

Schematic Reference

- **HVAC Schematics**
- **Instrument Cluster Schematics**

Connector End View Reference

- **HVAC Connector End Views**

- **Instrument Panel, Gages, and Console Connector End Views**
- **INLINE HARNESS CONNECTOR END VIEWS**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data List**

Circuit/System Verification

The DIC should display "SC" or "OC".

Circuit/System Testing

1. With the ignition OFF disconnect the OAT sensor.
2. Turn ON the ignition with the engine OFF.
    - If the DIC does not display "OC", test the OAT sensor signal circuit for a short to ground, an open or high resistance.
    - If the OAT sensor signal circuit tests normal, replace the HVAC module.
3. With the ignition OFF, connect a 3-amp fused jumper wire between the signal circuit of the OAT sensor and a good ground.
4. Turn ON the ignition.
    - If the DIC displays "SC", test the OAT sensor ground circuit for an open or a high resistance.
    - If the OAT sensor ground circuit tests normal, replace the OAT sensor.
    - If the DIC does not displays "SC", test the OAT sensor signal circuit for an open, a short to voltage or a high resistance.
    - If the OAT sensor signal circuit tests normal, replace the HVAC module.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Ambient Air Temperature Gage Sensor Replacement**

- **Control Module References** for the HVAC module replacement, setup and programming

DTC B3567

DTC Descriptor

DTC B3567 01

Driver Information Center Select Switch Circuit

DTC B3567 07

Driver Information Center Select Switch Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC B3567

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
DIC Switch Signal Circuit	1	1	P3567	P3567
DIC Switch Ground Reference Circuit	-	1	-	-
1. Driver Information Center (DIC) Switch(es) Inoperative				

Circuit/System Description

The driver information center (DIC) switch is a multiplexed switch that functions as a DIC/Dimmer switch. Battery power is provided to the DIC switch via the instrument panel cluster (IPC) with the DIC switch signal circuit pulled up to battery voltage in the IPC. The IPC also provides the DIC switch with a ground reference. The switch input to the cluster is pulled low or grounded when a switch is activated. The DIC switch is a momentary contact switch that connects a series of resistors in a resistor ladder format. The IPC monitors the DIC switch signal circuit to determine the DIC switch inputs. Each switch state - RESET, MENU, MAINT- corresponds to a certain resistance value. The IPC determines the switch state by the voltage drop across the resistors. A stuck switch or a short to battery sets a DTC.

Conditions for Running the DTC

The ignition is in ACCESSORY or RUN.

Conditions for Setting the DTC

- The IPC detects that the DIC switch is stuck.
- The IPC detects that the DIC switch signal circuit is shorted to battery.

Action Taken When the DTC Sets

The IPC ignores the DIC switch inputs.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.
- The PCM/ECM receives a clear code command from the scan tool.

Diagnostic Aids

- When the DIC switches are stuck, only the Trip A/B switch functions correctly. When the Trip A/B switch is stuck, all other DIC switches function correctly.
- Only the DIC signal circuit can be diagnosed as shorted to battery.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**
- **INLINE HARNESS CONNECTOR END VIEWS**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. With the ignition ON, install a scan tool.

2. Activate and release the DIC switches.
3. With the scan tool observe the DIC information switch parameter in the IPC scan tool Data List.
    - If the scan tool displays Active and Inactive simultaneously, check for a poor connection at the harness connector of the DIC switch.
4. With the ignition OFF, disconnect the DIC/Dimmer Switch.
5. Connect a test lamp between the DIC switch signal and a good ground.
    - If the test lamp illuminates, check the DIC switch signal circuits for a short to battery.

- If the circuit tests normal, replace the IPC.

- If the DIC switch signal circuits tests normal, replace the DIC switch.

- If the test lamp does not illuminate, replace the IPC.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Control Module References** for the IPC replacement, setup and programming
- **Driver Information Center Switch Replacement (Impala)** or **Driver Information Center Switch Replacement (Monte Carlo)**

DTC P0461

DTC Descriptor

DTC P0461

Fuel Level Sensor Circuit Performance

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0461

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Level Sensor Reference Voltage Circuit	P0462	-	-	P0461

Fuel Level Sensor Signal Circuit	P0462	P0463 1	P0463	P0461
Fuel Level Sensor Low Reference Circuit	-	P0463 1	P0463	P0461
1. Fuel Gage Inaccurate or Inoperative				

Circuit/System Description

The fuel level sensor changes resistance in response to the fuel level. The powertrain control module (PCM) or the engine control module (ECM) monitors the signal circuit of the fuel level sensor in order to determine the fuel level. When the fuel tank is full, the sensor resistance is low and the PCM/ECM senses a low signal voltage. When the fuel tank is empty, the sensor resistance is high and the PCM/ECM senses a high signal voltage. The PCM/ECM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The PCM/ECM sends the fuel level percentage via GMLAN serial data circuit to the body control module (BCM). The BCM sends a GMLAN message to the instrument panel cluster (IPC) in order to display the fuel level percent on the fuel gage. The fuel information is also used for misfire and evaporative emission (EVAP) diagnostics.

This diagnostic tests for a stuck fuel level sensor signal. The PCM/ECM sets this DTC if the fuel level sensor signal appears to be stuck based on a lack of signal variation expected during normal operation.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

The PCM/ECM does not detect a change in fuel level of at least 1.6 percent over a distance of 193 km (120 miles).

Action Taken When the DTC Sets

- The fuel gage defaults to empty.
- The low fuel indicator illuminates.
- The PCM/ECM records the operating conditions at the time that the diagnostic test fails. The PCM/ECM displays the failure information in the Failure Records on the scan tool.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.

- The history DTC clears after 40 malfunction-free warm-up cycles.
- The PCM/ECM receives a clear code command from the scan tool.

Reference Information

Fuel Level Specifications

Fuel Level Specifications

Schematic Reference

- **Instrument Cluster Schematics**
- **Engine Controls Schematics** for the 5.3L engine
- **Engine Controls Schematics** for the 3.5L engine
- **Engine Controls Schematics** for the 3.9L engine

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**
- **Engine Control Module (ECM) Connector End Views** for the 5.3L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.5L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.9L engine

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. With the ignition OFF, remove the fuel level sender.
2. Inspect for the following conditions:
    - The fuel level sensor is stuck, perhaps due to an interference with the fuel strainer.
    - The fuel tank contains foreign material for instance, ice.

- If any of the above condition is not present, replace the fuel level sensor.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Fuel Level Sensor Replacement** for the 5.3L engine
- **Fuel Sender Assembly Replacement** for the 3.5L engine
- **Fuel Level Sensor Replacement** for the 3.9L engine
- **Control Module References** for the PCM/ECM replacement, setup, and programming

DTC P0462

DTC Descriptor

DTC P0462

Fuel Level Sensor Circuit Low Voltage

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0462

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Level Sensor Reference Voltage Circuit	P0462	-	-	P0461
Fuel Level Sensor Signal Circuit	P0462	P0463 1	P0463	P0461
Fuel Level Sensor Low Reference Circuit	-	P0463 1	P0463	P0461
1. Fuel Gage Inaccurate or Inoperative				

Circuit/System Description

The fuel level sensor changes resistance in response to the fuel level. The powertrain control module (PCM) or the engine control module (ECM) monitors the signal circuit of the fuel level sensor in order to determine the fuel level. When the fuel tank is full, the sensor resistance is low and the PCM/ECM senses a low signal voltage. When the fuel tank is empty, the sensor resistance is high and the PCM/ECM senses a high signal voltage. The PCM/ECM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The PCM/ECM sends the fuel level percentage via GMLAN serial data circuit to the body control module (BCM). The BCM sends a GMLAN message to the instrument panel cluster (IPC) in order to display the fuel level percent on the fuel gage. The fuel information is also used for misfire and evaporative emission (EVAP) diagnostics.

Conditions for Running the DTC

- The ignition is ON, with the engine running.
- The system voltage is between 9-16 volts.

Conditions for Setting the DTC

- The sender output is less than 0.39 volt.
- The above condition is present for greater than 30 seconds.

Action Taken When the DTC Sets

- The fuel gage defaults to empty.
- The low fuel indicator illuminates.
- The PCM/ECM records the operating conditions at the time that the diagnostic test fails. The PCM/ECM displays the failure information in the Failure Records on the scan tool

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.
- The PCM/ECM receives a clear code command from the scan tool.

Reference Information

Fuel Level Specifications

Fuel Level Specifications

Schematic Reference

- **Instrument Cluster Schematics**
- **Engine Controls Schematics** for the 5.3L engine
- **Engine Controls Schematics** for the 3.5L engine
- **Engine Controls Schematics** for the 3.9L engine

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**

- **Engine Control Module (ECM) Connector End Views** for the 5.3L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.5L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.9L engine

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Verification

With the scan tool installed and the ignition ON, the Fuel Tank Level Remaining parameter in the PCM/ECM EVAP Data List should indicate a value at or greater than 98 percent.

Circuit/System Testing

1. With the ignition OFF, disconnect C413.
2. With the ignition ON, install a scan tool and observe the Fuel Tank Level Remaining parameter in the PCM/ECM EVAP Data List.
    - If the Fuel Tank Level Remaining parameter indicates a value less than 4 percent, check the signal circuit of the fuel level sensor for a short to ground between C413 and the fuel level sensor.

- If the fuel level sensor circuit tests normal between C413 and the fuel level sensor, replace the fuel level sensor.

- If the Fuel Tank Level Remaining parameter indicates a value greater than 4 percent, check the signal circuit of the fuel level sensor circuit for a short to ground between C413 and the PCM/ECM.

- If the fuel level sensor circuit tests normal between C413 and the PCM/ECM replace the PCM/ECM

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Fuel Level Sensor Replacement** for the 5.3L engine
- **Fuel Sender Assembly Replacement** for the 3.5L engine
- **Fuel Level Sensor Replacement** for the 3.9L engine
- **Control Module References** for the PCM/ECM replacement, setup, and programming

DTC P0463

DTC Descriptor

DTC P0463

Fuel Level Sensor Circuit High Voltage

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0463

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Level Sensor Reference Voltage Circuit	P0462	-	-	P0461
Fuel Level Sensor Signal Circuit	P0462	P0463 1	P0463	P0461
Fuel Level Sensor Low Reference Circuit	-	P0463 1	P0463	P0461
1. Fuel Gage Inaccurate or Inoperative				

Circuit/System Description

The fuel level sensor changes resistance in response to the fuel level. The powertrain control module (PCM) or the engine control module (ECM) monitors the signal circuit of the fuel level sensor in order to determine the fuel level. When the fuel tank is full, the sensor resistance is low and the PCM/ECM senses a low signal voltage. When the fuel tank is empty, the sensor resistance is high and the PCM/ECM senses a high signal voltage. The PCM/ECM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The PCM/ECM sends the fuel level percentage via GMLAN serial data circuit to the body control module (BCM). The BCM sends a GMLAN message to the instrument panel cluster (IPC) in order to display the fuel level percent on the fuel gage. The fuel information is also used for misfire and evaporative emission (EVAP) diagnostics.

Conditions for Running the DTC

- The ignition is ON, with the engine running.
- The system voltage is between 9-16 volts.

Conditions for Setting the DTC

- The sensor output is greater than 2.9 volts.
- The above condition is present for greater than 30 seconds.

Action Taken When the DTC Sets

- The fuel gage defaults to empty.
- The low fuel indicator illuminates.
- The PCM/ECM records the operating conditions at the time that the diagnostic test fails. The PCM/ECM displays the failure information in the Failure Records on the scan tool

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.
- The PCM/ECM receives a clear code command from the scan tool.

Reference Information

Fuel Level Specifications

Fuel Level Specifications

Schematic Reference

- **Instrument Cluster Schematics**
- **Engine Controls Schematics** for the 5.3L engine
- **Engine Controls Schematics** for the 3.5L engine
- **Engine Controls Schematics** for the 3.9L engine

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**
- **Engine Control Module (ECM) Connector End Views** for the 5.3L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.5L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.9L engine

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Verification

With the scan tool installed and the ignition ON, the Fuel Tank Level Remaining parameter in the PCM/ECM EVAP Data List indicates a value at or greater than 4 percent.

Circuit/System Testing

1. With the ignition OFF, disconnect C413.
2. Connect a 3-ampere fused jumper wire between the signal circuit of the fuel level sensor and the low reference circuit of the fuel level sensor on the male terminal side of the connector.
3. With the ignition ON, install a scan tool and observe the Fuel Tank Level Remaining parameter in the PCM/ECM EVAP Data List.
    - If the Fuel Tank Level Remaining parameter indicates a value less than 98 percent, check the signal circuit and the low reference circuit of the fuel level sensor for an open, a high resistance or a short to voltage.

- If both the signal circuit and the low reference circuit tests normal, replace the PCM/ECM.

- If the Fuel Tank Level Remaining parameter indicates a value greater than 98 percent, check the signal circuit and the low reference circuit of the fuel level sensor for an open, for a high resistance or a short to voltage between C413 and the fuel level sensor.

- If both the signal circuit and the low reference circuit tests normal between C413 and the fuel level sensor, replace the fuel level sensor.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Fuel Level Sensor Replacement** for the 5.3L engine
- **Fuel Sender Assembly Replacement** for the 3.5L engine
- **Fuel Level Sensor Replacement** for the 3.9L engine

- **Control Module References** for the PCM/ECM replacement, setup, and programming

DTC P0464

Circuit Description

The fuel level sensor changes resistance based on the fuel level. The engine control module (ECM) monitors the signal circuit of the fuel level sensor in order to determine fuel level. When the fuel tank is full, the sensor resistance is low and the ECM senses a low signal voltage. When the fuel tank is empty, the sensor resistance is high and the ECM senses a high signal voltage. The ECM uses the signal circuit of the fuel level sensor in order to calculate the total remaining fuel percent in the tank. The ECM sends the fuel level message via the class 2 serial data circuit to the instrument panel cluster (IPC) for the fuel gage display. The fuel level information is also used for misfire and evaporative emission (EVAP) diagnostics.

This diagnostic tests for an intermittent fuel level sensor signal. If a change in fuel level is detected, the engine-off natural vacuum small leak test DTC P0442 is aborted due to a refueling event. Before aborting DTC P0442 a refueling event test is executed to confirm that a refueling event has occurred. If refueling is confirmed, the test is considered a pass. Otherwise, the DTC P0464 sets indicating an intermittent signal problem.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0464 Fuel Level Sensor Circuit Intermittent

Conditions for Running the DTC

- The ignition is OFF.
- DTC P0442 is running.

Conditions for Setting the DTC

- The fuel level change is greater than 10 percent during engine off test.
- The above condition is present for greater than 30 seconds.

Action Taken When the DTC Sets

- DTC P0442 is aborted.
- The ECM records the operating conditions at the time the diagnostic fails. The ECM displays the failure information in the Failure Records on the scan tool.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction free warm-up cycles.
- The ECM receives the clear code command from the scan tool.

Diagnostic Aids

- Use the Freeze Frame and/or Failure Records data in order to locate an intermittent condition. If you cannot duplicate the DTC, the information included in the Freeze Frame and/or Failure Records data may aid in determining the number of miles since the DTC set. The Fail Counter and Pass Counter can also aid in determining the number of ignition cycles that the diagnostic reported a pass and/or fail. Operate the vehicle within the same freeze frame conditions, i.e. RPM, engine load, vehicle speed, temperature, etc. This will isolate when the DTC failed.

  Refer to **Testing for Intermittent Conditions and Poor Connections** .

- If the DTC sets without a refueling event, refer to **Fuel Gage Inaccurate or Inoperative**.

DTC P0521

DTC Descriptor

DTC P0521

Engine Oil Pressure (EOP) Sensor Performance.

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0521

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Engine Oil Pressure 5-Volts Reference Circuit	P0522	P0522	-	P0521
Engine Oil Pressure Sensor Signal Circuit	P0522	P0522	P0523	P0521
Low Reference	-	P0523	-	P0521

Circuit/System Description

The engine oil pressure (EOP) sensor changes voltage based on the engine oil pressure. The

EOP sensor is a 3-wire sensor comprising of the signal circuit, the low reference circuit and the 5-volt reference circuit. The engine control module (ECM) or the powertrain control module (PCM) supplies 5-volts to the EOP sensor via the 5-volt reference circuit and provides ground via the EOP low reference circuit. The ECM/PCM monitors the signal circuit of the EOP sensor to determine if the engine oil pressure sensor voltage is within the normal operating range of approximately 1-4 volts. When the engine oil pressure is high, the EOP sensor voltage is high and the ECM/PCM senses a high signal voltage. When the engine oil pressure is low, the EOP sensor voltage is low and the ECM/PCM senses a low signal voltage. The ECM sends the EOP information to the instrument panel cluster (IPC) via GMLAN serial data message.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

The ECM/PCM does not detect a change in the engine oil pressure of at least 34.5 kPa (5.0 psi) over a predetermined variance of the engine speed.

Action Taken When the DTC Sets

- The ECM/PCM records the operating conditions at the time the diagnostics test fails. The ECM/PCM displays this information in the Failure Records on the scan tool.
- The IPC illuminates the EOP indicator.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.
- The ECM/PCM receives a clear code command from the scan tool.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**
- **Engine Control Module (ECM) Connector End Views** for the 3.5L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.9L engine
- **Engine Control Module (ECM) Connector End Views** for the 5.3L engine

- **INLINE HARNESS CONNECTOR END VIEWS**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Verification

With the scan tool installed, observe the Engine Oil Pressure Sensor parameter in the IPC ECM/PCM Data List. With the engine idling, the EOP sensor parameter should indicate a range of 0.7 volts - 2.5 volts.

Circuit/System Testing

With the engine idling, install a scan tool and observe the Engine Oil Pressure Sensor parameter.

- If the Engine Oil Pressure Sensor parameter is not within the range of 0.7 volts - 2.5 volts, replace the EOP sensor.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Engine Oil Pressure Sensor and/or Switch Replacement** for the 3.5L engine
- **Engine Oil Pressure Sensor and/or Switch Replacement** for the 3.9L engine
- **Engine Oil Pressure Sensor and/or Switch Replacement** for the 5.3L engine

DTC P0522

DTC Descriptor

DTC P0522

Engine Oil Pressure (EOP) Sensor Circuit Low Voltage.

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0522

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Engine Oil Pressure 5-Volts Reference Circuit	P0522	P0522	-	P0521
Engine Oil Pressure Sensor Signal Circuit	P0522	P0522	P0523	P0521
Low Reference	-	P0523	-	P0521

Circuit/System Description

The engine oil pressure (EOP) sensor changes voltage based on the engine oil pressure. The EOP sensor is a 3-wire sensor comprising of the signal circuit, the low reference circuit and the 5-volt reference circuit. The engine control module (ECM) or the powertrain control module (PCM) supplies 5-volts to the EOP sensor via the 5-volt reference circuit and provides ground via the EOP low reference circuit. The ECM/PCM monitors the signal circuit of the EOP sensor to determine the engine oil pressure sensor voltage is within the normal operating range of approximately 1-4 volts. When the engine oil pressure is high, the EOP sensor voltage is high and the ECM/PCM senses a high signal voltage. When the engine oil pressure is low, the EOP sensor voltage is low and the ECM/PCM senses a low signal voltage. The ECM/PCM sends the EOP information to the instrument panel cluster (IPC) via GMLAN serial data message.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The ECM/PCM detects that the EOP sensor signal circuit is less than 0.195 volts.
- The above condition is present for greater than 10 seconds.

Action Taken When the DTC Sets

- The ECM/PCM records the operating conditions at the time the diagnostics test fails. The ECM/PCM displays this information in the Failure Records on the scan tool.
- The IPC illuminates the EOP indicator.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.

- The history DTC clears after 40 malfunction-free warm-up cycles.
- The ECM/PCM receives a clear code command from the scan tool.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**
- **Engine Control Module (ECM) Connector End Views** for the 3.5L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.9L engine
- **Engine Control Module (ECM) Connector End Views** for the 5.3L engine
- **INLINE HARNESS CONNECTOR END VIEWS**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. With the ignition OFF, disconnect the EOP sensor.
2. Connect a 3-amp fused jumper wire between the EOP sensor signal circuit and the EOP 5-volt reference circuit.
3. With the ignition ON, install a scan tool and observe the Engine Oil Pressure Sensor parameter in the IPC ECM/PCM Data List.
   - If the Engine Oil Pressure Sensor parameter is at or above 880 kPa (127.63 psi), repair the EOP sensor harness connector or replace the EOP sensor.
4. Disconnect the fused jumper and measure the voltage between the 5-volt reference circuit and the low reference circuit of the EOP sensor.
   - If the voltage measured is greater than 4.7 volts, check the EOP sensor signal circuit for a short to ground, an open or a high resistance.

- If the voltage measured is less than 4.7 volts, check the EOP 5-volt reference circuit for a short to ground, an open or a high resistance.

- If both circuits tests normal, replace the ECM/PCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Engine Oil Pressure Sensor and/or Switch Replacement** for the 3.5L engine
- **Engine Oil Pressure Sensor and/or Switch Replacement** for the 3.9L engine
- **Engine Oil Pressure Sensor and/or Switch Replacement** for the 5.3L engine
- **Control Module References** for ECM/PCM replacement, setup and programming

DTC P0523

DTC Descriptor

DTC P0523

Engine Oil Pressure (EOP) Sensor Circuit High Voltage.

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0523

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Engine Oil Pressure 5-Volts Reference Circuit	P0522	P0522	-	P0521
Engine Oil Pressure Sensor Signal Circuit	P0522	P0522	P0523	P0521
Low Reference	-	P0523	-	P0521

Circuit/System Description

The engine oil pressure (EOP) sensor changes voltage based on the engine oil pressure. The EOP sensor is a 3-wire sensor comprising of the signal circuit, the low reference circuit and the 5-volt reference circuit. The engine control module (ECM) or the powertrain control module (PCM) supplies 5-volts to the EOP sensor via the 5-volt reference circuit and provides ground via the EOP low reference circuit. The ECM/PCM monitors the signal circuit of the EOP sensor to determine the engine oil pressure sensor voltage is within the normal operating range of approximately 1-4 volts. When the engine oil pressure is high, the EOP sensor voltage is high and the ECM/PCM senses a high signal voltage. When the engine oil pressure is low, the EOP sensor voltage is low and the ECM/PCM senses a low signal voltage. The ECM/PCM sends the EOP information to the instrument panel cluster (IPC) via GMLAN serial data message.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The ECM/PCM detects that the EOP sensor signal circuit is greater than 4.8 volts.
- The above condition is present for greater than 10 seconds.

Action Taken When the DTC Sets

- The ECM/PCM records the operating conditions at the time the diagnostics test fails. The ECM/PCM displays this information in the Failure Records on the scan tool.
- The IPC illuminates the EOP indicator.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.
- The ECM/PCM receives a clear code command from the scan tool.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**
- **Engine Control Module (ECM) Connector End Views** for the 3.5L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.9L engine
- **Engine Control Module (ECM) Connector End Views** for the 5.3L engine
- **INLINE HARNESS CONNECTOR END VIEWS**

Electrical Information Reference

- **Circuit Testing**

- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. With the ignition OFF, disconnect the EOP sensor.
2. With the ignition ON, install a scan tool and observe the Engine Oil Pressure Sensor parameter in the IPC ECM/PCM Data List.
    - If the EOP sensor parameter is at or above 8 kPa (1.16 psi), check the EOP sensor signal circuit for a short to voltage.
3. With the ignition OFF, disconnect the negative battery cable and measure the resistance of the EOP sensor low reference circuit.
    - If the resistance measured is greater than 5 ohms, check the EOP sensor low reference circuit for an open or a high resistance.

- If the resistance measured is less than 5 ohms, replace the EOP sensor.

- If both circuits tests normal, replace the ECM/PCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Engine Oil Pressure Sensor and/or Switch Replacement** for the 3.5L engine
- **Engine Oil Pressure Sensor and/or Switch Replacement** for the 3.9L engine
- **Engine Oil Pressure Sensor and/or Switch Replacement** for the 5.3L engine
- **Control Module References** for ECM/PCM replacement, setup and programming

DTC P0608

DTC Descriptor

DTC P0608

Vehicle Speed Output Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle

DTC P0608

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Vehicle Speed Signal Circuit	P0608	P0608 1	P0608	-

Circuit/System Description

The instrument panel cluster (IPC) displays the vehicle speed based on the information from the engine control module (ECM) or the powertrain control module (PCM). The ECM/PCM converts the data from the vehicle speed sensor to a 4000 pulses/mile signal. The ECM then sends the vehicle speed signal information via the GMLAN serial data circuit to the IPC. The IPC displays the vehicle speed based on the GMLAN serial data message from the ECM.

Conditions for Running the DTC

- The ignition is ON, with the engine running.
- The system voltage is between 9-16 volts.
- The engine speed is more than 400 RPM.

Conditions for Setting the DTC

- The ECM/PCM detects that the commanded state of the driver and the actual state of the signal do not match.
- The above condition is present for greater than 5 seconds.

Action Taken When the DTC Sets

The PCM/ECM records the operating conditions at the time that the diagnostic test fails. The PCM/ECM displays the failure information in the Failure Records on the scan tool.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.
- The PCM/ECM receives a clear code command from the scan tool.

Reference Information

Schematic Reference

- **Instrument Cluster Schematics**
- **Engine Controls Schematics**
- **Engine Controls Schematics**

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**
- **Engine Control Module (ECM) Connector End Views** for the 3.5L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.9L engine
- **Engine Control Module (ECM) Connector End Views** for the 5.3L engine
- **INLINE HARNESS CONNECTOR END VIEWS**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. Install a scan tool.
2. Raise the vehicles drive wheels.
3. Start the engine.
4. Place the transmission into drive.
5. With the scan tool, observe the Vehicle Speed Sensor (VSS) parameter in the ECM Engine Data list.
    - If the vehicle speed sensor parameter matches the speedometer display, check for a poor connection at the harness connector of the ECM/PCM.
6. Turn OFF the ignition.
7. Disconnect the ECM/PCM connector C000.
8. With the ignition ON, measure the voltage from the vehicle speed signal circuit to a good ground.
    - If the voltage measured is more than 9 V, test the vehicle speed signal circuit for a short to battery voltage.

- If the vehicle speed circuit tests normal, replace the ECM/PCM.

- If the voltage measured is less than 9 V, test the vehicle speed signal circuit for an open, a high resistance or for a short to ground.
- If the circuit teats normal, replace the IPC.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification

Control Module References for IPC and ECM/PCM replacement, setup and programming

DTC P0654

DTC Descriptor

DTC P0654

Engine Speed Output Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle

DTC P0654

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Engine Speed Signal Circuit	P0654	P0654	P0654	-

Circuit/System Description

The engine control module (ECM) or the powertrain control module (PCM) creates the engine speed signal by pulsing the engine speed signal circuit to ground. The ECM/PCM monitors the voltage on the engine speed signal circuit. If the ECM/PCM determines that the voltage is not within the normal operating range, the ECM/PCM sets a DTC.

Conditions for Running the DTC

- The ignition is ON, with the engine running.
- The system voltage is between 9-16 volts.
- The engine speed is more than 400 RPM.

Conditions for Setting the DTC

- The ECM/PCM detects that the commanded state of the driver and the actual state of the signal do not match.

- The above condition is present for greater than 5 seconds.

Action Taken When the DTC Sets

The PCM/ECM records the operating conditions at the time that the diagnostic test fails. The PCM/ECM displays the failure information in the Failure Records on the scan tool.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction free warm-up cycles.
- The PCM/ECM receives a clear code command from the scan tool.

Reference Information

Schematic Reference

- **Instrument Cluster Schematics**
- **Engine Controls Schematics**
- **Engine Controls Schematics** for the 3.5L engine
- **Engine Controls Schematics**

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**
- **Engine Control Module (ECM) Connector End Views** for the 3.5L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.9L engine
- **Engine Control Module (ECM) Connector End Views** for the 5.3L engine
- **INLINE HARNESS CONNECTOR END VIEWS**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. Install a scan tool
2. Start the engine
3. With the scan tool, observe the Engine Speed parameter in the ECM/PCM Engine Data list.
    - If the engine speed parameter matches the tachometer display, check for a poor connection at the harness connector of the ECM/PCM.
4. Turn OFF the ignition.
5. Disconnect the ECM/PCM connector C000
6. With the ignition ON, install one lead of the signal generator to the engine speed signal circuit at the ECM/PCM connector and the other lead to a good ground.
7. Set the signal generator to generate a tachometer signal and observe the vehicle tachometer.
    - If the vehicle tachometer indicates an engine RPM, check for a poor connection at the harness connector of the ECM/PCM.

- If the connector is normal, replace the ECM/PCM.

- If the vehicle tachometer does not indicate an engine RPM, test the engine speed signal circuit for a short to voltage, short to ground or an open.

- If the engine speed circuit tests normal, replace the IPC.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification

Control Module References for IPC and ECM/PCM replacement, setup and programming

SYMPTOMS - INSTRUMENT PANEL, GAGES AND CONSOLE

IMPORTANT: The following steps must be completed before using the symptom diagnostic tables.

1. Before using the symptom diagnostic tables, perform the **Diagnostic System Check - Vehicle** in order to determine that there are no DTCs set, and that the control modules can communicate via the serial data link.
2. Review the system operation in order to understand the system functions. Refer to the following description and operations.
    - **Instrument Panel Cluster (IPC) Description and Operation**
    - **Indicator/Warning Message Description and Operation**
    - **Driver Information Center (DIC) Description and Operation**

- **Audible Warnings Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which can affect the operation of the instrument panel cluster or the audible warnings system. Refer to **Checking Aftermarket Accessories**
- Inspect the accessible system components or the visible system components for obvious damage or for obvious conditions which can cause the symptom.
- Inspect for the proper fluid levels.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

Gages and Odometer

- **Instrument Panel Cluster (IPC) Gages Inoperative**
- **Fuel Gage Inaccurate or Inoperative**
- **Tachometer Inaccurate or Inoperative**

Indicators

- **ABS Indicator Always On**
- **ABS Indicator Inoperative**
- **Air Bag Indicator Circuit Malfunction**
- **Brake Warning Indicator Always On**
- **Brake Warning Indicator Inoperative**
- **Charge Indicator Always On**
- **Charge Indicator Inoperative**
- **Engine Coolant Temperature Indicator Always On**
- **Symptoms - Cruise Control**
- **Door Ajar Indicator Malfunction**
- **Engine Oil Pressure Indicator Always On**
- **Low Engine Oil Level Indicator Always On**
- **Malfunction Indicator Lamp (MIL) Inoperative**

- **Malfunction Indicator Lamp (MIL) Always On**
- **Malfunction Indicator Lamp (MIL) Diagnosis**
- **Malfunction Indicator Lamp (MIL) Diagnosis**
- **MPH (Km/h) Indicator Inoperative**
- **Odometer Trip/Reset Switch Inoperative**
- **Outside Air Temperature Display Inaccurate or Inoperative**
- **Seat Belt Indicator Circuit Malfunction - Driver**
- **Seat Belt Indicator Circuit Malfunction - Passenger**
- **Security Indicator LED Inoperative**
- **Traction Off Indicator Always On**
- **Traction Off Indicator Inoperative**
- **Trunk Ajar Indicator Always On**
- **Trunk Ajar Indicator Inoperative**
- **Turn Signal Lamps and/or Indicators Always On or Flashing**
- **Turn Signal Lamps and/or Indicators Inoperative**

Driver Information Center

Driver Information Center (DIC) Switch(es) Inoperative

Audible Warnings

- **Chime Always On**
- **Chime Inoperative**

FUEL GAGE INACCURATE OR INOPERATIVE

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle

Circuit/System Description

The fuel level sensor changes resistance in response to the fuel level. The engine control module (ECM) or the powertrain control module (PCM) monitors the signal circuit of the fuel level sensor in order to determine the fuel level. When the fuel tank is full, the sensor resistance is low and the ECM/PCM senses a low signal voltage. When the fuel tank is empty, the sensor resistance is high and the ECM/PCM senses a high signal voltage. The ECM/PCM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The ECM/PCM sends the fuel information to the instrument panel cluster via the GMLAN serial data circuit in order to control the fuel gage and display the fuel level. Then fuel information is also used for misfire and evaporative emission (EVAP) diagnostics.

Reference Information

Schematic Reference

- **Instrument Cluster Schematics**
- **Engine Controls Schematics**
- **Engine Controls Schematics** for the 3.5L engine
- **Engine Controls Schematics**

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**
- **Engine Control Module (ECM) Connector End Views**
- **Engine Control Module (ECM) Connector End Views** for the 3.5L engine
- **Engine Control Module (ECM) Connector End Views**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. Disconnect C000.
2. Connect a signal generator and instrument panel tester between the signal circuit of the fuel level sender and the low reference circuit of the fuel sender on the male side.
3. With the ignition ON and the engine OFF, vary the resistance on the signal generator from 40-250 ohms.
   - If the fuel gage displays the correct fuel level, check the signal circuit and the low reference circuit of the fuel level sensor for a high resistance between the fuel level sensor and C413.
   - If both the signal circuit and the low reference circuit tests normal, check for a poor connection at the harness connector of the fuel level sensor.
   - If the harness connector is normal, check for a misaligned fuel sender or a

misaligned fuel tank.

4. Install a scan tool.
5. With the ignition ON and the engine OFF, vary the resistance on the signal generator from 40-250 ohms and observe the Fuel Level Remaining parameter in the ECM/PCM EVAP Data list.
    - If the scan tool does not display the correct fuel level percent, replace the instrument panel cluster (IPC).
    - If the scan tool does display the correct fuel level percent, check the signal circuit and the low reference circuit of the fuel level sensor for a high resistance between the ECM/PCM and C413.
    - If both the signal circuit and the low reference circuit tests normal, check for a poor connection at the harness connector of the ECM/PCM.
    - If the harness connector is normal, replace the ECM/PCM.

Component Testing

Measure the resistance of the float arm of the fuel level sender while moving the float arm between 40-250 ohms.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification

- **Fuel Level Sensor Replacement**
- **Fuel Sender Assembly Replacement**
- **Fuel Level Sensor Replacement**
- **Control Module References**

INSTRUMENT PANEL CLUSTER (IPC) GAGES INOPERATIVE

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle

Circuit/System Description

This diagnostic procedure applies to serial data gages located in the instrument panel cluster (IPC) which include the speedometer, tachometer, engine coolant temperature gage and volt gage if equipped.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**
- **INLINE HARNESS CONNECTOR END VIEWS**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Lifting and Jacking the Vehicle**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

IMPORTANT: If the suspect gage is the speedometer, the drive wheels of the vehicle must be raised and the transmission must be placed in drive or first gear.

1. Install a scan tool.
2. Start the vehicle.
3. With the scan tool, perform the Display(s) Test in the IPC Output Controls.
    - If the gage moves from 0 to its maximum value and back to 0 when you perform the displays test, check the for a poor connection at the harness connector of the IPC.
    - If the gage does not perform the displays test by moving from 0 to its maximum value and back to 0, replace the IPC
4. If the suspect gage is the speedometer, the gage display must match the ECM/PCM vehicle speed parameter in the ECM/PCM Engine Data List with the vehicle drive wheel raised and transmission in drive or first gear.
    - If the gage display does not match the ECM/PCM vehicle speed parameter, replace the IPC

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Ambient Air Temperature Gage Sensor Replacement

ODOMETER TRIP/RESET SWITCH INOPERATIVE

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle

Circuit/System Description

The instrument panel cluster (IPC) calculates the mileage based on the vehicle speed signal circuit from the engine control module (ECM). The ECM/powertrain control module (PCM) sends a serial data message to the IPC indicating the value of the odometer. The odometer will display 'error' if an internal memory failure is detected. The odometer displays either miles or kilometers and the desired units can be accessed by pressing the trip/reset switch.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

Instrument Panel, Gages, and Console Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. Turn ON the ignition, with the engine OFF
2. Press the trip reset button
    - If the odometer display does not switch between trip and odometer, replace the

IPC.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification

Control Module References

TACHOMETER INACCURATE OR INOPERATIVE

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The instrument panel cluster (IPC) displays the engine speed based on the engine speed data from the engine control module (ECM) or the powertrain control module (PCM). The ECM/PCM converts the data from the engine speed sensor to a 2 pulses/engine revolution signal. The ECM/PCM sends a GMLAN message to the IPC indicating the engine speed. The IPC displays the engine speed based on the GMLAN serial data message from the ECM/PCM.

Reference Information

Schematic Reference

- **Instrument Cluster Schematics**
- **Engine Controls Schematics** for the 5.3L engine
- **Engine Controls Schematics** for the 3.5L engine
- **Engine Controls Schematics** for the 3.9L engine

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**
- **Engine Control Module (ECM) Connector End Views** for the 5.3L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.5L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.9L engine

Electrical Information Reference

- **Circuit Testing**

- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. With the scan tool, under Special Functions, perform the tachometer gage sweep test.
    - If the tachometer gage does not sweep from its low to high position, replace the instrument panel cluster.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for IPC replacement, setup, and programming

ENGINE OIL PRESSURE INDICATOR ALWAYS ON

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**
- **Engine Control Module (ECM) Connector End Views** for the 3.5L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.9L engine
- **Engine Control Module (ECM) Connector End Views** for the 5.3L engine
- **INLINE HARNESS CONNECTOR END VIEWS**

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. Start the engine.
    - If the engine oil pressure (EOP) indicator illuminates after the displays test, replace the IPC.

- If the EOP indicator does not illuminate after the IPC displays test, check for a poor connection at the harness connector of the IPC.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification

- Engine Oil Pressure Sensor and/or Switch Replacement
- Engine Oil Pressure Sensor and/or Switch Replacement
- Engine Oil Pressure Sensor and/or Switch Replacement
- **Control Module References** for IPC replacement, setup and programming

LOW ENGINE OIL LEVEL INDICATOR ALWAYS ON

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle

Low Engine Oil Level Indicator Always On

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Engine Oil Level Sensor/Switch Signal Circuit	-	1	1	-
Engine Oil Level Low Reference Circuit	-	1	-	-

1. Low Engine Oil Level Indicator Always On

Circuit/System Description

The engine oil level (EOL) sensor/switch is a normally closed switch that opens with a low engine oil level condition. With the ignition switch turned ON and the engine not running, the engine control module (ECM) or the powertrain control module (PCM) detects a low signal voltage at the signal circuit of engine oil level sensor/switch. When the engine is running and the engine oil level is low, the ECM/PCM detects a high signal voltage at the signal circuit of the engine oil level sensor/switch. The ECM/PCM monitors the engine oil level switch signal circuit. When the ECM/PCM detects a high signal voltage on the engine oil level switch signal circuit, the ECM/PCM sends a GMLAN serial data message to the instrument panel cluster (IPC) requesting the low engine oil indicator ON.

Diagnostic Aids

- When the Low Engine Oil Level indicator displays in the IPC or DIC due to a low engine oil level condition, make sure that the ignition is turned OFF before adding or changing the oil in the vehicle. Failure to do so may result in the Low Engine Oil Level indicator or message staying on after the engine attains proper oil level.
- When the Low Engine Oil Level indicator displays in the IPC or DIC and the ignition is not turned OFF before adding or changing the engine oil, the Low Engine Oil Level indicator may stay ON even after the proper oil level is attained. For the Low Engine Oil Level indicator to turn OFF, the engine has to undergo a thermocycle process, refer to **Indicator/Warning Message Description and Operation**
- Before replacing the IPC because of the Low Engine Oil Level indicator staying ON after an oil change or engine oil addition, it is necessary for the engine to undergo a thermocycle process as stated above. The IPC may not be malfunctioning but only needs the Low Engine Oil Level indicator turned off. Refer to **Indicator/Warning Message Description and Operation**

Reference Information

Schematic Reference

- **Instrument Cluster Schematics**
- **Engine Controls Schematics** for the 5.3L engine
- **Engine Controls Schematics** for the 3.5L engine
- **Engine Controls Schematics** for the 3.9L engine

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**
- **Engine Control Module (ECM) Connector End Views** for the 5.3L engine

- **Engine Control Module (ECM) Connector End Views** for the 3.5L engine
- **Engine Control Module (ECM) Connector End Views** for the 3.9L engine

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. With the ignition ON and the scan tool installed, observe the Low Engine Oil Level Indicator display in the IPC and the scan tool Low Engine Oil Level Indicator Command parameter in the ECM/PCM IPC Data List.
    - If the Low Engine Oil Level Indicator does not display in the IPC and the scan tool Low Engine Oil Level Indicator Command parameter displays OFF, check for a poor connection at the harness connector of the engine oil level switch.
2. With the scan tool installed, observe the Engine Oil Level Switch parameter in the ECM/PCM Engine Data List.
    - If the Engine Oil Level Switch parameter displays OK, replace the IPC.
3. With the ignition OFF, disconnect the engine oil level switch.
4. Connect a 3-amp fused jumper wire between the engine oil level switch signal circuit and a good ground.
5. With the ignition ON, and the scan tool installed, observe the Engine Oil Level Switch parameter in the ECM/PCM Engine Data List.
    - If the Engine Oil Level Switch parameter displays OK, check the engine oil level switch ground circuit for an open or a high resistance.

- If the engine oil level switch ground circuit tests normal, replace the engine oil level switch.

- If the Engine Oil Level Switch parameter displays LOW, check the engine oil level signal circuit for an open, a high resistance or a short to voltage.

- If the engine oil level switch signal circuit tests normal, replace the ECM/PCM

Repair Procedures

IMPORTANT: **Always perform the Diagnostic Repair Verification**

- Engine Oil Pressure Sensor and/or Switch Replacement
- Engine Oil Pressure Sensor and/or Switch Replacement
- Engine Oil Pressure Sensor and/or Switch Replacement
- Control Module References

MPH (KM/H) INDICATOR INOPERATIVE

Diagnostic Fault Information

IMPORTANT: **Always perform the Diagnostic System Check - Vehicle**

Circuit/System Description

The English/Metric switch is a momentary switch embedded in the instrument panel cluster (IPC). Pressing and releasing the English/Metric switch changes the status of the IPC mph to km/h. Power and ground is provided to the English/Metric switch from the IPC. The IPC reads the switch input and will activate the English or Metric system when selected.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

Instrument Panel, Gages, and Console Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. Turn ON the ignition, with the engine OFF

2. Press and release the English/Metric switch.
    - If both the mph indicator and the km/h indicator illuminates in the IPC, check for poor connections at the harness connector of the IPC.

- If the IPC does not display the mph and km/h indicator when switch is pressed and released, replace the IPC.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification

Control Module References for IPC replacement, setup and programming

DRIVER INFORMATION CENTER (DIC) SWITCH(ES) INOPERATIVE

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle

Driver Information Center (DIC) Switch(es) Inoperative

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
DIC Switch Signal Circuit	1	1	P3567	P3567
DIC Switch Ground Reference Circuit	-	1	-	-
1. Driver Information Center (DIC) Switch(es) Inoperative				

Circuit/System Description

The driver information center (DIC) switch is a multiplexed switch that functions as a DIC/Dimmer switch. Battery power is provided to the DIC switch via the instrument panel cluster (IPC) with the DIC switch signal circuit pulled up to battery voltage in the IPC. The IPC also provides the DIC switch with a ground reference. The switch input to the cluster is pulled low or grounded when a switch is activated. The DIC switch is a momentary contact switch that connects a series of resistors in a resistor ladder format. The IPC monitors the DIC switch signal circuit to determine the DIC switch inputs. Each switch state - RESET, MENU, MAINT- corresponds to a certain resistance value. The IPC determines the switch state by the voltage drop across the resistors. A stuck switch or a short to battery sets a DTC.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

- Instrument Panel, Gages, and Console Connector End Views
- INLINE HARNESS CONNECTOR END VIEWS

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. With the ignition ON, install a scan tool.
2. Activate and release each of the DIC switches.
3. With the scan tool observe the DIC information switch parameters in the IPC scan tool Data List
    - If the test lamp does not illuminate, check the DIC switch ignition 1 voltage circuit for an open or a high resistance.
4. Connect a test lamp between the DIC switch ignition 1 voltage circuit and the DIC switch ground circuit.
    - If the test lamp does not illuminate, check the DIC switch ground circuit for an open or a high resistance.

- If the test lamp does illuminate, check the DIC switch signal circuits for an open or a high resistance

- If the DIC switch signal circuits tests normal, replace the DIC switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Driver Information Center Switch Replacement (Impala) or **Driver Information Center Switch Replacement (Monte Carlo)**

OUTSIDE AIR TEMPERATURE DISPLAY INACCURATE OR INOPERATIVE

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle

Circuit/System Description

The HVAC module monitors the signal circuit of the outside air temperature sensor. The outside air temperature (OAT) sensor is a thermistor which varies in resistance as the temperature changes. When the resistance of OAT sensor increases, the outside air temperature is cold. When the resistance of the OAT sensor decreases, the outside air temperature is high. The HVAC module interfaces with the ambient air temperature via two discreet circuits. The HVAC module applies 5 volts to an internal input resistor that is connected to the signal circuit of the outside air temperature sensor. The HVAC module provides ground through the low reference circuit. The HVAC module uses the outside air temperature resistance and voltage for automatic control calculations and conversion to temperature values. The HVAC module sends the temperature value to the instrument panel cluster (IPC) via GMLAN serial data circuits for display in the driver information center (DIC). If the OAT sensor is opened or shorted, the temperature display is either a cold or hot extreme. An open OAT sensor will display -40°F (-40°C) in the DIC and an OAT sensor shorted to battery displays +189.5°F (+87.5°C).

Diagnostic Aids

- The following variable represents the latest temperature value to be displayed by the DIC. This variable can be Degrees Fahrenheit or Celsius.

  Range: -40°F to +189.5°F (-40°C to 87.5°F). The default readout is 190°F (87.5°C).

- After the ignition has been shutoff and the engine is not running, the OAT sensor must cool down for a period of time before OAT sensor reading is accurate. This is because the engine produces considerable heat after it has been shutdown. Without air movement across the OAT sensor such as when the vehicle is moving, the OAT sensor provides a false outside temperature reading that can be attributed to engine heat. A falling OAT sensor reading is always accepted and filtered into the display.
- Upon initial vehicle startup, the OAT sensor speed counter estimates the amount of time the vehicle will need to be in motion before the OAT sensor will be reading true outside temperature. As soon as the counter reaches this point it is assumed the driver has been driving the given amount of time for the sensor to cool to ambient. At this point the outside air temperature readings are filtered into the display.

Reference Information

Schematic Reference

- HVAC Schematics
- Instrument Cluster Schematics

Connector End View Reference

- HVAC Connector End Views
- Instrument Panel, Gages, and Console Connector End Views
- INLINE HARNESS CONNECTOR END VIEWS

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data List

Circuit/System Verification

The DIC should display "SC" or "OC".

Circuit/System Testing

1. With the ignition OFF disconnect the OAT sensor.
2. Turn ON the ignition with the engine OFF.
   - If the DIC does not display "OC", test the OAT sensor signal circuit for a short to ground, an open or high resistance.
   - If the OAT sensor signal circuit tests normal, replace the HVAC module.
3. With the ignition OFF, connect a 3-amp fused jumper wire between the signal circuit of the OAT sensor and a good ground.
4. Turn ON the ignition.
   - If the DIC displays "SC", test the OAT sensor ground circuit for an open or a high resistance.
   - If the OAT sensor ground circuit tests normal, replace the OAT sensor.
   - If the DIC does not displays "SC", test the OAT sensor signal circuit for an open, a short to voltage or a high resistance.
   - If the OAT sensor signal circuit tests normal, replace the HVAC module.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Ambient Air Temperature Gage Sensor Replacement**
- **Control Module References**

CHIME ALWAYS ON

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Chime Always On

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Key-in-Ignition Switch Signal Circuit	1	2	2
Key-in-Ignition Switch ground Circuit	-	2	-

1. Chime Always On
2. Chime Inoperative

Circuit/System Description

The body control module (BCM) monitors the key in ignition switch. When the key is in the ignition, the key in ignition switch is closed with the signal circuit low. When the key is not in the ignition, the key in ignition switch is open with the signal circuit high. The key in ignition signal circuit is grounded when you fully insert the ignition key into the ignition switch. This in turn pulls the BCM key-in-ignition input low.

Reference Information

Schematic Reference

- **Instrument Cluster Schematics**
- **Audible Warnings Schematics**
- **Body Control System Schematics**

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**

- **Computer/Integrating Systems Connector End Views**
- **INLINE HARNESS CONNECTOR END VIEWS**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. With the ignition ON, make sure no indicator(s) are illuminated in the instrument panel cluster (IPC) and perform the indicator diagnostic first if any indicator(s) are illuminated before performing the following diagnostics.
2. Turn the ignition OFF
3. Remove the key from the ignition.
4. Turn the headlamp switch OFF and open the driver door.
    - If the chime does not sound, check for poor connections at the harness connector of the BCM.
5. With the ignition ON, install a scan tool and observe the Park Lamp Switch parameter in the BCM Exterior Lights Data List.
    - The scan tool should display Inactive, but if the scan tool displays active refer to **Park, License, and Tail Lamps Always On** .
6. With the ignition ON, install a scan tool and observe the Headlamp Switch parameter in the BCM Exterior Lights Data List.
    - The scan tool should display Inactive, but if the scan tool displays active refer to **Headlamps Always On - Low or High Beam** .
7. With the ignition turned OFF, disconnect the BCM connector C3.
8. With the ignition ON, install a scan tool and observe the Key-in-Ignition cylinder parameter in the BCM Inputs Data List.
    - If the Key-in-Ignition cylinder parameter displays Active, replace the BCM.

- If the Key-in-Ignition cylinder parameter displays Inactive, check the key-in-ignition switch signal circuit for a short to ground.

- If the key-in-ignition switch circuit tests normal, replace the key-in-ignition switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Ignition Switch Replacement**
- **Control Module References** for the BCM replacement, setup and programming

CHIME INOPERATIVE

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Chime Inoperative

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Key-in-Ignition Switch Signal Circuit	1	2	2
Key-in-Ignition Switch ground Circuit	-	2	-
1. Chime Always On 2. Chime Inoperative			

Circuit/System Description

The body control module (BCM) monitors the key in ignition switch. When the key is in the ignition, the key in ignition switch is closed with the signal circuit low. When the key is not in the ignition, the key in ignition switch is open with the signal circuit high. The key in ignition signal circuit is grounded when you fully insert the ignition key into the ignition switch. This in turn pulls the BCM key-in-ignition input low.

Reference Information

Schematic Reference

- **Instrument Cluster Schematics**
- **Audible Warnings Schematics**
- **Body Control System Schematics**

Connector End View Reference

- **Instrument Panel, Gages, and Console Connector End Views**

- **Computer/Integrating Systems Connector End Views**
- **INLINE HARNESS CONNECTOR END VIEWS**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. With the ignition ON, make sure no indicator(s) are illuminated in the instrument panel cluster (IPC) and perform the indicator diagnostic first if any indicator(s) are illuminated before performing the following diagnostics.
2. Open the driver door.
3. With the ignition ON install a scan tool and observe the Driver Door Ajar Switch parameter in the BCM Doors Data List.
   - If the scan tool does not display Door Ajar, refer to **Symptoms - Doors** .
4. Turn the parklamp switch ON and observe the Parklamp Switch parameter in the BCM Exterior Lights Data List.
   - If the scan tool displays OFF, refer to **Park, License, and Tail Lamps Inoperative** .
5. Turn ON the radio and adjust the radio balance and fade to the left front speaker.
   - If the radio speakers are not operating properly, refer to **Speakers Inoperative - One or More** .
6. Turn the ignition OFF, with the key still in the ignition key cylinder.
7. Open the driver door.
8. Turn on the parklamp and the headlamp.
   - If the chime does not sound, check the key-in-ignition signal circuit for an open, a high resistance or a short to voltage.

- If the key-in-ignition signal circuit test normal, check the key-in-ignition ground circuit for an open or a high resistance.

- If the key-in-ignition ground circuit tests normal, replace the key-in-ignition switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Ignition Switch Replacement**
- **Control Module References** for the radio replacement, setup, and programming

REPAIR INSTRUCTIONS

AMBIENT AIR TEMPERATURE GAGE SENSOR REPLACEMENT

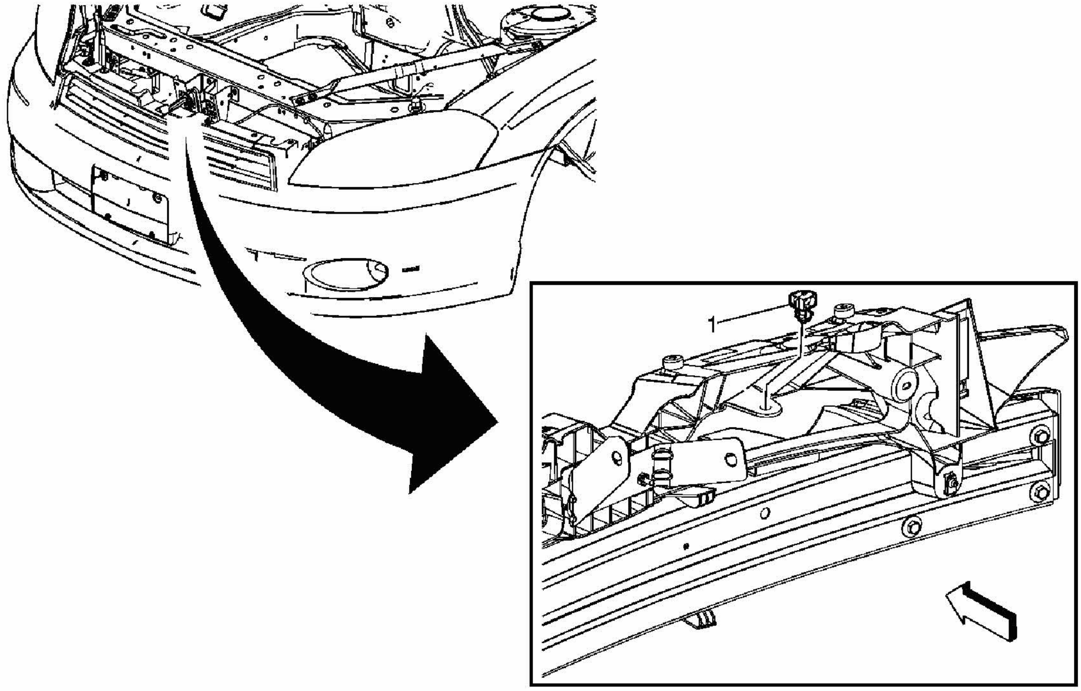


Fig. 12: Replacing Ambient Air Temperature Gage Sensor
Courtesy of GENERAL MOTORS CORP.

Ambient Air Temperature Gage Sensor Replacement

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the Upper Radiator Air Baffle. Refer to **Radiator Air Baffle and Deflector Replacement - Upper** .	
1	Sensor Assembly, Ambient Air Temperature

ELECTRONIC COMPASS CALIBRATION

Compass Calibration

Before calibrating the compass, drive the vehicle to an area that is magnetically clean (free of large metallic objects).

1. Turn ON the ignition.
2. Press the MODE button in order to advance to the COMPASS CALIBRATION mode.
3. Press the SELECT button in order to display PRESS RESET TO RECALIBRATE.
4. Press the RESET button.
5. Drive the vehicle in circles at a speed of less than mph 16 km/h (10 mph) until the driver information center (DIC) displays CALIBRATION COMPLETE and the compass displays the proper vehicle heading. The calibration procedure is now complete.

Compass Magnetic Variation Adjustment

Magnetic variation adjustments are required when the compass displays a constant error in heading. Variation is the difference between magnetic north and true north due to geographical location.

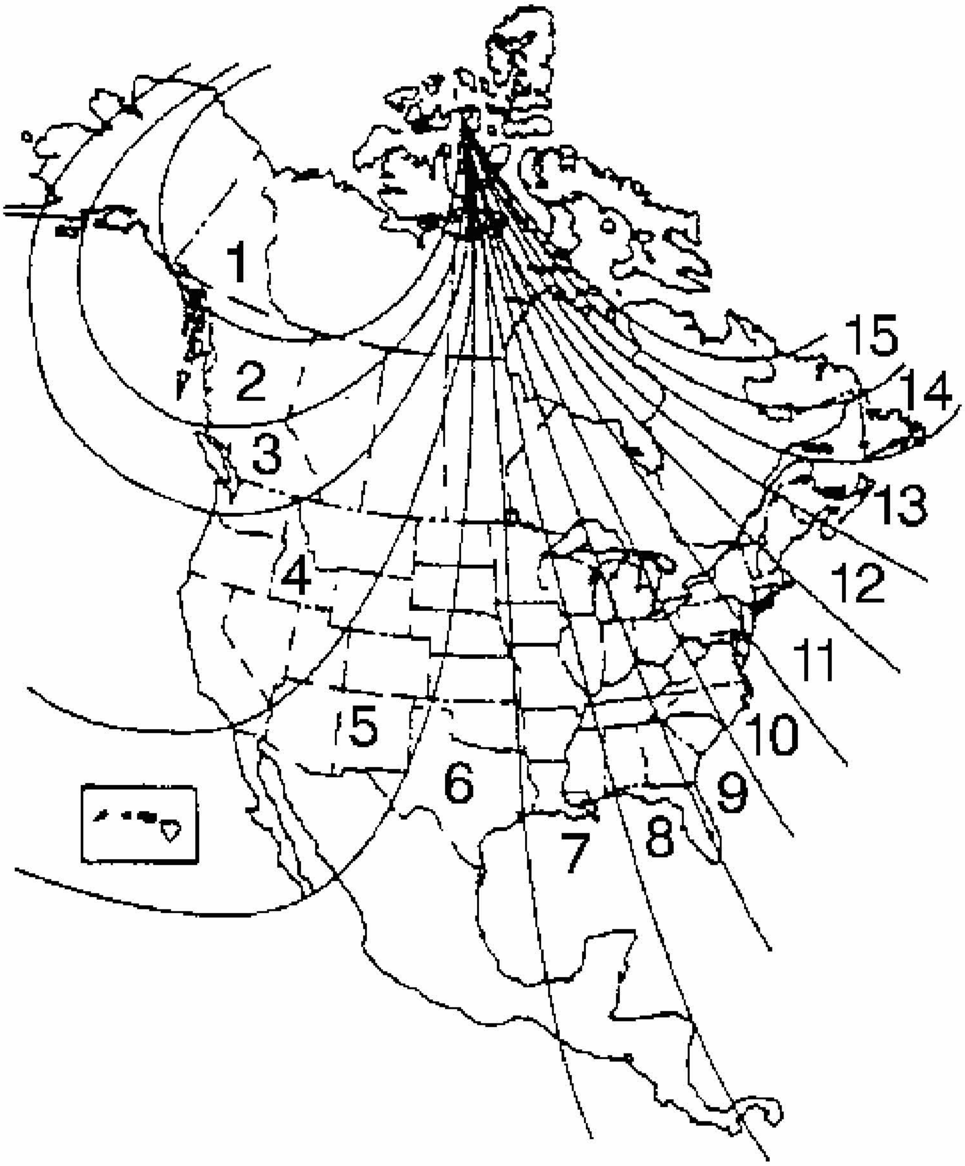


Fig. 13: Illustrating Magnetic Variation Zones
Courtesy of GENERAL MOTORS CORP.

1. Locate your geographic location. Refer to the variation zone map.
2. Turn ON the ignition, with the engine OFF.
3. Press the MODE button in order to advance to the COMPASS CALIBRATION mode.
4. Press the SELECT button in order to display RESET CHANGES ZONE.
5. Press the RESET button in order to advance to the proper zone number.

6. Press the MODE button in order to enter and set the zone number.

RIGHT CLOSEOUT/INSULATOR PANEL REPLACEMENT

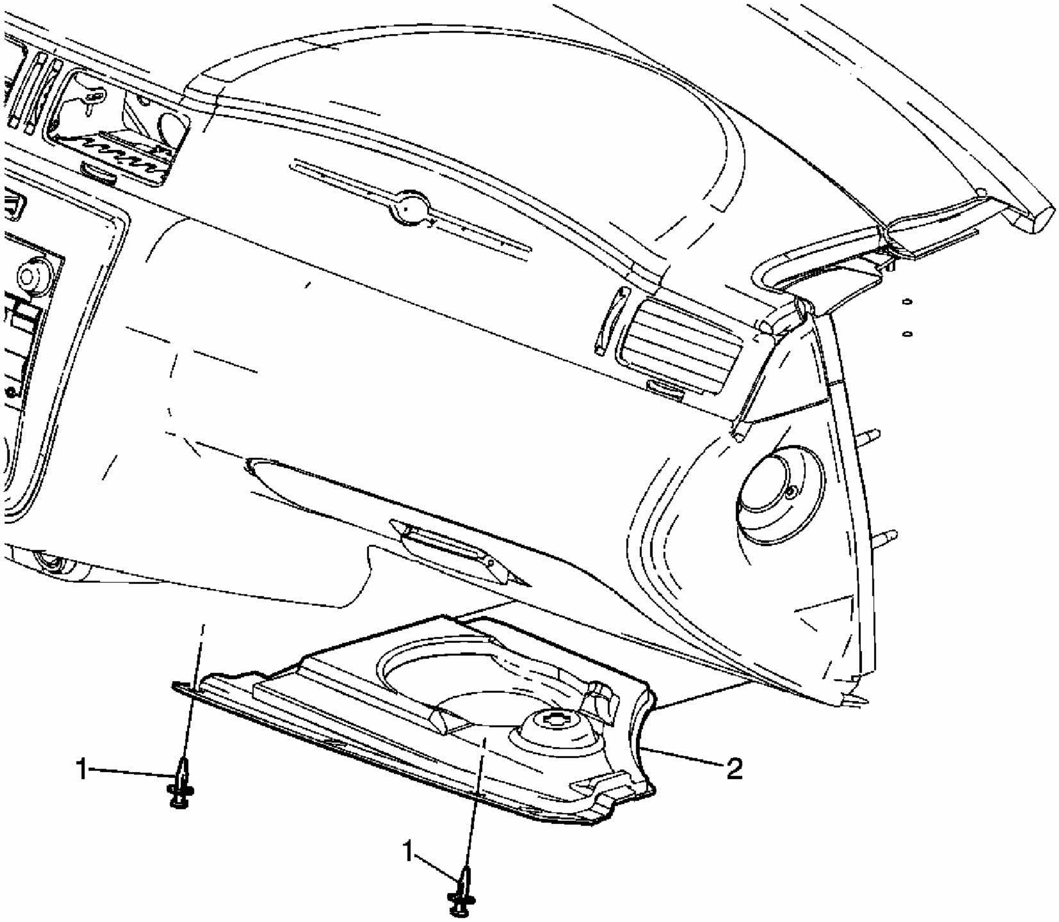


Fig. 14: Replacing Right Closeout/Insulator Panel
Courtesy of GENERAL MOTORS CORP.

Closeout/Insulator Panel Replacement - Right

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Retainer, Push Pin (Qty: 2)
2	Closeout/Insulator Panel, Instrument Panel **Tip:** 1. Impala shown Monte Carlo similar. 2. Remove the courtesy lamp, if equipped.

LEFT CLOSEOUT/INSULATOR PANEL REPLACEMENT

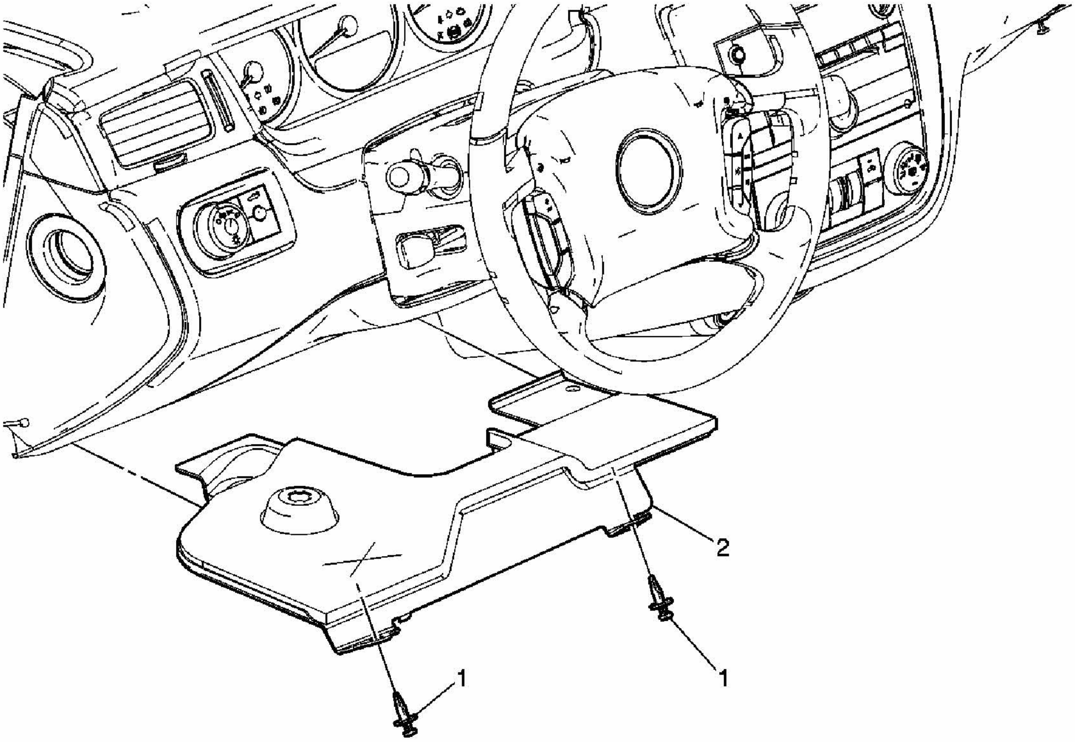


Fig. 15: Replacing Left Closeout/Insulator Panel
Courtesy of GENERAL MOTORS CORP.

Closeout/Insulator Panel Replacement - Left

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Push Pin Retainer (Qty: 2)
2	Instrument Panel Closeout/Insulator Panel **Tip:** 1. Impala shown Monte Carlo similar. 2. Remove the courtesy lamp, if equipped.

INSTRUMENT PANEL (I/P) LOWER CENTER TRIM REPLACEMENT

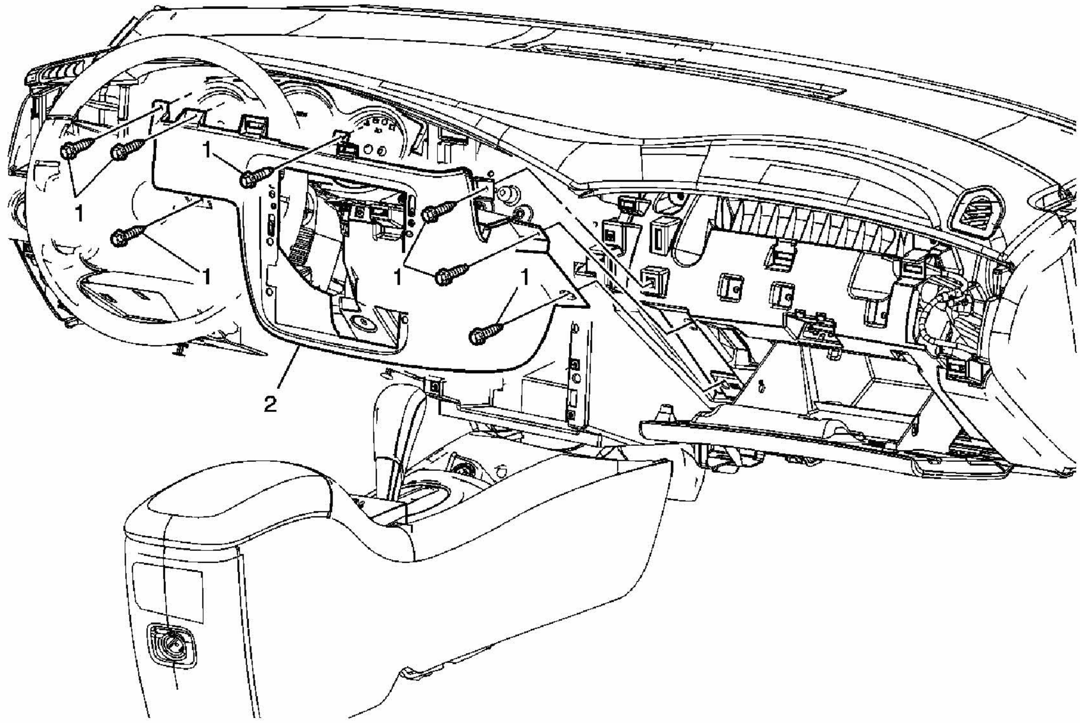


Fig. 16: Replacing Instrument Panel (I/P) Lower Center Trim
Courtesy of GENERAL MOTORS CORP.

Trim Replacement - Instrument Panel (I/P) Lower Center

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the Instrument Panel Cluster Trim Panel. Refer to **Trim Panel Replacement - Instrument Panel (I/P) Cluster (Monte Carlo)**. 2. Remove the Instrument Panel Trim Plate. Refer to **Trim Plate Replacement - Instrument Panel (I/P) (Impala)** or **Trim Plate Replacement - Instrument Panel (I/P) (Monte Carlo)**. 3. Remove the Radio. Refer to **Radio Replacement** . 4. Remove the HVAC Control Module. Refer to **HVAC Control Assembly Replacement** .	
1	Instrument Panel Center Lower Trim Panel Screws (Qty 7)

	Tighten: 2 N.m (18 lb in)
2	Instrument Panel Center Lower Trim Panel

INSTRUMENT PANEL (I/P) EXTENSION TRIM PLATE REPLACEMENT (IMPALA)

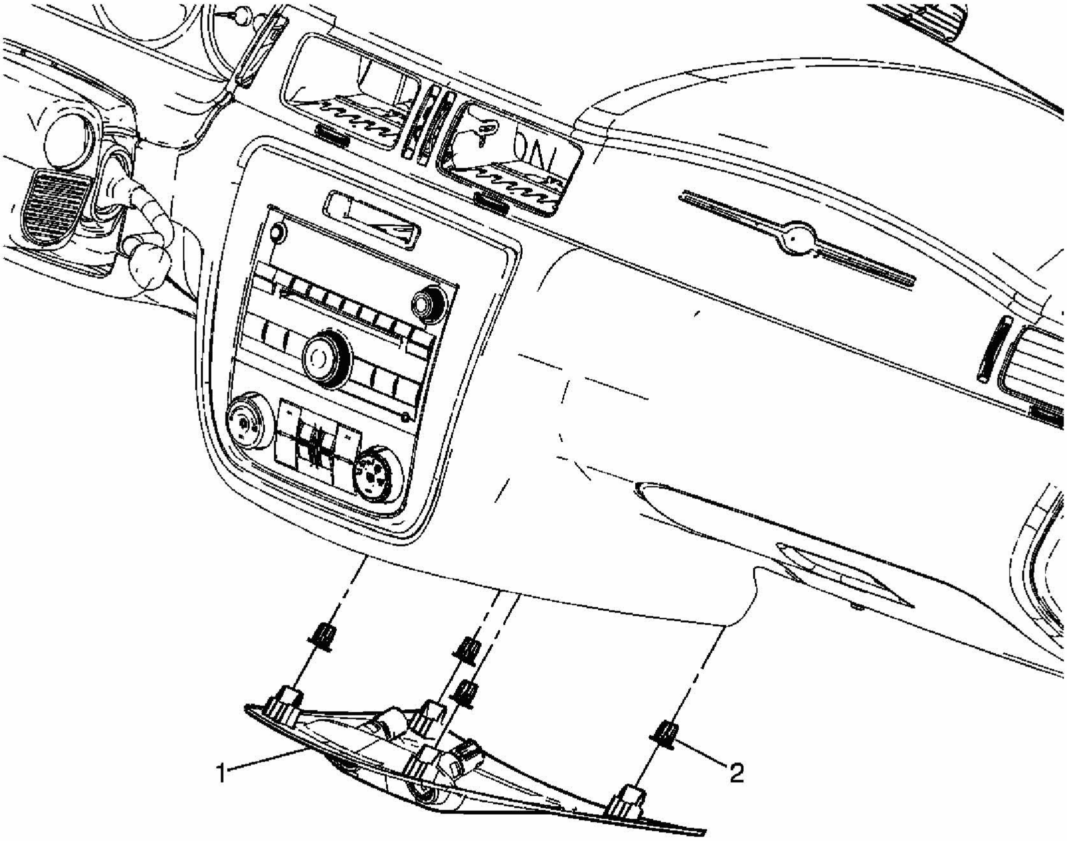


Fig. 17: Replacing Instrument Panel (I/P) Extension Trim Plate
Courtesy of GENERAL MOTORS CORP.

Instrument Panel (I/P) Extension Trim Plate Replacement (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Extension Panel Assembly, Instrument Panel **Tip:** 1. Disconnect electrical connectors. 2. Remove the 12-volt accessory power receptacles. Refer to **Cigar Lighter Housing or 12 Volt Accessory Power Receptacle Replacement** .
2	Clip, Retainer (Qty 4)

KNEE BOLSTER REINFORCEMENT REPLACEMENT (IMPALA)

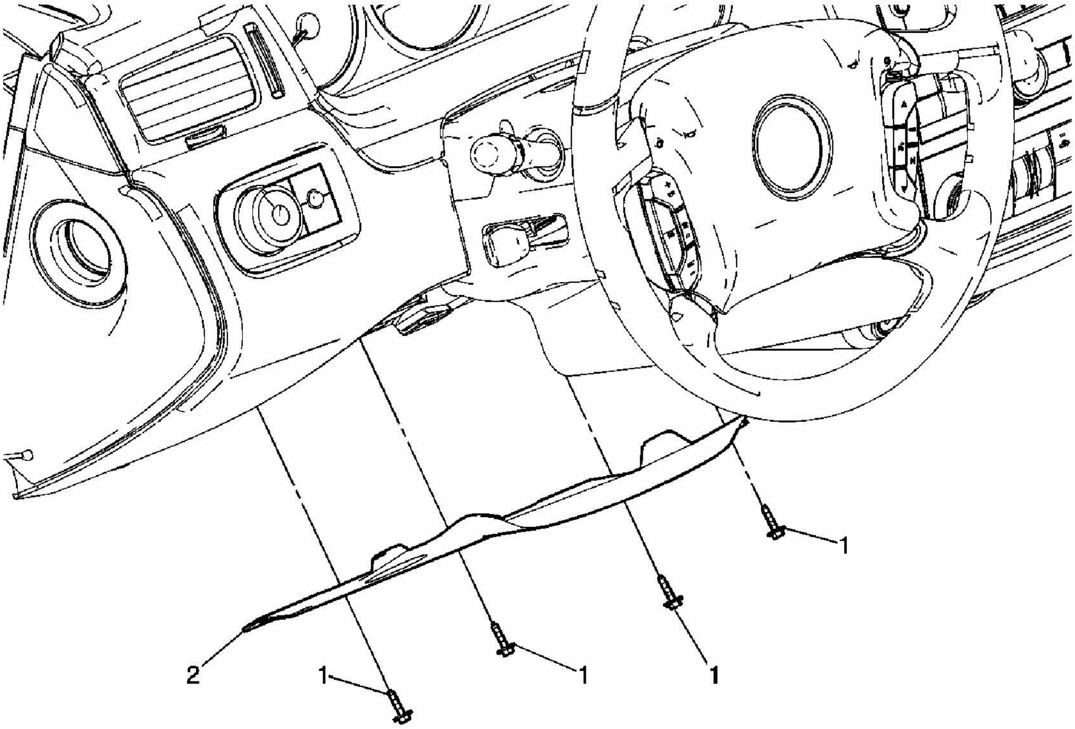


Fig. 18: Replacing Knee Bolster Reinforcement
Courtesy of GENERAL MOTORS CORP.

Knee Bolster Reinforcement Replacement (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the steering column filler panel. Refer to **Steering Column Filler Replacement**.	
1	Bolt, Knee Bolster Reinforcement (Qty: 4) **Tighten:** 2 N.m (18 lb in)
2	Reinforcement, Instrument Panel Drivers Knee Bolster

KNEE BOLSTER REINFORCEMENT REPLACEMENT (MONTE CARLO)

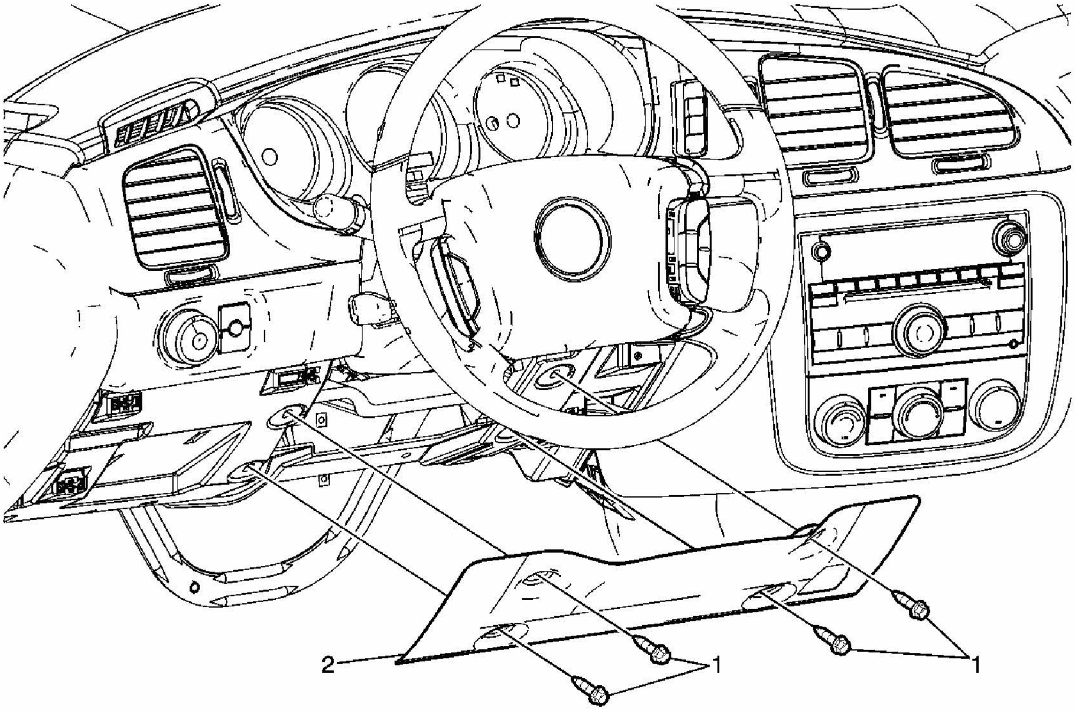


Fig. 19: Replacing Knee Bolster Reinforcement
Courtesy of GENERAL MOTORS CORP.

Knee Bolster Reinforcement Replacement (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the steering column filler panel. Refer to **Steering Column Filler Replacement**.	
1	Screw, Knee Bolster Reinforcement (Qty: 4) **Tighten:** 2 N.m (18 lb in)
2	Reinforcement Assembly, Knee Bolster

RIGHT KNEE BOLSTER BRACKET REPLACEMENT

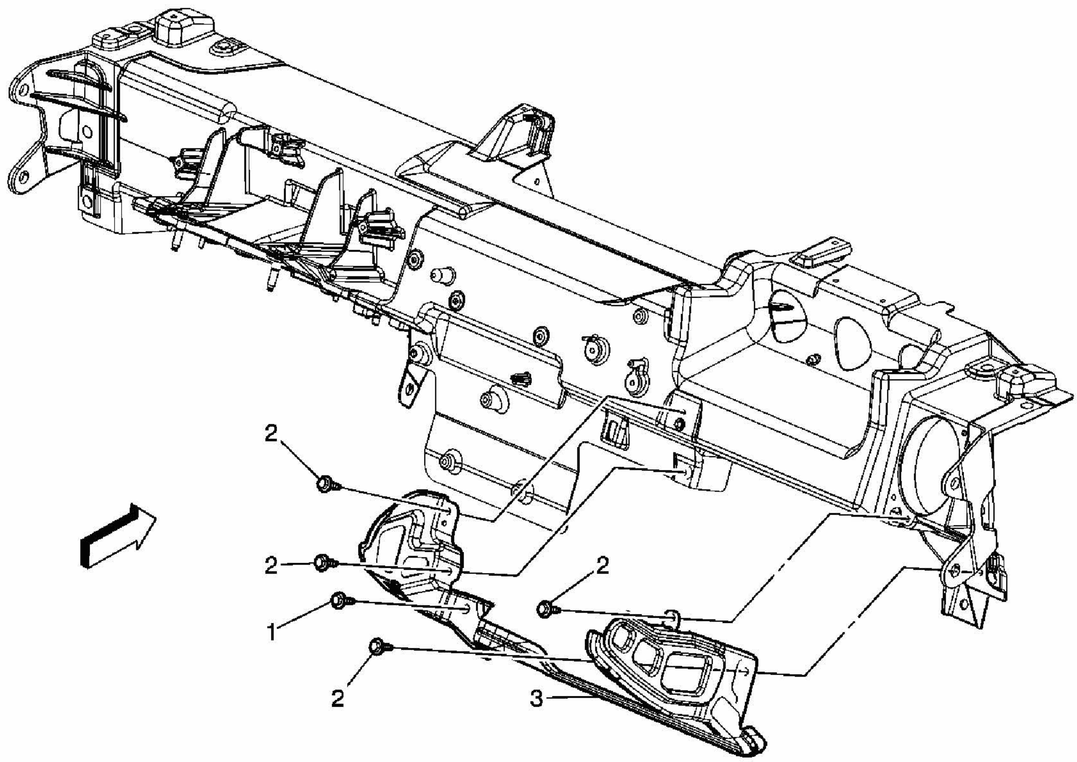


Fig. 20: Replacing Right Knee Bolster Bracket
Courtesy of GENERAL MOTORS CORP.

Knee Bolster Bracket Replacement - Right

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the instrument panel lower trim panel. Refer to **Instrument Panel (I/P) Trim Panel Replacement - Lower (Impala)** or **Instrument Panel (I/P) Trim Panel Replacement - Lower (Monte Carlo)**.	
1	Passenger Knee Bolster Bracket to HVAC Module Bolt **Tighten:** 4 N.m (35 lb in)
2	Passenger Knee Bolster Bracket Bolts (Qty: 4) **Tighten:** 10 N.m (89 lb in)
3	Passenger Knee Bolster Bracket Assembly

LEFT KNEE BOLSTER BRACKET REPLACEMENT

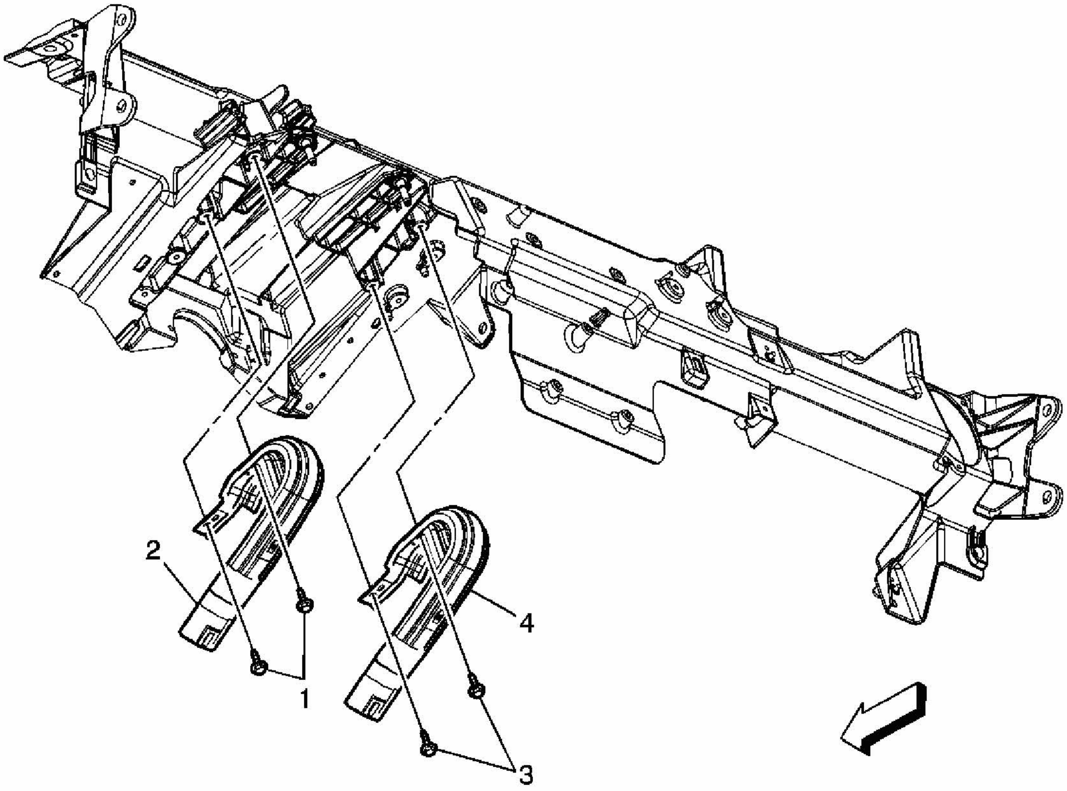


Fig. 21: Replacing Left Knee Bolster Bracket
Courtesy of GENERAL MOTORS CORP.

Knee Bolster Bracket Replacement - Left

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the Instrument Panel Lower Trim Panel. Refer to **Instrument Panel (I/P) Trim Panel Replacement - Lower (Impala)** or **Instrument Panel (I/P) Trim Panel Replacement - Lower (Monte Carlo)**.	
1	Bolt, Drivers Knee Bolster Bracket (Qty 2) **Tighten:** 10 N.m (89 lb in)
2	Bracket Assembly, Drivers Knee Bolster-Left
3	Bolt, Drivers Knee Bolster Bracket (Qty 2) **Tighten:** 10 N.m (89 lb in)
4	Bracket Assembly, Drivers Knee Bolster- Right

INSTRUMENT PANEL (I/P) TRIM PLATE REPLACEMENT - (IMPALA)

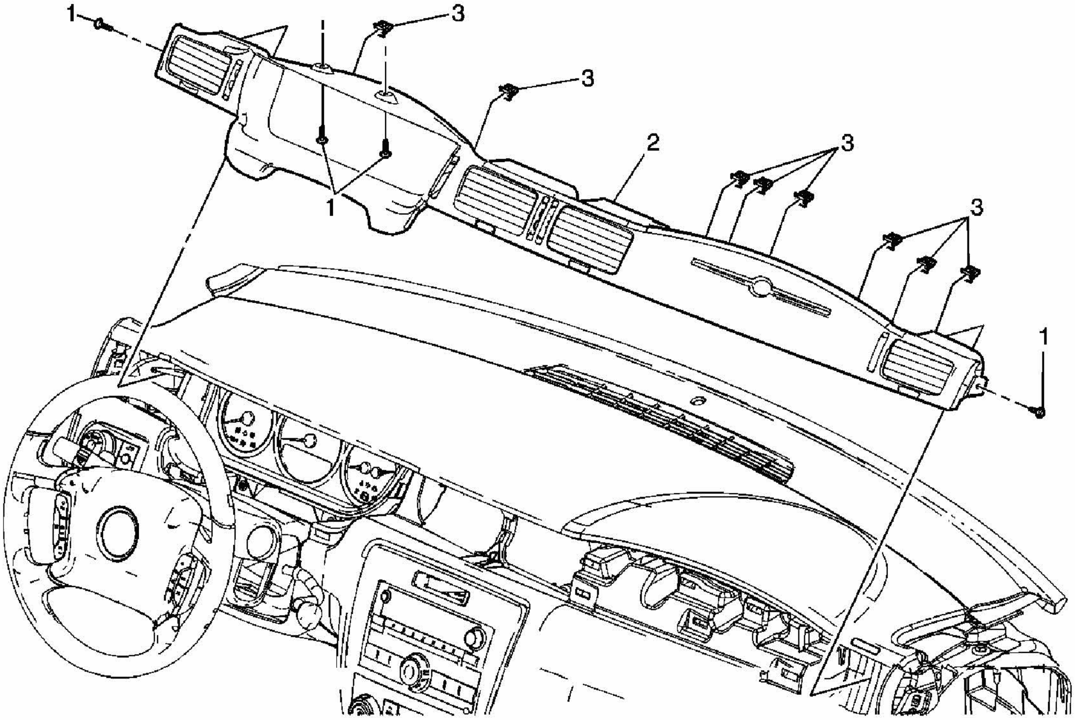


Fig. 22: Replacing Instrument Panel (I/P) Trim Plate
Courtesy of GENERAL MOTORS CORP.

Trim Plate Replacement - Instrument Panel (I/P) (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the instrument panel outer trim covers. Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Left** and **Instrument Panel (I/P) Outer Trim Cover Replacement - Right**.	
1	Screw, Instrument Panel Trim Plate (Qty: 4) **Tighten:** 2 N.m (18 lb in)
2	Plate Assembly, Instrument Panel Trim **Tip:** 1. Disconnect the electrical connector. 2. Tilt the steering column to the lowest position.

	3. Remove the driver information center switch. Refer to **Driver Information Center Switch Replacement (Impala)** or **Driver Information Center Switch Replacement (Monte Carlo)**.
3	Clip, Retainer (Qty: 8)

INSTRUMENT PANEL (I/P) TRIM PLATE REPLACEMENT - (MONTE CARLO)

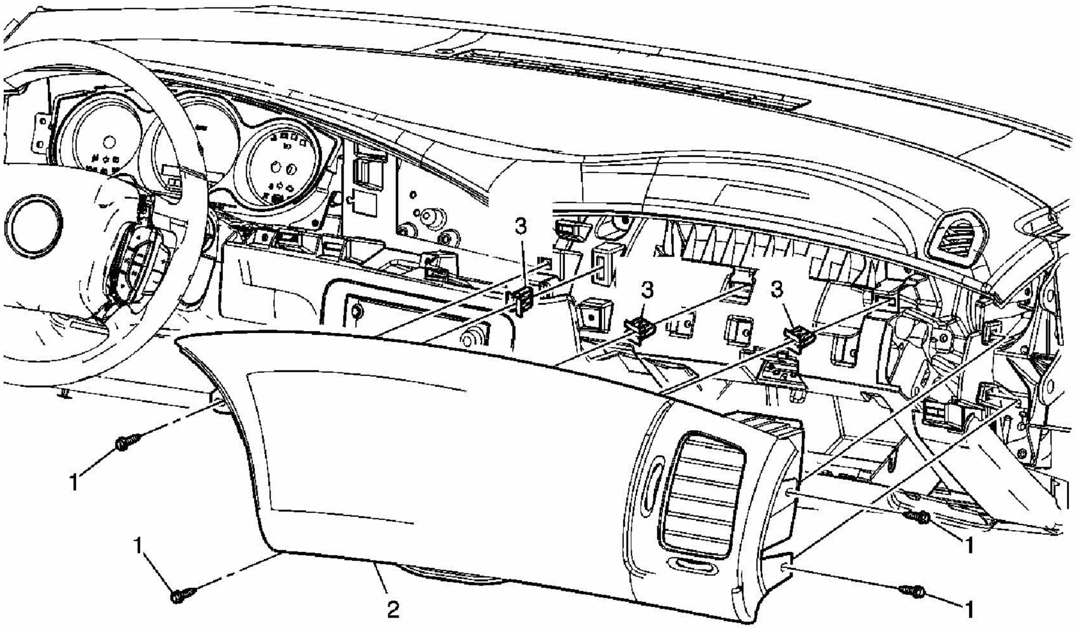


Fig. 23: Replacing Instrument Panel (I/P) Trim Plate
Courtesy of GENERAL MOTORS CORP.

Trim Plate Replacement - Instrument Panel (I/P) (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the Instrument Panel Cluster Trim Panel. Refer to **Trim Panel Replacement - Instrument Panel (I/P) Cluster (Monte Carlo)**. 2. Remove the Right Instrument Panel Outer Trim Cover. Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Right**.	
	Instrument Panel Trim Plate Screws (Qty 4)

1	**Tighten:** 2 N.m (18 lb in)
2	Instrument Panel Trim Plate
3	Retainer Clips (Qty 3)

INSTRUMENT PANEL (I/P) LOWER TRIM PLATE REPLACEMENT - (MONTE CARLO)

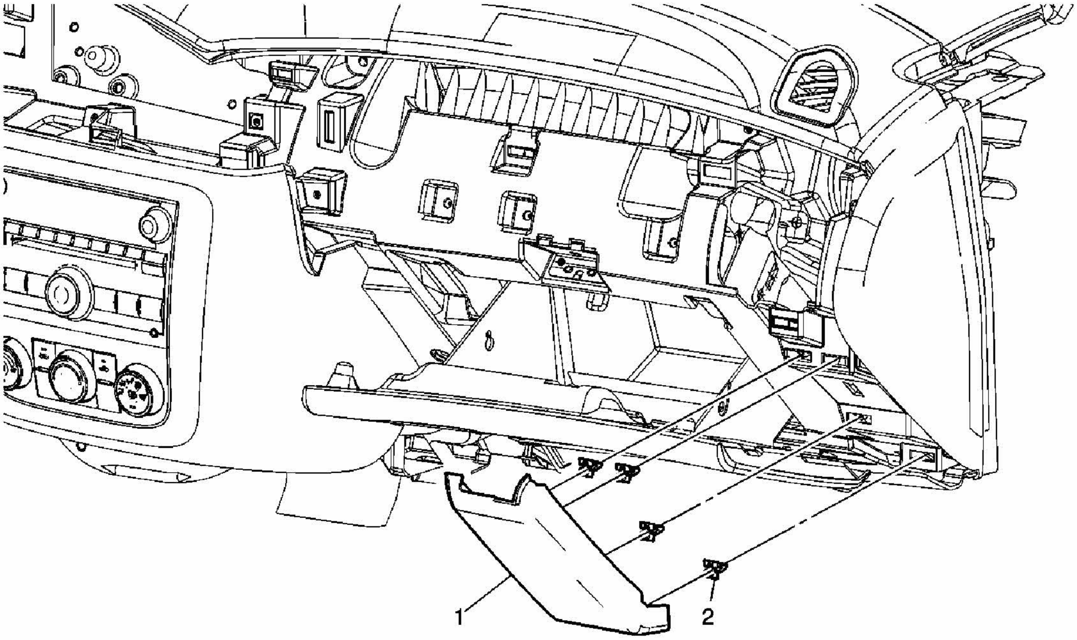


Fig. 24: Replacing Instrument Panel (I/P) Lower Trim Plate
Courtesy of GENERAL MOTORS CORP.

Trim Plate Replacement - Instrument Panel (I/P) Lower (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the Instrument Panel Trim Plate. Refer to **Trim Plate Replacement - Instrument Panel (I/P) (Impala)** or **Trim Plate Replacement - Instrument Panel (I/P) (Monte Carlo)**.	
1	Instrument Panel Lower Trim Plate
2	Retainer Clips (Qty 4)

INSTRUMENT PANEL (I/P) ACCESSORY TRIM PLATE REPLACEMENT - (IMPALA)

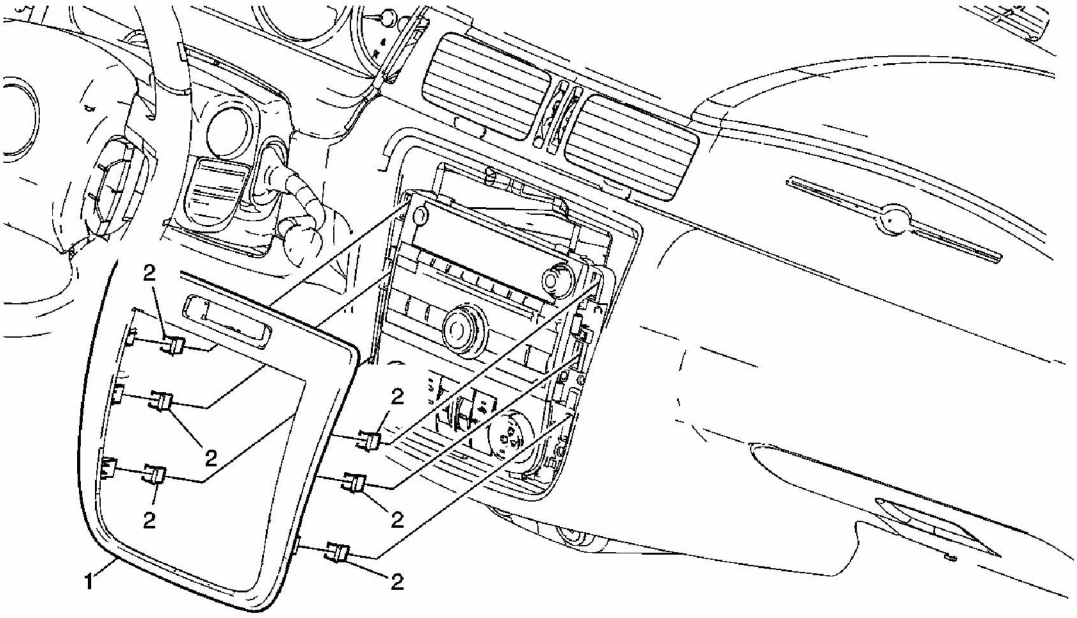


Fig. 25: Replacing Instrument Panel (I/P) Accessory Trim Plate
Courtesy of GENERAL MOTORS CORP.

Trim Plate Replacement - Instrument Panel (I/P) Accessory (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Plate Assembly, Instrument Panel Accessory **Tip:** 1. Disconnect electrical connectors. 2. Remove the Inflatable Restraint Indicator. Refer to **Indicator Replacement - Inflatable Restraint IP Module** .
2	Clip, Retainer (Qty 6)

INSTRUMENT PANEL (I/P) ACCESSORY TRIM PLATE REPLACEMENT - (MONTE CARLO)

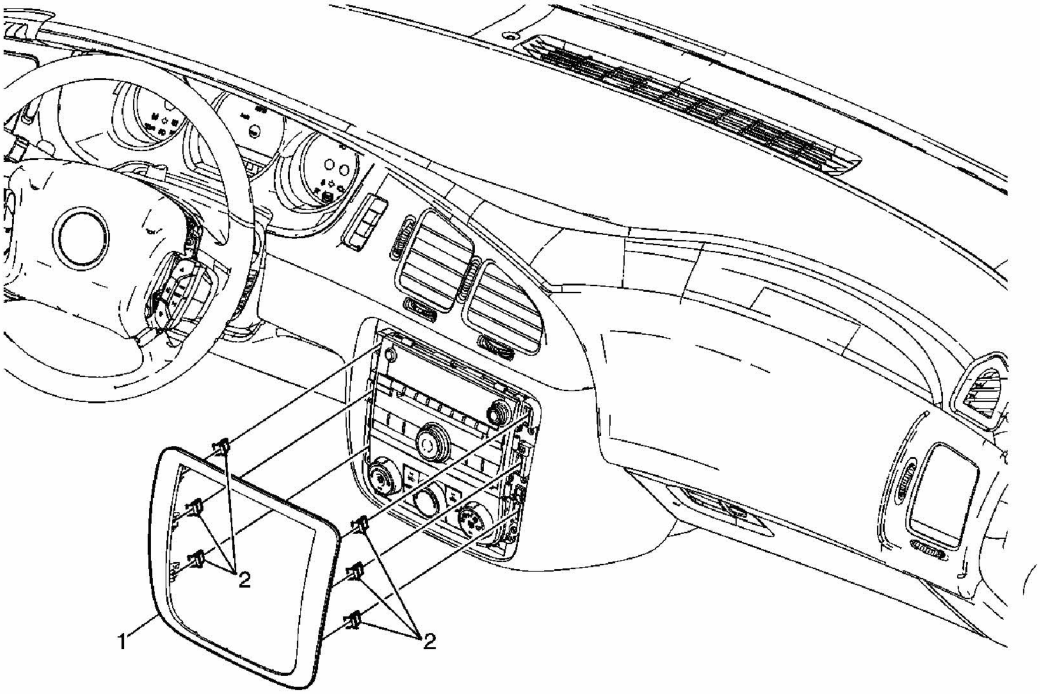


Fig. 26: Replacing Instrument Panel (I/P) Accessory Trim Plate
Courtesy of GENERAL MOTORS CORP.

Trim Plate Replacement - Instrument Panel (I/P) Accessory (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Plate Assembly, Instrument Panel Accessory Trim **Tip:** Use a flat bladed plastic trim tool to aid in the removal of the trim plate.
2	Clip, Retainer (Qty 6)

INSTRUMENT PANEL (I/P) UPPER TRIM PANEL REPLACEMENT

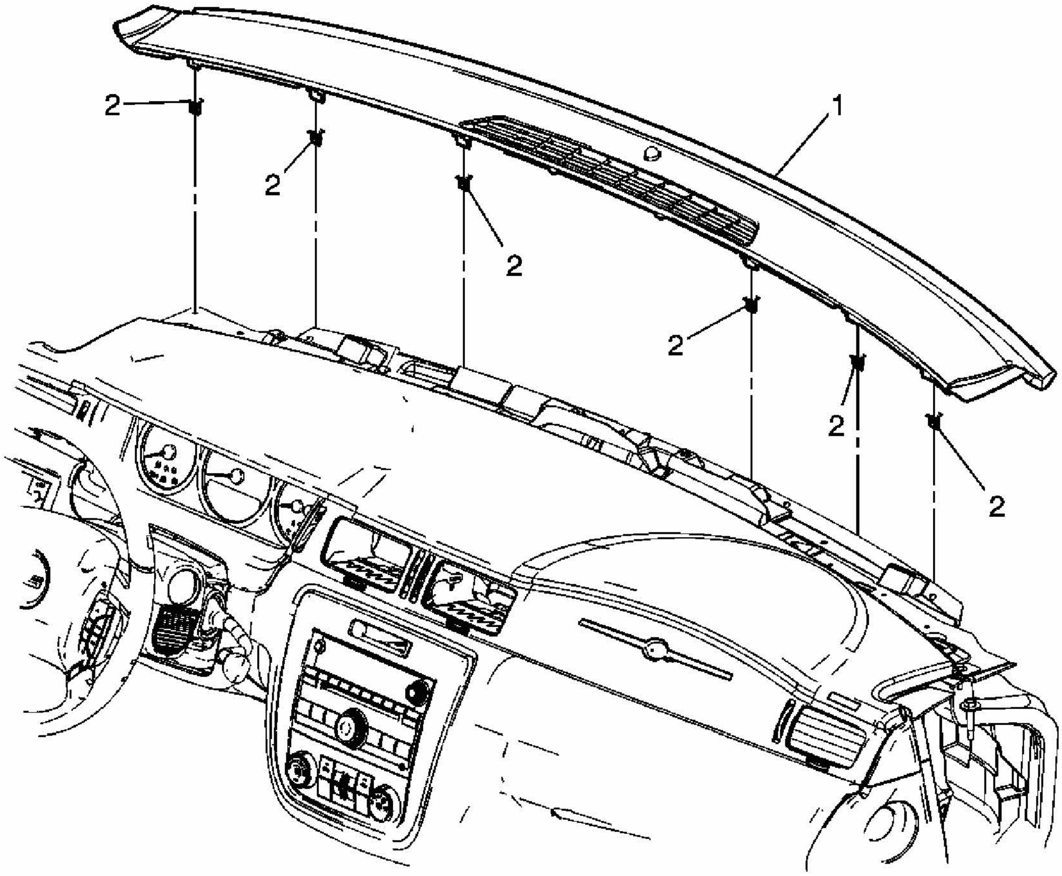


Fig. 27: Replacing Instrument Panel (I/P) Upper Trim Panel
Courtesy of GENERAL MOTORS CORP.

Trim Panel Replacement - Instrument Panel (I/P) Upper

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the Windshield Garnish Moldings. Refer to **Garnish Molding Replacement - Windshield Pillar (Impala)** or **Garnish Molding Replacement - Windshield Pillar (Monte Carlo)** .	
1	Instrument Panel Upper Trim Panel Assembly **Tip:** 1. Impala Shown Monte Carlo similar. 2. Disconnect electrical connectors. 3. Remove the Ambient Light Sensor.
2	Retainer Clips **Tip:** Impala (Qty 6) Monte Carlo (Qty 10)

INSTRUMENT PANEL (I/P) CLUSTER TRIM PANEL REPLACEMENT - (MONTE CARLO)

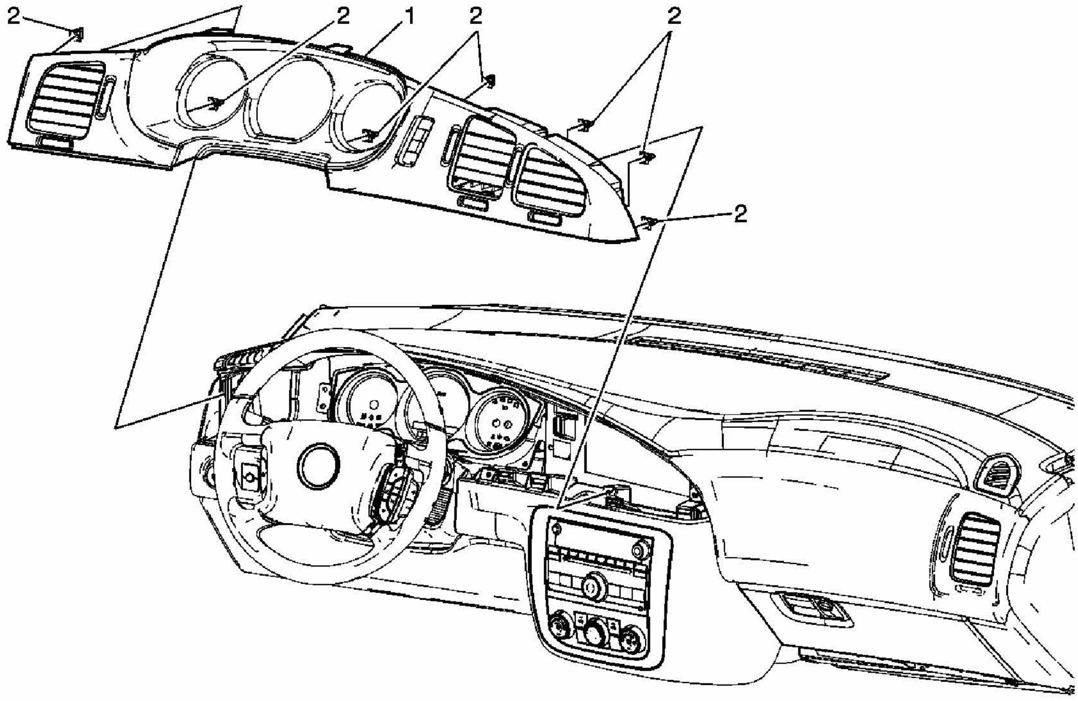


Fig. 28: Replacing Instrument Panel (I/P) Cluster Trim Panel
Courtesy of GENERAL MOTORS CORP.

Trim Panel Replacement - Instrument Panel (I/P) Cluster (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Plate Assembly, Instrument Panel Cluster Trim **Tip:** Use a flat bladed plastic trim tool to aid in the removal of the Trim Plate.
2	Clip, Retainer (Qty 7)

RIGHT INSTRUMENT PANEL (I/P) OUTER TRIM COVER REPLACEMENT

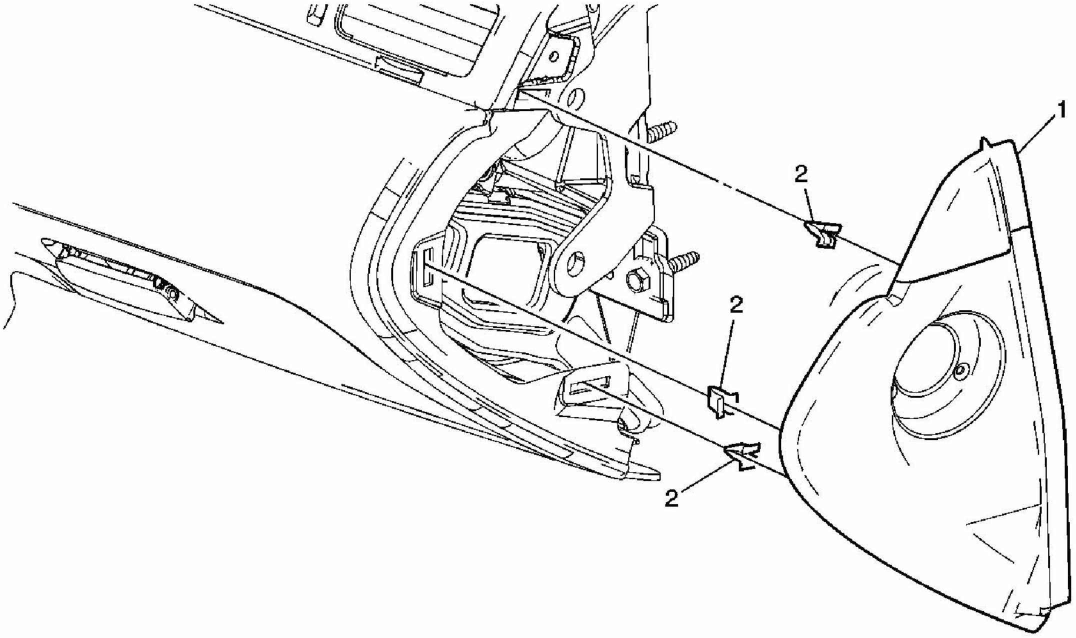


Fig. 29: Replacing Right Instrument Panel (I/P) Outer Trim Cover
Courtesy of GENERAL MOTORS CORP.

Instrument Panel (I/P) Outer Trim Cover Replacement - Right

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Trim Cover, Instrument Panel Outer **Tip:** Impala shown Monte Carlo Similar.
2	Clip, Retainer (Qty 3)

LEFT INSTRUMENT PANEL (I/P) OUTER TRIM COVER REPLACEMENT

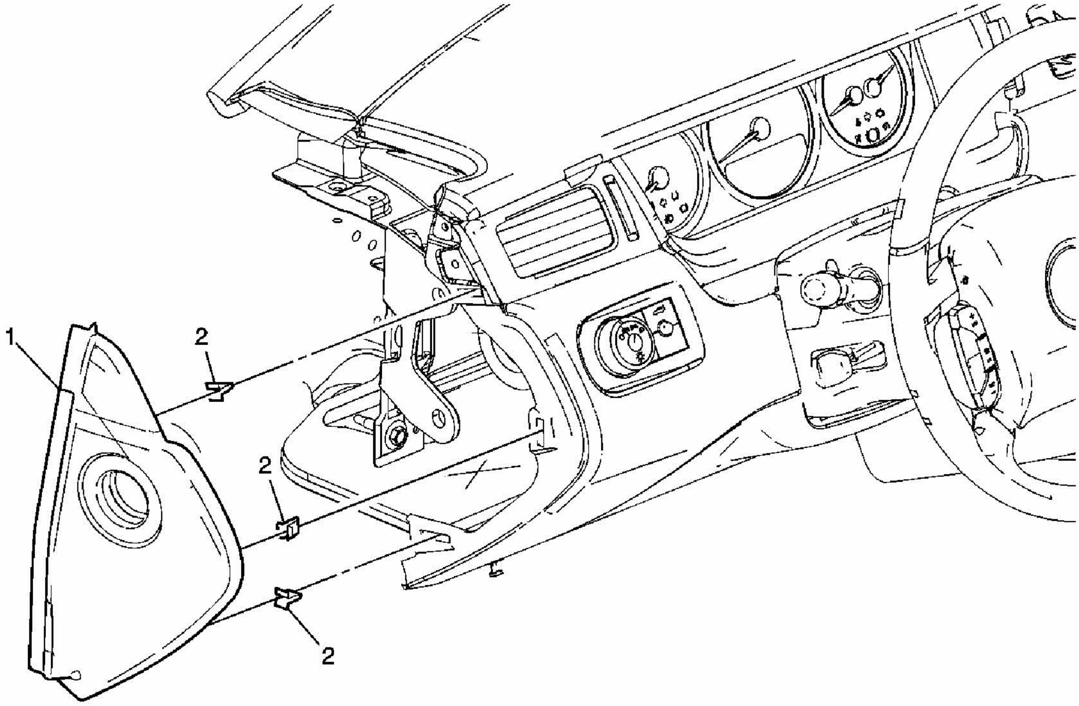


Fig. 30: Replacing Left Instrument Panel (I/P) Outer Trim Cover
Courtesy of GENERAL MOTORS CORP.

Instrument Panel (I/P) Outer Trim Cover Replacement - Left

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Trim Cover, Instrument Panel Outer **Tip:** Impala shown Monte Carlo similar.
2	Clip, Retainer (Qty 3)

INSTRUMENT PANEL (I/P) COMPARTMENT REPLACEMENT - (MONTE CARLO)

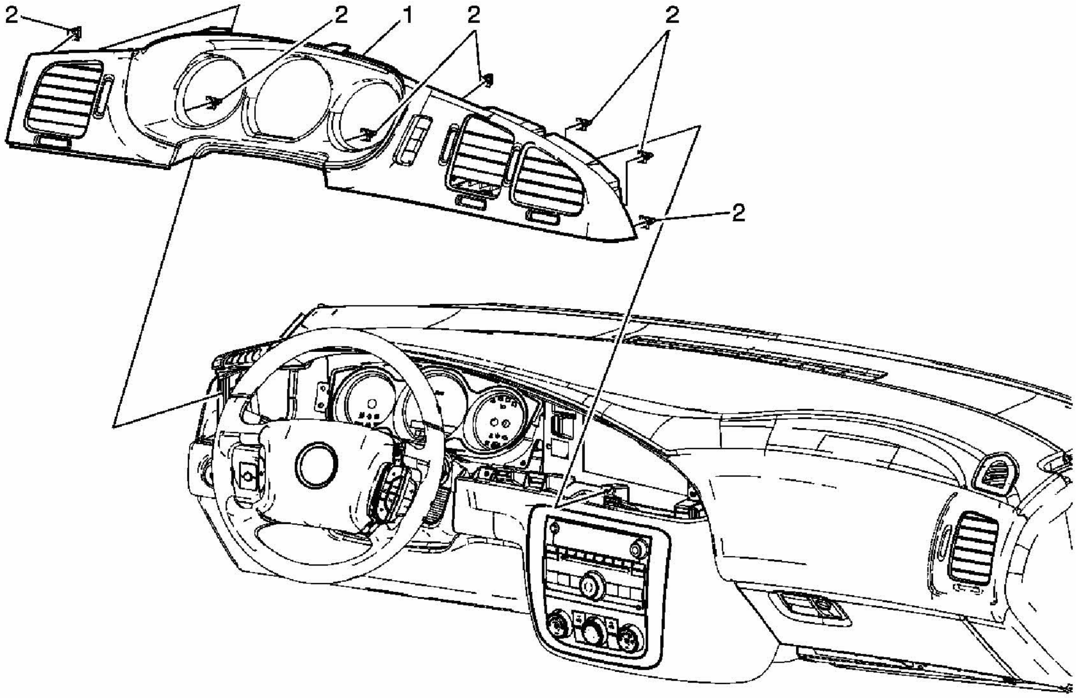


Fig. 31: Replacing Instrument Panel (I/P) Compartment
Courtesy of GENERAL MOTORS CORP.

Compartment Replacement - Instrument Panel (I/P) (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Screw, Instrument Panel Compartment (Qty 3) **Tighten:** 2 N.m (18 lb in)
2	Compartment Assembly, Instrument Panel

INSTRUMENT PANEL (I/P) COMPARTMENT STRIKER REPLACEMENT - (IMPALA)

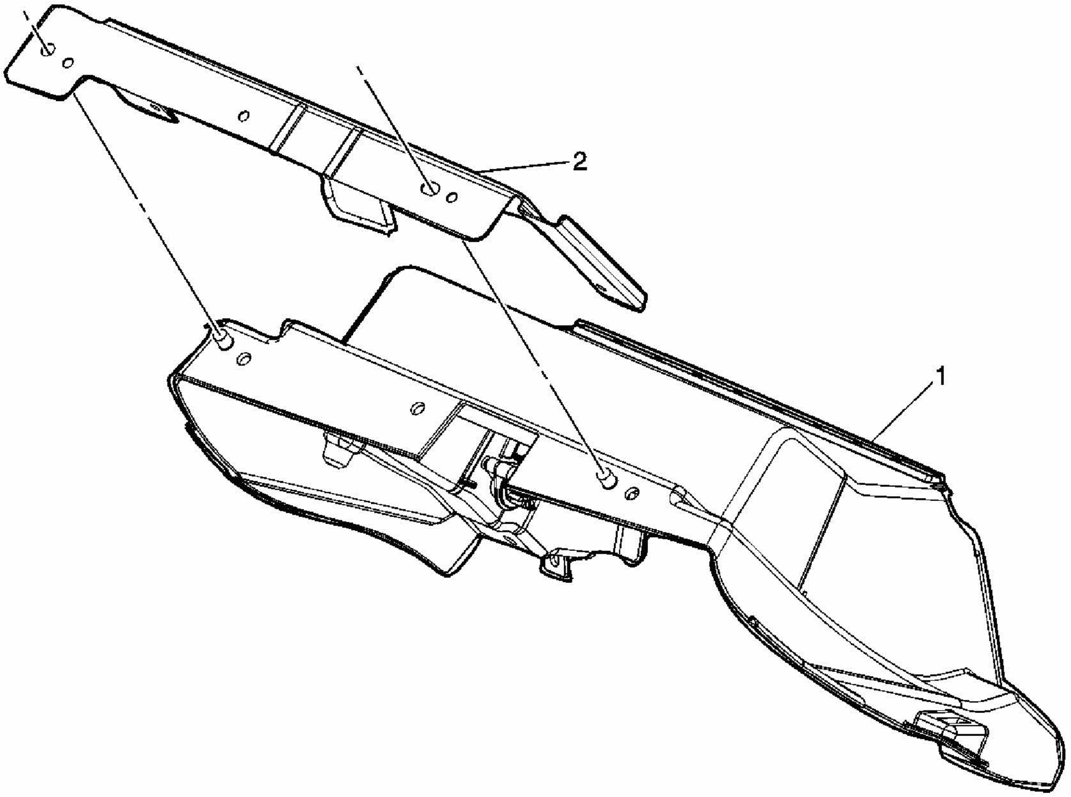


Fig. 32: Replacing Instrument Panel (I/P) Compartment Striker
Courtesy of GENERAL MOTORS CORP.

Striker Replacement - Instrument Panel (I/P) Compartment (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Panel Assembly, Instrument Panel Compartment Inner Refer to **Instrument Panel Compartment Inner Panel Replacement (Impala)**.
2	Striker Assembly, Instrument Panel Compartment.

INSTRUMENT PANEL (I/P) COMPARTMENT STRIKER REPLACEMENT - (MONTE CARLO)

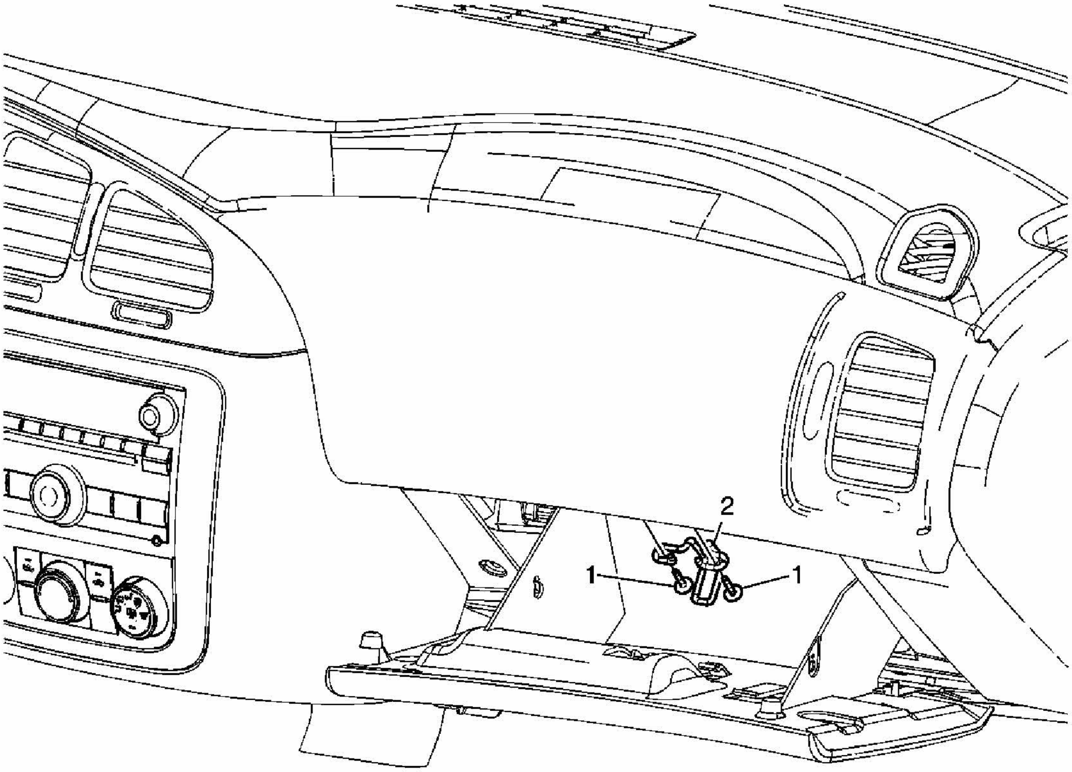


Fig. 33: Replacing Instrument Panel (I/P) Compartment Striker
Courtesy of GENERAL MOTORS CORP.

Striker Replacement - Instrument Panel (I/P) Compartment (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Instrument Panel Compartment Striker Screws (Qty 2) **Tighten:** 2 N.m (18 lb in)
2	Instrument Panel Compartment Striker

INSTRUMENT PANEL (I/P) COMPARTMENT DOOR REPLACEMENT - (IMPALA)

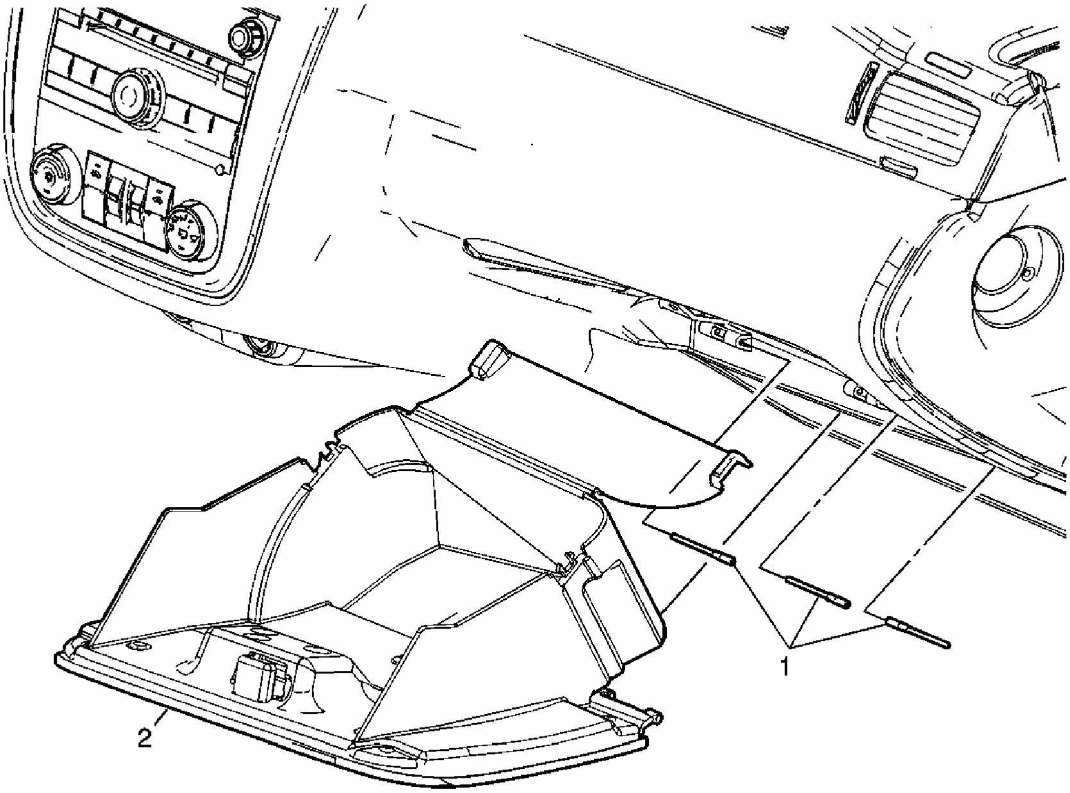


Fig. 34: Replacing Instrument Panel (I/P) Compartment Door
Courtesy of GENERAL MOTORS CORP.

Door Replacement - Instrument Panel (I/P) Compartment (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Pin, Compartment Door Hinge (Qty 3) **Tip:** Use a small pointed tool in order to drive the pins out of the hinge.
2	Door Assembly, Instrument Panel Compartment **Tip:** 1. Squeeze the compartment bin enough to pull the door and bin assembly out the opening past the stops and the dampener. 2. Remove the compartment Latch Assembly. Refer to **Latch Replacement - Instrument Panel (I/P) Compartment (Impala)** or **Latch Replacement - Instrument Panel (I/P) Compartment (Monte Carlo)**.

INSTRUMENT PANEL (I/P) COMPARTMENT LATCH REPLACEMENT (IMPALA)

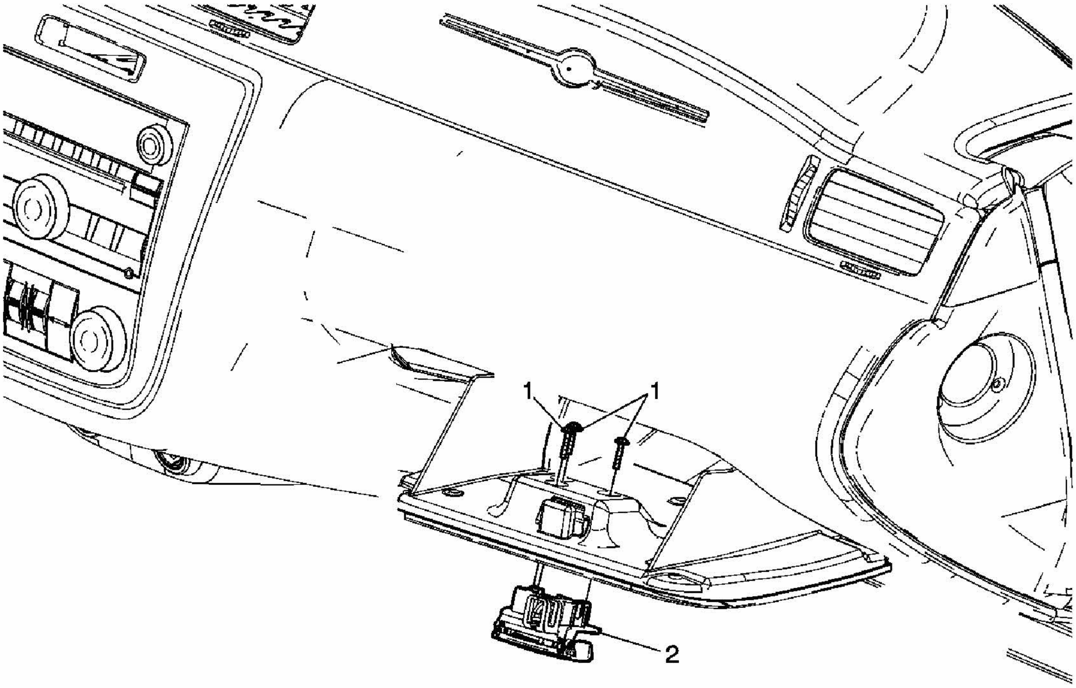


Fig. 35: Replacing Instrument Panel (I/P) Compartment Latch
Courtesy of GENERAL MOTORS CORP.

Latch Replacement - Instrument Panel (I/P) Compartment (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Screw, Instrument Panel Compartment Latch (Qty 3) **Tighten:** 2 N.m (18 lb in)
2	Latch Assembly, Instrument Panel Compartment

INSTRUMENT PANEL (I/P) COMPARTMENT LATCH REPLACEMENT - (MONTE CARLO)

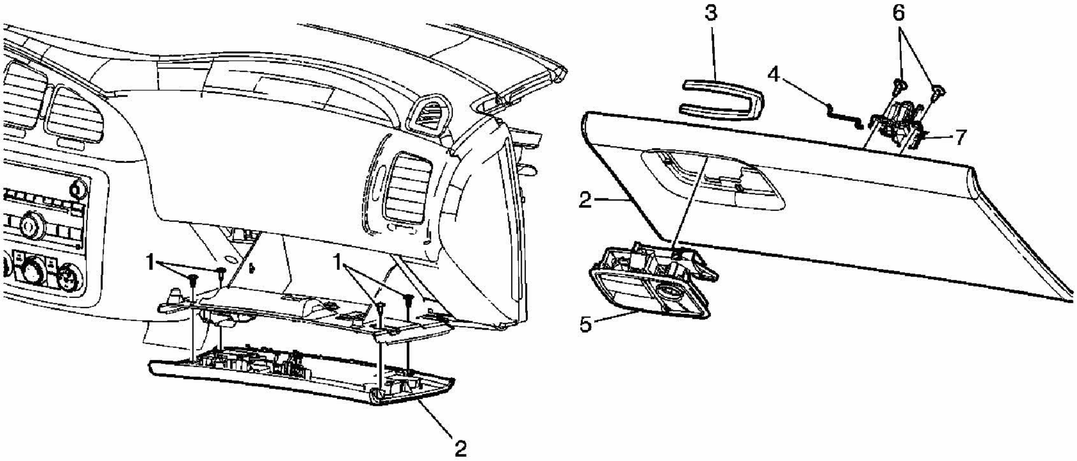


Fig. 36: Replacing Instrument Panel (I/P) Compartment Latch
Courtesy of GENERAL MOTORS CORP.

Latch Replacement - Instrument Panel (I/P) Compartment (Monte Carlo)

Callout	Component Name
NOTE: Refer to Fastener Notice in Cautions and Notices. **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Instrument Panel Compartment Inner Screws (Qty 4) **Tighten:** 2 N.m (18 lb in)
2	Instrument Panel Compartment Door
3	Instrument Panel Compartment Handle "U" Clip Retainer
4	Instrument Panel Compartment Latch Rod
5	Instrument Panel Compartment Handle Assembly
6	Instrument Panel Compartment Latch Screws (Qty 2) **Tighten:** 2 N.m (18 lb in)
7	Instrument Panel Compartment Latch Assembly

I/P COMPARTMENT DAMPENER REPLACEMENT - (IMPALA)

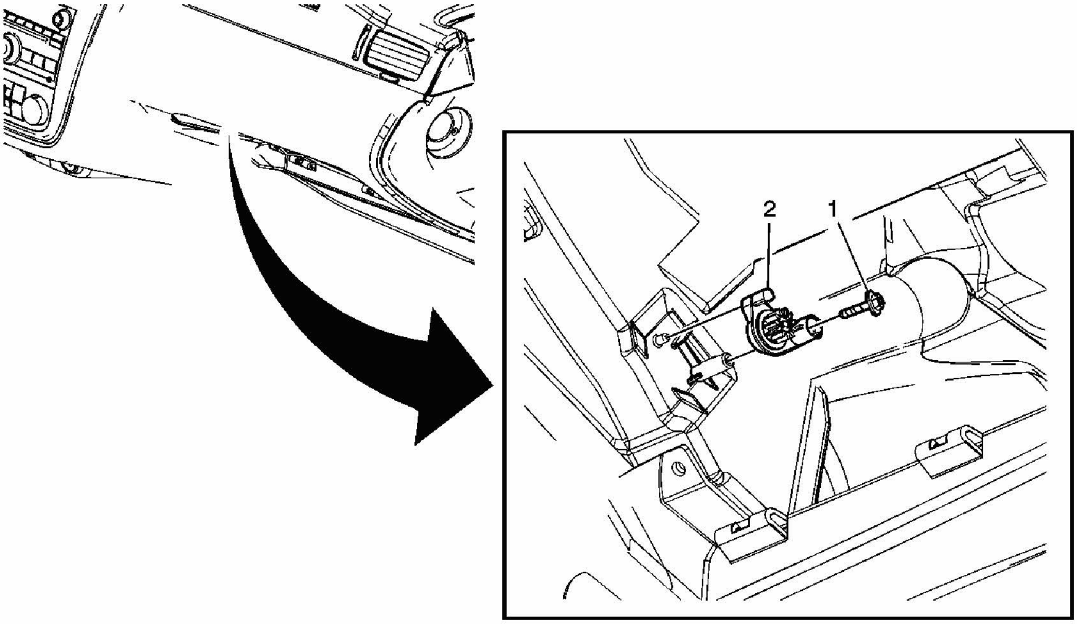


Fig. 37: Replacing I/P Compartment Dampener
Courtesy of GENERAL MOTORS CORP.

Dampener Replacement - I/P Compartment (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the Instrument Panel Compartment Door Assembly. Refer to **Door Replacement - Instrument Panel (I/P) Compartment (Impala)**.	
1	Screw, Instrument Panel Compartment Striker (Qty 1) **Tighten:** 2 N.m (18 lb in)
2	Dampener Assembly, Instrument Panel Compartment

INSTRUMENT PANEL COMPARTMENT INNER PANEL REPLACEMENT (IMPALA)

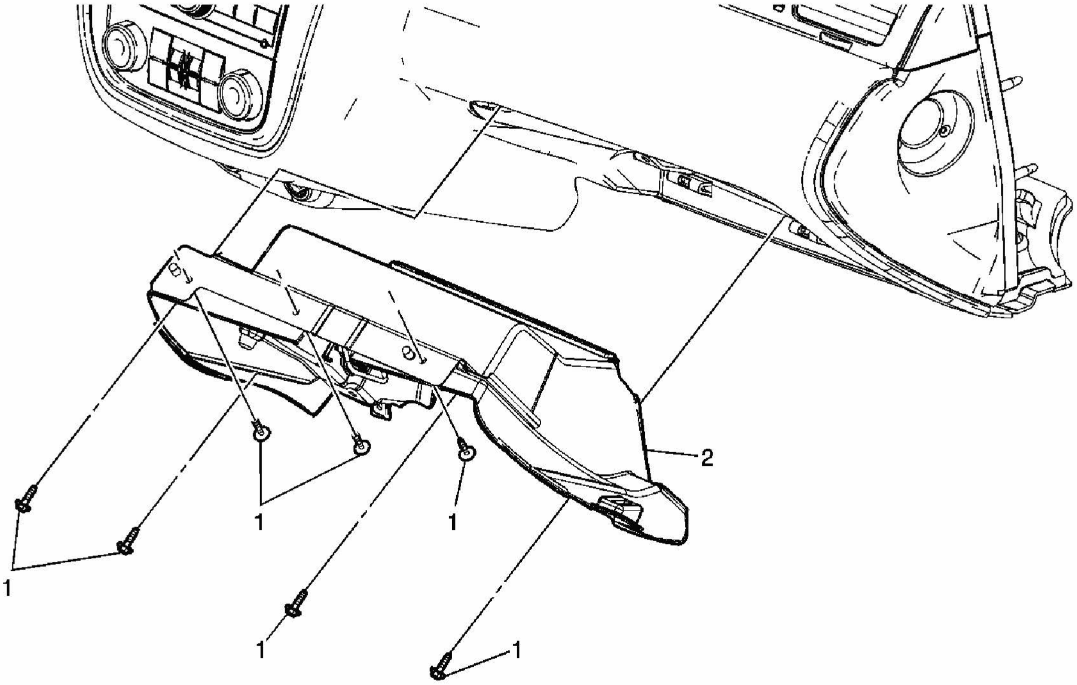


Fig. 38: Replacing Instrument Panel Compartment Inner Panel
Courtesy of GENERAL MOTORS CORP.

Instrument Panel Compartment Inner Panel Replacement (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the Instrument Panel Compartment Door Assembly. Refer to **Door Replacement - Instrument Panel (I/P) Compartment (Impala)** 2. Remove the Right Side Instrument Panel Closeout/Insulator. Refer to **Closeout/Insulator Panel Replacement - Right**. 3. Remove the Right Side Carpet Retainer. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** . 4. Remove the Instrument Panel Right Hand Outer Trim Cover. Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Right**. 5. Remove the Instrument Panel Trim Plate Right Outer Screw. Refer to **Trim Plate Replacement - Instrument Panel (I/P) (Impala)** or **Trim Plate Replacement - Instrument Panel (I/P) (Monte Carlo)**.	

1	Instrument Panel Compartment Inner Panel Screws (Qty 7) **Tighten:** 2 N.m (18 lb in)
2	Instrument Panel Compartment Inner Panel Assembly **Tip:** Flex the bottom right hand corner of the Instrument Panel in order to remove the Instrument Panel Compartment Inner Panel Assembly.

INSTRUMENT PANEL (I/P) UPPER TRIM PAD REPLACEMENT - (IMPALA)

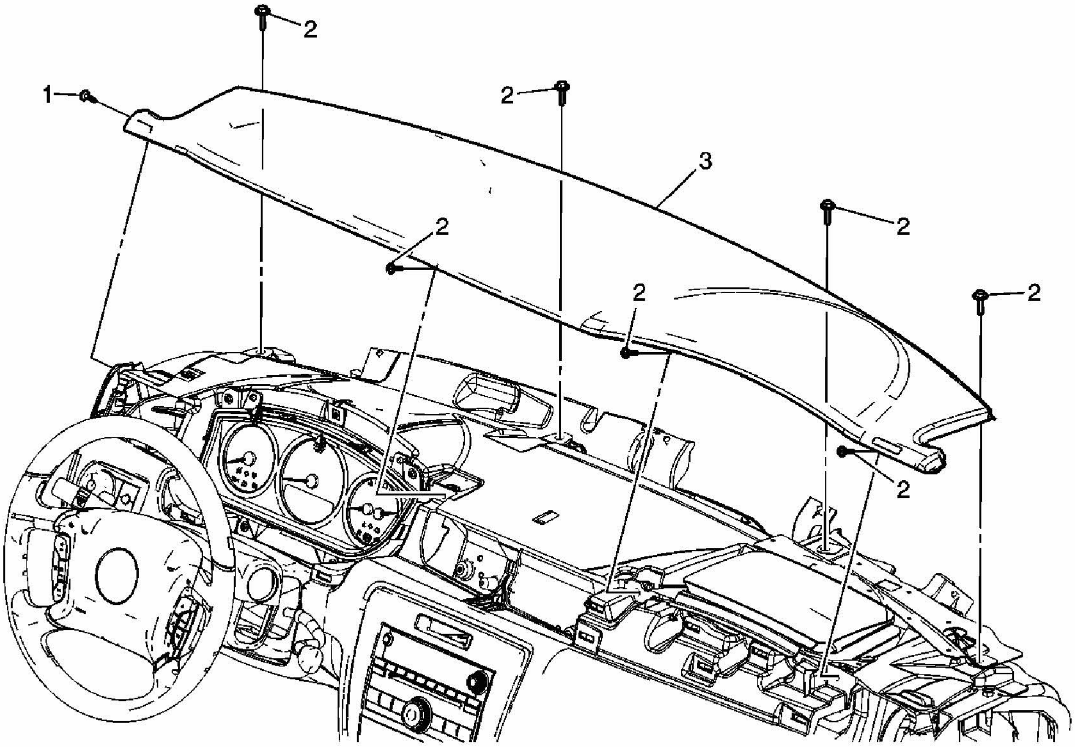


Fig. 39: Replacing Instrument Panel (I/P) Upper Trim Pad
Courtesy of GENERAL MOTORS CORP.

Trim Pad Replacement - Instrument Panel (I/P) Upper (Impala)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">NOTE:
Refer to Fastener Notice in Cautions and Notices.
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.
Preliminary Procedure
1. Remove the Instrument Panel Upper Trim Panel. Refer to Trim Panel</td></tr>
</table>

Replacement - Instrument Panel (I/P) Upper 2. Remove the Instrument Panel Trim Plate. Refer to **Trim Plate Replacement - Instrument Panel (I/P) (Impala)** or **Trim Plate Replacement - Instrument Panel (I/P) (Monte Carlo)**.	
1	Instrument Panel Upper Trim Pad Screw (Qty 1) **Tighten:** 2 N.m (18 lb in)
2	Instrument Panel Upper Trim Pad Bolt (Qty 7) **Tighten:** 10 N.m (88 lb in)
3	Instrument Panel Upper Trim Pad Assembly **Tip:** Disconnect the electrical connector.

INSTRUMENT PANEL (I/P) UPPER TRIM PAD REPLACEMENT - (MONTE CARLO)

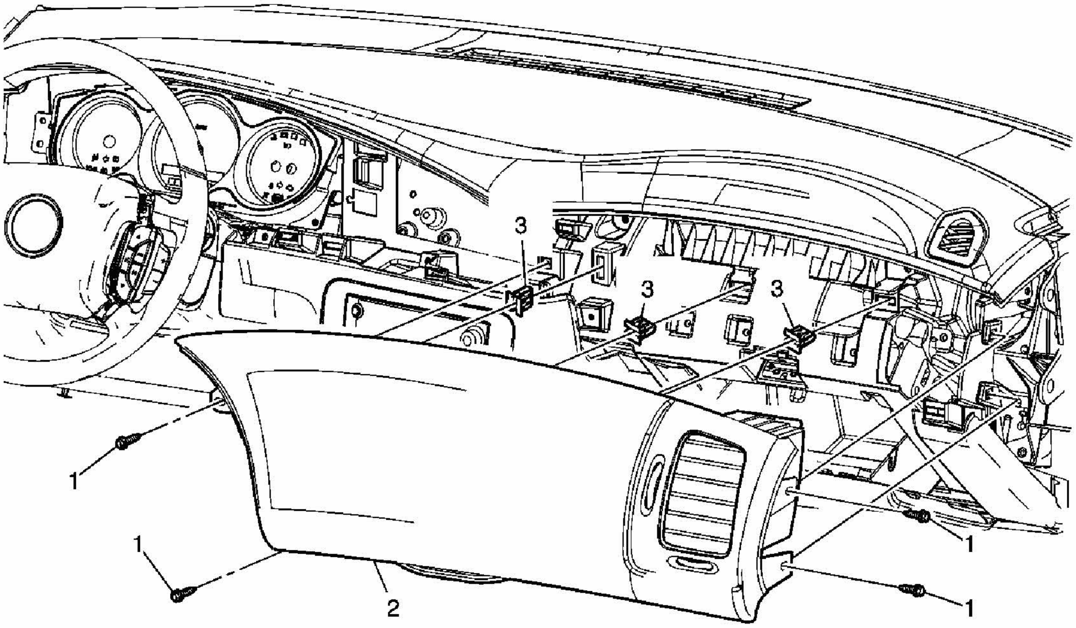


Fig. 40: Replacing Instrument Panel (I/P) Upper Trim Pad
Courtesy of GENERAL MOTORS CORP.

Trim Pad Replacement - Instrument Panel (I/P) Upper (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	

<table>
<tr><td colspan="2">Preliminary Procedures
1. Remove the Instrument Panel Upper Trim Panel. Refer to Trim Panel Replacement - Instrument Panel (I/P) Upper.
2. Remove the Left Instrument Panel Outer Trim Cover. Refer to Instrument Panel (I/P) Outer Trim Cover Replacement - Left.
3. Remove the Instrument Panel Trim Plate. Refer to Trim Plate Replacement - Instrument Panel (I/P) (Impala) or Trim Plate Replacement - Instrument Panel (I/P) (Monte Carlo)</td></tr>
<tr><td>1</td><td>Instrument Panel Upper Trim Pad Screws (Qty 8)
Tighten: 2 N.m (18 lb in)</td></tr>
<tr><td>2</td><td>Instrument Panel Upper Trim Pad Assembly</td></tr>
</table>

STEERING COLUMN FILLER REPLACEMENT

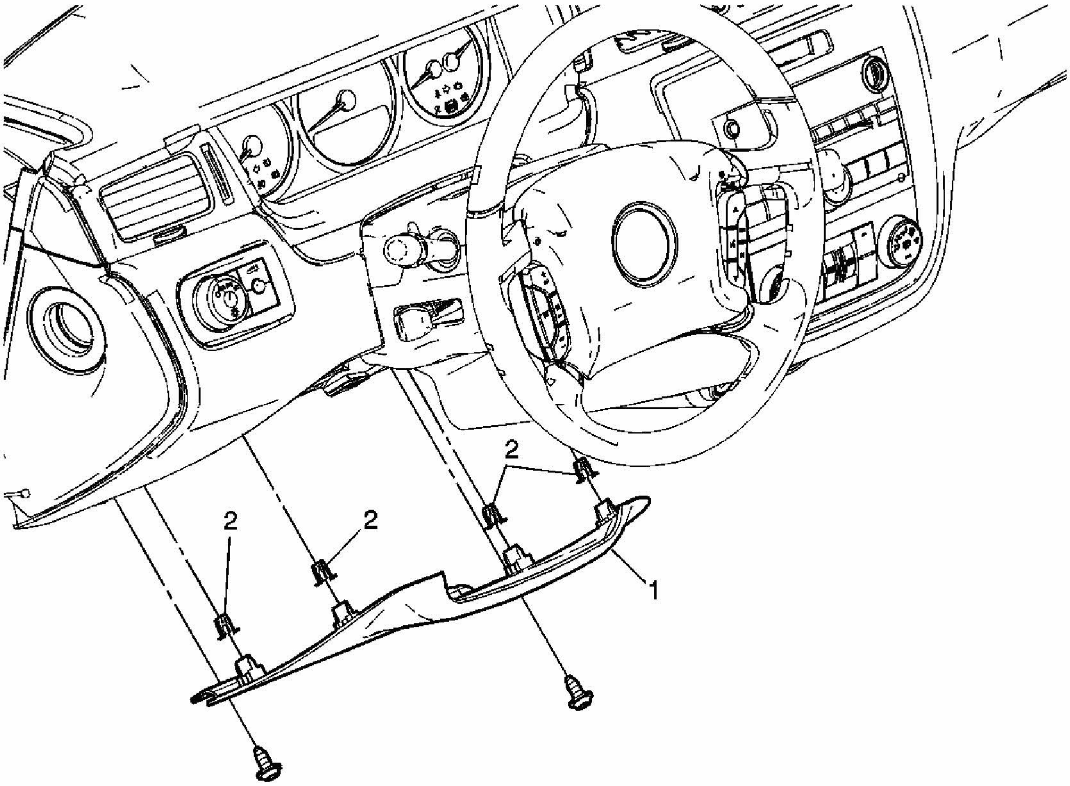


Fig. 41: Replacing Steering Column Filler
Courtesy of GENERAL MOTORS CORP.

Steering Column Filler Replacement

Callout	Component Name

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Steering Column Filler Panel Screws (Qty 2) **Tighten:** 2 N.m (18 lb in)
2	Steering Column Filler Panel Assembly **Tip:** Impala shown Monte Carlo similar.
3	Retainer Clip (Qty 4)

INSTRUMENT PANEL (I/P) CENTER SUPPORT BRACKET REPLACEMENT

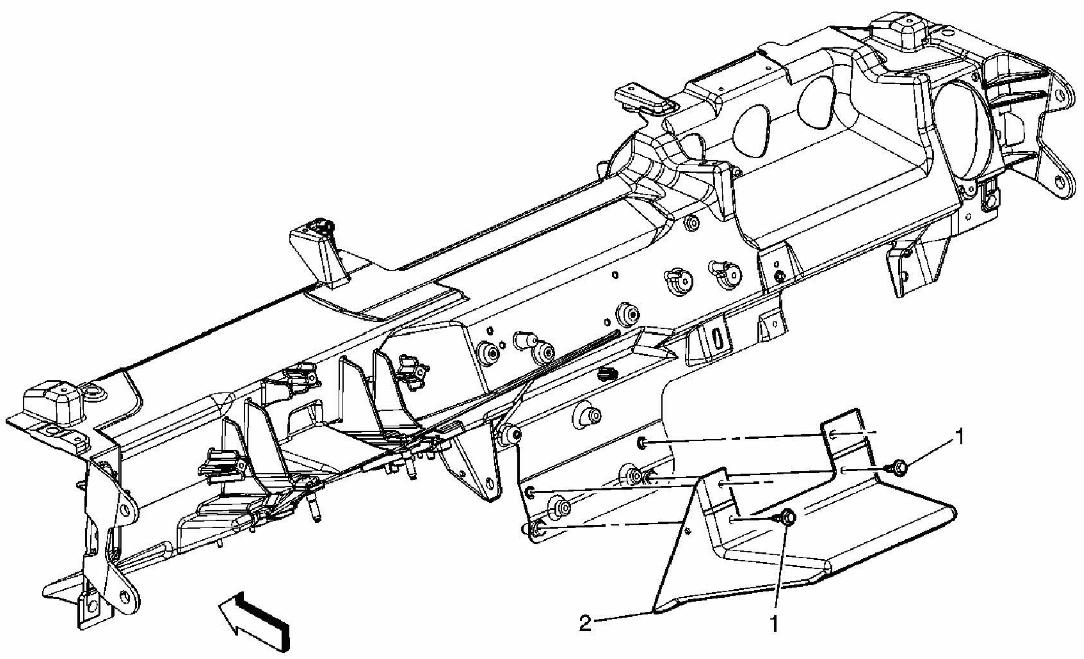


Fig. 42: Replacing Instrument Panel (I/P) Center Support Bracket
Courtesy of GENERAL MOTORS CORP.

Bracket Replacement - Instrument Panel (I/P) Center Support

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the Instrument Panel Lower Trim Panel. Refer to **Instrument Panel (I/P) Trim Panel Replacement - Lower (Impala)** or **Instrument Panel (I/P) Trim Panel Replacement - Lower (Monte Carlo)**.	
1	Bolt, Instrument Panel Center Support Bracket (Qty 2)

	Tighten: 10 N.m (89 lb in)
2	Bracket Assembly, Instrument Panel Center Support

DRIVER INFORMATION CENTER SWITCH REPLACEMENT (IMPALA)

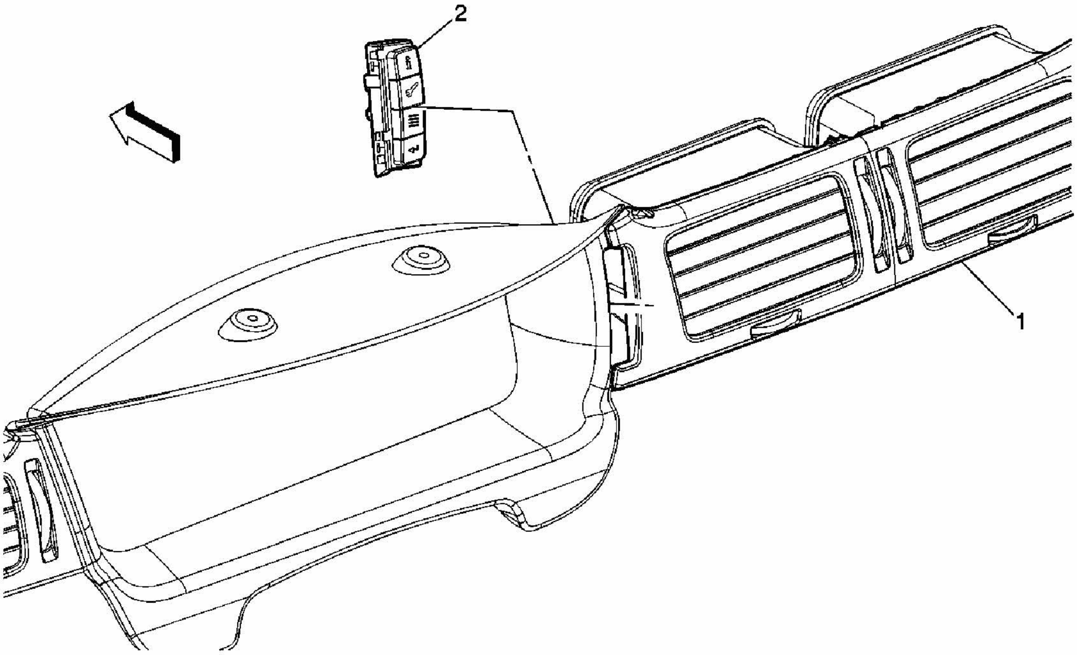


Fig. 43: Replacing Driver Information Center Switch
Courtesy of GENERAL MOTORS CORP.

Driver Information Center Switch Replacement (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Plate Assembly, Instrument Panel Trim Refer to **Trim Plate Replacement - Instrument Panel (I/P) (Impala)** or **Trim Plate Replacement - Instrument Panel (I/P) (Monte Carlo)**.
2	Switch Assembly, Driver Information Center

DRIVER INFORMATION CENTER SWITCH REPLACEMENT (MONTE CARLO)

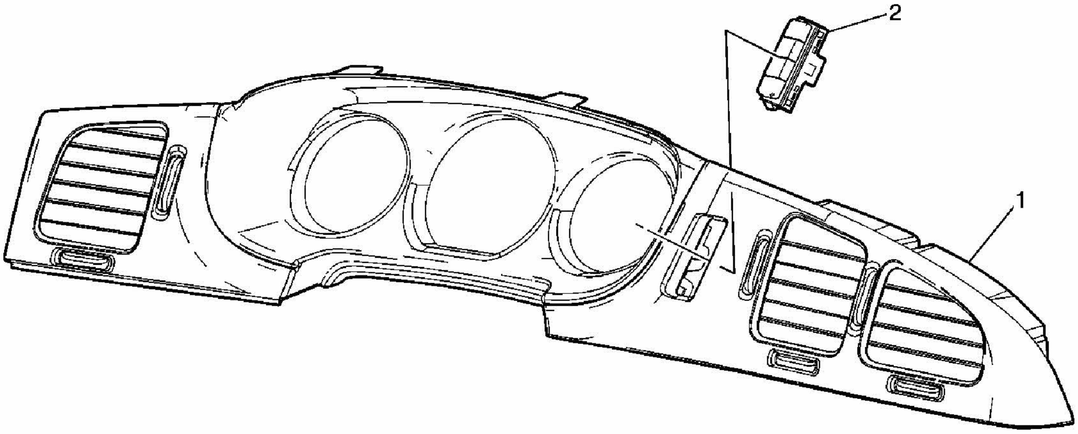


Fig. 44: Replacing Driver Information Center Switch
Courtesy of GENERAL MOTORS CORP.

Driver Information Center Switch Replacement (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Plate Assembly, Instrument Panel Cluster Trim Refer to **Trim Panel Replacement - Instrument Panel (I/P) Cluster (Monte Carlo)**
2	Switch Assembly, Drivers Information

INSTRUMENT PANEL CLUSTER (IPC) REPLACEMENT (IMPALA)

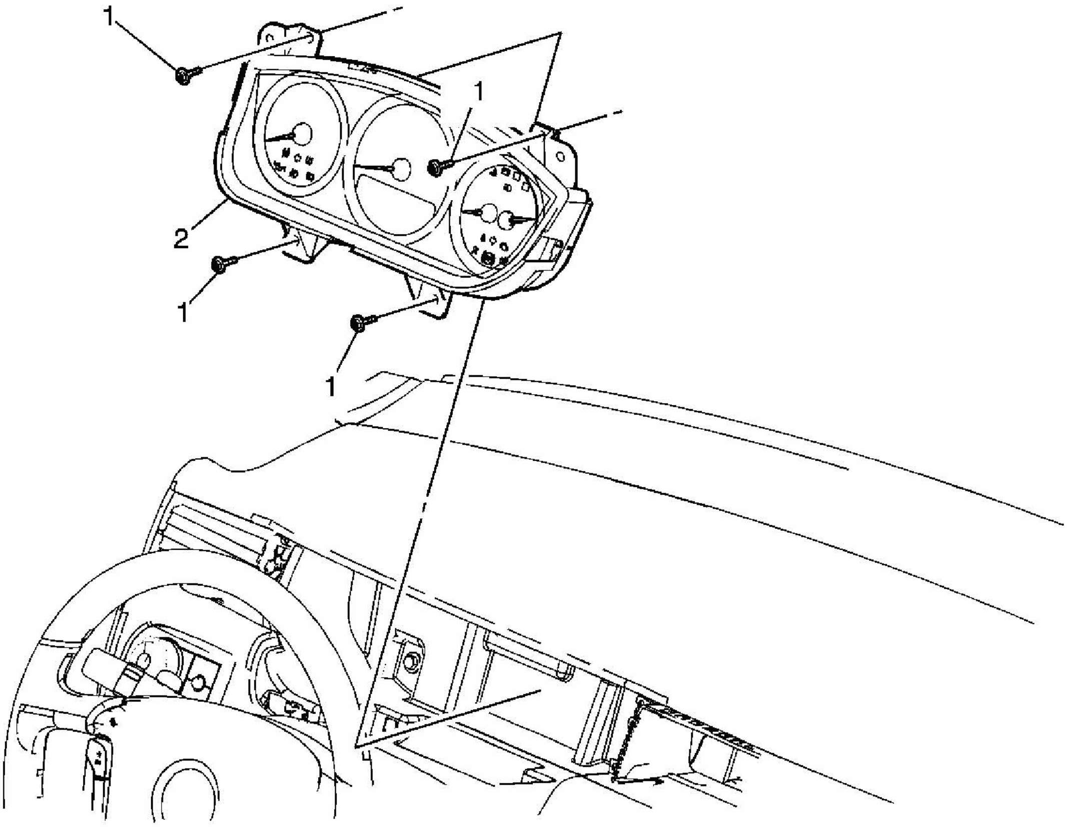


Fig. 45: Replacing Instrument Panel Cluster (IPC)
Courtesy of GENERAL MOTORS CORP.

Instrument Panel Cluster (IPC) Replacement (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the Instrument Panel Trim Plate. Refer to **Trim Plate Replacement - Instrument Panel (I/P) (Impala)** or **Trim Plate Replacement - Instrument Panel (I/P) (Monte Carlo)**.	
1	Screw, Instrument Panel Cluster (Qty 4) **Tighten:** 2 N.m (18 lb in)
2	Cluster Assembly, Instrument Panel **Tip:** Disconnect the electrical connector.

INSTRUMENT PANEL CLUSTER (IPC) REPLACEMENT (MONTE CARLO)

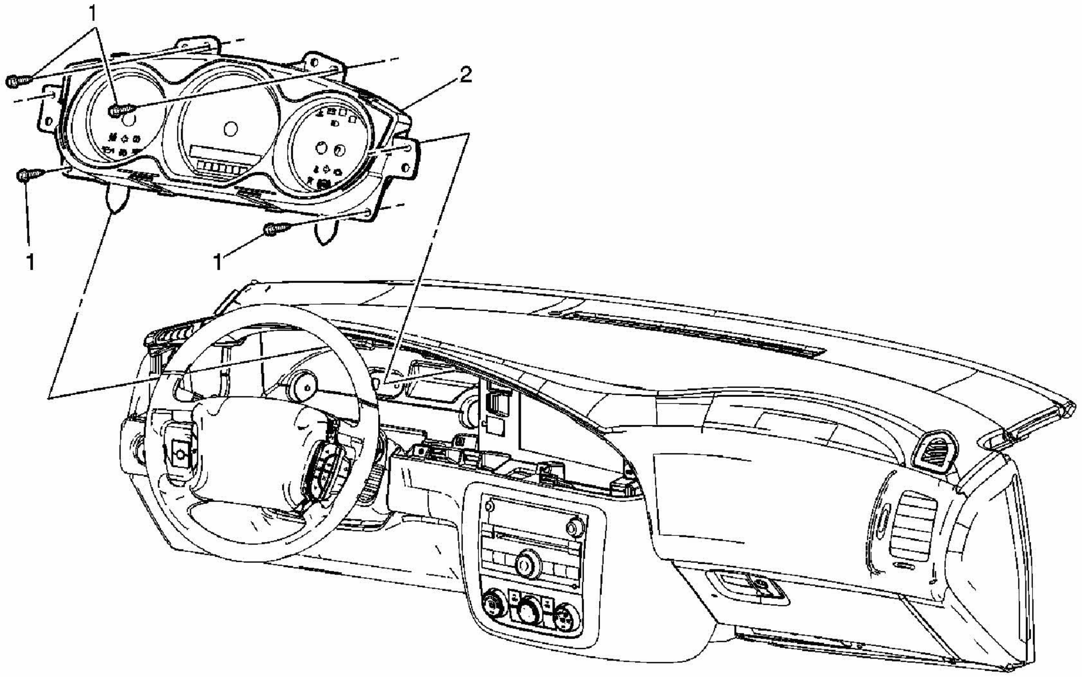


Fig. 46: Replacing Instrument Panel Cluster (IPC)
Courtesy of GENERAL MOTORS CORP.

Instrument Panel Cluster (IPC) Replacement (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the Instrument Panel Cluster Trim Plate. Refer to **Trim Panel Replacement - Instrument Panel (I/P) Cluster (Monte Carlo)**.	
1	Screw, Instrument Panel Cluster (Qty 4) **Tighten:** 2 N.m (18 lb in)
2	Cluster Assembly, Instrument Panel **Tip:** Disconnect the electrical connector.

LOWER INSTRUMENT PANEL (I/P) TRIM PANEL REPLACEMENT - (IMPALA)

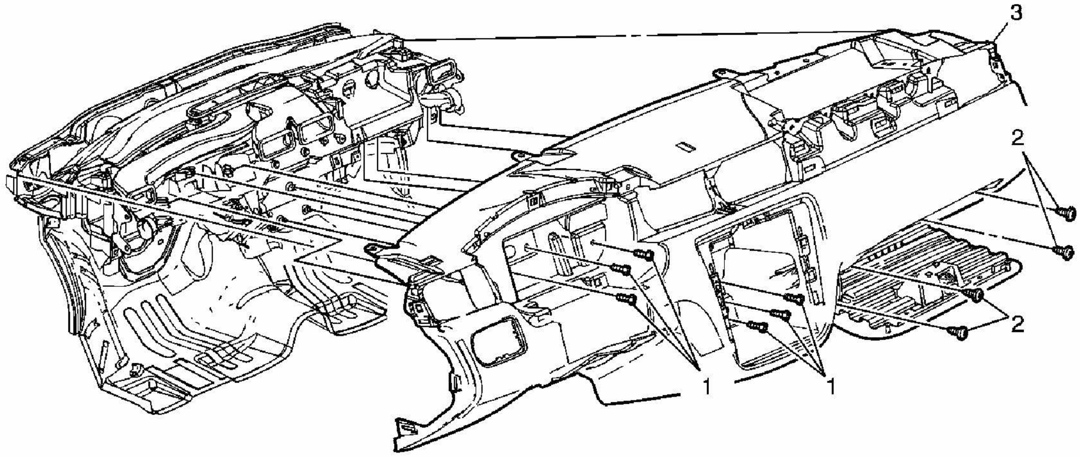


Fig. 47: Replacing Lower Instrument Panel (I/P) Trim Panel
Courtesy of GENERAL MOTORS CORP.

Instrument Panel (I/P) Trim Panel Replacement - Lower (Impala)

Callout	Component Name

NOTE:
Refer to Fastener Notice in Cautions and Notices.

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Remove the Instrument Panel Upper Trim Pad. Refer to **Trim Pad Replacement - Instrument Panel (I/P) Upper (Impala)** or **Trim Pad Replacement - Instrument Panel (I/P) Upper (Monte Carlo)**.
2. Remove the Instrument Panel Cluster Assembly. Refer to **Instrument Panel Cluster (IPC) Replacement (Impala)** or **Instrument Panel Cluster (IPC) Replacement (Monte Carlo)**.
3. Remove the Headlamp Switch Assembly. Refer to **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)** .
4. Remove the Right and Left Insulator Panels. Refer to **Closeout/Insulator Panel Replacement - Right** and **Closeout/Insulator Panel Replacement - Left**.
5. Remove the Instrument Panel Inflatable Restraint. Refer to **Inflatable Restraint Instrument Panel Module Replacement** .
6. Remove the Drivers Knee Bolster Reinforcement. Refer to **Knee Bolster Reinforcement Replacement (Impala)** or **Knee Bolster Reinforcement Replacement (Monte Carlo)**.
7. Remove the Steering Column. Refer to **Steering Column Replacement** .

8. Remove the Radio. Refer to **Radio Replacement** . 9. Remove the HVAC Control Module. Refer to **HVAC Control Assembly Replacement** .	
1	Instrument Panel Lower Trim Panel Bolts (Qty 6) **Tighten:** 10 N.m (88 lb in)
2	Instrument Panel Lower Trim Panel Screws (Qty 4) **Tighten:** 2 N.m (18 lb in)
3	Instrument Panel Lower Trim Panel Assembly **Tip:** 1. Note routing of the wiring harness prior to removal to aid in the reinstallation. 2. Disconnect all electrical connections to the trim panel.

LOWER INSTRUMENT PANEL (I/P) TRIM PANEL REPLACEMENT - (MONTE CARLO)

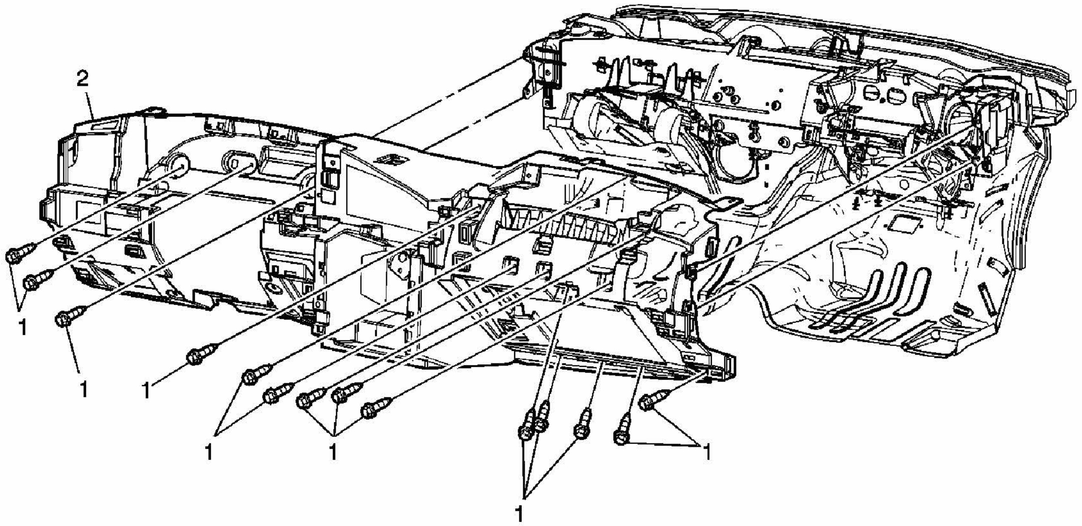


Fig. 48: Replacing Lower Instrument Panel (I/P) Trim Panel
Courtesy of GENERAL MOTORS CORP.

Instrument Panel (I/P) Trim Panel Replacement - Lower (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	

Preliminary Procedures

1. Remove the instrument panel upper trim pad. Refer to **Trim Pad Replacement - Instrument Panel (I/P) Upper (Impala)** or **Trim Pad Replacement - Instrument Panel (I/P) Upper (Monte Carlo)**.
2. Remove the headlamp switch. Refer to **Headlamp Switch Replacement (Impala)** or **Headlamp Switch Replacement (Monte Carlo)** .
3. Remove the instrument panel cluster assembly. Refer to **Instrument Panel Cluster (IPC) Replacement (Impala)** or **Instrument Panel Cluster (IPC) Replacement (Monte Carlo)**.
4. Remove the instrument panel lower center trim panel. Refer to **Trim Replacement - Instrument Panel (I/P) Lower Center**.
5. Remove the right and left insulator panels. Refer to **Closeout/Insulator Panel Replacement - Right** and **Closeout/Insulator Panel Replacement - Left**.
6. Remove the drivers knee bolster reinforcement. Refer to **Knee Bolster Reinforcement Replacement (Impala)** or **Knee Bolster Reinforcement Replacement (Monte Carlo)**.
7. Remove the steering column. Refer to **Steering Column Replacement** .
8. Remove the radio. Refer to **Radio Replacement** .
9. Remove the HVAC control module. Refer to **HVAC Control Assembly Replacement** .

1	Lower Instrument Panel Trim Panel Bolts (Qty: 14) **Tighten:** 2 N.m (18 lb in)
2	Lower Instrument Panel Trim Panel Assembly **Tip:** 1. Note routing of the wiring harness prior to removal of the lower instrument panel, to aid in the reinstallation. 2. Disconnect all electrical connections to the trim panel. 3. With the aid of an assistant remove the lower instrument panel from the vehicle.

INSTRUMENT PANEL (I/P) CARRIER REPLACEMENT

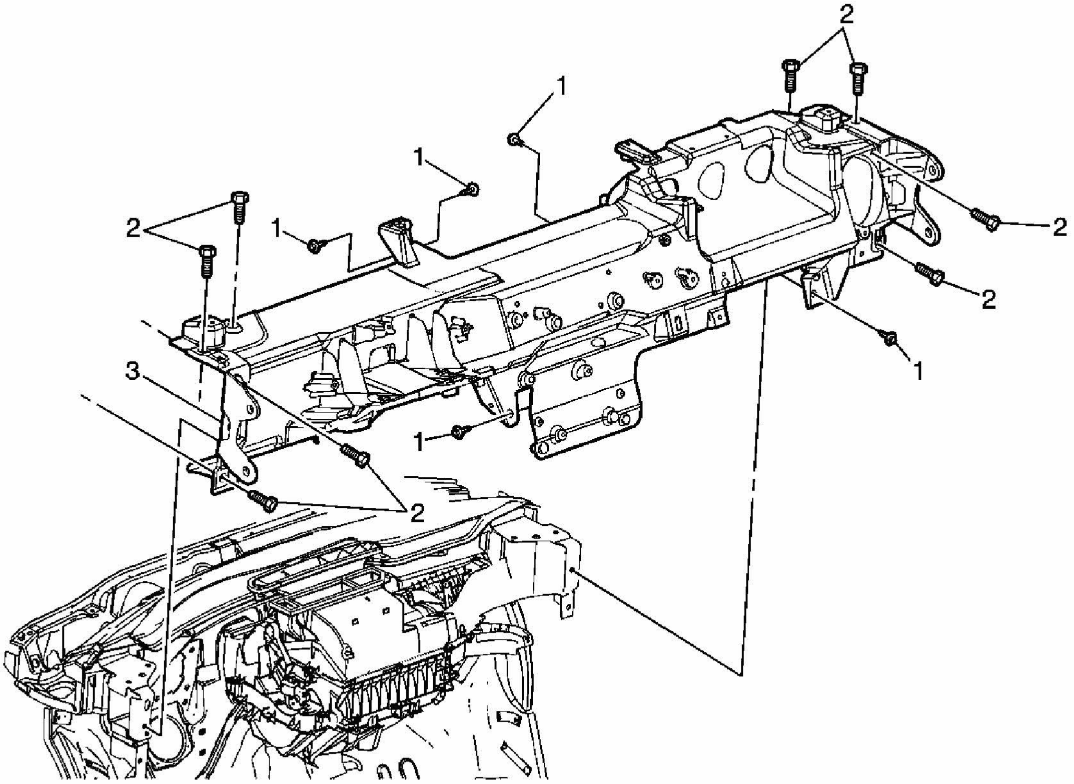


Fig. 49: Replacing Instrument Panel (I/P) Carrier
Courtesy of GENERAL MOTORS CORP.

Instrument Panel (I/P) Carrier Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the Instrument Panel Lower Trim Panel. Refer to **Instrument Panel (I/P) Trim Panel Replacement - Lower (Impala)** or **Instrument Panel (I/P) Trim Panel Replacement - Lower (Monte Carlo)**. 2. Remove the Drivers Knee Bolster Brackets. Refer to **Knee Bolster Bracket Replacement - Left**. 3. Remove the Passenger Knee Bolster Bracket. Refer to **Knee Bolster Bracket Replacement - Right**. 4. Remove the Instrument Panel Center Support Bracket. Refer to **Bracket**	

Replacement - Instrument Panel (I/P) Center Support.

5. Remove the Air Distributor Duct Assembly. Refer to **Air Distributor Duct Replacement** .
6. Remove the Right Air Outlet Duct Assembly. Refer to **Air Outlet Duct Replacement - Instrument Panel (I/P) - Upper Right** .

1	Bolt, Instrument Panel Carrier to HVAC Module (Qty 5) **Tighten:** 4 N.m (35 lb in)
2	Bolt, Instrument Panel Carrier to Body (Qty 8) **Tighten:** 25 N.m (18 lb ft)
3	Carrier Assembly, Instrument Panel **Tip:** 1. Note routing of the wiring harness to aid in the reinstallation. 2. With the aid of an assistant, remove from the vehicle. 3. Remove the Defroster Air Outlet Duct Assembly. Refer to **Air Outlet Duct Replacement - Defroster**

CONSOLE COMPARTMENT DOOR REPLACEMENT - (MONTE CARLO)

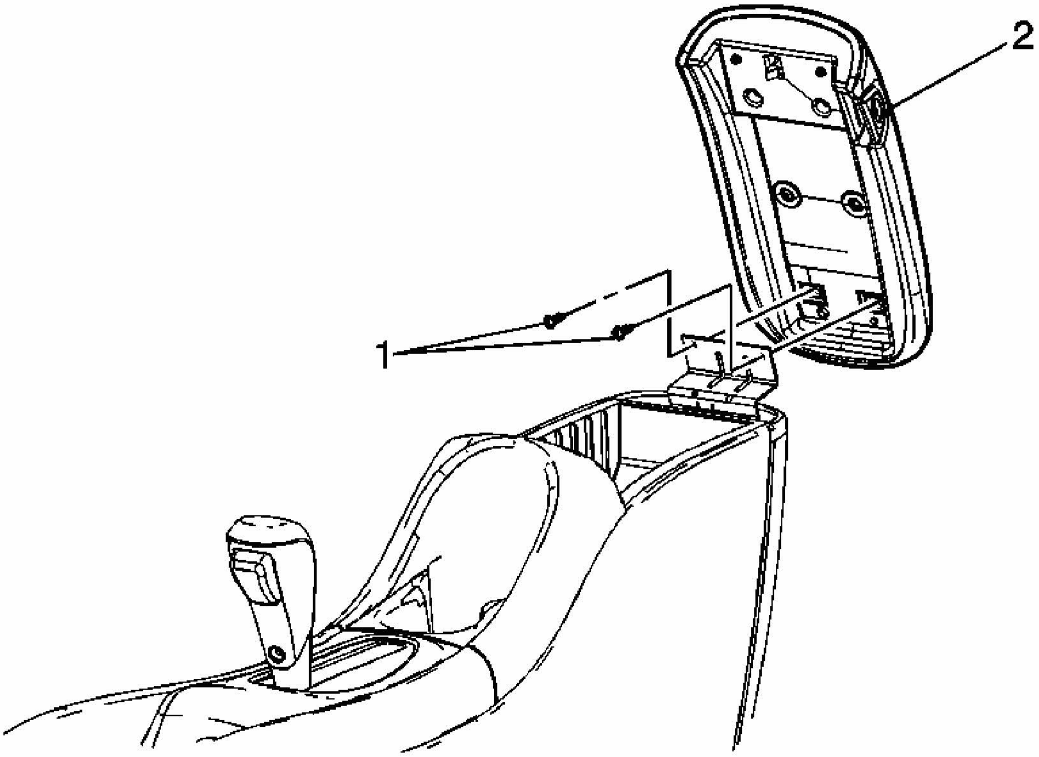


Fig. 50: Replacing Console Compartment Door
Courtesy of GENERAL MOTORS CORP.

Door Replacement - Console Compartment (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Front Floor Console Door Screws (Qty 4) **Tighten:** 2 N.m (18 lb in)
2	Front Floor Console Door Assembly

CONSOLE COMPARTMENT DOOR HINGE REPLACEMENT (MONTE CARLO)

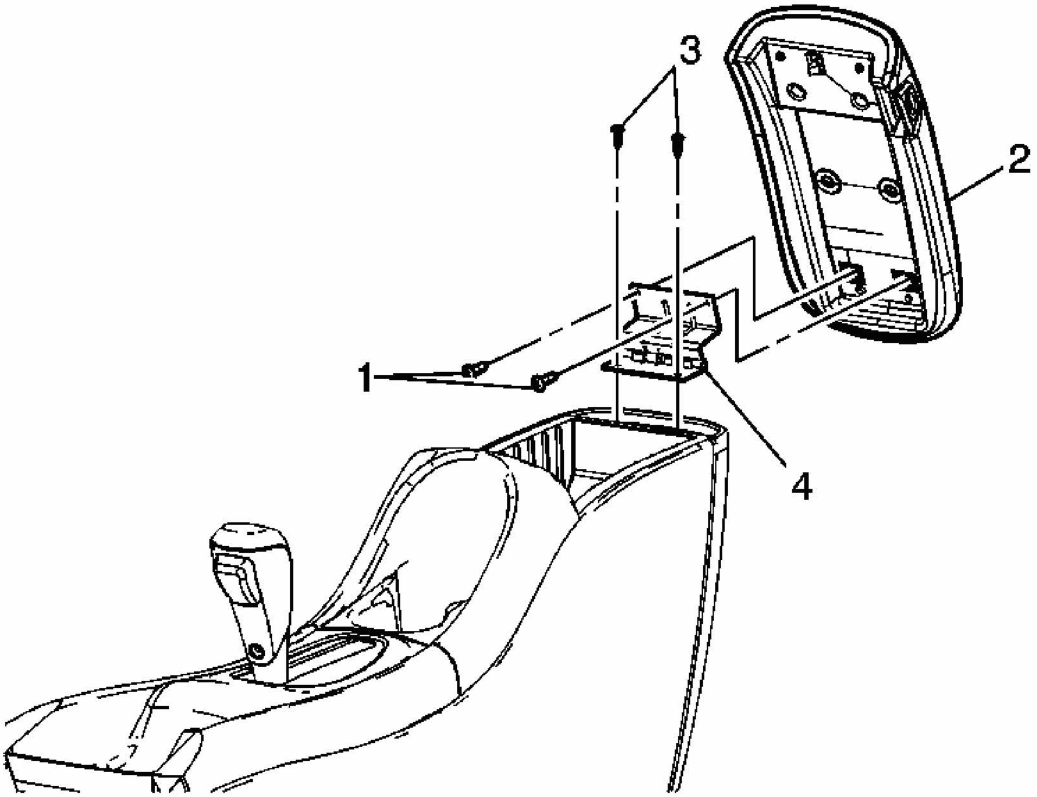


Fig. 51: Replacing Console Compartment Door Hinge
Courtesy of GENERAL MOTORS CORP.

Console Compartment Door Hinge Replacement (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Front Floor Console Door Screws (Qty 2) **Tighten:** 2 N.m (18 lb in)
2	Front Floor Console Door Assembly
3	Front Floor Console Hinge Screws (Qty 2) **Tighten:** 2 N.m (18 lb in)
4	Front Floor Console Door Hinge

CONSOLE COMPARTMENT DOOR LATCH REPLACEMENT - (IMPALA)

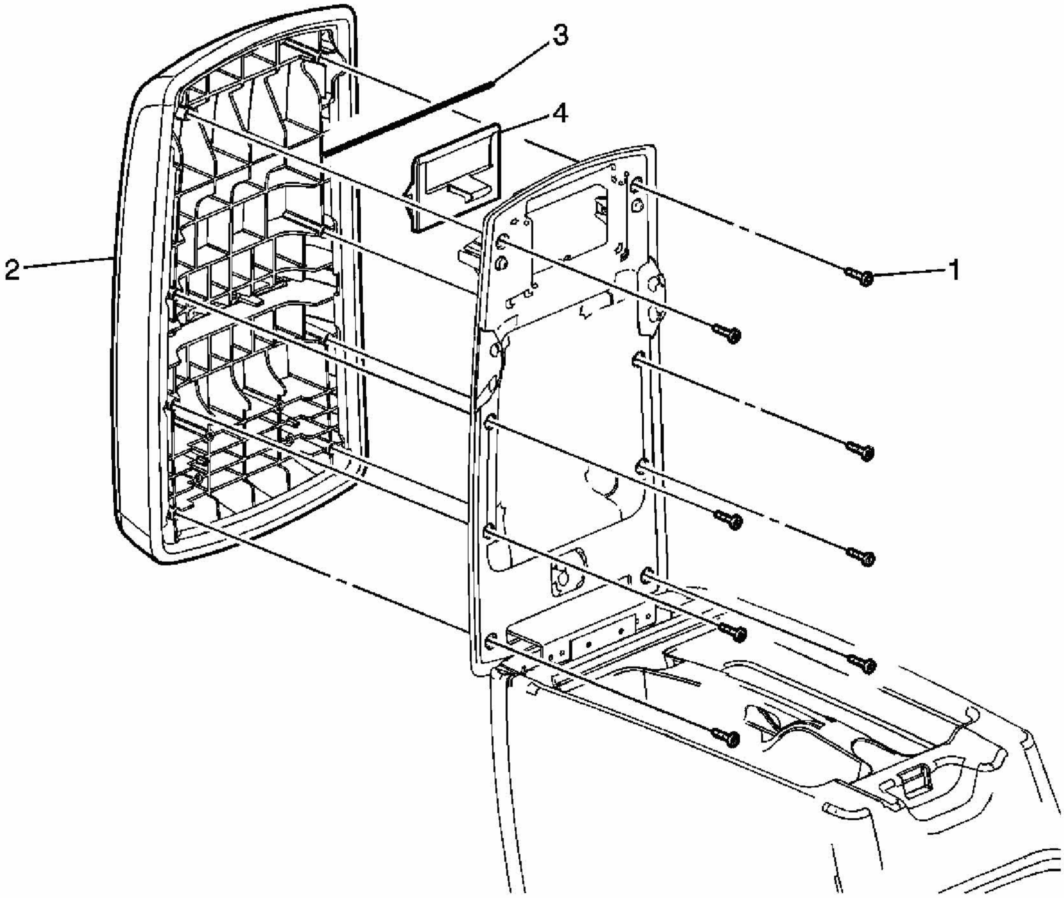


Fig. 52: Replacing Console Compartment Door Latch
Courtesy of GENERAL MOTORS CORP.

Latch Replacement - Console Compartment Door (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Front Floor Console Armrest Inner Screws (Qty 8) **Tighten:** 2 N.m (18 lb in)
2	Front Floor Console Armrest Cover Assembly **Tip:** Separate the armrest cover assembly from the inner panel.
3	Front Floor Console Armrest Latch Spring
4	Front Floor Console Armrest Latch Assembly

CONSOLE COMPARTMENT DOOR LATCH REPLACEMENT - (MONTE CARLO)

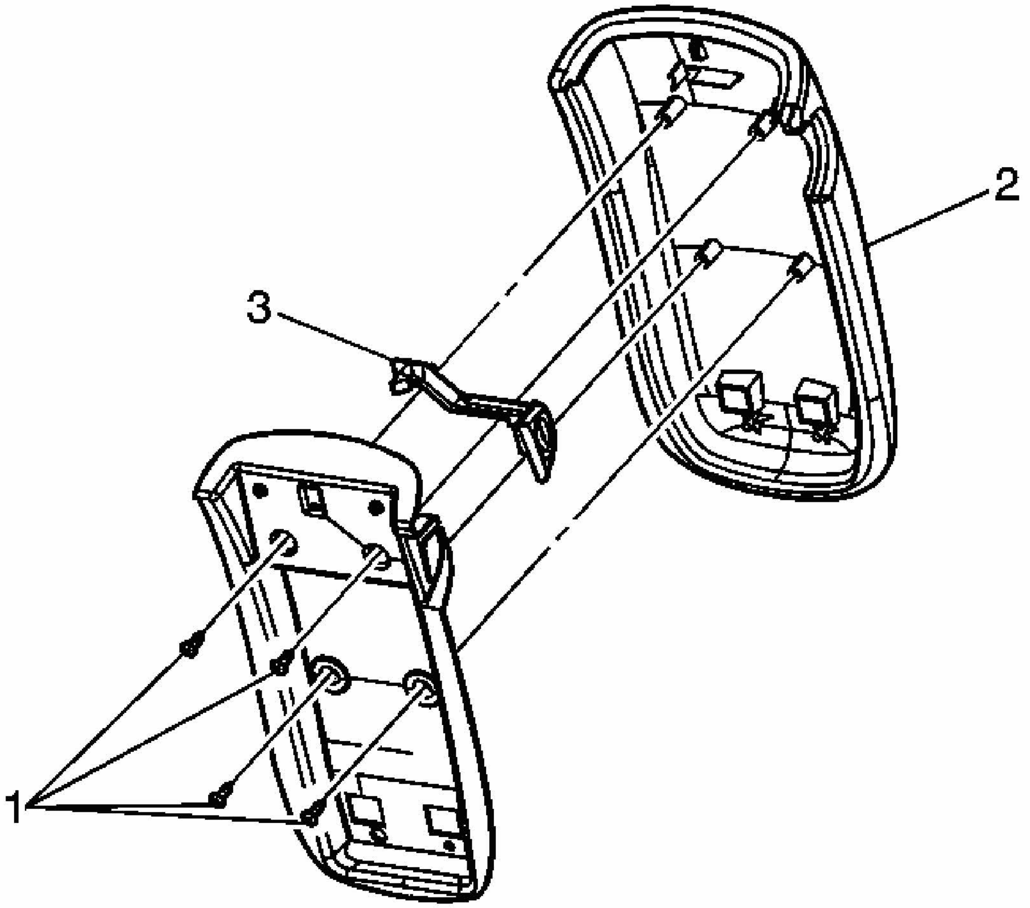


Fig. 53: Replacing Console Compartment Door Latch
Courtesy of GENERAL MOTORS CORP.

Latch Replacement - Console Compartment Door (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the Front Floor Console Door Assembly. Refer to **Door Replacement - Console Compartment (Monte Carlo)**.	
1	Front Floor Console Door Inner Screws (Qty 4) **Tighten:** 2 N.m (18 lb in)

2	Front Floor Console Door Cover Assembly
3	Front Floor Console Door Latch

CONSOLE UPPER TRIM PLATE REPLACEMENT - (MONTE CARLO)

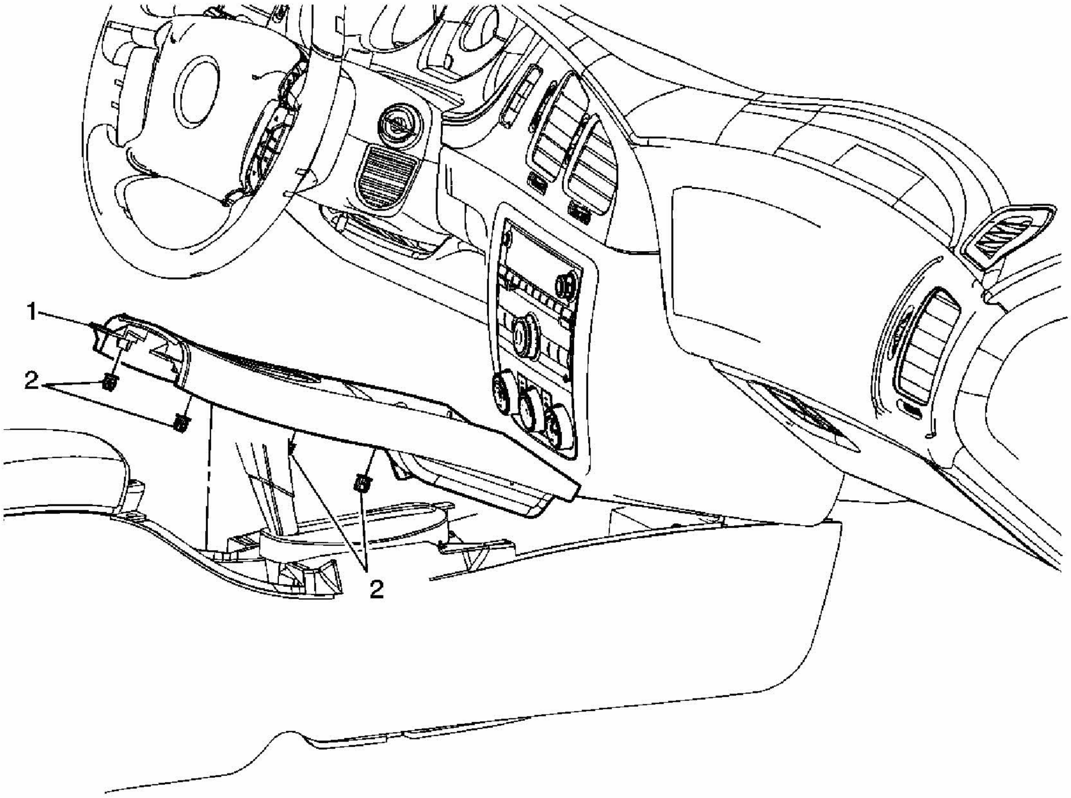


Fig. 54: Replacing Console Upper Trim Plate
Courtesy of GENERAL MOTORS CORP.

Trim Plate Replacement - Console Upper (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Place the front floor shifter in the Neutral position. 2. Remove the front floor console cupholder assembly. Refer to **Cupholder Replacement - Front Floor Console (Impala)** or **Cupholder Replacement - Front Floor Console (Monte Carlo)**.	
1	Front Floor Console Trim Plate
2	Retainer Clips (Qty: 4)

CONSOLE REAR TRIM PLATE REPLACEMENT - (IMPALA)

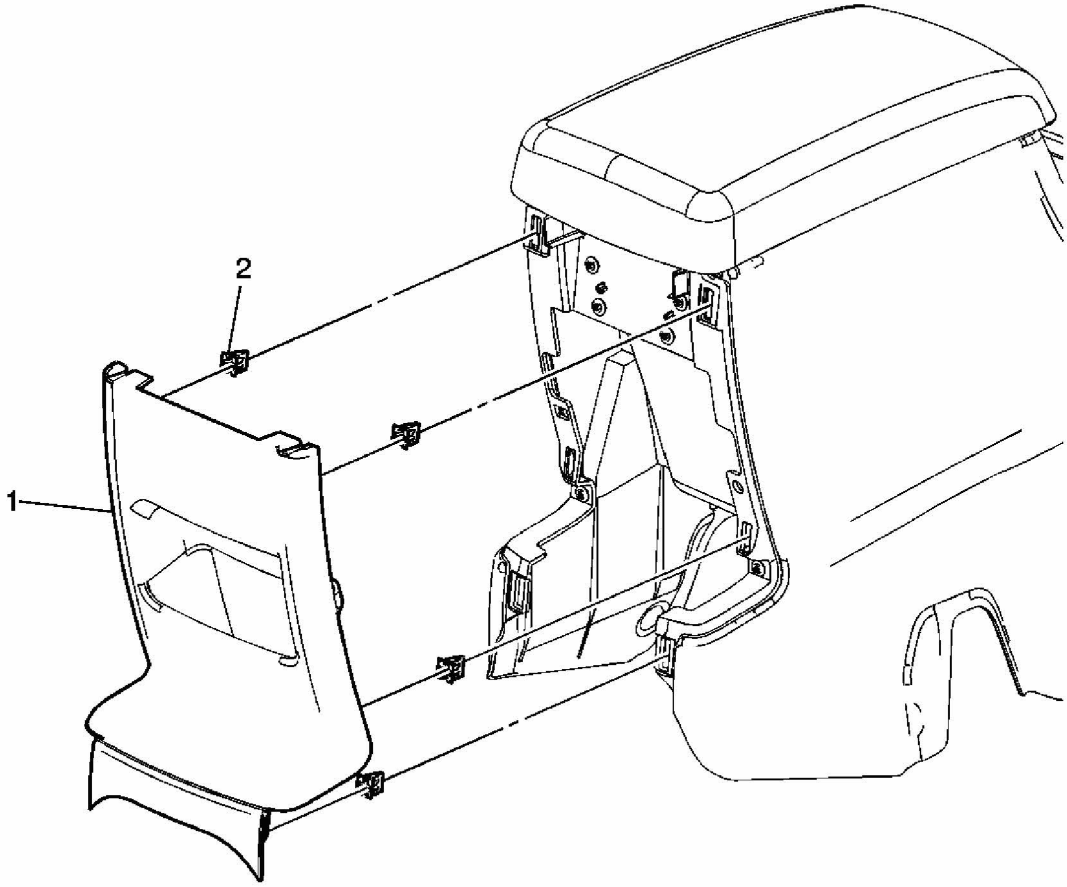


Fig. 55: Replacing Console Rear Trim Plate
Courtesy of GENERAL MOTORS CORP.

Trim Plate Replacement - Console Rear (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Plate Assembly, Front Floor Console
2	Clip, Retainer (Qty 6)

CONSOLE FRONT TRIM PLATE REPLACEMENT - (IMPALA)

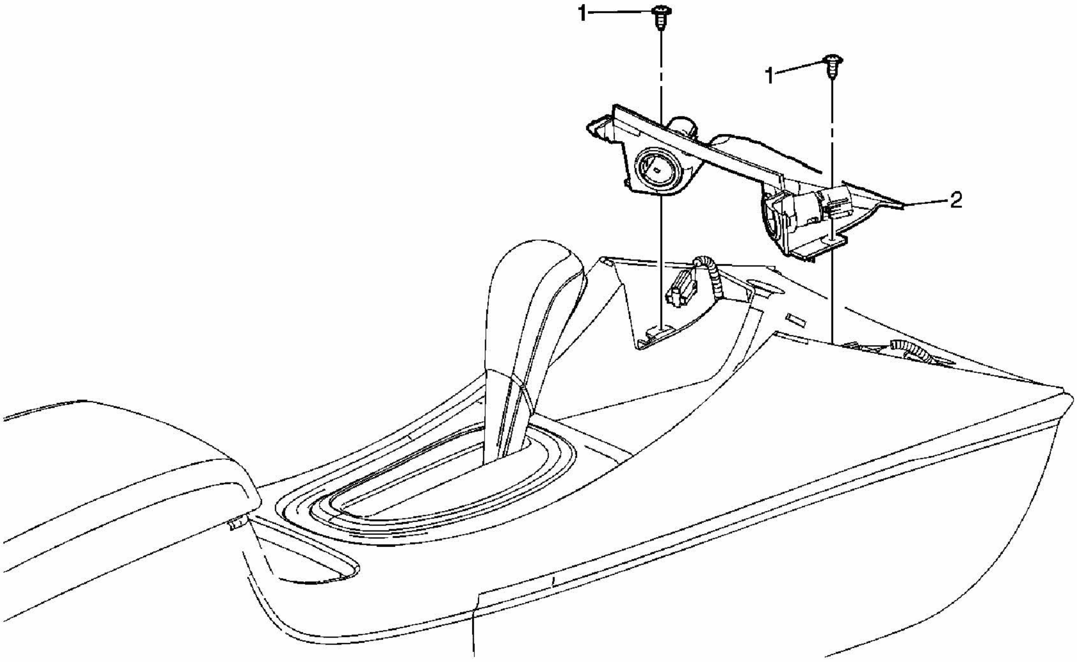


Fig. 56: Replacing Console Front Trim Plate
Courtesy of GENERAL MOTORS CORP.

Trim Plate Replacement - Console Front (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the Front Floor Console. Refer to **Console Replacement - Front Floor (Impala)** or **Console Replacement - Front Floor (Monte Carlo)**.	
1	Screw, Front Floor Console Trim Panel (Qty 2) **Tighten:** 2 N.m (18 lb in)
2	Panel Assembly, Front Floor Console Trim **Tip:** 1. Disconnect electrical connectors. 2. Remove the 12 volt Accessory Power Receptacles. Refer to **Cigar Lighter Housing or 12 Volt Accessory Power Receptacle Replacement** .

CONSOLE SHIFT LEVER BEZEL REPLACEMENT (IMPALA)

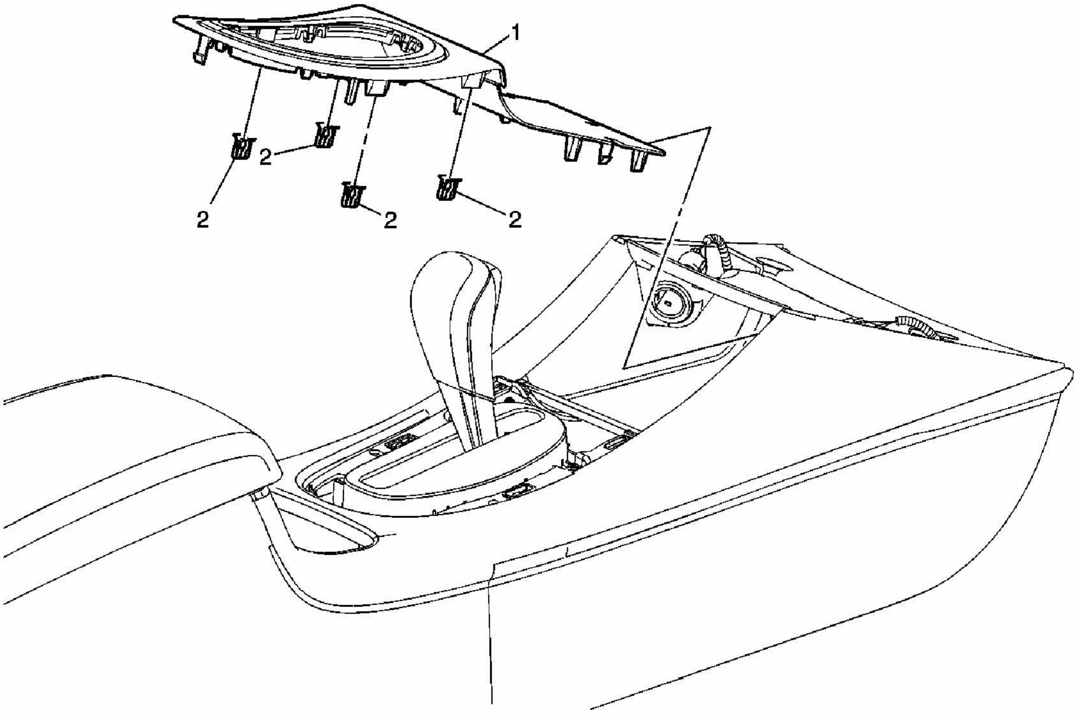


Fig. 57: Replacing Console Shift Lever Bezel
Courtesy of GENERAL MOTORS CORP.

Console Shift Lever Bezel Replacement (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Bezel Assembly, Console Shift Lever **Tip:** 1. Block the drive wheels. 2. Move shift lever to the neutral position. 3. Use a flat bladed plastic trim tool to aid in the removal of the shift bezel.
2	Clip, Retainer (Qty 4)

FRONT FLOOR CONSOLE REPLACEMENT - (IMPALA)

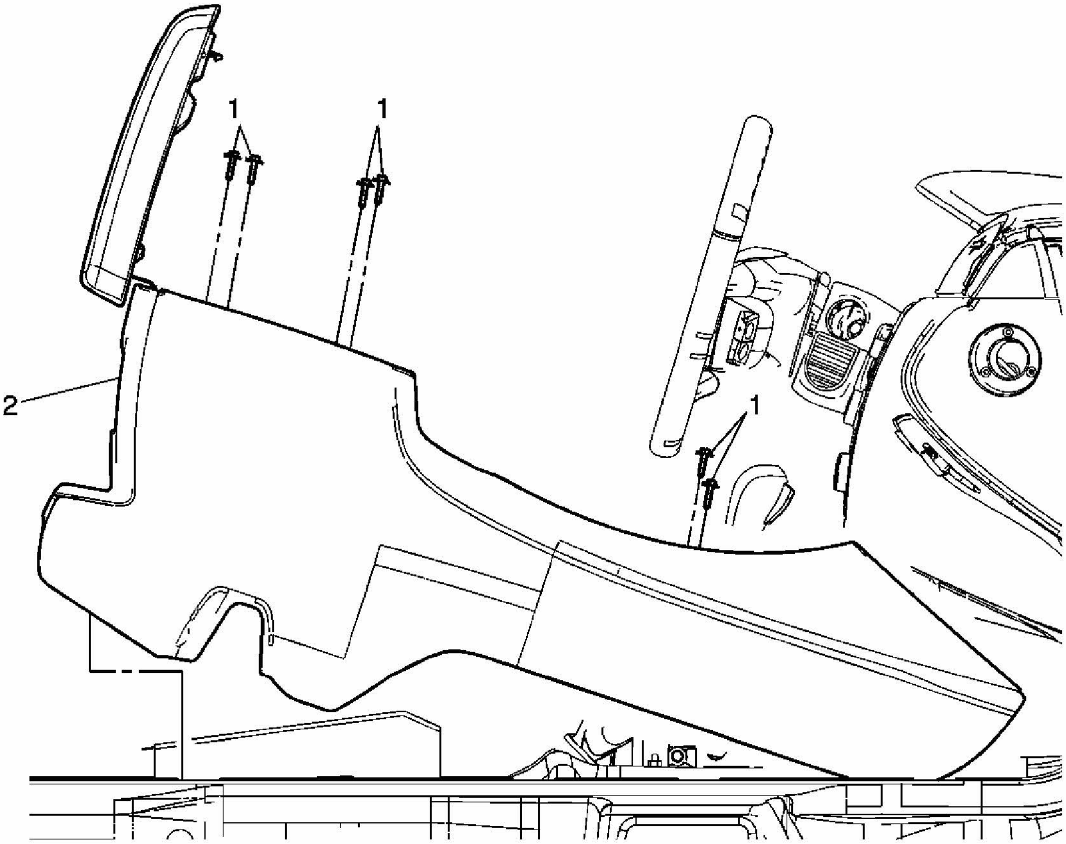


Fig. 58: Replacing Front Floor Console
Courtesy of GENERAL MOTORS CORP.

Console Replacement - Front Floor (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the Front Floor Console Bin Liner. 2. Remove the Console Shift Lever Bezel. Refer to **Console Shift Lever Bezel Replacement (Impala)**	
1	Front Floor Console Bolts (Qty 6) **Tighten:** 7 N.m (62 lb in)
	Front Floor Console Assembly

2	**Tip:** Disconnect the electrical connector.

FRONT FLOOR CONSOLE REPLACEMENT - (MONTE CARLO)

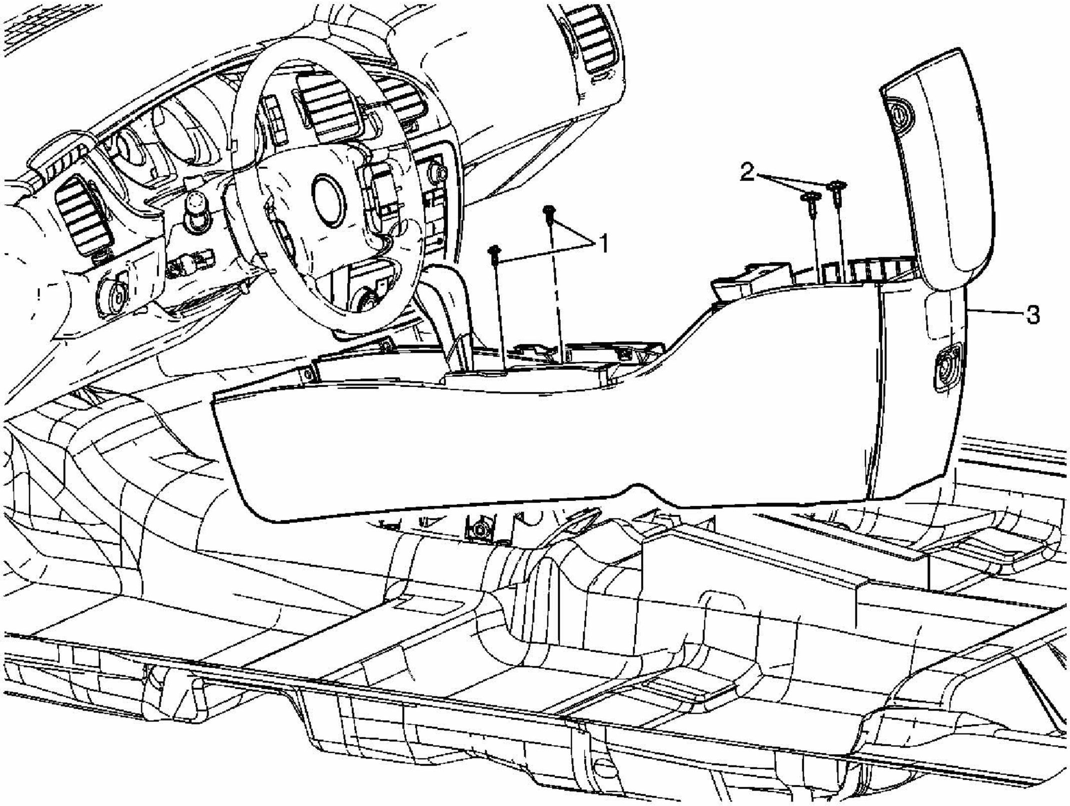


Fig. 59: Replacing Front Floor Console
Courtesy of GENERAL MOTORS CORP.

Console Replacement - Front Floor (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the Front Floor Console Upper Trim Plate Assembly. Refer to **Trim Plate Replacement - Console Upper (Monte Carlo)**.	
1	Front Floor Console Screws (Qty 2) **Tighten:** 7 N.m (62 lb in)
2	Front Floor Console Bolts (Qty 2)

	Tighten: 7 N.m (62 lb in)
3	Front Floor Console Assembly **Tip:** Disconnect the electrical connectors.

CONSOLE FLOOR BRACKET REPLACEMENT

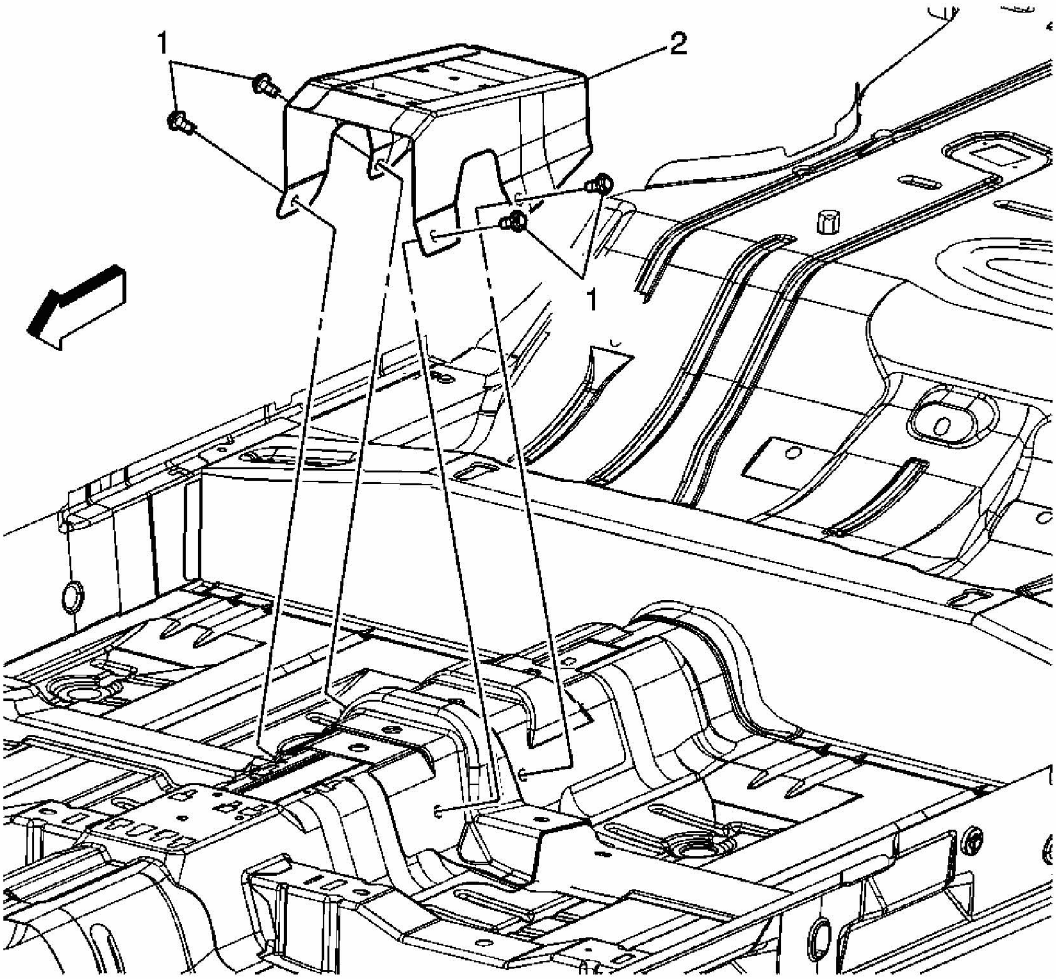


Fig. 60: Replacing Console Floor Bracket
Courtesy of GENERAL MOTORS CORP.

Bracket Replacement - Console Floor

Callout	Component Name
NOTE: Refer to Fastener Notice in Cautions and Notices. **Fastener Tightening Specifications:** Refer to **Fastener Tightening**	

Specifications. **Preliminary Procedure:** Remove the Front Floor Console. Refer to **Console Replacement - Front Floor (Impala)** or **Console Replacement - Front Floor (Monte Carlo)**.	
1	Front Floor Console Reinforcement Bracket Bolts (Qty 4) **Tip:** Pull the carpet back enough to access the bolts. **Tighten:** 44 N.m (32 lb ft)
2	Front Floor Console Reinforcement Bracket Assembly

FRONT FLOOR CONSOLE ARMREST REPLACEMENT - (IMPALA)

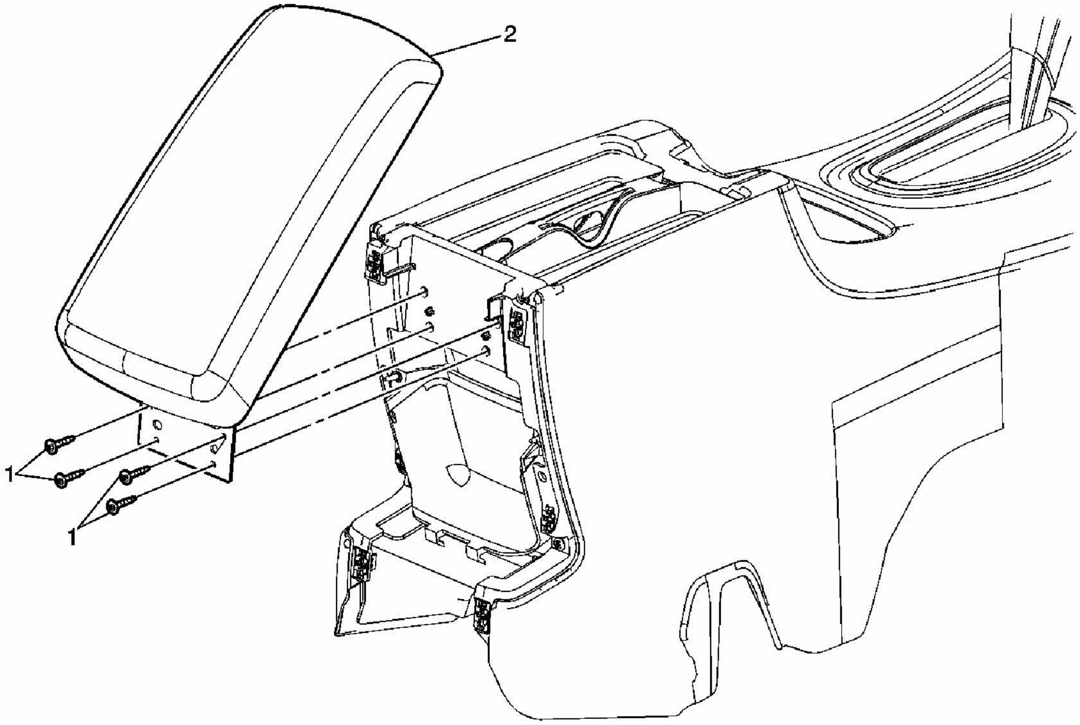


Fig. 61: Replacing Front Floor Console Armrest
Courtesy of GENERAL MOTORS CORP.

Console Armrest Replacement - Front Floor (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the Front Floor Console Rear Trim Plate. Refer to **Trim Plate Replacement - Console Rear (Impala)**.	

1	Screw, Front Floor Console Armrest Hinge (Qty 4) **Tighten:** 2 N.m (18 lb in)
2	Armrest Assembly, Front Floor Console

FLOOR CONSOLE ARM REST HINGE REPLACEMENT - (IMPALA)

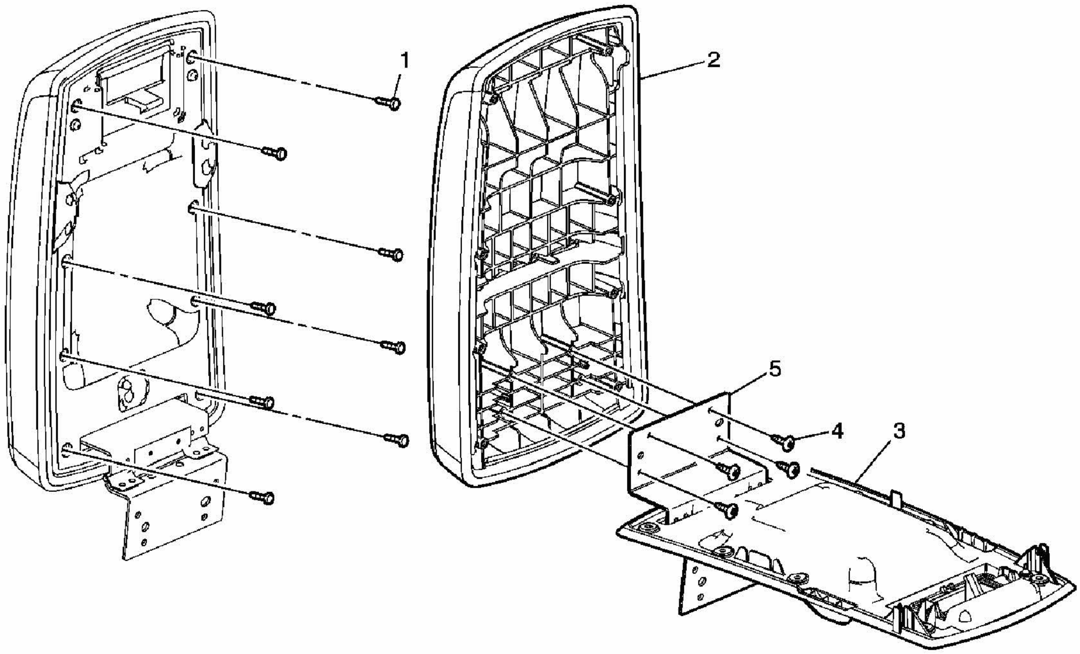


Fig. 62: Replacing Floor Console Arm Rest Hinge
Courtesy of GENERAL MOTORS CORP.

Hinge Replacement - Floor Console Arm Rest (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the Front Floor Console Armrest Assembly. Refer to **Hinge Replacement - Floor Console Arm Rest (Impala)**.	
1	Screw, Front Floor Console Armrest (Qty 8) **Tighten:** 2 N.m (18 lb in)
2	Armrest Assembly, Front Floor Console Armrest **Tip:** Separate the armrest cover assembly from the inner panel.
3	Panel, Front Floor Console Armrest Inner

	Tip: Rotate the inner panel in order to access the hinge screws.
4	Screws, Front Floor Console Armrest Hinge (Qty 4) **Tighten:** 2 N.m (18 lb in)
5	Hinge Assembly, Front Floor Console Armrest **Tip:** Remove the hinge from the inner panel.

FRONT FLOOR CONSOLE CUPHOLDER REPLACEMENT - (IMPALA)

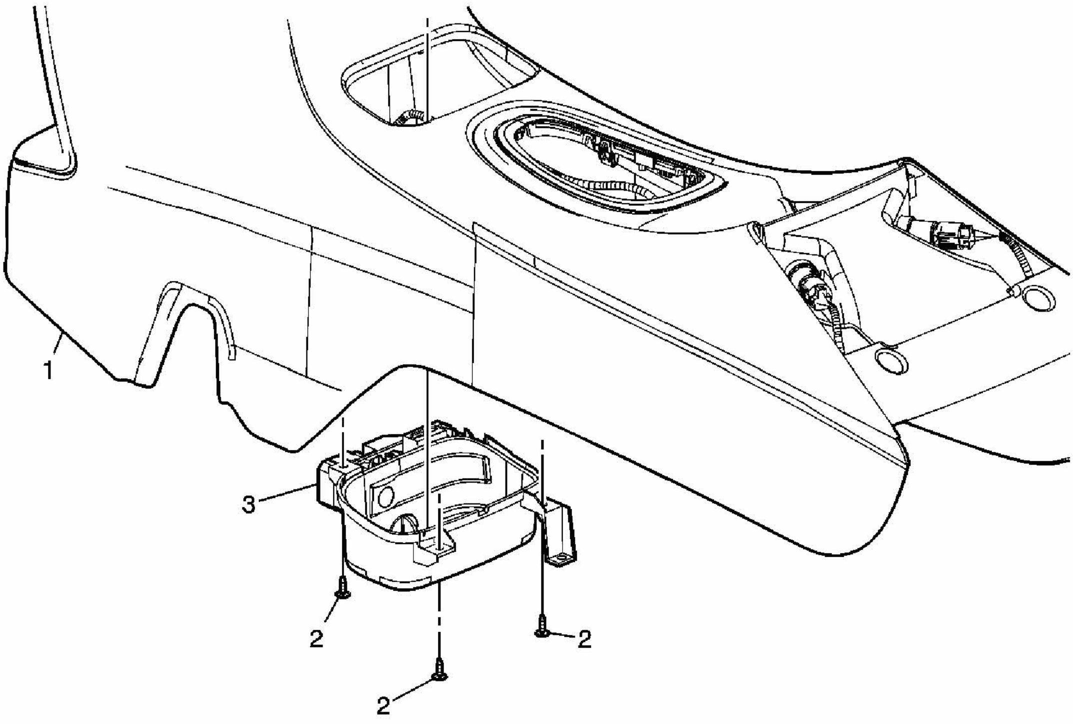


Fig. 63: Replacing Front Floor Console Cupholder
Courtesy of GENERAL MOTORS CORP.

Cupholder Replacement - Front Floor Console (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice in Cautions and Notices.** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Front Floor Console **Tip:** Remove the front floor console. Refer to **Console Replacement - Front Floor (Impala)** or **Console Replacement - Front Floor (Monte Carlo)**.

2	Front Floor Console Cup Holder Screw (Qty: 3) **Tighten:** 2 N.m (18 lb in)
3	Front Floor Console Cup Holder Assembly

FRONT FLOOR CONSOLE CUPHOLDER REPLACEMENT - (MONTE CARLO)

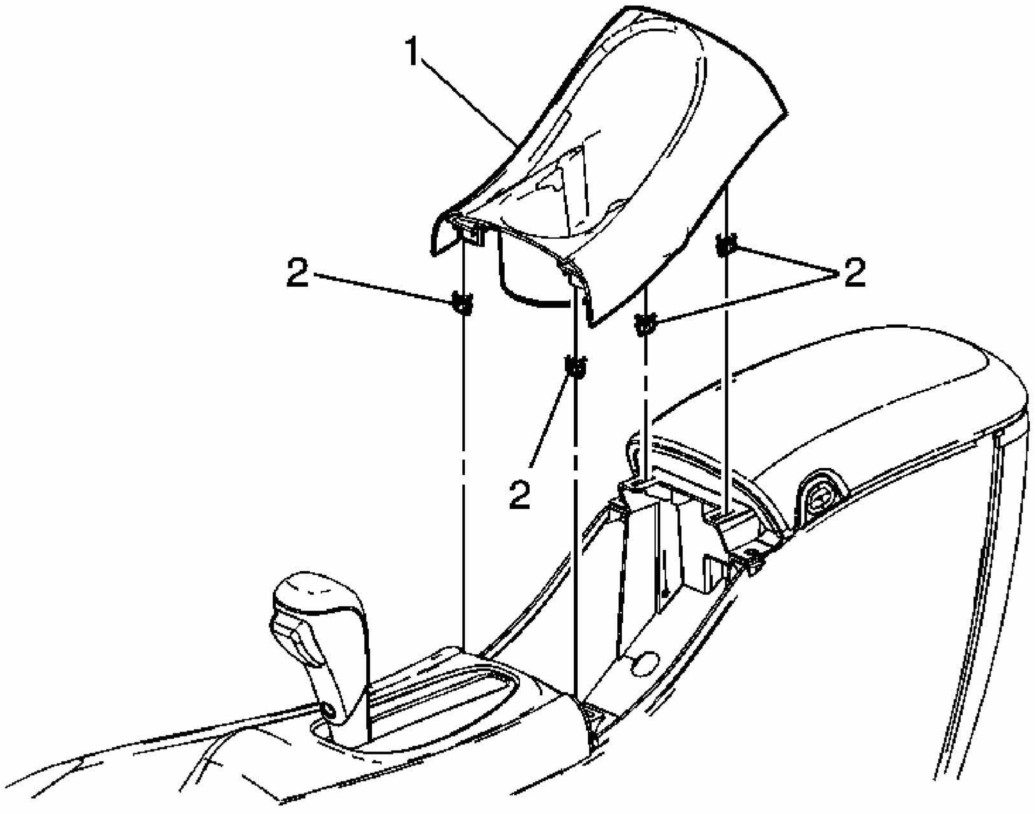


Fig. 64: Replacing Front Floor Console Cupholder
Courtesy of GENERAL MOTORS CORP.

Cupholder Replacement - Front Floor Console (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Front Floor Console Cupholder Assembly
2	Retainer Clip (Qty 4)

DESCRIPTION AND OPERATION

INSTRUMENT PANEL CLUSTER (IPC) DESCRIPTION AND OPERATION

Displays Test

Certain instrument panel cluster (IPC) features are tested when the ignition is turned on in order to verify the features are working properly. The following occurs at key up:

- The air bag indicator flashes 7 times (not IPC controlled).
- The ABS indicator illuminates briefly.
- The battery Indicator illuminates briefly.
- The brake indicator illuminates briefly.
- The coolant temperature indicator.
- The engine oil pressure indicator illuminates briefly.
- The malfunction indicator lamp (MIL) illuminates briefly (not IPC controlled).
- The seat belt indicator illuminates for 70 seconds or until the driver seat belt is latched (not IPC controlled).
- The security indicator illuminates briefly.
- The tire pressure low indicator
- The vehicle dynamics caution (VDC) indicator
- All message center segments illuminate briefly.
- All odometer segments illuminate briefly.
- The PRNDL segment illuminates briefly.

Indicators and Warning Messages

Refer to **Indicator/Warning Message Description and Operation**.

Engine Coolant Temperature Gage

The instrument panel cluster (IPC) displays the engine coolant temperature as determined by the engine control module (ECM) or the powertrain control module (PCM). The IPC receives a GMLAN message from the PCM indicating the engine coolant temperature. The engine coolant temperature gage defaults to 60°C (140°F) or below if:

- The ECM/PCM detects a malfunction in the engine coolant temperature sensor circuit.
- The IPC detects a loss of GMLAN communications with the ECM/PCM.
- The BCM detects a loss of GMLAN communications with the ECM/PCM.

Fuel Gage

The instrument panel cluster (IPC) displays the fuel level as determined by the ECM/PCM. The IPC receives a GMLAN message from the ECM/PCM indicating the fuel level percent. The fuel gage defaults to empty if:

- The ECM/PCM detects a malfunction in the fuel level sensor circuit.
- The IPC detects a loss of GMLAN communications with the ECM/PCM.

When the fuel level is less than a pre-determined value, the low fuel indicator illuminates in the IPC.

Odometer

The IPC contains a season odometer and trip odometer A or B. Momentarily press the trip/reset switch on the IPC in order to toggle between the season odometer and the trip odometer. Press the trip/reset switch for greater than 2 seconds, while the trip odometer is displayed, in order to reset the trip odometer. The IPC displays the vehicle mileage and trip mileage as determined by the IPC. The IPC calculates the mileage based on the GMLAN vehicle speed information from the ECM/PCM. The odometer will display 'error' if an internal IPC memory failure is detected. The odometer displays either miles or kilometers as requested by the activation of the English/metric button on the IPC.

PRNDL Display

The IPC displays the selected gear position as determined by the ECM/PCM. The IPC receives a GMLAN message from the ECM/PCM indicating the gear position. The PRNDL display blanks if:

- The ECM/PCM detects a malfunction in the transmission range switch circuit.
- The IPC detects a loss of GMLAN communications with the ECM/PCM.

Speedometer

The IPC displays the vehicle speed as determined by the ECM/PCM. The IPC calculates the mileage based on the GMLAN vehicle speed information from the ECM/PCM. The speedometer defaults to 0 km/h (0 mph) if the IPC detects a loss of GMLAN communications with both the ECM/PCM.

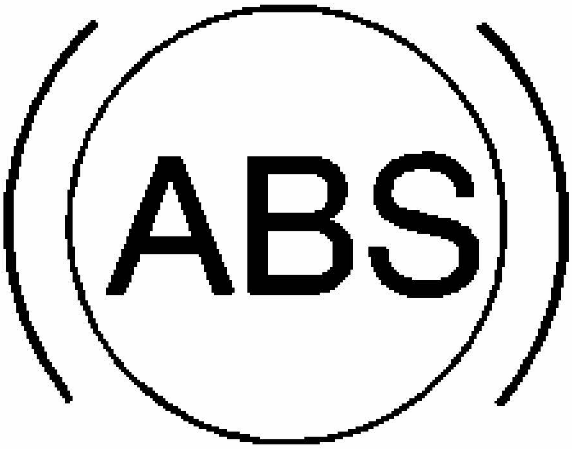
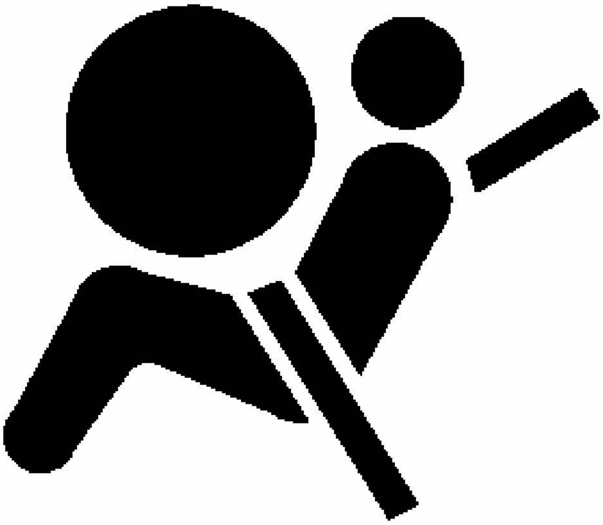
Tachometer

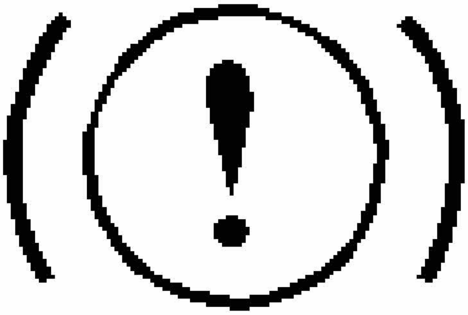
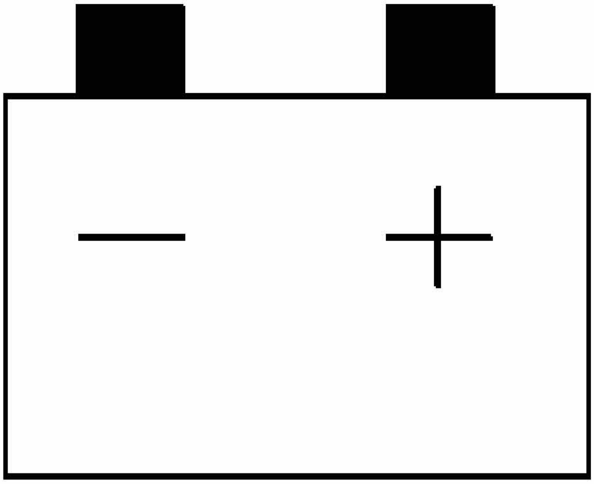
The IPC displays the engine speed as determined by the ECM/PCM. The IPC receives a GMLAN message from the ECM/PCM indicating the engine speed. The tachometer will default to 0 rpm if:

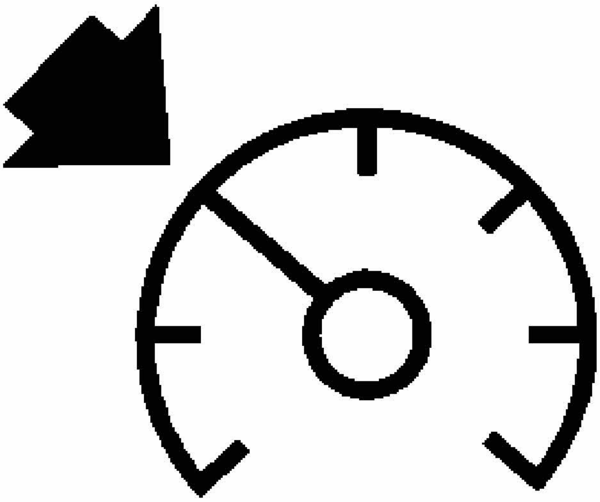
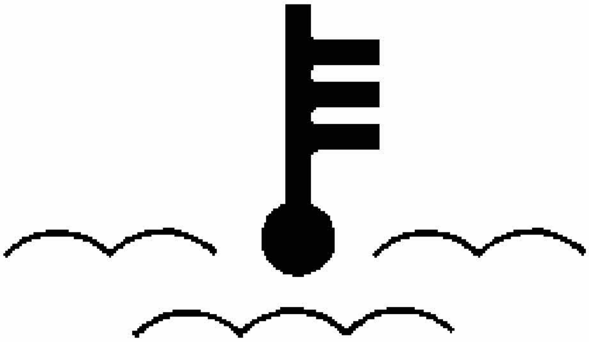
- The ECM/PCM detects a malfunction in the engine speed sensor circuit.
- The IPC detects a loss of GMLAN communications with the ECM/PCM.

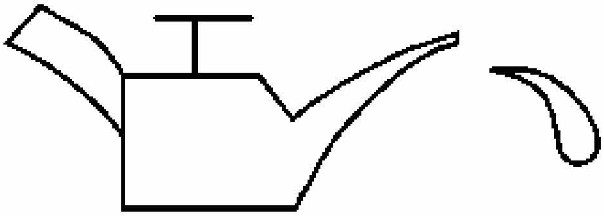
INDICATOR/WARNING MESSAGE DESCRIPTION AND OPERATION

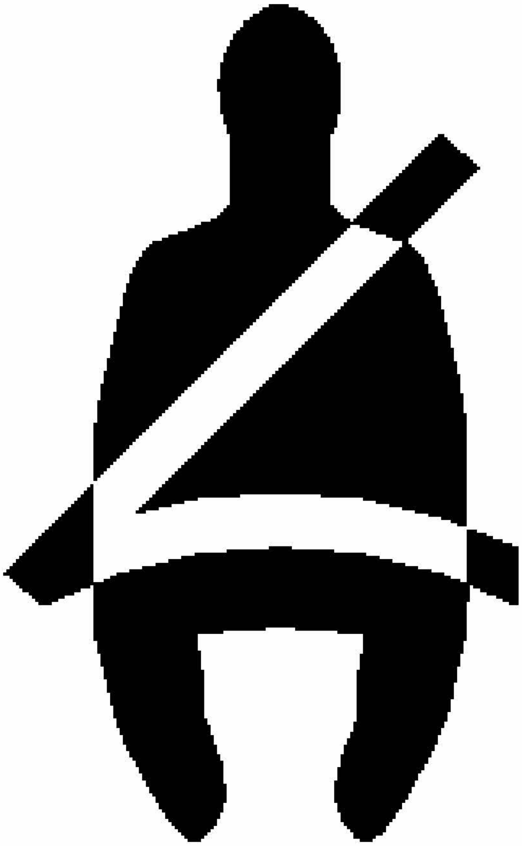
IPC Indicators

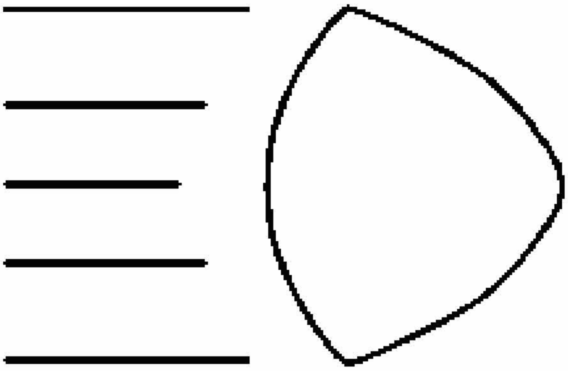
Symbol	Description
	ABS: Refer to **ABS Description and Operation**
	Air Bag: Refer to **SIR System Description and Operation**

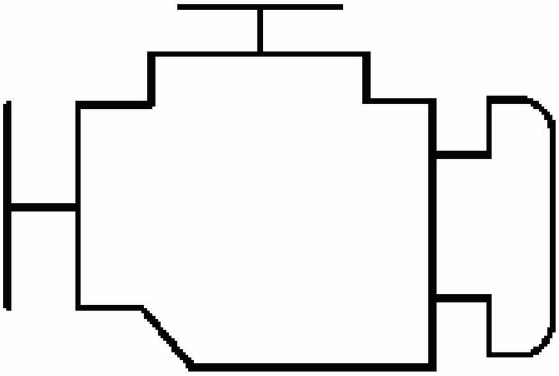
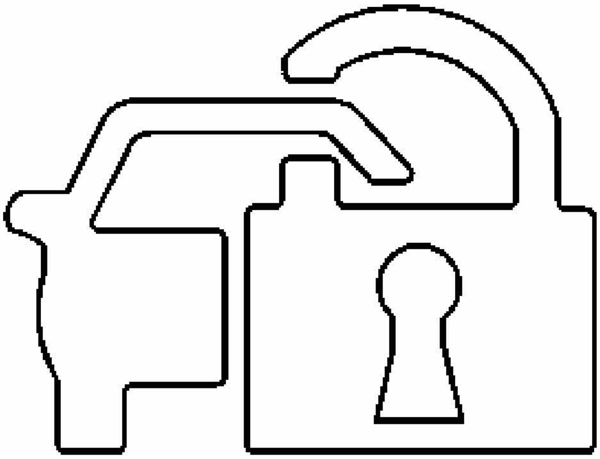
 (Export) BRAKE (Domestic)	Brake: Refer to **Brake Warning System Description and Operation**
	Charge: Refer to **Charging System Description and Operation**

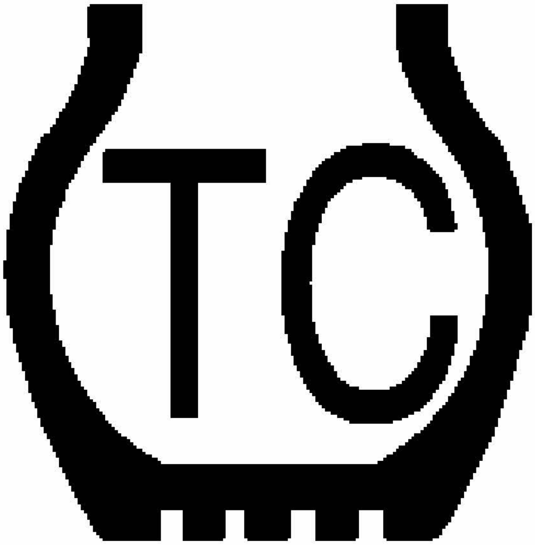
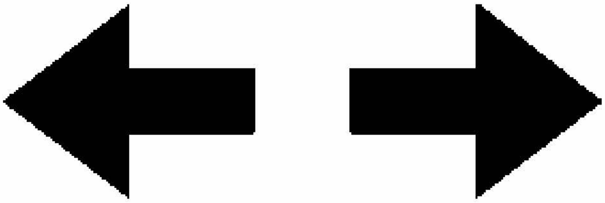
	Cruise: Refer to **Cruise Control Description and Operation**
	Engine Coolant Temperature: Refer to **Cooling System Description and Operation**
	Engine Oil Pressure: Refer to Indicator/Warning Message

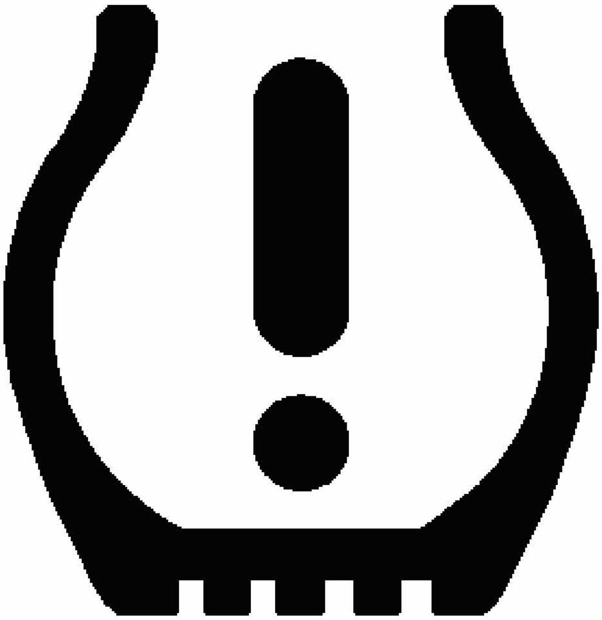
	Description and Operation
	Fasten Safety Belt: Refer to **Seat Belt System Description and Operation**

	
	Front Fog Lamps: Refer to **Exterior Lighting Systems**

	Description and Operation
	High Beam: Refer to **Exterior Lighting Systems Description and Operation**
km/h	km/h: Refer to Indicator/Warning Message Description and Operation
	Malfunction Indicator Lamp (MIL): Refer to **Engine Control Module (ECM) Description** for the 3.5L engine, **Engine Control Module (ECM) Description** for the 3.9L engine or to **Engine Control Module (ECM) Description** for

	the 5.3L engine
MPH	MPH: Refer to **Indicator/Warning Message Description and Operation**
	Security: Refer to **Vehicle Theft Deterrent (VTD) Description and Operation**

	Traction Control : Refer to **ABS Description and Operation**
	Turn Signals: Refer to **Exterior Lighting Systems Description and Operation**

	Tire Pressure Low: Refer to **Tire Pressure Monitor Description and Operation**
VEHICLE DYNAMICS CAUTION (VDC) INDICATOR	VDC: Refer to **Engine Control Module (ECM) Description**

DIC Warning Messages

Symbol	Description
AIRBAG FAILED	Refer to **Exterior Lighting Systems Description and Operation**
AUTOMATIC LIGHTS CONTROL OFF	Refer to **Exterior Lighting Systems Description and Operation**
AUTOMATIC LIGHTS CONTROL ON	Refer to **Exterior Lighting Systems Description and Operation**
BATTERY SAVER ACTIVE	Refer to **Charging System Description and Operation**
BRAKE FLUID LOW ADD BRAKE FLUID	Brake: Refer to **Brake Warning System Description and Operation**
BUCKLE PASSENGER SEAT BELT	Refer to **Seat Belt System Description and Operation**
BUCKLE SEATBELT	Refer to **Seat Belt System Description and Operation**
CALIBRATING: DRIVE IN CIRCLES	Refer to **Electronic Compass Calibration**

CALIBRATION COMPLETE	Refer to **Electronic Compass Calibration**
CHANGE ENGINE OIL SOON	Refer to **Indicator/Warning Message Description and Operation**
CHECK TIRE PRESSURE (if equipped)	Refer to **Tire Pressure Monitor Description and Operation**
CHECK LEFT FRONT TIRE PRESSURE	Refer to **Tire Pressure Monitor Description and Operation**
CHECK LEFT REAR TIRE PRESSURE	Refer to **Tire Pressure Monitor Description and Operation**
CHECK RIGHT FRONT TIRE PRESSURE	Refer to **Tire Pressure Monitor Description and Operation**
CHECK RIGHT REAR TIRE PRESSURE	Refer to **Tire Pressure Monitor Description and Operation**
COOLANT LEVEL LOW ADD COOLANT	Refer to **Cooling System Description and Operation**
CRUISE SET TO XXX	Cruise: Refer to **Cruise Control Description and Operation**
DRIVER DOOR OPEN	Refer to **Door Ajar Indicator Description and Operation**
DRIVER 1	Refer to **Indicator/Warning Message Description and Operation**
DRIVER 2	Refer to **Indicator/Warning Message Description and Operation**
ENGINE HOT TURN A/C OFF	Refer to **Cooling System Description and Operation**
ENGINE OIL LOW ADD OIL	Refer to **Indicator/Warning Message Description and Operation**
ENGINE OVERHEATED IDLE ENGINE	Refer to **Cooling System Description and Operation**
ENGINE OVERHEATED STOP ENGINE	Refer to **Cooling System Description and Operation**
ENGINE POWER REDUCED	Refer to **Throttle Actuator Control (TAC) System Description** for the 3.5L engine, **Throttle Actuator Control (TAC) System Description** for the 3.9L engine or **Throttle Actuator Control (TAC) System Description** for the 5.3L engine
FUEL LEVEL LOW	Refer to **Indicator/Warning Message Description and Operation**
HOOD OPEN	Refer to **BODY FRONT END**
HOT SHOT SYSTEM ACTIVE	Refer to **Wiper/Washer System**

	Description and Operation
HOT SHOT SYSTEM FAULT	Refer to **Wiper/Washer System Description and Operation**
ICE POSSIBLE	Refer to **Indicator/Warning Message Description and Operation**
LEFT REAR DOOR OPEN	Refer to **Door Ajar Indicator Description and Operation**
OIL PRESSURE LOW STOP ENGINE	Refer to **Indicator/Warning Message Description and Operation**
PARK ASSIST FAULT	Refer to **Park Assist Menu**
PASSENGER DOOR OPEN	Refer to **Door Ajar Indicator Description and Operation**
RAINSENSE WIPERS ACTIVE	Refer to **Wiper/Washer System Description and Operation**
REMOTE KEY LEARNING ACTIVE	Refer to **Keyless Entry System Description and Operation**
REMOTE KEY LEARNING COMPLETE	Refer to **Keyless Entry System Description and Operation**
REPLACE BATTERY IN REMOTE KEY	Refer to **Keyless Entry System Description and Operation**
RIGHT REAR DOOR OPEN	Refer to **Door Ajar Indicator Description and Operation**
SERVICE A/C SYSTEM	Refer to **AIR TEMPERATURE DESCRIPTION AND OPERATION**
SERVICE AIR BAG	Refer to **SIR System Description and Operation**
SERVICE BATTERY CHARGING SYSTEM	Refer to **Charging System Description and Operation**
SERVICE BRAKE ASSIST	Refer to **Brake Assist System Description and Operation**
SERVICE PARK ASSIST	Refer to **Park Assist Menu**
SERVICE POWER STEERING	Refer to **Power Steering System Description and Operation (w/o Electro-Hydraulic Steering)**
SERVICE STABILITYTRAK	Refer to **ABS Description and Operation**
SERVICE SUSPENSION SYSTEM	Refer to **Front Suspension Description and Operation** or **Rear Suspension Description and Operation**
SERVICE TIRE MONITOR SYSTEM	Refer to **Tire Pressure Monitor Description and Operation**
	Refer to **Vehicle Theft Deterrent (VTD)**

SERVICE THEFT SYSTEM	**Description and Operation**
SERVICE TRACTION CONTROL	Refer to **ABS Description and Operation**
SERVICE TRANSMISSION	Refer to **Electronic Component Description** for the 4T65-E transmission
SERVICE VEHICLE SOON	Refer to **Indicator/Warning Message Description and Operation**
SPEED LIMITED TO XXX	Refer to **Cruise Control Description and Operation**
STABILITY SYS ACTIVE	Refer to **ABS Description and Operation**
STABILITYTRAK NOT READY	Refer to **ABS Description and Operation**
STABILITYTRAK OFF	ABS: Refer to **ABS Description and Operation**
STARTING DISABLED SERVICE THROTTLE	Refer to **Throttle Actuator Control (TAC) System Description** for the 3.5L engine, **Throttle Actuator Control (TAC) System Description** for the 3.9L engine or **Throttle Actuator Control (TAC) System Description** for the 5.3L engine
THEFT ATTEMPTED	Refer to **Theft Systems Description and Operation**
TIGHTEN GAS CAP	Refer to **Indicator/Warning Message Description and Operation**
TIRE LEARNING ACTIVE	Refer to **Tire Pressure Monitor Description and Operation**
TIRE PRESSURE SYSTEM RESET	Refer to **Tire Pressure Monitor Description and Operation**
TRACTION CONTROL OFF	Refer to **ABS Description and Operation**
TRANS HOT IDLE ENGINE	Refer to **Electronic Component Description** for the 4T65-E transmission
TRUNK OPEN	Refer to **Luggage Compartment Description and Operation**
TURN SIGNAL ON	Refer to **Exterior Lighting Systems Description and Operation**
WAIT TO START	Refer to **Theft Systems Description and Operation**
WASHER FLUID LOW ADD FLUID	Refer to **Wiper/Washer System Description and Operation**

CHANGE ENGINE OIL

The driver information center (DIC) displays the CHANGE ENGINE OIL SOON message when the engine control module (ECM) determines that the engine oil life drops below 5 percent. The ECM sends a GMLAN message to the instrument panel cluster (IPC) requesting the CHANGE ENGINE OIL display. After the oil is changed, reset the engine oil monitor. Refer to **GM Oil Life System - Resetting** . Refer to the following before adding or changing engine oil:

- When the Low Engine Oil Level/Change Engine Oil Soon indicator displays in the IPC or DIC due to a low engine oil level condition, make sure that the ignition is turned OFF before adding or changing the oil in the vehicle. Failure to do so may result in the Low Engine Oil Level/Change Engine Oil Soon or message staying on after the engine attains proper oil level.
- When the Low Engine Oil Level/Change Engine Oil Soon indicator displays in the IPC or DIC and the ignition is not turned OFF before adding or changing the engine oil, the Low Engine Oil Level/Change Engine Oil Soon indicator may stay ON even after the proper oil level is attained. For the Low Engine Oil Level/Change Engine Oil Soon to turn OFF, the engine has to undergo a thermocycle process, refer to **Indicator/Warning Message Description and Operation**. The description of the Low Engine Oil Level/Change Engine Oil Soon in this article will outline how to clear the indicator.
- Before replacing the IPC because of the Low Engine Oil Level/Change Engine Oil Soon staying ON after an oil change or engine oil addition, it is necessary for the engine to undergo a thermocycle process as stated above. The IPC may not be malfunctioning but only needs the Low Engine Oil Level/Change Engine Oil Soon turned off. Refer to **Indicator/Warning Message Description and Operation** for an outline on how to clear the indicator. The description of the Low Engine Oil Level/Change Engine Oil Soon in this article will outline how to clear the indicator.

Driver 1 and Driver 2

The driver information center (DIC) displays Driver 1 or Driver 2 warning to notify the driver when the Driver Identifier has changed. The BCM receives a serial data message from the RCDLR when the vehicle is accessed via the key fob and depending on the key fob used, the BCM sends a driver identifier serial data message to the DIC. The DIC displays either Driver 1 or Driver 2 depending on the driver identifier serial data message from the BCM. When the driver is identified, the radio and other DIC information will revert to the last presets and settings used by the particular Driver 1 or Driver 2.

Engine Oil Pressure

The instrument panel cluster (IPC) displays the engine oil pressure as determined by the ECM. The ECM monitors the engine oil pressure sensor signal circuit to determine the engine oil pressure. When the engine oil pressure is high, the EOP sensor voltage is high and the ECM senses a high signal voltage. When the engine oil pressure is low, the EOP sensor voltage is low and the ECM/PCM senses a low signal voltage. The ECM sends the EOP information to the instrument panel cluster (IPC) via GMLAN serial data message. The instrument panel cluster (IPC) receives a GMLAN message requesting display of the engine oil pressure indicator from the ECM.

ICE POSSIBLE

The driver information center (DIC) displays ICE POSSIBLE for 10 seconds when the outside air temperature drops below 2.0°C (36°F). The instrument panel cluster (IPC) receives a GMLAN message indicating the outside air temperature from the HVAC control module

km/h and MPH

km/h

> The instrument panel cluster (IPC) displays the km/h indicator when the cluster detects that Metric units have been requested.

MPH

> The IPC displays the MPH indicator when the cluster detects that English units have been requested.

FUEL LEVEL LOW

The driver information center (DIC) displays FUEL LEVEL LOW when the instrument panel cluster (IPC) determines that the fuel level is less than 7.84 percent. The IPC receives a GMLAN message indicating the fuel level information from the engine control module (ECM).

ENGINE OIL LOW

The driver information center (DIC) displays ENGINE OIL LOW ADD OIL when the engine control module (ECM) detects a low engine oil level condition from the engine oil level sensor/switch. The instrument panel cluster (IPC) receives a GMLAN message indicating a low engine oil level condition. Refer to **GM Oil Life System - Resetting** . Refer to the following before adding or changing engine oil:

- When the Low Engine Oil Level/Change Engine Oil Soon indicator displays in the IPC or DIC due to a low engine oil level condition, make sure that the ignition is turned OFF before adding or changing the oil in the vehicle. Failure to do so may result in the Low Engine Oil Level/Change Engine Oil Soon or message staying on after the engine attains proper oil level.
- When the Low Engine Oil Level/Change Engine Oil Soon indicator displays in the IPC or DIC and the ignition is not turned OFF before adding or changing the engine oil, the Low Engine Oil Level/Change Engine Oil Soon indicator may stay ON even after the proper oil level is attained. For the Low Engine Oil Level/Change Engine Oil Soon to turn OFF, the engine has to undergo a thermocycle process, refer to

Indicator/Warning Message Description and Operation. The description of the Low Engine Oil Level/Change Engine Oil Soon in this article will outline how to clear the indicator.

- Before replacing the IPC because of the Low Engine Oil Level/Change Engine Oil Soon staying ON after an oil change or engine oil addition, it is necessary for the engine to undergo a thermocycle process as stated above. The IPC may not be malfunctioning but only needs the Low Engine Oil Level/Change Engine Oil Soon turned off. Refer to **Indicator/Warning Message Description and Operation** for an outline on how to clear the indicator. The description of the Low Engine Oil Level/Change Engine Oil Soon in this article will outline how to clear the indicator.

OIL PRESSURE LOW

The driver information center (DIC) displays OIL PRESSURE LOW STOP ENGINE when the engine control module (ECM) detects low engine oil pressure condition from the engine oil pressure (EOP) sensor/switch. The instrument panel cluster (IPC) receives a GMLAN message requesting display of the indicator from the ECM.

SERVICE VEHICLE SOON

The driver information center (DIC) displays SERVICE VEHICLE SOON when the engine control module (ECM) detects certain malfunctions that are not related to the emissions system. The instrument panel cluster (IPC) receives a GMLAN message requesting illumination from the instrument panel module (IPM).

TIGHTEN GAS CAP

The driver information center (DIC) displays TIGHTEN GAS CAP when the fuel tank cover is not tight. The IPC receives a GMLAN message indicating the fuel tank cover needs to be tightened.

DRIVER INFORMATION CENTER (DIC) DESCRIPTION AND OPERATION

The driver information center (DIC) displays the DIC WOW for 5 seconds when it first powers up. If enabled through Personalization, the DIC then returns to the last display status before no power condition.

There are 4 switch functions for the DIC.

- Info
- Maintenance
- Menu
- Set/Reset

Info

The INFO switch is used to navigate between vehicle information parameters. Cycle through the following vehicle parameters by successive pressing of the INFO switch

- Blank Display
- Average Fuel Economy (AFE)
- Average Vehicle Speed (AVE)
- Displacement on Demand (DOD)
- Elapsed Time
- Fuel Range
- Instantaneous Fuel Economy (IFE)/ Displacement on Demand (DOD)
- Instantaneous Fuel Economy (IFE)
- Speedometer
- Trip A
- Trip B

Maintenance

- Blank Display
- Compass Zone Setting
- Compass Recalibration
- English/Metric Units
- Front Tire Pressure
- Key Fob Programming Menu
- Oil Life Index (OLI)
- Park Assist Menu
- Rear Tire Pressure
- Tire Pressure LF
- Tire Pressure RF
- Tire Pressure LR
- Tire Pressure RR
- Tire Inflation Monitoring System (TIMS) Reset
- Tire Programming Menu

Average Fuel Economy

Average fuel economy is calculated using the equation: AFE = Distance/Fuel

- Distance = The accumulated distance travelled since the last reset of this value
- Fuel = The accumulated fuel consumption since the last reset of this value

The ECM sends the average fuel economy GMLAN message to the IPC. The value of this mode is retained during ignition OFF and can be changed between English units and metric units by selecting from the DIC options menu.

Average Speed

Average speed is calculated using the equation: Average Speed = AVS Distance/AVS Time

- Distance = The accumulated distance travelled since the last reset of this value
- Ignition On = The accumulated ignition on time since the last reset of this value

Oil Life Remaining

The engine control module (ECM) or the powertrain control module (PCM) sends the oil life remaining percentage to the instrument panel cluster (IPC) via GMLAN message. The instrument panel cluster receives a GMLAN message indicating the engine oil life remaining. The driver information center (DIC) displays the current percentage of the GM Oil Life System as determined by the ECM/PCM. When the oil life remaining percentage drops below 5 percent, the DIC displays CHANGE ENGINE OIL SOON. When the engine oil is changed, reset the GM Oil Life System. Refer to **GM Oil Life System - Resetting** .

Fuel Range

This message indicates the estimated distance that the vehicle can travel under the current fuel economy and fuel level conditions since the last battery connection to the IPC. Fuel Range is calculated using the equation: Fuel Range = Range Distance/Range Fuel Used.

- Range Distance = The accumulated distance travelled since the last reset of this value.
- Fuel Used = The accumulated fuel delivered since the last reset of this value

The ECM/PCM sends the fuel range value to the instrument panel cluster (IPC). The instrument panel cluster (IPC) receives a GMLAN message with fuel information. The fuel range value is retained during ignition OFF and can be changed between English and Metric units by accessing the DIC English/Metric menu. The Fuel Range display cannot be reset. LOW is displayed when fuel range is below a predetermined value.

Instantaneous Fuel Economy (IFE)

Instantaneous fuel economy (IFE) is calculated using the equation: IFE = Distance/Fuel Used.

- Distance = The accumulated distance travelled for the last 2 seconds
- Fuel = The accumulated fuel delivered for the last 2 seconds

The instrument panel cluster (IPC) receives a GMLAN message from the ECM/PCM. The distance information is calculated by the IPC using the vehicle speed information from the

ECM/PCM. These values are retained during ignition OFF and can be changed between English and Metric units accessing the DIC English/Metric menu. The IFE display cannot be reset.

Elapsed Time

The timer records elapsed time starting from activation. When the driver information center (DIC) displays the timer, pressing the SET/RESET switch for 1.0 seconds on the DIC resets the timer. Pressing the SET/RESET button on the DIC switch for approximately 1.0 seconds starts and stops the timer. The DIC displays the timer in one of the following formats:

The DIC displays the timer in the following format: XX: XX:XX:

The first XX represents hours elapsed, the second XX represents minutes elapsed, and the third XX represents seconds elapsed. The maximum range of the timer is 99 hours, 59 minutes, and 59 seconds. After the maximum range is reached, the timer displays all zeros (00:00:00).

Tire Pressure Monitor

The instrument panel cluster (IPC) receives a GMLAN message from the tire pressure monitoring (TPM) system for front and rear tire pressure data. The driver information center (DIC) will display the pressure for each of the front and rear tires. When a tire with low air pressure is present, the DIC displays XX TIRE PRESSURE LOW.

Park Assist Menu

The park assist menu is displayed in the DIC. The DIC displays the current state of the park assist until the IPC receives a message indicating otherwise. The DIC displays (- - -) when communication with park assist is lost.

Fuel Display

Parameter	Update Rate	Range	Reset Value	Units
Average Fuel Economy	1.0 seconds	0.0-99.9	99.9	MPG or L/100 KM
Instant Fuel Economy	2.0 second	0-70	N/A	MPG or L/100 KM
Fuel Range	1.0 second	0-999	N/A	MI/KM
Fuel Used	1 second	0-999.9	0.0	Gal/L

English/Metric Button

The English/Metric button is used to toggle between English and Metric unit systems and can be accessed through the DIC MAINTENANCE switch function.

Trip A/B

The trip odometer A or B can be accessed through the DIC INFO switch function.

Trip Display

DIC Trip Display	Range	
	Metric	English
ODOMETER	######km	######MI
TRIP A	####.#km	####.#MI
TRIP B	####.#km	####.#MI

Language

The DIC is capable of displaying in three languages

- English
- French
- Spanish

A simultaneous press of the INFO and MENU switches for about 1 second provides a shortcut to change the language without understanding the currently displayed language.

Compass

The DIC displays the compass information on the right most 2 characters of the first DIC line when the compass is an option on the vehicle. When corresponding to the true north radial degrees, the compass displays the following directions

Compass Display

Radial Degree (True North)	Compass Direction
337.5 to 22.5	N
22.5 to 67.5	NE
67.5 to 112.5	E
112.5 to 157.5	SE
157.5 to 202.5	S
247.5 to 292.5	W

Outside Air Temperature

The DIC displays the outside air temperature based on GMLAN message from the HVAC controller. The IPC receives the outside air temperature information for display in the DIC. The outside air temperature can be displayed in English or Metric systems and the English/Metric menu can be accessed via the DIC maintenance switch. The DIC displays (- - -) when an invalid outside air temperature is received.

AUDIBLE WARNINGS DESCRIPTION AND OPERATION

The audible warnings alert the driver of a system concern or a critical vehicle condition. The audio amplifier generates the audible warnings through the left front speaker. The audio amplifier receives audible warning requests via the GMLAN serial data circuit. If the audio amplifier receives multiple audible warning requests, the warning with the highest priority sounds first. The following lists the audible warning priority and the pulse rate:

1. Fast rate chime-200 pulses per minute
2. Medium rate chime-150 pulses per minute
3. Slow rate chime-50 pulses per minute
4. Single chime

Fasten Safety Belt Warning

The audio amplifier activates the fasten safety belt audible warning as requested by the body control module (BCM). The BCM sends a GMLAN message to the audio amplifier indicating the chime frequency at a slow rate and a duration of 8 seconds. The fasten safety belt warning sounds and the fasten safety belt indicator illuminates when the following occurs:

- The ignition switch transitions to ON.
- The inflatable restraint sensing and diagnostic module (SDM) detects that the driver's seat belt is not buckled and the signal is low. The SDM sends a GMLAN message to the BCM indicating the seat belt status. The instrument panel cluster (IPC) receives a GMLAN message from the BCM indicating the driver seat belt status.

If the seat belt is buckled when the ignition is turned ON, the chime does not sound. If the seat belt is buckled while the chime is sounding, the chime stops. If the seat belt is unbuckled after the initial transition to ON, the chime does not sound.

Lights On Warning

The audio amplifier activates the lights on warning as requested by the body control module (BCM). The BCM sends a GMLAN message to the audio amplifier indicating the chime frequency of a fast rate and at a continuous duration. The lights on warning sounds when the following occurs:

- The ignition is OFF.
- The BCM determines that the driver door is open and the signal circuit is low.
- The BCM determines that the headlamp switch is in the park or head position.

Brake Warning

The audio amplifier activates the brake audible warning as requested by the instrument panel cluster (IPC). The IPC sends a GMLAN message to the audio amplifier indicating the chime frequency of a fast rate and at a continuous duration. The brake warning sounds and the BRAKE indicator illuminates when the following occurs:

- The ignition is ON.
- The vehicle speed is greater than 8 km/h (4.9 mph). The IPC receives a GMLAN message from the engine control module (ECM) indicating the vehicle speed.
- The IPC determines that the park brake is engaged and the signal circuit is low.
- The brake fluid is low.
- The dynamic rear proportioning (DRP) failed

Key-In-Ignition Warning

The audio amplifier activates the key-in-ignition audible warning as requested by the body control module (BCM). The BCM sends a GMLAN message to the radio indicating the chime frequency of a medium rate and continuous duration. The key-in-ignition warning sounds when the following occurs:

- The ignition switch is OFF.
- The BCM determines that the driver door is open and the signal circuit is low. The IPC also receives a GMLAN message from the BCM indicating the door ajar status
- The BCM determines that the key-in-ignition switch is open and the signal circuit is high. The IPC receives a GMLAN message from the BCM indicating the key-in-ignition status.

Door Ajar Warning

The audio amplifier activates the door ajar audible warning as requested by the body control module (BCM). The BCM sends a GMLAN message to the radio indicating the chime frequency of a medium rate and continuous duration. The door ajar warning sounds and the door ajar indicator illuminates when the following occurs:

- The BCM determines that the driver door is open and the signal circuit is low. The IPC also receives a GMLAN message from the BCM requesting illumination of the door ajar indicator.
- The vehicle is not in PARK. The BCM receives a GMLAN message from the ECM/BCM indicating the gear position.

Additional Warnings

The following warnings have an associated instrument panel cluster (IPC) indicator:

- Hot coolant temperature-The audio amplifier activates the audible warning as requested by the body control module (BCM) or the ECM/PCM. The BCM sends a GMLAN message to the audio amplifier indicating the chime frequency of a medium rate and at a continuous duration.

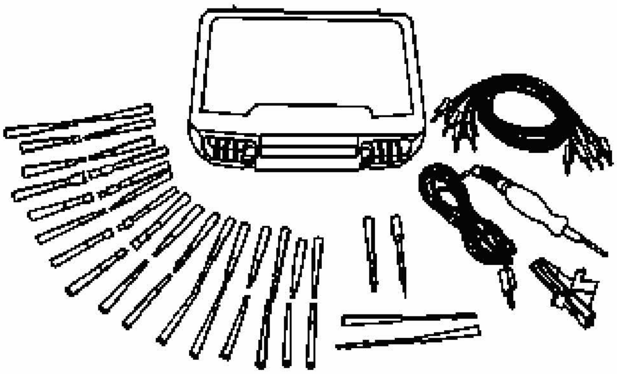
- Low fuel-The audio amplifier activates the audible warning as requested by the BCM. The BCM sends a GMLAN message to the audio amplifier indicating the chime frequency of a medium rate and at a continuous duration.
- Low engine oil pressure-The audio amplifier activates the audible warning as requested by the IPC. The BCM sends a GMLAN message to the audio amplifier indicating the chime frequency of a medium rate and at a continuous duration. The low engine oil pressure indicator will be ON in the IPC.

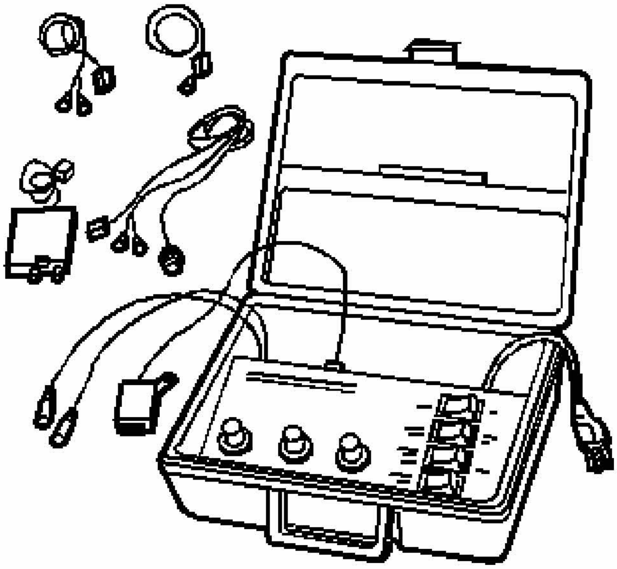
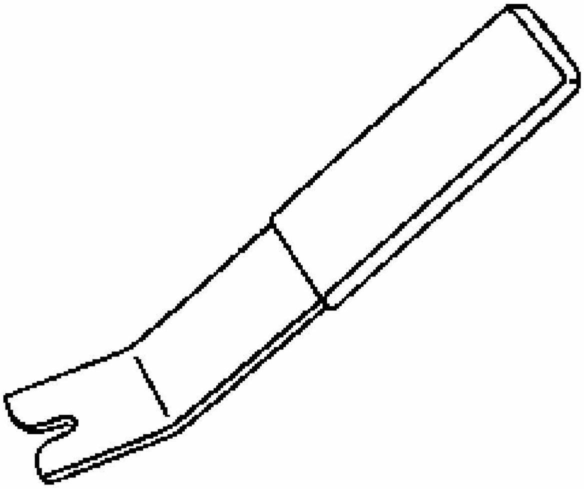
Refer to **Indicator/Warning Message Description and Operation**.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description
	J 35616-A Connector Test Adapter Kit
	J 33431-C

	Signal Generator and Instrument Panel Tester
	J 38778 Door Trim Pad Clip Remover

2006 ACCESSORIES & EQUIPMENT

Horns - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

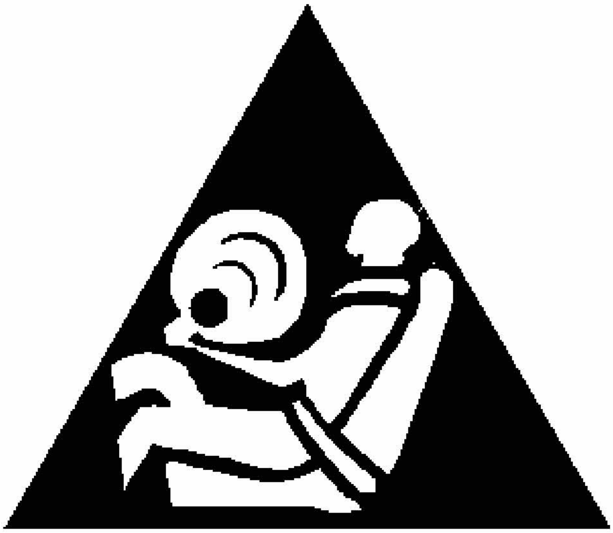
Fastener Tightening Specifications

Application	Specification	
	Metric	English
Horn Bracket Bolt	10 N.m	7 lb ft

SCHEMATIC AND ROUTING DIAGRAMS

HORNS SCHEMATIC ICONS

Horns Schematic Icons

Icon	Icon Definition
	CAUTION: When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Refer to SIR DISABLING AND ENABLING ZONES . Failure to observe the correct procedure could cause deployment of the SIR components, personal injury, or unnecessary SIR system repairs.

HORNS SCHEMATICS

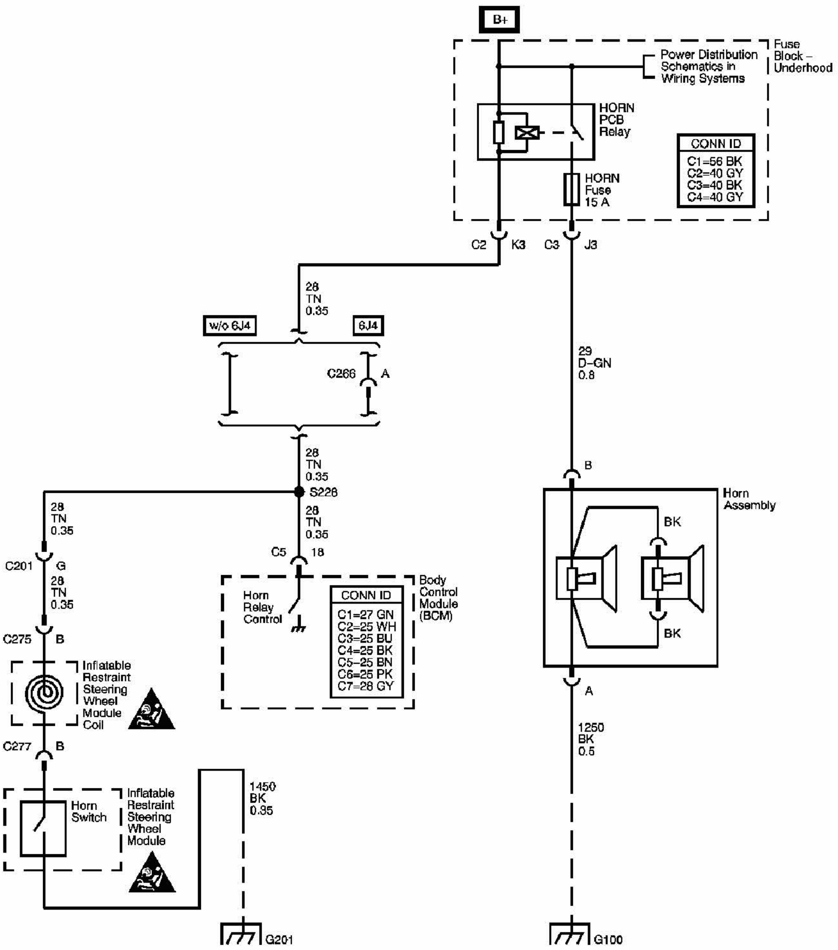

B+
Fuse Block – Underhood
Power Distribution Schematics in Wiring Systems
HORN PCB Relay
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
HORN Fuse 15 A
C2
K3
C3
J3
28
TN
0.35
w/o 6J4
6J4
C266
A
29
D–GN
0.8
28
TN
0.35
S228
28
TN
0.35
B
Horn Assembly
BK
BK
28
TN
0.35
C201
G
28
TN
0.35
C5
18
Horn Relay Control
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Body Control Module (BCM)
C275
B
Inflatable Restraint Steering Wheel Module Coil
A
1250
BK
0.5
C277
B
1450
BK
0.35
Horn Switch
Inflatable Restraint Steering Wheel Module
G201
G100

Fig. 1: Horns Schematics - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

HORNS COMPONENT VIEWS

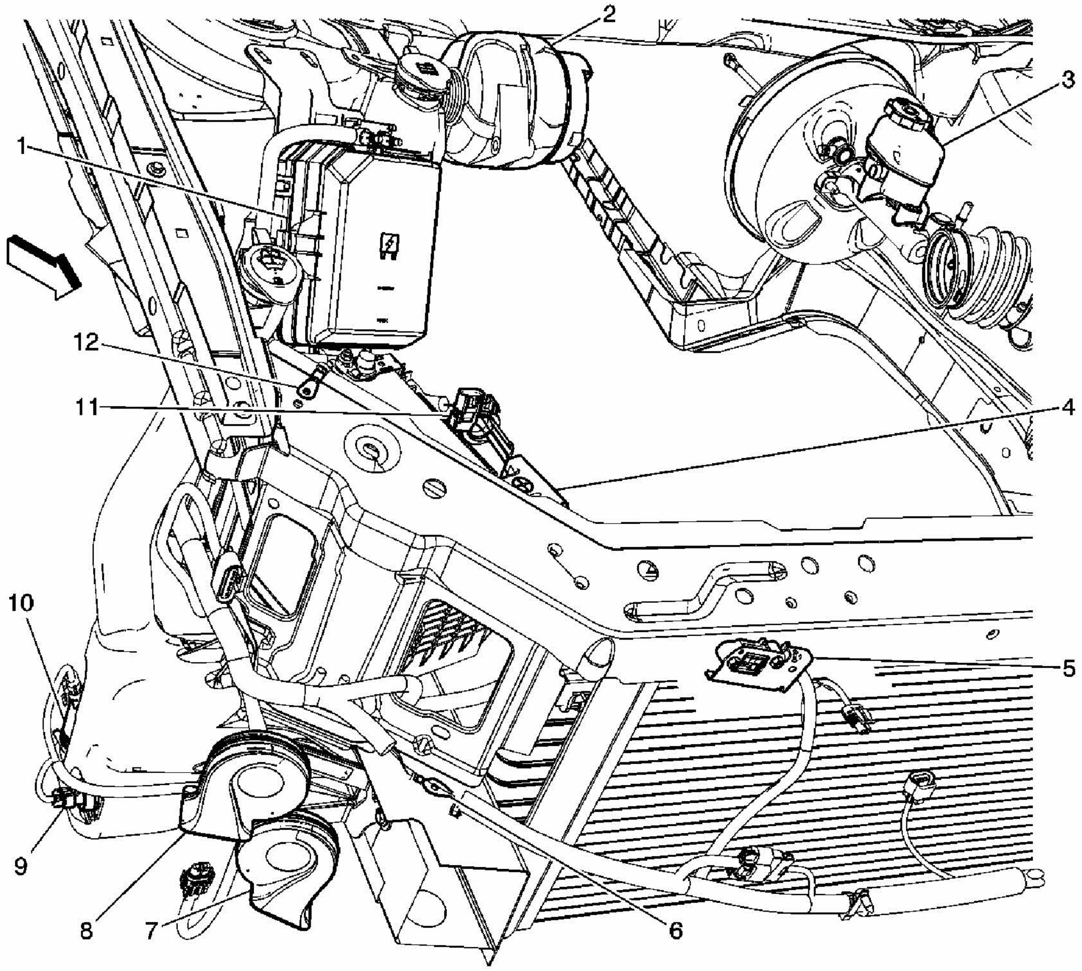


Fig. 2: RF of the Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	Fuse Block - Underhood
2	Generator
3	Brake Fluid Level Switch
4	Battery
5	Inflatable Restraint Front end Sensor - Right
6	G100
7	Horn Assembly
8	Windshield Washer Fluid Container
9	Windshield Washer Fluid Level Switch
10	Windshield Washer Fluid Pump
11	Battery Current Sensor

12	G102

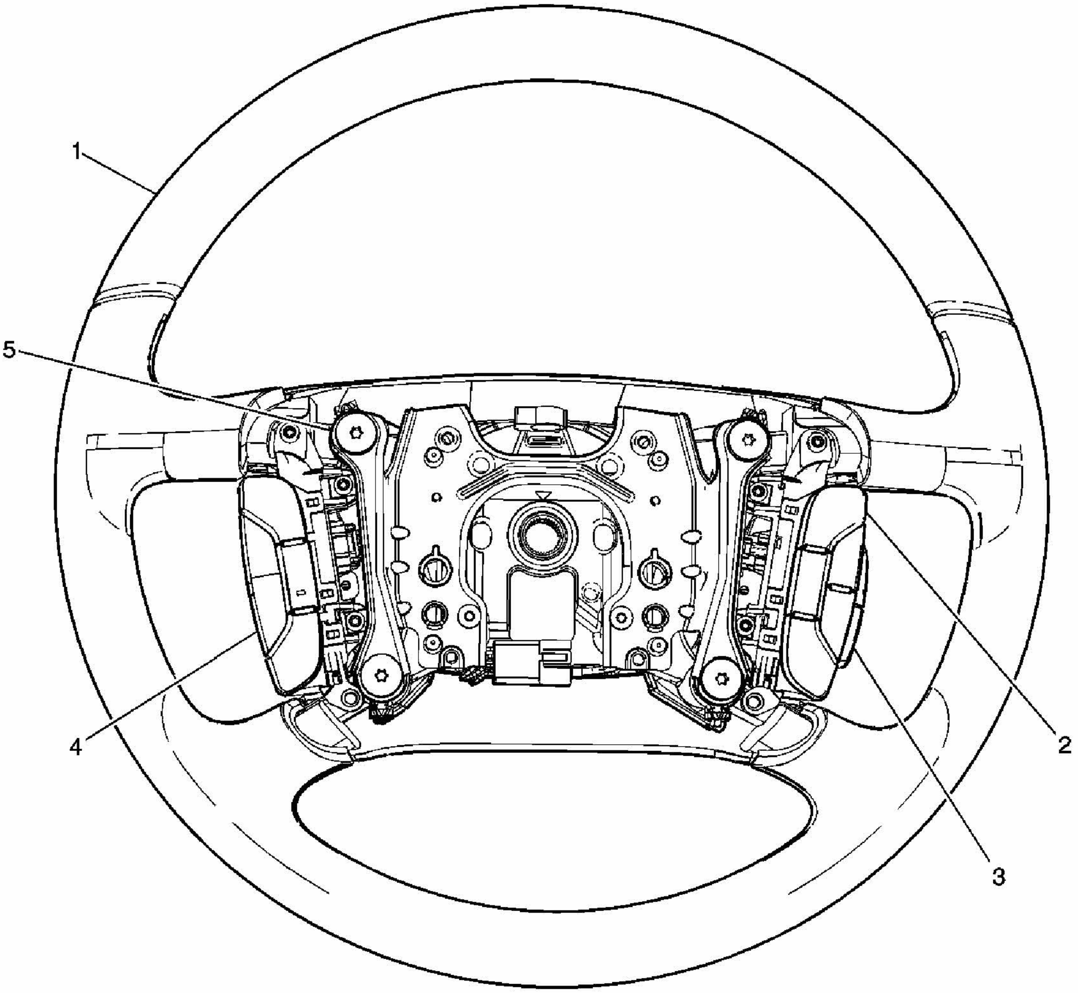


Fig. 3: Steering Wheel Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Steering Wheel
2	Steering Wheel Controls-Right
3	Radio Controls
4	Steering Wheel Control-Right
5	Horn Contact Plate

HORNS CONNECTOR END VIEWS

Horn Assembly

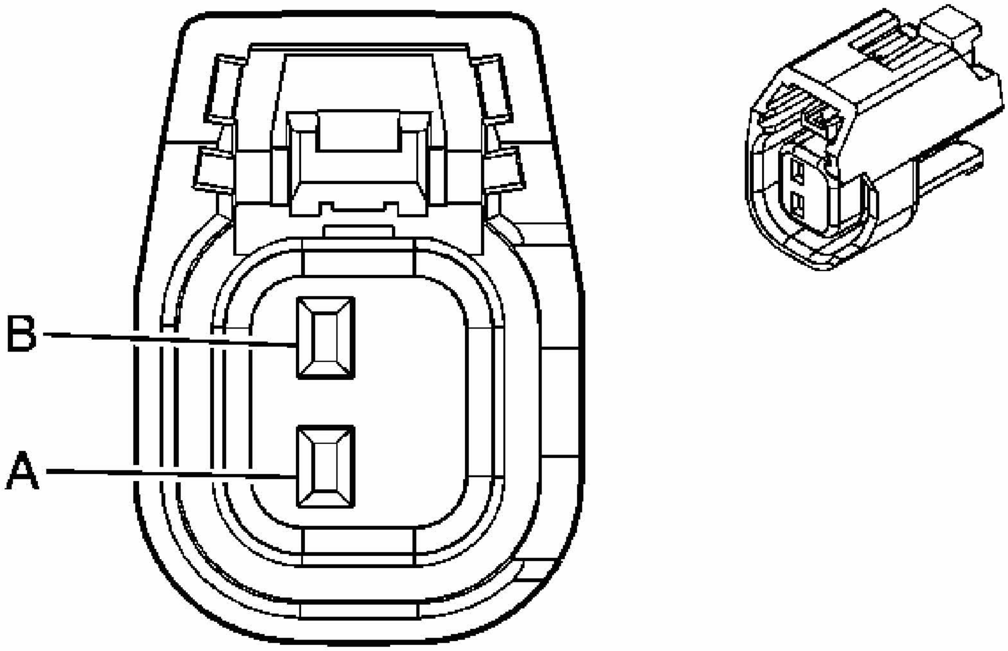


Fig. 4: Horns Connector End View
Courtesy of GENERAL MOTORS CORP.

Horns Connector End Views

Connector Part Information

- OEM: 15419715
- Service: 88988313
- Description: 2-Way F GT 150 Sealed (GY)

Terminal Part Information

- Pins: A, B
- Terminal/Tray: 12191819/8
- Core/Insulation Crimp: Pins A - E/A
- Core/Insulation Crimp: Pins B - 2/A
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Horn Assembly

Pin	Wire Color	Circuit No.	Function
A	BK	1250	Ground

B	D-GN	29	Horn Control

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - HORNS

Begin the system diagnosis with the **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL OUTPUT CONTROLS

Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection(s)	Description
Horn	Output Control	Energizes the horn relay for 5 seconds

SCAN TOOL DATA LIST

The Horns Scan Tool Data List contains all of the horn related parameters that are available on the scan tool. The parameters in the list are arranged in alphabetical order. The column, Data List, indicates the location of the parameter within the scan tool menu selections. Use the Horns Scan Tool Data List as directed by a diagnostic table or in order to supplement the diagnostic procedures. Begin all of the diagnostic procedures with **Diagnostic System Check - Vehicle** in Vehicle DTC Information.

Use the Scan Tool Data List only after the following is determined:

- There is no published DTC procedure nor published symptom procedure for the customer concern.
- The DTC or symptom diagnostic procedure indicated by the diagnostic system check does not resolve the customer concern.

The Typical Data Values are obtained from a properly operating vehicle under the conditions specified in the first row of the Scan Tool Data List table. Comparison of the parameter values from the suspect vehicle with the Typical Data Values may reveal the source of the customer concern.

Scan Tool Data List

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF			
Battery Voltage	Data	Volts	Varies
Horn Output	Outputs	On/Off	Off

SCAN TOOL DATA DEFINITIONS

Battery Voltage

The scan tool displays the current state of the battery in volts.

Horn Output

The horn output indicates the state that the control module has commanded for the relay.

DTC B2750

Circuit Description

The body control module (BCM) controls the horn relay by grounding the control circuit of the horn relay coil. When the horn relay coil is grounded, the horn relay contacts close applying voltage to the horn through the horn supply voltage circuit.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B2750

Horn Relay Coil Circuit

This vehicle has DTCs which include DTC Symptoms. For more information on DTC Symptoms, refer to **DTC Symptom Description** .

DTC B2750

DTC Symptom	DTC Symptom Descriptor
00	Short to battery

Conditions for Running the DTC

The DTC can only set when the output is actively being requested by the CPU.

Conditions for Setting the DTC

The following condition exists for more than 125 milliseconds:

The DTC will set if the output driver device detects current in excess of its capacity.

Action Taken When the DTC Sets

The BCM disables the output to the horn relay until the next ignition cycle.

Conditions for Clearing the DTC

- The current DTC clears when the fault is no longer present.
- The current DTC will become history when the request for the output is removed.
- The history DTC will clear after 50 consecutive fault-free ignition cycles have occurred.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step verifies the operation of the horn relay. Listen for an audible click when commanding the horn relay ON and the OFF.

3: This step verifies that voltage is supplied to the coil side of the horn relay. The horn fuse supplies power to the coil side of the horn relay.

4: This step verifies that the BCM is providing ground to the horn relay.

DTC B2750

Step	Action	Yes	No
Schematic Reference: Horns Schematics **Connector End View Reference: Horns Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the horn relay ON and OFF. Does the horn relay turn ON and OFF with each command?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
	1. Turn OFF the ignition. 2. Disconnect the horn relay.		

3	3. Turn ON the ignition, with the engine OFF. 4. Probe the battery positive voltage circuit of the horn relay with a test lamp connected to a good ground. Does the test lamp illuminate?	Go to **Step 4**	Go to **Step 10**
4	1. Connect a test lamp between control circuit of the horn relay and battery positive voltage circuit of the horn relay. 2. With a scan tool, command the horn relay On and OFF. Does the test lamp turn ON and OFF with each command?	Go to **Step 8**	Go to **Step 5**
5	Does the test lamp remain illuminated with each command?	Go to **Step 7**	Go to **Step 6**
6	Test the control circuit of the horn relay for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**
7	Test the control circuit of the horn relay for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**
8	Inspect for poor connections at the horn relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 11**
9	Inspect for poor connections at the harness connector of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 13**	Go to **Step 12**
10	Repair the open in the battery positive voltage circuit of the horn relay. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 13**	-
	Replace the horn relay.		

11	Did you complete the replacement?	Go to **Step 13**	-
12	Replace the BCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 13**	-
13	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC. Does the DTC reset?	Go to **Step 2**	System OK

SYMPTOMS - HORNS

IMPORTANT: The following steps must be completed before using the symptom tables:

1. Perform **Diagnostic System Check - Vehicle** in Vehicle DTC Information before using the symptom tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Horns System Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the horn system. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Perform the following if a horn buzzes or has a harsh tone:
  - Inspect for debris in the joint where the horn fastens to the vehicle.
  - Test the torque of the horn mounting hardware. The horn mounting hardware should be tightened to a torque of 10 N.m (7 lb ft).

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Horns Always On**
- **Horns Inoperative**
- **Horns - Poor Tone**

HORNS ALWAYS ON

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: Tests if ground is constantly being applied to the horn relay.

5: The horn relay control circuit includes the horn slip ring and the horn switch. The horn switch is part of the inflatable restraint steering wheel module. The horn slip ring and the horn switch must be tested for a short to ground when testing the relay control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems and **Inflatable Restraint Steering Wheel Module Replacement** in SIR.

Horns Always On

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the body control module (BCM) Horn Output ON and OFF. Are the horns on at all times?	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems
3	1. Turn OFF the ignition. 2. Disconnect the horn relay. Are the horns on at all times?	Go to **Step 8**	Go to **Step 4**
4	Connect a test lamp between the battery positive voltage circuit of the horn relay coil and the horn relay control circuit. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 6**

5	**IMPORTANT:** **The horn switch is part of the inflatable restraint steering wheel module. Refer to Inflatable Restraint Steering Wheel Module Replacement in SIR.** To disable the SIR system, refer to **SIR Disabling and Enabling Zone 3** in SIR.Test the horn relay control circuit for a short to ground. The horn relay control circuit includes the horn slip ring and the horn switch. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	Go to **Step 11**	Go to **Step 7**
6	Inspect for poor connections at the horn relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 9**
7	Inspect for poor connections at the harness connector of the BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 10**
8	Repair the short to voltage in the horn control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 11**	-
9	Replace the horn relay. Did you complete the replacement?	Go to **Step 11**	-
10	**IMPORTANT:** **Perform the BCM programming procedure when replacing the BCM. Refer to Body Control Module (BCM) Programming/RPO Configuration in Computer/Integrating Systems.** Replace the BCM. Refer to **Body Control Module Replacement** in Computer/Integrating Systems.Did you complete the replacement?	Go to **Step 11**	-
11	Operate the horns. Do the horns operate properly?	System OK	Go to **Step 1**

HORNS INOPERATIVE

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: Verifies that the body control module (BCM) is providing ground to the horn relay.

5: Tests for voltage at the battery positive voltage terminal of the horn relay coil.

7: Tests for voltage at the battery positive voltage terminal of the horn relay switch. The HORN fuse supplies power to the battery positive voltage terminal of the horn relay switch.

15: The horns need maximum current flow to operate properly. A high resistance, greater than 0.5 ohms, in the horn control circuit or the horn ground circuit could cause operating problems with the horns. Check the circuits for faults that would restrict current flow.

17: The horn relay control circuit includes the horn slip ring and the horn switch. The horn switch is part of the inflatable restraint steering wheel module. The horn slip ring and the horn switch must be tested for a high resistance, an open or a short to voltage when testing the relay control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems and **Inflatable Restraint Steering Wheel Module Replacement** in SIR.

Horns Inoperative

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Depress the horn switch. Do the horns operate?	Go to **Step 3**	Go to **Step 5**
3	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the body control module (BCM) Horn Output ON and OFF. Do the horns operate?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 4**
4	Test the BCM portion of the horn relay control circuit for a high resistance or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.		

	Did you find and correct the condition?	Go to **Step 24**	Go to **Step 13**
5	1. Turn OFF the ignition. 2. Disconnect the horn relay. 3. Connect a test lamp between the battery positive voltage circuit of the horn relay coil and a good ground. Does the test lamp illuminate?	Go to **Step 6**	Go to **Step 16**
6	1. Connect a test lamp between the battery positive voltage circuit of the horn relay coil and the horn relay control circuit. 2. Depress and hold the horn switch. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 17**
7	Connect a test lamp between the battery positive voltage circuit of the horn relay switch and a good ground. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 18**
8	Momentarily connect a 15-amp fused jumper wire between the battery positive voltage circuit of the horn relay switch and the horn control circuit. Do the horns operate?	Go to **Step 14**	Go to **Step 9**
9	1. Reconnect the horn relay. 2. Disconnect the horn connector. 3. Connect a test lamp between the horn control circuit and a good ground. 4. Depress and hold the horn switch. Does the test lamp illuminate?	Go to **Step 10**	Go to **Step 19**
10	1. Connect a test lamp between the horn control circuit and the horn ground circuit. 2. Depress and hold the horn switch. Does the test lamp illuminate?	Go to **Step 11**	Go to **Step 20**
11	Inspect for poor connections at the harness connector of the horn. Refer to **Testing for Intermittent Conditions and Poor**		

	Connections and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 24**	Go to **Step 12**
12	1. Connect a 15-amp fused jumper wire between the positive battery terminal and the control terminal of the horn. 2. Connect another jumper wire between the negative battery terminal and the ground terminal of the horn. Do the horns operate?	Go to **Step 15**	Go to **Step 23**
13	Inspect for poor connections at the harness connector of the BCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 24**	Go to **Step 21**
14	Inspect for poor connections at the horn relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 24**	Go to **Step 22**
15	Repair the high resistance in the horn control circuit or the horn ground circuit. A resistance as low as 0.5 ohms could cause operating problems with the horns. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 24**	-
16	Repair the open or high resistance in the battery positive voltage circuit of the horn relay coil. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 24**	-
17	**IMPORTANT:** **The horn switch is part of the inflatable restraint steering wheel module. Refer to Inflatable Restraint Steering Wheel Module Replacement in SIR.** To disable the SIR system refer to **SIR Disabling and Enabling Zone 3** in SIR.Repair the open or short to voltage in		-

	the horn relay control circuit. The horn relay control circuit includes the horn slip ring and the horn switch. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you complete the repair?	Go to **Step 24**	
18	Repair the open or high resistance in the battery positive voltage circuit of the horn relay switch. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 24**	-
19	Repair the open or high resistance in the horn control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 24**	-
20	Repair the open or high resistance in the horn ground circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 24**	-
21	**IMPORTANT:** **Perform the BCM programming procedure when replacing the BCM. Refer to Body Control Module (BCM) Programming/RPO Configuration in Computer/Integrating Systems.** Replace the BCM. Refer to **Body Control Module Replacement** in Computer/Integrating Systems.Did you complete the repair?	Go to **Step 24**	-
22	Replace the horn relay. Did you complete the replacement?	Go to **Step 24**	-
23	Replace the horns. Refer to **Horn Replacement**. Did you complete the replacement?	Go to **Step 24**	-
24	Operate the horns. Do the horns operate properly?	System OK	Go to **Step 1**

HORNS - POOR TONE

Horns - Poor Tone

Step	Action	Yes	No
	Did you perform the Diagnostic System		Go to **Diagnostic**

1	Check - Vehicle?	Go to **Step 2**	**System Check - Vehicle** in Vehicle DTC Information
2	Depress the horn switch. Do the horns have a harsh tone or buzzing?	Go to **Step 3**	Go to **Symptoms - Horns**
3	- Test the horn mounting hardware for adequate torque. The hardware should be tightened to 10 N.m (7 lb ft). - Inspect the horns for debris in the joint where the horns attach to the vehicle. Did you find and correct the condition?	Go to **Step 7**	Go to **Step 4**
4	1. Disconnect the horn connector. 2. Connect a 15-amp fused jumper wire between the positive battery terminal and the control terminal of the horn. 3. Connect another jumper wire between the negative battery terminal and the ground terminal of the horn. Does the horn have a harsh tone or buzzing?	Go to **Step 6**	Go to **Step 5**
5	Repair the high resistance in the horn control circuit or the horn ground circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 7**	-
6	Replace the horns. Refer to **Horn Replacement**. Did you complete the replacement?	Go to **Step 7**	-
7	Operate the horns. Does the horn operate properly?	System OK	Go to **Step 1**

REPAIR INSTRUCTIONS

HORN REPLACEMENT

Removal Procedure

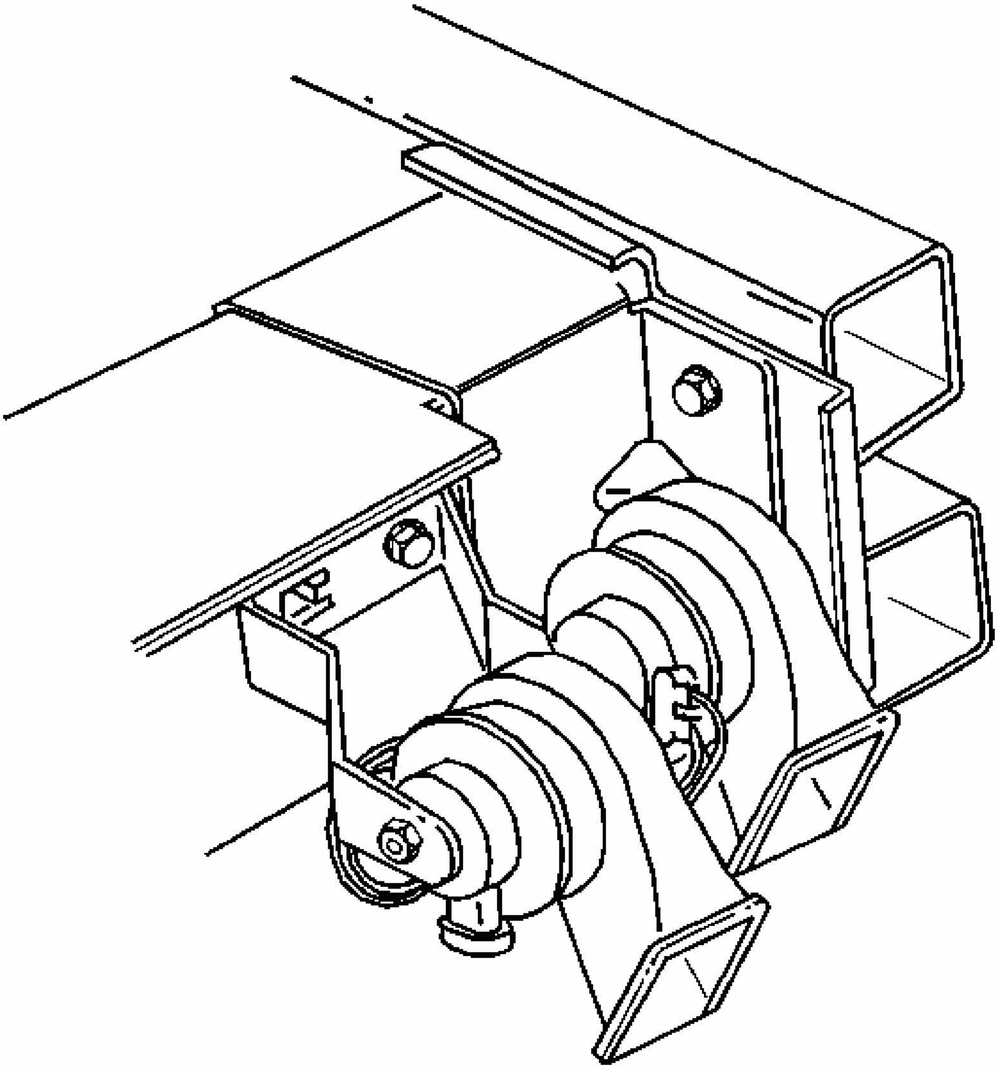


Fig. 5: Vehicle Horn
Courtesy of GENERAL MOTORS CORP.

1. Open the hood.
2. Remove the right headlamp. Refer to **HEADLAMP REPLACEMENT (MONTE CARLO)** in Lighting Systems.
3. Disconnect the horn electrical connector.

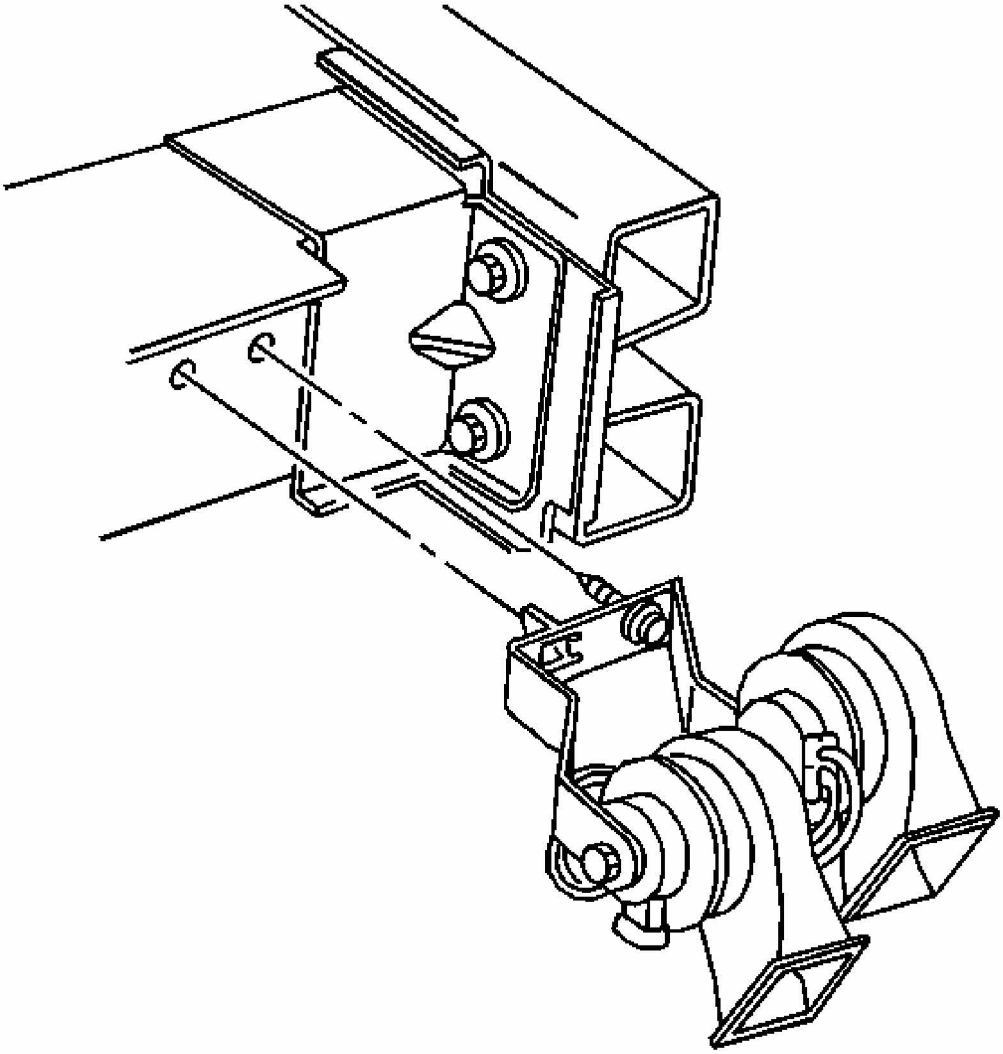


Fig. 6: Horn Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the horn bracket bolt.
5. Remove the horn from the frame rail extension.

Installation Procedure

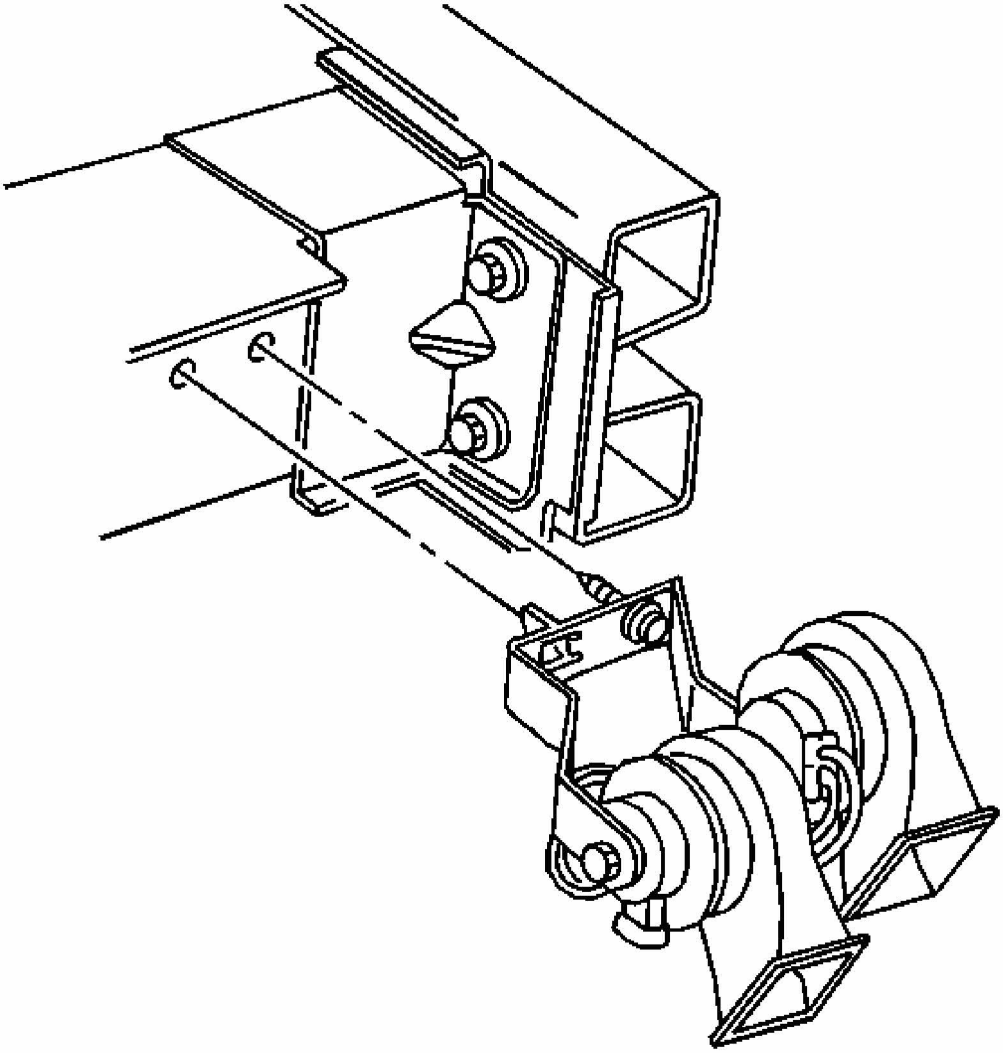


Fig. 7: Horn Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Position the horn to the frame rail extension; insert the horn anti-rotation tab into the slot on the frame rail.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the horn bracket bolt.

Tighten: Tighten the bolt to 15 N.m (11 lb ft).

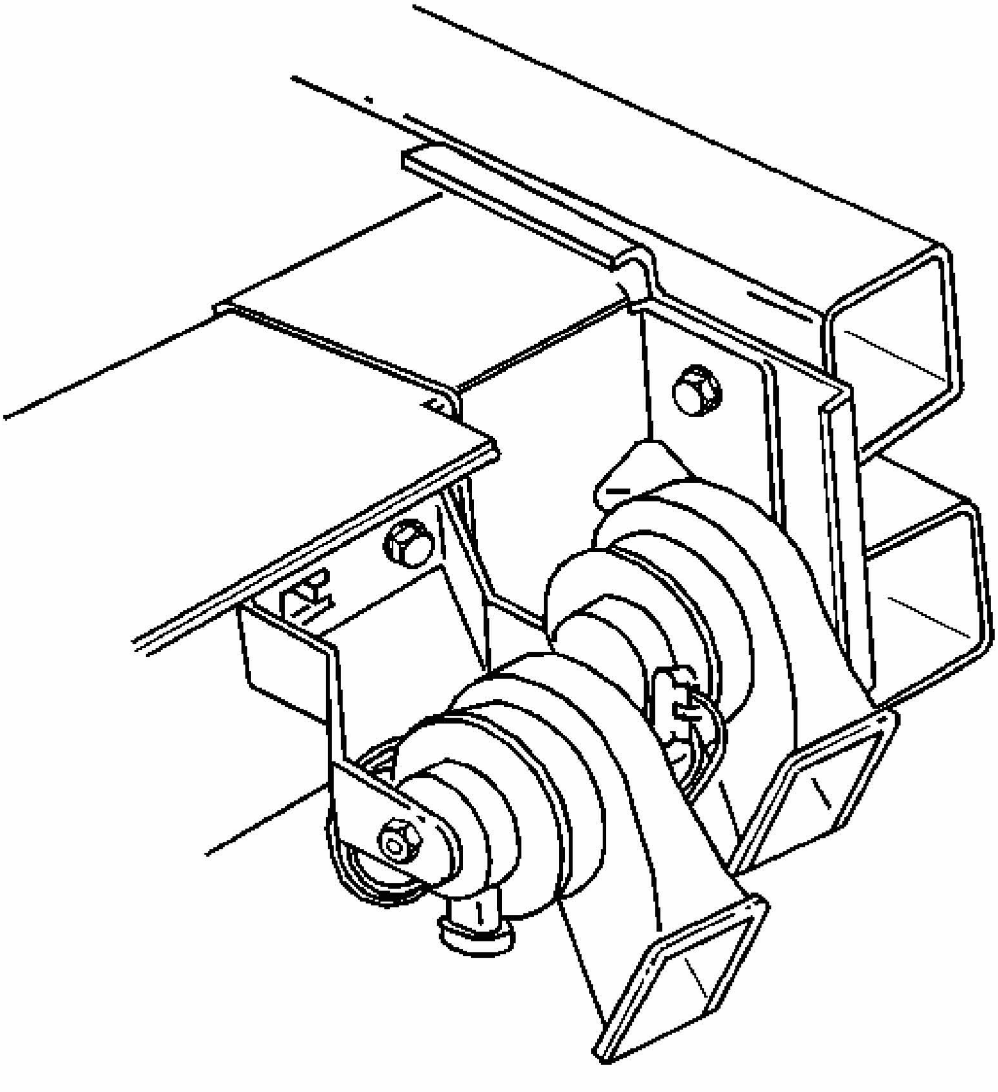


Fig. 8: Vehicle Horn
Courtesy of GENERAL MOTORS CORP.

3. Connect the horn electrical connector.
4. Install the right headlamp. Refer to **HEADLAMP REPLACEMENT (MONTE CARLO)** in Lighting Systems.
5. Close the hood.

DESCRIPTION AND OPERATION

HORNS SYSTEM DESCRIPTION AND OPERATION

System Description

The horn system consists of the following components:

- HORN fuse
- Horn relay
- Horn slip ring
- Horn switch (The horn switch is part of the inflatable restraint steering wheel module.)
- Horn assembly
- Body Control Module (BCM)

System Operation

The vehicle horn system is activated under the following conditions:

- The horn switch is depressed.
- The body control module (BCM) commands the horns on. The BCM commands the horns on under any of the following conditions:
  - When the panic button is depressed on the remote control door lock transmitter. For further information refer to **Keyless Entry System Description and Operation** in Keyless Entry.
  - When the keyless entry system is used to lock the vehicle, a horn chirp may sound to notify the driver that the vehicle has been locked. The notification feature may be enabled or disabled through personalization. For further information refer to **Keyless Entry System Description and Operation** in Keyless Entry.

Circuit Operation

Battery positive voltage is applied at all times to the horn relay coil and the horn relay switch. Pressing the horn switch applies ground to the horn relay control circuit. The BCM may also apply ground to the horn relay control circuit as described above. When the horn relay control circuit is grounded, the horn relay is energized and battery positive voltage is applied to the horns through the horn control circuit. The horns sound as long as ground is applied to the horn relay control circuit.

2006 HVAC

Heating, Ventilation and Air Conditioning - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
A/C Compressor Clutch Bolt	12 N.m	106 lb in
A/C Compressor Drain Plug	16 N.m	12 lb ft
A/C Compressor Front Bolt	50 N.m	36 lb ft
A/C Compressor Front Nut	50 N.m	36 lb ft
A/C Compressor Hose to A/C Compressor Block fitting Nut	17 N.m	12.5 lb ft
A/C Compressor Hose to A/C Condenser Block Fitting Nut	17 N.m	12.5 lb ft
A/C Compressor Hose to Evaporator tube Block Fitting Nut	17 N.m	12.5 lb ft
A/C Compressor Pressure Relief Valve	8 N.m	70 lb in
A/C Compressor Rear Bolt	50 N.m	36 lb ft
A/C Refrigerant Pressure Sensor	4.7 N.m	41 lb in
Air Distributor Duct Bolts	10 N.m	88 lb in
Air Distributor Duct Screw	1.5 N.m	13 lb in
Blower Motor Control Module Screws	1.5 N.m	13 lb in
Blower Motor Screws	1.5 N.m	13 lb in
Evaporator Line Block Fitting to TXV Nut	17 N.m	12.5 lb ft
Heater Core Cover Screws	1.5 N.m	13 lb in
Heater Core Outlet Cover Screws	1.5 N.m	13 lb in
HVAC Module Case Screws	1.5 N.m	13 lb in
HVAC Module to Front of Dash Nuts	10 N.m	89 lb in
Service Port Valve Core	11 N.m	98 lb in
TXV to Evaporator Screws	7 N.m	62 lb in

REFRIGERANT SYSTEM CAPACITIES

Refrigerant System Capacities

Application	Specification	
	Metric	English

Abrupt Refrigerant Loss	60 ml[1]	2.0 oz[1]
PAG Oil GM P/N 12378526 for United States PAG Oil GM P/N 88900060 for Canada		
Compressor Replacement		
IMPORTANT: **Compressor failure can occur if the oil removed during refrigerant recovery is not replaced.** - The 7CVC service compressor is shipped with 150 ml[2] (5 oz[2]) of PAG oil.		
Condenser Replacement	30 ml[2]	1.0 oz[2]
Evaporator Replacement	90 ml[2]	3.0 oz[2]
Any Line Set (Hose/Tube or Tube Assembly) Replacement	30 ml*	1.0 oz*
- Total System PAG Oil Capacity	150.0 ml	5 oz
R-134a		
- Refrigerant Charge LZE, LZ4 or LZ9	0.61 kg	1.35 lb
- Refrigerant Charge LS4	0.55 kg	1.2 lb
[1] Abrupt refrigerant loss due to large leak, hose rupture, collision, or pressure relief valve opening. Conditions that allow the refrigerant to seep or bleed off over time do not cause this oil loss. Upon replacement of a component that caused a large refrigerant loss, also add the required amount of oil for the particular component. [2] If more than the specified amount of PAG oil was drained from a component, add the amount drained.		

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - HEATING, VENTILATION AND AIR CONDITIONING

Begin the system diagnosis with **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check - Vehicle will provide the following information:

- The identification of the control modules which are not communicating
- The identification of any stored DTCs and their status

The use of the Diagnostic System Check - Vehicle will identify the correct procedures to begin vehicle diagnosis. These must be performed before system DTC or symptom diagnosis.

LEAK TESTING

Tools Required

- **J 39400-A** Halogen Leak Detector. See **Special Tools**.
- **J 41447** Leak Detection Dye. See **Special Tools**.
- **J 42220** Leak Detection Lamp. See **Special Tools**.
- **J 43872** Fluorescent Dye Cleaner. See **Special Tools**.
- **J 46297** A/C Dye Injector Kit. See **Special Tools**.
- **J 46297-12** Replacement Dye Cartridges. See **Special Tools**.

Refrigerant Leak Testing

IMPORTANT: General Motors vehicles are now manufactured with fluorescent dye installed directly into the air conditioning (A/C) system.

The fluorescent dye mixes and flows with the polyalkylene glycol (PAG) oil throughout the refrigerant system.

Verifying some passive leaks may require using the **J 39400-A** , even though the A/C system contains fluorescent dye. See **Special Tools**.

The only time that adding additional fluorescent dye is required is after flushing the A/C system.

Fluorescent Leak Detector

Fluorescent dye will assist in locating any leaks in the A/C system.

IMPORTANT: PAG oil is water soluble.

- Condensation on the evaporator core or the refrigerant lines may wash the PAG oil and fluorescent dye away from the actual leak. Condensation may also carry dye through the HVAC module drain.
- Leaks in the A/C system will be indicated in a light green or yellow color when using the leak detection lamp.

  Use the leak detection lamp in the following areas:

  - All fittings or connections that use seal washers or O-rings
  - All of the A/C components
  - The A/C compressor shaft seal
  - The A/C hoses and pressure switches
  - The HVAC module drain tube, if the evaporator core is suspected of leaking

  - The service port sealing caps

    The sealing cap is the primary seal for the service ports.

- Follow the instructions supplied with the **J 42220** . See **Special Tools**.
- To prevent false diagnosis in the future, thoroughly clean the residual dye from any area where leaks were found. Use a rag and the approved **J 43872** . See **Special Tools**.

Fluorescent Dye Injection

IMPORTANT: Use only fluorescent dye approved by General Motors.

- **J 41447 can be poured directly into a removed A/C component. See Special Tools.**
- **J 46297-12 is injected into the low side port using J 46297 . See Special Tools.**

- Not all of the fluorescent dyes are compatible with PAG oil. Some types of dye decrease the oil viscosity or may chemically react with the oil.
- R-134A leak detection dye requires time to work. Depending upon the leak rate, a leak may not become visible for between 15 minutes and 7 days.

IMPORTANT: Do NOT overcharge the A/C system with dye. Use only one 7.39 ml (0.25 oz) charge.

- To prevent false diagnosis, thoroughly clean any residual dye from the service port with a rag and the approved fluorescent dye cleaner **J 43872** . See **Special Tools**.

Halogen Leak Detector

CAUTION: Do not operate the detector in a combustible atmosphere since its sensor operates at high temperatures or personal injury and/or damage to the equipment may result.

Ensure that the vehicle has at least 0.45 kg (1 lb) of refrigerant in the A/C refrigeration system in order to perform a leak test. Refer to **Refrigerant Recovery and Recharging** for recharging the A/C system.

IMPORTANT: Halogen leak detectors are sensitive to the following items:

- **Windshield washing solutions**
- **Many solvents and cleaners**

- **Some adhesives used in the vehicle**

Clean and dry all surfaces in order to prevent a false warning. Liquids will damage the detector.

IMPORTANT: Follow a continuous path in order to ensure that you will not miss any possible leaks. Test all areas of the system for leaks.

Follow the instructions supplied with the **J 39400-A** . See **Special Tools**.

AIR CONDITIONING (A/C) SYSTEM PERFORMANCE TEST (LZE, LZ4, LZ9)

Test Description

This test measures the operating efficiency of the A/C system under the following conditions:

- The current ambient air temperature
- The current relative humidity
- The high side pressure of the A/C system
- The low side pressure of the A/C system
- The temperature of the air being discharged into the passenger compartment

The number(s) below refer to the step number(s) on the diagnostic table.

1: This step determines if the A/C system has at least the minimum refrigerant charge required to operate the system without damage.

2: This step measures the performance of the A/C system.

3: This step is to allow for vehicle variations as well as high ambient air temperatures.

Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)

<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td colspan="5">IMPORTANT:
• The ambient air temperature must be at least 16°C (60°F).
• Do not induce additional air flow across the front of the vehicle during the test.
• If you were sent here from a DTC diagnostic table, clear the DTC upon completion of this test.</td></tr>
<tr><td></td><td>1. Park the vehicle inside or in the shade.
2. Open the windows in order to ventilate the interior of the vehicle.</td><td>Above 16°</td><td></td><td></td></tr>
</table>

1	3. If the A/C system was operating, allow the A/C system to equalize for about 2 minutes. 4. Turn OFF the ignition 5. Install the **J 43600** ACR 2000 Air Conditioning Service Center. See **Special Tools**. 6. Record the ambient air temperature displayed on the **J 43600** . See **Special Tools**. 7. Record readings of the low and high side STATIC pressures. Are both the low and high side pressures within the specified value?	C (60°F) - 345 kPa (50 psi) Above 24° C (75°F) - 483 kPa (70 psi) Above 33° C (90°F) - 690 kPa (100 psi)	Go to **Step 2**	Go to **Leak Testing**
	IMPORTANT: **Record the relative humidity and the ambient air temperature AT THE TIME OF THE TEST.** 1. Close the vehicle doors and windows. 2. Open the driver door window 12.7-15.2 cm (5-6 in). 3. Select the following HVAC control setting: • The A/C is ON • The coldest temperature setting • The maximum blower speed • Recirculation mode • The IP panel outlet mode • All IP panel outlets are OPEN • The passenger side of a Dual Zone HVAC control module is turned OFF 4. Install the temperature probes of the **J 43600** in the left and right center panel air outlets. See			

2	**Special Tools**. 5. Apply the parking brake. 6. Place the transmission in PARK 7. Start the engine. 8. Operate the A/C system for 5 minutes. 9. Inspect A/C components for the following conditions: - Abnormal frost areas - Unusual noises **IMPORTANT:** **When performing this step it is necessary to press the RESET button on the J 43600 before pressing the PRINT button. See Special Tools.** 10. Print the following information: - The panel outlet air temperatures - The low-side pressure - The high-side pressure 11. Compare the low and high side pressures and the panel output temperatures to the A/C performance table below. Does all the data recorded fall within the specified ranges of the A/C performance table?	-	Go to **Step 8**	Go to **Step 3**
3	If the pressures and temperatures recorded do not fall within the specified ranges: 1. Continue to operate the A/C system for an additional 5 minutes. 2. Record the pressures and temperatures again. 3. Compare the low and high side pressures and the panel output	-		

	temperature to the A/C performance table. Does all the data recorded fall within the specified ranges of the A/C performance table?		Go to **Step 8**	Go to **Step 4**
4	Do the high and low side pressures fall within the specified ranges, but the panel outlet temperatures do not?	-	Go to **Air Conditioning (A/C) Diagnostics - Pressure Zone A**	Go to **Step 5**
5	Is the low side pressure greater than the specified range, but the high side pressure is within or less than the specified range?	-	Go to **Air Conditioning (A/C) Diagnostics - Pressure Zone B**	Go to **Step 6**
6	Are the low and high side pressures both greater than the specified ranges?	-	Go to **Air Conditioning (A/C) Diagnostics - Pressure Zone C**	Go to **Step 7**
7	Is the high side pressure greater than the specified range, but the low side pressure is within or less than the specified range?	-	Go to **Air Conditioning (A/C) Diagnostics - Pressure Zone D**	Go to **Step 8**
8	Operate the system in order to verify the test results. Did you find the same results?	-	System OK	Go to **Symptoms - HVAC Systems - Manual** in HVAC Systems - Manual

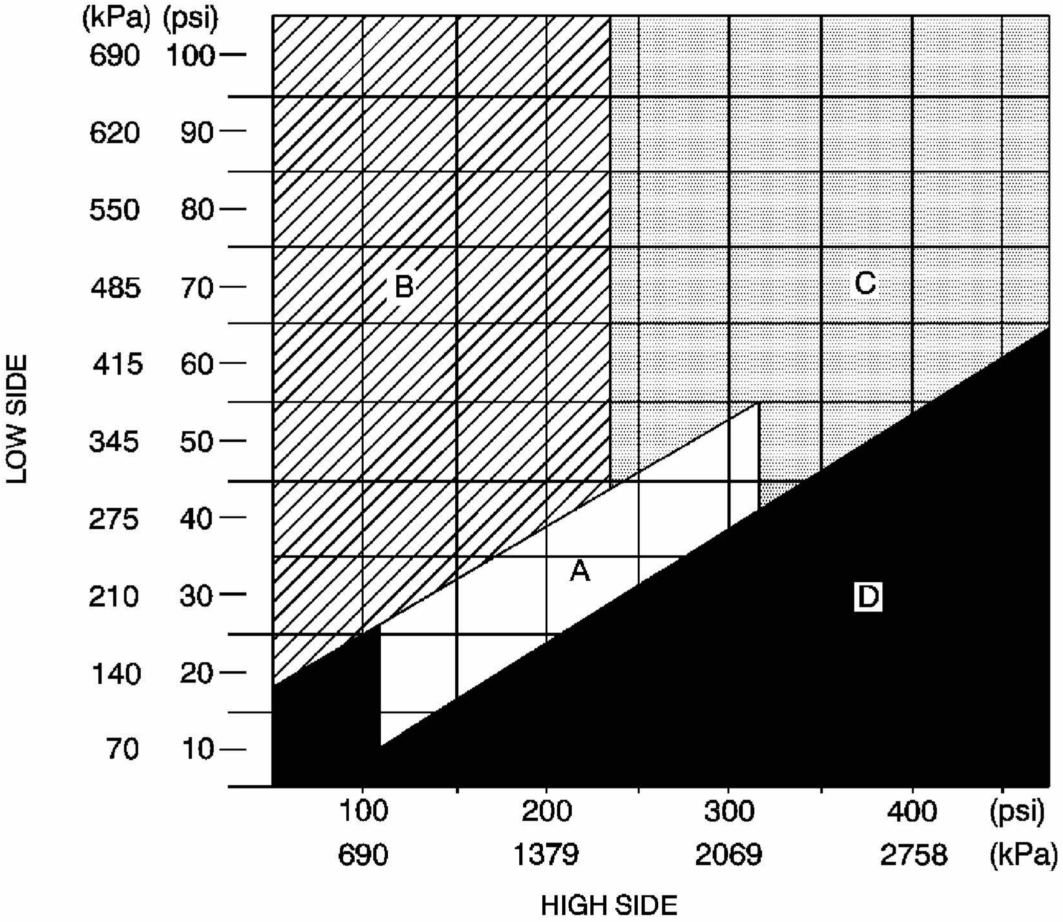


Fig. 1: A/C System Pressure - Zone Classification
Courtesy of GENERAL MOTORS CORP.

A/C Performance Table

Ambient Air Temperature	Relative Humidity	Service Port Pressure		Maximum Left Center Discharge Air Temperature
		Low Side	High Side	
13-18°C (55-65°F)	0-100%	175-239 kPa (25-35 psi)	920-1360 kPa (133-197 psi)	11°C (51.8°F)
18-24°C (65-75°F)	Below 40%	175-225 kPa (25-33 psi)	940-1360 kPa (136-197 psi)	9°C (48.2°F)
	Above 40%	175-256 kPa (25-37 psi)	1080-1480 kPa (157-215 psi)	12°C (53.6°F)
24-29°C (75-	Below 35%	175-238 kPa (25-35 psi)	1200-1510 kPa (174-219 psi)	11°C (51.8°F)
	35-50%	181-246 kPa (26-	1260-1540 kPa	11°C (58.1°F)

85°F)		36 psi)	(183-224 psi)	
	Above 50%	192-262 kPa (27-38 psi)	1310-1580 kPa (190-229 psi)	12°C (53.6°F)
29-35°C (85-95°F)	Below 30%	188-258 kPa (27-37 psi)	1400-1720 kPa (203-250 psi)	12°C (53.6°F)
	30-50%	196-262 kPa (28-38 psi)	1420-1720 kPa (206-250 psi)	13°C (55.4°F)
	Above 50%	206-268 kPa (30-40 psi)	1460-1720 kPa (212-250 psi)	13°C (55.4°F)
35-41°C (95-105°F)	Below 20%	214-282 kPa (31-41 psi)	1640-1950 kPa (238-283 psi)	14°C (57.2°F)
	20-40%	216-282 kPa (31-41 psi)	1640-1950 kPa (238-283 psi)	14°C (57.2°F)
	Above 40%	220-282 kPa (32-41 psi)	1640-1950 kPa (238-283 psi)	14°C (57.2°F)
41-46°C (105-115°F)	Below 20%	243-303 kPa (35-44 psi)	1890-2140 kPa (274-311 psi)	16°C (60.8°F)
	Above 20%	242-303 kPa (35-44 psi)	1890-2140 kPa (274-311 psi)	16°C (60.8°F)
46-49°C (115-120°F)	Below 30%	263-310 kPa (38-45 psi)	2060-2210 kPa (299-321 psi)	17°C (62.6°F)

AIR CONDITIONING (A/C) SYSTEM PERFORMANCE TEST (LS4)

Test Description

This test measures the operating efficiency of the A/C system under the following conditions:

- The current ambient air temperature (AAT)
- The current relative humidity
- The high side pressure of the A/C system
- The low side pressure of the A/C system
- The temperature of the air being discharged into the passenger compartment

The numbers below refer to the step numbers on the diagnostic table.

1: This step determines if the A/C system has at least the minimum refrigerant charge required to operate the system without damage.

2: This step measures the performance of the A/C system.

3: This step is to allow for vehicle variations as well as high (AATs).

Air Conditioning (A/C) System Performance Test (LS4)

Step	Action	Values	Yes	No
IMPORTANT: • **The ambient air temperature (AAT) must be at least 16°C (60°F).** • **Do not induce additional air flow across the front of the vehicle during the test.** • **If you were sent here from a DTC diagnostic table, clear the DTC upon completion of this test.**				
1	1. Park the vehicle inside or in the shade. 2. Open the windows in order to ventilate the interior of the vehicle. 3. If the A/C system was operating, allow the A/C system to equalize for about 2 minutes. 4. Turn OFF the ignition. 5. Install the **J 43600** ACR 2000 Air Conditioning Service Center. See **Special Tools**. 6. Record the ambient air temperature (AAT) displayed on the **J 43600** . See **Special Tools**. 7. Record readings of the low and high side STATIC pressures. Are both the low and high side pressures within the specified value?	Above 16°C (60°F) - 345 kPa (50 psi) Above 24°C (75°F) - 483 kPa (70 psi) Above 33°C (90°F) - 690 kPa (100 psi)	Go to **Step 2**	Go to **Leak Testing**
	IMPORTANT: **Record the relative humidity and the AAT AT THE TIME OF THE TEST.** 1. Close the vehicle doors and windows. 2. Open the driver door window 12.7-15.2 cm (5-6 in). 3. Select the following HVAC control setting: • The A/C is ON. • The coldest temperature setting			

2	• The maximum blower speed • Recirculation mode • The instrument panel (I/P) outlet mode • All I/P outlets are OPEN 4. Install the temperature probes of the **J 43600** in the left and right center panel air outlets. See **Special Tools**. 5. Apply the parking brake. 6. Place the transmission in PARK. 7. Start the engine. 8. Operate the A/C system for 5 minutes. 9. Inspect A/C components for the following conditions: • Abnormal frost areas • Unusual noises **IMPORTANT:** **When performing this step it is necessary to press the RESET button on the J 43600 before pressing the PRINT button. See Special Tools.** 10. Print the following information: • The panel outlet air temperatures • The low-side pressure • The high-side pressure 11. Compare the low and high side pressures and the panel output temperatures to the A/C performance table below. Does all the data recorded fall within the specified ranges of the A/C performance table?	-	Go to **Step 8**	Go to **Step 3**
	If the pressures and temperatures			

3	recorded do not fall within the specified ranges: 1. Continue to operate the A/C system for an additional 5 minutes. 2. Record the pressures and temperatures again. 3. Compare the low and high side pressures and the panel output temperature to the A/C performance table. Does all the data recorded fall within the specified ranges of the A/C performance table?	-	Go to **Step 8**	Go to **Step 4**
4	Do the high and low side pressures fall within the specified ranges, but the panel outlet temperatures do not?	-	Go to **Air Conditioning (A/C) Diagnostics - Pressure Zone A**	Go to **Step 5**
5	Is the low side pressure greater than the specified range, but the high side pressure is within or less than the specified range?	-	Go to **Air Conditioning (A/C) Diagnostics - Pressure Zone B**	Go to **Step 6**
6	Are the low and high side pressures both greater than the specified ranges?	-	Go to **Air Conditioning (A/C) Diagnostics - Pressure Zone C**	Go to **Step 7**
7	Is the high side pressure greater than the specified range, but the low side pressure is within or less than the specified range?	-	Go to **Air Conditioning (A/C) Diagnostics - Pressure Zone D**	Go to **Step 8**
	Operate the system in order to verify the test results.			Go to **Symptoms -**

8	Did you find the same results?	-	System OK	**HVAC Systems - Manual** in HVAC Systems - Manual

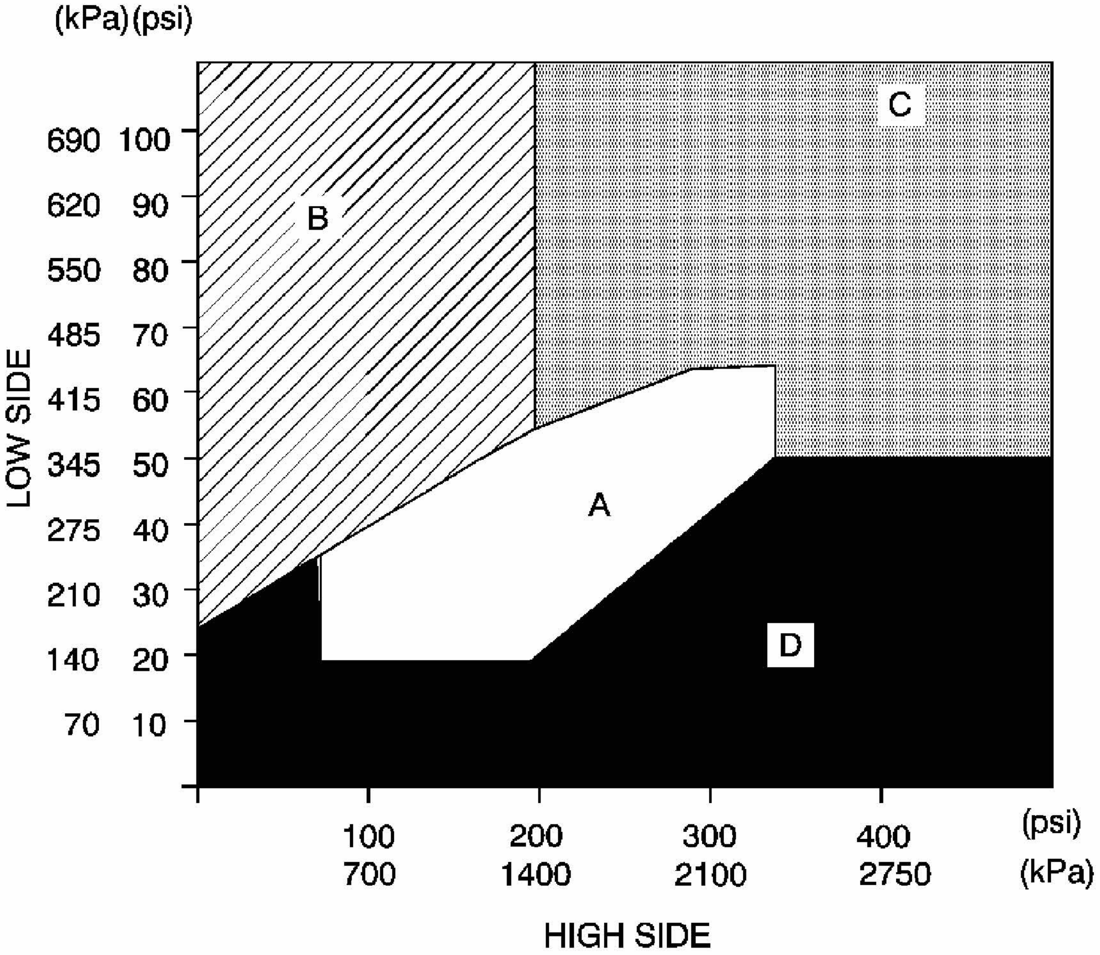


Fig. 2: A/C System Pressure - Zone Classification
Courtesy of GENERAL MOTORS CORP.

A/C Performance Table

Ambient Air Temperature	Relative Humidity	Service Port Pressure		Maximum Left Center Discharge Air Temperature
		Low Side	High Side	
13-18°C (55-65°F)	0-100%	151-234 kPa (22-34 psi)	558-909 kPa (81-132 psi)	12°C (52°F)
	Below 40%	151-234 kPa (22-	730-1109 kPa (106-	9°C (48°F)

19-24°C (66-75°F)		34 psi)	161 psi)	
	Above 40%	151-275 kPa (22-40 psi)	771-1150 kPa (112-167 psi)	14°C (57°F)
25-29°C (76-85°F)	Below 35%	165-268 kPa (24-39 psi)	1012-1322 kPa (147-192 psi)	13°C (54°F)
	35-50%	186-282 kPa (27-41 psi)	1019-1329 kPa (148-193 psi)	13°C (55°F)
	Above 50%	206-310 kPa (30-45 psi)	1040-1336 kPa (151-194 psi)	17°C (61°F)
30-35°C (86-95°F)	Below 30%	206-303 kPa (30-44 psi)	1233-1577 kPa (179-229 psi)	15°C (59°F)
	30-50%	220-323 kPa (32-47 psi)	1240-1577 kPa (180-229 psi)	18°C (63°F)
	Above 50%	241-344 kPa (35-50 psi)	1247-1577 kPa (181-229 psi)	19°C (66°F)
36-41°C (96-105°F)	Below 20%	248-344 kPa (36-50 psi)	1502-1839 kPa (218-267 psi)	18°C (64°F)
	20-40%	254-358 kPa (37-52 psi)	1502-1839 kPa (218-267 psi)	19°C (66°F)
	Above 40%	275-372 kPa (40-54 psi)	1502-1832 kPa (218-266 psi)	22°C (70°F)
42-46°C (106-115°F)	Below 20%	296-385 kPa (43-56 psi)	1770-2060 kPa (257-299 psi)	22°C (70°F)
	Above 20%	303-392 kPa (44-57 psi)	1756-2053 kPa (255-298 psi)	23°C (72°F)
47-49°C (116-120°F)	Below 30%	344-427 kPa (50-62 psi)	1977-2280 kPa (287-331 psi)	25°C (77°F)

AIR CONDITIONING (A/C) DIAGNOSTICS - PRESSURE ZONE A

Air Conditioning (A/C) Diagnostics - Pressure Zone A

Step	Action	Value	Yes	No
DEFINITION: The high and low side pressures may be normal or slightly less than normal. • Air Delivery Concern • Slight Refrigerant Under Charge • Refrigerant Contamination				
	Were you sent here from the A/C System Performance Test?			Go to **Air Conditioning (A/C) System**

1		-	Go to **Step 2**	**Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)**
2	Refer to the instrument panel outlet air temperatures recorded during the A/C system performance test. Does the discharge air temperature between the right and left center instrument panel outlets vary by more than 1-2°C (2-3°F)?	-	Go to **Step 7**	Go to **Step 3**
3	Did the customer mention that the A/C system output temperatures are good at first, but then turn warm during extended drives?	-	Go to **Step 4**	Go to **Step 5**
4	Increase engine speed to 2000 RPM. During extended operation of the A/C system, does the low side pressure decrease, possibly accompanied by heavy frost on the liquid line between the expansion device and the evaporator?	-	Go to **Air Conditioning (A/C) Diagnostics - Pressure Zone D**	Go to **Step 5**
5	1. Refer to the pressures recorded during the A/C system performance test. 2. Inspect for the following conditions: **CAUTION:** **Refer to Moving Parts and Hot Surfaces Caution .** - The high side pressure is slightly greater than the specified pressure ranges but still within Zone A on the A/C Pressure-Zone Classification Chart in the A/C System Performance	-		

	Test. Refer to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)Air Conditioning (A/C) System Performance Test (LS4)** . - The discharge line is hot. - The suction line is cool. Do the listed conditions exist?		Go to **Step 7**	Go to **Step 6**
6	1. Refer to the pressures recorded during the A/C system performance test. 2. Inspect for the following conditions: - The low side pressure is slightly lower than the specified pressure ranges but still within Zone A on the A/C Pressure-Zone Classification Chart in the A/C System Performance Test. Refer to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)Air Conditioning (A/C) System Performance Test (LS4)** . - The discharge line is warm to hot. - The suction line is cool to warm. Do the listed conditions exist?	-	Go to **Step 8**	Go to **Too Hot in Vehicle**
	The A/C system may be undercharged. 1. Leak test A/C system. Refer to **Leak Testing**. 2. Recharge the A/C system to			

7	specifications. Refer to **Refrigerant Recovery and Recharging**. Is the action complete?	-	Go to **Step 13**	-
8	The A/C system may be contaminated. View the information screen on the **J 43600** for detection of foreign gases in the A/C system. See **Special Tools**. Do foreign gases exist?	-	Go to **Step 9**	Go to **Step 10**
9	1. Evacuate the A/C system to a scavenging tank. Refer to **Refrigerant Recovery and Recharging**. 2. Recharge the A/C system to specifications. Is the action complete?	-	Go to **Step 13**	-
10	The A/C system may contain too much moisture or air. 1. Evacuate and recharge the A/C system to specifications. Refer to **Refrigerant Recovery and Recharging**. 2. Operate the A/C system and inspect the instrument panel outlet air temperatures. Refer to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)**. Are the instrument panel outlet air temperatures within the specified ranges of the A/C Performance Test Table?	-	Go to **Step 14**	Go to **Step 11**
	The A/C system may contain too			

11	much refrigerant oil. **IMPORTANT:** **Review the vehicle's A/C repair history.** If the vehicle history shows multiple A/C repairs and is suspected of improper PAG oil balancing in the previous repairs, perform the following procedure: 1. Drain all of the PAG oil drain bottle on the ACR 2000. 2. Flush the A/C system. Refer to **Flushing**. Was more than the total system capacity of refrigerant oil recovered from the ACR 2000 oil drain bottle?	150 ml (5 oz)	Go to **Step 12**	Go to **Step 13**
12	1. Add the specified amount of refrigerant oil. Refer to **Refrigerant System Capacities**. 2. Recharge the A/C system. Refer to **Refrigerant Recovery and Recharging**. Are the actions complete?	-	Go to **Step 13**	-
13	1. Record the low and high side pressures and the instrument panel outlet air temperature. 2. Compare the instrument panel outlet air temperatures to those listed in the A/C System Performance Chart. Refer to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)**.	-		

	Are the high and low side pressures and the instrument panel outlet air temperatures within specifications?		Go to **Step 14**	-
14	Operate the system in order to verify the repair. Did you find and correct the condition?	-	System OK	Go to **Symptoms - HVAC Systems - Manual**

AIR CONDITIONING (A/C) DIAGNOSTICS - PRESSURE ZONE B

Air Conditioning (A/C) Diagnostics - Pressure Zone B

Step	Action	Yes	No
DEFINITION: The low side pressure is higher than normal and the high side pressure is lower than normal. • Malfunctioning A/C Compressor • Refrigerant Under Charge			
1	Were you sent here from the A/C System Performance Test?	Go to **Step 2**	Go to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)**
2	After continued operation of the A/C system, do the low and the high side pressures equalize or become static?	Go to **Step 5**	Go to **Step 3**
	1. Refer to the pressures recorded during the A/C System Performance Test. 2. Inspect for the following conditions: **CAUTION:** **Refer to Moving Parts and Hot Surfaces Caution .** • The low side pressure is equal to or greater than the specified pressure range of the A/C Performance Table. Refer to **Air**		

3	**Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)Air Conditioning (A/C) System Performance Test (LS4)** . - The high side pressure is less than the specified pressure range of the A/C Performance Table. Refer to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)Air Conditioning (A/C) System Performance Test (LS4)** . - The low side refrigerant line at the compressor feels cool to warm. - The high side refrigerant line at the compressor feels warm to hot. Do the listed conditions exist?	Go to **Step 5**	Go to **Step 4**
4	1. Refer to the pressures recorded during the A/C System Performance Test. 2. Inspect for the following conditions: **CAUTION:** **Refer to Moving Parts and Hot Surfaces Caution .** - The low side pressure is greater than the specified pressure range of the A/C Performance Table. Refer to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)Air Conditioning (A/C) System Performance Test (LS4)** . - The high side pressure is less than the specified pressure range of the A/C Performance Table. Refer to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)Air Conditioning (A/C) System Performance Test**		Go to **Air Conditioning**

	(LS4) . - The low side refrigerant line at the compressor feels warm. - The high side refrigerant line at the compressor feels warm to hot. Do the listed conditions exist?	Go to **Step 5**	**(A/C) System Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)**
5	The A/C system has a low refrigerant charge. Evacuate and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging**. Is the action complete?	Go to **Step 6**	-
6	1. After you perform the repairs, record the following: - The low and the high side pressures - The instrument panel outlet air temperature 2. Compare the pressures and the temperature to those listed in the A/C Performance Chart. Refer to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)**. Are the readings within the specified ranges found on the A/C Performance Chart?	Go to **Step 13**	Go to **Step 7**
7	The A/C compressor is malfunctioning. Remove the expansion device and inspect for contamination. Refer to **Thermal Expansion Valve Replacement**. Did you find metal flakes on the expansion device?	Go to **Step 9**	Go to **Step 8**
8	Inspect the expansion device for a brown, powdery residue indicating desiccant in the A/C system. Is a brown, powdery residue present?	Go to **Step 11**	Go to **Step 12**
	1. Remove the compressor hose from the compressor. Refer to **Compressor**		

9	**Hose Assembly Replacement**. 2. Inspect for metal flake contamination at the line connections and the compressor ports. Is metal flake contamination present?	Go to **Step 10**	Go to **Step 12**
10	1. Replace the A/C compressor. Refer to **Compressor Replacement (RPOs LZE, LZ4, LZ9)** or **Compressor Replacement (RPO LS4)**. 2. Replace the thermal expansion valve. Refer to **Thermal Expansion Valve Replacement**. 3. Replace the A/C refrigerant filter. Refer to **Air Conditioning (A/C) Refrigerant Filter Replacement**. 4. Evacuate and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging**. Is the action complete?	Go to **Step 13**	-
11	1. Flush the A/C system. Refer to **Flushing**. 2. Replace the thermal expansion valve. Refer to **Thermal Expansion Valve Replacement**. 3. Replace the A/C compressor. Refer to **Compressor Replacement (RPOs LZE, LZ4, LZ9)** or **Compressor Replacement (RPO LS4)**. 4. Replace the A/C refrigerant filter. Refer to **Air Conditioning (A/C) Refrigerant Filter Replacement**. 5. Replace the condenser. Refer to **Condenser Replacement**. 6. Evacuate and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging**. Is the action complete?	Go to **Step 13**	-
	1. Replace the A/C compressor. Refer to		

12	**Compressor Replacement (RPOs LZE, LZ4, LZ9)** or **Compressor Replacement (RPO LS4)**. 2. Evacuate and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging**. Is the action complete?	Go to **Step 13**	-
13	Operate the system in order to verify the repair Did you find and correct the condition?	System OK	Go to **Symptoms - HVAC Systems - Manual**

AIR CONDITIONING (A/C) DIAGNOSTICS - PRESSURE ZONE C

Air Conditioning (A/C) Diagnostics - Pressure Zone C

Step	Action	Yes	No
DEFINITION: The low and the high side pressures are both higher than normal. • Restricted Condenser Air Flow • Cooling Fan Malfunction • Expansion Device Malfunction			
1	Were you sent here from the A/C System Performance Test?	Go to **Step 2**	Go to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)**
2	1. Start the engine. 2. Turn ON the A/C. 3. Inspect for proper cooling fan operation. Refer to **Cooling System Description and Operation** . Are the cooling fans ON and operating properly?	Go to **Step 3**	Go to **Step 5**
	Visually inspect for the following conditions:		

3	• Damaged condenser cooling fins • Missing or misaligned air baffles • Restricted air flow Do any of these conditions exist?	Go to **Step 4**	Go to **Step 6**
4	Repair the air flow restriction. Is the action complete?	Go to **Step 9**	-
5	Repair the fault to the cooling fan operation. Refer to **Cooling Fan Inoperative** . Is the repair complete?	Go to **Step 9**	-
6	**CAUTION:** **Refer to Moving Parts and Hot Surfaces Caution .** Feel the liquid line on both sides of the expansion device.Are the temperatures on both sides of the expansion device similar?	Go to **Step 7**	Go to **Step 8**
7	Replace the damaged or faulty thermal expansion valve. Refer to **Thermal Expansion Valve Replacement**. Is the action complete?	Go to **Step 9**	-
8	1. Air is in the refrigerant system, or the system is overcharged. Refer to the view screen on **J 43600** for foreign gas content in the refrigerant. See **Special Tools**. 2. Recover and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging**. Is the action complete?	Go to **Step 9**	-
9	1. Record the low and high side pressures and the instrument panel outlet air temperature after you have performed the repairs. 2. Compare the pressures and the instrument panel outlet air temperature to those listed in the A/C Performance Chart. Refer to **Air Conditioning (A/C) System Performance Test**		Go to **Air Conditioning (A/C) System Performance**

	(LZE, LZ4, LZ9) or **Air Conditioning (A/C) System Performance Test (LS4)**. Are the readings within the specified ranges listed in the A/C Performance Chart?	Go to **Step 10**	**Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)**
10	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Symptoms - HVAC Systems - Manual**

AIR CONDITIONING (A/C) DIAGNOSTICS - PRESSURE ZONE D

Air Conditioning (A/C) Diagnostics - Pressure Zone D

Step	Action	Yes	No
DEFINITION: The low side pressure is lower than normal and the high side pressure is higher than normal. • A restriction in the A/C system. • Debris in the system.			
1	Were you sent here from the A/C System Performance Test?	Go to **Step 2**	Go to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)**
2	**CAUTION:** **Refer to Moving Parts and Hot Surfaces Caution .** Feel the liquid line before the expansion device.Is the liquid line cold before the expansion device?	Go to **Step 3**	Go to **Step 8**
3	Feel along the surfaces of the following high side components: • The compressor discharge hose • The condenser • The liquid line between the condenser and the expansion device		

	Did you detect an abrupt drop in temperature along the surfaces of any of the listed components?	Go to **Step 7**	Go to **Step 4**
4	1. Feel the liquid line at the expansion device location for extreme cold, possibly accompanied by heavy frost. 2. Feel along the liquid line beyond the expansion device location for warm temperature. Is the liquid line extremely cold at the expansion device location and warm beyond the expansion device location?	Go to **Step 11**	Go to **Step 5**
5	Feel along the surfaces of the following low side components: • The evaporator inlet tube between the expansion device and the evaporator core • The evaporator outlet tube between the evaporator core and the compressor suction hose • The compressor suction hose Did you feel an abrupt temperature change along the surfaces of any of the listed components?	Go to **Step 7**	Go to **Step 6**
6	Feel along the surfaces of the low and the high side components. • The evaporator inlet tube between the expansion device and the evaporator core • The evaporator outlet tube and the compressor • The compressor suction hose • The compressor discharge hose • The condenser • The evaporator inlet tube between the		

	condenser and the expansion device Are the temperatures of these components only mildly warm?	Go to **Step 14**	Go to **Step 8**
7	1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**. 2. Remove the restriction from the component, or replace the component which produced an abrupt temperature drop. Is the action complete?	Go to **Step 9**	-
8	1. Recover the refrigerant and evacuate the system. Refer to **Refrigerant Recovery and Recharging**. 2. Record the weight of the recovered refrigerant. 3. Compare the weight of the recovered refrigerant with the system capacity. Refer to **Refrigerant System Capacities**. Is the weight of the recovered refrigerant charge greater than 75 percent of the total system capacity?	Go to **Step 9**	Go to **Step 10**
9	Recharge the A/C System. Refer to **Refrigerant Recovery and Recharging**. Is the cooling performance improved?	Go to **Step 21**	Go to **Step 10**
10	1. Leak test the system. Refer to **Leak Testing**. 2. Repair any leaks. Is the action complete?	Go to **Step 21**	-
11	The expansion device is restricted. 1. Replace the expansion device. Refer to **Thermal Expansion Valve Replacement**. 2. If the expansion device was restricted, note the type of debris present.		

	Are metal flakes present?	Go to **Step 12**	Go to **Step 13**
12	1. Remove the compressor hose assembly from the vehicle. Refer to **Compressor Hose Assembly Replacement**. 2. Inspect the hose for debris by blowing shop air through one end of the hose while covering the other end with a shop towel. 3. Observe the amount of debris collected in the shop towel. Did a large amount of debris collect in the shop towel?	Go to **Step 18**	Go to **Step 20**
13	If the expansion device was restricted with a brown or black residue, perform the following procedure: 1. Flush the A/C System. Refer to **Flushing**. 2. Replace the A/C refrigerant filter. Refer to **Air Conditioning (A/C) Refrigerant Filter Replacement**. 3. Replace the condenser. Refer to **Condenser Replacement**. Are the actions complete?	Go to **Step 21**	-
14	1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**. 2. Disconnect the compressor hose from the compressor. Refer to **Compressor Hose Assembly Replacement**. 3. Inspect for the presence of debris in the compressor suction port. Is debris present in the compressor suction port?	Go to **Step 15**	Go to **Step 19**
	1. Remove the debris from the suction		

15	port. 2. Inspect the expansion device for damage or debris. Refer to **Thermal Expansion Valve Replacement**. Did you find evidence of damage or debris?	Go to **Step 17**	Go to **Step 16**
16	If the expansion device does not show any signs of damage or debris, perform the following procedure: 1. Remove the compressor hose assembly from the vehicle. Refer to **Compressor Hose Assembly Replacement**. 2. Inspect the hose for debris by blowing shop air through one end of the hose while covering the other end with a shop towel. 3. Observe the amount of debris collected in the shop towel. Did a large amount of debris collect in the shop towel?	Go to **Step 18**	Go to **Step 19**
17	1. Replace the expansion device. Refer to **Thermal Expansion Valve Replacement**. 2. If the expansion device was restricted, observe the type of debris present. Are metal flakes present?	Go to **Step 12**	Go to **Step 13**
18	If a large amount of debris was collected in the shop towel from the suction hose, perform the following procedure: • Replace the A/C condenser. Refer to **Condenser Replacement**. • Replace the A/C refrigerant filter. Refer to **Air Conditioning (A/C) Refrigerant Filter Replacement**.		

	Is the action complete?	Go to **Step 19**	-
19	Install the compressor hose assembly. Refer to **Compressor Hose Assembly Replacement**. Is the action complete?	Go to **Step 21**	-
20	1. Install the compressor hose assembly. Refer to **Compressor Hose Assembly Replacement**. 2. Recharge the A/C system. Refer to **Refrigerant Recovery and Recharging**. Are the actions complete?	Go to **Step 21**	-
21	1. Record the low and the high side pressures and the instrument panel outlet air temperature after you perform the repairs. 2. Compare the pressures and the instrument panel outlet air temperature to those listed in the A/C Performance Chart. Refer to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)**. Are the readings within the specified ranges as shown on the A/C Performance Chart?	Go to **Step 22**	Go to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)**
22	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Symptoms - HVAC Systems - Manual**

HEATING PERFORMANCE DIAGNOSTIC

Heating Performance Diagnostic

Step	Action	Yes	No
DEFINITION: Heating system performance.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Symptoms - HVAC Systems - Manual**
	1. Start the engine.		

2	2. Allow the engine to idle. Does the engine reach normal operating temperature?	Go to **Step 3**	Go to **Step 9**
3	**CAUTION:** **Refer to Moving Parts and Hot Surfaces Caution in Cautions and Notices.** 1. Allow the engine to idle. 2. Select the FLOOR mode. 3. Select the minimum blower speed. 4. Select the warmest temperature setting. 5. Feel the temperature of the inlet and outlet heater hoses at the heater core. Does the inlet heater hose feel warmer than the outlet heater hose?	Go to **Step 7**	Go to **Step 4**
4	1. Install a thermometer into the center I/P PANEL air outlet. 2. Secure a thermometer to the heater core outlet heater hose. 3. Select the PANEL mode. 4. Select the maximum blower speed. 5. Select the warmest temperature setting. 6. Record the temperature at the following locations: - The center I/P PANEL air outlet - The heater core outlet heater hose 7. Compare the recorded temperatures. Are the two temperature readings about equal?	Go to **Step 5**	Go to **Step 6**
5	1. Inspect and repair the following areas of the vehicle for cold air leaks: - The cowl - The recirculation door - The HVAC module case 2. Perform the necessary repairs.		

	Are the repairs complete?	Go to **Step 10**	-
6	1. Inspect the temperature door operation. Refer to **Diagnostic System Check - Vehicle** in Vehicle DTC Information. 2. Perform any necessary repairs. Are the repairs complete?	Go to **Step 10**	-
7	1. Turn OFF the engine. 2. Backflush the heater core. 3. Start the engine. 4. Select the FLOOR mode. 5. Select the minimum blower speed. 6. Select the warmest temperature setting. 7. Feel the temperature of the inlet and outlet heater hoses at the heater core. Does the inlet heater hose feel warmer than the outlet heater hose?	Go to **Step 8**	Go to **Step 10**
8	Replace the heater core. Refer to **Heater Core Replacement**. Is the repair complete?	Go to **Step 10**	-
9	Repair the low engine temperature concern. Refer to **Engine Fails To Reach Normal Operating Temperature** in Engine Cooling. Is the repair complete?	Go to **Step 10**	-
10	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

DEFROSTING INSUFFICIENT

Defrosting Insufficient

Step	Action	Yes	No
DEFINITION: Time required to defrost the windshield is longer than usual.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Symptoms - HVAC Systems - Manual**
	1. Start the engine. 2. Select the DEFROST mode.		

2	3. Select the maximum blower speed. Does sufficient air flow from the defroster outlets?	Go to **Step 3**	Go to **Step 10**
3	Measure the engine operating temperature. Does the engine reach normal operating temperature?	Go to **Step 4**	Go to **Step 8**
4	1. Select the minimum blower speed. 2. Select the warmest temperature setting. **CAUTION:** **Refer to Moving Parts and Hot Surfaces Caution in Cautions and Notices.** 3. Feel the temperature of the inlet and outlet heater hoses at the heater core. Does the inlet heater hose feel warmer than the outlet heater hose?	Go to **Step 11**	Go to **Step 5**
5	Test the operation of the A/C compressor clutch. Does the A/C compressor clutch engage?	Go to **Step 7**	Go to **Step 6**
6	Repair the A/C compressor clutch. Refer to **HVAC Compressor Clutch Does Not Engage** in HVAC Systems-Manual. Is the repair complete?	Go to **Step 14**	-
7	Perform the A/C system performance test. Refer to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)**. Is the A/C system operating within the specifications?	Go to **Step 9**	Go to **Step 12**
8	Repair the low engine temperature concern. Refer to **Engine Fails To Reach Normal Operating Temperature** in Engine Cooling. Is the repair complete?	Go to **Step 14**	-
9	Inspect for correct operation of the recirculation door. Is the recirculation door operating correctly?	Go to **Step 14**	Go to **Step 13**
	Repair the air delivery concern. Refer to **Air**		

10	**Delivery Improper** in HVAC Systems - Manual. Is the repair complete?	Go to **Step 14**	-
11	Repair the heating concern. Refer to **Heating Performance Diagnostic**. Is the repair complete?	Go to **Step 14**	-
12	Repair the A/C performance concern. Refer to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)**. Is the repair complete?	Go to **Step 14**	-
13	Repair the recirculation door concern. Refer to **Air Delivery Improper** in HVAC Systems Manual. Is the repair complete?	Go to **Step 14**	-
14	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

NOISE DIAGNOSIS - BLOWER MOTOR

Noise Diagnosis - Blower Motor

Step	Action	Yes	No
DEFINITION: Noise originating from the blower motor.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Symptoms - HVAC Systems - Manual**
2	Inspect the air inlet grille for debris. Is debris present?	Go to **Step 8**	Go to **Step 3**
3	1. Sit inside the vehicle. 2. Close the vehicle doors and windows. 3. Turn ON the ignition, with the engine OFF. 4. Cycle the blower motor through all of the speeds in order to determine where and when the noise occurs. Did you hear a noise during the blower operation?	Go to **Step 4**	Go to **Step 11**
	Inspect for excessive vibration at each		

4	blower motor speed by feeling the blower case. Is excess vibration present?	Go to **Step 6**	Go to **Step 5**
5	Listen to the blower motor at each blower speed. Is the blower motor making a squeaking or chirping noise?	Go to **Step 9**	Go to **Step 11**
6	1. Remove the blower motor. Refer to **Blower Motor Replacement**. 2. Inspect the blower motor impeller for deposits of foreign material. 3. Inspect the blower motor for deposits of foreign material. Did you find any foreign material on the blower motor or blower motor impeller?	Go to **Step 8**	Go to **Step 7**
7	Inspect the blower motor for the following conditions: 1. Cracked blades 2. A loose impeller retainer 3. Improper impeller alignment Did you find any of these conditions?	Go to **Step 9**	Go to **Step 10**
8	Remove the foreign material. Is the action complete?	Go to **Step 10**	-
9	Replace the blower motor. Refer to **Blower Motor Replacement**. Is the repair complete?	Go to **Step 11**	-
10	Install the blower motor. Refer to **Blower Motor Replacement**. Is the action complete?	Go to **Step 11**	-
11	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

NOISE DIAGNOSIS - AIR CONDITIONING (A/C) SYSTEM

Noise Diagnosis - Air Conditioning (A/C) System

Step	Action	Yes	No
DEFINITION: Noise originating from the A/C compressor, drive belt or the A/C lines.			

1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Symptoms - HVAC Systems - Manual**
2	1. A/C system noises can be generally categorized into 3 areas: • Screeching, squealing or chirping noises • Moaning noises • Vibration/rattle noises 2. Start the engine. 3. Ensure that the A/C is ON. Is a screeching or squealing noise heard when the A/C is engaged?	Go to **Step 3**	Go to **Step 9**
3	With the engine OFF, inspect the drive belt for excessive wear. Refer to **Drive Belt Excessive Wear Diagnosis** for the 3.5L engine or to **Drive Belt Excessive Wear Diagnosis** for the 3.9L engine or to **Drive Belt Excessive Wear Diagnosis** for the 5.3L engine. Is the drive belt excessively worn?	Go to **Step 18**	Go to **Step 4**
4	Inspect the drive belt tension. Refer to **Drive Belt Tensioner Diagnosis** for the 3.5L engine or to **Drive Belt Tensioner Diagnosis** for the 3.9L engine or to **Drive Belt Tensioner Diagnosis** for the 5.3L engine. Is the drive belt tension correct?	Go to **Step 5**	Go to **Step 19**
5	Inspect the drive belt for excessive oil coverage. Is the drive belt covered with oil?	Go to **Step 17**	Go to **Step 6**
6	1. Start the engine. 2. Ensure that the A/C is ON. 3. Inspect the compressor and the clutch. Is the A/C compressor locked up?	Go to **Step 24**	Go to **Step 7**
7	Is the A/C compressor clutch slipping?	Go to **Step 23**	Go to **Step 8**
	CAUTION: **Refer to Moving Parts and Hot Surfaces**		

8	**Caution** . Using a stethoscope, listen to the A/C compressor for any abnormal noise.Is the compressor causing an abnormal noise?	Go to **Step 15**	Go to **Step 10**
9	Does a moaning noise exist when the A/C clutch is engaged?	Go to **Step 10**	Go to **Step 12**
10	Listen to the A/C compressor components and mounting for noise concerns using a stethoscope. Are any of these components loose, damaged or excessively worn?	Go to **Step 20**	Go to **Step 11**
11	1. Idle the engine. 2. Engage the A/C compressor clutch. 3. Using a stethoscope, move around the entire refrigerant plumbing system. Listen for any abnormal noises caused by a component of the A/C system touching another component. Are any of the A/C components grounding out and causing a vibration noise?	Go to **Step 22**	Go to **Step 13**
12	Does a vibration or rattle noise exist when the A/C clutch is engaged?	Go to **Step 13**	Go to **Step 14**
13	Does the noise stop when the A/C clutch is disengaged?	Go to **Step 15**	Go to **Step 25**
14	1. Idle the engine in PARK with the A/C compressor clutch engaged. 2. Using a stethoscope, move around the entire A/C system testing for any abnormal noises caused by a component. Do any of the A/C components cause an abnormal noise?	Go to **Step 21**	Go to **Step 25**
15	Verify that the A/C system is properly charged. Refer to **Refrigerant System Capacities**. Is the A/C system properly charged?	Go to **Step 26**	Go to **Step 16**
16	Recharge the A/C system to specification. Refer to **Refrigerant Recovery and Recharging**.		

	Is the abnormal compressor noise still present?	Go to **Step 24**	Go to **Step 26**
17	Repair the oil leak. Is the action complete?	Go to **Step 26**	-
18	Replace the drive belt. Refer to **Drive Belt Replacement** for the 3.5L engine or to **Drive Belt Replacement** for the 3.9L engine or to **Drive Belt Replacement - Accessory** for the 5.3L engine. Is the action complete?	Go to **Step 26**	-
19	Replace the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** for the 3.5L engine or to **Drive Belt Tensioner Replacement** for the 3.9L engine or to **Drive Belt Tensioner Replacement - Accessory** for the 5.3L engine. Is the action complete?	Go to **Step 26**	-
20	Repair or replace the A/C compressor mounting component. Is the action complete?	Go to **Step 26**	-
21	Repair or replace the component which is causing the moaning concern as needed. Is the action complete?	Go to **Step 26**	-
22	Correctly route or insulate the A/C component. Is the action complete?	Go to **Step 26**	-
23	Replace the A/C compressor clutch. Refer to **Compressor Clutch Assembly Replacement**. Is the action complete?	Go to **Step 26**	-
24	Replace the A/C compressor. Refer to **Compressor Replacement (RPOs LZE, LZ4, LZ9)** or **Compressor Replacement (RPO LS4)**. Is the action complete?	Go to **Step 26**	-
25	The concern may be caused by an engine related component. Refer to **Vibration Analysis - Engine** . Did you find and correct the condition?	Go to **Step 26**	-
26	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

NOISE DIAGNOSIS - HVAC MODULE

Noise Diagnosis - HVAC Module

Step	Action	Yes	No
DEFINITION: Noise originating from the HVAC module.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Symptoms - HVAC Systems - Manual**
2	1. Start the engine. 2. Cycle through all of the following: • Blower motor speeds • HVAC modes • Temperature control settings 3. Determine the type of noise: • Scrape, pop • Tick/click, chirp or groaning • Air rush/whistle Is a scrape or pop noise evident when selecting modes or temperature settings?	Go to **Step 6**	Go to **Step 3**
3	Is a tick/click, chirping, groaning or scraping noise present, but decreases as blower motor speed is decreased?	Go to **Step 6**	Go to **Step 4**
4	Is an air rush/whistle noise evident in all modes but not all temperature settings?	Go to **Step 6**	Go to **Step 5**
5	Is an air rush/whistle noise evident only in defrost or floor mode?	Go to **Step 6**	Go to **Step 1**
6	Remove the lower trim panel. Refer to **Instrument Panel (I/P) Trim Panel Replacement - Lower (Impala)** or **Instrument Panel (I/P) Trim Panel Replacement - Lower (Monte Carlo)** in Instrument Panel, Gages, and Console. Is the action complete?	Go to **Step 7**	-
7	1. Inspect the mode valve assembly for proper operation. 2. Inspect the ducts for obstructions or foreign materials.		

	Were any of these conditions found?	Go to **Step 10**	Go to **Step 8**
8	Inspect the mode valve assembly, temperature doors and seals for warping or cracking. Are the doors in normal condition?	Go to **Step 11**	Go to **Step 9**
9	Replace the appropriate door, mode valve assembly or seals. Is the repair complete?	Go to **Step 11**	-
10	Remove any obstructions or foreign material found. Is the action complete?	Go to **Step 11**	-
11	Install the lower trim panel. Refer to **Instrument Panel (I/P) Trim Panel Replacement - Lower (Impala)** or **Instrument Panel (I/P) Trim Panel Replacement - Lower (Monte Carlo)** in Instrument Panel, Gages, and Console. Is the action complete?	Go to **Step 12**	-
12	Operate the system to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

ODOR DIAGNOSIS

Odor Diagnosis

Step	Action	Yes	No
DEFINITION: Odor originating or noticed through the HVAC system.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Symptoms - HVAC Systems - Manual**
2	1. Sit inside the vehicle. 2. Close all of the doors and windows. 3. Start the engine. 4. Allow the engine idle at normal operating temperature. 5. Select the maximum blower speed. 6. Select the PANEL air outlet mode. 7. Select the coldest temperature setting. 8. Cycle through all of the blower speeds, modes and temperatures to define what type of odor is present.		

	• Musty smell • Coolant smell • Oil smell Does the odor have a musty smell?	Go to **Step 3**	Go to **Step 8**
3	Inspect the HVAC air inlet grille for debris. Is debris present?	Go to **Step 4**	Go to **Step 5**
4	Remove any debris. Is the action complete?	Go to **Step 15**	-
5	Inspect for wet carpeting. Is the carpet wet?	Go to **Step 6**	Go to **Step 14**
6	Inspect for the following conditions: • Water leaks around the windshield • Blockage of the HVAC module drain • Leaks around the door seals Is a leak present?	Go to **Step 7**	Go to **Step 14**
7	Repair the leak as necessary. Is the action complete?	Go to **Step 15**	-
8	Does the odor have a coolant smell?	Go to **Step 9**	Go to **Step 12**
9	Inspect the cooling system for leaks. Refer to **Loss of Coolant** . Is a leak present?	Go to **Step 10**	Go to **Step 12**
10	Inspect for coolant leaking inside the vehicle or for a film build-up on the windshield. Is the condition present?	Go to **Step 11**	Go to **Step 15**
11	Replace the heater core. Refer to **Heater Core Replacement**. Is the action complete?	Go to **Step 15**	-
12	Does the odor have an oily smell?	Go to **Step 13**	Go to **Step 15**
	1. Inspect the engine compartment for any leaks. Refer to the following procedures: • **Oil Leak Diagnosis** for the 3.5L engine • **Oil Leak Diagnosis** for the 3.9L engine		

13	- **Oil Leak Diagnosis** for the 5.3L engine - **Fluid Leak Diagnosis** for the 4T65-E transmission - **Power Steering Fluid Leaks** 2. Repair any oil leaks. Is the action complete?	Go to **Step 15**	-
14	A musty odor can be caused by mold or mildew build-up on the evaporator or the heater core or inside of the HVAC module. Refer to **Odor Correction**. Is the action complete?	Go to **Step 15**	-
15	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

REPAIR INSTRUCTIONS

ODOR CORRECTION

Eliminating Air Conditioning Odor

Odors may be emitted from the air conditioning system primarily at start up in hot, humid climates. The following conditions may cause the odor:

- Debris is present in the HVAC module.
- Microbial growth on the evaporator core

When the blower motor fan is turned on, the microbial growth may release an unpleasant musty odor into the passenger compartment. To remove odors of this type, the microbial growth must be eliminated. Perform the following procedure:

Deodorize the evaporator core using Deodorizing Aerosol Kit.

Perform the following steps in order to deodorize the A/C system:

1. Ensure that the plenum which draws outside air into the HVAC module is clear of debris.
2. Disable the A/C compressor clutch operation by disconnecting the clutch coil electrical connector.
3. Dry the evaporator core by performing the following steps:
    1. Start the engine.

    2. Select the warmest temperature setting.
    3. Select the recirculation mode.
    4. Run the blower motor on high for 10 minutes.
4. Locate an area in the air conditioning duct between the blower motor and the evaporator core downstream of the blower motor.
5. Drill a 3.175 mm (0.125 in) hole where the hole will not interfere with or damage the following components:
    - The blower motor
    - The evaporator core
    - Any other operating part the of system
6. Wear safety goggles and latex gloves in order to perform the following actions:
    1. Select the maximum blower speed.
    2. Insert the deodorizer extension tube into the hole to the mark on the extension tube.
    3. Use short spray bursts and vary the direction of spray for a 2-3 minute period of time.
7. Shut the engine OFF. Allow the vehicle to sit for 3-5 minutes.
8. Seal the 3.175 mm (0.125 in) hole with body sealer or RTV gasket compound.
9. Start the engine.
10. Operate the blower motor on high for 15-20 minutes to dry.
11. Reconnect the A/C compressor clutch coil electrical connector.
12. Verify proper clutch operation.

REFRIGERANT RECOVERY AND RECHARGING

Tools Required

- **J 43600** ACR 2000 Air Conditioning Service Center. See **Special Tools**.
- **J 45037** A/C Oil Injector. See **Special Tools**.

CAUTION: Avoid breathing the A/C Refrigerant 134a (R-134a) and the lubricant vapor or the mist. Exposure may irritate the eyes, nose, and throat. Work in a well ventilated area. In order to remove R-134a from the A/C system, use service equipment that is certified to meet the requirements of SAE J 2210 (R-134a recycling equipment). If an accidental system discharge occurs, ventilate the work area before continuing service. Additional health and safety information may be obtained from the refrigerant and lubricant manufacturers.

CAUTION: For personal protection, goggles and gloves should be worn and a clean cloth wrapped around fittings, valves, and connections when doing work that includes opening the refrigerant system. If R-134a comes in contact with any part of the body severe frostbite and personal injury can result. The exposed area should be flushed immediately with cold water and prompt medical help should be obtained.

NOTE: R-134a is the only approved refrigerant for use in this vehicle. The use of any other refrigerant may result in poor system performance or component failure.

NOTE: To avoid system damage use only R-134a dedicated tools when servicing the A/C system.

NOTE: Use only Polyalkylene Glycol Synthetic Refrigerant Oil (PAG) for internal circulation through the R-134a A/C system and only 525 viscosity mineral oil on fitting threads and O-rings. If lubricants other than those specified are used, compressor failure and/or fitting seizure may result.

NOTE: R-12 refrigerant and R-134a refrigerant must never be mixed, even in the smallest of amounts, as they are incompatible with each other. If the refrigerants are mixed, compressor failure is likely to occur. Refer to the manufacturer instructions included with the service equipment before servicing.

The **J 43600** is a complete air conditioning service center for R-134a. See **Special Tools**. The ACR 2000 recovers, recycles, evacuates and recharges A/C refrigerant quickly, accurately and automatically. The unit has a display screen that contains the function controls and displays prompts that will lead the technician through the recover, recycle, evacuate and recharge operations. R-134a is recovered into and charged out of an internal storage vessel. The ACR 2000 automatically replenishes this vessel from an external source tank in order to maintain a constant 5.45-6.82 kg (12-15 lbs) of A/C refrigerant.

The ACR 2000 has a built in A/C refrigerant identifier that will test for contamination, prior to recovery and will notify the technician if there are foreign gases present in the A/C system. If foreign gases are present, the ACR 2000 will not recover the refrigerant from the A/C system.

The ACR 2000 also features automatic air purge, single pass recycling and an automatic oil drain.

Refer to the **J 43600** ACR 2000 manual for operation and setup instruction. See **Special Tools**. Always recharge the A/C System with the proper amount of R-134a. Refer to **Refrigerant System Capacities** for the correct amount.

A/C Refrigerant System Oil Charge Replenishing

If oil was removed from the A/C system during the recovery process or due to component replacement, the oil must be replenished. Oil can be injected into a charged system using **J 45037** . See **Special Tools**. For the proper quantities of oil to add to the A/C refrigerant system, refer to **Refrigerant System Capacities**.

FLUSHING

Tools Required

- **J 43600** ACR 2000 Air Conditioning Service Center. See **Special Tools**.
- **J 45268** Flush Adapter Kit. See **Special Tools**.
- **J 41447** Leak Detection Dye. See **Special Tools**.
- **J 42220** Universal 12V Leak Detection Lamp. See **Special Tools**.

IMPORTANT: Flushing with the ACR 2000 is not intended to remove metal from the A/C system.

Flushing is intended to remove the following:

- Contaminated PAG oil
- Desiccant, following a desiccant bag failure
- Overcharge of PAG oil
- Refrigerant contamination

IMPORTANT: Warmer engine or ambient temperature decreases the refrigerant recovery time during the A/C flush procedure.

1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**.
2. Remove the A/C refrigerant filter. Refer to **Air Conditioning (A/C) Refrigerant Filter Replacement**.
3. Remove the thermal expansion valve (TXV). Refer to **Thermal Expansion Valve Replacement**.
4. Install the stud for the **J 45268** kit onto the J 45268-115. See **Special Tools**.
5. Install the J 45268-115 in place of the TXV.

NOTE: Refer to Fastener

Notice .

6. Install the TXV mounting bolts.

   Tighten: Tighten the bolts to 7 N.m (62 lb in).

7. Connect the evaporator line to the J 45268-115.
8. Install the TXV block fitting nut.

   Tighten: Tighten the bolts to 17 N.m (12.5 lb ft).

9. Remove the A/C compressor. Refer to **Compressor Replacement (RPOs LZE, LZ4, LZ9)** or **Compressor Replacement (RPO LS4)**.
10. Install J 45268-10 to the A/C compressor hose assembly.
11. Install the nut and bolt from the **J 45268** kit to the J 45268-10 and compressor hose assembly. See **Special Tools**.

    Tighten: Tighten the bolts to 17 N.m (12.5 lb ft).

12. Forward flow refrigerant flushing is recommended for contaminated refrigerant or PAG oil.

    Perform the following procedure:

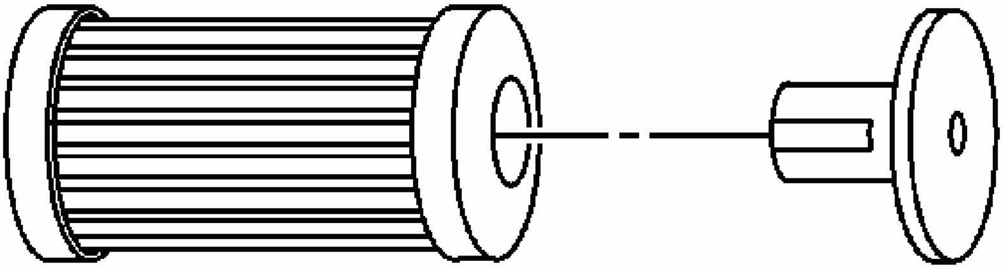


Fig. 3: View Of A/C Filter And Check Valve
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The filter inside J 45268-1 is serviceable. Remove and discard the check valve from the filter.

1. Service the filter with ACDelco P/N GF 470, before each flush.

   2. Install the port plugs J 45268-9 onto the J 45268-10.
   3. Install the fitting J 45268-7 onto the J 45268-10.
   4. Install the fitting J 45268-8 onto the J 45268-10.
   5. Connect J 45268-1 flush filter to the suction port of J 45268-7 flush adapter.
   6. Connect the blue hose from the **J 43600** to the J 45268-1 flush filter adapter. See **Special Tools**.
   7. Connect the red hose from the **J 43600** to the J 45268-8 flush adapter. See **Special Tools**.
13. Reverse flow refrigerant flush is recommended for desiccant bag failure. Replace the A/C condenser when the A/C flush is complete and perform the following procedure:

    IMPORTANT: The filter inside J 45268-1 is serviceable. Remove and discard the check valve from the filter.

   1. Service the filter with ACDelco P/N GF 470, before each flush.
   2. Install the port plugs J 45268-9 onto the J 45268-10.
   3. Install the fitting J 45268-7 onto the J 45268-10.
   4. Install the fitting J 45268-8 onto the J 45268-10.
   5. Connect J 45268-1 flush filter to the discharge port of J 45268-7 flush adapter.
   6. Connect the blue hose from **J 43600** to the J 45268-1 flush filter adapter. See **Special Tools**.
   7. Connect the red hose from **J 43600** to the J 45268-8 flush adapter. See **Special Tools**.

    IMPORTANT: Close the valve on the external refrigerant tank, before starting the flush process.

14. Flush the A/C system. Follow the instructions supplied with the **J 43600** . See **Special Tools**.
15. Disconnect the red hose on the **J 43600** from the J 45268-10. See **Special Tools**.
16. Disconnect the blue hose on the **J 43600** from the J 45268-1. See **Special Tools**.
17. Remove J 45268-1 from the J 45268-10.
18. Remove the J 45268-10 from the A/C compressor hose assembly.

    IMPORTANT: Flushing will remove all the PAG oil from the A/C system. The A/C system must be replenished with the correct amount of PAG oil.

19. If you will reinstall the removed A/C compressor, perform the following procedure:

   1. Remove the A/C compressor drain plug.
   2. Drain the PAG oil from the A/C compressor. Rotate the compressor input shaft to assist in draining the PAG oil from the compressor.
   3. Install the A/C compressor drain plug.

      Tighten: Tighten the drain plug to 16 N.m (12 lb ft).

   4. Add the total system capacity of PAG oil to the A/C compressor. Refer to **Refrigerant System Capacities** .

20. If you will replace the A/C compressor after flushing the system, perform the following procedure:
    1. Determine if the new service compressor is shipped with PAG oil. Refer to the **Refrigerant System Capacities** .
    2. If the service compressor is shipped with PAG oil, DO NOT drain the new PAG oil from the compressor.
    3. Deduct the amount of PAG oil shipped with the service compressor from the amount of PAG oil listed in the capacities table. Refer to **Refrigerant System Capacities** .
    4. Add the calculated amount to the compressor, as needed.

IMPORTANT: Flushing will remove the fluorescent leak detection dye from the A/C system.

21. Add one bottle of **J 41447** directly to the A/C Compressor. See **Special Tools**.
22. Install the A/C compressor. Refer to **Compressor Replacement (RPOs LZE, LZ4, LZ9)** or **Compressor Replacement (RPO LS4)**.
23. Remove J 45268-115.
24. Inspect the TXV for debris. Clean or replace as needed.
25. Install the TXV. Refer to **Thermal Expansion Valve Replacement**.
26. Install the A/C refrigerant filter. Refer to **Air Conditioning (A/C) Refrigerant Filter Replacement**.
27. Evacuate and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging**.
28. Leak test the fittings using **J 42220** . See **Special Tools**.

COMPRESSOR OIL BALANCING

Draining Procedure

IMPORTANT: Drain and measure as much of the refrigerant oil as possible from the removed compressor.

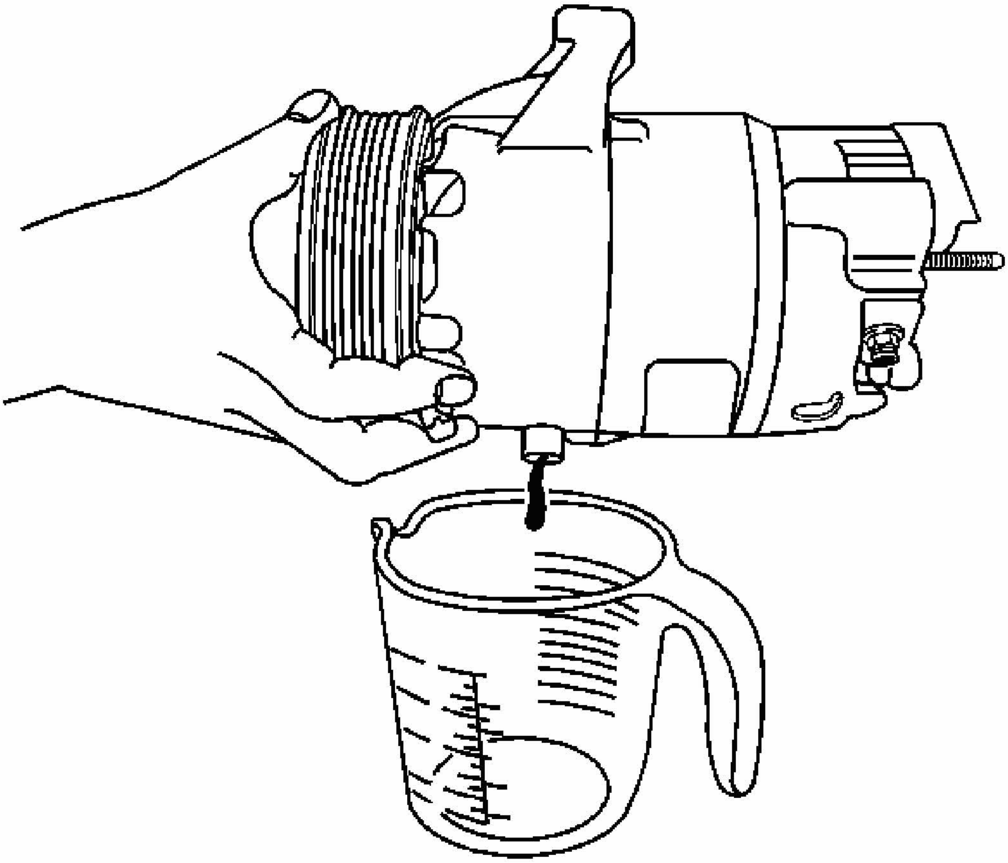


Fig. 4: Draining Oil From Compressor
Courtesy of GENERAL MOTORS CORP.

1. Remove the compressor crankcase oil drain plug and drain the crankcase into a clean, graduated container.
2. Drain the oil from both the suction and discharge ports of the removed compressor into the same container.

   Rotate the compressor shaft to assist in draining the compressor.

3. Measure and record the amount of oil drained from the removed compressor.

   This measurement will be used during installation of the replacement compressor.

4. Properly discard the used refrigerant oil.

Balancing Procedure

IMPORTANT: The refrigerant oil in the A/C system must be balanced during compressor replacement.

1. The replacement compressor is shipped with the total system capacity of refrigerant oil.

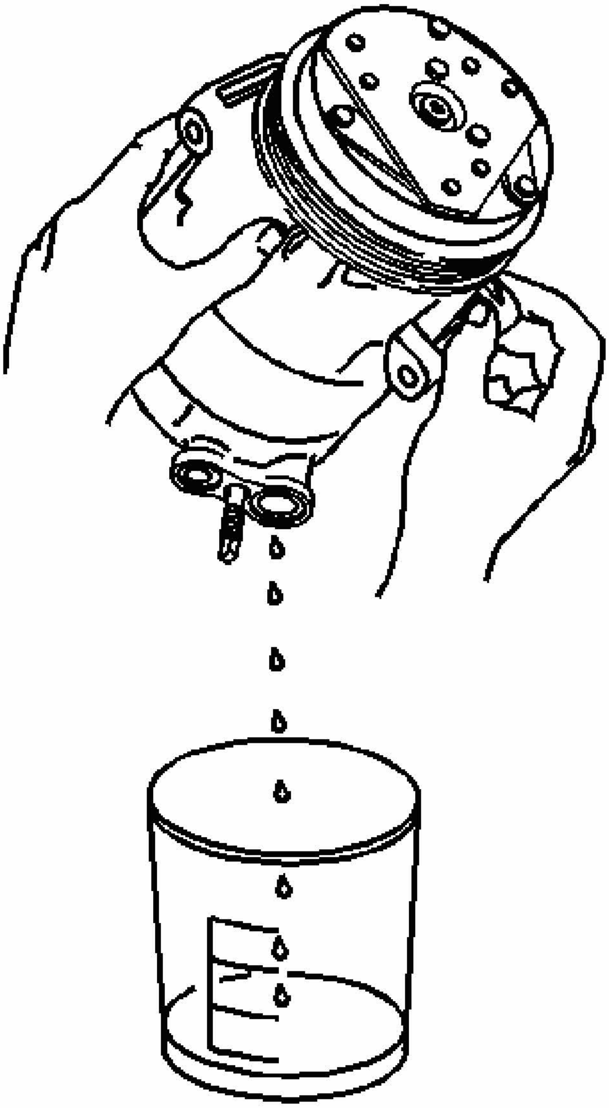


Fig. 5: Draining A/C Refrigerant Oil From Compressor
Courtesy of GENERAL MOTORS CORP.

2. Before installing the compressor, the refrigerant oil may have to be partially drained:
    1. Refer to the amount of refrigerant oil recorded during the compressor removal.

2. Subtract the amount recorded from the total system capacity. Refer to **Refrigerant System Capacities**.

   The difference between the total system capacity and the recorded amount is the calculated amount to be drained from the replacement compressor.

3. Drain the calculated amount of refrigerant oil from the replacement compressor.

COMPRESSOR REPLACEMENT (RPOS LZE, LZ4, LZ9)

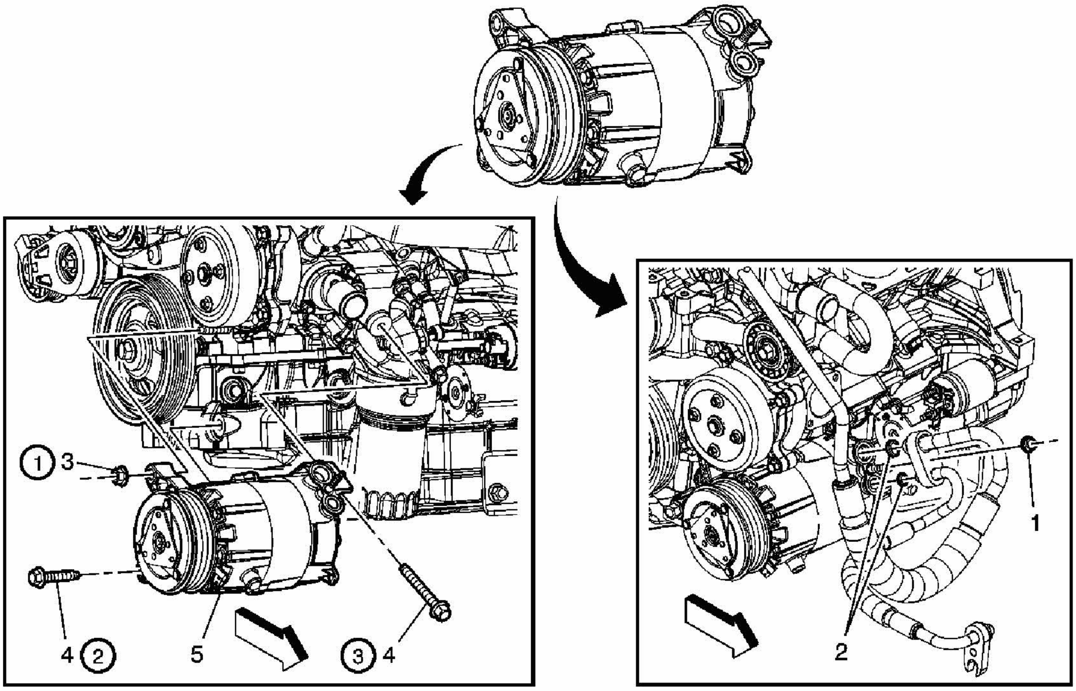


Fig. 6: Replacing Compressor
Courtesy of GENERAL MOTORS CORP.

Compressor Replacement (RPOs LZE, LZ4, LZ9)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**. 2. Remove the drive belt. Refer to **Drive Belt Replacement** for the 3.5L engine or	

Drive Belt Replacement for the 3.9L engine.

3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Remove the right engine splash shield. Refer to **Splash Shield Replacement - Engine - Right** .
5. Disconnect the electrical connector.

1	Nut, A/C Compressor Hose **Tip:** Remove the A/C compressor hose from the A/C compressor and cap hose. **Tighten:** 17 N.m (12.5 lb ft)
2	Washer, Sealing **Tip:** Remove and discard sealing washers. Refer to **Sealing Washer Replacement**.
3	Nut, A/C Compressor **Tip:** Tighten in sequence with A/C compressor mounting bolts. **Tighten:** 50 N.m (37 lb ft)
4	Bolt, A/C Compressor **Tip:** Tighten the A/C compressor mounting bolts and nut in sequence. **Tighten:** 50 N.m (37 lb ft)
5	Compressor Assembly, A/C **IMPORTANT:** **Use a low viscosity, polyalkylene glycol (PAG) oil. Use of the incorrect oil can result in compressor failure.** **Tip:** • When replacing the A/C compressor, balance the compressor. Refer to **Compressor Oil Balancing** • Using **J 39400** leak test A/C compressor fittings. See **Special Tools**.

COMPRESSOR REPLACEMENT (RPO LS4)

Tools Required

J 39400-A Halogen Leak Detector. See **Special Tools**.

Removal Procedure

1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**.
2. Remove the drive belt. Refer to **Drive Belt Replacement - Accessory** for the 5.3L

engine.

3. Remove the lower radiator air baffle and deflector. Refer to **Radiator Air Baffle and Deflector Replacement - Lower** .

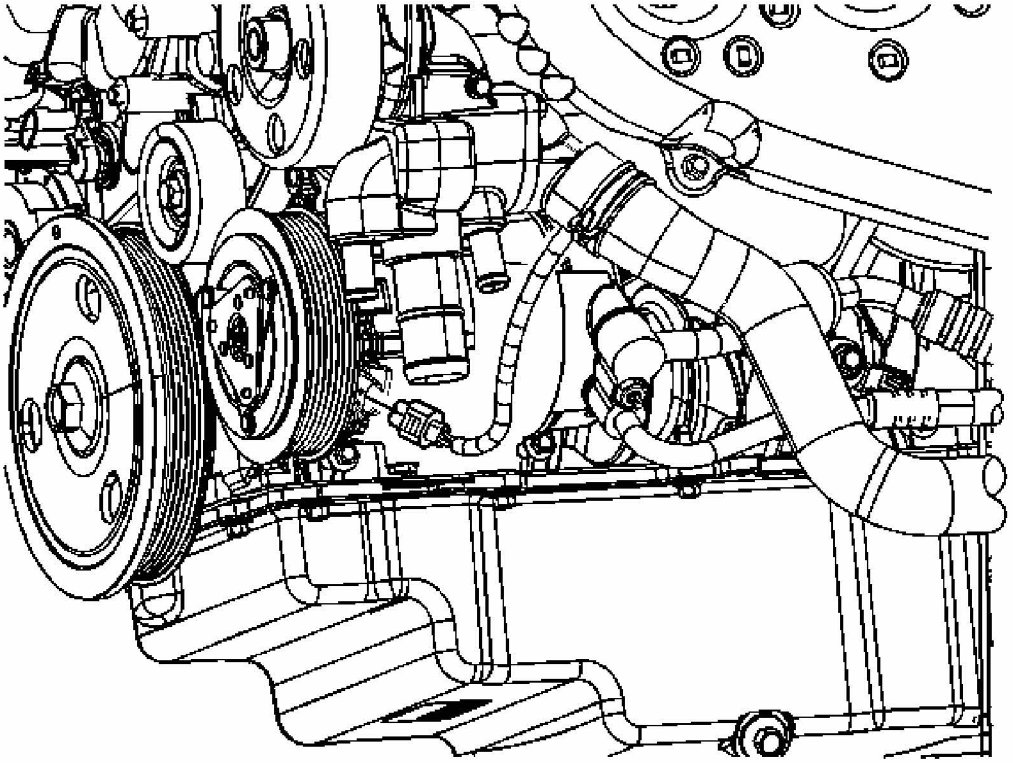


Fig. 7: A/C Compressor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the A/C compressor electrical connector.

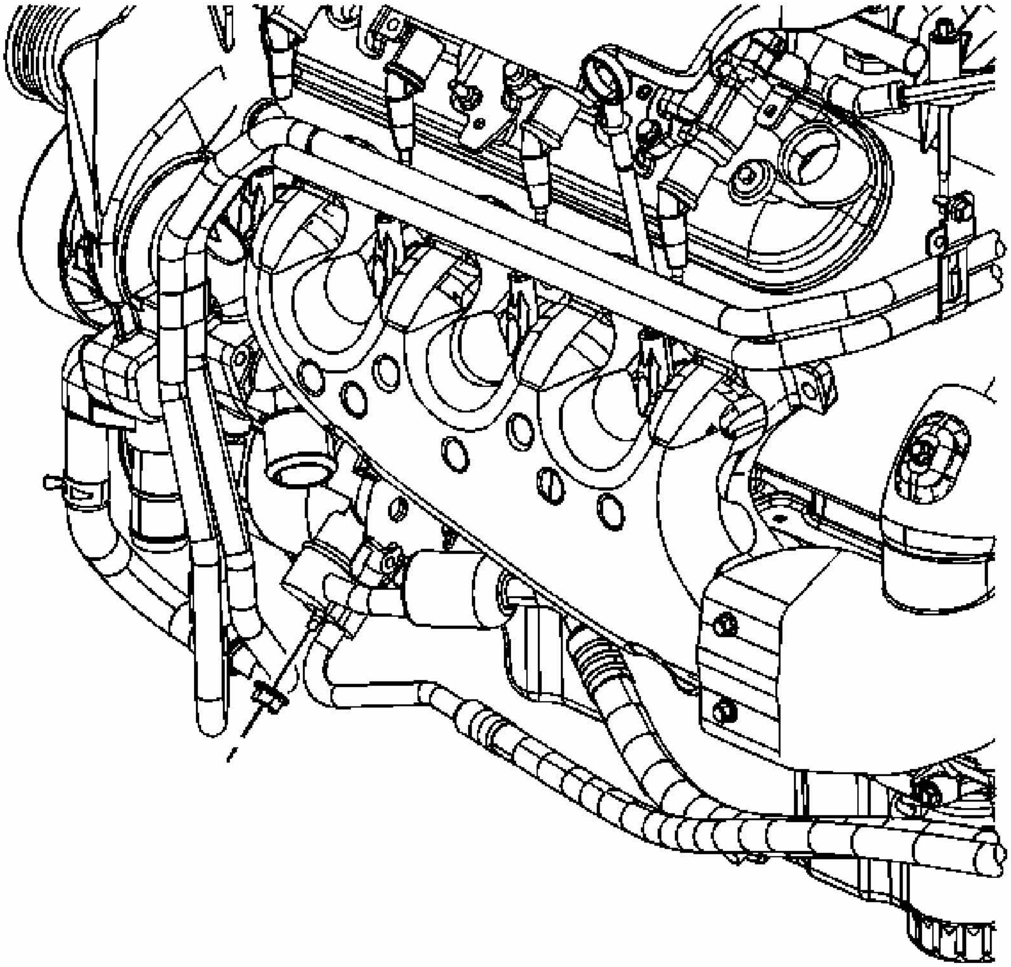


Fig. 8: A/C Compressor Hose Nut
Courtesy of GENERAL MOTORS CORP.

5. Remove the A/C compressor hose nut from the A/C compressor.

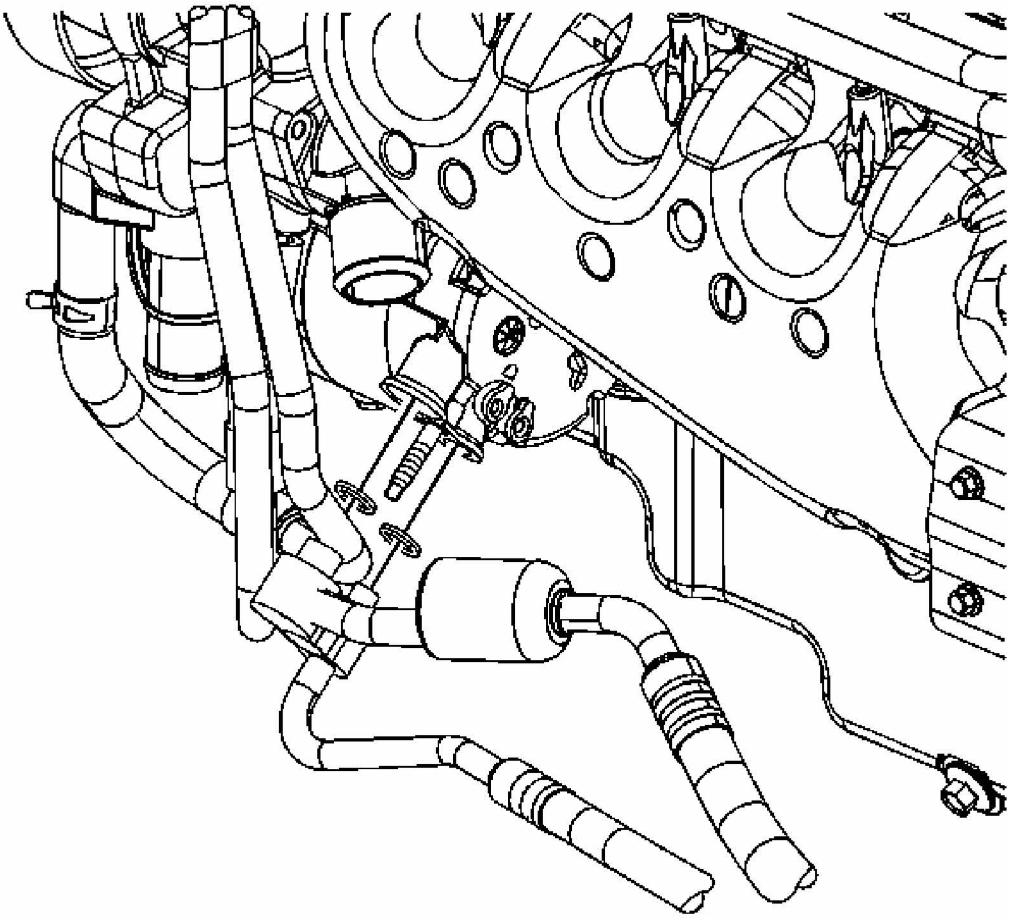


Fig. 9: A/C Compressor Hose At The A/C Compressor
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Remove and discard all sealing washers.

6. Remove the A/C compressor hose from the A/C compressor.

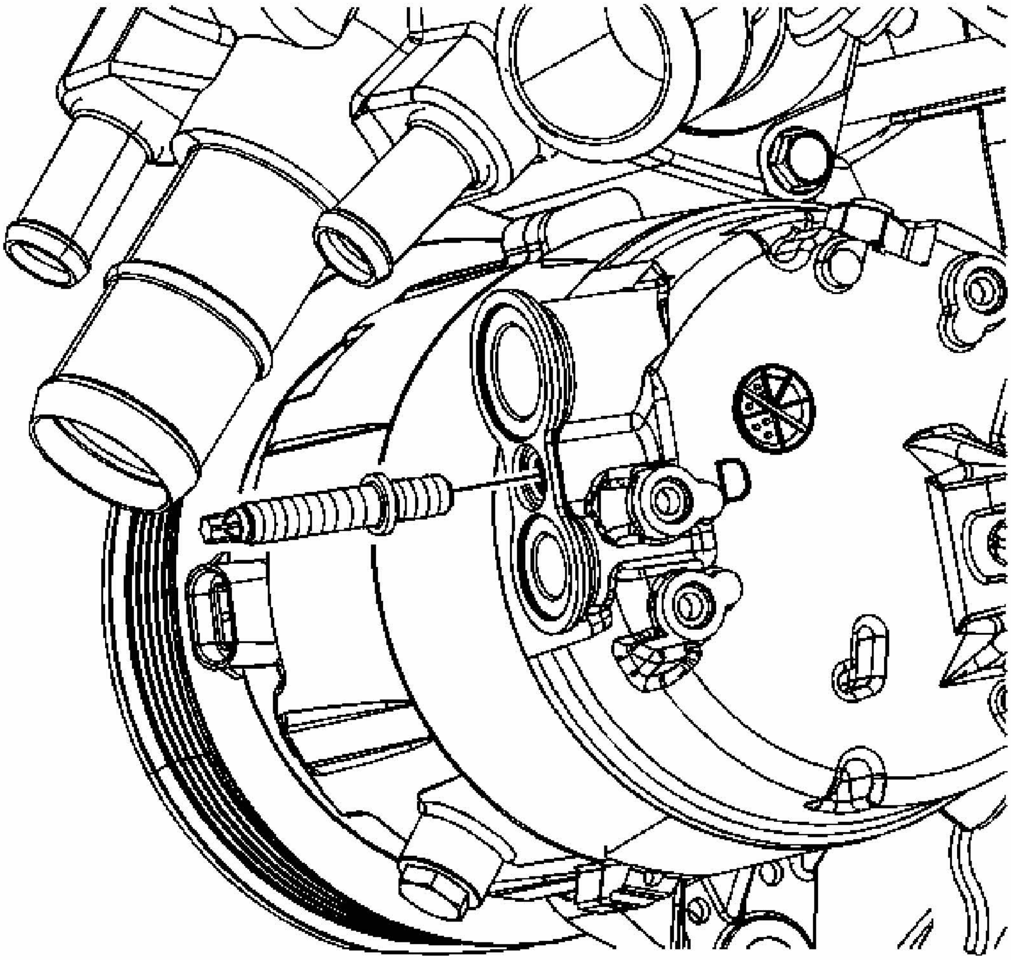


Fig. 10: Stud At The A/C Compressor
Courtesy of GENERAL MOTORS CORP.

7. Remove the stud from the A/C compressor.

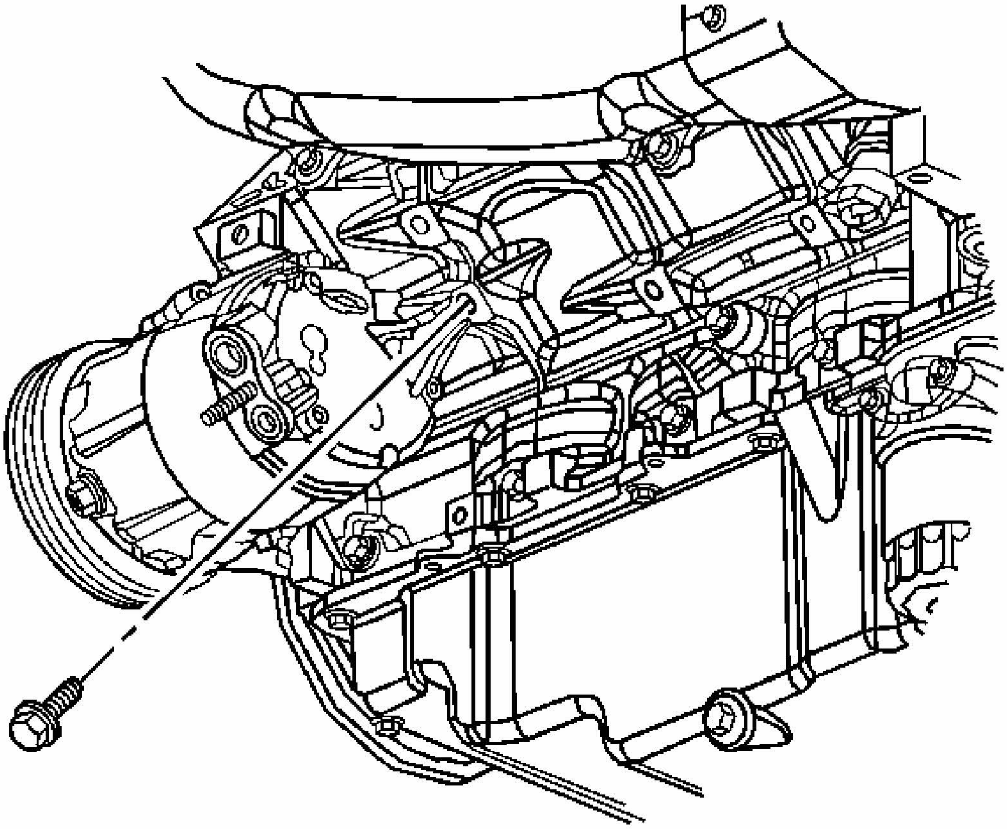


Fig. 11: Rear Mounting Bolt At The A/C Compressor
Courtesy of GENERAL MOTORS CORP.

8. Loosen the rear mounting bolt from the A/C compressor.

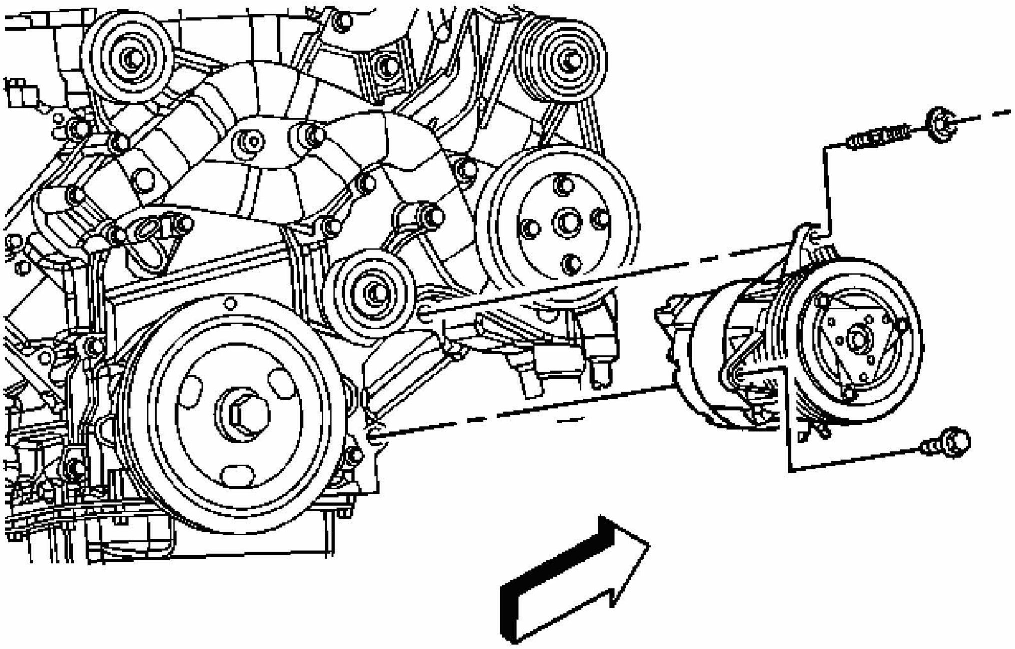


Fig. 12: Front Mounting Bolt At The A/C Compressor
Courtesy of GENERAL MOTORS CORP.

9. Remove the front mounting bolt from the A/C compressor.
10. Remove the front mounting nut from the A/C compressor.
11. Remove the front A/C compressor mounting stud.
12. Install a floor stand under the right front cradle.
13. Loosen the right front cradle bolt and lower the cradle.
14. Remove the A/C compressor.

IMPORTANT: Replacement compressors are shipped with polyalkylene glycol (PAG) oil.

15. If replacing the compressor, balance the compressor oil. Refer to **Compressor Oil Balancing**.

Installation Procedure

NOTE: Refer to Fastener Notice .

1. Install the compressor drain plug.

   Tighten: Tighten the drain plug to 16 N.m (12 lb ft).

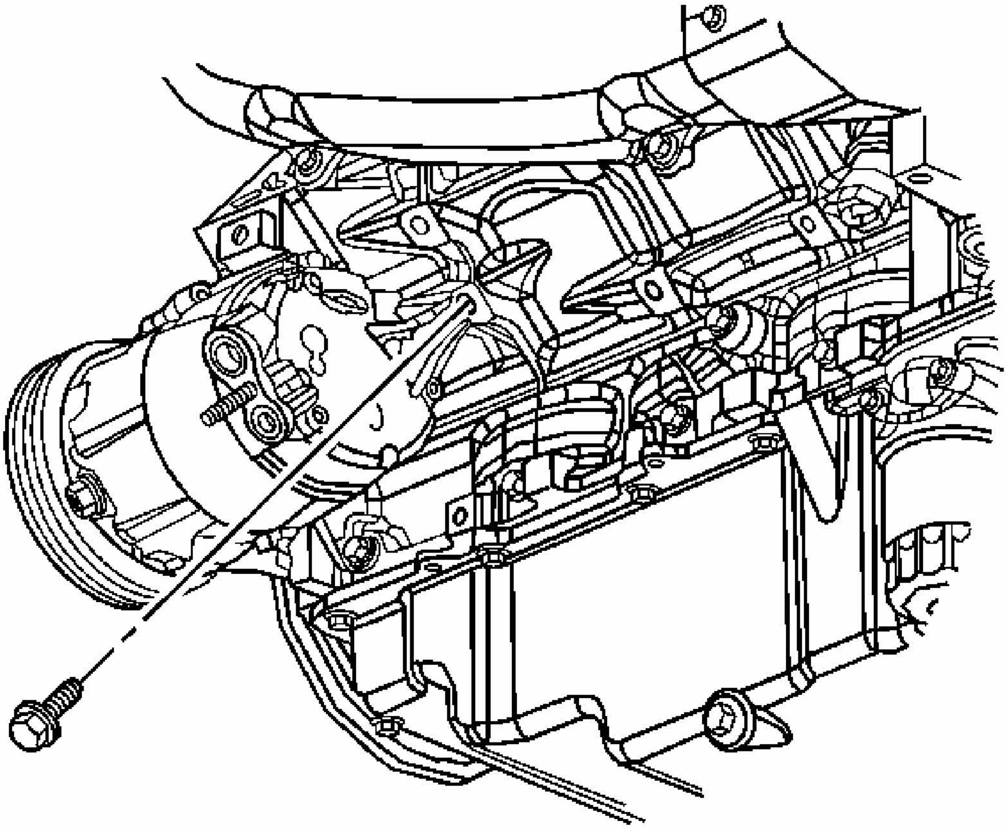


Fig. 13: Rear Mounting Bolt At The A/C Compressor
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Install the A/C compressor ensuring that the back of the A/C compressor is inserted onto the bolt. Do not tighten the bolt at this time.

2. Install the A/C compressor into the vehicle.

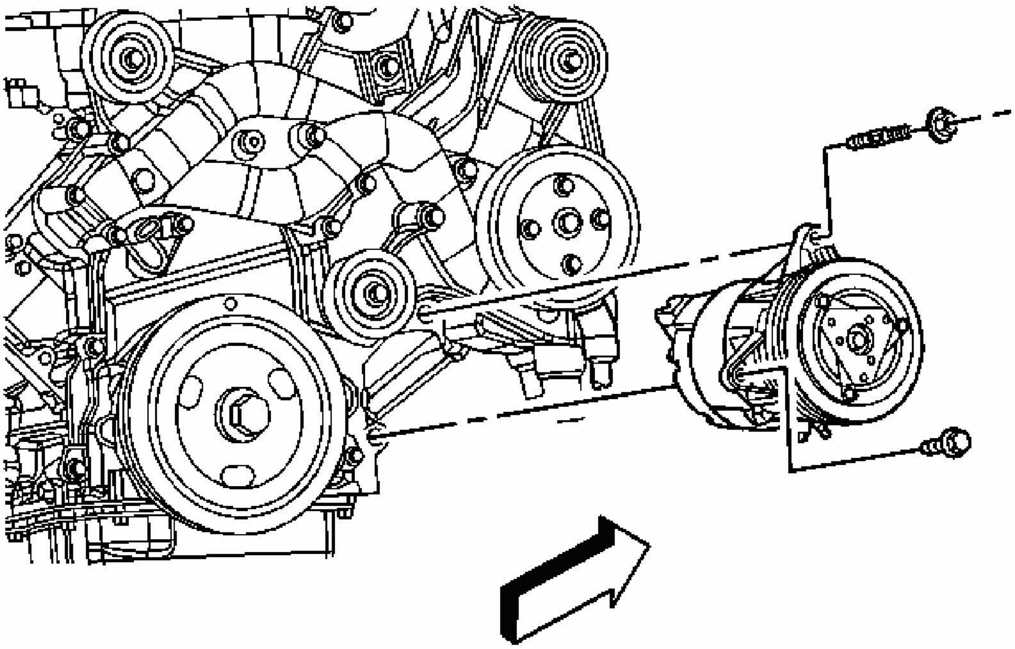


Fig. 14: Front Mounting Bolt At The A/C Compressor
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not tighten at this time.

3. Install the front A/C compressor mounting bolt.
4. Install the front A/C compressor mounting stud.

   Tighten: Tighten the stud to 10 N.m (89 lb in).

5. Install the front A/C compressor nut.

   Tighten:
   - Tighten the nut to 50 N.m (36 lb ft).
   - Tighten the front bolt to 50 N.m (36 lb ft).
   - Tighten the rear bolt to 50 N.m (36 lb ft).

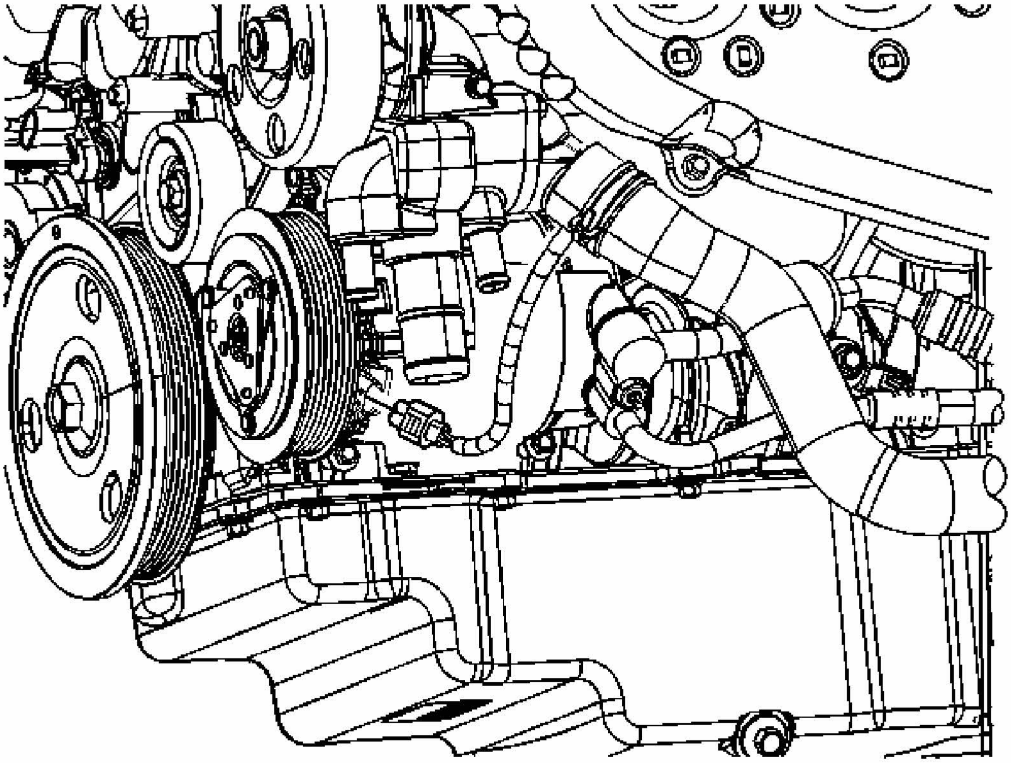


Fig. 15: A/C Compressor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Connect the A/C compressor electrical connector.
7. Raise the cradle into position and tighten the bolt.

   Tighten: Tighten the bolt to 145 N.m (107 lb ft).

8. Remove the floor stand from under the vehicle.

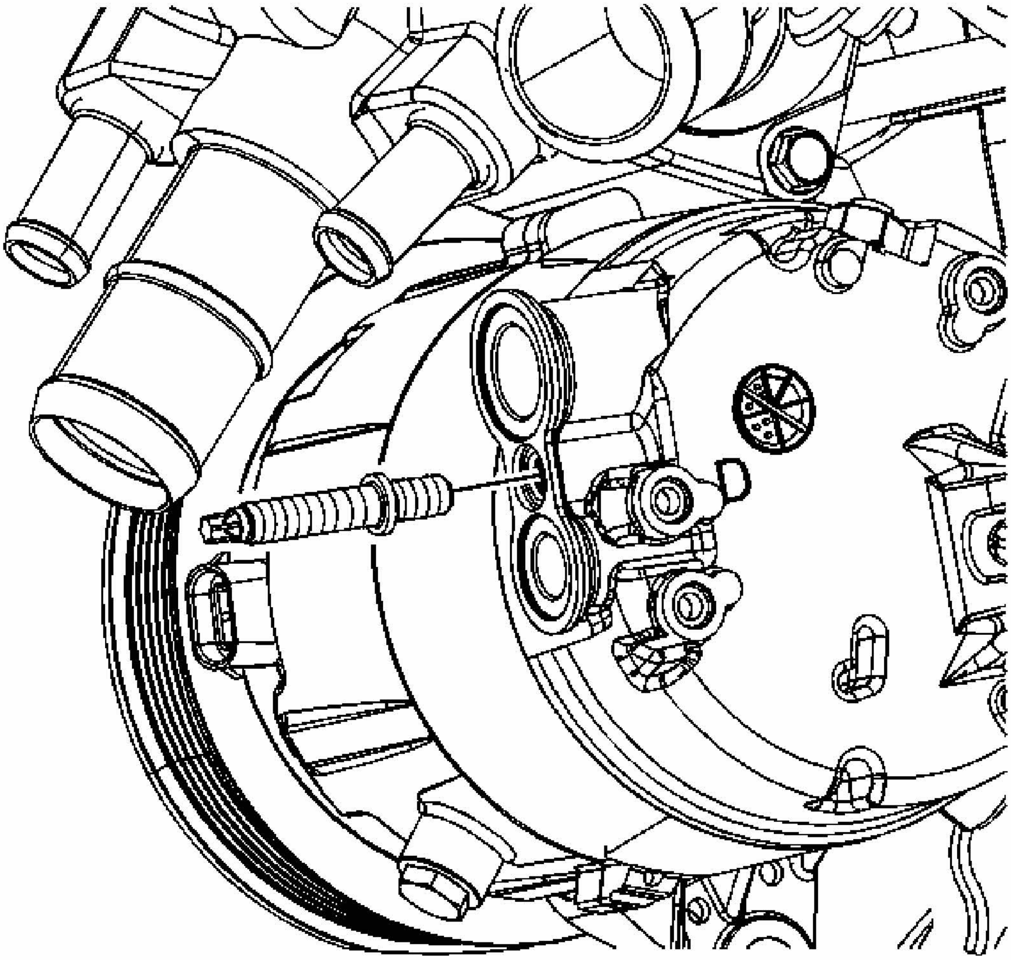


Fig. 16: Stud At The A/C Compressor
Courtesy of GENERAL MOTORS CORP.

9. Install the stud to the back of the A/C compressor.

   Tighten: Tighten the stud to 10 N.m (89 lb in).

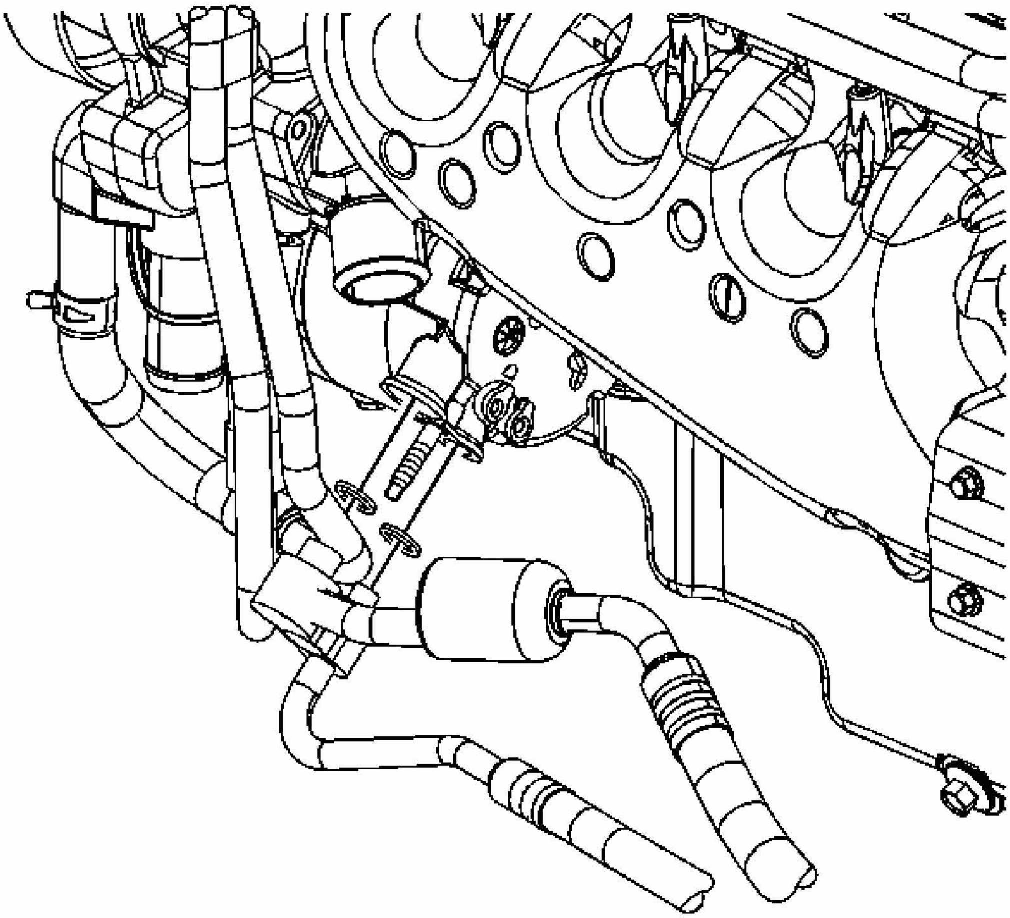


Fig. 17: A/C Compressor Hose At The A/C Compressor
Courtesy of GENERAL MOTORS CORP.

10. Install new sealing washers. Refer to **Sealing Washer Replacement**.
11. Install the A/C compressor hose to the A/C compressor.

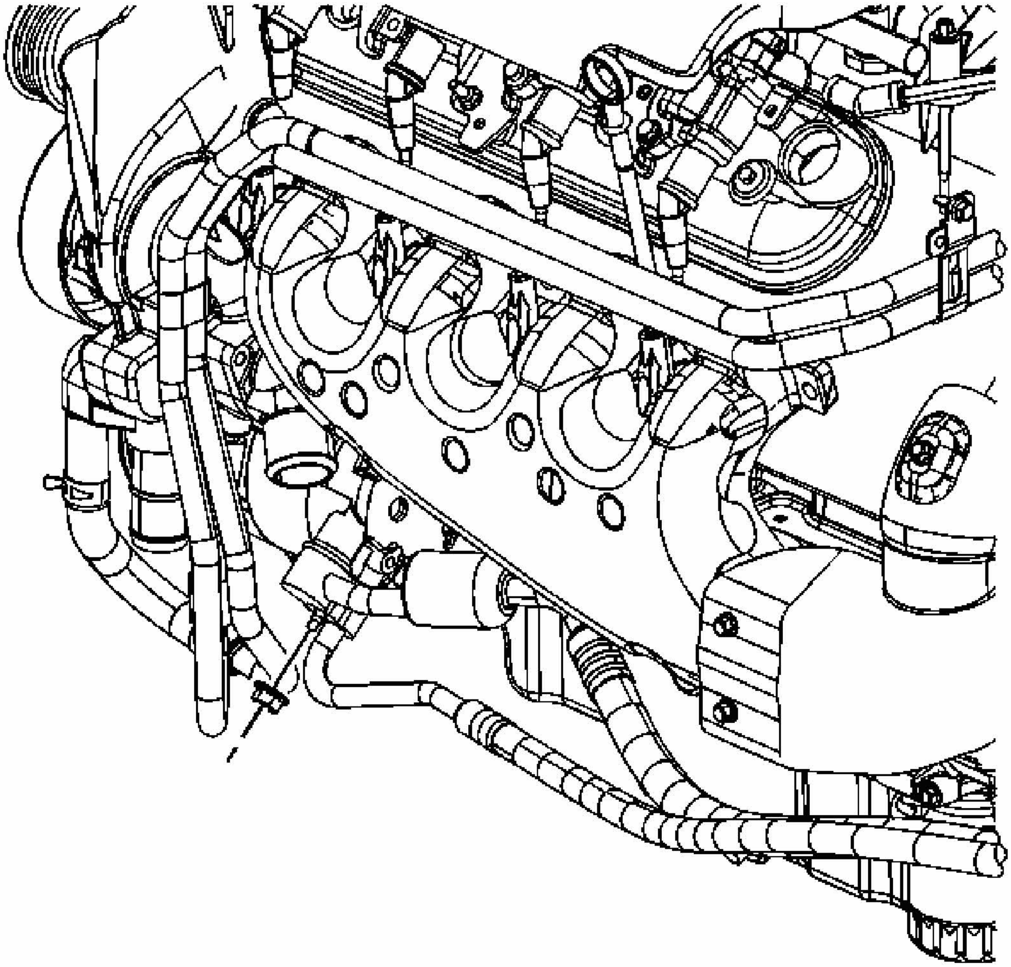


Fig. 18: A/C Compressor Hose Nut
Courtesy of GENERAL MOTORS CORP.

12. Install the A/C compressor hose nut.

    Tighten: Tighten the nut to 17 N.m (12.5 lb ft).

13. Install the lower radiator air baffle and deflector. Refer to **Radiator Air Baffle and Deflector Replacement - Lower** .
14. Install the drive belt. Refer to **Drive Belt Replacement - Accessory** for the 5.3L engine.
15. Evacuate and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging**.
16. Leak test the fittings of the component using **J 39400-A** . See **Special Tools**.

COMPRESSOR CLUTCH ASSEMBLY REPLACEMENT

Tools Required

- **J 37872** Compressor Clutch Holding Tool. See **Special Tools**.
- **J 6083** Snap Ring Pliers. See **Special Tools**.

Removal Procedure

1. Remove the compressor. Refer to **Compressor Replacement (RPOs LZE, LZ4, LZ9)** or **Compressor Replacement (RPO LS4)**.

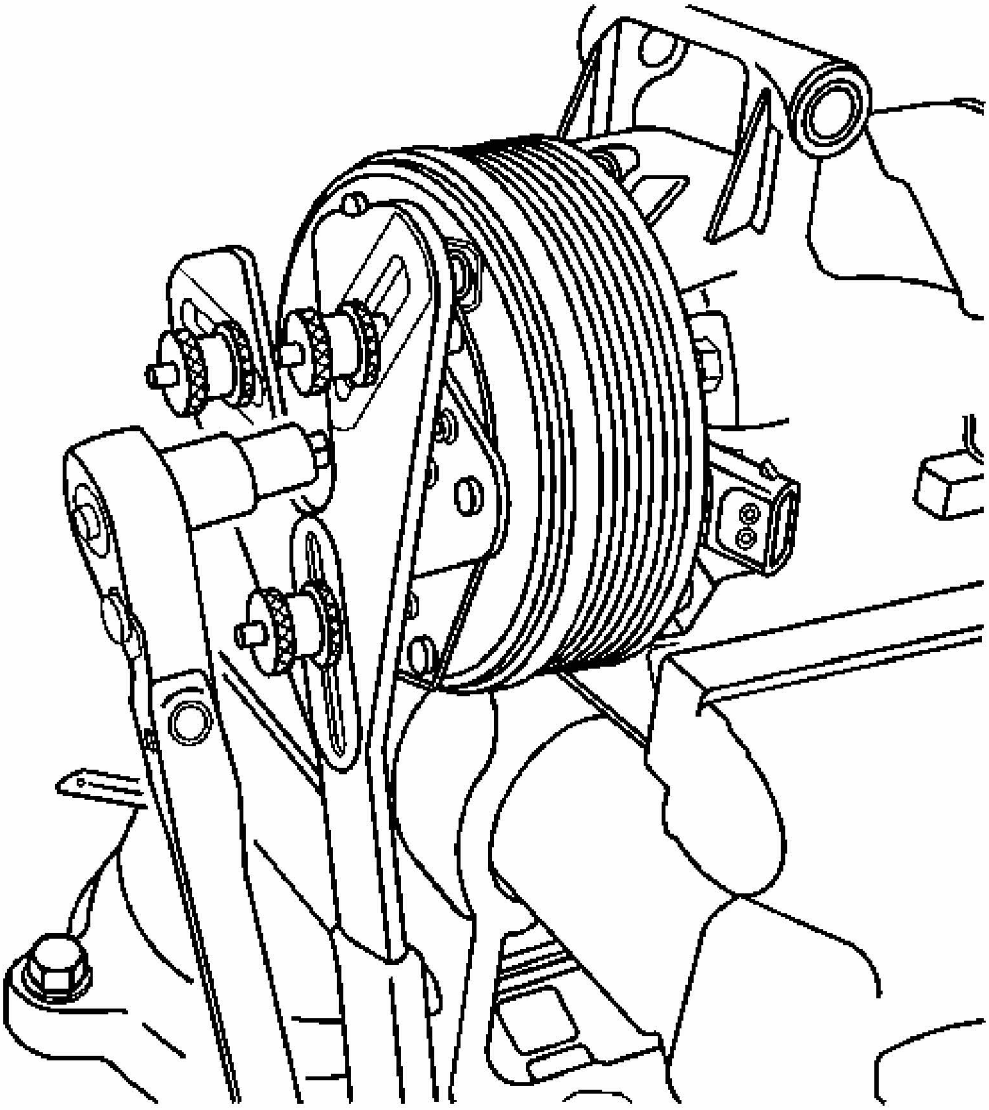


Fig. 19: Identifying Compressor Clutch Plate Bolt
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Remove the three adjustable dowels from the J37872 Compressor Clutch Holding Tool. Install three 5/16 x 1 inch bolts in place of the dowels.

2. Remove and discard the compressor clutch plate bolt.

   Use the **J 37872** to hold the compressor clutch plate from turning. See **Special Tools**.

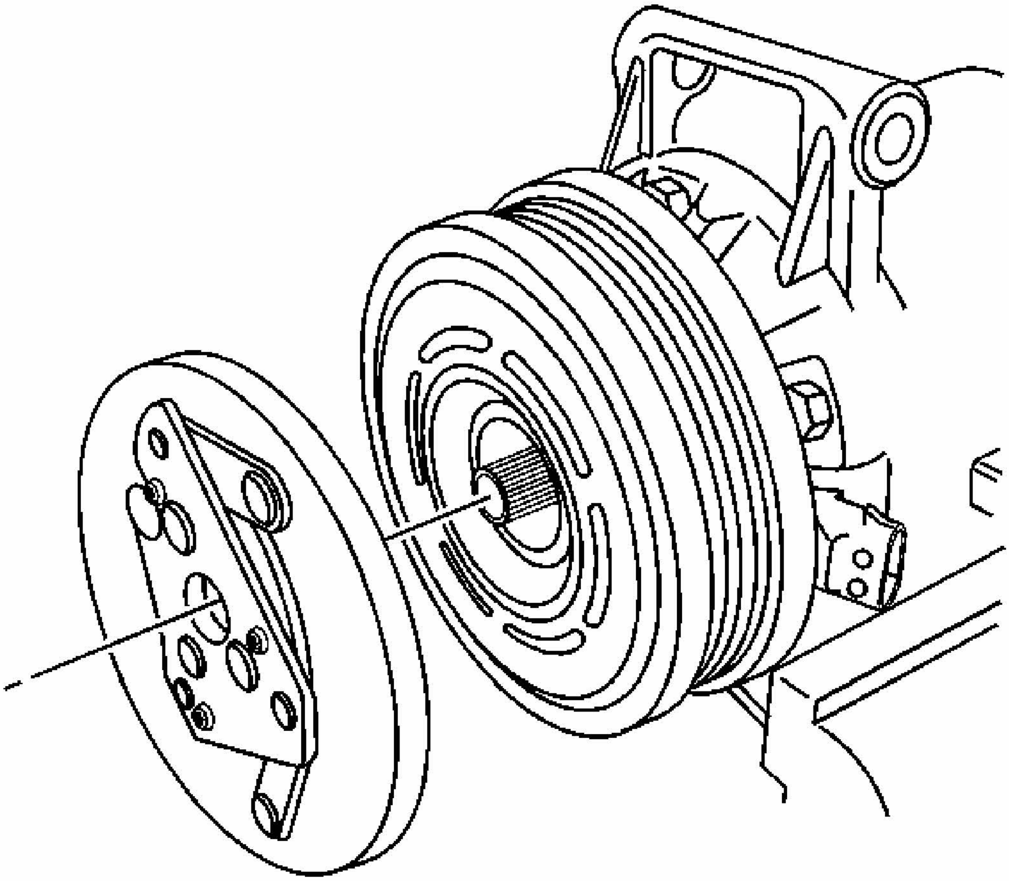


Fig. 20: Identifying Compressor Clutch Plate
Courtesy of GENERAL MOTORS CORP.

3. Remove the compressor clutch plate from the compressor.

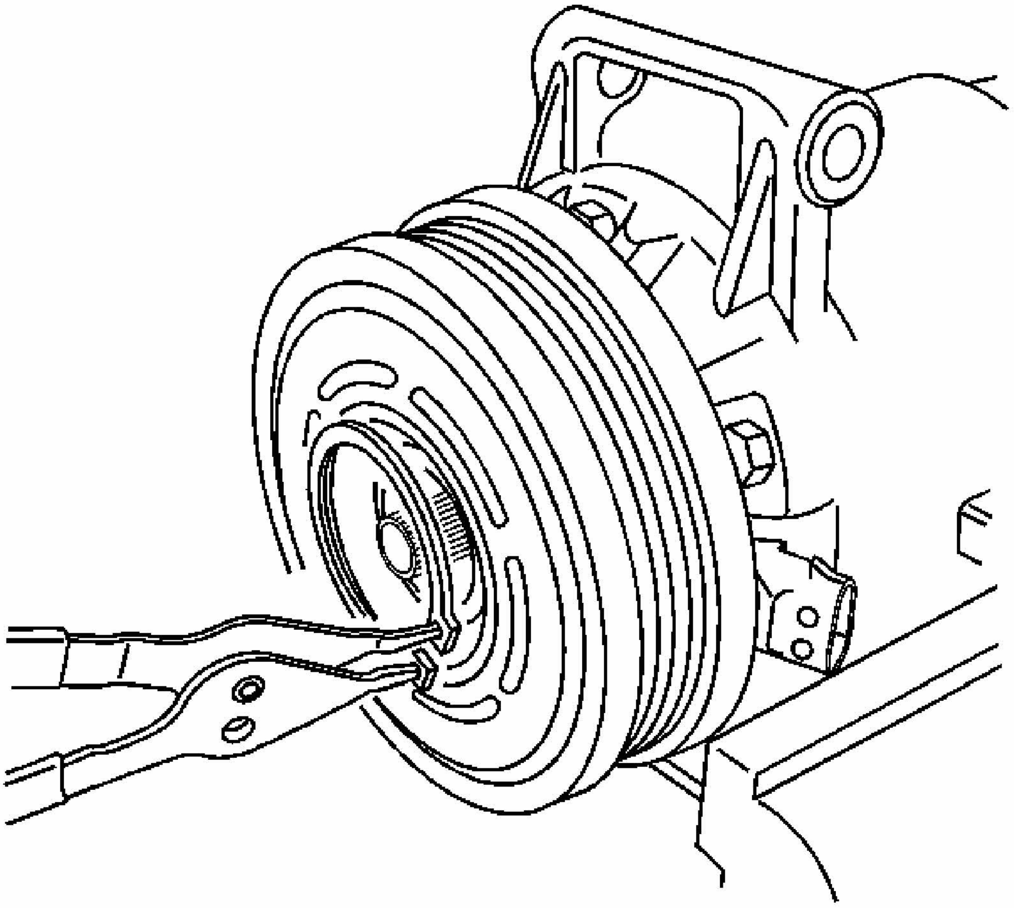


Fig. 21: View Of Compressor Pulley Snap Ring
Courtesy of GENERAL MOTORS CORP.

4. Remove the compressor pulley snap ring using the **J 6083** . See **Special Tools**.

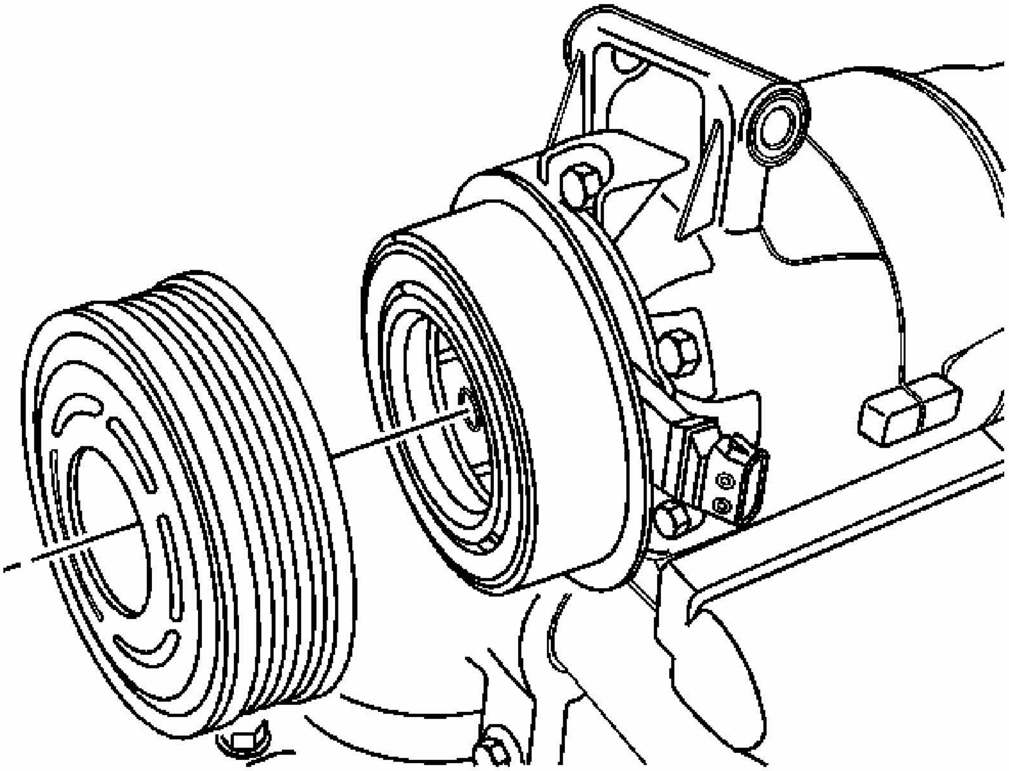


Fig. 22: Identifying Compressor Pulley
Courtesy of GENERAL MOTORS CORP.

5. Remove the compressor pulley from the compressor.

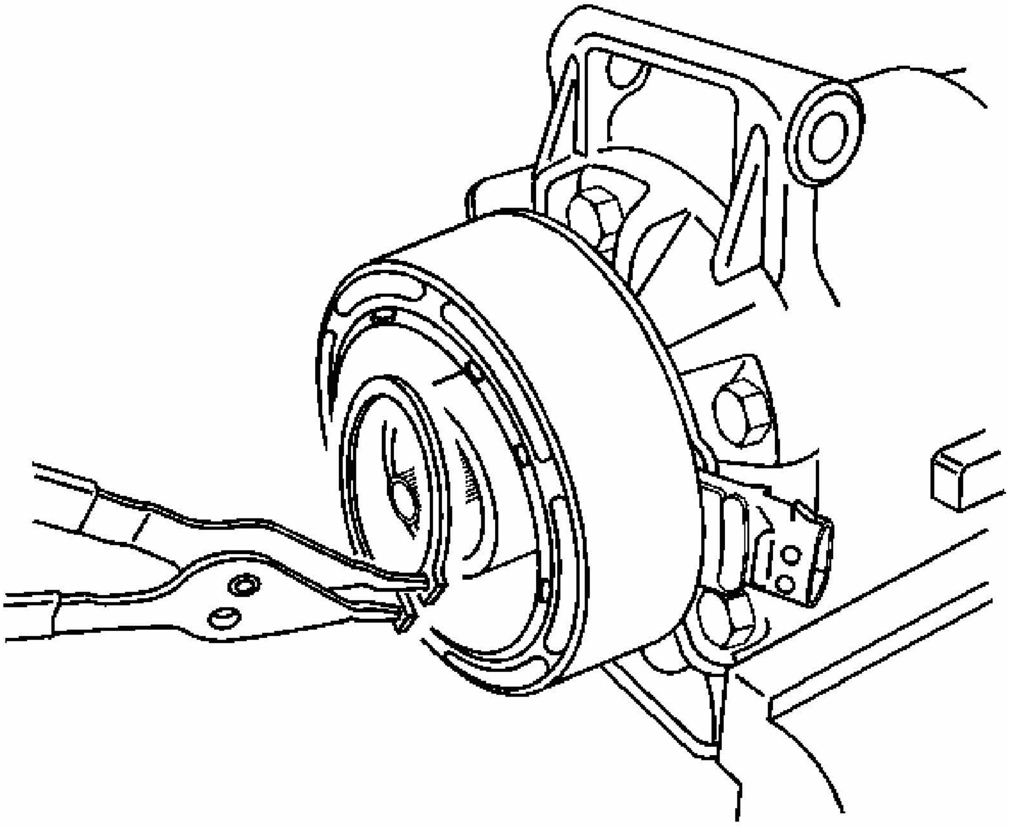


Fig. 23: Identifying Compressor Clutch Coil And Snap Ring
Courtesy of GENERAL MOTORS CORP.

6. Remove the compressor clutch coil snap ring using the **J 6083** . See **Special Tools**.

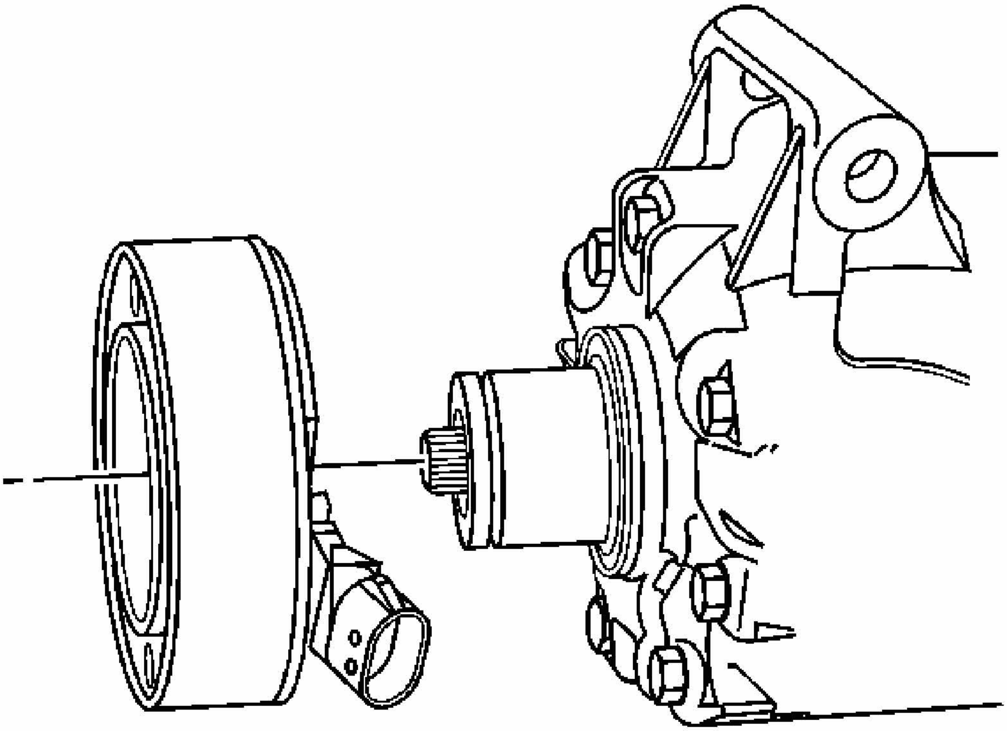


Fig. 24: Identifying Compressor Clutch Coil To Compressor
Courtesy of GENERAL MOTORS CORP.

7. Remove the compressor clutch coil from the compressor.

Installation Procedure

1. Carefully clean the clutch plate bolt threads with a M6x1.0 tap. Carefully blow out debris with compressed air.

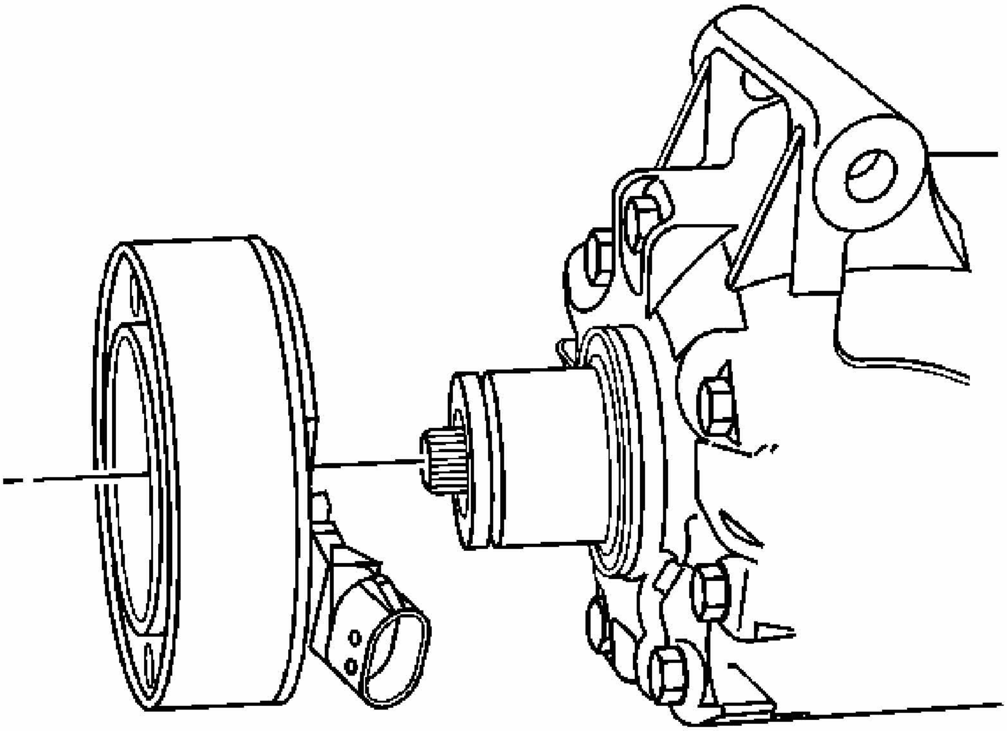


Fig. 25: Identifying Compressor Clutch Coil To Compressor
Courtesy of GENERAL MOTORS CORP.

2. Install the compressor clutch coil to the compressor.

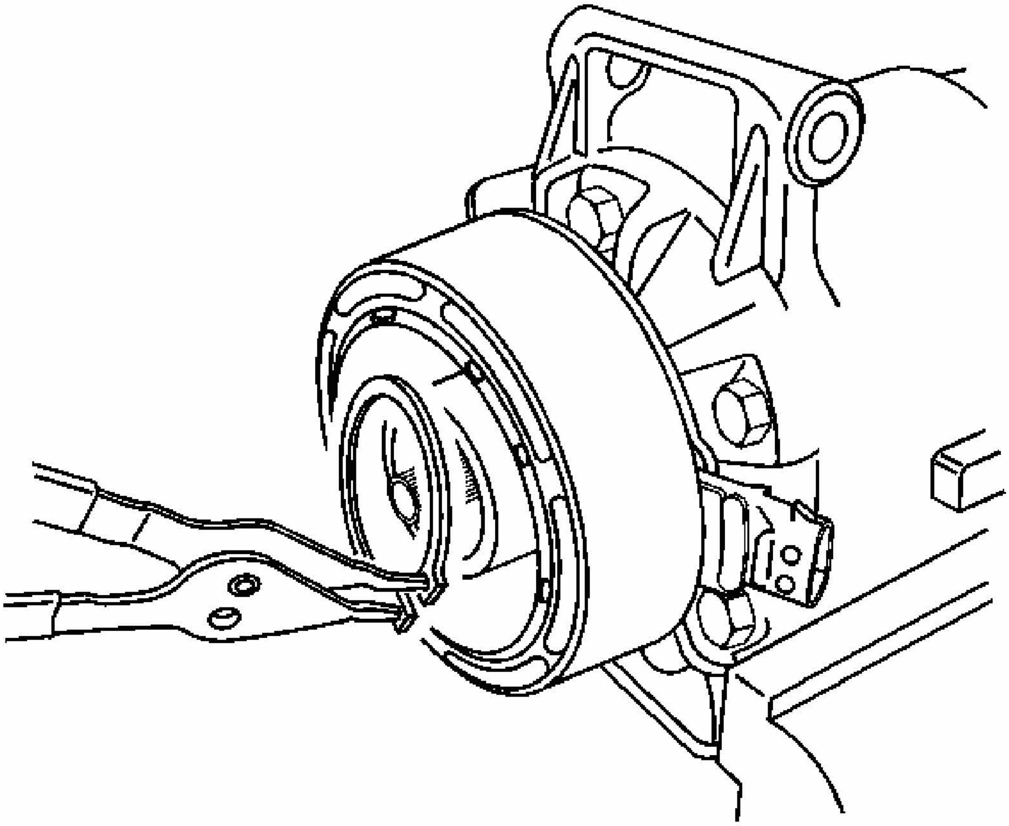


Fig. 26: Identifying Compressor Clutch Coil And Snap Ring
Courtesy of GENERAL MOTORS CORP.

3. Install the compressor clutch coil snap ring using the **J 6083** . See **Special Tools**.

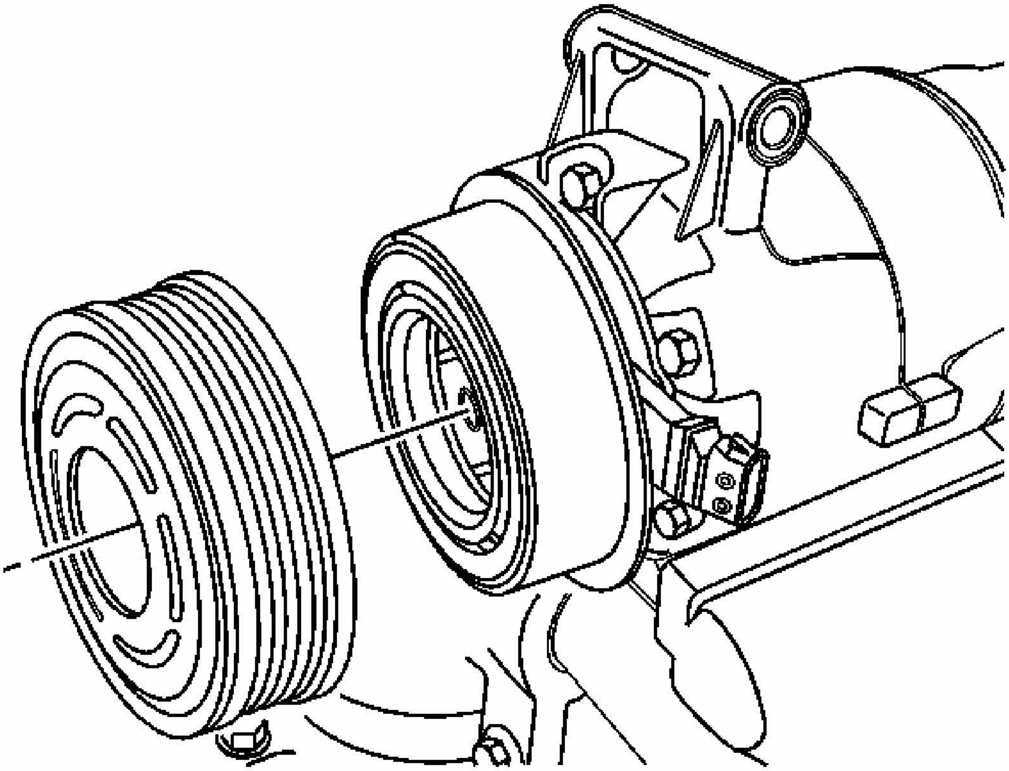


Fig. 27: Identifying Compressor Pulley
Courtesy of GENERAL MOTORS CORP.

4. Install the compressor pulley to the compressor.

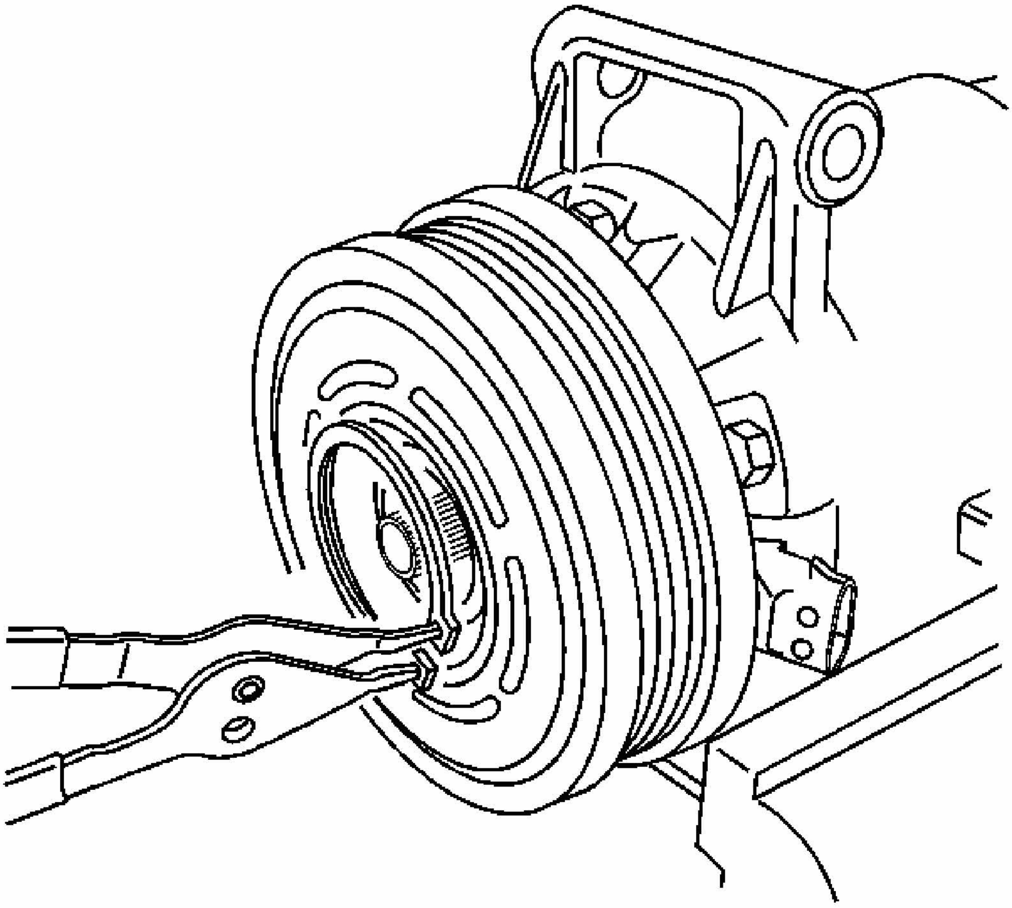


Fig. 28: View Of Compressor Pulley Snap Ring
Courtesy of GENERAL MOTORS CORP.

5. Install the compressor pulley snap ring using the **J 6083** . See **Special Tools**.
6. Place a small amount of oil on the 0.4 mm (0.016 in) air gap shim and place inside the clutch drive plate.

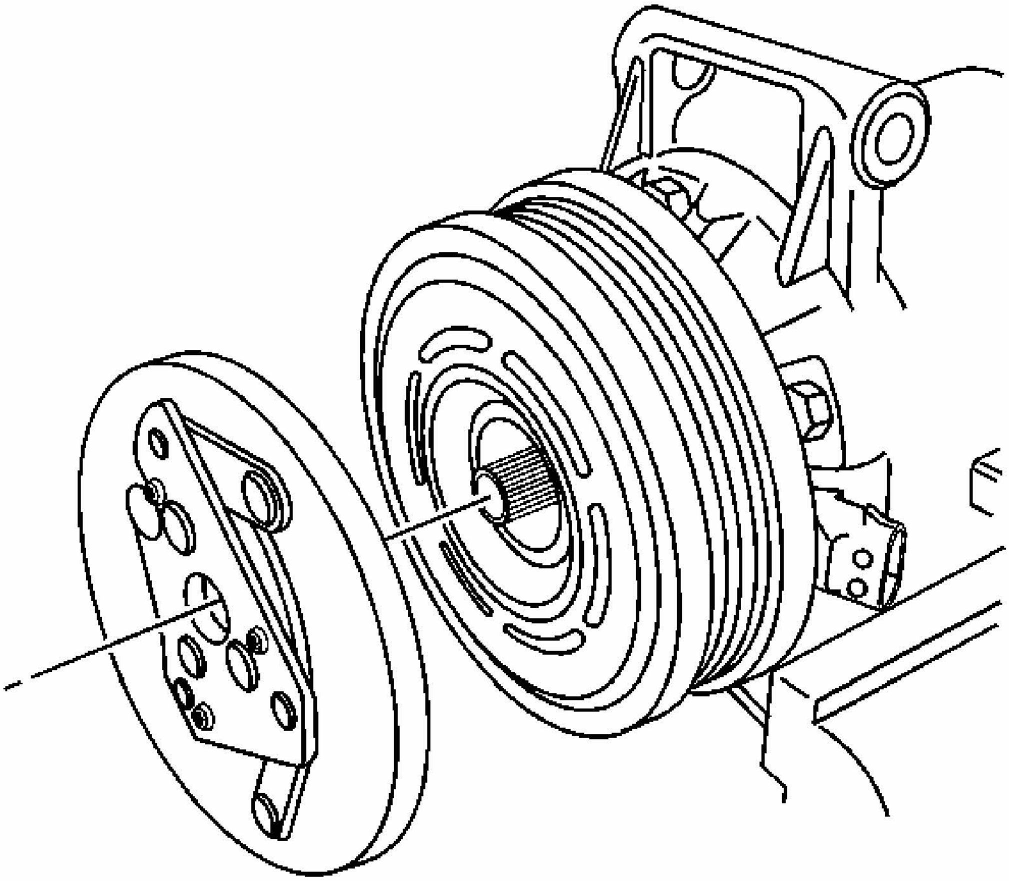


Fig. 29: Identifying Compressor Clutch Plate
Courtesy of GENERAL MOTORS CORP.

7. Install the compressor clutch plate to the compressor.

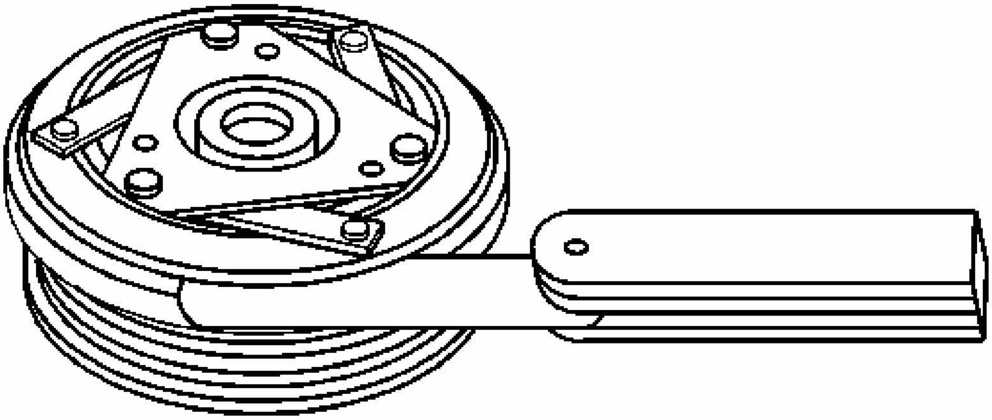


Fig. 30: View Of Air Gap Between Pulley And Drive Plate
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Make certain that the drive plate does not drag against the pulley when the pulley is rotated.

8. Measure the air gap between the pulley and the drive plate. Adjust the shims to achieve a 0.3-0.6 mm (0.012-0.024 in) air gap.

NOTE: Refer to Fastener Notice in Cautions and Notices.

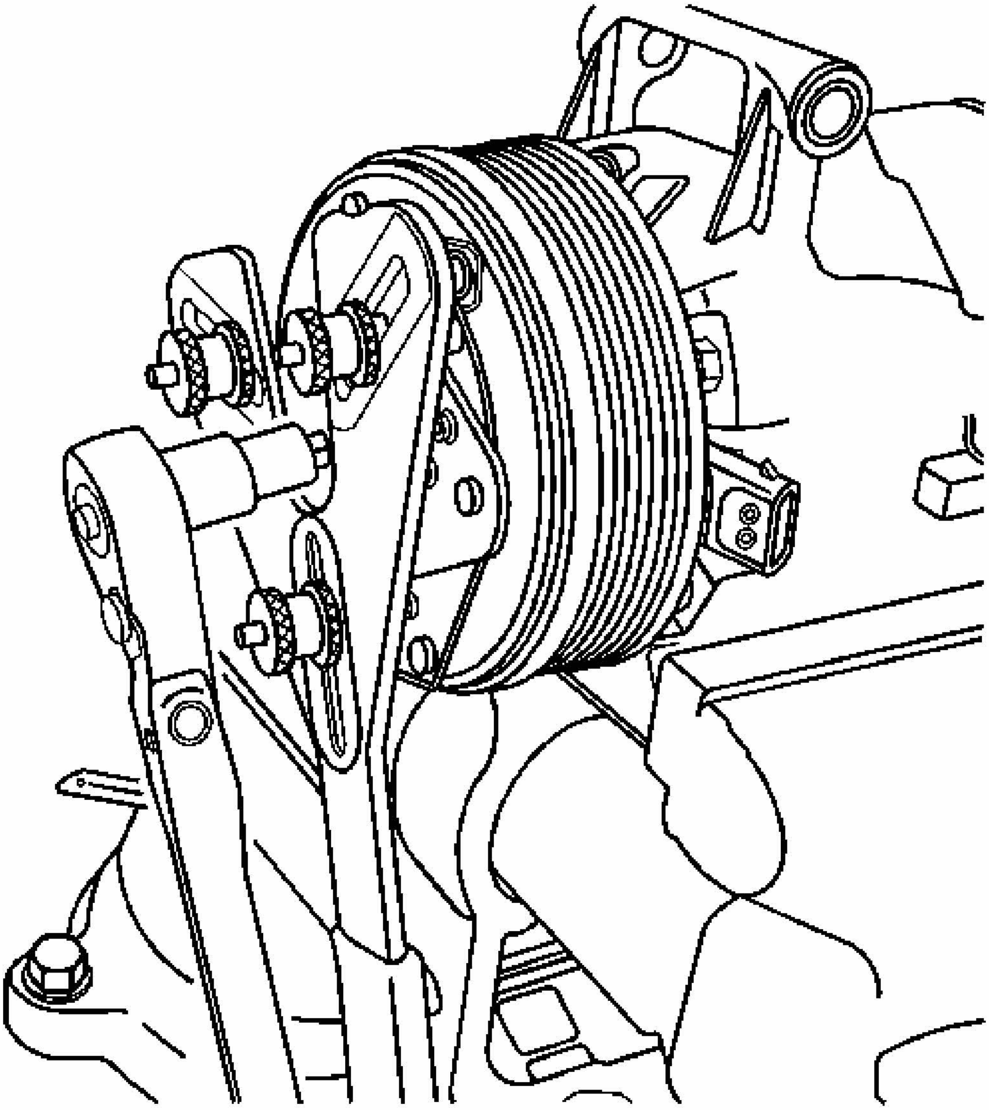


Fig. 31: Identifying Compressor Clutch Plate Bolt
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Make certain that the new drive plate bolt has colored adhesive on at least 5 threads.

9. Install the clutch drive plate bolt.
10. Tighten the compressor clutch drive plate bolt.

Use the **J 37872** to hold the compressor clutch plate from turning. See **Special Tools**.

Tighten: Tighten the bolt to 12 N.m (106 lb in).

11. Install the compressor. Refer to **Compressor Replacement (RPOs LZE, LZ4, LZ9)** or **Compressor Replacement (RPO LS4)**.
12. Leak test the fittings using the **J 39400-A** . See **Special Tools**.

COMPRESSOR PRESSURE RELIEF VALVE REPLACEMENT

Tools Required

J 39400-A Halogen Leak Detector. See **Special Tools**.

Removal Procedure

1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

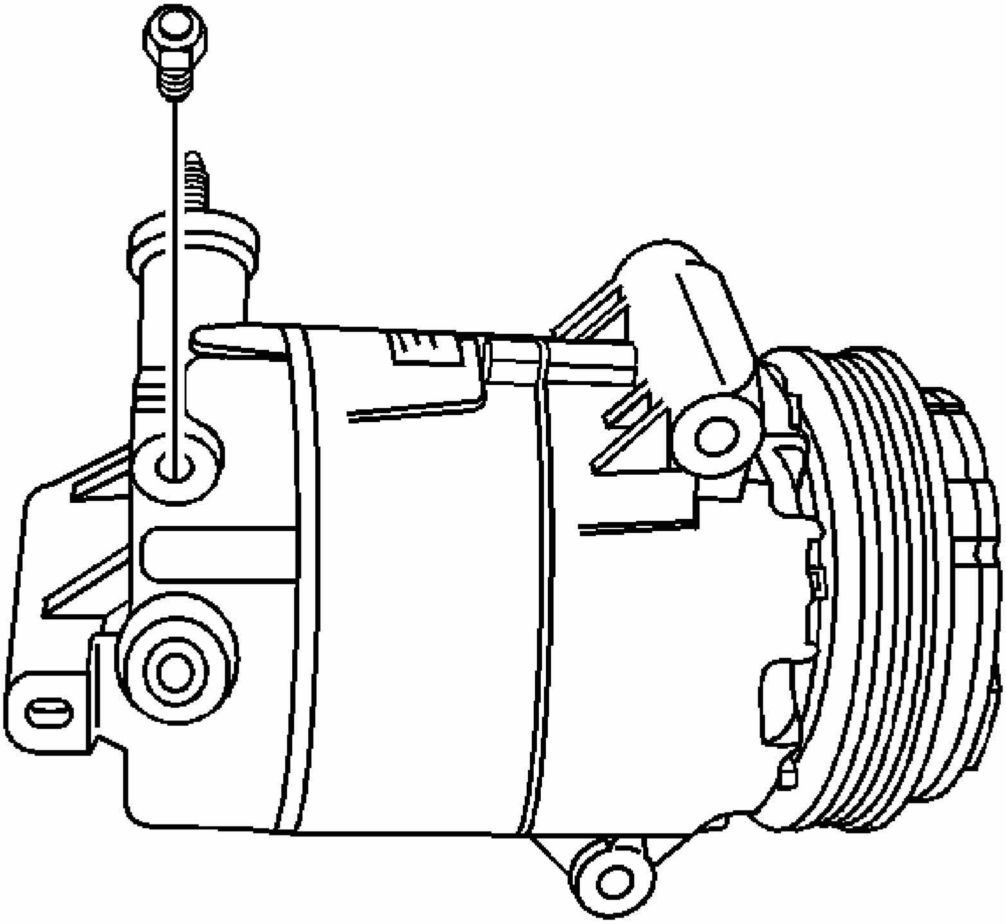


Fig. 32: Identifying Compressor Pressure Relief Valve
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Cap or tape the open A/C components immediately to prevent system contamination.

3. Remove the high pressure relief valve.
4. Cap or tape the A/C compressor.

Installation Procedure

1. Remove the cap or tape from the A/C compressor.
2. Lubricate the O-ring on the high pressure relief valve. Refer to **O-Ring Replacement**.

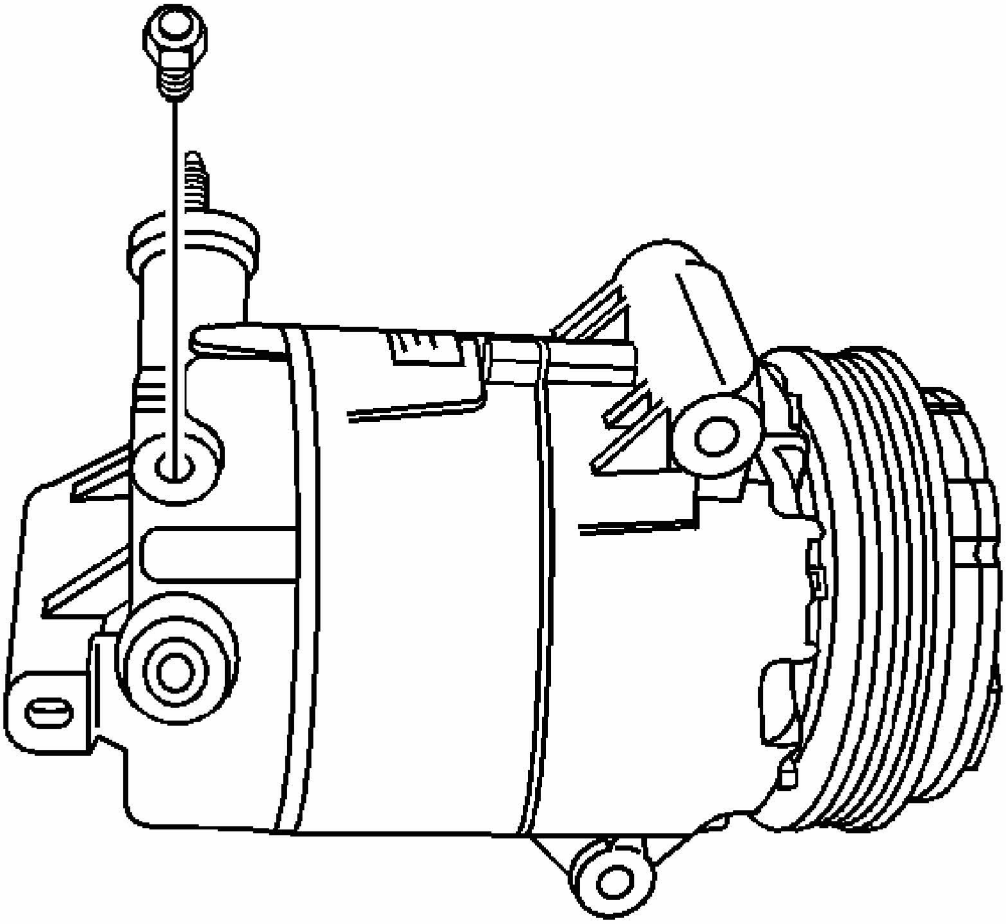


Fig. 33: Identifying Compressor Pressure Relief Valve
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

3. Install the high pressure relief valve.

   Tighten: Tighten the valve to 8 N.m (70 lb in).

4. Lower the vehicle.
5. Evacuate and recharge the refrigerant system. Refer to **Refrigerant Recovery and Recharging**.
6. Leak test the fittings of the component using **J 39400-A** . See **Special Tools**.

SEALING WASHER REPLACEMENT

Removal Procedure

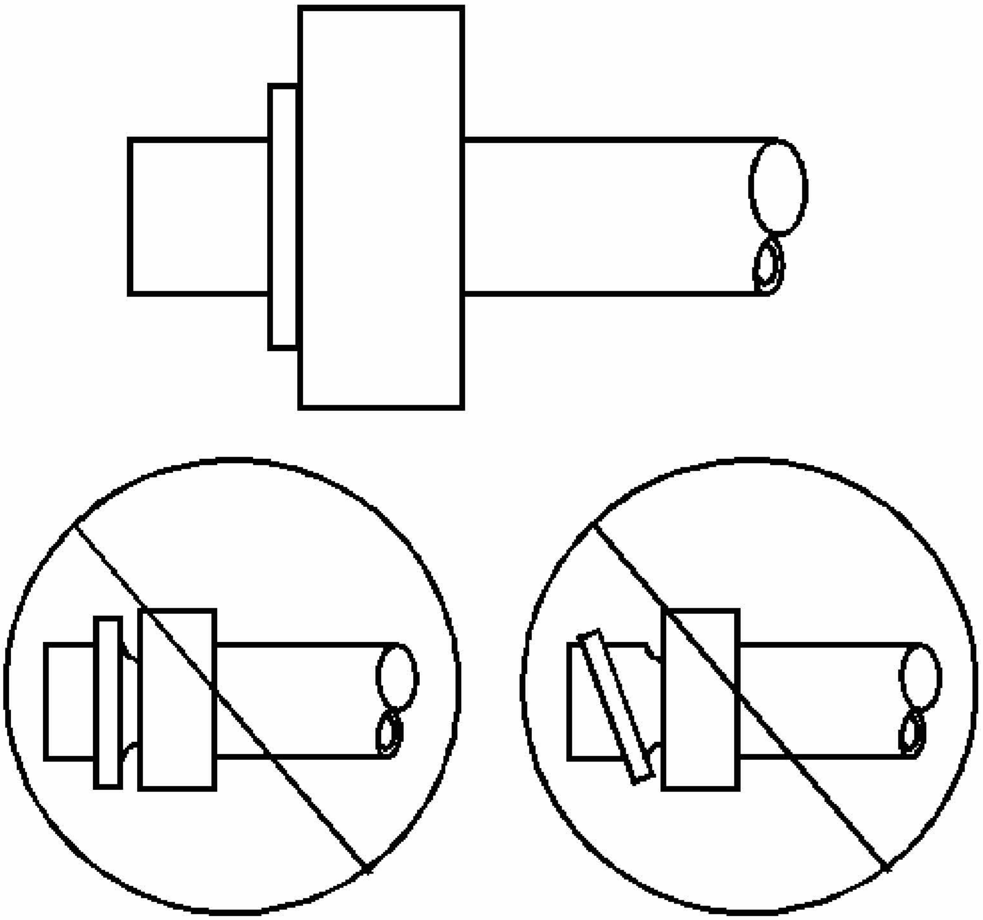


Fig. 34: Identifying Good And Bad Sealing Washer Positions
Courtesy of GENERAL MOTORS CORP.

1. Remove the seal washer from the A/C refrigerant component.

   IMPORTANT: Cap or tape the open A/C refrigerant components immediately to prevent system contamination.

2. Inspect the seal washer for signs of damage to help determine the root cause of the failure.
3. Inspect the A/C refrigerant components for damage or burrs. Repair if necessary.

IMPORTANT: DO NOT reuse sealing washer.

4. Discard the sealing washer.

Installation Procedure

IMPORTANT: Flat washer type seals do not require lubrication.

1. Inspect the new seal washer for any signs of cracks, cuts, or damage.

   Do not use a damaged seal washer.

2. Remove the cap or tape from the A/C refrigerant components.

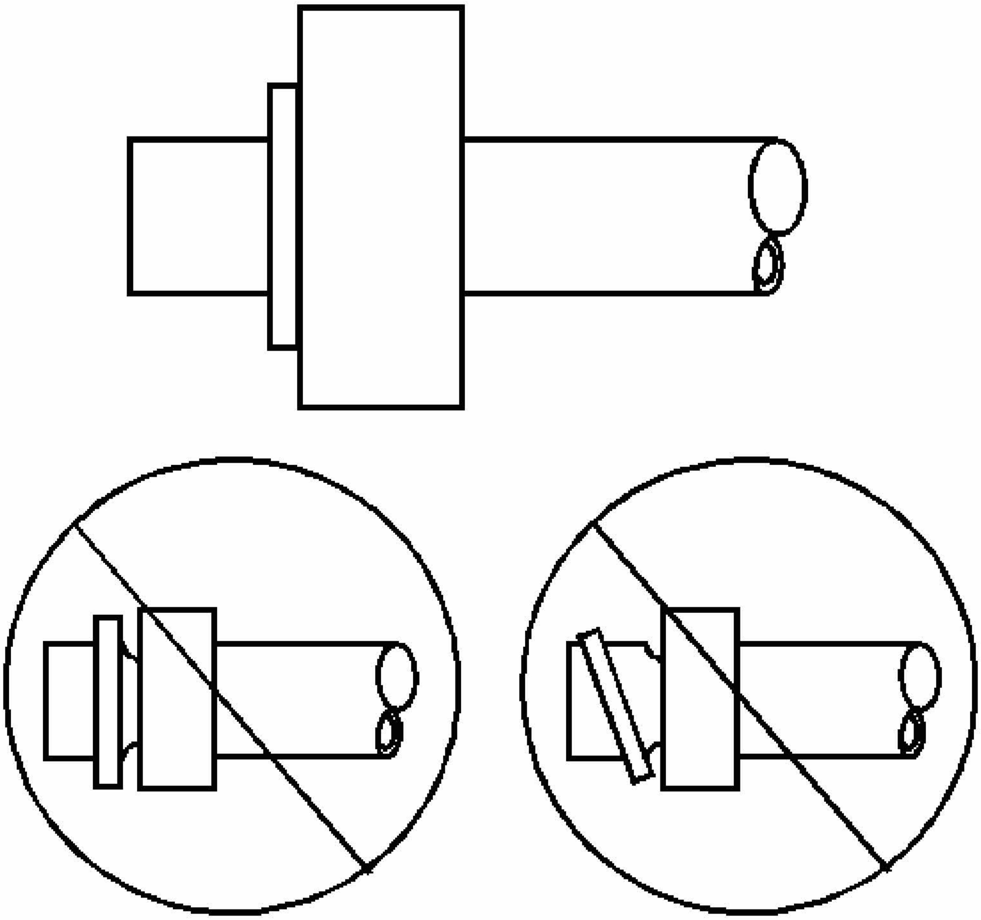


Fig. 35: Identifying Good And Bad Sealing Washer Positions
Courtesy of GENERAL MOTORS CORP.

3. Using a lint-free clean, dry cloth, clean the sealing surfaces of the A/C refrigerant components.
4. Carefully install the new seal washer onto the A/C refrigerant component.

   The washer must completely bottom against the surface of the fitting.

   IMPORTANT: After tightening the A/C components, there should be a slight sealing washer gap of approximately 1.2 mm (3/64 in) between the A/C line and the A/C component.

5. Assemble the remaining A/C refrigerant components.

O-RING REPLACEMENT

Removal Procedure

1. Disassemble the A/C refrigerant components.

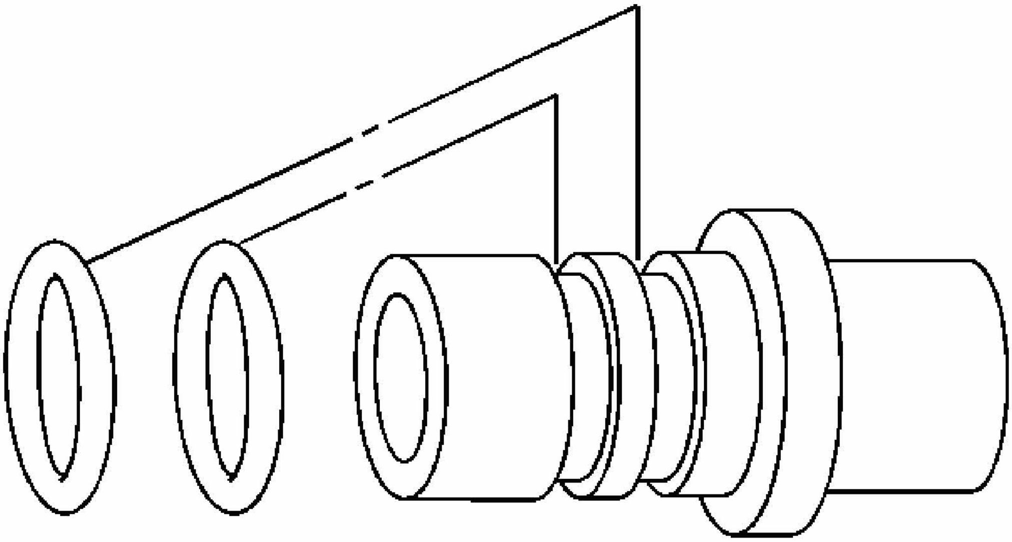


Fig. 36: Removing O-Ring Seals
Courtesy of GENERAL MOTORS CORP.

2. Remove the O-ring seals from the A/C refrigerant component.
3. Inspect the O-ring seals for signs of damage.
4. Inspect the A/C refrigerant components for damage or burrs. Repair if necessary.

IMPORTANT: Cap or tape the open A/C refrigerant components immediately to prevent system contamination.

5. Cap or tape the A/C refrigerant components.
6. Discard the O-ring seals.

Installation Procedure

1. Inspect the new O-ring seals for any sign or cracks, cuts, or damage. Replace if necessary.
2. Remove the cap or tape from the A/C refrigerant components.
3. Using a lint-free clean, dry cloth, carefully clean the sealing surfaces of the A/C

refrigerant components.

IMPORTANT: DO NOT allow any of the mineral base 525 viscosity refrigerant oil on the new O-ring seal to enter the refrigerant system.

4. Lightly coat the new O-ring seals with mineral base 525 viscosity refrigerant oil.

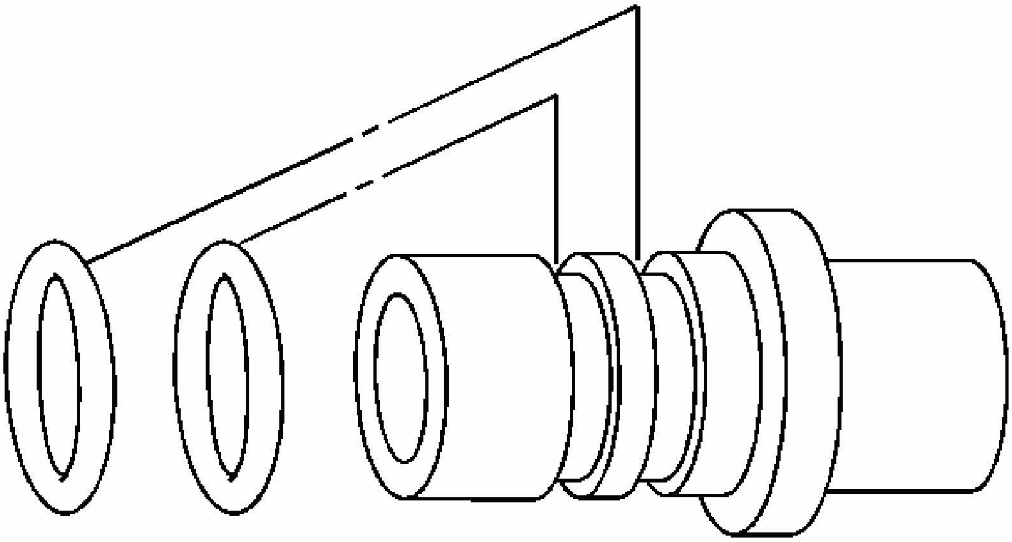


Fig. 37: Removing O-Ring Seals
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: DO NOT reuse O-ring seals.

5. Carefully slide the new O-ring seals onto the A/C refrigerant component.
6. The O-ring seals must be fully seated.
7. Assemble the A/C components.

A/C LINE/TUBE CONNECTOR REMOVAL/REPLACEMENT

Tools Required

J 39400-A Halogen Leak Detector. See **Special Tools**.

Removal Procedure

1. Recover the refrigerant from the A/C system. Refer to **Refrigerant Recovery and Recharging**.

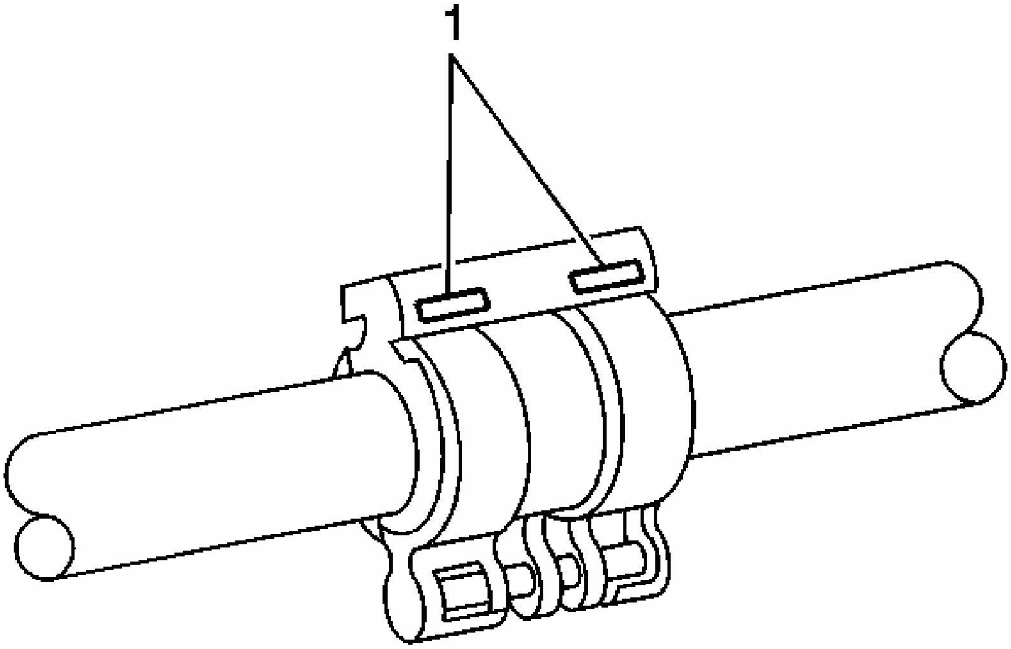


Fig. 38: A/C Coupling Assembly Locking Tab Access Slots
Courtesy of GENERAL MOTORS CORP.

2. Locate the A/C coupling assembly's locking tab access slots (1).

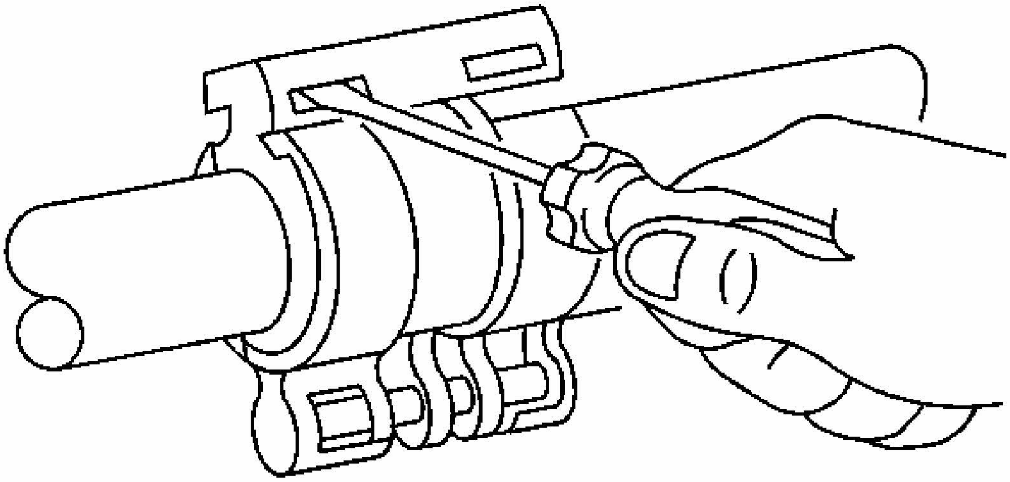


Fig. 39: Releasing First Locking Tab
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When separating the A/C coupling assembly, apply light pressure between the two halves of the coupling to prevent the locking tabs from reengaging.

3. Carefully insert a small flat bladed screwdriver into the first locking tab access slot and gently lift the locking tab to release the lock.

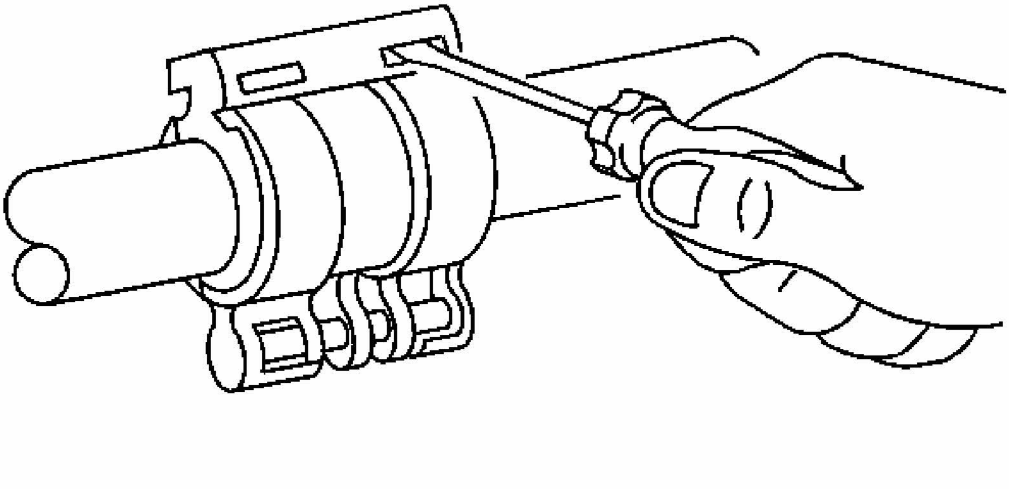


Fig. 40: Releasing Second Locking Tab
Courtesy of GENERAL MOTORS CORP.

4. Carefully insert a small flat bladed screwdriver into the second locking tab access slot and gently lift the locking tab to release the lock.

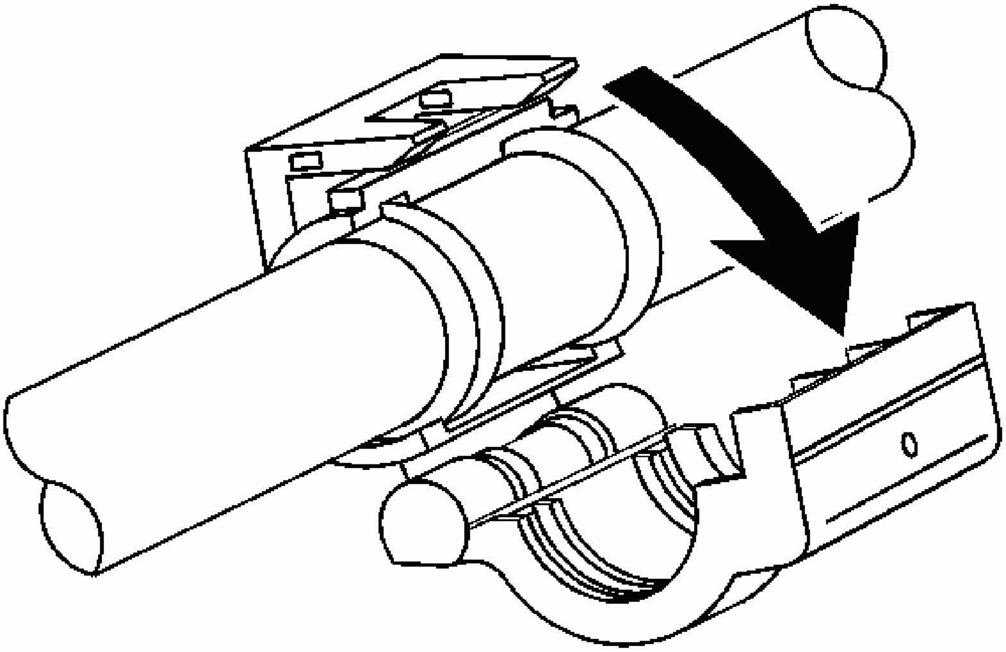


Fig. 41: Removing A/C Coupling Assembly
Courtesy of GENERAL MOTORS CORP.

5. Open and remove the A/C coupling assembly from the A/C refrigerant component.

Installation Procedure

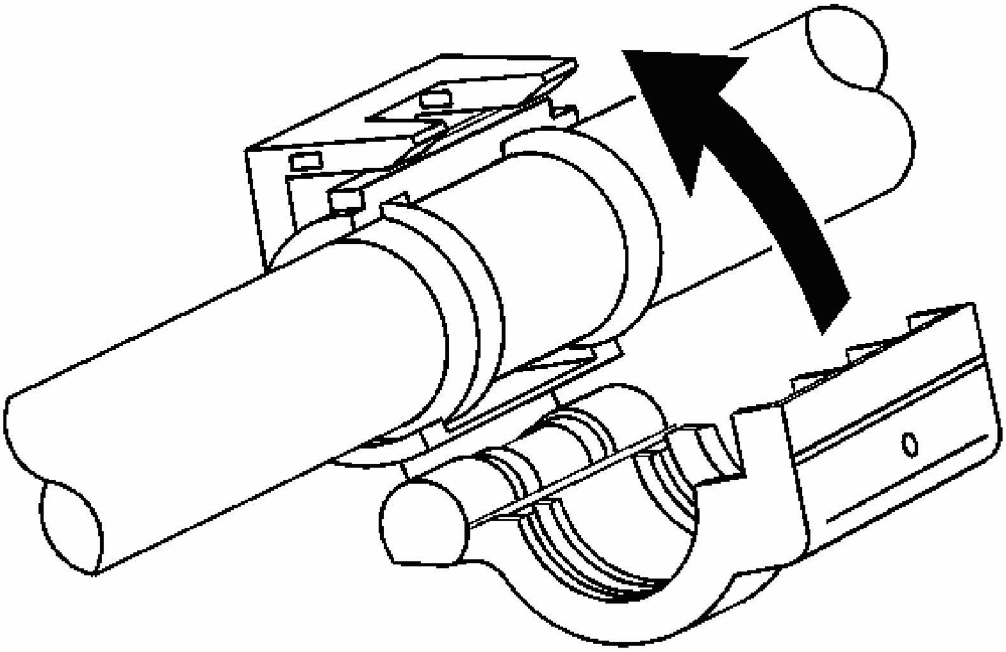


Fig. 42: Installing A/C Coupling Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Inspect the A/C coupling assembly locking tabs for damage or wear. Replace the A/C coupler assembly if any conditions exist.

1. Install the A/C coupling assembly to the A/C refrigerant component.

   IMPORTANT: Ensure that the A/C coupling assembly is latched securely to the A/C refrigerant component.

2. Close the A/C coupling assembly.
3. Evacuate and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging**.
4. Leak test the fittings of the component using **J 39400-A** . See **Special Tools**.

COMPRESSOR HOSE ASSEMBLY REPLACEMENT

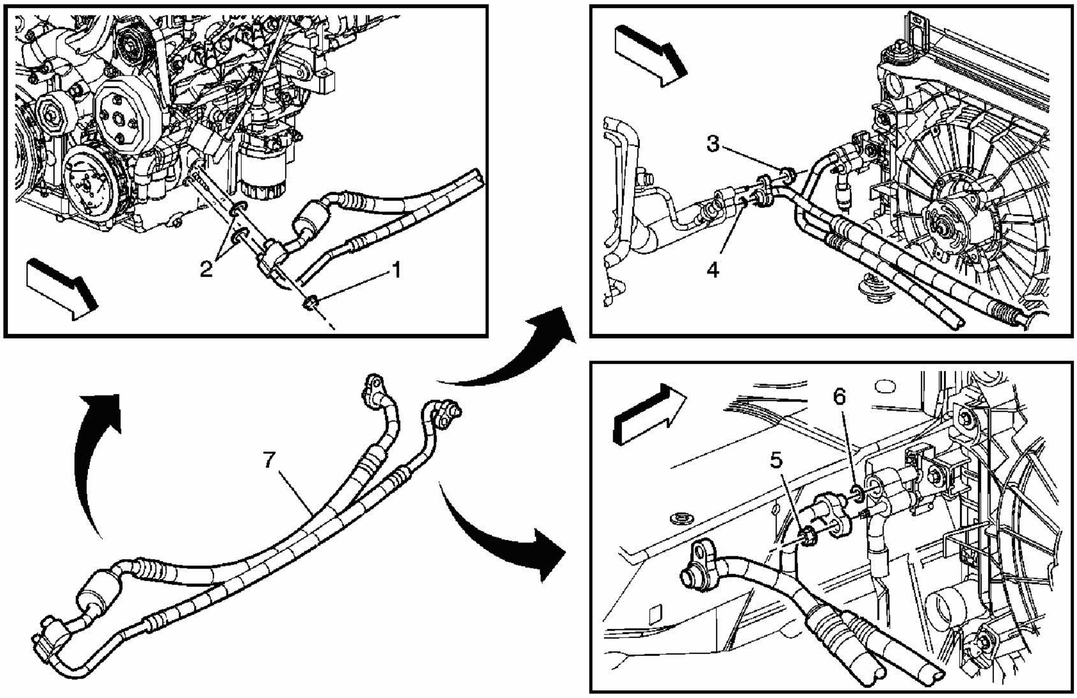


Fig. 43: Replacing Compressor Hose Assembly
Courtesy of GENERAL MOTORS CORP.

Compressor Hose Assembly Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**. 2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .	
1	Nut, A/C Compressor Hose **Tighten:** 17 N.m (12.5 lb in)
2	Washer, Sealing **Tip:** Remove and discard sealing washers. Refer to **Sealing Washer Replacement**.
3	Nut, A/C Compressor and Evaporator Tube

	Tighten: 17 N.m (12.5 lb in)
4	Washer, Sealing **Tip:** Remove and discard sealing washer. Refer to **Sealing Washer Replacement**.
5	Nut, A/C Compressor and Condenser **Tighten:** 17 N.m (12.5 lb in)
6	Washer, Sealing **Tip:** Remove and discard sealing washer. Refer to **Sealing Washer Replacement**.
7	Hose Assembly, A/C Compressor **Tip:** Leak test the fittings. Refer to **Leak Testing**.

AIR CONDITIONING EVAPORATOR THERMAL EXPANSION VALVE TUBE REPLACEMENT

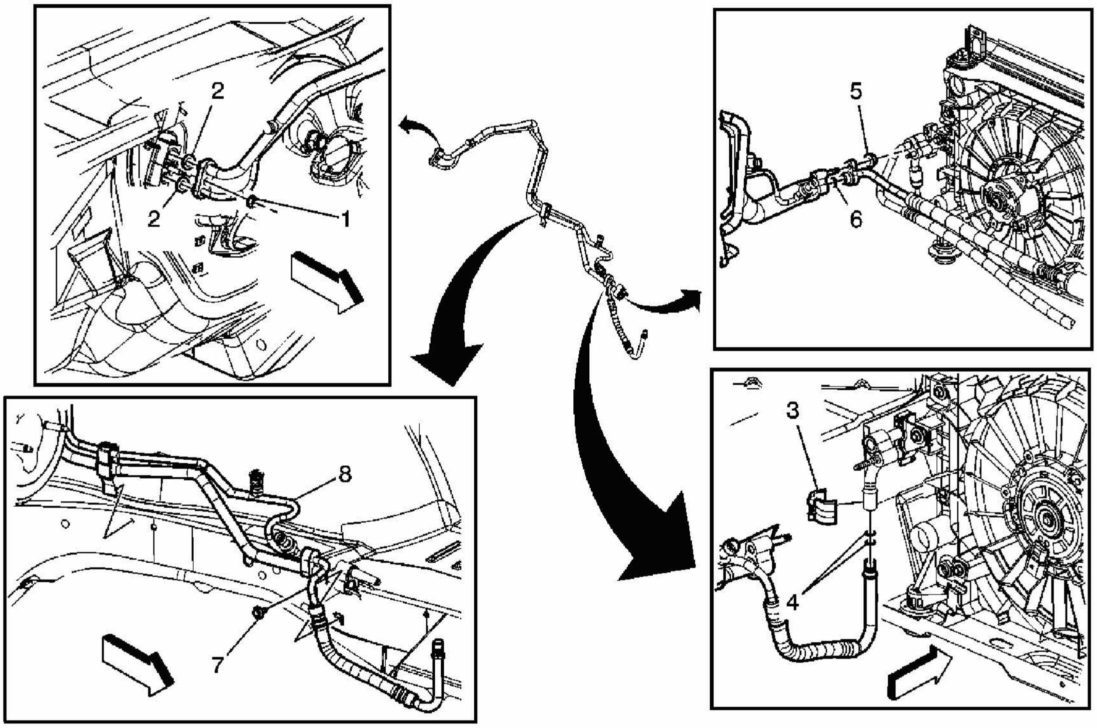


Fig. 44: Replacing Air Conditioning Evaporator Thermal Expansion Valve Tube
Courtesy of GENERAL MOTORS CORP.

Air Conditioning Evaporator Thermal Expansion Valve Tube Replacement

Callout	Component Name
NOTE: Refer to Fastener Notice .	

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** for the 3.5L engine or **Air Cleaner Assembly Replacement** for the 3.9L engine or **Air Cleaner Assembly Replacement** for the 5.3L engine.
3. Remove the brake pressure modulator valve bracket. Refer to **Brake Pressure Modulator Valve (BPMV) Bracket Replacement** .

1	Nut, A/C Evaporator TXV Tube **Tighten:** 16 N.m (12 lb ft).
2	Washer, Sealing **Tip:** Remove and discard the sealing washers. Refer to **Sealing Washer Replacement**.
3	Connector, A/C Condenser Tube **Tip:** Remove the connector tube. Refer to **A/C Line/Tube Connector Removal/Replacement**.
4	O-ring, Seal **Tip:** Remove and discard O-ring. Refer to **O-Ring Replacement**.
5	Nut, A/C Compressor and Evaporator Tube **Tighten:** 17 N.m (12.5 lb ft).
6	Washer, Sealing **Tip:** Remove and discard the sealing washers. Refer to **Sealing Washer Replacement**.
7	Bolt, A/C Condenser and A/C Evaporator Tube Clamp **Tighten:** 10 N.m (89 lb in)
8	Tube Assembly, A/C Evaporator TXV

AIR CONDITIONING (A/C) REFRIGERANT FILTER REPLACEMENT

Tools Required

J 39400-A Halogen Leak Detector. See **Special Tools**.

Removal Procedure

1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** for the 3.5L engine or to **Air Cleaner Assembly Replacement** for the 3.9L engine or to

Air Cleaner Assembly Replacement for the 5.3L engine.

3. Remove the A/C line coupling from the evaporator tube to condenser tube. Refer to **A/C Line/Tube Connector Removal/Replacement**.

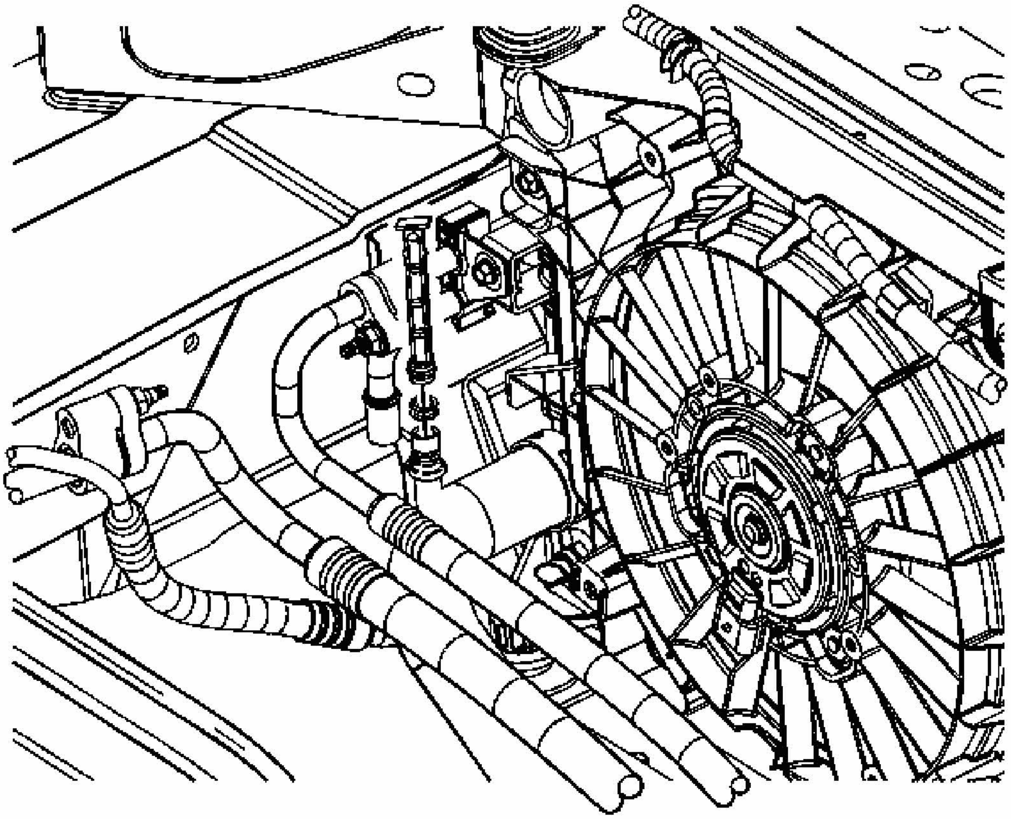


Fig. 45: Disconnecting/Connecting Evaporator Tube At Condenser
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the evaporator tube from the condenser.
5. Remove and discard the O-ring seals. Refer to **O-Ring Replacement**.
6. Remove the refrigerant filter from the evaporator tube.

Installation Procedure

1. Replace the O-ring seals on the evaporator tube. Refer to **O-Ring Replacement**.

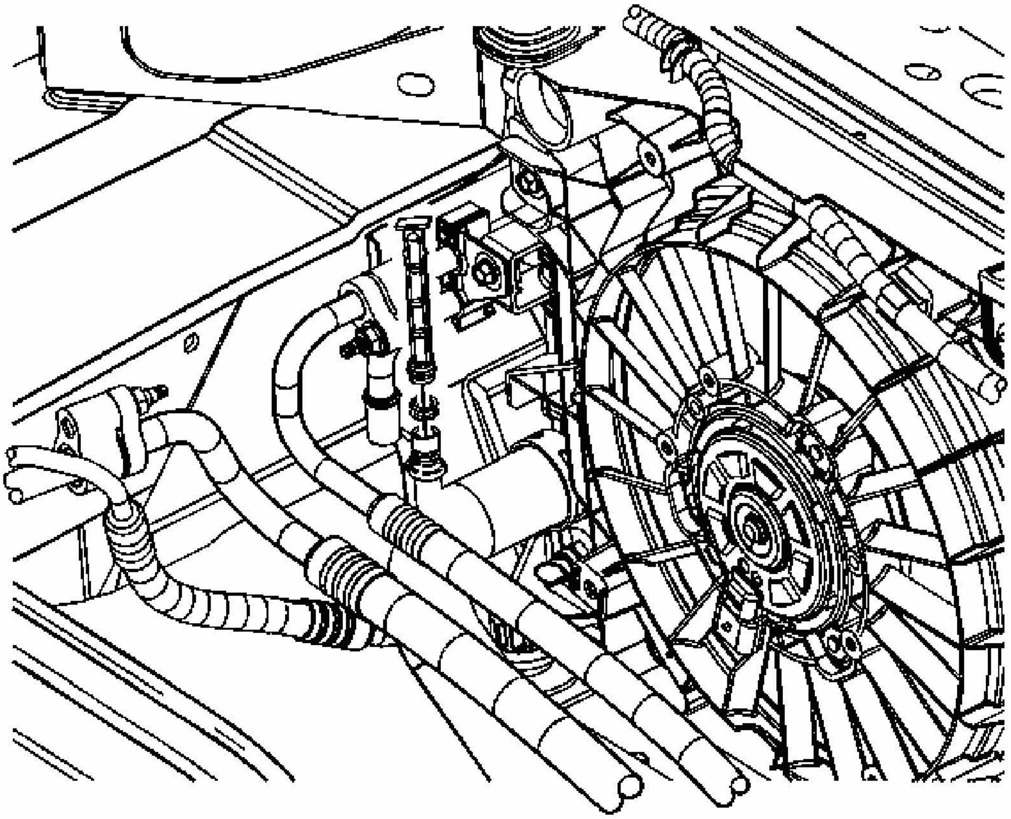


Fig. 46: Locating Air Conditioning (A/C) Refrigerant Filter
Courtesy of GENERAL MOTORS CORP.

2. Install a new refrigerant filter to the evaporator tube.
3. Connect the evaporator tube to the condenser.
4. Install the A/C line coupling to the evaporator tube and condenser tube. Refer to **A/C Line/Tube Connector Removal/Replacement**.
5. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** for the 3.5L engine or to **Air Cleaner Assembly Replacement** for the 3.9L engine or to **Air Cleaner Assembly Replacement** for the 5.3L engine.
6. Evacuate and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging**.
7. Leak test the fittings of the component using **J 39400-A** . See **Special Tools**.

SERVICE PORTS REPLACEMENT

Tools Required

J 39037 Charge Valve Octagon Socket. See **Special Tools**.

Removal Procedure

1. Remove the service port cap.
2. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**.

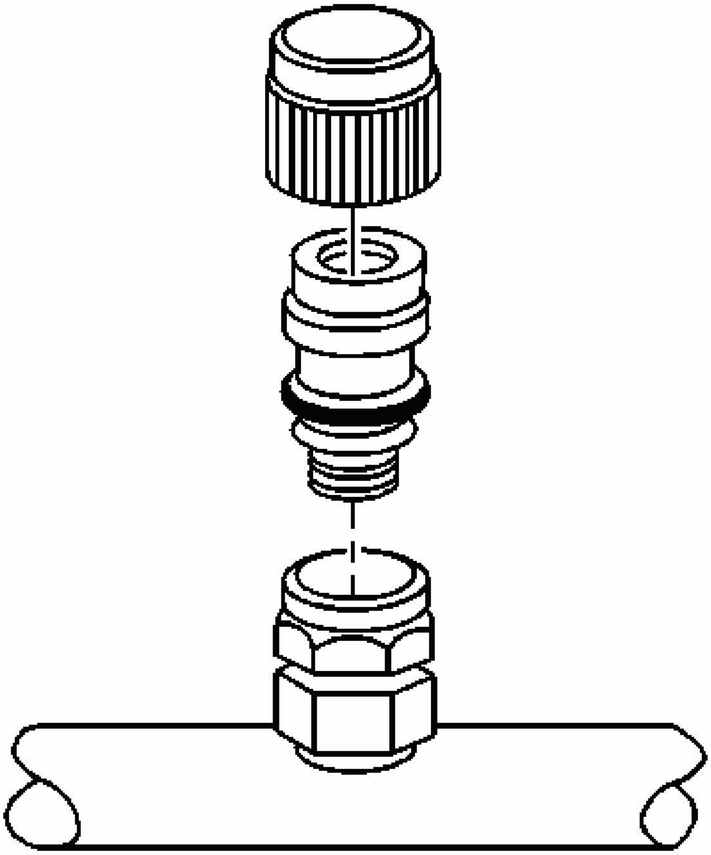


Fig. 47: View Of Service Port
Courtesy of GENERAL MOTORS CORP.

3. Use the **J 39037** to remove the service port. See **Special Tools**.

Installation Procedure

1. Replace the O-ring. Refer to **O-Ring Replacement**.

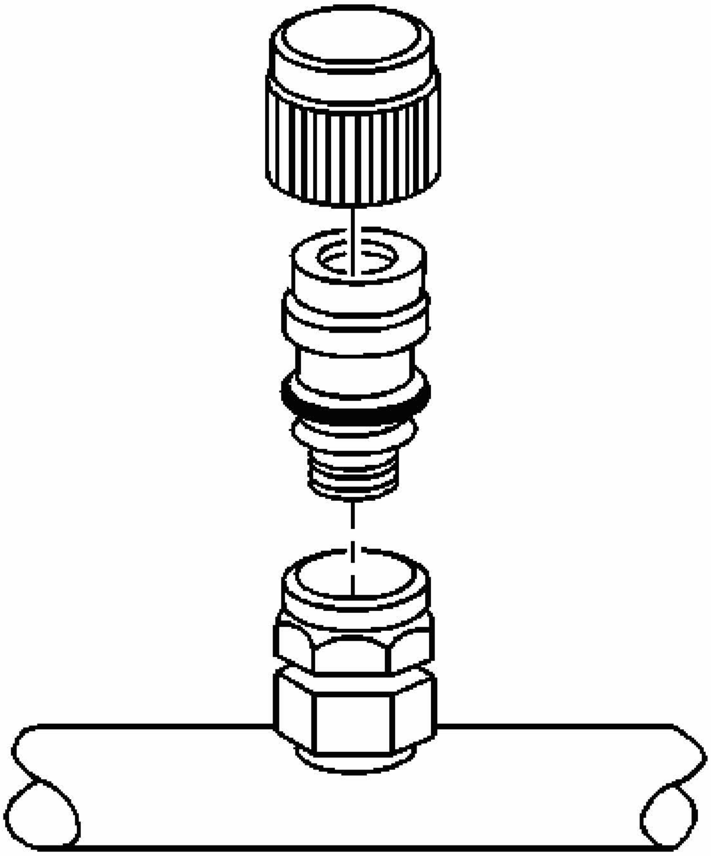


Fig. 48: View Of Service Port
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the service port valve.

   Tighten: Tighten the valve to 11 N.m (98 lb in).

3. Evacuate and charge the system. Refer to **Refrigerant Recovery and Recharging**.
4. Leak test the A/C service port. Refer to **Leak Testing**.
5. Install the service port cap.

THERMAL EXPANSION VALVE REPLACEMENT

Tools Required

J 39400-A Halogen Leak Detector. See **Special Tools**.

Removal Procedure

1. Recover the refrigerant from the A/C system. Refer to **Refrigerant Recovery and Recharging**.

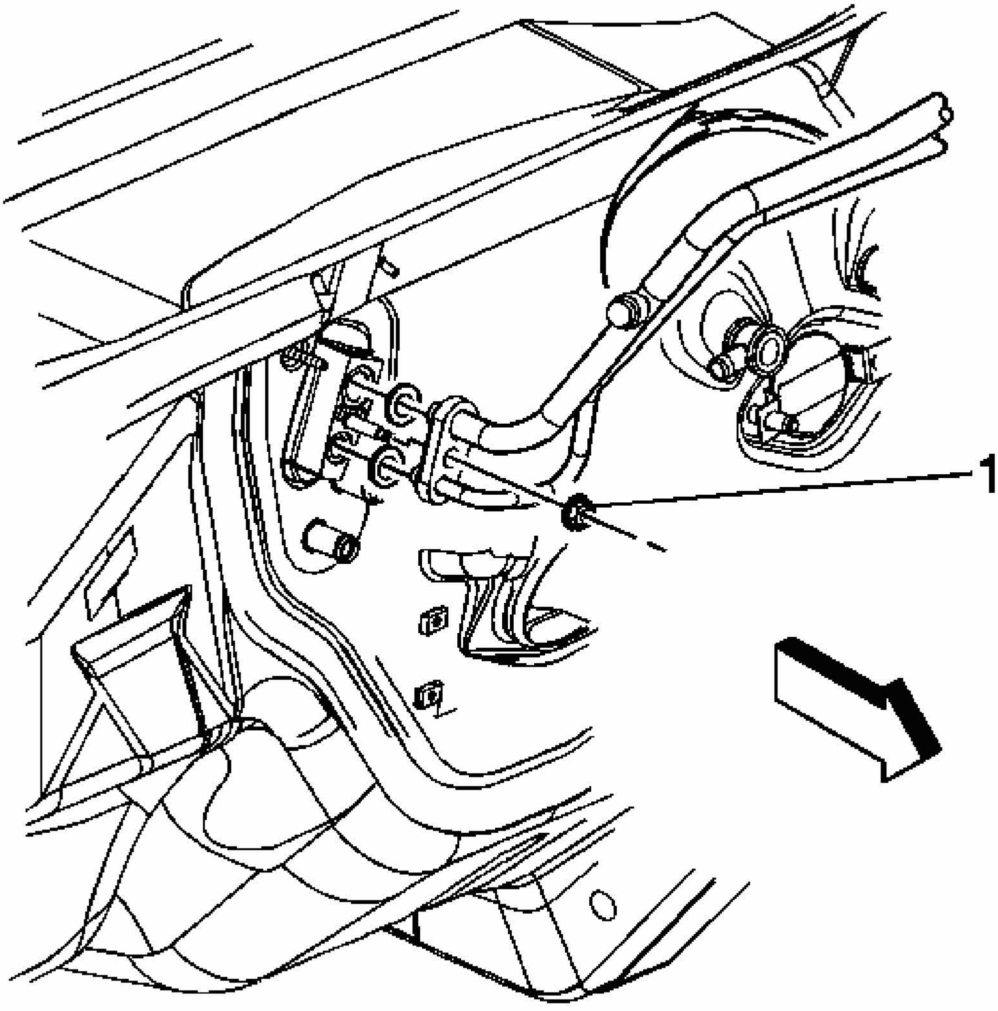


Fig. 49: Removing/Installing Evaporator Tube To Thermostatic Expansion Valve (TXV) Nut
Courtesy of GENERAL MOTORS CORP.

2. Remove the evaporator tube to thermal expansion valve (TXV) nut (1).

3. Disconnect the evaporator outlet and inlet tube from the TXV.
4. Remove and discard the sealing washers.

IMPORTANT: Cap or tape the open evaporator inlet and outlet tubes immediately to prevent contamination of the refrigerant system.

5. Cap off the evaporator inlet and outlet tube.

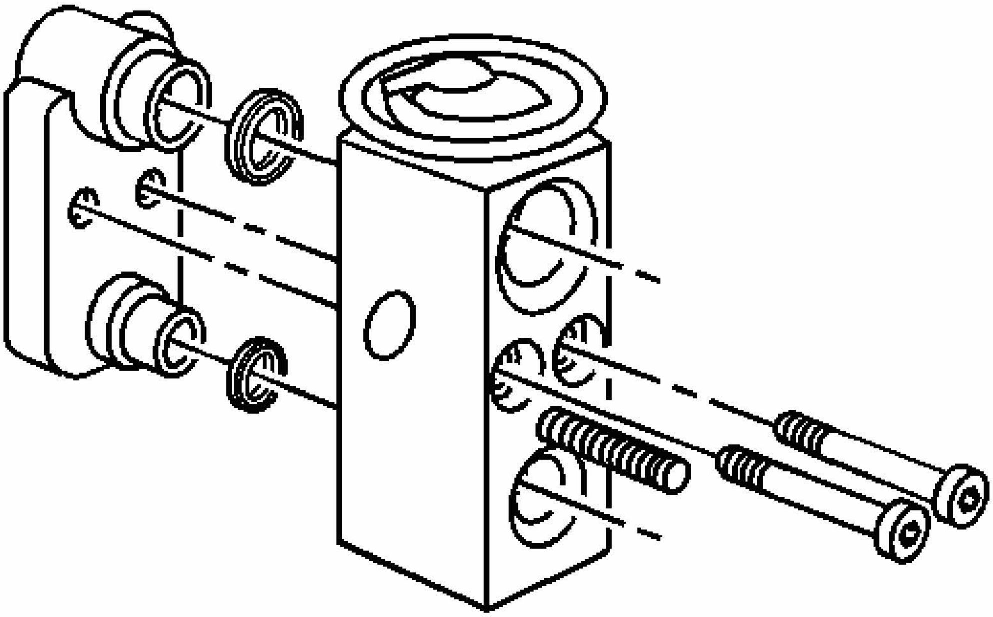


Fig. 50: View Of TXV
Courtesy of GENERAL MOTORS CORP.

6. Remove the TXV to evaporator bolts.
7. Remove the TXV from the evaporator core.
8. Remove and discard the sealing washers.

Installation Procedure

1. Install the new sealing washers onto the evaporator core. Refer to **Sealing Washer Replacement**.

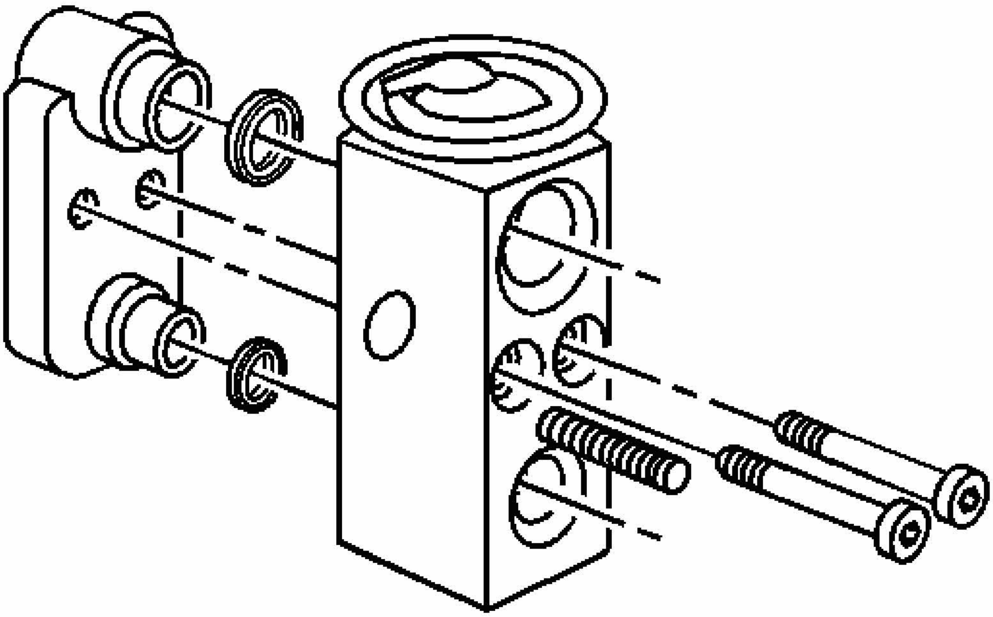


Fig. 51: View Of TXV
Courtesy of GENERAL MOTORS CORP.

2. Install the TXV to the evaporator core.

NOTE: **Refer to Fastener Notice .**

3. Install the TXV to evaporator bolts.

   Tighten: Tighten the bolts to 7 N.m (62 lb in).

4. Remove the cap or tape from the evaporator inlet and outlet tubes.
5. Install the new sealing washers onto the evaporator inlet and outlet tubes. Refer to **Sealing Washer Replacement**.
6. Install the evaporator outlet and inlet tube to the TXV.

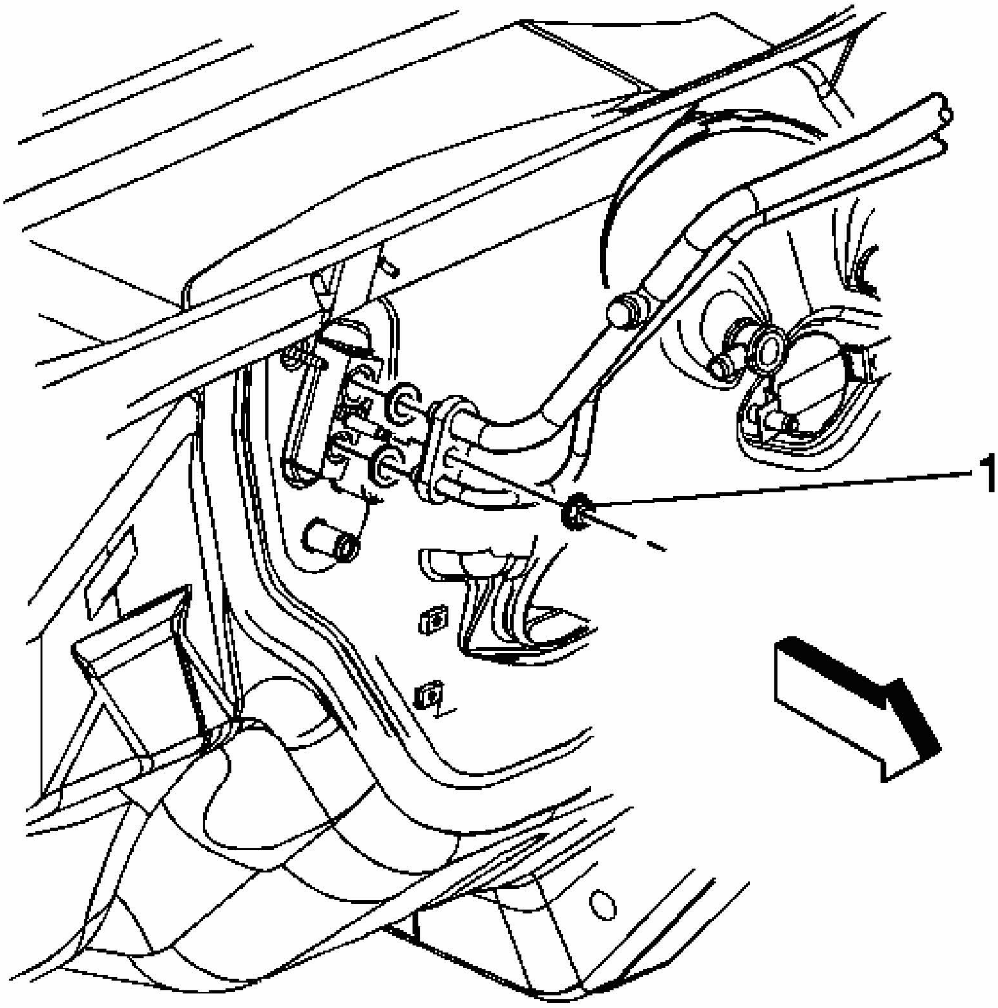


Fig. 52: Removing/Installing Evaporator Tube To Thermostatic Expansion Valve (TXV) Nut
Courtesy of GENERAL MOTORS CORP.

7. Install the evaporator tube nut (1).

   Tighten: Tighten the nut to 17 N.m (13 lb ft).

8. Evacuate and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging**.
9. Leak test the fittings of the component using **J 39400-A** . See **Special Tools**.

AIR CONDITIONING (A/C) REFRIGERANT PRESSURE SENSOR REPLACEMENT

Tools Required

J 39400-A Halogen Leak Detector. See **Special Tools**.

Removal Procedure

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** for the 3.5L engine or **Air Cleaner Assembly Replacement** for the 3.9L engine or **Air Cleaner Assembly Replacement** for the 5.3L engine
2. Disconnect the electrical connector from the A/C refrigerant pressure sensor.

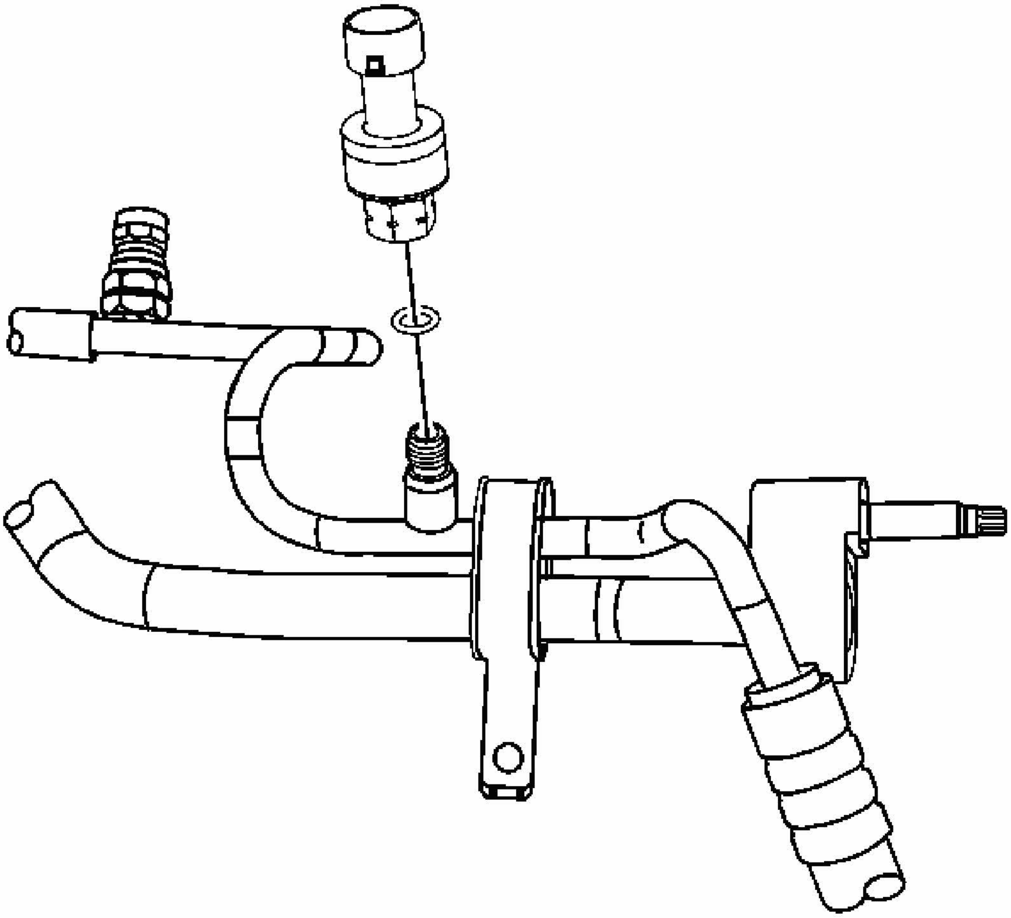


Fig. 53: Identifying Refrigerant Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

3. Remove the A/C refrigerant pressure sensor from the evaporator tube.

Installation Procedure

1. Replace the O-ring seal for the A/C refrigerant pressure sensor. Refer to **O-Ring Replacement**.

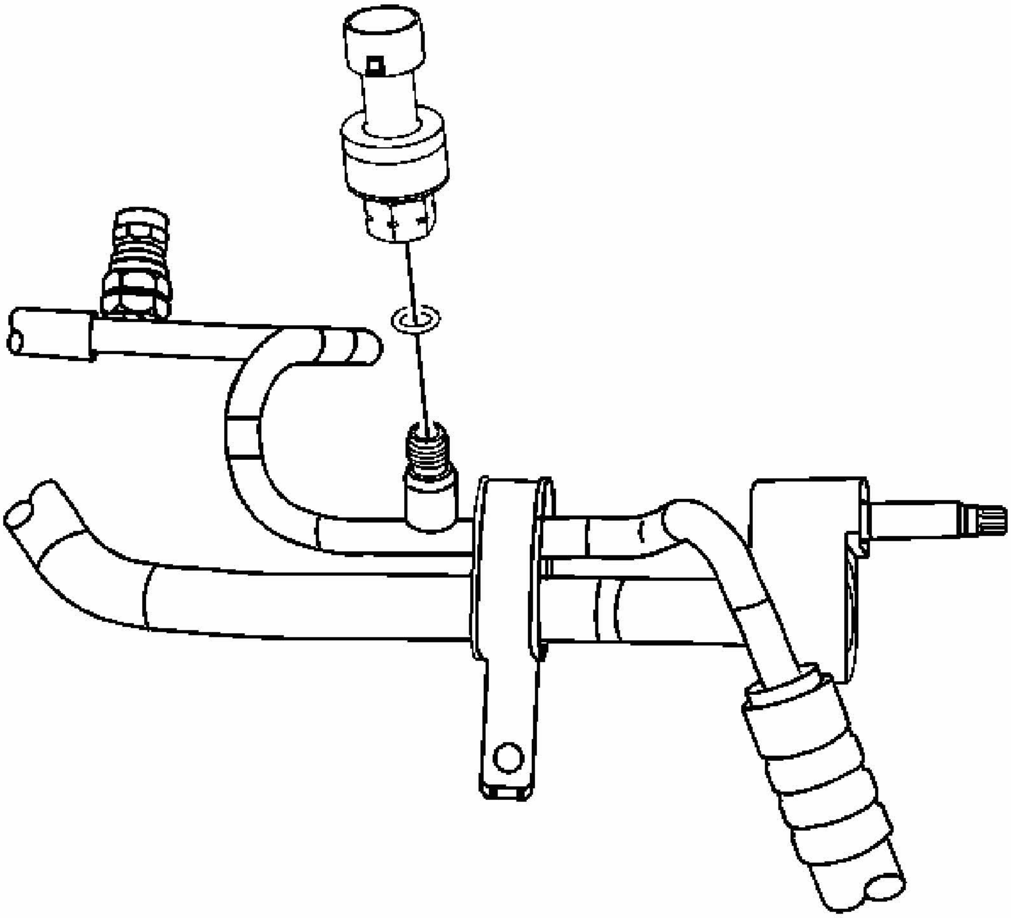


Fig. 54: Identifying Refrigerant Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE .**

2. Install the A/C refrigerant pressure sensor to the evaporator tube.

   Tighten: Tighten the sensor to 4.7 N.m (41 lb in).

3. Connect the electrical connector to the A/C refrigerant pressure sensor.
4. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** for the

3.5L engine or **Air Cleaner Assembly Replacement** for the 3.9L engine or **Air Cleaner Assembly Replacement** for the 5.3L engine

5. Leak test the fittings of the component using **J 39400-A** . See **Special Tools**.

CONDENSER REPLACEMENT

Tools Required

J 39400-A Halogen Leak Detector. See **Special Tools**.

Removal Procedure

1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**.
2. Remove the radiator. Refer to **Radiator Replacement** .

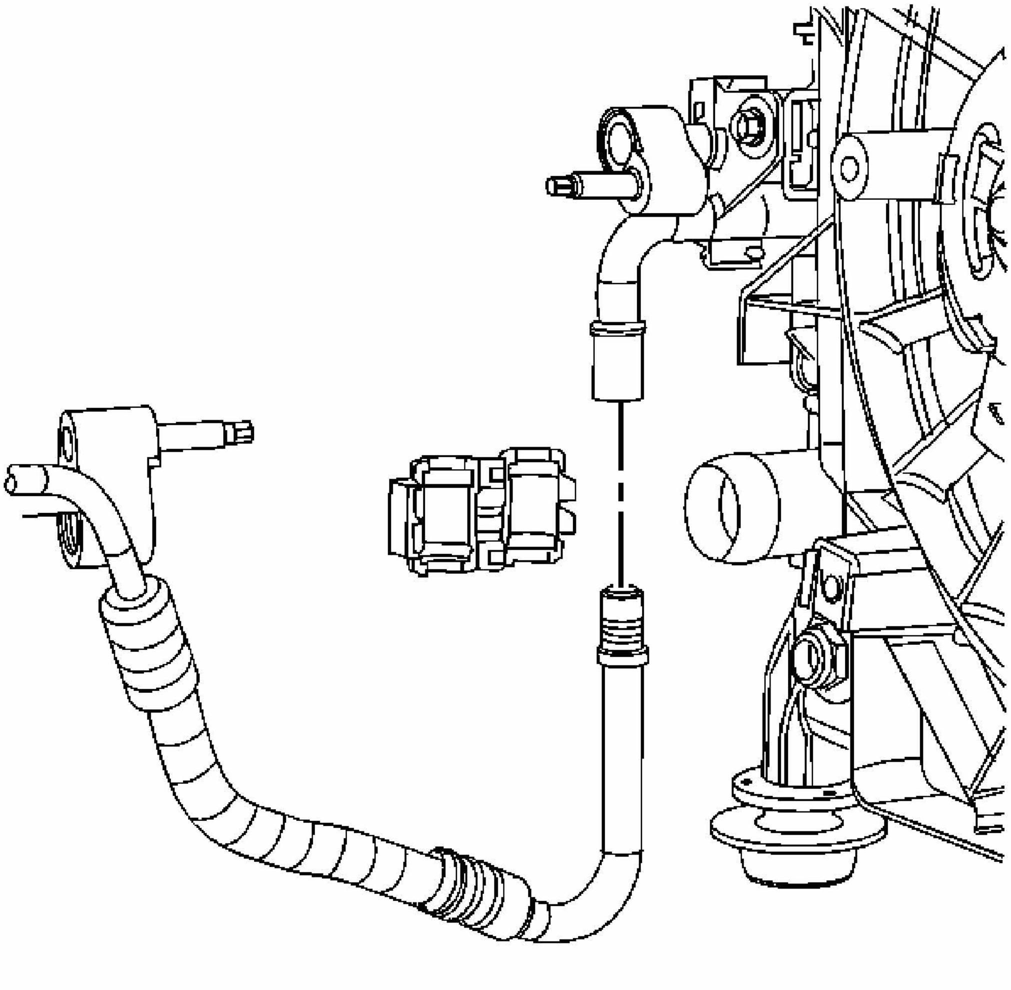


Fig. 55: Removing/Installing A/C Line Coupling At Condenser Tube

Courtesy of GENERAL MOTORS CORP.

3. Remove the A/C line coupling from the condenser tube to evaporator tube. Refer to **A/C Line/Tube Connector Removal/Replacement**.

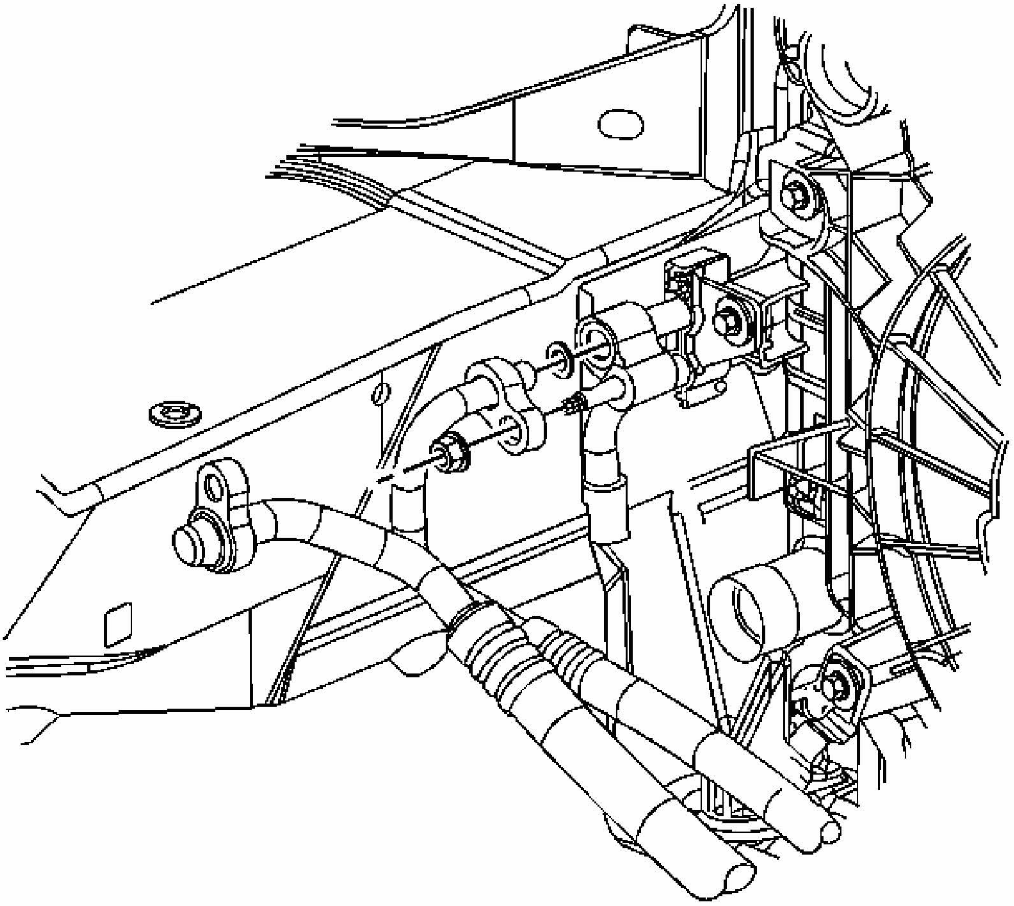


Fig. 56: Identifying A/C Compressor Hose Nut
Courtesy of GENERAL MOTORS CORP.

4. Remove the A/C compressor line nut from the condenser and position the A/C compressor line aside.
5. Remove the condenser from the vehicle.
6. Remove and discard the O-ring seals and seal washer.

Installation Procedure

1. If replacing the condenser, add refrigerant oil to the condenser. Refer to **Refrigerant**

System Capacities for system capacity information.

2. Install the condenser to the vehicle.
3. Install a new seal washer onto the A/C compressor hose. Refer to **Sealing Washer Replacement**.
4. Install new O-ring seals onto the evaporator tube. Refer to **O-Ring Replacement**.

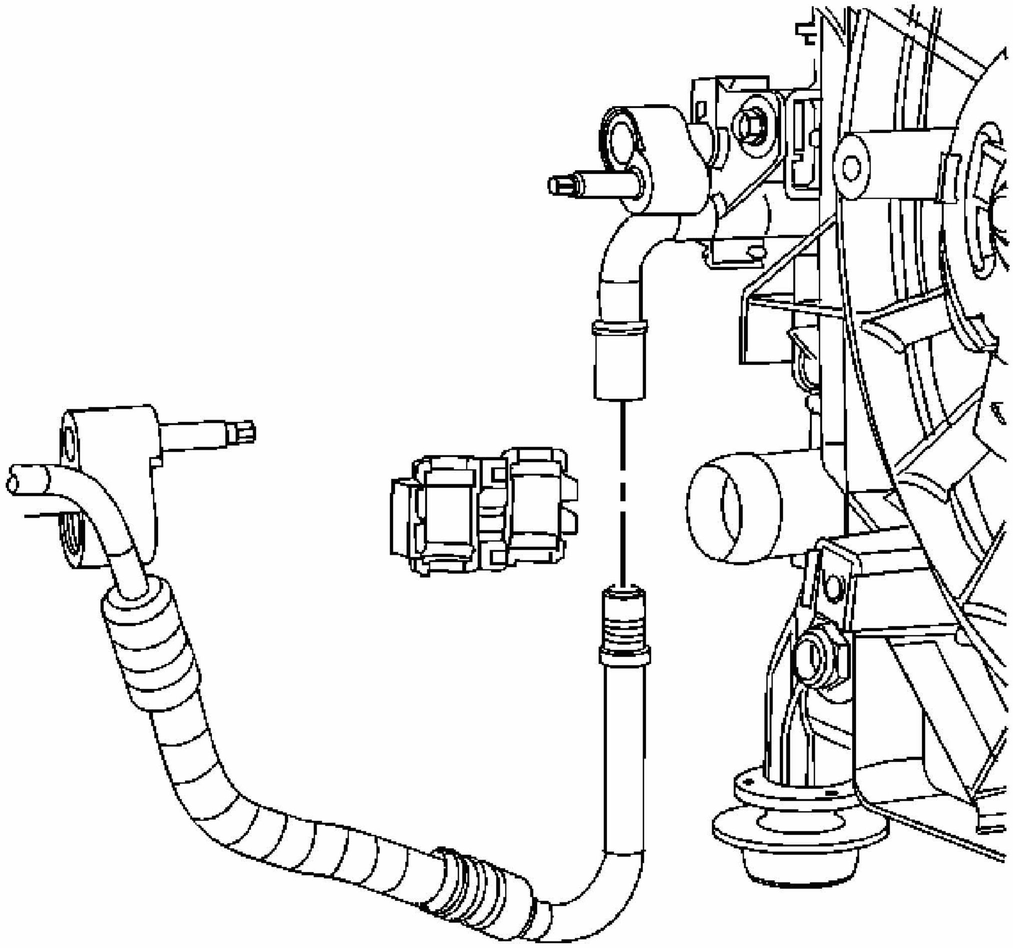


Fig. 57: Removing/Installing A/C Line Coupling At Condenser Tube
Courtesy of GENERAL MOTORS CORP.

5. Install the evaporator tube to the condenser.
6. Install the A/C line coupling to the evaporator tube and condenser tube. Refer to **A/C Line/Tube Connector Removal/Replacement**.

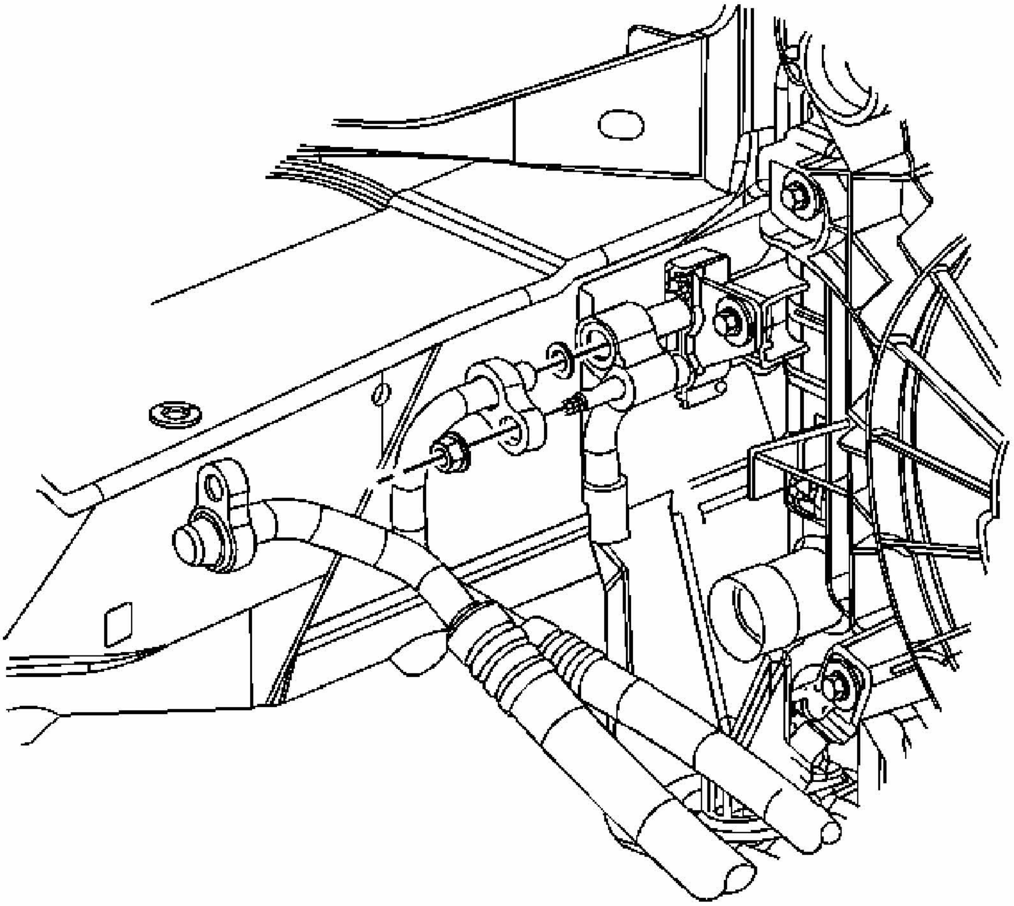


Fig. 58: Identifying A/C Compressor Hose Nut
Courtesy of GENERAL MOTORS CORP.

7. Install the A/C compressor hose to the condenser.

   NOTE: Refer to FASTENER NOTICE .

   Install the A/C compressor hose block fitting nut to the condenser.

   Tighten: Tighten the nut to 17 N.m (12.5 lb ft).

8. Install the radiator. Refer to **Radiator Replacement** .
9. Evacuate and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging**.
10. Leak test the fittings of the component using **J 39400-A** . See **Special Tools**.

AIR CONDITIONING (A/C) EVAPORATOR CASE ASSEMBLY REPLACEMENT

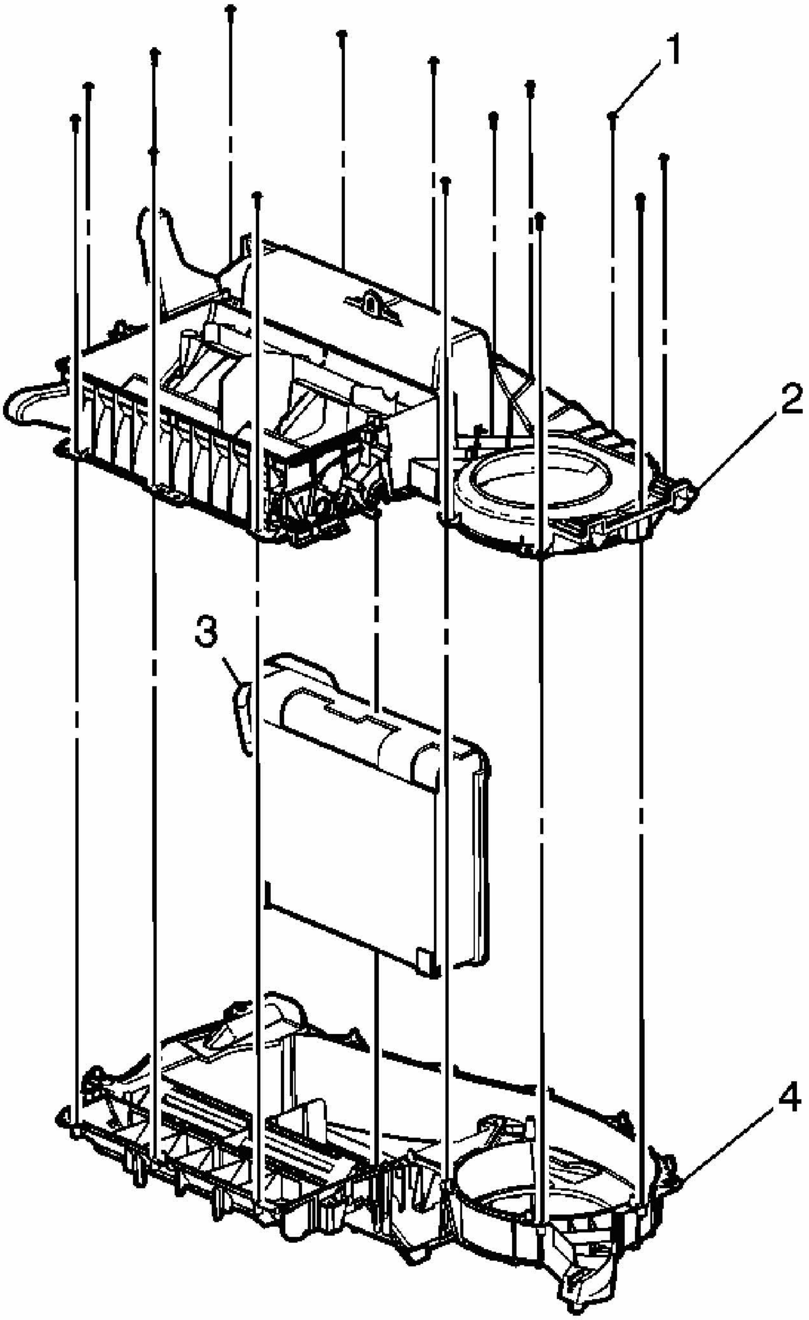


Fig. 59: Replacing Air Conditioning (A/C) Evaporator Case Assembly
Courtesy of GENERAL MOTORS CORP.

Air Conditioning (A/C) Evaporator Case Assembly Replacement

Callout	Component Name

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**

Preliminary Procedure

1. Remove the HVAC module. Refer to **HVAC Module Assembly Replacement**.
2. Remove the mode valve assembly. Refer to **Mode Valve Assembly Replacement**.
3. Remove the heater core. Refer to **Heater Core Replacement**.

1	Evaporator Case Assembly Screw (Qty: 17) **Tip:** Remove the heat stakes that secure the HVAC module assembly upper case to the HVAC module lower case using a small chisel. **Tighten:** 1.5 N.m (13 lb in)
2	Evaporator - Upper Case
3	Air Conditioning Evaporator
4	Evaporator - Lower Case

BLOWER CONTROL MODULE REPLACEMENT

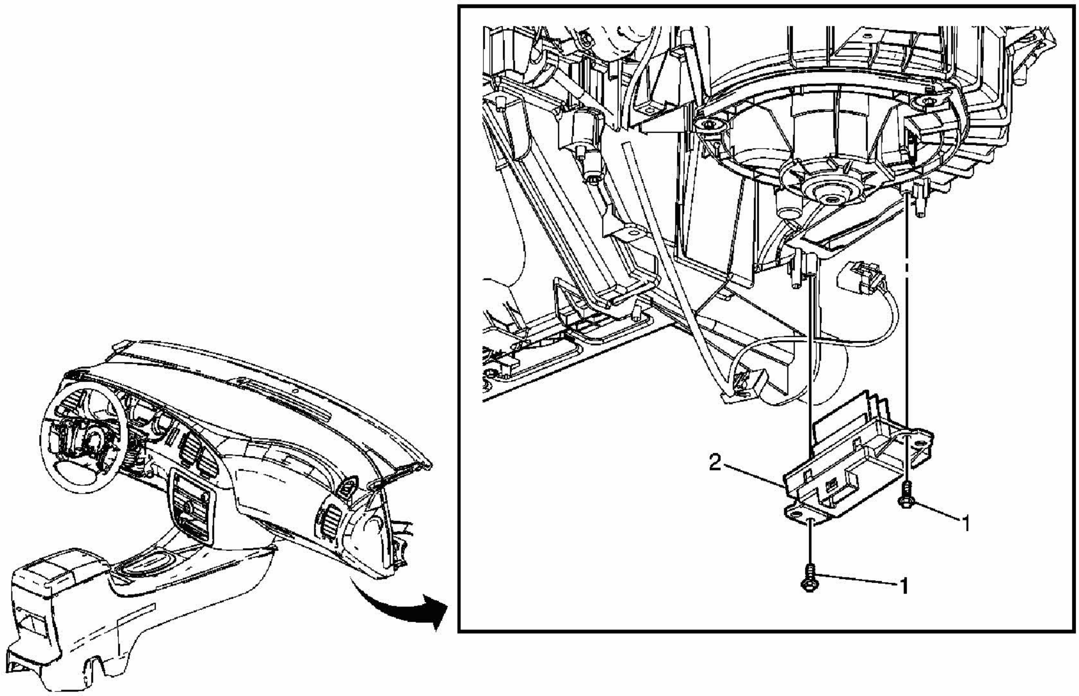


Fig. 60: Replacing Blower Control Module

Courtesy of GENERAL MOTORS CORP.

Blower Control Module Replacement

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**

Preliminary Procedure

1. Remove the right closeout insulator. Refer to **Closeout/Insulator Panel Replacement - Right**
2. Disconnect the blower motor resistor electrical connector.</td></tr>
<tr><td>1</td><td>Screw, Blower Motor Resistor (Qty: 2)
Tip: Remove the heat stakes that secure the blower motor resistor to the HVAC module assembly using a small chisel.

Tighten: 1.5 N.m (13 lb in)</td></tr>
<tr><td>2</td><td>Resistor, Blower Motor</td></tr>
</table>

HVAC MODULE ASSEMBLY REPLACEMENT

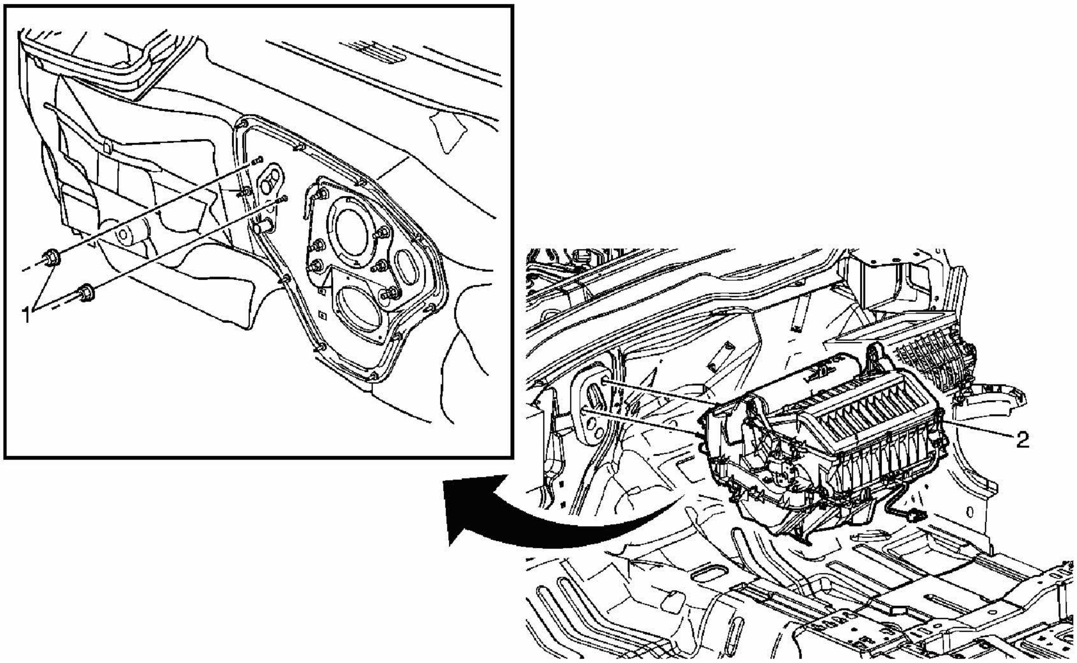


Fig. 61: Replacing HVAC Module Assembly

Courtesy of GENERAL MOTORS CORP.

HVAC Module Assembly Replacement

Callout	Component Name
NOTE: Refer to Fastener Notice . **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications** CAUTION: Refer to Battery Disconnect Caution **Preliminary Procedure** 1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** 2. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging** 3. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** 4. Remove the inlet heater hose from the heater core. Refer to **Heater Hose Replacement - Inlet (RPO LS4)** or **Heater Hose Replacement - Inlet (RPOs LZE, LZ4, LZ9)** 5. Remove the outlet heater hose from the heater core. Refer to **Heater Hose Replacement - Outlet (RPO LS4)** or **Heater Hose Replacement - Outlet (RPOs LZE, LZ4, LZ9)** 6. Remove the air conditioning evaporator thermal expansion valve tube from the thermal expansion valve. Refer to **Air Conditioning Evaporator Thermal Expansion Valve Tube Replacement** 7. Remove the evaporator drain tube from the evaporator case. 8. Remove the instrument panel (I/P) carrier. Refer to **Instrument Panel (I/P) Carrier Replacement**	
1	Nut, Heater and Air Conditioning Module **Tighten:** 10 N.m (89 lb in)
2	Module Assembly, Heater and Air Conditioning Evaporator

EVAPORATOR CORE REPLACEMENT

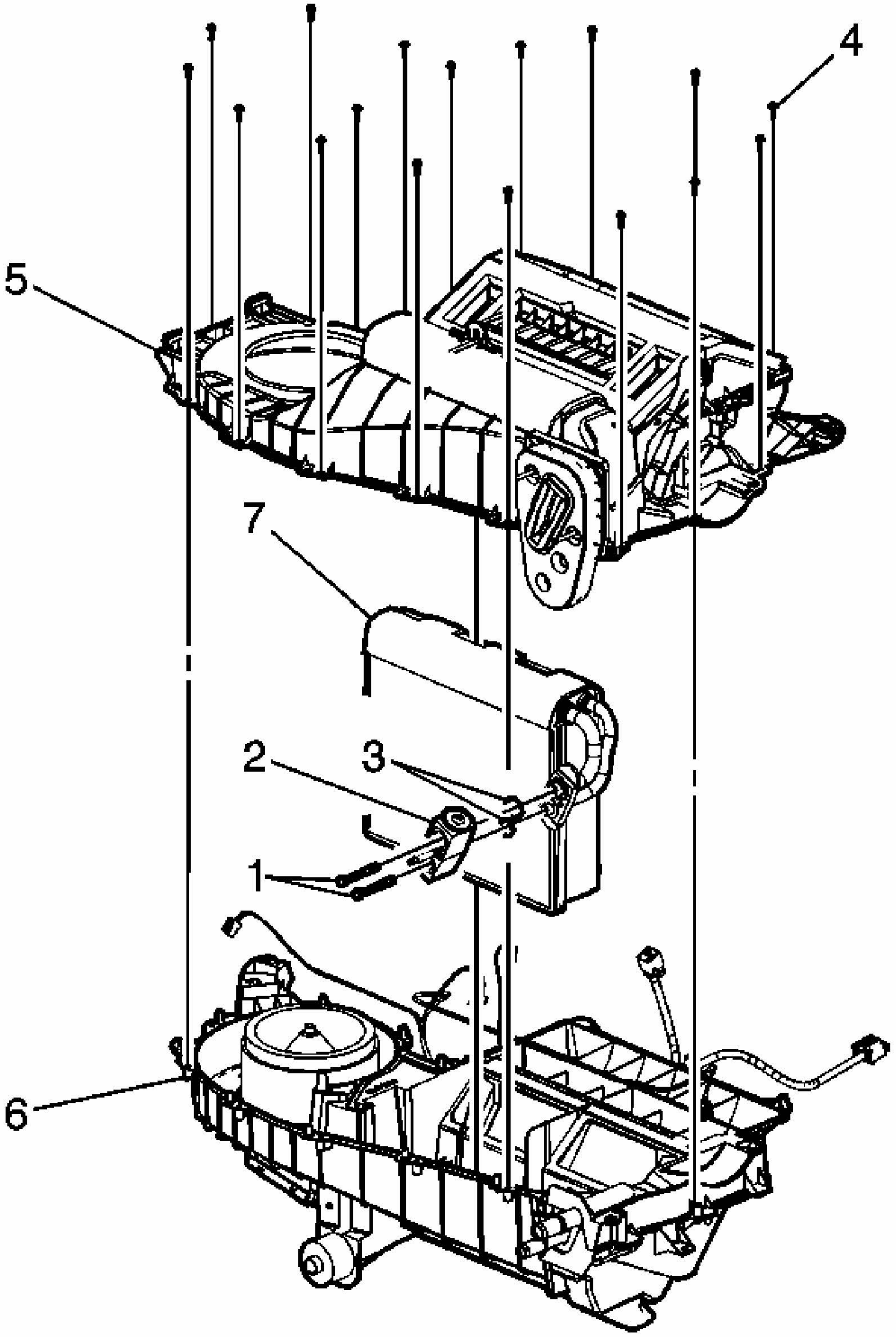


Fig. 62: Replacing Evaporator Core

Courtesy of GENERAL MOTORS CORP.

Evaporator Core Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications** **Preliminary Procedure** 1. Remove the HVAC module. Refer to **HVAC Module Assembly Replacement** **IMPORTANT:** **Leave the left temperature actuator attached to the air inlet assembly.** 2. Remove the air inlet assembly. Refer to **Air Inlet Assembly Replacement**	
1	Bolt, Thermal Expansion Valve (Qty: 2) **Tighten:** 7 N.m (62 lb in)
2	Valve, Thermal Expansion
3	Washer, Sealing **Tip:** Remove and discard sealing washers. Refer to **Sealing Washer Replacement**
4	Screw, Evaporator Case Assembly (Qty: 17) **Tip:** Remove the heat stakes that secure the HVAC module assembly upper case to the HVAC module lower case using a small chisel. **Tighten:** 1.5 N.m (13 lb in)
5	Case, Evaporator - Upper
6	Case, Evaporator - Lower
7	Evaporator, Air Conditioning

HEATER HOSE REPLACEMENT - INLET (RPO LS4)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or

Draining and Filling Cooling System (9C1, 9C3 Static Fill) or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

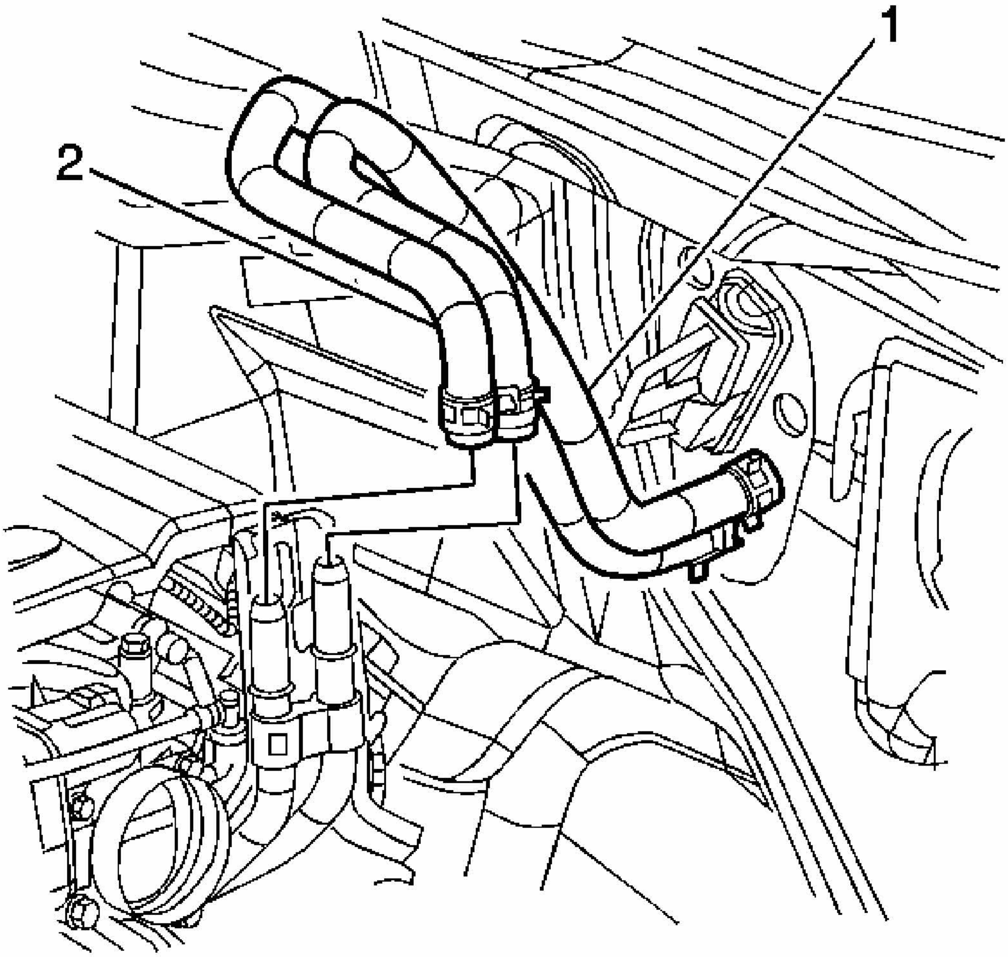


Fig. 63: Heater Hoses & Clamp
Courtesy of GENERAL MOTORS CORP.

2. Use **J 38185** to reposition the heater inlet hose clamp at the heater pipe.

IMPORTANT: Cap or plug the cooling components to prevent system contamination.

3. Remove the heater inlet hose (1) from the heater pipe.

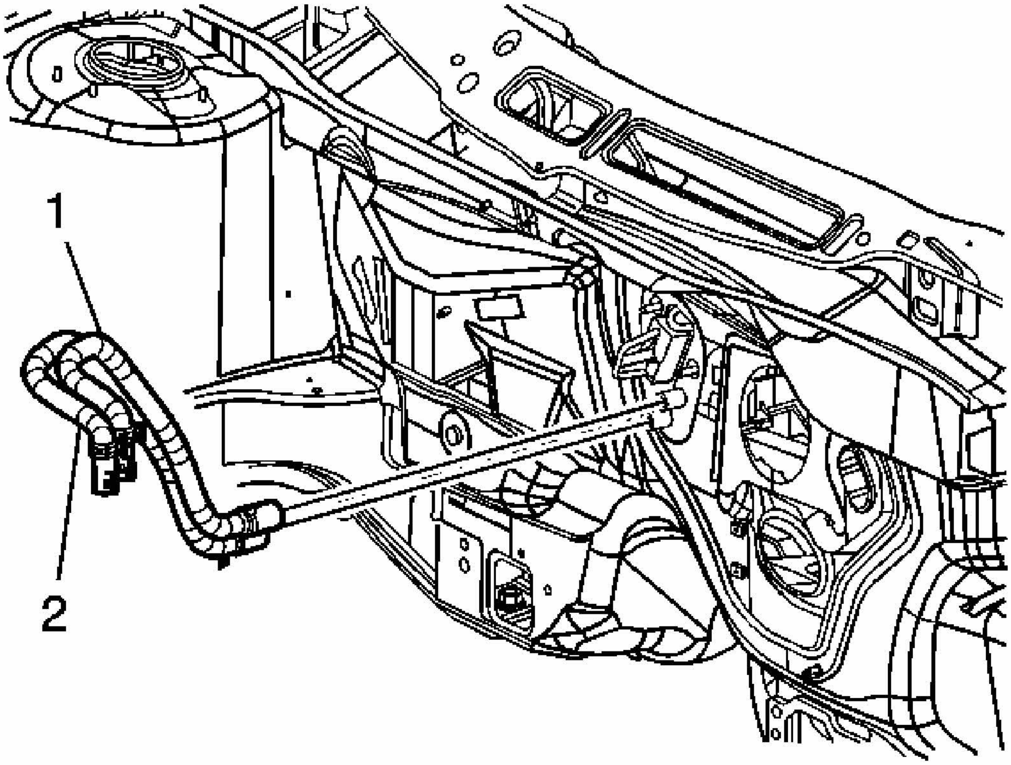


Fig. 64: Heater Hoses
Courtesy of GENERAL MOTORS CORP.

4. Use **J 38185** to reposition the heater inlet hose clamp at the heater core.
5. Remove the heater inlet hose (1) from the heater core.

Installation Procedure

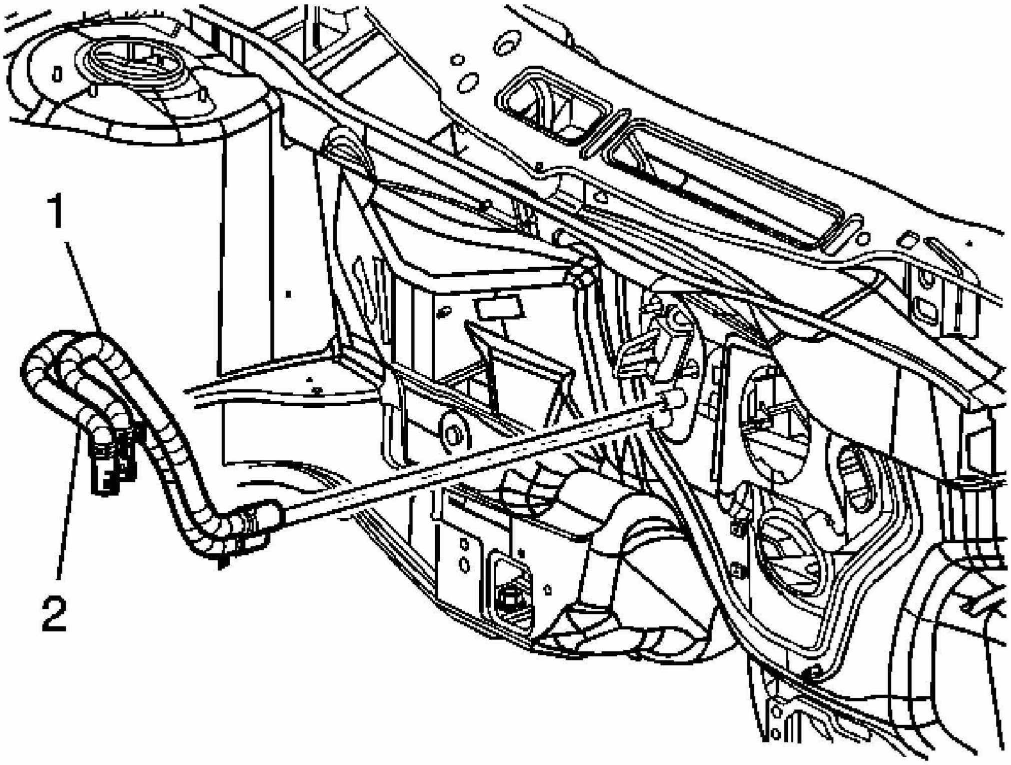


Fig. 65: Heater Hoses
Courtesy of GENERAL MOTORS CORP.

1. Connect heater inlet hose (1) to the heater core.
2. Use **J 38185** to reposition the heater inlet hose to the heater core clamp.

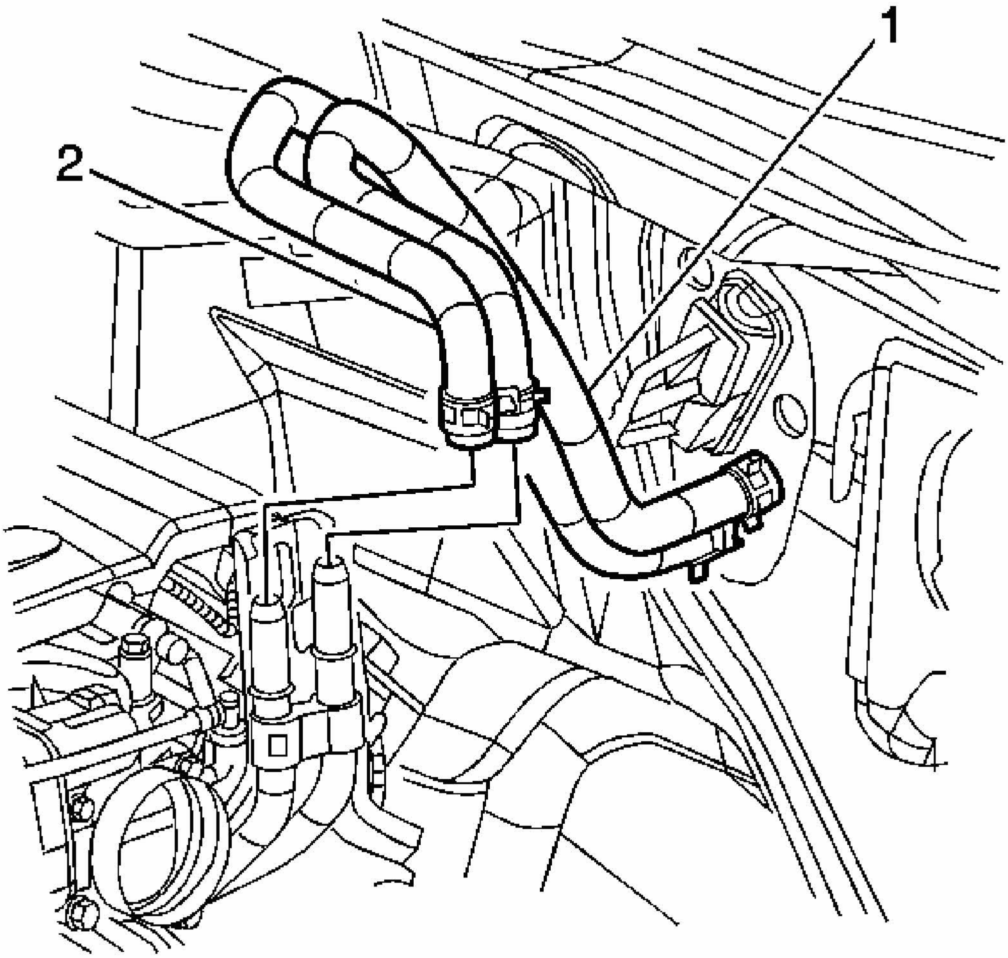


Fig. 66: Heater Hoses & Clamp
Courtesy of GENERAL MOTORS CORP.

3. Install the heater inlet hose (1) to the heater pipe.
4. Use **J 38185** to reposition the heater inlet hose to the heater pipe clamp.
5. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

INLET HEATER HOSE REPLACEMENT - (RPOS LZE, LZ4, LZ9)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the coolant. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
2. Remove the surge tank from the surge tank bracket.
3. Reposition the heater inlet hose clamp at the heater core using the **J 38185** .
4. Reposition the heater inlet hose clamp at the engine using the **J 38185** .

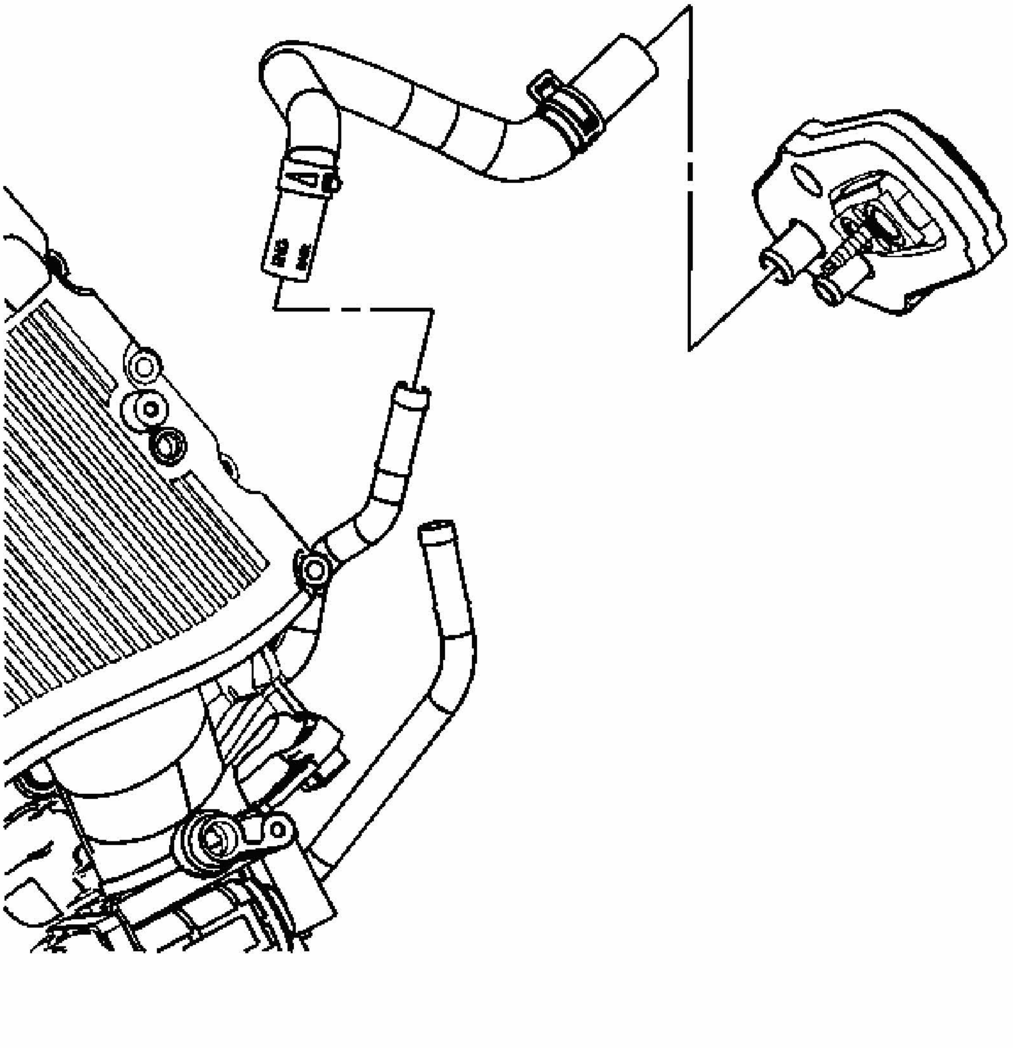


Fig. 67: Removing Heater Inlet Hose From Heater Core
Courtesy of GENERAL MOTORS CORP.

5. Remove the heater inlet hose from the heater core.
6. Remove the heater inlet hose from the engine.
7. Remove both heater inlet hose clamps from the heater inlet hose.

Installation Procedure

1. Install both heater inlet hose clamps to the heater inlet hose.

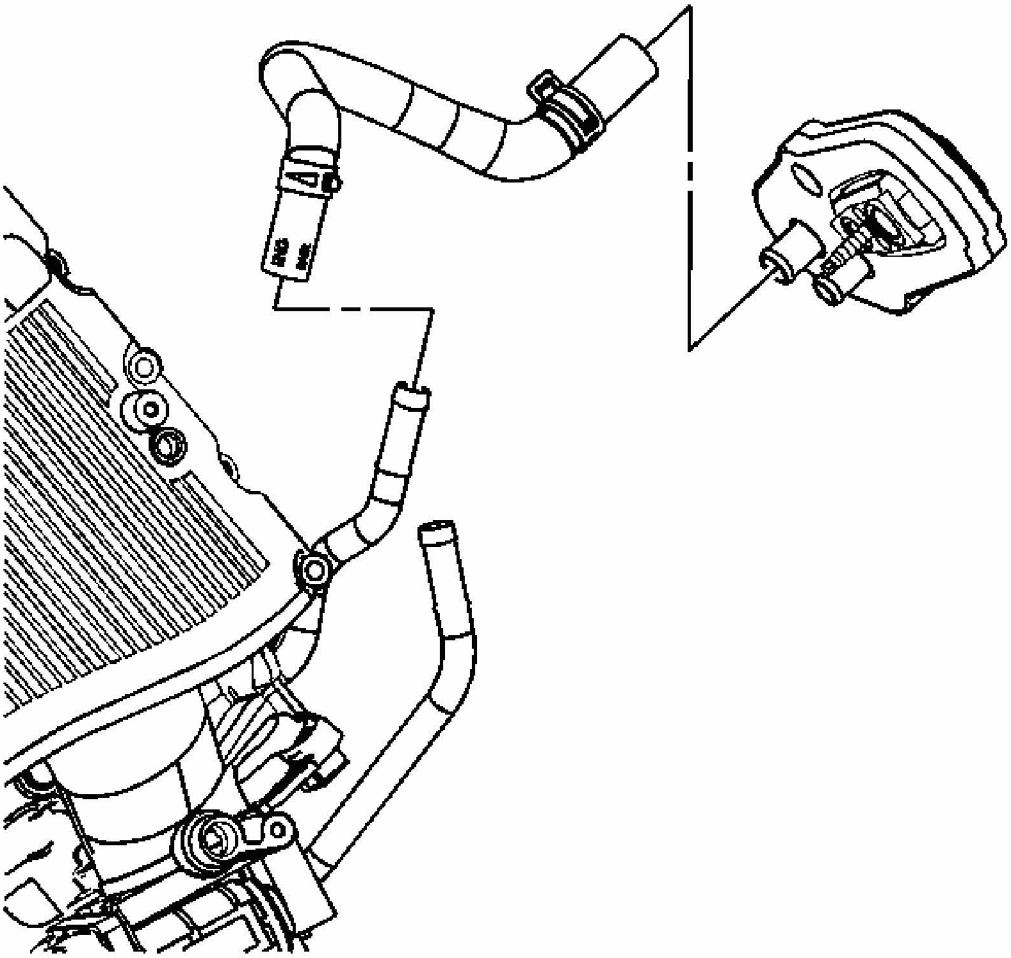


Fig. 68: Removing Heater Inlet Hose From Heater Core
Courtesy of GENERAL MOTORS CORP.

2. Install the heater inlet hose to the engine.
3. Install the heater inlet hose to the heater core.
4. Reposition the heater inlet hose clamp at the engine using the **J 38185** .

5. Reposition the heater inlet hose clamp at the heater core using the **J 38185** .
6. Install the surge tank to the surge tank bracket.
7. Fill the coolant. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

OUTLET HEATER HOSE REPLACEMENT - (RPO LS4)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

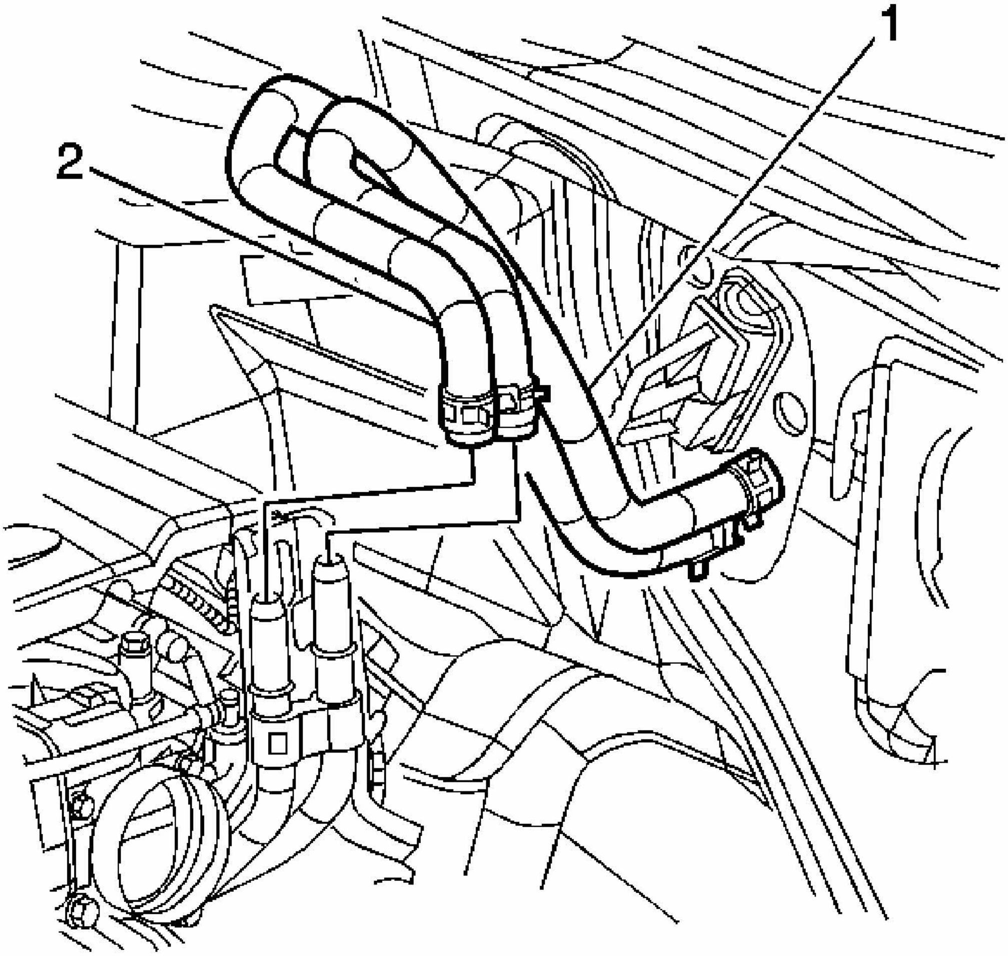


Fig. 69: Heater Hoses & Clamp
Courtesy of GENERAL MOTORS CORP.

2. Use **J 38185** to reposition the heater outlet hose clamp to the heater pipe.
3. Remove the heater outlet hose (2) from the heater pipe.

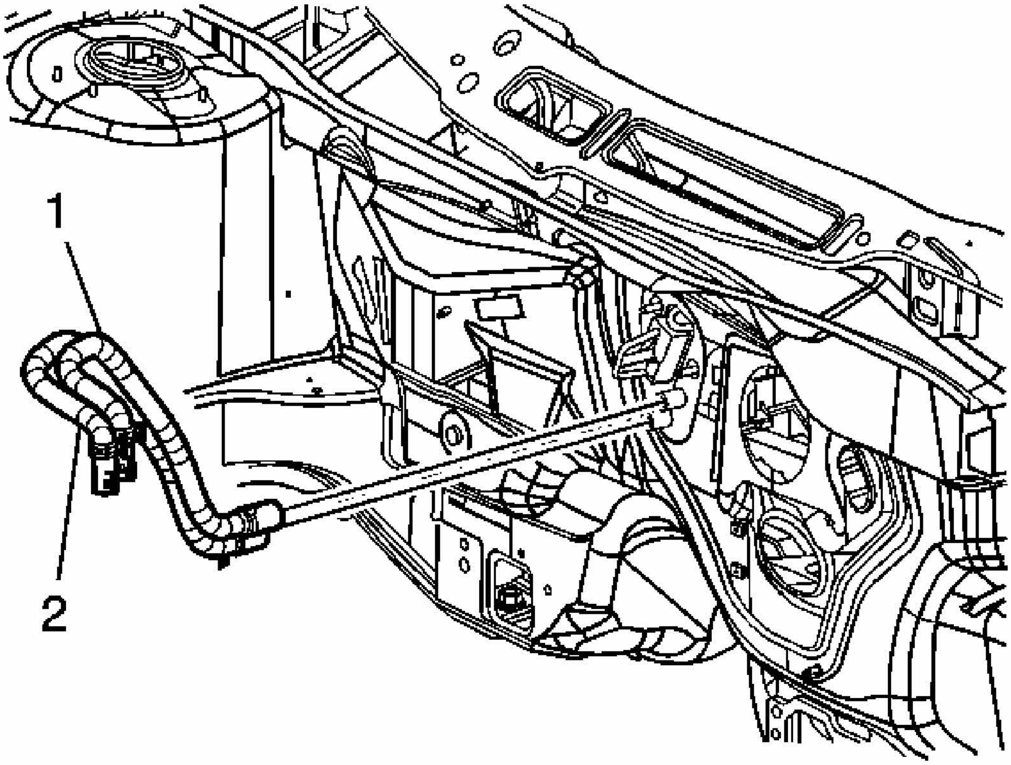


Fig. 70: Heater Hoses
Courtesy of GENERAL MOTORS CORP.

4. Use **J 38185** to reposition the heater outlet hose to the heater core clamp.
5. Remove the heater outlet hose (2) from the heater core.

Installation Procedure

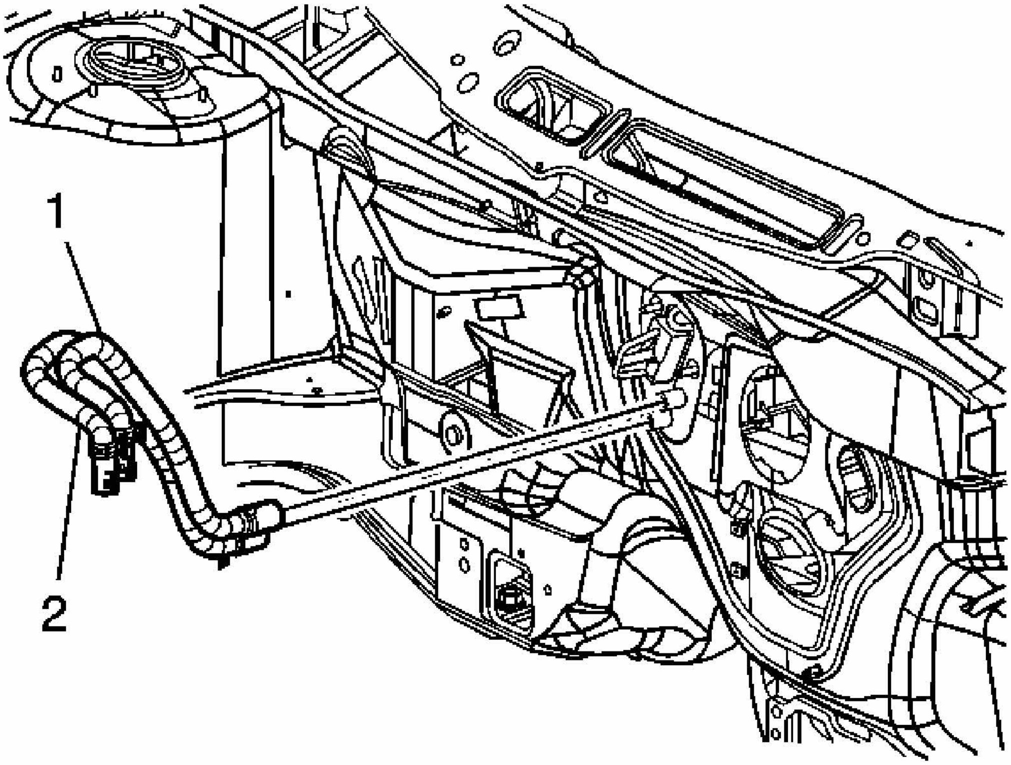


Fig. 71: Heater Hoses
Courtesy of GENERAL MOTORS CORP.

1. Connect heater outlet hose (2) to the heater core.
2. Use **J 38185** to reposition the heater outlet hose to heater core clamp.

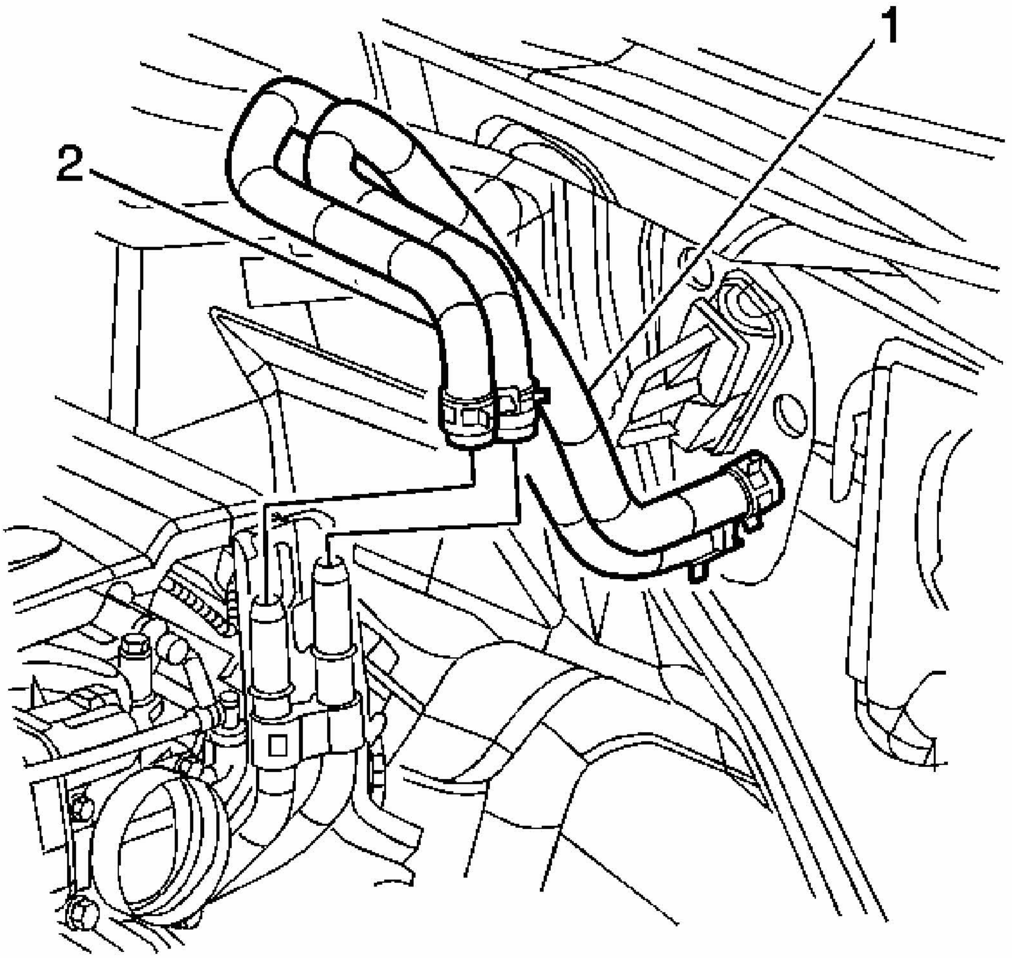


Fig. 72: Heater Hoses & Clamp
Courtesy of GENERAL MOTORS CORP.

3. Install the heater outlet hose (2) to the heater pipe.
4. Use **J 38185** to reposition the heater outlet hose to the heater pipe clamp.
5. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

OUTLET HEATER HOSE REPLACEMENT - (RPOS LZE, LZ4, LZ9)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the coolant. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
2. Remove the surge tank from the surge tank bracket.
3. Reposition the heater outlet hose clamp at the heater core using the **J 38185** .
4. Reposition the heater outlet hose clamp at the engine using the **J 38185** .

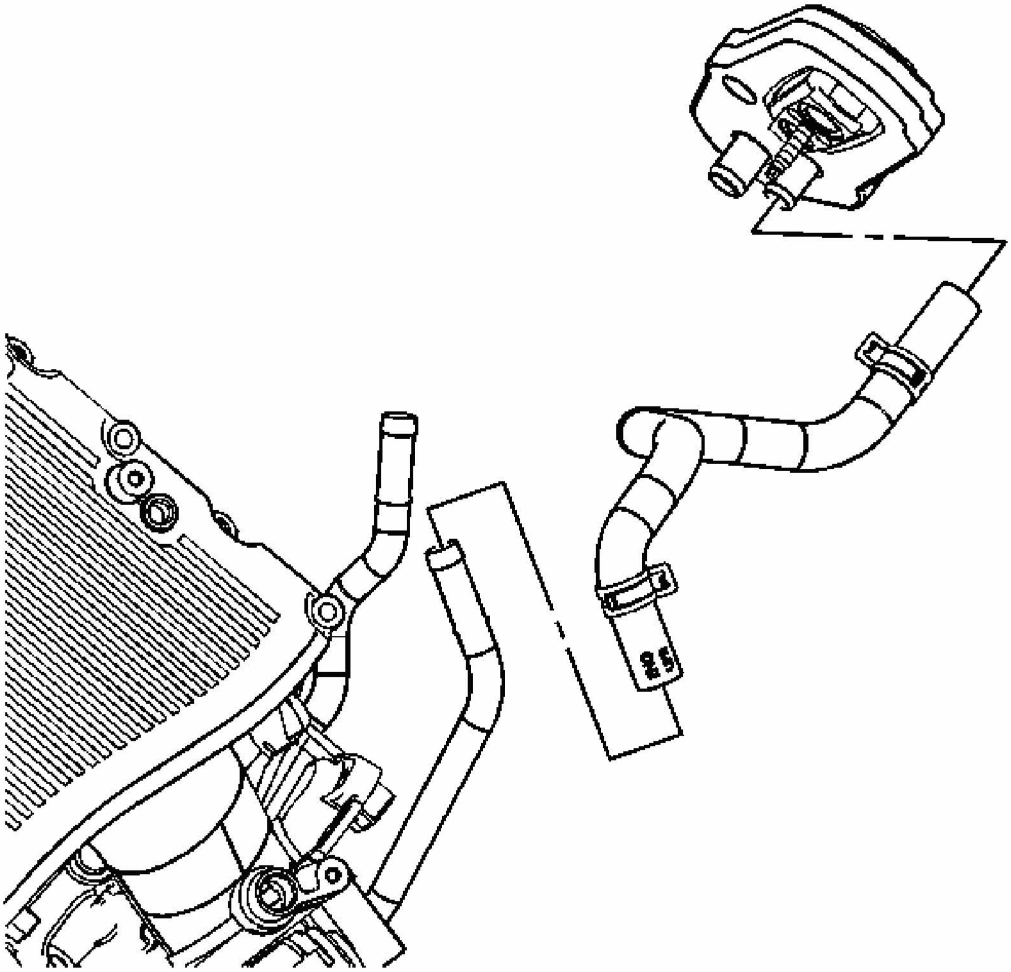


Fig. 73: Removing Heater Outlet Hose From Heater Core

Courtesy of GENERAL MOTORS CORP.

5. Remove the heater outlet hose from the heater core.
6. Remove the heater outlet hose from the engine.
7. Remove both heater outlet hose clamps from the heater outlet hose.

Installation Procedure

1. Install both heater outlet hose clamps to the heater outlet hose.

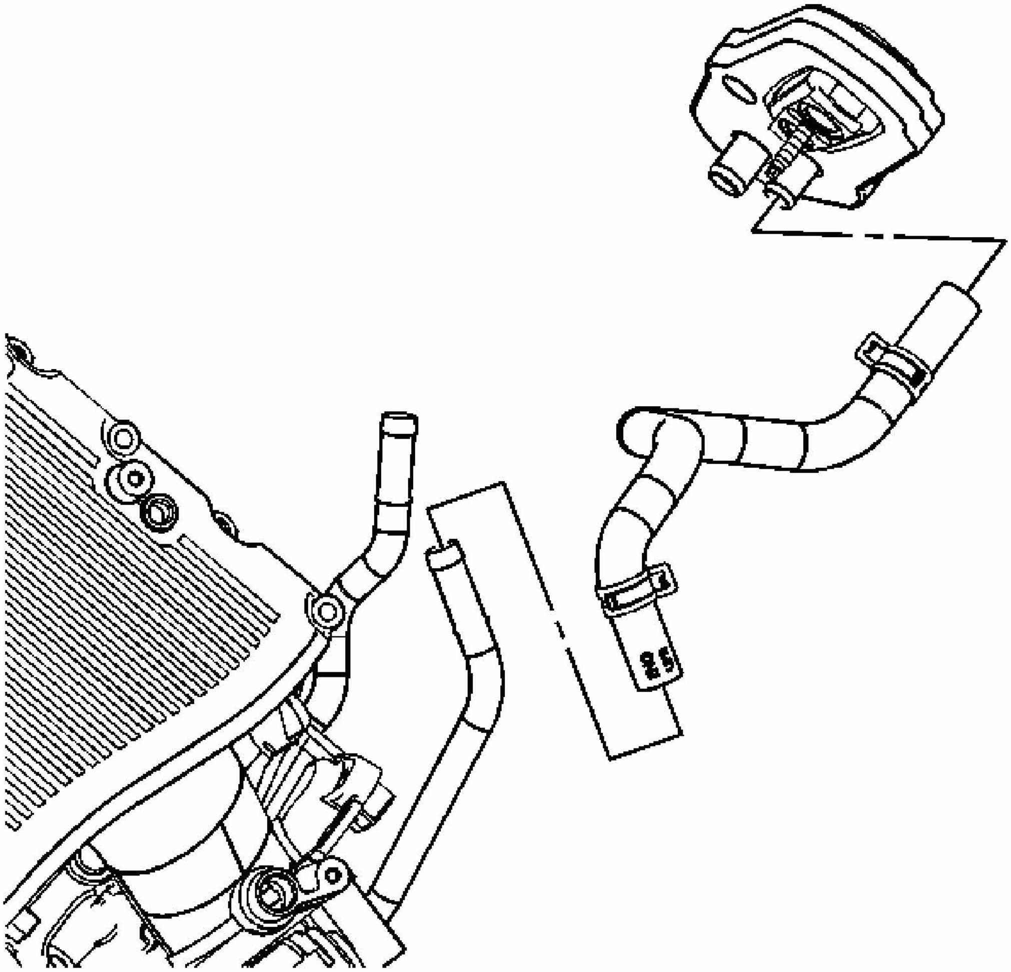


Fig. 74: Removing Heater Outlet Hose From Heater Core
Courtesy of GENERAL MOTORS CORP.

2. Install the heater outlet hose to the engine.

3. Install the heater outlet hose to the heater core.
4. Reposition the heater outlet hose clamp at the engine using the **J 38185** .
5. Reposition the heater outlet hose clamp at the heater core using the **J 38185** .
6. Install the surge tank to the surge tank bracket.
7. Fill the coolant. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

HEATER PIPES REPLACEMENT (RPO LS4)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** for the 5.3L engine.
2. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

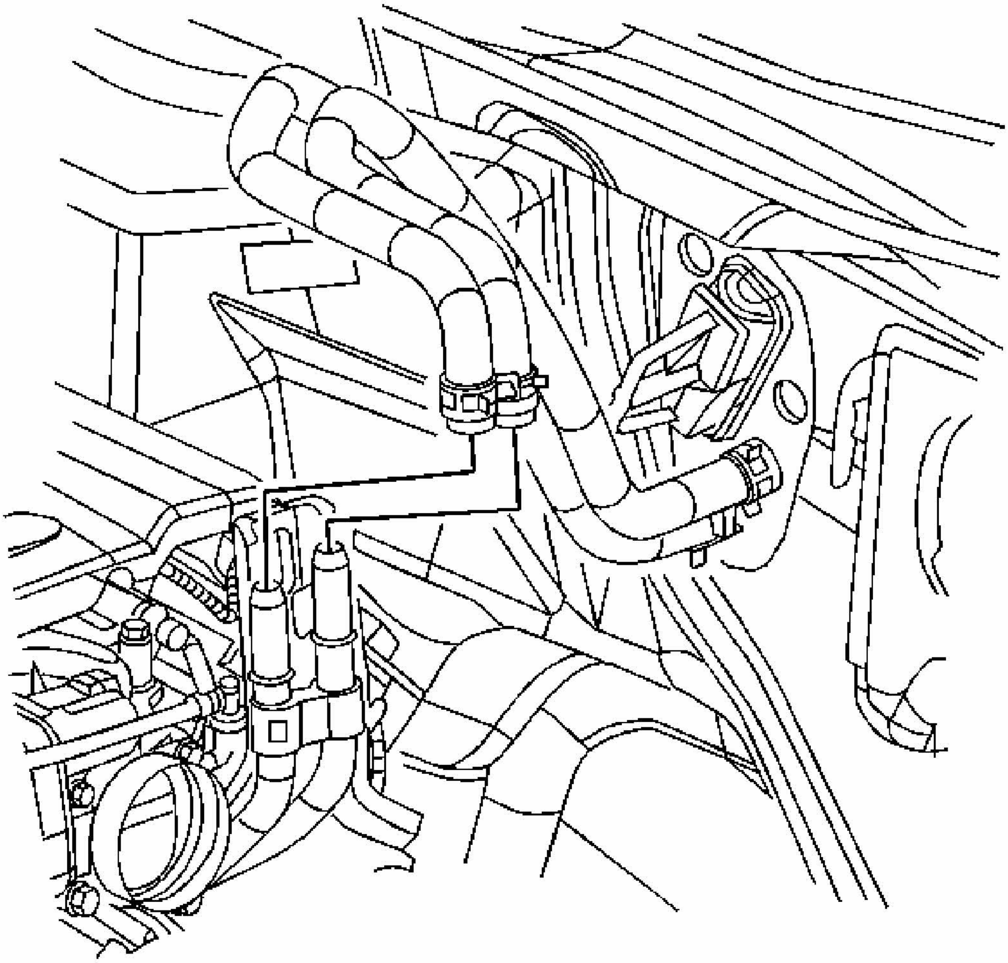


Fig. 75: Heater Hoses & Clamps
Courtesy of GENERAL MOTORS CORP.

3. Release and reposition the heater inlet and outlet hose clamps using the **J 38185** .

IMPORTANT: Cap or plug the cooling components to prevent system contamination.

4. Remove the heater hoses from heater pipes.

NOTE: Do not apply excessive force on the heater core pipes during hose removal. Applying excessive force on the heater core pipes may damage the heater core pipes.

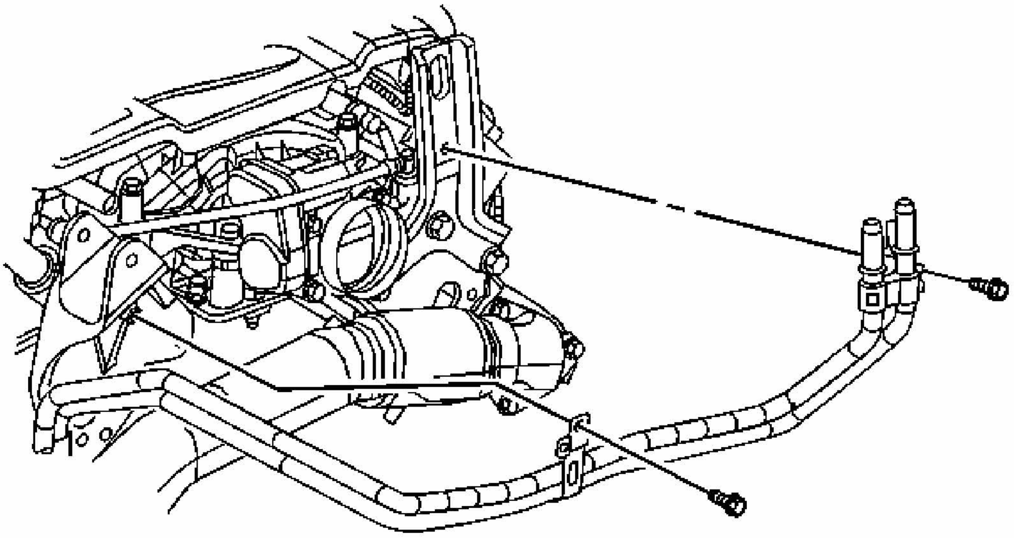


Fig. 76: Heater Core Pipes
Courtesy of GENERAL MOTORS CORP.

5. Remove the heater pipe assembly retaining bolts from the rear the of engine.

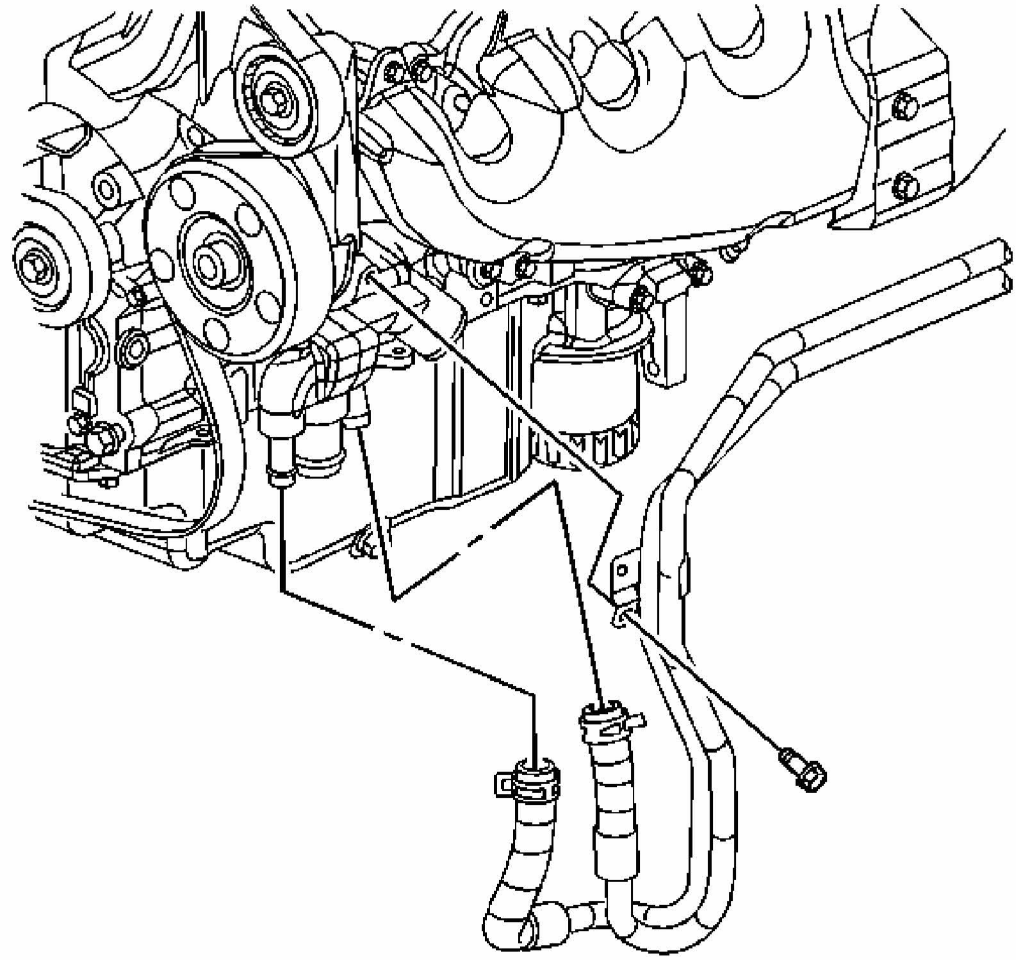


Fig. 77: Heater Pipe Assembly
Courtesy of GENERAL MOTORS CORP.

6. Remove the heater pipe assembly retaining bolt from the front of the engine.
7. Release and reposition the heater pipe hose clamps at the engine using the **J 38185** .
8. Remove the heater pipe hoses from the engine.
9. Remove the heater pipe assembly from the vehicle.

Installation Procedure

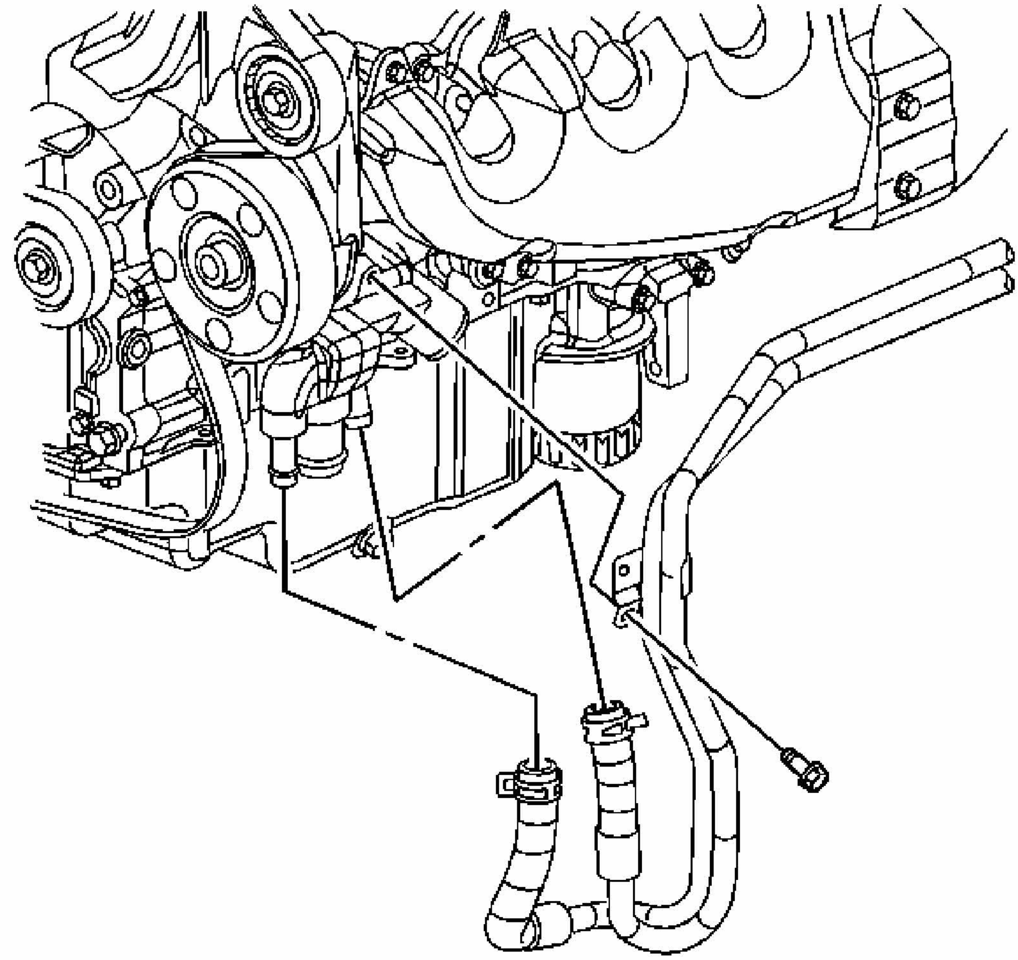


Fig. 78: Heater Pipe Assembly
Courtesy of GENERAL MOTORS CORP.

1. Using a lint-free clean, dry cloth, carefully clean the sealing surfaces of the heater pipe assembly at the engine and heater hoses.
2. Install the heater pipe assembly into position in the vehicle.
3. Install the heater pipe hoses to the engine.
4. Reposition and release the heater pipe hose clamps at the engine using the **J 38185** .
5. Loosely install the heater pipe assembly retaining bolt to the front of the engine.

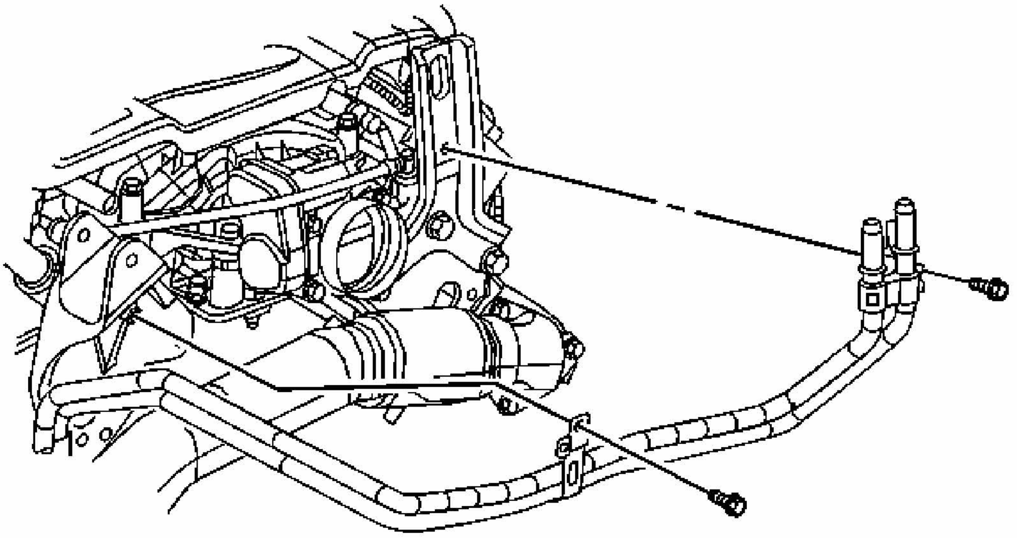


Fig. 79: Heater Core Pipes
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

6. Install the heater pipe assembly retaining bolts to the rear of the engine.

   Tighten: Tighten all the heater pipe assembly bolts to 16 N.m (12 lb ft).

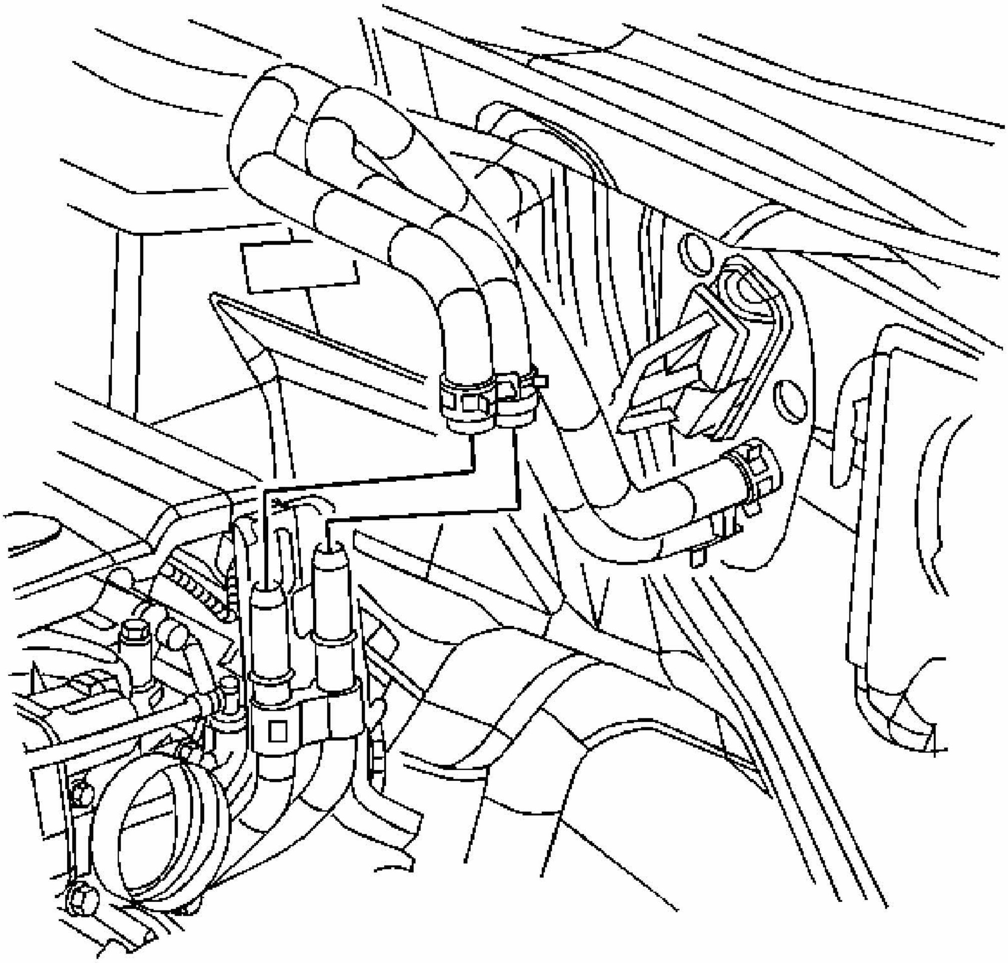


Fig. 80: Heater Hoses & Clamps
Courtesy of GENERAL MOTORS CORP.

7. Connect heater hoses to the heater pipe assembly.
8. Install the heater hose clamps into position using the **J 38185** .
9. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** for the 5.3L engine.
10. Fill the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .

HEATER PIPES REPLACEMENT (RPOS LZE, LZ4, LZ9)

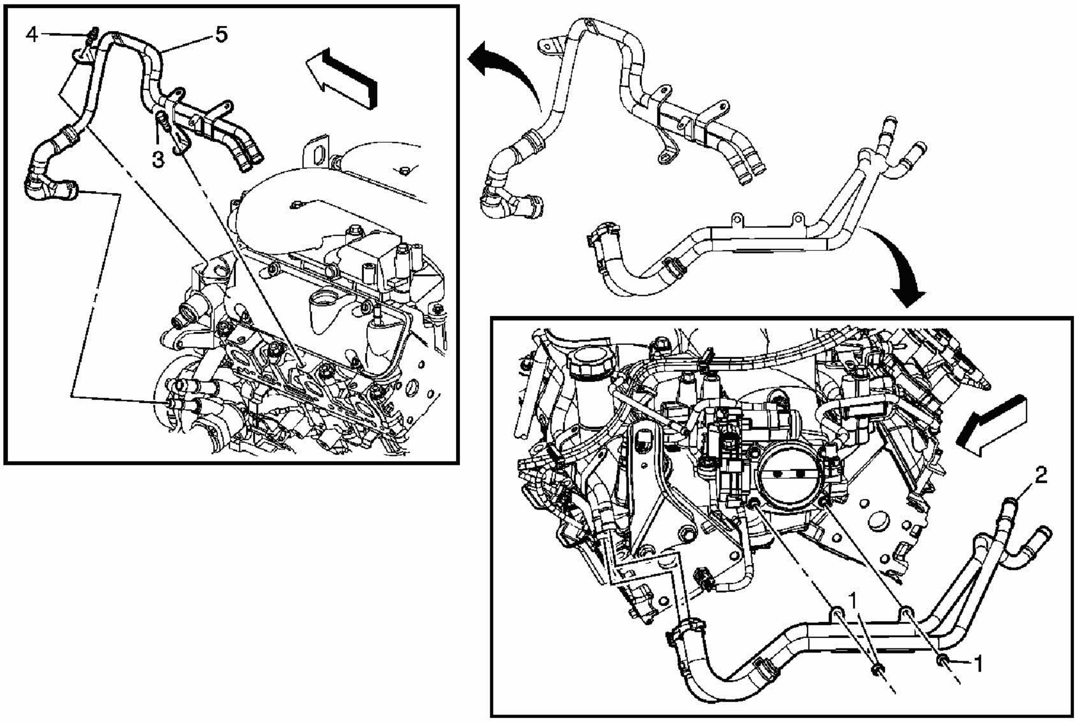


Fig. 81: Replacing Heater Pipes
Courtesy of GENERAL MOTORS CORP.

Heater Pipes Replacement (RPOs LZE, LZ4, LZ9)

Callout	Component Name

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LS4 Static Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9 Static Fill)** or **Draining and Filling Cooling System (9C1, 9C3 Static Fill)** or **Draining and Filling Cooling System (LS4 GE 47716 Fill)** or **Draining and Filling Cooling System (LZE, LZ4, LZ9, 9C1, 9C3 GE 4771 Fill)** .
2. Remove heater inlet hose from the heater pipe assembly. Refer to **Heater Hose Replacement - Inlet (RPO LS4)** or **Heater Hose Replacement - Inlet (RPOs LZE, LZ4, LZ9)**
3. Remove heater outlet hose from the heater pipe assembly. Refer to **Heater Hose Replacement - Outlet (RPO LS4)** or **Heater Hose Replacement - Outlet**

(RPOs LZE, LZ4, LZ9) 4. Remove the air cleaner duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** for the 3.9L engine.	
1	Nut, Pipe Assembly - Heater Inlet and Outlet Pipe - Left **Tighten:** 10 N.m (89 lb in)
2	Pipe Assembly, Heater Inlet and Outlet Pipe - Left **Tip:** Using **J 38185** disconnect the left heater pipe assembly from the front heater pipe assembly
3	Bolt, Pipe Assembly - Heater Inlet and Outlet Pipe - Front **Tighten:** 25 N.m (18 lb in)
4	Stud, Pipe Assembly - Heater Inlet and Outlet Pipe - Front **Tighten:** 10 N.m (89 lb in)
5	Pipe Assembly, Heater Inlet and Outlet Pipe - Front

PASSENGER COMPARTMENT AIR FILTER REPLACEMENT

Removal Procedure

1. Position the windshield wipers in the UP position, by keying the ignition OFF when the wiper reach the desired position.
2. Raise the hood.
3. Remove the rear hood seal. Refer to **Seal Replacement - Hood Rear** in Body Front End.
4. Remove the washer hose from the right air inlet grill panel and position aside.

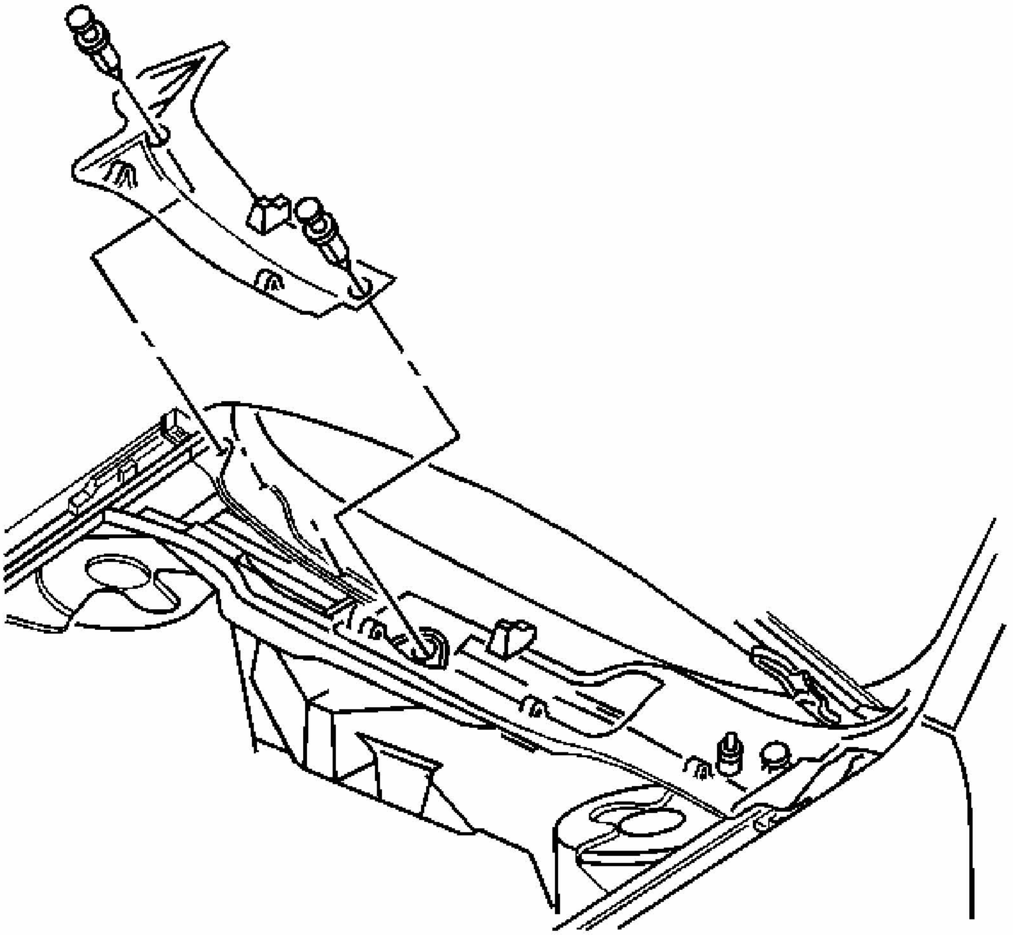


Fig. 82: Removing Right Air Inlet Grill Panel Retainers
Courtesy of GENERAL MOTORS CORP.

5. Remove the two push pin retainers from the right air inlet grill panel.

IMPORTANT: Do not remove the third push pin retainer from the right air inlet grill panel

6. Position the left side of the right air inlet grill panel on to the windshield.

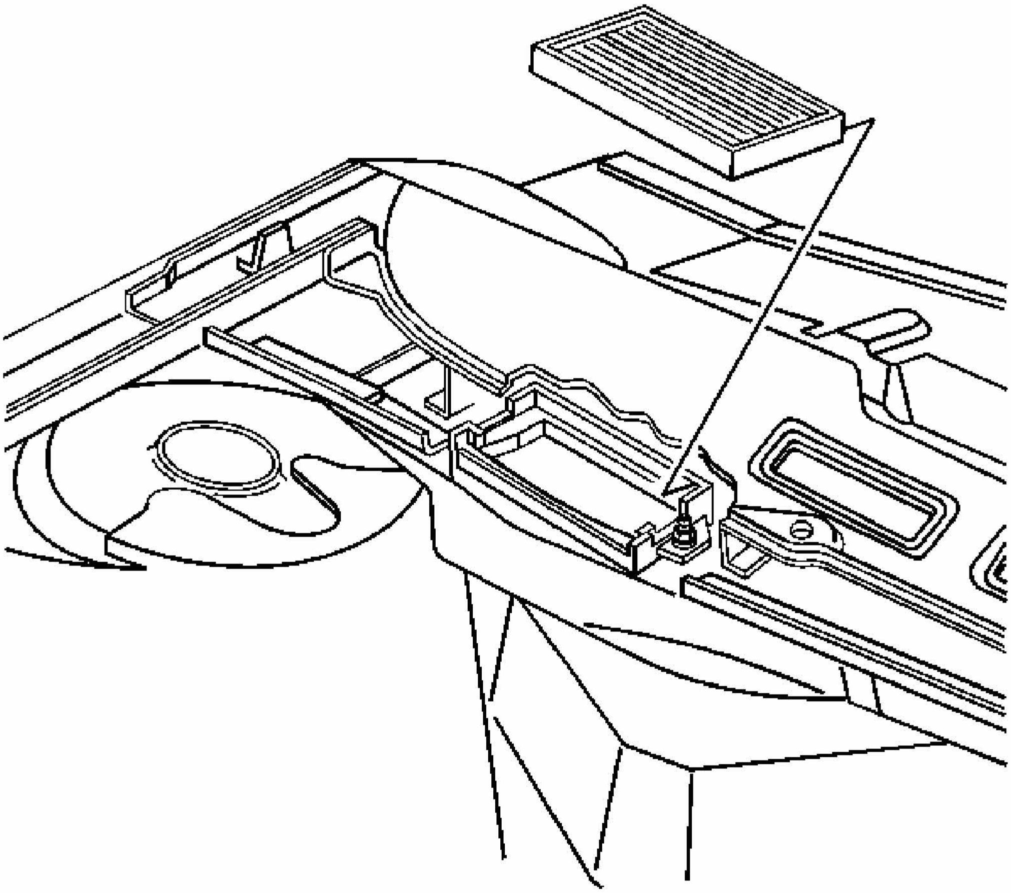


Fig. 83: View Of Passenger Compartment Air Filter
Courtesy of GENERAL MOTORS CORP.

7. Remove the passenger compartment air filter.

Installation Procedure

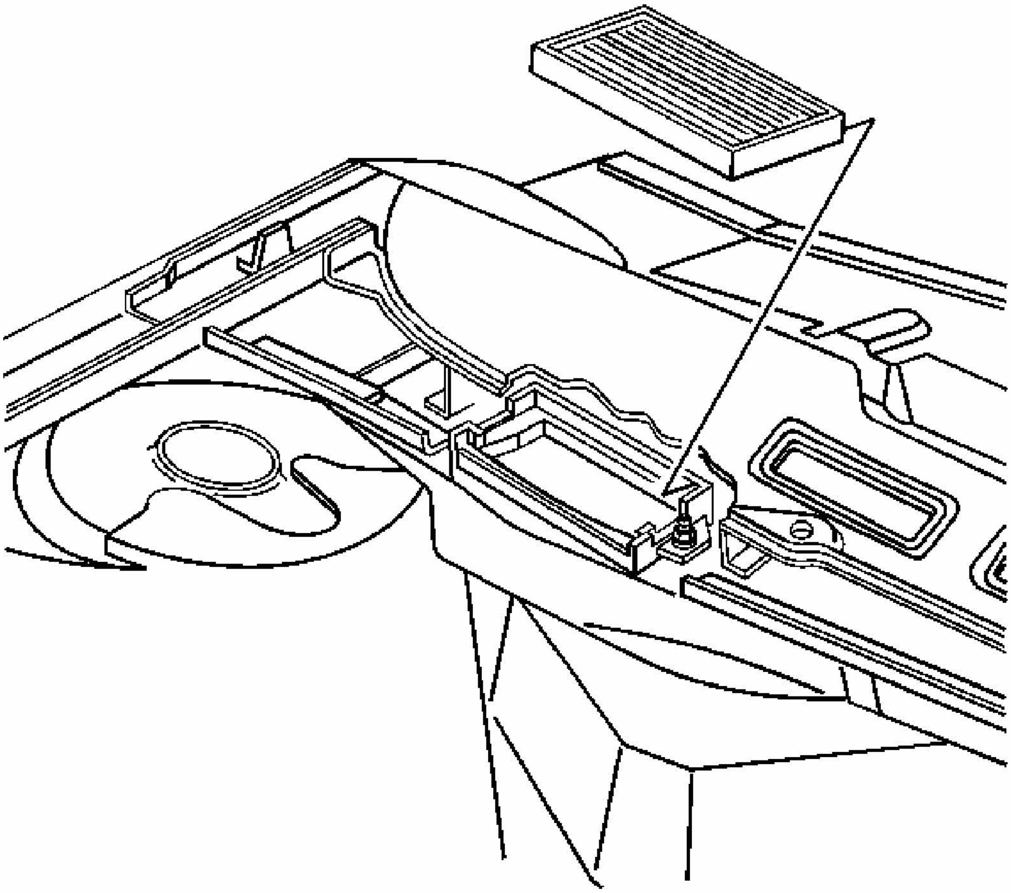


Fig. 84: View Of Passenger Compartment Air Filter
Courtesy of GENERAL MOTORS CORP.

1. Install the passenger compartment air filter.

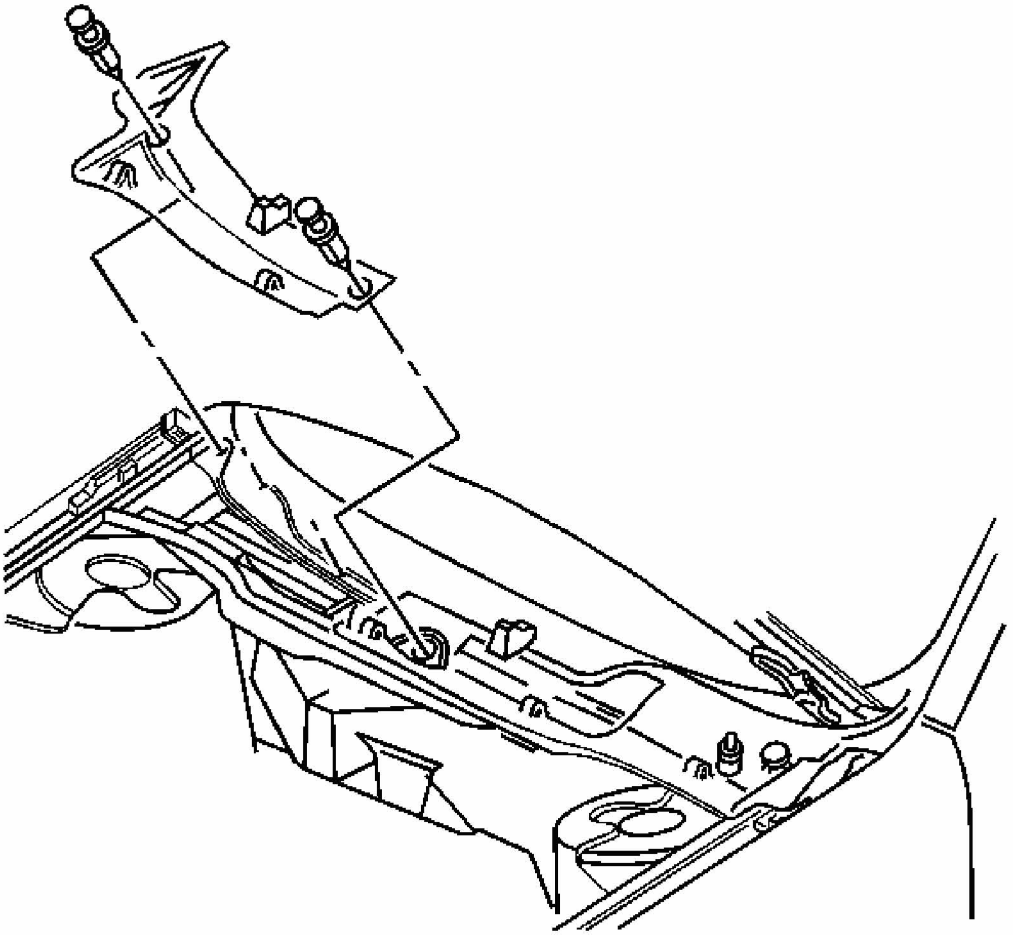


Fig. 85: Removing Right Air Inlet Grill Panel Retainers
Courtesy of GENERAL MOTORS CORP.

2. Install the left side of the right air inlet grill panel in to position.
3. Install the push pin retainers to the right air inlet grill panel.
4. Position the washer hose in to the right air inlet grill panel clips.
5. Install the rear hood seal. Refer to **Seal Replacement - Hood Rear** in Body Front End.
6. Close the hood.
7. Return the windshield wipers to the PARK position.

AIR INLET ASSEMBLY REPLACEMENT

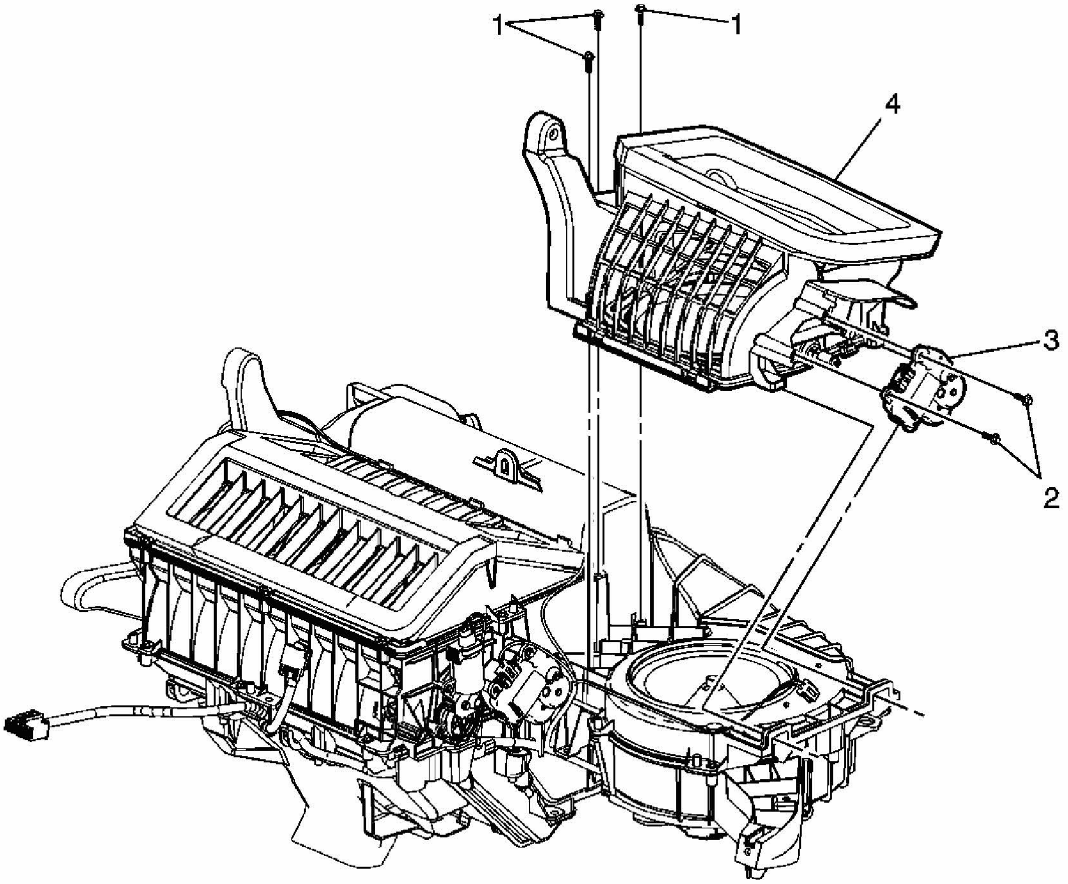


Fig. 86: Replacing Air Inlet Assembly
Courtesy of GENERAL MOTORS CORP.

Air Inlet Assembly Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the HVAC module. Refer to **HVAC Module Assembly Replacement**. 2. Disconnect the electrical connector from the recirculation actuator.	
1	Screw, Air Inlet Assembly (Qty: 3) **Tighten:** 1.5 N.m (13 lb in)
	Screw, Recirculation Actuator (Qty: 2)

2	**Tighten:** 1.5 N.m (13 lb in)
3	Actuator, Recirculation
4	Housing Assembly, Air Inlet

BLOWER MOTOR REPLACEMENT

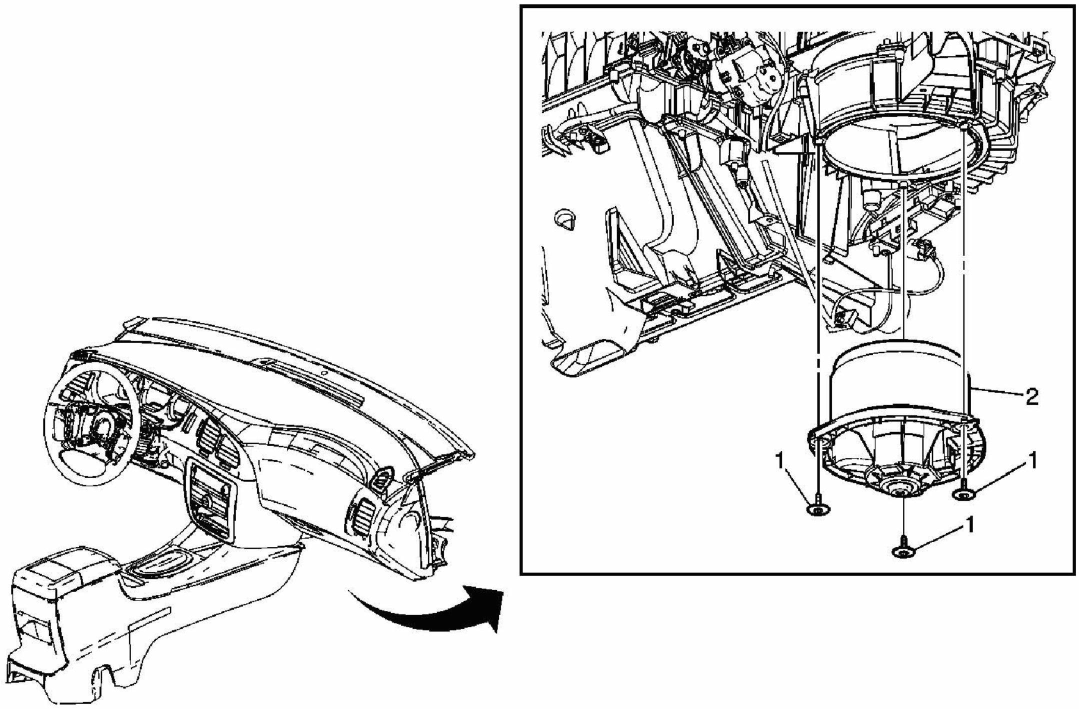


Fig. 87: Replacing Blower Motor
Courtesy of GENERAL MOTORS CORP.

Blower Motor Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the right closeout insulator. Refer to **Closeout/Insulator Panel Replacement - Right** . 2. Disconnect the blower motor electrical connector.	
	Screw, Blower Motor (Qty: 2)

1	**Tighten:** 1.5 N.m (13 lb in)
2	Motor, Blower

AIR DISTRIBUTOR DUCT REPLACEMENT

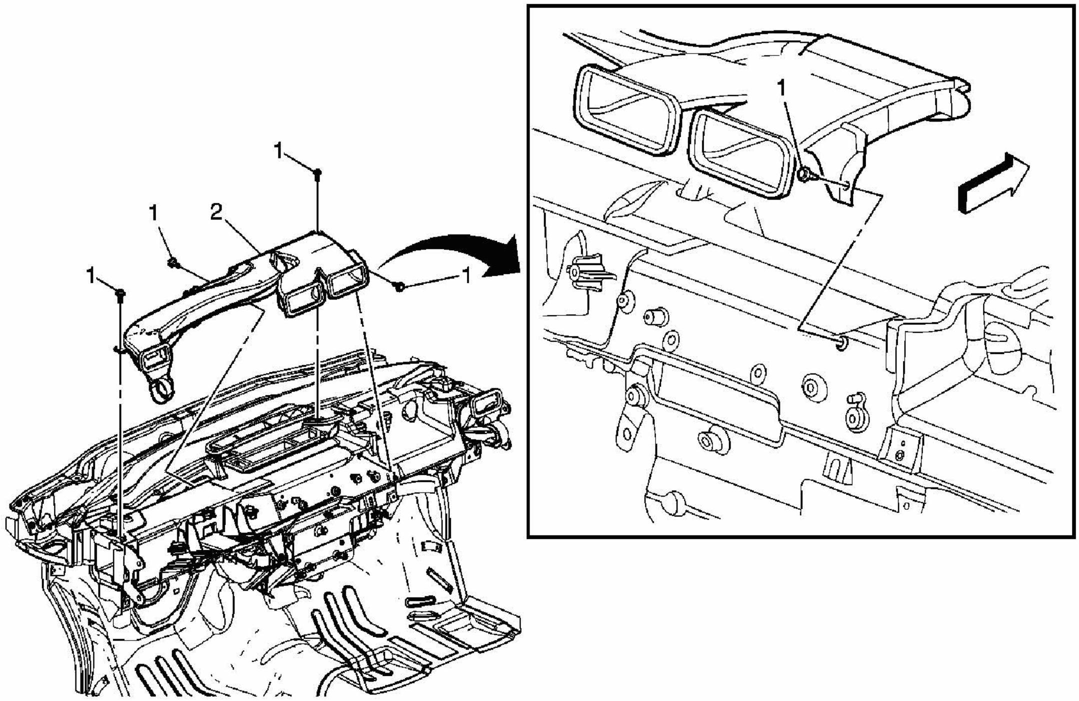


Fig. 88: Replacing Air Distributor Duct
Courtesy of GENERAL MOTORS CORP.

Air Distributor Duct Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the lower instrument panel trim pad. Refer to **Instrument Panel (I/P) Trim Panel Replacement - Lower (Impala)** or **Instrument Panel (I/P) Trim Panel Replacement - Lower (Monte Carlo)** .	
1	Bolt, Air Distributor Assembly **Tighten:** 10 N.m (89 lb in)
2	Distributor Assembly, Air

UPPER RIGHT AIR OUTLET DUCT REPLACEMENT - INSTRUMENT PANEL (I/P)

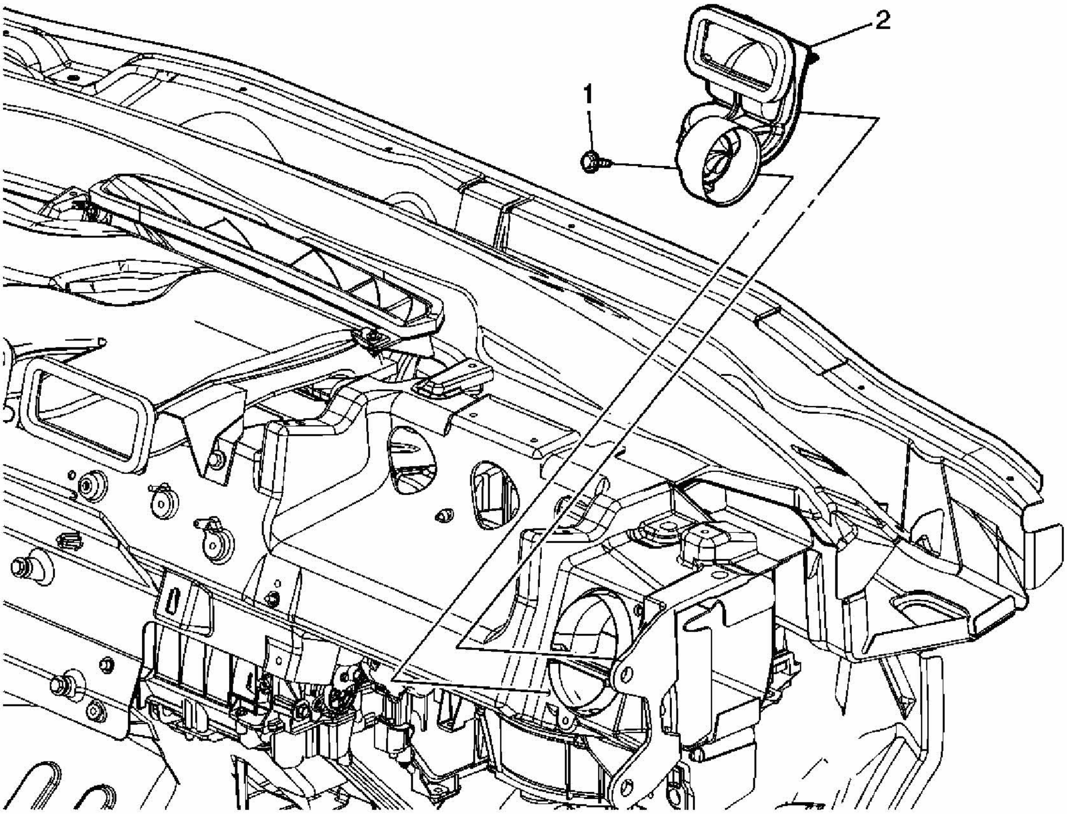


Fig. 89: Replacing Upper Right Air Outlet Duct
Courtesy of GENERAL MOTORS CORP.

Air Outlet Duct Replacement - Instrument Panel (I/P) - Upper Right

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the lower instrument panel trim pad. Refer to **Instrument Panel (I/P) Trim Panel Replacement - Lower (Impala)** or **Instrument Panel (I/P) Trim Panel Replacement - Lower (Monte Carlo)** .	
1	Bolt, Duct Assembly, Air Distributor Right Hand Extension **Tighten:** 16 N.m (12 lb ft)
2	Duct Assembly, Air Distributor Right Hand Extension

REAR FLOOR AIR OUTLET REPLACEMENT

Removal Procedure

1. Remove the floor carpet. Refer to **Carpet Replacement (Impala)** or **Carpet Replacement (Monte Carlo)** .

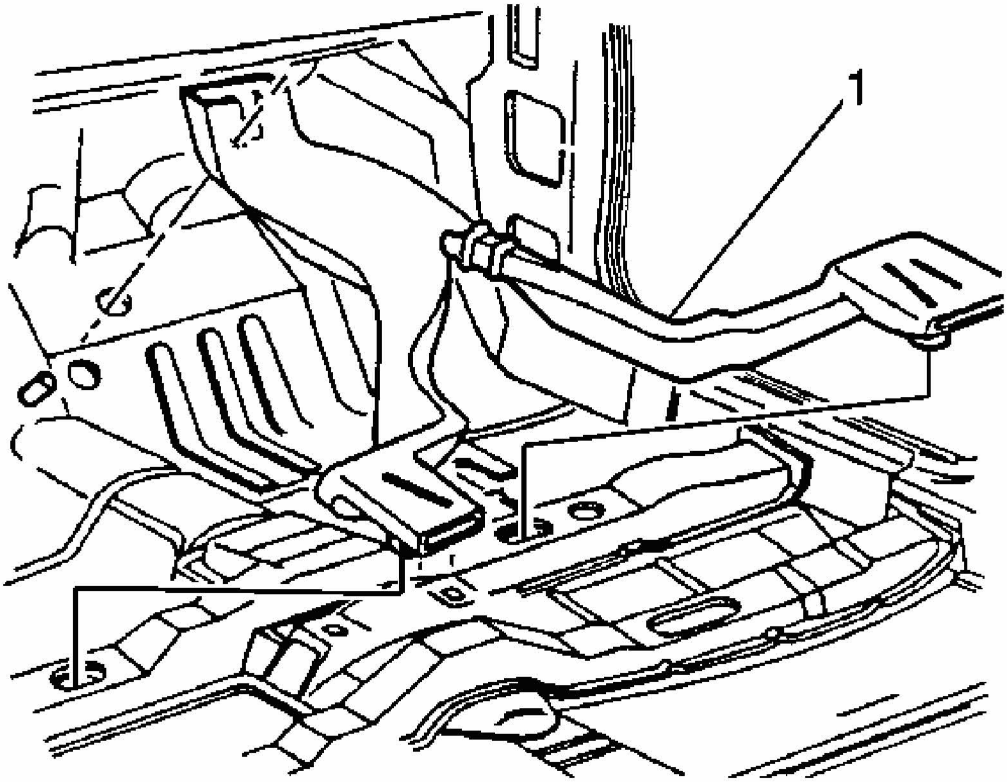


Fig. 90: Locating Rear Floor Air Outlet Duct
Courtesy of GENERAL MOTORS CORP.

2. Remove the rear floor air outlet duct (1) from the holes in the floor reinforcement.
3. Disconnect the rear floor air outlet duct from the heater outlet cover.
4. Remove the rear floor air outlet duct.

Installation Procedure

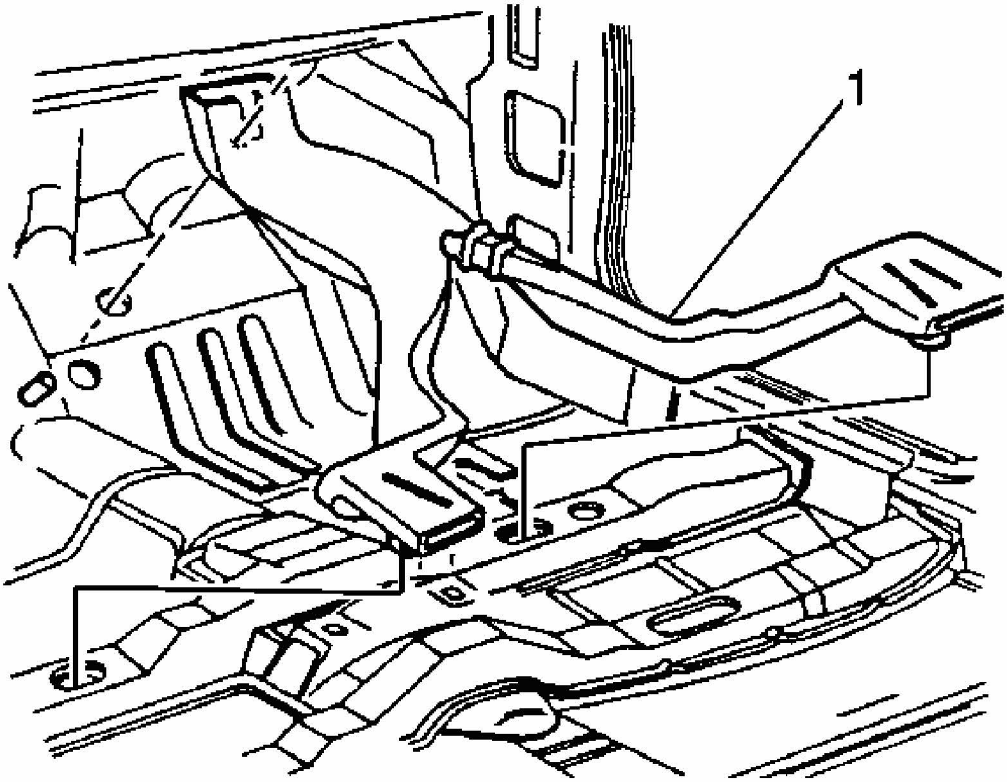


Fig. 91: Locating Rear Floor Air Outlet Duct
Courtesy of GENERAL MOTORS CORP.

1. Install the rear floor air outlet duct.
2. Connect the rear floor air outlet duct to the heater outlet cover.
3. Position the rear floor air outlet duct (1) into the holes in the floor reinforcement.
4. Install the floor carpet. Refer to **Carpet Replacement (Impala)** or **Carpet Replacement (Monte Carlo)** .

DEFROSTER AIR OUTLET DUCT REPLACEMENT

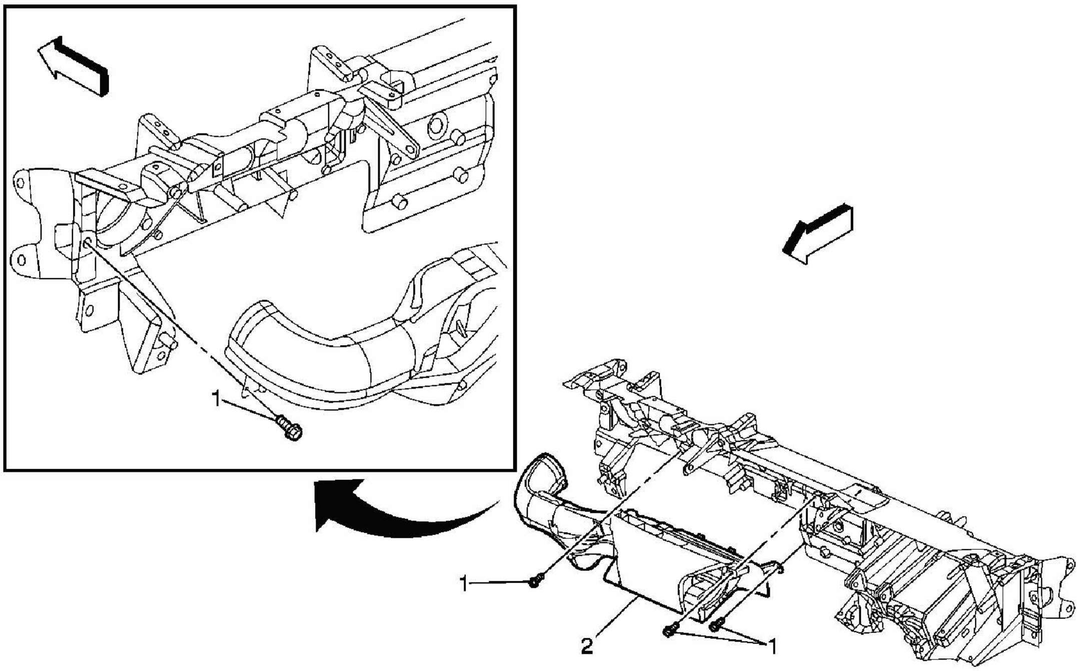


Fig. 92: Replacing Defroster Air Outlet Duct
Courtesy of GENERAL MOTORS CORP.

Air Outlet Duct Replacement - Defroster

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the instrument panel carrier. Refer to **Instrument Panel (I/P) Carrier Replacement** .	
1	Air Distributor Assembly - Windshield Defroster Nozzle Bolt (Qty: 4) **Tighten:** 10 N.m (89 lb in).
2	Distributor Assembly - Windshield Defroster Nozzle and Air

AIR TEMPERATURE DOOR REPLACEMENT

Removal Procedure

1. Remove the HVAC module assembly. Refer to **HVAC Module Assembly Replacement**.
2. Remove the screws that secure the recirculation housing to the HVAC module assembly.

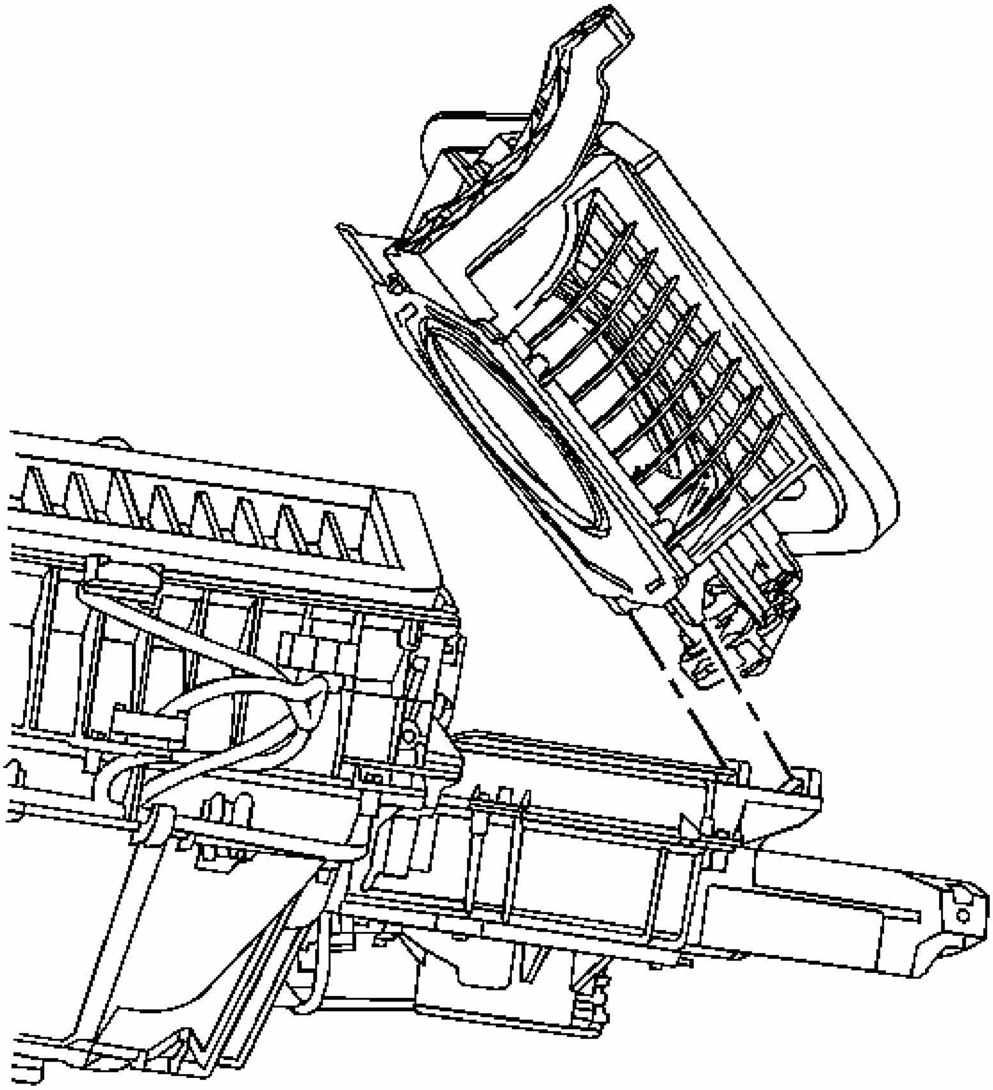


Fig. 93: Identifying Recirculation Housing
Courtesy of GENERAL MOTORS CORP.

3. Remove the recirculation housing from the HVAC module assembly.
4. Remove the screws that secure the mode actuator to the HVAC module assembly.
5. Remove the mode actuator from the HVAC module assembly.
6. Remove the screws that secure HVAC module assembly upper case to the HVAC module assembly lower case.
7. Remove the heat stakes that secure the HVAC module assembly upper case to the HVAC module lower case using a small chisel.

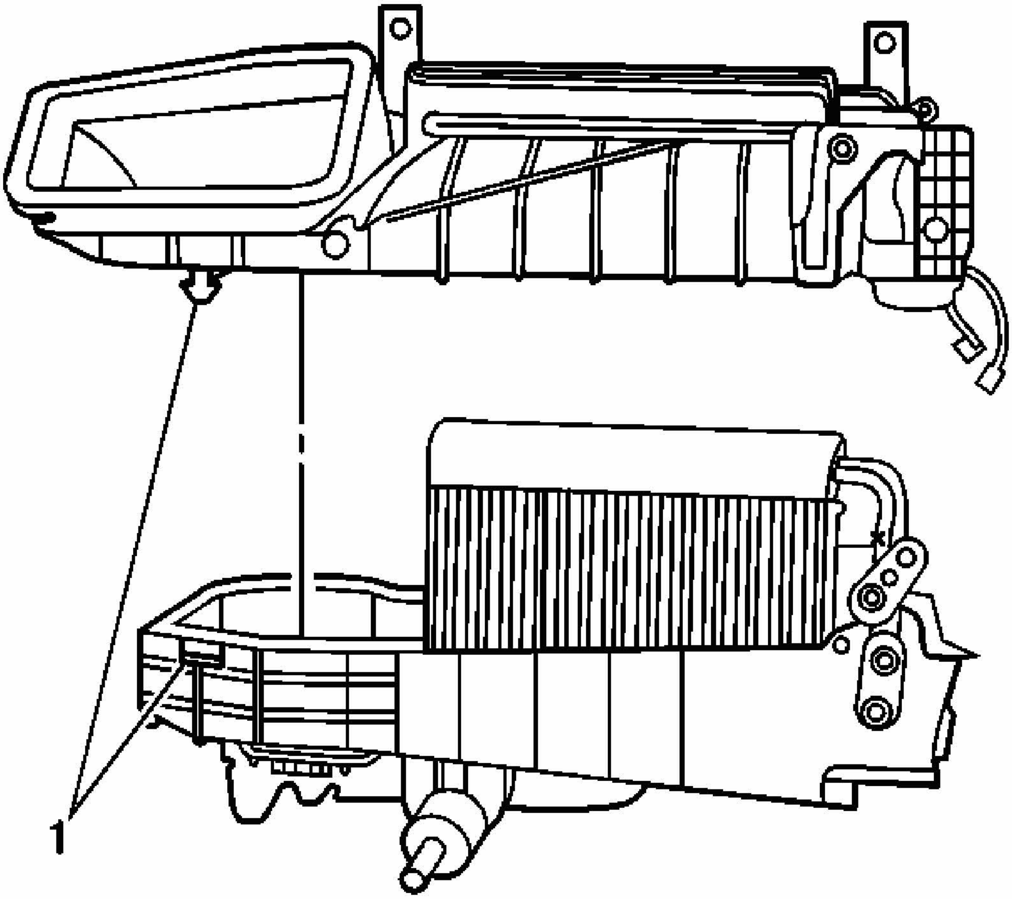


Fig. 94: View Of Upper & Lower HVAC Module Assembly Case
Courtesy of GENERAL MOTORS CORP.

8. Separate the HVAC module assembly case (1).
9. Remove the screws that secure the air temperature actuator to the HVAC module assembly upper case.
10. Remove the air temperature actuator from the HVAC module assembly upper case.

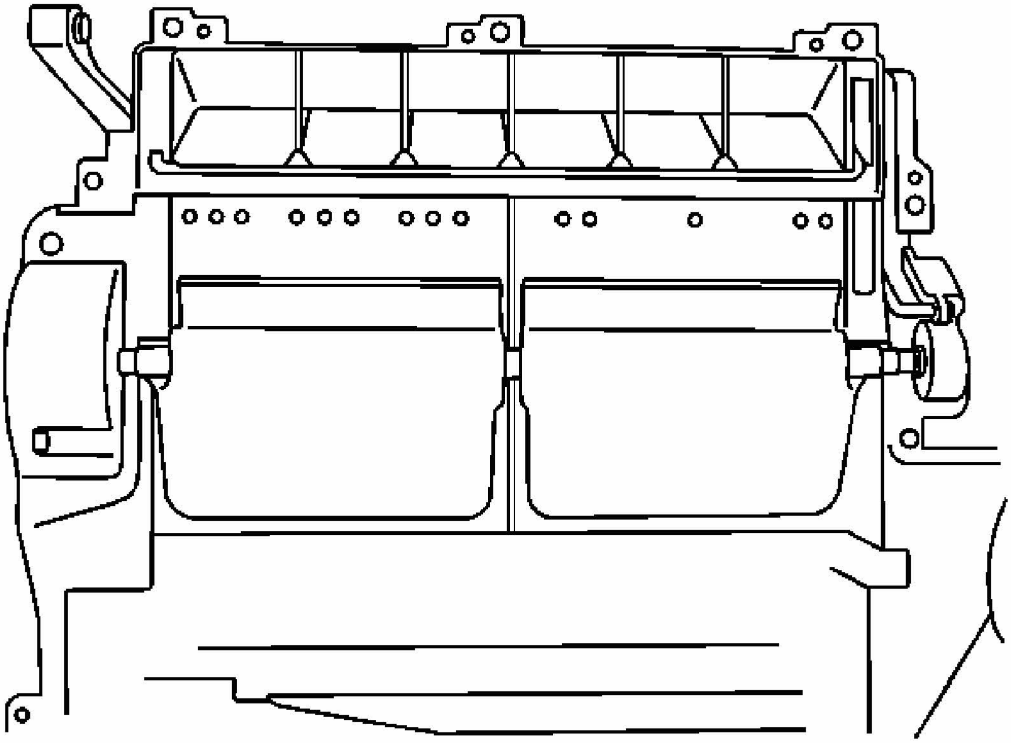


Fig. 95: Removing Air Temperature Door - Right
Courtesy of GENERAL MOTORS CORP.

11. Remove the air temperature door from the HVAC module assembly upper case.

Installation Procedure

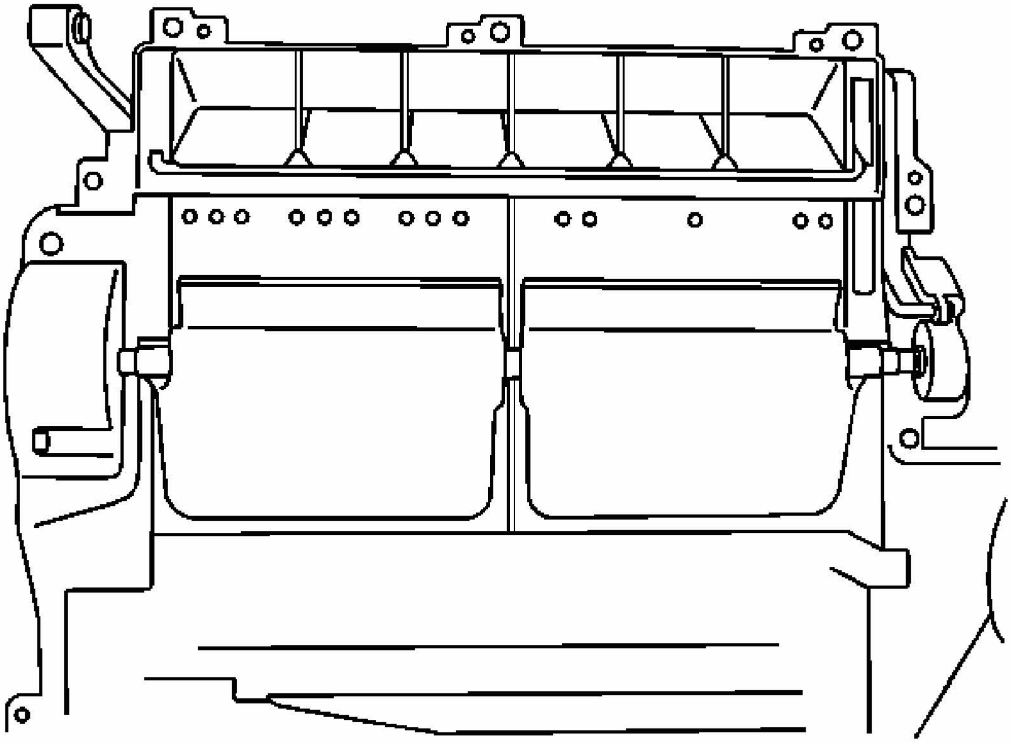


Fig. 96: Removing Air Temperature Door - Right
Courtesy of GENERAL MOTORS CORP.

1. Install the air temperature door to the HVAC module assembly upper case.
2. Install the air temperature actuator to the HVAC module assembly upper case.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

3. Install the screws that secure the air temperature actuator to the HVAC module assembly upper case.

   Tighten: Tighten the screws to 1.5 N.m (13 lb in).

4. From the inside of the upper case, drill the dimples adjacent to the heat stakes using a 5.5 mm (7/32 in) drill bit.

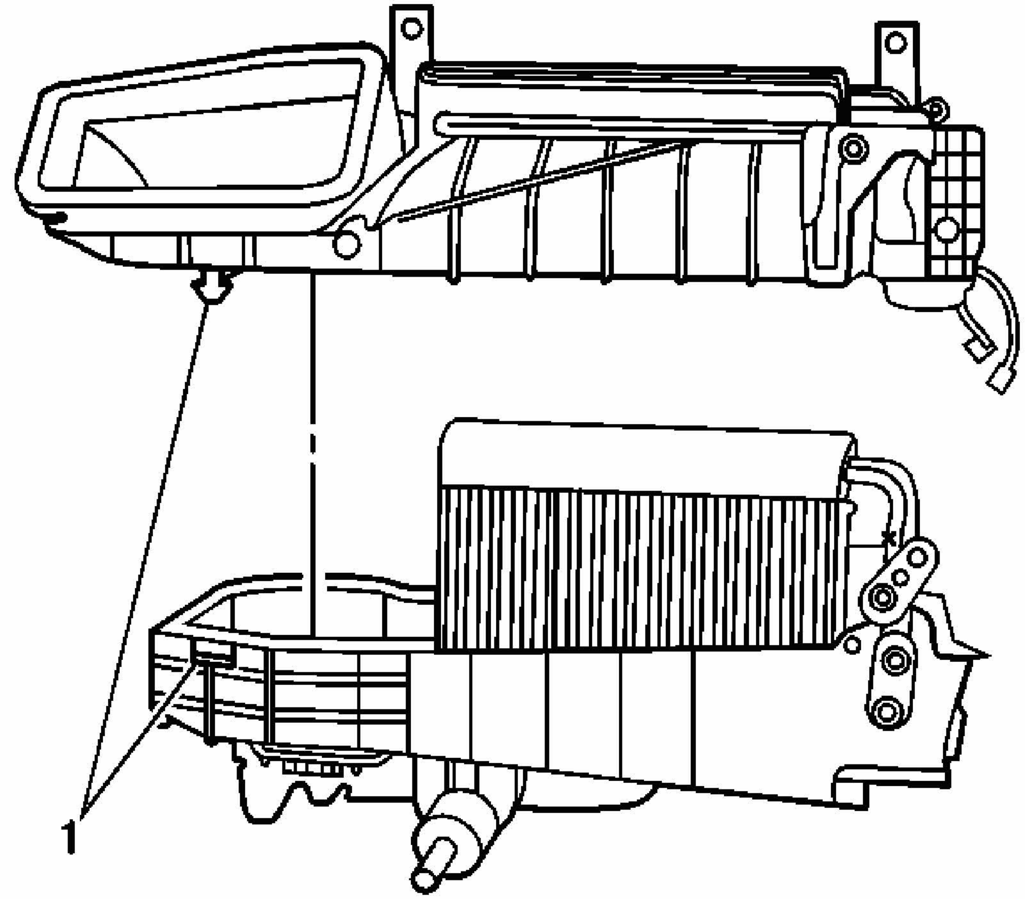


Fig. 97: View Of Upper & Lower HVAC Module Assembly Case
Courtesy of GENERAL MOTORS CORP.

5. Align and attach the upper and lower HVAC module assembly case.
6. Install the removed screws that secure the HVAC module assembly upper case to the HVAC module assembly lower case to their original position.

   Tighten: Tighten the screws to 1.5 N.m (13 lb in).

7. Install new screws that will secure the HVAC module assembly upper case to the HVAC module assembly lower case in the locations adjacent to the heat stakes.

   Tighten: Tighten the screws to 1.5 N.m (13 lb in).

8. Install the mode actuator.
9. Install the screws that secure the mode actuator to the HVAC module assembly.

Tighten: Tighten the screws to 1.5 N.m (13 lb in).

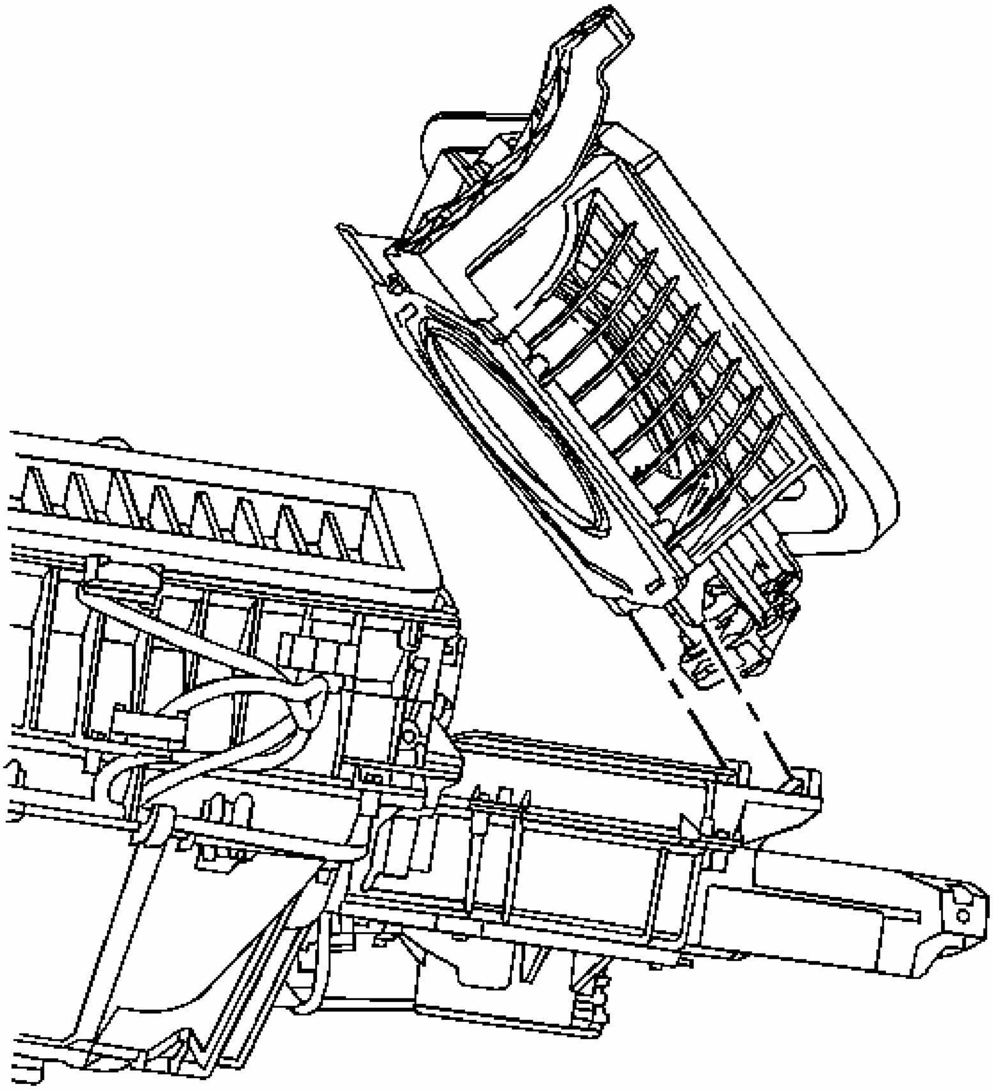


Fig. 98: Identifying Recirculation Housing
Courtesy of GENERAL MOTORS CORP.

10. Install the recirculation housing to the HVAC module assembly.
11. Install the screws that secure the recirculation housing to the HVAC module assembly.

    Tighten: Tighten the screws to 1.5 N.m (13 lb in).

12. Install the HVAC module assembly. Refer to **HVAC Module Assembly Replacement**.

MODE VALVE ASSEMBLY REPLACEMENT

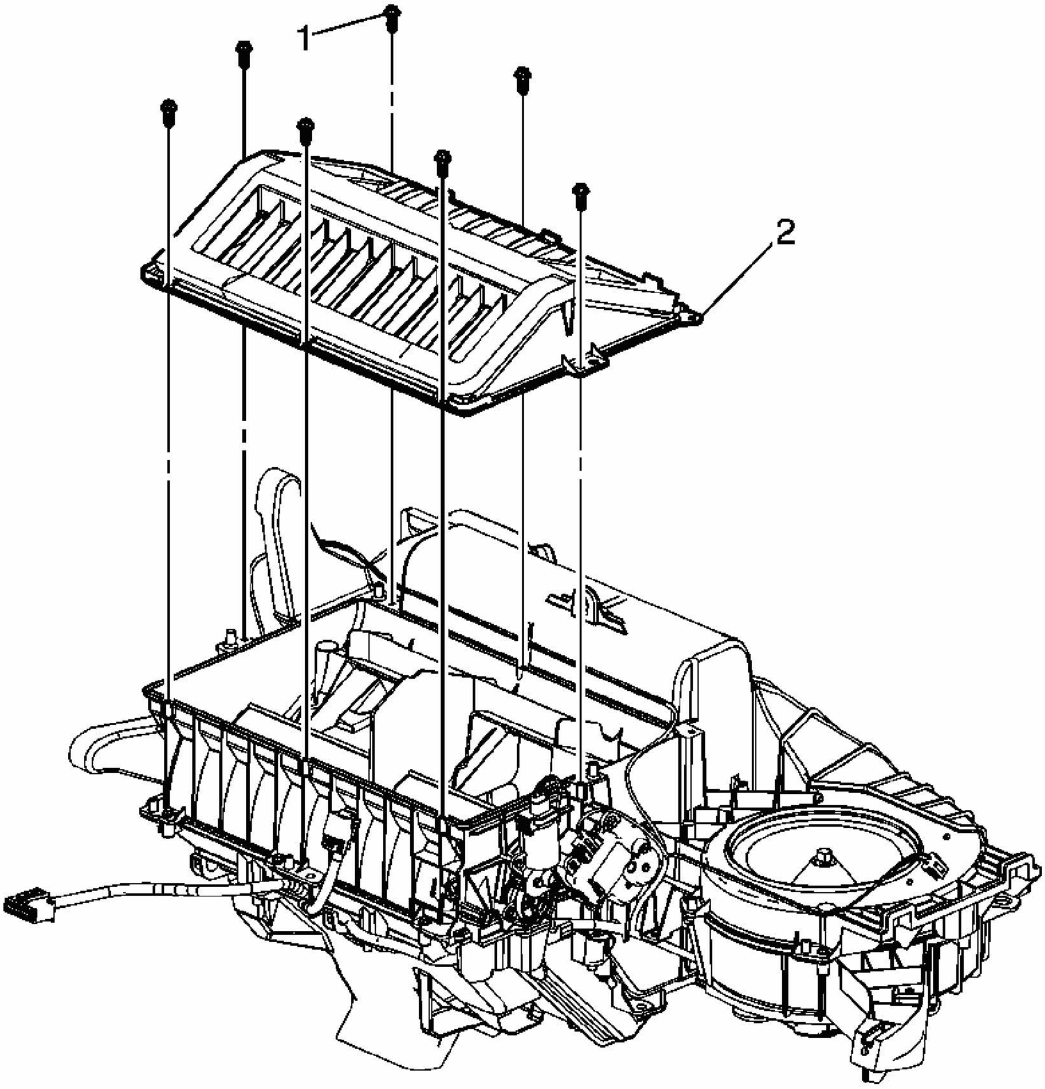


Fig. 99: Replacing Mode Valve Assembly
Courtesy of GENERAL MOTORS CORP.

Mode Valve Assembly Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .**	
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
Preliminary Procedure	

1. Remove the HVAC module. Refer to **HVAC Module Assembly Replacement**. **IMPORTANT:** **Leave the left temperature actuator attached to the air inlet assembly.** 2. Remove the air inlet assembly. Refer to **Air Inlet Assembly Replacement**.	
1	Screw, Mode Valve Assembly (Qty: 7) **Tip:** Remove the heat stakes that secure the mode valve assembly to the HVAC module assembly upper case using a small chisel. **Tighten:** 1.5 N.m (13 lb in)
2	Mode Valve Assembly

HEATER CORE COVER REPLACEMENT

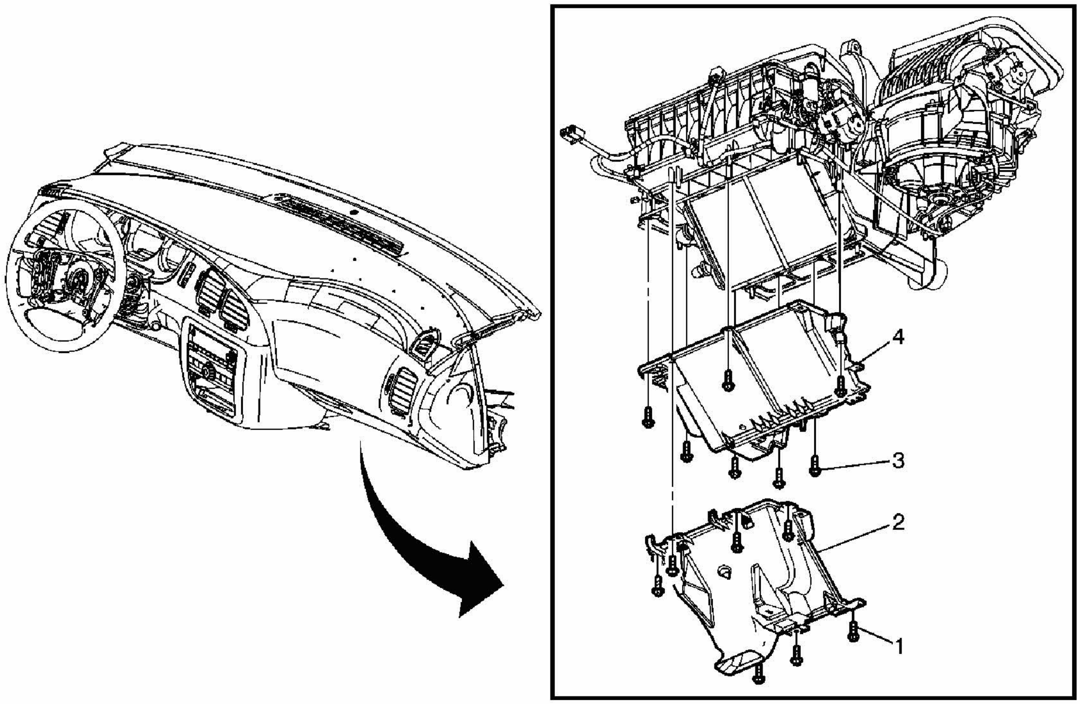


Fig. 100: Replacing Heater Core Cover
Courtesy of GENERAL MOTORS CORP.

Heater Core Cover Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .**	

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Remove the right closeout panel. Refer to **Closeout/Insulator Panel Replacement - Right** .
2. Remove the left closeout panel. Refer to **Closeout/Insulator Panel Replacement - Left** .
3. Remove the rear floor air outlet duct. Refer to **Air Outlet Replacement - Rear Floor**.

1	Screw, Floor Air Outlet Cover (Qty: 7) **Tip:** Remove the heat stakes that secure the HVAC module assembly upper case to the HVAC module lower case using a small chisel. **Tighten:** 1.5 N.m (13 lb in)
2	Cover, Floor Air Outlet
3	Screw, Heater Core Cover (Qty: 7) **Tip:** Remove the heat stakes that secure the HVAC module assembly upper case to the HVAC module lower case using a small chisel. **Tighten:** 1.5 N.m (13 lb in)
4	Cover, Heater Core

HEATER CORE REPLACEMENT

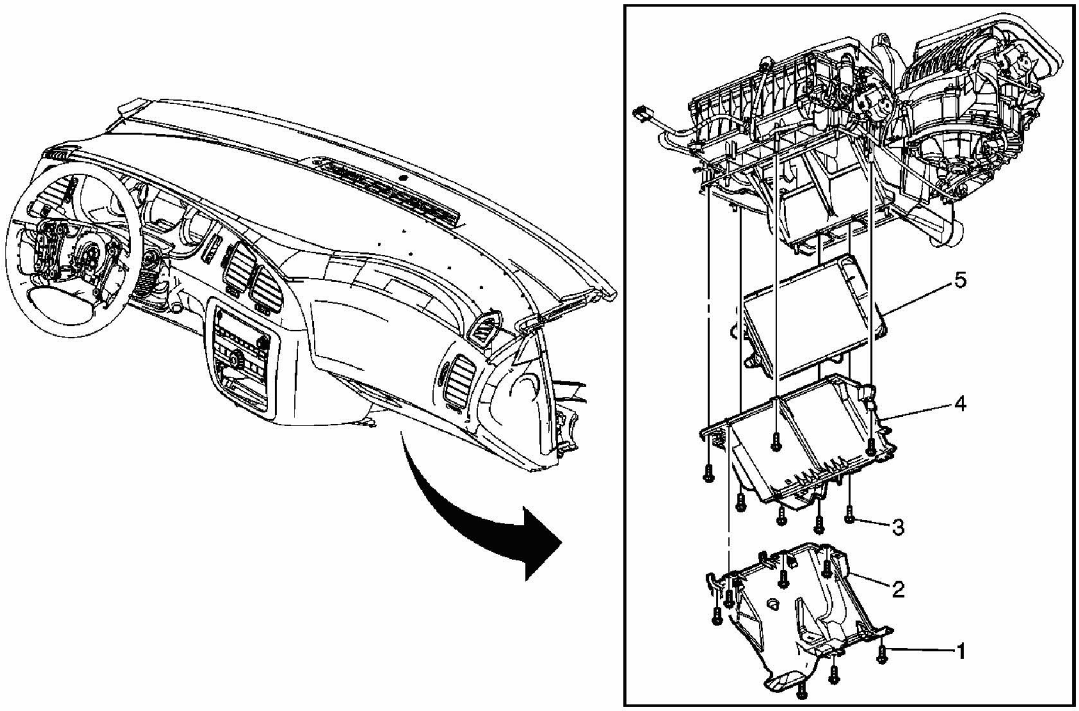


Fig. 101: Replacing Heater Core
Courtesy of GENERAL MOTORS CORP.

Heater Core Replacement

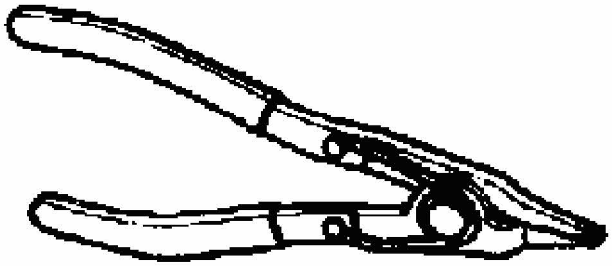
Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the right closeout panel. Refer to **Closeout/Insulator Panel Replacement - Right** . 2. Remove the left closeout panel. Refer to **Closeout/Insulator Panel Replacement - Left** . 3. Remove the rear floor air outlet duct. Refer to **Air Outlet Replacement - Rear Floor**.	
1	Floor Air Outlet Cover Screws (Qty: 7) **Tip:** Remove the heat stakes that secure the HVAC module assembly upper case to the HVAC module lower case using a small chisel. **Tighten:** 1.5 N.m (13 lb in)

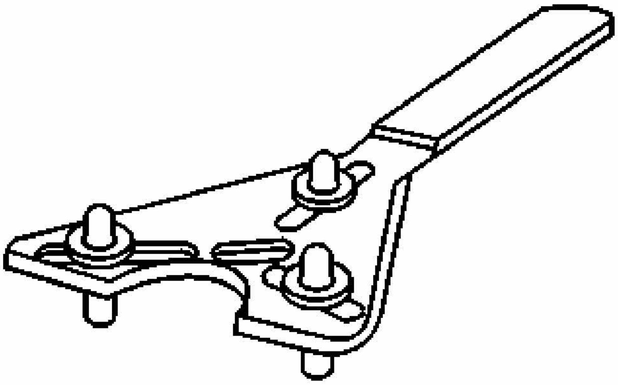
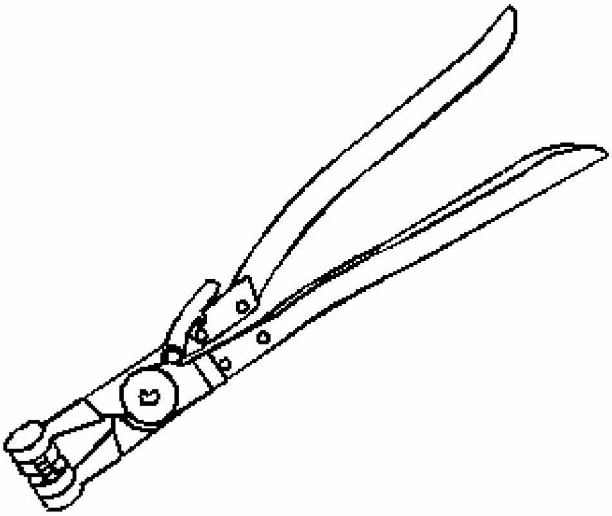
2	Floor Air Outlet Cover
3	Heater Core Cover Screws (Qty: 7) **Tip:** Remove the heat stakes that secure the HVAC module assembly upper case to the HVAC module lower case using a small chisel. **Tighten:** 1.5 N.m (13 lb in)
4	Heater Core Cover
5	Heater Core

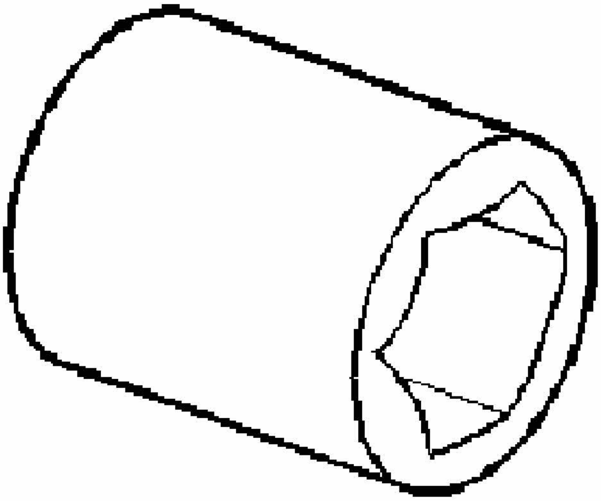
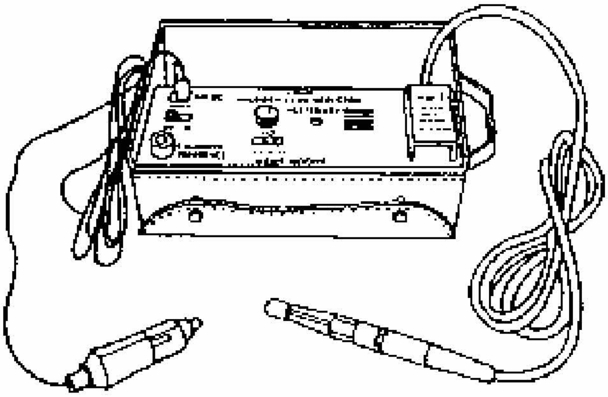
SPECIAL TOOLS AND EQUIPMENT

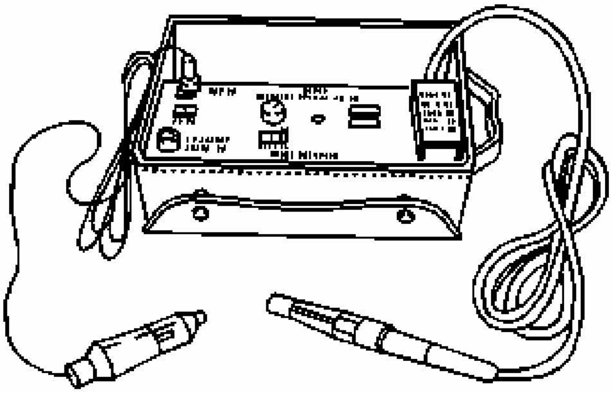
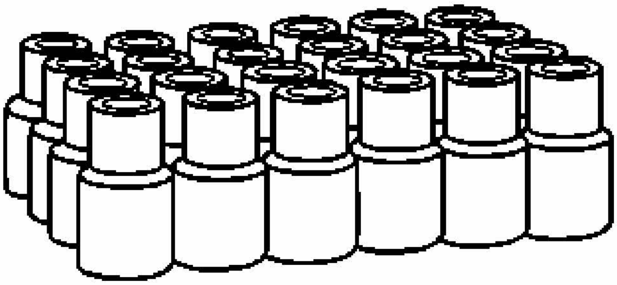
SPECIAL TOOLS

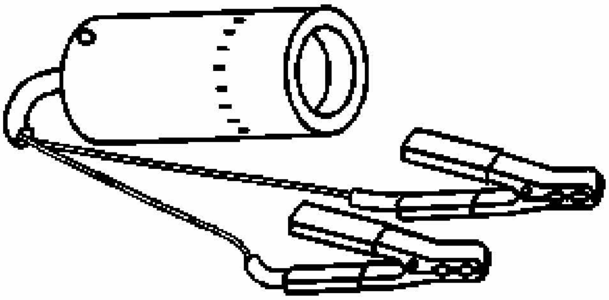
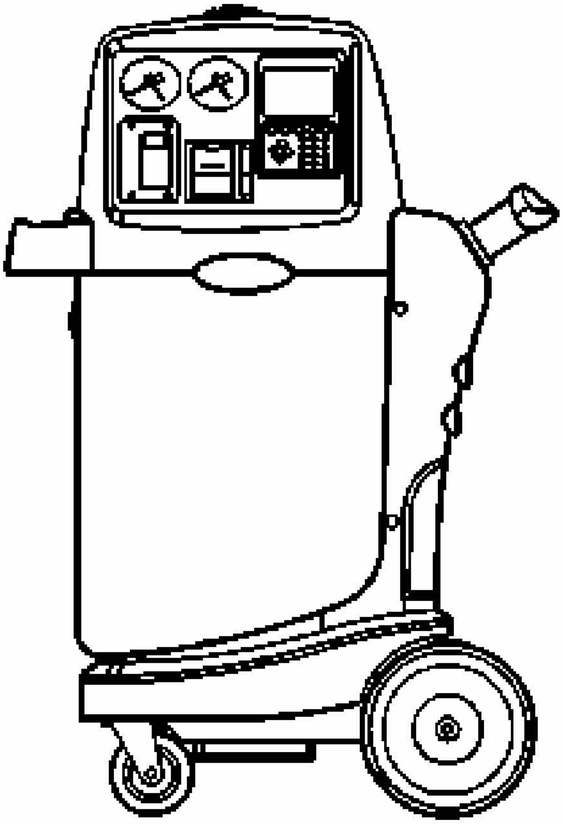
Special Tools

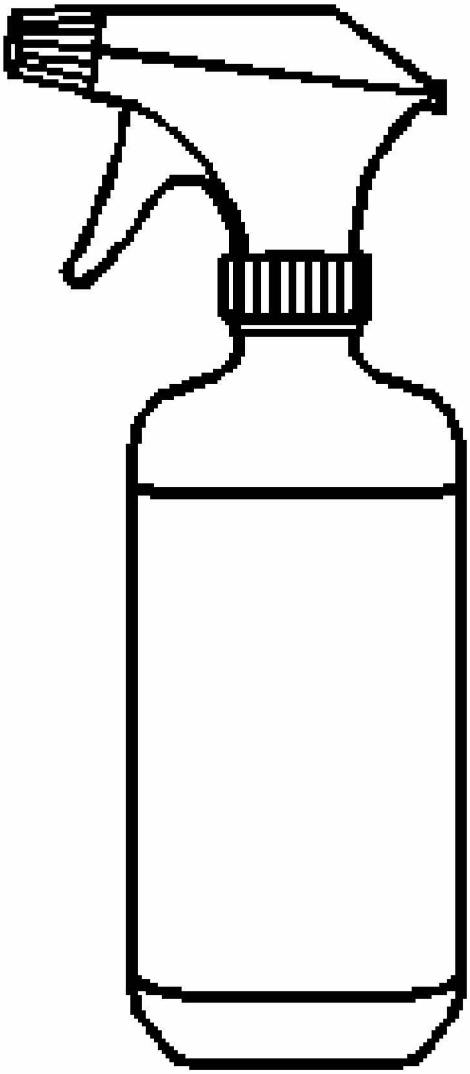
Illustration	Tool Number/ Description
	J 6083 External Snap Ring Pliers
	J 37872 Universal Spanner Wrench

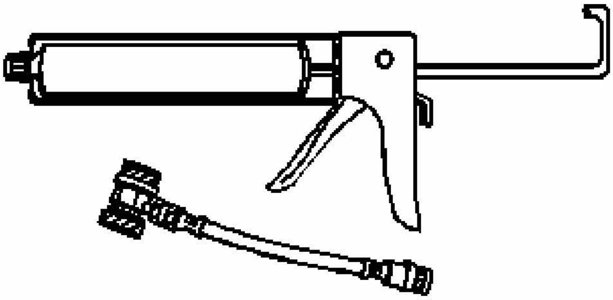
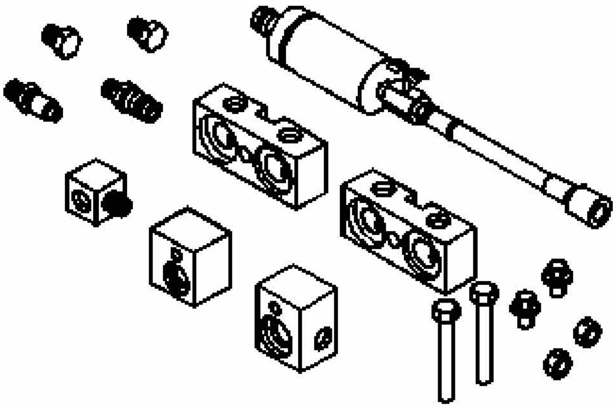
	
	J 38185 Hose Clamp Pliers

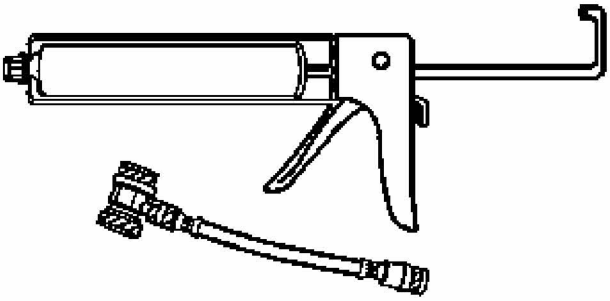
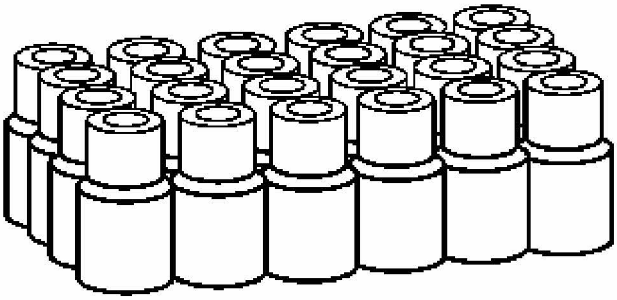
	J 39037 Charge Valve Octagon Socket
	J 39400 Electronic Halogen Leak Detector

	J 39400-A Halogen Leak Detector
	J 41447 R134A A/C Tracer Dye - Box of 24
	J 42220 Universal 12V Leak Detection Lamp

	
	J 43600 ACR 2000 Air Conditioning Service Center

	J 43872 Fluorescent Dye Cleaner

	J 45037 A/C Oil Injector
	J 45268 A/C Flushing Adapter Kit
	J 46297 A/C Dye Injector Kit

	
	J 46297 12 Replacement Dye Cartridges

2006 HVAC

HVAC Systems - Manual - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Heater and A/C Control Assembly Screw	1.5 N.m	13 lb in
Mode Actuator Screw	1.5 N.m	13 lb in
Recirculation Actuator Screw	1.5 N.m	13 lb in
Temperature Actuator - Left Screw	1.5 N.m	13 lb in
Temperature Actuator - Right Screw	1.5 N.m	13 lb in

SCHEMATIC AND ROUTING DIAGRAMS

HVAC SCHEMATICS

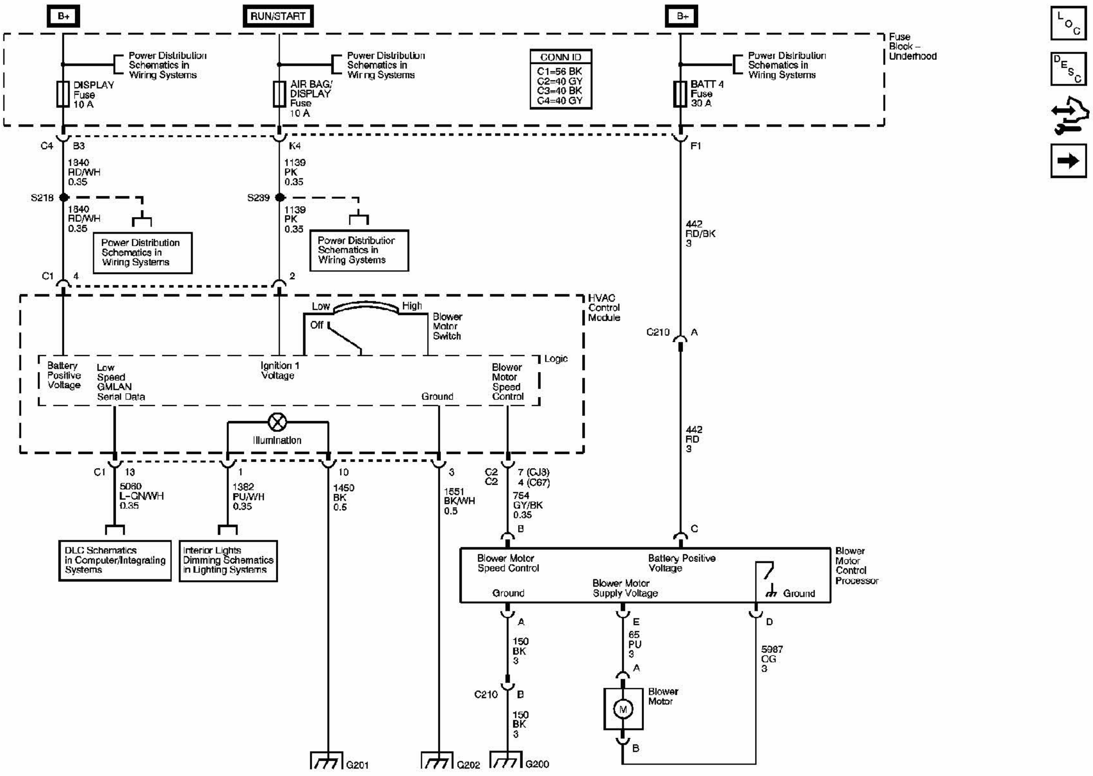

B+
RUN/START
B+
Power Distribution Schematics in Wiring Systems
DISPLAY Fuse 10 A
Power Distribution Schematics in Wiring Systems
AIR BAG/ DISPLAY Fuse 10 A
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
Power Distribution Schematics in Wiring Systems
BATT 4 Fuse 30 A
Fuse Block – Underhood
C4
B3
1840 RD/WH 0.35
K4
1139 PK 0.35
F1
S218
1840 RD/WH 0.35
Power Distribution Schematics in Wiring Systems
S239
1139 PK 0.35
Power Distribution Schematics in Wiring Systems
442 RD/BK 3
C1
4
2
HVAC Control Module
C210
A
Low
High
Off
Blower Motor Switch
Logic
Battery Positive Voltage
Low Speed GMLAN Serial Data
Ignition 1 Voltage
Ground
Blower Motor Speed Control
Illumination
442 RD 3
C1
13
5060 L-GN/WH 0.35
1
1382 PU/WH 0.35
10
1450 BK 0.5
3
1551 BK/WH 0.5
C2
C2
7 (CJ3)
4 (C67)
754 GY/BK 0.35
B
C
DLC Schematics in Computer/Integrating Systems
Interior Lights Dimming Schematics in Lighting Systems
Blower Motor Speed Control
Battery Positive Voltage
Blower Motor Supply Voltage
Ground
Ground
Blower Motor Control Processor
A
E
D
150 BK 3
65 PU 3
5987 OG 3
A
C210
B
Blower Motor
M
150 BK 3
B
G201
G202
G200

Fig. 1: Power, Ground, And Blower Motor Control - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

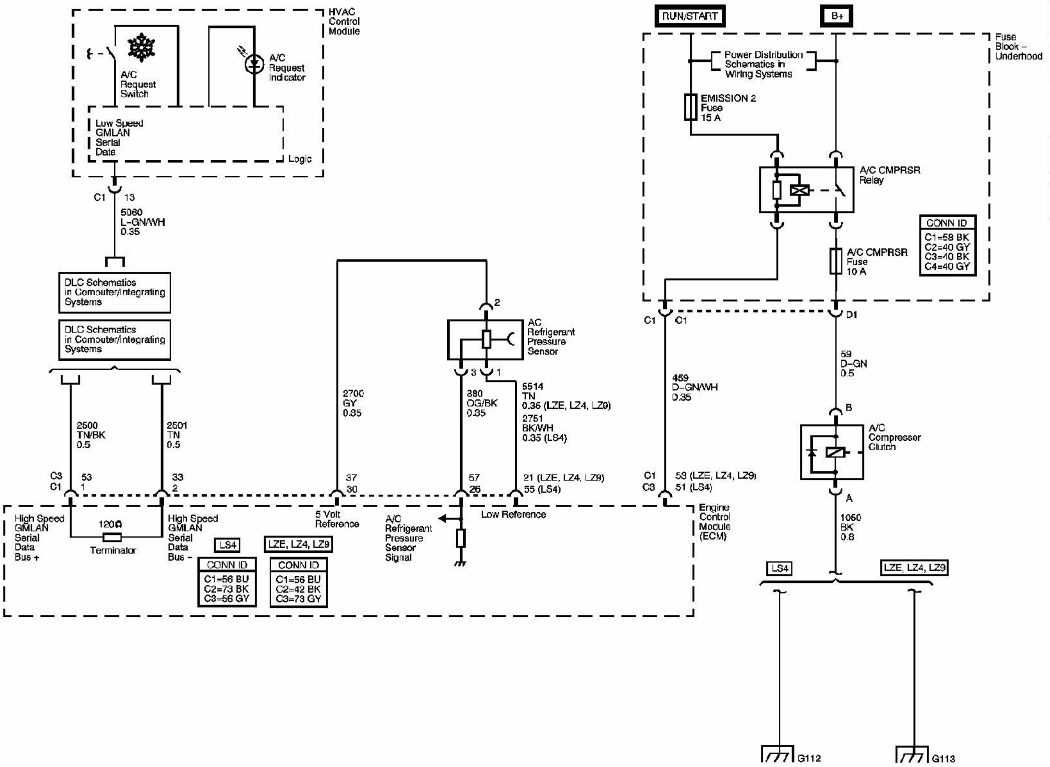

HVAC Control Module
A/C Request Switch
A/C Request Indicator
Low Speed GMLAN Serial Data
Logic
C1 13
5060 L-GN/WH 0.35
DLC Schematics in Computer/Integrating Systems
DLC Schematics in Computer/Integrating Systems
2500 TN/BK 0.5
2501 TN 0.5
C3 C1 53 1
33 2
2700 GY 0.35
37 30
2
AC Refrigerant Pressure Sensor
3 1
380 OG/BK 0.35
57 26
5514 TN 0.35 (LZE, LZ4, LZ9)
2751 BK/WH 0.35 (LS4)
21 (LZE, LZ4, LZ9) 55 (LS4)
High Speed GMLAN Serial Data Bus +
120Ω Terminator
High Speed GMLAN Serial Data Bus -
LS4
CONN ID
C1=56 BU
C2=73 BK
C3=56 GY
LZE, LZ4, LZ9
CONN ID
C1=56 BU
C2=42 BK
C3=73 GY
5 Volt Reference
A/C Refrigerant Pressure Sensor Signal
Low Reference
Engine Control Module (ECM)
RUN/START
B+
Fuse Block - Underhood
Power Distribution Schematics in Wiring Systems
EMISSION 2 Fuse 15 A
A/C CMPRSR Relay
A/C CMPRSR Fuse 10 A
CONN ID
C1=58 BK
C2=40 GY
C3=40 BK
C4=40 GY
C1 C1
D1
459 D-GN/WH 0.35
C1 C3 53 (LZE, LZ4, LZ9) 51 (LS4)
59 D-GN 0.5
B
A/C Compresser Clutch
A
1050 BK 0.8
LS4
LZE, LZ4, LZ9
G112
G113

Fig. 2: A/C Compressor Controls - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

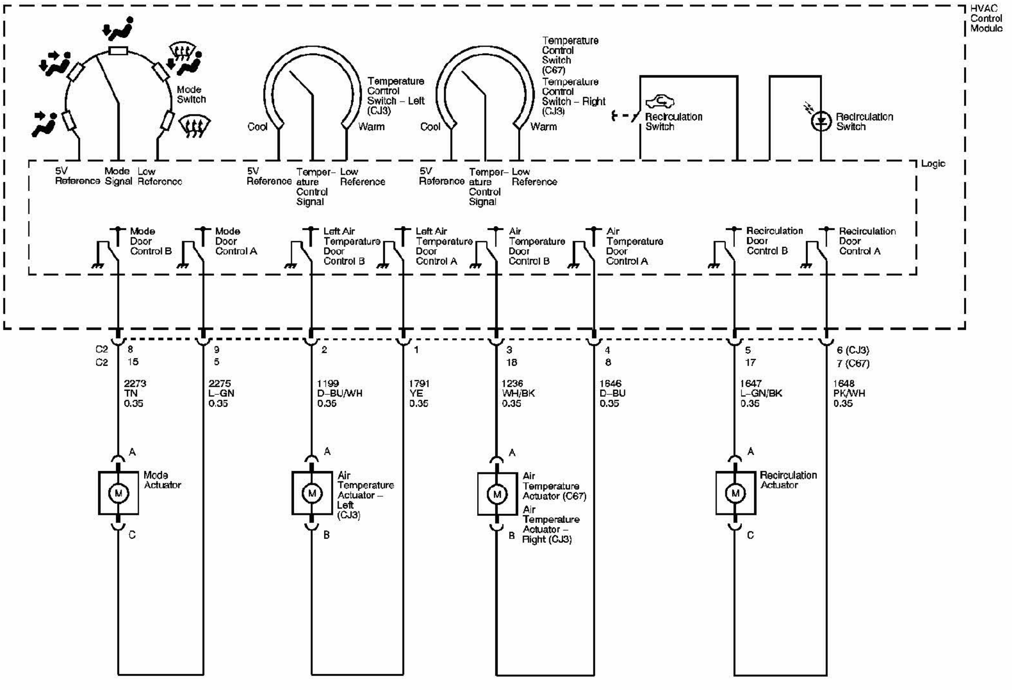

HVAC Control Module
Mode Switch
Temperature Control Switch - Left (CJ3)
Cool
Warm
Cool
Warm
Temperature Control Switch (C67)
Temperature Control Switch - Right (CJ3)
Recirculation Switch
Recirculation Switch
Logic
5V Reference
Mode Signal
Low Reference
5V Reference
Temperature Control Signal
Low Reference
5V Reference
Temperature Control Signal
Low Reference
Mode Door Control B
Mode Door Control A
Left Air Temperature Door Control B
Left Air Temperature Door Control A
Air Temperature Door Control B
Air Temperature Door Control A
Recirculation Door Control B
Recirculation Door Control A
C2 C2
8 15
9 5
2
1
3 18
4 8
5 17
6 (CJ3) 7 (C67)
2273 TN 0.35
2275 L-GN 0.35
1199 D-BU/WH 0.35
1791 YE 0.35
1236 WH/BK 0.35
1646 D-BU 0.35
1647 L-GN/BK 0.35
1648 PK/WH 0.35
A
Mode Actuator
C
A
Air Temperature Actuator - Left (CJ3)
B
A
Air Temperature Actuator (C67)
Air Temperature Actuator - Right (CJ3)
B
A
Recirculation Actuator
C
M

Fig. 3: Mode And Air Temperature Controls - Wiring Diagram

Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

HVAC COMPONENT VIEWS

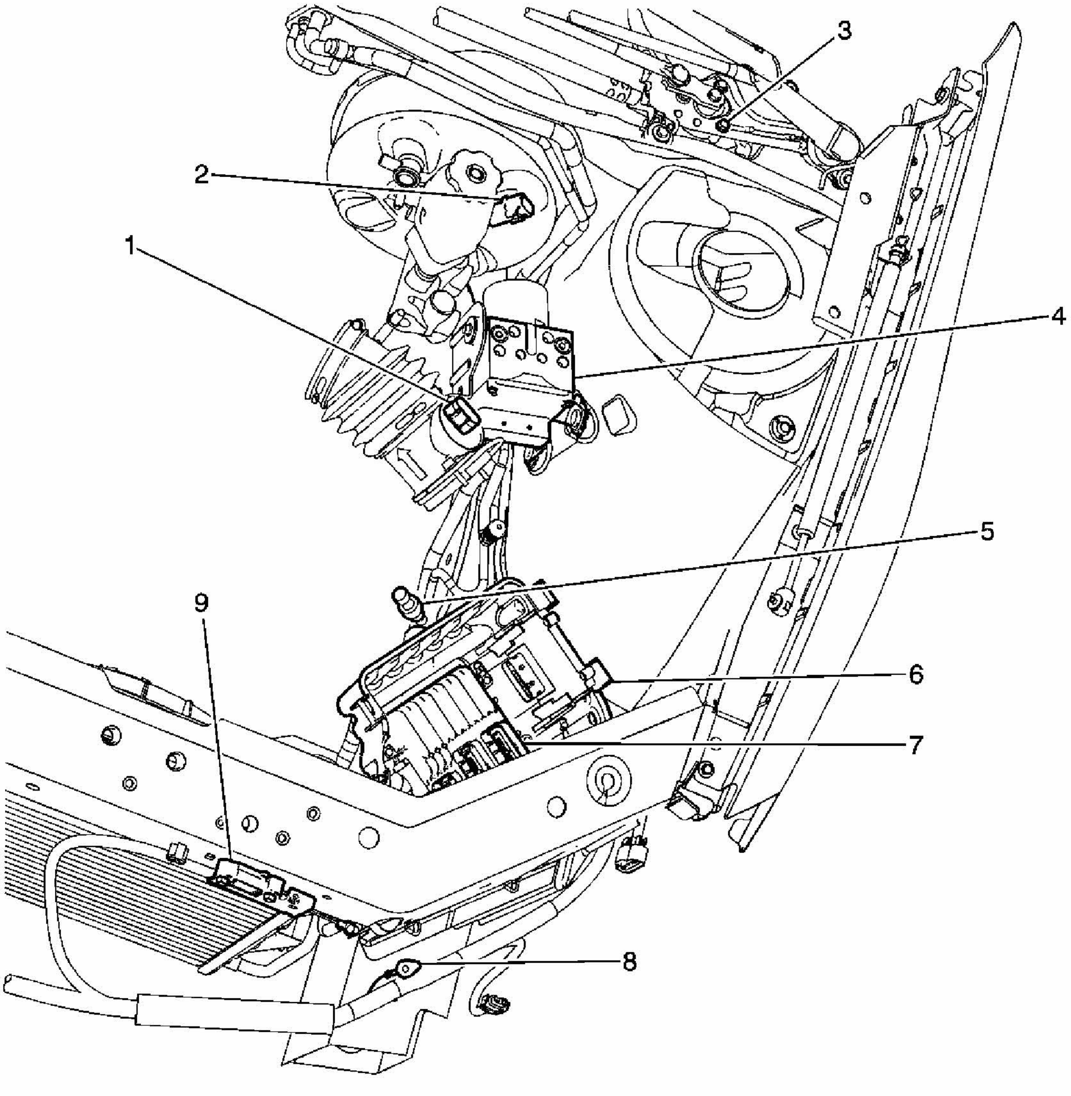


Fig. 4: LF of the Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	Mass Air Flow (MAF) / Intake Air Temperature (IAT) Sensor
2	Brake Fluid Level Switch
3	Windshield Wiper Motor

4	Electronic Brake Control Module (EBCM)
5	A/C Refrigerant Pressure Sensor
6	Transmission Control Module (TCM)
7	Engine Control Module (ECM)
8	G101
9	Inflatable Restraint Front end Sensor - Left

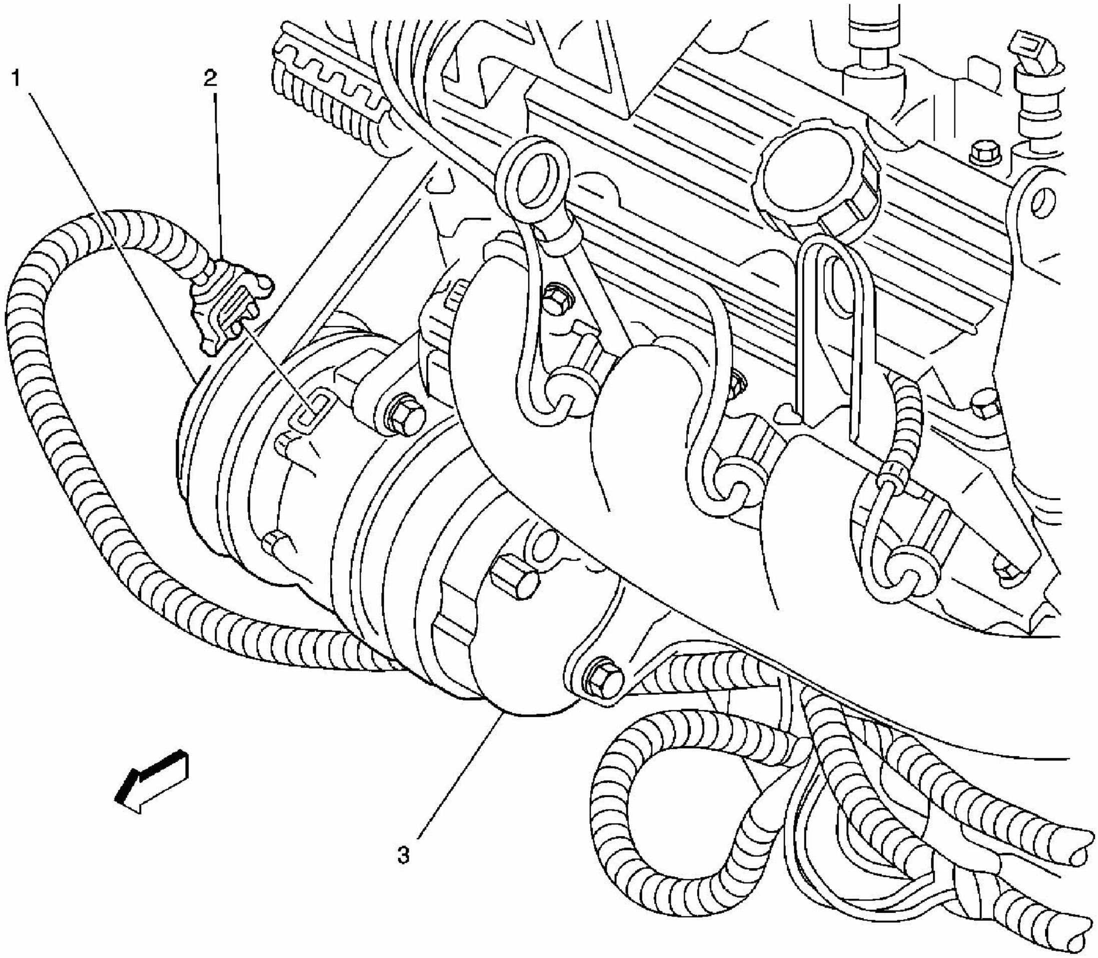


Fig. 5: Lower Right Front Of Engine Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
1	A/C Compressor Clutch
2	A/C Compressor Clutch Connector
3	A/C Compressor

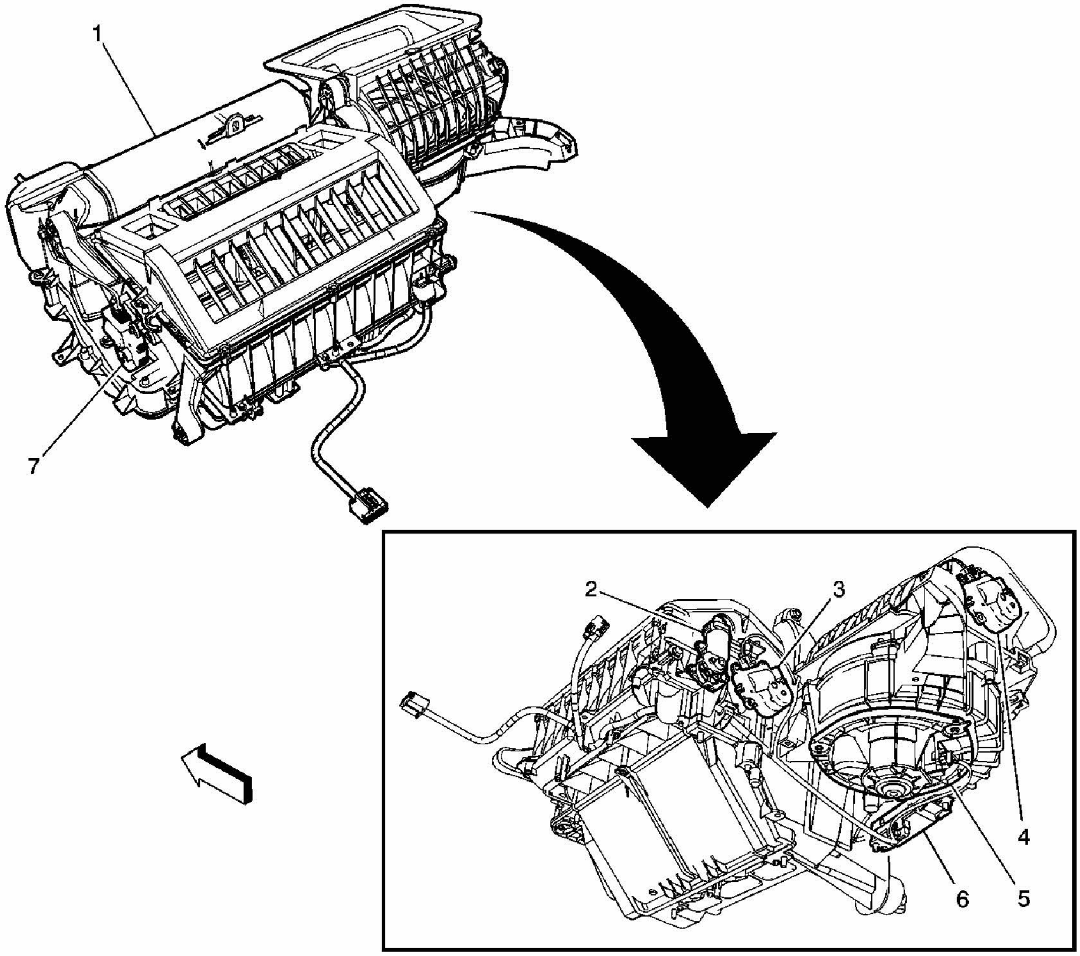


Fig. 6: Interior HVAC Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 6

Callout	Component Name
1	HVAC Module
2	Mode Actuator
3	Temperature Actuator
4	Temperature Actuator
5	Blower Motor
6	Blower Motor Resistor Assembly
7	Recirculation Actuator

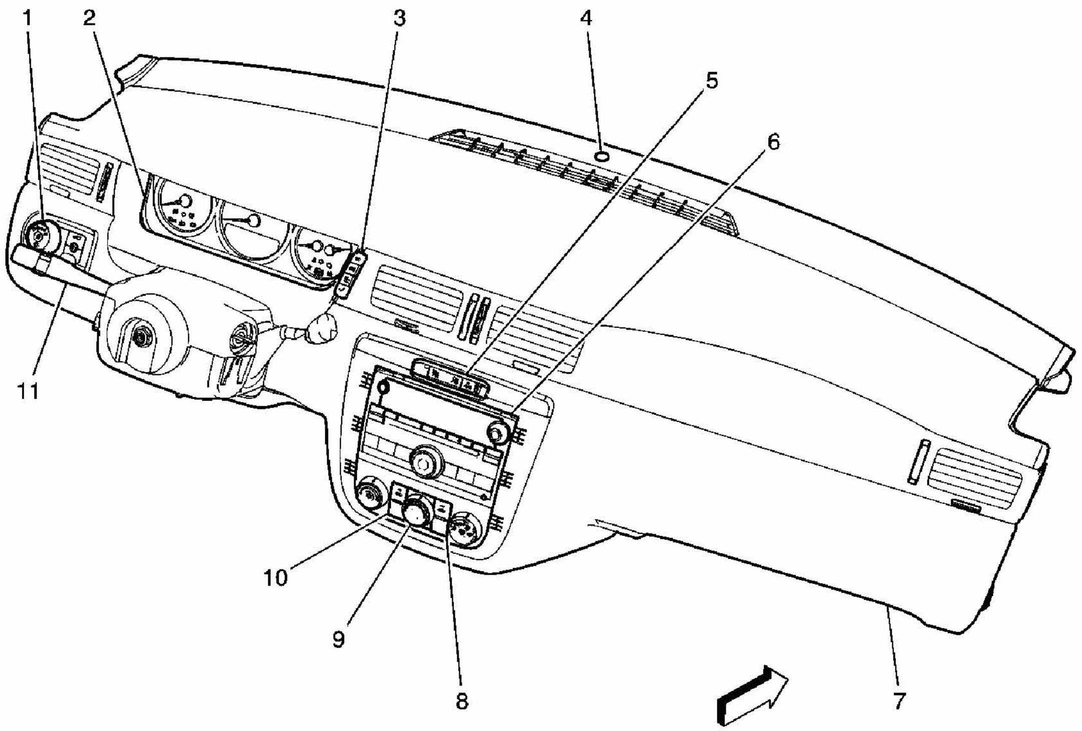


Fig. 7: I/P Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 7

Callout	Component Name
1	Headlamp Switch
2	Instrument Panel Cluster (IPC)
3	Driver Information Center (DIC) Switch
4	Ambient Light Sensor
5	Inflatable Restraint Passenger Air Bag On/Off Indicator (Sedan w/o 9C1, 9C3)
6	Radio
7	I/P Trim Panel
8	Heated Seat Switch-Passenger (KA7)
9	HVAC Control Module
10	Heated Seat Switch-Driver (KA7)
11	Turn Signal / Multifunction Switch

HVAC CONNECTOR END VIEWS

Ambient Air Temperature Sensor

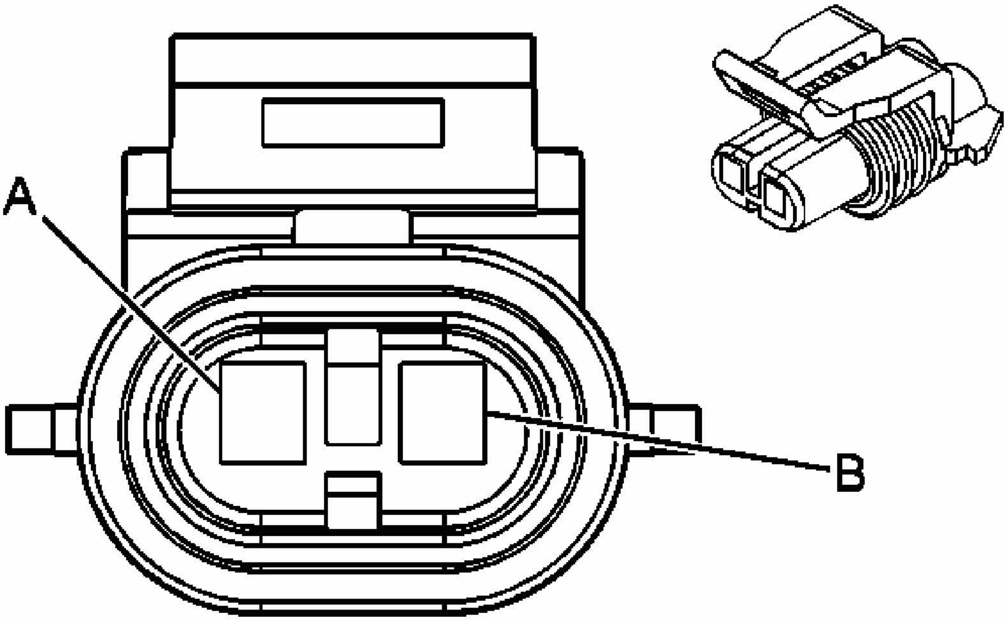


Fig. 8: Sliding Door Detent Switch - (E58/E59) Connector End Views
Courtesy of GENERAL MOTORS CORP.

HVAC Connector End Views

Connector Part Information

- OEM: 12052642
- Service: 12101856
- Description: 2-Way F Metri-Pack 150 Sealed (GN)

Terminal Part Information

- Terminal/Tray: 12048074/2
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Ambient Air Temperature Sensor

Pin	Wire Color	Circuit No.	Function
A	L-GN/BK	735	Ambient Air Temperature Sensor Signal
B	YE	61	Low Reference

A/C Compressor Clutch

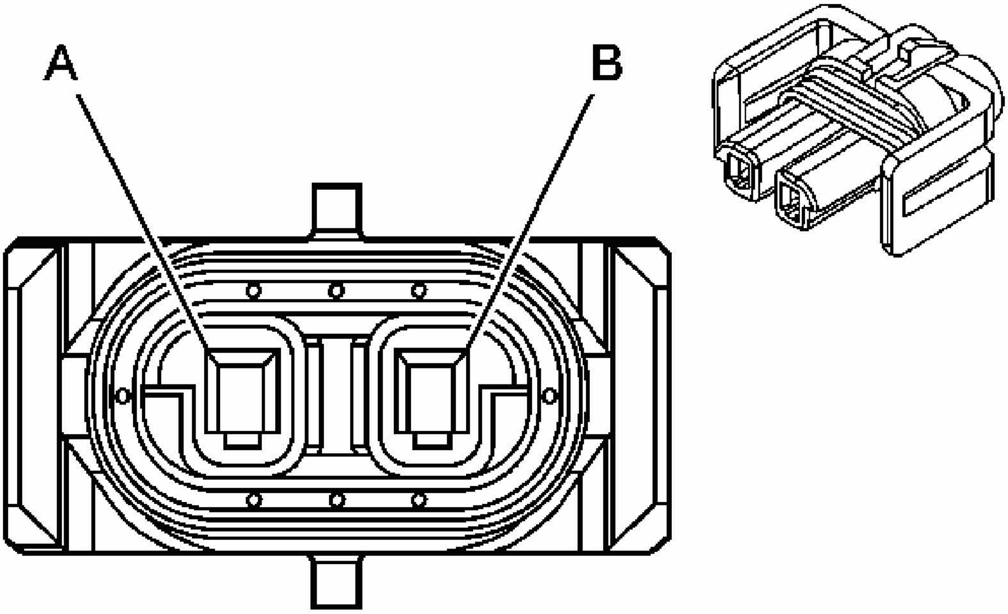


Fig. 9: Connector End View
Courtesy of GENERAL MOTORS CORP.

HVAC Connector End Views

Connector Part Information

- OEM: 12162017
- Service: 12101937
- Description: 2-Way F Metri-Pack 150 Sealed (GY)

Terminal Part Information

- Terminal/Tray: 12048074/2
- Core/Insulation Crimp: E/1
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

A/C Compressor Clutch

Pin	Wire Color	Circuit No.	Function
A	BK	1050	Ground
B	D-GN	59	A/C Compressor Clutch Supply Voltage

A/C Refrigerant Pressure Sensor

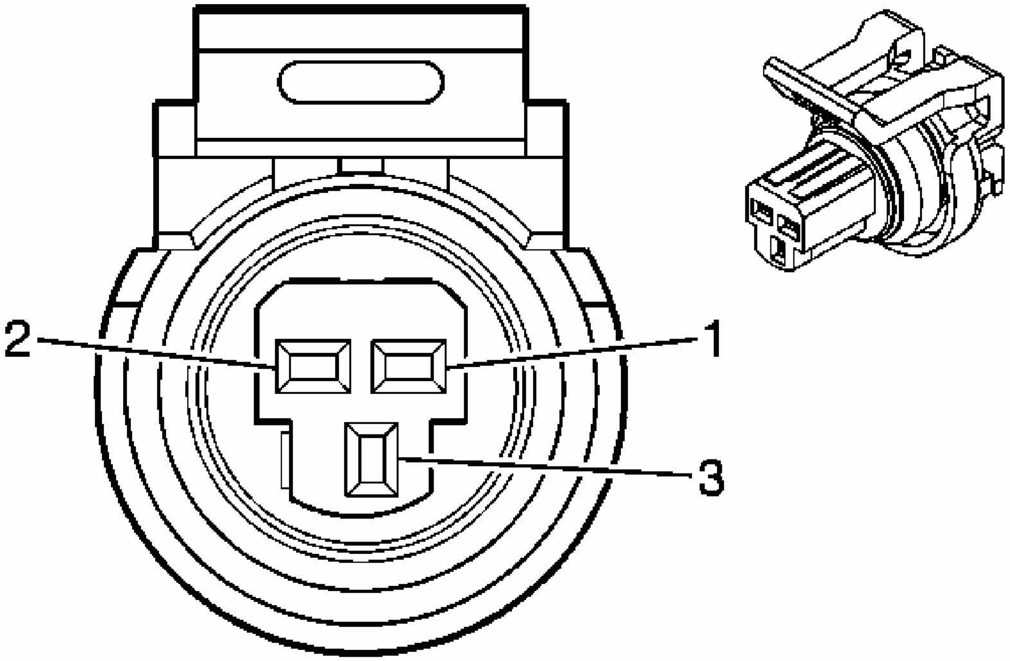


Fig. 10: Connector End View
Courtesy of GENERAL MOTORS CORP.

HVAC Connector End Views

Connector Part Information

- OEM: 15477863
- Service: 88988301
- Description: 3-Way F GT 150 Sealed (BK)

Terminal Part Information

- Terminal/Tray: 15326267/19
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

A/C Refrigerant Pressure Sensor

Pin	Wire Color	Circuit No.	Function
1	BK/WH	2751	Low Reference

2	GY	2700	A/C Pressure Sensor 5 Volt Reference
3	OG/BK	380	A/C Refrigerant Pressure Sensor Signal
1	TN	5514	Low Reference

Air Temperature Actuator (C67)

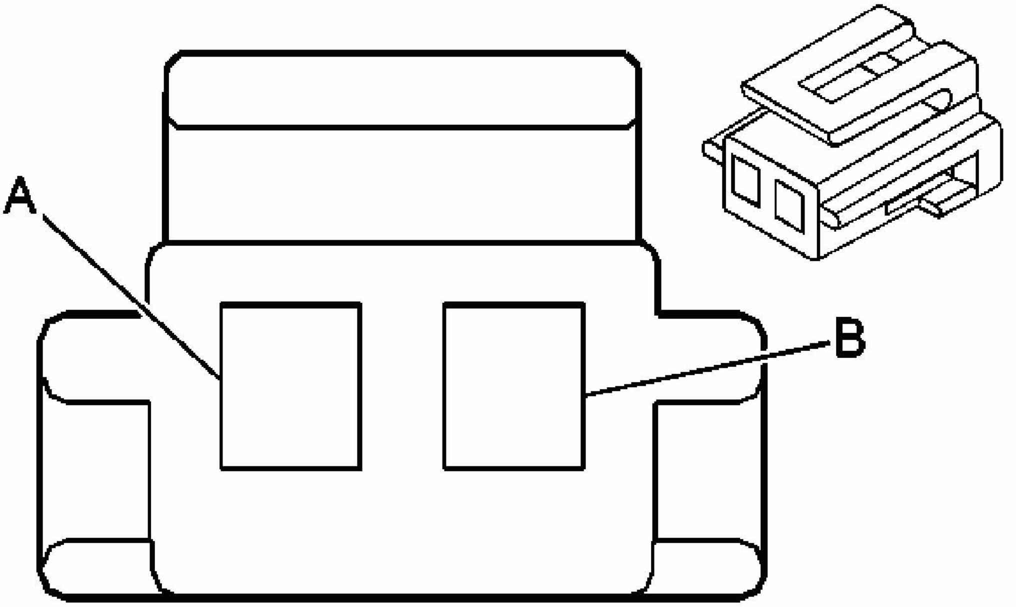


Fig. 11: Connector End View
Courtesy of GENERAL MOTORS CORP.

HVAC Connector End Views

Connector Part Information

- OEM: 12059110
- Service: 88953271
- Description: 2-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12064971/5
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Air Temperature Actuator (C67)

Pin	Wire Color	Circuit No.	Function
A	WH/BK	1236	Auxiliary Air Temperature Door Control
B	D-BU	1646	Auxiliary Air Temperature Door Position Signal

Air Temperature Actuator - Left (CJ3)

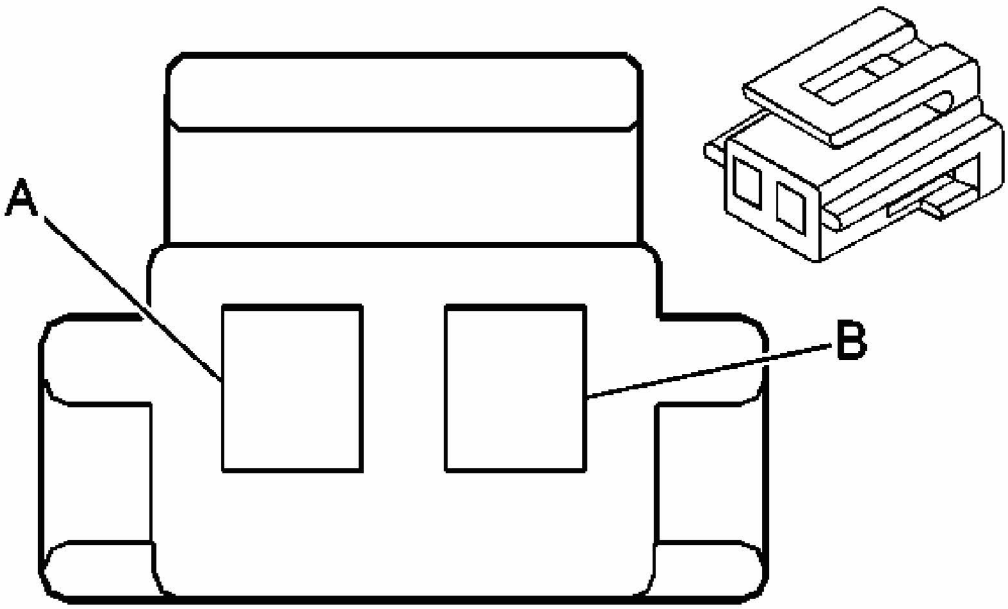


Fig. 12: Connector End View
Courtesy of GENERAL MOTORS CORP.

HVAC Connector End Views

Connector Part Information

- OEM: 12059110
- Service: 88953271
- Description: 2-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Pins: A, B
- Terminal/Tray: 12064971/5

- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Air Temperature Actuator - Left (CJ3)

Pin	Wire Color	Circuit No.	Function
A	D-BU/WH	1199	Air Temperature Door Control
B	YE	1791	Low Reference

Air Temperature Actuator - Right (CJ3)

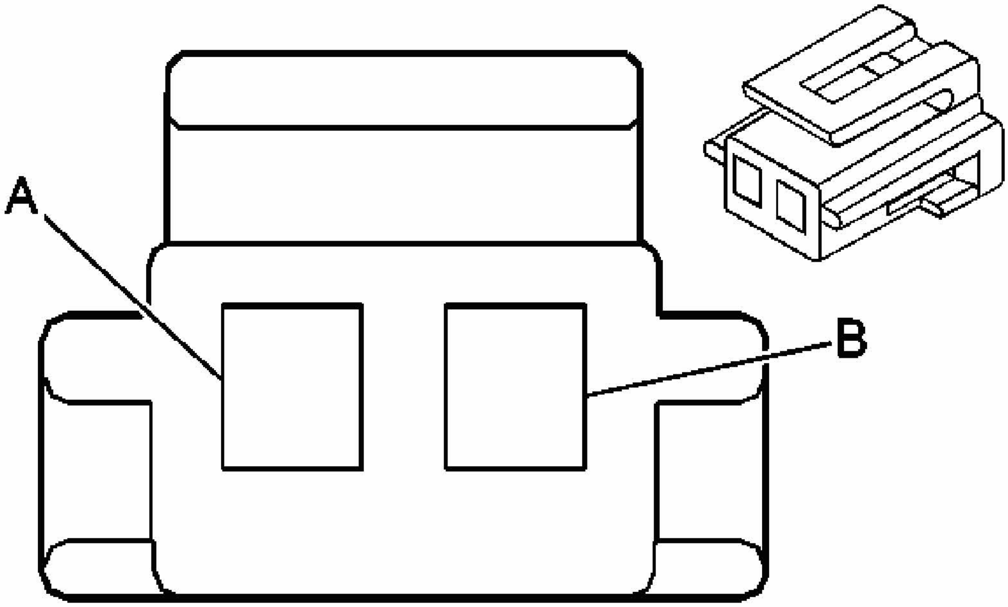


Fig. 13: Connector End View
Courtesy of GENERAL MOTORS CORP.

HVAC Connector End Views

Connector Part Information

- OEM: 12059110
- Service: 88953271
- Description: 2-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Pins: A, B

- Terminal/Tray: 12064971/5
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Air Temperature Actuator - Right (CJ3)

Pin	Wire Color	Circuit No.	Function
A	WH/BK	1236	Auxiliary Air Temperature Door Control
B	D-BU	1646	Auxiliary Air Temperature Door Position Signal

Blower Motor

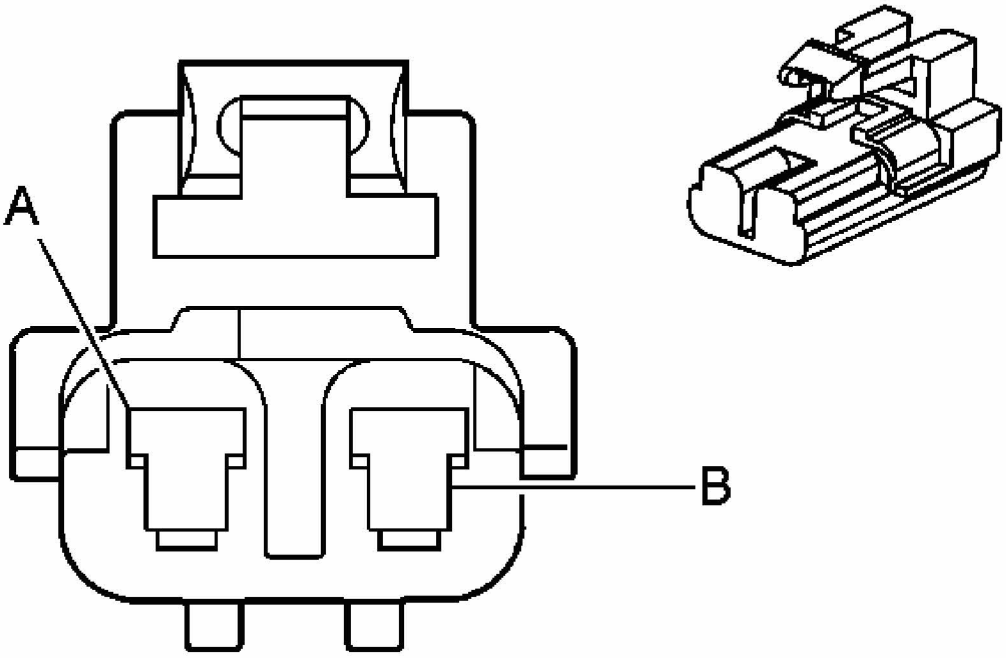


Fig. 14: Blower Motor Connector End View
Courtesy of GENERAL MOTORS CORP.

HVAC Connector End Views

Connector Part Information

- OEM: 12084957

- Service: 12126461
- Description: 2-Way F Metri-Pack 280 (BK)

Terminal Part Information

- Pins: A, B
- Terminal/Tray: 12015858/4
- Core/Insulation Crimp: F/G
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Blower Motor

Pin	Wire Color	Circuit No.	Function
A	PU	65	Blower Motor Supply Voltage
B	OG	5987	TBD

Blower Motor Control Processor

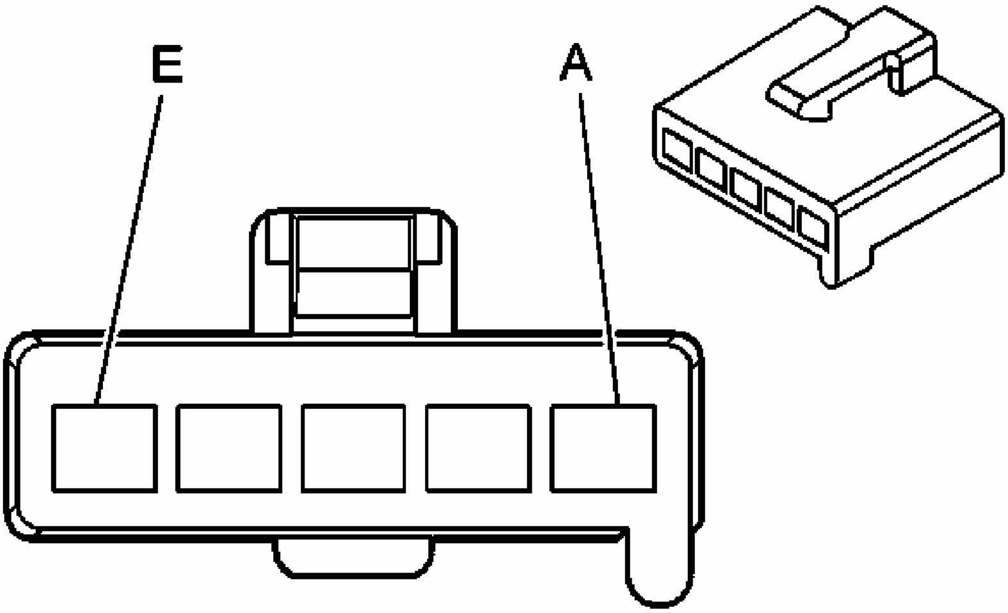


Fig. 15: Connector End View
Courtesy of GENERAL MOTORS CORP.

HVAC Connector End Views

Connector Part Information

- OEM: 12041429
- Service: 12167129
- Description: 5-Way F Metri-Pack 280 (BK)

Terminal Part Information

- Pins: A, C, D, E
- Terminal/Tray: 12015858/4
- Core/Insulation Crimp: F/G
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

- Pins: B
- Terminal/Tray: 12034046/2
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Blower Motor Control Processor

Pin	Wire Color	Circuit No.	Function
A	BK	150	Ground
B	GY/BK	754	Blower Motor Speed Control
C	RD	442	Battery Positive Voltage
D	OG	5987	TBD
E	PU	65	Blower Motor Supply Voltage

HVAC Control Module C1

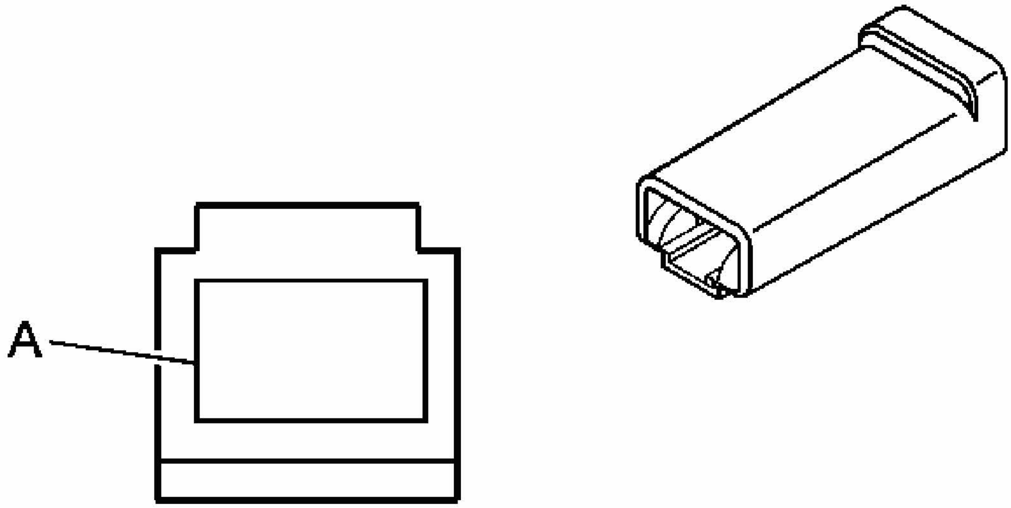


Fig. 16: Connector End View
Courtesy of GENERAL MOTORS CORP.

HVAC Connector End Views

Connector Part Information

- OEM: 15429808
- Service: See Catalog
- Description: 16-Way F Micro 64 Modular (BU)

Terminal Part Information

- Pins: 1, 2, 3, 4, 8, 9, 10, 12, 13
- Terminal/Tray: 15359541/4
- Core/Insulation Crimp: M/M
- Release Tool/Test Probe: 15381651-2/J-35616-64A (L-BU)

HVAC Control Module C1

Pin	Wire Color	Circuit No.	Function
1	PU/WH	1382	LED Dimming Signal/LED Dimming Supply
2	PK	1139	Ignition 1 Voltage
3	BK/WH	1551	Ground
4	RD/WH	1840	Battery Positive Voltage

5-7	-	-	Not Used
8	WH	193	Rear Defog Relay Control
9	L-GN/BK	735	Ambient Air Temperature Sensor Signal
10	BK	1450	Ground
11	-	-	Not Used
12	YE	61	Low Reference
13	D-GN	5060	Low Speed GMLAN Serial Data
14-16	-	-	Not Used

HVAC Control Module C2 (C67)

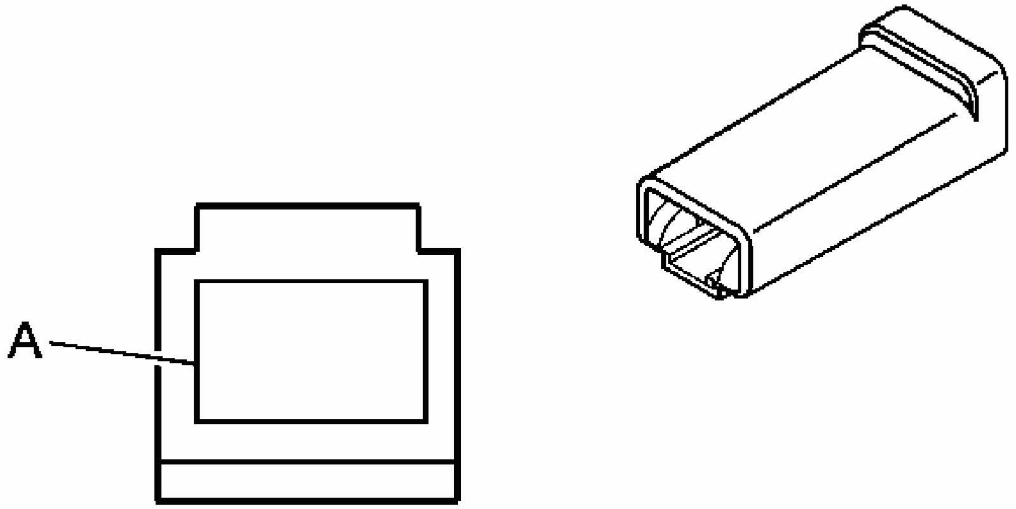


Fig. 17: Connector End View
Courtesy of GENERAL MOTORS CORP.

HVAC Connector End Views

Connector Part Information

- OEM: 15491304
- Service: See Catalog
- Description: 20-Way F Receptacle 0.64 (GY)

Terminal Part Information

- Pins: 4, 5, 7, 8, 15, 17, 18

- Terminal/Tray: 7116-4618-02/14
- Core/Insulation Crimp: P/P
- Release Tool/Test Probe: J-38125-215/J-35616-64A (L-BU)

- Pins: 3, 4, 5, 6, 7, 8, 9
- Terminal/Tray: 15359541/4
- Core/Insulation Crimp: M/M
- Release Tool/Test Probe: 15381651-2/J-35616-64A (L-BU)

- Pins: 1-3, 9-14, 19-20
- Terminal/Tray: 12034046/2
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

- Pins: 4, 5, 6, 7, 8, 15, 16, 17, 18
- Terminal/Tray: 7116-4618-02/14
- Core/Insulation Crimp: P/P
- Release Tool/Test Probe: J-38125-215/J-35616-64A (L-BU)

- Pins: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10-16
- Terminal/Tray: 15359541/4
- Core/Insulation Crimp: Pins 1, 2, 3, 4, 5, 6, 7, 8, 9 - M/M
- Core/Insulation Crimp: Pins 10-16 - M/M
- Release Tool/Test Probe: 15381651-2/J-35616-64A (L-BU)

HVAC Control Module C2 (C67)

Pin	Wire Color	Circuit No.	Function
1-3	-	-	Not Used
4	GY/BK	754	Blower Motor Speed Control
5	L-GN	2275	Mode Door Position Signal
6	-	-	Not Used
7	PK/WH	1648	Recirculation Door Control A
8	D-BU	1646	Auxiliary Air Temperature Door Position Signal
9-14	-	-	Not Used
15	TN	2273	Mode Door Control
16	-	-	Not Used
17	L-GN/BK	1647	Recirculation Door Control B

18	WH/BK	1236	Auxiliary Air Temperature Door Control
19-20	-	-	Not Used
1-2	-	-	Not Used
3	WH/BK	1236	Auxiliary Air Temperature Door Control
4	D-BU	1646	Auxiliary Air Temperature Door Position Signal
5	L-GN/BK	1647	Recirculation Door Control B
6	PK/WH	1648	Recirculation Door Control A
7	GY/BK	754	Blower Motor Speed Control
8	TN	2273	Mode Door Control
9	L-GN	2275	Mode Door Position Signal
10-16	-	-	Not Used

HVAC Control Module C2 (CJ3)

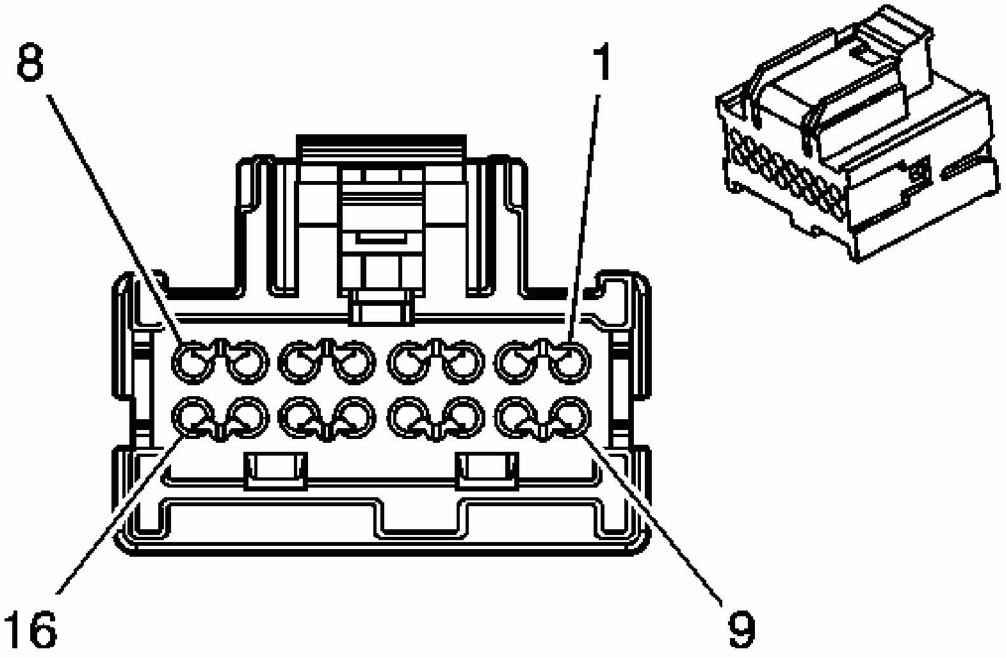


Fig. 18: Connector End View
Courtesy of GENERAL MOTORS CORP.

HVAC Connector End Views

Connector Part Information

- OEM: 15416970
- Service: See Catalog
- Description: 16-Way F Micro 64 Modular (BK)

Terminal Part Information

HVAC Control Module C2 (CJ3)

Pin	Wire Color	Circuit No.	Function
1	YE	1791	Low Reference
2	D-BU/WH	1199	Air Temperature Door Control
3	WH/BK	1236	Auxiliary Air Temperature Door Control
4	D-BU	1646	Auxiliary Air Temperature Door Position Signal
5	L-GN/BK	1647	Recirculation Door Control B
6	PK/WH	1648	Recirculation Door Control A
7	GY/BK	754	Blower Motor Speed Control
8	TN	2273	Mode Door Control
9	L-GN	2275	Mode Door Position Signal
10-16	-	-	Not Used

Mode Actuator

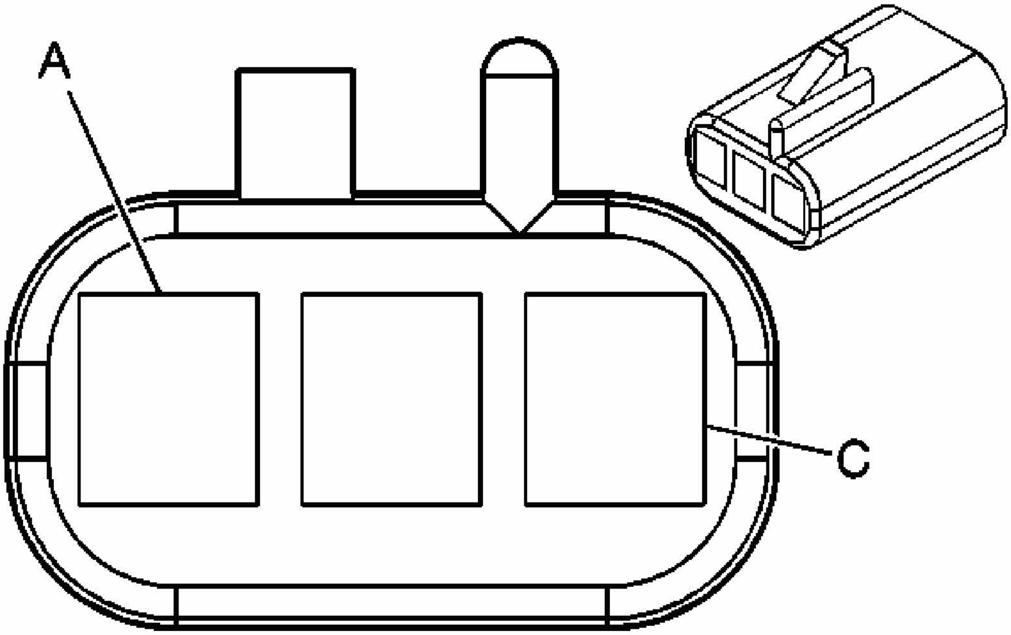


Fig. 19: Connector End Views
Courtesy of GENERAL MOTORS CORP.

HVAC Connector End Views

Connector Part Information

- OEM: 12047781
- Service: 12101864
- Description: 3-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Pins: A, C
- Terminal/Tray: 12064971/5
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

- Pins: A, C, B
- Terminal/Tray: 12064971/5
- Core/Insulation Crimp: Pins A, C - E/C
- Core/Insulation Crimp: Pins B - E/C

- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Mode Actuator

Pin	Wire Color	Circuit No.	Function
A	TN	2273	Mode Door Control
B	-	-	Not Used
C	L-GN	2275	Mode Door Position Signal

Recirculation Actuator

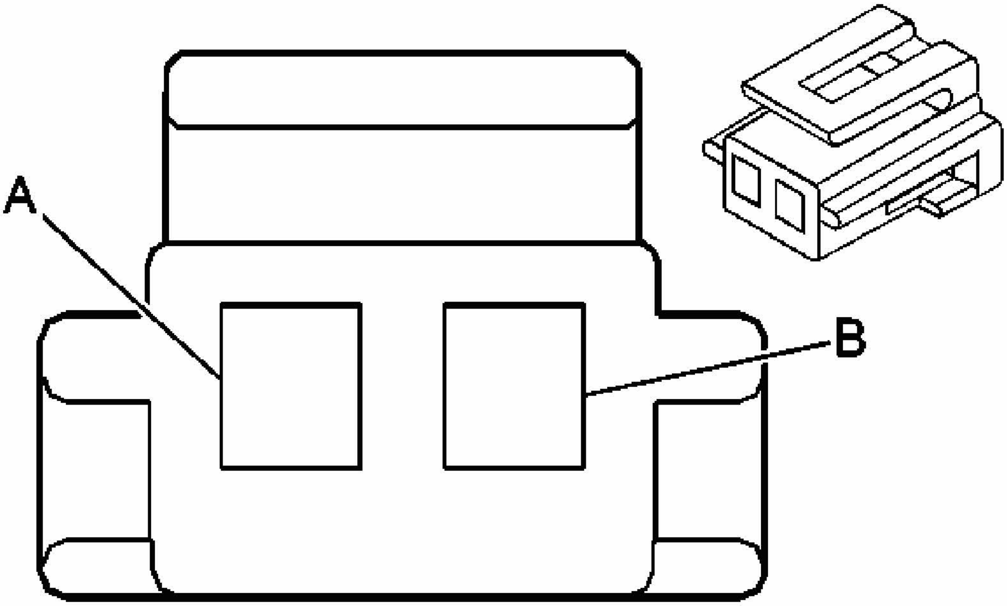


Fig. 20: Connector End View
Courtesy of GENERAL MOTORS CORP.

HVAC Connector End Views

Connector Part Information

- OEM: 12059110
- Service: 88953271
- Description: 2-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Pins: A, B

- Terminal/Tray: 12064971/5
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

- Pins: A, B
- Terminal/Tray: 12064971/5
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Recirculation Actuator

Pin	Wire Color	Circuit No.	Function
A	L-GN/BK	1647	Recirculation Door Control B
B	PK/WH	1648	Recirculation Door Control A

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B0158	Outside Air Temperature Sensor Circuit
DTC B0223, B0233, B0248, B0268, B0408, B0418, or B0428	MULTIPLE VALUES Refer to **DTC B0223, B0233, B0248, B0268, B0408, B0418, or B0428**
DTC P0532 or P0533	Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit Low Voltage, Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit High Voltage
DTC P0645	Air Conditioning Clutch Relay Control Circuit

SCAN TOOL OUTPUT CONTROLS

PCM Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection(s)	Description
A/C Relay	Engine Output Controls	The powertrain control module (PCM) energizes the A/C relay to engage the A/C compressor clutch when you select ON. The A/C compressor clutch should remain engaged until commanded OFF.

SCAN TOOL DATA LIST

Use the Scan Tool Data Display Values and Definitions Information in order to assist in diagnosing the HVAC system. Compare the vehicles actual scan tool data with the typical data display value table information. Use the data information in order to aid in understanding the nature of the problem when the vehicle does not match with the typical data display values.

The scan tool data values were taken from a known good vehicle under the following conditions:

- The ignition switch is in the ON position.
- The engine is running at idle.
- The vehicle is in PARK.
- The doors are closed.
- The windows are closed.
- The A/C is ON.
- The ambient air temperatures are at 22-27°C (70-80°F).

PCM Scan Tool Data List

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Engine idling, A/C ON, ambient air temperature between 22-27°C (70-80°F)			
A/C High Side Pressure	Engine Data 2	kPa/psi	1100 kPa/159 psi
A/C High Side Pressure	Engine Data 2	Volts	2.18 Volts
A/C Off For WOT	Engine Data 2	Yes/No	No
A/C Pressure Disable	Engine Data 2	Yes/No	No
A/C Relay Circuit Status	Output Driver Data	OK/Fault/Invalid State	OK
A/C Relay Command	Engine Data 1/Engine Data 2/EGR Data/Misfire Data	On/Off	On
A/C Request Signal	Engine Data 2	Yes/No	Yes

SCAN TOOL DATA DEFINITIONS

The HVAC Scan Tool Data Definitions contains a brief description of all HVAC related parameters available on the scan tool. The list is in alphabetical order. A given parameter may appear in any one of the data lists. In some cases, the parameter may appear more than once or in more than one data list in order to group certain related parameters together.

PCM - A/C Relay Command

The scan tool displays On or Off. On is displayed when the powertrain control module (PCM) has energized the A/C compressor clutch relay.

PCM - Engine Data 2 - A/C High Side Pressure

The scan tool displays -103 to +3119 kPa (-14 to +452 psi). This parameter represents the A/C refrigerant pressure sensor voltage signal converted to pressure.

PCM - Engine Data 2 - A/C High Side Pressure

The scan tool displays 0-5 volts. The output of the A/C refrigerant pressure sensor.

PCM - Engine Data 2 - A/C Off For WOT

The scan tool displays Yes or No. Yes indicates that the PCM has disabled the A/C compressor, because the throttle position (TP) sensor signal is at wide open throttle.

PCM - Engine Data 2 - A/C Pressure Disable

The scan tool displays Yes or No. Yes is displayed when the system pressure exceeds 3034 kPa (440 psi).

PCM - Engine Data 2 - A/C Request Signal

The scan tool displays Yes or No. Yes is displayed when the HVAC control module is requesting A/C system operation.

PCM - Output Driver Data - A/C Relay Circuit Status

The scan tool displays OK, Fault, or Invalid State. The scan tool indicates the diagnostic state of the A/C relay control circuit.

DTC B0158

Circuit Description

The ambient air temperature sensor provides the HVAC control module software with the temperature of the air outside the vehicle. That temperature can be displayed in the driver information center (DIC). A reference voltage is supplied to the sensor thermistor and the HVAC control module determines the voltage drop across that device which is proportional to temperature. As the air temperature increases, the resistance decreases and the voltage signal decreases. As the air temperature decreases, the resistance increases and the voltage signal increases.

DTC Descriptors

This diagnostic procedure supports the following DTC:

DTC B0158

Outside Air Temperature Sensor Circuit

This vehicle has DTCs which include DTC Symptoms. For more information on DTC Symptoms, refer to **DTC Symptom Description** .

DTC B0158

DTC Symptom	DTC Symptom Descriptor
05	Short to Battery or Open
06	Short to Ground or Open

Conditions for Running the DTC

The ignition is turned ON.

Conditions for Setting the DTC

The HVAC control module detects the ambient air temperature sensor signal circuit is less than 2 counts for more than 30 seconds or more than 253 counts for more than 30 seconds.

Action Taken When the DTC Sets

- The DIC will display 15°C (59°F) for outside air temperature.
- The DIC will display SERVICE A/C SYSTEM.

The system operates using a default value.

Conditions for Clearing the DTC

- The DTC will become history if the HVAC control module no longer detects the condition that set the DTC.
- The history DTC will clear after 50 fault-free ignition cycles.
- The DTC can be cleared with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step tests for the proper operation of the circuit in the high voltage range.

4: This step tests for the proper operation of the circuit in the low voltage range. If the fuse in the jumper opens when you perform this test, the signal circuit is shorted to voltage.

DTC B0158

Step	Action	Values	Yes	No
Schematic Reference: HVAC Schematics **Connector End View Reference: HVAC Connector End Views**				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the Appropriate Air Temp parameter in the Climate Control Panel, Open/Short Data list. Does the scan tool indicate that the Appropriate Air Temp parameter is within the specified range?	2-253 Counts	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the appropriate air temperature sensor. 3. Turn ON the ignition, with the engine OFF. 4. With a scan tool, observe the Appropriate Air Temp parameter. Does the scan tool indicate that the Appropriate Air Temp parameter is greater than the specified value?	253 Counts	Go to **Step 4**	Go to **Step 5**
	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit of the appropriate air temperature sensor and the low reference circuit of the			

4	appropriate air temperature sensor. 3. Turn ON the ignition, with the engine OFF. 4. With a scan tool, observe the Appropriate Air Temp parameter. Does the scan tool indicate that the Appropriate Air Temp parameter is less than the specified value?	2 Counts	Go to **Step 9**	Go to **Step 6**
5	Test the signal circuit of the appropriate air temperature sensor for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
6	Test the signal circuit of the appropriate air temperature sensor for a short to voltage, a high resistance, or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 7**
7	Test the low reference circuit of the appropriate air temperature sensor for a high resistance or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 8**
8	Test the following signal circuits for a short to voltage: • Ambient air temperature sensor • Ambient light sensor Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
	Inspect for poor connections at the			

9	harness connector of the appropriate air temperature sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 11**
10	Inspect for poor connections at the harness connector of the HVAC control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
11	Replace the appropriate air temperature sensor. Did you complete the replacement?	-	Go to **Step 13**	-
12	Replace the HVAC control module. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	-	Go to **Step 2**	System OK

DTC B0223, B0233, B0248, B0268, B0408, B0418, OR B0428

Circuit Description

The HVAC control module controls the HVAC actuators to regulate the airflow through the HVAC system. Each actuator is a 2-wire bi-directional electric motor. Two control circuits enable the actuator to operate. The control circuits use either a 0 or 12-volt value to coordinate the actuator movement. When the actuator is at rest, both control circuits have a value of 0 volts. In order to move the actuator, the HVAC control module grounds the appropriate control circuit for the commanded direction. The HVAC control module reverses the polarity of the control circuits to move the actuator in the opposite direction.

The HVAC control module determines the door position by counting motor pulses on one of the control circuits. The HVAC control module converts the pulses to counts with a range of 0-255 counts.

When a calibration or recalibration procedure is performed, the HVAC control module calculates the door travel range. The HVAC control module compares the total number of pulses to calibrated limits. If the total pulse count is less than or equal to the maximum calibrated limited and more that or equal to the minimum calibrated limit, then the calibration is considered successful.

- Air Flow Control 3 Circuit refers to the mode actuator.
- Air Flow Control 7 Circuit refers to the recirculation actuator.
- Temperature Control 1 Circuit refers to the driver temperature actuator.
- Temperature Control 2 Circuit refers to the passenger temperature actuator.
- Temperature Control 3 Circuit refers to the rear temperature actuator.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

DTC B0223 05

Recirculate Position Command Circuit short to battery or open

DTC B0223 06

Recirculate Position Command Circuit short to ground or open

DTC B0223 61

Recirculate Position Command Circuit actuator stuck

DTC B0233 05

Air Flow Control Circuit short to battery or open

DTC B0233 06

Air Flow Control Circuit short to ground or open

DTC B0233 61

Air Flow Control Circuit actuator stuck

DTC B0248 05

Air Flow Control 3 Circuit short to battery or open

DTC B0248 06

Air Flow Control 3 Circuit short to ground or open

DTC B0248 61

Air Flow Control 3 Circuit actuator stuck

DTC B0268 05

Air Flow Control 7 Circuit short to battery or open

DTC B0268 06

Air Flow Control 7 Circuit short to ground or open

DTC B0268 61

Air Flow Control 7 Circuit actuator stuck

DTC B0408 05

Temperature Control 1 Circuit short to battery or open

DTC B0408 06

Temperature Control 1 Circuit short to ground or open

DTC B0408 61

Temperature Control 1 Circuit actuator stuck

DTC B0418 05

Temperature Control 2 Circuit short to battery or open

DTC B0418 06

Temperature Control 2 Circuit short to ground or open

DTC B0418 61

Temperature Control 2 Circuit actuator stuck

DTC B0418 05

Temperature Control 2 Circuit short to battery or open

DTC B0418 06

Temperature Control 2 Circuit short to ground or open

DTC B0418 61

Temperature Control 2 Circuit actuator stuck

DTC B0428 05

Temperature Control 3 Circuit short to battery or open

DTC B0428 06

Temperature Control 3 Circuit short to ground or open

DTC B0428 61

Temperature Control 3 Circuit actuator stuck

Conditions for Running the DTC

The HVAC control module has completed a calibration/recalibration of the actuator.

Conditions for Setting the DTC

The HVAC control module does not detect any movement of the actuator, after 2 unsuccessful attempts at moving the actuator.

Action Taken When the DTC Sets

The HVAC control module will recalibrate the appropriate actuator each time the ignition switch is turned ON.

Conditions for Clearing the DTC

- The DTC will become history if the HVAC control module no longer detects a failure.
- The history DTC will clear after 100 fault-free ignition cycles.
- The DTC can be cleared with a scan tool.

Diagnostic Aids

Inspect the appropriate actuator door and actuator for the following conditions:

- A misaligned actuator
- Broken or binding linkages or actuator door
- Obstruction that prevents the actuator door from operating within its full range of motion
- Missing seals to the actuator door
- Misaligned seals to the actuator door

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step drives the actuator in one direction. The actuator shaft will not move if the actuator door is already in the position you are attempting to drive it to.

4: This step drives the actuator in the opposite direction.

DTC B0223, B0233, B0248, B0268, B0408, B0418, or B0428

Step	Action	Values	Yes	No
Schematic Reference: HVAC Schematics **Connector End View Reference: HVAC Connector End Views**				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Test the appropriate door control A circuit and the appropriate door control B circuit for an open, high resistance, short to ground, or a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the HVAC control module. 3. Connect a 10-amp fused jumper wire between the actuator door control A circuit of the appropriate actuator and battery positive voltage. 4. Connect a 10-amp fused jumper wire between the actuator door	-		

	control B circuit of the appropriate actuator and a good ground. Does the actuator shaft rotate?		Go to **Step 7**	Go to **Step 4**
4	1. Connect a 10-amp fused jumper wire between the actuator door control B circuit of the appropriate actuator and battery positive voltage. 2. Connect a 10-amp fused jumper wire between the actuator door control A circuit of the appropriate actuator and a good ground. Does the actuator shaft rotate?	-	Go to **Step 7**	Go to **Step 5**
5	Inspect the appropriate door and actuator for the following conditions: • A misaligned actuator • Broken or binding linkages or actuator door • An obstruction that prevents the actuator door from operating within its full range of motion • Missing seals to the actuator door • Misaligned seals to the actuator door Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 6**
6	Inspect for poor connections at the harness connector of the appropriate actuator. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 8**
7	Inspect for poor connections at the harness connector of the HVAC control module. Refer to **Testing for Intermittent Conditions and Poor**	-		

	Connections and **Connector Repairs** . Did you find and correct the condition?		Go to **Step 10**	Go to **Step 9**
8	**IMPORTANT:** **Perform the recalibration procedure for the appropriate actuator.** Replace the appropriate actuator. Refer to the following: - **HVAC Control Assembly Replacement** - **Mode Actuator Replacement** - **Air Temperature Actuator Replacement - Left** - **Air Temperature Actuator Replacement - Right** - Rear air temperature actuator Did you complete the replacement?	-	Go to **Step 10**	-
9	Replace the HVAC control module. Refer to **HVAC Control Assembly Replacement** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 10**	-
10	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text. Does the DTC reset?	-	Go to **Step 2**	System OK

DTC P0532 OR P0533

Circuit Description

The powertrain control module (PCM) monitors the high side refrigerant pressure through an A/C refrigerant pressure sensor. When the pressure is high, the signal voltage is high. When the pressure is low, the signal voltage is low. When pressure is high, the PCM commands the cooling fans on. When pressure is too high or too low, the PCM will not allow the A/C compressor clutch to engage. The PCM sends the A/C pressure data to the dash integration module (DIM) over the class 2 serial data circuit. The DIM will command the inline A/C orifice solenoid to increase or decrease the high side pressure. This keeps the high side pressure in a normal operating range. This will prevent the A/C compressor clutch from disengaging under normal operating conditions. The DIM will not request A/C compressor clutch engagement if the A/C pressure is too high.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

DTC P0532

Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit Low Voltage

DTC P0533

Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit High Voltage

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- A/C pressure of less than 0.1 volt or more than 4.92 volts
- The condition must be present for more than 5 seconds

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL)
- The PCM will store the conditions present when the DTC set as Fail Records data only.

Conditions for Clearing the DTC

- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using the scan tool Clear DTC Information function.

Diagnostic Aids

Test the following conditions:

- Visually inspect the sensor for contamination or damage.
- Inspect for the following that may affect the sensors accuracy:
  - A malfunction within the refrigerant system causing low pressure
  - Visually inspect the A/C components and lines for damage.
- Refer to **Testing for Intermittent Conditions and Poor Connections** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: This step tests for the proper operation of the circuit in the low voltage range.

5: This step tests for the proper operation of the circuit in the high voltage range. If the fuse in the jumper opens when you perform this test, the signal circuit is shorted to ground.

6: This step tests for a short to voltage in the 5-volt reference circuit.

7: This step tests for a high resistance or an open in the low reference circuit.

DTC P0532 or P0533

Step	Action	Values	Yes	No
Schematic Reference: NEED LINK MISSING MISSING **Connector End View Reference: NEED LINK MISSING MISSING**				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	**IMPORTANT:** **The ambient air temperature must be above 3°C (38°F).** 1. Turn OFF the ignition. 2. Inspect the A/C compressor for free rotation operation. 3. Start the engine. 4. Place the HVAC Control Module in the OFF position. Does the A/C compressor operate?	-	Go to **NEED LINK or step**	Go to **Step 3**
3	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the A/C High Side Pressure parameter in the powertrain control module Engine Data 2 list. Does the scan tool indicate that the	0.1-4.9 V	Go to	

	A/C High Side Pressure parameter is within the specified range?		Diagnostic Aids	Go to **Step 4**
4	1. Turn OFF the ignition. 2. Disconnect the A/C refrigerant pressure sensor. 3. Turn ON the ignition, with the engine OFF. 4. With a scan tool, observe the A/C High Side Pressure parameter in the powertrain control module Engine Data 2 list. Does the scan tool indicate that the A/C High Side Pressure parameter is less than the specified value?	0.1 V	Go to **Step 5**	Go to **Step 11**
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the A/C refrigerant pressure sensor and the signal circuit of the A/C refrigerant pressure sensor. 3. Turn ON the ignition, with the engine OFF. 4. With a scan tool, observe the A/C High Side Pressure parameter in the powertrain control module Engine Data 2 list. Does the scan tool indicate that the A/C High Side Pressure parameter is greater than the specified value?	4.9 V	Go to **Step 6**	Go to **Step 9**
6	1. Disconnect the fused jumper wire. 2. Measure the voltage between the 5-volt reference circuit of the A/C refrigerant pressure sensor and the low reference circuit of the A/C refrigerant	4.9 V		

	pressure sensor. Does the voltage measure less than the specified value?		Go to **Step 7**	Go to **Step 8**
7	1. Turn OFF the ignition. 2. Disconnect the negative battery cable. 3. Measure the resistance from the low reference circuit of the A/C refrigerant pressure sensor to a good ground. Does the resistance measure less than the specified value?	5	Go to **Step 13**	Go to **Step 12**
8	Test the 5-volt reference circuit of the A/C refrigerant pressure sensor for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
9	Test the 5-volt reference circuit of the A/C refrigerant pressure sensor for a short to ground, a high resistance, or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 10**
10	Test the signal circuit of the A/C refrigerant pressure sensor for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
11	Test the signal circuit of the A/C refrigerant pressure sensor for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
	1. Disconnect the HVAC control module. 2. Test the low reference circuit of			

12	the A/C refrigerant pressure sensor for a high resistance or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
13	Inspect for poor connections at the harness connector of the A/C refrigerant pressure sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 15**
14	Inspect for poor connections at the harness connector of the powertrain control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
15	Replace the A/C refrigerant pressure sensor. Refer to **NEED LINK MISSING MISSING** . Did you complete the replacement?	-	Go to **Step 17**	-
16	Replace the powertrain control module. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 17**	-
17	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text. Does the DTC reset?	-	Go to **Step 2**	System OK

DTC P0645

Circuit Description

Ignition voltage is supplied directly to the A/C compressor clutch relay. The powertrain control module (PCM) controls the relay by grounding the control circuit through an internal solid state device called a driver. The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line, which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be near 0 volts. When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be near battery voltage.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0645

Air Conditioning Clutch Relay Control Circuit

Conditions for Running the DTC

- The ignition voltage is between 9-18 volts.
- The PCM driver is activated for at least 0.5 second.

Conditions for Setting the DTC

The PCM detects an improper voltage level on the output circuit that controls the A/C relay.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM stores the failure records.
- The A/C compressor clutch is disabled.

Conditions for Clearing the DTC

- The DTC will become history if the PCM no longer detects a failure.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: Listen for an audible click when the A/C compressor clutch relay operates. Command both the ON and OFF states. Repeat the commands, as necessary.

4: This step tests for voltage at the coil side of the A/C compressor clutch relay. The 10-amp fuse supplies power to the coil side of the A/C compressor clutch relay.

5: This step verifies that the PCM is providing ground to the A/C compressor clutch relay.

6: This step tests if ground is constantly being applied to the A/C compressor clutch relay.

7: This step tests for a short to voltage or an open.

13: Perform the programming procedure for the PCM.

DTC P0645

Step	Action	Yes	No
Schematic Reference: HVAC Schematics **Connector End View Reference: HVAC Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	**IMPORTANT:** **The ambient air temperature must be above 3°C (38°F).** 1. Turn OFF the ignition. 2. Inspect the A/C compressor for free rotation operation. 3. Start the engine. 4. Place the HVAC control module in the OFF position. Does the A/C compressor operate?	Go to **HVAC Compressor Clutch Does Not Disengage**	Go to **Step 3**
3	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the A/C Relay ON and OFF in the Special Functions, Engine Output Controls list. Does the A/C Relay turn ON and OFF with each command?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 4**
	1. Turn OFF the ignition. 2. Disconnect the A/C compressor clutch relay.		

4	3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 3 voltage circuit of the A/C compressor clutch relay with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 11**
5	1. Connect a test lamp between the control circuit of the A/C compressor clutch relay and the ignition 3 voltage circuit of the A/C compressor clutch relay. 2. With a scan tool, command the A/C Relay ON and OFF. Does the test lamp turn ON and OFF with each command?	Go to **Step 9**	Go to **Step 6**
6	Does the test lamp remain illuminated with each command?	Go to **Step 8**	Go to **Step 7**
7	Test the control circuit of the A/C compressor clutch relay for a short to voltage or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
8	Test the control circuit of the A/C compressor clutch relay for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
9	Inspect for poor connections at the A/C compressor clutch relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
10	Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
	Repair the ignition 3 voltage circuit of the A/C compressor clutch relay. Refer to		

11	**Wiring Repairs** . Did you complete the repair?	Go to **Step 14**	-
12	Replace the A/C compressor clutch relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	Go to **Step 14**	-
13	Replace the PCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 14**	-
14	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

SYMPTOMS - HVAC SYSTEMS - MANUAL

IMPORTANT: Review the system operation in order to familiarize yourself with the system functions. Refer to:

- **Air Delivery Description and Operation**
- **Air Temperature Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the HVAC System. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Verify the A/C compressor clutch turns freely and is not seized.
- The A/C compressor will not operate in cold outside air temperatures. Refer to **Air Temperature Description and Operation**.
- The following conditions may cause window fogging:
  - Wet carpet or mats
  - High humidity
  - Interior water leak
  - Blocked A/C evaporator drain tube

  - Maximum passenger capacity
  - Blocked body pressure relief valves
- Inspect the air distribution system for causes of reduced air flow:
  - Obstructed or dirty passenger compartment air filter, if equipped
  - Blocked or damaged air inlet or outlet vents

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **HVAC Compressor Clutch Does Not Engage**
- **HVAC Compressor Clutch Does Not Disengage**
- **Blower Motor Always On**
- **Blower Motor Inoperative**
- **Blower Motor Malfunction**
- **Too Hot in Vehicle**
- **Too Cold in Vehicle**
- **Air Delivery Improper**
- **Leak Testing**
- **Defrosting Insufficient**
- **Noise Diagnosis - Blower Motor**
- **Noise Diagnosis - Air Conditioning (A/C) System**
- **Noise Diagnosis - HVAC Module**
- **Odor Diagnosis**

HVAC COMPRESSOR CLUTCH DOES NOT ENGAGE

Test Description

The numbers below refer to the step numbers on the diagnostic table.

> **2:** The A/C compressor relay output is disabled if engine coolant temperature is above 124°C (255°F).
>
> **3:** Placing the fan switch in the ON position, along with placing the air temperature control switch in a cold setting, activates A/C operation. For the purpose of this and

future steps where A/C operation is necessary, bi-level mode is used for consistent testing.

6: The HVAC control module is inoperative when the module does not respond to any operator control requests to enable the A/C compressor. The blower motor may still operate independent of the A/C controls.

HVAC Compressor Clutch Does Not Engage

Step	Action	Values	Yes	No
Schematic Reference: HVAC Schematics **Connector End View Reference: HVAC Connector End Views** DEFINITION: The A/C compressor clutch will not engage when an A/C request has been made and a Powertrain DTC has not been set.				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Install a scan tool. 2. Start the engine. 3. With a scan tool, observe the Engine Coolant Temperature Sensor (ECT) parameter in the Powertrain data list. Does the scan tool indicate that the ECT parameter is above the specified temperature?	124°C (255°F)	Go to **Engine Overheating**	Go to **Step 3**
3	**IMPORTANT:** **Ambient air temperature must be above 3°C (38°F).** 1. Start the engine. 2. Place the blower motor switch in the maximum speed position. 3. Place the A/C request switch in the ON position. 4. Place the air temperature switch in the coldest position. Does the A/C compressor operate?	-	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 4**
	1. Park the vehicle inside or in the shade.			

4	2. Open the windows in order to ventilate the interior of the vehicle. 3. Turn OFF the ignition. 4. Install the **J 43600** ACR 2000 Air Conditioning Service Center. 5. Record the ambient air temperature at the vehicle. 6. Record readings of the low and high side STATIC pressures. 7. Compare the pressure values with the specifications for the ambient air temperature. Refer to **Air Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)** . Are the pressure values within specifications for the ambient air temperature, and within 103 kPa (15 psi) of each other?	-	Go to **Step 5**	Go to 48125
5	1. Turn ON the ignition, with the engine OFF. 2. With a scan tool, observe the A/C High Side Pressure parameter in the Powertrain Control Module engine data 2 list. 3. Compare the A/C High Side Pressure on the scan tool to the high side pressure value on the **J 43600** . Are the high side pressure values within 103 kPa (15 psi) of each other?	-	Go to **Step 6**	Go to **Step 16**
6	Is the HVAC control module inoperative?	-	Go to **Step 15**	Go to **Step 7**

7	1. Start the engine. 2. With a scan tool, observe the A/C Request Signal parameter in the Powertrain Control Module engine data 2 list. 3. Place the air temperature switch in the coldest position. 4. Place the A/C request switch in the ON position. Does the scan tool indicate that the A/C Request Signal parameter is YES?	-	Go to **Step 8**	Go to **Step 27**
8	With a scan tool, observe the A/C Relay Command status in the powertrain control module (PCM) data list. Does the scan tool indicate that the A/C Relay Command status is ON?	-	Go to **Step 9**	Go to **Step 28**
9	With a scan tool, command the A/C Relay ON and OFF. Does the A/C compressor clutch relay turn ON and OFF with each command?	-	Go to **Step 13**	Go to **Step 10**
10	1. Turn OFF the ignition. 2. Disconnect the A/C compressor clutch relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the coil side battery positive voltage circuit of the A/C compressor clutch relay with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 11**	Go to **Step 23**
	1. Connect a test lamp between the A/C compressor clutch relay control circuit of the A/C compressor clutch relay and the coil side battery positive voltage			

11	supply circuit of the A/C compressor clutch relay. 2. With a scan tool, command the A/C Relay ON and OFF. Does the test lamp turn ON and OFF with each command?	-	Go to **Step 25**	Go to **Step 12**
12	Does the test lamp remain illuminated with each command?	-	Go to **Step 19**	Go to **Step 18**
13	1. Turn OFF the ignition. 2. Disconnect the A/C compressor clutch relay. 3. Probe the switch side battery positive voltage circuit of the A/C compressor clutch relay with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 14**	Go to **Step 22**
14	Connect a 10-amp fused jumper wire between the switch side battery positive voltage circuit of the A/C compressor clutch relay and the A/C compressor clutch supply voltage circuit of the A/C compressor clutch. Does the A/C compressor clutch engage?	-	Go to **Step 25**	Go to **Step 20**
15	Test the ignition 3 voltage circuit of the HVAC control module for the following: - A short to ground - A high resistance - An open Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 34**	Go to **Step 17**
	Test the ground circuit of the A/C refrigerant pressure sensor for an			

16	open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 34**	Go to **Step 24**
17	Test the ground circuit of the HVAC control module for an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 34**	Go to **Step 27**
18	Test the A/C compressor clutch relay control circuit of the A/C compressor clutch relay for an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 34**	Go to **Step 28**
19	Test the A/C compressor clutch relay control circuit of the A/C compressor clutch relay for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 34**	Go to **Step 28**
20	Test the A/C compressor clutch supply voltage circuit at the A/C compressor clutch for the following: • A short to ground • A high resistance • An open Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 34**	Go to **Step 21**
21	Test the ground circuit of the A/C compressor clutch for a high resistance or an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the	-		Go to **Step**

	condition?		Go to **Step 34**	**26**
22	Repair the switch side battery positive voltage circuit of the A/C compressor clutch relay. Refer to **Wiring Repairs** . Did you complete the repair?	-	Go to **Step 34**	-
23	Repair the coil side battery positive voltage circuit of the A/C compressor clutch relay. Refer to **Wiring Repairs** . Did you complete the repair?	-	Go to **Step 34**	-
24	Inspect for poor connections at the harness connector of the A/C refrigerant pressure sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 34**	Go to **Step 29**
25	Inspect for poor connections at the A/C compressor clutch relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 34**	Go to **Step 30**
26	Inspect for poor connections at the harness connector of the A/C compressor clutch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 34**	Go to **Step 31**
27	Inspect for poor connections at the harness connector of the HVAC control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 34**	Go to **Step 32**
	Inspect for poor connections at the			

28	harness connector of the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 34**	Go to **Step 33**
29	Replace the A/C refrigerant pressure sensor. Refer to **Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 34**	-
30	Replace the A/C compressor clutch relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	-	Go to **Step 34**	-
31	Replace the A/C compressor clutch. Refer to **Compressor Clutch Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 34**	-
32	Replace the HVAC control module. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 34**	-
33	Replace the PCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 34**	-
34	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 4**

HVAC COMPRESSOR CLUTCH DOES NOT DISENGAGE

HVAC Compressor Clutch Does Not Disengage

Step	Action	Values	Yes	No
Schematic Reference: HVAC Schematics **Connector End View Reference: HVAC Connector End Views** DEFINITION: The A/C compressor clutch will not disengage when an A/C request has not been made and a Powertrain DTC has not been set.				
	Did you perform the Diagnostic			Go to

1	System Check - Vehicle?	-	Go to **Step 2**	**Diagnostic System Check - Vehicle**
2	1. Start the engine. 2. Place the blower motor switch in the OFF position. 3. Place the A/C request switch in the OFF position. Does the A/C compressor operate?	-	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections**
3	With a scan tool, observe the A/C Relay Command status in the powertrain control module (PCM) engine data 2 list. Does the scan tool indicate that the A/C Relay Command status is ON?	-	Go to **Step 4**	Go to **Step 5**
4	With a scan tool, observe the A/C Request Signal parameter in the PCM engine data 2 list. Does the scan tool indicate that the A/C Request Signal parameter is YES?	-	Go to **Step 10**	Go to **Step 11**
5	Remove the A/C compressor clutch relay. Does the A/C compressor clutch turn OFF?	-	Go to **Step 6**	Go to **Step 8**
6	Measure the resistance between the switch side A/C compressor clutch relay terminals. Does the resistance measurement equal the specified value?	infinity	Go to **Step 7**	Go to **Step 9**
7	Test the A/C compressor clutch relay control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 11**
8	Test the A/C compressor clutch supply voltage circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** .	-		

	Did you find and correct the condition?		Go to **Step 16**	Go to **Step 13**
9	Inspect for poor connections at the A/C compressor clutch relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 12**
10	Inspect for poor connections at the harness connector of the HVAC control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 14**
11	Inspect for poor connections at the harness connector of the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 15**
12	Replace the A/C compressor clutch relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	-	Go to **Step 16**	-
13	Replace the A/C compressor clutch. Refer to **Compressor Clutch Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
14	Replace the HVAC control module. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 16**	-
15	Replace the PCM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 16**	-

16	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 3**

BLOWER MOTOR ALWAYS ON

Blower Motor Always On

Step	Action	Values	Yes	No
Schematic Reference: HVAC Schematics **Connector End View Reference: HVAC Connector End Views** DEFINITION: The blower motor is ON while the HVAC control is in the OFF position.				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn ON the ignition, with the engine OFF. 2. Turn OFF the HVAC controls. Is the blower motor OFF?	-	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	1. Install a scan tool. 2. With the scan tool, observe the Desired Blower Mtr Speed parameter in the Heating and Air Conditioning data list. Does the scan tool indicate that the Desired Blower Mtr Speed parameter is near the specified value?	0 counts	Go to **Step 4**	Go to **Step 7**
4	Disconnect the HVAC control module. Does the blower motor continue to operate?	-	Go to **Step 5**	Go to **Step 7**
5	Inspect or test the blower motor housing and the blower motor speed control circuit in the blower motor harness for a short to ground. Refer to **Circuit Testing** and**Wiring Repairs** . Did you find and correct the	-		

	condition?		Go to **Step 10**	Go to **Step 6**
6	Inspect for poor connections at the harness connector of the blower motor control processor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 8**
7	Inspect for poor connections at the harness connector of the HVAC control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 9**
8	Replace the blower motor control processor. Refer to **Blower Motor Replacement** . Did you complete the replacement?	-	Go to **Step 10**	-
9	Replace the HVAC control module. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 10**	-
10	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 3**

BLOWER MOTOR INOPERATIVE

Blower Motor Inoperative

Step	Action	Values	Yes	No
Schematic Reference: HVAC Schematics **Connector End View Reference: HVAC Connector End Views** DEFINITION: The blower motor is inoperative in all speed positions.				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**

2	1. Turn ON the ignition, with the engine OFF. 2. Place the blower switch in each speed position. Does the blower motor operate in any of the speed positions?	-	Go to **Blower Motor Malfunction**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the blower motor connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the blower motor supply voltage circuit and the blower motor control circuit. 5. Place the blower motor switch in the minimum speed position. Does the test lamp illuminate?	-	Go to **Step 9**	Go to **Step 4**
4	Test the battery positive voltage circuit of the blower motor control processor for an open, a high resistance or a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 5**
5	Test the ground circuit of the blower motor control processor for an open or a high resistance. Refer to **Circuit Testing** and**Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 6**
	IMPORTANT: **Ensure that the blower motor control processor connector and**			

6	**the HVAC control module connectors are connected during this step in order to avoid misdiagnosis.** 1. Measure the voltage from the blower motor speed control circuit at the HVAC control module to a good ground. 2. With a scan tool, command the blower motor OFF and ON. Does the voltage measure near the specified values for each commanded state?	5 V OFF 1 V ON	Go to **Step 10**	Go to **Step 7**	
7	1. Turn OFF the ignition. 2. Disconnect the HVAC control module. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the blower motor speed control circuit of the HVAC control module to a good ground. Does the voltage measure near the specified value?	5 V	Go to **Step 11**	Go to **Step 8**	
8	Test the blower motor speed control circuit of the HVAC control module for an open, short to ground or short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?		Go to **Step 15**		Go to **Step 10**
	Inspect for poor connections at the harness connector of the blower motor. Refer to				

9	**Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
10	Inspect for poor connections at the harness connector of the blower motor control processor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
11	Inspect for poor connections at the harness connector of the HVAC control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
12	Replace the blower motor. Refer to **Blower Motor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
13	Replace the blower motor control processor. Refer to **Blower Motor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the HVAC control module. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 15**	-
15	Operate the system in order to verify the repair.	-		

	Did you correct the condition?		System OK	Go to **Step 2**

BLOWER MOTOR MALFUNCTION

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step will determine if one or more blower speeds are inoperative.

3: This step determines if the HVAC control module and blower motor control processor are attempting to control the blower motor speed.

5: The measured voltage on the blower motor speed control circuit should steadily decrease from 4.6 volts to 1.1 volts as the blower motor speed is adjusted from the minimum speed position to the maximum speed position.

Blower Motor Malfunction

Step	Action	Values	Yes	No
Schematic Reference: HVAC Schematics **Connector End View Reference: HVAC Connector End Views** DEFINITION: The blower motor operates in at least one, but not all, speed positions.				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn ON the ignition, with the engine OFF. 2. Place the blower motor switch in each speed position. Does the blower motor operate at the desired speeds?	-	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the blower motor connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the blower motor supply voltage circuit and the blower motor control circuit. 5. Place the blower motor switch	-		

	from the minimum speed position to the maximum speed position. Does the test lamp illuminate and increase intensity?		Go to **Step 7**	Go to **Step 4**
4	Test the battery positive voltage circuit and ground circuit of the blower motor control processor for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 5**
5	**IMPORTANT:** **Ensure that the blower motor control processor and HVAC control module connectors are connected during this step in order to avoid misdiagnosis.** 1. Backprobe and measure the voltage from the blower motor speed control circuit at the HVAC control module to a good ground. 2. Gradually adjust the blower motor switch from the minimum speed position to the maximum speed position. Does the measured voltage continuously decrease between the specified values?	4.7-1 V	Go to **Step 8**	Go to **Step 6**
6	1. Turn OFF the ignition. 2. Disconnect the HVAC control module. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the blower motor speed control circuit of the HVAC control module to a good ground. Does the voltage measure near the	5 V		

	specified value?		Go to **Step 8**	Go to **Step 9**
7	Inspect for poor connections at the harness connector of the blower motor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
8	Inspect for poor connections at the harness connector of the blower motor control processor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 11**
9	Inspect for poor connections at the harness connector of the HVAC control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
10	Replace the blower motor. Refer to **Blower Motor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
11	Replace the blower motor control processor. Refer to **Blower Motor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	Replace the HVAC control module. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 13**	-
13	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 2**

TOO HOT IN VEHICLE

Too Hot in Vehicle

Step	Action	Values	Yes	No
Schematic Reference: HVAC Schematics **Connector End View Reference: HVAC Connector End Views** DEFINITION: The temperature cannot be adjusted, or the cooling is insufficient during A/C operation.				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn ON the ignition, with the engine OFF. 2. Place the blower motor switch in each speed position. Does the blower motor operate in any of the speed positions?	-	Go to **Step 3**	Go to **Blower Motor Inoperative**
3	Does the blower motor operate at the desired speeds?	-	Go to **Step 4**	Go to **Blower Motor Malfunction**
4	When the A/C is ON, does the customer concern occur?	-	Go to **Step 5**	Go to **Step 7**
5	1. Start the engine. 2. Place the blower motor switch in the maximum speed position. 3. Place the mode switch in the MAX position. Does the recirculation door move to the recirculation position?	-	Go to **Step 6**	Go to **Air Delivery Improper**
6	1. Place the blower motor switch in the maximum speed position. 2. Place the mode switch in the MAX position. 3. Place the temperature switch in the coldest position. Does the A/C compressor operate?	-	Go to **Step 7**	Go to **HVAC Compressor Clutch Does Not Engage**
	Perform the refrigerant system performance test. Refer to **Air**			

7	**Conditioning (A/C) System Performance Test (LZE, LZ4, LZ9)** or **Air Conditioning (A/C) System Performance Test (LS4)** . Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 8**
8	1. Observe the drive shaft of the air temperature actuator. 2. Place the air temperature switch from the coldest position to the warmest position. Does the air temperature actuator drive shaft rotate at all?	-	Go to **Step 9**	Go to **Step 10**
9	Inspect the air temperature door and the air temperature actuator for the following conditions: • A misaligned air temperature actuator-Refer to **Air Temperature Actuator Replacement - Right** or **Air Temperature Actuator Replacement - Left**. • Broken or binding linkages or air temperature door • An obstruction that prevents the air temperature door from operating within its full range of motion • Missing seals to the air temperature door • Misaligned seals to the air temperature door Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 10**
10	Test the control A and control B circuits of the air temperature actuator for an open or a high resistance. Refer to **Circuit Testing** and **Wiring**	-		

	Repairs . Did you find and correct the condition?		Go to **Step 18**	Go to **Step 11**
11	1. Connect a test lamp between the air temperature actuator control A circuit and the control B circuit. 2. Move the air temperature control from hot to cold. Does the test lamp illuminate with each command?	-	Go to **Step 14**	Go to **Step 12**
12	Test the ignition 3 voltage circuit of the HVAC control module for the following: - An open - A high resistance - A short to ground Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 13**
13	Test the ground circuit of the HVAC control module for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 15**
14	Inspect for poor connections at the harness connector of the air temperature actuator. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 16**
	Inspect for poor connections at the harness connector of the HVAC control module. Refer to **Testing for**			

15	**Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 17**
16	Replace the air temperature actuator. Refer to **Air Temperature Actuator Replacement - Right** or **Air Temperature Actuator Replacement - Left**. Did you complete the replacement?	-	Go to **Step 18**	-
17	Replace the HVAC control module. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 18**	-
18	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 2**

TOO COLD IN VEHICLE

Too Cold in Vehicle

Step	Action	Values	Yes	No
Schematic Reference: HVAC Schematics **Connector End View Reference: HVAC Connector End Views** DEFINITION: The temperature cannot be adjusted, or the heating is insufficient.				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn ON the ignition, with the engine OFF. 2. Place the blower motor switch in each speed position. Does the blower motor operate in any of the speed positions?	-	Go to **Step 3**	Go to **Blower Motor Inoperative**
3	Does the blower motor operate at the desired speeds?	-	Go to **Step 4**	Go to **Blower Motor Malfunction**

4	Inspect the cooling system for the following conditions: - A low coolant level - A loose or worn accessory drive belt - A leaking radiator hose or heater hose - A kinked radiator hose or heater hose - A missing radiator cap pressure seal - A leaking radiator cap Refer to **Heating Performance Diagnostic** . Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 5**
5	1. Start the engine. 2. Place the blower motor switch in the maximum speed position. 3. Place the mode switch in the MAX position. Does the recirculation door move to the recirculation position?	-	Go to **Step 6**	Go to **Air Delivery Improper**
6	Place the mode switch in the VENT or HTR positions. Does the A/C compressor operate?	-	Go to **HVAC Compressor Clutch Does Not Disengage**	Go to **Step 7**
7	1. Observe the drive shaft of the air temperature actuator. 2. Place the air temperature switch from the coldest position to the warmest position. Does the air temperature actuator drive shaft rotate at all?	-	Go to **Step 8**	Go to **Step 10**
	Inspect the air temperature door and			

8	the air temperature actuator for the following conditions: • A misaligned air temperature actuator-Refer to **Air Temperature Actuator Replacement - Right** or **Air Temperature Actuator Replacement - Left**. • Broken or binding linkages or air temperature door • An obstruction that prevents the air temperature door from operating within its full range of motion • Missing seals to the air temperature door • Misaligned seals to the air temperature door Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 9**
9	Test the air temperature actuator control A and control B circuits of the air temperature actuator for an open or a high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 10**
10	1. Connect a test lamp between the air temperature actuator control A circuit and the control B circuit. 2. Move the air temperature control from hot to cold. Does the test lamp illuminate with each command?	-	Go to **Step 13**	Go to **Step 11**
	Test the ignition 3 voltage circuit of the HVAC control module for the			

11	following: - An open - A high resistance - A short to ground Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 12**
12	Test the ground circuit of the HVAC control module for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 15**
13	Inspect for poor connections at the harness connector of the air temperature actuator. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 14**
14	Inspect the air temperature actuator, door and any attaching linkage for binding or a condition that prevents drive shaft rotation. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 16**
15	Inspect for poor connections at the harness connector of the HVAC control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 17**
16	Replace the air temperature actuator. Refer to **Air Temperature Actuator Replacement - Right** or **Air Temperature Actuator**	-		

	Replacement - Left. Did you complete the replacement?		Go to **Step 18**	-
17	Replace the HVAC control module. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 18**	-
18	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 2**

AIR DELIVERY IMPROPER

Air Delivery Improper

Step	Action	Yes	No
Schematic Reference: HVAC Schematics **Connector End View Reference: HVAC Connector End Views** DEFINITION: Air does not flow correctly from the air distribution outlets.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn ON the ignition, with the engine OFF. 2. Turn OFF the HVAC controls. Is the blower motor OFF?	Go to **Step 3**	Go to **Blower Motor Always On**
3	Place the blower motor switch in each speed position. Does the blower motor operate in each speed position?	Go to **Step 4**	Go to **Blower Motor Inoperative**
4	Does the blower motor operate at the desired speeds?	Go to **Step 5**	Go to **Blower Motor Malfunction**
5	1. Install a scan tool. 2. With a scan tool, observe the current DTC list. Does the scan tool display any DTCs?	Go to **49559**	Go to **Step 6**
6	Place the mode switch in each mode position. Does the air flow from the correct air distribution outlets in each selected mode	Go to **Testing for Intermittent Conditions and Poor**	

	position?	**Connections**	Go to **Step 7**
7	Inspect for poor connections at the harness connector of the HVAC control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 10**	Go to **Step 8**
8	Inspect and the air distribution system for the following conditions: • A restricted passenger compartment air filter • An obstruction restricting air flow • Air leaks • Misaligned ducts Did you find and correct the condition?	Go to **Step 10**	Go to **Step 9**
9	Replace the HVAC control module. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 10**	-
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

RE-CALIBRATING ACTUATORS

Calibration Procedure

Use the following steps to perform the calibration update:

1. Turn OFF the ignition.
2. Remove the battery positive voltage circuit fuse of the HVAC Control Module.

IMPORTANT: The module memory will not clear if the battery positive voltage circuit fuse is installed in less than 60 seconds.

3. Wait 60 seconds.
4. Install the fuse.

REPAIR INSTRUCTIONS

HVAC CONTROL ASSEMBLY REPLACEMENT

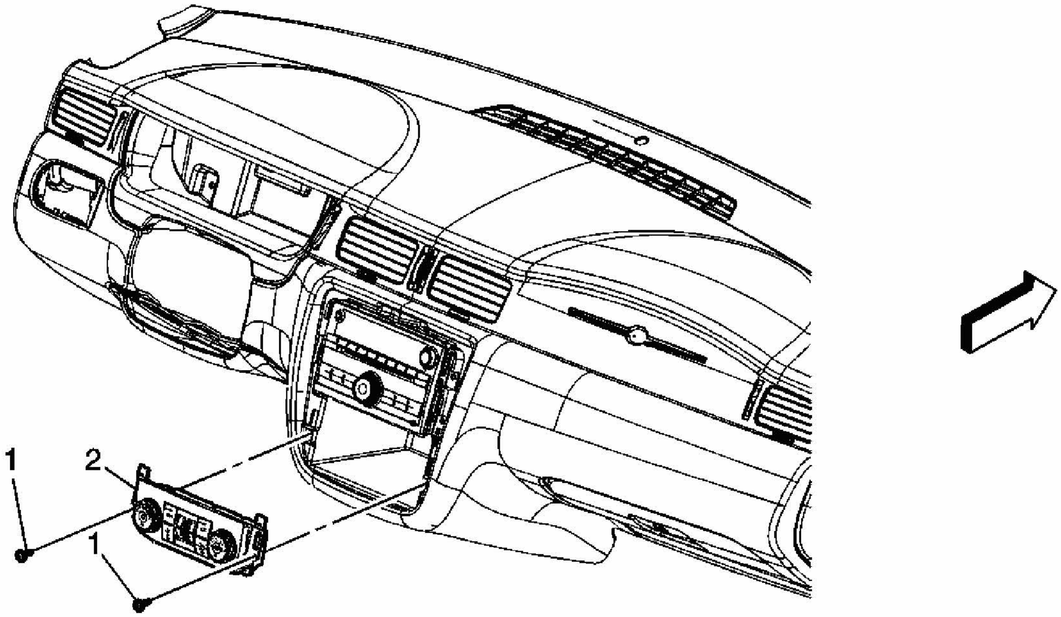


Fig. 21: Replacing HVAC Control Assembly
Courtesy of GENERAL MOTORS CORP.

HVAC Control Assembly Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the accessory trim plate. Refer to **Trim Plate Replacement - Instrument Panel (I/P) Accessory (Impala)** or **Trim Plate Replacement - Instrument Panel (I/P) Accessory (Monte Carlo)** .	
1	Screw, Heater and A/C Control Assembly (Qty: 2) **Tip:** Disconnect the HVAC control assembly electrical connector. **Tighten:** 1.5 N.m (13 lb in)
2	Control Assembly, Heater and Air Conditioning

RIGHT AIR TEMPERATURE ACTUATOR REPLACEMENT

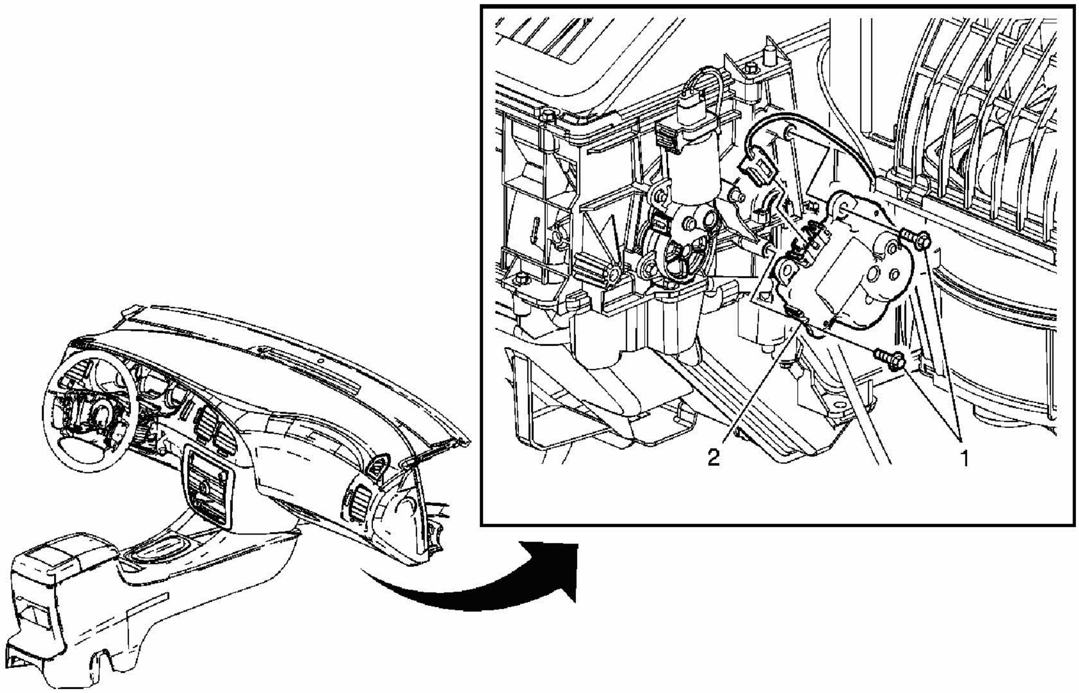


Fig. 22: Replacing Right Air Temperature Actuator
Courtesy of GENERAL MOTORS CORP.

Air Temperature Actuator Replacement - Right

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the instrument panel (I/P) compartment inner panel. Refer to **Instrument Panel Compartment Inner Panel Replacement (Impala)** . 2. Disconnect the right air temperature actuator electrical connector.	
1	Screw, Temperature Actuator - Right (Qty: 2) **Tighten:** 1.5 N.m (13 lb in)
2	Actuator, Temperature - Right

LEFT AIR TEMPERATURE ACTUATOR REPLACEMENT

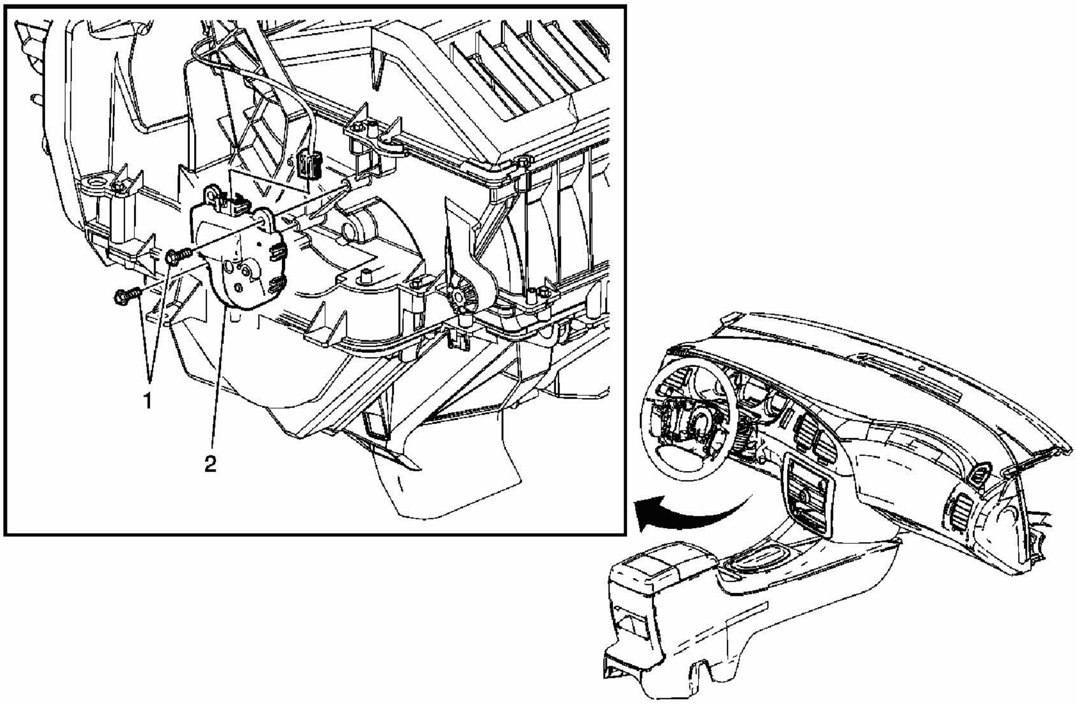


Fig. 23: Replacing Left Air Temperature Actuator
Courtesy of GENERAL MOTORS CORP.

Air Temperature Actuator Replacement - Left

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the left knee bolster bracket. Refer to **Knee Bolster Bracket Replacement - Left** . 2. Disconnect the left air temperature actuator electrical connector.	
1	Screw, Temperature Actuator - Left (Qty: 2) **Tighten:** 1.5 N.m (13 lb in)
2	Actuator, Temperature - Left

MODE ACTUATOR REPLACEMENT

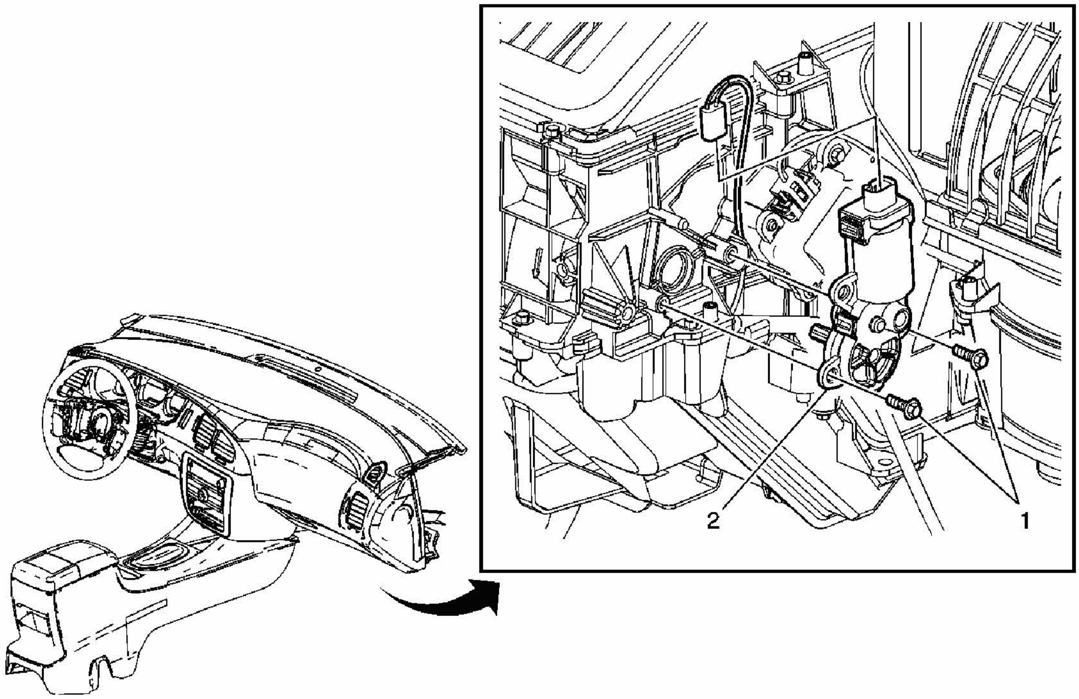


Fig. 24: Replacing Mode Actuator
Courtesy of GENERAL MOTORS CORP.

Mode Actuator Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications** . **Preliminary Procedure** 1. Remove the instrument panel (I/P) compartment. Refer to **Compartment Replacement - Instrument Panel (I/P) (Monte Carlo)** . 2. Disconnect the mode actuator electrical connector.	
1	Screw, Mode Actuator (Qty: 2) **Tighten:** 1.5 N.m (13 lb in)
2	Actuator, Mode

RECIRCULATION ACTUATOR REPLACEMENT

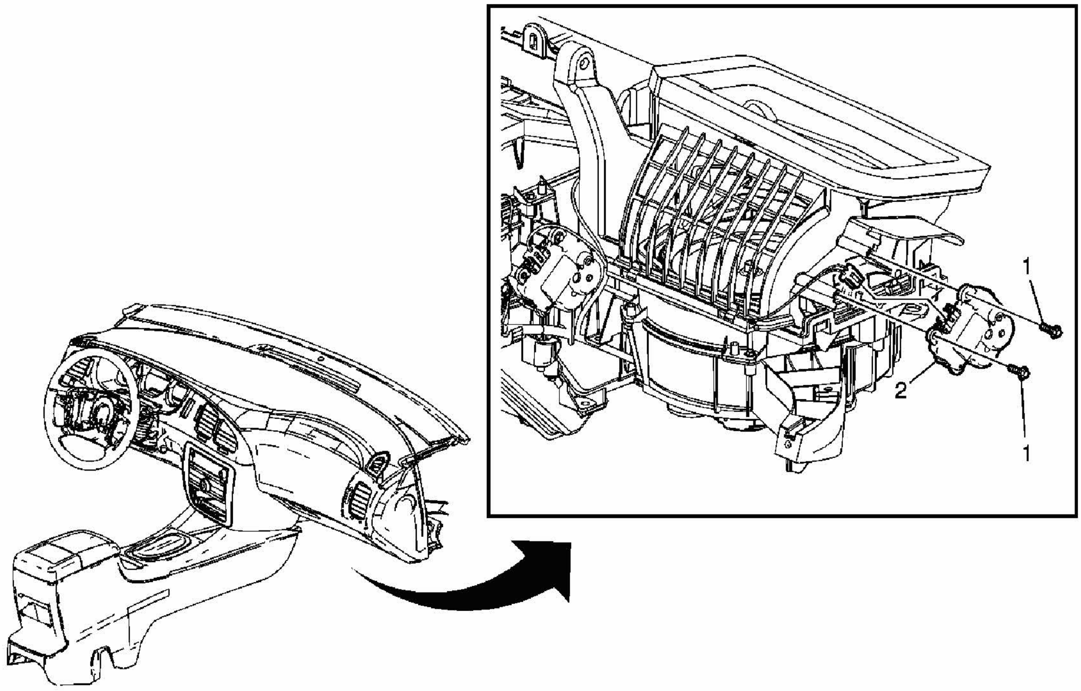


Fig. 25: Replacing Recirculation Actuator
Courtesy of GENERAL MOTORS CORP.

Recirculation Actuator Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the right closeout panel. Refer to **Closeout/Insulator Panel Replacement - Right** . 2. Disconnect the recirculation actuator electrical connector.	
1	Screw, Recirculation Actuator (Qty: 2) **Tighten:** 1.5 N.m (13 lb in)
2	Actuator, Recirculation

DESCRIPTION AND OPERATION

AIR DELIVERY DESCRIPTION AND OPERATION

The air delivery controls are divided into 4 areas:

- HVAC Control Components
- Air Speed
- Air Distribution
- Recirculation Operation

HVAC Control Components

HVAC Control Module

The HVAC control module is a Class 2 device that interfaces between the operator and the HVAC system to maintain air temperature and distribution settings. The battery positive voltage circuit provides power that the control module uses for keep alive memory (KAM). If the battery positive voltage circuit loses power, all HVAC DTCs and settings will be erased from KAM. The control module supports the following features:

Air Delivery Description and Operation

Feature	Availability
Afterblow	Optional
Purge	No
Personalization	No
Actuator Calibration	Yes

Mode/Recirculation Actuator

The mode/recirculation actuator is a 2 wire bi-directional electric motor. Two control circuits enable the actuator to operate. The control circuits use either a 0 or 12-volt value to coordinate the actuator movement. When the actuator is at rest, both control circuits have a value of 0 volts. In order to move the actuator, the HVAC control module grounds the appropriate control circuit for the commanded direction. The HVAC control module reverses the polarity of the control circuits to move the actuator in the opposite direction.

The HVAC control module determines the door position by counting motor pulses on one of the control circuits. These pulses are small voltage fluctuations that occur when the brush is shorted across 2 commutator contacts as the motor rotates. As the actuator shaft rotates, the HVAC control module monitors the voltage drop across an internal resistance to detect the pulses. The HVAC control module converts the pulses to counts with a range of 0-255 counts. The HVAC control module uses a range of 0-255 counts to index the actuator position.

Mode Valve Assembly

The film valve system has several operating characteristics:

- The cycle time for a mode change will vary based on the starting point of the film valve relative to the requested mode position.
- The maximum time to achieve a mode change occur when the film valve travels between vent and defrost.
- Mode change times may very slightly based on variations in system airflow, temperature and voltage.
- The amount of air rush noise heard when a mode change is requested that causes the film valve to move through 3 or more primary modes is dependent on blower speed.
- Recalibration will typically occur when the engine is OFF. The actuator noise heard during recalibration may be more noticeable than during normal operation.

Blower Motor Control Processor

The blower motor control processor is an interface between the HVAC control module and the blower motor. The blower motor speed control, battery positive voltage and ground circuits enable the control processor to operate. The HVAC control module provides a pulse width modulation (PWM) signal to the control processor in order to command the blower motor speed. The processor supplies 12 volts to the blower motor through the blower motor voltage supply circuit. The control processor uses the blower motor ground as a low side control to adjust the blower motor speed.

Air Speed

The blower motor forces air to circulate within the vehicles interior. The vehicle operator determines the blower motor's speed by placing the blower motor switch in a desired speed position. The blower motor will only operate if the blower motor switch is in any position other than OFF, and the ignition switch is in the RUN position, with the exception of afterblow.

Once a blower speed is selected, the blower speed remains constant, until a new speed is selected.

As the requested blower speed increases, the following conditions occur:

- The HVAC control module increases the amount of time that the blower motor speed control circuit is modulated to ground.
- The voltage and duty cycle, measured between the blower motor speed control circuit and ground, decrease.

As the requested blower speed decreases, the following conditions occur:

- The HVAC control module decreases the amount of time that the blower motor speed control circuit is modulated to ground.
- The voltage and duty cycle, measured between the blower motor speed control circuit

and ground, increase.

Afterblow

Afterblow is a feature that dries the evaporator core by operating the blower motor after the engine is turned OFF. This reduces the amount of microbial growth that can create undesirable odors. The vehicle does not come equipped with the afterblow feature turned ON. If the afterblow feature is required due to an odor concern, it must be turned ON by the scan tool.

The following conditions must be met for afterblow to operate:

- The A/C compressor operated for more than 10 seconds.
- The A/C compressor, after operating for more than 10 seconds has not been deactivated for more than 10 minutes.
- The system voltage is at least 11 volts to start and 10 volts to continue to run.
- The ignition has been in the OFF position for at least 20 minutes.

Once the above conditions have been met, the following sequence of events will occur:

- The blower will run for 4 minutes at 59 percent blower speed.
- The recirculation door moves to the Outside Air position.
- The mode valve moves to the Floor position.

Air Distribution

The HVAC control module controls the mode actuator in order to distribute airflow to a desired outlet. The mode switch provides the vehicle operator with the ability to override the automatic setting. When the mode switch is moved to heater through Defrost positions, the A/C compressor clutch engages and the recirculation actuator will be moved to the Outside Air position. When VENT is pressed, the following will occur:

- The mode valve will be moved to the Panel position.
- The recirculation actuator will follow user request if the blower is ON and the power mode is in Run.
- The A/C compressor will follow user request if the blower is ON and the power mode is in Run.

Recirculation Operation

The HVAC control module controls the air intake through the recirculation actuator. Recirculation is not available when the mode is in heater through Defrost. The operator must activate the blower for Recirculation operation.

Remote Start

Remote Start Activation

The following describes the HVAC control head functionality upon receiving the remote start active serial data message and a power mode status is set to off/awake. The intake air temperature (IAT) on manual systems, is utilized to determine the moding of the following features: Blower Mode (Bi-level, Floor, Defrost, Recirc and Rear Defrost. These features are determined by the IAT during activation sequence and are maintained for the duration of engine run time. Calibrated temperatures are utilized to provide low, mid and high temperature ranges for the selectable feature. Blower and mode have the range to select any valid feature positions. When the remote start active serial data is received, ignition-OFF loop HVAC algorithms will act the same as if a run power mode was received, i.e. re-calibration, afterblow, ignition-OFF motor positioning etc. The OFF timer and the ignition ON timer have the functionality as in the Run mode.

Remote Start De-activation

When the remote start is exited, class 2 power mode equals run mode or remote start engine. In the case of manual settings, the displays will revert to the actual state of operation of the features, on the basis of their normal control algorithms.

AIR TEMPERATURE DESCRIPTION AND OPERATION

The air temperature controls are divided into 4 areas

- HVAC Control Components
- Heating and A/C Operation
- Engine Coolant
- A/C Cycle

HVAC Control Components

HVAC Control Module

The HVAC control module is a Class 2 device that interfaces between the operator and the HVAC system to maintain air temperature and distribution settings. The battery positive voltage circuit provides power that the control module uses for keep alive memory (KAM). If the battery positive voltage circuit loses power, all HVAC DTCs and settings will be erased from KAM. The control module supports the following features:

Air Temperature Description and Operation

Feature	Availability
Afterblow	Optional
Purge	No
Personalization	No
Actuator Calibration	Yes

Air Temperature Actuator

The air temperature actuator is a 2-wire bi-directional electric motor. Two control circuits enable the actuator to operate. The control circuits use either a 0-volt or 12-volt value to coordinate the actuator movement. When the actuator is at rest, both control circuits have a value of 0 volts. In order to move the actuator, the HVAC control module grounds the appropriate control circuit for the commanded direction. The HVAC control module reverses the polarity of the control circuits to move the actuator in the opposite direction.

The HVAC control module determines the door position by counting motor pulses on one of the control circuits. These pulses are small voltage fluctuations that occur when the brush is shorted across 2 commutator contacts as the motor rotates. As the actuator shaft rotates, the HVAC control module monitors the voltage drop across an internal resistance to detect the pulses. The HVAC control module converts the pulses to counts with a range of 0-255 counts. The HVAC control module uses a range of 0-255 counts to index the actuator position.

A/C Refrigerant Pressure Sensor

The A/C refrigerant pressure sensor is a 3-wire piezoelectric pressure transducer. A 5-volt reference, low reference, and signal circuits enable the sensor to operate. The A/C pressure signal can be between 0-5 volts. When the A/C refrigerant pressure is low, the signal value is near 0 volts. When the A/C refrigerant pressure is high, the signal value is near 5 volts.

The A/C refrigerant pressure sensor protects the A/C system from operating when an excessively high or low pressure condition exists. The powertrain control module (PCM) disables the compressor clutch under the following conditions:

- A/C pressure is more than 3034 kPa (440 psi). The clutch will be enabled after the pressure decreases to less than 2068 kPa (300 psi).
- A/C pressure is less than 241 kPa (35 psi). The clutch will be enabled after the pressure increases to more than 248 kPa (36 psi).

Heating and A/C Operation

The purpose of the heating and A/C system is to provide heated and cooled air to the interior of the vehicle. The A/C system will also remove humidity from the interior and reduce windshield fogging. The vehicle operator can determine the passenger compartment temperature by adjusting the air temperature switch. Regardless of the temperature setting, the following can affect the rate that the HVAC system can achieve the desired temperature:

- Recirculation actuator setting
- Difference between inside and desired temperature
- Difference between ambient and desired temperature
- Blower motor speed setting

- Mode setting

The A/C system can be engaged by either pressing the A/C switch or by selecting the following modes:

- Max A/C
- Heater
- Mix-Blend
- Front Defrost

The A/C LED will not illuminate unless the driver presses the A/C request switch on the HVAC control module. Otherwise, the A/C system may be running without the A/C LED indicator illuminated. The following conditions must be met in order for the powertrain control module (PCM) to turn ON the compressor clutch:

- The ambient air temperature is above 4°C (40°F).
- The engine coolant temperature (ECT) is less than 124°C (255°F).
- The A/C pressure is between 241-3034 kPa (35-440 psi).

Once engaged, the compressor clutch will be disengaged for the following conditions:

- The throttle position is 100 percent.
- The A/C pressure is more than 3034 kPa (440 psi).
- The A/C pressure is less than 241 kPa (35 psi).
- The engine coolant temperature (ECT) is more than 124°C (255°F).
- The engine speed is more than 5480 RPM for at least 409 seconds.
- A transmission shift has occurred.
- The PCM detects excessive torque load.
- The PCM detects insufficient idle quality.
- The PCM detects a hard launch condition.

When the compressor clutch disengages, the compressor clutch diode protects the electrical system from a voltage spike.

Remote Start

Remote Start Activation

The following describes the HVAC control head functionality upon receiving the remote start active serial data message and a power mode status is set to OFF/awake. The intake air temperature (IAT) on manual systems, is utilized to determine the moding of the following features: Blower Mode (Bi-level, Floor, Defrost, Recirc and Rear Defrost. These features are determined by the IAT during activation sequence and are maintained for the duration of engine run time. Calibrated temperatures are utilized to provide low, mid and high temperature ranges for the selectable feature. Blower and mode have the range to select any valid feature positions. When the remote start active serial data is received, ignition-OFF loop HVAC algorithms will act the same as if a run power mode was received, i.e. re-calibration, afterblow, ignition-OFF motor positioning etc. The OFF timer and the ignition ON timer have the functionality as in the Run mode.

Remote Start De-activation

When the remote start is exited, class 2 power mode equals run mode or remote start engine. In the case of manual settings, the displays will revert to the actual state of operation of the features, on the basis of their normal control algorithms.

Engine Coolant

Engine coolant is the key element of the heating system. The thermostat controls engine operating coolant temperature. The thermostat also creates a restriction for the cooling system that promotes a positive coolant flow and helps prevent cavitation. Coolant enters the heater core through the inlet heater hose in a pressurized state.

The heater core is located inside the HVAC module assembly. The heat of the coolant flowing through the heater core is absorbed by the ambient air drawn through the HVAC module assembly. Heated air is distributed to the passenger compartment through the HVAC module assembly for passenger comfort.

The amount of heat delivered to the passenger compartment is controlled by opening or closing the air temperature door. The coolant exits the heater core through the return heater hose and recirculates back through the engine cooling system.

A/C Cycle

Refrigerant is the key element in an air conditioning system. R-134a is presently the only EPA approved refrigerant for automotive use. R-134a is a very low temperature gas that can transfer the undesirable heat and moisture from the passenger compartment to the outside air.

A Delphi model CVC7 piston type compressor is used on this model year vehicle. The A/C compressor is belt driven and operates when the magnetic clutch is engaged. The compressor builds pressure on the vapor refrigerant, which adds heat to the refrigerant. The refrigerant is discharged from the compressor through the discharge hose and is forced to flow to the condenser and then through the balance of the A/C system. The A/C system is mechanically protected with the use of a high pressure relief valve. If the high pressure switch were to fail or if the refrigerant system becomes restricted and refrigerant pressure continues to rise, the high pressure relief will pop open and release refrigerant from the system.

Compressed refrigerant enters the condenser in a high temperature, high pressure vapor state.

As the refrigerant flows through the condenser, the heat of the refrigerant is transferred to the ambient air passing through the condenser. Cooling the refrigerant causes the refrigerant to condense and change from a vapor to a liquid state.

The condenser is located in front of the radiator for maximum heat transfer. The condenser is made of aluminum tubing and aluminum cooling fins, which allows rapid heat transfer for the refrigerant. The semi-cooled liquid refrigerant exits the condenser and flows through the liquid line to the TXV.

The TXV is located at the evaporator inlet. The TXV is the dividing point for the high and the low pressure sides of the A/C system. As the refrigerant passes through the TXV, the pressure on the refrigerant is lowered. Due to the pressure differential on the liquid refrigerant, the refrigerant will begin to boil at the TXV. The TXV also meters the amount of liquid refrigerant that can flow into the evaporator.

Refrigerant exiting the TXV flows into the evaporator core in a low pressure, liquid state. Ambient air is drawn through the HVAC module and passes through the evaporator core. Warm and moist air causes the liquid refrigerant to boil inside of the evaporator core. The boiling refrigerant absorbs heat from the ambient air and draws moisture onto the evaporator. The refrigerant exits the evaporator through the suction line and back to the compressor in a vapor state, and completes the A/C cycle of heat removal. At the compressor, the refrigerant is compressed again and the cycle of heat removal is repeated.

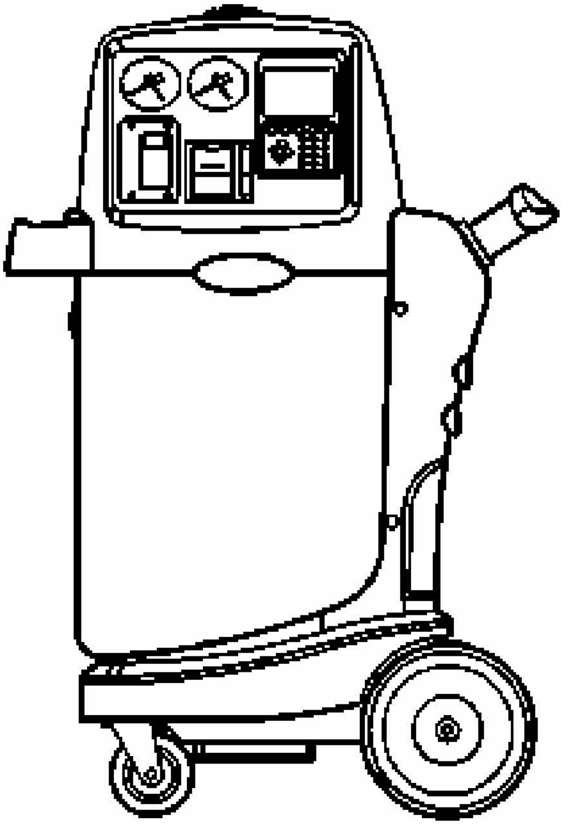
The conditioned air is distributed through the HVAC module for passenger comfort. The heat and moisture removed from the passenger compartment condenses and is discharged from the HVAC module as water.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description

	J 43600 ACR 2000 Air Conditioning Service Center

2006 BRAKES

Hydraulic Brakes - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Hose Bracket Bolts	10 N.m	89 lb in
Brake Hose to Brake Caliper Bolt	54 N.m	40 lb ft
Brake Pedal Bolt and Nut	40 N.m	30 lb ft
Brake Pedal Bracket Reinforcement Bolt	25 N.m	18 lb ft
Brake Pipe Fittings at Master Cylinder	18 N.m	13 lb ft
Brake Pipe Fittings at Pressure Modulator Valve	25 N.m	18 lb ft
Brake Pipe Fittings for Brake and Fuel Line Bundle	15 N.m	11 lb ft
Brake Pipe Fittings - Tube Nut - at the wheels	18 N.m	13 lb ft
EGR Valve Wiring Harness Heat Shield Nut and Bolt	10 N.m	89 lb in
Front Brake Pipe Retainer Bolt	6 N.m	53 lb in
Master Cylinder Mounting Nuts	33 N.m	24 lb ft
Rear Brake Pipe Clip Bolt	25 N.m	18 lb ft

BRAKE COMPONENT SPECIFICATIONS

Brake Component Specifications

Application	Specification	
	Metric	English
Brake Caliper Bleeder Valve - Front	13 N.m	115 lb in
Brake Caliper Bleeder Valve - Rear	11 N.m	97 lb in

BRAKE SYSTEM SPECIFICATIONS

Brake System Specifications

Application	Specification	
	Metric	English
Brake Pedal Travel • Maximum specification with 445 N (100	74 mm	2.91 in

lbs) of force applied to the brake pedal with the ignition OFF and the booster power reserve depleated		

SCHEMATIC AND ROUTING DIAGRAMS

BRAKE WARNING SYSTEM SCHEMATICS

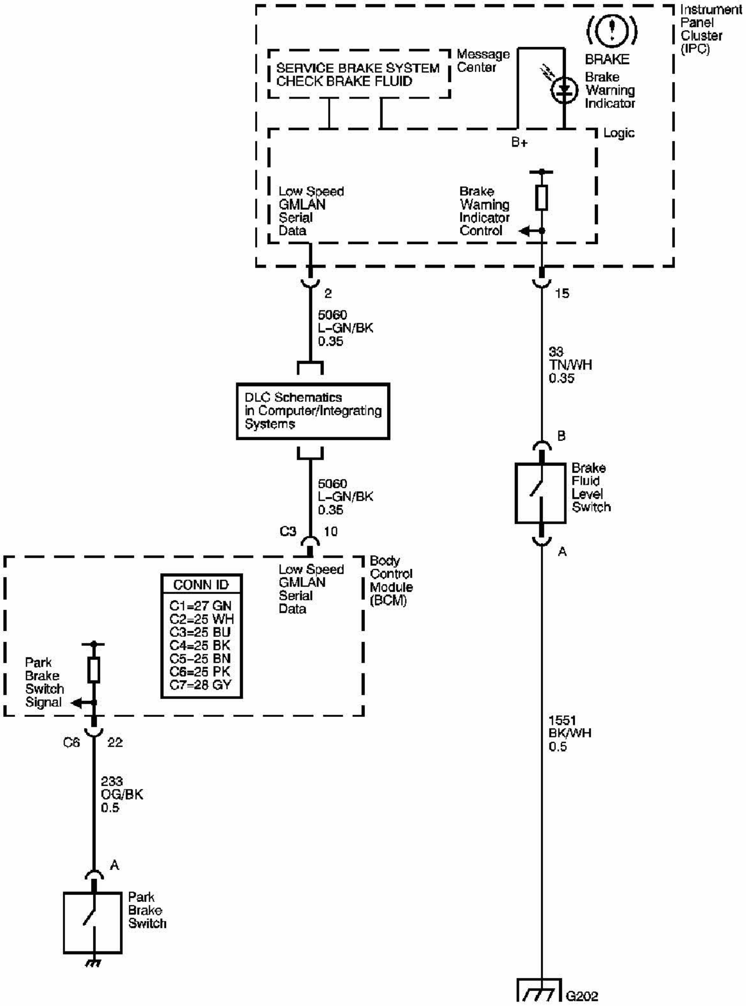

Instrument Panel Cluster (IPC)
SERVICE BRAKE SYSTEM CHECK BRAKE FLUID
Message Center
BRAKE
Brake Warning Indicator
B+
Logic
Low Speed GMLAN Serial Data
Brake Warning Indicator Control
2
5060 L-GN/BK 0.35
15
33 TN/WH 0.35
DLC Schematics in Computer/Integrating Systems
5060 L-GN/BK 0.35
B
Brake Fluid Level Switch
A
C3 10
Low Speed GMLAN Serial Data
Body Control Module (BCM)
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Park Brake Switch Signal
C6 22
233 OG/BK 0.5
A
Park Brake Switch
1551 BK/WH 0.5
G202

Fig. 1: Brake Warning System Schematics - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

HYDRAULIC BRAKES COMPONENT VIEWS

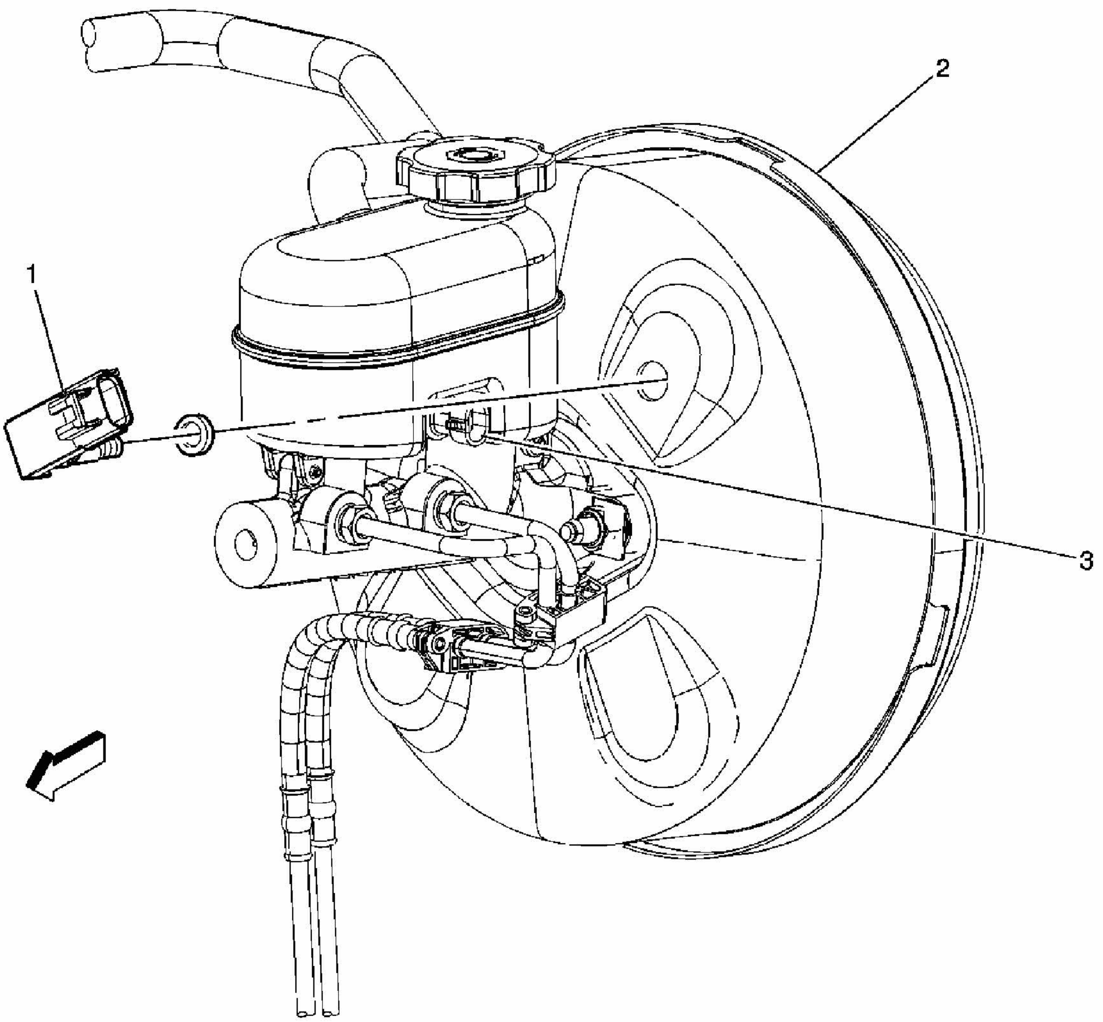


Fig. 2: Left Rear Of Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	Brake Booster Vacuum Sensor (LS4)
2	Brake Booster
3	Brake Fluid Level Switch

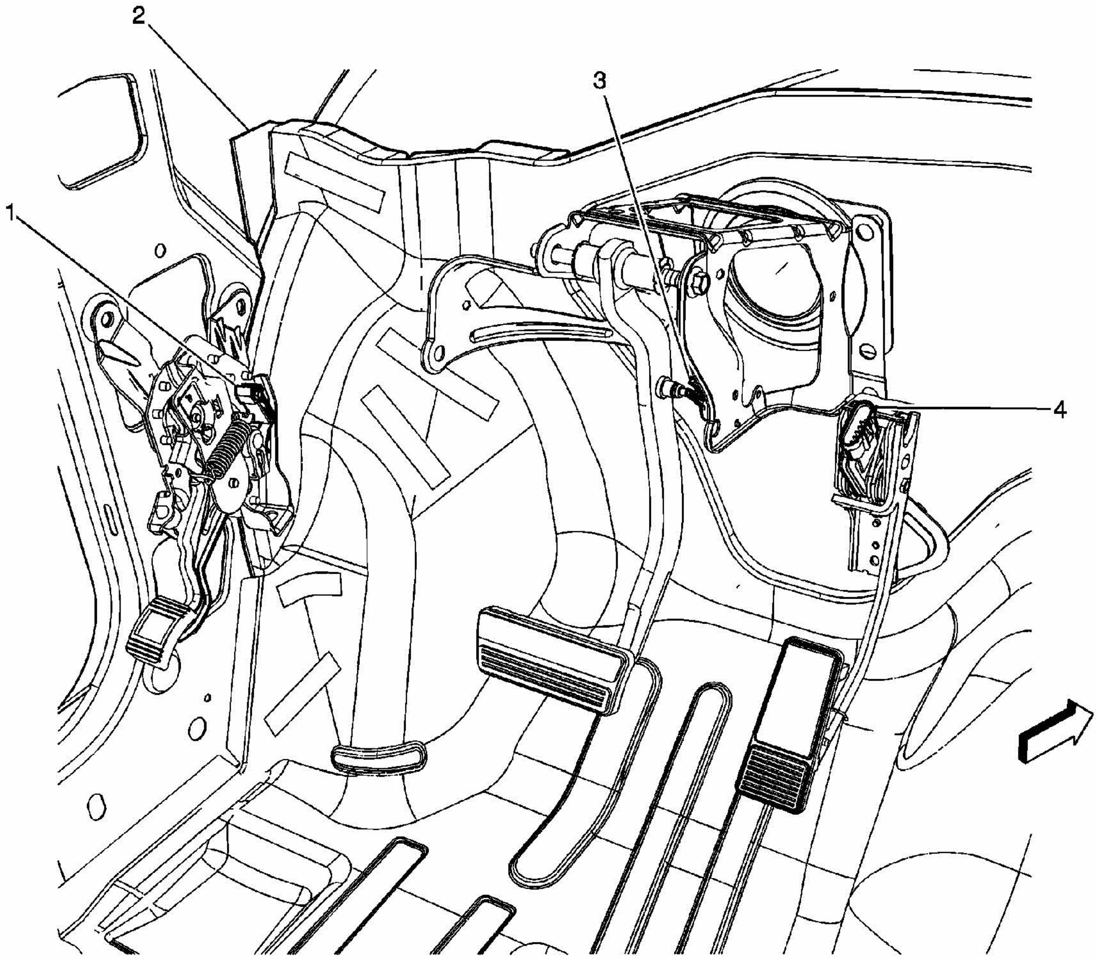


Fig. 3: Pedal Assemblies
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Park Brake Switch
2	Dash Panel
3	Brake Pedal Position Sensor
4	Accelerator Pedal Position (APP) Sensor

HYDRAULIC BRAKES CONNECTOR END VIEWS

Brake Fluid Level Switch

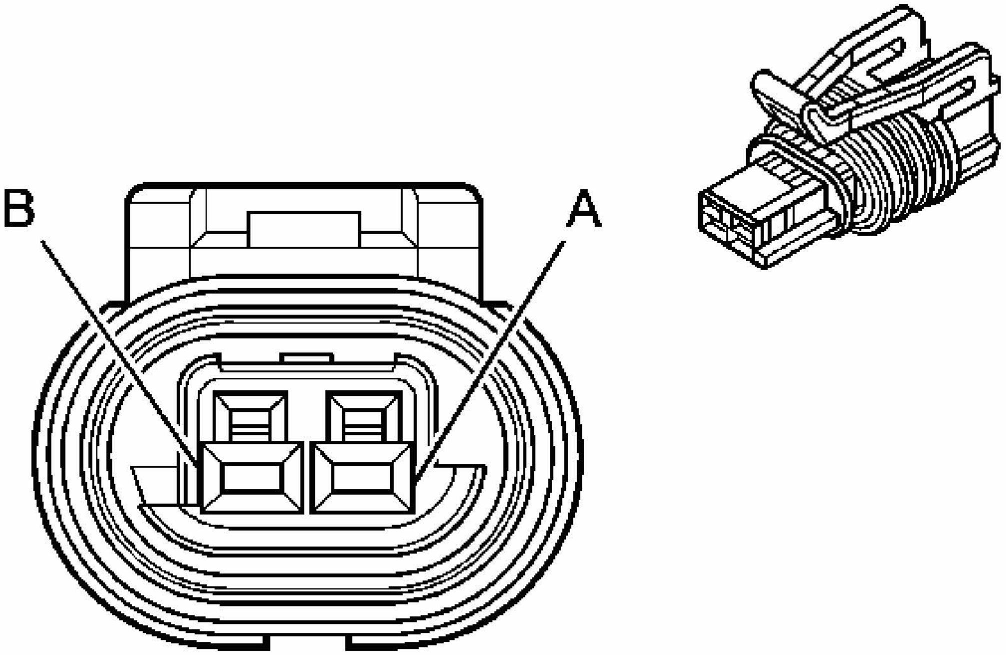


Fig. 4: Brake Fluid Level Switch Connector End View
Courtesy of GENERAL MOTORS CORP.

Hydraulic Brakes Connector End Views

Connector Part Information

- OEM: 15449028
- Service: 88987978
- Description: 2-Way F GT 150 Sealed (BK)

Terminal Part Information

- Terminal/Tray: 15326267/19
- Core/Insulation Crimp: E/4
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Brake Booster Vacuum Sensor

Pin	Wire Color	Circuit No.	Function
A	BK/WH	1551	Ground
B	TN/WH	6032	Brake Warning Indicator Control

Brake Fluid Level Switch

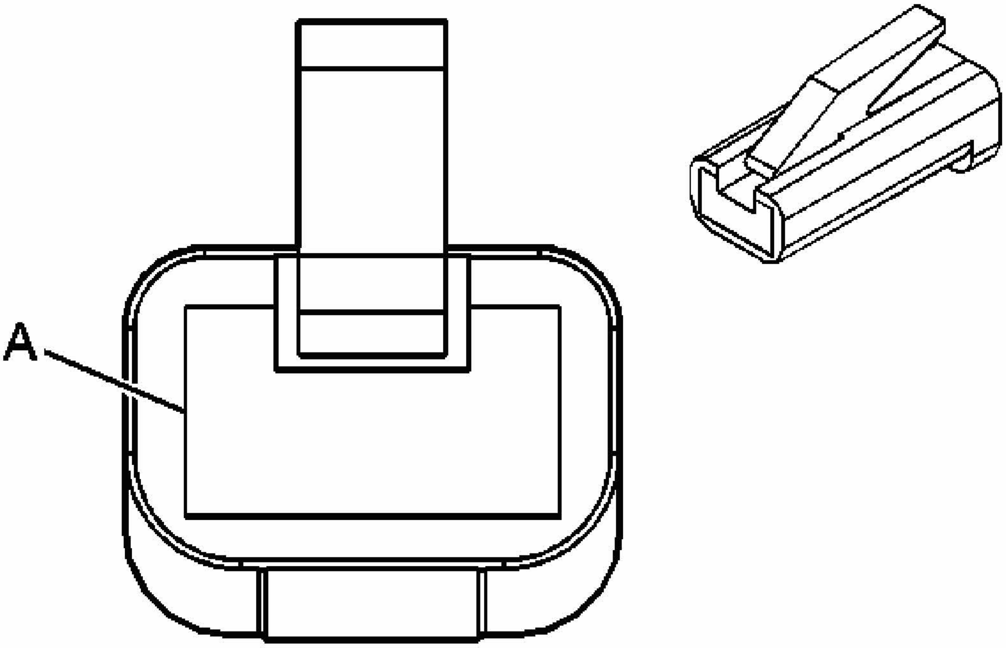


Fig. 5: Park Brake Switch Connector End View
Courtesy of GENERAL MOTORS CORP.

Hydraulic Brakes Connector End Views

Connector Part Information

- OEM: 12004267
- Service: 12102561
- Description: 1-Way F 56 (BK)

Terminal Part Information

- Terminal/Tray: 12124515/1
- Core/Insulation Crimp: C/D
- Release Tool/Test Probe: 12094430/J-35616-42 (RD)

Brake Fluid Level Switch

Pin	Wire Color	Circuit No.	Function
A	OG/BK	233	Park Brake Switch Signal

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - HYDRAULIC BRAKES

Begin the hydraulic brake system diagnosis with the **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system.
- The ability of the control modules to communicate through the serial data circuit.
- The identification of any stored diagnostic trouble codes (DTCs) and their status.

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL DATA LIST

Instrument Panel Cluster (IPC)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON, engine OFF, brake fluid level normal, and park brake released.			
Brake Fluid Switch	Data	OK/Low	OK
Park Brake Switch	Inputs	On/Off	Off

SCAN TOOL DATA DEFINITIONS

Brake Fluid Switch

The scan tool displays OK or Low. The status of the brake fluid level sensor signal.

Park Brake Switch

The scan displays Off or On. The status of the park brake switch signal.

DTC C0267

DTC Descriptor

DTC C0267

Low Brake Fluid Indicated

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC C0267

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Warning Indicator Control Circuit	C0267	-	-	-
Ground	-	-	-	-

Circuit/System Description

The brake fluid level switch monitors the level of brake fluid in the master cylinder. When the instrument panel cluster (IPC) sees the brake warning indicator control circuit grounded, it turns ON the brake warning indicator and sends a serial data message to the electronic brake control module (EBCM) that tells the EBCM that the brake fluid level is low.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

Low brake fluid is detected.

Action Taken When the DTC Sets

- The EBCM disables the ABS/TCS/DRP for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The Traction Control indicator turns ON.
- The red brake warning indicator turns ON.
- The driver information center (DIC) displays the SERVICE BRAKE SYSTEM/TRACTION SYSTEM message.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Reference Information

Schematic Reference

Brake Warning System Schematics

Connector End View Reference

ABS Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Verification

Inspect the master cylinder reservoir for the proper brake fluid level.

- If brake fluid level is low, refer to **Hydraulic Brake System Diagnosis**.

Circuit/System Testing

Note: This test should only be performed if brake fluid is not low.

1. With the park brake released and the ignition OFF, disconnect the brake fluid level switch connector. Ignition ON, verify the brake indicator lamp on IPC is illuminated.
    - If the Brake indicator lamp is not illuminated, replace the brake fluid level switch.
2. With the ignition ON, use a scan tool to observe the Brake Fluid Switch parameter in IPC. Verify parameter is OK.
    - If the Brake Fluid Switch parameter is Low, repair short to ground in the brake warning indicator control circuit.
3. Replace the IPC.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Master Cylinder Fluid Level Sensor Replacement**
- **Control Module References** for IPC replacement, setup, and programming

SYMPTOMS - HYDRAULIC BRAKES

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform **Diagnostic System Check - Vehicle** before using the brake indicator

symptom tables in order to verify that all of the following are true:
  - There are no DTCs set.
  - The control module(s) can communicate via the serial data link.
2. Perform the **Brake System Vehicle Road Test** before using the hydraulic brake symptom tables in order to duplicate the customer's concern.
3. Review the system operation in order to familiarize yourself with the system functions. Refer to the following:
   - **Brake Warning System Description and Operation**
   - **Hydraulic Brake System Description and Operation**
   - **Brake Assist System Description and Operation**
   - **Disc Brake System Description and Operation** in Disc Brakes

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the brake warning system. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Brake Warning Indicator Always On**
- **Brake Warning Indicator Inoperative**
- **Brake Pulsation**
- **Brake System Noise**
- **Braking Action Uneven - Pulls to One Side**
- **Braking Action Uneven - Front to Rear**
- **Brake Pedal Excessive Travel**
- **Brake Pedal Excessive Effort**
- **Brakes Drag**
- **Brake System Slow Release**
- **Brake Fluid Loss**

BRAKE WARNING INDICATOR ALWAYS ON

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The body control module (BCM) sees the park brake switch signal grounded, it sends a serial data message to the instrument panel cluster (IPC) requesting illumination of the red brake indicator.

Reference Information

Schematic Reference

Brake Warning System Schematics

Connector End View Reference

Computer/Integrating Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. With the scan tool, select instrument panel special functions Lamp Test. Command the instrument panel lamps OFF. Verify brake lamp turns OFF.
    - If the brake lamp does not turn OFF, replace the IPC.
2. Disconnect the park brake switch. With a scan tool, observe the Park Brake Switch parameter. Verify parameter is reading ON.
    - If the parameter is OFF, replace the park brake switch.
3. Test the park brake switch signal circuit for a short to ground. Verify no short is found.
    - If short is found, repair the circuit.
4. Replace the BCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Park Brake Warning Lamp Switch Replacement**
- **Control Module References** for IPC replacement, setup, and programming

BRAKE WARNING INDICATOR INOPERATIVE

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The instrument panel cluster (IPC) sees the brake fluid level switch input grounded and illuminates the red brake indicator. The body control module (BCM) sees the park brake switch input grounded, it sends a serial data message to the IPC requesting illumination of the red brake indicator.

Reference Information

Schematic Reference

Brake Warning System Schematics

Connector End View Reference

Computer/Integrating Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. With the scan tool, select instrument panel special functions Lamp Test. Command the instrument panel lamps ON. Verify brake lamp turns ON.

   - If the brake lamp does not turn ON, replace the IPC.
2. Release the park brake. Disconnect the brake fluid level switch. Connect a 3-amp jumper wire between the signal circuit of the brake fluid level switch and the ground circuit of the brake fluid level switch. Ignition ON, verify the brake lamp is ON.
   - If the brake lamp does not turn ON, test the signal circuit and ground circuit for a high resistance/open or replace the brake fluid level switch.
3. Disconnect the park brake switch. Connect a 3-amp jumper wire between signal circuit of the park brake switch and ground. Ignition ON, verify the brake lamp is ON.
   - If the brake lamp does not turn ON, test the signal circuit high resistance/open or replace the BCM.
4. Replace the park brake switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Master Cylinder Fluid Level Sensor Replacement**
- **Park Brake Warning Lamp Switch Replacement**
- **Control Module References** for BCM and IPC replacement, setup, and programming

BRAKE PULSATION

Test Description

The numbers below refer to the step numbers on the diagnostic table:

2: Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

3: Antilock brake system operation could produce feedback through the brake pedal during application of the brake system.

Brake Pulsation

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom Table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect the suspension system for proper operation. Refer to **Diagnostic Starting Point - Suspension General Diagnosis** in Suspension General Diagnosis.		

	Did you find and correct a condition?	Go to **Step 6**	Go to **Step 3**
3	Inspect the antilock brake system, if equipped, for proper operation. Refer to **Diagnostic Starting Point - Antilock Brake System** in Antilock Brake System. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 4**
4	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 5**
5	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
6	Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKE SYSTEM NOISE

Brake System Noise

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 3**
3	Inspect the brake assist system for proper operation. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 4**
4	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 5**
5	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to **Step 6**	Go to **Step 8**
	Ensure the park brake shoes are not adjusted		

6	too tightly, possibly causing a noise under certain conditions. Are the park brake shoes adjusted too tightly?	Go to **Step 7**	Go to **Step 8**
7	1. Clean and inspect the park brake shoes for excessive wear and/or damage. 2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration, heat spots, and excessive radial runout. 3. If any of these conditions are present, replace the affected components. 4. Adjust the park brake system. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 8**
8	Inspect the park brake system for proper operation. Refer to **Park Brake System Diagnosis** in Park Brake. Did you find and correct a condition?	Go to **Step 9**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
9	Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKING ACTION UNEVEN - PULLS TO ONE SIDE

Test Description

The numbers below refer to the step numbers on the diagnostic table:

2: Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

3: Steering components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

Braking Action Uneven - Pulls to One Side

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
	Inspect the suspension system for proper		

2	operation. Refer to **Diagnostic Starting Point - Suspension General Diagnosis** in Suspension General Diagnosis. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 3**
3	Inspect the steering system for proper operation. Refer to **Diagnostic Starting Point - Power Steering System (w/o Electro-Hydraulic Steering)** in Power Steering System. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 4**
4	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 5**
5	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
6	Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKING ACTION UNEVEN - FRONT TO REAR

Test Description

The number below refers to the step number on the diagnostic table:

> **2:** Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

Braking Action Uneven - Front to Rear

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect the suspension system for proper operation. Refer to **Diagnostic Starting Point - Suspension General Diagnosis** in Suspension General Diagnosis. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 3**

3	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 4**
4	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 5**
5	Inspect the brake assist system for proper operation. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
6	Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKE PEDAL EXCESSIVE TRAVEL

Brake Pedal Excessive Travel

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect for proper brake pedal travel. Refer to **Brake Pedal Travel Measurement and Inspection**. Is the brake pedal travel distance within the acceptable limits?	Go to **Step 5**	Go to **Step 3**
	1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. • For the brake pedal pushrod component inspection, refer to **Brake Pedal Pushrod Inspection** . • Inspect the brake pedal bushings for excessive wear and/or damage and inspect the brake pedal for a misaligned, bent, and/or damaged		

3	condition. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Refer to the following procedures as necessary: - **Brake Pedal Assembly Replacement** - **Vacuum Brake Booster Replacement (3.5L 3.9L) Vacuum Brake Booster Replacement (5.3L)**- for pedal pushrod replacement Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to **Step 4**	Go to **Step 5**
4	Inspect for proper brake pedal travel. Refer to **Brake Pedal Travel Measurement and Inspection**. Is the brake pedal travel distance within the acceptable limits?	Go to **Step 8**	Go to **Step 5**
5	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 8**	Go to **Step 6**
6	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 8**	Go to **Step 7**
7	Inspect the brake assist system for proper operation. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 8**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
8	Road test the vehicle to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKE PEDAL EXCESSIVE EFFORT

Brake Pedal Excessive Effort

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect the brake assist system for proper operation. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 3**
3	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 4**
4	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
5	Road test the vehicle to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKES DRAG

Brakes Drag

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Is the vehicle equipped with an adjustable stop lamp switch and/or an adjustable cruise control release switch?	Go to **Step 3**	Go to **Step 4**
3	1. Inspect the stop lamp switch for proper adjustment to ensure that the brake pedal is fully releasing. 2. Inspect the cruise control release switch, if equipped, for proper adjustment to ensure that the brake pedal is fully releasing. Did you find and correct a condition?	Go to **Step 14**	Go to **Step 4**

4	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to **Step 5**	Go to **Step 7**
5	Ensure the park brake shoes are not adjusted too tightly, possibly causing drag under certain conditions. Are the park brake shoes adjusted too tightly?	Go to **Step 6**	Go to **Step 7**
6	1. Clean and inspect the park brake shoes for excessive wear and/or damage. 2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration, heat spots, and excessive radial runout. 3. If any of these conditions are present, replace the affected components. 4. Adjust the park brake system Did you find and correct a condition?	Go to **Step 14**	Go to **Step 7**
7	Inspect the park brake system for proper operation. Refer to **Park Brake System Diagnosis** in Park Brake. Did you find and correct a condition?	Go to **Step 14**	Go to **Step 8**
8	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 14**	Go to **Step 9**
9	1. Separate the brake booster pushrod from the brake pedal. 2. Inspect the brake corners to determine if the brake drag condition is still present. Do the brake corners still exhibit the brake drag condition?	Go to **Step 11**	Go to **Step 10**
10	Replace the brake pedal assembly. Did you complete the replacement?	Go to **Step 14**	-
11	1. Separate the master cylinder from the brake booster. Do not disconnect any brake pipes. 2. Inspect the brake corners to determine if the brake drag condition is still		

	present. Do the brake corners still exhibit the brake drag condition?	Go to **Step 13**	Go to **Step 12**
12	Replace the brake booster assembly. Did you complete the replacement?	Go to **Step 14**	-
13	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 14**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
14	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKE SYSTEM SLOW RELEASE

Brake System Slow Release

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 3**
3	Inspect the brake assist system for proper operation. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 4**
4	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
5	Road test the vehicle to confirm proper operation. Refer to **Brake System Vehicle Road Test**.		

	Is the condition still present?	Go to **Step 2**	System OK

BRAKE FLUID LOSS

Brake Fluid Loss

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 3**
3	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 4**
4	1. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. Refer to **Master Cylinder Replacement**. 2. Inspect the rear of the master cylinder for a brake fluid leak. 3. Inspect for brake fluid in the vacuum brake booster. Did you find a brake fluid leak?	Go to **Step 5**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
5	Replace the brake master cylinder and the vacuum brake booster. Refer to **Master Cylinder Replacement** and **Vacuum Brake Booster Replacement (3.5L 3.9L)** or **Vacuum Brake Booster Replacement (5.3L)**. Did you complete the replacement?	Go to **Step 6**	-
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle to confirm proper operation. Refer to **Brake System Vehicle Road Test**.		

	Is the condition still present?	Go to **Step 2**	System OK

DISC BRAKE SYSTEM DIAGNOSIS

Test Description

The numbers below refer to the step numbers on the diagnostic table.

9: Lubricant leaks from non-brake system components may come in contact with and contaminate brake system components.

10: Lubricant leaks from non-brake system components may come in contact with and contaminate brake system components.

12: Disc brake rotor shields/backing plates that come in contact with disc brake rotors may cause brake system noise.

15: Disc brake rotor thickness variation that exceeds the maximum acceptable level can cause brake pulsation.

19: Disc brake rotor thickness variation that exceeds the maximum acceptable level can cause brake pulsation.

22: Disc brake rotor assembled lateral runout (LRO) that exceeds the maximum acceptable level can lead to thickness variation.

Disc Brake System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the DISC brake system in order to determine if the DISC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
	Visually inspect the disc brake pads for the following conditions: Refer to **Brake Pad Inspection** in Disc Brakes. • Lining thickness below specifications • Uneven and/or abnormal wear - edge-to-edge and/or side-to-side		

2	- Looseness or damage - including pad hardware - Evidence of contamination from an external substance Did you find any conditions to indicate a concern with any of the front and/or rear disc brake pads?	Go to **Step 3**	Go to **Step 12**
3	Are any of the front and/or rear disc brake pads contaminated?	Go to **Step 8**	Go to **Step 4**
4	Are any of the front and/or rear disc brake pads worn unevenly?	Go to **Step 7**	Go to **Step 5**
5	Are any of the front and/or rear disc brake pads and/or pad hardware loose or damaged?	Go to **Step 7**	Go to **Step 6**
6	1. Remove and inspect the worn disc brake pads for glazing, looseness, heat spots or damage. 2. Replace the worn disc brake pads as a complete axle set. Refer to **Brake Pads Replacement - Front** and/or **Brake Pads Replacement - Rear** in Disc Brakes. Did you complete the inspection and replacement?	Go to **Step 12**	-
	NOTE: **Support the brake caliper with heavy mechanic's wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.** **IMPORTANT:** **Do NOT disconnect the hydraulic brake flex hoses from the calipers.** 1. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets and support the		

7	calipers. Refer to **Brake Caliper Replacement - Front** and/or **Brake Caliper Replacement - Rear** in Disc Brakes. 2. Inspect the disc brake caliper mounting bracket and the mounting/sliding hardware for the following conditions: Refer to **Disc Brake Mounting and Hardware Inspection - Front** and/or **Disc Brake Mounting and Hardware Inspection - Rear** in Disc Brakes. • Binding or seized hardware • Worn, damaged or missing hardware components • Loose, bent, cracked, or damaged caliper mounting bracket 3. Replace components as required. Refer to the following procedures in Disc Brakes, as required: • **Brake Caliper Bracket Replacement - Front** • **Brake Caliper Bracket Replacement - Rear** • **Disc Brake Hardware Replacement - Front** • **Disc Brake Hardware Replacement - Rear** 4. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. Refer to **Brake Pads Replacement - Front** and/or **Brake Pads Replacement - Rear** in Disc Brakes. Did you complete the inspection and replacement?	Go to **Step 12**	-
	1. Inspect the disc brake calipers, brake hoses and brake pipes for evidence of an external brake fluid leak.		

8	2. Replace any components found to be leaking brake fluid. Refer to the following procedures as required: - **Brake Caliper Overhaul - Front** or **Brake Caliper Replacement - Front** in Disc Brakes - **Brake Caliper Overhaul - Rear** or **Brake Caliper Replacement - Rear** in Disc Brakes - **Brake Hose Replacement - Front** - **Brake Hose Replacement - Rear** - **Brake Pipe Replacement** Did you find and correct the source of the leak causing contamination of the pads?	Go to **Step 11**	Go to **Step 9**
9	1. Inspect the wheel drive shaft outer seals for damage and evidence of a grease leak. 2. Replace any wheel drive shaft seal that is found to be leaking grease which may be the source of the contamination to the pads. Refer to **Wheel Drive Shaft Outer Joint and Seal Replacement** in Wheel Drive Shafts. Did you find and correct the source of the leak causing contamination of the pads?	Go to **Step 11**	Go to **Step 10**
10	1. Inspect the automatic transmission cooling system lines, if equipped, for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 2. Inspect the power steering system hoses for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 3. Replace any components found to be leaking fluid which may be the source of the contamination to the pads.		-

	Did you find and correct the source of the leak causing contamination of the pads?	Go to **Step 11**	
11	1. Clean the remaining disc brake system components to remove any traces of the contaminant. NOTE: **Support the brake caliper with heavy mechanic's wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.** IMPORTANT: **Do NOT disconnect the hydraulic brake flex hoses from the calipers.** 2. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets and support the calipers. Refer to **Brake Caliper Replacement - Front** and/or **Brake Caliper Replacement - Rear** in Disc Brakes. 3. Inspect the disc brake caliper mounting/sliding hardware for the following conditions: Refer to **Disc Brake Mounting and Hardware Inspection - Front** and/or **Disc Brake Mounting and Hardware Inspection - Rear** in Disc Brakes. - Binding or seized hardware - Distorted, worn, damaged or missing hardware components 4. Replace the caliper mounting/sliding hardware components as required. Refer to **Disc Brake Hardware Replacement - Front** and/or **Disc**		-

	Brake Hardware Replacement - Rear in Disc Brakes. 5. Replace the contaminated disc brake pads as a complete axle set. Refer to **Brake Pads Replacement - Front** and/or**Brake Pads Replacement - Rear** in Disc Brakes. Did you complete the cleaning, inspection and replacement?	Go to **Step 12**	
12	Visually inspect each of the rear disc brake rotor shields/backing plates, if equipped, for evidence of contact with the brake rotors. Are any of the brake rotor shields/backing plates contacting the brake rotors?	Go to **Step 13**	Go to **Step 14**
13	Repair or replace the disc brake rotor shields/backing plates as required. Refer to **Disc Brake Backing Plate Replacement - Rear** in Disc Brakes. Did you complete the repair or replacement?	Go to **Step 14**	-
14	1. Check the thickness of each of the disc brake rotors. **IMPORTANT:** **Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.** 2. Make a determination for each brake rotor if the rotor can be REFINISHED and REMAIN ABOVE the minimum requirements. Refer to **Brake Rotor Thickness Measurement** in Disc Brakes.Does the disc brake rotor meet the minimum requirements for REFINISHING?	Go to **Step 15**	Go to **Step 18**
15	**IMPORTANT:** **Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.** Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to **Brake**		

	Rotor Thickness Variation Measurement in Disc Brakes.Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to **Step 17**	Go to **Step 16**
16	1. Inspect each of the disc brake rotors for the following surface and wear conditions: Refer to **Brake Rotor Surface and Wear Inspection** in Disc Brakes. • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level **IMPORTANT:** **Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.** 2. Make a determination for each brake rotor if the rotor requires refinishing based upon the results of the inspection. If the brake rotor exhibits any of the conditions listed previously, it requires refinishing. Does the brake rotor require REFINISHING?	Go to **Step 17**	Go to **Step 22**
17	1. Refinish the brake rotor. Refer to **Brake Rotor Refinishing** in Disc Brakes. 2. Inspect the brake rotor thickness. Refer to **Brake Rotor Thickness Measurement** in Disc Brakes. Were you able to REFINISH the brake rotor within the minimum requirements?	Go to **Step 22**	Go to **Step 21**
18	Is the brake rotor at or below the DISCARD		

	requirements?	Go to **Step 21**	Go to **Step 19**
19	**IMPORTANT:** **Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.** Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to **Brake Rotor Thickness Variation Measurement** in Disc Brakes.Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to **Step 21**	Go to **Step 20**
20	1. Inspect each of the disc brake rotors for the following surface and wear conditions: Refer to **Brake Rotor Surface and Wear Inspection** in Disc Brakes. - Heavy rust and/or pitting - Cracks and/or heat spots - Excessive blueing discoloration - Deep or excessive scoring beyond maximum acceptable level **IMPORTANT:** **Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.** 2. Make a determination for each brake rotor if the rotor requires replacement based upon the results of the inspection. If the brake rotor exhibits any of the conditions listed previously, it requires replacement. Does the brake rotor require REPLACEMENT?	Go to **Step 21**	Go to **Step 22**
	IMPORTANT: **Whenever a brake rotor is replaced, the assembled lateral runout (LRO) of the rotor must**		

21	**be measured to ensure optimum performance of the disc brakes.** Replace the brake rotor. Refer to **Brake Rotor Replacement - Front** or **Brake Rotor Replacement - Rear** in Disc Brakes.Did you complete the replacement?	Go to **Step 24**	-
22	**IMPORTANT:** **Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.** Inspect each of the disc brake rotors for assembled lateral runout (LRO) that exceeds the maximum acceptable level. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Measurement** in Disc Brakes.Does the brake rotor exhibit assembled LRO that exceeds the maximum acceptable level?	Go to **Step 23**	Go to **Step 24**
23	Correct the LRO for each brake rotor that was determined to have LRO exceeding the maximum acceptable level. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction** in Disc Brakes. Did you complete the operation?	Go to **Step 24**	-
24	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Disc Brake System OK Return to Symptom Table	-

HYDRAULIC BRAKE SYSTEM DIAGNOSIS

Hydraulic Brake System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the HYDRAULIC brake system in order to determine if the HYDRAULIC brake system is operating properly. You will be directed by the appropriate Symptom Table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom Table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
	Inspect and adjust the brake fluid level in the brake master cylinder. Refer to **Master**		

2	**Cylinder Reservoir Filling**. Was the brake fluid level low?	Go to **Step 3**	Go to **Step 4**
3	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: • Fluid separation (indicating two types of fluid are present) ▪ Swirled appearance - oil-based substance ▪ Layered appearance - silicone-based substance • Fluid discoloration ▪ Cloudy appearance - moisture ▪ Dark appearance/ suspended particles in fluid - dirt, rust, corrosion, brake dust 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. Do any of the above conditions exist?	Go to **Step 5**	Go to **Step 6**
4	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: • Fluid separation (indicating two types of fluid are present) ▪ Swirled appearance - oil-based substance ▪ Layered appearance - silicone-based substance • Fluid discoloration ▪ Cloudy appearance - moisture ▪ Dark appearance/ suspended particles in fluid - dirt, rust, corrosion, brake dust 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master		

	cylinder grommets for swelling, indicating fluid contamination. Do any of the above conditions exist?	Go to **Step 5**	Go to **Step 12**
5	1. Flush the hydraulic brake system. Refer to **Hydraulic Brake System Flushing**. 2. If the brake fluid WAS contaminated with an oil-based or a silicone-based fluid (indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets), perform the following: 1. Remove ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated. 2. Clean out the hydraulic brake pipes using denatured alcohol (or equivalent). 3. Dry the brake pipes using non-lubricated, filtered air. 4. Repair or replace ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated. - **Master Cylinder Overhaul** or **Master Cylinder Replacement** ; also perform the following: Clean the brake master cylinder reservoir using denatured alcohol (or equivalent), then dry the reservoir using non-lubricated, filtered air, or if necessary, replace the brake master cylinder reservoir.		-

	Replace the brake master cylinder reservoir cap diaphragm. - **Brake Hose Replacement - Front** - **Brake Hose Replacement - Rear** - **Brake Caliper Overhaul - Front** or **Brake Caliper Replacement - Front** for the disc brake. - **Brake Caliper Overhaul - Rear** or **Brake Caliper Replacement - Rear** for the disc brake. - **Brake Pressure Modulator Valve (BPMV) Replacement** , if equipped, for the Antilock Brake System. 3. If the brake fluid was NOT contaminated with an oil-based fluid, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap diaphragm which may have allowed moisture or dirt to enter the system. 4. Refill and bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**. Did you complete the operation and any required repairs and/or replacements?	Go to **Step 9**	
	1. Inspect the following hydraulic brake system components for external fluid leaks; repair or replace any of the components found to be leaking brake fluid.		

6	• **Master Cylinder Overhaul** or **Master Cylinder Replacement** Brake master cylinder reservoir cap diaphragm • **Brake Hose Replacement - Front** • **Brake Hose Replacement - Rear** • **Brake Pipe Replacement** • **Brake Caliper Overhaul - Front** or **Brake Caliper Replacement - Front** for the disc brake. • **Brake Caliper Overhaul - Rear** or **Brake Caliper Replacement - Rear** for the disc brake. • **Brake Pressure Modulator Valve (BPMV) Replacement** , if equipped, for the Antilock Brake System. 2. If you repaired or replaced any of the brake system components listed, bleed the hydraulic brake system. While bleeding the hydraulic brake system, observe for the following: Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**. • The presence of air in the system at a bleeder valve location other than at the repair location (except if the brake master cylinder and/or the proportioning valves, if equipped [non-ABS], were replaced) • An unrestricted and even flow of brake fluid per axle (during the bleeding procedure) Did you find and correct a condition?	Go to **Step 7**	Go to **Step 12**
	Was there air in the system at a bleeder valve		

7	location other than at the repair location, (except if the brake master cylinder and/or the proportioning valves, if equipped [non-ABS], were replaced)?	Go to **Step 19**	Go to **Step 8**
8	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to **Step 9**	Go to **Step 10**
9	Inspect the hydraulic function of the brake calipers for proper operation. Refer to **Hydraulic Brake Component Operation Visual Inspection**. Was the hydraulic function of the brake calipers operating properly?	Go to **Step 21**	Go to **Step 14**
10	Was the flow of brake fluid restricted or uneven through front axle hydraulic components during the bleeding procedure?	Go to **Step 13**	Go to **Step 11**
11	Was the flow of brake fluid restricted or uneven through rear axle hydraulic components during the bleeding procedure?	Go to **Step 17**	-
12	Inspect the hydraulic function of the brake calipers for proper operation. Refer to **Hydraulic Brake Component Operation Visual Inspection**. Was the hydraulic function of the brake calipers operating properly?	Go to **Step 15**	Go to **Step 13**
13	Determine if the brake caliper is restricting the flow of brake fluid and/or not operating properly: 1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information. 2. Remove the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** . 3. Open the suspected caliper bleeder valve. 4. Using a large C-clamp, compress the caliper piston and observe for an unrestricted flow of brake fluid and for free movement of the caliper piston. 5. Close the caliper bleeder valve.		

	Was the flow of brake fluid unrestricted and did the caliper piston move freely?	Go to **Step 17**	Go to **Step 14**
14	Repair or replace any brake caliper that was not operating properly. • **Brake Caliper Overhaul - Front** or **Brake Caliper Replacement - Front** for the disc brake. • **Brake Caliper Overhaul - Rear** or **Brake Caliper Replacement - Rear** for the disc brake. Did you complete the repair and/or replacement?	Go to **Step 21**	-
15	Bleed the hydraulic brake system to observe for the presence of air in the system and to observe for an unrestricted and even flow of brake fluid per axle (during the bleeding procedure). Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**. Was there air in the system?	Go to **Step 19**	Go to **Step 16**
16	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to **Step 21**	Go to **Step 17**
17	1. Inspect the hydraulic brake pipes and flexible brake hoses for signs of a fluid restriction; such as being bent, kinked, pinched or damaged. Refer to **Brake Pipe and Hose Inspection**. 2. Replace any of the hydraulic brake pipes and/or flexible brake hoses found to be bent, kinked, pinched or damaged. Refer to the following procedures as necessary: • **Brake Hose Replacement - Front** • **Brake Hose Replacement - Rear** • **Brake Pipe Replacement** 3. If none of the hydraulic brake pipes or flexible brake hoses were visibly bent, kinked, pinched, or damaged, replace		

	the hydraulic brake flex hoses at the restricted location. Did you find and correct a condition?	Go to **Step 21**	Go to **Step 18**
18	If equipped with Antilock Brakes, replace the brake pressure modulator valve (BPMV), in order to correct the hydraulic brake dynamic rear proportioning mechanical operation. Refer to **Brake Pressure Modulator Valve (BPMV) Replacement** for the Antilock Brake System. Did you complete the replacement?	Go to **Step 21**	-
19	1. Inspect the hydraulic brake system components for brake fluid seepage at a seal and/or fitting location, which may have drawn air into the system. 2. Inspect the hydraulic brake system components for evidence of a recent repair, which may have introduced air into the system. 3. Repair or replace any of the components found to be installed incorrectly or seeping brake fluid. Did you find and correct a condition?	Go to **Step 21**	Go to **Step 20**
20	1. Inspect the brake master cylinder for internal fluid leaks. Refer to **Brake System Internal Leak Test**. 2. Repair or replace the brake master cylinder if it is found to be leaking brake fluid internally. Refer to **Master Cylinder Overhaul** or **Master Cylinder Replacement**. Did you find and correct a condition?	Go to **Step 21**	Return to Symptom Table
21	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Hydraulic Brake System OK Return to Symptom Table	-

BRAKE ASSIST SYSTEM DIAGNOSIS

Brake Assist System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the brake ASSIST system in order to determine if the brake ASSIST system is operating properly. You will be directed by the appropriate Symptom Table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom Table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect for proper brake pedal travel. Refer to **Brake Pedal Travel Measurement and Inspection**. Is the brake pedal travel distance within the acceptable limits?	Go to **Step 5**	Go to **Step 3**
3	1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components: • For the brake pedal pushrod component inspection, refer to **Brake Pedal Pushrod Inspection** . • Inspect the brake pedal bushings for excessive wear and/or damage and inspect the brake pedal for a misaligned, bent and/or damaged condition. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged: • **Brake Pedal Assembly Replacement** • **Vacuum Brake Booster Replacement (3.5L 3.9L)** **Vacuum Brake Booster Replacement (5.3L)** (for a bent or damaged pedal pushrod replacement) Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to **Step 4**	Go to **Step 5**
	Reinspect for proper brake pedal travel.		

4	Refer to **Brake Pedal Travel Measurement and Inspection**. Is the brake pedal travel distance within the acceptable limits?	Go to **Step 8**	Go to **Step 5**
5	Check the engine vacuum source that supplies vacuum to the vacuum brake booster. Refer to **Brake System Vacuum Source Test (STS)**. Is the vacuum reading within the acceptable limits?	Go to **Step 6**	• Go to **Diagnostic Starting Point - Engine Mechanical** for the 3.4L engine • Go to **Diagnostic Starting Point - Engine Mechanical** for the 3.8L engine • Go to **Diagnostic Starting Point - Engine Mechanical** for the 5.3L engine
6	During the vacuum source inspection, did the vacuum booster check valve operate properly?	Go to **Step 8**	Go to **Step 7**
7	Replace the vacuum booster check valve. Refer to **Vacuum Brake Booster Check Valve and/or Hose Replacement (3.5l, 3.9L)** or **Vacuum Brake Booster Check Valve and/or Hose Replacement (5.3L)**. Did you complete the replacement?	Go to **Step 8**	-
8	1. Pump the brake pedal several times until the brake pedal becomes hard. 2. Maintain moderate foot pressure on the brake pedal and start the engine. Observe pedal operation.		

	Did the brake pedal drop slightly, then remain firm after the engine was started?	Go to **Step 9**	Go to **Step 12**
9	1. Release the brake pedal. 2. Turn the ignition OFF, then wait 15 seconds. 3. Pump the brake pedal two times to check for vacuum booster available vacuum reserve. Observe pedal effort. If operating properly, the vacuum brake booster should maintain assist for at least two pedal applications. Did the brake pedal effort increase significantly?	Go to **Step 12**	Go to **Step 10**
10	Inspect the brake pedal pushrod and the brake pedal for misalignment, a bent condition and/or damage. Is the brake pedal pushrod and/or the brake pedal misaligned, bent or damaged?	Go to **Step 11**	Go to **Step 13**
11	Replace the brake pedal pushrod and/or the brake pedal, as necessary: - **Brake Pedal Assembly Replacement** - **Vacuum Brake Booster Replacement (3.5L 3.9L)** or **Vacuum Brake Booster Replacement (5.3L)** (for a bent or damaged pedal pushrod replacement) Did you complete the replacement?	Go to **Step 13**	-
12	Replace the vacuum brake booster. Refer to **Vacuum Brake Booster Replacement (3.5L 3.9L)** or **Vacuum Brake Booster Replacement (5.3L)**. Did you complete the replacement?	Go to **Step 13**	-
13	Install or connect any components that were removed or disconnected during diagnosis. Did you complete the operation?	Brake Assist System OK Return to Symptom Table	-

BRAKE SYSTEM VEHICLE ROAD TEST

Preliminary Inspections

1. Visually inspect easily accessible brake system components for obvious damage and/or leaks which may indicate that the vehicle should not be driven until further inspections have been completed.
2. Inspect the brake master cylinder reservoir fluid level and adjust only if necessary for brake system road testing. Refer to **Master Cylinder Reservoir Filling**.
3. Inspect the tire inflation pressures and adjust as necessary.
4. Inspect the tire tread patterns to ensure that they are the same or very similar, especially per axle.
5. Ensure that the vehicle is not loaded unevenly prior to brake system road testing.

Road Testing Procedure

CAUTION: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

1. Start the engine and allow it to idle.
2. Check to see if the brake system warning lamp remains illuminated.
3. If the brake system warning lamp remains illuminated, DO NOT proceed to test drive the vehicle until it is diagnosed and repaired. Refer to **Symptoms - Hydraulic Brakes**.
4. Select a smooth, dry, clean and level road or large lot that is as free of traffic and obstacles as possible for brake system low speed road testing.
5. With the transmission in PARK, lightly apply the brake pedal. Observe both the pedal feel and the pedal travel.
6. If the brake pedal apply felt spongy, or the pedal travel was excessive, DO NOT drive the vehicle until it is repaired.
7. If the brake pedal apply did not feel spongy and the pedal travel was not excessive, proceed to step 8.
8. Release and apply the brakes.
9. While continuing to apply the brakes, shift the transmission into DRIVE, release the brakes and allow the engine to idle the vehicle away from the stopped position. Observe for a slow release of the brake system.
10. With the aid of an assistant to observe the vehicle's performance from outside of the vehicle, drive the vehicle at a low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to them, while you observe both the pedal effort and the pedal travel.

11. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
12. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 13.
13. Drive the vehicle in the opposite direction, at the same low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to him.
14. Drive the vehicle at a low speed and shift the transmission into NEUTRAL without applying the brakes. Observe for a rapid deceleration in vehicle speed, indicating possible brake drag.
15. Select a smooth, dry, clean and level road that is as free of heavy traffic as possible for brake system moderate speed road testing.
16. Drive the vehicle at a moderate speed. Observe for a pull and/or incorrect tracking of the vehicle without the brakes applied.
17. While continuing to drive the vehicle at a moderate speed, perform several light applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system noise, pulsation and/or brake drag.
18. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
19. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 20.
20. While continuing to drive the vehicle at a moderate speed, perform several moderate applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system pulsation and/or uneven braking action - either side to side, or front to rear.

    A small amount of vehicle front end dip is expected during a moderate apply of the brakes.

21. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.

BRAKE PEDAL TRAVEL MEASUREMENT AND INSPECTION

Tools Required

J 28662 Brake Pedal Effort Gauge. See **Special Tools**.

1. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal becomes firm, in order to deplete the brake booster power reserve.
2. Install the **J 28662** to the brake pedal. See **Special Tools**.

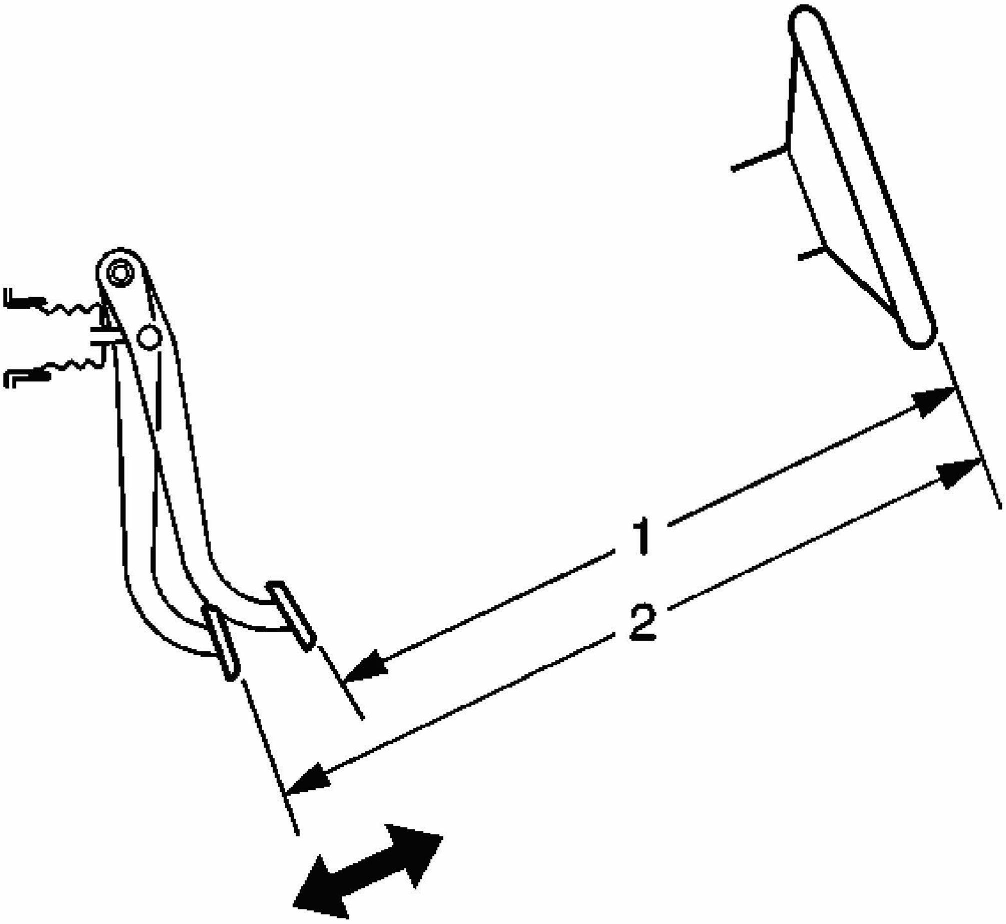


Fig. 6: Measuring Brake Pedal Travel
Courtesy of GENERAL MOTORS CORP.

3. Measure and record the distance (1) from the brake pedal to the rim of the steering wheel; note the points of measurement.
4. Apply and maintain the brakes with 445 N (100 lb) of force to the brake pedal, as indicated on the **J 28662** . See Special Tools.
5. While maintaining 445 N (100 lb) of force to the brake pedal, measure and record the distance (2) from the same point on the brake pedal to the same point on the rim of the steering wheel.
6. Release the brakes and repeat steps 4 and 5 to obtain a second measurement. After obtaining a second measurement, proceed to step 7.
7. Average the first and second measurements recorded during the two applies of the brakes.

8. Subtract the initial measurement, unapplied (1), from the averaged, applied measurement (2) to obtain the brake pedal travel distance.

   Specification: Maximum brake pedal travel (measured with the ignition OFF, brake booster power assist depleted, and the brakes cool): 74 mm (2.91 in).

BRAKE SYSTEM VACUUM SOURCE TEST (STS)

1. Disconnect the engine vacuum hose from the vacuum brake booster check valve.
2. Install a vacuum gage to the engine vacuum hose.
3. Start the engine and allow the engine to idle until normal operating temperatures are reached.
4. Check to see if the engine vacuum reading is within the specified normal engine vacuum range.

   Specification: 47-68 kPa (14-20 in Hg)

5. Turn the ignition OFF.
6. If the engine vacuum reading is within the specified normal range, proceed to step 10.
7. If the engine vacuum reading is NOT within the specified normal range, inspect the engine vacuum hose for the following conditions.
   - Tight connection to the engine
   - Collapse, deformation or contamination
   - Cracks, cuts, dry-rot
8. If any of these conditions were found with the engine vacuum hose, replace the hose, then repeat steps 2-4.
9. If none of these conditions were found with the engine vacuum hose, then there is an engine vacuum source problem, check the engine vacuum system.
10. Remove the vacuum brake booster check valve from the booster.
11. Install the check valve to the engine vacuum hose.
12. Install the vacuum gage to the check valve.
13. Start the engine and allow the engine to idle until normal operating temperatures are reached.
14. Turn the ignition OFF.
15. Check to see if the engine vacuum reading is maintained within the specified normal engine vacuum range.

    Specification: 47-68 kPa (14-20 in Hg)

16. If the engine vacuum reading is maintained within the specified normal range, proceed to step 18.

17. If the engine vacuum reading is NOT maintained within the specified normal range, replace the brake booster check valve, then repeat steps 11-15.
18. Inspect the brake booster check valve grommet for the following conditions:
    - Firm connection to the vacuum brake booster
    - Deformation or contamination
    - Cracks, cuts, dry-rot
19. If any of these conditions were found with the check valve grommet, replace the grommet.

BRAKE SYSTEM EXTERNAL LEAK INSPECTION

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. In order to inspect for external brake fluid leaks, first check the fluid level in the master cylinder.

   While a slight brake fluid level drop can be considered a normal condition due to brake lining wear, a very low level may indicate a brake fluid leak in the hydraulic system.

2. If the fluid level is abnormally low, adjust the brake fluid level. Refer to **Master Cylinder Reservoir Filling**.
3. Start the engine and allow it to idle.
4. Apply constant, moderate foot pressure to the brake pedal.

   If the brake pedal gradually falls away while under foot pressure, there may be a brake fluid leak.

5. Turn OFF the ignition.
6. Visually inspect the following brake system components for brake fluid leaks, excessive corrosion, and damage. Give particular attention to all brake pipe and flexible hose connections to ensure that there are not any slight brake fluid leaks - even though the brake pedal may feel firm and hold steady:
    - Master cylinder brake pipe fittings
    - All brake pipe connections
    - Brake pipes
    - Brake hoses and connections
    - Brake calipers and/or wheel cylinders, if equipped

7. While slight dampness around the master cylinder reservoir can be considered acceptable, brake fluid leaking from any of the brake system components requires immediate attention. If any of these components exhibit signs of brake fluid leakage, repair or replace those components. After the repair or replacement, reinspect the hydraulic brake system to assure proper function.

BRAKE SYSTEM INTERNAL LEAK TEST

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Start the engine and allow it to idle.
2. Apply light, steady pressure to the brake pedal. Observe both the brake pedal feel and travel.
3. Release the brakes and turn OFF the ignition.
4. If the brake pedal apply felt spongy, but the brake pedal travel was not excessive, perform the following steps:
    1. Inspect the brake system for external leaks. Refer to **Brake System External Leak Inspection**.
    2. Pressure bleed the brake system in order to purge any air that may be trapped in the system. Refer to **Hydraulic Brake System Bleeding (Manual)Hydraulic Brake System Bleeding (Pressure)**.

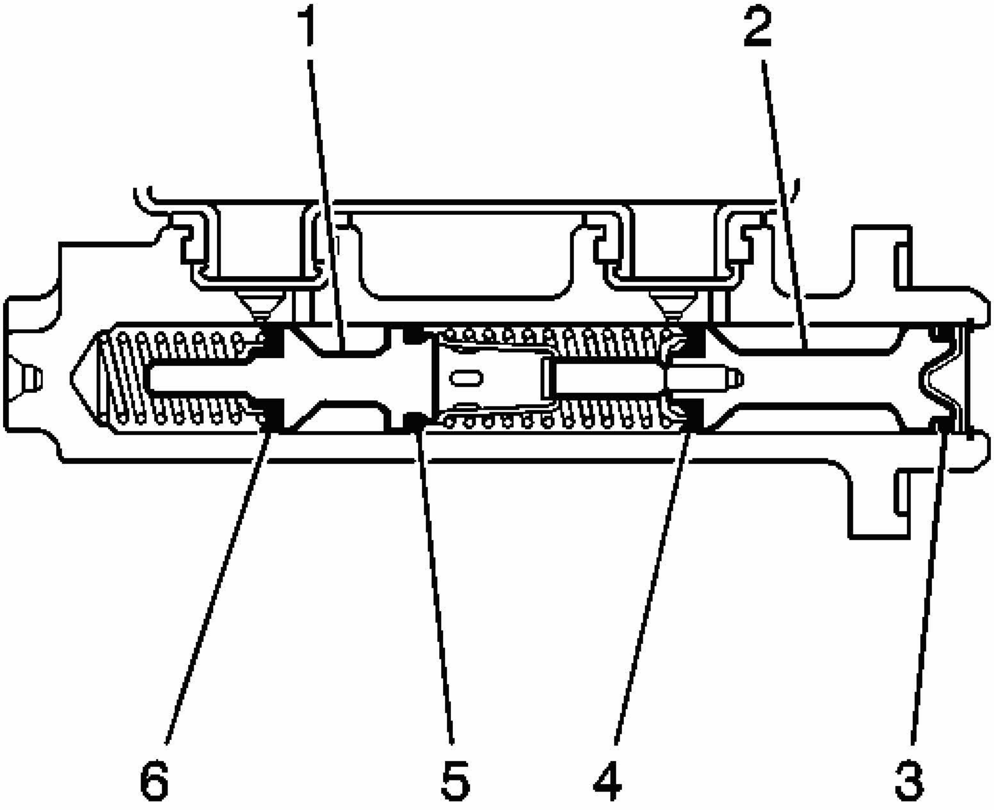


Fig. 7: Cross Sectional View Of Brake Master Cylinder
Courtesy of GENERAL MOTORS CORP.

5. If the brake pedal apply did not feel spongy, but the brake pedal travel was excessive, perform the following steps:
    1. Loosen the master cylinder-to-brake power booster mounting nuts.
    2. Carefully pull the master cylinder away from the brake power booster just enough to inspect the mounting surface of the master cylinder.
    3. Inspect the master cylinder mounting surface at the primary piston (2) for brake fluid leaks.
6. If the master cylinder exhibits any leakage around the primary piston (2), then the primary piston primary seal (4) and/or secondary seal (3) is leaking and the master cylinder requires overhaul or replacement.
7. If the master cylinder primary piston (2) does not exhibit any leakage, pressure bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

8. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, but then gradually fell, then the master cylinder requires overhaul or replacement due to an internal leak past the secondary piston (1) from the secondary piston primary seal (6) or secondary seal (5).
9. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, then fell slightly, then became steady again, then the brake pressure modulator valve (BPMV) may be leaking internally, and may require replacement.

HYDRAULIC BRAKE COMPONENT OPERATION VISUAL INSPECTION

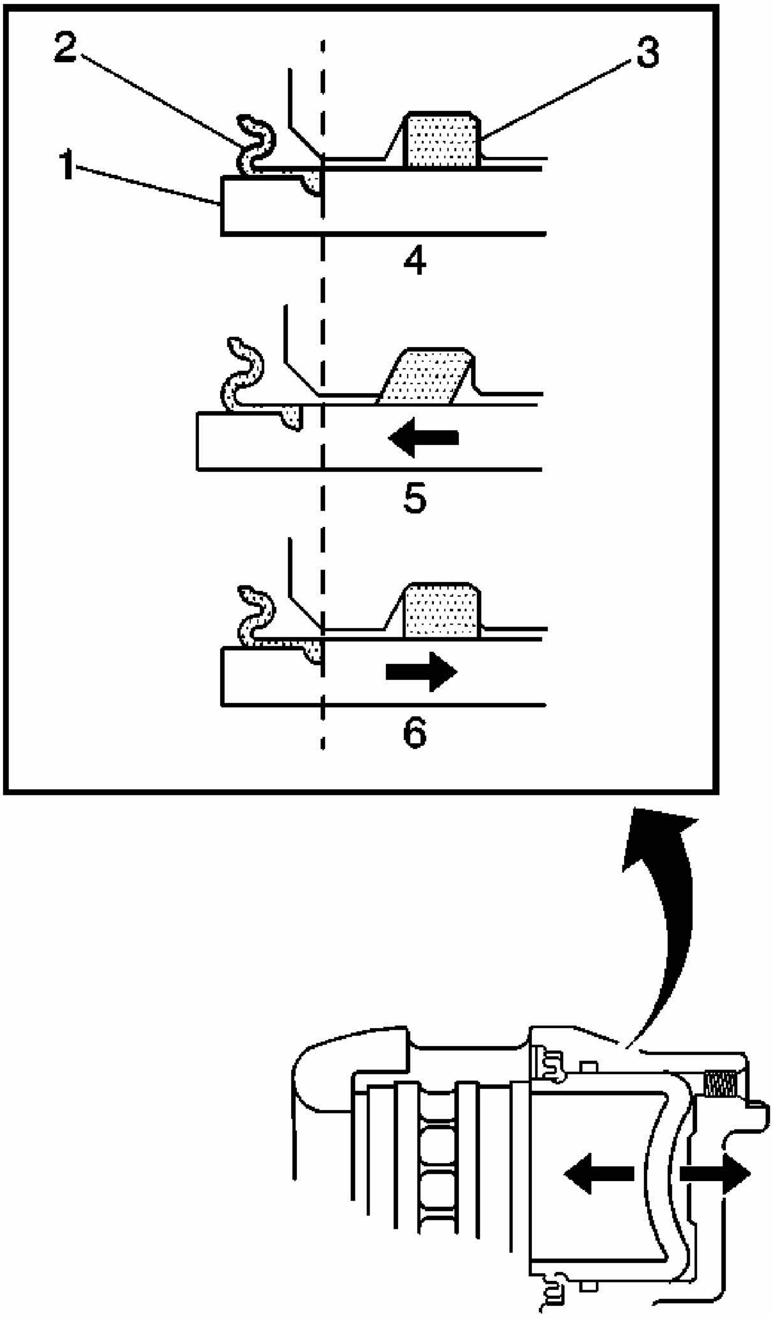


Fig. 8: Identifying Brake Caliper/Pad Inspection Areas
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. With the tire and wheel assemblies removed and the brake rotors retained by wheel lug nuts, visually inspect the caliper piston dust boot (2) sealing area to ensure that there are no brake fluid leaks.
2. If any evidence of a brake fluid leak is present, the brake caliper requires overhaul or replacement.
3. While the brake system is at rest (4), observe the position of the caliper piston (1) in relation to the caliper housing.
4. Have an assistant apply and release the brake pedal several times while you observe the operation of the hydraulic brake caliper.
    1. Observe the caliper piston (1) for unrestricted and even movement during each apply of the brake system (5).
    2. Observe the caliper piston (1) for an unrestricted and even return motion during each release of the brake system (6).
5. If the caliper piston (1) did not exhibit unrestricted and even movement during brake system apply and/or release, the piston square seal (3) may be worn or damaged and the caliper may require overhaul or replacement.

BRAKE PIPE AND HOSE INSPECTION

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Visually inspect all of the brake pipes for the following conditions:
    - Kinks, improper routing, missing or damaged retainers
    - Leaking fittings, excessive corrosion
2. If any of the brake pipes exhibited any of the conditions listed, then the identified pipe, or pipes, require replacement.
3. Ensure that the vehicle axles are properly supported at ride height in order to maintain the proper relationship of the flexible brake hoses to the chassis.

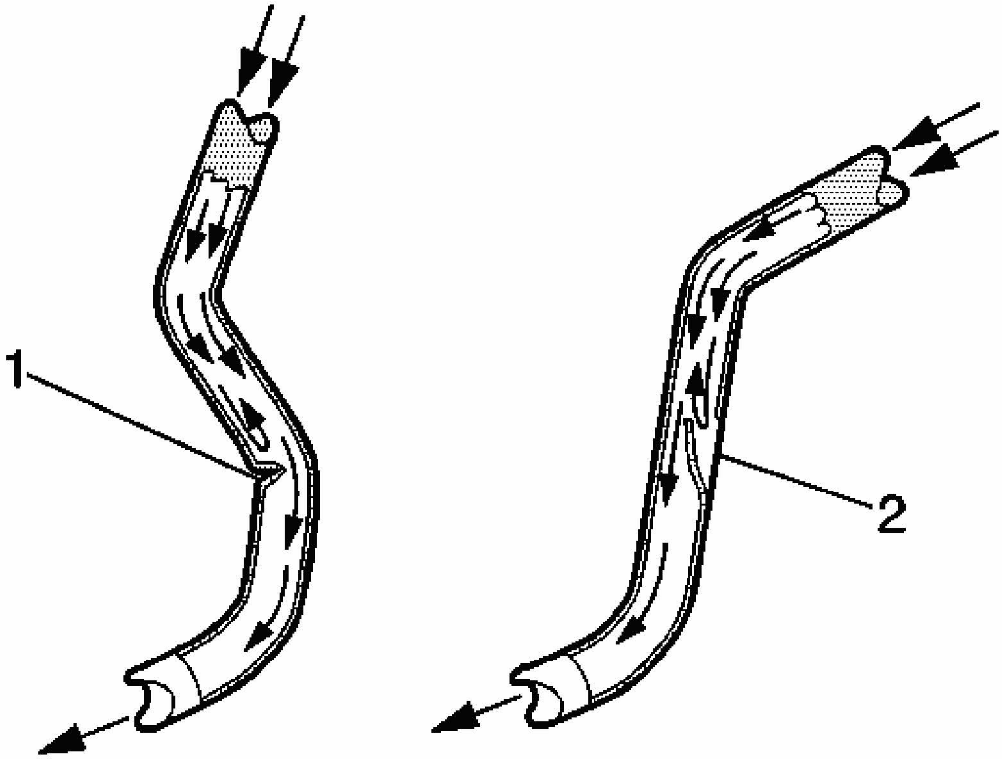


Fig. 9: Identifying Flexible Brake Hose Failure Conditions
Courtesy of GENERAL MOTORS CORP.

4. Visually inspect all of the flexible brake hoses for the following conditions:
    - Kinks (1), improper routing, twists, chafing, missing or damaged retainers
    - Leaking connections, cracking, dry-rot, blisters, bulges
5. If any of the flexible brake hoses exhibited any of the conditions listed, then the identified flexible brake hose, or hoses require replacement.
6. Squeeze the flexible brake hoses with firm finger pressure to check for soft spots (2), indicating an internal restriction. Check the entire length of each flexible brake hose.
7. If any of the flexible brake hoses were found to have soft spots (2), then the identified flexible brake hose, or hoses require replacement.

BRAKE PEDAL PUSHROD INSPECTION

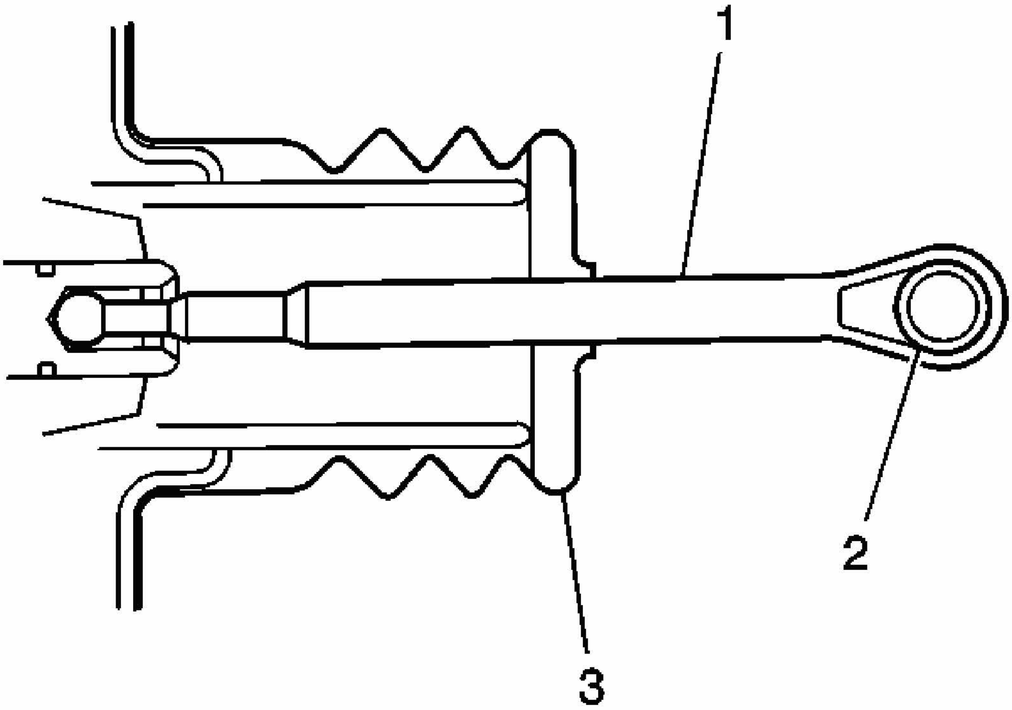


Fig. 10: View of Brake Pedal Pushrod
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the brake pedal pushrod (1) from the brake pedal.
2. Inspect the brake pedal pushrod eyelet bushing (2), if equipped, for cracks and/or excessive wear.
3. Reposition the pedal pushrod boot (3) toward the front of the vehicle to expose as much of the pedal pushrod (1) as possible.
4. Inspect the brake pedal pushrod (1) for straightness.
5. If the brake pedal pushrod eyelet bushing (2) exhibited cracks and/or excessive wear, then the bushing requires replacement.
6. If the brake pedal pushrod (1) is not straight, then the pushrod requires replacement.
7. Return the pedal pushrod boot (3) to its original position on the pedal pushrod (1).
8. Connect the brake pedal pushrod (1) to the brake pedal.

REPAIR INSTRUCTIONS

MASTER CYLINDER RESERVOIR FILLING

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: When adding fluid to the brake master cylinder reservoir, use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Visually inspect the brake fluid level through the brake master cylinder reservoir.
2. If the brake fluid level is at or below the half-full point during routine fluid checks, the brake system should be inspected for wear and possible brake fluid leaks.
3. If the brake fluid level is at or below the half-full point during routine fluid checks, and an inspection of the brake system did not reveal wear or brake fluid leaks, the brake fluid may be topped-off up to the maximum-fill level.
4. If brake system service was just completed, the brake fluid may be topped-off up to the maximum-fill level.
5. If the brake fluid level is above the half-full point, adding brake fluid is not recommended under normal conditions.
6. If brake fluid is to be added to the master cylinder reservoir, clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm. Use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.

MASTER CYLINDER RESERVOIR REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Remove the master cylinder from the vehicle. Refer to **Master Cylinder Replacement**.
2. Secure the master cylinder in a vise. Do not clamp the master cylinder body, secure only at the flange.

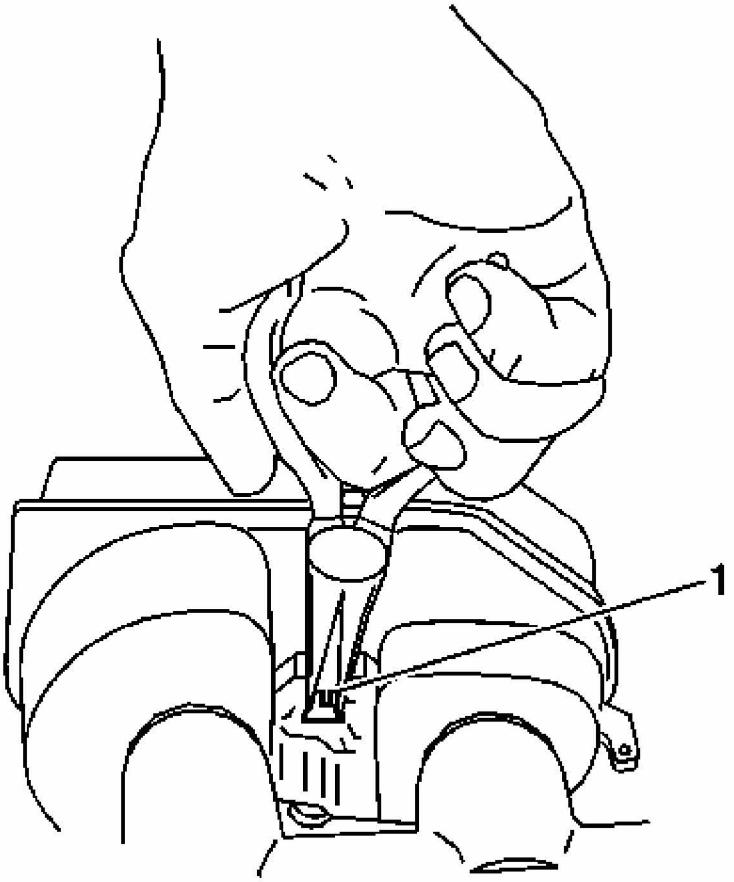


Fig. 11: Removing Brake Fluid Level Sensor
Courtesy of GENERAL MOTORS CORP.

3. Remove the brake fluid level sensor. Using needle nose pliers, carefully depress the retaining tabs on the end of the brake fluid level sensor (1) and press the sensor through the reservoir to remove.

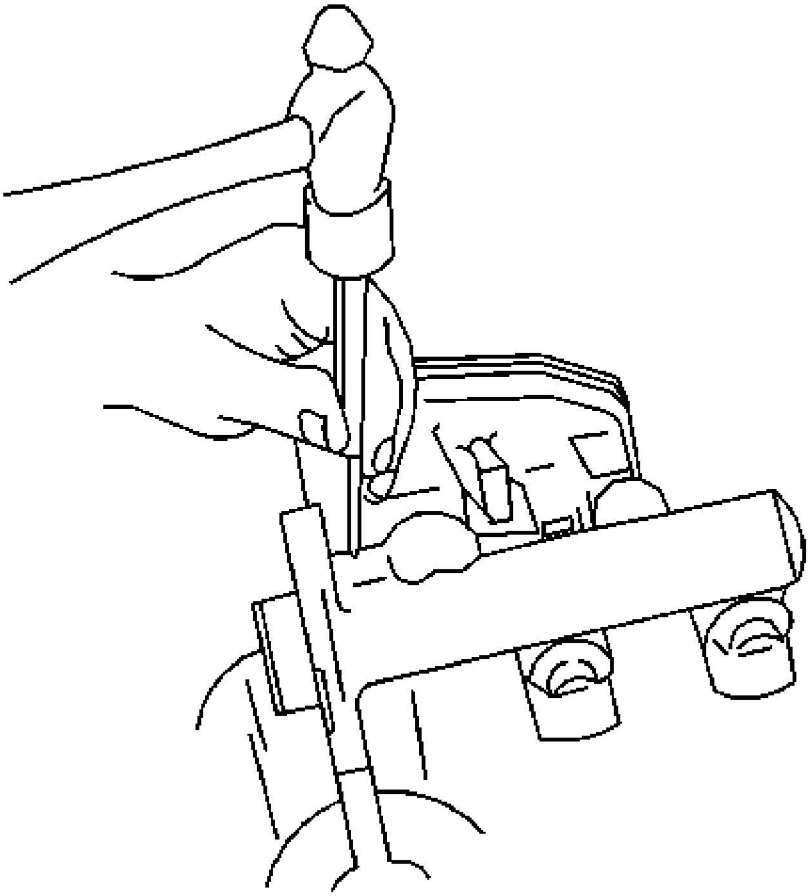


Fig. 12: Removing/Installing Reservoir Retaining Pins
Courtesy of GENERAL MOTORS CORP.

4. Carefully tap out the reservoir retaining pins.
5. Remove the reservoir from the master cylinder by pulling the reservoir straight up and away from the cylinder.
6. Remove the seals from the master cylinder.

Installation Procedure

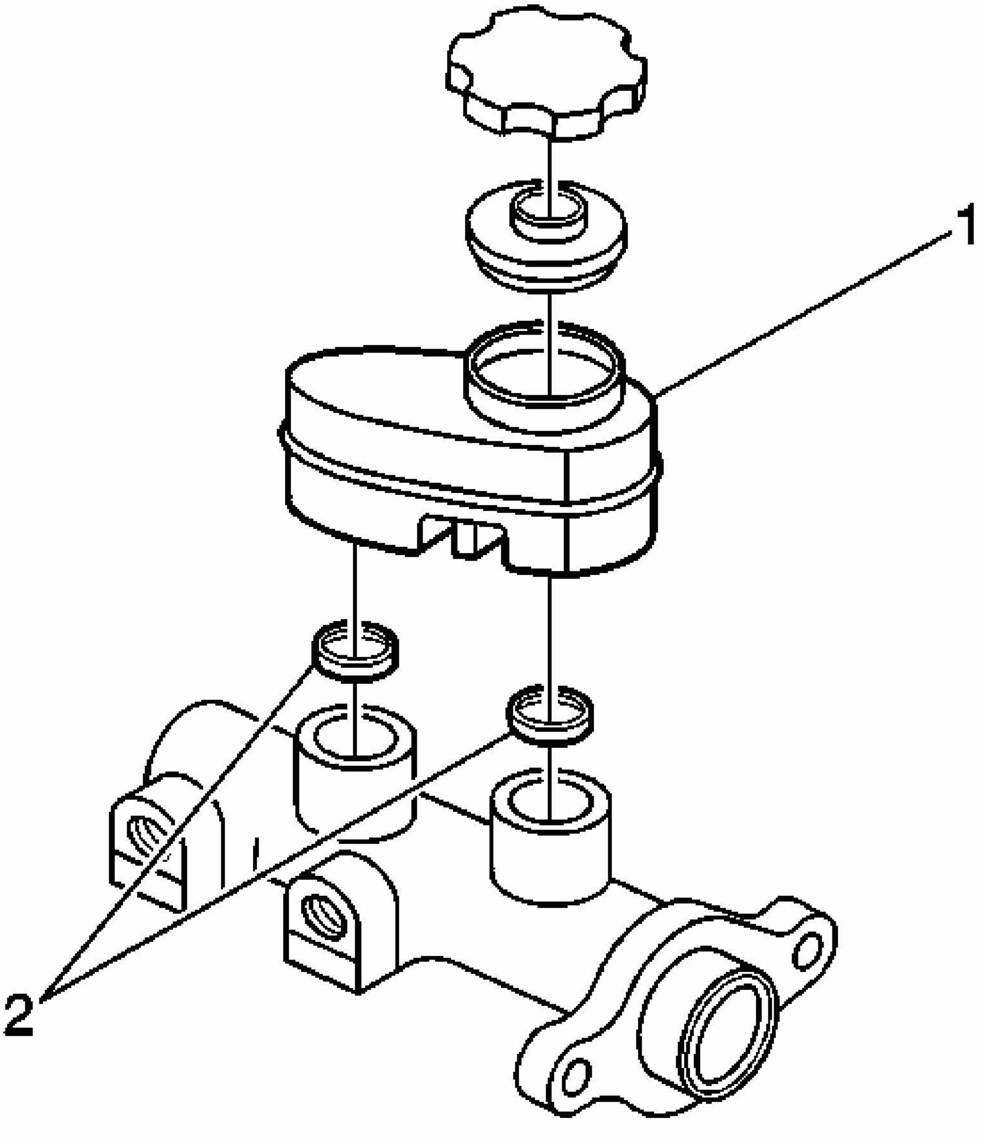


Fig. 13: Exploded View Of Master Cylinder Reservoir
Courtesy of GENERAL MOTORS CORP.

1. Inspect the reservoir (1) for cracks or deformation. If found, replace the reservoir.
2. Clean the reservoir with denatured alcohol, or equivalent.
3. Dry the reservoir with non-lubricated, filtered air.
4. Lubricate the new seals (2) and the outer surface area of the reservoir-to-housing barrels with Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667) or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.

5. Install the lubricated seals (2), make sure they are fully seated.
6. Install the reservoir (1) to the master cylinder, by pressing the reservoir straight down on the master cylinder until the pin holes are aligned.

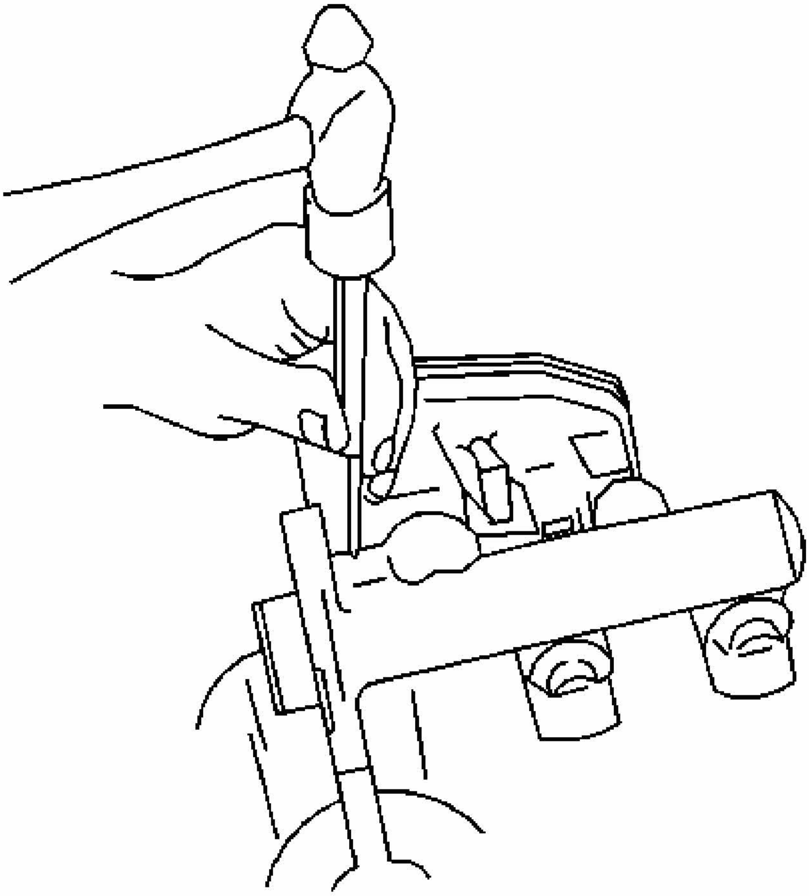


Fig. 14: Removing/Installing Reservoir Retaining Pins
Courtesy of GENERAL MOTORS CORP.

7. Carefully tap the reservoir retaining pins into place to secure the reservoir.
8. Place the brake fluid level sensor into the reservoir, press into place to secure the sensor retaining tabs.
9. Remove the master cylinder from the vise.
10. Install master cylinder to the vehicle. Refer to **Master Cylinder Replacement**.

MASTER CYLINDER REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

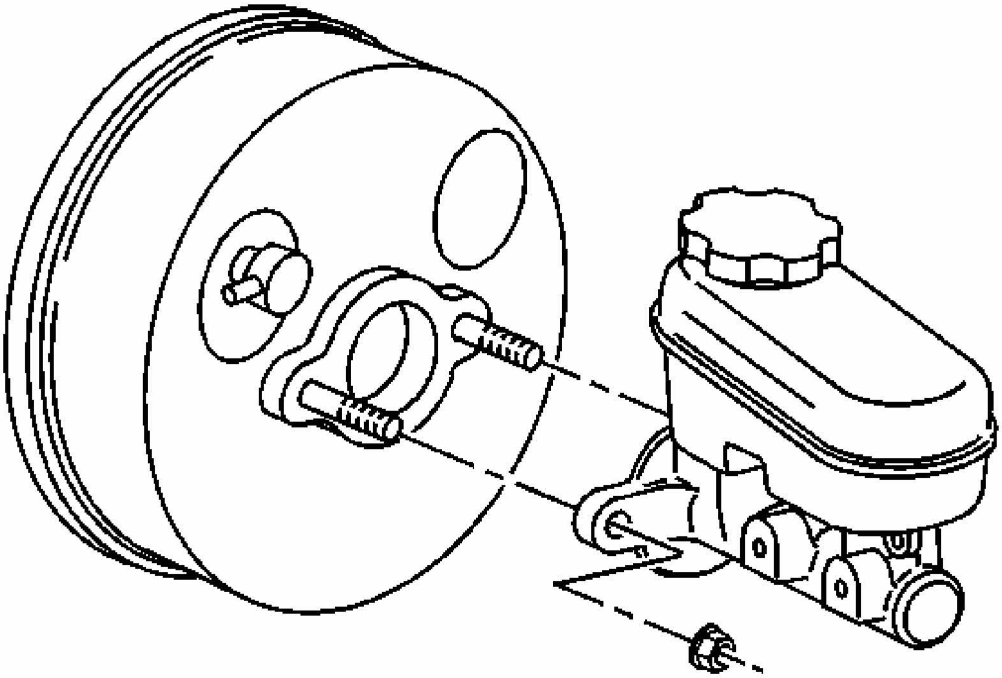


Fig. 15: View Of Master Cylinder
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the electrical connector from the brake fluid level sensor.
2. Disconnect the brake pipes from the master cylinder.

IMPORTANT: Install a rubber cap or plug to the exposed brake pipe fitting ends in order to prevent brake fluid loss and contamination.

3. Plug the open brake pipe ends.
4. Remove master cylinder mounting nuts.

5. Remove the master cylinder from the vehicle.
6. Drain the master cylinder reservoir of all brake fluid.

Installation Procedure

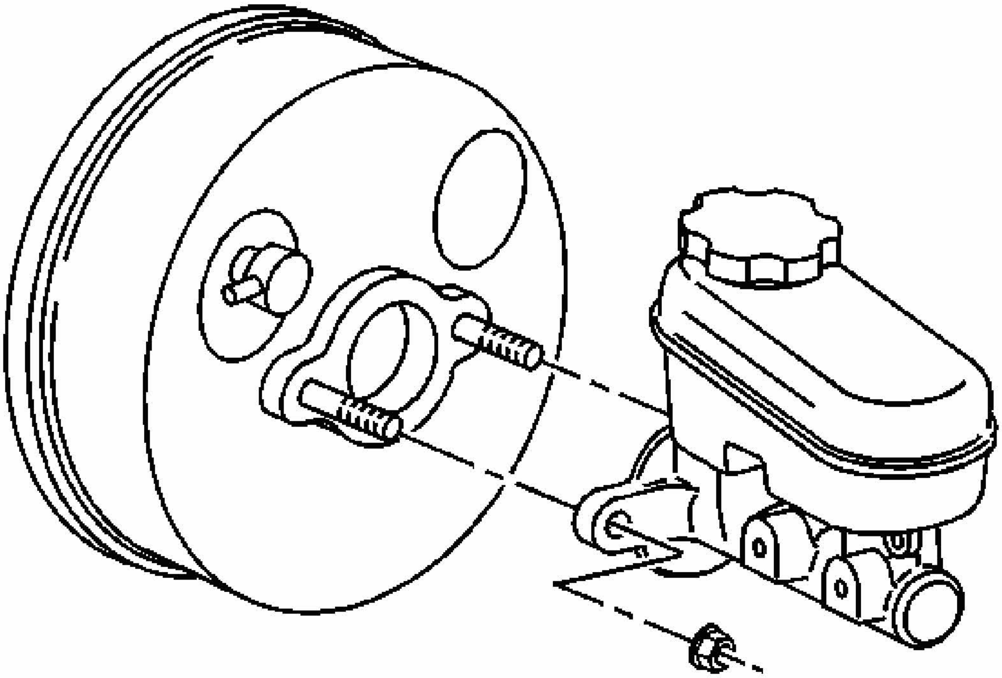


Fig. 16: View Of Master Cylinder
Courtesy of GENERAL MOTORS CORP.

1. Bench bleed the master cylinder. Refer to **Master Cylinder Bench Bleeding**.
2. Install the master cylinder to the vacuum brake booster.

NOTE: **Refer to Fastener Notice .**

3. Install the master cylinder mounting nuts.

Tighten: Tighten the master cylinder mounting nuts to 33 N.m (24 lb ft).

4. Remove the plugs from the brake pipes
5. Connect the brake pipes to the master cylinder.

Tighten: Tighten the brake pipe fittings at the master cylinder to 18 N.m (13 lb ft).

6. Connect the electrical connector to the brake fluid level sensor.
7. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

MASTER CYLINDER OVERHAUL

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

Disassembly Procedure

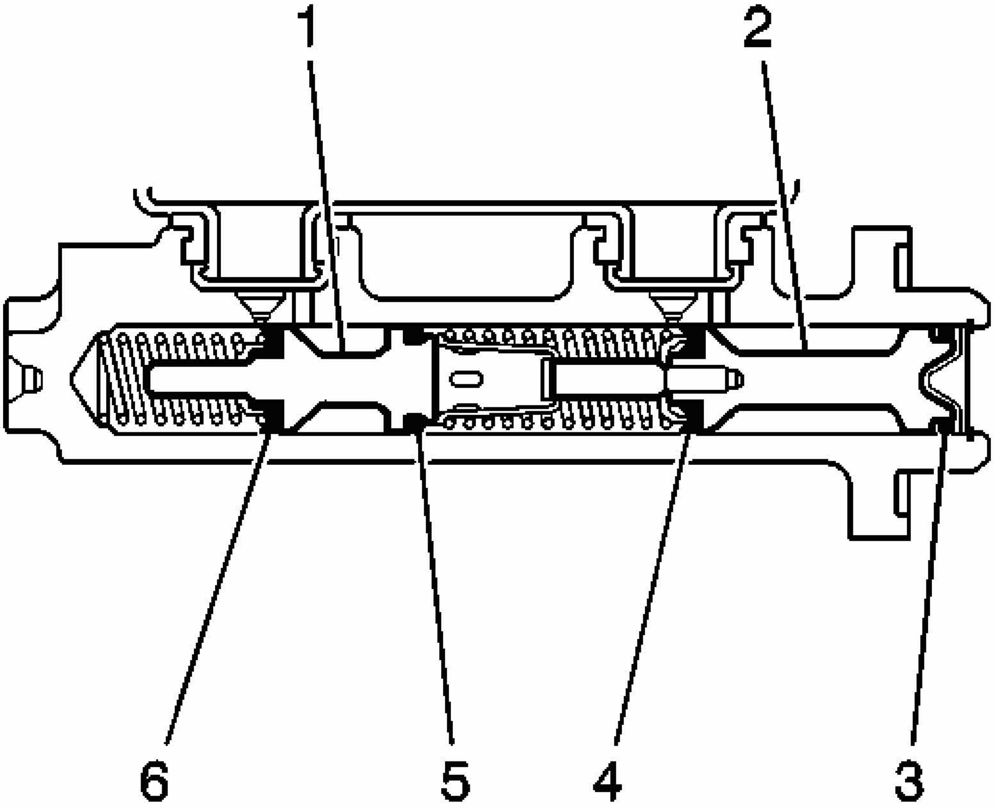


Fig. 17: Cross Sectional View Of Brake Master Cylinder
Courtesy of GENERAL MOTORS CORP.

1. Remove the brake master cylinder from the vehicle. Refer to **Master Cylinder Replacement**.
2. Secure the mounting flange of the brake master cylinder in a bench vise so that the rear of the primary piston is accessible.
3. Clean the outside of the master cylinder reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
4. Remove the reservoir cap and diaphragm from the reservoir.
5. Inspect the reservoir cap and diaphragm for the following conditions. If any of these conditions are present, replace the affected components.
    - Cuts or cracks
    - Nicks or deformation
6. Remove the master cylinder reservoir from the master cylinder. Refer to **Master Cylinder Reservoir Replacement**.
7. Using a smooth, round-ended tool, depress the primary piston (2) and remove the piston retainer.
8. Remove the primary piston assembly from the cylinder bore.
9. Plug the cylinder inlet ports and the rear outlet port. Apply low pressure, non-lubricated, filtered air into the front outlet port, in order the remove the secondary piston (1) with the primary (6) and secondary (5) seals, and the return spring.
10. Discard the primary piston assembly, the piston retainer, and the seals and seal retainer from the secondary piston.

Assembly Procedure

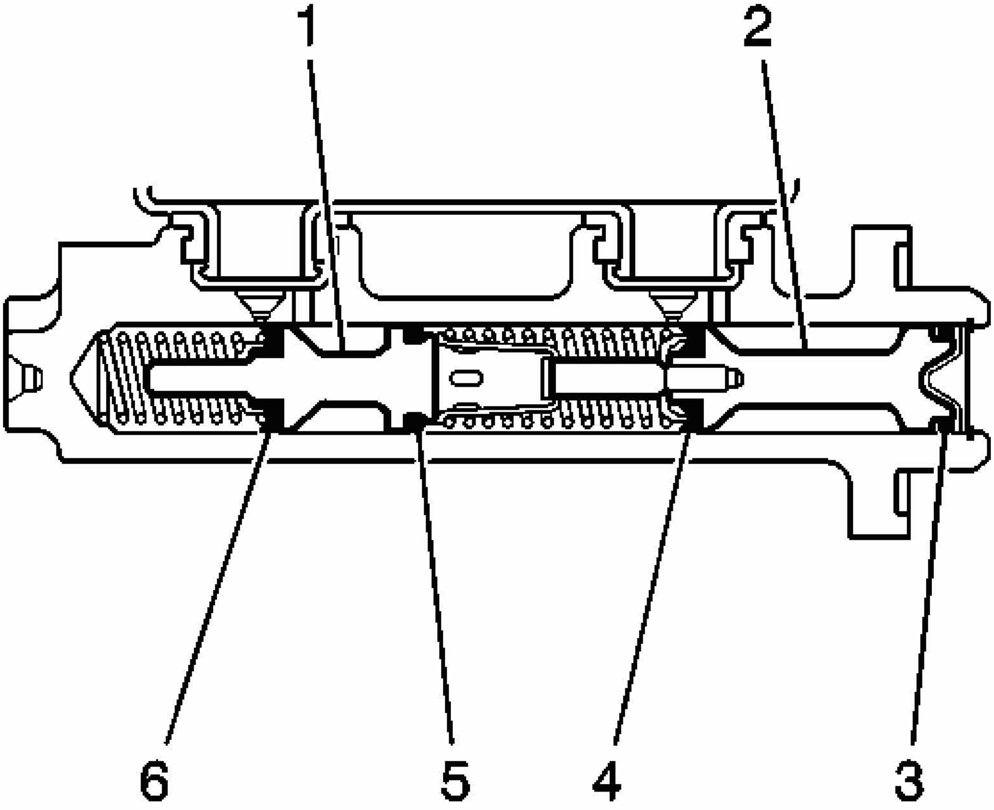


Fig. 18: Cross Sectional View Of Brake Master Cylinder
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not use abrasives to clean the brake master cylinder bore.

1. Clean the interior and exterior of the master cylinder, the secondary piston (1), and the return spring in denatured alcohol, or equivalent.
2. Inspect the master cylinder bore, inlet and outlet ports, the secondary piston (1), and the return spring for cracks, scoring, pitting, and/or corrosion. Replace the master cylinder if any of these conditions exist.
3. Dry the master cylinder and the individual components with non-lubricated, filtered air.
4. Lubricate the master cylinder bore, the secondary piston (1), the return spring, and all of the individual overhaul components with Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
5. Assemble the lubricated, new primary seal (6) and retainer, and new secondary seal (5)

onto the secondary piston.

6. Install the lubricated return spring and secondary piston assembly (1) into the cylinder bore.
7. Install the lubricated, new primary piston assembly (2) into the cylinder bore.
8. Using a smooth, round-ended tool, depress the primary piston (2) and install the new piston retainer.
9. Install the master cylinder reservoir to the master cylinder. Refer to **Master Cylinder Reservoir Replacement**.
10. Install the reservoir cap and diaphragm to the reservoir.
11. Install the master cylinder to the vehicle. Refer to **Master Cylinder Replacement**.

MASTER CYLINDER BENCH BLEEDING

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

NOTE: When adding fluid to the brake master cylinder reservoir, use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

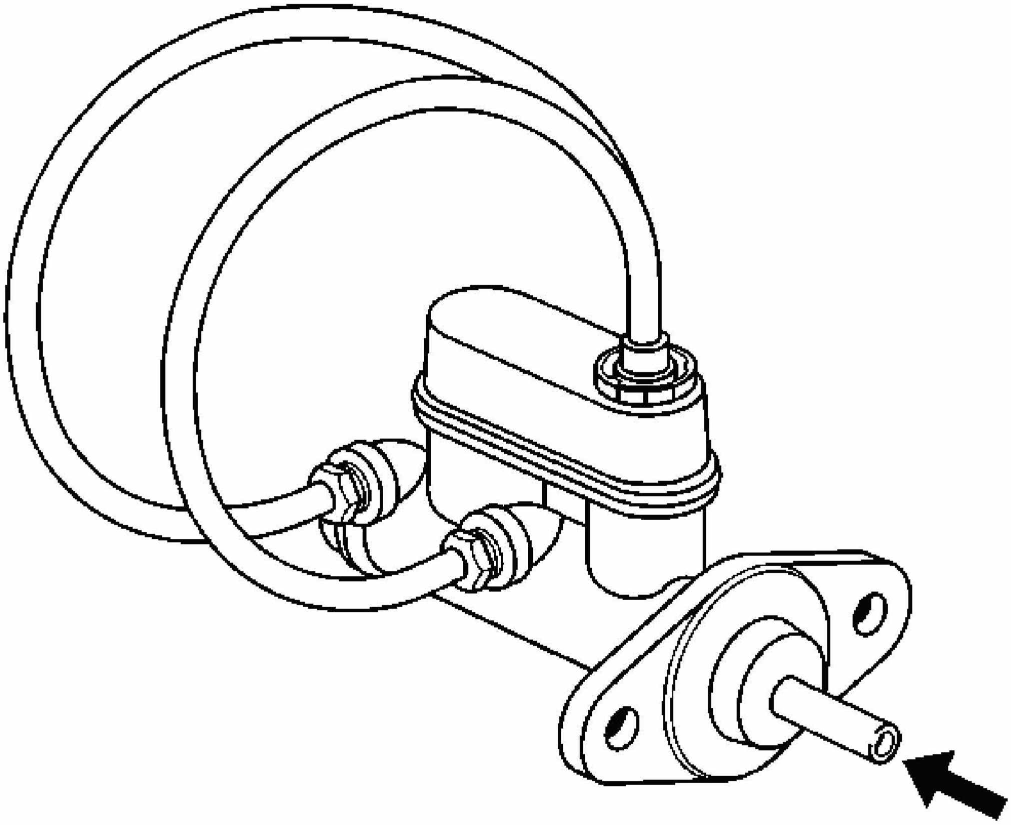


Fig. 19: Bleeding Master Cylinder
Courtesy of GENERAL MOTORS CORP.

1. Secure the mounting flange of the brake master cylinder in a bench vise so that the rear of the primary piston is accessible.
2. Remove the master cylinder reservoir cap and diaphragm.
3. Install suitable fittings to the master cylinder ports that match the type of flare seat required and also provide for hose attachment.
4. Install transparent hoses to the fittings installed to the master cylinder ports, then route the hoses into the master cylinder reservoir.
5. Fill the master cylinder reservoir to at least the half-way point with Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
6. Ensure that the ends of the transparent hoses running into the master cylinder reservoir are fully submerged in the brake fluid.
7. Using a smooth, round-ended tool, depress and release the primary piston as far as it will travel, a depth of about 25 mm (1 in), several times. Observe the flow of fluid

coming from the ports.

As air is bled from the primary and secondary pistons, the effort required to depress the primary piston will increase and the amount of travel will decrease.

8. Continue to depress and release the primary piston until fluid flows freely from the ports with no evidence of air bubbles.
9. Remove the transparent hoses from the master cylinder reservoir.
10. Install the master cylinder reservoir cap and diaphragm.
11. Remove the fittings with the transparent hoses from the master cylinder ports. Wrap the master cylinder with a clean shop cloth to prevent brake fluid spills.
12. Remove the master cylinder from the vise.

MASTER CYLINDER FLUID LEVEL SENSOR REPLACEMENT

Removal Procedure

1. Disconnect the electrical connector from brake fluid level sensor.

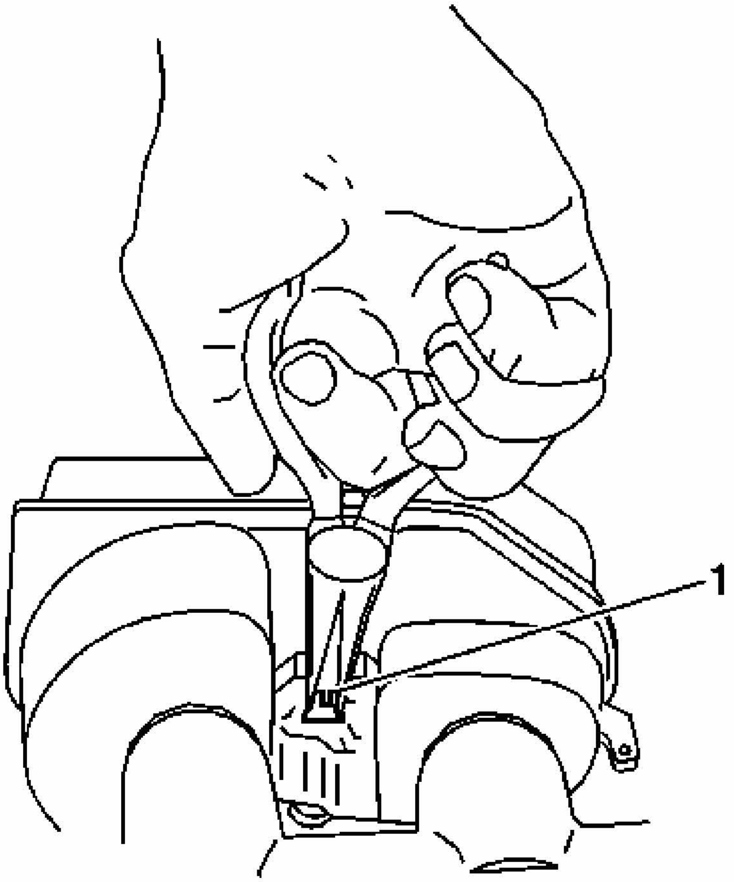


Fig. 20: Removing Brake Fluid Level Sensor
Courtesy of GENERAL MOTORS CORP.

2. Remove the brake fluid level sensor. Using needle nose pliers, carefully depress the retaining tabs on the end of the brake fluid level sensor (1) and press the sensor through the reservoir to remove.

Installation Procedure

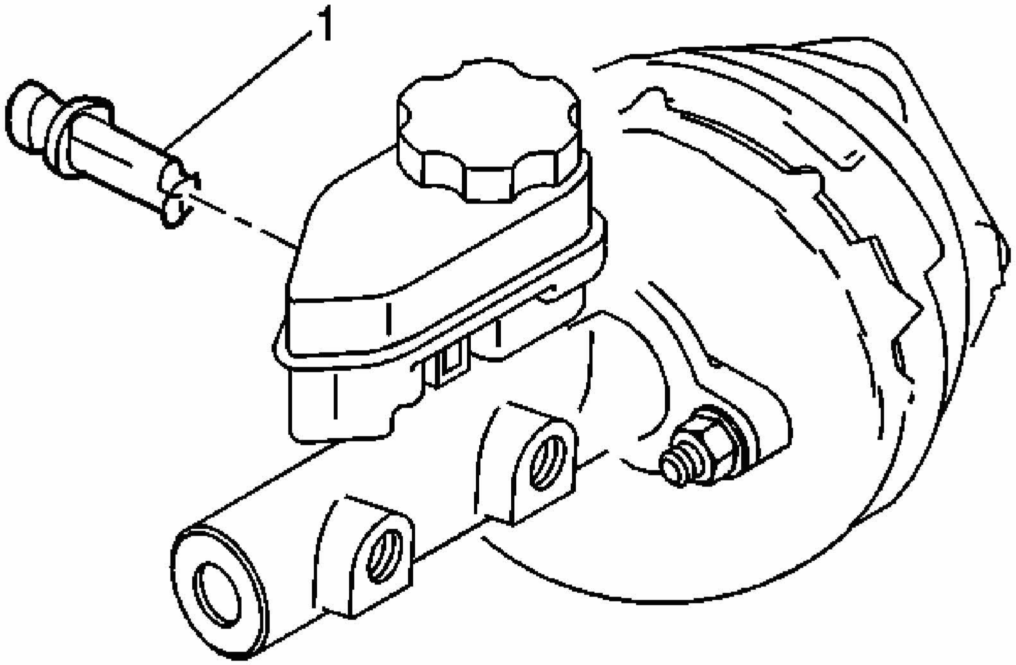


Fig. 21: Locating Master Cylinder Fluid Level Sensor
Courtesy of GENERAL MOTORS CORP.

1. Place the brake fluid level sensor (1) into the reservoir, press into place to secure the sensor retaining tabs.
2. Connect the electrical connector to the brake fluid level sensor (1).

BRAKE PEDAL ASSEMBLY REPLACEMENT

Removal Procedure

1. Remove the left instrument panel insulator.
2. Push the BCM up and move the bottom of the BCM away from and out of the mounting bracket slot. Position the BCM aside.
3. Remove the cruise control release switch, if equipped.
4. Release the wiring harness clips from the bracket.

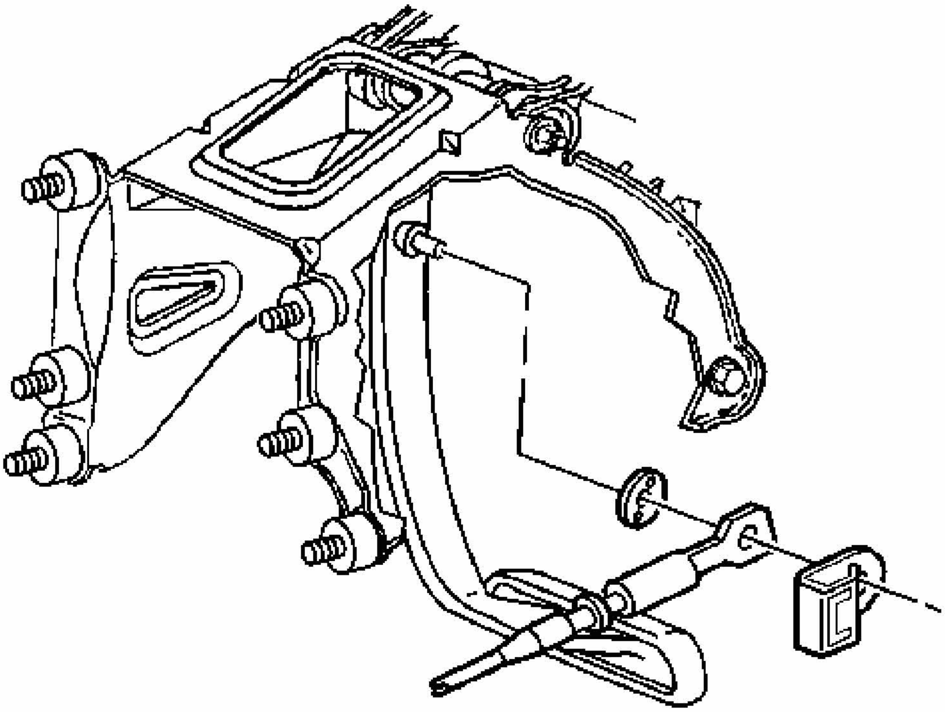


Fig. 22: Brake Pedal Pushrod & Washer
Courtesy of GENERAL MOTORS CORP.

5. Remove the brake pedal pushrod retaining clip from the brake pedal.
6. Remove the brake pedal pushrod and washer from the brake pedal.

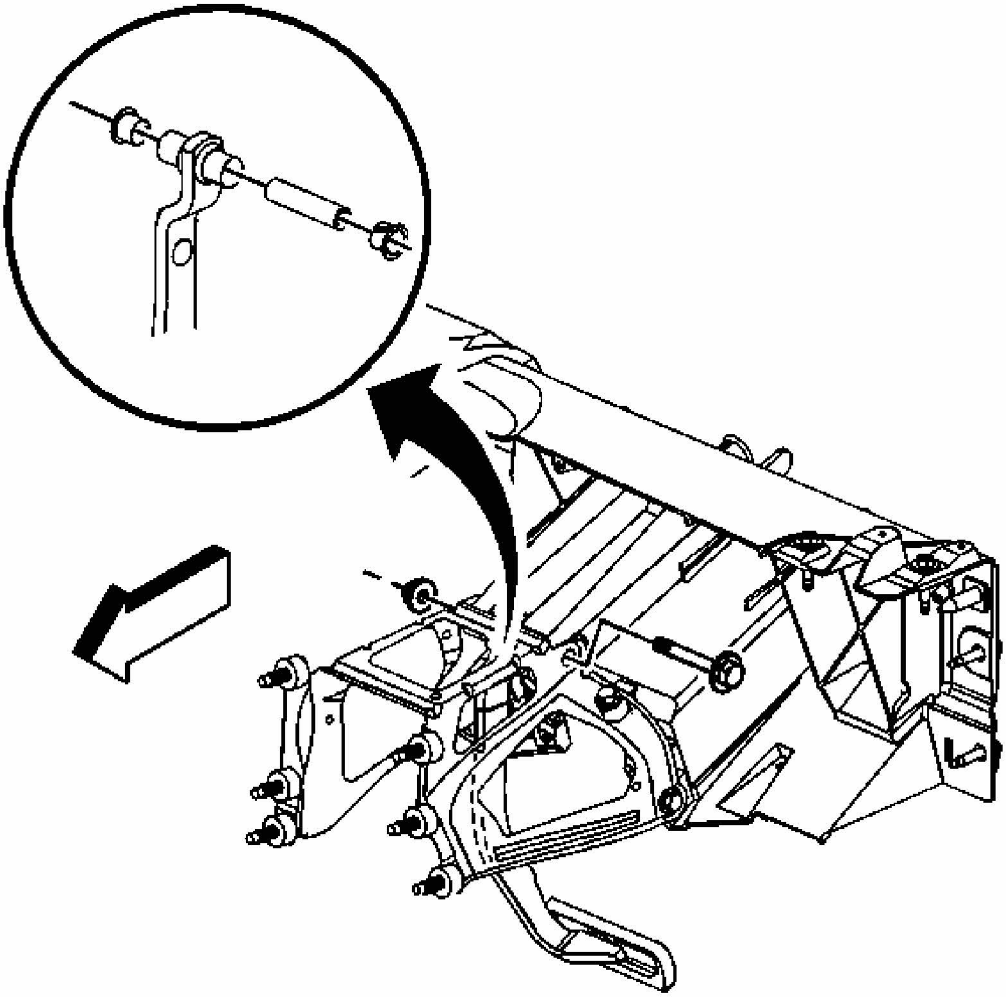


Fig. 23: Brake Pedal Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

7. Remove the brake pedal nut and bolt.
8. Remove the brake pedal and bushings.

Installation Procedure

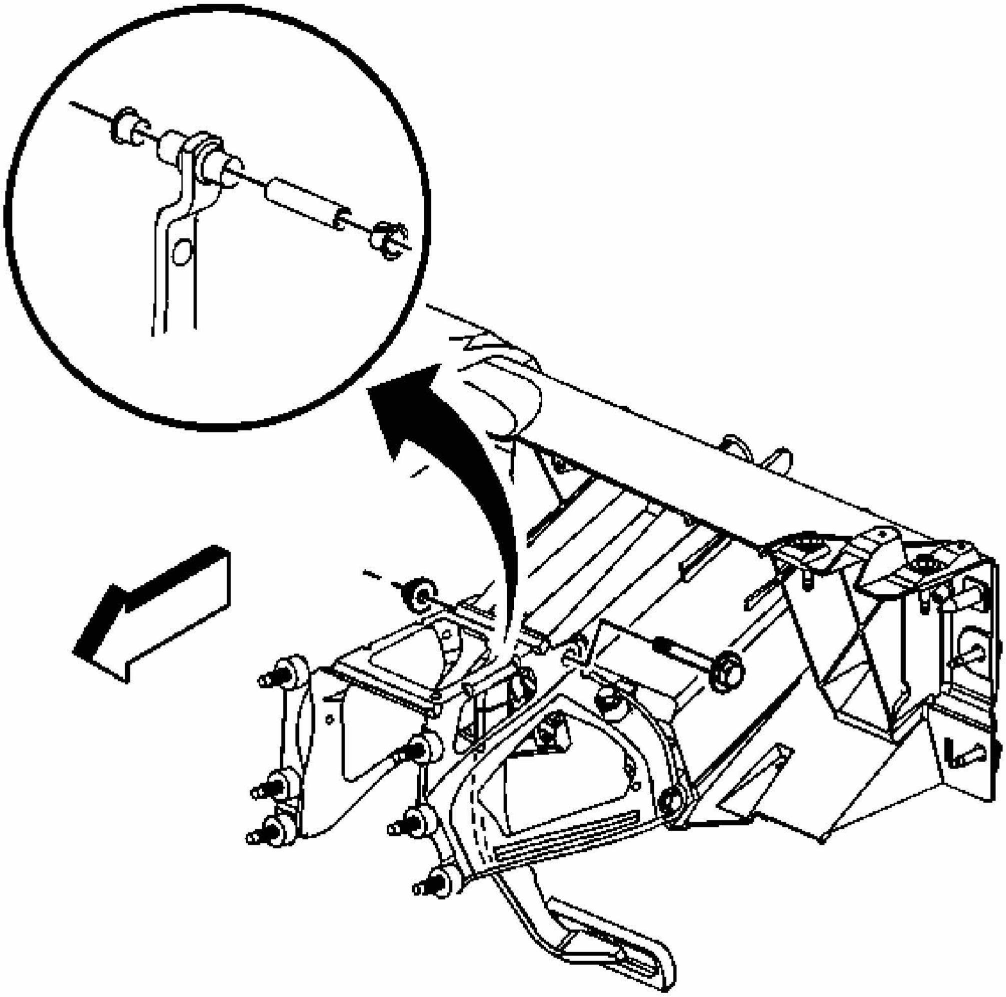


Fig. 24: Brake Pedal Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the brake pedal and bushings.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the brake pedal nut and bolt.

Tighten: Tighten the brake pedal nut and bolt to 40 N.m (30 lb ft).

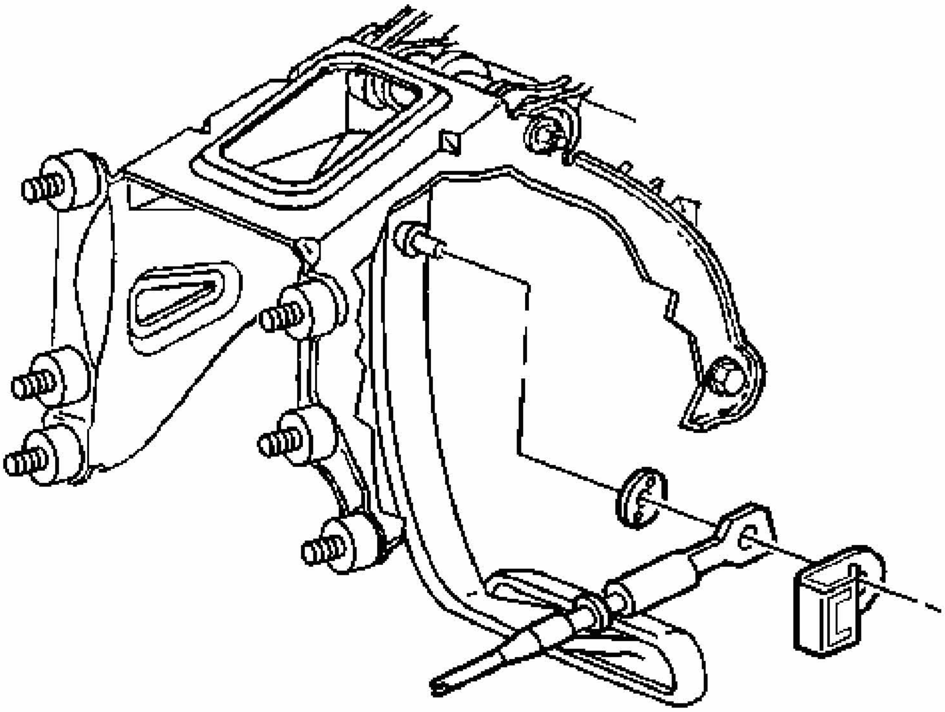


Fig. 25: Brake Pedal Pushrod & Washer
Courtesy of GENERAL MOTORS CORP.

3. Install the brake pedal washer and pushrod to the brake pedal.
4. Install the brake pedal pushrod retaining clip to the brake pedal.
5. Secure the wiring harness clips to the bracket.
6. Install the cruise control release switch, if equipped.
7. Insert the top of the BCM up into the mounting bracket, then engage the bottom of the BCM into the mounting bracket slot.
8. Install the left instrument panel insulator.

BRAKE PIPE REPLACEMENT

Tools Required

J 45405 Pipe Flaring Tool Kit. See **Special Tools**.

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

CAUTION: Always use double walled steel brake pipe when replacing brake pipes. The use of any other pipe is not recommended and may cause brake system failure. Carefully route and retain replacement brake pipes. Always use the correct fasteners and the original location for replacement brake pipes. Failure to properly route and retain brake pipes may cause damage to the brake pipes and cause brake system failure.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

IMPORTANT: When servicing brake pipes, note the following:

- **If sectioning brake pipe, use replacement pipe of the same type and outside diameter.**
- **Use fittings of the appropriate size and type.**
- **Only create flares of the same type or design as originally equipped on the vehicle.**

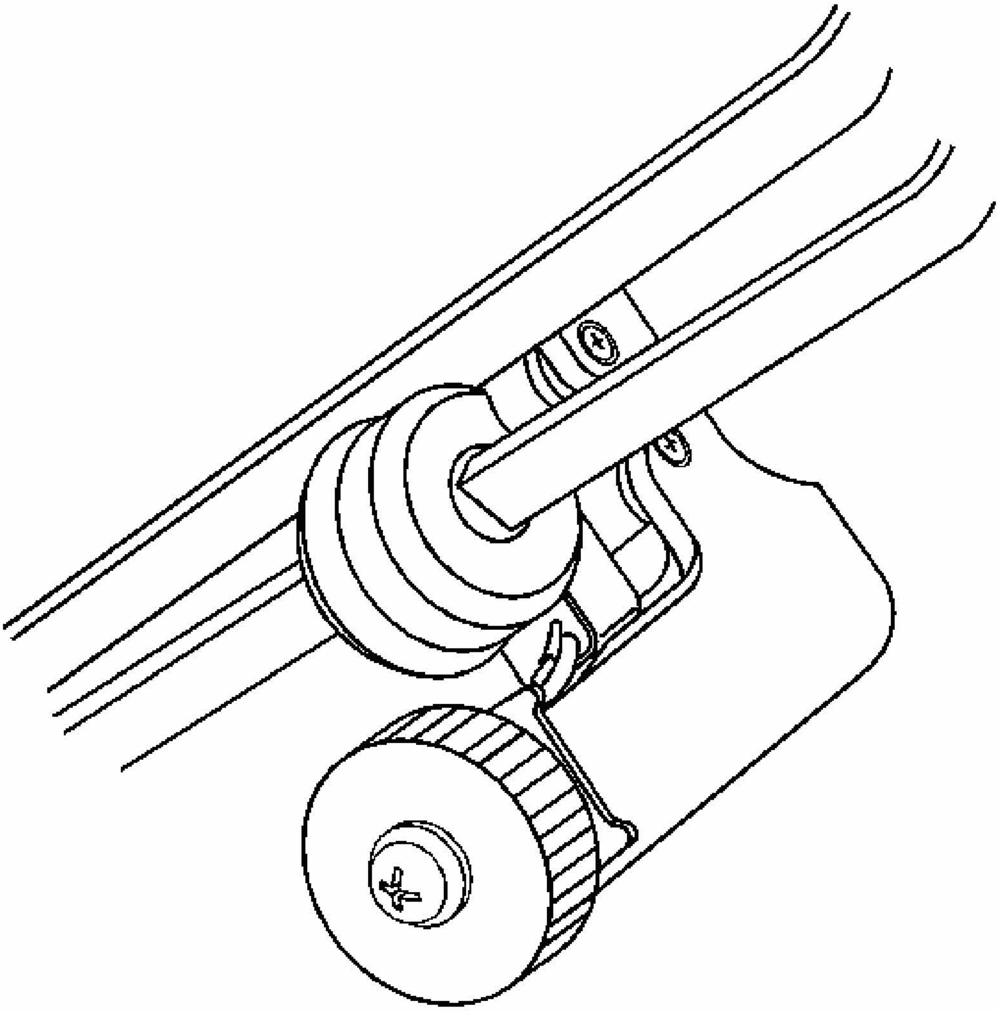


Fig. 26: Sectioning Brake Pipe Using Pipe Cutter
Courtesy of GENERAL MOTORS CORP.

1. Inspect the section of brake pipe to be replaced.
2. Release the brake pipe to be replaced from the retainers, as required.
3. Select an appropriate location to section the brake pipe, if necessary.
    - Allow adequate clearance in order to maneuver the **J 45405** . See Special Tools.
    - Avoid sectioning the brake pipe at bends or mounting points.
4. Using a string or wire, measure the length of the pipe to be replaced including all pipe bends.
5. Add to the measurement taken the appropriate additional length required for each flare to be created.

Specification: 6.35 mm (0.250 in) for 4.76 mm (3/16 in) diameter pipe

IMPORTANT: Ensure that the brake pipe end to be flared is cut at a square, 90 degree angle to the pipe length.

6. Using the pipe cutter included in the **J 45405** , carefully cut the brake pipe squarely to the measured length. See **Special Tools**.
7. Remove the sectioned brake pipe from the vehicle.
8. Select the appropriate size of brake pipe and tube nuts, as necessary. The brake pipe outside diameter determines brake pipe size.

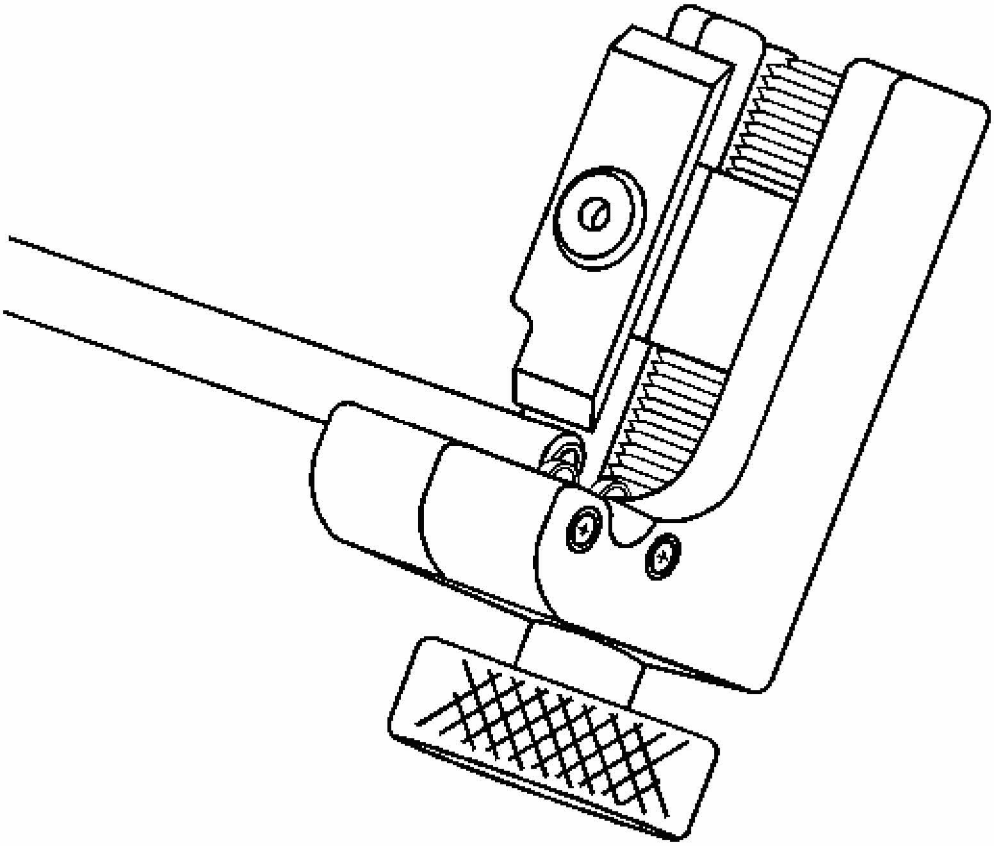


Fig. 27: Stripping Nylon Coating From Brake Pipe Ends
Courtesy of GENERAL MOTORS CORP.

9. Strip the nylon coating from the brake pipe ends to be flared, if necessary.
   - Select the appropriate blade on the coating stripping tool included in the **J 45405** ,

by unthreading the blade block from the stripping tool and installing the block with the desired blade facing the tool rollers. See **Special Tools**.

Specification: 6.35 mm (0.250 in) blade for 4.76 mm (3/16 in) diameter pipe

- Insert the brake pipe end to be flared into the stripping tool to the depth of the ledge on the tool rollers.
- While holding the brake pipe firmly against the stripping tool roller ledges, rotate the thumbwheel of the tool until the blade contacts the brake pipe coated surface.

IMPORTANT: Do not gouge the metal surface of the brake pipe.

- Rotate the stripping tool in a clockwise direction, ensuring that the brake pipe end remains against the tool roller ledges.
- After each successive revolution of the stripping tool, carefully rotate the thumbwheel of the tool clockwise, in order to continue stripping the coating from the brake pipe until the metal pipe surface is exposed.
- Loosen the thumbwheel of the tool and remove the brake pipe.

IMPORTANT: Ensure that all loose remnants of the nylon coating have been removed from the brake pipe.

- Inspect the stripped end of the brake pipe to ensure that the proper amount of coating has been removed.

Specification: 6.35 mm (0.250 in) for 4.76 mm (3/16 in) diameter pipe

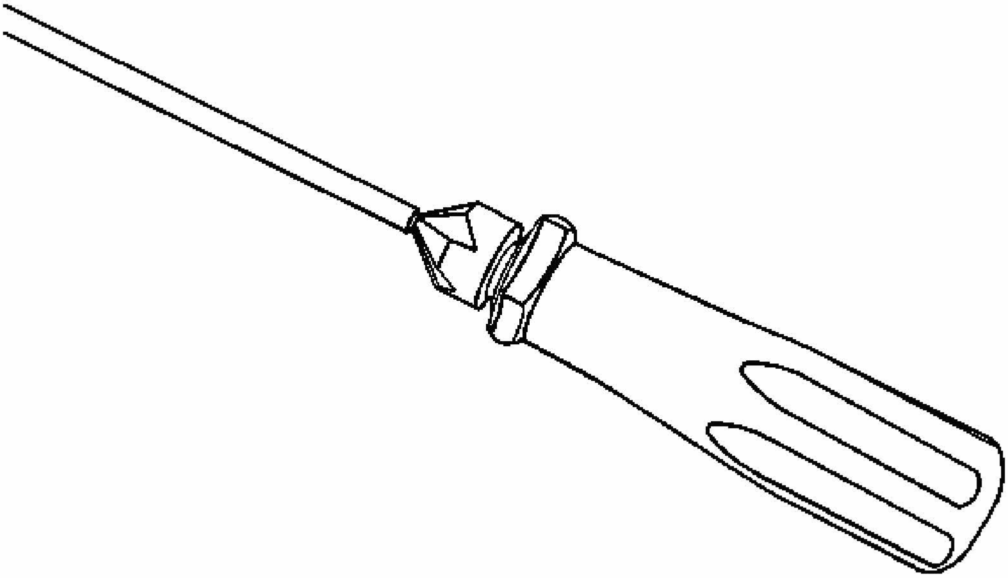


Fig. 28: Chamfering Pipe Using De-Burring Tool
Courtesy of GENERAL MOTORS CORP.

10. Chamfer the inside and outside diameter of the pipe with the de-burring tool included in the **J 45405** . See **Special Tools**.
11. Install the tube nuts on the brake pipe, noting their orientation.
12. Clean the brake pipe and the **J 45405** of lubricant, contaminants, and debris. See **Special Tools**.

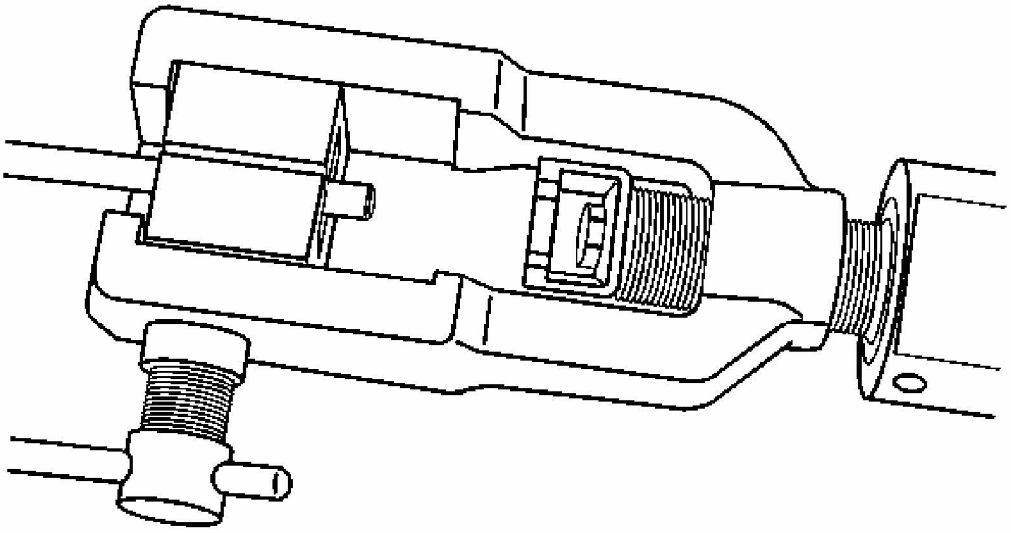


Fig. 29: Installing Die Halves Into Die Cage
Courtesy of GENERAL MOTORS CORP.

13. Loosen the die clamping screw of the **J 45405** . See **Special Tools**.
14. Select the corresponding die set and install the die halves into the die cage with the full, flat face of one die facing the clamping screw, and the counterbores of both dies facing the forming ram.

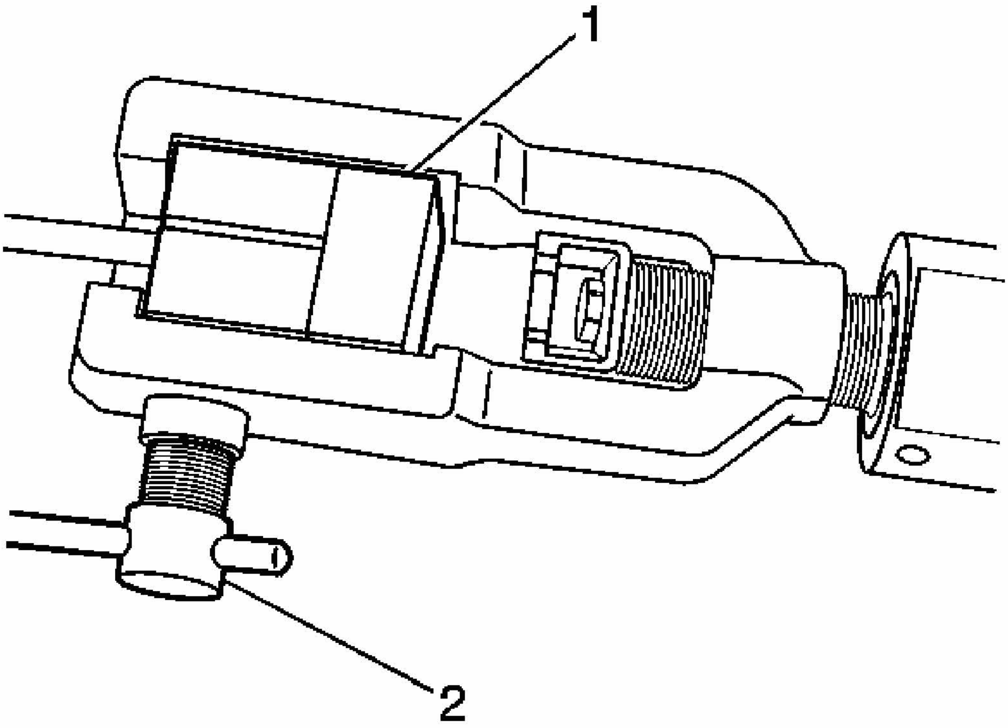


Fig. 30: View Of Clamping Screw & Unused Die
Courtesy of GENERAL MOTORS CORP.

15. Place the flat face of an unused die (1) against the die halves in the clamping cage and hold firmly against the counterbored face of the dies.
16. Insert the prepared end of the pipe to be flared through the back of the dies until the pipe is seated against the flat surface of the unused die (1).
17. Remove the unused die (1).
18. Ensure that the rear of both dies are seated firmly against the enclosed end of the die cage.
19. Firmly hand tighten the clamping screw (2) against the dies.

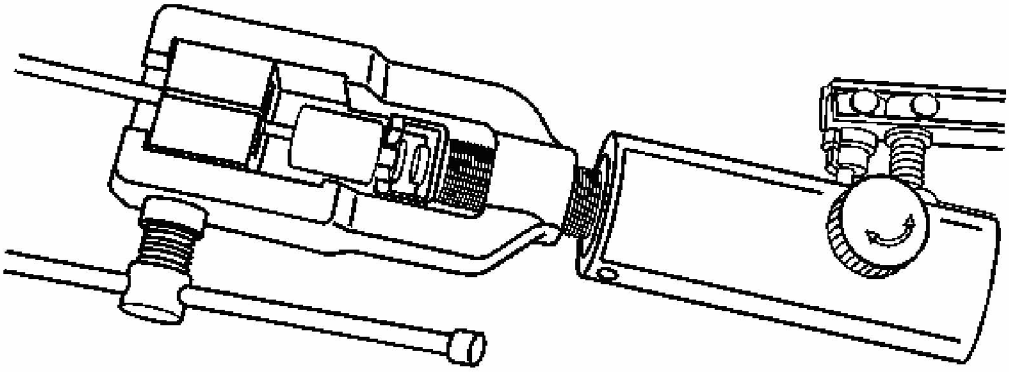


Fig. 31: Rotating J 45405 To Bottom Against Die Cage
Courtesy of GENERAL MOTORS CORP.

20. Select the appropriate forming mandrel and place into the forming ram.
21. Rotate the hydraulic fluid control valve clockwise to the closed position.
22. Rotate the body of the **J 45405** until it bottoms against the die cage. See **Special Tools**.

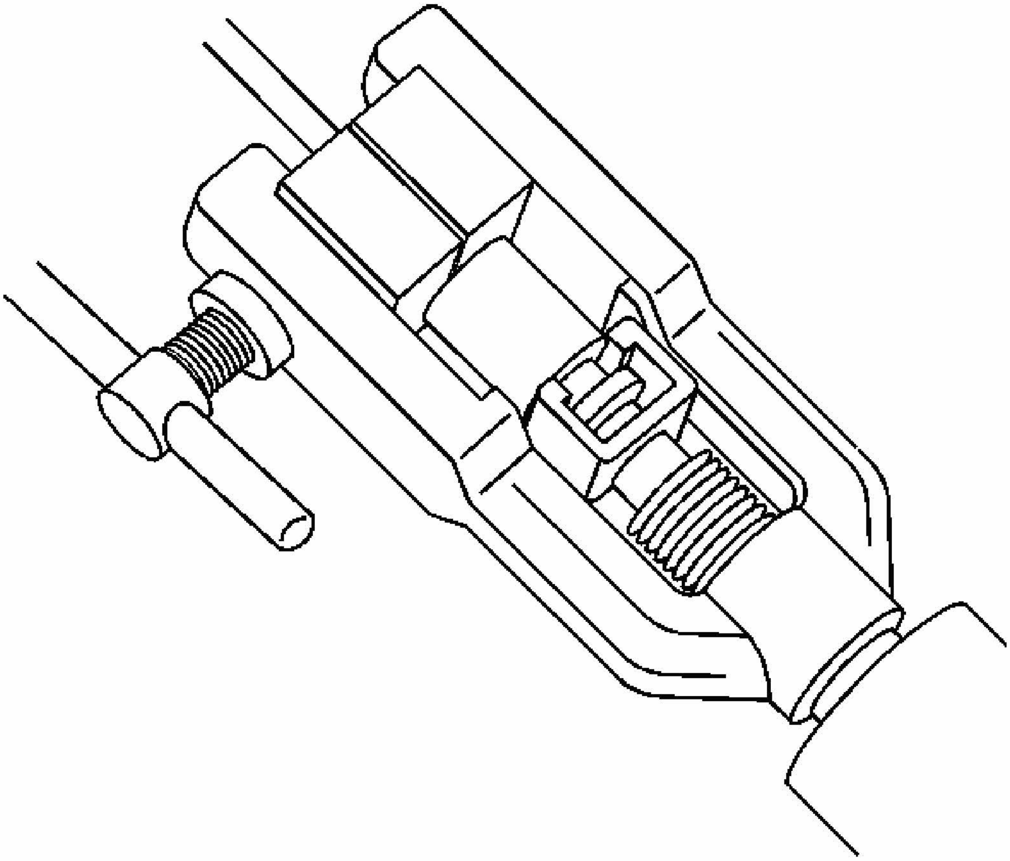


Fig. 32: Bottoming Forming Mandrel Against Clamping Dies Using Pipe Flaring Tool
Courtesy of GENERAL MOTORS CORP.

23. While guiding the forming mandrel into the exposed end of pipe to be flared, operate the lever of the **J 45405** until the forming mandrel bottoms against the clamping dies. See **Special Tools**.
24. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.
25. Loosen the die clamping screw and remove the dies and pipe.
26. If necessary, lightly tap the dies until the die halves separate.

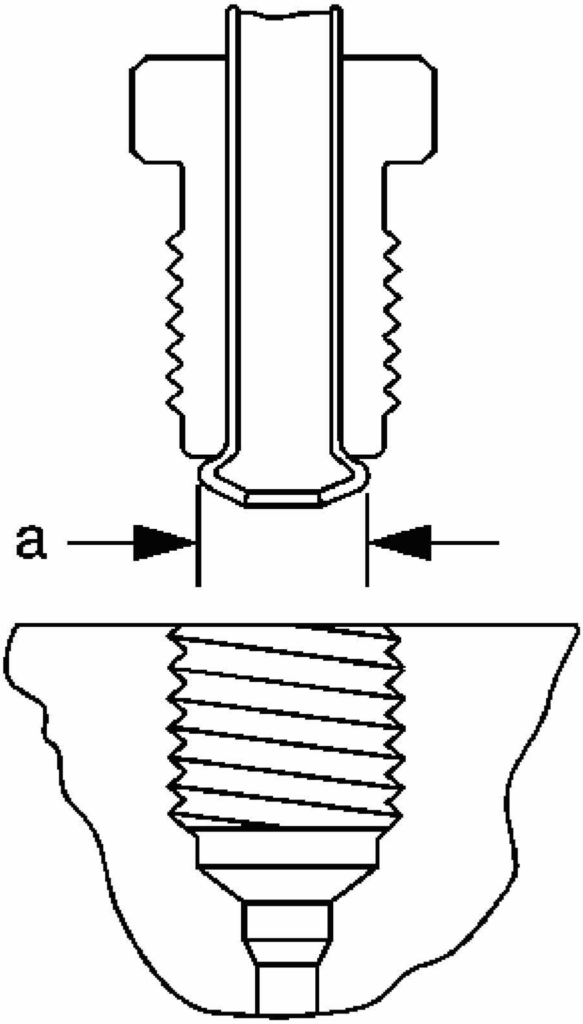


Fig. 33: Inspecting Brake Pipe Flare Diameter
Courtesy of GENERAL MOTORS CORP.

27. Inspect the brake pipe flare for correct shape and diameter (a).

    Specification: 7.10 mm (0.279 in) +/- 0.18 mm (0.007 in) flare diameter for 4.76 mm (3/16 in) diameter pipe

28. If necessary, using the removed section of pipe as a template, shape the new pipe with a suitable brake pipe bending tool.

IMPORTANT: When installing the pipe, maintain a clearance of 19 mm

(3/4 in) from all moving or vibrating components.

29. Install the pipe to the vehicle with the appropriate brake pipe unions as required.
30. If previously released, secure the brake pipe to the retainers.
31. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
32. With the aid of an assistant, inspect the brake pipe flares for leaks by starting the engine and applying the brakes.

FRONT BRAKE HOSE REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
3. Clean all dirt and foreign material from the brake hoses and brake pipe fitting.

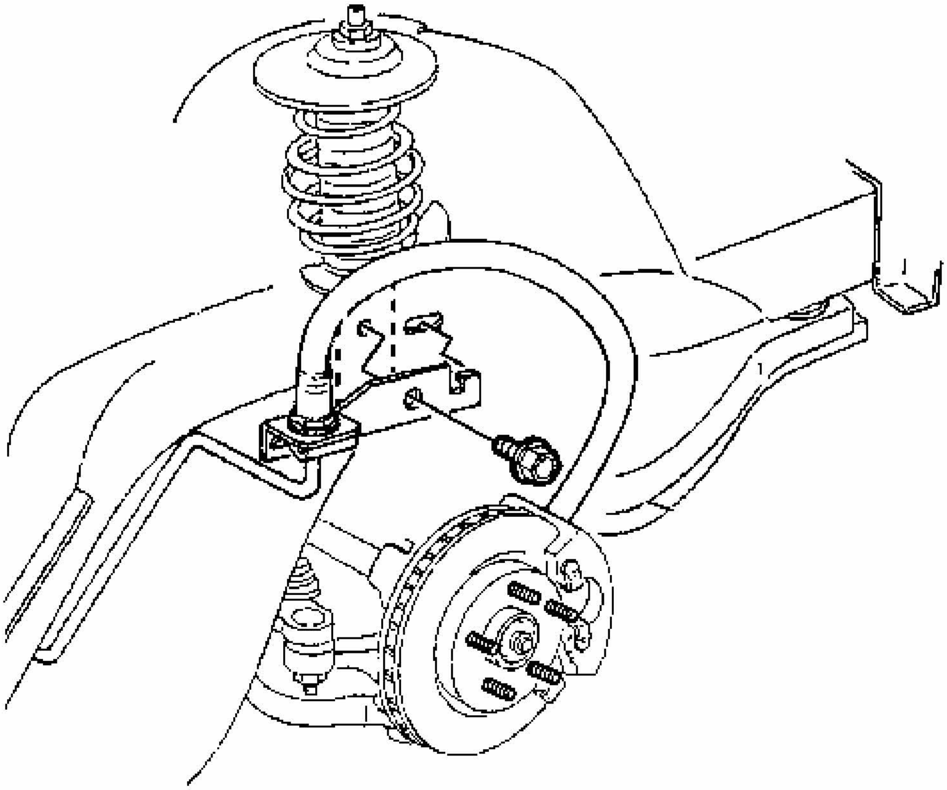


Fig. 34: Front Brake Hose & Mounting Bracket
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Install a rubber cap or plug to the exposed brake pipe fitting end to prevent brake fluid loss and contamination.

4. Use a backup wrench on the hose fitting, disconnect the brake pipe fitting from the brake hose, then cap or plug the brake pipe fitting end.

   Do not bend the brake pipe or the bracket.

5. Remove the brake hose retaining clip from the hose mounting bracket.
6. Remove the hose from the bracket.

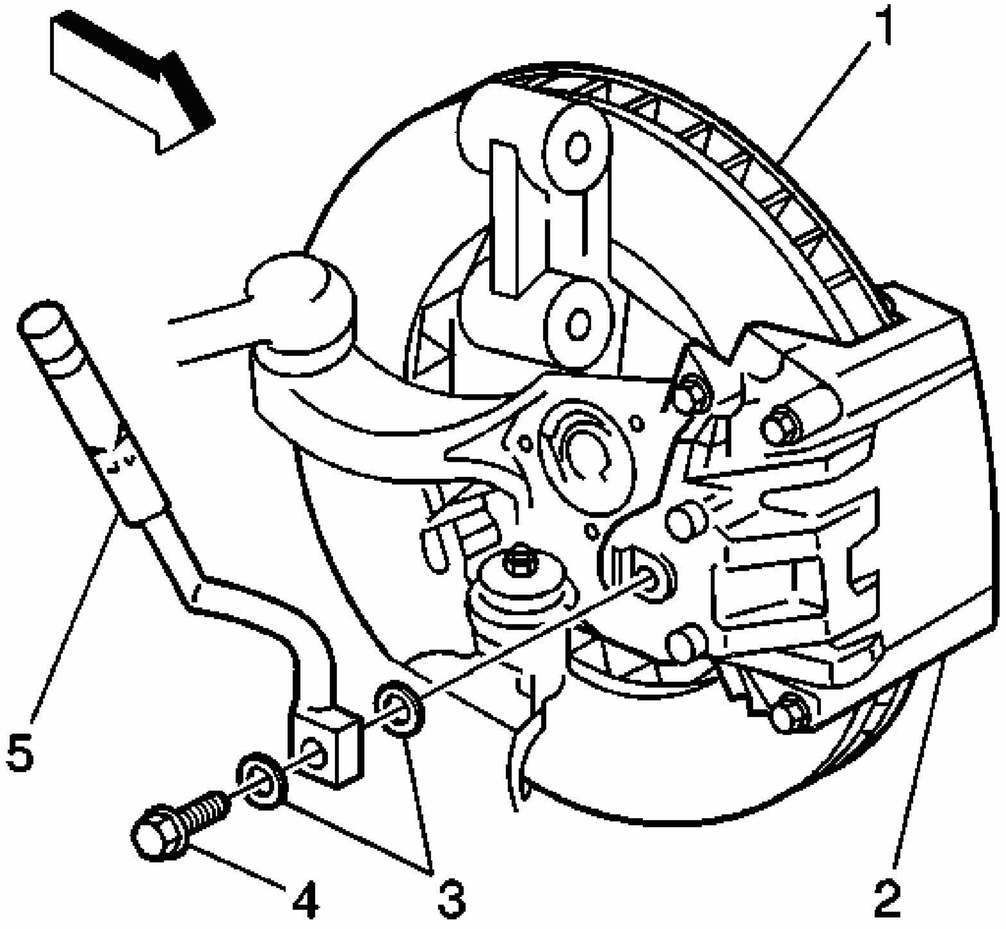


Fig. 35: Removing/Installing Brake Hose At Brake Caliper
Courtesy of GENERAL MOTORS CORP.

7. Remove the brake hose to caliper bolt (4) from the brake caliper (2).
8. Remove the brake hose (5) from the brake caliper (2).
9. Remove and discard the two copper brake hose gaskets (3). These gaskets may be stuck to the brake caliper and/or the brake hose end.

Installation Procedure

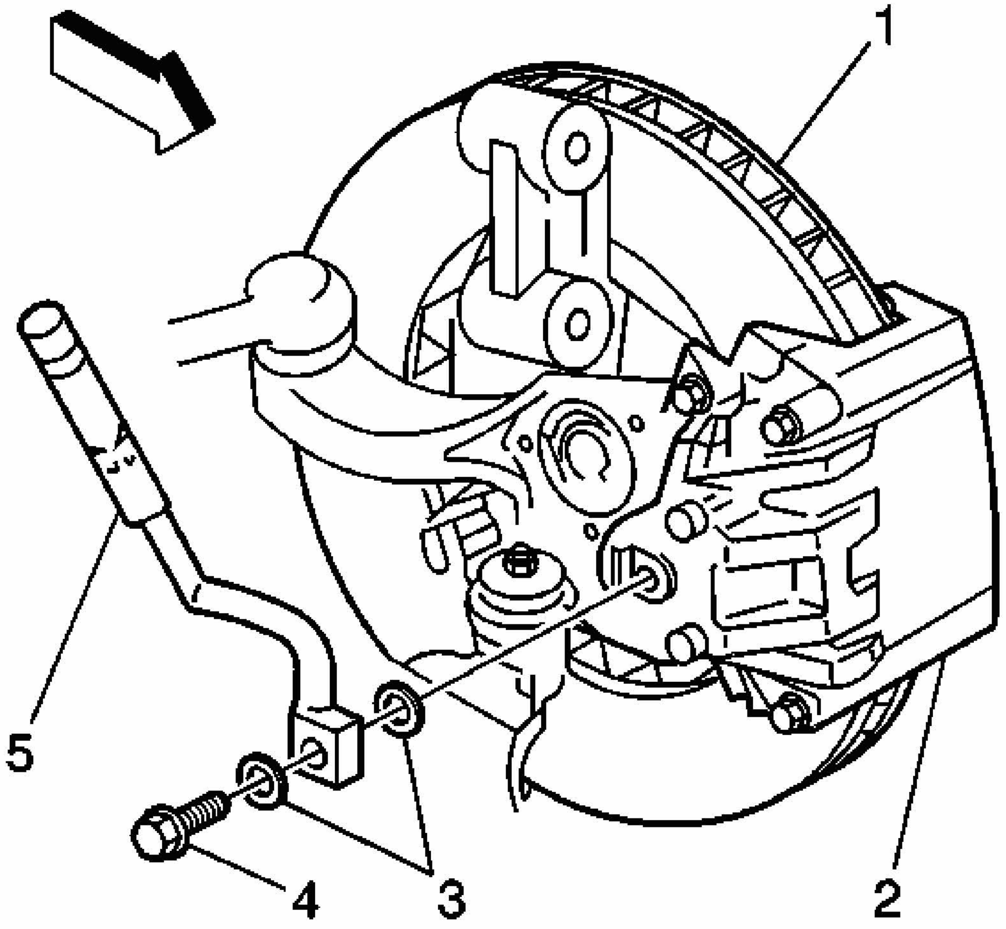


Fig. 36: Removing/Installing Brake Hose At Brake Caliper
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Install NEW copper brake hose gaskets (3).

1. Assemble the NEW copper brake hose gaskets (3), and the brake hose bolt (4) to the brake hose.

   NOTE: Refer to Fastener Notice .

2. Install the brake hose to caliper bolt to the brake caliper.

   Tighten: Tighten the brake hose to brake caliper bolt to 54 N.m (40 lb ft).

3. With the weight of the vehicle on the suspension, install the brake hose into the bracket.

   There should not be any kinks in the hose.

   Align the hose fitting with the notch in the bracket. Use the hose paint stripe as a visual aid.

4. Install the retainer onto the hose fitting at the bracket.
5. Remove the rubber cap or plug from the exposed brake pipe fitting end.

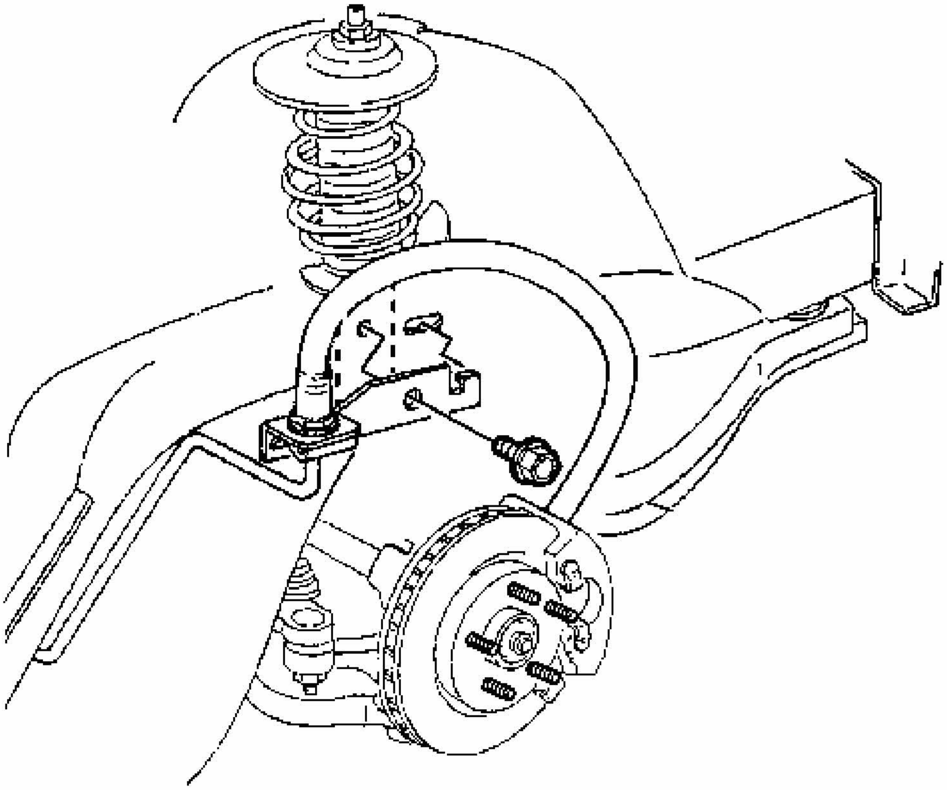


Fig. 37: Front Brake Hose & Mounting Bracket
Courtesy of GENERAL MOTORS CORP.

6. Connect the brake pipe fitting to the brake hose:
   - Use a backup wrench on the hose fitting.
   - Do not bend the bracket or pipe.

Tighten: Tighten the brake pipe fitting to 18 N.m (13 lb ft).

7. Install the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
8. Ensure that the hose does not make contact with any part of the suspension. Check the hose in extreme right and extreme left turn conditions. If the hose makes contact, remove the hose and correct the condition.
9. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
10. Lower the vehicle.

REAR BRAKE HOSE REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
3. Clean all dirt and foreign material from the brake hoses and brake pipe fitting.

IMPORTANT: Install a rubber cap or plug to the exposed brake pipe fitting end to prevent brake fluid loss and contamination.

4. Use a backup wrench on the hose fitting, disconnect the brake pipe fitting from the brake hose, then cap or plug the brake pipe fitting end.

   Do not bend the brake pipe or the bracket.

5. Remove the brake hose retaining clip from the hose mounting bracket.
6. Remove the hose from the bracket.

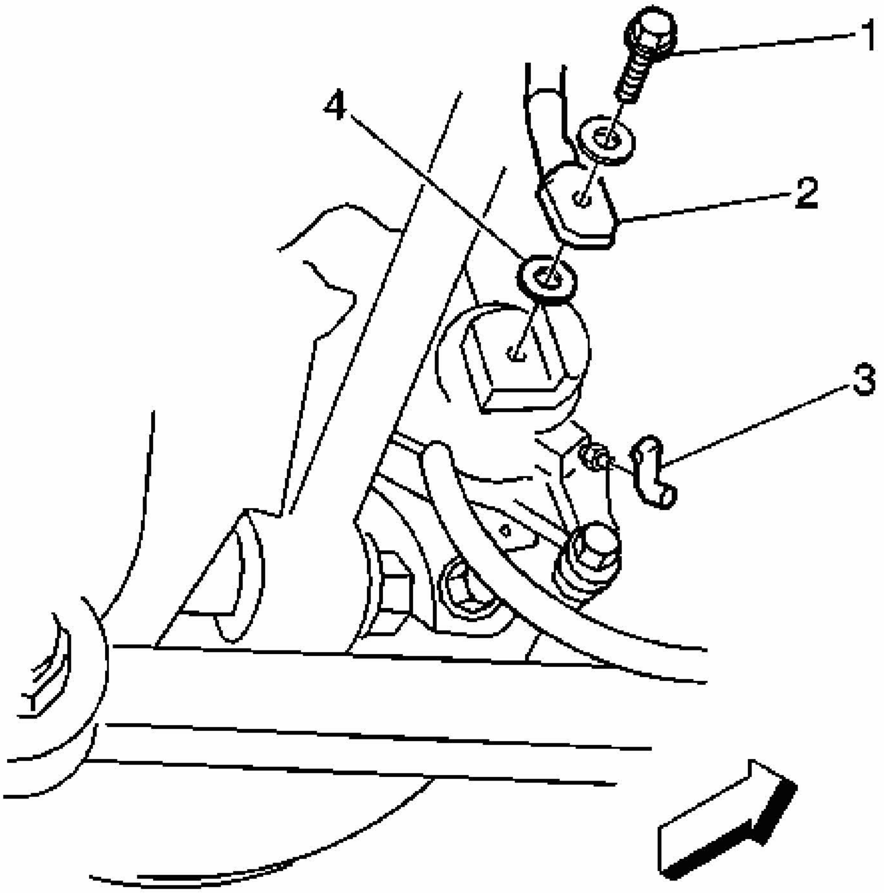


Fig. 38: Rear Brake Hose At Caliper
Courtesy of GENERAL MOTORS CORP.

7. Remove the brake hose to caliper bolt (1) from the brake caliper.
8. Remove the brake hose (2) from the brake caliper.
9. Remove and discard the two copper brake hose gaskets (4). These gaskets may be stuck to the brake caliper and/or the brake hose end.

Installation Procedure

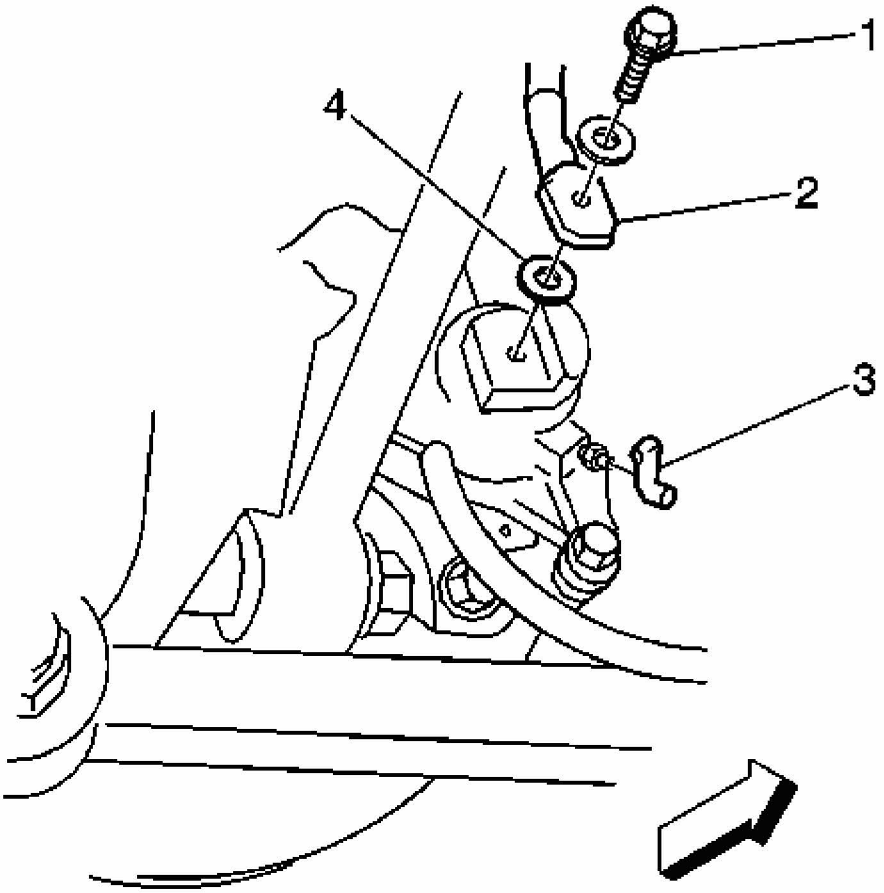


Fig. 39: Rear Brake Hose At Caliper
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Install NEW copper brake hose gaskets (4).

1. Assemble the NEW copper brake hose gaskets (4), and the brake hose bolt (1) to the brake hose (2).

   NOTE: Refer to Fastener Notice .

2. Install the brake hose to caliper bolt (1) to the brake caliper.

   Tighten: Tighten the brake hose to brake caliper bolt to 54 N.m (40 lb ft).

3. With the weight of the vehicle on the suspension, install the brake hose into the bracket.

   There should not be any kinks in the hose.

   Align the hose fitting with the notch in the bracket. Use the hose paint stripe as a visual aid.

4. Install the retainer onto the hose fitting at the bracket.
5. Remove the rubber cap or plug from the exposed brake pipe fitting end.
6. Connect the brake pipe fitting to the brake hose:
   - Use a backup wrench on the hose fitting.
   - Do not bend the bracket or pipe.

     Tighten: Tighten the brake pipe fitting to 18 N.m (13 lb ft).

7. Install the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
8. Ensure that the hose does not make contact with any part of the suspension. If the hose makes contact, remove the hose and correct the condition.
9. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
10. Lower the vehicle.

HYDRAULIC BRAKE SYSTEM BLEEDING (MANUAL)

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: When adding fluid to the brake master cylinder reservoir, use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Place a clean shop cloth beneath the brake master cylinder to prevent brake fluid spills.
2. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal effort increases significantly, in order to deplete the brake booster power

reserve.

3. If you have performed a brake master cylinder bench bleeding on this vehicle, or if you disconnected the brake pipes from the master cylinder, you must perform the following steps:
    1. Ensure that the brake master cylinder reservoir is full to the maximum-fill level. If necessary, add Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.

        If removal of the reservoir cap and diaphragm is necessary, clean the outside of the reservoir on and around the cap prior to removal.

    2. With the rear brake pipe installed securely to the master cylinder, loosen and separate the front brake pipe from the front port of the brake master cylinder.
    3. Allow a small amount of brake fluid to gravity bleed from the open port of the master cylinder.
    4. Reconnect the brake pipe to the master cylinder port and tighten securely.
    5. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
    6. Loosen the same brake pipe to purge air from the open port of the master cylinder.
    7. Tighten the brake pipe, then have the assistant slowly release the brake pedal.
    8. Wait 15 seconds, then repeat steps 3.3-3.7 until all air is purged from the same port of the master cylinder.
    9. With the front brake pipe installed securely to the master cylinder, after all air has been purged from the front port of the master cylinder, loosen and separate the rear brake pipe from the master cylinder, then repeat steps 3.3-3.8.
    10. After completing the final master cylinder port bleeding procedure, ensure that both of the brake pipe-to-master cylinder fittings are properly tightened.
4. Fill the brake master cylinder reservoir with Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. Ensure that the brake master cylinder reservoir remains at least half-full during this bleeding procedure. Add fluid as needed to maintain the proper level.

    Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.

5. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit bleeder valve.
6. Install a transparent hose over the end of the bleeder valve.
7. Submerge the open end of the transparent hose into a transparent container partially filled with Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.

8. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
9. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
10. Tighten the bleeder valve, then have the assistant slowly release the brake pedal.
11. Wait 15 seconds, then repeat steps 8-10 until all air is purged from the same wheel hydraulic circuit.
12. With the right rear wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the right rear hydraulic circuit, install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve.
13. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
14. With the left front wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the left front hydraulic circuit, install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve.
15. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
16. With the left rear wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the left rear hydraulic circuit, install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit bleeder valve.
17. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
18. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel hydraulic circuit bleeder valves are properly tightened.
19. Fill the brake master cylinder reservoir to the maximum-fill level with Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
20. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.

IMPORTANT: If it is determined that air was induced into the system upstream of the ABS modulator prior to servicing, the ABS Automated Bleed Procedure must be performed.

21. If the brake pedal feels spongy, repeat the bleeding procedure again. If the brake pedal still feels spongy after repeating the bleeding procedure, perform the following steps:
    1. Inspect the brake system for external leaks. Refer to **Brake System External Leak Inspection**.
    2. Pressure bleed the hydraulic brake system in order to purge any air that may still be trapped in the system.
22. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

IMPORTANT: DO NOT allow the vehicle to be driven until it is diagnosed and repaired.

23. If the brake system warning lamp remains illuminated, refer to **Symptoms - Hydraulic Brakes**.

HYDRAULIC BRAKE SYSTEM BLEEDING (PRESSURE)

Tools Required

- **J 29532** Diaphragm Type Brake Pressure Bleeder, or equivalent. See **Special Tools**.
- **J 35589-A** Brake Pressure Bleeder Adapter. See **Special Tools**.

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: When adding fluid to the brake master cylinder reservoir, use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

NOTE: Refer to BRAKE FLUID EFFECTS ON PAINT AND ELECTRICAL COMPONENTS NOTICE in Cautions and Notices.

1. Place a clean shop cloth beneath the brake master cylinder to prevent brake fluid spills.
2. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal effort increases significantly, in order to deplete the brake booster power reserve.
3. If you have performed a brake master cylinder bench bleeding on this vehicle, or if you disconnected the brake pipes from the master cylinder, you must perform the following steps:
    1. Ensure that the brake master cylinder reservoir is full to the maximum-fill level. If necessary, add Delco Supreme 11® GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.

       If removal of the reservoir cap is necessary, clean the outside of the reservoir on and around the cap prior to removal.

    2. With the rear brake pipe installed securely to the master cylinder, loosen and separate the front brake pipe from the front port of the brake master cylinder.
    3. Allow a small amount of brake fluid to gravity bleed from the open port of the master cylinder.

    4. Reconnect the brake pipe to the master cylinder port and tighten securely.
    5. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
    6. Loosen the same brake pipe to purge air from the open port of the master cylinder.
    7. Tighten the brake pipe, then have the assistant slowly release the brake pedal.
    8. Wait 15 seconds, then repeat steps 3.3-3.7 until all air is purged from the same port of the master cylinder.
    9. With the front brake pipe installed securely to the master cylinder - after all air has been purged from the front port of the master cylinder - loosen and separate the rear brake pipe from the master cylinder, then repeat steps 3.3-3.8.
    10. After completing the final master cylinder port bleeding procedure, ensure that both of the brake pipe-to-master cylinder fittings are properly tightened.
4. Fill the brake master cylinder reservoir to the maximum-fill level with Delco Supreme 11® GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.

   Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.

5. Install the **J 35589-A** to the brake master cylinder reservoir. See **Special Tools**.
6. Check the brake fluid level in the **J 29532** , or equivalent. See **Special Tools**. Add Delco Supreme 11® GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container as necessary to bring the level to approximately the half-full point.
7. Connect the **J 29532** , or equivalent, to the **J 35589-A** . See **Special Tools**.
8. Charge the **J 29532** , or equivalent, air tank to 175-205 kPa (25-30 psi). See **Special Tools**.
9. Open the **J 29532** , or equivalent, fluid tank valve to allow pressurized brake fluid to enter the brake system. See **Special Tools**.
10. Wait approximately 30 seconds, then inspect the entire hydraulic brake system in order to ensure that there are no existing external brake fluid leaks.

    Any brake fluid leaks identified require repair prior to completing this procedure.

11. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit bleeder valve.
12. Install a transparent hose over the end of the bleeder valve.
13. Submerge the open end of the transparent hose into a transparent container partially filled with Delco Supreme 11® GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
14. Loosen the bleeder valve to purge air from the wheel hydraulic circuit. Allow fluid to

flow until air bubbles stop flowing from the bleeder, then tighten the bleeder valve.

15. With the right rear wheel hydraulic circuit bleeder valve tightened securely - after all air has been purged from the right rear hydraulic circuit - install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve.
16. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
17. With the left front wheel hydraulic circuit bleeder valve tightened securely - after all air has been purged from the left front hydraulic circuit - install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve.
18. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
19. With the left rear wheel hydraulic circuit bleeder valve tightened securely - after all air has been purged from the left rear hydraulic circuit - install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit bleeder valve.
20. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
21. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel hydraulic circuit bleeder valves are properly tightened.
22. Close the **J 29532** , or equivalent, fluid tank valve, then disconnect the **J 29532** , or equivalent, from the **J 35589-A** . See **Special Tools**.
23. Remove the **J 35589-A** from the brake master cylinder reservoir. See **Special Tools**.
24. Fill the brake master cylinder reservoir to the maximum-fill level with Delco Supreme 11® GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
25. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.
26. If the brake pedal feels spongy perform the following steps:
    1. Inspect the brake system for external leaks. Refer to **Brake System External Leak Inspection** .
    2. If equipped with Antilock Brakes, using a scan tool, perform the antilock brake system automated bleeding procedure to remove any air that may have been trapped in the BPMV. Refer to **ABS Automated Bleed Procedure** in Antilock Brake System.
27. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

IMPORTANT: DO NOT allow the vehicle to be driven until it is diagnosed and repaired.

28. If the brake system warning lamp remains illuminated, refer to **Symptoms - Hydraulic Brakes**.

HYDRAULIC BRAKE SYSTEM FLUSHING

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

NOTE: When adding fluid to the brake master cylinder reservoir, use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:
   - Fluid separation, indicating two types of fluid are present; a substance other than the recommended brake fluid has been introduced into the brake hydraulic system
     - Swirled appearance - oil-based substance
     - Layered appearance - silicone-based substance
   - Fluid discoloration, indicating the presence of moisture or particles that have been introduced into the brake hydraulic system
     - Cloudy appearance - moisture
     - Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust
2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating brake fluid contamination.
3. If the brake fluid WAS contaminated with an oil-based or a silicone-based substance, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following:
   1. Remove ALL of the following components listed from the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.
      - **Master Cylinder Replacement**
      - **Brake Hose Replacement - Front**
      - **Brake Hose Replacement - Rear**
      - **Brake Caliper Replacement - Front** in Disc Brakes
      - **Brake Caliper Replacement - Rear** in Disc Brakes
      - **Brake Pressure Modulator Valve (BPMV) Replacement** in Antilock Brake System

2. Clean out all the hydraulic brake pipes using denatured alcohol, or equivalent.
3. Dry the brake pipes using non-lubricated, filtered air.
4. Repair or replace ALL of the following components listed and install them to the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.
    - **Master Cylinder Overhaul** or **Master Cylinder Replacement**; also perform the following:

      Clean the brake master cylinder reservoir using denatured alcohol, or equivalent, then dry the reservoir using non-lubricated, filtered air. Inspect the reservoir for cracks and/or damage and replace if necessary. Refer to **Master Cylinder Reservoir Replacement** .

      Replace the brake master cylinder reservoir cap diaphragm.

    - **Brake Hose Replacement - Front**
    - **Brake Hose Replacement - Rear**
    - **Brake Caliper Overhaul - Front** or **Brake Caliper Replacement - Front** in Disc Brakes
    - **Brake Caliper Overhaul - Rear** or **Brake Caliper Replacement - Rear** in Disc Brakes
    - **Brake Pressure Modulator Valve (BPMV) Replacement** in Antilock Brake System

4. If the brake fluid was NOT contaminated with an oil-based or a silicone-based substance, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap diaphragm. The diaphragm may have allowed the moisture or particles to enter the hydraulic system.
5. Fill the brake master cylinder reservoir to the maximum-fill level with Delco Supreme 11®, GM P/N 12377967 (Canada P/N 992667) or equivalent, DOT-3 brake fluid from a clean, sealed brake fluid container.
6. Pressure bleed the hydraulic brake system. Begin the procedure with the pressure bleeder reservoir filled to the maximum-fill level with the correct brake fluid as indicated. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

VACUUM BRAKE BOOSTER REPLACEMENT (3.5L 3.9L)

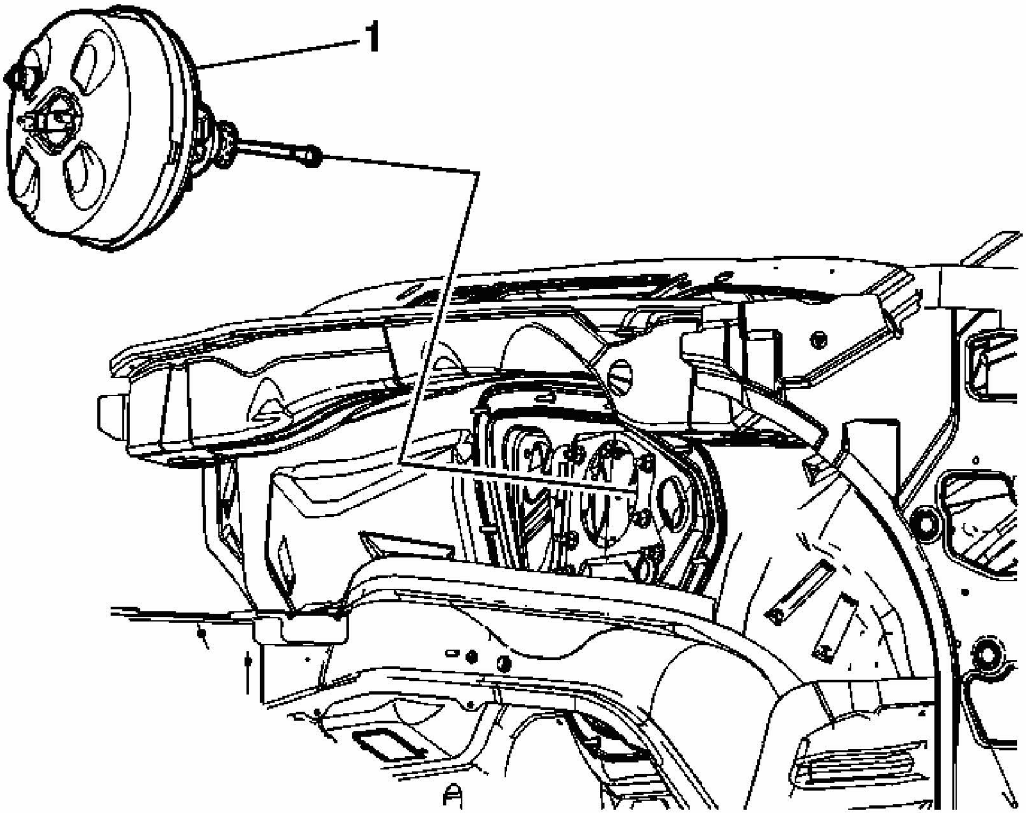


Fig. 40: Replacing Vacuum Brake Booster
Courtesy of GENERAL MOTORS CORP.

Vacuum Brake Booster Replacement (3.5L 3.9L)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the intake manifold cover for the 3.5L. Refer to **Engine Mount Replacement** . 2. Remove the intake manifold cover for the 3.9L. Refer to **Intake Manifold Cover Replacement** . 3. Remove the air cleaner assembly for the 3.5L. Refer to **Air Cleaner Assembly Replacement** . 4. Remove the air cleaner assembly for the 3.9L. Refer to **Air Cleaner Assembly Replacement** . 5. Remove the brake pressure modulator valve (BPMV) mounting bracket. Refer to	

Brake Pressure Modulator Valve (BPMV) Bracket Replacement . 6. Remove the master cylinder assembly. Refer to **Master Cylinder Replacement**. 7. Remove the exhaust crossover pipe. Refer to **Exhaust Crossover Pipe Replacement (RPOs LZE/LZ4/LZ9)** or **Exhaust Crossover Pipe Replacement (RPO LS4)** .	
1	Brake Booster **Tip:** • Before removing the brake booster, ensure that all the brake pipes are capped or plugged to prevent contamination of the brake system and brake fluid leakage. • Using the **J 22805-B** , remove the brake booster. • Bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

VACUUM BRAKE BOOSTER REPLACEMENT (5.3L)

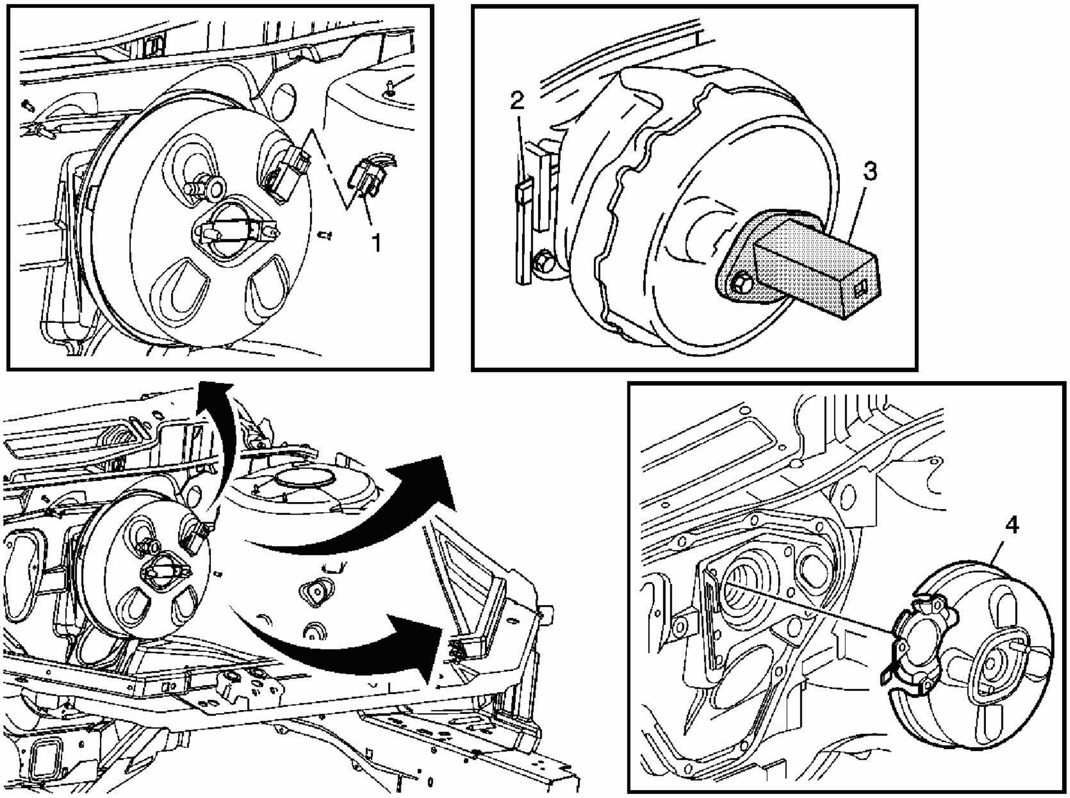


Fig. 41: Replacing Vacuum Brake Booster
Courtesy of GENERAL MOTORS CORP.

Vacuum Brake Booster Replacement (5.3L)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement** 2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** . 3. Remove the brake pressure modulator valve (BPMV) mounting bracket. Refer to **Brake Pressure Modulator Valve (BPMV) Bracket Replacement** . 4. Remove the master cylinder assembly. Refer to **Master Cylinder Replacement**. 5. Remove the exhaust crossover pipe. Refer to **Exhaust Crossover Pipe Replacement (RPOs LZE/LZ4/LZ9)** or **Exhaust Crossover Pipe Replacement (RPO LS4)** .	
1	DOD Electrical Connector
2	Release Lever
3	Tool **Tip:** Using the **J 22805-B** , remove the brake booster.
4	Brake Booster **Tip:** • Before removing the brake booster, ensure that all the brake pipes are capped or plugged to prevent contamination of the brake system and brake fluid leakage. • It may be necessary to remove the retaining bolts for the coolant lines underneath the throttle body and at the front of the engine to relocate the coolant lines to remove the booster. • Bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

VACUUM BRAKE BOOSTER CHECK VALVE AND/OR HOSE REPLACEMENT (3.5L, 3.9L)

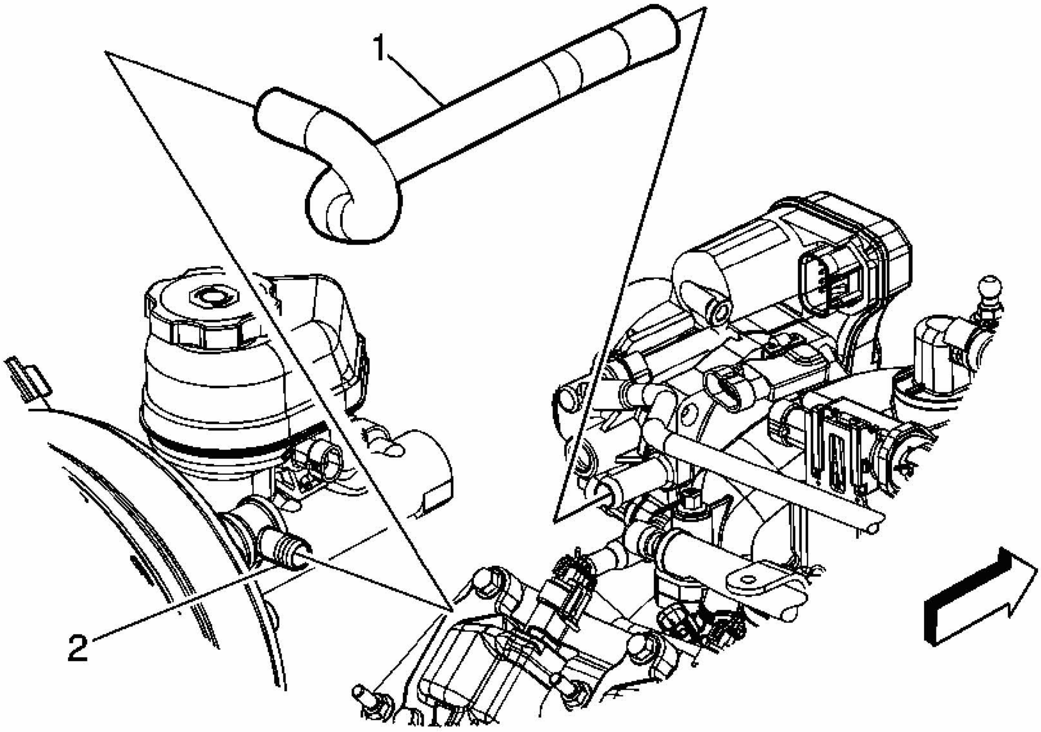


Fig. 42: Replacing Vacuum Brake Booster Check Valve and/or Hose
Courtesy of GENERAL MOTORS CORP.

Vacuum Brake Booster Check Valve and/or Hose Replacement (3.5l, 3.9L)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Special Tools** . **Preliminary Procedure** 1. Remove the intake manifold cover if equipped with the 3.5L. Refer to **Intake Manifold Cover Replacement** . 2. Remove the intake manifold cover if equipped with the 3.9L. Refer to **Intake Manifold Cover Replacement**	
1	Vacuum Hose **Tip:** Remove the vacuum hose from the vacuum fitting on the engine before removing it from the check valve.
2	Check Valve **Tip:** Use a flat blade screw driver to remove the check vale from the brake booster. Also, when install the check valve, apply a small amount of clean oil motor to the valve.

VACUUM BRAKE BOOSTER CHECK VALVE AND/OR HOSE REPLACEMENT (5.3L)

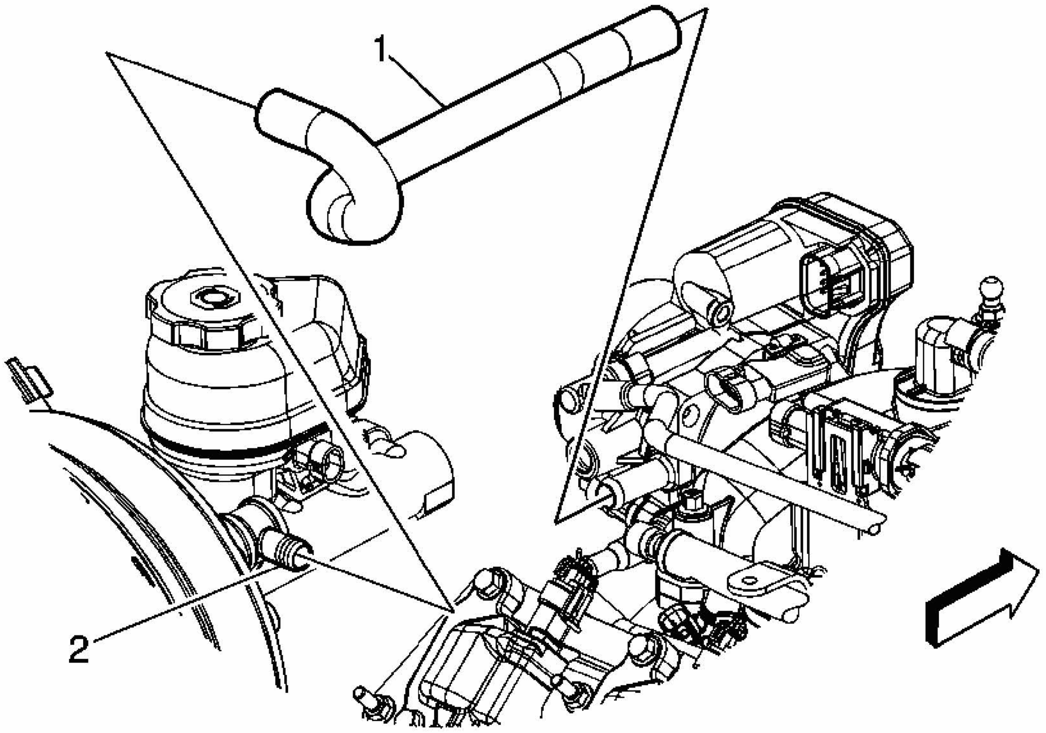


Fig. 43: Replacing Vacuum Brake Booster Check Valve and/or Hose
Courtesy of GENERAL MOTORS CORP.

Vacuum Brake Booster Check Valve and/or Hose Replacement (5.3L)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Special Tools** . **Preliminary Procedure:** Remove the engine sight shield. Refer to **Valve Rocker Arm Cover Replacement - Left** .	
1	Vacuum Hose **Tip:** Remove the vacuum hose from the vacuum fitting on the engine before removing it from the check valve.
2	Check Valve **Tip:** Use a flat blade screw driver to remove the check vale from the brake booster. Also, when install the check valve, apply a small amount of clean oil motor to the valve.

DESCRIPTION AND OPERATION

BRAKE FLUID AND BRAKE FLUID HANDLING

CAUTION: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- **Eye contact-rinse thoroughly with water.**
- **Skin contact-wash with soap and water.**
- **If ingested-consult a physician immediately.**

CAUTION: Use only Delco Supreme 11, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT 3 brake fluid from a clean, sealed container. Do not use fluid from an open container that may be contaminated with water. Improper or contaminated fluid could result in damage to components, or loss of braking, with possible injury.

NOTE: When filling the master cylinder, use only Delco Supreme 11, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT 3 brake fluid. Do not use a container which has been used for petroleum based fluids, or a container which is wet with water. Petroleum based fluids will cause swelling and distortion of rubber parts in the hydraulic brake system, and water will mix with brake fluid, lowering the boiling point. Keep all fluid containers capped to prevent contamination.

NOTE: Brake fluid will damage electrical connections and painted surfaces. Use shop cloths, suitable containers, and fender covers to prevent brake fluid from contacting these areas. Always re-seal and wipe off brake fluid containers to prevent spills.

NOTE: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, immediately flush the area with water to minimize the potential for damage.

NOTE: Power steering fluid, engine oil, brake fluid, or any mineral based fluids cannot be mixed. If brake seals contact power steering fluid or steering seals contact brake fluid, seal damage will result.

IMPORTANT:

- **Do not reuse the brake fluid collected during the hydraulic brake system bleeding.**
- **Always store brake fluid in a closed container.**

- **Reseal brake fluid containers immediately after use.**
- **Do not use brake fluid left in an open container.**
- **Do not use brake fluid left in an improperly sealed container.**
- **Do not use the following fluids in the hydraulic brake system:**
    - **Power steering fluid**
    - **Automatic transmission fluid**
    - **DOT 5 silicone hydraulic brake fluid**

BRAKE WARNING SYSTEM DESCRIPTION AND OPERATION

Brake System Indicators

Brake

The instrument panel cluster (IPC) illuminates the BRAKE indicator when any of the following occurs:

- The body control module (BCM) detects that the park brake is applied and sends serial data message to illuminate indicator.
- The IPC detects a low brake fluid condition.
- The electronic brake control module (EBCM) detects a malfunction with the antilock brake system (ABS). The IPC receives a serial data message from the EBCM requesting illumination.
- The IPC performs the displays test at the start of each ignition cycle. The indicator illuminates for approximately 5 seconds.

Check Brake Fluid

The IPC illuminates the CHECK BRAKE FLUID indicator in the driver information center (DIC) and sends a serial data message in order to activate an audible warning when the IPC detects that the brake fluid level is below the normal operating range.

HYDRAULIC BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Fluid Reservoir

Contains supply of brake fluid for the hydraulic brake system.

Hydraulic Brake Master Cylinder

Converts mechanical input force into hydraulic output pressure.
Hydraulic output pressure is distributed from the master cylinder through two hydraulic circuits, supplying diagonally-opposed wheel apply circuits.

Hydraulic Brake Pressure Balance Control System

Regulates brake fluid pressure delivered to hydraulic brake wheel circuits, in order to control the distribution of braking force.
Pressure balance control is achieved through dynamic rear proportioning (DRP), which is a function of the ABS modulator. Refer to **ABS Description and Operation** in Antilock Brake System for specific information on the operation of DRP.

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

Converts hydraulic input pressure into mechanical output force.

System Operation

Mechanical force is converted into hydraulic pressure by the master cylinder, regulated to meet braking system demands by the pressure balance control system, and delivered to the hydraulic brake wheel circuits by the pipes and flexible hoses. The wheel apply components then convert the hydraulic pressure back into mechanical force which presses linings against rotating brake system components.

BRAKE ASSIST SYSTEM DESCRIPTION AND OPERATION

System Component Description

The brake assist system consists of the following:

Brake Pedal

Receives, multiplies and transfers brake system input force from driver.

Brake Pedal Pushrod

Transfers multiplied input force received from brake pedal to brake booster.

Vacuum Brake Booster

Uses source vacuum to decrease effort required by driver when applying brake system input force.

When brake system input force is applied, air at atmospheric pressure is admitted to the rear of both vacuum diaphragms, providing a decrease in brake pedal effort required.

When input force is removed, vacuum replaces atmospheric pressure within the booster.

Vacuum Source

Supplies force used by vacuum brake booster to decrease brake pedal effort.

Vacuum Source Delivery System

Enables delivery and retention of source vacuum for vacuum brake booster.

System Operation

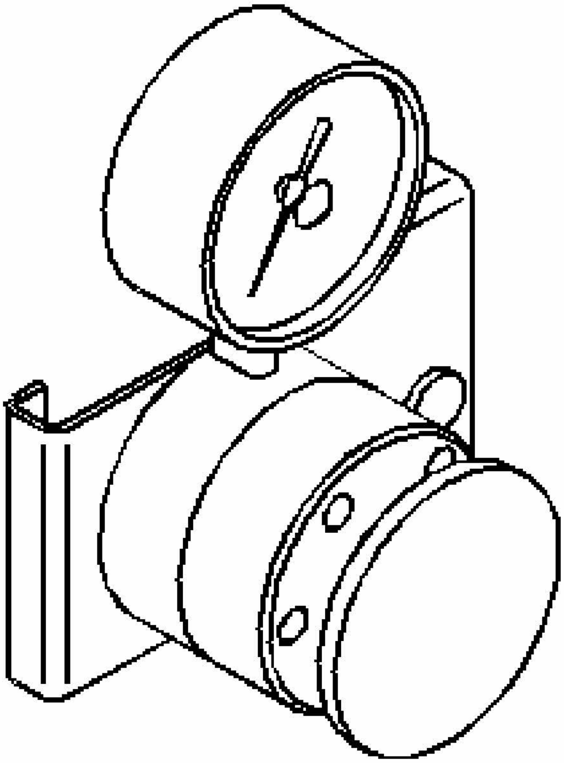
Brake system input force is multiplied by the brake pedal and transferred by the pedal pushrod to the hydraulic brake master cylinder. Effort required to apply the brake system is reduced by the vacuum brake booster.

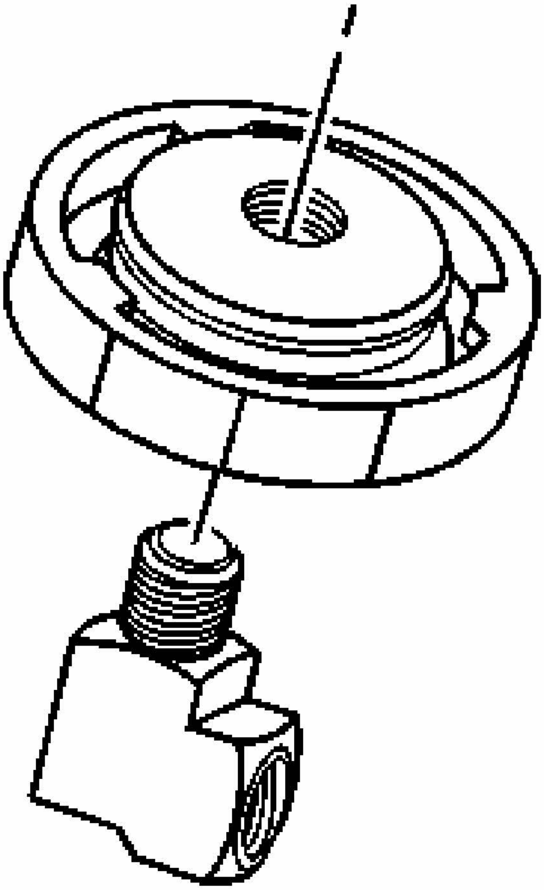
SPECIAL TOOLS AND EQUIPMENT

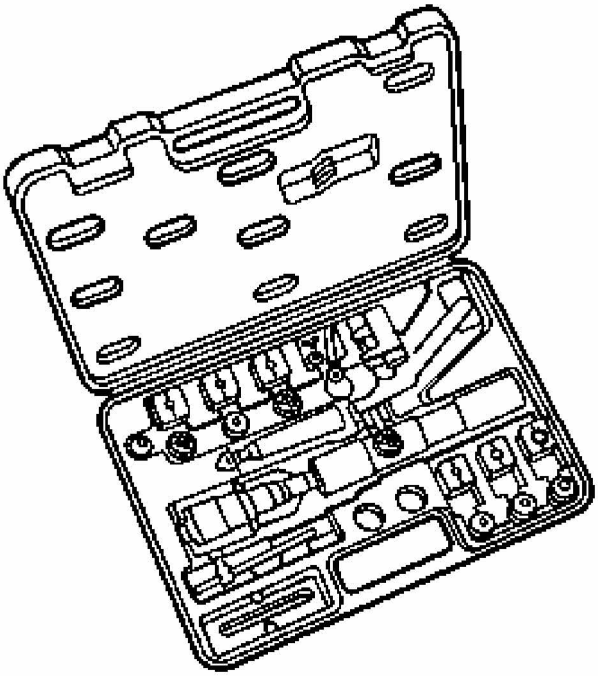
SPECIAL TOOLS

Special Tools

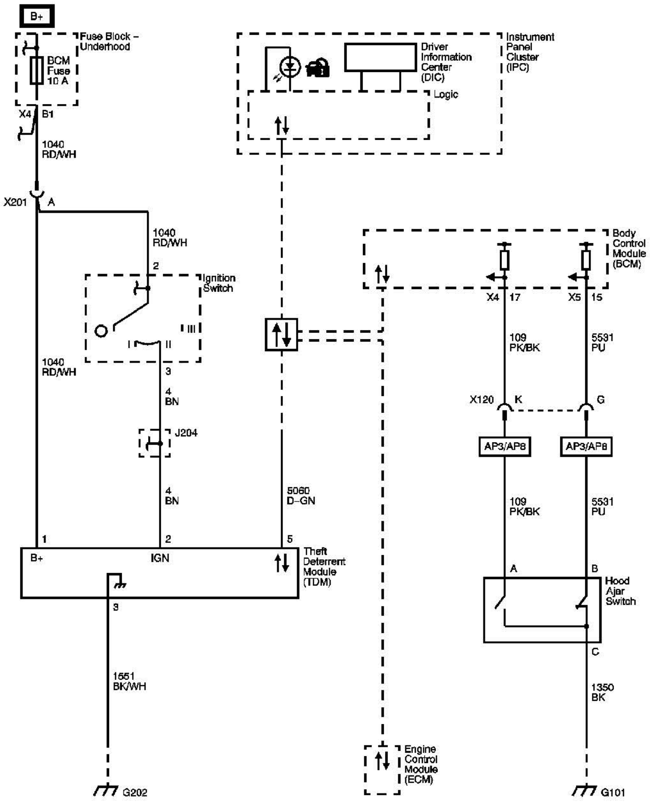
Illustration	Tool Number/ Description
	J 28662 Brake Pedal Effort Gauge

	
	J 29532 Diaphragm Pressure Bleeder

	J 35589-A Brake Pressure Bleeder Adapter

	J 45405 Pipe Flaring Tool Kit

Immobilizer Schematics


B+
Fuse Block – Underhood
BCM Fuse 10 A
X4
B1
1040 RD/WH
X201
A
1040 RD/WH
2
Ignition Switch
I
II
III
3
1040 RD/WH
4 BN
J204
4 BN
Driver Information Center (DIC)
Instrument Panel Cluster (IPC)
Logic
5060 D–GN
Body Control Module (BCM)
X4
17
X5
15
109 PK/BK
5531 PU
X120
K
G
AP3/AP8
AP3/AP8
109 PK/BK
5531 PU
1
2
5
B+
IGN
Theft Deterrent Module (TDM)
3
1551 BK/WH
G202
Engine Control Module (ECM)
A
B
Hood Ajar Switch
C
1350 BK
G101

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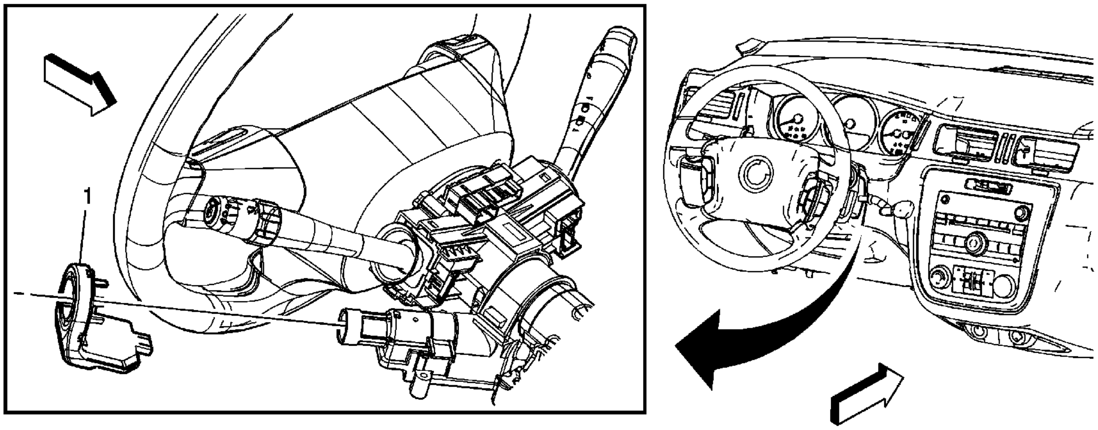
Theft Deterrent Module Replacement



Callout	Component Name
Preliminary Procedure Remove the ignition lock cylinder. Refer to Ignition Lock Cylinder Replacement .	
1	Module Assembly, Theft Deterrent **Tip** Disconnect the electrical connector.

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Immobilizer System Component Programming

10-Minute Immobilizer Relearn

This 10-minute relearn procedure will relearn the prerelease password and the challenge/response data between the theft deterrent module (TDM) and the engine control module (ECM).

1. Connect a scan tool to the vehicle in the pass-thru arrangement.
2. Turn ON the ignition, with the engine OFF.
3. Ensure that all power consuming devices are turned OFF on the vehicle.
4. On the Techline Terminal, select Service Programming System and follow the Techline Terminal on-screen instructions, using the Pass-Thru method. Ensure the correct programming selection is chosen based on component being replaced or programmed. For this procedure, go to the V.T.D. Vehicle Theft Deterrent Learn menu and choose the Vehicle Theft Deterrent Learn, ECM, or PK3 Replaced selection.
5. At this point the scan tool must remain connected for the duration of the 10-minute relearn procedure.

   Important:
   - The scan tool will initially display 12 Minutes. The first 2 minutes allow the scan tool to initialize the appropriate control module. The remaining 10 minutes is the relearn timer.
   - On some vehicles the security indicator may be illuminated for the duration of the 10-minute relearn procedure.

6. Observe the scan tool, after approximately 10 minutes the scan tool will display "Programming Successful, Turn OFF Ignition". The vehicle is now ready to relearn the key information and/or the passwords on the next ignition switch transition from OFF to CRANK.
7. Turn OFF the ignition and wait 2 minutes.
8. With a master vehicle key, turn the ignition to the RUN position for 15 seconds, then start the vehicle. The TDM and ECM have now relearned the pre-release password and the challenge/response data.
9. With a scan tool, clear any DTCs.

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Adding Keys

Important:

- To initiate, this procedures requires that a learned master key be available.
- A total of 10 keys may be programmed to a single vehicle.
- This procedure adds keys only. The procedure does not erase previously learned keys.
- The keys to be learned must duplicate the mechanical cut of the current key.
- If more than one valet key is to be learned, immediately precede each valet key with a learned master key.

1. With a previously learned master key, turn ON the ignition, with the engine OFF.
2. Turn OFF the ignition and remove the key.
3. Within 10 seconds of turning OFF the ignition, insert the key to be learned and turn ON the ignition. The vehicle has now learned the new key.

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Replacing Keys (North America except Canada)

10-Minute Vehicle Key Relearn

Important: This procedure will only relearn the vehicle keys. This procedure will not learn the immobilizer prerelease password or the challenge/response data. Do not use this procedure as a substitute for a 10-minute relearn when replacing or reprogramming a theft deterrent module (TDM) or engine control module (ECM). Doing so will result in a failure to learn the pre-release password and/or the challenge/response data.

This 10-minute learn procedure should be used when all vehicle keys are desired to be replaced or reprogrammed. This procedure will erase all previously learned vehicle keys from the TDM. Once the 10-minute learn procedure has been completed, any remaining vehicle keys may be programmed using the Adding Keys procedure to ensure their continued functionality.

1. Connect a scan tool to the vehicle in the pass-thru arrangement.
2. Turn ON the ignition, with the engine OFF.
3. Ensure that all power consuming devices are turned OFF on the vehicle.
4. On the Techline Terminal, select Service Programming System and follow the Techline Terminal on-screen instructions, using the Pass-Thru method. Ensure the correct programming selection is chosen based on component being replaced or programmed. For this procedure, go to the V.T.D. Vehicle Theft Deterrent Learn menu and choose the Vehicle Theft Deterrent Learn for Learning Replacement Keys selection.
5. At this point the scan tool must remain connected for the duration of the 10-minute relearn procedure.

   Important:

   - The scan tool will initially display 12 Minutes. The first 2 minutes allow the scan tool to initialize the appropriate control module. The remaining 10 minutes is the relearn timer.
   - On some vehicles the security indicator may be illuminated for the duration of the 10-minute relearn procedure.

6. Observe the scan tool, after approximately 10 minutes the scan tool will display "Programming Successful, Turn OFF Ignition". The vehicle is now ready to relearn the key information and/or the passwords on the next ignition switch transition from OFF to CRANK.
7. Turn OFF the ignition and wait 2 minutes.
8. With a master vehicle key, turn the ignition to the RUN position for 15 seconds, then start the vehicle. The TDM has now learned the key transponder information.
9. With a scan tool, clear any DTCs.

30-Minute Vehicle Key Relearn

Important: This procedure will only relearn the vehicle keys. This procedure will not learn the immobilizer prerelease password or the challenge/response data. Do not use this procedure as a substitute for a 10-minute relearn when replacing or reprogramming a TDM or ECM. Doing so will result in a failure to learn the prerelease password and/or the challenge/response data.

This 30-minute learn procedure should be used when all vehicle keys are desired to be replaced or reprogrammed. This procedure will erase all previously learned vehicle keys from the TDM. Once

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the 30-minute learn procedure has been completed, any remaining vehicle keys may be programmed using the Adding Keys procedure to ensure their continued functionality.

1. With an unlearned master vehicle key, turn ON the ignition, with the engine OFF.
2. Observe the security indicator, after approximately 10 minutes the telltale will turn off.
3. Turn OFF the ignition, and wait 5 seconds.
4. Repeat steps 1-3 two more times for a total of 3 cycles or 30 minutes.

   Important: The TDM learns the key transponder information upon the ignition switch transition from OFF to ON. You must turn the ignition OFF before attempting to start the vehicle.

5. With a master vehicle key, start the vehicle. The vehicle has now learned the key transponder information.
6. If additional keys are required to be learned, refer to Adding Keys.
7. With a scan tool, clear any DTCs.

Replacing Keys (Canada)

10-Minute Vehicle Key Relearn

Important: This procedure will only relearn the vehicle keys. This procedure will not learn the immobilizer prerelease password or the challenge/response data. Do not use this procedure as a substitute for a 10-minute relearn when replacing or reprogramming a theft deterrent module (TDM) or engine control module (ECM). Doing so will result in a failure to learn the pre-release password and/or the challenge/response data.

This 10-minute learn procedure should be used when all vehicle keys are desired to be replaced or reprogrammed. This procedure will erase all previously learned vehicle keys from the TDM. Once the 10-minute learn procedure has been completed, any remaining vehicle keys may be programmed using the Adding Keys procedure to ensure their continued functionality.

1. Connect a scan tool to the vehicle in the pass-thru arrangement.
2. Turn ON the ignition, with the engine OFF.
3. Ensure that all power consuming devices are turned OFF on the vehicle.
4. On the Techline Terminal, select Service Programming System and follow the Techline Terminal on-screen instructions, using the Pass-Thru method. Ensure the correct programming selection is chosen based on component being replaced or programmed. For this procedure, go to the VTD Vehicle Theft Deterrent Learn menu and choose the Vehicle Theft Deterrent Learn for Learning Replacement Keys selection.
5. At this point the scan tool must remain connected for the duration of the 10-minute relearn procedure.

   Important:

   - The scan tool will initially display 12 Minutes. The first 2 minutes allow the scan tool to initialize the appropriate control module. The remaining 10 minutes is the relearn timer.
   - On some vehicles the security indicator may be illuminated for the duration of the 10-minute relearn procedure.

6. Observe the scan tool, after approximately 10 minutes the scan tool will display "Programming Successful, Turn OFF Ignition". The vehicle is now ready to relearn the key information and/or the passwords on the next ignition switch transition from OFF to RUN.
7. Turn OFF the ignition and wait 2 minutes.
8. With a master vehicle key, turn the ignition to the RUN position for 15 seconds, then start the vehicle. The TDM has now learned the key transponder information.
9. With a scan tool, clear any DTCs.

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Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Floor Console Armrest Screws	2 N·m	18 lb in
Front Floor Console Armrest Hinge Screws	2 N·m	18 lb in
Front Floor Console Armrest Inner Screws	2 N·m	18 lb in
Front Floor Console Bolts/Screws	7 N·m	62 lb in
Front Floor Console Bracket Bolts	10 N·m	89 lb in
Front Floor Console Cupholder Screws	2 N·m	18 lb in
Front Floor Console Front Trim Plate Screws	2 N·m	18 lb in
Instrument Panel Carrier to Body Bolts	25 N·m	18 lb ft
Instrument Panel Carrier to HVAC Module Bolts	4 N·m	35 lb in
Instrument Panel Center Support Bracket Bolts	10 N·m	89 lb in
Instrument Panel Compartment Dampener Screws	2 N·m	18 lb in
Instrument Panel Compartment Inner Panel Screws	2 N·m	18 lb in
Instrument Panel Compartment Latch Screws	2 N·m	18 lb in
Instrument Panel Lower Trim Panel Bolts/Screws	2 N·m	18 lb in
Instrument Panel Trim Plate Screws	2 N·m	18 lb in
Instrument Panel Upper Trim Pad Bolts/Screws	2 N·m	18 lb in
Knee Bolster Bracket to Carrier Bolts	10 N·m	89 lb in
Knee Bolster Bracket to HVAC Module Bolts	4 N·m	35 lb in
Knee Bolster Reinforcement Bolts	2 N·m	18 lb in

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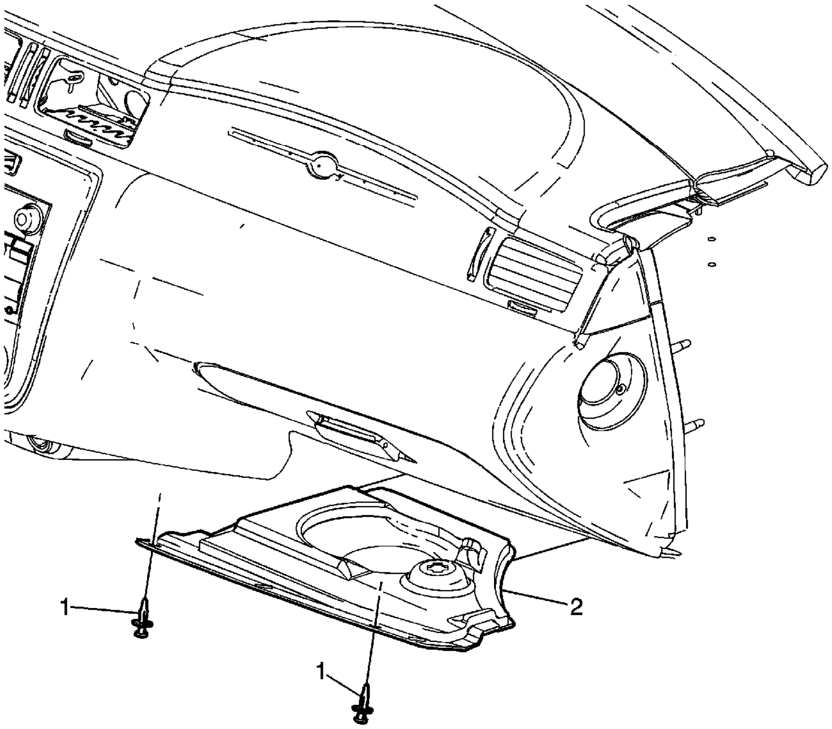
Instrument Panel Insulator Panel Replacement - Right Side



Callout	Component Name
1	Push Pin Retainer (Qty: 2)
2	Instrument Panel Closeout/Insulator Panel **Tip** Remove the courtesy lamp, if equipped.

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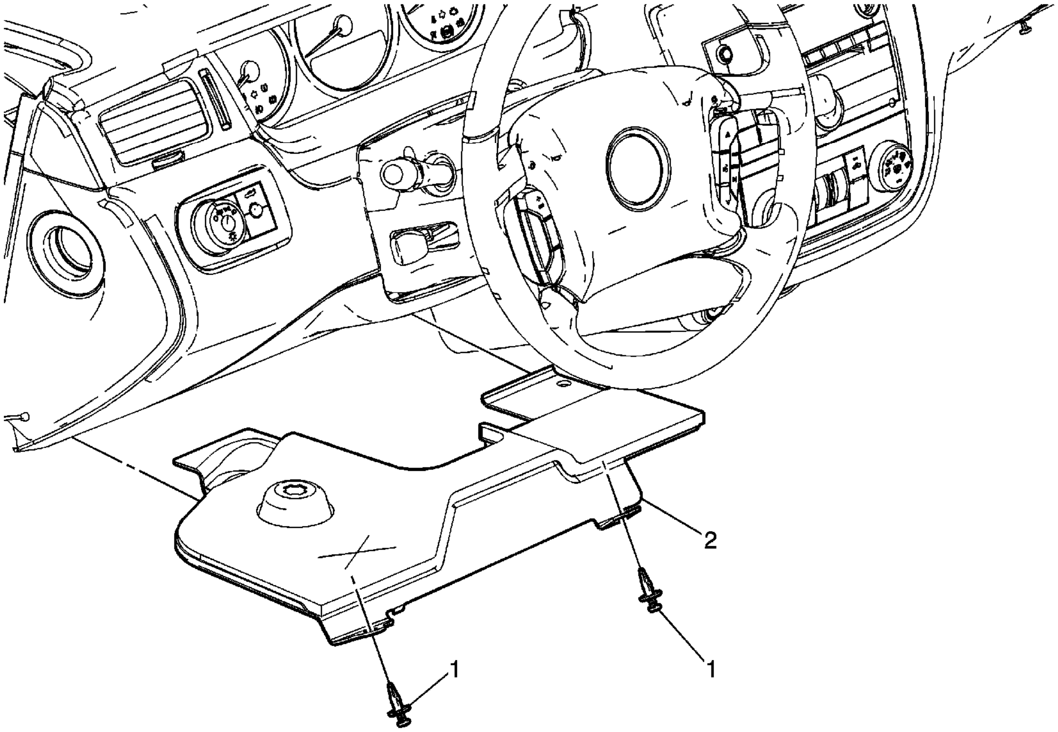
Instrument Panel Insulator Panel Replacement - Left Side



Callout	Component Name
1	Push Pin Retainer (Qty: 2)
2	Instrument Panel Closeout/Insulator Panel **Tip** Remove the courtesy lamp, if equipped.

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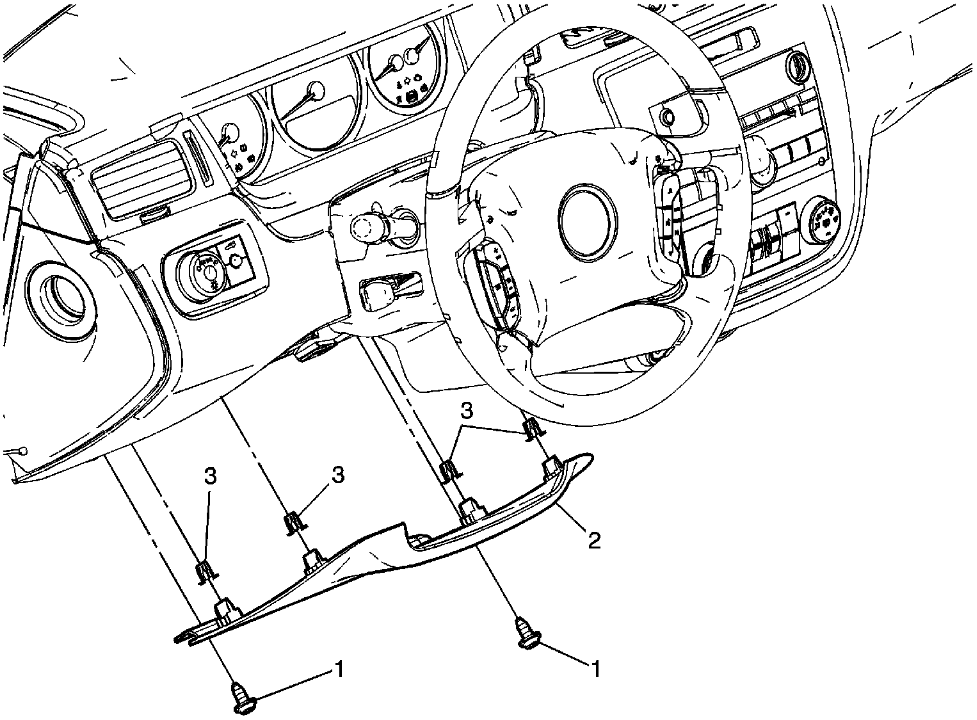
Steering Column Opening Filler Replacement



Callout	Component Name
1	Steering Column Filler Panel Screw (Qty: 2) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Steering Column Filler Panel Assembly
3	Retainer Clip (Qty: 4)

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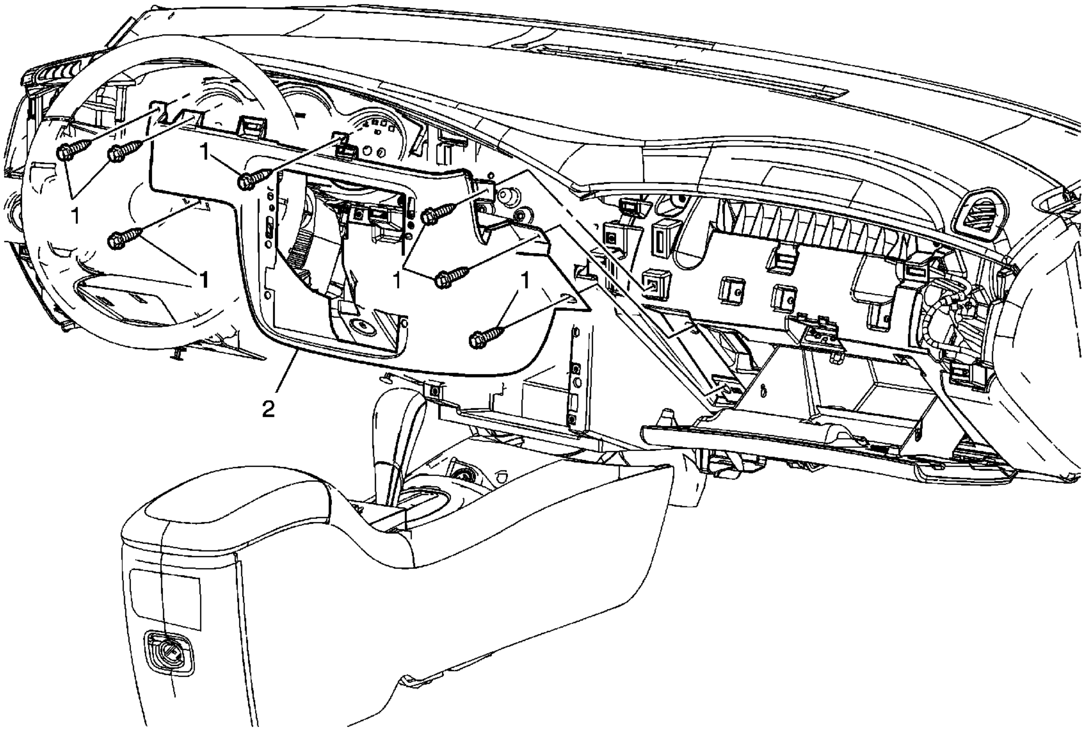
Instrument Panel Lower Center Trim Replacement



Callout	Component Name
Preliminary Procedures 1. Remove the instrument panel trim plate. Refer to Instrument Panel Trim Plate Replacement. 2. Remove the radio. Refer to Radio Replacement. 3. Remove the HVAC control module. Refer to Heater and Air Conditioning Control Replacement.	
1	Instrument Panel Center Lower Trim Panel Screw (Qty: 7) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Instrument Panel Center Lower Trim Panel

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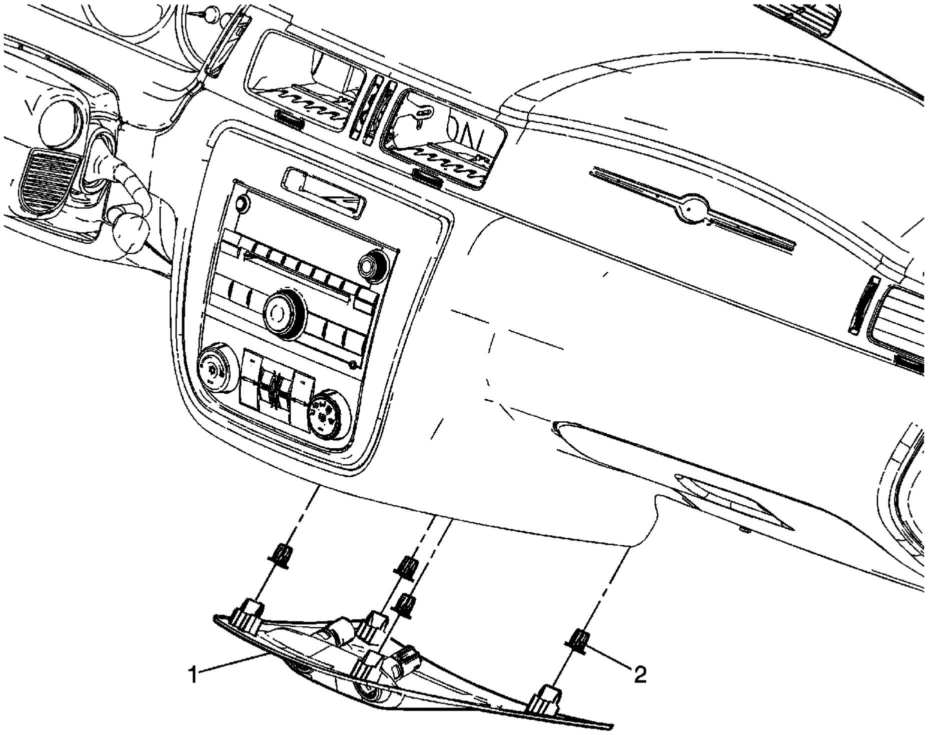
Instrument Panel Extension Trim Plate Replacement



Callout	Component Name
1	Instrument Panel Extension Panel Assembly **Tip** 1. Disconnect electrical connectors. 2. Remove the 12-volt accessory power receptacles. Refer to Cigar Lighter Receptacle or 12-Volt Accessory Power Receptacle Replacement .
2	Retainer Clips (Qty 4)

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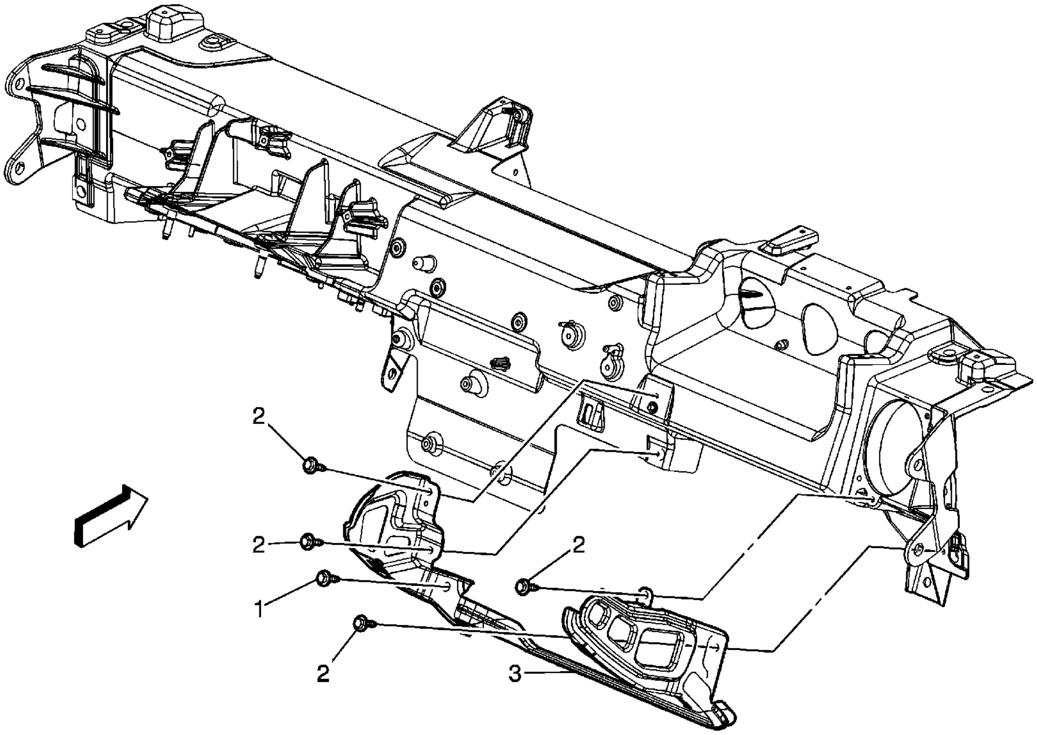
Passenger Knee Bolster Bracket Replacement



Callout	Component Name
Preliminary Procedure Remove the instrument panel lower trim panel. Refer to Instrument Panel Lower Trim Panel Replacement.	
1	Passenger Knee Bolster Bracket to HVAC Module Bolt **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 4 N·m (35 lb in)
2	Passenger Knee Bolster Bracket Bolt (Qty: 4) **Tighten** 10 N·m (89 lb in)
3	Passenger Knee Bolster Bracket Assembly

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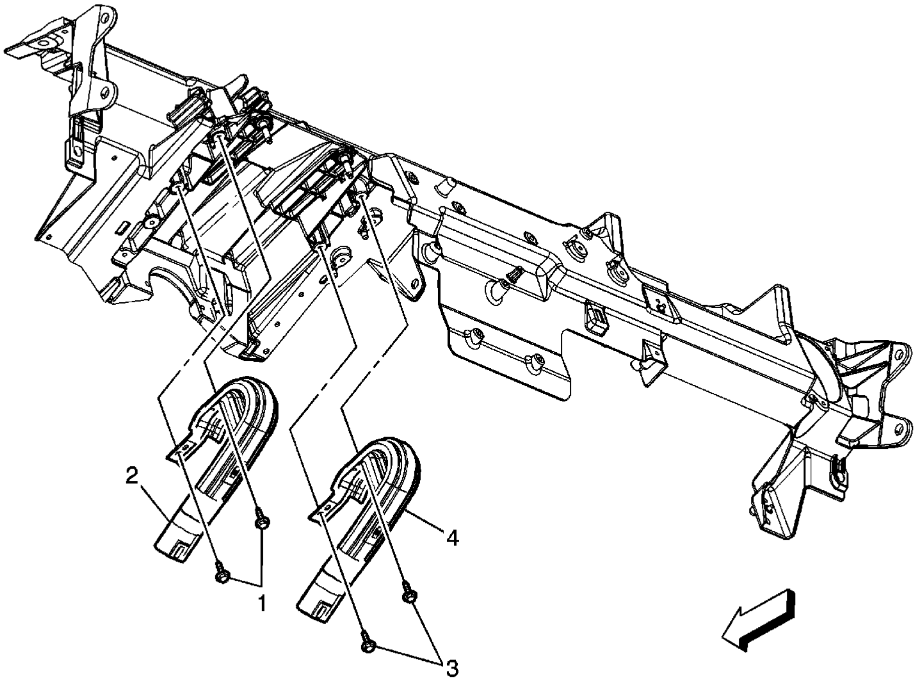
Driver Knee Bolster Bracket Replacement



Callout	Component Name
Preliminary Procedure Remove the instrument panel lower trim panel. Refer to Instrument Panel Lower Trim Panel Replacement.	
1	Driver Knee Bolster Bracket Bolt (Qty 2) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 10 N·m (89 lb in)
2	Driver Knee Bolster - Left Bracket Assembly
3	Driver Knee Bolster Bracket Bolt (Qty 2) **Tighten** 10 N·m (89 lb in)
4	Driver Knee Bolster - Right Bracket Assembly

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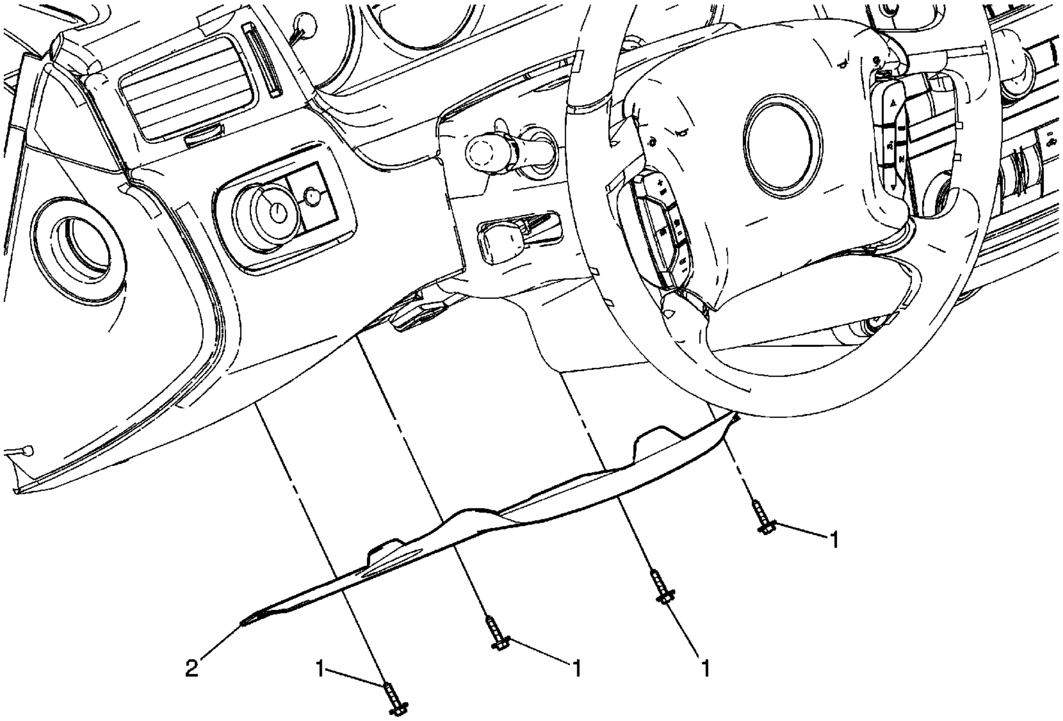
Driver Knee Bolster Reinforcement Replacement



Callout	Component Name
Preliminary Procedure Remove the steering column filler panel. Refer to Steering Column Opening Filler Replacement.	
1	Knee Bolster Reinforcement Bolt (Qty: 4) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Instrument Panel Drivers Knee Bolster Reinforcement

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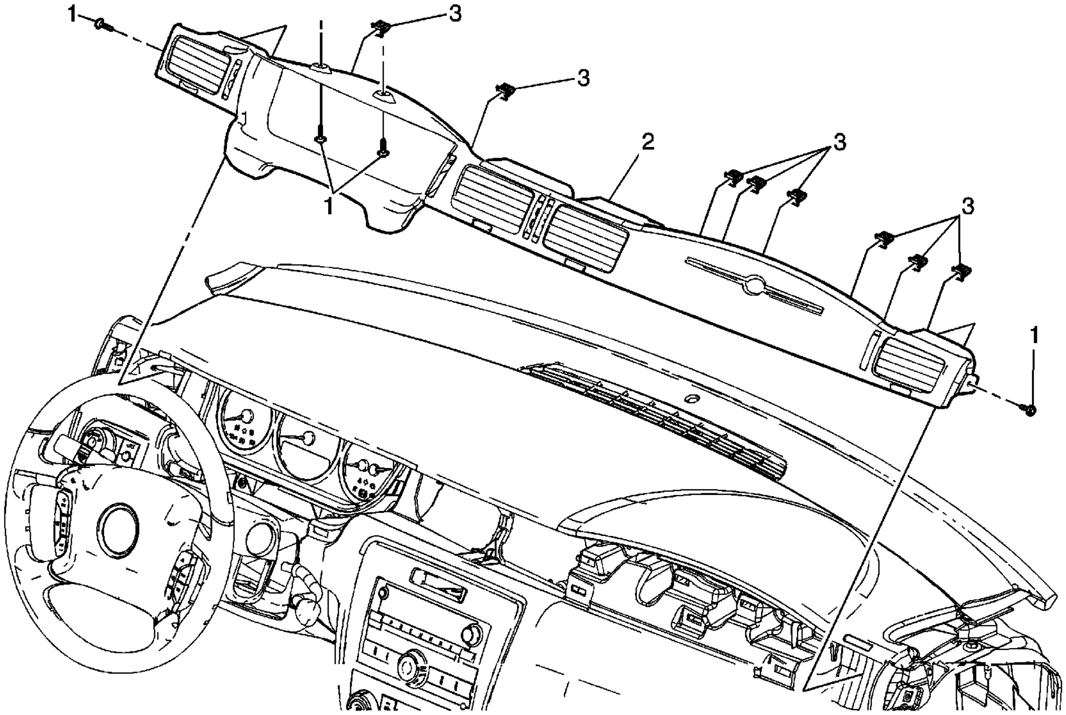
Instrument Panel Trim Plate Replacement



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedure
Remove the instrument panel (I/P) outer trim covers. Refer to Instrument Panel Outer Trim Cover Replacement - Left Side and Instrument Panel Outer Trim Cover Replacement - Right Side.</td></tr>
<tr><td>1</td><td>Instrument Panel Trim Plate Screw (Qty: 4)
Caution: Refer to Fastener Caution in the Preface section.
Tighten
2 N·m (18 lb in)</td></tr>
<tr><td>2</td><td>Instrument Panel Trim Plate Assembly
Procedure
1. Disconnect the electrical connector.
2. Tilt the steering column to the lowest position.
3. Remove the driver information center switch. Refer to Driver Information Display Switch Replacement.</td></tr>
</table>

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3	Retainer Clip (Qty: 8)

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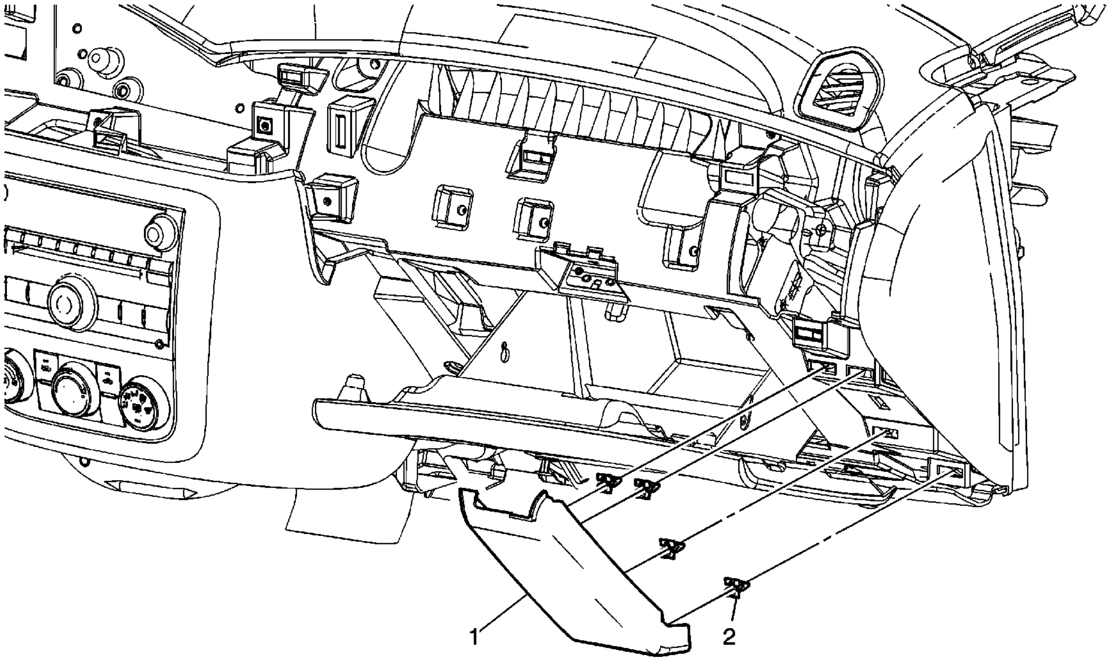
Instrument Panel Lower Trim Plate Replacement



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2"><i>Fastener Tightening Specifications:</i> Refer to Fastener Tightening Specifications .
Preliminary Procedure
Remove the instrument panel trim plate. Refer to Instrument Panel Trim Plate Replacement .</td></tr>
<tr><td>1</td><td>Instrument Panel Lower Trim Plate</td></tr>
<tr><td>2</td><td>Retainer Clips (Qty: 4)</td></tr>
</table>

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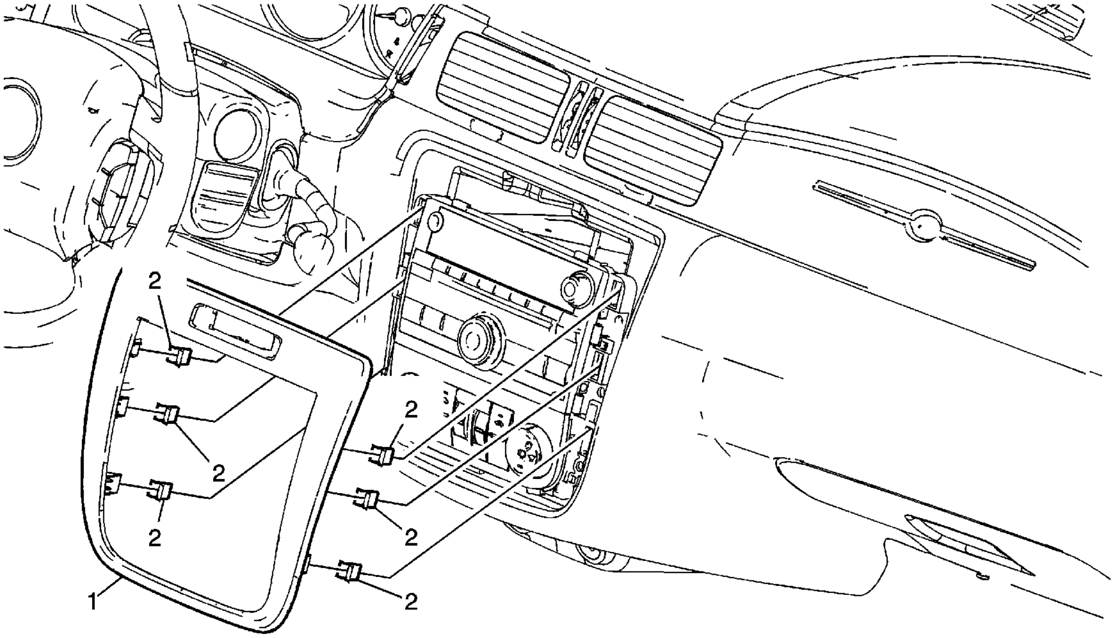
Instrument Panel Accessory Trim Plate Replacement



Callout	Component Name
1	Instrument Panel Accessory Plate Assembly **Procedure** 1. Disconnect electrical connectors. 2. Remove the inflatable restraint iIndicator. Refer to Inflatable Restraint Instrument Panel Module Indicator Replacement.
2	Retainer Clip (Qty 6)

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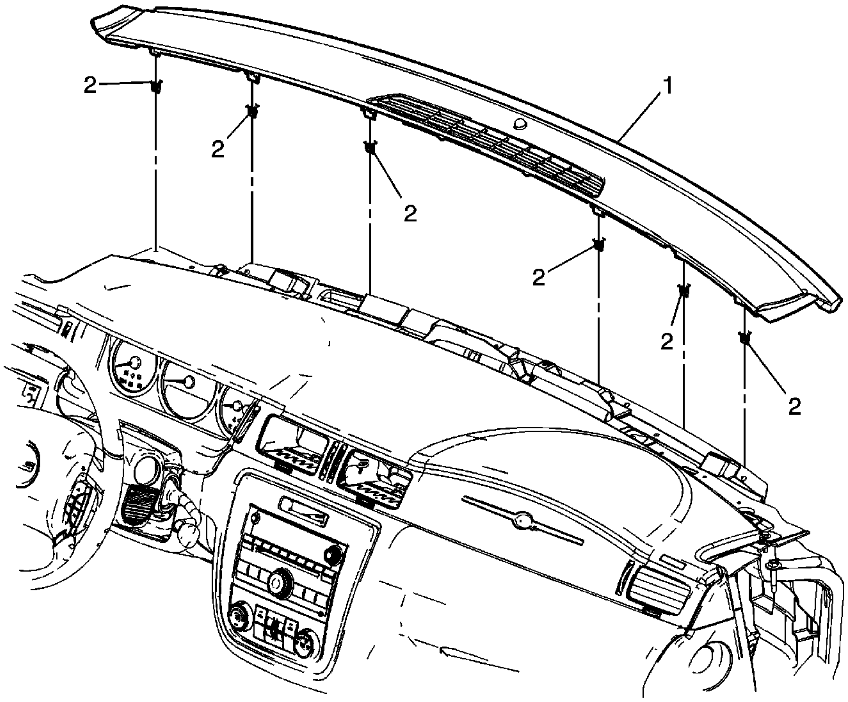
Instrument Panel Upper Trim Panel Replacement



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedure
Remove the windshield garnish moldings. Refer to Windshield Pillar Garnish Molding Replacement .</td></tr>
<tr><td>1</td><td>Instrument Panel Upper Trim Panel Assembly
Procedure
1. Disconnect electrical connectors.
2. Remove the ambient light sensor.</td></tr>
<tr><td>2</td><td>Retainer Clip (Qty: 6)</td></tr>
</table>

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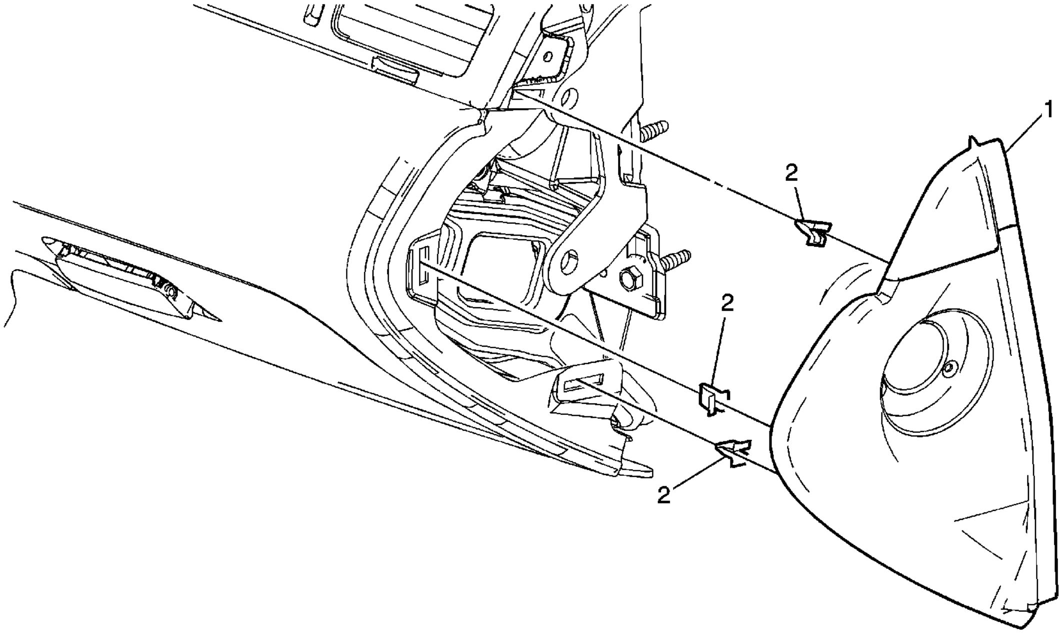
Instrument Panel Outer Trim Cover Replacement - Right Side



Callout	Component Name
1	Instrument Panel Outer Trim Cover
2	Retainer Clip (Qty: 3)

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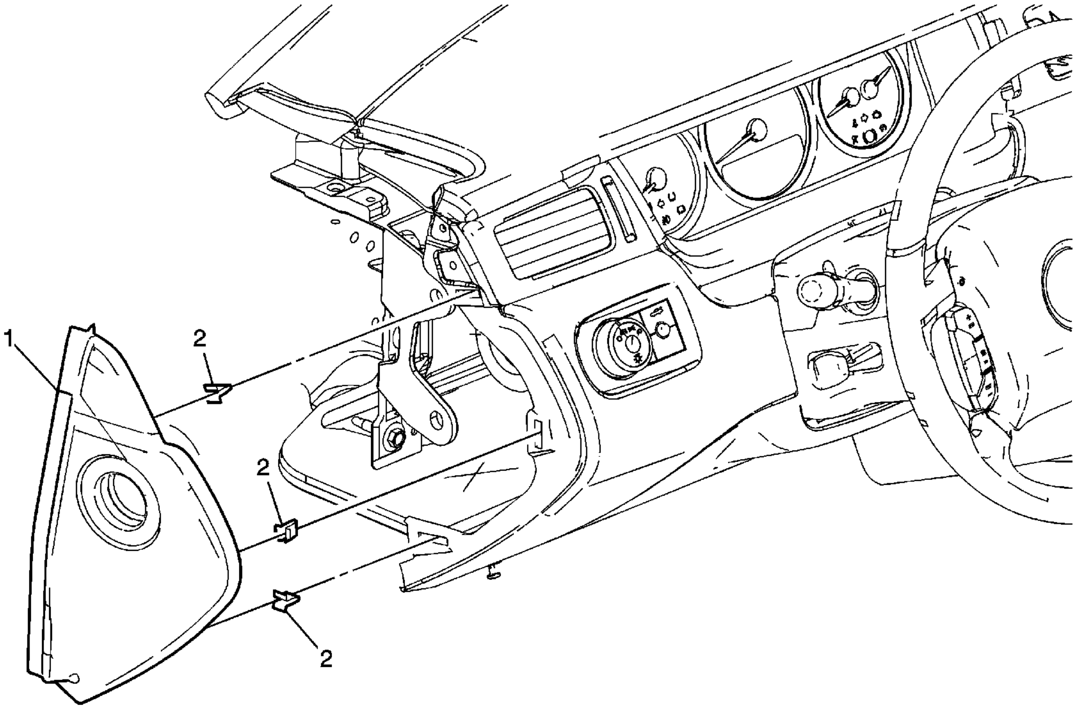
Instrument Panel Outer Trim Cover Replacement - Left Side



Callout	Component Name
1	Instrument Panel Outer Trim Cover
2	Retainer Clip (Qty: 3)

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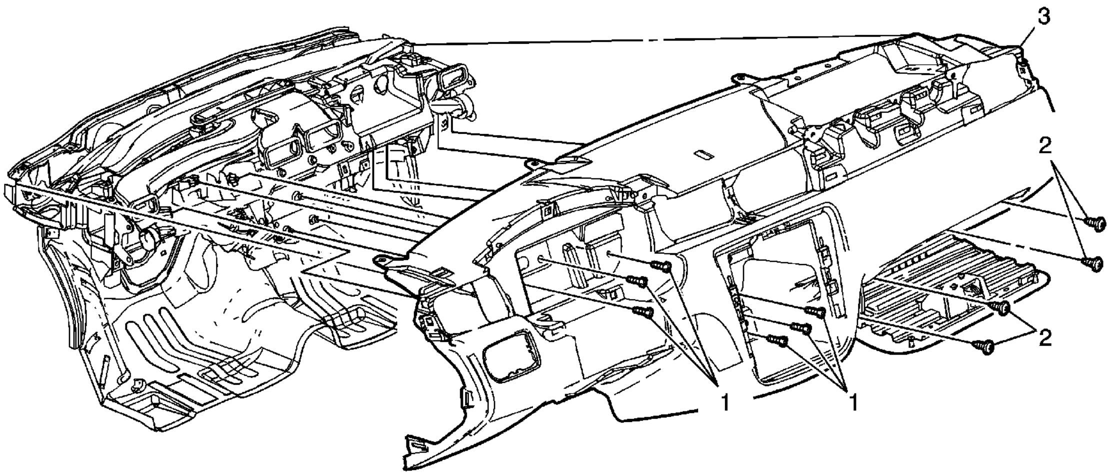
Instrument Panel Lower Trim Panel Replacement



Callout	Component Name
Preliminary Procedure 1. Remove the instrument panel (I/P) upper trim pad. Refer to Instrument Panel Upper Trim Pad Replacement. 2. Remove the I/P cluster assembly. Refer to Instrument Cluster Replacement. 3. Remove the headlamp switch assembly. Refer to Headlamp Switch Replacement. 4. Remove the right and left insulator panels. Refer to Instrument Panel Insulator Panel Replacement - Right Side and Instrument Panel Insulator Panel Replacement - Left Side. 5. Remove the I/P inflatable restraint. Refer to Inflatable Restraint Instrument Panel Module Replacement. 6. Remove the drivers knee bolster reinforcement. Refer to Driver Knee Bolster Reinforcement Replacement. 7. Remove the steering column. Refer to Steering Column Replacement. 8. Remove the radio. Refer to Radio Replacement. 9. Remove the HVAC control module. Refer to Heater and Air Conditioning Control Replacement.	
1	Instrument Panel Lower Trim Panel Bolt (Qty 6) **Caution:** Refer to Fastener Caution in the Preface section.

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	Tighten 10 N·m (88 lb in)
2	Instrument Panel Lower Trim Panel Screw (Qty 4) **Tighten** 2 N·m (18 lb in)
3	Instrument Panel Lower Trim Panel Assembly **Procedure** 1. Note routing of the wiring harness prior to removal to aid in the reinstallation. 2. Disconnect all electrical connections to the trim panel.

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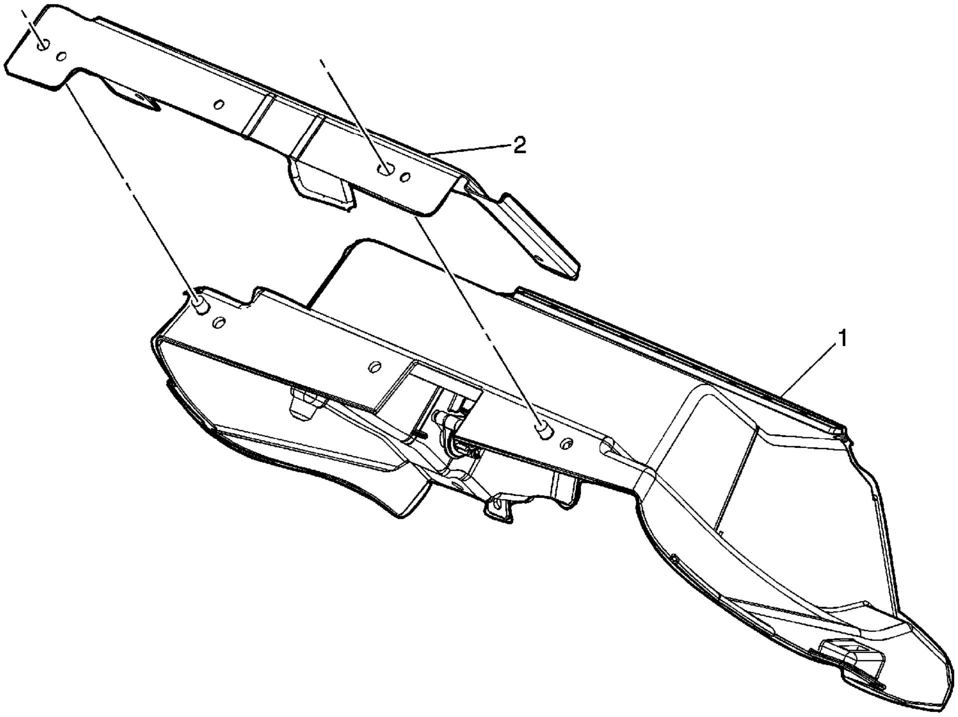
Instrument Panel Compartment Door Lock Striker Replacement



Callout	Component Name
1	Instrument Panel Compartment Inner Panel Assembly Refer to Instrument Panel Compartment Inner Panel Replacement.
2	Instrument Panel Compartment Striker Assembly

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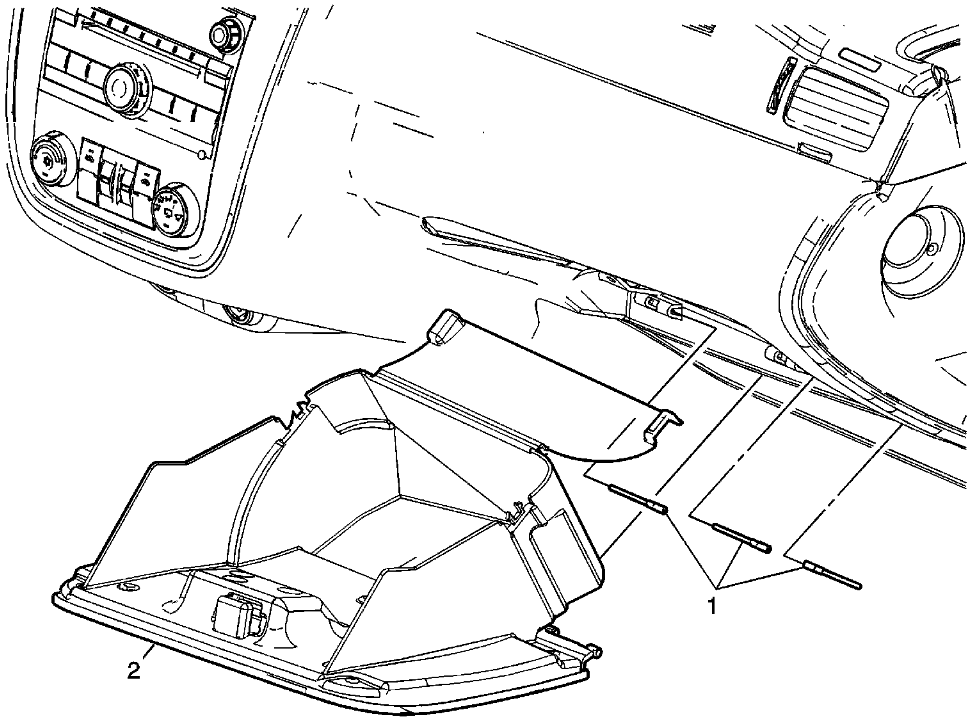
Instrument Panel Compartment Door Replacement



Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.	
1	Pin, Compartment Door Hinge (Qty 3) **Tip** Use a small pointed tool in order to drive the pins out of the hinge.
2	Door Assembly, Instrument Panel Compartment **Tip** 1. Squeeze the compartment bin enough to pull the door and bin assembly out the opening past the stops and the dampener. 2. Remove the compartment Latch Assembly. Refer to Instrument Panel Compartment Door Latch Replacement.

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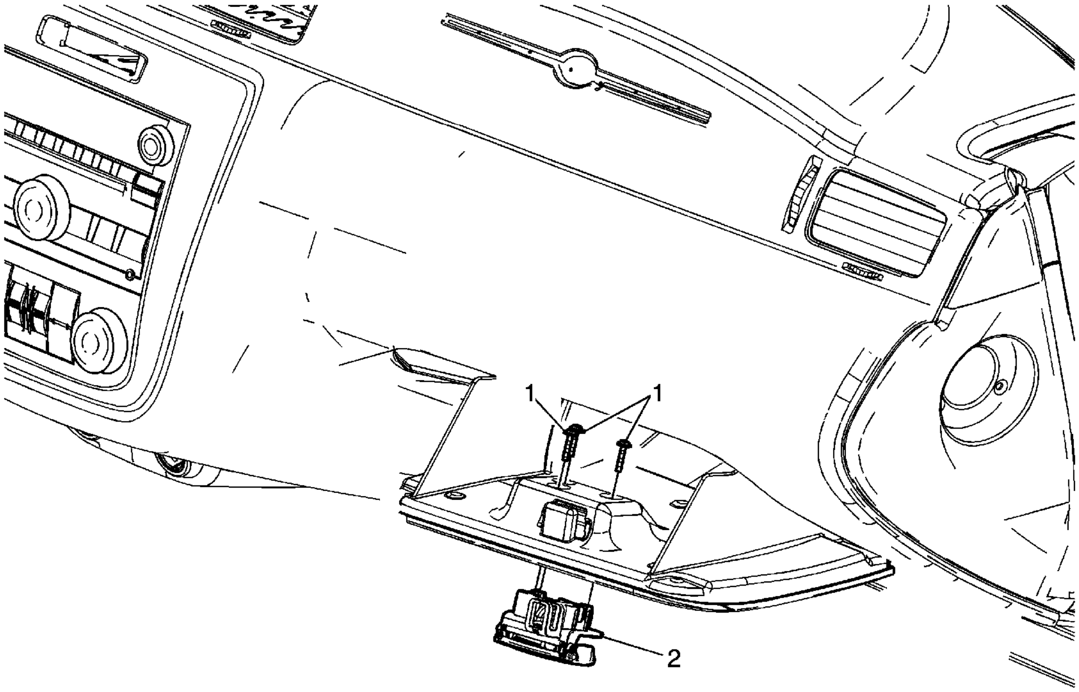
Instrument Panel Compartment Door Latch Replacement



Callout	Component Name
1	Instrument Panel Compartment Latch Screw (Qty 3) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Instrument Panel Compartment Latch Assembly

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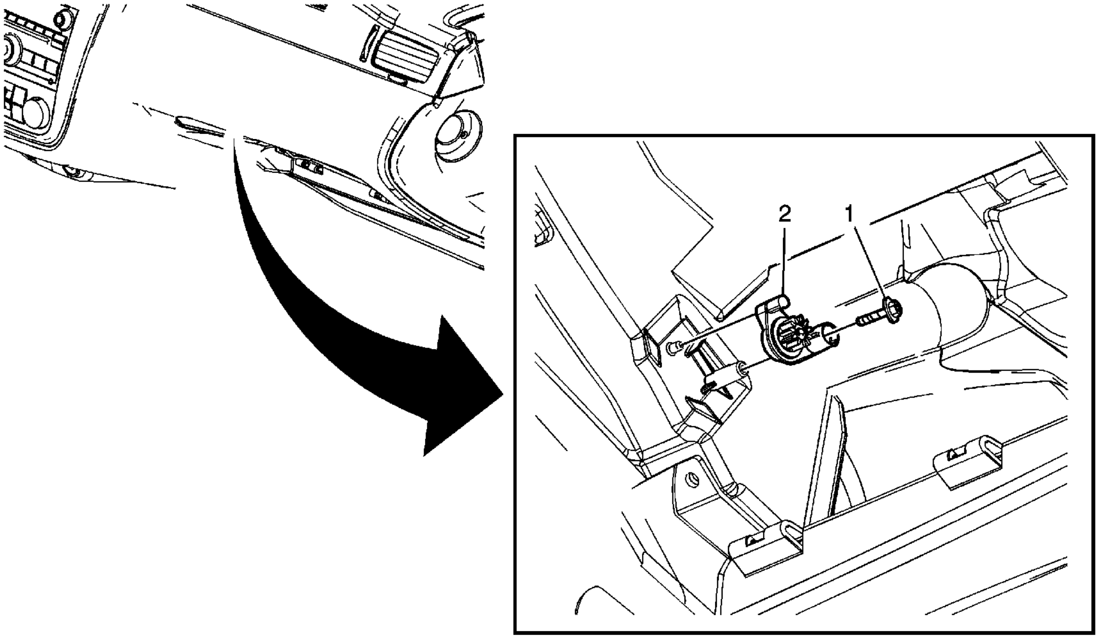
Instrument Panel Compartment Door Dampener Replacement



Callout	Component Name
Preliminary Procedure Remove the instrument panel compartment door assembly. Refer to Instrument Panel Compartment Door Replacement.	
1	Instrument Panel Compartment Striker Screw (Qty 1) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Instrument Panel Compartment Dampener Assembly

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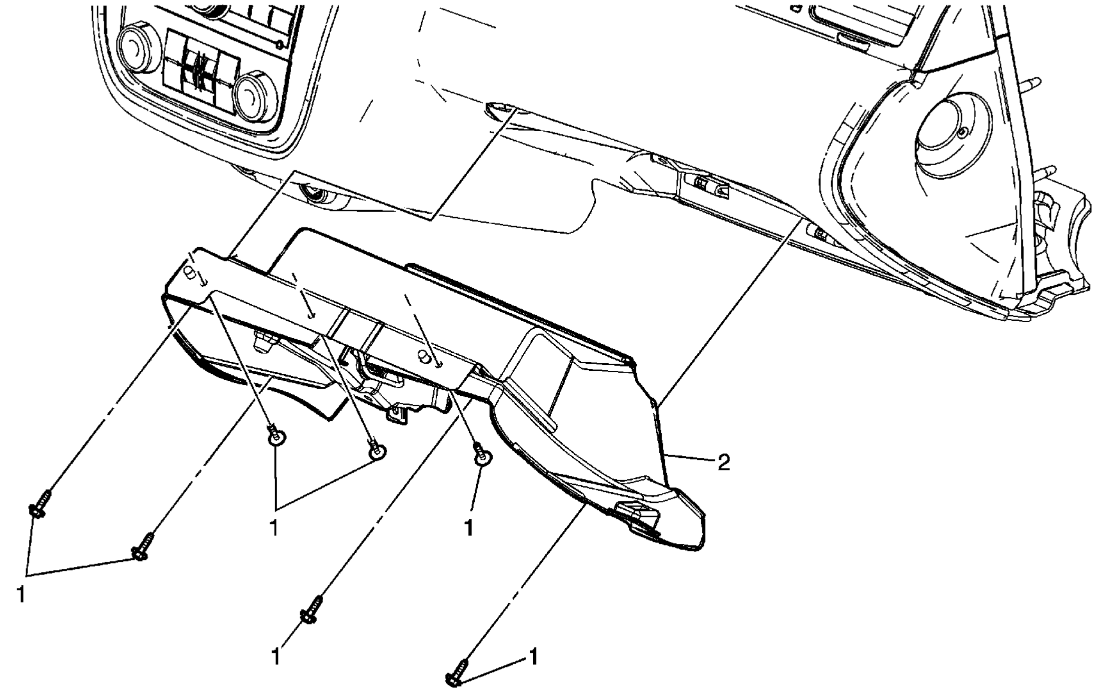
2009 Chevrolet Impala | Impala (VIN W) Service Manual | Body Hardware and Trim | Instrument Panel and Console Trim | Repair Instructions | Document ID: 2151967

Instrument Panel Compartment Inner Panel Replacement



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">**Preliminary Procedures**
1. Remove the instrument panel compartment door assembly. Refer to Instrument Panel Compartment Door Replacement.
2. Remove the right side instrument panel closeout/insulator. Refer to Instrument Panel Insulator Panel Replacement - Right Side.
3. Remove the right side carpet retainer. Refer to Front Side Door Opening Floor Carpet Retainer Replacement.
4. Remove the instrument panel right hand outer trim cover. Refer to Instrument Panel Outer Trim Cover Replacement - Right Side.
5. Remove the instrument panel trim plate right outer screw. Refer to Instrument Panel Trim Plate Replacement.</td></tr>
<tr><td>1</td><td>Instrument Panel Compartment Inner Panel Screw (Qty 7)
Caution: Refer to Fastener Caution in the Preface section.
Tighten
2 N·m (18 lb in)</td></tr>
</table>

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2	Instrument Panel Compartment Inner Panel Assembly **Tip** Flex the bottom right hand corner of the instrument panel in order to remove the instrument panel compartment inner panel assembly.

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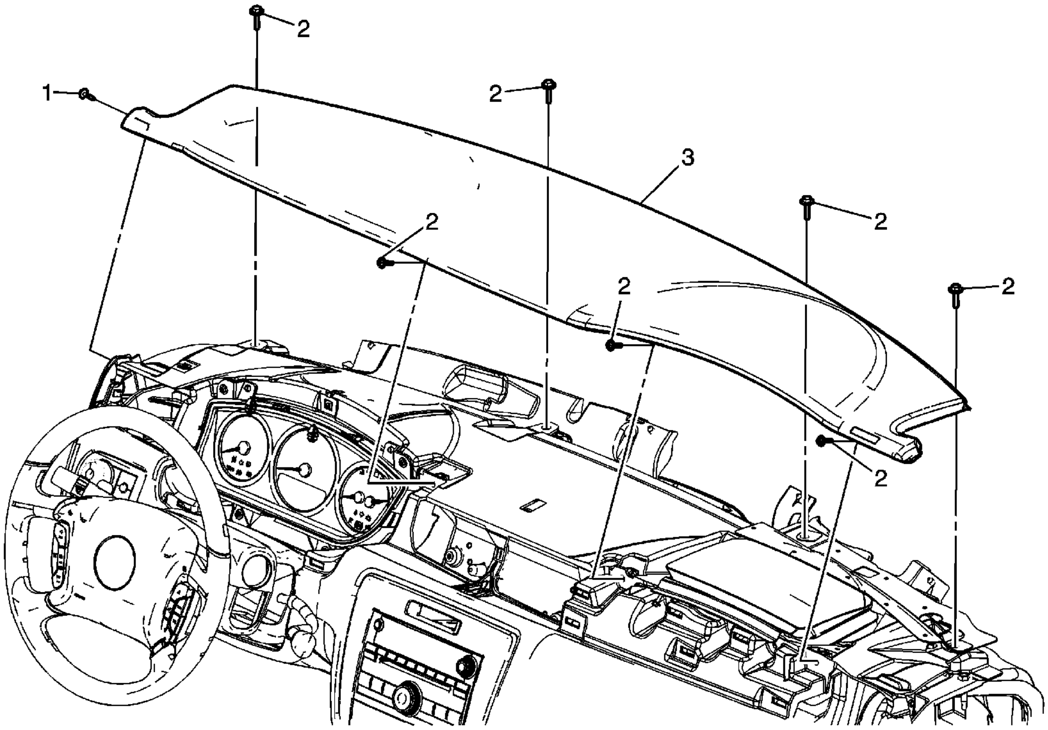
Instrument Panel Upper Trim Pad Replacement



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">**Preliminary Procedure**
1. Remove the instrument panel (I/P) upper trim panel. Refer to Instrument Panel Upper Trim Panel Replacement.
2. Remove the I/P trim plate. Refer to Instrument Panel Trim Plate Replacement.</td></tr>
<tr><td>1</td><td>Instrument Panel Upper Trim Pad Screw
Caution: Refer to Fastener Caution in the Preface section.
Tighten
2 N·m (18 lb in)</td></tr>
<tr><td>2</td><td>Instrument Panel Upper Trim Pad Bolt (Qty: 7)
Tighten
10 N·m (88 lb in)</td></tr>
<tr><td>3</td><td>Instrument Panel Upper Trim Pad Assembly
Procedure</td></tr>
</table>

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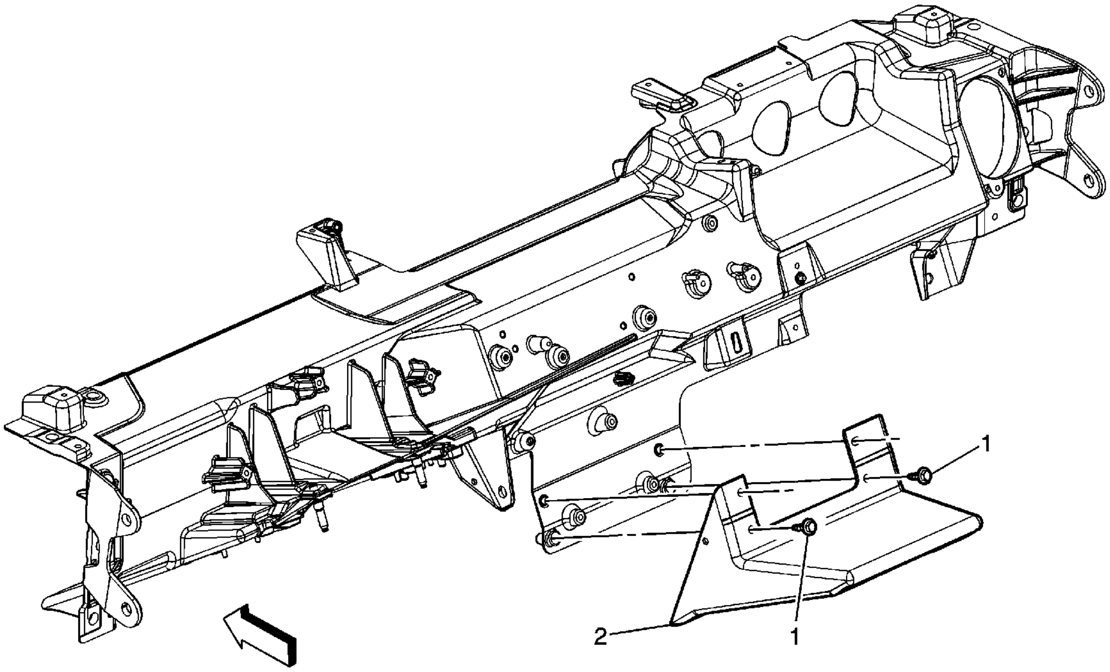
	Disconnect the electrical connector.

2009 Chevrolet Impala | Impala (VIN W) Service Manual | Body Hardware and Trim | Instrument Panel and Console Trim | Repair Instructions | Document ID: 2151969

Instrument Panel Center Support Bracket Replacement



Callout	Component Name
Preliminary Procedure Remove the instrument panel lower trim panel. Refer to Instrument Panel Lower Trim Panel Replacement.	
1	Instrument Panel Center Support Bracket Bolt (Qty: 2) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 10 N·m (89 lb in)
2	Instrument Panel Center Support Bracket Assembly

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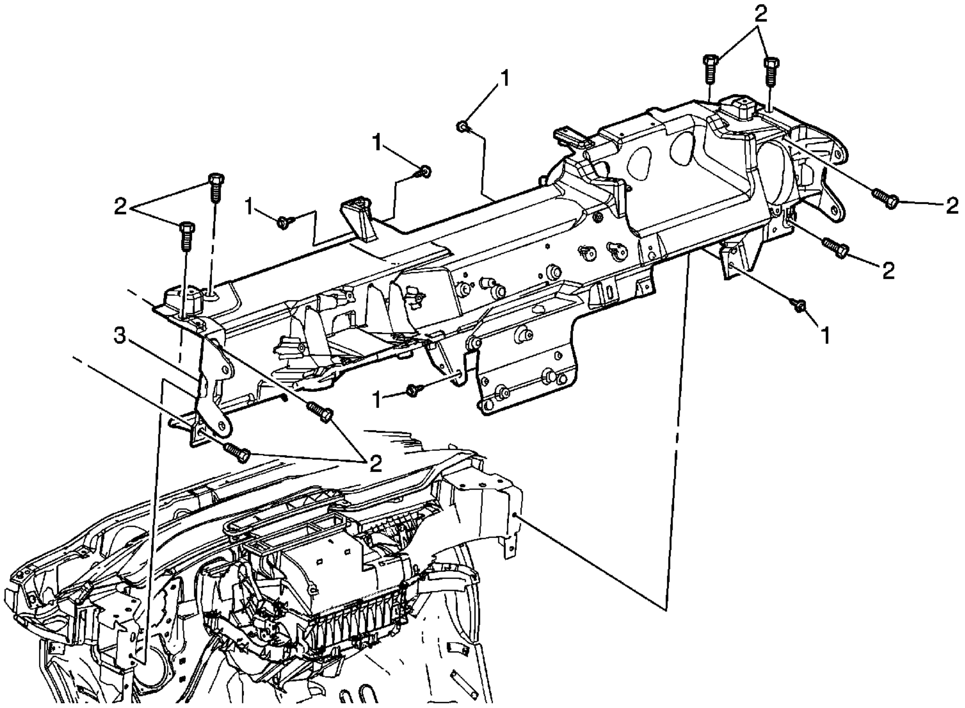
2009 Chevrolet Impala | Impala (VIN W) Service Manual | Body Hardware and Trim | Instrument Panel and Console Trim | Repair Instructions | Document ID: 2151970

Instrument Panel Carrier Replacement



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedure
1. Remove the instrument panel lower trim panel. Refer to Instrument Panel Lower Trim Panel Replacement.
2. Remove the drivers knee bolster brackets. Refer to Driver Knee Bolster Bracket Replacement.
3. Remove the passenger knee bolster bracket. Refer to Passenger Knee Bolster Bracket Replacement.
4. Remove the brake pedal nut and bolt, and pedal bracket bolts. Refer to Brake Pedal Assembly Replacement.
5. Remove the instrument panel center support bracket. Refer to Instrument Panel Center Support Bracket Replacement.
6. Remove the air distributor duct assembly. Refer to Air Distributor Duct Replacement.
7. Remove the right air outlet duct assembly. Refer to Instrument Panel Outer Air Outlet Upper Duct Replacement - Right Side.</td></tr>
<tr><td>1</td><td>Instrument Panel Carrier to HVAC Module Bolt (Qty: 5)
Caution: Refer to Fastener Caution in the Preface section.
Tighten</td></tr>
</table>

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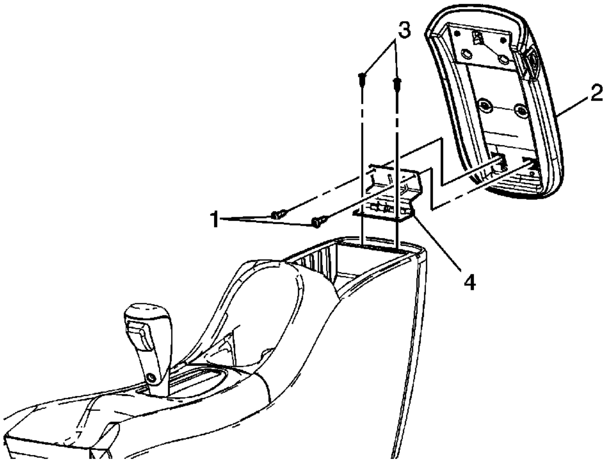
	4 N·m (35 lb in)
2	Instrument Panel Carrier to Body Bolt (Qty: 8) **Tighten** 25 N·m (18 lb ft)
3	Instrument Panel Carrier Assembly **Tip** 1. Note routing of the wiring harness to aid in the reinstallation. 2. With the aid of an assistant, remove the carrier from the vehicle. 3. Remove the defroster air outlet duct assembly. Refer to Defroster Air Outlet Duct Replacement.

2009 Chevrolet Impala | Impala (VIN W) Service Manual | Body Hardware and Trim | Instrument Panel and Console Trim | Repair Instructions | Document ID: 2151971

Front Floor Console Compartment Door Hinge Replacement



Callout	Component Name
1	Front Floor Console Door Screw (Qty: 2) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Front Floor Console Door Assembly
3	Front Floor Console Hinge Screw (Qty: 2) **Tighten** 2 N·m (18 lb in)
4	Front Floor Console Door Hinge

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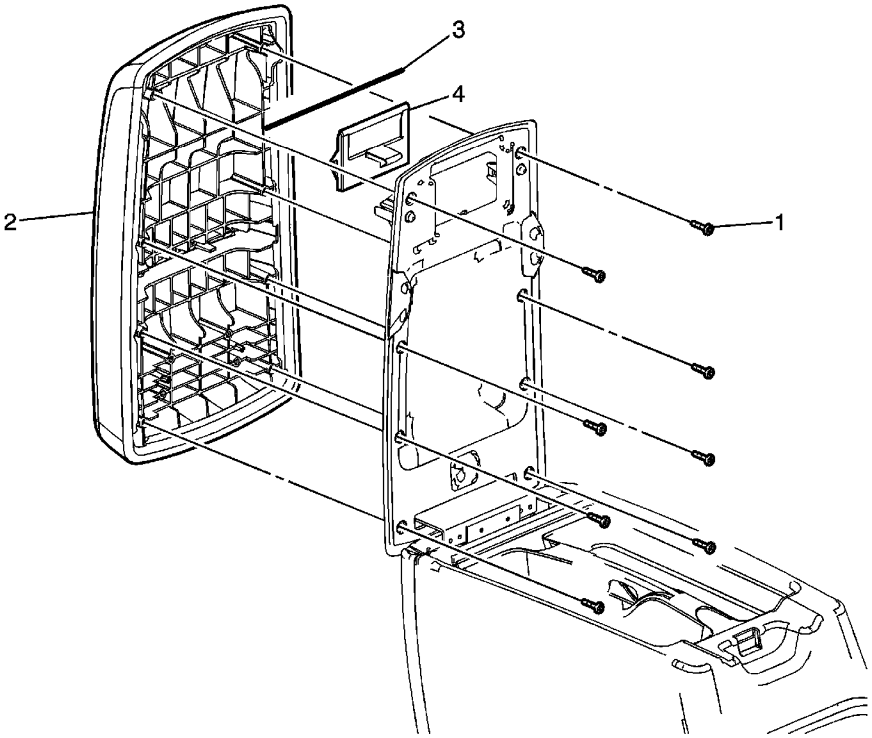
Front Floor Console Compartment Door Latch Replacement



Callout	Component Name
1	Front Floor Console Armrest Inner Screw (Qty 8) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Front Floor Console Armrest Cover Assembly **Procedure** Separate the armrest cover assembly from the inner panel.
3	Front Floor Console Armrest Latch Spring
4	Front Floor Console Armrest Latch Assembly

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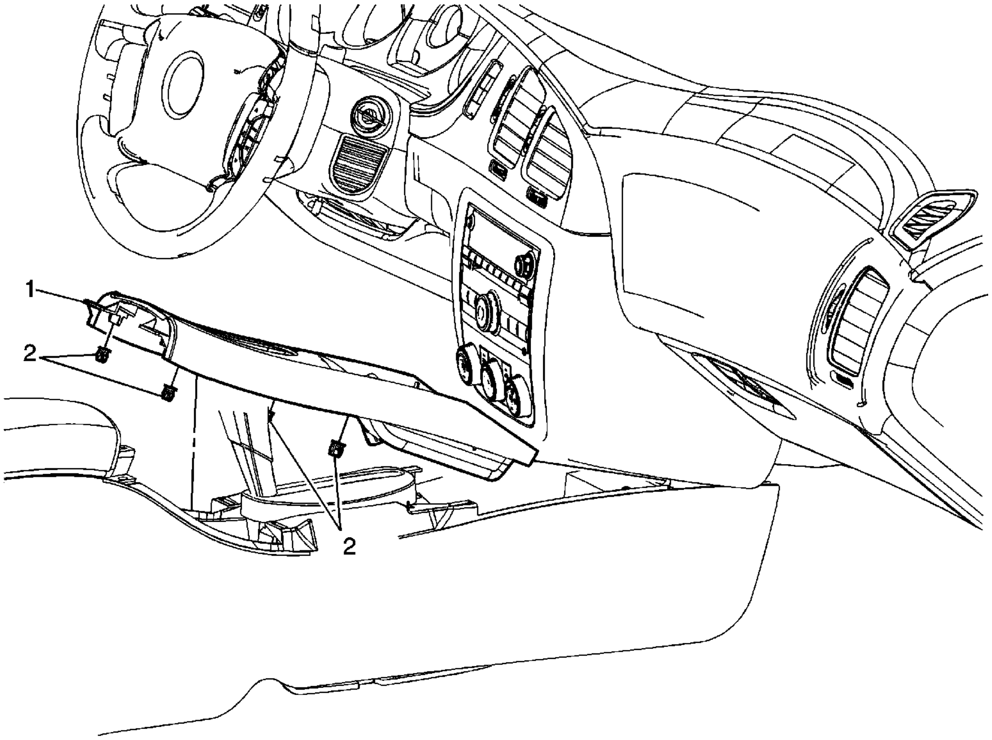
Front Floor Upper Console Trim Plate Replacement



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Caution: To prevent component damage, DO NOT use metal tools to remove the trim.
Preliminary Procedures
1. Place the front floor shifter in the Neutral position.
2. Remove the front floor console cupholder assembly. Refer to Front Floor Console Cup Holder Replacement.
Tip
• For console removal and shift lock actuator access, use ONLY a plastic trim tool to lift the trim plate from the console. Do not use any tool between the trim plate and the shifter.
• Apply the park brake and shift lever rearward. The sound deadener must be reinstalled if the wire harness is removed or replaced.</td></tr>
<tr><td>1</td><td>Front Floor Console Trim Plate</td></tr>
<tr><td>2</td><td>Retainer Clip (Qty: 4)</td></tr>
</table>

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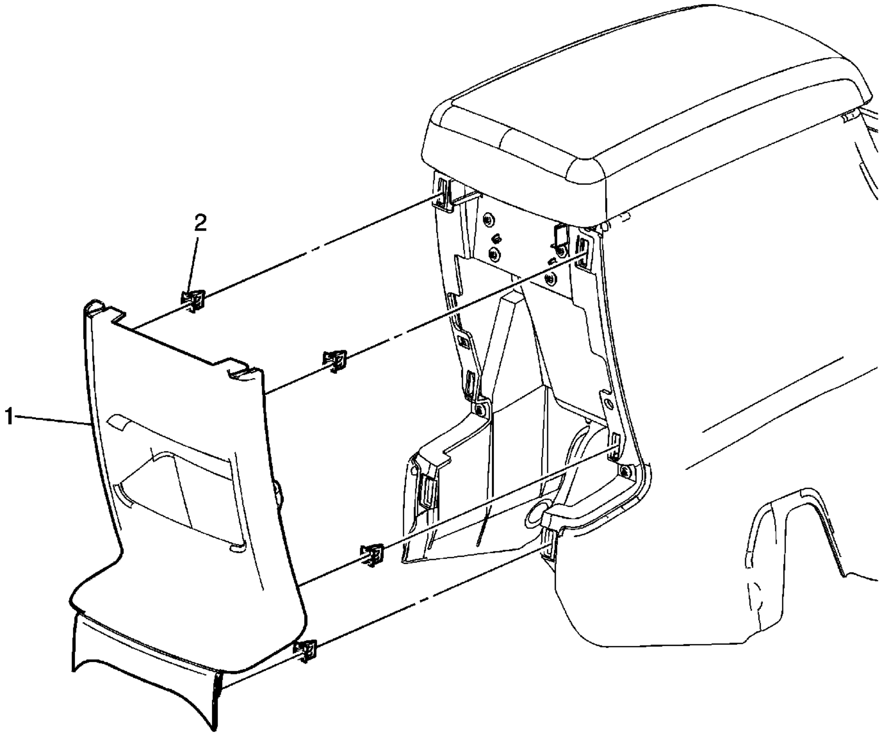
Console Rear Trim Plate Replacement



Callout	Component Name
1	Front Floor Console Plate Assembly
2	Retainer Clip (Qty 6)

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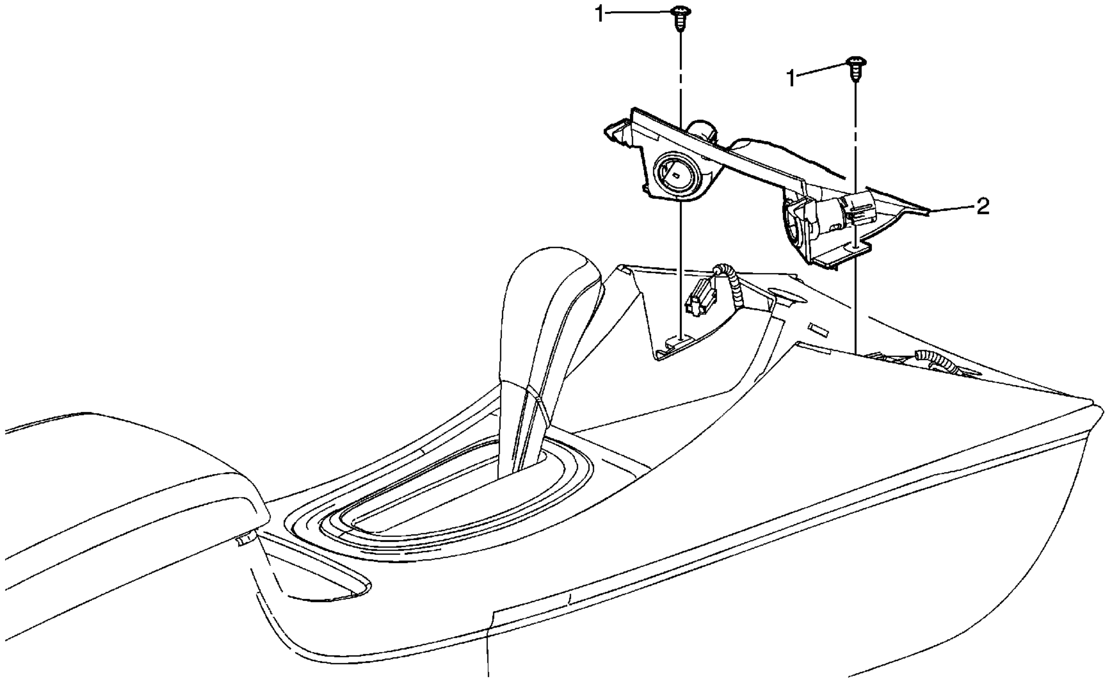
Console Front Trim Plate Replacement



Callout	Component Name
Preliminary Procedure Remove the front floor console. Refer to Front Floor Console Replacement.	
1	Front Floor Console Trim Panel Screw (Qty 2) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Front Floor Console Trim Panel Assembly **Tip** 1. Disconnect electrical connectors. 2. Remove the 12 volt accessory power receptacles. Refer to Cigar Lighter Receptacle or 12-Volt Accessory Power Receptacle Replacement.

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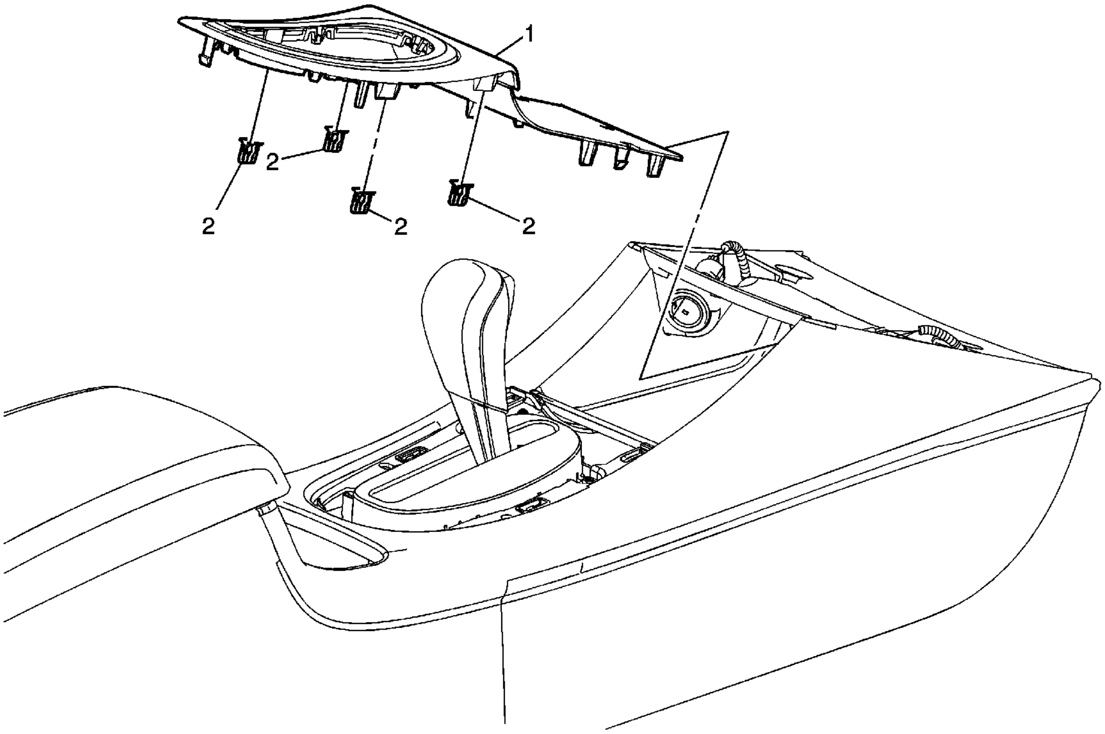
Console Shift Lever Bezel Replacement



Callout	Component Name
1	Console Shift Lever Bezel Assembly **Tip** 1. Block the drive wheels. 2. Move shift lever to the neutral position. 3. Use a flat-bladed plastic trim tool to aid in the removal of the shift bezel. 4. For console removal and shift lock actuator access, use ONLY a plastic trim tool to lift the trim bezel from the console. Do not use any tool between the trim bezel and the shifter. 5. Apply the park brake and shift lever rearward. The sound deadener must be reinstalled if the wire harness is removed or replaced.
2	Retainer Clips (Qty: 4)

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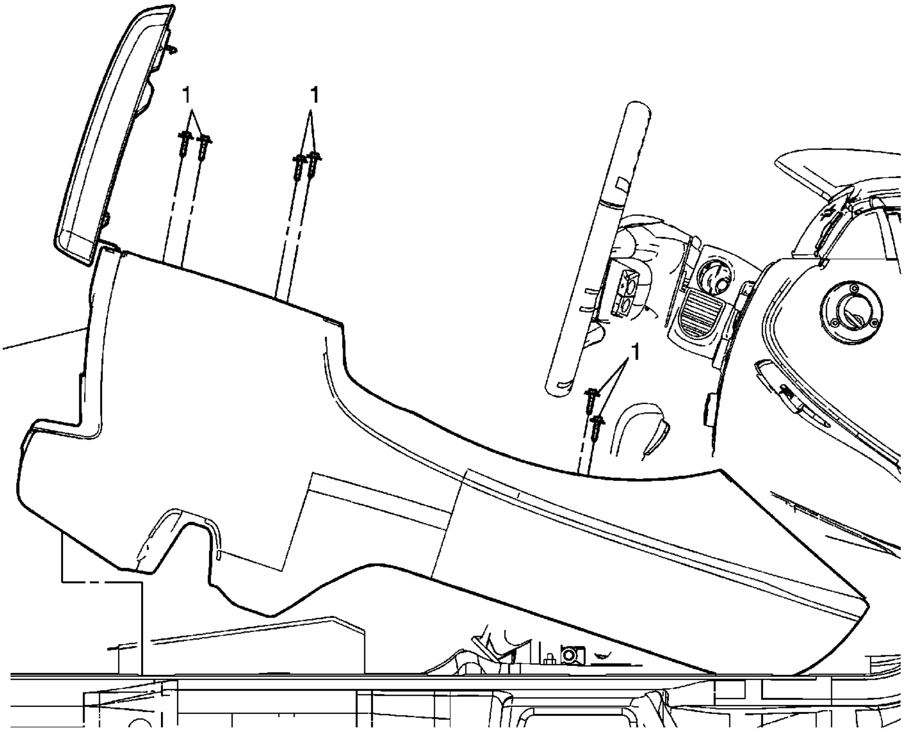
Front Floor Console Replacement



<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Caution: To prevent component damage, DO NOT use metal tools to remove the trim.

Preliminary Procedure
1. Remove the front floor console bin liner.
2. Remove the console shift lever bezel. Refer to Console Shift Lever Bezel Replacement.
3. Use ONLY a plastic trim tool to lift the shift lever bezel from the console. Do not use any tool between the trim bezel and the shifter.
4. Apply the park brake and shift lever rearward. The sound deadener must be reinstalled if the wire harness is removed or replaced.</td></tr>
<tr><td>1</td><td>Front Floor Console Bolt (Qty: 6)

Caution: Refer to Fastener Caution in the Preface section.

Tighten
7 N·m (62 lb in)</td></tr>
<tr><td>2</td><td>Front Floor Console Assembly

Procedure</td></tr>
</table>

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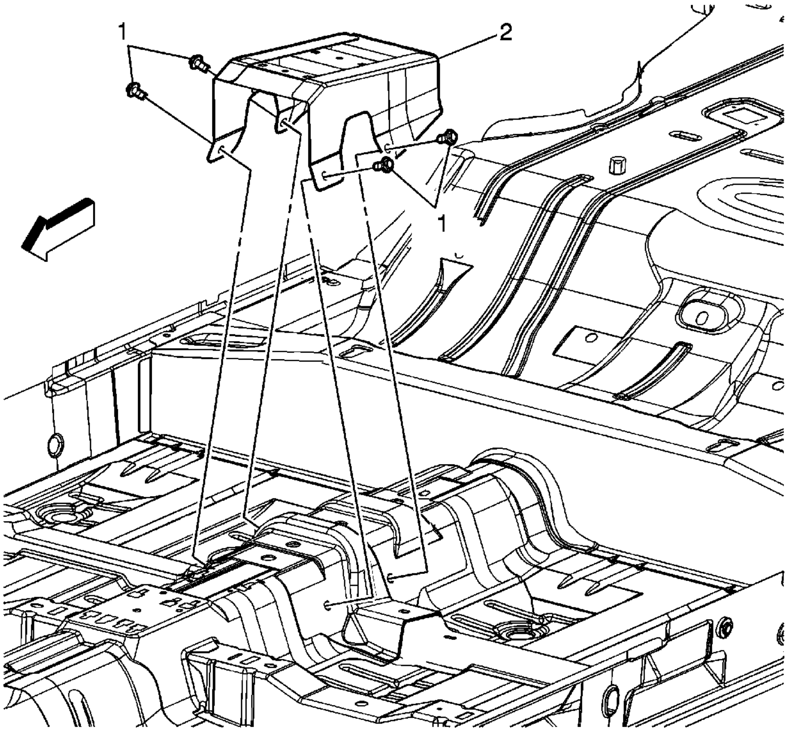
	Disconnect the electrical connector.

2009 Chevrolet Impala | Impala (VIN W) Service Manual | Body Hardware and Trim | Instrument Panel and Console Trim | Repair Instructions | **Document ID: 2151978**

Floor Console Bracket Replacement



Callout	Component Name
Preliminary Procedure Remove the front floor console. Refer to Front Floor Console Replacement.	
1	Front Floor Console Reinforcement Bracket Bolt (Qty 4) **Caution:** Refer to Fastener Caution in the Preface section. **Tip** Pull the carpet back enough to access the bolts. **Tighten** 44 N·m (32 lb ft)
2	Front Floor Console Reinforcement Bracket Assembly

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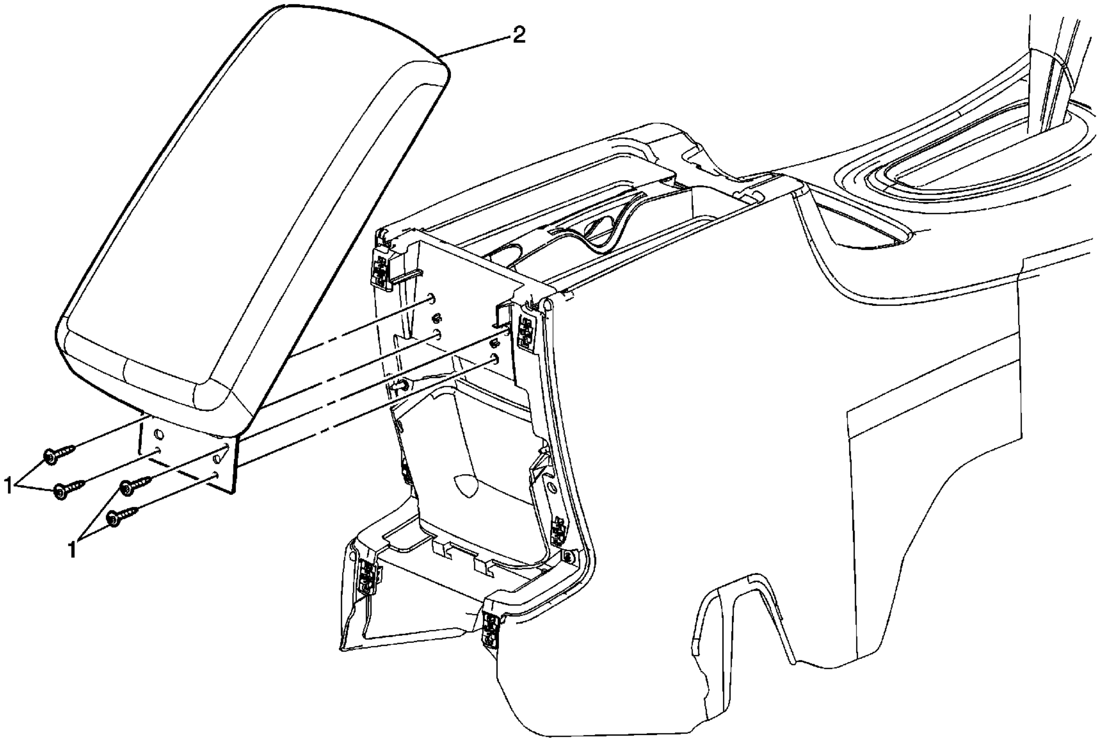
2009 Chevrolet Impala | Impala (VIN W) Service Manual | Body Hardware and Trim | Instrument Panel and Console Trim | Repair Instructions | Document ID: 2151980

Front Floor Console Armrest Replacement



Callout	Component Name
Preliminary Procedure Remove the front floor console rear trim plate. Refer to Console Rear Trim Plate Replacement.	
1	Front Floor Console Armrest Hinge Screw (Qty 4) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Front Floor Console Armrest Assembly

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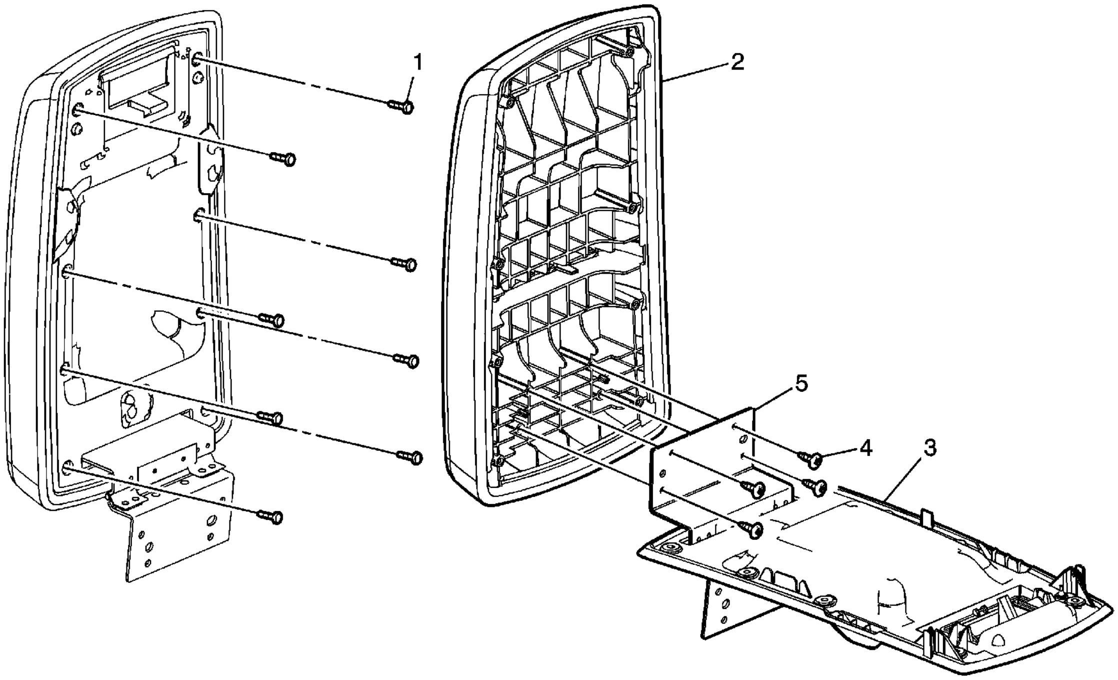
Front Floor Console Armrest Hinge Replacement



Callout	Component Name
Preliminary Procedure Remove the front floor console armrest assembly. Refer to Front Floor Console Armrest Hinge Replacement.	
1	Front Floor Console Armrest Screw (Qty 8) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Front Floor Console Armrest Armrest Assembly **Tip** Separate the armrest cover assembly from the inner panel.
3	Front Floor Console Armrest Inner Panel **Tip** Rotate the inner panel in order to access the hinge screws.
	Front Floor Console Armrest Hinge Screw (Qty 4)

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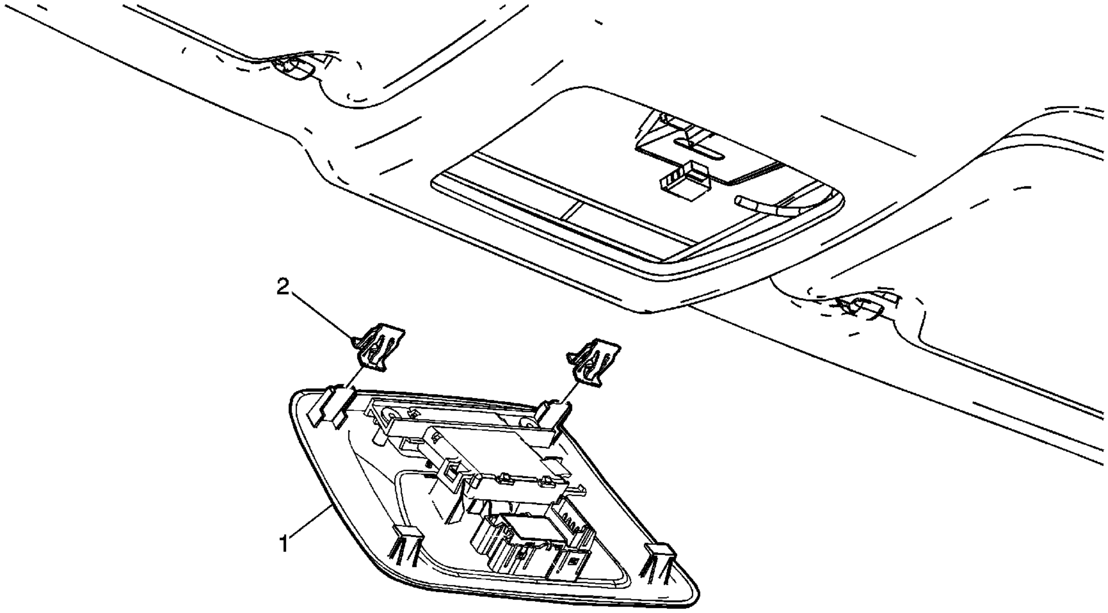
4	**Tighten** 2 N·m (18 lb in)
5	Front Floor Console Armrest Hinge Assembly **Tip** Remove the hinge from the inner panel.

Roof Console Replacement



Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications .	
1	Overhead Console **Tip** • Lower the front of the console first. • Disconnect the electrical connectors.
2	Overhead Console Retainer Clip

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2006 ACCESSORIES & EQUIPMENT

Interior Trim - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Assist Handle Screw	2 N.m	18 lb in
Center Pillar Upper Trim Screw	2 N.m	18 lb in
Headliner Trim Retainer	2 N.m	18 lb in
Sunshade Screws	2 N.m	18 lb in
Sunshade Anchor Screws	2 N.m	18 lb in
Quarter Upper Trim Panel Screw	2 N.m	18 lb in
Windshield Garnish Molding Screw	2 N.m	18 lb in

REPAIR INSTRUCTIONS

ELIMINATING UNWANTED ODORS IN VEHICLES

GM Vehicle Care Odor Eliminator, GM P/N 12378554 (Canadian P/N 88901678), may control or eliminate odors in the interior and luggage compartment areas of GM vehicles. This non-toxic, biodegradable, odorless product has been shown to greatly reduce or remove the following types of odor:

- Objectionable smells of mold and mildew resulting from vehicle water leaks
- Customer created odors, such as smoke

You may safely use GM Vehicle Care Odor Eliminator on fabrics, vinyl, leather, carpet, and sound deadening materials. You may also induce this product into HVAC modules and instrument panel ducts for the control of non-bacterial related odors.

IMPORTANT: This product leaves no residual scent and should not be used as an air freshener.

This product may result in the permanent elimination of an odor and may be preferable to customers whose allergies make them sensitive to perfumes. This product may effectively remove odors when directly contacting the odor source. In cases such as water leaks, use this product with diagnostic procedures to first eliminate the primary cause of the odor. Then use further applications on the residual odor to permanently correct the vehicle condition.

How to Use this Product

- Spray GM Vehicle Care Odor Eliminator directly or as an additive with carpet shampoo in steam cleaners.
- Do not use on any interior surface that plain water would deteriorate, because this product will have the same effect. Also avoid letting this product come into contact with vinegar or any acidic substance. Acid-based products will hamper the effectiveness of GM Vehicle Care Odor Eliminator.
- Instructions and cautions are printed on the bottle, but additional help is available. If you encounter a persistent or recurring odor, you may call to obtain additional information and usage suggestions.
    - In the USA, call 1-800-955-8591.
    - In Canada, call 1-800-977-4145.

FRONT CARPET RETAINER REPLACEMENT (IMPALA)

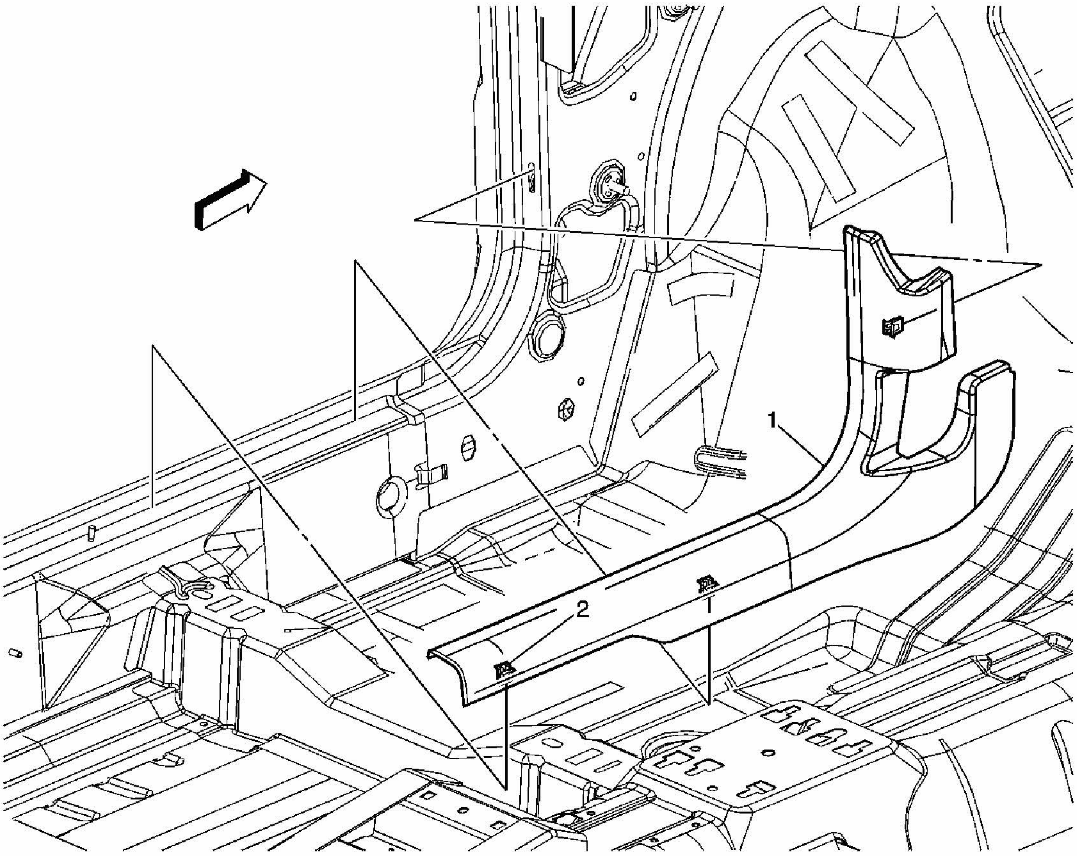


Fig. 1: Replacing Front Carpet Retainer
Courtesy of GENERAL MOTORS CORP.

Carpet Retainer Replacement - Front (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar**.	
1	Retainer Assembly, Front Side Door Carpet
2	Clip, Front Side Door Carpet Retainer Assembly

FRONT CARPET RETAINER REPLACEMENT (MONTE CARLO)

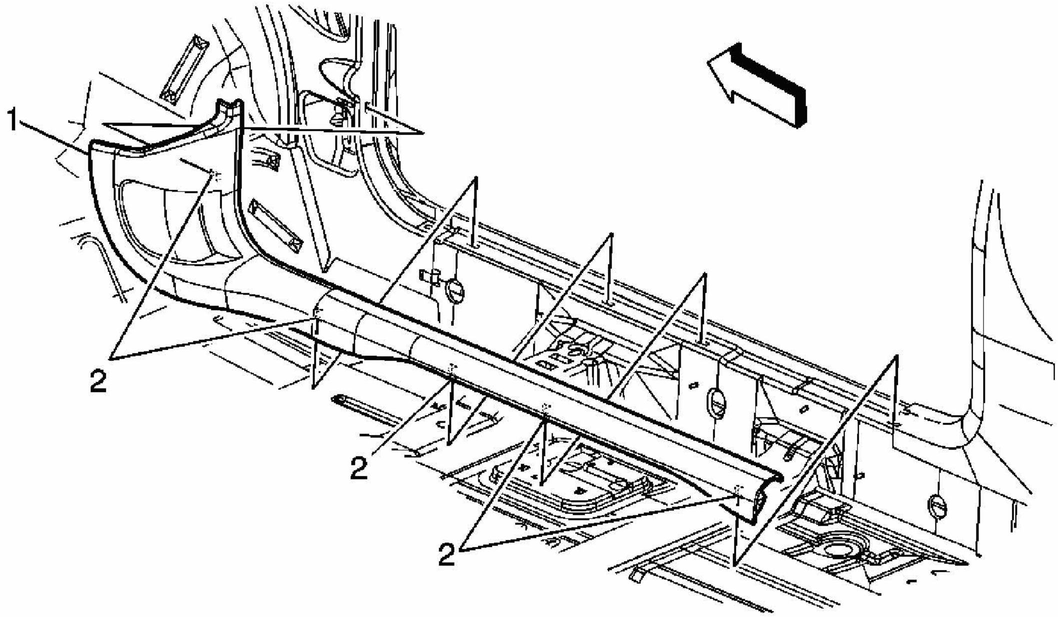


Fig. 2: Replacing Front Carpet Retainer
Courtesy of GENERAL MOTORS CORP.

Carpet Retainer Replacement - Front (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Front Side Door Carpet Retainer Assembly
2	Front Side Door Carpet Retainer Clip (Qty: 5)

FLOOR CARPET DRYING

If the carpet or the pad or insulator is wet, use the following criteria for drying or for replacing the components:

- For a 1-piece carpet assembly bonded to a cotton or a fiber padding, replace the entire assembly.

- For a 2-piece carpet assembly with a cotton or a fiber padding, replace the padding only. While the carpet is out of the vehicle, dry the carpet using the method described below.
- For a 1-piece carpet assembly bonded to a foam padding or attached to a synthetic padding, dry the carpet using the method described below.
- For a 2-piece carpet assembly with a synthetic padding, dry the assembly using the method described below.

Drying Method

1. If you observe puddles of liquid on the carpet face, use a wet vacuum to remove the excess moisture.
2. Blot the face of the carpet with a towel in order to absorb as much moisture as possible.
3. Point a fan at the affected area and air dry the carpet.

CARPET REPLACEMENT (IMPALA)

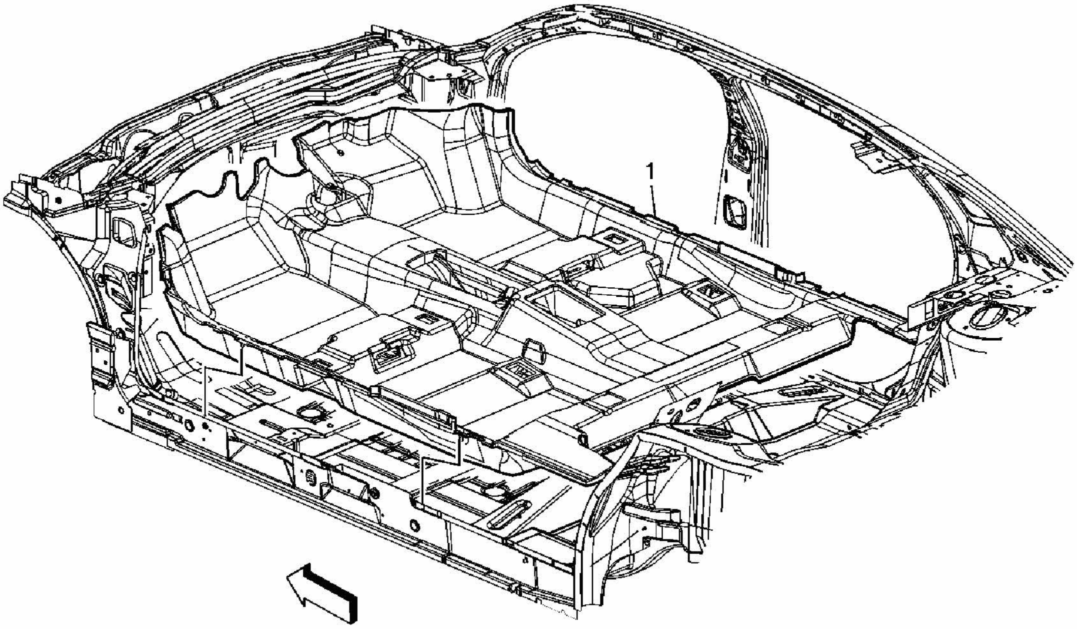


Fig. 3: Replacing Carpet
Courtesy of GENERAL MOTORS CORP.

Carpet Replacement (Impala)

Callout	Component Name
NOTE: Refer to Fastener	

Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedures

1. Remove the front seats. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)** .
2. Remove the rear seat. Refer to **Seat Cushion Replacement - Rear (Impala)** or **Seat Cushion Replacement - Rear (Monte Carlo)** .
3. Remove the floor console. Refer to **Console Replacement - Front Floor (Impala)** or **Console Replacement - Front Floor (Monte Carlo)** .
4. Remove the carpet retainers. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)**.
5. Loosen the center lower pillar garnish moldings. Refer to **Trim Panel Replacement - Lower Center Pillar**.
6. Loosen the lower lock pillar garnish moldings. Refer to **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)**
7. Remove the lower front seat belt bolt.

1	Carpet Assembly, Floor Panel

CARPET REPLACEMENT (MONTE CARLO)

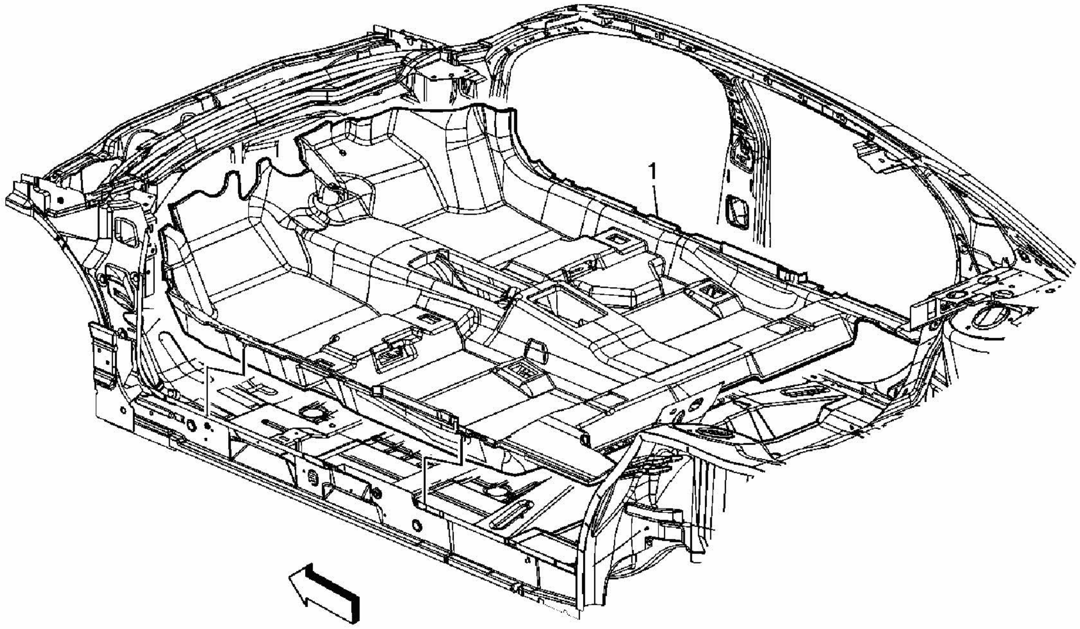


Fig. 4: Replacing Carpet

Courtesy of GENERAL MOTORS CORP.

Carpet Replacement (Monte Carlo)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.

Preliminary Procedures

1. Remove the front seats. Refer to Seat Replacement - Front Bucket (Impala) or Seat Replacement - Front Bucket (Monte Carlo) .
2. Remove the rear seat. Refer to Seat Cushion Replacement - Rear (Impala) or Seat Cushion Replacement - Rear (Monte Carlo) .
3. Remove the floor console. Refer to Console Replacement - Front Floor (Impala) or Console Replacement - Front Floor (Monte Carlo) .
4. Remove the carpet retainers. Refer to Carpet Retainer Replacement - Front (Impala) or Carpet Retainer Replacement - Front (Monte Carlo).
5. Loosen the lower lock pillar garnish moldings. Refer to Trim Panel Replacement - Rear Quarter Lower (Impala) or Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)
6. Remove the lower front seat belt bolt.</td></tr>
<tr><td>1</td><td>Floor Panel Carpet Assembly</td></tr>
</table>

HEADLINER REPLACEMENT (IMPALA)

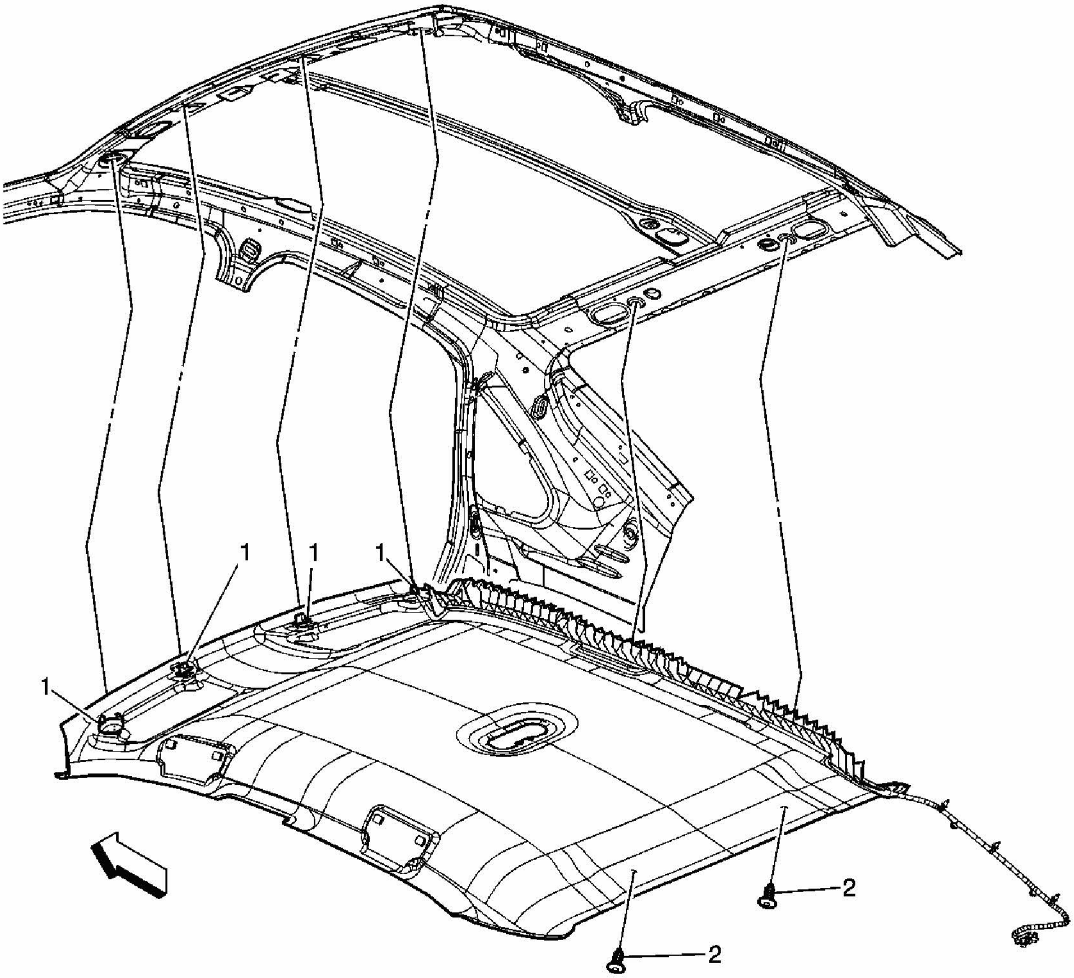


Fig. 5: Replacing Headliner
Courtesy of GENERAL MOTORS CORP.

Headliner Replacement (Impala)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.
Preliminary Procedure
1. Disable the SIR. Refer to SIR Disabling and Enabling Zone 2 (Monte Carlo) or SIR Disabling and Enabling Zone 2 (Impala) and SIR Disabling and Enabling Zone 6 (Monte Carlo) or SIR Disabling and Enabling Zone 6 (Impala) .
2. Remove the rear quarter upper trim panel. Refer to Trim Panel Replacement - Rear Quarter Upper (Impala) or Trim Panel Replacement - Rear Quarter Upper (Monte Carlo).
3. Remove the upper center pillar trim. Refer to Trim Panel Replacement - Upper</td></tr>
</table>

<table>
<tr><td colspan="2">Center Pillar.
4. Remove the windshield pillar trim. Refer to Garnish Molding Replacement - Windshield Pillar (Impala) or Garnish Molding Replacement - Windshield Pillar (Monte Carlo).
5. Remove the sunshades. Refer to Sunshade Replacement.
6. Remove the sunshade anchors. Refer to Sunshade Anchor Replacement.
7. Remove the assist handles. Refer to Assist Handle Replacement.</td></tr>
<tr><td>1</td><td>Headlining Trim Screws
Tip: These screws come off with the sunshade and sunshade anchors.</td></tr>
<tr><td>2</td><td>Headlining Trim Retainer (Qty: 2)</td></tr>
<tr><td>3</td><td>Headlining Trim
Tip:
1. Disconnect the electrical connectors.
2. Fully recline the front seat backs.
3. Tilt the steering wheel fully upward.
4. Set the parking brake and put shifter in low gear.
5. Cover the instrument panel to protect from damage.
6. Remove through the front passenger door opening.</td></tr>
</table>

HEADLINER REPLACEMENT (MONTE CARLO)

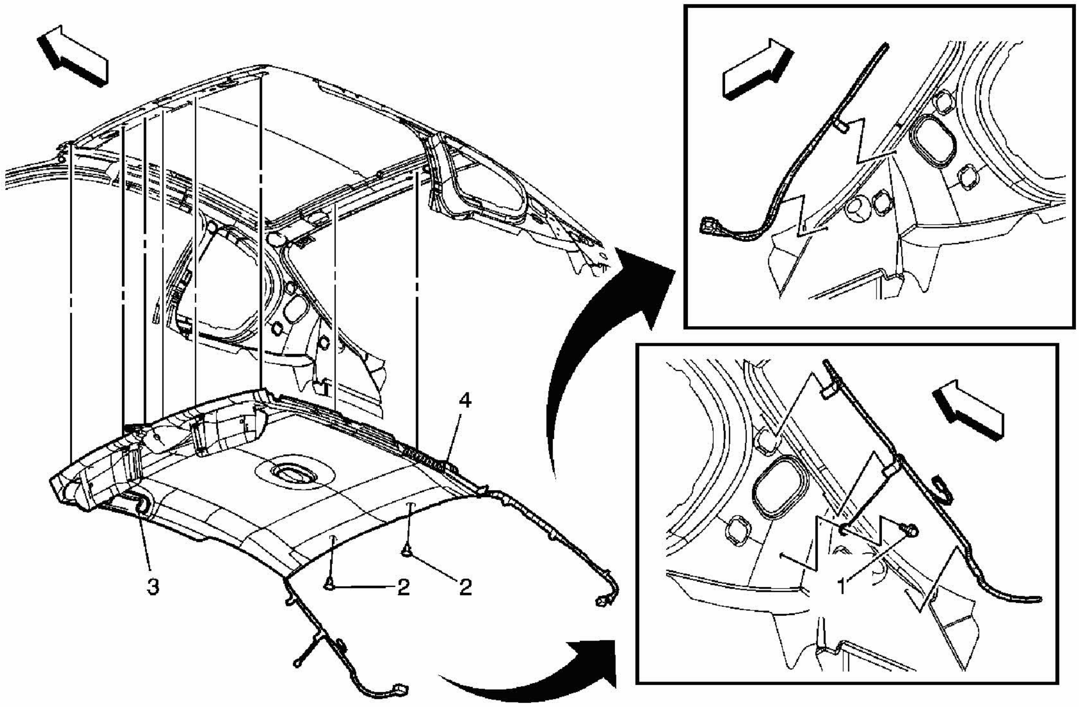


Fig. 6: Replacing Headliner
Courtesy of GENERAL MOTORS CORP.

Headliner Replacement (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the windshield garnish trim moldings. Refer to **Garnish Molding Replacement - Windshield Pillar (Impala)** or **Garnish Molding Replacement - Windshield Pillar (Monte Carlo)**. 2. Remove the sunshades and the sunshade retaining clips. Refer to **Sunshade Replacement**. 3. Remove the upper quarter trim panels. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)**. 4. Remove the coat hooks. Refer to **Coat Hook Replacement (Monte Carlo)**. 5. Remove the weather strips around the top of each door opening. 6. Remove the front passenger seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)** .	
1	Trim Panel Screw **Tighten:** 2 N.m (18 lb in)
2	Headliner Trim Panel Retainer (Qty: 2)
3	Assist Handle Retainer (Qty: 2)
4	Headliner Trim Panel Assembly **Tip:** 1. Place the front seats fully forward with the seat back fully reclined. 2. Disconnect the electrical connectors. 3. With the aid of an assistant, remove the headliner out of the side door.

ASSIST HANDLE REPLACEMENT

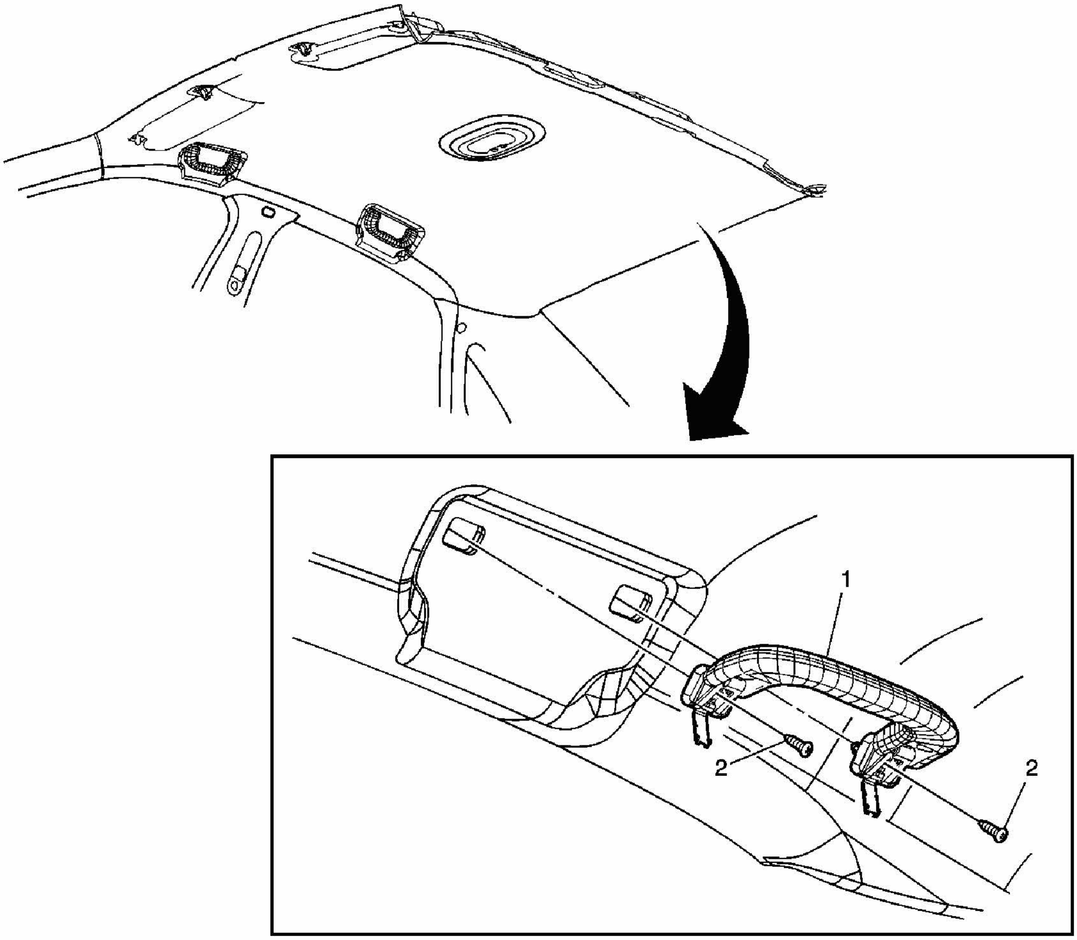


Fig. 7: Replacing Assist Handle
Courtesy of GENERAL MOTORS CORP.

Assist Handle Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to Fastener Tightening Specifications.	
1	Assist Handle Screw **Tighten:** 2 N.m (18 lb in)
2	Assist Handle Assembly

COAT HOOK REPLACEMENT (MONTE CARLO)

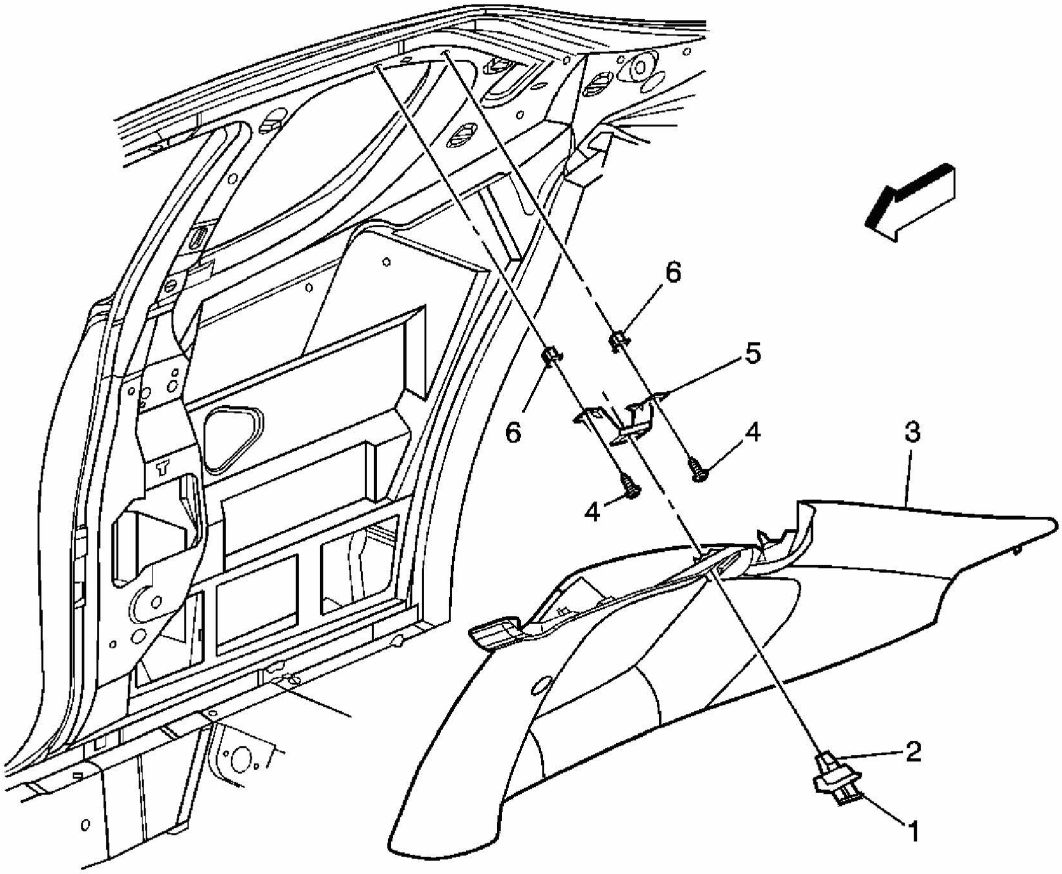


Fig. 8: Replacing Coat Hook
Courtesy of GENERAL MOTORS CORP.

Coat Hook Replacement (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Coat Hook
2	Coat Hook Retainer Clip
3	Quarter Upper Trim Finish Panel Assembly **Tip:** Pull out to disengage the retainers and tilt inward and up to allow the tabs on the trim panel to release from the vehicle.
4	Coat Hook Anchor Plate Screw (Qty: 2) **Tighten:** 2 N.m (18 lb in)
5	Coat Hook Anchor Plate

6	Retainer Clip Screw (Qty: 2)

OVERHEAD CONSOLE REPLACEMENT

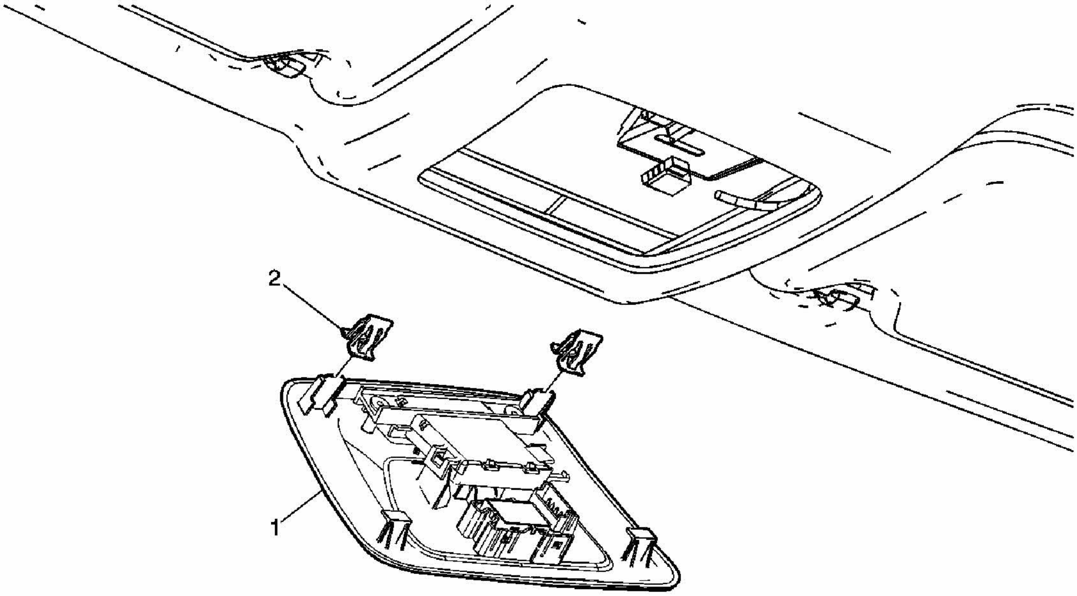


Fig. 9: Replacing Overhead Console
Courtesy of GENERAL MOTORS CORP.

Console Replacement - Overhead

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Overhead Console **Tip:** • Lower the front of the console first. • Disconnect the electrical connectors.
2	Overhead Console Retainer Clip

SUNSHADE REPLACEMENT

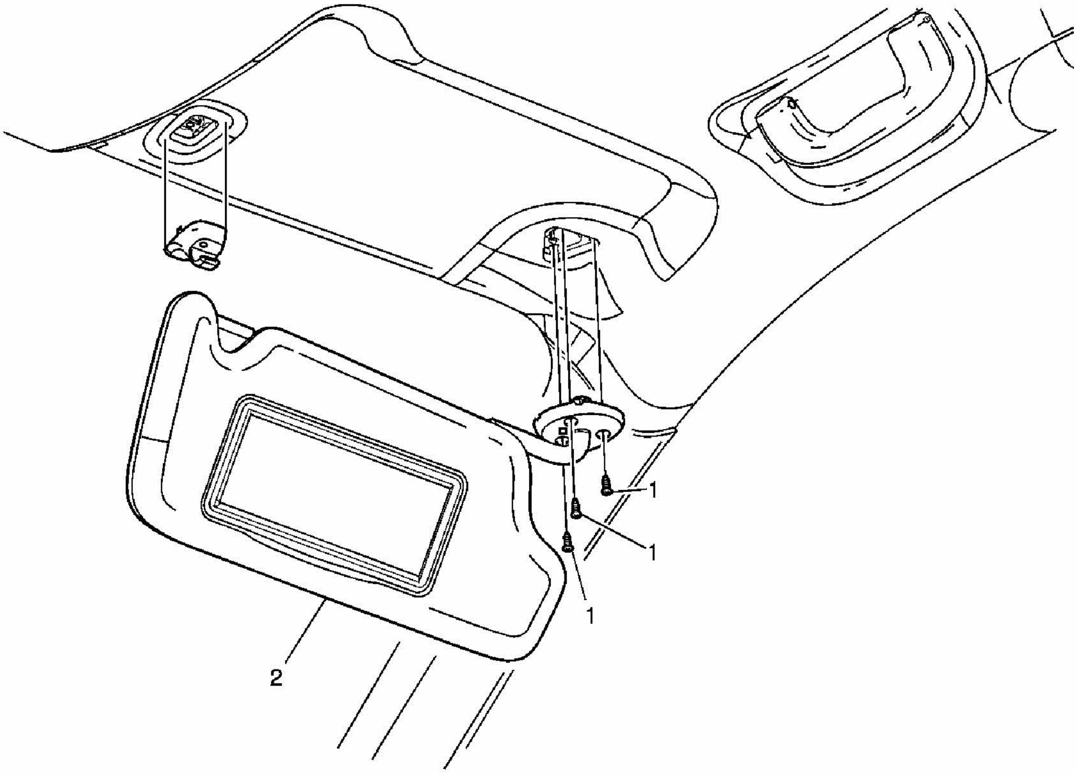


Fig. 10: Replacing Sunshade
Courtesy of GENERAL MOTORS CORP.

Sunshade Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .**	
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Sunshade Assembly Screw (Qty: 3) **Tighten:** 2 N.m (18 lb in)
2	Sunshade Assembly

SUNSHADE ANCHOR REPLACEMENT

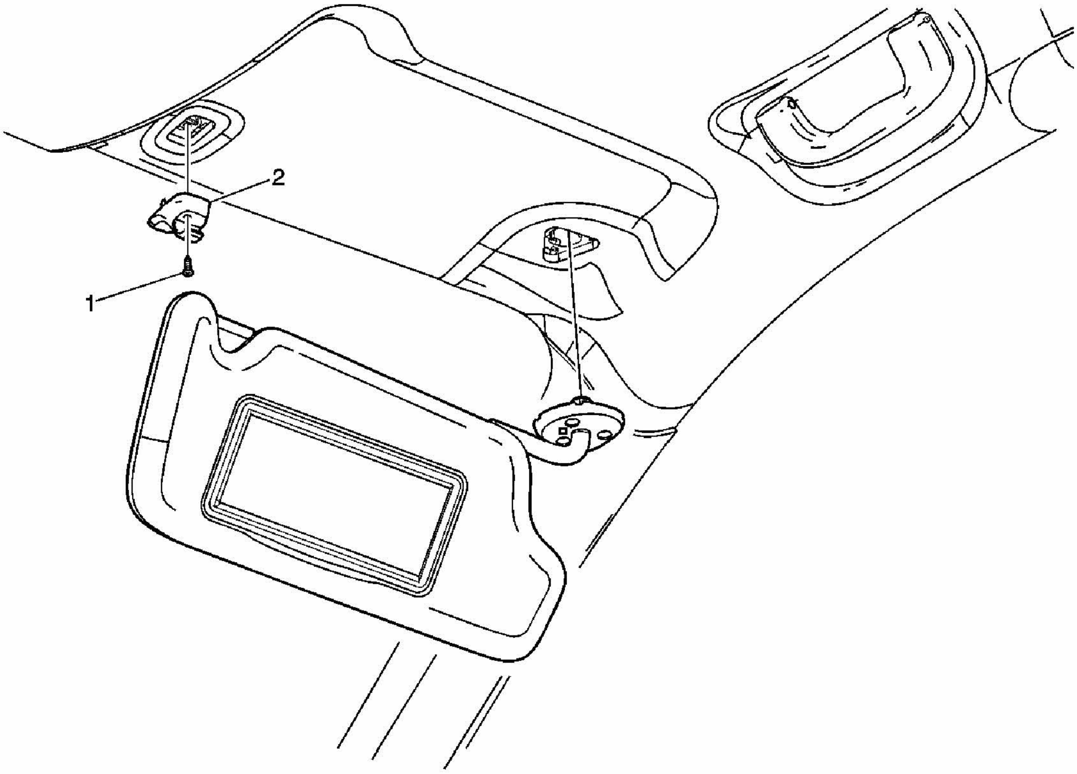


Fig. 11: Replacing Sunshade Anchor
Courtesy of GENERAL MOTORS CORP.

Sunshade Anchor Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Sunshade Anchor Screw **Tighten:** 2 N.m (18 lb in)
2	Sunshade Anchor

WINDSHIELD PILLAR GARNISH MOLDING REPLACEMENT (IMPALA)

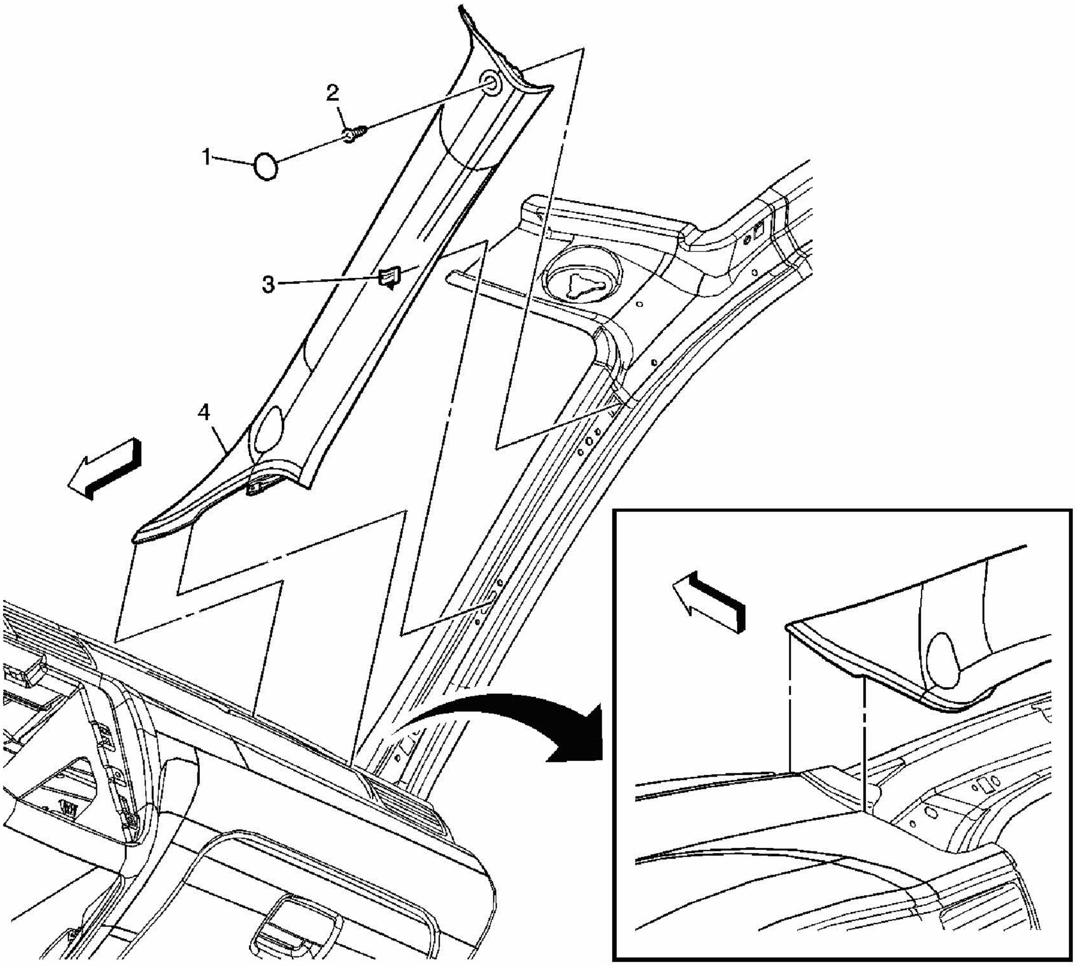


Fig. 12: Replacing Windshield Pillar Garnish Molding
Courtesy of GENERAL MOTORS CORP.

Garnish Molding Replacement - Windshield Pillar (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Windshield Side Upper Garnish Screw Cover
2	Windshield Side Upper Garnish Screw **Tighten:** 2 N.m (18 lb in)
3	Windshield Side Upper Garnish Retainer Clip
4	Windshield Side Upper Garnish Molding Assembly

WINDSHIELD PILLAR GARNISH MOLDING REPLACEMENT (MONTE CARLO)

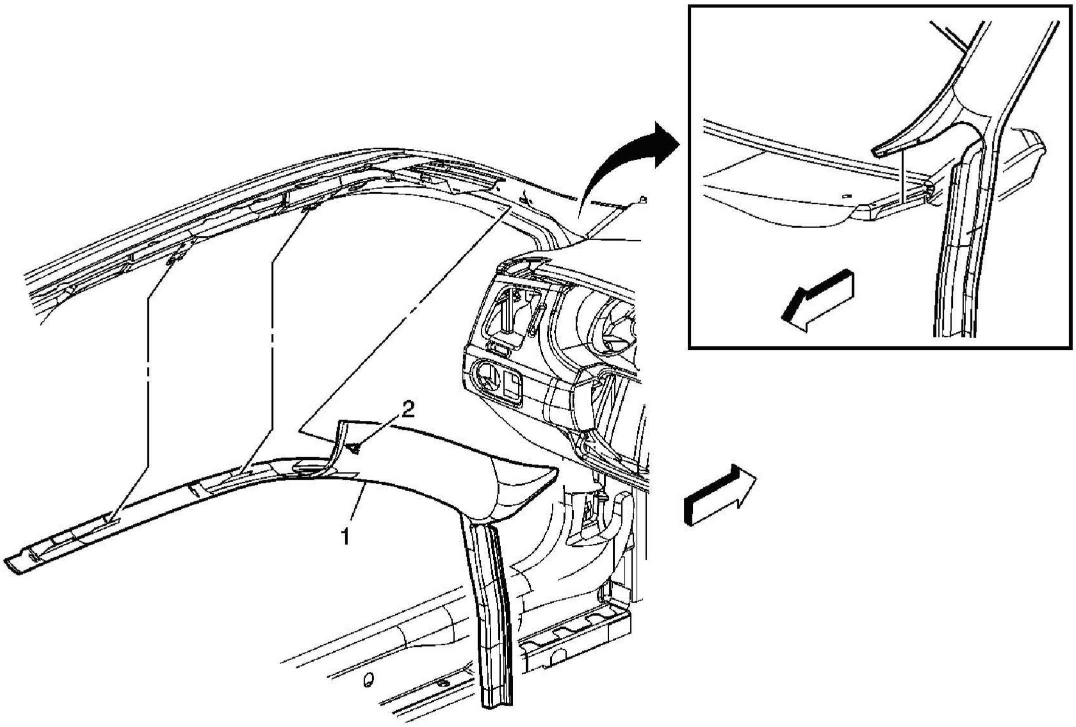


Fig. 13: Replacing Windshield Pillar Garnish Molding
Courtesy of GENERAL MOTORS CORP.

Garnish Molding Replacement - Windshield Pillar (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Windshield Garnish Molding Assembly
2	Windshield Side Garnish Molding Clip

UPPER CENTER PILLAR TRIM PANEL REPLACEMENT

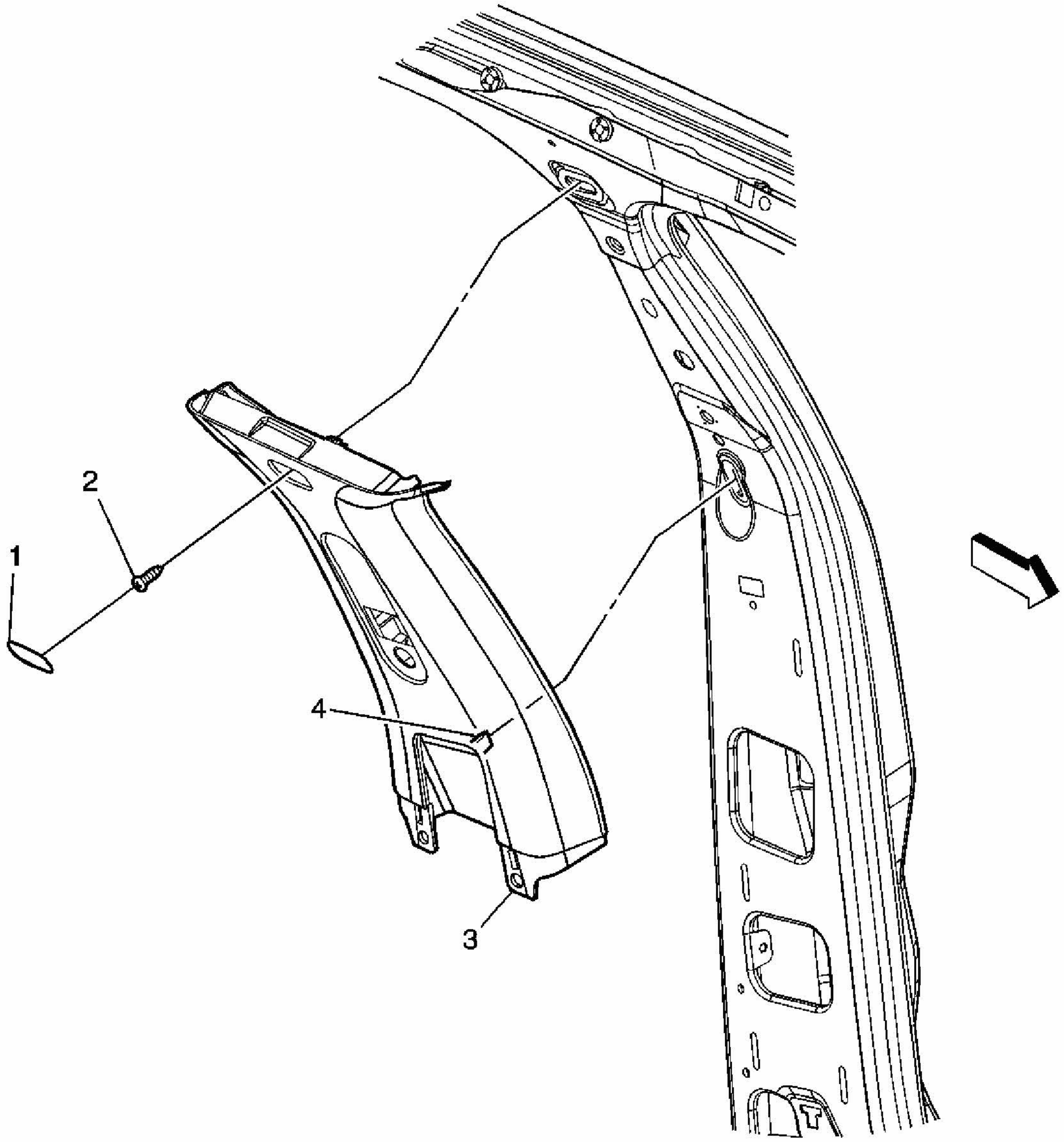


Fig. 14: Replacing Upper Center Pillar Trim Panel
Courtesy of GENERAL MOTORS CORP.

Trim Panel Replacement - Upper Center Pillar

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar**.	
1	Center Pillar Upper Trim Screw Cover

2	Center Pillar Upper Trim Screw **Tighten:** 2 N.m (18 lb in)
3	Center Pillar Upper trim **Tip:** 1. Remove the seat belt D-ring from the adjuster assembly. **Tighten:** 35 N.m (25 lb ft) 2. Pull the trim panel toward the inside of the vehicle to disengage the retainers.
4	Center Pillar Upper Trim Clip

LOWER CENTER PILLAR TRIM PANEL REPLACEMENT

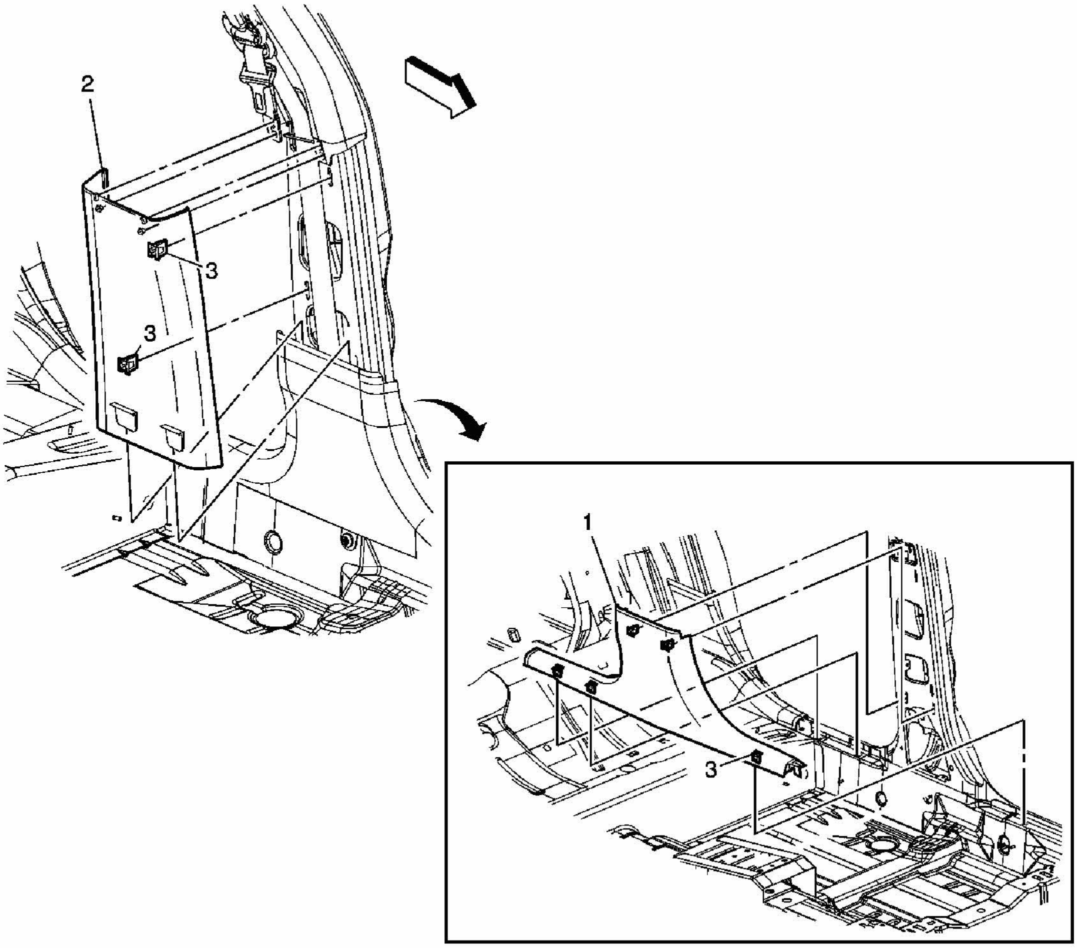


Fig. 15: Replacing Lower Center Pillar Trim Panel
Courtesy of GENERAL MOTORS CORP.

Trim Panel Replacement - Lower Center Pillar

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Front and Rear Side Door Floor Carpet Retainer
2	Center Pillar Upper Trim Panel
3	Center Pillar Trim Retainer Clip

REAR QUARTER UPPER TRIM PANEL REPLACEMENT (IMPALA)

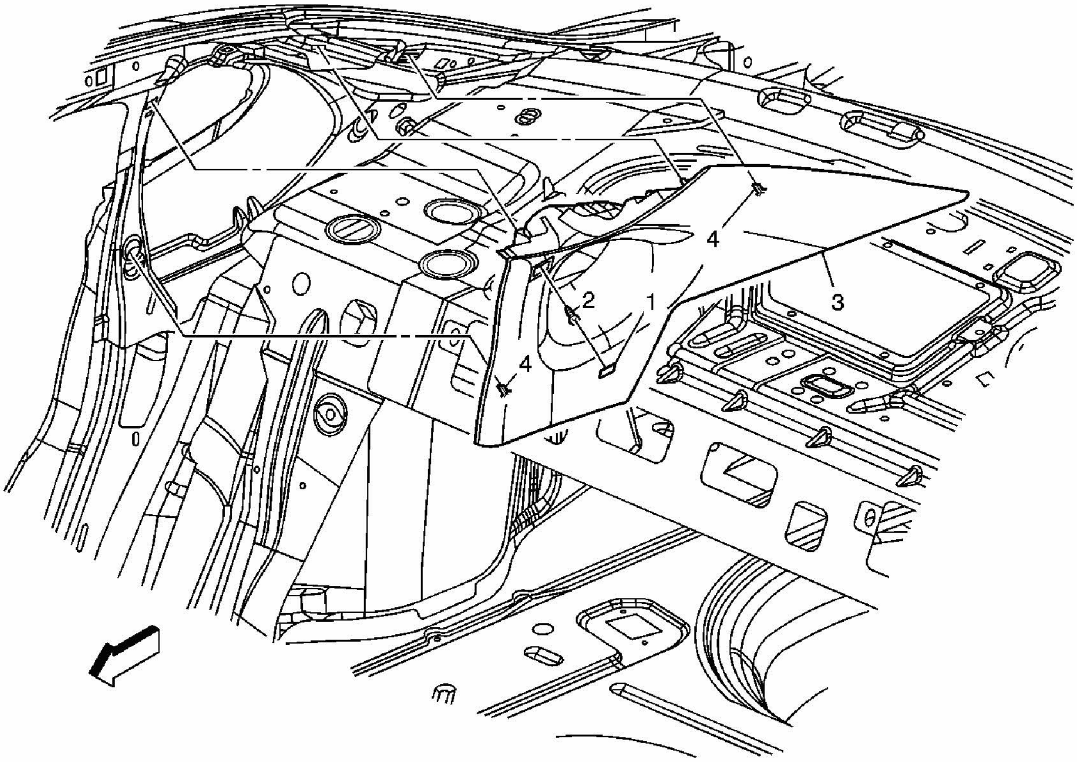


Fig. 16: Replacing Rear Quarter Upper Trim Panel
Courtesy of GENERAL MOTORS CORP.

Trim Panel Replacement - Rear Quarter Upper (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Upper Quarter Upper Trim Panel Screw Cover
2	Upper Quarter Upper Trim Panel Screw **Tighten:** 2 N.m (18 lb in)
3	Upper Quarter Upper Trim Panel Assembly
4	Upper Quarter Upper Trim Clip

REAR QUARTER UPPER TRIM PANEL REPLACEMENT (MONTE CARLO)

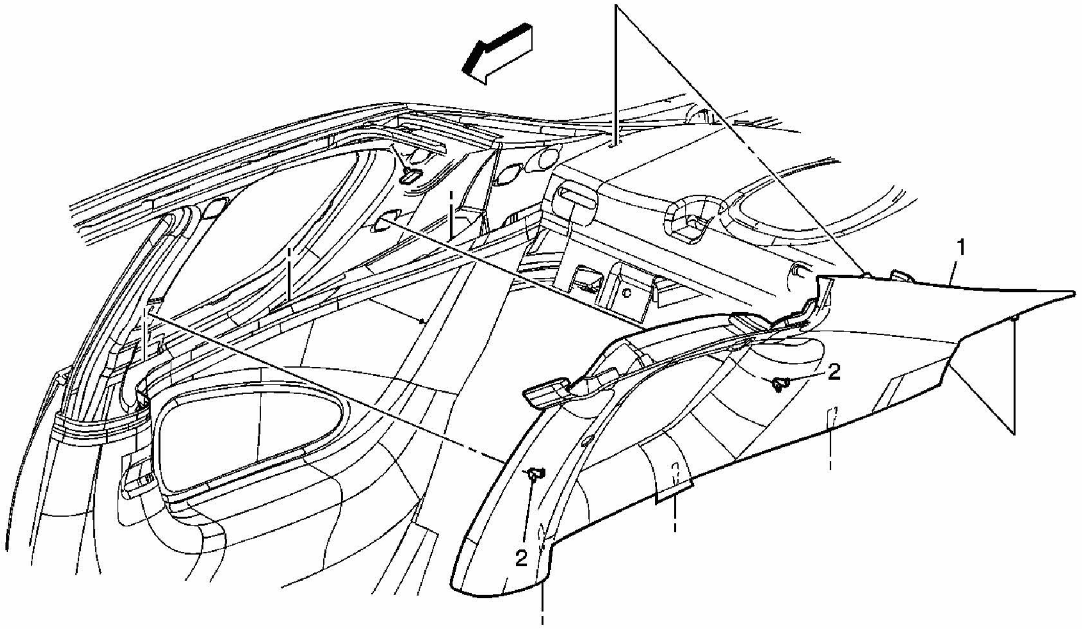


Fig. 17: Replacing Rear Quarter Upper Trim Panel
Courtesy of GENERAL MOTORS CORP.

Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)

Callout	Component Name
NOTE: Refer to Fastener Notice . **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the coat hook. Refer to **Coat Hook Replacement (Monte Carlo)**.	
1	Quarter Upper Trim Finish Panel Assembly **Tip:** Pull out to disengage the retainers and tilt inward and up to allow the tabs on the trim panel to release from the vehicle.
2	Quarter Upper Trim Finish Panel Retainer (Qty: 2)

REAR QUARTER LOWER TRIM PANEL REPLACEMENT (IMPALA)

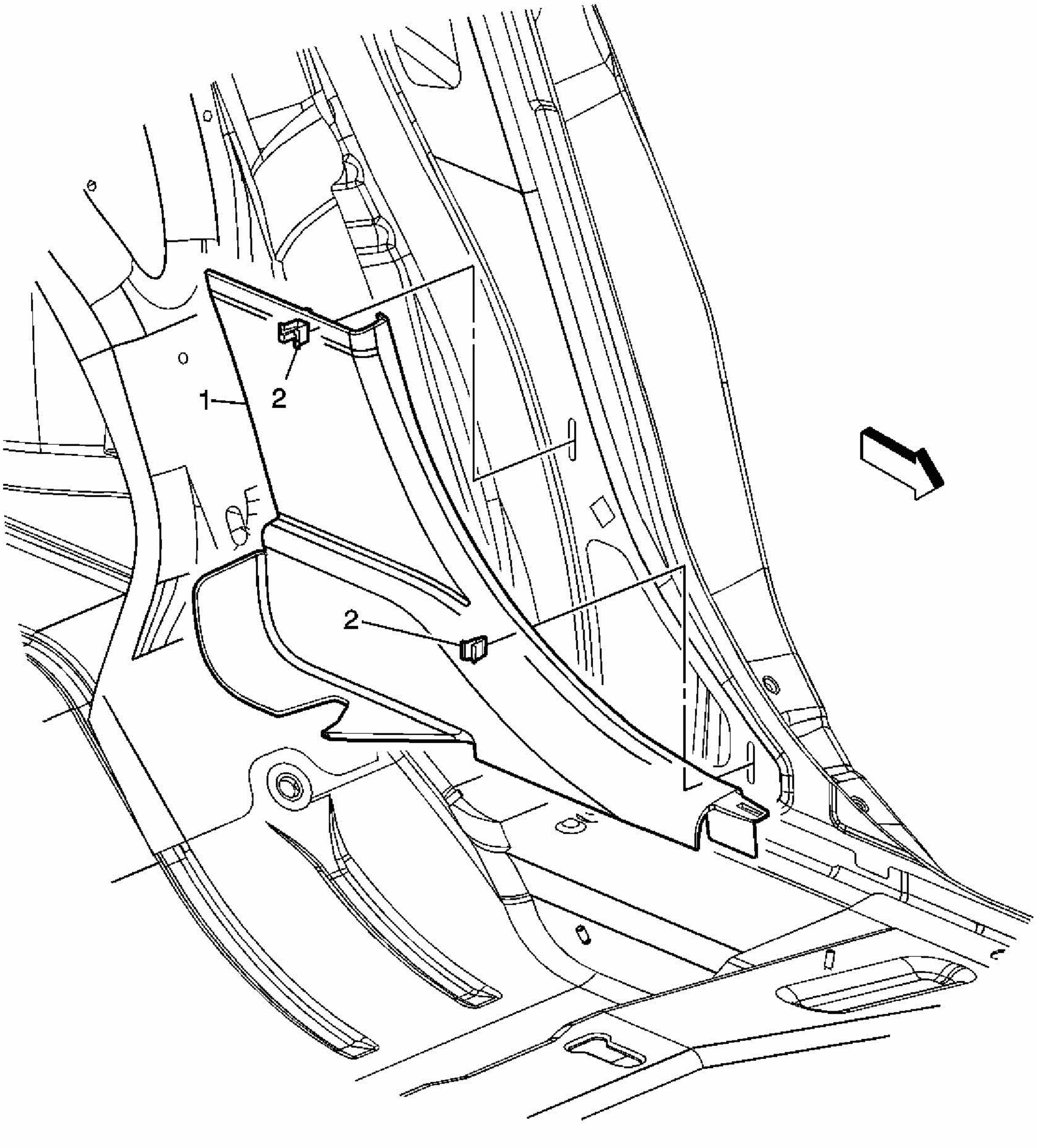


Fig. 18: Replacing Rear Quarter Lower Trim Panel
Courtesy of GENERAL MOTORS CORP.

Trim Panel Replacement - Rear Quarter Lower (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar**.	
1	Quarter Lower Trim Finish Panel Assembly
2	Quarter Lower Trim Finish Panel Retainer Clip (Qty: 2)

REAR QUARTER LOWER TRIM PANEL REPLACEMENT (MONTE CARLO)

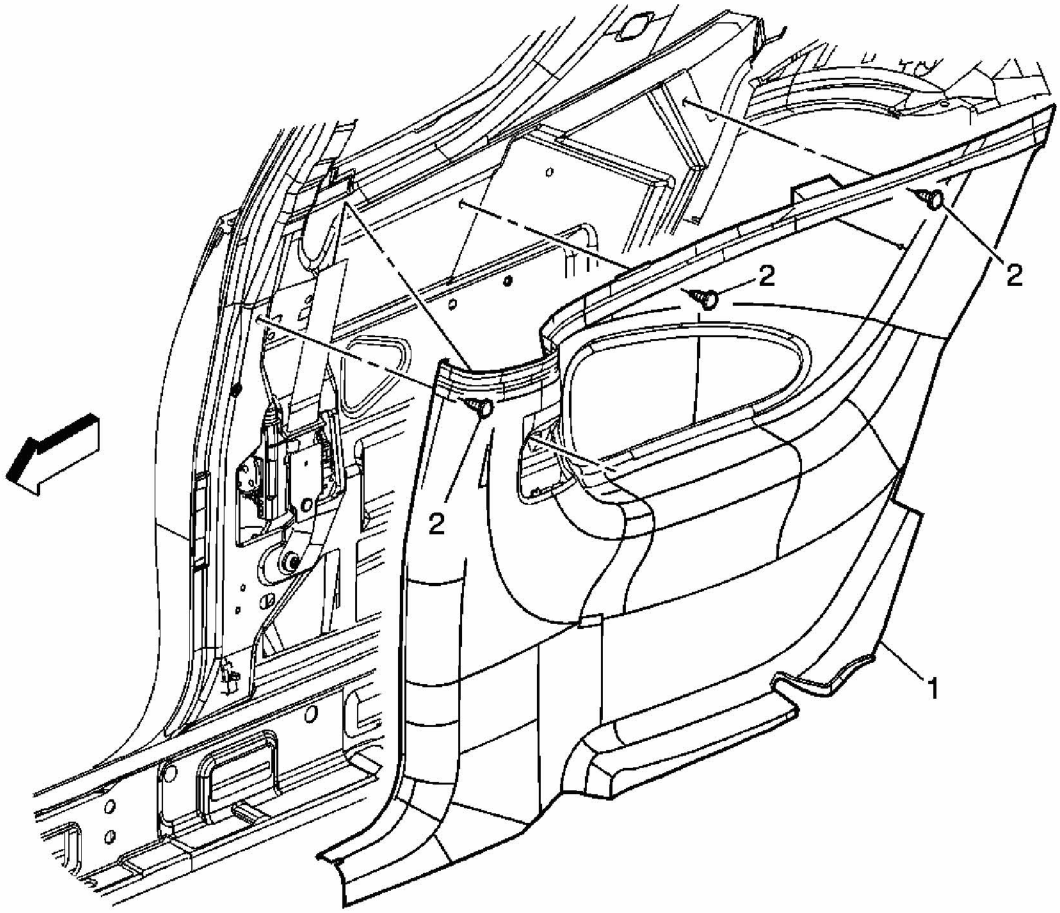


Fig. 19: Replacing Rear Quarter Lower Trim Panel
Courtesy of GENERAL MOTORS CORP.

Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the rear quarter upper trim panel. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)**.	
1	Quarter Lower Trim Finish Panel Assembly **Tip:** Route the front seat belt through the trim panel.
	Quarter Lower Trim Finish Panel Retainer (Qty: 3)

2	**Tip:** Right side shown has 3 retainers, the left side is similar but has 4 retainers.

REAR WINDOW SHELF TRIM PANEL REPLACEMENT

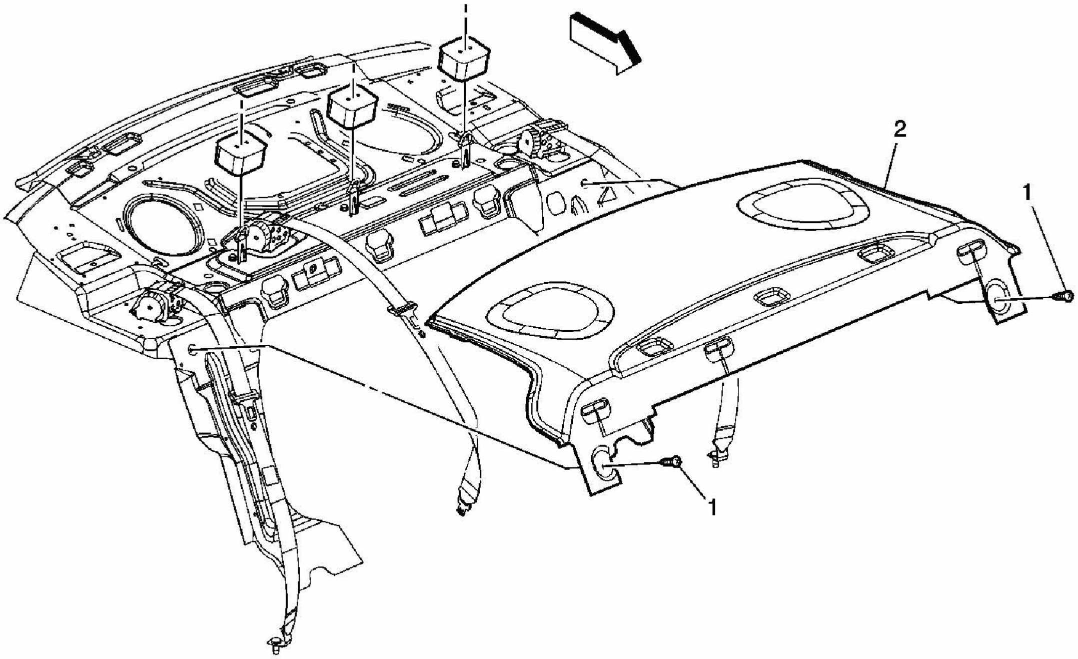


Fig. 20: Replacing Rear Window Shelf Trim Panel
Courtesy of GENERAL MOTORS CORP.

Trim Panel Replacement - Rear Window Shelf

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the rear quarter upper trim panel. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)**. 2. Remove the rear quarter lower trim panel. Refer to **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)**. 3. Remove the rear seat belt bolts.	
1	Rear Window Trim Panel Retainer
2	Rear Window Trim Panel Assembly

GENERAL INFORMATION

Service Reminder Indicators - General Motors (Except Cadillac)

OIL CHANGE REMINDERS

NOTE: This article is only to be used for resetting maintenance reminder lights (when applicable). Some models (not all) may be equipped with one or more resetable maintenance reminder lights indicating maintenance is required. Once required maintenance services are performed, resetting of lights may be required. Information is provided to reset these lights where applicable.

NOTE: Most vehicles are equipped with a Malfunction Indicator Light (MIL) or check engine light. If light comes on and remains on while driving, the vehicle requires some type of repair. See appropriate service and repair information. After repairing fault(s) and clearing fault code(s), the MIL or check engine light should go out. Some models may use a dual-function indicator light, which is also used to indicate emission component service is due. After performing required service, reset indicator light.

NOTE: Most General Motors 1981-88 vehicles do not use a Service Reminder Indicator (SRI).

CHANGE ENGINE OIL LIGHT (PASSENGER CARS)

1989-92 OLDSMOBILE TORONADO & TROFEO

With Information Center Display

1. OIL LIFE INDEX is one of 4 engine data displays used on models with Information Center display. It will display remaining oil life as estimated percentage of the useful life of oil. It will show 100 percent when the system is reset. After changing oil, reset oil life display.
2. To reset the display, press ENG DATA button (1989-90) or OPTIONS button (1991-92) until oil life index is displayed. Then, press and hold in ENG DATA and GAGE buttons (1989) or RESET/ENTER button (1990-92) for at least 5 seconds. This will reset remaining oil life to 100 percent.

With Visual Information Center

1. OIL LIFE is one of the displays used on models with a Visual Information Center (VIC). It will display data regarding previous oil change. A bar graph display shows full when oil is changed. Bar graph will go down as vehicle is driven and oil ages.

When bar graph reaches CHANGE OIL mark, oil should be changed. After changing oil, reset oil life display.

2. To reset the display, press INFO hard key and then OIL LIFE soft key to display oil life index. Press RESET soft key. A reset confirmation page will appear and ask if oil has been changed. Press YES soft key to reset bar graph, and update last oil change date and mileage information.

1990-91 CHEVROLET CORVETTE

1. Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the oil is nearly worn out. A CHANGE OIL light on left side of instrument cluster is illuminated when it is time to change oil.
2. To reset oil life monitor, turn ignition on. Depress ENG MET button on trip monitor and release. Within 5 seconds, depress and release ENG MET button again. Within 5 seconds, depress and hold the RANGE button on trip monitor. The CHANGE OIL light should flash.
3. Hold the RANGE button depressed until the CHANGE OIL light stops flashing and goes out. When the light goes out, the engine oil life monitor is reset. This should take about 10 seconds. If the light does not reset, turn the ignition off and repeat the procedure.

1990-91 OLDSMOBILE CUTLASS CALAIS, CUTLASS SUPREME, CUTLASS CIERA, CUTLASS CRUISER, EIGHTY-EIGHT, NINETY-EIGHT & TOURING SEDAN

1. An oil change reminder displays estimated percentage of the remaining useful life of the oil. When vehicle is started, a tone will sound and approximate distance to next oil change will be displayed.
2. When remaining oil life is 10 percent or less, the system will calculate distance to next oil change. When the oil life is 0 percent, the display will show CHANGE OIL NOW. After changing oil, reset oil life display.
3. To reset the display, press and hold in OIL button to select the oil life display. Then, press and hold in RESET and OIL buttons for at least 5 seconds. This will reset oil life display to 100 percent.

1991-93 BUICK PARK AVENUE

1. CHANGE OIL SOON light will come on when engine oil has broken down enough to require changing. After changing oil, reset oil life display.
2. To reset light, locate reset button hole under passenger side of dash. Use a pencil or similar object to push and hold button (inside hole) for 5 seconds. The CHANGE OIL SOON light will flash 4 times to indicate light has been reset.

1992-96 CHEVROLET CORVETTE

1. The CHANGE OIL light, located on left side of instrument cluster is illuminated when

its time to change oil. When engine oil is changed, reset CHANGE OIL indicator even if indicator did not illuminate. This ensures indicator accuracy for next oil change.

2. To reset oil life monitor, turn ignition on. Ensure DLC terminal No. 12 is not grounded. Press ENG MET button, located on the trip monitor, and release. Within 5 seconds, press and release ENG MET button again. Within another 5 seconds, press and hold the GAUGES button located on the trip monitor.
3. CHANGE OIL light will begin flashing. Hold GAUGES button depressed until CHANGE OIL light goes out. When light goes out, engine oil life monitor is reset. This should take about 10 seconds. If light does not reset, turn ignition off and repeat procedure.

1992-93 OLDSMOBILE EIGHTY EIGHT & NINETY EIGHT

1. Oil change reminder display is similar to 1990-91 models, but reset procedures are different. After changing oil, reset oil life display.
2. To reset the display, press and release the TEST button. Press and release the OIL button. Press and hold the RESET button for at least 7 seconds. This will reset oil life display to 100 percent.

1994-99 BUICK LESABRE

1. CHANGE OIL SOON light will come on when engine oil has broken down enough to require changing. After changing oil, reset oil life display.
2. To reset light, turn ignition on. Open glove box to access oil reset button. Press and hold oil reset button in glove box for at least 5 seconds, but not longer than 60 seconds. The CHANGE OIL SOON light will flash 4 times to indicate light has been reset.

1994-96 BUICK PARK AVENUE

1. CHANGE OIL SOON light will come on when engine oil has broken down enough to require changing. After changing oil, reset oil life display.
2. To reset light, turn ignition on. Open glove box to access oil reset button. Press and hold oil reset button in glove box for at least 5 seconds, but not longer than 60 seconds. The CHANGE OIL SOON light will flash 4 times to indicate light has been reset.

1994 BUICK ROADMASTER

1. Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the engine oil is nearly worn out. A CHANGE OIL light on the instrument cluster is illuminated when it is time to change the engine oil.
2. To reset CHANGE OIL light, press reset switch located behind fuse block access door.

1994 CHEVROLET CAPRICE

1. Engine oil life monitor calculates engine oil temperature and RPM. It indicates when

the engine oil is nearly worn out. A CHANGE OIL light on the instrument cluster is illuminated when it is time to change the engine oil.

2. To reset CHANGE OIL light, press reset switch located behind fuse block access door.

1995-96 BUICK ROADMASTER

1. Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the engine oil is nearly worn out. A CHANGE OIL light on the instrument cluster is illuminated when it is time to change the engine oil.
2. To reset oil life monitor and turn off CHANGE OIL light, turn ignition switch to ON position with engine off. Depress accelerator pedal to wide open throttle 3 times within 5 seconds. This throttle signal will inform the PCM to reset the oil life monitor and turn off the light. If light does not turn off, turn ignition off and repeat procedure.

1995-96 CHEVROLET CAPRICE

1. Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the engine oil is nearly worn out. A CHANGE OIL light on the instrument cluster is illuminated when it is time to change the engine oil.
2. To reset oil life monitor and turn off CHANGE OIL light, turn ignition switch to ON position with engine off. Depress accelerator pedal to wide open throttle 3 times within 5 seconds. This throttle signal will inform the PCM to reset the oil life monitor and turn off the light. If light does not turn off, turn ignition off and repeat procedure.

1995-99 OLDSMOBILE AURORA

1. The Driver Information Center (DIC) displays estimated percentage of the remaining useful life of engine oil or transaxle fluid. When remaining oil or fluid life is 0 percent, the display will show CHANGE OIL NOW or CHANGE TRNS FLUID NOW. After changing engine oil or transaxle fluid, reset oil life display.
2. To reset the display, turn ignition on with engine off. Press ENG button to select the OIL LIFE or TRNS FLUID LIFE percentage display. Then, press and hold in RESET for at least 5 seconds.
3. The word RESET will appear. Then, OIL LIFE 100 or TRNS FLUID 100 will be displayed.

1995-97 OLDSMOBILE EIGHTY EIGHT & NINETY EIGHT

1. Oil change reminder display is similar to 1990-91 models, but reset procedures are different. After changing oil, reset oil life display.
2. To reset the display, press and release RESET button on Driver Information Center (DIC). Press SEL button (with down arrow) to select OIL. Press SEL button (with left and right arrows) to display oil life. Press and hold RESET button for about 5 seconds. A reset message will display, then oil life will display 100 percent.

1997-2004 BUICK CENTURY & REGAL

1. Engine oil life monitor calculates engine oil temperature and engine revolutions. It indicates when the engine oil is nearly worn out. CHANGE OIL or CHANGE OIL SOON light on the instrument cluster is illuminated when it is time to change the engine oil. See **Fig. 1** and **Fig. 2** .
2. To reset oil life monitor on a vehicle with a Driver Information Center, go to step 4. To reset the oil life monitor on a vehicle NOT equipped with a Driver Information Center, turn ignition switch to ON or RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds.
3. On 1997-98 vehicles, if the CHANGE OIL or CHANGE OIL SOON light flashes 2 times, the system is reset. However, if light comes on for 5 seconds, system did not reset. Repeat reset procedure. On 1999-2004 vehicles, if the CHANGE OIL or CHANGE OIL SOON light flashes, the system is resetting. Turn ignition off. Start vehicle. If oil light comes back on and stays on, the oil life monitor has not reset. Repeat reset procedure.
4. If vehicle is equipped with a Driver Information Center (DIC), reset oil life monitor by pressing the Driver Information Center RESET button for 5 seconds while viewing the oil life display.

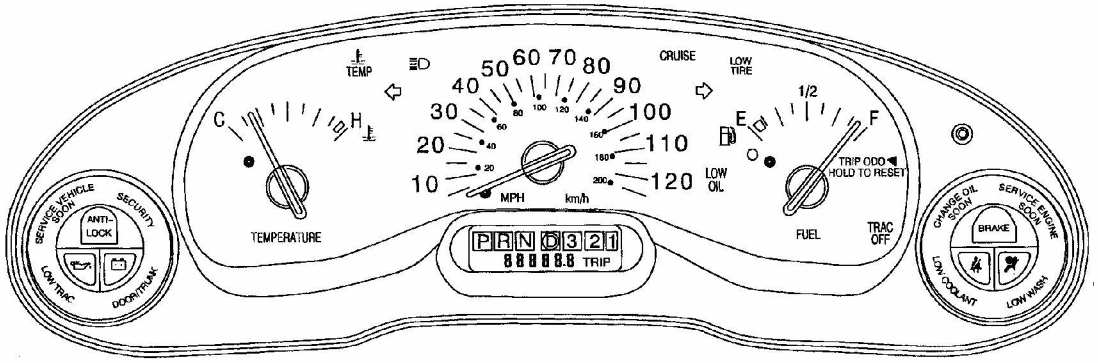

TEMP
CRUISE
LOW TIRE
C
H
TEMPERATURE
10
20
30
40
50
60
70
80
90
100
110
120
20
40
60
80
100
120
140
160
180
200
MPH
km/h
1/2
E
F
TRIP ODO◄ HOLD TO RESET
LOW OIL
FUEL
TRAC OFF
PRND321
88888.8 TRIP
SERVICE VEHICLE SOON
SECURITY
ANTI-LOCK
LOW TRAC
DOOR/TRUNK
CHANGE OIL SOON
SERVICE ENGINE SOON
BRAKE
LOW COOLANT
LOW WASH
G00032224

Fig. 1: Identifying Instrument Cluster (2002-04 Buick Century)
Courtesy of GENERAL MOTORS CORP.

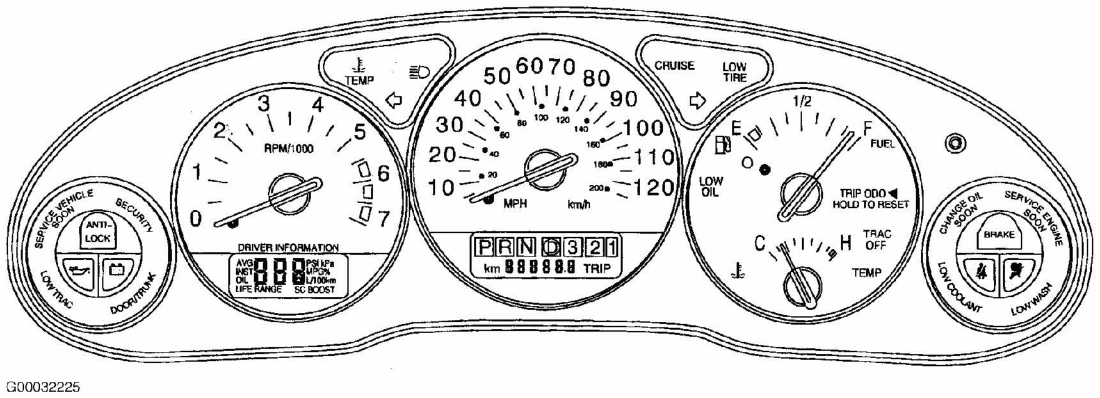

TEMP
CRUISE
LOW TIRE
50 60 70 80 90 100 110 120
40 30 20 10
MPH
km/h
RPM/1000
0 1 2 3 4 5 6 7
DRIVER INFORMATION
AVG INST OIL LIFE RANGE
PSI KPa MPG % L/100km SC BOOST
PRND321
km 888888.8 TRIP
1/2
E
F
FUEL
LOW OIL
TRIP ODO ◀ HOLD TO RESET
TRAC OFF
C
H
TEMP
SERVICE VEHICLE SOON
SECURITY
ANTI-LOCK
LOW TRAC
DOOR/TRUNK
CHANGE OIL SOON
SERVICE ENGINE SOON
BRAKE
LOW COOLANT
LOW WASH
G00032225

Fig. 2: Identifying Instrument Cluster (2002-04 Buick Regal)
Courtesy of GENERAL MOTORS CORP.

1997-2004 BUICK PARK AVENUE

1. To display this light, press the GAGE INFO or GAGES button on the Driver Information Center (DIC). To identify oil maintenance light, see **Fig. 3** and **Fig. 4** . When oil life index is less than 10 percent, display will show OIL LIFE INDEX CHANGE OIL. After changing oil, reset system.
2. To reset light, display OIL LIFE INDEX. Hold RESET button for more than 5 seconds. After reset, oil life will change to 100 percent.

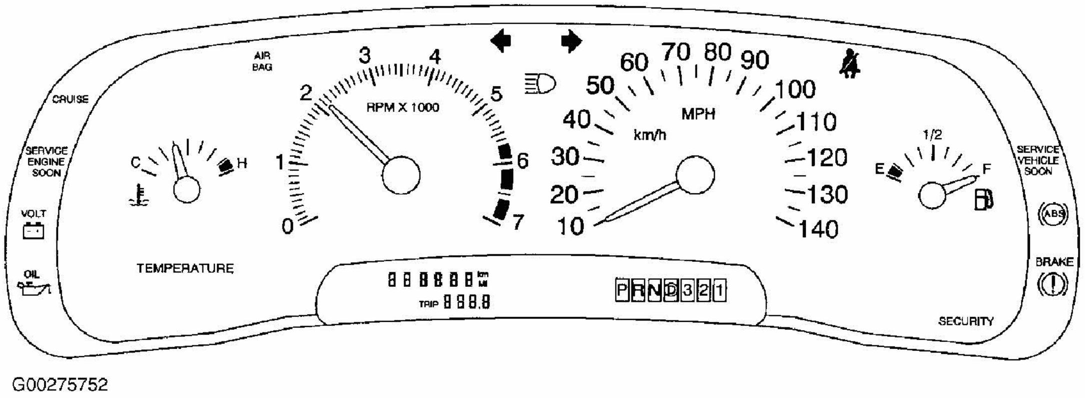

AIR BAG
CRUISE
SERVICE ENGINE SOON
VOLT
OIL
C
H
TEMPERATURE
RPM X 1000
0 1 2 3 4 5 6 7
10 20 30 40 50 60 70 80 90 100 110 120 130 140
MPH
km/h
1/2
E
F
SERVICE VEHICLE SOON
ABS
BRAKE
SECURITY
888888 km mi
TRIP 888.8
PRND321
G00275752

Fig. 3: Identifying Base Instrument Cluster
Courtesy of GENERAL MOTORS CORP.

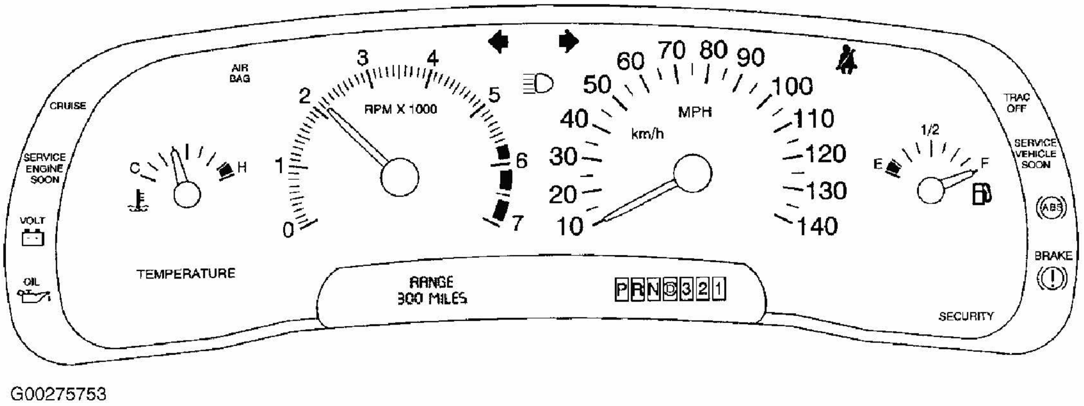

AIR BAG
CRUISE
SERVICE ENGINE SOON
VOLT
OIL
TEMPERATURE
C
H
RPM X 1000
0
1
2
3
4
5
6
7
60
70
80
90
50
100
40
110
30
120
20
130
10
140
km/h
MPH
1/2
E
F
TRAC OFF
SERVICE VEHICLE SOON
ABS
BRAKE
RANGE 300 MILES
PRND321
SECURITY
G00275753

Fig. 4: Identifying Instrument Cluster With Driver Information Center
Courtesy of GENERAL MOTORS CORP.

1997-2000 CHEVROLET CORVETTE

1. The CHANGE OIL light is illuminated when its time to change engine oil, usually between 3000 and 10,000 miles since last oil change. The Driver Information Center (DIC) will display CHANGE OIL NOW when an oil change is due.
2. To reset oil life monitor, turn ignition switch to RUN position, with engine off. Press TRIP button, located on DIC switch to display OIL LIFE. Message will display percentage of oil life remaining.
3. Press and hold RESET button on DIC for at least 2 seconds. Word RESET will appear, then OIL LIFE 99. Turn ignition off.

1997-2001 CHEVROLET LUMINA

1. Engine oil life monitor calculates engine oil temperature and engine revolutions. It indicates when the engine oil is nearly worn out. CHANGE OIL or CHANGE OIL SOON light on the instrument cluster is illuminated when it is time to change the engine oil.
2. To reset oil life monitor on a vehicle with a Driver Information Center, go to step 4. To reset the oil life monitor on a vehicle NOT equipped with a Driver Information Center, turn ignition switch to ON or RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds.
3. On 1997-98 vehicles, if the CHANGE OIL or CHANGE OIL SOON light flashes 2 times, the system is reset. However, if light comes on for 5 seconds, system did not reset. Repeat reset procedure. On 1999-2001 vehicles, if the CHANGE OIL or CHANGE OIL SOON light flashes, the system is resetting. Turn ignition off. Start vehicle. If oil light comes back on and stays on, the oil life monitor has not reset. Repeat reset procedure.
4. If vehicle is equipped with a Driver Information Center (DIC), reset oil life monitor by

pressing the Driver Information Center RESET button for 5 seconds while viewing the oil life display.

1997-1999 CHEVROLET MONTE CARLO

1. Engine oil life monitor calculates engine oil temperature and engine revolutions. It indicates when the engine oil is nearly worn out. CHANGE OIL or CHANGE OIL SOON light on the instrument cluster is illuminated when it is time to change the engine oil.
2. To reset oil life monitor on a vehicle with a Driver Information Center, go to step 4. To reset the oil life monitor on a vehicle NOT equipped with a Driver Information Center, turn ignition switch to ON or RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds.
3. On 1997 vehicles, if the CHANGE OIL or CHANGE OIL SOON light flashes 2 times, the system is reset. However, if light comes on for 5 seconds, system did not reset. Repeat reset procedure. On 1999 vehicles, if the CHANGE OIL or CHANGE OIL SOON light flashes, the system is resetting. Turn ignition off. Start vehicle. If oil light comes back on and stays on, the oil life monitor has not reset. Repeat reset procedure.
4. If vehicle is equipped with a Driver Information Center (DIC), reset oil life monitor by pressing the Driver Information Center RESET button for 5 seconds while viewing the oil life display.

1997-2003 PONTIAC GRAND PRIX

1. Engine oil life monitor calculates engine oil temperature and engine revolutions. It indicates when the engine oil is nearly worn out. CHANGE OIL SOON or OIL LIFE light is illuminated when it is time to change the engine oil.
2. To reset the oil life monitor on a vehicle equipped with a Driver Information Center, turn ignition switch to RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds. If the CHANGE OIL SOON light flashes, the system is resetting. Turn ignition off. Start vehicle. If CHANGE OIL SOON light comes back on and stays on, the oil life monitor has not reset. Repeat procedure.
3. To reset the oil life monitor on a vehicle equipped with a Trip Computer, press the MODE button until the light appears lit next to OIL LIFE. Press and hold the RESET button for 3 seconds. Oil life percentage should change to 100 percent.

1998-2002 CHEVROLET CAMARO

1. The CHANGE OIL (or CHANGE ENGINE OIL) message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change.
2. To reset the oil life monitor, turn the ignition switch to RUN position, with engine off. Press the TRIP/OIL RESET button on the instrument panel for 12 seconds. The OIL CHANGE light will start to flash to confirm that system is reset. Reset is complete

when OIL CHANGE light goes out.

1998-2002 OLDSMOBILE INTRIGUE

1. Engine oil life monitor calculates engine oil temperature and engine revolutions. It indicates when the engine oil is nearly worn out. CHANGE OIL or CHANGE OIL SOON light on the instrument cluster is illuminated when it is time to change the engine oil.
2. To reset oil life monitor on a vehicle with a Driver Information Center, go to step 4. To reset the oil life monitor on a vehicle NOT equipped with a Driver Information Center, turn ignition switch to ON or RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds.
3. If the CHANGE OIL or CHANGE OIL SOON light flashes, the system is resetting. Turn ignition off. Start vehicle. If oil light comes back on and stays on, the oil life monitor has not reset. Repeat reset procedure.
4. If vehicle is equipped with a Driver Information Center (DIC), reset oil life monitor by pressing the Driver Information Center RESET button for 5 seconds while viewing the oil life display.

1998-2002 PONTIAC FIREBIRD

1. The CHANGE OIL (or CHANGE ENGINE OIL) message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change.
2. To reset the oil life monitor, turn the ignition switch to RUN position, with engine off. Press the TRIP/OIL RESET button on the instrument panel for 12 seconds. The OIL CHANGE light will start to flash to confirm that system is reset. Reset is complete when OIL CHANGE light goes out.

1999-2003 OLDSMOBILE ALERO

1. The CHANGE OIL (or CHANGE ENGINE OIL) message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change.
2. To reset the engine oil life monitor, turn ignition on with engine off. Press and release the RESET button. RESET button is located inside of driver's side instrument panel fuse block/panel (left end of instrument panel). The CHANGE OIL/CHANGE ENGINE OIL light will begin to flash. Press and hold the RESET button again. Reset procedure is complete when chimes sound and light goes out.

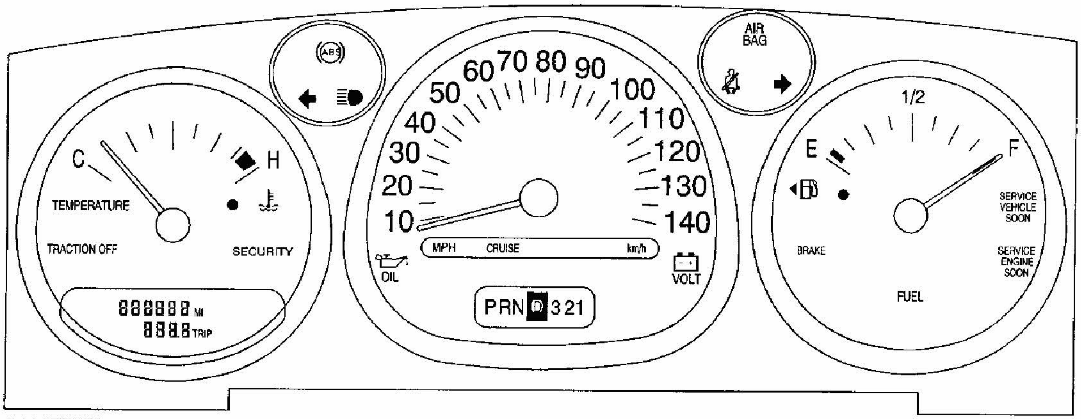
1999-2003 PONTIAC GRAND AM

1. The CHANGE OIL (or CHANGE ENGINE OIL) message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change.
2. To reset the engine oil life monitor, turn ignition on with engine off. Press and release the RESET button. RESET button is located inside of driver's side instrument panel

fuse block/panel (left end of instrument panel). The CHANGE OIL/CHANGE ENGINE OIL light will begin to flash. Press and hold the RESET button again. Reset procedure is complete when chimes sound and light goes out.

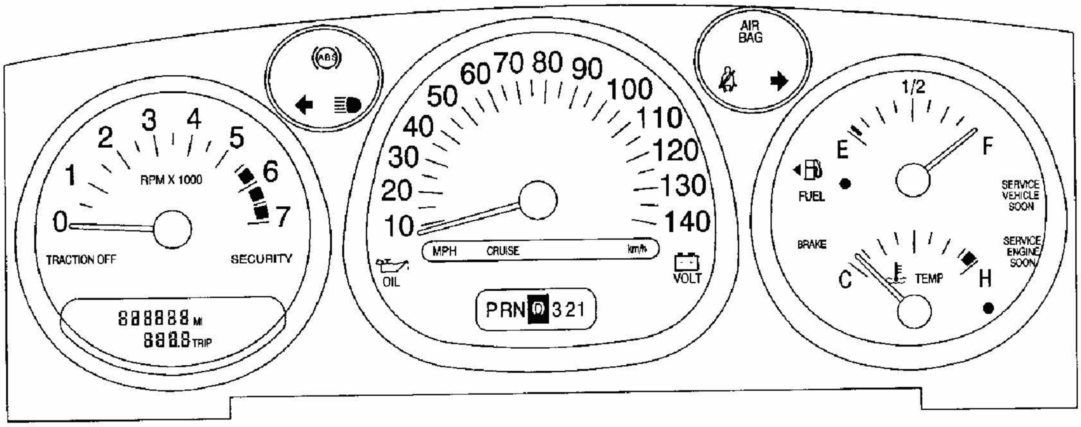
2000-2004 BUICK LESABRE

1. To display this light, press the GAGE INFO or GAGES button on the Driver Information Center (DIC). To identify oil maintenance light, see **Fig. 5** and **Fig. 6** . When oil life index is less than 10 percent, display will show OIL LIFE INDEX CHANGE OIL. After changing oil, reset system.
2. To reset light, display OIL LIFE INDEX. Hold RESET button for more than 5 seconds. After reset, oil life will change to 100 percent.


ABS
AIR BAG
C
H
TEMPERATURE
TRACTION OFF
SECURITY
888888 MI
888.8 TRIP
10
20
30
40
50
60
70
80
90
100
110
120
130
140
MPH
CRUISE
km/h
OIL
VOLT
PRN D 3 2 1
E
1/2
F
SERVICE VEHICLE SOON
BRAKE
SERVICE ENGINE SOON
FUEL

G00275750

Fig. 5: Identifying Standard Instrument Cluster
Courtesy of GENERAL MOTORS CORP.


ABS
AIR BAG
0
1
2
3
4
5
6
7
RPM X 1000
TRACTION OFF
SECURITY
888888 MI
888.8 TRIP
10
20
30
40
50
60
70
80
90
100
110
120
130
140
MPH
CRUISE
km/h
OIL
VOLT
PRN D 3 2 1
E
1/2
F
FUEL
BRAKE
SERVICE VEHICLE SOON
SERVICE ENGINE SOON
C
TEMP
H

G00275751

Fig. 6: Identifying Instrument Cluster With Tachometer
Courtesy of GENERAL MOTORS CORP.

2000-01 CHEVROLET IMPALA & MONTE CARLO

1. The CHANGE ENGINE OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.
2. There are 2 ways to reset the engine oil life monitor. To reset the engine oil life monitor using the accelerator pedal, go to step 5. To reset the engine oil life monitor using the radio, turn the radio off. Turn ignition to ACC or ON, with the engine off. Press and hold the DISP button on the radio for at least 5 seconds until SETTINGS is displayed.
3. Press the SEEK up or down arrow to scroll through the main menu. Scroll until OIL LIFE appears on the display. Press the PREV or NEXT button to enter the sub-menu. RESET will be displayed.
4. Press the DISP button to reset. A chime will sound to verify the new setting and DONE will be displayed for one second. Once the message indicator has been reset, scroll through the menu until EXIT appears on the display. Press the DISP button to exit the program. A chime will sound to verify the exit.
5. To reset the engine oil life monitor using the accelerator pedal, turn ignition on with engine off. Fully depress and release the accelerator pedal slowly 3 times within 5 seconds. If CHANGE ENGINE OIL light flashes, oil life monitor is reset. If the CHANGE ENGINE OIL light comes back on and stays on, oil life monitor has not reset. Repeat reset procedure.

2000-03 PONTIAC BONNEVILLE

1. Press the SELECT button on the Driver Information Panel until OIL LIFE INDEX function displays. When oil life index is less than 10 percent, the display will show ENGINE OIL CHANGE SOON.
2. To reset the oil life monitor, display OIL LIFE INDEX function. Press and hold the RESET button for more than 5 seconds while OIL LIFE INDEX is displayed. Oil life monitor is reset when oil life index changes to 100 percent.

2001-04 CHEVROLET CORVETTE

1. The CHANGE OIL SOON light is illuminated when its time to change engine oil, usually between 3000 and 10,000 miles since last oil change. See **Fig. 7**. The Driver Information Center (DIC) will display CHANGE OIL NOW when an oil change is due.
2. To reset oil life monitor, turn ignition switch to ON or RUN position, with engine off. Press TRIP button, located on DIC switch to display OIL LIFE. Message will display percentage of oil life remaining.
3. Press and hold RESET button on DIC for at least 2 seconds. OIL LIFE REMAIN 100 percent will appear. Turn ignition off.

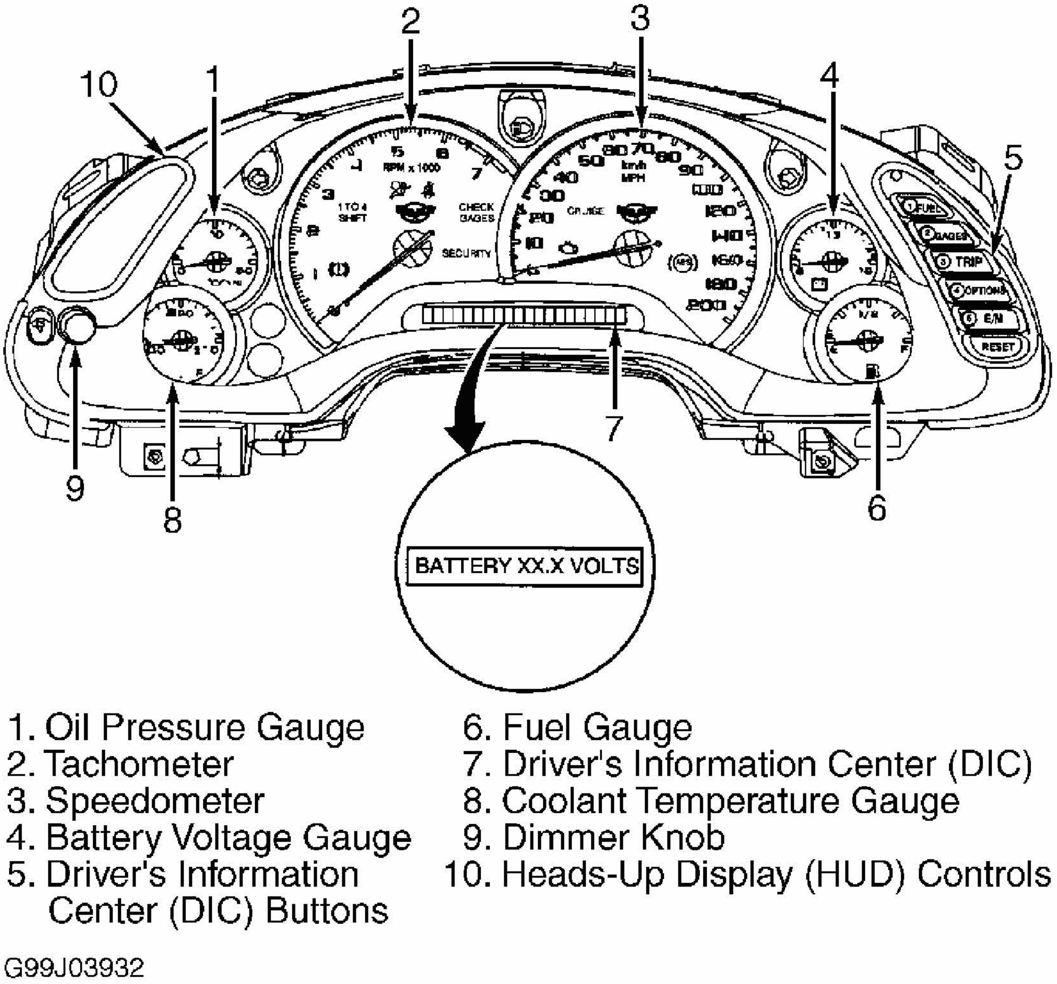

2
3
10
1
4
5
FUEL
GAGES
TRIP
OPTIONS
E/M
RESET
7
9
8
6
BATTERY XX.X VOLTS
1. Oil Pressure Gauge
2. Tachometer
3. Speedometer
4. Battery Voltage Gauge
5. Driver's Information Center (DIC) Buttons
6. Fuel Gauge
7. Driver's Information Center (DIC)
8. Coolant Temperature Gauge
9. Dimmer Knob
10. Heads-Up Display (HUD) Controls
G99J03932

Fig. 7: Identifying Instrument Cluster (2002-04 Chevrolet Corvette)
Courtesy of GENERAL MOTORS CORP.

2001-03 OLDSMOBILE AURORA

1. The Driver Information Center (DIC) displays estimated percentage of the remaining useful life of engine oil. When remaining oil life is close to 0 percent remaining, the display will show CHANGE OIL NOW or CHANGE OIL SOON. After changing oil, reset oil life percentage display.
2. To reset the display, turn ignition on with engine off. Press Driver Information Center (DIC) SELECT right arrow button to select OIL LIFE percentage display. Then, press and hold DIC RESET button for at least 5 seconds. When DIC RESET button is released, OIL LIFE 100 percent will be displayed.

2002-04 CHEVROLET IMPALA & MONTE CARLO

1. The CHANGE ENGINE OIL message is displayed when its time to change engine oil,

usually between 3000 and 7500 miles since last oil change. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature. See **Fig. 8**-**Fig. 11** .

2. There are 2 ways to reset the engine oil life monitor. To reset the engine oil life monitor using the accelerator pedal, go to step 5. To reset the engine oil life monitor using the radio, turn the radio off. Turn ignition to ACC or ON, with the engine off. Press and hold the TUNE DISP button on the radio for at least 5 seconds until SETTINGS is displayed.
3. On Impala, press the SEEK PTYPE up or down arrow to scroll through the main menu. On Monte Carlo, press the SEEK PSCAN up or down arrow to scroll through the main menu. On all models, scroll until OIL LIFE appears on the display. Press the 1 PREV or 2 NEXT button to enter the sub-menu. RESET will be displayed.
4. Press the TUNE DISP button to reset. A chime will sound to verify the new setting and DONE will be displayed for one second. Once the message indicator has been reset, scroll through the menu until EXIT appears on the display. Press the TUNE DISP button to exit the program. A chime will sound to verify the exit.
5. To reset the engine oil life monitor using the accelerator pedal, turn ignition on with engine off. Fully depress and release the accelerator pedal slowly 3 times within 5 seconds. If CHANGE ENGINE OIL light flashes, oil life monitor is reset. If the CHANGE ENGINE OIL light comes back on and stays on, oil life monitor has not reset. Repeat reset procedure.

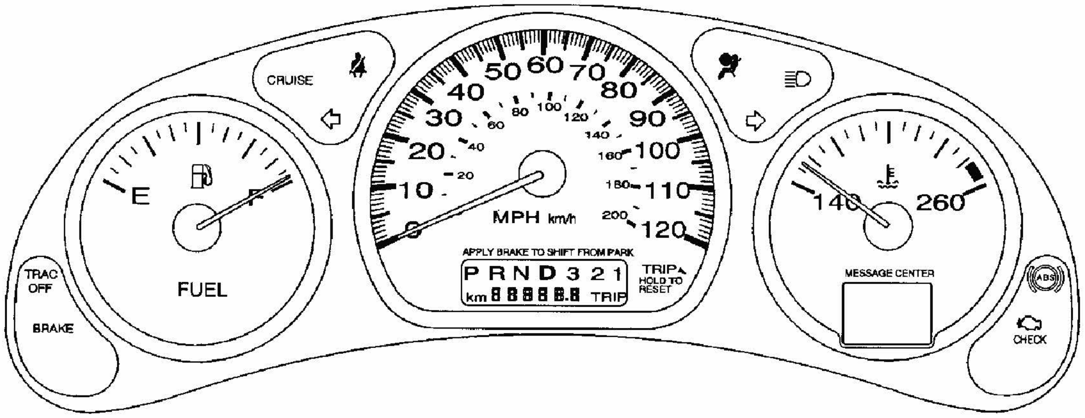

CRUISE
50
60
70
40
80
30
90
20
100
10
110
0
120
20
40
60
80
100
120
140
160
180
200
MPH km/h
APPLY BRAKE TO SHIFT FROM PARK
P R N D 3 2 1
km 88888.8 TRIP
TRIP
HOLD TO RESET
E
F
FUEL
TRAC OFF
BRAKE
140
260
MESSAGE CENTER
ABS
CHECK
G00275763

Fig. 8: Identifying Instrument Cluster (2004 Chevrolet Impala & Monte Carlo V6)
Courtesy of GENERAL MOTORS CORP.

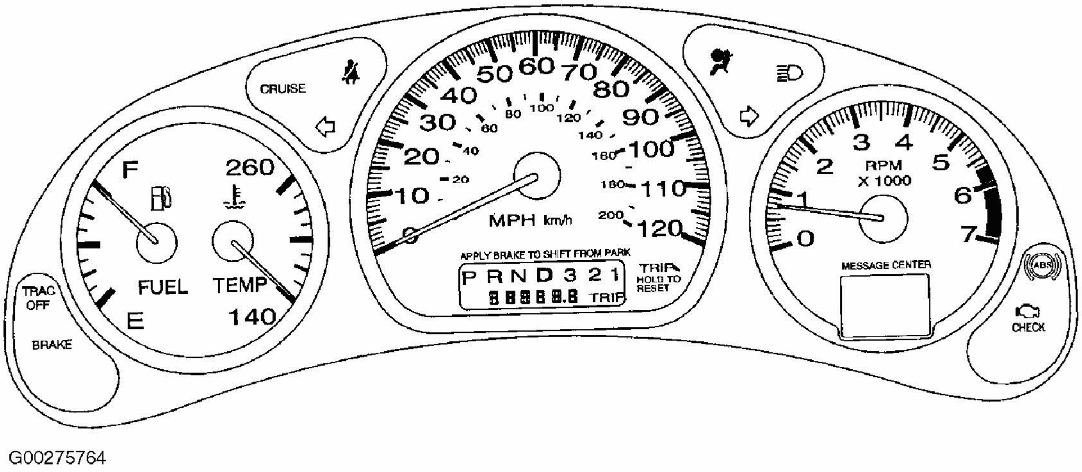

CRUISE
F
260
FUEL
TEMP
E
140
TRAC OFF
BRAKE
MPH km/h
APPLY BRAKE TO SHIFT FROM PARK
P R N D 3 2 1
TRIP
HOLD TO RESET
RPM X 1000
MESSAGE CENTER
ABS
CHECK
G00275764

Fig. 9: Identifying Instrument Cluster (2004 Chevrolet Impala V6)
Courtesy of GENERAL MOTORS CORP.

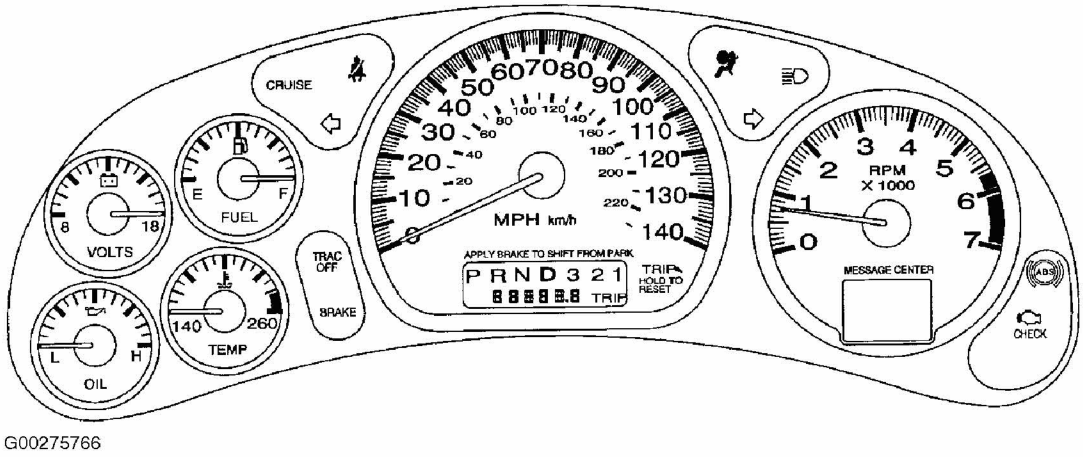
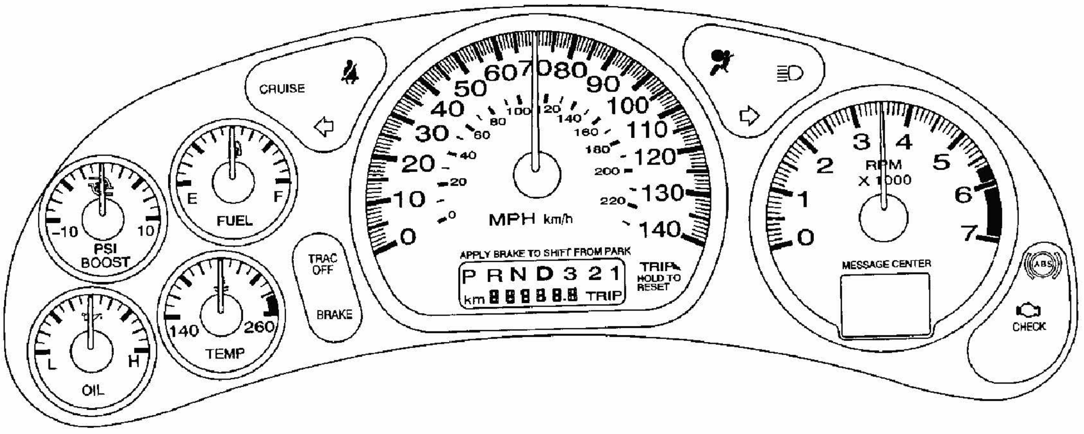

CRUISE
VOLTS
8
18
FUEL
E
F
OIL
L
H
TEMP
140
260
TRAC OFF
BRAKE
MPH km/h
APPLY BRAKE TO SHIFT FROM PARK
P R N D 3 2 1
TRIP
HOLD TO RESET
RPM X 1000
MESSAGE CENTER
ABS
CHECK
G00275766

Fig. 10: Identifying Instrument Cluster (2004 Monte Carlo V6)
Courtesy of GENERAL MOTORS CORP.


CRUISE
PSI
BOOST
-10
10
E
F
FUEL
L
H
OIL
140
260
TEMP
TRAC
OFF
BRAKE
MPH km/h
APPLY BRAKE TO SHIFT FROM PARK
P R N D 3 2 1
km 888888.8 TRIP
TRIP
HOLD TO
RESET
RPM
X 1000
MESSAGE CENTER
ABS
CHECK

G00275765

Fig. 11: Identifying Instrument Cluster (2004 Chevrolet Impala & Monte Carlo Supercharged V6)
Courtesy of GENERAL MOTORS CORP.

2004 CHEVROLET MALIBU

GM Oil Life System calculates when to change your engine oil and filter based on vehicle use. See **Fig. 12**. Anytime your oil is changed, reset the system so it can calculate when the next oil change is required. If a situation occurs where you change your oil prior to a Change Oil Soon message being turned on, reset the system. After changing the engine oil, reset the system.

1. Display OIL LIFE RESET on the DIC.
2. Press and hold ENTER button for at least one second. An ACKNOWLEDGED display message will appear for 3 seconds or until the next button is pressed. This will tell you the system has been reset.
3. Turn key to OFF.
4. If Change Oil Soon message comes back on when you start your vehicle, engine oil life system has not reset. Repeat the procedure.

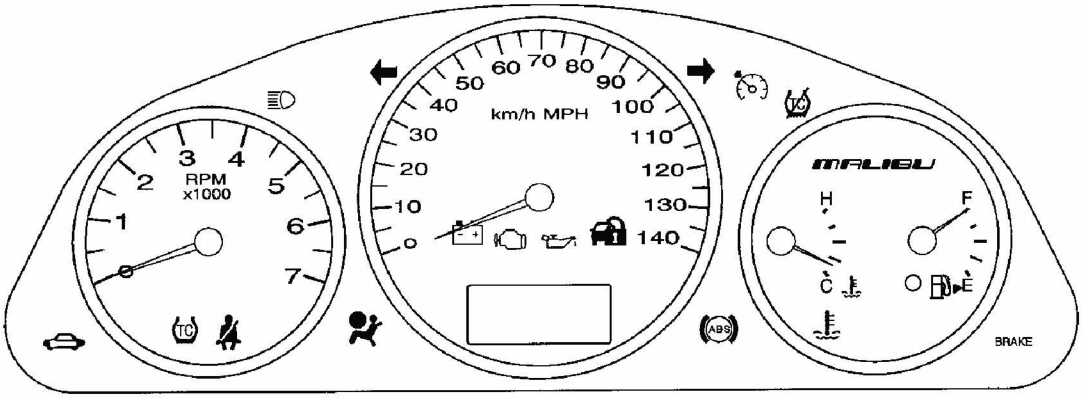

0
1
2
3
4
5
6
7
RPM
x1000
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
km/h MPH
MALIBU
H
F
C
E
BRAKE
G00275767

Fig. 12: Identifying Instrument Cluster (2004 Chevrolet Malibu)
Courtesy of GENERAL MOTORS CORP.

2004 OLDSMOBILE ALERO

The GM Oil Life System™ calculates when to change engine oil and filter, based on vehicle use. Whenever the oil is changed, the system must be reset so the next required oil changed can be calculated. If oil is changed before CHANGE OIL lamp is lit, reset the oil life system. See **Fig. 13**.

1. Turn ignition to ON, with engine off.
2. Slowly fully press and release accelerator pedal 3 times within 5 seconds. Reset is complete when chimes sound and CHANGE OIL lamp goes out. If lamp stays on and no chime is heard, repeat the reset procedure.
3. Turn key to OFF.
4. If CHANGE OIL lamp comes back on when vehicle is started, engine oil life system has not reset. Repeat procedure.

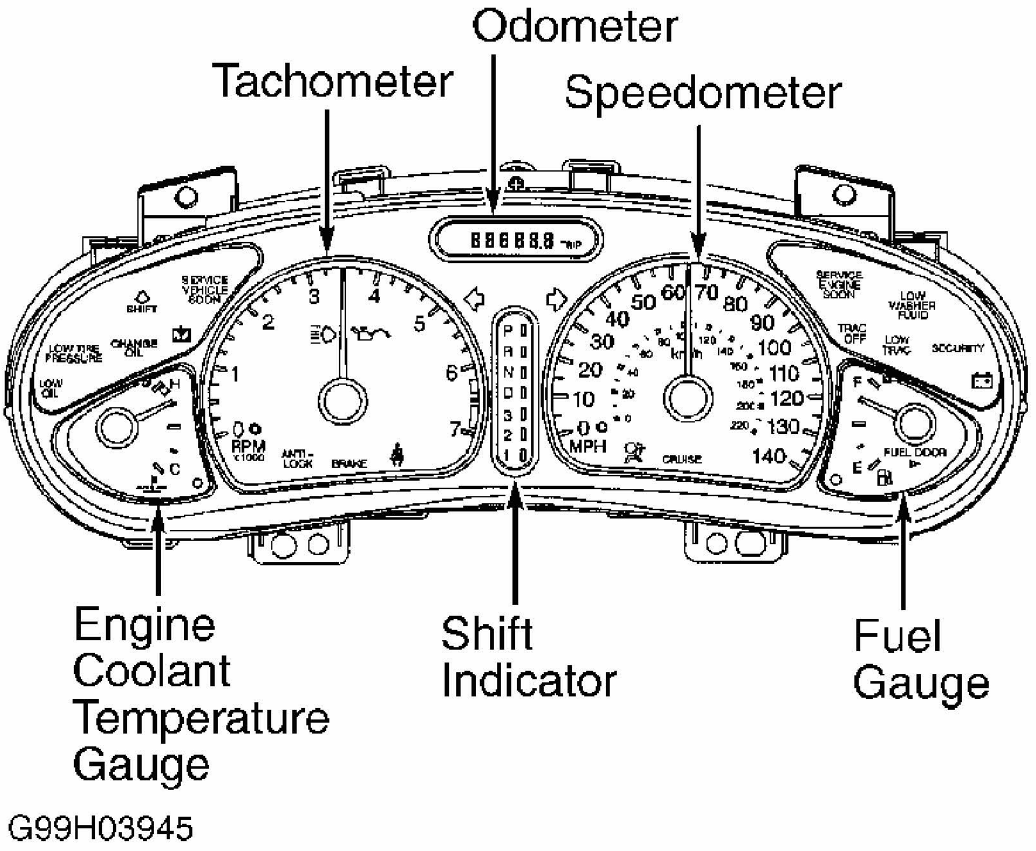

Odometer
Tachometer
Speedometer
SERVICE VEHICLE SOON
SHIFT
CHANGE OIL
LOW TIRE PRESSURE
LOW OIL
RPM x1000
ANTI-LOCK
BRAKE
P R N D 3 2 1
MPH
km/h
CRUISE
SERVICE ENGINE SOON
LOW WASHER FLUID
TRAC OFF
LOW TRAC
SECURITY
FUEL DOOR
Engine Coolant Temperature Gauge
Shift Indicator
Fuel Gauge
G99H03945

Fig. 13: Identifying Instrument Panel Cluster
Courtesy of GENERAL MOTORS CORP.

2004 PONTIAC BONNEVILLE

Display OIL LIFE on the DIC. See **Fig. 14**-**Fig. 16** . Turn ignition OFF. Press and hold RESET button for more than 5 seconds. Oil life will change to 100 percent.

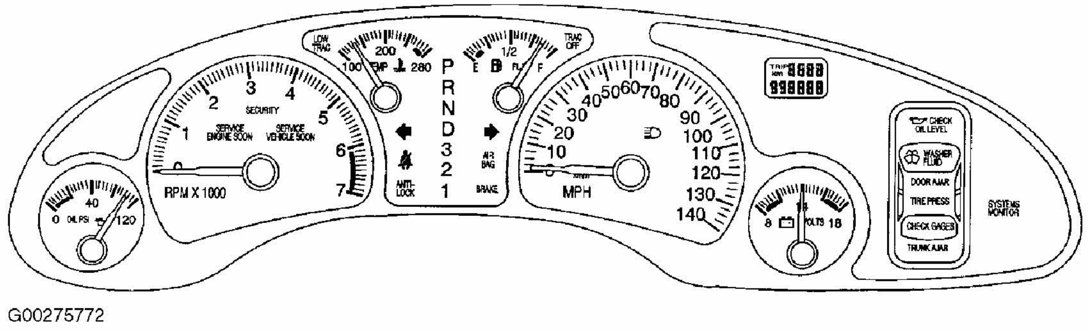

LOW TRAC
TRAC OFF
RPM X 1000
SECURITY
SERVICE ENGINE SOON
SERVICE VEHICLE SOON
P R N D 3 2 1
ANTI-LOCK
AIR BAG
BRAKE
MPH
OIL PSI
VOLTS
CHECK OIL LEVEL
WASHER FLUID
DOOR AJAR
TIRE PRESS
CHECK GAGES
TRUNK AJAR
SYSTEMS MONITOR
G00275772

Fig. 14: Identifying Standard Instrument Cluster (2004 Pontiac Bonneville; 3.8L V6)

Courtesy of GENERAL MOTORS CORP.

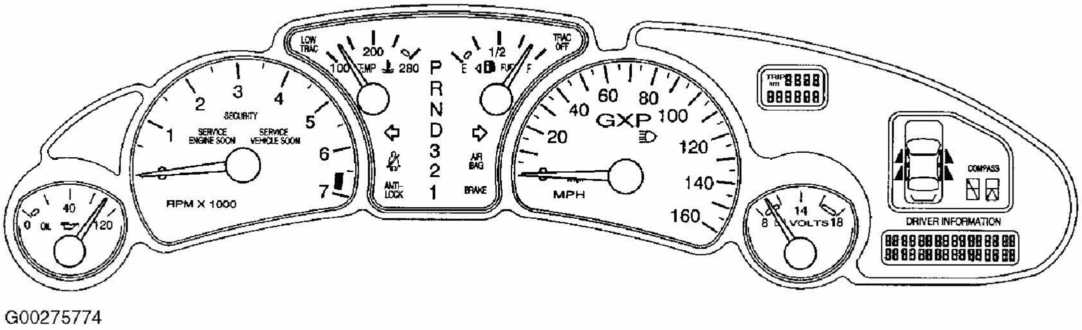

LOW TRAC
100
TEMP
200
280
P
R
N
D
3
2
1
E
1/2
F
TRAC OFF
1
2
3
4
5
6
7
SECURITY
SERVICE ENGINE SOON
SERVICE VEHICLE SOON
RPM X 1000
ANTI-LOCK
AIR BAG
BRAKE
20
40
60
80
100
120
140
160
GXP
MPH
0
OIL
40
120
8
14
VOLTS
18
TRIP
COMPASS
DRIVER INFORMATION
G00275774

Fig. 15: Identifying Instrument Cluster With Driver Information Center (2004 Pontiac Bonneville; 3.8L V6)
Courtesy of GENERAL MOTORS CORP.

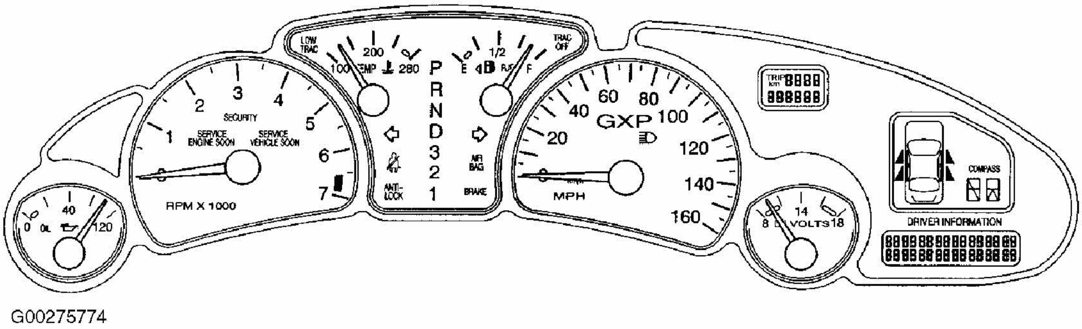

LOW TRAC
100
TEMP
200
280
P
R
N
D
3
2
1
E
1/2
F
TRAC OFF
1
2
3
4
5
6
7
SECURITY
SERVICE ENGINE SOON
SERVICE VEHICLE SOON
RPM X 1000
ANTI-LOCK
AIR BAG
BRAKE
20
40
60
80
100
120
140
160
GXP
MPH
0
OIL
40
120
8
14
VOLTS
18
TRIP
COMPASS
DRIVER INFORMATION
G00275774

Fig. 16: Identifying Instrument Cluster With Driver Information Center (2004 Pontiac Bonneville; 4.6L V6)
Courtesy of GENERAL MOTORS CORP.

2004 PONTIAC GRAND AM

The GM Oil Life System™ calculates when to change engine oil and filter, based on vehicle use. Whenever the oil is changed, the system must be reset so the next required oil changed can be calculated. If oil is changed before CHANGE OIL lamp is lit, reset the oil life system. See **Fig. 17**.

1. Turn ignition to ON, with engine off.
2. Slowly fully press and release accelerator pedal 3 times within 5 seconds. Reset is complete when chimes sound and CHANGE OIL lamp goes out. If lamp stays on and no chime is heard, repeat the reset procedure.
3. Turn key to OFF.
4. If CHANGE OIL lamp comes back on when vehicle is started, engine oil life system

has not reset. Repeat procedure.

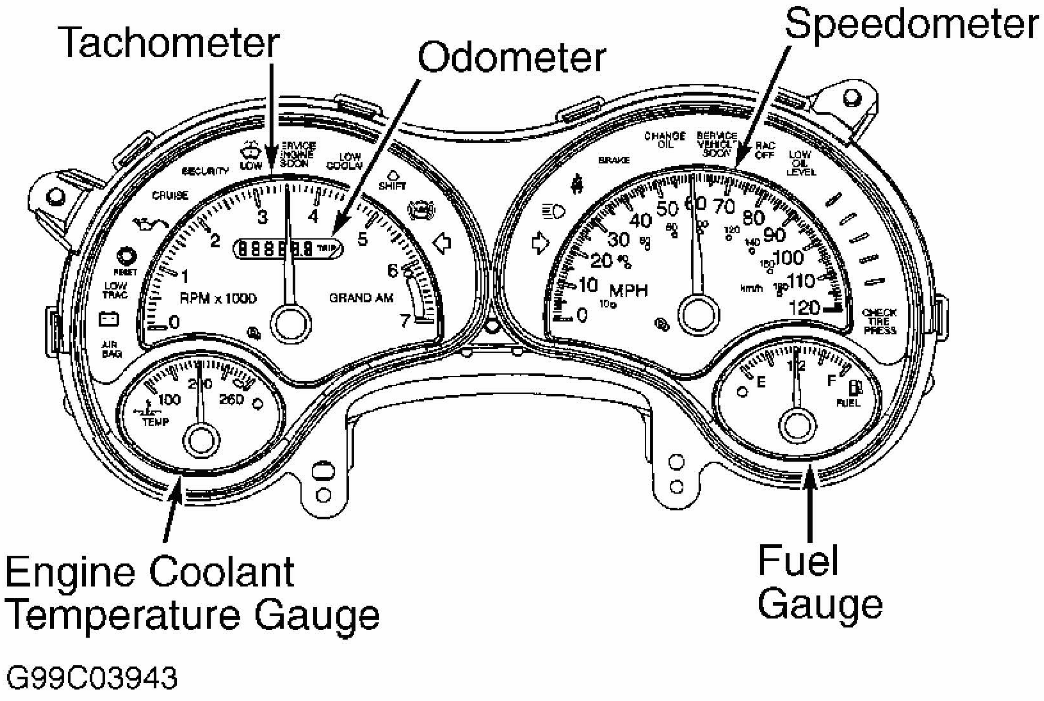

Tachometer
Odometer
Speedometer
Engine Coolant Temperature Gauge
Fuel Gauge
SECURITY
CRUISE
LOW
SERVICE ENGINE SOON
LOW COOLANT
SHIFT
RESET
LOW TRAC
AIR BAG
RPM x 1000
TRIP
GRAND AM
TEMP
BRAKE
CHANGE OIL
SERVICE VEHICLE SOON
RAC OFF
LOW OIL LEVEL
MPH
km/h
CHECK TIRE PRESS
FUEL
E
F
1/2
G99C03943

Fig. 17: Identifying Instrument Panel Cluster
Courtesy of GENERAL MOTORS CORP.

2004 PONTIAC GRAND PRIX

GM Oil Life System calculates when to change your engine oil and filter based on vehicle use. Anytime your oil is changed, reset the system so it can calculate when the next oil change is required. If a situation occurs where you change your oil prior to a CHANGE OIL SOON message appearing on the DIC, reset the system. See **Fig. 18**.

1. Press options button on the DIC until ENGINE OIL MONITOR appears on the DIC screen.
2. Press set/reset button to reset the system. Next screen indicates that the engine oil monitor system has been reset. If vehicle is equipped with the trip computer DIC, when the gage button is pressed and OIL LIFE REMAINING mode appears, it should read 100 percent OIL LIFE REMAINING.
3. Turn key to OFF.
4. If CHANGE OIL SOON message comes back on when you start your vehicle, the engine oil life system has not reset. Repeat procedure.

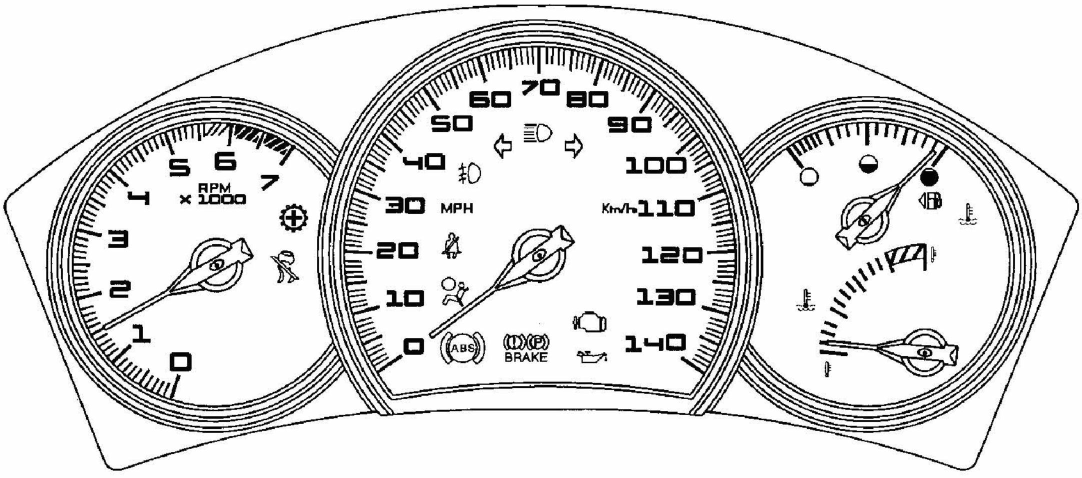

0
1
2
3
4
5
6
7
RPM
x 1000
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
MPH
Km/h
ABS
BRAKE
G00275775

Fig. 18: Identifying Instrument Cluster (2004 Pontiac Grand Prix)
Courtesy of GENERAL MOTORS CORP.

2004 PONTIAC GTO

The GM Oil Life System™ calculates when to change your engine oil and filter based on vehicle use. Anytime your oil is changed, reset the system so it can calculate when the next oil change is required. If a situation occurs where you change your oil prior to a Service Engine Oil message being turned on, reset the system. See **Fig. 19**.

1. With engine off, turn ignition key to ON.
2. Fully press and release accelerator pedal slowly 2 times within 5 seconds.
3. Turn key to LOCK. If Service Engine Oil message comes back on when you start your vehicle, engine oil life system has not reset. Repeat procedure.

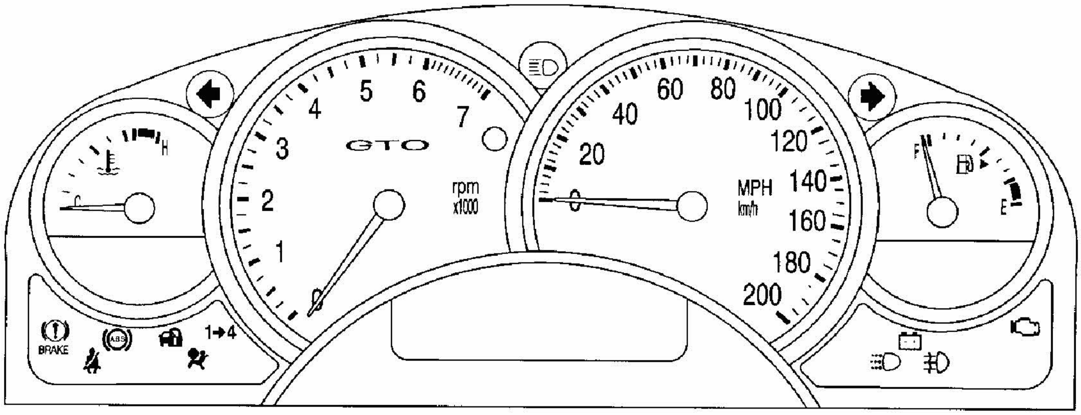

H
C
0
1
2
3
4
5
6
7
GTO
rpm
x1000
0
20
40
60
80
100
120
140
160
180
200
MPH
km/h
F
E
BRAKE
ABS
1→4
G00275776

Fig. 19: Identifying Instrument Cluster (Pontiac GTO)

Courtesy of GENERAL MOTORS CORP.

2005 BUICK CENTURY

After changing the engine oil, reset the system by performing the following steps:

1. Turn the ignition key to RUN with the engine off.
2. Fully press and release the accelerator pedal slowly three times within five seconds. If the CHANGE OIL SOON light flashes, the system is resetting.
3. Turn the key to OFF, then start the vehicle. The oil life will change to 100 percent. If the CHANGE OIL SOON light comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

2005-07 BUICK LACROSSE

After changing the engine oil, reset the system by performing the following steps:

- Vehicles with Driver Information Center (DIC)
  1. Press the option button on the DIC until ENGINE OIL MONITOR appears on the DIC screen.
  2. Press the set/reset button to reset the system. The next screen indicates that the CHANGE OIL SOON message has been reset. If the vehicle has the uplevel DIC, when the gages button is pressed and the OIL LIFE REMAINING mode appears, it should read 100 percent OIL LIFE REMAINING.
  3. Turn the key to OFF.
- Vehicles without Driver Information Center (DIC)
  1. With the engine off, turn the ignition key to RUN.
  2. Fully press and release the accelerator pedal slowly three times within five seconds.
  3. Turn the key to OFF, then start the vehicle.

If the light or message comes back on when you start your vehicle, the oil life system has not reset. Repeat the procedure.

2005 BUICK LESABRE & PARK AVENUE

Always reset the engine oil life to 100% after every oil change. It will not reset itself. To reset the Engine Oil Life System, do the following:

1. Display the OIL LIFE INDEX on the DIC.
2. Press and hold the RESET button on the DIC for more than five seconds. The oil life will change to 100%.

3. Turn the key to OFF.

If the CHANGE ENGINE OIL SOON message comes back on when you start your vehicle, the Engine Oil Life System has not reset. Repeat the procedure.

2005 CHEVROLET CLASSIC

GM Oil Life System calculates when to change your engine oil and filter based on vehicle use. Anytime your oil is changed, reset the system so it can calculate when the next oil change is required. If a situation occurs where you change your oil prior to a Change Oil Soon message being turned on, reset the system. After changing the engine oil, reset the system.

1. Display OIL LIFE RESET on the DIC.
2. Press and hold ENTER button for at least one second. An ACKNOWLEDGED display message will appear for 3 seconds or until the next button is pressed. This will tell you the system has been reset.
3. Turn key to OFF.
4. If Change Oil Soon message comes back on when you start your vehicle, engine oil life system has not reset. Repeat the procedure.

2005-07 CHEVROLET COBALT

After changing the engine oil, the system must be reset as follows:

1. Turn the ignition to RUN, with engine off.
2. Press the information and reset buttons on the DIC at the same time to enter the personalization menu.
3. Press the information button to scroll through the available personalization menu modes until the DIC display shows OIL-LIFE RESET.
4. Press and hold the reset button until the DIC display shows ACKNOWLEDGED. This will tell you the system has been reset.
5. Turn the key to LOCK.

If the CHANGE OIL SOON message comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the reset procedure.

2005-07 CHEVROLET CORVETTE

To reset the CHANGE ENGINE OIL message after an oil change, do the following:

1. Press the TRIP button so the OIL LIFE percentage is displayed.
2. Press RESET and hold for two seconds. OIL LIFE REMAINING 100% will appear.

If the CHANGE ENGINE OIL message comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

2005-06 CHEVROLET IMPALA & MONTE CARLO

To reset the CHANGE ENGINE OIL message, use one of the following procedures:

Using The Radio

1. Turn the ignition to ACC or ON, with the radio off.
2. Press and hold the TUNE DISP knob on the radio for at least five seconds until SETTINGS is displayed.
3. Press the SEEK PSCAN up or down arrow to scroll through the main menu.
4. Scroll until OIL LIFE appears on the display.
5. Press the 1 PREV or 2 NEXT buttons to enter the sub-menu. RESET will be displayed.
6. Press the TUNE DISP knob to reset. A chime will be heard to verify the new setting and DONE will be displayed for one second.
7. Once the indicator has been reset, scroll until EXIT appears on the display.
8. Press the TUNE DISP knob to exit programming. A chime will be heard to verify the exit.
9. Turn the key to OFF.

If the CHANGE ENGINE OIL message comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

Using the Accelerator Pedal

1. Turn the ignition to ON, with the engine off.
2. Fully press and release the accelerator pedal slowly three times within five seconds. If the CHANGE ENGINE OIL message flashes, the system is reset.
3. However, if it stays on, it did not reset. Repeat the procedure.
4. Turn the key to OFF.

If the CHANGE ENGINE OIL message comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

2005-06 CHEVROLET MALIBU

After changing the engine oil, reset the system by performing the following steps:

1. Display OIL LIFE RESET on the DIC.
2. Press and hold the ENTER button for at least one second. An ACKNOWLEDGED display message will appear for three seconds or until the next button is pressed. This

will tell you the system has been reset.

3. Turn the key to OFF.

2005 PONTIAC BONNEVILLE

Always reset the engine oil life to 100% after every oil change. It will not reset itself. To reset the Engine Oil Life System, do the following:

1. Display OIL LIFE on the DIC.
2. Press and hold the RESET button for more than five seconds. The oil life will change to 100%.
3. Turn the key to OFF.

If the ENGINE OIL CHANGE SOON DIC message comes back on when you start your vehicle, the Engine Oil Life System has not reset. Repeat the procedure.

2005-07 PONTIAC G6

1. With the CHANGE OIL SOON message displayed, press any of the three DIC buttons to clear the CHANGE OIL SOON message.
2. Display OIL LIFE RESET on the DIC.
3. Press and hold the ENTER button for at least one second. An ACKNOWLEDGED display message will appear for three seconds or until the next button is pressed. This will tell you the system has been reset.
4. Turn the ignition to OFF. If CHANGE OIL SOON message comes back after engine is started, repeat reset procedure.

2005 PONTIAC GRAND AM

After changing the engine oil, the system must be reset. To reset the CHANGE OIL light, use the following procedure:

Using the Accelerator Pedal

1. Turn the ignition to ON, with the engine off.
2. Fully press and release the accelerator pedal slowly three times within five seconds. The reset is complete when you hear the chimes and the CHANGE OIL light goes out. However, if the light stays on and no chime is heard, you will need to repeat the reset procedure.
3. Turn the key to OFF.

If the CHANGE OIL light comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

2005-07 PONTIAC GRAND PRIX

1. Turn ignition on, with engine off. Press the options button on the DIC until ENGINE OIL MONITOR appears on the DIC screen.
2. Press the SET/RESET button to reset the system. The next screen indicates that the engine oil monitor system has been reset. If the vehicle is equipped with the trip computer DIC, when the gage button is pressed and the OIL LIFE REMAINING mode appears, it should read 100 percent OIL LIFE REMAINING.
3. Turn ignition off. If CHANGE OIL SOON message comes back on when engine is started, repeat reset procedure.

2005-06 PONTIAC GTO

The Engine Oil Life System calculates when to change the engine oil and filter based on vehicle use. Anytime engine oil is changed, reset the system so it can calculate when the next oil change is required. If a situation occurs where you change your oil prior to the Service Engine Oil message being turned on, reset the system. See **Fig. 19**.

1. With the engine off, turn the ignition key to ON.
2. Fully press and release the accelerator pedal slowly two times within five seconds.
3. Turn the key to LOCK. If the Service Engine Oil message comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

2006-07 BUICK LUCERNE

After changing the engine oil, reset the system by performing the following steps:

1. Press the option button on the DIC until ENGINE OIL MONITOR appears on the DIC screen.
2. Press the set/reset button to reset the system. The next screen indicates that the CHANGE OIL SOON message has been reset. If the vehicle has the uplevel DIC, when the gages button is pressed and the OIL LIFE REMAINING mode appears, it should read 100 percent OIL LIFE REMAINING.
3. Turn the key to OFF. If the light or message comes back on when you start your vehicle, the oil life system has not reset. Repeat the procedure.

2006-07 PONTIAC SOLSTICE

1. Turn ignition to RUN position, with engine off.
2. Press the information and reset buttons on the DIC at the same time to enter personalization menu.
3. Press the information button to scroll through the available personalization menu modes until the DIC display shows OIL LIFE RESET.
4. Press and hold reset button until the DIC display shows ACKNOWLEDGED. This indicates that system has been reset.

5. Turn ignition to LOCK position. If the CHANGE OIL SOON message comes back when engine is started, repeat reset procedure.

2007 CHEVROLET IMPALA & MONTE CARLO

After changing the engine oil, reset the system by performing the following steps:

1. Press the option button on the DIC until OIL LIFE REMAINING appears on the DIC screen.
2. Press the SET/RESET button on DIC for more than 5 seconds. The oil life will change to 100%.
3. Turn the key to OFF. If the light or message comes back on when you start your vehicle, the oil life system has not reset. Repeat the procedure.

2007 CHEVROLET MALIBU

After changing the engine oil, reset the system by performing the following steps:

1. Display OIL LIFE RESET appears on the DIC screen.
2. Press hold the ENTER button on DIC for at least 3 seconds. An ACKNOWLEDGE display message will appear for 3 seconds or until the next button is pressed. The oil life will change to 100%.
3. Turn the key to OFF. If the light or message comes back on when you start your vehicle, the oil life system has not reset. Repeat the procedure.

2007 PONTIAC G5

1. Turn ignition to RUN position, with engine off.
2. Press the information and reset buttons on the DIC at the same time to enter personalization menu.
3. Press the information button to scroll through the available personalization menu modes until the DIC display shows OIL LIFE RESET.
4. Press and hold reset button until the DIC display shows ACKNOWLEDGED. This indicates that system has been reset.
5. Turn ignition to LOCK position. If the CHANGE OIL SOON message comes back when engine is started, repeat reset procedure.

CHANGE ENGINE OIL LIGHT (LIGHT TRUCKS, VANS & SUVS)

1996-98 GM C/K SERIES

NOTE: **These models may or may not be equipped with an CHANGE OIL SOON (or CHANGE ENGINE OIL) light.**

1. To reset oil life monitor, turn ignition switch to RUN position, with engine off. Cycle accelerator pedal from closed throttle to Wide Open Throttle (WOT) 3 times within 5 seconds. CHANGE OIL SOON light will flash for 2 seconds when system is reset.
2. If CHANGE OIL SOON light comes on and stays on for 5 seconds, the system did not reset. Repeat reset procedures.

1999-2000 GM C/K SERIES

1. The CHANGE OIL SOON (or CHANGE ENGINE OIL) light is illuminated when its time to change engine oil, usually between 3000 and 10,000 miles since last oil change.
2. To reset oil life monitor, turn ignition switch to RUN position, with engine off. Cycle accelerator pedal from closed throttle to Wide Open Throttle (WOT) 3 times within 5 seconds. CHANGE OIL SOON light will flash for 2 seconds when system is reset.
3. If CHANGE OIL SOON light comes on and stays on for 5 seconds, the system did not reset. Repeat reset procedures.

2000-01 CHEVROLET VENTURE

1. The CHANGE ENGINE OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.
2. To reset the oil life monitor, turn the ignition on with the engine off. Fully depress and release the accelerator pedal slowly 3 times within 5 seconds. Turn ignition off. If CHANGE ENGINE OIL light flashes 2 times, oil life monitor is reset. If the CHANGE ENGINE OIL light comes back on and stays on for 5 seconds, oil life monitor has not reset. Repeat this step.

2000-01 OLDSMOBILE SILHOUETTE

1. The CHANGE ENGINE OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.
2. To reset the oil life monitor, turn the ignition on with the engine off. Fully depress and release the accelerator pedal slowly 3 times within 5 seconds. Turn ignition off. If CHANGE ENGINE OIL light flashes 2 times, oil life monitor is reset. If the CHANGE ENGINE OIL light comes back on and stays on for 5 seconds, oil life monitor has not reset. Repeat this step.

2000-01 PONTIAC MONTANA

1. The CHANGE ENGINE OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.
2. To reset the oil life monitor, turn the ignition on with the engine off. Fully depress and

release the accelerator pedal slowly 3 times within 5 seconds. Turn ignition off. If CHANGE ENGINE OIL light flashes 2 times, oil life monitor is reset. If the CHANGE ENGINE OIL light comes back on and stays on for 5 seconds, oil life monitor has not reset. Repeat this step.

2001-04 GM C/K SERIES

The engine oil life monitor will indicate when to change the engine oil - usually between 3,000 miles (5,000 km) and 10,000 miles (16,000 km) since the last oil change. See **Fig. 20**. Under severe conditions, the CHANGE OIL SOON light may be displayed before 3,000 miles (5,000 km). The vehicle must not be driven more than 10,000 miles (16,000 km) or 12 months without an oil change.

Reset the oil life monitor when the oil has been changed, use the following procedure.

1. Turn the ignition key to the RUN position.
2. Fully push and release the accelerator pedal 3 times within 5 seconds.
3. If the Change Oil Soon light flashes, the system is resetting.
4. Start the vehicle.
5. The oil life will change to 100%.
6. If the Change Oil Soon light comes back on, the system has not reset. Repeat the procedure.

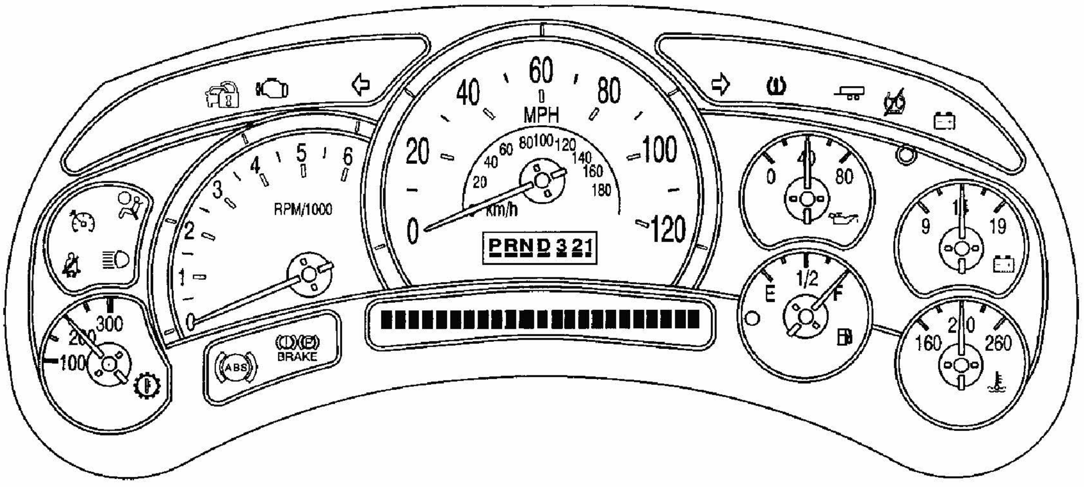


Fig. 20: Identifying Instrument Cluster (2004 Chevrolet Avalanche, Silverado, Suburban, Tahoe, GMC Sierra, Yukon & Yukon XL)
Courtesy of GENERAL MOTORS CORP.

2001-04 PONTIAC AZTEK

Engine oil life monitor calculates engine oil temperature and engine revolutions. It indicates when the engine oil is nearly worn out. CHANGE ENGINE OIL light on the instrument cluster is illuminated when it is time to change the engine oil. See **Fig. 21**.

1. To reset oil life monitor on a vehicle with a Driver Information Center (DIC), go to step 3. To reset the oil life monitor on a vehicle NOT equipped with a Driver Information Center, turn ignition switch to ON or RUN position with engine off.
2. Depress accelerator pedal slowly from closed throttle to wide open throttle 3 times within 5 seconds. Turn ignition off. Start vehicle. If CHANGE ENGINE OIL light comes back on and stays on, the oil life monitor has not reset. Repeat reset procedure.
3. To reset oil life monitor on a vehicle equipped with a Driver Information Center (DIC), turn ignition switch to ON position with engine off. Press MODE button on DIC until OIL LIFE LEFT/HOLD SET TO RESET is displayed. Press and hold SET button until 100 percent is displayed. Three chimes should sound and CHANGE ENGINE OIL message will go out. If CHANGE ENGINE OIL message comes back on, system has not reset. Repeat reset procedures.

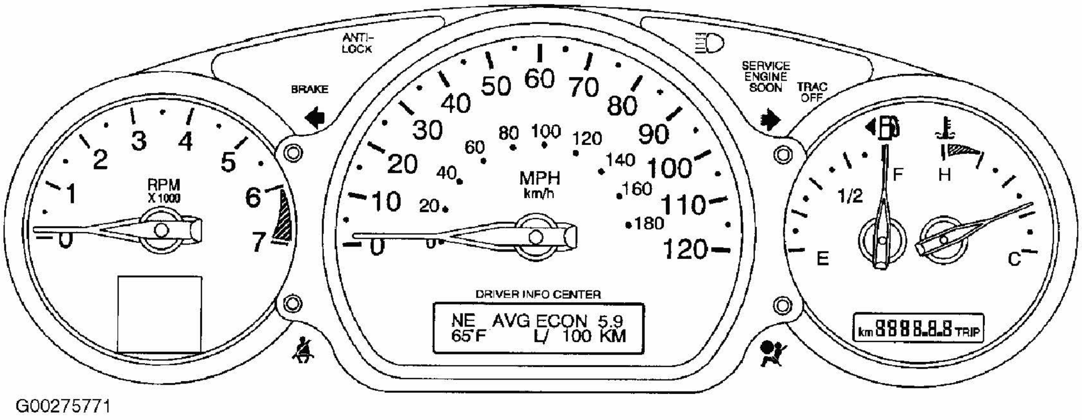


Fig. 21: Identifying Instrument Cluster (2004 Pontiac Aztek)
Courtesy of GENERAL MOTORS CORP.

2002-04 BUICK RENDEZVOUS

Engine oil life monitor calculates engine oil temperature and engine revolutions. It indicates when the engine oil is nearly worn out. CHANGE ENGINE OIL light on the instrument cluster is illuminated when it is time to change the engine oil. See **Fig. 22**.

1. To reset oil life monitor on a vehicle with a Driver Information Center (DIC), go to step 3. To reset the oil life monitor on a vehicle NOT equipped with a Driver Information Center, turn ignition switch to ON or RUN position with engine off.
2. Depress accelerator pedal slowly from closed throttle to wide open throttle 3 times within 5 seconds. Turn ignition off. Start vehicle. If CHANGE ENGINE OIL light

comes back on and stays on, the oil life monitor has not reset. Repeat reset procedure.

3. To reset oil life monitor on a vehicle equipped with a Driver Information Center (DIC), turn ignition switch to ON position with engine off. Press MODE button on DIC until OIL LIFE LEFT/HOLD SET TO RESET is displayed. Press and hold SET button until 100 percent is displayed. Three chimes should sound and CHANGE ENGINE OIL message will go out. If CHANGE ENGINE OIL message comes back on, system has not reset. Repeat reset procedures.

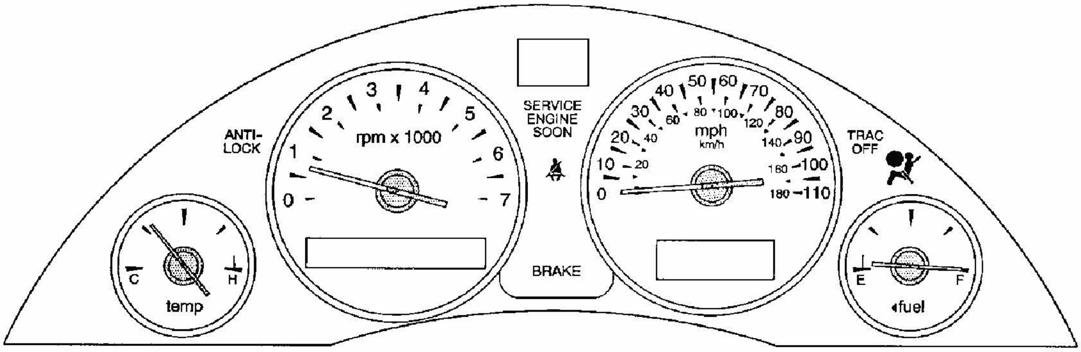


Fig. 22: Identifying Instrument Cluster (2004 Buick Rendezvous)
Courtesy of GENERAL MOTORS CORP.

2002-04 CHEVROLET TRAILBLAZER

The CHANGE ENG OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. See **Fig. 23**. Under severe conditions, the indicator may come on before 3000 miles. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.

Vehicle should not be driven more than 7500 miles or 12 months without an oil and oil filter change. System will not detect dust in the oil. So if vehicle is driven in a dusty area, be sure to change oil and oil filter every 3000 miles or sooner if CHANGE OIL SOON indicator comes on. Reset system when oil has been changed.

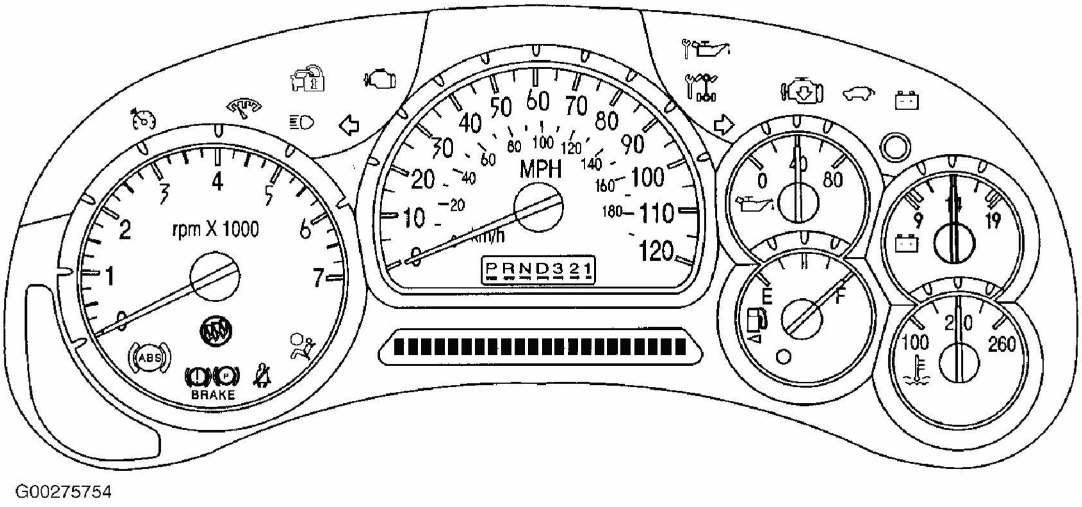


Fig. 23: Identifying Instrument Panel Cluster
Courtesy of GENERAL MOTORS CORP.

Manually Resetting Oil Life System

To reset the oil life monitor, turn ignition switch to ON or RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds. If CHANGE ENG OIL light flashes for 5 seconds, oil life monitor is reset. If the CHANGE ENG OIL light does not flash, oil life monitor has not reset. Repeat this step.

Reset Oil Life System Using Driver Information Center

If vehicle is equipped with a Driver Information Center (DIC), reset oil life monitor by pressing the Driver Information Center SELECT button for 5 seconds while ENGINE OIL LIFE is displayed.

2002-04 CHEVROLET VENTURE

1. The CHANGE ENGINE OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. See **Fig. 24** and **Fig. 25** . The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.
2. To reset the oil life monitor, turn the ignition switch to RUN position with the engine off. Press trip/reset button repeatedly until OIL is displayed on Driver Information Center (DIC). Once OIL is displayed, press and hold trip/reset button for 5 seconds. When trip/reset button is released, 100 will be displayed (indicating 100 percent oil life remaining). Turn ignition off. If CHANGE ENGINE OIL message comes back on and stays on, oil life monitor has not reset. Repeat this procedure.

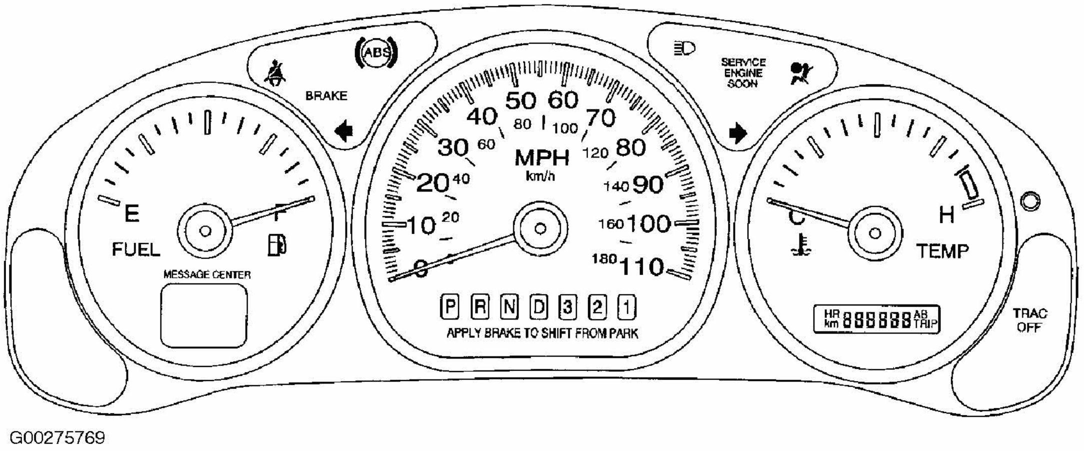

ABS
BRAKE
SERVICE ENGINE SOON
E
F
FUEL
MESSAGE CENTER
MPH
km/h
APPLY BRAKE TO SHIFT FROM PARK
P R N D 3 2 1
C
H
TEMP
HR km 888888 AB TRIP
TRAC OFF
G00275769

Fig. 24: Identifying Instrument Cluster
Courtesy of GENERAL MOTORS CORP.

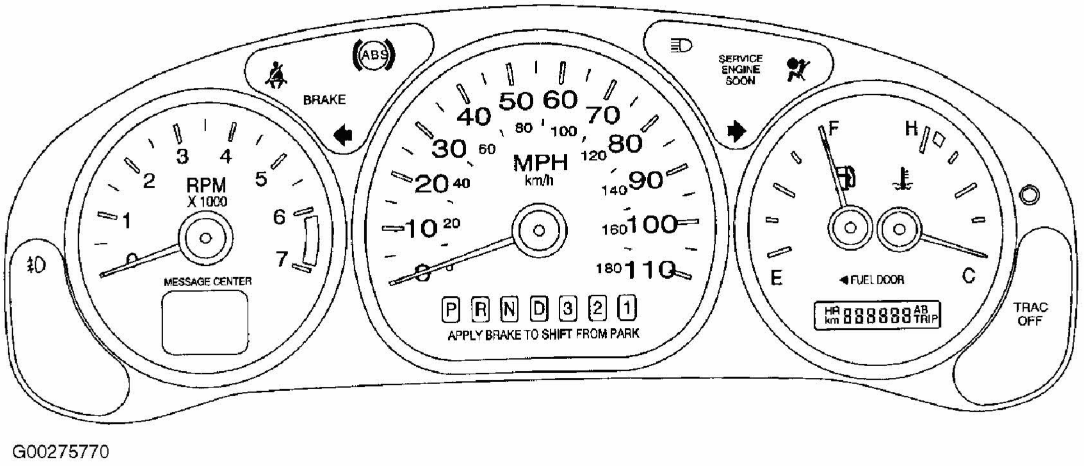

ABS
BRAKE
SERVICE ENGINE SOON
RPM X 1000
MESSAGE CENTER
MPH
km/h
APPLY BRAKE TO SHIFT FROM PARK
P R N D 3 2 1
F
H
E
C
◄FUEL DOOR
HR km 888888 AB TRIP
TRAC OFF
G00275770

Fig. 25: Identifying Instrument Cluster With Tachometer
Courtesy of GENERAL MOTORS CORP.

2002-04 GMC ENVOY & ENVOY XL

The CHANGE ENG OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. See Fig. 26. Under severe conditions, the indicator may come on before 3000 miles. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.

Vehicle should not be driven more than 7500 miles or 12 months without an oil and oil filter change. System will not detect dust in the oil. So if vehicle is driven in a dusty area, be sure to change oil and oil filter every 3000 miles or sooner if CHANGE OIL SOON indicator comes on. Reset system when oil has been changed.

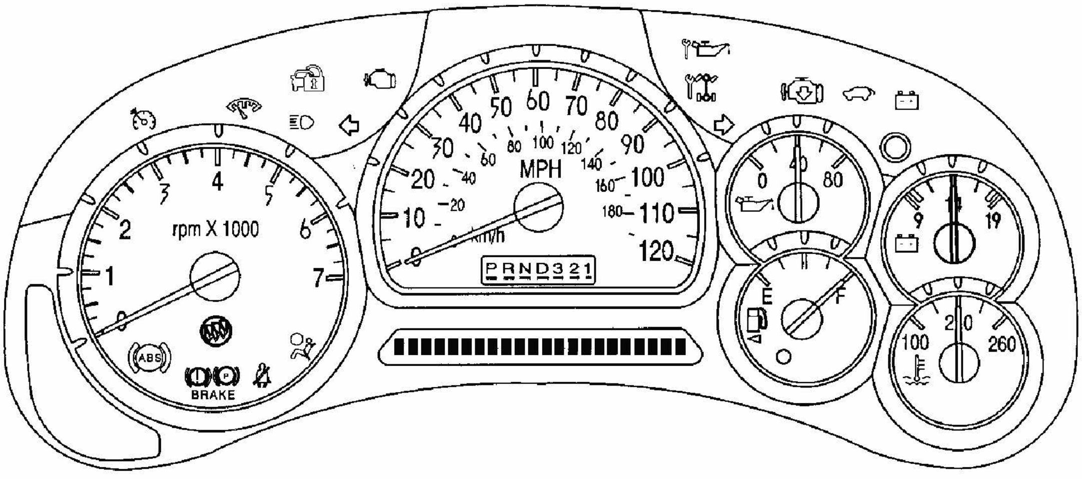


Fig. 26: Identifying Instrument Panel Cluster
Courtesy of GENERAL MOTORS CORP.

Manually Resetting Oil Life System

To reset the oil life monitor, turn ignition switch to ON or RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds. If CHANGE ENG OIL light flashes for 5 seconds, oil life monitor is reset. If the CHANGE ENG OIL light does not flash, oil life monitor has not reset. Repeat this step.

Reset Oil Life System Using Driver Information Center

If vehicle is equipped with a Driver Information Center (DIC), reset oil life monitor by pressing the Driver Information Center SELECT button for 5 seconds while ENGINE OIL LIFE is displayed.

2002-04 OLDSMOBILE BRAVADA

The CHANGE ENG OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. See **Fig. 27**. Under severe conditions, the indicator may come on before 3000 miles. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.

Vehicle should not be driven more than 7500 miles or 12 months without an oil and oil filter change. System will not detect dust in the oil. So if vehicle is driven in a dusty area, be sure to change oil and oil filter every 3000 miles or sooner if CHANGE OIL SOON indicator comes on. Reset system when oil has been changed.

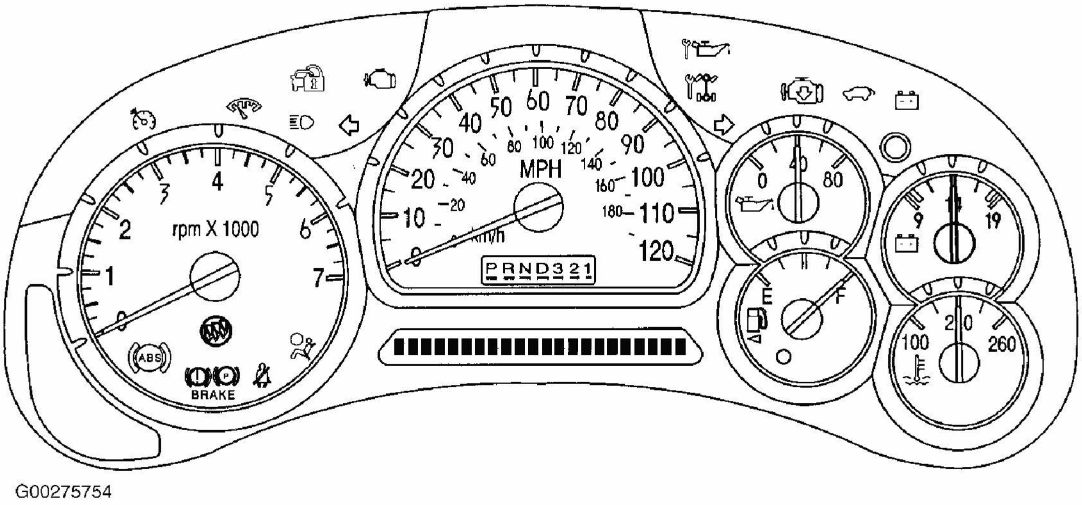


Fig. 27: Identifying Instrument Panel Cluster
Courtesy of GENERAL MOTORS CORP.

Manually Resetting Oil Life System

To reset the oil life monitor, turn ignition switch to ON or RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds. If CHANGE ENG OIL light flashes for 5 seconds, oil life monitor is reset. If the CHANGE ENG OIL light does not flash, oil life monitor has not reset. Repeat this step.

Reset Oil Life System Using Driver Information Center

If vehicle is equipped with a Driver Information Center (DIC), reset oil life monitor by pressing the Driver Information Center SELECT button for 5 seconds while ENGINE OIL LIFE is displayed.

2002-04 OLDSMOBILE SILHOUETTE

1. The CHANGE ENGINE OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. See **Fig. 28** and **Fig. 29** . The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.
2. To reset the oil life monitor, turn the ignition switch to RUN position with the engine off. Press trip/reset button repeatedly until OIL is displayed on Driver Information Center (DIC). Once OIL is displayed, press and hold trip/reset button for 5 seconds. When trip/reset button is released, 100 will be displayed (indicating 100 percent oil life remaining). Turn ignition off. If CHANGE ENGINE OIL message comes back on and stays on, oil life monitor has not reset. Repeat this procedure.

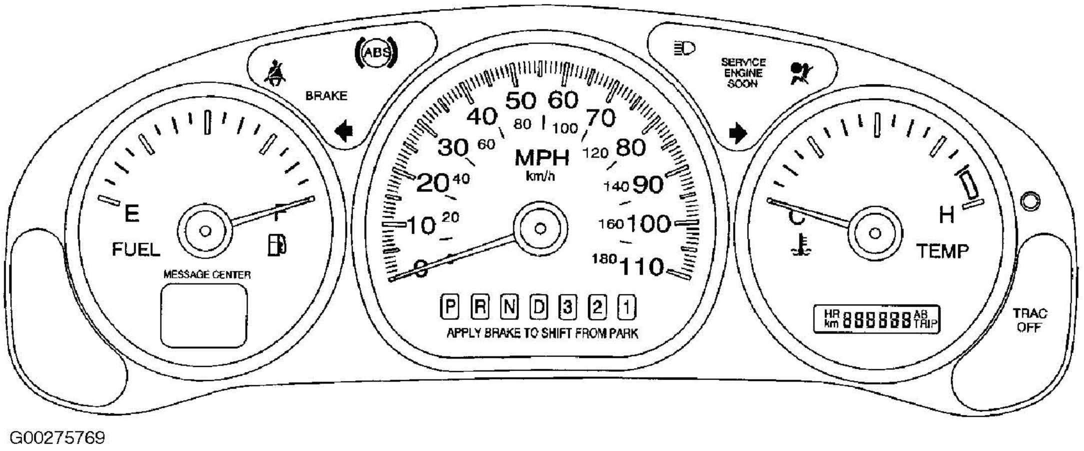

BRAKE
SERVICE ENGINE SOON
FUEL
E
F
MESSAGE CENTER
MPH
km/h
APPLY BRAKE TO SHIFT FROM PARK
P R N D 3 2 1
C
H
TEMP
TRAC OFF
G00275769

Fig. 28: Identifying Instrument Cluster
Courtesy of GENERAL MOTORS CORP.

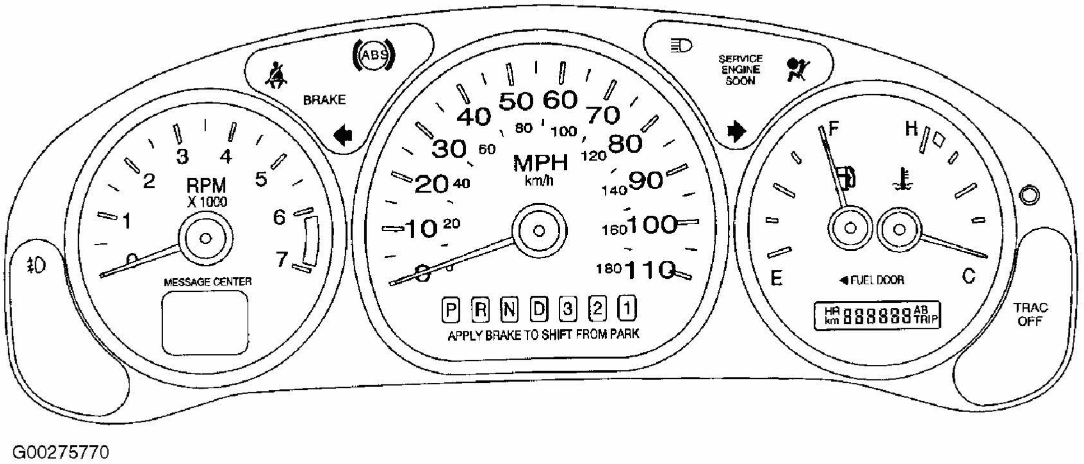

BRAKE
SERVICE ENGINE SOON
RPM X 1000
MESSAGE CENTER
MPH
km/h
APPLY BRAKE TO SHIFT FROM PARK
P R N D 3 2 1
F
H
E
C
◄FUEL DOOR
TRAC OFF
G00275770

Fig. 29: Identifying Instrument Cluster With Tachometer
Courtesy of GENERAL MOTORS CORP.

2002-04 PONTIAC MONTANA

1. The CHANGE ENGINE OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. See **Fig. 28** and **Fig. 29** . The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.
2. To reset the oil life monitor, turn the ignition switch to RUN position with the engine off. Press trip/reset button repeatedly until OIL is displayed on Driver Information Center (DIC). Once OIL is displayed, press and hold trip/reset button for 5 seconds. When trip/reset button is released, 100 will be displayed (indicating 100 percent oil life remaining). Turn ignition off. If CHANGE ENGINE OIL message comes back on and

stays on, oil life monitor has not reset. Repeat this procedure.

2003-04 CHEVROLET EXPRESS, CUTAWAY & RV CUTAWAY

Engine oil life monitor will show when to change the engine oil and oil filter. This will usually occur between 3000 and 7500 miles since the last oil change. Under severe conditions, the indicator may come on before 3000 miles. See **Fig. 30**.

Vehicle should not be driven more than 7500 miles or 12 months without an oil and oil filter change. The system will not detect dust in the oil. So if the vehicle is driven in a dusty area, be sure to change the oil and oil filter every 3000 miles or sooner if the CHANGE OIL SOON indicator comes on.

1. To reset oil life monitor when the oil has been changed, turn ignition ON, with engine off.
2. Fully press and release accelerator pedal 3 times within 10 seconds.
3. If CHANGE OIL light flashes for 5 seconds, the system is reset. If light does not display for 5 seconds, you will need to reset the system again.

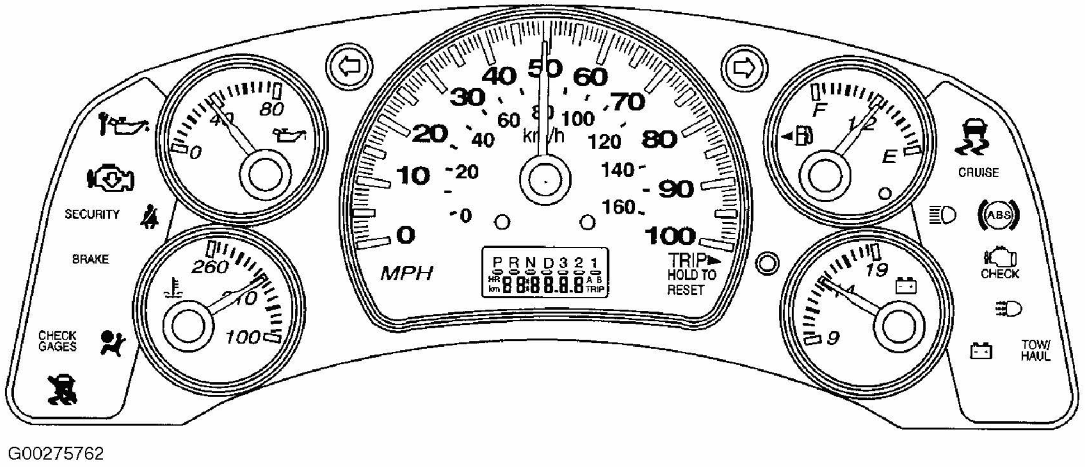


Fig. 30: Identifying Instrument Cluster (2004 Chevrolet Express, Cutaway & RV Cutaway)
Courtesy of GENERAL MOTORS CORP.

2003-04 GMC SAVANA, SAVANA CAMPER SPECIAL & SAVANA SPECIAL

Engine oil life monitor will show when to change the engine oil and oil filter. This will usually occur between 3000 and 7500 miles since the last oil change. Under severe conditions, the indicator may come on before 3000 miles. See **Fig. 31**.

Vehicle should not be driven more than 7500 miles or 12 months without an oil and oil filter change. The system will not detect dust in the oil. So if the vehicle is driven in a dusty area, be sure to change the oil and oil filter every 3000 miles or sooner if the CHANGE OIL SOON indicator comes on.

1. To reset oil life monitor when the oil has been changed, turn ignition ON, with engine off.
2. Fully press and release accelerator pedal 3 times within 10 seconds.
3. If CHANGE OIL light flashes for 5 seconds, the system is reset. If light does not display for 5 seconds, you will need to reset the system again.

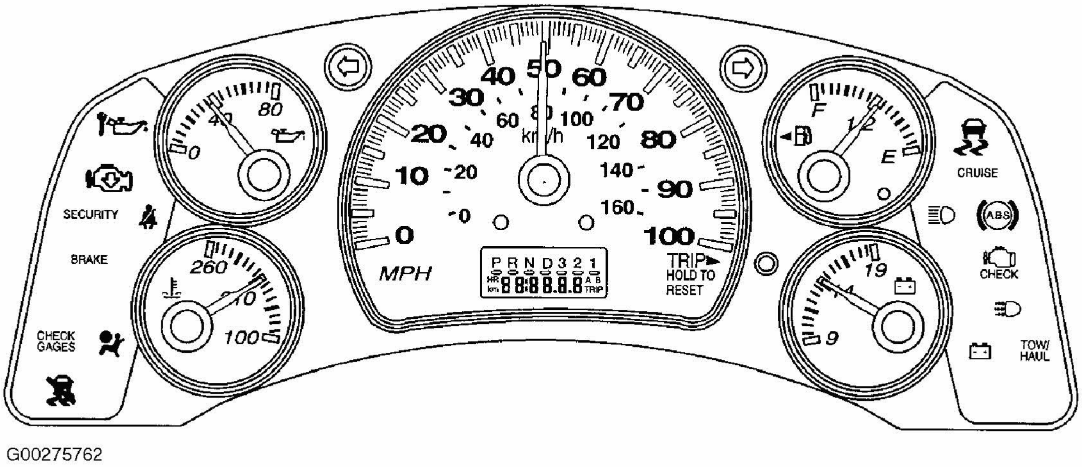
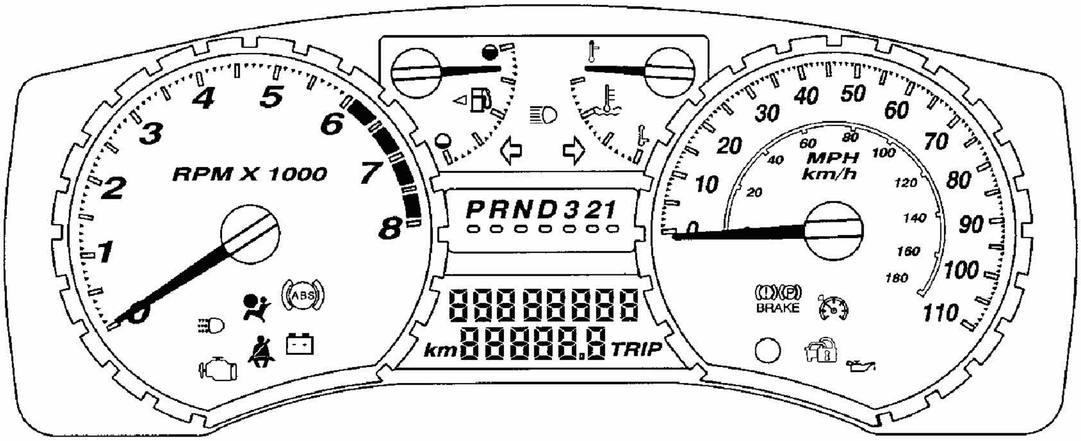

0
40
80
SECURITY
BRAKE
260
210
100
CHECK GAGES
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
160
km/h
MPH
P R N D 3 2 1
TRIP
HOLD TO RESET
F
1/2
E
19
14
9
CRUISE
ABS
CHECK
TOW/ HAUL
G00275762

Fig. 31: Identifying Instrument Cluster (2004 GMC Savana, Savana Camper Special & Savana Special)
Courtesy of GENERAL MOTORS CORP.

2004-07 CHEVROLET COLORADO

1. Turn ignition ON, with engine off.
2. Press and release reset stem on instrument panel while OIL LIFE message is displayed.
3. Once the alternating OIL LIFE and RESET messages appear, press and hold stem in until several beeps will sound. This confirms that oil life system has been reset. Turn ignition off. If CHANGE OIL messages comes back after starting engine, repeat reset procedure.


RPM X 1000
0
1
2
3
4
5
6
7
8
PRND321
km
TRIP
MPH
km/h
BRAKE
0
10
20
30
40
50
60
70
80
90
100
110

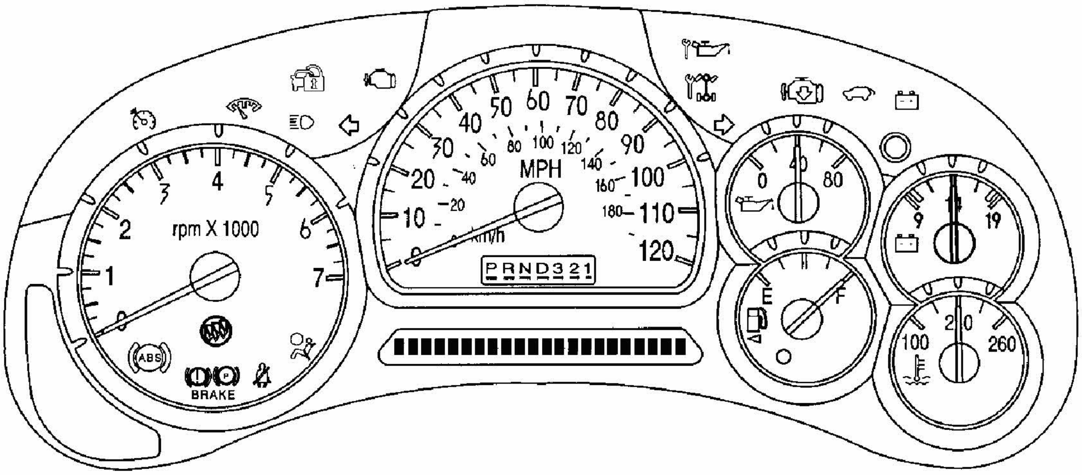
G00275761

Fig. 32: Identifying Instrument Cluster (2004 Chevrolet Colorado)
Courtesy of GENERAL MOTORS CORP.

2004 BUICK RAINIER

The CHANGE ENG OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. See **Fig. 33**. Under severe conditions, the indicator may come on before 3000 miles. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.

Vehicle should not be driven more than 7500 miles or 12 months without an oil and oil filter change. System will not detect dust in the oil. So if vehicle is driven in a dusty area, be sure to change oil and oil filter every 3000 miles or sooner if CHANGE OIL SOON indicator comes on. Reset system when oil has been changed.


rpm X 1000
0
1
2
3
4
5
6
7
MPH
km/h
PRND321
0
10
20
30
40
50
60
70
80
90
100
110
120
BRAKE
0
40
80
9
19
E
F
100
260

G00275754

Fig. 33: Identifying Instrument Panel Cluster

Courtesy of GENERAL MOTORS CORP.

Manually Resetting Oil Life System

To reset the oil life monitor, turn ignition switch to ON or RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds. If CHANGE ENG OIL light flashes for 5 seconds, oil life monitor is reset. If the CHANGE ENG OIL light does not flash, oil life monitor has not reset. Repeat this step.

Reset Oil Life System Using Driver Information Center

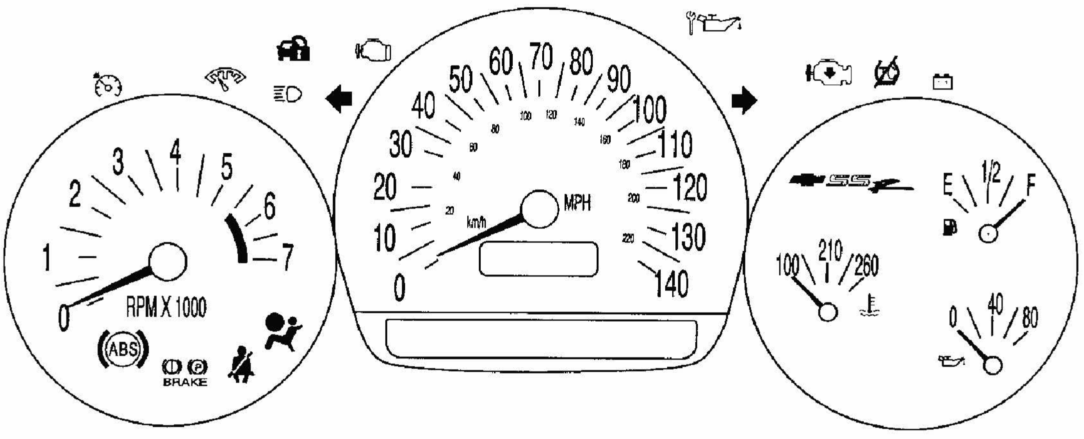
If vehicle is equipped with a Driver Information Center (DIC), reset oil life monitor by pressing the Driver Information Center SELECT button for 5 seconds while ENGINE OIL LIFE is displayed.

2004 CHEVROLET SSR

This vehicle has an engine oil life monitor. See **Fig. 34**. The GM Oil Life System™ will show when to change engine oil and oil filter. This will usually occur between 3000 miles and 7500 miles since the last oil change. Under severe conditions, the indicator may come on before 3000 miles.

Vehicle should not be driven more than 7500 miles or 12 months without an oil and oil filter change. The system will not detect dust in the oil. So if the vehicle is driven in a dusty area, be sure to change the oil and oil filter every 3000 miles or sooner if the CHANGE OIL SOON indicator comes on. Reset the system when the oil has been changed.

1. Turn ignition to ON without starting the engine.
2. Fully push and release accelerator pedal slowly 3 times within 5 seconds.
3. If CHANGE ENG OIL light flashes for 5 seconds, the system is reset. If light does not flash, repeat the procedure.



G00275768

Fig. 34: Identifying Instrument Cluster (2004 Chevrolet SSR)
Courtesy of GENERAL MOTORS CORP.

2004-07 GMC CANYON

1. Turn ignition on, with engine off.
2. Press and hold reset stem on instrument cluster until the OIL LIFE message is displayed.
3. Once the alternating OIL LIFE and RESET messages appear, press and hold the stem until several beeps will sound. This confirms that oil life system has been reset. If CHANGE OIL message comes after starting the engine, repeat reset procedure.

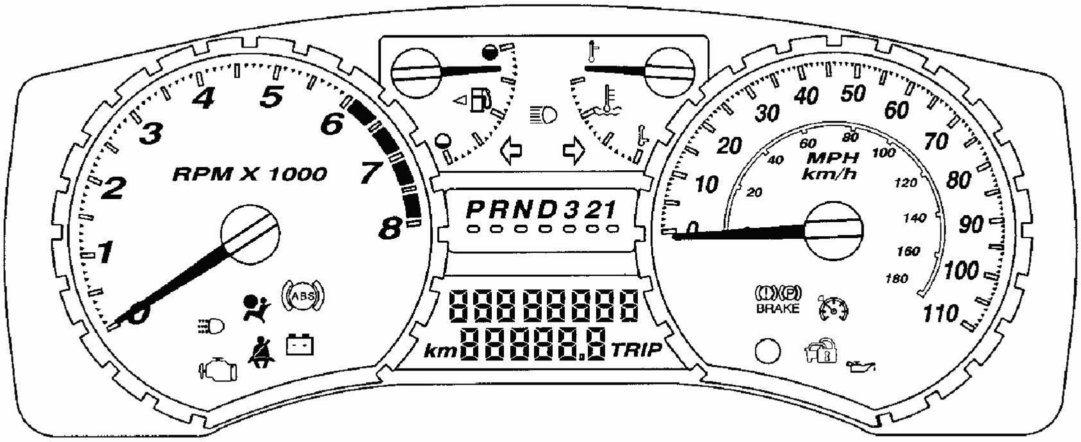


Fig. 35: Identifying Instrument Cluster (2004 GMC Canyon)
Courtesy of GENERAL MOTORS CORP.

2004 GMC ENVOY XUV

The CHANGE ENG OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. See **Fig. 36**. Under severe conditions, the indicator may come on before 3000 miles. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.

Vehicle should not be driven more than 7500 miles or 12 months without an oil and oil filter change. System will not detect dust in the oil. So if vehicle is driven in a dusty area, be sure to change oil and oil filter every 3000 miles or sooner if CHANGE OIL SOON indicator comes on. Reset system when oil has been changed.

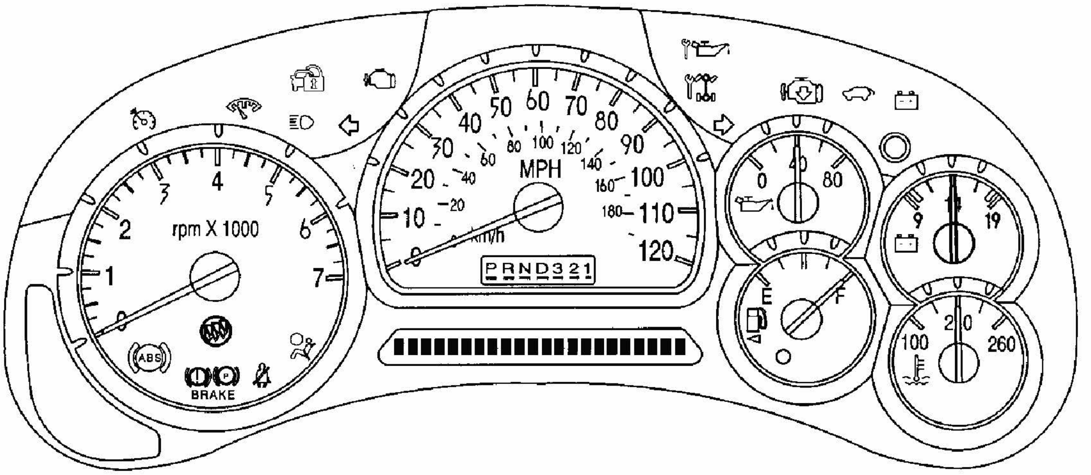


Fig. 36: Identifying Instrument Panel Cluster
Courtesy of GENERAL MOTORS CORP.

Manually Resetting Oil Life System

To reset the oil life monitor, turn ignition switch to ON or RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds. If CHANGE ENG OIL light flashes for 5 seconds, oil life monitor is reset. If the CHANGE ENG OIL light does not flash, oil life monitor has not reset. Repeat this step.

Reset Oil Life System Using Driver Information Center

If vehicle is equipped with a Driver Information Center (DIC), reset oil life monitor by pressing the Driver Information Center SELECT button for 5 seconds while ENGINE OIL LIFE is displayed.

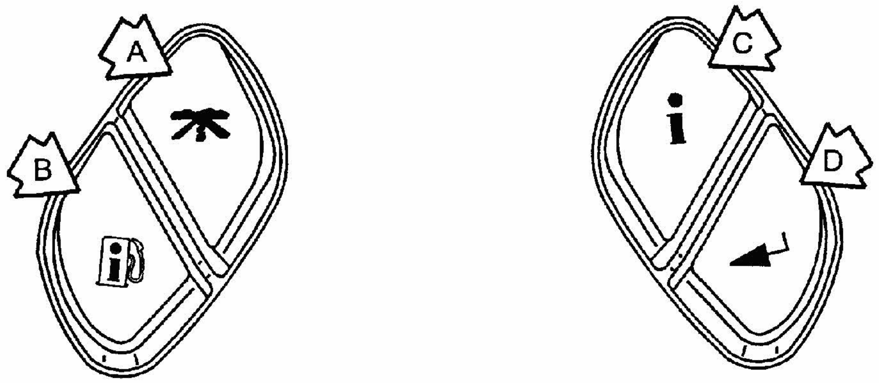
2005-06 BUICK RAINIER

To reset the change engine oil light, do the following:

1. Turn the ignition key to RUN with the engine off.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to LOCK.

If the change engine oil light comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

For vehicles with the Driver Information Center (DIC), see **Fig. 37** to identify DIC steering wheel buttons.



A (Trip Information)

Press this button to display the odometer, trip odometers,timer, and (if equipped) a tire pressure monitor and engine hours.

B (Fuel Information)

Press this button to display the current range, fuel used, average fuel economy, and engine oil life.

C (Customization)

Press this button to access the vehicle settings menu and customize the personal settings on your vehicle.

D (Select)

Press this button to reset certain DIC functions and set your customization settings.

Pressing any of the four DIC buttons will acknowledge DIC messages and clear them from the DIC display.

G00374418

Fig. 37: Identifying Driver Information Center (DIC) Steering Wheel Buttons (Some 2005 Models)
Courtesy of GENERAL MOTORS CORP.

2005-07 BUICK RENDEZVOUS

If your vehicle does not have the optional Driver Information Center (DIC), do the following:

1. Turn the ignition to ON, with the engine off.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF. If the CHANGE ENGINE OIL message comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

If your vehicle has the optional DIC, do the following:

1. Turn the ignition to ON, with the engine off.
2. Press the MODE button until the DIC reads OIL LIFE LEFT/HOLD SET TO RESET.

3. Press and hold the SET button until 100% is displayed. You will hear three chimes and the CHANGE ENGINE OIL message will go off. Turn the key to OFF.

If the CHANGE ENGINE OIL message comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

2005-07 BUICK TERRAZA

1. With the ignition key in RUN but the engine off, repeatedly push the set/reset button until OIL is displayed on the Driver Information Center (DIC).
2. Once OIL is displayed, push and hold the set/reset button for five seconds. The number will disappear and be replaced by 100 (indicating 100% oil life remaining).
3. Turn the key to LOCK.

2005-06 CHEVROLET EQUINOX

1. Turn the ignition key to RUN with the engine off.
2. Fully press and release the accelerator pedal three times within five seconds. The change engine oil light will flash while the system is resetting.
3. Turn the key to LOCK.

2005-06 CHEVROLET EXPRESS, CUTAWAY & RV CUTAWAY

To reset the change engine oil light, do the following:

1. Turn the ignition key to RUN with the engine off.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. If the Change Engine Oil light flashes for five seconds, the system is reset.
4. Turn the key to LOCK.

If the change engine oil light comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure. If it still does not reset, see your dealer for service.

2005-07 CHEVROLET SILVERADO & TRAILBLAZER

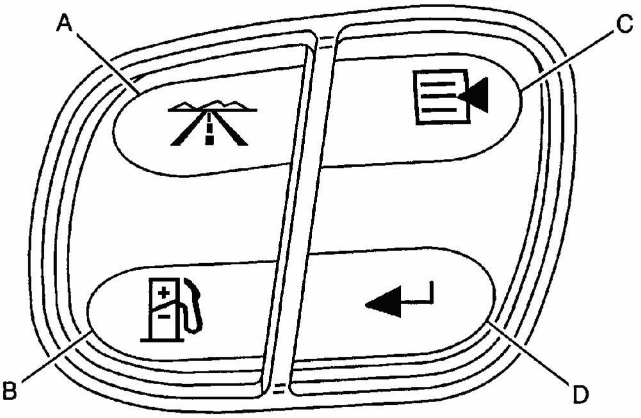
1. Turn ignition key to RUN position, with engine off.
2. Fully press and release the accelerator pedal slowly 3 times within 5 seconds. If the OIL LIFE RESET message flashes for 10 seconds, the system is resetting.
3. Turn the key to LOCK. If CHANGE ENGINE OIL message comes back after engine starts, repeat reset procedure.

2005-06 CHEVROLET SSR

Always reset the engine oil life system to 100% after every oil change. It will not reset itself. To reset the change engine oil light, do the following:

1. Press the fuel information button until ENGINE OIL LIFE appears on the Driver Information Center (DIC). See .
2. Press and hold the select button. The engine oil life percentage will change to 100.
3. Turn the key to OFF.

If the change engine oil light comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.



A. *(Trip Information)* : Press this button to display the odometer, trip odometer, and the timer.
B. *(Fuel Information)* : Press this button to display the current fuel and engine oil information.
C. *(Personalization)* : Press this button to access the vehicle personalization menu and customize the personalization settings on your vehicle.
D. *(Select)* : Press this button to reset certain DIC functions, acknowledge DIC warning messages and clear them from the DIC, and set your personalization settings.

G00374419

Fig. 38: Identifying DIC Steering Wheel Buttons (Chevrolet SSR)
Courtesy of GENERAL MOTORS CORP.

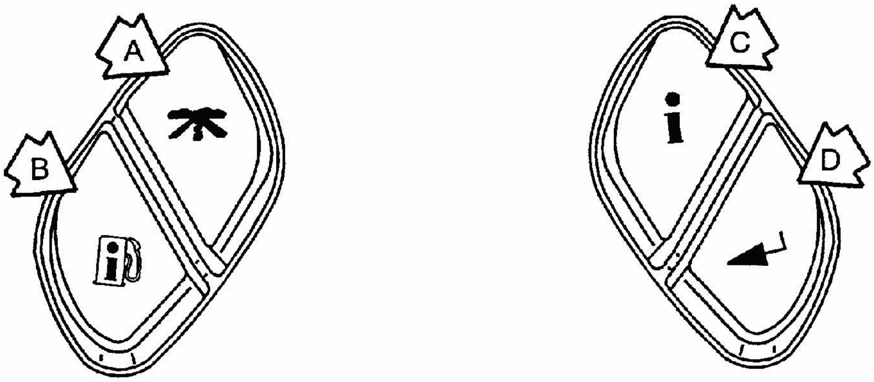
2005-06 CHEVROLET TRAILBLAZER

To reset the change engine oil light, do the following:

1. Turn the ignition key to RUN with the engine off.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to LOCK.

If the change engine oil light comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

For vehicles with the Driver Information Center (DIC), see **Fig. 39** to identify DIC steering wheel buttons.



A (Trip Information)

Press this button to display the odometer, trip odometers,timer, and (if equipped) a tire pressure monitor and engine hours.

B (Fuel Information)

Press this button to display the current range, fuel used, average fuel economy, and engine oil life.

C (Customization)

Press this button to access the vehicle settings menu and customize the personal settings on your vehicle.

D (Select)

Press this button to reset certain DIC functions and set your customization settings.

Pressing any of the four DIC buttons will acknowledge DIC messages and clear them from the DIC display.

G00374418

Fig. 39: Identifying Driver Information Center (DIC) Steering Wheel Buttons (Some Models)
Courtesy of GENERAL MOTORS CORP.

2005-07 CHEVROLET UPLANDER

1. Turn ignition key to RUN position, with engine off. Repeatedly push the SET/RESET button until OIL is displayed on the Driver Information Center (DIC).
2. Once OIL is displayed, push and hold the SET/RESET button for 5 seconds. The number will disappear and be replaced by 100 (indicating 100% oil life remaining).
3. Turn key to LOCK position. If CHANGE OIL SOON message comes back after engine starts, repeat reset procedure.

2005-06 CHEVROLET VENTURE

1. With the ignition key in RUN but the engine off, repeatedly push the trip/reset button

until OIL is displayed on the Driver Information Center (DIC).

2. Once OIL is displayed, push and hold the trip/reset button for five seconds. The number will disappear and be replaced by 100 (indicating 100% oil life remaining).
3. Turn the key to OFF.

2005-06 GM C/K SERIES

On vehicles equipped with the DIC, use the fuel button to reach the ENGINE OIL LIFE screen and then press and hold the select button for five seconds while ENGINE OIL LIFE is displayed. See **Fig. 39**. OIL LIFE RESET will appear on the display for 10 seconds to let you know the system is reset.

On vehicles NOT equipped with the DIC, do the following:

1. Turn the ignition key to RUN with the engine off.
2. Fully press and release the accelerator pedal slowly three times within five seconds. If the OIL LIFE RESET message flashes for 10 seconds, the system is resetting.
3. Turn the key to LOCK.

If the CHANGE ENGINE OIL message comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure. If it still does not reset, see your dealer for service.

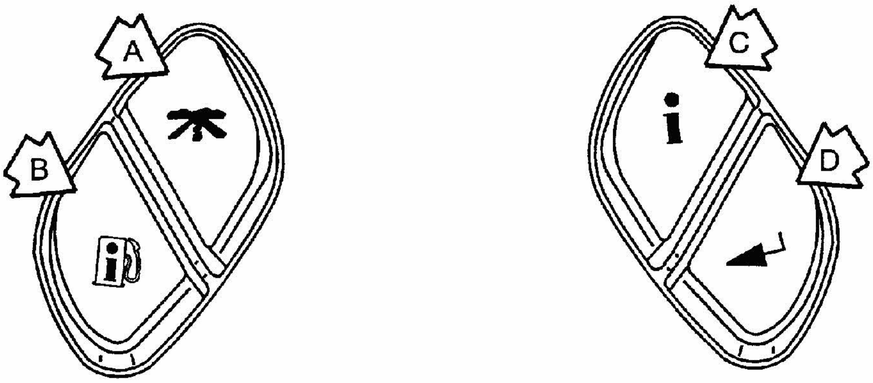
2005-06 GMC ENVOY, ENVOY XL & ENVOY XUV

To reset the change engine oil light, do the following:

1. Turn the ignition key to RUN with the engine off.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to LOCK.

If the change engine oil light comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

For vehicles with the Driver Information Center (DIC), see **Fig. 40** to identify DIC steering wheel buttons.



A (Trip Information)

Press this button to display the odometer, trip odometers,timer, and (if equipped) a tire pressure monitor and engine hours.

B (Fuel Information)

Press this button to display the current range, fuel used, average fuel economy, and engine oil life.

C (Customization)

Press this button to access the vehicle settings menu and customize the personal settings on your vehicle.

D (Select)

Press this button to reset certain DIC functions and set your customization settings.

Pressing any of the four DIC buttons will acknowledge DIC messages and clear them from the DIC display.

G00374418

Fig. 40: Identifying Driver Information Center (DIC) Steering Wheel Buttons (2005 Models)
Courtesy of GENERAL MOTORS CORP.

2005-07 GMC SAVANA, SAVANA CAMPER SPECIAL & SAVANA SPECIAL

To reset the change engine oil light, do the following:

1. Turn ignition to RUN position, with engine off.
2. Fully press and release accelerator pedal slowly 3 times within 5 seconds.
3. If the CHANGE ENGINE OIL light flashes for 5 seconds, the system is reset.
4. Turn the key to LOCK.

If the CHANGE ENGINE OIL light comes back on when you start your vehicle, the engine oil life system has not reset. Repeat reset procedure.

2005 PONTIAC AZTEK

If your vehicle does not have the optional Driver Information Center (DIC), do the following:

1. Turn the ignition to ON, with the engine off.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF. If the CHANGE ENGINE OIL message comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

If your vehicle has the optional DIC, do the following:

1. Turn the ignition to ON, with the engine off.
2. Press the MODE button until the DIC reads OIL LIFE LEFT/HOLD SET TO RESET.
3. Press and hold the SET button until 100% is displayed. You will hear three chimes and the CHANGE ENGINE OIL message will go off. Turn the key to OFF.

If the CHANGE ENGINE OIL message comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

2005-06 PONTIAC MONTANA

1. With the ignition key in RUN but the engine off, repeatedly push the trip/reset button until OIL is displayed on the Driver Information Center (DIC).
2. Once OIL is displayed, push and hold the trip/reset button for five seconds. The number will disappear and be replaced by 100 (indicating 100% oil life remaining).
3. Turn the key to OFF.

2006-07 BUICK RAINIER

1. Turn the ignition to ON, with the engine off.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF. If the CHANGE ENGINE OIL message comes back on when you start your vehicle, the engine oil life system has not reset. Repeat the procedure.

2006-07 CHEVROLET AVALANCHE

After changing the engine oil, reset the system by performing the following steps:

1. Display OIL LIFE REMAINING on DIC.
2. Press hold the SET/RESET button on DIC or trip odometer stem (if not equipped with DIC) for at more than 5 seconds. The oil life will change to 100%.
3. Turn the key to OFF. If the light or message comes back on when you start your vehicle, the oil life system has not reset. Repeat the procedure.

2006-07 CHEVROLET HHR

1. Turn the ignition to RUN position, with engine off.
2. Press INFORMATION and RESET buttons on the DIC at the same time to enter personalization menu.
3. Press INFORMATION button to scroll through the available personalization menu modes until the DIC display shows OIL LIFE RESET.
4. Press and hold RESET button until the DIC display shows ACKNOWLEDGED. This indicates that system has been reset.
5. Turn ignition off. If CHANGE OIL SOON message comes back when engine is started, repeal reset procedure.

2006-07 GMC YUKON DENALI & YUKON XL DENALI

1. Turn ignition key to RUN position, with engine off. Display the OIL LIFE REMAINING on the DIC.
2. Press and hold the SET/RESET button on DIC for more than 5 seconds. The oil life will change to 100%.
3. Turn ignition off. If the CHANGE ENGINE OIL SOON message comes back on when engine is started, repeat reset procedure.

2006-07 PONTIAC TORRENT

1. Turn ignition to RUN position, with engine off.
2. Fully press and release the accelerator pedal slowly 3 times within 5 seconds. The CHANGE ENGINE OIL light will flash while system is resetting.
3. When light stops flashing, turn the key to LOCK position. If the light or message comes back on when engine is started, the engine oil life system has not reset. Repeat reset procedure.

2007 CHEVROLET EQUINOX

1. Turn ignition ON, with engine off.
2. Fully press and release the accelerator pedal slowly 3 times within 5 seconds. The CHANGE OIL LIGHT will flash while system is resetting.
3. When light stops flashing, turn key to LOCK. If the CHANGE ENGINE OIL message comes back on when you start the engine, repeat the reset procedure.

2007 CHEVROLET SUBURBAN

1. Turn ignition ON, with engine off. Display OIL LIFE REMAINING on DIC
2. Press and hold SET/RESET button on DIC or trip odometer reset stem (if not equipped with DIC) for more than 5 seconds. The oil life should change to 100%. Turn ignition off. If CHANGE ENGINE OIL SOON message comes back after starting engine, repeat reset procedure.

2007 GMC ACADIA

1. Turn ignition ON, with engine off.
2. Fully press and release the accelerator pedal slowly 3 times within 5 seconds. The CHANGE OIL LIGHT will flash while system is resetting.
3. When light stops flashing, turn key OFF. If the CHANGE ENGINE OIL SOON message comes back on when you start the engine, repeat the reset procedure.

2007 GMC ENVOY & ENVOY DENALI

1. Turn ignition key to RUN position, with engine off.
2. Fully press and release the accelerator pedal slowly 3 times within 5 seconds. The CHANGE OIL LIGHT will flash while the system is resetting.
3. When light stops flashing, turn key to LOCK position. If light/message comes back when engine is started, repeat reset procedure.

2007 GMC SIERRA CLASSIC & SIERRA DENALI CLASSIC

1. Turn ignition key to RUN position, with engine off.
2. Fully press and release the accelerator pedal slowly 3 times within 5 seconds. If the OIL LIFE RESET message flashes for 10 seconds, the system is resetting.
3. Turn the key to LOCK. If CHANGE ENGINE OIL message comes back after engine starts, repeat reset procedure.

CHANGE TRNS FLUID NOW DISPLAY

1995-99 OLDSMOBILE AURORA

1. The Driver Information Center (DIC) displays estimated percentage of the remaining useful life of engine oil or transaxle fluid. When remaining oil or fluid life is 0 percent, the display will show CHANGE OIL NOW or CHANGE TRNS FLUID NOW. After changing engine oil or transaxle fluid, reset oil life display.
2. To reset the display, turn ignition on with engine off. Press ENG button to select the OIL LIFE or TRNS FLUID LIFE percentage display. Then, press and hold in RESET for at least 5 seconds.
3. The word RESET will appear. Then, OIL LIFE 100 or TRNS FLUID 100 will be displayed.

CHECK ENGINE LIGHT

1989-94 GEO TRACKER

Federal

1. CHECK ENGINE light functions as a service reminder indicator and emission system service. CHECK ENGINE light will come on each 50,000 miles (PCV and EGR), each 80,000 miles (oxygen sensor) and each 100,000 miles (charcoal canister) to indicate needed emission system service.
2. After servicing and/or replacing components, reset CHECK ENGINE light by sliding cancel switch to its opposite position. See **LIGHT RESET SWITCH LOCATION (GEO TRACKER)** for switch location.

LIGHT RESET SWITCH LOCATION (GEO TRACKER)

Application	Location
1989-91	Behind Access Panel, Directly Below Steering Column
1992-94	(1) Behind Instrument Panel, Next To Left Speaker
(1) See **Fig. 41**.	

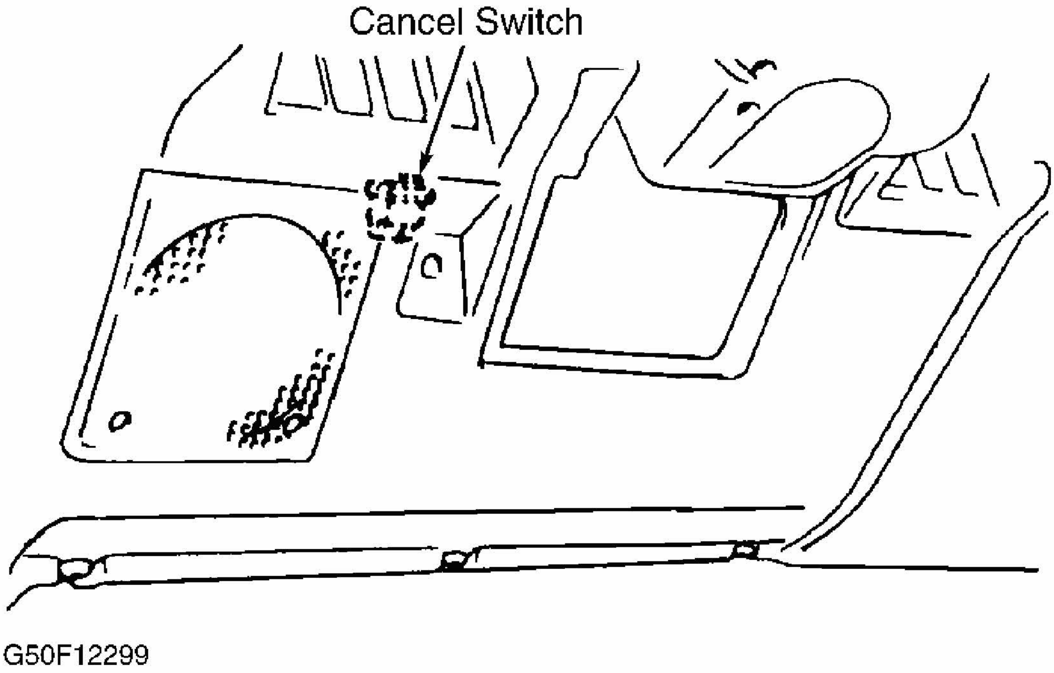


Fig. 41: Light Reset Switch Location (1992-94 Geo Tracker - Federal)
Courtesy of GENERAL MOTORS CORP.

California

CHECK ENGINE light indicates when it is necessary to have emission system serviced, regardless of mileage. CHECK ENGINE light comes on briefly when starting as a bulb check. If light does not come on or stays on continually, repair as necessary.

FUEL FILTER LIFE RESET

2006 GM TRUCKS

This feature is available on vehicles with steering wheel controls. When fuel button is pressed and FUEL FILTER LIFE appears on the display, this information will give the percentage of fuel filter life remaining.

NOTE: Message will appear when a reset is performed either by using the steering wheel controls or the following manual procedure.

Reset Procedure

NOTE: For vehicles with steering wheel controls, press and hold the select button for 5 seconds while FUEL FILTER LIFE message is displayed. This message will appear on the DIC for 10 seconds. For vehicles without steering wheel controls, do the following:

1. Without pressing the pedals, turn ignition key to on position without starting engine. Wait 5 seconds.
2. Completely press brake and accelerator pedals simultaneously and hold for 10 seconds. The system is now reset.
3. Turn ignition key off. The next time engine is started, message will no longer be displayed. Always reset FUEL FILTER LIFE system after a fuel filter change.

OXYGEN SENSOR REMINDER FLAG

1980 MODELS

1. Every 30,000 miles, a reminder flag appears in speedometer face, indicating service of oxygen sensor is necessary. See **Fig. 42**. Inspect and service oxygen sensor as necessary and reset flag.
2. To reset flag, remove instrument panel trim plate. Remove instrument cluster lens. Using pointed tool, apply light downward pressure on notches of flag until it is reset. An alignment mark will appear in left center of odometer window when flag is fully reset.

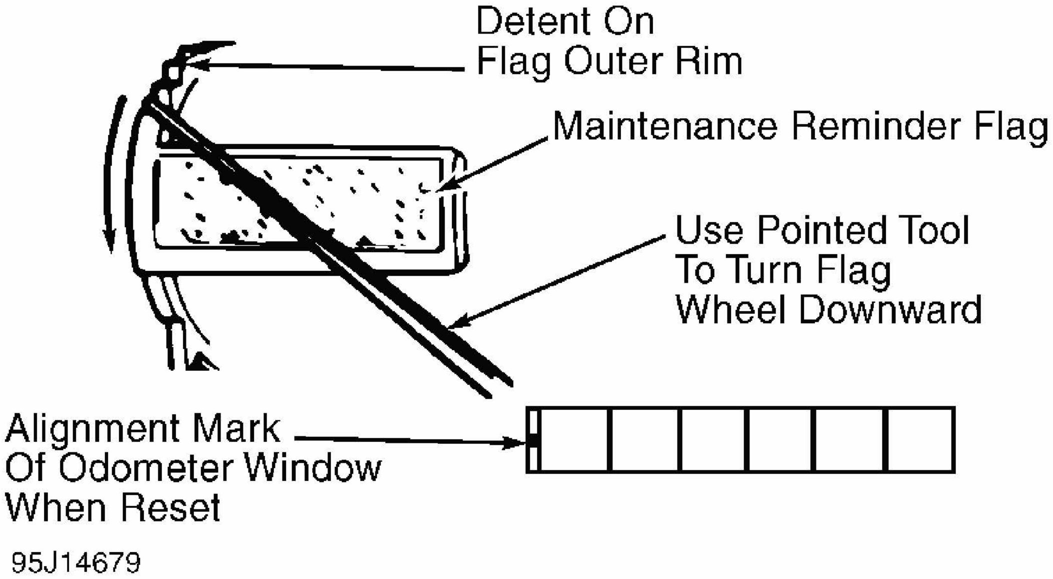

Detent On
Flag Outer Rim
Maintenance Reminder Flag
Use Pointed Tool
To Turn Flag
Wheel Downward
Alignment Mark
Of Odometer Window
When Reset
95J14679

Fig. 42: Resetting Reminder Flag (1980 General Motors)
Courtesy of GENERAL MOTORS CORP.

OXYGEN SENSOR WARNING LIGHT

1985-86 SPRINT

At 30,000 mile intervals, a SENSOR light in dash will start flashing, indicating oxygen sensor needs replacement. To reset mileage counter (after sensor replacement), locate SENSOR light cancel switch on right side of fuse box. Return cancel switch to OFF position. Start engine to ensure light remains off.

SERVICE REMINDER MESSAGE

1987-89 PONTIAC 6000 STE

The SERVICE REMINDER message light is used on models with a Driver Information Center (DIC). After performing necessary services, reset service reminder light.

To reset service reminder, push DIC button until desired service item is displayed. Press and hold down the DIC button. With button pressed, the distance display will decrease in increments of 500 miles. Release button when desired distance is displayed on the DIC.

1988-89 PONTIAC BONNEVILLE

The SERVICE REMINDER message light is used on models with a Driver Information Center (DIC). After performing necessary services, reset service reminder light.

To reset service reminder, push DIC button until desired service item is displayed. Press and hold down the DIC button. With button pressed, the distance display will decrease in increments of 500 miles. Release button when desired distance is displayed on the DIC.

1990-91 PONTIAC BONNEVILLE

1. The SERVICE REMINDER message light is used on models with a Driver Information Center (DIC). After performing necessary services, reset service reminder light.
2. To reset service reminder, push DIC button until service item preceding desired service item is displayed. Press and hold down the DIC button. This will advance display to desired service item and, with button pressed, the distance between service intervals will decrease in increments of 500 miles.
3. Release button when desired distance is displayed on the DIC. If the SERVICE REMINDER remains on after resetting, drive vehicle. Light should go out within 10 miles of driving.

TIRE PRESSURE MONITOR SYSTEM

1987-96 CHEVROLET CORVETTE

Tire Pressure Monitor Warning Indicators

NOTE: The LOW TIRE PRESSURE warning light may come on if the vehicle is close to another vehicle that has a similar warning system and a low tire.

When the LOW TIRE PRESSURE warning light illuminates, immediately check air pressure of all tires and adjust to the specified pressure. This warning light will remain illuminated until ignition is turned off, even if tires are inflated while vehicle is running. If SERVICE LTPWS warning light illuminates, there is a problem in the TPM system. See appropriate manufacturer service information.

1997 BUICK PARK AVENUE

CHECK TIRE PRESSURE or TIRE PRESSURE LOW message will come on the Driver Information Center (DIC) if air pressure in one tire is lower than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if air pressure is adjusted. Message will stay on until system is recalibrated. Check and adjust air pressure in all 4 tires before recalibrating system.

1. To recalibrate the system, turn ignition on with engine off. On 1997-98 models, press the GAGES button on the Driver Information Center (DIC) until TIRE PRESSURE appears on the display. On 1999-2002 models, press the GAGE INFO button on the Driver Information Center (DIC) until TIRE PRESSURE appears on the display. On all models, press and hold the DIC RESET button for 5 seconds.

2. After 5 seconds the display will show TIRE PRESSURE RESET. After DIC RESET button is released, TIRE PRESSURE NORMAL will appear on display. If TIRE PRESSURE RESET does not appear on the display after 5 seconds, retry recalibration process. If after retrying recalibration process system still does not reset, repair system as necessary.

1997-2004 CHEVROLET CORVETTE

NOTE: **If the wheels have been rotated, or tire pressure sensor or RCDLR is replaced, the TPM system needs to relearn tire pressure sensor IDs. See TIRE PRESSURE SENSOR RELEARN in appropriate manufacturer service information.**

1997 PONTIAC GRAND PRIX

The vehicle must be driven 10-20 miles before the check tire pressure system will work properly. The CHECK TIRE PRESS light will come on if the pressure in one tire becomes at least 8 psi higher or lower than the other 3 tires. The check tire pressure won't turn on the light if more than one tire is low or high, or if the system is not calibrated properly.

The CHECK TIRE PRESS light will stay on until the ignition is turned off or the CALIBRATE TIRE PRESS button is pushed (located under the dash). Don't press the CALIBRATE TIRE PRESS button without first correcting the cause of the problem by adjusting tire pressure in all 4 tires. If the CALIBRATE TIRE PRESS button is pressed while tire pressures are incorrect, the system will not work properly and may not alert the driver when a tire is low.

1. If the Electronic Brake Control Module (EBCM) detects a tire with low pressure, it signals the Driver Information Center (DIC) to turn on the CHECK TIRE PRESSURE light. To reset the display, turn ignition on with engine off.
2. Press and hold calibrate tire pressure button for about 3 seconds. Button is under lower left part of instrument panel, to right of steering column. CHECK TIRE PRESSURE light will flash 3 times and go out.

1998-05 LESABRE & PARK AVENUE

NOTE: **When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated. See TIRE PRESSURE SENSOR RELEARN in appropriate manufacturer service information.**

1999-2002 BUICK CENTURY & REGAL

The LOW TIRE light will come on if air pressure in one tire drops to 12 psi less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, if air pressure is adjusted or if battery is disconnected. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.

1. To reset system, turn ignition switch to ON (or RUN) position, with engine off. Press and hold Red RESET button for about 5 seconds. RESET button is located in instrument panel fuse block. Fuse block is located under cover at end of passenger's side of dash. Reset button is first button in top row of fuse block.
2. When system is reset, LOW TIRE light will come on, flash 3 times, and go off. If light does not turn off, repeat step 1. If light will not turn off, repair system as necessary.

1999-2001 OLDSMOBILE ALERO

CHECK TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi (kPa) less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if air pressure is adjusted. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.

1. To reset tire inflation monitor, turn ignition switch on, with engine off. Press and release the RESET button. RESET button is located inside of driver's side instrument panel fuse panel. The CHANGE OIL indicator light will begin to flash.
2. Press and release the RESET button again. The CHANGE OIL indicator light will turn off, and the CHECK TIRE PRESSURE indicator light will begin to flash. While the CHECK TIRE PRESSURE indicator light is flashing, press and hold the RESET button until the chime sounds indicating system is reset. If CHECK TIRE PRESSURE light does not go out, repeat reset procedure. If system still will not reset, repair system as necessary.

1999-2002 PONTIAC GRAND AM

CHECK TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi (kPa) less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if air pressure is adjusted. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.

1. To reset tire inflation monitor, turn ignition switch on, with engine off. Press and release the RESET button. RESET button is located inside of driver's side instrument panel fuse panel. The CHANGE OIL indicator light will begin to flash.
2. Press and release the RESET button again. The CHANGE OIL indicator light will turn off, and the CHECK TIRE PRESSURE indicator light will begin to flash. While the CHECK TIRE PRESSURE indicator light is flashing, press and hold the RESET button until the chime sounds indicating system is reset. If CHECK TIRE PRESSURE light does not go out, repeat reset procedure. If system still will not reset, repair system as necessary.

2000-05 CHEVROLET IMPALA & MONTE CARLO

NOTE: When a wheel is replaced or rotated, tire pressure has been adjusted, or vehicle's battery has been disconnected, TPM system will need to be recalibrated. See TIRE PRESSURE SENSOR RELEARN in appropriate manufacturer service information.

2000-05 PONTIAC BONNEVILLE

CHECK TIRE PRESSURE or TIRE PRESS message will come on if air pressure in one tire is lower than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if air pressure is adjusted. Message will stay on until system is recalibrated. Check and adjust air pressure in all 4 tires before recalibrating system.

1. If vehicle is equipped with Systems Monitor, go to step 2. To recalibrate vehicle equipped with Driver Information Center (DIC), turn ignition on with engine off. Using the MODE and SELECT button on DIC, change display until TIRE PRESSURE appears. Press and hold RESET button for 5 seconds. TIRE PRESSURE RESET should now appear on display. If TIRE PRESSURE RESET does not appear on display after 5 seconds, repair system as necessary. Using a scan tool, clear TPM DTC.
2. To recalibrate vehicle equipped with Systems Monitor, turn ignition on with engine off. Press and hold TIRE PRESS RESET button for 5 seconds. TIRE PRESS light on the Systems Monitor should begin to flash. Release the TIRE PRESS RESET button. TIRE PRESS light should go out and system is now reset. If TIRE PRESS light does not begin to flash after 5 seconds, repair system as necessary. Using a scan tool, clear TPM DTC.

2001-03 CHEVROLET CORVETTE

NOTE: When the wheels have been rotated or a tire pressure sensor has been replaced, retrain tire pressure sensor. See TIRE PRESSURE SENSOR RELEARN in appropriate manufacturer service information.

2001-03 OLDSMOBILE AURORA

The Tire Pressure Monitor (TPM) system alerts the driver when a large change in the pressure of one tire exists, while the vehicle is being driven. The TPM system uses the Electronic Brake Control Module (EBCM), ABS wheel speed sensor inputs, class 2 serial data circuit, and the Driver Information Center (DIC) to perform the system functions. The EBCM contains software to calculate relative tire pressure differences. The software requires approximately 30 minutes of straight line driving in 3 different speed ranges to complete the calibration process to have full capability for detecting a tire pressure condition. The speed ranges are 15-40 MPH, 40-70 MPH and 70-90 MPH.

1. LOW TIRE PRESSURE light comes on if air pressure in one tire is lower than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if tire pressure is adjusted. Light will stay on until ignition is turned off, or system is reset. Check and adjust air pressure in all 4 tires before resetting system.
2. To reset system, turn ignition on with the engine off. Press SELECT right arrow button on Driver Information Center (DIC) until GAGE mode is entered. Press the SELECT down arrow until TIRE PRESSURE is displayed.
3. Press and hold the DIC RESET button for 5 seconds. After 5 seconds, TIRE PRESSURE RESET should appear on display. After releasing the DIC RESET button, TIRE PRESSURE NORMAL should appear on display. System is now reset. Using a scan tool, clear the TPM DTC.
4. If TIRE PRESSURE RESET does not appear on display, repeat reset procedures. If system does not reset after trying reset procedures again, repair system as necessary.

2002-03 BUICK LESABRE

CHECK TIRE PRESSURE message will come on if air pressure in one tire is lower than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if air pressure is adjusted. Message will stay on until system is recalibrated. Check and adjust air pressure in all 4 tires before recalibrating system.

1. To recalibrate the system, turn ignition on with engine off. On 2000 models, press the GAGES button on the Driver Information Center (DIC) until TIRE PRESSURE appears on the display. On 2001-2003 models, press the GAGE INFO button on the Driver Information Center (DIC) until TIRE PRESSURE appears on the display. On all models, press and hold the DIC RESET button for 5 seconds.
2. After 5 seconds, the display will show TIRE PRESSURE RESET. After DIC RESET button is released, TIRE PRESSURE NORMAL will appear on display. If TIRE PRESSURE RESET does not appear on the display after 5 seconds, retry recalibration process. If system does not reset after trying recalibration procedures again, repair system as necessary.

2002 CHEVROLET IMPALA & MONTE CARLO

LOW TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi (kPa) less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, if air pressure is adjusted or when vehicle battery is disconnected. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.

1. There are 2 ways to reset the tire inflation monitor. To reset the tire inflation monitor using the exterior or interior lamp controls, go to step 4. To reset tire inflation monitor

using the radio, turn the radio off. Turn ignition to ACC or ON, with the engine off. Press and hold the TUNE DISP button on the radio for at least 5 seconds until settings is displayed.

2. On Impala, press the SEEK PTYPE up or down arrow to scroll through the main menu. On Monte Carlo, press the SEEK PSCAN up or down arrow to scroll through the main menu. On all models, scroll until TIRE MON appears on the display. Press the 1 PREV or 2 NEXT button to enter the sub-menu. RESET will be displayed.
3. Press the TUNE DISP button to reset. A chime will sound to verify the new setting and DONE will be displayed for one second. Once the message has been reset, scroll through the menu until EXIT appears on the display. Press the TUNE DISP button to exit the program. A chime will sound to verify the exit.
4. On Impala, to reset the tire inflation monitor using the interior lamp controls, turn the interior lamp controls from OFF to ON position 3 times with ignition switch in ON position. On Monte Carlo, to reset the tire inflation monitor using the exterior lamp controls, turn exterior lamp controls from OFF to parking lamps 3 times with ignition switch in ON position.

2002 OLDSMOBILE ALERO

The Tire Pressure Monitor (TPM) system alerts the driver when a large change in the pressure of one tire exists, while the vehicle is being driven. The TPM system uses the Electronic Brake Control Module (EBCM), ABS wheel speed sensor inputs, class 2 serial data circuit, and the Driver Information Center (DIC) to perform the system functions. The EBCM contains software to calculate relative tire pressure differences. The software requires approximately 30 minutes of straight line driving in 3 different speed ranges to complete the calibration process to have full capability for detecting a tire pressure condition. The speed ranges are 15-40 MPH, 40-70 MPH and 70-90 MPH.

1. LOW TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, if air pressure is adjusted or if vehicle battery is disconnected. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.
2. To reset tire inflation monitor, turn ignition switch on, with engine off. Press and release the RESET button. RESET button is located inside of driver's side instrument panel fuse block (left end of instrument panel). The CHANGE OIL indicator light will begin to flash.
3. Press and release the RESET button again. The CHANGE OIL indicator light will turn off, and the LOW TIRE PRESSURE indicator light will begin to flash. While the LOW TIRE PRESSURE indicator light is flashing, press and hold the RESET button until the chime sounds indicating system is reset. If the LOW TIRE PRESSURE indicator light does not go out, repeat reset procedure. If system still will not reset, repair system as necessary.

2002 PONTIAC GRAND AM

The Tire Pressure Monitor (TPM) system alerts the driver when a large change in the pressure of one tire exists, while the vehicle is being driven. The TPM system uses the Electronic Brake Control Module (EBCM), ABS wheel speed sensor inputs, class 2 serial data circuit, and the Driver Information Center (DIC) to perform the system functions. The EBCM contains software to calculate relative tire pressure differences. The software requires approximately 30 minutes of straight line driving in 3 different speed ranges to complete the calibration process to have full capability for detecting a tire pressure condition. The speed ranges are 15-40 MPH, 40-70 MPH and 70-90 MPH.

1. LOW TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, if air pressure is adjusted or if vehicle battery is disconnected. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.
2. To reset tire inflation monitor, turn ignition switch on, with engine off. Press and release the RESET button. RESET button is located inside of driver's side instrument panel fuse block (left end of instrument panel). The CHANGE OIL indicator light will begin to flash.
3. Press and release the RESET button again. The CHANGE OIL indicator light will turn off, and the LOW TIRE PRESSURE indicator light will begin to flash. While the LOW TIRE PRESSURE indicator light is flashing, press and hold the RESET button until the chime sounds indicating system is reset. If the LOW TIRE PRESSURE indicator light does not go out, repeat reset procedure. If system still will not reset, repair system as necessary.

2003-04 BUICK CENTURY & REGAL

Using Reset Button

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicles Loading Information Label for recommended tire pressure. The label is attached to the center pillar, near the driver's door latch. Turn ON ignition, with engine OFF.
2. Press and hold the red RESET button located in the passenger side instrument panel fuse block.
3. The LOW TIRE indicator will flash 3 times, then turn off.
4. Use the scan tool in order to clear the TPM DTC.

Using Scan Tool

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicles Loading Information Label for recommended tire pressure. The label is attached to the center pillar, near the driver's door latch. Turn ON ignition, with engine OFF.

2. Install scan tool. Turn ON ignition, with engine OFF.
3. With scan tool, select Special Functions.
4. Select TIM Reset.
5. Press Reset soft key.
6. LOW TIRE indicator will flash 3 times, then turn OFF.
7. Use scan tool in order to clear the TPM DTC.

2003-04 BUICK PARK AVENUE

There are 2 ways to reset the Tire Pressure Monitor (TPM) system. After resetting, TPM system requires up to 30 minutes of straight line driving in each of the 3 speed ranges to complete the calibration process. The speed ranges are 15-40 MPH, 40-70 MPH, and 70-90 MPH.

Using Driver Information Center

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicles Tire Placard for tire pressures. Tire Placard is permanently located on the edge of the driver's door.
2. Turn ON ignition, with engine off.
3. Press GAGE INFO button until TIRE PRESSURE is displayed.
4. Press and hold RESET button until TIRE PRESSURE RESET is displayed.
5. Release RESET button, TIRE PRESSURE NORMAL is displayed.
6. Use scan tool in order to clear the TPM DTC.

Using Scan Tool

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicles Tire Placard for tire pressures. Tire Placard is permanently located on the edge of the driver's door.
2. Install a scan tool. Turn ON ignition, with engine off.
3. With scan tool, select Special Functions.
4. Select Tire Pressure Reset.
5. Press Reset soft key and TIRE PRESSURE NORMAL is displayed on the DIC.
6. Use scan tool in order to clear the TPM DTC.

2003-07 BUICK RENDEZVOUS

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed

and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition switch to ON position, with engine off.
4. Press and hold the MODE button until DIC display reads "LOW TIRE PRESSURE HOLD SET TO RESET".
5. Press and hold SET button until a chime sounds and "TIRE PRESSURE RESET" is displayed.
6. System will now sound a chime 3 times, and DIC will display "TIRE PRESSURE NORMAL".

NOTE: If low tire pressure warning message is still set, TPM system has not reset. Repeat procedure.

7. After resetting, the TPM system requires up to 5 miles (8 km) of flat, smooth road, straight line driving in each of the 4 speed ranges (about 10-20 minutes in each range) to complete the calibration process:
    - 19-40 MPH (31-65 KM/H).
    - 40-59 MPH (65-95 KM/H).
    - 59-74.5 MPH (95-120 KM/H).
    - 74.5-90 MPH (120-145 KM/H).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Calibration Mode, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Detection Mode, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

1. There are 3 different ways to reset the TPM system. If using the exterior lamp switch, go to next step. If using the RDS radio, go to step 3. If using a scan tool, go to step 6.
2. Adjust all tire pressures to the recommended Psi (kPa). Refer to tire placard located on the inside of the rear trunk lid. Turn ignition ON, with engine OFF. Cycle exterior lamp switch from OFF to parking lamps 3 times within 5 seconds. Using scan tool, clear the TPM DTC.
3. Adjust all tire pressures to the recommended Psi (kPa). Refer to tire placard located on the inside of the rear trunk lid. Turn ignition to ACC or ON, with engine OFF. Turn radio OFF.
4. Press and hold the DISP button until SETTINGS is displayed. Press SEEK up or down arrows until TIRE MON is displayed. Press the PREV or NEXT button to enter the sub-menu. RESET will be displayed.
5. Press the DISP button, a chime will sound and DONE will be displayed. Scroll until EXIT is displayed. Press the DISP button to exit the TPM reset mode. A chime will sound to verify exit. Using scan tool, clear TPM DTC.
6. Adjust all tire pressures to the recommended Psi (kPa). Refer to tire placard located on the inside of the rear trunk lid. Install the scan tool.
7. Turn ignition ON, with engine OFF. With the scan tool select SPECIAL FUNCTIONS. Select TIM Reset. Press the RESET soft key. Using scan tool, clear TPM DTC.

2003-05 PONTIAC AZTEK

1. Check and adjust air pressure in all 4 tires before resetting system. Refer to tire placard located on the inside edge of the driver's door. Turn ignition ON, with engine off.
2. Press the MODE button on the Driver Information System until LOW TIRE PRESSURE HOLD SET TO RESET is displayed.
3. Press and hold the SET button until a chime sounds and TIRE PRESSURE RESET is displayed and a chime sounds 3 times.
4. Release the SET button and TIRE PRESSURE NORMAL will be displayed.

2004 BUICK LESABRE

There are 2 ways to reset the Tire Pressure Monitor (TPM) system. After resetting, TPM system requires up to 30 minutes of straight line driving in each of the 3 speed ranges to complete the calibration process. The speed ranges are 15-40 MPH, 40-70 MPH, and 70-90 MPH.

Using Driver Information Center

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicles Tire Placard for tire pressures. Tire Placard is permanently located on the edge of the driver's door.
2. Turn ON ignition, with engine off.

3. Press GAGE INFO button until TIRE PRESSURE is displayed.
4. Press and hold RESET button until TIRE PRESSURE RESET is displayed.
5. Release RESET button, TIRE PRESSURE NORMAL is displayed.
6. Use scan tool in order to clear the TPM DTC.

Using Scan Tool

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicles Tire Placard for tire pressures. Tire Placard is permanently located on the edge of the driver's door.
2. Install a scan tool. Turn ON ignition, with engine off.
3. With scan tool, select Special Functions.
4. Select Tire Pressure Reset.
5. Press Reset soft key and TIRE PRESSURE NORMAL is displayed on the DIC.
6. Use scan tool in order to clear the TPM DTC.

2004-06 CHEVROLET AVALANCHE, SILVERADO, SUBURBAN & TAHOE

NOTE: When the wheels have been rotated, or a tire pressure sensor or PDM/RCDLR has been replaced, retrain tire pressure sensor. See TIRE PRESSURE SENSOR RELEARN in appropriate manufacturer service information.

2004 CHEVROLET CORVETTE

1. Turn ON ignition, with engine OFF. Press DIC RESET button in order to clear any warning messages.
2. Press and release OPTIONS button until display is blank.
3. Press and hold RESET button for 3 seconds.

NOTE: If the DIC does not display TIRE TRAINING message, ensure TPM option is enabled in the RCDLR. Check TPM option and Set Options/TPM. The scan tool can be used to enable, or disable TPM option in the RCDLR. Check TPM DTC display and Set Options/TPM DTC. The scan tool can be used to enable or disable TPM DTC displaying option on the DIC.

4. Press and release OPTIONS button until TIRE TRAINING is displayed.
5. Press and release RESET button and LEARN L FRONT TIRE is displayed, verifying learn mode has been enabled.

NOTE: If a horn chirp does not sound after 15 seconds, remove then reinstall sensor activating tool.

6. Starting at left front sensor, hold Tire Pressure Sensor Activating Tool (J-41760) over valve stem until a horn chirp sounds.
7. After horn chirp sounds, proceed as in step 6 for the next 3 sensors in the following order of right front, right rear and left rear.
8. Turn ignition OFF to exit learn mode.

2004 CHEVROLET AVALANCHE, SUBURBAN & TAHOE

NOTE: If the wheels have been rotated, or tire pressure sensor or RCDLR is replaced, the TPM system needs to relearn tire pressure sensor IDs. See TIRE PRESSURE SENSOR RELEARN in appropriate manufacturer service information.

2004-07 GMC SIERRA & YUKON

NOTE: When the wheels have been rotated, or a tire pressure sensor or PDM/RCDLR has been replaced, retrain tire pressure sensor.

The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the system has been in learn mode for more than 5 minutes. If the learn mode is canceled before any sensor has been learned, the PDM/RCDLR will remember all current sensor IDs and their locations. As soon as the first sensor ID code is learned, all other IDs are erased from the PDM/RCDLR's memory. On models that display the individual tire pressure on DIC, updated tire pressures will not be displayed until PDM/RCDLR receives 2 more valid transmissions from each sensor. After performing the procedure below, always test drive the vehicle above 25 mph for at least 2 minutes before viewing tire pressures on DIC.

NOTE: Before proceeding with the steps below, ensure that no other sensor learn procedure is being performed simultaneously, or that tire pressures are not being adjusted on a TPM equipped vehicle within close proximity.

NOTE: In the following procedure, a TPM Sensor Activation Tool (J-46079) may be used in place of increasing/decreasing pressures to enable sensor. To use, place activator antenna against the tire sidewall close to the wheel rim at the valve stem location, then press and release the ACTIVATE button.

NOTE: If TPM Sensor Activation Tool (J-46079) is used, and vehicle is having trouble entering relearn mode, check batteries in activation tool. Low batteries may allow some functions to work, but not allow vehicle to perform learn function. When the internal

battery is fresh (fully charged), the indicator is "full" or all dark. When the battery is depleted, the indicator shows "empty" or all light.

1. Turn ignition switch to ON position, with engine off. Apply parking brake.

NOTE: If learn mode cannot be enabled, TPM system is not enabled in PDM/RCDLR. See appropriate manufacturer service information.

2. Turn headlight switch from OFF to parking lamps 4 times within 4 seconds. A double horn chirp will sound and the low tire pressure indicator will begin to flash indicating the learn mode has been enabled (the low tire pressure indicator should continue flashing throughout the matching procedure, and "SERVICE TIRE MONITOR" message will be displayed on the DIC).

WARNING: Overinflating tires may cause personal injury or damage to the tires and wheels. When increasing tire pressure, do not exceed the maximum inflation pressure as noted on the tire sidewall.

NOTE: If a horn chirp does not sound after 35 seconds for any of the 4 sensors, turn ignition switch to OFF position to exit the learn mode. Repeat procedure from step 1.

3. Starting with left front tire, increase or decrease the pressure for 8-10 seconds, or until a horn chirp sounds. Horn chirp may occur before the 8-10 second pressure increase/decrease time period has been reached, or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached.
4. After horn chirp has sounded, proceed as in step 3 for the next 3 sensors in the following order: right front, right rear and left rear.
5. After left rear sensor has been learned, check to see if the low tire pressure indicator is still flashing. If it is, turn ignition switch to OFF position to exit relearn procedure. Adjust all tire pressures to specification. If the low tire pressure indicator is not flashing, repeat procedure from step 1.
6. The DIC may list all 4 of the tire pressures at 0 psi after tire pressure sensor relearn procedure has been performed (although PDM/RCDLR reads correct learn value of the tires). To complete the relearn procedure, drive the vehicle at highway speeds for 5 minutes.

2004 GMC YUKON & YUKON XL

NOTE: When the wheels have been rotated or a tire pressure sensor has

been replaced, retrain tire pressure sensor. See TIRE PRESSURE SENSOR RELEARN in appropriate manufacturer service information.

2004 PONTIAC BONNEVILLE

There are 3 ways to reset the Tire Pressure Monitor (TPM) system. After resetting, TPM system requires up to 30 minutes of straight line driving in each of the 3 speed ranges to complete the calibration process. The speed ranges are 15-40 MPH, 40-70 MPH, and 70-90 MPH.

Using Systems Monitor

1. Set all tire pressures to the recommended Psi (kPa). See vehicles Tire Placard for tire pressures. Tire placard is located on the inside of the rear compartment lid.
2. Turn ON ignition, with engine OFF.
3. Press and hold TIRE PRESS RESET button until the TIRE PRESS indicator begins to flash.
4. Release TIRE PRESS RESET button and the TIRE PRESS indicator will turn off.
5. Use scan tool in order to clear the TPM DTC.

Using Driver Information Center (If Equipped)

1. Set all tire pressures to the recommended Psi (kPa). See vehicles Tire Placard for tire pressures. Tire placard is located on the inside of the rear compartment lid.
2. Turn ON ignition, with engine OFF.
3. Press MODE button until TIRE PRESSURE is displayed.
4. Press and hold RESET button until TIRE PRESSURE RESET is displayed.
5. Release RESET button, TIRE PRESSURE NORMAL is displayed.
6. Use scan tool in order to clear the TPM DTC.

Using Scan Tool

1. Set all tire pressures to the recommended Psi (kPa). See vehicles Tire Placard for tire pressures. Tire placard is located on the inside of the rear compartment lid.
2. Install a scan tool. Turn ON ignition, with engine OFF.
3. With scan tool select Special Functions.
4. Select Tire Pressure Reset.
5. Press Reset soft key.
6. TIRE PRESS indicator will turn off on the Systems Monitor, or TIRE PRESSURE NORMAL is displayed on the DIC, if equipped.
7. Use scan tool in order to clear the TPM DTC.

2004-07 PONTIAC GRAND PRIX

NOTE: After resetting, the TPM system requires up to 5 miles of flat, smooth road straight line driving in each of the 4 speed ranges to complete the calibration process. The speed ranges are 19-40 MPH, 40-59 MPH, 59-74.5 MPH and 74.5-90 MPH.

1. Set all tire pressures to recommended Psi (kPa), see vehicles Tire Placard located on edge of driver's door.
2. Turn ON ignition, with engine OFF.
3. Press vehicle information button until TIRE INFLATION MONITOR SYSTEM PRESS (down/left arrow) SWITCH TO RESET is displayed.
4. If the system is being reset due to a low tire pressure condition, press and hold down/left arrow button until TIRE INFLATION MONITOR SYSTEM HAS BEEN RESET is displayed. If the system is being reset due to a tire rotation, press and hold down/left arrow button for 5 seconds.
5. Release down/left arrow button and TIRE PRESSURE NORMAL is displayed.

2005 BUICK CENTURY

NOTE: There are 2 ways to reset the Tire Pressure Monitor (TPM) system. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the 3 speed ranges to complete the calibration process. The speed ranges are as follows:

- **24-64 km/h (15-40 mph)**
- **64-113 km/h (40-70 mph)**
- **113-145 km/h (70-90 mph)**

Using RESET button

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn ON the ignition, with the engine OFF.
3. Press and hold the red RESET button located in the passenger side instrument panel fuse block.
4. The LOW TIRE indicator will flash 3 times, then turn off.
5. Use the scan tool in order to clear the TPM DTC.

Using Scan Tool

1. Adjust all tire pressures to the recommended kPa/psi.
2. Install the scan tool.

3. Turn ON the ignition, with the engine OFF.
4. With the scan tool select Special Functions.
5. Select TIM Reset.
6. Press the Reset soft key.
7. The LOW TIRE indicator will flash 3 times, then turn OFF.
8. Use the scan tool in order to clear the TPM DTC.

2005 BUICK LESABRE & PARK AVENUE

NOTE: There are 2 ways to reset the tire pressure monitor (TPM) system. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the 3 speed ranges to complete the calibration process.

- **24-64 km/h (15-40 mph)**
- **64-113 km/h (40-70 mph)**
- **113-145 km/h (70-90 mph)**

Using the DIC

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn ON the ignition, with the engine OFF.
3. Press the GAGE INFO button until TIRE PRESSURE is displayed.
4. Press and hold the RESET button until TIRE PRESSURE RESET is displayed.
5. Release the RESET button. The TIRE PRESSURE NORMAL message should be displayed on the DIC.
6. Clear the TPM DTC with a scan tool.

Using Scan Tool

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn ON the ignition, with the engine OFF.
3. Select Special Functions with the scan tool.
4. Select Tire Pressure Reset.
5. Press the Reset soft key. The TIRE PRESSURE NORMAL message should be displayed on the DIC.
6. Clear the TPM DTC with the scan tool.

2005-07 CHEVROLET AVALANCHE, SILVERADO, SUBURBAN & TAHOE

NOTE: When the wheels have been rotated or a tire pressure sensor has

been replaced, retrain tire pressure sensor.

1. Turn ignition switch to ON position, with engine off. Apply parking brake.

NOTE: **If learn mode cannot be enabled, TPM system is not enabled in PDM/RCDLR. See appropriate manufacturer service information.**

2. Turn headlight switch from OFF to parking lamps 4 times within 4 seconds. A double horn chirp will sound and the low tire pressure indicator will begin to flash to indicate the learn mode has been enabled (the low tire pressure indicator should continue flashing throughout the matching procedure, and "SERVICE TIRE MONITOR" message will be displayed on the DIC).

WARNING: **Overinflating tires may cause personal injury or damage to the tires and wheels. When increasing tire pressure, do not exceed the maximum inflation pressure as noted on the tire sidewall.**

NOTE: **If a horn chirp does not sound after 35 seconds for any of the 4 sensors, turn ignition switch to OFF position to exit the learn mode. Repeat procedure from step 1.**

3. Starting with left front tire, increase or decrease the pressure for 8-10 seconds, or until a horn chirp sounds. Horn chirp may occur before the 8-10 second pressure increase/decrease time period has been reached, or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached.
4. After horn chirp has sounded, proceed as in step 3 for the next 3 sensors in the following order: right front, right rear and left rear.
5. After left rear sensor has been learned, check to see if the low tire pressure indicator is still flashing. If it is, turn ignition switch to OFF position to exit relearn procedure. Adjust all tire pressures to specification. If the low tire pressure indicator is not flashing, repeat procedure from step 1.
6. On some models, the DIC may list all 4 of the tire pressures at 0 psi after tire pressure sensor relearn procedure has been performed (although PDM/RCDLR reads correct learn value of the tires). To complete the relearn procedure on these models, drive the vehicle at highway speeds for 5 minutes.

2005-07 CHEVROLET CORVETTE

NOTE: **In the following procedure, a TPM Sensor Activation Tool (J-46079) must be used.**

NOTE: If the tire pressure sensor or RCDLR is replaced, the TPM system needs to relearn tire pressure sensor IDs.

The TPM system will cancel the learn mode if more then 2 minutes have passed and no sensors have been learned, or if the RCDLR has been in learn mode for more than 5 minutes. If the learn mode is canceled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory.

1. Turn ignition switch to ACC position. Apply parking brake.
2. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating the learn mode has been enabled.
3. Starting with left front tire, hold antenna of TPM Sensor Activation Tool (J-46079) against the tire sidewall close to the wheel rim at the valve stem location, then press and release the ACTIVATE button and wait for a horn chirp.
4. After horn chirp has sounded, proceed as in step 3 for the next 3 sensors in the following order: right front, right rear and left rear.
5. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position.

2005 CHEVROLET IMPALA & MONTE CARLO

NOTE: There are 3 different ways to reset the Tire Pressure Monitor (TPM) system. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the 3 speed ranges to complete the calibration process.

Using Exterior Lamp Switch

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn ON the ignition, with the engine OFF.
3. Cycle the exterior lamp switch from OFF to parking lamps 3 times within 5 seconds.
4. Use the scan tool in order to clear the TPM DTC.

Using RDS Radio, If Equipped

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn the ignition to ACC or ON, with the engine OFF.
3. Turn the radio OFF.
4. Press and hold the DISP button until SETTINGS is displayed.
5. Press the SEEK up or down arrows until TIRE MON is displayed.
6. Press the PREV or NEXT button to enter the sub-menu. RESET will be displayed.

7. Press the DISP button, A chime will sound and DONE will be displayed.
8. Scroll until EXIT is displayed.
9. Press the DISP button to exit the TPM reset mode. A chime will sound to verify exit.
10. Use the scan tool in order to clear the TPM DTC.

Using Scan Tool

1. Adjust all tire pressures to the recommended kPa/psi.
2. Install the scan tool.
3. Turn ON the ignition, with the engine OFF.
4. With the scan tool select Special Functions.
5. Select TIM Reset.
6. Press the Reset soft key.
7. Use the scan tool in order to clear the TPM DTC.

2005-06 GMC YUKON & YUKON XL

NOTE: **When the wheels have been rotated or a tire pressure sensor has been replaced, retrain tire pressure sensor. See TIRE PRESSURE SENSOR RELEARN in appropriate manufacturer service information.**

2005 PONTIAC AZTEK

NOTE: **After resetting, the tire pressure monitor (TPM) system requires up to 8 km/h (5 miles) of flat, smooth road, straight line driving in each of the 4 speed ranges to complete the calibration process. The speed ranges are as follows:**

- **24-64 km/h (15-40 mph)**
- **64-113 km/h (40-70 mph)**
- **113-145 km/h (70-90 mph)**

Using the DIC

1. Set all tire pressures to the recommended kPa/psi.
2. Turn ON the ignition, with the engine OFF.
3. Press the MODE button until LOW TIRE PRESSURE HOLD SET TO RESET is displayed.
4. Press and hold the SET button until a chime sounds and TIRE PRESSURE RESET is displayed and a chime sounds 3 times.

5. Release the SET button and TIRE PRESSURE NORMAL is displayed.

2005-06 PONTIAC GRAND PRIX

Using Driver Information Center (DIC)

NOTE: After resetting, the tire pressure monitoring (TPM) system requires up to 8 km/h (5 miles) of flat, smooth road straight line driving in each of the 4 speed ranges to complete the calibration process.

1. Set all tire pressures to the recommended kPa/psi.
2. Turn ON the ignition, with the engine OFF.
3. Press the vehicle information button until TIRE INFLATION MONITOR SYSTEM PRESS (down/left arrow) SWITCH TO RESET is displayed.
4. If the system is being reset due to a low tire pressure condition, press and hold the down/left arrow button until TIRE INFLATION MONITOR SYSTEM HAS BEEN RESET is displayed. If the system is being reset due to a tire rotation, press and hold the down/left arrow button for 5 seconds.
5. Release the down/left arrow button and TIRE PRESSURE NORMAL is displayed.

2005-06 PONTIAC VIBE

NOTE: After resetting, the tire pressure monitoring (TPM) system requires 60 minutes or more of driving at a speed of 30 km/h (19 mph) or above to complete the calibration process to have full capability for detecting a tire pressure condition.

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn ON the ignition, with the engine OFF.
3. Press and hold the tire pressure warning reset switch until the tire pressure warning indicator blinks 3 times at one second intervals.
4. If the tire pressure warning indicator does not blink, repeat the procedure starting at step 2.
5. Drive the vehicle for 60 minutes or more at a speed of 30 km/h (19 mph).
6. Verify the system has initialized. Turn ON the ignition, with the engine OFF and observe the tire pressure warning indicator.
    - System Initialized: light on for 3 seconds.
    - System not initialized: light on for 4 seconds.

2006-07 BUICK LACROSSE

NOTE: When the wheels have been rotated, or a tire pressure sensor has been replaced, retrain tire pressure sensor.

WARNING: **Stray signals from other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn chirps are heard from the vehicle while performing the learn procedure, most likely a stray sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component. Before proceeding with the steps below, verify the following: No other sensor learn procedure is being performed simultaneously within close proximity. Tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Park Brake and Headlamp Switch input parameters are functioning correctly.**

1. Turn ON the ignition, with the engine OFF.
2. Apply the parking brake.
3. Initiate the TPM Learn Mode using one of the following procedures:
   - Using a scan tool, initiate the TPM Learn Mode. A double horn chirp will sound indicating the Learn Mode has been enabled. The left front turn signal will also be illuminated
   - On vehicles equipped with keyless entry, simultaneously press the keyless entry transmitters lock and unlock buttons until a double horn chirp sounds indicating the Learn Mode has been enabled. The left front turn signal will also be illuminated.
   - On vehicles not equipped with keyless entry, press and release the driver information center (DIC) INFO button until the RELEARN TIRE POSITIONS message appears on the DIC display. Press and hold the SET/RESET button until a double horn chirp sounds and the DIC displays a TIRE LEARNING ACTIVE message indicating the Learn Mode has been enabled. The left front turn signal will also be illuminated.
4. Starting with the left front tire, learn the tire pressure using one of the following methods:
   - **Method 1:** Hold the antenna of the tool against the tire sidewall close to the wheel rim at the valve stem location then press and release the activate button and wait

for a horn chirp.

- **Method 2:** Increase/decrease the tire pressure for 8-10 seconds then wait for a horn chirp. The horn chirp may occur before or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached.

WARNING: **Over inflating tires may cause personal injury or damage to the tires and wheels. When increasing tire pressure do not exceed the maximum inflation pressure as noted on the tire sidewall.**

5. After the horn chirp has sounded, repeat step 4 for the remaining 3 sensors in the following order: Right front, Right rear, Left rear.
6. After the LR sensor has been learned, a horn chirp will sound indicating all sensors have been learned.
7. Turn OFF the ignition to exit the learn mode.
8. After the learn mode has been exited, adjust all tires to the recommended pressures.

2006-07 BUICK LUCERNE

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition switch to ON position, with engine off.
4. Press and hold the vehicle information button until DIC display reads "PRESS TO RESET TIRE SYSTEM".
5. Press and hold SET/RESET button for about 5 seconds. After 5 seconds, system will display "TIRE PRESSURE RESET".
6. System will now sound a chime 3 times, and DIC will display "TIRE PRESSURE NORMAL".

NOTE: If low tire pressure warning message is still set, TPM system

has not reset. Repeat procedure. If it does not work after two tries, refer to appropriate service information.

7. After resetting, the TPM system requires about 20-45 minutes of driving in each of the following speed ranges to complete the calibration process:
   - 25-40 MPH (40-64 KM/H).
   - 40-60 MPH (65-96 KM/H).
   - 60-85 MPH (96-136 KM/H).

   NOTE: Learning process does not need to be completed during a single trip.

2006-07 BUICK RAINIER

NOTE: When the wheels have been rotated, or a tire pressure sensor or EGM/LGM has been replaced, retrain tire pressure sensor.

NOTE: If this procedure is performed following replacement and reprogramming of the Liftgate Module (LGM), DIC may display a low tire pressure fault and all tire pressures read 0 psi. If this problem occurs, contact vehicle manufacturer for repair procedure.

The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the system has been in learn mode for more than 5 minutes. If the learn mode is canceled before any sensor has been learned, the EGM/LGM will remember all current sensor IDs and their locations. As soon as the first sensor ID code is learned, all other IDs are erased from the EGM/LGM's memory. On models that display the individual tire pressure on DIC, updated tire pressures will not be displayed until EGM/LGM receives 2 more valid transmissions from each sensor. After performing the procedure below, always test drive the vehicle above 25 mph for at least 2 minutes before viewing tire pressures on DIC.

NOTE: Before proceeding with the steps below, ensure that no other sensor learn procedure is being performed simultaneously, or that tire pressures are not being adjusted on a TPM equipped vehicle within close proximity.

NOTE: In the following procedure, a TPM Sensor Activation Tool (J-46079) may be used in place of increasing/decreasing pressures to enable sensor. To use, place activator antenna against the tire sidewall close to the wheel rim at the valve stem location, then

press and release the ACTIVATE button.

NOTE: **If TPM Sensor Activation Tool (J-46079) is used, and vehicle is having trouble entering relearn mode, check batteries in activation tool. Low batteries may allow some functions to work, but not allow vehicle to perform learn function. When the internal battery is fresh (fully charged), the indicator is "full" or all dark. When the battery is depleted, the indicator shows "empty" or all light.**

1. Turn ignition switch to ON position, with engine off. Apply parking brake.

   NOTE: **If learn mode cannot be enabled, TPM system is not enabled in EGM/LGM. See appropriate manufacturer service information.**

2. Turn headlight switch from OFF to parking lamps 4 times within 4 seconds. A double horn chirp will sound and the low tire pressure indicator will begin to flash to indicate the learn mode has been enabled.

   WARNING: **Overinflating tires may cause personal injury or damage to the tires and wheels. When increasing tire pressure, do not exceed the maximum inflation pressure as noted on the tire sidewall.**

3. Starting with left front tire, increase or decrease the pressure for 8-10 seconds, or until a horn chirp sounds. Horn chirp may occur before the 8-10 second pressure increase/decrease time period has been reached, or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached.
4. After horn chirp has sounded, proceed as in step 3 for the next 3 sensors in the following order: right front, right rear and left rear.
5. After left rear sensor has been learned, turn ignition switch to OFF position. Adjust all tire pressures to specification.

2006-07 CHEVROLET COLORADO

NOTE: **When the wheels have been rotated, or a tire pressure sensor has been replaced, retrain tire pressure sensor.**

NOTE: **Learn Mode Cancellation The learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any sensor that has not been learned. If the learn mode is cancelled before the first sensor is learned, the original sensor IDs will be**

maintained. If the learn mode is canceled for any reason after the first sensor is learned, all IDs are erased from the BCM memory and if equipped, the DIC will display dashes for tire pressures.

WARNING: **Stray signals from other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn chirps are heard from the vehicle while performing the learn procedure, most likely a stray sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component. Before proceeding with the steps below, verify the following: No other sensor learn procedure is being performed simultaneously within close proximity. Tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Park Brake and Headlamp Switch input parameters are functioning correctly.**

1. Turn ON the ignition, with the engine OFF.
2. Apply the parking brake.
3. Turn the exterior lamp switch from OFF to parking lamps 4 times within 4 seconds. A horn chirp will sound and the low tire pressure indicator will begin to flash indicating the learn mode has been enabled.
4. Starting with the left front tire, learn the tire pressure using one of the following methods: Method 1: Hold the antenna of the tool against the tire sidewall close to the wheel rim at the valve stem location then press and release the activate button and wait for a horn chirp. Method 2: Increase/decrease the tire pressure for 8-10 seconds then wait for a horn chirp. The horn chirp may occur before or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached.

WARNING: **Over inflating tires may cause personal injury or damage to the tires and wheels. When increasing tire pressure do not exceed the maximum inflation pressure as noted on the tire sidewall.**

5. After the horn chirp has sounded, repeat step 4 for the remaining 3 sensors in the following order: Right front, Right rear, Left rear.

6. After the LR sensor has been learned, a horn chirp will sound indicating all sensors have been learned.
7. Turn OFF the ignition to exit the learn mode.
8. After the learn mode has been exited, adjust all tires to the recommended pressures.

2006-07 CHEVROLET EQUINOX

NOTE: When the wheels have been rotated, or a tire pressure sensor has been replaced, retrain tire pressure sensor.

NOTE: Learn Mode Cancellation: The learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any sensor that has not been learned. If the learn mode is cancelled before the first sensor is learned, the original sensor IDs will be maintained. If the learn mode is canceled for any reason after the first sensor is learned, all IDs are erased from the BCM memory and if equipped, the DIC will display dashes for tire pressures.

> **WARNING: Stray signals from other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn chirps are heard from the vehicle while performing the learn procedure, most likely a stray sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component. Before proceeding with the steps below, verify the following: No other sensor learn procedure is being performed simultaneously within close proximity. Tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Park Brake and Headlamp Switch input parameters are functioning correctly.**

1. Turn ON the ignition, with the engine OFF.
2. Apply the parking brake.
3. Turn the exterior lamp switch from OFF to parking lamps 4 times within 4 seconds. A horn chirp will sound and the low tire pressure indicator will begin to flash indicating

the learn mode has been enabled.

4. Starting with the left front tire, learn the tire pressure using one of the following methods:
   - **Method 1:** Hold the antenna of the tool against the tire sidewall close to the wheel rim at the valve stem location then press and release the activate button and wait for a horn chirp.
   - **Method 2:** Increase/decrease the tire pressure for 8-10 seconds then wait for a horn chirp. The horn chirp may occur before or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached.

   WARNING: **Over inflating tires may cause personal injury or damage to the tires and wheels. When increasing tire pressure do not exceed the maximum inflation pressure as noted on the tire sidewall.**

5. After the horn chirp has sounded, repeat step 4 for the remaining 3 sensors in the following order: Right front, Right rear, Left rear.
6. After the LR sensor has been learned, a horn chirp will sound indicating all sensors have been learned.
7. Turn OFF the ignition to exit the learn mode.
8. After the learn mode has been exited, adjust all tires to the recommended pressures.

2006-07 CHEVROLET IMPALA & MONTE CARLO

NOTE: **If a tire pressure sensor or the RCDLR is replaced, or if wheels have been rotated, tire pressure sensor must be retrained.**

The TPM system will cancel the learn mode if more then 2 minutes have passed and no sensors have been learned, or if the RCDLR has been in learn mode for more than 5 minutes. If the learn mode is canceled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory.

NOTE: **Before proceeding with the steps below, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.**

NOTE: **In the following procedures, a TPM Sensor Activation Tool (J-46079) may be used in place of increasing/decreasing pressures to enable sensor. To use, place activator antenna against the tire sidewall close to the wheel rim at the valve stem location, then**

press and release the ACTIVATE button.

NOTE: **If TPM Sensor Activation Tool (J-46079) is used, and vehicle is having trouble entering relearn mode, check batteries in activation tool. Low batteries may allow some functions to work, but not allow vehicle to perform learn function. When the internal battery is fresh (fully charged), the indicator is "full" or is all dark. When the battery is depleted, the indicator shows "empty" or is all light.**

Relearn Procedure Using Keyless Entry System

1. Turn ignition switch to ACC position. Apply parking brake.
2. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating the learn mode has been enabled.

WARNING: **Overinflating tires may cause personal injury or damage to the tires and wheels. When increasing tire pressure, DO NOT exceed the maximum inflation pressure as noted on the tire sidewall.**

3. Starting with left front tire, increase or decrease the pressure for 5-8 seconds, or until a horn chirp sounds. The horn chirp may occur before the 5-8 second pressure increase/decrease time period has been reached, or up to 30 seconds after the 5-8 second pressure increase/decrease time period has been reached.
4. After horn chirp has sounded, proceed as in step 3 for the next 3 sensors in the following order: right front, right rear and left rear.
5. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position. Adjust all tire pressures to specification.

Relearn Procedure Using Scan Tool

NOTE: **Before proceeding with the steps below, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.**

1. Connect scan tool. Turn ignition switch to ACC position. Apply parking brake.
2. Using scan tool, select "SPECIAL FUNCTIONS".
3. Select "SENSOR LEARN MODE ENABLE", and press ENTER key.
4. Press ON soft key. A horn chirp will sound, indicating the learn mode has been enabled.

WARNING: **Overinflating tires may cause personal injury or damage to the tires and wheels. When increasing tire pressure, DO NOT exceed the maximum inflation pressure as noted on the tire sidewall.**

5. Starting with left front tire, increase or decrease pressure for 5-8 seconds, or until a horn chirp sounds. The horn chirp may occur before the 5-8 second pressure increase/decrease time period has been reached, or up to 30 seconds after the 5-8 second pressure increase/decrease time period has been reached.
6. After horn chirp has sounded, proceed as in step 5 for the next 3 sensors in the following order: right front, right rear and left rear.
7. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position. Adjust all tire pressures to specification.

2006-07 CHEVROLET TRAILBLAZER

NOTE: When the wheels have been rotated, or a tire pressure sensor or EGM/LGM has been replaced, retrain tire pressure sensor.

NOTE: If this procedure is performed following replacement and reprogramming of the Liftgate Module (LGM), DIC may display a low tire pressure fault and all tire pressures read 0 psi. If this problem occurs, contact vehicle manufacturer for repair procedure.

The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the system has been in learn mode for more than 5 minutes. If the learn mode is canceled before any sensor has been learned, the EGM/LGM will remember all current sensor IDs and their locations. As soon as the first sensor ID code is learned, all other IDs are erased from the EGM/LGM's memory. On models that display the individual tire pressure on DIC, updated tire pressures will not be displayed until EGM/LGM receives 2 more valid transmissions from each sensor. After performing the procedure below, always test drive the vehicle above 25 mph for at least 2 minutes before viewing tire pressures on DIC.

NOTE: Before proceeding with the steps below, ensure that no other sensor learn procedure is being performed simultaneously, or that tire pressures are not being adjusted on a TPM equipped vehicle within close proximity.

NOTE: In the following procedure, a TPM Sensor Activation Tool (J-46079) may be used in place of increasing/decreasing pressures

to enable sensor. To use, place activator antenna against the tire sidewall close to the wheel rim at the valve stem location, then press and release the ACTIVATE button.

NOTE: If TPM Sensor Activation Tool (J-46079) is used, and vehicle is having trouble entering relearn mode, check batteries in activation tool. Low batteries may allow some functions to work, but not allow vehicle to perform learn function. When the internal battery is fresh (fully charged), the indicator is "full" or all dark. When the battery is depleted, the indicator shows "empty" or all light.

1. Turn ignition switch to ON position, with engine off. Apply parking brake.

   NOTE: If learn mode cannot be enabled, TPM system is not enabled in EGM/LGM. See appropriate manufacturer service information.

2. Turn headlight switch from OFF to parking lamps 4 times within 4 seconds. A double horn chirp will sound and the low tire pressure indicator will begin to flash to indicate the learn mode has been enabled.

   WARNING: Overinflating tires may cause personal injury or damage to the tires and wheels. When increasing tire pressure, do not exceed the maximum inflation pressure as noted on the tire sidewall.

3. Starting with left front tire, increase or decrease the pressure for 8-10 seconds, or until a horn chirp sounds. Horn chirp may occur before the 8-10 second pressure increase/decrease time period has been reached, or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached.
4. After horn chirp has sounded, proceed as in step 3 for the next 3 sensors in the following order: right front, right rear and left rear.
5. After left rear sensor has been learned, turn ignition switch to OFF position to exit the learn mode. Adjust all tire pressures to specification.

2006-07 GMC CANYON

NOTE: When the wheels have been rotated, or a tire pressure sensor has been replaced, retrain tire pressure sensor.

NOTE: Learn Mode Cancellation The learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any

sensor that has not been learned. If the learn mode is cancelled before the first sensor is learned, the original sensor IDs will be maintained. If the learn mode is canceled for any reason after the first sensor is learned, all IDs are erased from the BCM memory and if equipped, the DIC will display dashes for tire pressures.

WARNING: **Stray signals from other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn chirps are heard from the vehicle while performing the learn procedure, most likely a stray sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component. Before proceeding with the steps below, verify the following: No other sensor learn procedure is being performed simultaneously within close proximity. Tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Park Brake and Headlamp Switch input parameters are functioning correctly.**

1. Turn ON the ignition, with the engine OFF.
2. Apply the parking brake.
3. Turn the exterior lamp switch from OFF to parking lamps 4 times within 4 seconds. A horn chirp will sound and the low tire pressure indicator will begin to flash indicating the learn mode has been enabled.
4. Starting with the left front tire, learn the tire pressure using one of the following methods: Method 1: Hold the antenna of the tool against the tire sidewall close to the wheel rim at the valve stem location then press and release the activate button and wait for a horn chirp. Method 2: Increase/decrease the tire pressure for 8-10 seconds then wait for a horn chirp. The horn chirp may occur before or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached.

   WARNING: **Over inflating tires may cause personal injury or damage to the tires and wheels. When increasing tire pressure do not exceed the maximum inflation pressure as noted on the tire sidewall.**

5. After the horn chirp has sounded, repeat step 4 for the remaining 3 sensors in the

following order: Right front, Right rear, Left rear.

6. After the LR sensor has been learned, a horn chirp will sound indicating all sensors have been learned.
7. Turn OFF the ignition to exit the learn mode.
8. After the learn mode has been exited, adjust all tires to the recommended pressures.

2006-07 GMC ENVOY

NOTE: **When the wheels have been rotated, or a tire pressure sensor or EGM/LGM has been replaced, retrain tire pressure sensor.**

NOTE: **If this procedure is performed following replacement and reprogramming of the Liftgate Module (LGM), DIC may display a low tire pressure fault and all tire pressures read 0 psi. If this problem occurs, contact vehicle manufacturer for repair procedure.**

The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the system has been in learn mode for more than 5 minutes. If the learn mode is canceled before any sensor has been learned, the EGM/LGM will remember all current sensor IDs and their locations. As soon as the first sensor ID code is learned, all other IDs are erased from the EGM/LGM's memory. On models that display the individual tire pressure on DIC, updated tire pressures will not be displayed until EGM/LGM receives 2 more valid transmissions from each sensor. After performing the procedure below, always test drive the vehicle above 25 mph for at least 2 minutes before viewing tire pressures on DIC.

NOTE: **Before proceeding with the steps below, ensure that no other sensor learn procedure is being performed simultaneously, or that tire pressures are not being adjusted on a TPM equipped vehicle within close proximity.**

NOTE: **In the following procedure, a TPM Sensor Activation Tool (J-46079) may be used in place of increasing/decreasing pressures to enable sensor. To use, place activator antenna against the tire sidewall close to the wheel rim at the valve stem location, then press and release the ACTIVATE button.**

NOTE: **If TPM Sensor Activation Tool (J-46079) is used, and vehicle is having trouble entering relearn mode, check batteries in activation tool. Low batteries may allow some functions to work, but not allow vehicle to perform learn function. When the internal**

battery is fresh (fully charged), the indicator is "full" or all dark. When the battery is depleted, the indicator shows "empty" or all light.

1. Turn ignition switch to ON position, with engine off. Apply parking brake.

NOTE: **If learn mode cannot be enabled, TPM system is not enabled in EGM/LGM. See appropriate manufacturer service information.**

2. Turn headlight switch from OFF to parking lamps 4 times within 4 seconds. A double horn chirp will sound and the low tire pressure indicator will begin to flash to indicate the learn mode has been enabled.

WARNING: **Overinflating tires may cause personal injury or damage to the tires and wheels. When increasing tire pressure, do not exceed the maximum inflation pressure as noted on the tire sidewall.**

3. Starting with left front tire, increase or decrease the pressure for 8-10 seconds, or until a horn chirp sounds. Horn chirp may occur before the 8-10 second pressure increase/decrease time period has been reached, or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached.
4. After horn chirp has sounded, proceed as in step 3 for the next 3 sensors in the following order: right front, right rear and left rear.
5. After left rear sensor has been learned, turn ignition switch to OFF position. Adjust all tire pressures to specification.

2006-07 PONTIAC TORRENT

NOTE: **When the wheels have been rotated, or a tire pressure sensor has been replaced, retrain tire pressure sensor.**

NOTE: **Learn Mode Cancellation The learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any sensor that has not been learned. If the learn mode is cancelled before the first sensor is learned, the original sensor IDs will be maintained. If the learn mode is canceled for any reason after the first sensor is learned, all IDs are erased from the BCM memory and if equipped, the DIC will display dashes for tire pressures.**

WARNING: **Stray signals from other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn**

chirps are heard from the vehicle while performing the learn procedure, most likely a stray sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component. Before proceeding with the steps below, verify the following: No other sensor learn procedure is being performed simultaneously within close proximity. Tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Park Brake and Headlamp Switch input parameters are functioning correctly.

1. Turn ON the ignition, with the engine OFF.
2. Apply the parking brake.
3. Turn the exterior lamp switch from OFF to parking lamps 4 times within 4 seconds. A horn chirp will sound and the low tire pressure indicator will begin to flash indicating the learn mode has been enabled.
4. Starting with the left front tire, learn the tire pressure using one of the following methods:
    - **Method 1:** Hold the antenna of the tool against the tire sidewall close to the wheel rim at the valve stem location then press and release the activate button and wait for a horn chirp.
    - **Method 2:** Increase/decrease the tire pressure for 8-10 seconds then wait for a horn chirp. The horn chirp may occur before or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached.

    WARNING: **Over inflating tires may cause personal injury or damage to the tires and wheels. When increasing tire pressure do not exceed the maximum inflation pressure as noted on the tire sidewall.**

5. After the horn chirp has sounded, repeat step 4 for the remaining 3 sensors in the following order: Right front, Right rear, Left rear.
6. After the LR sensor has been learned, a horn chirp will sound indicating all sensors have been learned.
7. Turn OFF the ignition to exit the learn mode.
8. After the learn mode has been exited, adjust all tires to the recommended pressures.

2006 BRAKES

Park Brake - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Park Brake Bracket Bolts	14 N.m	124 lb in
Park Brake Cable Guide Mounting Bolt	10 N.m	89 lb in
Park Brake Pedal Assembly Retaining Nuts	25 N.m	18 lb ft
Park Brake Warning Lamp Switch Mounting Screw	3 N.m	26 lb in

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - PARK BRAKE

Begin the system diagnosis by reviewing the system description and operation. Reviewing the description and operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the description and operation information will also help you determine if the condition described by the customer is normal operation. Refer to **Symptoms - Park Brake** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

SYMPTOMS - PARK BRAKE

IMPORTANT: Review the system operation in order to familiarize yourself with the system functions.

Refer to **Park Brake System Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the park brake system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

Park Brake Will Not Hold or Release

PARK BRAKE WILL NOT HOLD OR RELEASE

Park Brake Will Not Hold or Release

Step	Action	Yes	No
1	Were you sent here from the Park Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Park Brake**
2	Inspect the park brake system for proper operation. Refer to **Park Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 3**
3	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis** in Hydraulic Brakes. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 4**
4	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis** in Hydraulic Brakes. Did you find and correct a condition?	Go to **Step 5**	Go to **Diagnostic Starting Point - Park Brake**
5	Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test** in Hydraulic Brakes. Is the condition still present?	Go to **Step 2**	System OK

PARK BRAKE SYSTEM DIAGNOSIS

Park Brake System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the PARK brake system in order to determine if the PARK brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Hydraulic Brake Symptom table?	Go to **Step 4**	Go to **Step 2**
2	Were you sent here from a Park Brake Symptom table?	Go to **Step 4**	Go to **Step 3**
	Is the symptom related to the ability of the park brake system to hold and/or release?		Go to **Diagnostic Starting Point -**

3		Go to **Diagnostic Starting Point - Park Brake**	**Hydraulic Brakes** in Hydraulic Brakes
4	1. Raise and support the vehicle with the rear axle supported by jack stands. Refer to **Lifting and Jacking the Vehicle** in General Information. 2. With the park brake RELEASED, attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. Do the rear brakes have a significant amount of drag?	Go to **Step 11**	Go to **Step 5**
5	1. Apply the park brake. 2. Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. Do the rear brakes have a significant amount of drag?	Go to **Step 6**	Go to **Step 7**
6	1. Release the park brake. 2. Rotate the rear wheels to check the rear brakes for a significant reduction in the amount of drag. Did the rear brakes exhibit a significant reduction in the amount of drag?	Go to **Step 21**	Go to **Step 11**
7	Visually inspect the park brake cable connections and the cables that are accessible on the UNDERSIDE of the vehicle for disconnections and/or damage. Were any of the park brake cables disconnected and/or damaged?	Go to **Step 8**	Go to **Step 9**
8	Reconnect or replace the park brake cables as necessary. Refer to the following procedures as necessary: • **Park Brake Cable Replacement - Front** • **Park Brake Cable Replacement -**		-

	Rear (Z7U) Did you complete the repair and/or replacement?	Go to **Step 9**	
9	Check the adjustment of the park brake. Refer to **Park Brake Adjustment**. Was the park brake adjusted properly?	Go to **Step 11**	Go to **Step 10**
10	Adjust the park brake. Refer to **Park Brake Adjustment**. Were you able to adjust the park brake?	Go to **Step 16**	Go to **Step 11**
11	**NOTE:** **Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.** 1. Remove the rear brake rotors. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes. 2. Inspect the park brake shoe hardware for looseness, damaged, broken or missing components. 3. Check the park brake actuators for a seized condition. Does the park brake hardware and/or the park brake actuators require replacement?	Go to **Step 12**	Go to **Step 13**
12	1. Replace park brake hardware components as necessary. Refer to **Park Brake Shoe Replacement**. 2. Replace the park brake actuators as necessary. Refer to **Park Brake Actuator Replacement**. Did you complete the replacement?	Go to **Step 13**	-
13	Have an assistant apply and release the park brake, while you observe the park brake cables for free movement. Did the park brake cables move freely?	Go to **Step 14**	Go to **Step 17**
14	Check the adjustment of the park brake. Refer to **Park Brake Adjustment**.		

	Was the park brake adjusted properly?	Go to **Step 16**	Go to **Step 15**
15	Adjust the park brake. Refer to **Park Brake Adjustment**. Were you able to adjust the park brake?	Go to **Step 16**	Go to **Step 26**
16	1. Apply the park brake. 2. Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. 3. Release the park brake. 4. Rotate the rear wheels to check the rear brakes for a significant reduction of drag. Did the park brake apply and release properly?	Go to **Step 28**	Return to Symptom Table
17	Disconnect the park brake cable connections that are accessible on the UNDERSIDE of the vehicle one at a time and check each cable for free movement. Do any of the park brake cables accessible on the underside of the vehicle require replacement?	Go to **Step 18**	Go to **Step 19**
18	Replace any of the park brake cables that do not have free movement - not releasing properly. Refer to the following procedures as necessary: - **Park Brake Cable Replacement - Front** - **Park Brake Cable Replacement - Rear (Z7U)** Did you complete the replacement?	Go to **Step 19**	-
19	1. Disconnect the front park brake cable connection accessible INSIDE the vehicle at the park brake pedal assembly and check for free movement. 2. Replace the front park brake cable if it does not have free movement. Refer to **Park Brake Cable Replacement -**		

	Front. Did you find and correct a condition?	Go to **Step 24**	Go to **Step 20**
20	Replace the park brake pedal assembly. Refer to **Park Brake Pedal Assembly Replacement**. Did you complete the replacement?	Go to **Step 25**	-
21	Check the adjustment of the park brake. Refer to **Park Brake Adjustment**. Is the park brake adjusted properly?	Go to **Step 28**	Go to **Step 22**
22	Adjust the park brake. Refer to **Park Brake Adjustment**. Were you able to adjust the park brake?	Go to **Step 27**	Go to **Step 23**
23	1. Remove the rear brake rotors, if they have not yet been removed. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes. 2. Check the park brake actuators for a seized condition. 3. Replace the park brake actuators as necessary. Refer to **Park Brake Actuator Replacement**. Did you find and correct a condition?	Go to **Step 24**	Go to **Step 26**
24	Adjust the park brake. Refer to **Park Brake Adjustment**. Were you able to adjust the park brake?	Go to **Step 27**	Go to **Step 26**
25	Adjust the park brake. Refer to **Park Brake Adjustment**. Were you able to adjust the park brake?	Go to **Step 27**	Return to Symptom Table
26	1. Replace the component that is used to adjust the park brake system. Refer to **Park Brake Cable Equalizer Replacement**. 2. Adjust the park brake. Refer to **Park Brake Adjustment**. Did you complete the replacement and adjustment?	Go to **Step 27**	Return to Symptom Table
	1. Apply the park brake. 2. Attempt to rotate the rear wheels to		

27	check the rear brakes for a significant amount of drag. 3. Release the park brake. 4. Rotate the rear wheels to check the rear brakes for a significant reduction of drag. Did the park brake apply and release properly?	Go to **Step 28**	Return to Symptom Table
28	Install or connect any components that were removed or disconnected during diagnosis. Did you complete the operation?	Park Brake System OK Return to Symptom Table	-

PARK BRAKE SHOE INSPECTION

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

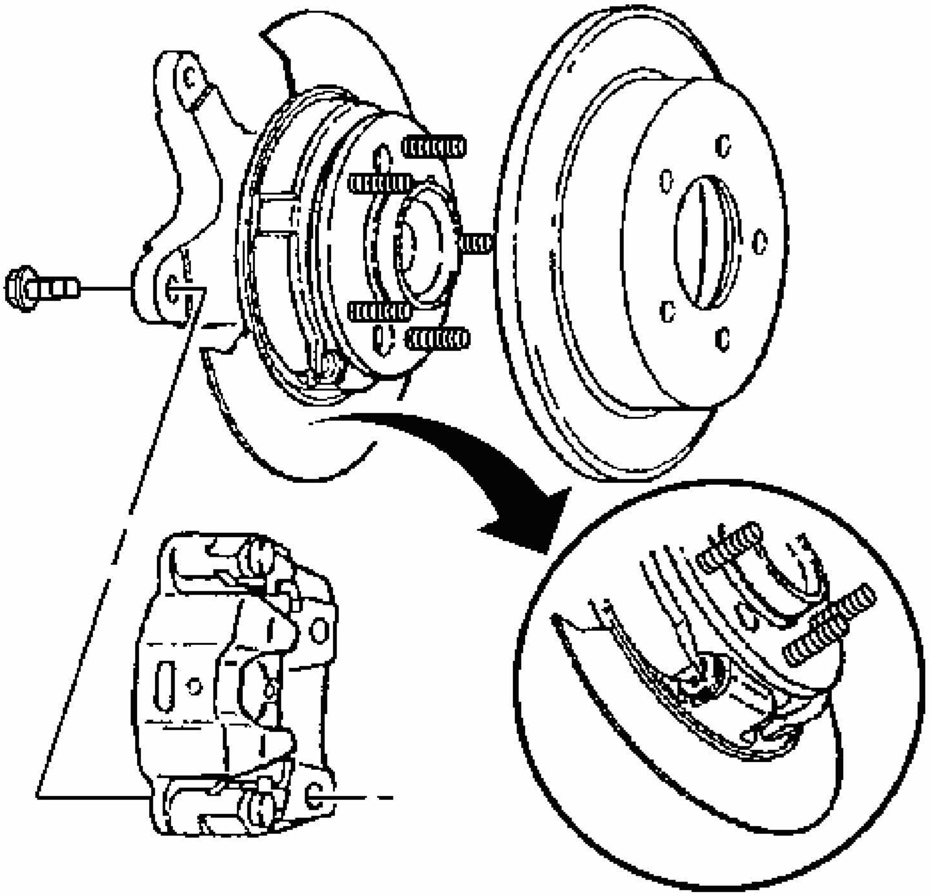


Fig. 1: Identifying Rear Brake Components
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Remove the rear brake caliper bracket with the rear brake caliper. Refer to **Brake Caliper Bracket Replacement - Rear** in Disc Brakes.
4. Remove the rear brake rotor. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
5. Inspect the park brake shoe and lining. If it exhibits any of the following conditions, then it requires replacement :
    - Excessive wear indicated by the park brake lining being worn down to the shoe

- Brake lining cracking
- Oil or fluid contamination of the brake lining

6. Install the rear brake rotor. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
7. Install the rear brake caliper with the rear brake caliper bracket. Refer to **Brake Caliper Bracket Replacement - Rear** in Disc Brakes.
8. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
9. Lower the vehicle.

REPAIR INSTRUCTIONS

PARK BRAKE SHOE REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

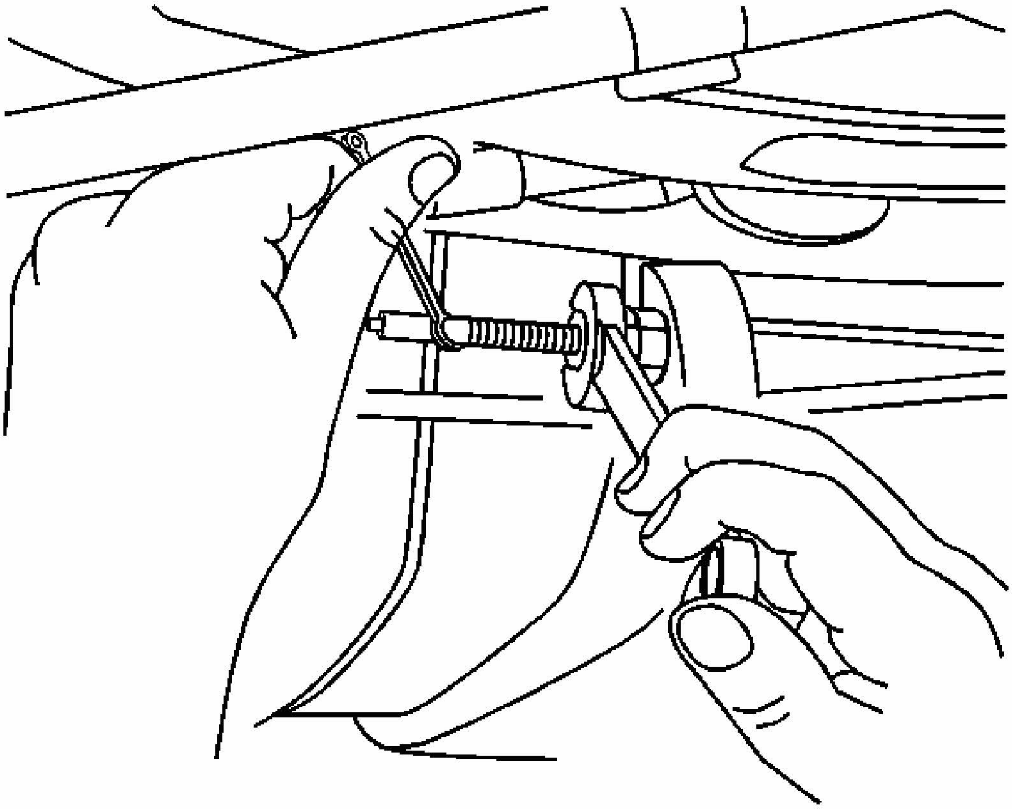


Fig. 2: Adjusting Park Brake Tension At Equalizer Assembly
Courtesy of GENERAL MOTORS CORP.

3. Relieve the park brake system tension at the equalizer assembly.
4. Remove the rear caliper bracket. Refer to **Brake Caliper Bracket Replacement - Rear** in Disc Brakes.
5. Remove the rear rotor. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.

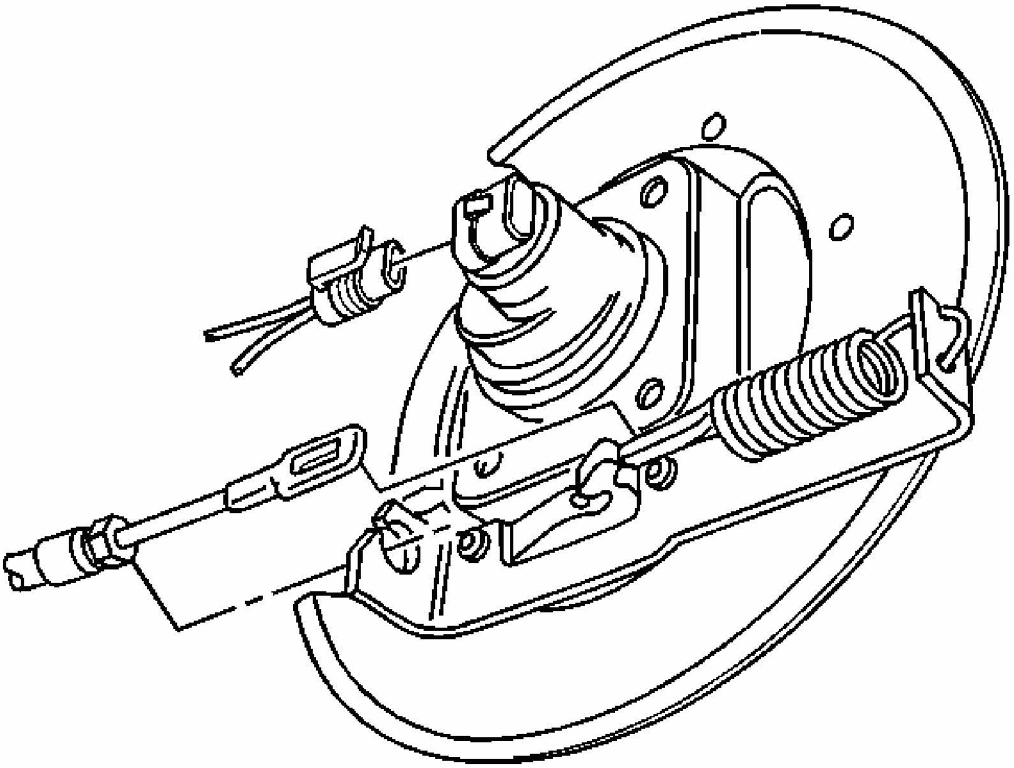


Fig. 3: View Of Rear Park Brake Cable & Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Disconnect and remove the rear park brake cable from the bracket at the rear wheel. Refer to **Park Brake Cable Replacement - Rear (Z7U)**.
7. Disconnect the park brake cable return spring from the park brake actuator and bracket at the rear wheel.
8. Remove the rear hub. Refer to **Wheel Bearing/Hub Replacement - Rear** in Rear Suspension.

   The rear hub, backing plate, park brake cable bracket, and park brake actuator will be removed as an assembly.

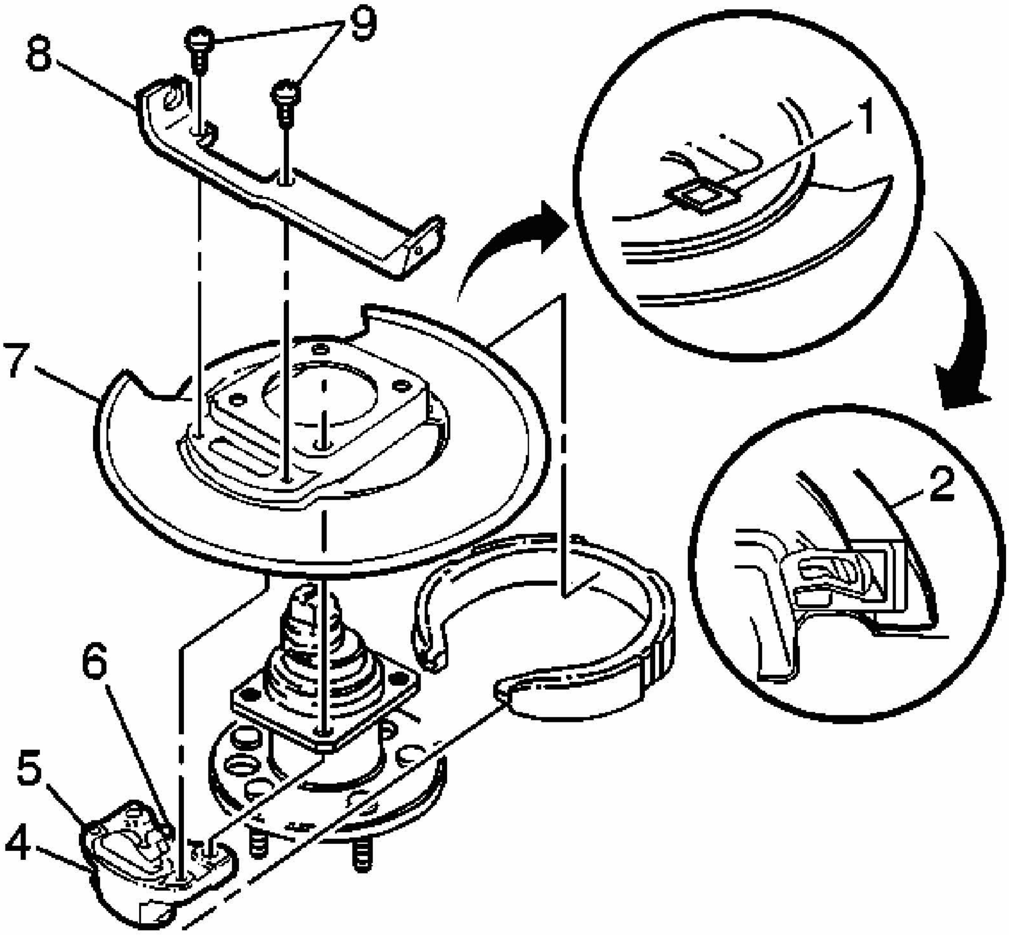


Fig. 4: Identifying Parking Brake Components
Courtesy of GENERAL MOTORS CORP.

9. Remove the 2 retainers (9) and the park brake cable bracket (8) from the park brake actuator (4). Position the rear hub aside.
10. Remove the park brake shoe and actuator (4) from the backing plate (7).
11. Separate the park brake shoe from the actuator.

Installation Procedure

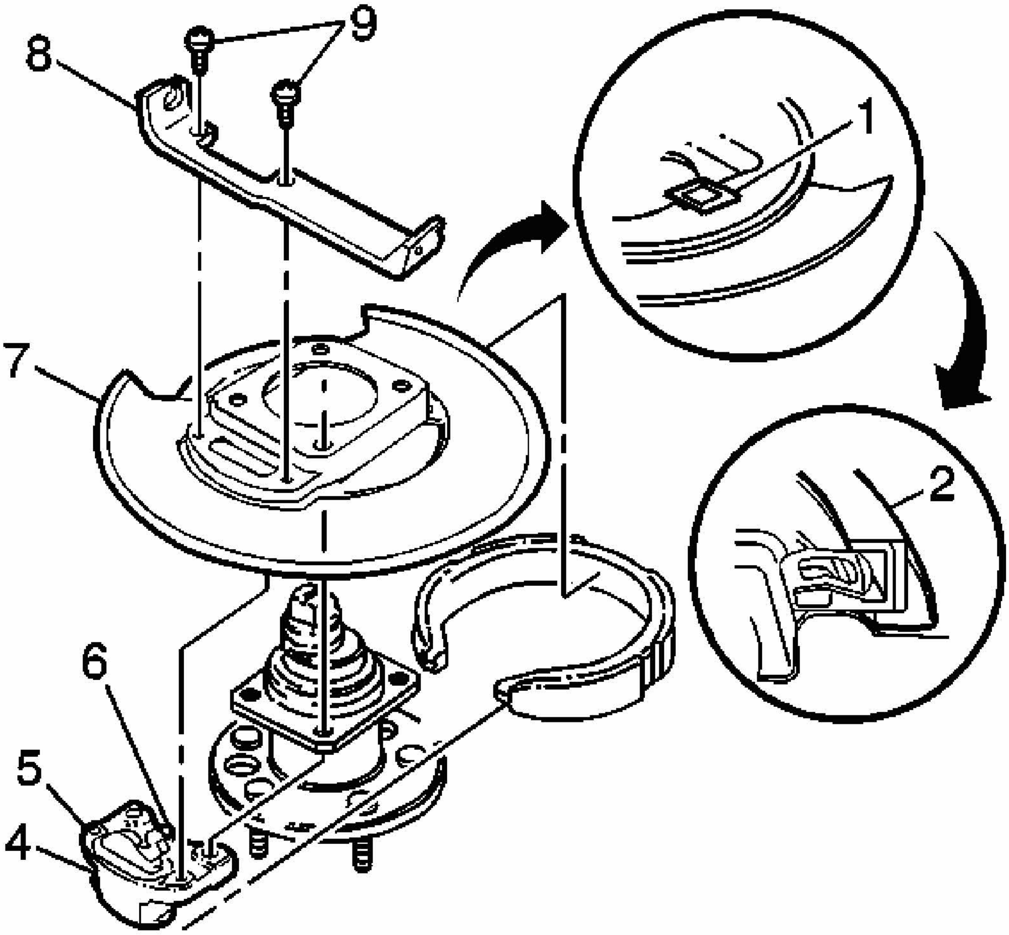


Fig. 5: Identifying Parking Brake Components
Courtesy of GENERAL MOTORS CORP.

1. Assemble the park brake shoe to the actuator (4).
2. Install the park brake shoe and actuator (4) onto the backing plate (7).
3. Position the park brake shoe, actuator (4), and backing plate (7) over the rear hub.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

4. Install the park brake cable bracket (8) and the two retainers (9).

   Tighten: Tighten the bracket retainers to 14 N.m (124 lb in).

5. Install the rear hub. Refer to **Wheel Bearing/Hub Replacement - Rear** in Rear

Suspension.

The rear hub, backing plate, park brake cable bracket, and park brake actuator will be installed as an assembly.

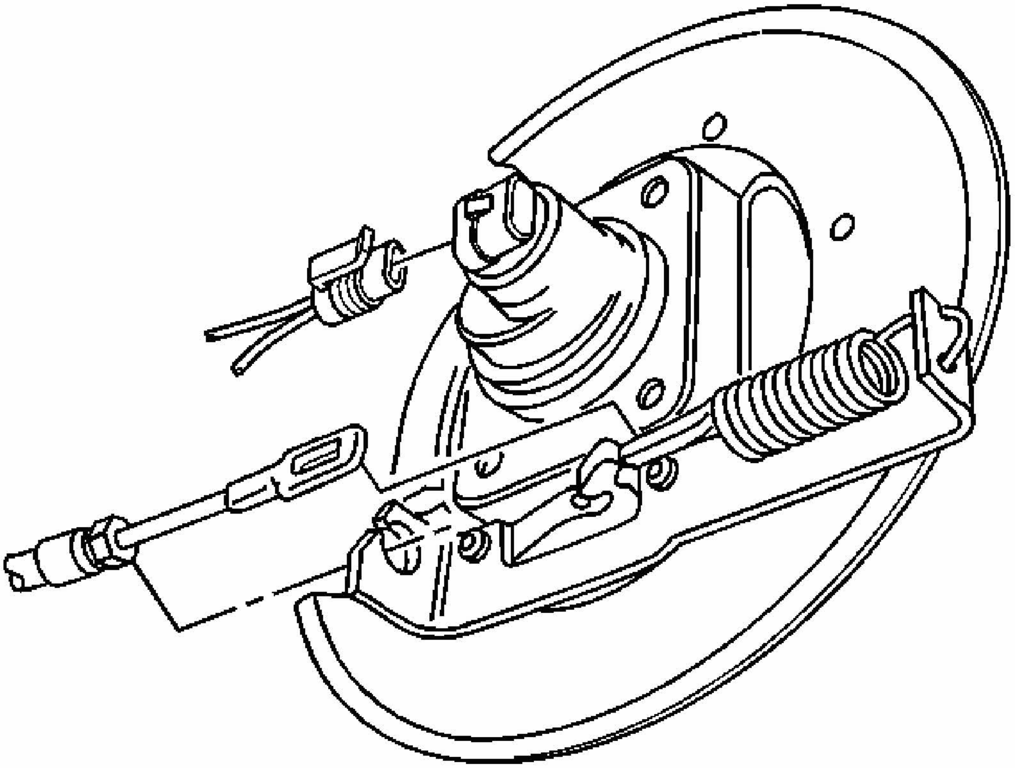


Fig. 6: View Of Rear Park Brake Cable & Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Install and connect the rear park brake cable to the bracket at the rear wheel.
7. Connect the park brake cable return spring to the park brake actuator and bracket at the rear wheel.
8. Install the rear rotor. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
9. Install the rear caliper bracket. Refer to **Brake Caliper Bracket Replacement - Rear** in Disc Brakes.
10. Install the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
11. Adjust the park brake system. Refer to **Park Brake Adjustment**.

12. Lower the vehicle.

PARK BRAKE PEDAL ASSEMBLY REPLACEMENT

Tools Required

J 37043 Parking Brake Cable Release Tool. See **Special Tools**.

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

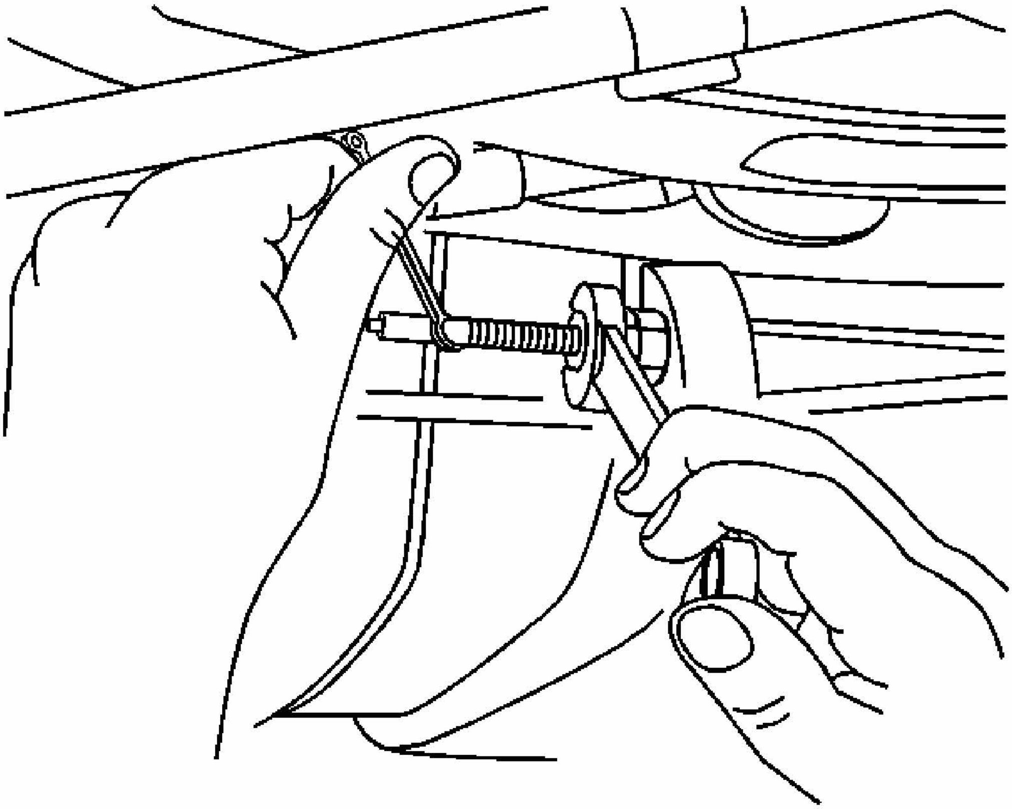


Fig. 7: Adjusting Park Brake Tension At Equalizer Assembly
Courtesy of GENERAL MOTORS CORP.

2. Relieve the cable tension at the park brake equalizer.

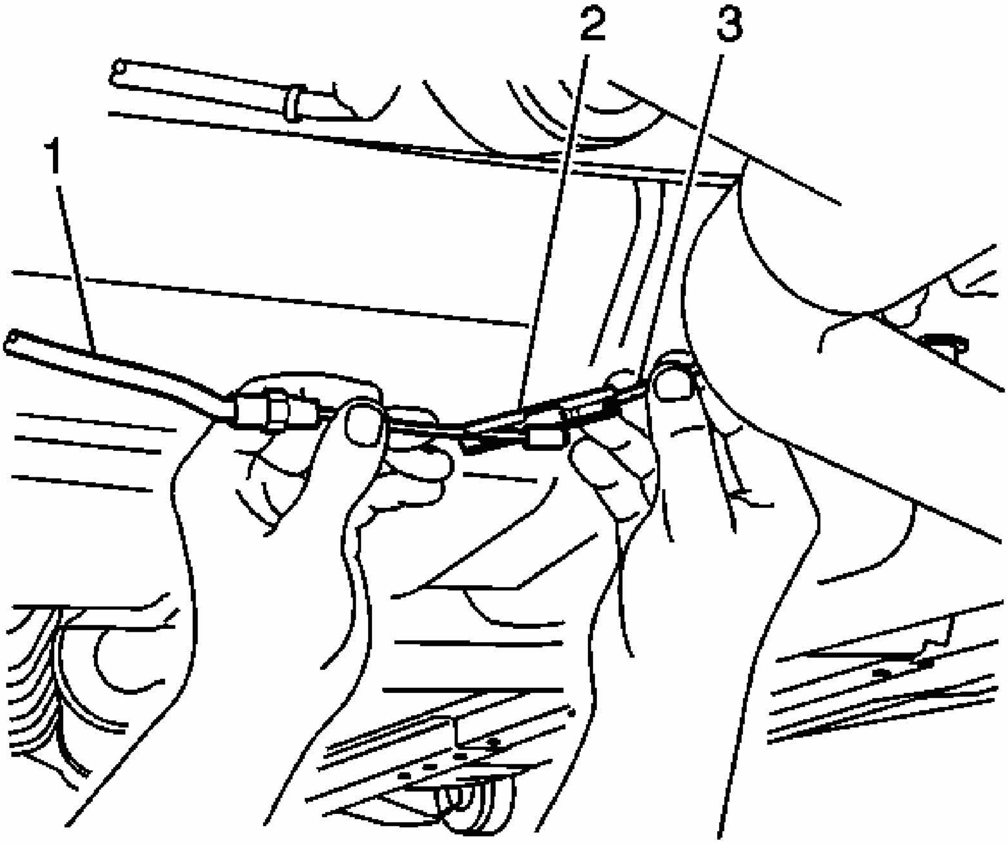


Fig. 8: View Of Front Brake Cable Connected To Right Rear Cable
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the front cable from the connector (2).
4. Lower the vehicle.
5. Remove the left side closeout/insulator panel. Refer to **Closeout/Insulator Panel Replacement - Left** in Instrument Panel, Gages, and Console.
6. Remove the left side front carpet retainers. Refer to **Trim Panel Replacement - Lower Center Pillar** in Interior Trim.
7. Disconnect the electrical connector at the park brake switch.

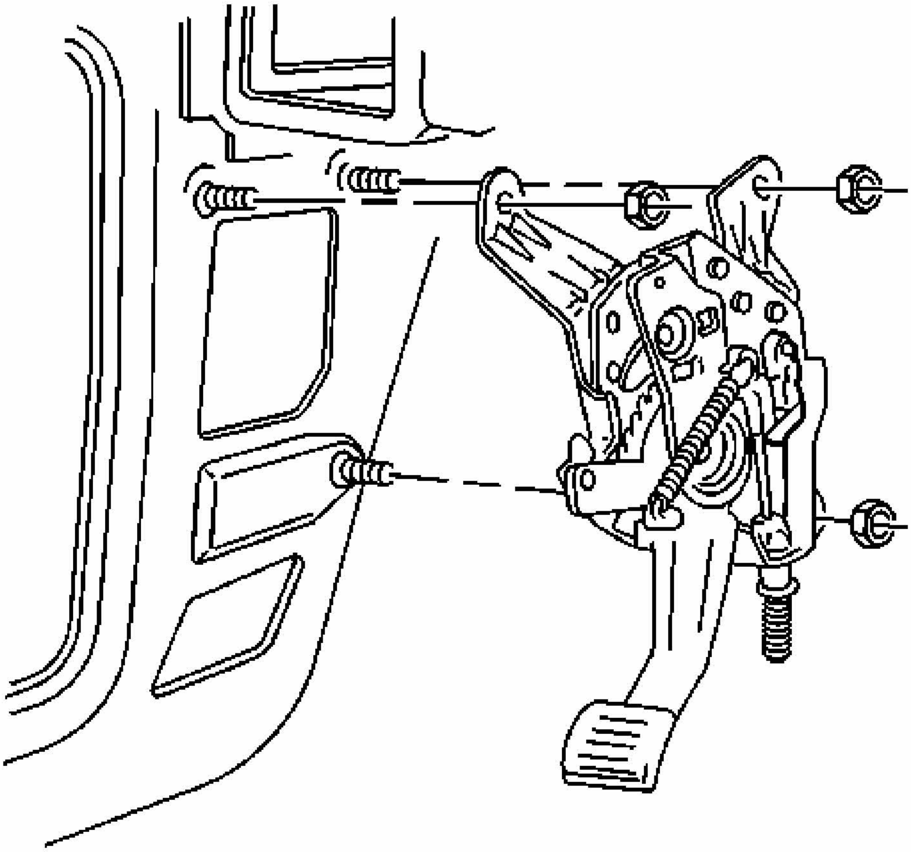


Fig. 9: Park Brake Pedal Assembly
Courtesy of GENERAL MOTORS CORP.

8. Remove the 3 park brake pedal assembly retraining nuts from the body mounting studs.

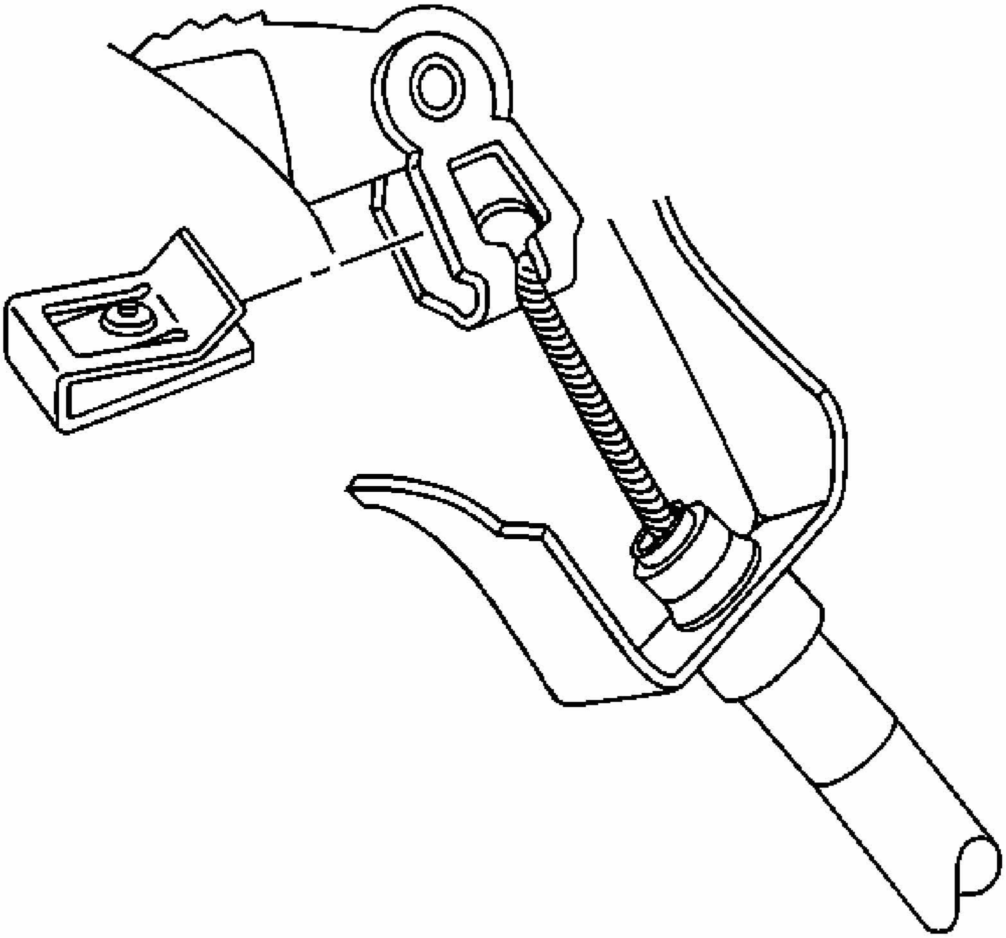


Fig. 10: View Of Retaining Clip
Courtesy of GENERAL MOTORS CORP.

9. Remove the retaining clip and disconnect the cable button from the clevis.
10. Use the **J 37043** to release and remove cable from the bracket on the pedal assembly. See **Special Tools**.
11. Remove the park brake pedal assembly.

Installation Procedure

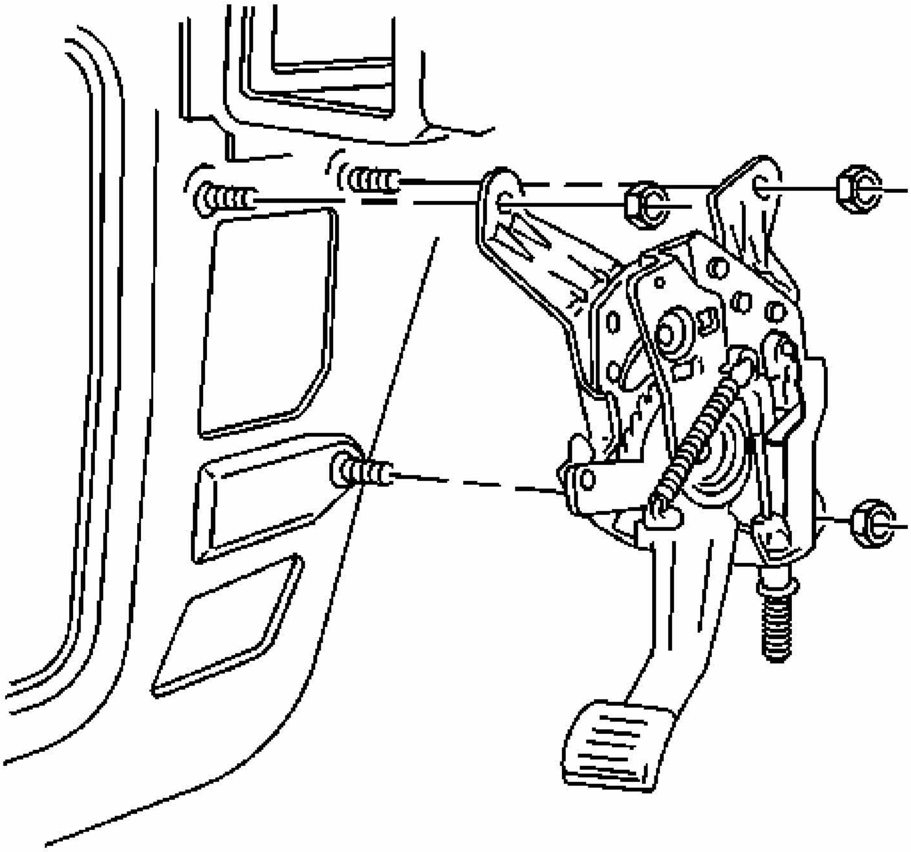


Fig. 11: Park Brake Pedal Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the park brake assembly onto the body mounting studs.

   NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the 3 park brake pedal assembly retaining nuts.

   Tighten: Tighten the nuts to 25 N.m (18 lb ft).

3. Install the front park brake cable into the bracket on the park brake pedal assembly.

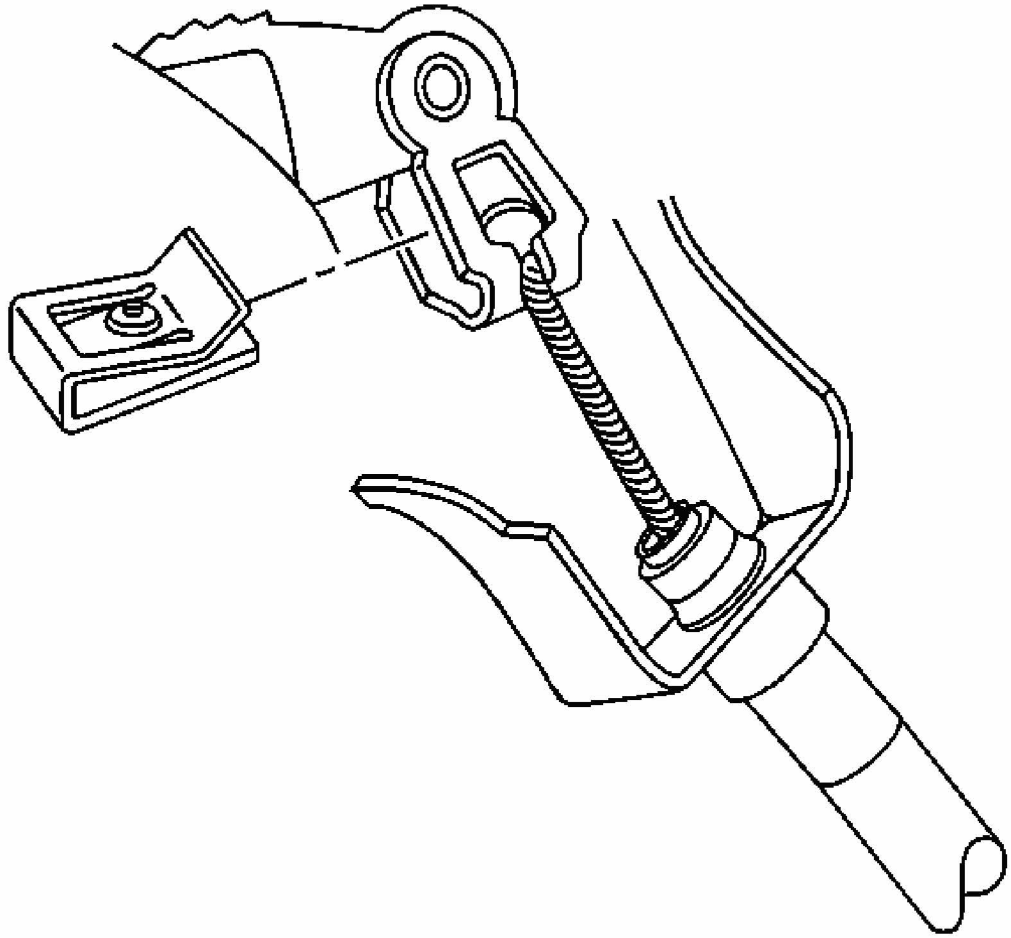


Fig. 12: View Of Retaining Clip
Courtesy of GENERAL MOTORS CORP.

4. Insert the cable button into the clevis and install the retaining clip.
5. Connect the electrical connector to the park brake switch.
6. Reposition the carpeting properly.
7. Install the left side carpet retainers and the lower center pillar trim panel on the left side. Refer to **Trim Panel Replacement - Lower Center Pillar** in Interior Trim.
8. Install the left side closeout/insulator panel. Refer to **Closeout/Insulator Panel Replacement - Left** in Instrument Panel, Gages, and Console.
9. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
10. Install the front park brake cable through the park brake cable guides.

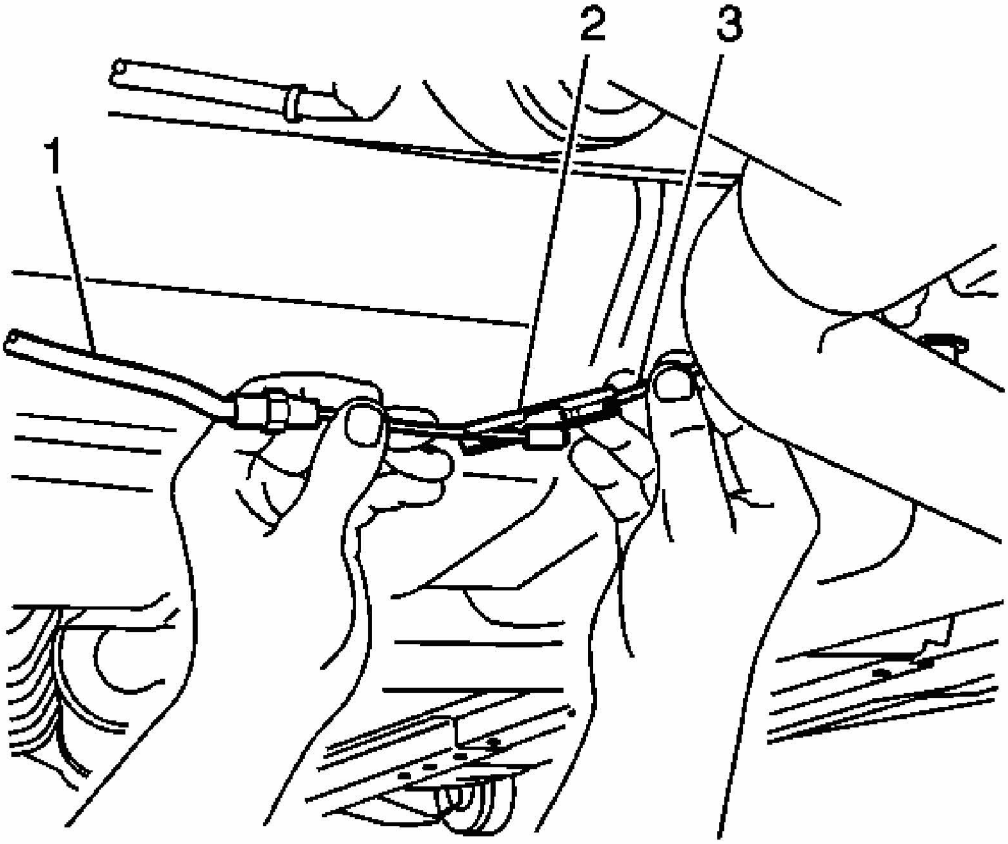


Fig. 13: View Of Front Brake Cable Connected To Right Rear Cable
Courtesy of GENERAL MOTORS CORP.

11. Connect the front park brake cable (1) to the rear cable (3) at the connector clip (2).

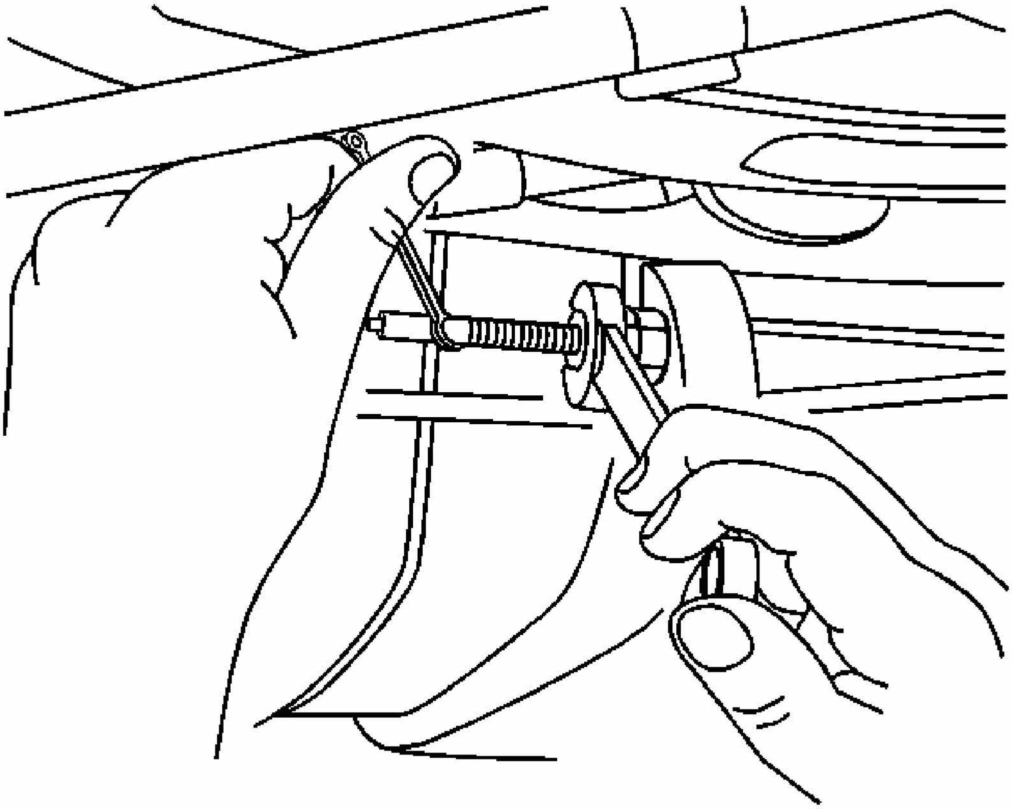


Fig. 14: Adjusting Park Brake Tension At Equalizer Assembly
Courtesy of GENERAL MOTORS CORP.

12. Tighten the nut on the equalizer in order to remove slack in the cable.
13. Lower the vehicle.

PARK BRAKE WARNING LAMP SWITCH REPLACEMENT

Removal Procedure

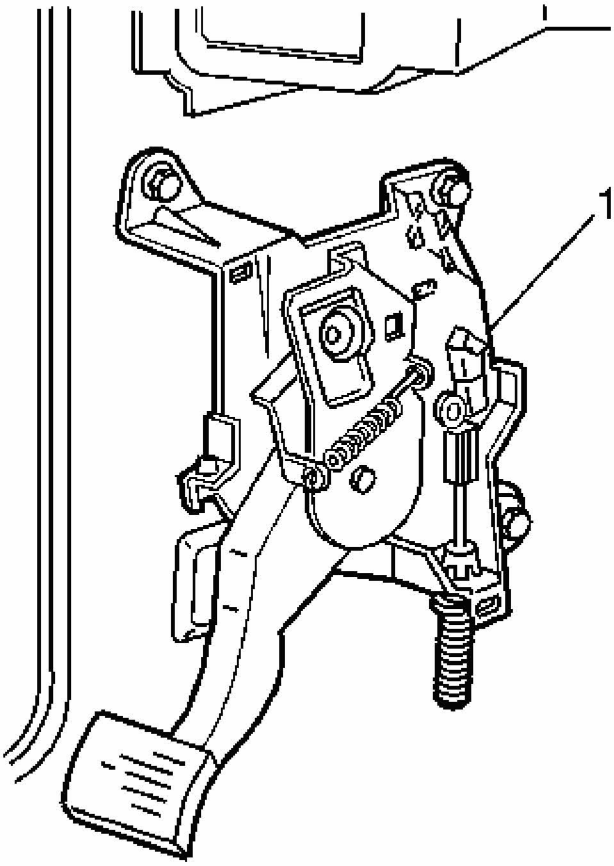


Fig. 15: Parking Brake Indicator Switch
Courtesy of GENERAL MOTORS CORP.

1. Remove the left side instrument panel insulator.
2. Remove the left carpet retainers. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** in Interior Trim.
3. Disconnect the electrical connector from the switch.
4. Remove the mounting screw.
5. Remove the parking brake indicator switch (1).

Installation Procedure

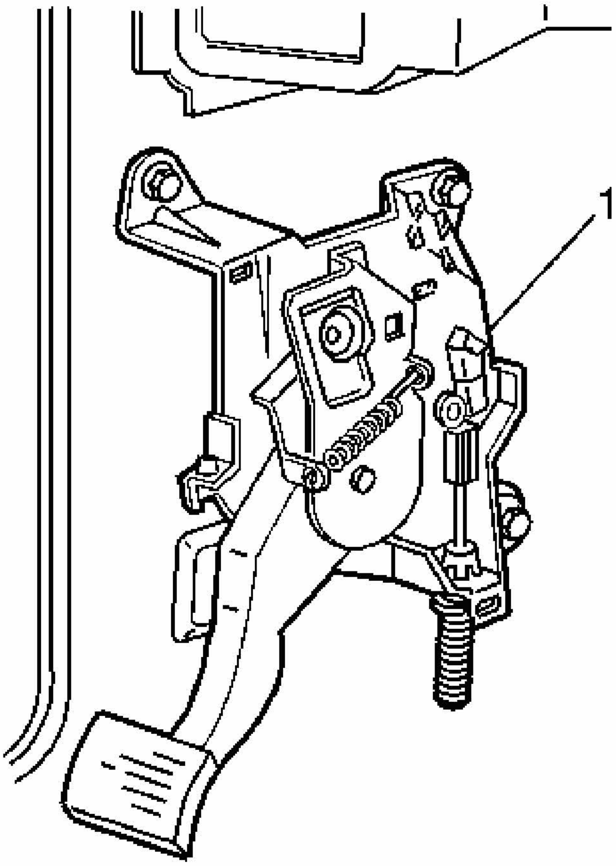


Fig. 16: Parking Brake Indicator Switch
Courtesy of GENERAL MOTORS CORP.

1. Install the parking brake indicator switch (1).

   NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the mounting screw.

   Tighten: Tighten the mounting screw to 3 N.m (26 lb in).

3. Connect the electrical connector to the switch.

   Check the operation of the switch.

4. Install the left carpet retainers. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** in Interior Trim.
5. Install the left side instrument panel insulator.

FRONT PARK BRAKE CABLE REPLACEMENT

Tools Required

J 37043 Parking Brake Cable Release Tool. See **Special Tools**.

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

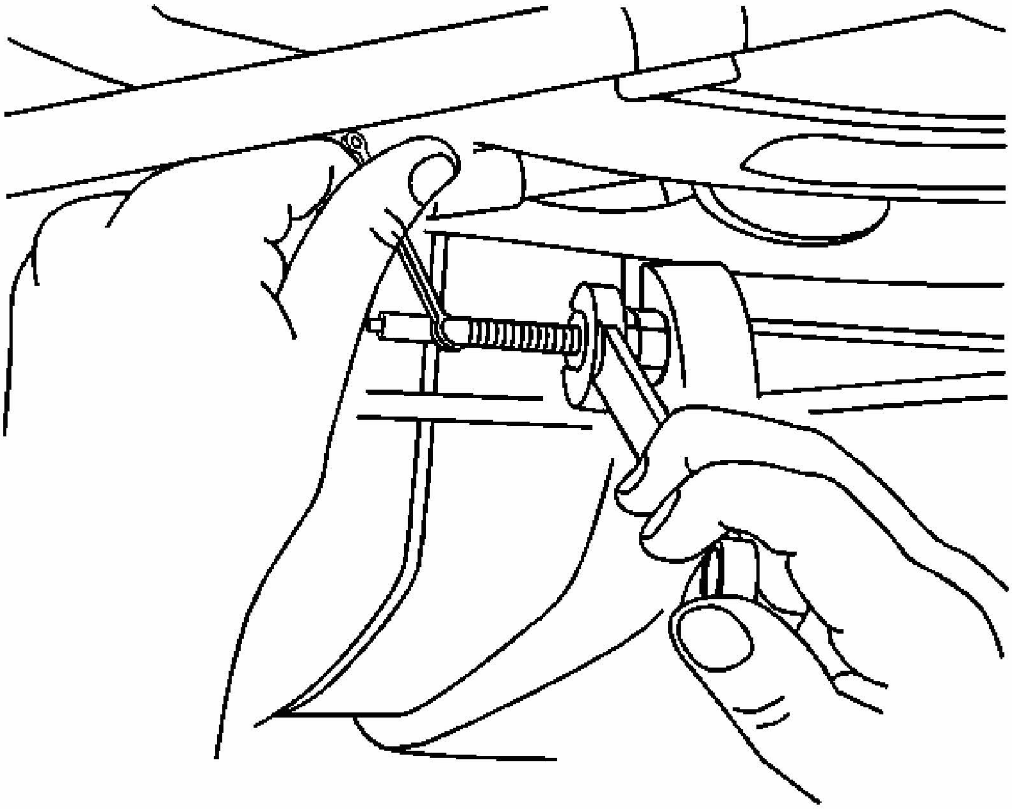


Fig. 17: Adjusting Park Brake Tension At Equalizer Assembly
Courtesy of GENERAL MOTORS CORP.

2. Relieve the cable tension at the park brake equalizer.

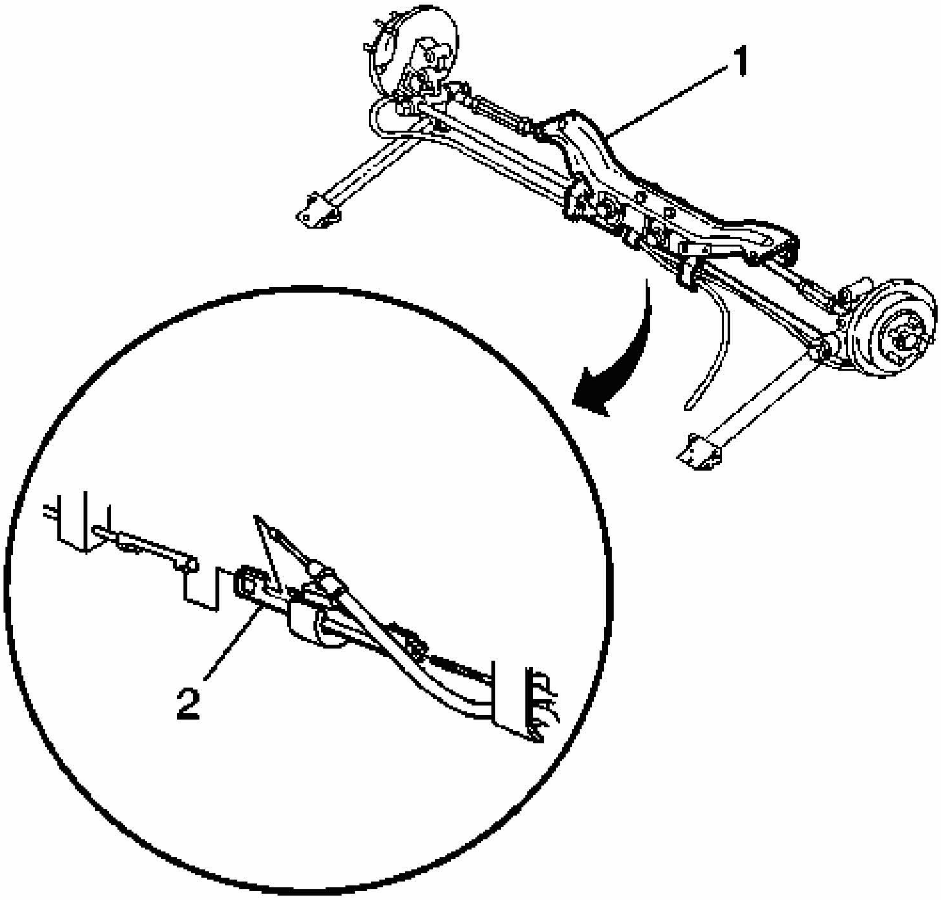


Fig. 18: View Of Parking Brake Adjustment
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the front cable from the connector (2).

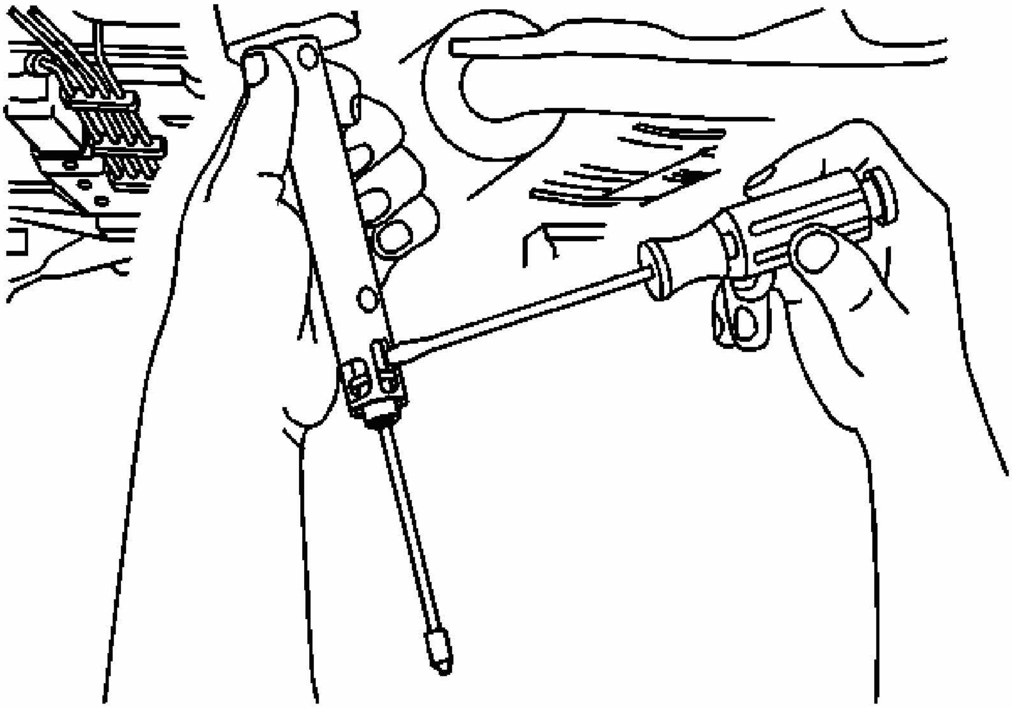


Fig. 19: Installing/Removing Equalizer Assembly From Front Park Brake Cable
Courtesy of GENERAL MOTORS CORP.

4. Remove the front cable from the equalizer.
5. Remove the front cable from the cable guides.
6. Lower the vehicle.
7. Remove the left side closeout/insulator panel. Refer to **Closeout/Insulator Panel Replacement - Left** in Instrument Panel, Gages, and Console.
8. Remove the lower center pillar panel on the left side and the left side carpet retainers. Refer to **Trim Panel Replacement - Lower Center Pillar** in Interior Trim.
9. Fold back the carpeting in order to gain access to the front park brake cable.

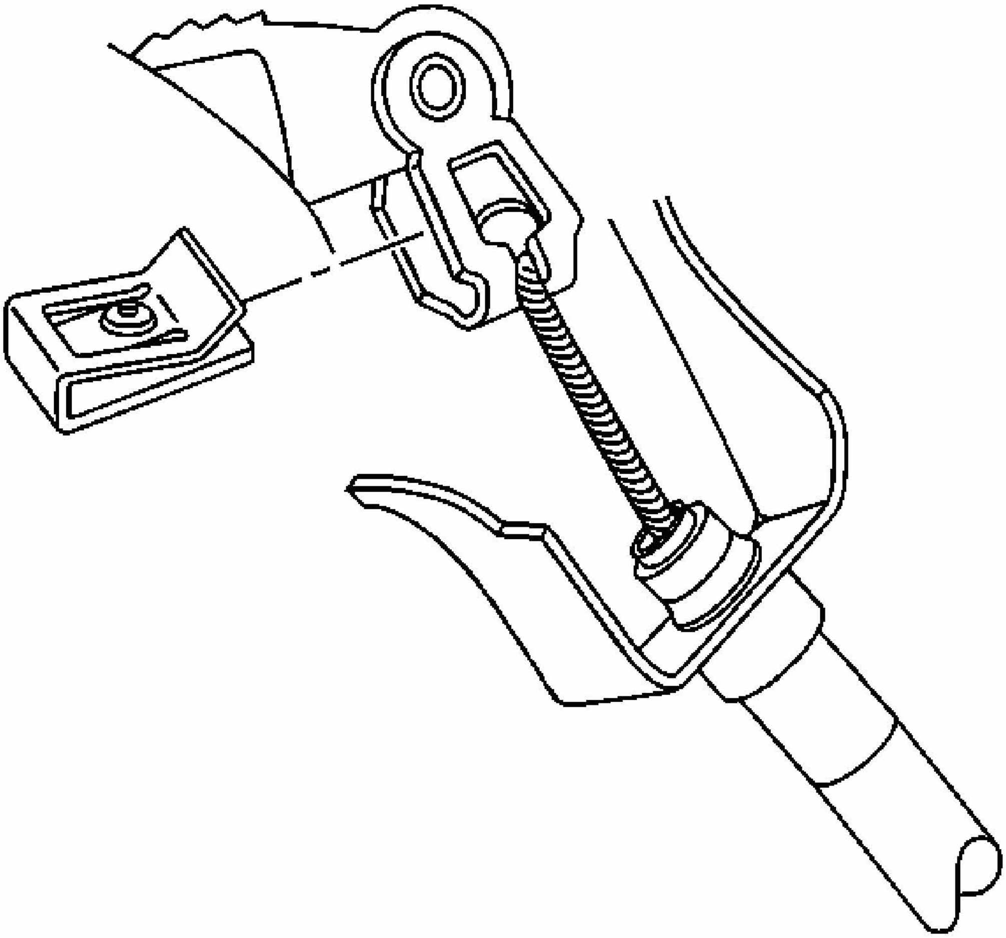


Fig. 20: View Of Retaining Clip
Courtesy of GENERAL MOTORS CORP.

10. Remove the retaining clip and disconnect the cable from the clevis.
11. Use the**J 37043** to release the retainer holding cable to the bracket on the pedal assembly. See **Special Tools**.
12. Remove the front cable from the vehicle.

    Note routing of the cable for installation.

Installation Procedure

1. Install the front cable into the vehicle as noted in the removal procedure.
2. Install the front park brake cable into the bracket on the park brake pedal assembly.

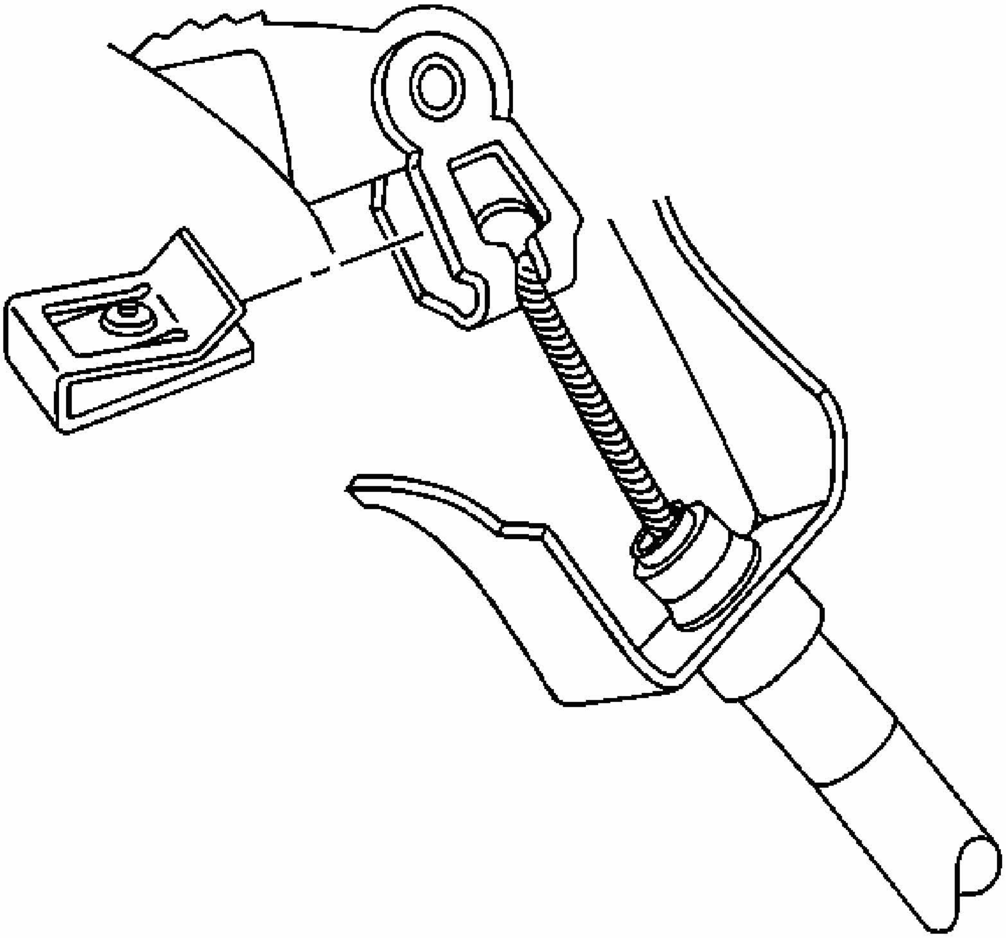


Fig. 21: View Of Retaining Clip
Courtesy of GENERAL MOTORS CORP.

3. Insert the cable button end into the clevis and install the retaining clip.
4. Reposition the carpeting properly.
5. Install the left side carpet retainers and the lower center pillar trim panel on the left side. Refer to **Trim Panel Replacement - Lower Center Pillar** in Interior Trim.
6. Install the left side closeout/insulator panel. Refer to **Closeout/Insulator Panel Replacement - Left** in Instrument Panel, Gages, and Console.
7. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
8. Install the front park brake cable through the park brake cable guides.
9. Install the front park brake cable into the equalizer.

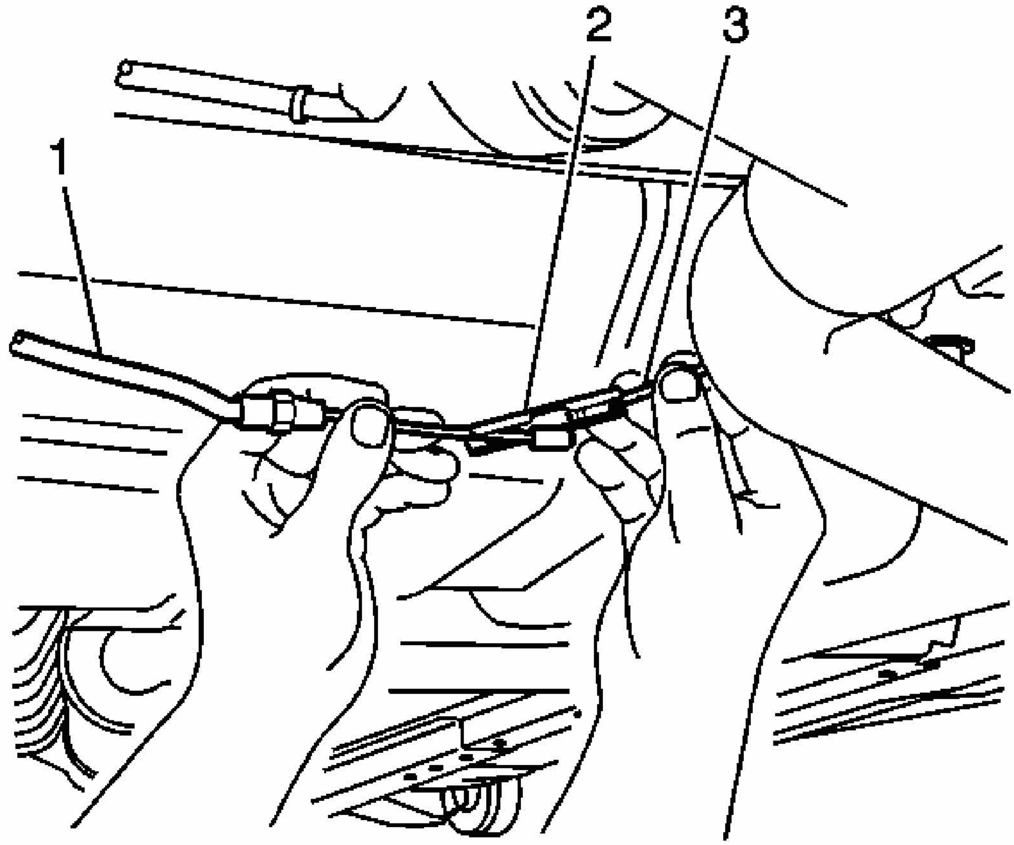


Fig. 22: View Of Front Brake Cable Connected To Right Rear Cable
Courtesy of GENERAL MOTORS CORP.

10. Connect the front park brake cable (1) to the rear cable (3) at the connector clip (2).

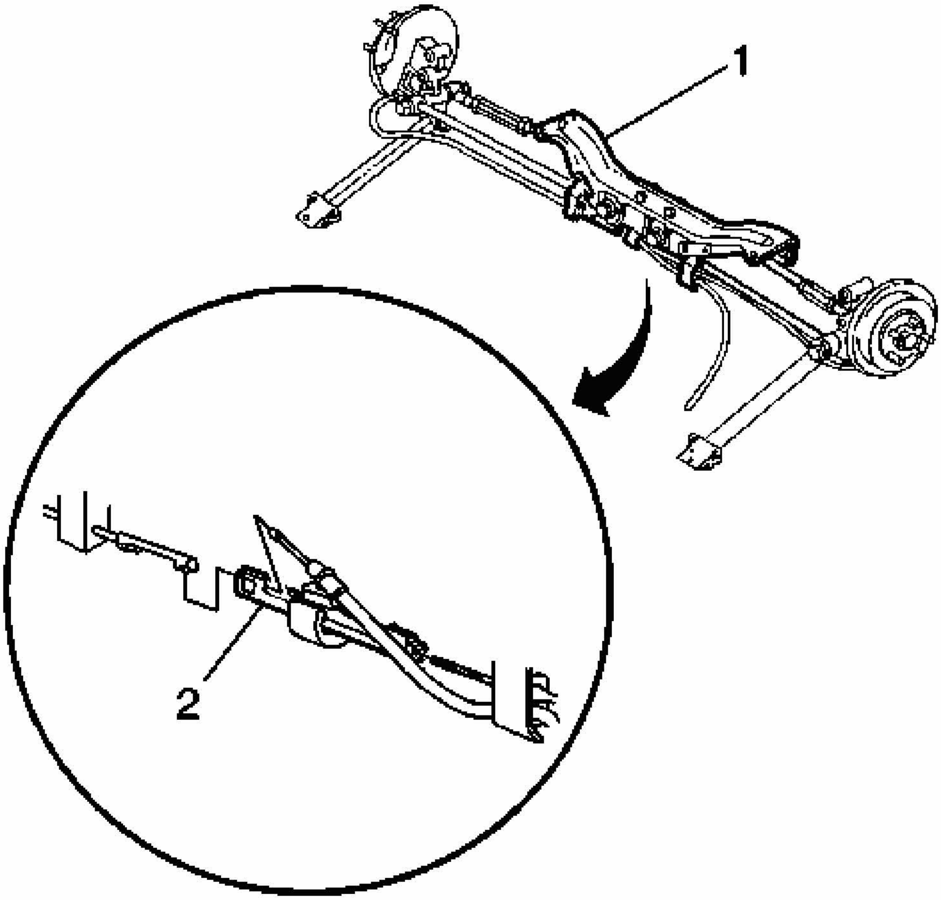


Fig. 23: View Of Parking Brake Adjustment
Courtesy of GENERAL MOTORS CORP.

11. Tighten the nut on the equalizer (2) in order to remove slack in the cable.
12. Lower the vehicle.

PARK BRAKE CABLE REPLACEMENT - REAR (Z7U)

Tools Required

J 37043 Parking Brake Cable Release Tool. See Special Tools.

Removal Procedure

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Relieve the park brake cable tension at the equalizer.
3. Disconnect the front cable from the rear cable that is to be replaced.

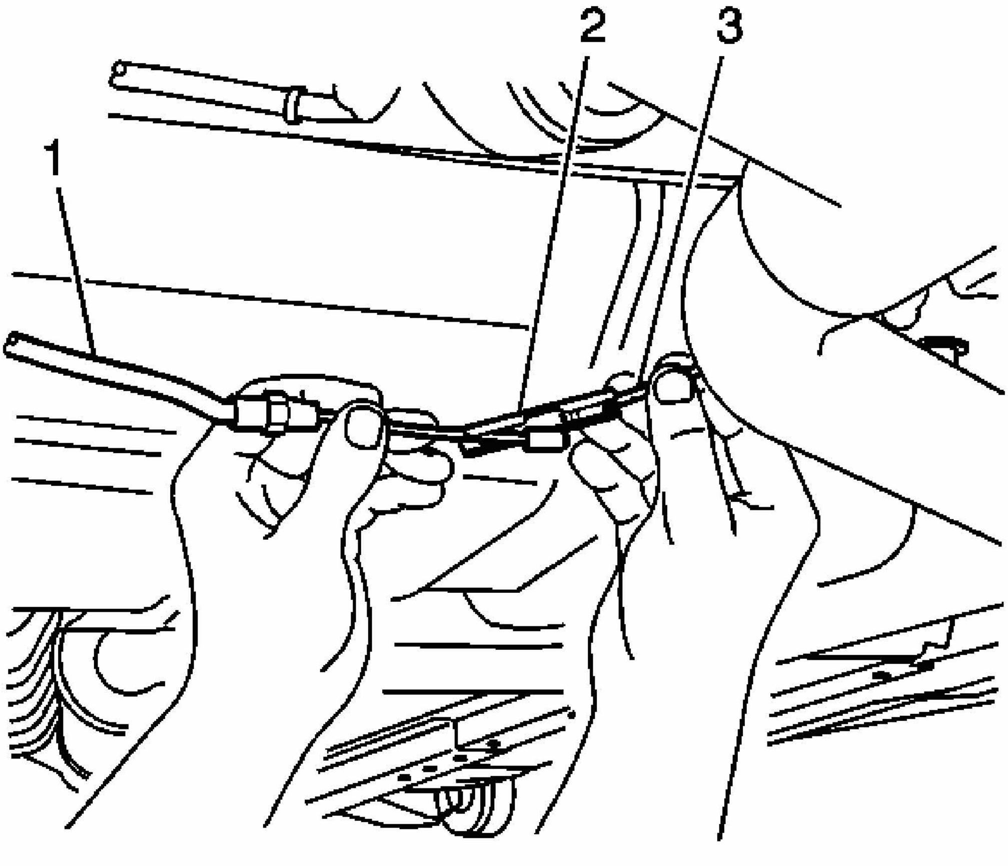


Fig. 24: View Of Front Brake Cable Connected To Right Rear Cable
Courtesy of GENERAL MOTORS CORP.

- For the right rear cable, disconnect the cable (3) from the clip (2).
- For the left rear cable, fully remove the equalizer nut from the equalizer stud, which is part of the left rear cable.

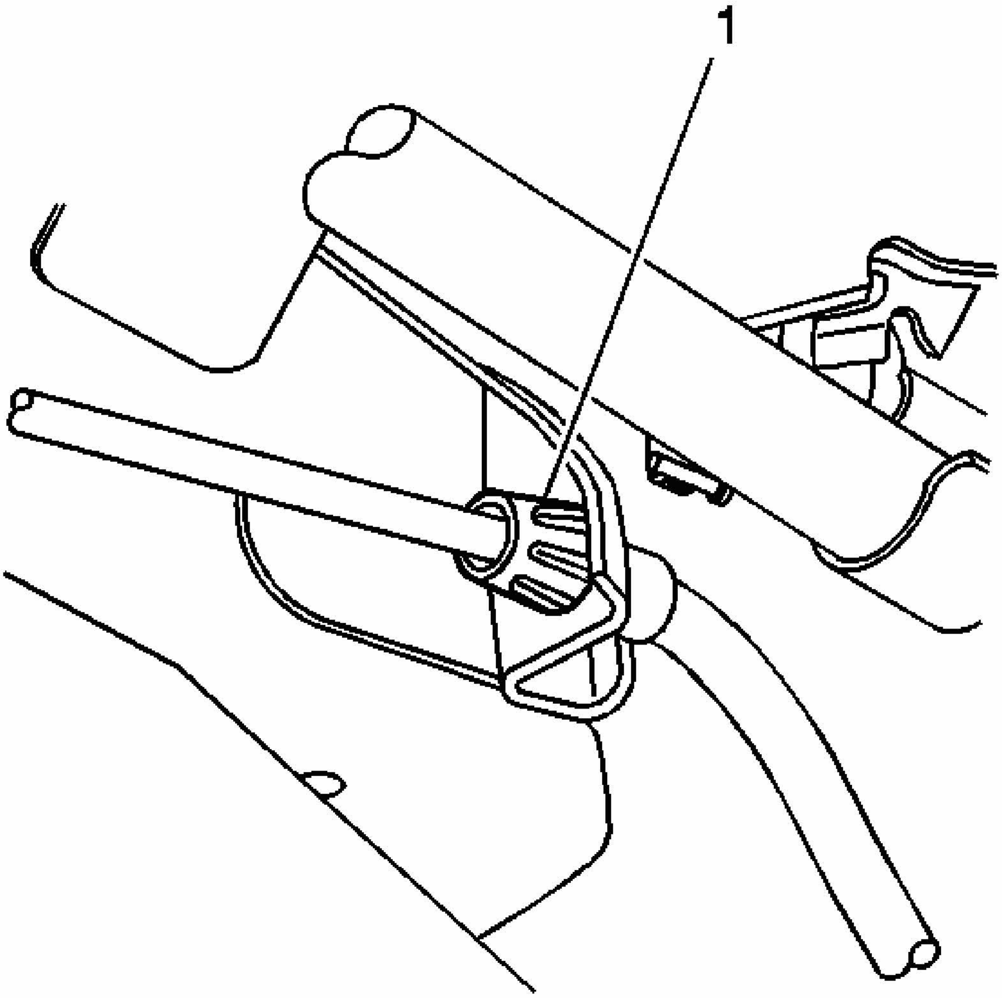


Fig. 25: Rear Park Brake Cable To Support Bracket Retainer (Z7U)
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the retainer (1) that holds the cable to the support bracket. Use the**J 37043** to release the retainer. See **Special Tools**.

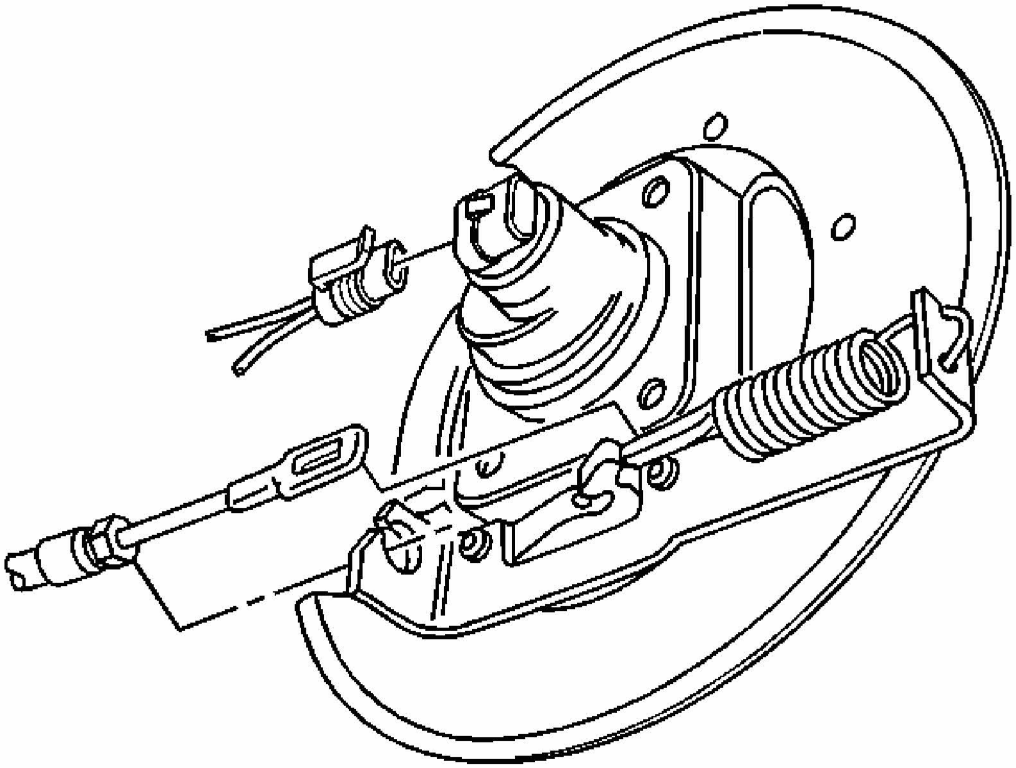


Fig. 26: View Of Rear Park Brake Cable & Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the park brake cable from the actuator lever.
6. Remove cable retaining pin from the support bracket and remove the park brake cable.

Installation Procedure

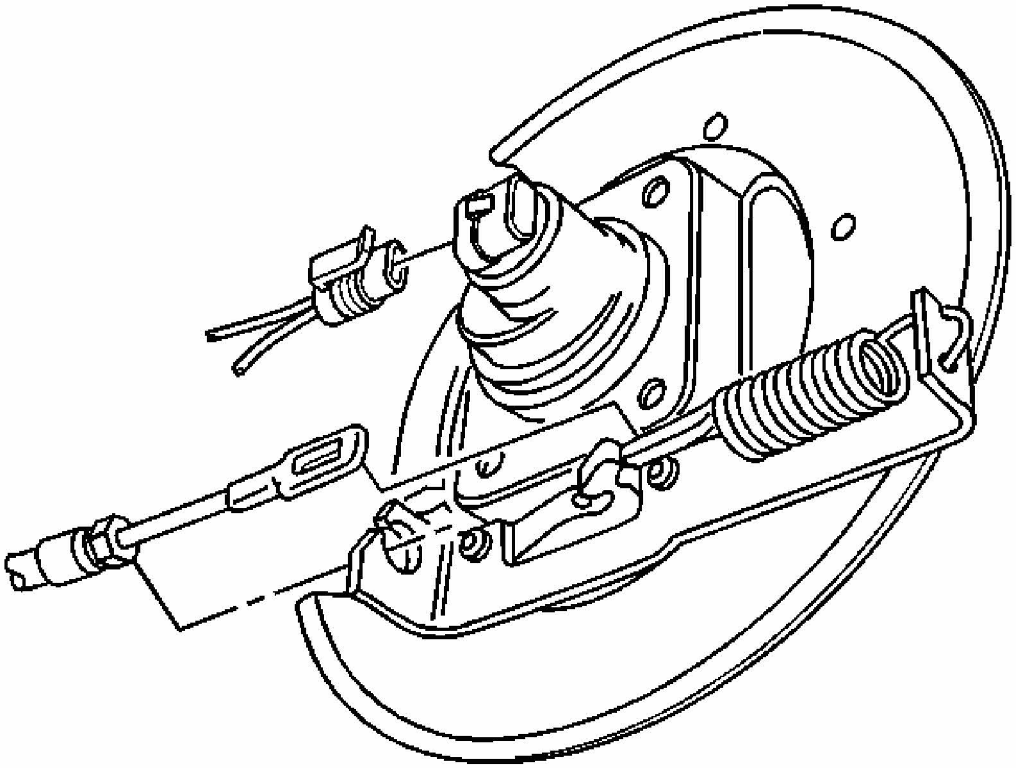


Fig. 27: View Of Rear Park Brake Cable & Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Position the park brake cable into the support bracket and install the cable retaining pin.
2. Install the park brake cable to the actuator lever.

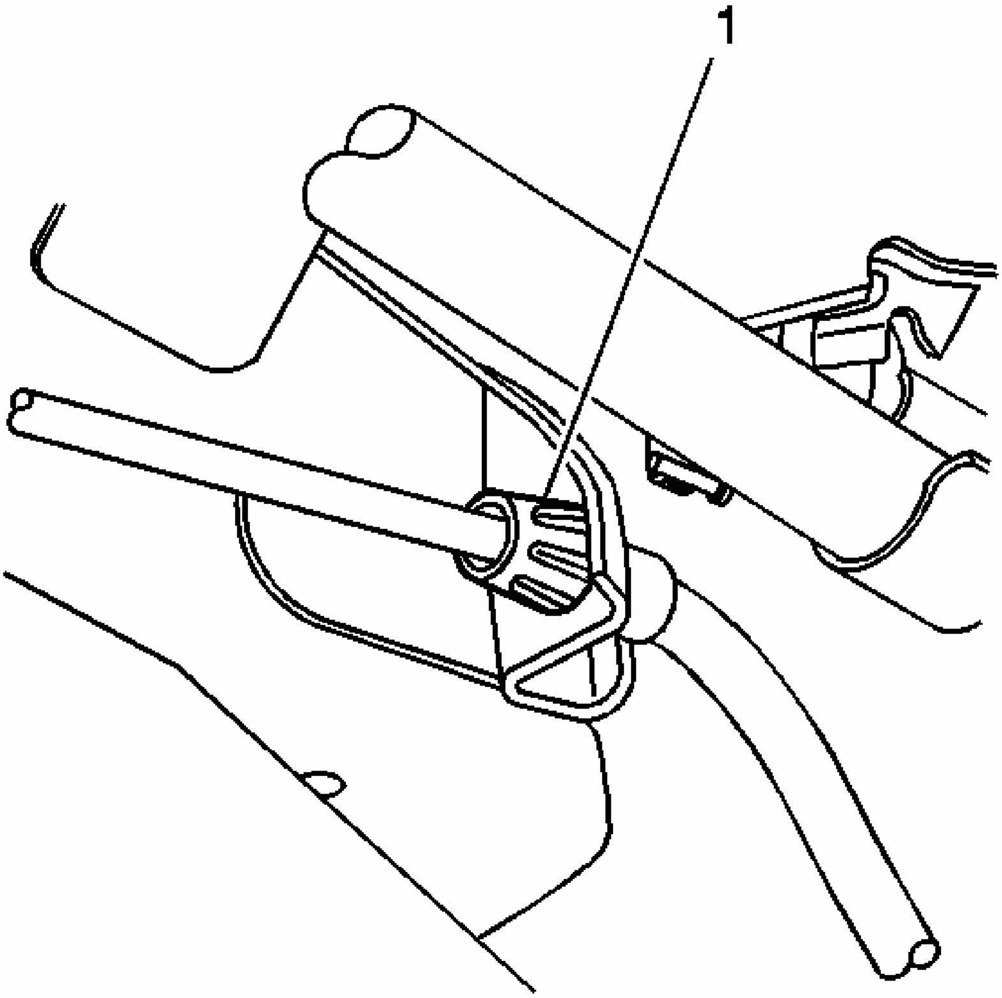


Fig. 28: Rear Park Brake Cable To Support Bracket Retainer (Z7U)
Courtesy of GENERAL MOTORS CORP.

3. Connect the retainer (1) that holds the cable to the support bracket.
4. Connect the rear cable to the front cable.

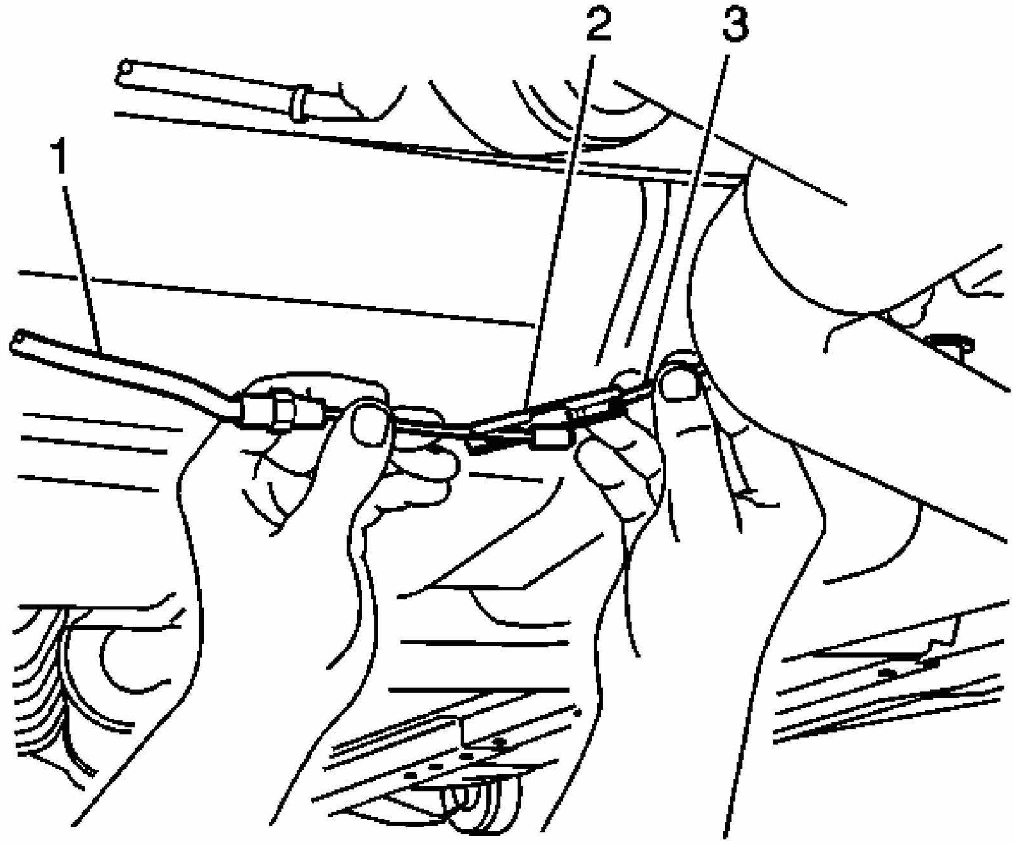


Fig. 29: View Of Front Brake Cable Connected To Right Rear Cable
Courtesy of GENERAL MOTORS CORP.

- For the right rear cable, connect the cable (3) to the clip (2).
- For the left rear cable, install the equalizer stud to the equalizer nut, which is part of the equalizer assembly.

5. Adjust the park brake. Refer to **Park Brake Adjustment**.
6. Lower the vehicle.

PARK BRAKE CABLE EQUALIZER REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

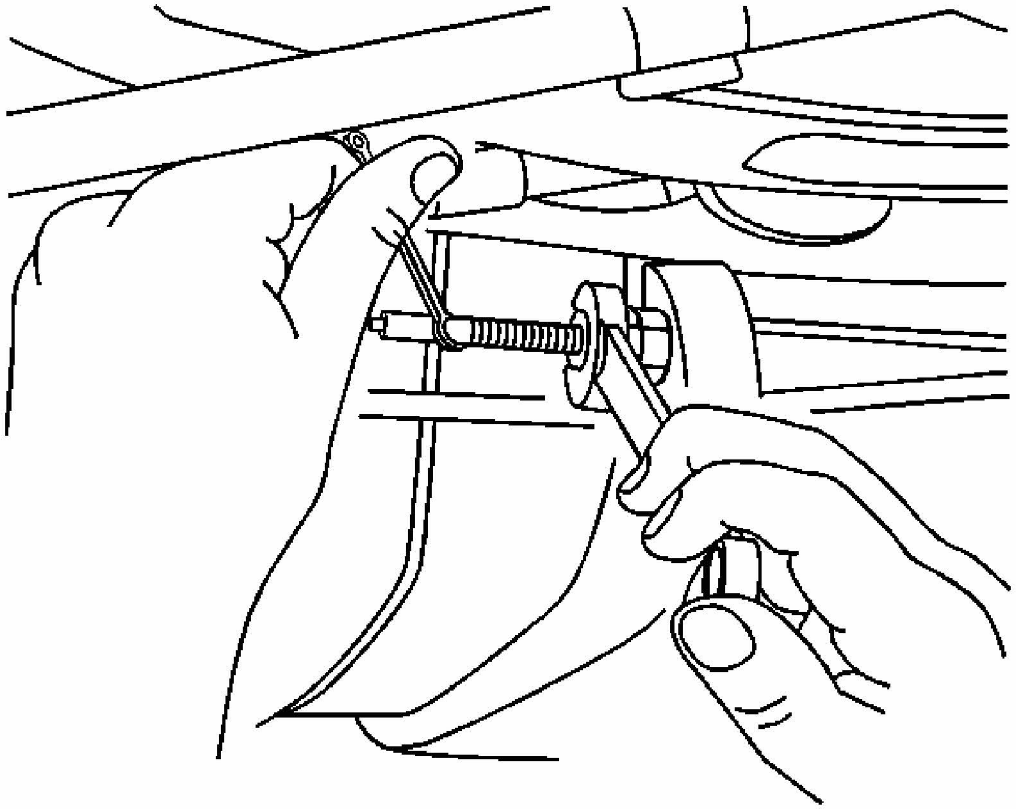


Fig. 30: Adjusting Park Brake Tension At Equalizer Assembly
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the left rear park brake cable and adjustment stud assembly from the equalizer assembly by removing the equalizer nut from the adjustment stud.

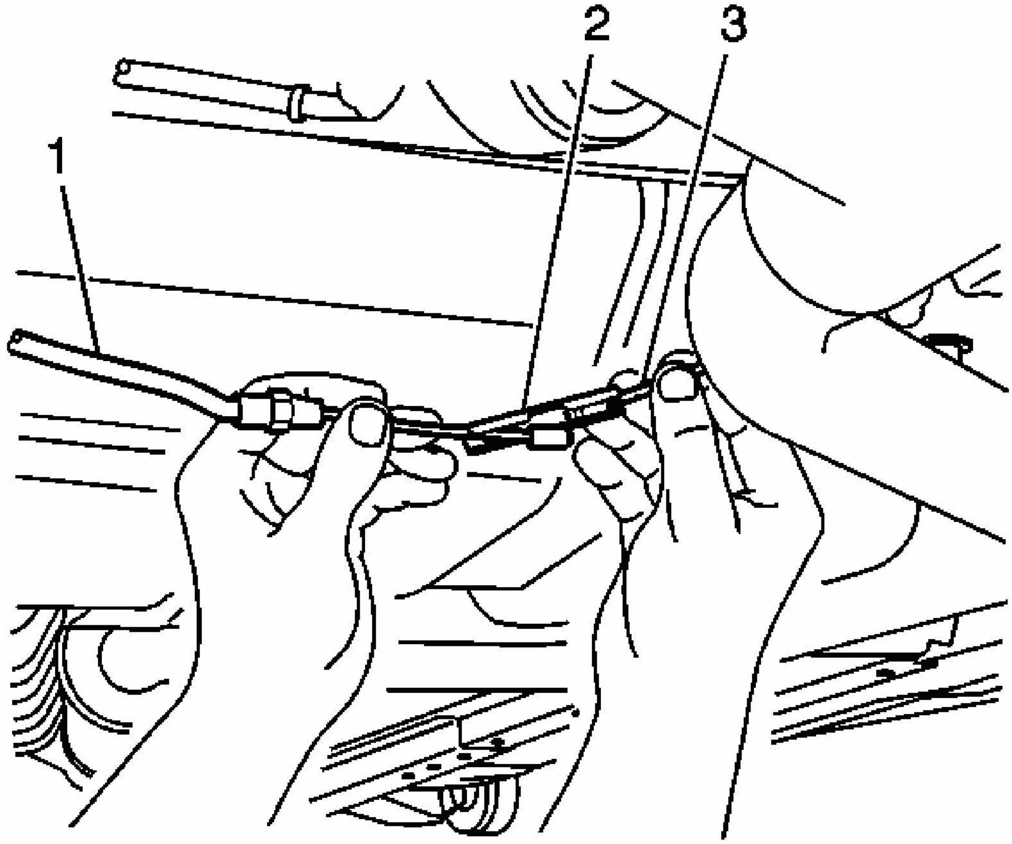


Fig. 31: View Of Front Brake Cable Connected To Right Rear Cable
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the front park brake cable (1) from the right rear cable (3) at the connector clip (2).

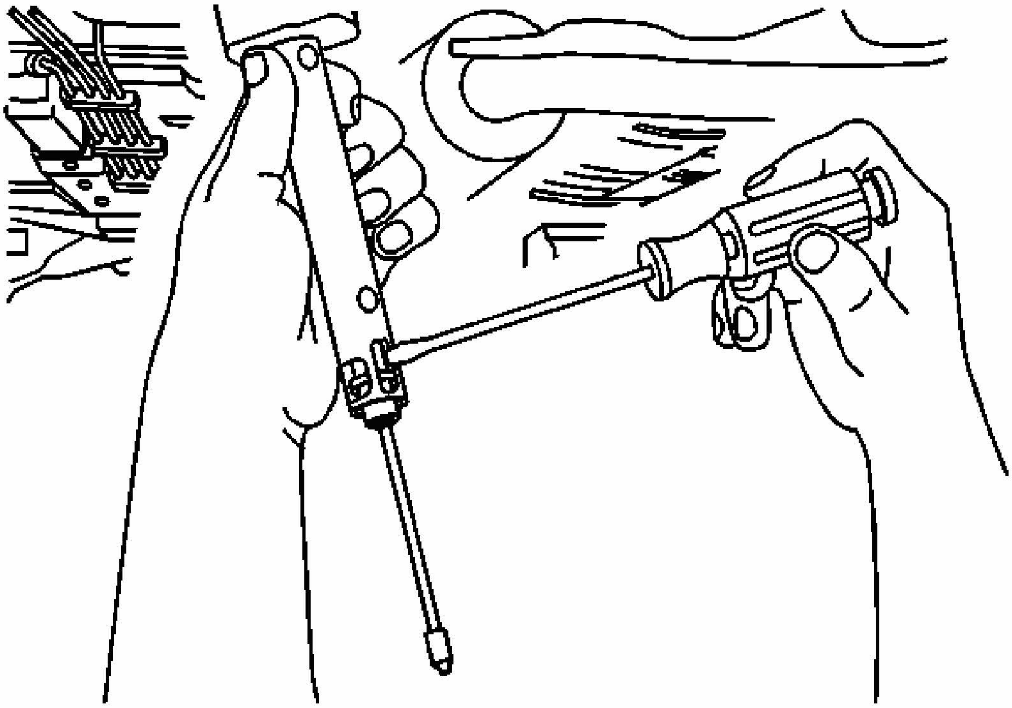


Fig. 32: Installing/Removing Equalizer Assembly From Front Park Brake Cable
Courtesy of GENERAL MOTORS CORP.

4. Remove the equalizer assembly from the front park brake cable. Insert a flat bladed tool into the equalizer and lightly twist to reposition the equalizer retaining tab. This will release the assembly from the cable.

Installation Procedure

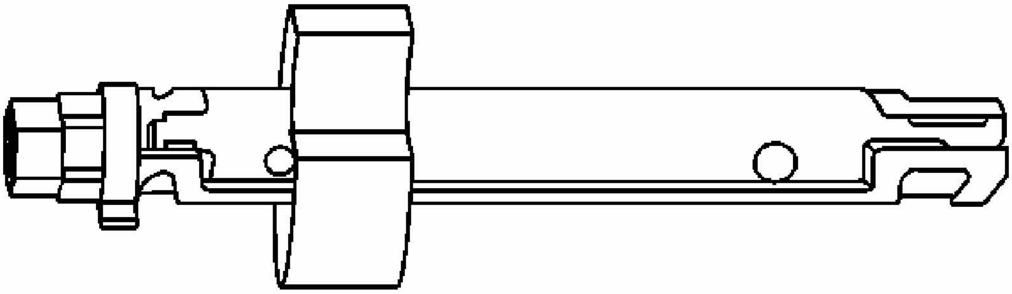


Fig. 33: View Of Equalizer Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the equalizer assembly to the front park brake cable.

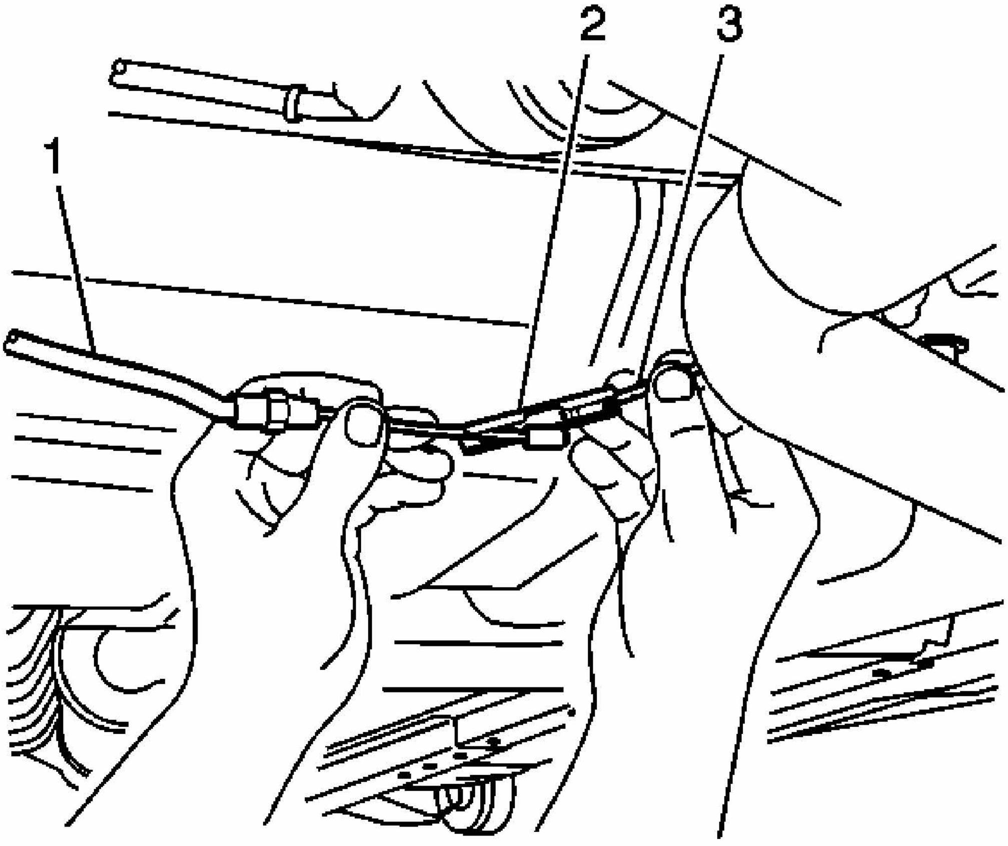


Fig. 34: View Of Front Brake Cable Connected To Right Rear Cable
Courtesy of GENERAL MOTORS CORP.

2. Connect the front brake cable (1) to the right rear cable (3) at the connector clip (2).
3. Connect the left rear brake cable and adjustment stud assembly to the equalizer assembly by installing the adjustment stud to the equalizer nut.
4. Adjust the Park Brake System. Refer to **Park Brake Adjustment**.
5. Lower the vehicle.

PARK BRAKE ACTUATOR REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

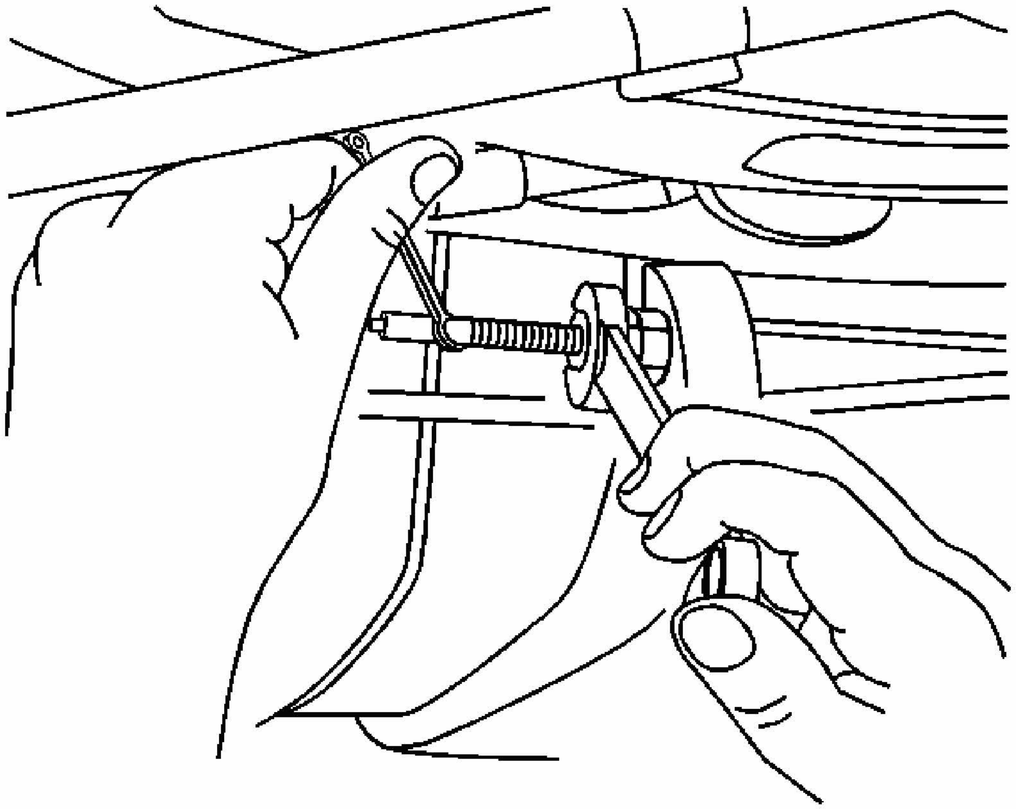


Fig. 35: Adjusting Park Brake Tension At Equalizer Assembly
Courtesy of GENERAL MOTORS CORP.

3. Relieve the park brake system tension at the equalizer assembly.
4. Remove the rear caliper bracket. Refer to **Brake Caliper Bracket Replacement - Rear** in Disc Brakes.
5. Remove the rear rotor. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.

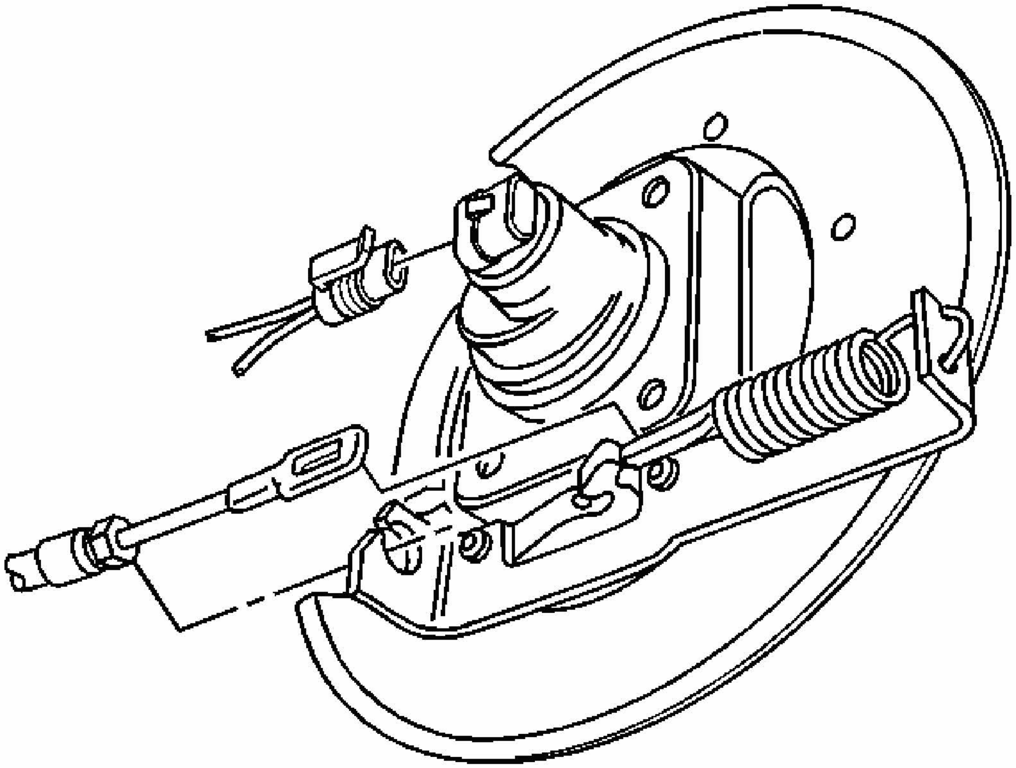


Fig. 36: View Of Rear Park Brake Cable & Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Disconnect and remove the rear park brake cable from the bracket at the rear wheel. Refer to **Park Brake Cable Replacement - Rear (Z7U)**.
7. Disconnect the park brake cable return spring from the park brake actuator and bracket at the rear wheel.
8. Remove the rear hub. Refer to **Wheel Bearing/Hub Replacement - Rear** in Rear Suspension.

The rear hub, backing plate, park brake cable bracket, and park brake actuator will be removed as an assembly.

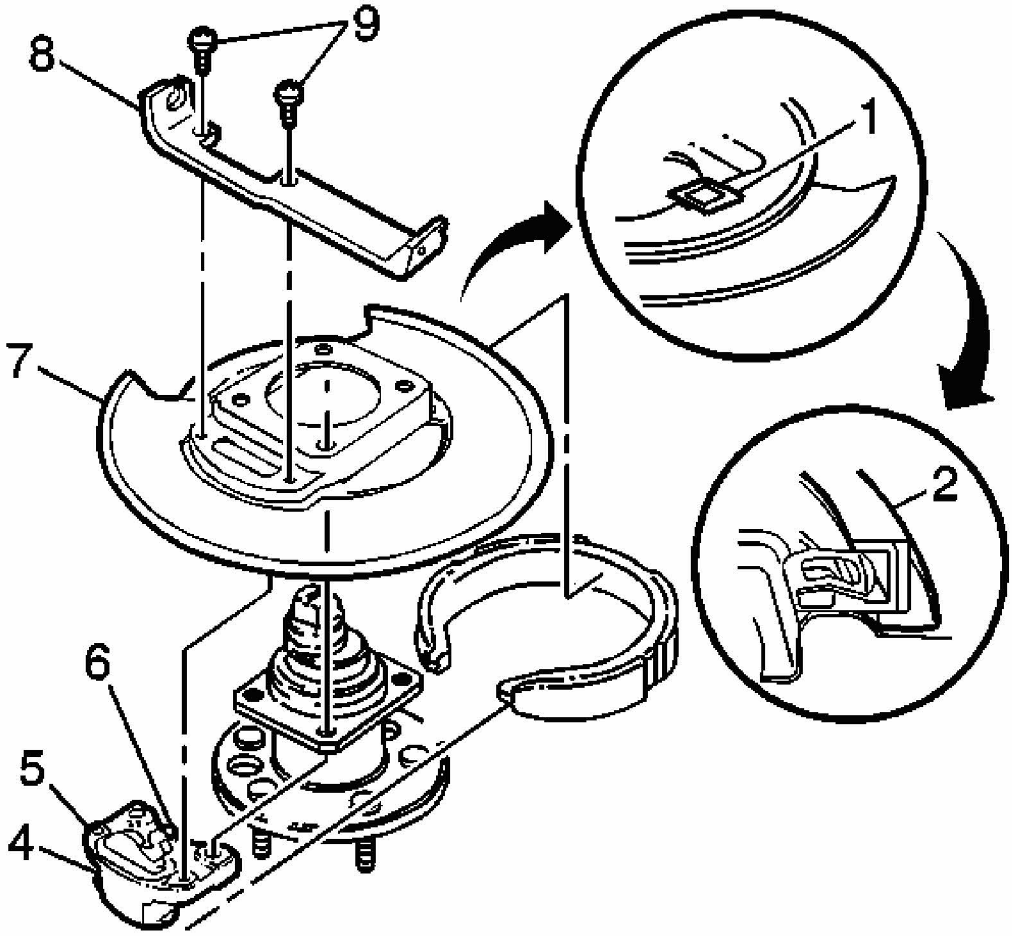


Fig. 37: Identifying Parking Brake Components
Courtesy of GENERAL MOTORS CORP.

9. Remove the 2 retainers (9) and the park brake cable bracket (8) from the park brake actuator (4). Position the rear hub aside.
10. Remove the park brake shoe and actuator (4) from the backing plate (7).
11. Separate the actuator (4) from the park brake shoe.

Installation Procedure

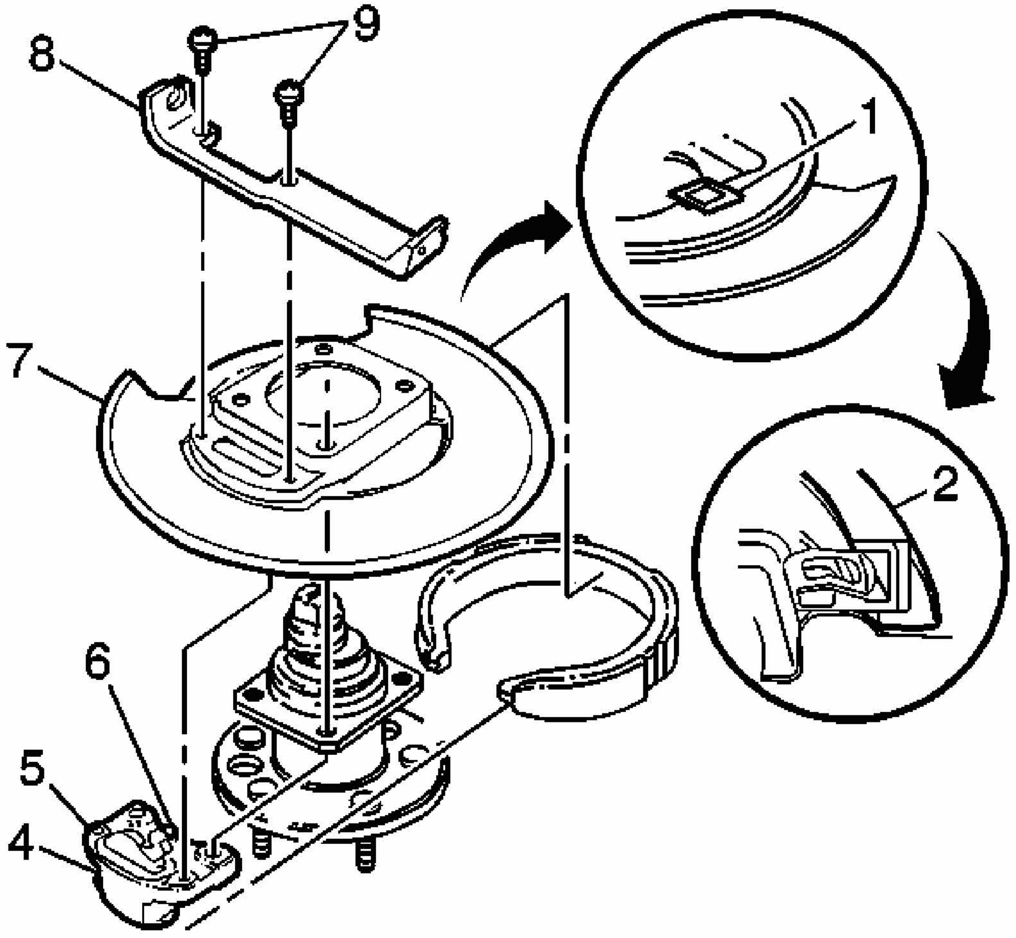


Fig. 38: Identifying Parking Brake Components
Courtesy of GENERAL MOTORS CORP.

1. Assemble the actuator (4) to the park brake shoe.
2. Install the park brake shoe and actuator (4) onto the backing plate (7).
3. Position the park brake shoe, actuator (4), and backing plate (7) over the rear hub.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the park brake cable bracket (8) and the two retainers (9)

   Tighten: Tighten the bracket retainers to 14 N.m (124 lb in).

5. Install the rear hub. Refer to **Wheel Bearing/Hub Replacement - Rear** in Rear

Suspension.

The rear hub, backing plate, park brake cable bracket, and park brake actuator will be installed as an assembly.

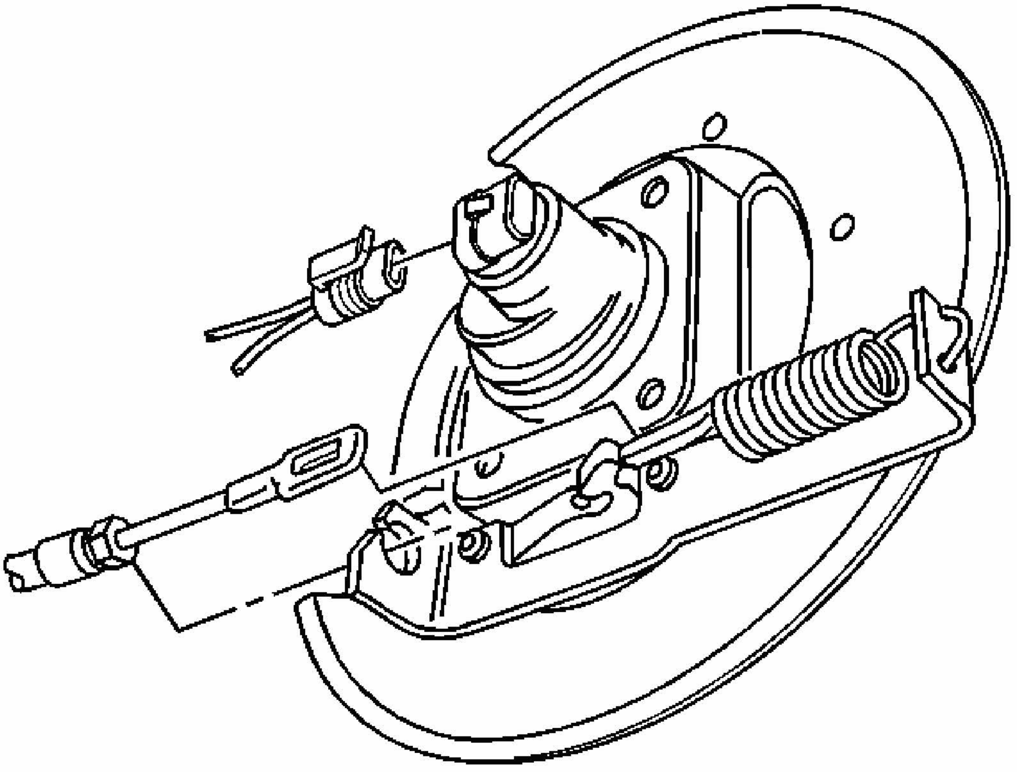


Fig. 39: View Of Rear Park Brake Cable & Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Install and connect the rear park brake cable to the bracket at the rear wheel. Refer to **Park Brake Cable Replacement - Rear (Z7U)**.
7. Connect the park brake cable return spring to the park brake actuator and bracket at the rear wheel.
8. Install the rear rotor. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
9. Install the rear caliper bracket. Refer to **Brake Caliper Bracket Replacement - Rear** in Disc Brakes.
10. Install the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
11. Adjust the park brake system. Refer to **Park Brake Adjustment** in Park Brake.

12. Lower the vehicle.

PARK BRAKE ADJUSTMENT

Tools Required

J 21177-A Drum-to-Brake Shoe Clearance Gage. See **Special Tools**.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Apply and fully release the parking brake 6 times.
2. Verify that the parking brake pedal releases completely.
    - Turn ON the ignition. Verify that the BRAKE indicator lamp is off.
    - If the BRAKE indicator lamp is on, ensure that the parking brake pedal is in release mode and fully returned to stop. Remove the slack in the front parking brake cable by pulling downward on the cable.
3. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Remove the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

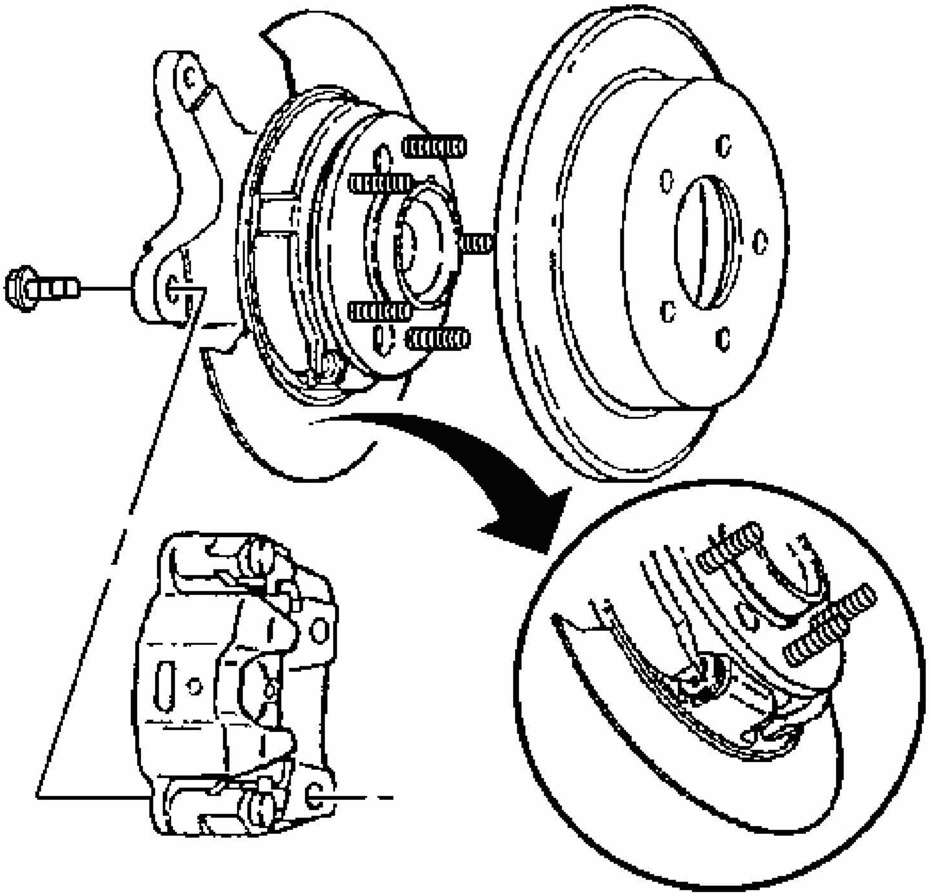


Fig. 40: Identifying Rear Brake Components
Courtesy of GENERAL MOTORS CORP.

5. Remove both rear caliper brackets. Refer to **Brake Caliper Bracket Replacement - Rear** in Disc Brakes.
6. Relieve tension on the park brake system at the park brake equalizer.
7. Remove both rear brake rotors. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.

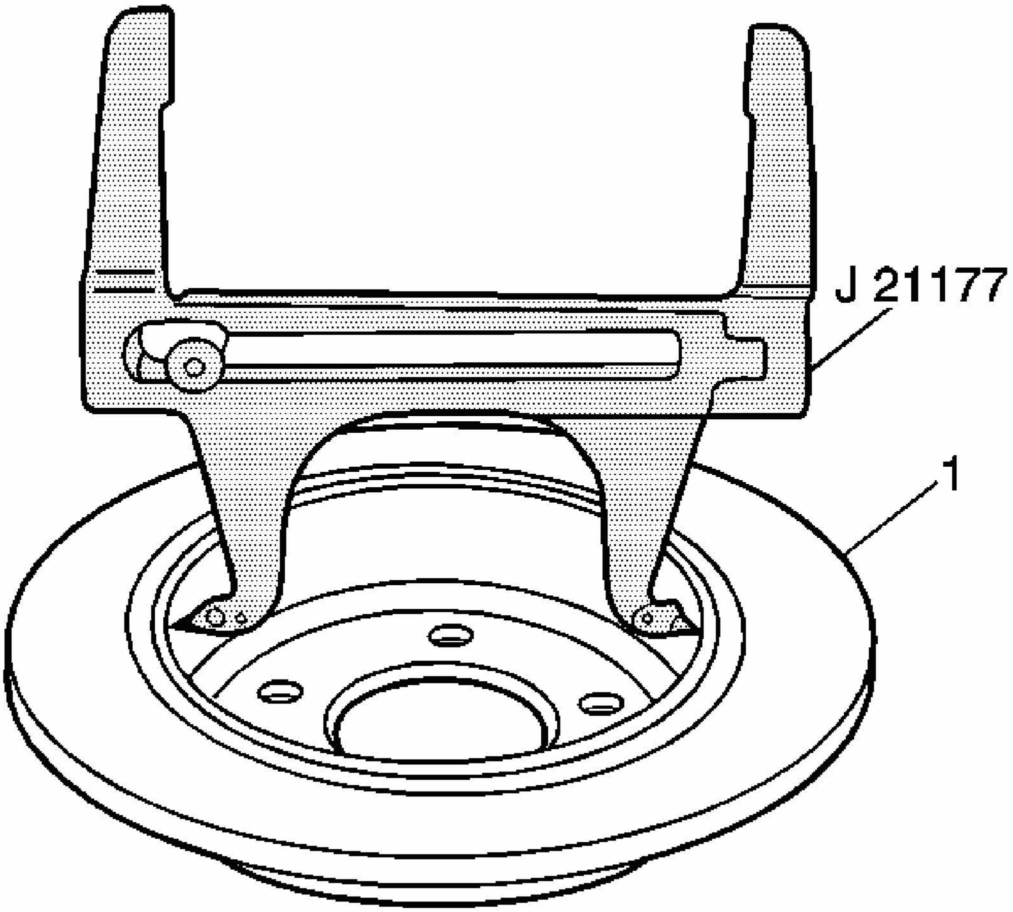


Fig. 41: Measuring Inside Of Rotor
Courtesy of GENERAL MOTORS CORP.

8. Set the **J 21177-A** inside of the park brake drum (1) at the widest point. See **Special Tools**.
    - Place the contacts on the tool to the widest point of the drum.
    - Tighten the set screw on the tool to ensure the proper measurement when removing the tool from the drum.

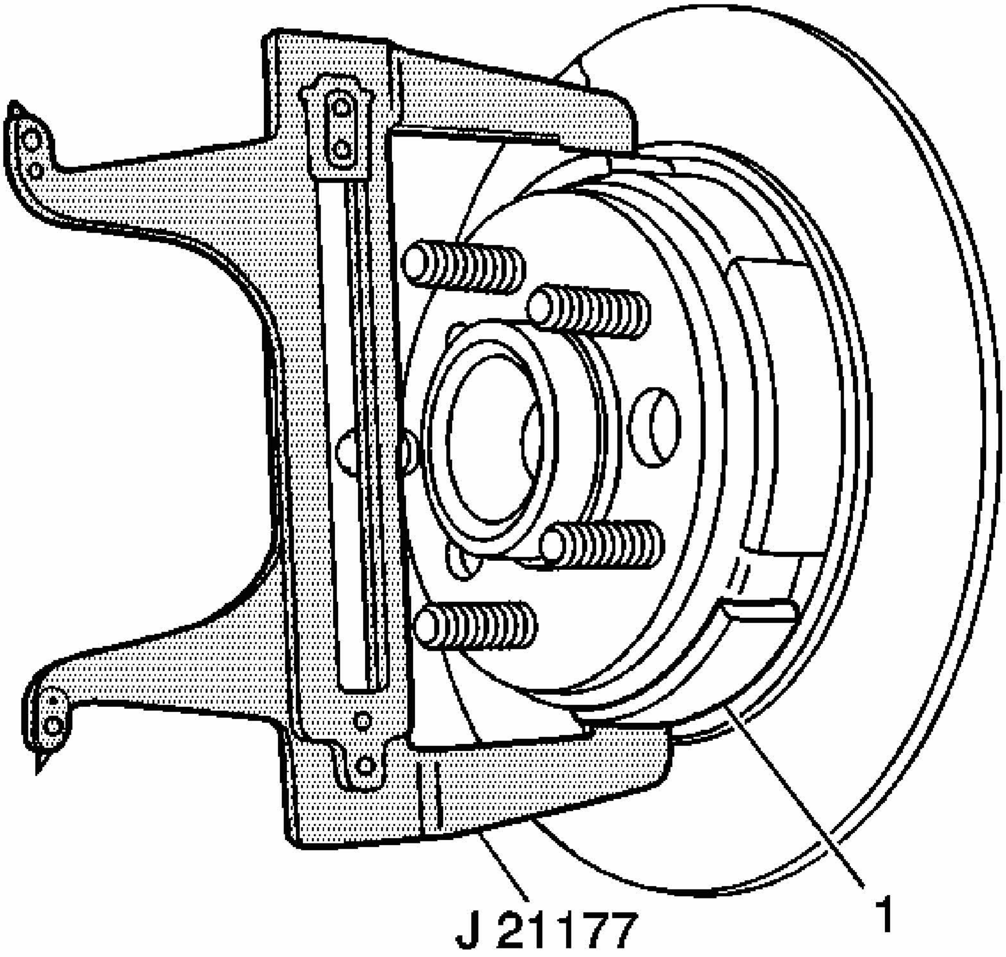


Fig. 42: Adjusting Parking Brake Shoes Using Special Tool
Courtesy of GENERAL MOTORS CORP.

9. Position the **J 21177-A** over the park brake shoe (1) at the widest point. See **Special Tools**.
10. Turn the adjuster on the actuator until the park brake shoe just contacts the **J 21177-A** . See **Special Tools**.
11. Repeat steps 8-10 for the opposite side.
12. Install both rear brake rotors. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
13. Install both rear caliper brackets. Refer to **Brake Caliper Bracket Replacement - Rear** in Disc Brakes.
14. Install the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and**

Installation in Tires and Wheels.

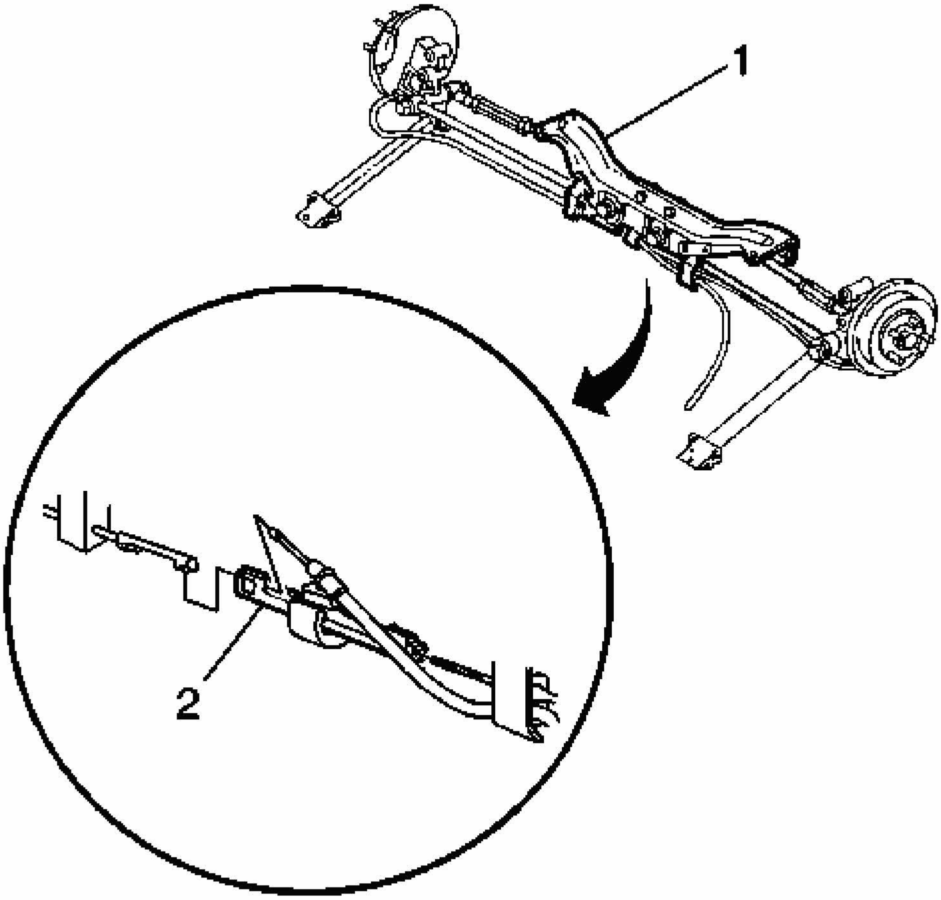


Fig. 43: View Of Parking Brake Adjustment
Courtesy of GENERAL MOTORS CORP.

15. Adjust the parking brake by turning the nut at the equalizer (2) while spinning both rear wheels. When either rear wheel starts to drag, back off the nut one full turn.
16. Lower the vehicle to curb height.
17. Apply the parking brake, then inspect for rotation of the rear wheels. If the rear wheels rotate during this inspection, then readjust the parking brake shoes.
18. Release the parking brake. Verify that the wheels rotate freely.
19. Lower the vehicle.

DESCRIPTION AND OPERATION

PARK BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The park brake system consists of the following:

Park Brake Pedal Assembly

Receives and transfers park brake system apply input force from driver to park brake cable system.

Releases applied park brake system when depressed again.

Park Brake Cables

Transfers input force received from park brake pedal, through park brake cable equalizer, to park brake apply lever.

Park Brake Cable Equalizer

Evenly distributes input force to both the left and right park brake units.

Threaded park brake cable equalizers are also used to remove slack in park brake cables.

Park Brake Apply Lever

Multiplies and transfers input force to park brake actuator.

Park Brake Actuator/Adjuster

Uses multiplied input force from apply lever to expand park brake shoe toward the friction surface of the drum-in-hat portion of the rear brake rotor.

Threaded park brake actuators are also used to control clearance between the park brake shoe and the friction surface of the drum-in-hat portion of the rear brake rotor.

Park Brake Shoe

Applies mechanical output force from park brake actuator to friction surface of the drum-in-hat portion of the rear brake rotor.

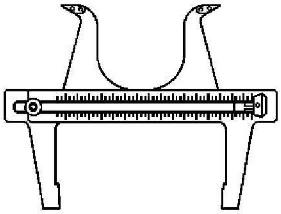
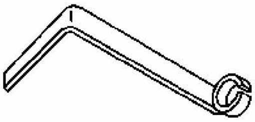
System Operation

Park brake apply input force is received by the park brake pedal assembly being depressed, transferred and evenly distributed, through the park brake cables and the park brake cable equalizer, to the left and right park brake apply levers. The park brake apply levers multiply and transfer the apply input force to the park brake actuators which expand the park brake shoe toward the friction surface of the drum-in-hat portion of the rear brake rotor in order to prevent the rotation of the rear tire and wheel assemblies. The park brake pedal assembly releases an applied park brake system when it is depressed again.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description
	J 21177-A Drum-to-Brake Shoe Clearance Gage
	J 37043 Parking Brake Cable Release Tool

2006 STEERING

Power Steering System - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Inner Tie Rod	100 N.m	74 lb ft
Outer Tie Rod End Jam Nut	70 N.m	52 lb ft
Outer Tie Rod End Nut *	30 N.m + 120°	22 lb ft + 120°
Power Steering Cooler Retaining Nuts	14 N.m	124 lb in
Power Steering Gear Cylinder Line Fittings	17 N.m	13 lb ft
Power Steering Gear Mounting Bolts	88 N.m	65 lb ft
Power Steering Pipe Fittings	27 N.m	20 lb ft
Power Steering Pressure Hose Bracket Bolt (V6)	23 N.m	17 lb ft
Power Steering Pressure Hose Bracket Bolt (V8)	55 N.m	41 lb ft
Power Steering Pressure Hose Clip Nut (V6)	9 N.m	80 lb in
Power Steering Pump Flow Control Valve	75 N.m	55 lb ft
Power Steering Pump Mounting Bolts (V6)	34 N.m	25 lb ft
Power Steering Pump Mounting Bolts (V8)	25 N.m	18 lb in
Power Steering Remote Reservoir Bolt (V8)	25 N.m	18 lb in
Rack Bearing Preload Lock Nut	68 N.m	50 lb ft
Reservoir Inlet Hose Clip Bolt (V6)	58 N.m	43 lb ft
Reservoir Inlet Pipe Bolt (V8)	55 N.m	41 lb ft
* Visually inspect to ensure that 21/2 - 41/2 threads are visible past the nylon washer.		

POWER STEERING PUMP SPECIFICATIONS

Power Steering Pump Specifications

Vehicle	Engine Code	Engine Size	High Flow		Pressure Relief	
			LPM	GPM	kPa	PSI
W Chevy	LZ4/LZE	3.5L	9.1/10.6	2.4/2.8	9653/10342	1400/1500
	LZ9	3.9L	9.1/10.6	2.4/2.8	9653/10342	1400/1500
	LS4	5.3L	9.1/10.6	2.4/2.8	9846/10342	1428/1500

COMPONENT LOCATOR

POWER STEERING GEAR DISASSEMBLED VIEW (RACK AND PINION)

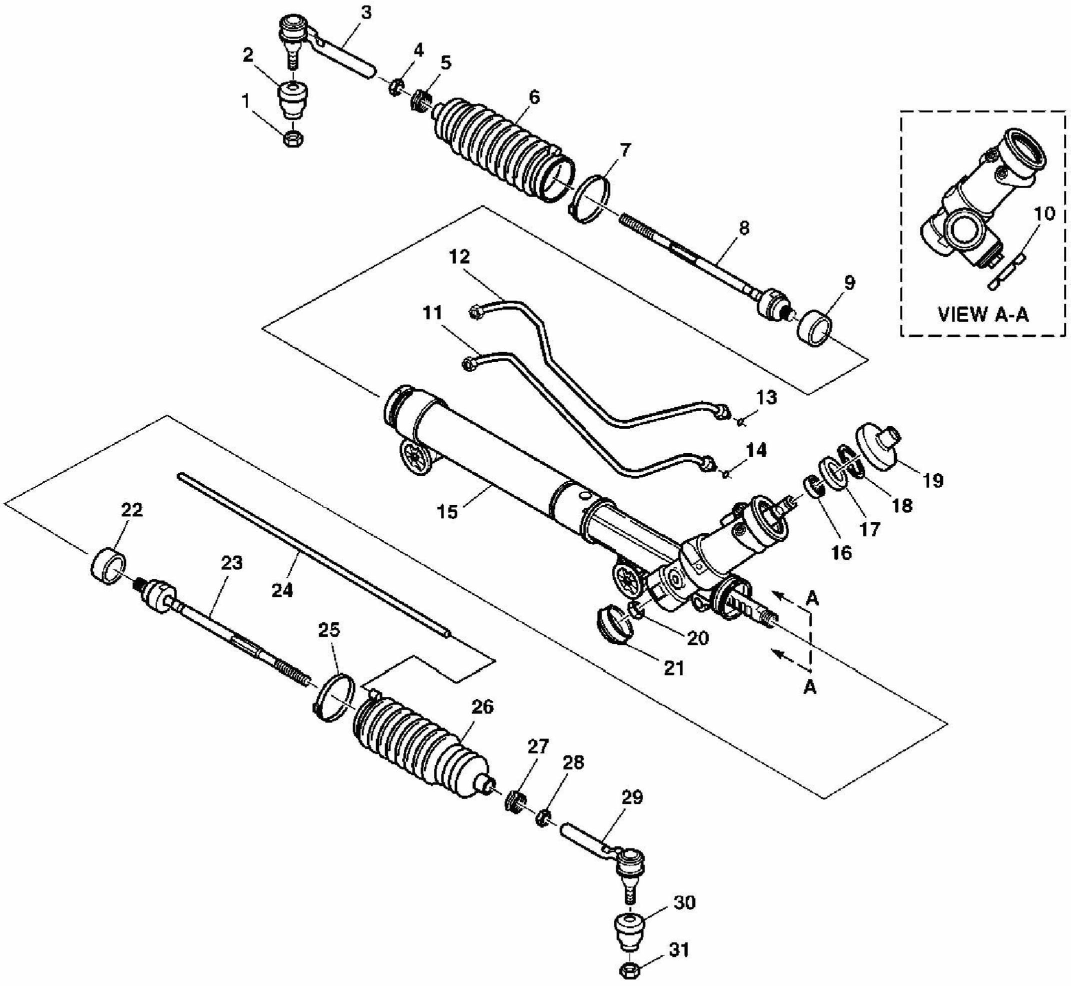

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Fig. 1: Rack and Pinion Power Steering Gear
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 1

Callout	Component Name
1	Hexagon Torque Prevailing Nut
2	Tie Rod Seal
3	Outer Tie Road Assembly
4	Hexagon Jam Nut
5	Tie Rod End Clamp
6	Rack and Pinion Boot
7	Boot Clamp
8	Inner Tie Rod Assembly
9	Shock Dampener Ring

10	Adjuster Plug Lock Nut
11	Cylinder Line Assembly (RH)
12	Cylinder Line Assembly (LH)
13	O-Ring Seal
14	O-Ring Seal
15	Rack and Pinion Gear Assembly (Partial)
16	Needle Bearing Annulus Assembly
17	Seal Adapter
18	Retaining Ring
19	Spool Shaft Seal
20	Hexagon Lock Nut
21	Dust Cover
22	Shock Dampener Ring
23	Inner Tie Rod Assembly
24	Breather Tube
25	Boot Clamp
26	Rack and Pinion Boot
27	Tie Rod End Clamp
28	Hexagon Jam Nut
29	Outer Tie Rod Assembly
30	Tie Rod Seal
31	Hexagon Torque Prevailing Nut

POWER STEERING PUMP DISASSEMBLED VIEW (CB SERIES PUMP)

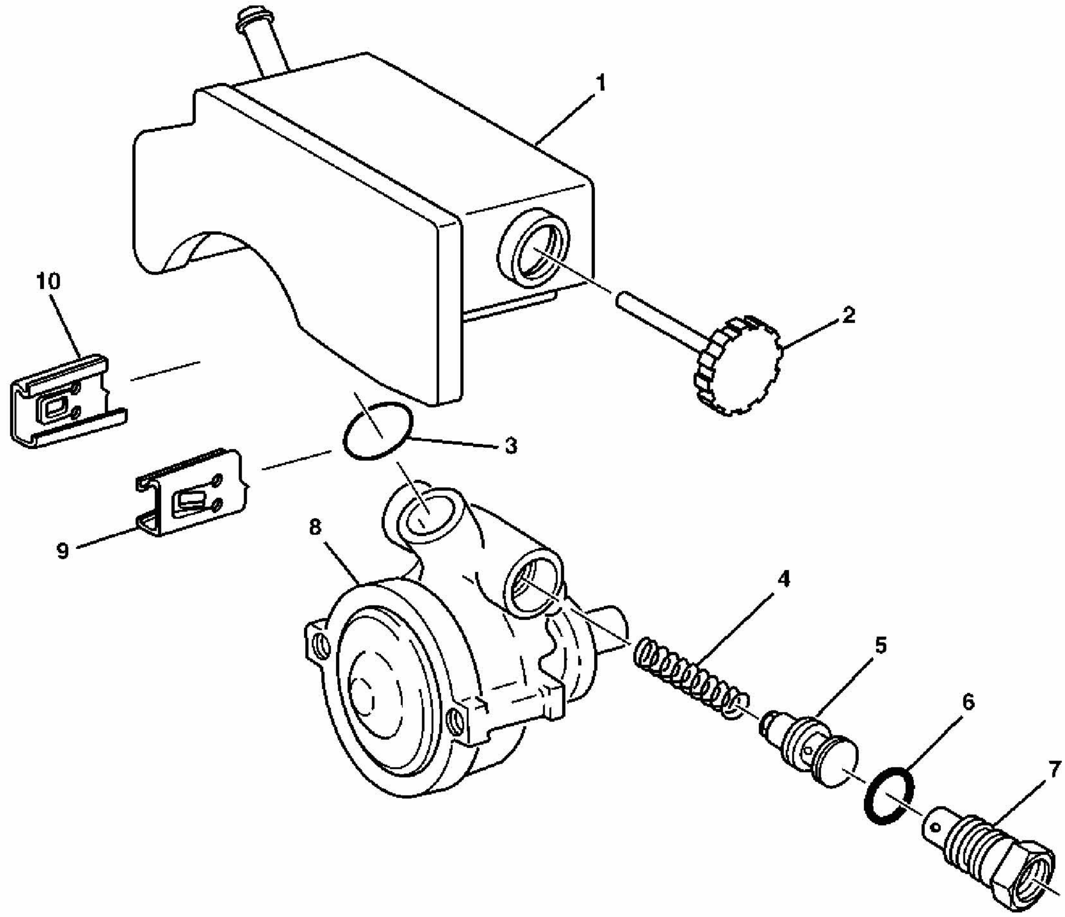


Fig. 2: Exploded View Of Power Steering Pump Components (CB Series)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	Hydraulic Pump Reservoir Assembly (Typical)
2	Reservoir Capstick Assembly
3	O-Ring Seal
4	Flow Control Spring
5	Control Valve Assembly
6	O-Ring Seal
7	O-Ring Union Fitting
8	Hydraulic Pump Housing Assembly
9	Reservoir Retaining Clip (RH)
10	Reservoir Retaining Clip (LH)

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - POWER STEERING SYSTEM (W/O ELECTRO-HYDRAULIC STEERING)

Begin the system diagnosis by reviewing the system Description and Operation. Refer to **Description and Operation**. Reviewing the Description and Operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the Description and Operation information will also help you determine if the condition described by the customer is normal operation. Refer to **Symptoms - Power Steering System** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

SYMPTOMS - POWER STEERING SYSTEM

IMPORTANT: Review the system description and operation in order to familiarize yourself with the system functions. Refer to Power Steering System Description and Operation (w/o Electro-Hydraulic Steering).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the power steering system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the power steering reservoir for the proper power steering fluid level and condition.

Symptoms List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Power Steering Fluid Leaks**
- **Rattle, Clunk, or Shudder Noise from the Power Steering System**
- **Whine or Growl Noise from the Power Steering System**
- **Steering Effort Hard or Too Easy in One or Both Directions**

POWER STEERING SYSTEM TEST PROCEDURE

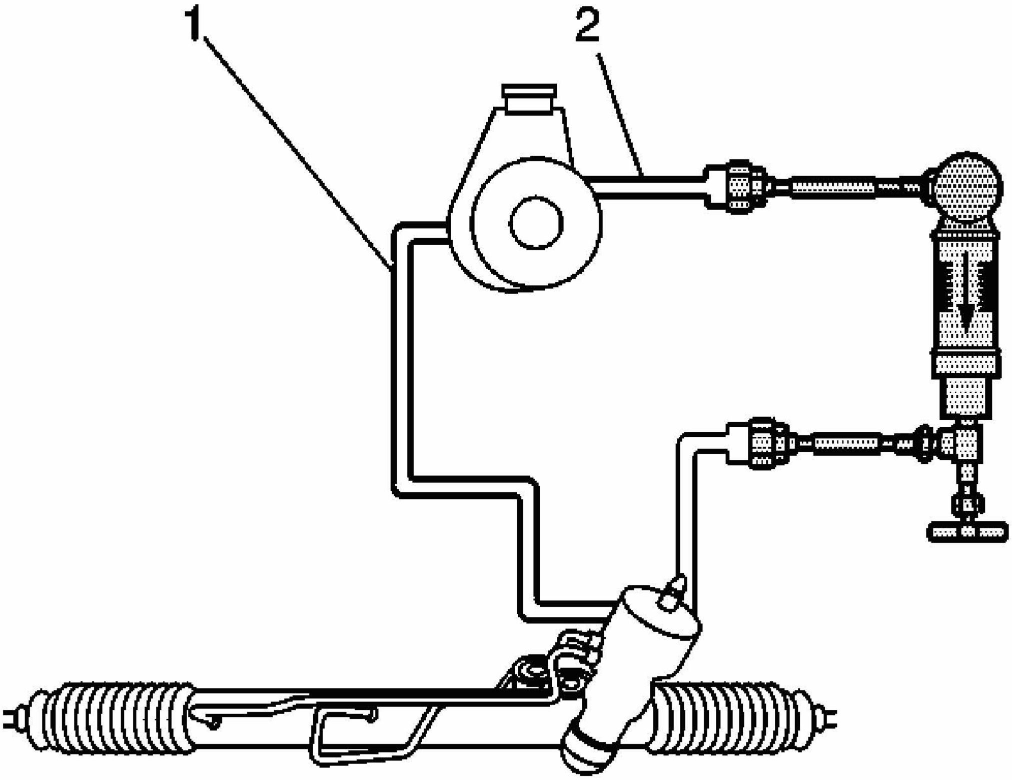


Fig. 3: Testing Rack and Pinion System Pressures
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Power Steering Return Hose
2	Power Steering Pressure Hose

Test Description

The numbers below refer to the step numbers on the diagnostic table.

5: This step tests the system for restrictions.

7: This step tests the following components for the following conditions:

- The pump for internal leaks
- The power steering pipes for kinks

8: This step tests the ability of the pump to regulate flow at maximum pressure.

10: This step tests the ability of the pump to regulate flow under normal operating conditions.

12: This step tests the internal components of the pump and the gear.

Power Steering System Test Procedure

Step	Action	Value(s)	Yes	No
DEFINITION: The Power Steering System Test Procedure will perform the following functions: • Test the operation of the hydraulic power steering system. • Test the operation of the power steering pump and power steering gear. • Identify restrictions in the system.				
1	Inspect the power steering fluid for the following indications of contamination: • Milky fluid - water • Brown fluid - burnt • Debris in fluid - plastic or dirt Is the fluid free of contamination?	-	Go to **Step 3**	Go to **Step 2**
2	Flush the power steering system. Refer to **Flushing the Power Steering System**. Did you complete the procedure?	-	Go to **Step 3**	-
3	**IMPORTANT:** **In order to accurately diagnose the system, the malfunction must be present during the test procedure.** Attempt to duplicate the condition.Is the condition present?	-	Go to **Step 4**	System OK
4	1. Turn the ignition switch to the OFF position. 2. Place a drain pan under the vehicle in order to catch any power steering fluid. 3. Disconnect the power steering pressure pipe/hose from the power steering pump or the power steering gear as necessary. 4. Install the **J 44721** Power Steering System Analyzer. See **Special**	-		

	Tools. 5. Fill the power steering system. Refer to **Checking and Adding Power Steering Fluid**. Did you complete the installation?		Go to **Step 5**	-
5	1. Fully open the **J 44721** valve. See **Special Tools**. 2. Start the engine. **NOTE:** **Refer to STEERING WHEEL IN THE FULL TURN POSITION NOTICE in Cautions and Notices.** 3. Turn the steering wheel and BRIEFLY hold the steering wheel against the steering stop in order to release any trapped air from the system. 4. Inspect and ensure that all of the power steering pipe/hose connections are not leaking. 5. Making sure the steering wheel is OFF the steering stop, observe the pressure reading. Is the pressure reading greater than the specified value?	1379 kPa (200 psi)	Go to **Step 6**	Go to **Step 7**
6	**IMPORTANT:** **A restriction may be present in the power steering system. Turn off the engine IMMEDIATELY.** Locate and repair the restriction.Did you complete the repair?	-	Go to **Step 18**	-
7	1. Allow the engine to run until the engine reaches full operating temperature. 2. Record the pressure reading and flow reading. 3. Partially close the **J 44721** valve until the system pressure reaches	4827 kPa		

	the specified value, then record the FLOW reading. See **Special Tools**. 4. Subtract second flow reading from the first flow reading. Is the flow DECREASE greater than 3.8 L (1 gal) per minute?	(700 psi)	Go to **Step 13**	Go to **Step 8**
8	**NOTE:** **Do not leave the valve fully closed for more than 5 seconds, or the pump could be damaged internally.** Fully close then open the **J 44721** valve 3 times. See **Special Tools**. Record all of the high pressure readings. Refer to **Power Steering Pump Specifications** for power steering system pressure relief specifications.Are the three high pressure readings within specifications?	-	Go to **Step 9**	Go to **Step 15**
9	Are the three high pressure readings within 245 kPa (50 psi) of each other?	-	Go to **Step 10**	Go to **Step 14**
10	1. Increase the engine speed to approximately 1500 RPM. 2. Record the flow reading. Refer to **Power Steering Pump Specifications** for power steering system pressure specifications. Is the actual flow reading within specifications?	-	Go to **Step 11**	Go to **Step 13**
11	Is the difference between the actual flow reading and the maximum flow specification more than 3.8 L (1 gal) per minute?	-	Go to **Step 16**	Go to **Step 12**
12	**NOTE:** **Refer to STEERING WHEEL IN THE FULL TURN POSITION NOTICE in Cautions and Notices.** Turn the steering wheel from steering stop to steering stop and record the FLOW readings at each stop.Is the flow LOWER than 3.8 L (1 gal) per minute?	-	Go to **Step 18**	Go to **Step 17**
	Replace the power steering pump. Refer			

13	to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)**. Did you complete the replacement?	-	Go to **Step 18**	-
14	1. Remove the power steering pump flow control valve. Refer to **Power Steering Pump Flow Control Valve Replacement - Off Vehicle (CB Series)**. 2. Inspect the flow control valve. If any burrs or scratches are noticed on the flow control valve, replace the flow control valve. Do NOT attempt to clean the flow control valve. Refer to **Power Steering Pump Flow Control Valve Replacement - Off Vehicle (CB Series)**. 3. Inspect the flow control valve bore. If any burrs or scratches are present in the control valve bore, replace the power steering pump. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)**. Did you complete the repair?	-	Go to **Step 18**	-
15	Replace the power steering pump flow control valve. Refer to **Power Steering Pump Flow Control Valve Replacement - Off Vehicle (CB Series)**. Did you complete the replacement?	-	Go to **Step 18**	-
	1. Remove the power steering pump flow control valve and inspect for any wear or damage. Do NOT disassemble the flow control valve. 2. If the flow control valve is worn			

16	damaged, replace the flow control valve. Refer to **Power Steering Pump Flow Control Valve Replacement - Off Vehicle (CB Series)**. Did you complete the repair?	-	Go to **Step 18**	-
17	The power steering gear is leaking across the piston or bypassing the valve circuit. Replace the power steering gear. Refer to **Power Steering Gear Replacement**. Did you complete the replacement?	-	Go to **Step 18**	-
18	Test the power steering system for the original condition. Does the original condition still exist?	-	Go to **Step 5**	Go to **Step 19**
19	1. Disconnect and remove the **J 44721** from the vehicle. See **Special Tools**. 2. Connect the vehicle power steering pipes/hoses. 3. Bleed the power steering system and add fluid as necessary. Refer to **Bleeding the Power Steering System**. Did you complete the repair?	-	System OK	-

POWER STEERING FLUID LEAKS

Power Steering Fluid Leaks

Step	Action	Yes	No
1	Did you review the Power Steering System General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Power Steering System**
2	Verify that power steering fluid leaks are present. Is the power steering system leaking?	Go to **Step 3**	System OK
3	Inspect the power steering system fittings. Are the fittings leaking?	Go to **Step 8**	Go to **Step 4**
4	Inspect the power steering hoses.		

	Are the hoses leaking?	Go to **Step 9**	Go to **Step 5**
5	Inspect the power steering sensors. Are the sensors leaking?	Go to **Step 10**	Go to **Step 6**
6	Inspect the power steering pump and the reservoir for leaks. Is the power steering pump or reservoir leaking?	Go to **Step 11**	Go to **Step 7**
7	Inspect the power steering gear for leaks. Is the power steering gear leaking?	Go to **Step 12**	Go to **Step 8**
8	**NOTE:** **Refer to FASTENER NOTICE in Cautions and Notices.** Tighten the fittings. Refer to **Fastener Tightening Specifications**.Did you complete the repair?	Go to **Step 13**	-
9	Replace the power steering hoses. Refer to the appropriate procedure(s): • **Power Steering Pressure Pipe/Hose Replacement (LS4)** or **Power Steering Pressure Pipe/Hose Replacement (LZ4/LZE/LZ9)** • **Power Steering Return Hose Replacement (LS4)** or **Power Steering Return Hose Replacement (LZ4/LZE/LZ9)** Did you complete the repair?	Go to **Step 13**	-
10	Replace the power steering sensors. Did you complete the repair?	Go to **Step 13**	-
11	Replace the power steering pump or reservoir. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)** or **Power Steering Reservoir Replacement - Off Vehicle (CB Series)**. Did you complete the repair?	Go to **Step 13**	-
12	Replace the power steering gear. Refer to **Power Steering Gear Replacement**. Did you complete the repair?	Go to **Step 13**	-
	Operate the system in order to verify the		

13	repair. Did you correct the condition?	System OK	Go to **Step 3**

RATTLE, CLUNK, OR SHUDDER NOISE FROM THE POWER STEERING SYSTEM

Rattle, Clunk, or Shudder Noise from the Power Steering System

Step	Action	Yes	No
1	Did you review the Power Steering System General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Power Steering System**
2	Verify that a rattle, clunk or shudder noise is present. Is a rattle, clunk or shudder noise present?	Go to **Step 3**	System OK
3	Inspect the power steering hoses for proper routing and clearance. Is the routing or clearance of the power steering hoses incorrect?	Go to **Step 11**	Go to **Step 4**
4	Inspect the engine drive belt for cracking or excessive wear. Refer to one of the following procedures: • **Drive Belt Excessive Wear Diagnosis** for the 3.5L engine • **Drive Belt Excessive Wear Diagnosis** for the 3.9L engine • **Drive Belt Excessive Wear Diagnosis** for the 5.3L engine Is the drive belt cracked or excessively worn?	Go to **Step 12**	Go to **Step 5**
5	Inspect the power steering pump pulley for damage. Is the power steering pump pulley damaged?	Go to **Step 13**	Go to **Step 6**
6	Inspect the power steering pump for the proper installation. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)**. Is the power steering pump installation incorrect?	Go to **Step 14**	Go to **Step 7**

7	Inspect the power steering gear for the proper installation. Refer to **Power Steering Gear Replacement**. Is the power steering gear installation incorrect?	Go to **Step 15**	Go to **Step 8**
8	Inspect the rack and pinion gear rack bearing preload adjustment. Refer to **Rack and Pinion Gear Rack Bearing Preload Adjustment - Off Vehicle (Rack and Pinion)**. Is the rack and pinion preload adjustment incorrect?	Go to **Step 16**	Go to **Step 9**
9	Inspect the suspension. Is the suspension worn?	Go to **Step 17**	Go to **Step 10**
10	Inspect the intermediate steering shaft. Is the intermediate steering shaft worn?	Go to **Step 18**	Go to **Step 3**
11	Adjust or replace the hoses. Refer to the appropriate procedure(s): • **Power Steering Cooler Pipe/Hose Replacement** • **Power Steering Pressure Pipe/Hose Replacement (LS4)** or **Power Steering Pressure Pipe/Hose Replacement (LZ4/LZE/LZ9)** • **Power Steering Return Hose Replacement (LS4)** or **Power Steering Return Hose Replacement (LZ4/LZE/LZ9)** Did you complete the repair?	Go to **Step 19**	-
12	Replace the engine drive belt. Refer to one of the following procedures: • **Drive Belt Replacement** for the 3.5L engine • **Drive Belt Replacement** for the 3.9L engine • **Drive Belt Replacement - Accessory** for the 5.3L engine		

	Did you complete the repair?	Go to **Step 19**	-
13	Replace the power steering pump pulley. Refer to **Power Steering Pulley Replacement (LS4)** or **Power Steering Pulley Replacement (LZ4/LZE/LZ9)**. Did you complete the replacement?	Go to **Step 19**	-
14	Install the power steering pump correctly. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)**. Did you complete the repair?	Go to **Step 19**	-
15	Install the power steering gear correctly. Refer to **Power Steering Gear Replacement**. Did you complete the repair?	Go to **Step 19**	-
16	Adjust the rack and pinion preload. Refer to **Rack and Pinion Gear Rack Bearing Preload Adjustment - Off Vehicle (Rack and Pinion)**. Did you complete the repair?	Go to **Step 19**	-
17	Replace the worn suspension components. Refer to **Diagnostic Starting Point - Suspension General Diagnosis** . Did you complete the replacement?	Go to **Step 19**	-
18	Replace the intermediate shaft. Refer to **Intermediate Steering Shaft Replacement** . Did you complete the replacement?	Go to **Step 19**	-
19	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM

Whine or Growl Noise from the Power Steering System

Step	Action	Yes	No
1	Did you review the Power Steering System Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Power Steering System**
2	Verify that a whine or growl noise is present.		

	Is a whine or growl noise present?	Go to **Step 3**	System OK
3	Perform the power steering test procedure in order to diagnose a hydraulic condition and repair or replace a component. Refer to **Power Steering System Test Procedure**. Did you repair or replace a power steering system component?	Go to **Step 10**	Go to **Step 4**
4	Using the **J 39570** Chassis Ear, inspect the power steering gear for a whine or growl noise. Is the noise present at the power steering gear?	Go to **Step 7**	Go to **Step 5**
5	Using the **J 39570** , inspect the power steering pump for a whine or growl noise. Is the noise present at the power steering pump?	Go to **Step 8**	Go to **Step 6**
6	Using the **J 39570** , inspect the power steering hoses for a whine or growl noise. Is the noise present at the power steering hoses?	Go to **Step 9**	Go to **Step 2**
7	Replace the power steering gear. Refer to **Power Steering Gear Replacement**. Did you complete the repair?	Go to **Step 10**	-
8	Replace the power steering pump. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)**. Did you complete the repair?	Go to **Step 10**	-
9	Adjust the routing of the power steering hoses. Did you complete the repair?	Go to **Step 10**	-
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

STEERING EFFORT HARD OR TOO EASY IN ONE OR BOTH DIRECTIONS

Steering Effort Hard or Too Easy in One or Both Directions

Step	Action	Yes	No
1	Did you review the Power Steering System General Description and perform the necessary inspections?		Go to **Symptoms - Power Steering**

		Go to **Step 2**	**System**
2	Verify that the steering effort is hard or too easy in one or both directions. Does the system operate normally?	System OK	Go to **Step 3**
3	Perform the power steering test procedure. Refer to **Power Steering System Test Procedure**. Did you complete the procedure?	Go to **Step 4**	-
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

REPAIR INSTRUCTIONS

BLEEDING THE POWER STEERING SYSTEM

Tools Required

- **J 35555** Metal Mityvac. See **Special Tools**.
- **J 43485** Power Steering Bleeder Adapter. See **Special Tools**.

IMPORTANT: Hoses touching the frame, body, or engine may cause system noise.

1. Verify that the hoses do not touch any other part of the vehicle.

   IMPORTANT: Loose connections may not leak, but could allow air into the steering system.

2. Verify that all hose connections are tight.

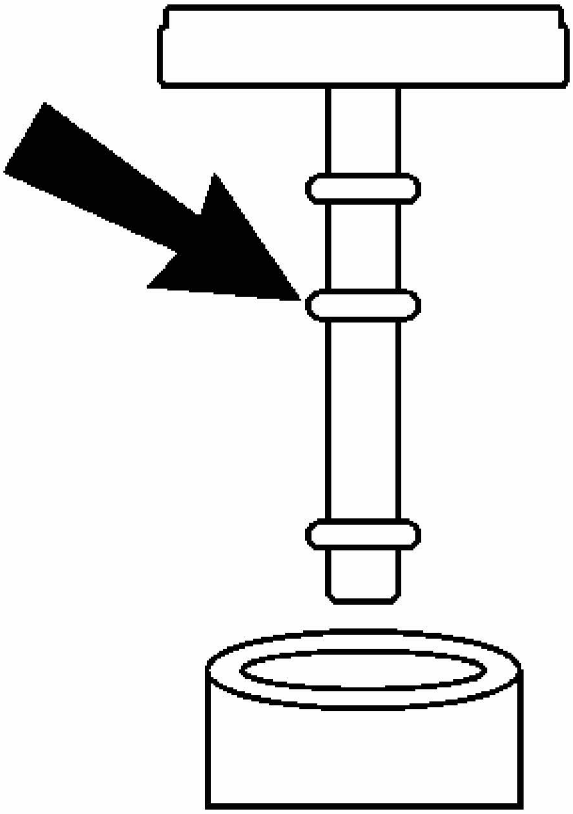


Fig. 4: Identifying FULL COLD Level On Reservoir Cap
Courtesy of GENERAL MOTORS CORP.

NOTE: If the power steering system has been serviced, an accurate fluid level reading cannot be obtained unless air is bled from the steering system. The air in the fluid may cause pump cavitation noise and may cause pump damage over a period of time.

IMPORTANT: Maintain the fluid level throughout the bleed procedure.

3. Remove the pump reservoir cap.

IMPORTANT: Use clean, new power steering fluid only.

4. Fill the pump reservoir with fluid to the FULL COLD level.

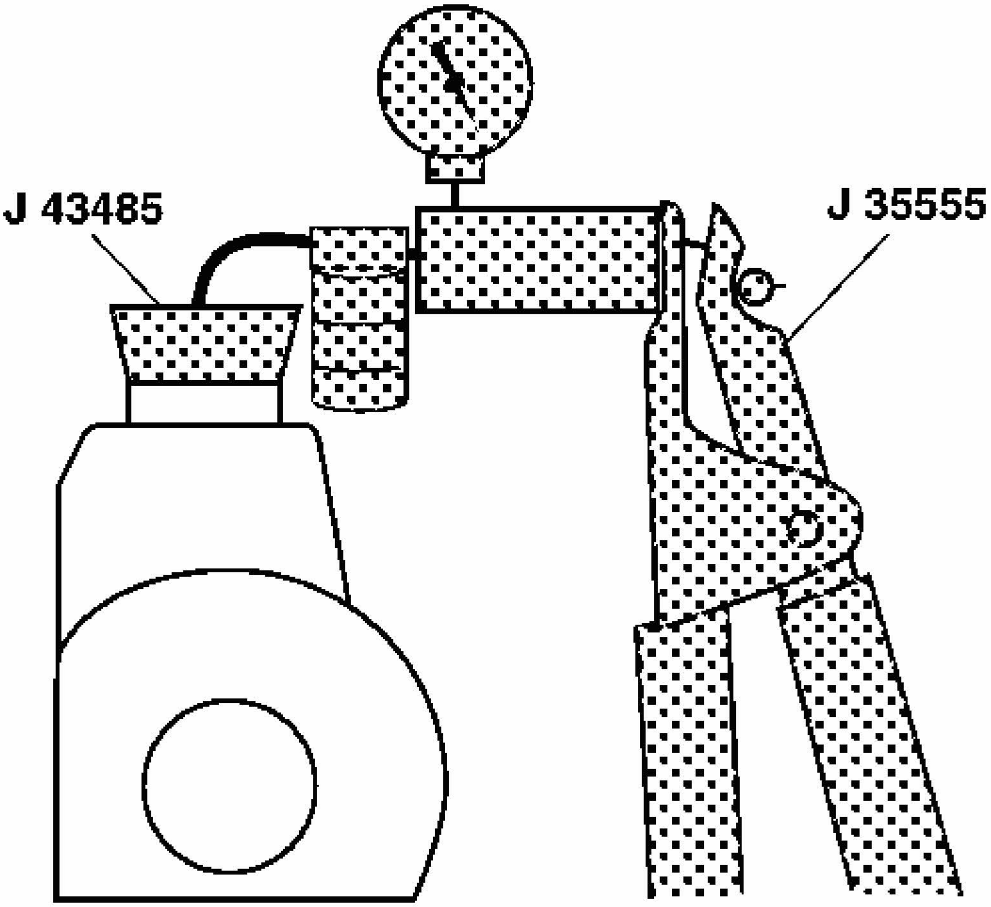


Fig. 5: Bleeding Power Steering System Using J 43485 & J 35555
Courtesy of GENERAL MOTORS CORP.

5. Attach the **J 43485** to the **J 35555** or equivalent. See **Special Tools**.
6. Place the **J 43485** on or in the pump reservoir filler neck. See **Special Tools**.
7. Apply a vacuum of 68 kPa (20 in Hg) maximum.
8. Wait 5 minutes.

   Typical vacuum drop is 7-10 kPa (2-3 in Hg). If the vacuum does not remain steady, refer to **Excessive Vacuum Drop Diagnosis** at the end of this procedure.

9. Remove the **J 43485** and the **J 35555** . See **Special Tools**.

10. Reinstall the pump reservoir cap.
11. Start the engine. Allow the engine to idle.
12. Turn off the engine.
13. Verify the fluid level. Repeat steps 11-13 until the fluid stabilizes.

IMPORTANT: Do not turn steering wheel to lock.

14. Start the engine. Allow the engine to idle.
15. Turn the steering wheel 180-360 degrees in both directions 5 times.
16. Switch the ignition off.

NOTE: When adding fluid or making a complete fluid change, always use the proper power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

17. Verify the fluid level.

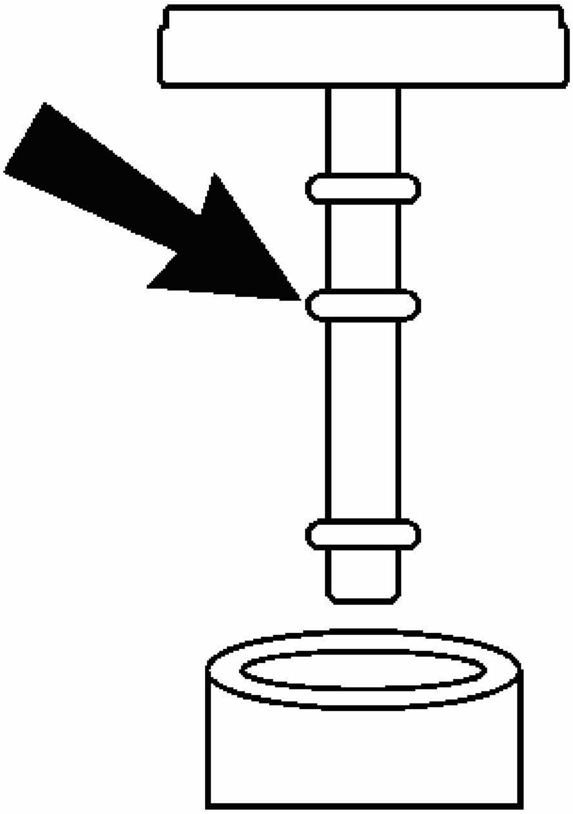


Fig. 6: Identifying FULL COLD Level On Reservoir Cap
Courtesy of GENERAL MOTORS CORP.

18. Remove the pump reservoir cap.

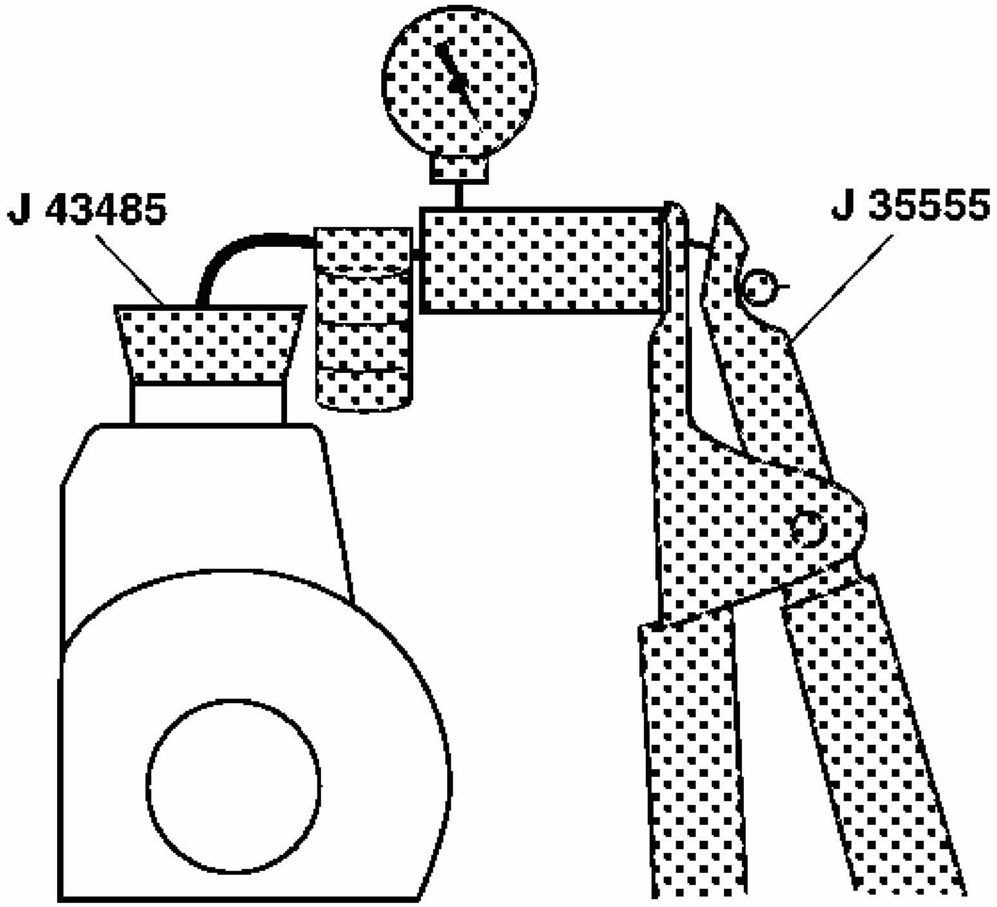


Fig. 7: Bleeding Power Steering System Using J 43485 & J 35555
Courtesy of GENERAL MOTORS CORP.

19. Attach the **J 43485** to the **J 35555** or equivalent. See **Special Tools**.
20. Place the **J 43485** on or in the pump reservoir filler neck. See **Special Tools**.
21. Apply a vacuum of 68 kPa (20 in Hg) maximum.
22. Wait 5 minutes.
23. Remove the **J 43485** and the **J 35555** . See **Special Tools**.
24. Verify the fluid level.

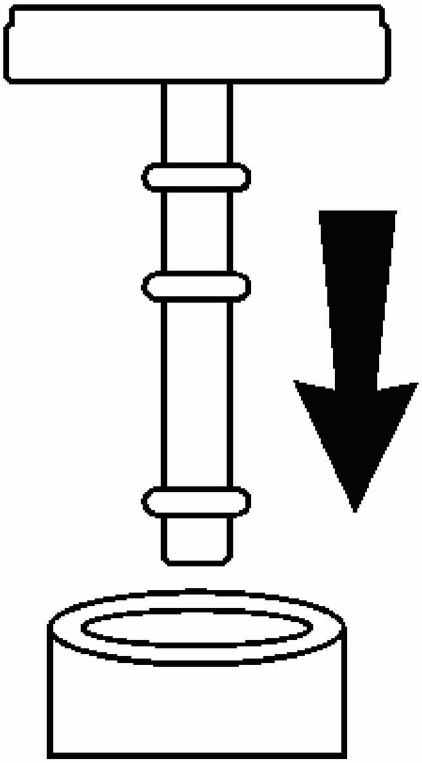


Fig. 8: View Of Pump Reservoir Cap
Courtesy of GENERAL MOTORS CORP.

25. Reinstall the pump reservoir cap.

Excessive Vacuum Drop Diagnosis

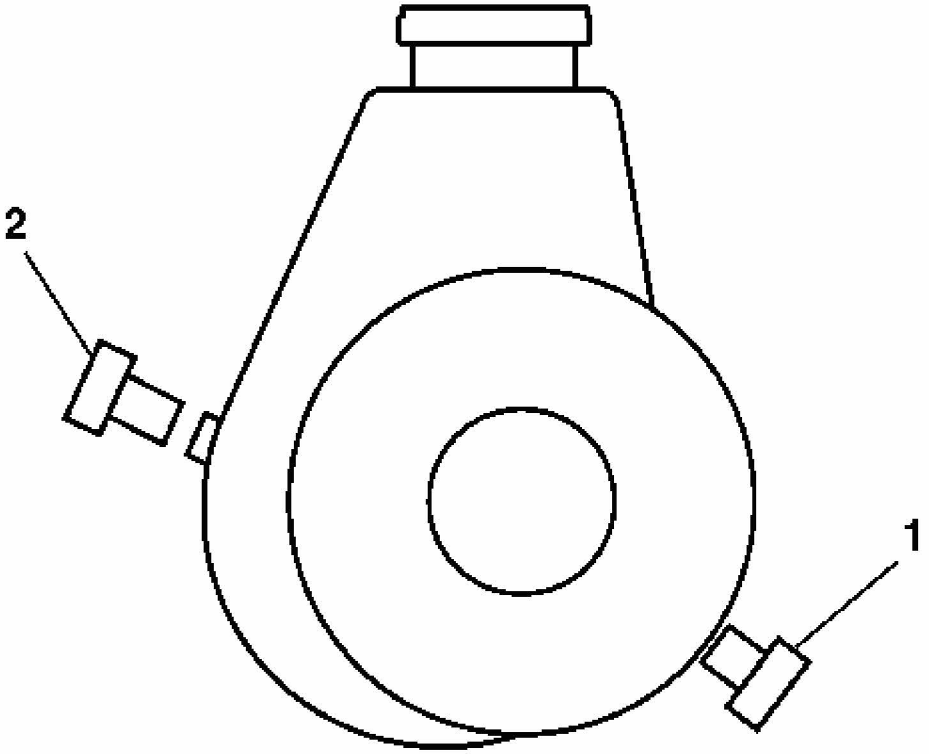


Fig. 9: Installing Plugs Into Power Steering Pump Pressure & Return Ports
Courtesy of GENERAL MOTORS CORP.

1. If the vacuum continues to drop, remove the pressure and return hose from the pump.
2. Install the plugs (1,2) supplied with the **J 43485** into the pressure and return port. See **Special Tools**.

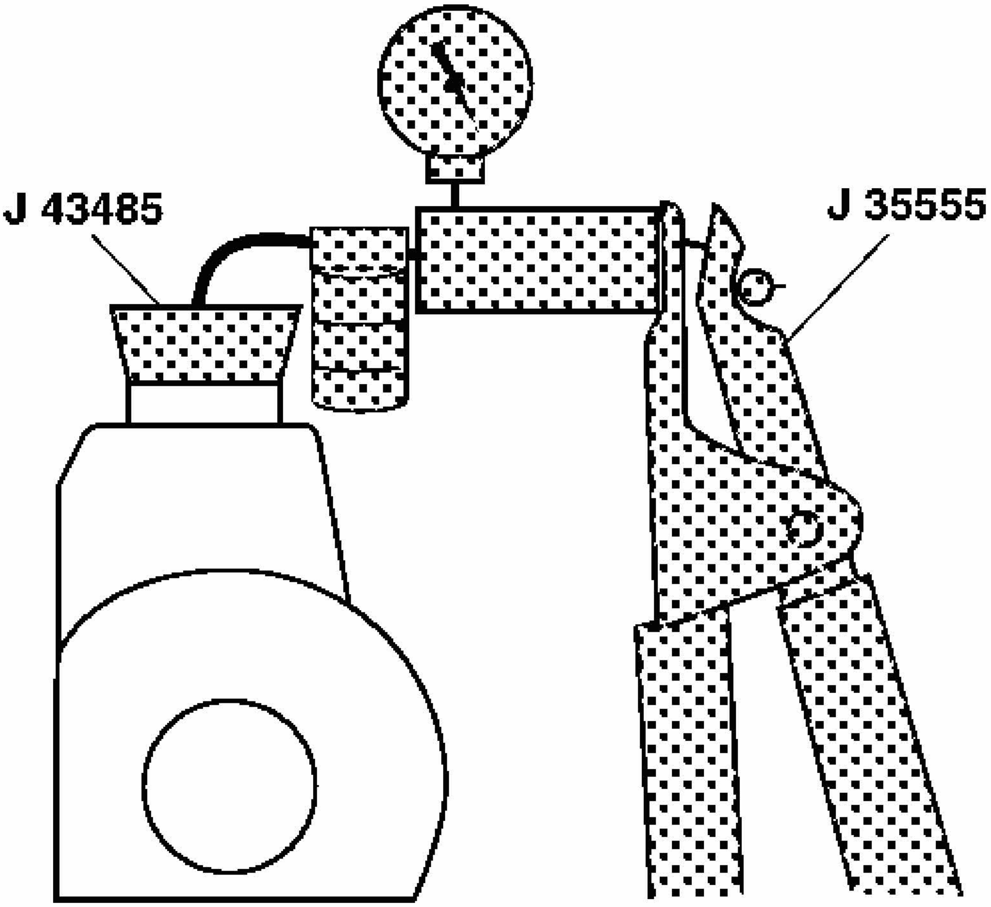


Fig. 10: Bleeding Power Steering System Using J 43485 & J 35555
Courtesy of GENERAL MOTORS CORP.

3. Attach the **J 43485** to the **J 35555** or equivalent. See **Special Tools**.
4. Place the **J 43485** on or in the pump reservoir filler neck. See **Special Tools**.
5. Apply a vacuum of 68 kPa (20 in Hg) maximum.
6. If the vacuum drops again, repair or replace the pump. If the vacuum holds steady, continue to check the other parts of the steering system.

IMPORTANT: Fluid must be free from bubbles and foam. Be aware of periodic bubbles that indicate a loose connection or leaking O-ring seal in the return hose or the pressure hose. Fluid must be free from discoloration.

7. Observe the fluid.
8. If condition persists, replace the following parts:
   - The return hose clamps
   - The return hose O-rings
   - The pressure hose O-rings
   - The gear cylinder line O-rings
   - The reservoir to pump O-ring
9. Repeat the bleed procedure from the beginning.
10. Drive the vehicle approximately 16 km (10 mi) in order to warm the system to operating temperature. Evaluate vehicle on a smooth flat surface.
11. Verify the following conditions:
    - There is smooth power assist.
    - The vehicle operates quietly.
    - The pump maintains the proper fluid level.
    - There is not any leaking in the steering system.
    - The fluid is free of foam or discoloration.

CHECKING AND ADDING POWER STEERING FLUID

NOTE: When adding fluid or making a complete fluid change, always use the proper power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

1. Clean the area surrounding the reservoir cap.
2. Remove the reservoir cap.
3. Inspect the power steering pump fluid level at regular intervals. Use the appropriate procedure below.

   Add fluid when required. Refer to **Fluid and Lubricant Recommendations** in Maintenance and Lubrication.

   #### Fluid Is Hot

   1. Run the engine until the fluid reaches about 80°C (170°F).
   2. Turn the engine OFF.
   3. Remove the reservoir cap.
   4. Inspect the fluid level on the capstick.
   5. Ensure that the fluid level is at the HOT/FULL mark on the capstick.
4. If the fluid level is low, add power steering fluid to the proper level.

5. Install the reservoir cap.
6. When checking the fluid level after servicing the steering system, bleed the air from the system. Refer to **Bleeding the Power Steering System**.

FLUSHING THE POWER STEERING SYSTEM

IMPORTANT: Do not reuse any drained power steering fluid regardless of appearance or condition.

1. Turn off the engine.
2. Raise the front end of the vehicle off the ground until the tires and wheels turn freely. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Place a large container under the fluid return hose in order to collect the draining fluid.
4. Remove the fluid return hose at the power steering pump reservoir inlet connection.
5. Plug the reservoir return hose inlet connection on the power steering pump.

IMPORTANT:

- **This step may require 4 L (4 qt) of power steering fluid until the draining fluid appears clear.**
- **Do not run the engine without the power steering fluid level at FULL COLD.**

6. Run the engine at idle while an assistant maintains the fluid level at FULL COLD in the reservoir using new approved power steering fluid.
7. Turn off the engine.
8. Turn the steering wheel fully to the left and to the right.
9. Remove the plug from the pump reservoir inlet connection.
10. Install the fluid return hose to the pump reservoir.
11. Maintain the fluid level at FULL COLD.
12. Operate the engine at idle for approximately 15 minutes.
13. Repeat steps 3-5.
14. Inspect the power steering fluid for the following indications of contamination:
    - Milky fluid - water
    - Brown fluid - burnt
    - Plastic debris or dirt chunks
15. If the fluid is contaminated, repeat steps 6-12 in order to complete a third flush.
16. Remove the plug from the pump reservoir inlet connection.
17. Install the fluid return hose to the pump reservoir.
18. Clean any spilled fluid.

19. Bleed the power steering system. Refer to **Bleeding the Power Steering System**

REMOTE POWER STEERING FLUID RESERVOIR REPLACEMENT

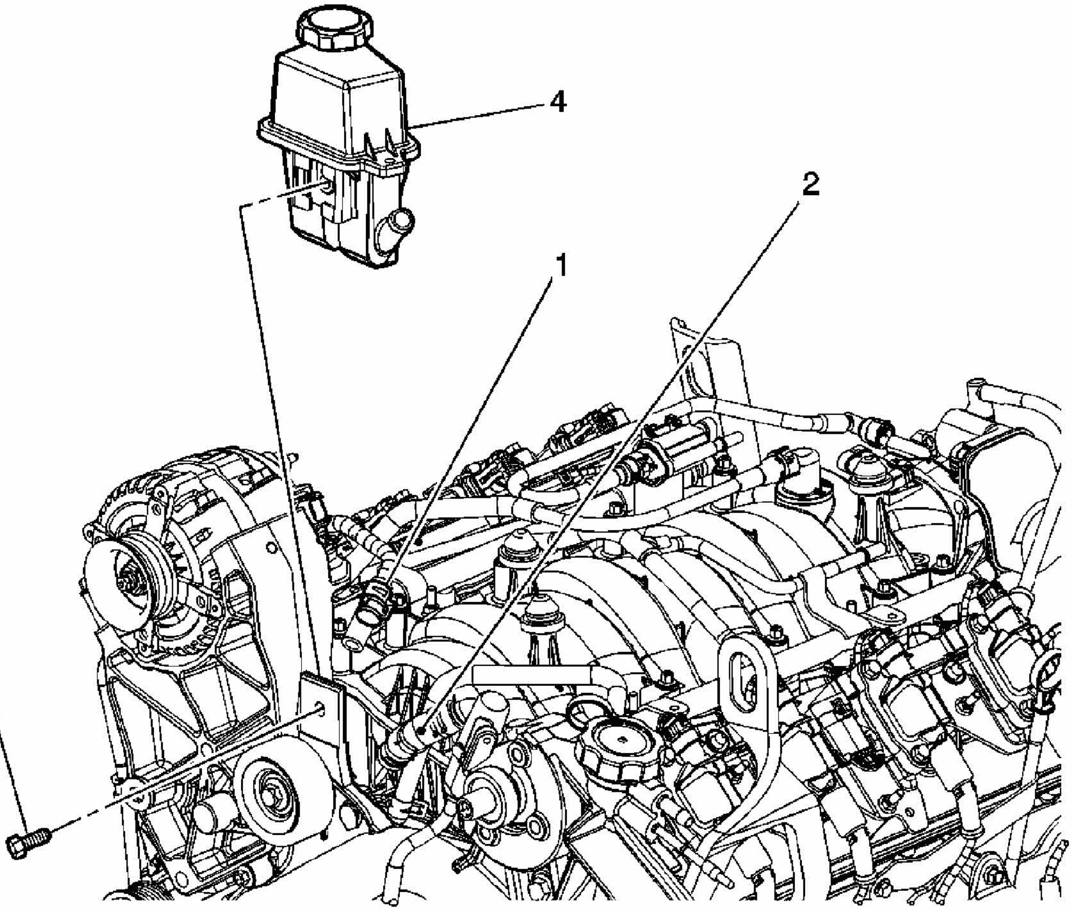


Fig. 11: Replacing Remote Power Steering Fluid Reservoir
Courtesy of GENERAL MOTORS CORP.

Remote Power Steering Fluid Reservoir Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications** .**Preliminary Procedure**	
1	Clamp, Power Steering Return Hose **Tip:** Using the appropriate tool, remove the power steering fluid from the reservoir. Also, plug the open end of the hose to limit the amount of fluid leakage.
	Clamp, Power Steering Pump Feed Hose

2	**Tip:** Plug or cap the hose between the power steering pump and the reservoir so as to limit the amount of fluid loss.
3	Bolt, Remote Power Steering Reservoir (Qty: 1) **Tighten:** 18 N.m (13 lb ft)
4	Reservoir, Power Steering Remote

POWER STEERING PULLEY REPLACEMENT (LS4)

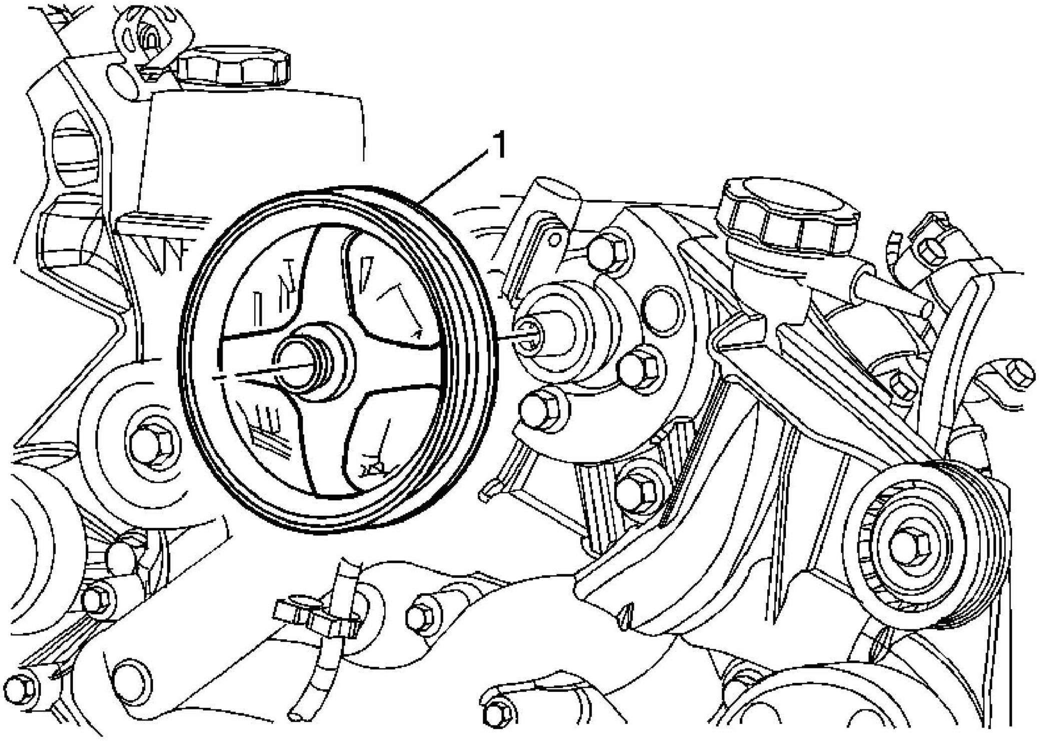


Fig. 12: Replacing Power Steering Pulley
Courtesy of GENERAL MOTORS CORP.

Power Steering Pulley Replacement (LS4)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** . **Tools Required** • **J 25034-C** Pulley Remover. See **Special Tools**. • **J 25033-C** Power Steering Pump Pulley Installer. See **Special Tools**.	

<table>
<tr><td colspan="2">Preliminary Procedure:
Remove the drive belt. Refer to <u>Drive Belt Replacement - Accessory</u> for the 5.3L engine.</td></tr>
<tr><td>1</td><td>Pulley, Power Steering Pump
Tip:
1. Use the J 25034-C pulley remover to remove the pulley from the pump. See <u>Special Tools</u>.
2. Use the J 25033-C power steering pump pulley installer to install the pulley to the pump. See <u>Special Tools</u>.</td></tr>
</table>

POWER STEERING PULLEY REPLACEMENT (LZ4/LZE/LZ9)

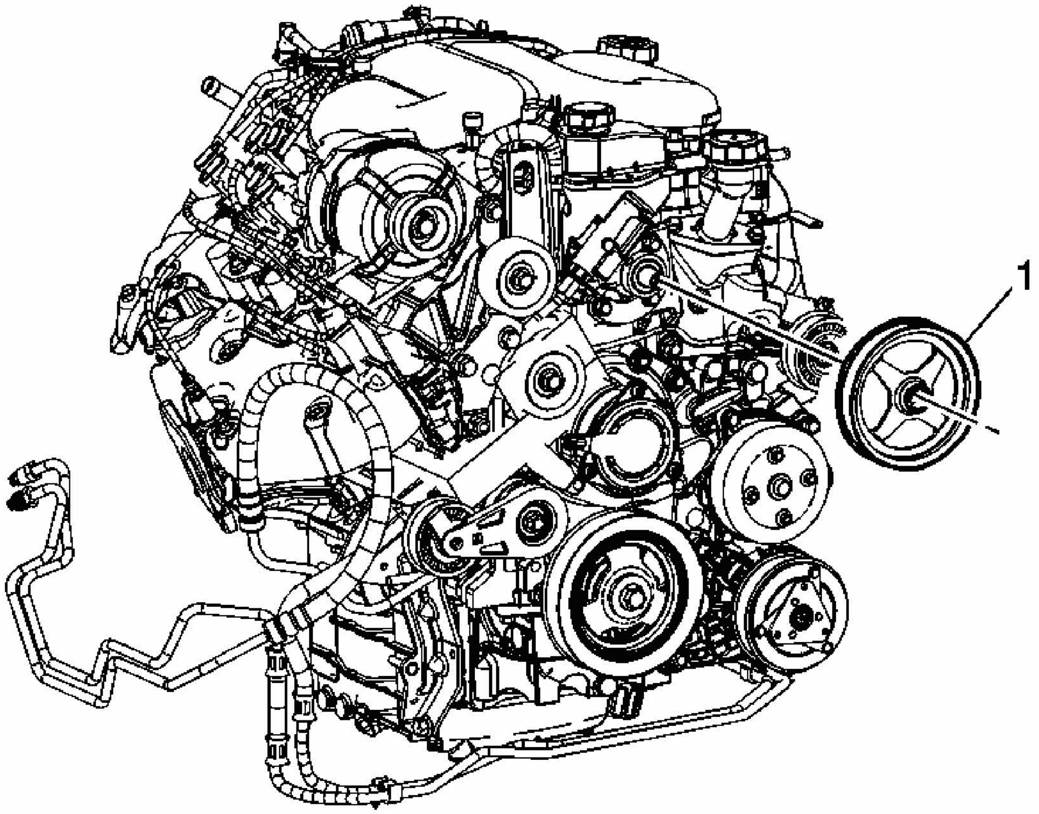


Fig. 13: Replacing Power Steering Pulley
Courtesy of GENERAL MOTORS CORP.

Power Steering Pulley Replacement (LZ4/LZE/LZ9)

Callout	Component Name

<table>
<tr><td colspan="2">Fastener Tightening Specifications: Refer to Fastener Tightening Specifications .

Tools Required
• J 25034-C Pulley Remover. See Special Tools.
• J 25033-C Power Steering Pump Pulley Installer. See Special Tools.

Preliminary Procedure:
Remove the drive belt. Refer to Drive Belt Replacement for the 3.5L engine or Drive Belt Replacement for the 3.9L engine</td></tr>
<tr><td>1</td><td>Pulley, Power Steering Pump
Tip:
1. Use the J 25034-C pulley remover to remove the pulley from the pump. See Special Tools.
2. Use the J 25033-C power steering pump pulley installer to install the pulley to the pump. See Special Tools.</td></tr>
</table>

POWER STEERING PUMP REPLACEMENT (LS4)

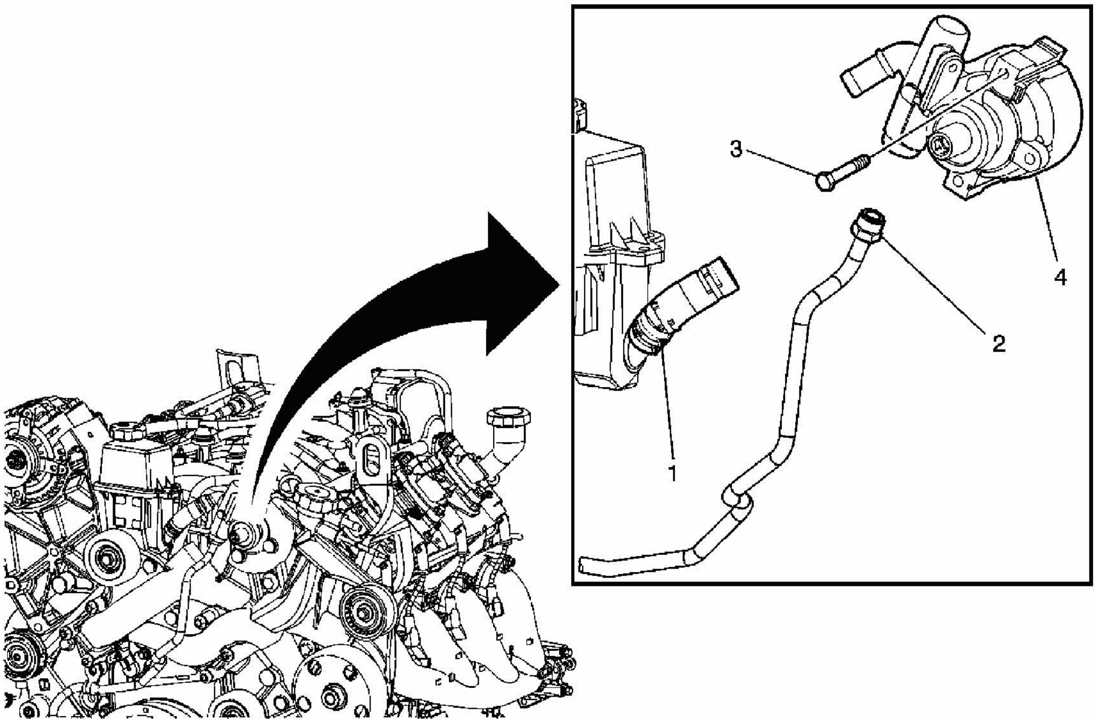


Fig. 14: Replacing Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

Power Steering Pump Replacement (LS4)

Callout	Component Name
NOTE: **Refer to Fastener Notice .**	
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Place a drain pan under the vehicle. 2. Remove the drive belt. Refer to **Drive Belt Replacement - Accessory** for the 5.3L engine. 3. Remove the power steering pump pulley. Refer to **Power Steering Pulley Replacement (LS4)** or **Power Steering Pulley Replacement (LZ4/LZE/LZ9)**. 4. Fill and bleed the power steering system after the repair has been completed. Refer to **Bleeding the Power Steering System**.	
1	Clamp, Power Steering Pump Hose **Tip:** Use an appropriate tool to remove the power steering fluid from the reservoir before relocating the clamp. Also plug the end of the hose between the reservoir and the power steering pump to limit the leakage of the steering fluid.
2	Fitting, Power Steering High Pressure Hose **Tighten:** 27 N.m (20 lb ft)
3	Bolt, Power Steering Pump (Qty: 3) **Tighten:** 25 N.m (18 lb ft)
4	Pump, Power Steering

POWER STEERING PUMP REPLACEMENT (LZ4/LZE/LZ9)

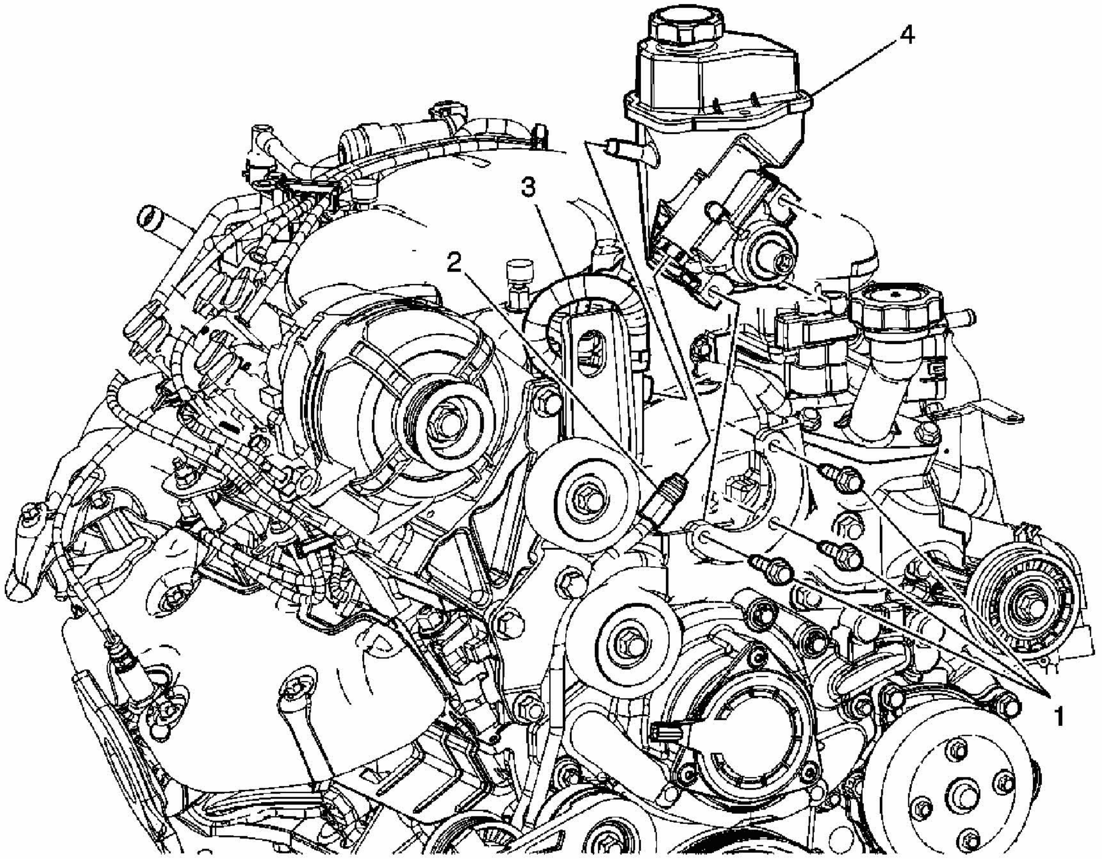


Fig. 15: Replacing Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

Power Steering Pump Replacement (LZ4/LZE/LZ9)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the drive belt. Refer to **Drive Belt Replacement** for the 3.5L engine or **Drive Belt Replacement** for the 3.9L engine. 2. Remove the power steering pump pulley. Refer to **Power Steering Pulley Replacement (LS4)** or **Power Steering Pulley Replacement (LZ4/LZE/LZ9)**. 3. Remove the intake manifold Cover. Refer to **Intake Manifold Cover Replacement** for the 3.5L engine or **Intake Manifold Cover Replacement** for the 3.9L engine.	
	Bolt, Power Steering Pump (Qty: 3)

1	**Tip:** Use an appropriate tool to remove the power steering fluid from the reservoir before removing the hoses from the pump. **Tighten:** 25 N.m (18 lb ft)
2	Fitting, Power Steering High Pressure Hose **Tighten:** 27 N.m (20 lb ft)
3	Clamp, Power Steering Return Hose (at pump) **Tip:** Position the clamp rearward to remove the hose from the pump.
4	Pump, Power Steering

POWER STEERING RESERVOIR REPLACEMENT - OFF VEHICLE (CB SERIES)

Disassembly Procedure

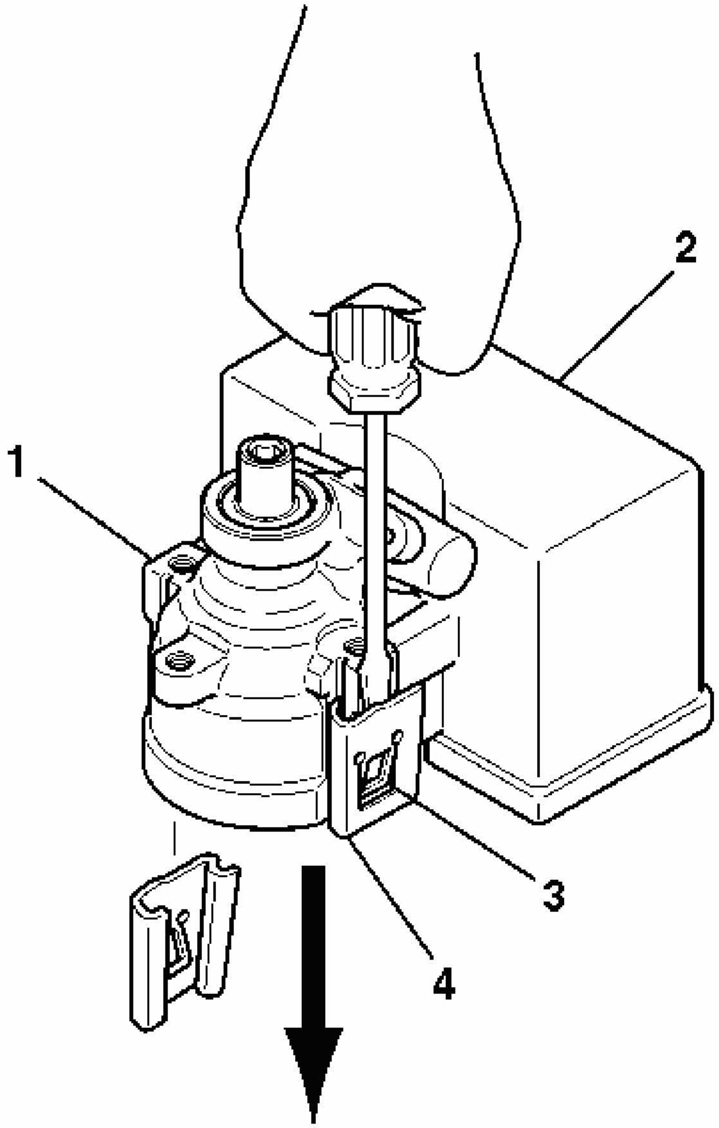


Fig. 16: Removing Power Steering Reservoir (CB Series)
Courtesy of GENERAL MOTORS CORP.

1. Place the hydraulic pump (1) on a fixed, flat surface, with the shaft facing upward.
2. Insert a screwdriver into the retaining clip tab (3).
3. Using the screwdriver, force the retaining clip tab (3) outward.
4. Slide the reservoir clip (4) away from the hydraulic pump assembly (1).
5. Repeat the above steps to remove the second reservoir clip (4).

6. Remove the reservoir (2) from the hydraulic pump housing (1).
7. Remove the O-ring seal from the neck of the reservoir (2) or inside the hydraulic pump housing (1). Discard the O-ring seal.

Assembly Procedure

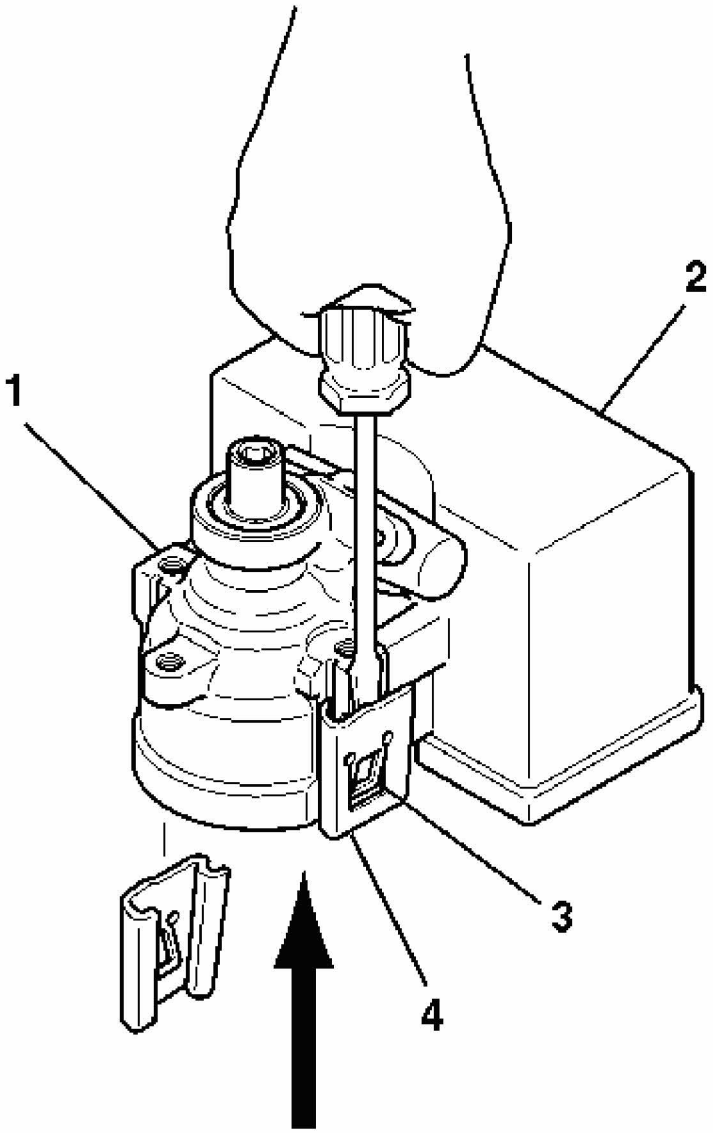


Fig. 17: View Of Power Steering Pump And Reservoir (CB Series)
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the new O-ring seal with power steering fluid.

2. Install the new O-ring seal onto the neck of the reservoir (2).
3. Install the reservoir (2) onto the hydraulic pump assembly (1). Ensure the reservoir neck is completely engaged onto the hydraulic pump assembly (1).
4. Align the feet of the reservoir with the sides of the hydraulic pump housing.
5. Install the new reservoir retaining clips (4) (supplied with the pump). Ensure the retaining clip tabs (3) fully engage with the hydraulic pump housing (1).

POWER STEERING PUMP FLOW CONTROL VALVE REPLACEMENT - OFF VEHICLE (CB SERIES)

Disassembly Procedure

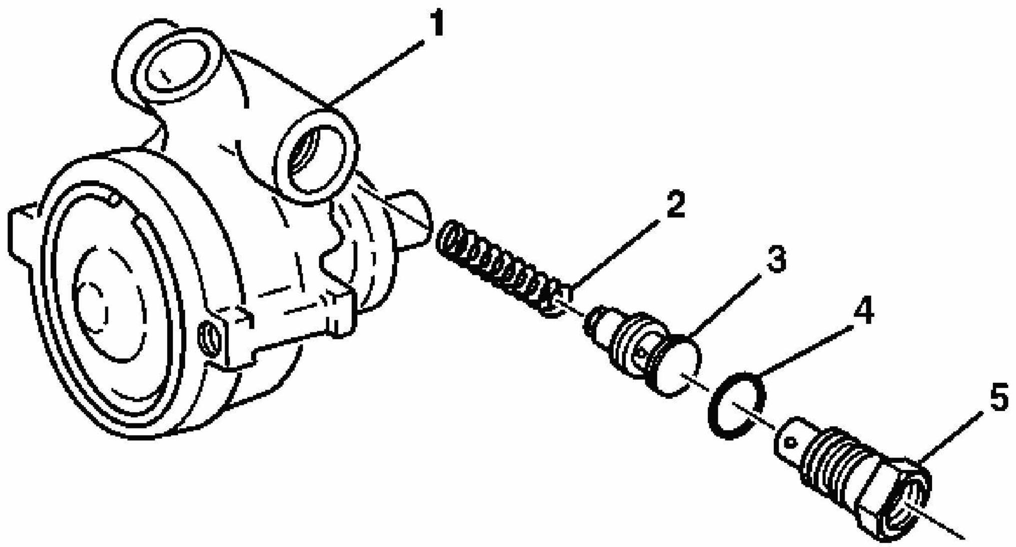


Fig. 18: Exploded View Of Power Steering Pump Flow Control Valve (CB Series)
Courtesy of GENERAL MOTORS CORP.

1. Remove the O-ring union fitting (5) from the hydraulic pump housing assembly (1).
2. Remove the O-ring seal (4) from the O-ring union fitting (5).
3. Remove the control valve assembly (3).
4. Remove the flow control spring (2).

Assembly Procedure

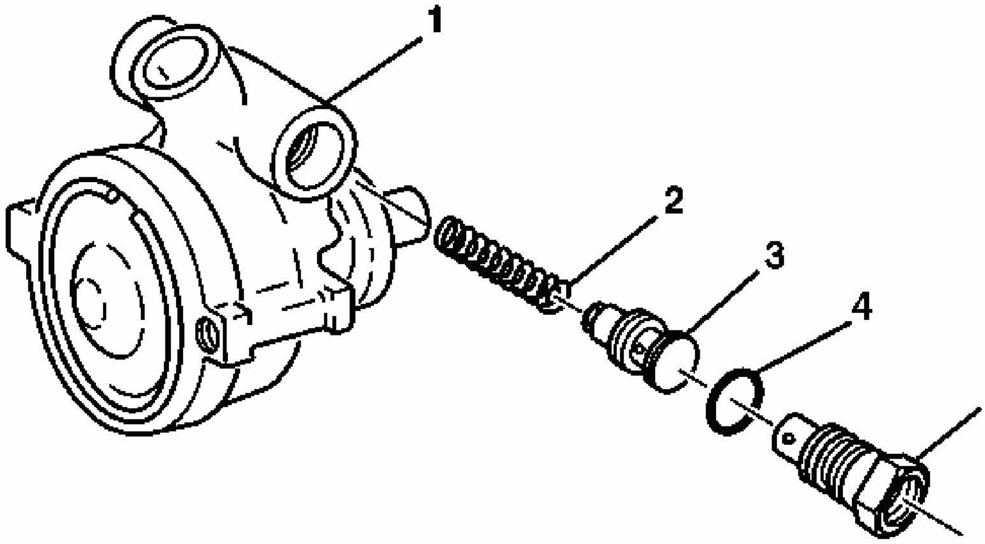


Fig. 19: Exploded View Of Power Steering Pump Flow Control Valve (CB Series)
Courtesy of GENERAL MOTORS CORP.

1. Install the flow control spring (2) to the hydraulic pump housing assembly (1).
2. Install the control valve assembly (3).
3. Lubricate the O-ring seal (4) with power steering fluid.
4. Install the O-ring seal (4) onto the O-ring union fitting (5).

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

5. Install the O-ring union fitting (5) into the hydraulic pump housing assembly (1).

   Tighten: Tighten the fitting (5) to 75 N.m (55 lb ft).

POWER STEERING PUMP DRIVE SHAFT SEAL REPLACEMENT (CB)

Removal Procedure

1. Remove the power steering pump from the vehicle, if necessary. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)**.

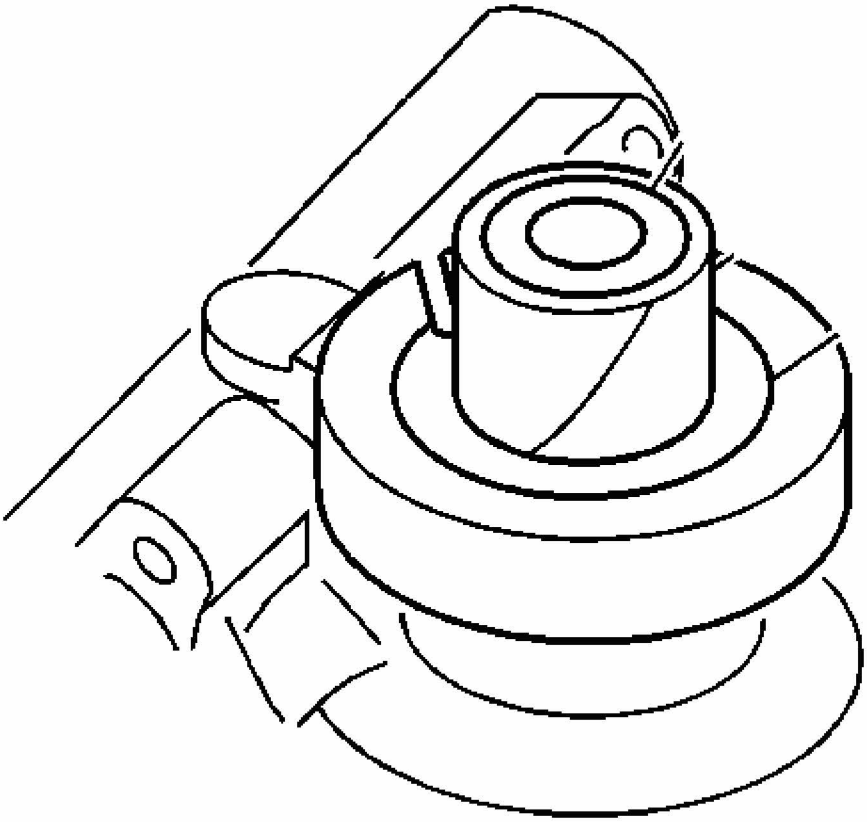


Fig. 20: Power Steering Pump Drive Shaft Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Protect the drive shaft with the shim stock.

2. Use a small chisel in order to remove the seal.

   Discard the seal.

Installation Procedure

1. Lubricate the new drive shaft seal using power steering fluid.

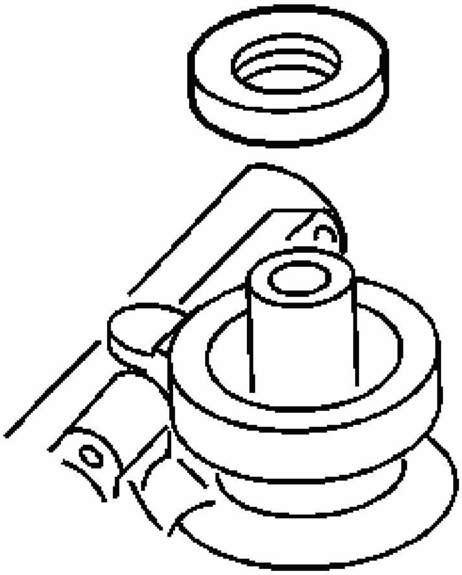


Fig. 21: Power Steering Pump Drive Shaft Seal
Courtesy of GENERAL MOTORS CORP.

2. Use a deep socket in order to install the new drive shaft seal.
3. Install the power steering pump, if removed. Refer to **Power Steering Pump Replacement (LS4)** or **Power Steering Pump Replacement (LZ4/LZE/LZ9)**.

RACK AND PINION OUTER TIE ROD END REPLACEMENT

Tools Required

J 24319-B Universal Steering Linkage Puller. See **Special Tools**.

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

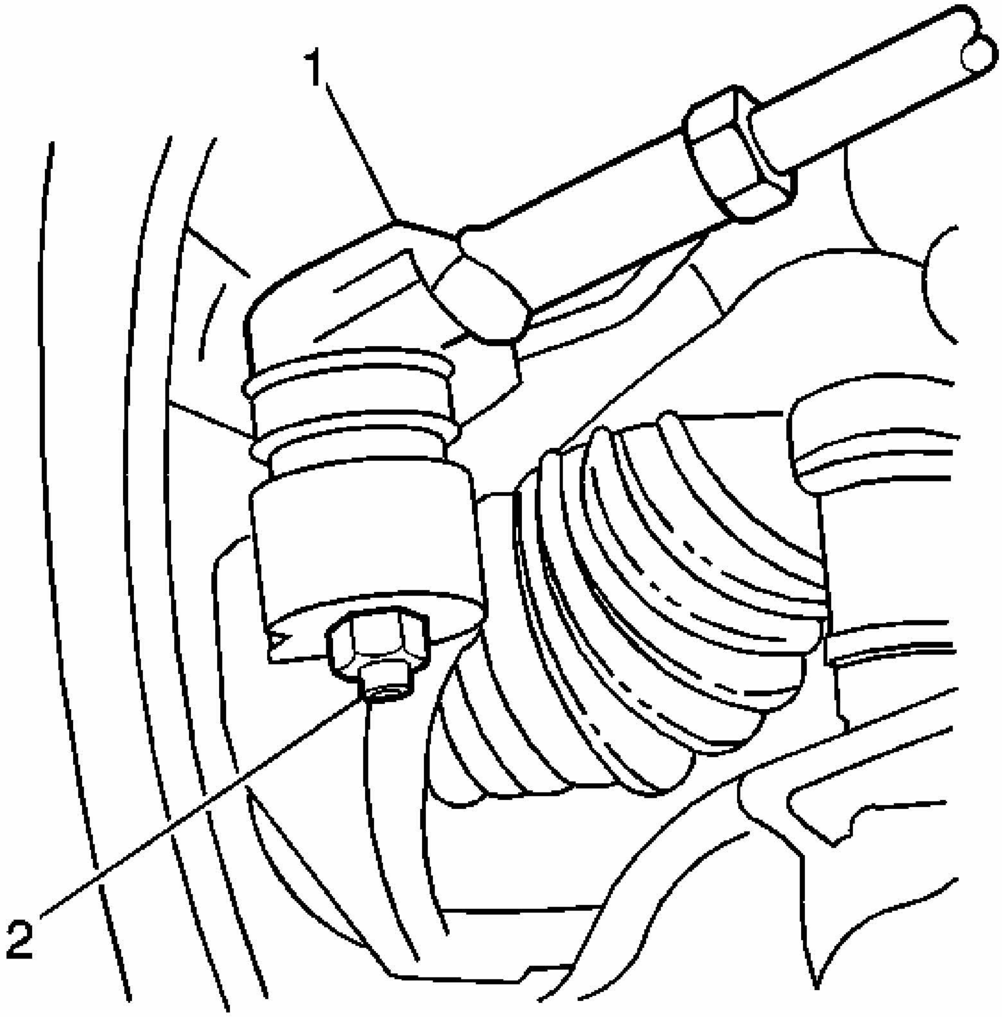


Fig. 22: Identifying Outer Tie Rod & Retaining Nut
Courtesy of GENERAL MOTORS CORP.

3. Remove the prevailing torque nut (2) from the outer tie rod assembly (1).

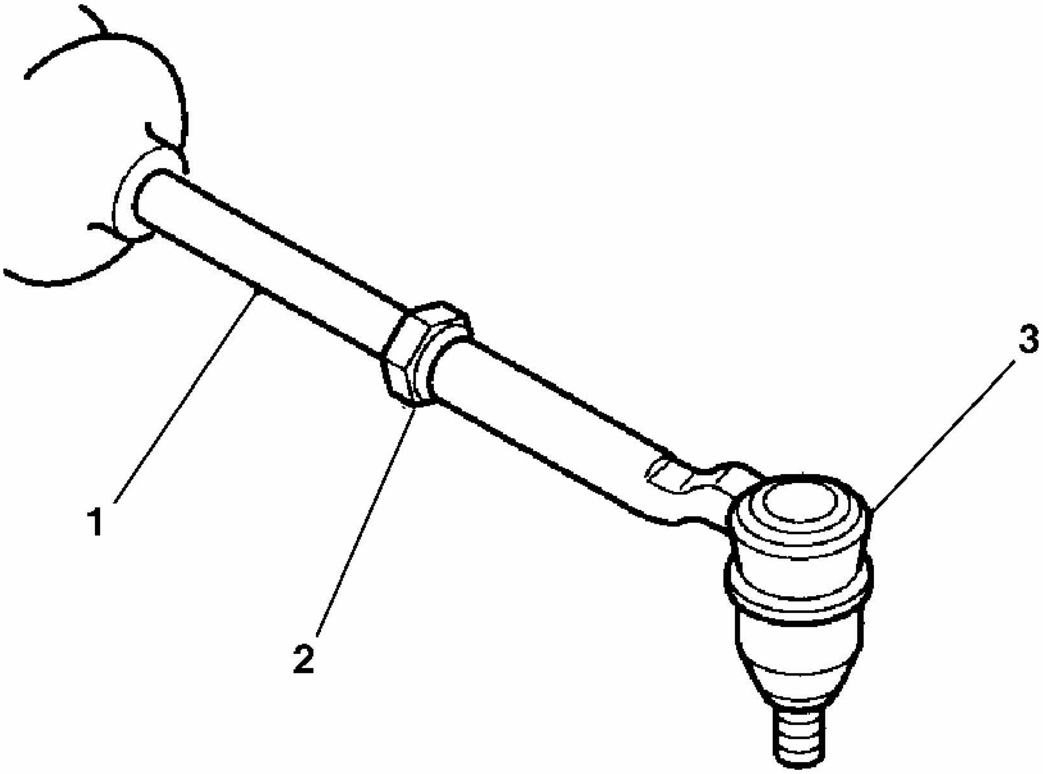


Fig. 23: Identifying Tie Rod & Jam Nut
Courtesy of GENERAL MOTORS CORP.

4. Loosen the jam nut (2) on the inner tie rod assembly (1).

NOTE: **Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.**

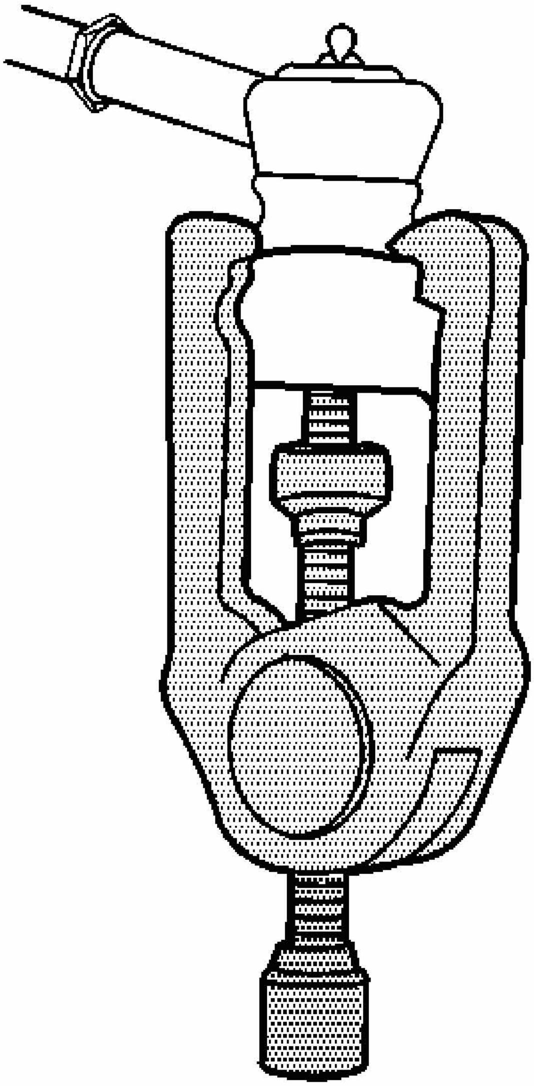


Fig. 24: Removing Outer Tie Rod Assembly From Steering Knuckle
Courtesy of GENERAL MOTORS CORP.

5. Remove the outer tie rod assembly from the steering knuckle using **J 24319-B** . See **Special Tools**.

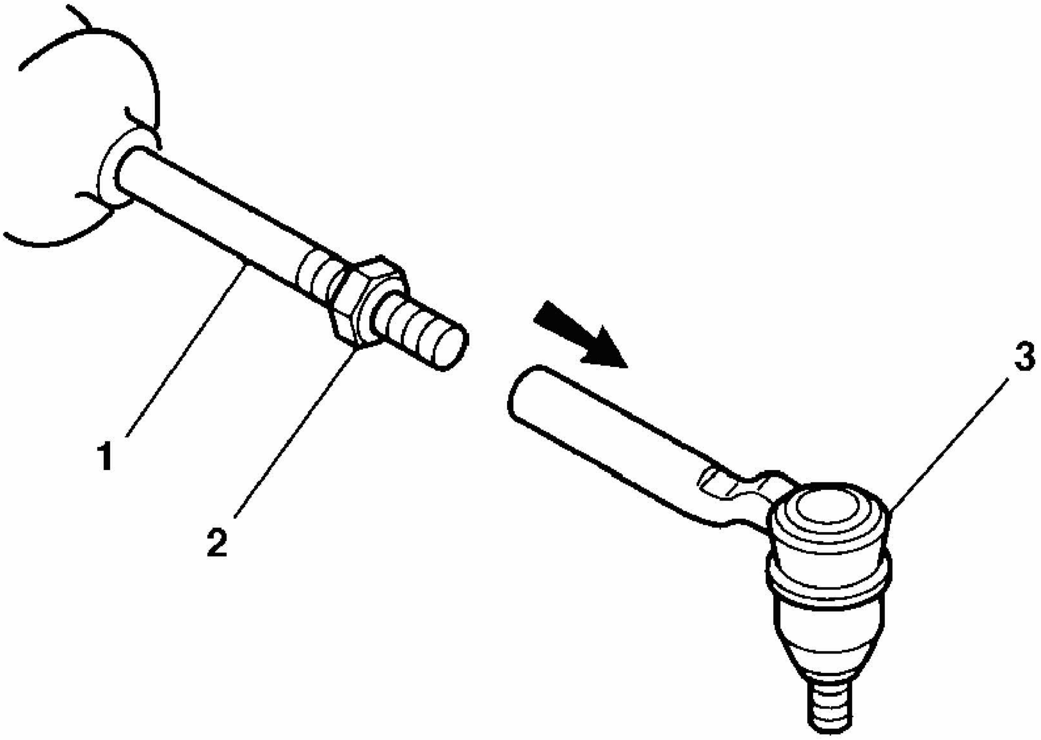


Fig. 25: View Of Outer Tie Rod & Inner Tie Rod
Courtesy of GENERAL MOTORS CORP.

6. Remove the outer tie rod assembly (3) from the inner tie rod assembly (1).

Installation Procedure

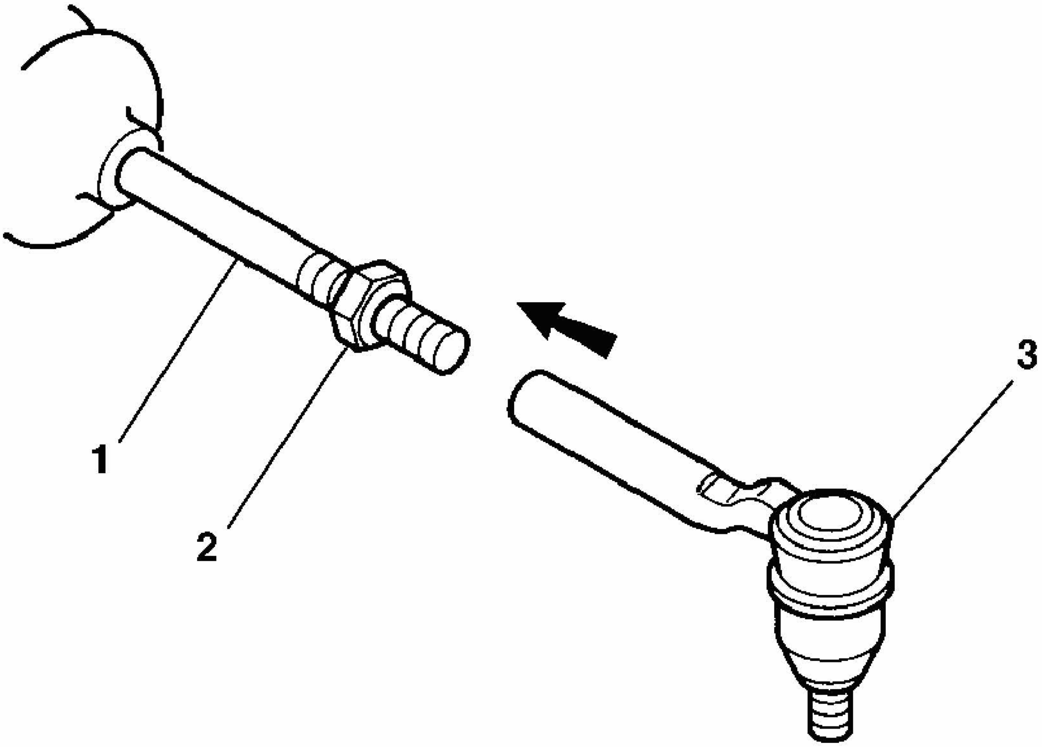


Fig. 26: Installing Outer Tie Rod Assembly To Inner Tie Rod Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the outer tie rod assembly (3) to the inner tie rod assembly (1). Do NOT tighten the jam nut (2).

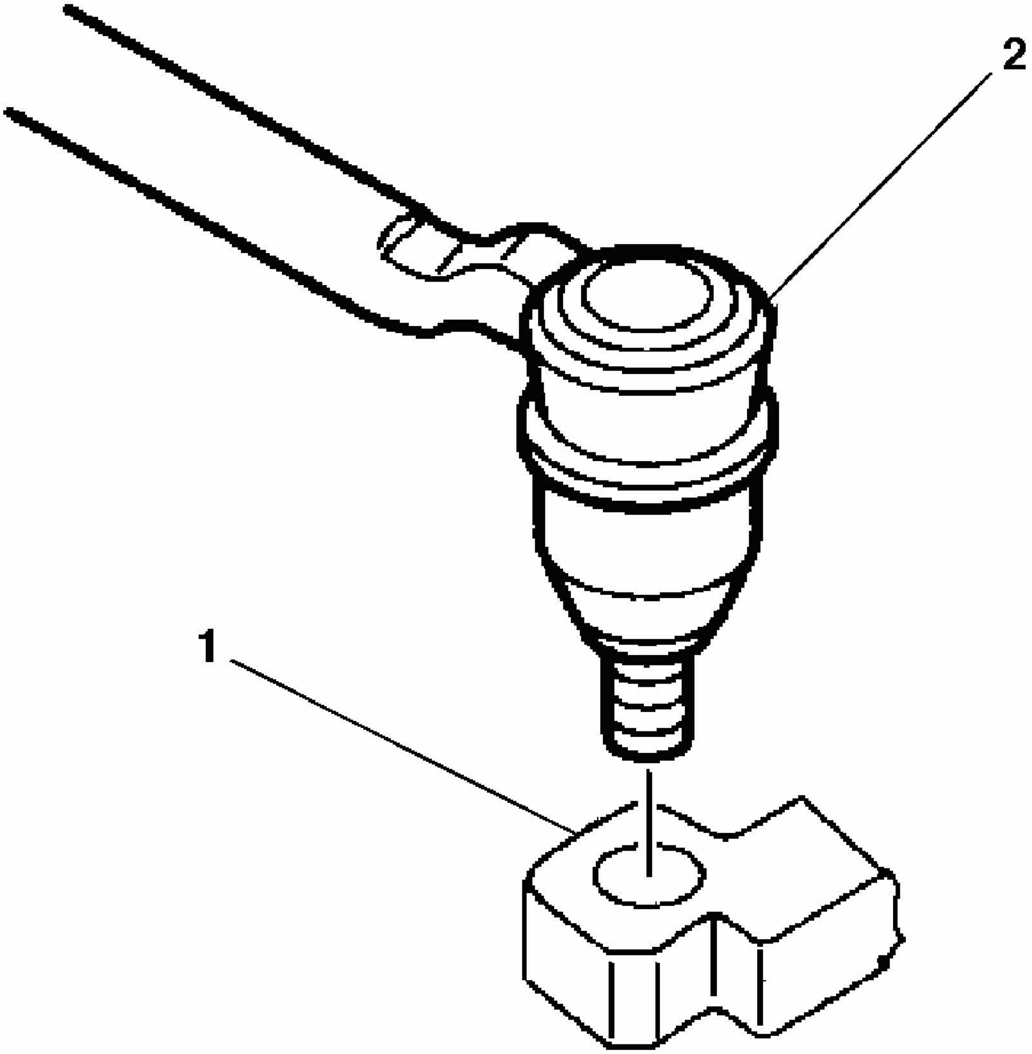


Fig. 27: View Of Outer Tie Rod & Steering Knuckle
Courtesy of GENERAL MOTORS CORP.

2. Install the outer tie rod assembly (2) to the steering knuckle (1).

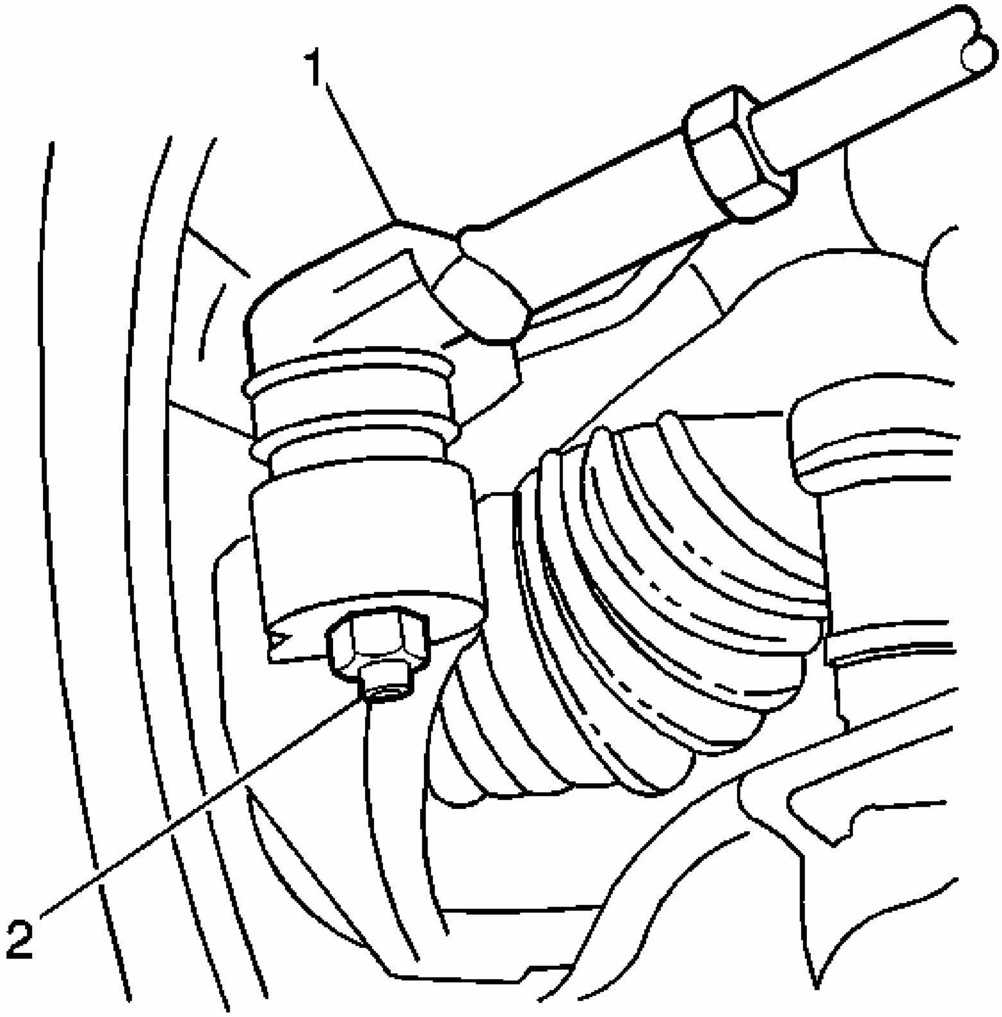


Fig. 28: Identifying Outer Tie Rod & Retaining Nut
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

3. Install the prevailing torque nut (2) to the outer tie rod assembly (1).

   Tighten: Tighten the nut to 30 N.m (22 lb ft) plus 120 degrees. Visually inspect to ensure that 2 1/2 to 4 1/2 threads are visible past the nylon washer.

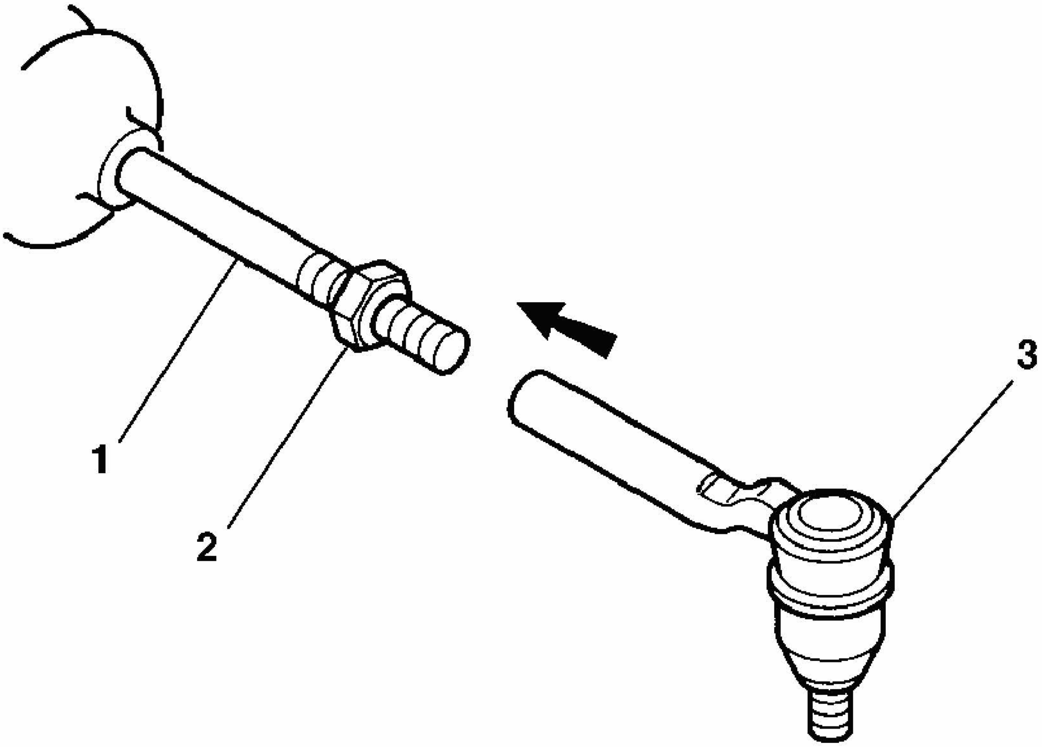


Fig. 29: Installing Outer Tie Rod Assembly To Inner Tie Rod Assembly
Courtesy of GENERAL MOTORS CORP.

4. Install tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
5. Lower the vehicle.
6. Perform a front end alignment. Refer to **Measuring Wheel Alignment** in Wheel Alignment.

RACK AND PINION BOOT REPLACEMENT - ON VEHICLE

Tools Required

J 22610 Keystone Clamp Pliers

Removal Procedure

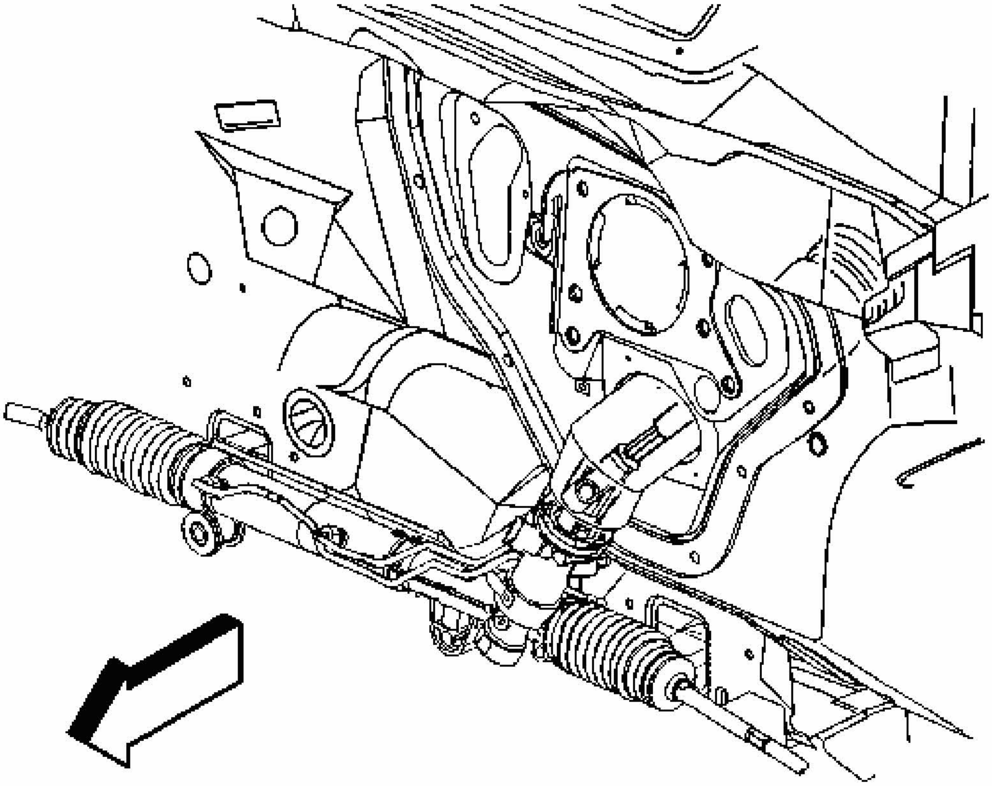


Fig. 30: View Of Steering Rack Assembly
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Remove the outer tie rod from the inner tie rod assembly. Refer to **Rack and Pinion Outer Tie Rod End Replacement**.
4. Remove the intermediate steering shaft lower pinch bolt. Refer to **Intermediate Steering Shaft Replacement** in Steering Wheel and Column.
5. Remove the rear frame mounting bolts to allow for tool access. Refer to **Frame Replacement** in Frame and Underbody.

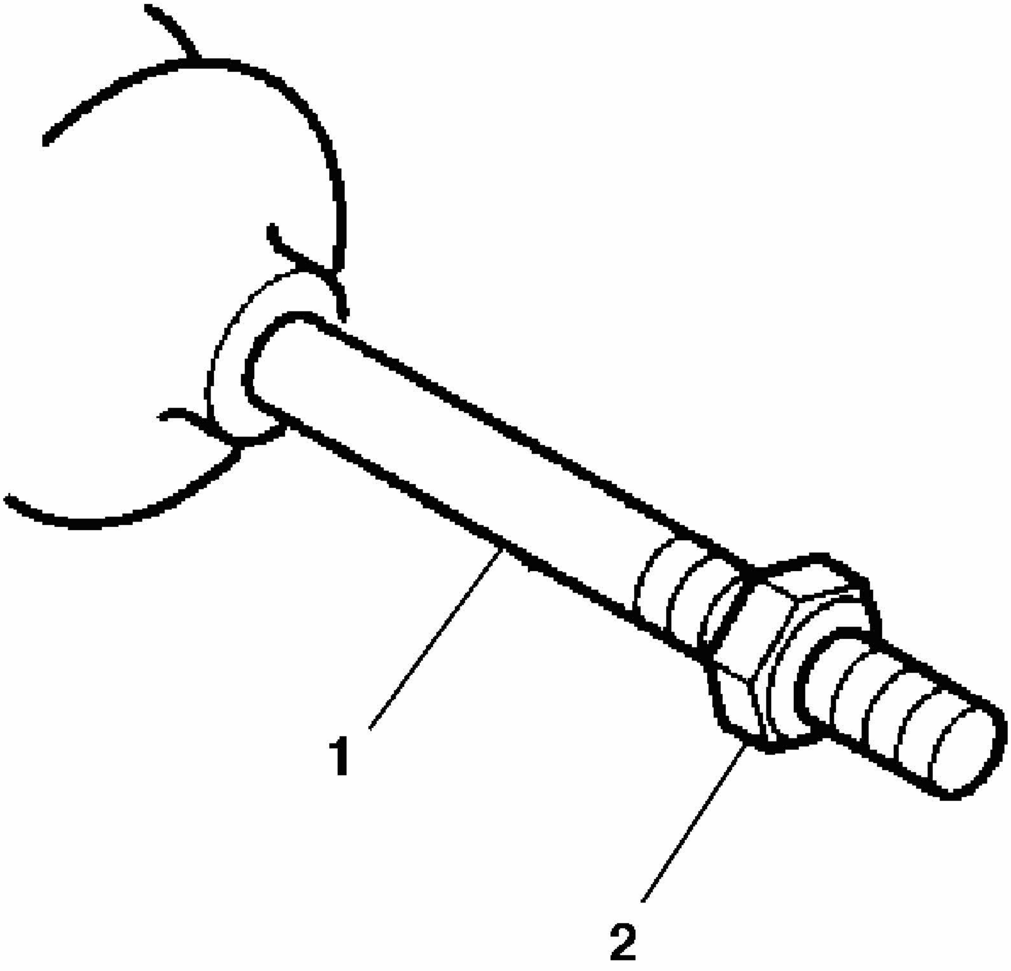


Fig. 31: Identifying Inner Tie Rod Assembly Jam Nut
Courtesy of GENERAL MOTORS CORP.

6. Remove the inner tie rod jam nut (2) from the inner tie rod assembly (1).

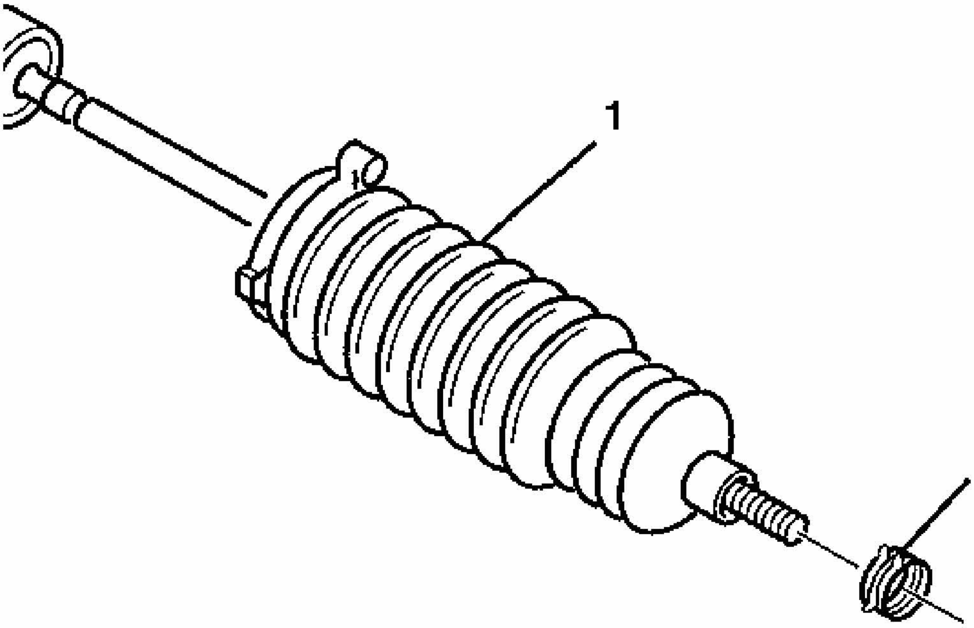


Fig. 32: View Of Tie Rod End Clamp, Rack & Pinion Boot
Courtesy of GENERAL MOTORS CORP.

7. Remove the clamp (2) from the end of the inner tie rod boot (1).

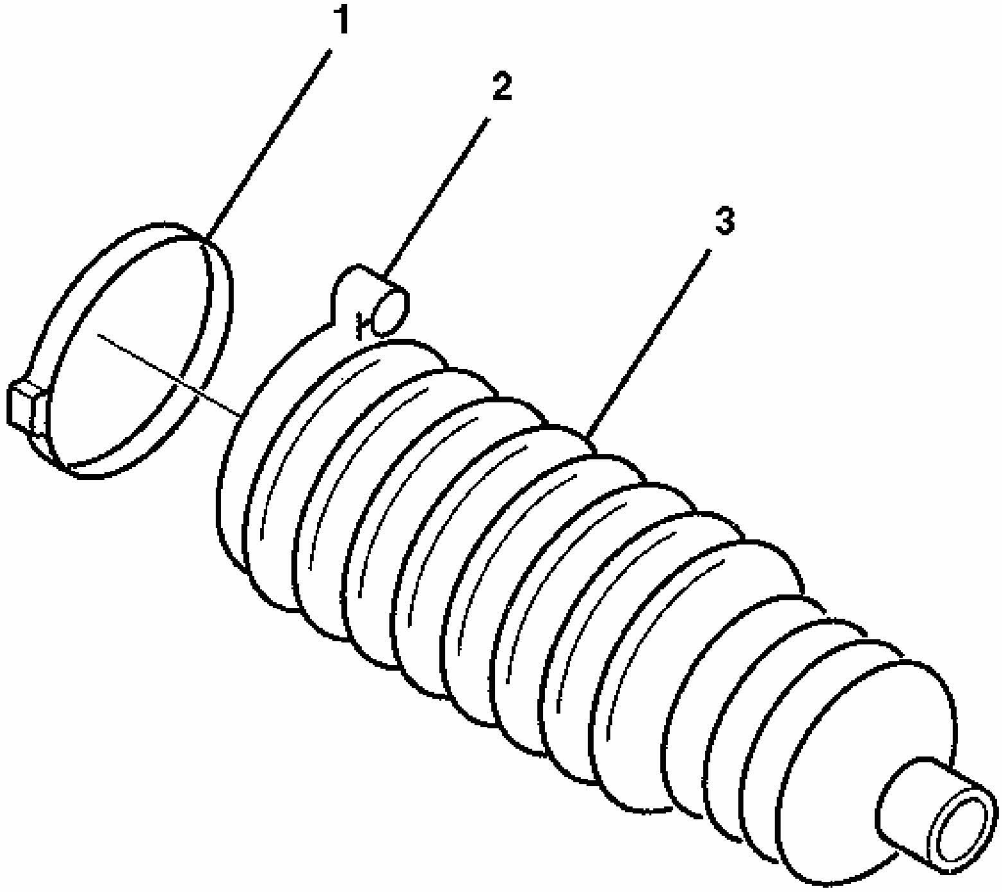


Fig. 33: View Of Inner Tie Rod Boot Clamp
Courtesy of GENERAL MOTORS CORP.

8. Remove the inner tie rod boot clamp (1) from the inner tie rod boot (3) with side cutters.
9. Discard the inner tie rod boot clamp (1).

IMPORTANT: Prior to removing breather tube (2) or the inner tie rod boot (3), mark the location of the breather tube (2) on the power steering gear assembly.

10. Remove the inner tie rod boot (3) and the breather tube (2).

Installation Procedure

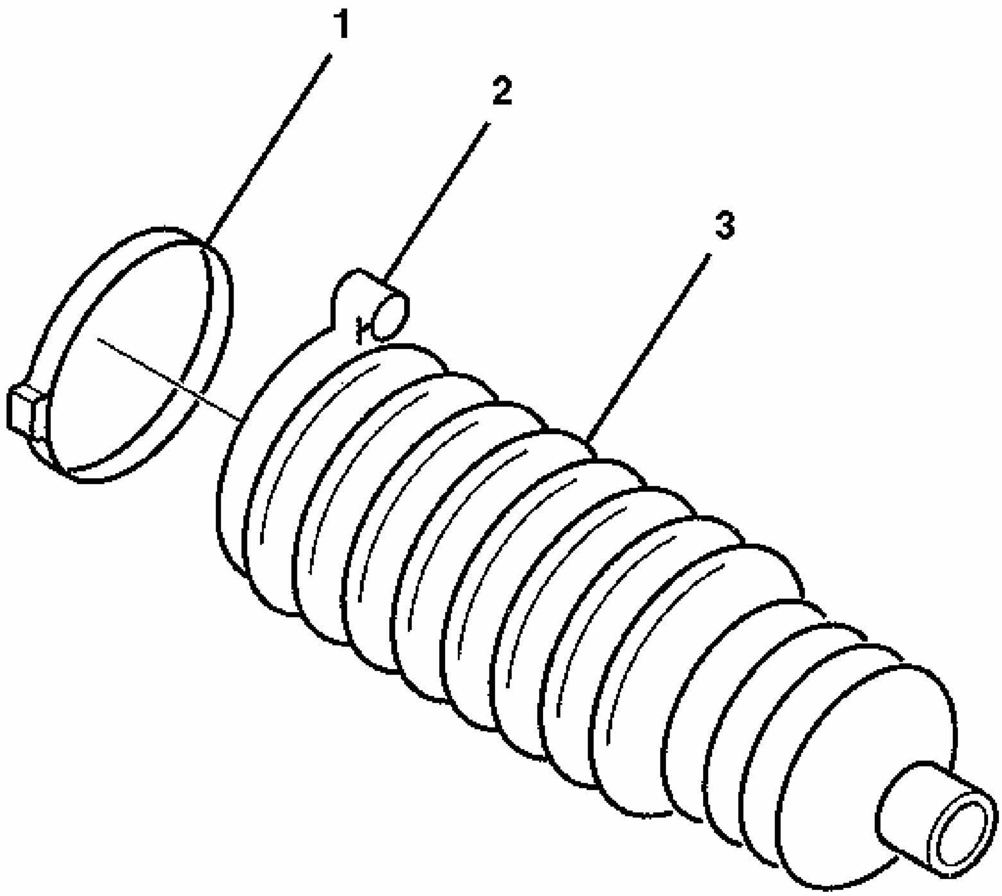


Fig. 34: View Of Inner Tie Rod Boot Clamp
Courtesy of GENERAL MOTORS CORP.

1. Install the new inner tie rod boot clamp (1) onto the inner tie rod boot (3).

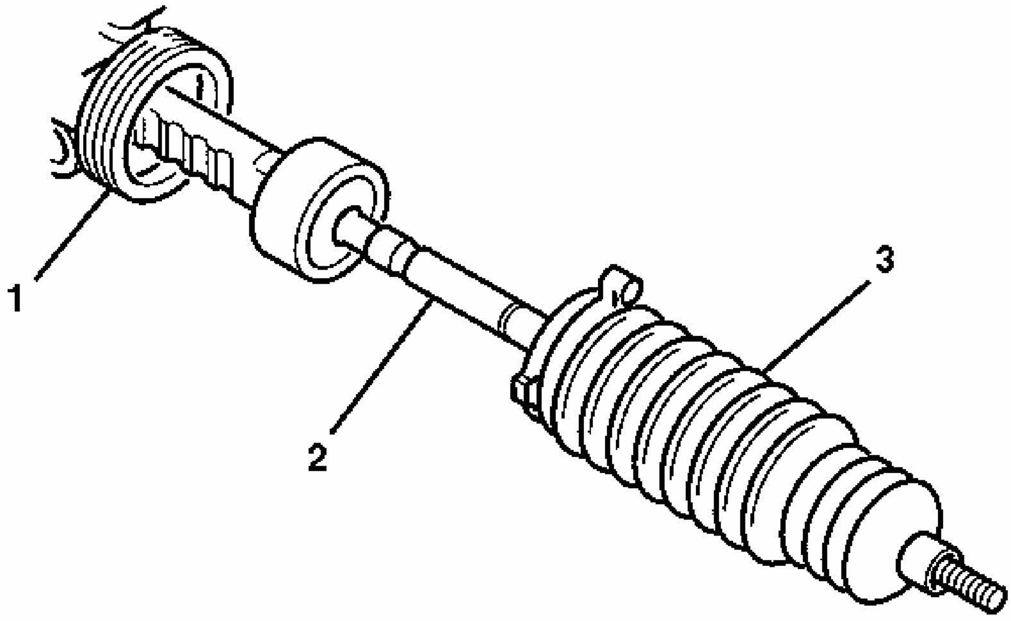


Fig. 35: Inner Tie Rod, Rack And Pinion Gear & Rack And Pinion Boot
Courtesy of GENERAL MOTORS CORP.

2. Prior to the inner tie rod boot (3) installation, apply grease to the inner tie rod assembly (2) and the power steering gear assembly (1).
3. Install the inner tie rod boot (3) onto the inner tie rod assembly (2).
4. Align the breather tube with the mark made during removal and the molded nipple of the inner tie rod boot.
5. Install the inner tie rod boot (3) onto the power steering gear assembly until the inner tie rod boot (3) is seated in the power steering gear assembly groove.

IMPORTANT: The inner tie rod boot (3) must not be twisted, puckered or out of shape in any way. If the inner tie rod boot (3) is not shaped properly, adjust the inner tie rod boot (3) by hand before installing the boot clamp.

6. Install the inner tie rod boot (3) onto the inner tie rod assembly (2).

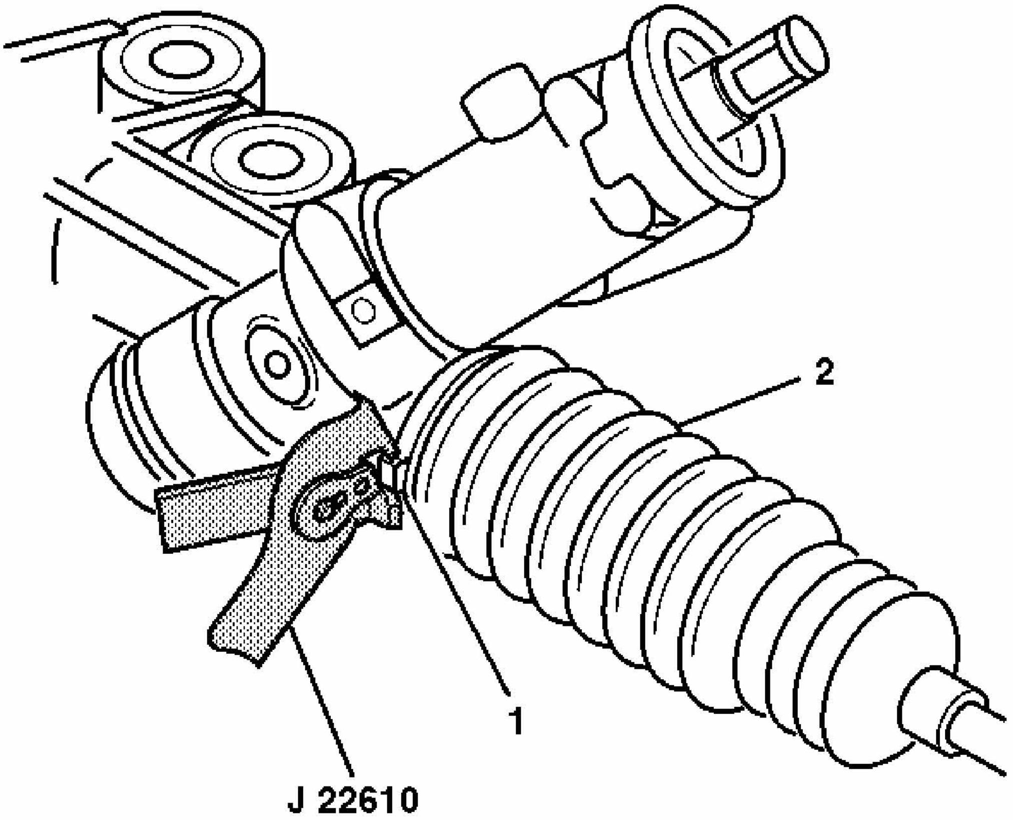


Fig. 36: Installing Inner Tie Rod Boot Clamp
Courtesy of GENERAL MOTORS CORP.

7. Using the**J 22610** install the inner tie rod boot clamp (1) on the inner tie rod boot (2) by firmly crimping the inner tie rod boot clamp (1).
8. Install the inner tie rod small boot clamp (2).

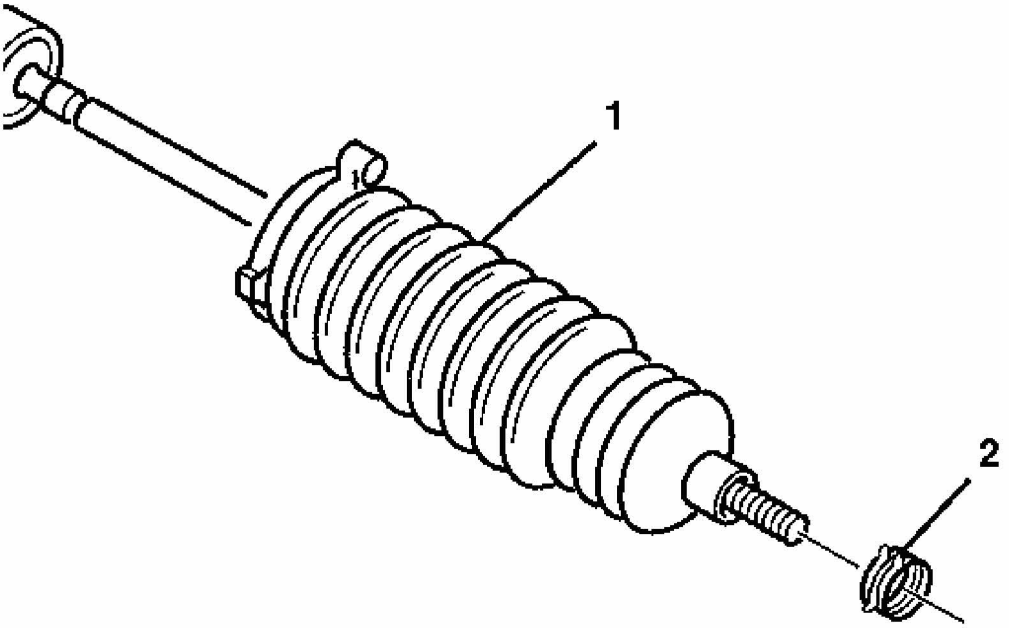


Fig. 37: View Of Tie Rod End Clamp, Rack & Pinion Boot
Courtesy of GENERAL MOTORS CORP.

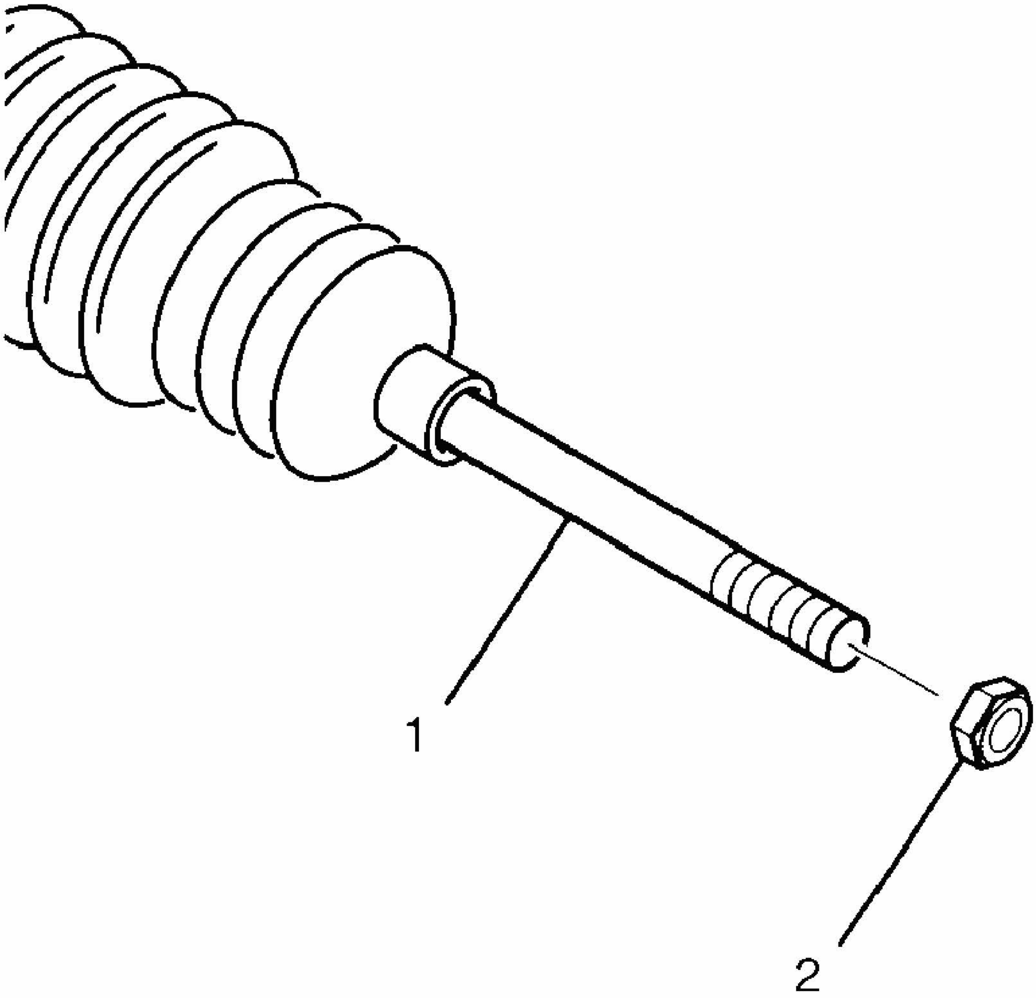


Fig. 38: View Of Inner Tie Rod & Hex Jam Nut
Courtesy of GENERAL MOTORS CORP.

9. Install the inner tie rod jam nut (2) to the inner tie rod assembly (1).
10. Install the rear frame mounting bolts. Refer to **Frame Replacement** in Frame and Underbody.
11. Install the intermediate steering shaft lower pinch bolt. Refer to **Intermediate Steering Shaft Replacement** in Steering Wheel and Column.
12. Install the outer tie rod to the inner tie rod assembly. Refer to **Rack and Pinion Outer Tie Rod End Replacement**.

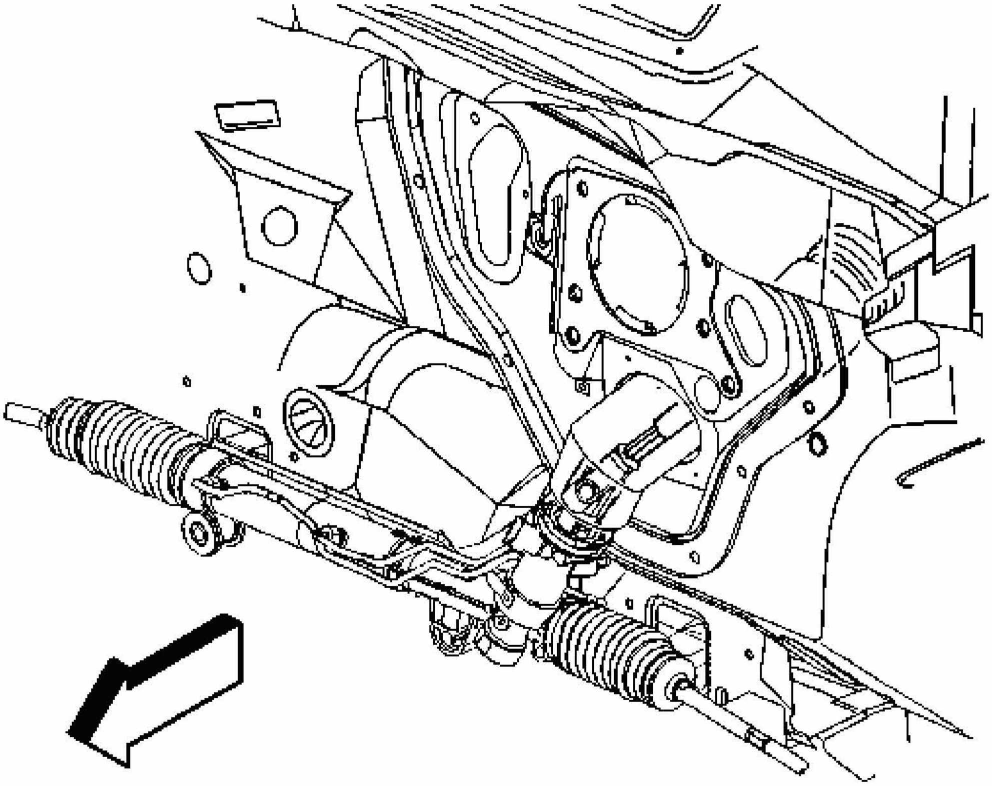


Fig. 39: View Of Steering Rack Assembly
Courtesy of GENERAL MOTORS CORP.

13. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
14. Lower the vehicle.
15. Perform a front end alignment. Refer to **Measuring Wheel Alignment** in Wheel Alignment.

POWER STEERING COOLER PIPE/HOSE REPLACEMENT

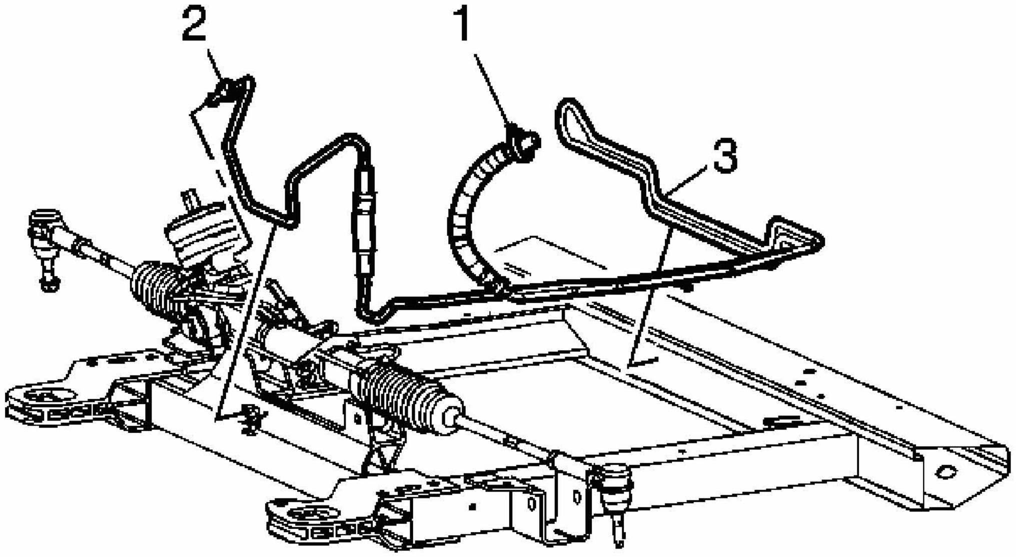


Fig. 40: Replacing Power Steering Cooler Pipe/Hose
Courtesy of GENERAL MOTORS CORP.

Power Steering Cooler Pipe/Hose Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Place a drain pan under the vehicle. 2. Raise and lower the vehicle as necessary to access the power steering hose clamp (at pipe) and fitting (at the rack and pinion). Refer to **Lifting and Jacking the Vehicle** . 3. Fill and bleed the power steering system after the repair has been completed. Refer to **Bleeding the Power Steering System**.	
1	Clamp, Power Steering Cooler Pipe/Hose to Return Pipe/Hose **Tip:** 1. Position the clamp off of the hose. 2. Use a shop rag or suitable plug to minimize fluid loss from the hose.

2	Nut, Power Steering Cooler Pipe/Hose Fitting **Tighten:** 27 N.m (20 lb ft)
3	Pipe/Hose, Power Steering Cooler **Tip:** Release the power steering cooler pipe/hose from the retainers on the frame.

POWER STEERING PRESSURE PIPE/HOSE REPLACEMENT (LS4)

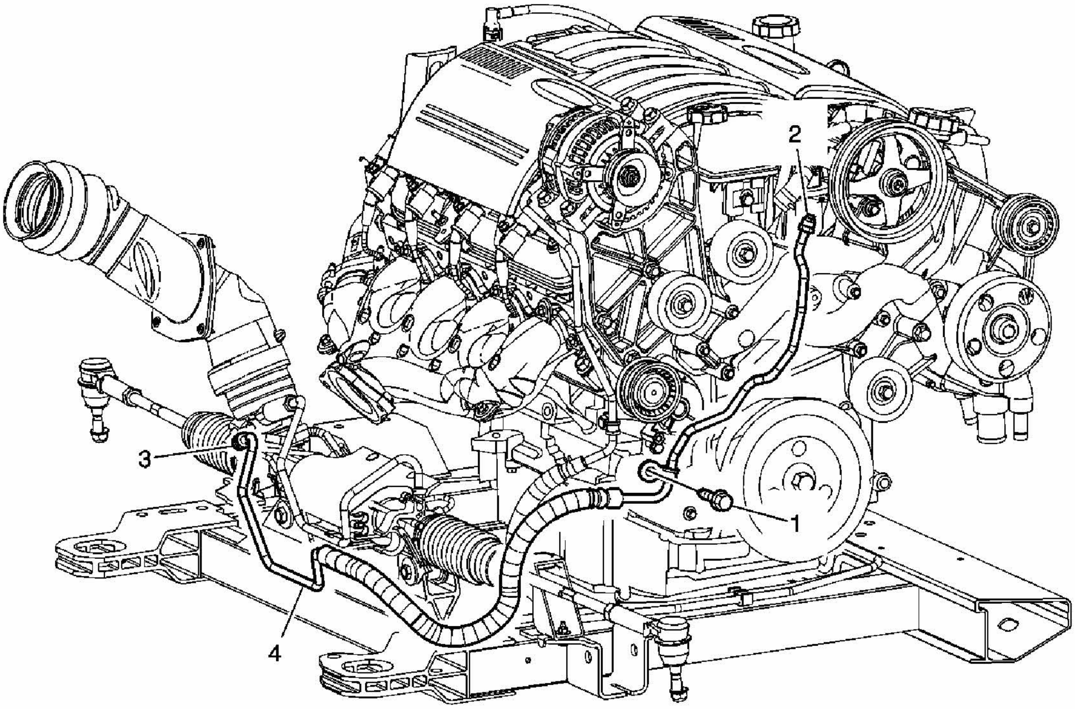


Fig. 41: Replacing Power Steering Pressure Pipe/Hose
Courtesy of GENERAL MOTORS CORP.

Power Steering Pressure Pipe/Hose Replacement (LS4)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the drive belt. Refer to **Drive Belt Replacement - Accessory** for the 5.3L engine.	

<table>
<tr><td colspan="2">2. Place a drain pan under the vehicle.
3. Raise and lower the vehicle as necessary to access the power steering hose fitting at the rack and pinion. Refer to <u>Lifting and Jacking the Vehicle</u> .
4. Fill and bleed the power steering system after the repair has been completed. Refer to <u>Bleeding the Power Steering System</u>.</td></tr>
<tr><td>1</td><td>Bolt, Drive Belt Tensioner
Tip: Only remove the one tensioner bolt that retains the power steering pressure hose.

Tighten: 50 N.m (37 lb ft)</td></tr>
<tr><td>2</td><td>Nut, Power Steering Pressure Hose Fitting (at pump)

Tighten: 27 N.m (20 lb ft)</td></tr>
<tr><td>3</td><td>Nut, Power Steering Pressure Hose Fitting (at rack and pinion)

Tighten: 27 N.m (20 lb ft)</td></tr>
<tr><td>4</td><td>Hose, Power Steering Pressure
Tip: Release the hose from the retainers to remove it from the vehicle.</td></tr>
</table>

POWER STEERING PRESSURE PIPE/HOSE REPLACEMENT (LZ4/LZE/LZ9)

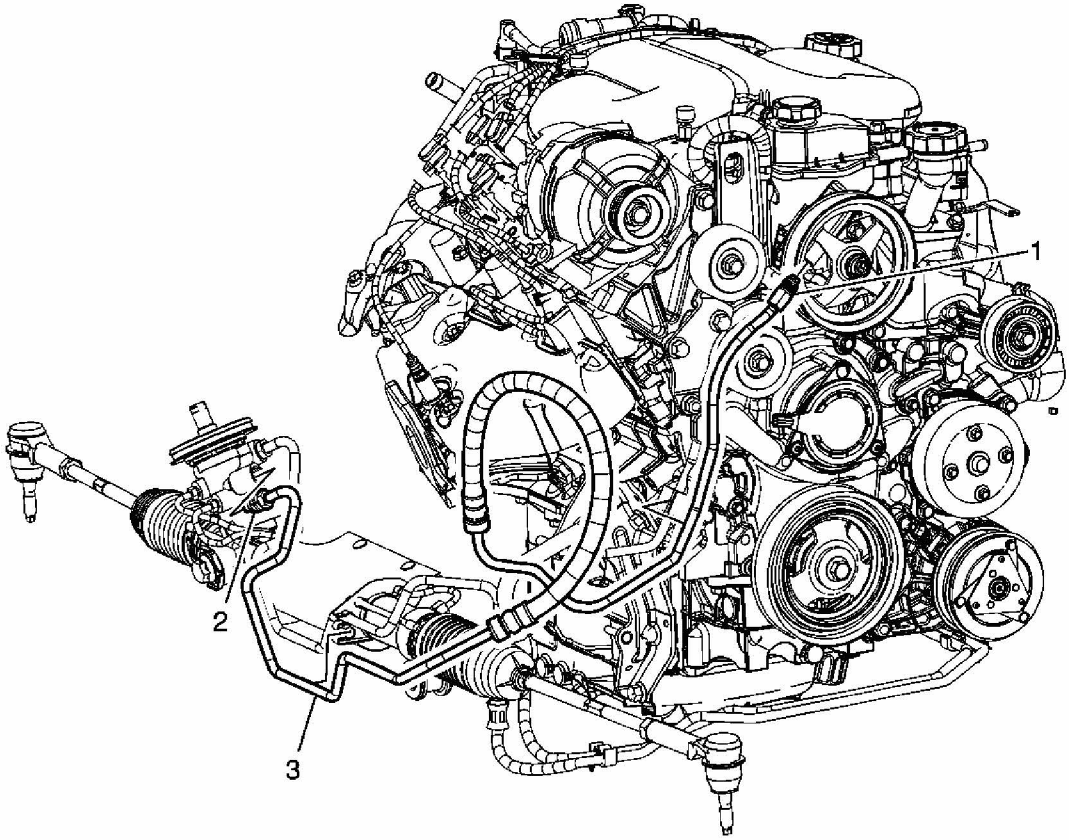


Fig. 42: Replacing Power Steering Pressure Pipe/Hose
Courtesy of GENERAL MOTORS CORP.

Power Steering Pressure Pipe/Hose Replacement (LZ4/LZE/LZ9)

Callout	Component Name

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedures

1. Place a drain pan under the vehicle.
2. Remove the drive belt. Refer to **Drive Belt Replacement** for the 3.5L engine or **Drive Belt Replacement** for the 3.9L engine.
3. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** for the 3.5L engine or **Drive Belt Tensioner Replacement** for the 3.9L engine.
4. Raise and lower the vehicle as necessary to access the pipe fitting at the rack and pinion. Refer to **Lifting and Jacking the Vehicle** .

5. Fill and bleed the power steering system after the repair has been completed. Refer to **Bleeding the Power Steering System**.	
1	Fitting, Power Steering High Pressure Hose (at pump) **Tighten:** 27 N.m (20 lb ft)
2	Fitting, Power Steering High Pressure Hose (at rack and pinion) **Tighten:** 27 N.m (20 lb ft)
3	Hose, Power Steering High Pressure **Tip:** Release the hose from the retainers to remove it from the vehicle.

POWER STEERING RETURN HOSE REPLACEMENT (LS4)

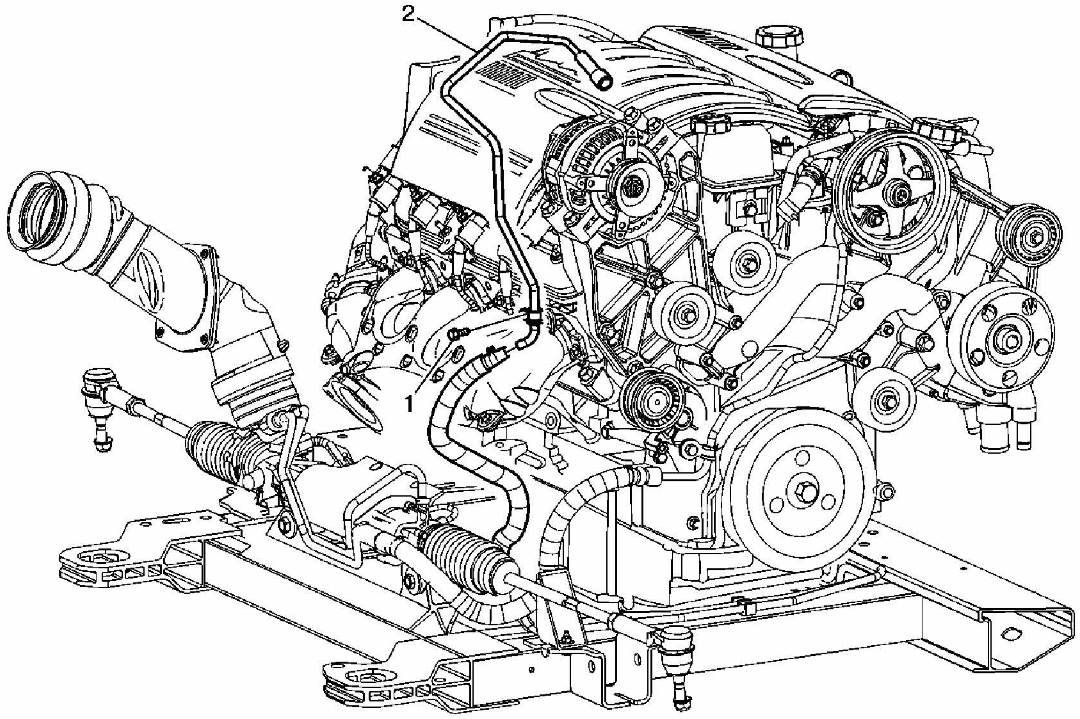


Fig. 43: Replacing Power Steering Return Hose
Courtesy of GENERAL MOTORS CORP.

Power Steering Return Hose Replacement (LS4)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	

Preliminary Procedures	
1. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement** for the 5.3L engine. 2. Place a drain pan under the vehicle. 3. Raise and lower the vehicle as necessary to access the power steering return hose clamp at the cooler pipe/hose. Refer to **Lifting and Jacking the Vehicle** . 4. Fill and bleed the power steering system after the repair has been completed. Refer to **Bleeding the Power Steering System**.	
1	Bolt, Power Steering Return Hose/Pipe **Tighten:** 55 N.m (41 lb ft) **Tip:** Remove the power steering return hose clamp (at cooler pipe).
2	Pipe/Hose, Power Steering Return **Tip:** Remove the power steering return pipe/hose clamp (at reservoir).

POWER STEERING RETURN HOSE REPLACEMENT (LZ4/LZE/LZ9)

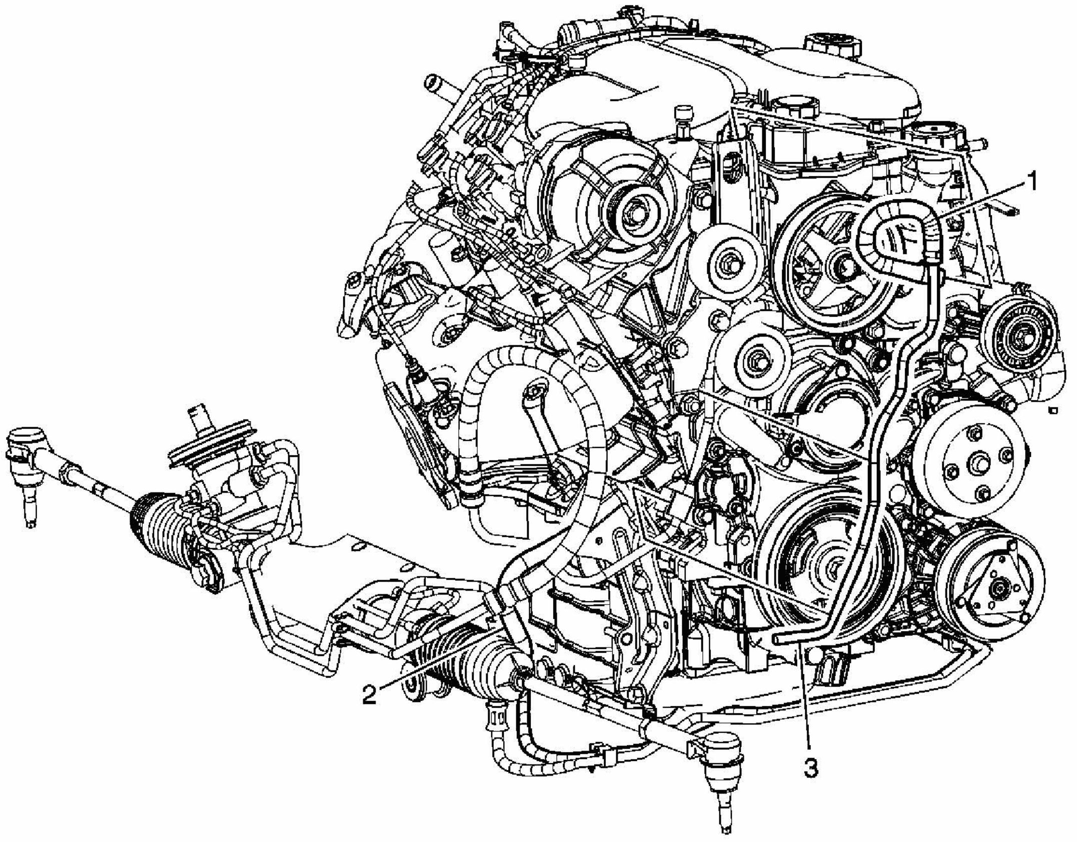


Fig. 44: Replacing Power Steering Return Hose
Courtesy of GENERAL MOTORS CORP.

Power Steering Return Hose Replacement (LZ4/LZE/LZ9)

Callout	Component Name
	NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement** for the 3.5L engine or **Intake Manifold Cover Replacement** for the 3.9L engine. 2. Place a drain pan under the vehicle. 3. Remove the belt tensioner. Refer to **Drive Belt Tensioner Replacement** for the 3.5L engine or **Drive Belt Tensioner Replacement** for the 3.9L engine. 4. Raise and lower the vehicle as necessary to access the power steering return hose clamp at the cooler pipe/hose. Refer to **Lifting and Jacking the Vehicle** . 5. Fill and bleed the power steering system after the repair has been completed. Refer to **Bleeding the Power Steering System**.
1	Clamp, Power Steering Return Pipe/Hose (at reservoir)
2	Clamp, Power Steering Return Pipe/Hose (at cooler pipe)
3	Pipe/Hose, Power Steering Pump Return **Tip:** Release the return pipe/hose from the retainer to remove it from the vehicle.

POWER STEERING GEAR REPLACEMENT

Tools Required

J 42640 Steering Column Lock Pin

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Place a drain pan under the vehicle.

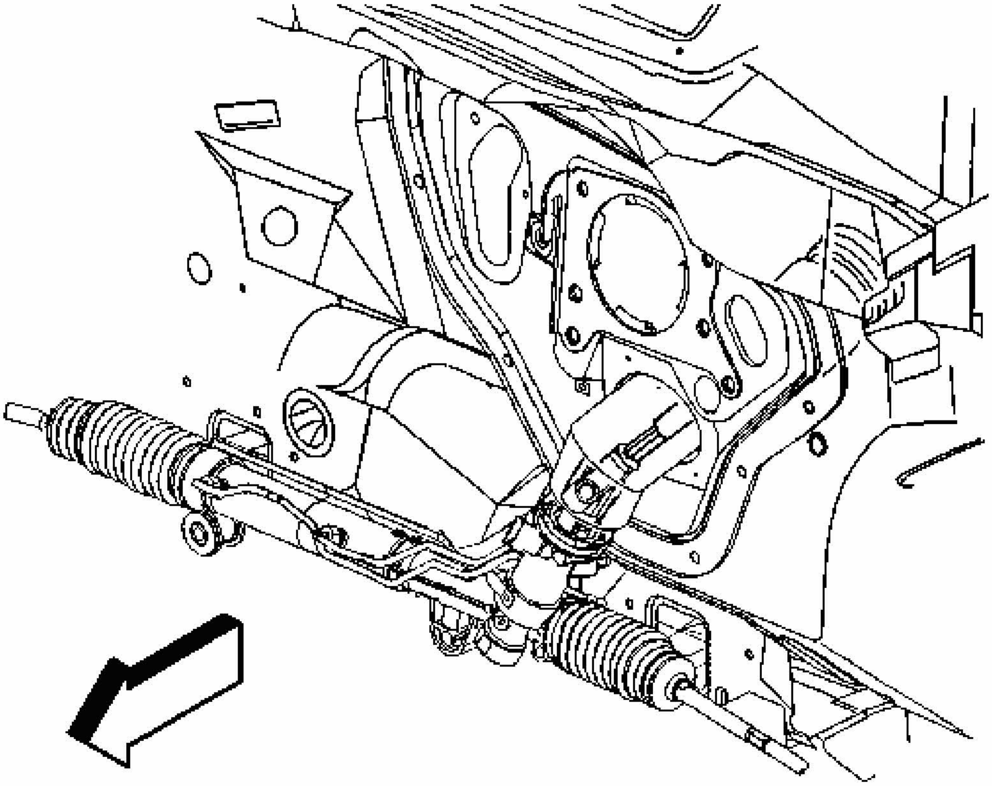


Fig. 45: View Of Steering Rack Assembly
Courtesy of GENERAL MOTORS CORP.

3. Remove the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .

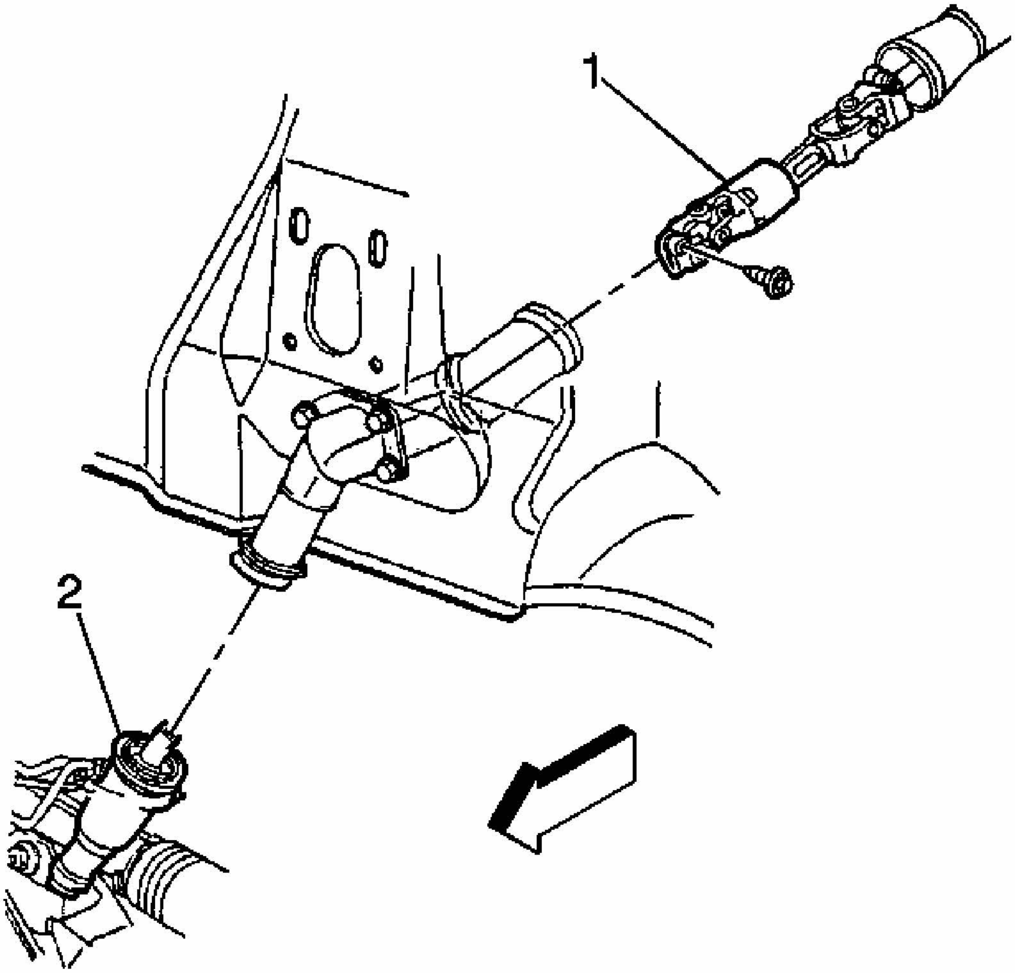


Fig. 46: View Of Intermediate Steering Shaft To Power Steering Gear Stub Shaft
Courtesy of GENERAL MOTORS CORP.

CAUTION: Failure to disconnect the intermediate shaft from the rack and pinion stub shaft can result in damage to the steering gear and/or intermediate shaft. This damage can cause loss of steering control which could result in personal injury.

NOTE: Set steering shaft so the block tooth on the upper steering shaft is at the 12 o'clock position, the wheels on the vehicle are straight ahead and set the ignition switch to the LOCK position. Failure to follow these procedures could result in damage to the coil.

NOTE: The wheels of the vehicle must be straight ahead and the steering column in the LOCK position before disconnecting the steering column or intermediate shaft from the steering gear. Failure to do so will cause the SIR coil assembly to become uncentered, which may cause damage to the coil assembly.

4. Remove the lower pinch bolt from the power steering gear stub shaft (2).

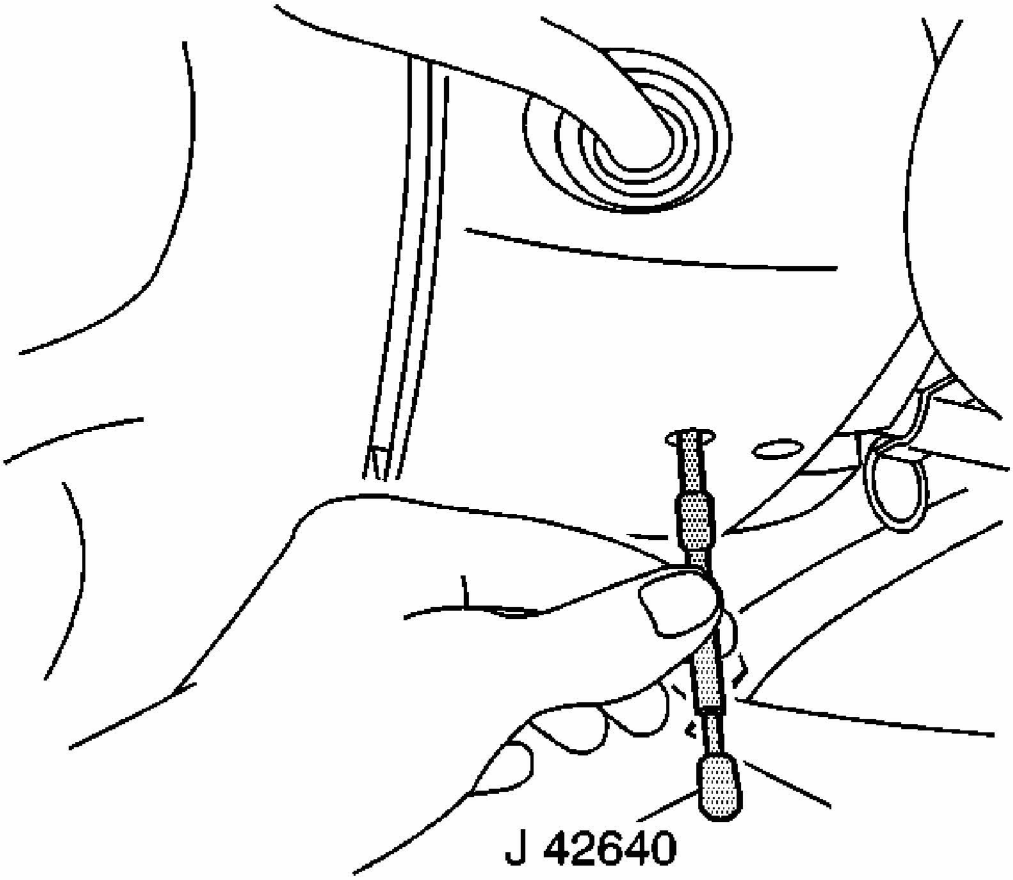


Fig. 47: Identifying J 42640
Courtesy of GENERAL MOTORS CORP.

5. Insert **J 42640** into the steering column access hole in order to lock the steering column. This will maintain the correct orientation.
6. Remove the intermediate steering shaft (1) from the power steering gear stub shaft (2).
7. Remove both of the tie rod ends from the steering knuckles. Refer to **Rack and Pinion**

Outer Tie Rod End Replacement.

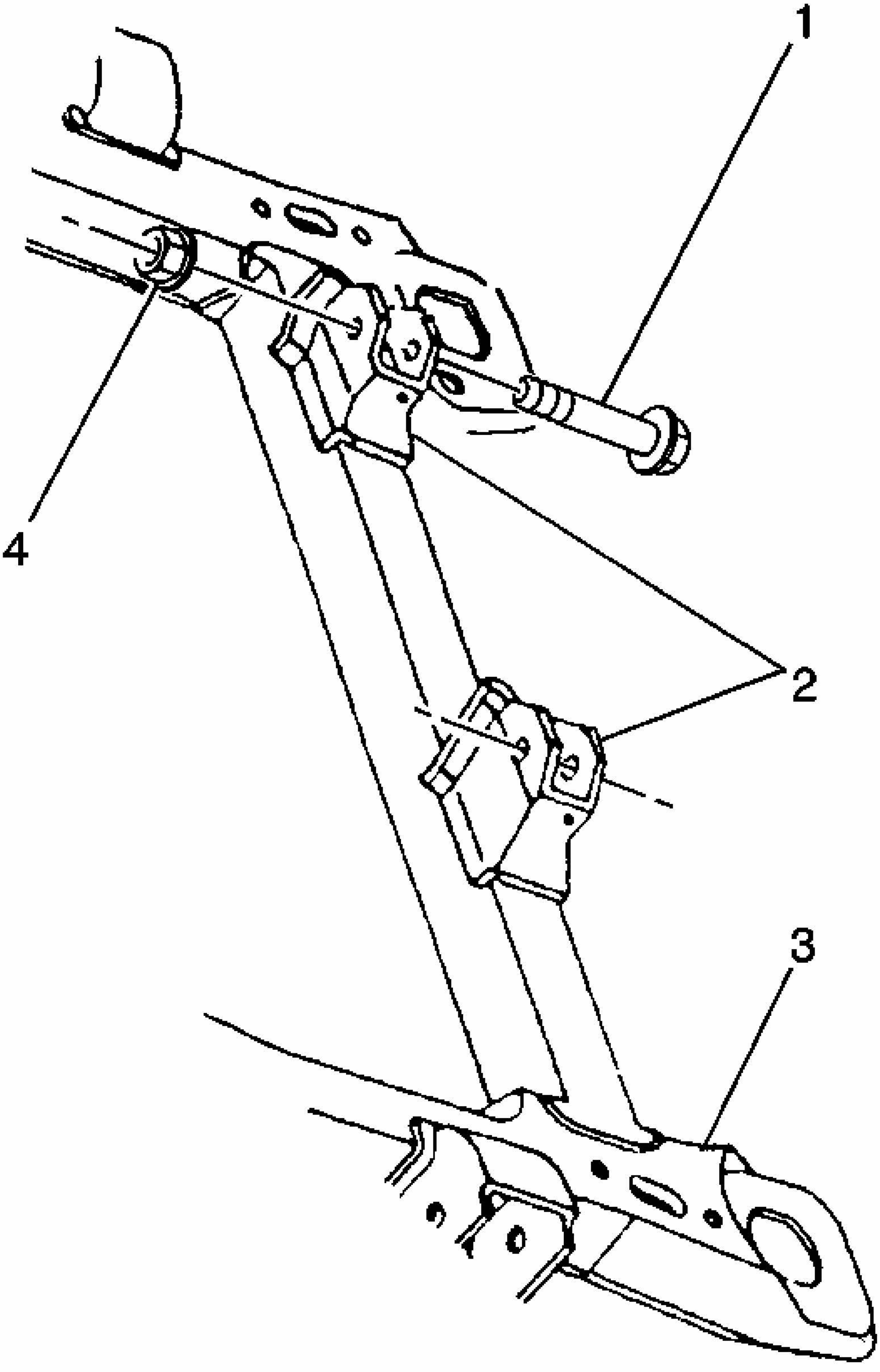


Fig. 48: View Of Rear Of Frame
Courtesy of GENERAL MOTORS CORP.

8. Support the rear of the frame (3) using jackstands.
9. Remove the frame bolts from the rear of the frame. Refer to **Frame Replacement** .

NOTE: Do not lower the rear of the frame too far as damage to the engine components nearest to the cowl may result.

10. Lower the rear of the frame (3).
11. Remove the power steering pressure hose from the power steering gear. Refer to **Power Steering Pressure Pipe/Hose Replacement (LS4)** or **Power Steering Pressure Pipe/Hose Replacement (LZ4/LZE/LZ9)**.
12. Remove the power steering return hose from the power steering gear. Refer to **Power Steering Return Hose Replacement (LS4)** or **Power Steering Return Hose Replacement (LZ4/LZE/LZ9)**.
13. Remove the power steering gear mounting bolts and nuts (1, 4).
14. Remove the power steering gear through the left wheel opening.

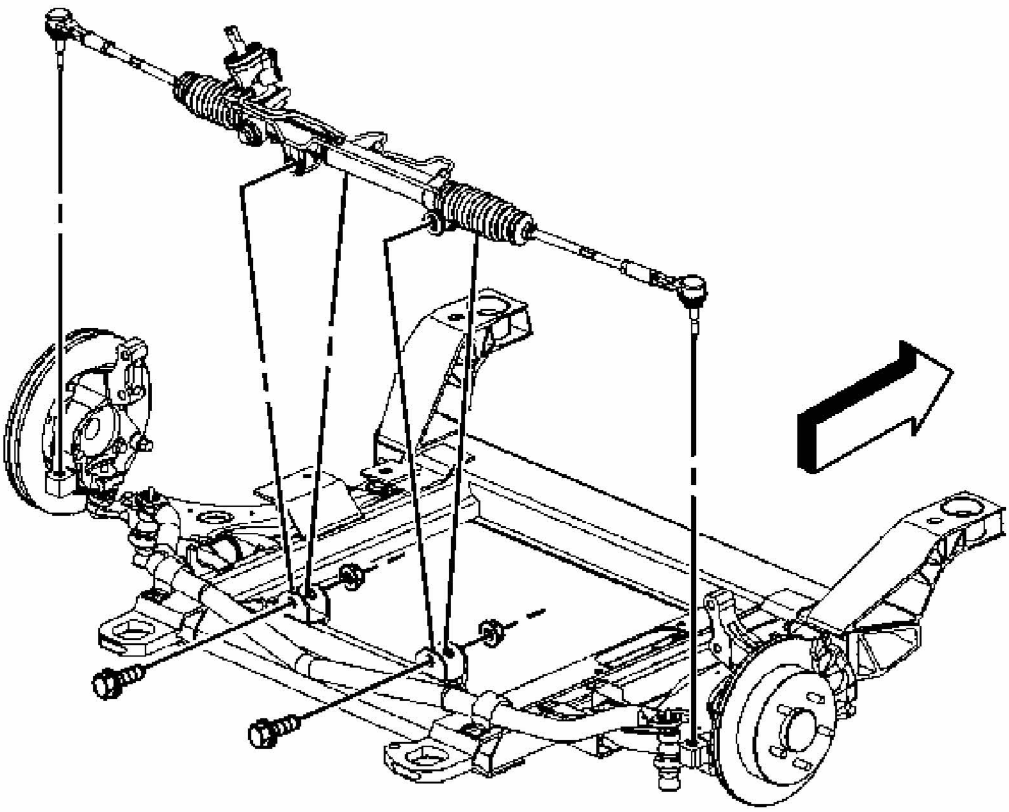


Fig. 49: View Of Power Steering Gear
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

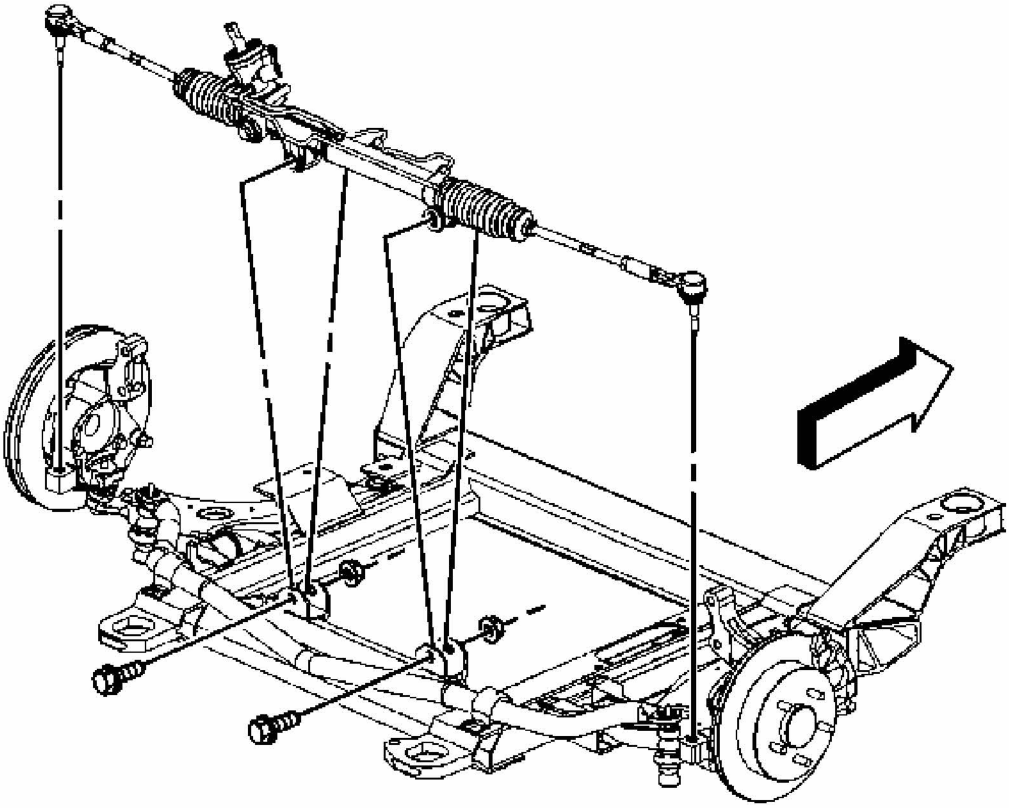


Fig. 50: View Of Power Steering Gear
Courtesy of GENERAL MOTORS CORP.

1. Install the power steering gear through the left wheel opening.

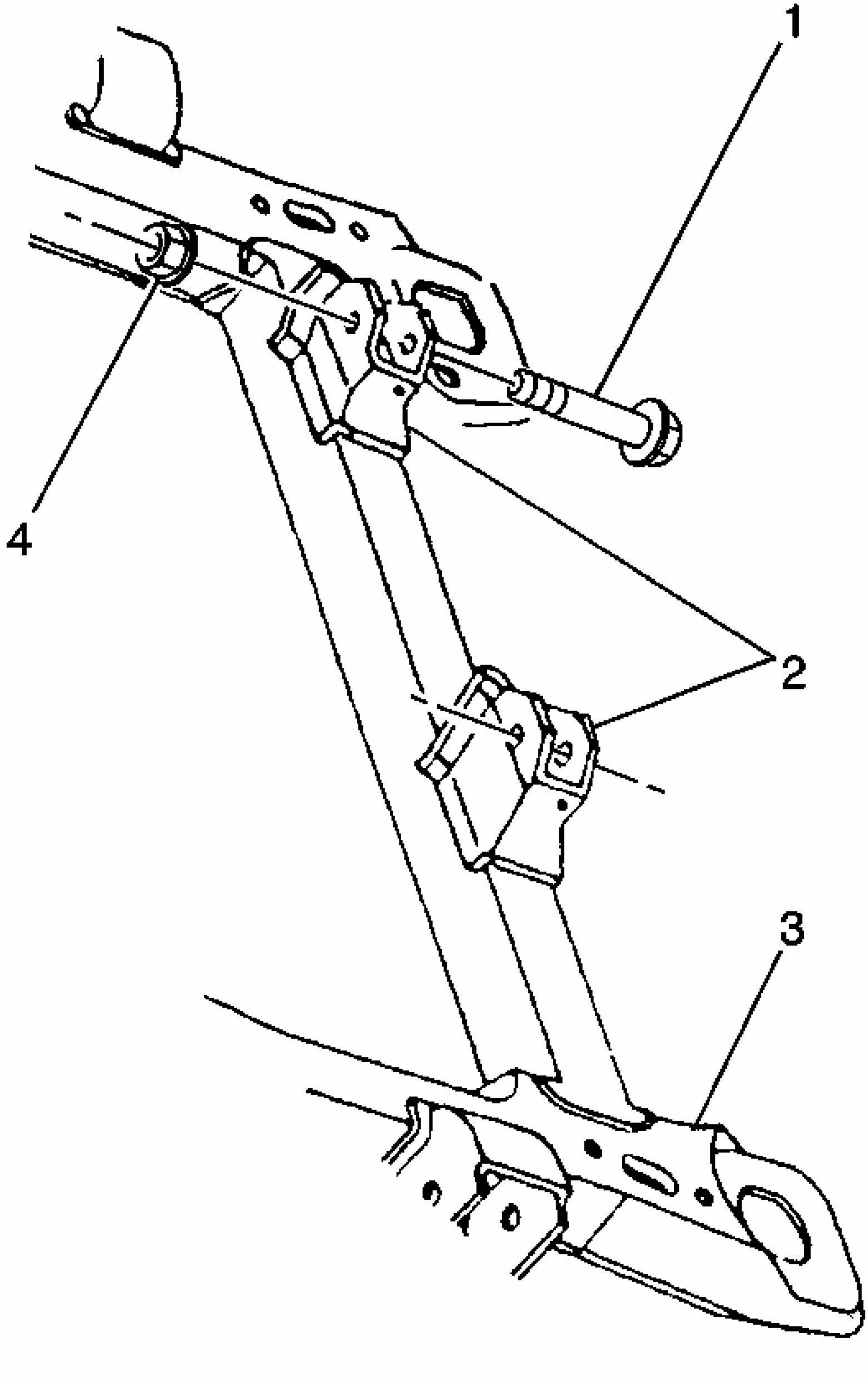


Fig. 51: View Of Rear Of Frame
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

2. Install the power steering gear mounting bolts and nuts (1, 4).

   Tighten: Tighten the power steering gear mounting bolts to 90 N.m (66 lb ft).

3. Inspect the threads on the power steering pressure hose and the power steering return hose.
4. Inspect the O-ring seals on the power steering hoses.
5. Replace the seals if damaged, lubricate the seals before installation.
6. Install the clamp that holds the power steering hoses to the power steering gear.
7. Install the power steering pressure hose to the power steering gear. Refer to **Power Steering Pressure Pipe/Hose Replacement (LS4)** or **Power Steering Pressure Pipe/Hose Replacement (LZ4/LZE/LZ9)**.
8. Install the power steering return hose to the power steering gear. Refer to **Power Steering Return Hose Replacement (LS4)** or **Power Steering Return Hose Replacement (LZ4/LZE/LZ9)**.
9. Raise the frame into position (3).
10. Install rear frame bolts. Refer to **Frame Replacement** .
11. Remove the jackstands.
12. Install the tie rod ends to the steering knuckles. Refer to **Rack and Pinion Outer Tie Rod End Replacement**.

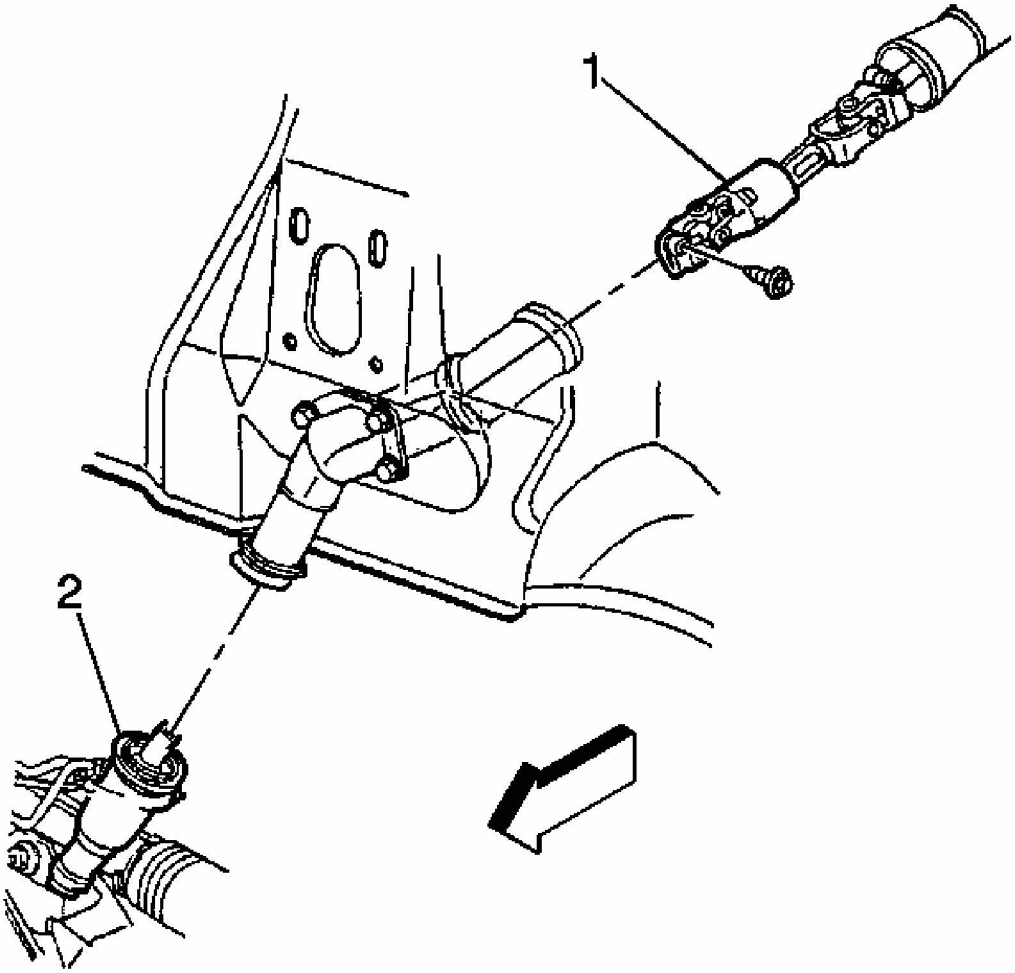


Fig. 52: View Of Intermediate Steering Shaft To Power Steering Gear Stub Shaft
Courtesy of GENERAL MOTORS CORP.

NOTE: **Set steering shaft so the block tooth on the upper steering shaft is at the 12 o'clock position, the wheels on the vehicle are straight ahead and set the ignition switch to the LOCK position. Failure to follow these procedures could result in damage to the coil.**

IMPORTANT: **During the installation of the intermediate steering shaft, ensure the steering shaft is seated before you install the pinch bolt. The two mating shafts may disengage if the pinch bolt is inserted into the coupling before the steering shaft installation.**

13. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
14. Install the intermediate steering shaft (1) to the power steering gear stub shaft (2).
15. Install the lower pinch bolt to the intermediate steering shaft at the power steering gear stub shaft.

    Tighten: Tighten the pinch bolt to 48 N.m (35 lb ft).

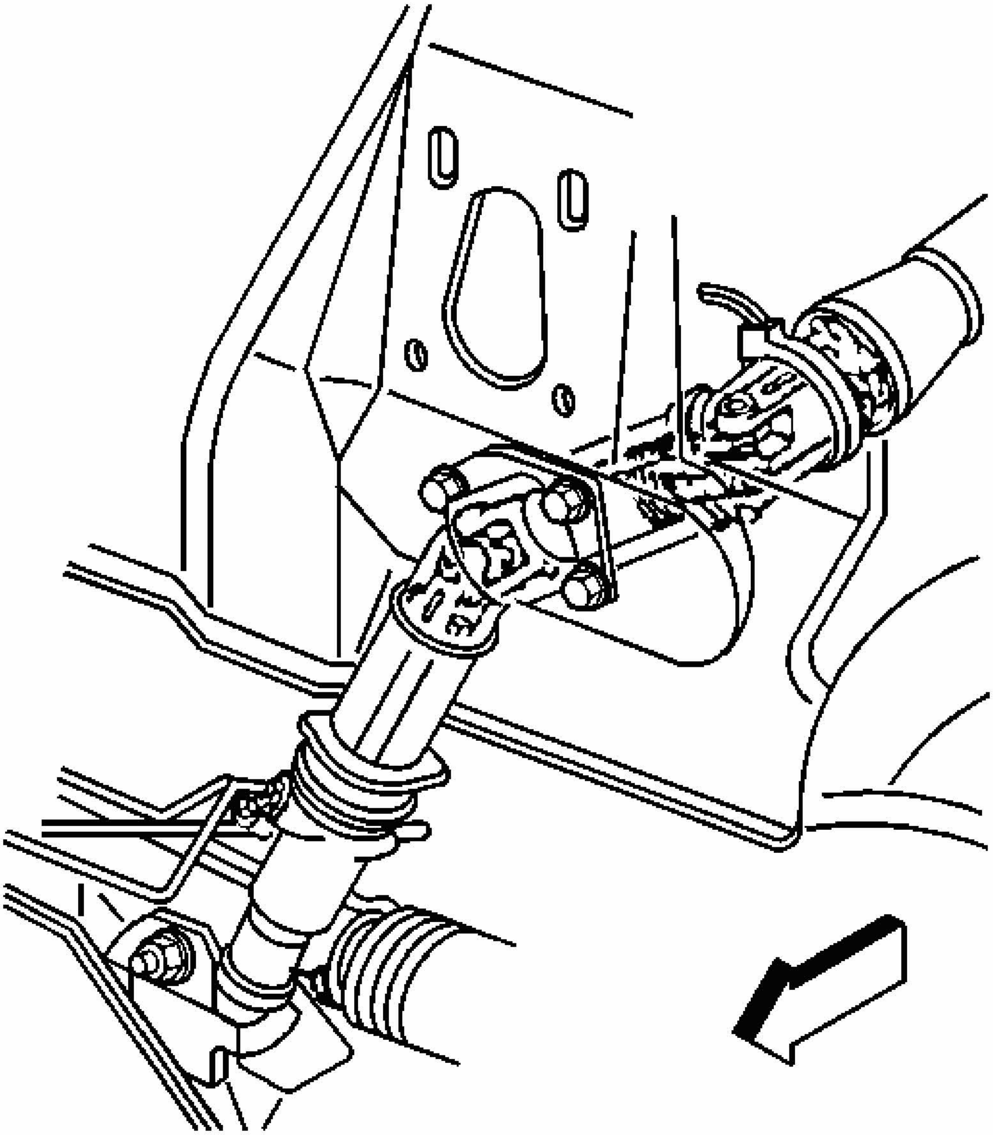


Fig. 53: Providing Access To Intermediate Steering Shaft Lower Pinch Bolt
Courtesy of GENERAL MOTORS CORP.

16. Install the intermediate steering shaft seal onto the power steering gear.
17. Install the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
18. Remove the drain pan from under the vehicle.
19. Lower the vehicle.
20. Remove the **J 42640** from the steering column.
21. Fill the power steering system with power steering fluid. Refer to **Checking and Adding Power Steering Fluid**.
22. Bleed the power steering system. Refer to **Bleeding the Power Steering System**.
23. Inspect the power steering system for leaks. Refer to **Power Steering Fluid Leaks**.
24. Preform a front end alignment. Refer to **Measuring Wheel Alignment** .

RACK AND PINION GEAR RACK BEARING PRELOAD ADJUSTMENT - OFF VEHICLE (RACK AND PINION)

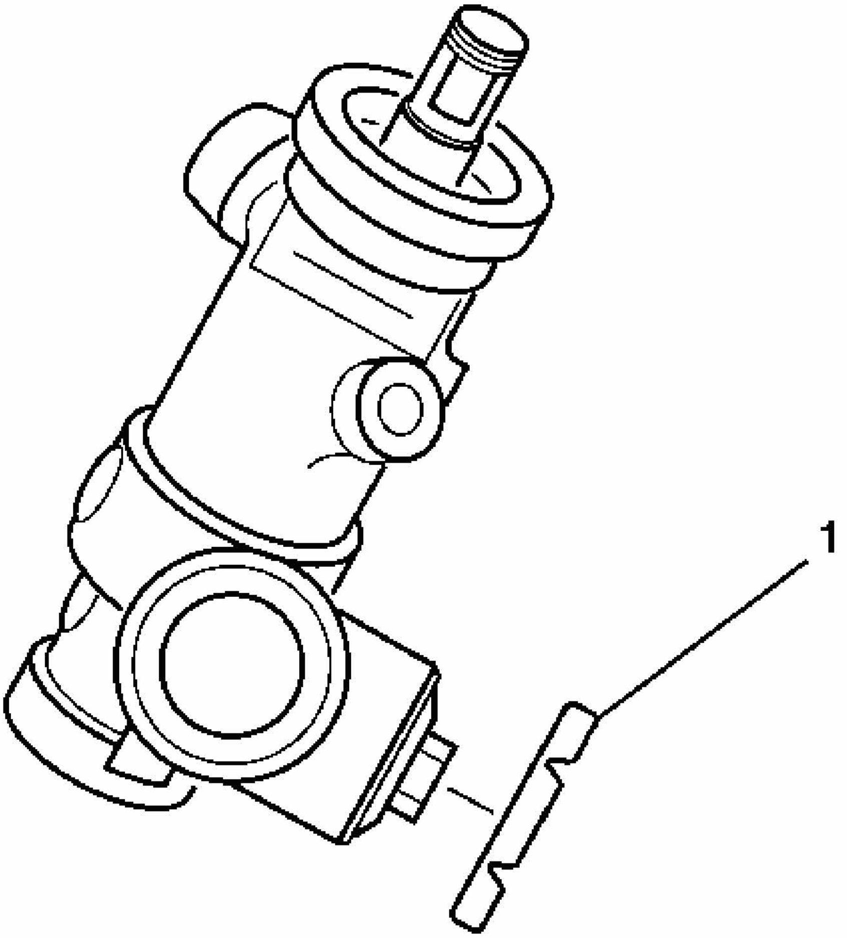


Fig. 54: View Of Adjuster Plug Lock Nut (Rack & Pinion)
Courtesy of GENERAL MOTORS CORP.

1. Loosen the adjuster plug lock nut (1).
2. Turn the adjuster plug clockwise until the adjuster plug bottoms in the gear assembly.
3. Turn the adjuster plug back 50 degrees to 70 degrees (approximately one flat).

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the adjuster plug lock nut (1) to the adjuster plug.

   Tighten: Hold the adjuster plug stationary while tightening the adjuster plug lock nut (1) to 68 N.m (50 lb ft).

RACK AND PINION BOOT AND BREATHER TUBE REPLACEMENT - OFF VEHICLE

Tools Required

J 22610 Keystone Clamp Pliers.

Disassembly Procedure

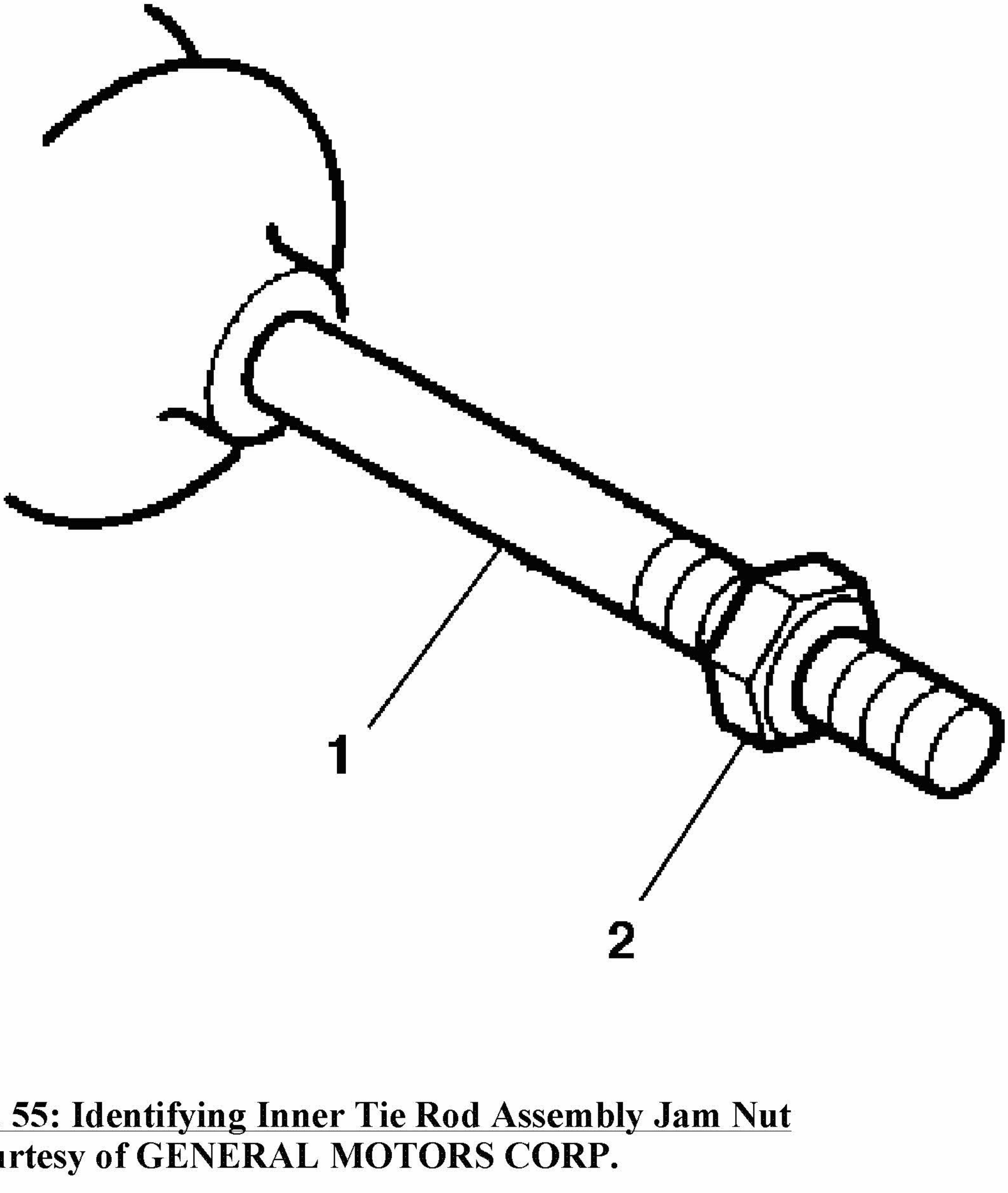


Fig. 55: Identifying Inner Tie Rod Assembly Jam Nut
Courtesy of GENERAL MOTORS CORP.

1. To remove the outer tie rod. Refer to **Rack and Pinion Outer Tie Rod End Replacement**.
2. Remove the hexagon jam nut (2) from the inner tie rod assembly (1).

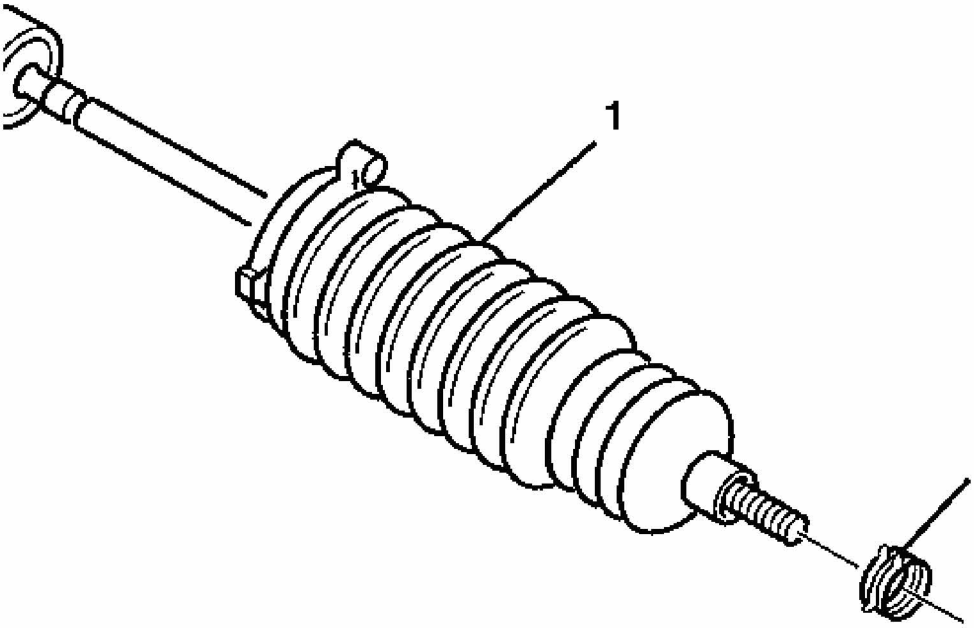


Fig. 56: View Of Tie Rod End Clamp At Rack & Pinion Boot
Courtesy of GENERAL MOTORS CORP.

3. Remove the tie rod end clamp (2) from the rack and pinion boot (1).

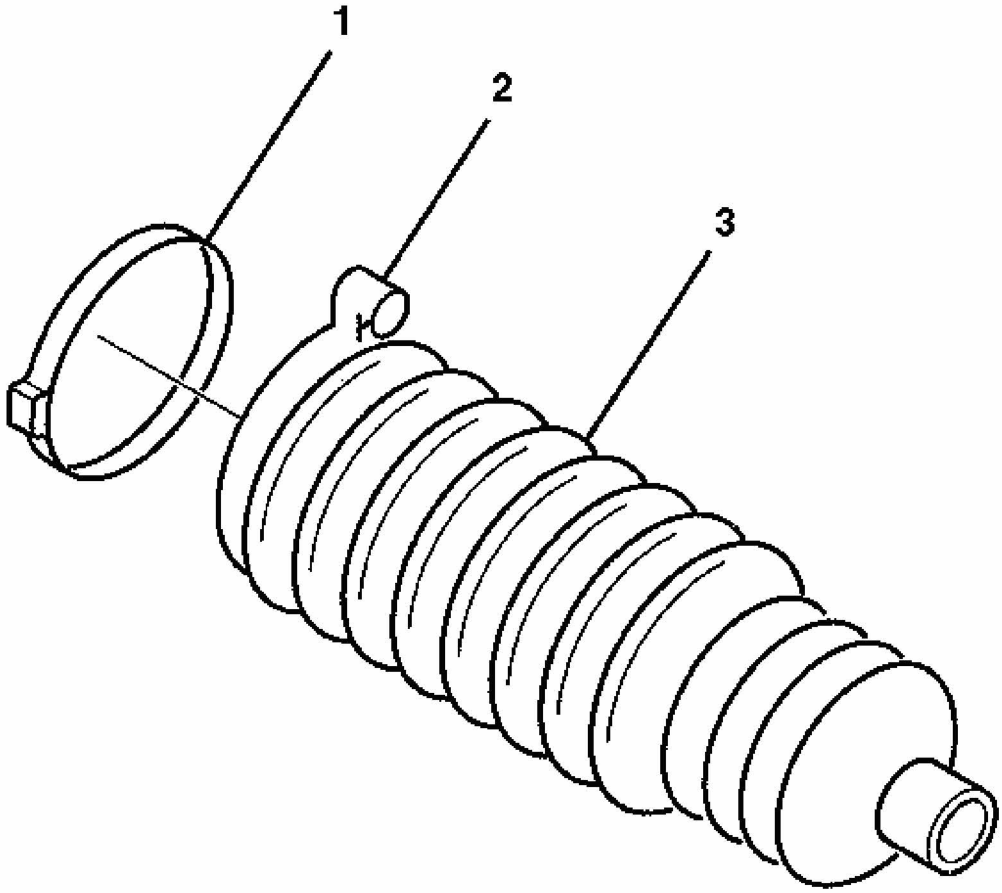


Fig. 57: View Of Boot Clamp And Rack & Pinion Boot
Courtesy of GENERAL MOTORS CORP.

4. Remove the boot clamp (1) from the rack and pinion boot with side cutters.
5. Discard the boot clamp (1).

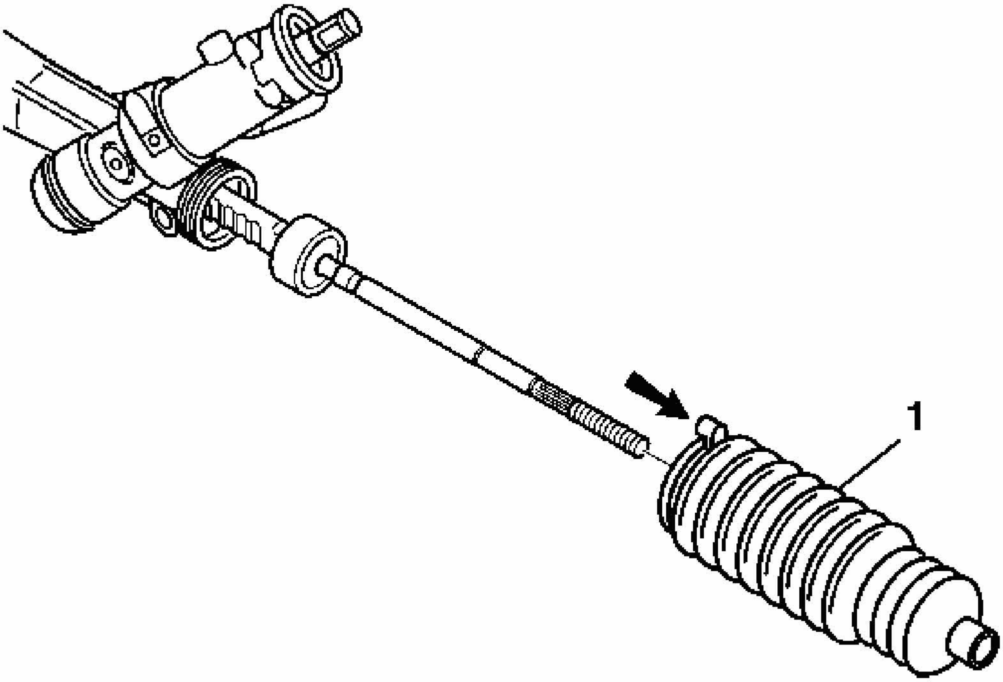


Fig. 58: Identifying Rack & Pinion Boot & Breather Tube
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If a breather tube is present, mark the location of the breather tube on the gear assembly before removal of the rack and pinion boot.

6. Remove the rack and pinion boot (1) and the breather tube, if present, from the rack and pinion gear assembly.

Assembly Procedure

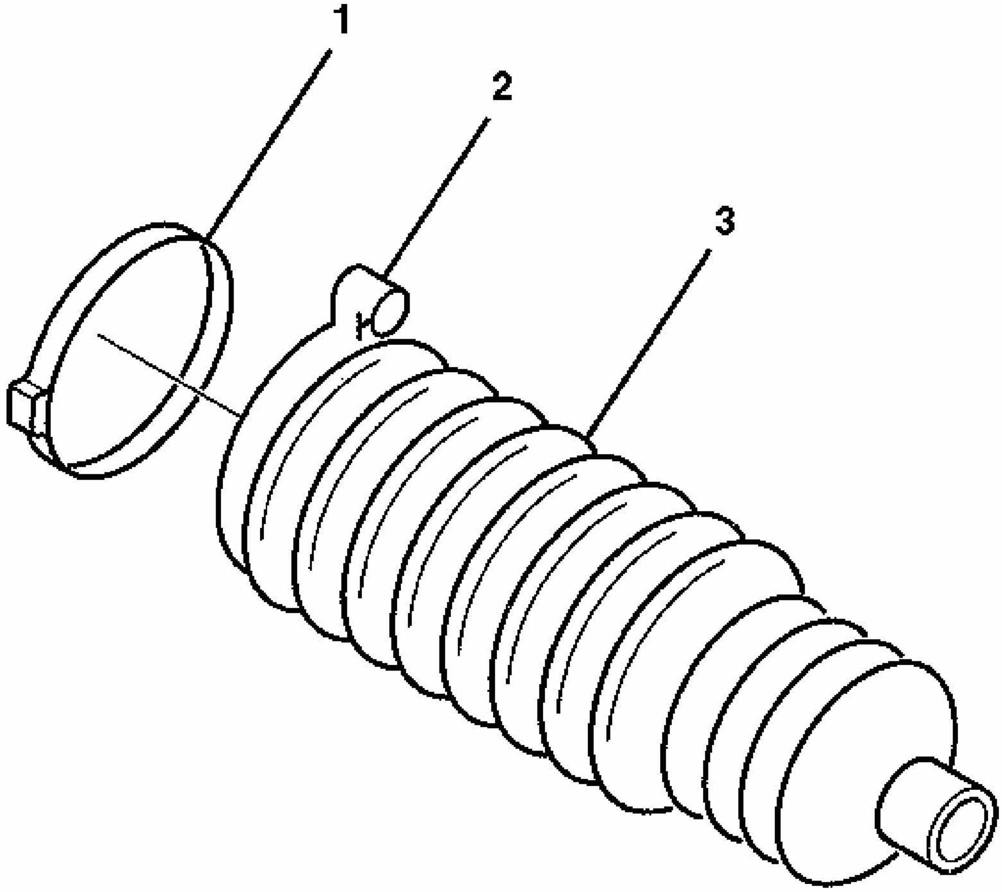


Fig. 59: View Of Boot Clamp And Rack & Pinion Boot
Courtesy of GENERAL MOTORS CORP.

1. Install the new boot clamp (1) onto the rack and pinion boot (3).

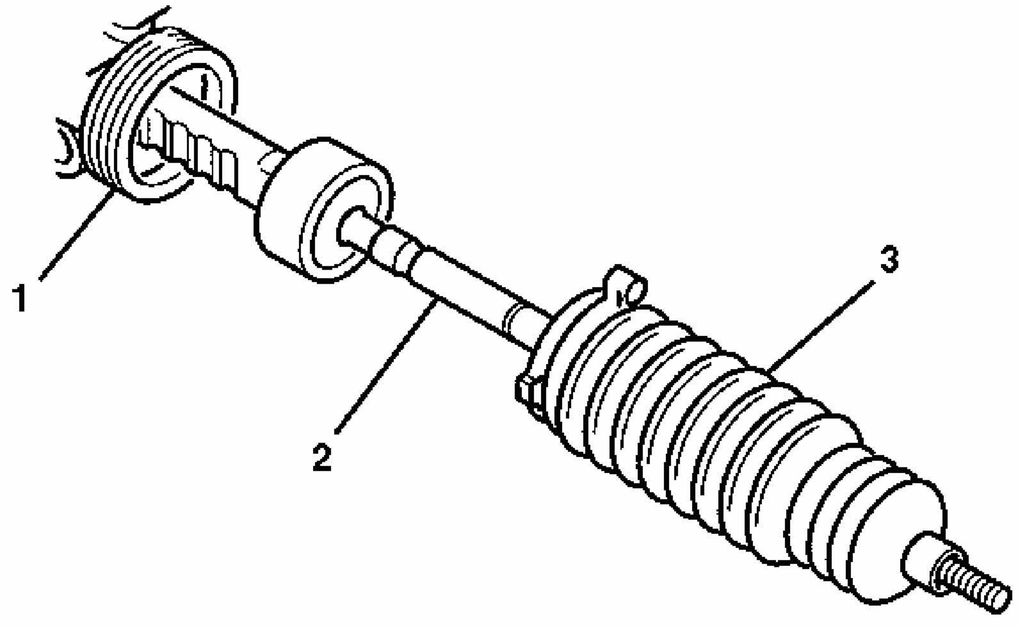


Fig. 60: Rack & Pinion Gear Assembly, Boot & Inner Tie Rod Assembly
Courtesy of GENERAL MOTORS CORP.

2. Prior to rack and pinion boot installation, apply grease to the inner tie rod assembly (2) and the rack and pinion gear assembly (1).
3. Install the rack and pinion boot (3) onto the inner tie rod assembly (2).
4. If present, install the breather tube while aligning the breather tube with the mark made during removal and the molded nipple of the rack and pinion boot.

IMPORTANT: The rack and pinion boot (3) must not be twisted, puckered or out of shape in any way. If the rack and pinion boot (3) is not shaped properly, adjust the rack and pinion boot (3) by hand before installing the boot clamp.

5. Install the rack and pinion boot onto the gear assembly (1) until the rack and pinion boot (3) is seated in the gear assembly groove.

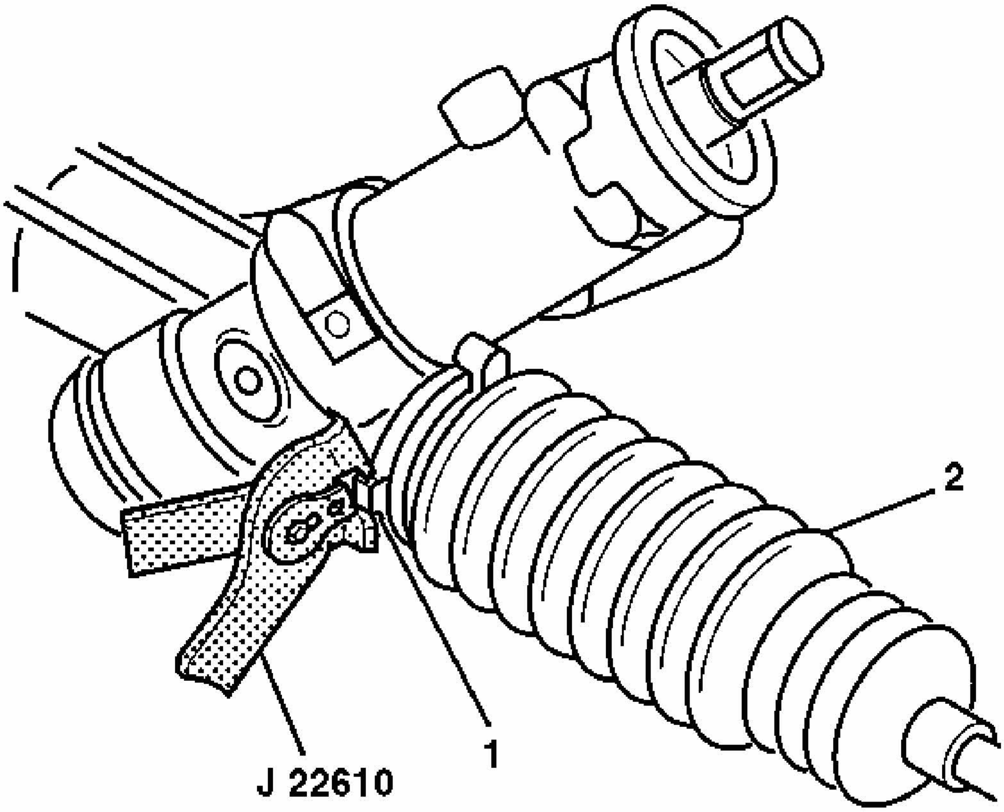


Fig. 61: Using J 22610 To Install Boot Clamp
Courtesy of GENERAL MOTORS CORP.

6. Install the boot clamp (1) on the rack and pinion boot (2) with **J 22610** .
7. Crimp the boot clamp (1).
8. Pinch the pliers together on the rack and pinion boot (2) in order to install the tie rod end clamp.

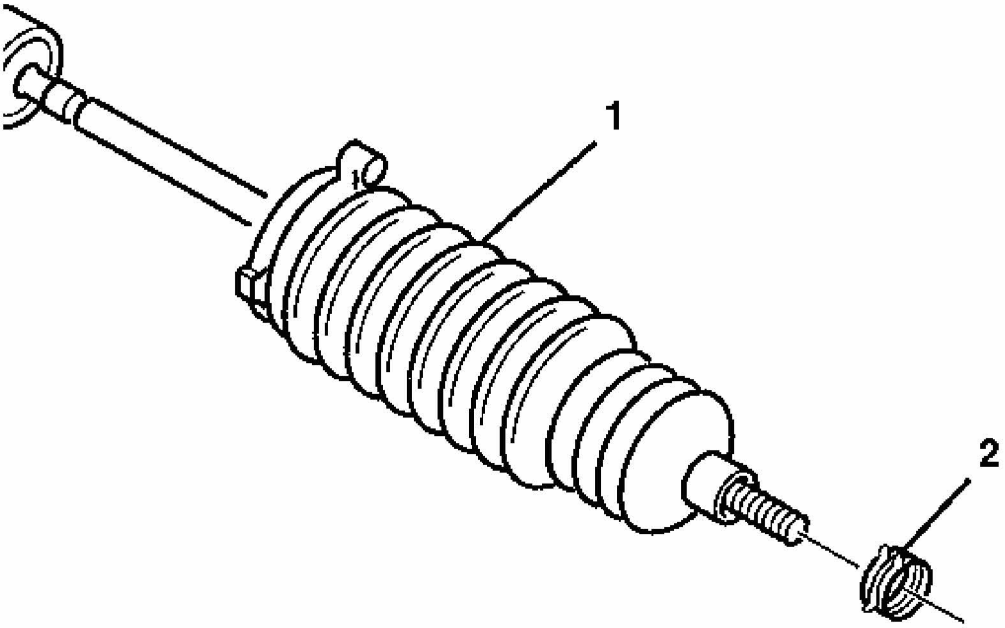


Fig. 62: View Of Tie Rod End Clamp At Rack & Pinion Boot
Courtesy of GENERAL MOTORS CORP.

9. Install the tie rod end clamp (2) onto the rack and pinion boot (1).

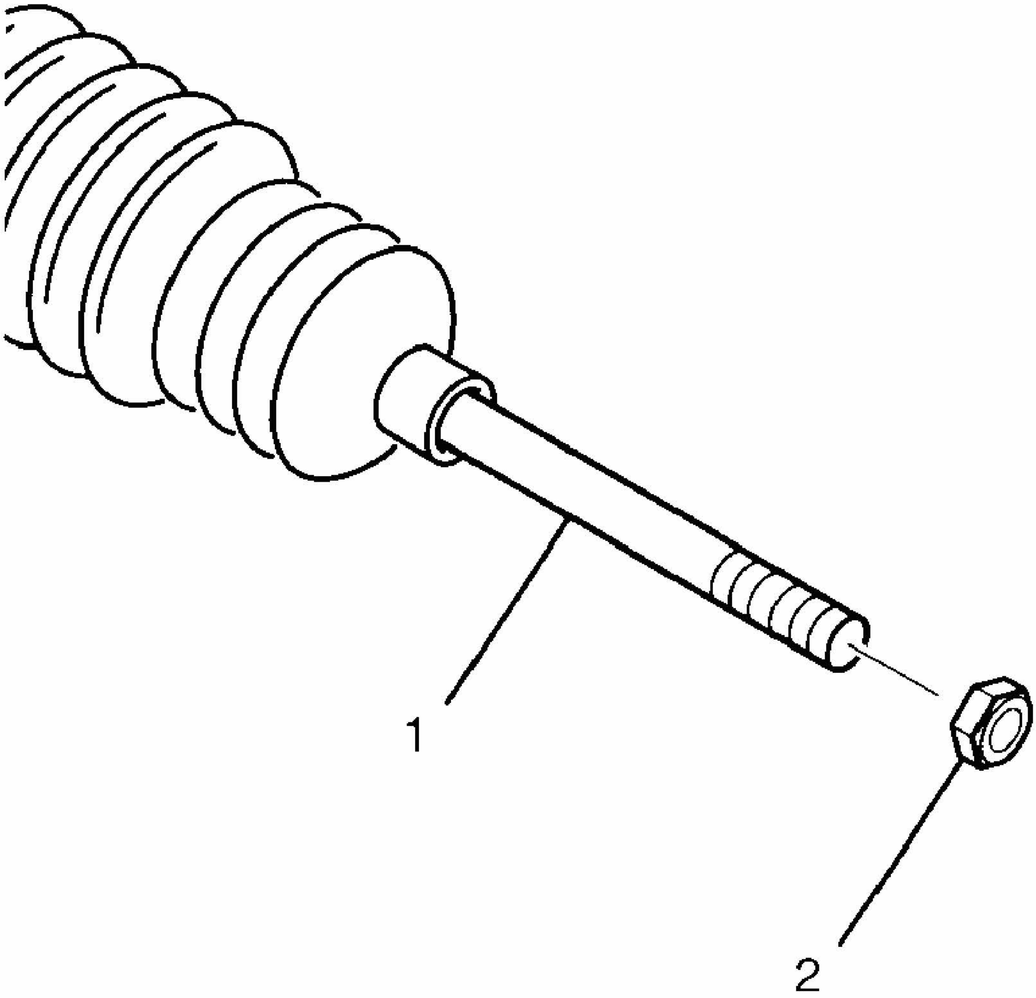


Fig. 63: View Of Inner Tie Rod & Hex Jam Nut
Courtesy of GENERAL MOTORS CORP.

10. Install the hexagon jam nut (2) to the inner tie rod assembly (1).
11. To assemble the outer tie rod assembly. Refer to **Rack and Pinion Outer Tie Rod End Replacement**.

RACK AND PINION INNER TIE ROD REPLACEMENT - OFF VEHICLE (QUIET VALVE)

Disassembly Procedure

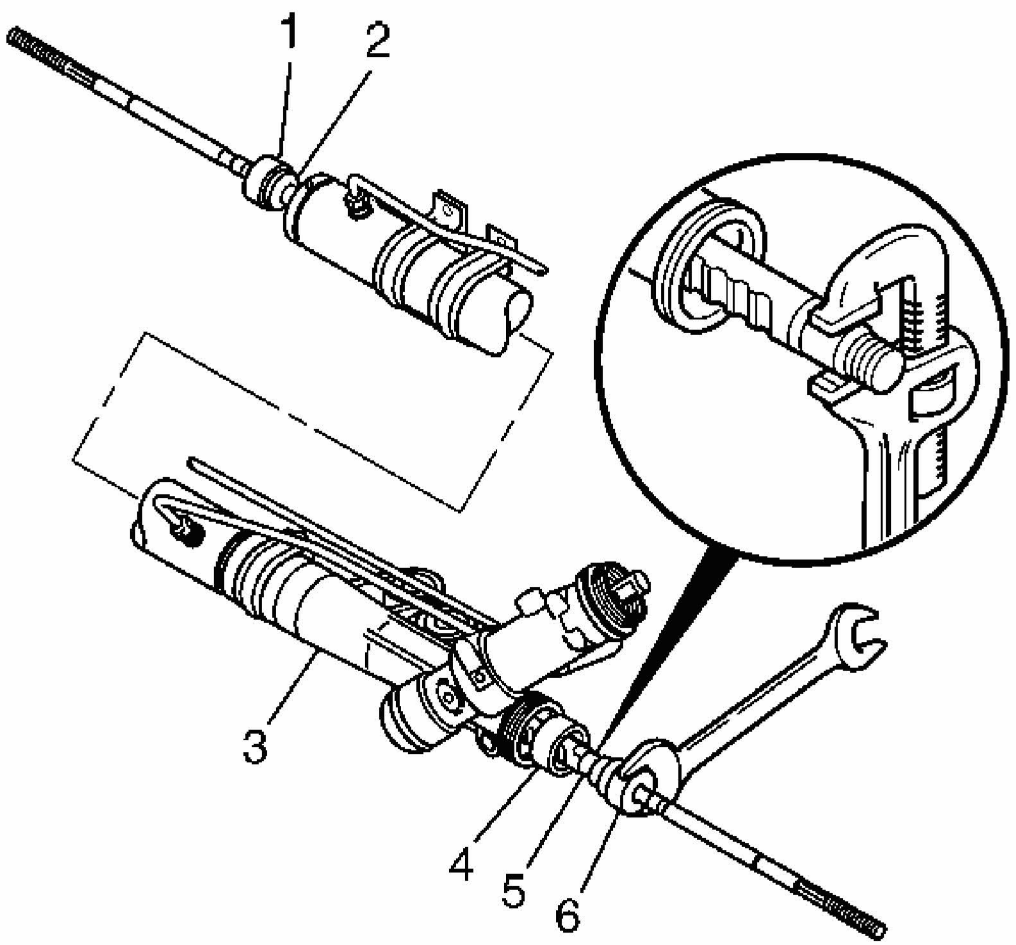


Fig. 64: Identifying Inner Tie Rod Components
Courtesy of GENERAL MOTORS CORP.

1. Remove the rack and pinion boot. Refer to **Rack and Pinion Boot and Breather Tube Replacement - Off Vehicle**.
2. Place the gear in a vise.

NOTE: **Do not change the steering gear preload adjustment before moving the inner tie rod from the steering gear. Changing the steering gear preload adjustment before moving the inner tie rod could result in damage to the pinion and the steering gear.**

3. Remove the shock dampener (4) from the inner tie rod assembly (6).
4. Slide the shock dampener (4) back on the rack (5).

NOTE: Refer to PIPE WRENCH POSITIONING NOTICE in Cautions and Notices.

5. Place a pipe wrench on the rack (5) next to the inner tie rod housing (6).
6. Place a wrench on the flats of the inner tie rod housing (6).
7. Rotate the inner tie rod housing (6) counterclockwise, while holding the rack stationary, until the inner tie rod separates from the rack (5).

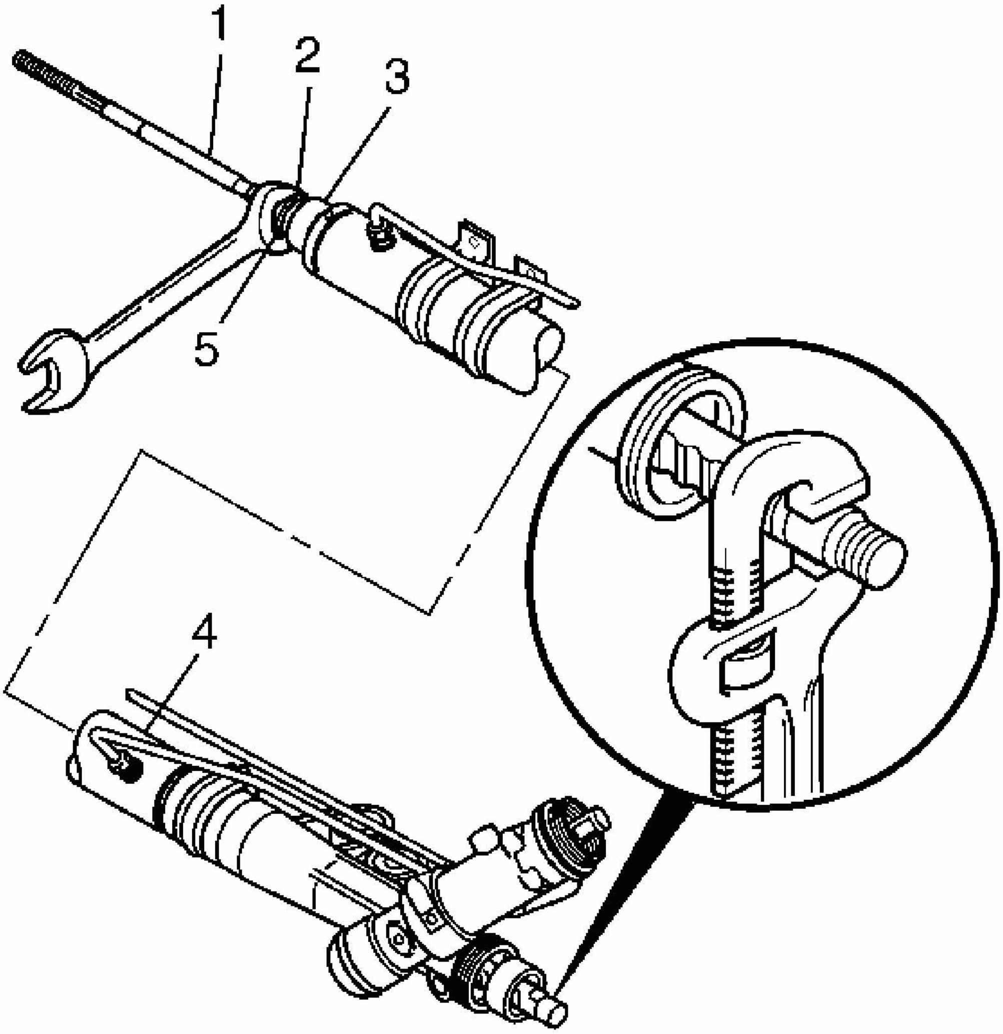


Fig. 65: Separating Inner Tie Rod From Rack
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not change the steering gear preload adjustment before

moving the inner tie rod from the steering gear. Changing the steering gear preload adjustment before moving the inner tie rod could result in damage to the pinion and the steering gear.

8. Remove the shock dampener (3) from the inner tie rod housing (2).
9. Slide the shock dampener (3) back on the rack (5).

NOTE: Refer to PIPE WRENCH POSITIONING NOTICE in Cautions and Notices.

10. Place a pipe wrench on the rack.
11. Place a wrench on the flats of the inner tie rod housing (2).
12. Rotate the inner tie rod housing (2) counterclockwise, while holding the rack stationary, until the inner tie rod (1) separates from the rack (5).

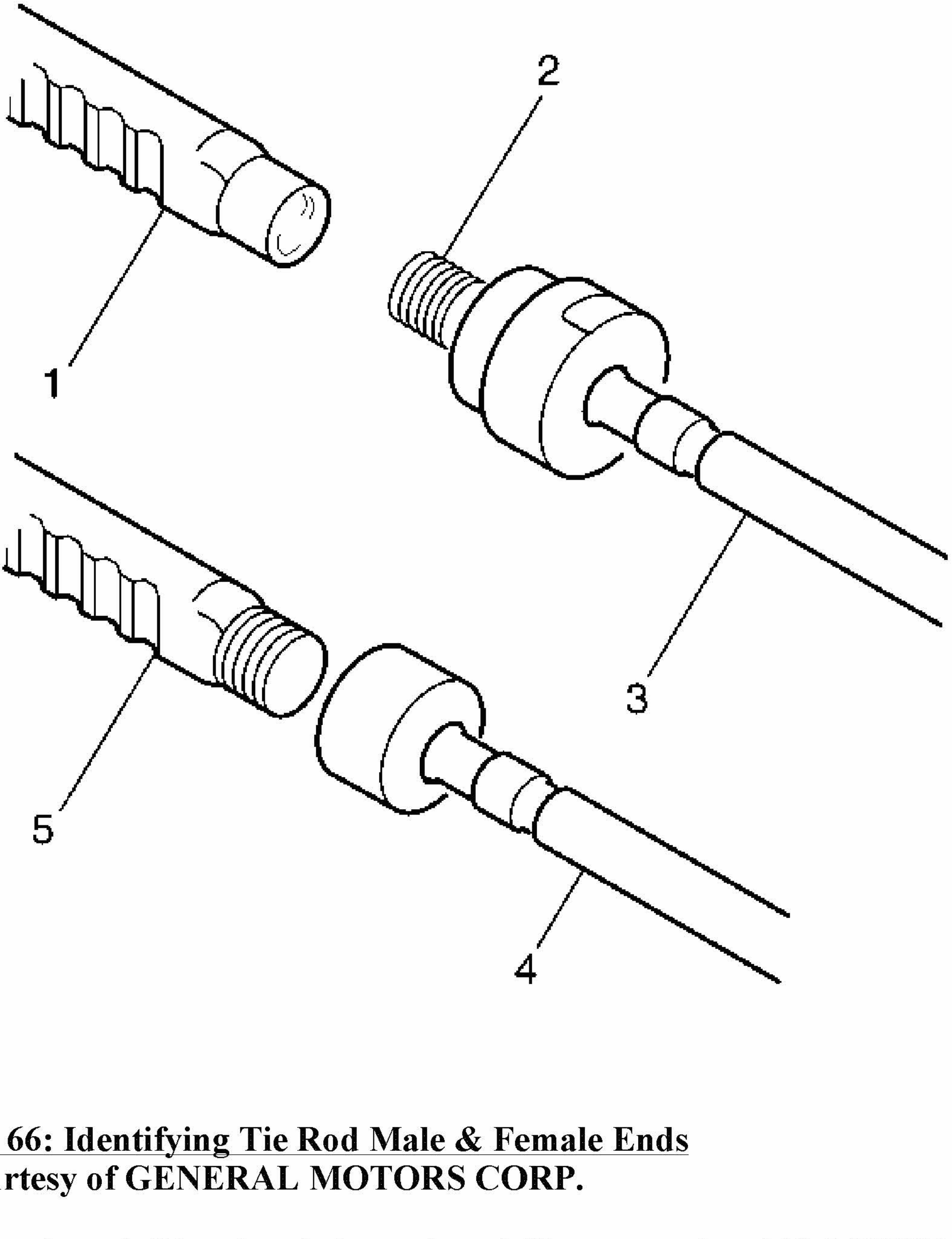


Fig. 66: Identifying Tie Rod Male & Female Ends
Courtesy of GENERAL MOTORS CORP.

13. If female rack (1) and male inner tie rod (3), remove the old LOCTITE® from the threads (2) of the inner tie rod and the rack.

    If male rack (5) and female inner tie rod (4) LOCTITE® will not be present.

Assembly Procedure

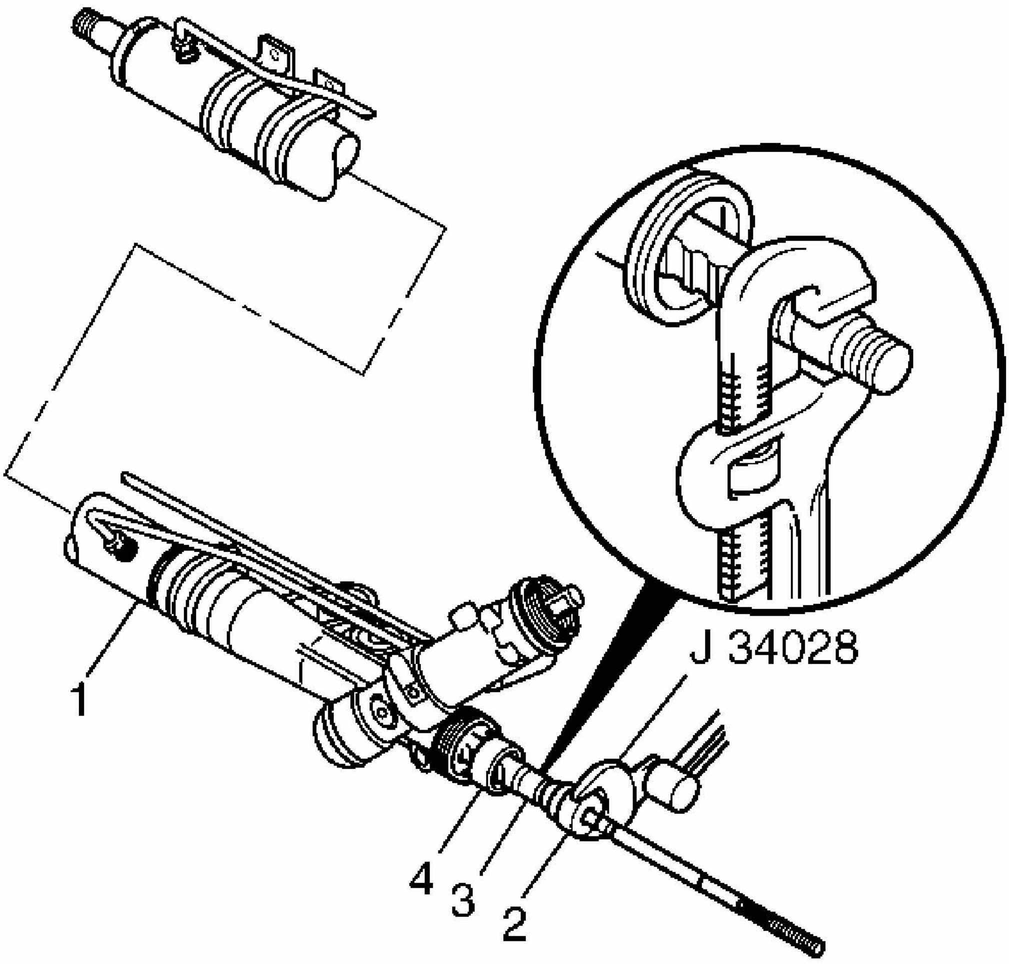


Fig. 67: Connecting Inner Tie Rod To Rack
Courtesy of GENERAL MOTORS CORP.

1. Slide the shock dampener (4) forward onto the rack (3).

IMPORTANT: Threads must be clean prior to LOCTITE® application. Check LOCTITE® or equivalent container for expiration date. Use only enough LOCTITE® to evenly coat threads. If male rack (3) and female inner tie rod (2) do not apply LOCTITE®.

2. If female rack (3) and male inner tie rod (2), apply LOCTITE® 262 or equivalent to the inner tie rod threads.
3. Attach the inner tie rod onto the rack (3).

NOTE: Refer to PIPE WRENCH POSITIONING NOTICE in Cautions and Notices.

4. Place a pipe wrench on the rack (3) next to the inner tie rod housing (2).

NOTE: Refer to Fastener Notice Cautions and Notices.

5. Place a torque wrench and **J 34028** on the flats of the inner tie rod housing (2). See **Special Tools**.

   Tighten: Tighten the inner tie rod to 100 N.m (74 lb ft).

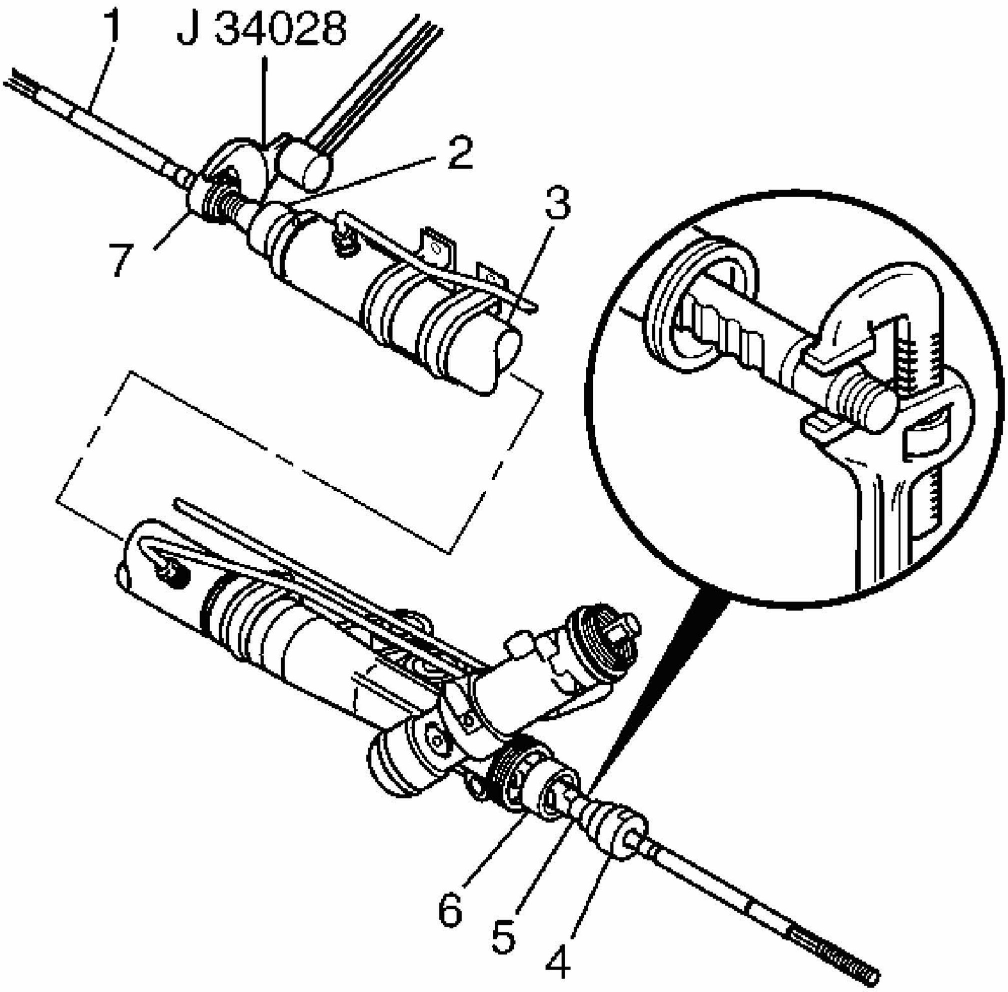


Fig. 68: Tighten The Inner Tie Rod To Rack
Courtesy of GENERAL MOTORS CORP.

6. Slide the shock dampener (2) forward onto the rack.

IMPORTANT: Threads must be clean prior to LOCTITE® application. Check LOCTITE® or equivalent container for expiration date. Use only enough LOCTITE® to evenly coat threads. If male rack and female inner tie rod (1) do not apply LOCTITE®.

7. If female rack and male inner tie rod (1), apply LOCTITE® 262 or equivalent to the inner tie rod threads.
8. Attach the inner tie rod (1) onto the rack.

NOTE: Refer to PIPE WRENCH POSITIONING NOTICE in Cautions and Notices.

9. Place a pipe wrench on the rack next to the inner tie rod housing (4).
10. Place a torque wrench and **J 34028** on the flats of the inner tie rod housing (7). See **Special Tools**.

    Tighten: Tighten the inner tie rod to 100 N.m (74 lb ft).

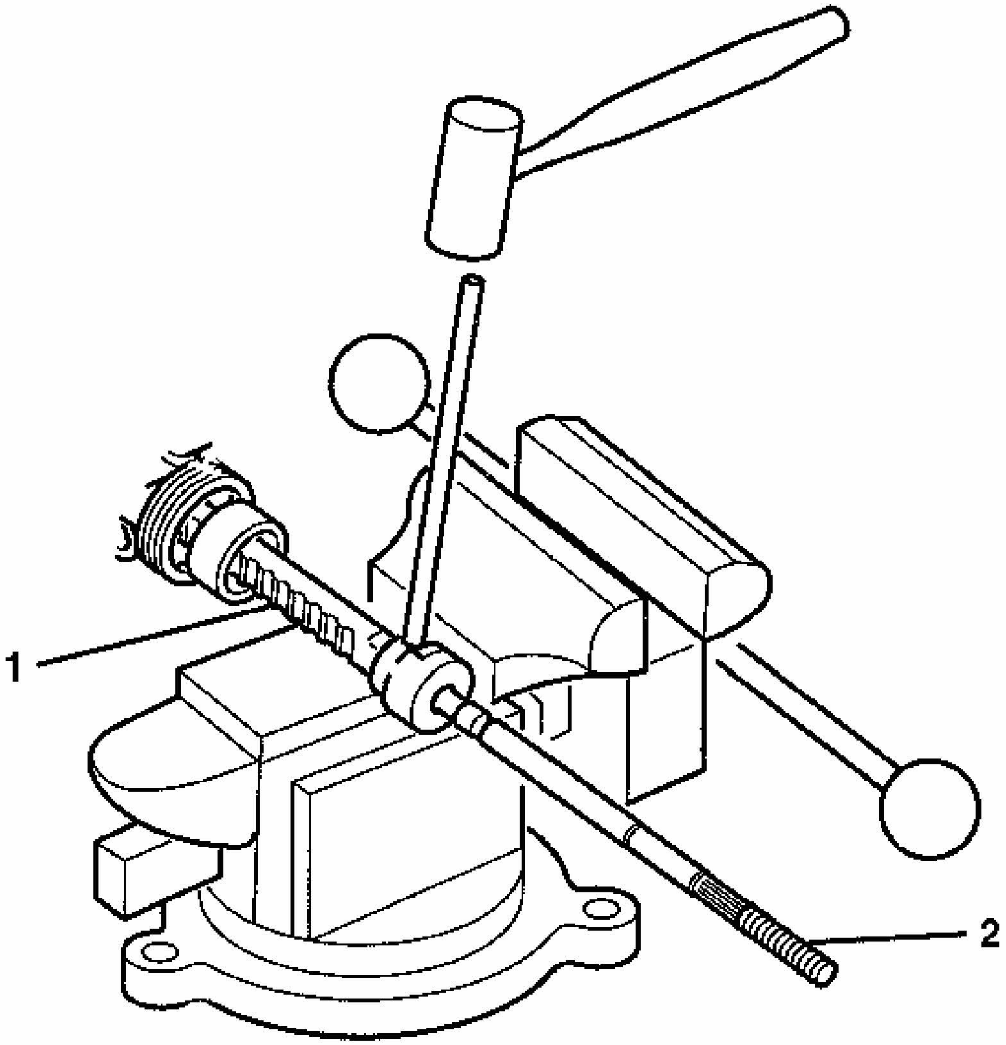


Fig. 69: Staking Both Sides Of Female Inner Tie Rod Assembly Housing To The Male Rack
Courtesy of GENERAL MOTORS CORP.

11. Place the inner tie rod assembly (2) in a vise.

IMPORTANT: If female rack (1) and male inner tie rod (2) do not stake. If male rack (1) and female inner tie rod (2) you must stake.

12. Stake both sides of the female inner tie rod assembly housing to the male rack.

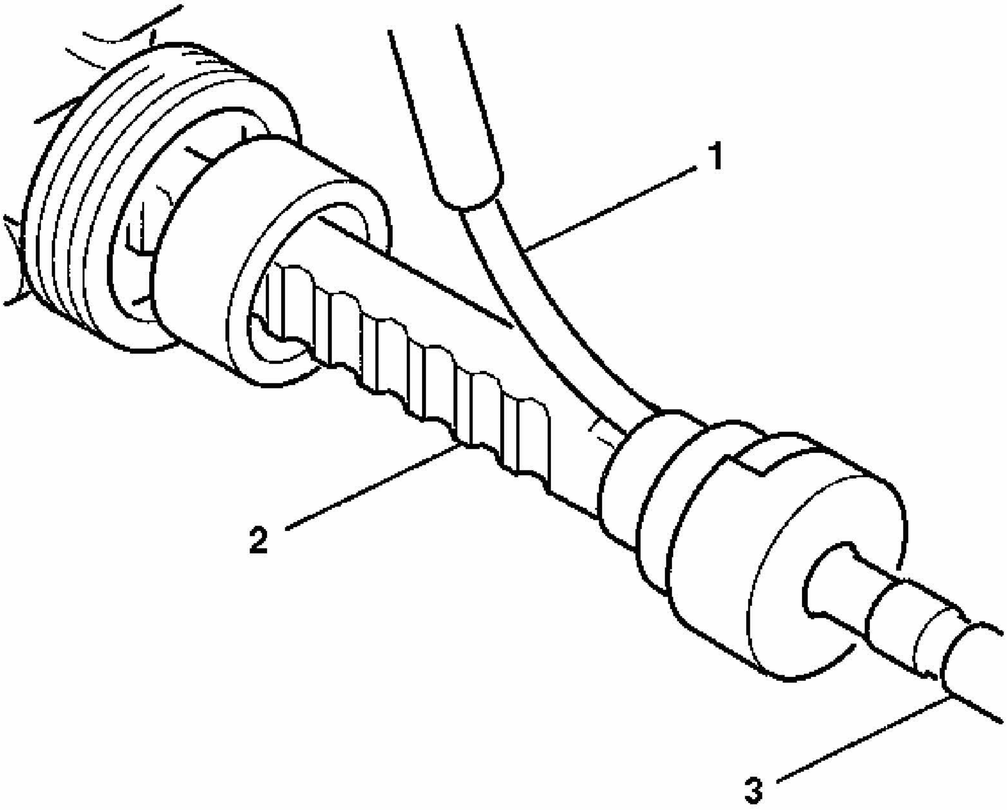


Fig. 70: Inserting Gage Between Rack & Inner Tie Rod Housing
Courtesy of GENERAL MOTORS CORP.

13. Insert a 0.25 mm gage (1) between the rack (2) and the inner tie rod housing in order to check both stakes. The feeler gage (1) must not pass between the rack and the housing stake.

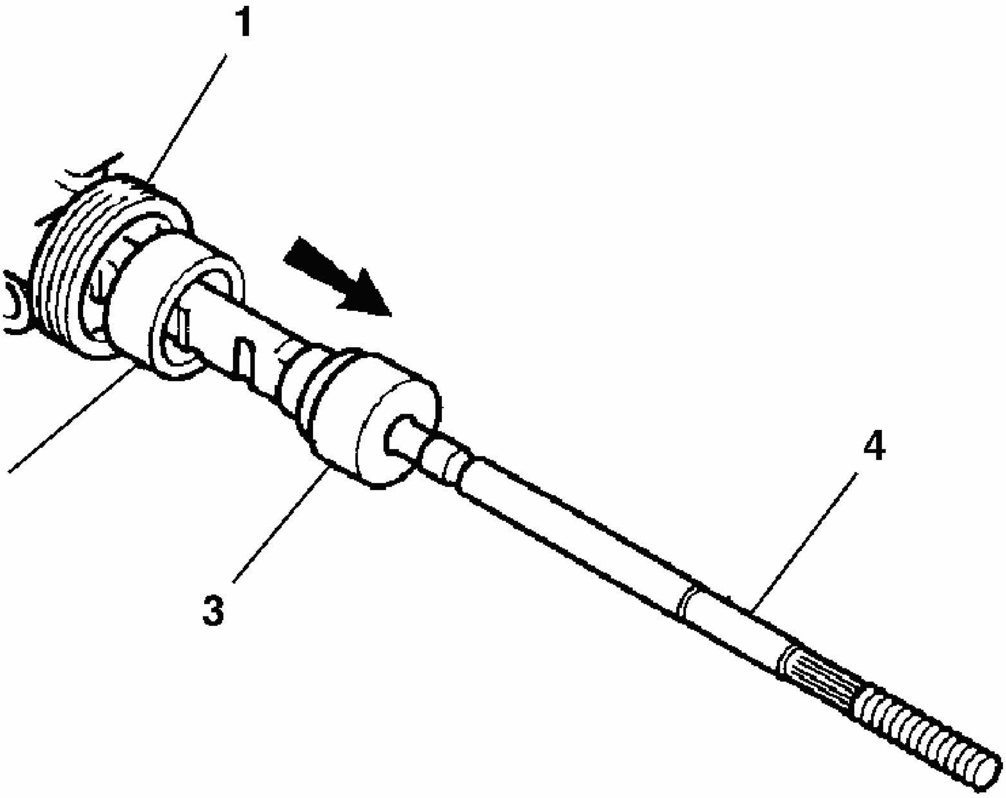


Fig. 71: Identifying Shock Dampener & Inner Tie Rod Housing
Courtesy of GENERAL MOTORS CORP.

14. Slide the shock dampener (2) over the inner tie rod housing (3) until the front lip of the shock dampener (2) bottoms against the inner tie rod housing (3).
15. To assemble the rack and pinion boot. Refer to **Rack and Pinion Boot and Breather Tube Replacement - Off Vehicle**.

STEERING GEAR CYLINDER PIPE ASSEMBLIES/O-RING SEALS REPLACEMENT - OFF VEHICLE

Removal Procedure

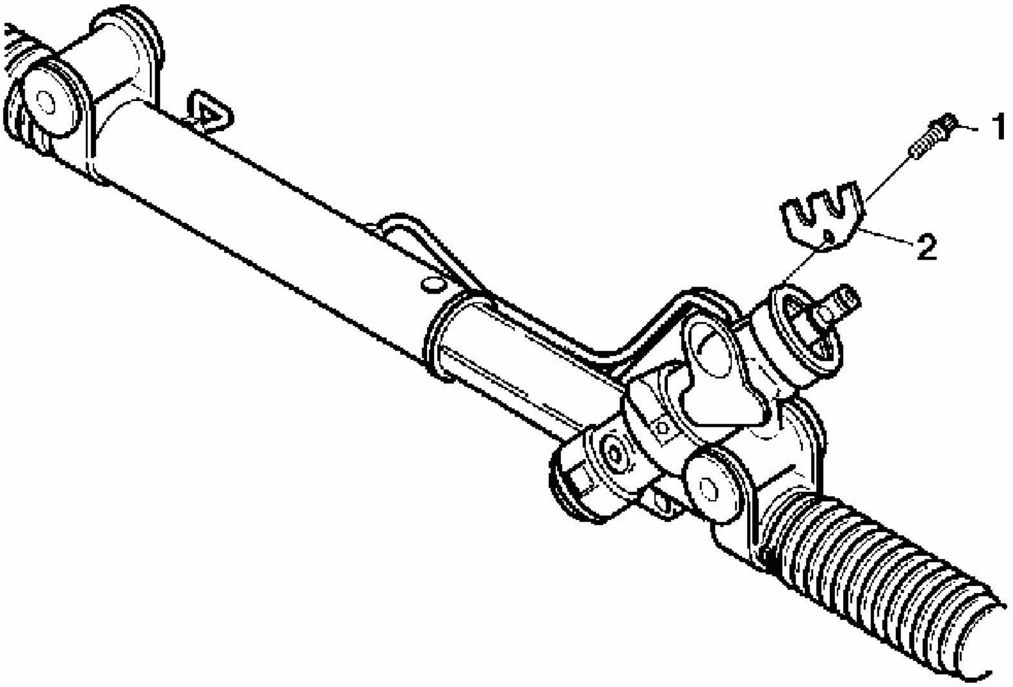


Fig. 72: Removing Cylinder Line Retaining Plate
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Protect the boots from sharp tools and from the sharp edges of surrounding components.

1. Remove the TORX® screw (1) from the cylinder line retaining plate (2) at the valve end.
2. Remove the cylinder line retaining plate (2).

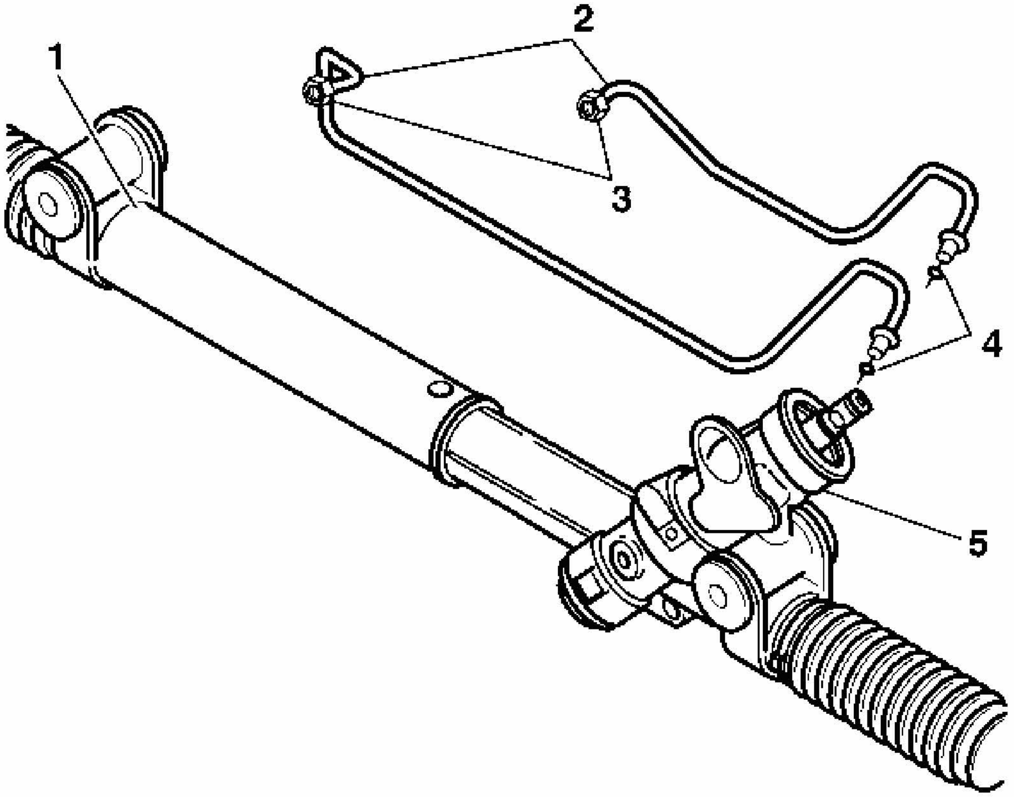


Fig. 73: Removing Both Cylinder Line Assemblies From Gear Assembly
Courtesy of GENERAL MOTORS CORP.

3. Loosen both cylinder line nuts (3) on cylinder end of the gear assembly (1).
4. Remove both cylinder line assemblies (2) from the rack and pinion gear assembly (1).
5. Remove and discard the O-rings seals (4) from the valve end (5).

Installation Procedure

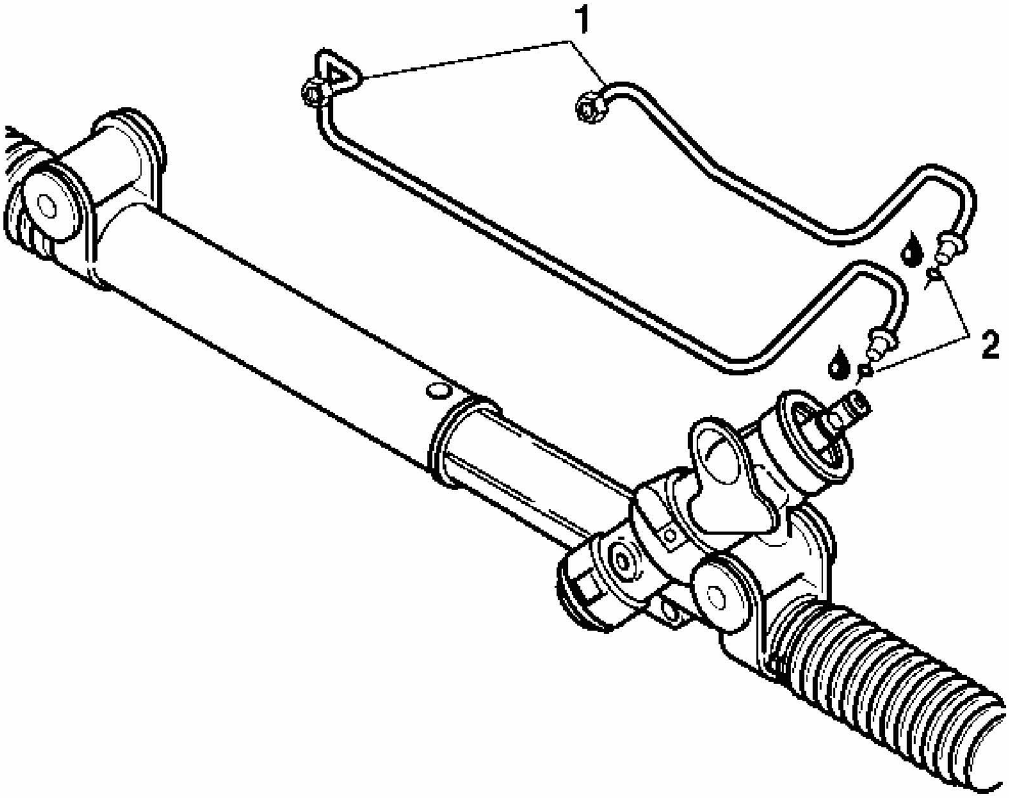


Fig. 74: Inspecting Cylinder Lines
Courtesy of GENERAL MOTORS CORP.

1. Inspect the cylinder lines (1) for the following items:
    - Cracks
    - Dents
    - Damage to the threads
2. Replace the parts as needed.
3. Lubricate and install the O-rings seals (2) onto the cylinder lines (1).

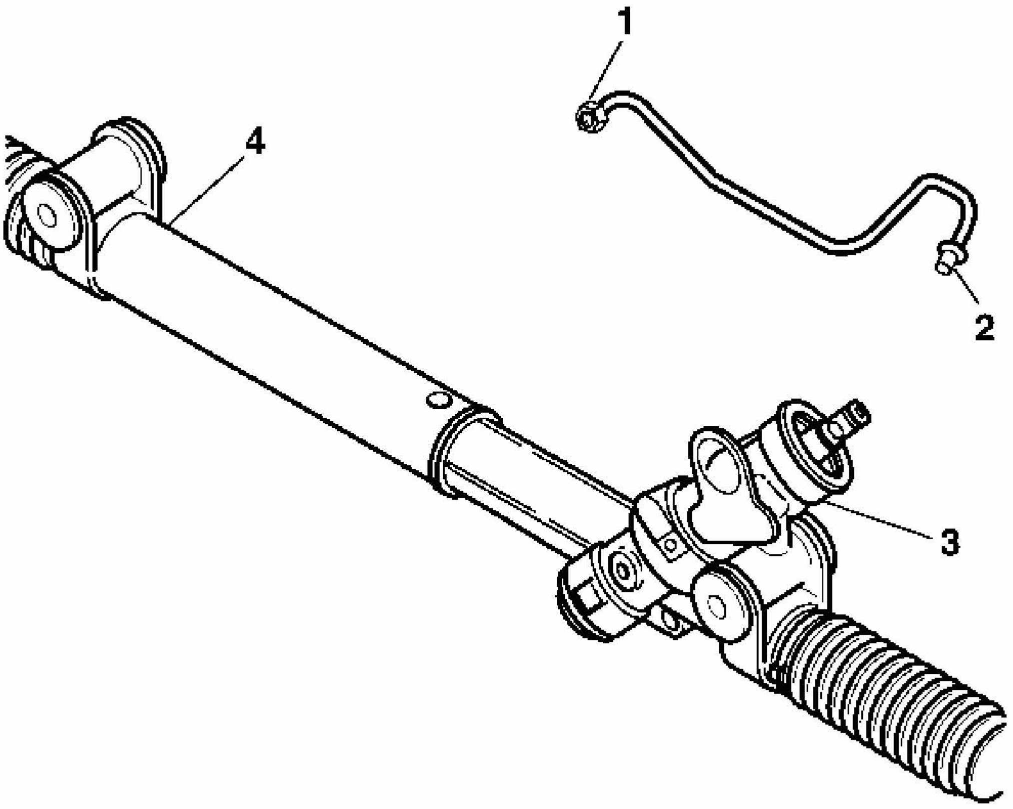


Fig. 75: Installing Smaller Cylinder Line Into Valve Housing
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: You must install the smaller cylinder line into the valve housing (3) first.

4. Place the smaller cylinder line (2) into the valve housing (3).

IMPORTANT: Hold the smaller cylinder line (2) in place. Do not torque the cylinder line nut (1).

5. Place the other end of the cylinder line at the gear tube end (4).

   Finger tighten the cylinder line nut (1) on the smaller cylinder line.

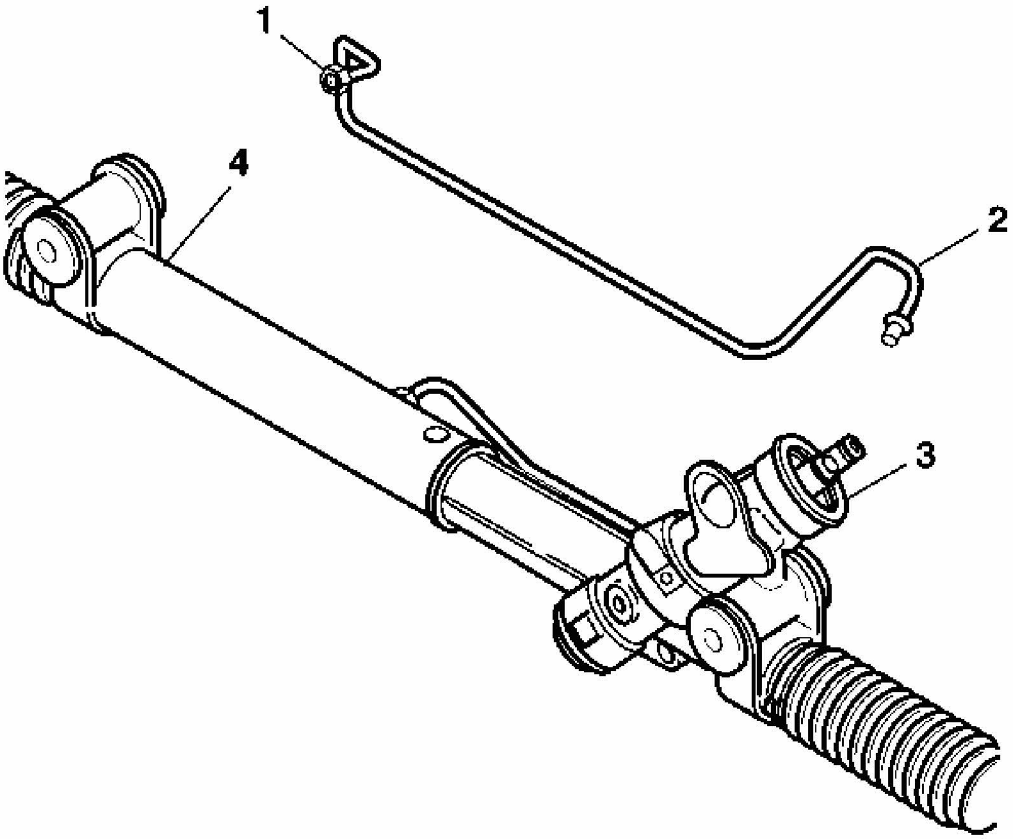


Fig. 76: Installing Larger Cylinder Line Into Valve Housing
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: You must install the larger cylinder line into the valve housing (3) first.

6. Place the larger cylinder line (2) into the valve housing (3).

IMPORTANT: Hold the larger cylinder line (2) in place. Do not torque the cylinder line nut (1).

7. Place the other end of the cylinder line at the gear tube end (4).

   Finger tighten the cylinder line nut (1) on the larger cylinder line.

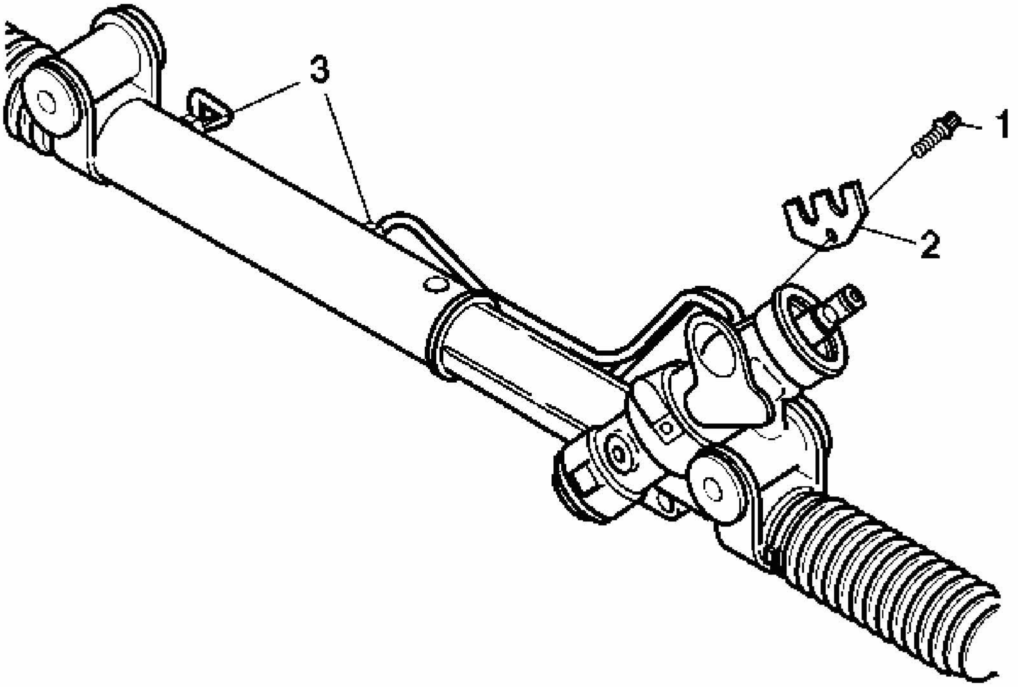


Fig. 77: Installing Cylinder Line Retaining Plate
Courtesy of GENERAL MOTORS CORP.

8. Place the cylinder line retaining plate (2) over the cylinder line beads at the valve end.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

9. Install the TORX® screw (1) into the cylinder line retaining plate (2) and tighten using an E 8 socket.

   Tighten: Tighten the screw to 15 N.m (12 lb ft).

10. Tighten both cylinder line nuts (3) at the cylinder end.

    Tighten: Tighten the nuts to 31 N.m (23 lb ft).

DESCRIPTION AND OPERATION

POWER STEERING SYSTEM DESCRIPTION AND OPERATION (W/O ELECTRO-HYDRAULIC STEERING)

The hydraulic power steering pump is a constant displacement vane-type pump that provides hydraulic pressure and flow for the power steering gear. The hydraulic power steering pumps are either belt-driven or direct-drive, cam-driven.

The power steering fluid reservoir holds the power steering fluid and may be integral with the power steering pump or remotely located. The following locations are typical locations for the remote reservoir:

- Mounted to the front of the dash panel
- Mounted to the inner fender
- Mounted to a bracket on the engine

The 2 basic types of power steering gears are listed below:

- A recirculating ball system
- A rack and pinion system

In the recirculating ball system, a worm gear converts steering wheel movement to movement of a sector shaft. A pitman arm attached to the bottom of the sector shaft actually moves one tie rod and an intermediate rod move the other tie rod.

In the rack and pinion system, the rack and the pinion are the 2 components that convert steering wheel rotation to lateral movement. The steering shaft is attached to the pinion in the steering gear. The pinion rotates with the steering wheel. Gear teeth on the pinion mesh with the gear teeth on the rack. The rotating pinion moves the rack from side to side. The lateral action of the rack pushes and pulls the tie rods in order to change the direction of the vehicle's front wheels.

The power steering pressure hose connects the power steering pump union fitting to the power steering gear and allows pressurized power steering fluid to flow from the pump to the gear.

The power steering return hose returns fluid from the power steering gear back to the power steering fluid reservoir. The power steering return line may contain an integral fin-type or line-type power steering fluid cooler.

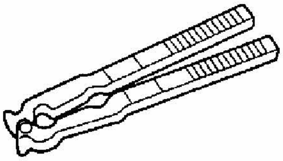
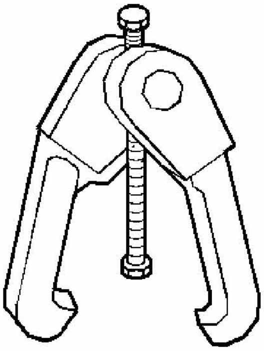
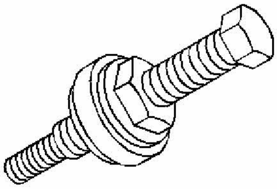
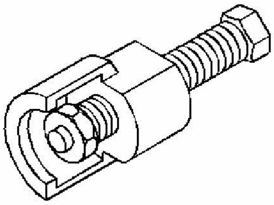
In a typical power steering system, a pump generates hydraulic pressure, causing fluid to flow, via the pressure hose, to the steering gear valve assembly. The steering gear valve assembly regulates the incoming fluid to the right and left chambers in order to assist in right and left turns.

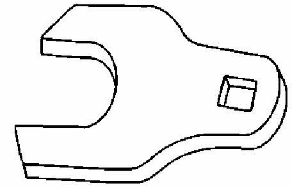
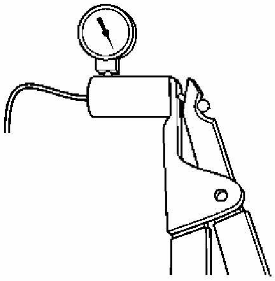
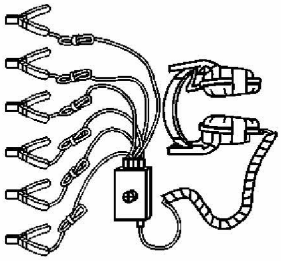
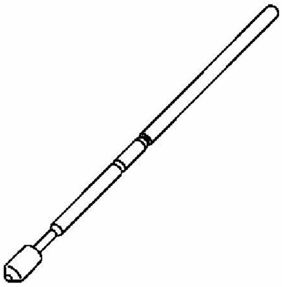
Turning the steering wheel activates the valve assembly, which applies greater fluid pressure and flow to 1 side of the steering gear piston, and lower pressure and flow to the other side of the piston. The pressure assists the movement of the gear piston. Tie rods transfer this force to the front wheels, which turn the vehicle right or left.

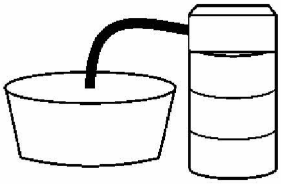
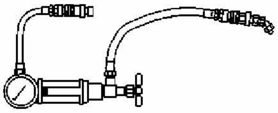
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description
	J 22610 Keystone Clamp Pliers
	J 24319-B Steering Linkage and Tie Rod Puller
	J 25033-C Pulley Installer
	J 25034-C Pulley Remover

	J 34028 Inner Tie Rod Wrench
	J 35555 Metal Mity Vac
	J 39570 Chassis Ear
	J 42640 Steering Column Anti-rotation Pin
	J 43485 Power Steering Bleeder Adapter

	
	J 44721 Power Steering Analyzer

2006 SUSPENSION

Rear Suspension - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Hose Bracket Bolt	10 N.m	89 lb in
Rear Strut Mount to Body Nuts	45 N.m	33 lb ft
Rear Strut Rod to Strut Mount Nut	75 N.m	55 lb in
Rear Strut to Knuckle Nuts	120 N.m	89 lb ft
Rear Suspension Support Mounting Bolts	110 N.m	81 lb ft
Rear Wheel Hub/Bearing to Knuckle Bolts	75 N.m	55 lb ft
Spindle Rods to Knuckle Nuts	150 N.m	111 lb ft
Spindle Rod to Rear Support Bolts	135 N.m	100 lb ft
Stabilizer Shaft Bracket Nuts	48 N.m	35 lb ft
Stabilizer Shaft Link Nuts (Lower)	50 N.m	37 lb ft
Stabilizer Shaft Link Nuts (Upper)	52 N.m	38 lb ft
Trailing Arm to Body Bracket Bolt	105 N.m	77 lb ft
Trailing Arm Bracket to Body Bolts	52 N.m	38 lb ft
Trailing Arm to Knuckle Bolt	240 N.m	177 lb ft

REPAIR INSTRUCTIONS

REAR WHEEL BEARING/HUB REPLACEMENT

Removal Procedure

IMPORTANT: The wheel bearing in the rear wheel hub is integrated into one unit. The hub is non-serviceable. If the hub and/or bearing is damaged, replace the complete hub and bearing assembly.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tires and wheels. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Remove the brake rotor. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.

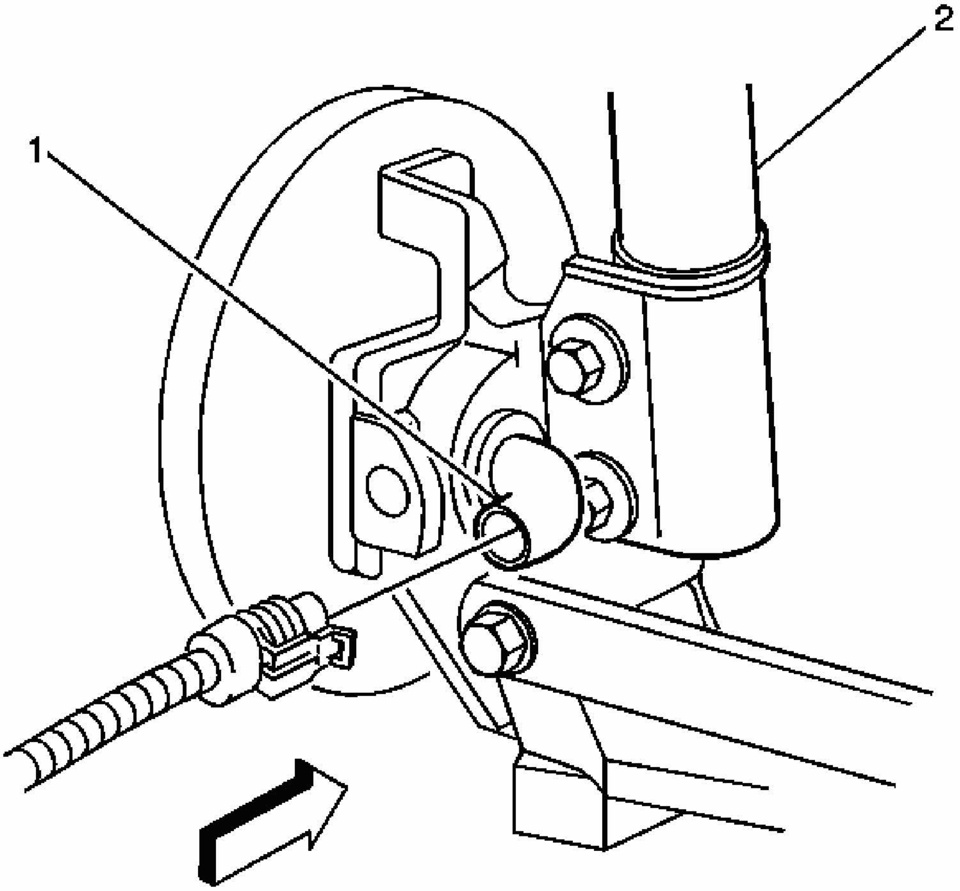


Fig. 1: Rear Wheel Speed Sensors Component View
Courtesy of GENERAL MOTORS CORP.

4. Remove the ABS electrical connector from the wheel speed sensor (1), if equipped.
5. Remove the park brake cable from the park brake actuator. Refer to **Park Brake Cable Replacement - Rear (Z7U)** in Park Brake.
6. Remove the mounting bolts from the rear bearing/hub.

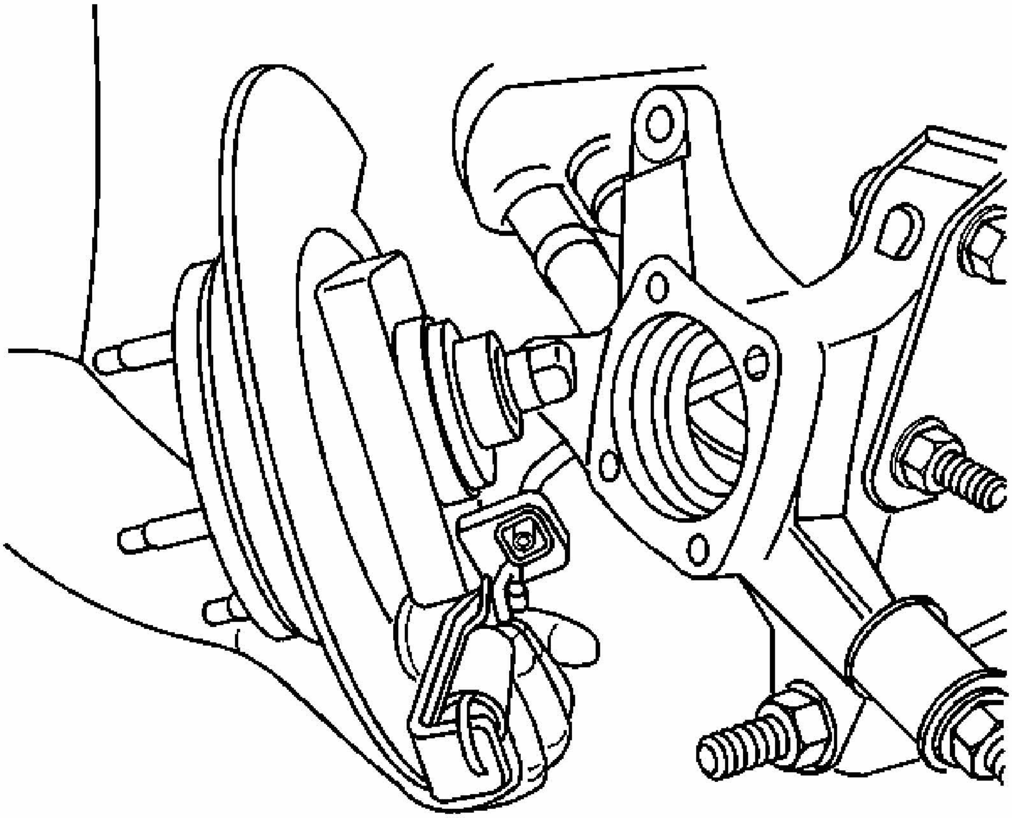


Fig. 2: Removing And Installing Park Brake Actuator
Courtesy of GENERAL MOTORS CORP.

7. Remove the wheel bearing/hub and park brake assembly from the knuckle.
8. Remove the park brake actuator from the rear wheel bearing/hub. Refer to **Park Brake Actuator Replacement** in Park Brake.

Installation Procedure

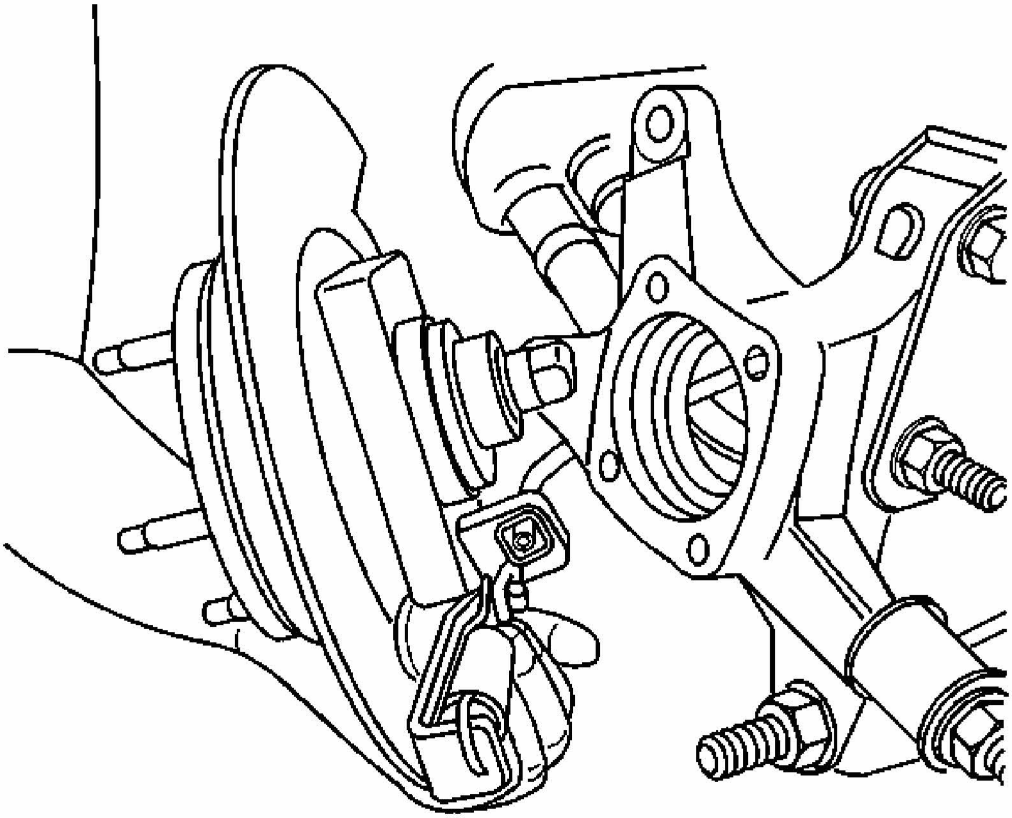


Fig. 3: Removing And Installing Park Brake Actuator
Courtesy of GENERAL MOTORS CORP.

1. Install the park brake actuator to the rear wheel bearing/hub. Refer to **Park Brake Actuator Replacement** in Park Brake.
2. Install the wheel bearing/hub and park brake assembly to the knuckle.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

3. Install the wheel bearing/hub-to-knuckle bolts.

   Tighten: Tighten the bolts to 75 N.m (55 lb ft).

4. Install the park brake cable to the park brake actuator. Refer to **Park Brake Cable Replacement - Rear (Z7U)** in Park Brake.

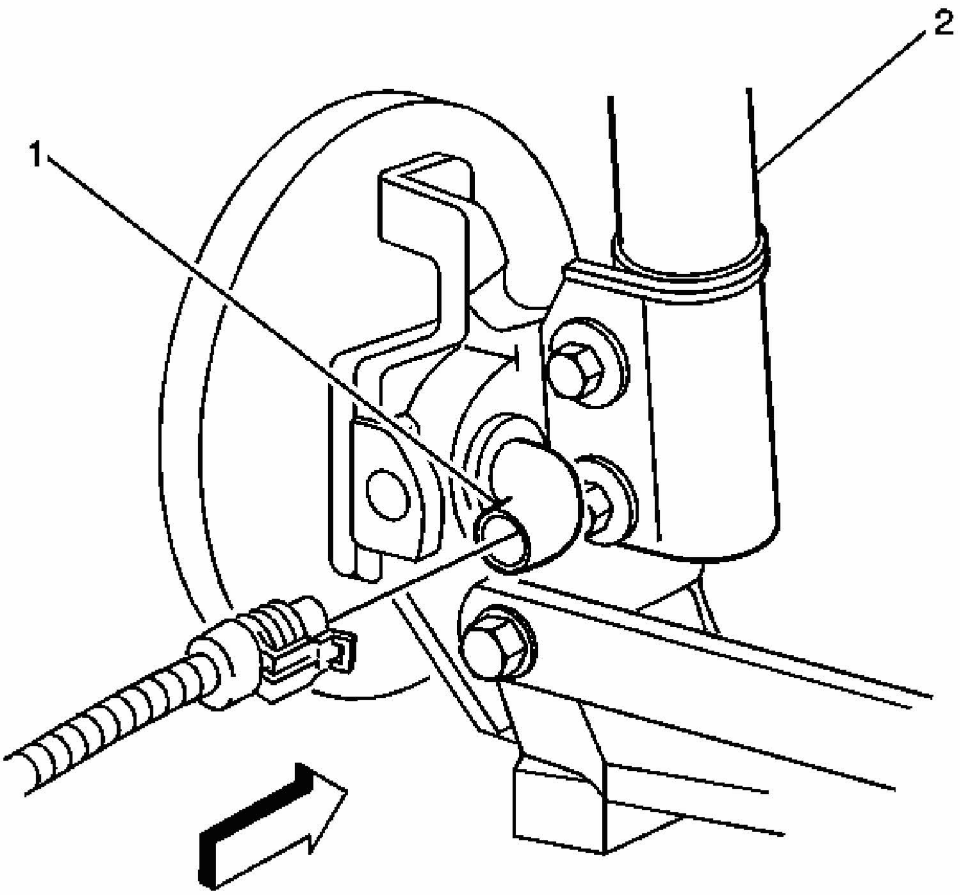


Fig. 4: Rear Wheel Speed Sensors Component View
Courtesy of GENERAL MOTORS CORP.

5. Install the ABS electrical connector to the wheel speed sensor (1), if equipped.
6. Install the brake rotor. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
7. Install the tires and wheels. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
8. Lower the vehicle.

SUPPORT REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

2. Remove the rear tires and wheels. Refer to **Tire and Wheel Removal and Installation** .
3. Remove the exhaust pipe. Refer to **Muffler Replacement (Single Outlet)** or **Muffler Replacement (Dual Outlet)** .
4. Disconnect the brake lines from the rear suspension support. Refer to **Brake Hose Replacement - Rear** .
5. Disconnect the parking brake cables and tensioner from the suspension support. Refer to **Park Brake Cable Replacement - Rear (Z7U)** .
6. Remove the stabilizer shaft from the rear suspension support. Refer to **Stabilizer Shaft Replacement**.

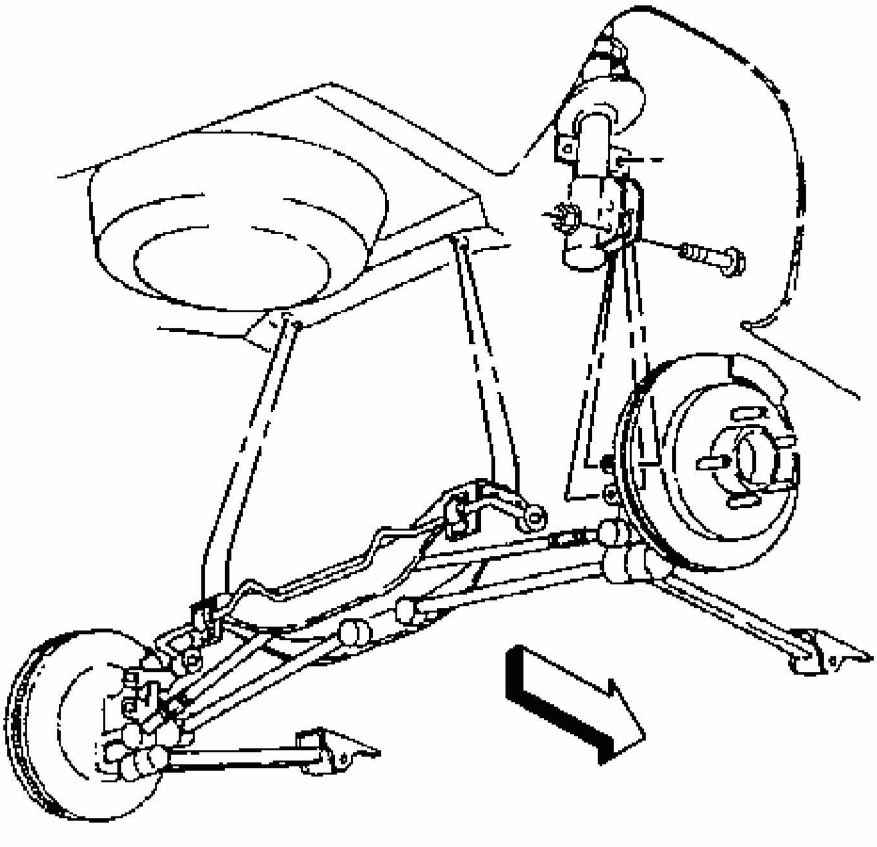


Fig. 5: Rear Suspension Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Support the rear suspension support with jack stands before removing the mounting bolts.

7. Remove the rear suspension support mounting bolts.
8. Remove the rear wheel spindle rods bolts from the knuckle.
9. Lower the rear suspension support in order to gain access to the rear wheel spindle rod bolts.
10. Remove the rear wheel spindle rods bolts from the rear suspension support.
11. Remove the rear suspension support.

Installation Procedure

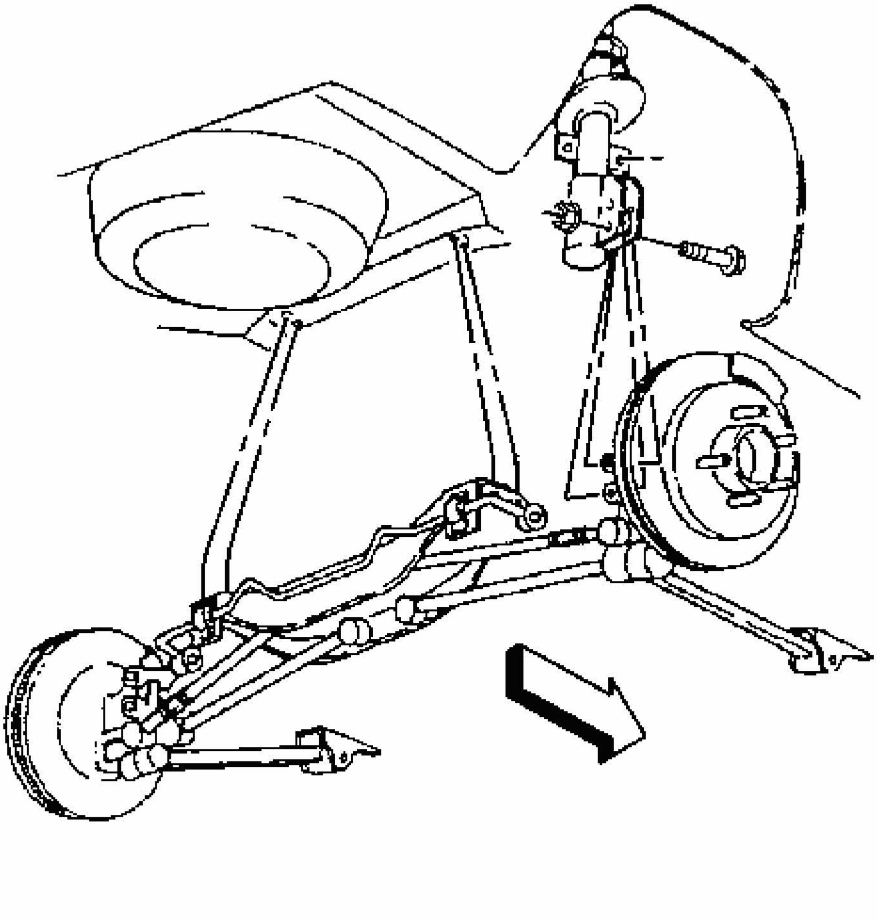


Fig. 6: Rear Suspension Components
Courtesy of GENERAL MOTORS CORP.

1. Position the rear suspension support in place.

NOTE: **Refer to Fastener Notice .**

2. Install the rear wheel spindle rod-to-rear suspension support bolts and nuts.

   Tighten: Tighten the nuts to 135 N.m (100 lb ft).

3. Install the rear suspension support mounting bolts.

   Tighten: Tighten the bolts to 110 N.m (81 lb ft).

4. Position the rear wheel spindle rod to the knuckle.
5. Install the retaining bolts and nuts to the knuckle.

   Tighten: Tighten the nut to 150 N.m (111 lb ft).

6. Install the stabilizer shaft to the rear suspension support. Refer to **Stabilizer Shaft Replacement**.
7. Connect the brake lines to the rear suspension support. Refer to **Brake Hose Replacement - Rear** .
8. Install the parking brake cables and the tensioner. Refer to **Park Brake Cable Replacement - Rear (Z7U)** .
9. Install the exhaust pipe. Refer to **Muffler Replacement (Single Outlet)** or **Muffler Replacement (Dual Outlet)** .
10. Install the tires and wheels. Refer to **Tire and Wheel Removal and Installation** .
11. Lower the vehicle.
12. Adjust the rear wheel alignment. Refer to **Measuring Wheel Alignment** .

KNUCKLE REPLACEMENT

Removal Procedure

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

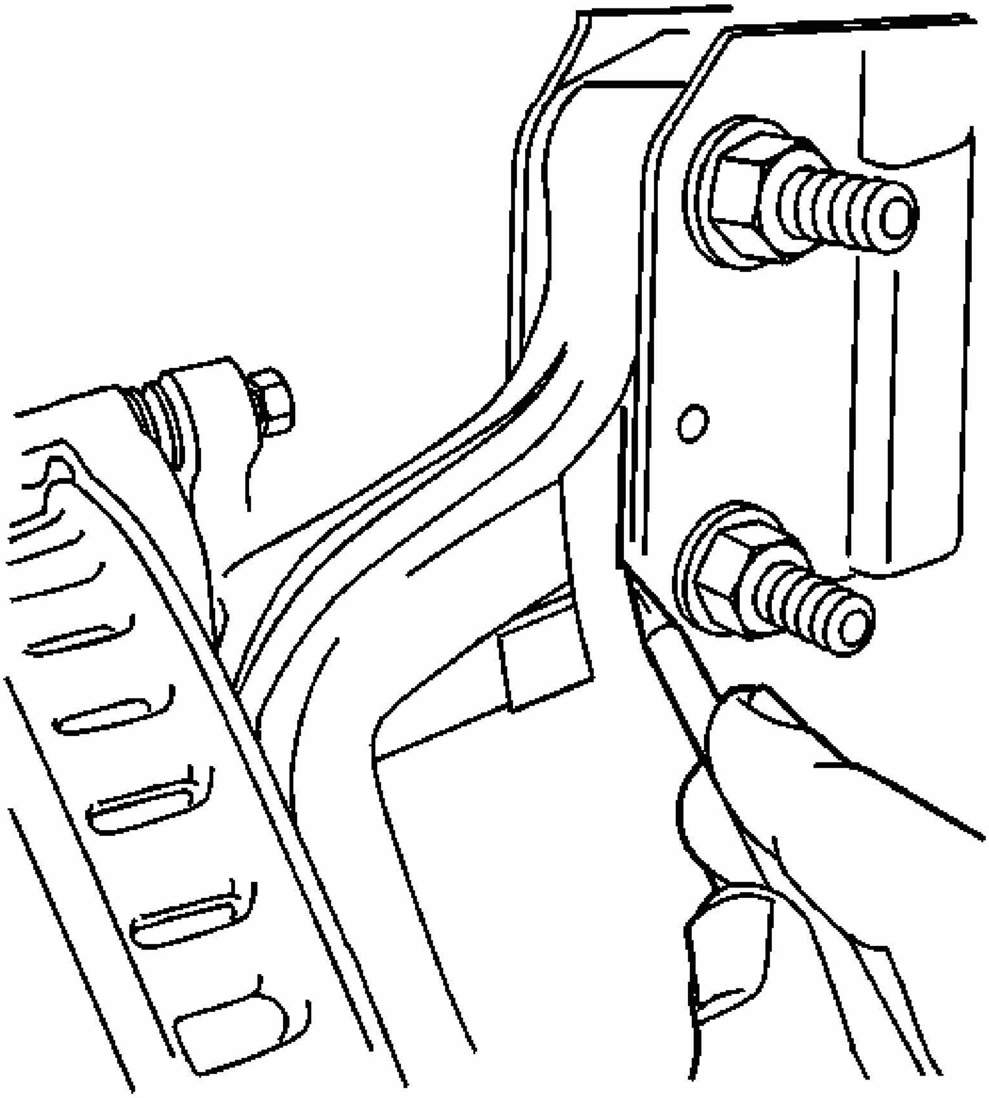


Fig. 7: Scribing Strut To Knuckle
Courtesy of GENERAL MOTORS CORP.

3. Scribe the strut to the knuckle.
4. Remove the bearing/hub assembly. Refer to **Wheel Bearing/Hub Replacement - Rear**.
5. Remove the rear wheel spindle rods from the knuckle. Refer to **Spindle Rod Replacement**.

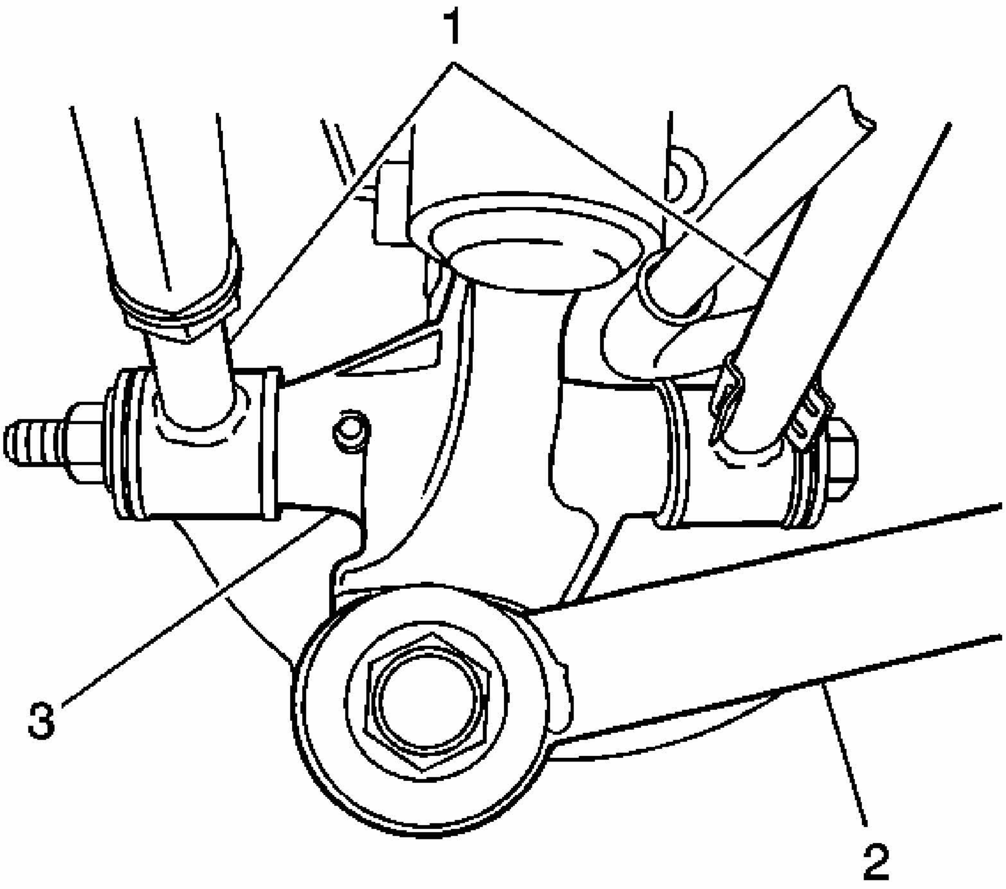


Fig. 8: View Of Trailing Arm & Knuckle
Courtesy of GENERAL MOTORS CORP.

6. Remove the trailing arm (2) from the knuckle (3). Refer to **Trailing Arm Replacement**.

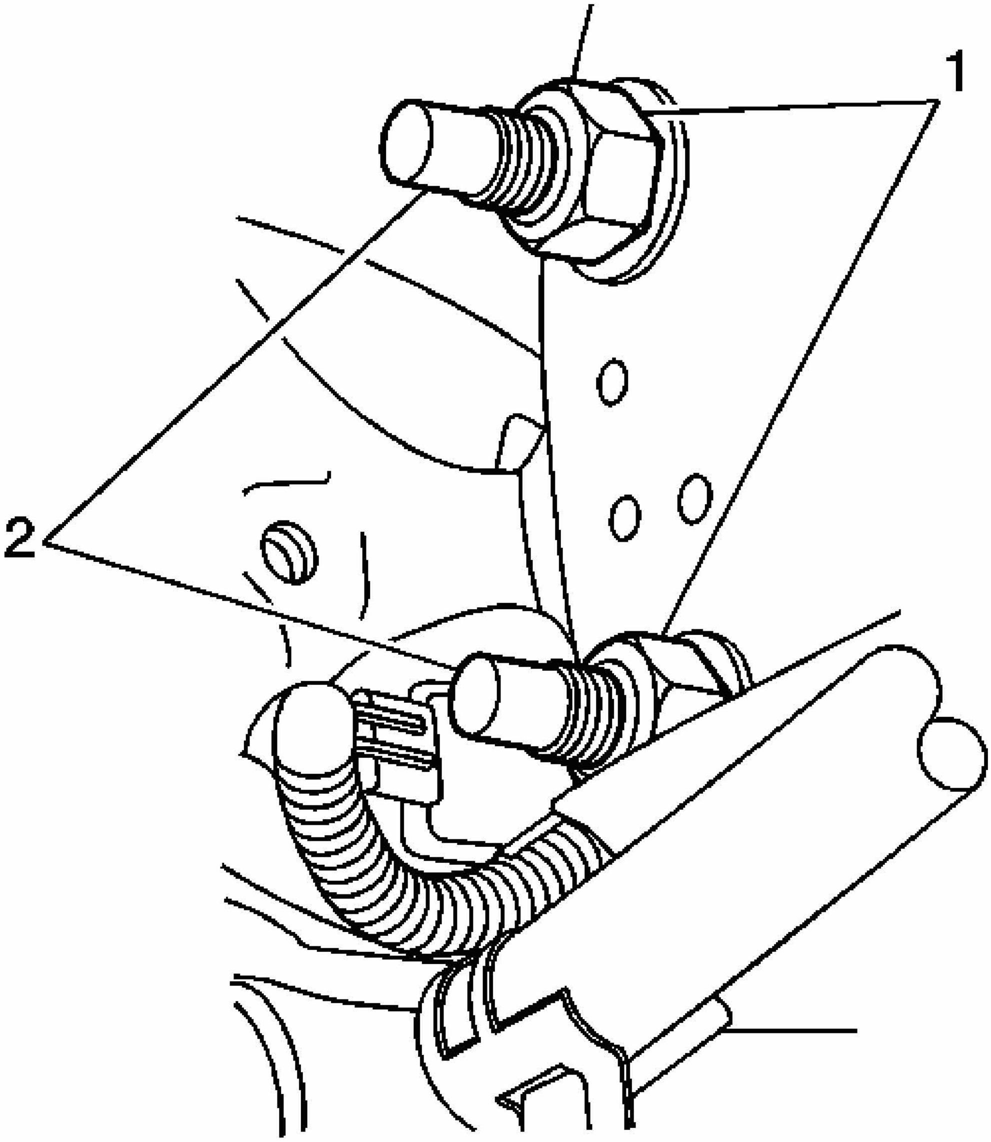


Fig. 9: Rear Strut To Knuckle
Courtesy of GENERAL MOTORS CORP.

7. Remove the rear strut to knuckle bolts (2) and the nuts (1). Refer to **Strut Assembly Replacement**.
8. Remove the knuckle (5) from the vehicle.

Installation Procedure

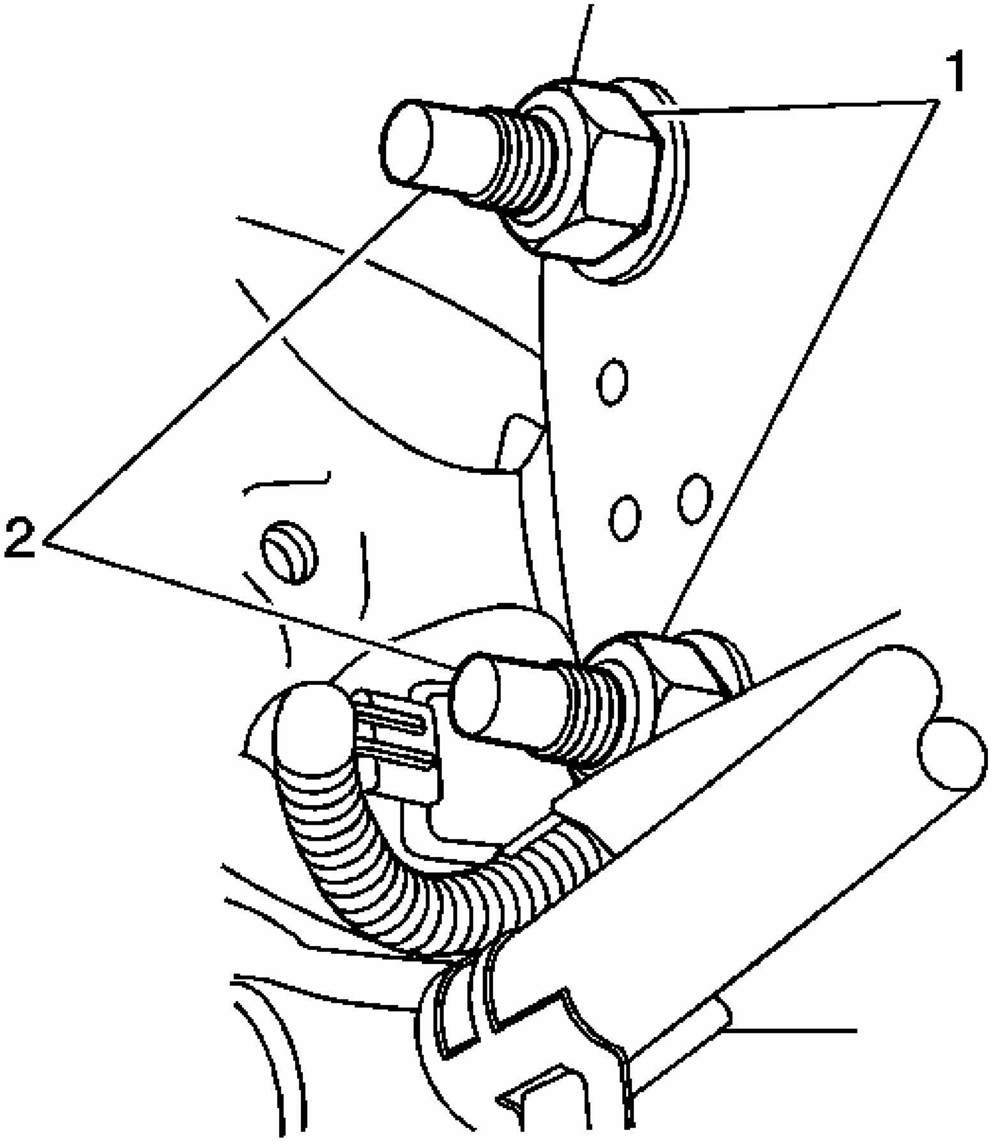


Fig. 10: Rear Strut To Knuckle
Courtesy of GENERAL MOTORS CORP.

1. Install the knuckle to the vehicle.
2. Hand start the strut to knuckle bolts (2) and nuts (1). Do not tighten the nuts at this time.

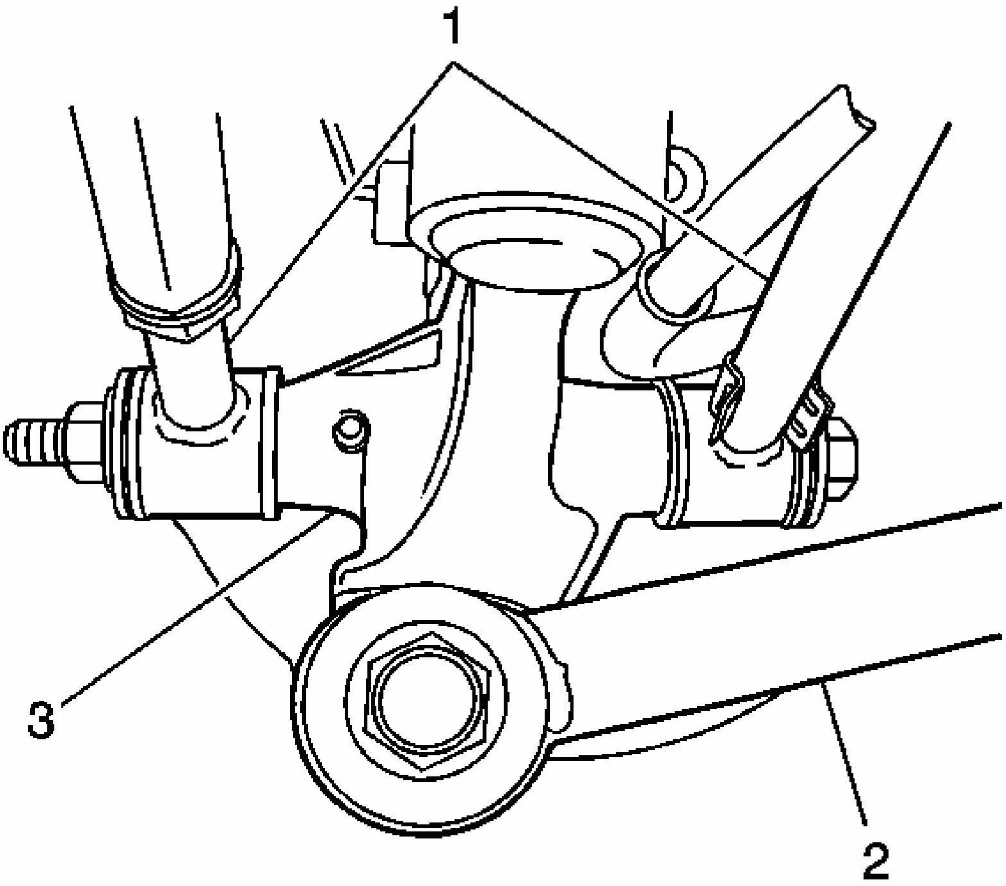


Fig. 11: View Of Trailing Arm & Knuckle
Courtesy of GENERAL MOTORS CORP.

3. Connect the rear suspension trailing arm (2) to the knuckle (3). Refer to **Trailing Arm Replacement**.

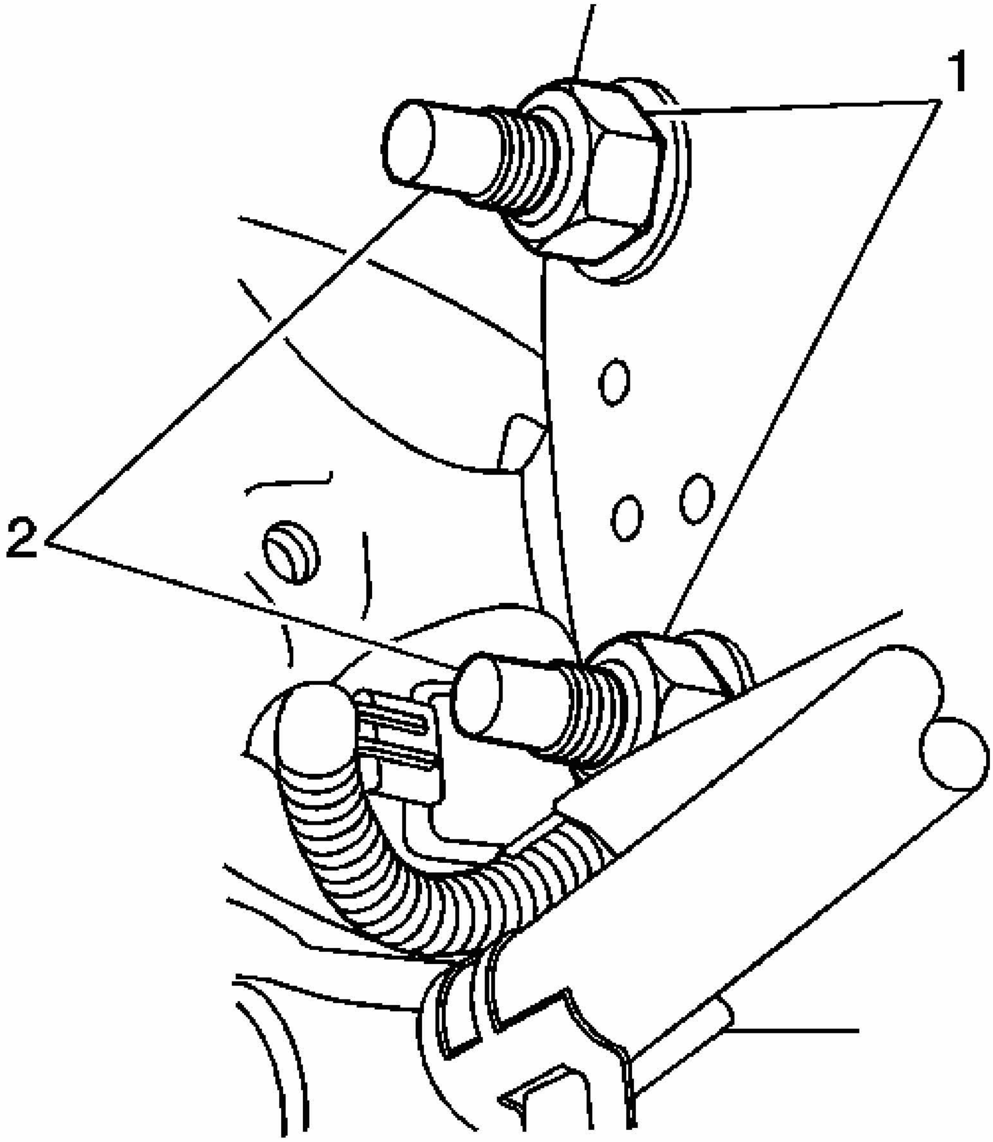


Fig. 12: Rear Strut To Knuckle
Courtesy of GENERAL MOTORS CORP.

4. Connect the rear wheel spindle rods to the knuckle. Refer to **Spindle Rod Replacement**.
5. Install the bearing/hub assembly. Refer to **Wheel Bearing/Hub Replacement - Rear**.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

6. Tighten the strut to knuckle bolts (2) and nuts (1).

   Tighten: Tighten bolts to 120 N.m (89 lb ft).

7. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
8. Lower the vehicle.
9. Inspect the rear wheel alignment, adjust if necessary. Refer to **Measuring Wheel Alignment** in Wheel Alignment.

STABILIZER SHAFT REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tires and wheels. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

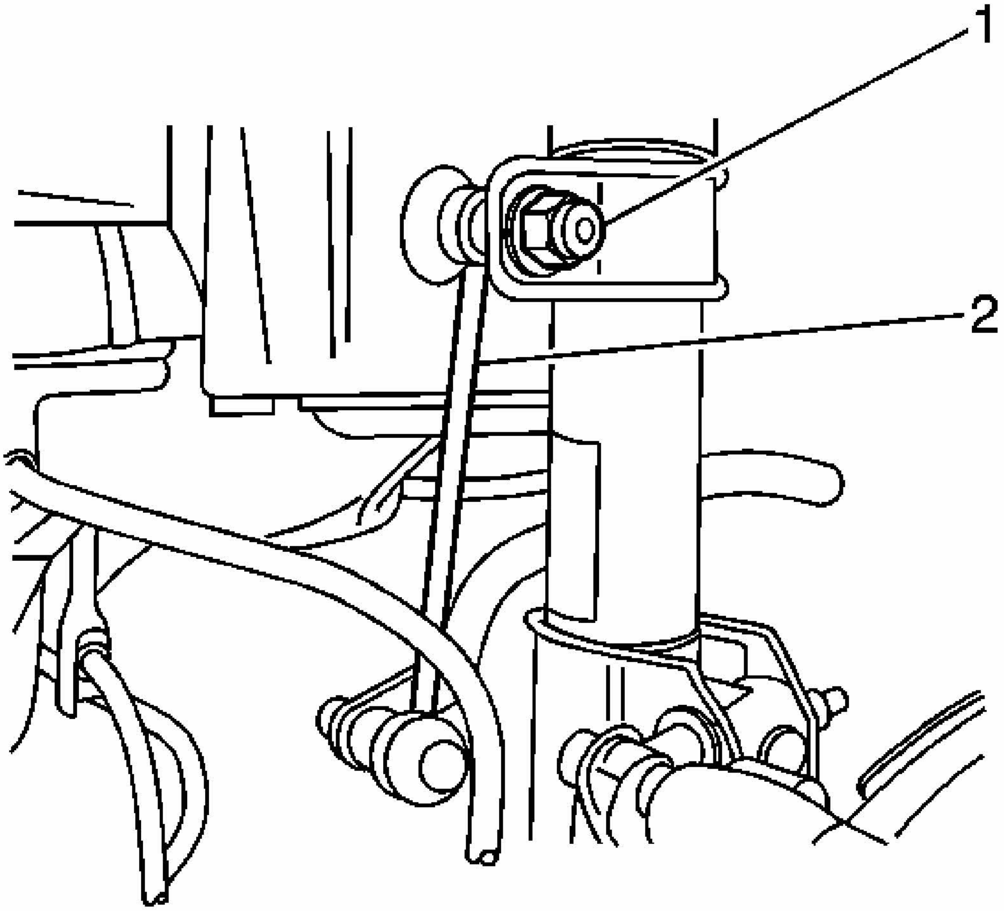


Fig. 13: View Of Stabilizer Shaft Link
Courtesy of GENERAL MOTORS CORP.

3. Remove the left and right stabilizer shaft link nuts from the stabilizer shaft links (1).

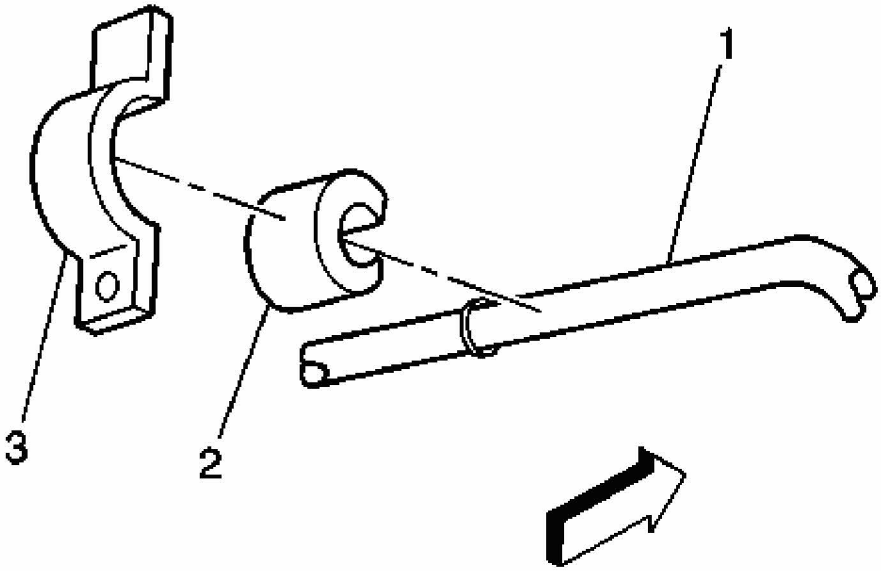


Fig. 14: Stabilizer Shaft, Insulator, & Insulator Bracket
Courtesy of GENERAL MOTORS CORP.

4. Remove the insulator brackets (3) and the bolts from the stabilizer shaft (1).
5. Remove the stabilizer shaft (1) from the rear suspension support.

Installation Procedure

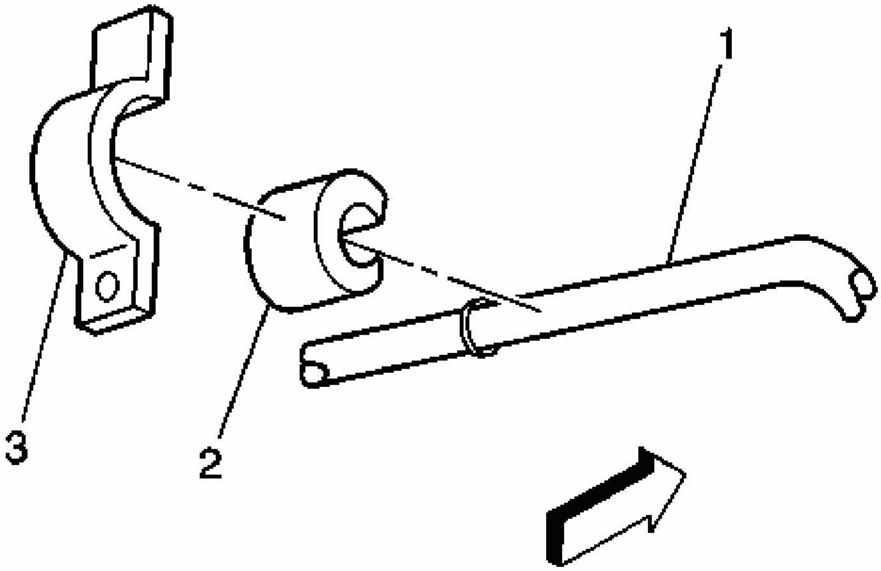


Fig. 15: Stabilizer Shaft, Insulator, & Insulator Bracket
Courtesy of GENERAL MOTORS CORP.

1. Install the stabilizer shaft (1) to the rear suspension support.
2. Install the stabilizer shaft insulator brackets (3) and hand tighten the bolts. Do not tighten the bolts at this time.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

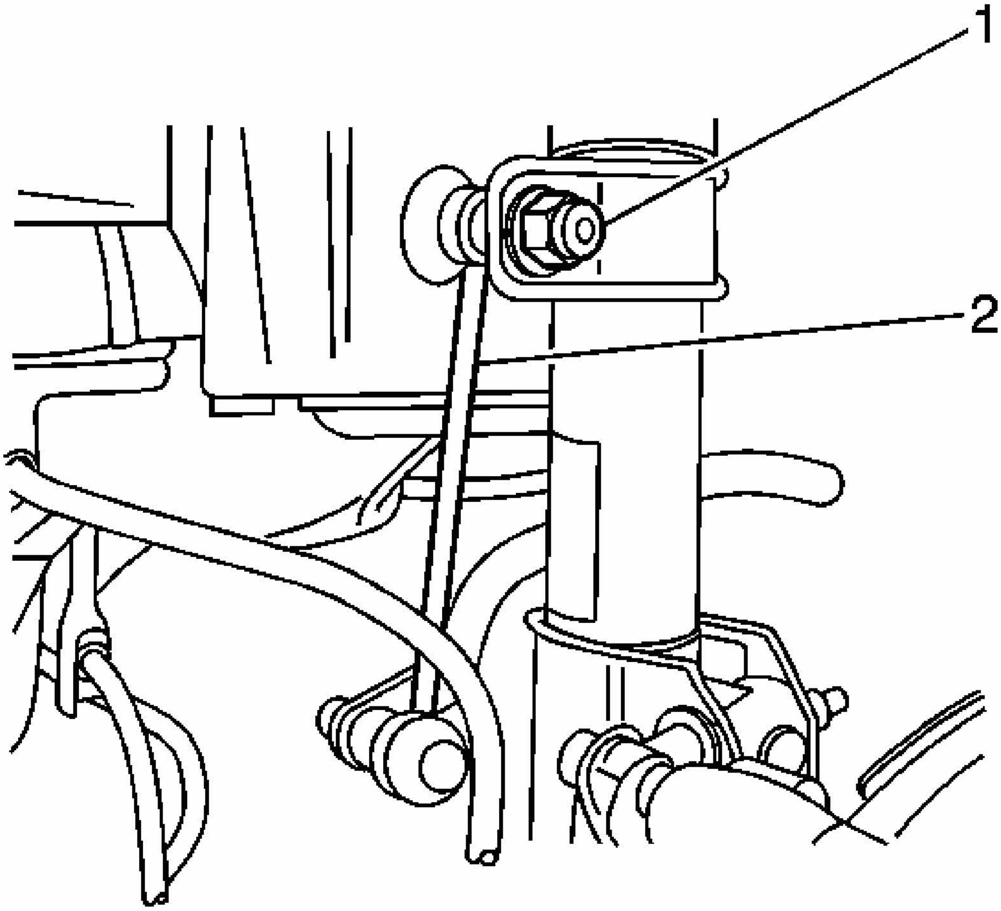


Fig. 16: View Of Stabilizer Shaft Link
Courtesy of GENERAL MOTORS CORP.

3. Install the right and left stabilizer shaft link nuts to the stabilizer shaft links (1).

   Tighten:

   - Tighten the stabilizer shaft link nuts to 52 N.m (38 lb ft).
   - Tighten the stabilizer shaft insulator bracket nuts to 48 N.m (35 lb ft).

4. Install the tires and wheels. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
5. Lower the vehicle.

STABILIZER SHAFT INSULATOR REPLACEMENT

Removal Procedure

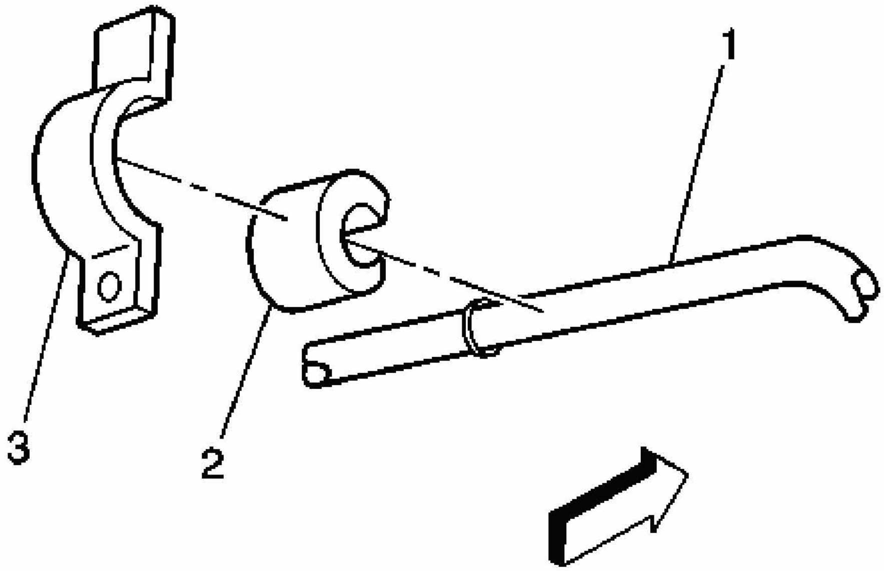


Fig. 17: Stabilizer Shaft, Insulator, & Insulator Bracket
Courtesy of GENERAL MOTORS CORP.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the bolt from the stabilizer shaft insulator bracket (3).
3. Remove the stabilizer shaft insulator bracket.
4. Remove the stabilizer shaft insulator (2) from the stabilizer shaft.

Installation Procedure

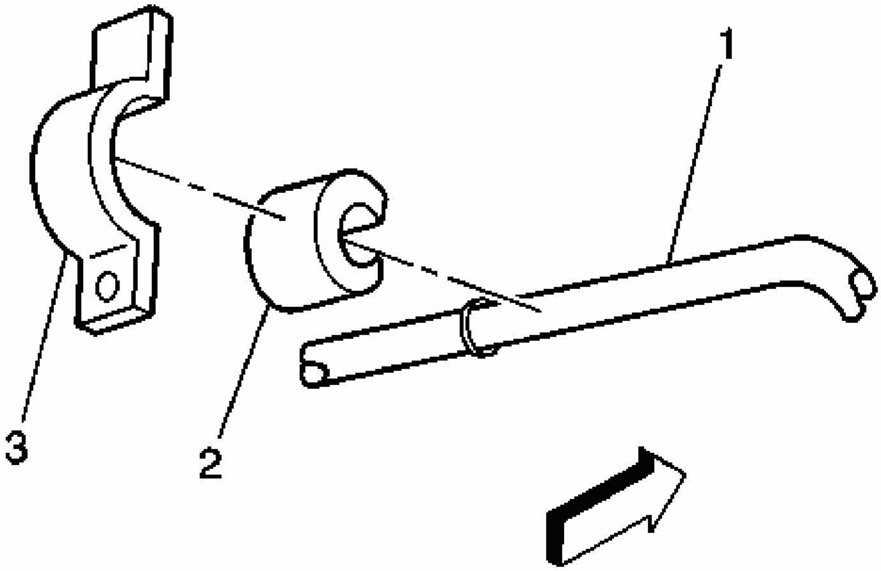


Fig. 18: Stabilizer Shaft, Insulator, & Insulator Bracket
Courtesy of GENERAL MOTORS CORP.

1. Install the stabilizer shaft insulator (2) to the stabilizer shaft.
2. Install the stabilizer shaft insulator bracket (3).

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

3. Install the stabilizer shaft bracket nuts.

   Tighten: Tighten the bolts to 48 N.m (35 lb ft).

4. Lower the vehicle.

STABILIZER SHAFT LINK REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

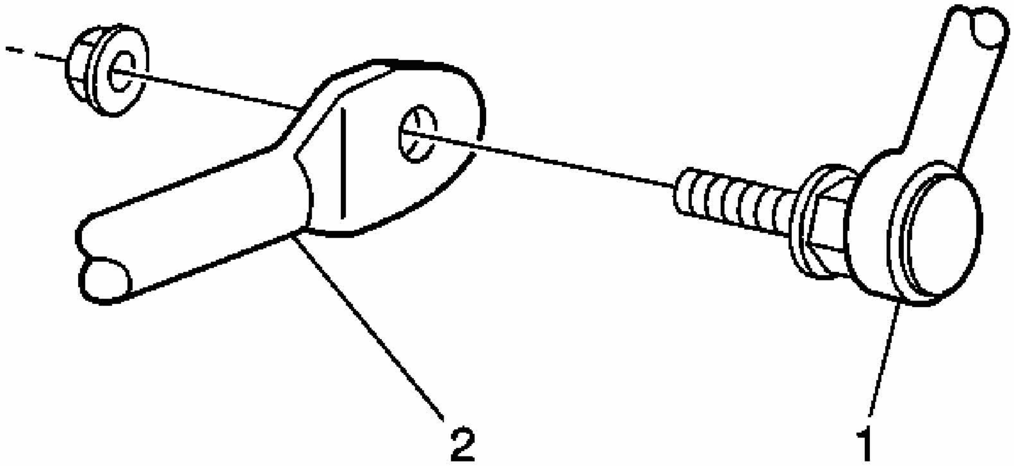


Fig. 19: View Of Stabilizer Shaft And Link
Courtesy of GENERAL MOTORS CORP.

2. Remove the stabilizer shaft link nut from the stabilizer shaft link (1) and the stabilizer shaft (2).

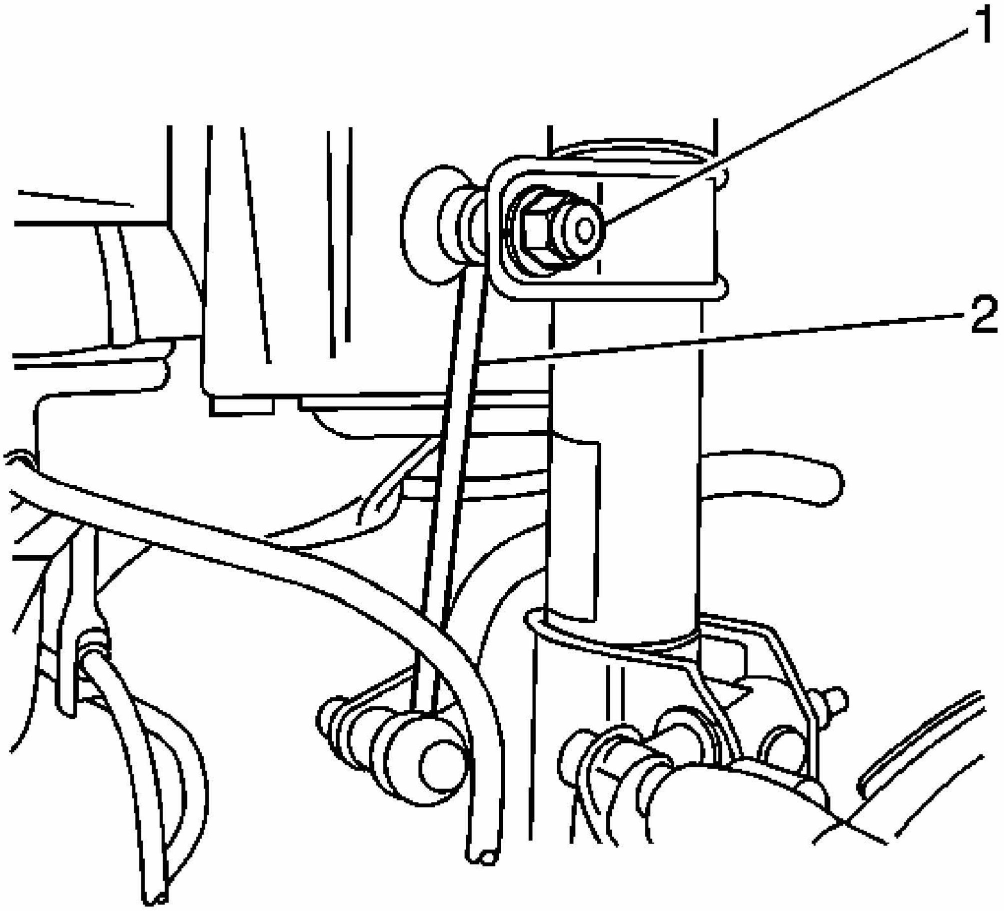


Fig. 20: View Of Stabilizer Shaft Link
Courtesy of GENERAL MOTORS CORP.

3. Remove the stabilizer shaft link nut from the stabilizer shaft link (1) and the strut.
4. Remove the stabilizer shaft link (1) from the vehicle.

Installation Procedure

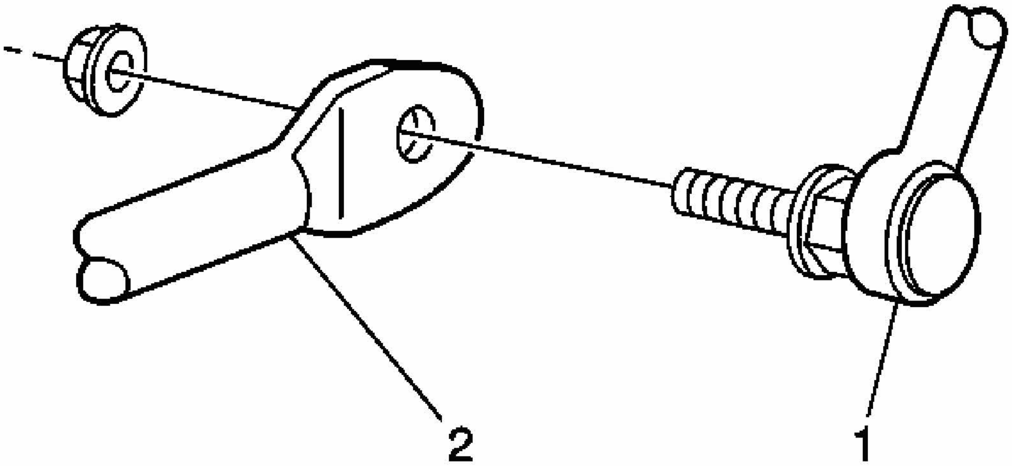


Fig. 21: View Of Stabilizer Shaft And Link
Courtesy of GENERAL MOTORS CORP.

1. Install the stabilizer shaft link (1) to the vehicle.
2. Connect the stabilizer shaft link (1) to the stabilizer shaft (2).

NOTE: **Refer to Fastener Notice .**

3. Install the lower stabilizer shaft link nut to the stabilizer shaft link (1) and the stabilizer shaft (2).

   Tighten: Tighten the nut to 50 N.m (37 lb ft).

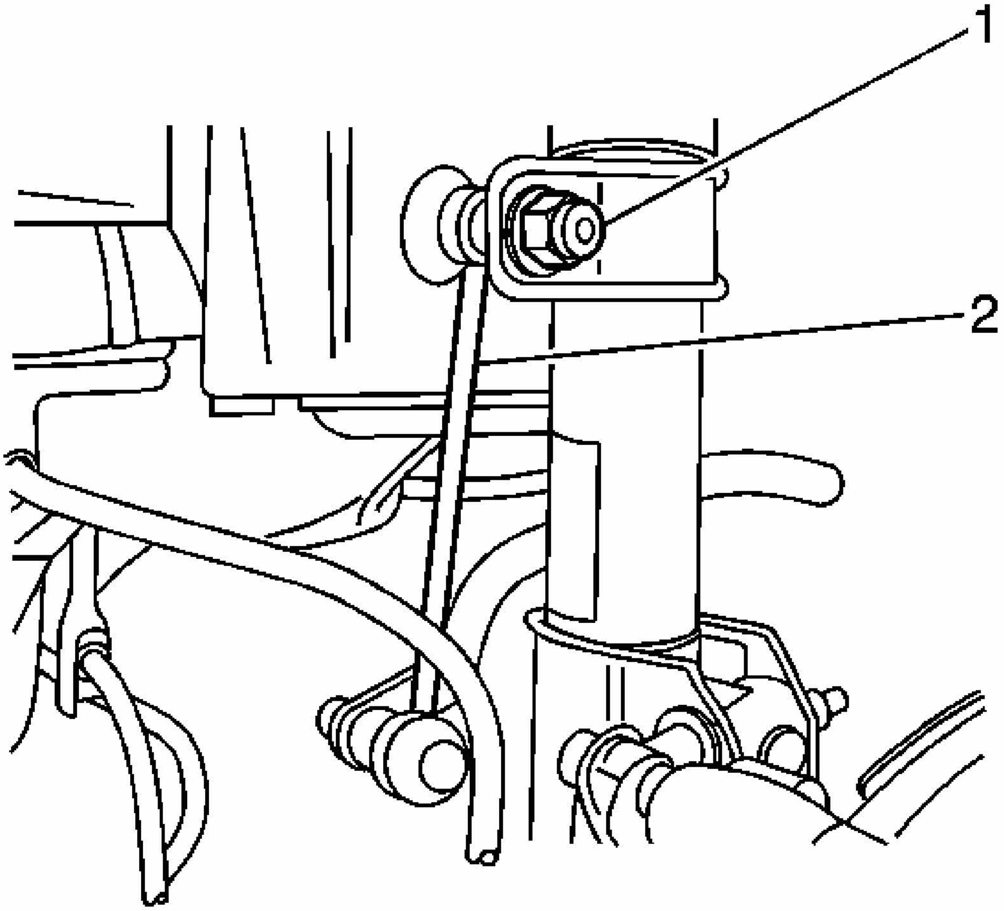


Fig. 22: View Of Stabilizer Shaft Link
Courtesy of GENERAL MOTORS CORP.

4. Connect the stabilizer shaft link (1) to the strut.
5. Install the upper stabilizer shaft link nut to the stabilizer shaft link (1) and the strut.

   Tighten: Tighten the nut to 52 N.m (38 lb ft).

6. Lower the vehicle.

TRAILING ARM REPLACEMENT

Removal Procedure

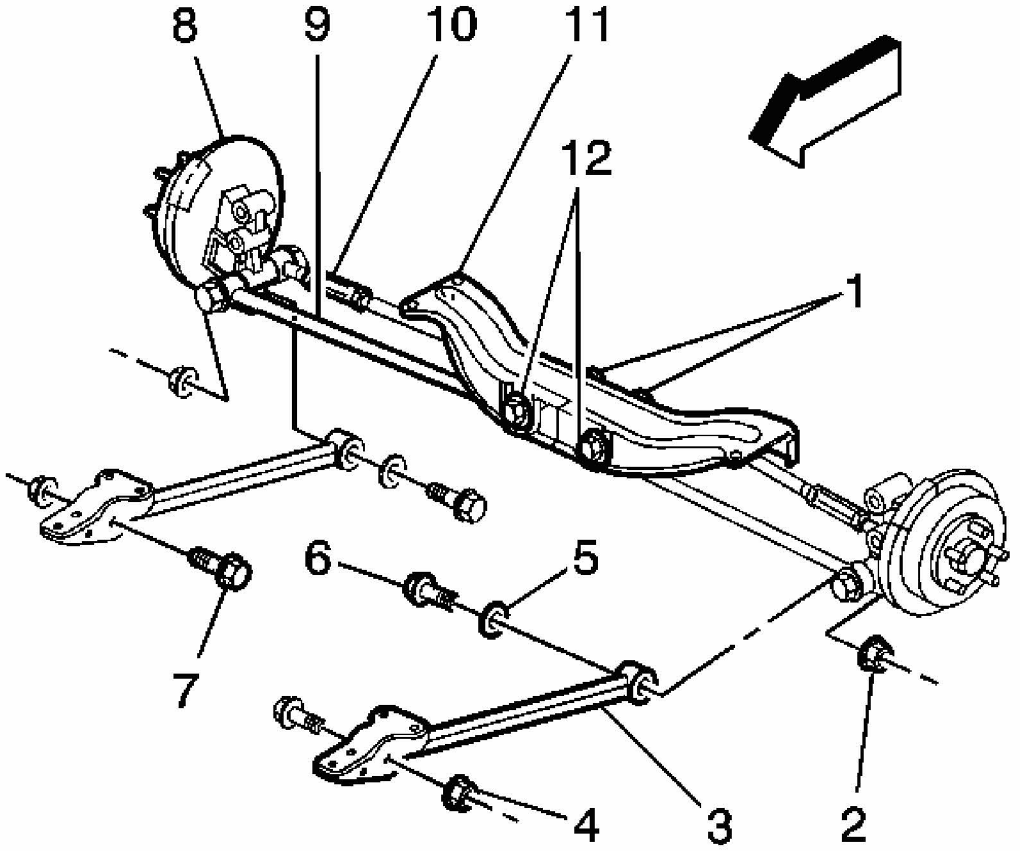


Fig. 23: Exploded View Of Rear Suspension
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the bolt (6) and nut (2) from the trailing arm (3) and the knuckle (8).
3. Remove the nut (4) and bolt (7) from the trailing arm (3) and the trailing arm bracket.
4. Remove the trailing arm (3) from the vehicle.

Installation Procedure

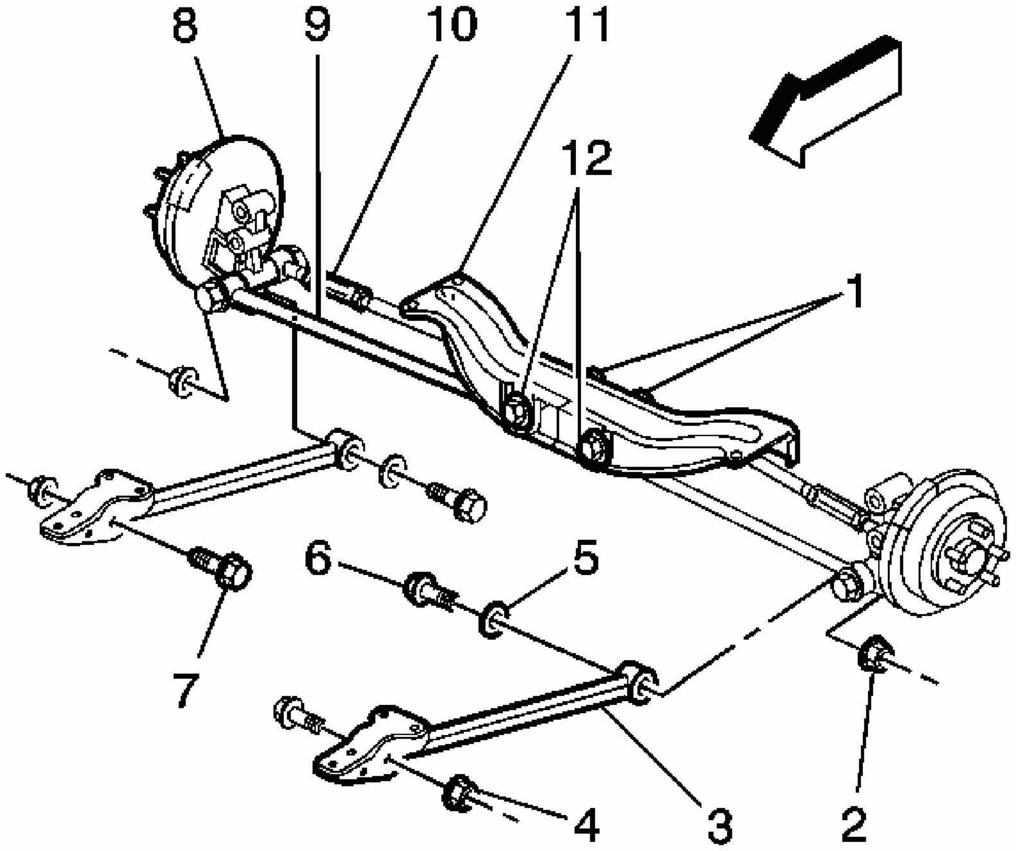


Fig. 24: Exploded View Of Rear Suspension
Courtesy of GENERAL MOTORS CORP.

1. Install the trailing arm (3) to the trailing arm bracket.

   NOTE: **Refer to Fastener Notice .**

2. Install the bolt (7) and nut (4) to the trailing arm (3) and the trailing arm bracket.

   Tighten: Tighten the bolt and nut to 105 N.m (77 lb ft).

3. Install the trailing arm (3) to the knuckle (8).
4. Install the bolt (6) and nut (2) to the trailing arm (3) and the knuckle (8).

   Tighten: Tighten the nut to 240 N.m (177 lb ft).

5. Lower the vehicle.

SPINDLE ROD REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

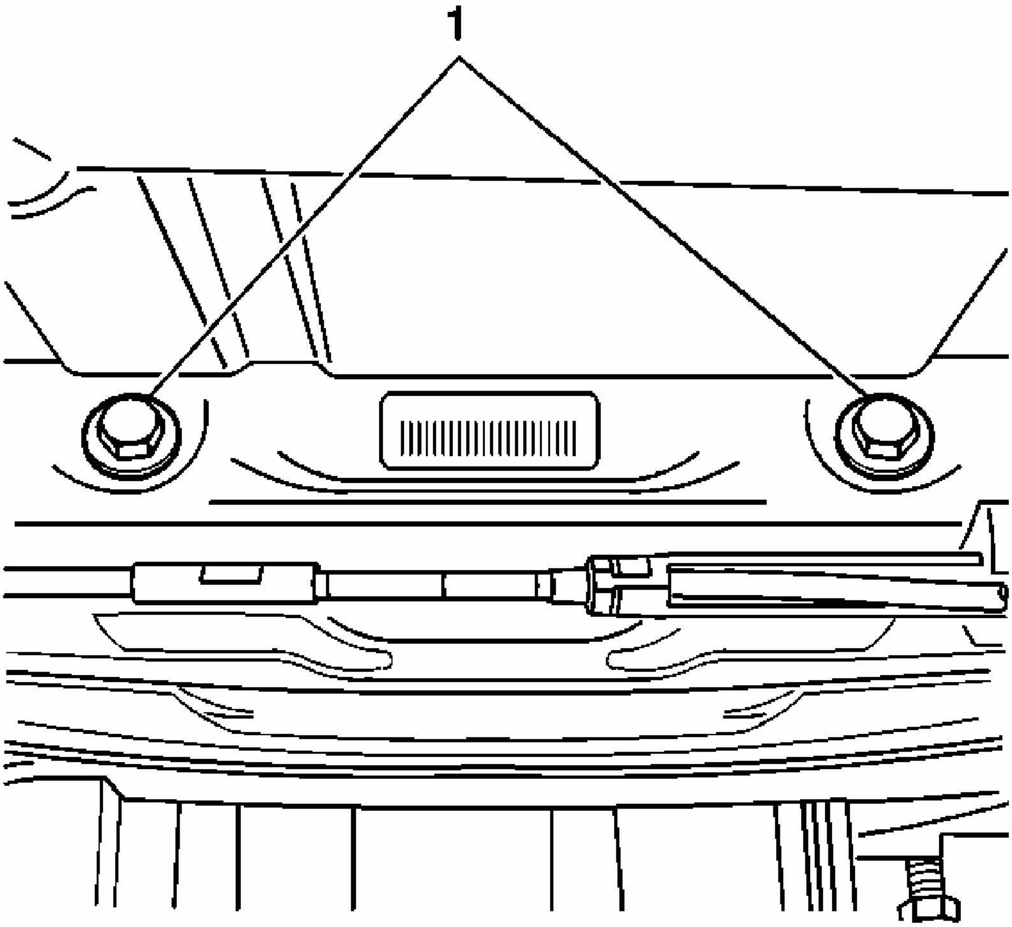


Fig. 25: View Of Spindle Rod And Rear Suspension Support Bolt
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use a transmission jack or suitable hoist stands to prop the rear suspension support.

3. Lower the rear suspension support to gain clearance to the spindle rod to knuckle bolt.

Refer to **Support Replacement**.

4. Remove the bolt (1) and nut from the spindle rod and the rear suspension support.

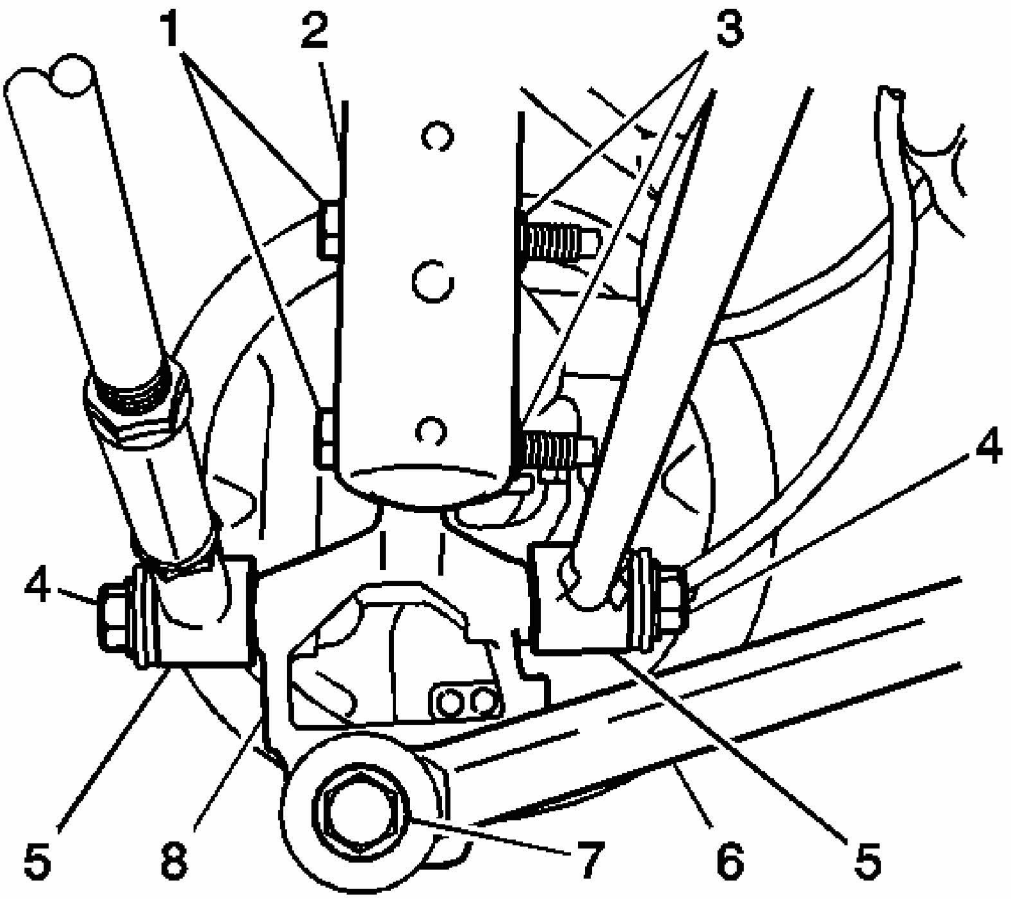


Fig. 26: View Of Spindle Rod, Knuckle, And Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the spindle rod to knuckle bolt (4) and nut.
6. Push the spindle rod to knuckle bolt (4) forward enough to provide clearance for the spindle rod (5) removal.
7. Remove the spindle rod (5) from the vehicle.

Installation Procedure

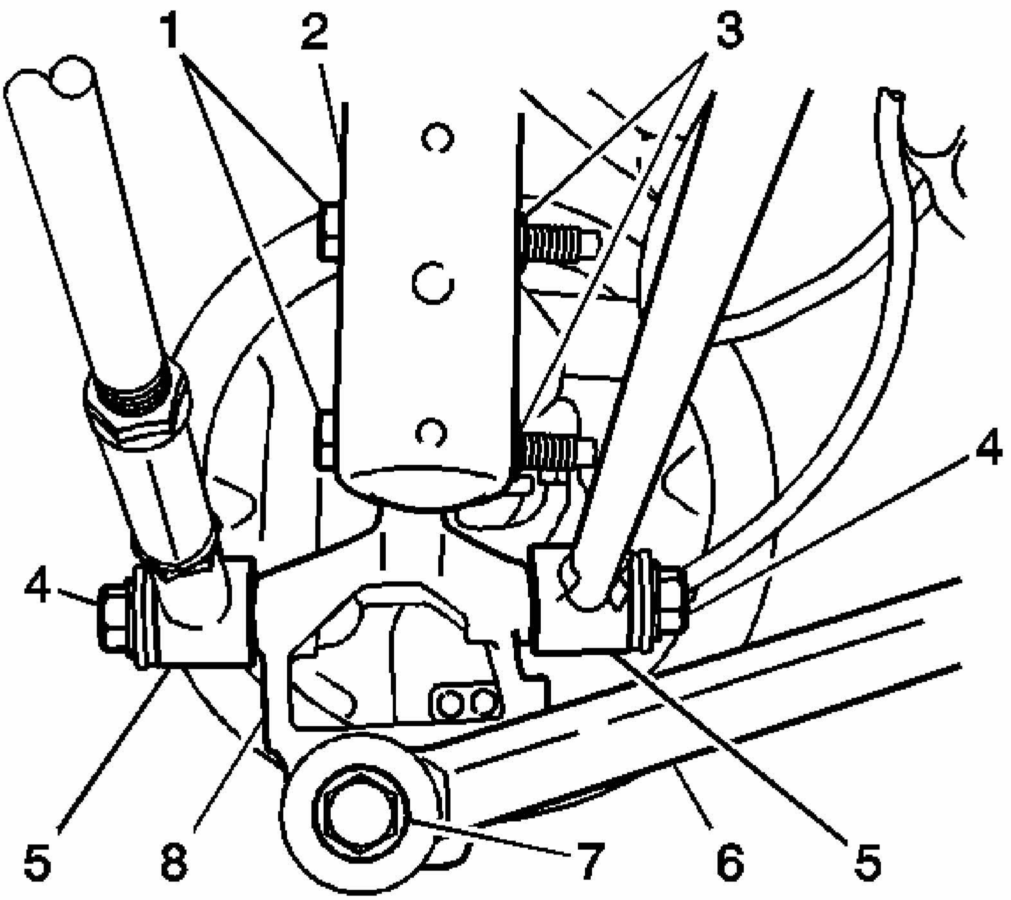


Fig. 27: View Of Spindle Rod, Knuckle, And Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the spindle rod (5) to the vehicle.
2. Install the spindle rod (5) to the knuckle (8).

NOTE: **Refer to Fastener Notice .**

3. Install the spindle rod to knuckle bolt (4) and nut.

Tighten: Tighten the nut to 150 N.m (110 lb ft).

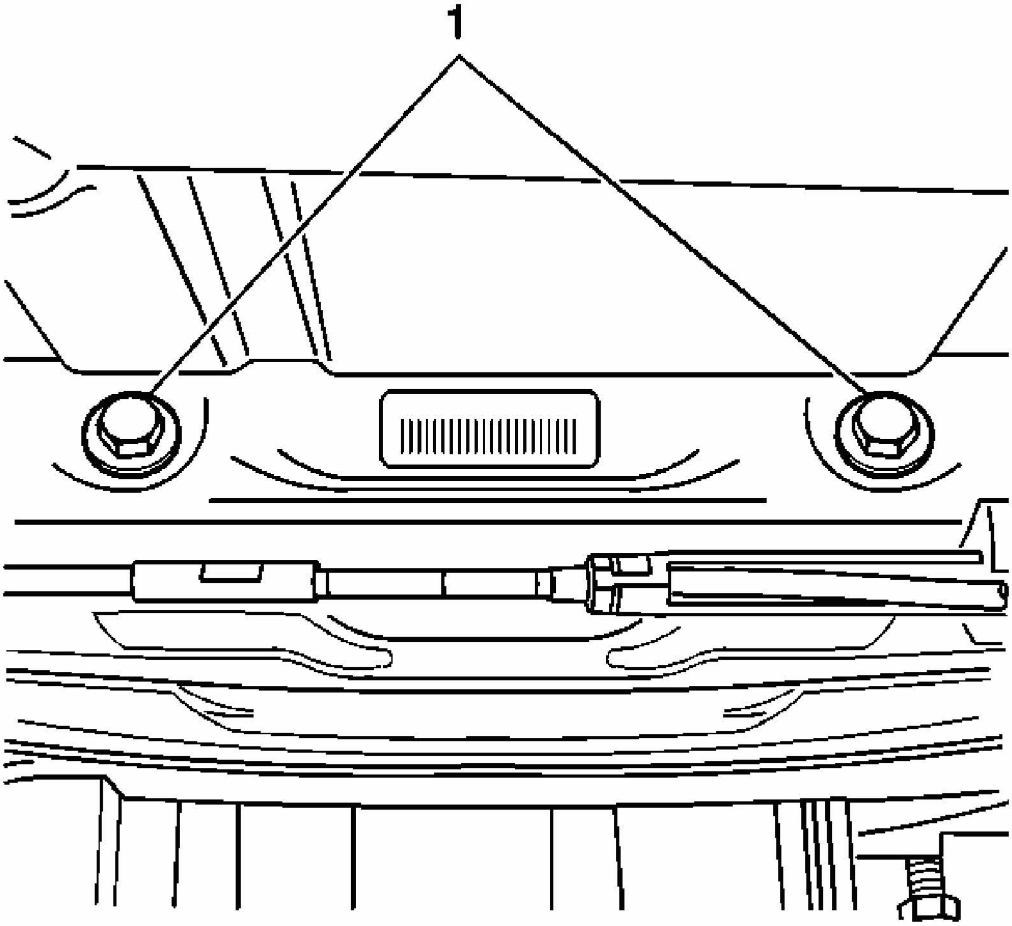


Fig. 28: View Of Spindle Rod And Rear Suspension Support Bolt
Courtesy of GENERAL MOTORS CORP.

4. Install the spindle rod to the rear suspension support.
5. Install the bolt (1) and nut to the rear suspension support.

   Tighten: Tighten the bolt to 135 N.m (100 lb ft).

6. Install the rear suspension support. Refer to **Support Replacement**.
7. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
8. Lower the vehicle.
9. Adjust the wheel toe angle. Refer to **Wheel Alignment Specifications** in Wheel Alignment.

STRUT ASSEMBLY REPLACEMENT

Removal Procedure

NOTE: Care should be taken to avoid chipping or scratching the coating when handling the suspension coil spring. Damage to the coating can cause premature failure.

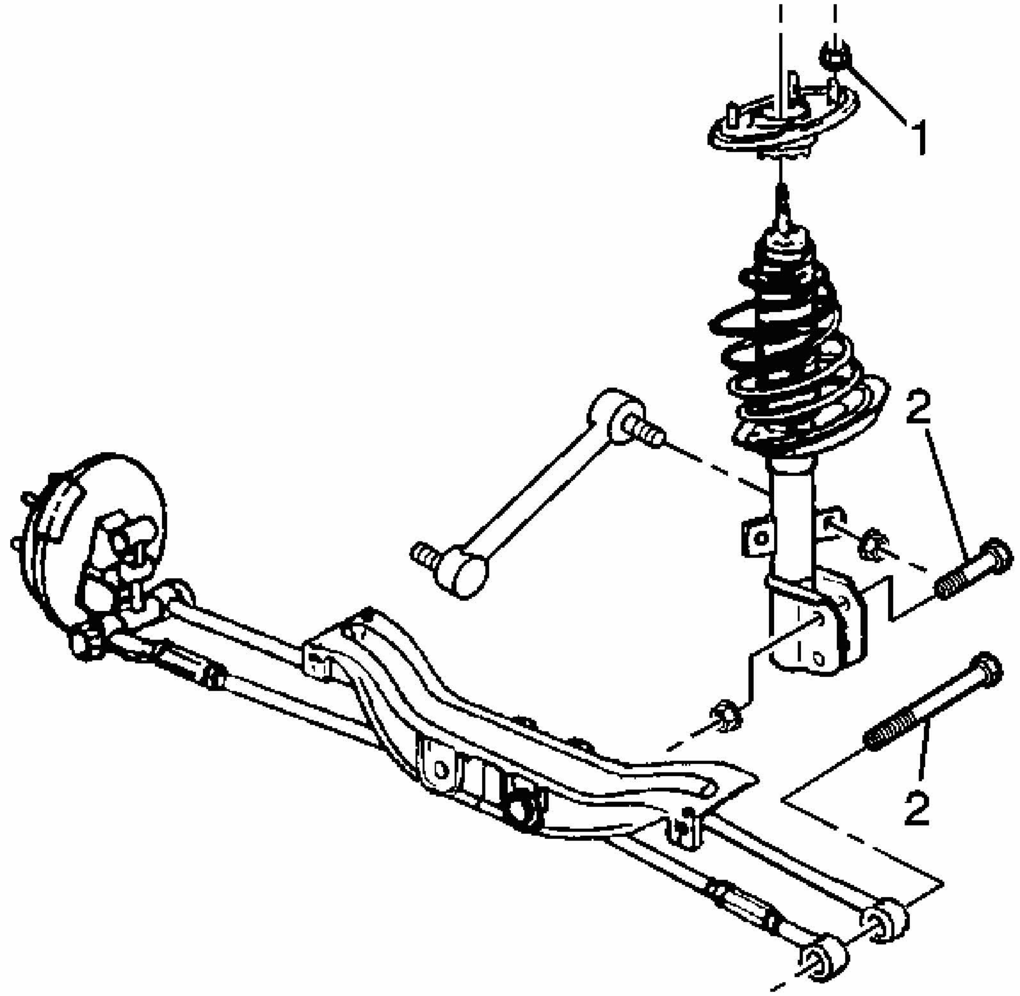


Fig. 29: View Of Strut-To-Body Mount Nuts And Brake Hose Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the strut-to-body mount nuts (1).
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and**

Installation .

4. Remove the stabilizer shaft link from the strut. Refer to **Stabilizer Shaft Link Replacement**.
5. Remove the bolt (2) from the brake hose bracket (3) and the strut assembly.

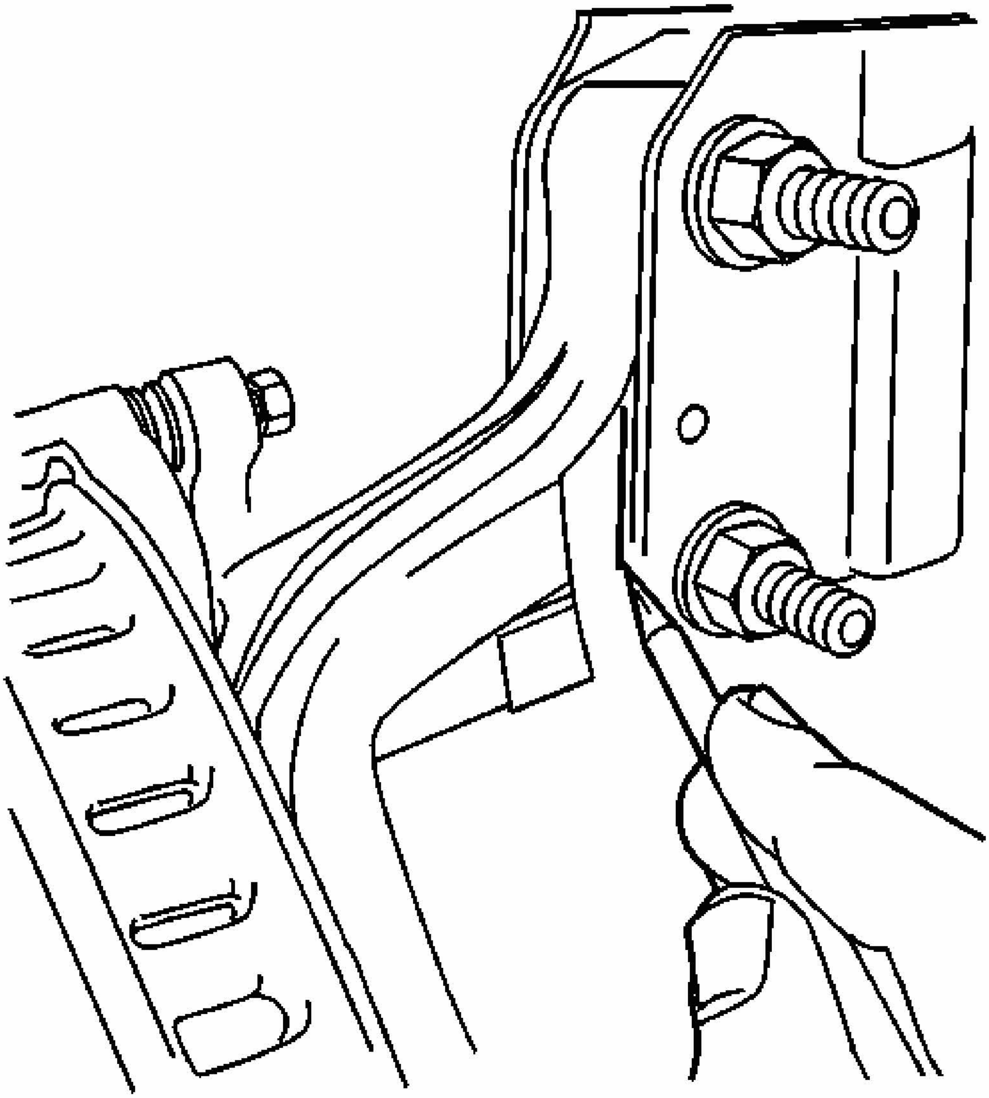


Fig. 30: Scribing Strut To Knuckle
Courtesy of GENERAL MOTORS CORP.

6. Scribe the strut to the knuckle.

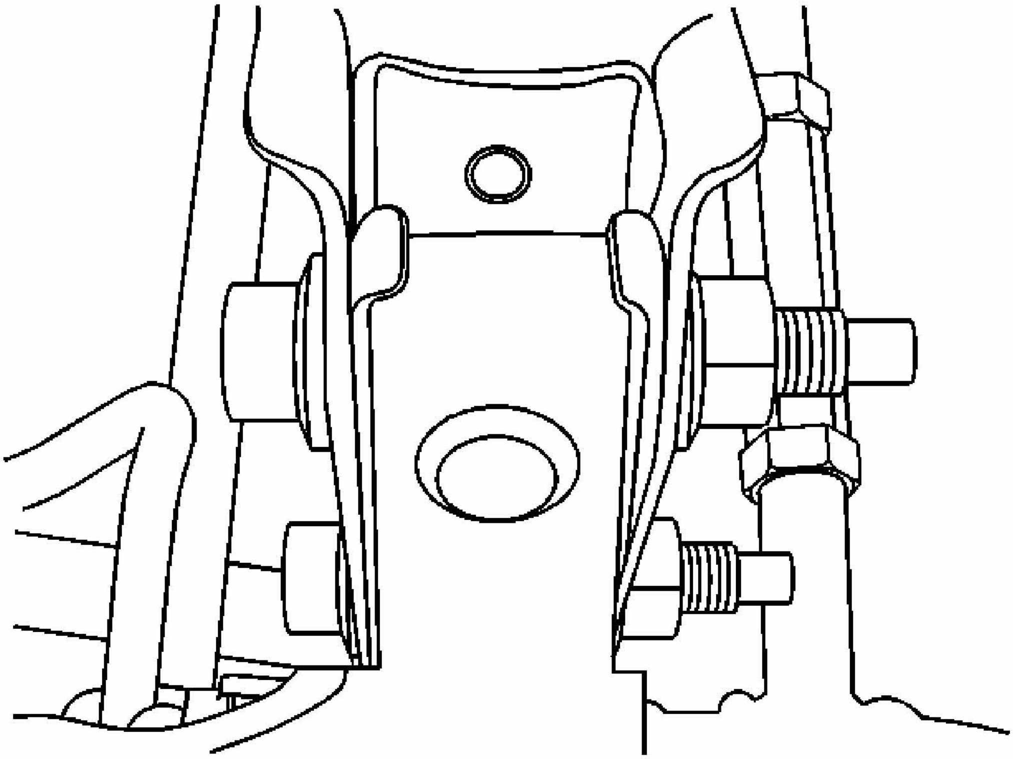


Fig. 31: View Of Strut
Courtesy of GENERAL MOTORS CORP.

NOTE: The knuckle must be retained after the strut-to-knuckle bolts have been removed. Failure to observe this may cause ball joint and/or wheel drive shaft damage.

7. Remove the strut to knuckle bolts.
8. Remove the strut from the vehicle.

Installation Procedure

NOTE: Care should be taken to avoid chipping or scratching the coating when handling the suspension coil spring. Damage to the coating can cause premature failure.

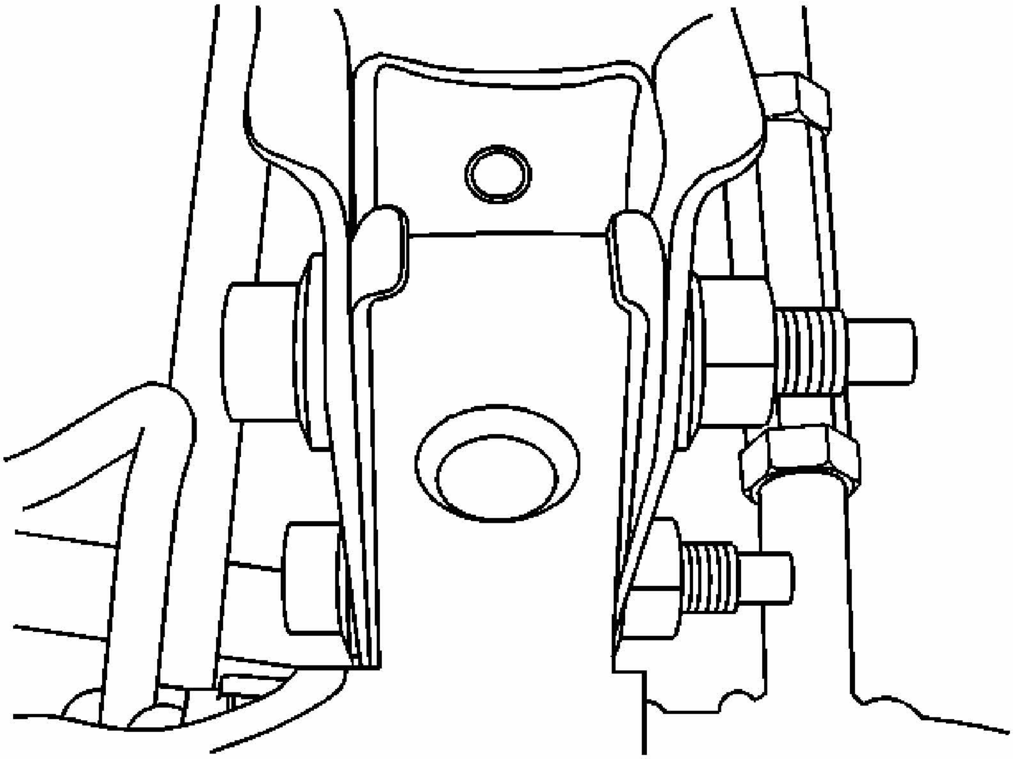


Fig. 32: View Of Strut
Courtesy of GENERAL MOTORS CORP.

1. Install the strut into place.

NOTE: **Refer to Fastener Notice .**

2. Install the strut to knuckle bolts.

Tighten: Tighten the strut to knuckle bolts and nuts to 120 N.m (89 lb ft).

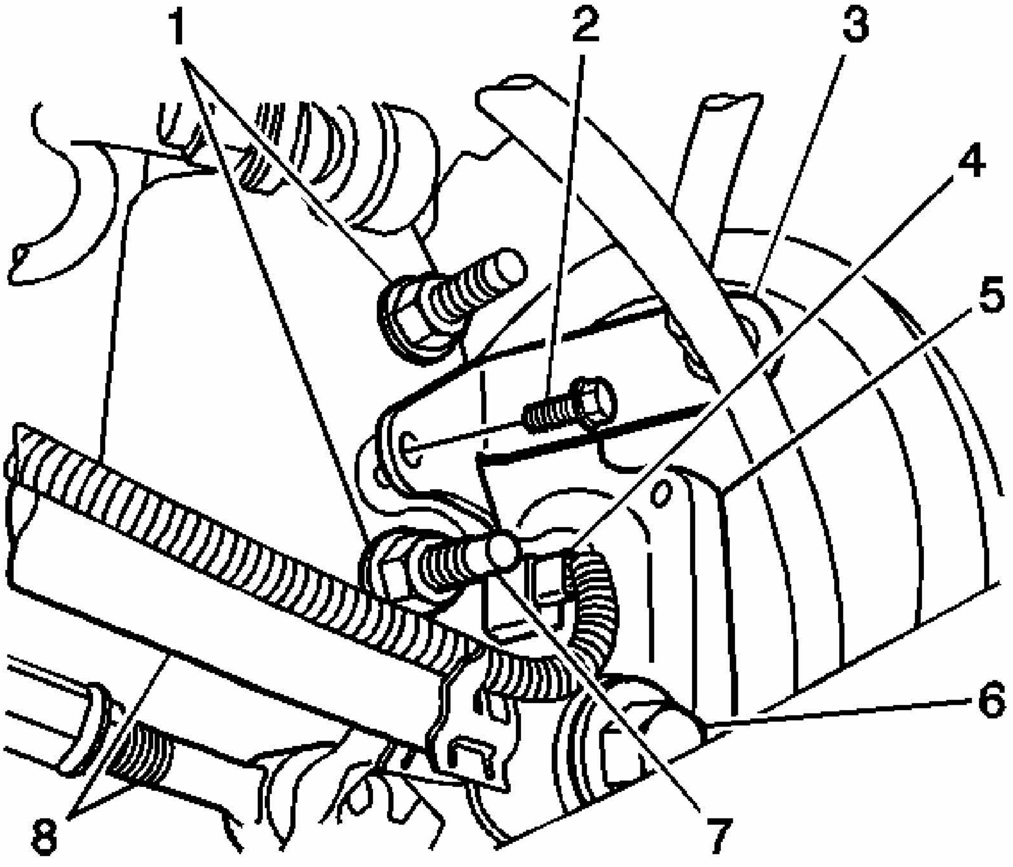


Fig. 33: View Of Brake Hose Bracket And Bolt And Strut Assembly
Courtesy of GENERAL MOTORS CORP.

3. Install the bolt (2) to the brake hose bracket (3) and the strut assembly.

   Tighten: Tighten the bolt to 10 N.m (89 lb in).

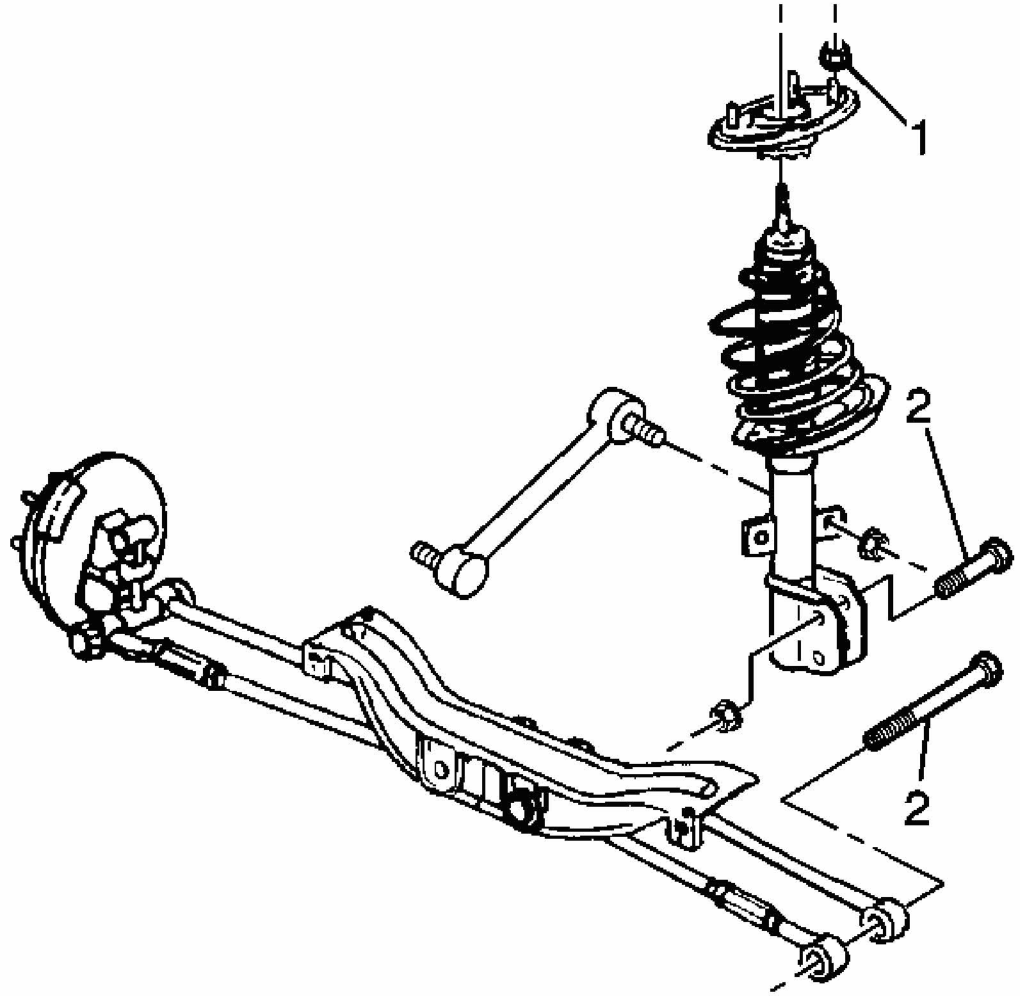


Fig. 34: View Of Strut-To-Body Mount Nuts And Brake Hose Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

4. Connect the stabilizer shaft link to the strut. Refer to **Stabilizer Shaft Link Replacement**.
5. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
6. Install strut to body mount nuts (1).

   Tighten: Tighten the strut to body mount nuts to 45 N.m (33 lb ft).

7. Lower the vehicle.
8. Adjust the rear wheel alignment. Refer to **Wheel Alignment Specifications** .

SUSPENSION SHOCK/STRUT DISPOSAL

CAUTION: Gas charged shock absorbers contain high pressure gas. Do not remove the snap ring from inside the top of the tube. If the snap ring is removed, the contents of the shock absorber will come out with extreme force which may result in personal injury.

CAUTION: To prevent personal injury, wear safety glasses when centerpunching and drilling the shock absorber. Use care not to puncture the shock absorber tube with the centerpunch.

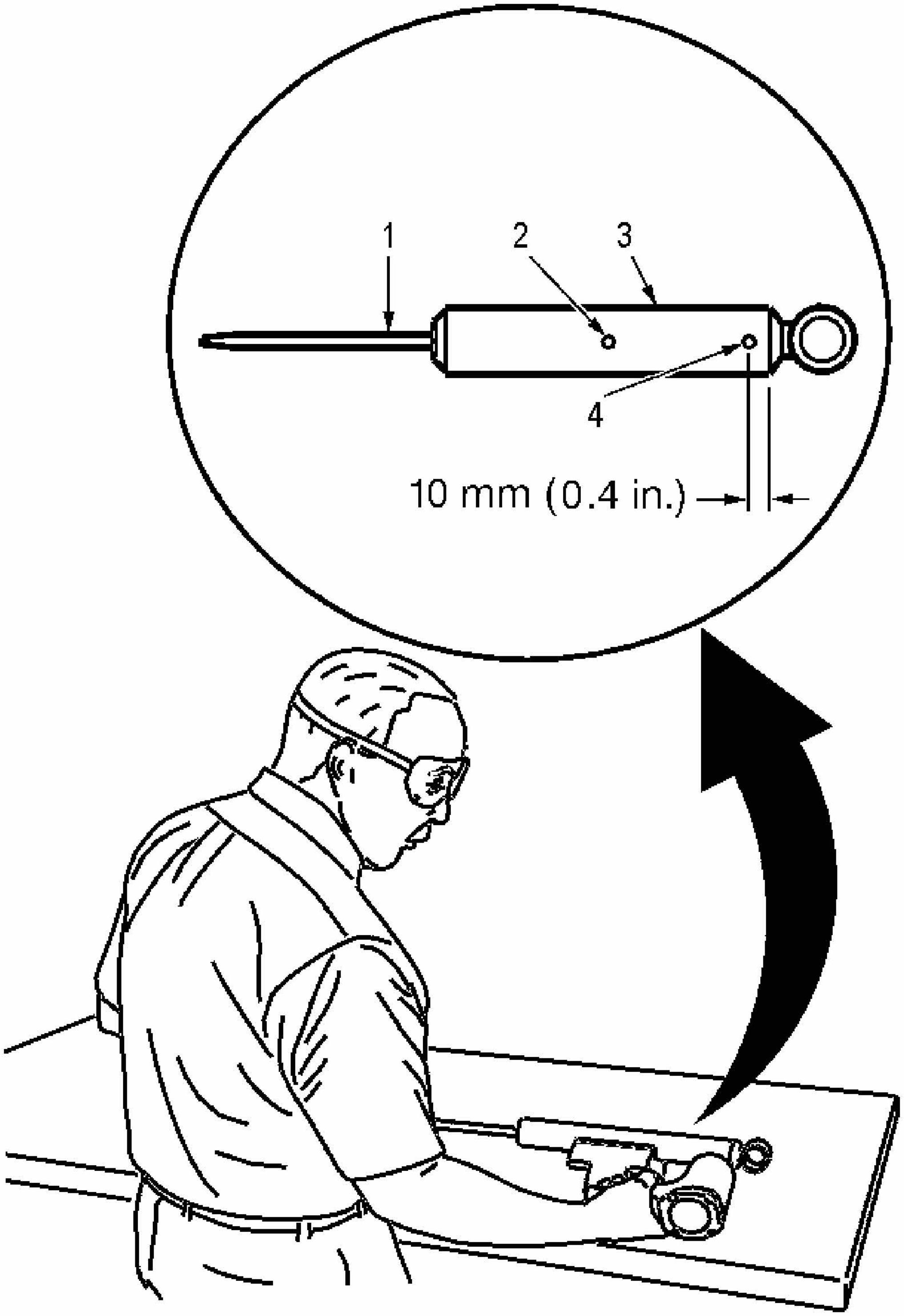


Fig. 35: Drilling Hole In Shock Absorber At Centerpunched Locations
Courtesy of GENERAL MOTORS CORP.

1. Make an indentation 10 mm (0.4 in) from the bottom (4) of the tube (3) using a centerpunch.
2. Clamp the shock absorber in a vise horizontally with the shock absorber rod (1) completely extended.
3. Drill a hole in the shock absorber at the centerpunch (4) using a 5 mm (3/16 in) drill bit. Gas or a gas/oil mixture will exhaust when the drill bit penetrates the shock absorber. Use shop towels in order to contain the escaping oil.
4. Make an indentation in the middle (2) of the tube (3) with a centerpunch.
5. Drill a second hole in the shock absorber at the centerpunch (2) using a 5 mm (3/16 in) drill bit. Oil will exhaust when the drill bit penetrates the shock absorber. Use shop towels in order to contain the escaping oil.
6. Remove the shock absorber from the vise. Hold the shock absorber over a drain pan horizontally with the holes down. Move the rod (1) in and out of the tube (3) to completely drain the oil from the shock absorber.

STRUT, STRUT COMPONENT AND/OR SPRING REPLACEMENT

Tools Required

- **J 42991** Strut Rod Nut Socket
- **J 45400** Strut Spring Compressor

Disassembly Procedure

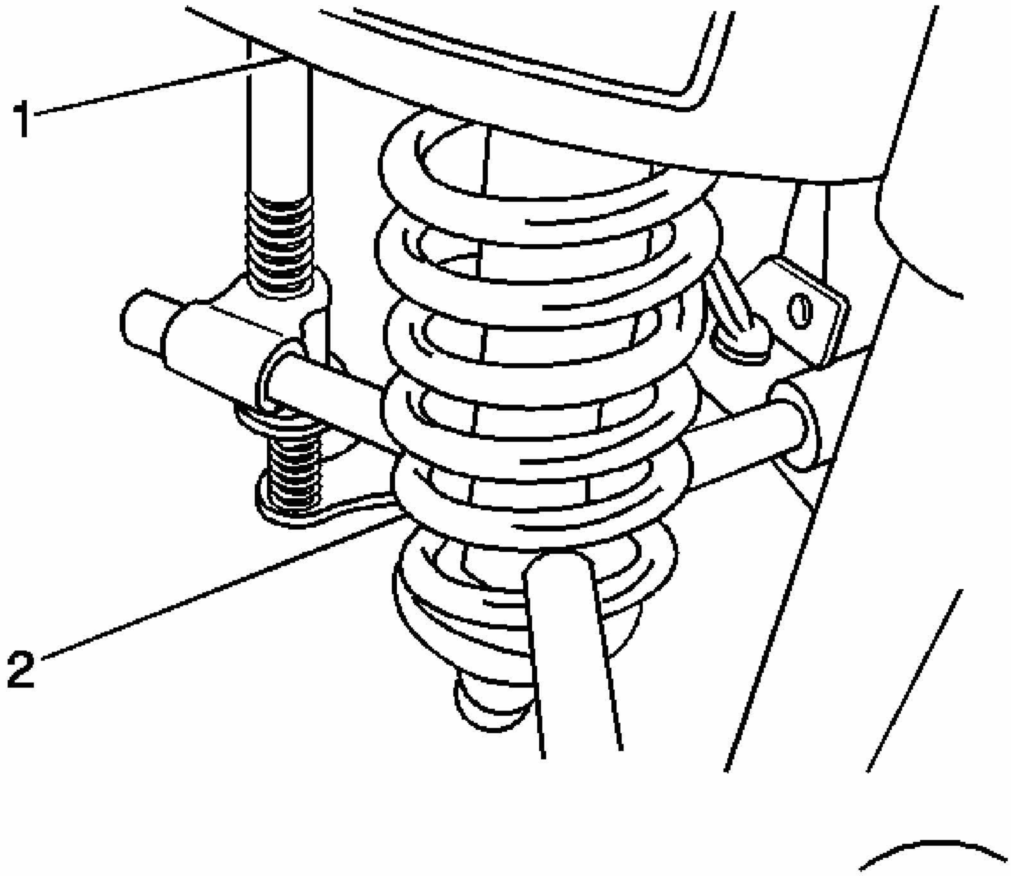


Fig. 36: Compressing/Releasing Lower Part Of Shock Spring
Courtesy of GENERAL MOTORS CORP.

1. Remove the strut from the vehicle. Refer to **Strut Assembly Replacement**.
2. Install the strut (2) in the **J 45400** (1).

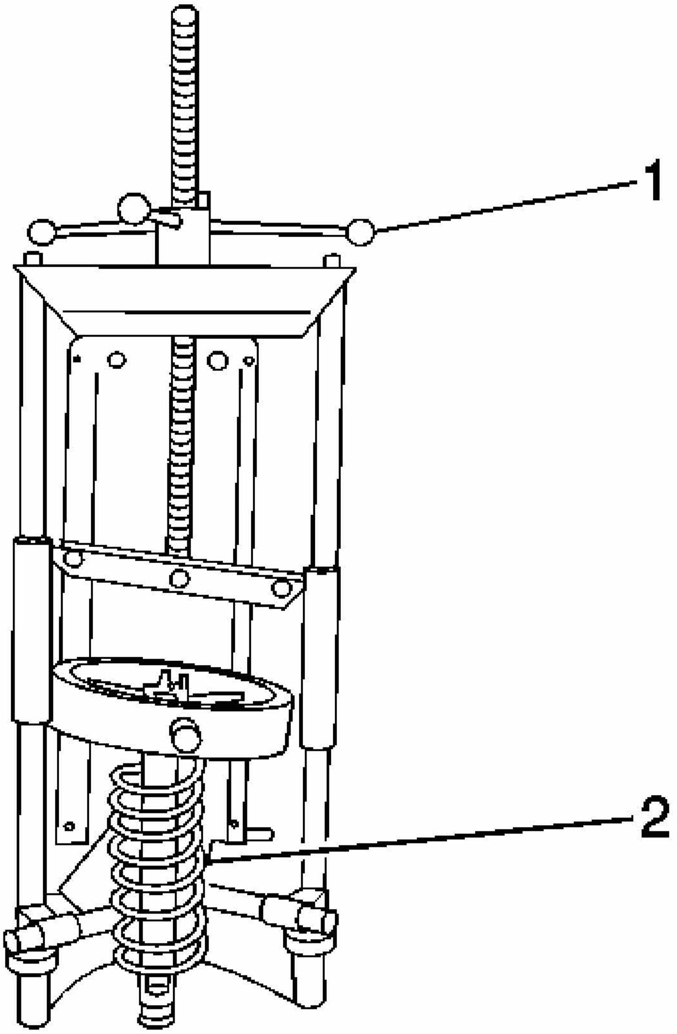


Fig. 37: View Of Compressor Forcing Screw & Coil Spring
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The spring is compressed when the strut moves freely.

3. Turn the spring compressor forcing screw (1) until the coil spring (2) is compressed.

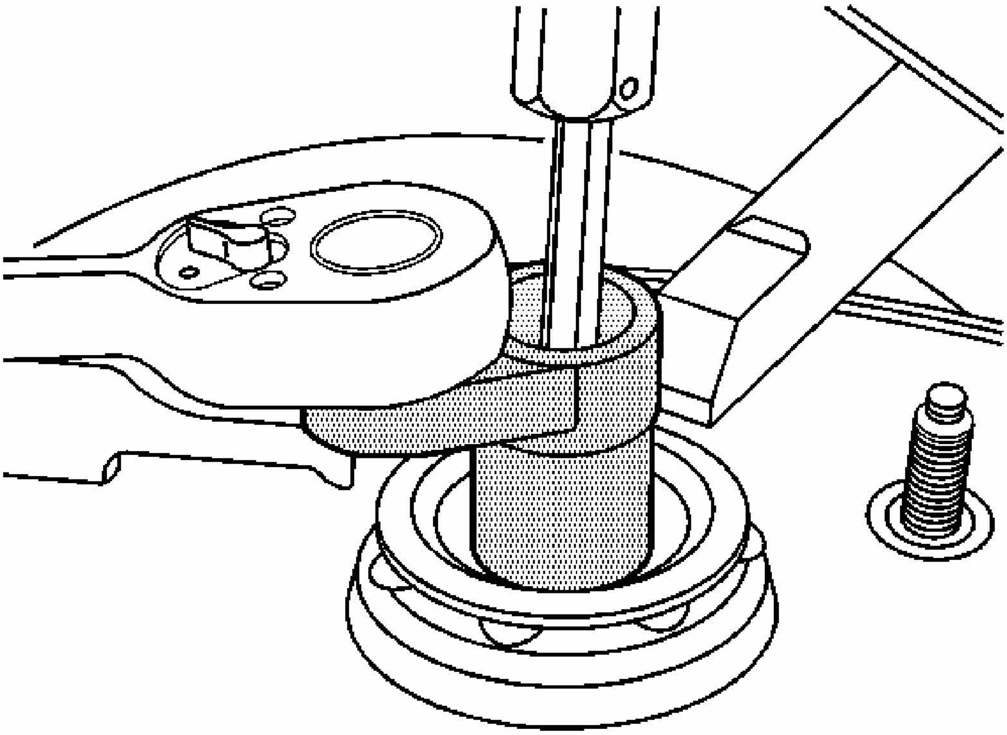


Fig. 38: Removing/Installing Strut Retaining Nut
Courtesy of GENERAL MOTORS CORP.

4. Use a 45 TORX® socket in order to hold the strut shaft. Remove the upper strut mount nut by turning with **J 42991** .
5. Remove the strut from the **J 45400** .

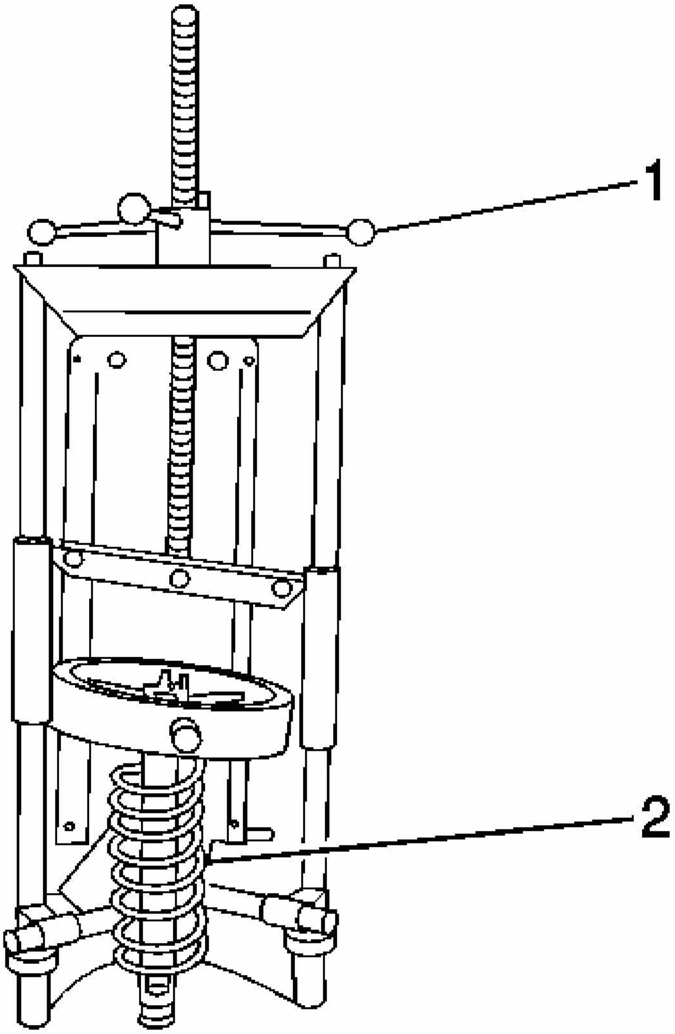


Fig. 39: View Of Compressor Forcing Screw & Coil Spring
Courtesy of GENERAL MOTORS CORP.

6. Loosen the compressor forcing screw (1) until the upper strut mount and coil spring (2) may be removed.
7. Remove the upper strut mount and the coil spring from the **J 45400** .

Assembly Procedure

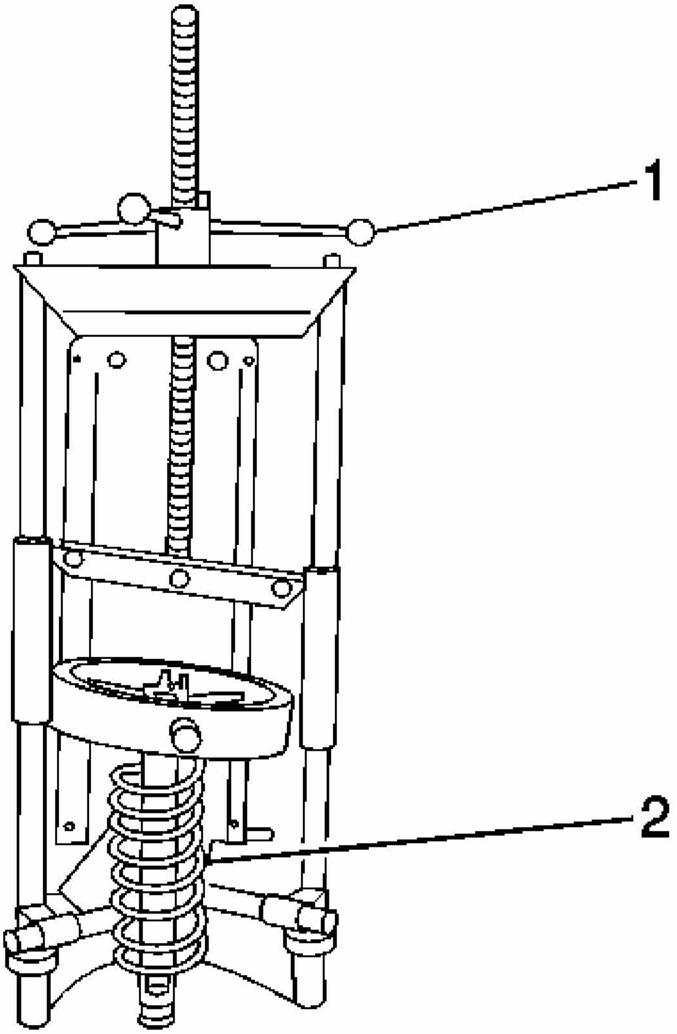


Fig. 40: View Of Compressor Forcing Screw & Coil Spring
Courtesy of GENERAL MOTORS CORP.

1. Install the coil spring and upper strut mount to the **J 45400** .
2. Turn the spring compressor forcing screw (1) until the coil spring is compressed.
3. Install the strut to the coil spring and upper strut mount.

NOTE: **Refer to Fastener Notice .**

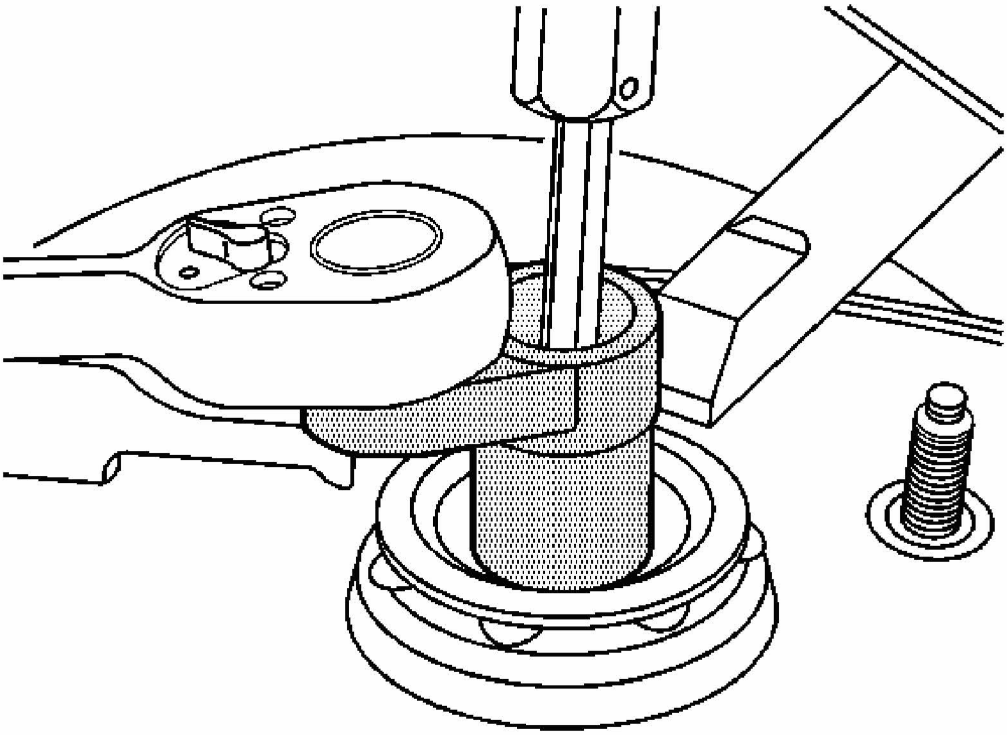


Fig. 41: Removing/Installing Strut Retaining Nut
Courtesy of GENERAL MOTORS CORP.

4. Install the strut rod to mount nut.

   Using the **J 42991** and a 45 TORX® socket, tighten the strut mount nut.

   Tighten: Tighten the strut mount nut to 75 N.m (55 lb ft).

5. Remove the strut from the **J 45400** .
6. Install the strut to the vehicle. Refer to **Strut Assembly Replacement**.

WHEEL STUD REPLACEMENT

Tools Required

J 6627-A Tie Rod Puller

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General

Information.

2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Remove the rear wheel bearing/hub assembly. Refer to **Wheel Bearing/Hub Replacement - Rear**.
4. Separate the backing plate from the rear hub. Refer to **Disc Brake Backing Plate Replacement - Rear** in Disc Brakes.

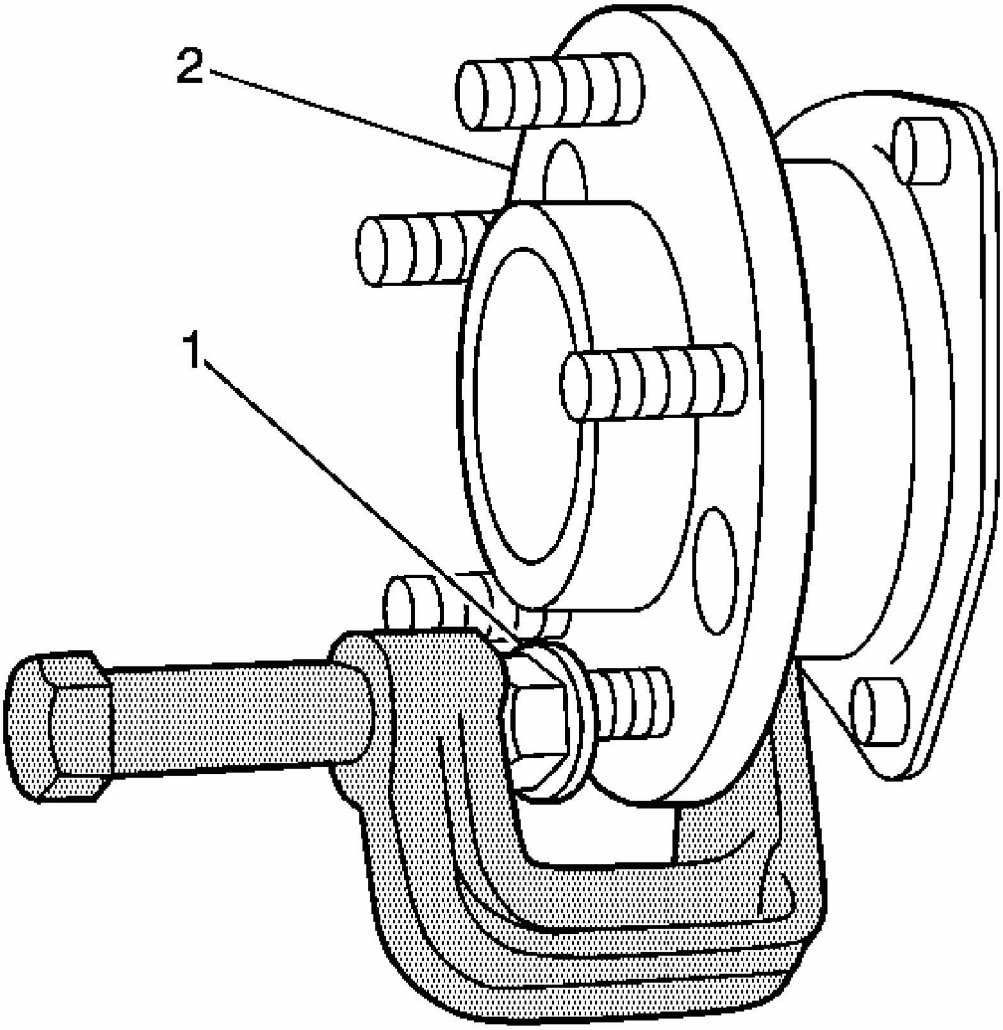


Fig. 42: View Of Stud And Hub
Courtesy of GENERAL MOTORS CORP.

5. Use the **J 6627-A** in order to extract the stud (1) from the hub (2).

Installation Procedure

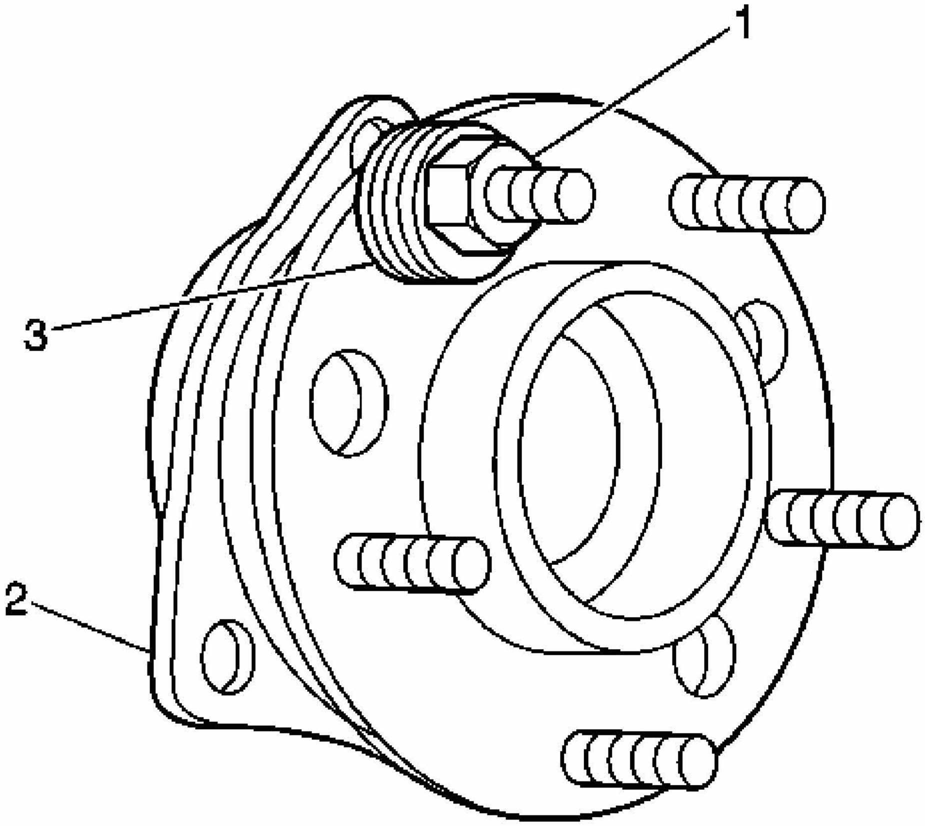


Fig. 43: Installing Wheel Stud
Courtesy of GENERAL MOTORS CORP.

1. Install a replacement stud in the wheel hub.
2. Add enough washers (3) in order to draw the stud into the hub (2).
3. Install the wheel nut (1) with the flat side against the washers (3).

IMPORTANT: Fully seat the wheel stud against the hub flange (2).

4. Tighten the wheel nut (1) until the wheel stud is fully seated against the hub flange.
5. Back off the wheel nut (1) and remove the washers (3).
6. Install the backing plate. Refer to **Disc Brake Backing Plate Replacement - Rear** in Disc Brakes.

7. Install the rear wheel bearing/hub assembly. Refer to **Wheel Bearing/Hub Replacement - Rear**.
8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
9. Lower the vehicle.

DESCRIPTION AND OPERATION

REAR SUSPENSION DESCRIPTION AND OPERATION

The rear suspension utilizes coil springs over struts and light weight aluminum knuckles. Each wheel is mounted to a tri-link independent suspension system. The 3 links are identified as the inverted U-channel trailing arm and the tubular front and rear rods.

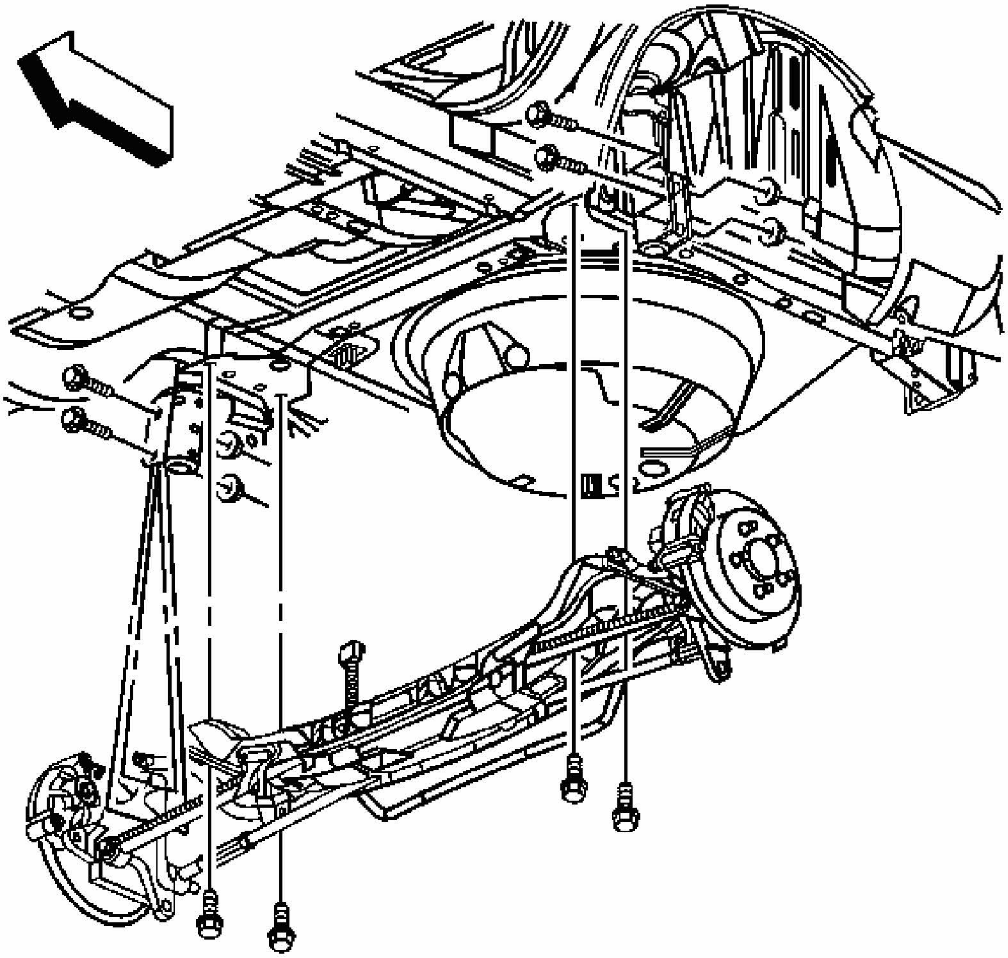


Fig. 44: View Of Rear Suspension
Courtesy of GENERAL MOTORS CORP.

Parallel links allow the rear wheels to deflect upward when the rear wheels hit a road hazard, without moving the toe angle in a positive direction. An advantage of this suspension system is the reduction of unsprung and overall weight. Handling is improved with the independent action of each rear wheel. The rods control the lateral wheel deflection.

Several techniques are employed to achieve this independent wheel movement. The tri-link design may be compared to a right angle. The wheel is located at the right angle formed by the rods and the trailing arm. The ends of the tri-links hinge in order to provide vertical wheel travel. The solid links force the wheel to travel through a controlled arc whose fore-aft position is determined by the trailing arm, and whose lateral position is determined by the rods.

Aside from maintaining geometric wheel location, each portion of the suspension has additional functions. The knuckle supports the brake caliper. All brake torque and braking forces are transmitted through the tri-links and the strut. The final duty of the rods is to maintain the camber angle of the wheel throughout the wheel's travel, and to allow for setting the toe. The overall result of this rear suspension geometry is to maintain the rear wheels in a near vertical position at all times.

The stabilizer shaft attaches to the stabilizer bar drop link and extends rearward, where the stabilizer connects to the rear suspension support by 2 rubber bushings and mounting brackets.

A non-serviceable unit hub and bearing bolts to the knuckle. This hub and bearing is a sealed, maintenance-free unit.

Check the suspension system periodically for the following conditions:

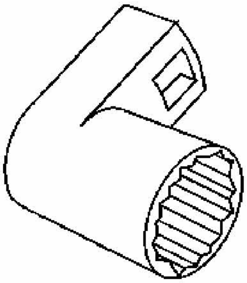
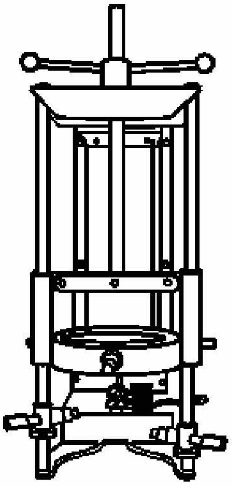
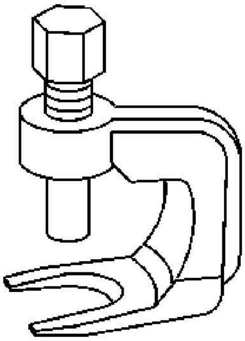
- Shock absorbency
- Bushing durability
- Tightness of attaching bolts
- Visible damage
- Misalignment
- Excessive wear

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/Description

	J 42991 Strut Rod Nut Socket
	J 45400 Strut Spring Compressor
	J 6627-A Tie Rod Puller

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Garage Door Opener Push-Button Nuts	2 N·m	18 lb in
Garage Door Opener Push-Button Screws	2 N·m	18 lb in

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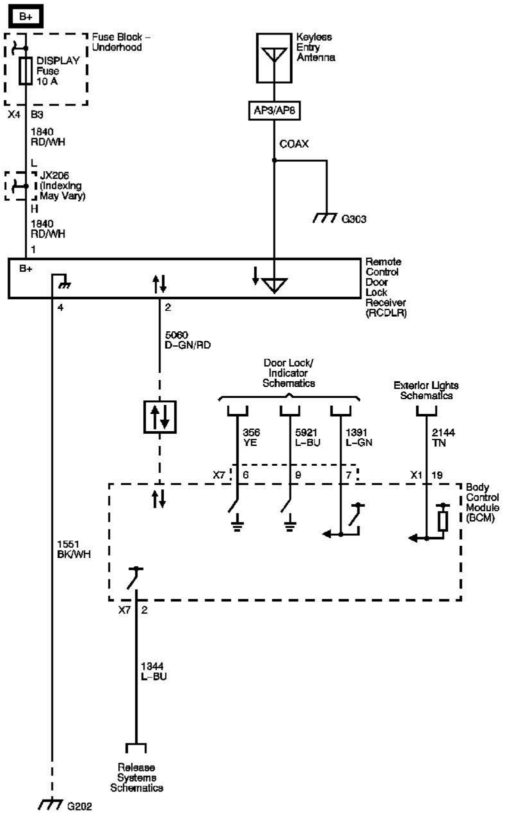
Keyless Entry


B+
Fuse Block – Underhood
DISPLAY Fuse 10 A
X4
B3
1840
RD/WH
L
JX206 (Indexing May Vary)
H
1840
RD/WH
1
Keyless Entry Antenna
AP3/AP8
COAX
G303
B+
4
2
Remote Control Door Lock Receiver (RCDLR)
5060
D-GN/RD
Door Lock/ Indicator Schematics
Exterior Lights Schematics
356
YE
5921
L-BU
1391
L-GN
2144
TN
X7
6
9
7
X1
19
Body Control Module (BCM)
1551
BK/WH
X7
2
1344
L-BU
Release Systems Schematics
G202

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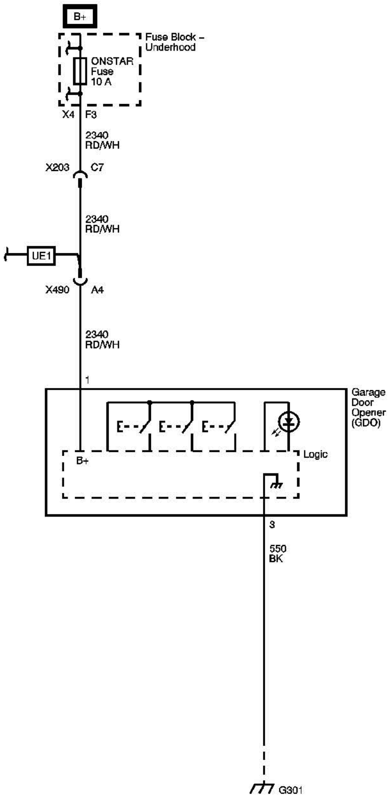
Garage Door Opener


B+
Fuse Block – Underhood
ONSTAR Fuse 10 A
X4
F3
2340 RD/WH
X203
C7
2340 RD/WH
UE1
X490
A4
2340 RD/WH
1
Garage Door Opener (GDO)
B+
Logic
3
550 BK
G301

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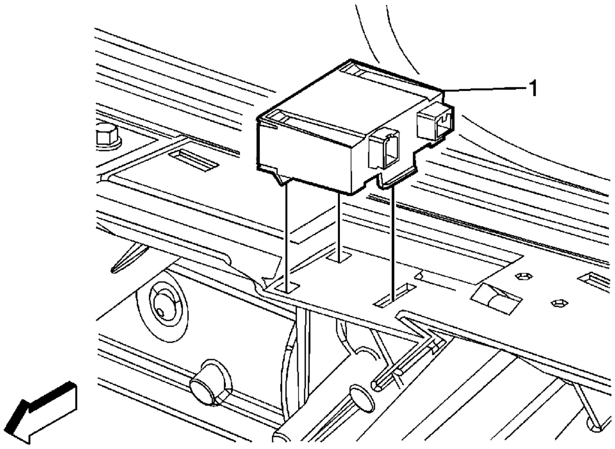
2009 Chevrolet Impala | Impala (VIN W) Service Manual | Safety and Security | Remote Functions | Repair Instructions |
Document ID: 1724606

Remote Control Door Lock Receiver Replacement



Callout	Component Name
Preliminary Procedure 1. Remove the instrument panel (I/P) upper trim panel. Refer to Instrument Panel Upper Trim Panel Replacement . 2. Program the remote control door lock receiver after replacement. Refer to Control Module References .	
1	Remote Control Door Lock Transmitter Assembly **Tip** - Disconnect the electrical connector. - Push the 2 tabs towards the module assembly in order to release the module.

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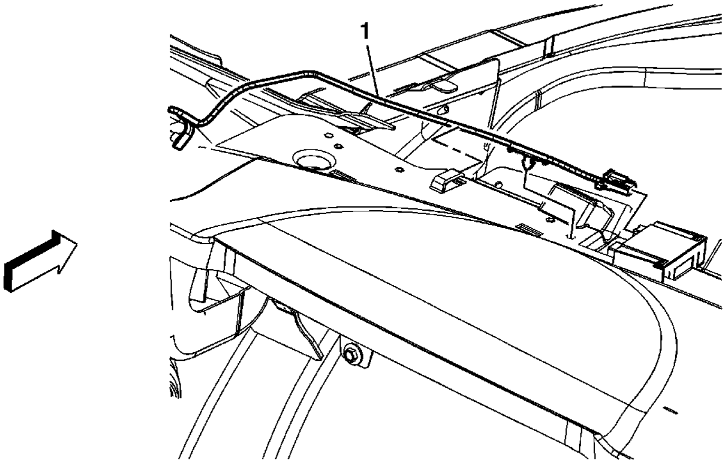
Document ID: 1911161

Remote Control Door Lock Receiver Antenna Replacement



Callout	Component Name
Preliminary Procedure Remove the instrument panel upper trim panel. Refer to Instrument Panel Upper Trim Panel Replacement .	
1	Remote Control Door Lock Receiver Antenna Assembly **Tip** • Disconnect the antenna from the door lock receiver. • Vehicles produced after December 6, 2006 will not have the antenna cable connected to the windshield. • Service antenna cables cannot be connected to the windshield.

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Garage Door Opener Programming - Universal

Important: Do not use the garage door opener (GDO) with any garage door opener that does not have the stop and reverse safety feature. This includes any garage door opener model manufactured before April 1, 1982.

Ensure that people and objects are clear of the garage door while performing programming operations.

Programming the GDO for Rolling Code Receivers

Important: If the programming procedure is unsuccessful, it may be necessary to perform the Erasing Channels procedure first.

This procedure will learn a rolling code garage door opener to the GDO transmitter. The learn process must be completed within 30 seconds.

1. Press the two outside buttons of the GDO for one to two seconds, then immediately release them.
2. Locate the "Learn" or "Smart" button on the garage door opener receiver (located on the garage door opener motor-head unit). It is often found where the hanging antenna wire is attached to the motor-head unit and may be a colored button. Refer to the garage door opener operator's manual or call 1-866-572-2728 for assistance. Press the "Learn" or "Smart" button. The garage door opener operator's manual may provide assistance in determining when the unit is in learn mode.
3. Immediately return to the GDO transmitter in the vehicle. Press and hold the button that is to be learned; the LED above the button will begin to flash slowly. When the garage door moves, immediately release the button. The LED will flash rapidly until programming is complete.
4. Press the button used during the learn operation again in order to verify that the GDO transmitter has been programmed.

The GDO is compatible with most, but not all, types of garage door openers. If the GDO LED does not flash rapidly after 90 seconds, there may be a compatibility conflict with the garage door opener. Call 1-866-572-2728 to address compatibility concerns.

Programming the GDO for Fixed Code Receivers

Important: If the programming procedure is unsuccessful, it may be necessary to perform the Erasing Channels procedure first.

This procedure will learn a fixed code garage door opener to the GDO transmitter. To determine if the customer has a fixed code garage door opener, remove the battery cover on the customer supplied transmitter. If a row of dip switches is present, the garage door opener is a fixed code version. The transmitter should have anywhere from 8 to 12 switches. The garage door opener receiver may also have a set of dip switches. If the number of switches on the receiver and the transmitter do not match, use the receiver switches to program the GDO. Each dip switch may have either two or three positions. The two position switch can either be ON or OFF. The three position switch can either be ON, NEUTRAL, or OFF.

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1. Write down the positions of the dip switches. The positions of the switches will be entered from left to right into the GDO using the three buttons.
2. Press all three buttons on the GDO for three seconds and immediately release them. The LEDs should flash slowly, indicating that the GDO is in programming mode.
3. Enter the positions of the dip switches one at a time. If a position of a dip switch is on, press the left button on the GDO. If the position is neutral, press the middle button of the GDO. If the position is off, press the right button of the GDO. Enter all of the positions of the dip switches. The procedure must be completed in two and a half minutes.
4. After entering all of the switch positions, firmly press and release all three buttons at the same time. The indicator lights will turn on.
5. Press and hold the button that is to be learned; the LED above the button will begin to flash slowly. When the garage door moves, immediately release the button. The LED will flash rapidly until programming is complete.
6. Press the button used during the learn operation again in order to verify that the GDO transmitter has been programmed.

The GDO is compatible with most, but not all, types of garage door openers. If the GDO light does not flash rapidly after 90 seconds, there may be a compatibility conflict with the garage door opener. Call 1-866-572-2728 to address compatibility concerns.

Erasing Channels

To erase programmed channels, press and hold the two outside buttons until the lights on the GDO transmitter begins to flash. Once the LEDs begin to flash, release both buttons; all learned codes are now erased.

Individual channels cannot be erased, but can be reprogrammed using the procedures above.

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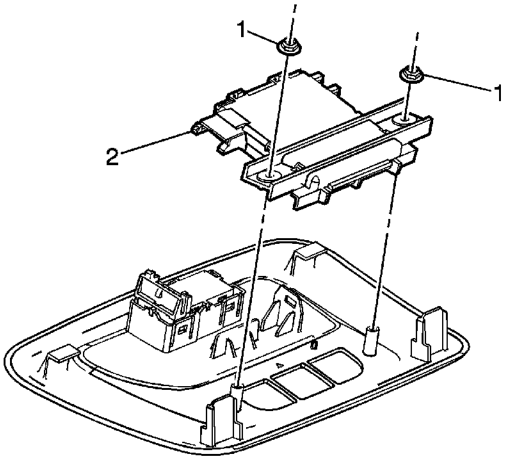
Document ID: 2154104

Garage Door Opener Transmitter Replacement



Callout	Component Name
Preliminary Procedure 1. Remove the overhead console. Refer to Roof Console Replacement. 2. Program the garage door opener after replacement. Refer to Control Module References.	
1	Garage Door Opener Pushbutton Nut **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 2 N·m (18 lb in)
2	Garage Door Opener Pushbutton

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Transmitter Programming

Next Available Slot

Note:

- On some vehicles, keyless entry transmitters may also be programmed using the driver information center (DIC). Refer to the vehicle owners manual for information.
- All transmitters which are to be recognized by the remote control door lock receiver (RCDLR) must be programmed in a single programming sequence. Once the Invalidate All Fobs selection is made, all learned transmitters are erased. If all the existing transmitters associated with the vehicle are not learned at this time, they will become inoperative and require additional programming.
- Do not operate or program the transmitters in the vicinity of other vehicles that are in the keyless entry program mode. This prevents the programming of the transmitters to the incorrect vehicle.
- The keyless entry transmitter used in the Advance 2 Way Remote Start System is unique to the system. When servicing or replacing a transmitter, ensure that the correct transmitter is used. The correct transmitter part number can be found in the Accessory section of the parts catalog. Attempting to replace an Advance 2 Way Remote Start transmitter with a regular service part may result in a failure to program the transmitter.

This procedure will program keyless entry transmitters in sequential order. If two transmitters are currently learned to the vehicle as transmitters 1 and 2, using this procedure will learn the next transmitter are transmitter 3, and so on.

1. With a scan tool, access the Remote Control Door Lock Receiver Module Setup menu. Select Program Key Fobs.
2. Select Next Available Slot. The vehicle chime will sound two times to indicate programming mode has been entered. Follow the on-screen instructions. After each transmitter has been programmed, the vehicle chime will sound to confirm the programming.
3. When all the desired transmitters have been programmed, cycle the ignition from ON to OFF, exit the vehicle, and operate the transmitter functions in order to verify correct system operation.

Invalidate All Fobs

Note:

- On some vehicles, keyless entry transmitters may also be programmed using the driver information center (DIC). Refer to the vehicle owners manual for information.
- All transmitters which are to be recognized by the remote control door lock receiver (RCDLR) must be programmed in a single programming sequence. Once the Invalidate All Fobs selection is made, all learned transmitters are erased. If all the existing transmitters associated with the vehicle are not learned at this time, they will become inoperative and require additional programming.
- Do not operate or program the transmitters in the vicinity of other vehicles that are in the keyless entry program mode. This prevents the programming of the transmitters to the incorrect vehicle.
- The keyless entry transmitter used in the Advance 2 Way Remote Start System is unique to

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the system. When servicing or replacing a transmitter, ensure that the correct transmitter is used. The correct transmitter part number can be found in the Accessory section of the parts catalog. Attempting to replace an Advance 2 Way Remote Start transmitter with a regular service part may result in a failure to program the transmitter.

This procedure will first erase all known keyless entry transmitters. After all transmitters are erased, the procedure will begin to program keyless entry transmitters in sequential order, beginning with transmitter 1.

1. With a scan tool, access the Remote Control Door Lock Receiver Module Setup menu. Select Program Key Fobs.
2. Select Invalidate All Fobs. This will erase all learned transmitters and prepare the RCDLR to learn new transmitters. Follow the on-screen instructions. After each transmitter has been programmed, the vehicle chime will sound to confirm the programming.
3. When all the desired transmitters have been programmed, cycle the ignition from ON to OFF, exit the vehicle, and operate the transmitter functions in order to verify correct system operation.

Transmitter Slot Programming

Note: The keyless entry transmitter used in the Advance 2 Way Remote Start System is unique to the system. When servicing or replacing a transmitter, ensure that the correct transmitter is used. The correct transmitter part number can be found in the Accessory section of the parts catalog. Attempting to replace an Advance 2 Way Remote Start transmitter with a regular service part may result in a failure to program the transmitter.

Transmitter slot programming allows a single transmitter to be programmed into a specific slot without affecting any of the other programmed transmitters. By using slot programming, the transmitter originally programmed to a specific slot is erased and the new transmitter learned in its placed.

1. Install a scan tool.
2. Turn ON the ignition with the engine OFF.
3. With the scan tool, select Body.
4. Select Remote Control Door Lock Receiver (RCDLR).
5. Select Module Setup.
6. Select Program Key Fobs.
7. Select the key fob desired to be programmed.
8. Follow the scan tool on screen instructions.
9. Remove the scan tool.
10. Exit the vehicle. Operate all functions on transmitters to verify correct system operation.

2006 ACCESSORIES & EQUIPMENT

Seats - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Center Seat Armrest Bolt	3 N.m	25 lb in
Front Center Seat Bolt	44 N.m	32 lb ft
Front Seat Adjuster Bolt	45 N.m	33 lb ft
Front Seat Back Cushion Frame Bolt	45 N.m	33 lb ft
Front Seat Cushion Frame Bolt	45 N.m	33 lb ft
Front Seat Cushion Frame Nut	9 N.m	80 lb in
Front Seat Cushion Outer Trim Panel Screw	2 N.m	18 lb in
Front Seat Heater Control Module Screw	2 N.m	18 lb in
Power Recliner Motor Bolt	9 N.m	80 lb in
Rear Seat Armrest Nut	3 N.m	25 lb in
Rear Seat Back Cushion Bolt	45 N.m	33 lb ft
Rear Seat Back Cushion Nut	45 N.m	33 lb ft

SCHEMATIC AND ROUTING DIAGRAMS

DRIVER SEAT SCHEMATICS

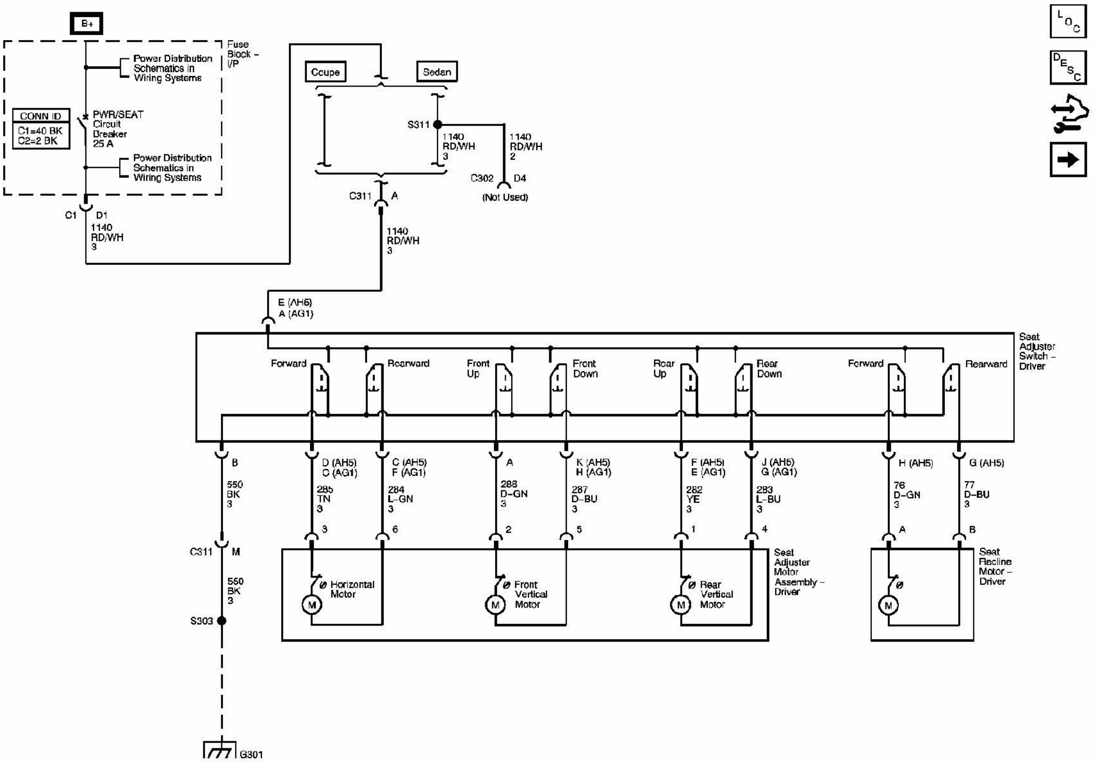

B+
Fuse Block – I/P
Power Distribution Schematics in Wiring Systems
CONN ID
C1=40 BK
C2=2 BK
PWR/SEAT Circuit Breaker 25 A
Power Distribution Schematics in Wiring Systems
C1
D1
1140 RD/WH 3
Coupe
Sedan
S311
1140 RD/WH 3
1140 RD/WH 2
C302
D4
(Not Used)
C311
A
1140 RD/WH 3
E (AH6) A (AG1)
Seat Adjuster Switch – Driver
Forward
Rearward
Front Up
Front Down
Rear Up
Rear Down
Forward
Rearward
B
550 BK 3
D (AH5) C (AG1)
285 TN 3
C (AH5) F (AG1)
284 L–GN 3
A
288 D–GN 3
K (AH5) H (AG1)
287 D–BU 3
F (AH5) E (AG1)
282 YE 3
J (AH5) G (AG1)
283 L–BU 3
H (AH5)
76 D–GN 3
G (AH5)
77 D–BU 3
3
6
2
5
1
4
A
B
C311
M
550 BK 3
S303
Horizontal Motor
Front Vertical Motor
Rear Vertical Motor
Seat Adjuster Motor Assembly – Driver
Seat Recline Motor – Driver
M
M
M
M
G301

Fig. 1: 8-Way Power - Wiring Diagram

Courtesy of GENERAL MOTORS CORP.

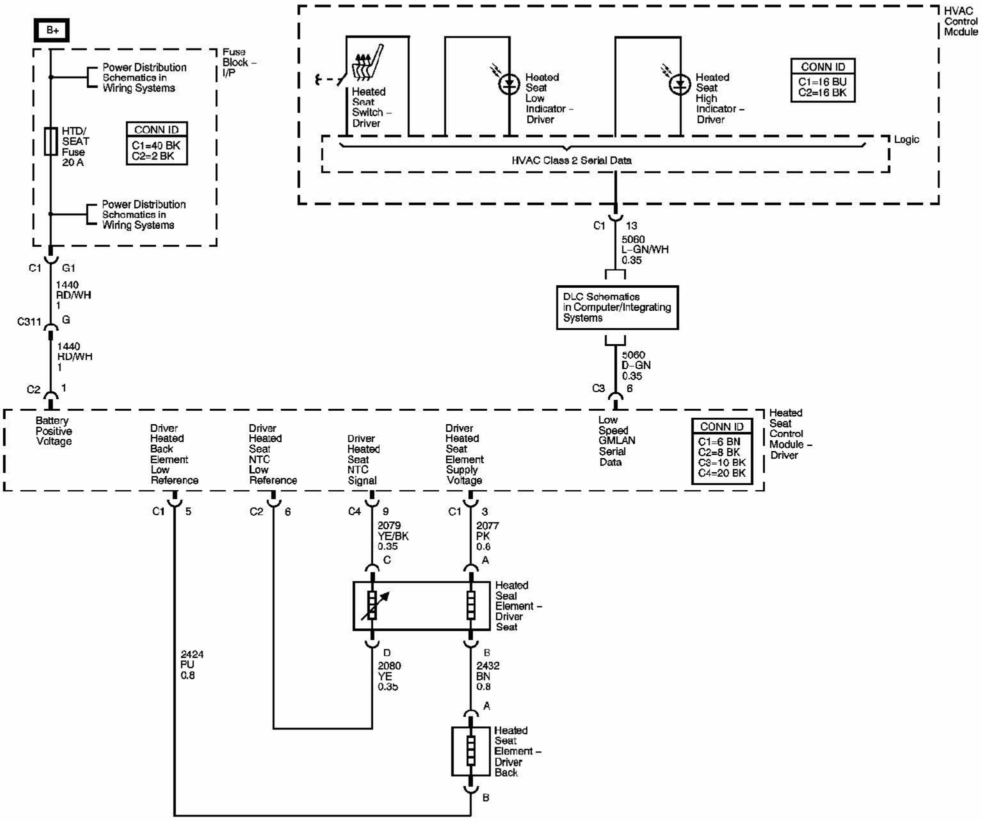

B+
Power Distribution Schematics in Wiring Systems
Fuse Block – I/P
HTD/ SEAT Fuse 20 A
CONN ID
C1=40 BK
C2=2 BK
Power Distribution Schematics in Wiring Systems
C1 G1
1440 RD/WH 1
C311 G
1440 RD/WH 1
C2 1
Heated Seat Switch – Driver
Heated Seat Low Indicator – Driver
Heated Seat High Indicator – Driver
CONN ID
C1=16 BU
C2=16 BK
HVAC Control Module
Logic
HVAC Class 2 Serial Data
C1 13
5060 L–GN/WH 0.35
DLC Schematics in Computer/Integrating Systems
5060 D–GN 0.35
C3 6
Battery Positive Voltage
Driver Heated Back Element Low Reference
Driver Heated Seat NTC Low Reference
Driver Heated Seat NTC Signal
Driver Heated Seat Element Supply Voltage
Low Speed GMLAN Serial Data
CONN ID
C1=6 BN
C2=8 BK
C3=10 BK
C4=20 BK
Heated Seat Control Module – Driver
C1 5
C2 6
C4 9
C1 3
2079 YE/BK 0.35
2077 PK 0.6
C
A
Heated Seal Element – Driver Seat
D
B
2424 PU 0.8
2080 YE 0.35
2432 BN 0.8
A
Heated Seat Element – Driver Back
B

Fig. 2: Heat Controls - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

PASSENGER SEAT SCHEMATICS

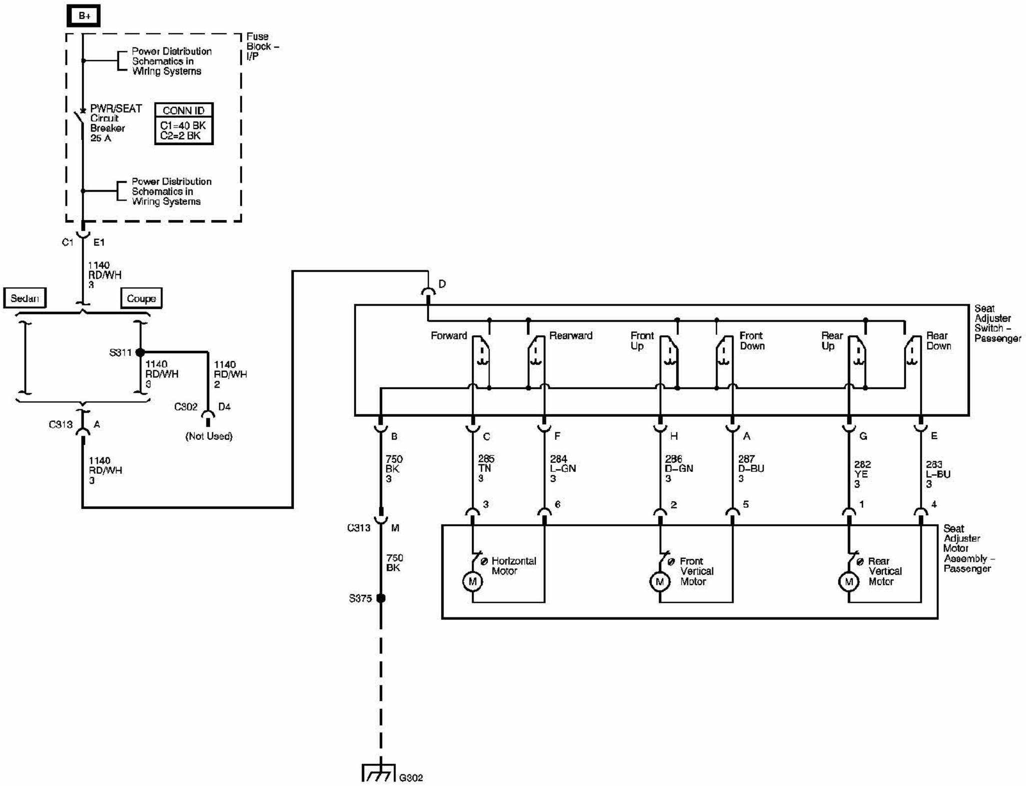

B+
Fuse Block – I/P
Power Distribution Schematics in Wiring Systems
PWR/SEAT Circuit Breaker 25 A
CONN ID
C1=40 BK
C2=2 BK
Power Distribution Schematics in Wiring Systems
C1
E1
1140 RD/WH 3
Sedan
Coupe
S311
1140 RD/WH 3
1140 RD/WH 2
C302
D4
(Not Used)
C313
A
1140 RD/WH 3
D
Seat Adjuster Switch – Passenger
Forward
Rearward
Front Up
Front Down
Rear Up
Rear Down
B
750 BK 3
C
285 TN 3
F
284 L-GN 3
H
286 D-GN 3
A
287 D-BU 3
G
282 YE 3
E
283 L-BU 3
3
6
2
5
1
4
C313
M
750 BK
S375
Horizontal Motor
M
Front Vertical Motor
M
Rear Vertical Motor
M
Seat Adjuster Motor Assembly – Passenger
G302

Fig. 3: 6-Way Power - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

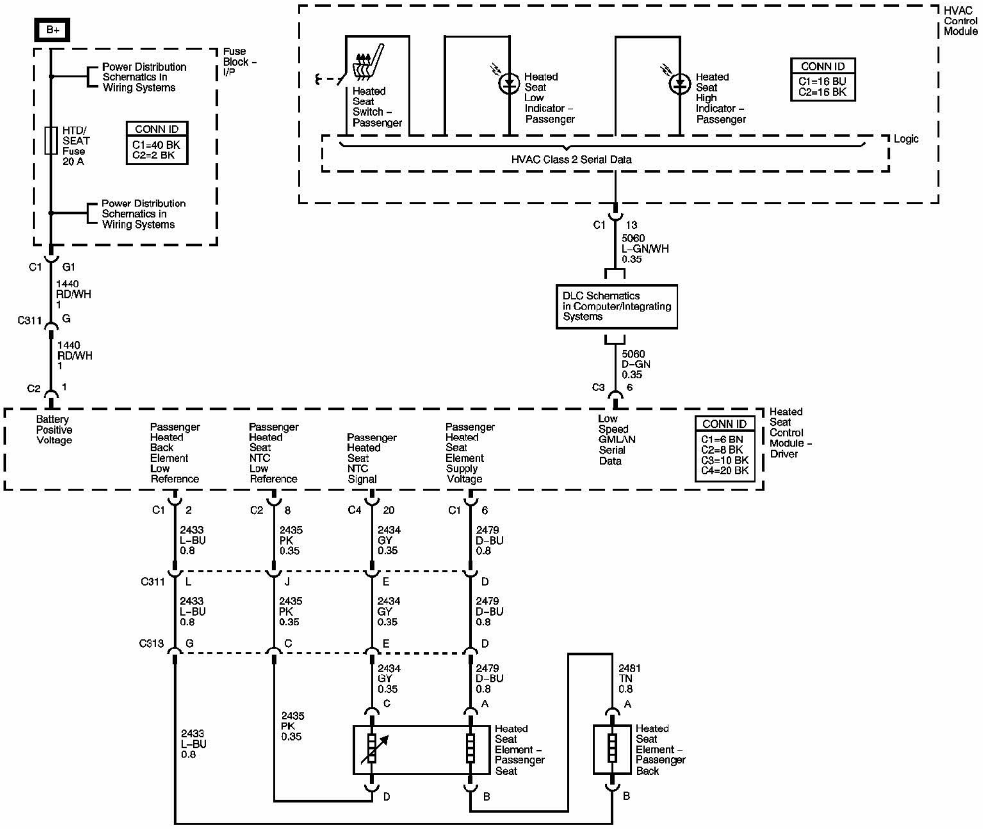

B+
Fuse Block - I/P
Power Distribution Schematics in Wiring Systems
HTD/ SEAT Fuse 20 A
CONN ID
C1=40 BK
C2=2 BK
Power Distribution Schematics in Wiring Systems
C1 G1
1440 RD/WH 1
C311 G
1440 RD/WH 1
C2 1
HVAC Control Module
Heated Seat Switch - Passenger
Heated Seat Low Indicator - Passenger
Heated Seat High Indicator - Passenger
CONN ID
C1=16 BU
C2=16 BK
Logic
HVAC Class 2 Serial Data
C1 13
5060 L-GN/WH 0.35
DLC Schematics in Computer/Integrating Systems
5060 D-GN 0.35
C3 6
Heated Seat Control Module - Driver
Battery Positive Voltage
Passenger Heated Back Element Low Reference
Passenger Heated Seat NTC Low Reference
Passenger Heated Seat NTC Signal
Passenger Heated Seat Element Supply Voltage
Low Speed GMLAN Serial Data
CONN ID
C1=6 BN
C2=8 BK
C3=10 BK
C4=20 BK
C1 2
2433 L-BU 0.8
C2 8
2435 PK 0.35
C4 20
2434 GY 0.35
C1 6
2479 D-BU 0.8
C311 L J E D
2433 L-BU 0.8
2435 PK 0.35
2434 GY 0.35
2479 D-BU 0.8
C313 G C E D
2434 GY 0.35
2479 D-BU 0.8
2481 TN 0.8
C A A
Heated Seat Element - Passenger Seat
Heated Seat Element - Passenger Back
2433 L-BU 0.8
2435 PK 0.35
D B B

Fig. 4: Heat Controls - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

POWER SEAT SYSTEMS COMPONENT VIEWS

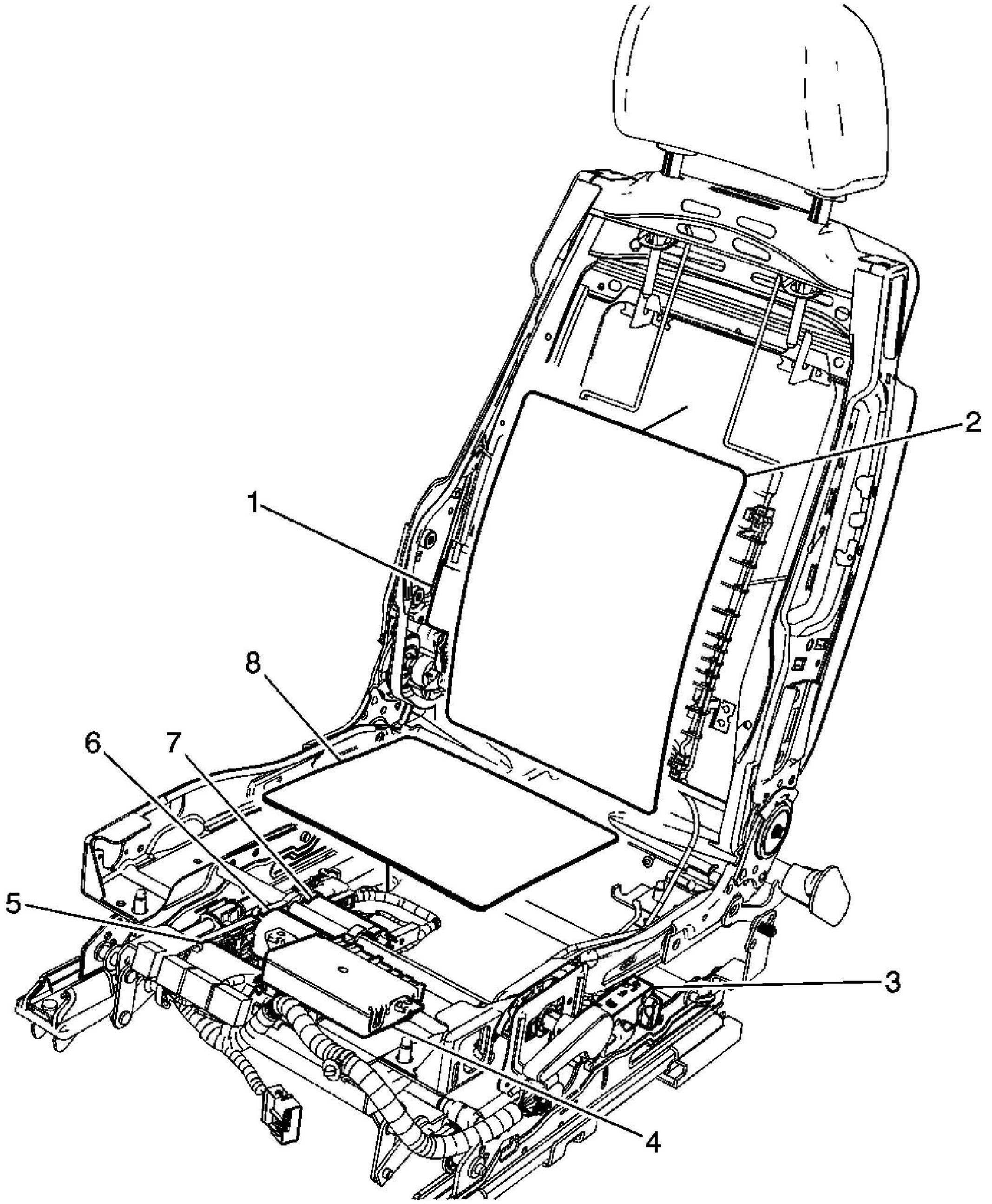


Fig. 5: Driver Seat Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
1	Seat Lumbar Motor
2	Heated Seat Element - Driver - Back (KA1)
3	Seat Adjuster Switch - Driver

4	Heated Seat Control Module (KA1)
5	Seat Horizontal Motor
6	Seat Adjuster Motor - Front
7	Seat Adjuster Motor - Rear
8	Heated Seat Element - Driver - Seat (KA1)

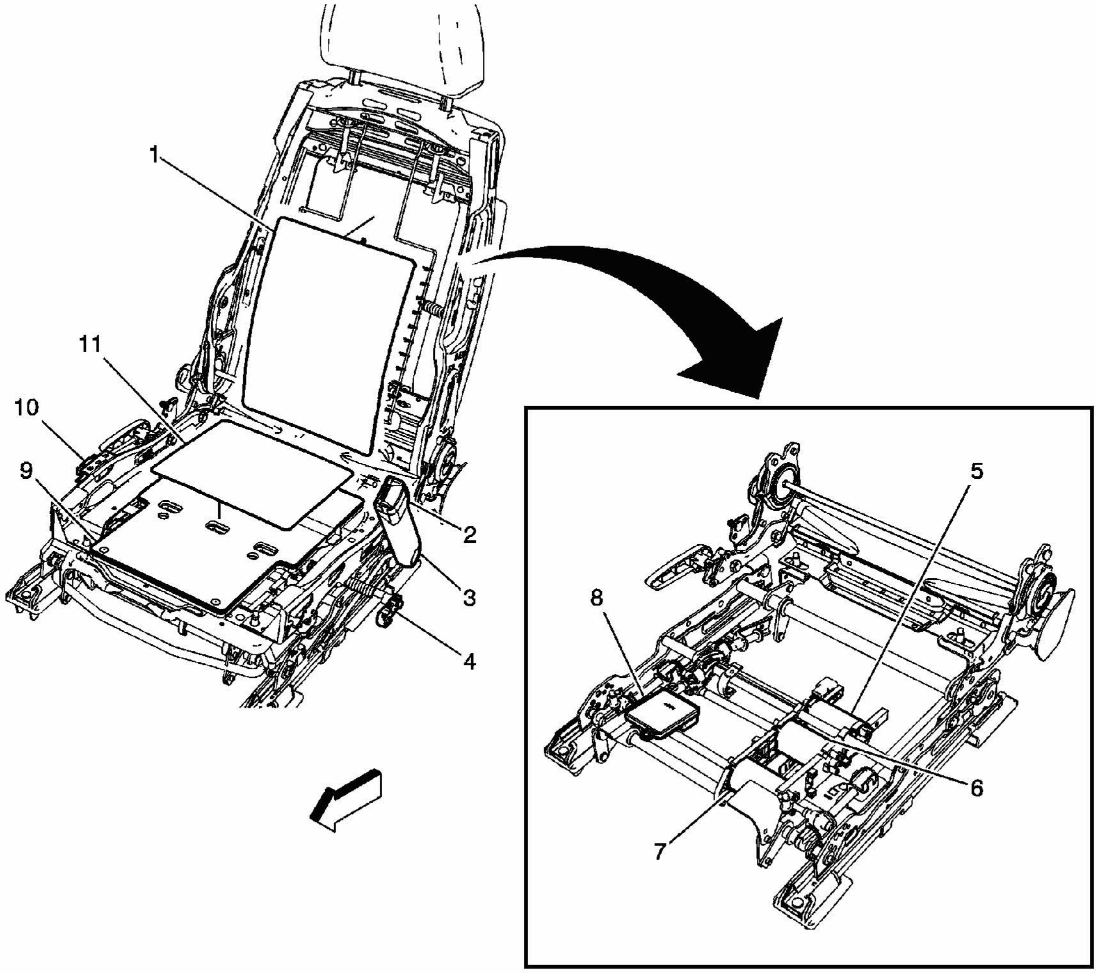


Fig. 6: Passenger Seat Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 6

Callout	Component Name
1	Heated Seat Element - Passenger - Back (KA1)
2	Seat Belt Switch - Passenger
3	Inflatable Restraint Front Passenger Presence System (PPS) Sensor
4	Seat Adjuster Motor - Rear
5	Seat Adjuster Motor - Front
6	Seat Horizontal Motor

7	Inflatable Restraint Front Passenger Presence System (PPS) Module
8	Inflatable Restraint Front Passenger Presence System (PPS) Sensor Pad
9	Seat Adjuster Switch - Passenger
10	Heated Seat Element - Passenger - Seat (KA1)

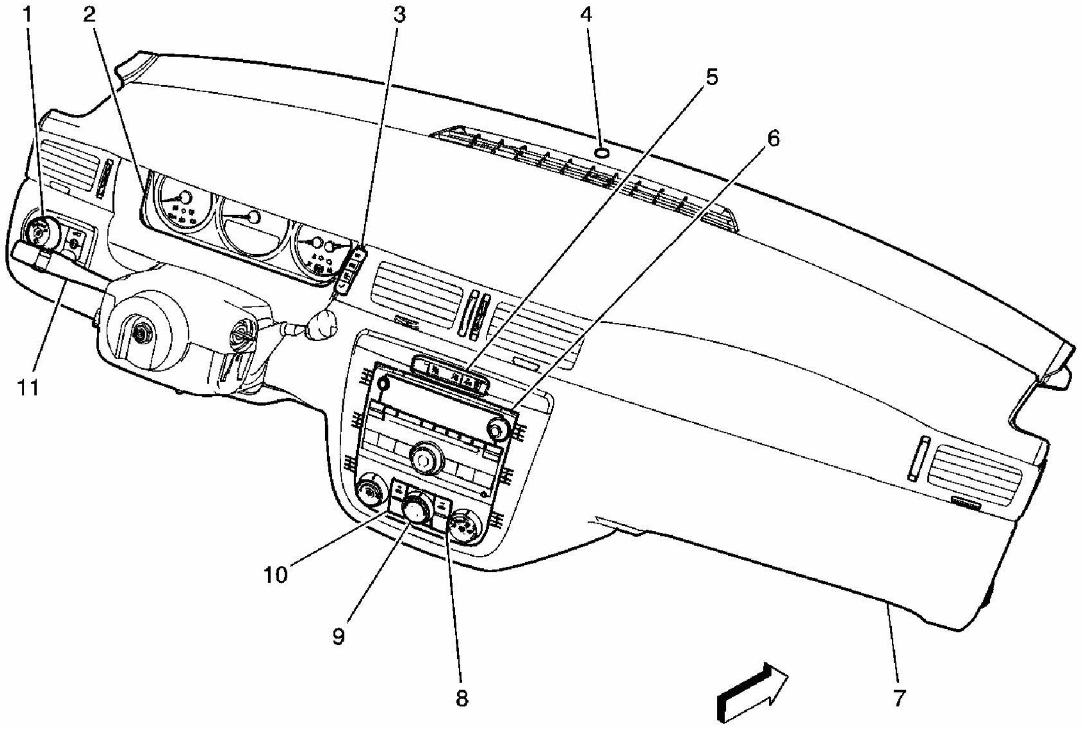


Fig. 7: I/P Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 7

Callout	Component Name
1	Headlamp Switch
2	Instrument Panel Cluster (IPC)
3	Driver Information Center (DIC) Switch
4	Ambient Light Sensor
5	Inflatable Restraint Passenger Air Bag On/Off Indicator (Sedan w/o 9C1, 9C3)
6	Radio
7	I/P Trim Panel
8	Heated Seat Switch-Passenger (KA7)
9	HVAC Control Module

10	Heated Seat Switch-Driver (KA7)
11	Turn Signal / Multifunction Switch

POWER SEAT SYSTEMS CONNECTOR END VIEWS

Heated Seat Control Module - Driver C1 (KA1)

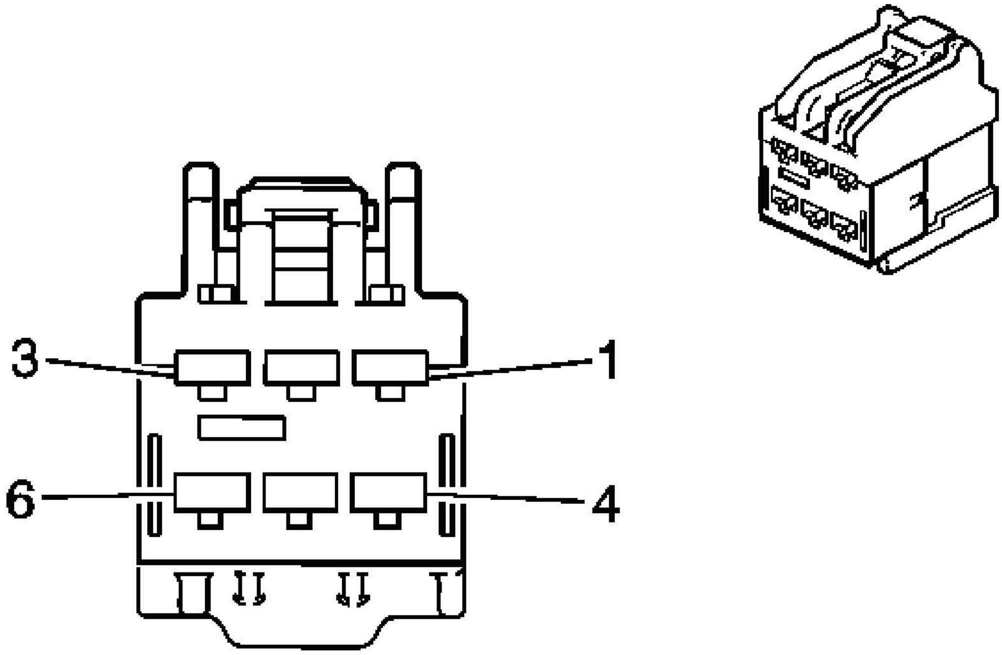


Fig. 8: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information

- OEM: 15486524
- Service: See Catalog
- Description: 6-Way F 2.8mm Sumitomo (BN)

Terminal Part Information

- Terminal/Tray: 8100-4444/22
- Core/Insulation Crimp: 2/A
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Heated Seat Control Module - Driver C1 (KA1)

Pin	Wire Color	Circuit No.	Function
1	-	-	Not Used
2	L-BU	2433	Passenger Heated Seat Back Element Control
3	PK	2077	Heated Seat Cushion Element Supply Voltage
4	-	-	Not Used
5	PU	2424	Driver Heated Seat Back Element Control
6	D-BU	2479	Passenger Heated Seat Element Supply Voltage

Heated Seat Control Module - Driver C2 (KA1)

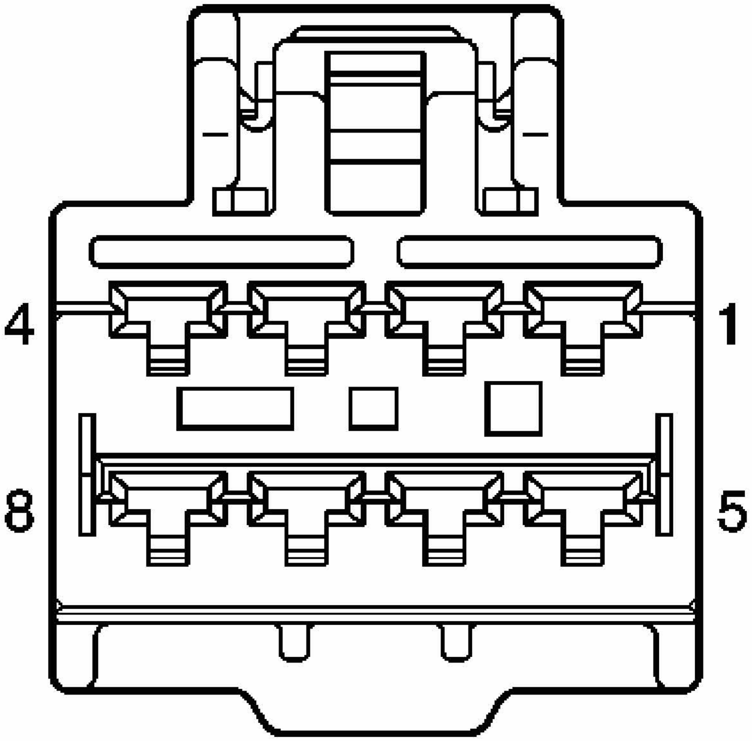


Fig. 9: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information

- OEM: 15491286
- Service: 88988652
- Description: 8-Way F Receptacle 2.8 (BK)

Terminal Part Information

- Pins: 1, 2
- Terminal/Tray: 8100-4444/22
- Core/Insulation Crimp: 2/A
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

- Pins: 6, 8
- Terminal/Tray: 8100-4443/22
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Heated Seat Control Module - Driver C2 (KA1)

Pin	Wire Color	Circuit No.	Function
1	RD/WH	1440	Battery Positive Voltage
2	BK	550	Ground
3-5	-	-	Not Used
6	YE	2080	Driver Heated Seat Cushion Temperature Sensor Low Reference
7	-	-	Not Used
8	PK	2435	Passenger Heated Seat Cushion Temperature Sensor Low Reference

Heated Seat Control Module - Driver C3 (KA1)

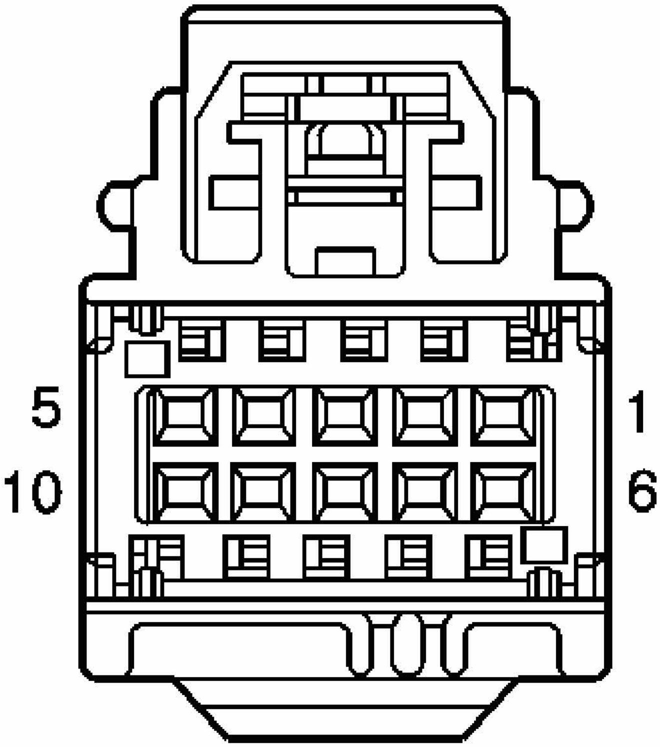


Fig. 10: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information

- OEM: 15491259
- Service: See Catalog
- Description: 10-Way F Yazaki Unsealed (BK)

Terminal Part Information

- Pins: 6
- Terminal/Tray: 7116-4618-02/14
- Core/Insulation Crimp: P/P
- Release Tool/Test Probe: J-38125-215/J-35616-64A (L-BU)

Heated Seat Control Module - Driver C3 (KA1)

Pin	Wire Color	Circuit No.	Function
1-5	-	-	Not Used
6	D-GN	5060	Low Speed GMLAN Serial Data
7-10	-	-	Not Used

Heated Seat Control Module - Driver C4 (KA1)

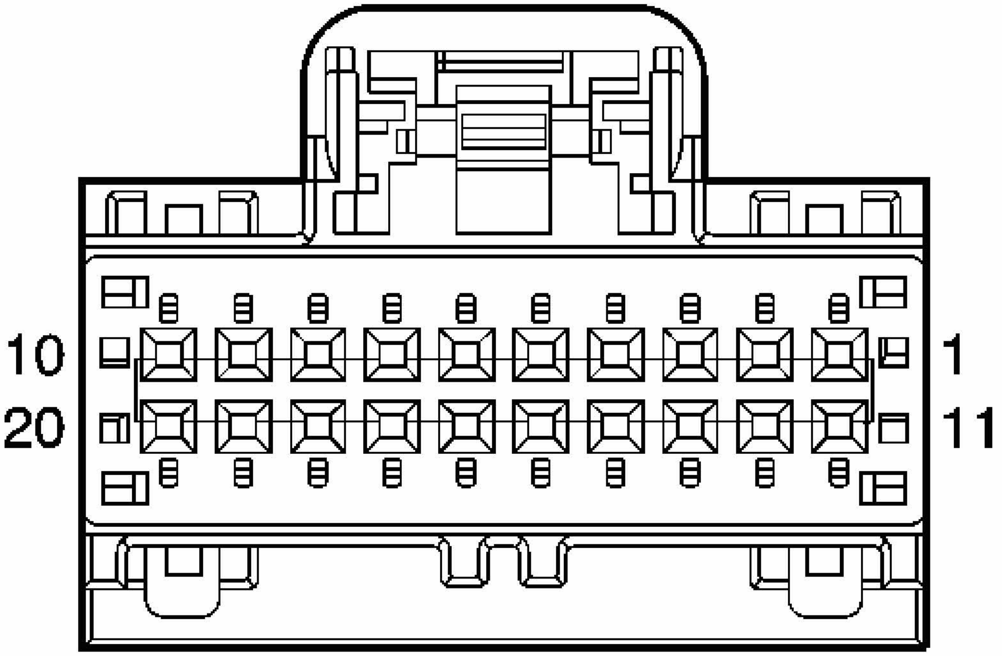


Fig. 11: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information

- OEM: 15489824
- Service: See Catalog
- Description: 20-Way F Receptacle 0.64 (BK)

Terminal Part Information

- Pins: 9, 20
- Terminal/Tray: 7116-4618-02/14

- Core/Insulation Crimp: P/P
- Release Tool/Test Probe: J-38125-215/J-35616-64A (L-BU)

Heated Seat Control Module - Driver C4 (KA1)

Pin	Wire Color	Circuit No.	Function
1-8	-	-	Not Used
9	YE/BK	2079	Heated Seat Cushion Temperature Sensor Signal
10-19	-	-	Not Used
20	GY	2434	Passenger Heated Seat Cushion Temperature Sensor Signal

Heated Seat Element - Driver - Back (KA1)

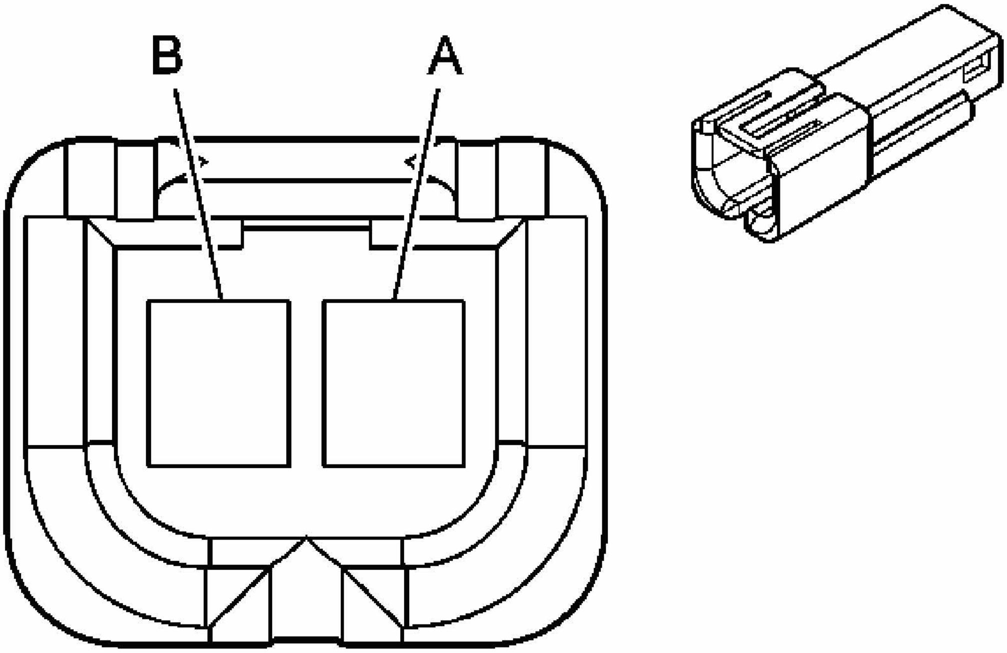


Fig. 12: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information

- OEM: 12064778

- Service: See Catalog
- Description: 2-Way M Metri-Pack 150 Series (L-GN)

Terminal Part Information

- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Heated Seat Element - Driver - Back (KA1)

Pin	Wire Color	Circuit No.	Function
A	BN	2432	Driver Heated Seat Back Element Supply Voltage
B	PU	2424	Driver Heated Seat Back Element Control

Heated Seat Element - Driver - Seat (KA1)

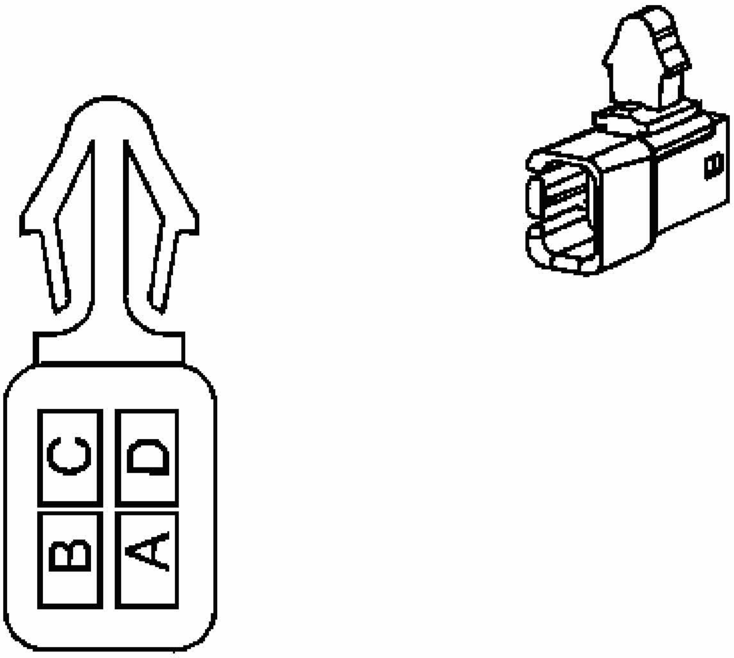


Fig. 13: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information

- OEM: 12066498
- Service: See Catalog
- Description: 4-Way M Metri-Pack 150 Series (BK)

Terminal Part Information

- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: Pins A, B - E/A
- Core/Insulation Crimp: Pins C, D - E/C
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Heated Seat Element - Driver - Seat (KA1)

Pin	Wire Color	Circuit No.	Function
A	PK	2077	Heated Seat Cushion Element Supply Voltage
B	BN	2432	Driver Heated Seat Back Element Supply Voltage
C	YE/BK	2079	Heated Seat Cushion Temperature Sensor Signal
D	YE	2080	Driver Heated Seat Cushion Temperature Sensor Low Reference

Heated Seat Element - Passenger - Back

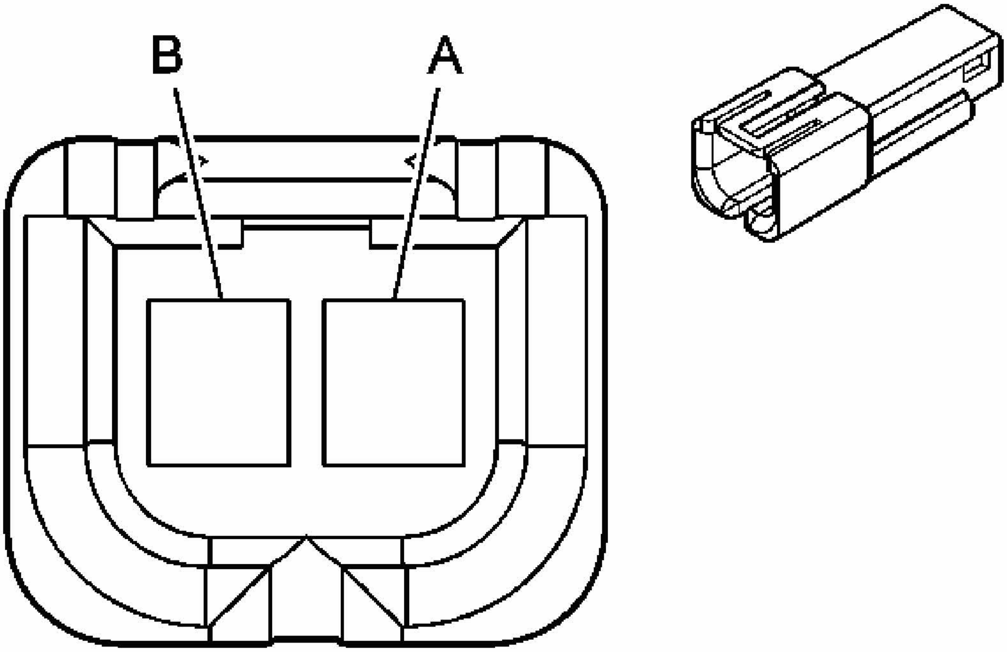


Fig. 14: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information - OEM: 12064778 - Service: See Catalog - Description: 2-Way M Metri-Pack 150 Series (L-GN) **Terminal Part Information** - Terminal/Tray: 12047581/2 - Core/Insulation Crimp: E/A - Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Heated Seat Element - Passenger - Back

Pin	Wire Color	Circuit No.	Function
A	TN	2481	Passenger Heated Seat Back Element Supply Voltage
B	L-BU	2433	Passenger Heated Seat Back Element

			Control

Heated Seat Element - Passenger - Seat

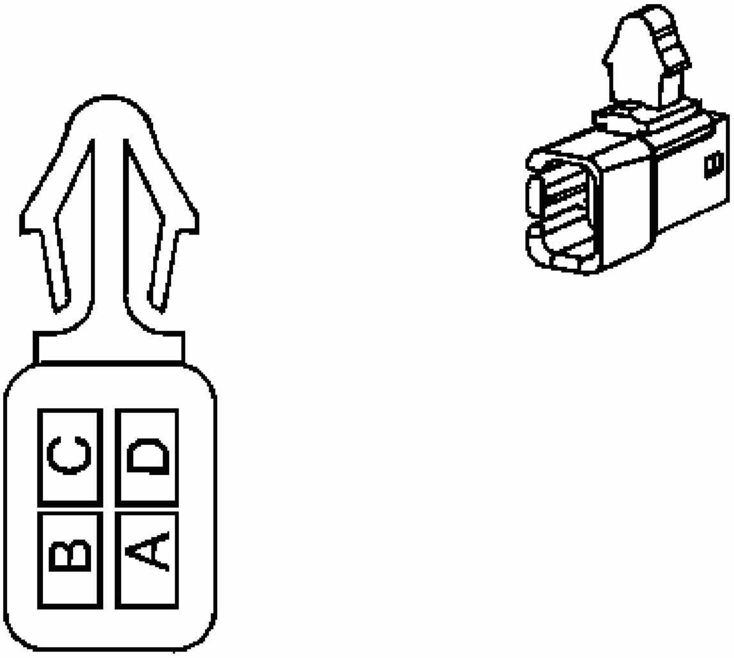


Fig. 15: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information

- OEM: 12066498
- Service: See Catalog
- Description: 4-Way M Metri-Pack 150 Series (BK)

Terminal Part Information

- Terminal/Tray: 12047581/2
- Core/Insulation Crimp: Pins A, B - E/A
- Core/Insulation Crimp: Pins C, D - E/C
- Release Tool/Test Probe: 12094429/J-35616-3 (GY)

Heated Seat Element - Passenger - Seat

Pin	Wire Color	Circuit No.	Function
A	D-BU	2479	Passenger Heated Seat Element Supply Voltage
B	TN	2481	Passenger Heated Seat Back Element Supply Voltage
C	GY	2434	Passenger Heated Seat Cushion Temperature Sensor Signal
D	PK	2435	Passenger Heated Seat Cushion Temperature Sensor Low Reference

Seat Adjustor Motor Assembly - Driver

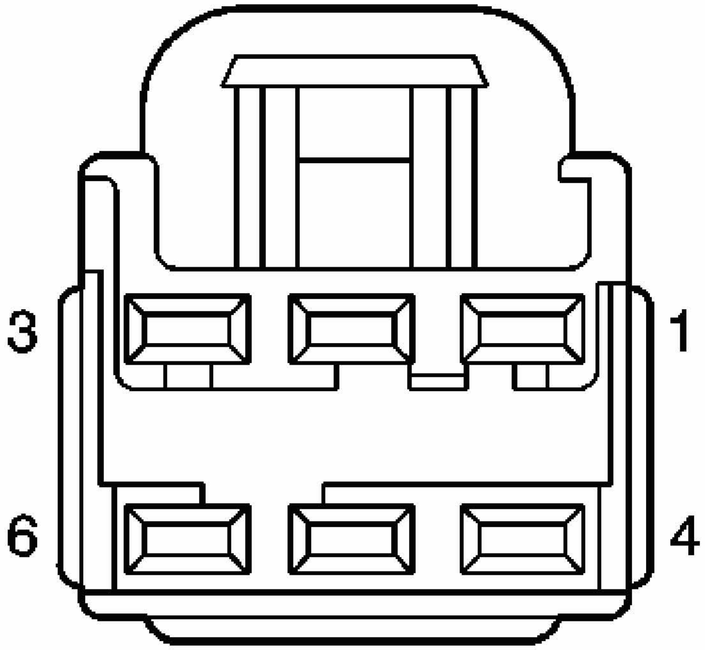


Fig. 16: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information
- OEM: 10847014

- Service: See Catalog
- Description: 6-Way F Yazaki 2.8mm Unsealed (L-GY)

Terminal Part Information

- Terminal/Tray: 7116-4112-02/9
- Core/Insulation Crimp: C/D
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Seat Adjustor Motor Assembly - Driver

Pin	Wire Color	Circuit No.	Function
1	YE	282	Driver Seat Rear Vertical Motor Up Control
2	D-GN	286	Driver Seat Front Vertical Motor Up Control
3	TN	285	Driver Seat Horizontal Motor Forward Control
4	L-BU	283	Driver Seat Rear Vertical Motor Down Control
5	D-BU	287	Driver Seat Front Vertical Motor Down Control
6	L-GN	284	Driver Seat Horizontal Motor Rearward Control

Seat Adjustor Motor Assembly - Passenger

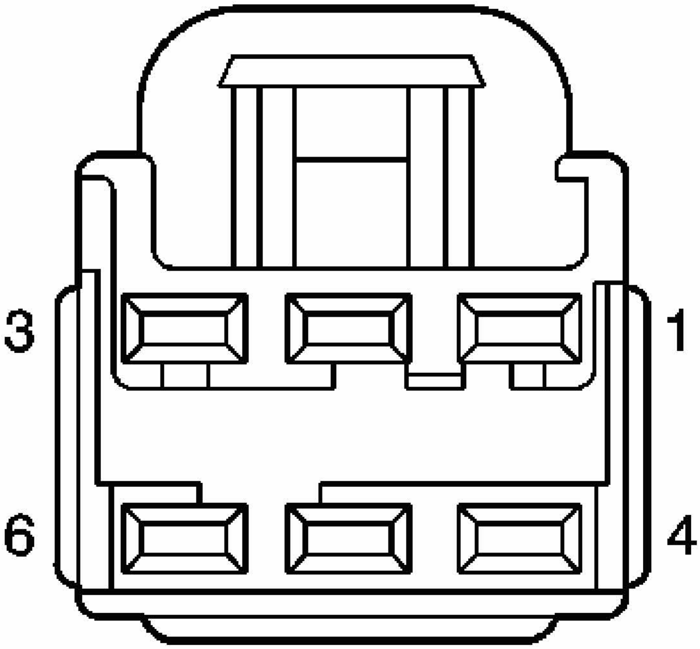


Fig. 17: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information

- OEM: 10847014
- Service: See Catalog
- Description: 6-Way F Yazaki 2.8mm Unsealed (L-GY)

Terminal Part Information

- Terminal/Tray: 7116-4112-02/9
- Core/Insulation Crimp: C/D
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Seat Adjustor Motor Assembly - Passenger

Pin	Wire Color	Circuit No.	Function
1	YE	282	Driver Seat Rear Vertical Motor Up Control
			Driver Seat Front Vertical Motor Up

2	D-GN	286	Control
3	TN	285	Driver Seat Horizontal Motor Forward Control
4	L-BU	283	Driver Seat Rear Vertical Motor Down Control
5	D-BU	287	Driver Seat Front Vertical Motor Down Control
6	L-GN	284	Driver Seat Horizontal Motor Rearward Control

Seat Adjustor Switch - Driver (AG1)

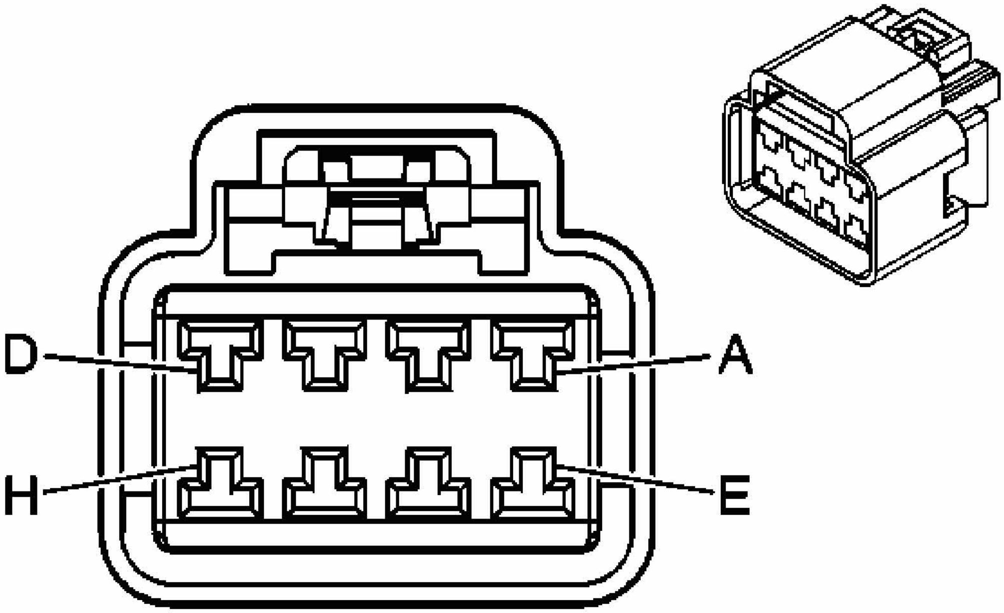


Fig. 18: Seat Adjustor Switch Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information

- OEM: 15326924
- Service: 15306174
- Description: 8-Way F GT 280 (BK)

Terminal Part Information

- Terminal/Tray: 15304713/19
- Core/Insulation Crimp: F/D
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Seat Adjustor Switch - Driver (AG1)

Pin	Wire Color	Circuit No.	Function
A	D-GN	286	Driver Seat Front Vertical Motor Up Control
B	BK	550	Ground
C	TN	285	Driver Seat Horizontal Motor Forward Control
D	RD/WH	1140	Battery Positive Voltage
E	YE	282	Driver Seat Rear Vertical Motor Up Control
F	L-GN	284	Driver Seat Horizontal Motor Rearward Control
G	L-BU	283	Driver Seat Rear Vertical Motor Down Control
H	D-BU	287	Driver Seat Front Vertical Motor Down Control

Seat Adjustor Switch - Driver (AH5)

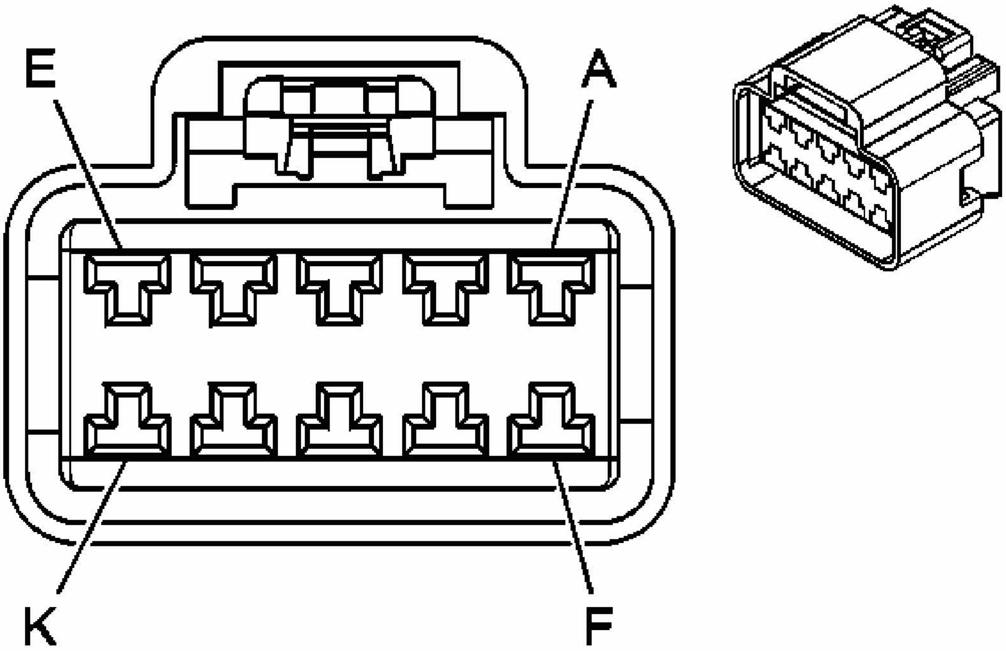


Fig. 19: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information

- OEM: 15326931
- Service: 15306309
- Description: 10-Way F GT 280 (BK)

Terminal Part Information

- Terminal/Tray: 15304713/19
- Core/Insulation Crimp: F/D
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Seat Adjustor Switch - Driver (AH5)

Pin	Wire Color	Circuit No.	Function
A	D-GN	286	Driver Seat Front Vertical Motor Up Control
B	BK	550	Ground

C	L-GN	284	Driver Seat Horizontal Motor Rearward Control
D	TN	285	Driver Seat Horizontal Motor Forward Control
E	RD/WH	1140	Battery Positive Voltage
F	YE	282	Driver Seat Rear Vertical Motor Up Control
G	D-BU	77	Passenger Seat Recline Motor Rearward
H	D-GN	76	Passenger Seat Recline Motor Forward
J	L-BU	283	Driver Seat Rear Vertical Motor Down Control
K	D-BU	287	Driver Seat Front Vertical Motor Down Control

Seat Adjustor Switch - Passenger (AG2)

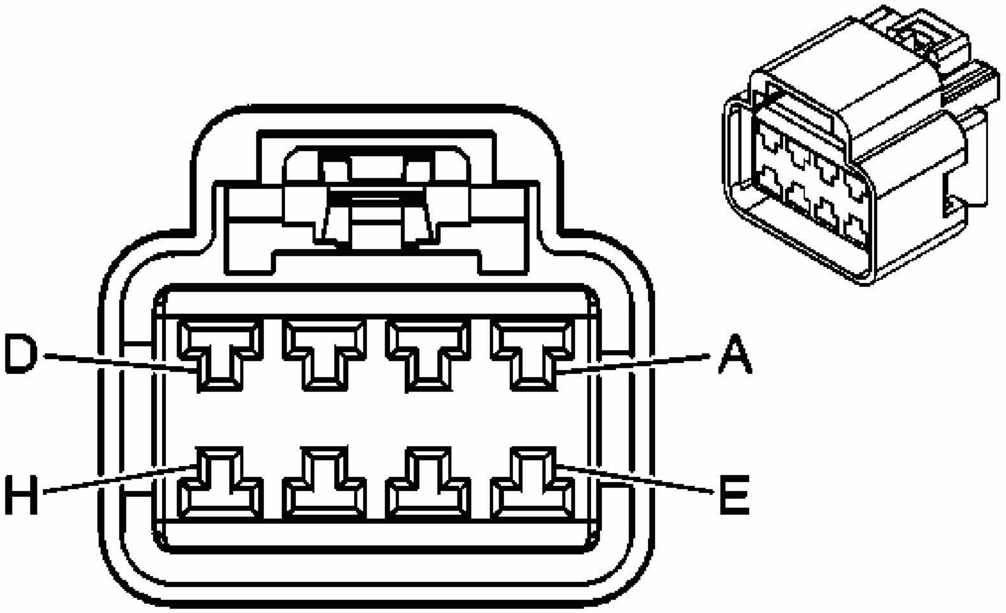


Fig. 20: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information

- OEM: 15326924
- Service: 15306174
- Description: 8-Way F GT 280 Series (BK)

Terminal Part Information

- Terminal/Tray: 15304713/19
- Core/Insulation Crimp: F/D
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Seat Adjustor Switch - Passenger (AG2)

Pin	Wire Color	Circuit No.	Function
A	D-BU	287	Passenger Seat Front Vertical Motor Down Control
B	BK	750	Ground
C	TN	285	Passenger Seat Horizontal Motor Forward Control
D	RD/WH	1140	Battery Positive Voltage
E	L-BU	283	Passenger Seat Rear Vertical Motor Down Control
F	L-GN	284	Passenger Seat Horizontal Motor Rearward Control
G	YE	282	Passenger Seat Rear Vertical Motor Up Control
H	D-GN	286	Passenger Seat Front Vertical Motor Up Control

Seat Recline Motor - Driver (AH5)

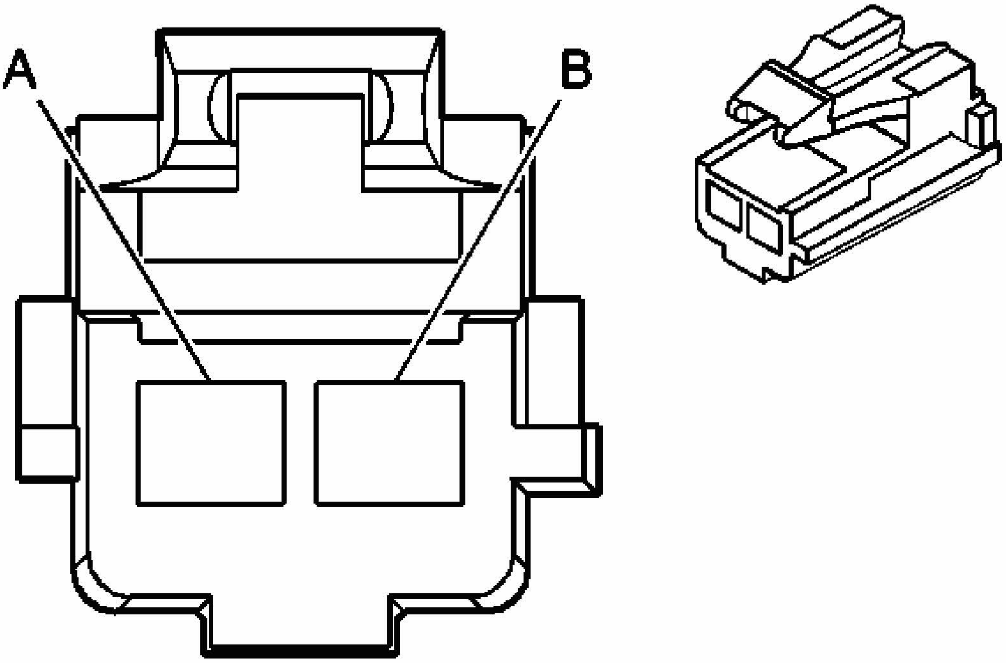


Fig. 21: Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Seat Systems Connector End Views

Connector Part Information
• OEM: 12129081 • Service: See Catalog • Description: 2-Way F Metri-Pack 280 Flex Lock (BK)
Terminal Part Information
• Terminal/Tray: 12110842/4 • Core/Insulation Crimp: F/G • Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Seat Recline Motor - Driver (AH5)

Pin	Wire Color	Circuit No.	Function
A	D-GN	76	Passenger Seat Recline Motor Forward
B	D-BU	77	Passenger Seat Recline Motor

			Rearward

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTCs B1925 02, B1925 05, B2170 02 and B2170 05	Left Seat Heater Cushion Sensor Circuit Shorted to Ground, Left Seat Heater Cushion Sensor Circuit Shorted to Battery or Open, Right Seat Heater Cushion Sensor Circuit Shorted to Ground, Right Seat Heater Cushion Sensor Circuit Shorted to Battery or Open
DTC B2425 04, B2425 0A, B2425 0B, B2425 1F, B2430 04, B2430 0A, B2430 0B, B2430 1F	Left Seat Heater Circuit Open, Left Seat Heater Circuit Rate of Change Below Threshold, Left Seat Heater Circuit Current Above Threshold, Left Seat Heater Circuit Intermittent, Right Seat Heater Circuit Open, Right Seat Heater Circuit Rate of Change Below Threshold, Right Seat Heater Circuit Current Above Threshold, Right Seat Heater Circuit Intermittent

DIAGNOSTIC STARTING POINT - SEATS

Always begin the diagnosis by reviewing the system Description and Operation. Reviewing the Description and Operation will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the Description and Operation will also help you determine if the condition described by the customer is normal operation.

Begin diagnosis with the **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes and their status

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL DATA LIST

Memory Seat Module (MSM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF			

8-Digit GM Part Number	ID Information	Numeric	Varies
Battery Voltage	Data	Volts	Varies
Calibration ID	ID Information	Numeric	Varies
Current	Data	amps	0.5-8.5
Front Vertical Sensor	Sensor Data 1	A/D/Volts	0.0-255/0.0-5.0
Horizontal Sensor	Sensor Data 1	A/D/Volts	0.0-255/0.0-5.0
Lumbar Horizontal Sensor	Sensor Data 2	A/D/Volts	0.0-255/0.0-5.0
PROM ID	ID Information	Numeric	Varies
Rear Vertical Sensor	Sensor Data 1	A/D/Volts	0.0-255/0.0-5.0
Recline Sensor	Sensor Data 1	A/D/Volts	0.0-255/0.0-5.0
Seat Forward	Inputs and Outputs	Active/Inactive	Inactive
Seat Front Down	Inputs and Outputs	Active/Inactive	Inactive
Seat Front Up	Inputs and Outputs	Active/Inactive	Inactive
Seat Lumbar Forward	Inputs and Outputs	Active/Inactive	Inactive
Seat Lumbar Rearward	Inputs and Outputs	Active/Inactive	Inactive
Seat Rearward	Inputs and Outputs	Active/Inactive	Inactive
Seat Rear Down	Inputs and Outputs	Active/Inactive	Inactive
Seat Rear Up	Inputs and Outputs	Active/Inactive	Inactive
Seat Recline Forward	Inputs and Outputs	Active/Inactive	Inactive
Seat Recline Rearward	Inputs and Outputs	Active/Inactive	Inactive

Driver Door Switch Assembly (DDSA)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF			
8-Digit GM Part Number	ID Information	Numeric	Varies
Battery Voltage	Data	Volts	Varies
Calibration ID	ID Information	Numeric	Varies
Julian Date of Build	ID Information	Numeric	Varies
Memory Recall Switches	Inputs	Idle Memory 1 Memory 2 Exit	Idle

Year Module Built	ID Information	Numeric	Varies

Rear Integration Module (RIM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF			
8-Digit GM Part Number	ID Information	Numeric	Varies
Battery Voltage	Data	Volts	Varies
Driver Heated Seat Status	Input/Output	Off/On	Off
Hardware ID	ID Information	Numeric	Varies
Julian Date of Build	ID Information	Numeric	Varies
Load Shed Lvl. 1 Heated Seats	Input/Output	Enable/Disabled	Disabled
Load Shed Lvl. 2 Heated Seats	Input/Output	Enable/Disabled	Disabled
Pass. Heated Seat Status	Input/Output	Off/On	Off
PROM ID	ID Information	Numeric	Varies
Year Module Built	ID Information	Numeric	Varies

Climate Control Panel

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF			
8-Digit GM Part Number	Module Information	Numeric	Varies
Calibration ID	Module Information	Numeric	Varies
Driver Heated Seat Status	Non-HVAC Data	Off/High/Low	Off
Driver Heated Seat Sw.	Non-HVAC Data	Pressed/Off	Off
Julian Date of Build	Module Information	Numeric	Varies
Passenger Heated Seat Status	Non-HVAC Data	Off/High/Low	Off
Pass. Heated Seat Sw.	Non-HVAC Data	Pressed/Off	Off
PROM ID	Module Information	Numeric	Varies
Year Module Built	Module Information	Numeric	Varies

SCAN TOOL DATA DEFINITIONS

8 - Digit GM Part Number

The scan tool displays the part number of the module.

Battery Voltage

The scan tool displays 0-16 Volts. The voltage measured between the module's battery positive circuit and ground circuit.

Calibration ID

The scan tool displays a 4-digit number. This number designates the calibration or program level used in the PROM.

Current

The scan tool displays 0-127.5 amps. The amount of amps used during seat operation.

Driver Heated Seat Status - CCP

The scan tool displays Off/High/Low. When the heated seat is on, the scan tool will display the status signal from the rear integration module to the climate control panel as High or Low.

Driver Heated Seat Status - RIM

The scan tool displays On/Off. When the heated seat is on, the scan tool will display the status signal from the heated seat module to the rear integration module as On.

Driver Heated Seat Sw. - CCP

The scan tool displays Idle/Pressed. When the driver heated seat switch is pressed, the scan tool will momentarily display the switch input of the climate control panel as Pressed.

Front Vertical Sensor

The scan tool displays 0-5.0 Volts or 0-255 A/D. The sensor potentiometer provides an analog voltage which varies directly with the seat front vertical position. High scan tool values (Volts or A/D) indicate that the seat front is in the up position and low values indicate that the seat front is in the down position.

Horizontal Sensor

The scan tool displays 0-5.0 Volts or 0-255 A/D. The sensor potentiometer provides an analog voltage which varies directly with the seat horizontal position. High scan tool values (Volts or A/D) indicate that the seat is in the forward position and low values indicate that the seat is in the rearward position.

Julian Date of Build

The scan tool displays a 3-digit number. This number is the day of the year that the module was built.

Load Shed Lvl. 1 Heated Seat

The scan tool displays Disabled/Enable. During a pre-determined heavy loading condition, the driver information module (DIM) will send out a class 2 message to the rear integration module (RIM) that a load shed level 1 is in effect and the scan tool will display Enable.

Load Shed Lvl. 2 Heated Seat

The scan tool displays Disabled/Enable. During a pre-determined heavy loading condition, the driver information module (DIM) will send out a class 2 message to the rear integration module (RIM) that a load shed level 2 is in effect and the scan tool will display Enable.

Lumbar Horizontal Sensor

The scan tool displays 0-5.0 Volts or 0-255 A/D. The sensor potentiometer provides an analog voltage which varies directly with the lumbar horizontal position. High scan tool values (Volts or A/D) indicate that the Lumbar is in the forward position and low values indicate that the lumbar is in the rearward position.

Memory Recall Switches

The scan tool displays Idle/Memory 1/memory 2/Exit. When a memory function switch is pressed, the scan tool will momentarily display the function as selected.

Pass. Heated Seat Status - RIM

The scan tool displays Off/On. When the heated seat is ON, the scan tool will display the status signal from the heated seat module to the rear integration module (RIM) as On.

Pass. Heated Seat SW. - CCP

The scan tool displays Idle/Pressed. When the passenger heated seat switch is pressed, the scan tool will momentarily display the heated seat switch input of the climate control panel as Pressed.

Passenger Heated Seat Status - CCP

The scan tool displays Off/High/Low. When the passenger heated seat switch is pressed, the scan tool will display the status signal from the rear integration module to the climate control panel as High or Low.

Personalization Option

This is the state of the personalization option as it is stored in the Dash Integration Module (DIM). When the Personalization Option is selected, the scan tool displays the directions to activate or deactivate the personalization option. The asterisk beside the option indicates that the personalization option is activated. The personalization option is normally set to the activated state during assembly of the vehicle.

PROM ID

The scan tool displays a 4-digit number. This is the identification number of the PROM that is incorporated into the module.

Rear Vertical Sensor

The scan tool displays 0-5.0 Volts or 0-255 A/D. The sensor potentiometer provides an analog voltage which varies directly with the seat rear vertical position. High scan tool values (Volts or A/D) indicate that the seat rear vertical is in the up position and low values indicate that the seat rear vertical is in the down position.

Recline Sensor

The scan tool displays 0-5.0 Volts or 0-255 A/D. The sensor potentiometer provides an analog voltage which varies directly with the seat recline position. High scan tool values (Volts or A/D) indicate that the seat recline is in the froward position and low values indicate that the seat recline is in the rearward position.

Seat Forward - Input

The scan tool displays Inactive/Active. When the seat forward switch is activated, the scan tool will momentarily display the switch input to the memory seat module as Active.

Seat Forward - Output

The scan tool displays Inactive/Active. When the seat forward switch is activated or when a memory recall occurs, the scan tool will display Active while the output from the memory seat module is commanding the seat horizontal motor in the forward direction.

Seat Front Down - Input

The scan tool displays Inactive/Active. When the seat front down switch is activated the scan tool will momentarily display the switch input to the memory seat module as Active.

Seat Front Down - Output

The scan tool displays Inactive/Active. When the seat front down switch is activated or when a memory recall occurs, the scan tool will display Active while the output from the memory seat module is commanding the seat front vertical motor in the down direction.

Seat Front Up - Input

The scan tool displays Inactive/Active. When the seat front up switch is activated, the scan tool will momentarily display the switch input to the memory seat module as Active.

Seat Front Up - Output

The scan tool displays Inactive/Active. When the seat front up switch is activated or when a memory recall occurs, the scan tool will display Active while the output from the memory seat module is commanding the seat front vertical motor in the up direction.

Seat Lumbar Forward - Input

The scan tool displays Inactive/Active. When the seat lumbar forward switch is activated, the scan tool will momentarily display the switch input to the memory seat module as Active.

Seat Lumbar Forward - Output

The scan tool displays Inactive/Active. When the seat lumbar forward switch is activated or when a memory recall occurs, the scan tool will display Active while the output from the memory seat module is commanding the lumbar horizontal motor in the forward direction.

Seat Lumbar Rearward - Input

The scan tool displays Inactive/Active. When the seat lumbar rearward switch is activated, the scan tool will momentarily display the switch input to the memory seat module as Active.

Seat Lumbar Rearward - Output

The scan tool displays Inactive/Active. When the seat lumbar rearward switch is activated or when a memory recall occurs, the scan tool will display Active while the output from the memory seat module is commanding the lumbar horizontal motor in the rearward direction.

Seat Rear Down - Input

The scan tool displays Inactive/Active. When the seat rear down switch is activated, the scan tool will momentarily display the switch input to the memory seat module as Active.

Seat Rear Down - Output

The scan tool displays Inactive/Active. When the seat rear down switch is activated or when a memory recall occurs, the scan tool will display Active while the output from the memory seat module is commanding the seat rear vertical motor in the down direction.

Seat Rear Up - Input

The scan tool displays Inactive/Active. When the seat rear up switch is activated, the scan tool will momentarily display the switch input to the memory seat module as Active.

Seat Rear Up - Output

The scan tool displays Inactive/Active. When the seat rear up switch is activated or when a memory recall occurs, the scan tool will display Active while the output from the memory seat module is commanding the seat rear vertical motor in the up direction.

Seat Rearward - Input

The scan tool displays Inactive/Active. When the seat rearward switch is activated, the scan tool will momentarily display the switch input to the memory seat module as Active.

Seat Rearward - Output

The scan tool displays Inactive/Active. When the seat rearward switch is activated or when a memory recall occurs, the scan tool will display Active while the output from the memory seat module is commanding the seat horizontal motor in the rearward direction.

Seat Recline Forward - Input

The scan tool displays Inactive/Active. When the seat recline forward switch is activated, the scan tool will momentarily display the switch input to the memory sear module as Active.

Seat Recline Forward - Output

The scan tool displays Inactive/Active. When the seat recline forward switch is activated or when a memory recall occurs, the scan tool will display Active while the output from the memory seat module is commanding the seat recline motor in the forward direction.

Seat Recline Rearward - Input

The scan tool displays Inactive/Active. When the seat recline rearward switch is activated, the scan tool will momentarily display the switch input to the memory seat module as Active.

Seat Recline Rearward - Output

The scan tool displays Inactive/Active. When the seat recline rearward switch is activated or when a memory recall occurs, the scan tool will display Active while the output from the memory seat module is commanding the seat recline motor in the rearward direction.

Year Module Built

The scan tool displays a 4-digit number. This number represents the year the module was built.

DTC B1925 OR B2170

DTC Descriptor

This diagnostic procedure supports the following DTCs:

DTC B1925 02

Left Seat Heater Cushion Sensor Circuit Shorted to Ground

DTC B1925 05

Left Seat Heater Cushion Sensor Circuit Shorted to Battery or Open

DTC B2170 02

Right Seat Heater Cushion Sensor Circuit Shorted to Ground

DTC B2170 05

Right Seat Heater Cushion Sensor Circuit Shorted to Battery or Open

Diagnostic Fault Information

IMPORTANT: Always perform the prior to using this diagnostic procedure.

DTC B1925 or B2170

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Driver Heated Seat Element Control	B2425 0C	B2425 04	-
Driver Heated Seat Element Supply Voltage	B2425 0B	B2425 04	B2425 0C
Driver Heated Seat Temperature Sensor Low Reference	-	B1925 05	-
Driver Heated Seat Temperature Sensor Signal	B1925 02	B1925 05	B1925 05
Passenger Heated Seat Element Control	B2430 0C	B2430 04	-
Passenger Heated Seat Element Supply Voltage	B2430 0B	B2430 04	B2430 0C
Passenger Heated Seat Temperature Sensor Low Reference	-	B2170 05	-
Passenger Heated Seat Temperature Sensor Signal	B2170 02	B2170 05	B2170 05

Circuit/System Description

The heated seat temperature sensor that set this diagnostic trouble code (DTC) is located in the seat cushion just under the seat cover with the seat heating element. The heated seat module supplies a separate 5 volt reference voltage through the temperature sensor signal circuit and a ground through the low reference circuit to the sensor. The module monitors the voltage of the sensor signal circuit to determine the temperature of the seat. The temperature sensor varies in resistance based on the temperature of the heating element, causing the signal voltage to change. Once the seat reaches the set temperature, the module will then cycle the control circuit of the heating elements ON and OFF in order to maintain the desired seat temperature based on the feedback voltage from the sensors.

Conditions for Running the DTC

The heated seat module is active, and none of the power diagnostic DTCs are current.

Conditions for Setting the DTC

B1925/B2170 02

The temperature sensor voltage drops below 0.80 volts for more than 1 second.

B1925/B2170 05

The temperature sensor voltage exceeds 5 volts for more than 1 second.

Action Taken When the DTC Sets

The heated seat function for the affected seat will be disabled.

Conditions for Clearing the DTC

- The current DTC will clear 3 seconds after the reference voltage returns to normal operating range.
- The history DTC will clear after 50 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

- **Driver Seat Schematics**
- **Passenger Seat Schematics**

Connector End View Reference

Power Seat Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

1. Ignition OFF, disconnect the heated seat module harness connectors C2 and C4.
2. Test for 850-12.0K ohms of resistance between the signal circuit and the low reference circuit of the seat temperature sensor.
    - If greater than 12.0K ohms, test the signal circuit and low reference circuit for a short to voltage or an open/high resistance. If the circuits/connections test normal, replace the heated seat temperature sensor.
    - If less than 850 ohms, test the signal circuit for a short to ground. If the circuit/connections test normal, replace the heated seat temperature sensor.
3. If all circuits/connections circuits test normal, replace the heated seat module.

Repair Procedures

IMPORTANT: Always perform the after completing the diagnostic procedure.

- **Seat Cushion Heater Element Replacement - Front (Impala)** or **Seat Cushion Heater Element Replacement - Front (Monte Carlo)**
- **Control Module References** for Heated Seat Control Module Replacement-Front.

DTC B2425 OR B2430

DTC Descriptor

This diagnostic procedure supports the following DTCs:

DTC B2425 04

Left Seat Heater Circuit Open

DTC B2425 0A

Left Seat Heater Circuit Rate of Change Below Threshold

DTC B2425 0B

Left Seat Heater Circuit Current Above Threshold

DTC B2425 1F

Left Seat Heater Circuit Intermittent

DTC B2430 04

Right Seat Heater Circuit Open

DTC B2430 0A

Right Seat Heater Circuit Rate of Change Below Threshold

DTC B2430 0B

Right Seat Heater Circuit Current Above Threshold

DTC B2430 1F

Right Seat Heater Circuit Intermittent

Diagnostic Fault Information

IMPORTANT: Always perform the prior to using this diagnostic procedure.

DTC B2425 or B2430

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Heated Seat Element Control	B2425 0C	B2425 04	-	-
Driver Heated Seat Element Supply Voltage	B2425 0B	B2425 04	B2425 0C	-
Driver Heated Seat Temperature Sensor Low Reference	-	B1925 05	-	-
Driver Heated Seat Temperature Sensor Signal	B1925 02	B1925 05	B1925 05	-
Passenger Heated Seat Element Control	B2430 0C	B2430 04	-	-
Passenger Heated Seat Element Supply Voltage	B2430 0B	B2430 04	B2430 0C	-
Passenger Heated Seat Temperature Sensor Low Reference	-	B2170 05	-	-
Passenger Heated Seat Temperature Sensor Signal	B2170 02	B2170 05	B2170 05	-

Circuit/System Description

When the heated seat function is active, the heated seat module supplies battery voltage through the element supply voltage circuit to the seat heater elements. The module controls the seat temperature by providing a ground through the heated seat element control circuit to the seat heater elements. The module then monitors the current flow through the heating element and the temperature sensor rate of change to verify correct operation.

Conditions for Running the DTC

The heated seat module is active, and none of the power diagnostic DTCs are current.

Conditions for Setting the DTC

The following conditions exist for more than 1 second:

B2425/B2430 04

The module does not detect a temperature change within 30 seconds.

B2425/B2430 0A

The module detects that the set point temperature has not been reached within 5 minutes.

B2425/B2430 0B

By measuring output current, the heated seat module calculates that the heating element resistance is below the minimum resistance for more than 300mS.

B2425/B2430 0C

By measuring output current, the heated seat module calculates that the heating element resistance is above the maximum resistance for more than 300mS.

B2425/B2430 1F

The temperature sensor voltage is erratic or changes suddenly.

Action Taken When the DTC Sets

The heated seat function for the affected seat will be disabled.

Conditions for Clearing the DTC

- The current DTC clears when the malfunction is no longer present, and the power mode changes to OFF then back to ACC or RUN.
- The history DTC will clear after 50 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

- **Driver Seat Schematics**

- **Passenger Seat Schematics**

Connector End View Reference

Power Seat Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

1. Ignition OFF, disconnect the seat back heating element harness connector.
2. Test for less than 6.0 ohms of resistance between the supply voltage terminal and the control terminal of the heater element.
    - If greater than 6.0 ohms, replace the seat back heating element.
3. Connect the seat back heating element harness connector.
4. Disconnect the heated seat module harness connectors C2 and C4.
5. Test for less than 6.0 ohms of resistance between the heating element supply voltage circuit and the heating element control circuit of the seat heating elements.
    - If greater than 6.0 ohms, test the supply voltage circuit and the control circuit for an open/high resistance. If the circuits/connections test normal, replace the seat cushion heating element.
6. Test the supply voltage circuit of the seat heating elements for a short to battery voltage.
7. Test the control circuit of the seat heating elements for a short to ground.
8. If all circuits/connections circuits test normal, replace the heated seat module.

Repair Procedures

IMPORTANT: Always perform the after completing the diagnostic procedure.

- **Seat Back Heater Element Replacement - Front (Impala)** or **Seat Back Heater**

Element Replacement - Front (Monte Carlo)

- **Seat Cushion Heater Element Replacement - Front (Impala)** or **Seat Cushion Heater Element Replacement - Front (Monte Carlo)**
- **Control Module References** for Heated Seat Control Module Replacement-Front.

SYMPTOMS - SEATS

IMPORTANT: The following steps must be completed before using the symptom tables.

1. When diagnosing a heated seat system condition perform the **Diagnostic System Check - Vehicle** , before using the symptom tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control module(s) can communicate via the serial data link.
2. Review the system description and operation from the following list in order to familiarize yourself with the system functions:
    - **Power Seats System Description and Operation**
    - **Heated Seats Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the power seats. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the seat adjuster track for conditions which may cause binding or objects within the seat adjustment range which obstruct movement or interfere with wiring.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to the following in order to diagnosis the symptom:

- **Power Seat Inoperative**
- **Heated Seat Inoperative**

POWER SEAT INOPERATIVE

Power Seat Inoperative

Step	Action	Yes	No
Schematic Reference: Driver Seat Schematics or **Passenger Seat Schematics** **Connector End View Reference: Power Seat Systems Connector End Views** DEFINITION: One or more of the power seat functions are inoperative.			
1	Did you review the power seat system description and operation and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Seats**
2	1. Verify that the power seat inoperative complaint is present. 2. Attempt to operate all of the power seat motors through their full range of adjustment. Does the power seat system operate as described in the system description and operation?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Are all of the power seat motors inoperative?	Go to **Step 4**	Go to **Step 6**
4	1. Disconnect the seat adjuster switch. 2. Connect a test lamp from the battery positive voltage circuit of the switch connector to a good ground. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 10**
5	Connect a test lamp from the battery positive voltage circuit of the switch connector to the ground circuit of the switch connector. Does the test lamp illuminate?	Go to **Step 9**	Go to **Step 11**
6	1. Disconnect the inoperative seat motor. 2. Connect a test lamp between the motor control circuits of the harness connector. 3. Operate the appropriate seat switch in both directions. Does the test lamp illuminate in both directions?	Go to **Step 8**	Go to **Step 7**
	Test the motor control circuits for a short to ground or an open. Refer to the		

7	following: • **Circuit Testing** • **Wiring Repairs** • **Connector Repairs** Did you find and correct the condition?	Go to **Step 14**	Go to **Step 9**
8	Inspect for poor connections at harness connector of the inoperative seat motor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
9	Inspect for poor connections at harness connector of the seat adjuster switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
10	Repair the short to ground or open in the battery positive voltage circuit of the seat adjuster switch. Refer to **Wiring Repairs** or **Connector Repairs** . Did you complete the repair?	Go to **Step 14**	-
11	Repair the open in the ground circuit of the seat adjuster switch. Refer to **Wiring Repairs** or **Connector Repairs** . Did you complete the repair?	Go to **Step 14**	-
12	Replace the seat adjuster switch. Refer to **Seat Switch Replacement - Power (Impala)** or **Seat Switch Replacement - Power (Monte Carlo)**. Did you complete the replacement?	Go to **Step 14**	-
13	Replace the seat motor. Refer to **Seat Adjuster Replacement - Front (Impala)** or **Seat Adjuster Replacement - Front (Monte Carlo)** or **Power Recliner Motor Replacement - Front Seat (Impala)**. Did you complete the replacement?	Go to **Step 14**	-
14	Operate the system in order to verify the repair.		

	Did you correct the condition?	System OK	Go to **Step 2**

HEATED SEAT INOPERATIVE

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The driver and front passenger heated seats are controlled by separate heated seat switches. Both switches are located in the climate control panel (CCP). When a heated seat switch is pressed, the CCP sends a GMLAN message via the serial data line to the heated seat module indicating the heated seat request. In response to this signal, the heated seat module activates the heated seat by applying battery voltage to the seat heating elements. The heated seat module then sends a GMLAN message back to the CCP commanding it to illuminate the appropriate seat temperature indicator.

Reference Information

Schematic Reference

Driver Seat Schematics

- **Driver Seat Schematics**
- **Passenger Seat Schematics**

Connector End View Reference

Power Seat Systems Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

Ignition ON, use a scan tool to observe the appropriate Heated Seat Switch parameter while pressing the heated seat switch. The reading should change between Idle and Pressed.

- If not, replace the HVAC control module.
- If the parameter displays Pressed, replace the heated seat module.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for HVAC and heated seat control module replacement, setup, and programming.

POWER SEAT ADJUSTER MECHANICAL DIAGNOSIS

Power Seat Adjuster Mechanical Diagnosis

Condition	Possible Cause	Correction
Horizontal Operation of Seat Not Smooth but Jerky-Apparent Hard Operation	The adjuster horizontal actuator is damaged.	Replace the adjuster assembly.
Horizontal Chuck or Looseness	• The horizontal actuator is improperly adjusted to the rack. • The top plate subassembly is loose.	• Replace the adjuster assembly. • Replace the adjuster assembly.
One Adjuster Will Not Operate Horizontally	• The horizontal drive cable is disconnected or damaged. • The horizontal actuator is inoperative.	• Inspect the drive cables, they must be straight to be engaged. Replace if damaged. • Replace the adjuster assembly.
One Adjuster Will not Operate Vertically	• The vertical drive cable is disconnected or damaged. • The vertical actuator subassembly is inoperative.	• Inspect the vertical drive cables, replace if damaged. • Replace the adjuster assembly.
Both Adjusters Will Not Operate Horizontally and/or Vertically	• The motor is damaged or inoperative. • The wiring harness is	• Replace the adjuster assembly • Replace the wiring

	damaged.	harness.
Vertical Chuck or Looseness	The vertical actuator is inoperative.	Replace the adjuster assembly.

REPAIR INSTRUCTIONS

FRONT BUCKET SEAT REPLACEMENT (IMPALA)

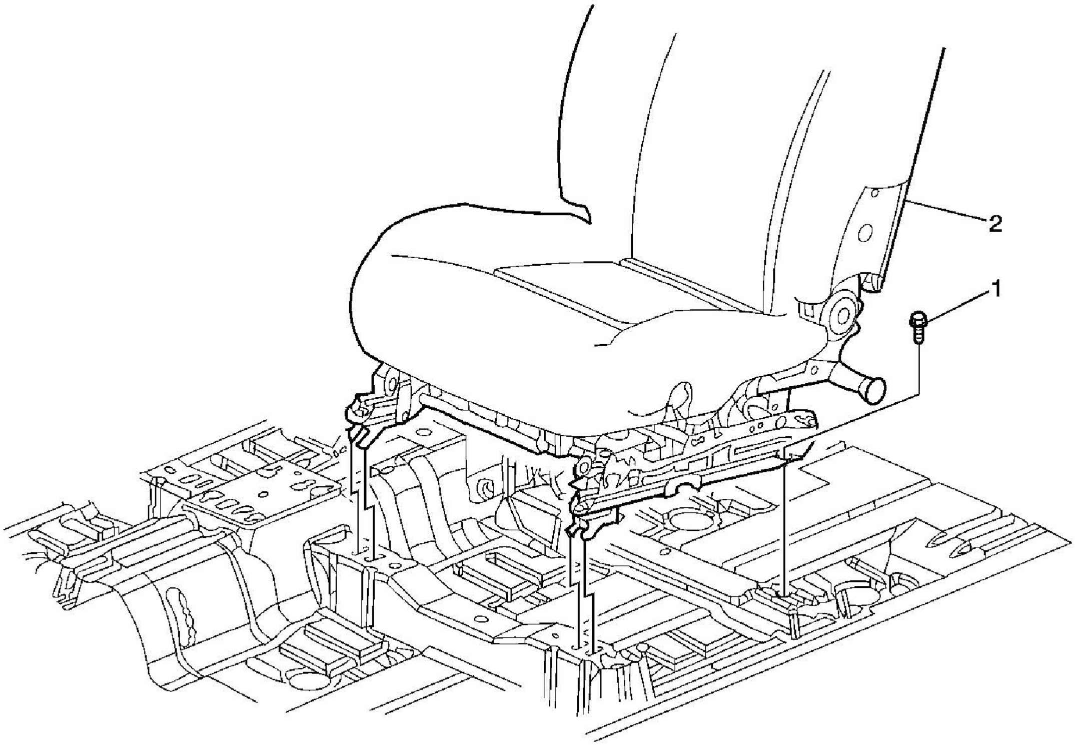


Fig. 22: Replacing Front Bucket Seat
Courtesy of GENERAL MOTORS CORP.

Seat Replacement - Front Bucket (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Disconnect the seat belt from the seat. Refer to **Seat Belt Retractor Pretensioner Replacement - Front** .	
1	Bolt, Seat Adjuster (Qty: 2) **Tip:** Adjust the seat forward or rearward to access the bolts.

	Tighten: 45 N.m (33 lb ft)
2	Seat Assembly **Tip:** Disconnect the electrical connectors.

FRONT BUCKET SEAT REPLACEMENT (MONTE CARLO)

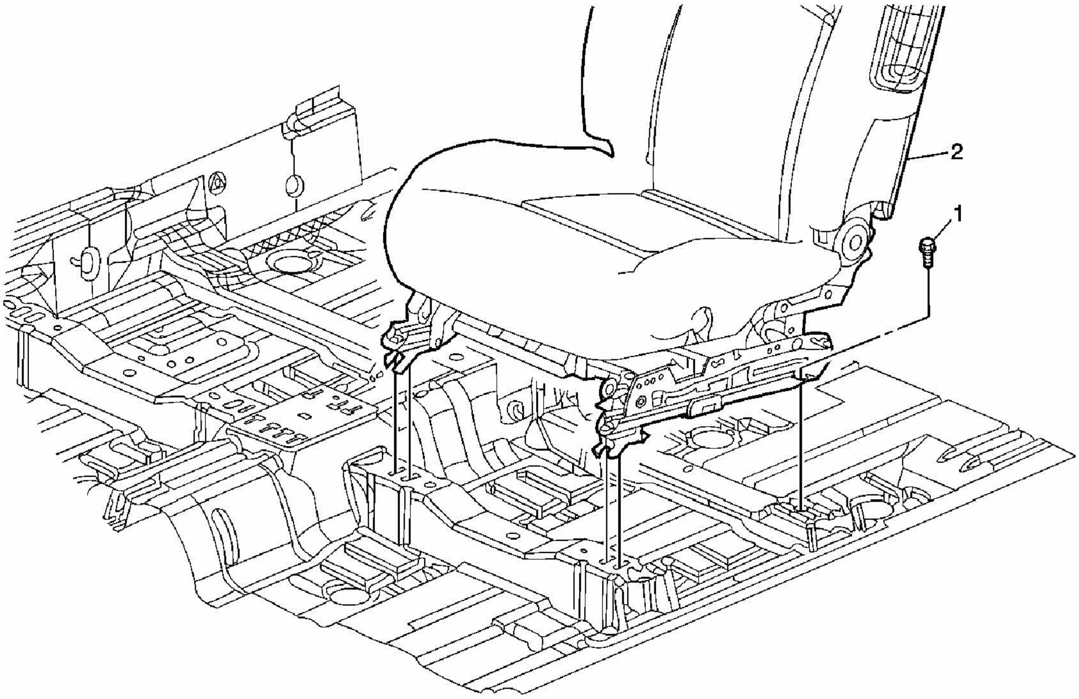


Fig. 23: Replacing Front Bucket Seat
Courtesy of GENERAL MOTORS CORP.

Seat Replacement - Front Bucket (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 7** and **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)** . 2. Disconnect the seat belt from the seat. Refer to **Seat Belt Retractor Pretensioner Replacement - Front** .	

1	Bolt, Seat Adjuster (Qty: 2) **Tip:** Adjust the seat forward or rearward to access the bolts. **Tighten:** 45 N.m (33 lb ft)
2	Seat Assembly **Tip:** Disconnect the electrical connectors.

CENTER SEAT REPLACEMENT (IMPALA)

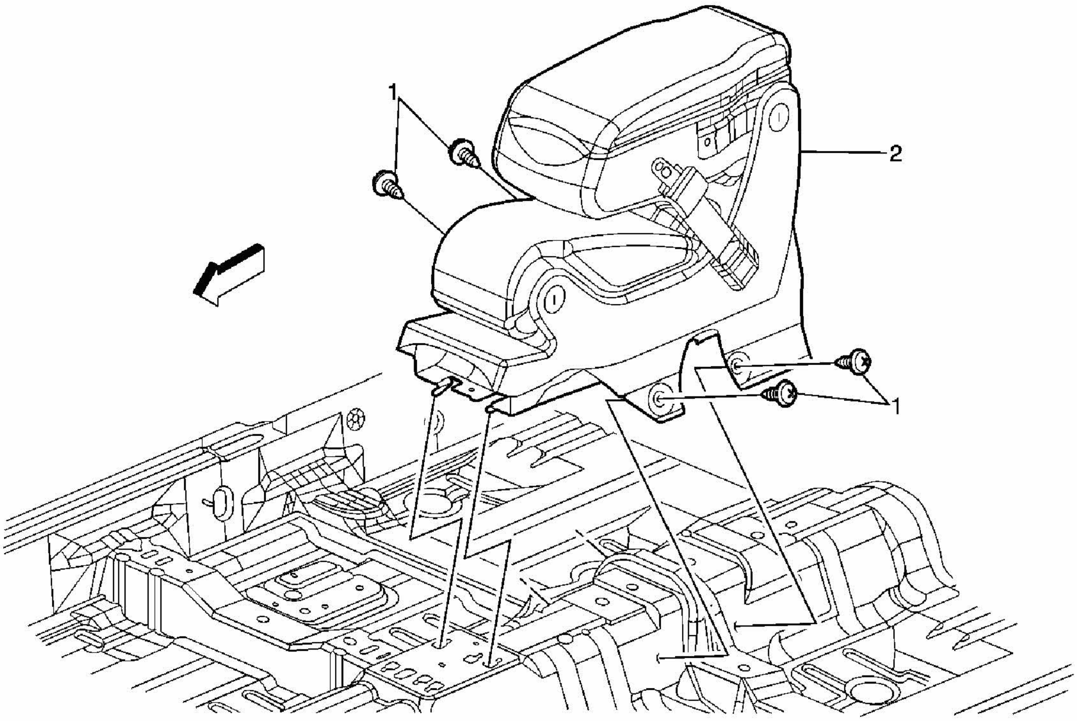


Fig. 24: Replacing Center Seat
Courtesy of GENERAL MOTORS CORP.

Seat Replacement - Center (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the front seats. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.	
1	Bolt, Front Center Seat Assembly (Qty: 4)

	Tighten: 9 N.m (80 lb in)
2	Seat Assembly, Front Center **Tip:** 1. Slide the center seat assembly forward and lift up to disengage the retaining hooks at the front of the seat. 2. Disconnect the electrical connectors.

FRONT SEAT CUSHION FRAME REPLACEMENT (IMPALA)

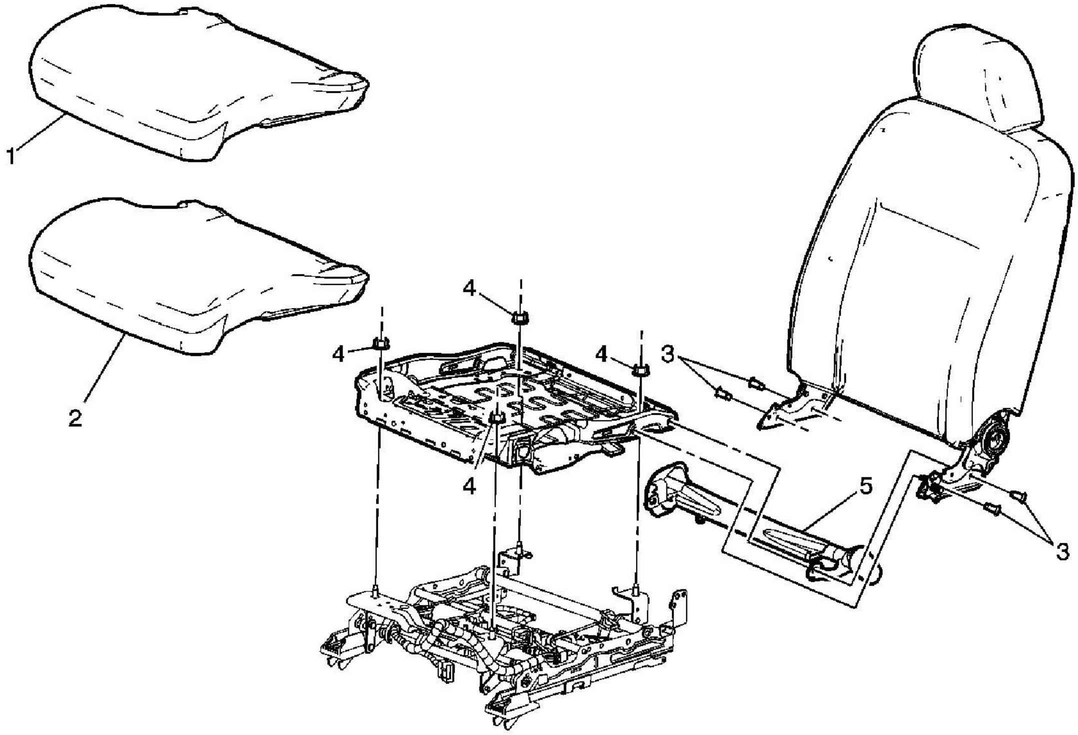


Fig. 25: Replacing Front Seat Cushion Frame
Courtesy of GENERAL MOTORS CORP.

Seat Cushion Frame Replacement - Front (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure**	

1. Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**. 2. Remove the lumbar actuator knob. Refer to **Lumbar Support Knob Replacement (Impala)** or **Lumbar Support Knob Replacement (Monte Carlo)**. 3. Remove the recliner handle. Refer to **Seat Back Recliner Handle Replacement - Front (Impala)** or **Seat Back Recliner Handle Replacement - Front (Monte Carlo)**. 4. Remove the power seat switch knob. Refer to **Knob Replacement - Power Seat Switch - Seat Cushion (Impala)** or **Knob Replacement - Power Seat Switch - Seat Cushion (Monte Carlo)**. 5. Remove the seat cushion outer trim panel. Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)**.	
1	Cover, Seat Cushion Refer to **Seat Cushion Cover and Pad Replacement - Front (Impala)** or **Seat Cushion Cover and Pad Replacement - Front (Monte Carlo)**.
2	Pad, Seat Cushion Refer to **Seat Cushion Cover and Pad Replacement - Front (Impala)** or **Seat Cushion Cover and Pad Replacement - Front (Monte Carlo)**.
3	Bolt, Front Seat Cushion Frame (Qty: 4) **Tighten:** 45 N.m (33 lb ft)
4	Nut, Front Seat Cushion Frame (Qty: 4) **Tighten:** 9 N.m (80 lb in)
5	Reinforcement, Seat Cushion Frame Rear
6	Frame, Front Seat Cushion **Tip:** 1. Remove the heated seat module, if equipped. Refer to **Heated Seat Control Module Replacement - Front (Impala)** or **Heated Seat Control Module Replacement - Front (Monte Carlo)**. 2. Remove the inflatable restraint passenger presence system if working on the passenger seat. Refer to **Inflatable Restraint Passenger Presence System Replacement - Front (Impala)** or **Inflatable Restraint Passenger Presence System Replacement - Front (Monte Carlo)** . 3. Re-zero the inflatable restraint passenger presence system whenever the seat cushion or any component of the passenger presence system is removed. Refer to **Passenger Presence System Programming**

	and Setup .

FRONT SEAT CUSHION FRAME REPLACEMENT (MONTE CARLO)

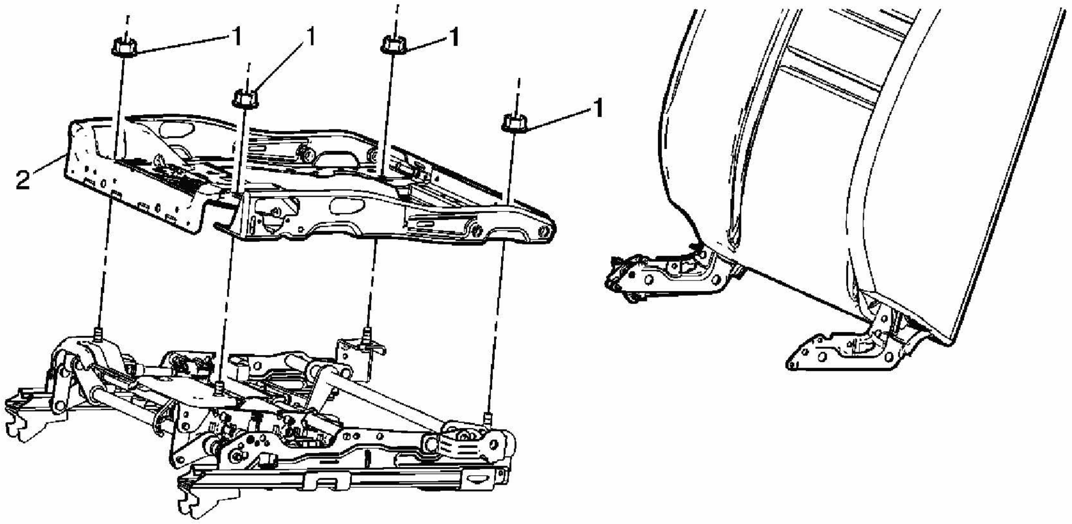


Fig. 26: Replacing Front Seat Cushion Frame
Courtesy of GENERAL MOTORS CORP.

Seat Cushion Frame Replacement - Front (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Disable the SIR system if working on the driver or passenger seat. Refer to **SIR Disabling and Enabling Zone 7** and **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)** in SIR. 2. Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**. 3. Remove the lumbar actuator knob. Refer to **Lumbar Support Knob Replacement (Impala)** or **Lumbar Support Knob Replacement (Monte Carlo)**. 4. Remove the recliner handle. Refer to **Seat Back Recliner Handle Replacement - Front (Impala)** or **Seat Back Recliner Handle Replacement - Front (Monte Carlo)**.	

<table>
<tr><td colspan="2">5. Remove the power seat switch knob. Refer to Knob Replacement - Power Seat Switch - Seat Cushion (Impala) or Knob Replacement - Power Seat Switch - Seat Cushion (Monte Carlo).
6. Remove the seat cushion outer trim panel. Refer to Seat Cushion Outer Trim Panel Replacement (Impala) or Seat Cushion Outer Trim Panel Replacement (Monte Carlo).
7. Remove the front seat cushion cover and pad. Refer to Seat Cushion Cover and Pad Replacement - Front (Impala) or Seat Cushion Cover and Pad Replacement - Front (Monte Carlo).</td></tr>
<tr><td>1</td><td>Nut, Front Seat Cushion Frame (Qty: 4)
Tighten: 9 N.m (80 lb in)</td></tr>
<tr><td>2</td><td>Frame, Front Seat Cushion
Tip:
1. Remove the heated seat module, if equipped. Refer to Heated Seat Control Module Replacement - Front (Impala) or Heated Seat Control Module Replacement - Front (Monte Carlo).
2. Remove the inflatable restraint passenger presence system if working on the passenger seat. Refer to Inflatable Restraint Passenger Presence System Replacement - Front (Impala) or Inflatable Restraint Passenger Presence System Replacement - Front (Monte Carlo) .
3. Re-zero the inflatable restraint passenger presence system whenever the seat cushion or any component of the passenger presence system is removed. Refer to Passenger Presence System Programming and Setup .</td></tr>
</table>

SEAT CUSHION OUTER TRIM PANEL REPLACEMENT (IMPALA)

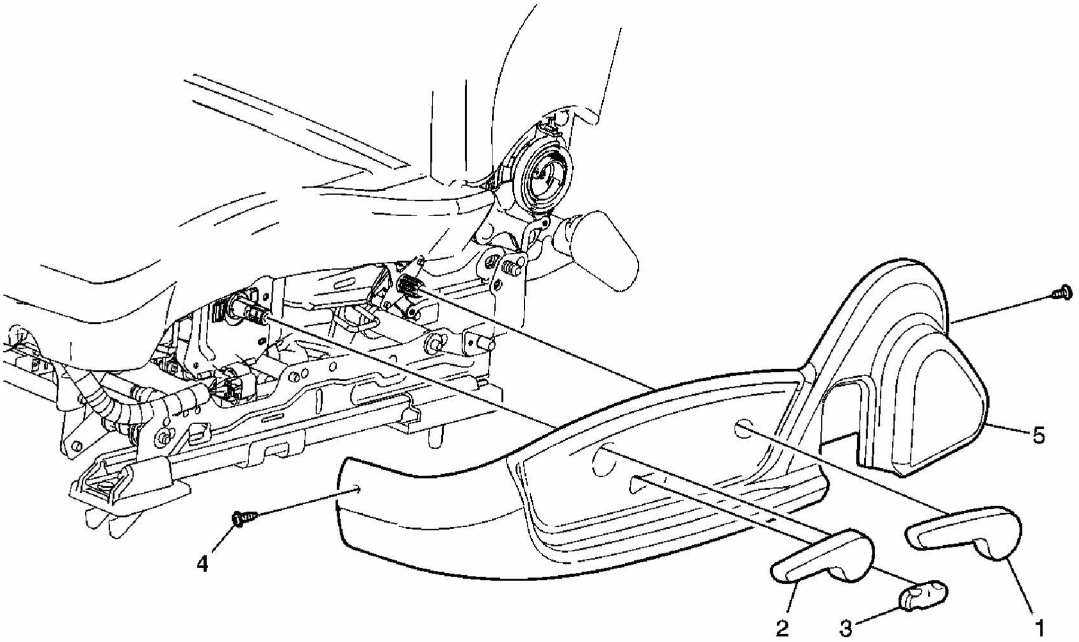


Fig. 27: Replacing Seat Cushion Outer Trim Panel
Courtesy of GENERAL MOTORS CORP.

Seat Cushion Outer Trim Panel Replacement (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Handle, Recliner **Tip:** Using a flat-bladed tool, push the retainer clip downward and pull outward to release the handle.
2	Handle, Lumbar Actuator **Tip:** Pull outward to remove.
3	Knob, Power Seat Switch **Tip:** Pull outward to remove.
4	Screw, Seat Cushion Outer Trim Panel (Qty: 2) **Tighten:** 2 N.m (18 lb in)
5	Panel, Seat Cushion Outer Trim

SEAT CUSHION OUTER TRIM PANEL REPLACEMENT (MONTE CARLO)

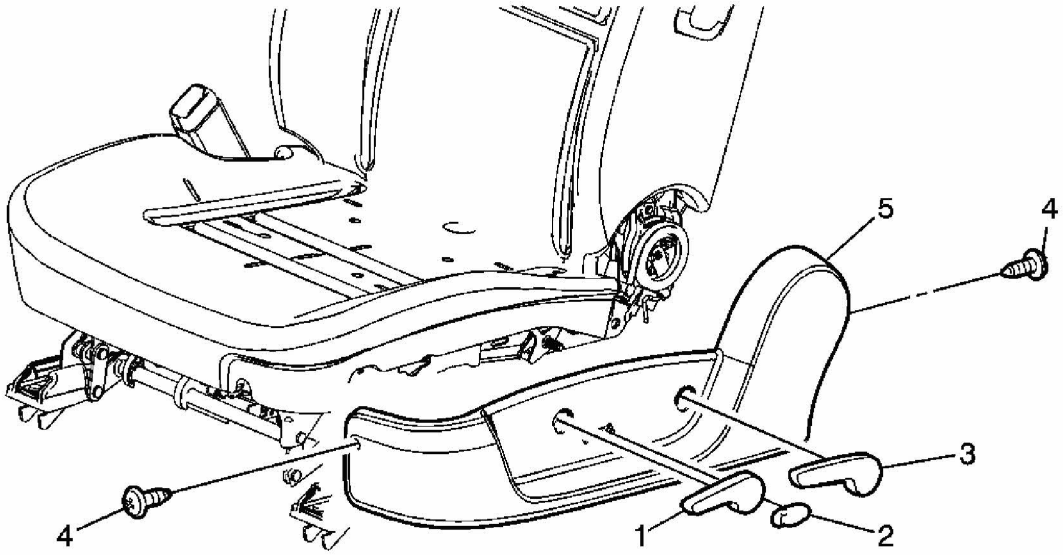


Fig. 28: Replacing Seat Cushion Outer Trim Panel
Courtesy of GENERAL MOTORS CORP.

Seat Cushion Outer Trim Panel Replacement (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Handle, Lumbar Actuator **Tip:** Pull outward to remove.
2	Handle, Recliner **Tip:** Using a flat-bladed tool, push the retainer clip downward and pull outward to release the handle.
3	Knob, Power Seat Switch **Tip:** Pull outward to remove.
4	Screw, Seat Cushion Outer Trim Panel (Qty: 2) **Tighten:** 2 N.m (18 lb in)
5	Panel, Seat Cushion Outer Trim **Tip:** 1. Disconnect the power seat switch electrical connector. 2. Remove the power seat switch from the trim panel. Refer to **Seat Switch Replacement - Power (Impala)** or **Seat Switch**

	Replacement - Power (Monte Carlo).

FRONT SEAT CUSHION COVER AND PAD REPLACEMENT (IMPALA)

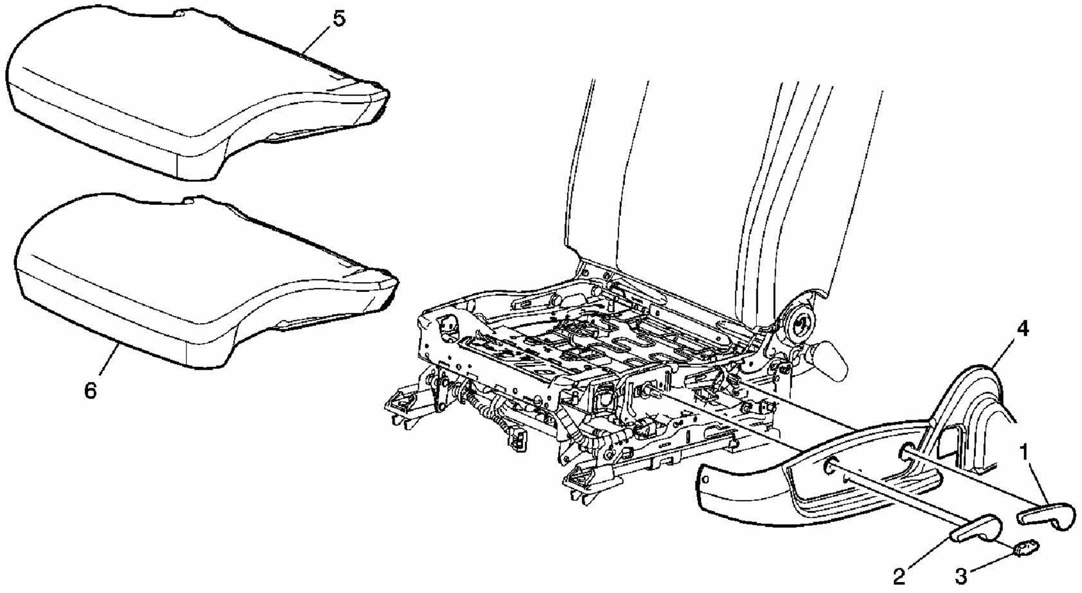


Fig. 29: Replacing Front Seat Cushion Cover And Pad
Courtesy of GENERAL MOTORS CORP.

Seat Cushion Cover and Pad Replacement - Front (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the front seats. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.	
1	Handle, Recliner **Tip:** Using a flat-bladed tool, push the retainer clip downward and pull outward to release the handle.
2	Handle, Lumbar Actuator **Tip:** Pull outward to remove.
3	Knob, Power Seat Switch **Tip:** Pull outward to remove.
4	Panel, Seat Cushion Outer Trim Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)**.
	Cover, Seat Cushion **Tip:**

5	1. Release the j-channel from the seat cushion frame. 2. Disconnect the seat cushion heater electrical connector, if equipped. 3. Remove the seat cushion cover and pad as an assembly from the frame.
6	Pad, Seat Cushion **Tip:** Remove the seat cushion pad from the cover by pulling away to release to hook and loop fasteners.

FRONT SEAT CUSHION COVER AND PAD REPLACEMENT (MONTE CARLO)

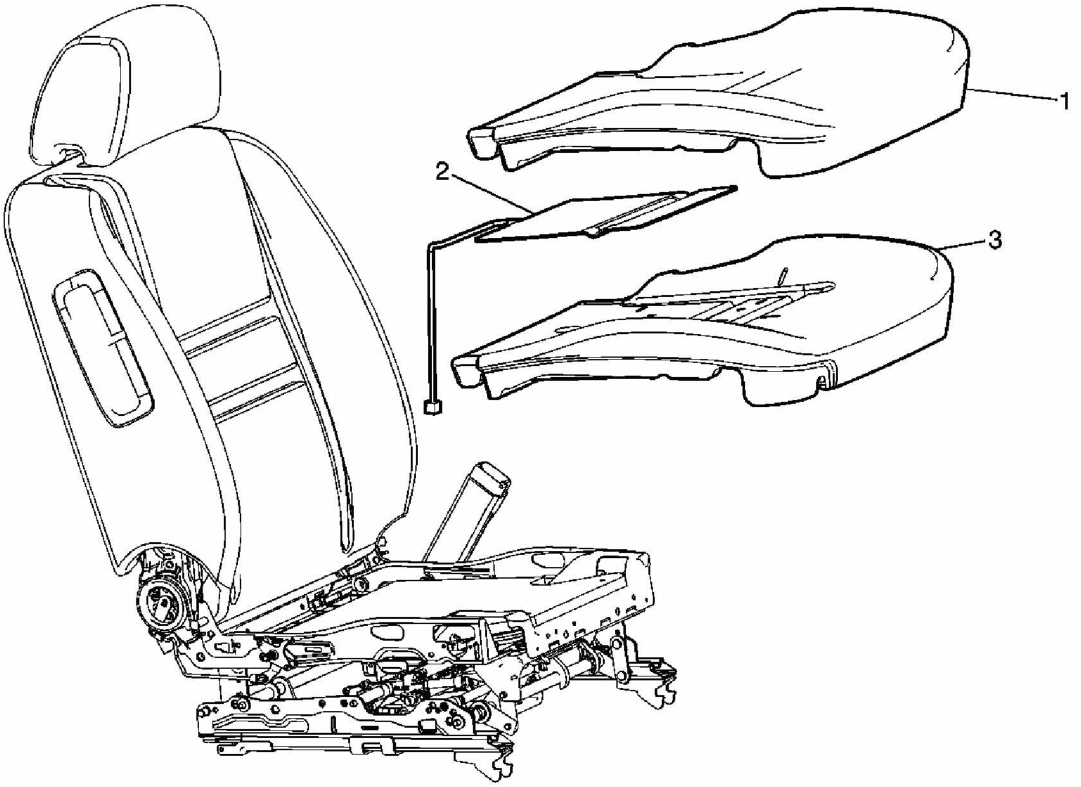


Fig. 30: Replacing Front Seat Cushion Cover And Pad
Courtesy of GENERAL MOTORS CORP.

Seat Cushion Cover and Pad Replacement - Front (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Disable the SIR system if working on the passenger seat. Refer to **SIR Disabling and Enabling Zone 7** and **SIR Disabling and Enabling Zone 9 (Monte Carlo)**	

or **SIR Disabling and Enabling Zone 9 (Impala)** .

2. Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.
3. Remove the recliner handle. Refer to **Seat Back Recliner Handle Replacement - Front (Impala)** or **Seat Back Recliner Handle Replacement - Front (Monte Carlo)**.
4. Remove the lumbar handle. Refer to **Lumbar Support Knob Replacement (Impala)** or **Lumbar Support Knob Replacement (Monte Carlo)**.
5. Remove the power seat switch knob. Refer to **Knob Replacement - Power Seat Switch - Seat Cushion (Impala)** or **Knob Replacement - Power Seat Switch - Seat Cushion (Monte Carlo)**.
6. Remove the seat cushion outer trim panel. Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)**.

1	Cover, Seat Cushion **Tip:** 1. Release the j-channel from the seat cushion frame. 2. Disconnect the seat cushion heater electrical connector, if equipped. 3. Remove the seat cushion cover and pad as an assembly from the frame. 4. Remove the seat cushion pad from the cover by pulling away to release to hook and loop fasteners.
2	Heater Assembly, Seat Cushion **Tip:** 1. Disconnect the electrical connector. 2. The seat cushion heater is attached to the pad with adhesive, peel away from the pad to remove.
3	Pad, Seat Cushion

SEAT BACK COVER AND PAD REPLACEMENT (IMPALA)

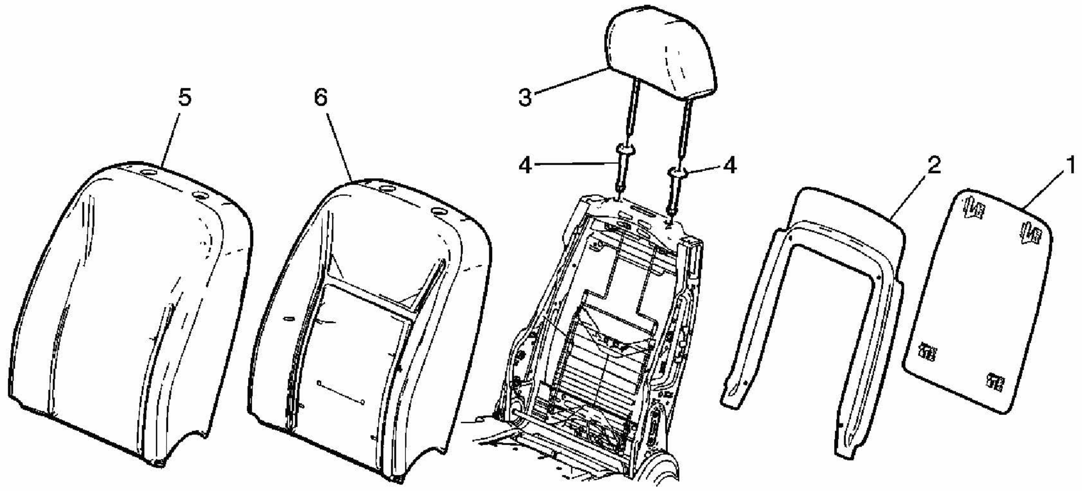


Fig. 31: Replacing Seat Back Cover And Pad
Courtesy of GENERAL MOTORS CORP.

Seat Back Cover and Pad Replacement (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.	
1	Panel, Seat Back Cushion Finish Refer to **Seat Back Panel Replacement - Front (Impala)** or **Seat Back Panel Replacement - Front (Monte Carlo)**.
2	Panel, Seat Back Cushion Rear Finish Refer to **Seat Back Panel Replacement - Front (Impala)** or **Seat Back Panel Replacement - Front (Monte Carlo)**.
3	Restraint, Front Seat Head Refer to **Head Restraint Replacement - Front Seat (Impala)** or **Head Restraint Replacement - Front Seat (Monte Carlo)**.
4	Guides, Front Seat Head Restraint Refer to **Head Restraint Guide Replacement - Front Seat (Impala)** or **Head Restraint Guide Replacement - Front Seat (Monte Carlo)**.
5	Cover, Seat Back Cushion **Tip:** Disconnect the j-channel from the seat back frame and remove the pad and cover as an assembly.
6	Pad, Seat Back Cushion **Tip:** The pad is secured to the cover with hook and loop fasteners.

SEAT BACK COVER AND PAD REPLACEMENT (MONTE CARLO)

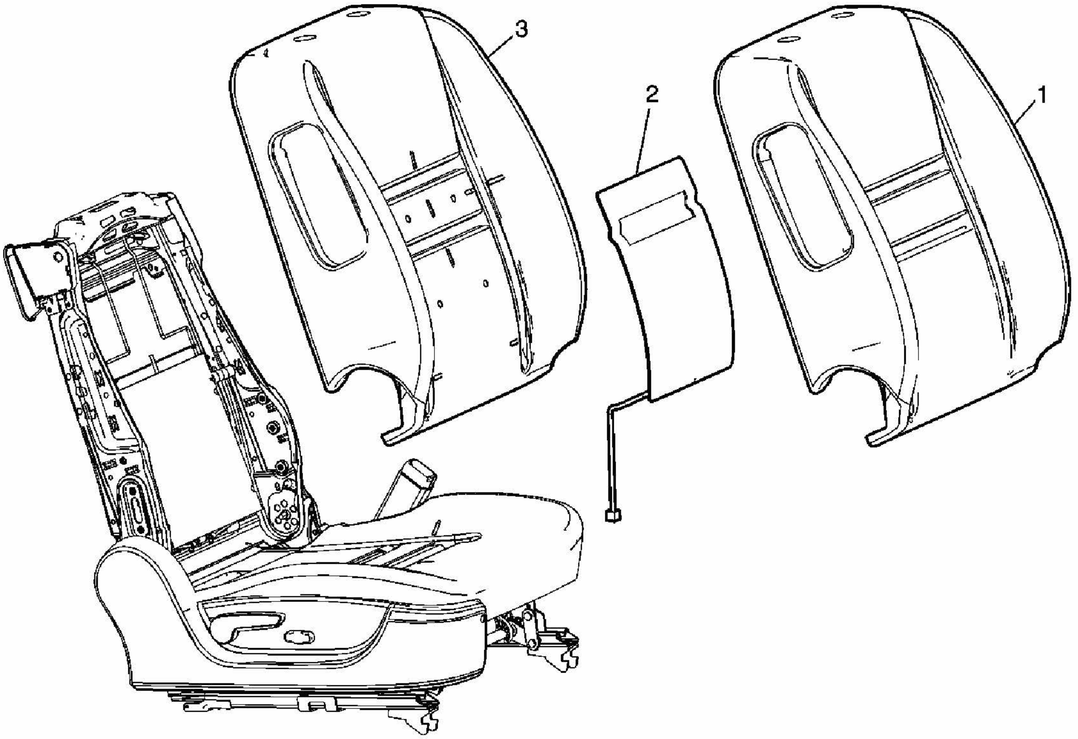


Fig. 32: Replacing Seat Back Cover And Pad
Courtesy of GENERAL MOTORS CORP.

Seat Back Cover and Pad Replacement (Monte Carlo)

Callout	Component Name

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Disable the SIR system if working on the passenger seat. Refer to **SIR Disabling and Enabling Zone 7** and **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)** .
2. Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.
3. Remove the front seat back cushion finish panel. Refer to **Seat Back Panel Replacement - Front (Impala)** or **Seat Back Panel Replacement - Front (Monte Carlo)**.
4. Remove the front seat head restraint. Refer to **Head Restraint Replacement - Front Seat (Impala)** or **Head Restraint Replacement - Front Seat (Monte Carlo)**.
5. Remove the front seat head restraint guides. Refer to **Head Restraint Replacement - Front Seat (Impala)** or **Head Restraint Replacement - Front**

Seat (Monte Carlo).	
1	Cover, Seat Back Cushion **Tip:** 1. Disconnect the j-channel from the seat back frame and remove the pad and cover as an assembly. 2. The pad is secured to the cover with hook and loop fasteners.
2	Element, Front Seat Back Heater **Tip:** If equipped, disconnect the electrical connector and peel the heater element off the pad.
3	Pad, Seat Back Cushion

FRONT SEAT BACK FRAME REPLACEMENT (IMPALA)

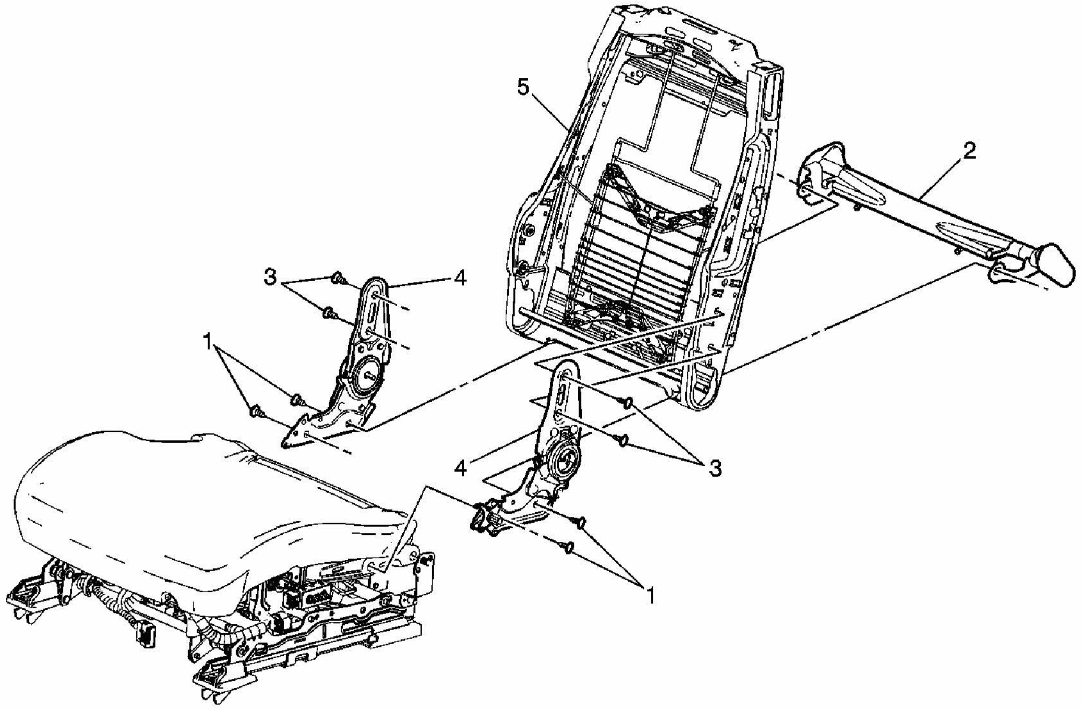


Fig. 33: Replacing Front Seat Back Frame
Courtesy of GENERAL MOTORS CORP.

Seat Back Frame Replacement - Front (Impala)

Callout	Component Name
NOTE: Refer to Fastener Notice .	

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.
2. Remove the lumbar actuator knob. Refer to **Lumbar Support Knob Replacement (Impala)** or **Lumbar Support Knob Replacement (Monte Carlo)**.
3. Remove the recliner handle. Refer to **Seat Back Recliner Handle Replacement - Front (Impala)** or **Seat Back Recliner Handle Replacement - Front (Monte Carlo)**.
4. Remove the power seat switch knob. Refer to **Knob Replacement - Power Seat Switch - Seat Cushion (Impala)** or **Knob Replacement - Power Seat Switch - Seat Cushion (Monte Carlo)**.
5. Remove the seat cushion outer trim panel. Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)**.
6. Remove the front seat back cushion cover and pad. Refer to **Seat Back Cover and Pad Replacement (Impala)** or **Seat Back Cover and Pad Replacement (Monte Carlo)**.
7. Remove the lumbar assembly. Refer to **Lumbar Replacement - Front Seat (Impala)** or **Lumbar Replacement - Front Seat (Monte Carlo)**.

1	Bolt, Front Seat Cushion Frame (Qty: 4) **Tighten:** 45 N.m (33 lb ft)
2	Reinforcement, Seat Cushion Frame Rear
3	Bolt, Front Seat Back Cushion Frame (Qty: 4) **Tighten:** 45 N.m (33 lb ft)
4	Recliner Assembly, Seat
5	Frame Assembly, Seat Back

FRONT SEAT BACK FRAME REPLACEMENT (MONTE CARLO)

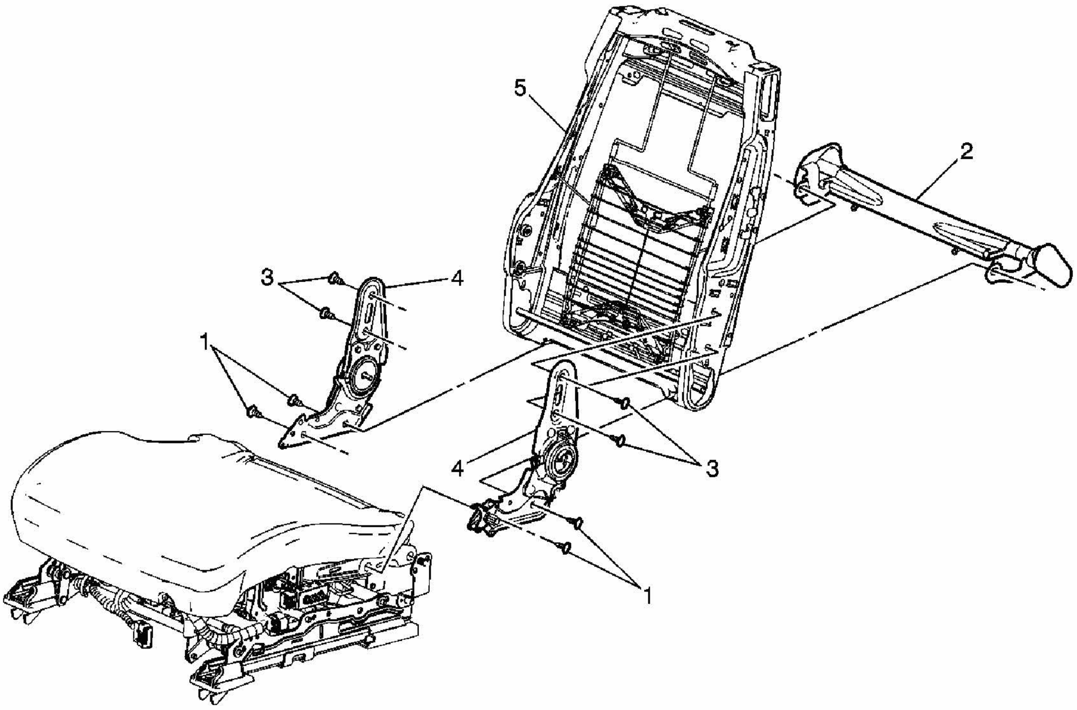


Fig. 34: Replacing Front Seat Back Frame
Courtesy of GENERAL MOTORS CORP.

Seat Back Frame Replacement - Front (Monte Carlo)

Callout	Component Name

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Disable the SIR system if working on the passenger seat. Refer to **SIR Disabling and Enabling Zone 7** and **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)** .
2. Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.
3. Remove the lumbar actuator knob. Refer to **Lumbar Support Knob Replacement (Impala)** or **Lumbar Support Knob Replacement (Monte Carlo)**.
4. Remove the recliner handle. Refer to **Seat Back Recliner Handle Replacement - Front (Impala)** or **Seat Back Recliner Handle Replacement - Front (Monte**

Carlo).

5. Remove the power seat switch knob. Refer to **Knob Replacement - Power Seat Switch - Seat Cushion (Impala)** or **Knob Replacement - Power Seat Switch - Seat Cushion (Monte Carlo)**.
6. Remove the seat cushion outer trim panel. Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)**.
7. Remove the front seat back cushion cover and pad. Refer to **Seat Back Cover and Pad Replacement (Impala)** or **Seat Back Cover and Pad Replacement (Monte Carlo)**.
8. Remove the side impact air bag. Refer to **Inflatable Restraint Side Impact Module Replacement - Front (Monte Carlo)** .
9. Remove the lumbar assembly. Refer to **Lumbar Replacement - Front Seat (Impala)** or **Lumbar Replacement - Front Seat (Monte Carlo)**.

1	Bolt, Front Seat Cushion Frame (Qty: 4) **Tighten:** 45 N.m (33 lb ft)
2	Reinforcement, Seat Cushion Frame Rear
3	Bolt, Front Seat Back Cushion Frame (Qty: 4) **Tighten:** 45 N.m (33 lb ft)
4	Recliner Assembly, Seat
5	Frame Assembly, Seat Back

FRONT SEAT BACK RECLINER REPLACEMENT (IMPALA)

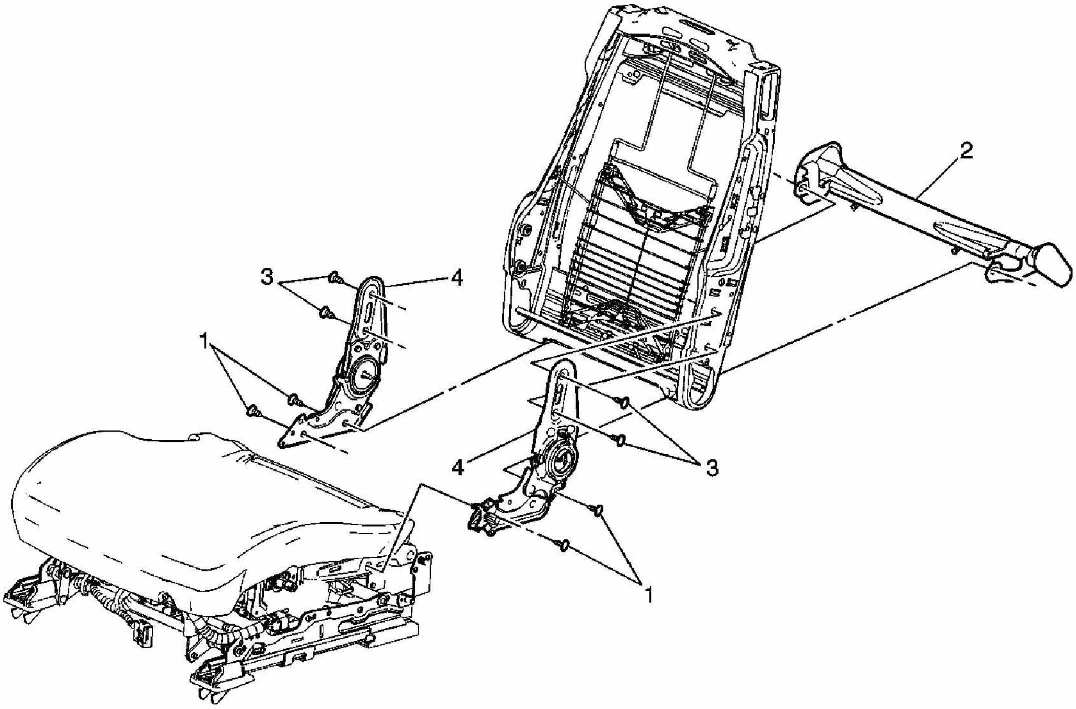


Fig. 35: Replacing Seat Back Recliner
Courtesy of GENERAL MOTORS CORP.

Seat Back Recliner Replacement - Front (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**. 2. Remove the lumbar actuator knob. Refer to **Lumbar Support Knob Replacement (Impala)** or **Lumbar Support Knob Replacement (Monte Carlo)**. 3. Remove the recliner handle. Refer to **Seat Back Recliner Handle Replacement - Front (Impala)** or **Seat Back Recliner Handle Replacement - Front (Monte Carlo)**. 4. Remove the power seat switch knob. Refer to **Knob Replacement - Power Seat Switch - Seat Cushion (Impala)** or **Knob Replacement - Power Seat Switch -**	

Seat Cushion (Monte Carlo).

5. Remove the seat cushion outer trim panel. Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)**.
6. Remove the front seat back cushion cover and pad. Refer to **Seat Back Cover and Pad Replacement (Impala)** or **Seat Back Cover and Pad Replacement (Monte Carlo)**.
7. Remove the lumbar assembly. Refer to **Lumbar Replacement - Front Seat (Impala)** or **Lumbar Replacement - Front Seat (Monte Carlo)**.

1	Bolt, Front Seat Cushion Frame (Qty: 4) **Tighten:** 45 N.m (33 lb ft)
2	Reinforcement, Seat Cushion Frame Rear
3	Bolt, Front Seat Back Cushion Frame (Qty: 4) **Tighten:** 45 N.m (33 lb ft)
4	Recliner Assembly, Seat Inner
5	Recliner Assembly, Seat Outer

FRONT SEAT BACK RECLINER REPLACEMENT (MONTE CARLO)

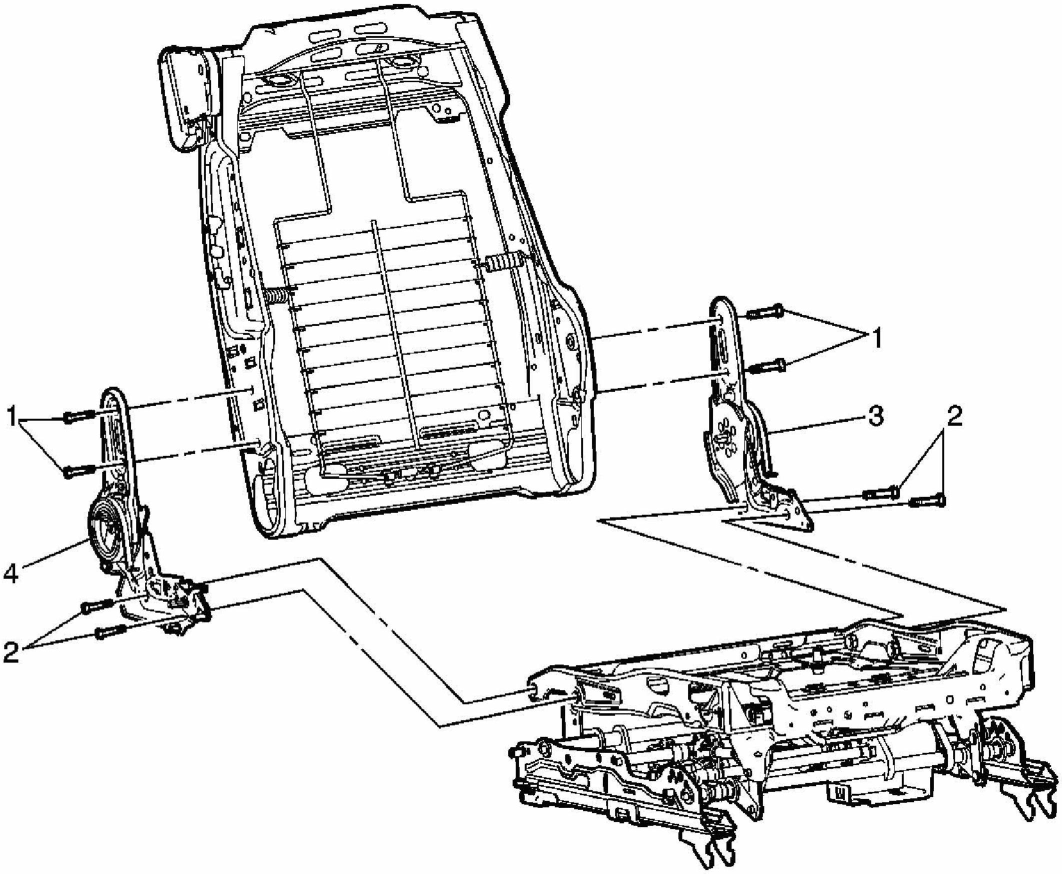


Fig. 36: Replacing Front Seat Back Recliner
Courtesy of GENERAL MOTORS CORP.

Seat Back Recliner Replacement - Front (Monte Carlo)

Callout	Component Name

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Disable the SIR system if working on the passenger seat. Refer to **SIR Disabling and Enabling Zone 7** and **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)** .
2. Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.
3. Remove the lumbar actuator knob. Refer to **Lumbar Support Knob**

Replacement (Impala) or **Lumbar Support Knob Replacement (Monte Carlo)**.

4. Remove the recliner handle. Refer to **Seat Back Recliner Handle Replacement - Front (Impala)** or **Seat Back Recliner Handle Replacement - Front (Monte Carlo)**.
5. Remove the power seat switch knob. Refer to **Knob Replacement - Power Seat Switch - Seat Cushion (Impala)** or **Knob Replacement - Power Seat Switch - Seat Cushion (Monte Carlo)**.
6. Remove the seat cushion outer trim panel. Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)**.
7. Remove the front seat back cushion cover and pad. Refer to **Seat Back Cover and Pad Replacement (Impala)** or **Seat Back Cover and Pad Replacement (Monte Carlo)**.
8. Remove the lumbar assembly. Refer to **Lumbar Replacement - Front Seat (Impala)** or **Lumbar Replacement - Front Seat (Monte Carlo)**.

1	Bolt, Front Seat Cushion Frame (Qty: 4) **Tighten:** 45 N.m (33 lb ft)
2	Bolt, Front Seat Back Cushion Frame (Qty: 4) **Tighten:** 45 N.m (33 lb ft)
3	Recliner Assembly, Seat Inner
4	Recliner Assembly, Seat Outer

FRONT SEAT POWER RECLINER MOTOR REPLACEMENT (IMPALA)

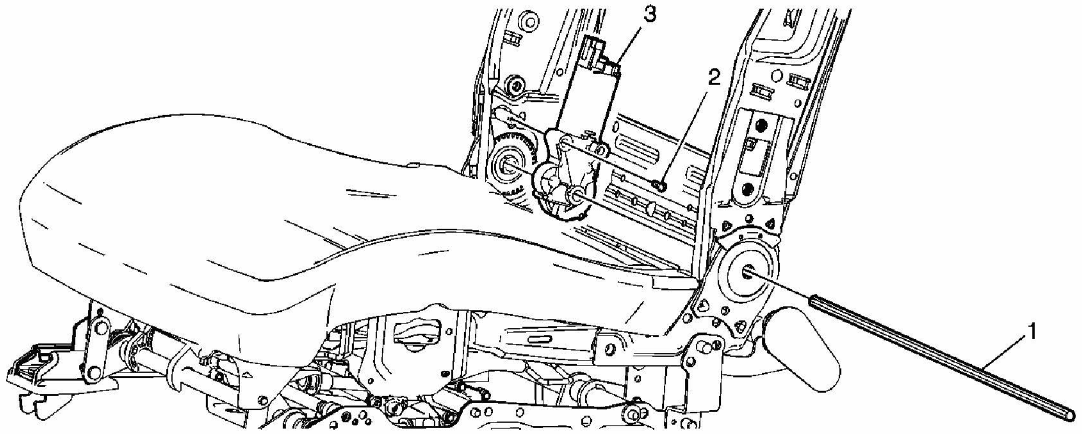


Fig. 37: Replacing Front Seat Power Recliner Motor
Courtesy of GENERAL MOTORS CORP.

Power Recliner Motor Replacement - Front Seat (Impala)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.

Preliminary Procedure

1. Remove the front seat. Refer to Seat Replacement - Front Bucket (Impala) or Seat Replacement - Front Bucket (Monte Carlo).
2. Remove the lumbar actuator knob. Refer to Lumbar Support Knob Replacement (Impala) or Lumbar Support Knob Replacement (Monte Carlo).
3. Remove the recliner handle. Refer to Seat Back Recliner Handle Replacement - Front (Impala) or Seat Back Recliner Handle Replacement - Front (Monte Carlo).
4. Remove the power seat switch knob. Refer to Knob Replacement - Power Seat Switch - Seat Cushion (Impala) or Knob Replacement - Power Seat Switch - Seat Cushion (Monte Carlo).
5. Remove the seat cushion outer trim panel. Refer to Seat Cushion Outer Trim Panel Replacement (Impala) or Seat Cushion Outer Trim Panel Replacement (Monte Carlo).
6. Remove the front seat back cushion cover and pad. Refer to Seat Back Cover and Pad Replacement (Impala) or Seat Back Cover and Pad Replacement (Monte Carlo).</td></tr>
<tr><td>1</td><td>Bracket, Seat Recliner
Tip: Remove the push on nuts from the ends for the rod and slide out to remove.</td></tr>
<tr><td>2</td><td>Bolt, Front Seat Back Cushion Frame

Tighten: 9 N.m (80 lb in)</td></tr>
<tr><td>3</td><td>Motor, Front Seat Recliner Actuator</td></tr>
</table>

FRONT SEAT BACK RECLINER HANDLE REPLACEMENT - (IMPALA)

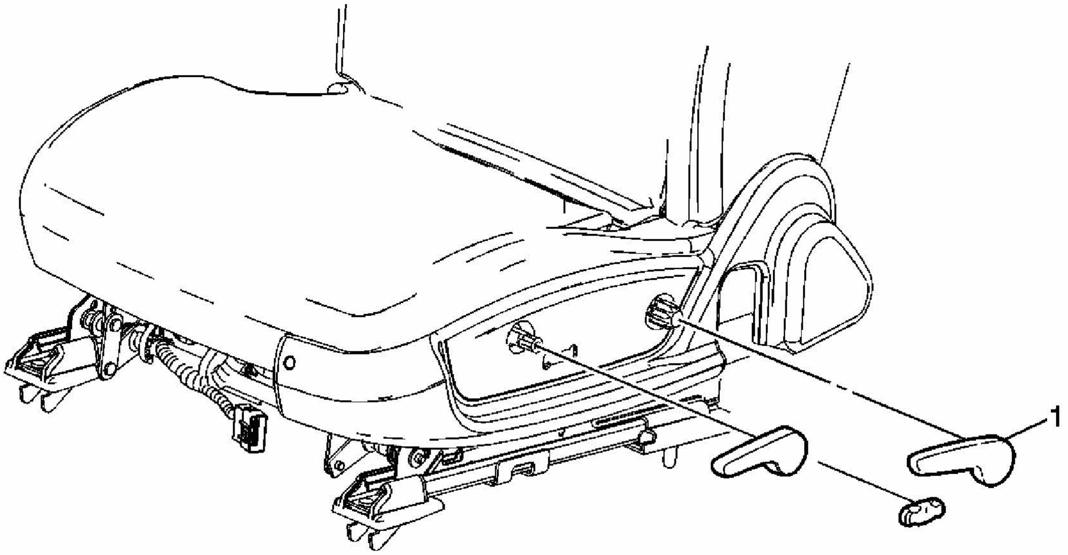


Fig. 38: Replacing Front Seat Back Recliner Handle
Courtesy of GENERAL MOTORS CORP.

Seat Back Recliner Handle Replacement - Front (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Handle, Recliner **Tip:** Using a flat-bladed tool, push the retainer clip downward and pull outward to release the handle.

FRONT SEAT BACK RECLINER HANDLE REPLACEMENT (MONTE CARLO)

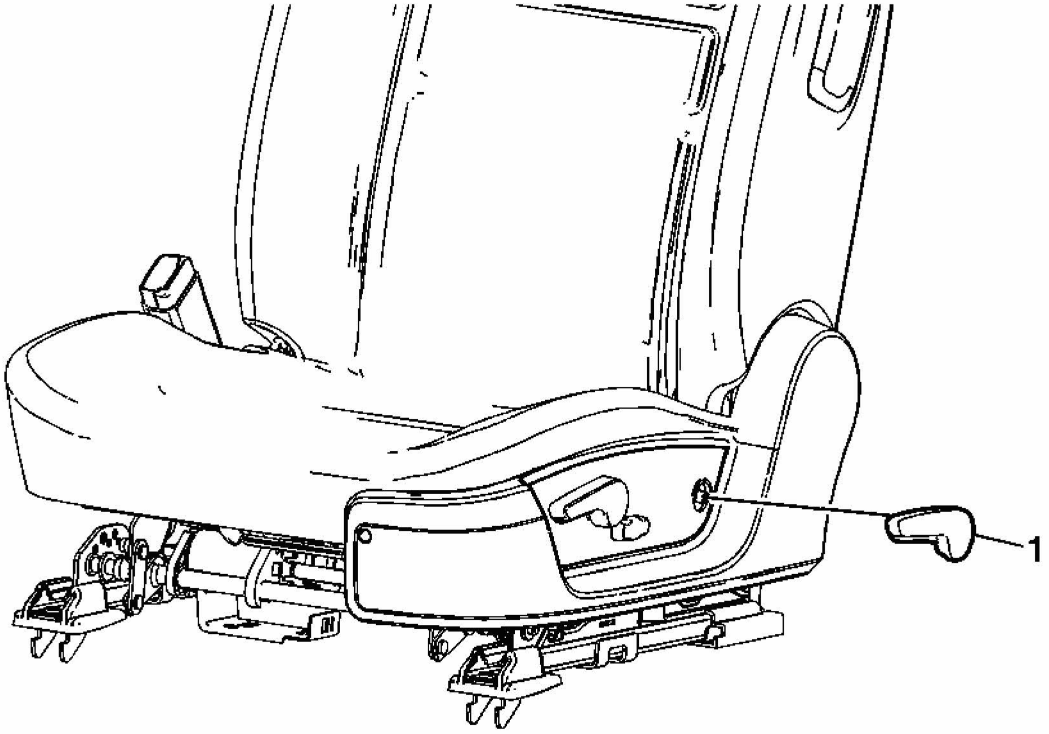


Fig. 39: Replacing Front Seat Back Recliner Handle
Courtesy of GENERAL MOTORS CORP.

Seat Back Recliner Handle Replacement - Front (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Handle, Recliner **Tip:** Using a flat-bladed tool, push the retainer clip downward and pull outward to release the handle.

FRONT SEAT BACK RELEASE KNOB AND BEZEL REPLACEMENT (MONTE CARLO)

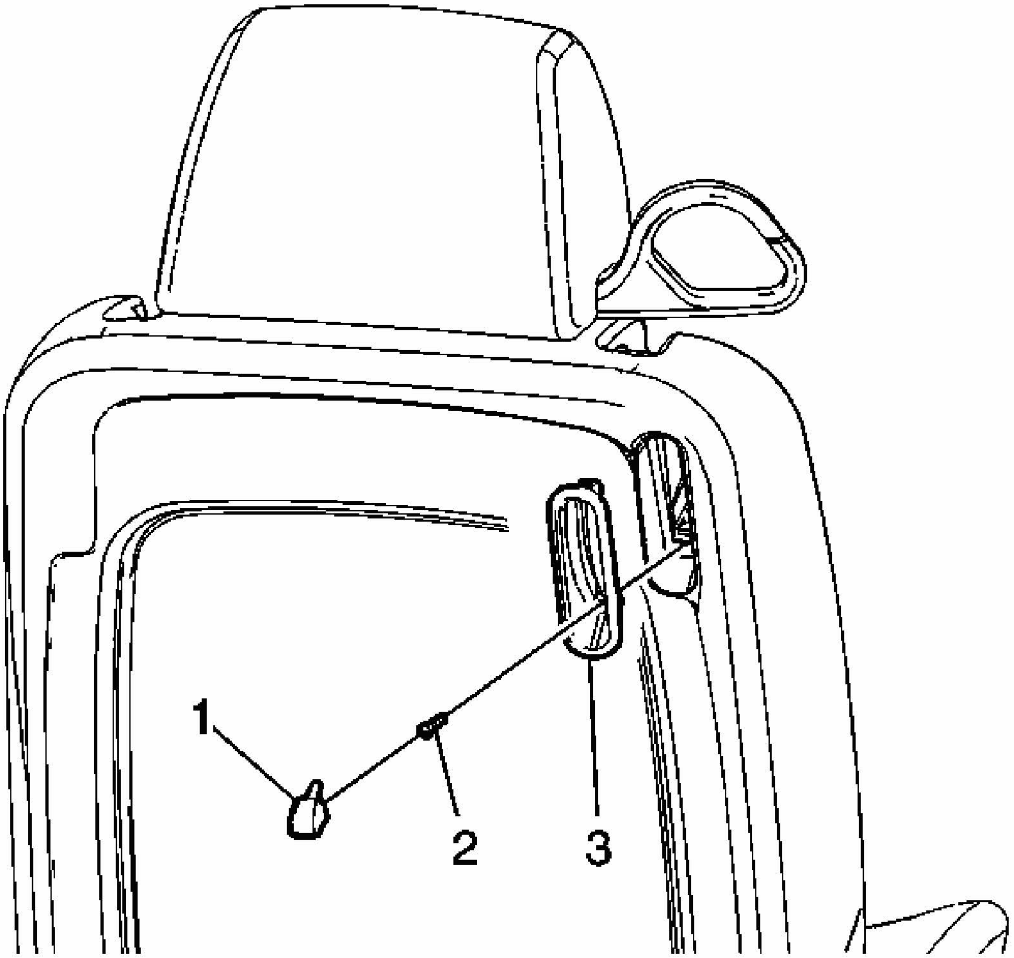


Fig. 40: Replacing Front Seat Back Release Knob And Bezel
Courtesy of GENERAL MOTORS CORP.

Seat Back Release Knob and Bezel Replace - Front (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Knob, Front Seat Back Release Latch Knob
2	Screw, Front Seat Back Release Latch Cover **Tighten:** 3 N.m (25 lb in)

3	Cover, Front Seat Back Release Latch

FRONT SEAT BACK PANEL REPLACEMENT (IMPALA)

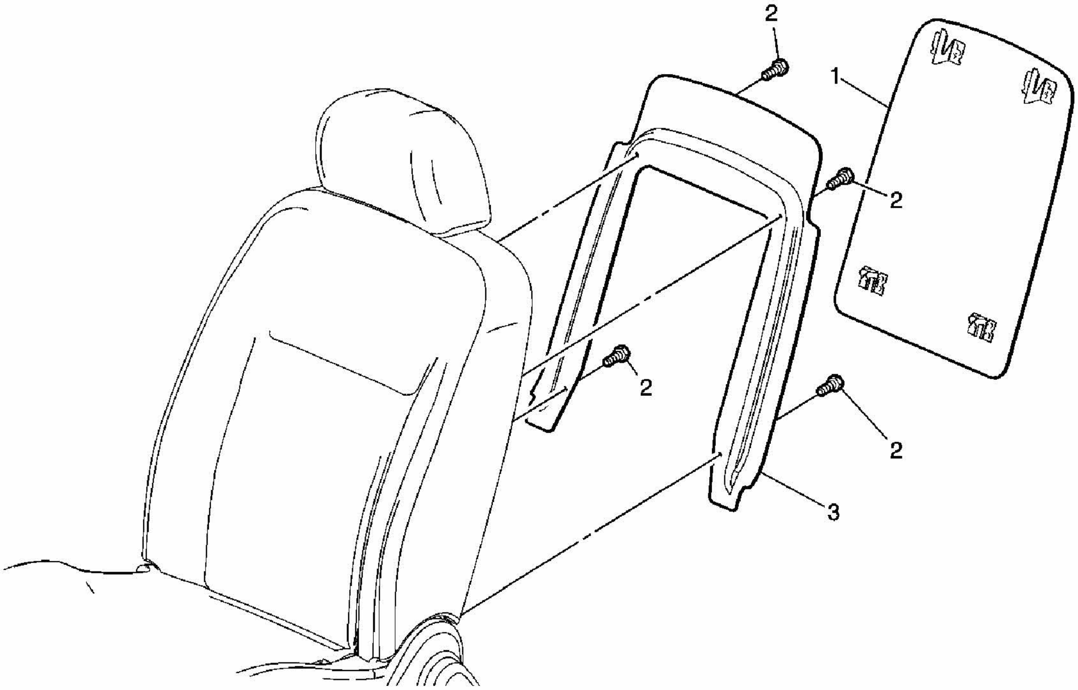


Fig. 41: Replacing Front Seat Back Panel
Courtesy of GENERAL MOTORS CORP.

Seat Back Panel Replacement - Front (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Panel, Seat Back Cushion Finish **Tip:** Push upward and pull back at the bottom edge of the seat back panel to release the lower edge and then pull down to remove.
2	Retainer, Seat Back Cushion Rear Finish (Qty: 4)
3	Panel, Seat Back Cushion Rear Finish

FRONT SEAT BACK PANEL REPLACEMENT (MONTE CARLO)

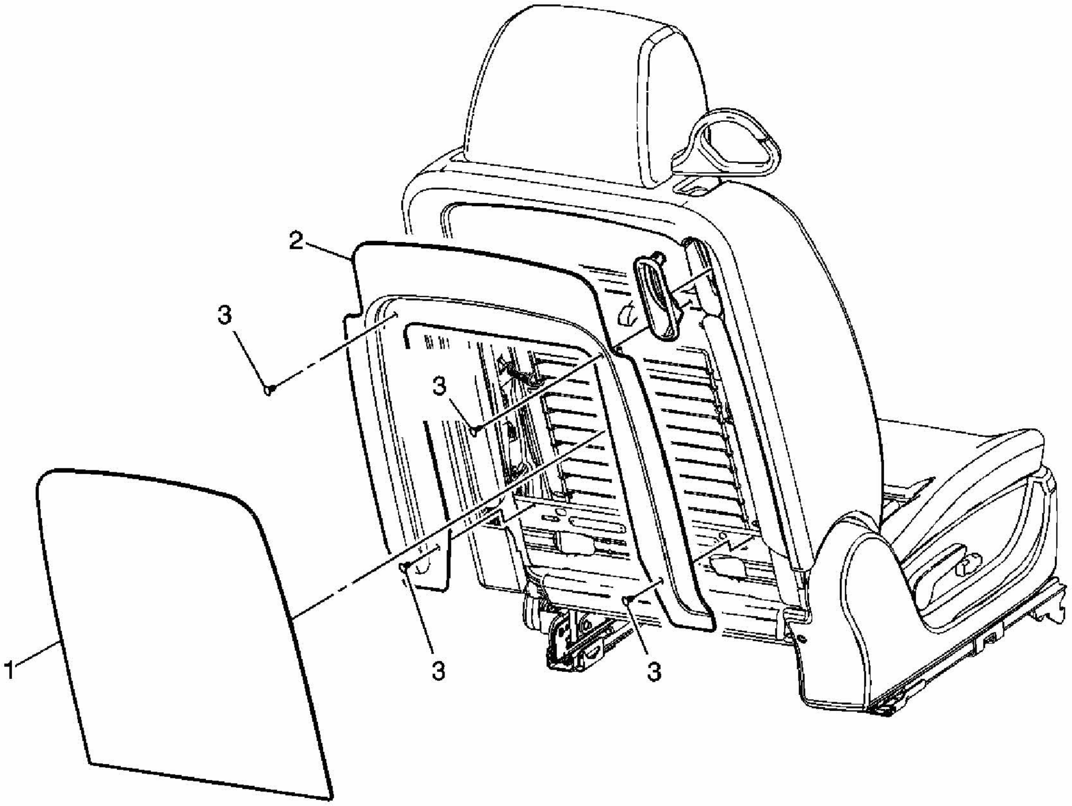


Fig. 42: Replacing Front Seat Back Panel
Courtesy of GENERAL MOTORS CORP.

Seat Back Panel Replacement - Front (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Panel, Seat Back Cushion Finish **Tip:** Push upward and pull back at the bottom edge of the seat back panel to release the lower edge and then pull down to remove.
2	Panel, Seat Back Cushion Rear Finish
3	Retainer, Seat Back Cushion Rear Finish (Qty: 4)

FRONT SEAT LUMBAR REPLACEMENT (IMPALA)

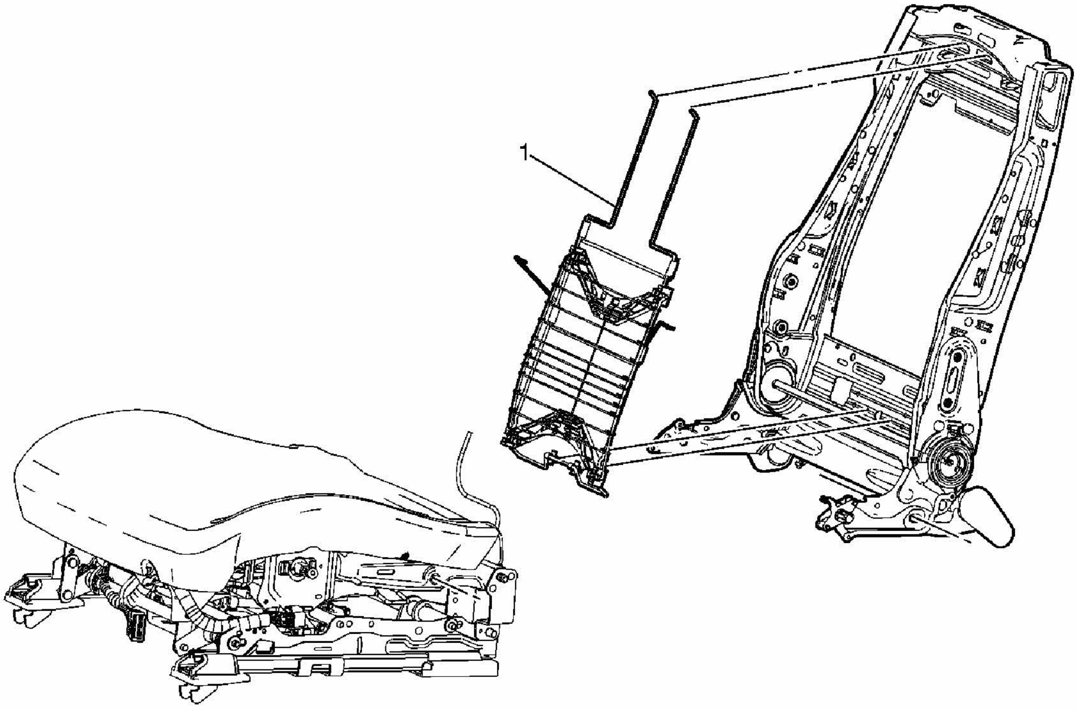


Fig. 43: Replacing Front Seat Lumbar
Courtesy of GENERAL MOTORS CORP.

Lumbar Replacement - Front Seat (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the front seat back cushion cover and pad. Refer to **Seat Back Cover and Pad Replacement (Impala)** or **Seat Back Cover and Pad Replacement (Monte Carlo)**.	
1	Lumbar Assembly, Front Seat Back **Tip:** 1. Push the retainers at the bottom out of the seat back frame to release the bottom of the lumbar assembly. 2. Tilt and pull down and forward to remove the top portion of the lumbar assembly from the seat back frame. 3. Disconnect the lumbar cable.

FRONT SEAT LUMBAR REPLACEMENT (MONTE CARLO)

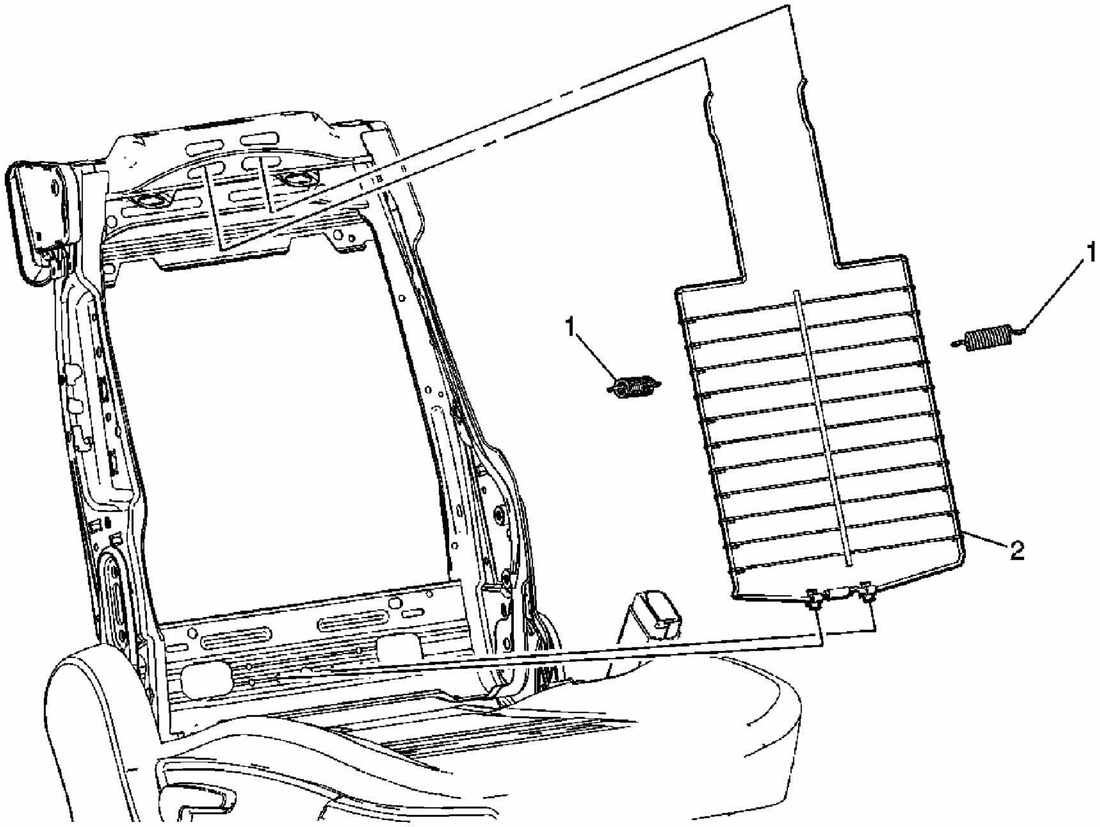


Fig. 44: Replacing Front Seat Lumbar
Courtesy of GENERAL MOTORS CORP.

Lumbar Replacement - Front Seat (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the front seat back cushion cover and pad. Refer to **Seat Back Cover and Pad Replacement (Impala)** or **Seat Back Cover and Pad Replacement (Monte Carlo)**.	
1	Spring, Front Seat Lumbar (Qty: 2)
2	Lumbar Assembly, Front Seat Back **Tip:** 1. Push the retainers at the bottom out of the seat back frame to release the bottom of the lumbar assembly. 2. Tilt and pull down and forward to remove the top portion of the lumbar assembly from the seat back frame.

LUMBAR SUPPORT KNOB REPLACEMENT (IMPALA)

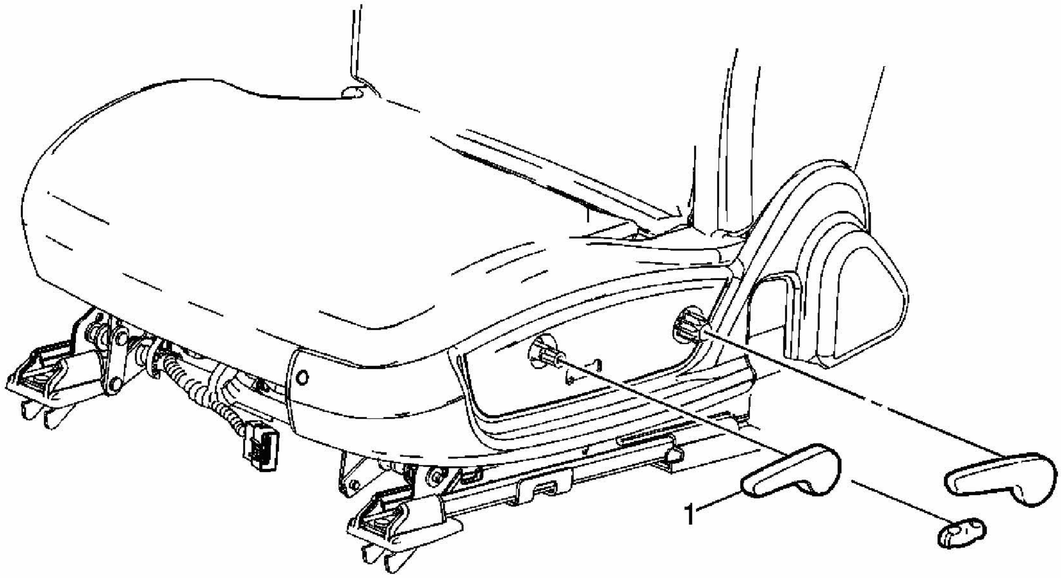


Fig. 45: Replacing Lumbar Support Knob
Courtesy of GENERAL MOTORS CORP.

Lumbar Support Knob Replacement (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Knob, Lumbar Actuator **Tip:** Pull outward to remove.

LUMBAR SUPPORT KNOB REPLACEMENT (MONTE CARLO)

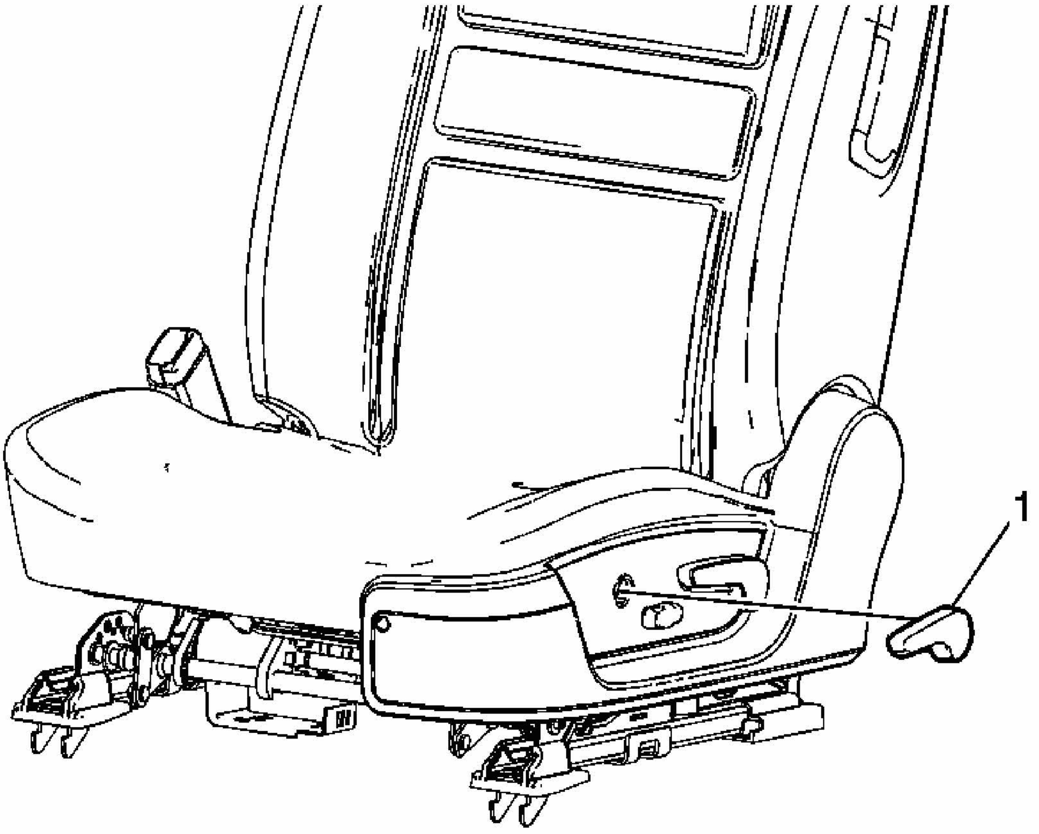


Fig. 46: Replacing Lumbar Support Knob
Courtesy of GENERAL MOTORS CORP.

Lumbar Support Knob Replacement (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Knob, Lumbar Actuator **Tip:** Pull outward to remove.

FRONT SEAT ADJUSTER REPLACEMENT (IMPALA)

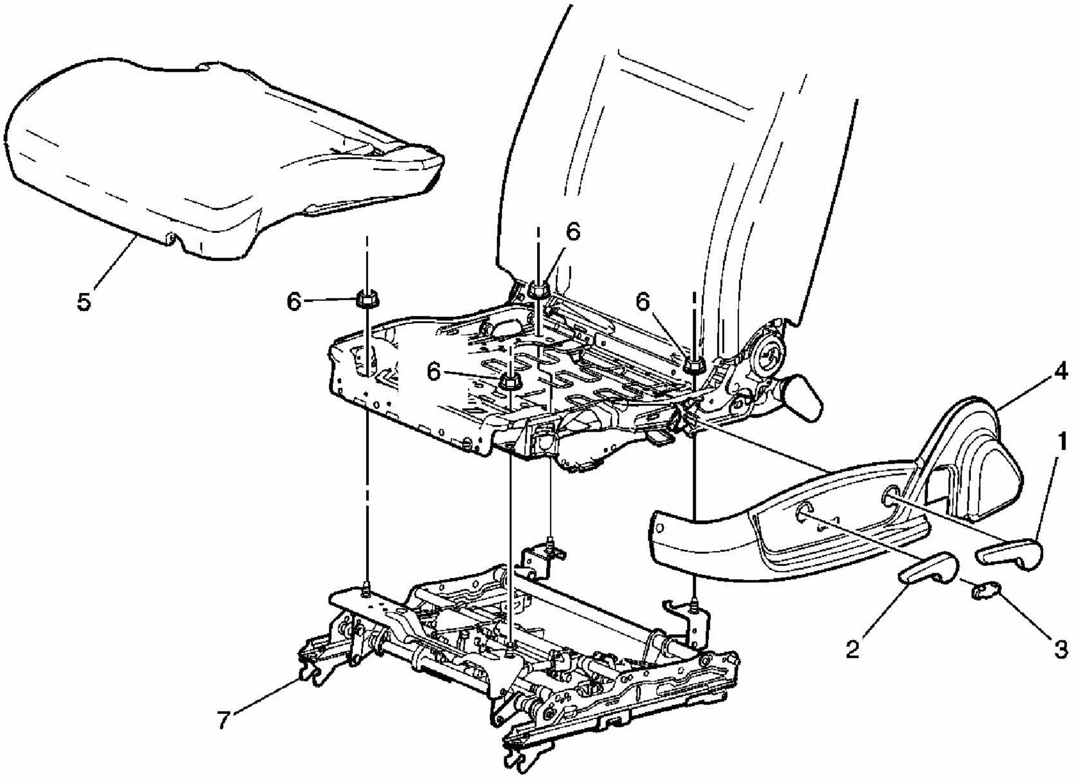


Fig. 47: Replacing Front Seat Adjuster
Courtesy of GENERAL MOTORS CORP.

Seat Adjuster Replacement - Front (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.	
1	Handle, Recliner **Tip:** Using a flat-bladed tool, push the retainer clip downward and pull outward to release the handle.
2	Handle, Lumbar Actuator **Tip:** Pull outward to remove.
3	Knob, Power Seat Switch **Tip:** Pull outward to remove.
	Panel, Seat Cushion Outer Trim

4	Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)**.
5	Cover, Seat Cushion **Tip:** 1. Release the j-channel from the seat cushion frame. 2. Disconnect the seat cushion heater electrical connector, if equipped. 3. Remove the seat cushion cover and pad as an assembly from the frame.
6	Nut, Front Seat Cushion Frame (Qty: 4) **Tighten:** 9 N.m (80 lb in)
7	Adjuster Assembly, Front Seat

FRONT SEAT ADJUSTER REPLACEMENT (MONTE CARLO)

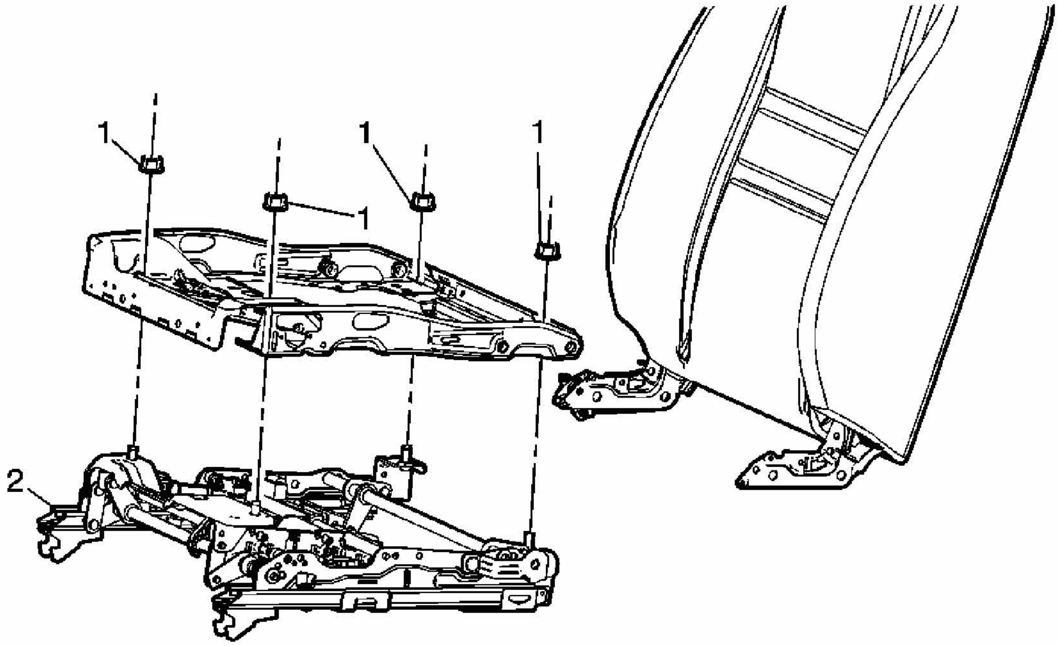


Fig. 48: Replacing Front Seat Adjuster
Courtesy of GENERAL MOTORS CORP.

Seat Adjuster Replacement - Front (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .**	

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Disable the SIR system if working on the passenger seat. Refer to **SIR Disabling and Enabling Zone 7** and **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)** .
2. Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.
3. Remove the front seat cushion cover and pad. Refer to **Seat Cushion Cover and Pad Replacement - Front (Impala)** or **Seat Cushion Cover and Pad Replacement - Front (Monte Carlo)**.

1	Nut, Front Seat Cushion Frame (Qty: 4) **Tighten:** 9 N.m (80 lb in)
2	Adjuster Assembly, Front Seat

PASSENGER SIDE SEAT ADJUSTER REPLACEMENT (IMPALA W/O AG2)

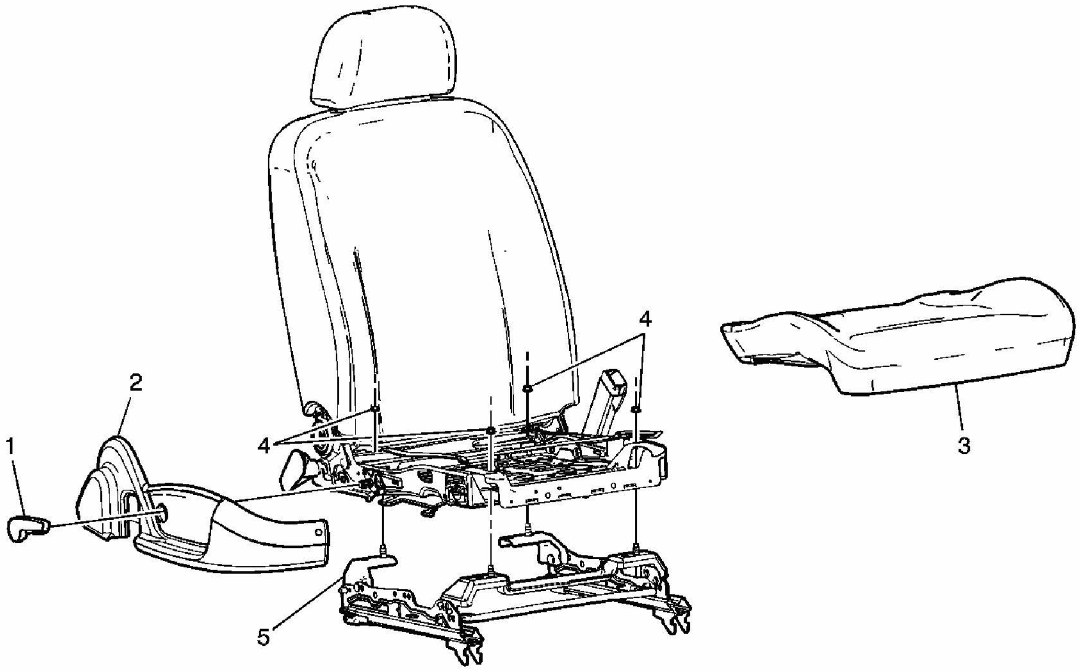


Fig. 49: Replacing Passenger Side Seat Adjuster
Courtesy of GENERAL MOTORS CORP.

Seat Adjuster Replacement - Passenger Side (Impala w/o AG2)

Callout	Component Name

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.

1	Handle, Recliner **Tip:** Using a flat-bladed tool, push the retainer clip downward and pull outward to release the handle.
2	Panel, Seat Cushion Outer Trim Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)**.
3	Cover, Seat Cushion **Tip:** 1. Release the j-channel from the seat cushion frame. 2. Disconnect the seat cushion heater electrical connector, if equipped. 3. Remove the seat cushion cover and pad as an assembly from the frame.
4	Nut, Front Seat Cushion Frame (Qty: 4) **Tighten:** 9 N.m (80 lb in)
5	Adjuster Assembly, Front Seat

POWER SEAT SWITCH AND SEAT CUSHION KNOB REPLACEMENT (IMPALA)

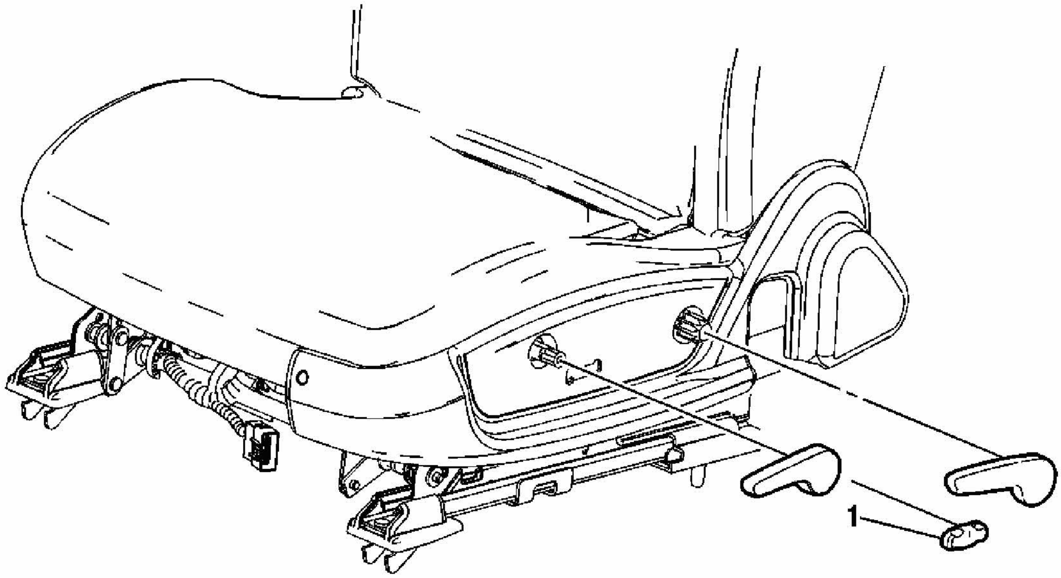


Fig. 50: Replacing Power Seat Switch And Seat Cushion Knob
Courtesy of GENERAL MOTORS CORP.

Knob Replacement - Power Seat Switch - Seat Cushion (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Knob, Power Seat Switch **Tip:** Pull outward to remove.

POWER SEAT SWITCH AND SEAT CUSHION KNOB REPLACEMENT (MONTE CARLO)

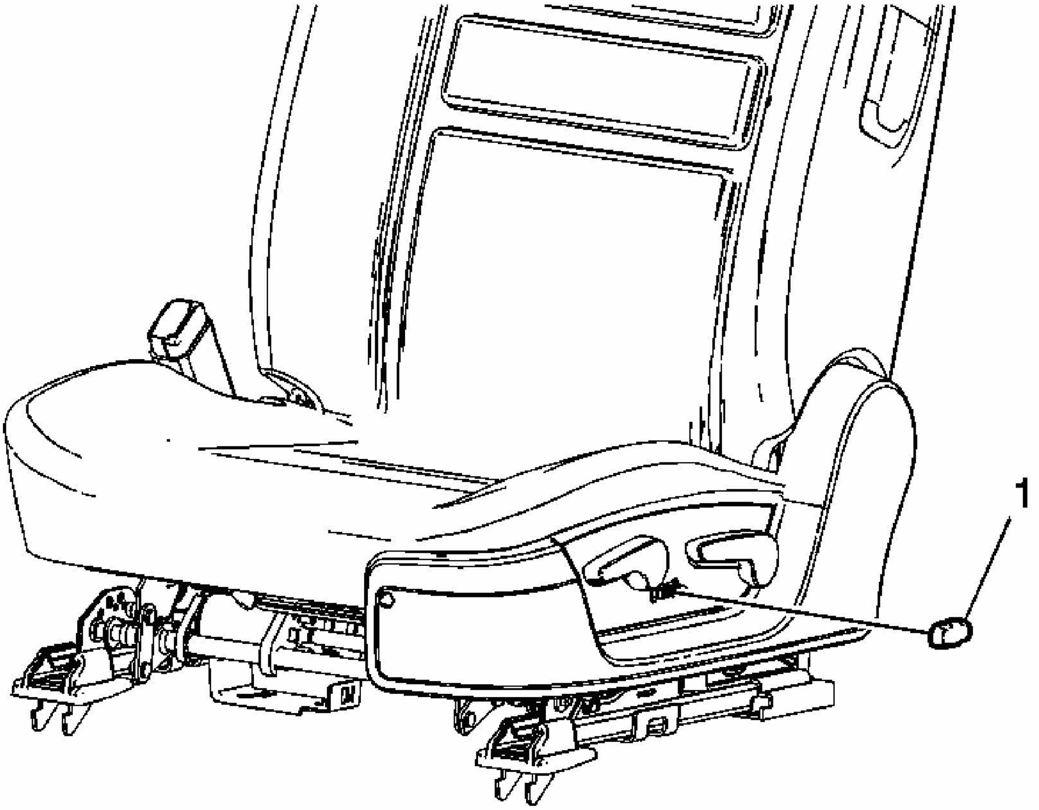


Fig. 51: Replacing Power Seat Switch And Seat Cushion Knob
Courtesy of GENERAL MOTORS CORP.

Knob Replacement - Power Seat Switch - Seat Cushion (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Knob, Power Seat Switch **Tip:** Pull outward to remove.

POWER SEAT SWITCH REPLACEMENT (IMPALA)

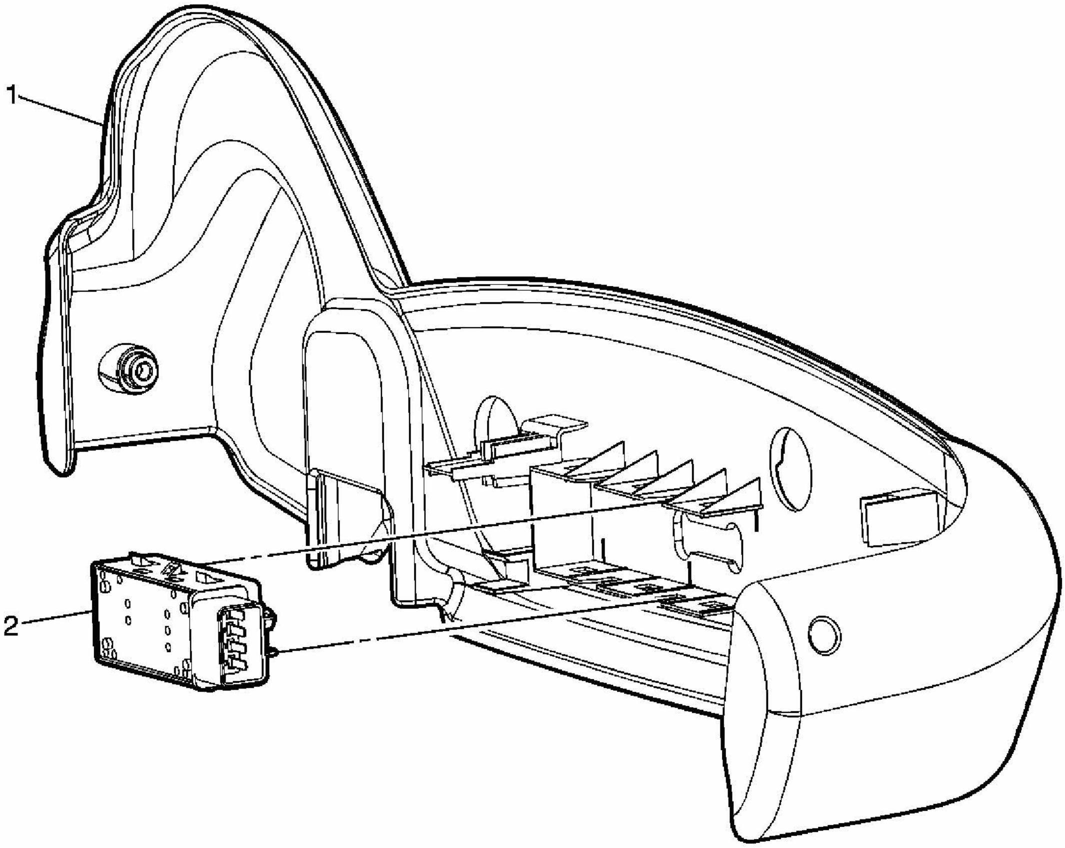


Fig. 52: Replacing Power Seat Switch
Courtesy of GENERAL MOTORS CORP.

Seat Switch Replacement - Power (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Panel, Seat Cushion Outer Trim Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)**.
2	Switch, Power Seat **Tip:** 1. Disconnect the electrical connector. 2. Release the tabs and pull out of the outer trim panel to remove.

POWER SEAT SWITCH REPLACEMENT (MONTE CARLO)

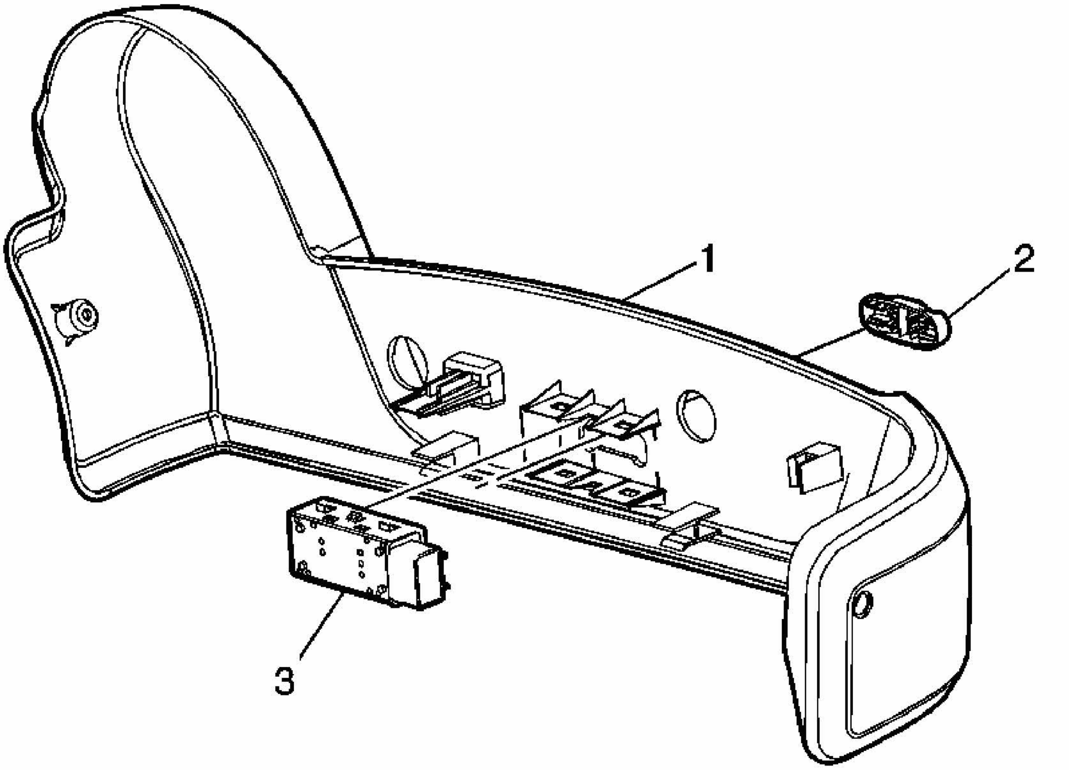


Fig. 53: Replacing Power Seat Switch
Courtesy of GENERAL MOTORS CORP.

Seat Switch Replacement - Power (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Panel, Seat Cushion Outer Trim Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)**.
2	Knob, Power Seat Switch
3	Switch, Power Seat **Tip:** 1. Disconnect the electrical connector. 2. Release the tabs and pull out of the outer trim panel to remove.

FRONT SEAT BACK HEATER ELEMENT REPLACEMENT (IMPALA)

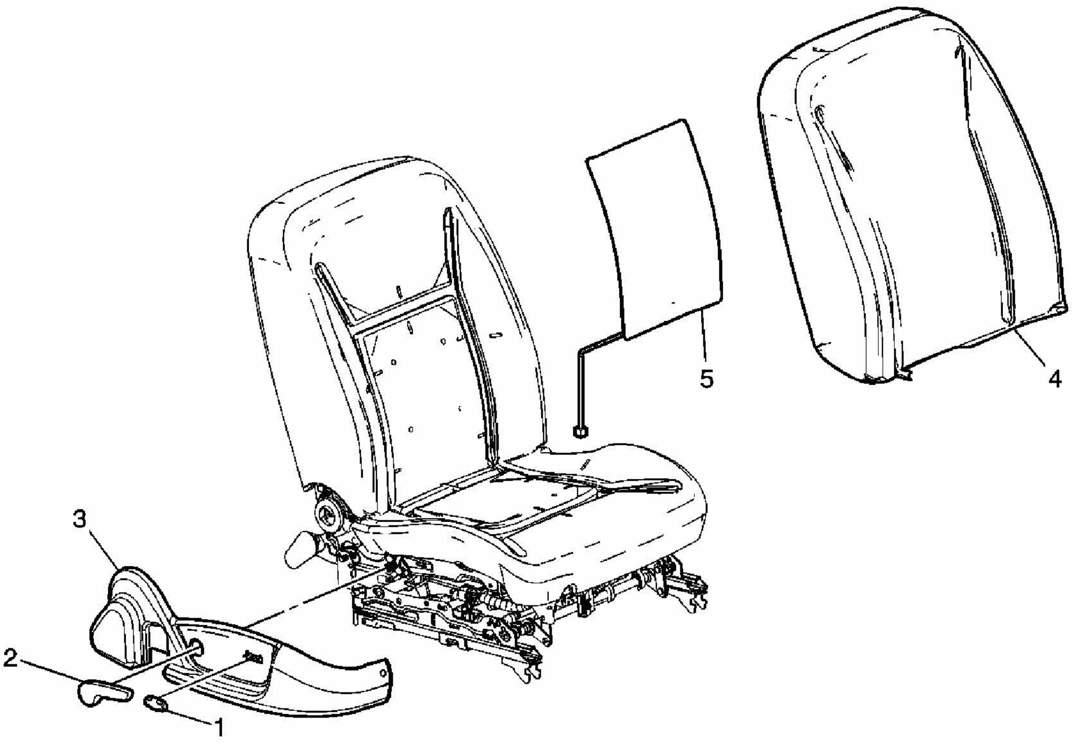


Fig. 54: Replacing Front Seat Back Heater Element
Courtesy of GENERAL MOTORS CORP.

Seat Back Heater Element Replacement - Front (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.	
1	Handle, Recliner **Tip:** Using a flat-bladed tool, push the retainer clip downward and pull outward to release the handle.
2	Knob, Power Seat Switch **Tip:** Pull outward to remove.
3	Panel, Seat Cushion Outer Trim Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)**.
4	Cover, Seat Back Cushion Refer to **Seat Back Cover and Pad Replacement (Impala)** or **Seat Back Cover and Pad Replacement (Monte Carlo)**.
	Heater Assembly, Seat Back Cushion **Tip:**

5	1. Disconnect the electrical connector. 2. The seat cushion back heater is attached to the pad with adhesive, peel away from the pad to remove.

FRONT SEAT BACK HEATER ELEMENT REPLACEMENT (MONTE CARLO)

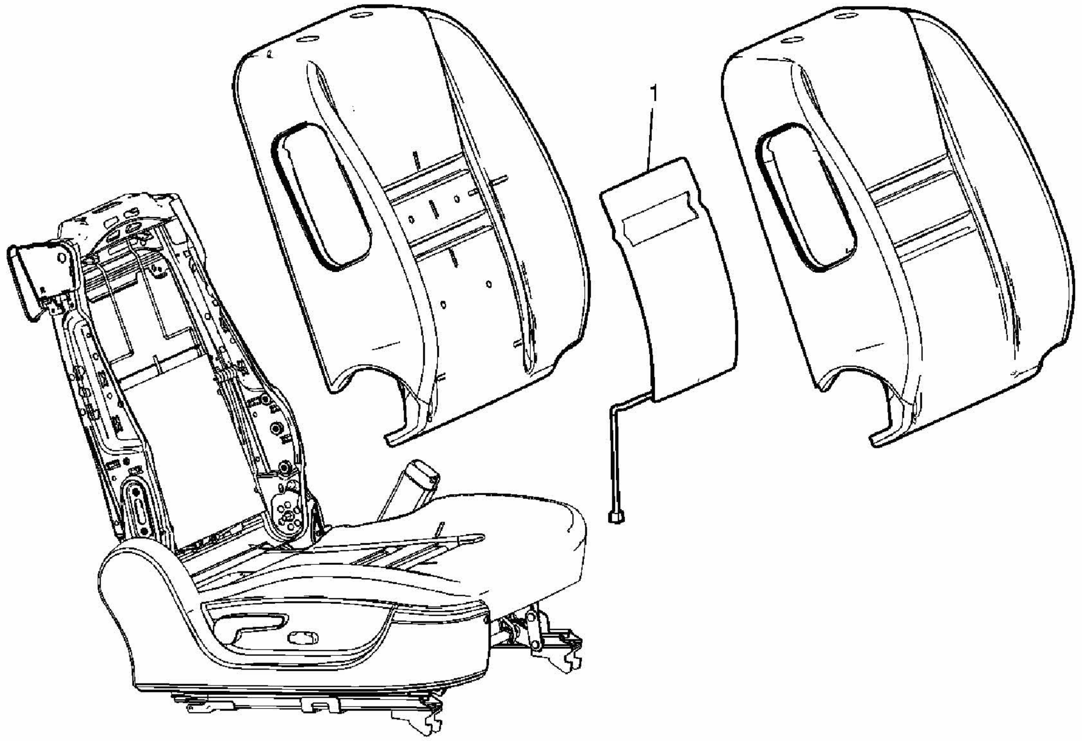


Fig. 55: Replacing Front Seat Back Heater Element
Courtesy of GENERAL MOTORS CORP.

Seat Back Heater Element Replacement - Front (Monte Carlo)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.
Preliminary Procedure
1. Disable the SIR system. Refer to SIR Disabling and Enabling Zone 7 and SIR Disabling and Enabling Zone 9 (Monte Carlo) or SIR Disabling and Enabling Zone 9 (Impala) .
2. Remove the front seat. Refer to Seat Replacement - Front Bucket (Impala) or Seat Replacement - Front Bucket (Monte Carlo).
3. Remove the seat back cushion cover and pad. Refer to Seat Back Cover and Pad Replacement (Impala) or Seat Back Cover and Pad Replacement (Monte</td></tr>
</table>

Carlo).	
1	Heater Assembly, Seat Back Cushion **Tip:** 1. Disconnect the electrical connector. 2. The seat cushion back heater is attached to the pad with adhesive, peel away from the pad to remove.

FRONT SEAT CUSHION HEATER ELEMENT REPLACEMENT (IMPALA)

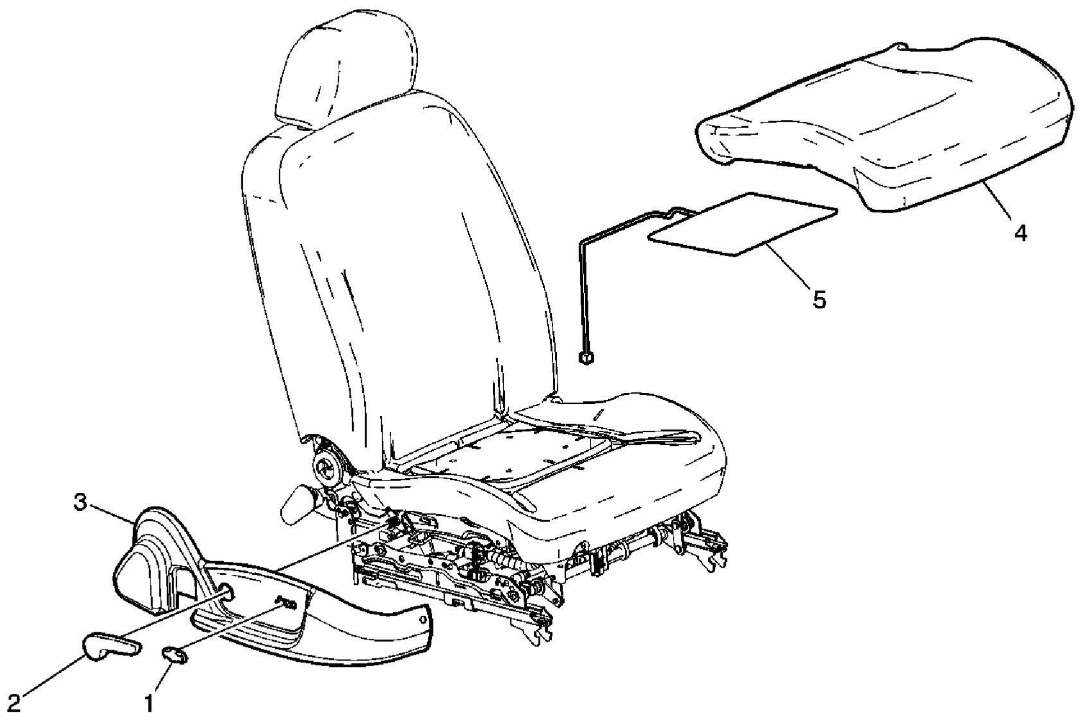


Fig. 56: Replacing Front Seat Cushion Heater Element
Courtesy of GENERAL MOTORS CORP.

Seat Cushion Heater Element Replacement - Front (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.	
1	Handle, Recliner **Tip:** Using a flat-bladed tool, push the retainer clip downward and pull outward to release the handle.
	Knob, Power Seat Switch

2	**Tip:** Pull outward to remove.
3	Panel, Seat Cushion Outer Trim Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)**.
4	Cover, Seat Cushion Refer to **Seat Cushion Cover and Pad Replacement - Front (Impala)** or **Seat Cushion Cover and Pad Replacement - Front (Monte Carlo)**.
5	Heater Assembly, Seat Cushion **Tip:** 1. Disconnect the electrical connector. 2. The seat cushion heater is attached to the pad with adhesive, peel away from the pad to remove.

FRONT SEAT CUSHION HEATER ELEMENT REPLACEMENT (MONTE CARLO)

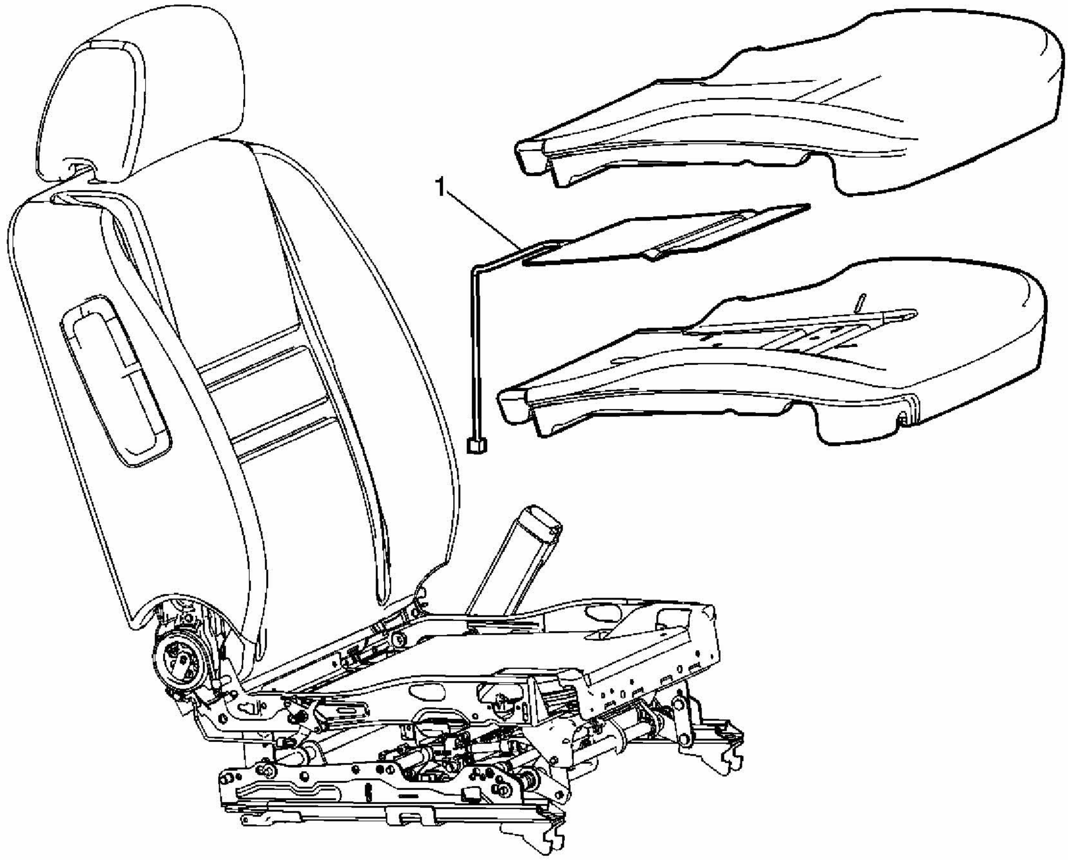


Fig. 57: Replacing Front Seat Cushion Heater Element
Courtesy of GENERAL MOTORS CORP.

Seat Cushion Heater Element Replacement - Front (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Disable the SIR system if working on the passenger seat. Refer to **SIR Disabling and Enabling Zone 7** and **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)** . 2. Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**. 3. Remove the seat cushion cover and pad. Refer to **Seat Cushion Cover and Pad Replacement - Front (Impala)** or **Seat Cushion Cover and Pad Replacement - Front (Monte Carlo)**.	
1	Heater Assembly, Seat Cushion **Tip:** 1. Disconnect the electrical connector. 2. The seat cushion heater is attached to the pad with adhesive, peel away from the pad to remove.

FRONT HEATED SEAT CONTROL MODULE REPLACEMENT (IMPALA)

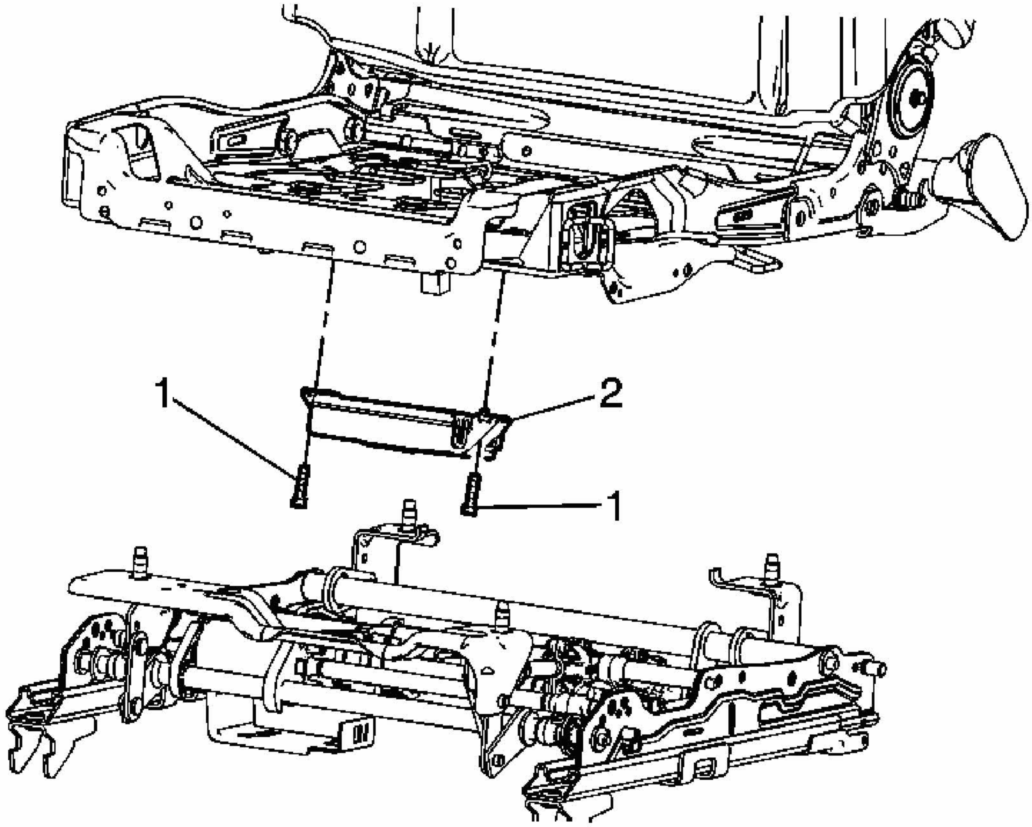


Fig. 58: Replacing Front Heated Seat Control Module
Courtesy of GENERAL MOTORS CORP.

Heated Seat Control Module Replacement - Front (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**. 2. Remove the front seat adjuster. Refer to **Seat Adjuster Replacement - Front (Impala)** or **Seat Adjuster Replacement - Front (Monte Carlo)**.	
1	Screw, Front Seat Heater Control Module (Qty: 2)

	Tighten: 2 N.m (18 lb in)
2	Module, Front Seat Heater Control **Tip:** Disconnect the electrical connector.

FRONT HEATED SEAT CONTROL MODULE REPLACEMENT (MONTE CARLO)

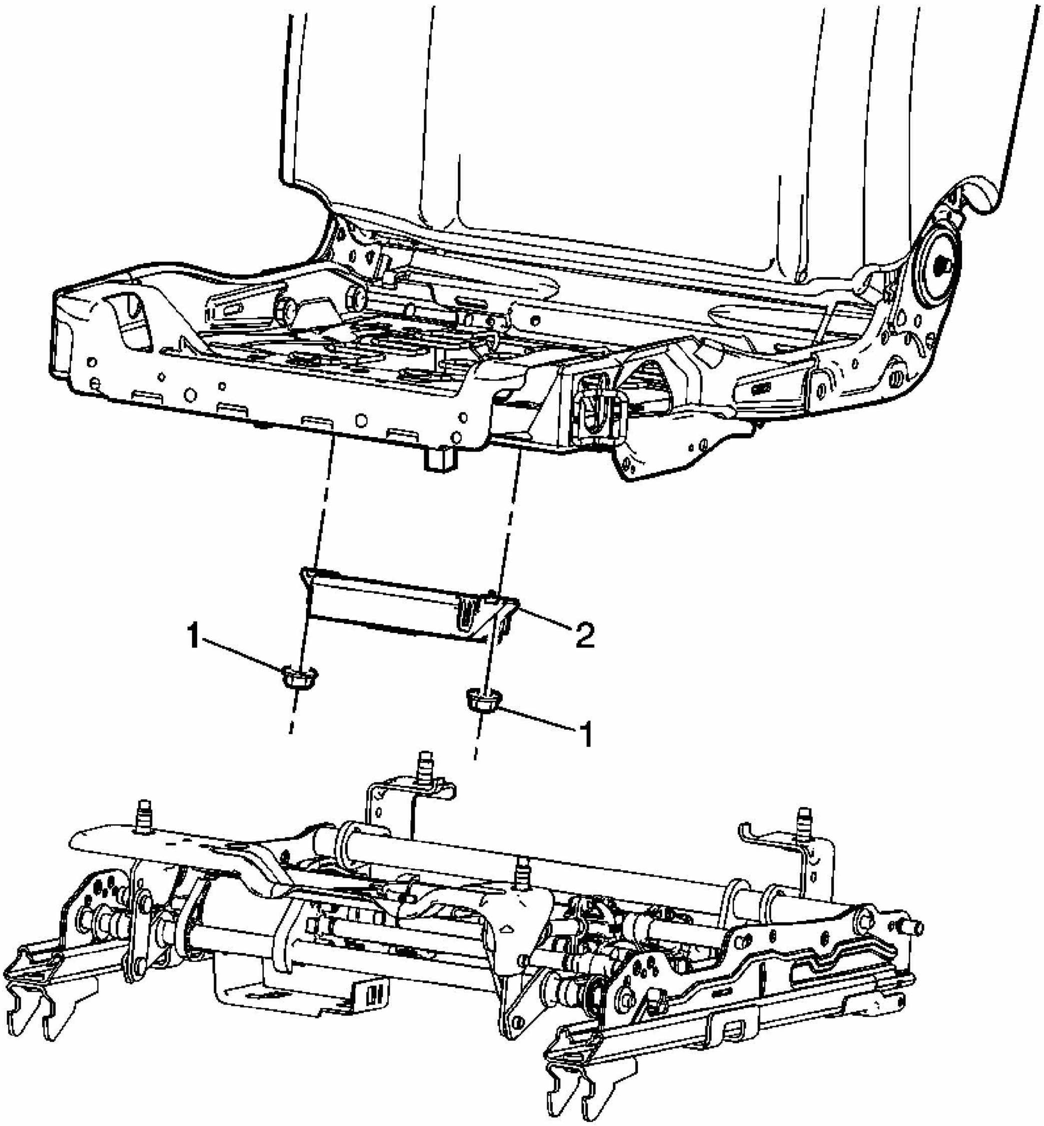


Fig. 59: Replacing Front Heated Seat Control Module
Courtesy of GENERAL MOTORS CORP.

Heated Seat Control Module Replacement - Front (Monte Carlo)

Callout	Component Name
NOTE:	

Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Disable the SIR system if working on the passenger seat. Refer to **SIR Disabling and Enabling Zone 7** and **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)** .
2. Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)**.
3. Remove the front seat adjuster. Refer to **Seat Adjuster Replacement - Front (Impala)** or **Seat Adjuster Replacement - Front (Monte Carlo)**.

1	Nut, Front Seat Heater Control Module (Qty: 2) **Tighten:** 3 N.m (25 lb in)
2	Module, Front Seat Heater Control **Tip:** Disconnect the electrical connector.

FRONT SEAT HEAD RESTRAINT REPLACEMENT (IMPALA)

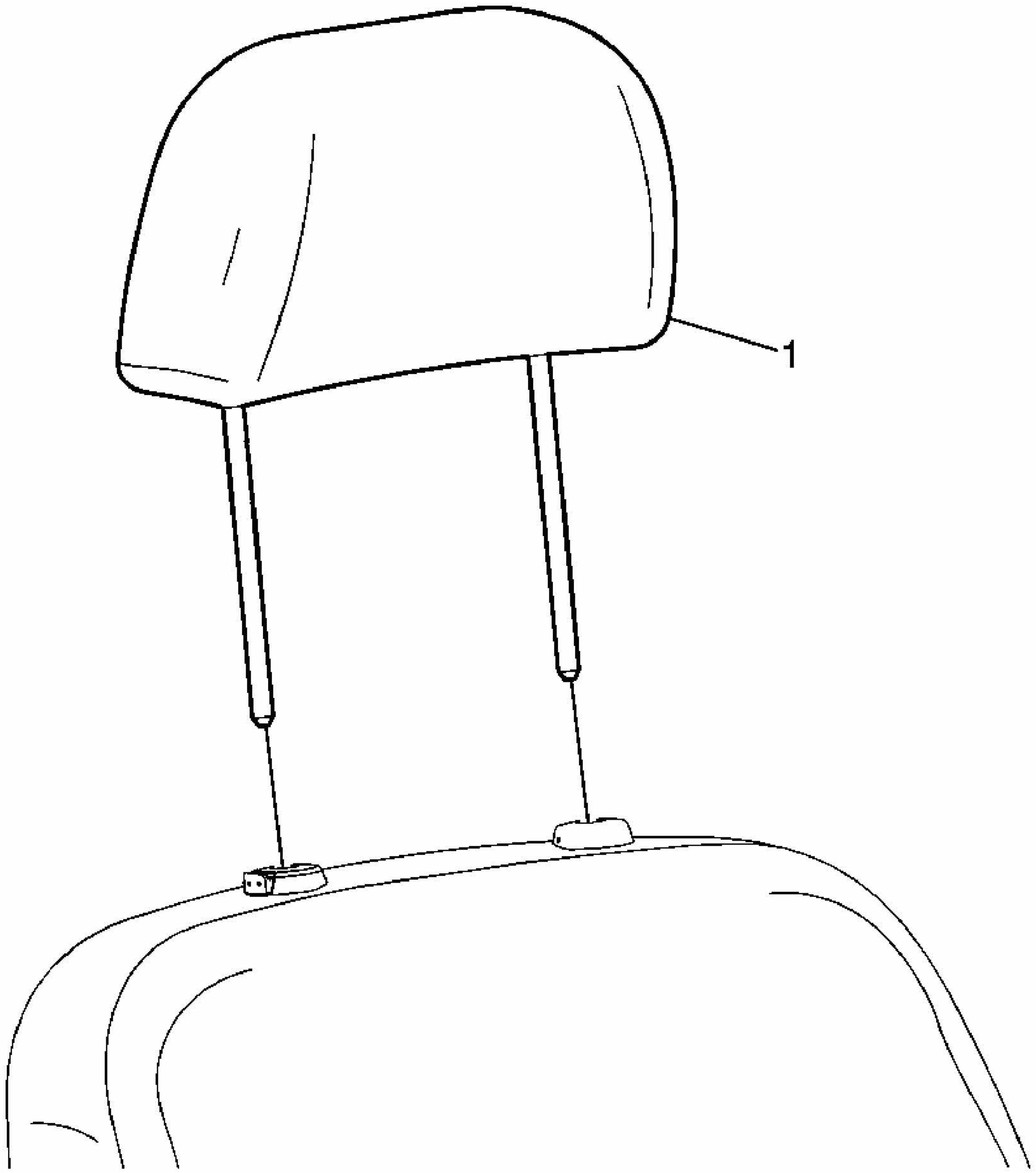


Fig. 60: Replacing Front Seat Head Restraint
Courtesy of GENERAL MOTORS CORP.

Head Restraint Replacement - Front Seat (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Restraint, Front Seat Head **Tip:** 1. Depress the button on the inboard head restraint guide to raise the

	head restraint to the full up position. 2. Insert a small diameter tool into the hole on the inboard side of the outboard head restraint guide and pull upward to remove.

FRONT SEAT HEAD RESTRAINT REPLACEMENT (MONTE CARLO)

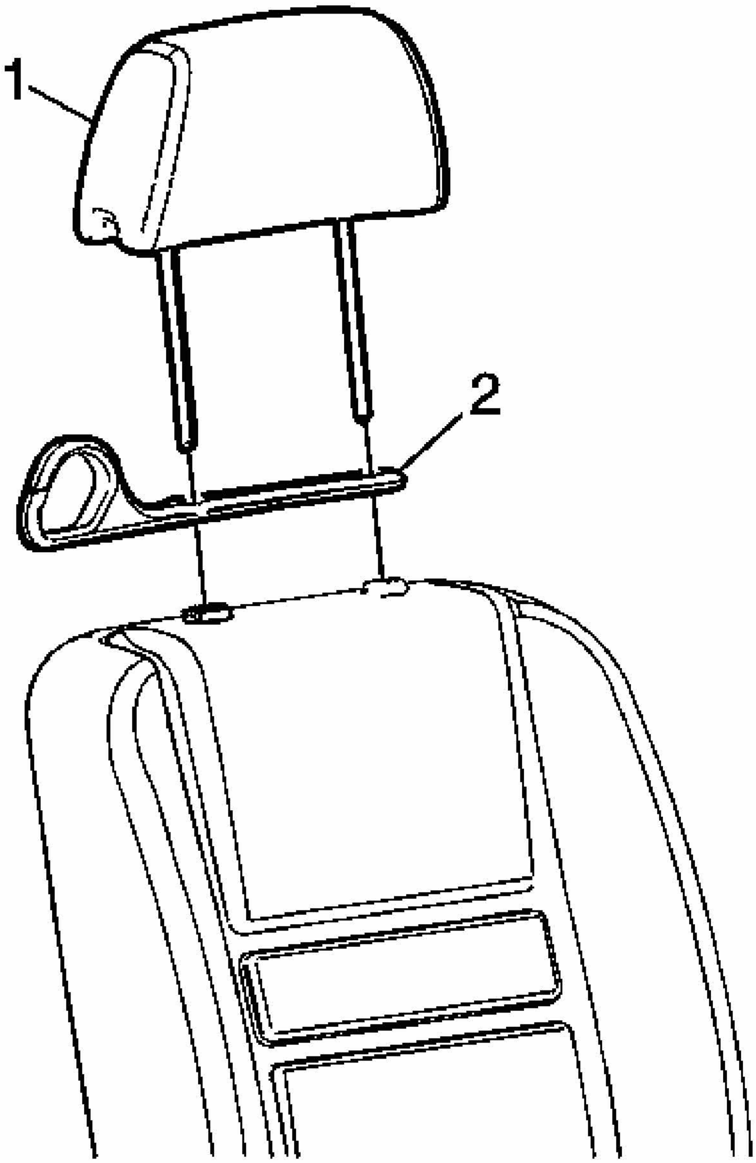


Fig. 61: Replacing Front Seat Head Restraint
Courtesy of GENERAL MOTORS CORP.

Head Restraint Replacement - Front Seat (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Restraint, Front Seat Head **Tip:** 1. Depress the button on the inboard head restraint guide to raise the head restraint to the full up position. 2. Insert a small diameter tool into the hole on the inboard side of the outboard head restraint guide and pull upward to remove.
2	Guide, Seat Shoulder Belt **Tip:** Cut the retainers that secure the should belt guide to the head restraint to remove and install new retainers to reinstall.

FRONT SEAT HEAD RESTRAINT GUIDE REPLACEMENT (IMPALA)

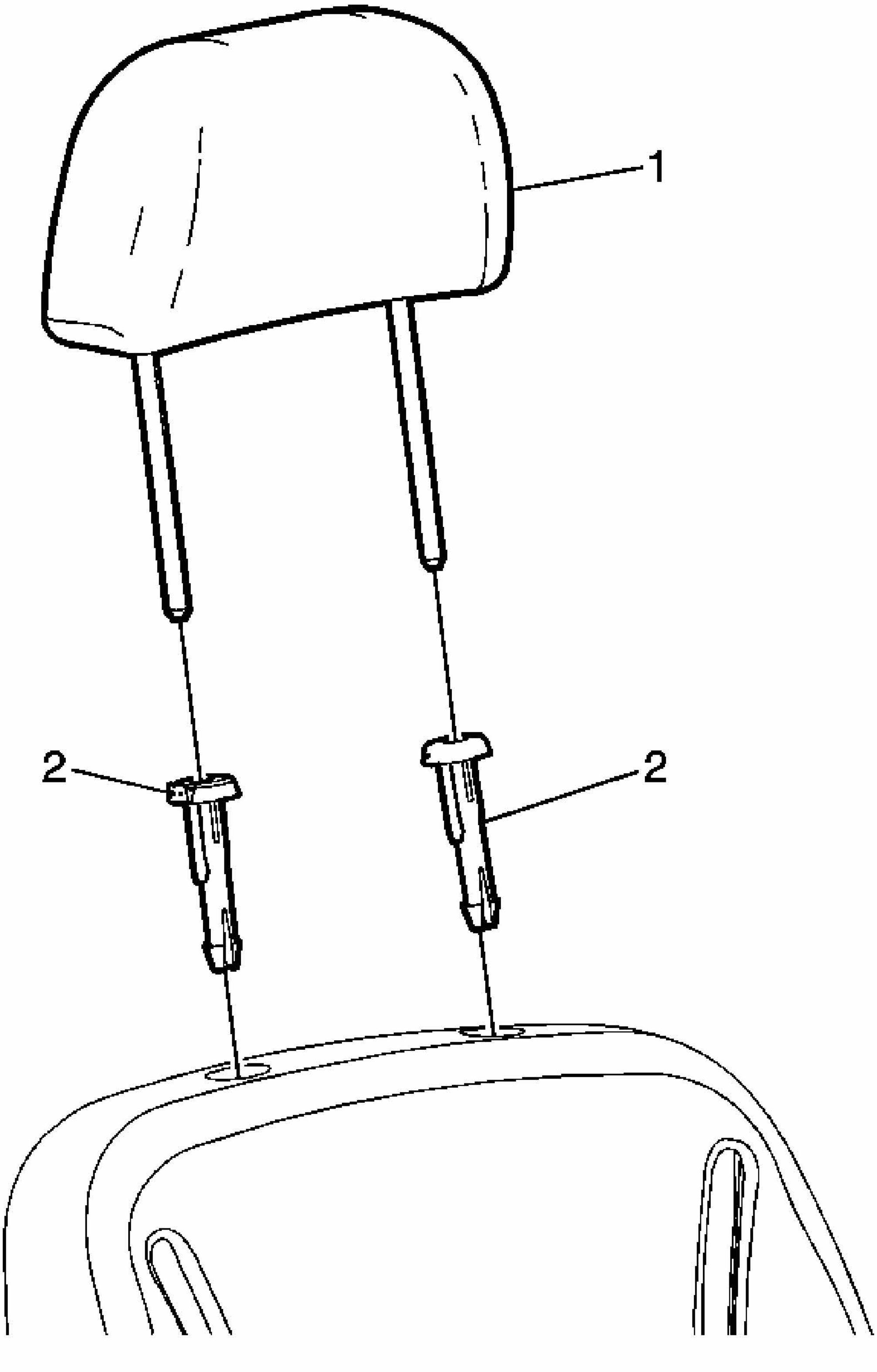


Fig. 62: Replacing Front Seat Head Restraint Guide

Courtesy of GENERAL MOTORS CORP.

Head Restraint Guide Replacement - Front Seat (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedure:** Remove the front seat back panel. Refer to **Seat Back Panel Replacement - Front (Impala)** or **Seat Back Panel Replacement - Front (Monte Carlo)**.	
1	Restraint, Front Seat Head **Tip:** 1. Depress the button on the inboard head restraint guide to raise the head restraint to the full up position. 2. Insert a small diameter tool into the hole on the inboard side of the outboard head restraint guide and pull upward to remove.
2	Guide, Front Seat Head Restraint (Qty: 2) **Tip:** Reach up and into the top of the seat back, while pressing the tabs on the bottom of the head restraint guide, pull the guide from the seat back frame.

FRONT SEAT HEAD RESTRAINT GUIDE REPLACEMENT (MONTE CARLO)

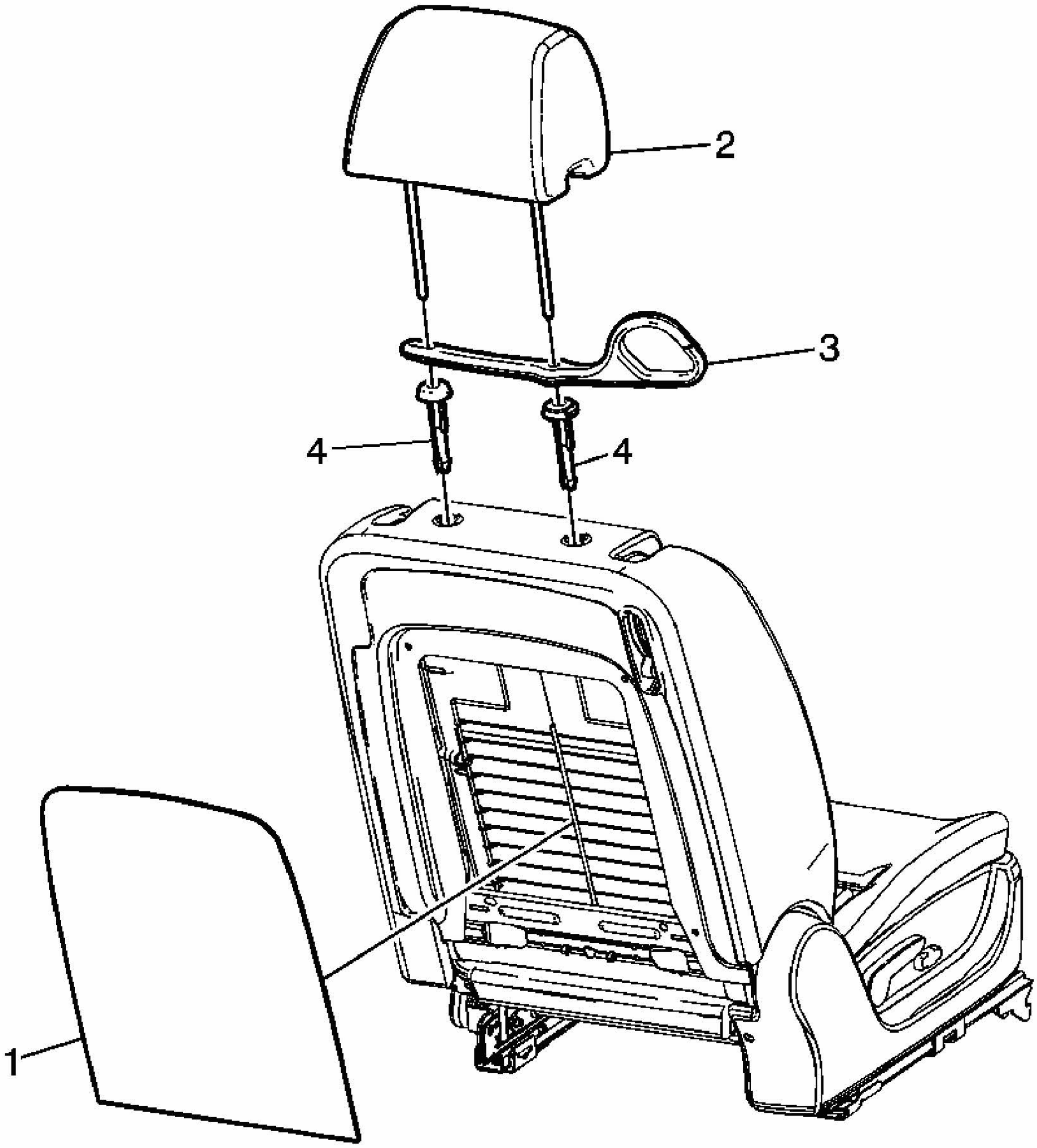


Fig. 63: Replacing Front Seat Head Restraint Guide
Courtesy of GENERAL MOTORS CORP.

Head Restraint Guide Replacement - Front Seat (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Panel, Front Seat Back Finish Refer to **Seat Back Panel Replacement - Front (Impala)** or **Seat Back Panel Replacement - Front (Monte Carlo)**.
	Restraint, Front Seat Head **Tip:**

2	1. Depress the button on the inboard head restraint guide to raise the head restraint to the full up position. 2. Insert a small diameter tool into the hole on the inboard side of the outboard head restraint guide and pull upward to remove.
3	Guide, Seat Shoulder Belt
4	Guide, Front Seat Head Restraint (Qty: 2) **Tip:** Reach up and into the top of the seat back, while pressing the tabs on the bottom of the head restraint guide, pull the guide from the seat back frame.

FRONT SEAT ARMREST REPLACEMENT (IMPALA)

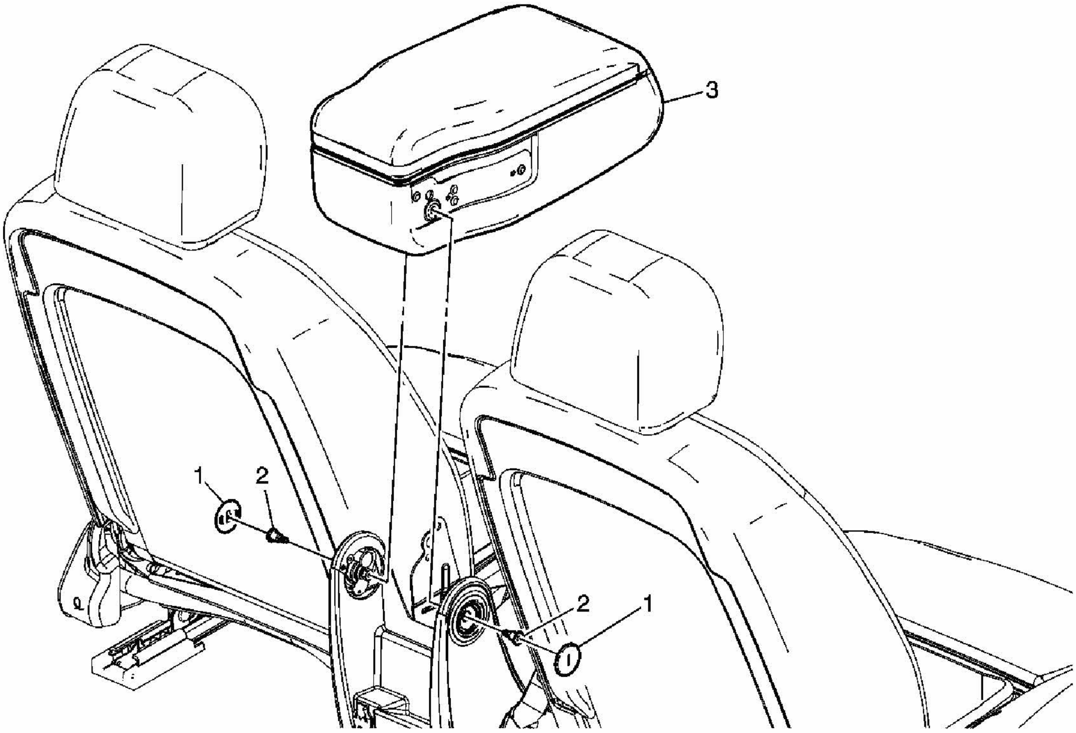


Fig. 64: Replacing Front Seat Armrest
Courtesy of GENERAL MOTORS CORP.

Armrest Replacement - Front Seat (Impala)

Callout	Component Name
NOTE: Refer to Fastener Notice .	
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.	

1	Cover, Front Center Seat Armrest Bolt (Qty: 2) **Tip:** Move the front bucket seats forward far enough to gain access to the armrest bolt cover.
2	Bolt, Front Center Seat Armrest (Qty: 2) **Tighten:** 3 N.m (25 lb in)
3	Armrest Assembly, Front Center Seat

FRONT SEAT ARMREST CUP HOLDER REPLACEMENT

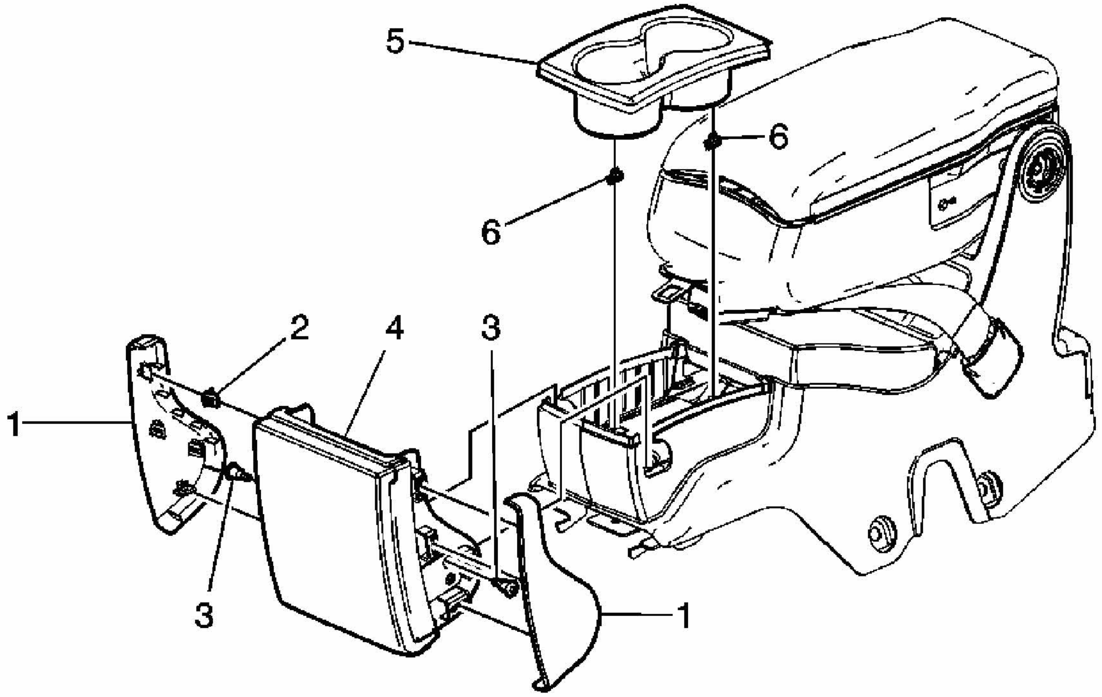


Fig. 65: Replacing Front Seat Armrest Cup Holder
Courtesy of GENERAL MOTORS CORP.

Armrest Cup Holder Replacement - Front Seat

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	End Cap, Front Seat Cup Holder (Qty: 2)
2	Clip, End Cap Retainer (Qty: 8)
3	Bolt, Front Seat Panel Pivot (Qty: 2) **Tighten:** 3 N.m (25 lb in)

4	Panel Assembly, Front Seat
5	Holder, Front Center Seat Cup
6	Clip, Front Center Seat Cup Holder (Qty: 2)

FRONT SEAT ARMREST STOWAGE COMPARTMENT REPLACEMENT

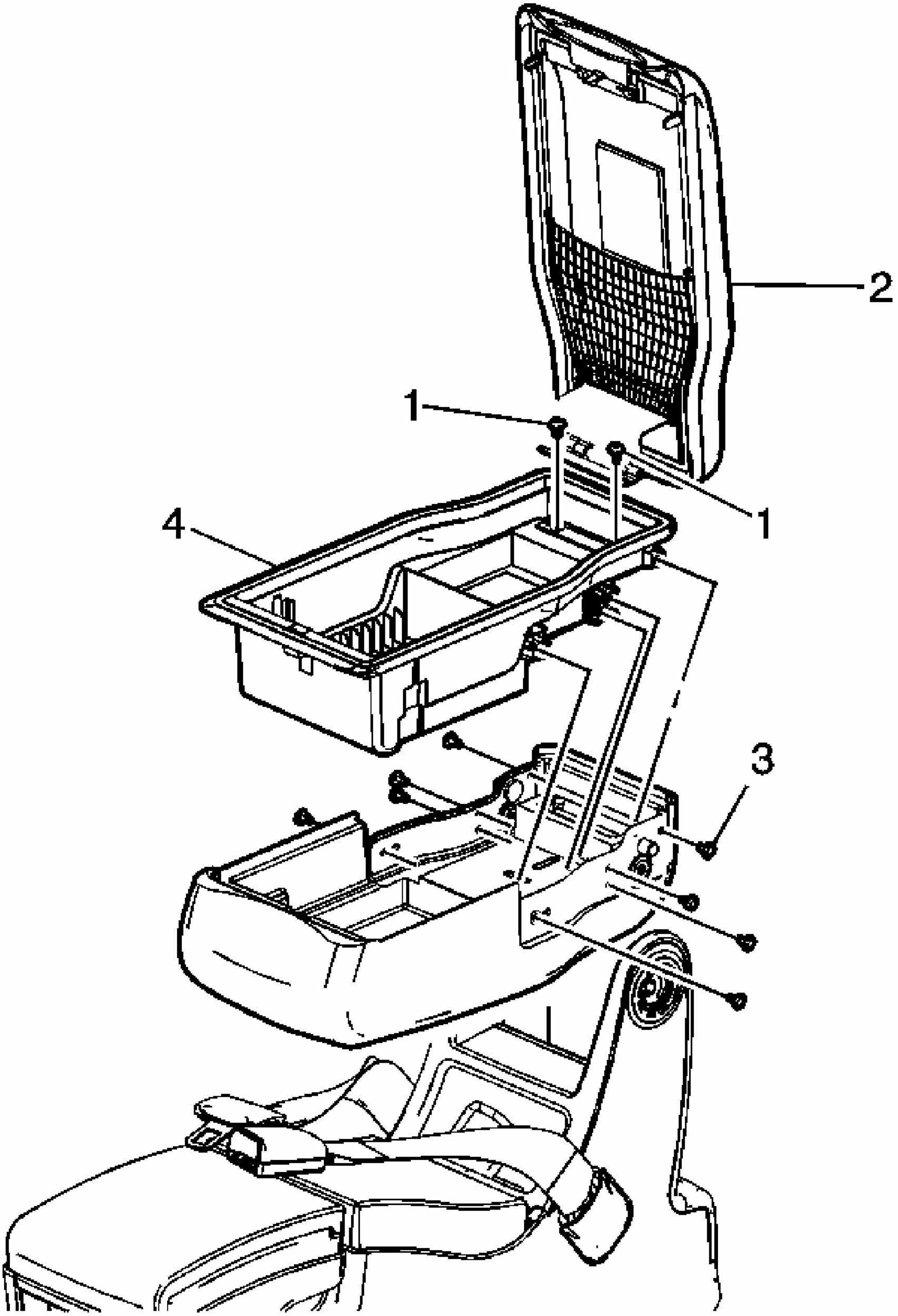


Fig. 66: Replacing Front Seat Armrest Stowage Compartment
Courtesy of GENERAL MOTORS CORP.

Front Seat Armrest Stowage Compartment Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Screw, Front Seat Armrest Hinge (Qty: 2) **Tighten:** 3 N.m (25 lb in)
2	Lid Assembly, Front Seat Armrest
3	Screw, Front Seat Armrest Bin (Qty: 8) **Tighten:** 3 N.m (25 lb in)
4	Compartment Assembly, Front Seat Armrest Stowage

FRONT SEAT ARMREST HINGE REPLACEMENT

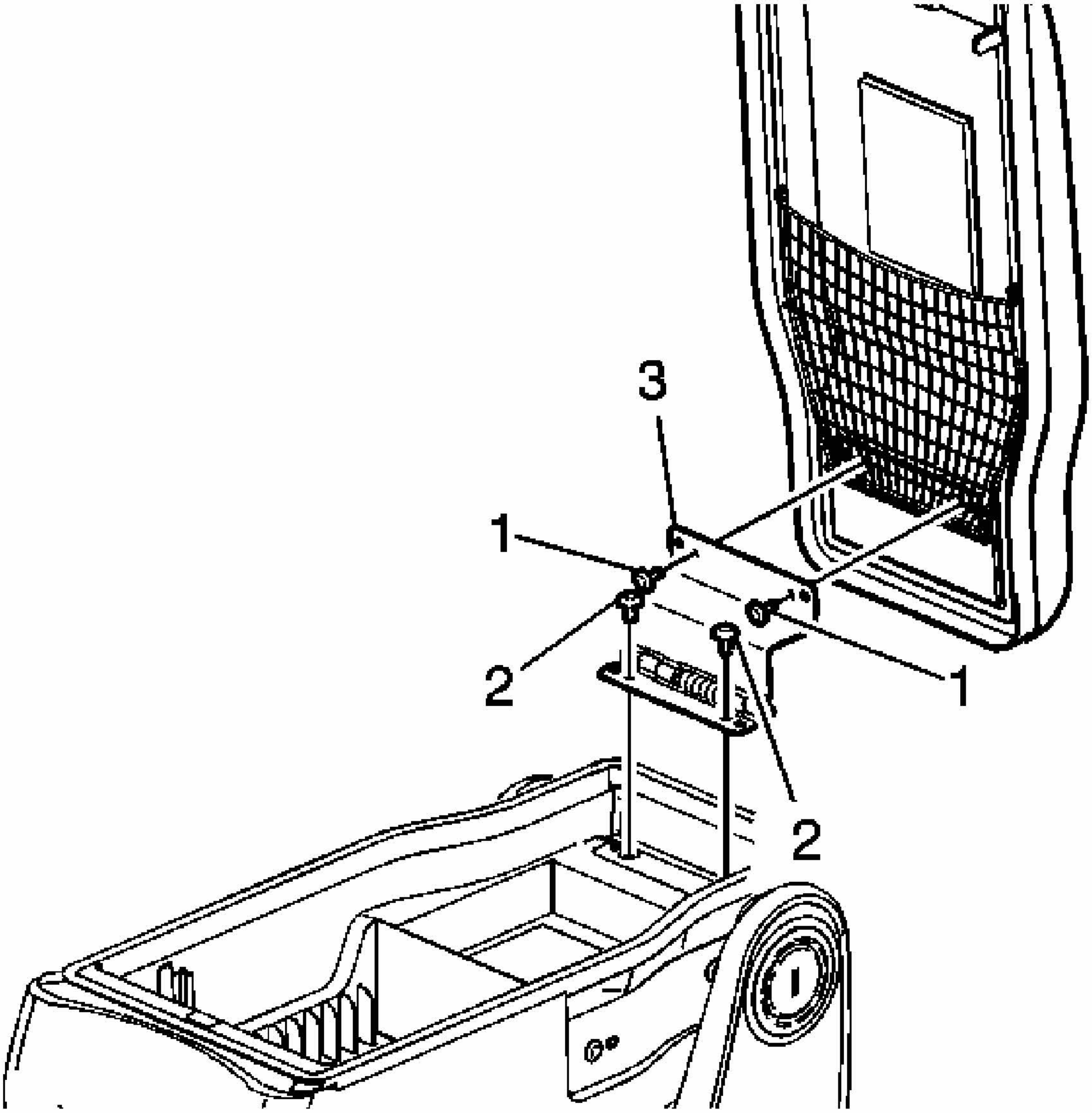


Fig. 67: Replacing Front Seat Armrest Hinge
Courtesy of GENERAL MOTORS CORP.

Front Seat Armrest Hinge Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Screw, Front Seat Armrest Hinge (Qty: 2) **Tighten:** 3 N.m (25 lb in)
2	Screw, Front Seat Armrest Hinge (Qty: 2)

	Tighten: 3 N.m (25 lb in)
3	Hinge, Front Seat Armrest

FRONT SEAT ARMREST LATCH REPLACEMENT

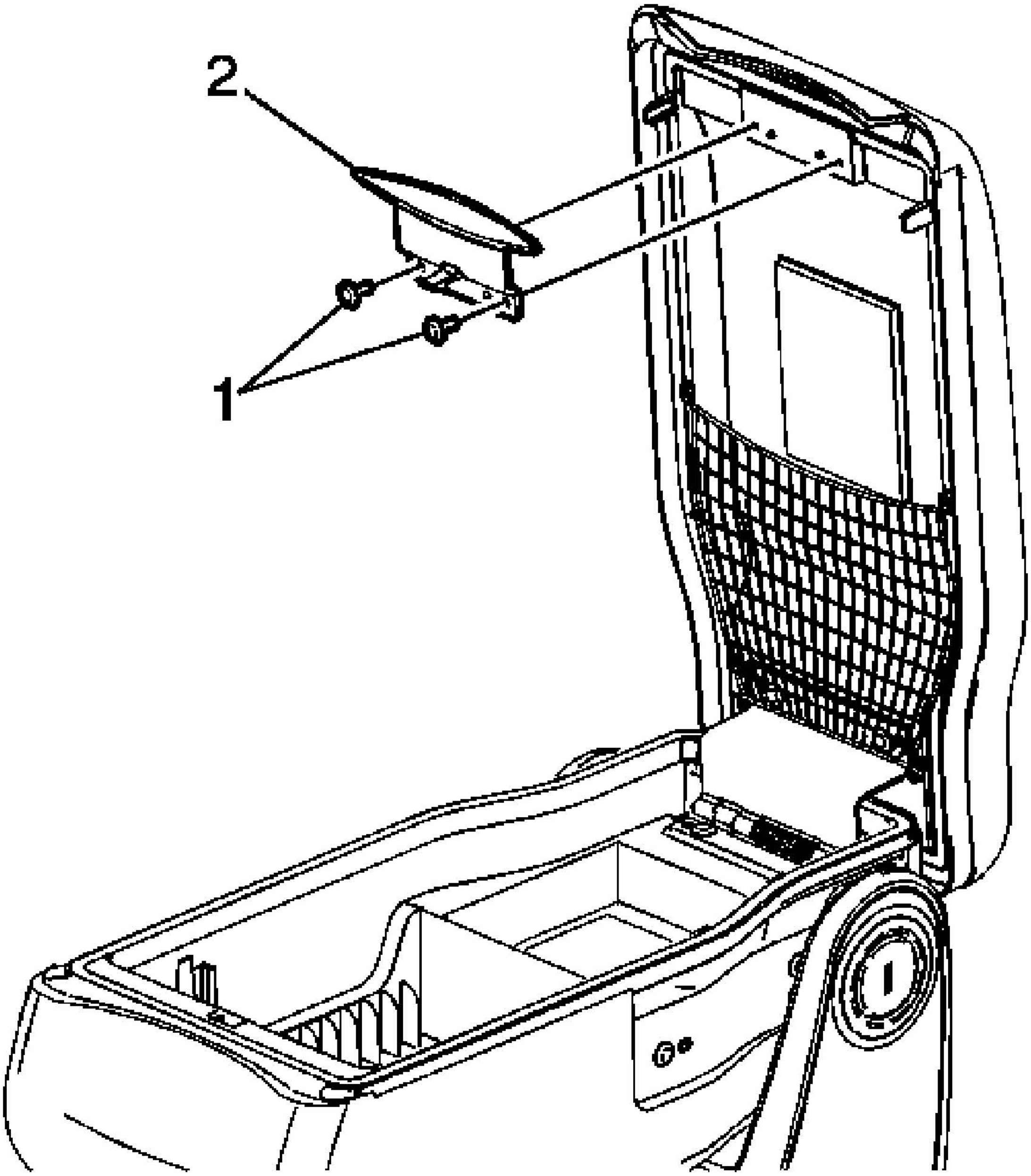


Fig. 68: Replacing Front Seat Armrest Latch
Courtesy of GENERAL MOTORS CORP.

Front Seat Armrest Latch Replacement

Callout	Component Name
NOTE:	

Refer to Fastener Notice . **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Screw, Front Seat Armrest Hinge (Qty: 2) **Tighten:** 3 N.m (25 lb in)
2	Latch Assembly, Front Seat Armrest

FRONT SEAT ARMREST LID REPLACEMENT

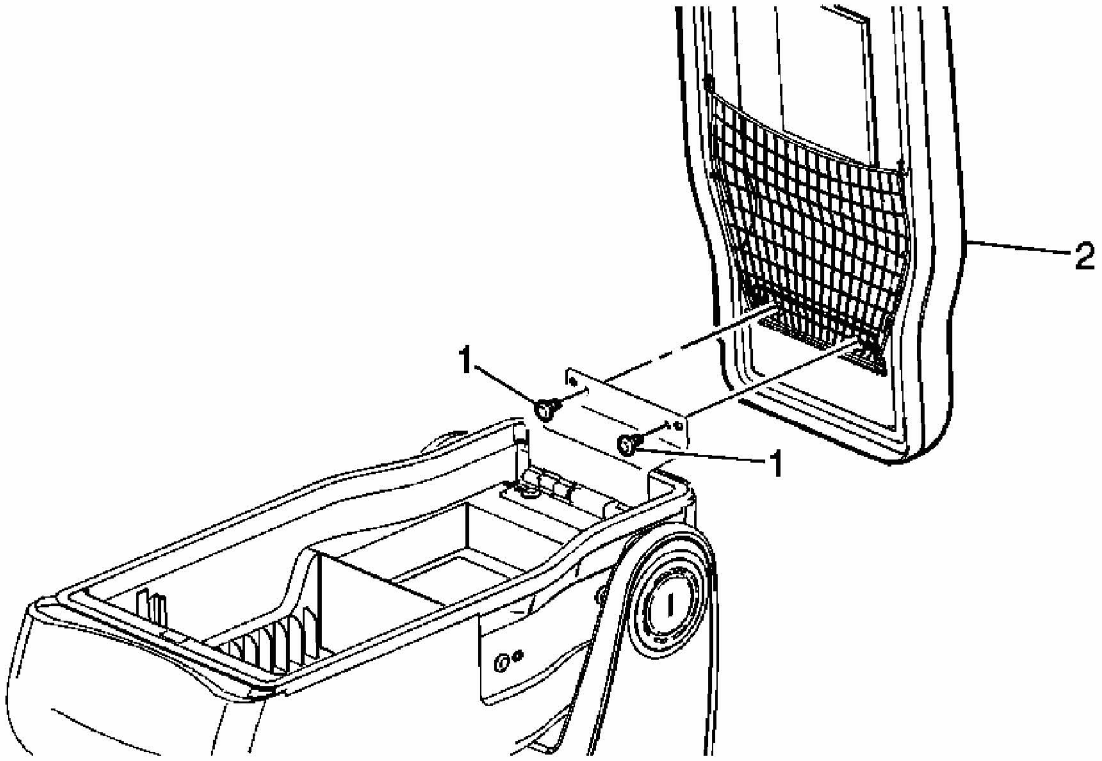


Fig. 69: Replacing Front Seat Armrest Lid
Courtesy of GENERAL MOTORS CORP.

Front Seat Armrest Lid Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Screw, Front Seat Armrest Hinge (Qty: 2) **Tighten:** 3 N.m (25 lb in)

2	Lid Assembly, Front Seat Armrest

REAR SEAT CUSHION REPLACEMENT (IMPALA)

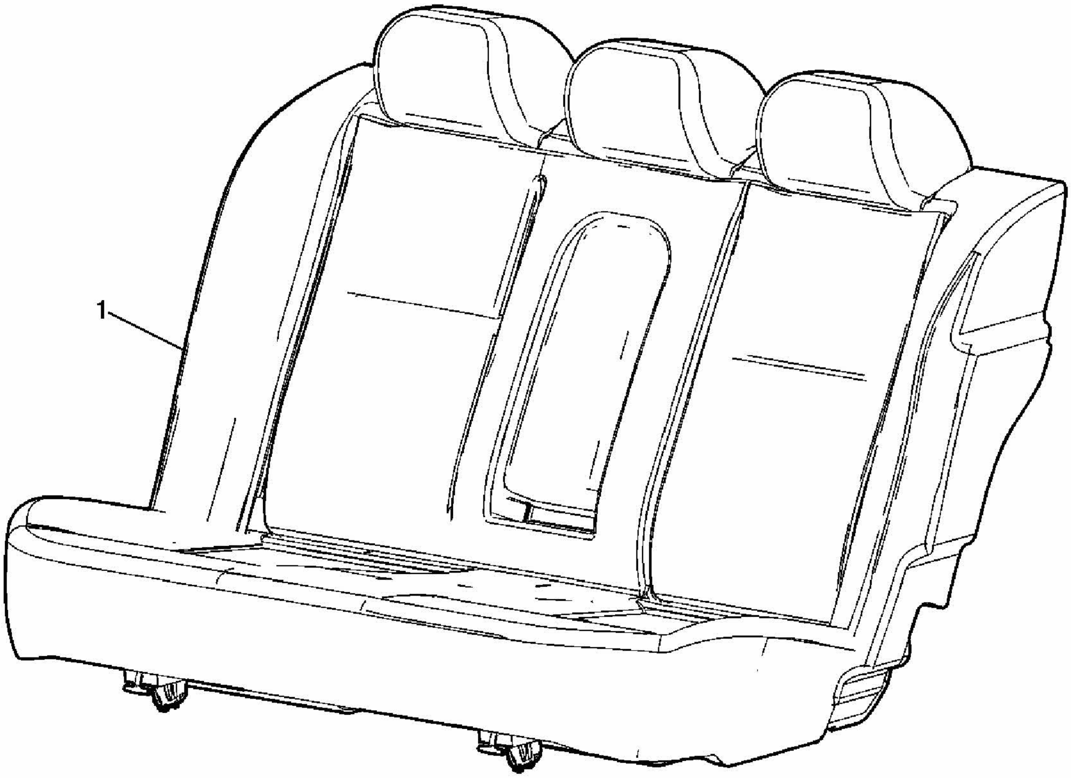


Fig. 70: Replacing Rear Seat Cushion
Courtesy of GENERAL MOTORS CORP.

Seat Cushion Replacement - Rear (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Cushion Assembly, Rear Seat **Tip:** Pull on the pull handle at the front of the seat cushion to disengage the integral retainers, and lift out of the vehicle.

REAR SEAT CUSHION REPLACEMENT (MONTE CARLO)

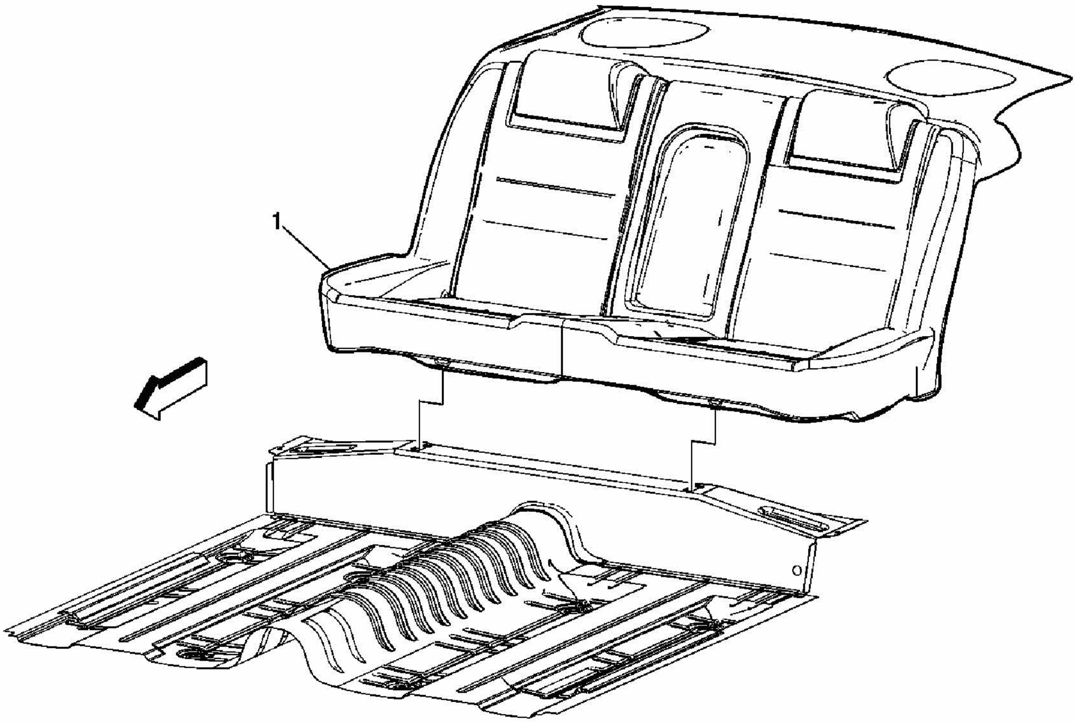


Fig. 71: Replacing Rear Seat Cushion
Courtesy of GENERAL MOTORS CORP.

Seat Cushion Replacement - Rear (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	
1	Cushion Assembly, Rear Seat **Tip:** Pull up on the front of the seat cushion to disengage the integral retainers, and lift out of the vehicle.

REAR SEAT CUSHION FLOOR STOWAGE COMPARTMENT REPLACEMENT

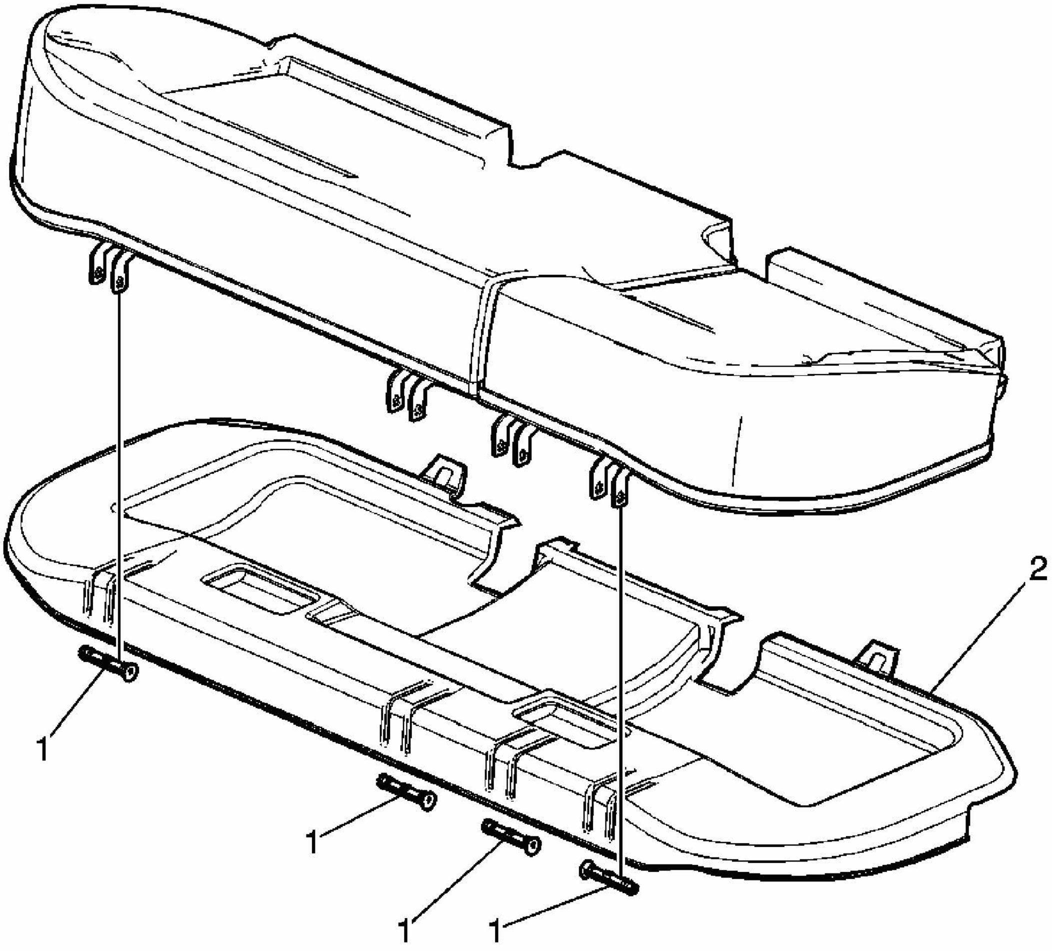


Fig. 72: Replacing Rear Seat Cushion Floor Stowage Compartment
Courtesy of GENERAL MOTORS CORP.

Rear Seat Cushion Floor Stowage Compartment Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the rear seat cushion. Refer to **Seat Cushion Replacement - Rear (Impala)** or **Seat Cushion Replacement - Rear (Monte Carlo)**.	
1	Rear Seat Cushion Bushing (Qty: 4)
2	Rear Seat Cushion Floor Stowage Compartment **Tip:** Once the bushings are removed the seat cushion assembly can be separated from the floor stowage compartment.

REAR SEAT CUSHION COVER AND PAD REPLACEMENT (IMPALA)

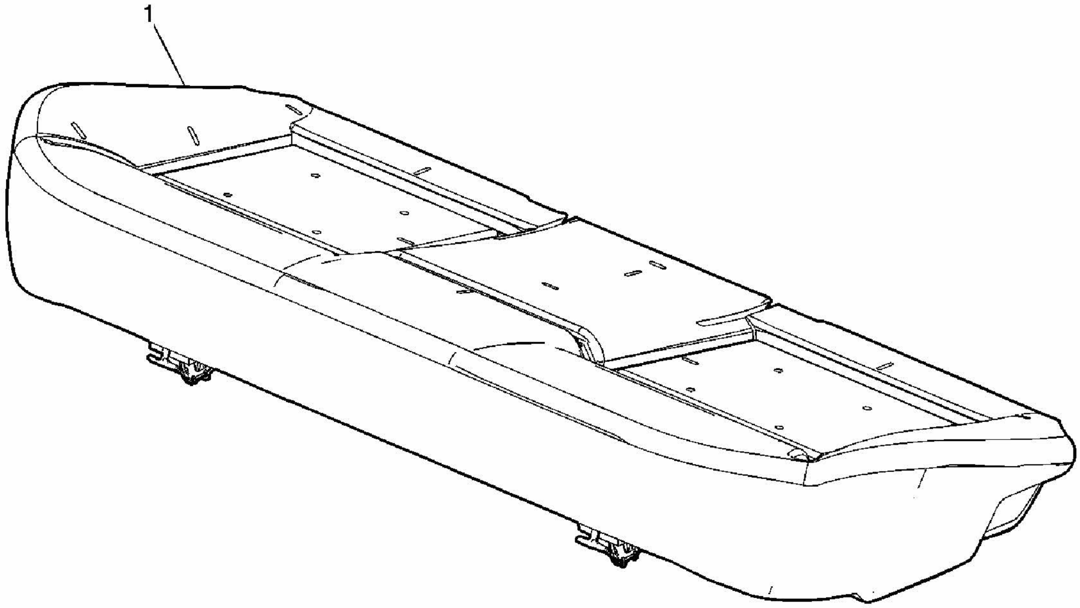


Fig. 73: Replacing Rear Seat Cushion Cover And Pad
Courtesy of GENERAL MOTORS CORP.

Seat Cushion Cover and Pad Replacement - Rear (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures:** Remove the rear seat cushion. Refer to **Seat Cushion Replacement - Rear (Impala)** or **Seat Cushion Replacement - Rear (Monte Carlo)**.	
1	Cover, Rear Seat Cushion **Tip:** The cushion cover and pad are serviced as an assembly.

REAR SEAT CUSHION COVER AND PAD REPLACEMENT (MONTE CARLO)

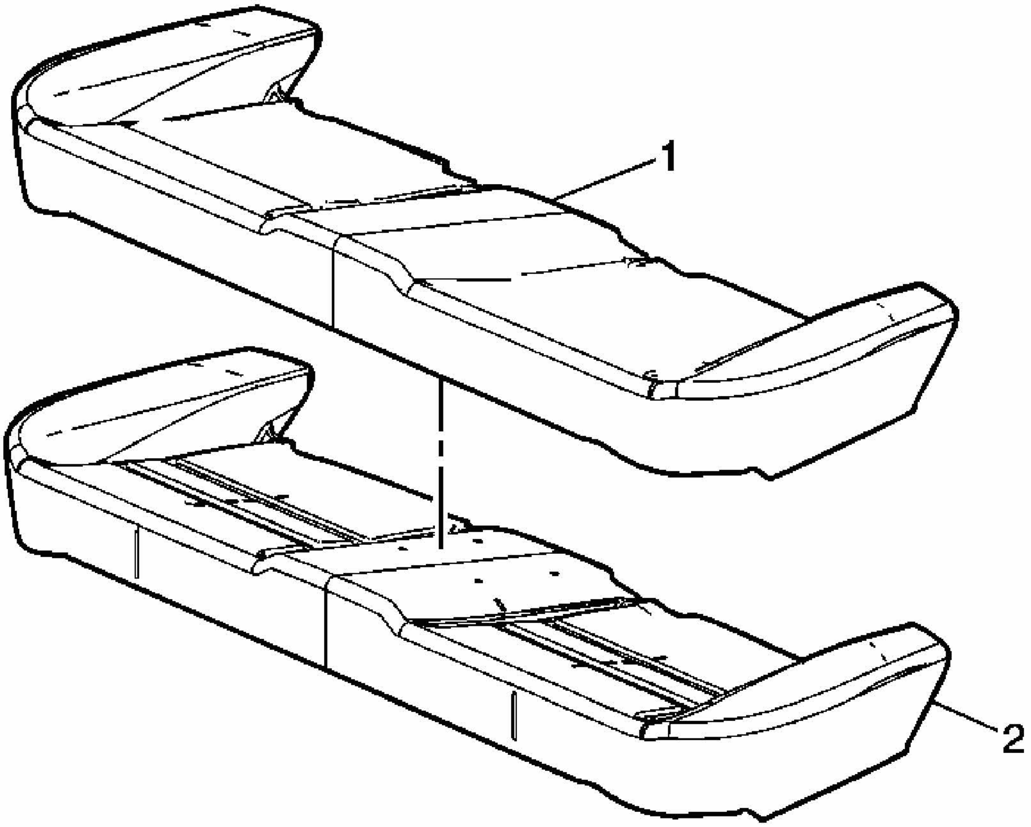


Fig. 74: Replacing Rear Seat Cushion Cover And Pad
Courtesy of GENERAL MOTORS CORP.

Seat Cushion Cover and Pad Replacement - Rear (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures:** Remove the rear seat cushion. Refer to **Seat Cushion Replacement - Rear (Impala)** or **Seat Cushion Replacement - Rear (Monte Carlo)**.	
1	Cover, Rear Seat Cushion **Tip:** Remove the hog rings that secure the rear seat cushion cover to the pad.
2	Pad, Rear Seat Cushion

REAR SEAT BACK REPLACEMENT (IMPALA)

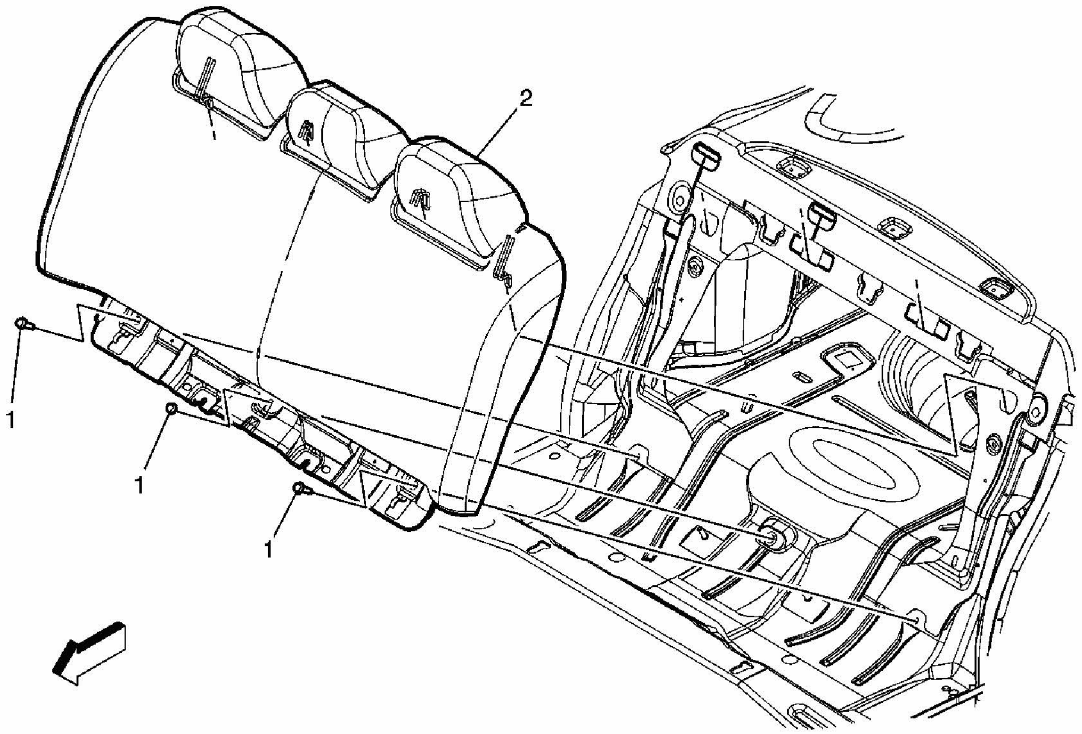


Fig. 75: Replacing Rear Seat Back
Courtesy of GENERAL MOTORS CORP.

Seat Back Replacement - Rear (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the rear seat cushion. Refer to **Seat Cushion Replacement - Rear (Impala)** or **Seat Cushion Replacement - Rear (Monte Carlo)**.	
1	Rear Seat Back Cushion Bolts (Qty: 3) **Tighten:** 45 N.m (33 lb ft)
2	Rear Seat Back Cushion Nut **Tighten:** 45 N.m (33 lb ft)
3	Rear Seat Back Cushion **Tip:** Lift upward to clear the retaining hooks on the seat back to remove.

REAR SEAT BACK REPLACEMENT (MONTE CARLO)

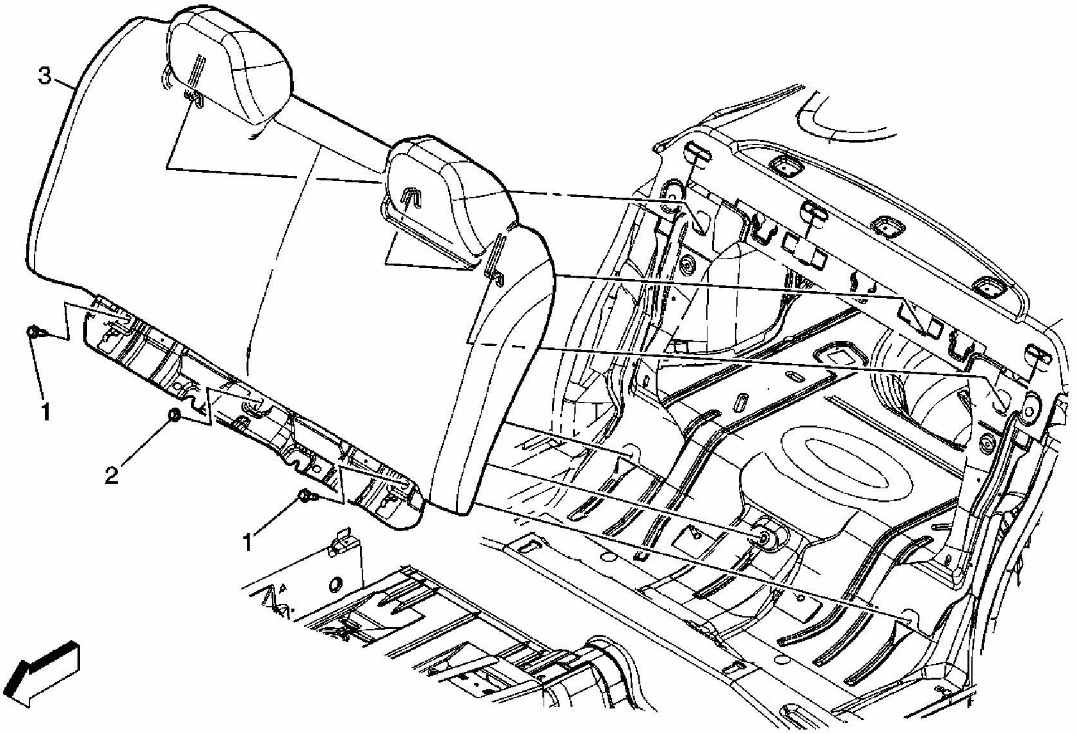


Fig. 76: Replacing Rear Seat Back
Courtesy of GENERAL MOTORS CORP.

Seat Back Replacement - Rear (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the rear seat cushion. Refer to **Seat Cushion Replacement - Rear (Impala)** or **Seat Cushion Replacement - Rear (Monte Carlo)**.	
1	Bolt, Rear Seat Back Cushion (Qty: 2) **Tighten:** 45 N.m (33 lb ft)
2	Nut, Rear Seat Back Cushion **Tighten:** 45 N.m (33 lb ft)
3	Cushion, Rear Seat Back **Tip:** Lift upward to clear the retaining hooks on the seat back to remove.

REAR SEAT BACK COVER AND PAD REPLACEMENT (IMPALA)

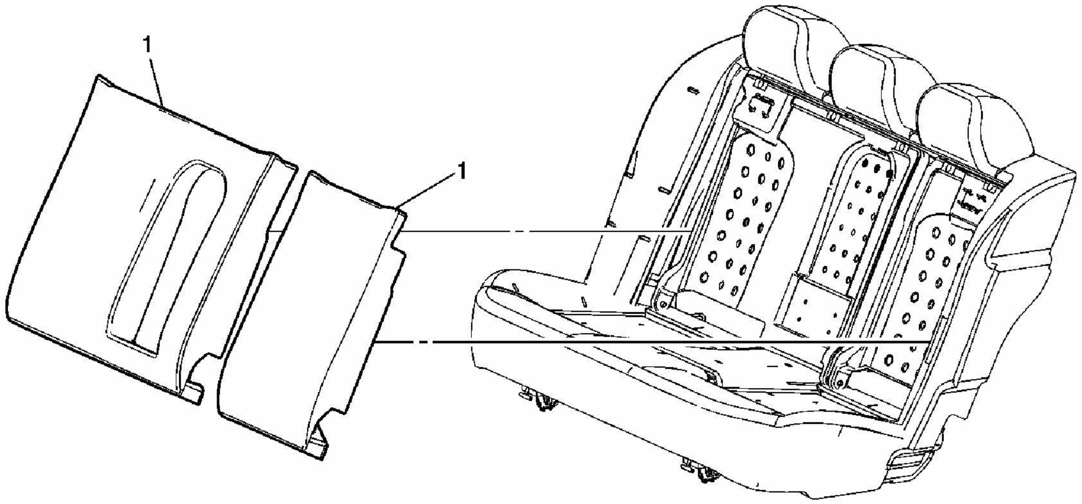


Fig. 77: Replacing Rear Seat Back Cover and Pad
Courtesy of GENERAL MOTORS CORP.

Seat Back Cover and Pad Replacement - Rear (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the rear seat cushion. Refer to **Seat Cushion Replacement - Rear (Impala)** or **Seat Cushion Replacement - Rear (Monte Carlo)**. 2. Remove the rear seat back cushion. Refer to **Seat Back Replacement - Rear (Impala)** or **Seat Back Replacement - Rear (Monte Carlo)**. 3. Remove the rear seat center shoulder belt assemblies. Refer to **Seat Belt Buckle Replacement - Rear** . 4. Remove the rear seat armrest. Refer to **Armrest Replacement - Rear Seat (Impala)** or **Armrest Replacement - Rear Seat (Monte Carlo)**.	
1	Cover, Rear Seat Back Cushion **Tip:** 1. Fold the rear seat back cushion panels forward enough to gain access to the retainers for the seat back cushion cover. 2. Remove the rear seat back cushion cover and pad from the rear seat back panels. 3. The seat back cushion cover and pad are serviced as an assembly.

REAR SEAT BACK COVER AND PAD REPLACEMENT (MONTE CARLO)

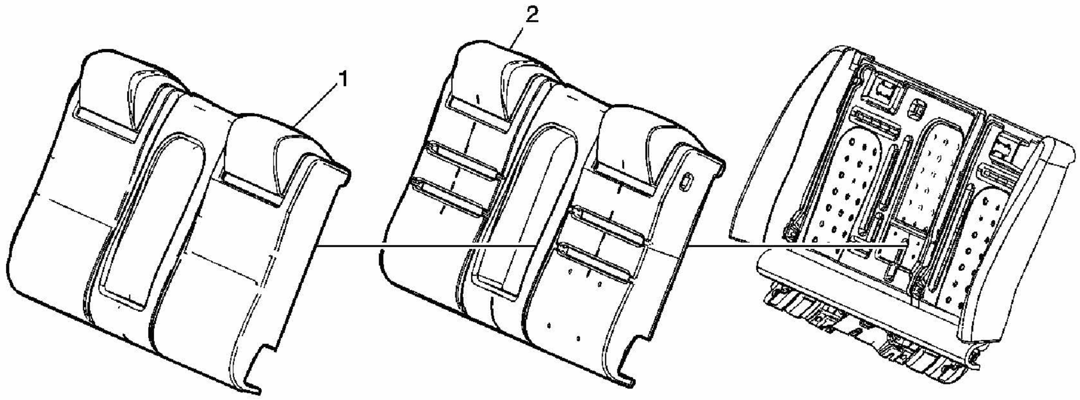


Fig. 78: Replacing Rear Seat Back Cover And Pad
Courtesy of GENERAL MOTORS CORP.

Seat Back Cover and Pad Replacement - Rear (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the rear seat cushion. Refer to **Seat Cushion Replacement - Rear (Impala)** or **Seat Cushion Replacement - Rear (Monte Carlo)**. 2. Remove the rear seat back cushion. Refer to **Seat Back Replacement - Rear (Impala)** or **Seat Back Replacement - Rear (Monte Carlo)**. 3. Remove the rear seat center shoulder belt assemblies. Refer to **Seat Belt Buckle Replacement - Rear** . 4. Remove the rear seat armrest. Refer to **Armrest Replacement - Rear Seat (Impala)** or **Armrest Replacement - Rear Seat (Monte Carlo)**.	
1	Cover, Rear Seat Back Cushion **Tip:** 1. Fold the rear seat back cushion panels forward enough to gain access to the retainers for the seat back cushion cover. 2. Remove the rear seat back cushion cover and pad from the rear seat back panels. 3. Remove the rear seat back cushion cover from the pad by pulling away from the pad to release the hook and look fasteners.
2	Pad, Rear Seat Back Cushion

REAR SPLIT FOLDING SEAT BACK BOLSTER REPLACEMENT (MONTE CARLO)

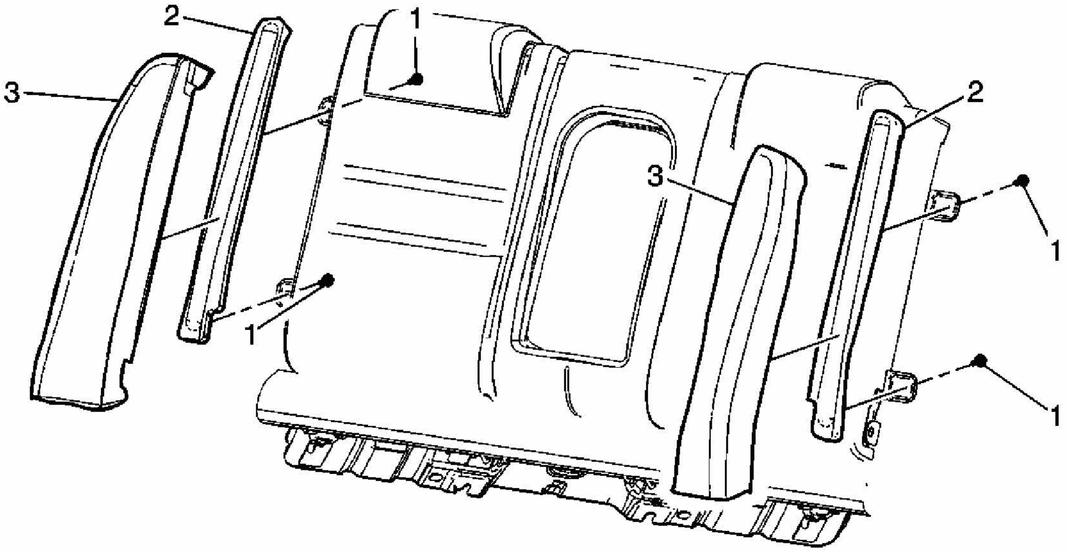


Fig. 79: Replacing Rear Split Folding Seat Back Bolster
Courtesy of GENERAL MOTORS CORP.

Seat Back Bolster Replacement - Rear Split Folding (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the rear seat cushion. Refer to **Seat Cushion Replacement - Rear (Impala)** or **Seat Cushion Replacement - Rear (Monte Carlo)**. 2. Remove the rear seat back cushion. Refer to **Seat Back Replacement - Rear (Impala)** or **Seat Back Replacement - Rear (Monte Carlo)**.	
1	Rear Seat Back Bolster Screws (Qty: 4) **Tighten:** 3 N.m (25 lb in)
2	Rear Seat Back Bolster Cover
3	Rear Seat Back Bolster Pad

REAR SEAT ARMREST REPLACEMENT (IMPALA)

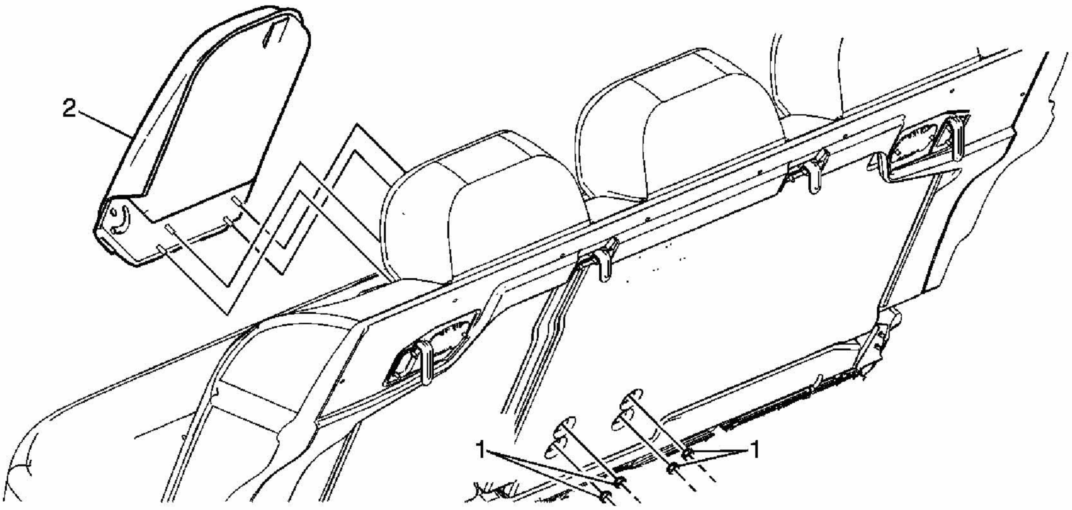


Fig. 80: Replacing Rear Seat Armrest
Courtesy of GENERAL MOTORS CORP.

Armrest Replacement - Rear Seat (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	
1	Nut, Rear Seat Armrest (Qty: 4) **Tip:** Fold the rear seat back cushion forward to gain access to the nuts. **Tighten:** 3 N.m (25 lb in)
2	Armrest Assembly, Rear Seat

REAR SEAT ARMREST REPLACEMENT (MONTE CARLO)

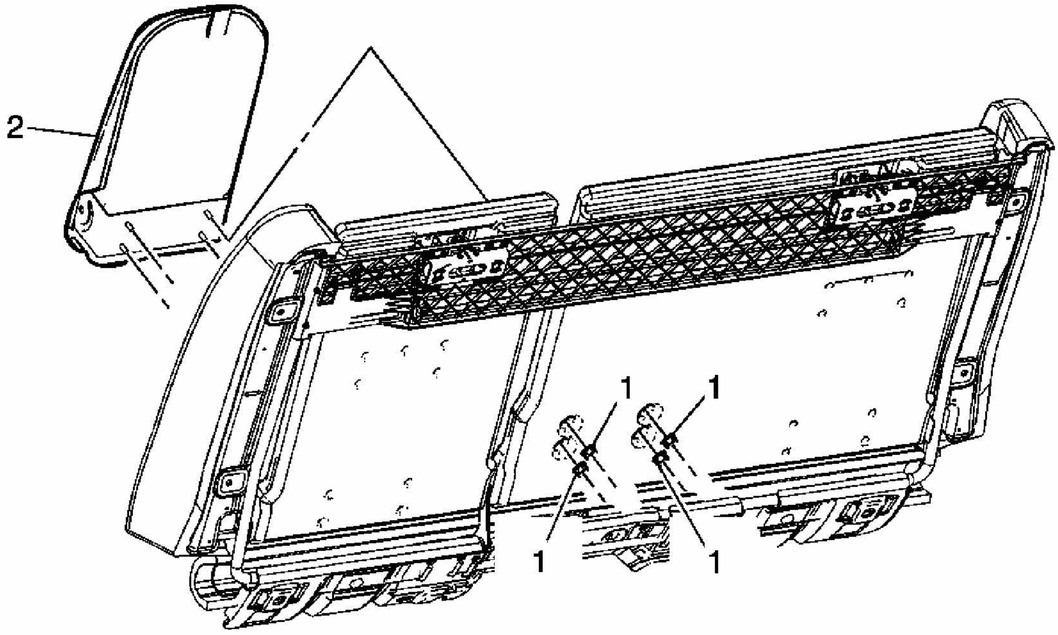


Fig. 81: Replacing Rear Seat Armrest
Courtesy of GENERAL MOTORS CORP.

Armrest Replacement - Rear Seat (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the rear seat cushion. Refer to **Seat Cushion Replacement - Rear (Impala)** or **Seat Cushion Replacement - Rear (Monte Carlo)**. 2. Remove the rear seat back cushion. Refer to **Seat Back Replacement - Rear (Impala)** or **Seat Back Replacement - Rear (Monte Carlo)**. 3. Remove the rear seat back cushion cover and pad. Refer to **Seat Back Cover and Pad Replacement - Rear (Impala)** or **Seat Back Cover and Pad Replacement - Rear (Monte Carlo)**.	
1	Nut, Rear Seat Armrest (Qty: 4) **Tip:** Fold the rear seat back cushion forward to gain access to the nuts. **Tighten:** 3 N.m (25 lb in)

2	Armrest Assembly, Rear Seat

DESCRIPTION AND OPERATION

POWER SEATS SYSTEM DESCRIPTION AND OPERATION

The driver and passenger power seat systems each consist of the following components:

- Seat Adjuster Switch
- Seat Horizontal Motor
- Seat Front Vertical Motor
- Seat Rear Vertical Motor
- Seat Recline Motor
- SEATS Circuit Breaker 30 A

Seat Adjuster Switch

The seat adjuster switches provide both power and ground to the selected seat motors. Battery positive voltage is supplied at all times to the driver and passenger seat adjuster switches from the SEATS Circuit Breaker located in the left rear fuse block. Both seat adjuster switches are grounded through the switch ground circuit and G307.

Motors

All of the seat motors operate independently of each other. Each motor contains an electronic circuit breaker (PTC) that opens in the event of a circuit overload and will reset only after voltage has been removed from the circuit. There are four seat position motors. These are the horizontal motor, front vertical motor, rear vertical motor, and the seat back recline motor. The horizontal motor moves the entire seat forward and rearward. The seat vertical motors may operate independently to tilt the front or rear of the seat cushion up or down. Both motors can also run simultaneously to move the entire seat up or down. The recline motor moves the angle of the seat back forward or rearward.

Horizontal

When the seat switch is operated to move the entire seat forward, battery positive voltage is applied through the switch contacts and the horizontal motor forward control circuit to the motor. The motor is grounded through the horizontal motor rearward switch contacts and the horizontal motor rearward control circuit to the motor. The motor runs in order to drive the entire seat forward until the switch is released. Moving the entire seat rearward works similarly to moving the entire seat forward, except that battery positive voltage and ground are applied on opposite circuits causing the motor to run in the opposite direction.

Rear Vertical

When the seat switch is operated to tilt the rear of the seat cushion up, battery positive voltage is applied through the switch contacts and the rear vertical motor up control circuit to the rear vertical motor. The motor is grounded through the down switch contacts and the rear vertical motor down control circuit to the motor. The motor runs in order to drive the rear of the seat cushion up until the switch is released. Tilting the rear of the seat cushion down works similarly to tilting the rear of the seat cushion up, except that battery positive voltage and ground are applied on opposite circuits causing the motor to run in the opposite direction.

Front Vertical

When the seat switch is operated to tilt the front of the seat cushion up, battery positive voltage is applied through the switch contacts and the front vertical motor up control circuit to the motor. The motor is grounded through the down switch contacts and the front vertical motor down control circuit to the motor. The motor runs in order to drive the front of the seat cushion up until the switch is released. Tilting the front of the seat cushion down works similarly to tilting the front of the seat cushion up, except that battery positive voltage and ground are applied on opposite circuits causing the motor to run in the opposite direction.

Entire Seat Up or Down

When the seat switch is operated in order to move the entire seat to the up position, battery positive voltage is simultaneously applied through the front and rear vertical motor up switch contacts and the front and rear vertical motor up control circuits to both vertical motors. The motors are grounded through the down switch contacts and the front and rear vertical motor down control circuits to both vertical motors. Both motors run simultaneously in order to drive the entire seat up until the switch is released. Moving the entire seat down works similarly to moving the entire seat up, except that battery positive voltage and ground are applied on the opposite circuits causing the motors to run in the opposite direction.

Recline

When the seat recline switch is operated to move the seat back forward, battery positive voltage is applied through the switch contacts and the recline motor forward control circuit to the motor. The motor is grounded through the rearward switch contacts and the recline motor rearward control circuit to the motor. The motor runs in order to move the seat back forward until the switch is released. Moving the seat back rearward works similarly to moving the seat back forward, except that battery positive voltage and ground are applied on the opposite circuits causing the motor to run in the opposite direction.

HEATED SEATS DESCRIPTION AND OPERATION

The front heated seat system consists of the following components.

- Left heated seat switch
- Right heated seat switch

- Heated seat module
- Left seat cushion heater element
- Left seat back heater element
- Left seat temperature sensor
- Right seat cushion heater element
- Right seat back heater element
- Right seat temperature sensor
- Climate Control Panel (CCP)
- HTD SEAT MOD 10 A

Power and Ground

Battery positive voltage is supplied at all times to the heated seat module from the HTD SEAT MOD fuse located in the underhood fuse block. This voltage is used by the modules to supply power to the seat heating elements. The module is grounded through the module ground circuits and G?

Heated Seat Operation

The driver and passenger heated seats are controlled by a single heated seat module that is located under the driver seat cushion. Both heated seats are controlled by separate heated seat switches that are located in the climate control panel (CCP). When a heated seat switch is pressed, the CCP sends a GMLAN message via the serial data line to the heated seat module indicating the heated seat command. In response to this signal, the heated seat module then applies battery positive voltage through the element supply voltage circuit to the appropriate seat heating elements. The heated seat module then sends a GMLAN message back to the CCP to either illuminate or turn off the appropriate temperature indicator.

Temperature Regulation

When the ignition is turned to the ON position, the heated seats will initialize in the OFF state. With each activation of the heated seat switch, the heated seat module will cycle the temperature setting in the following manner: HIGH, LOW, and OFF.

The heated seat system is designed in order to warm the seat cushion and seat back to approximately 42°C (107.6°F) when in the high heat position, and 37°C (98.6°F) when in the low heat position. The heated seat module monitors the seat temperature through the temperature sensor signal circuit and the temperature sensor (thermistor) that is located in the seat cushion. The temperature sensor is a variable resistor, it's resistance changes as the temperature of the seat changes. When the temperature sensor resistance indicates to the heated seat module that the seat has reached the desired temperature, the module opens the ground path of the seat heating elements through the heated seat element control circuit. The module will then cycle the element control circuit open and closed in order to maintain the desired temperature.

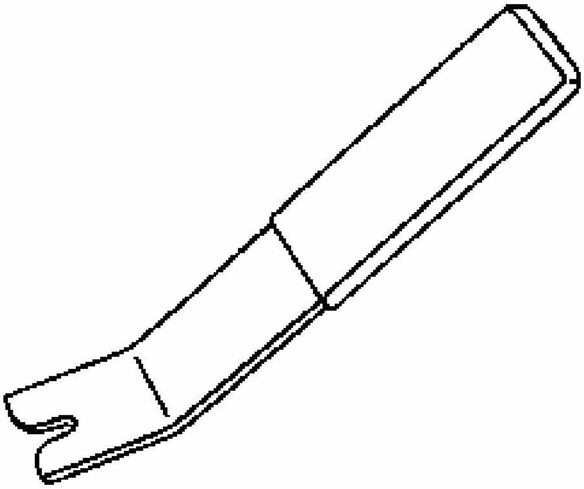
Load Management

The load-shed operation is a means of reducing vehicle electrical loads during a low voltage or low battery state of charge (SOC) condition. During certain load-shed conditions, all heated seat functions will be disabled. Refer to **Load Shed System Description and Operation** .

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/Description
	J 38778 Door Trim Pad and Garnish Clip Remover

2006 RESTRAINTS

SIR - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

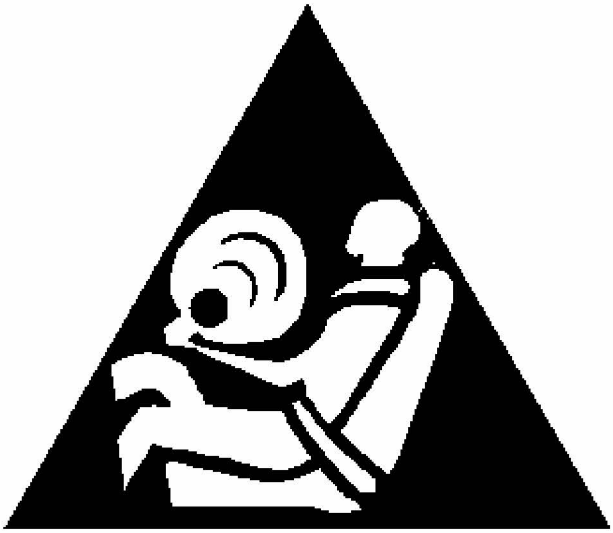
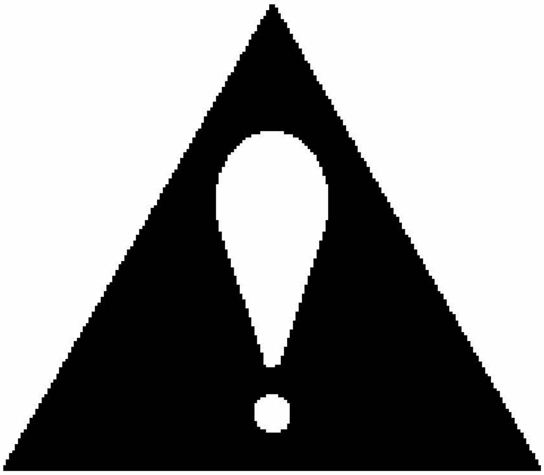
Application	Specification	
	Metric	English
Inflatable Restraint Front End Sensor Fasteners	11 +/- 1.5 N.m	97 +/- 13 lb in
Inflatable Restraint Instrument Panel (I/P) Module Fasteners	10 N.m	89 lb in
Inflatable Restraint Roof Rail Module Fasteners	9 N.m	80 lb in
Inflatable Restraint Sensing and Diagnostic Module (SDM) Fasteners	10 N.m	89 lb in
Inflatable Restraint Side Impact Module Fasteners	5 N.m	45 lb in
Inflatable Restraint Side Impact Sensor (SIS) Fasteners	10 N.m	89 lb in
Seat Shoulder Belt Retractor Pretensioner Anchor Fastener	42 N.m	31 lb ft
Seat Shoulder Belt Retractor Pretensioner Fastener	42 N.m	31 lb ft
Seat Shoulder Belt Retractor Pretensioner Guide Fastener	42 N.m	31 lb ft

SCHEMATIC AND ROUTING DIAGRAMS

SIR SCHEMATIC ICONS

SIR Schematic Icons

Icon	Icon Definition
	CAUTION: **When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Refer to SIR Disabling and Enabling Zones. Failure to observe the correct procedure could cause deployment of the SIR components, personal injury, or unnecessary SIR system repairs.**

	
	**IMPORTANT:** • In order to prevent accidental deployment, the shorting bars close in order to short the connectors when the connectors are separated. • Twisted-pair wires provide an effective shield that helps protect sensitive electronic components from electrical interference. If the wires were covered with shielding, install new shielding. In order to prevent electrical interference from degrading the performance of the connected components, you must maintain the proper specification when making any repairs to the twisted-pair wires shown : ○ The wires must be twisted a minimum of 9 turns per 31 cm (12 in) as measured anywhere along the length of the wires ○ The outside diameter of the twisted wires must not exceed 6.0 mm (0.25 in)

SIR SCHEMATICS

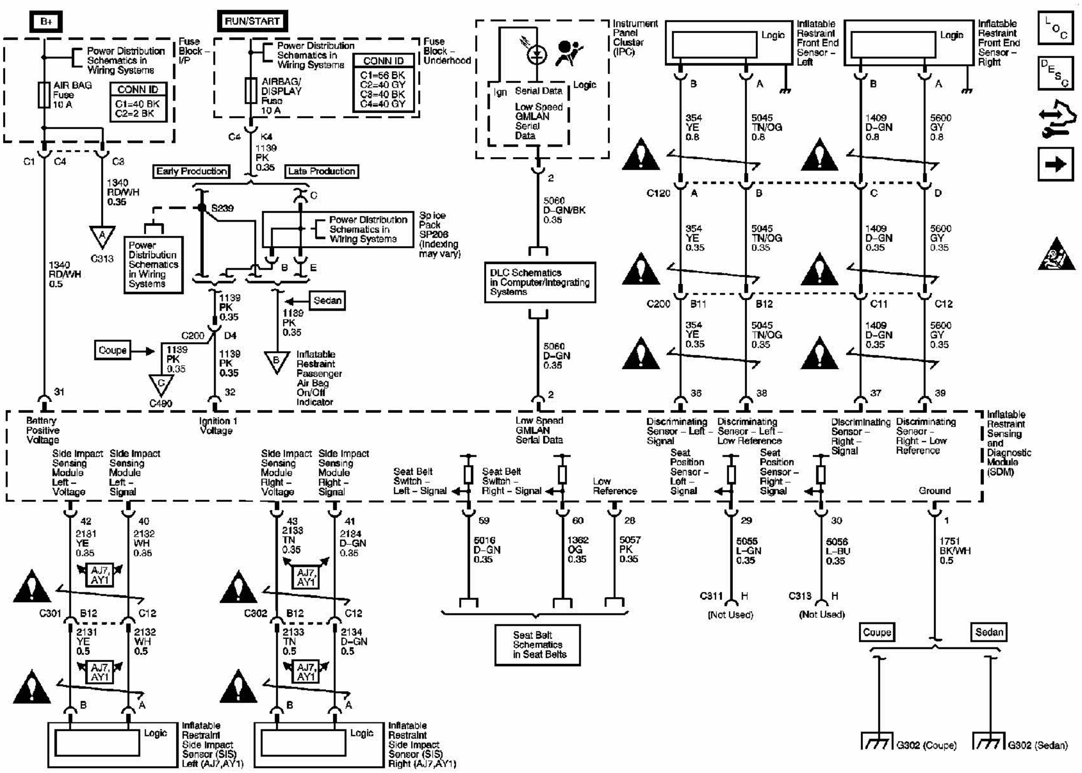

B+
RUN/START
Power Distribution Schematics in Wiring Systems
Fuse Block – I/P
AIR BAG Fuse 10 A
CONN ID C1=40 BK C2=2 BK
Fuse Block – Underhood
AIRBAG/DISPLAY Fuse 10 A
CONN ID C1=56 BK C2=40 GY C3=40 BK C4=40 GY
Instrument Panel Cluster (IPC)
Ign Serial Data Logic
Low Speed GMLAN Serial Data
Inflatable Restraint Front End Sensor – Left
Inflatable Restraint Front End Sensor – Right
Logic
Early Production
Late Production
S239
Splice Pack SP206 (Indexing may vary)
1340 RD/WH 0.35
1340 RD/WH 0.5
1139 PK 0.35
G313
Sedan
Coupe
C200
D4
C490
Inflatable Restraint Passenger Air Bag On/Off Indicator
5060 D-GN/BK 0.35
DLC Schematics in Computer/Integrating Systems
5060 D-GN 0.35
C120
C200
354 YE 0.8
5045 TN/OG 0.8
1409 D-GN 0.8
5600 GY 0.8
354 YE 0.35
5045 TN/OG 0.35
1409 D-GN 0.35
5600 GY 0.35
B11 B12 C11 C12
31 32 2 36 38 37 39
Battery Positive Voltage
Ignition 1 Voltage
Low Speed GMLAN Serial Data
Discriminating Sensor – Left – Signal
Discriminating Sensor – Left – Low Reference
Discriminating Sensor – Right – Signal
Discriminating Sensor – Right – Low Reference
Inflatable Restraint Sensing and Diagnostic Module (SDM)
Side Impact Sensing Module Left – Voltage
Side Impact Sensing Module Left – Signal
Side Impact Sensing Module Right – Voltage
Side Impact Sensing Module Right – Signal
Seat Belt Switch – Left – Signal
Seat Belt Switch – Right – Signal
Low Reference
Seat Position Sensor – Left – Signal
Seat Position Sensor – Right – Signal
Ground
42 40 43 41 59 60 28 29 30 1
2131 YE 0.35
2132 WH 0.35
2133 TN 0.35
2134 D-GN 0.35
AJ7, AY1
C301 B12 C12
C302 B12 C12
2131 YE 0.5
2132 WH 0.5
2133 TN 0.5
2134 D-GN 0.5
5016 D-GN 0.35
1362 OG 0.35
5057 PK 0.35
5055 L-GN 0.35
5056 L-BU 0.35
1751 BK/WH 0.5
C311 H (Not Used)
C313 H (Not Used)
Seat Belt Schematics in Seat Belts
Inflatable Restraint Side Impact Sensor (SIS) Left (AJ7,AY1)
Inflatable Restraint Side Impact Sensor (SIS) Right (AJ7,AY1)
G302 (Coupe)
G302 (Sedan)

Fig. 1: Power, Ground, DLC, Indicators, Sensors, And References - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

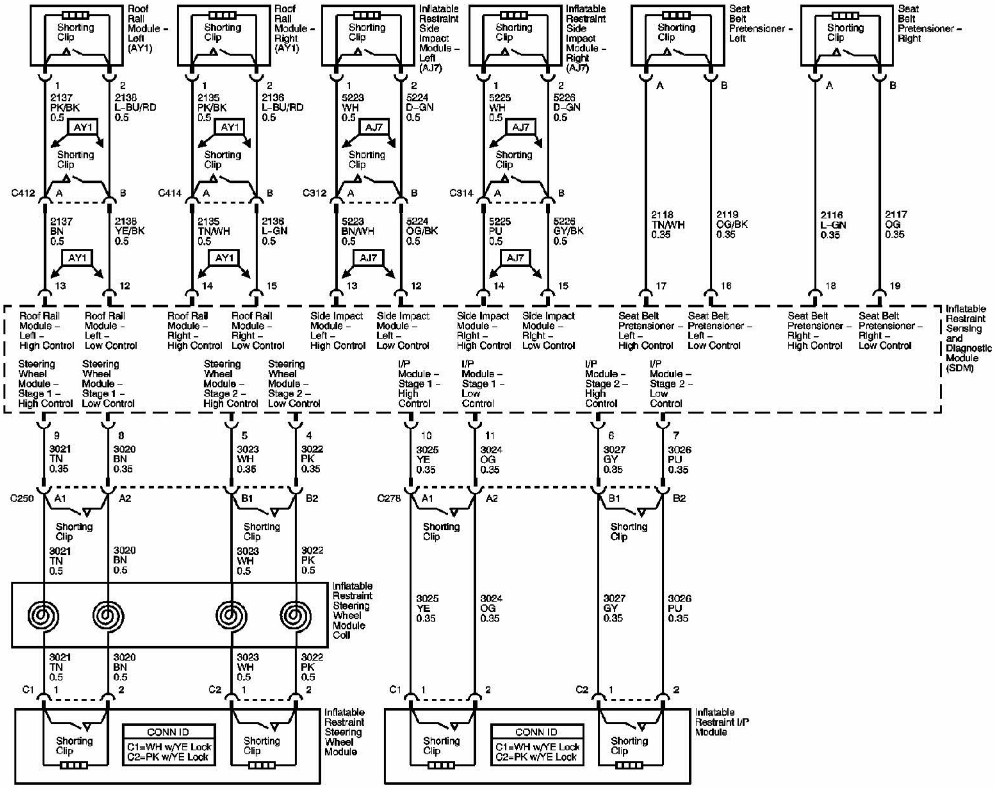

Roof Rail Module – Left (AY1)
Roof Rail Module – Right (AY1)
Inflatable Restraint Side Impact Module – Left (AJ7)
Inflatable Restraint Side Impact Module – Right (AJ7)
Seat Belt Pretensioner – Left
Seat Belt Pretensioner – Right
Shorting Clip
1
2
A
B
2137 PK/BK 0.5
2138 L-BU/RD 0.5
2135 PK/BK 0.5
2136 L-BU/RD 0.5
5223 WH 0.5
5224 D-GN 0.5
5225 WH 0.5
5226 D-GN 0.5
AY1
AJ7
C412
C414
C312
C314
2137 BN 0.5
2138 YE/BK 0.5
2135 TN/WH 0.5
2136 L-GN 0.5
5223 BN/WH 0.5
5224 OG/BK 0.5
5225 PU 0.5
5226 GY/BK 0.5
2118 TN/WH 0.35
2119 OG/BK 0.35
2116 L-GN 0.35
2117 OG 0.35
13
12
14
15
17
16
18
19
Roof Rail Module – Left – High Control
Roof Rail Module – Left – Low Control
Roof Rail Module – Right – High Control
Roof Rail Module – Right – Low Control
Side Impact Module – Left – High Control
Side Impact Module – Left – Low Control
Side Impact Module – Right – High Control
Side Impact Module – Right – Low Control
Seat Belt Pretensioner – Left – High Control
Seat Belt Pretensioner – Left – Low Control
Seat Belt Pretensioner – Right – High Control
Seat Belt Pretensioner – Right – Low Control
Inflatable Restraint Sensing and Diagnostic Module (SDM)
Steering Wheel Module – Stage 1 – High Control
Steering Wheel Module – Stage 1 – Low Control
Steering Wheel Module – Stage 2 – High Control
Steering Wheel Module – Stage 2 – Low Control
I/P Module – Stage 1 – High Control
I/P Module – Stage 1 – Low Control
I/P Module – Stage 2 – High Control
I/P Module – Stage 2 – Low Control
9
8
5
4
10
11
6
7
3021 TN 0.35
3020 BN 0.35
3023 WH 0.35
3022 PK 0.35
3025 YE 0.35
3024 OG 0.35
3027 GY 0.35
3026 PU 0.35
C250
C278
A1
A2
B1
B2
3021 TN 0.5
3020 BN 0.5
3023 WH 0.5
3022 PK 0.5
Inflatable Restraint Steering Wheel Module Coil
C1
C2
CONN ID
C1=WH w/YE Lock
C2=PK w/YE Lock
Inflatable Restraint Steering Wheel Module
Inflatable Restraint I/P Module

Fig. 2: Deployment Loops - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

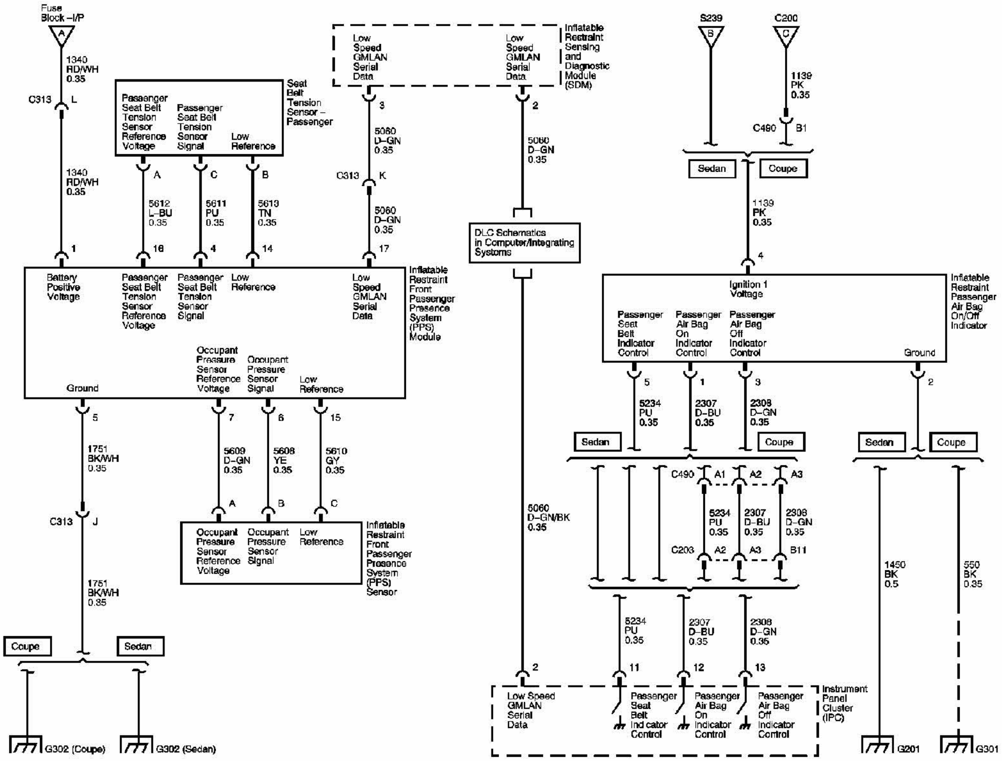

Fuse Block –I/P
A
1340 RD/WH 0.35
C313
L
Seat Belt Tension Sensor – Passenger
Passenger Seat Belt Tension Sensor Reference Voltage
Passenger Seat Belt Tension Sensor Signal
Low Reference
A
C
B
5612 L-BU 0.35
5611 PU 0.35
5613 TN 0.35
1
16
4
14
Low Speed GMLAN Serial Data
Inflatable Restraint Sensing and Diagnostic Module (SDM)
3
2
5060 D-GN 0.35
C313
K
17
Battery Positive Voltage
Inflatable Restraint Front Passenger Presence System (PPS) Module
Occupant Pressure Sensor Reference Voltage
Occupant Pressure Sensor Signal
Ground
5
7
6
15
1751 BK/WH 0.35
5609 D-GN 0.35
5608 YE 0.35
5610 GY 0.35
C313
J
Inflatable Restraint Front Passenger Presence System (PPS) Sensor
Coupe
Sedan
G302 (Coupe)
G302 (Sedan)
DLC Schematics in Computer/Integrating Systems
5060 D-GN/BK 0.35
S239
B
C200
C
1139 PK 0.35
C490
B1
Ignition 1 Voltage
Inflatable Restraint Passenger Air Bag On/Off Indicator
Passenger Seat Belt Indicator Control
Passenger Air Bag On Indicator Control
Passenger Air Bag Off Indicator Control
5234 PU 0.35
2307 D-BU 0.35
2308 D-GN 0.35
A1
A2
A3
C203
B11
1450 BK 0.5
550 BK 0.35
11
12
13
Passenger Seat Belt Ind cator Control
Instrument Panel Cluster (IPC)
G201
G301

Fig. 3: Passenger Presence System - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

SIR COMPONENT VIEWS

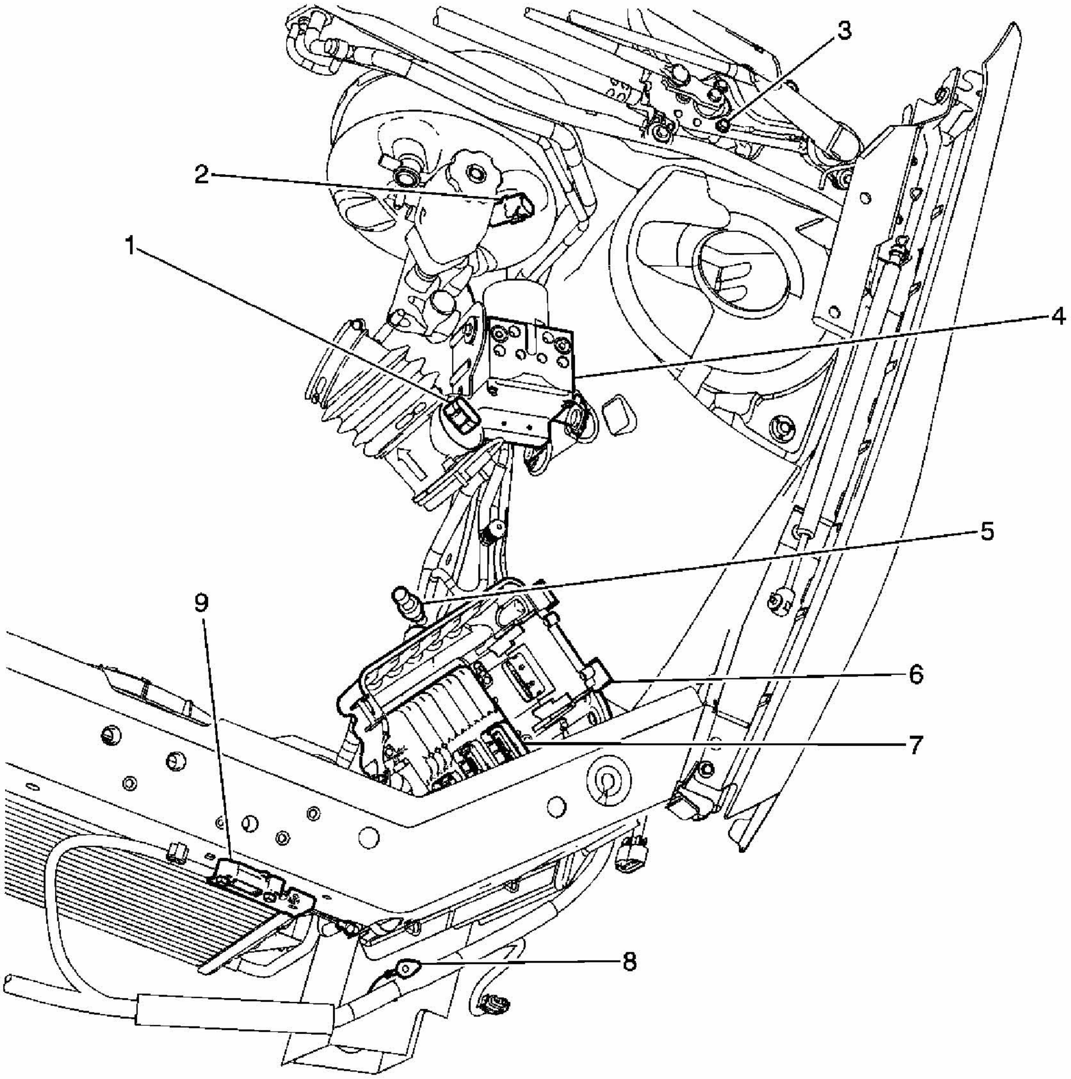


Fig. 4: LF Of The Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	Mass Air Flow (MAF) / Intake Air Temperature (IAT) Sensor
2	Brake Fluid Level Switch

3	Windshield Wiper Motor
4	Electronic Brake Control Module (EBCM)
5	A/C Refrigerant Pressure Sensor
6	Transmission Control Module (TCM)
7	Engine Control Module (ECM)
8	G101
9	Inflatable Restraint Front end Sensor - Left

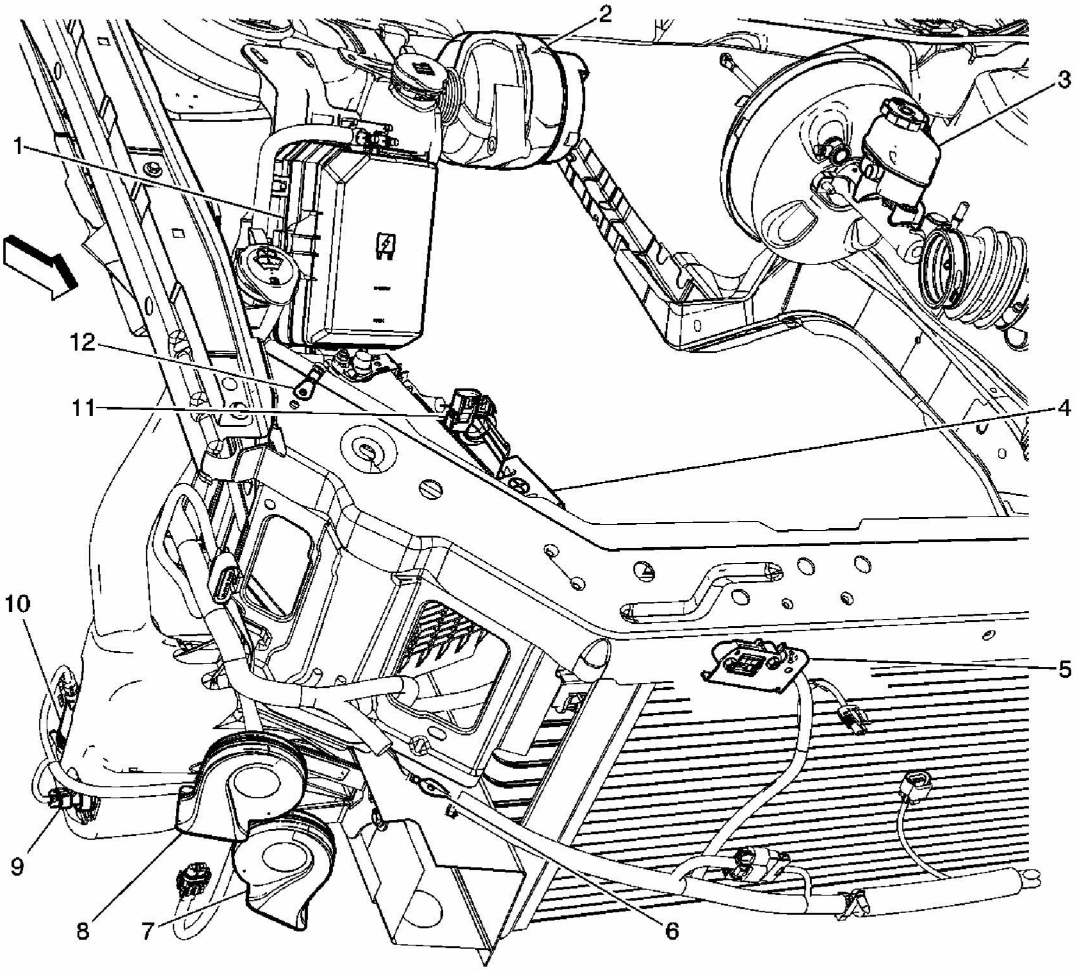


Fig. 5: RF Of The Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
1	Fuse Block - Underhood
2	Generator
3	Brake Fluid Level Switch

4	Battery
5	Inflatable Restraint Front end Sensor - Right
6	G100
7	Horn Assembly
8	Windshield Washer Fluid Container
9	Windshield Washer Fluid Level Switch
10	Windshield Washer Fluid Pump
11	Battery Current Sensor
12	G102

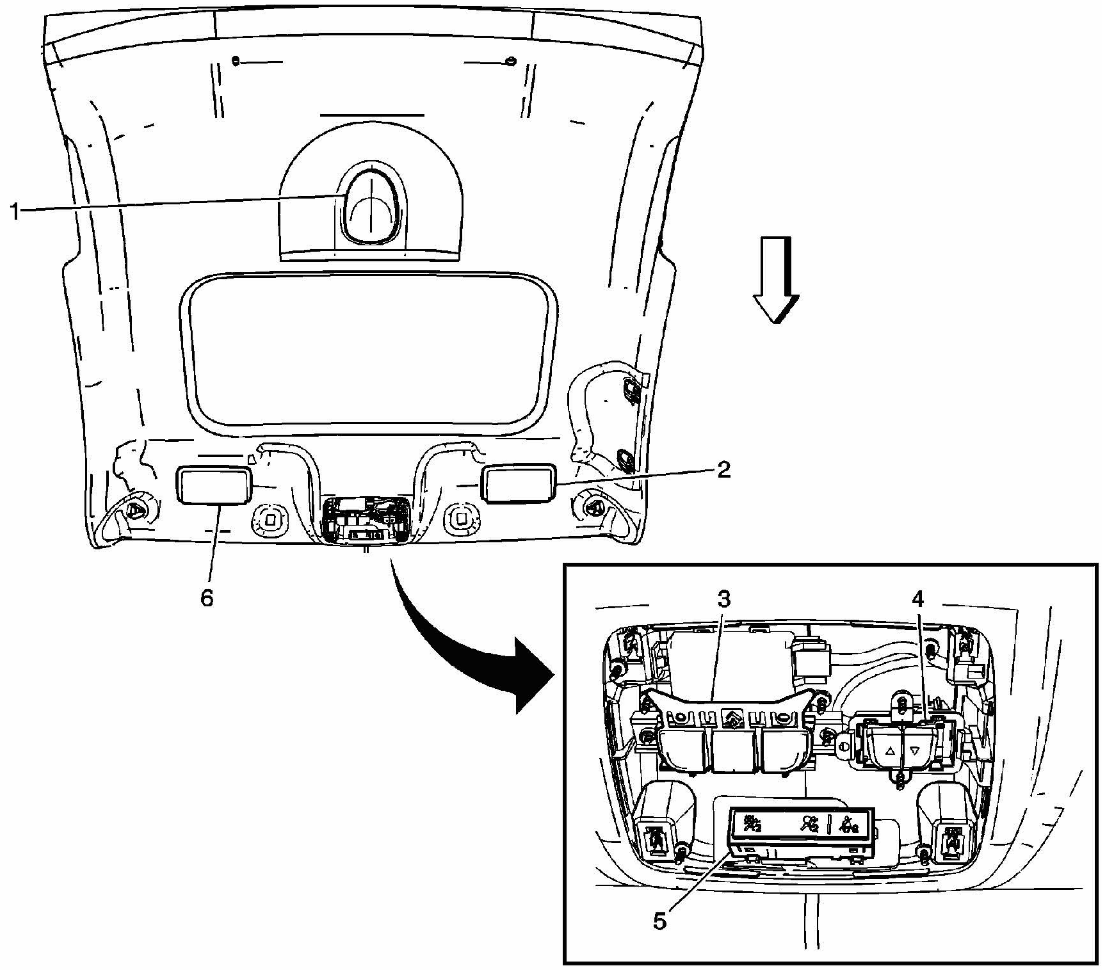


Fig. 6: Headliner Components (Coupe)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 6

Callout	Component Name
1	Dome Lamp
2	Vanity Mirror Lamp - Right (DH6)

3	Garage Door Opener (UG1)
4	Sunroof Switch (CF5)
5	Inflatable Restraint Passenger Air Bag On/Off Indicator
6	Vanity Mirror Lamp - Left (DH6)

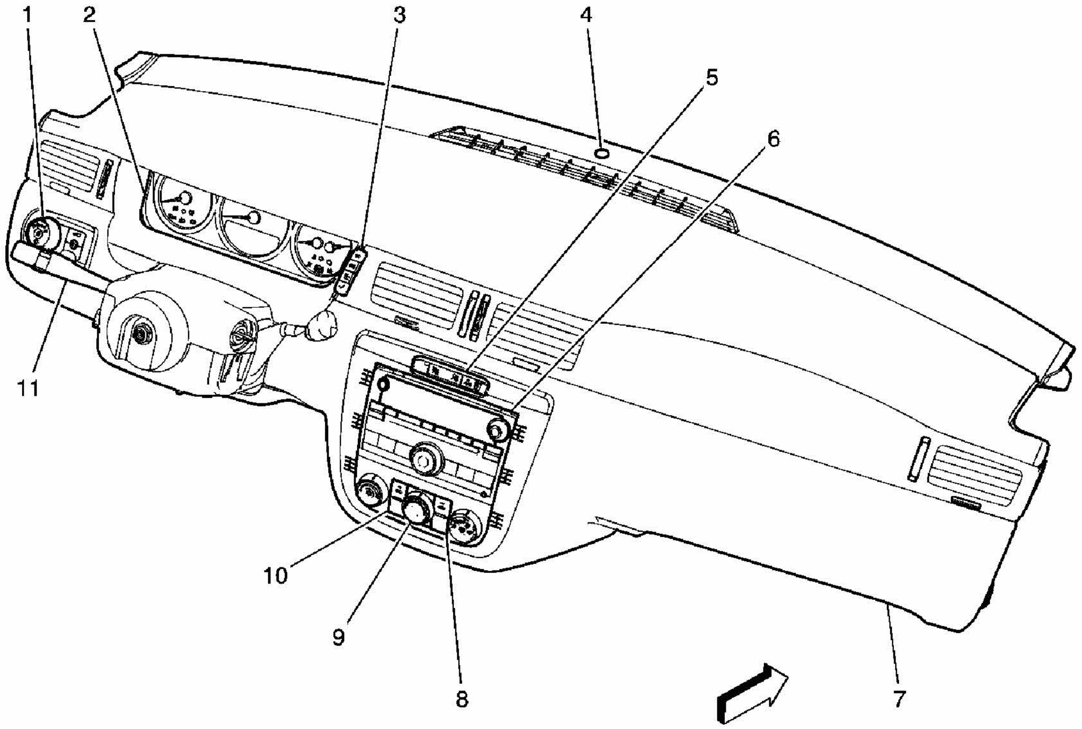


Fig. 7: I/P Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 7

Callout	Component Name
1	Headlamp Switch
2	Instrument Panel Cluster (IPC)
3	Driver Information Center (DIC) Switch
4	Ambient Light Sensor
5	Inflatable Restraint Passenger Air Bag On/Off Indicator (Sedan w/o 9C1, 9C3)
6	Radio
7	I/P Trim Panel
8	Heated Seat Switch-Passenger (KA7)
9	HVAC Control Module
10	Heated Seat Switch-Driver (KA7)

11	Turn Signal / Multifunction Switch

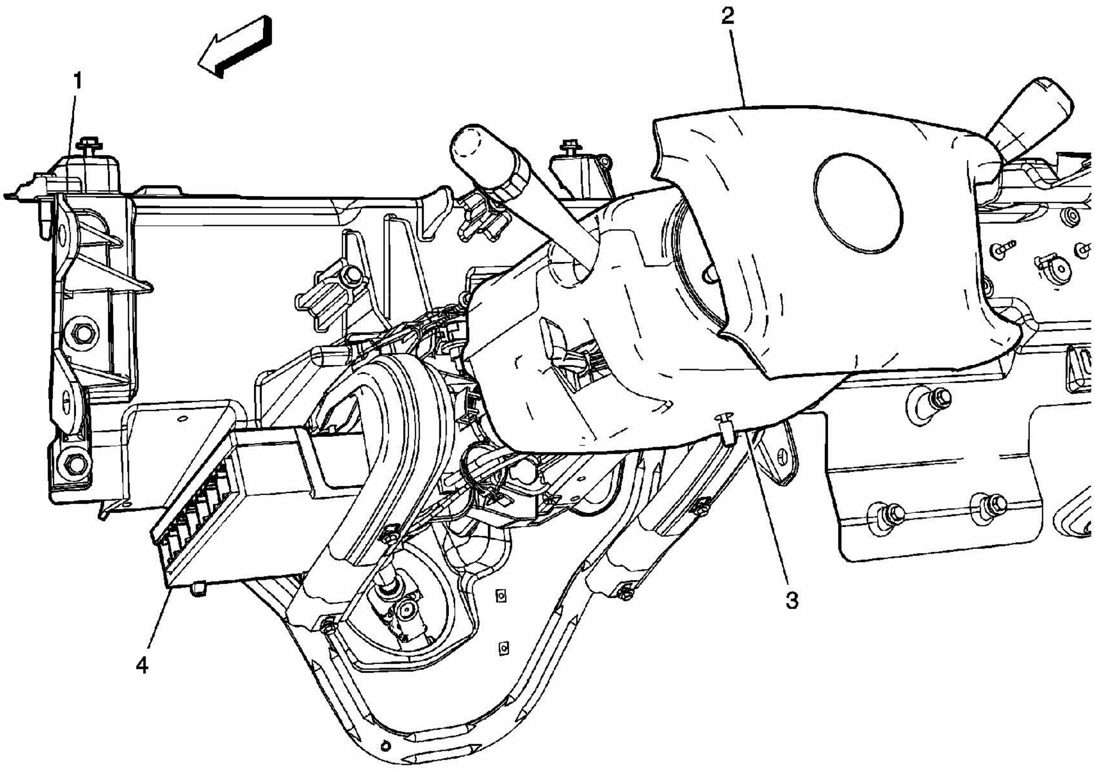


Fig. 8: Near The Steering Column
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 8

Callout	Component Name
1	I/P Carrier
2	Inflatable Restraint Steering Wheel Module
3	Steering Column
4	Body Control Module (BCM)

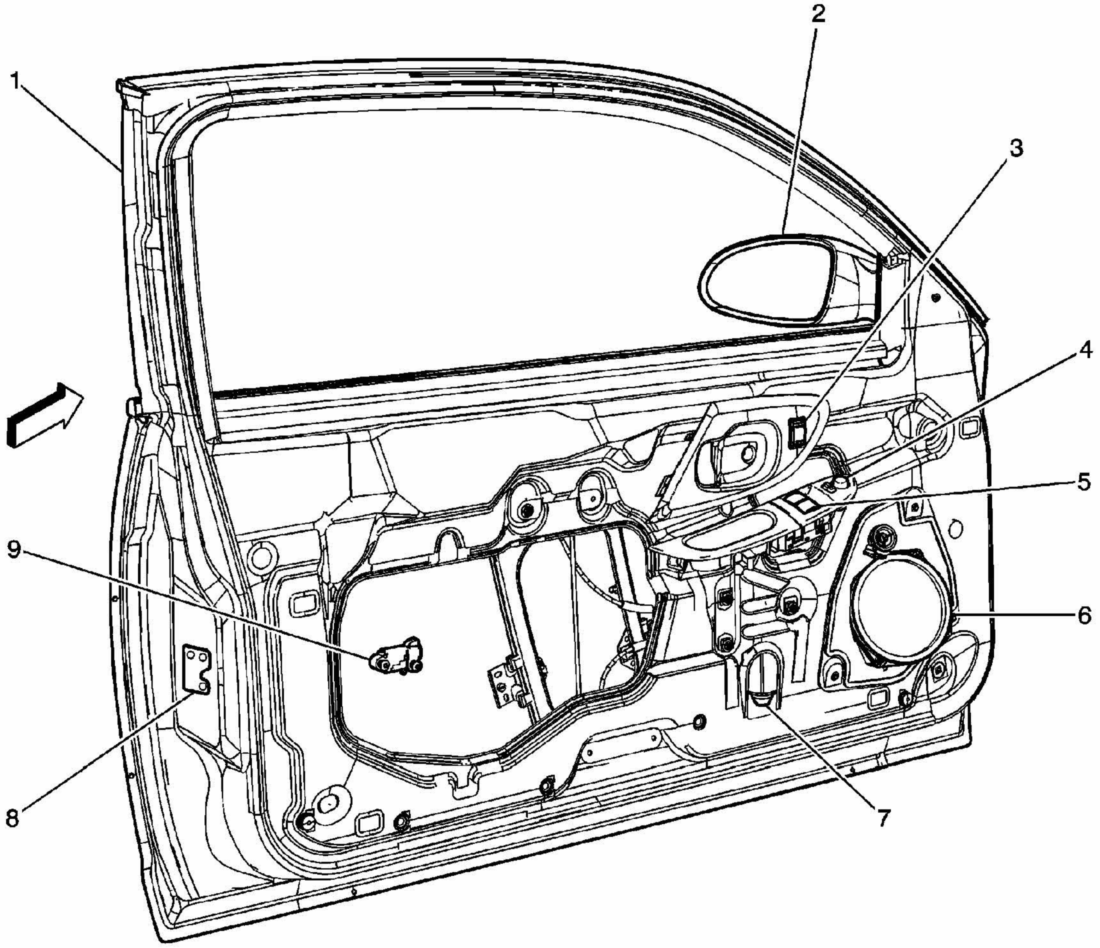


Fig. 9: Left Front Door Components (Coupe)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 9

Callout	Component Name
1	Door Frame
2	Outside Rearview Mirror - Driver
3	Door Lock Switch - Driver
4	Outside Rearview Mirror Switch
5	Window Switch - Driver
6	Speaker - LF Door
7	Window Motor - Driver
8	Door Lock Actuator - Driver
9	Inflatable Restraint Side Impact Sensor (SIS) Left (AJ7)

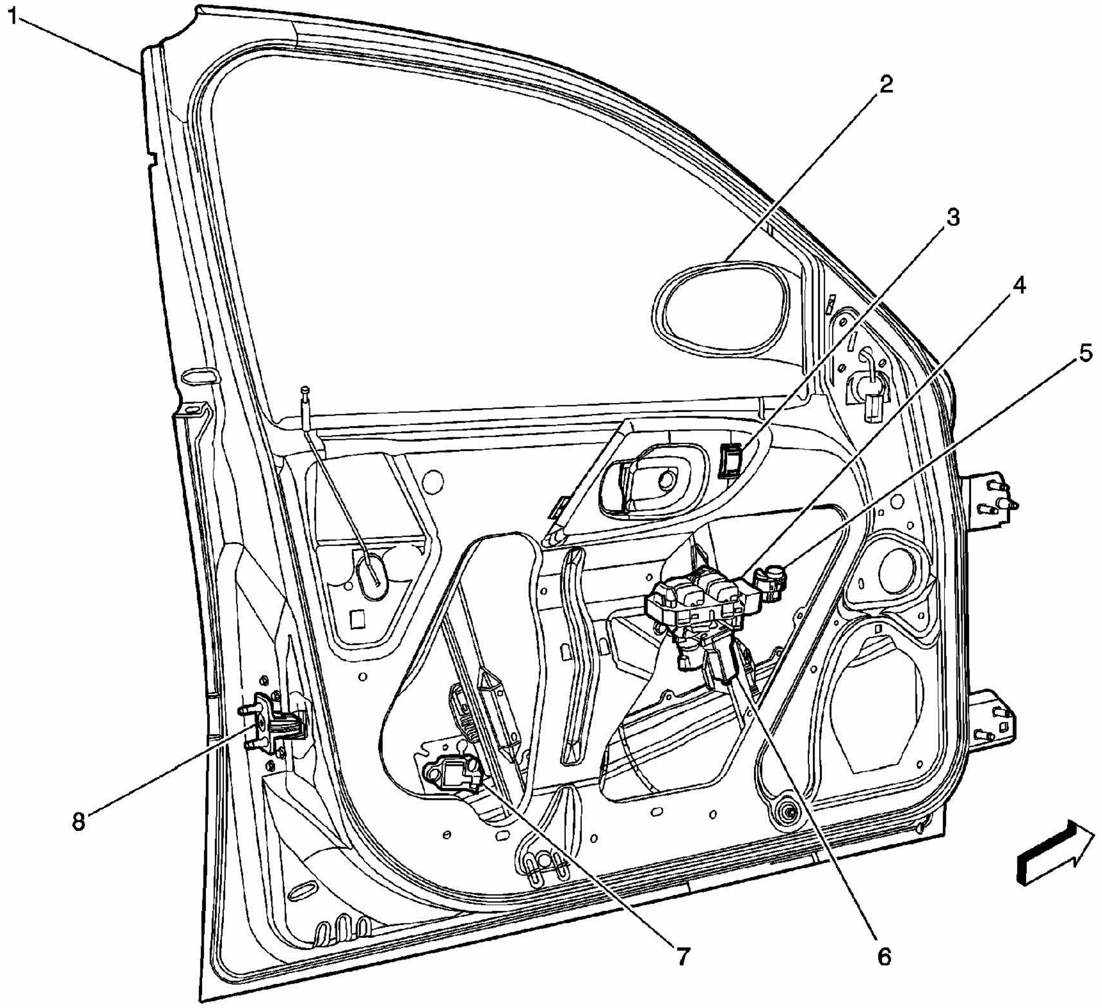


Fig. 10: Driver Door (Sedan)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 10

Callout	Component Name
1	Door Frame
2	Outside Rearview Mirror - Driver
3	Door Lock Switch - Driver
4	Window Switch - Driver
5	Outside Rearview Mirror Switch
6	Window Motor - Driver
7	Inflatable Restraint Side Impact Sensor (SIS) Left (AY1)
8	Door Lock - Driver

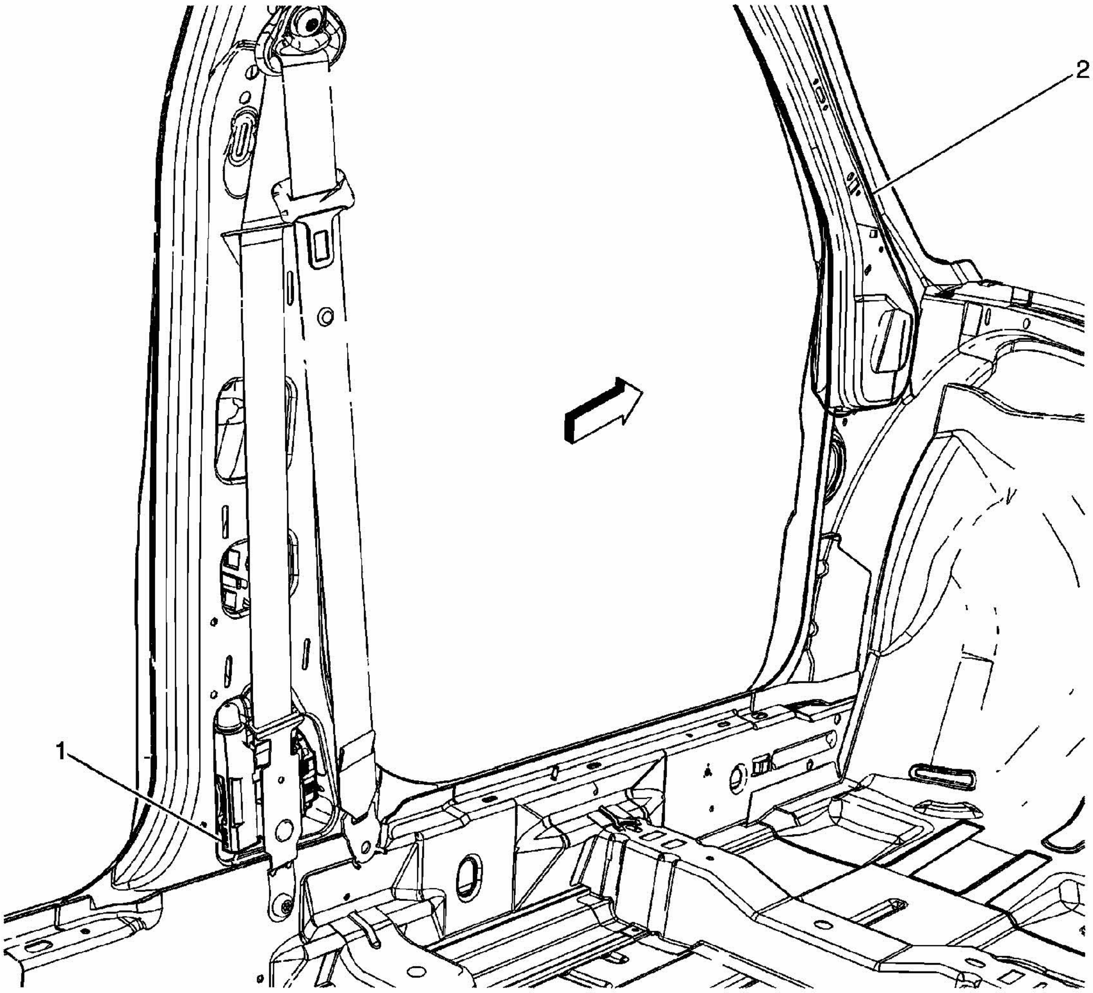


Fig. 11: On the left B-Pillar
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 11

Callout	Component Name
1	Seat Belt Pretensioner - Left
2	Left A-Pillar

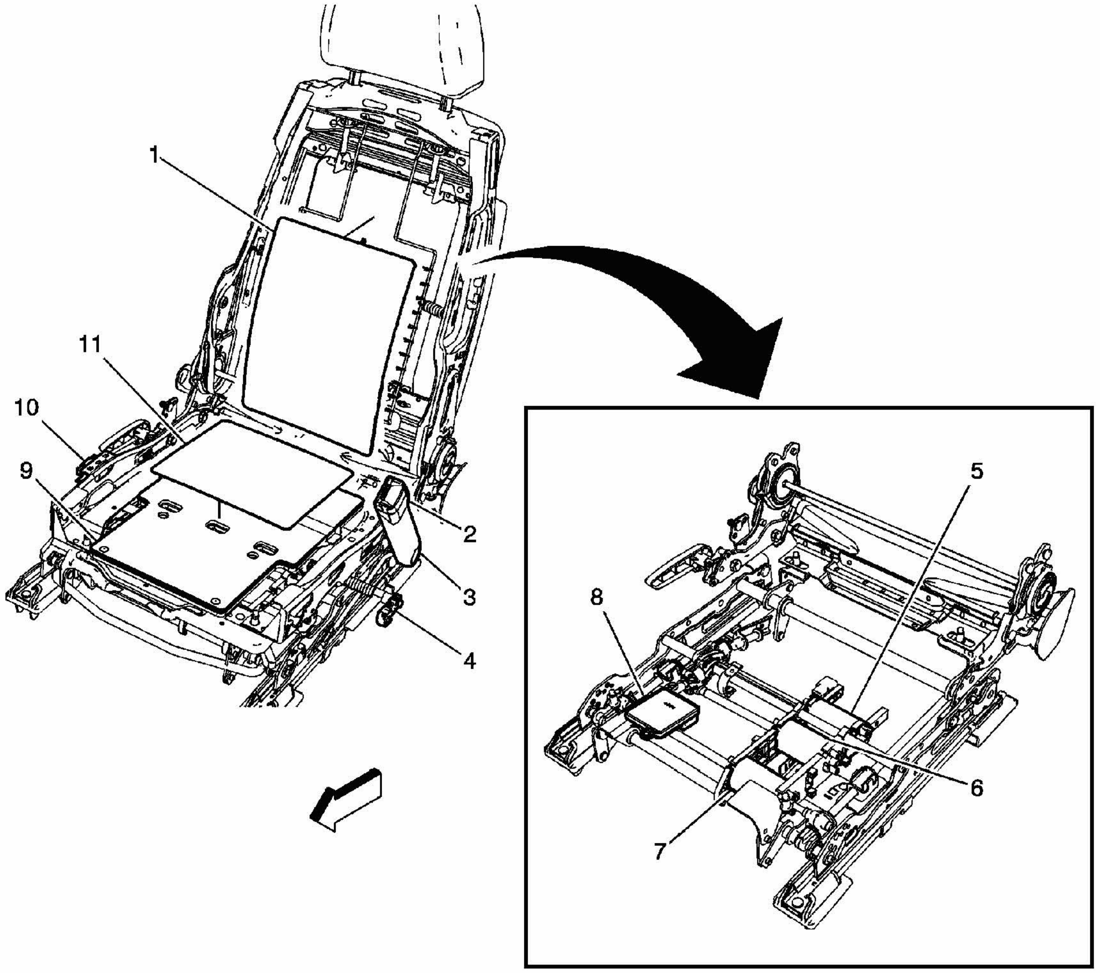


Fig. 12: Passenger Seat Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 12

Callout	Component Name
1	Heated Seat Element - Passenger - Back (KA1)
2	Seat Belt Switch - Passenger
3	Inflatable Restraint Front Passenger Presence System (PPS) Sensor
4	Seat Adjuster Motor - Rear
5	Seat Adjuster Motor - Front
6	Seat Horizontal Motor
7	Inflatable Restraint Front Passenger Presence System (PPS) Module
8	Inflatable Restraint Front Passenger Presence System (PPS) Sensor Pad
9	Seat Adjuster Switch - Passenger
10	Heated Seat Element - Passenger - Seat (KA1)

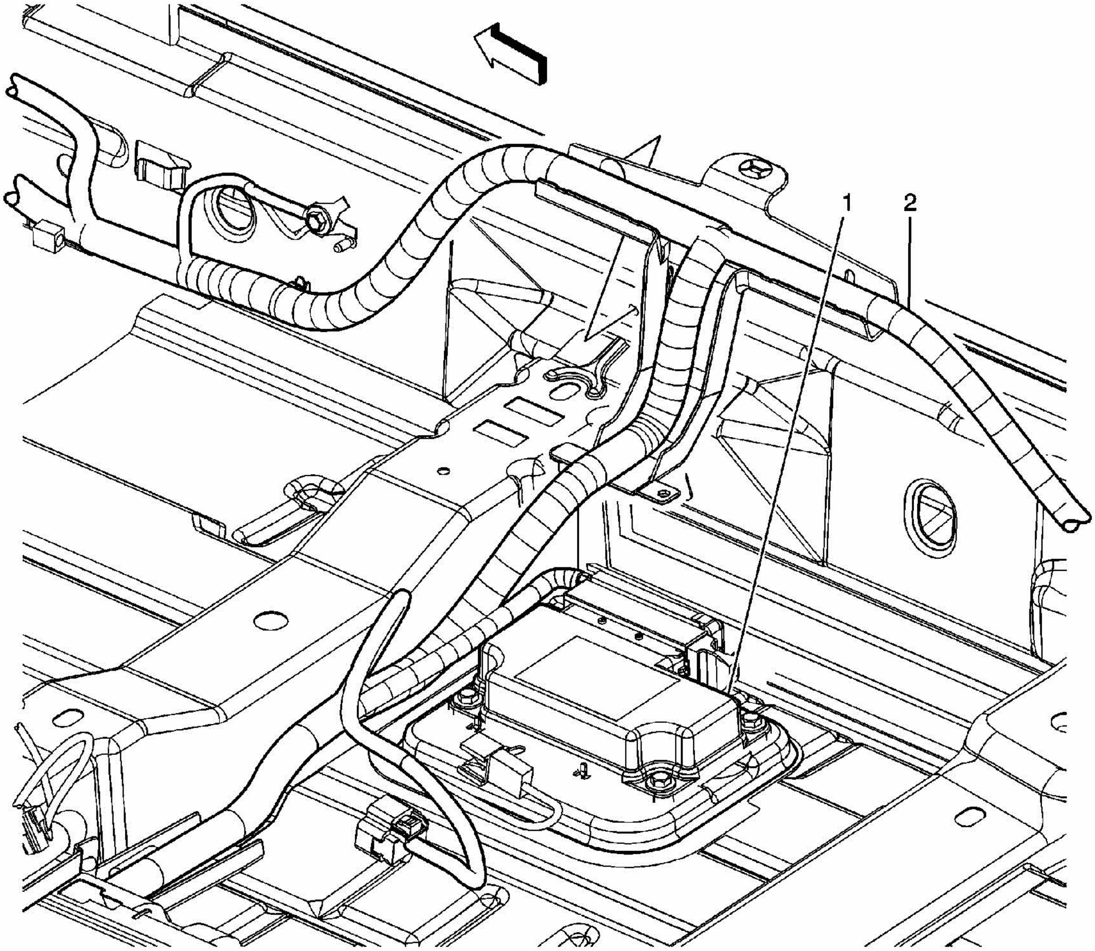


Fig. 13: Under The Passenger Seat
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 13

Callout	Component Name
1	Inflatable Restraint Sensing and Diagnostic Module (SDM)
2	Front Passenger Floor Panel

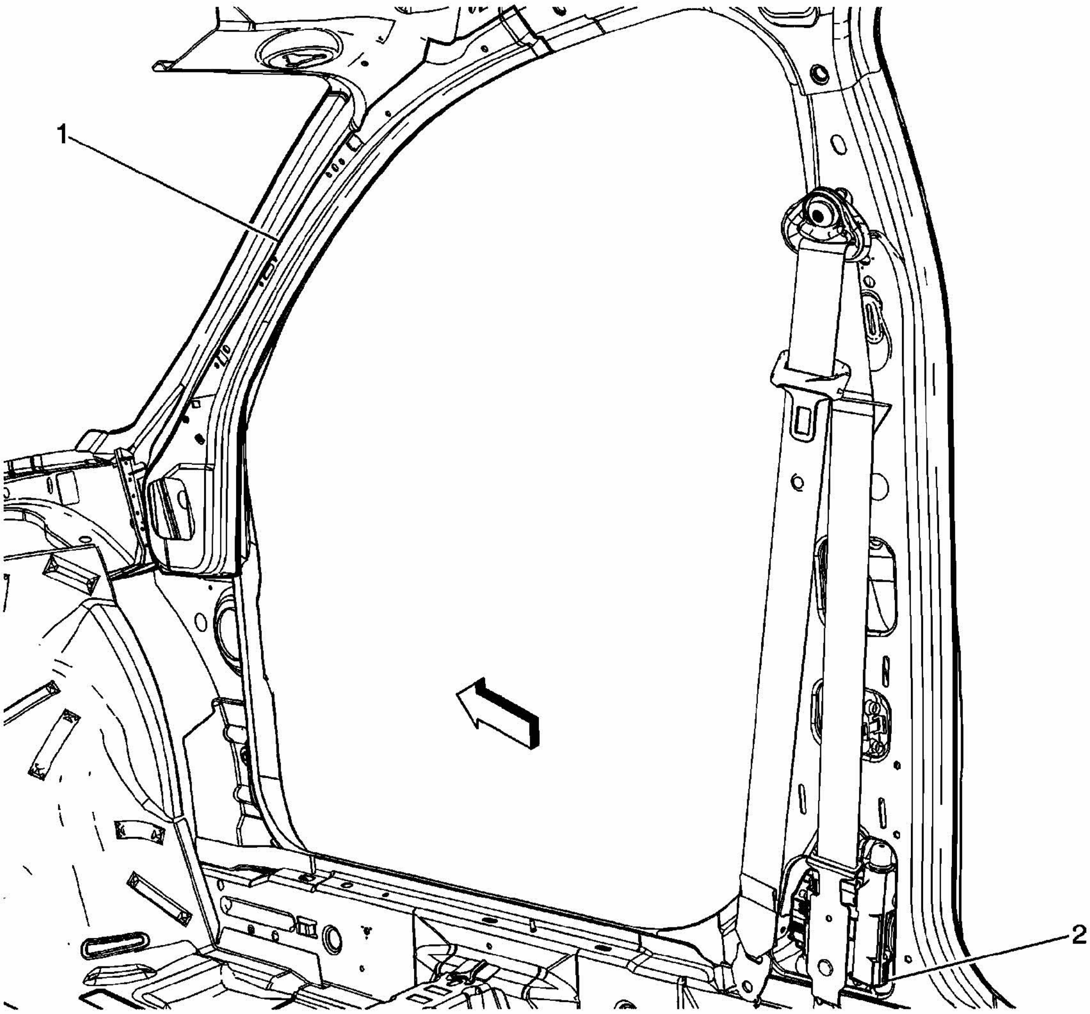


Fig. 14: On The Right B-Pillar
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 14

Callout	Component Name
1	Right A-Pillar
2	Seat Belt Pretensioner - Right

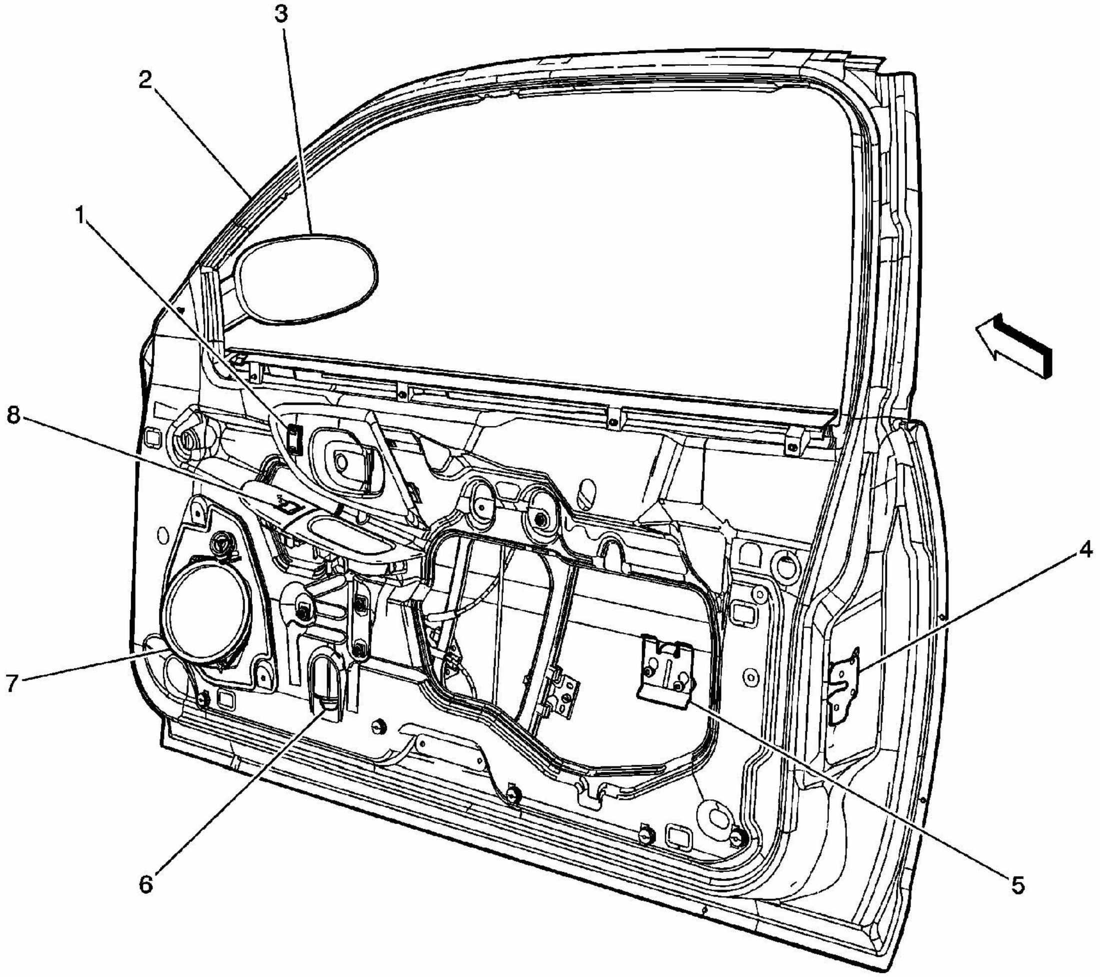


Fig. 15: Right Front Door Components (Coupe)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 15

Callout	Component Name
1	Door Lock Switch - Passenger
2	Door Frame
3	Outside Rearview Mirror - Passenger
4	Door Lock Actuator - Passenger
5	Inflatable Restraint Side Impact Sensor (SIS) Right (AJ7)
6	Window Motor - Front Passenger
7	Speaker - RF Door
8	Window Switch - Passenger

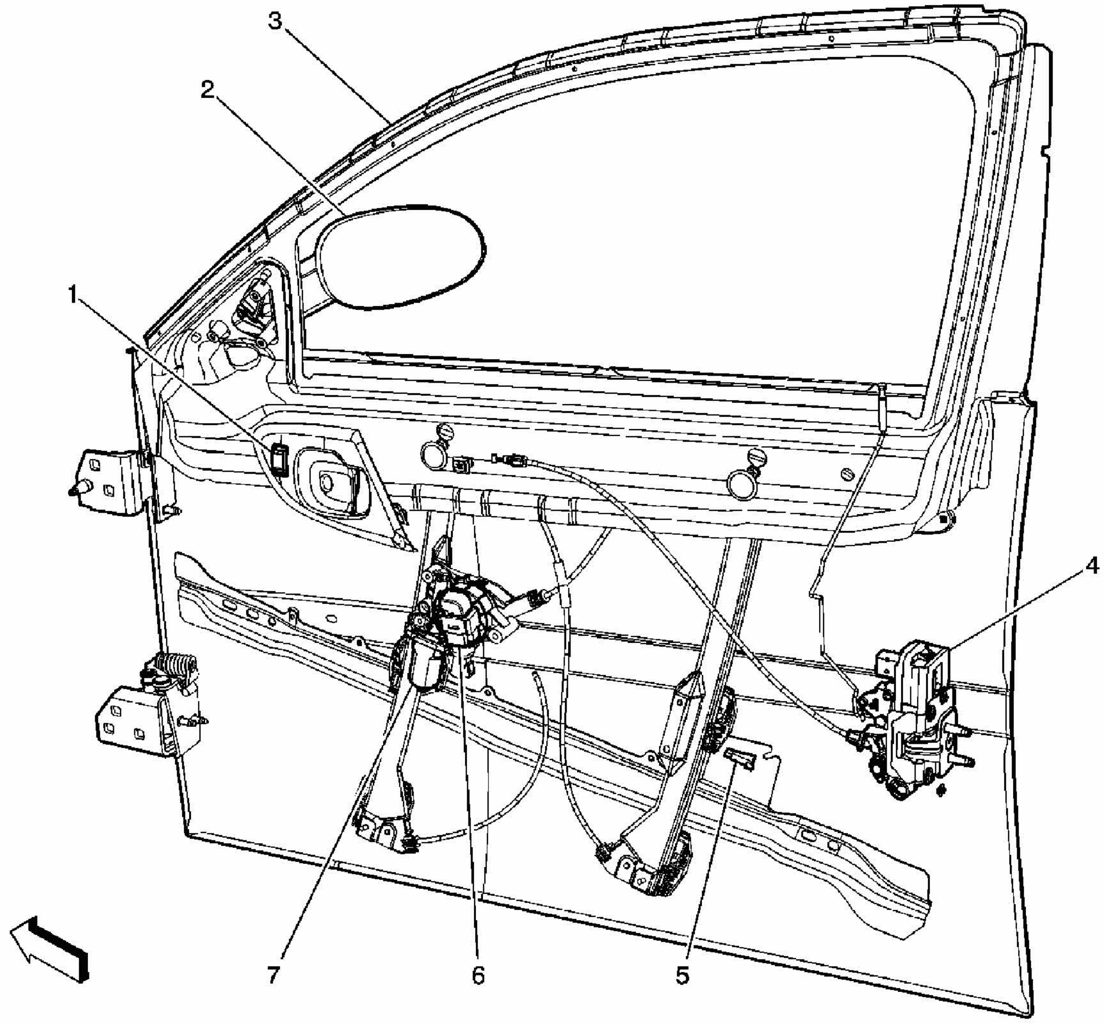


Fig. 16: Passenger Door (Sedan)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 16

Callout	Component Name
1	Door Lock Switch - Front Passenger
2	Outside Rearview Mirror - Passenger
3	Door Frame
4	Door Lock - Front Passenger
5	Inflatable Restraint Side Impact Sensor (SIS) Right (AY1)
6	Window Switch - Front Passenger
7	Window Motor - Front Passenger

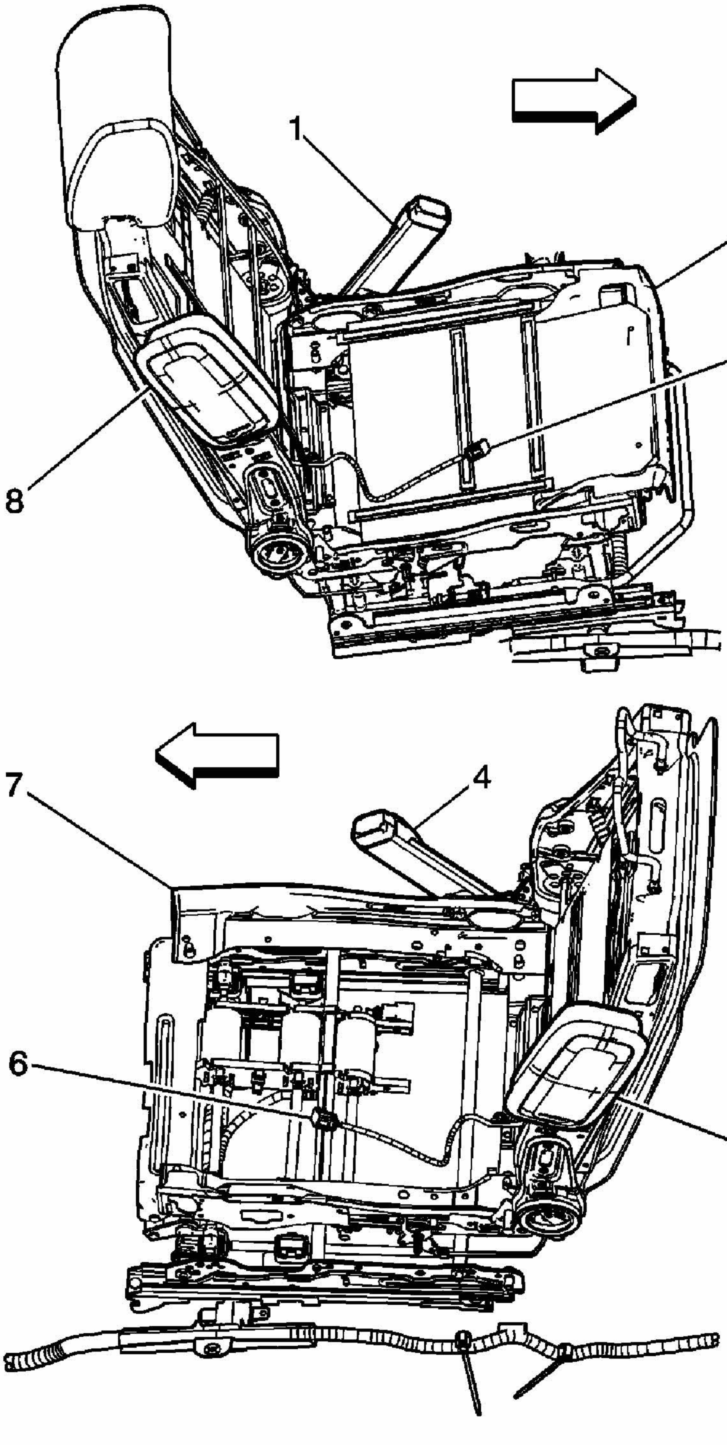


Fig. 17: Front Seat Airbag Inlines
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 17

Callout	Component Name
1	Seat Belt Switch-Passenger

2	Passenger
3	C314
4	Seat Belt Switch-Driver
5	Inflatable Restraint Side Impact Module-Left
6	C312
7	Driver Seat
8	Inflatable Restraint Side Impact Module-Right

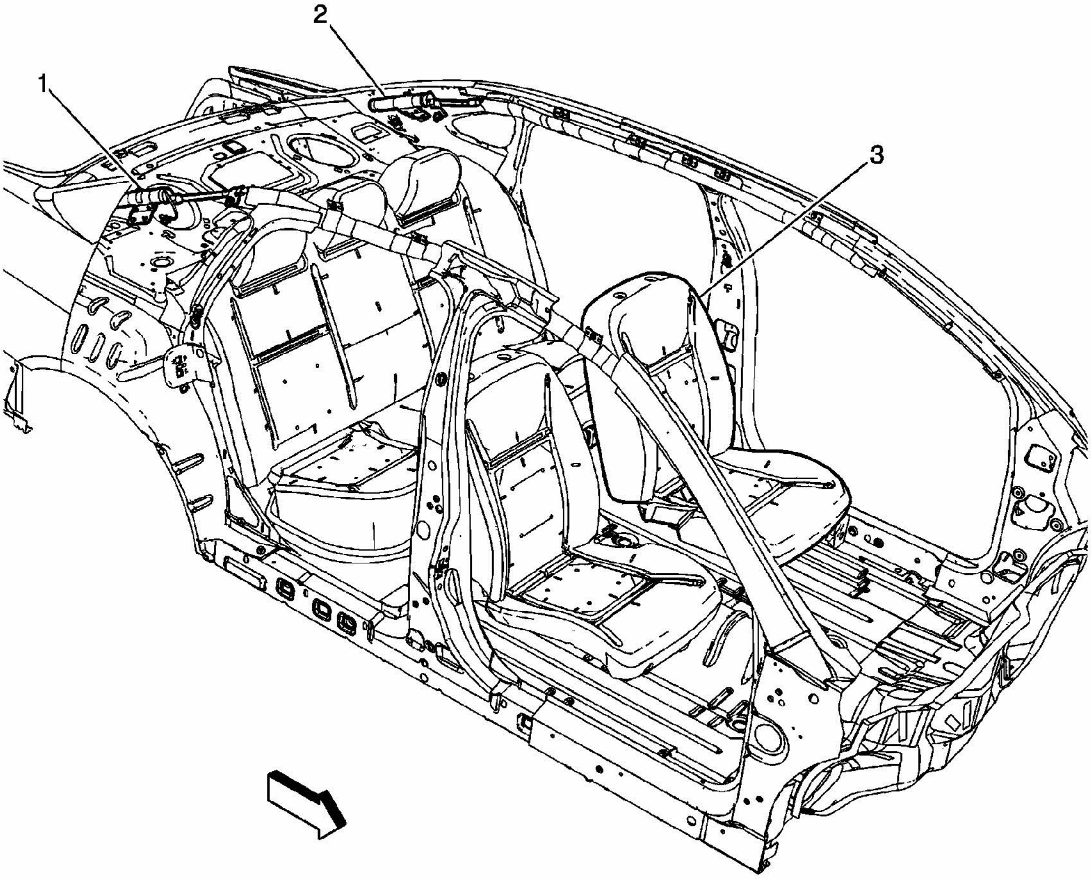


Fig. 18: Roof Rail Air Bags (AY1)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 18

Callout	Component Name
1	Roof Rail Module - Right
2	Roof Rail Module - Left
3	Drivers Seat

SIR ZONE IDENTIFICATION VIEWS

The SIR Zone Identification Views shown below illustrate the approximate location of all SIR components available for the vehicle. This will assist in determining the appropriate SIR Disabling and Enabling Zones for a given service procedure, refer to **SIR Disabling and Enabling Zones**.

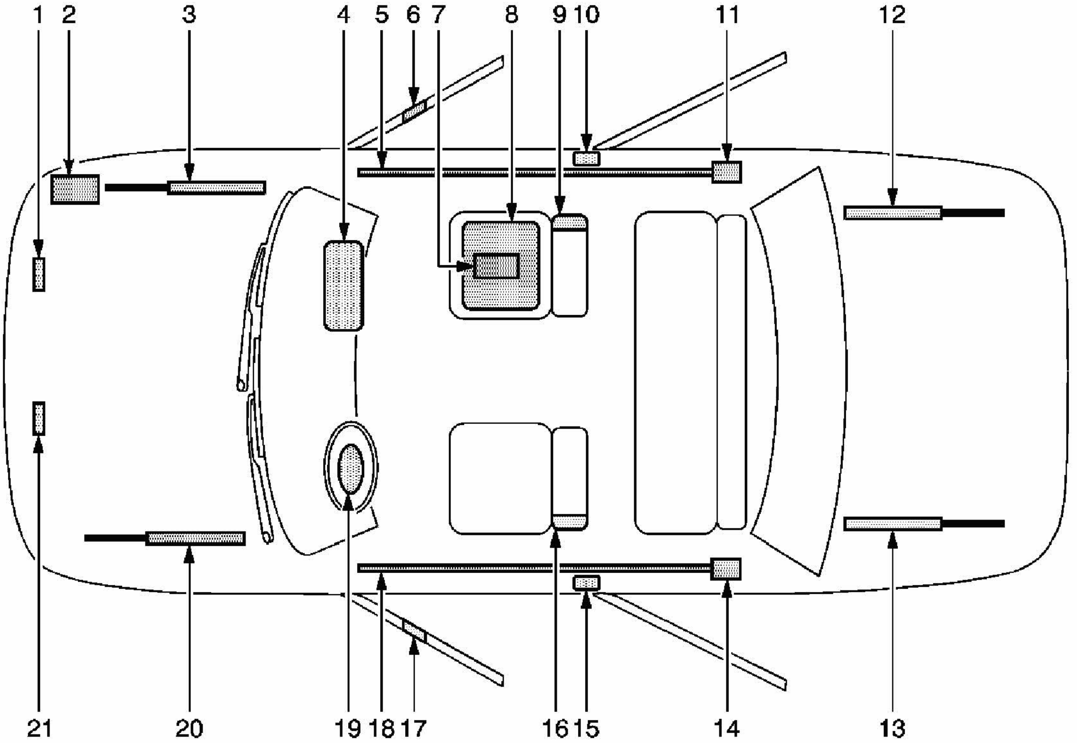


Fig. 19: Impala/Monte Carlo
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 19

Callout	Component Name
1	Front End Sensor-Located under the hood at the front right side of the vehicle
2	Front Hood Assist Rod-A gas shock located under the front hood on the passenger side
3	I/P Air Bag-Located at the top right under the instrument panel
4	Roof Rail Air Bag (Impala Only)-Located under the headliner, extending from the passenger front windshield pillar to the passenger rear windshield pillar
5	Side Impact Sensor (SIS)-Located behind door panel on the passenger front door
6	Sensing and Diagnostic Module (SDM)-Located underneath the passenger front seat under the vehicle carpet

7	Passenger Presence System (PPS)-Located on the passenger front seat underneath the seat bottom trim
8	RF Side Impact Air Bag (Monte Carlo only)-Located on the seat back of passenger seat
9	Seat Belt Pretensioner-Located under the trim near the bottom of the center pillar on the passenger side of vehicle in the Sedan
10	Inflator Module for Roof Rail Air Bag (Impala Only)-Located behind the garnish molding on the upper rear pillar
11	Rear Hood Assist Rod-A gas shock located under the rear truck lid on the passenger side
12	Rear Hood Assist Rod-A gas shock located under the rear truck lid on the driver side
13	Inflator Module for Roof Rail Air Bag (Impala Only)-Located behind garnish molding on the upper rear pillar
14	Seat Belt Pretensioner-Located under the trim near the bottom of the center pillar on the driver side of vehicle in the Sedan
15	LF Side Impact Air Bag (Monte Carlo only)-Located on the seat back of driver seat
16	Side Impact Sensor (SIS)-Located behind door panel on the driver front door
17	Roof Rail Air Bag (Impala Only)-Located under the headliner, extending from the driver front windshield pillar to the driver rear windshield pillar
18	Steering Wheel Air Bag-Located on the steering wheel
19	Front Hood Assist Rod-A gas shock located under the front hood on the driver side
20	Vehicle Battery-Located at the front left of the engine compartment
21	Front End Sensor-Located under the hood at the front left side of the vehicle

SIR CONNECTOR END VIEWS

Inflatable Restraint Front End Sensor - Left

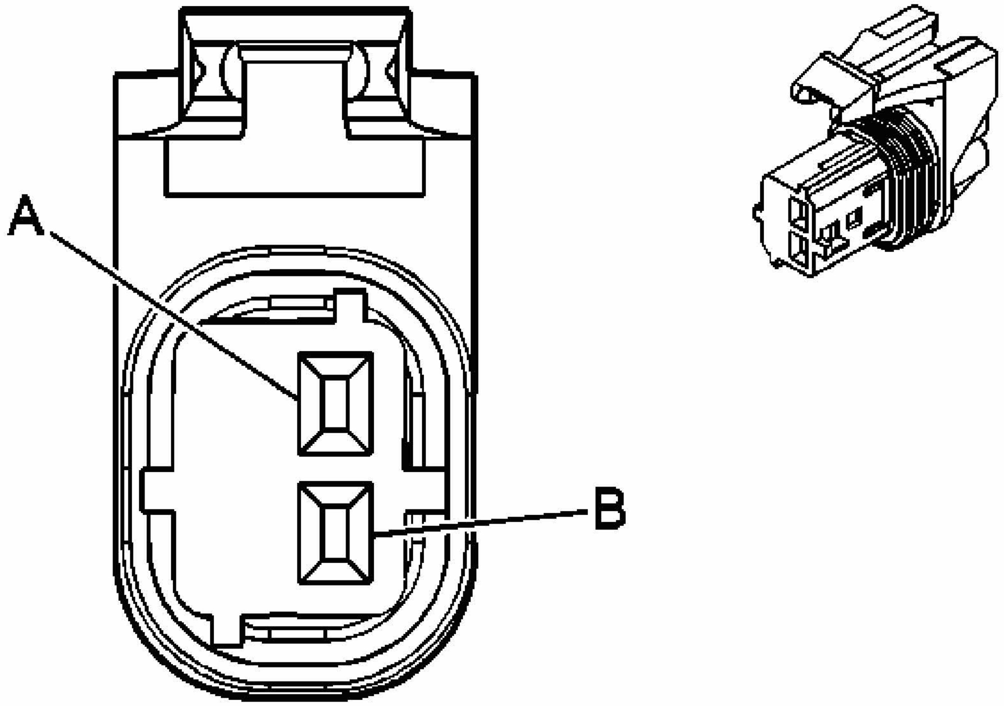


Fig. 20: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 15356723
- Service: 15306439
- Description: 2-Way F GT 150 Sealed (YE)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Inflatable Restraint Front End Sensor - Left

Pin	Wire Color	Circuit No.	Function
A	TN/OG	5045	Discriminating Sensor - Low Reference

B	YE	354	Discriminating Sensor - Signal

Inflatable Restraint Front End Sensor - Right

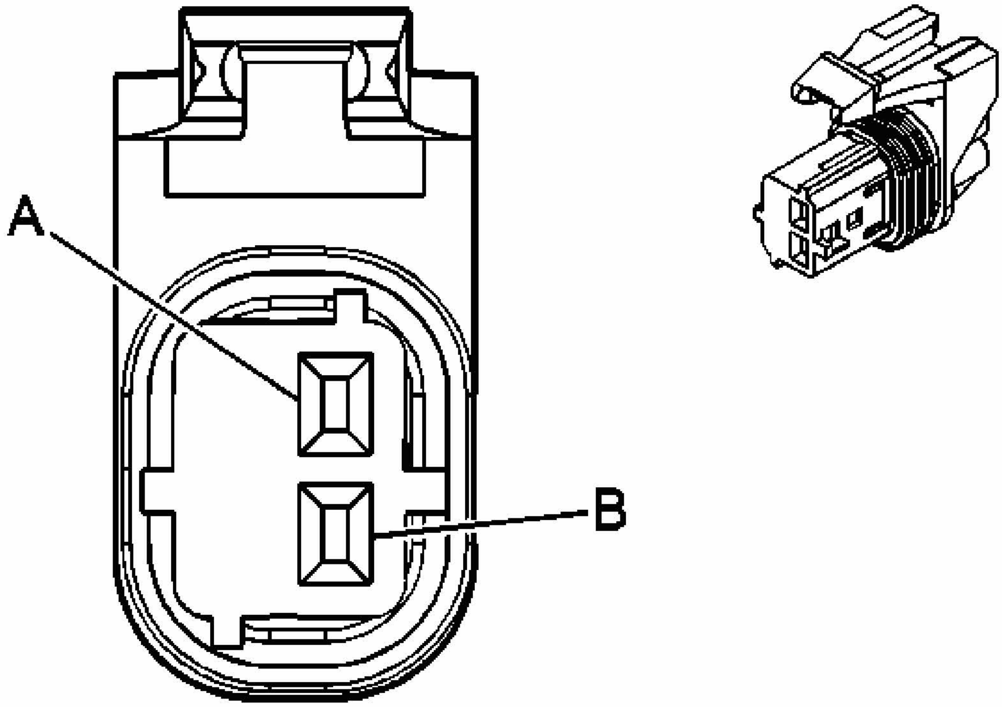


Fig. 21: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 15356723
- Service: 15306439
- Description: 2-Way F GT 150 Sealed (YE)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Inflatable Restraint Front End Sensor - Right

Pin	Wire Color	Circuit No.	Function
A	GY	5600	Discriminating Sensor - Right - Low Reference
B	D-GN	1409	Discriminating Sensor - Right - Signal

Inflatable Restraint Front Passenger Presence System (PPS) Module

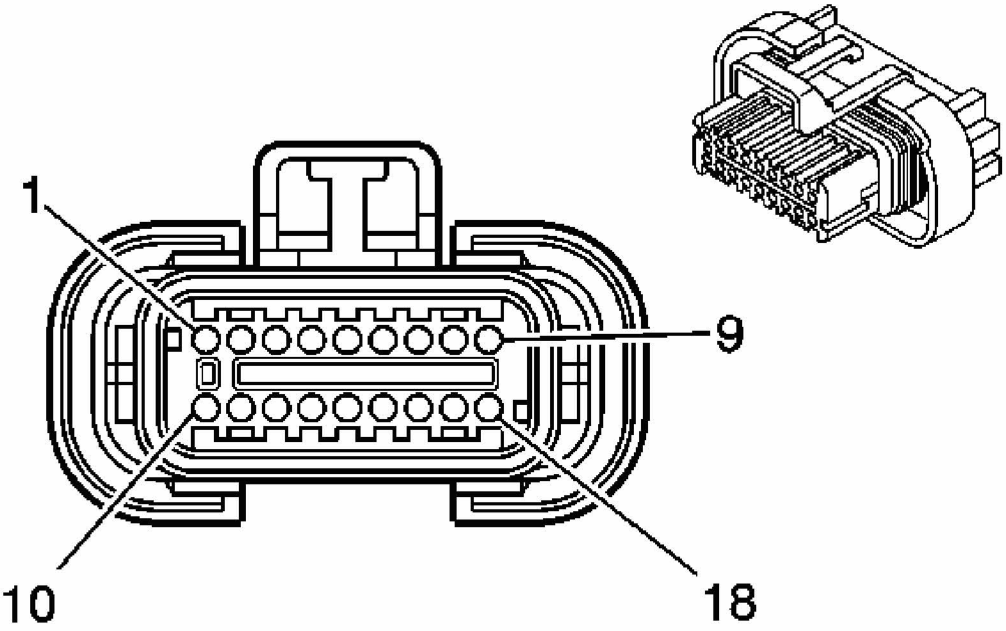


Fig. 22: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 13510845
- Service: See Catalog
- Description: 18-Way F Micro-Pack 100W Sealed Header Base 18 (BK)

Terminal Part Information

- Terminal/Tray: Service with Terminated Lead
- Core/Insulation Crimp: N/A

- Release Tool/Test Probe: 12122523/J-35616-6 (BN)

Inflatable Restraint Front Passenger Presence System (PPS) Module

Pin	Wire Color	Circuit No.	Function
1	RD/WH	1340	Battery Positive Voltage
2-3	-	-	Not Used
4	PU	5611	Passenger Seat Belt Tension Sensor Signal
5	BK/WH	1751	Ground
6	YE	5608	Occupant Pressure Sensor Signal
7	D-GN	5609	Occupant Pressure Sensor Reference Voltage
8-13	-	-	Not Used
14	TN	5613	Low Reference
15	GY	5610	Low Reference
16	L-BU	5612	Passenger Seat Belt Tension Sensor Reference Voltage
17	D-GN	5060	Low Speed GMLAN Serial Data
18	-	-	Not Used

Inflatable Restraint Front Passenger Presence System (PPS) Sensor

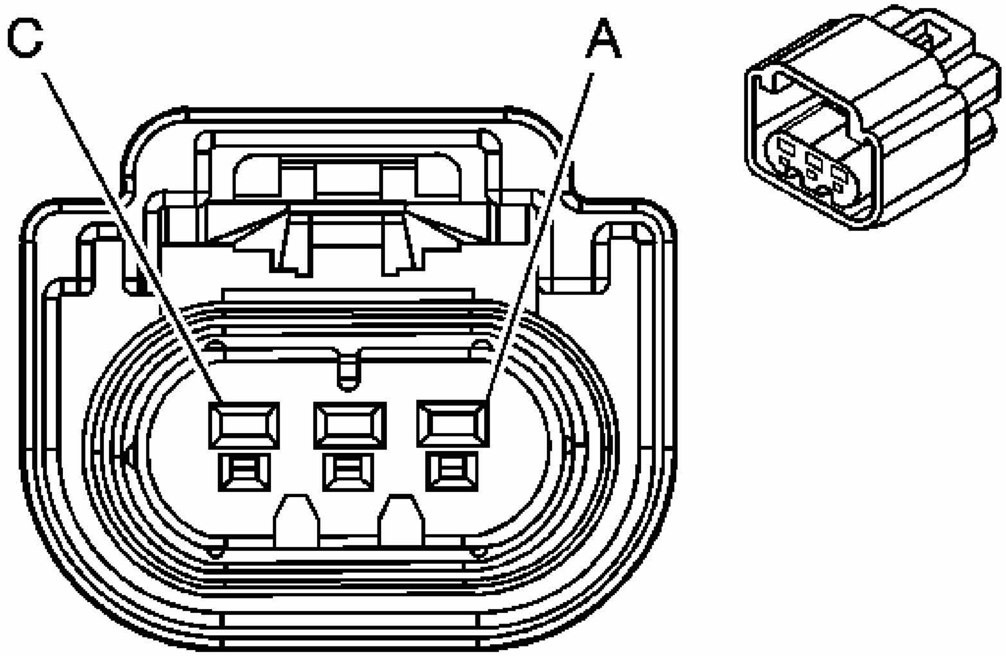


Fig. 23: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 15422250
- Service: 88987995
- Description: 3-Way F GT 150 Sealed (D-GY)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Inflatable Restraint Front Passenger Presence System (PPS) Sensor

Pin	Wire Color	Circuit No.	Function
A	D-GN	5609	Occupant Pressure Sensor Reference Voltage
B	YE	5608	Occupant Pressure Sensor Signal

C	GY	5610	Low Reference

Inflatable Restraint I/P Module, C1

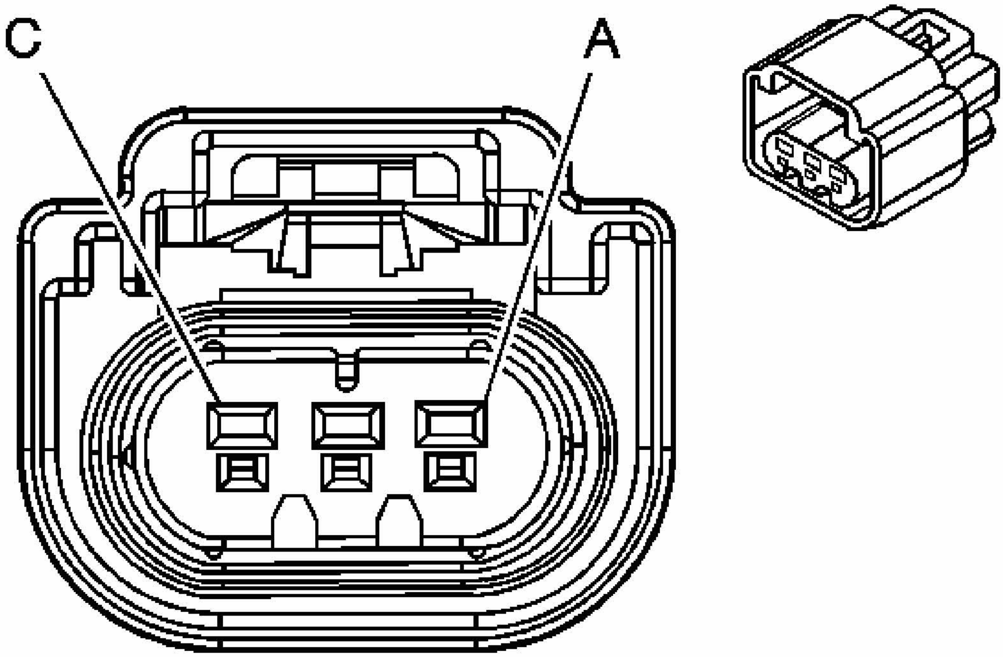


Fig. 24: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: CA54561236
- Service: See Catalog
- Description: 2-Way F AMP (WH w/YE Lock)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: N/A

Inflatable Restraint I/P Module, C1

Pin	Wire Color	Circuit No.	Function
1	YE	3025	I/P Module - Stage 1 - High Control
2	OG	3024	I/P Module - Stage 1 - Low Control

Inflatable Restraint I/P Module, C2

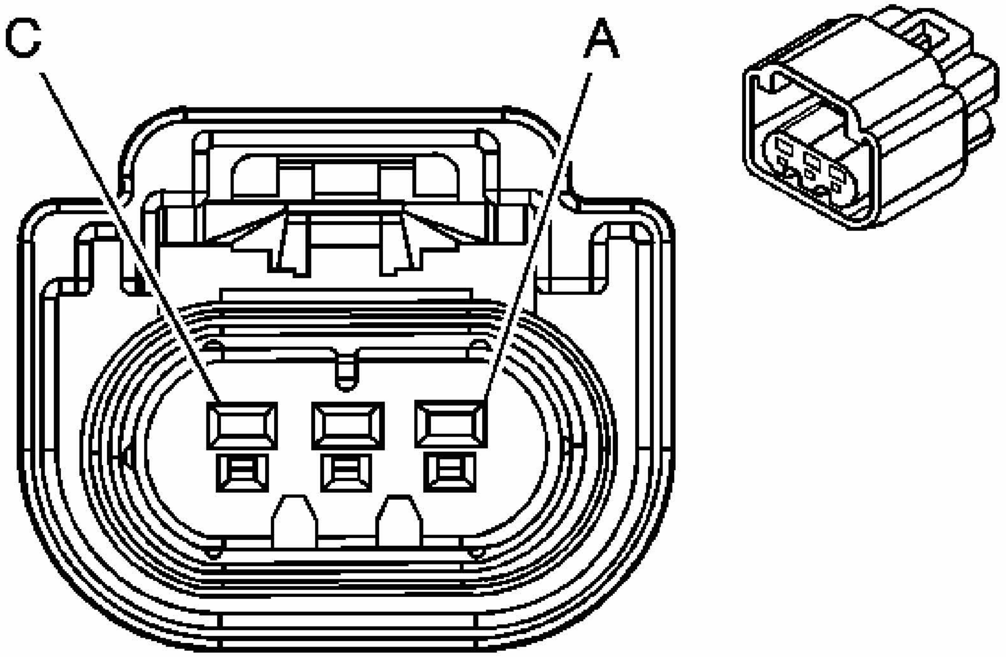


Fig. 25: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: CA54560222
- Service: See Catalog
- Description: 2-Way F AMP (PK w/YE Lock)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: N/A

Inflatable Restraint I/P Module, C2

Pin	Wire Color	Circuit No.	Function
1	GY	3027	I/P Module - Stage 2 - High Control
2	PU	3026	I/P Module - Stage 2 - Low Control

Inflatable Restraint Passenger Air Bag On/Off Indicator

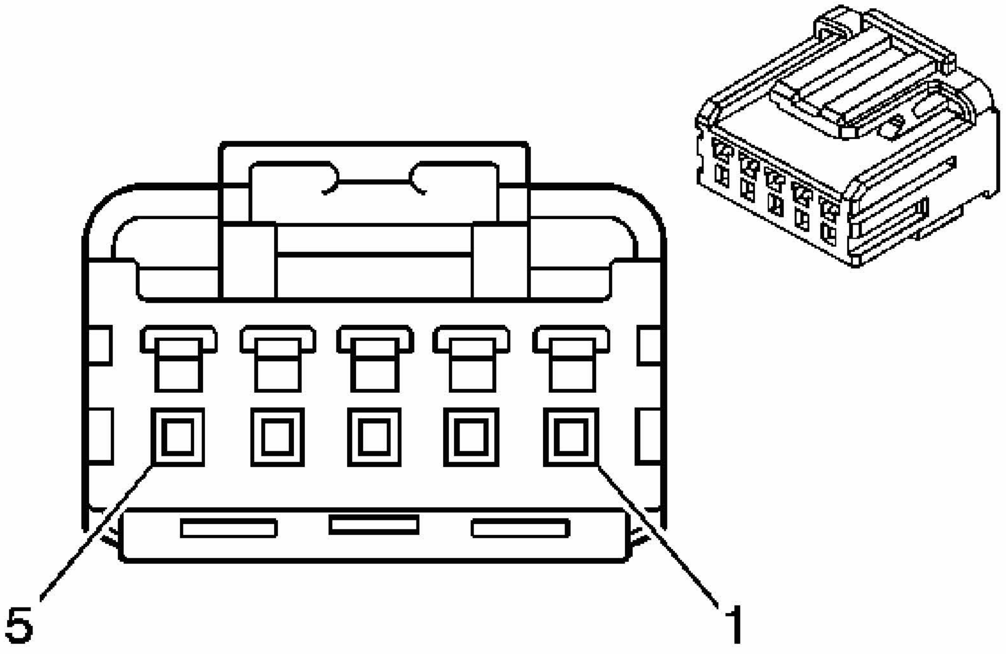


Fig. 26: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 15398877
- Service: Not Serviced
- Description: 5-Way F HCM (WH)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: 12094429/J-35616-64A (L-BU)

Inflatable Restraint Passenger Air Bag On/Off Indicator

Pin	Wire Color	Circuit No.	Function
1	D-BU	2307	Passenger Air Bag On Indicator Control
2	BK	550	Ground
3	D-GN	2308	Passenger Air Bag Off Indicator Control
4	PK	1139	Ignition 1 Voltage
5	PU	5234	Passenger Seat Belt Indicator Control
2	BK	1450	Ground

Inflatable Restraint Passenger Air Bag On/Off Indicator (9C1/9C3)

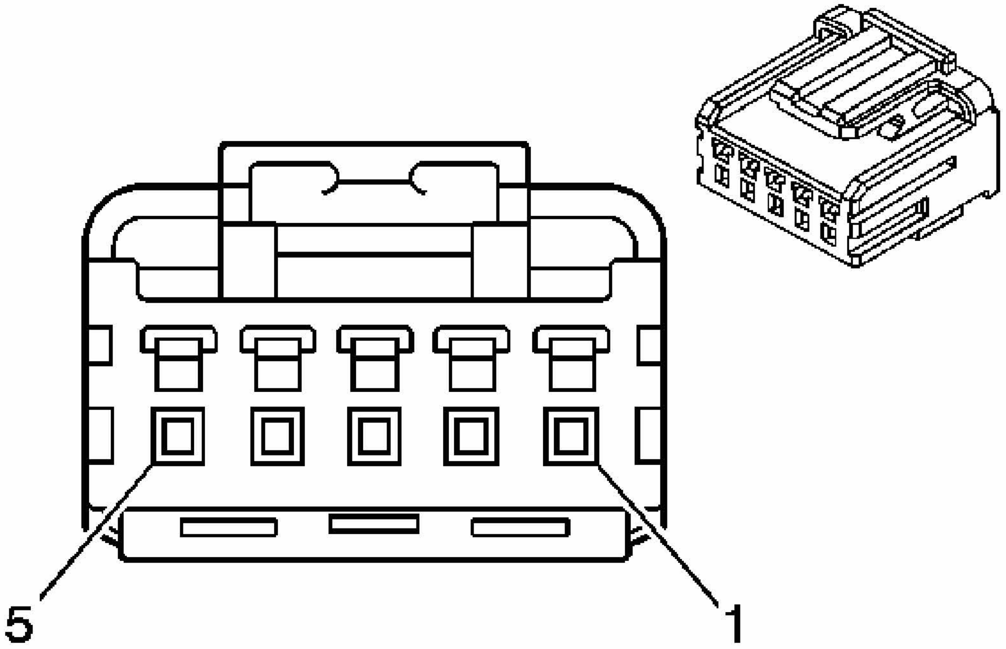


Fig. 27: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 15398877
- Service: Not Serviced

- Description: 5-Way F HCM (NA)

Terminal Part Information

- Terminal/Tray: SHCM-A03T-P025/20
- Core/Insulation Crimp: J/J
- Release Tool/Test Probe: 12094429/J-35616-64A (L-BU)

Inflatable Restraint Passenger Air Bag On/Off Indicator (9C1/9C3)

Pin	Wire Color	Circuit No.	Function
1	D-BU	2307	Passenger Air Bag On Indicator Control
2	BK	1450	Ground
3	D-GN	2308	Passenger Air Bag Off Indicator Control
4	PK	1139	Ignition 1 Voltage
5	PU	5234	Passenger Seat Belt Indicator Control

Inflatable Restraint Sensing and Diagnostic Module (AJ7)

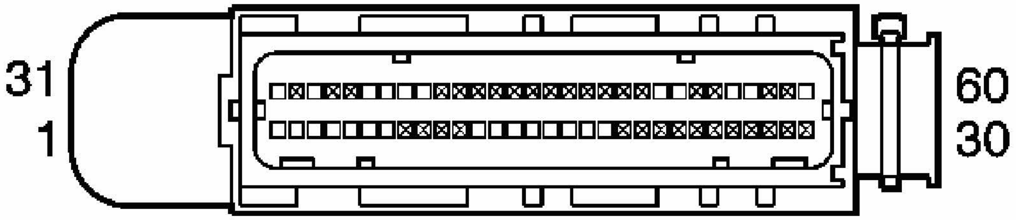


Fig. 28: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 15492274 (w/o AY1,AJ7)/15492273 (AY1, AJ7)
- Service: See Catalog
- Description: 60-Way F Receptacle 0.64 Series Sealed (YE)

Terminal Part Information

- Terminal/Tray: Service with Terminated Lead
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: 15315247/J-35616-64A (L-BU)

Inflatable Restraint Sensing and Diagnostic Module (AJ7)

Pin	Wire Color	Circuit No.	Function
1	BK/WH	1751	Ground
2	D-GN	5060	Low Speed GMLAN Serial Data
3	D-GN	5060	Low Speed GMLAN Serial Data
4	PK	3022	Steering Wheel Module - Stage2 - Low Control
5	WH	3023	Steering Wheel Module - Stage2 - High Control
6	GY	3027	I/P Module - Stage 2 - High Control
7	PU	3026	I/P Module - Stage 2 - Low Control
8	BN	3020	Steering Wheel Module - Stage1 - Low Control
9	TN	3021	Steering Wheel Module - Stage1 - High Control
10	YE	3025	I/P Module - Stage 1 - High Control
11	OG	3024	I/P Module - Stage 1 - Low Control
12	OG/BK	5224	Side Impact Module - Left - Low Control (AJ7)
13	BN/WH	5223	Side Impact Module - Left - High Control (AJ7)
14	PU	5225	Side Impact Module - Right - High Control (AJ7)
15	GY/BK	5226	Side Impact Module - Right - Low Control (AJ7)
16	OG/BK	2119	Seat Belt Pretensioner - Left - Low Control
17	TN/WH	2118	Seat Belt Pretensioner - Left - High Control
18	L-GN	2116	Seat Belt Pretensioner - Right - High Control
19	OG	2117	Seat Belt Pretensioner - Right - Low Control
20-27	-	-	Not Used
28	PK	5057	Seat Position Sensor - Low Reference
29	L-GN	5055	Seat Position Sensor- Left - Signal

30	L-BU	5056	Seat Position Sensor- Right - Signal
31	RD/WH	1340	Battery Positive Voltage
32	PK	1139	Ignition 1 Voltage
33-35	-	-	Not Used
36	YE	354	Discriminating Sensor - Signal
37	D-GN	1409	Discriminating Sensor - Right - Signal
38	TN/OG	5045	Discriminating Sensor - Low Reference
39	GY	5600	Discriminating Sensor - Right - Low Reference
40	WH	2132	Side Impact Sensing Module - Left - Signal
41	D-GN	2134	Side Impact Sensing Module - Right - Signal
42	YE	2131	Side Impact Sensing Module - Left - Voltage
43	TN	2133	Side Impact Sensing Module - Right - Voltage
44-58	-	-	Not Used
59	D-GN	5016	Seat Belt Switch - Left - Signal
60	OG	1362	Seat Belt Switch - Right - Signal

Inflatable Restraint Sensing and Diagnostic Module (AY1)

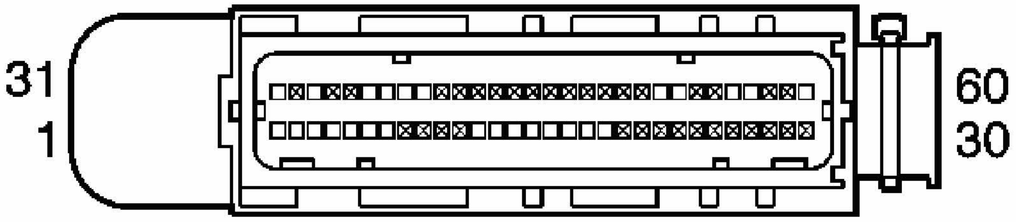


Fig. 29: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 15492274 (w/o AY1,AJ7)/15492273 (AY1, AJ7)
- Service: See Catalog
- Description: 60-Way F Receptacle 0.64 Series Sealed (YE)

Terminal Part Information

- Terminal/Tray: Service with Terminated Lead
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: 15315247/J-35616-64A (L-BU)

Inflatable Restraint Sensing and Diagnostic Module (AY1)

Pin	Wire Color	Circuit No.	Function
1	BK/WH	1751	Ground
2	D-GN	5060	Low Speed GMLAN Serial Data
3	D-GN	5060	Low Speed GMLAN Serial Data
4	PK	3022	Steering Wheel Module - Stage2 - Low Control
5	WH	3023	Steering Wheel Module - Stage2 - High Control
6	GY	3027	I/P Module - Stage 2 - High Control
7	PU	3026	I/P Module - Stage 2 - Low Control
8	BN	3020	Steering Wheel Module - Stage1 - Low Control
9	TN	3021	Steering Wheel Module - Stage1 - High Control
10	YE	3025	I/P Module - Stage 1 - High Control
11	OG	3024	I/P Module - Stage 1 - Low Control
12	YE/BK	2138	Side Impact Module - LF - Low Control
13	BN	2137	Side Impact Module - LF - High Control
14	TN/WH	2135	Side Impact Module - RF - High Control
15	L-GN	2136	Side Impact Module - RF - Low Control
16	OG/BK	2119	Seat Belt Pretensioner - Left - Low Control
17	TN/WH	2118	Seat Belt Pretensioner - Left - High Control
18	L-GN	2116	Seat Belt Pretensioner - Right - High Control

19	OG	2117	Seat Belt Pretensioner - Right - Low Control
20-27	-	-	Not Used
28	PK	5057	Seat Position Sensor - Low Reference
29	L-GN	5055	Seat Position Sensor- Left - Signal
30	L-BU	5056	Seat Position Sensor- Right - Signal
31	RD/WH	1340	Battery Positive Voltage
32	PK	1139	Ignition 1 Voltage
33-35	-	-	Not Used
36	YE	354	Discriminating Sensor - Signal
37	D-GN	1409	Discriminating Sensor - Right - Signal
38	TN/OG	5045	Discriminating Sensor - Low Reference
39	GY	5600	Discriminating Sensor - Right - Low Reference
40	WH	2132	Side Impact Sensing Module - Left - Signal
41	D-GN	2134	Side Impact Sensing Module - Right - Signal
42	YE	2131	Side Impact Sensing Module - Left - Voltage
43	TN	2133	Side Impact Sensing Module - Right - Voltage
44-58	-	-	Not Used
59	D-GN	5016	Seat Belt Switch - Left - Signal
60	OG	1362	Seat Belt Switch - Right - Signal

Inflatable Restraint Sensing and Diagnostic Module (w/o AY1)

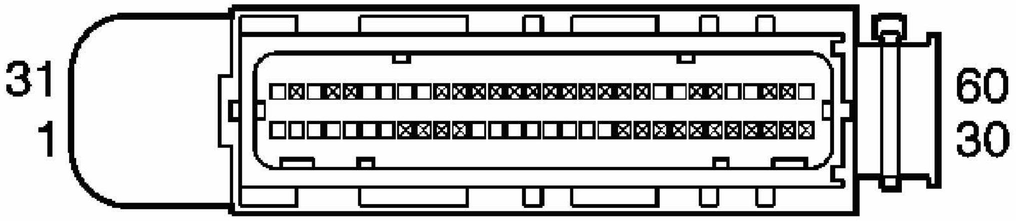


Fig. 30: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 15492274
- Service: See Catalog
- Description: 60-Way F Receptacle 0.64 Series Sealed (YE)

Terminal Part Information

- Terminal/Tray: Service with Terminated Lead
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: 15315247/J-35616-64A (L-BU)

Inflatable Restraint Sensing and Diagnostic Module (w/o AY1)

Pin	Wire Color	Circuit No.	Function
1	BK/WH	1751	Ground
2	D-GN	5060	Low Speed GMLAN Serial Data
3	D-GN	5060	Low Speed GMLAN Serial Data
4	PK	3022	Steering Wheel Module - Stage2 - Low Control
5	WH	3023	Steering Wheel Module - Stage2 - High Control
6	GY	3027	I/P Module - Stage 2 - High Control
7	PU	3026	I/P Module - Stage 2 - Low Control
8	BN	3020	Steering Wheel Module - Stage1 - Low Control
9	TN	3021	Steering Wheel Module - Stage1 - High Control
10	YE	3025	I/P Module - Stage 1 - High Control
11	OG	3024	I/P Module - Stage 1 - Low Control
12-15	-	-	Not Used
16	OG/BK	2119	Seat Belt Pretensioner - Left - Low Control
17	TN/WH	2118	Seat Belt Pretensioner - Left - High Control
18	L-GN	2116	Seat Belt Pretensioner - Right - High Control
19	OG	2117	Seat Belt Pretensioner - Right - Low

			Control
20-27	-	-	Not Used
28	PK	5057	Seat Position Sensor - Low Reference
29	L-GN	5055	Seat Position Sensor- Left - Signal
30	L-BU	5056	Seat Position Sensor- Right - Signal
31	RD/WH	1340	Battery Positive Voltage
32	PK	1139	Ignition 1 Voltage
33-35	-	-	Not Used
36	YE	354	Discriminating Sensor - Signal
37	D-GN	1409	Discriminating Sensor - Right - Signal
38	TN/OG	5045	Discriminating Sensor - Low Reference
39	GY	5600	Discriminating Sensor - Right - Low Reference
40-58	-	-	Not Used
59	D-GN	5016	Seat Belt Switch - Left - Signal
60	OG	1362	Seat Belt Switch - Right - Signal

Inflatable Restraint Side Impact Module - Left (AJ7)

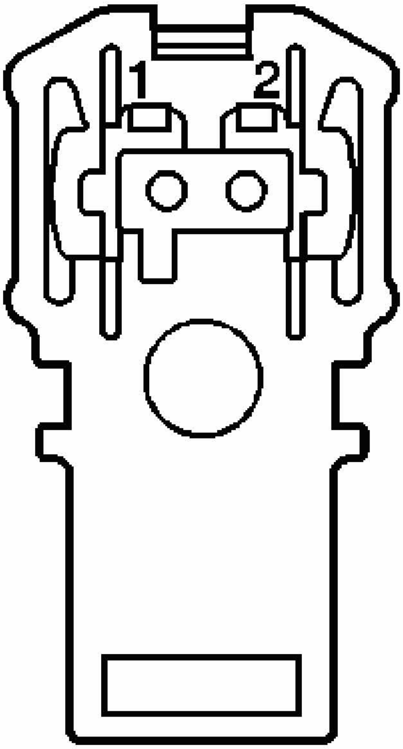


Fig. 31: Inflatable Restraint Side Impact Module Connector End View - Left (AJ7)
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: CA-252-92-5 Q
- Service: See Catalog
- Description: 2-Way F (YE)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: N/A

Inflatable Restraint Side Impact Module - Left (AJ7)

Pin	Wire Color	Circuit No.	Function

1	WH	5223	Side Impact Module - Left - High Control
2	D-GN	5224	Side Impact Module - Left - Low Control

Inflatable Restraint Side Impact Module - Right (AJ7)

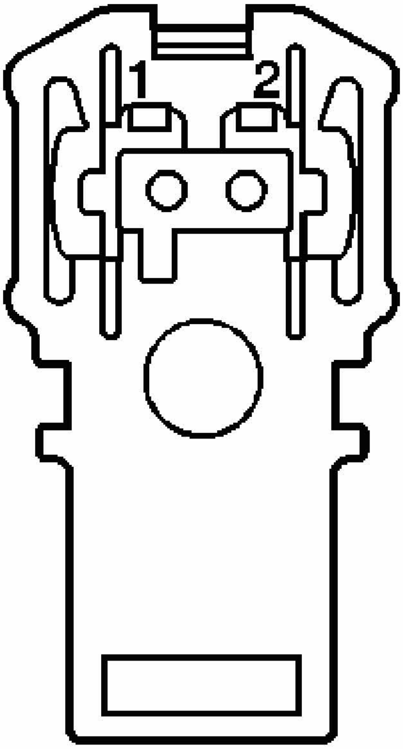


Fig. 32: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: CA-252-92-5 Q
- Service: See Catalog
- Description: 2-Way F (YE)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: N/A

Inflatable Restraint Side Impact Module - Right (AJ7)

Pin	Wire Color	Circuit No.	Function
1	WH	5225	Side Impact Module - Right - High Control
2	D-GN	5226	Side Impact Module - Right - Low Control

Inflatable Restraint Side Impact Sensor (SIS) - Left (AY1)

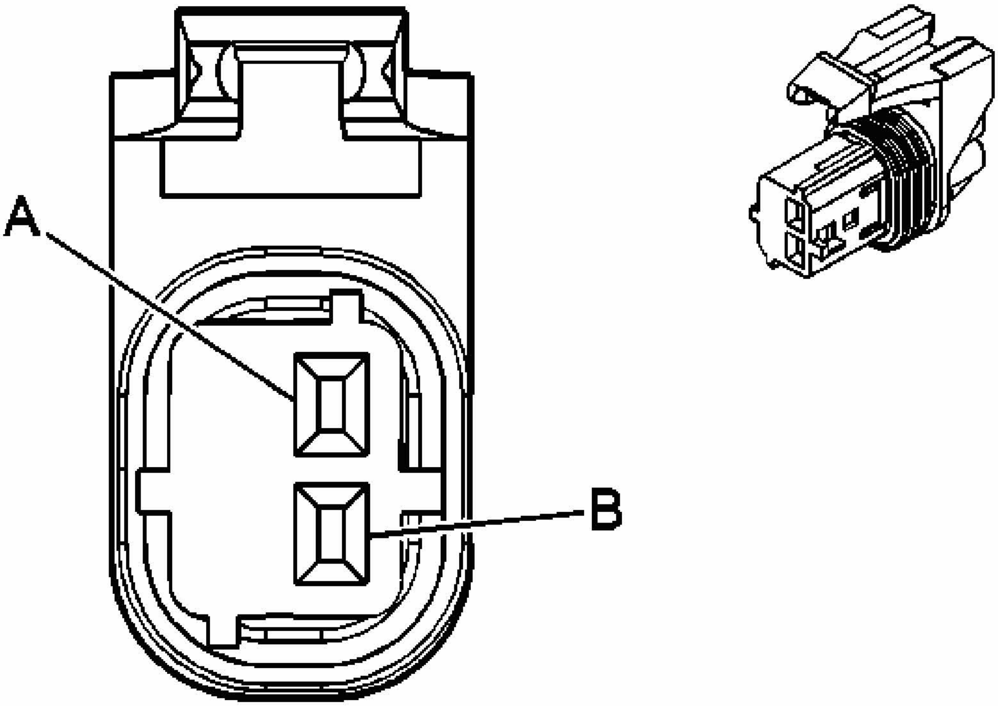


Fig. 33: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 15356723
- Service: 15306439
- Description: 2-Way F GT 150 Sealed (YE)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Inflatable Restraint Side Impact Sensor (SIS) - Left (AY1)

Pin	Wire Color	Circuit No.	Function
A	WH	2132	Side Impact Sensing Module - Left - Signal
B	YE	2131	Side Impact Sensing Module - Left - Voltage

Inflatable Restraint Side Impact Sensor (SIS) - Right

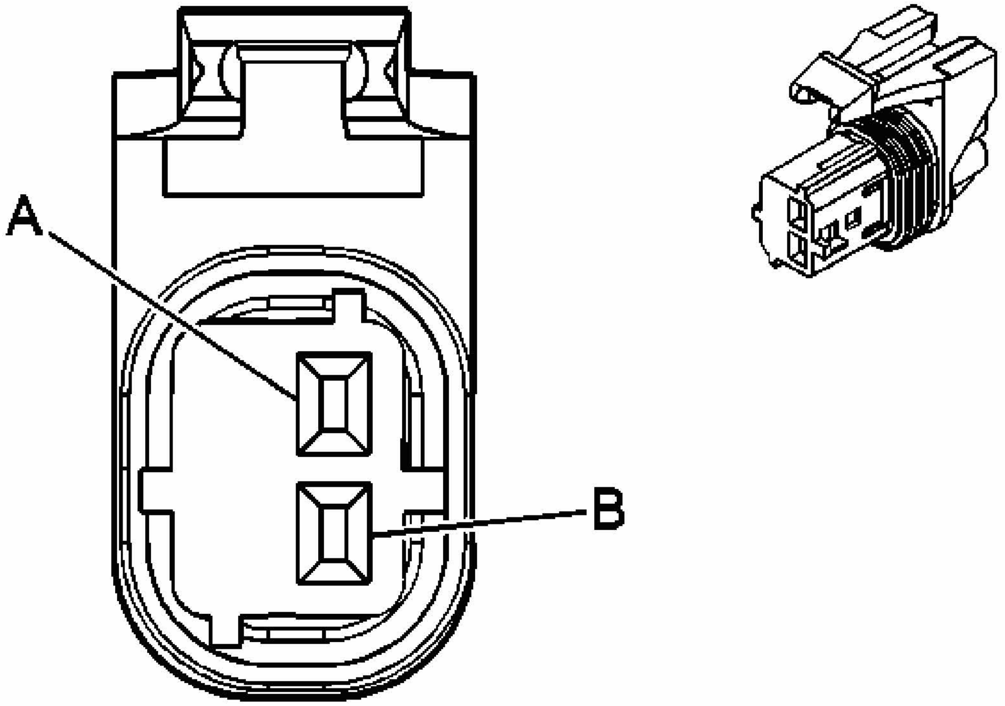


Fig. 34: Connector End Views

Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 15356723
- Service: 15306439
- Description: 2-Way F GT 150 Sealed (YE)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Inflatable Restraint Side Impact Sensor (SIS) - Right

Pin	Wire Color	Circuit No.	Function
A	D-GN	2134	Side Impact Sensing Module - Right - Signal
B	TN	2133	Side Impact Sensing Module - Right - Voltage

Inflatable Restraint Side Impact Sensor (SIS) - Right (AY1)

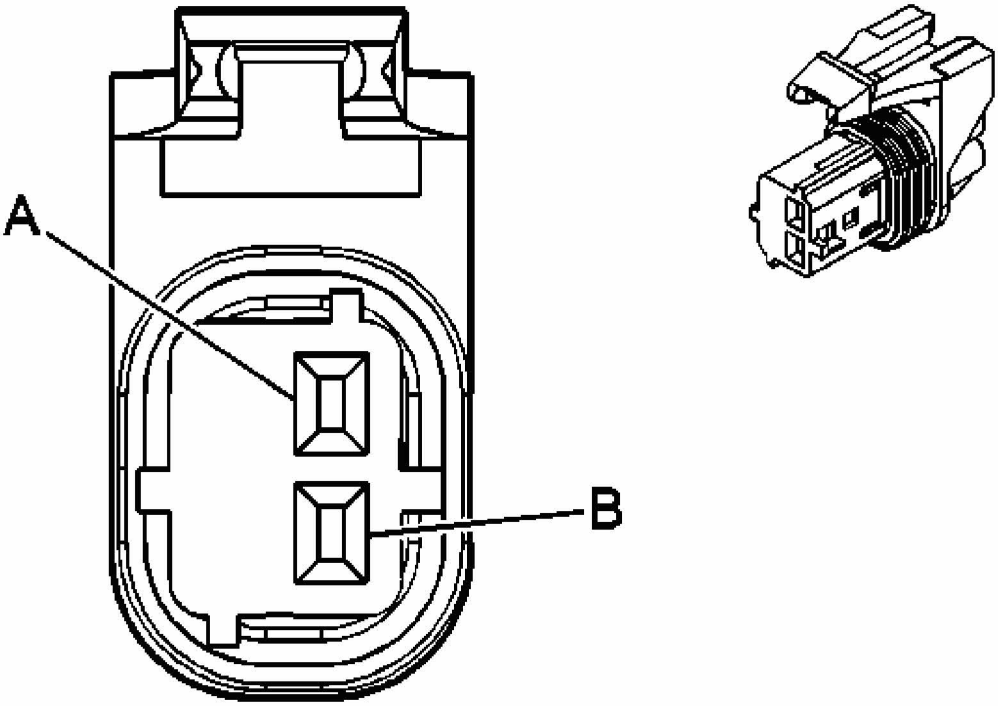


Fig. 35: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 15356723
- Service: 15306439
- Description: 2-Way F GT 150 Sealed (YE)

Terminal Part Information

- Terminal/Tray: 12191819/8
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Inflatable Restraint Side Impact Sensor (SIS) - Right (AY1)

Pin	Wire Color	Circuit No.	Function
A	D-GN	2134	Side Impact Sensing Module - Right - Signal

B	TN	2133	Side Impact Sensing Module - Right - Voltage

Inflatable Restraint Steering Wheel Module, C1

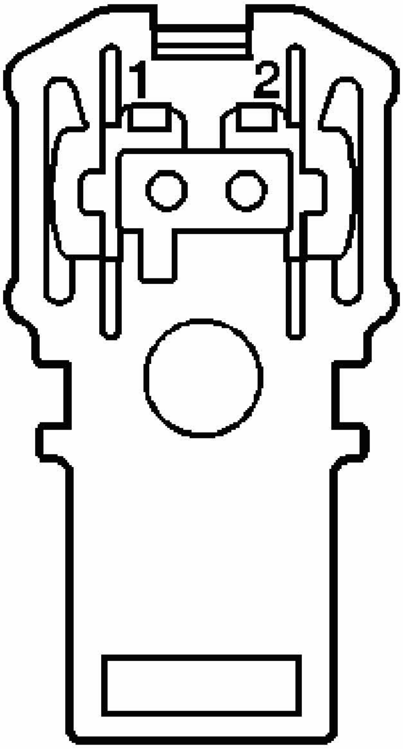


Fig. 36: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: CA54561236
- Service: See Catalog
- Description: 2-Way F AMP (WH w/YE Lock)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A

- Release Tool/Test Probe: N/A

Inflatable Restraint Steering Wheel Module, C1

Pin	Wire Color	Circuit No.	Function
1	TN	3021	Steering Wheel Module - Stage 1 - High Control
2	BN	3020	Steering Wheel Module - Stage 1 - Low Control

Inflatable Restraint Steering Wheel Module, C2

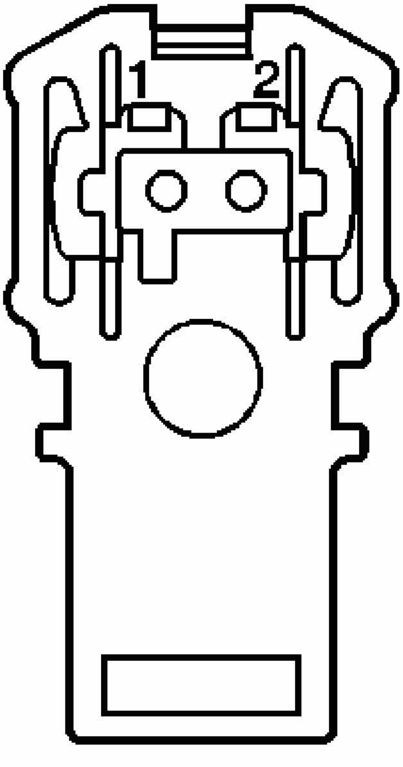


Fig. 37: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: CA54560222

- Service: See Catalog
- Description: 2-Way F AMP (WH w/YE Lock)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: N/A

Inflatable Restraint Steering Wheel Module, C2

Pin	Wire Color	Circuit No.	Function
1	WH	3023	Steering Wheel Module - Stage 2 - High Control
2	PK	3022	Steering Wheel Module - Stage 2 - Low Control

Roof Rail Module - Left (AY1)

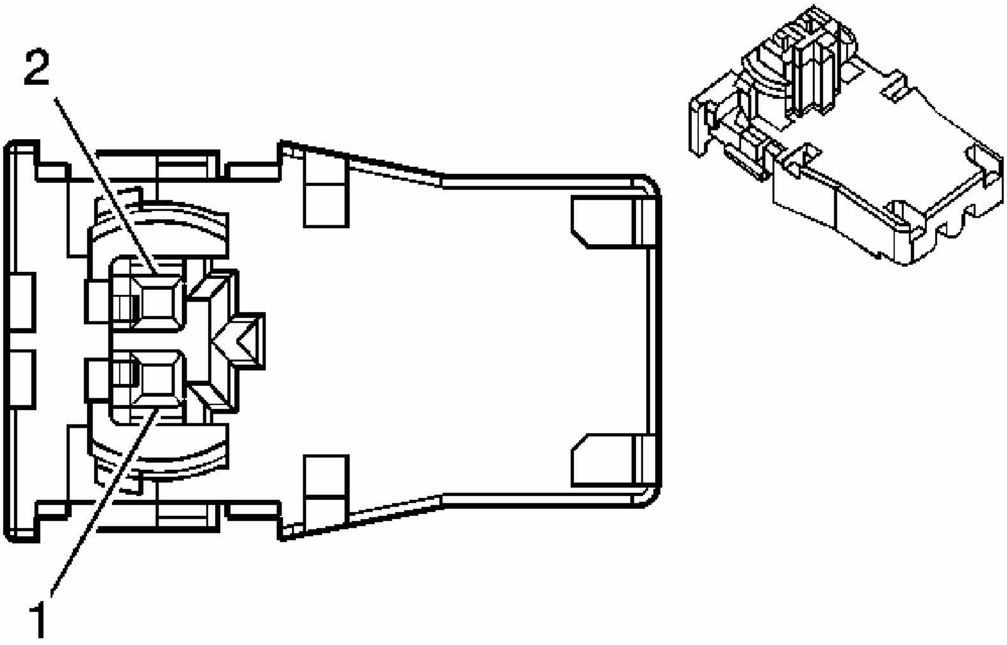


Fig. 38: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 15454450
- Service: See Catalog
- Description: 2-Way F 90 Degree Lockable Squib (YE)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: N/A

Roof Rail Module - Left (AY1)

Pin	Wire Color	Circuit No.	Function
1	PK/BK	2137	Side Impact Module - Left - High Control
2	YE/BK	2138	Side Impact Module - Left - Low Control

Roof Rail Module - Right (AY1)

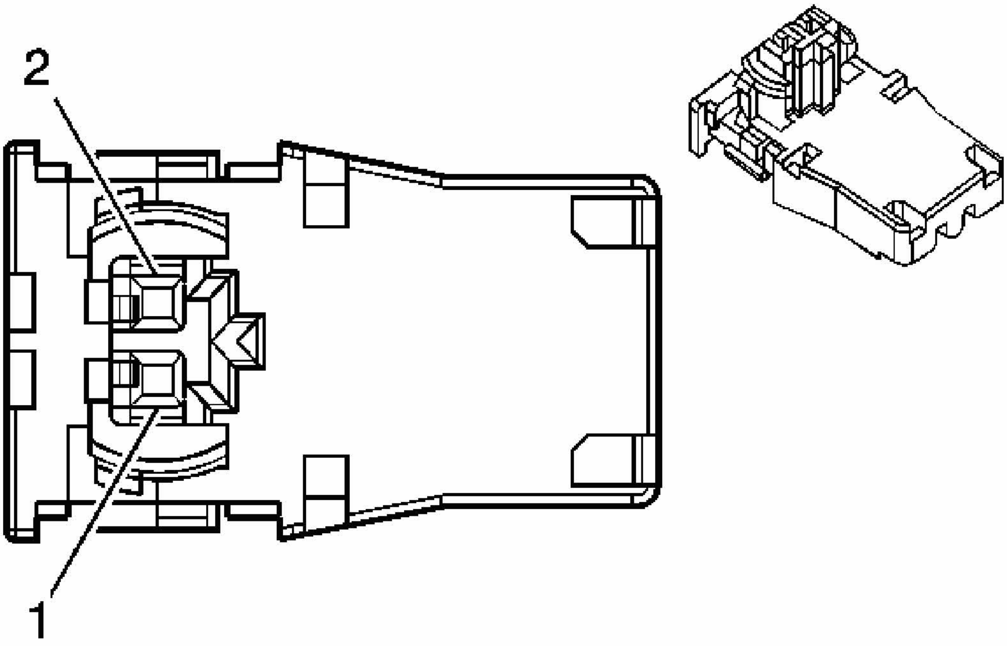


Fig. 39: Connector End Views

Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 15454451
- Service: See Catalog
- Description: 2-Way F 90 Degree Lockable Squib (YE)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: N/A

Roof Rail Module - Right (AY1)

Pin	Wire Color	Circuit No.	Function
1	PK/BK	2135	Side Impact Module - RF - High Control
2	L-BU/RD	2136	Side Impact Module - RF - Low Control

Seat Belt Pretensioner - Left

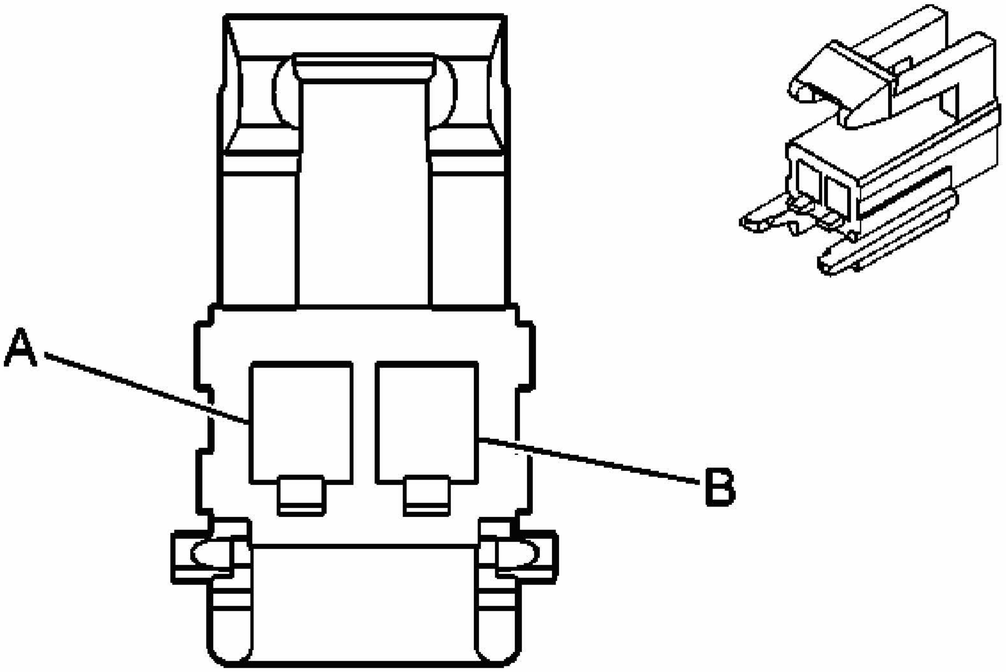


Fig. 40: Connector End View
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 12110505
- Service: 15306044
- Description: 2-Way F Metri-Pack 150 (YE)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Seat Belt Pretensioner - Left

Pin	Wire Color	Circuit No.	Function
A	TN/WH	2118	Seat Belt Pretensioner - Left - High Control
			Seat Belt Pretensioner - Left - Low

B	OG/BK	2119	Control

Seat Belt Pretensioner - Right

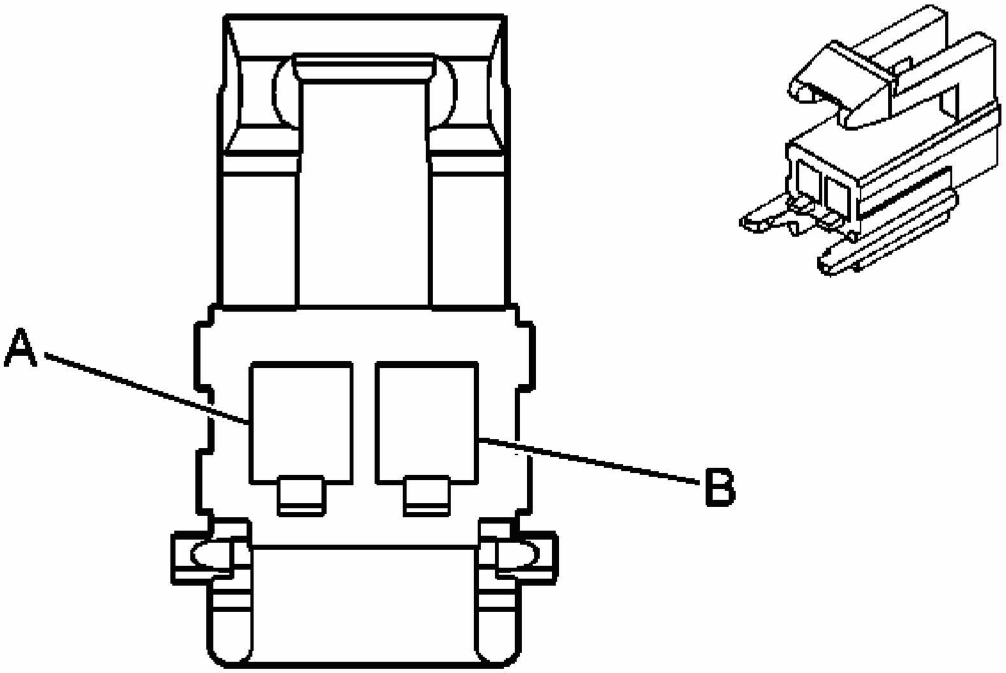


Fig. 41: Connector End View
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 12110505
- Service: 15306044
- Description: 2-Way F Metri-Pack 150 (YE)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Seat Belt Pretensioner - Right

Pin	Wire Color	Circuit No.	Function
A	L-GN	2116	Seat Belt Pretensioner - Right - High Control
B	OG	2117	Seat Belt Pretensioner - Right - Low Control

Seat Belt Tension Sensor - Passenger

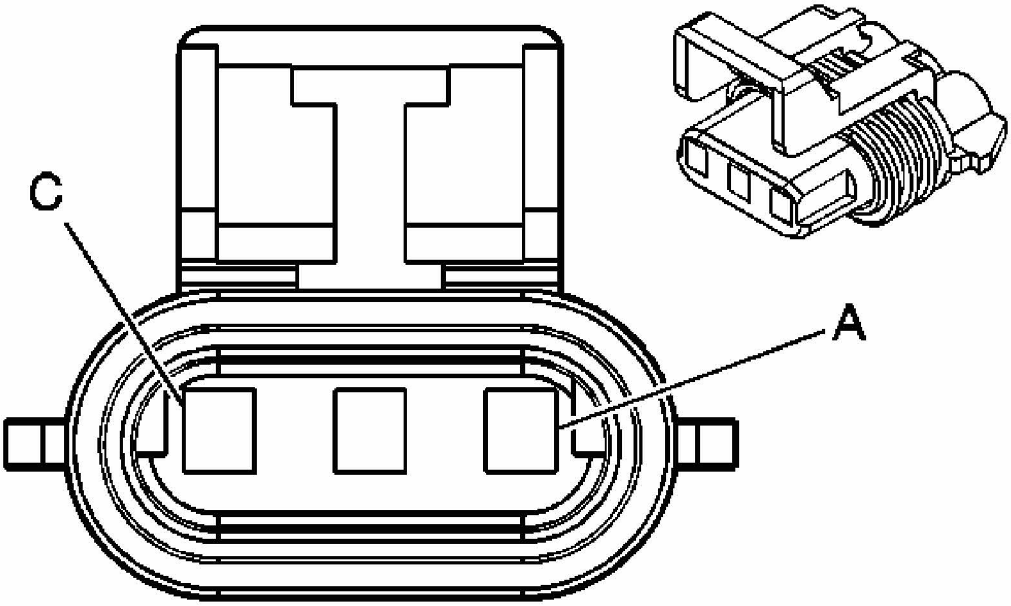


Fig. 42: Connector End Views
Courtesy of GENERAL MOTORS CORP.

SIR Connector End Views

Connector Part Information

- OEM: 12110293
- Service: 12117025
- Description: 3-Way F Metri-Pack 150 Sealed (BK)

Terminal Part Information

- Terminal/Tray: Service with Pigtail
- Core/Insulation Crimp: N/A
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Seat Belt Tension Sensor - Passenger

Pin	Wire Color	Circuit No.	Function
A	L-BU	5612	Passenger Seat Belt Tension Sensor Reference Voltage
B	TN	5613	Low Reference
C	PU	5611	Passenger Seat Belt Tension Sensor Signal

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B0012 or B0013	Refer to **DTC B0012 or B0013**
DTC B0014	Refer to **DTC B0014**
DTC B0015	Refer to **DTC B0015**
DTC B0016	Refer to **DTC B0016**
DTC B0019 or B0020	Refer to **DTC B0019 or B0020**
DTC B0021	Refer to **DTC B0021**
DTC B0022	Refer to **DTC B0022**
DTC B0023	Refer to **DTC B0023**
DTC B0052 or B0053	Refer to **DTC B0052 or B0053**
DTC B0055	Refer to **DTC B0055**
DTC B0056	Refer to **DTC B0056**
DTC B0057	Refer to **DTC B0057**
DTC B0071	Refer to **DTC B0071**
DTC B0074	Refer to **DTC B0074**
DTC B0081	Refer to **DTC B0081**
DTC B0083 or B0084	Refer to **DTC B0083 or B0084**
DTC B0085 or B0086	Refer to **DTC B0085 or B0086**
DTC B1001	Refer to **DTC B0081**
DTC B1019	Refer to **DTC B1019**
DTC B1370	Refer to **DTC B1019**

DIAGNOSTIC STARTING POINT - SIR

Begin the system diagnosis with the **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check will provide the following information:

- The identification of the control module which commands the system

- The ability of the control module to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of **Diagnostic System Check - Vehicle** in Vehicle DTC Information, will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL DATA LIST

The SIR scan tool data list contains all the restraint system related parameters that are available on the scan tool. The parameters in the list are arranged in alphabetical order. The column, Data List, indicates the location of the parameter within the scan tool menu selections.

Use the SIR scan tool data list as directed by a diagnostic table or in order to supplement the diagnostic procedures. Begin all of the diagnostic procedures with the **Diagnostic System Check - Vehicle** . Use the SIR Scan Tool Data List after the following is determined:

- A diagnostic directs the use of the Data List.
- There is no published diagnostic trouble code (DTC) procedure nor published symptom procedure for the customer concern.
- The DTC or symptom diagnostic procedure indicated by the diagnostic system check does not resolve the customer concern.

The typical data values are obtained from a properly operating vehicle under the conditions specified in the second row of the scan tool data list table. Comparison of the parameter values from the suspect vehicle with the typical data values may reveal the source of the customer concern.

SIR Scan Tool Data List

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON/Engine OFF/No DTCs Set/Driver Seat Belt Buckled/Passenger Seat Belt Unbuckled			
Battery Voltage Signal	Data	Volts	12 Volts
Driver Seat Belt Switch	Sensor Data	Buckled/Unbuckled	Buckled
Passenger Seat Belt Switch	Sensor Data	Buckled/Unbuckled	Unbuckled
PPS Type	Sensor Information	Not Present/Manual/Auto/Auto+Manual	Auto
Primary Key Status	Key Identification	Invalid/Valid/Unknown	Valid

Received Primary Key	Key Identification	4-digit number	Varies
Received VIN Digits 2-5	Key Identification	4-digit number	Varies
Received VIN Digits 6-7	Key Identification	2-digit number	Varies
Run/Crank	Data	Active/Inactive	Varies
SDM Primary Key	Key Identification	4-digit number	Varies
Secondary Key Status	Key Identification	Invalid/Valid/Unknown	Valid
SIR Warning Indicator	Data	OFF/ON	OFF

Passenger Presence System Scan Tool Data List

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON/Engine OFF/Driver Seat Belt Buckled/Passenger Seat Belt Unbuckled			
Battery Voltage Signal	Data	Volts	Varies
Power Mode	Data	Off/Accessory/Run/Crank Request	Inactive
PPS Fault Status	Data	No Fault/ Plant Mode/Fault/Mismatch	No Fault
SDM Enable Status	Data	Enabled/Disabled	Enabled
PPS Enable Status	Data	Enabled/Disabled	Disabled
Passenger Classification	Data	Unknown/Calibrating/Empty Seat/Small/Large/Re-Zero	Empty Seat
Passenger Status	Data	-	Varies
Pressure Sensor	Data	Volts	Varies
Seat Belt Tension Sensor	Data	Volts	Varies
Primary Key Status	Key Identification	Invalid/Valid/Unknown	Valid
PPS Primary Key	Key Identification	4-digit number	Varies
Received Primary Key	Key Identification	4-digit number	Varies

SCAN TOOL DATA DEFINITIONS

The SIR scan tool data definitions contain a brief description of all SIR related parameters available on the scan tool. The parameters that are available on the scan tool are listed below in alphabetical order.

Battery Voltage

The scan tool displays 0-20 volts. This is the system voltage measured by the SDM between the battery input and ground.

Driver Seat Belt Switch

The scan tool displays whether the driver seat belt is buckled or unbuckled.

Passenger Seat Belt Switch

The scan tool displays whether the passenger seat belt is buckled or unbuckled.

PPS Type

The scan tool displays if there is a passenger airbag suppression device used on this vehicle and if so, whether it is has an automatic, manual key switch or both.

Primary Key Status

The scan tool displays if there is a passenger airbag suppression device used on this vehicle and if so, whether it is has an automatic, manual key switch or both.

Received Primary Key

The scan tool displays what the BCM is sending out as the primary key. The SDM then compares it to what it has stored. This should match the SDM Primary Key.

Received VIN Digits 2-5

The scan tool displays the Secondary Key which includes digits 2 though 5 of the VIN that the BCM sends to the SDM.

Received VIN Digits 6-7

The scan tool displays the Secondary Key which includes digits 6 and 7 of the VIN that the BCM sends to the SDM.

Run/Crank

The scan tool displays what the current power mode of the SDM.

SDM Primary Key

The scan tool displays primary key that the SDM has stored to memory.

Secondary Key Status

The scan tool displays whether the Secondary Key is valid or invalid. This determines if the VIN stored in SDM memory matches what is stored in the BCM.

SIR Warning Indicator

The scan tool displays whether the SIR warning indicator has been requested ON or OFF.

Passenger Presence System

Battery Voltage Signal

The scan tool displays 0-20 volts. This is the system voltage measured by the PPS module between the battery input and ground.

Power Mode

The scan tool displays the current power mode.

PPS Fault Status

The scan tool displays the current condition of the PPS system to determine if the SDM or PPS is causing the PPS Disabled condition.

SDM Enable Status

The scan tool displays the current status of the PPS system within the SDM. When disabled, SDM will default to deactivate the deployment loops related to the passenger airbags. PPS Fault Status and SDM Fault status should match.

PPS Enable Status

The scan tool displays the current status of the PPS system. This information is sent to the SDM for deactivation of the deployment loops related to the passenger airbags. PPS Enable Status and SDM Enable status should match.

Passenger Classification

The scan tool displays the calculated seat occupant status or need to re-zero.

Passenger Status

The scan tool displays the calculated seat occupant status including relationship to seat position.

Pressure Sensor

The scan tool displays the voltage determined by the weight/position of the seat occupant.

Seat Belt Tension Sensor

The scan tool displays voltage which is used to determine whether a child infant seat is mounted in the passenger seat or not.

Primary Key Status

The scan tool displays the status of the primary key based on the comparison between the SDM and the PPS. If the Status is other than Valid the PPS will not allow activation and should set a DTC.

PPS Primary Key

The scan tool displays primary key that the PPS has stored to memory.

Received Primary Key

The scan tool displays what the PPS received from the BCM as the primary key. The PPS then compares it to what it has stored to determine the Primary Key Status. The PPS Primary Key and Received Primary Key should match.

DTC B0012 OR B0013

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptor

DTC B0012 01

Driver Frontal Deployment Loop Stage 1 Short to Battery

DTC B0012 02

Driver Frontal Deployment Loop Stage 1 Short to Ground

DTC B0012 04

Driver Frontal Deployment Loop Stage 1 Open Circuit

DTC B0012 0D

Driver Frontal Deployment Loop Stage 1 Resistance Above Threshold

DTC B0012 0E

Driver Frontal Deployment Loop Stage 1 Resistance Below Threshold

DTC B0013 01

Driver Frontal Deployment Loop Stage 2 Short to Battery

DTC B0013 02

Driver Frontal Deployment Loop Stage 2 Short to Ground

DTC B0013 04

Driver Frontal Deployment Loop Stage 2 Open Circuit

DTC B0013 0D

Driver Frontal Deployment Loop Stage 2 Resistance Above Threshold

DTC B0013 0E

Driver Frontal Deployment Loop Stage 2 Resistance Below Threshold

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC B0012 or B0013

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance

Steering Wheel Module Stage 1 High Circuit	B0012 02	B0012 0D	B0012 04	B0012 01	B0012 0E
Steering Wheel Module Stage 1 Low Circuit	B0012 02	B0012 0D	B0012 04	B0012 01	B0012 0E
Steering Wheel Module Stage 2 High Circuit	B0013 02	B0013 0D	B0013 04	B0013 01	B0013 0E
Steering Wheel Module Stage 2 Low Circuit	B0013 02	B0013 0D	B0013 04	B0013 01	B0013 0E

Circuit/System Description

If a malfunction is detected, a DTC will be stored in non-volatile memory. During a frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy the steering wheel module. The SDM performs continuous diagnostic tests on the deployment loops to check for proper circuit continuity and for shorts to ground or voltage.

There are 2 shorting bars used within each connector which will short together both steering wheel module stage 1 high circuit and steering wheel module stage 1 low circuit and both steering wheel module stage 2 high circuit and steering wheel module stage 2 low circuit when the connector is disconnected. This will help to prevent unwanted deployment of the inflator module during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

B0012 01 Stage 1 or B0013 01 Stage 2

The steering wheel module high and/or low circuit is short to voltage for 120 milliseconds.

B0012 02 Stage 1 or B0013 02 Stage 2

The steering wheel module high and/or low circuit is short to ground for 120 milliseconds.

B0012 04 Stage 1 or B0013 04 Stage 2

The steering wheel module high and/or low circuit is open for 120 milliseconds.

B0012 0D Stage 1 or B0013 0D Stage 2

The steering wheel module deployment loop resistance is more than 5.1 ohms for 120 milliseconds.

B0012 0E Stage 1 or B0013 0E Stage 2

The steering wheel module deployment loop resistance is less than 1.3 ohms for 120 milliseconds.

Action Taken When the DTC Sets

- The SDM commands the AIR BAG indicator ON via serial data communications.
- The SDM will store a DTC, if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Special Tools Required

- **J 38715-A** SIR Driver/Passenger Load tool. See **Special Tools**.

Diagnostic Aids

This DTC usually indicates a poor connection or a wiring malfunction between the SDM and the deployment loop.

Circuit/System Testing

IMPORTANT: When removing connectors inspect for damage, corrosion or poor connection. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **The pretensioner**
- **The air bag module**
- **The SDM module**
- **The air bag wiring harness connector**
- **The SDM wiring harness connector**

1. Verify that the steering wheel module connector and the connector position assurance (CPA) are engaged.

   IMPORTANT: The connector and CPA may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.

   - If the above condition is found, make the appropriate repair.
2. Ignition OFF, disconnect the steering wheel module.
3. With the applicable adaptor, connect special tool **J 38715-A** . See **Special Tools**.
4. Ignition ON, with a scan tool, verify DTC is set as current.
   - If DTC is not set or is set as history, replace the steering wheel module.
5. Ignition OFF, disconnect special tool **J 38715-A** . See **Special Tools**.
6. Disconnect the steering wheel module coil in-line connector.
7. With the applicable adaptor, connect special tool **J 38715-A** . See **Special Tools**.
8. Ignition ON, with a scan tool, verify DTC is set as current.
   - If DTC is not set or is set as history, replace the steering wheel module coil.
9. Ignition OFF, disconnect special tool **J 38715-A** and the applicable adaptor. See **Special Tools**.
10. Disconnect the harness connector at the SDM.
11. Ignition ON, test for less than 1 volt between the applicable HI circuit and ground.
    - If not the specified range, test the circuit for a short to voltage.
12. Test for less than 1 volt between the applicable LOW circuit and ground.
    - If not the specified range, test the circuit for a short to voltage.
13. Ignition OFF, test for infinite resistance between the applicable HI circuit and ground.
    - If not the specified range, test the circuit for a short to ground.
14. Test for infinite resistance between the applicable LOW circuit and ground.
    - If not the specified range, test the circuit for a short to ground.
15. Test for less then 1 ohm of resistance between the SDM connector and the air bag module connector HI circuit

  - If not the specified range, test the circuit for an open/high resistance.

16. Test for less then 1 ohm of resistance between the SDM connector and the air bag module connector LOW circuit.
    - If not the specified range, test the circuit for an open/high resistance.
17. If all circuits test normal, replace the SDM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Inflatable Restraint Steering Wheel Module Coil Replacement (Coil)**
- **Inflatable Restraint Steering Wheel Module Replacement**
- **Control Module References** for SDM replacement, setup, and programming

DTC B0014

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0014 01

Left Front Side Deployment Loop Short to Battery

DTC B0014 02

Left Front Side Deployment Loop Short to Ground

DTC B0014 04

Left Front Side Deployment Loop Open Circuit

DTC B0014 0D

Left Front Side Deployment Loop Resistance Above Threshold

DTC B0014 0E

Left Front Side Deployment Loop Resistance Below Threshold

Diagnostic Fault Information

DTC B0014

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Side Impact Module - LF High Circuit	B0014 02	B0014 0D	B0014 04	B0014 01	B0014 0E
Side Impact Module - LF Low Circuit	B0014 02	B0014 0D	B0014 04	B0014 01	B0014 0E

Circuit/System Description

During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy the side impact module - LF. The SDM performs continuous diagnostic tests on the deployment loops to check for proper circuit continuity and for shorts to ground or voltage.

A shorting bar used within the side impact module - LF connector which will short together both side impact module - LF high and low circuits when the connector is disconnected, this will help to prevent unwanted deployment of the inflator module during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

B0014 01

The side impact module - LF high and/or low circuit is short to voltage for 120 milliseconds.

B0014 02

The side impact module - LF high and/or low circuit is short to ground for 120 milliseconds.

B0014 04

The side impact module - LF high and/or low circuit is open for 120 milliseconds.

B0014 0D

The side impact module - LF deployment loop resistance is more than 3.9 ohms for 120 milliseconds.

B0014 0E

The side impact module - LF deployment loop resistance is less than 1.1 ohms for 120 milliseconds.

Action Taken When the DTC Sets

- The SDM commands the AIR BAG indicator ON via serial data communications.
- The SIR system is disabled and no deployments are allowed.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- A history DTC will clear once 255 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Special Tools Required

- **J 38715-A** SIR Driver and Passenger SIR Load Tool. See **Special Tools**.
- **J 38715-30A** SIR Load Tool Adapter

Circuit/System Testing

IMPORTANT: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **The side impact module - LF**
- **The side impact module wiring harness**

- **The SDM module**
- **The side impact module - LF wiring harness connector**
- **The side impact module wiring harness connector**
- **The SDM wiring harness connector**

1. Ignition OFF, disconnect the side impact module - LF wiring harness connector located under the driver front seat.
2. Connect the **J 38715-A** to the harness side of the side impact module - LF wiring harness connector. See **Special Tools**. Use the PASSENGER INFLATOR connector located on the load tool.
3. Ignition ON, use a scan tool to observe the SIR DTC display. Verify DTC B0014 is set history.
   - If DTC B0014 is current turn OFF the ignition and remove the SDM connector. Refer to **Control Module References** .
   - Test and repair both side impact module - LF high and low circuits for a short to voltage, short to ground, or open/low resistance. If all circuits test normal then replace the SDM.
4. Ignition OFF, disconnect and remove the **J 38715-A** . See **Special Tools**. Then connect the side impact module - LF wiring harness connector. Remove the side impact module - LF connector. Use J 38715-30A to connect the **J 38715-A** to the harness side of the side impact module - LF connector. See **Special Tools**. Use the PASSENGER INFLATOR connector located on the load tool.
5. Ignition ON, use a scan tool to observe the SIR DTC display. Verify DTC B0014 is set history.
   - If DTC B0014 is current the replace the side impact module - LF wiring harness.
6. If DTC B0014 is history replace the side impact module - LF.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Inflatable Restraint Side Impact Module Replacement - Front (Monte Carlo)**
- **Inflatable Restraint Side Impact Module Wiring Harness Replacement**
- **Control Module References** for SDM replacement, setup, and programming

DTC B0015

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptor

DTC B0015 01

Left Front Seat Belt Pretensioner Deployment Loop Short to Battery

DTC B0015 02

Left Front Seat Belt Pretensioner Deployment Loop Short to Ground

DTC B0015 04

Left Front Seat Belt Pretensioner Deployment Loop Open Circuit

DTC B0015 0D

Left Front Seat Belt Pretensioner Deployment Loop Resistance Above Threshold

DTC B0015 0E

Left Front Seat Belt Pretensioner Deployment Loop Resistance Below Threshold

Diagnostic Fault Information

DTC B0015

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Seat Belt Pretensioner - LF High Circuit	B0015 02	B0015 0D	B0015 04	B0015 01	B0015 0E
Seat Belt Pretensioner - LF Low Circuit	B0015 02	B0015 0D	B0015 04	B0015 01	B0015 0E

Circuit/System Description

During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy the seat belt pretensioner - LF. The SDM performs continuous diagnostic tests on the deployment loops to check for proper circuit continuity and for shorts to ground or voltage. A shorting bar used within the seat belt pretensioner - LF connector which will short together both seat belt pretensioner - LF high and low circuits when the connector is disconnected, this will help to prevent unwanted deployment of the inflator module during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

B0015 01

The seat belt pretensioner - LF high and/or low circuit is short to voltage for 120 milliseconds.

B0015 02

The seat belt pretensioner - LF high and/or low circuit is short to ground for 120 milliseconds.

B0015 04

The seat belt pretensioner - LF high and/or low circuit is open for 120 milliseconds.

B0015 0D

The seat belt pretensioner - LF deployment loop resistance is more than 3.9 ohms for 120 milliseconds.

B0015 0E

The seat belt pretensioner - LF deployment loop resistance is less than 1.1 ohms for 120 milliseconds.

Action Taken When the DTC Sets

- The SDM commands the AIR BAG indicator ON via serial data communications.
- The SIR system is disabled and no deployments are allowed.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- A history DTC will clear once 255 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Special Tools Required

J 38715-A SIR Driver/Passenger Load Tool. See **Special Tools**.

Circuit/System Testing

IMPORTANT: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **The seat belt retractor pretensioner - LF**
- **The SDM module**
- **The seat belt retractor pretensioner - LF wiring harness connector**
- **The SDM wiring harness connector**

1. Ignition OFF, remove the lower center pillar trim and disconnect the seat belt retractor pretensioner - LF connector. Refer to **Trim Panel Replacement - Lower Center Pillar** .
2. Connect the **J 38715-A** to the harness side of the seat belt retractor pretensioner - LF wiring harness connector. See **Special Tools**. Use the PASSENGER INFLATOR connector located on the load tool.
3. Ignition ON, use a scan tool to observe the SIR DTC display. Verify DTC B0015 is set current.
    - If DTC B0015 is history replace the seat belt retractor pretensioner - LF.
4. Ignition OFF, disconnect and remove the **J 38715-A** . See **Special Tools**.
5. Disconnect the SDM harness connector.
6. Test the high and low circuits between the SDM and seat belt retractor pretensioner - LF for a short to voltage, short to ground, an open, or low resistance. Verify that a short to voltage, short to ground, or open/low resistance does not exist.

- If any of the above conditions are found make the appropriate repair.

7. If all circuits test normal then replace the SDM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Seat Belt Retractor Pretensioner Replacement - Front**
- **Control Module References** for SDM replacement, setup, and programming

DTC B0016

DTC Descriptor

DTC B0016 01

Left Roof Rail Deployment Loop Short to Battery

DTC B0016 02

Left Roof Rail Deployment Loop Short to Ground

DTC B0016 04

Left Roof Rail Deployment Loop Open Circuit

DTC B0016 0D

Left Roof Rail Deployment Loop Resistance Above Threshold

DTC B0016 0E

Left Roof Rail Deployment Loop Resistance Below Threshold

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC B0016

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Roof Rail Module - Left High Circuit	B0016 02	B0016 0D	B0016 04	B0016 01	B0016 0E

Roof Rail Module - Left Low Circuit	B0016 02	B0016 0D	B0016 04	B0016 01	B0016 0E

Circuit/System Description

During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy the roof side rail module. The SDM performs continuous diagnostic tests on the deployment loops to check for proper circuit continuity and for shorts to ground or voltage.

A shorting bar used within the roof rail module connector which will short together both roof rail module - left high and low circuits when the connector is disconnected, this will help to prevent unwanted deployment of the inflator module during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

B0016 01

The roof rail module - left high and/or low circuit is short to voltage for 120 milliseconds.

B0016 02

The roof rail module - left high and/or low circuit is short to ground for 120 milliseconds.

B0016 04

The roof rail module - left high and/or low circuit is open for 120 milliseconds.

B0016 0D

The roof rail module - left deployment loop resistance is more than 3.9 ohms for 120 milliseconds.

B0016 0E

The roof rail module - left deployment loop resistance is less than 1.1 ohms for 120 milliseconds.

Action Taken When the DTC Sets

- The SDM commands the AIR BAG indicator ON via serial data communications.
- The SIR system is disabled and no deployments are allowed.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- A history DTC will clear once 255 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Special Tools Required

J 38715-A SIR Driver/Passenger Load Tool. See **Special Tools**.

Circuit/System Testing

IMPORTANT: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **The roof rail module - left**
- **The SDM module**
- **The roof rail module - left wiring harness connector**
- **The SDM wiring harness connector**

1. Ignition OFF, remove the left quarter upper trim and disconnect the roof rail module - left connector. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .
2. Connect the **J 38715-A** to the harness side of the roof rail module - left connector. See **Special Tools**. Use the PASSENGER INFLATOR connector located on the load tool.
3. Ignition ON, use a scan tool to observe the SIR DTC display. Verify DTC B0016 is set in current.
    - If DTC B0016 is history replace the roof rail module - left.

4. Ignition OFF, disconnect and remove the **J 38715-A** . See **Special Tools**. Then remove the SDM connector, refer to **Control Module References** for connector location.
    - If damage or corrosion is found make the appropriate repair.
5. Test the high and low circuits between the SDM and roof rail module - left for a short to voltage, short to ground, or open/low resistance. Verify that a short to voltage, short to ground, or open/low resistance does not exist.
    - If damage or corrosion is found make the appropriate repair.
6. If all circuits test normal then replace the SDM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Inflatable Restraint Roof Rail Module Replacement**
- **Control Module References** for SDM replacement, setup, and programming

DTC B0019 OR B0020

DTC Descriptor

DTC B0019 01

Passenger Frontal Deployment Loop Stage 1 Short to Battery

DTC B0019 02

Passenger Frontal Deployment Loop Stage 1 Short to Ground

DTC B0019 04

Passenger Frontal Deployment Loop Stage 1 Open Circuit

DTC B0019 0D

Passenger Frontal Deployment Loop Stage 1 Resistance Above Threshold

DTC B0019 0E

Passenger Frontal Deployment Loop Stage 1 Resistance Below Threshold

DTC B0020 01

Passenger Frontal Deployment Loop Stage 2 Short to Battery

DTC B0020 02

Passenger Frontal Deployment Loop Stage 2 Short to Ground

DTC B0020 04

Passenger Frontal Deployment Loop Stage 2 Open Circuit

DTC B0020 0D

Passenger Frontal Deployment Loop Stage 2 Resistance Above Threshold

DTC B0020 0E

Passenger Frontal Deployment Loop Stage 2 Resistance Below Threshold

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC B0019 or B0020

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
I/P Module Stage 1 High Circuit	B0019 02	B0019 0D	B0019 04	B0019 01	B0019 0E
I/P Module Stage 1 Low Circuit	B0019 02	B0019 0D	B0019 04	B0019 01	B0019 0E
I/P Module Stage 2 High Circuit	B0020 02	B0020 0D	B0020 04	B0020 01	B0020 0E
I/P Module Stage 2 Low Circuit	B0020 02	B0020 0D	B0020 04	B0020 01	B0020 0E

Circuit/System Description

If a malfunction is detected, a DTC will be stored in non-volatile memory. During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy the instrument panel (I/P) module. The SDM performs continuous diagnostic tests on the deployment loops to check for proper circuit continuity and for shorts to ground or voltage. There are 2 shorting bars used within the I/P module connector which will short together both I/P module stage 1 high and low circuits, and both I/P module stage 2 high and low circuits, when the connector is disconnected. This will help to prevent unwanted deployment of the inflator module during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

B0019 01 Stage 1 or B0020 01 Stage 2

The I/P module high and/or low circuit is short to voltage for 120 milliseconds.

B0019 02 Stage 1 or B0020 02 Stage 2

The I/P module high and/or low circuit is short to ground for 120 milliseconds.

B0019 04 Stage 1 or B0020 04 Stage 2

The I/P module high and/or low circuit is open for 120 milliseconds.

B0019 0D Stage 1 or B0020 0D Stage 2

The I/P module deployment loop resistance is more than 5.1 ohms for 120 milliseconds.

B0019 0E Stage 1 or B0020 0E Stage 2

The I/P module deployment loop resistance is less than 1.3 ohms for 120 milliseconds.

Action Taken When the DTC Sets

- The SDM commands the AIR BAG indicator ON via serial data communications.
- The SIR System is disabled and no deployments are allowed.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- A history DTC will clear once 255 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Special Tools Required

- **J 38715-A** SIR Driver/Passenger Load tool. See **Special Tools**.
- **J 38715-80** Driver/Passenger Load Tool Adapter

Circuit/System Testing

IMPORTANT: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **The I/P module**
- **The SDM module**
- **The I/P wiring harness connector**
- **The SDM wiring harness connector**

1. Ignition OFF, remove the right I/P outer trim cover and disconnect I/P module in-line connector. Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Right** .
2. Use J 38715-80 adapter to connect the **J 38715-A** to the harness side of the I/P module in-line wiring harness connector. See **Special Tools**. Use the PASSENGER INFLATOR and BASE of COLUMN connectors located on the load tool.
3. Ignition ON, use a scan tool to observe the SIR DTC display. Verify DTC B0019 or B0020 are set current.
   - If DTC B0019 or B0020 is history replace the I/P module.
4. Ignition OFF, disconnect and remove the **J 38715-A** and adapter. See **Special Tools**. Then remove the SDM connector, refer to **Control Module References** for connector location.
5. Test the high and low circuits between the SDM and I/P module for a short to voltage, short to ground, an open, or low resistance. Verify that a short to voltage, short to ground, or open/low resistance does not exist.
   - If any of the above conditions are found make the appropriate repair.
6. If all circuits test normal then replace the SDM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Inflatable Restraint Instrument Panel Module Replacement**
- **Control Module References** for SDM replacement, setup, and programming

DTC B0021

DTC Descriptor

DTC B0021 01

Right Front Side Deployment Loop Short to Battery

DTC B0021 02

Right Front Side Deployment Loop Short to Ground

DTC B0021 04

Right Front Side Deployment Loop Open Circuit

DTC B0021 0D

Right Front Side Deployment Loop Resistance Above Threshold

DTC B0021 0E

Right Front Side Deployment Loop Resistance Below Threshold

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC B0021

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Side Impact Module - RF High Circuit	B0021 02	B0021 0D	B0021 04	B0021 01	B0021 0E
Side Impact Module - RF Low Circuit	B0021 02	B0021 0D	B0021 04	B0021 01	B0021 0E

Circuit/System Description

During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy the side impact module - RF. The SDM performs continuous diagnostic tests on the deployment loops to check for proper circuit continuity and for shorts to ground or voltage. A shorting bar used within the side impact module - RF connector which will short together both side impact module - RF high and low circuits when the connector is disconnected, this will help to prevent unwanted deployment of the inflator module during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

B0021 01

The side impact module - RF high and/or low circuit is short to voltage for 120 milliseconds.

B0021 02

The side impact module - RF high and/or low circuit is short to ground for 120 milliseconds.

B0021 04

The side impact module - RF high and/or low circuit is open for 120 milliseconds.

B0021 0D

The side impact module - RF deployment loop resistance is more than 3.9 ohms for 120 milliseconds.

B0021 0E

The side impact module - RF deployment loop resistance is less than 1.1 ohms for 120 milliseconds.

Action Taken When the DTC Sets

- The SDM commands the AIR BAG indicator ON via serial data communications.
- The SIR system is disabled and no deployments are allowed.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- A history DTC will clear once 255 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Special Tools Required

- **J 38715-A** SIR Driver/Passenger Load Tool. See Special Tools.
- **J 38715-30A** SIR Load Tool Adapter

Circuit/System Testing

IMPORTANT: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **The side impact module - RF**
- **The side impact module wiring harness**
- **The SDM module**
- **The side impact module - RF wiring harness connector**
- **The side impact module wiring harness connector**
- **The SDM wiring harness connector**

1. Ignition OFF, disconnect the side impact module - RF wiring harness connector located under the driver front seat.
2. Connect the **J 38715-A** to the harness side of the side impact module - RF wiring harness connector. See Special Tools. Use the PASSENGER INFLATOR connector located on the load tool.
3. Ignition ON, use a scan tool to observe the SIR DTC display. Verify DTC B0021 is set history.
    - If DTC B0021 is current turn OFF the ignition and remove the SDM connector. Refer to Control Module References for connector location.

   - Test and repair both side impact module - RF high and low circuits for a short to voltage, short to ground, or open/low resistance. If all circuits test normal then replace the SDM.
4. Ignition OFF, disconnect and remove the **J 38715-A** . See **Special Tools**. Then connect the side impact module - RF wiring harness connector. Remove the side impact module - RF connector. Use J 38715-30A to connect the **J 38715-A** to the harness side of the side impact module - RF connector. See **Special Tools**. Use the PASSENGER INFLATOR connector located on the load tool.
5. Ignition ON, use a scan tool to observe the SIR DTC display. Verify DTC B0021 is set history.
   - If DTC B0021 is current the replace the side impact module - RF wiring harness.
6. If DTC B0021 is history replace the side impact module - RF.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Inflatable Restraint Side Impact Module Replacement - Front (Monte Carlo)**
- **Inflatable Restraint Side Impact Module Wiring Harness Replacement**
- **Control Module References** for SDM replacement, setup, and programming

DTC B0022

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptor

DTC B0022 01

Right Front Seat Belt Pretensioner Deployment Loop Short to Battery

DTC B0022 02

Right Front Seat Belt Pretensioner Deployment Loop Short to Ground

DTC B0022 04

Right Front Seat Belt Pretensioner Deployment Loop Open Circuit

DTC B0022 0D

Right Front Seat Belt Pretensioner Deployment Loop Resistance Above Threshold

DTC B0022 0E

Right Front Seat Belt Pretensioner Deployment Loop Resistance Below Threshold

Diagnostic Fault Information

DTC B0022

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Seat Belt Pretensioner - RF High Circuit	B0022 02	B0022 0D	B0022 04	B0022 01	B0022 0E
Seat Belt Pretensioner - RF Low Circuit	B0022 02	B0022 0D	B0022 04	B0022 01	B0022 0E

Circuit/System Description

During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy the seat belt pretensioner - RF. The SDM performs continuous diagnostic tests on the deployment loops to check for proper circuit continuity and for shorts to ground or voltage. A shorting bar used within the seat belt pretensioner - RF connector which will short together both seat belt pretensioner - RF high and low circuits when the connector is disconnected, this will help to prevent unwanted deployment of the inflator module during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

B0022 01

The seat belt pretensioner - RF high and/or low circuit is short to voltage for 120 milliseconds.

B0022 02

The seat belt pretensioner - RF high and/or low circuit is short to ground for 120 milliseconds.

B0022 04

The seat belt pretensioner - RF high and/or low circuit is open for 120 milliseconds.

B0022 0D

The seat belt pretensioner - RF deployment loop resistance is more than 3.9 ohms for 120 milliseconds.

B0022 0E

The seat belt pretensioner - RF deployment loop resistance is less than 1.1 ohms for 120 milliseconds.

Action Taken When the DTC Sets

- The SDM commands the AIR BAG indicator ON via serial data communications.
- The SIR System is disabled and no deployments are allowed.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- A history DTC will clear once 255 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Special Tools Required

J 38715-A SIR Driver/Passenger Load Tool. See **Special Tools**.

Circuit/System Testing

IMPORTANT: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **The seat belt retractor pretensioner - RF**
- **The SDM module**
- **The seat belt retractor pretensioner - RF wiring harness connector**
- **The SDM wiring harness connector**

1. Ignition OFF, remove the lower center pillar trim and disconnect the seat belt retractor pretensioner - RF connector. Refer to **Trim Panel Replacement - Lower Center Pillar** .
2. Connect the **J 38715-A** to the harness side of the seat belt retractor pretensioner - RF wiring harness connector. See **Special Tools**. Use the PASSENGER INFLATOR connector located on the load tool.
3. Ignition ON, use a scan tool to observe the SIR DTC display. Verify DTC B0022 is set current.
   - If DTC B0022 is history replace the seat belt retractor pretensioner - RF.
4. Ignition OFF, disconnect and remove the **J 38715-A** . See **Special Tools**. Then remove the SDM connector, refer to **Control Module References** for connector location.
5. Disconnect the SDM harness connector.
6. Test the high and low circuits between the SDM and seat belt retractor pretensioner - RF for a short to voltage, short to ground, an open, or low resistance. Verify that a short to voltage, short to ground, or open/low resistance does not exist.
   - If any of the above conditions are found make the appropriate repair.
7. If all circuits test normal then replace the SDM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Seat Belt Retractor Pretensioner Replacement - Front**
- **Control Module References** for SDM replacement, setup, and programming

DTC B0023

DTC Descriptor

DTC B0023 01

Right Roof Rail Deployment Loop Short to Battery

DTC B0023 02

Right Roof Rail Deployment Loop Short to Ground

DTC B0023 04

Right Roof Rail Deployment Loop Open Circuit

DTC B0023 0D

Right Roof Rail Deployment Loop Resistance Above Threshold

DTC B0023 0E

Right Roof Rail Deployment Loop Resistance Below Threshold

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC B0023

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Roof Rail Module - Right High Circuit	B0023 02	B0023 0D	B0023 04	B0023 01	B0023 0E
Roof Rail Module - Right Low Circuit	B0023 02	B0023 0D	B0023 04	B0023 01	B0023 0E

Circuit/System Description

During a side or frontal crash of sufficient force, the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy the roof side rail module. The SDM performs continuous diagnostic tests on the deployment loops to check for proper circuit continuity and for shorts to ground or voltage. A shorting bar used within the roof rail module connector will short together both roof rail module - right high and low circuits when the connector is disconnected; this will help to prevent unwanted deployment of the inflator module during servicing.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

B0023 01

The roof rail module - right high and/or low circuit is short to voltage for 120 milliseconds.

B0023 02

The roof rail module - right high and/or low circuit is short to ground for 120 milliseconds.

B0023 04

The roof rail module - right high and/or low circuit is open for 120 milliseconds.

B0023 0D

The roof rail module - right deployment loop resistance is more than 3.9 ohms for 120 milliseconds.

B0023 0E

The roof rail module - right deployment loop resistance is less than 1.1 ohms for 120 milliseconds.

Action Taken When the DTC Sets

- The SDM commands the AIR BAG indicator ON via serial data communications.
- The SIR System is disabled and no deployments are allowed.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- A history DTC will clear once 255 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

Special Tools Required

J 38715-A SIR Driver/Passenger Load Tool. See **Special Tools**.

Circuit/System Testing

IMPORTANT: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **The roof rail module - right**
- **The SDM module**
- **The roof rail module - right wiring harness connector**
- **The SDM wiring harness connector**

1. Ignition OFF, remove the right quarter upper trim and disconnect the roof rail module - right connector. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .
2. Connect the **J 38715-A** to the harness side of the roof rail module - right connector. See **Special Tools**. Use the PASSENGER INFLATOR connector located on the load tool.
3. Ignition ON, use a scan tool to observe the SIR DTC display. Verify DTC B0023 is set in current.
   - If DTC B0023 is history replace the roof rail module - right.
4. Ignition OFF, disconnect and remove the **J 38715-A** . See **Special Tools**. Then remove the SDM connector, refer to **Control Module References** for connector location.
   - If damage or corrosion is found make the appropriate repair.
5. Test the high and low circuits between the SDM and roof rail module - right for a short to voltage, short to ground, or open/low resistance. Verify that a short to voltage, short to ground, or open/low resistance does not exist.
   - If damage or corrosion is found make the appropriate repair.
6. If all circuits test normal then replace the SDM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Inflatable Restraint Roof Rail Module Replacement**
- **Control Module References** for SDM replacement, setup, and programming

DTC B0052 OR B0053

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0052

Deployment Commanded

DTC B0053

Deployment Commanded with Loop DTCs Present

Circuit/System Description

The inflatable restraint sensing and diagnostic module (SDM) contains a sensing device that converts vehicle velocity changes into an electrical signal. The SDM compares this electrical signal to a value stored in memory. When the generated signal exceeds the stored value, the SDM performs additional signal processing and compares the generated signals to values stored in memory. When 2 of the generated signals exceed the stored values, the SDM will cause current to flow through the deployment loops, deploying the air bags and/or pretensioners causing DTC B0052 or B0053 to set.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

B0052

- The SDM detects a frontal impact of sufficient force to warrant deployment of the frontal modules.
- The SDM detects a side impact of sufficient force to warrant deployment of a side impact module and/or roof rail module.
- The SDM has deployed the seat belt pretensioner.

B0053

SDM commands inflators deployment with loop faults present.

Action Taken When the DTC Sets

- The SDM will only set DTC B0052 or the SDM sets DTC B0053 along with DTC B0052.
- The SDM commands the AIR BAG warning lamp ON via serial data communications.
- The SDM records crash data.

Conditions for Clearing the DTC

After an air bag deployment or 3 separate pretensioner deployments the DTC becomes latched and cannot be cleared.

Diagnostic Aids

IMPORTANT: The seat belt pretensioners may deploy for impacts that are not severe enough to warrant frontal or side air bag deployment. The SDM is capable of sustaining 3 pretensioner deployment events, or one frontal or side deployment event. After the maximum number of deployments has occurred, DTC B0052 sets and becomes a latched code, which cannot be cleared.

When DTC B0053 is accompanied by additional DTCs, other than B0052, repair the malfunction causing the other DTCs before replacing SDM.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Electrical Information Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

1. Ignition OFF, verify no signs of inflator module or pretensioner deployment exist.
    - If any signs of deployment exist, refer to **Repairs and Inspections Required After a Collision**.
2. With a scan tool, verify DTC B0052 or DTC B0053 is not set.
    - If the DTC is set, clear DTCs. If DTC resets, replace the SDM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for SDM replacement, setup, and programming

DTC B0055

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptor

DTC B0055 00

Side Airbag Deployment Commanded

Circuit/System Description

The inflatable restraint sensing and diagnostic module (SDM) contains a sensing device that converts vehicle velocity changes into an electrical signal. The SDM compares this electrical signal to a value stored in memory. When the generated signal exceeds the stored value, the SDM performs additional signal processing and compares the generated signals to values stored in memory. When 2 of the generated signals exceed the stored values, the SDM will cause current to flow through the inflator modules, deploying the side air bags and causing DTC B0055 to set. This DTC is set when the SDM has commanded an air bag deployment with no faults present.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

- This SDM detects a frontal crash of sufficient force to warrant deployment of the frontal inflator modules.
- The SDM detects a side impact crash of sufficient force to warrant deployment of a side inflator module.

Action Taken When the DTC Sets

- The SDM sets a DTC.
- DTC B0052 or B0053 will set.
- The SDM commands ON the AIR BAG warning lamp via serial data communications.
- The SDM records crash data.

Conditions for Clearing the DTC

DTC B0055 is a latched code. You cannot clear a latched code.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Electrical Information Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

1. Ignition OFF, Verify that the vehicle does not show any signs of side impact or frontal inflator module deployment.
    - If the vehicle displays any signs of inflator deployment, refer to **Repairs and Inspections Required After a Collision**.
2. With a scan tool verify DTC B0055 is not set.
    - If DTC B0055 is set, replace the SDM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for SDM replacement, setup, and programming

DTC B0056

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptor

DTC B0056 00

Passenger Frontal Airbag Suppressed

Circuit/System Description

When the ignition is turned ON, the passenger presence system (PPS) and the inflatable restraint sensing and diagnostic module (SDM) performs tests to diagnose critical malfunctions within itself. The PPS is used to monitor the weight of an occupant in the front passenger seat. If the pressure from the occupant's weight is less than a specified value or an empty seat is detected, the PPS module will send a suppress signal to the SDM to disable the instrument panel (I/P) module. When the PPS detects a fault within itself then the PPS will communicate to the SDM through GMLAN communications that a PPS fault is present. The SDM will suppress the deployment of the module and then turn the AIR BAG indicator ON.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

This DTC is set when the SDM has commanded an air bag deployment while the PPS has determined that the front passenger seat has one the following conditions:

- The pressure from the occupant's weight is less than a specified value, the PPS module sent a suppress signal to the SDM to suppress the I/P module
- Empty front passenger seat
- A PPS fault was detected

Action Taken When the DTC Sets

- The SDM sets a DTC B0056.
- DTC B0052, B0053, or B0055 will set along with this DTC.
- The SDM commands ON the AIR BAG warning lamp via serial data communications.

Conditions for Clearing the DTC

This code will set along with one of the following latched codes DTC B0052, B0053, or B0055, you cannot clear a latched code.

Diagnostic Aids

This code set because the PPS commanded to suppress the I/P module when the vehicle was involved in a collision and the SDM has commanded an air bag deployment.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Electrical Information Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

1. Ignition OFF, verify that the vehicle does not show any signs of inflator module or pretensioner deployment.
    - If the vehicle displays any signs of inflator deployment, refer to **Repairs and Inspections Required After a Collision**.
2. With a scan tool, verify DTC B0052, B0053, or B0055 is not set.
    - If DTC is set , refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
3. With a scan tool, clear DTCs, verify DTC B0056 is not set.
    - If DTC is set , replace the SDM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

DTC B0057

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptor

DTC B0057 00

Passenger Side Airbag Suppressed

Circuit/System Description

When the ignition is turned ON, the passenger presence system (PPS) and the inflatable restraint sensing and diagnostic module (SDM) performs tests to diagnose critical malfunctions within itself. The PPS is used to monitor the weight of an occupant in the front passenger seat. If the pressure from the occupant's weight is less than a specified value or an empty seat is detected, the PPS module will send a suppress signal to the SDM to disable the passenger side impact module (front seat air bag). When the PPS detects a fault within itself, then the PPS will communicate to the SDM through GMLAN communications that a PPS fault is present. The SDM will suppress the deployment of the module and then turn the AIR BAG indicator ON.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

This DTC is set when the SDM has commanded an air bag deployment while the PPS has determined that the front passenger seat has one the following conditions:

- The pressure from the occupant's weight is less than a specified value, the PPS module sent a suppress signal to the SDM to suppress the side impact module
- Empty front passenger seat
- A PPS fault was detected

Action Taken When the DTC Sets

- The SDM sets a DTC B0057.
- DTC B0052, B0053, or B0055 will set along with this DTC.
- The SDM commands ON the AIR BAG warning lamp via serial data communications.

Conditions for Clearing the DTC

This code will set along with one of the following latched codes DTC B0052, B0053, or B0055, you cannot clear a latched code.

Diagnostic Aids

This code set because the PPS commanded to suppress the side impact module when the vehicle was involved in a collision and the SDM has commanded an air bag deployment.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Electrical Information Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

1. Ignition OFF, verify no signs of inflator module or pretensioner deployment exist.
   - If any signs of deployment exist, refer to **Repairs and Inspections Required After a Collision**.
2. With a scan tool, verify DTC B0052, B0053, or B0055 is not set.
   - If DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
3. With a scan tool, clear DTCs, verify DTC B0057 is not set.
   - If DTC is set , replace the SDM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

DTC B0071

DTC Descriptor

DTC B0071 03

Passenger Seat Belt Tension Sensor Circuit

DTC B0071 07

Passenger Seat Belt Tension Sensor Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The inflatable restraint seat belt tension sensor is a 3-wire potentiometer mounted on the retractor or buckle side of the seat belt and provides an input to the passenger presence system (PPS). When an infant car seat is properly restrained on the front passenger seat, the seat belt is tightly secured through the car seat. The seat belt pulls on the tension sensor and changes the voltage signal to the PPS module. The PPS monitors the seat belt tension sensor circuit and if a fault is detected, DTC will be set. When the PPS detects this DTC within the PPS, it will notify the customer of the enable/disable status by turning ON the OFF indicator on the PASSENGER AIR BAG ON/OFF indicators. Then the PPS will communicate to the sensing and diagnostic module (SDM) through a serial data communications that a PPS fault is present. The SDM will then suppress the deployment of the instrument panel (I/P) module and then turn the AIR BAG indicator ON.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

- The PPS detects the voltage at the passenger seat belt tension retractor sensor signal is less than 0.05 volts or greater than 4.5 volts for 500 milliseconds.
- The PPS detects the voltage at the passenger seat belt tension retractor sensor 5-volt reference is less than 4.5 volts or greater than 9.1 volts for 500 milliseconds.
- The PPS detects the amperage at the passenger seat belt tension retractor sensor low reference is 25 ma or greater for 500 milliseconds.

Action Taken When the DTC Sets

- The PPS will set a DTC, and then communicate with the SDM via serial data communications.
- The SDM disables the I/P module deployment loop.
- The PPS will turn ON the passenger air bag status OFF indicator.
- The SDM commands the AIR BAG indicator ON via GMLAN serial data.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- A history DTC will clear once 255 malfunction-free ignition cycles have occurred.

Diagnostic Aids

Inspect the passenger seat belt tension retractor sensor signal, 5-volt reference, and low reference circuits carefully for cutting and/or chafing.

Reference Information

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Circuit/System Testing

IMPORTANT: The seat belt tension retractor sensor is not service separately. The Seat Belt Retractor Pretensioner Replacement - Right Front with the seat belt tension retractor sensor must be serviced as a complete unit.

IMPORTANT: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **The seat belt retractor pretensioner - RF**
- **The PPS module**
- **The seat belt retractor pretensioner - RF wiring harness connector**
- **The PPS wiring harness connector**

1. Ignition OFF, disconnect the seat belt tension retractor sensor.
2. Disconnect the PPS module connector.
3. Test the seat belt tension retractor sensor signal circuit for a short to ground, a high resistance, or an open. Verify that a short to ground, a high resistance, or an open does not exist.
    - If any of the above conditions are found make the appropriate repair.
4. Test the seat belt tension retractor sensor 5-volt reference circuit for a short to ground, a short to voltage, a high resistance, or an open. Verify that a short to ground, a short to voltage, a high resistance, or an open does not exist.
    - If any of the above conditions are found make the appropriate repair.
5. Test the seat belt tension retractor sensor low reference circuit for a short to ground, a short to voltage, a high resistance, or an open. Verify that a short to ground, a short to voltage, a high resistance, or an open does not exist.
    - If any of the above conditions are found make the appropriate repair
6. Ignition ON, engine OFF test the seat belt tension retractor sensor circuit with a DMM.

Measure the voltage of the seat belt tension retractor sensor circuit harness side and ground. The voltage should read 0.05-4.5 volts.

   - If the voltage is more than 5.0 volts test the seat belt tension retractor sensor circuit for a short to voltage. If the circuit tests good replace the PPS.

7. Reconnect all PPS components. Use the scan tool to clear all PPS DTCs. Rezero the PPS, refer to **Passenger Presence System Rezeroing Procedure**. Verify DTC B0071 does not exist.
   - If DTC B0071 reset replaced the PPS.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Seat Belt Retractor Pretensioner Replacement - Front**
- **Control Module References** for PPS replacement, setup, and programming.

DTC B0074

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptor

DTC B0074 03

Passenger Occupant Classification Sensor Circuit Voltage Below Threshold

DTC B0074 07

Passenger Occupant Classification Circuit Voltage Above Threshold

DTC B0074 08

Passenger Occupant Classification Circuit Signal Invalid

Circuit/System Description

The passenger presence system (PPS) uses a silicone filled sensor pad located underneath the passenger seat foam cushion and is connected by a hose clamp to a pressure sensor. The weight of the occupant sitting in the front passenger seat is measured as a pressure change within the bladder by the pressure sensor. The pressure sensor is a 3-wire sensor consisting of a power, ground, and signal circuit. The PPS continually monitors itself and if a fault in this circuit occurs, a DTC will set. When the SDM detects this DTC within the PPS, it will notify the customer of the enable/disable status by turning ON the OFF indicator on the PASSENGER AIR BAG ON/OFF indicators. Then the PPS will communicate to the sensing and diagnostic module (SDM) through serial data communications that a PPS fault is present. The SDM will then suppress the deployment of the instrument panel (I/P) module and then turn the AIR BAG indicator ON.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

- The PPS detects the voltage at the PPS sensor signal is less than 0.05 volts or greater than 4.5 volts for 500 milliseconds.
- The PPS detects the voltage at the PPS sensor 5-volt reference is less than 4.5 volts or greater than 9.1 volts for 500 milliseconds.
- The PPS detects the amperage at the PPS sensor low reference is 25 ma or greater for 500 milliseconds.

Action Taken When the DTC Sets

- The PPS will set a DTC, and then communicate with the SDM via serial data communications.
- The SDM disables the I/P module deployment loop.
- The PPS will turn ON the passenger air bag status OFF indicator.
- The SDM commands ON the AIR BAG warning lamp via serial data communications.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- A history DTC will clear once 255 malfunction-free ignition cycles have occurred.

Reference Information

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Testing

IMPORTANT: Important: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **The PPS pressure sensor**
- **The PPS module**
- **The PPS pressure sensor wiring harness connector**
- **The PPS module wiring harness connector**

1. Ignition OFF, inspect the component and harness sides of the connector for the PPS pressure sensor. Verify there is no damage or corrosion is found.
2. Disconnect the PPS module connector.
3. Test the PPS sensor signal circuit for a short to ground, a high resistance, or an open. Verify that a short to ground, a high resistance, or an open does not exist.
    - If any of the above conditions are found make the appropriate repair.
4. Test the PPS sensor low reference circuit for a short to ground, a short to voltage, a high resistance, or an open. Verify that a short to ground, a short to voltage, a high resistance, or an open does not exist.
    - If any of the above conditions are found make the appropriate repair.
5. Test the PPS sensor 5-volt reference circuit for a short to ground, a short to voltage, a high resistance, or an open. Verify that a short to ground, a short to voltage, a high resistance, or an open does not exist.
    - If any of the above conditions are found make the appropriate repair.
6. Ignition ON, engine OFF test the PPS sensor signal circuit with a DMM. Measure the voltage of the PPS sensor circuit harness side and ground. The voltage should read .05-4.5 volts.
    - If the voltage is more than 5.0 volts test the PPS sensor signal circuit for a short to voltage. If the circuit tests good replace the PPS.
7. Reconnect all PPS components. Use the scan tool to clear all PPS DTCs. Rezero the PPS, refer to **Passenger Presence System Rezeroing Procedure**. Verify DTC B0074 does not exist.
    - If DTC B0074 reset replaced the PPS.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after

completing the diagnostic procedure.

Control Module References for PPS replacement, setup, and programming

DTC B0081

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptor

DTC B0081 0F

Passenger Presence System Erratic

DTC B0081 3A

Passenger Presence System Incorrect Component Installed

DTC B0081 4B

Passenger Presence System Calibration Not Learned

DTC B0081 5A

Passenger Presence System Plausibility Failure

DTC B0081 39

Passenger Presence System Internal Electronic Failure

DTC B0081 71

Passenger Presence System Invalid Serial Data Received

Circuit/System Description

When the ignition is turned ON, the Passenger Presence System (PPS) and the inflatable restraint sensing and diagnostic module (SDM) performs tests to diagnose critical malfunctions within itself. When the SDM has completed the power-up mode, the SDM will establish communication with the PPS. The PPS will respond by commanding both of the PASSENGER AIR BAG ON/OFF indicators ON for 5 seconds. The SDM will then transmit a request message to the PPS to receive the PPS verification ID. The PPS will transmit the verification ID to the SDM, and the SDM will compare the ID received to data stored in memory. If the data stored in memory does not match the information transmitted by the PPS or the SDM has detects that the PPS has set a current DTC the SDM will then disable the instrument panel (I/P) module deployment loop, set DTC B0081 and command the AIR BAG indicator ON.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

All of the following conditions must exist for 5 seconds:

B0081 0F

- The SDM has received a fault present message from the PPS.
- The PPS is in assembly plant mode and the SDM is in production mode.

B0081 3A

The SDM has received a message from the PPS which indicates a vehicle and PPS mismatch.

B0081 4B

The PPS has failed the rezeroing procedure.

B0081 5A

- The PPS has lost communications with the SDM.
- When the PPS has requested the Passenger Air Bag Indicator to change states (from ON to OFF or OFF to ON) and the SDM change states message does not match with the PPS message.
- After the PPS change states, the SDM signal stating the Passenger Status Data Received is not valid within 2.6 seconds.

B0081 39

The SDM has received a critical malfunction message from the PPS.

B0081 71

The SDM has received invalid or no serial data from the PPS.

Action Taken When the DTC Sets

- The SDM commands the AIR BAG indicator ON, and the passenger air bag indicator to display OFF via serial data communications.
- The I/P module deployment loop will be disabled.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and there is no activity on the low speed serial data circuits.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

If either the SDM or PPS were replaced verify that the correct part numbers were used for the vehicle application.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Circuit/System Testing

IMPORTANT:

- **A DTC B0081 set in history may not clear until the PPS module enters the sleep mode.**
- **When removing connectors inspect for damage, corrosion or poor connection. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**
- **The PPS module**
- **The SDM module**

- **The PPS module harness connector**
- **The SDM wiring harness connector**

1. Ignition ON, with a scan tool retrieve DTCs from the PPS.
2. Ensure DTC B0081 5A is not set as current.
    - If DTC B0081 5A is current, replace the PPS.
3. Ensure DTC B0081 4B is not set as current.
    - If DTC B0081 4B is current, refer to **Passenger Presence System Rezeroing Procedure**.
4. With a scan tool, clear the DTCs from the PPS. All PPS DTCs should clear.
    - If any other PPS DTCs are set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
5. With a scan tool, retrieve DTCs from the SDM.
6. Ensure DTC B0081 3A is not set as current.
    - If DTC B0081 3A is current, replace the PPS with the correct part number.
7. Ensure DTC B0081 39 is not set as current.
    - If DTC B0081 39 is current, replace the PPS.
8. Ensure DTC B1000, B1001, or U0170 is not set as current.
    - If DTC B1000, B1001, or U0170 is current, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
9. Ensure DTC B0081 71 or B0081 0F is not set.
    - If DTC B0081 71 or B0081 0F is set, Clear the SDM DTCs. No other repairs are necessary.

Clearing DTC B0081

1. To enter the sleep mode, remove the scan tool, turn the ignition OFF, open and close the driver door.
2. With the ignition OFF and all doors closed, wait 30 seconds.
3. With a scan tool, clear DTC B0081. The DTC should now be cleared.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for PPS and SDM replacement, setup, and programming

DTC B0083 OR B0084

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptor

DTC B0083 00

Front End Sensor 1

DTC B0083 71

Front End Sensor 1 Invalid Serial Data Received (Left)

DTC B0083 39

Front End Sensor 1 Internal Electronic Failure (Left)

DTC B0083 0F

Front End Sensor 1 Erratic (Left)

DTC B0083 3A

Front End Sensor 1 Incorrect Component Installed (Left)

DTC B0084 00

Front End Sensor 2

DTC B0084 39

Front End Sensor 2 Internal Electronic Failure (Right)

DTC B0084 0F

Front End Sensor 2 Erratic (Right)

DTC B0084 3A

Front End Sensor 2 Incorrect Component Installed (Right)

DTC B0084 71

Front End Sensor 2 Invalid Serial Data Received (Right)

Diagnostic Fault Information

DTC B0083

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Roof Rail Module - Right High Circuit	B0083 00	B0083 00	B0083 00	B0083 00	B0083 0F
Roof Rail Module - Right Low Circuit	-	B0083 00	B0083 00	B0083 00	B0083 0F
Front End Sensor 2 Signal Circuit	B0084 00	B0084 00	B0084 00	B0084 00	B0084 0F
Front End Sensor 2 Low Reference Circuit	-	B0084 00	B0084 00	B0084 00	B0084 0F

Circuit/System Description

The inflatable restraint front end sensor utilizes a unidirectional 2-wire circuit. The front end sensor modulates current on the interface to send ID, state of health, and deployment commands to the inflatable restraint sensing and diagnostic module (SDM). The SDM serves as a power source and a ground for the front end sensor. When the ignition is turned ON and input power from the SDM is first detected, the front end sensor responds by performing internal diagnostics and sending an ID to the SDM. The SDM considers the ID to be valid if the response time is less than 5 seconds. The front end sensor continually communicates status messages to the SDM, which determines if a fault is present in the front end sensor circuit. When a fault is detected, the SDM may reset the front end sensor up to 2 times by removing and reapplying power to it. If the fault is still present, the SDM will set a DTC.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

All of the following conditions exist for 2.5 seconds:

B0083 00 or B0084 00

- The front end sensor has been shorted to voltage.
- The front end sensor has been shorted to voltage.
- The front end sensor circuit is open.
- The SDM has not received a message from the front end sensor for more than 375

milliseconds.

- The front end sensor current has been above 23 mA for longer than 5 milliseconds.

B0083 0F or B0084 0F

The SDM has received erratic messages from the front end sensor.

B0083 39 or B0084 39

- The SDM has received a NOK message from the front end sensor
- The SDM has not received a message.

B0083 3A or B0084 3A

- The SDM has received an ID message from the front end sensor, which does not match the ID stored in the SDM memory.
- The SDM has reset the front end sensor twice without detecting the correct ID message.

B0083 71 or B0084 71

The SDM has received invalid serial data from the front end sensor.

Action Taken When the DTC Sets

- The SDM commands the AIR BAG indicator ON via serial data communications.
- The SIR System is disabled and no deployments are allowed.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- A history DTC will clear once 255 malfunction-free ignition cycles have occurred.

Diagnostic Aids

A short to voltage on the low reference circuit for either right or left front end sensor will cause the Air Bag fuse to fail/open with no DTC code set.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Testing

IMPORTANT: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **The front end sensor**
- **The SDM module**
- **The front end sensor wiring harness connector**
- **The SDM wiring harness connector**

1. Ignition ON, if DTC B0083 is current, disconnect the front end sensor - left connector. If DTC B0084 is current, disconnect the front end sensor - right connector.
2. Remove the SDM connector.
3. Test the signal and voltage circuits between the SDM and front end sensor for a short to voltage, short to ground, or open/low resistance. Verify that a short to voltage, short to ground, or open/low resistance does not exist.
   - If any of the above conditions are found, make the appropriate repair.
4. Reconnect all SIR components. With the ignition ON, use the scan tool to clear the DTCs then recheck for DTCs.
   - If DTC B0083 was current, replace the front end sensor - left. If DTC B0084 was current, replace the front end sensor - right.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Inflatable Restraint Front End Sensor Replacement**
- **Control Module References** for SDM replacement, setup, and programming

Repair Verification

Ignition ON, use the scan tool to clear the DTCs then recheck for DTCs.

- If DTC B0083 or B0084 was current replace the SDM.

DTC B0085 OR B0086

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptor

DTC B0085 00

Left Front Side Impact Sensor

DTC B0085 02

Left Front Side Impact Sensor Short to Ground

DTC B0085 05

Left Front Side Impact Sensor Short to Voltage

DTC B0085 0F

Left Front Side Impact Sensor Erratic

DTC B0085 39

Left Front Side Impact Sensor Internal Electronic Failure

DTC B0085 3A

Left Front Side Impact Sensor Incorrect Component Installed

DTC B0085 71

Left Front Side Impact Sensor Invalid Serial Data Received

DTC B0086 00

Right Front Side Impact Sensor

DTC B0086 02

Right Front Side Impact Sensor Short to Ground

DTC B0086 05

Right Front Side Impact Sensor Short to Voltage

DTC B0086 0F

Right Front Side Impact Sensor Erratic

DTC B0086 39

Right Front Side Impact Sensor Internal Electronic Failure

DTC B0086 3A

Right Front Side Impact Sensor Incorrect Component Installed

DTC B0086 71

Right Front Side Impact Sensor Invalid Serial Data Received

Diagnostic Fault Information

DTC B0085 or B0086

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Side Impact Sensor LF Signal Circuit	-	B0085 00	B0085 00	B0085 00	B0085 0F
Side Impact Sensor LF Voltage	B0085 00	B0085 00	B0085 00	-	B0085 0F
Side Impact Sensor RF Signal Circuit	-	-	B0086 04	-	B0086 0F
Side Impact Sensor RF Voltage	B0086 00	B0086 00	B0086 00	-	B0086 0F

Circuit/System Description

The inflatable restraint side impact sensor (SIS) utilizes a unidirectional 2-wire circuit. The SIS modulates current on the interface to send ID, State of Health, and deployment commands to the inflatable restraint sensing and diagnostic module (SDM). The SDM serves as a power source and a ground for the SIS. When the ignition is turned ON and input power from the SDM is first detected, the SIS responds by performing internal diagnostics and sending an ID to the SDM. The SDM considers the ID to be valid if the response time is less than 5 seconds. The SIS continually communicates status messages to the SDM, which determines if a fault is present in the SIS circuit. When a fault is detected, the SDM resets the SIS twice by removing and reapplying power to it. If the fault is still present, the SDM will set a DTC.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

All of the following conditions exist for 2.5 seconds:

B0085 02 or B0086 02

- The SIS has been shorted to voltage.
- The SIS current has been above 23 mA for longer than 5 milliseconds.

B0085 05 or B0086 05

- The SIS has been shorted to ground.
- The SIS circuit is open.
- The SDM has not received a message from the SIS for more than 375 milliseconds.

B0085 0F or B0086 0F

The SDM has received erratic messages from the SIS.

B0085 39 or B0086 39

- The SDM has received a NOK message from the SIS.
- The SDM has not received a message.

B0085 3A or B0086 3A

- The SDM has received an ID message from the SIS which does not match the ID stored in the SDM memory.
- The SDM has reset the SIS twice without detecting the correct ID message.

B0085 71 or B0086 71

The SDM has received invalid serial data from the SIS.

Action Taken When the DTC Sets

- The SDM commands the AIR BAG indicator ON via serial data communications.

- The SIR System is disabled and no deployments are allowed.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the scan tool Clear DTCs function is used.
- A history DTC will clear once 255 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Testing

IMPORTANT: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **The SIS**
- **The SDM module**
- **The SIS wiring harness connector**
- **The SDM wiring harness connector**

1. Ignition OFF, if DTC B0085 is current, disconnect the LF SIS connector.
2. Remove the SDM connector, refer to **Control Module References** for location of connector.
3. Test the signal and voltage circuits between the SDM and SIS for a short to voltage, short to ground, or open/low resistance. Verify that a short to voltage, short to ground, or open/low resistance does not exist.
   - If any of the above conditions are found make the appropriate repair.

4. Reconnect all SIR components, then ignition ON use the scan tool to clear the DTCs then recheck for DTCs.
    - If DTC B0085 is current, replace the LF SIS. If DTC B0086 is current, replace the RF SIS. After replacement, clear and recheck for DTCs if DTC B0085 or DTC B0086 are still current, replace the SDM.

Repair Procedures

- **Inflatable Restraint Side Impact Sensor Replacement**
- **Control Module References** for SDM replacement, setup, and programming

DTC B1001

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptor

DTC B1001 00

SDM Option Configuration Error

Circuit/System Description

The inflatable restraint sensing and diagnostic module (SDM) stores a Primary Data Key, which is a four digit number, and a Secondary Data Key, which is a portion of the vehicle identification number (VIN). When the ignition is turned ON, the SDM compares this information to the information stored in the body control module (BCM) over the serial data communication circuit. If there is a mismatch between the information stored in the SDM and BCM, DTC B1001 will set.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

- The 4 digit Primary Data Key stored in the SDM does not match the 4 digits stored in the BCM.
- The VIN stored in the BCM does not match that of the vehicle.

- The VIN stored in the SDM does not match that of the BCM.

Action Taken When the DTC Sets

- The SDM commands ON the AIR BAG warning lamp via serial data communications.
- The SDM disables all deployments.

Conditions for Clearing the DTC

- The last 4 digit Primary Data Key in the SDM match the last 4 digits stored in the BCM.
- The VIN that is stored in the SDM matches the VIN stored in the BCM.

Diagnostic Aids

This DTC is an indication that an incorrect SDM is installed in the vehicle, or that the SDM and/or the BCM was replaced without reprogramming the BCM with the new information.

Reference Information

Description and Operation Reference

SIR System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

1. Ignition ON, use the scan tool to request SIR DTCs. Verify that DTC B1001 is set as current.
    - If DTC B1001 is history, clear codes and recheck.
2. Verify the scan tool parameter Secondary Key Status is Valid.
    - If the Secondary Key Status is not valid, verify that Received VIN Digits 2-5 and Received VIN Digits 2-5 parameters match the vehicle VIN. If the parameters do not match the VIN, reprogram the BCM.

    - If the Secondary Key Status is not valid, verify that Received VIN Digits 2-5 and Received VIN Digits 6-7 parameters match the vehicle VIN. If the parameters match the VIN, reprogram the SDM.
3. Verify the scan tool parameter Primary Key Status is Valid.
    - If the Primary Key Status is not valid, verify that the Received Primary Key and the SDM Primary Key parameters match. If the parameters do not match, use the scan tool to perform the Setup SDM Primary Key in BCM.
4. If all parameters are correct, use the scan tool to clear the DTCs. Verify that DTC B1001 is cleared.
    - If DTC B1001 is still current, replace the SDM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for SDM and BCM replacement, setup, and programming

DTC B1019

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptor

DTC B1019 00

System Configuration Error

DTC B1019 3A

Incorrect Component Installed

Circuit/System Description

The inflatable restraint sensing and diagnostic module (SDM) runs continuous diagnostic tests on the restraints system. If the SDM does not detect the passenger presence system (PPS) indicator or detects a fault in the PPS indicator circuit, DTC B1019 3A will set.

After the SDM is programmed, the SDM setup procedure is required. During this set up procedure, the SDM will compare the content that was just programmed to the actual components that are installed on the vehicle. If the SDM detects that there are too few or too many components on the system, DTC B1019 00 will set and not allow the setup procedure to complete.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

B1019 00

- The SDM was programmed with the wrong options for the vehicle.
- The wrong SDM was installed for the content of the vehicle.
- SDM connector may have bent pins or shorting bars causing the SDM to learn deployment loops that are not actually present.

B1019 3A

- The vehicle was configured for passenger presence system (PPS) but the SDM does not detect that the PPS indicator is present due to loss of power at indicator.
- The vehicle is not configured for PPS and the SDM detects that the PPS indicator is present.

Action Taken When the DTC Sets

- The SDM commands ON the AIR BAG warning lamp via serial data communications.
- The SDM disables all deployments when B1019 00 DTC is set current, not for B1019 3A.

Conditions for Clearing the DTC

- The correct SDM must be installed.
- The correct components must be installed.
- The PPS indicator operates as indicated in the **SIR System Description and Operation**.

Diagnostic Aids

If the SDM has been replaced, make sure that the correct part number was installed for this vehicle. If after programming the SDM and the B1019 00 sets current, check for bent pins or shorting bars at the SDM connector.

Reference Information

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Testing

B1019 3A

1. If the vehicle is equipped with a PPS system, verify the PPS indicator is present.
    - If not present, install the PPS status indicator
2. Verify the PPS Indicator operates as indicated in the **SIR System Description and Operation**.
    - If operation differs from that outlined in the Description and Operation, correct the fault in the PPS indicator circuit; refer to **Passenger Presence System Indicator Circuit Malfunction** to correct the condition.

B1019 00

1. Verify that the vehicle is equipped with all the SIR components it was configured for.
    - Restore the vehicle to the original content and perform the Setup New SDM special function in the scan tool.
2. Remove the SDM connector and verify the SDM connector is in good condition and has no bent pins, terminals or shorting bars.
    - If damage is found, repair the bent pins, terminals or shorting bars as needed and then perform the Setup New SDM special function in the scan tool.
3. Verify the correct SDM part number was installed.
    - If wrong SDM was installed, replace SDM
4. Verify the SDM was programmed with the correct software.
    - If SDM was not programmed correctly, reprogram SDM. Use the Scan Tool to program the SDM. Refer to **Repair Instructions** for programming procedure.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for SDM or BCM replacement, setup, and programming

DTC B1370

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

DTC Descriptor

DTC B1370 01

Device Ignition 1 Circuit Short to Battery

DTC B1370 06

Device Ignition 1 Circuit Short to Ground or Open

Diagnostic Fault Information

DTC B1370

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Ignition 1 Circuit	B1370 06	-	B1370 06	B1370 01	B1370 06

Circuit/System Description

The inflatable restraint sensing and diagnostic module (SDM) monitors the ignition 1 signal from the ignition switch. When the vehicle ignition switch is placed in the RUN or CRANK position the switch supplies voltage to the SDM ignition 1 input terminal. If an open, short to voltage, or short to ground in this SDM ignition 1 circuit is detected then DTC B1370 will set.

Conditions for Running the DTC

Ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

The following conditions exist for at least 10 seconds.

B1370 01

The SDM detects a short to battery in the ignition 1 voltage circuit when the switch is in the OFF position.

B1370 06

- The SDM detects a short to ground or an open in the ignition 1 voltage circuit when the ignition switch is in RUN or CRANK.
- The SDM sees that the vehicle power mode message is Run/Crank but does not detect the Run/Crank voltage on the ignition 1 input.
- There is an open circuit on the in the control side of the RUN/Crank relay.

Action Taken When the DTC Sets

- The SDM commands the AIR BAG indicator ON via serial data communications.
- The SDM stores DTC to memory.
- The SDM determines its power mode only from the GMLAN power mode messages and discards the ignition 1 input for the remainder of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Diagnostic Aids

The SIR fuse could be open and DTC B1370 will set if the low reference circuit is shorted to voltage/battery with no sensor code set for one of the following sensors:

- Right or Left front end sensors
- Right or Left side impact sensors

There is a current fault on the control side of the RUN/CRANK relay.

Reference Information

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Testing

IMPORTANT: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or

replacement of the affected component/connector.

- **The SDM module**
- **The SDM wiring harness connector**

1. Ignition OFF, remove the Air Bag fuse from the underhood fuse center. Ignition ON, engine OFF test the voltage from the supply voltage side of the AIR BAG fuse to a ground with a DMM. The voltage should read 9-16 volts.
   - If the voltage is less than 9-16 volts, correct the open or short on the voltage supply circuit or the open in the control side of the RUN/CRANK relay.
2. Remove the SDM connector. With the air bag fuse removed, test the ignition 1 voltage circuit between the underhood fuse center and the SDM for a short to voltage or an open. Verify that a short to voltage or an open does not exist.
   - If any of the above conditions are found, make the appropriate repair.
   - If ignition 1 voltage circuit test normal then refer to **Diagnostic Aids** within this repair.
3. If all circuits test normal, replace the SDM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for SDM replacement, setup, and programming

PASSENGER PRESENCE SYSTEM REZEROING PROCEDURE

Introduction

The Inflatable Restraints Passenger Presence System (PPS) is a calibrated system that requires rezeroing anytime the seat cushion trim attachments have been removed or the PPS has been replaced. The procedures below are designed to assist in the rezeroing of the PPS. Before you start, read these procedures carefully and completely. For further information regarding the PPS refer to **SIR System Description and Operation**.

IMPORTANT: The following procedures must be followed:

1. Read this procedure carefully and completely.
2. The PPS will not function properly if the PPS rezeroing procedure is not performed.
3. Perform the **Diagnostic System Check - Vehicle** after successfully completing the rezeroing procedure to ensure the system is functioning properly.

Passenger Presence System (PPS) Rezeroing Procedure

IMPORTANT: Before rezeroing the PPS, the front passenger seat must be completely empty of all items. The presence of any items on the front passenger seat will affect the calibration and operation of the PPS.

IMPORTANT: When rezeroing the PPS, the instrument panel cluster (IPC), and Passenger Air Bag ON/OFF indicator will begin dimming ON and OFF. This is normal operation during the rezeroing procedure and does not indicate additional system faults.

1. Empty the front outboard passenger seat.
2. Verify that all SIR and PPS components, connectors, and connector position assurances (CPAs) are properly connected and mounted.
3. Install a scan tool.
4. Turn ON the ignition, with the engine OFF.

   IMPORTANT: All SIR and PPS DTCs must be cleared before rezeroing the PPS. The presence of current or history DTCs will prevent the PPS from rezeroing and may set additional DTCs.

5. Use the scan tool in order to clear the SIR and PPS DTCs.
6. With a scan tool, request the PPS rezeroing procedure.
7. Initiate the PPS rezeroing procedure. The PPS will illuminate both PASSENGER AIR BAG ON and OFF indicators until the rezeroing procedure has been completed.
   - When the rezeroing procedure has been successfully completed, the PPS will display the current system status.
   - If the rezeroing procedure was unsuccessful, both PASSENGER AIR BAG ON and OFF indicators will alternate from no illumination to full illumination in 1 second intervals for 5 seconds. The PPS will treat an unsuccessful rezero attempt as a system fault.
8. If the rezeroing procedure was unsuccessful, repeat this procedure. Due to the communication status between the SDM and the PPS module, this procedure may have to be repeated until a successful rezero attempt has been achieved.
9. After the PPS has been successfully rezeroed, perform the **Diagnostic System Check - Vehicle** .

SYMPTOMS - SIR

IMPORTANT: Complete the following steps before using the symptom

tables:

1. Perform **Diagnostic System Check - Vehicle** in Vehicle DTC Information, before using the symptom tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The inflatable restraint sensing and diagnostic module (SDM) can communicate via the serial data link.
2. Review the SIR system description and operation in order to familiarize yourself with the system functions. Refer to **SIR System Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the SIR system. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Symptom List

- Refer to **Air Bag Indicator Circuit Malfunction** in order to diagnose the symptom.
- Refer to **Passenger Presence System Indicator Circuit Malfunction** in order to diagnose the symptom.

AIR BAG INDICATOR CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

Circuit/System Description

When the ignition is turned ON, the instrument panel cluster (IPC) flashes the AIR BAG indicator seven times. The inflatable restraint sensing and diagnostic module (SDM) performs diagnostic tests on the SIR system and then commands the IPC to turn the AIR BAG indicator OFF if no SIR malfunction exists. The AIR BAG indicator is controlled by the SDM via serial data communications. If the ignition 1 voltage is outside of the normal operating voltage range 9-16 volts, the SDM will command the IPC to turn the AIR BAG indicator ON with no diagnostic trouble codes (DTCs) present then disables all deployment loops.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Diagnostic Aids

A DTC B1370 may set if the ignition 1 circuit is outside the 9-16 volts range.

Circuit/System Testing

1. Ignition ON, use the scan tool to request the SIR data list display. Observe the Battery Voltage Parameter. The battery voltage on the scan tool should read 9-16 volts.
   - If the voltage is less than 9 volts, refer to **Diagnostic System Check - Vehicle** .
2. Ignition ON, monitor the IPC, the SIR warning indicator should flash then turn OFF. Verify that the SIR warning indicator flash and then turn OFF.
   - If the SIR warning indicator continually flash then replace the SDM.
3. Using the scan tool go to Body and Accessories, then go onward to Special Functions to Instrument Panel Cluster, and then go to Display Test. In the Display Test mode you can turn ON or OFF all the instrument panel indicators when commanded ON. Commanded the IPC indicators ON. The Air Bag indicator should turn ON.
   - If the Air Bag indicator does not turn ON, replace the IPC.

     Note: The AIR BAG warning indicator is not serviceable separately. The IPC must be serviced/replaced as a complete unit.
4. If the scan tool commands the Air Bag indicator ON and OFF then replace the SDM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for IPC and SDM replacement, setup, and programming

PASSENGER PRESENCE SYSTEM INDICATOR CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **STRATEGY BASED DIAGNOSIS** for an overview of the diagnostic approach.
- **DIAGNOSTIC PROCEDURE INSTRUCTIONS** provides an overview of each diagnostic category.

Circuit/System Description

The PASSENGER AIR BAG ON/OFF indicators are used to notify the driver when the Passenger Presence System (PPS) has enabled or disabled the instrument panel (I/P) inflator module. When the ignition is turned ON, the PPS module will commands both PASSENGER AIR BAG ON/OFF indicators ON for 5 seconds; then the PPS module conducts tests on the PPS components and circuits while both PASSENGER AIR BAG ON/OFF indicators are ON. If no malfunctions are detected, the PPS module will turn the PASSENGER AIR BAG indicator ON or OFF, depending on the status of the PPS. If a malfunction is detected, the PPS module will store a diagnostic trouble code (DTC), default the PPS to the OFF state, and communicate with the SDM that a DTC has been set. The SDM will request the instrument panel cluster (IPC) to turn the AIR BAG indicator ON to notify the driver of a malfunction.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

SIR Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Testing

IMPORTANT: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **The IPC module**
- **The PPS module**
- **The SDM module**
- **The IPC module wiring harness connector**
- **The PPS module wiring harness connector**
- **The SDM wiring harness connector**

1. Using the scan tool go to Body and Accessories, then go onward to Special Functions to Instrument Panel Cluster (IPC), and then go to Display Test. In the Display Test mode you can turn ON or OFF all the instrument panel indicators when commanded ON. Commanded the IPC indicators ON. The PPS indicators should turn ON.
   - If the Passenger AIR BAG ON/OFF indicators does not turn ON, remove the connector from the PPS indicator display.
   - On the PPS connector test and repair the Passenger AIR BAG ON/OFF indicator voltage circuit for a short to ground, a high resistance, or an open. If any of these conditions are found make the appropriate repair.
   - Connect a test lamp between the ignition 1 voltage circuit and Passenger Air Bag OFF indicator control circuit on the Passenger AIR BAG ON/OFF indicator connector. With the passenger seat empty use a scan tool to command the display test, verify the test lamp illuminate.
     - If test lamp illuminates replace the Passenger AIR BAG ON/OFF indicator.
   - Remove the IPC connector. Test and repair both ON and OFF indicator control circuits between the PPS indicator and the IPC for a short to voltage, high resistance, or an open. If any of these conditions are found make the appropriate repair.
   - If Passenger AIR BAG ON/OFF indicator voltage, ON, and OFF circuits tests good then replace the IPC.

     Note: The IPC must be serviced/replaced as a complete unit.
2. PPS indicators turns ON when command ON then replace the PPS.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Indicator Replacement - Inflatable Restraint IP Module**
- **Control Module References** for IPC and PPS replacement, setup, and programming

SIR DISABLING AND ENABLING ZONES

IMPORTANT: Refer to SIR Service Precautions before disabling the SIR system.

SIR component location affects how a vehicle should be serviced. There are parts of the SIR system installed in various locations around a vehicle. To find the location of the SIR components, refer to **SIR Zone Identification Views**.

There are several reasons for disabling the SIR system, such as repairs to the SIR system or servicing a component near or attached to an SIR component. There are several ways to disable the SIR system depending on what type of service is being performed. The following information covers the proper procedures for disabling/enabling the SIR system.

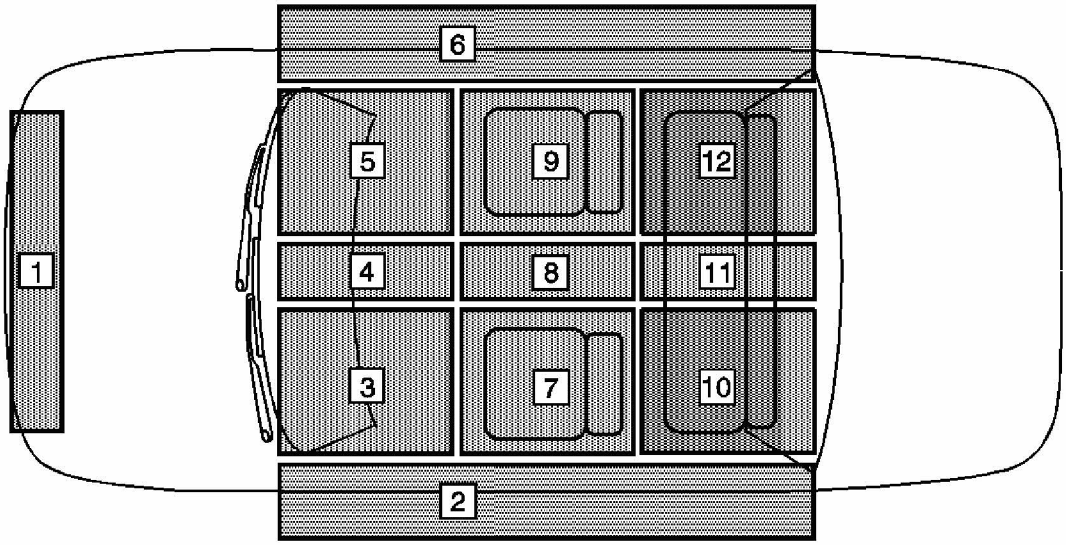


Fig. 43: Identifying SIR Disabling and Enabling Zones
Courtesy of GENERAL MOTORS CORP.

SIR Disabling and Enabling Zones

Zone	Description
1	Inflatable Restraints Front End Sensor (left/right)-Refer to **SIR**

	Disabling and Enabling Zone 1.
2	Driver/Left Inflatable Restraint Roof Rail Module (for Impala only), Side Impact Sensor (SIS), and Seat Belt Retractor Pretensioner-Refer to **SIR Disabling and Enabling Zone 2 (Monte Carlo)** or **SIR Disabling and Enabling Zone 2 (Impala)**.
3	Inflatable Restraint Steering Wheel Module and Coil-Refer to **SIR Disabling and Enabling Zone 3**.
4	Not Used
5	Inflatable Restraint Instrument Panel (I/P) Module-Refer to **SIR Disabling and Enabling Zone 5**.
6	Passenger/Right Inflatable Restraint Roof Rail Module (for Impala only), Side Impact Sensor (SIS), and Seat Belt Retractor Pretensioner. Refer to **SIR Disabling and Enabling Zone 6 (Monte Carlo)** or **SIR Disabling and Enabling Zone 6 (Impala)**.
7	Driver Seat with Side Impact Module (for Monte Carlo only)-Refer to **SIR Disabling and Enabling Zone 7**.
8	Not Used
9	Passenger Seat with Passenger Presence System (PPS), Inflatable Restraint Sensing and Diagnostic Module (SDM) (for both Impala and Monte Carlo), and Side Impact Module (for Monte Carlo only)-Refer to **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)**.
10-12	Not Used

REPAIR INSTRUCTIONS

SIR SERVICE PRECAUTIONS

CAUTION: When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Refer to SIR Disabling and Enabling Zones. Failure to observe the correct procedure could cause deployment of the SIR components, personal injury, or unnecessary SIR system repairs.

The inflatable restraint sensing and diagnostic module (SDM) maintains a reserved energy supply. The reserved energy supply provides deployment power for the air bags. Deployment power is available for as much as 1 minute after disconnecting the vehicle power. Disabling the SIR system prevents deployment of the air bags from the reserved energy supply.

General Service Instructions

The following are general service instructions which must be followed in order to properly repair the vehicle and return it to its original integrity:

- Do not expose inflator modules to temperatures above 65°C (150°F).
- Verify the correct replacement part number. Do not substitute a component from a different vehicle.
- Use only original GM replacement parts available from your authorized GM dealer. Do not use salvaged parts for repairs to the SIR system.

Discard any of the following components if it has been dropped from a height of 91 cm (3 ft) or greater:

- Inflatable restraint SDM
- Inflatable restraint instrument panel (I/P) module
- Inflatable restraint steering wheel module
- Inflatable restraint steering wheel module coil
- Inflatable restraint side impact modules (Monte Carlo)
- Inflatable restraint roof rail modules (Impala)
- Inflatable restraint side impact sensors (SIS)
- Inflatable restraint seat belt retractor pretensioners
- Inflatable restraint front end sensors

SIR DISABLING AND ENABLING ZONE 1

Disabling Procedure

IMPORTANT: Refer to SIR Service

Precautions.

1. Turn the steering wheel so that the vehicles wheels are pointing straight ahead.
2. Turn the ignition switch to the OFF position.
3. Remove the key from the ignition switch.

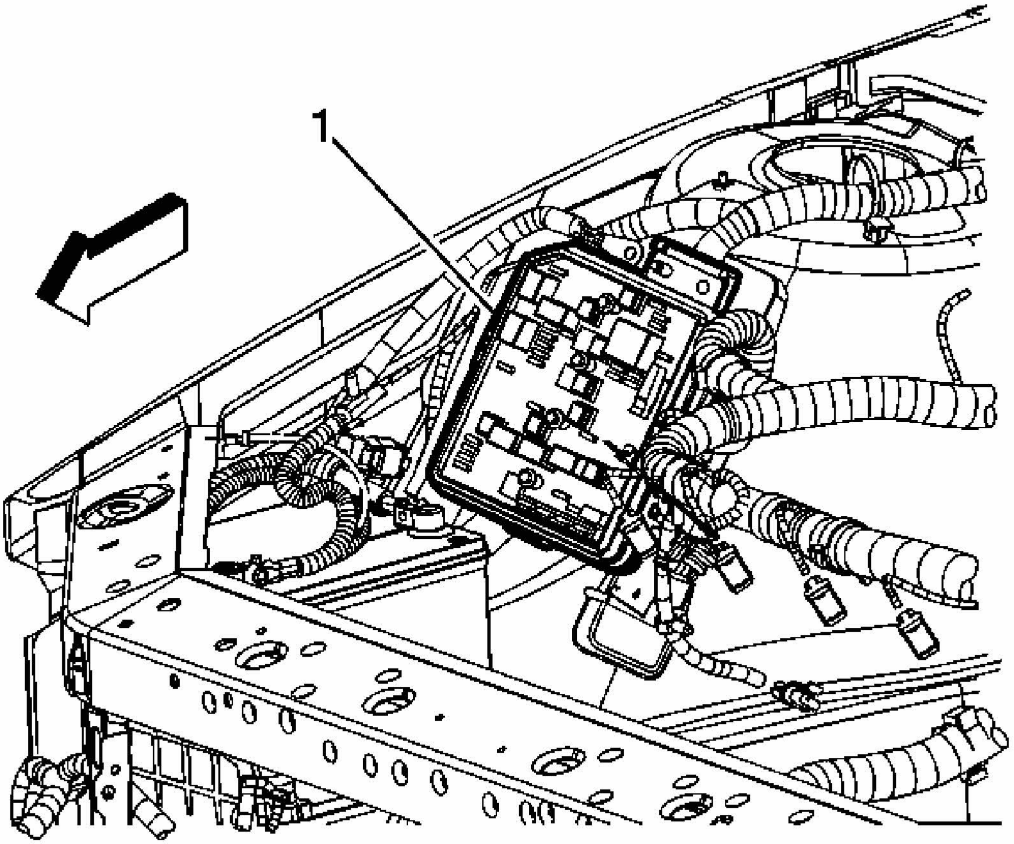


Fig. 44: Identifying Underhood Fuse Center
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: This sensing and diagnostic module (SDM) has 2 fused power inputs. To ensure there is no unwanted SIR deployment, personal injury, or unnecessary SIR system repairs, remove both AIR BAG (IGN) and AIR BAG (BATT) fuses. With the AIR BAG fuses removed and the ignition switch in the ON position, the AIR BAG warning indicator illuminates. This is normal operation, and does not indicate an SIR system malfunction.

4. Open the hood and locate the underhood fuse center (1) on right/passenger shock tower.
5. Lift the cover for the underhood fuse center.
6. Locate and remove the Air Bag Fuse from the underhood fuse center.

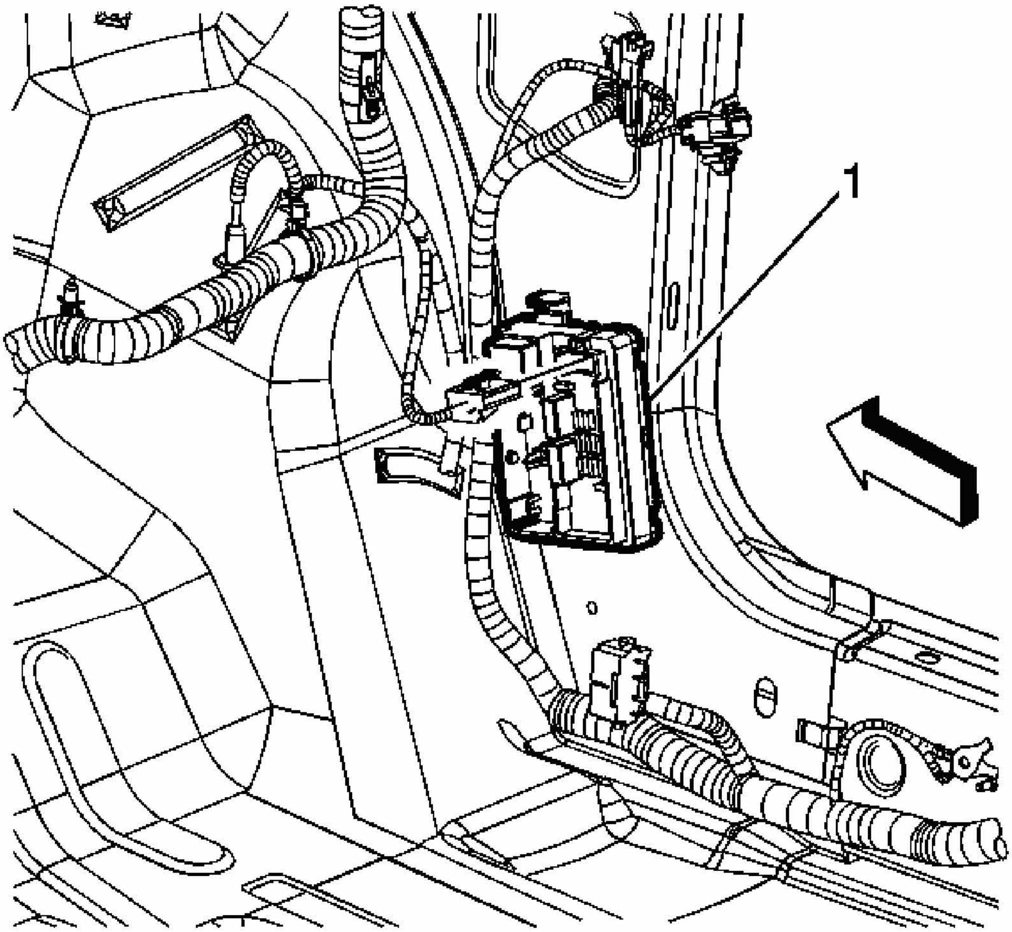


Fig. 45: Identifying Interior Fuse Center
Courtesy of GENERAL MOTORS CORP.

7. Pull back the carpet from the front lower right/passenger door pillar to expose the interior fuse center (1). Refer to **Junction Block Replacement - Accessory Wiring** .
8. Remove the cover then locate and remove the Air Bag Fuse from the interior fuse center.

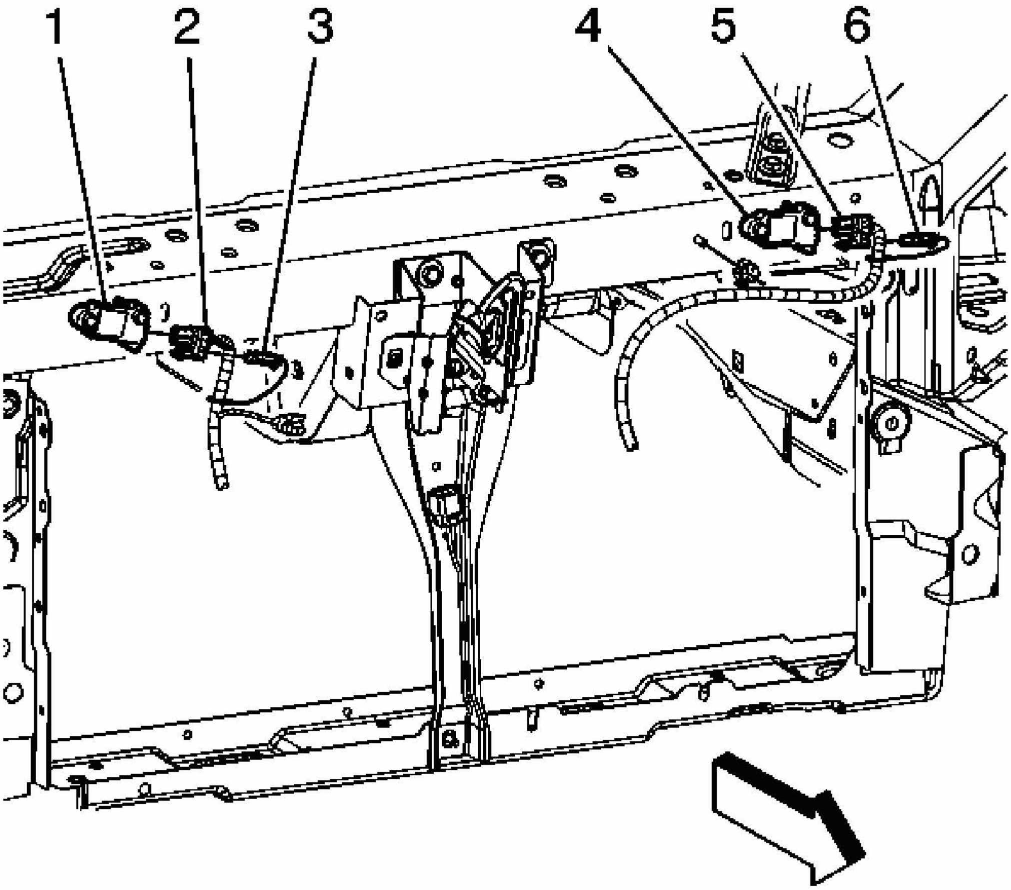


Fig. 46: Locating SIR Sensors & Connectors
Courtesy of GENERAL MOTORS CORP.

9. Remove the radiator upper air baffle and deflector and locate the left and right front end sensor (1, 4).
10. Remove the connector position assurance (CPA) (3, 6) from both front end sensors connector (2, 5).
11. Remove both front end sensor connectors (2, 5) from each front end sensor (1, 4).

Enabling Procedure

1. Remove the key from the ignition switch.

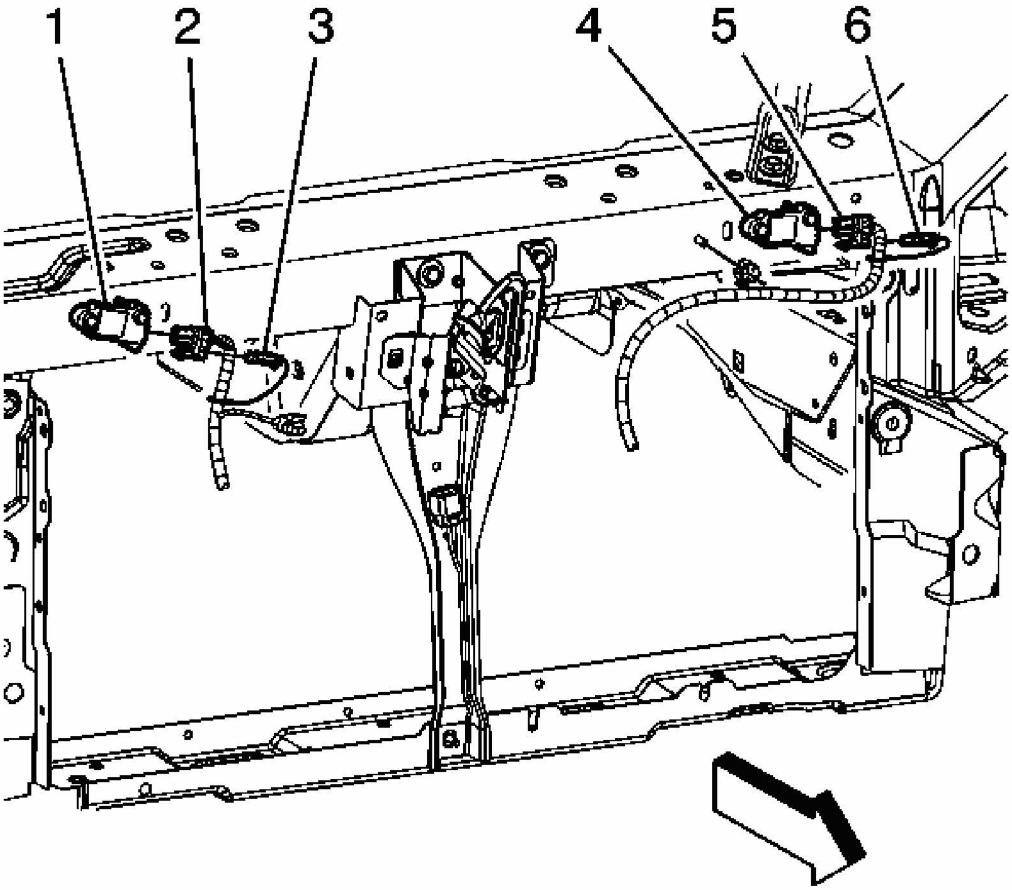


Fig. 47: Locating SIR Sensors & Connectors
Courtesy of GENERAL MOTORS CORP.

2. Connect both front end sensor connectors (2, 5) to each front end sensor (1, 4).
3. Install both CPA's (3, 6) into each front end sensor connector (2, 5).
4. Install the radiator upper air baffle and deflector.
5. Install both Air Bag Fuses, one in the underhood fuse center and one in the interior fuse center.
6. Replace both fuse center covers.
7. Use caution while reaching in and turn the ignition switch to the ON position.

   The AIR BAG indicator will flash then turn OFF.

   Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

SIR DISABLING AND ENABLING ZONE 2 (MONTE CARLO)

Disabling Procedure

1. Turn the steering wheel so that the vehicles wheels are pointing straight ahead.
2. Turn the ignition switch to the OFF position.
3. Remove the key from the ignition switch.

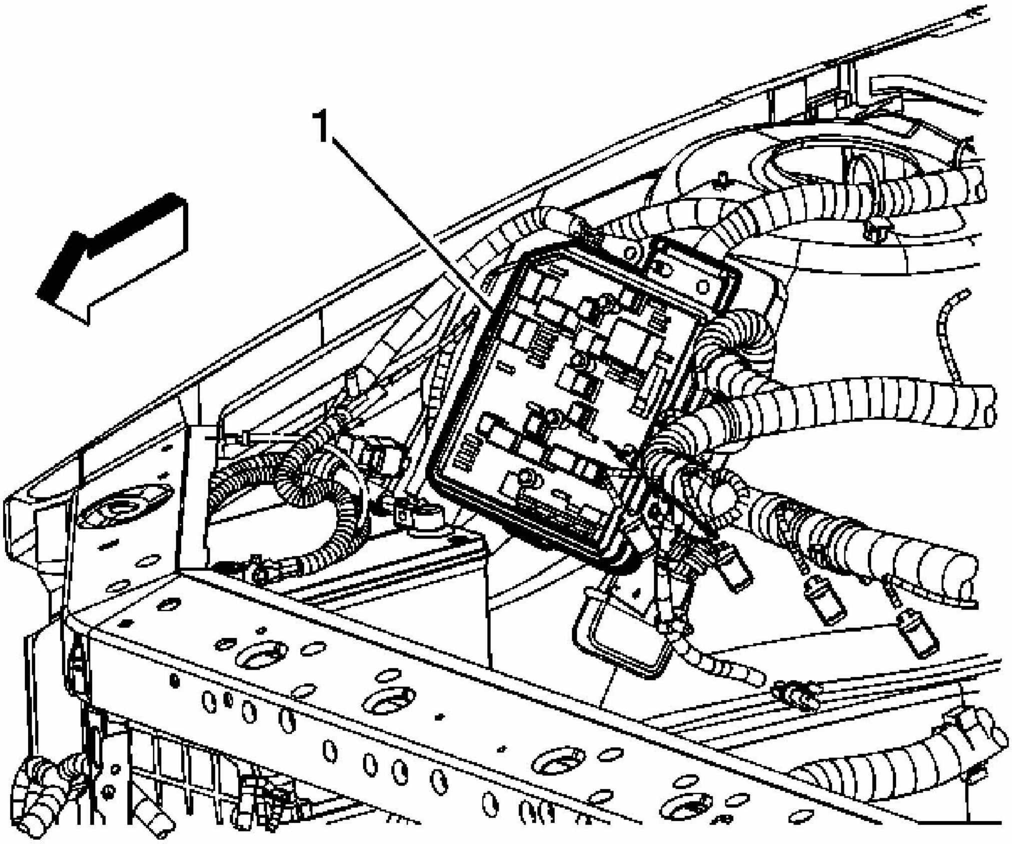


Fig. 48: Identifying Underhood Fuse Center
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: This sensing and diagnostic module (SDM) has 2 fused power inputs. To ensure there is no unwanted SIR deployment, personal injury, or unnecessary SIR system repairs, remove both AIR BAG (IGN) and AIR BAG (BATT) fuses. With the AIR BAG fuses removed and the ignition switch in the ON position, the AIR BAG warning indicator

illuminates. This is normal operation, and does not indicate an SIR system malfunction.

4. Open the hood and locate the underhood fuse center (1) on right/passenger shock tower.
5. Lift the cover for the underhood fuse center.
6. Locate and remove the Air Bag Fuse from the underhood fuse center.

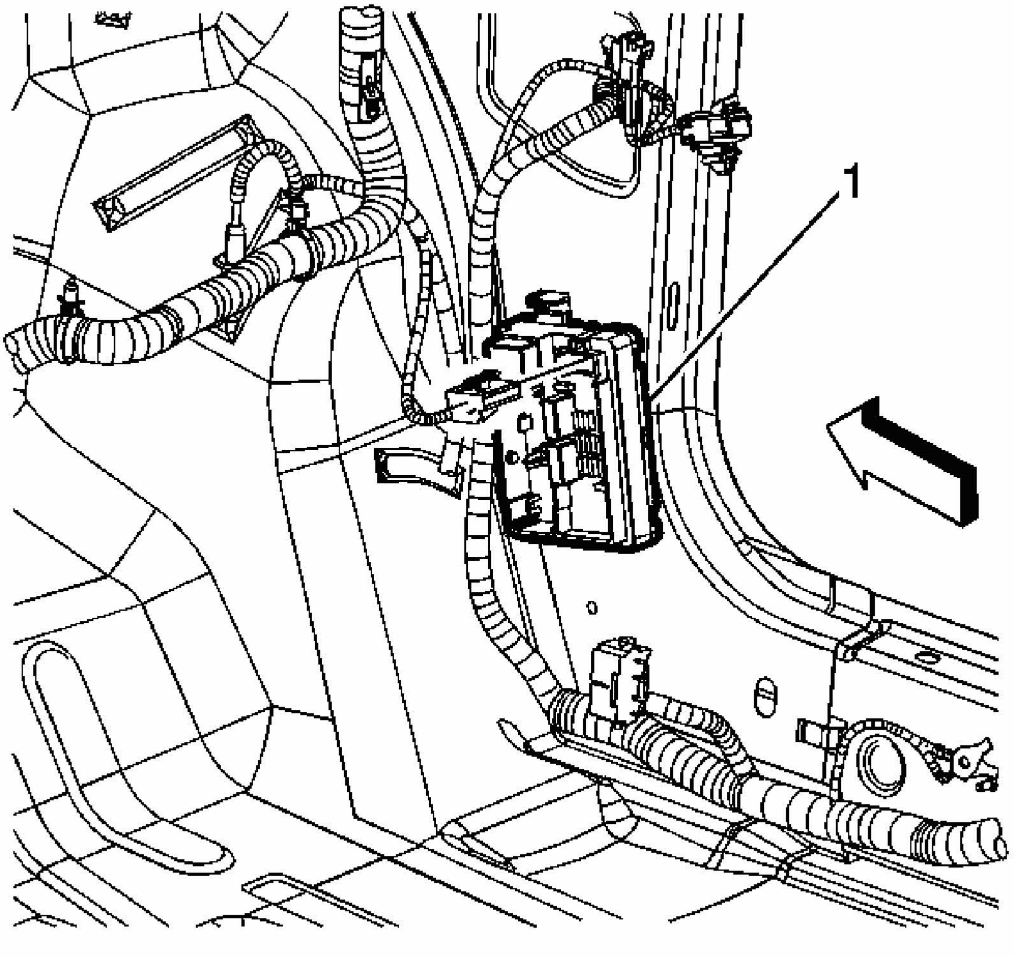


Fig. 49: Identifying Interior Fuse Center
Courtesy of GENERAL MOTORS CORP.

7. Pull back the carpet from the front lower right/passenger door pillar to expose the interior fuse center (1). Refer to **Junction Block Replacement - Accessory Wiring** .
8. Remove the cover then locate and remove the Air Bag Fuse from the interior fuse center.

9. To disable the seat belt retractor pretensioner - LF, go to step 10. To disable the side impact sensor (SIS) - left, go to step 13.

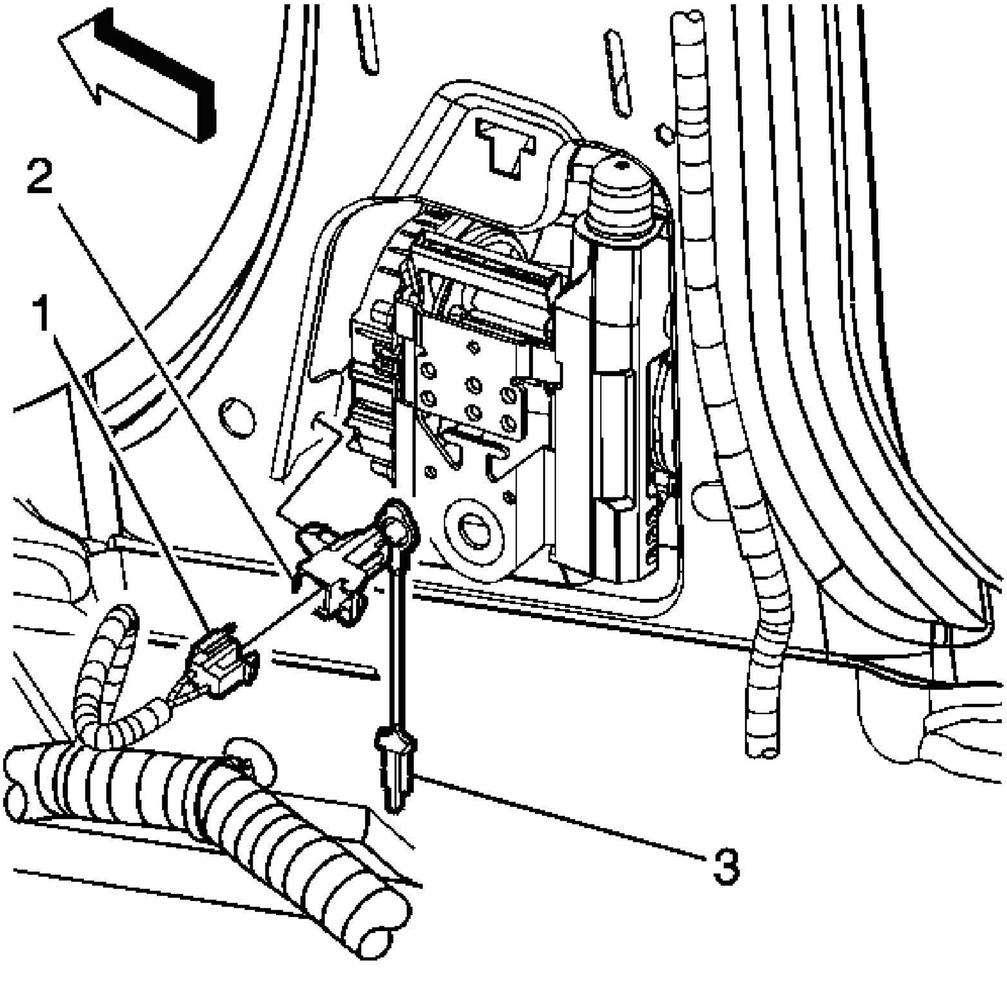


Fig. 50: Removing The Connector Position Assurance
Courtesy of GENERAL MOTORS CORP.

10. Remove the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .
11. Remove the connector position assurance (CPA) (3) from the seat belt retractor pretensioner - LF connector (2).
12. Disconnect the seat belt retractor pretensioner - LF connector (2) from the vehicle harness connector (1).

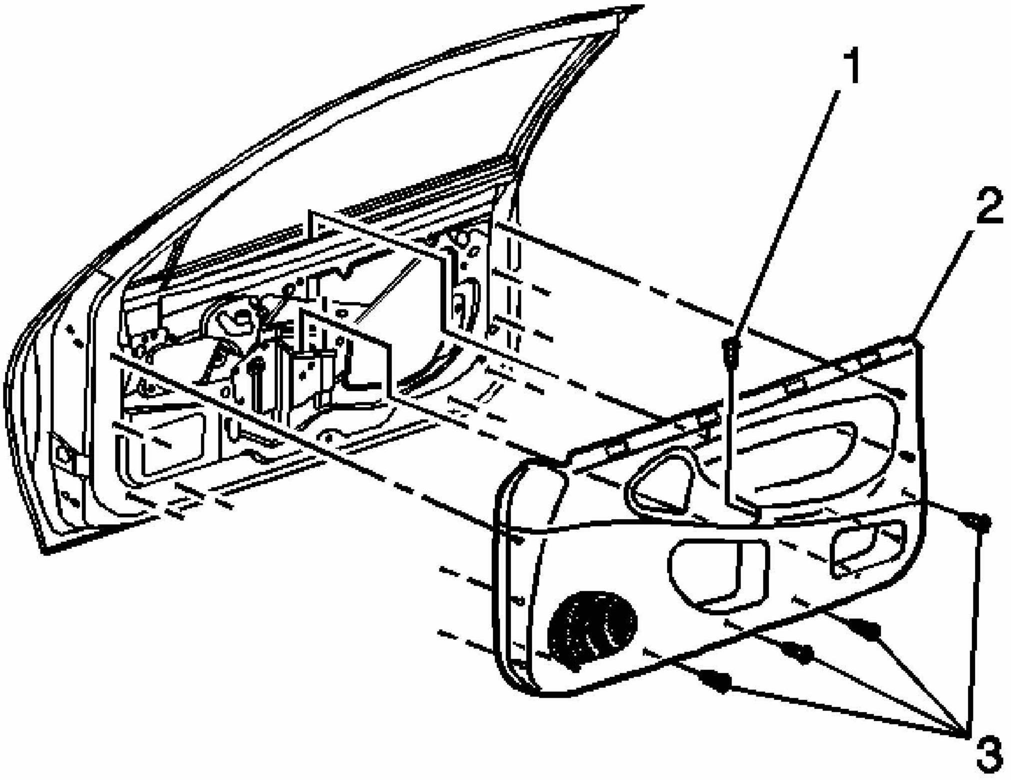


Fig. 51: View Of Door Trim Panel And mounting Screws
Courtesy of GENERAL MOTORS CORP.

13. Remove the LF door trim panel (2). Refer to **Trim Panel Replacement - Side Front Door (Impala)** .

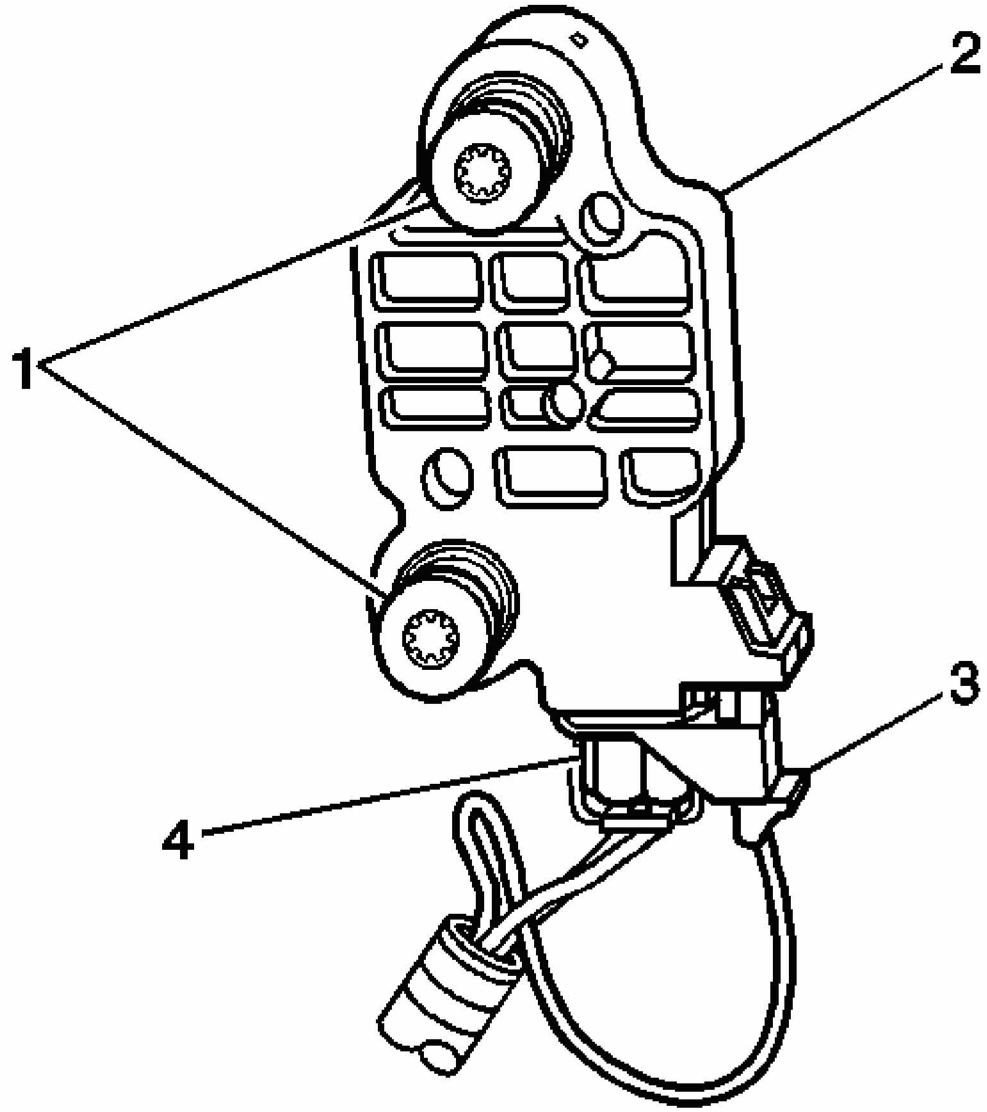


Fig. 52: Identifying Side Impact Sensor (SIS) Connector
Courtesy of GENERAL MOTORS CORP.

14. Remove the CPA (3) from the SIS - left connector (4).
15. Remove the SIS - left connector (4) from the SIS (2).

Enabling Procedure

1. Remove the key from the ignition switch.
2. To enable the SIS - left, go to step 3. To enable the seat belt retractor pretensioner - LF,

go to step 5.

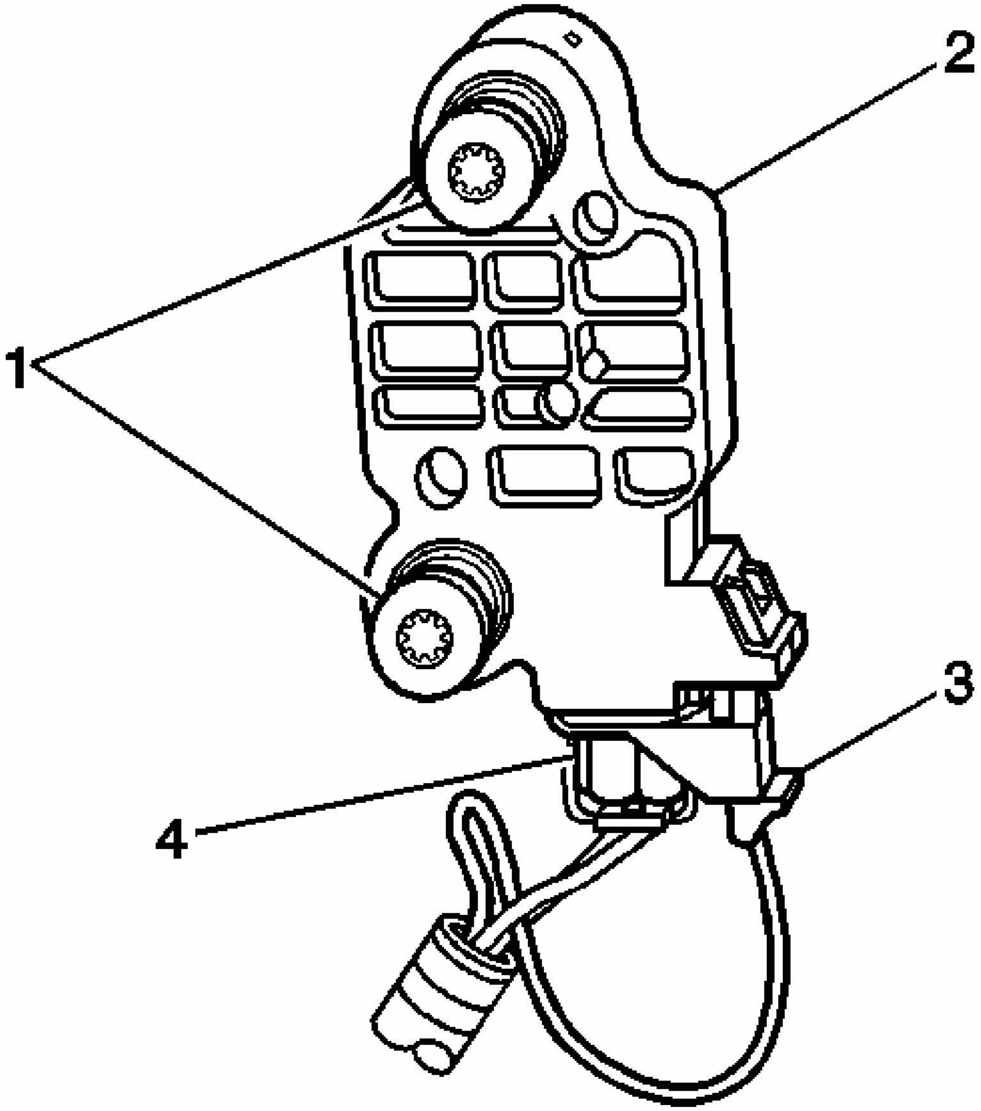


Fig. 53: Identifying Side Impact Sensor (SIS) Connector
Courtesy of GENERAL MOTORS CORP.

3. Install the SIS - left connector (4) to the SIS (2).
4. Install the CPA (3) to the SIS - left connector (4).

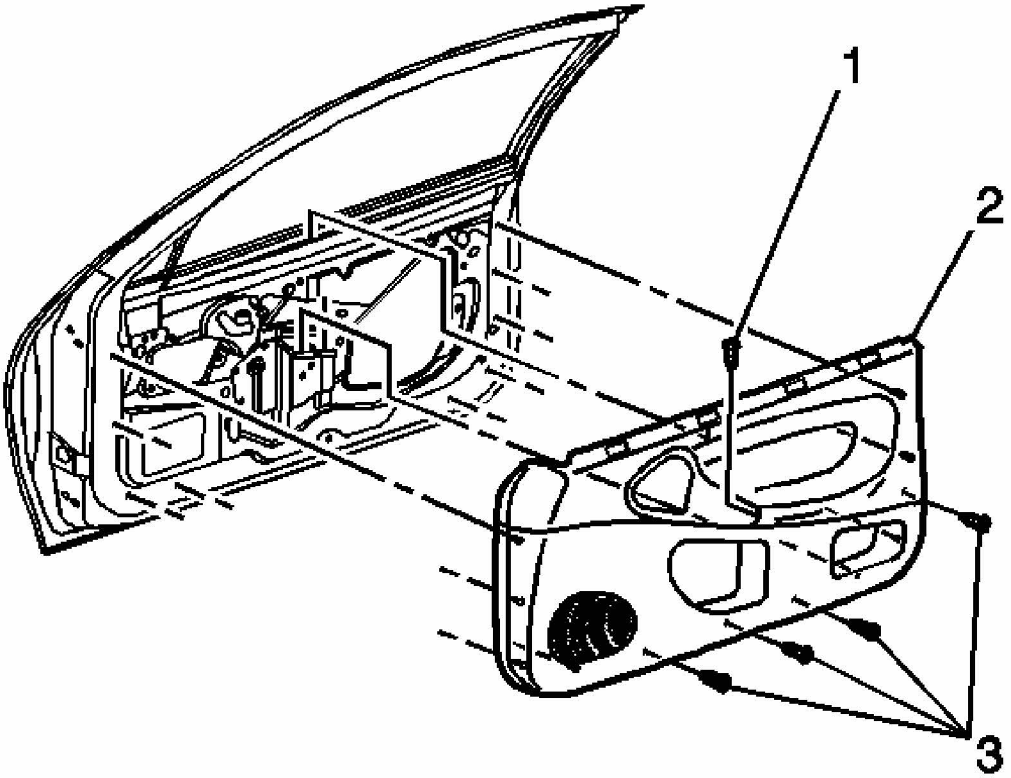


Fig. 54: View Of Door Trim Panel And mounting Screws
Courtesy of GENERAL MOTORS CORP.

5. Install the LF door trim panel (2). Refer to **Trim Panel Replacement - Side Front Door (Impala)** .

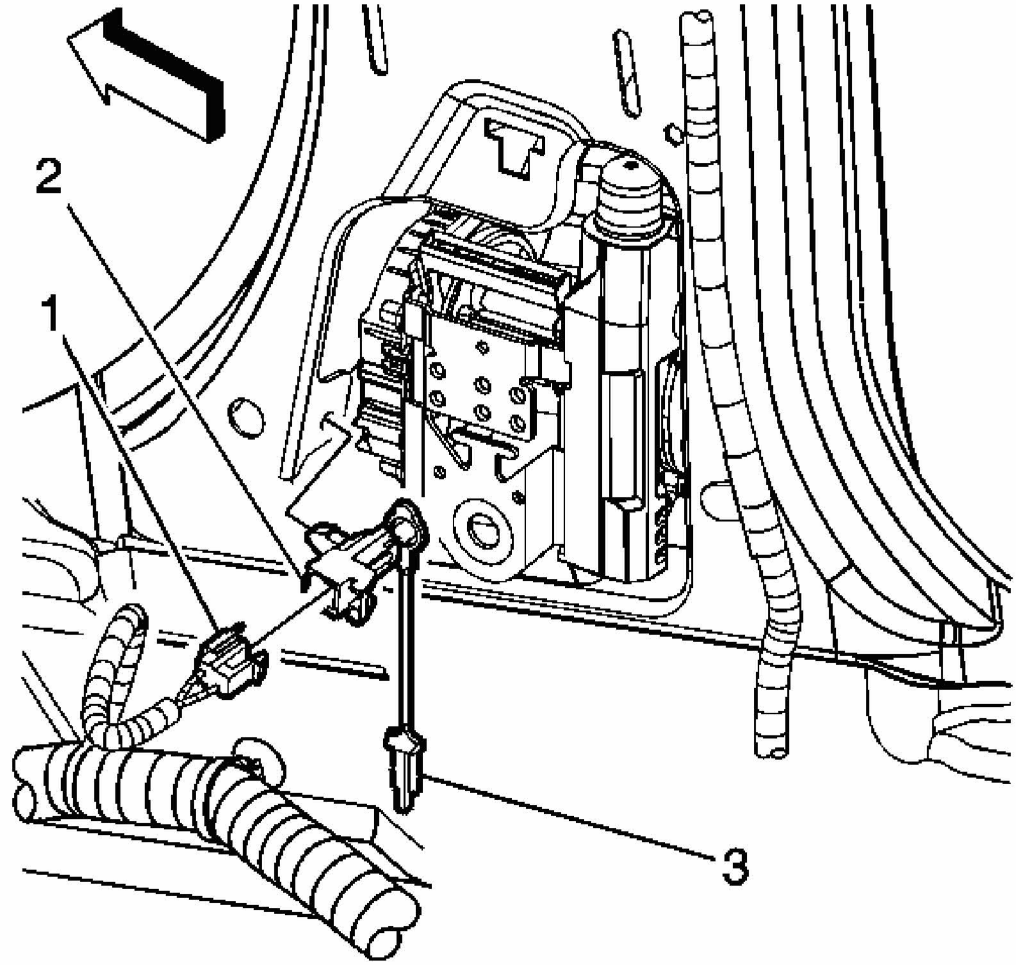


Fig. 55: Installing The CPA
Courtesy of GENERAL MOTORS CORP.

6. Connect the seat belt retractor pretensioner - LF connector (2) to vehicle harness connector (1).
7. Install the CPA (3) to the seat belt retractor pretensioner - LF connector (2).
8. Install the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .
9. Install both Air Bag Fuses, one in the underhood fuse center and one in the interior fuse center.
10. Replace both fuse center covers.
11. Use caution while reaching in and turn the ignition switch to the ON position.

The AIR BAG indicator will flash then turn OFF.

12. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

SIR DISABLING AND ENABLING ZONE 2 (IMPALA)

Disabling Procedure

1. Turn the steering wheel so that the vehicles wheels are pointing straight ahead.
2. Turn the ignition switch to the OFF position.
3. Remove the key from the ignition switch.

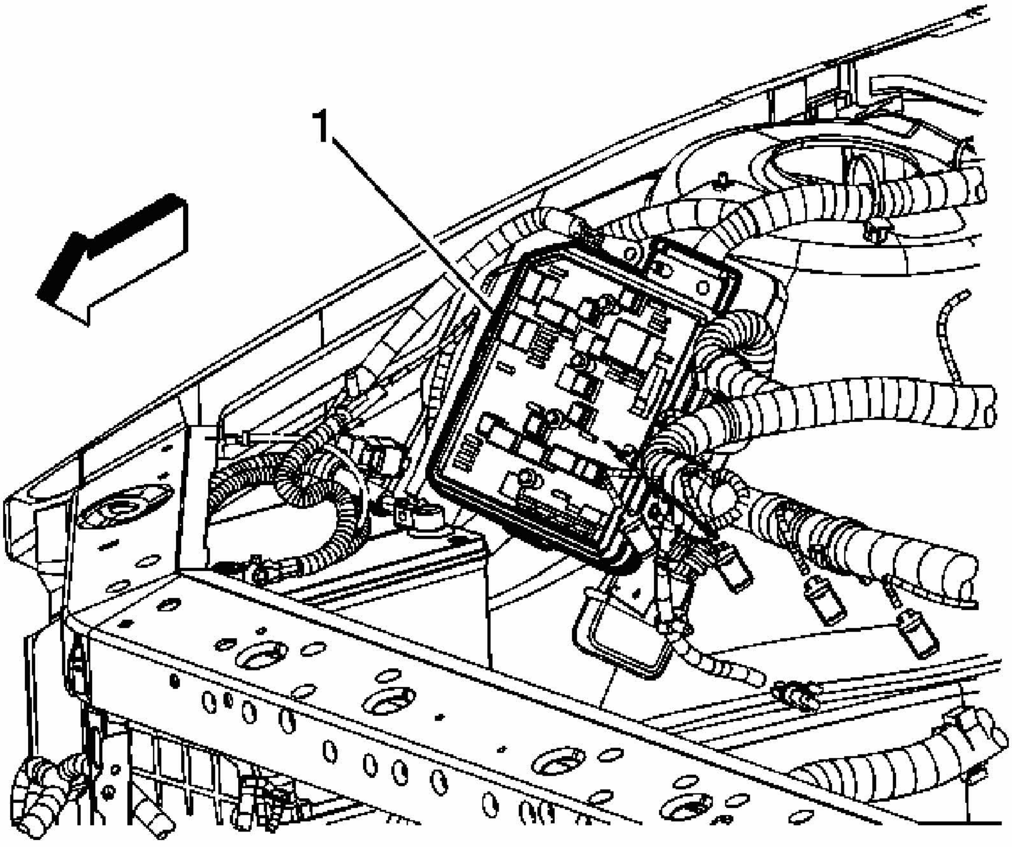


Fig. 56: Identifying Underhood Fuse Center
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: This sensing and diagnostic module (SDM) has 2 fused power inputs. To ensure there is no unwanted SIR

deployment, personal injury, or unnecessary SIR system repairs, remove both AIR BAG (IGN) and AIR BAG (BATT) fuses. With the AIR BAG fuses removed and the ignition switch in the ON position, the AIR BAG warning indicator illuminates. This is normal operation, and does not indicate an SIR system malfunction.

4. Open the hood and locate the underhood fuse center (1) on right/passenger shock tower.
5. Lift the cover for the underhood fuse center.
6. Locate and remove the Air Bag Fuse from the underhood fuse center.

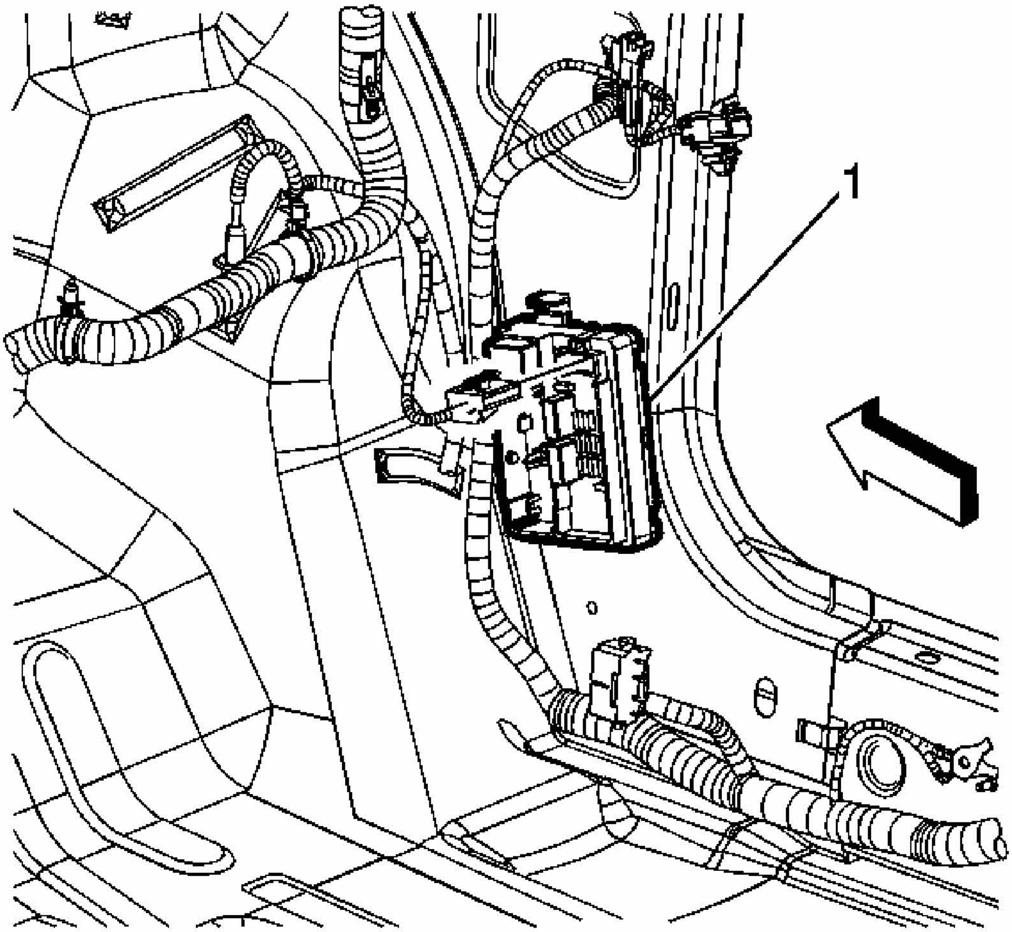


Fig. 57: Identifying Interior Fuse Center
Courtesy of GENERAL MOTORS CORP.

7. Pull back carpet from the front lower right/passenger door pillar to expose the interior fuse center (1). Refer to **Junction Block Replacement - Accessory Wiring** .
8. Remove the cover then locate and remove the Air Bag Fuse from the interior fuse center.
9. To disable the seat belt retractor pretensioner - LF, go to step 10. To disable the roof rail module - left, go to step 13 and for the side impact sensor (SIS) - left, go to step 16.

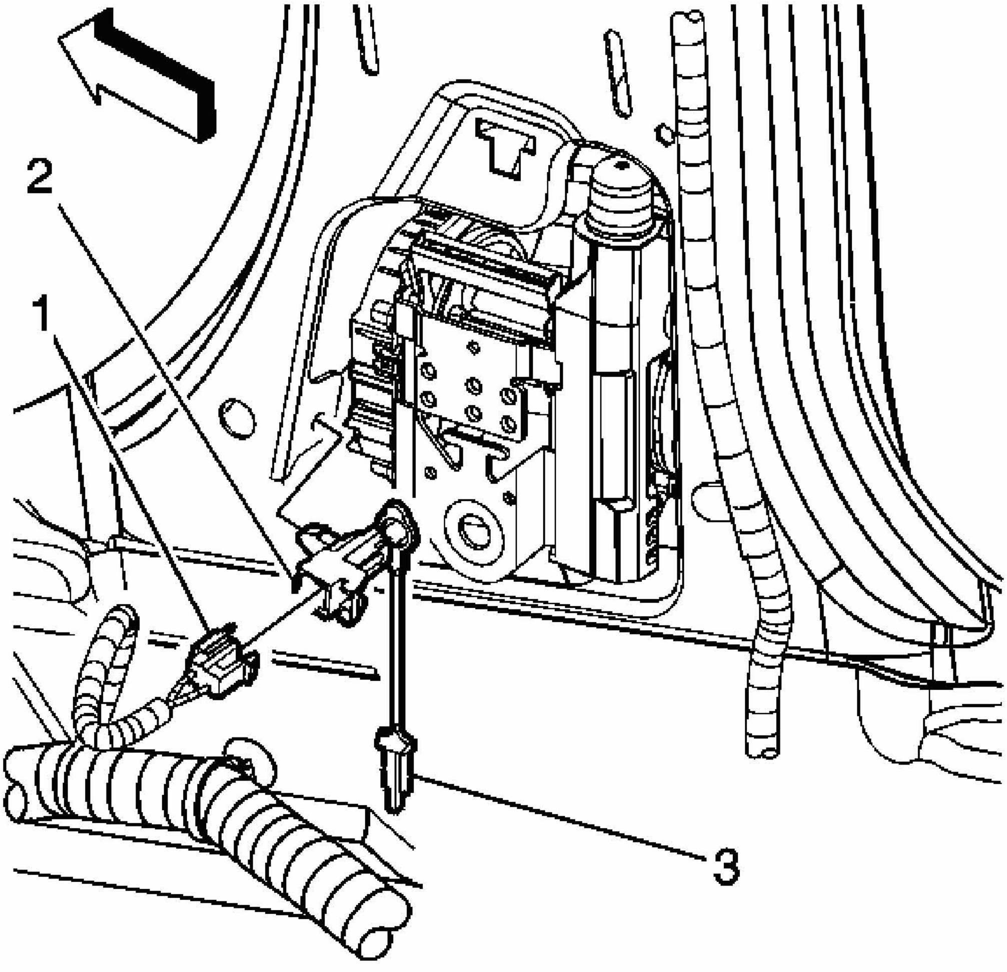


Fig. 58: Removing The Connector Position Assurance
Courtesy of GENERAL MOTORS CORP.

10. Remove the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .
11. Remove the connector position assurance (CPA) (3) from the seat belt retractor pretensioner - LF connector (2).

12. Disconnect the seat belt retractor pretensioner - LF connector (2) from the vehicle harness connector (1).

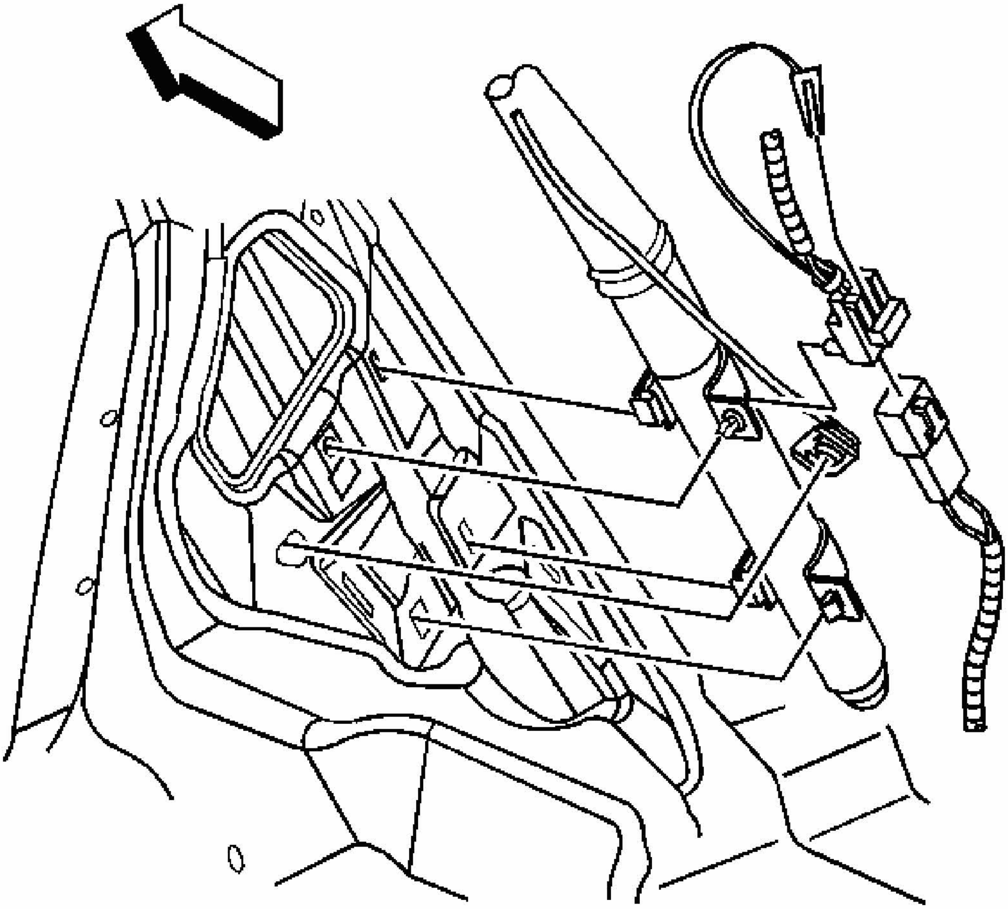


Fig. 59: Locating Roof Rail Module Connector
Courtesy of GENERAL MOTORS CORP.

13. Remove the upper trim molding from the rear quarter pillar. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .
14. Remove the CPA from the roof rail module - left connector.
15. Disconnect the roof rail module - left connector from the vehicle harness connector.

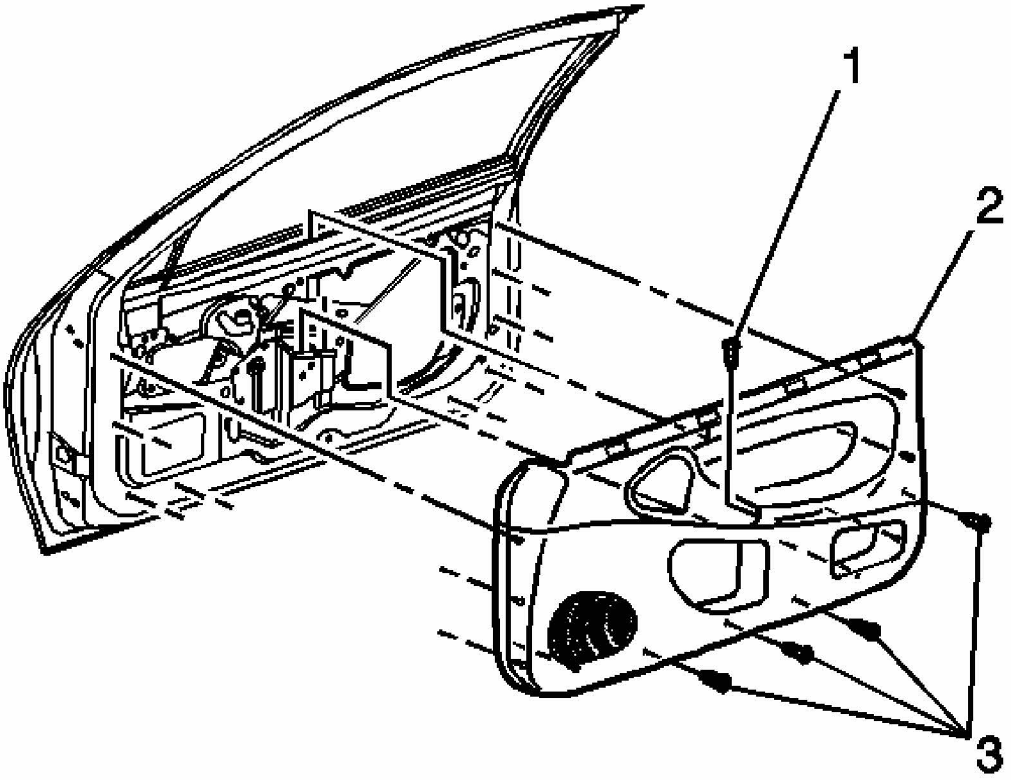


Fig. 60: View Of Door Trim Panel And mounting Screws
Courtesy of GENERAL MOTORS CORP.

16. Remove the LF door trim panel (2). Refer to **Trim Panel Replacement - Side Front Door (Impala)** .

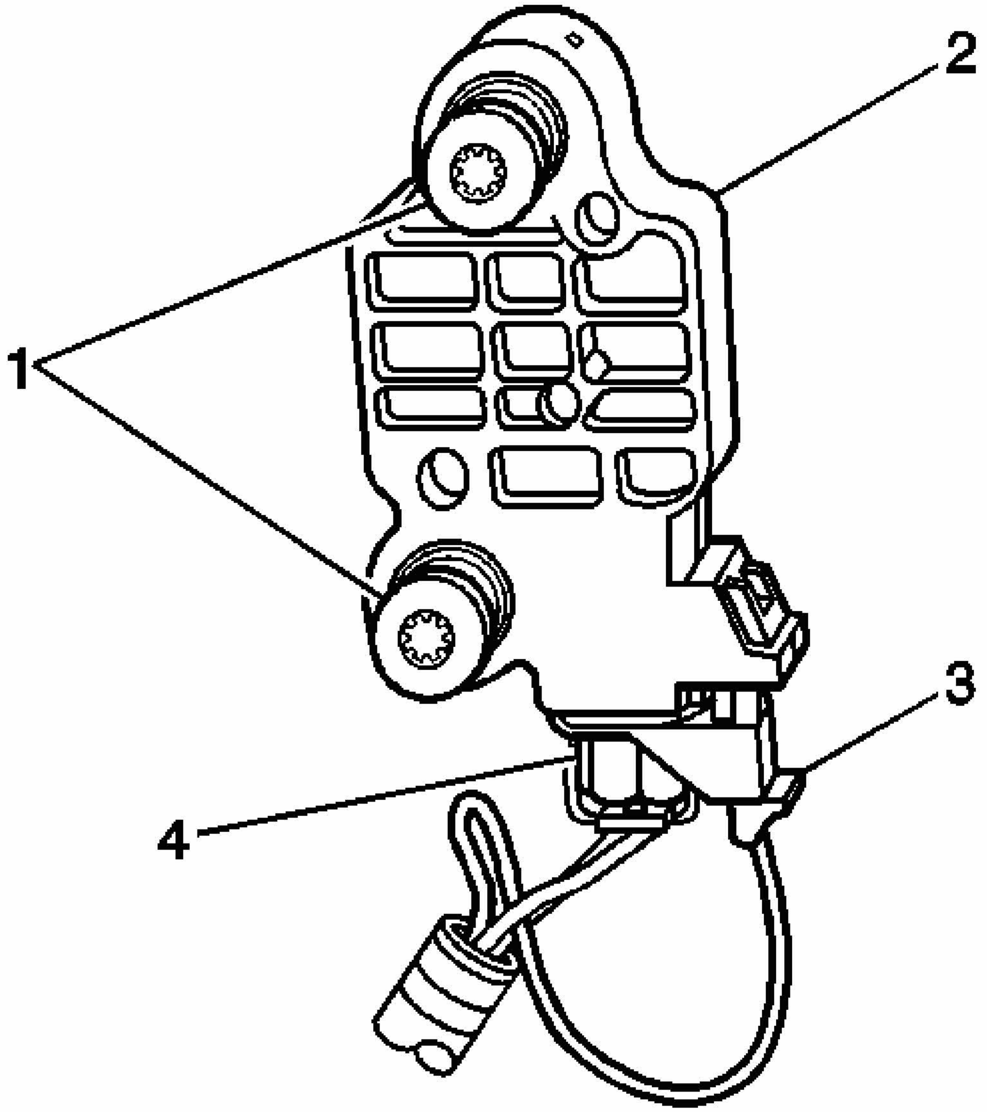


Fig. 61: Identifying Side Impact Sensor (SIS) Connector
Courtesy of GENERAL MOTORS CORP.

17. Remove the connector position assurance (CPA) (3) from the SIS - left connector (4).
18. Remove the SIS - left connector (4) from the SIS (2).

Enabling Procedure

1. Remove the key from the ignition switch.
2. To enable the SIS - left, go to step 3. To enable the roof rail module - left, go to step 6,

and to enable the seat belt retractor pretensioner - LF, go to step 9.

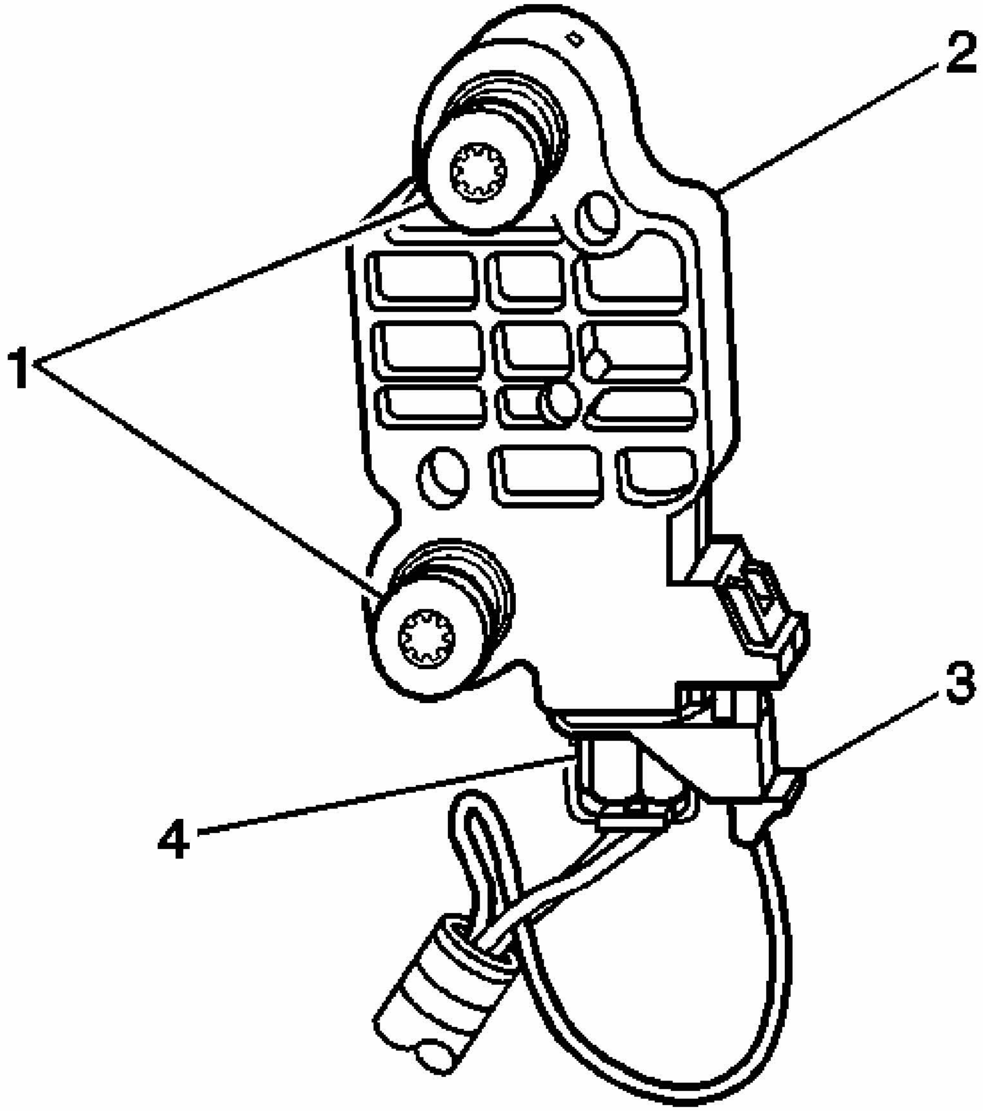


Fig. 62: Identifying Side Impact Sensor (SIS) Connector
Courtesy of GENERAL MOTORS CORP.

3. Install the SIS - left connector (4) to the SIS (2).
4. Install the CPA (3) to the SIS - left connector (4).

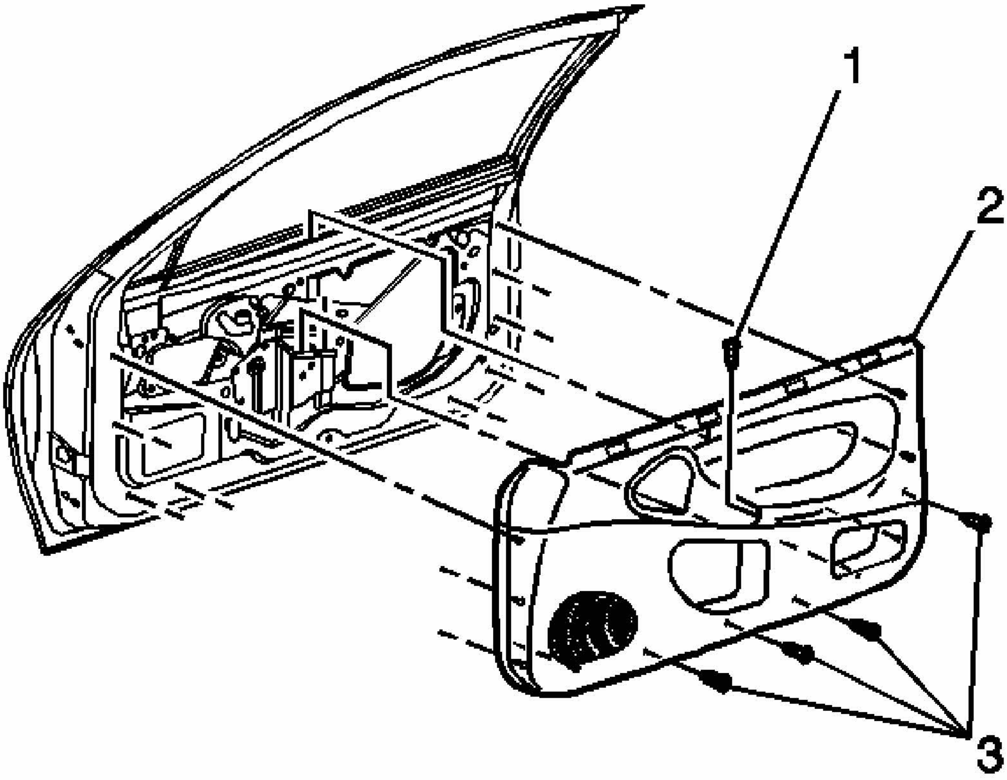


Fig. 63: View Of Door Trim Panel And mounting Screws
Courtesy of GENERAL MOTORS CORP.

5. Install the LF door trim panel (2). Refer to **Trim Panel Replacement - Side Front Door (Impala)** .

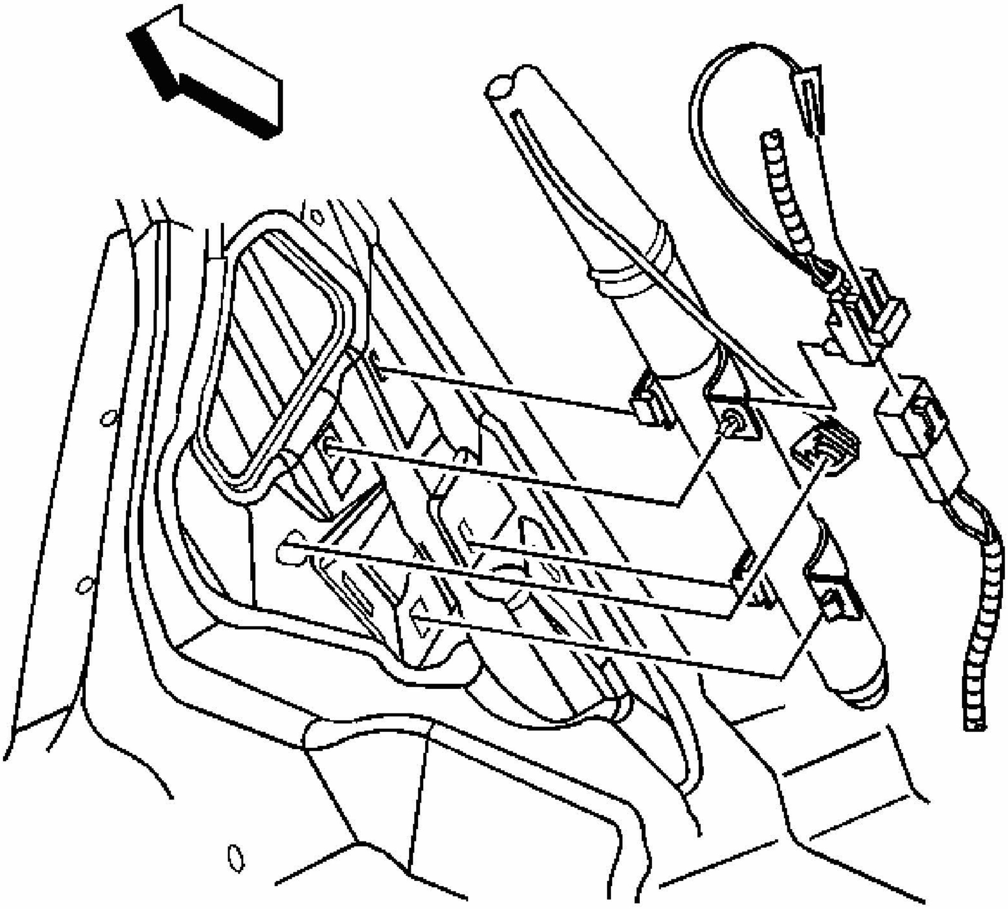


Fig. 64: Locating Roof Rail Module Connector
Courtesy of GENERAL MOTORS CORP.

6. Connect the roof rail module - left connector to the vehicle harness connector.
7. Install the CPA to the roof rail module - left connector.
8. Install the garnish molding to the upper lock pillar. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .

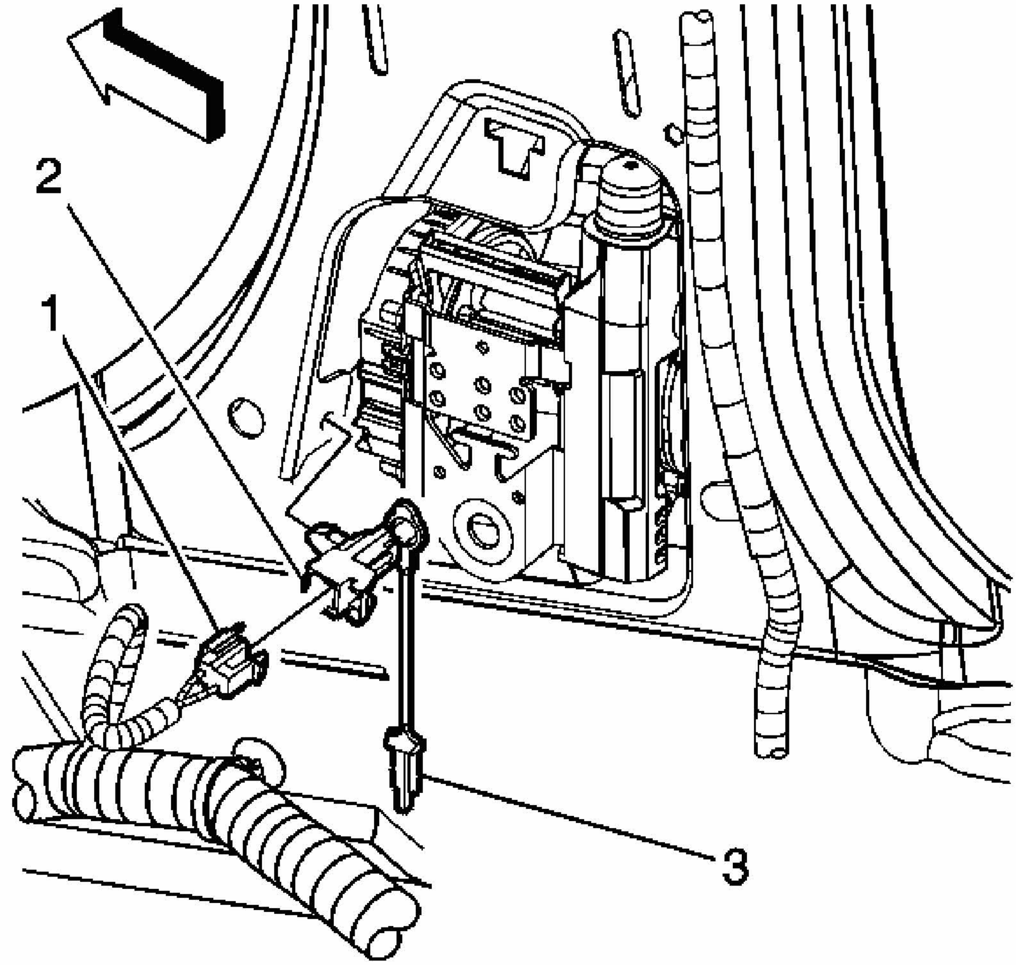


Fig. 65: Installing The CPA
Courtesy of GENERAL MOTORS CORP.

9. Connect the seat belt retractor pretensioner - LF connector (2) to vehicle harness connector (1).
10. Install the CPA (3) to the seat belt retractor pretensioner - LF connector (2).
11. Install the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .
12. Install both Air Bag Fuses, one in the underhood fuse center and one in the interior fuse center.
13. Replace both fuse center covers.
14. Use caution while reaching in and turn the ignition switch to the ON position.

The AIR BAG indicator will flash then turn OFF.

15. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

SIR DISABLING AND ENABLING ZONE 3

Disabling Procedure

1. Turn the steering wheel so that the vehicles wheels are pointing straight ahead.
2. Turn the ignition switch to the OFF position.
3. Remove the key from the ignition switch.

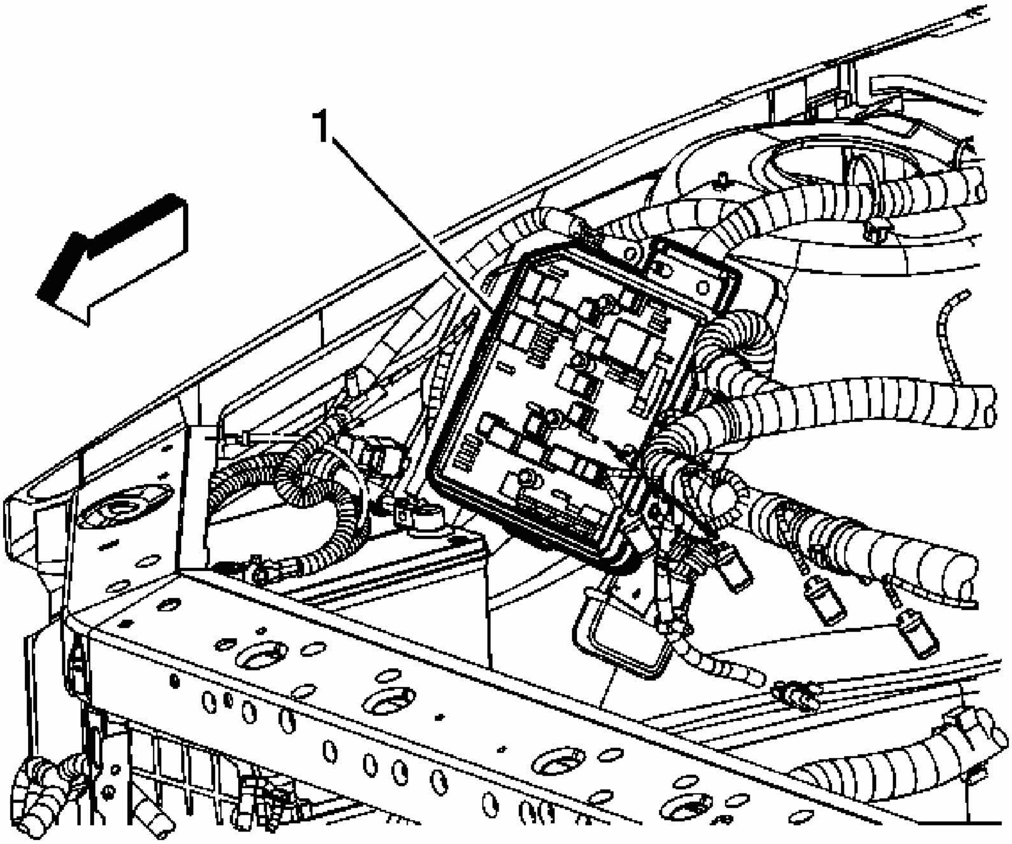


Fig. 66: Identifying Underhood Fuse Center
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: This sensing and diagnostic module (SDM) has 2 fused power inputs. To ensure there is no unwanted SIR

deployment, personal injury, or unnecessary SIR system repairs, remove both AIR BAG (IGN) and AIR BAG (BATT) fuses. With the AIR BAG fuses removed and the ignition switch in the ON position, the AIR BAG warning indicator illuminates. This is normal operation, and does not indicate an SIR system malfunction.

4. Open the hood and locate the underhood fuse center (1) on right/passenger shock tower.
5. Lift the cover for the underhood fuse center.
6. Locate and remove the Air Bag Fuse from the underhood fuse center.

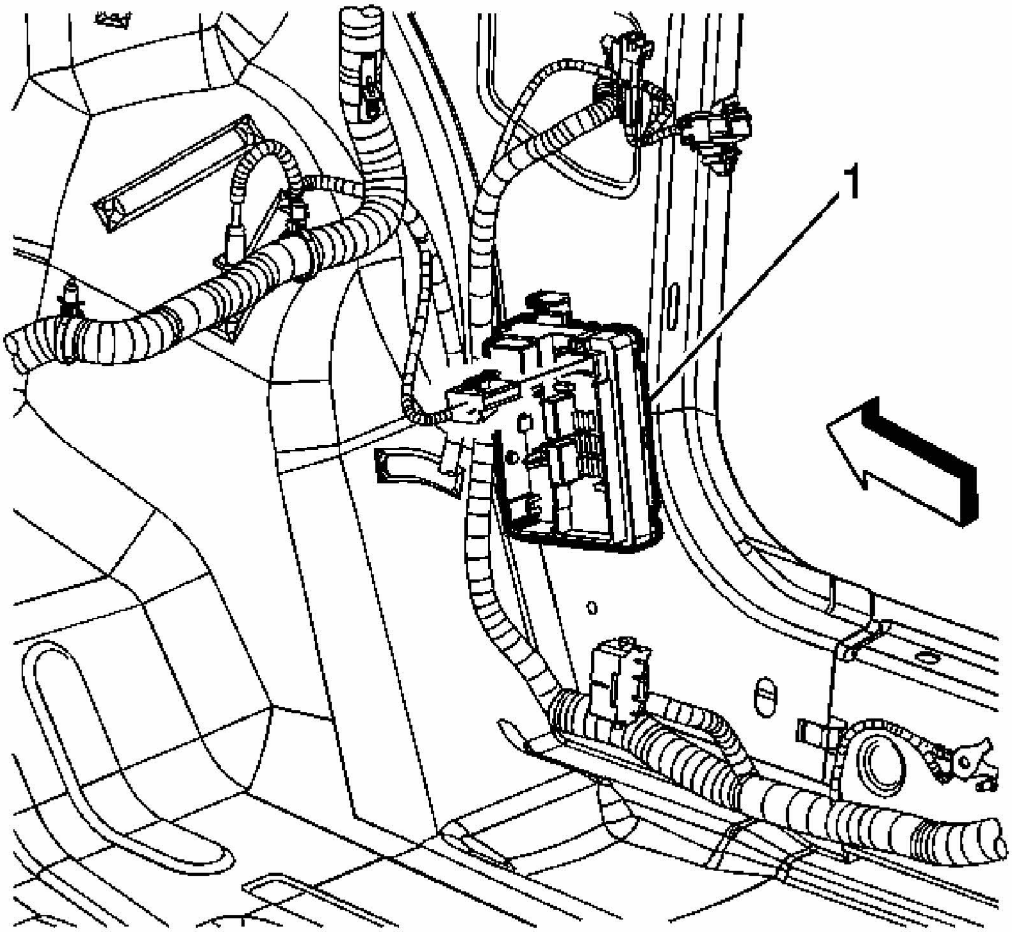


Fig. 67: Identifying Interior Fuse Center
Courtesy of GENERAL MOTORS CORP.

7. Pull back carpet from the front lower right/passenger door pillar to expose the interior fuse center (1), refer to **Junction Block Replacement - Accessory Wiring** .
8. Remove the cover then locate and remove the Air Bag Fuse from the interior fuse center.

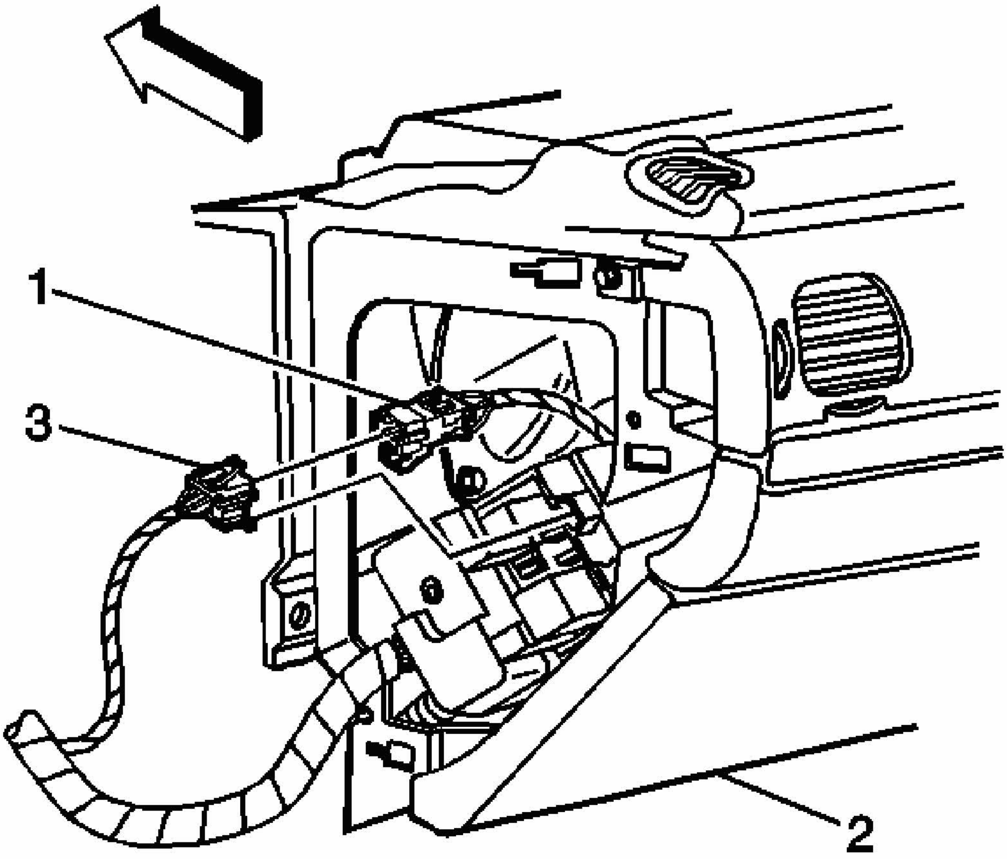


Fig. 68: Identifying I/P Module Connector To Vehicle Harness Connector (LH Side I/P)
Courtesy of GENERAL MOTORS CORP.

9. Remove the left/driver outer trim cover from the instrument panel (I/P). Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Left** .
10. Remove the connector position assurance (CPA) from the steering wheel module coil connector (1).
11. Disconnect the steering wheel module coil connector (1) from the vehicle harness connector (3).

Enabling Procedure

1. Remove the key from the ignition switch.

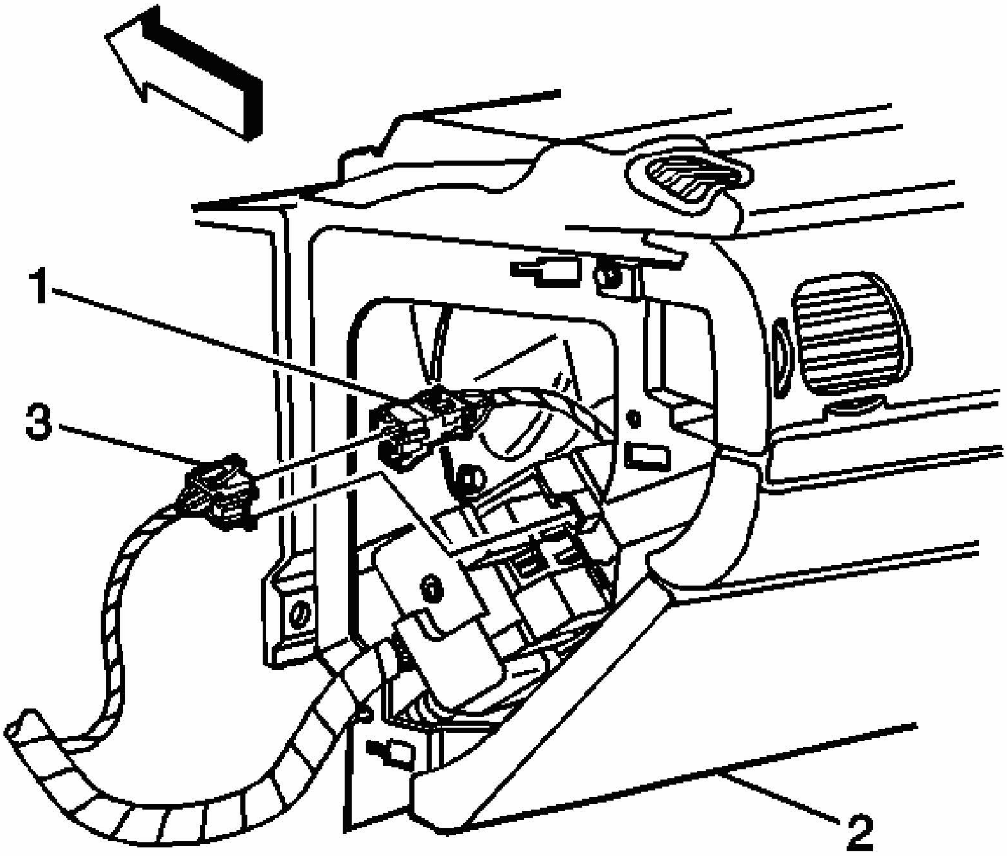


Fig. 69: Identifying I/P Module Connector To Vehicle Harness Connector (LH Side I/P)
Courtesy of GENERAL MOTORS CORP.

2. Connect the steering wheel module coil connector (1) to the vehicle harness connector (3).
3. Install the CPA to the steering wheel module coil connector (1).
4. Install the left outer trim cover to the I/P. Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Left** .
5. Install both Air Bag Fuses, one in the underhood fuse center and one in the interior fuse center.
6. Replace both fuse center covers.
7. Use caution while reaching in and turn the ignition switch to the ON position.

The AIR BAG indicator will flash then turn OFF.

8. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

SIR DISABLING AND ENABLING ZONE 5

Disabling Procedure

1. Turn the steering wheel so that the vehicles wheels are pointing straight ahead.
2. Turn the ignition switch to the OFF position.
3. Remove the key from the ignition switch.

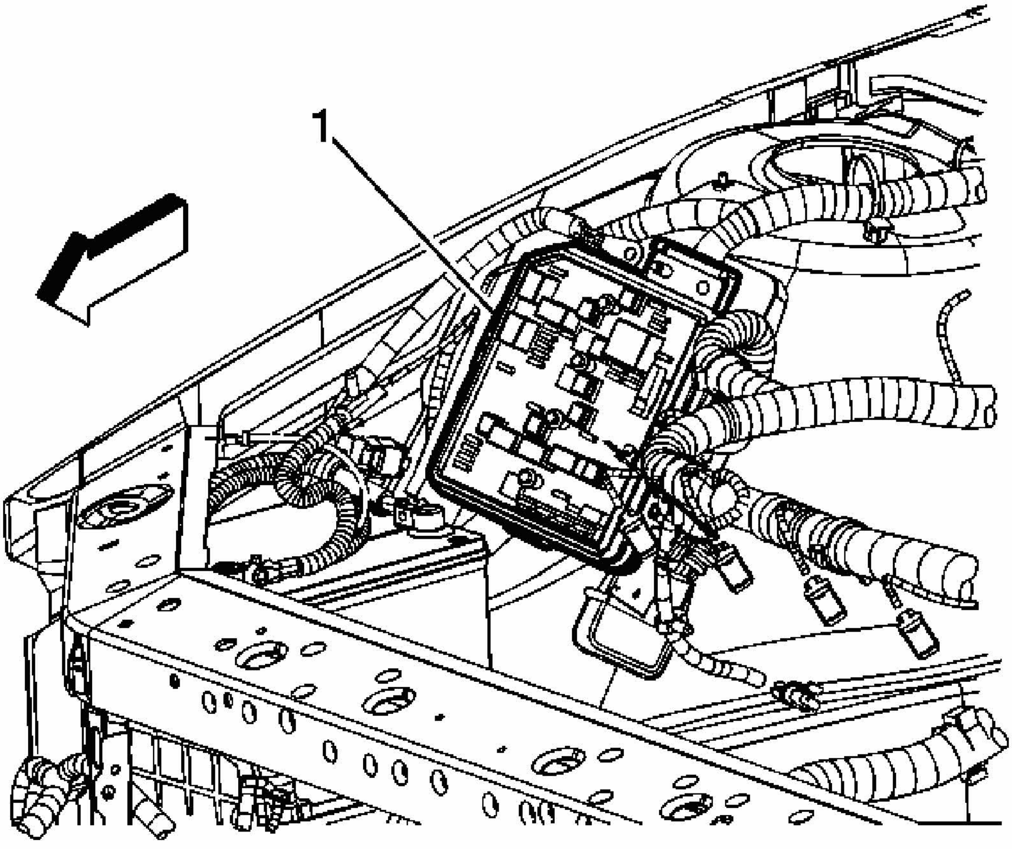


Fig. 70: Identifying Underhood Fuse Center
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: This sensing and diagnostic module (SDM) has two fused power inputs. To ensure there is no unwanted SIR

deployment, personal injury, or unnecessary SIR system repairs, remove both AIR BAG (IGN) and AIR BAG (BATT) fuses. With the AIR BAG fuses removed and the ignition switch in the ON position, the AIR BAG warning indicator illuminates. This is normal operation, and does not indicate an SIR system malfunction.

4. Open the hood and locate the underhood fuse center (1) on right/passenger shock tower.
5. Lift the cover for the underhood fuse center.
6. Locate and remove the Air Bag fuse from the underhood fuse center.

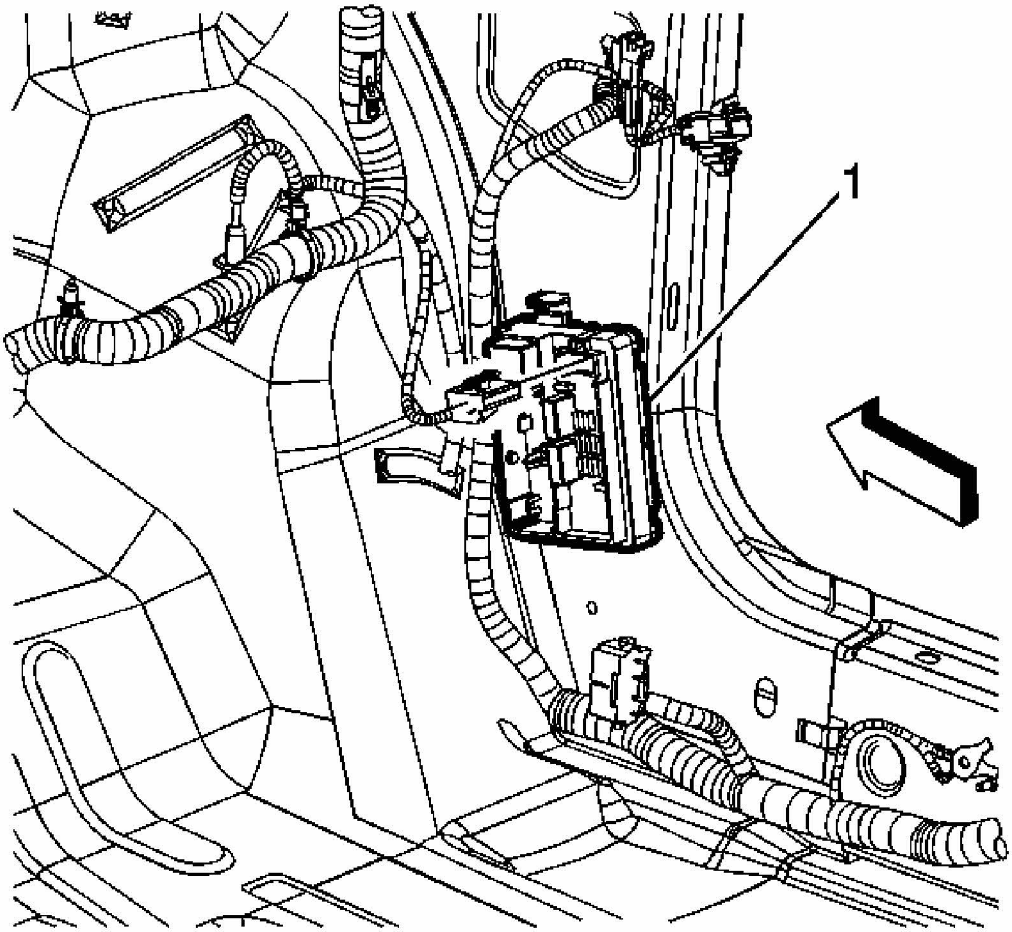


Fig. 71: Identifying Interior Fuse Center
Courtesy of GENERAL MOTORS CORP.

7. Pull back carpet from the front lower right/passenger door pillar to expose the interior fuse center (1), refer to **Junction Block Replacement - Accessory Wiring** .
8. Remove the cover then locate and remove the Air Bag fuse from the interior fuse center.

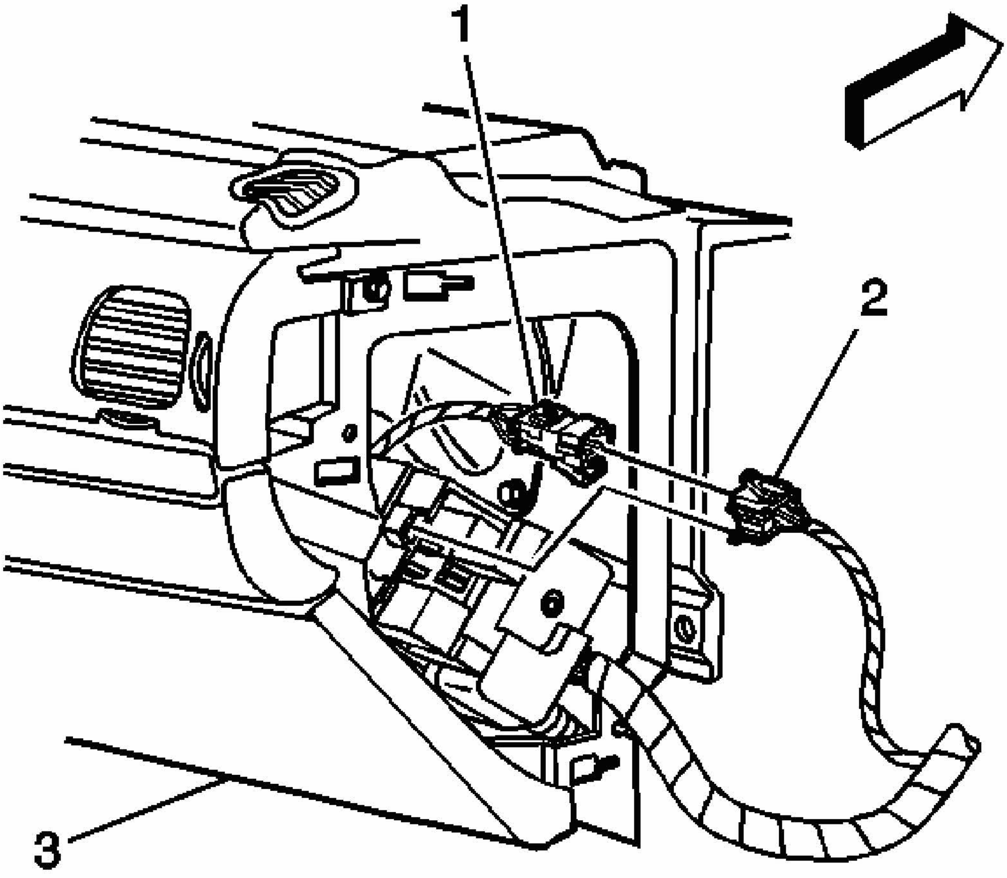


Fig. 72: Identifying I/P Module Connector To Vehicle Harness Connector
Courtesy of GENERAL MOTORS CORP.

9. Remove the right/passenger outer trim cover from the instrument panel (I/P) (3). Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Right** .
10. Remove the connector position assurance (CPA) from the I/P module connector (1).
11. Disconnect the I/P module connector (1) from the vehicle harness connector (2).

Enabling Procedure

1. Remove the key from the ignition switch.

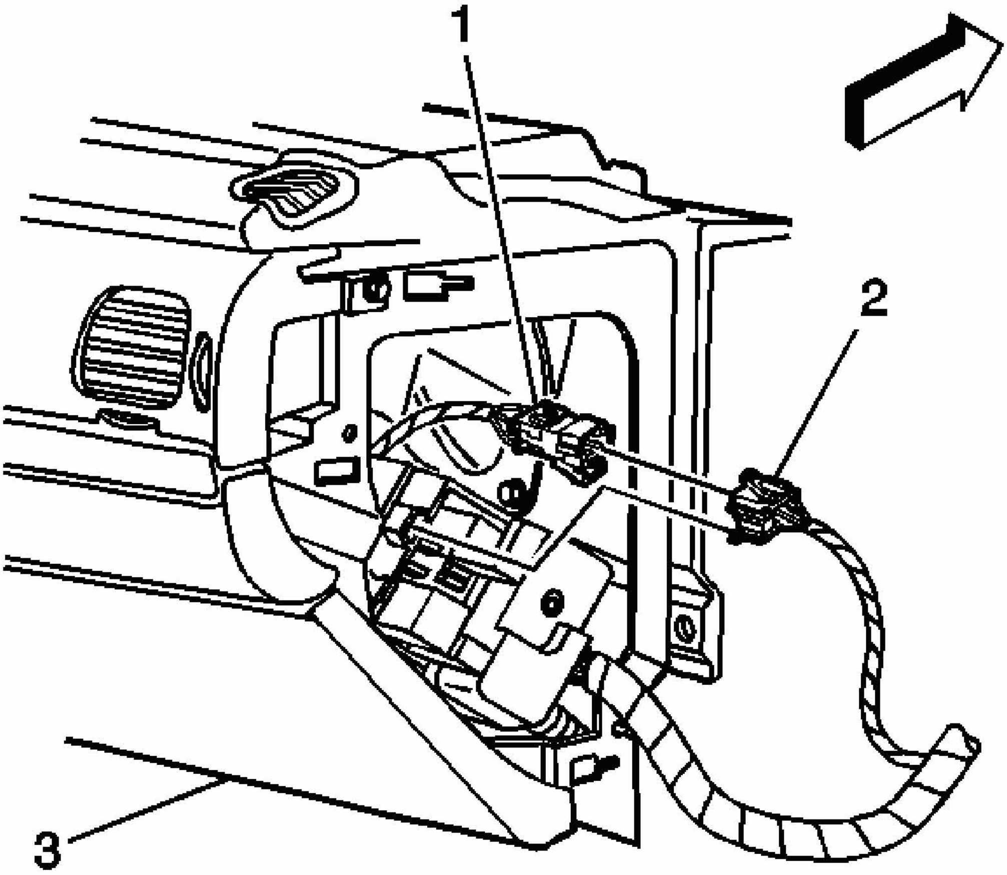


Fig. 73: Identifying I/P Module Connector To Vehicle Harness Connector
Courtesy of GENERAL MOTORS CORP.

2. Connect the I/P module connector (1) to the vehicle harness connector (2).
3. Install the CPA to the I/P module connector (1).
4. Install the right outer trim cover to the I/P (3). Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Right** .
5. Install both Air Bag Fuses, one in the underhood fuse center and one in the interior fuse center.
6. Replace both fuse center covers.
7. Use caution while reaching in and turn the ignition switch to the ON position.

   The AIR BAG indicator will flash then turn OFF.

8. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

SIR DISABLING AND ENABLING ZONE 6 (MONTE CARLO)

Disabling Procedure

1. Turn the steering wheel so that the vehicles wheels are pointing straight ahead.
2. Turn the ignition switch to the OFF position.
3. Remove the key from the ignition switch.

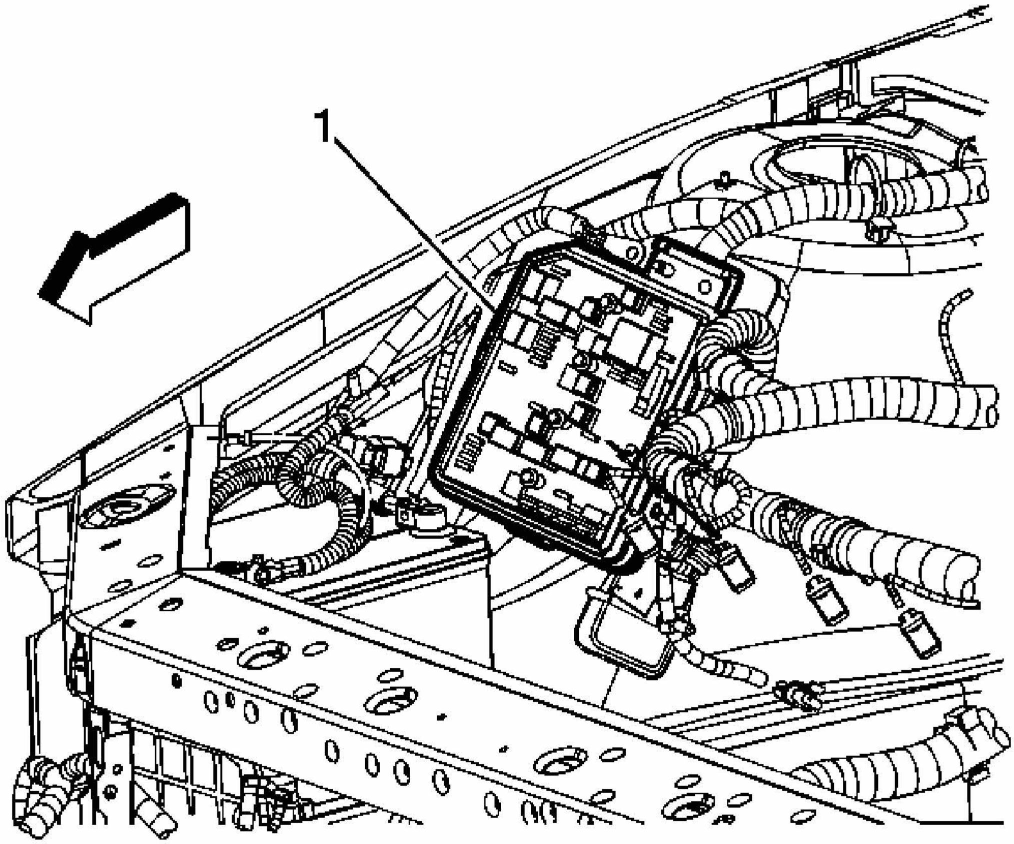


Fig. 74: Identifying Underhood Fuse Center
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: This sensing and diagnostic module (SDM) has 2 fused power inputs. To ensure there is no unwanted SIR deployment, personal injury, or unnecessary SIR system repairs, remove both AIR BAG (IGN) and AIR BAG (BATT) fuses. With the AIR BAG fuses removed and the ignition switch in the ON position, the AIR BAG warning indicator

illuminates. This is normal operation, and does not indicate an SIR system malfunction.

4. Open the hood and locate the underhood fuse center (1) on right/passenger shock tower.
5. Lift the cover for the underhood fuse center.
6. Locate and remove the Air Bag Fuse from the underhood fuse center.

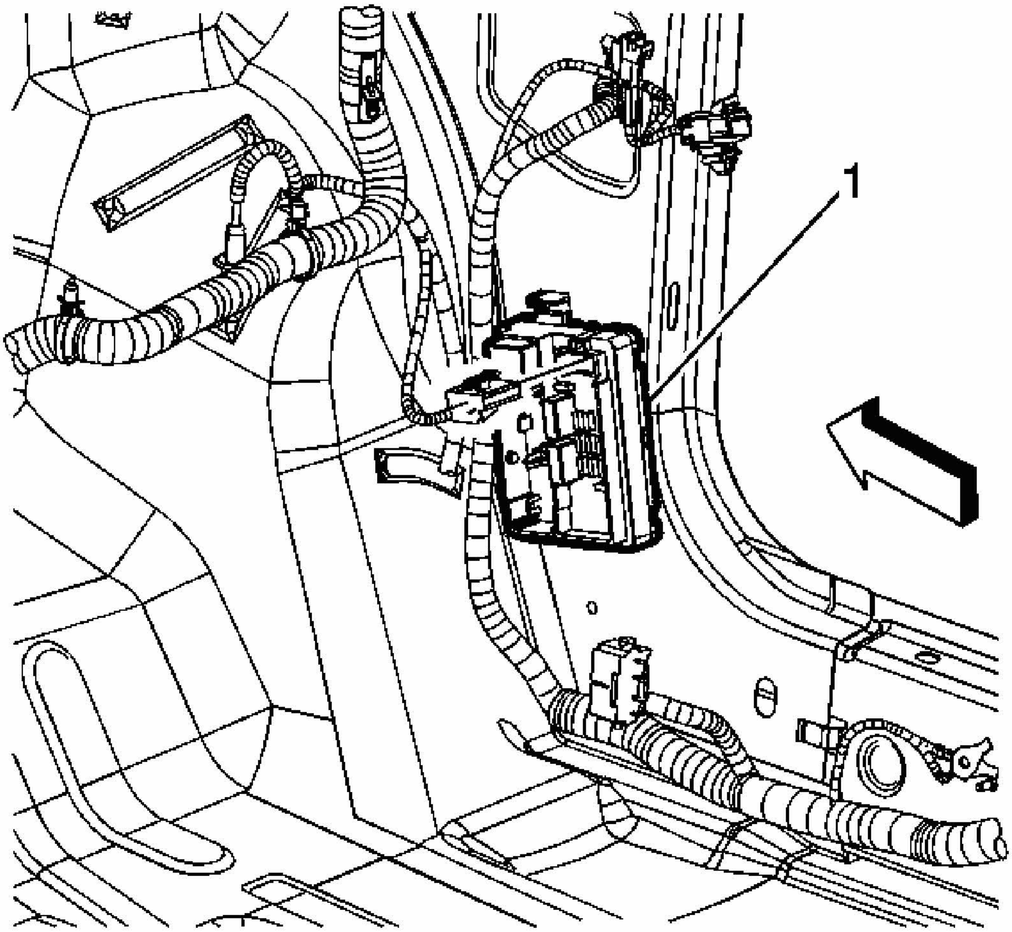


Fig. 75: Identifying Interior Fuse Center
Courtesy of GENERAL MOTORS CORP.

7. Pull back the carpet from the front lower right/passenger door pillar to expose the interior fuse center (1). Refer to **Junction Block Replacement - Accessory Wiring** .
8. Remove the cover then locate and remove the Air Bag Fuse from the interior fuse center.

9. To disable the seat belt retractor pretensioner - RF, go to step 10. To disable the side impact sensor (SIS) - right, go to step 13.

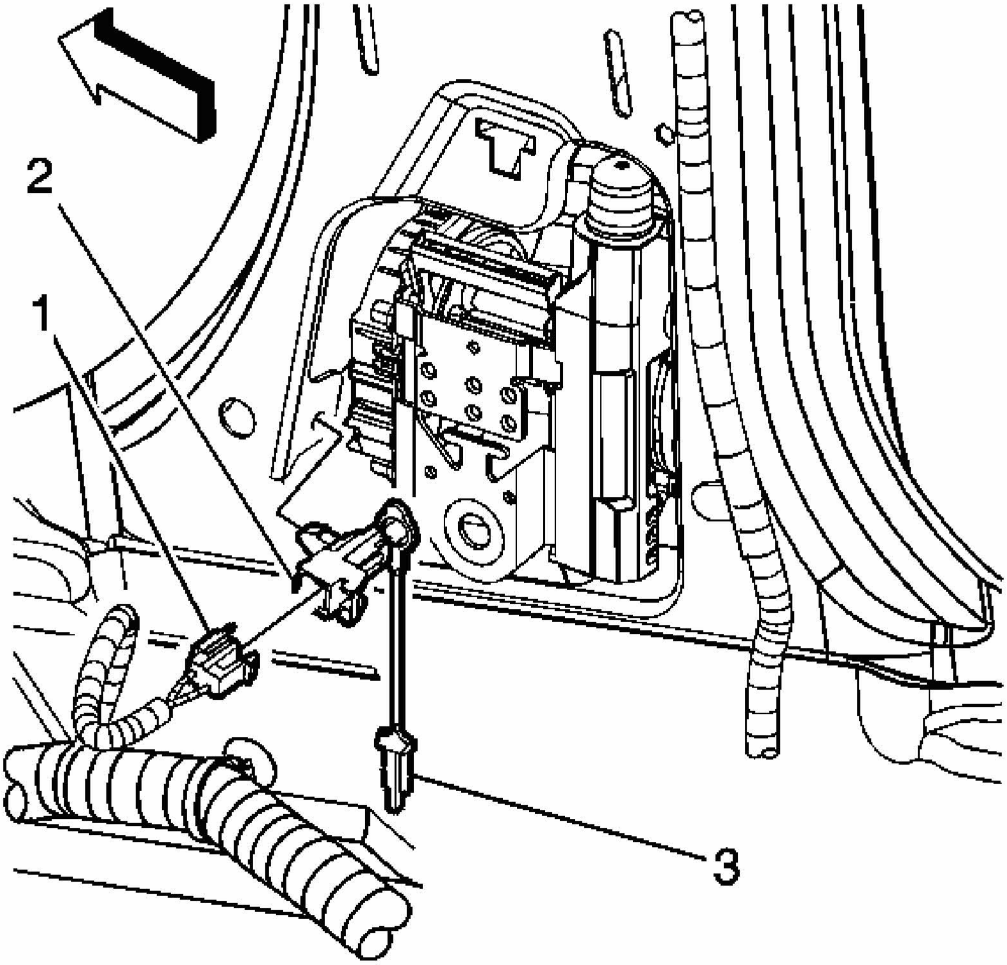


Fig. 76: Removing The Connector Position Assurance
Courtesy of GENERAL MOTORS CORP.

10. Remove the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .
11. Remove the connector position assurance (CPA) (3) from the seat belt retractor pretensioner - RF connector (2).
12. Disconnect the seat belt retractor pretensioner - RF connector (2) from the vehicle harness connector (1).

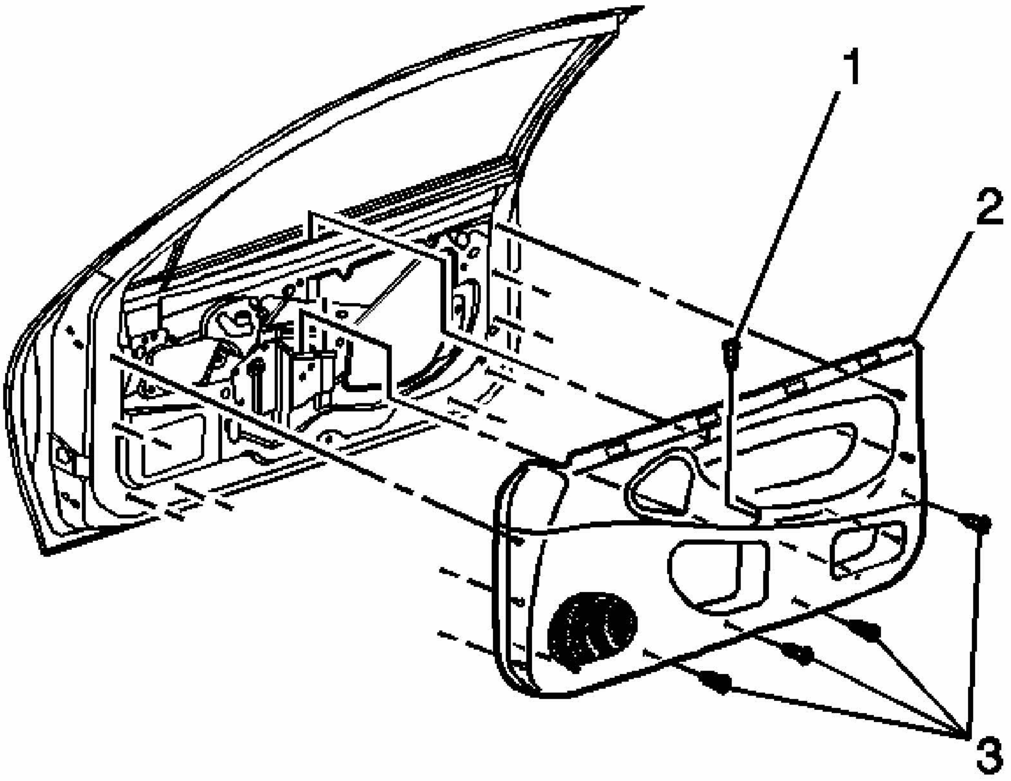


Fig. 77: View Of Door Trim Panel And mounting Screws
Courtesy of GENERAL MOTORS CORP.

13. Remove the RF door trim panel (2). Refer to **Trim Panel Replacement - Side Front Door (Impala)** .

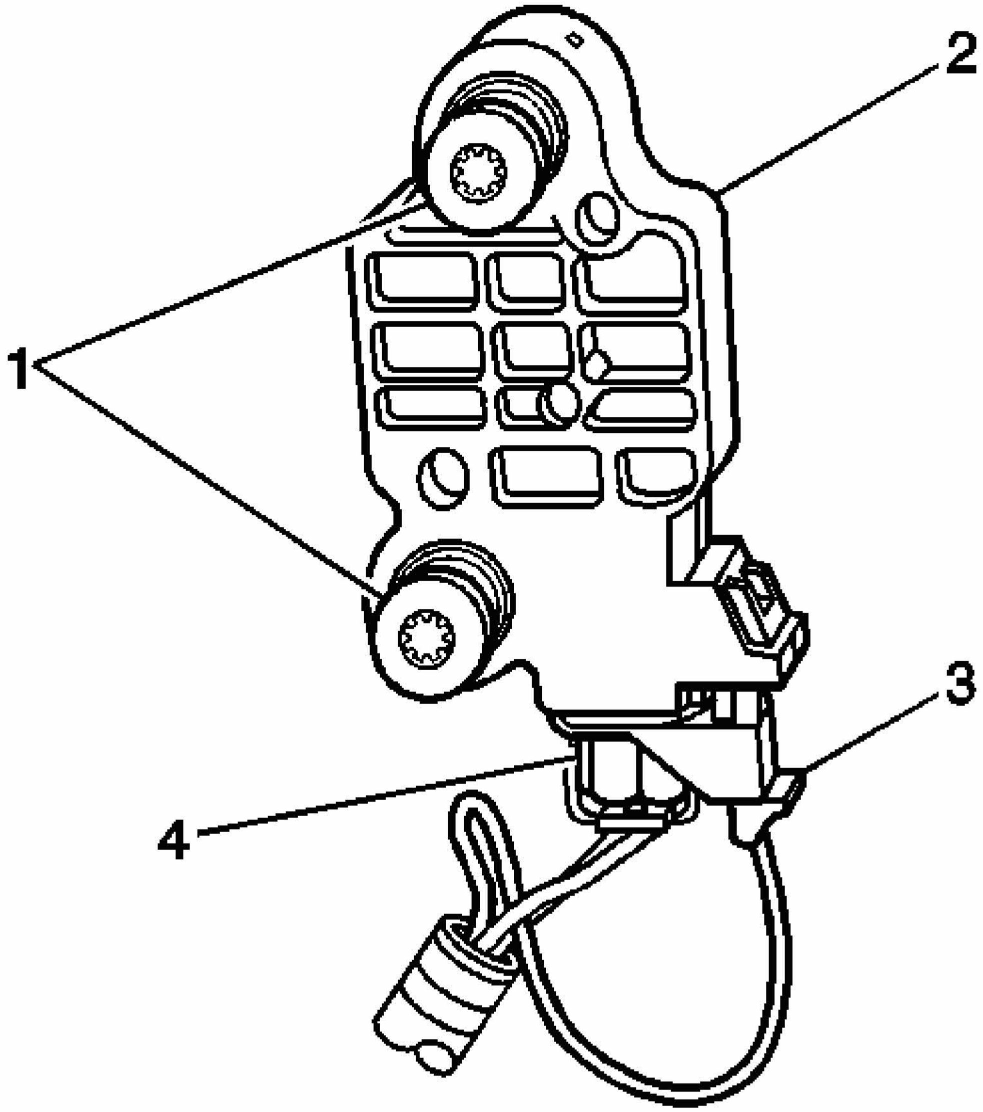


Fig. 78: Identifying Side Impact Sensor (SIS) Connector
Courtesy of GENERAL MOTORS CORP.

14. Remove the CPA (3) from the SIS - right connector (4).
15. Remove the SIS - right connector (4) from the SIS (2).

Enabling Procedure

1. Remove the key from the ignition switch.
2. To enable the SIS - right, go to step 3. To enable the seat belt retractor pretensioner -

RF, go to step 5.

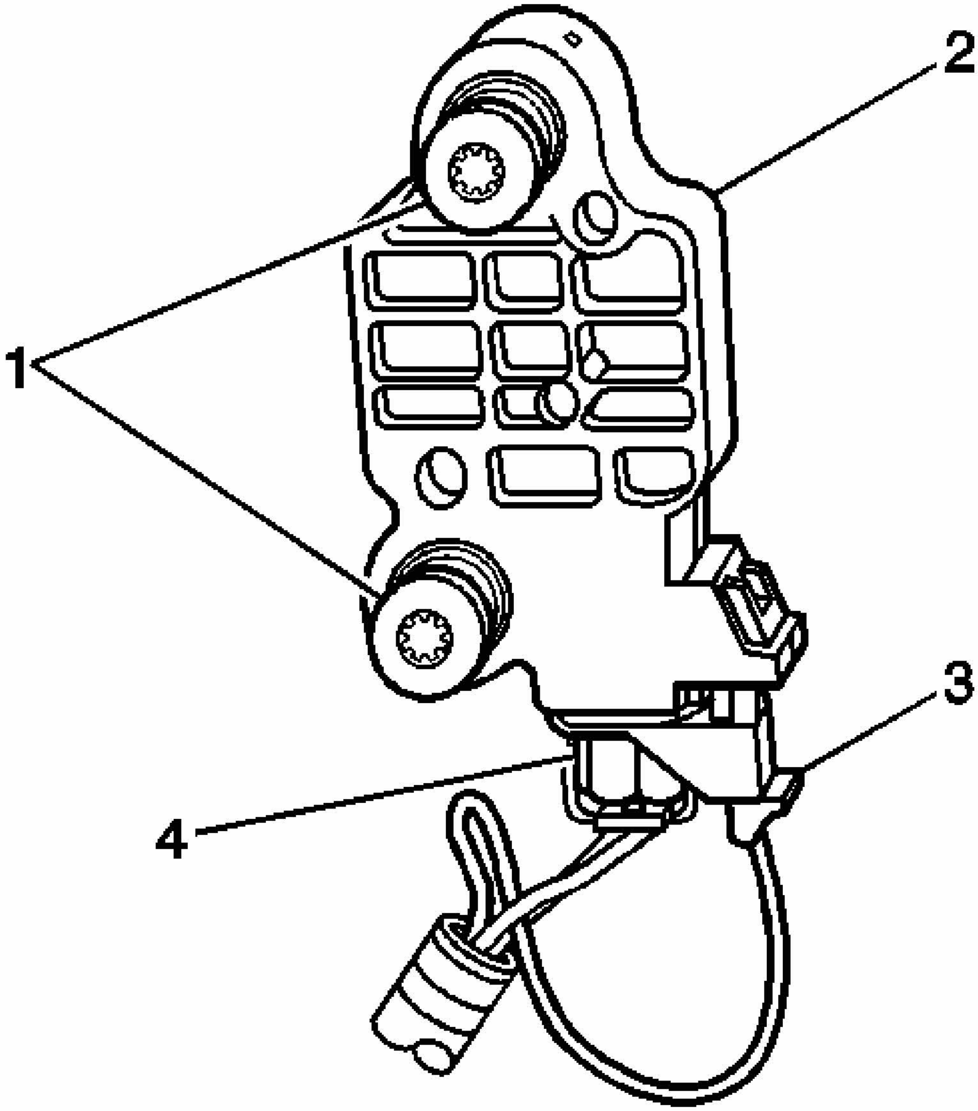


Fig. 79: Identifying Side Impact Sensor (SIS) Connector
Courtesy of GENERAL MOTORS CORP.

3. Install the SIS - right connector (4) to the SIS (2).
4. Install the CPA (3) to the SIS - right connector (4).

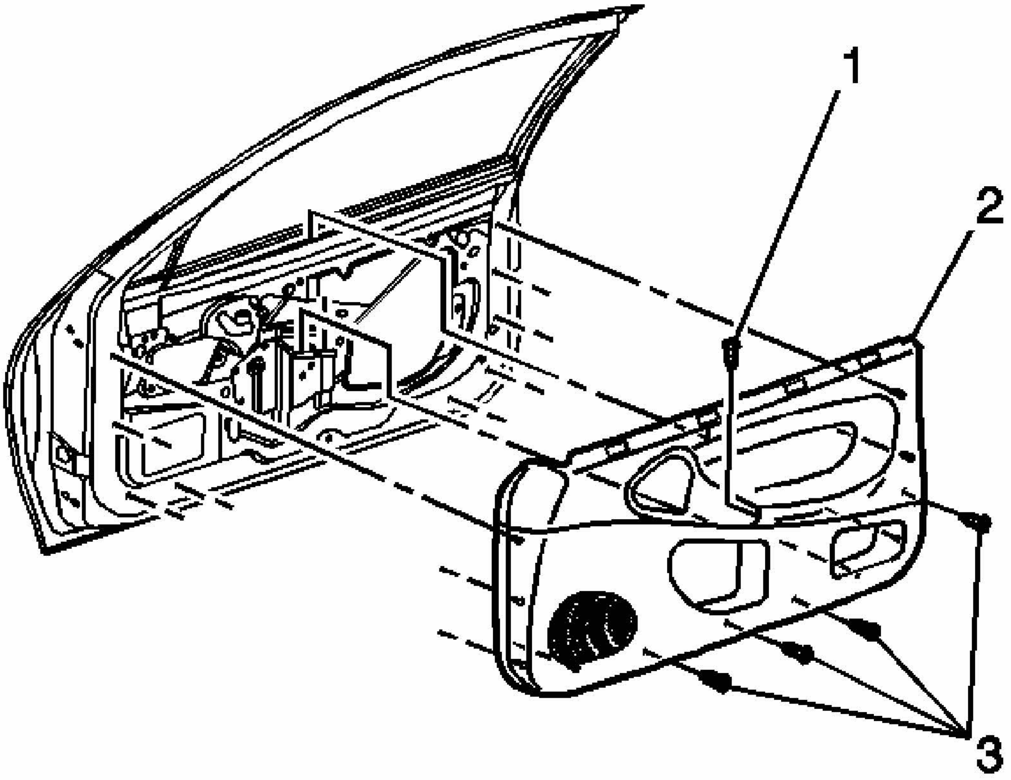


Fig. 80: View Of Door Trim Panel And mounting Screws
Courtesy of GENERAL MOTORS CORP.

5. Install the RF door trim panel (2). Refer to **Trim Panel Replacement - Side Front Door (Impala)** .

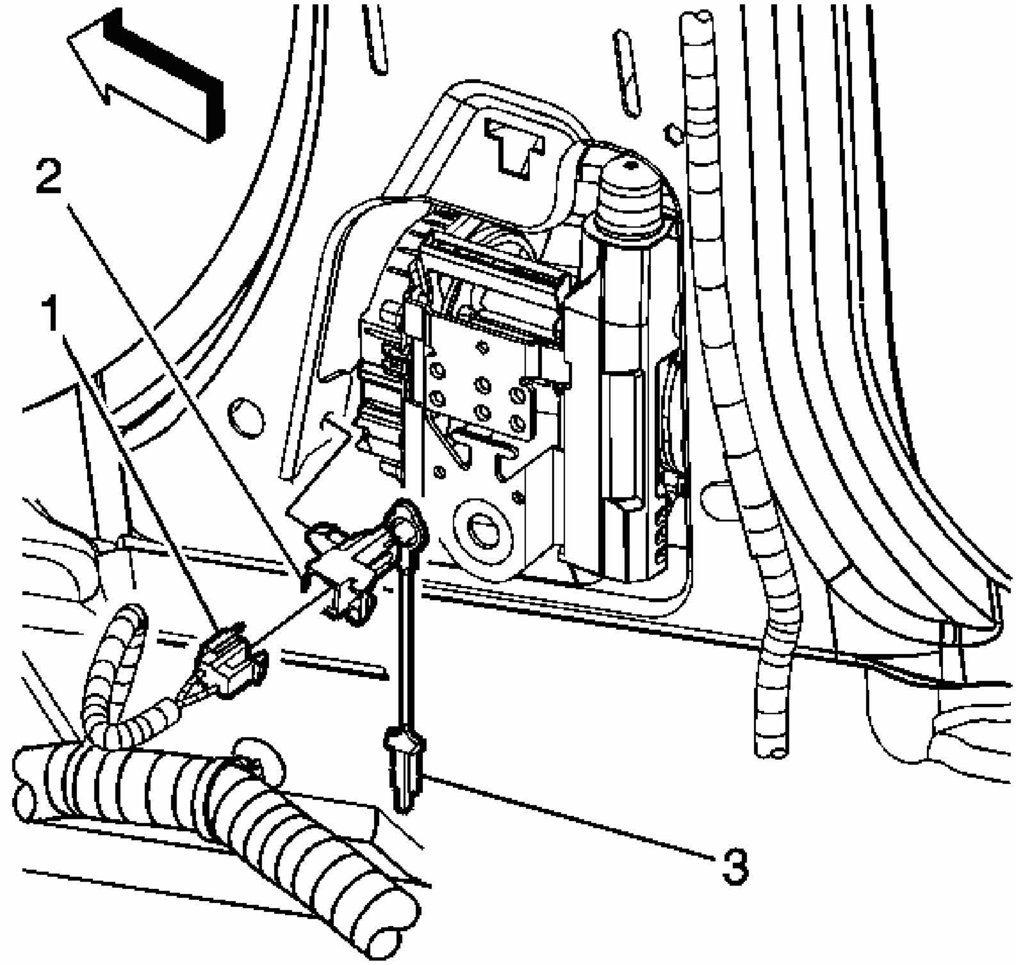


Fig. 81: Installing The CPA
Courtesy of GENERAL MOTORS CORP.

6. Connect the seat belt retractor pretensioner - RF connector (2) to vehicle harness connector (1).
7. Install the CPA (3) to the seat belt retractor pretensioner - RF connector (2).
8. Install the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .
9. Install both Air Bag Fuses, one in the underhood fuse center and one in the interior fuse center.
10. Replace both fuse center covers.
11. Use caution while reaching in and turn the ignition switch to the ON position.

The AIR BAG indicator will flash then turn OFF.

12. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

SIR DISABLING AND ENABLING ZONE 6 (IMPALA)

Disabling Procedure

1. Turn the steering wheel so that the vehicles wheels are pointing straight ahead.
2. Turn the ignition switch to the OFF position.
3. Remove the key from the ignition switch.

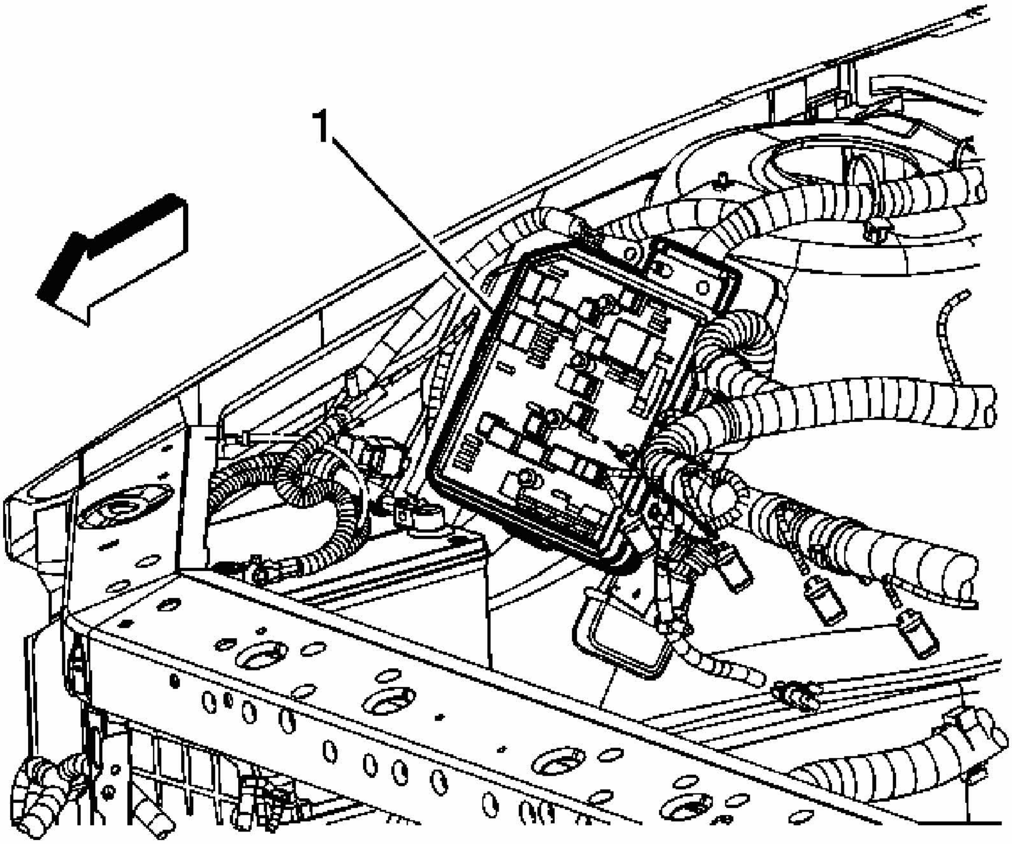


Fig. 82: Identifying Underhood Fuse Center
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: This sensing and diagnostic module (SDM) has 2 fused power inputs. To ensure there is no unwanted SIR

deployment, personal injury, or unnecessary SIR system repairs, remove both AIR BAG (IGN) and AIR BAG (BATT) fuses. With the AIR BAG fuses removed and the ignition switch in the ON position, the AIR BAG warning indicator illuminates. This is normal operation, and does not indicate an SIR system malfunction.

4. Open the hood and locate the underhood fuse center (1) on right/passenger shock tower.
5. Lift the cover for the underhood fuse center.
6. Locate and remove the Air Bag Fuse from the underhood fuse center.

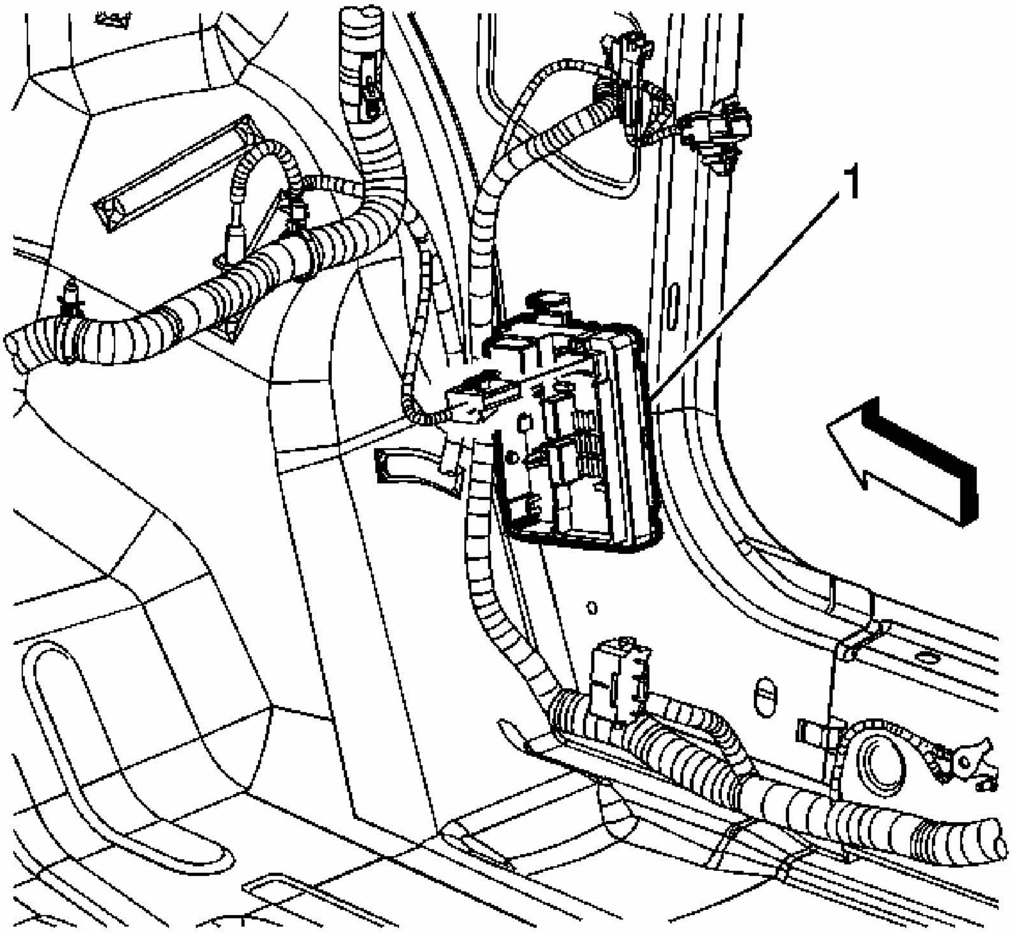


Fig. 83: Identifying Interior Fuse Center
Courtesy of GENERAL MOTORS CORP.

7. Pull back the carpet from the front lower right/passenger door pillar to expose the interior fuse center (1). Refer to **Junction Block Replacement - Accessory Wiring** .
8. Remove the cover then locate and remove the Air Bag Fuse from the interior fuse center.
9. To disable the seat belt retractor pretensioner - RF, go to step 10. To disable the roof rail module - right, go to step 13 and for the side impact sensor (SIS) - right, go to step 16.

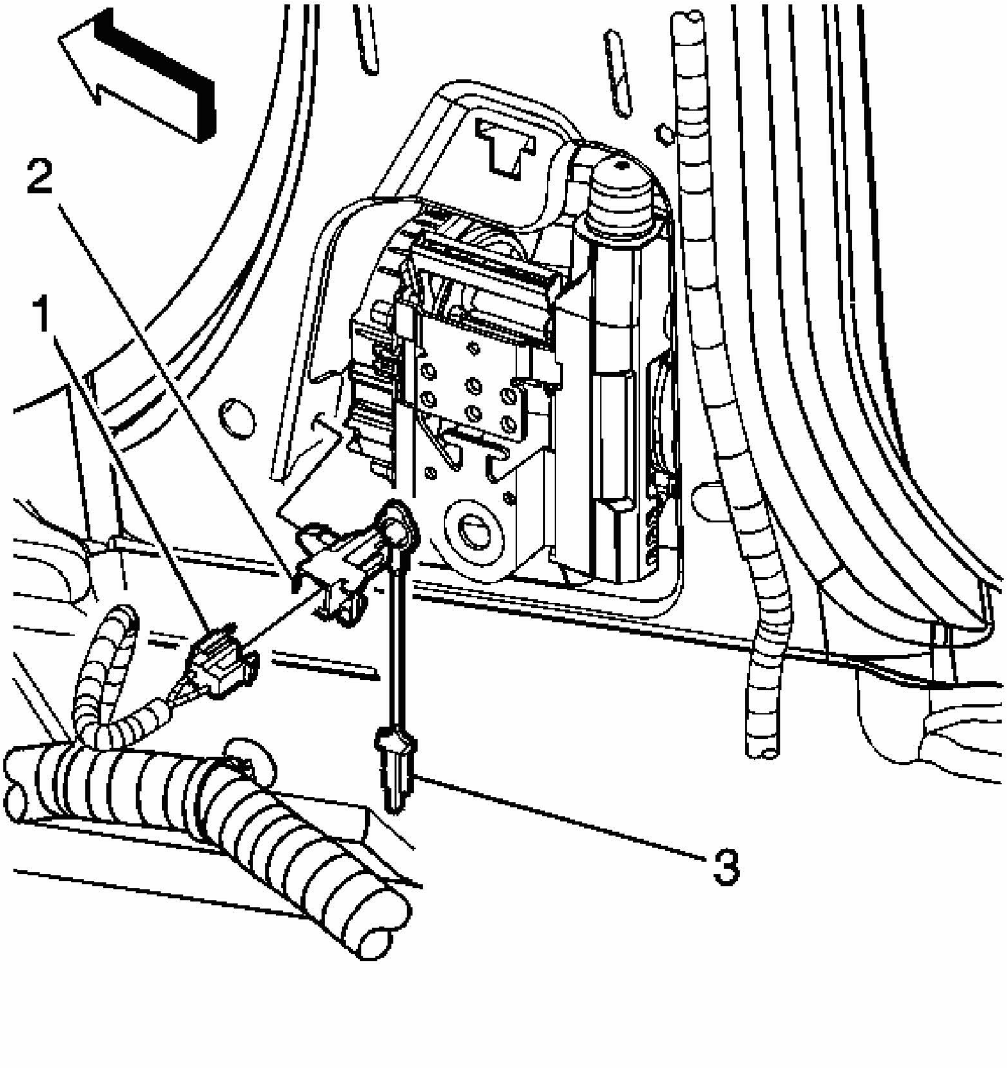


Fig. 84: Removing The Connector Position Assurance
Courtesy of GENERAL MOTORS CORP.

10. Remove the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .
11. Remove the connector position assurance (CPA) (3) from the seat belt retractor

pretensioner - RF connector (2).

12. Disconnect the seat belt retractor pretensioner - RF connector (2) from the vehicle harness connector (1).

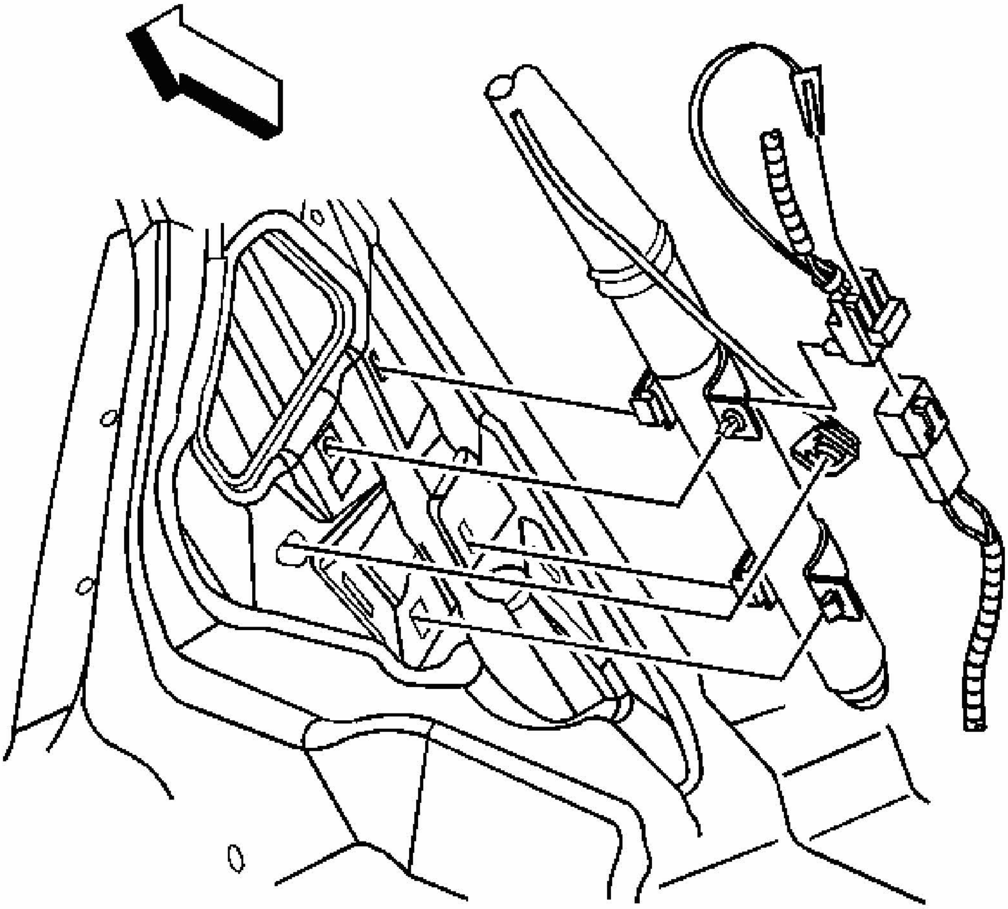


Fig. 85: Locating Roof Rail Module Connector
Courtesy of GENERAL MOTORS CORP.

13. Remove the upper trim molding from the rear quarter pillar. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .
14. Remove the CPA from the roof rail module - right connector.
15. Disconnect the roof rail module - right connector from the vehicle harness connector.

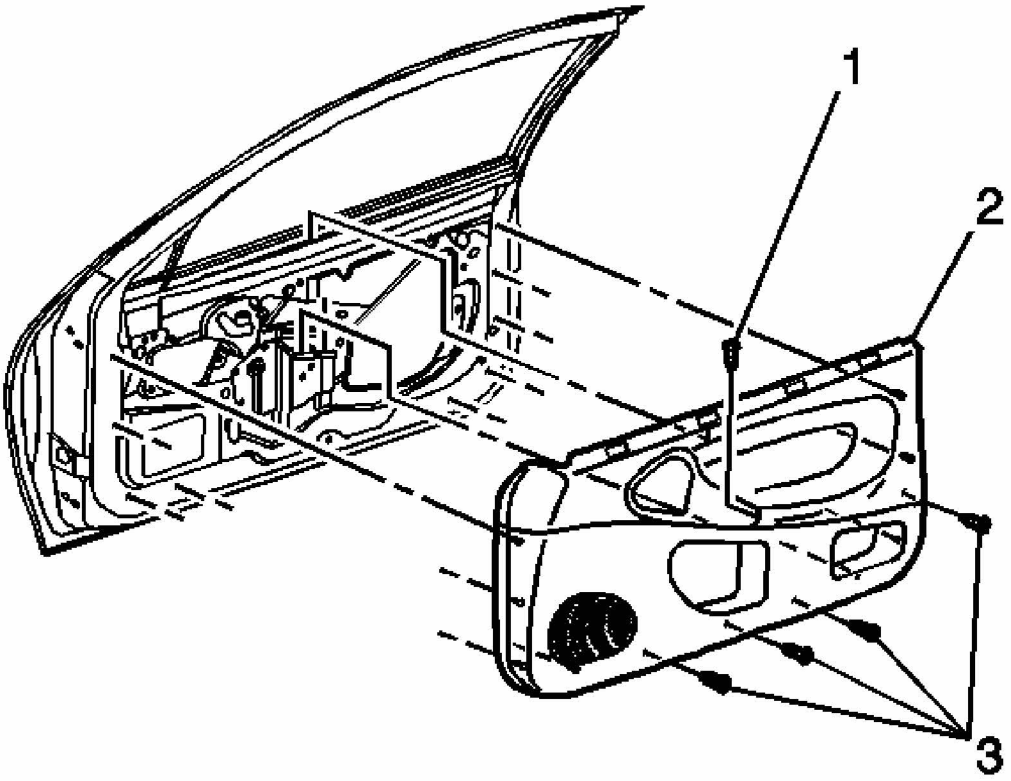


Fig. 86: View Of Door Trim Panel And mounting Screws
Courtesy of GENERAL MOTORS CORP.

16. Remove the RF door trim panel (2). Refer to **Trim Panel Replacement - Side Front Door (Impala)** .

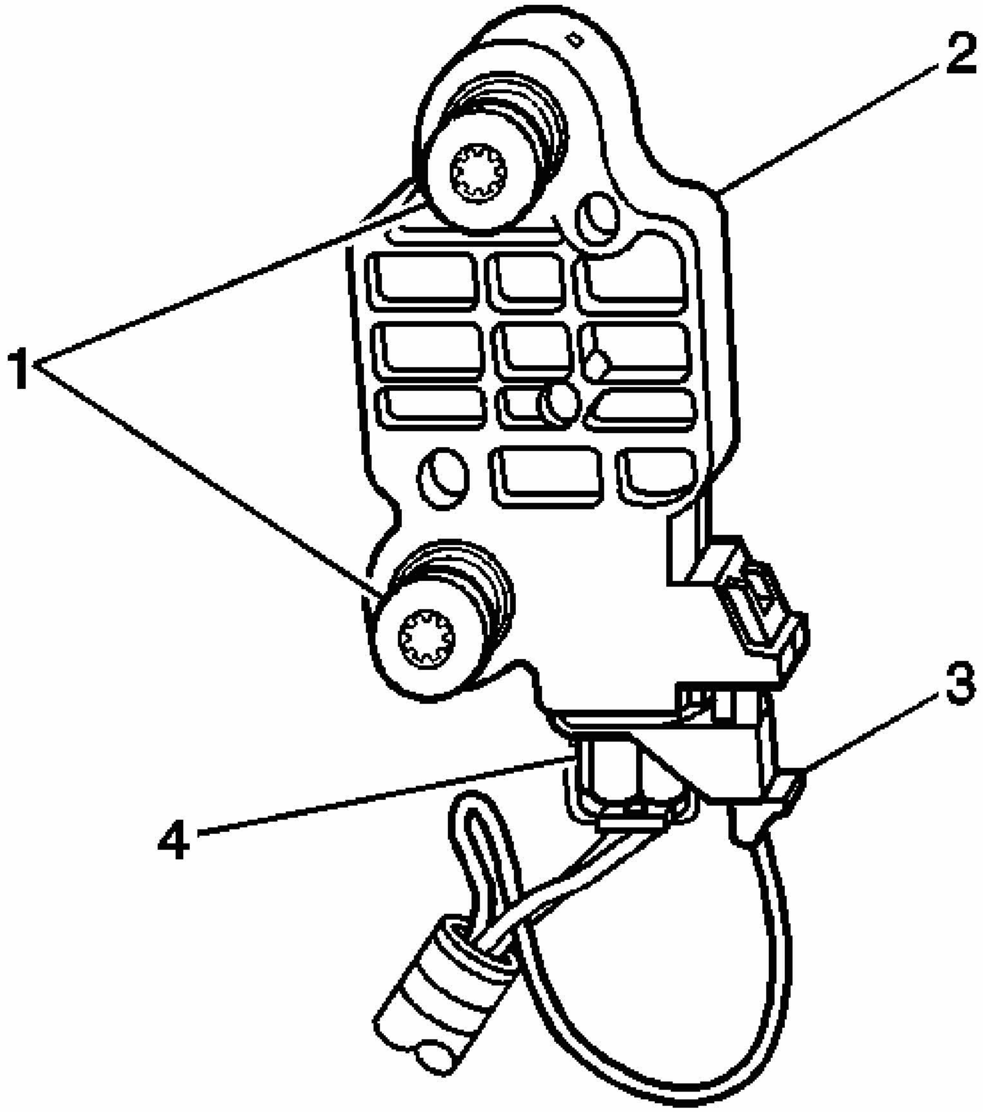


Fig. 87: Identifying Side Impact Sensor (SIS) Connector
Courtesy of GENERAL MOTORS CORP.

17. Remove the CPA (3) from the SIS - right connector (4).
18. Remove the SIS - right connector (4) from the SIS (2).

Enabling Procedure

1. Remove the key from the ignition switch.
2. To enable the SIS - right, go to step 3. To enable the roof rail module - right, go to step

6, and to enable the seat belt retractor pretensioner - RF, go to step 9.

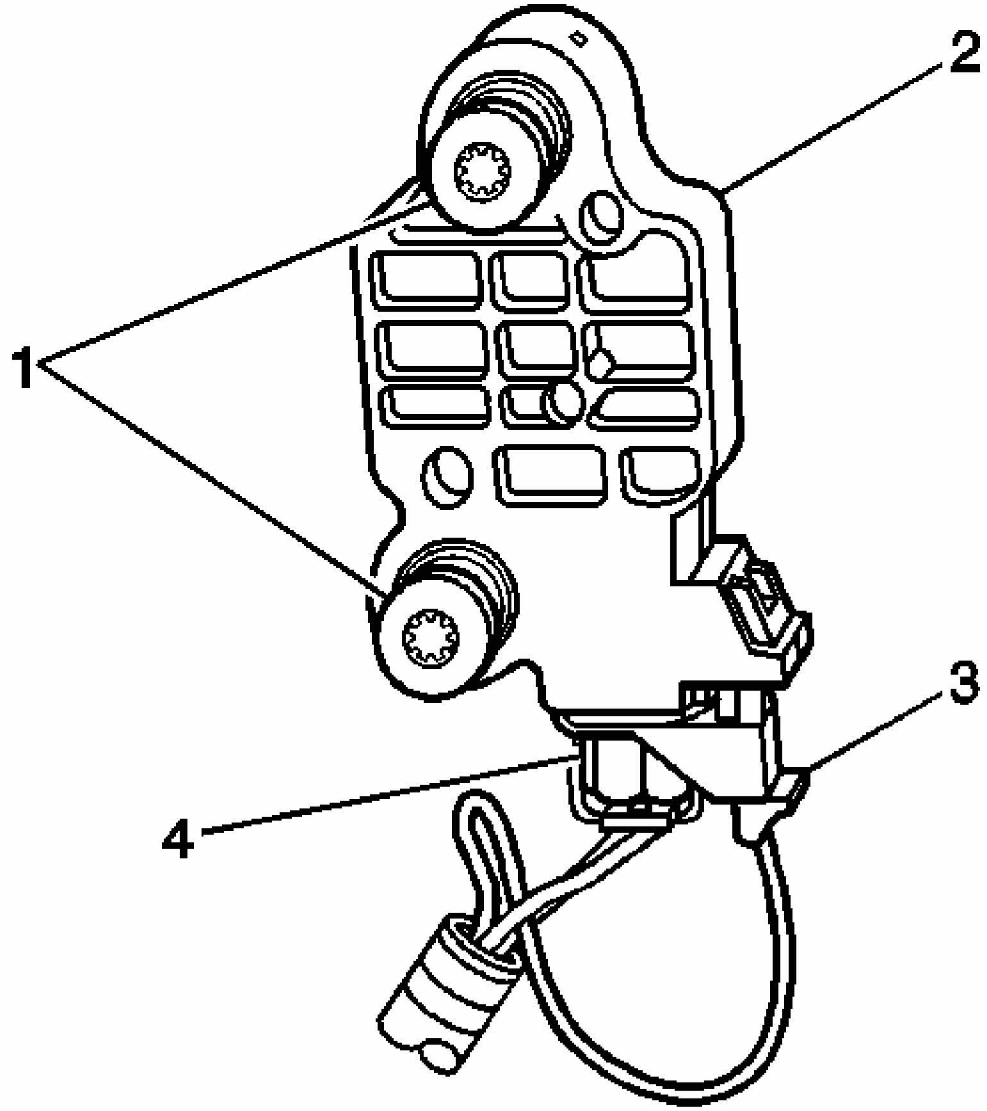


Fig. 88: Identifying Side Impact Sensor (SIS) Connector
Courtesy of GENERAL MOTORS CORP.

3. Install the SIS - right connector (4) to the SIS (2).
4. Install the CPA (3) to the SIS - right connector (4).

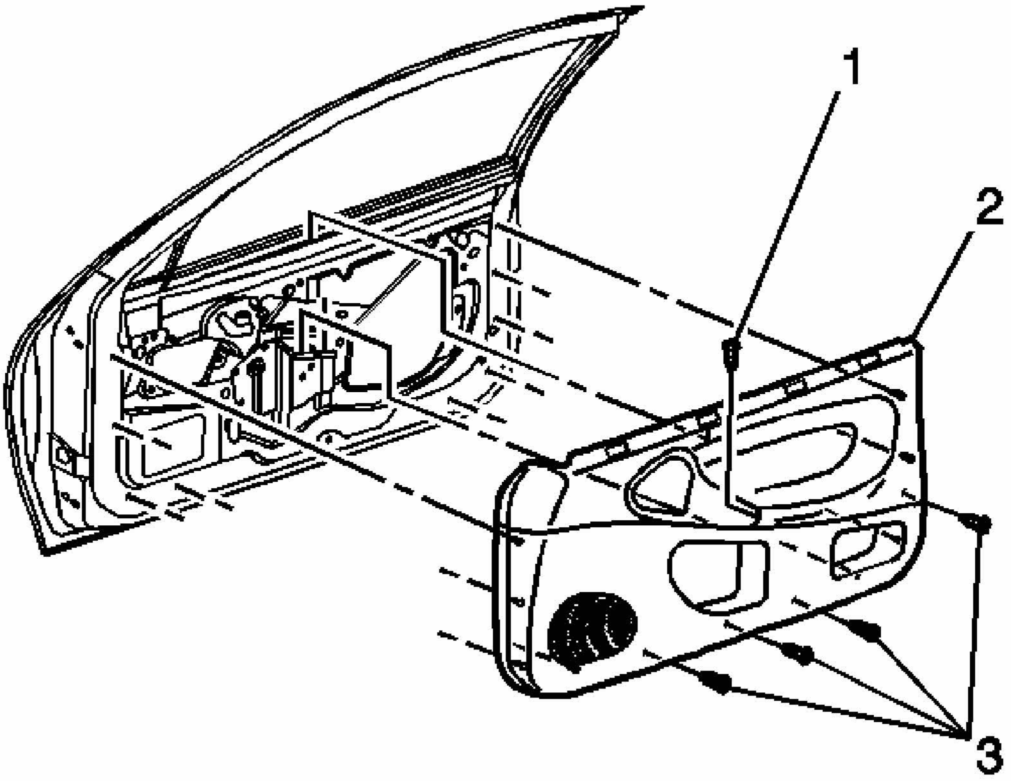


Fig. 89: View Of Door Trim Panel And mounting Screws
Courtesy of GENERAL MOTORS CORP.

5. Install the RF door trim panel (2). Refer to **Trim Panel Replacement - Side Front Door (Impala)** .

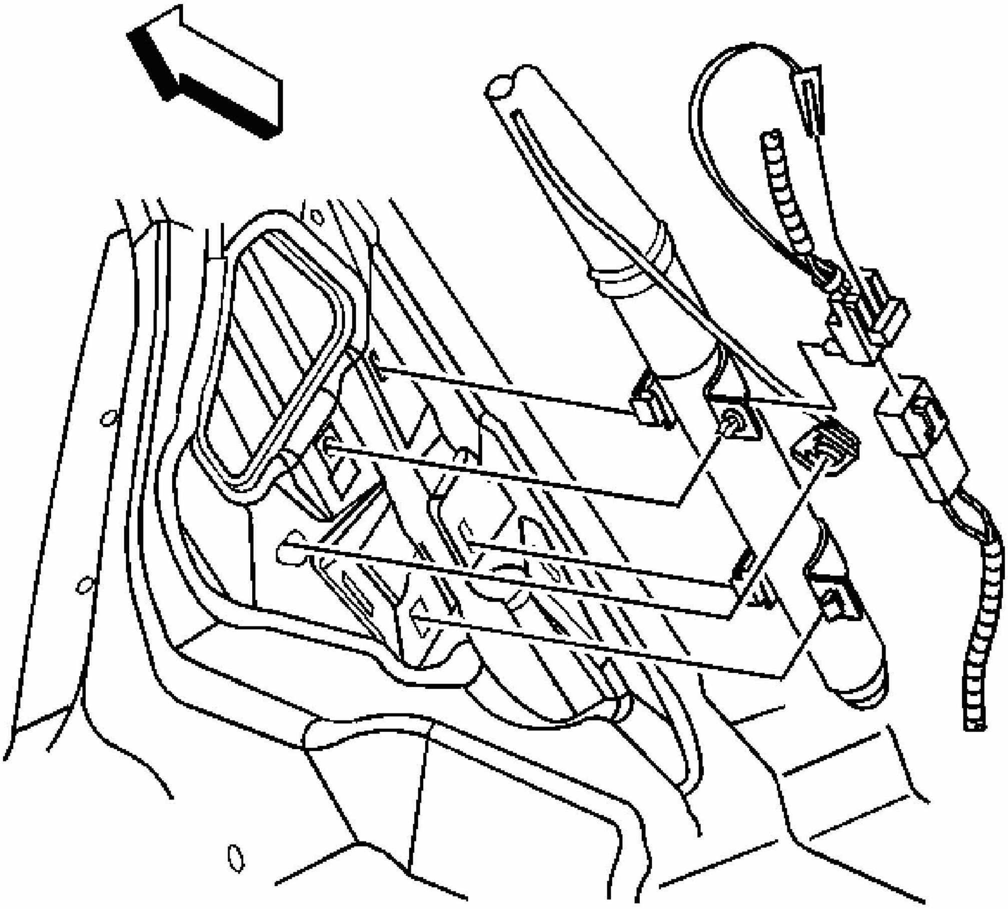


Fig. 90: Locating Roof Rail Module Connector
Courtesy of GENERAL MOTORS CORP.

6. Connect the roof rail module - right connector to the vehicle harness connector.
7. Install the CPA to the roof rail module - right connector.
8. Install the garnish molding to the upper lock pillar. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .

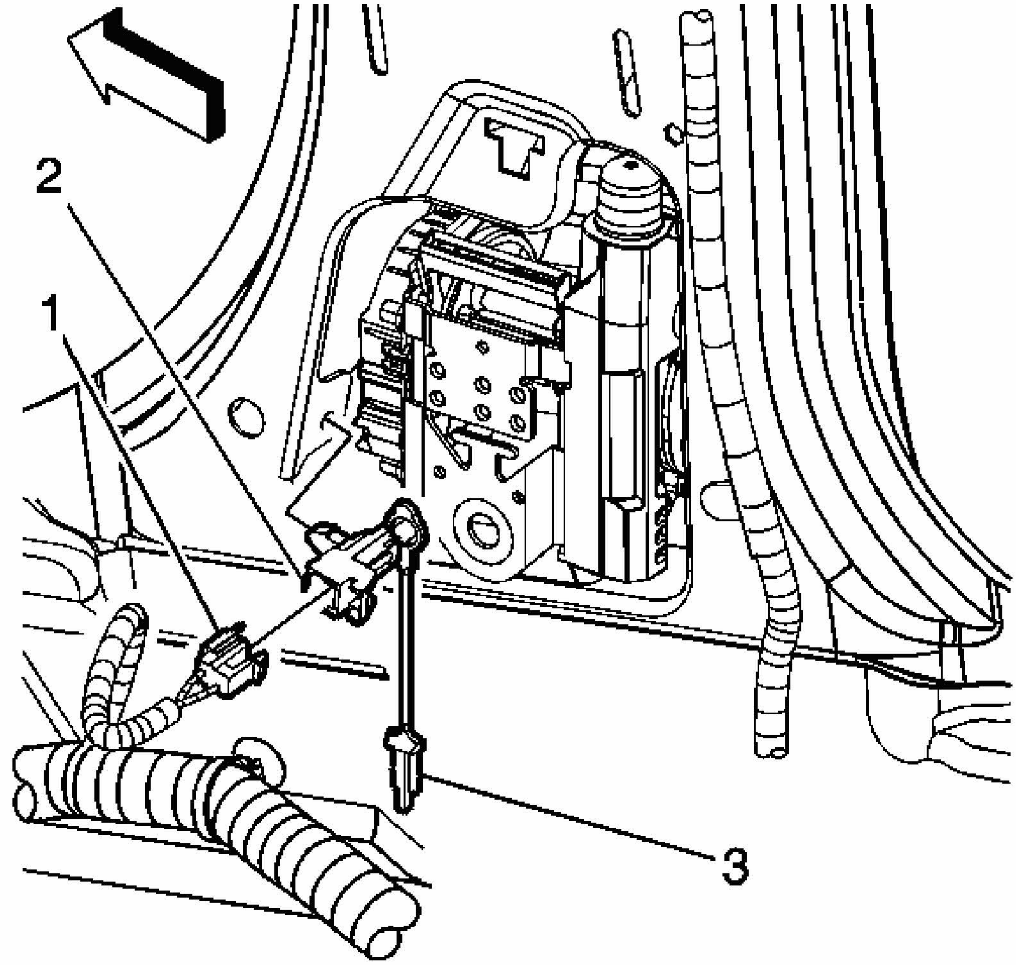


Fig. 91: Installing The CPA
Courtesy of GENERAL MOTORS CORP.

9. Connect the seat belt retractor pretensioner - RF connector (2) to vehicle harness connector (1).
10. Install the CPA (3) to the seat belt retractor pretensioner - RF connector (2).
11. Install the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .
12. Install both Air Bag Fuses, one in the underhood fuse center and one in the interior fuse center.
13. Replace both fuse center covers.
14. Use caution while reaching in and turn the ignition switch to the ON position.

The AIR BAG indicator will flash then turn OFF.

15. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

SIR DISABLING AND ENABLING ZONE 7

Disabling Procedure

1. Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
2. Turn the ignition switch to the OFF position.
3. Remove the key from the ignition switch.

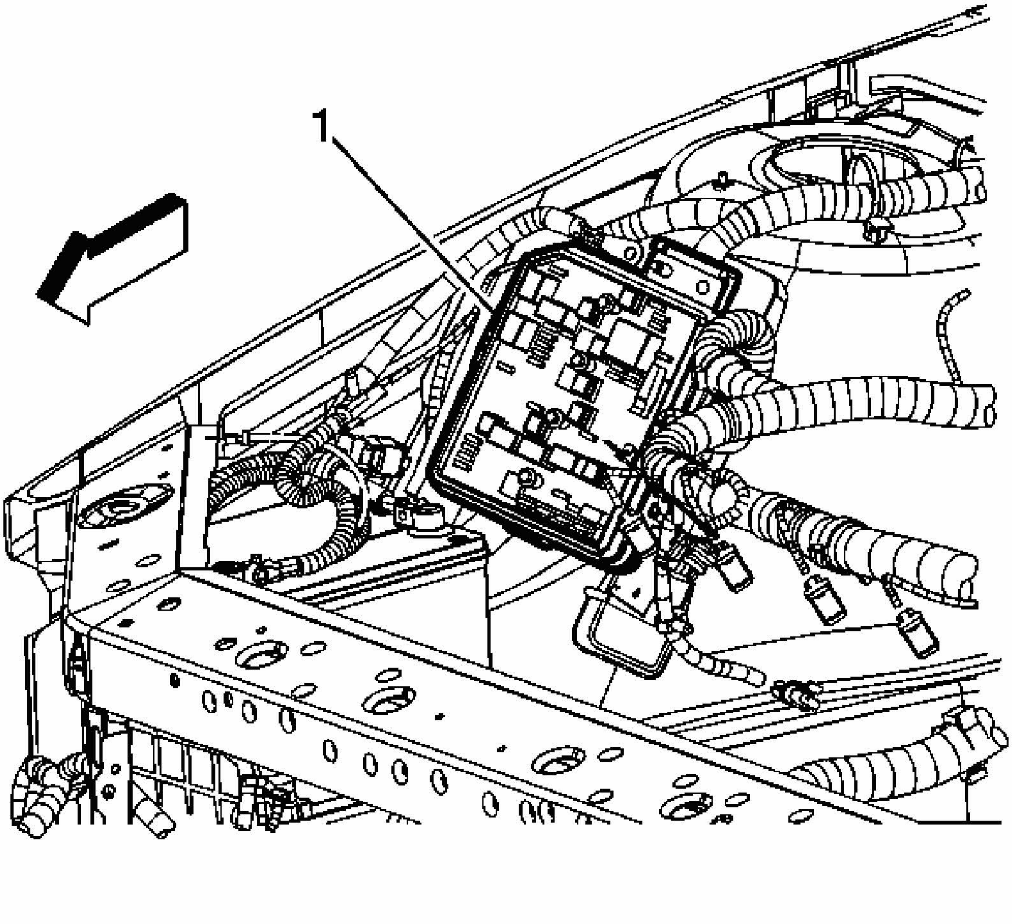


Fig. 92: Underhood Fuse Center
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: This sensing and diagnostic module (SDM) has 2 fused power inputs. To ensure there is no unwanted SIR

deployment, personal injury, or unnecessary SIR system repairs, remove both AIR BAG (IGN) and AIR BAG (BATT) fuses. With the AIR BAG fuses removed and the ignition switch in the ON position, the AIR BAG warning indicator illuminates. This is normal operation, and does not indicate an SIR system malfunction.

4. Open the hood and locate the underhood fuse center (1) on right/passenger shock tower.
5. Lift the cover for the underhood fuse center.
6. Locate and remove the Air Bag Fuse from the underhood fuse center.

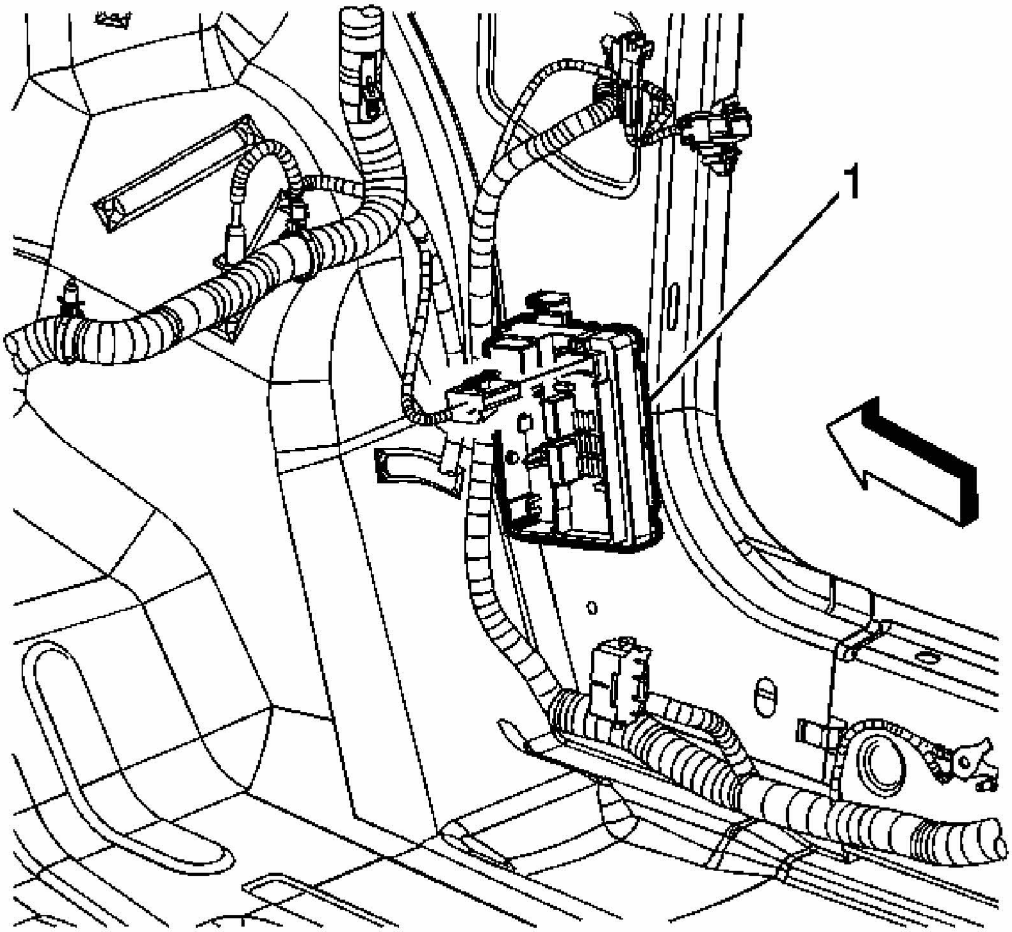


Fig. 93: Identifying Interior Fuse Center
Courtesy of GENERAL MOTORS CORP.

7. Pull back the carpet from the front lower right/passenger door pillar to expose the interior fuse center (1). Refer to **Junction Block Replacement - Accessory Wiring** .
8. Remove the cover then locate and remove the Air Bag Fuse from the interior fuse center.

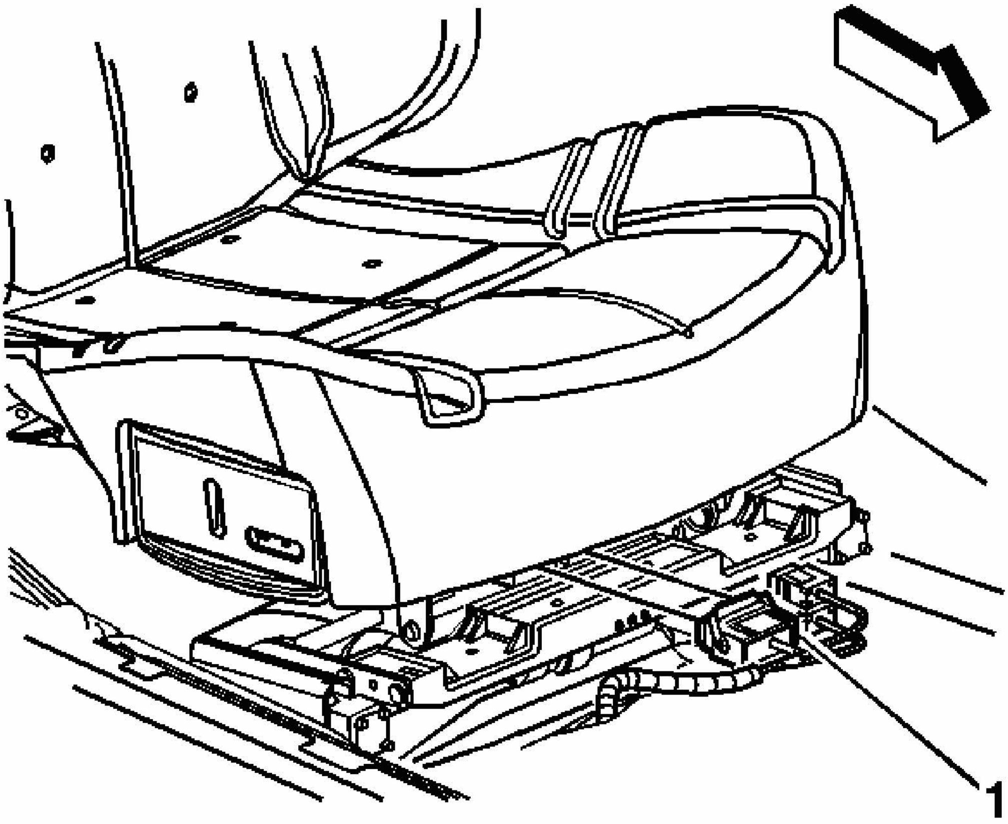


Fig. 94: Locating Side Impact Module & Pretensioner Yellow Connector
Courtesy of GENERAL MOTORS CORP.

9. Remove the connector position assurance (CPA) from the LF/driver side impact module connector (1) located under the front of driver seat.
10. Disconnect the LF side impact module connector (1) from the vehicle harness connector.

Enabling Procedure

1. Remove the key from the ignition switch.

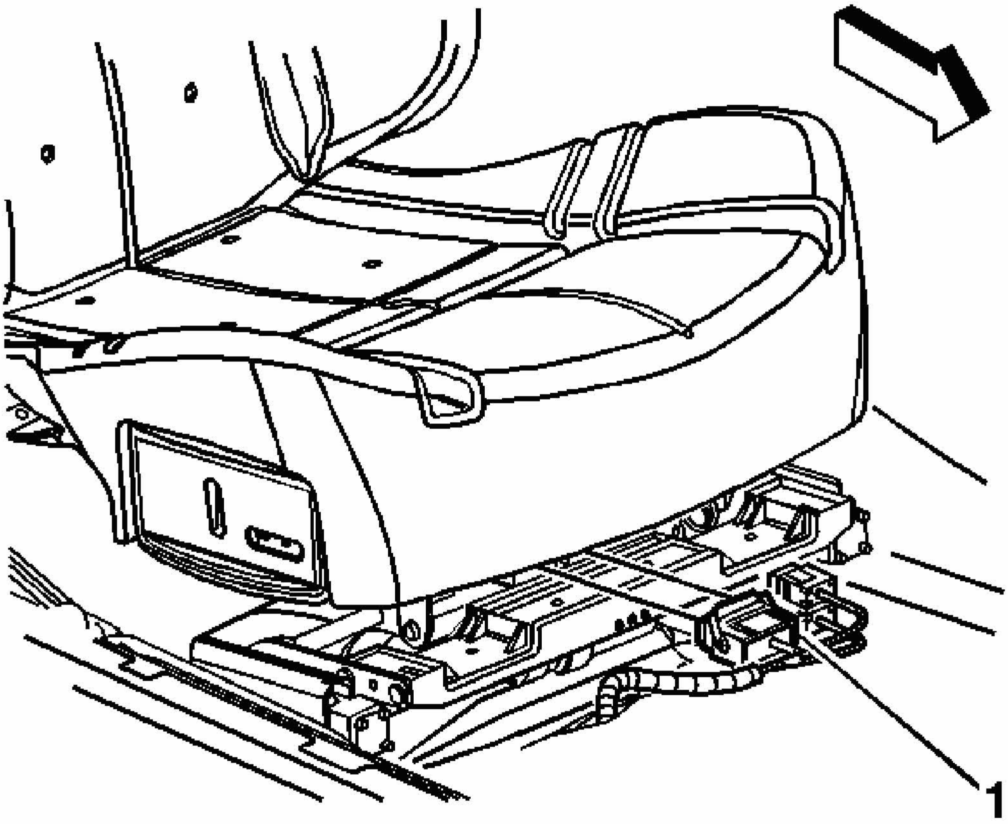


Fig. 95: Locating Side Impact Module & Pretensioner Yellow Connector
Courtesy of GENERAL MOTORS CORP.

2. Connect the LF side impact module connector (1) to the vehicle harness connector.
3. Install the CPA lock to the LF side impact module connector (1).
4. Install both Air Bag Fuses, one in the underhood fuse center and one in the interior fuse center.
5. Replace both fuse center covers.
6. Use caution while reaching in and turn the ignition switch to the ON position.

   The AIR BAG indicator will flash then turn OFF.

7. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

SIR DISABLING AND ENABLING ZONE 9 (MONTE CARLO)

Disabling Procedure

IMPORTANT: Refer to SIR Service Precautions.

1. Turn the steering wheel so that the vehicle wheels are pointing straight ahead.
2. Turn the ignition switch to the OFF position.
3. Remove the key from the ignition switch.

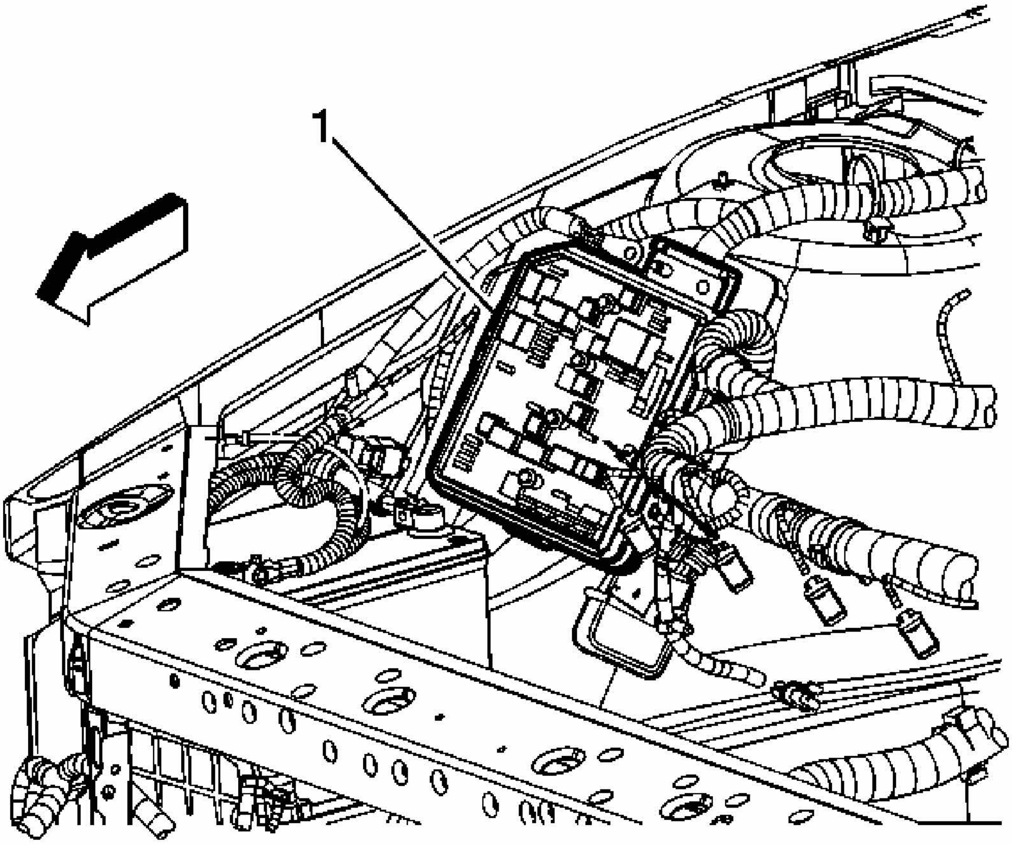


Fig. 96: Identifying Underhood Fuse Center
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: This sensing and diagnostic module (SDM) has 2 fused power inputs. To ensure there is no unwanted SIR deployment, personal injury, or unnecessary SIR system repairs, remove both AIR BAG (IGN) and AIR BAG (BATT) fuses. With the AIR BAG fuses removed and the ignition switch in the ON position, the AIR BAG warning indicator illuminates. This is normal operation, and does not

indicate an SIR system malfunction.

4. Open the hood and locate the underhood fuse center (1) on right/passenger shock tower.
5. Lift the cover for the underhood fuse center.
6. Locate and remove the Air Bag Fuse from the underhood fuse center.

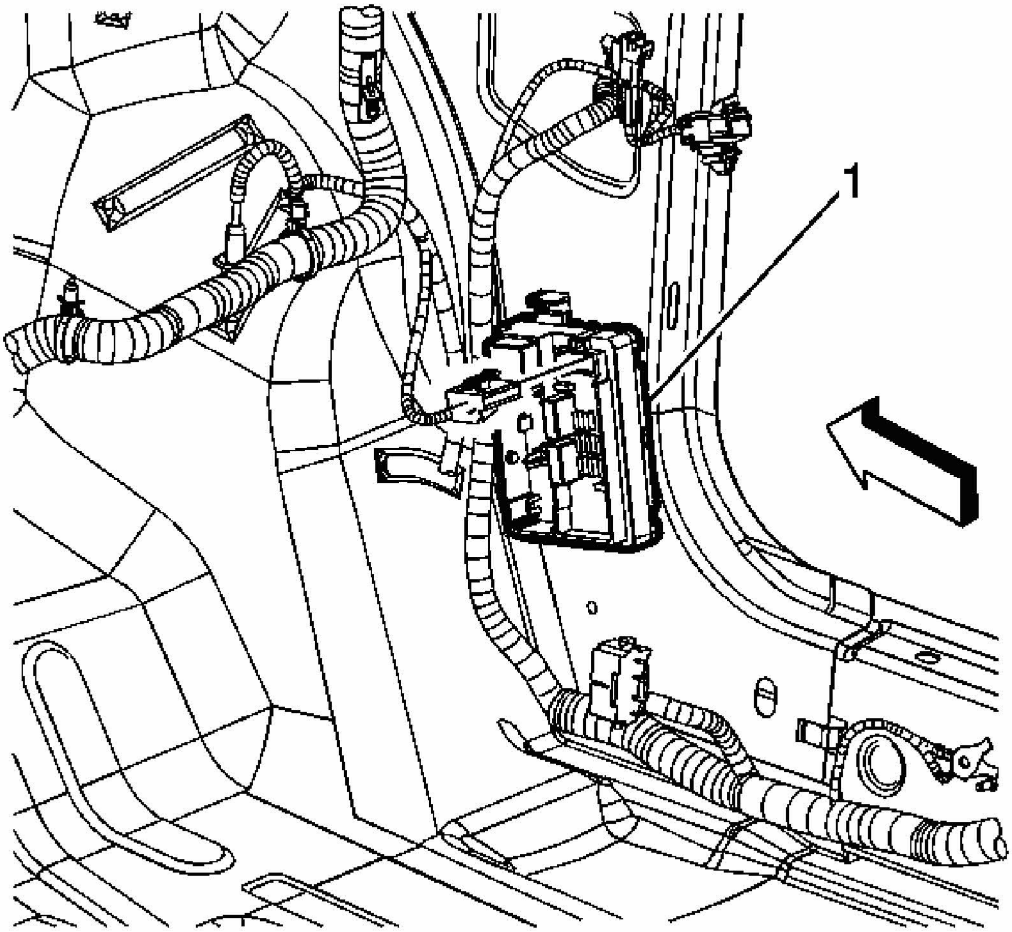


Fig. 97: Identifying Interior Fuse Center
Courtesy of GENERAL MOTORS CORP.

7. Pull back the carpet from the front lower right/passenger door pillar to expose the interior fuse center (1). Refer to **Junction Block Replacement - Accessory Wiring** .
8. Remove the cover then locate and remove the Air Bag Fuse from the interior fuse center.

9. When disabling the RF/passenger side impact module perform step 10, if the SDM needs disabling then use entire procedure.

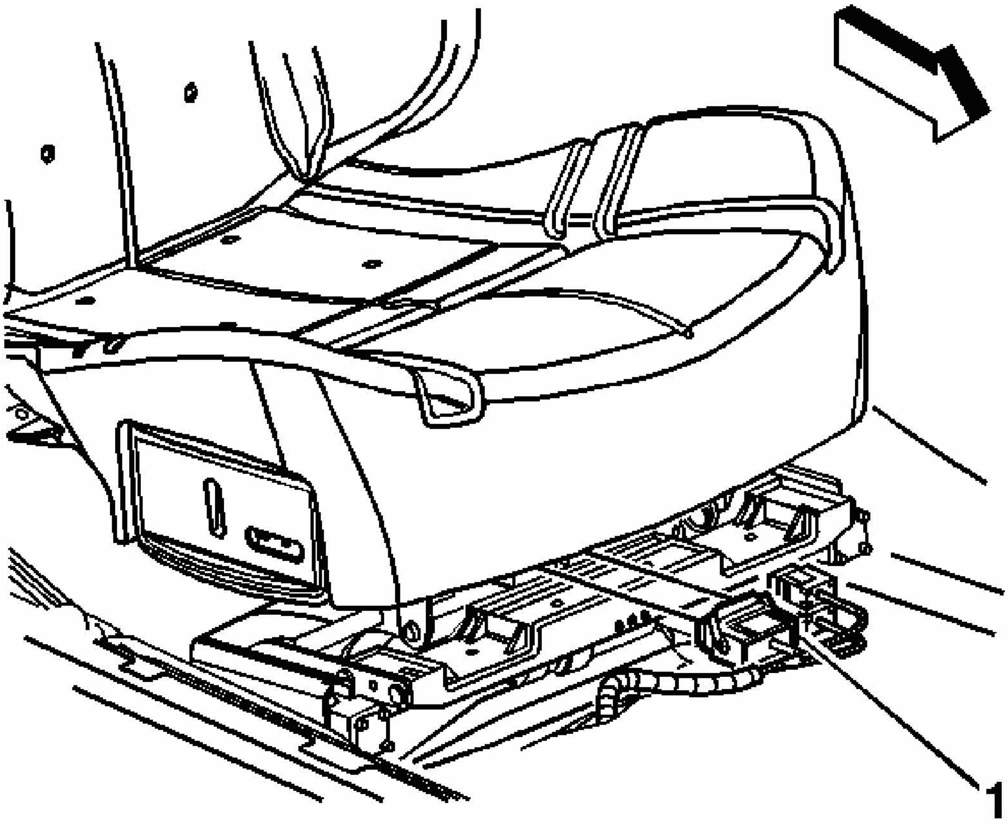


Fig. 98: Locating Side Impact Module & Pretensioner Yellow Connector
Courtesy of GENERAL MOTORS CORP.

10. Remove the connector position assurance (CPA) from the RF/passenger side impact module connector (1) located under the front of passenger seat.
11. Disconnect the RF side impact module connector (1) from the vehicle harness connector.

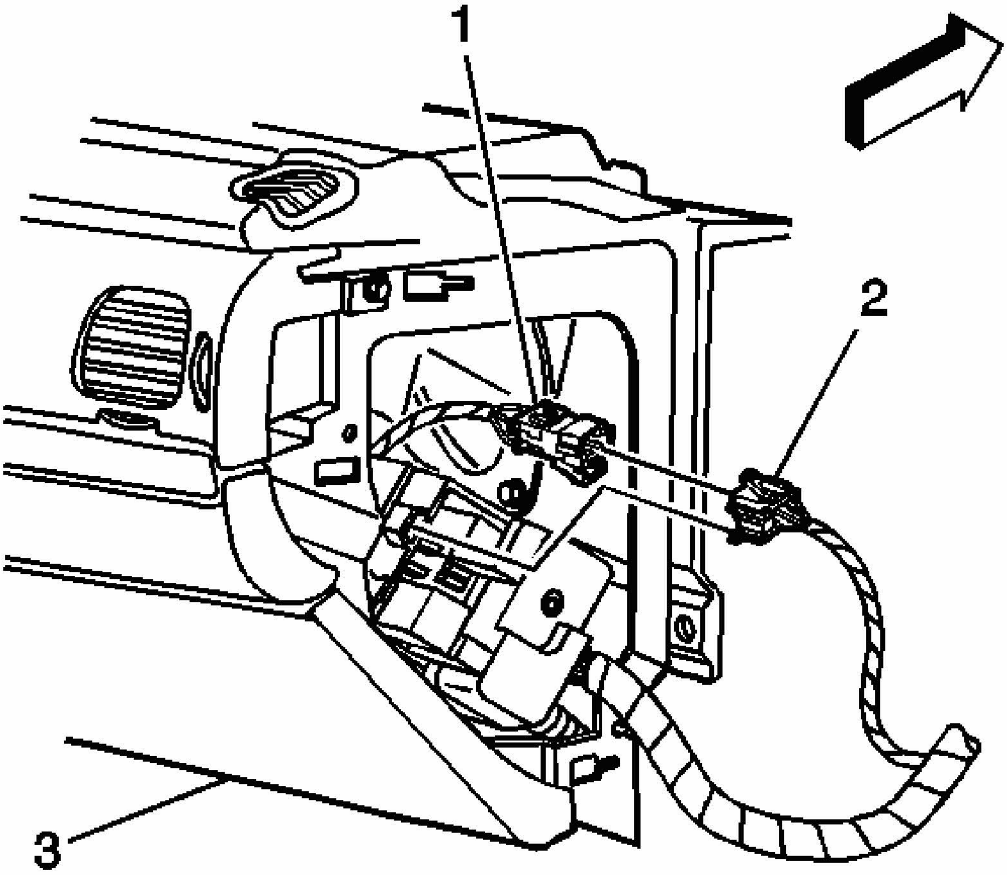


Fig. 99: Identifying I/P Module Connector To Vehicle Harness Connector
Courtesy of GENERAL MOTORS CORP.

12. Remove the right/passenger outer trim cover from the instrument panel (I/P) (3). Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Right** .
13. Remove the CPA from the I/P module connector (1).
14. Disconnect the I/P module connector (1) from the vehicle harness connector (2).

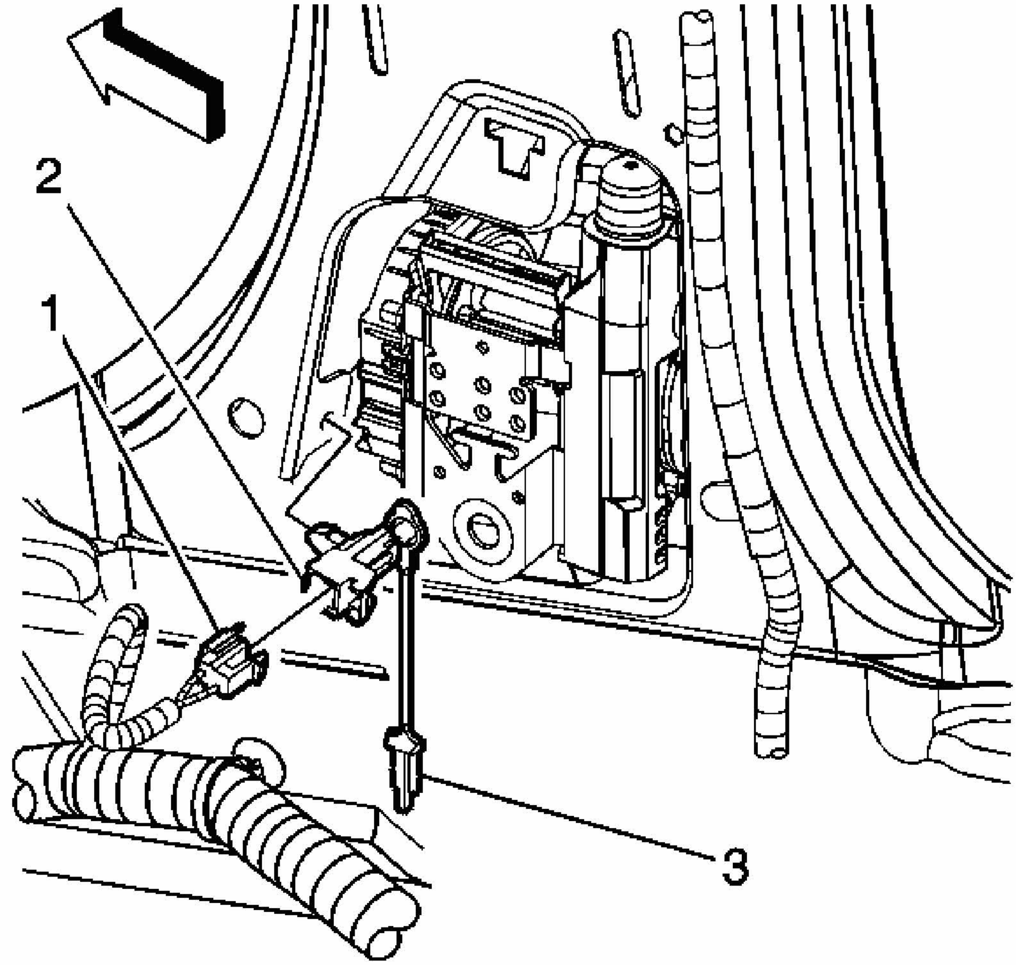


Fig. 100: Removing The CPA
Courtesy of GENERAL MOTORS CORP.

15. Remove the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .
16. Remove the CPA (3) from the seat belt retractor pretensioner - RF connector (2).
17. Disconnect the seat belt retractor pretensioner - RF connector (2) from the vehicle harness connector (1).

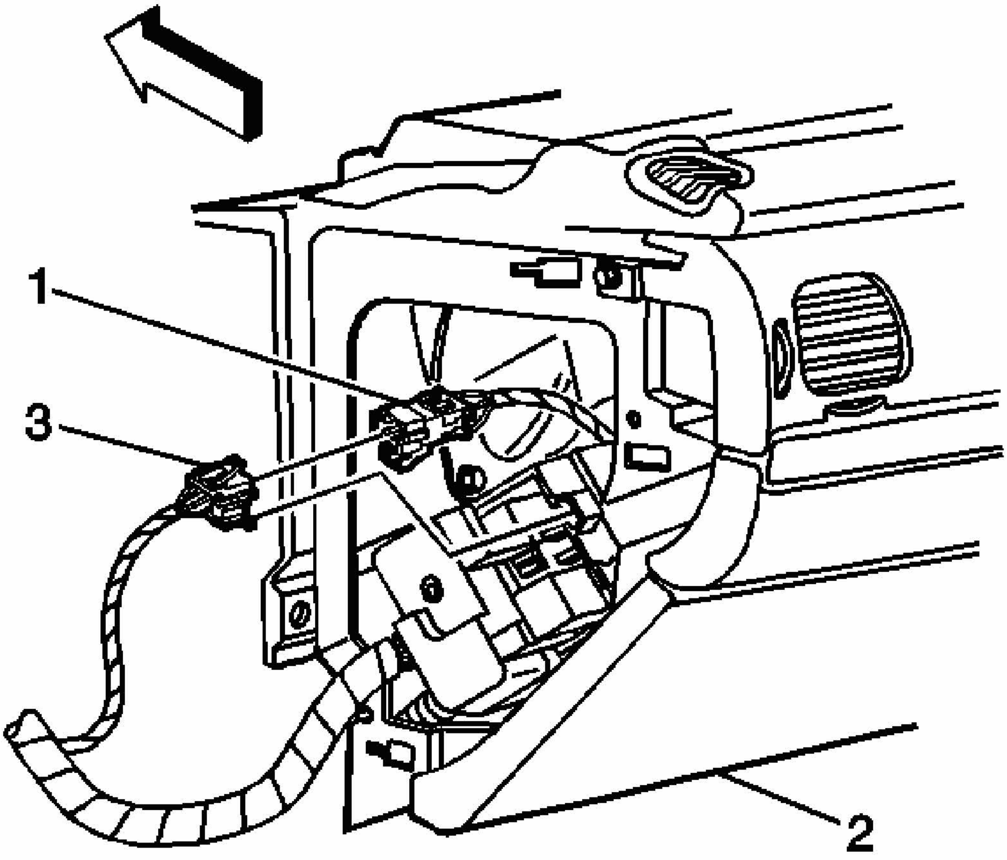


Fig. 101: Identifying I/P Module Connector To Vehicle Harness Connector (LH Side I/P)
Courtesy of GENERAL MOTORS CORP.

18. Remove the left/driver outer trim cover from the I/P. Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Left** .
19. Remove the CPA from the steering wheel module coil connector (1).
20. Disconnect the steering wheel module coil connector (1) from the vehicle harness connector (3).

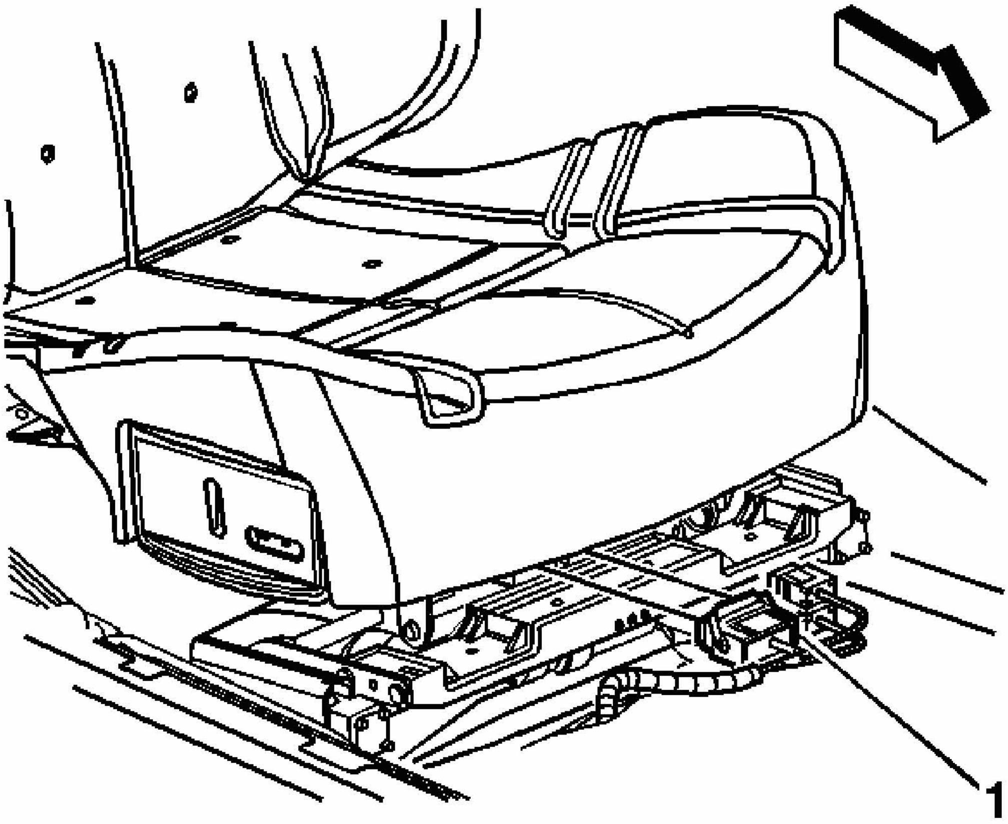


Fig. 102: Locating Side Impact Module & Pretensioner Yellow Connector
Courtesy of GENERAL MOTORS CORP.

21. Remove the CPA from the LF/driver side impact module connector (1) located under the front of driver seat.
22. Disconnect the LF side impact module connector (1) from the vehicle harness connector.

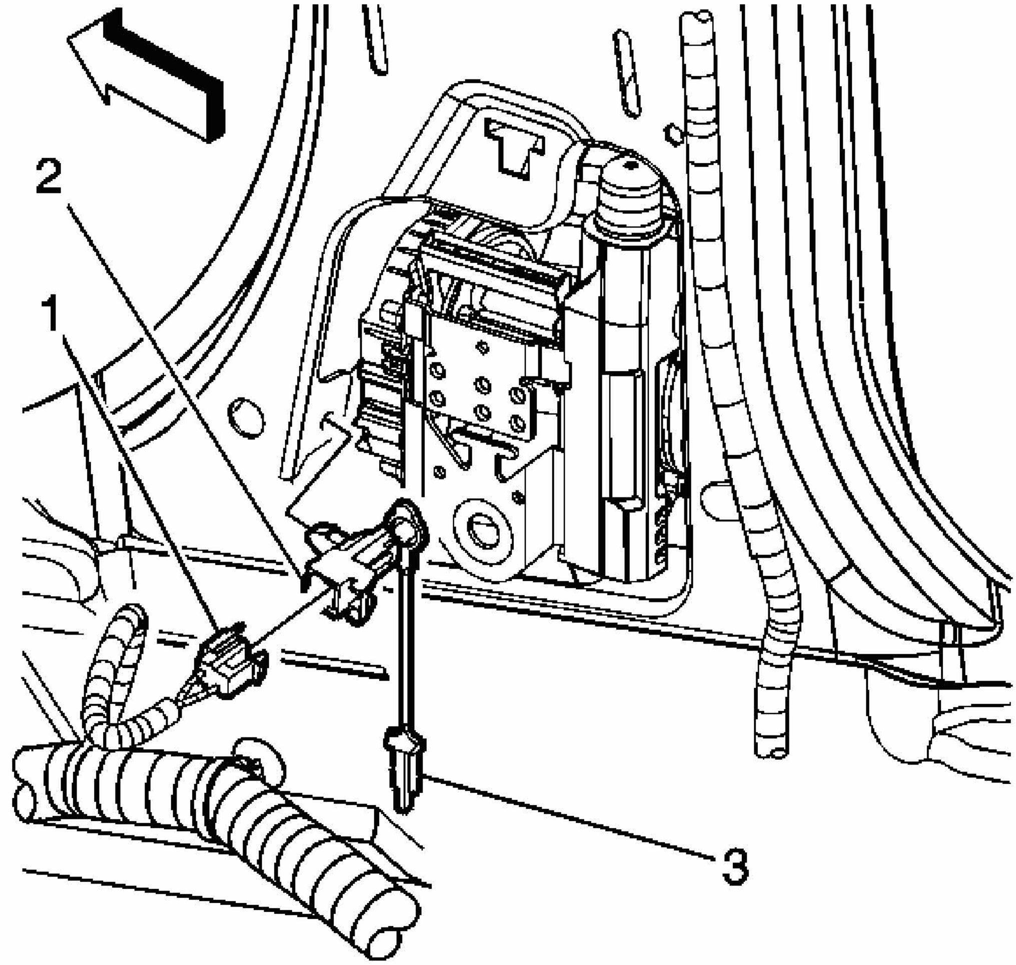


Fig. 103: Removing The CPA
Courtesy of GENERAL MOTORS CORP.

23. Remove the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .
24. Remove the CPA (3) from the seat belt retractor pretensioner - LF connector (2).
25. Disconnect the seat belt retractor pretensioner - LF connector (2) from the vehicle harness connector (1).

Enabling Procedure

1. Remove the key from the ignition switch.
2. When enabling the right/passenger side impact module proceed to step 3, if the SDM needs enabling then use entire procedure.

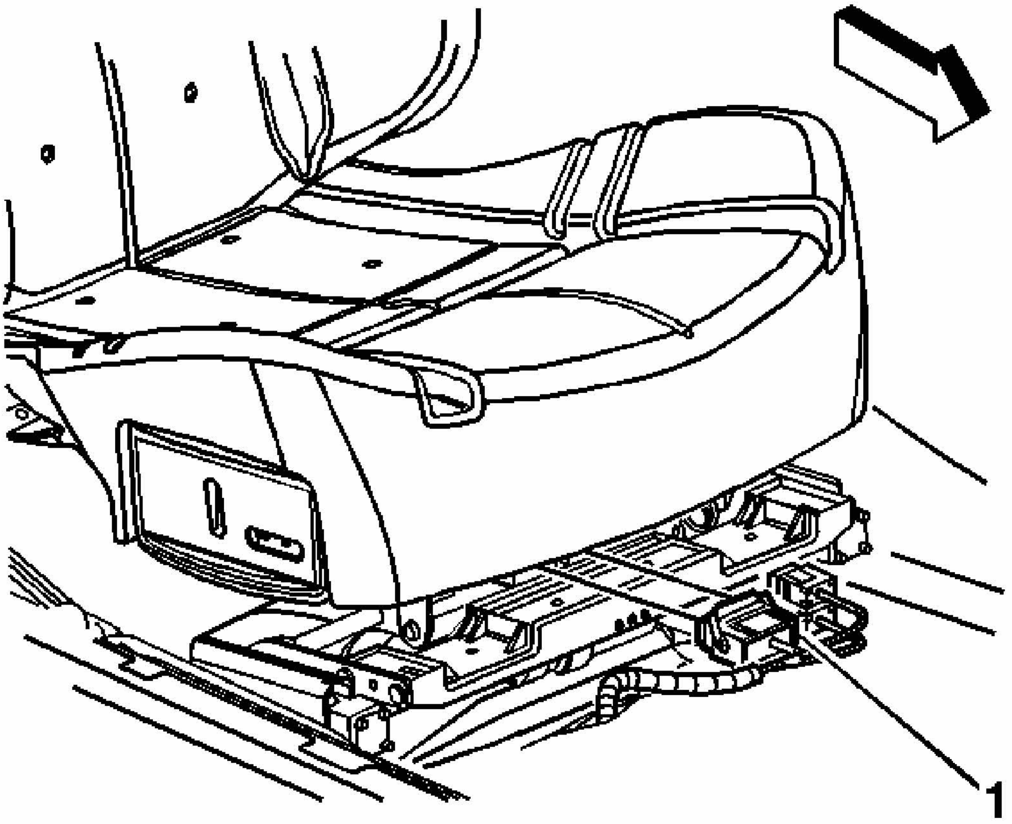


Fig. 104: Locating Side Impact Module & Pretensioner Yellow Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the RF side impact module connector (1) to the vehicle harness connector.
4. Install the CPA lock to the RF side impact module connector (1).

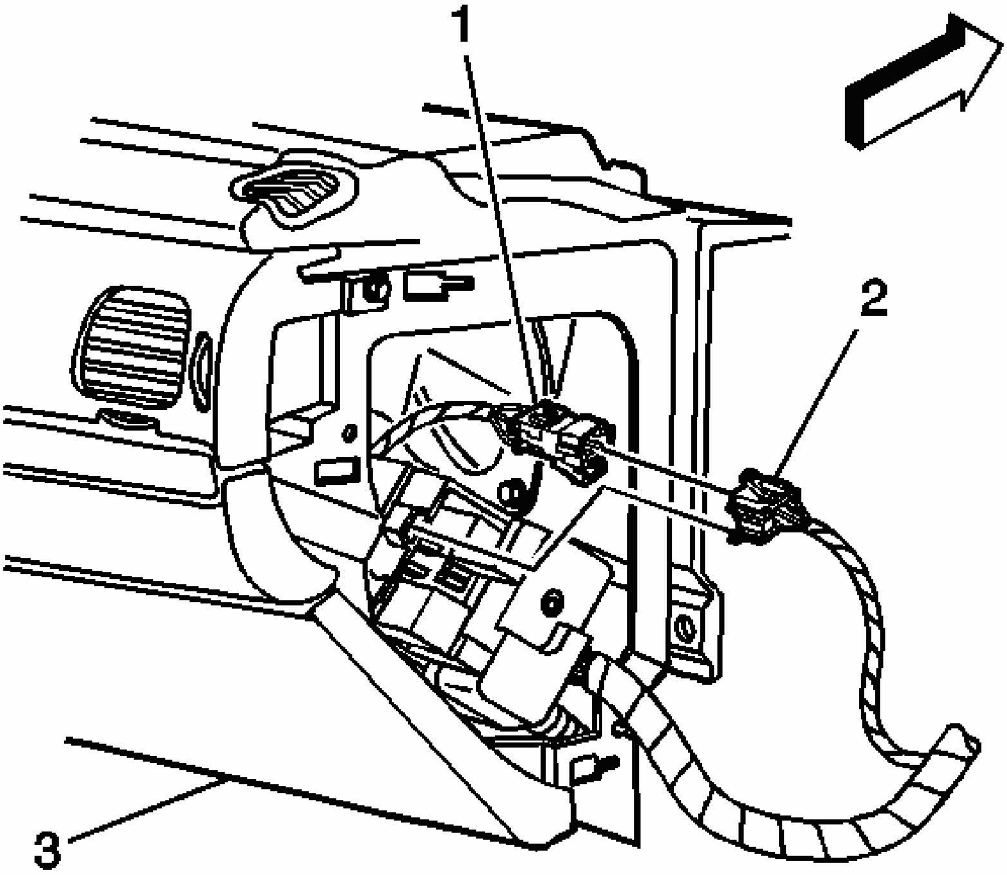


Fig. 105: Identifying I/P Module Connector To Vehicle Harness Connector
Courtesy of GENERAL MOTORS CORP.

5. Connect the I/P module connector (1) to the vehicle harness connector (2).
6. Install the CPA to the I/P module connector (1).
7. Install the right outer trim cover to the I/P (3). Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Right** .

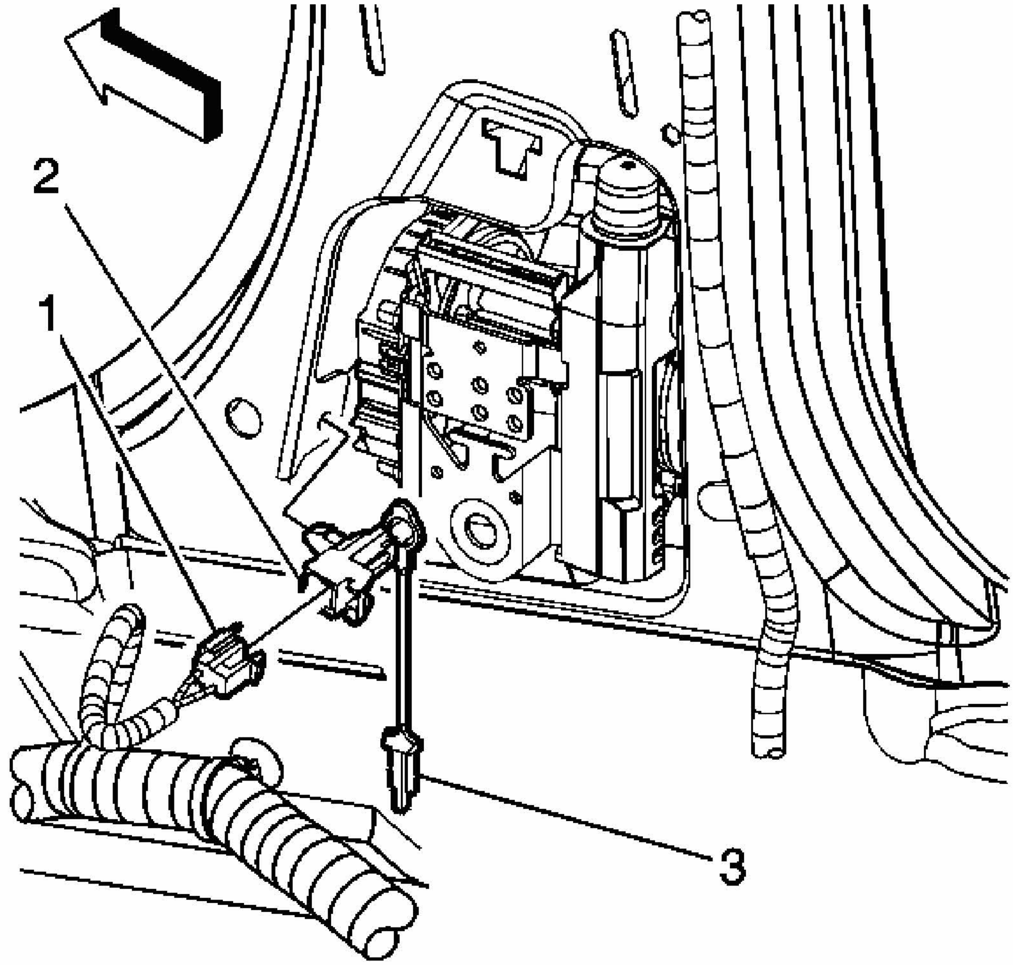


Fig. 106: Installing The CPA
Courtesy of GENERAL MOTORS CORP.

8. Connect the seat belt retractor pretensioner - RF connector (2) to vehicle harness connector (1).
9. Install the CPA (3) to the seat belt retractor pretensioner - RF connector (2).
10. Install the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .

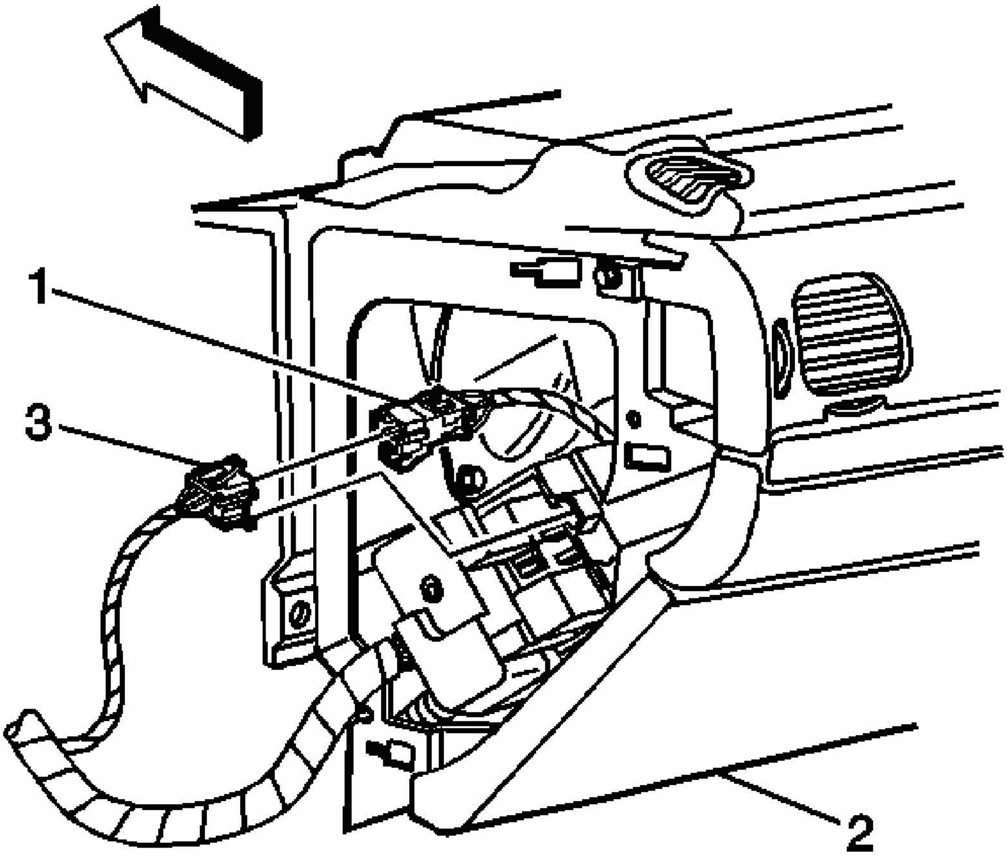


Fig. 107: Identifying I/P Module Connector To Vehicle Harness Connector (LH Side I/P)
Courtesy of GENERAL MOTORS CORP.

11. Connect the steering wheel module coil connector (1) to the vehicle harness connector (3).
12. Install the CPA to the steering wheel module coil connector (1).
13. Install the left outer trim cover to the I/P. Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Left** .

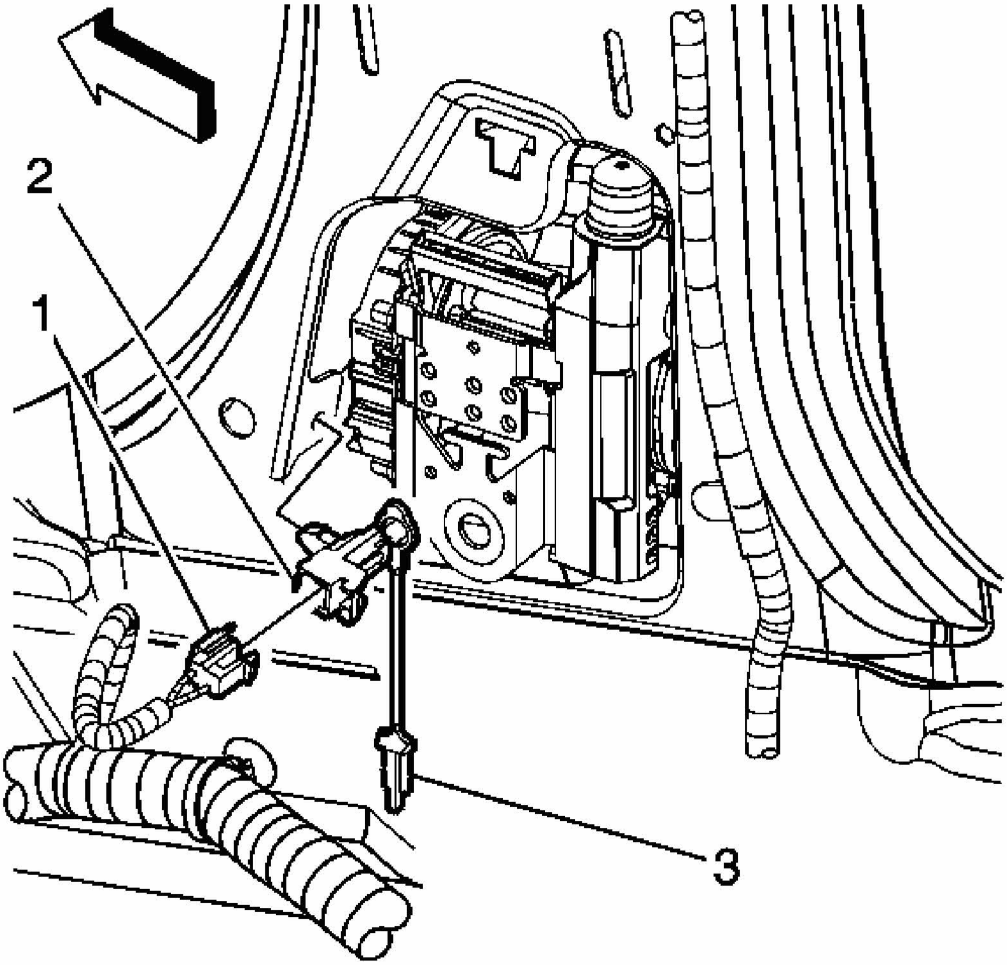


Fig. 108: Installing The CPA
Courtesy of GENERAL MOTORS CORP.

14. Connect the seat belt retractor pretensioner - LF connector (2) to vehicle harness connector (1).
15. Install the CPA (3) to the seat belt retractor pretensioner - LF connector (2).
16. Install the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .

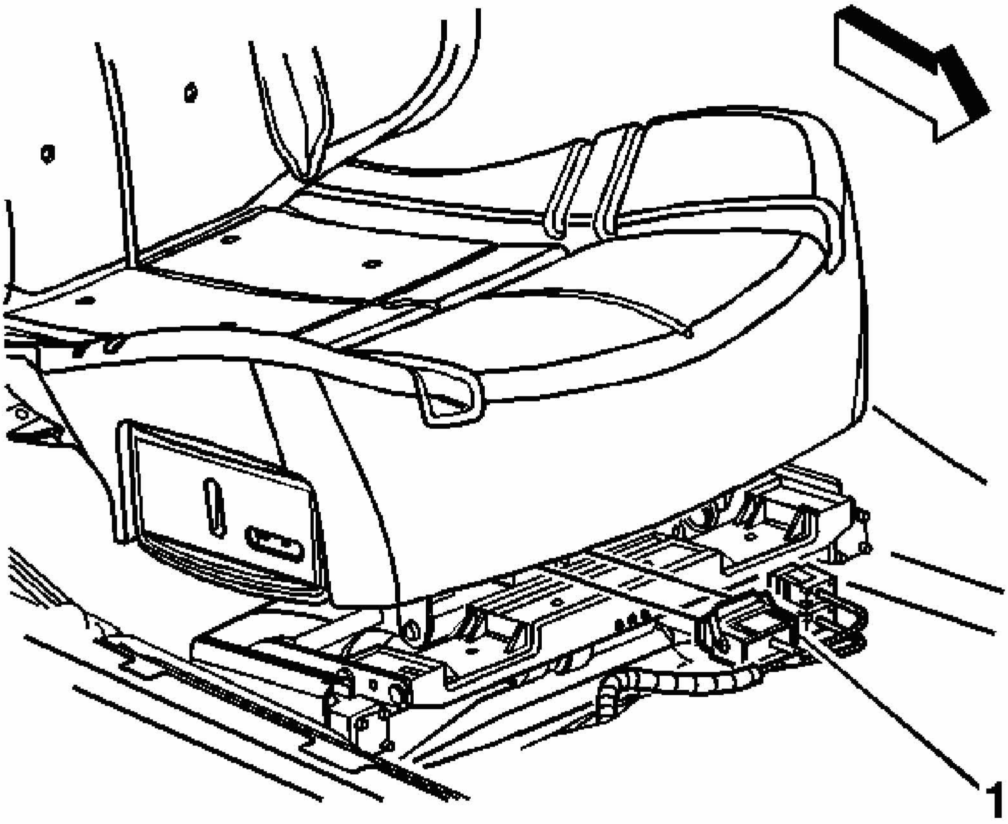


Fig. 109: Locating Side Impact Module & Pretensioner Yellow Connector
Courtesy of GENERAL MOTORS CORP.

17. Connect the LF side impact module connector (1) to the vehicle harness connector.
18. Install the CPA lock to the LF side impact module connector (1).
19. Install both Air Bag Fuses, one in the underhood fuse center and one in the interior fuse center.
20. Replace both fuse center covers.
21. Use caution while reaching in and turn the ignition switch to the ON position.

    The AIR BAG indicator will flash then turn OFF.

22. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

SIR DISABLING AND ENABLING ZONE 9 (IMPALA)

Disabling Procedure

IMPORTANT: Refer to SIR Service Precautions.

1. Turn the steering wheel so that the vehicle wheels are pointing straight ahead.
2. Turn the ignition switch to the OFF position.
3. Remove the key from the ignition switch.

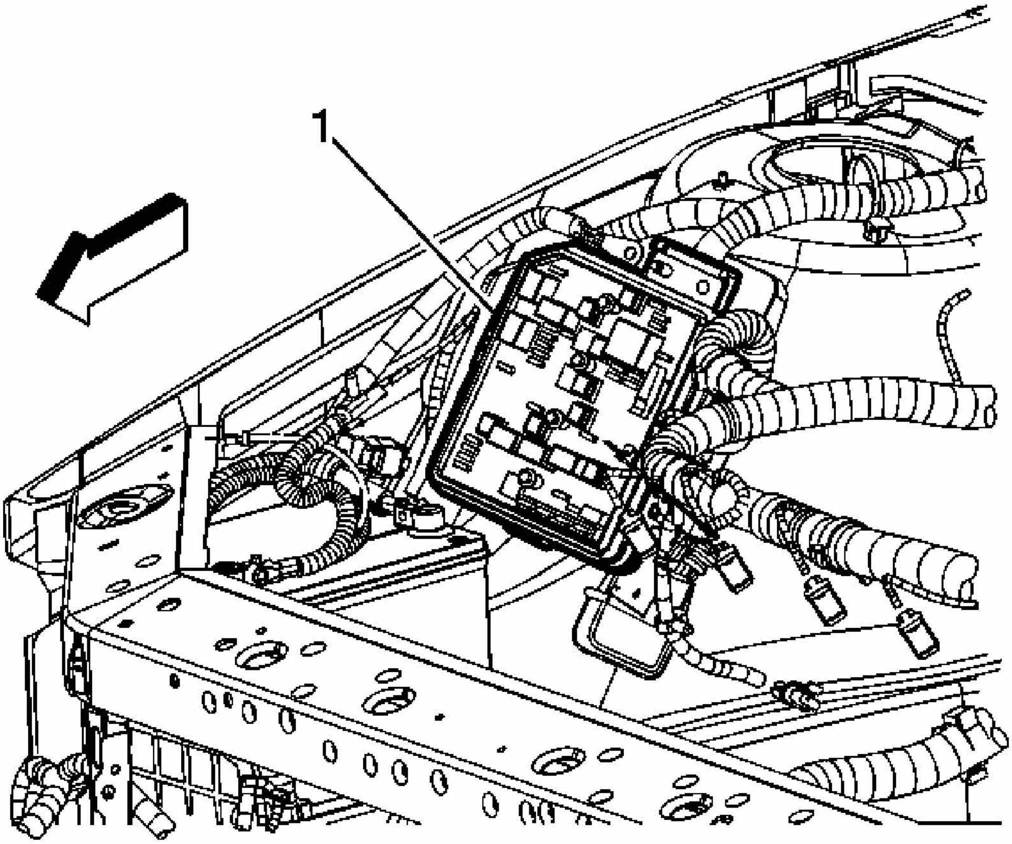


Fig. 110: Identifying Underhood Fuse Center
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: This sensing and diagnostic module (SDM) has 2 fused power inputs. To ensure there is no unwanted SIR deployment, personal injury, or unnecessary SIR system repairs, remove both AIR BAG (IGN) and AIR BAG (BATT) fuses. With the AIR BAG fuses removed and the ignition switch in the ON position, the AIR BAG warning indicator illuminates. This is normal operation, and does not

indicate an SIR system malfunction.

4. Open the hood and locate the underhood fuse center (1) on right/passenger shock tower.
5. Lift the cover for the underhood fuse center.
6. Locate and remove the Air Bag Fuse from the underhood fuse center.

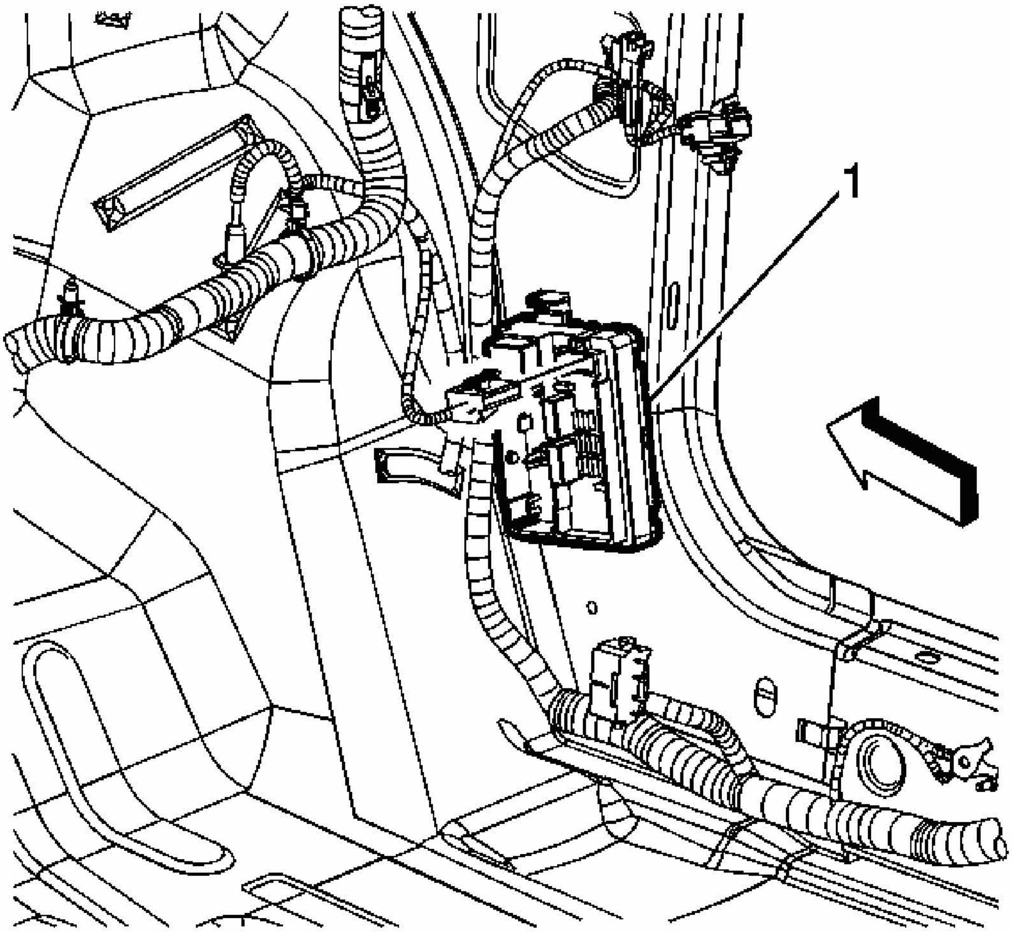


Fig. 111: Identifying Interior Fuse Center
Courtesy of GENERAL MOTORS CORP.

7. Pull back the carpet from the front lower right/passenger door pillar to expose the interior fuse center (1). Refer to **Junction Block Replacement - Accessory Wiring** .
8. Remove the cover then locate and remove the Air Bag Fuse from the interior fuse center.

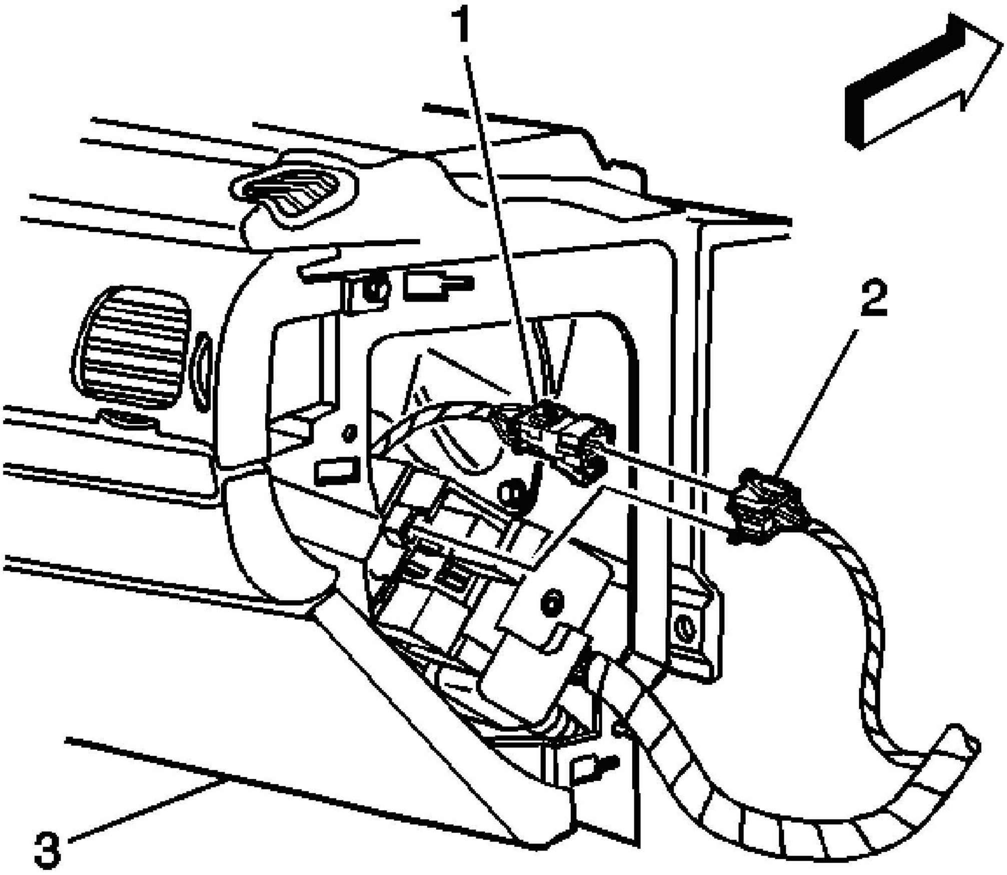


Fig. 112: Identifying I/P Module Connector To Vehicle Harness Connector
Courtesy of GENERAL MOTORS CORP.

9. Remove the right/passenger outer trim cover from the instrument panel (I/P) (3). Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Right** .
10. Remove the connector position assurance (CPA) from the I/P module connector (1).
11. Disconnect the I/P module connector (1) from the vehicle harness connector (2).

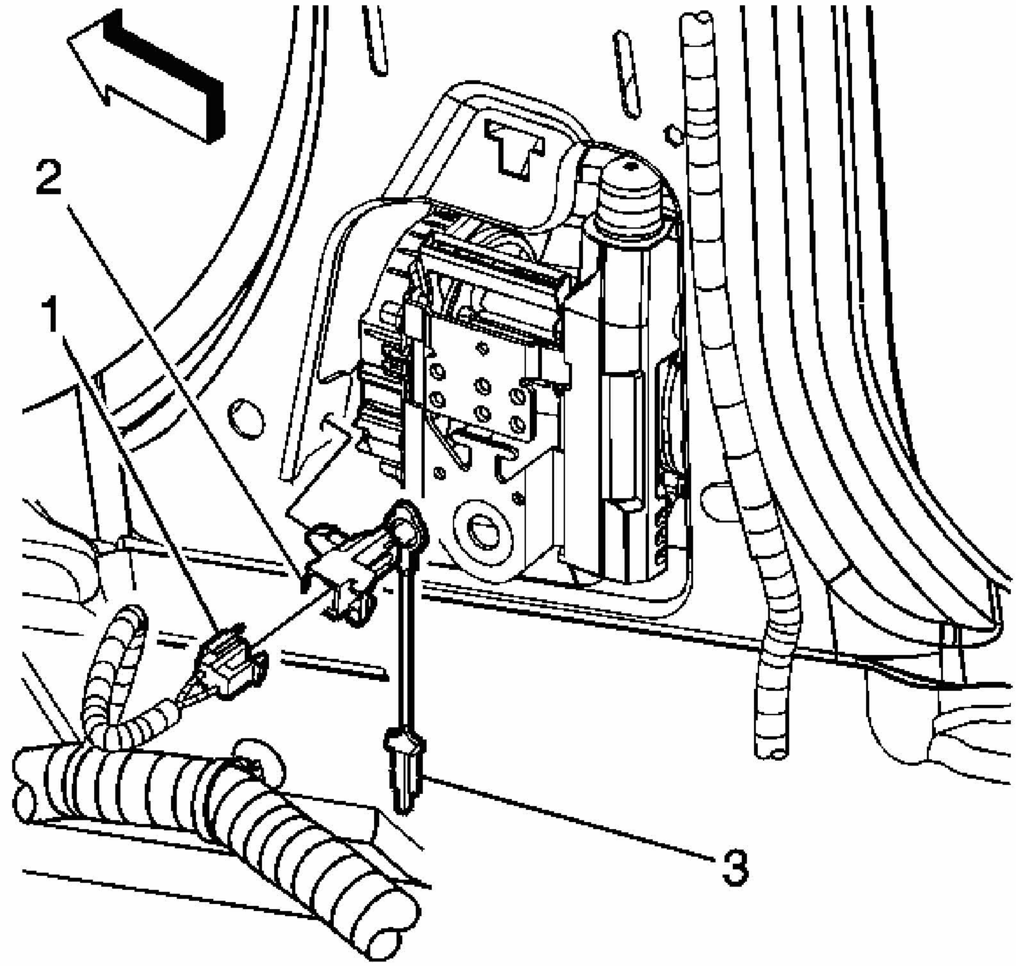


Fig. 113: Removing The CPA
Courtesy of GENERAL MOTORS CORP.

12. Remove the right/passenger lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .
13. Remove the CPA (3) from the seat belt retractor pretensioner - RF connector (2).
14. Disconnect the seat belt retractor pretensioner - RF connector (2) from the vehicle harness connector (1).

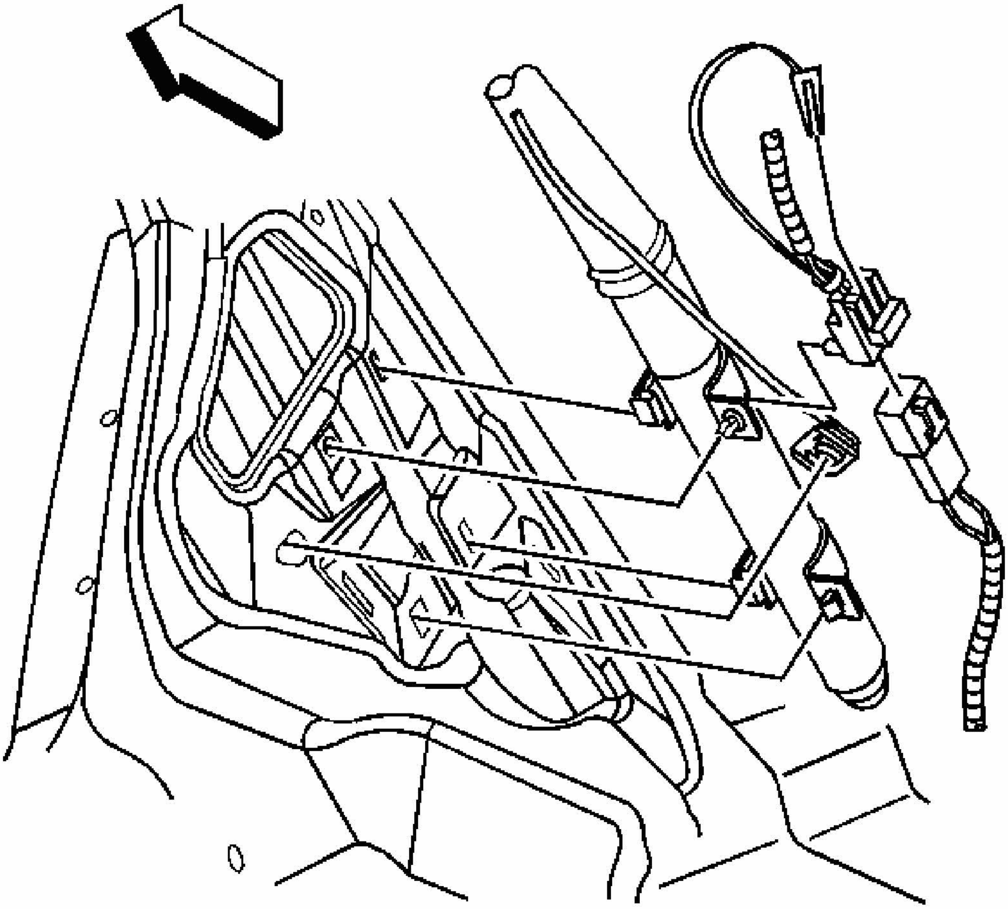


Fig. 114: Locating Roof Rail Module Connector
Courtesy of GENERAL MOTORS CORP.

15. Remove the upper trim molding from the rear quarter pillar. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .
16. Remove the CPA from the roof rail module - right connector.
17. Disconnect the roof rail module - right connector from the vehicle harness connector.

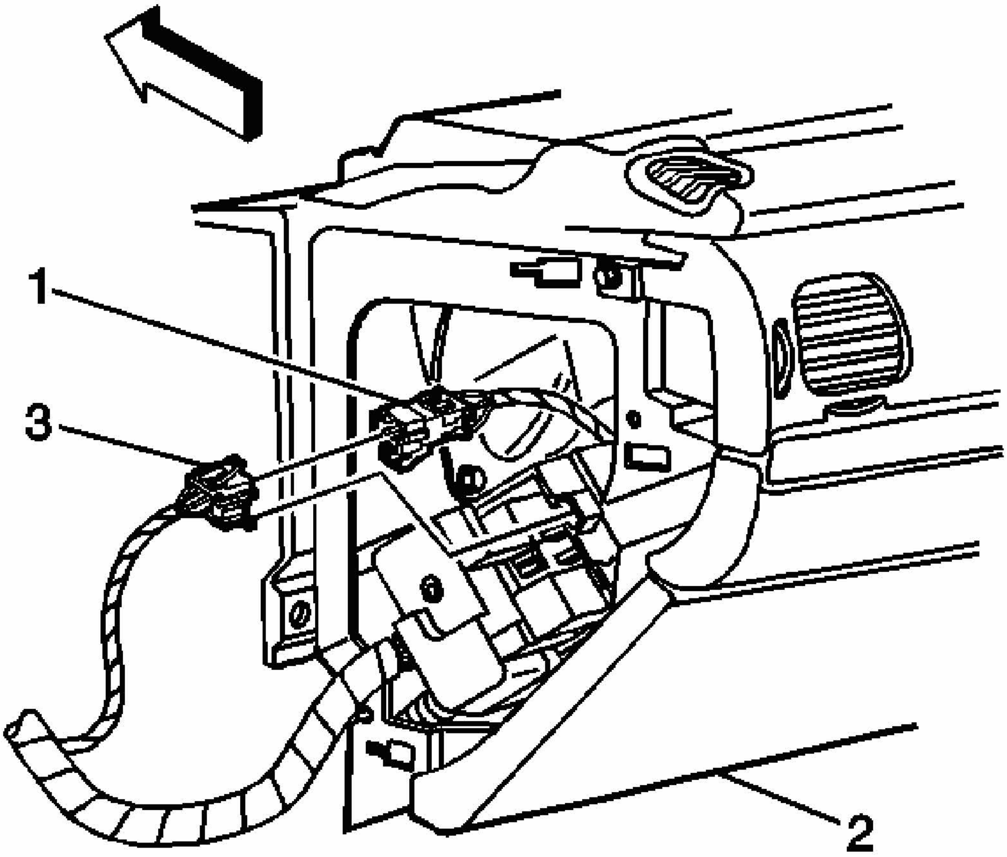


Fig. 115: Identifying I/P Module Connector To Vehicle Harness Connector (LH Side I/P)
Courtesy of GENERAL MOTORS CORP.

18. Remove the left/driver outer trim cover from the I/P. Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Left** .
19. Remove the CPA from the steering wheel module coil connector (1).
20. Disconnect the steering wheel module coil connector (1) from the vehicle harness connector (3).

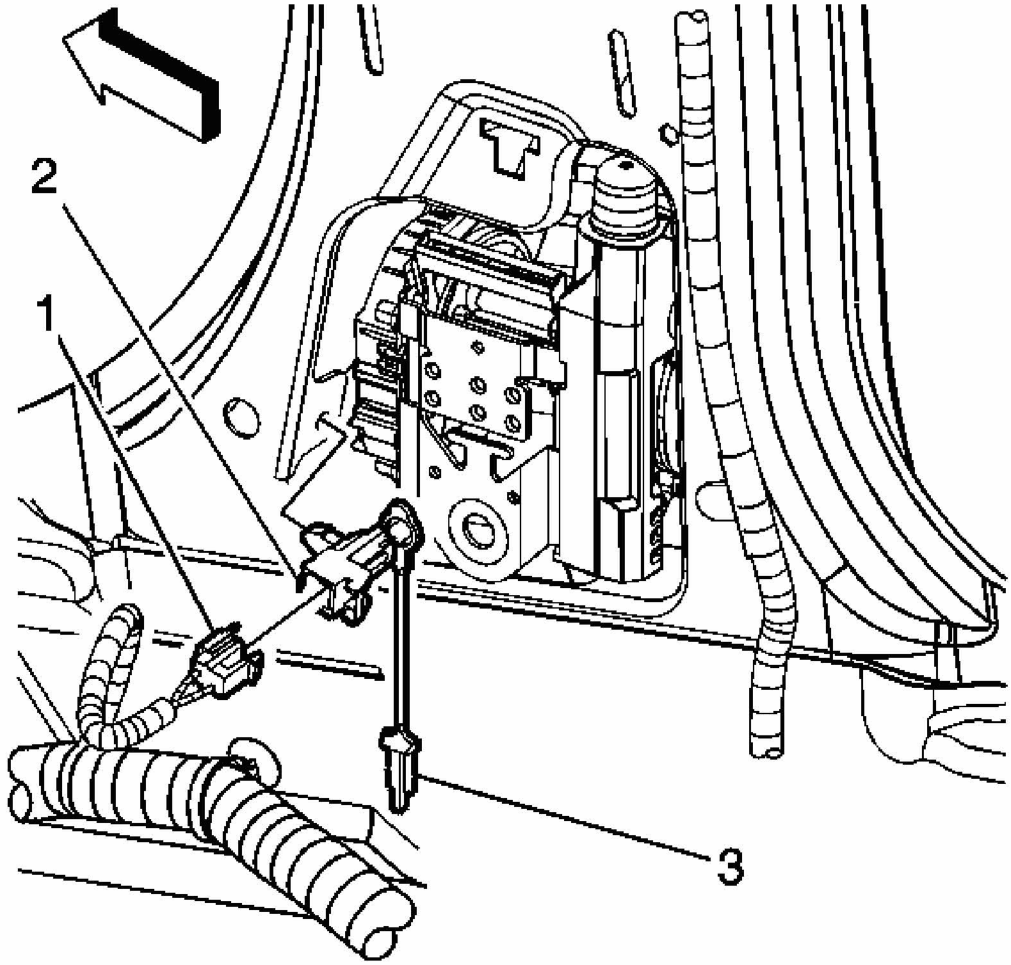


Fig. 116: Removing The CPA
Courtesy of GENERAL MOTORS CORP.

21. Remove the left/driver lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .
22. Remove the CPA (3) from the seat belt retractor pretensioner - LF connector (2).
23. Disconnect the seat belt retractor pretensioner - LF connector (2) from the vehicle harness connector (1).

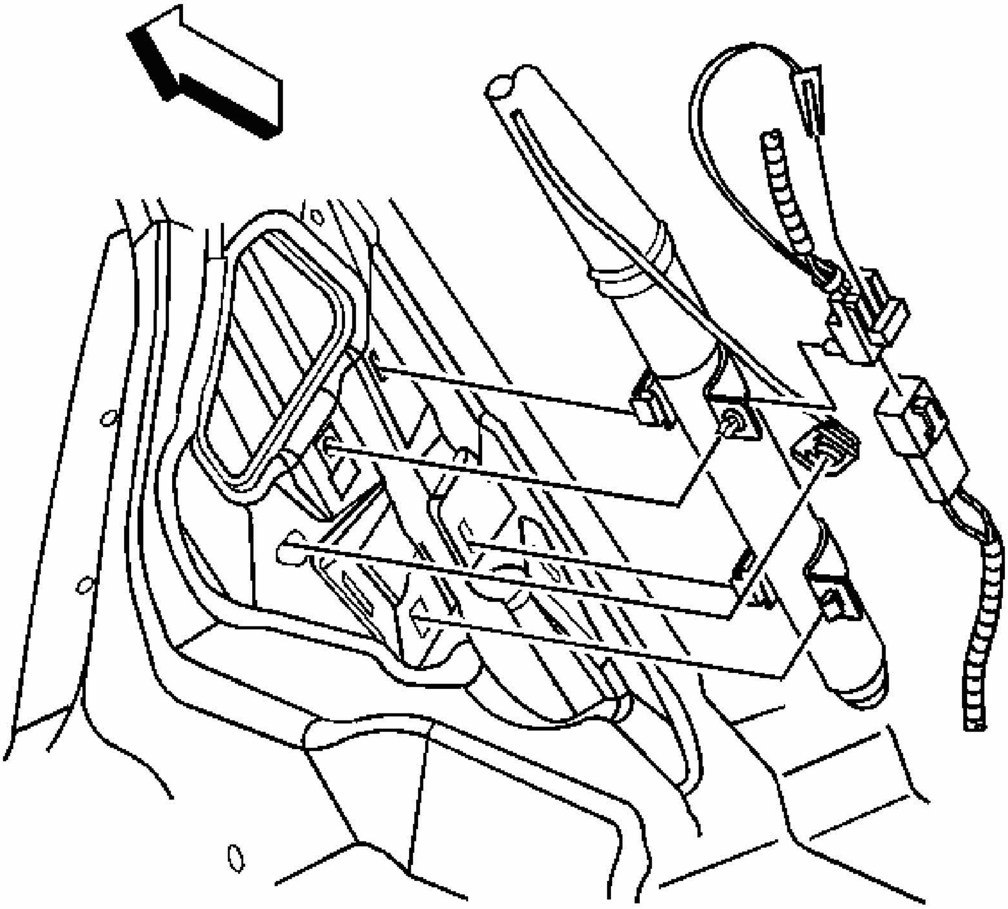


Fig. 117: Locating Roof Rail Module Connector
Courtesy of GENERAL MOTORS CORP.

24. Remove the upper trim molding from the rear quarter pillar. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .
25. Remove the CPA from the roof rail module - left connector.
26. Disconnect the roof rail module - left connector from the vehicle harness connector.

Enabling Procedure

1. Remove the key from the ignition switch.

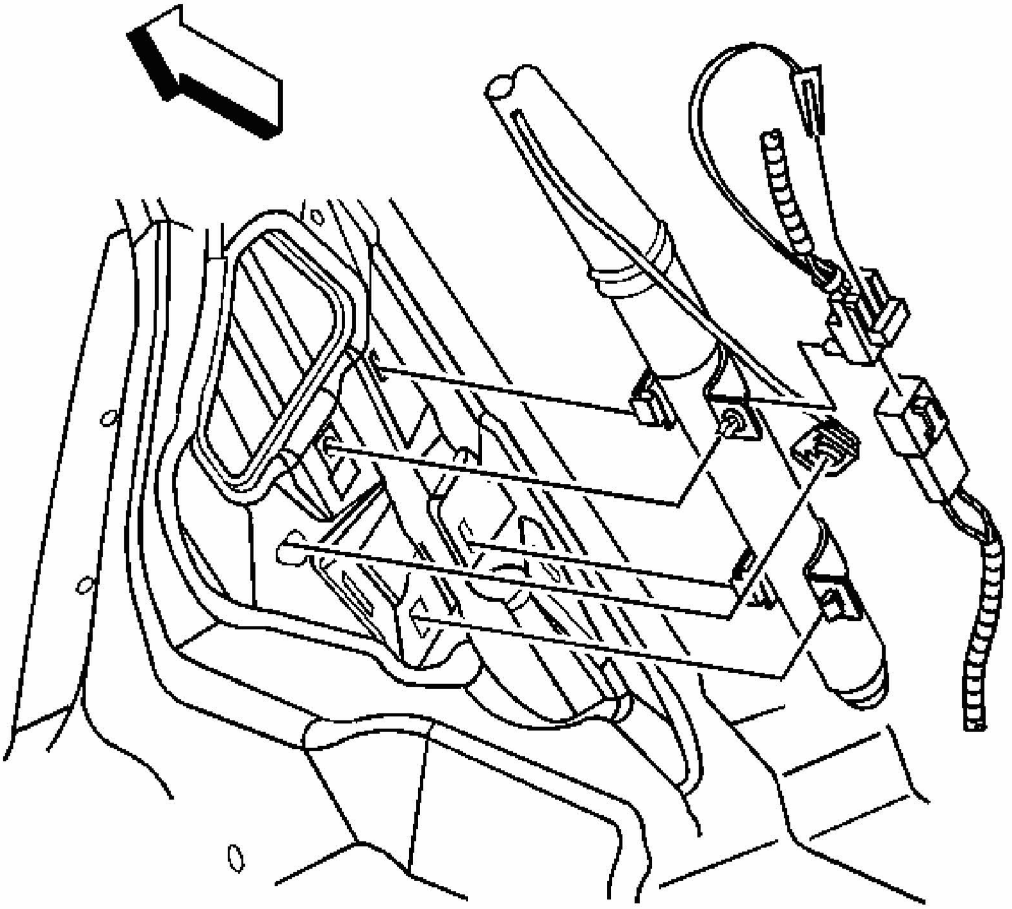


Fig. 118: Locating Roof Rail Module Connector
Courtesy of GENERAL MOTORS CORP.

2. Connect the roof rail module - left connector to the vehicle harness connector.
3. Install the CPA to the roof rail module - left connector.
4. Install the garnish molding to the upper lock pillar. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .

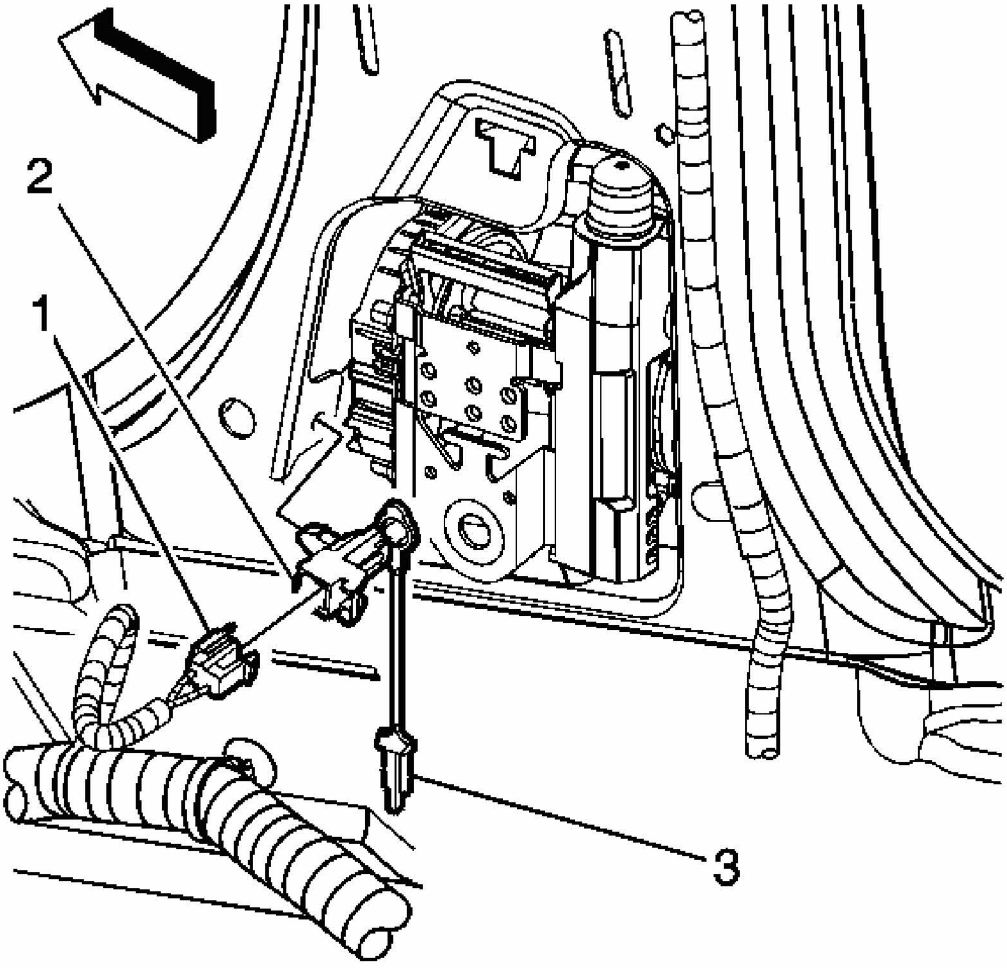


Fig. 119: Installing The CPA
Courtesy of GENERAL MOTORS CORP.

5. Connect the seat belt retractor pretensioner - LF connector (2) to vehicle harness connector (1).
6. Install the CPA (3) to the seat belt retractor pretensioner - LF connector (2).
7. Install the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .

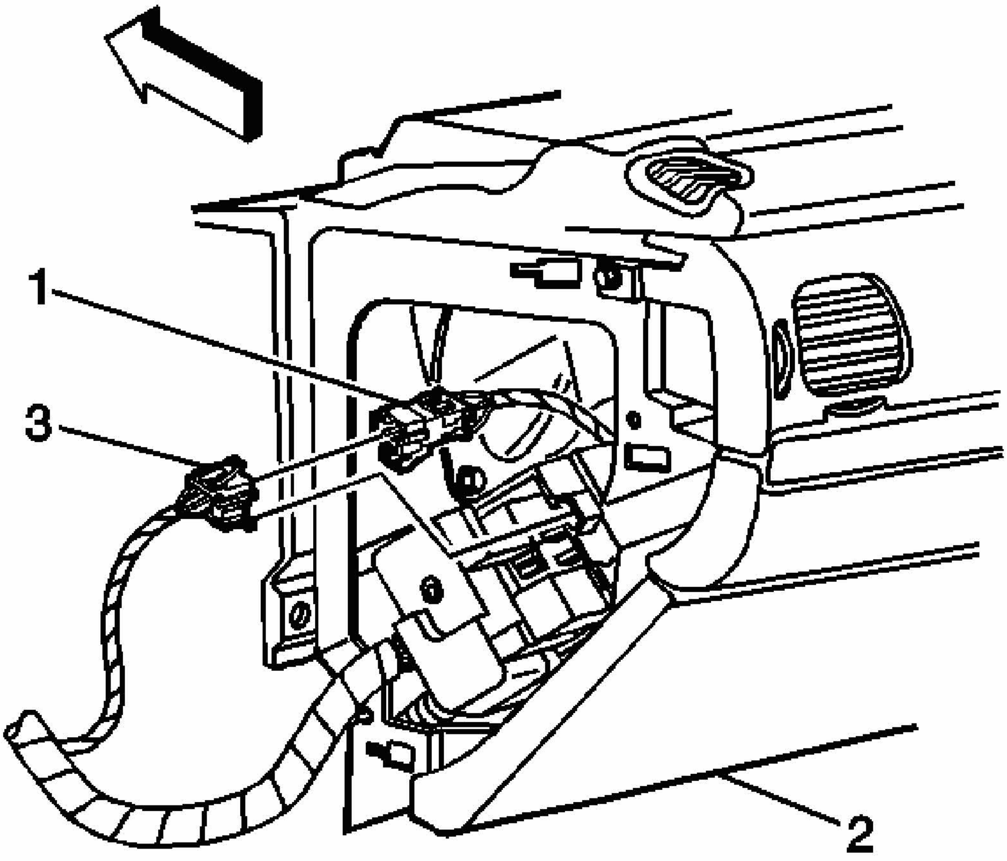


Fig. 120: Identifying I/P Module Connector To Vehicle Harness Connector (LH Side I/P)
Courtesy of GENERAL MOTORS CORP.

8. Connect the steering wheel module coil connector (1) to the vehicle harness connector (3).
9. Install the CPA to the steering wheel module coil connector (1).
10. Install the left outer trim cover to the I/P. Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Left** .

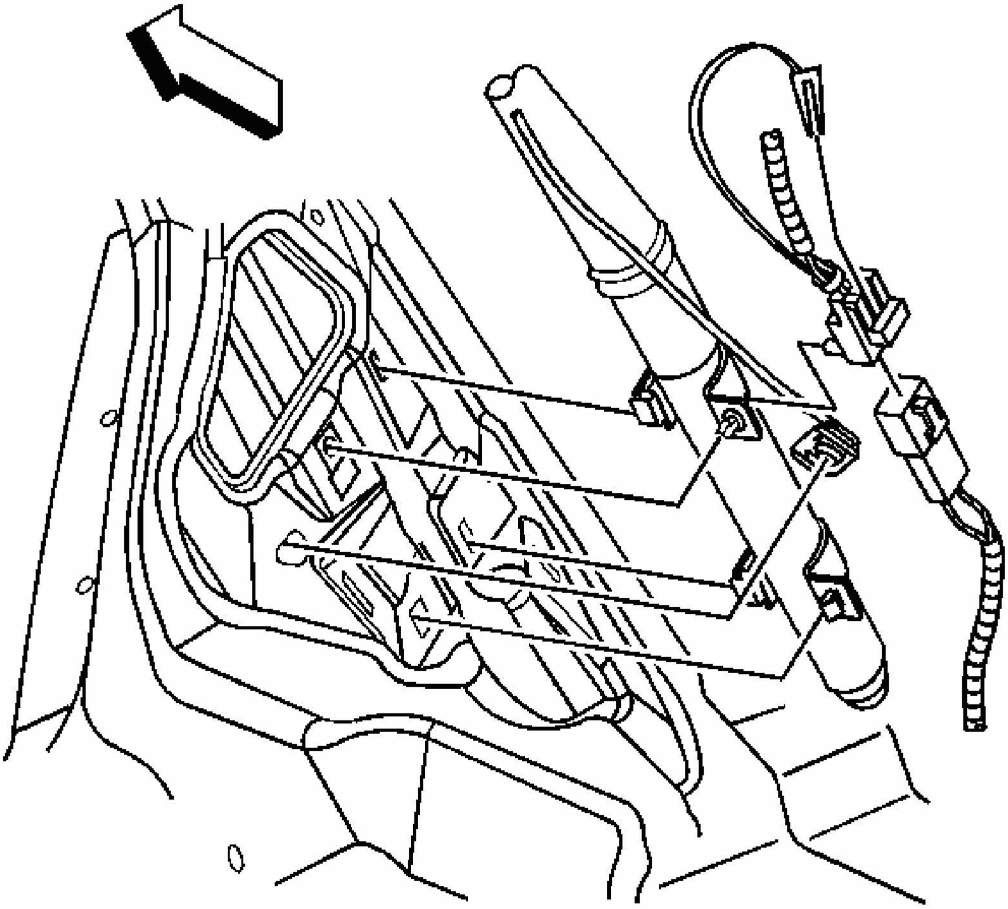


Fig. 121: Locating Roof Rail Module Connector
Courtesy of GENERAL MOTORS CORP.

11. Connect the roof rail module - right connector to the vehicle harness connector.
12. Install the CPA to the roof rail module - right connector.
13. Install the garnish molding to the upper lock pillar. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .

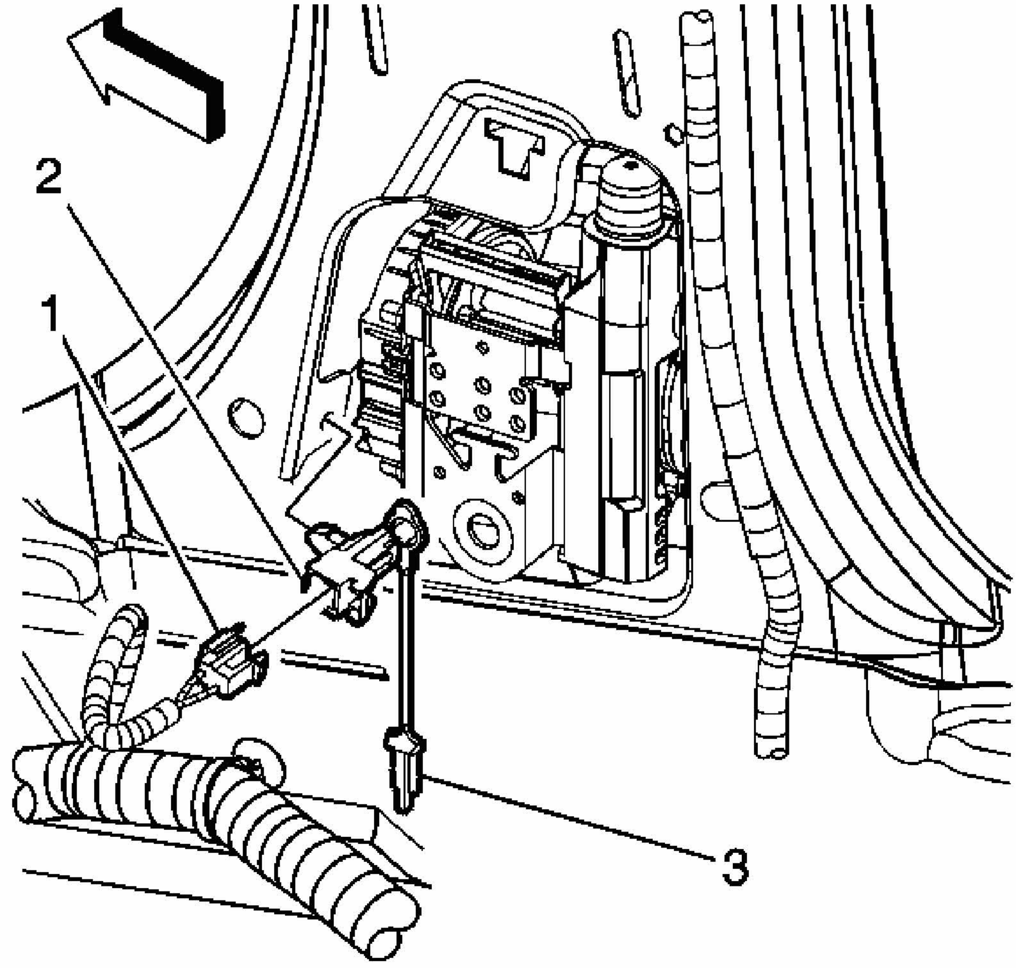


Fig. 122: Installing The CPA
Courtesy of GENERAL MOTORS CORP.

14. Connect the seat belt retractor pretensioner - RF connector (2) to vehicle harness connector (1).
15. Install the CPA (3) to the seat belt retractor pretensioner - RF connector (2).
16. Install the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .

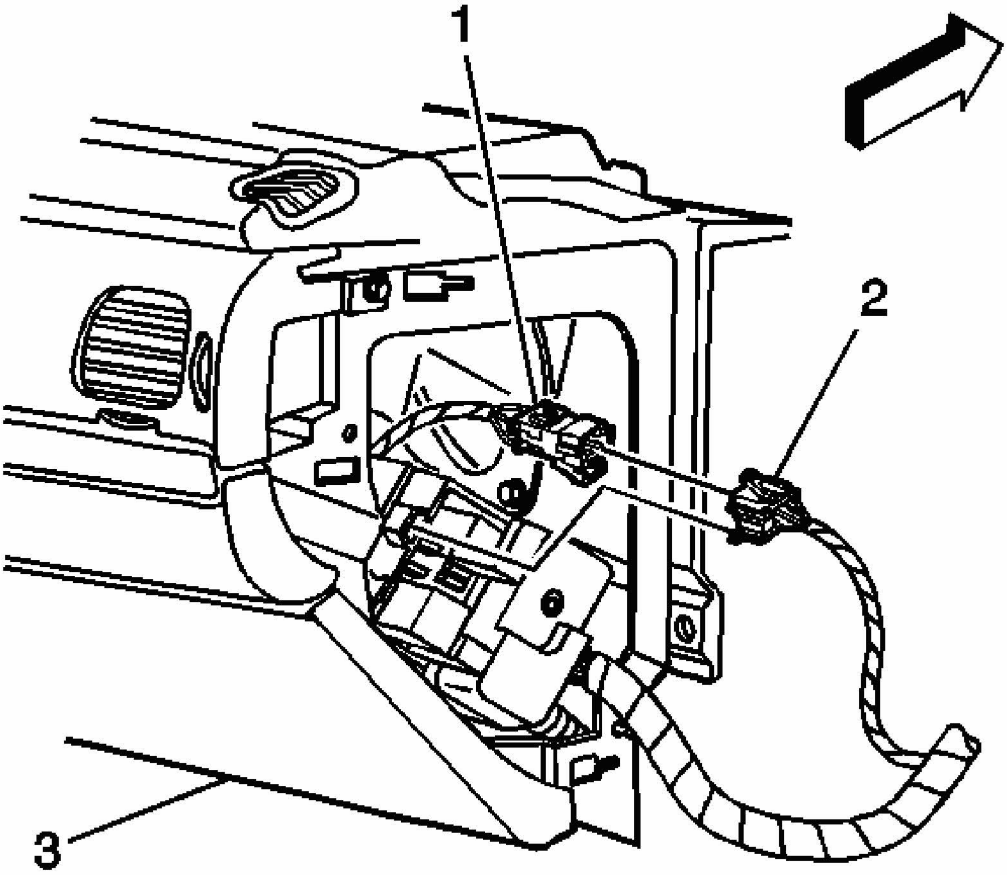


Fig. 123: Identifying I/P Module Connector To Vehicle Harness Connector
Courtesy of GENERAL MOTORS CORP.

17. Connect the I/P module connector (1) to the vehicle harness connector (2).
18. Install the CPA to the I/P module connector (1).
19. Install the right outer trim cover to the I/P (3). Refer to **Instrument Panel (I/P) Outer Trim Cover Replacement - Right** .
20. Install both Air Bag Fuses, one in the underhood fuse center and one in the interior fuse center.
21. Replace both fuse center covers.
22. Use caution while reaching in and turn the ignition switch to the ON position.

    The AIR BAG indicator will flash then turn OFF.

23. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

INFLATABLE RESTRAINT FRONT END SENSOR REPLACEMENT

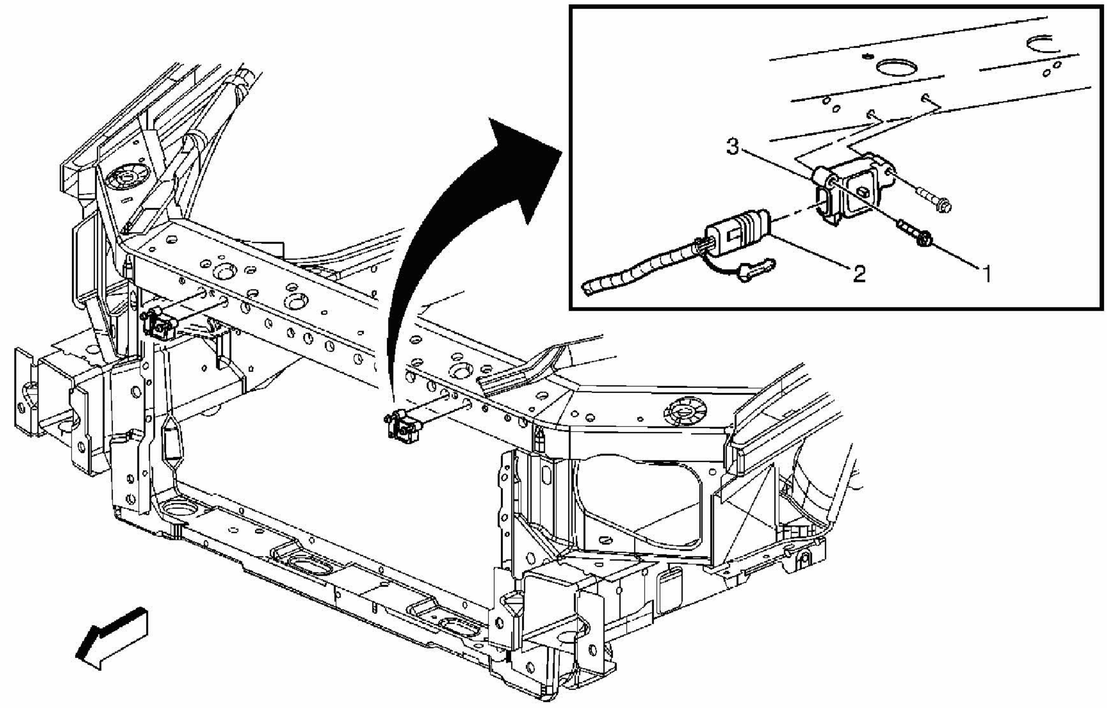


Fig. 124: Replacing Inflatable Restraint Front End Sensor
Courtesy of GENERAL MOTORS CORP.

Inflatable Restraint Front End Sensor Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **CAUTION:** **Refer to SIR Caution .** **Preliminary Procedures** 1. Disable the supplemental inflatable restraint (SIR) system. Refer to **SIR Disabling and Enabling Zone 1**. 2. Remove the upper air baffle and deflector. Refer to **Radiator Air Baffle and Deflector Replacement - Upper** . 3. Remove both headlamps. Refer to **HEADLAMP REPLACEMENT (IMPALA)** or **HEADLAMP REPLACEMENT (MONTE CARLO)** .	

4. Remove the fascia grille support bolts, 8 total. DO NOT remove the bumper fascia. Refer to **FRONT BUMPER ENERGY ABSORBER REPLACEMENT** .
5. Remove the retainers from fascia to grille support, 4 total.
6. Pull the grille support forward to gain clearance to the sensors.

1	Bolt, Inflatable Front End Sensor Mounting (Qty: 2) **Tighten:** 11 N.m (97 lb in)
2	Connector, Connector Position Assurance (CPA)
3	Sensor, Inflatable Front End

INFLATABLE RESTRAINT SIDE IMPACT SENSOR REPLACEMENT (IMPALA)

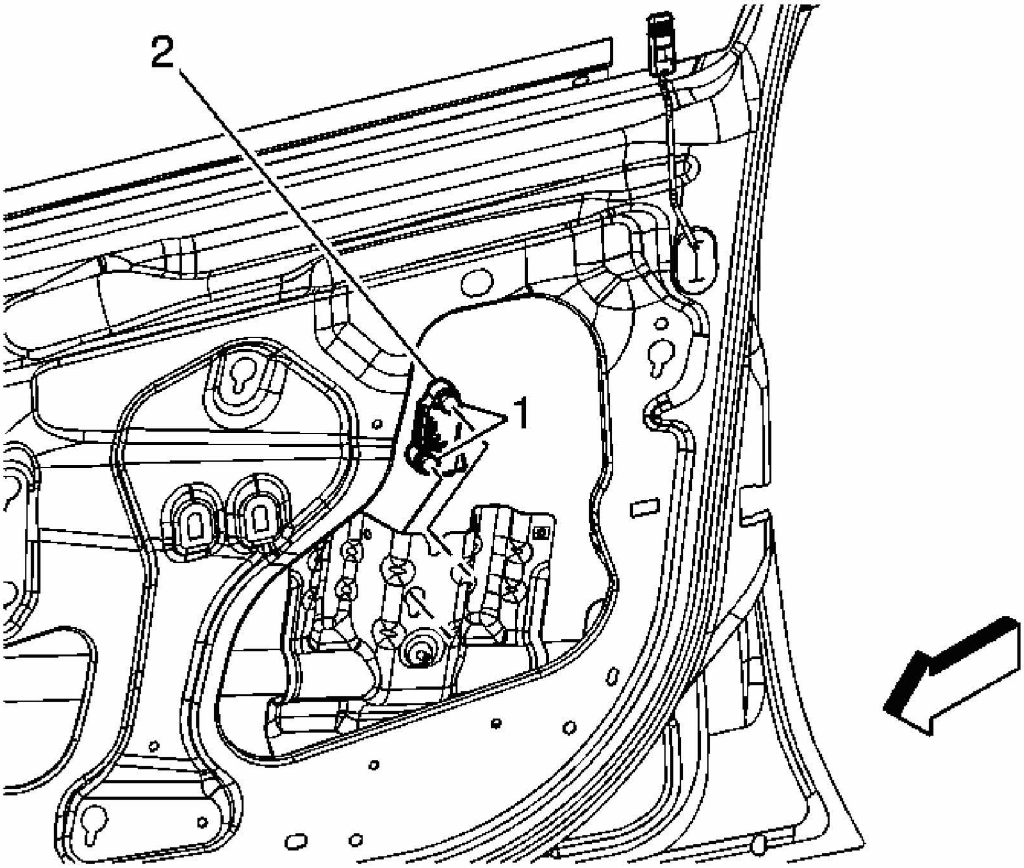


Fig. 125: Replacing Inflatable Restraint Side Impact Sensor
Courtesy of GENERAL MOTORS CORP.

Inflatable Restraint Side Impact Sensor Replacement (Impala)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">CAUTION:
Do not strike or jolt the inflatable restraint side impact sensor (SIS). Before applying power to the SIS make sure that it is securely fastened. Failure to observe the correct installation procedures could cause SIR deployment, personal injury, or unnecessary SIR system repairs.

CAUTION:
Refer to SIR Caution .

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.

Preliminary Procedure

1. Disable the SIR system. Refer to SIR Disabling and Enabling Zone 2 (Monte Carlo) or SIR Disabling and Enabling Zone 2 (Impala) for the left side or SIR Disabling and Enabling Zone 6 (Monte Carlo) or SIR Disabling and Enabling Zone 6 (Impala) for the right.
2. Remove the front door panel. Refer to Trim Panel Replacement - Side Front Door (Impala) .</td></tr>
<tr><td>1</td><td>Bolt/Screw, Inflatable Restraint Side Impact Sensor Assembly (Qty: 2)
Tip: Loosen the fasteners and slide the sensor out of the keyhole slots.

Tighten: 10 N.m (89 lb in)</td></tr>
<tr><td>2</td><td>Sensor Assembly, Inflatable Restraint Side Impact</td></tr>
</table>

INFLATABLE RESTRAINT SIDE IMPACT SENSOR REPLACEMENT (MONTE CARLO)

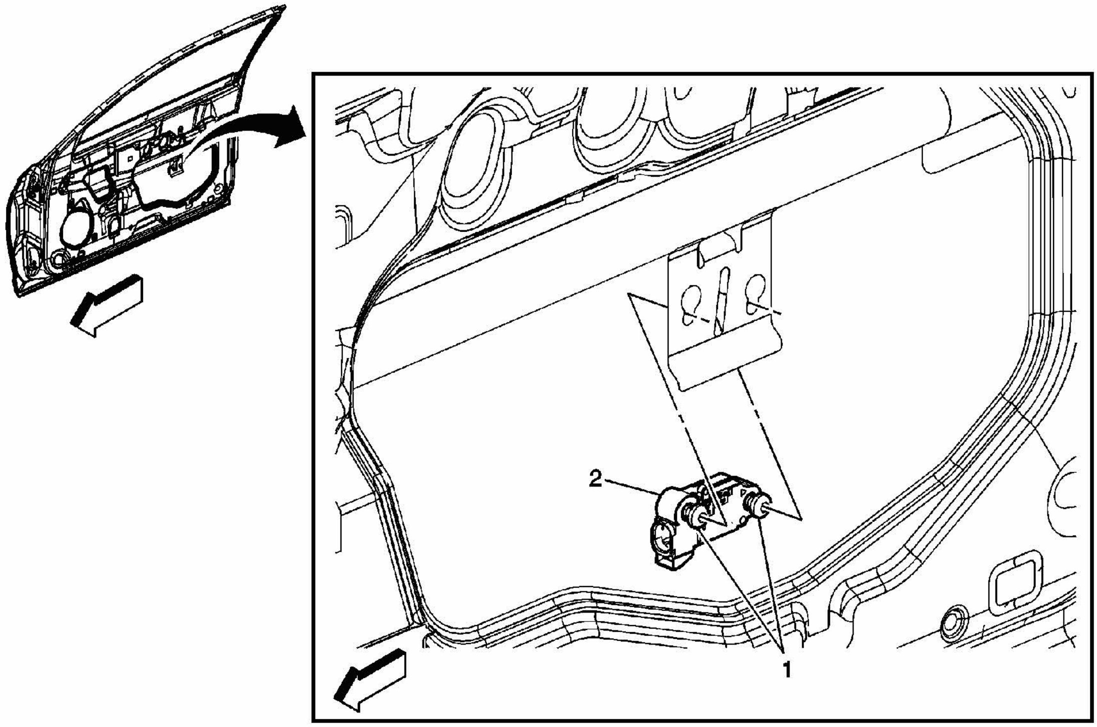


Fig. 126: Replacing Inflatable Restraint Side Impact Sensor
Courtesy of GENERAL MOTORS CORP.

Inflatable Restraint Side Impact Sensor Replacement (Monte Carlo)

Callout	Component Name

CAUTION:

When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Refer to SIR Disabling and Enabling Zones. Failure to observe the correct procedure could cause deployment of the SIR components, personal injury, or unnecessary SIR system repairs.

CAUTION:

Do not strike or jolt the inflatable restraint side impact sensor (SIS). Before applying power to the SIS make sure that it is securely fastened. Failure to observe the correct installation procedures could cause SIR deployment, personal injury, or unnecessary SIR system repairs.

NOTE:

Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 2 (Monte Carlo)** or for the left side or **SIR Disabling and Enabling Zone 6 (Monte**

Carlo) or for the right. 2. Remove the front door panel. Refer to **DOOR TRIM PANEL REPLACEMENT - (MONTE CARLO)** or **Trim Panel Replacement - Side Front Door (Impala)** .	
1	Bolt/Screw, Inflatable Restraint Side Impact Sensor Assembly (Qty: 2) **Tip:** Loosen the fasteners and slide the sensor out of the keyhole slots. **Tighten:** 9 N.m (80 lb in)
2	Inflatable Restraint Side Impact Sensor Assembly

INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE REPLACEMENT

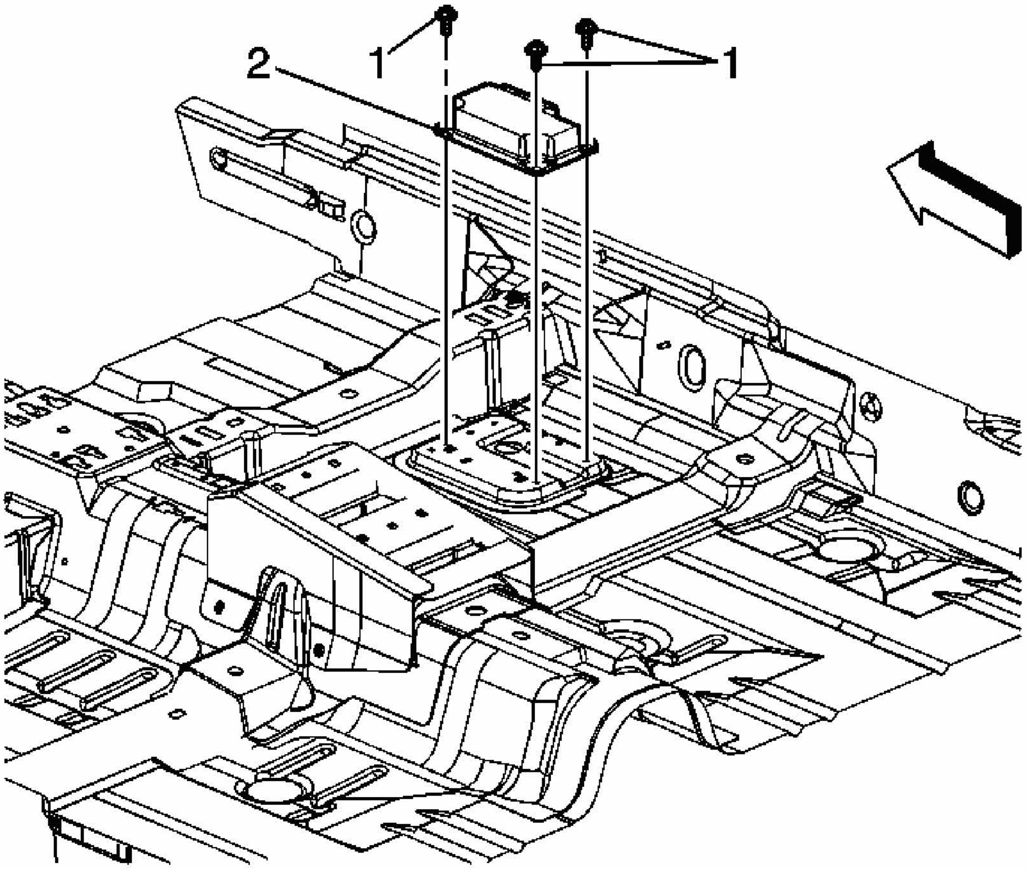


Fig. 127: Replacing Inflatable Restraint Sensing And Diagnostic Module
Courtesy of GENERAL MOTORS CORP.

Inflatable Restraint Sensing and Diagnostic Module Replacement

Callout	Component Name

CAUTION:

Do not strike or jolt the inflatable restraint sensing and diagnostic module (SDM). Before applying power to the SDM, make sure that it is securely fastened with the arrow facing toward the front of the vehicle. Failure to observe the correct installation procedure could cause SIR deployment, personal injury, or unnecessary SIR system repairs.

CAUTION:

Refer to SIR Caution .

NOTE:

Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Disable the supplemental inflatable restraint (SIR) system. Refer to **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)**.
2. Remove the right front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)** .
3. Pull the carpeting back in order to access the sensing and diagnostic module (SDM). Refer to **Carpet Replacement (Impala)** or **Carpet Replacement (Monte Carlo)** .
4. Program the inflatable restraint SDM after replacement. Refer to **Control Module References** .

1	Bolt/Screw, Inflatable Restraint Sensing and Diagnostic Module (Qty: 3) **Tighten:** 10 N.m (88 lb in)
2	Module Assembly, Inflatable Restraint Sensing and Diagnostic

INFLATABLE RESTRAINT STEERING WHEEL MODULE REPLACEMENT

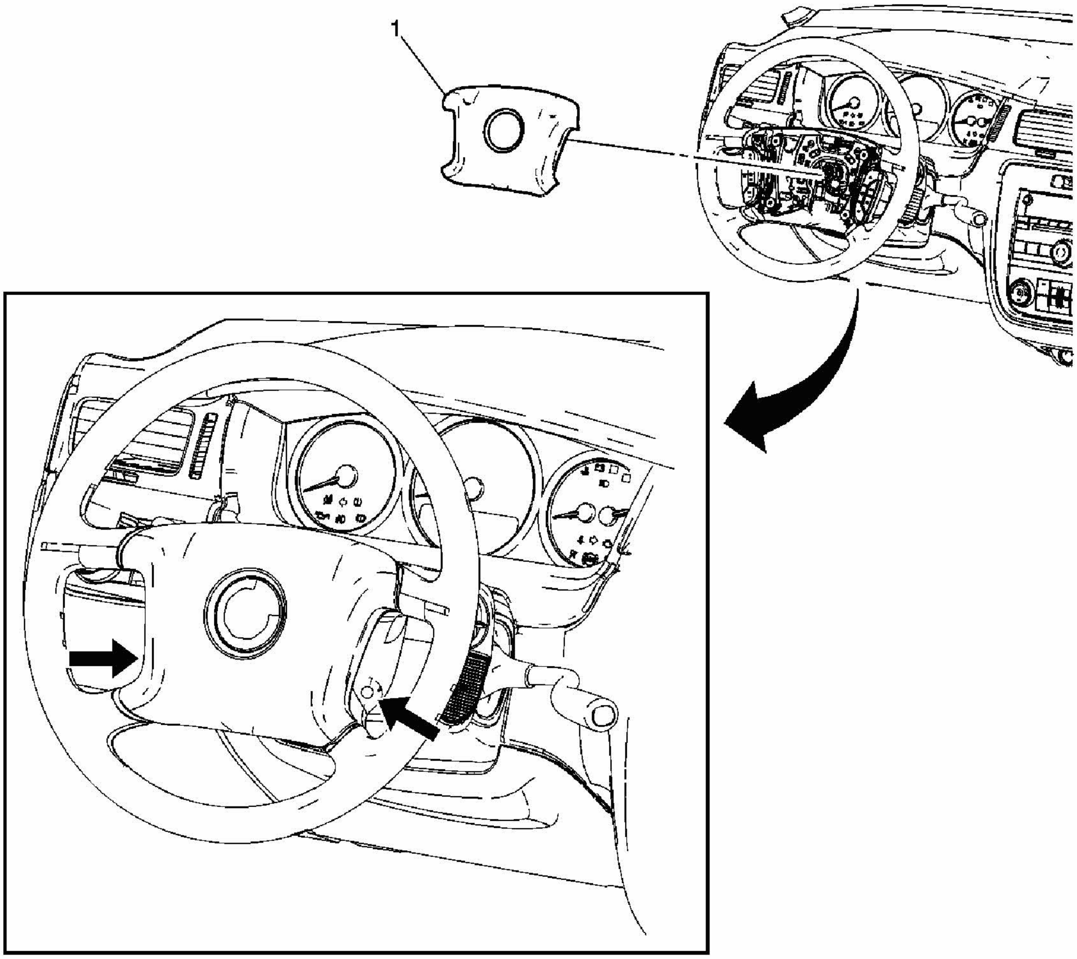


Fig. 128: Replacing Inflatable Restraint Steering Wheel Module
Courtesy of GENERAL MOTORS CORP.

Inflatable Restraint Steering Wheel Module Replacement

Callout	Component Name
CAUTION: **Refer to SIR Caution .** **CAUTION:** **Refer to SIR Inflator Module Handling and Storage Caution .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Disable the supplemental inflatable restraint (SIR) system. Refer to **SIR Disabling and Enabling Zone 3**.	
1	Module Assembly, Inflatable Restraint Steering Wheel **Tip:** Insert a small flat-bladed tool through the access openings, on the left

	and right of the steering wheel, push on the flat-bladed tool to release the steering wheel inflator from the steering wheel.

INFLATABLE RESTRAINT STEERING WHEEL MODULE COIL REPLACEMENT (COIL)

Tools Required

J 42640 Steering Column Anti Rotation Pin

Removal Procedure

CAUTION: Refer to SIR Caution in Cautions and Notices.

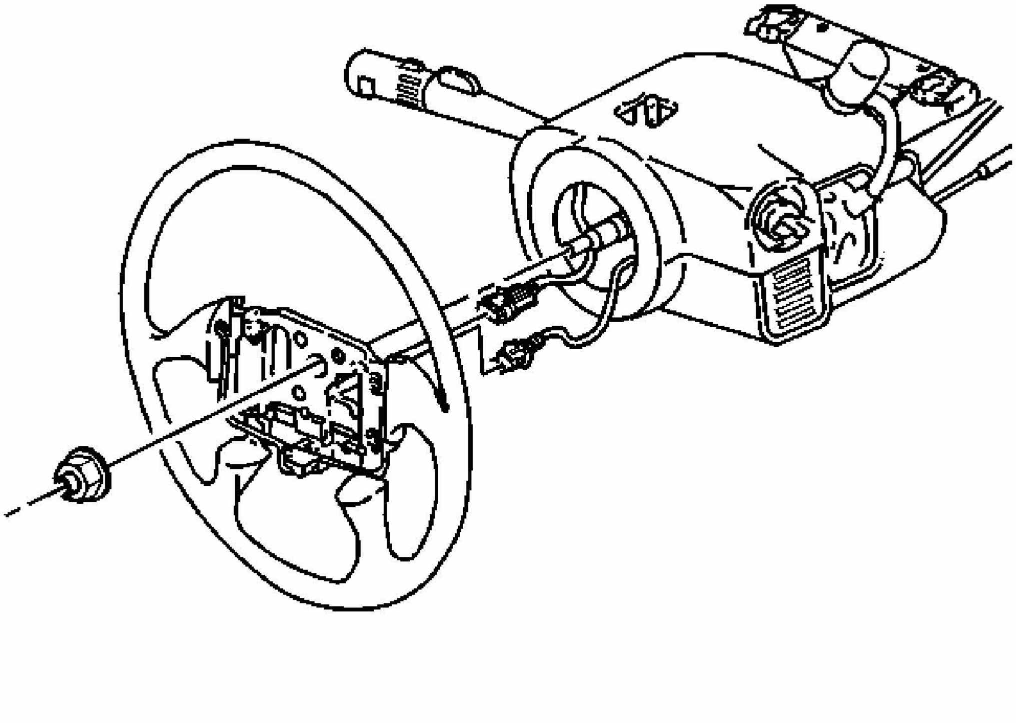


Fig. 129: Steering Wheel, Shaft & Nut
Courtesy of GENERAL MOTORS CORP.

1. Disable the SIR System. Refer to **SIR Disabling and Enabling Zone 3**.

NOTE: The wheels of the vehicle must be straight ahead and the steering column in the LOCK position before disconnecting the steering column or intermediate shaft from the steering gear. Failure to do so will cause the SIR coil assembly to become uncentered, which may cause damage to the coil

assembly.

2. Verify the following before removing the SIR coil:
   - The wheels on the vehicle are straight ahead.
   - That **J 42640** is installed or the ignition switch is in the LOCK position.
3. Remove the steering wheel from the steering shaft. Refer to **Steering Wheel Replacement** in Steering Wheel and Column.

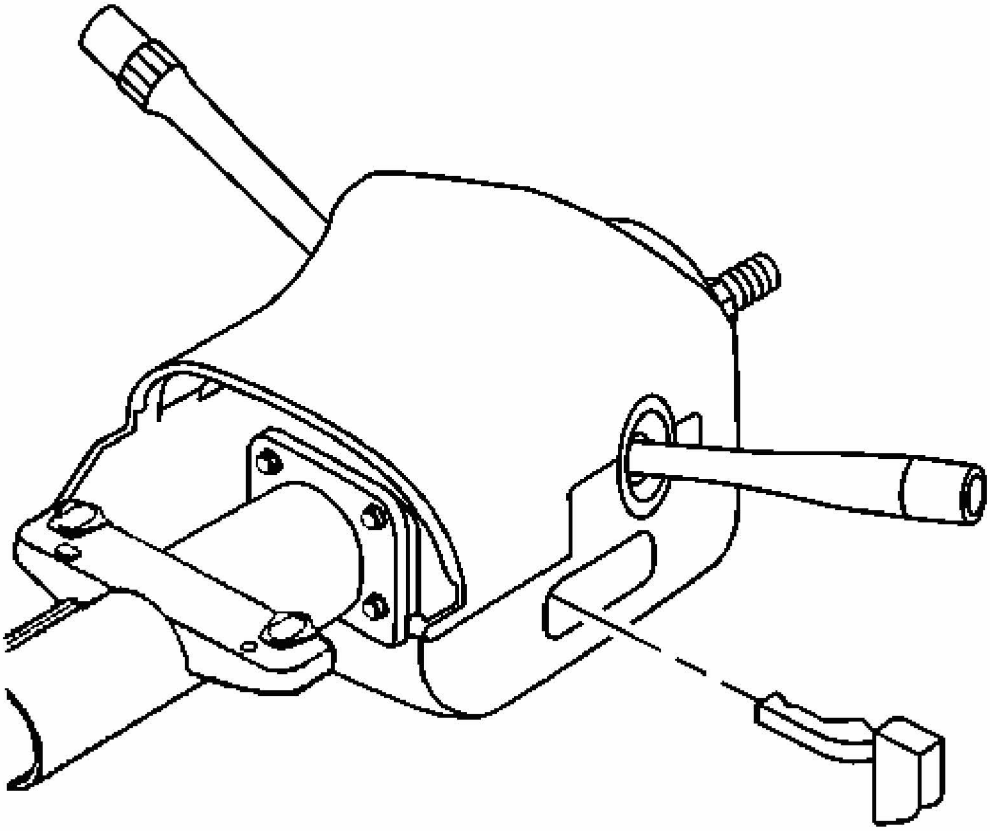


Fig. 130: Removing/Installing Tilt Lever
Courtesy of GENERAL MOTORS CORP.

4. On vehicles with a tilt column, pull the tilt lever straight out from the steering column.

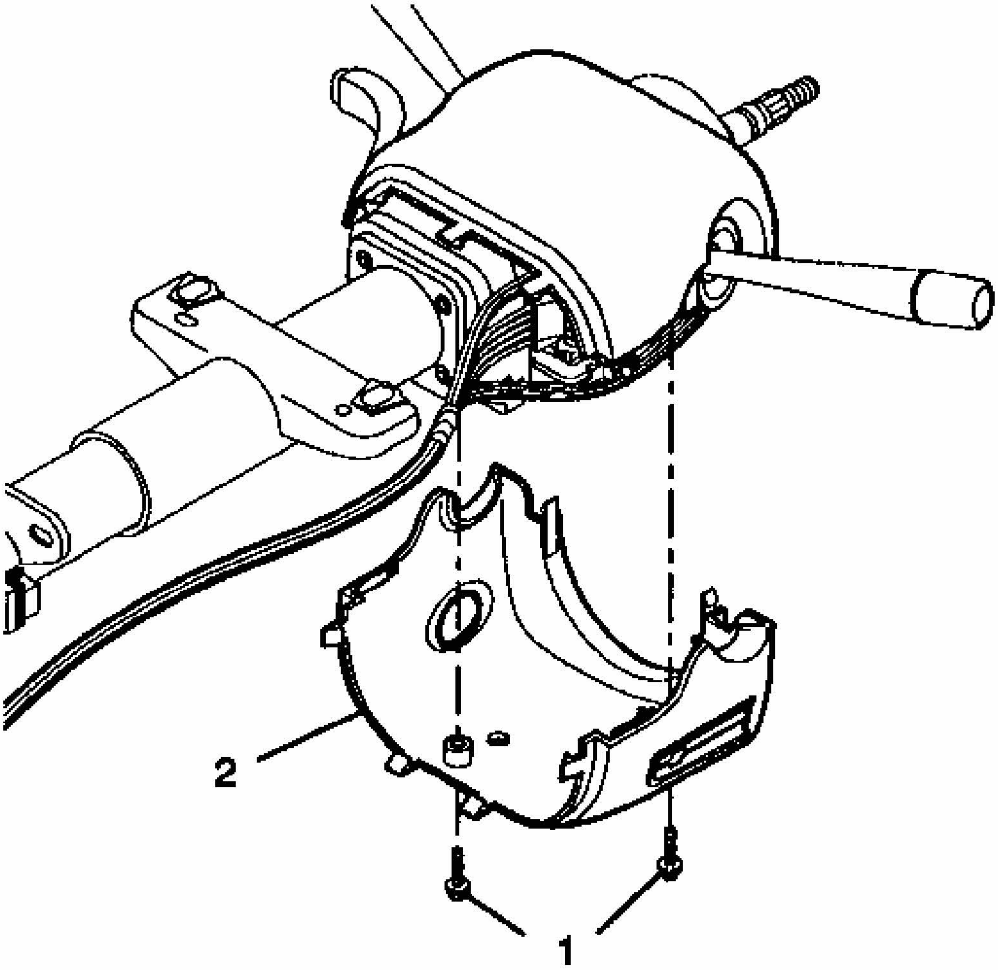


Fig. 131: Removing/Installing Lower Trim Cover
Courtesy of GENERAL MOTORS CORP.

5. Remove 2 TORX® head screws (1) from the lower trim cover (2).
6. Remove the lower trim cover (2).

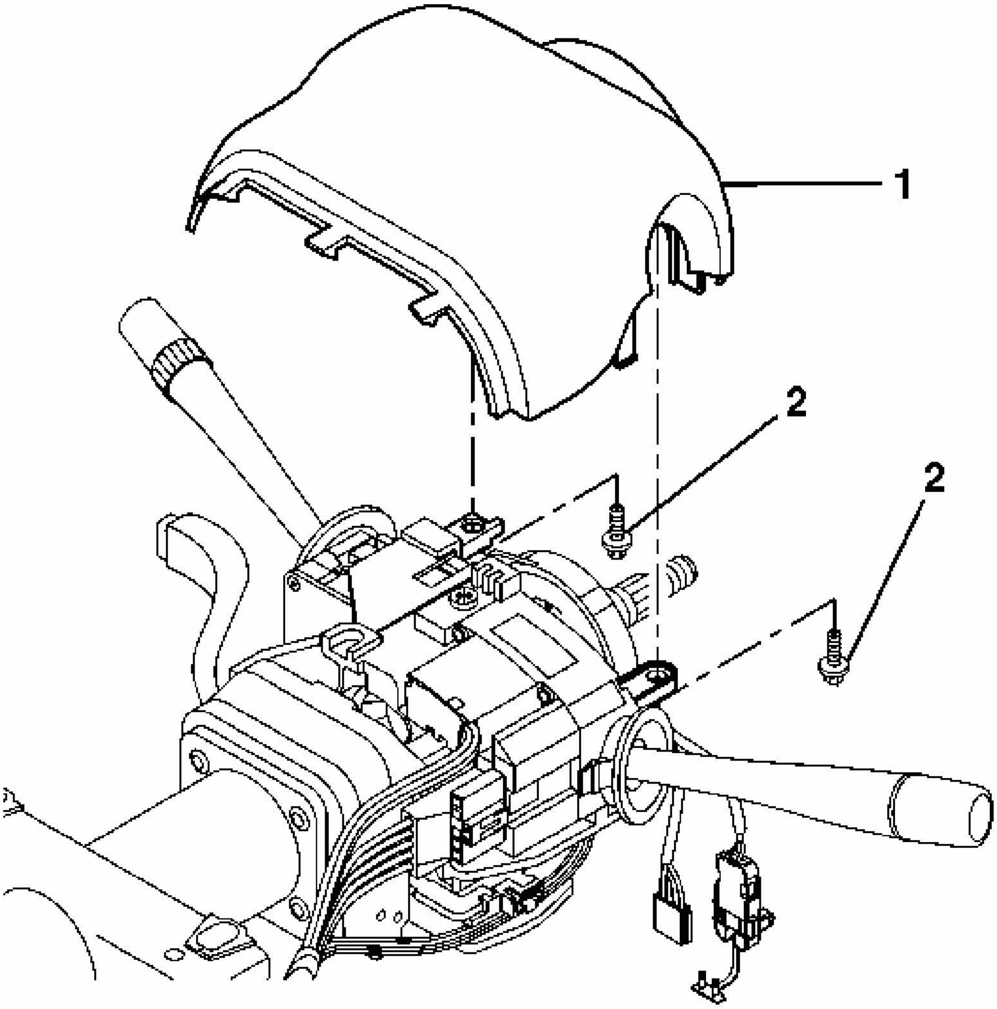


Fig. 132: Removing/Installing Upper Trim Cover
Courtesy of GENERAL MOTORS CORP.

7. Remove 2 TORX® head screws (2) from the upper trim cover (1).
8. Remove the upper trim cover (1).

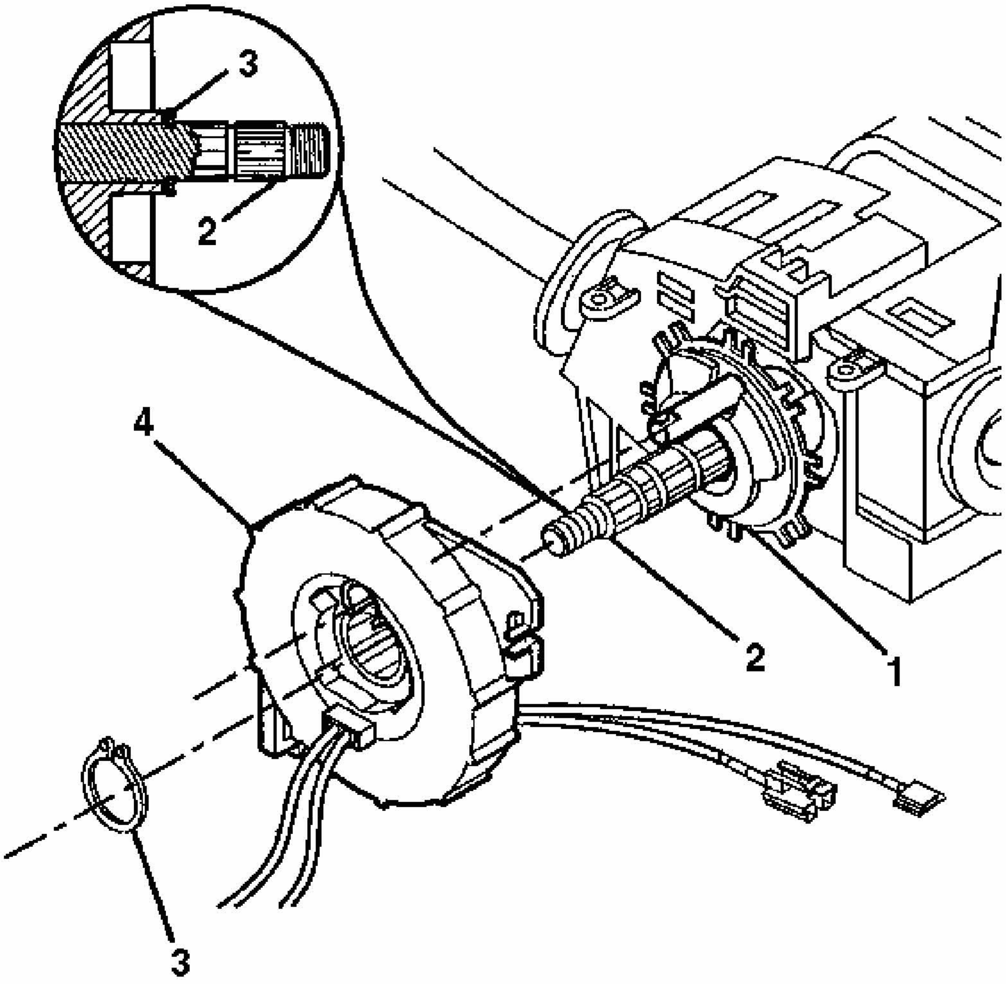


Fig. 133: Identifying SIR Coil, Steering Shaft Assembly & Retaining Ring
Courtesy of GENERAL MOTORS CORP.

9. Remove the wire harness straps from the steering wheel column wire harness.
10. Remove the retaining ring (3).
11. Remove the SIR coil (4) from the steering shaft.
12. If replacing, discard the SIR coil.

Installation Procedure

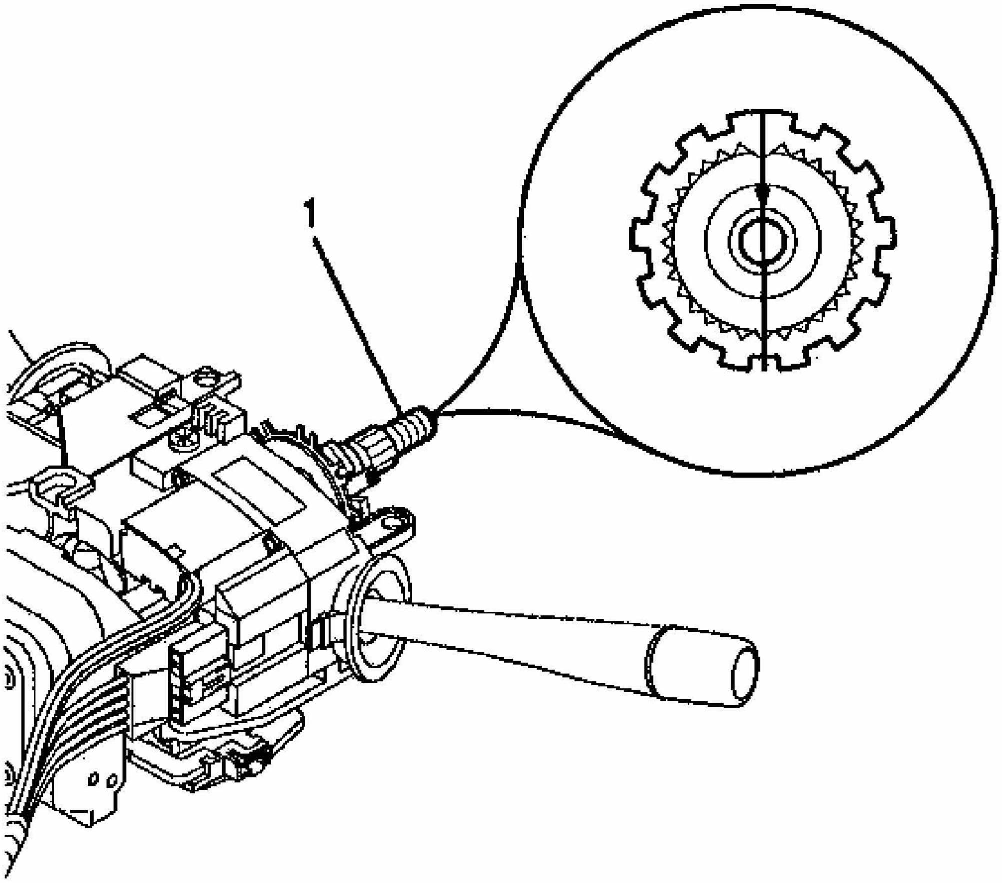


Fig. 134: View Of Block Tooth Of Steering Shaft Assembly In 12 O'clock Position
Courtesy of GENERAL MOTORS CORP.

NOTE: **The new SIR coil assembly will be centered. Improper alignment of the SIR coil assembly may damage the unit, causing an inflatable restraint malfunction.**

NOTE: **The wheels of the vehicle must be straight ahead and the steering column in the LOCK position before disconnecting the steering column or intermediate shaft from the steering gear. Failure to do so will cause the SIR coil assembly to become uncentered, which may cause damage to the coil assembly.**

1. Verify the following:
    - The wheels on the vehicle are straight ahead.

- That **J 42640** is installed or the ignition switch is in the LOCK position.

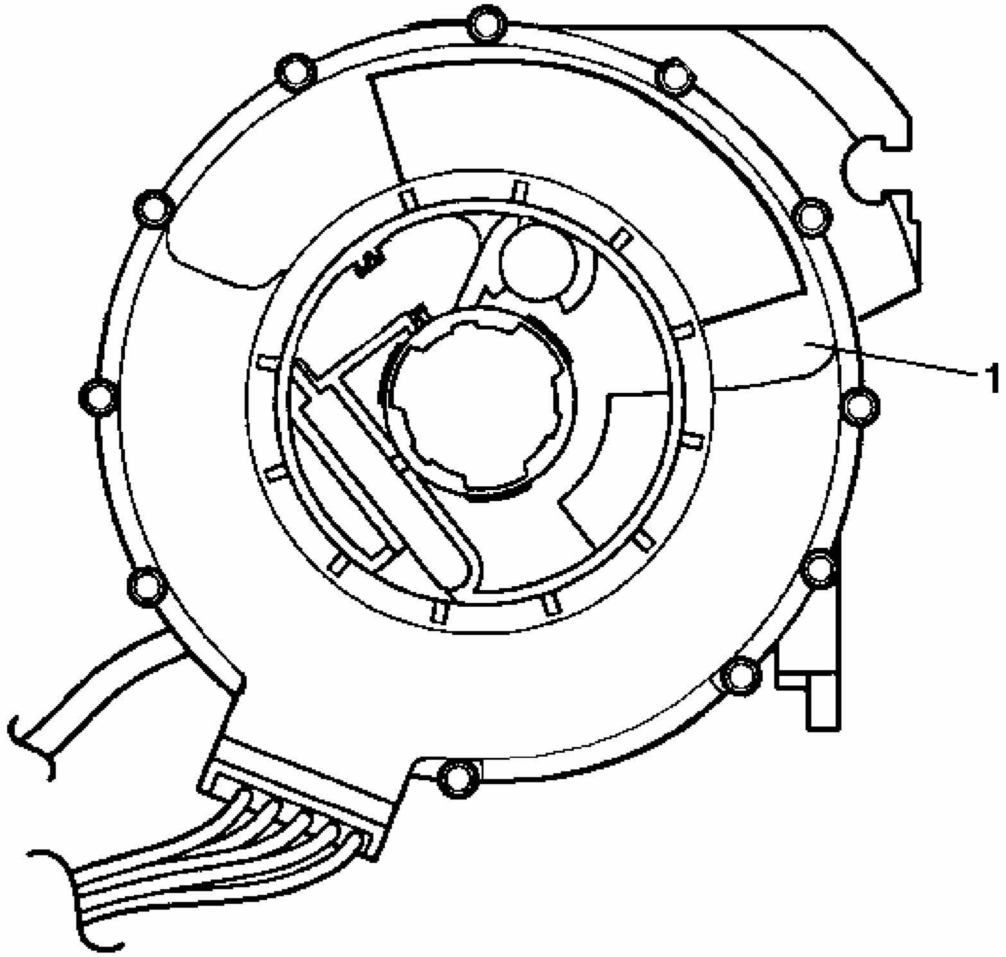


Fig. 135: View Of SIR Coil
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not remove the centering tab from the new SIR coil until the installation is complete. If the SIR coil does not come with a centering tab, you must center the SIR coil.

2. If reusing the existing coil it MUST be centered, refer to **Inflatable Restraint Steering Wheel Module Coil Centering** in Steering Wheel and Column.

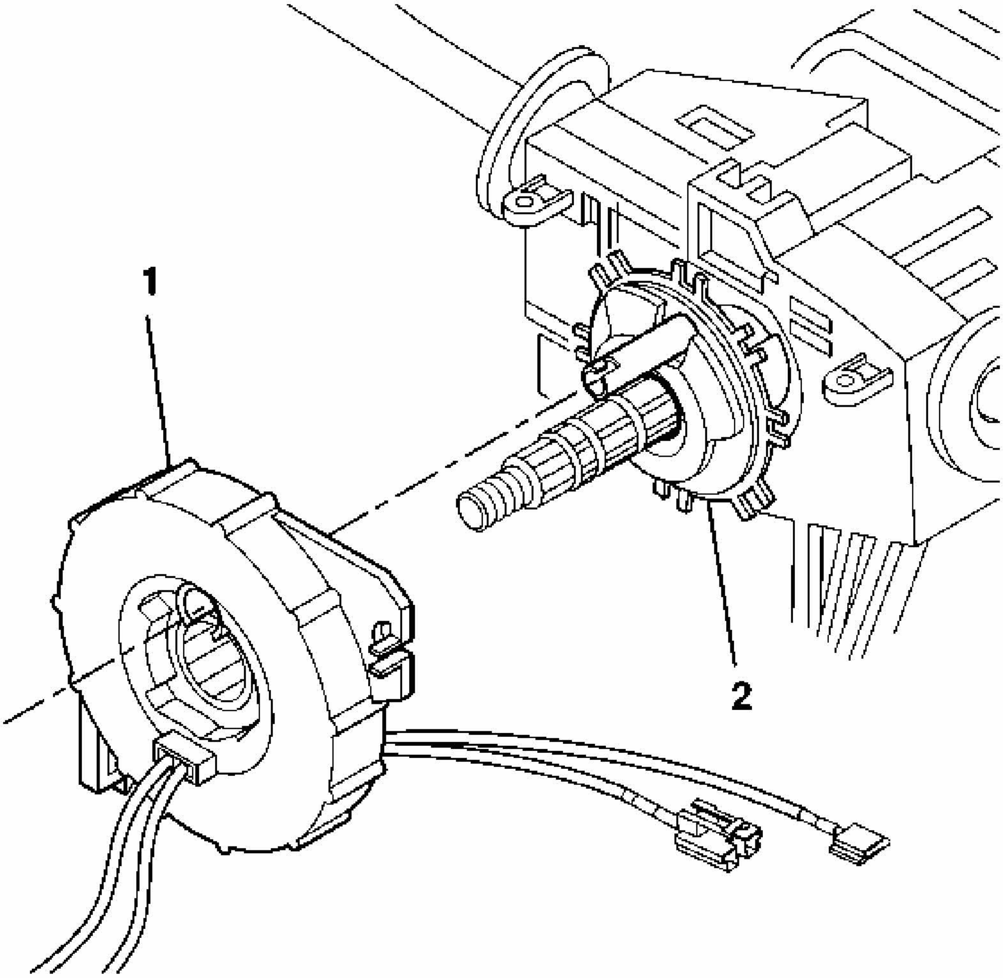


Fig. 136: Aligning SIR Coil Assembly With Horn Tower
Courtesy of GENERAL MOTORS CORP.

3. Align the SIR coil assembly (1) with the horn tower on the turn signal cancel cam assembly (2).

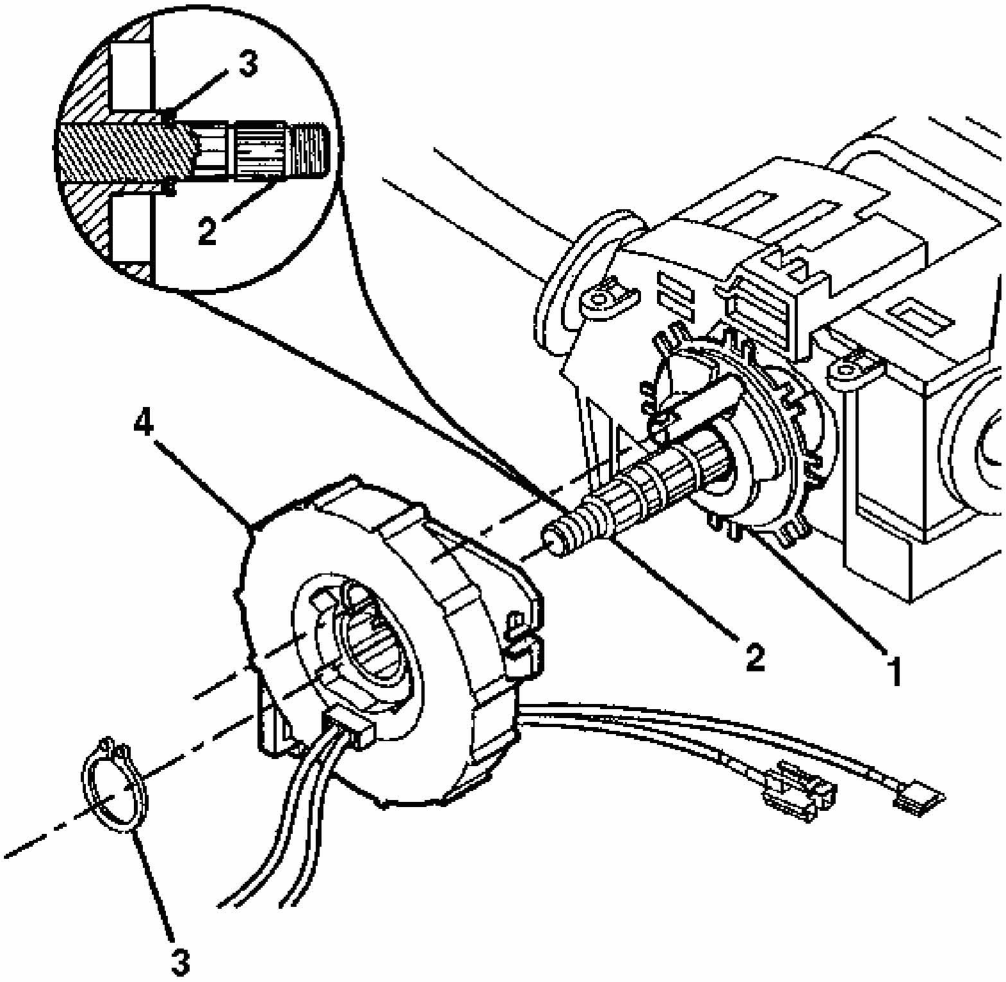


Fig. 137: Identifying SIR Coil, Steering Shaft Assembly & Retaining Ring
Courtesy of GENERAL MOTORS CORP.

4. Slide the SIR coil (4) onto the steering shaft assembly (2).
5. Firmly seat the retaining ring (3) into the groove on the steering shaft assembly (2).
6. Remove and discard the centering tab from the new SIR coil (4).

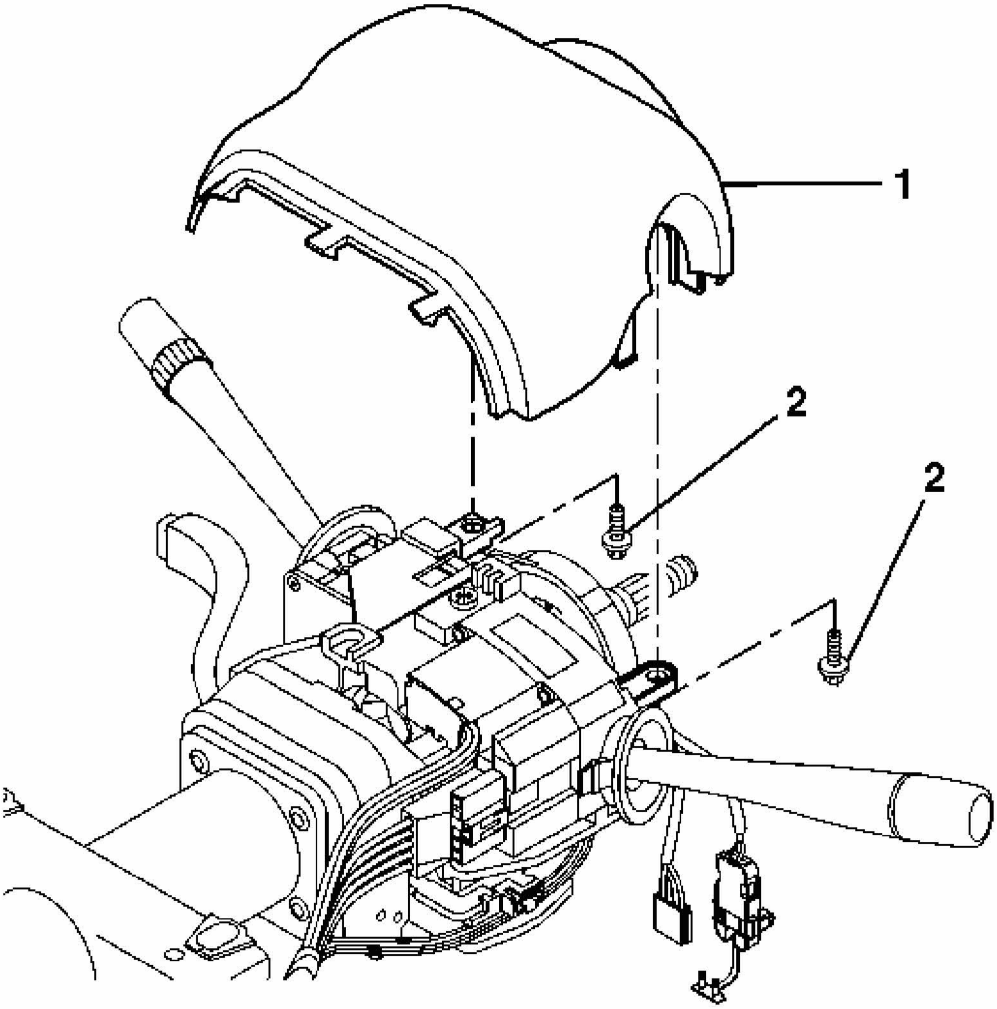


Fig. 138: Removing/Installing Upper Trim Cover
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

7. Install the upper trim cover (1) and secure by using 2 TORX® head screws (2).

   Tighten: Tighten the screws to 1.5 N.m (13 lb in).

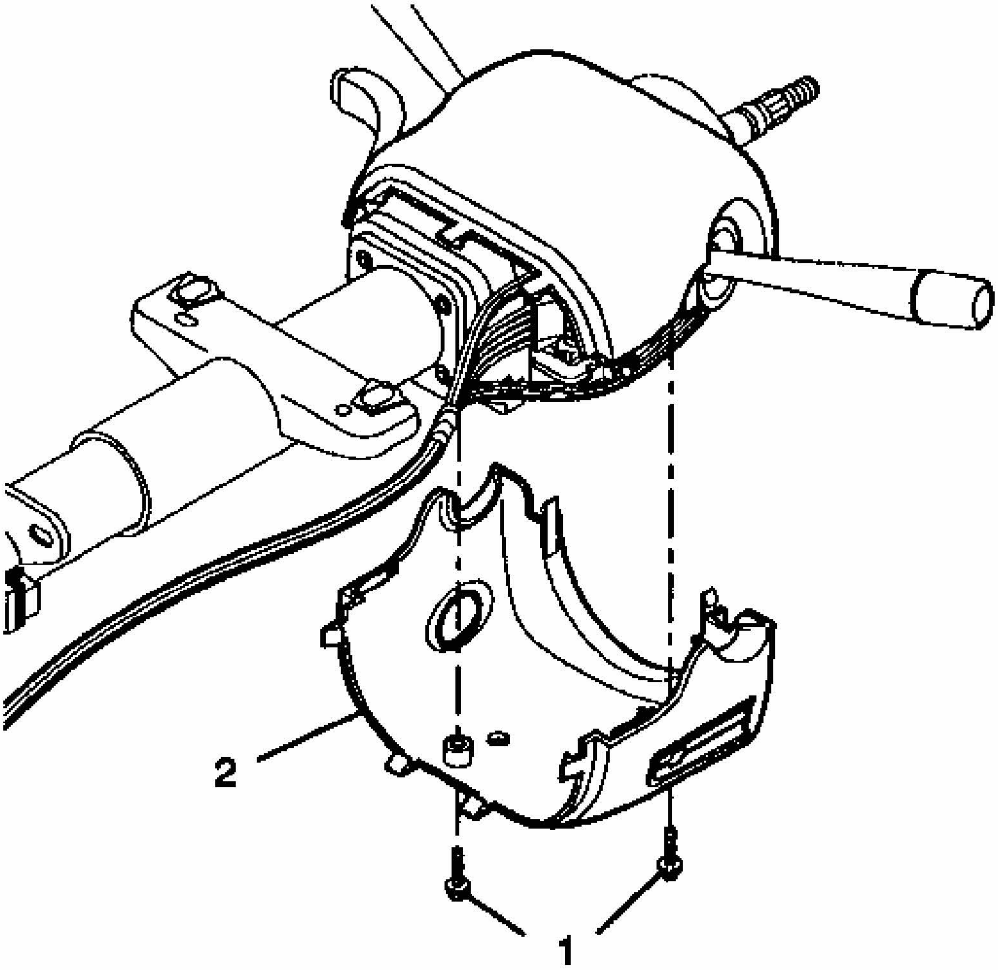


Fig. 139: Removing/Installing Lower Trim Cover
Courtesy of GENERAL MOTORS CORP.

8. Install the lower trim cover (2) and secure by using 2 TORX® head screws (1).

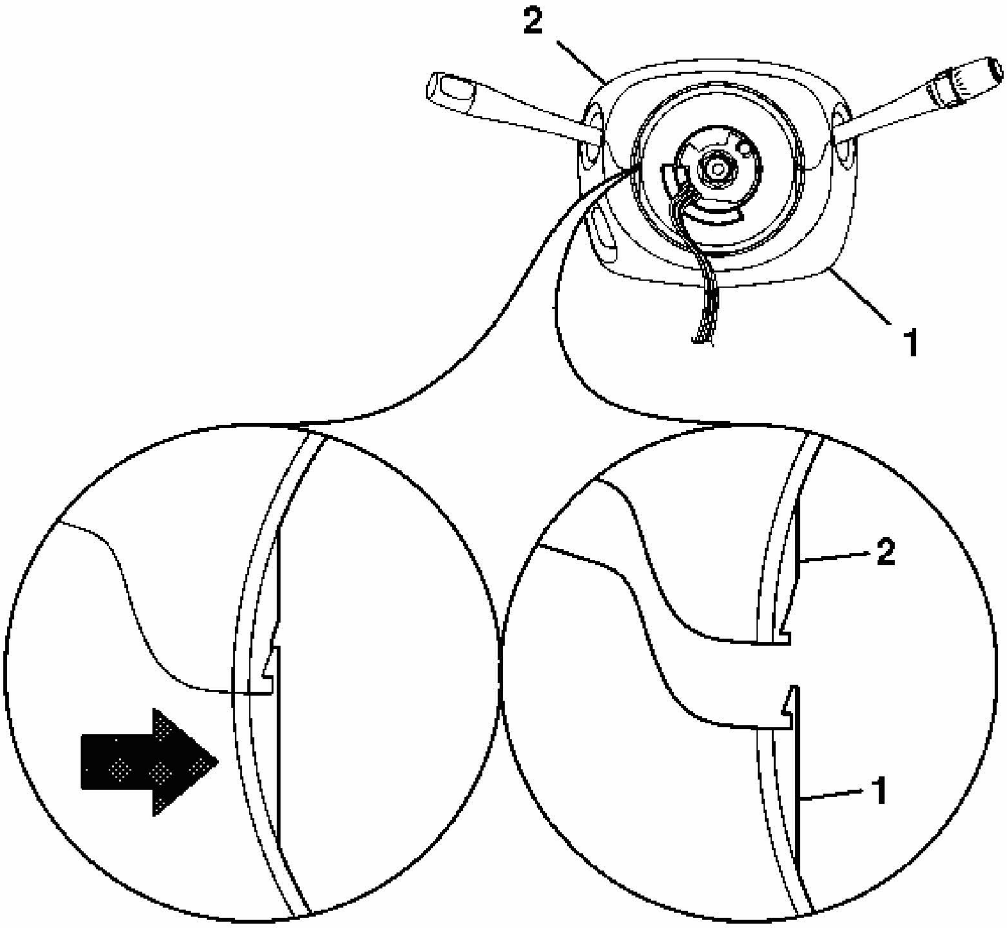


Fig. 140: Upper & Lower Trim Cover Tabs
Courtesy of GENERAL MOTORS CORP.

9. Verify that the tabs on the lower trim cover (1) engage with the tabs on the upper trim cover (2). Snap the tabs together.

   Tighten: Tighten the screws to 1.5 N.m (13 lb in).

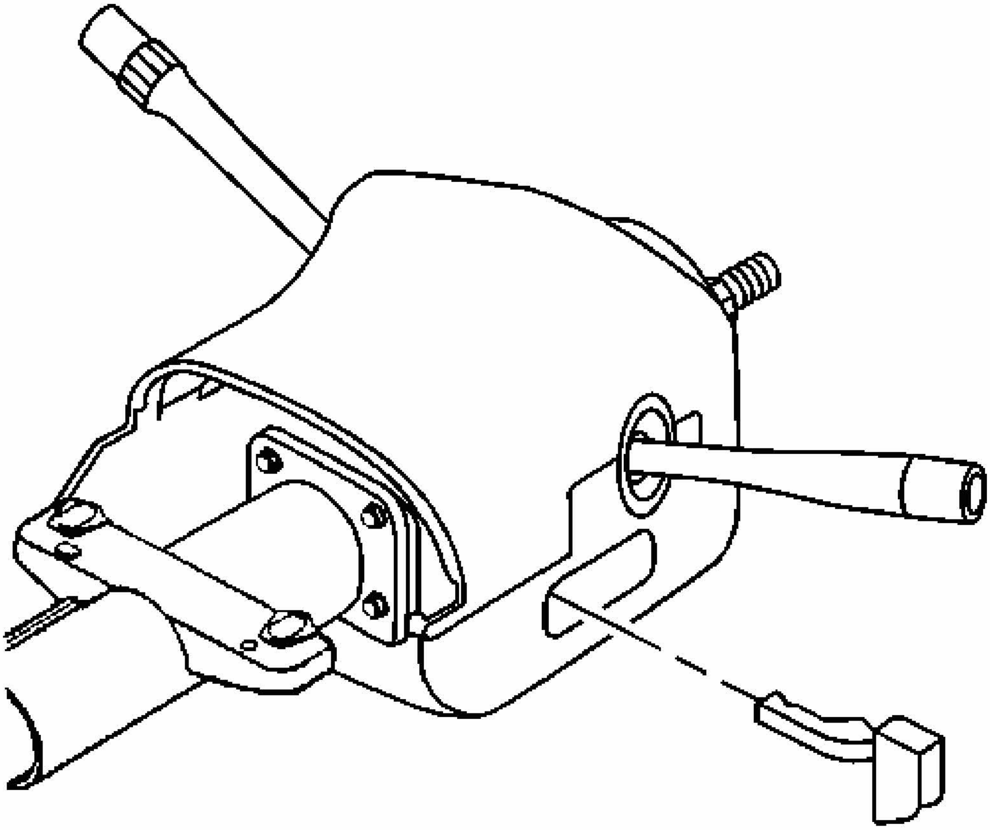


Fig. 141: Removing/Installing Tilt Lever
Courtesy of GENERAL MOTORS CORP.

10. On vehicles with a tilt column, align the tilt lever into the steering column.
11. Slide the tilt lever handle into the steering column until the handle locks into position.

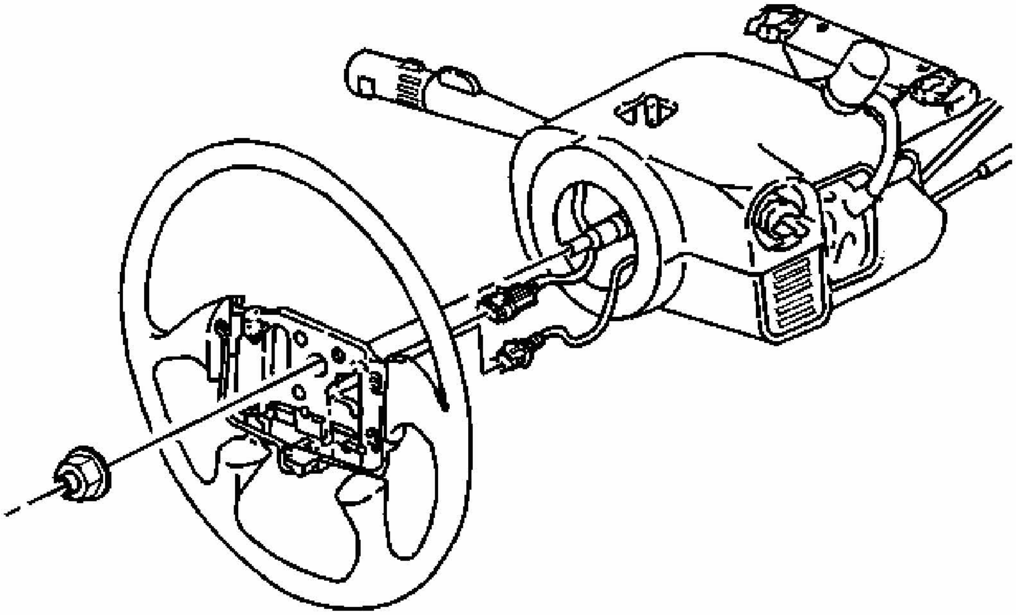


Fig. 142: Steering Wheel, Shaft & Nut
Courtesy of GENERAL MOTORS CORP.

12. Install the steering wheel onto the steering shaft. Refer to **Steering Wheel Replacement** in Steering Wheel and Column.
13. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3**.

INFLATABLE RESTRAINT INSTRUMENT PANEL MODULE REPLACEMENT

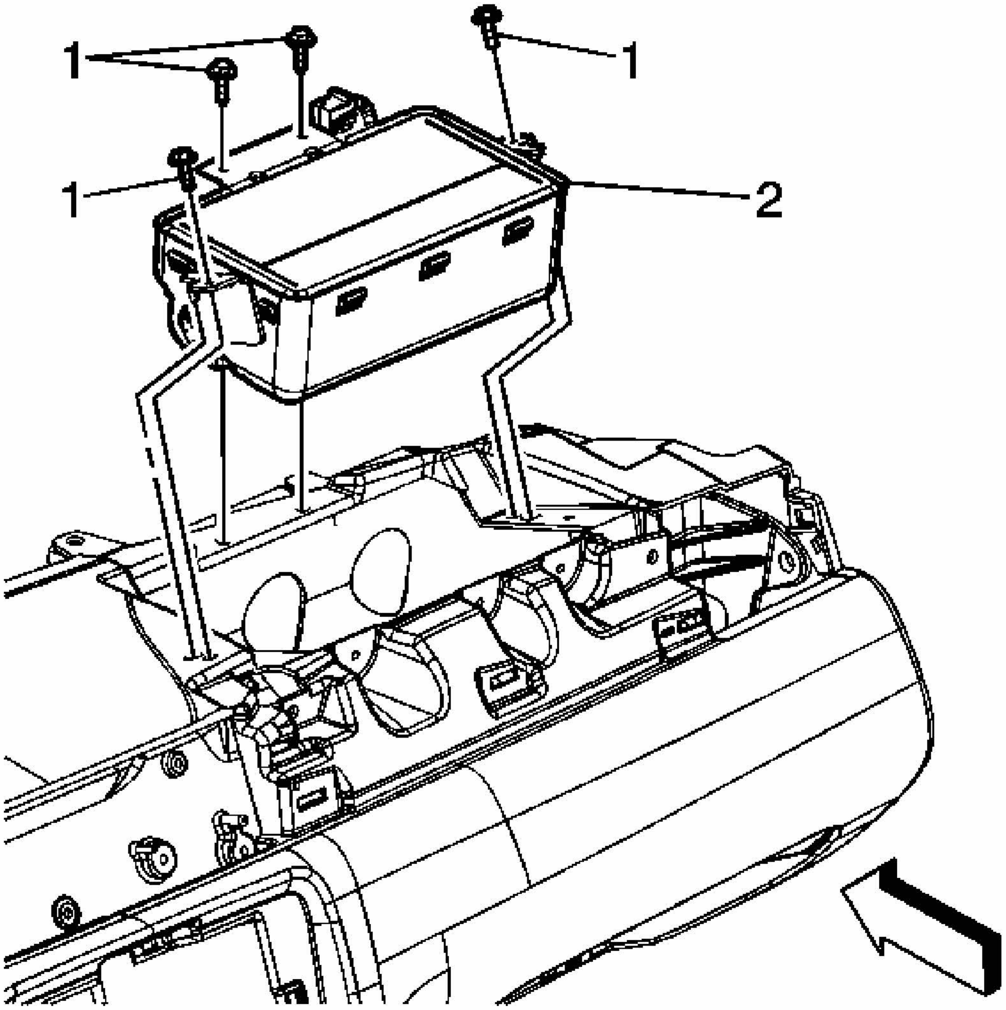


Fig. 143: Replacing Inflatable Restraint Instrument Panel Module
Courtesy of GENERAL MOTORS CORP.

Inflatable Restraint Instrument Panel Module Replacement

Callout	Component Name
CAUTION: Refer to SIR Caution .	
CAUTION: Refer to SIR Inflator Module Handling and Storage Caution .	
Fastener Tightening Specifications	

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Disable the SIR. Refer to **SIR Disabling and Enabling Zone 5**.
2. Remove the instrument panel (I/P) upper trim panel. Refer to **Trim Panel Replacement - Instrument Panel (I/P) Upper** .

1	Bolt, Inflatable Restraint I/P Module (Qty: 4) **Tighten:** 10 N.m (89 lb in)
2	Module Assembly, Inflatable Restraint I/P

INFLATABLE RESTRAINT PASSENGER PRESENCE SYSTEM REPLACEMENT - FRONT (IMPALA)

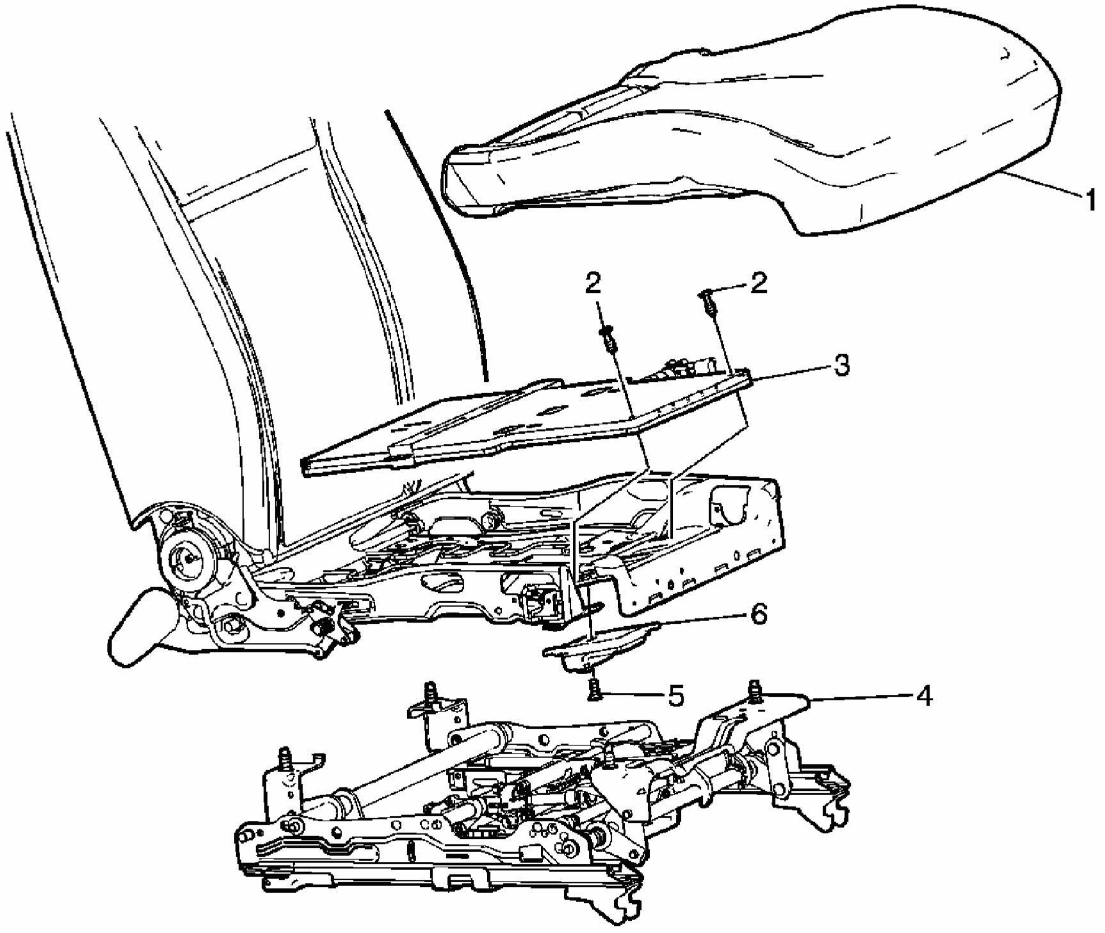


Fig. 144: Replacing Inflatable Restraint Passenger Presence System

Courtesy of GENERAL MOTORS CORP.

Inflatable Restraint Passenger Presence System Replacement - Front (Impala)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">CAUTION:
Replace the passenger presence system as a complete assembly to prevent possible injury to the occupant. All the components in the service kit are assembled and calibrated as a unit. Using only some of the components in the service kit will cause the passenger presence system to operate improperly.

CAUTION:
To avoid personal injuries, re-zero the passenger presence system whenever you remove or replace the seat cushion or trim. Failure to do so may cause the system to malfunction.

CAUTION:
Refer to SIR Caution .

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .

Preliminary Procedure

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 7** and **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)**.
2. Remove the front seat. Refer to **Seat Replacement - Front Bucket (Impala)** or **Seat Replacement - Front Bucket (Monte Carlo)** .
3. Remove the recliner handle. Refer to **Seat Back Recliner Handle Replacement - Front (Impala)** or **Seat Back Recliner Handle Replacement - Front (Monte Carlo)** .
4. Remove the power seat switch knob. Refer to **Knob Replacement - Power Seat Switch - Seat Cushion (Impala)** or **Knob Replacement - Power Seat Switch - Seat Cushion (Monte Carlo)** .
5. Remove the seat cushion outer trim panel. Refer to **Seat Cushion Outer Trim Panel Replacement (Impala)** or **Seat Cushion Outer Trim Panel Replacement (Monte Carlo)** .
6. Re-zero the inflatable restraint passenger presence system whenever the seat cushion or any component of the passenger presence system is removed. Refer to **Passenger Presence System Programming and Setup** .</td></tr>
<tr><td></td><td>Cover, Seat Cushion</td></tr>
</table>

1	Refer to **Seat Cushion Cover and Pad Replacement - Front (Impala)** or **Seat Cushion Cover and Pad Replacement - Front (Monte Carlo)** . **Tip:** Remove the seat cushion cover and pad as an assembly.
2	Retainer, Inflatable Restraint Passenger Presence Sensor (Qty: 2)
3	Sensor, Inflatable Restraint Passenger Presence System **Tip:** Disconnect the electrical connector.
4	Adjuster Assembly, Front Seat Refer to **Seat Adjuster Replacement - Front (Impala)** or **Seat Adjuster Replacement - Front (Monte Carlo)** .
5	Screw, Inflatable Restraint Front Passenger Presence Module (Qty: 2) **Tighten:** 3 N.m (25 lb in)
6	Module, Inflatable Restraint Front Passenger Presence **Tip:** Disconnect the electrical connector.

INFLATABLE RESTRAINT PASSENGER PRESENCE SYSTEM REPLACEMENT - FRONT (MONTE CARLO)

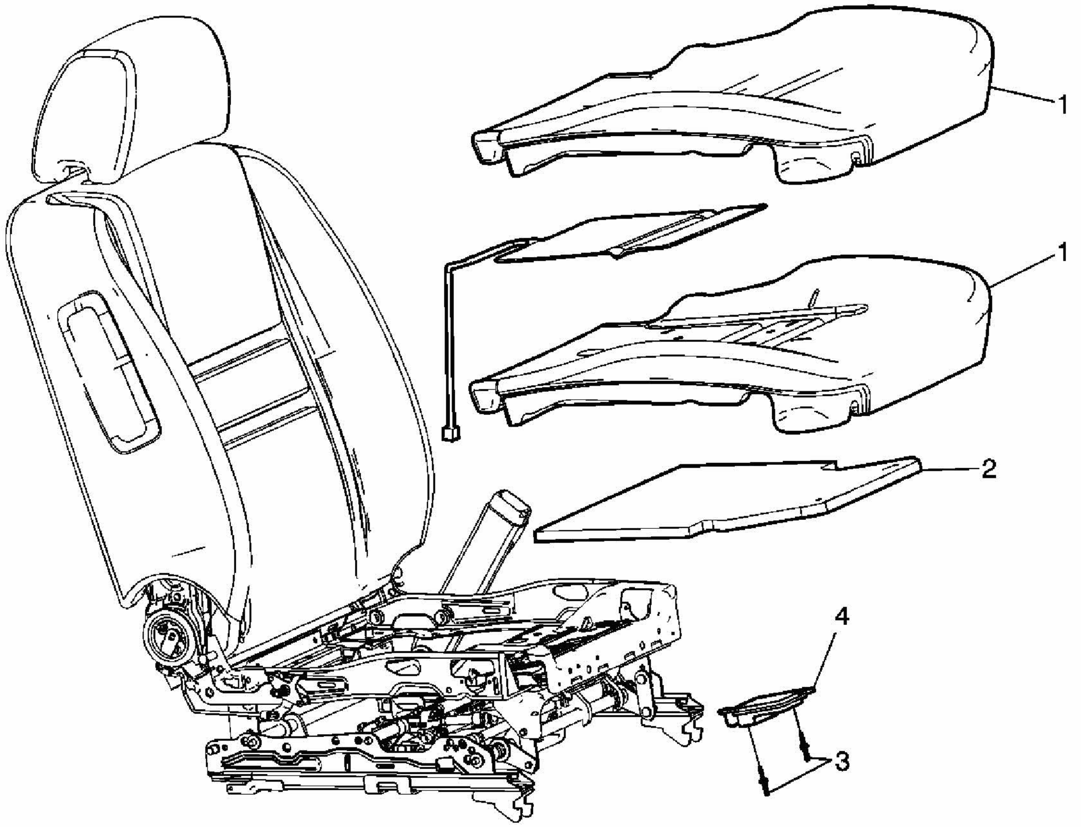


Fig. 145: Replacing Inflatable Restraint Passenger Presence System
Courtesy of GENERAL MOTORS CORP.

Inflatable Restraint Passenger Presence System Replacement - Front (Monte Carlo)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">CAUTION:
To avoid personal injuries, re-zero the passenger presence system whenever you remove or replace the seat cushion or trim. Failure to do so may cause the system to malfunction.

CAUTION:
Refer to SIR Caution .

CAUTION:
Replace the passenger presence system as a complete assembly to prevent possible injury to the occupant. All the components in the service kit are assembled and calibrated as a unit. Using only some of the components in the service kit will cause the passenger presence system to operate improperly.

Fastener Tightening Specifications: Refer to Fastener Tightening Specifications .

Preliminary Procedure
1. Disable the SIR system. Refer to SIR Disabling and Enabling Zone 9 (Monte Carlo) or SIR Disabling and Enabling Zone 9 (Impala).
2. Remove the front passenger seat. Refer to Seat Replacement - Front Bucket (Impala) or Seat Replacement - Front Bucket (Monte Carlo) .
3. Remove the recliner handle. Refer to Seat Back Recliner Handle Replacement - Front (Impala) or Seat Back Recliner Handle Replacement - Front (Monte Carlo) .
4. Remove the power seat switch knob. Refer to Knob Replacement - Power Seat Switch - Seat Cushion (Impala) or Knob Replacement - Power Seat Switch - Seat Cushion (Monte Carlo) .
5. Remove the seat cushion outer trim panel. Refer to Seat Cushion Outer Trim Panel Replacement (Impala) or Seat Cushion Outer Trim Panel Replacement (Monte Carlo) .
6. Re-zero the inflatable restraint passenger presence system whenever the seat cushion or any component of the passenger presence system is removed. Refer to Passenger Presence System Programming and Setup .</td></tr>
<tr><td>1</td><td>Cover, Seat Cushion
Refer to Seat Cushion Cover and Pad Replacement - Front (Impala) or Seat Cushion Cover and Pad Replacement - Front (Monte Carlo) .
Tip: Remove the seat cushion cover and pad as an assembly.</td></tr>
<tr><td>2</td><td>Sensor, Inflatable Restraint Passenger Presence System
Tip: Disconnect the electrical connector and remove front the seat frame.</td></tr>
<tr><td>3</td><td>Rivet, Inflatable Restraint Passenger Presence System (Qty: 2)</td></tr>
<tr><td></td><td>Module, Inflatable Restraint Front Passenger Presence</td></tr>
</table>

4	**Tip:** Disconnect the electrical connector.

INFLATABLE RESTRAINT SIDE IMPACT MODULE REPLACEMENT - FRONT (MONTE CARLO)

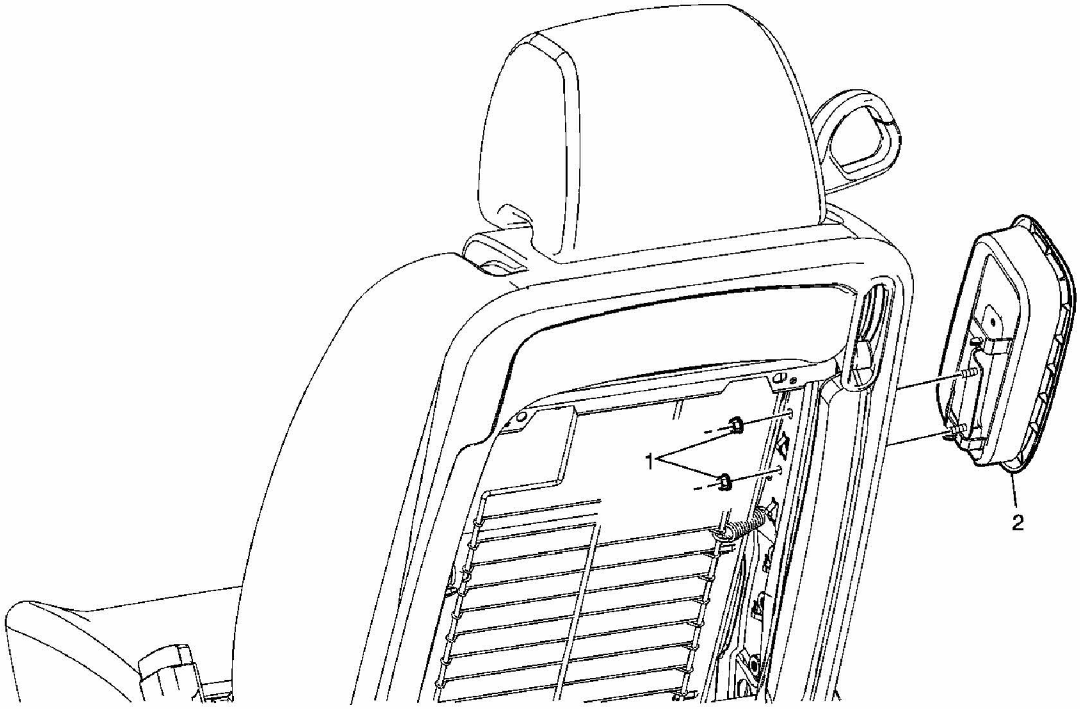


Fig. 146: Replacing Inflatable Restraint Side Impact Module
Courtesy of GENERAL MOTORS CORP.

Inflatable Restraint Side Impact Module Replacement - Front (Monte Carlo)

Callout	Component Name
CAUTION: Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary: • The seat cushion frame • The seat recliner, if equipped • The seat adjuster • The seat back frame Failure to do so may cause future personal injury. NOTE: Refer to Fastener Notice .	

<table>
<tr><td colspan="2">Fastener Tightening Specifications: Refer to Fastener Tightening Specifications .
Preliminary Procedure
1. Disable the SIR system. Refer to SIR Disabling and Enabling Zone 7 and SIR Disabling and Enabling Zone 9 (Monte Carlo) or SIR Disabling and Enabling Zone 9 (Impala).
2. Remove the front seat. Refer to Seat Replacement - Front Bucket (Impala) or Seat Replacement - Front Bucket (Monte Carlo) .
3. Remove the seat back cushion finish panel. Refer to Seat Back Panel Replacement - Front (Impala) or Seat Back Panel Replacement - Front (Monte Carlo) .</td></tr>
<tr><td>1</td><td>Nut, Side Impact Inflatable Restraint (Qty: 2)
Tighten: 5 N.m (44 lb in)</td></tr>
<tr><td>2</td><td>Module Assembly, Inflatable Restraint
Tip:
1. Disconnect the electrical connector.
2. Fully deploy the module before disposal. If the module was replaced under warranty, fully deploy and dispose of the module after the required retention period. Refer to Inflator Module Handling and Scrapping.</td></tr>
</table>

INFLATABLE RESTRAINT SIDE IMPACT MODULE WIRING HARNESS REPLACEMENT

Removal Procedure

CAUTION: Refer to SIR Inflator Module Handling and Storage Caution .

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 7** or **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)**.
2. Remove the side impact inflator module from the seat. Refer to **Inflatable Restraint Side Impact Module Replacement - Front (Monte Carlo)**.

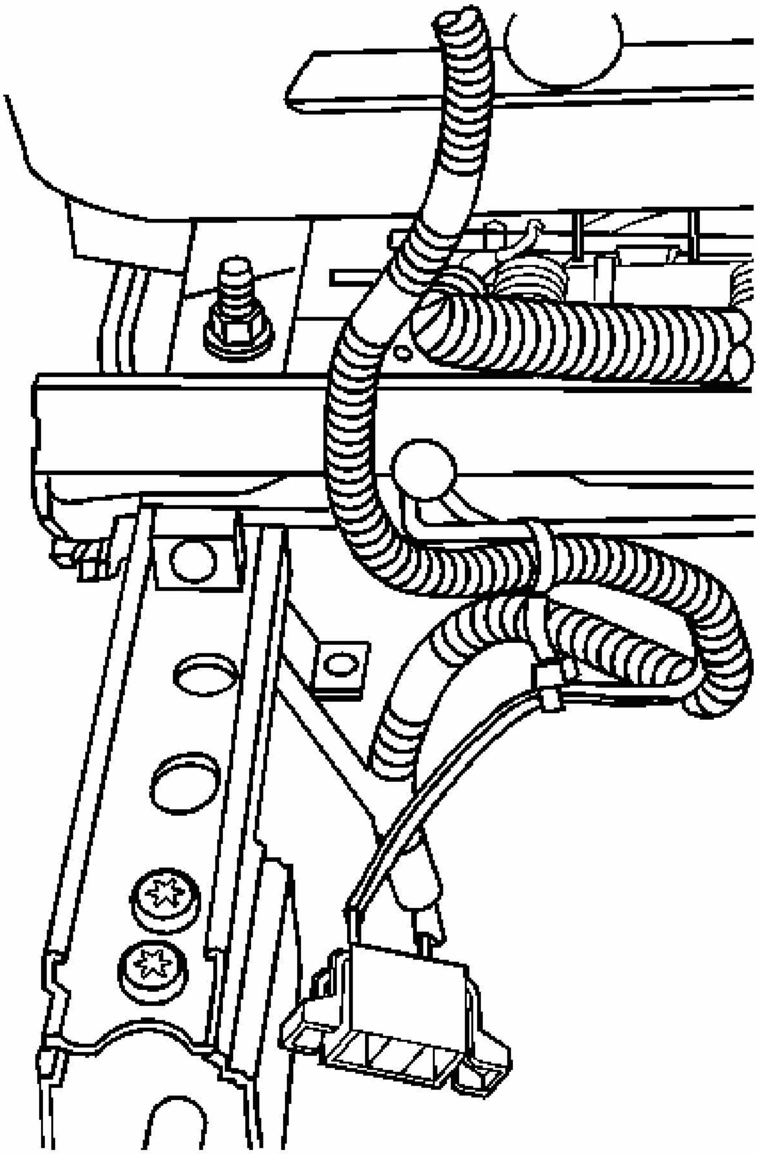


Fig. 147: Inflatable Restraint Side Impact Module Wiring Harness At Seat Frame With Retaining Clips
Courtesy of GENERAL MOTORS CORP.

3. With the seat back cover in the open position the wiring harness on the side impact inflator module will be exposed.

   Remove the retaining clips that secure the inflator module wiring harness to the seat.

4. Remove the wiring harness.

Installation Procedure

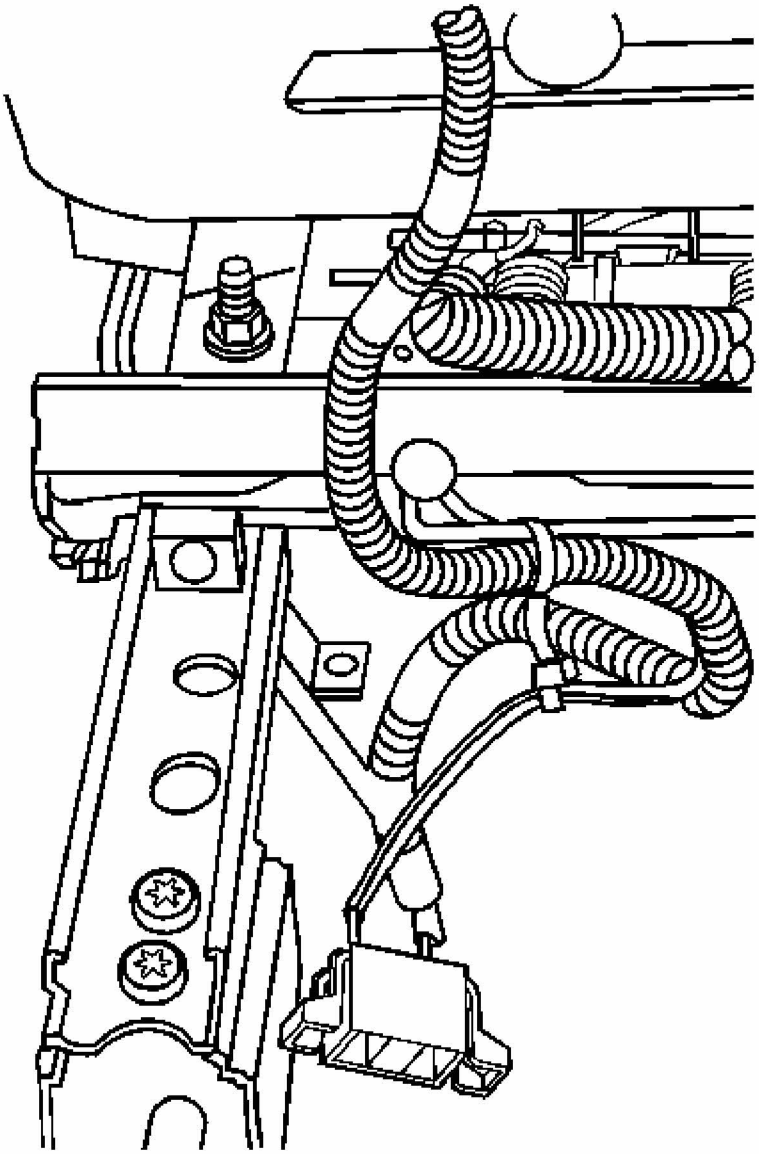


Fig. 148: Inflatable Restraint Side Impact Module Wiring Harness At Seat Frame With Retaining Clips
Courtesy of GENERAL MOTORS CORP.

1. Install the new inflator module wiring harness to the seat. Install the retaining clips that

secure the wiring harness to the seat.

2. Install the side impact inflator module to the seat. Refer to **Inflatable Restraint Side Impact Module Replacement - Front (Monte Carlo)**.
3. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 7** or **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)**.

INFLATABLE RESTRAINT IP MODULE INDICATOR REPLACEMENT

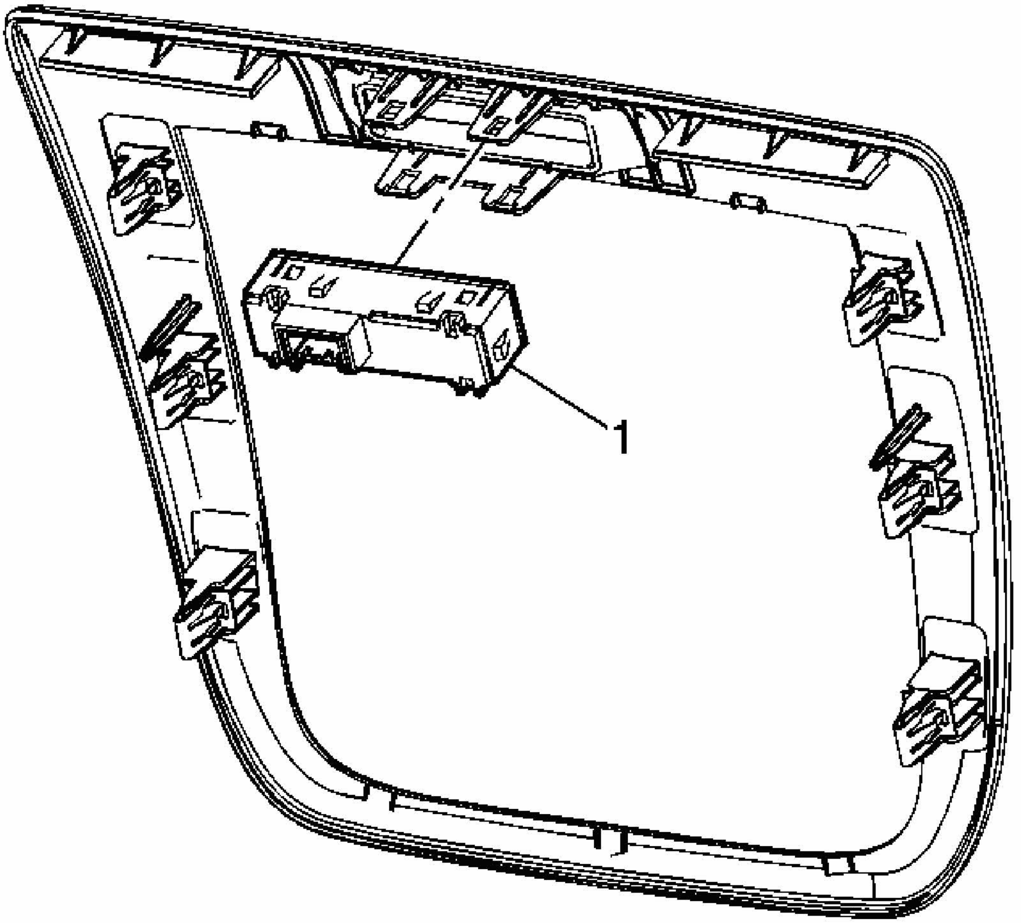


Fig. 149: Replacing Inflatable Restraint IP Module Indicator
Courtesy of GENERAL MOTORS CORP.

Indicator Replacement - Inflatable Restraint IP Module

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.	

Preliminary Procedure Remove the instrument panel accessory trim panel. Refer to **Trim Plate Replacement - Instrument Panel (I/P) Accessory (Impala)** or **Trim Plate Replacement - Instrument Panel (I/P) Accessory (Monte Carlo)** .	
1	Indicator Assembly, Inflatable Restraint Instrument Panel Module

INFLATABLE RESTRAINT ROOF RAIL MODULE REPLACEMENT

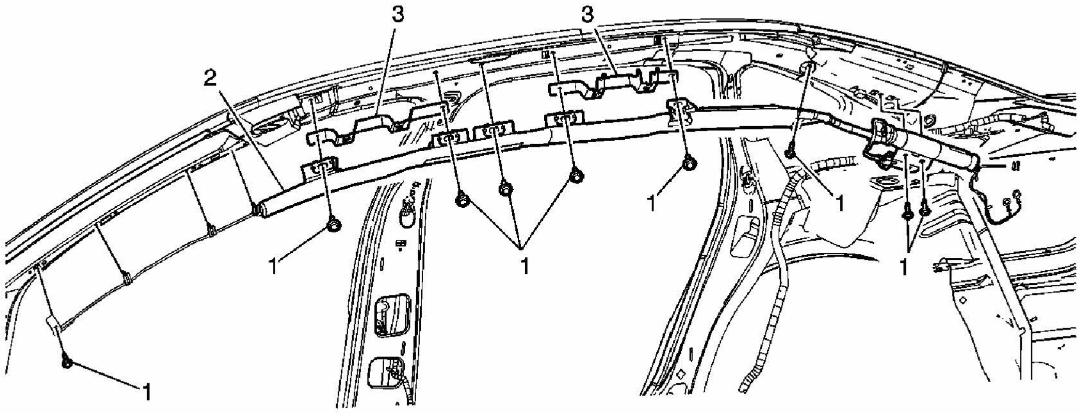


Fig. 150: Replacing Inflatable Restraint Roof Rail Module
Courtesy of GENERAL MOTORS CORP.

Inflatable Restraint Roof Rail Module Replacement

Callout	Component Name
CAUTION: **In order to prevent SIR deployment, personal injury, or unnecessary SIR system repairs, do not strike the door or the door pillar in the area of the side impact sensor (SIS). Turn OFF the ignition and remove the key when performing service in the area of the SIS.** **CAUTION:** **Refer to SIR Caution .** **CAUTION:** **Refer to SIR Inflator Module Handling and Storage Caution .** **NOTE:** **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.	

Preliminary Procedure

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 2 (Monte Carlo)** or **SIR Disabling and Enabling Zone 2 (Impala)** for the left side or **SIR Disabling and Enabling Zone 6 (Monte Carlo)** or **SIR Disabling and Enabling Zone 6 (Impala)**.
2. Remove the windshield pillar garnish molding. Refer to **Garnish Molding Replacement - Windshield Pillar (Impala)** or **Garnish Molding Replacement - Windshield Pillar (Monte Carlo)** .
3. Remove the center pillar trim. Refer to **Trim Panel Replacement - Upper Center Pillar** .
4. Remove the rear quarter upper trim panel. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .
5. Remove the assist handles. Refer to **Assist Handle Replacement** .
6. Lower the side of the headliner. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** .

1	Bolt, Inflatable Restraint Roof Side Rail **Tighten:** 9 N.m (80 lb in)
2	Module Assembly, Inflatable Restraint Roof Side Rail
3	Bracket Assembly, Assist Handle

SEAT BELT RETRACTOR PRETENSIONER REPLACEMENT - FRONT

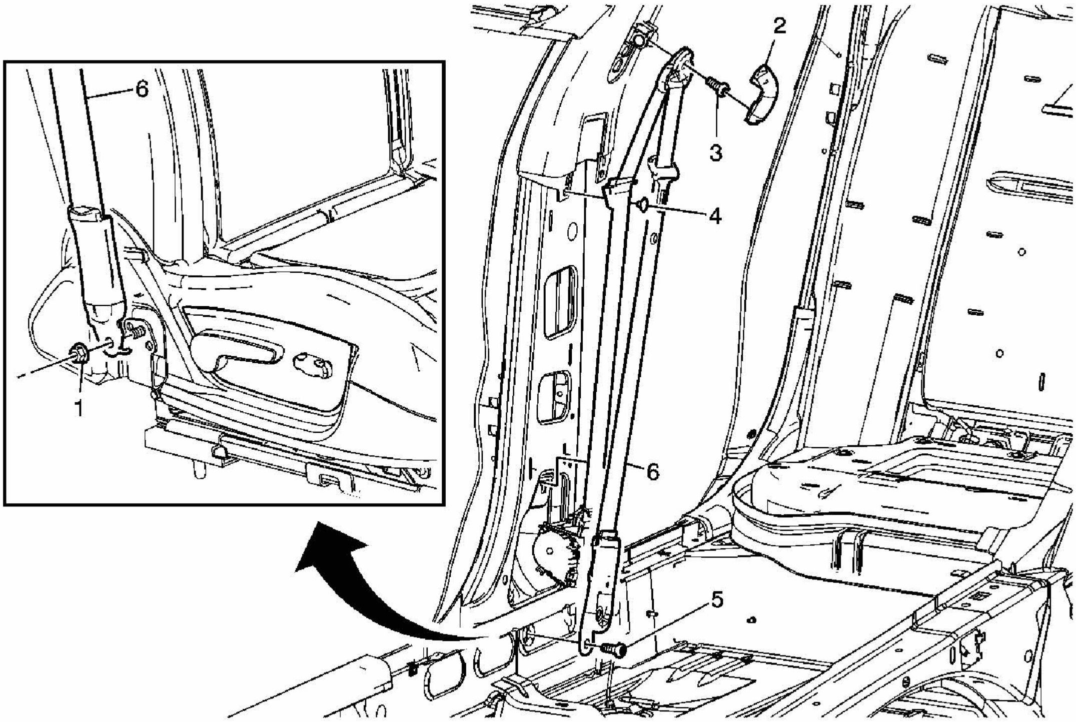


Fig. 151: Replacing Seat Belt Retractor Pretensioner
Courtesy of GENERAL MOTORS CORP.

Seat Belt Retractor Pretensioner Replacement - Front

Callout	Component Name
CAUTION: Refer to SIR Caution . CAUTION: In order to prevent accidental deployment and the risk of personal injury, do not dispose of an undeployed inflatable restraint seat belt pretensioner as normal shop waste. Undeployed seat belt pretensioners contain substances that could cause severe illness or personal injury if their sealed containers are damaged during disposal. Use the following deployment procedures to safely dispose of an undeployed seat belt pretensioner. Failure to observe the following disposal methods may be a violation of federal, state, or local laws. NOTE: Refer to Fastener Notice . **Fastener Tightening Specifications:** Refer to Fastener Tightening Specifications. **Preliminary Procedure** 1. Move the front seat all the way forward.	

2. Disable the SIR. Refer to **SIR Disabling and Enabling Zone 7** or **SIR Disabling and Enabling Zone 9 (Monte Carlo)** or **SIR Disabling and Enabling Zone 9 (Impala)**.
3. Remove the lower center pillar trim. Refer to **Trim Panel Replacement - Lower Center Pillar** .

1	Nut, Seat Shoulder Belt Anchor **Tip:** Disconnect the electrical connector. **Tighten:** 42 N.m (31 lb ft)
2	Cover, Seat Shoulder Belt Guide
3	Bolt, Seat Shoulder Belt Guide **Tighten:** 42 N.m (31 lb ft)
4	Fastener, Seat Shoulder Belt Guide
5	Bolt, Seat Shoulder Belt Retractor **Tighten:** 68 N.m (50 lb ft)
6	Retractor, Seat Shoulder Belt

REPAIRS AND INSPECTIONS REQUIRED AFTER A COLLISION

Accident With or Without Air Bag Deployment - Component Inspections

CAUTION: Proper operation of the SIR sensing system requires that any repairs to the vehicle structure return the vehicle structure to the original production configuration. Not properly repairing the vehicle structure could cause non-deployment in a collision or deployment for conditions less severe than intended.

After a collision, inspect the following components as indicated. If any damage is detected, replace the component. If damage to the mounting points or mounting hardware is detected, repair the component or replace the hardware as needed.

- Steering column-Perform the steering column accident damage checking procedures. Refer to **Steering Column Accident Damage Inspection** .
- Instrument panel (I/P) knee bolsters and mounting points-Inspect the knee bolsters for bending, twisting, buckling, or any other type of damage.
- I/P brackets, braces, etc.-Inspect for bending, twisting, buckling, or any other type of damage.
- Seat belts-Perform the seat belt operational and functional checks. Refer to **Operational and Functional Checks** .

- Seats and seat mounting points-Inspect for bending, twisting, buckling, or any other type of damage.
- Passenger seat bottom equipped with Passenger Presence System (PPS)-Check for any DTCs or problems that may cause the PPS not to function properly.

Accident With Frontal Deployment - Component Replacement and Inspections

After a collision involving air bag deployment, replace the following components.

IMPORTANT: The front passenger seat is equipped with a PPS, which detects an occupant. If the requirements for disabling the I/P air bag are met then the PPS will communicate with the SDM to disable/turn off the I/P air bag, even in a accident. For more information on the PPS refer to SIR System Description and Operation.

- Inflatable restraint I/P module, if deployed and after performing the necessary inspections listed above.
- Inflatable restraint steering wheel module
- Inflatable restraint SDM
- Inflatable restraint front end sensors
- Inflatable restraint seat belt retractor pretensioners

Perform additional inspections on the following components.

- Steering wheel module coil and the coil wiring pigtail-Inspect for melting, scorching, or other damage due to excessive heat.
- Mounting points or mounting hardware for the I/P module, steering wheel module, SDM, and pretensioners-Inspect for any damage and repair or replace each component as needed.

Accident With Side Air Bag Deployment - Component Replacement and Inspections

After a collision involving side air bag deployment, replace the following components.

- Inflatable restraint side impact sensors (SIS), on the side of the impact
- Inflatable restraint roof rail module, on the side of the impact (Impala)
- Inflatable restraint side impact module, on the side of the impact (Monte Carlo)
- Inflatable restraint SDM
- Inflatable restraint seat belt retractor pretensioners

Perform additional inspections on the following components.

- Mounting points or mounting hardware for the SIS-Inspect for any damage and repair or replace each component as needed.
- Mounting points or mounting hardware for the roof rail module (Impala) on the side of impact-Inspect for any damage and repair or replace each component as needed.
- Mounting points or mounting hardware for the side impact module (Monte Carlo) on the side of impact-Inspect for any damage and repair or replace each component as needed.
- Mounting points or mounting hardware for the SDM and seat belt retractor pretensioners-Inspect for any damage and repair or replace each component as needed.

INFLATOR MODULE HANDLING AND SCRAPPING

Live (Undeployed) Inflator Module

CAUTION: Refer to SIR Inflator Module Handling and Storage Caution .

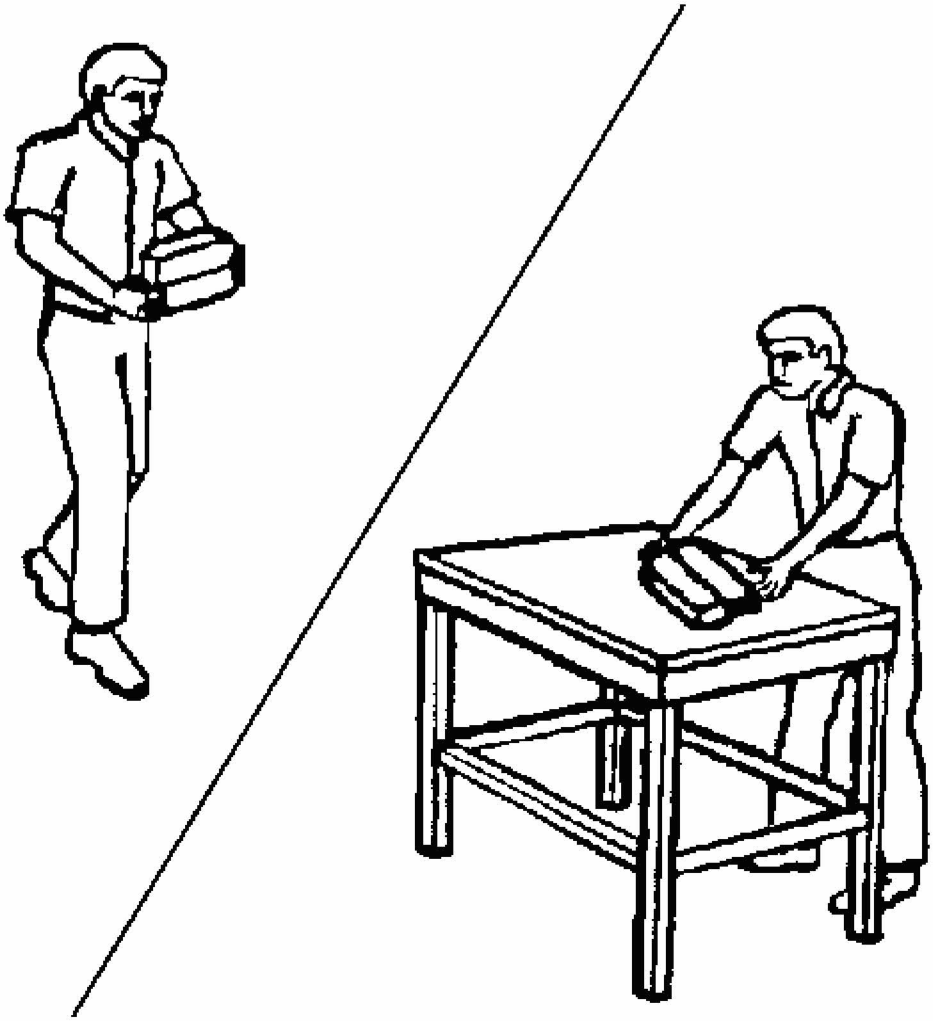


Fig. 152: View Of Proper Handling Of Undeployed Inflator Module
Courtesy of GENERAL MOTORS CORP.

Take special care when handling or storing a live (undeployed) inflator module. An inflator module deployment produces a rapid generation of gas. This may cause the inflator module, or an object in front of the inflator module, to project through the air in the event of an unlikely deployment.

Dual Stage Inflator Module

Dual stage inflator modules have 2 deployment stages. If stage 1 was used to deploy a dual stage inflator module, stage 2 may still be active. Therefore, a deployed dual stage inflator module must be treated as an active module. If disposal of a deployed or undeployed dual stage module is required both deployment loops must be energized to deploy the air bag.

Scrapping Procedure

During the course of a vehicles useful life, certain situations may arise which will require the disposal of a live (undeployed) inflator module. Do not dispose a live (undeployed) inflator module through normal disposal channels until the inflator module has been deployed. The following information covers the proper procedures for the disposing of a live (undeployed) inflator module.

Do not deploy the inflator module in the following situations:

- After replacement of an inflator module under warranty. The inflator module may need to be returned undeployed to the manufacturer.
- If the vehicle is the subject of a Product Liability report related to the SIR system and is subject to a Preliminary Investigation (GM-1241). Do not alter the SIR system in any manner.
- If the vehicle is involved in a campaign affecting the inflator modules. Follow the instructions in the Campaign Service Bulletin for proper SIR handling procedures.

Deployment Procedures

The inflator module can be deployed inside or outside of the vehicle. The method used depends upon the final disposition of the vehicle. Review the following procedures in order to determine which will work best in a given situation:

Deployment Outside Vehicle (Steering Wheel Module, I/P Module, and Side Impact Module)

Deploy the inflator module outside of the vehicle when the vehicle will be returned to service. Situations that require deployment outside of the vehicle include the following:

- Using the SIR diagnostics, you determine that the inflator module is malfunctioning.
- The inflator module is cosmetically damaged (scratched or ripped).
- The inflator module pigtail (if equipped) is damaged.
- The inflator module connector is damaged.
- The inflator module connector terminals are damaged.

Deployment and disposal of a malfunctioning inflator module is subject to any required retention period.

CAUTION: Refer to SIR Inflator Module Disposal Caution .

Tools Required

- **J 38826** SIR Deployment Harness. See **Special Tools**.
- **J 39401-B** SIR Deployment Fixture. See **Special Tools**.
- **J 38826-25** Roof Rail Module Adapter (Impala)
- **J 38826-25** Side Impact Module Adapter (Monte Carlo)
- **J 38826-75** Steering Wheel Module Adapter
- **J 38826-80** I/P Module Adapter

1. Turn OFF the ignition.
2. Remove the ignition key.
3. Put on safety glasses.
4. Remove the inflator module. Refer to the following:
    - If you are removing the steering wheel module, refer to **Inflatable Restraint Steering Wheel Module Replacement**.
    - If you are removing the instrument panel (I/P) module, refer to **Inflatable Restraint Instrument Panel Module Replacement**.
    - If you are removing a side impact module, refer to **Inflatable Restraint Side Impact Module Replacement - Front (Monte Carlo)**.
    - If you are removing a roof rail module, refer to **Inflatable Restraint Roof Rail Module Replacement**.

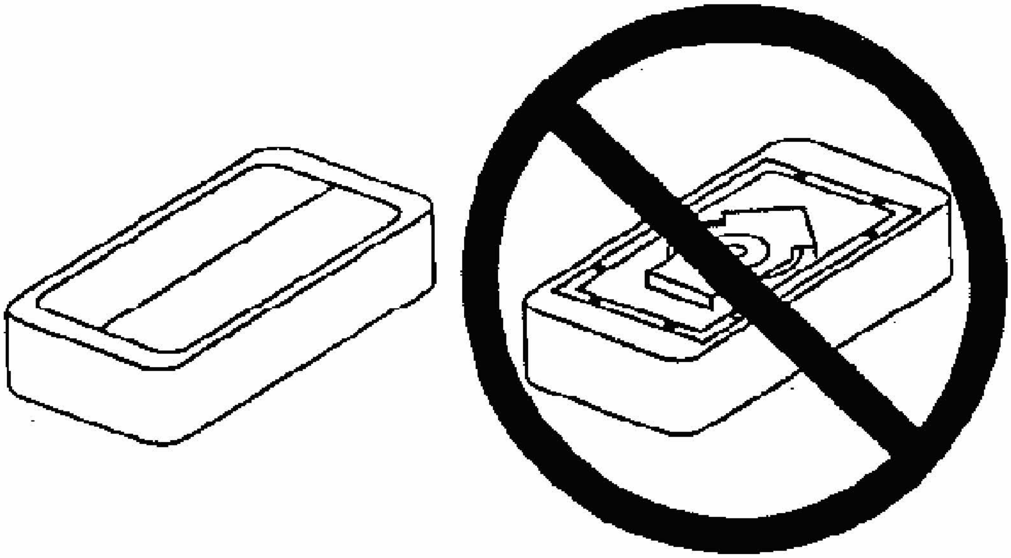


Fig. 153: Illustrating Proper Storage Of Inflator Module

Courtesy of GENERAL MOTORS CORP.

5. Place the inflator module with the vinyl trim cover facing up and away from the surface on a work bench.

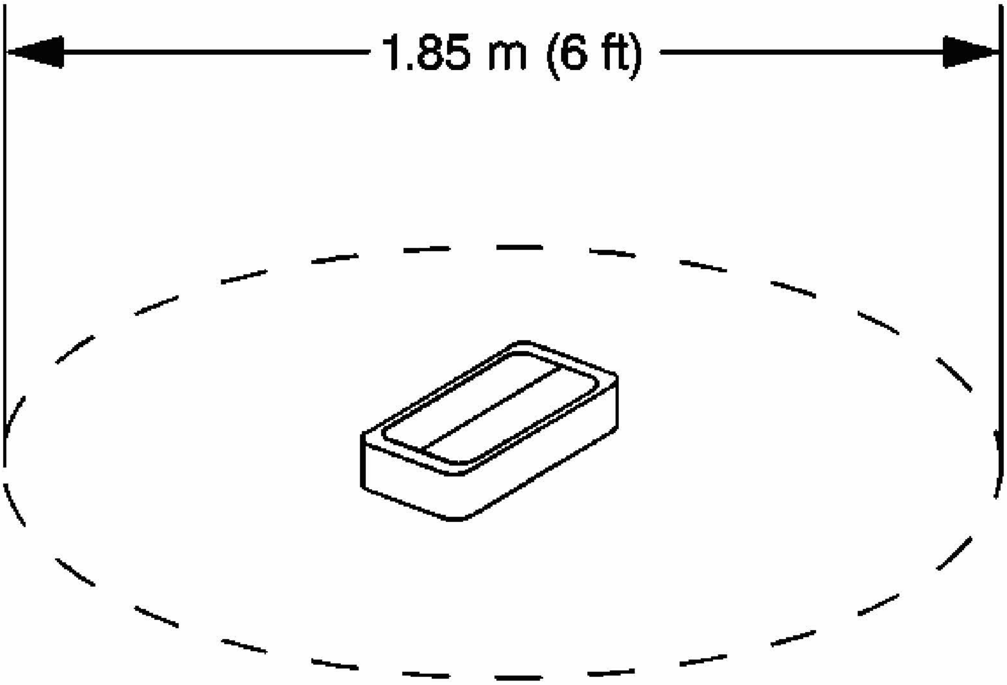


Fig. 154: Clearance For Deployment Of Inflator Module
Courtesy of GENERAL MOTORS CORP.

6. Clear a space on the ground about 1.85 m (6 ft) in diameter for deployment of the inflator module or deployment fixture. If possible, use a paved, outdoor location free of activity. Otherwise, use a space free of activity on the shop floor. Make sure you have sufficient ventilation.
7. Make sure no loose or flammable objects are in the area.

IMPORTANT: Dual stage deployments are only used in steering wheel and I/P inflator modules. If stage 1 was used to deploy a dual stage inflator module, stage 2 may still be active. If disposal of a deployed or undeployed dual stage module is required both deployment loops must be energized to deploy the air bag.

8. If you have a steering wheel inflator module, place the inflator module in the center of the space.

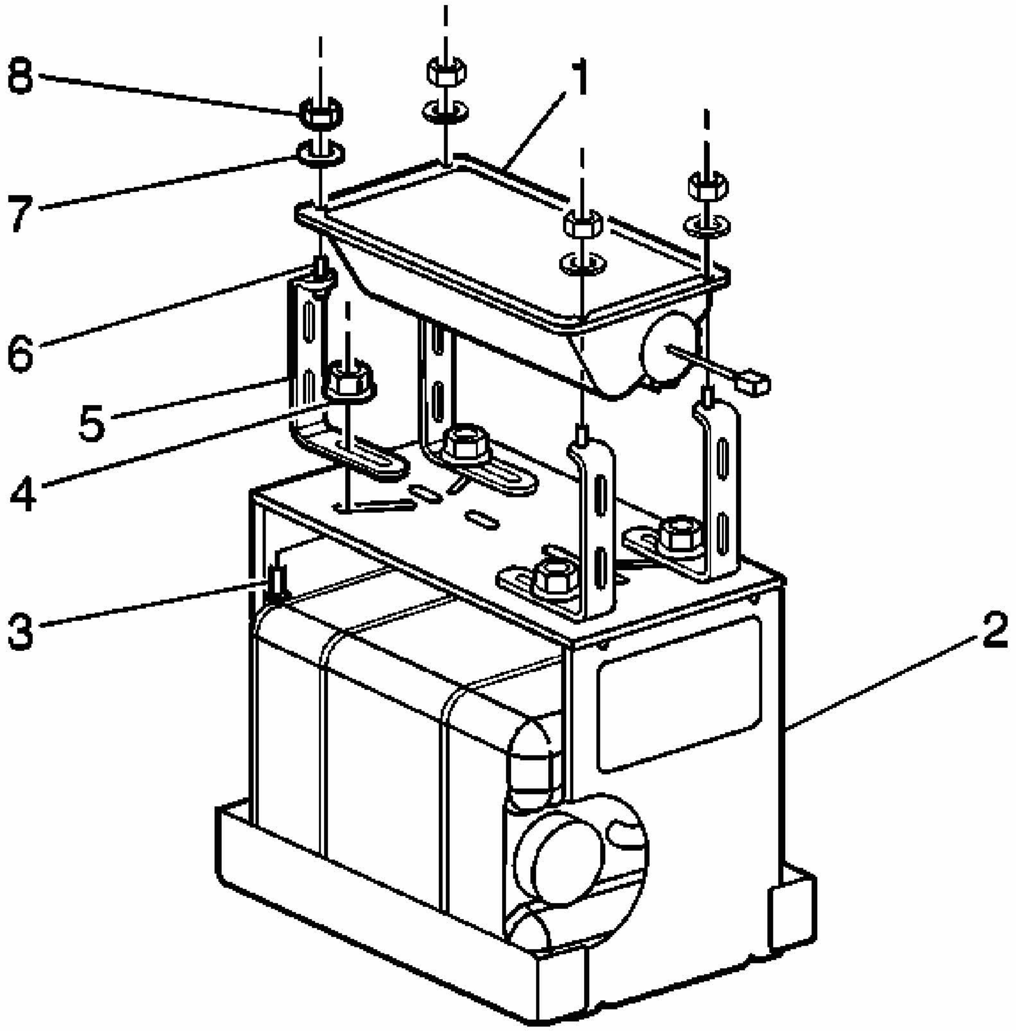


Fig. 155: Identifying I/P Module Components
Courtesy of GENERAL MOTORS CORP.

9. If you have an I/P inflator module, refer to the following instructions:
    1. Place the **J 39401-B** SIR deployment fixture (2) in the center of the cleared area. See **Special Tools**.
    2. Fill the deployment fixture with water or sand.
    3. Using the proper nuts and bolts, mount the I/P module (1) to the deployment fixture (2), with the vinyl trim facing up.

4. Securely tighten all fasteners that hold the I/P module (1) to the deployment fixture (2).

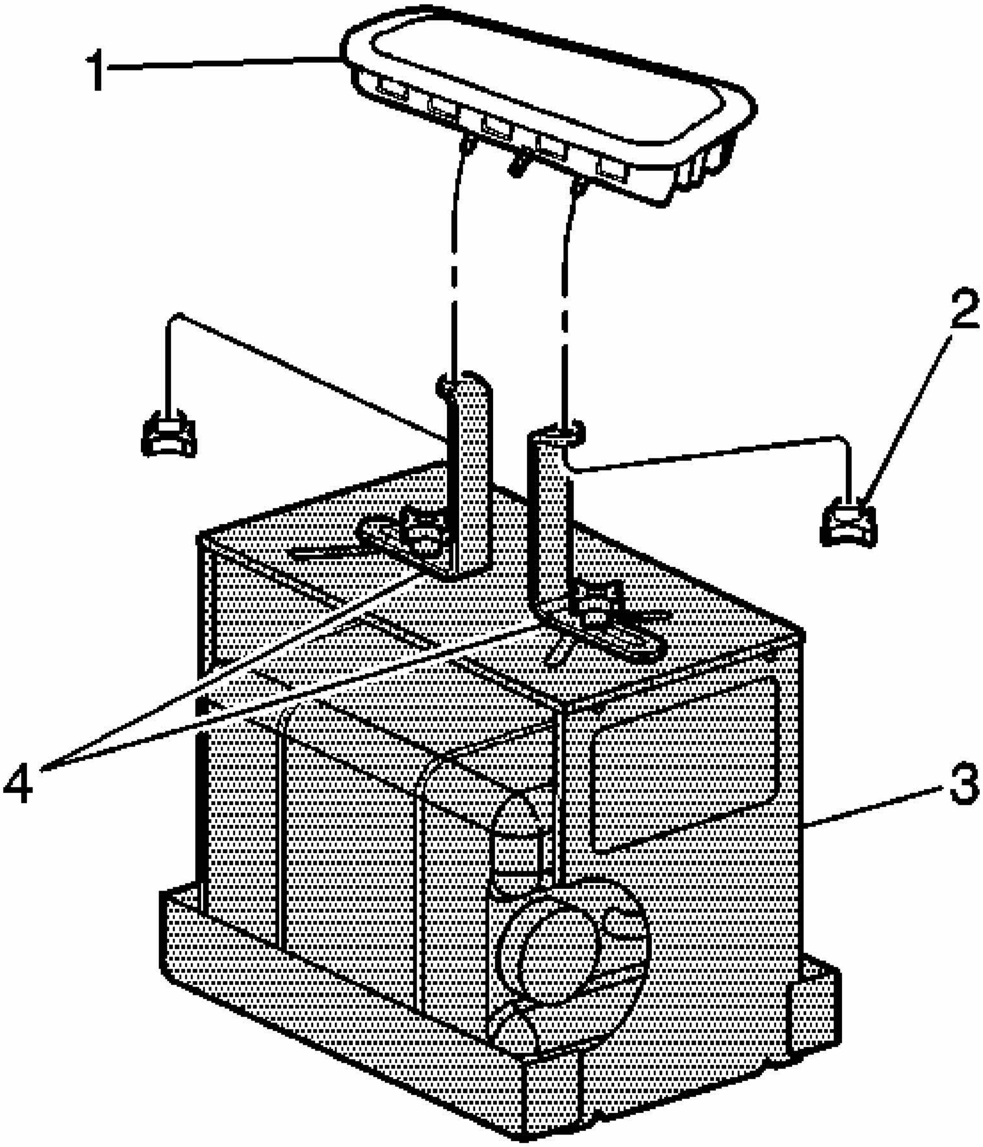


Fig. 156: View Of Side Impact Module & Components
Courtesy of GENERAL MOTORS CORP.

10. If you have a side impact module, refer to the following instructions:
    1. Place the **J 39401-B** SIR deployment fixture (3) in the center of the cleared area. See Special Tools.

2. Fill the deployment fixture with water or sand.
3. Using the proper nuts and mount the side impact module (1) to the deployment fixture (3), with the vinyl trim facing up.
4. Adjust and secure the fixture arms (4) to the deployment fixture (3).
5. Securely tighten all fasteners that hold the side impact module (1) to the deployment fixture (3).

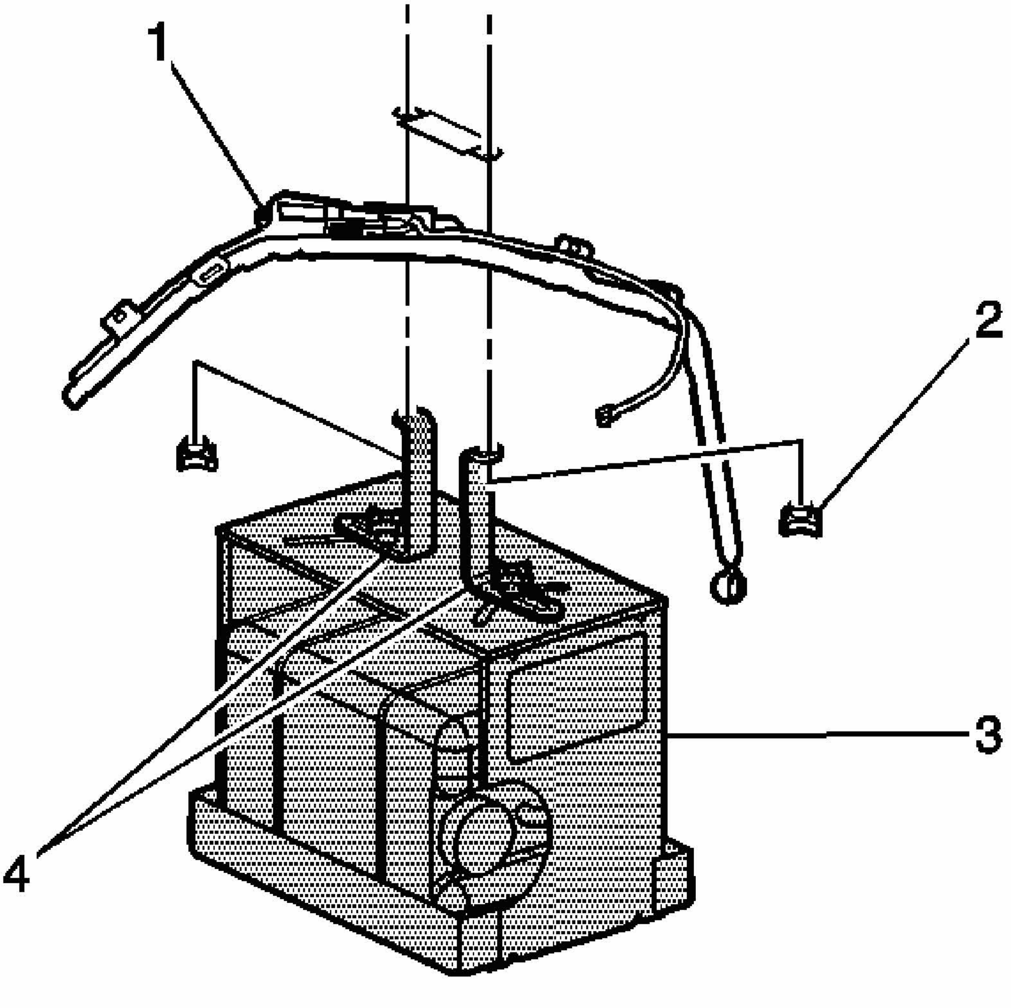


Fig. 157: Identifying Fasteners Holding Side Impact Module To Deployment Fixture
Courtesy of GENERAL MOTORS CORP.

11. If you have a roof rail module, refer to the following instructions:
    1. Place the **J 39401-B** SIR deployment fixture (3) in the center of the cleared area.

See **Special Tools**.

2. Fill the deployment fixture with water or sand.
3. Using the proper nuts (2) and mount the roof rail module (1) to the deployment fixture (3), with the vinyl face up.
4. Adjust and secure the fixture arms (4) to the deployment fixture (3).
5. Securely tighten all fasteners that hold the side impact module (1) to the deployment fixture (3).

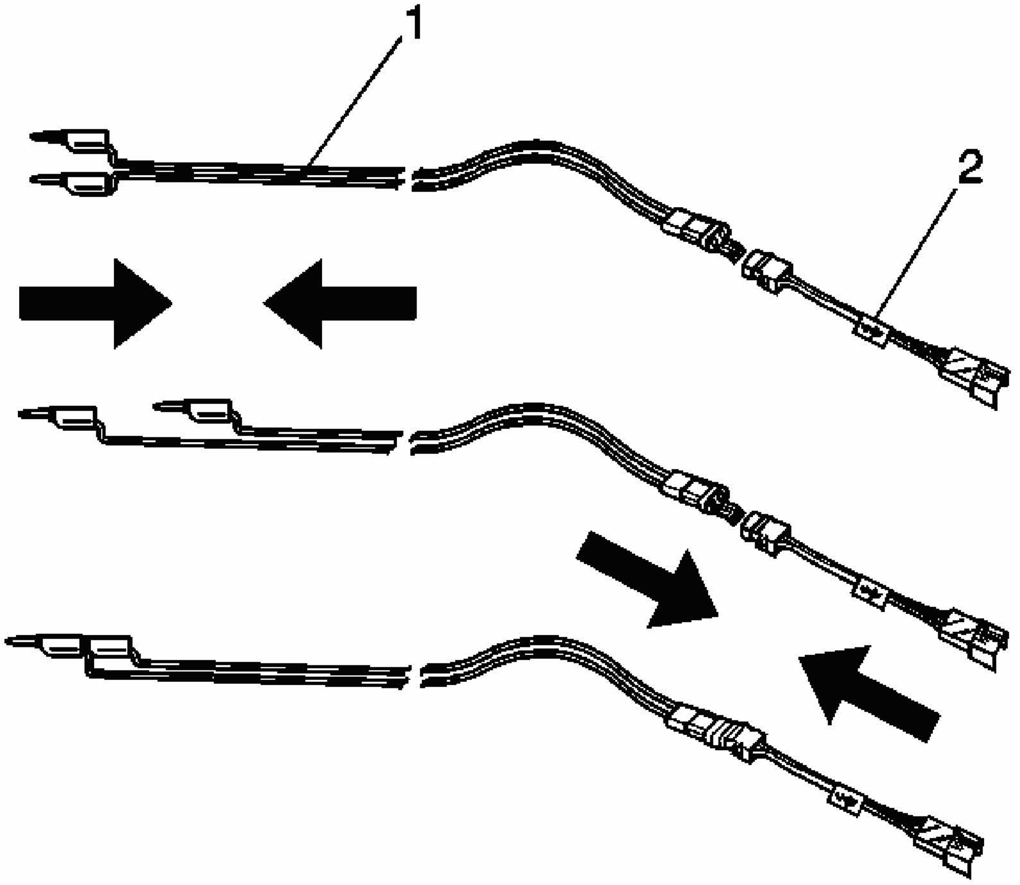


Fig. 158: Identifying SIR Deployment Harness & Adapter
Courtesy of GENERAL MOTORS CORP.

12. Inspect the **J 38826** and the appropriate pigtail adapter for damage. See **Special Tools**. Replace as needed.
13. Short the 2 SIR deployment harness leads (1) together using one banana plug seated into the other.

IMPORTANT: Refer to Tools Required list for the correct adapter.

14. Connect the appropriate pigtail adapter (2) to the SIR deployment harness (1).

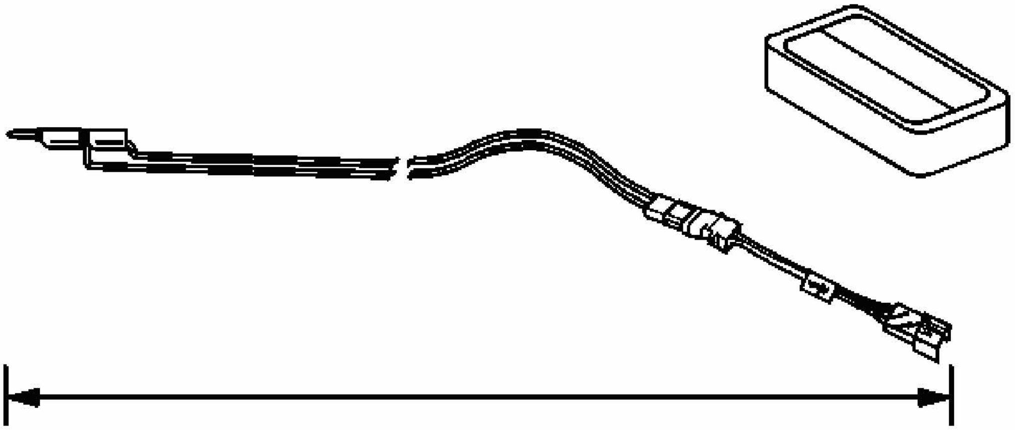


Fig. 159: Extending SIR Deployment Harness & Adapter
Courtesy of GENERAL MOTORS CORP.

15. Extend the SIR deployment harness and adapter to full length from the deployment fixture.

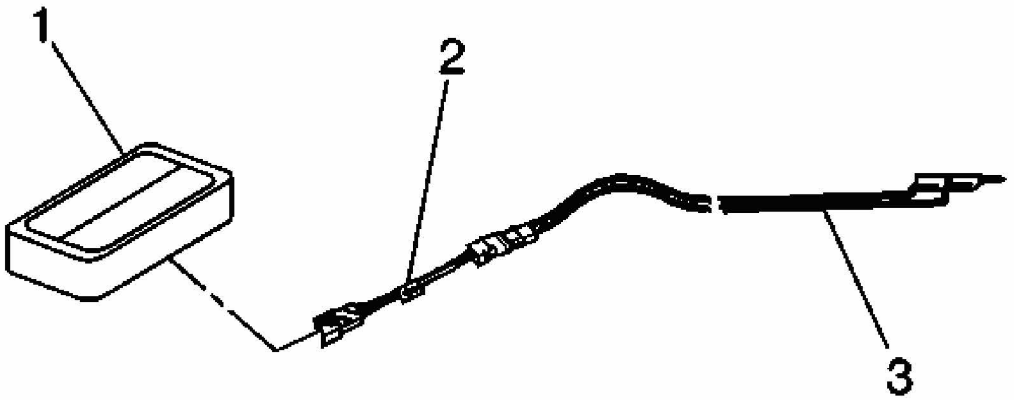


Fig. 160: Inflator Module & SIR Deployment Harness Adapter

Courtesy of GENERAL MOTORS CORP.

16. Connect the inflator module to the adapter (2) on the SIR deployment harness (1).
17. Place a 12 V minimum/2 A minimum power source (i.e., vehicle battery) near the shorted end of the harness.

IMPORTANT:

- **The rapid expansion of gas involved with deploying an inflator module is very loud. Notify all the people in the immediate area that you intend to deploy the inflator module.**
- **When the inflator module deploys, the deployment fixture may jump about 30 cm (1 ft) vertically. This is a normal reaction of the inflator module due to the force of the rapid expansion of gas inside the inflator module.**
- **If you are deploying a dual stage inflator module with stage 1 already deployed, the fixture may not move and the noise may have been reduced.**

18. Clear the area of people.

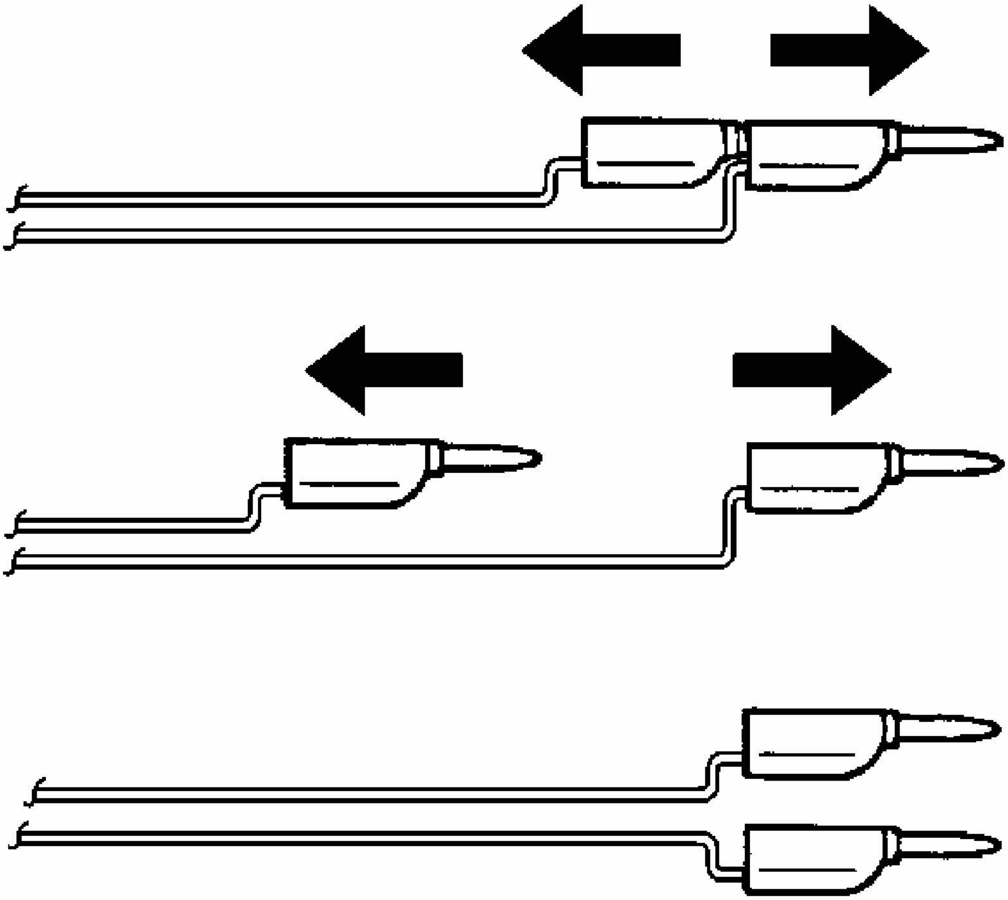


Fig. 161: Separating Banana Plugs
Courtesy of GENERAL MOTORS CORP.

19. Separate the 2 banana plugs on the SIR deployment harness.

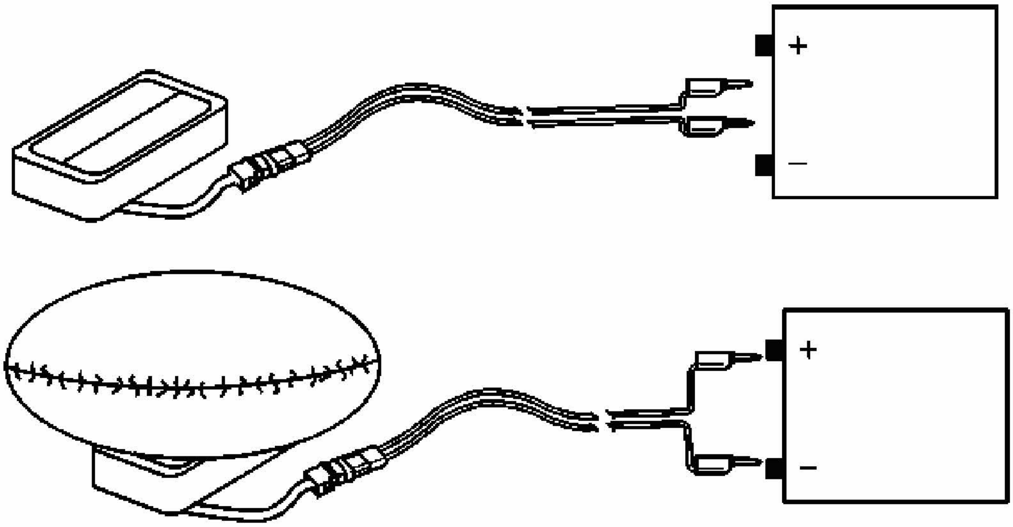


Fig. 162: Connecting SIR Deployment Harness Wires To Power Source
Courtesy of GENERAL MOTORS CORP.

20. Connect the SIR deployment harness wires to the power source. Inflator module deployment will occur when contact is made.

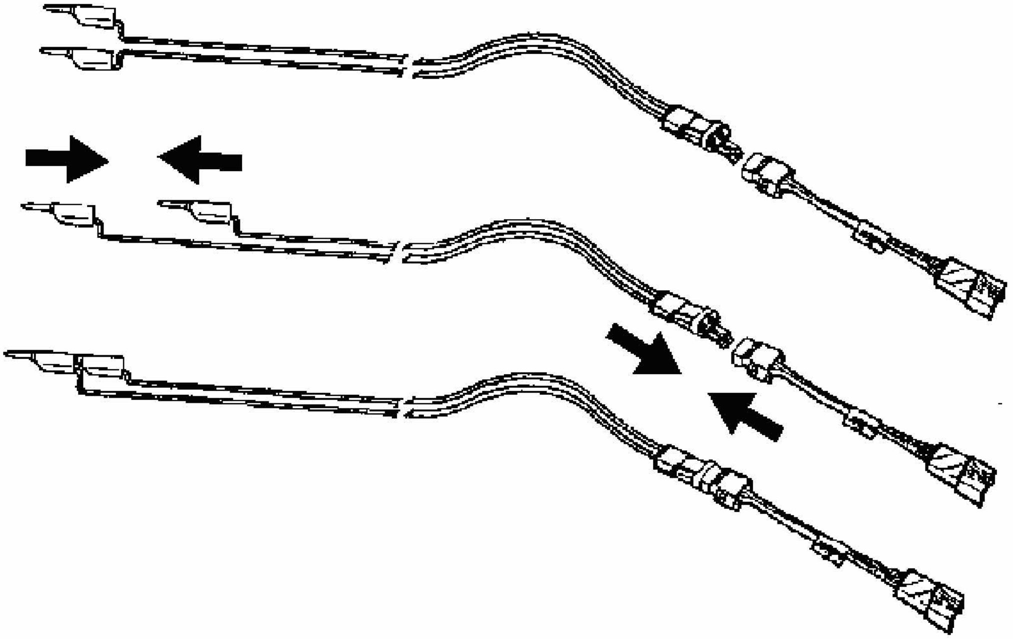


Fig. 163: View Of Deployment Harness Leads
Courtesy of GENERAL MOTORS CORP.

21. Disconnect the SIR deployment harness from the power source after the inflator module deploys.
22. If the inflator module did not deploy, disconnect the adapter and discontinue the procedure. Contact the Technical Assistance Group. Otherwise, proceed to the following steps.

CAUTION: Refer to SIR Deployed Inflator Modules Are Hot Caution .

23. Seat one banana plug into the other in order to short the deployment harness leads.

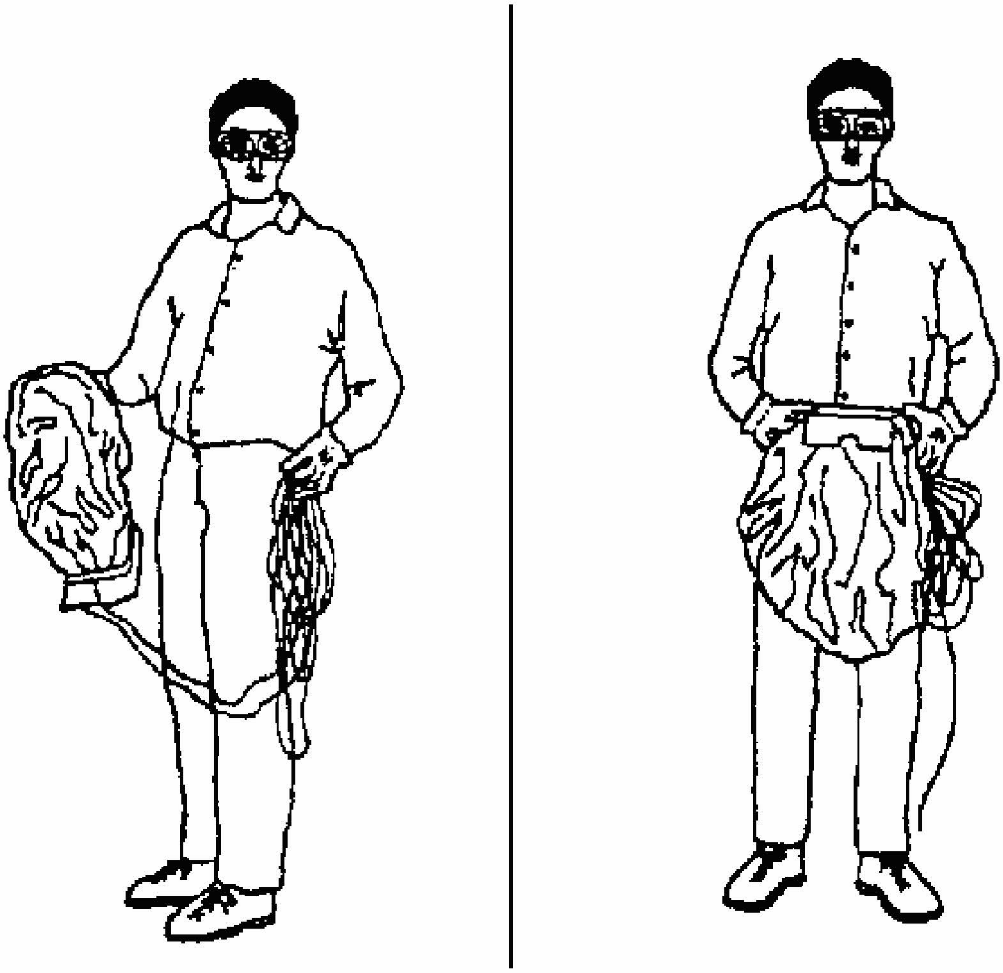


Fig. 164: Disposing Of Deployed Inflator Module
Courtesy of GENERAL MOTORS CORP.

24. Put on a pair of shop gloves.
25. Disconnect the pigtail adapter from the inflator module as soon as possible.
26. Inspect the pigtail adapter and the SIR deployment harness. Replace as needed.
27. Dispose of the deployed inflator module through normal refuse channels.
28. Wash hands with a mild soap.

Deployment Inside Vehicle (Vehicle Scrapping Procedure)

Deploy the inflator modules inside of the vehicle when destroying the vehicle or when salvaging the vehicle for parts. This includes but is not limited to the following situations:

- The vehicle has completed its useful life.
- Irreparable damage occurs to the vehicle in a non-deployment type accident.
- Irreparable damage occurs to the vehicle during a theft.
- The vehicle is being salvaged for parts to be used on a vehicle with a different VIN as opposed to rebuilding as the same VIN.

CAUTION: Refer to SIR Inflatable Module Deployment Outside Vehicle Caution .

1. Turn the ignition switch to the OFF position.
2. Remove the ignition key.
3. Put on safety glasses.
4. Remove all loose objects from the front seats.
5. Disable the SIR system. Refer to **SIR Disabling and Enabling Zones**.

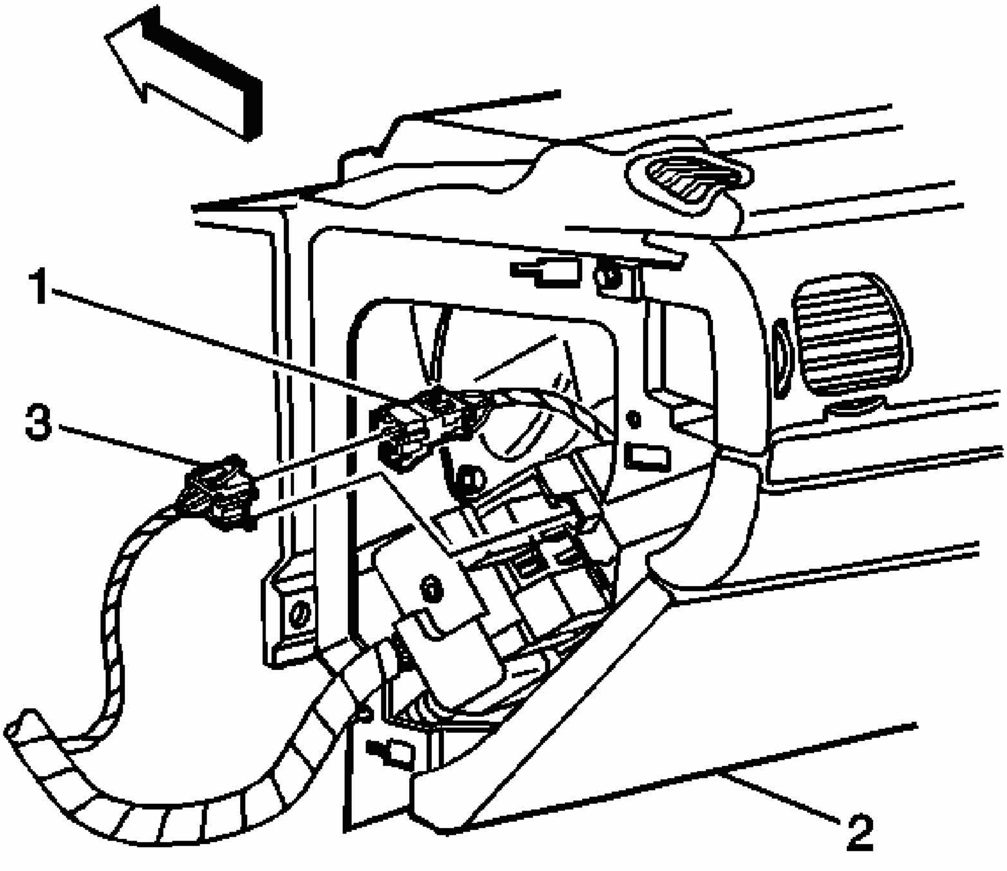


Fig. 165: Identifying I/P Module Connector To Vehicle Harness Connector (LH Side I/P)
Courtesy of GENERAL MOTORS CORP.

CAUTION: A deployed dual stage inflator module will look the same whether one or both stages were used. Always assume a deployed dual stage inflator module has an active stage 2. Improper handling or servicing can activate the inflator module and cause personal injury.

6. Disconnect the steering wheel module yellow connector (1) from vehicle harness yellow connector (3).

IMPORTANT: This vehicle is equipped with dual stage air bags, the steering wheel module will have 4 wires. Refer to SIR Connector End Views for determining high and low circuits.

7. Cut the yellow harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
8. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.

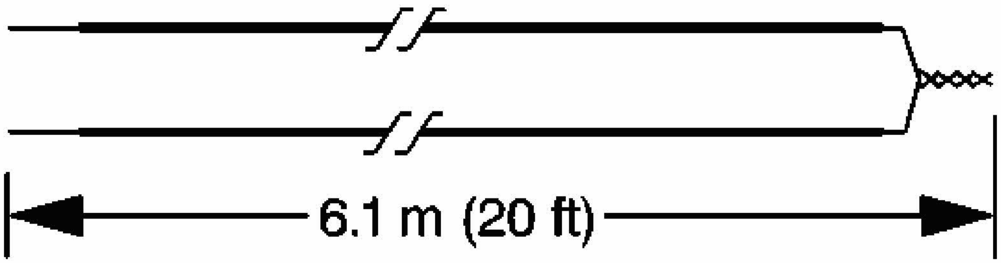


Fig. 166: Fabricating 20 Ft. Deployment Harness
Courtesy of GENERAL MOTORS CORP.

9. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gage) or thicker multi-strand wire. Use these wires to fabricate the driver deployment harness.
10. Strip 13 mm (0.5 in) of insulation from both ends of the wires cut in the previous step.
11. Twist together one end from each of the wires in order to short the wires. Deployment wires shall remain shorted, and not connected to a power source until you are ready to

deploy the inflator module.

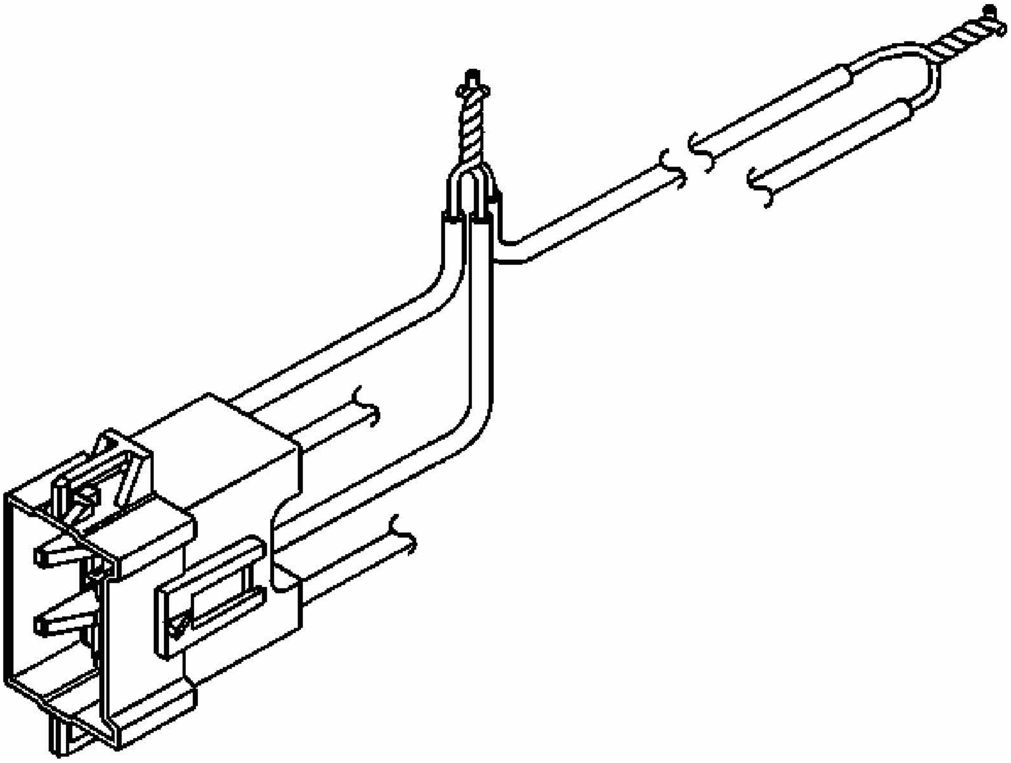


Fig. 167: Twisting Connector Wire Leads (High Circuits) To Deployment Harness Wire
Courtesy of GENERAL MOTORS CORP.

12. Twist together 2 connector wire leads (the high circuits from both stages of the steering wheel module) to one sets of deployment wires. Refer to **SIR Connector End Views** in order to determine the correct circuits.
13. Inspect that the 3 wire connection is secure.

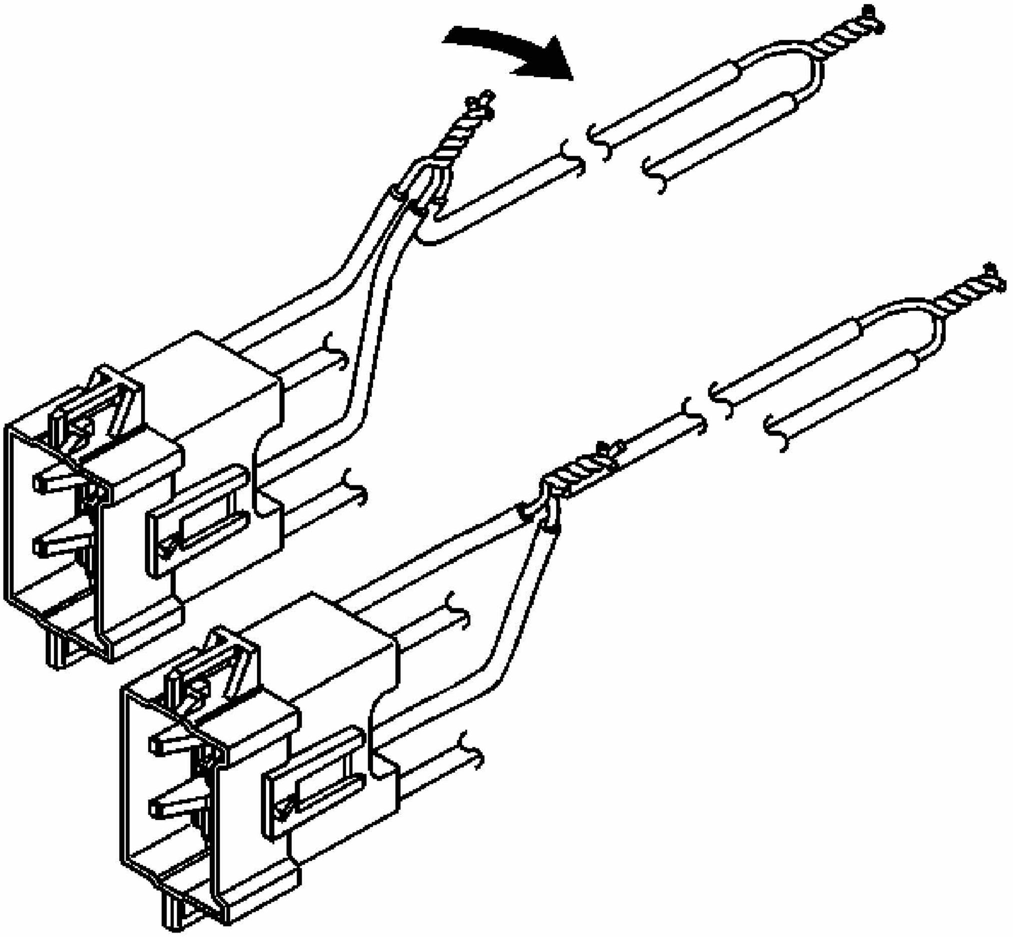


Fig. 168: Bending Twisted Connection Flat
Courtesy of GENERAL MOTORS CORP.

14. Bend flat the twisted connection.

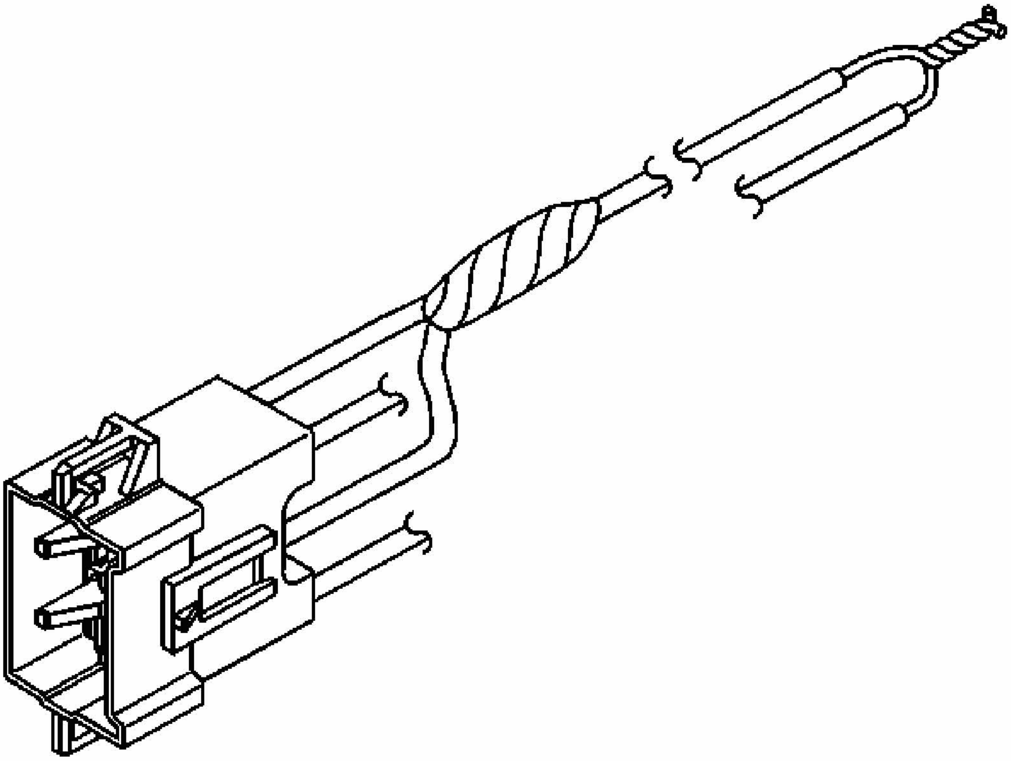


Fig. 169: Insulating Connection With Electrical Tape
Courtesy of GENERAL MOTORS CORP.

15. Secure and insulate the 3 wire connection to deployment harness using electrical tape.

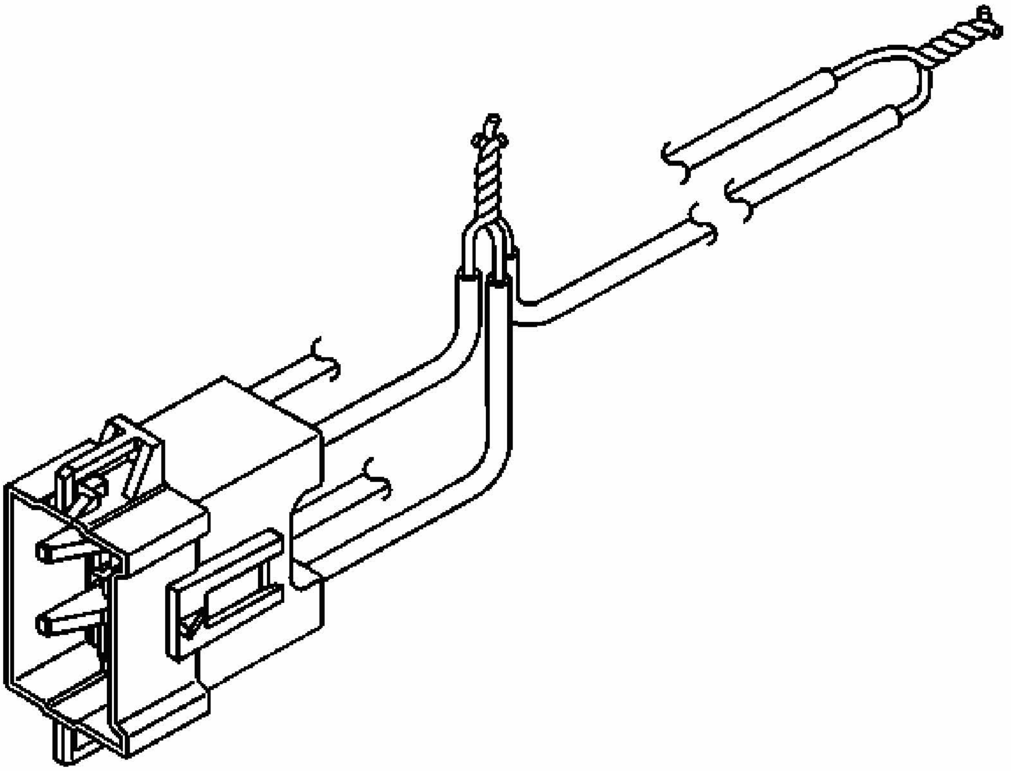


Fig. 170: Twisting Connector Wire Leads (Low Circuits) To Deployment Harness Wire
Courtesy of GENERAL MOTORS CORP.

16. Twist together 2 connector wire leads (the low circuits from both stages of the steering wheel module) to one sets of deployment wires. Refer to **SIR Connector End Views** in order to determine the correct circuits.
17. Inspect that the 3 wire connection is secure.

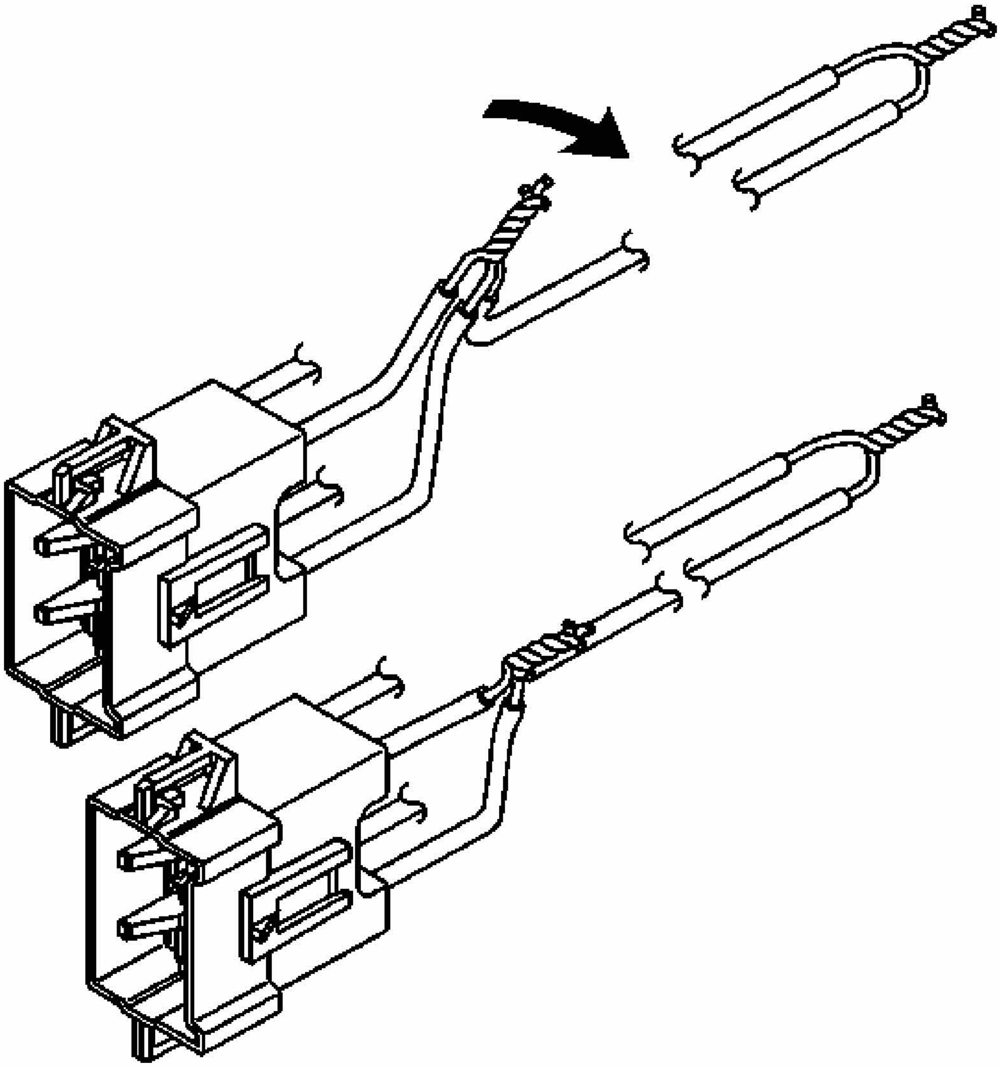


Fig. 171: Bending Twisted Connection Flat
Courtesy of GENERAL MOTORS CORP.

18. Bend flat the twisted connection.

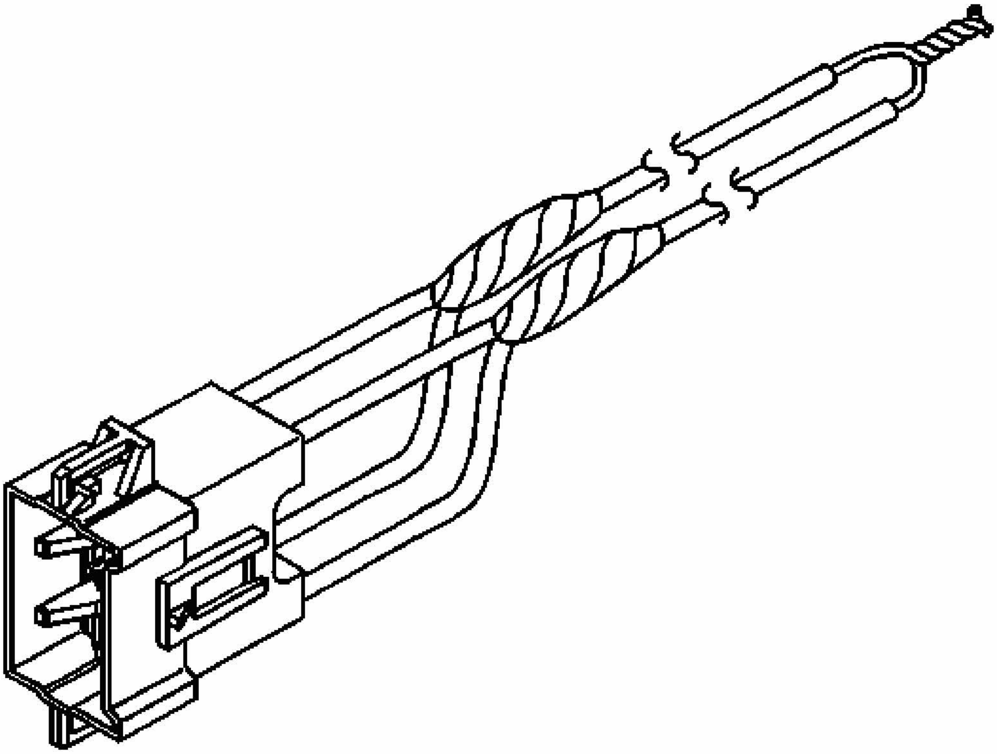


Fig. 172: Insulating Connection With Electrical Tape
Courtesy of GENERAL MOTORS CORP.

19. Secure and insulate the 3 wire connection to deployment harness using electrical tape.
20. Connect the deployment harness to the steering wheel module in-line connector.

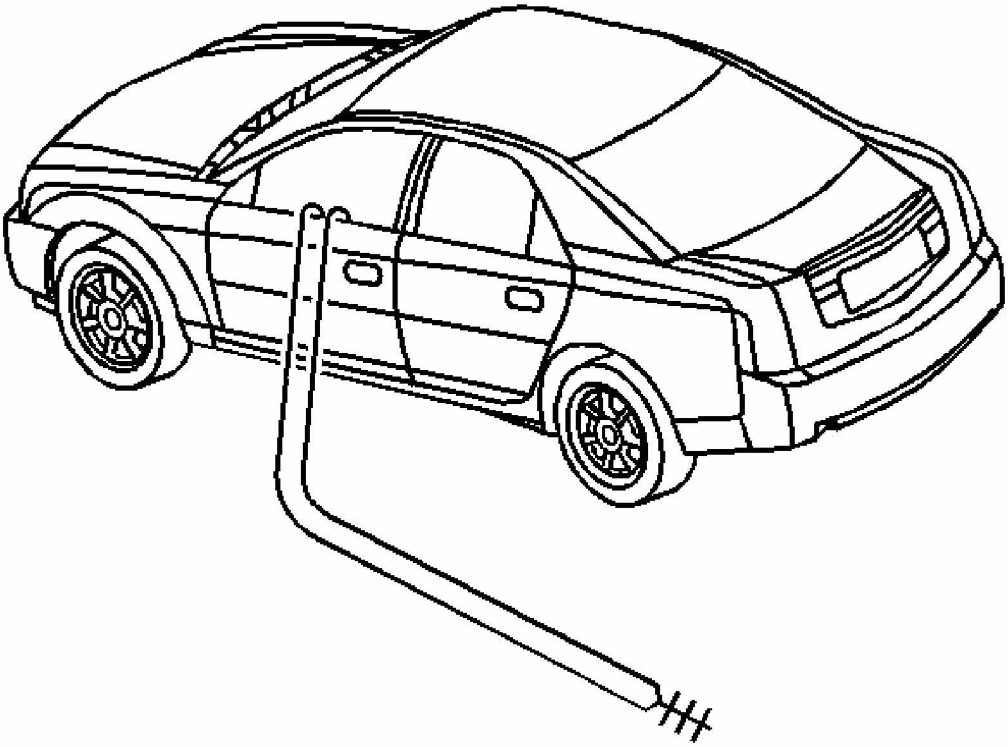


Fig. 173: Routing Deployment Harness Out Of Driver Side Of Vehicle
Courtesy of GENERAL MOTORS CORP.

21. Route the deployment harness out of the driver side of the vehicle.

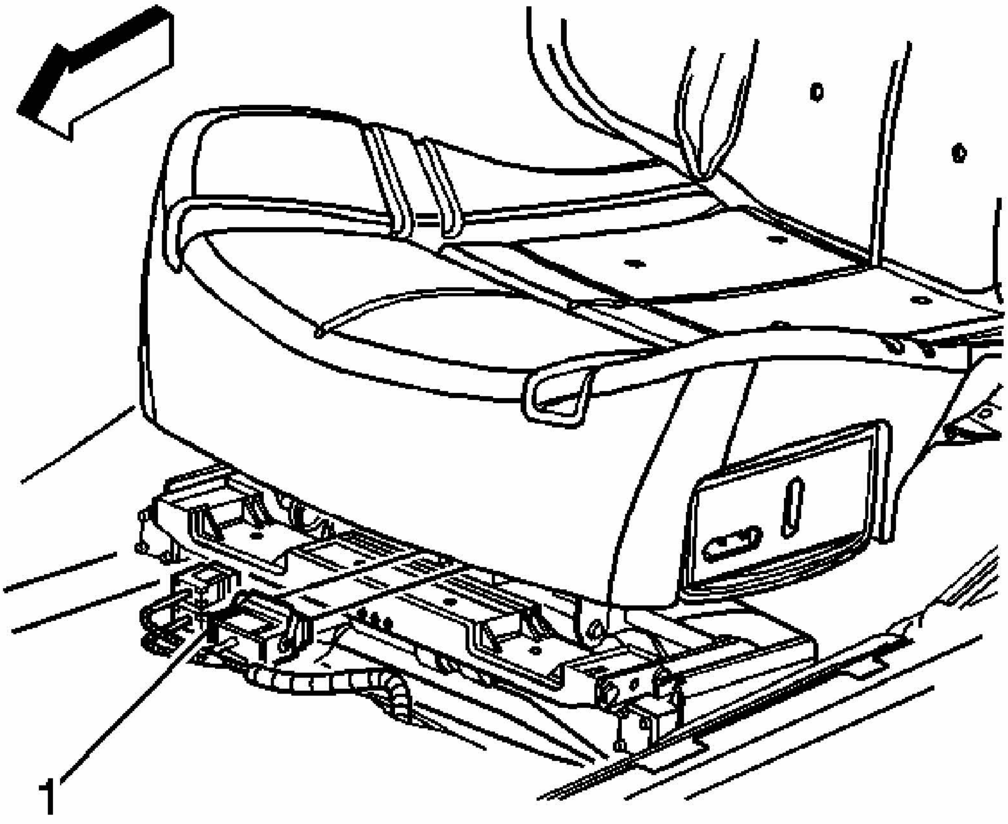


Fig. 174: Locating RF Side Impact Module & Pretensioner Yellow Connector
Courtesy of GENERAL MOTORS CORP.

22. For Monte Carlo, disconnect the driver/left side air bag yellow connector (1) from the vehicle wiring harness located under the front of driver seat.

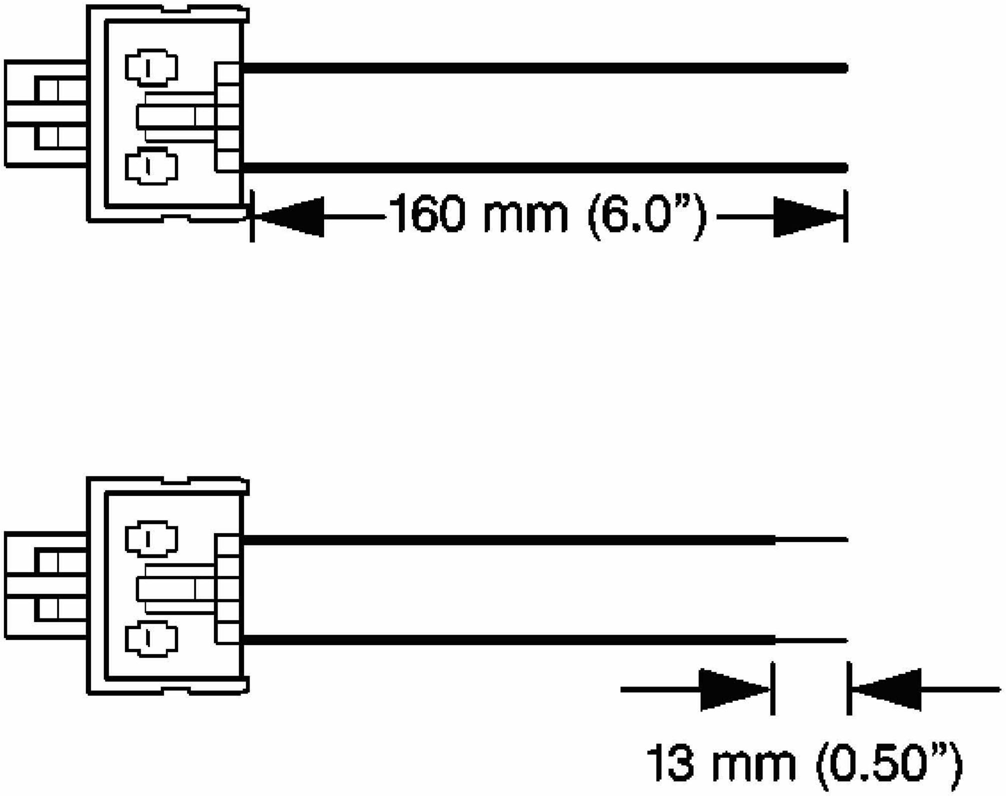


Fig. 175: Identifying Proper Stripping Of Connection Wire Leads
Courtesy of GENERAL MOTORS CORP.

23. Cut the harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
24. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.

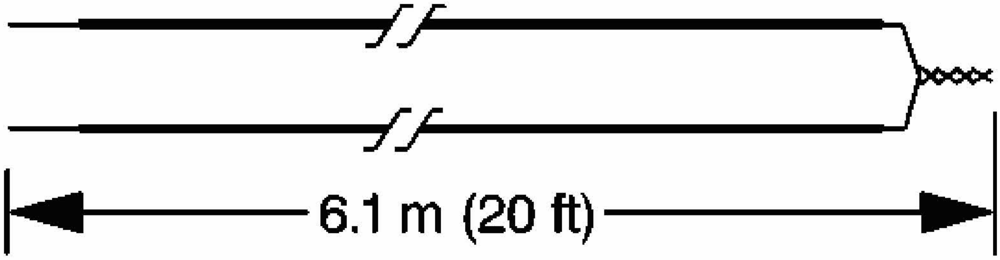


Fig. 176: Fabricating 20 Ft. Deployment Harness
Courtesy of GENERAL MOTORS CORP.

25. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gage) or thicker multi-strand wire. These wires will be used to fabricate the side air bag deployment harness.
26. Strip 13 mm (0.5 in) of insulation from both ends of the wires cut in the previous step.
27. Twist together one end from each of the wires in order to short the wires.

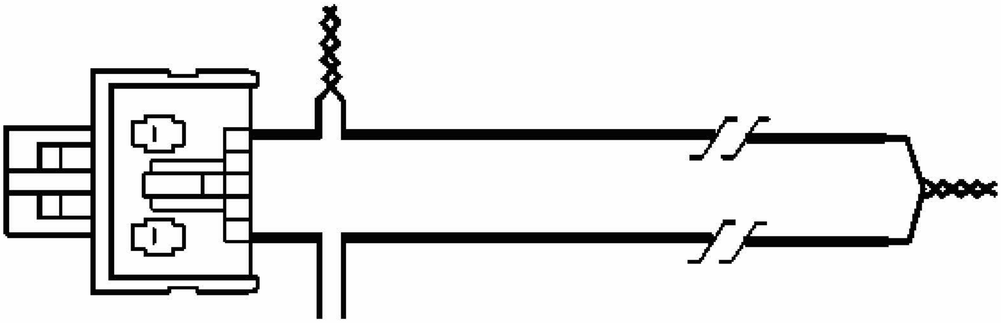


Fig. 177: View Of Proper Twisting Of Connector Wire Lead To Deployment Wire
Courtesy of GENERAL MOTORS CORP.

28. Twist together one connector wire lead to one deployment wire.

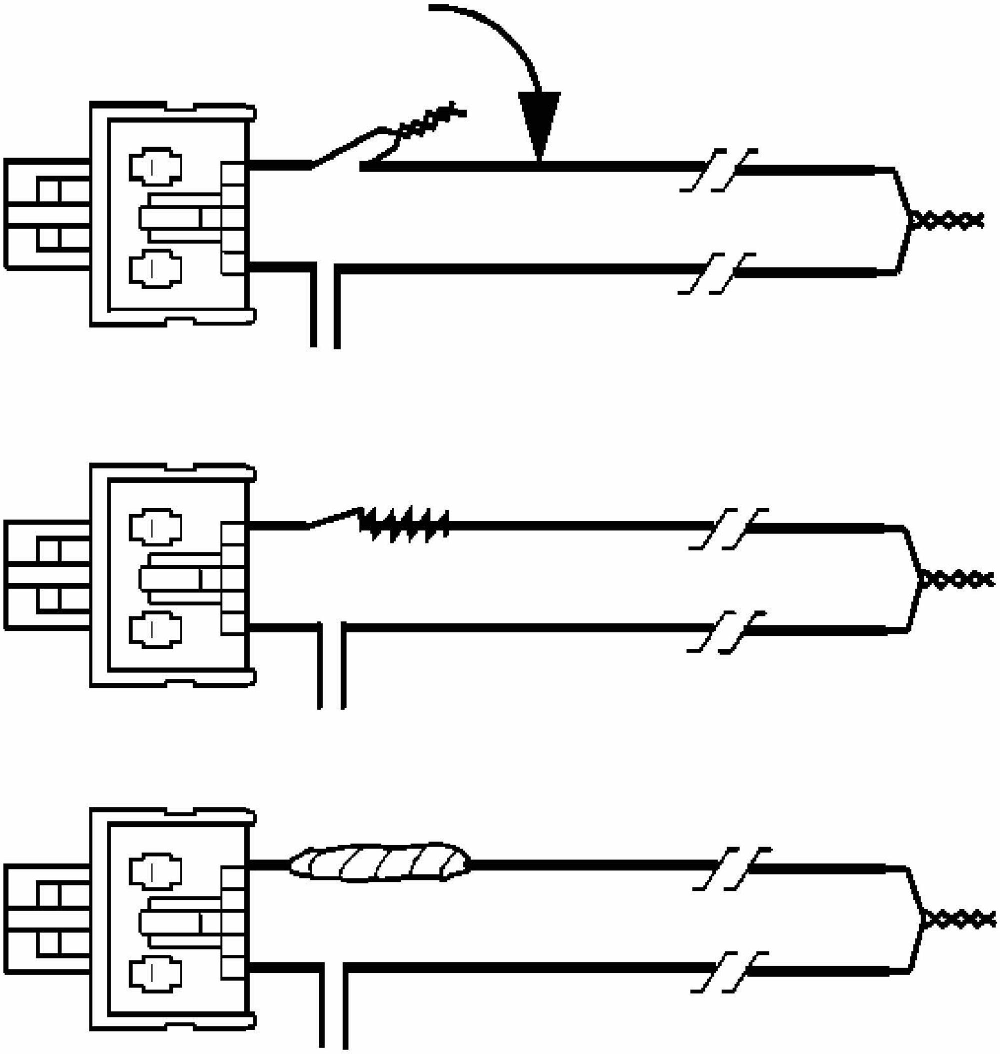


Fig. 178: Bending Twisted Connection Flat & Insulating With Tape
Courtesy of GENERAL MOTORS CORP.

29. Bend flat the twisted connection.
30. Secure and insulate the connection using electrical tape.

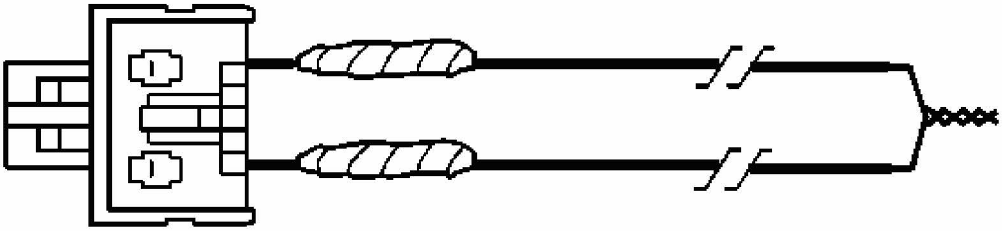


Fig. 179: Taping Remaining Connector Wire Lead To Remaining Deployment Wire
Courtesy of GENERAL MOTORS CORP.

31. Twist together, bend, and tape the remaining connector wire lead to the remaining deployment wire.
32. Connect the deployment harness to the side air bag yellow connector.

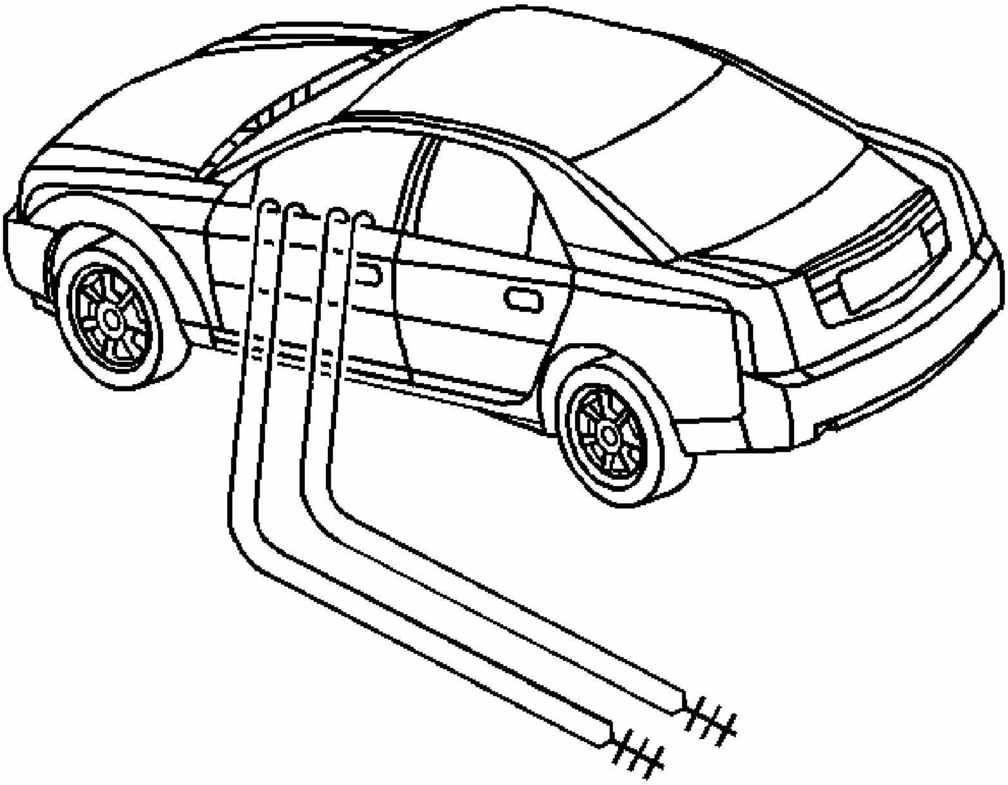


Fig. 180: Routing Deployment Harness Out Of Driver Side Of Vehicle
Courtesy of GENERAL MOTORS CORP.

33. Route the deployment harness out of the driver side of the vehicle.

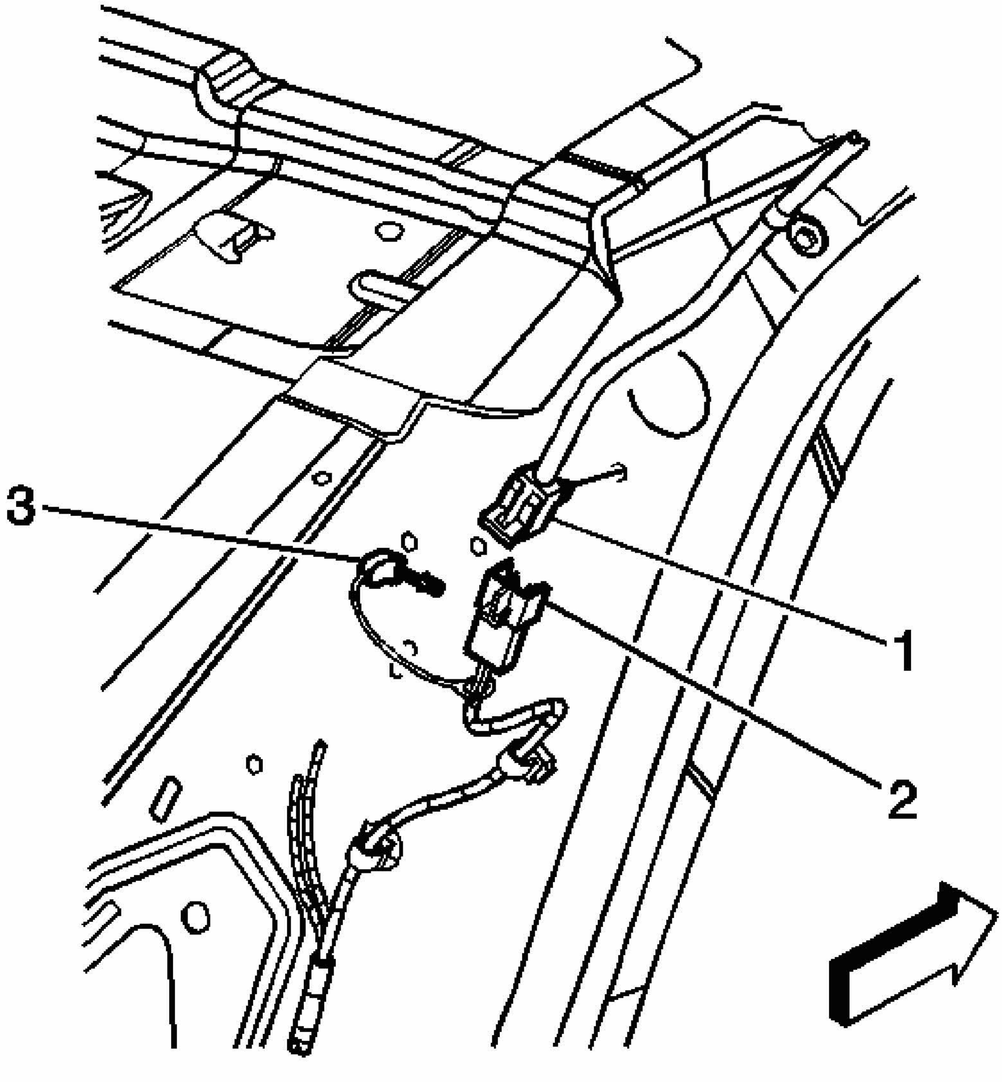


Fig. 181: Connector Position Assurance, Left/Driver Roof Rail Module Connector & Left Roof Rail Module Yellow Connector
Courtesy of GENERAL MOTORS CORP.

34. For Impala, disconnect the left/driver roof rail air bag yellow harness connector (1) from the vehicle harness connector (2).

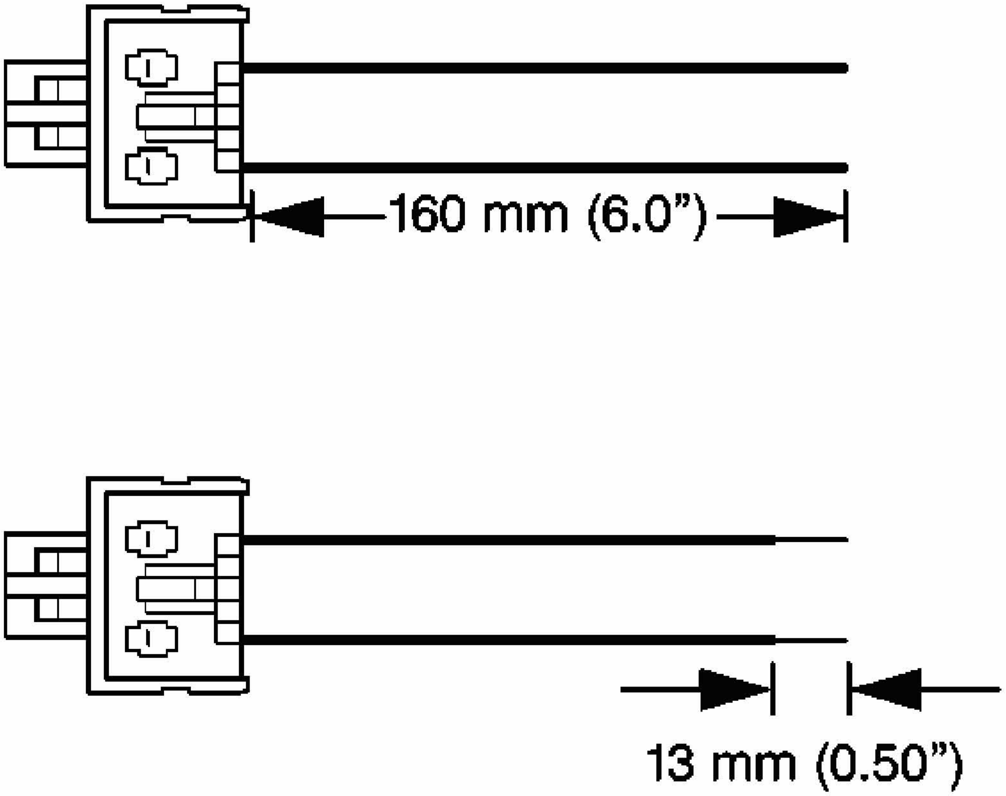


Fig. 182: Identifying Proper Stripping Of Connection Wire Leads
Courtesy of GENERAL MOTORS CORP.

35. Cut the harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
36. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.

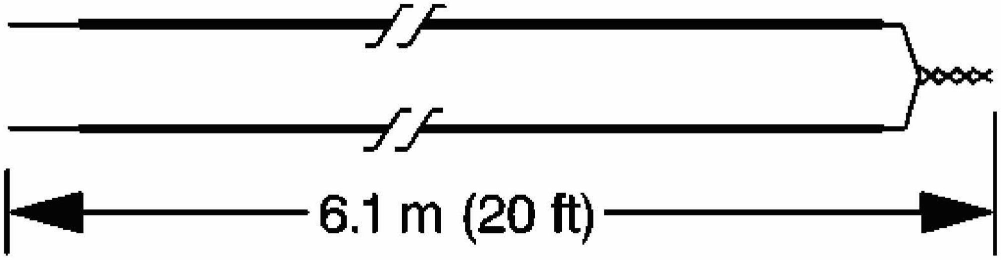


Fig. 183: Fabricating 20 Ft. Deployment Harness
Courtesy of GENERAL MOTORS CORP.

37. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gage) or thicker multi-strand wire. These wires will be used to fabricate the roof rail air bag deployment harness.
38. Strip 13 mm (0.5 in) of insulation from both ends of the wires cut in the previous step.
39. Twist together one end from each of the wires in order to short the wires.

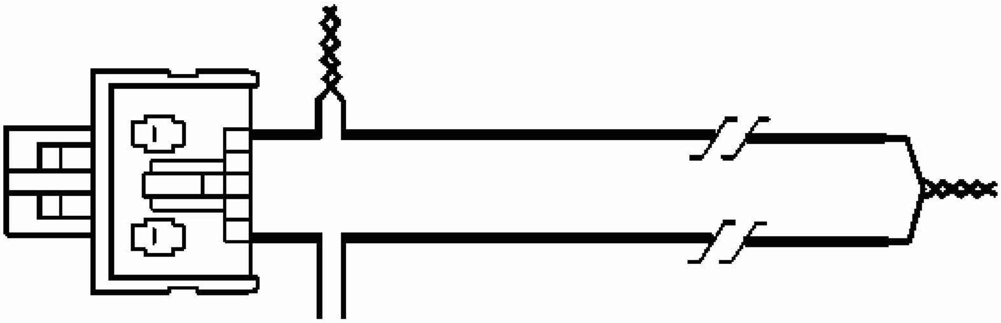


Fig. 184: View Of Proper Twisting Of Connector Wire Lead To Deployment Wire
Courtesy of GENERAL MOTORS CORP.

40. Twist together one connector wire lead to one deployment wire.

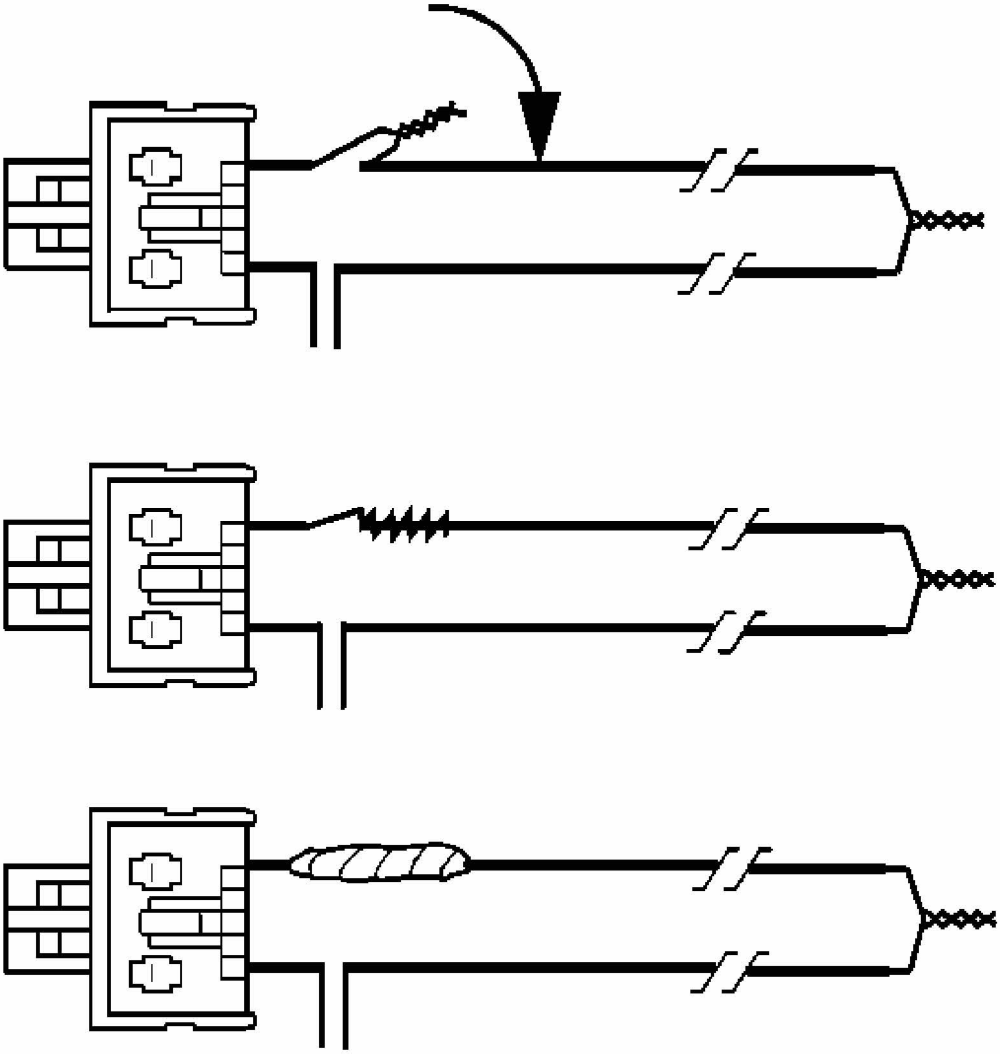


Fig. 185: Bending Twisted Connection Flat & Insulating With Tape
Courtesy of GENERAL MOTORS CORP.

41. Bend flat the twisted connection.
42. Secure and insulate the connection using electrical tape.

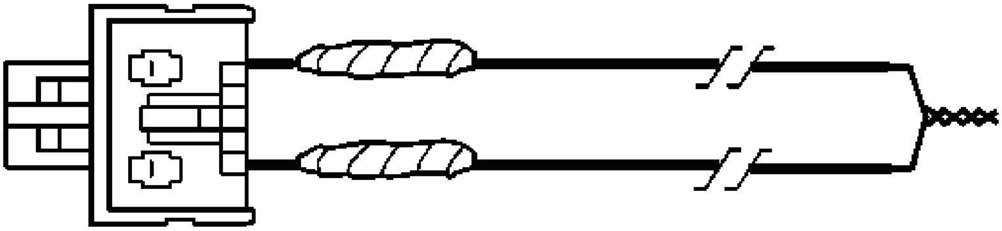


Fig. 186: Taping Remaining Connector Wire Lead To Remaining Deployment Wire
Courtesy of GENERAL MOTORS CORP.

43. Twist together, bend, and tape the remaining connector wire lead to the remaining deployment wire.
44. Connect the deployment harness to the roof rail air bag yellow connector.

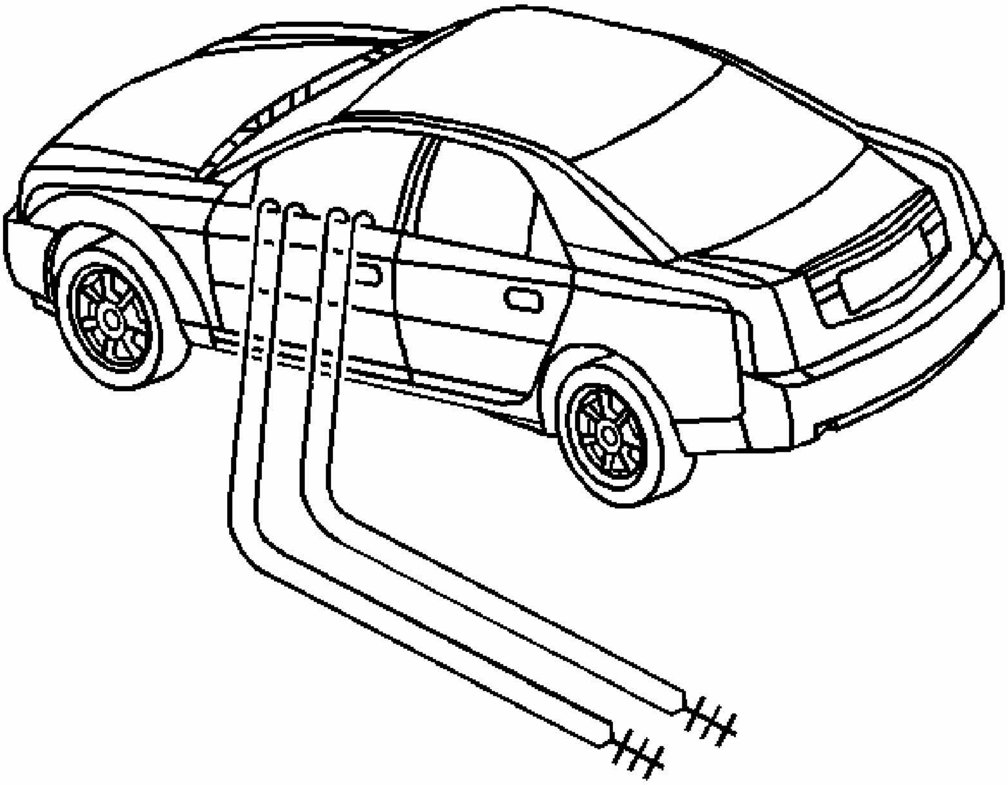


Fig. 187: Routing Deployment Harness Out Of Driver Side Of Vehicle
Courtesy of GENERAL MOTORS CORP.

45. Route the deployment harness out of the driver side of the vehicle.

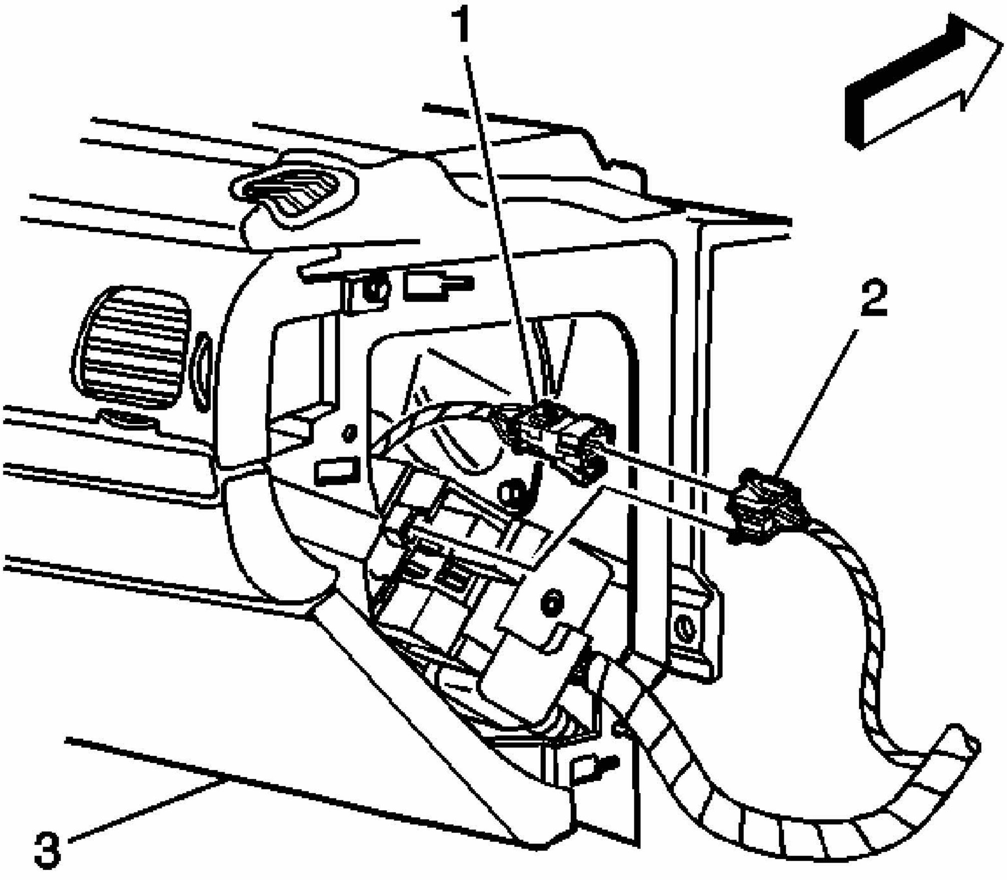


Fig. 188: Identifying I/P Module Connector To Vehicle Harness Connector
Courtesy of GENERAL MOTORS CORP.

46. Disconnect the I/P module yellow harness connector (1) from the vehicle harness connector (2).

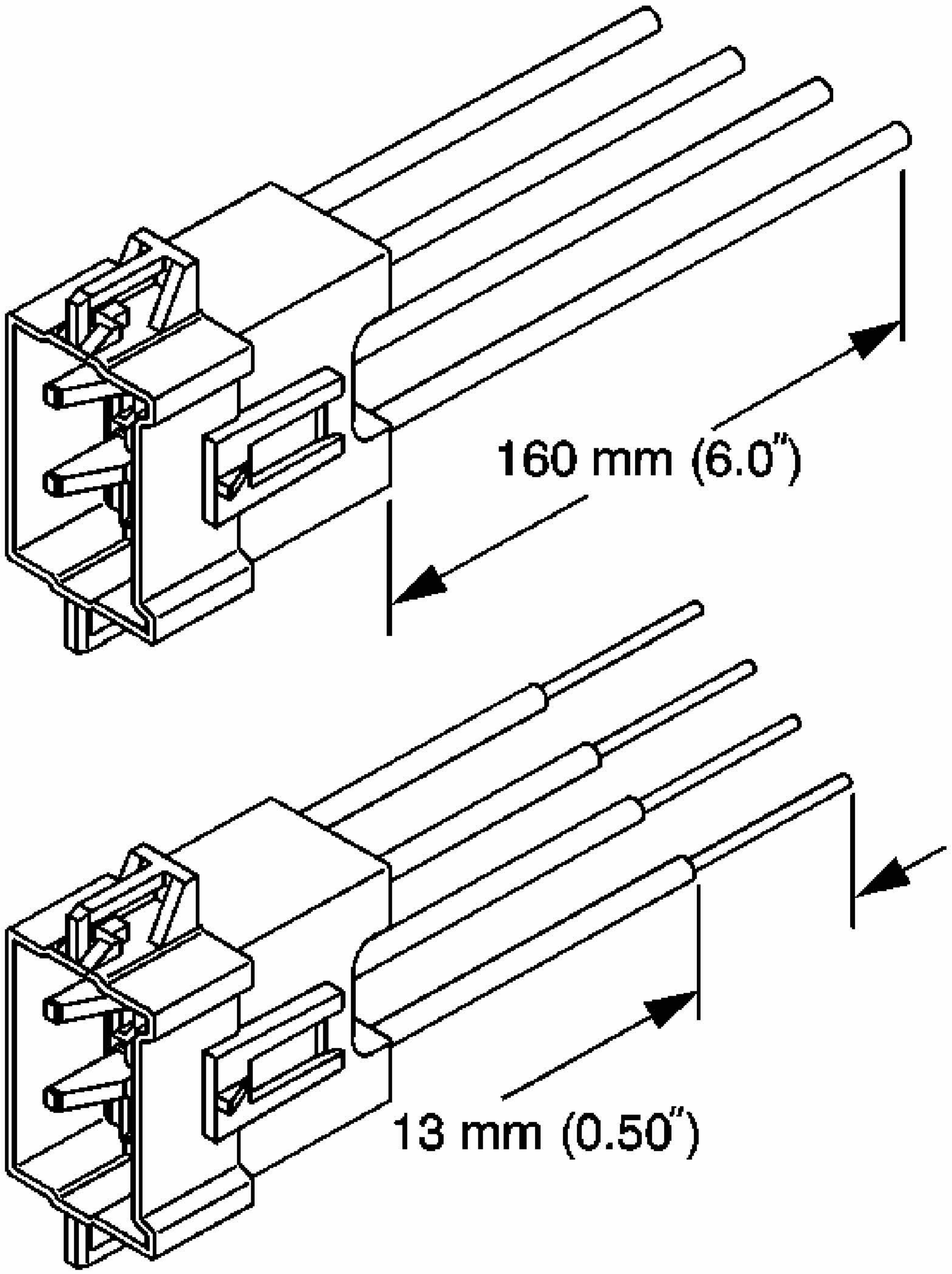


Fig. 189: Stripping SIR Wires
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: This vehicle is equipped with dual stage air bags, the I/P module will have 4 wires. Refer to SIR Connector End

Views for determining high and low circuits.

47. Cut the yellow harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
48. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.

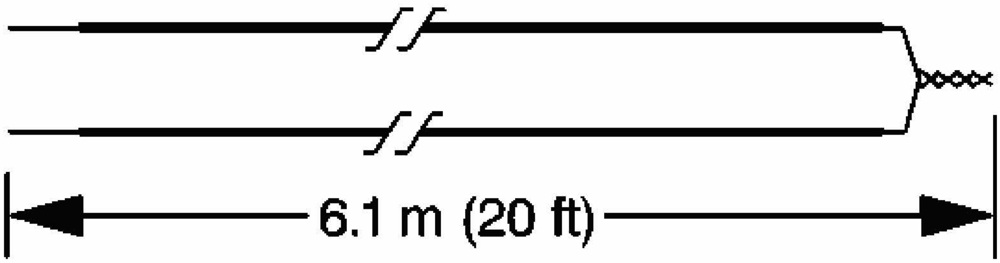


Fig. 190: Fabricating 20 Ft. Deployment Harness
Courtesy of GENERAL MOTORS CORP.

49. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gage) or thicker multi-strand wire. These wires will be used to fabricate the I/P module deployment harness.
50. Strip 13 mm (0.5 in) of insulation from both ends of the wires cut in the previous step.
51. Twist together one end from each of the wires in order to short the wires.

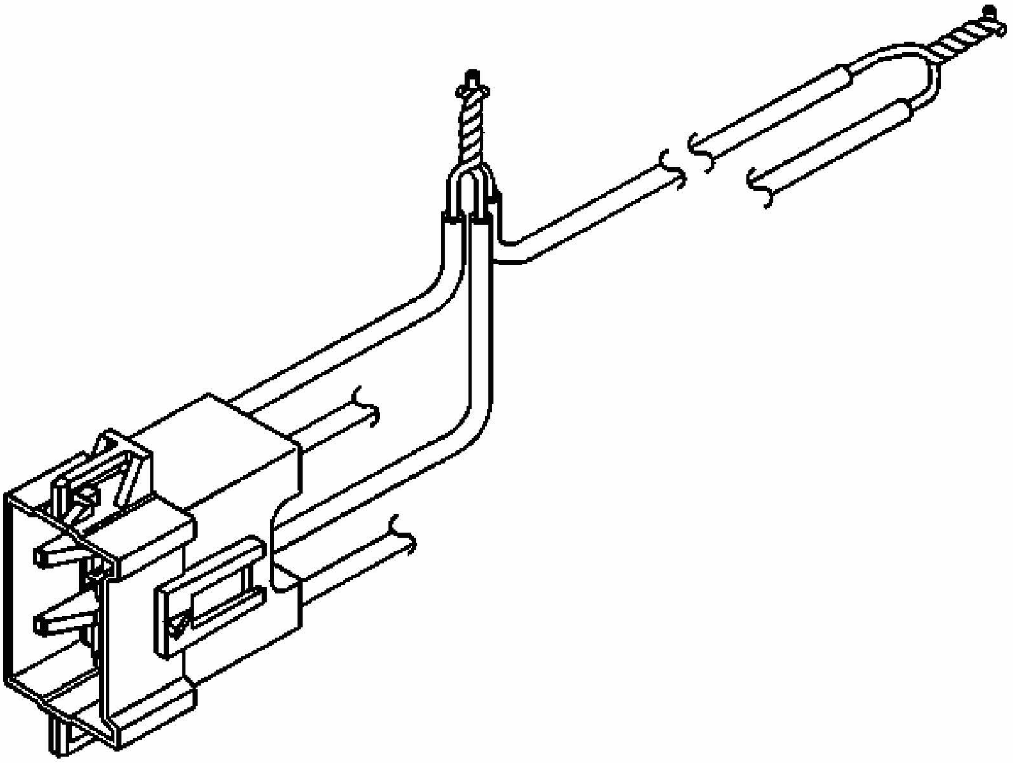


Fig. 191: Twisting Connector Wire Leads (High Circuits) To Deployment Harness Wire
Courtesy of GENERAL MOTORS CORP.

52. Twist together 2 connector wire leads (the high circuits from both stages of the steering wheel module) to one sets of deployment wires. Refer to **SIR Connector End Views** in order to determine the correct circuits.
53. Inspect that the 3 wire connection is secure.

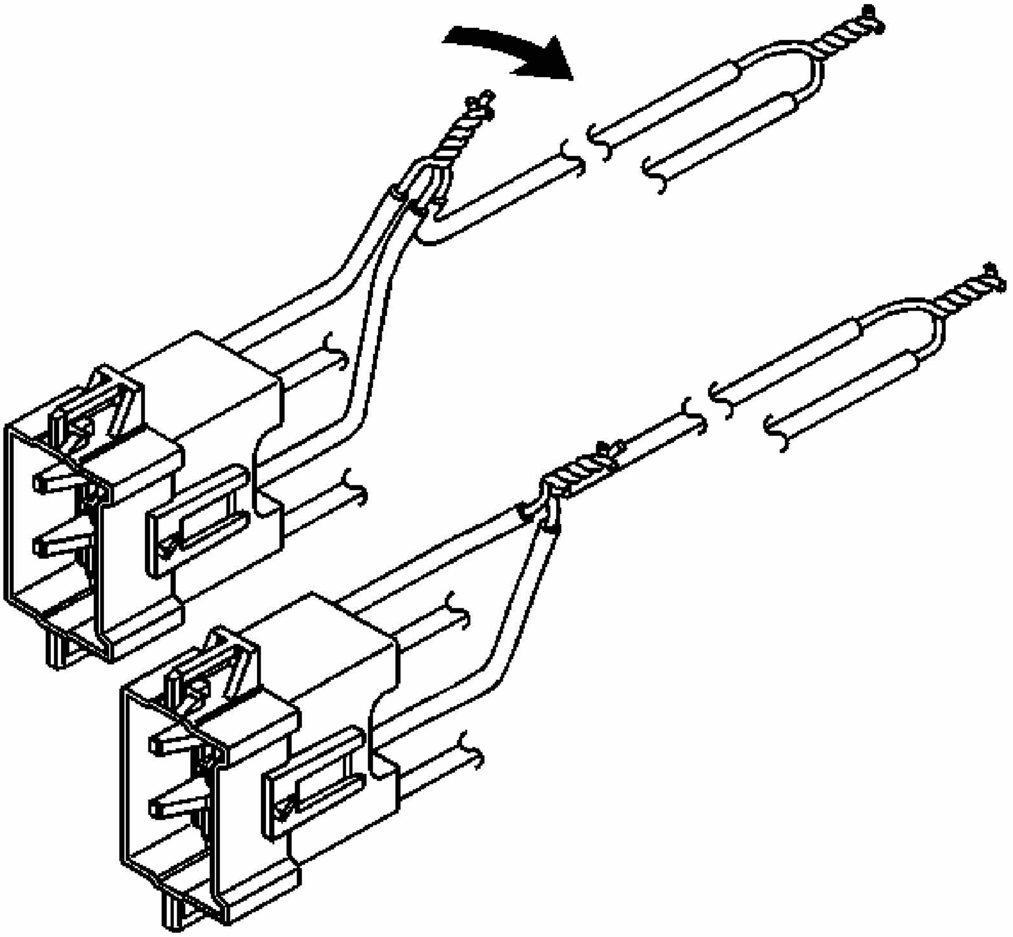


Fig. 192: Bending Twisted Connection Flat
Courtesy of GENERAL MOTORS CORP.

54. Bend flat the twisted connection.

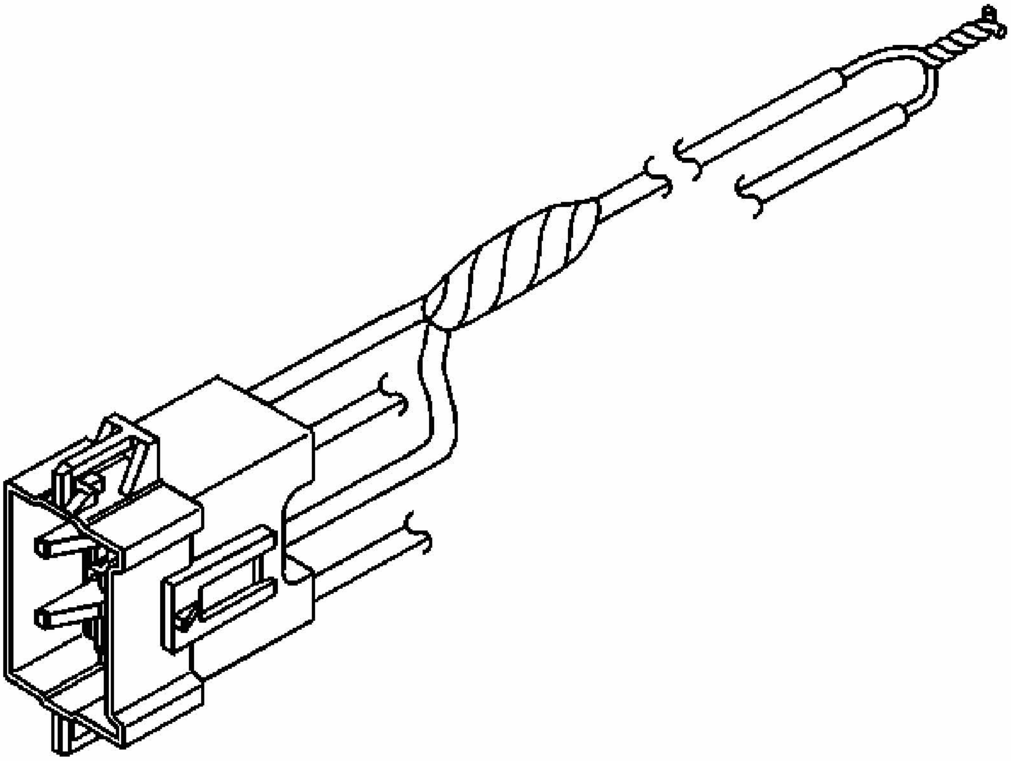


Fig. 193: Insulating Connection With Electrical Tape
Courtesy of GENERAL MOTORS CORP.

55. Secure and insulate the 3 wire connection to deployment harness using electrical tape.

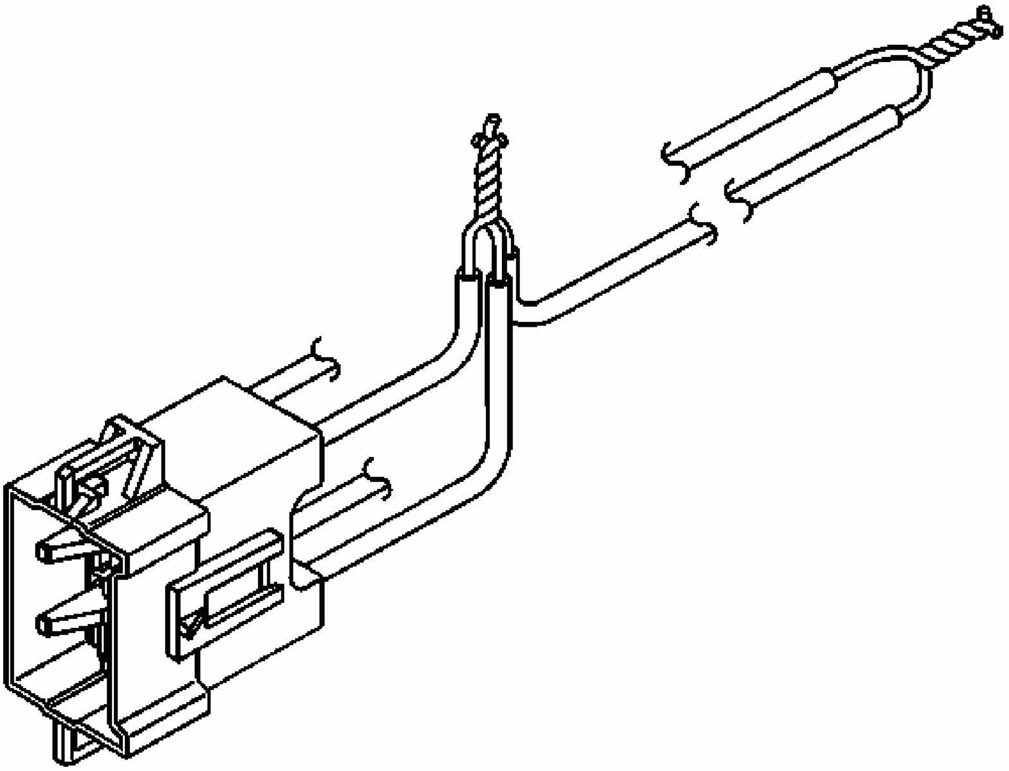


Fig. 194: Twisting Connector Wire Leads (Low Circuits) To Deployment Harness Wire
Courtesy of GENERAL MOTORS CORP.

56. Twist together 2 connector wire leads (the low circuits from both stages of the steering wheel module) to one sets of deployment wires. Refer to **SIR Connector End Views** in order to determine the correct circuits.
57. Inspect that the 3 wire connection is secure.

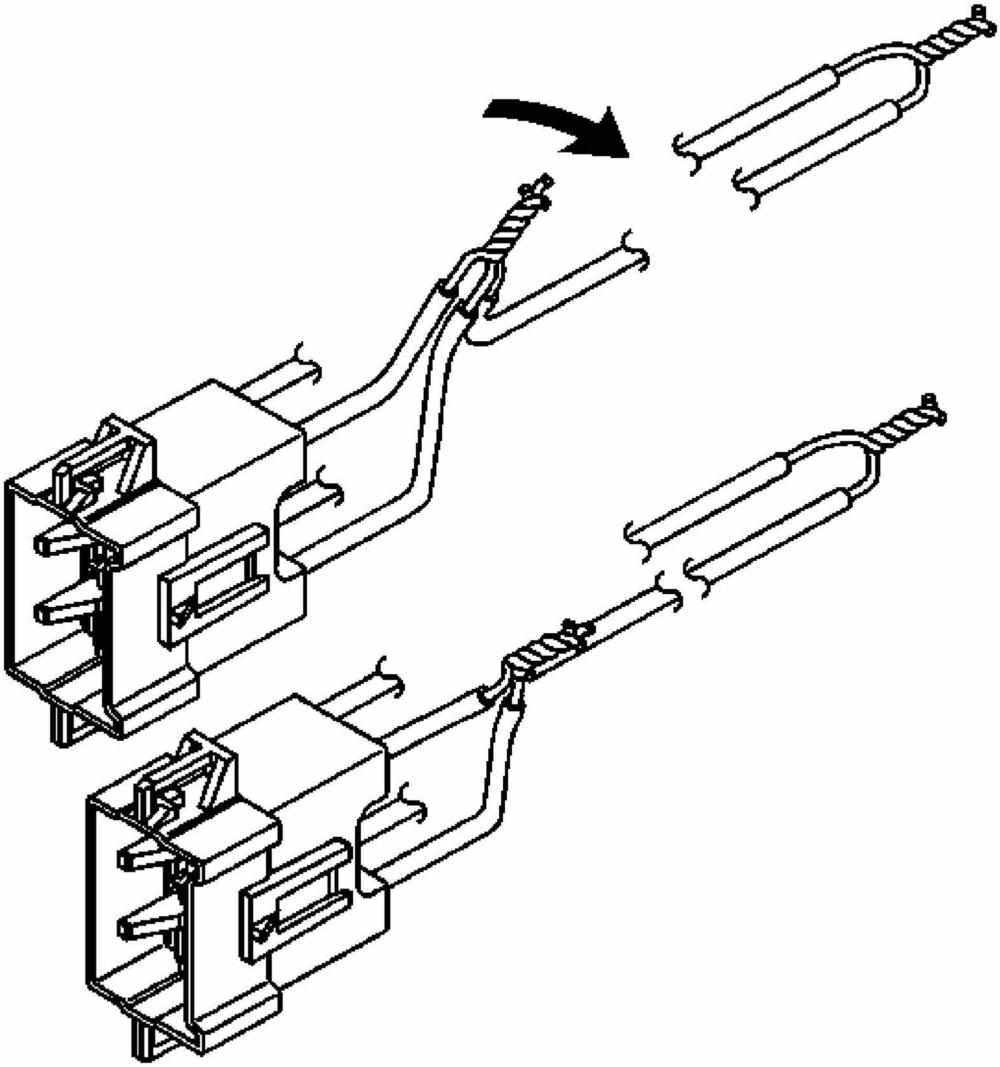


Fig. 195: Bending Twisted Connection Flat
Courtesy of GENERAL MOTORS CORP.

58. Bend flat the twisted connection.

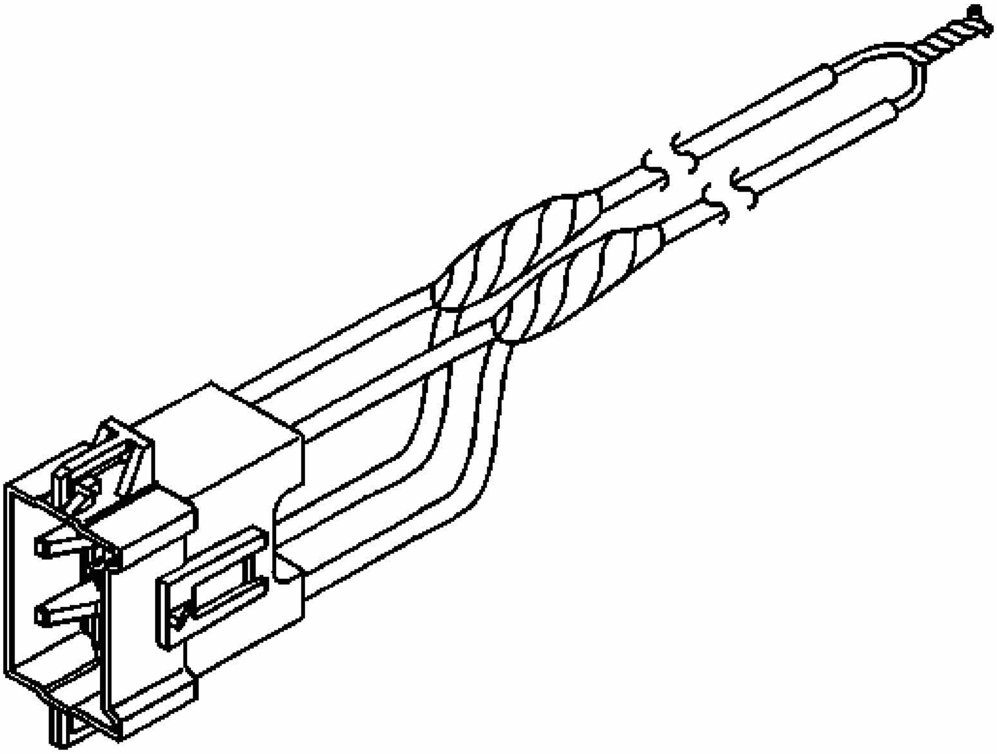


Fig. 196: Insulating Connection With Electrical Tape
Courtesy of GENERAL MOTORS CORP.

59. Secure and insulate the 3 wire connection to deployment harness using electrical tape.
60. Connect the deployment harness to the I/P module in-line connector.

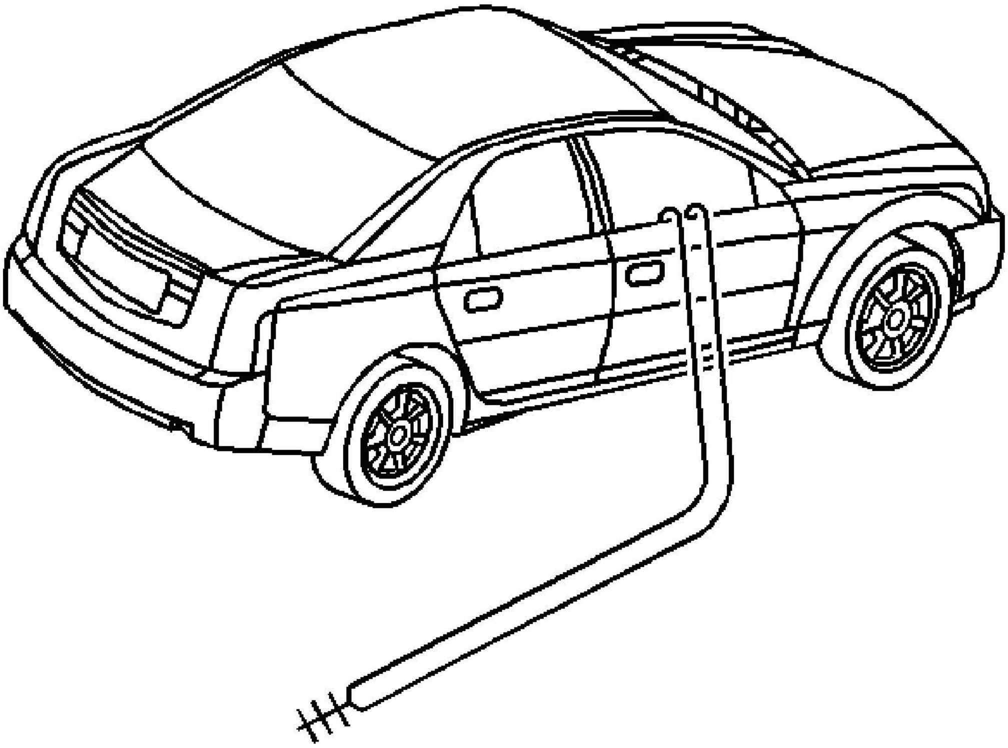


Fig. 197: Routing Deployment Harness Out Of The Passenger Side Of Vehicle
Courtesy of GENERAL MOTORS CORP.

61. Route the deployment harness out of the passenger side of the vehicle.

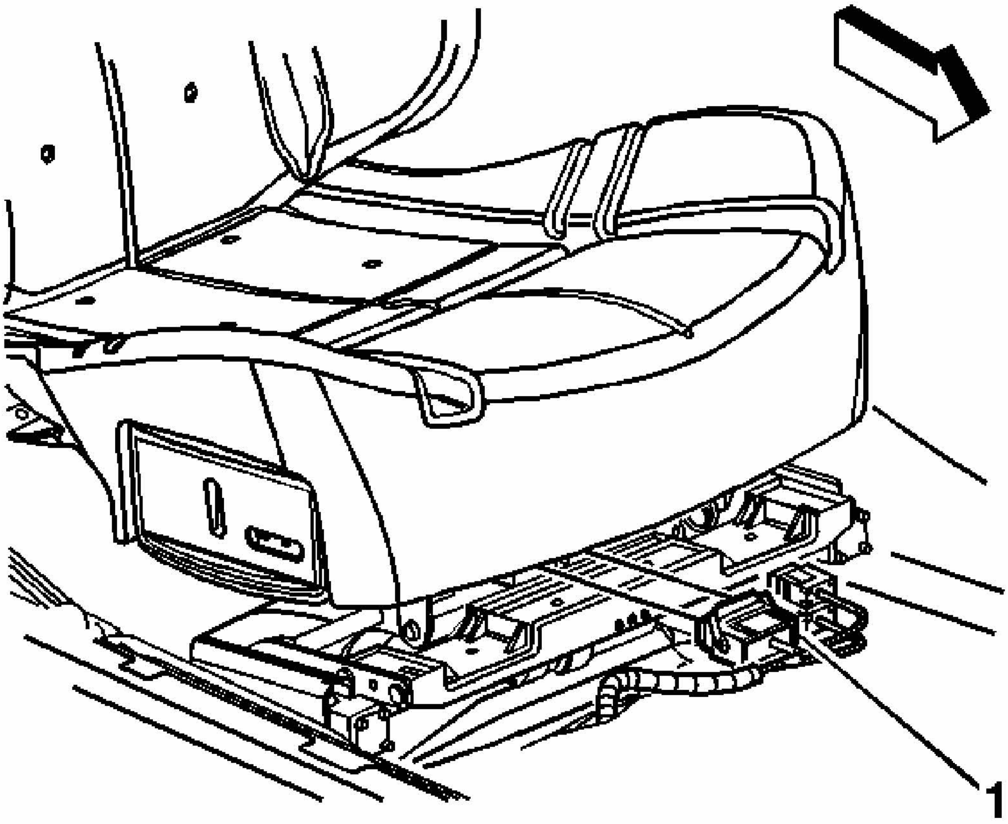


Fig. 198: Locating Side Impact Module & Pretensioner Yellow Connector
Courtesy of GENERAL MOTORS CORP.

62. For Monte Carlo, disconnect the passenger side air bag yellow connector (1) from the vehicle wiring harness located under the front of passenger seat.

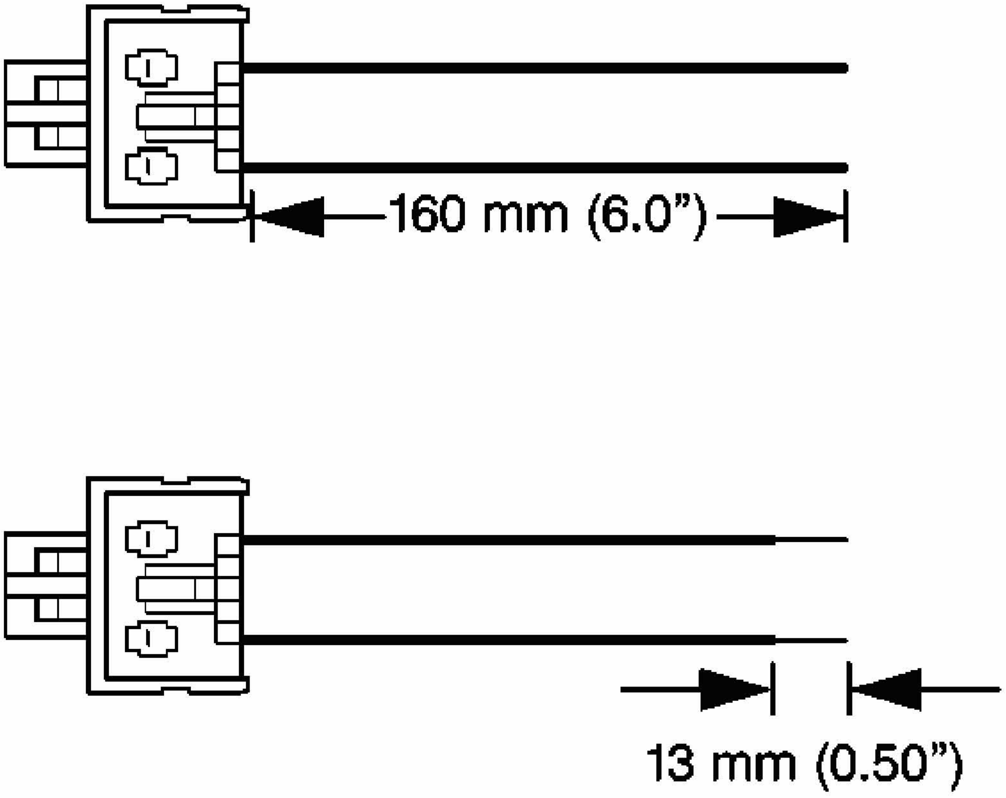


Fig. 199: Identifying Proper Stripping Of Connection Wire Leads
Courtesy of GENERAL MOTORS CORP.

63. Cut the harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
64. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.

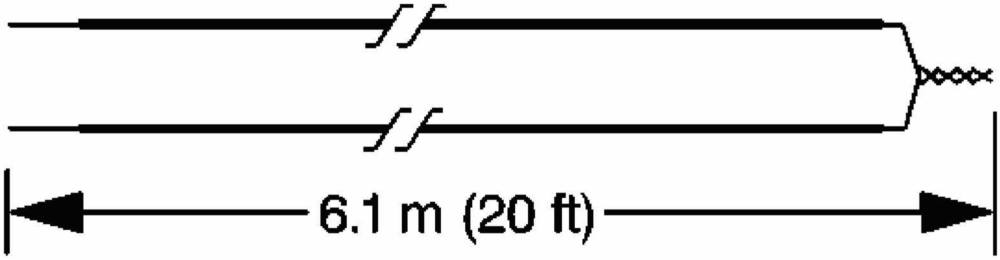


Fig. 200: Fabricating 20 Ft. Deployment Harness
Courtesy of GENERAL MOTORS CORP.

65. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gage) or thicker multi-strand wire. These wires will be used to fabricate the side air bag deployment harness.
66. Strip 13 mm (0.5 in) of insulation from both ends of the wires cut in the previous step.
67. Twist together one end from each of the wires in order to short the wires.

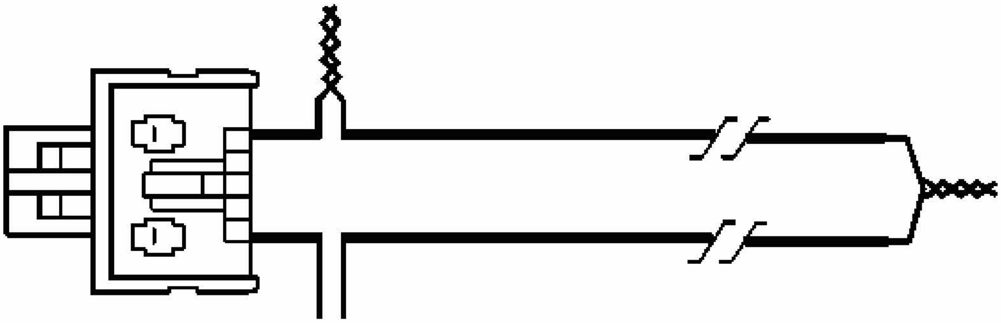


Fig. 201: View Of Proper Twisting Of Connector Wire Lead To Deployment Wire
Courtesy of GENERAL MOTORS CORP.

68. Twist together one connector wire lead to one deployment wire.

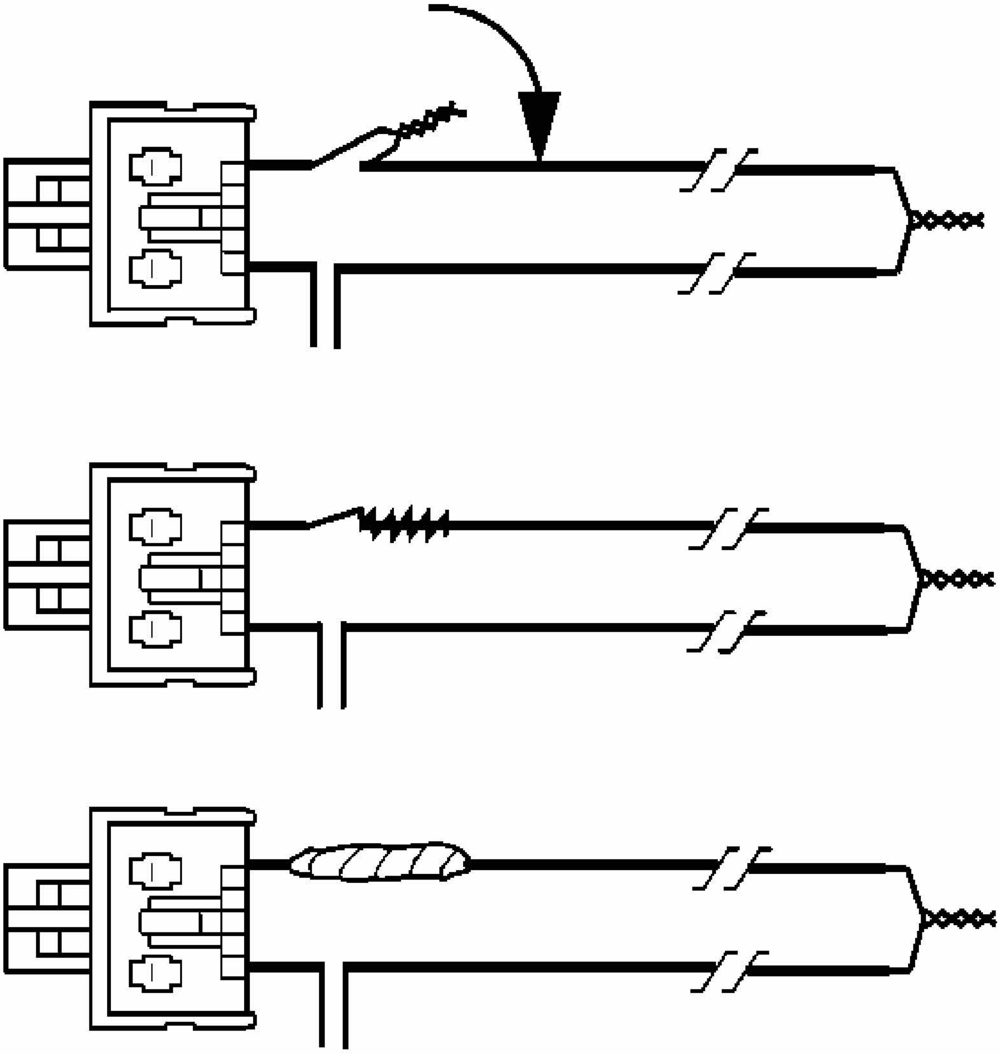


Fig. 202: Bending Twisted Connection Flat & Insulating With Tape
Courtesy of GENERAL MOTORS CORP.

69. Bend flat the twisted connection.
70. Secure and insulate the connection using electrical tape.

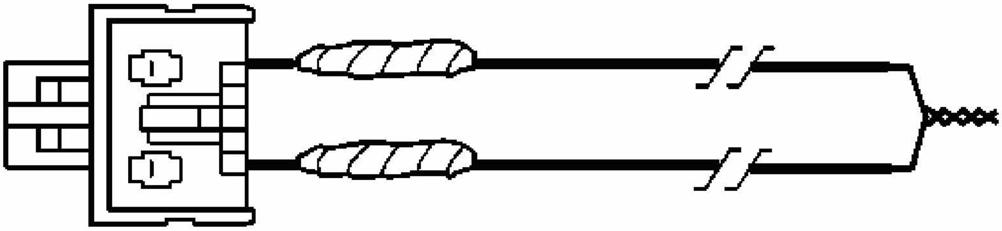


Fig. 203: Taping Remaining Connector Wire Lead To Remaining Deployment Wire
Courtesy of GENERAL MOTORS CORP.

71. Twist together, bend, and tape the remaining connector wire lead to the remaining deployment wire.
72. Connect the deployment harness to the side air bag yellow connector.

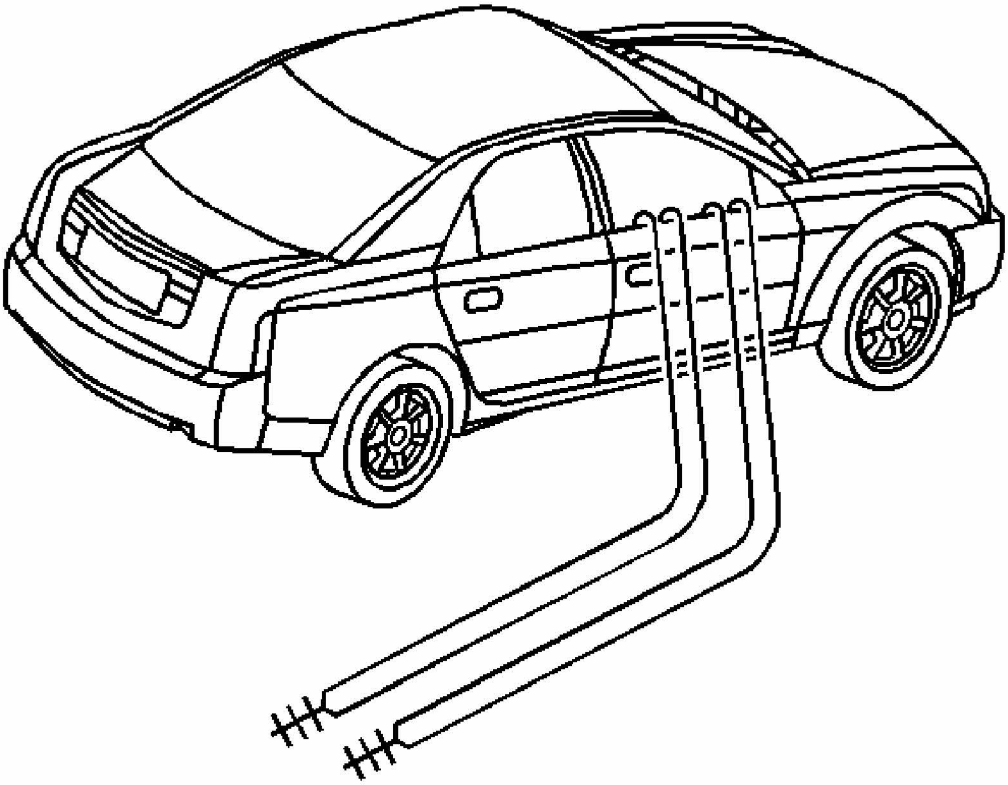


Fig. 204: Routing Deployment Harness Out Of Passenger Side Of Vehicle
Courtesy of GENERAL MOTORS CORP.

73. Route the deployment harness out of the passenger side of the vehicle.

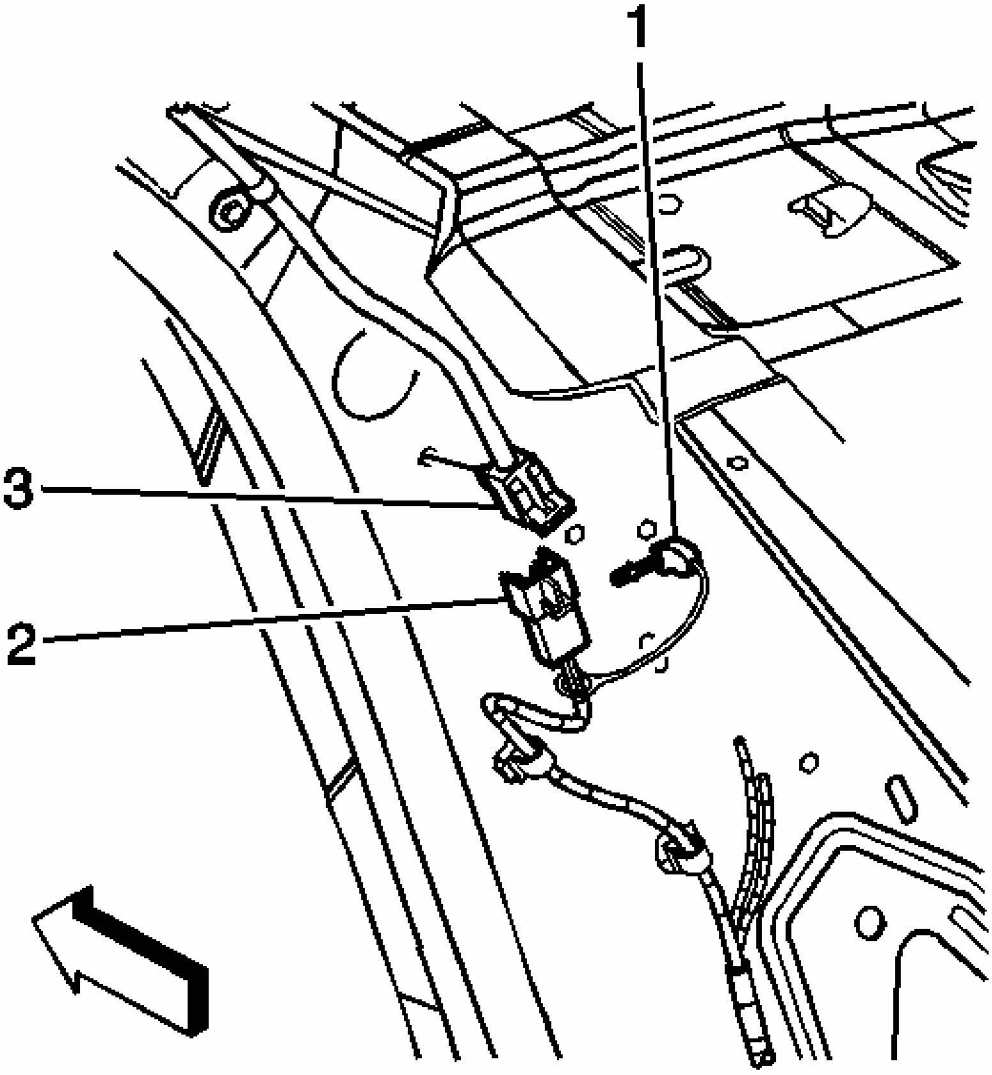


Fig. 205: CPA, Right Roof Rail Module Yellow Connector & Vehicle Harness Yellow Connector
Courtesy of GENERAL MOTORS CORP.

74. For Impala, disconnect the right/passenger roof rail air bag yellow harness connector (3) from the vehicle harness connector (2).

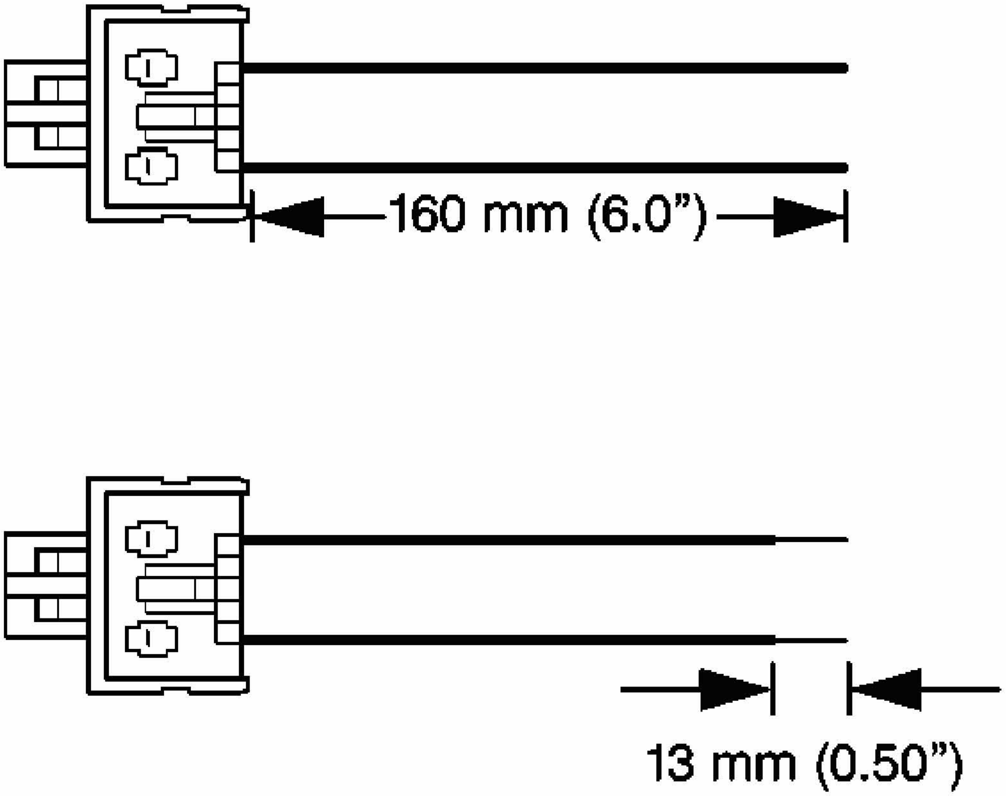


Fig. 206: Identifying Proper Stripping Of Connection Wire Leads
Courtesy of GENERAL MOTORS CORP.

75. Cut the harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
76. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.

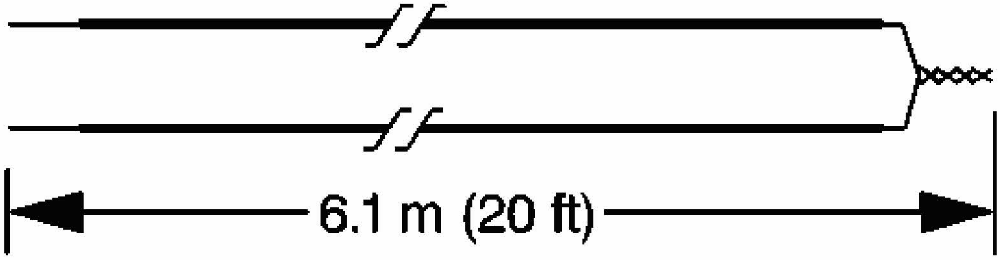


Fig. 207: Fabricating 20 Ft. Deployment Harness
Courtesy of GENERAL MOTORS CORP.

77. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gage) or thicker multi-strand wire. These wires will be used to fabricate the roof rail air bag deployment harness.
78. Strip 13 mm (0.5 in) of insulation from both ends of the wires cut in the previous step.
79. Twist together one end from each of the wires in order to short the wires.

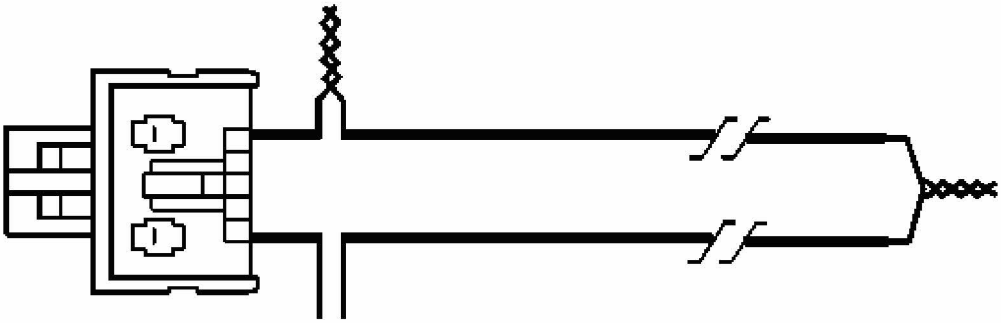


Fig. 208: View Of Proper Twisting Of Connector Wire Lead To Deployment Wire
Courtesy of GENERAL MOTORS CORP.

80. Twist together one connector wire lead to one deployment wire.

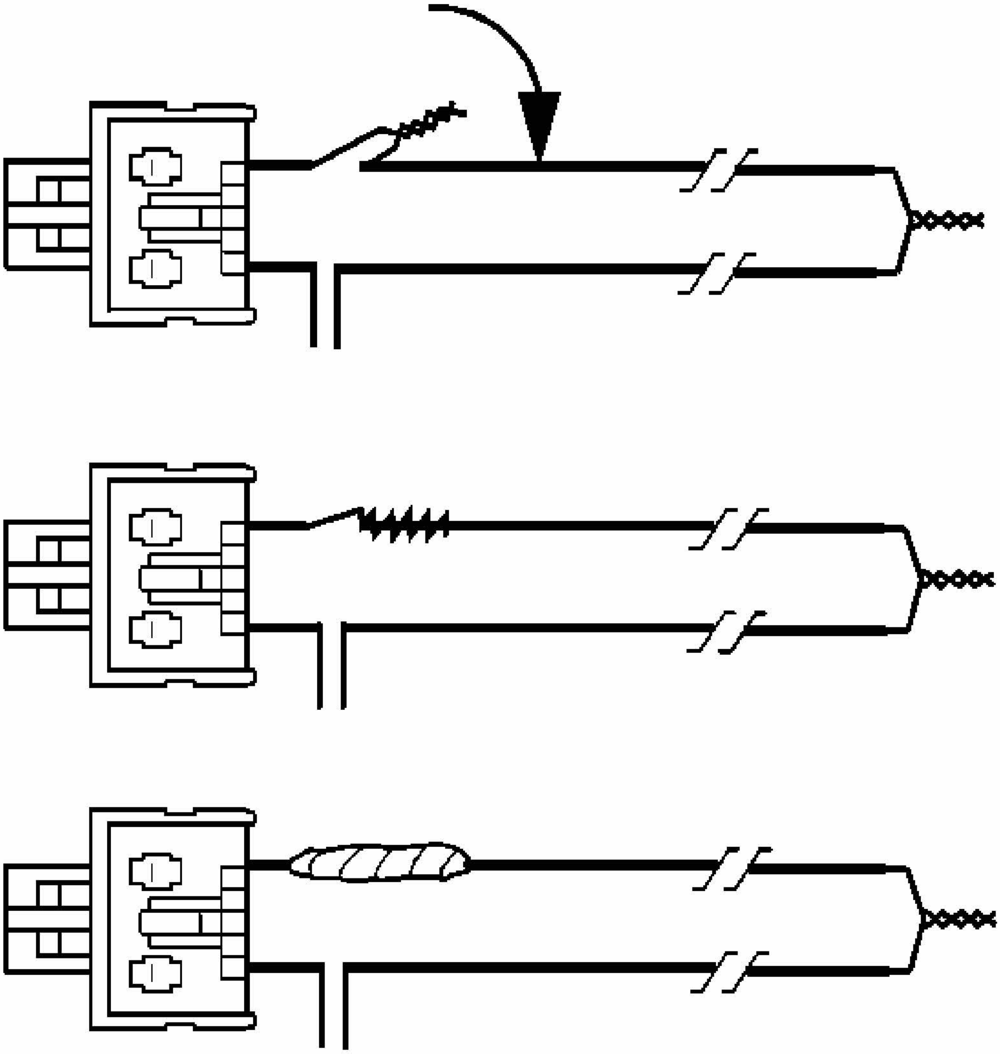


Fig. 209: Bending Twisted Connection Flat & Insulating With Tape
Courtesy of GENERAL MOTORS CORP.

81. Bend flat the twisted connection.
82. Secure and insulate the connection using electrical tape.

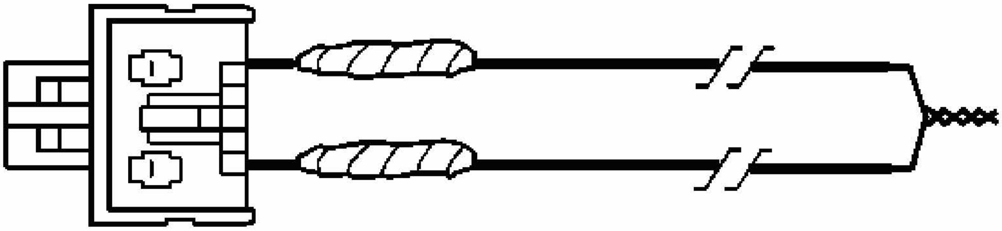


Fig. 210: Taping Remaining Connector Wire Lead To Remaining Deployment Wire
Courtesy of GENERAL MOTORS CORP.

83. Twist together, bend, and tape the remaining connector wire lead to the remaining deployment wire.
84. Connect the deployment harness to the roof rail air bag yellow connector.

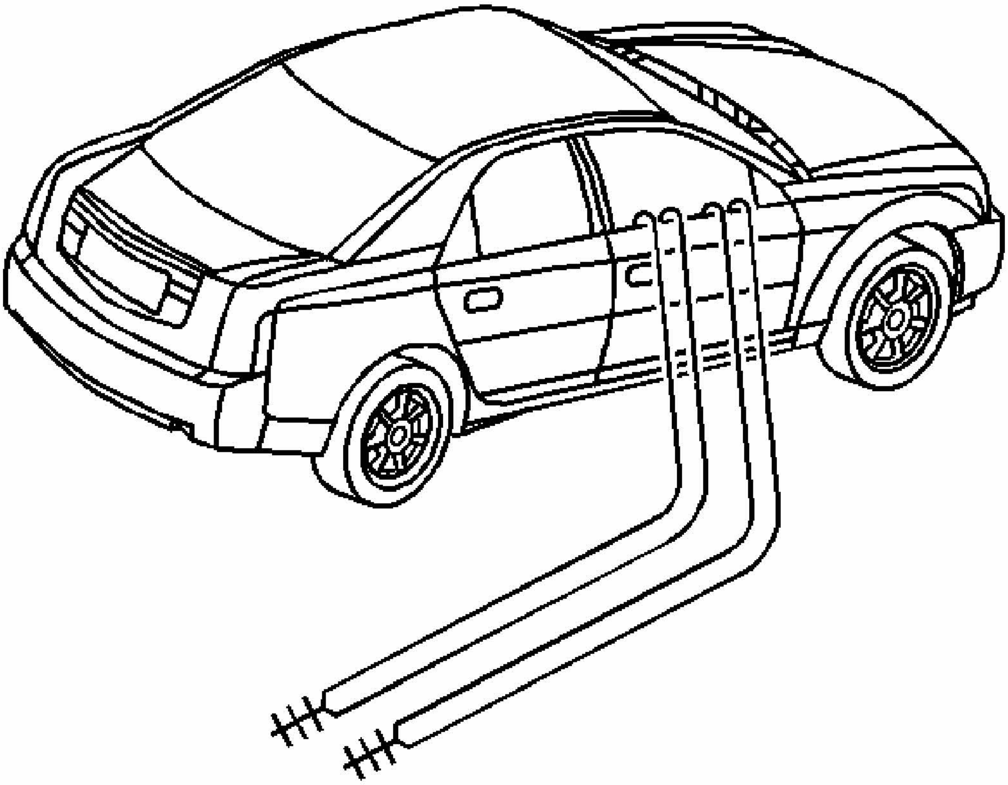


Fig. 211: Routing Deployment Harness Out Of Passenger Side Of Vehicle
Courtesy of GENERAL MOTORS CORP.

85. Route the deployment harness out of the passenger side of the vehicle.

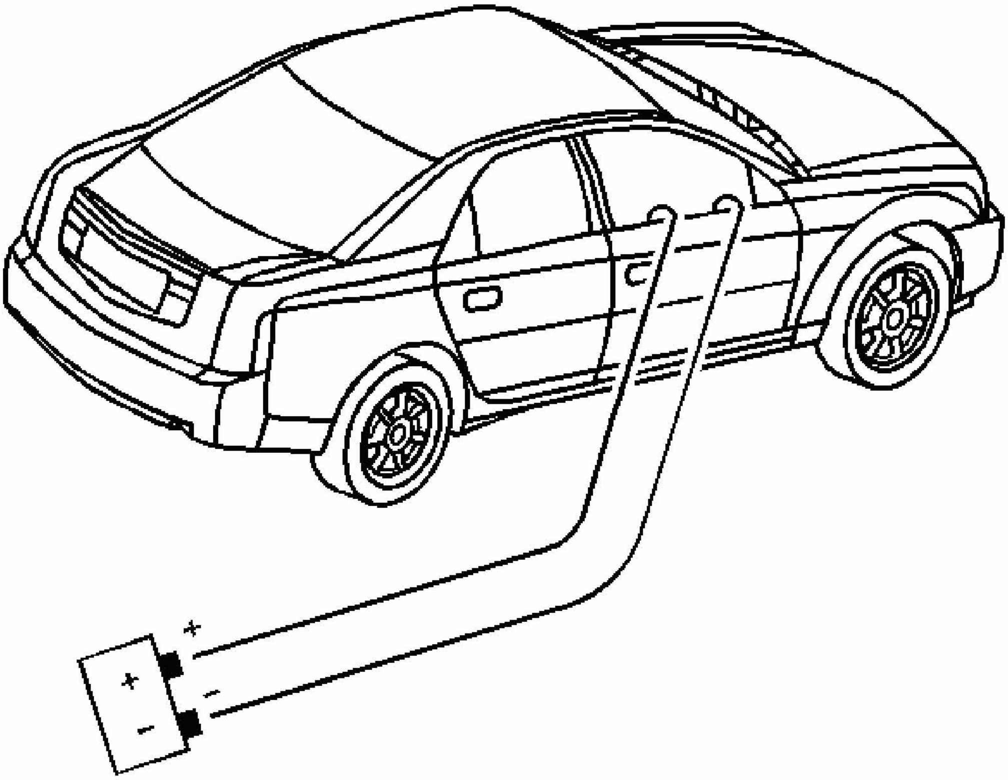


Fig. 212: Placing A Power Source Near Shorted End Of Harnesses
Courtesy of GENERAL MOTORS CORP.

86. Completely cover the windshield and front door window openings with a drop cloth.
87. Stretch out all of the deployment harness wires on the right side of the vehicle to their full length.
88. Deploy each deployment loop one at a time.
89. Place a power source, 12 V minimum/2 A minimum (i.e., a vehicle battery) near the shorted end of the harnesses.
90. Separate the one set of wires and touch the wires ends to the power source in order to deploy the inflator modules, doing one module at a time.
91. Disconnect the deployment harness from the power source and twist the wire ends together.
92. Continue the same process with the remaining deployment harnesses that are available.

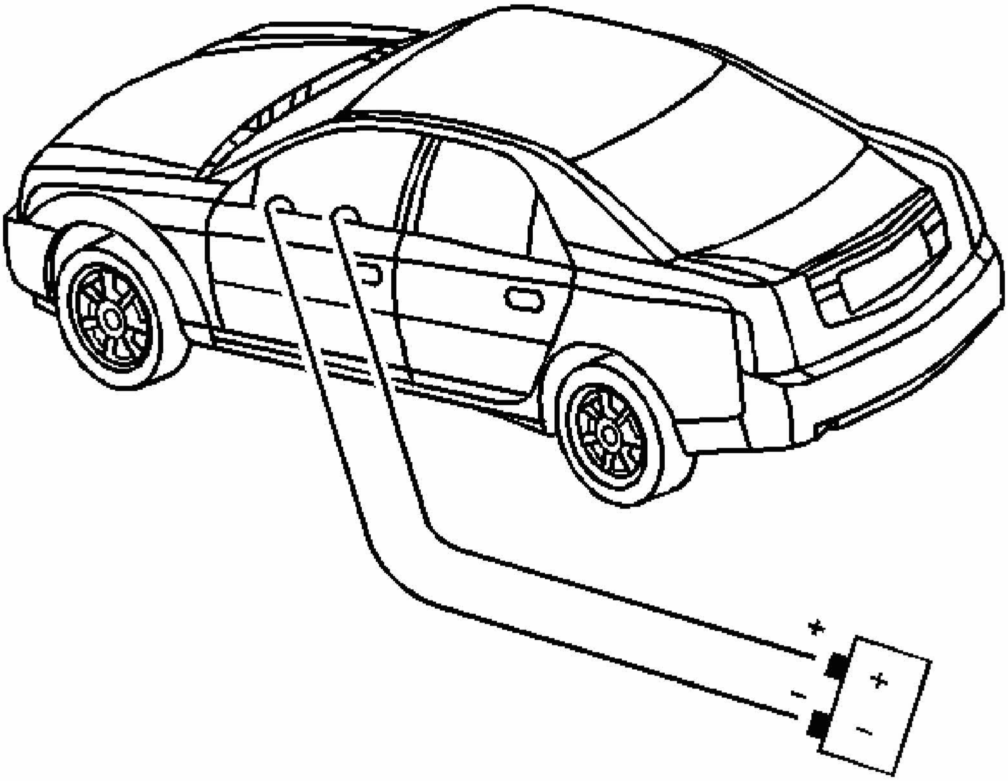


Fig. 213: Placing Power Source, 12 V minimum/2 A minimum Near Shorted End Of Harnesses
Courtesy of GENERAL MOTORS CORP.

93. Stretch out all of the deployment harness wires on the left side of the vehicle to their full length.
94. Deploy each deployment loop one at a time.
95. Place a power source, 12 V minimum/2 A minimum (i.e., a vehicle battery) near the shorted end of the harnesses.
96. Separate the one set of wires and touch the wires ends to the power source in order to deploy the inflator modules, doing one module at a time.
97. Disconnect the deployment harness from the power source and twist the wire ends together.
98. Continue the same process with the remaining deployment harnesses that are available.
99. Remove the drop cloth from the vehicle.
100. Disconnect all harnesses from the vehicle.
101. Discard the harnesses.

102. Scrap the vehicle in the same manner as a non-SIR equipped vehicle.
103. If one or all of the inflator modules did not deploy, perform the following steps to remove the undeployed modules from the vehicle and deploy separately:
    - **Inflatable Restraint Steering Wheel Module Replacement**
    - **Inflatable Restraint Instrument Panel Module Replacement**
    - **Inflatable Restraint Side Impact Module Replacement - Front (Monte Carlo)**
    - **Inflatable Restraint Roof Rail Module Replacement**

PRETENSIONER HANDLING AND SCRAPPING

CAUTION: When carrying an undeployed inflatable restraint seat belt retractor pretensioner:

- **Do not carry the seat belt pretensioner by the seat belt webbing or pigtail connector, if equipped.**
- **Carry the seat belt pretensioner by the housing, keeping hands and fingers away from the seat belt webbing.**
- **Make sure the opening, from which the seat belt webbing extends, faces downward and the seat belt webbing hangs freely.**

Failure to observe these guidelines may result in personal injury.

Scrapping Procedure

During the course of a vehicles useful life, certain situations may arise which will require the disposal of a live and undeployed seat belt retractor pretensioner. Do not dispose of a live and undeployed seat belt pretensioner through normal disposal channels until the seat belt pretensioner has been deployed. The following information covers the proper procedures for disposing of a live and undeployed seat belt pretensioner. Do not deploy the seat belt retractor pretensioner in the following situations:

- After replacement of a seat belt retractor pretensioner under warranty. The seat belt retractor pretensioner may need to be returned undeployed to the manufacturer.
- If the vehicle is the subject of a Product Liability report, GM1241, related to the SIR system or the seat belt system. If the vehicle is subject to the Product Liability report, do not alter the SIR or seat belt system in any manner.
- If the vehicle is involved in a campaign affecting the seat belt retractor pretensioners. Follow the instructions in the Campaign Service Bulletin for proper SIR handling

procedures.

Deployment Procedures

The seat belt pretensioner can be deployed inside or outside of the vehicle. The method used depends upon the final disposition of the vehicle. Review the following procedures in order to determine which will work best in a given situation.

Deployment Inside the Vehicle

Refer to **Inflator Module Handling and Scrapping** for deploying the pretensioner inside vehicle under Vehicle Scrapping Procedure.

Deployment Outside Vehicle for Seat Belt Pretensioners

Deploy the seat belt pretensioners outside of the vehicle when the vehicle will be returned to service. Situations that require deployment outside of the vehicle include the following:

- Using the SIR diagnostics, it is determined that the seat belt pretensioner is malfunctioning.
- The seat belt pretensioner pigtail, if equipped, is damaged.
- The seat belt retractor pretensioner connector is damaged.
- The seat belt retractor pretensioner connector terminals are damaged.

Deployment and disposal of a malfunctioning seat belt pretensioner is subject to any required retention period.

CAUTION: In order to prevent accidental deployment and the risk of personal injury, do not dispose of an undeployed inflatable restraint seat belt pretensioner as normal shop waste. Undeployed seat belt pretensioners contain substances that could cause severe illness or personal injury if their sealed containers are damaged during disposal. Use the following deployment procedures to safely dispose of an undeployed seat belt pretensioner. Failure to observe the following disposal methods may be a violation of federal, state, or local laws.

Tools Required

- **J 38826** SIR Deployment Harness. See **Special Tools**.
- **J 38826-25** for seat belt pretensioner module adapter. See **Special Tools**.
- **J 39401-B** SIR Deployment Fixture. See **Special Tools**.
- An appropriate pigtail adaptor

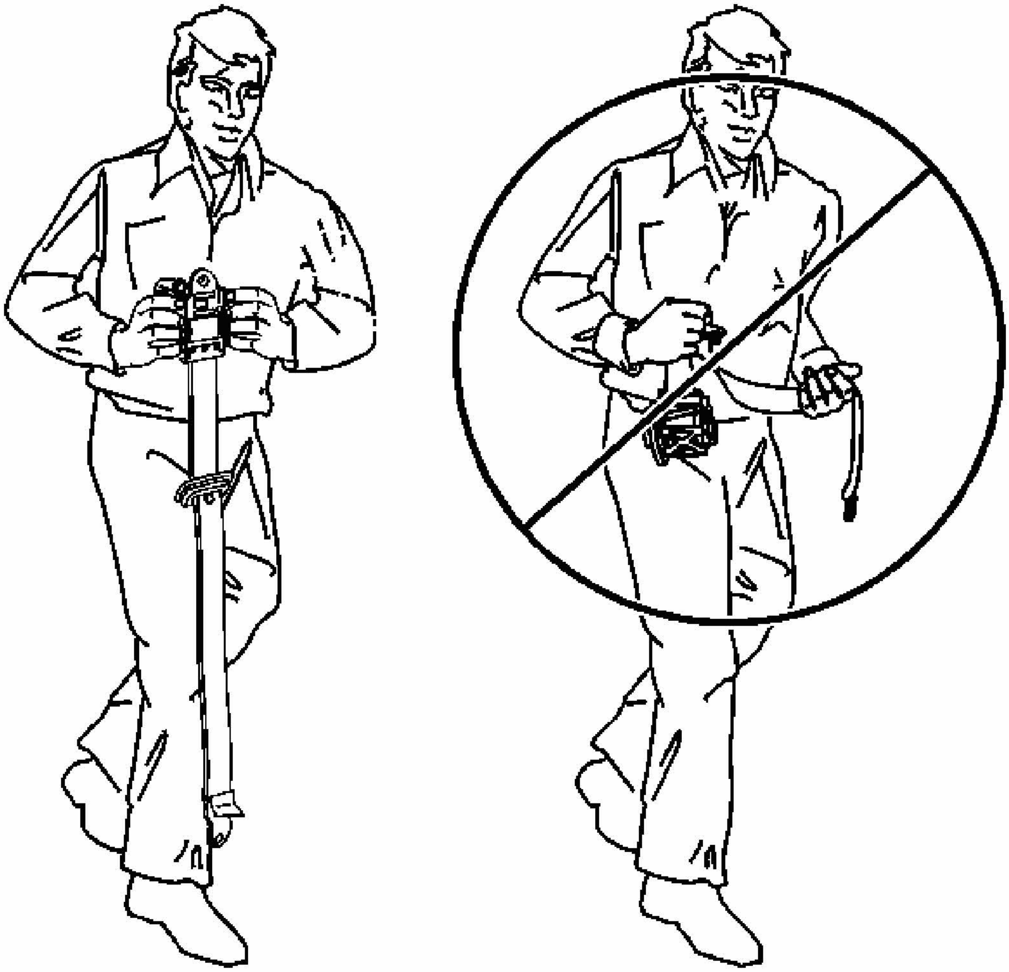


Fig. 214: Proper Transportation of Seat Belt Pretensioner
Courtesy of GENERAL MOTORS CORP.

1. Turn OFF the ignition.
2. Remove the ignition key.
3. Put on safety glasses.
4. Remove the seat belt retractor pretensioner from the vehicle. Refer to **Seat Belt Retractor Pretensioner Replacement - Front**.
5. When carrying a seat belt retractor pretensioner to the deployment area, keep fingers clear of the seat belt webbing.

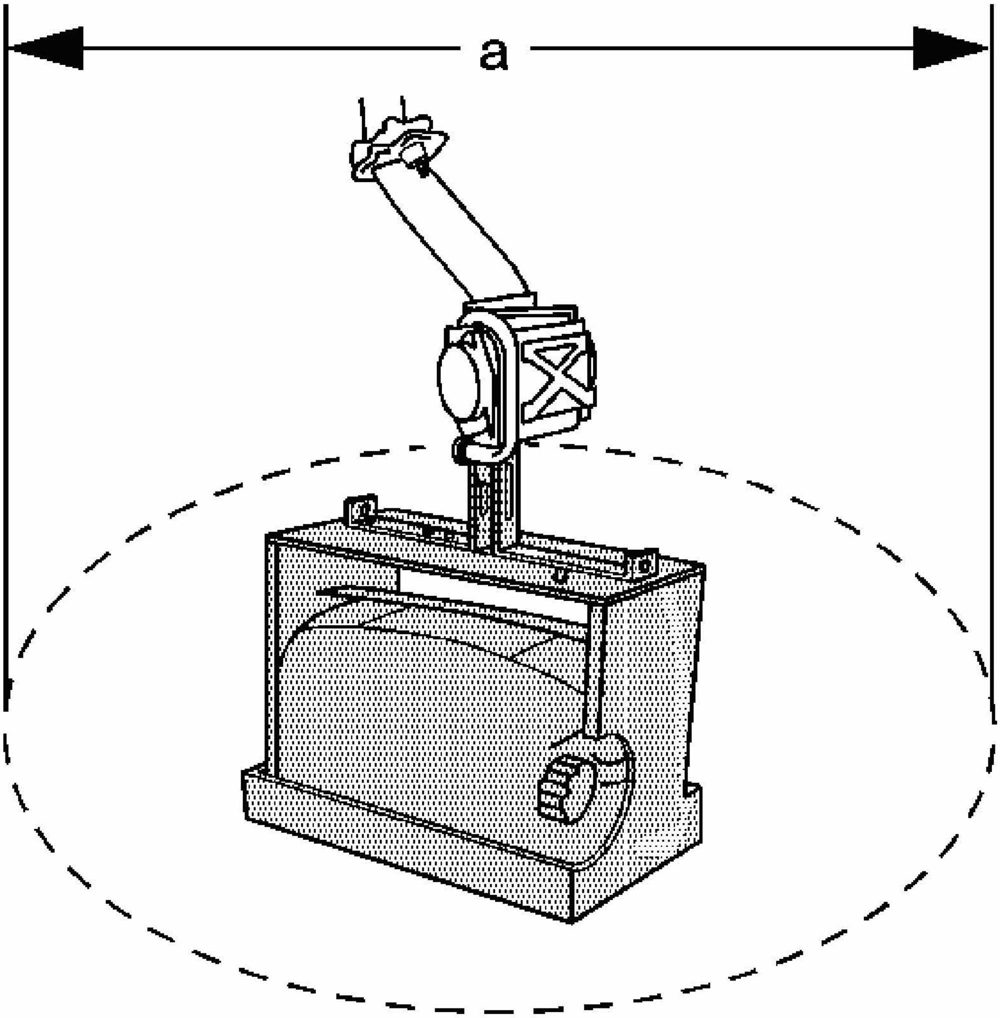


Fig. 215: Illustrating Proper Space For Deployment Of Pretensioner
Courtesy of GENERAL MOTORS CORP.

6. Clear a space on the ground about 1.85 m (6 ft) in diameter for deployment of the seat belt pretensioner. If possible, use a paved, outdoor location free of activity. Otherwise, use a space free of activity on the shop floor. Make sure you have sufficient ventilation.
7. Make sure no loose or flammable objects are in the area.
8. Place the **J 39401-B** in the center of the cleared area. See **Special Tools**.
9. Fill the fixture plastic reservoir with water or sand.

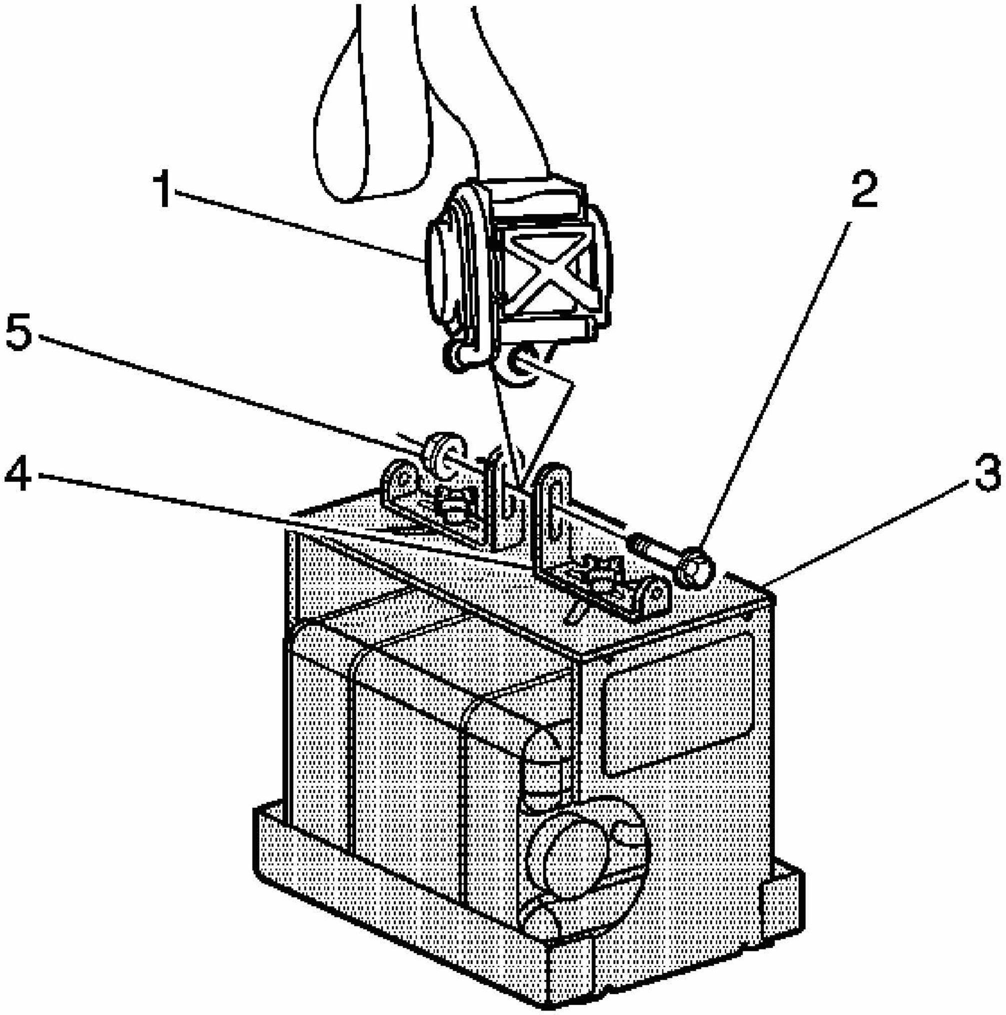


Fig. 216: Seat Belt Pretensioner And SIR Deployment Fixture
Courtesy of GENERAL MOTORS CORP.

10. Mount the seat belt pretensioner in the SIR deployment fixture with the seat belt webbing exiting through the top of the pretensioner. Use the following mounting method.
    - Adjust and secure two of the **J 39401-B** arms to the deployment fixture, with the short slotted portions of the arms standing vertically and facing toward the center of the deployment fixture. See **Special Tools**.
    - To mount, use the proper size bolt and nut with washers in order to secure the seat belt pretensioner mounting hole between the two deployment fixture brackets.
    - Securely tighten all fasteners prior to deployment.

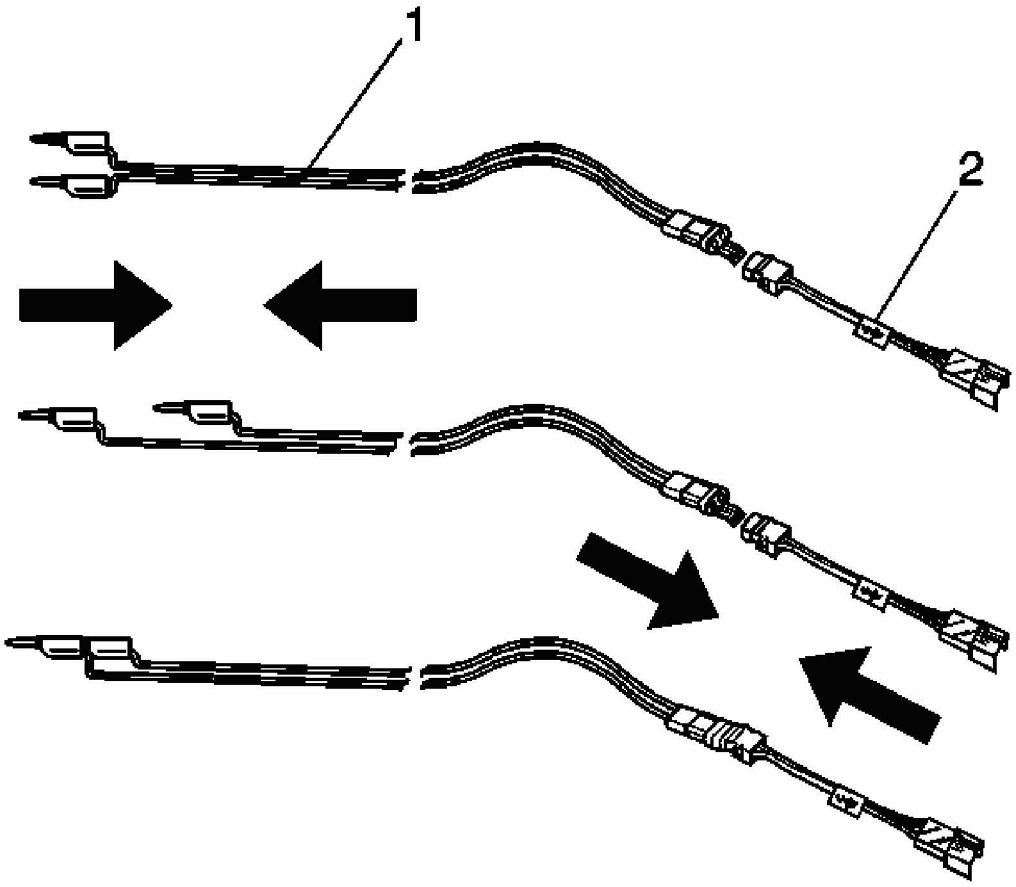


Fig. 217: Identifying SIR Deployment Harness & Adapter
Courtesy of GENERAL MOTORS CORP.

11. Inspect the **J 38826** and the appropriate pigtail adapter for damage. See **Special Tools**. Replace as needed.
12. Short the 2 SIR deployment harness (1) leads together using 1 banana plug seated into the other.

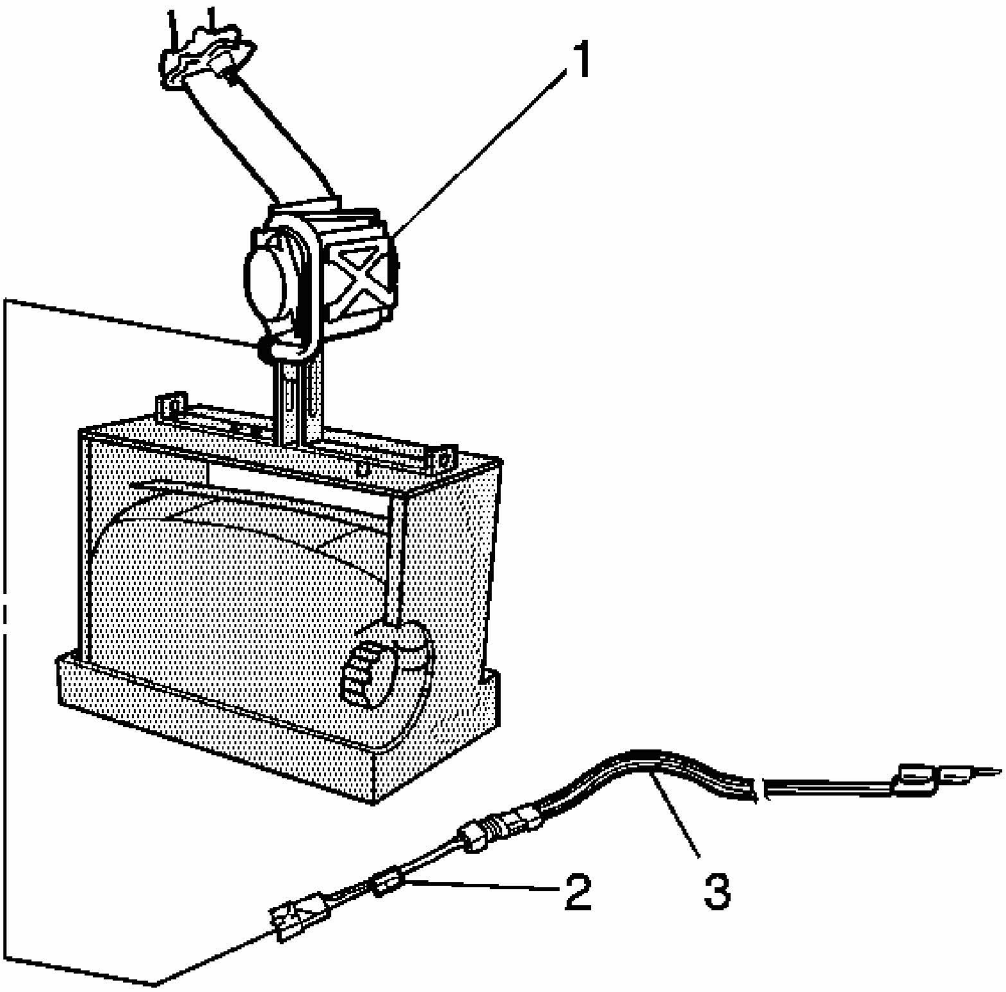


Fig. 218: Identifying Seat Belt Pretensioner Connector, Adapter & Deployment Harness
Courtesy of GENERAL MOTORS CORP.

13. Connect the appropriate pigtail adapter (2) to the SIR deployment harness (1).
14. Extend the SIR deployment harness and adapter to full length from the deployment fixture.
15. Connect the seat belt pretensioner connector to the adapter on the deployment harness.

IMPORTANT: When deploying a seat belt retractor pretensioner, the rapid expansion of gas is very loud. Notify the people in the immediate area that a seat belt pretensioner will be deployed.

16. Clear the area of people.

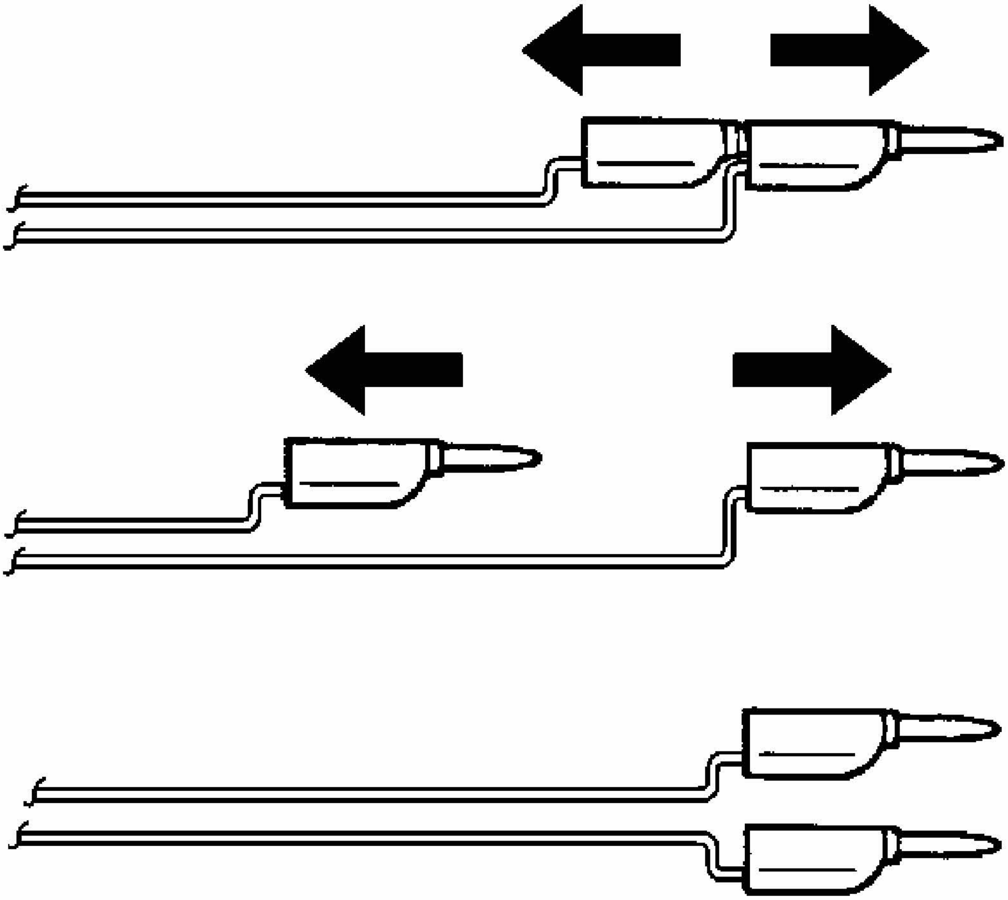


Fig. 219: Separating Banana Plugs
Courtesy of GENERAL MOTORS CORP.

17. Separate the 2 banana plugs on the SIR deployment harness.

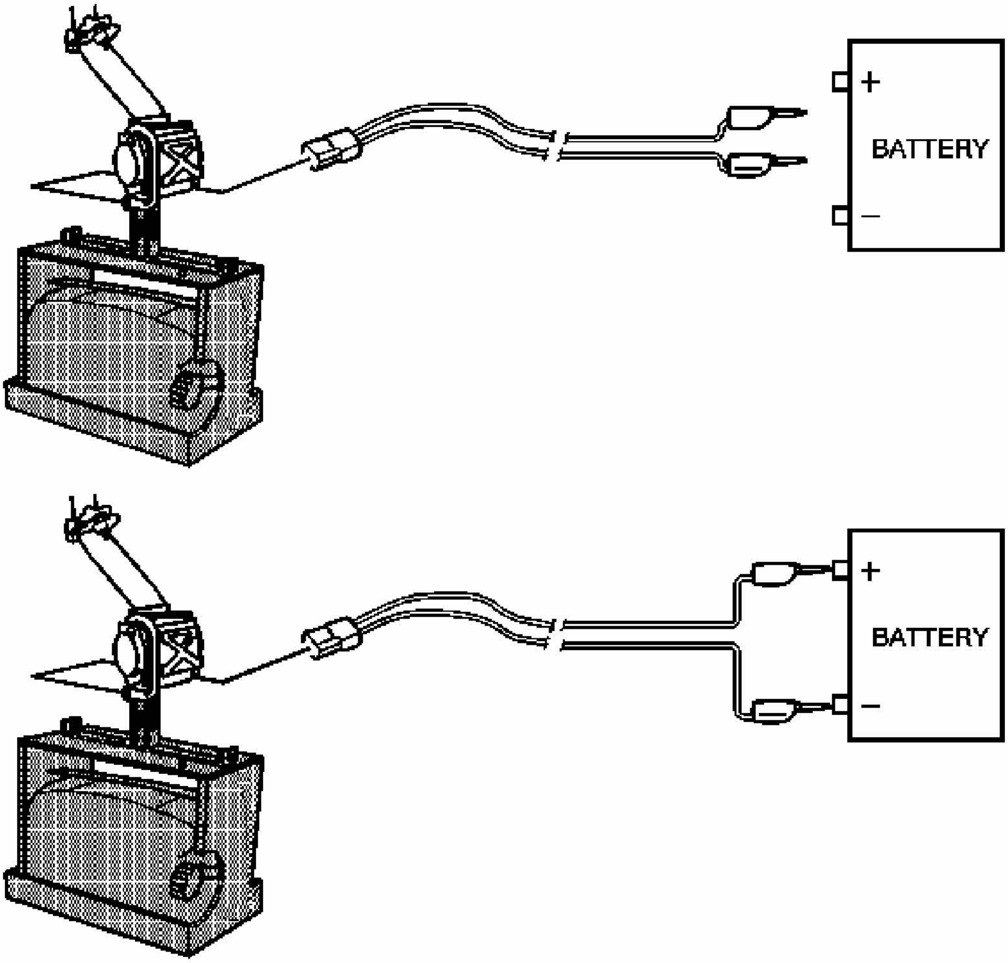


Fig. 220: Deploying Seat Belt Pretensioner
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When the seat belt retractor pretensioner deploys, the deployment fixture may jump about 30 cm (1 ft) vertically. This is a normal reaction of the seat belt pretensioner due to the force of the rapid expansion of gas inside the pretensioner.

18. Place a 12 V minimum/2 A minimum power source, such as a vehicle battery, near the shorted end of the harness.
19. Connect the SIR deployment harness wires to the power source. Seat belt pretensioner deployment will occur when contact is made.
20. Disconnect the SIR deployment harness from the power source after the seat belt

retractor pretensioner deploys.

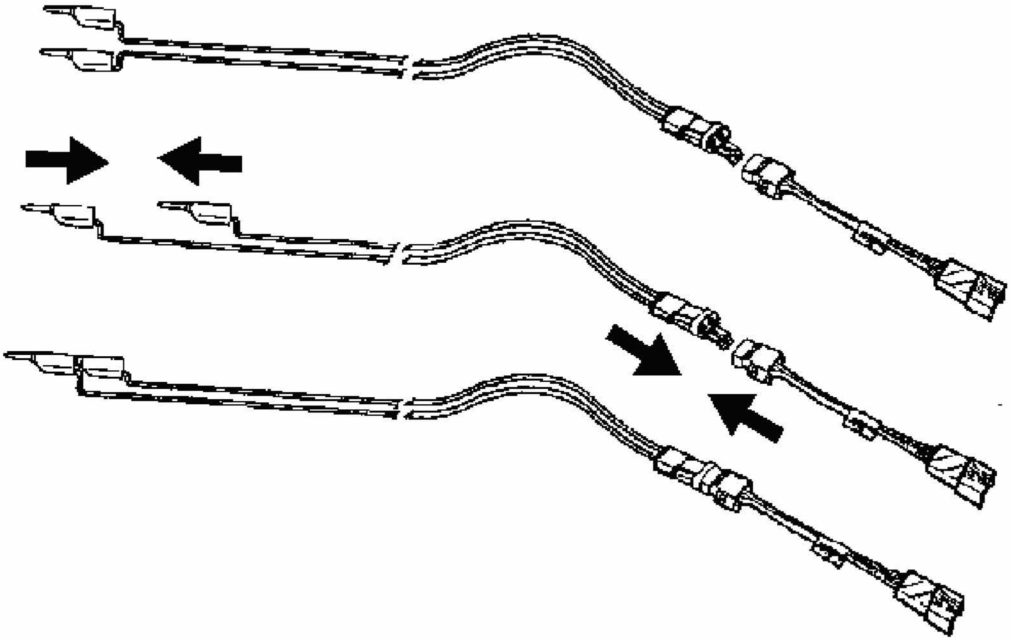


Fig. 221: View Of Deployment Harness Leads
Courtesy of GENERAL MOTORS CORP.

21. Seat one banana plug into the other in order to short the deployment harness leads.
22. If the seat belt retractor pretensioner did not deploy, disconnect the adapter and discontinue the procedure. Contact the Technical Assistance Group. Otherwise, proceed to the following steps.
23. Put on a pair of shop gloves.
24. Disconnect the pigtail adapter from the seat belt retractor pretensioner as soon as possible.
25. Dispose of the deployed seat belt retractor pretensioner through normal refuse channels.
26. Wash hands with a mild soap.

DESCRIPTION AND OPERATION

SIR SYSTEM DESCRIPTION AND OPERATION

SIR System Overview

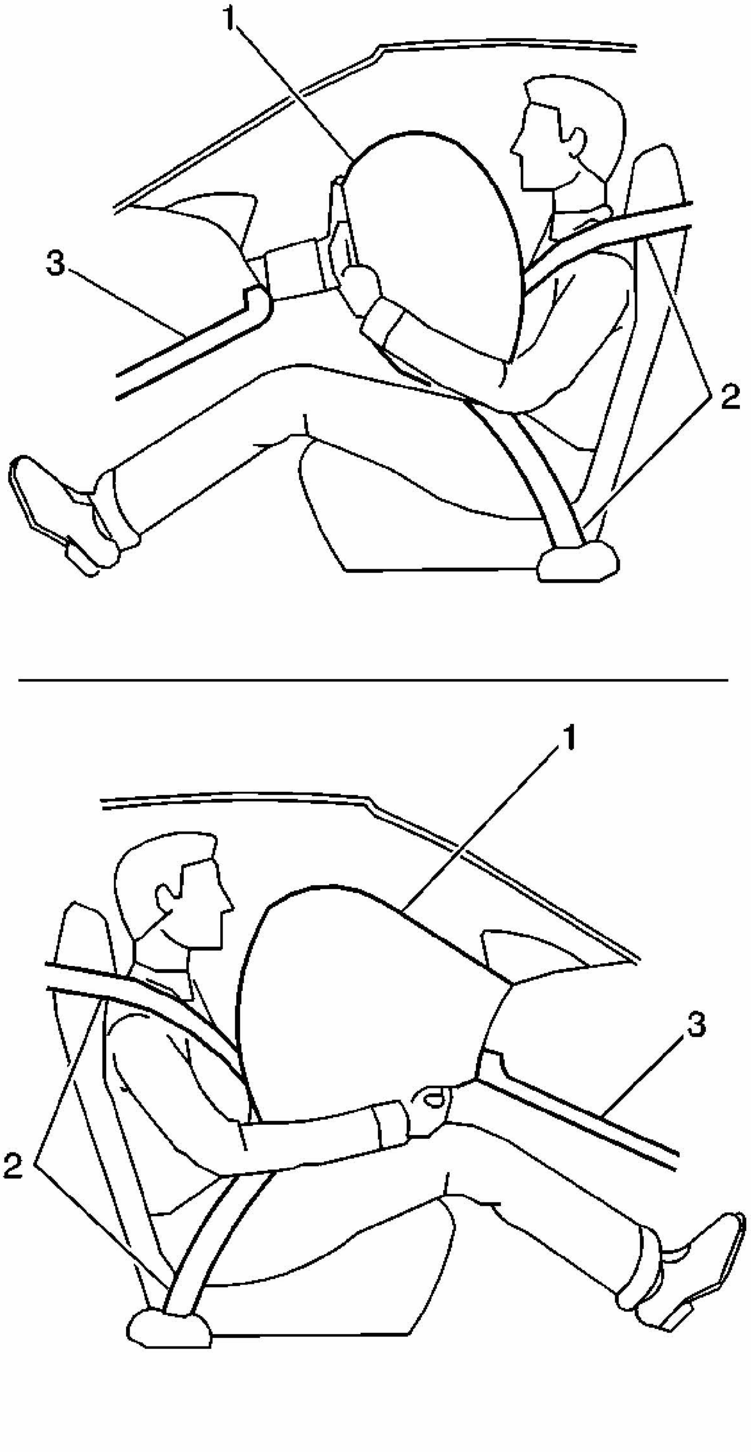


Fig. 222: Illustrating Deployed Inflatable Restraint
Courtesy of GENERAL MOTORS CORP.

The Supplemental Inflatable Restraint (SIR) System supplements the protection offered by the occupant seat belt system (2). The SIR system contains various inflator modules located throughout the vehicle, i.e. inflatable restraint steering wheel module (1) and the inflatable restraint instrument panel (I/P) module (1). Each inflator module has a deployment loop that is controlled by the inflatable restraint sensing and diagnostic module (SDM), which is mounted inside of the vehicle. The SDM determines the severity of a collision and commands deployment of each inflator module. The SDM performs continuous diagnostic monitoring of the SIR system electrical components. Upon detection of a circuit malfunction, the SDM will set a diagnostic trouble (DTC) and inform the driver by commanding the instrument panel cluster (IPC) to turn the AIR BAG indicator ON. The steering column and knee bolsters (3) are designed to absorb energy and compress during frontal collisions in order to limit leg movement and decrease the chance on injury to the driver and front passenger. After an air bag deployment, the SDM will send out a post-air message to the body control module (BCM). The BCM will unlock the doors and turn ON the emergency flashers then turn ON the interior lights 15 seconds after receipt of this message.

Frontal SIR System Description

The frontal SIR System consists of the following components:

- AIR BAG indicator located in the instrument panel cluster (IPC)
- Driver and passenger knee bolsters
- Inflatable restraint front end sensor (left/right)
- Inflatable restraint instrument panel (I/P) module
- Inflatable restraint sensing and diagnostic module (SDM)
- Inflatable restraint steering wheel module
- Inflatable restraint steering wheel module coil
- Inflatable restraint Passenger AIR BAG ON/OFF indicator
- Inflatable restraint passenger presence system (PPS)
- Inflatable restraint seat belt retractor pretensioners (left/right)
- Inflatable restraint wiring harnesses
- Steering wheel and column

A frontal collision of sufficient force will deploy the frontal air bags. The SDM contains a sensing device that converts vehicle velocity changes to an electrical signal. In the event of a frontal collision, the SDM receives a signal from the electronic frontal sensor which assists the SDM in determining the severity of the collision. The SDM compares these signals to a value stored in memory. When the generated signals exceed the stored value, the SDM will cause current to flow through the frontal deployment loops simultaneously deploying the frontal air bags. The SDM, I/P module, steering wheel module, steering wheel module coil, roof rail module, seat belt retractor pretensioner and the connecting wires makeup the frontal deployment loops. The SDM continuously monitors the deployment loops for malfunctions and turns the AIR BAG indicator ON if a fault is detected.

Inflatable Restraint Sensing and Diagnostic Module (SDM)

The inflatable restraint sensing and diagnostic module (SDM) is a microprocessor and the control center for the SIR System. This SDM has 2 fused power inputs; one fuse is for the battery voltage and the other fuse is for the ignition voltage. The SDM uses vehicle battery voltage as its main power input. The SDM then uses the vehicles Serial Data Communication line and the ignition voltage logic input for enabling or disabling the SIR deployment loops. The SDM contains internal sensors along with several external sensors, if equipped, mounted at strategic locations on the vehicle. In the event of a collision, the SDM compares the signals from the internal and external sensors to a value stored in memory. When the generated signals exceed the stored value, the SDM will cause current to flow through the appropriate deployment loops to deploy the air bags or seat belt pretensioners. If the force of the impact is not sufficient to warrant inflator module deployment, the SDM may still deploy the seat belt pretensioners. The SDM records the SIR system status when a deployment occurs and turns the AIR BAG indicator located in the instrument panel cluster (IPC) ON. As soon as three distinct deployment commands (representing different events) have been issued to any belt pretensioner, or the SDM commands any front and side air bag to deploy once, the SDM shall be considered to not be reusable. The SDM performs continuous diagnostic monitoring of the SIR system electrical components and circuitry when the ignition is turned ON. If the SDM detects a malfunction, a DTC will be stored and the SDM will command the AIR BAG indicator ON, notifying the driver that a malfunction exist. In the event that ignition positive voltage is lost during a collision, the SDM maintains a 23-volt loop reserve (23 VLR) for deployment of the air bags. It is important when disabling the SIR system for servicing or rescue operations to allow the 23 VLR to dissipate, which could take up to 1 minute.

Inflatable Restraint Passenger Presence System

IMPORTANT: The passenger presence system (PPS), heated seat element (if equipped), and the seat bottom foam cushion is a calibrated unit and cannot be service separately. After repairing or replacing the PPS, the system must be rezeroed in order to function properly.

The PPS is used to monitor the weight of an occupant on the front outboard passenger seat and communicate the status to the inflatable restraint sensing and diagnostic module (SDM) whether to enable or suppress the deployment of the instrument panel (I/P) module and the right front side impact module. The PPS consist of an electronic control module, silicone filled sensor pad, pressure sensor, seat belt tension retractor sensor, wiring harness, and PASSENGER AIR BAG ON/OFF indicators. The silicone filled sensor pad is located under the passenger seat foam cushion and is connected by a hose clamped to the pressure sensor. The weight of the occupant sitting in the front passenger seat is measured as a pressure change within the bladder by the pressure sensor. The pressure sensor sends a voltage signal to the PPS module. If the pressure from the occupants weight is less than a specified value, the PPS module will send a suppress signal to the SDM to disable the I/P and the right front side impact modules. If the pressure from the occupants weight is higher than a specified value, the PPS module will send an enable signal to the SDM to enable the I/P and the right front side impact modules. Using the serial data circuit the PPS module will communicate with the SDM, and then the SDM will communicate with the IPC to turn ON one of the PASSENGER AIR BAG ON/OFF indicators located in the center of the instrument panel cluster (IPC). By turning ON either the ON or OFF indicators the customer is notify of the enable/disable status. The PPS monitors itself for faults and will set DTCs if a fault is detected. The PPS will also notify the SDM of a fault and the SDM will request the IPC to turn ON the AIR BAG indicator located on the IPC.

Inflatable Restraint PASSENGER AIR BAG ON/OFF indicator

The PASSENGER AIR BAG ON/OFF indicators is used to notify the driver and passenger when the I/P and the right front air bag (if equipped) is enable or disable.

AIR BAG Indicator

The AIR BAG indicator, located in the instrument panel cluster (IPC), is used to notify the driver of SIR malfunctions and to verify that the inflatable restraint sensing and diagnostic module (SDM) is communicating with the IPC. When the ignition is turned ON, the SDM is supplied with ignition positive voltage. The SDM requests the IPC to flash the AIR BAG indicator seven times. While flashing the indicator, the SDM conducts tests on all SIR system components and circuits. If no malfunctions are detected, the SDM will communicate with the IPC through the serial data circuit and command the AIR BAG indicator OFF. The SDM provides continuous monitoring of the air bag circuits by conducting a sequence of checks. If a malfunction is detected the SDM will store a diagnostic trouble code (DTC) and command the IPC to turn the AIR BAG indicator ON via GMLAN serial data. The presence of a SIR system malfunction could result in non-deployment of the air bags or deployment in conditions less severe than intended. The AIR BAG indicator will remain ON until the malfunction has been repaired.

Dual Stage Inflator Modules

Dual stage inflator modules contain a housing, inflatable air bag, 2 initiating devices, canister of gas generating material and, in some cases, stored compressed gas. The 2 initiators are part of the frontal deployment loop. The function of the frontal deployment loops are to supply current through the steering wheel and instrument panel (I/P) inflator modules to deploy the air bags. The inflator modules have 2 stages of deployment, which varies the amount of restraint to the occupant according to the collision severity. For moderate frontal collisions the inflator modules deploy at less than full deployment (low deployment) which consists of stage 1 of the inflator module. For more severe frontal collisions, a full deployment is initiated which consists of stage 1 and stage 2 of the inflator module. The current passing through the initiators ignites the material in the canister producing a rapid generation of gas and is some cases, the release of compressed gas. The gas produced from this reaction rapidly inflates the air bag. Once the air bag is inflated, it quickly deflates through the air bag vent holes and/or the bag fabric.

Each dual stage inflator module is equipped with a shorting bar located in the connectors of the module. The shorting bar shorts the inflator module deployment loop circuitry to prevent unwanted deployment of the air bag when it is disconnected.

Inflatable Restraint Steering Wheel Module Coil

The steering wheel module coil is attached to the steering column and is located under the steering wheel. The steering wheel module coil consists of two or more current-carrying coils. The coils allow the rotation of the steering wheel while maintaining continuous electrical contact between the steering wheel module deployment loop and the steering wheel module. Two coil wires are used for the steering wheel module deployment loop. Additional coil wires are used for accessories that are attached to the steering wheel, depending on the vehicle model. The steering wheel module coil connector is located near the base of the steering column. The connector contains a shorting bar that shorts the steering wheel module coil deployment loop circuitry to prevent unwanted deployment of the steering wheel module when the connector is disconnected.

Steering Wheel and Column

The steering wheel and column are designed to absorb energy when driver contact is made with steering wheel or inflated module. In a collision, the driver may contact the steering wheel directly or load the steering wheel and column through the inflated module. When the driver applies load to the inflator module or the steering wheel, the column will compress downward, absorbing some of the impact and helping to reduce bodily injuries to the driver. The steering wheel and column must be inspected for damages after a collision.

Inflatable Restraint Front End Sensors

The front end sensor, also known as the electronic frontal sensor (EFS), is equipped on vehicles to supplement the SIR performance. The front end sensor is an electronic sensor and is not part of the deployment loops, but instead provides an input to the inflatable restraint sensing and diagnostic module (SDM). The front end sensor can assist in determining the severity of some frontal collisions. The SDM contains a microprocessor which performs calculations using the measured accelerations and compares these calculations to a value stored in memory. When the generated calculations exceed the stored value, the SDM will cause current to flow through the frontal deployment loops deploying the frontal air bags.

Inflatable Restraint Seat Belt Retractor Pretensioner

The seat belt retractor pretensioner modules contain a housing, a seat belt retractor, the seat belt webbing, an initiating device, and a canister of gas generating material. The initiator is part of the seat belt pretensioner deployment loop. When the vehicle is involved in a collision of sufficient force, the inflatable restraint sensing and diagnostic module (SDM) will cause current to flow through the deployment loops to the initiator. Current passing through the initiator ignites the material in the canister producing a rapid generation of gas and the release of compressed gas, if present. The gas produced from this reaction deploys the seat belt pretensioner and retracts the seat belt webbing, which removes slack in the seat belt.

Depending on the severity of the collision, the seat belt retractor pretensioner may deploy without the frontal inflator modules deploying, or they will deploy immediately before the frontal inflator modules deploy. As soon as three distinct deployment commands (representing different events) have been issued to any belt pretensioner the SDM shall be considered to not be reusable.

Each seat belt retractor pretensioner is equipped with a shorting bar located on the connector of the pretensioner. The shorting bar shorts the seat belt pretensioner deployment loop circuitry to prevent unwanted deployment of the pretensioner when servicing the seat belt pretensioner.

Inflatable Restraint Wiring Harness

The inflatable restraint wiring harness connects the inflator modules, the inflatable restraint sensing and diagnostic module (SDM), the deployment loops, and the serial data circuit together using weather - packed connectors. SIR connectors are yellow for easy identification. When repairing SIR wiring harnesses, follow the proper testing and repair procedures listed in this information.

Knee Bolster

The knee bolsters are designed to help restrain the lower torso of front seat occupants by absorbing the energy through the front seat occupants upper legs. In a collision, the front seat occupants legs may come in contact with the knee bolsters. The knee bolsters are designed to crush and deform, absorbing some of the impact and helping to reduce bodily injuries. The driver and passenger knee bolsters are located in the lower part of the instrument panel and must be inspected for damages after a collision.

Side SIR System Description

The side SIR system consists of the following components:

- AIR BAG indicator located in the instrument panel cluster (IPC)
- Inflatable restraint sensing and diagnostic module (SDM)
- Inflatable restraint seat belt retractor pretensioners (left/right)
- Inflatable restraint side impact modules (LF/RF) (Monte Carlo)
- Inflatable restraint side impact sensors (SIS) (left/right)
- Inflatable restraint roof rail modules (left/right) (Impala)
- Inflatable restraint wiring harnesses

The side impact modules are located in the outside portion of the front seat backs and the roof rail modules are located under the headliner extending from the front windshield pillar to the rear window pillar. The side impact modules and the roof rail modules contain a housing, inflatable air bag, initiating device, and a canister of gas generating material. The initiator is part of the side impact and roof rail module deployment loop. When a side impact of sufficient force occurs the SIS detects the impact and sends a signal to the SDM. The SDM compares the signal received from the SIS to a value stored in memory. When the generated signal exceeds the stored value, the SDM will cause current to flow through the side deployment loop deploying the side and the roof rail air bags. The SDM, side impact modules, roof rail modules and the connecting wires makeup the side deployment loops. The SDM continuously monitors the deployment loops for malfunctions and turns the AIR BAG indicator ON if a fault is present.

Each side impact and roof rail module is equipped with a shorting bar located on the connector of the module. The shorting bar shorts the side impact and roof rail modules deployment loop circuitry to prevent unwanted deployment of the air bag when servicing the inflator module.

Inflatable Restraint Side Impact Sensor (SIS)

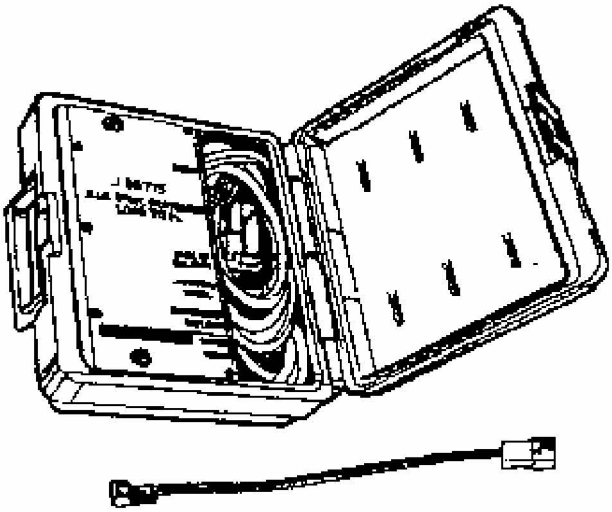
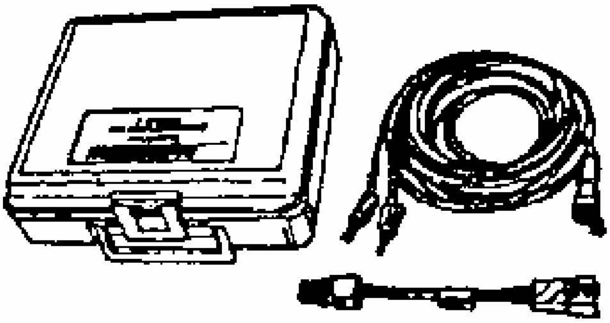
The side impact sensor (SIS) contains a sensing device which monitors vehicle acceleration and velocity changes to detect side collisions that are severe enough to warrant air bag deployment. The SIS is not part of the deployment loop, but instead provides an input to the inflatable restraint sensing and diagnostic module (SDM). The SDM contains a microprocessor that performs calculations using the measured accelerations and compares these calculations to a value stored in memory. When the generated calculations exceed the stored value, the SDM will cause current to flow through the deployment loops deploying the side and the roof rail air bags.

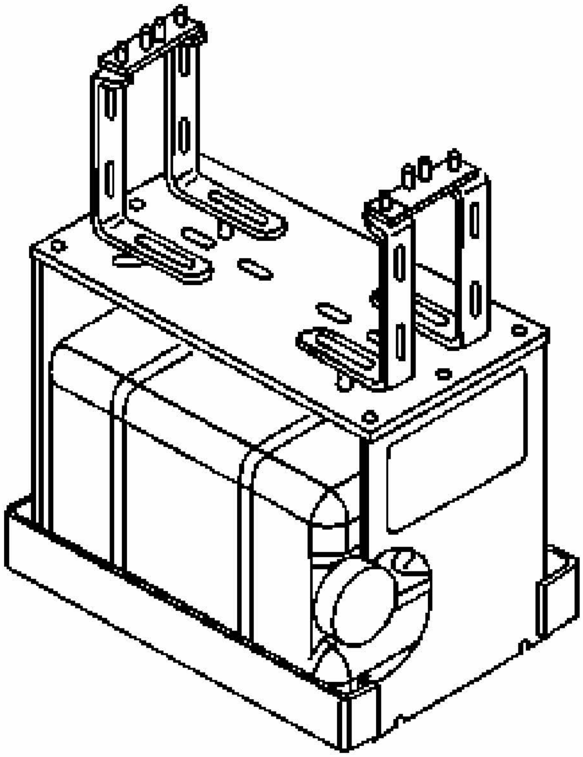
SPECIAL TOOLS AND EQUIPMENT

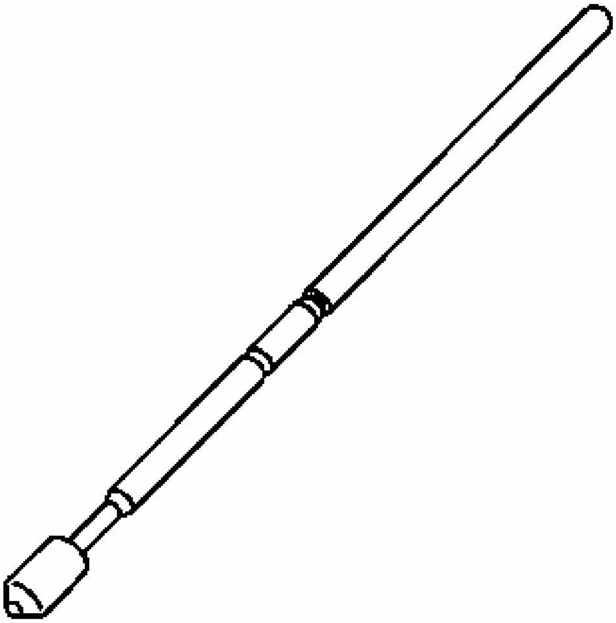
SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description
	J 38715-A Driver/Passenger Load Tool

	
	J 38826 SIR Deployment Harness

	J 39401-B SIR Deployment Fixture
	J 42640 Steering Column Anti-rotation Pin



2006 ACCESSORIES & EQUIPMENT

Stationary Windows - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

	Specification	
Application	Metric	English
Rearview Mirror Screw	2 N.m	18 lb in

SCHEMATIC AND ROUTING DIAGRAMS

DEFOGGER SCHEMATICS

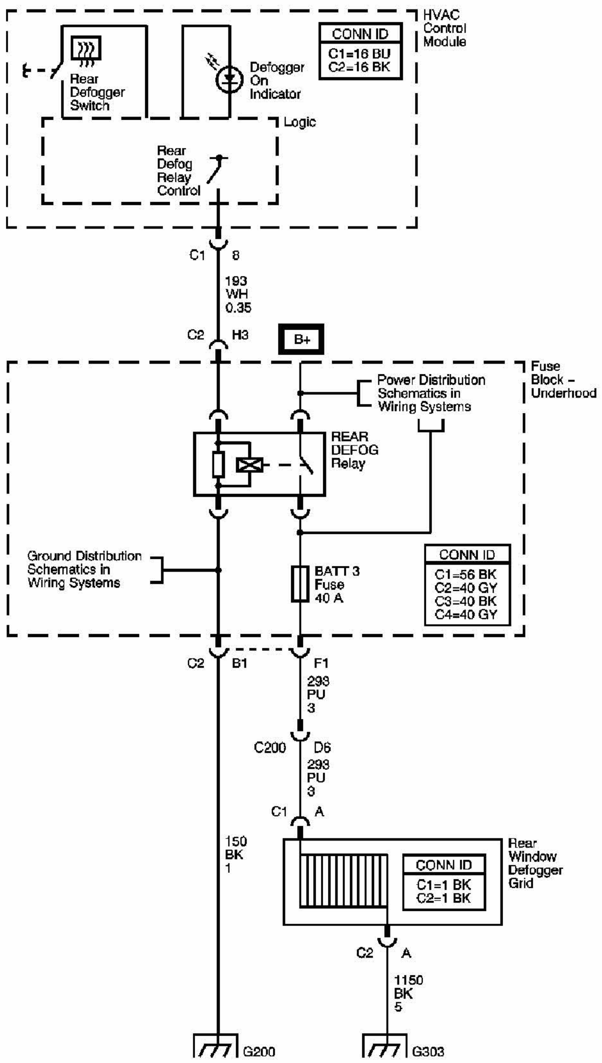

HVAC Control Module
CONN ID
C1=16 BU
C2=16 BK
Rear Defogger Switch
Defogger On Indicator
Logic
Rear Defog Relay Control
C1
8
193
WH
0.35
C2
H3
B+
Fuse Block - Underhood
Power Distribution Schematics in Wiring Systems
REAR DEFOG Relay
Ground Distribution Schematics in Wiring Systems
BATT 3 Fuse 40 A
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
C2
B1
F1
298
PU
3
C200
D6
298
PU
3
C1
A
150
BK
1
Rear Window Defogger Grid
CONN ID
C1=1 BK
C2=1 BK
C2
A
1150
BK
5
G200
G303

Fig. 1: Defogger Schematics - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

INSIDE REARVIEW MIRROR SCHEMATICS

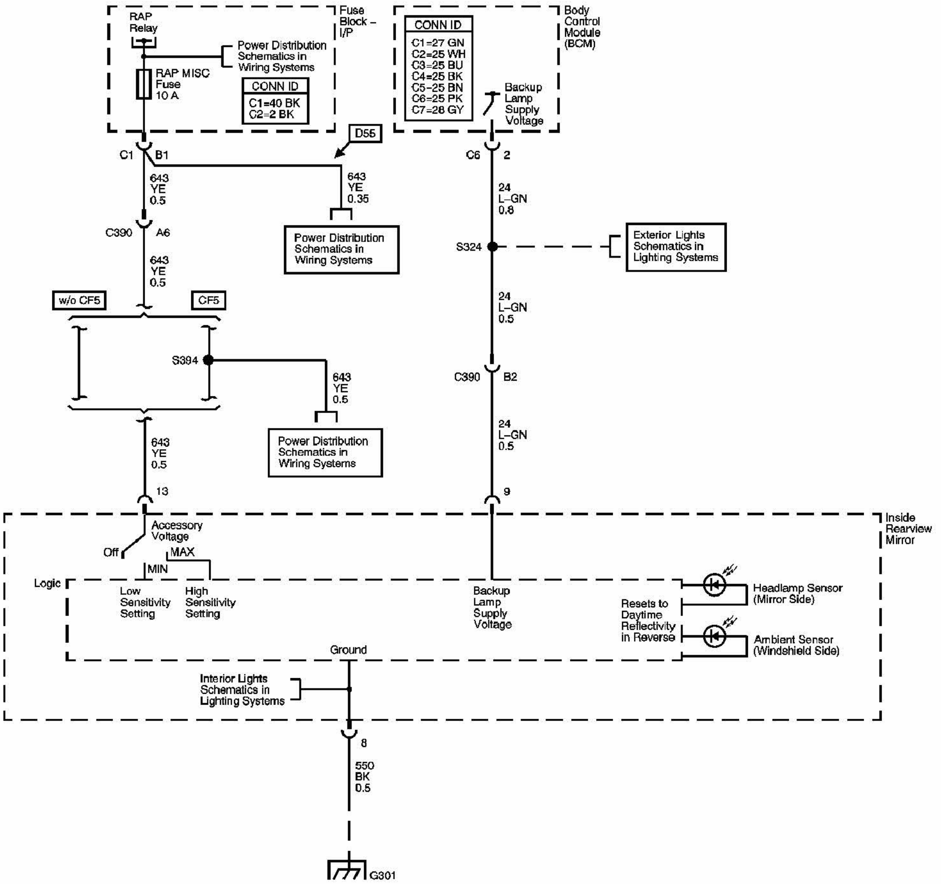

RAP Relay
Fuse Block – I/P
Power Distribution Schematics in Wiring Systems
RAP MISC Fuse 10 A
CONN ID
C1=40 BK
C2=2 BK
Body Control Module (BCM)
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Backup Lamp Supply Voltage
C1
B1
D55
643 YE 0.5
643 YE 0.35
C6
2
24 L–GN 0.8
Power Distribution Schematics in Wiring Systems
S324
Exterior Lights Schematics in Lighting Systems
C390
A6
643 YE 0.5
w/o CF5
CF5
24 L–GN 0.5
S394
643 YE 0.5
C390
B2
24 L–GN 0.5
643 YE 0.5
Power Distribution Schematics in Wiring Systems
13
9
Inside Rearview Mirror
Accessory Voltage
Off
MAX
MIN
Logic
Low Sensitivity Setting
High Sensitivity Setting
Backup Lamp Supply Voltage
Resets to Daytime Reflectivity in Reverse
Headlamp Sensor (Mirror Side)
Ambient Sensor (Windshield Side)
Ground
Interior Lights Schematics in Lighting Systems
8
550 BK 0.5
G301

Fig. 2: Inside Rearview Mirror Schematics - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

STATIONARY WINDOWS COMPONENT VIEWS

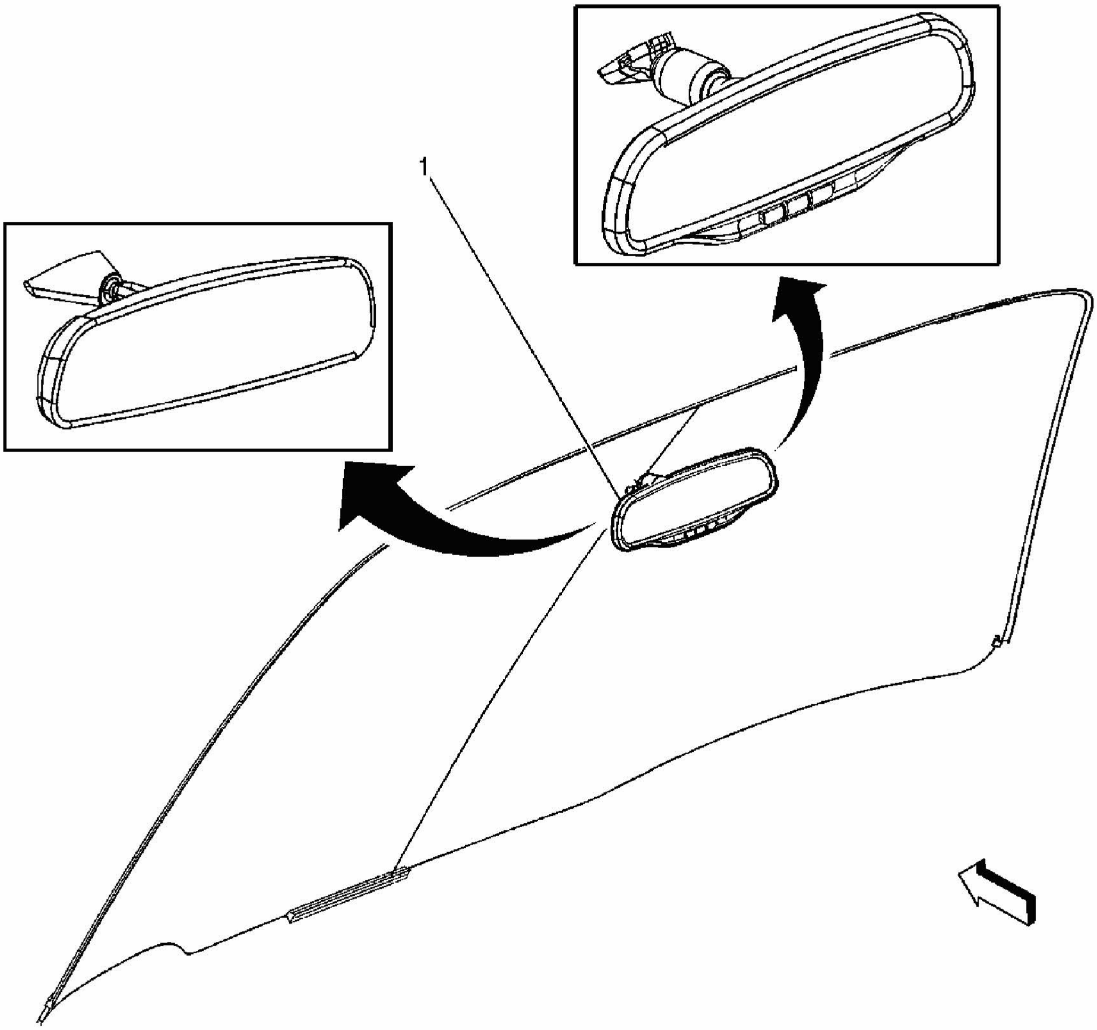


Fig. 3: View Of Roof/Headliner Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Inside Rearview Mirror

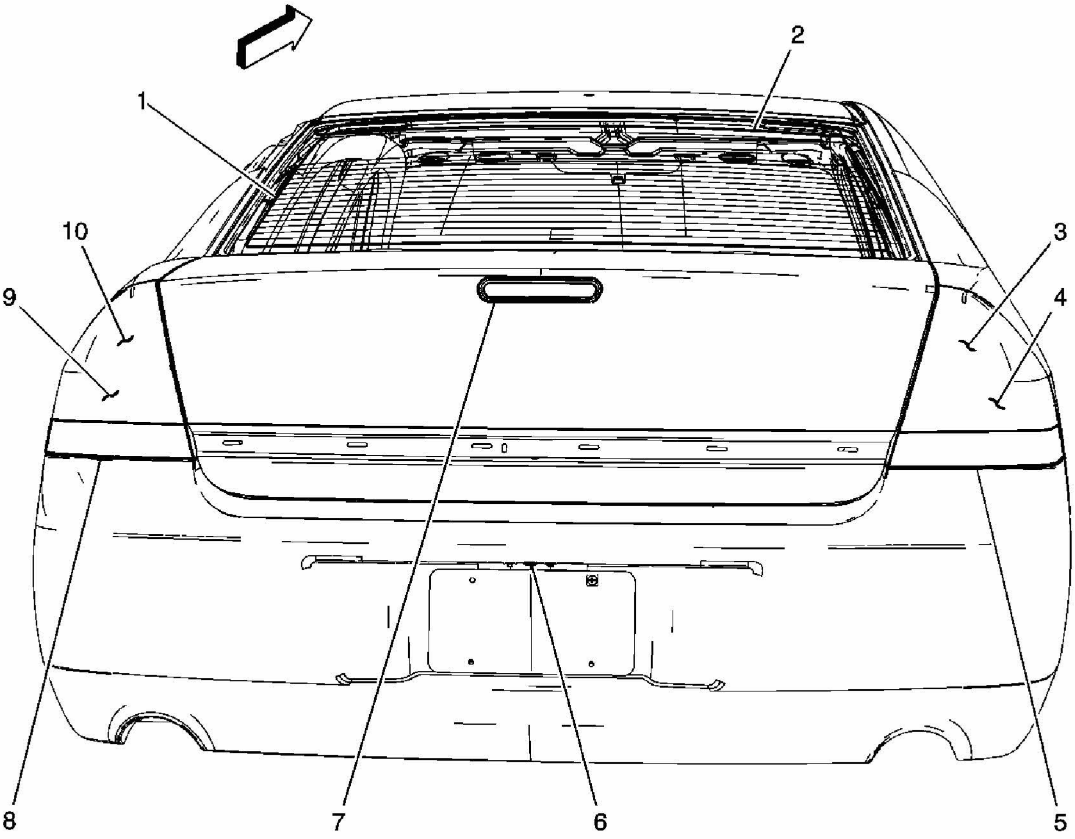


Fig. 4: Rear of the Vehicle
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	Rear Window Defogger Grid
2	Cellular and Navigation Antenna
3	Stop Lamp - Right
4	Tail/Stop and Turn Signal - Right
5	Backup Lamp - Right
6	License Lamp
7	Center High Mounted Stop Lamp (CHMSL)
8	Backup Lamp - Left
9	Tail/Stop and Turn Signal - Left
10	Stop Lamp - Left

STATIONARY WINDOWS CONNECTOR END VIEWS

Inside Rear View Mirror (DD6)

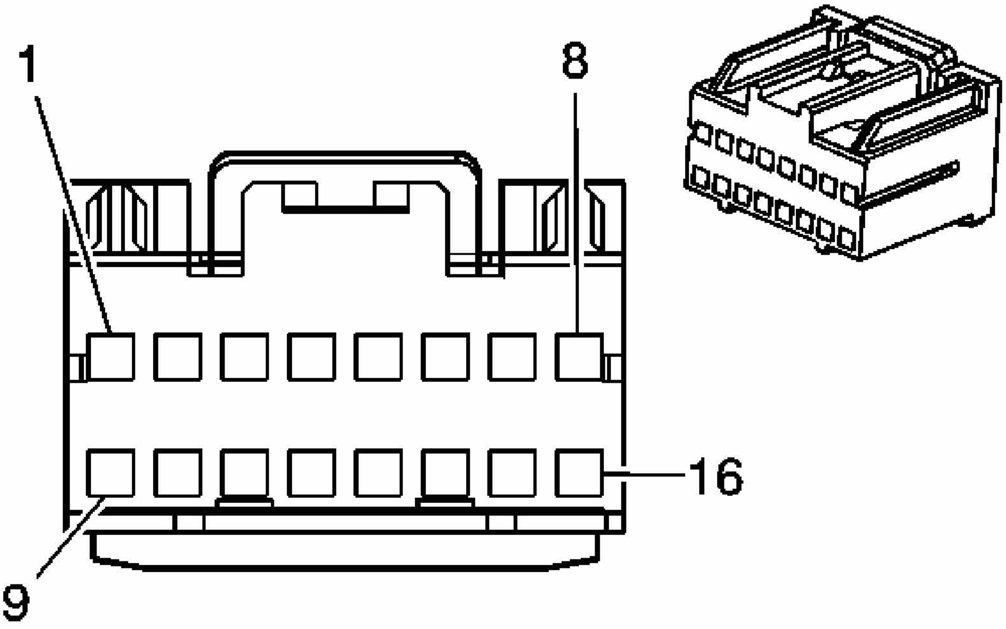


Fig. 5: Connector End View
Courtesy of GENERAL MOTORS CORP.

Stationary Windows Connector End Views

Connector Part Information

- OEM: 15441350
- Service: See Catalog
- Description: 16-Way F Micro 100A (BK)

Terminal Part Information

- Pins: 2, 6, 8, 9, 10, 11, 12, 13, 14, 15
- Terminal/Tray: 15445905
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: See Terminal Repair Kit

Inside Rear View Mirror (DD6)

Pin	Wire Color	Circuit No.	Function
1	-	-	Not Used
2	-	1489	Drain Wire
3-5	-	-	Not Used

6	OG	1732	Courtesy Lamps Supply Voltage
7	-	-	Not Used
8	BK	550	Ground
9	L-GN	24	Backup Lamp Supply Voltage
10	GY	655	Cellular Microphone Signal
11	D-GN/WH	2514	Keypad Signal
12	L-GN/BK	2515	Keypad Supply Voltage
13	YE	643	Accessory Voltage
14	YE/BK	2516	Keypad Green LED Signal
15	BN/WH	2517	Keypad Red LED Signal
16	-	-	Not Used

Inside Rear View Mirror (w/o DD6)

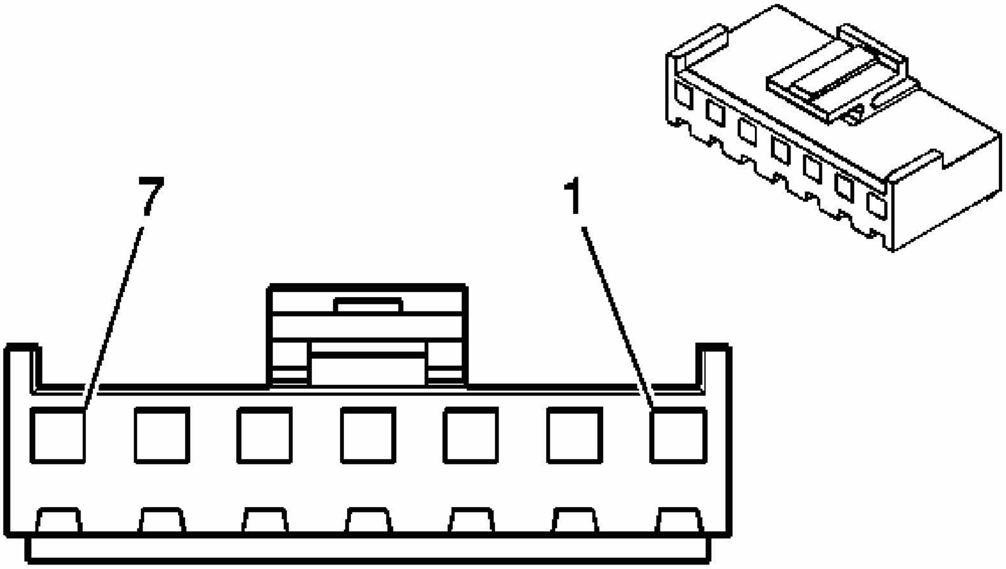


Fig. 6: Connector End View
Courtesy of GENERAL MOTORS CORP.

Stationary Windows Connector End Views

Connector Part Information

- OEM: 12124782
- Service: 15306078

- Description: 7-Way F MISC (BK)

Terminal Part Information

- Pins: 2, 7
- Terminal/Tray: SVH-21T-P1.1/20
- Core/Insulation Crimp: E/2
- Release Tool/Test Probe: 12094429/J-35616-18 (BK)

Inside Rear View Mirror (w/o DD6)

Pin	Wire Color	Circuit No.	Function
1	-	-	Not Used
2	OG	1732	Courtesy Lamps Supply Voltage
3-6	-	-	Not Used
7	BK	550	Ground

Rear Window Defogger Grid C1

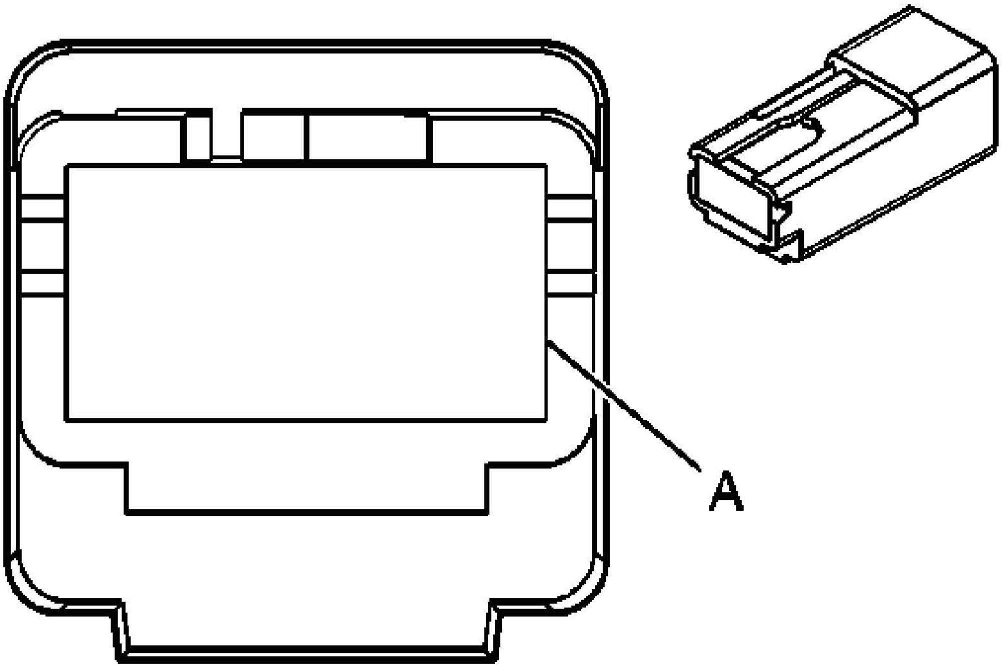


Fig. 7: Rear Window Defogger Grid C1 Connector End View
Courtesy of GENERAL MOTORS CORP.

Stationary Windows Connector End Views

Connector Part Information

- OEM: 12092133
- Service: 12167133
- Description: 1-Way F Metri-Pack 630 (BK)

Terminal Part Information

- Pins: A, A
- Terminal/Tray: 12034110/18
- Core/Insulation Crimp: Pins A - F/G
- Core/Insulation Crimp: Pins A - B/G
- Release Tool/Test Probe: 12094430/J-35616-42 (RD)

Rear Window Defogger Grid C1

Pin	Wire Color	Circuit No.	Function
A	PU	293	Rear Defog Element Supply Voltage
A	PU	293	Rear Defog Element Supply Voltage

Rear Window Defogger Grid C2

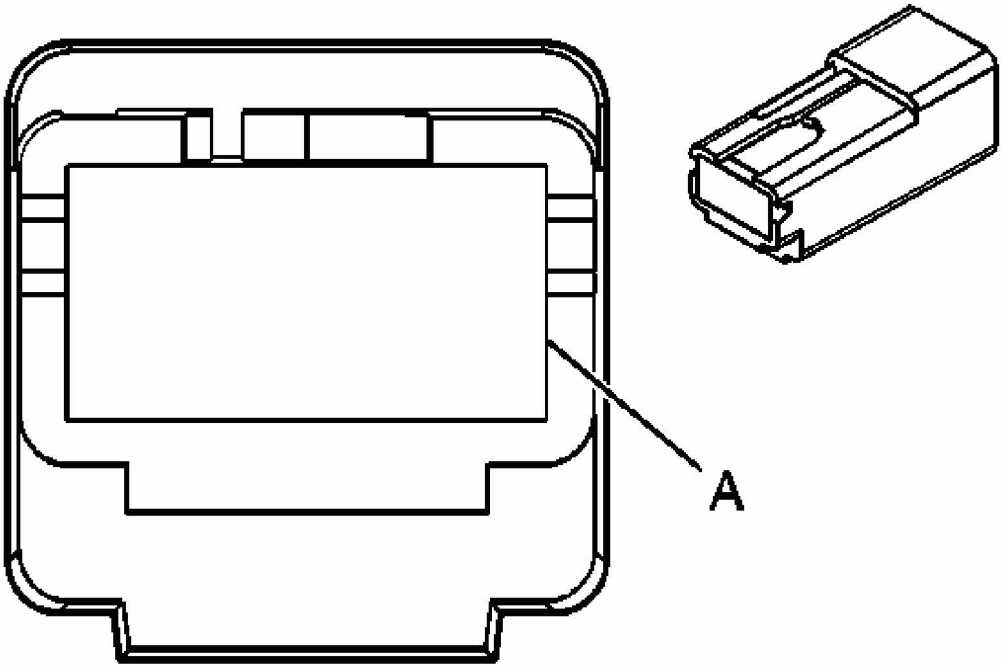


Fig. 8: Rear Window Defogger Grid C2 Connector End View
Courtesy of GENERAL MOTORS CORP.

Stationary Windows Connector End Views

Connector Part Information

- OEM: 12092133
- Service: 12167133
- Description: 1-Way F Metri-Pack 630 (BK)

Terminal Part Information

- Terminal/Tray: 12034110/18
- Core/Insulation Crimp: B/G
- Release Tool/Test Probe: 12094430/J-35616-42 (RD)

Rear Window Defogger Grid C2

Pin	Wire Color	Circuit No.	Function
A	BK	1150	Ground

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - STATIONARY WINDOWS

Begin diagnosis with the **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL OUTPUT CONTROLS

Body Control Module

Scan Tool Output Control	Additional Menu Selection(s)	Description
Rear Defogger Relay	Miscellaneous Test	The Body Control Module actuates the Rear Window Defogger relay. The rear window defogger grid should become warm.

SCAN TOOL DATA LIST

Body Control Module

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF			
Rear Defog Relay	Outputs	On/Off	Off

SCAN TOOL DATA DEFINITIONS

Body Control Module

Rear Defog Relay

The scan tool displays On/Off. When the rear window defogger switch is depressed, the body control module energizes the Rear Window Defogger relay by grounding the control circuit of the relay, which the scan tool displays as On.

DTC B0283

Circuit Description

The body control module (BCM) controls the REAR WINDOW DEFOGGER relay circuit. When the ignition switch is in Run position and the operator has depressed the defogger switch, the BCM provides ground to the REAR WINDOW DEFOGGER relay control circuit and the electronic compass module. The electronic compass module translates the signal to compass data which is then transmitted to the instrument panel cluster (IPC) for display of the rear defogger mode.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B0283

Electric Rear Defrost

Conditions for Running the DTC

The system voltage must be between 9-16 volts.

Conditions for Setting the DTC

- The BCM detects a short to battery positive voltage in the REAR WINDOW DEFOGGER relay control circuit when the BCM is trying to energize the relay.
- The BCM detects that the REAR WINDOW DEFOGGER relay control circuit is open.
- The condition above must be present for more than 1 second.

Action Taken When the DTC Sets

- The BCM stores DTC B0283 in memory.
- The rear window defogger will not operate.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: Tests for battery positive voltage at the coil side of the dear window defogger relay. The BATT MAIN 3 fuse supplies power to the coil side of the REAR WINDOW DEFOGGER relay.

3: Tests the control circuit side of the REAR WINDOW DEFOGGER relay for faults that cause DTC B0283.

4: Listen for an audible click when the REAR WINDOW DEFOGGER relay operates. Command both the ON and OFF states. Repeat the commands as necessary.

5: Verifies that the BCM is providing ground to the REAR WINDOW DEFOGGER relay.

DTC B0283

Step	Action	Yes	No
Schematic Reference: Defogger Schematics **Connector End View Reference: Stationary Windows Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Remove the REAR WINDOW DEFOGGER relay. 2. Connect a test lamp between the REAR WINDOW DEFOGGER relay BATT main 3 fused voltage supply circuit and ground at the REAR WINDOW DEFOGGER relay socket. Refer to **Circuit Testing** in Wiring Systems. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	Go to **Step 3**	Go to **Step 8**
3	1. Turn OFF the ignition. 2. Test the control circuit of the REAR WINDOW DEFOGGER relay for a short to battery positive voltage and ground. Refer to **Circuit Testing** in Wiring Systems. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 4**
4	1. Connect a test lamp between the BATT main 3 fused voltage supply circuit and the control circuit of the REAR WINDOW DEFOGGER relay socket. 2. Turn ON the ignition, with the engine OFF.		

	3. Using a scan tool, command the relay ON then OFF. Does the test lamp turn ON and OFF?	Go to **Step 6**	Go to **Step 5**
5	Test the control circuit of the REAR WINDOW DEFOGGER relay for an open. Refer to **Circuit Testing** in Wiring Systems. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 7**
6	Inspect for poor connections and terminal damage at the relay socket. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 9**
7	Inspect for poor connections at the harness connector of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 10**
8	Repair the short to ground, poor connection or an open in the BATT 3 fused voltage supply circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 11**	-
9	Replace the REAR WINDOW DEFOGGER relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** in Wiring Systems. Did you complete the replacement?	Go to **Step 11**	-
10	Replace the BCM. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 11**	-
11	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

SYMPTOMS - STATIONARY WINDOWS

IMPORTANT: For the inside rearview mirror with the automatic day-night feature, review the system operation in order to familiarize yourself with the system functions. Refer to Automatic Day-Night Mirror Description and Operation.
For the rear window defogger system, the following steps must be performed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** in Vehicle DTC Information, before using the symptom tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the rear window defogger system operation in order to familiarize yourself with the system functions. Refer to **Rear Window Defogger Description and Operation**.
3. Review the Automatic Day-Night Mirror Operation in order to familiarize yourself with the system functions. Refer to **Automatic Day-Night Mirror Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the rear window defogger or the automatic day-night feature of the inside rearview mirror. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Defogger Always On - Rear Window**
- **Defogger Inoperative - Rear Window**
- **Mirrors - Automatic Day-Night Inoperative**

DEFOGGER ALWAYS ON - REAR WINDOW

Defogger Always On - Rear Window

Step	Action	Yes	No
Schematic Reference: Defogger Schematics **Connector End View Reference: Master Electrical Component List**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Turn OFF the ignition. 2. Remove the REAR WINDOW DEFOGGER relay. Does the rear window defogger still on?	Go to **Step 5**	Go to **Step 3**
3	Using a test lamp, probe between the REAR WINDOW DEFOGGER relay battery positive voltage coil supply circuit and the REAR WINDOW DEFOGGER relay context circuit. Does the test lamp illuminate?	Go to **Step 4**	Go to **Step 6**
4	Test for a short to ground in the REAR WINDOW DEFOGGER relay control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 8**	Go to **Step 7**
5	Repair a short to battery positive voltage in the rear defog element supply voltage circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 8**	-
6	Replace the REAR WINDOW DEFOGGER relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** in Wiring Systems. Did you complete the replacement?	Go to **Step 8**	-
7	Replace the body control module (BCM). Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 8**	-

8	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

DEFOGGER INOPERATIVE - REAR WINDOW

Test Description

The number below refers to the step number on the diagnostic table.

> **5:** Listen for an audible click when the REAR DEFOG relay operates. Command both the ON and OFF states of the REAR DEFOG relay. Repeat the commands as necessary.

Defogger Inoperative - Rear Window

Step	Action	Yes	No
Schematic Reference: Defogger Schematics **Connector End View Reference: Stationary Windows Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	**IMPORTANT:** **Make sure that the park or head lights are turned OFF. The backlighting will effect the illumination of the rear window defogger indicator.** 1. Start the engine. 2. Depress the rear window defogger switch. 3. Observe the rear window defogger indicator on the HVAC control module. Does the rear window defogger indicator illuminate?	Go to **Step 3**	Go to **Step 12**
3	Connect a test lamp between the rear window defogger grid and ground. Does the test lamp illuminate?	Go to **Step 4**	Go to **Step 5**
	Connect a test lamp between the left side of the rear window defogger grid and the right side of the rear window defogger grid.	Go to **Testing for Intermittent Conditions and**	

4	Does the test lamp illuminate?	**Poor Connections** in Wiring Systems	Go to **Step 19**
5	Command the REAR DEFOG relay ON and OFF, by depressing the rear defogger switch on the HVAC control module. Do you hear a click when you command the REAR DEFOG relay ON and OFF?	Go to **Step 8**	Go to **Step 6**
6	1. Turn OFF the ignition. 2. Disconnect the REAR DEFOG relay. 3. Start the engine. 4. Connect a test lamp between the supply voltage circuit of the REAR DEFOG relay coil and ground. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 11**
7	1. Connect a test lamp between the supply voltage circuit of the REAR DEFOG relay coil and the control circuit of the REAR DEFOG relay. 2. Depress the rear window defogger switch. Does the test lamp illuminate?	Go to **Step 17**	Go to **Step 12**
8	1. Turn OFF the ignition. 2. Disconnect the REAR DEFOG relay. 3. Connect a test lamp between the battery positive voltage circuit of the REAR DEFOG relay switched input and ground. Does the test lamp illuminate?	Go to **Step 9**	Go to **Step 13**
9	1. Connect a 30-amp fused wire between the battery positive voltage circuit of the REAR DEFOG relay switched input and the relay switched output to the supply voltage circuit of the rear window defogger grid. 2. Connect a test lamp between the rear window defogger grid and ground.		

	Does the test lamp illuminate?	Go to **Step 17**	Go to **Step 10**
10	1. Disconnect the harness connector of the radio antenna module. 2. Connect a test lamp between the supply voltage circuit of the rear window defogger grid and ground. Does the test lamp illuminate?	Go to **Step 14**	Go to **Step 21**
11	Test the supply voltage circuit of the REAR DEFOG relay coil for an open or short to ground. Refer to **Circuit Testing** and to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 26**	Go to **Step 16**
12	Test the control circuit of the REAR DEFOG relay for an open or short to battery positive voltage. Refer to **Circuit Testing** and to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 26**	Go to **Step 15**
13	Test the battery positive voltage circuit of the REAR DEFOG relay switched input for an open or short to ground. Refer to **Circuit Testing** and to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 26**	Go to **Step 20**
14	Test the supply voltage circuit of the rear window defogger grid between the radio antenna module and the rear window defogger grid for an open or high resistance. Refer to **Circuit Testing** and to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 26**	Go to **Step 18**
15	Inspect for a poor connection at the harness connector of the HVAC control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and to **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 26**	Go to **Step 22**
16	Inspect for a poor connection at the harness connector of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and to **Connector Repairs** in Wiring Systems.		

	Did you find and correct the condition?	Go to **Step 26**	Go to **Step 23**
17	Inspect for a poor connection at the REAR DEFOG relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and to **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 26**	Go to **Step 24**
18	Inspect for a poor connection at the harness connector of the radio antenna module. Refer to **Testing for Intermittent Conditions and Poor Connections** and to **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 26**	Go to **Step 25**
19	Repair an open or high resistance in the ground circuit of the rear window defogger grid. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 26**	-
20	Repair the short to ground in the supply voltage circuit of the rear window defogger grid. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 26**	-
21	Repair an open or high resistance in the supply voltage circuit of the rear window defogger grid. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 26**	-
22	Replace the HVAC control module. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 26**	-
23	Replace the BCM. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 26**	-
24	Replace the REAR DEFOG relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** in Wiring Systems. Did you complete the replacement?	Go to **Step 26**	-

25	Replace the radio antenna module. Refer to **Antenna Module Replacement** in Entertainment. Did you complete the replacement?	Go to **Step 26**	-
26	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

DEFOGGER GRID LINES DIAGNOSIS

1. Start the engine.
2. Activate the rear window defogger system.
3. Connect a test lamp to ground.

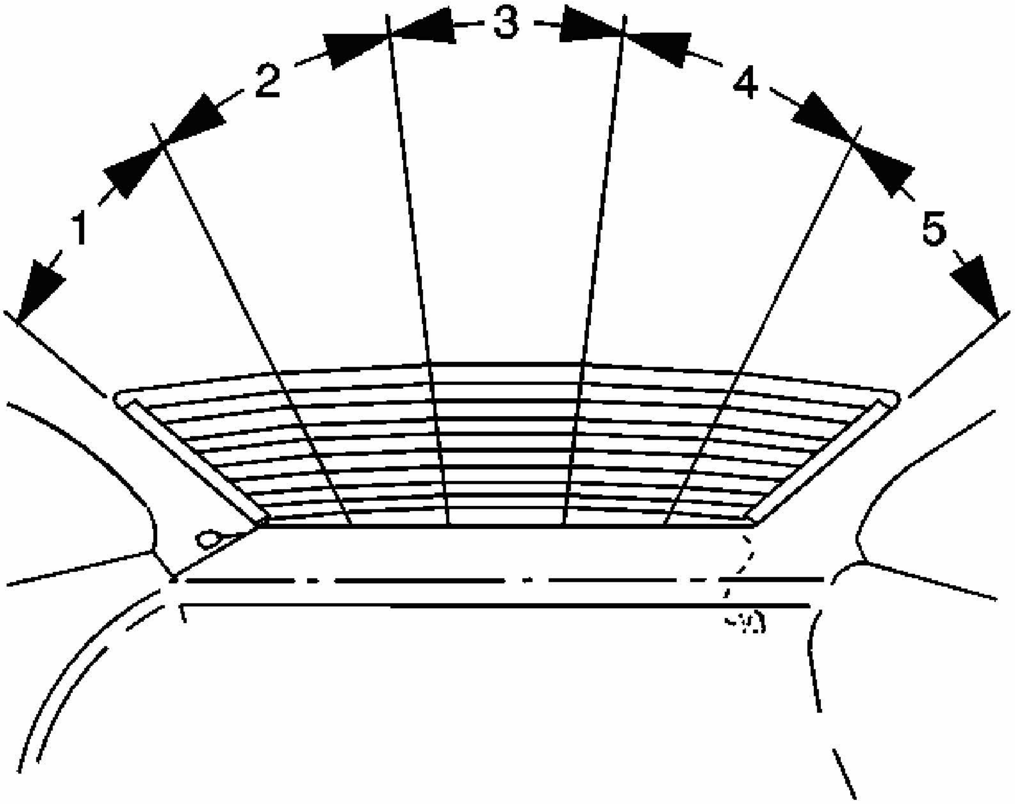


Fig. 9: Identifying Defogger Grid Line Zones
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The test lamp brilliance will decrease proportionately to

the increased resistance in the grid line as the probe is moved from the battery positive bus wire to the ground bus wire. The test lamp brilliance may vary from one window to another.

4. Move the test lamp probe from zone 5 to zone 1 along each grid line.
    - If the test lamp shows full brilliance at both ends of the grid lines, inspect for an open or poor connection in the ground circuit of the rear window defogger grid. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.

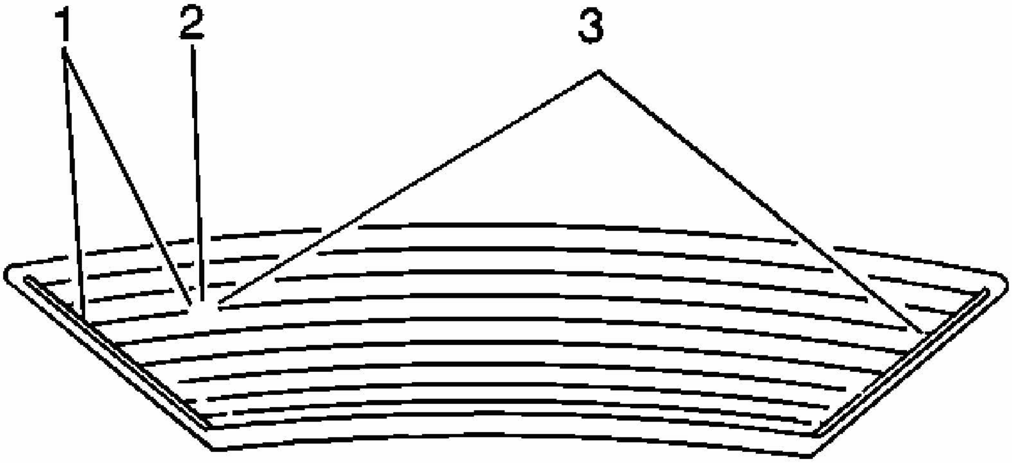


Fig. 10: Identifying Grid Line Test Locations
Courtesy of GENERAL MOTORS CORP.

- If the test lamp goes out, test the grid line in at least 2 places (1, 3) to eliminate the possibility of bridging the open (2) in the grid line.

5. If an open is discovered replace the rear window. Refer to **Rear Window Replacement**.

MIRRORS - AUTOMATIC DAY-NIGHT INOPERATIVE

Diagnostic Aids

The automatic day-night feature of the inside rearview mirror may not operate properly or become inoperative due to an intermittent short to battery voltage in the backup lighting system.

Mirrors - Automatic Day-Night Inoperative

Step	Action	Value(s)	Yes	No
Schematic Reference: Inside Rearview Mirror Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Turn ON the ignition, with the engine OFF. 2. Turn ON the automatic day-night feature of the inside rearview mirror. 3. Cover the sensor on the inside rearview mirror back, facing the front window. 4. Shine a bright light into the sensor on the inside rearview mirror face, facing the rear window. Does the inside rearview mirror darken?	-	Go to Diagnostic Aids	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the harness connector of the inside rearview mirror. 3. Measure the resistance between the ground circuit of the inside rearview mirror and ground. Is the resistance less than the specified value?	3 ohms	Go to **Step 4**	Go to **Step 9**
4	1. Turn ON the ignition, with the engine OFF. 2. Measure the voltage between the ignition voltage circuit and the ground circuit of the inside	9-16 V		

	rearview mirror. Is the voltage within the specified range?		Go to **Step 5**	Go to **Step 10**
5	1. Place the transmission in PARK. 2. Measure the voltage between the backup lamp supply voltage circuit and the ground circuit of the inside rearview mirror. Is the voltage less than the specified value?	0.5 V	Go to **Step 6**	Go to **Backup Lamps Inoperative** in Lighting Systems
6	1. Place the transmission in REVERSE. 2. Measure the voltage between the backup lamp supply voltage circuit and the ground circuit of the inside rearview mirror. Is the voltage within the specified range?	9-16 V	Go to **Step 8**	Go to **Step 7**
7	Test the backup lamp supply voltage circuit of the inside rearview mirror for an open or short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Backup Lamps Inoperative** in Lighting Systems
8	Inspect for poor connections at the harness connector of the inside rearview mirror. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
9	Repair an open or high resistance in the ground circuit of the inside rearview mirror. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 12**	-
	Repair an open or short to ground in			

10	the ignition voltage circuit of the inside rearview mirror. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 12**	-
11	Replace the inside rearview mirror. Refer to **Rearview Mirror Replacement**. Did you complete the replacement?	-	Go to **Step 12**	-
12	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 2**

REPAIR INSTRUCTIONS

STATIONARY WINDOW REVEAL MOLDING REPAIR

Removal Procedure

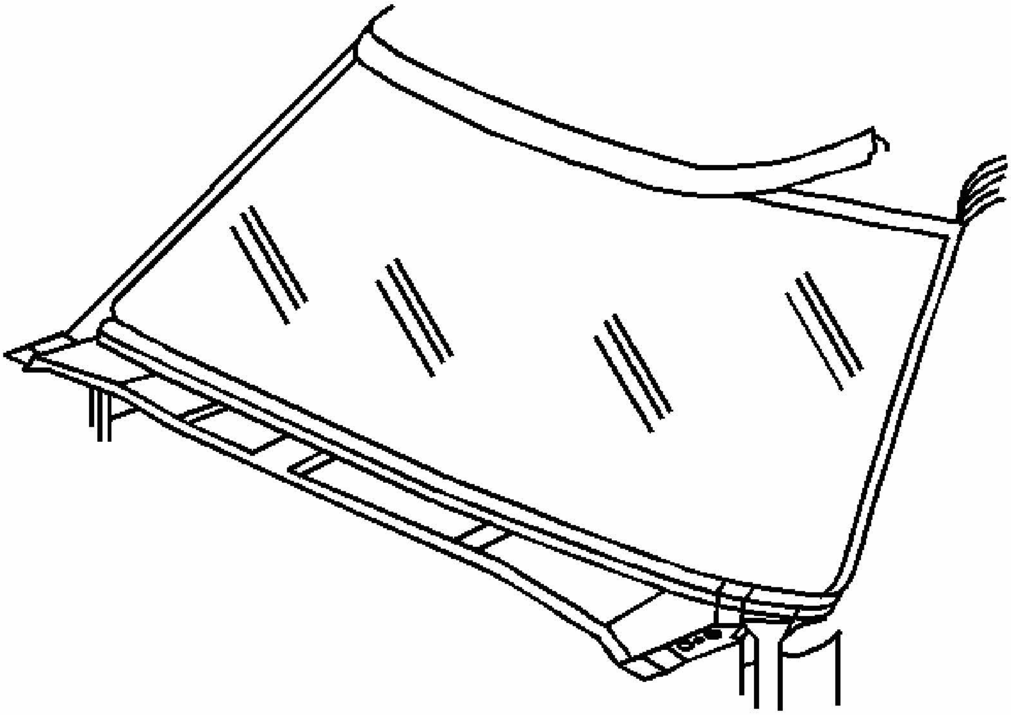


Fig. 11: View Of Window Reveal Molding
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to GLASS AND SHEET METAL HANDLING CAUTION in Cautions and Notices.

IMPORTANT: The window reveal molding fills the cavity between the body and window. If the reveal molding is stretched or damaged, it cannot be reused and it must be replaced.

1. Lift up on the loose area of the reveal molding.
2. Clean the top edge of the window surface and the reveal molding with a 50/50 mixture of isopropyl alcohol and water by volume on a dampened lint-free cloth.

Installation Procedure

CAUTION: Refer to Window Retention Caution in Cautions and Notices.

1. Verify all primers and urethane adhesive are within expiration dates.

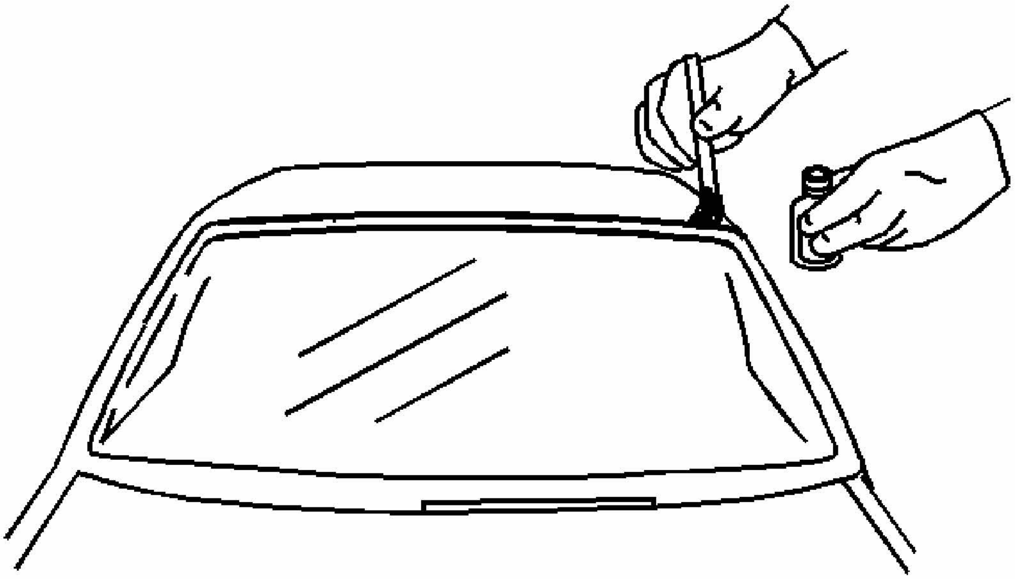


Fig. 12: Applying Glass Prep
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use care when applying the prep, clear #1, to the window. This primer dries almost instantly, and may stain the

viewing area of the window if not applied evenly.

2. Use a new dauber in order to apply glass prep, clear #1, to the channel area approximately 13 mm (1/2 in) to the upper edge of the window.
3. Wipe the glass primed area immediately with a clean lint-free cloth.
4. Shake the glass primer, black #2, for at least 1 minute.
5. Use a new dauber in order to apply glass primer, black #2, to the top edge of the window.

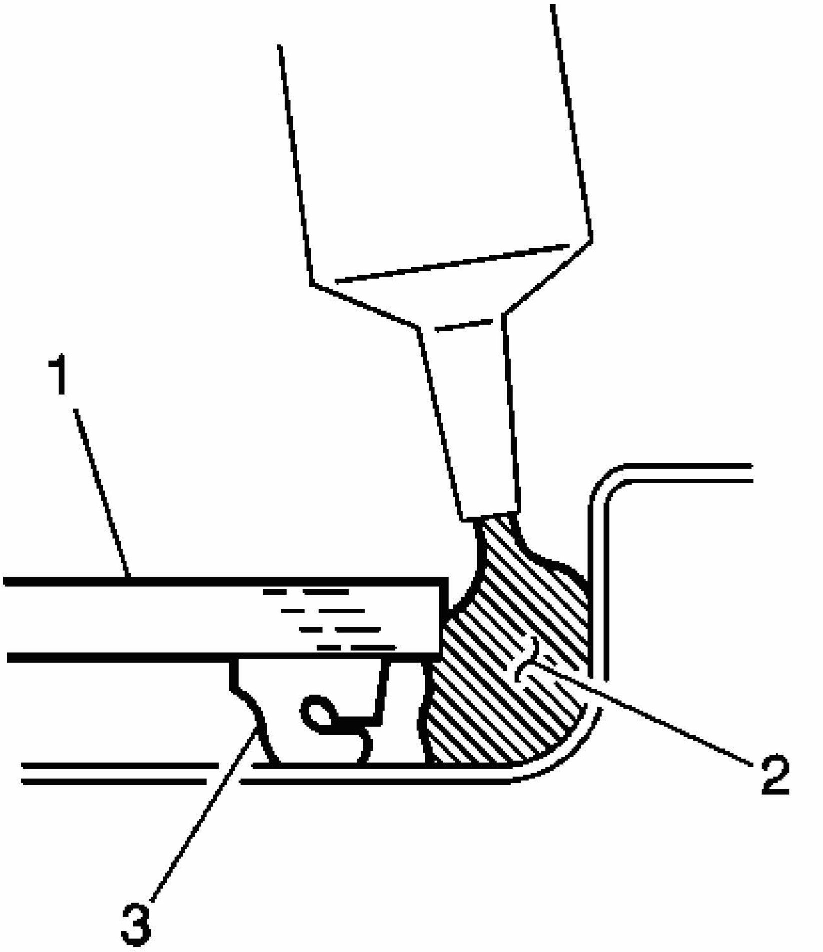


Fig. 13: Applying Urethane Adhesive Between Window & Pinch-Weld
Courtesy of GENERAL MOTORS CORP.

6. Apply a small bead of urethane adhesive (2) between the window (1) and the pinch-

weld.

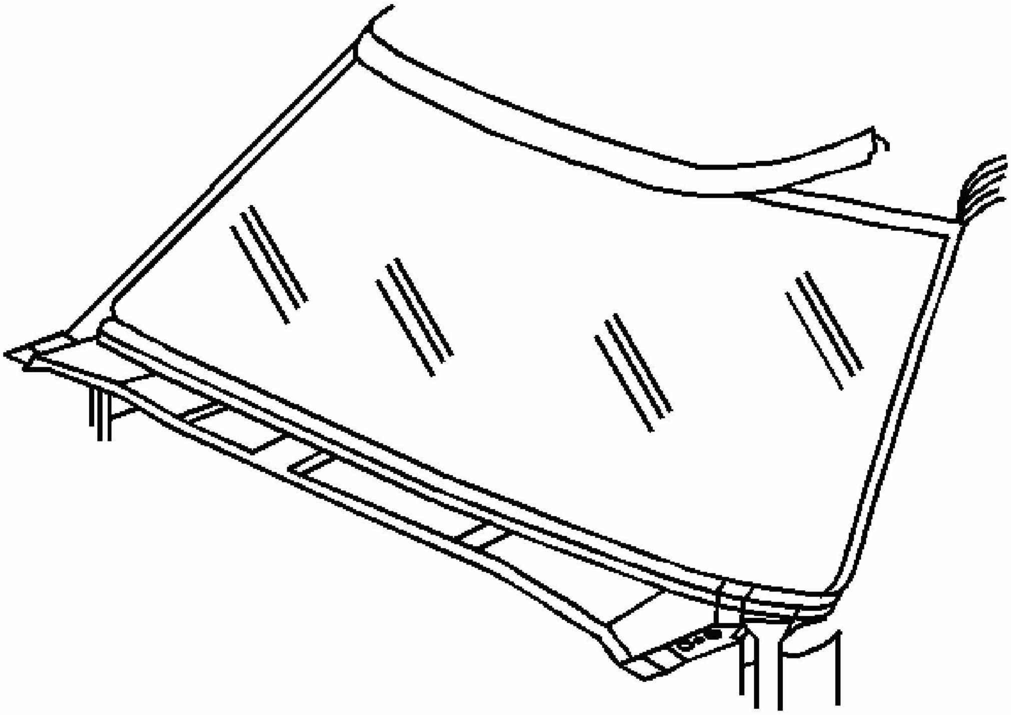


Fig. 14: View Of Window Reveal Molding
Courtesy of GENERAL MOTORS CORP.

7. Reinstall the window reveal molding.
    1. Start from the loose area and hand-press the reveal molding into place over the edge of the window.
    2. Run warm water over the reveal molding in order to speed the setup time of the urethane adhesive.
    3. Tape should be applied in order to retain the reveal molding to the window. This will maintain a flush fit with the body.
    4. The tape is to be removed after 6 hours.

WINDSHIELD REVEAL MOLDING REPLACEMENT

The windshield reveal molding is an applied molding design separate from the window. The reveal molding is bonded to the windshield and may be bonded to the body. The reveal molding may be replaced with the windshield as an assembly, or the reveal molding may be available as a separate service part. Refer to **Urethane Adhesive Installation of Stationary**

Windows.

REAR WINDOW REVEAL MOLDING REPLACEMENT

The rear window reveal molding is an applied molding design separate from the window. The rear window reveal molding is bonded to the rear window and may be bonded to the body. The rear window reveal molding may be replaced with rear window as an assembly, or the rear window reveal molding may be available as a separate service part. Refer to **Urethane Adhesive Installation of Stationary Windows**.

REARVIEW MIRROR REPLACEMENT

Removal Procedure

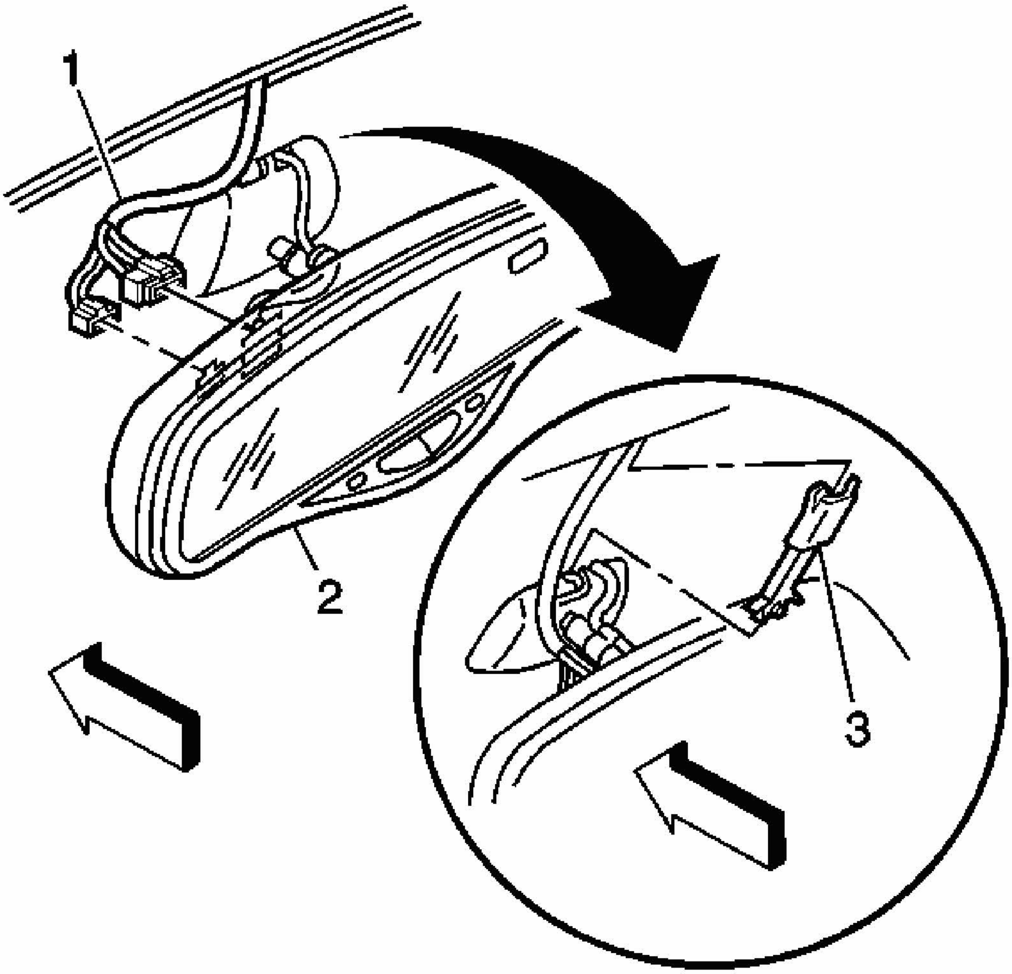


Fig. 15: Rearview Mirror Electrical Connector

Courtesy of GENERAL MOTORS CORP.

1. Disconnect the electrical connector (3) from the back of the mirror.
2. Remove the wire harness cover.
3. Adjust the mirror to the full upward position.
4. Remove the base trim cover.

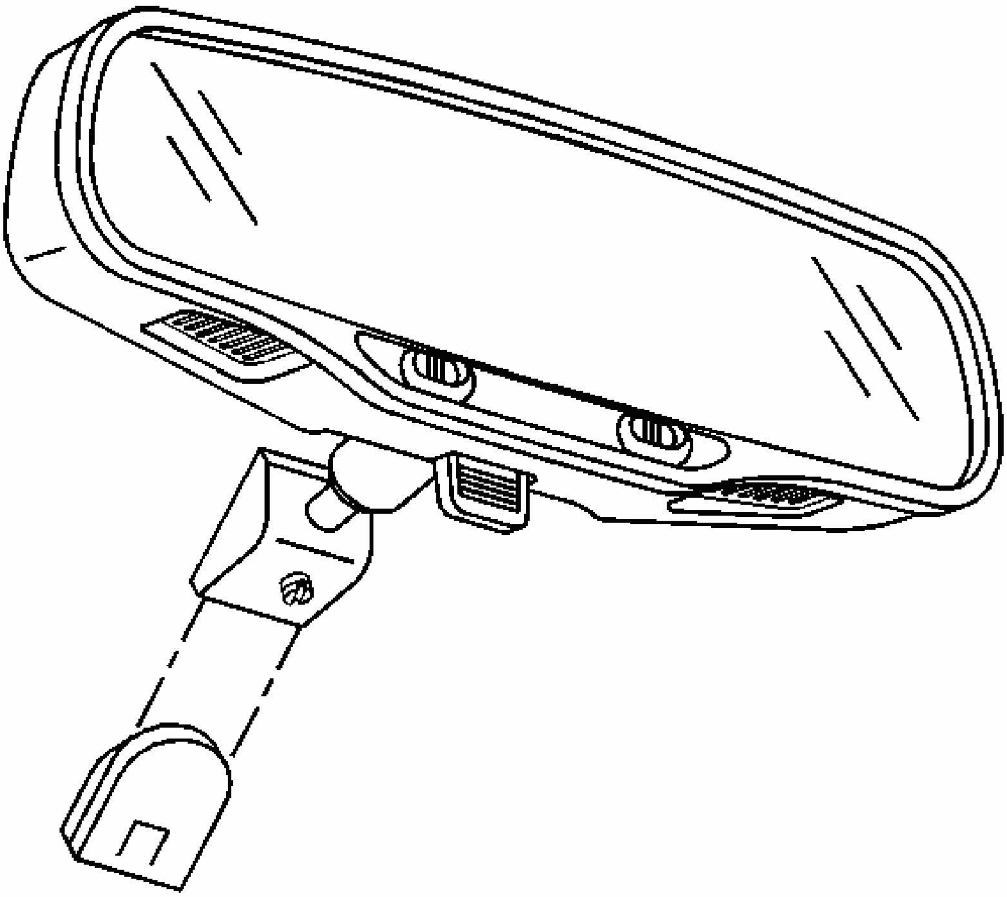


Fig. 16: Removing/Installing Rearview Mirror
Courtesy of GENERAL MOTORS CORP.

5. Loosen the screw at the base in order to remove the mirror from the button.
6. Slide the mirror in an upward motion in order to remove.

Installation Procedure

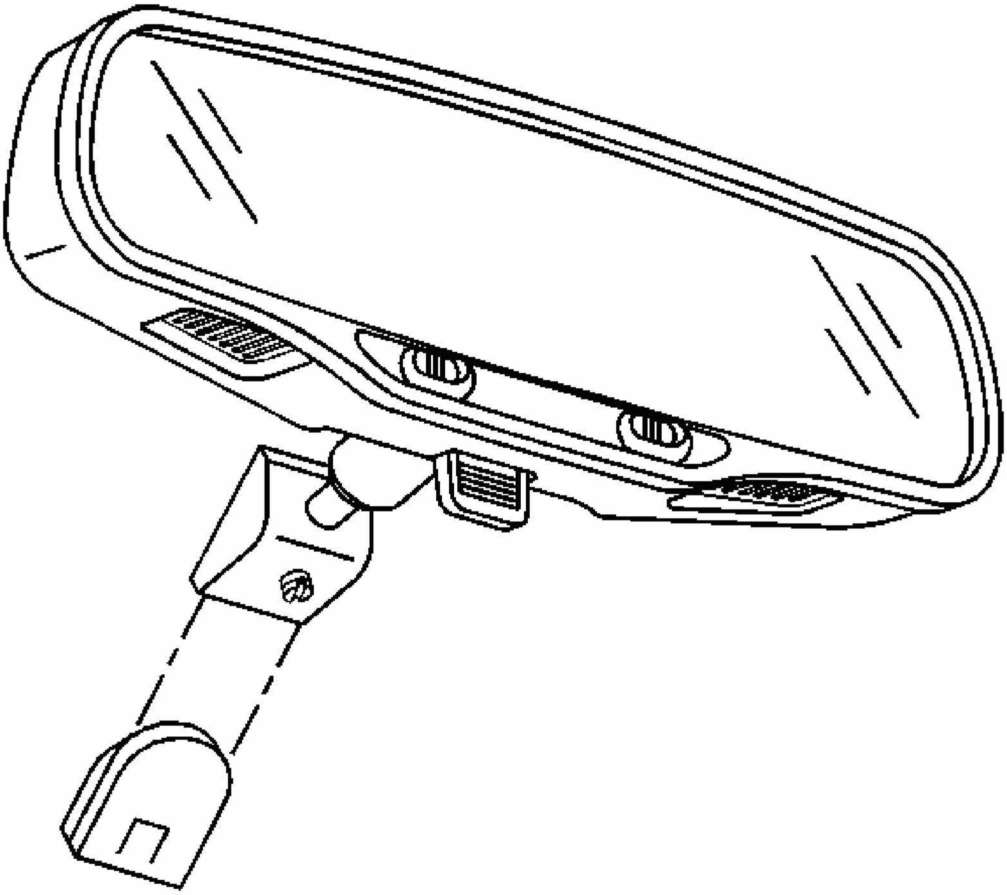


Fig. 17: Removing/Installing Rearview Mirror
Courtesy of GENERAL MOTORS CORP.

1. Position the center bottom of the mirror mount against the windshield at the top of the support button.
2. Slide the base of the mirror onto the button.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

3. Make sure the mirror is firmly seated on the windshield button by pushing down on the base of the mirror.

   Tighten: Tighten the screw (3) to 1.8 N.m (16 lb in) in order to secure the mirror base to the button.

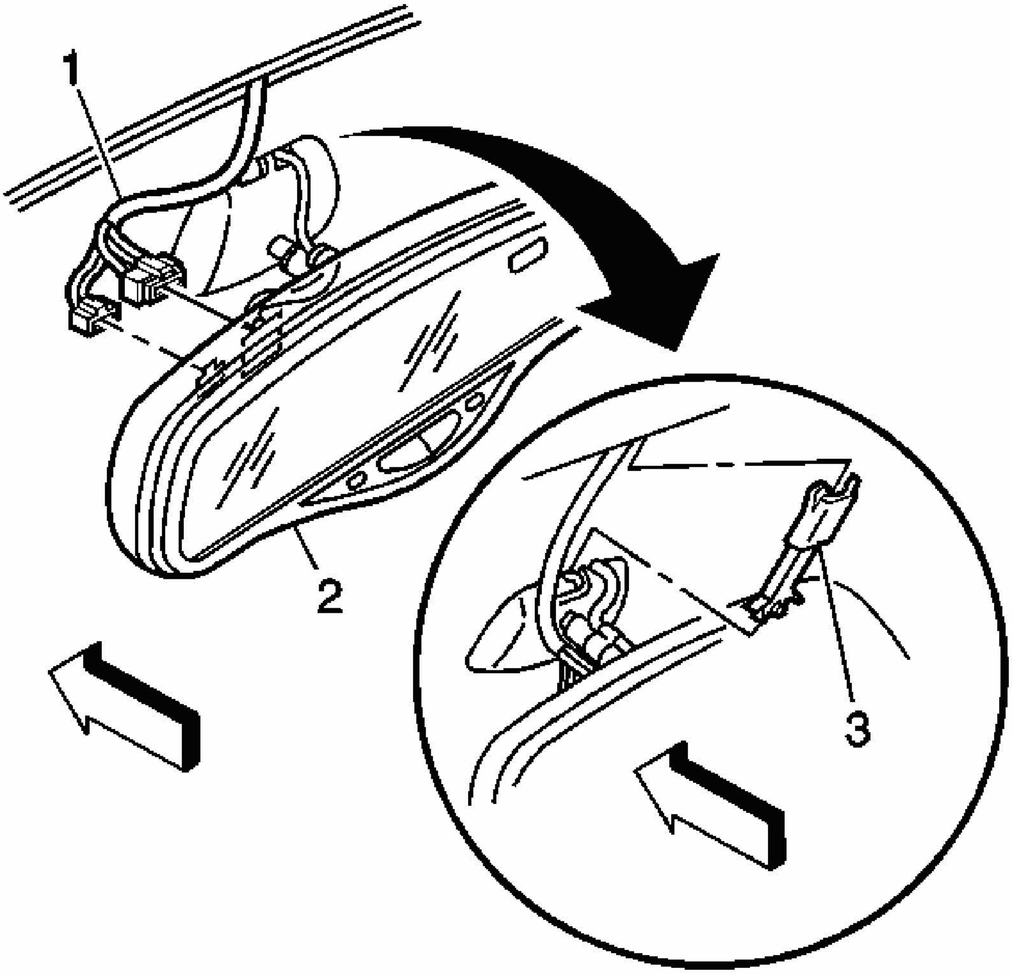


Fig. 18: Rearview Mirror Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Install the base trim cover.
5. Connect the electrical connector (3) to the back of the mirror.
6. Install the wire harness cover.
7. Reposition the mirror.

REARVIEW MIRROR SUPPORT INSTALLATION

Tools Required

- Inside Mirror Adhesive Kit GM P/N 1052369 (Canadian P/N 993362), or equivalent
- Safety Razor or Utility Knife

1. Determine the location of the mirror mounting base by marking the outside of the windshield with a marking pencil where the base was previously located. If it is not clear where the base was mounted, use the following steps to determine where the base should be installed:

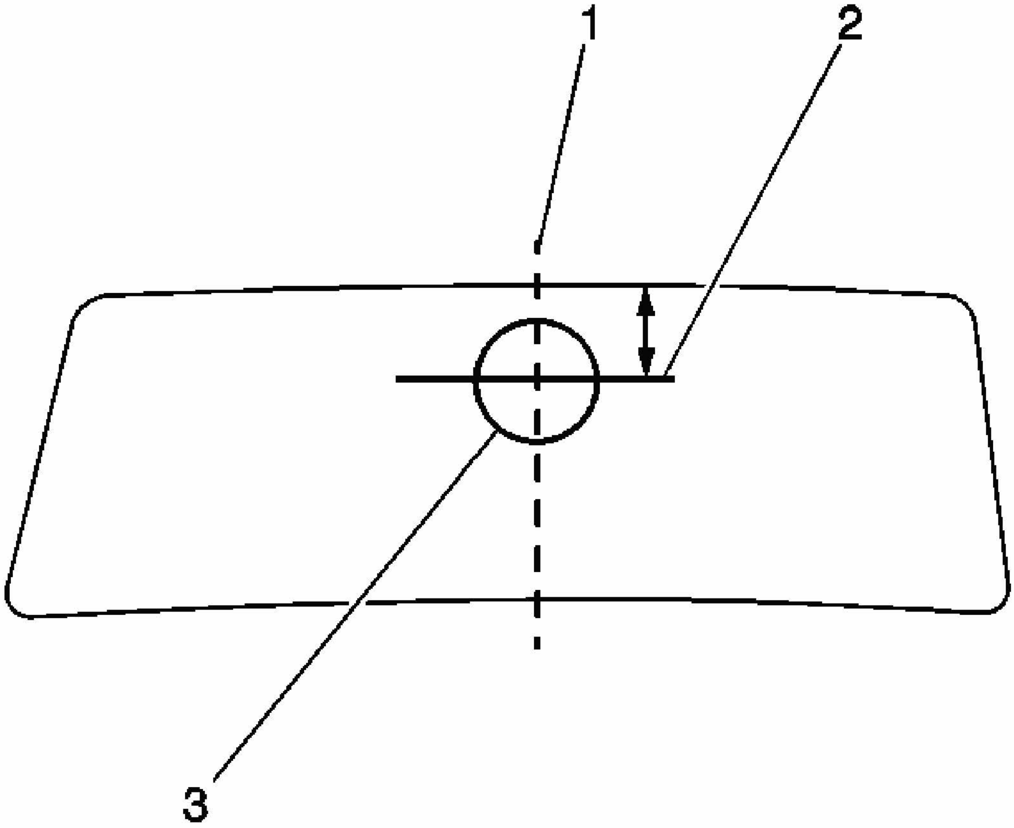


Fig. 19: Identifying Mirror Mounting Base Location
Courtesy of GENERAL MOTORS CORP.

   1. Using a measuring tape, measure the distance between the windshield pillars from the base of the shade line .
   2. Using a marking pencil, halfway between the windshield pillars, draw a centerline (1) on the windshield from the roof panel to the windshield base.
   3. Draw a perpendicular line intersecting the centerline (2) at that location.

      The top center of the mirror mounting base will be at the intersection of these lines.

2. Scrape the inside windshield thoroughly with a safety razor or utility knife in order to

remove all old adhesive.

3. If reinstalling the original mounting base, place the mirror mounting base in a suitable holding device, such as a vise.
4. Clean the mirror mounting base thoroughly with a safety razor or utility knife in order to remove all old adhesive.
5. Clean the inside windshield and the mounting surface of the mirror mounting base thoroughly with a clean cloth saturated with naphtha or a 50/50 mixture (by volume) of clean water and isopropyl alcohol.

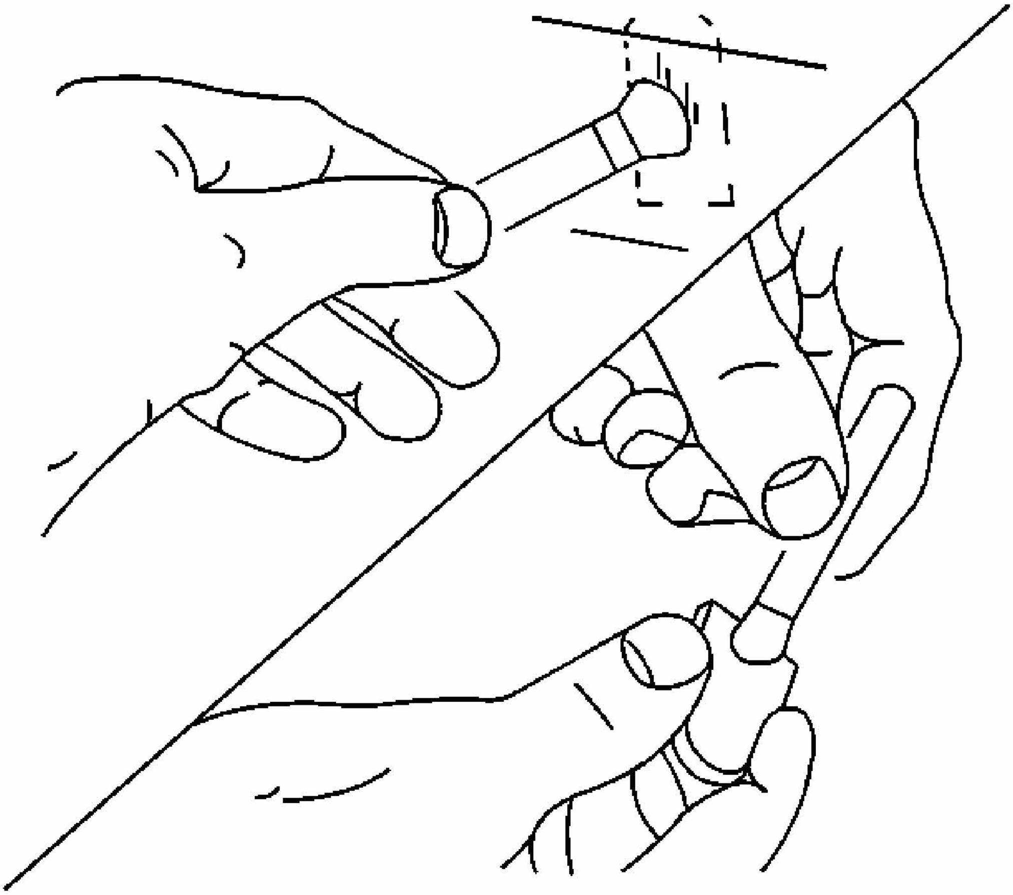


Fig. 20: Applying Adhesive To Mirror Base & Window
Courtesy of GENERAL MOTORS CORP.

6. Use Inside Mirror Adhesive Kit GM P/N 1052369 (Canadian P/N 993362), or equivalent, to apply a small amount of activator to the mounting surface of the mirror mounting base.
7. Apply a small amount of activator to the windshield where the mounting base is to be

installed.

8. Allow the activator to dry 5 minutes.

IMPORTANT: Do not touch the mounting surface of the mirror mounting base or the window.

9. Apply 1 drop of adhesive to the center of the mirror mounting base.

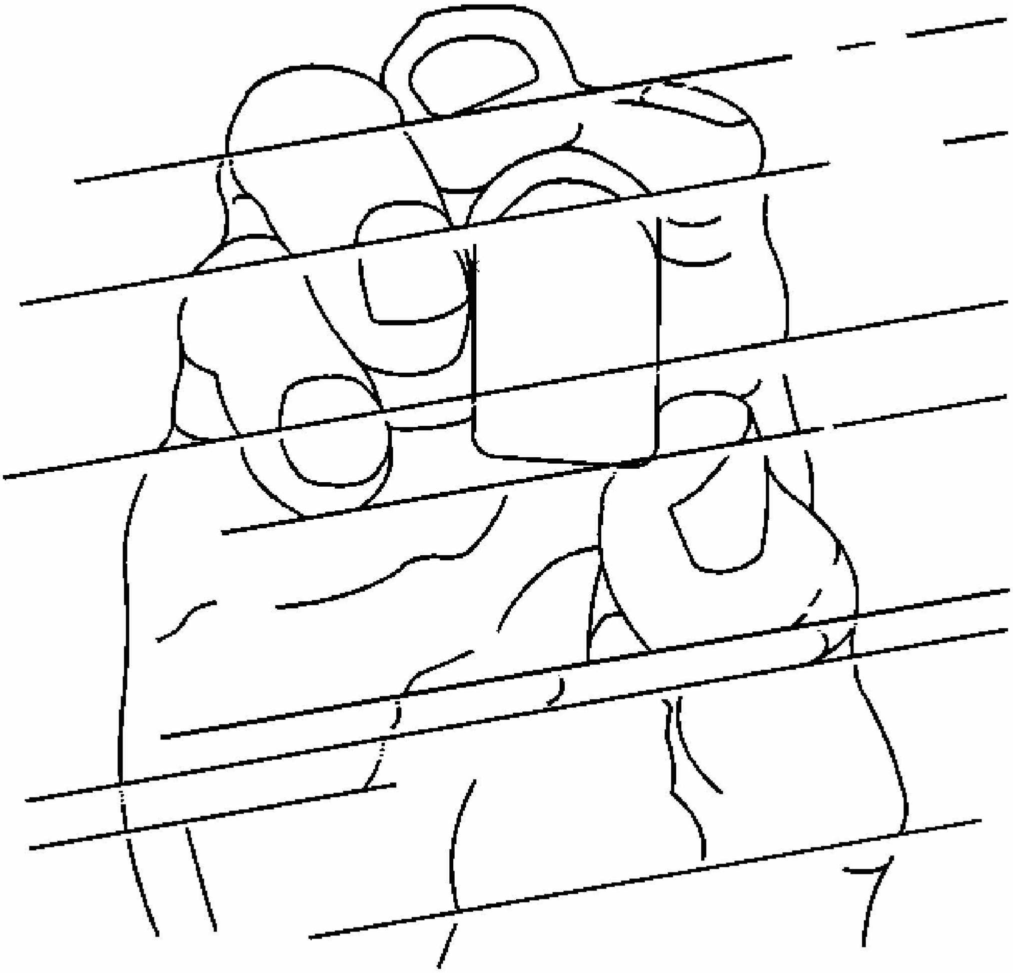


Fig. 21: Installing Mirror Mounting Base
Courtesy of GENERAL MOTORS CORP.

10. Immediately apply the mounting base to the windshield, ensuring that the mounting base aligns correctly to the marks made on the outside of the windshield.
11. Hold the mounting base firmly in place for 1 minute.

12. Allow the adhesive to set for 15 minutes.
13. Install the mirror to the mirror mounting base and fasten, if necessary.
14. Connect the electrical connector and install the wire cover, if equipped.

WINDSHIELD REPLACEMENT

Tools Required

- **J 24402-A** Glass Sealant Cold Knife Remover. See **Special Tools**.
- **J 39032** Stationary Glass Removal Tool. See **Special Tools**.
- Urethane Adhesive Kit GM P/N 12346392 or Equivalent
- Isopropyl Alcohol or Equivalent
- Cartridge-type Caulking Gun
- Commercial-type Utility Knife
- Razor Blade Scraper
- Suction Cups
- Plastic Paddle

Removal Procedure

IMPORTANT: Before cutting out a stationary window, apply a double layer of masking tape around the perimeter of the painted surfaces and the interior trim.

1. Open the hood.
2. Remove the windshield wiper arms and blades. Refer to **Wiper Arm Replacement** in Wipers/Washers Systems.
3. Remove the air inlet grille. Refer to **Air Inlet Grille Panel Replacement** in Body Front End.
4. Remove the windshield garnish moldings. Refer to **Garnish Molding Replacement - Windshield Pillar (Impala)** or **Garnish Molding Replacement - Windshield Pillar (Monte Carlo)** in Interior Trim.
5. Remove the rearview mirror. Refer to **Rearview Mirror Replacement** in Squeaks and Rattles.

CAUTION: If broken glass falls into the defroster outlets, it can be blown into the passenger compartment and cause personal injury.

6. Cover to protect the following parts from broken glass:
    1. Upper dash pad.

2. Defroster outlets and A/C outlets.
3. Seats and carpeting.

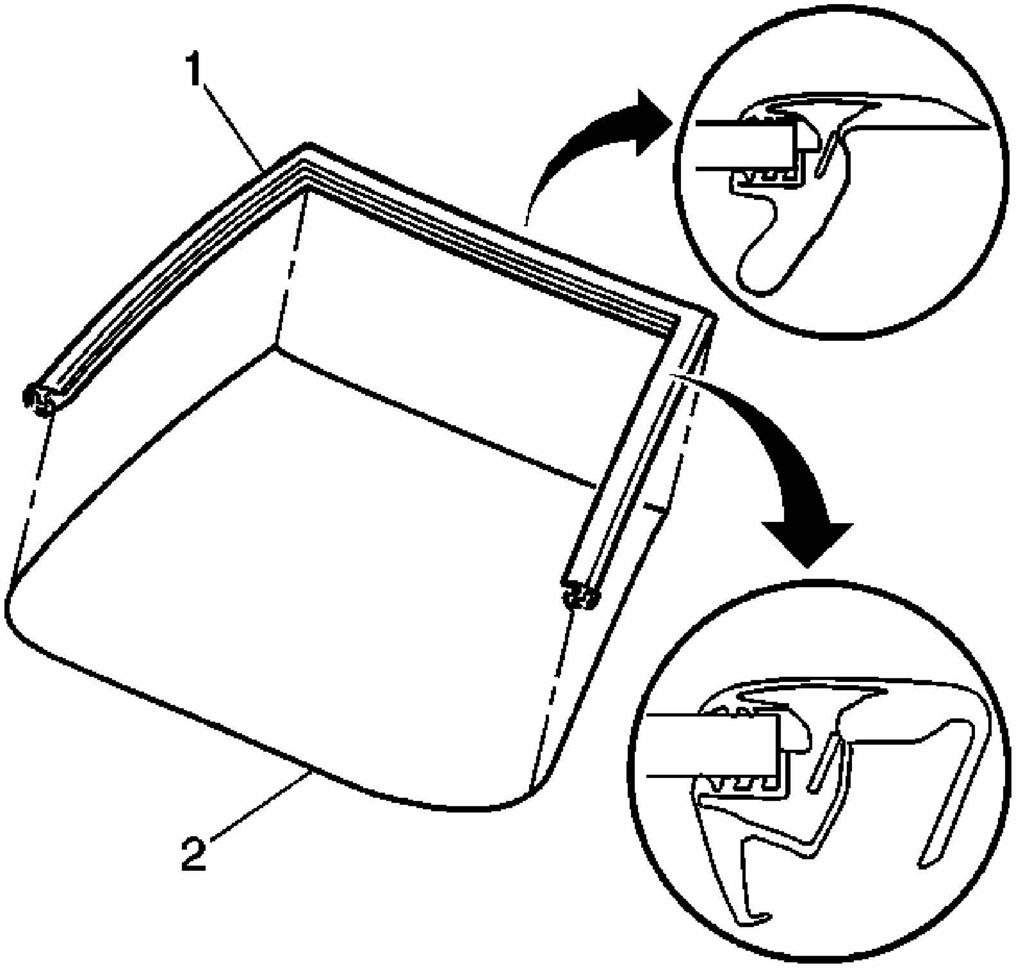


Fig. 22: Identifying Windshield Reveal Molding
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to GLASS AND SHEET METAL HANDLING CAUTION in Cautions and Notices.

IMPORTANT: The windshield reveal molding (1) is a one piece molding and fills the cavities between the body and windshield (2).

7. If the windshield reveal molding (1) is stretched or damaged it can not be reused.

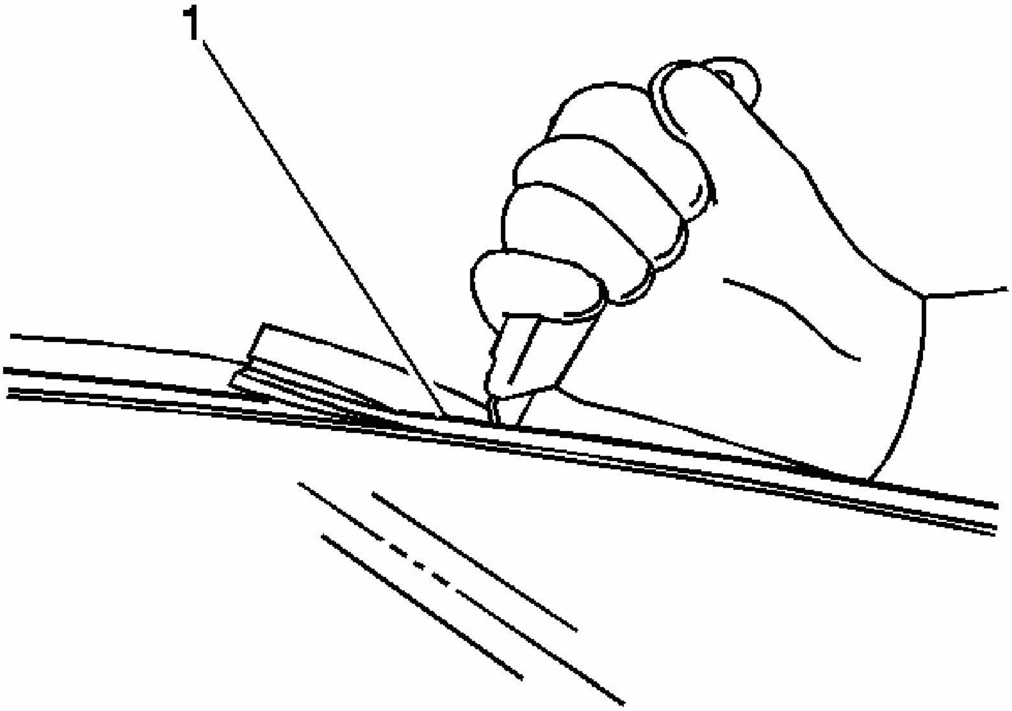


Fig. 23: Using Utility Knife To Remove Reveal Molding
Courtesy of GENERAL MOTORS CORP.

8. Remove the windshield reveal molding (1). Refer to **Windshield Reveal Molding Replacement**.

   Grasp the lower corner of the windshield reveal molding by hand and slowly pull the reveal molding away from the windshield.

   If the windshield reveal molding will not release, use a utility knife in order to cut around the windshield in order to remove the windshield reveal molding.

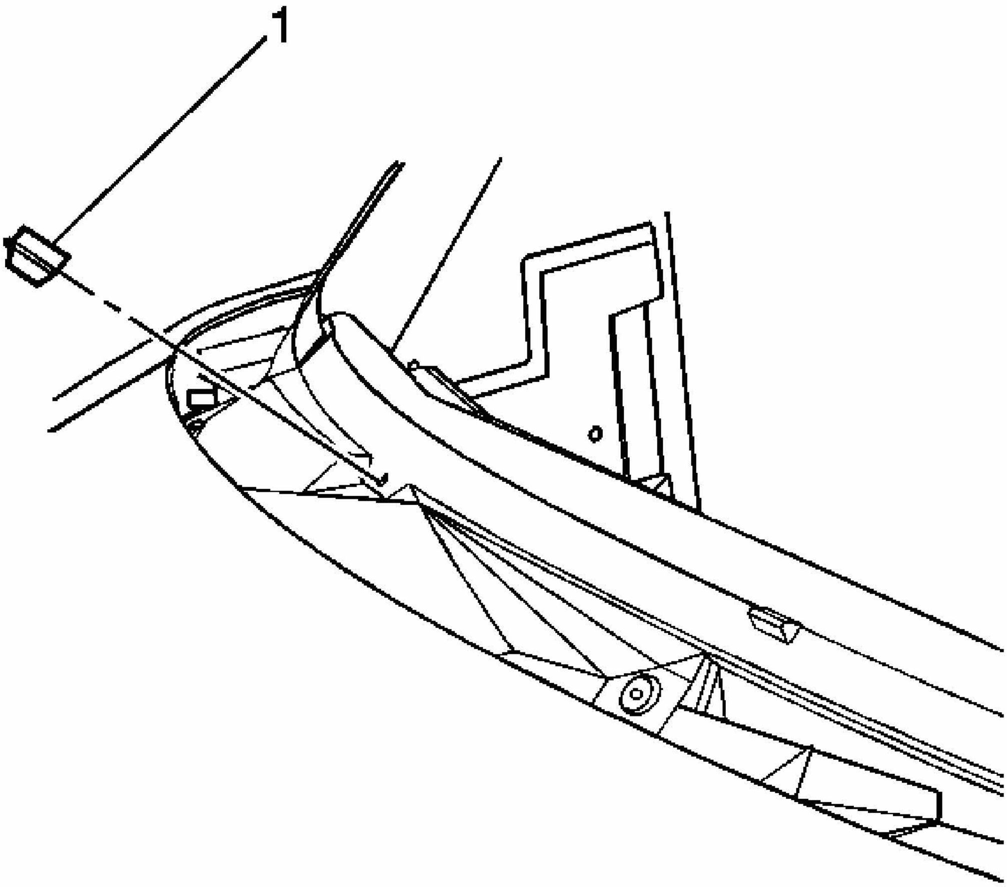


Fig. 24: Identifying Lower Windshield Supports
Courtesy of GENERAL MOTORS CORP.

9. Remove the lower windshield supports (1) from the cowl panel, if equipped.

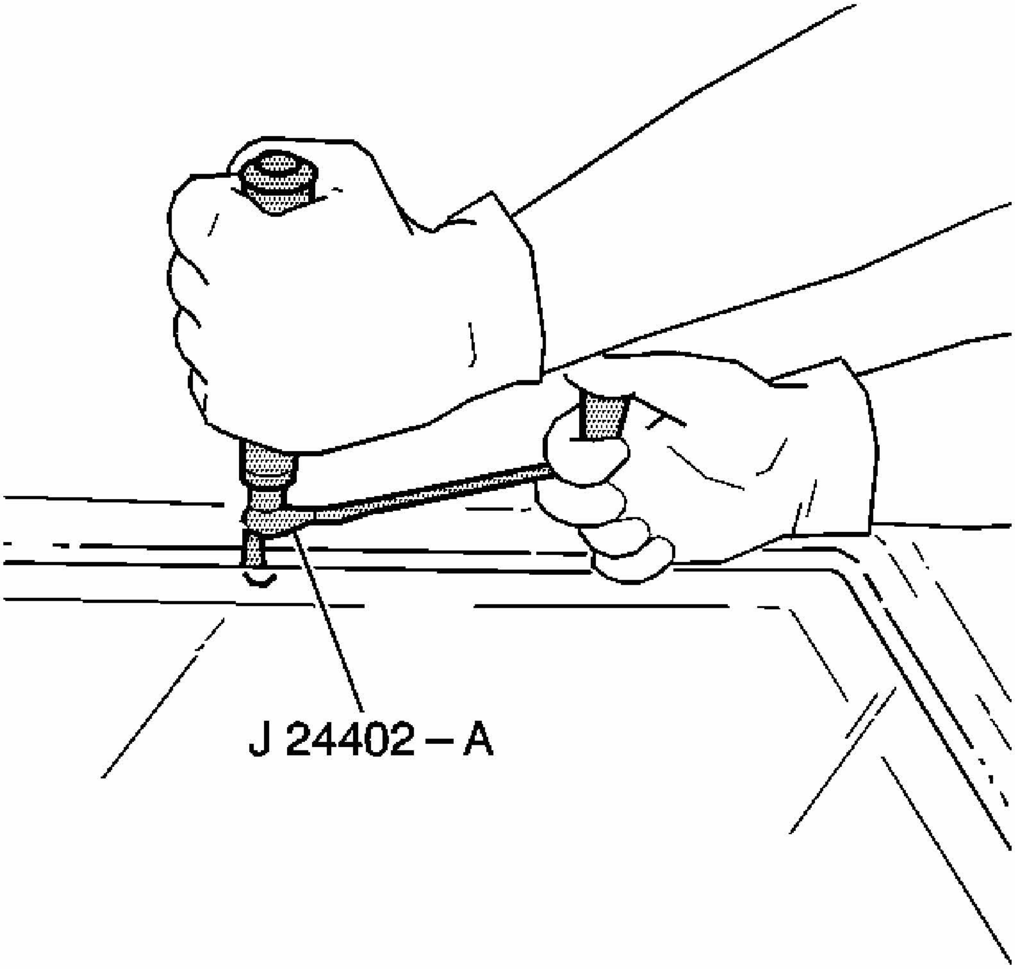


Fig. 25: Separating Urethane Adhesive From Window
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Keep the cutting edge of the tool against the window.

10. This will allow the urethane adhesive to be separated from the window.
    - Leave a base of urethane on the pinch-weld flange.
    - The only suitable lubrication is clear water.
    - Use**J 24402-A** , **J 39032** or equivalent in order to remove the window. See **Special Tools**.

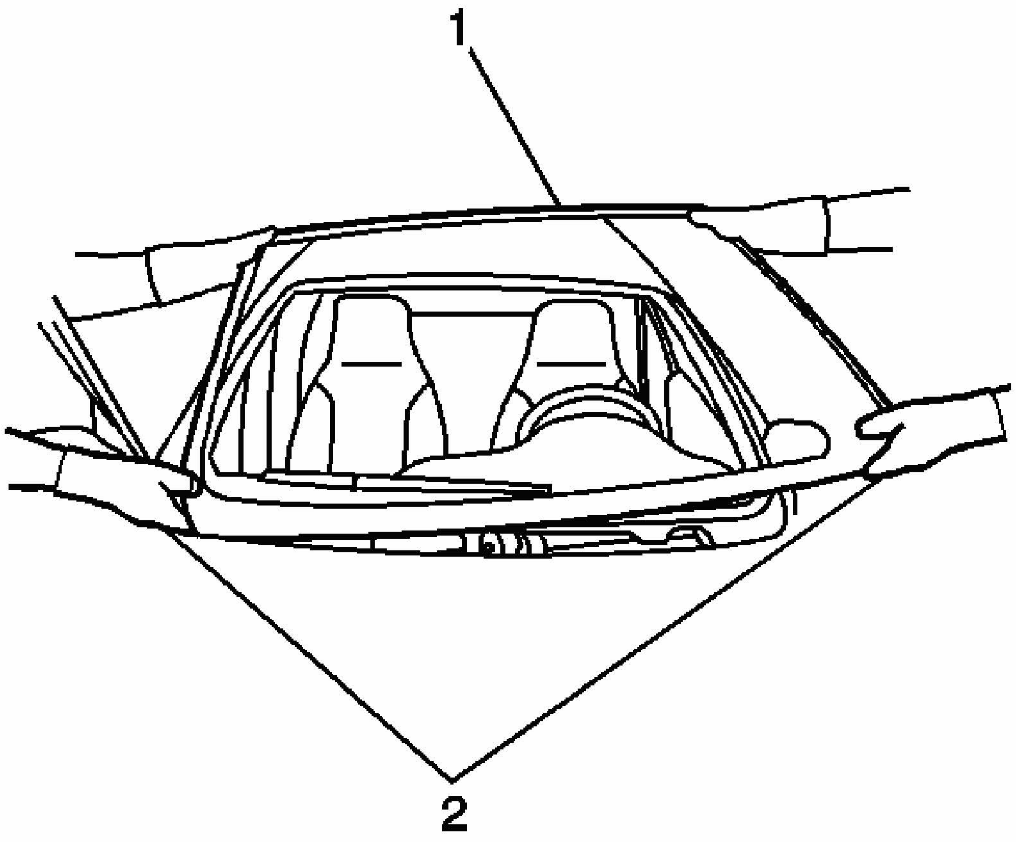


Fig. 26: Removing/Installing Windshield
Courtesy of GENERAL MOTORS CORP.

11. Remove the windshield (1) from the vehicle with the aid of an assistant (2).

Installation Procedure

1. Install a stationary window into the opening. Refer to **Urethane Adhesive Installation of Stationary Windows**.
2. Install the rearview mirror. Refer to **Rearview Mirror Replacement** in Squeaks and Rattles.
3. Install the windshield garnish molding. Refer to **Garnish Molding Replacement - Windshield Pillar (Impala)** or **Garnish Molding Replacement - Windshield Pillar (Monte Carlo)** in Interior Trim.
4. Install the air inlet grille. Refer to **Air Inlet Grille Panel Replacement** in Body Front End.
5. Install the windshield wipers arms and blades. Refer to **Wiper Arm Replacement** in

Wipers/Washer Systems.

6. Remove the double layer of masking tape around the perimeter of the painted surfaces and the interior trim.
7. Close the hood.

QUARTER WINDOW REPLACEMENT (MONTE CARLO)

Tools Required

- **J 39032** Stationary Glass Removal Tool. See **Special Tools**.
- Urethane Adhesive Kit GM P/N 12346392 or Equivalent
- Isopropyl Alcohol or Equivalent
- Cartridge-type Caulking Gun
- Commercial-type Utility Knife
- Razor Blade Scraper
- Suction Cups
- Plastic Paddle

Removal Procedure

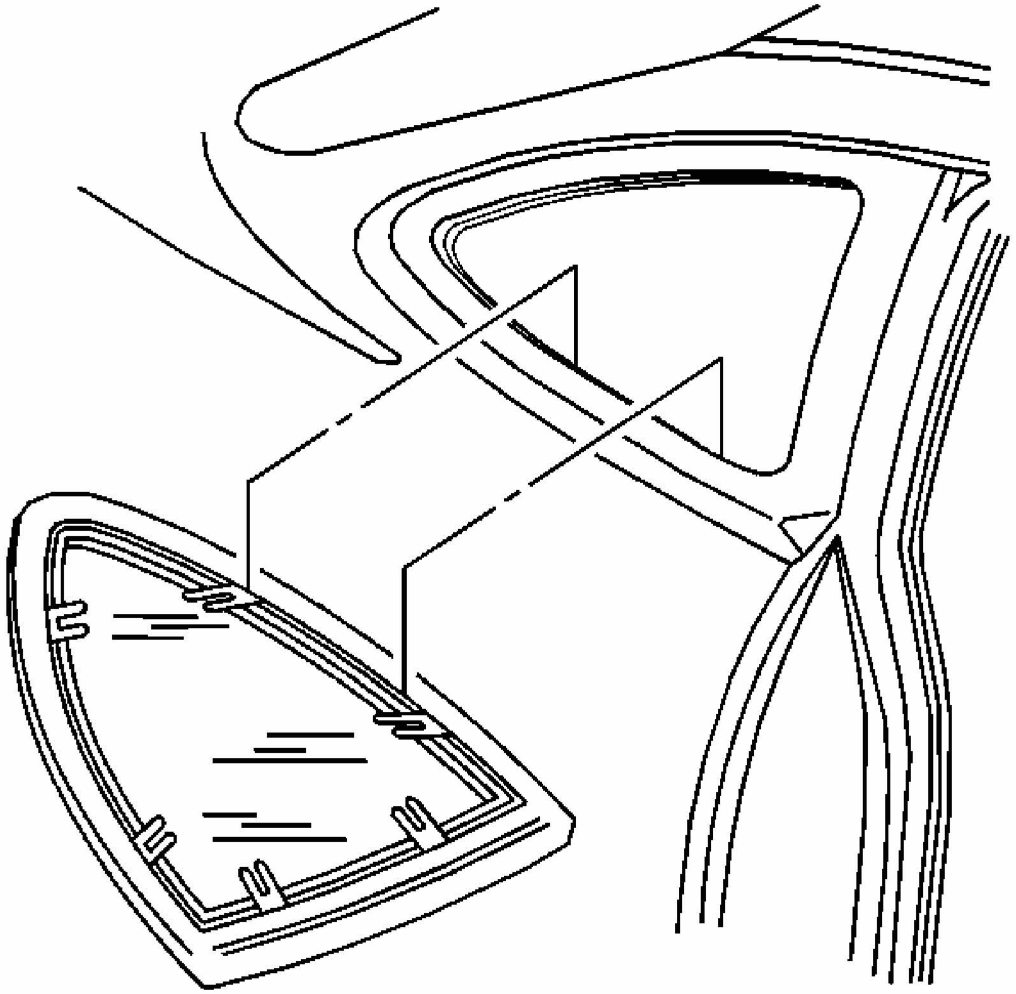


Fig. 27: View Of Rear Quarter Trim
Courtesy of GENERAL MOTORS CORP.

CAUTION: If a window is cracked but still intact, crisscross the window with masking tape in order to reduce the risk of damage or personal injury.

IMPORTANT: Before cutting out a stationary window, apply a double layer of masking tape around the perimeter of the painted surfaces and inner trim.

1. Remove the rear quarter upper trim. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper**

(Monte Carlo) in Interior Trim.

2. Remove the rear quarter lower trim. Refer to **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)** in Interior Trim.

CAUTION: Refer to GLASS AND SHEET METAL HANDLING CAUTION in Cautions and Notices.

IMPORTANT: Keep the cutting edge of the tool against the window. Do this from inside the vehicle to protect the outer painted surface.

3. This will allow the urethane adhesive to be separated from the window.
    - Leave a base of urethane on the pinch-weld flange.
    - The only suitable lubrication is clear water.
    - Use**J 39032** or equivalent in order to remove the window. See **Special Tools**.
    - Remove the quarter modular window from the pinch-weld flange.

Installation Procedure

1. Install a stationary window into the opening. Refer to **Urethane Adhesive Installation of Stationary Windows**.
2. Install the rear quarter lower trim. Refer to **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)** in Interior Trim.
3. Install the rear quarter upper trim panel. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** in Interior Trim.
4. Remove the double layer of masking tape around the perimeter of the painted surfaces and the interior trim.

QUARTER WINDOW REPLACEMENT (IMPALA)

Tools Required

- **J 39032** Stationary Glass Removal Tool. See **Special Tools**.
- Urethane Adhesive Kit GM P/N 12346392 or Equivalent
- Isopropyl Alcohol or Equivalent
- Cartridge-type Caulking Gun
- Commercial-type Utility Knife
- Razor Blade Scraper

- Suction Cups
- Plastic Paddle

Removal Procedure

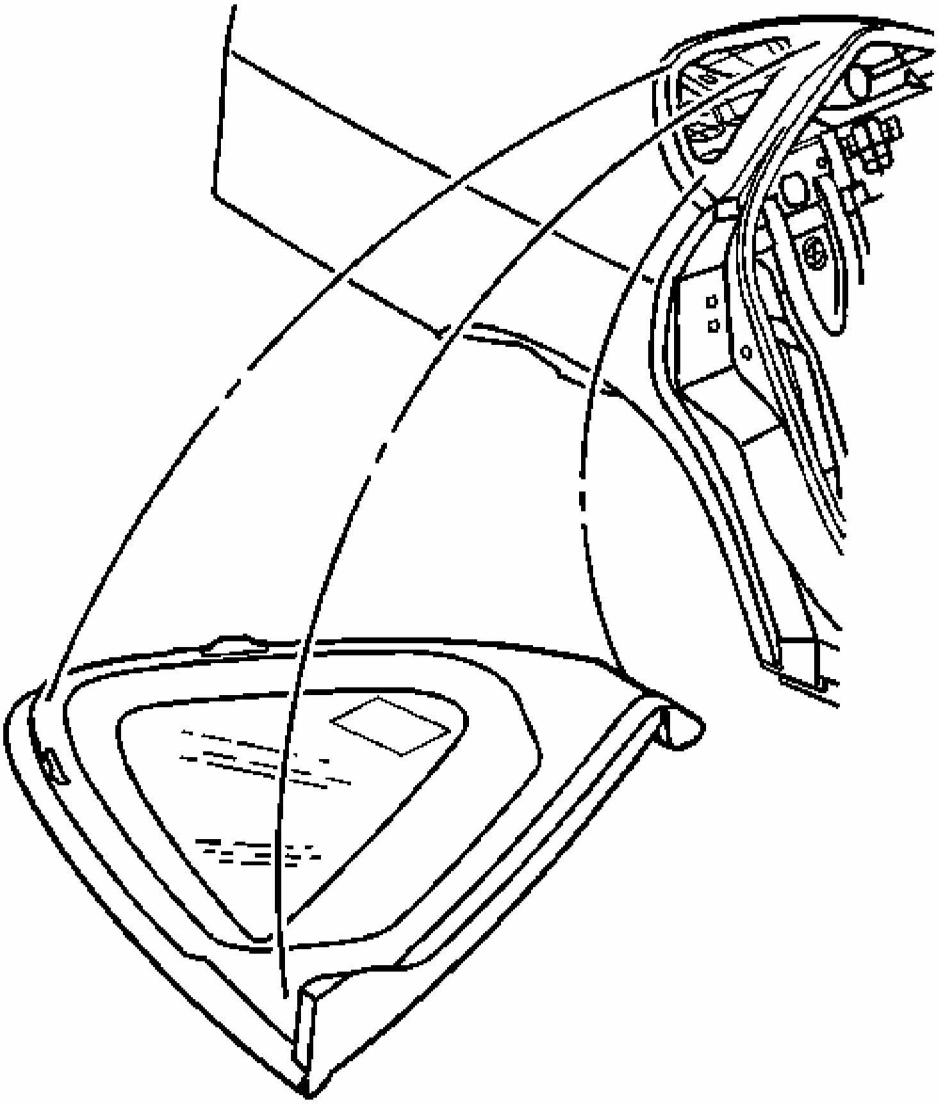


Fig. 28: Quarter Panel (Impala)
Courtesy of GENERAL MOTORS CORP.

CAUTION: If a window is cracked but still intact, crisscross the window with masking tape in order to reduce the risk of

damage or personal injury.

IMPORTANT: Before cutting out a stationary window, apply a double layer of masking tape around the perimeter of the painted surfaces and inner trim of the window.

1. Remove the rear quarter upper trim. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** in Interior Trim.
2. Remove the rear quarter lower trim. Refer to **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)** in Interior Trim.

CAUTION: Refer to GLASS AND SHEET METAL HANDLING CAUTION in Cautions and Notices.

IMPORTANT: Keep the cutting edge of the tool against the window. Do this from inside the vehicle to protect the outer painted surface.

3. This will allow the urethane adhesive to be separated from the window.
    - Leave a base of urethane on the pinch-weld flange.
    - The only suitable lubrication is clear water.
    - Use **J 39032** or equivalent in order to remove the window. See **Special Tools**.
    - Remove the quarter modular window from the pinch-weld flange.

Installation Procedure

1. Install a stationary window into the opening. Refer to **Urethane Adhesive Installation of Stationary Windows**.
2. Install the rear quarter lower trim. Refer to **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)** in Interior Trim.
3. Install the rear quarter upper trim panel. Refer to **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** in Interior Trim.
4. Remove the double layer of masking tape around the perimeter of the painted surfaces and the interior trim.

URETHANE ADHESIVE INSTALLATION OF STATIONARY WINDOWS

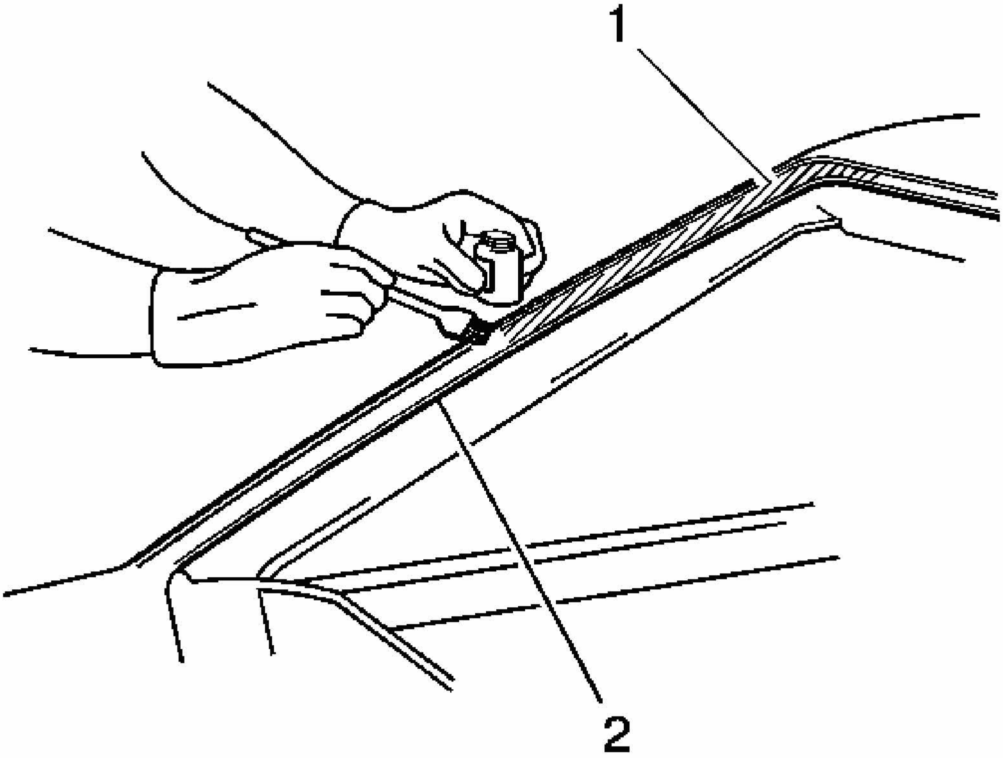


Fig. 29: Applying Pinch-Weld Primer
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to GLASS AND SHEET METAL HANDLING CAUTION in Cautions and Notices.

IMPORTANT: Remove all but approximately 2 mm (3/64 in) of the existing bead of urethane adhesive from the pinch-weld flange.

1. Remove all mounds or loose pieces of urethane adhesive from the pinch-weld area.
2. If the original window is being reused, remove all but a thin film of the existing urethane adhesive from the window surface by using a clean utility knife or razor blade scraper.
3. Inspect the following components for the causes of a broken window:
    - The flange of the window opening
    - The window reveal molding
4. Inspect for any of the following problems in order to help prevent future breakage of the window:

- High weld
- Solder spots on the pinchweld
- Hardened sealer
- Any other obstruction or irregularity in the pinch-weld flange

IMPORTANT: If corrosion of the pinch-weld flange is present or if sheet metal repairs or replacements are required, the pinch-weld flange must be refinished in order to restore the bonding area strength. If paint repairs are required, mask the flange bonding area prior to applying the color coat in order to provide a clean primer only surface. Materials such as BASF DE15®, DuPont 2610®, Sherwin-Williams PSE 4600 and NP70® and Martin-Semour 5120 and 5130® PPG DP90LF SPIES/ HECKER 3688/8590 - 3688/5150 - 4070/5090 STANDOX 11158/13320 - 14653/14980 products are approved for this application.

5. After repairing the opening as indicated, perform the following steps:
    1. Remove all traces of broken glass from the outer cowl panel, seats, floor and defroster ducts.
    2. Clean around the edge of the inside surface of the window with a 50/50 mixture of isopropyl alcohol and water by volume on a dampened lint free cloth.

CAUTION: Refer to WINDOW RETENTION CAUTION in Cautions and Notices.

6. Verify all primers and urethane adhesive are within expiration dates.

CAUTION: Failure to prep the area prior to the application of primer may cause insufficient bonding of urethane adhesive. Insufficient bonding of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

IMPORTANT: Do not apply the black #3 primer to the existing bead (1) of the urethane adhesive on the pinch-weld flange. Apply the primer only to nicks, scratches or the primed surfaces.

7. Shake the pinch-weld primer black #3 for at least 1 minute.
8. Use a new dauber in order to apply the primer to the surface of the pinch-weld flange (1).

9. Allow the pinch-weld primer to dry for approximately 10 minutes.

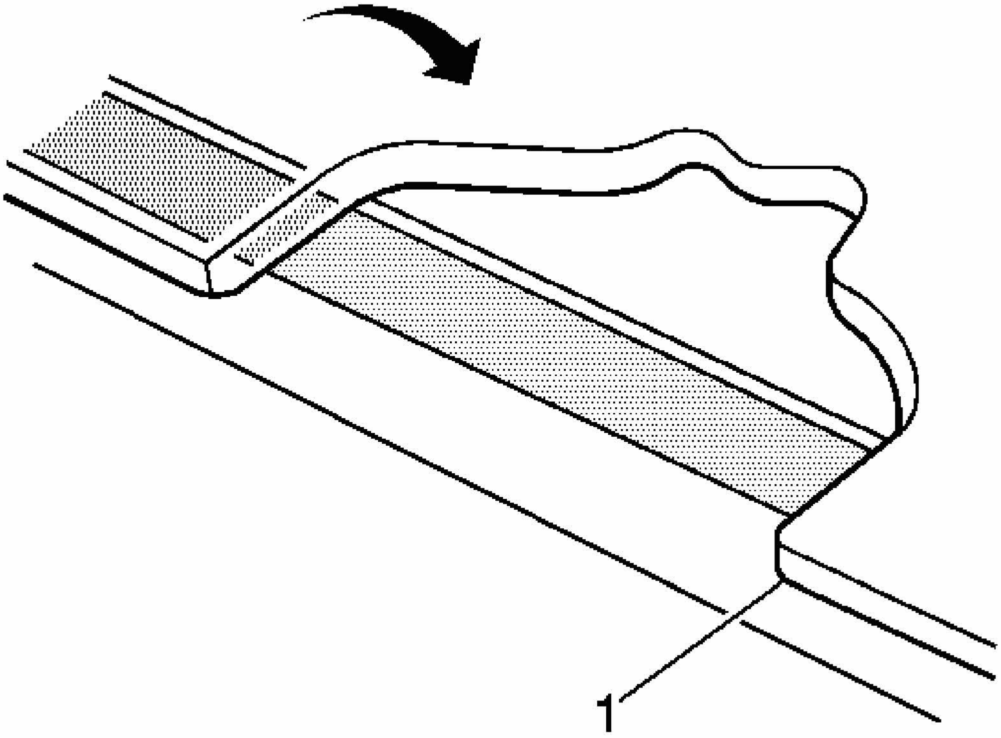


Fig. 30: Identifying Windshield & VIN Plate Filler Strip
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not use spacers when installing a windshield. The stress caused by the spacers may damage the windshield.

10. Install the windshield (1) and the VIN plate filler strip, if equipped.

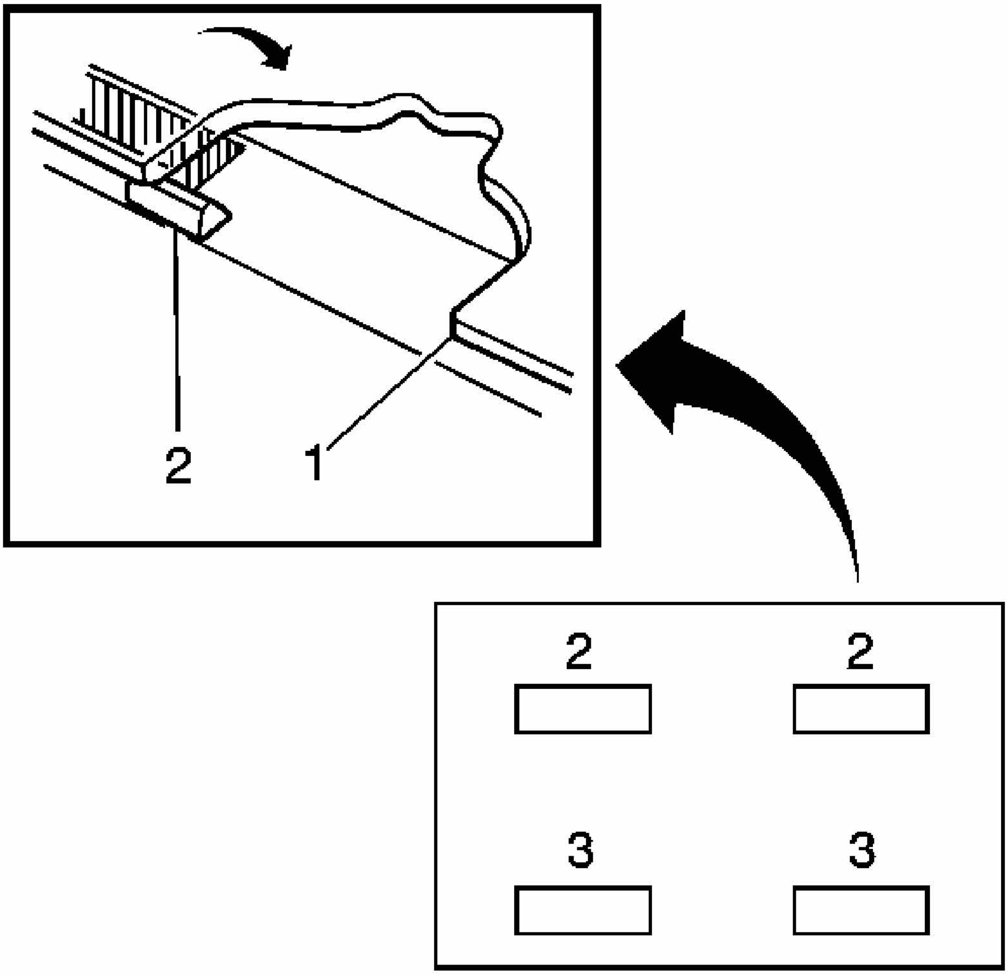


Fig. 31: Positioning Spacers & Blocks
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **When installing spacers (2) and/or blocks (3) space them equally around the quarter window, back window or the liftgate window (1) to aid in the height set, if equipped.**

11. Install the window to the vehicle.

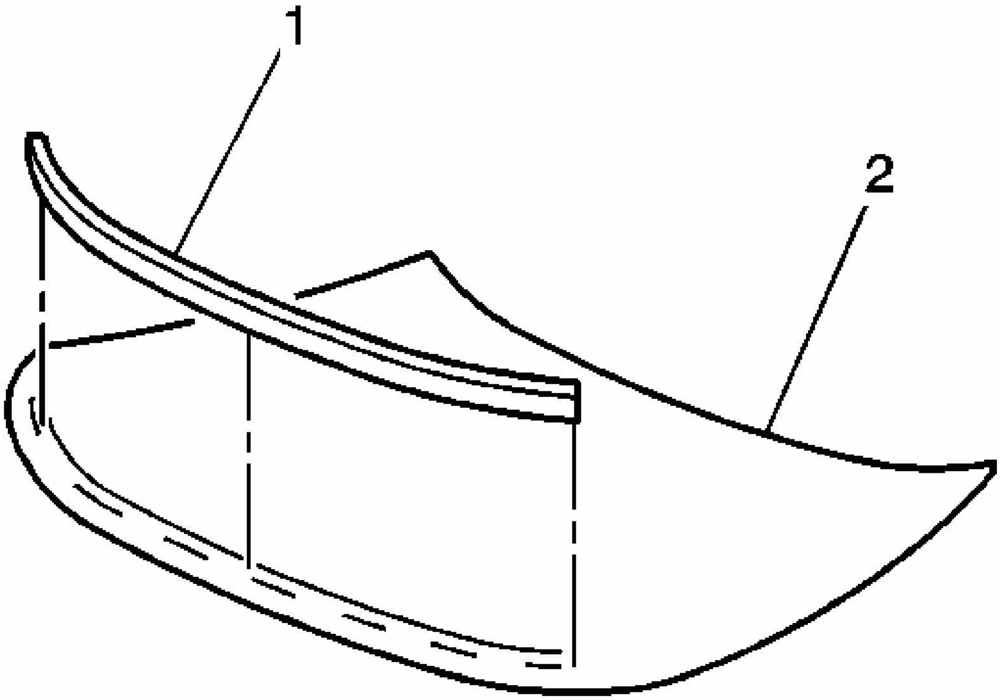


Fig. 32: Identifying Windshield Acoustic Strip
Courtesy of GENERAL MOTORS CORP.

12. Install the new windshield acoustic strip (1) to the windshield (2), if equipped or damaged.

    The acoustic strip aids in reducing noise.

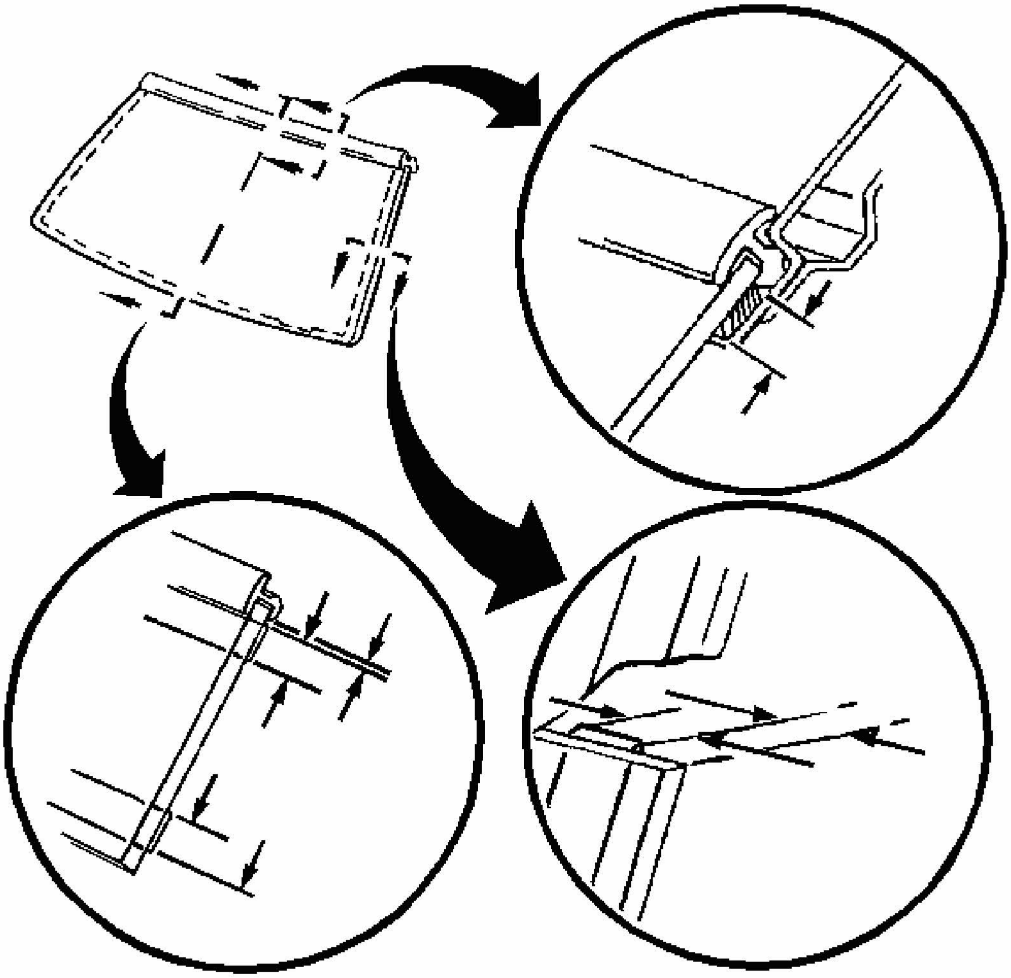


Fig. 33: Identifying Window Reveal Molding Installation Specifics
Courtesy of GENERAL MOTORS CORP.

13. If installing a new window reveal molding, start in the center and work toward each end pressing firmly into place.

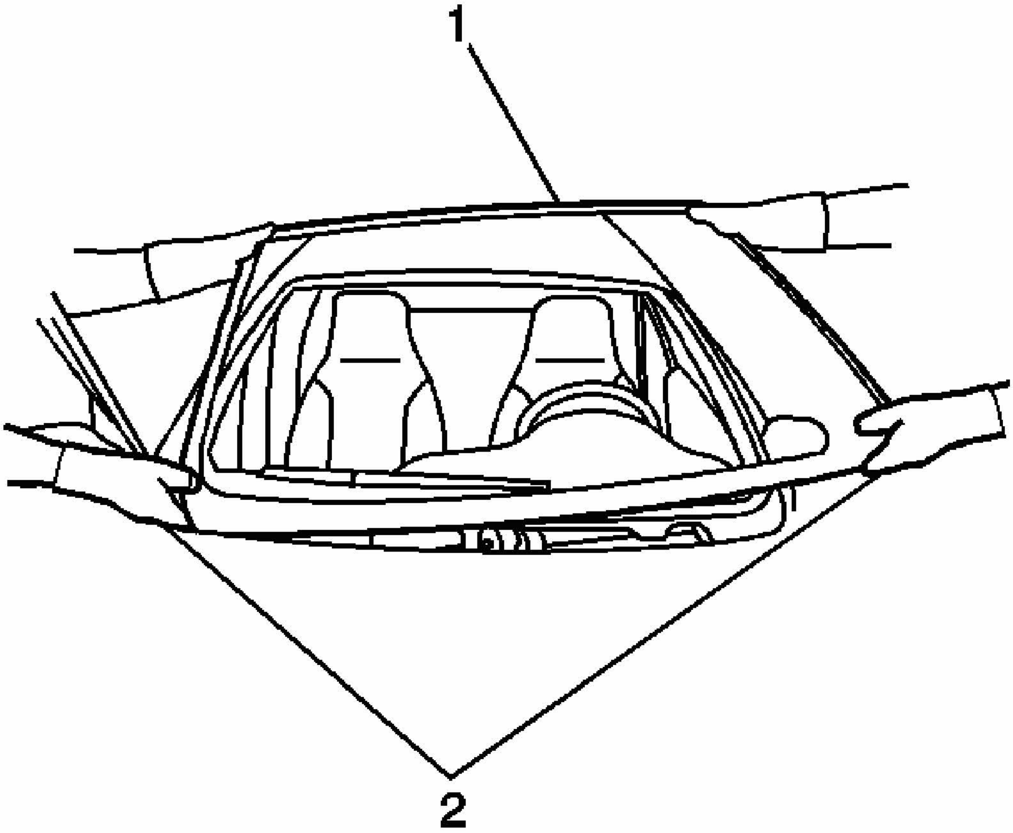


Fig. 34: Removing/Installing Windshield
Courtesy of GENERAL MOTORS CORP.

14. With the aid of an assistant, dry fit the window (1) to the opening in order to determine the correct position.

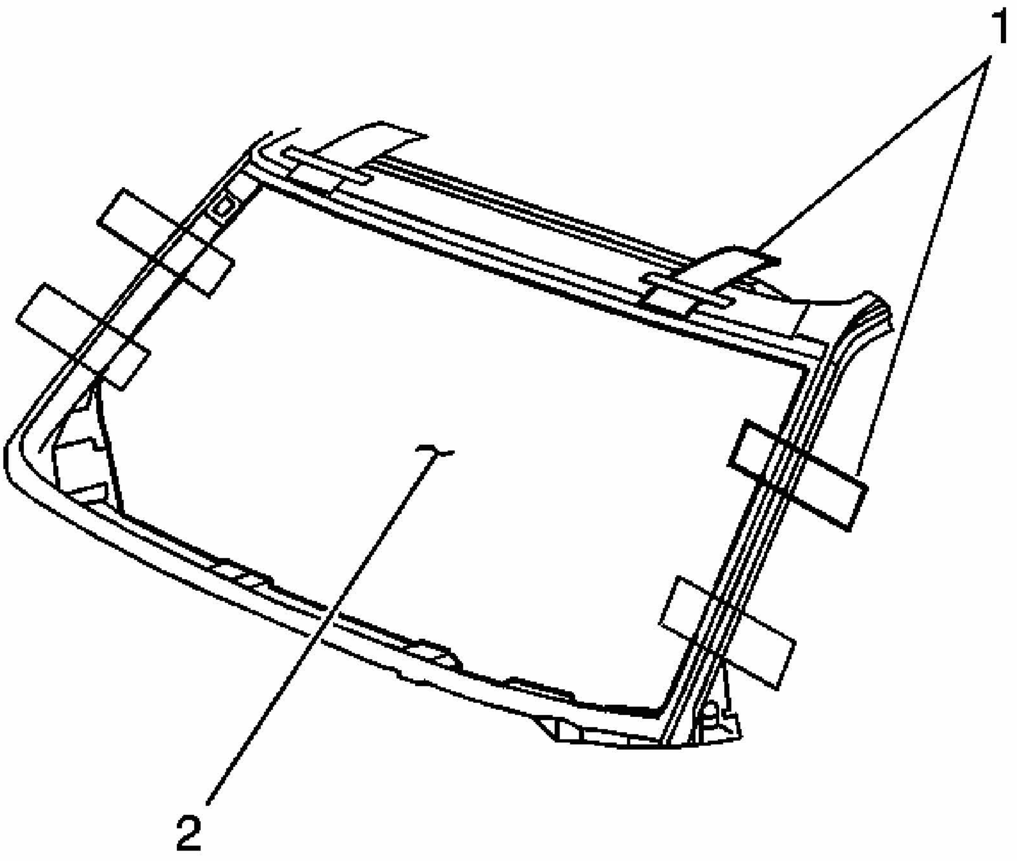


Fig. 35: Aligning Tape Lines On Window To Body
Courtesy of GENERAL MOTORS CORP.

15. Use masking tape in order to mark the locations (1) of the window (2) in the opening.
16. Cut the masking tape in the center and remove the window from the opening.

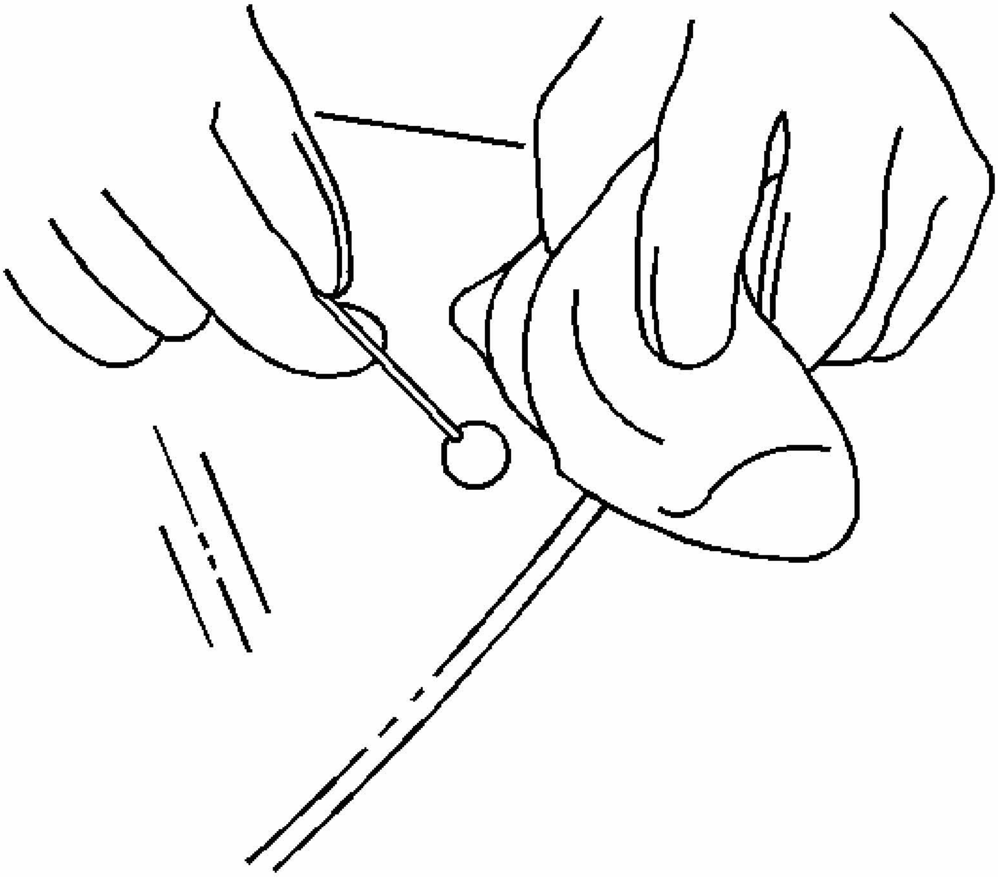


Fig. 36: Applying Glass Prep
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use care when applying glass prep clear #1 on the window. This primer dries almost instantly, and may stain the viewing area of the window if not applied evenly.

17. Use a new dauber in order to apply glass prep clear #1 to the area approximately 10-16 mm (3/8-5/8 in) around the entire perimeter of the window inner surface.

    Immediately wipe the glass primed area using a clean, lint-free cloth.

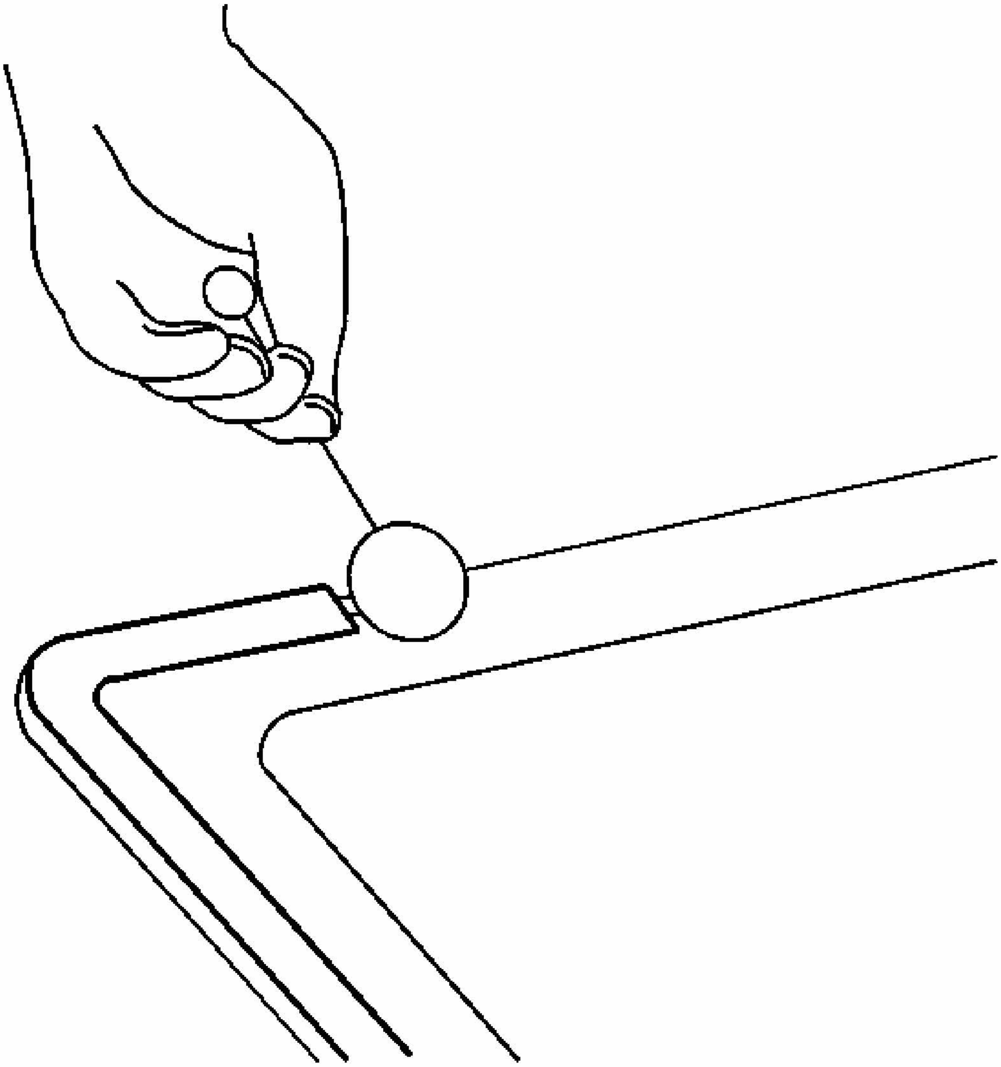


Fig. 37: Applying Glass Prep
Courtesy of GENERAL MOTORS CORP.

18. Apply a second coat of the glass prep clear #1 to the same area of the glass.

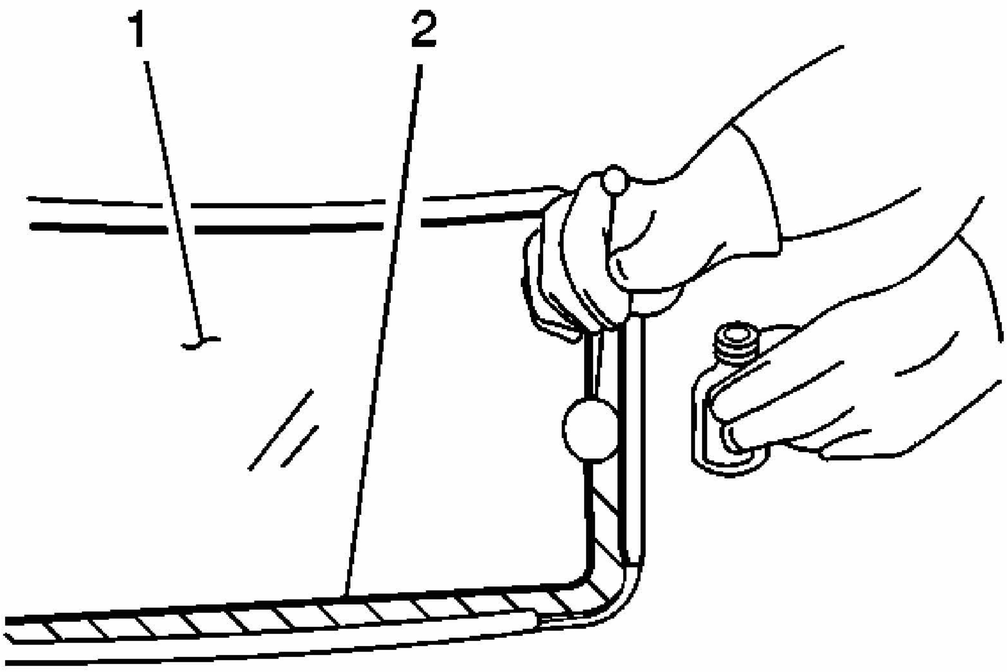


Fig. 38: Applying Glass Primer
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The glass primer black #2 is effective up to 8 hours after applying it to the glass. The primed surface of the glass must be kept clean.

19. Shake the glass primer black #2 for at least 1 minute.
20. Use a new dauber in order to apply the glass primer black #2 to the same areas (2) that glass prep clear #1 was applied.
21. Allow the glass primer to dry for approximately 10 minutes.

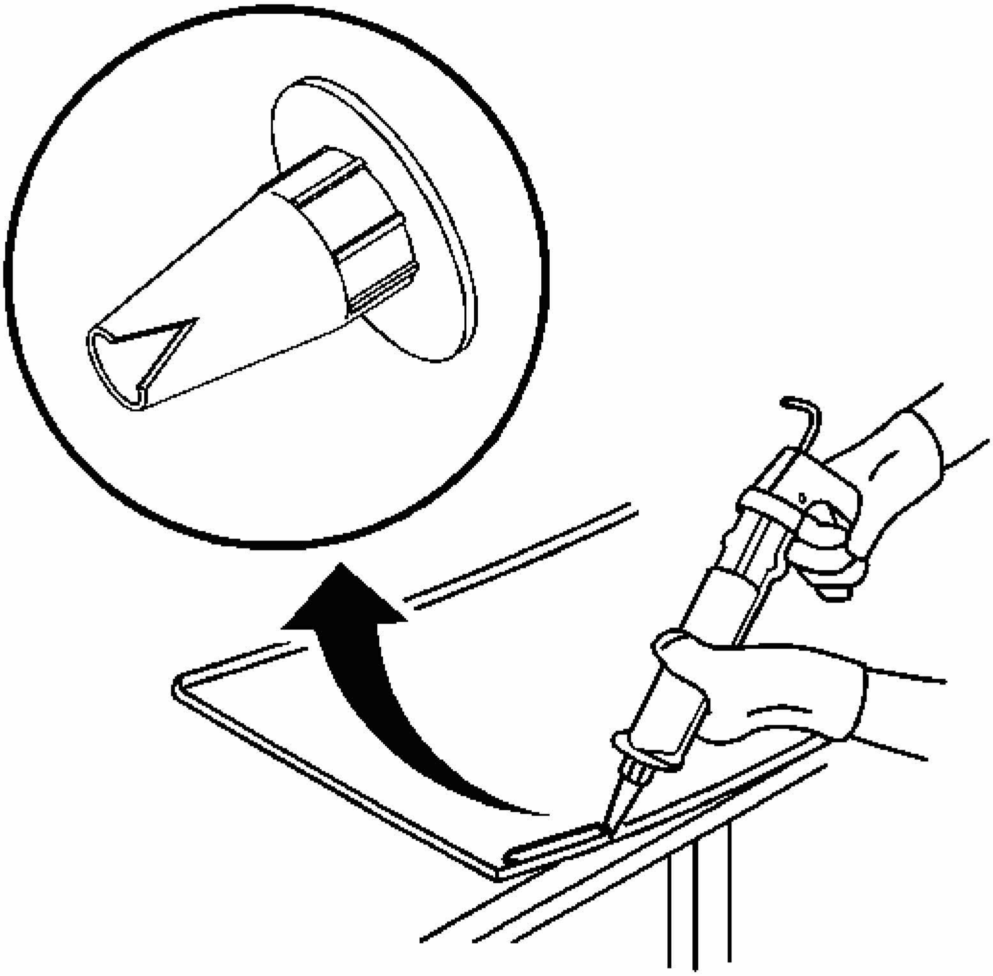


Fig. 39: View Of Modified Applicator Nozzle
Courtesy of GENERAL MOTORS CORP.

22. Cut the applicator nozzle in order to provide a bead of 12.7 mm (1/2 in) wide and 12.7 mm (1/2 in) high.

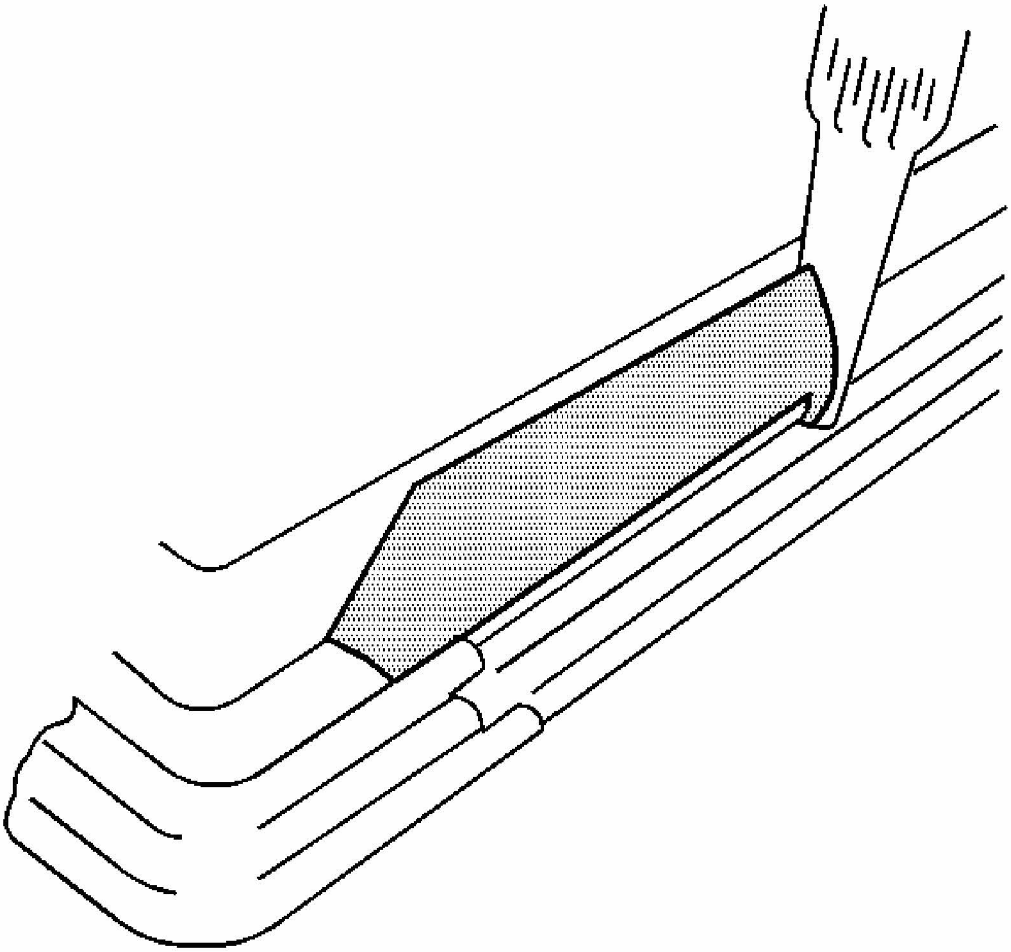


Fig. 40: Applying Bead Of Urethane Adhesive
Courtesy of GENERAL MOTORS CORP.

23. Use a cartridge-type caulking gun in order to apply a smooth, continuous bead of urethane adhesive.

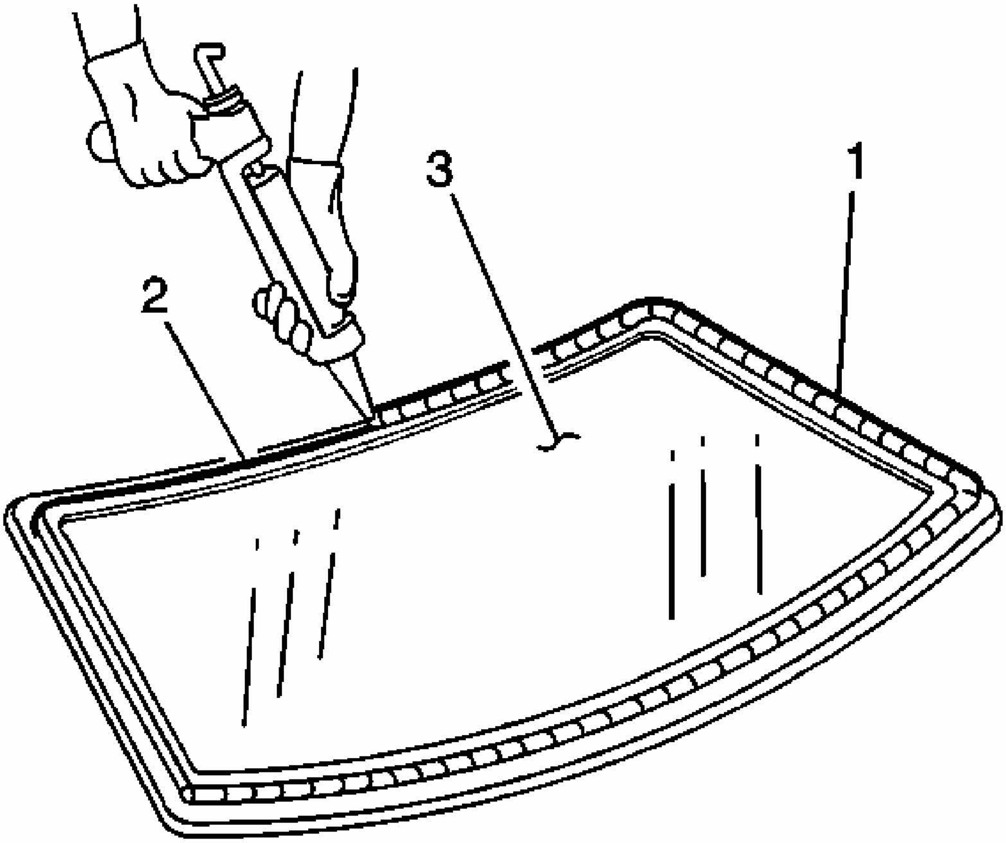


Fig. 41: Applying Urethane Adhesive To Inner Surface Of Window
Courtesy of GENERAL MOTORS CORP.

24. Use the edge of the window or the inside edge of the reveal molding as a guide for the nozzle in order to apply the urethane adhesive (1) to the inner surface of the window (3).

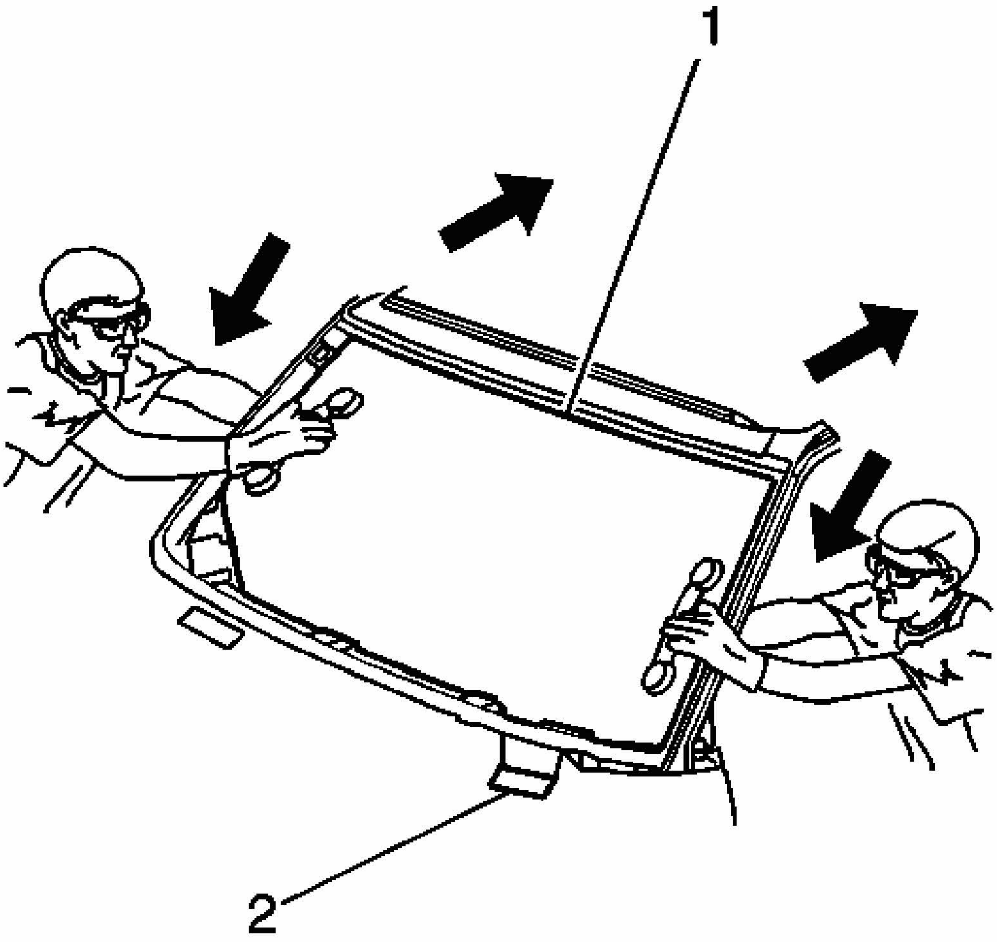


Fig. 42: Installing Windshield
Courtesy of GENERAL MOTORS CORP.

25. With the aid of an assistant, place the window in the opening. If installing a windshield, place the windshield on the lower supports (2), if equipped.

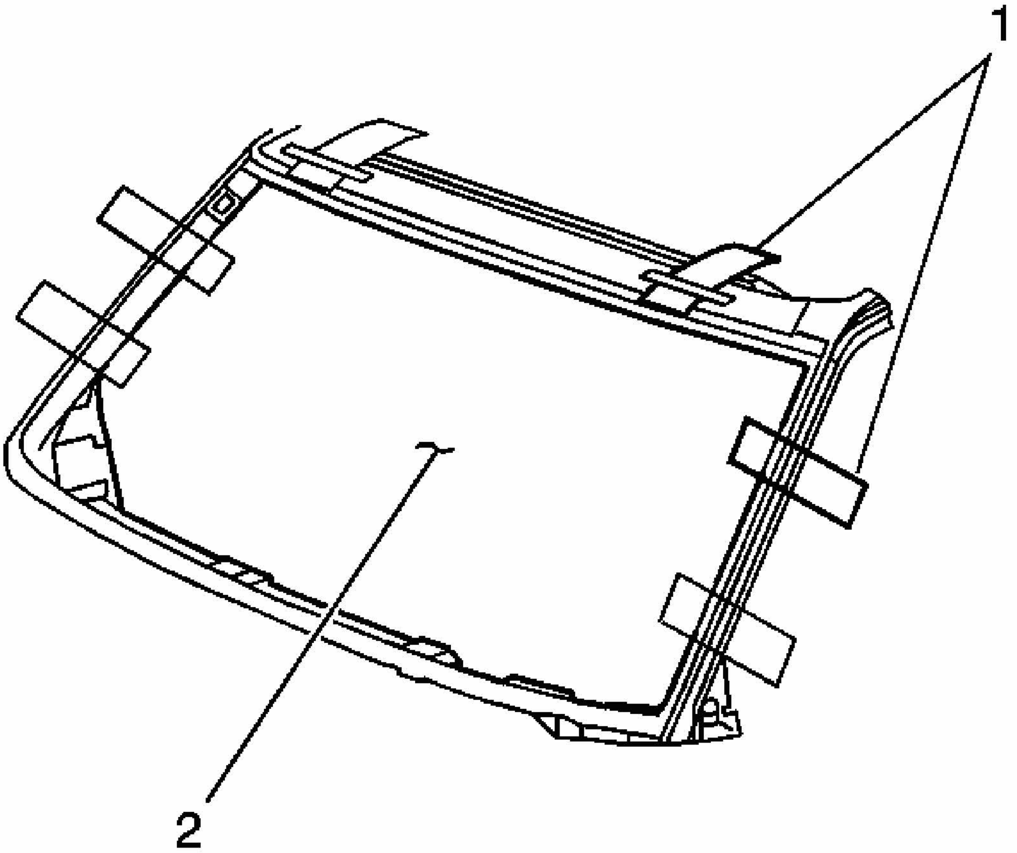


Fig. 43: Aligning Tape Lines On Window To Body
Courtesy of GENERAL MOTORS CORP.

26. Align the masking tape (1) lines on the window (2) and the body.

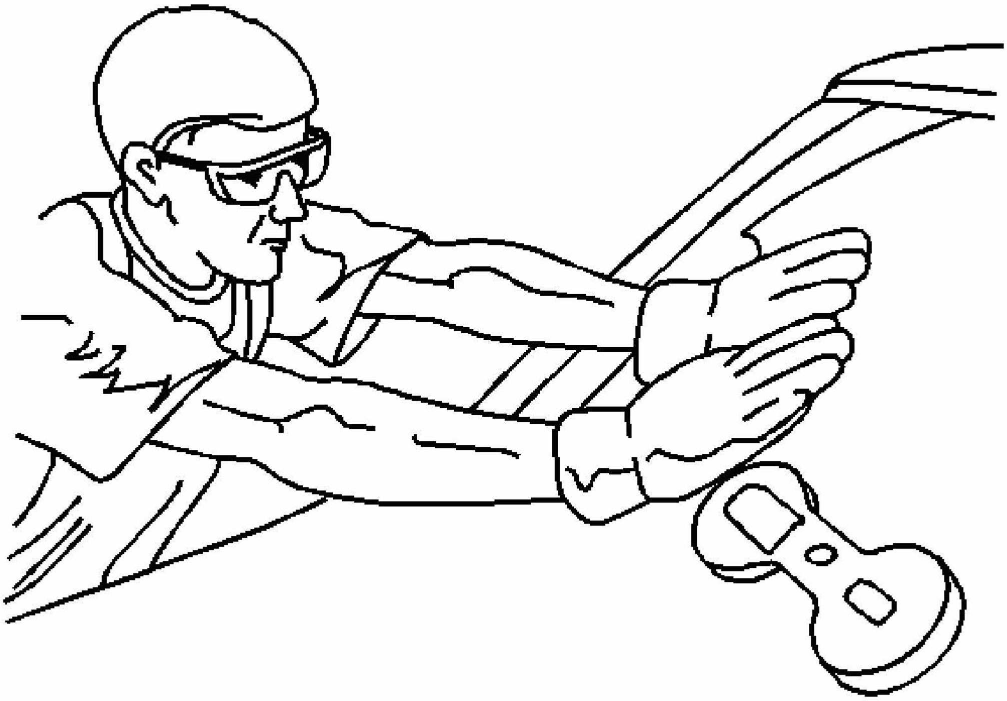


Fig. 44: Pressing Window Into Place
Courtesy of GENERAL MOTORS CORP.

27. Press the window firmly into place.
28. Tape the window to the body in order to minimize movement until the urethane adhesive cures.

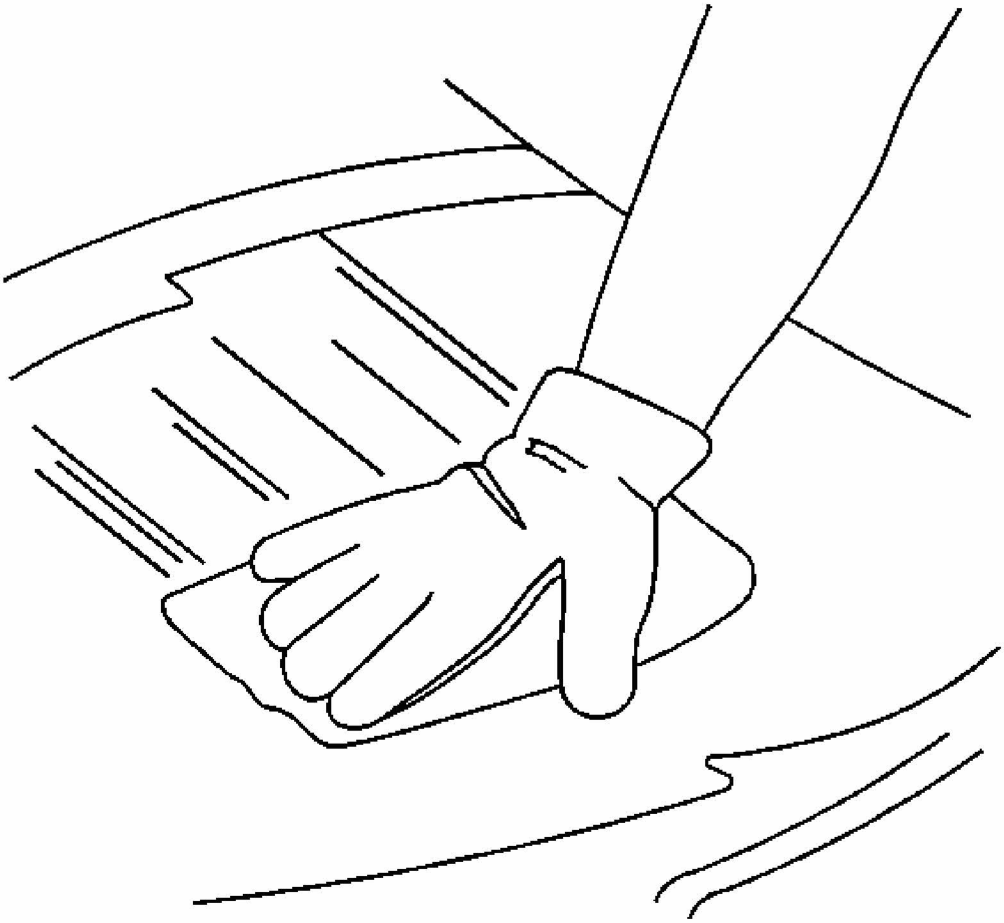


Fig. 45: Cleaning Window
Courtesy of GENERAL MOTORS CORP.

29. Clean any excess urethane adhesive from the body.

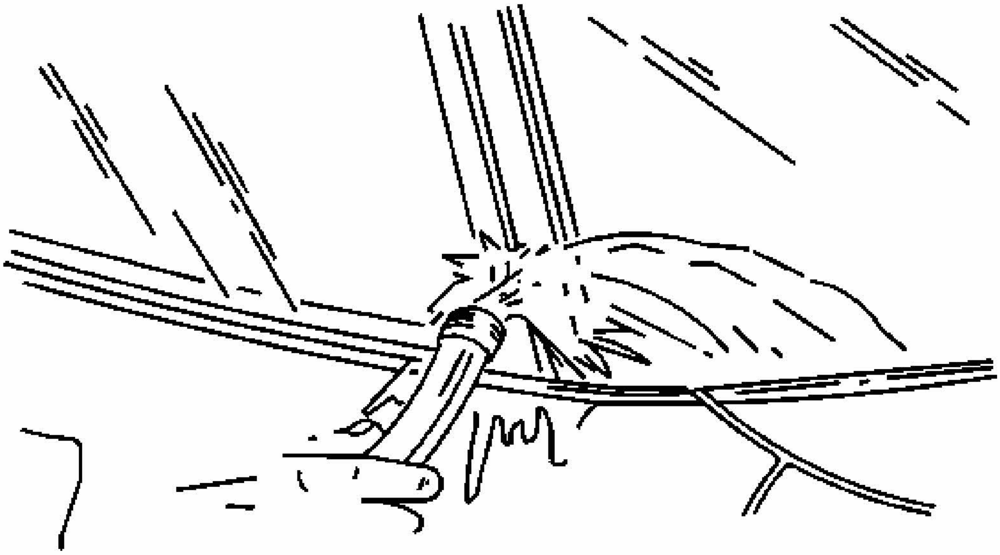


Fig. 46: Performing Water Hose Test
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not direct a hard stream of high pressure water to the freshly applied urethane adhesive.

30. Use a soft spray of warm water in order to immediately water test the window.
31. Inspect the window for leaks.
32. If any leaks are found, use a plastic paddle in order to apply extra urethane adhesive at the leak point.
33. Retest the window for leaks.

CAUTION: Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

- **For the moisture-curing type of urethane adhesive, allow a minimum of 6 hours at 21°C (70°F) or greater and with at least 30 percent relative humidity. Allow at least 24 hours for the complete curing of the urethane adhesive.**
- **For the chemical-curing type of urethane adhesive, allow a minimum of 1 hour.**

Do NOT physically disturb the repair area until after these minimum times have elapsed.

34. Maintain the following conditions in order to properly cure the urethane adhesive:
    - Partially lower a door window in order to prevent pressure buildups when closing doors before the urethane adhesive cures.
    - Do not drive the vehicle until the urethane adhesive is cured. Refer to the above curing times.
    - Do not use compressed air in order to dry the urethane adhesive.
35. Complete the window installation.

URETHANE ADHESIVE INSTALLATION OF ENCAPSULATED STATIONARY WINDOWS

IMPORTANT: Remove all but 2 mm (3/64 in) of the existing urethane adhesive from the pinch-weld flange. This will ensure proper depth of window in relations exterior trim.

1. Remove all mounds or loose pieces of urethane adhesive from pinch-weld flange areas.
2. If the original window assembly is being reused, remove all but a thin film of existing urethane from the window frame surface by using a clean utility knife or razor blade scraper.

IMPORTANT: If corrosion of the pinch-weld flange is present or if sheet metal repairs or replacement are required, the pinch-weld flange must be refinished in order to restore the bonding area strength. If paint repairs are required, mask the flange bonding area prior to applying the color coat in order to provide a clean primer only surface. Materials such as BASF DE15, DuPont 2610, Sherwin-Williams PSE 4600 and NP70, Martin-Semour 5120, PPG DP90LF, Spies/Hecker 3688/8590 3688/5150 4070/5090, and Standox 11158/13320 14653/14980 are approved for this application.

3. Clean around the inside edge of the window assembly with a 50/50 mixture of isopropyl alcohol and water on a dampened lint free cloth.
4. Verify all primers an urethane adhesives are within expiration dates.

CAUTION: Refer to WINDOW RETENTION CAUTION in Cautions and Notices.

5. Failure to prepare the area prior to application of primer may cause insufficient bonding

of urethane adhesive. Insufficient bonding of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

IMPORTANT: Do not apply the black #3 primer to the existing bead of urethane adhesive on the pinch-weld flange. Apply the primer only to nicks, scratches or the primed surfaces.

6. Shake the black #3 primer for at least 1 minute.
7. Use a dauber in order to apply the primer to the surface of the pinch-weld flange.
8. Allow the pinch-weld primer to dry for approximately 10 minutes.
9. With an assistant, dry fit the window assembly into the opening to determine correct position.
10. Using masking tape, mark the location of the window assembly to the opening.
11. Apply Glass Prep #1 followed by Glass Primer #2 on the encapsulation material. Allow to dry for 6 to 10 minutes.

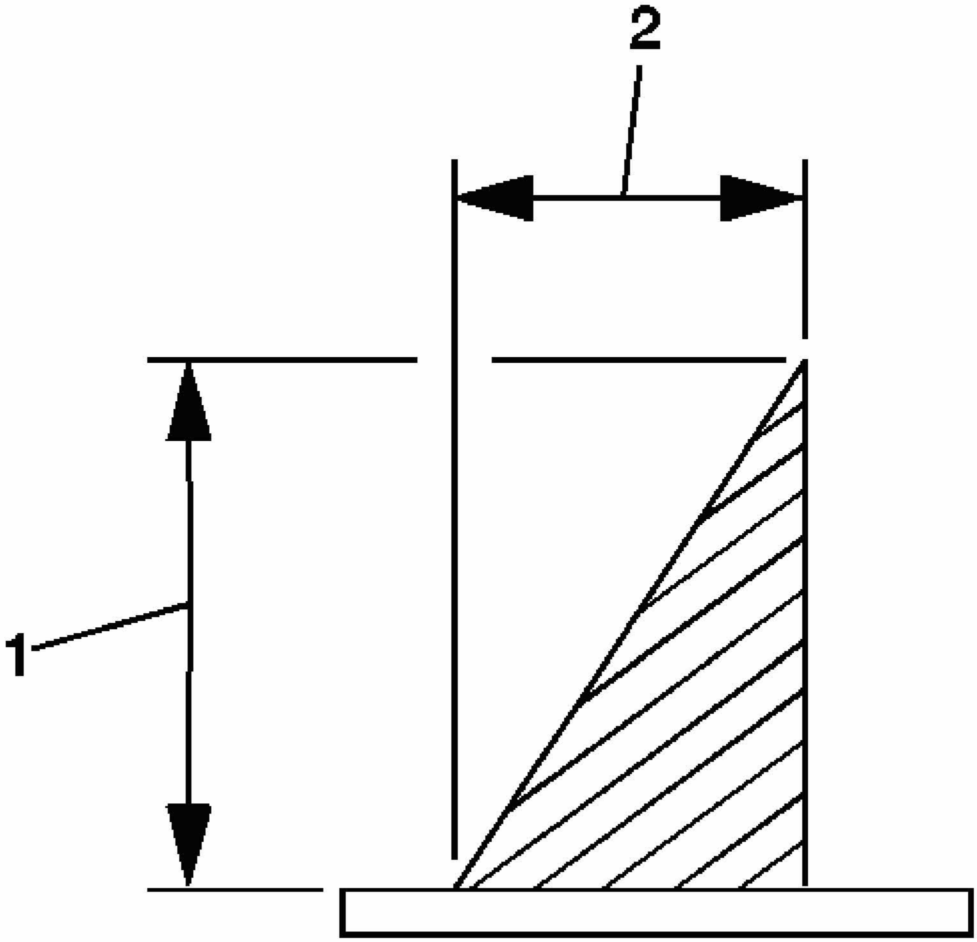


Fig. 47: Applicator Nozzle Hole Measurements
Courtesy of GENERAL MOTORS CORP.

12. Cut the applicator nozzle in order to provide a bead of 10 mm high (1) and 6 mm wide (2).

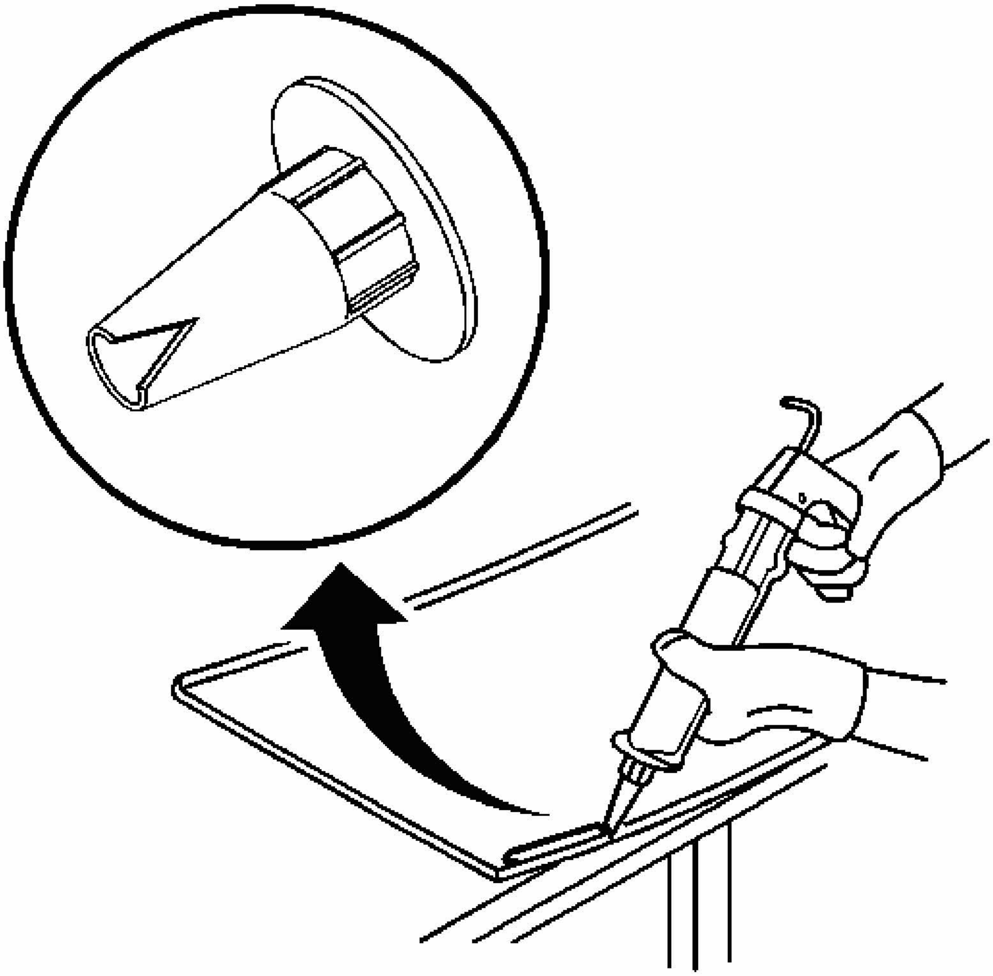


Fig. 48: View Of Modified Applicator Nozzle
Courtesy of GENERAL MOTORS CORP.

13. Using a cartridge-type caulking gun in order to apply a smooth continuous bead of urethane adhesive.

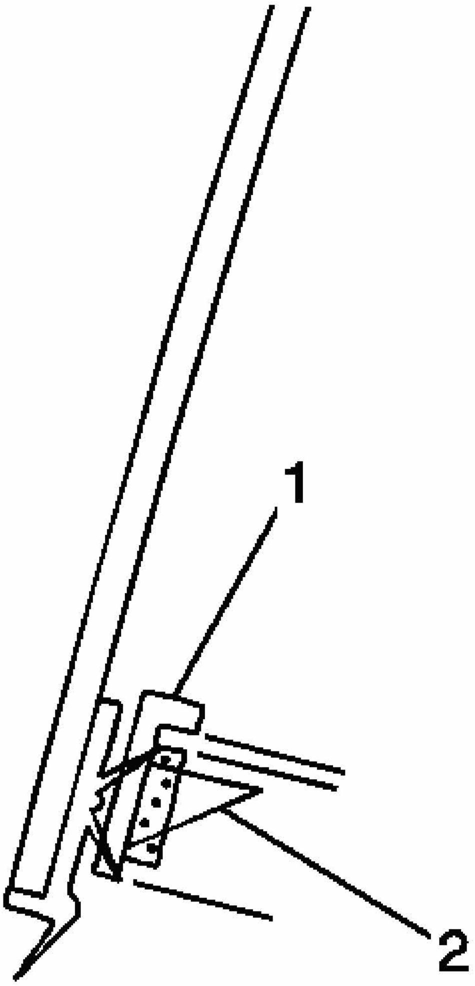


Fig. 49: Window Frame And Urethane Adhesive Bead
Courtesy of GENERAL MOTORS CORP.

14. Use the inside edge of the window frame (1) as a guide for the nozzle in order to apply the urethane adhesive bead (2) to the window frame bonding surface.
15. With the aid of an assistant, place the window assembly into the opening. Make sure window frame alignment pins are properly located.
16. Press the window firmly into place.
17. Tape to window to the body in order to minimize movement until the urethane adhesive cures.
18. Clean any excess urethane adhesive from the body.

IMPORTANT: Do not direct a stream of high pressure water to the freshly applied urethane adhesive.

19. Use a soft spray of warm water in order to immediately water test the window.
20. Inspect the window for leaks.
21. If any leaks are found, use a plastic paddle in order to apply extra urethane adhesive at the leak point.
22. Retest the window for leaks.

CAUTION: Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

- **For the moisture-curing type of urethane adhesive, allow a minimum of 6 hours at 21°C (70°F) or greater and with at least 30 percent relative humidity. Allow at least 24 hours for the complete curing of the urethane adhesive.**
- **For the chemical-curing type of urethane adhesive, allow a minimum of 1 hour.**

Do NOT physically disturb the repair area until after these minimum times have elapsed.

23. Maintain the following conditions in order to properly cure the urethane adhesive.
    - Partially lower a door window in order to prevent pressure buildups when closing doors before the urethane cures.
    - Do not drive the vehicle until the urethane adhesive is cured. Refer to above curing times.
    - Do not use compressed air in order to dry urethane adhesive.

REAR WINDOW REPLACEMENT

Tools Required

- **J 24402-A** Glass Sealant Cold Knife Remover. See Special Tools.
- **J 39032** Stationary Glass Removal Tool. See Special Tools.
- Urethane Adhesive Kit GM P/N 12346392 or Equivalent
- Isopropyl Alcohol or Equivalent
- Cartridge-type Caulking Gun

- Commercial-type Utility Knife
- Razor Blade Scraper
- Suction Cups
- Plastic Paddle

Removal Procedure

CAUTION: If a window is cracked but still intact, crisscross the window with masking tape in order to reduce the risk of damage or personal injury.

IMPORTANT: Before cutting out a stationary window, apply a double layer of masking tape around the perimeter of the painted surfaces and inner trim.

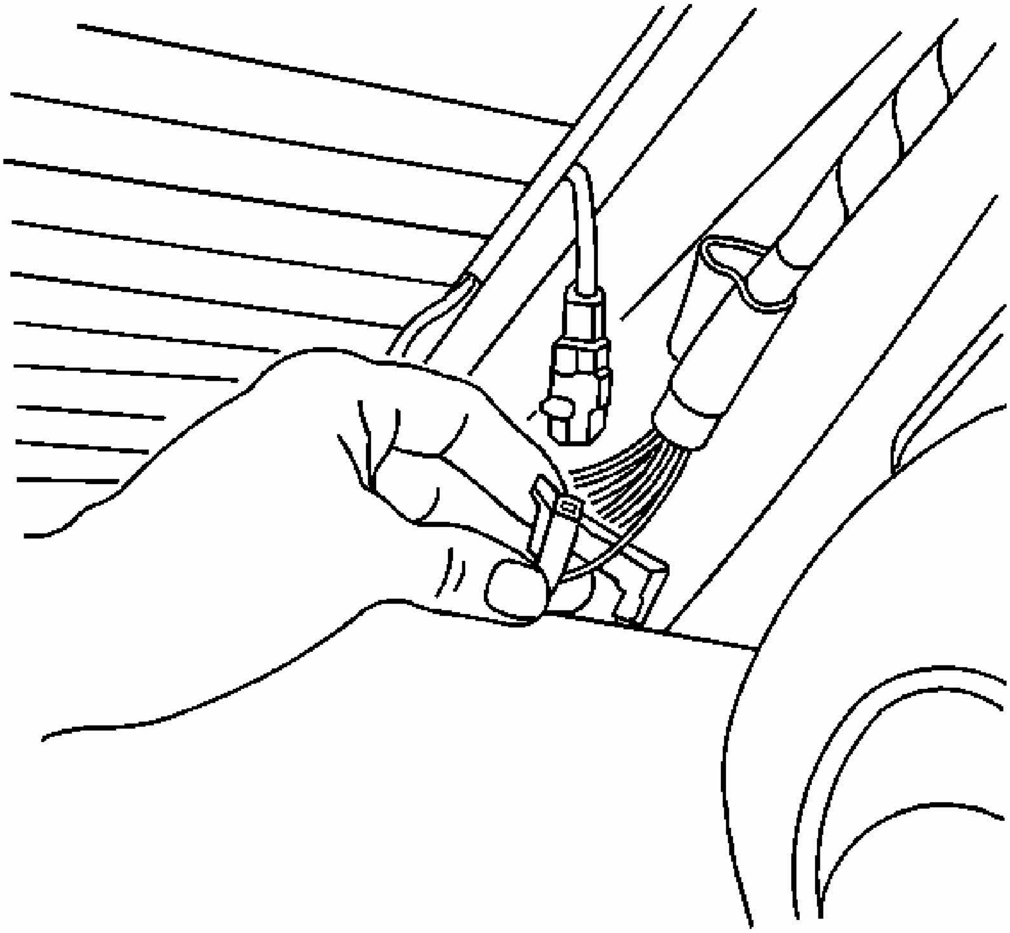


Fig. 50: Locating Rear Window Defogger Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the rear window defogger electrical connectors.
2. Disconnect the OnStar® connector, if equipped.

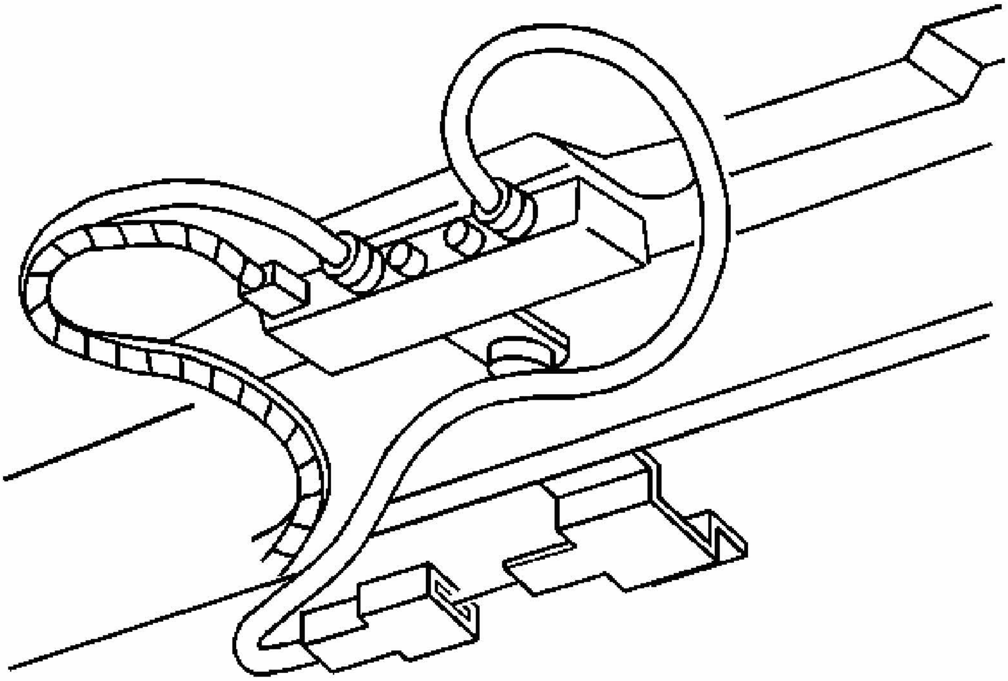


Fig. 51: Rear Window Radio Antenna Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the rear window radio antenna connector.

CAUTION: If broken glass falls into the defroster outlets, it can be blown into the passenger compartment and cause personal injury.

4. Cover to protect the following parts from broken glass:
   - Upper dash pad.
   - Defroster outlets and A/C outlets.
   - Seats and carpeting.
5. Open the rear compartment lid in order to access the reveal molding.

CAUTION: Refer to GLASS AND SHEET METAL HANDLING CAUTION in Cautions and Notices.

IMPORTANT: The rear window reveal molding is a one piece molding and fills the cavities between the body and window.

6. If the rear window reveal molding (1) is stretched or damaged it can not be reused.

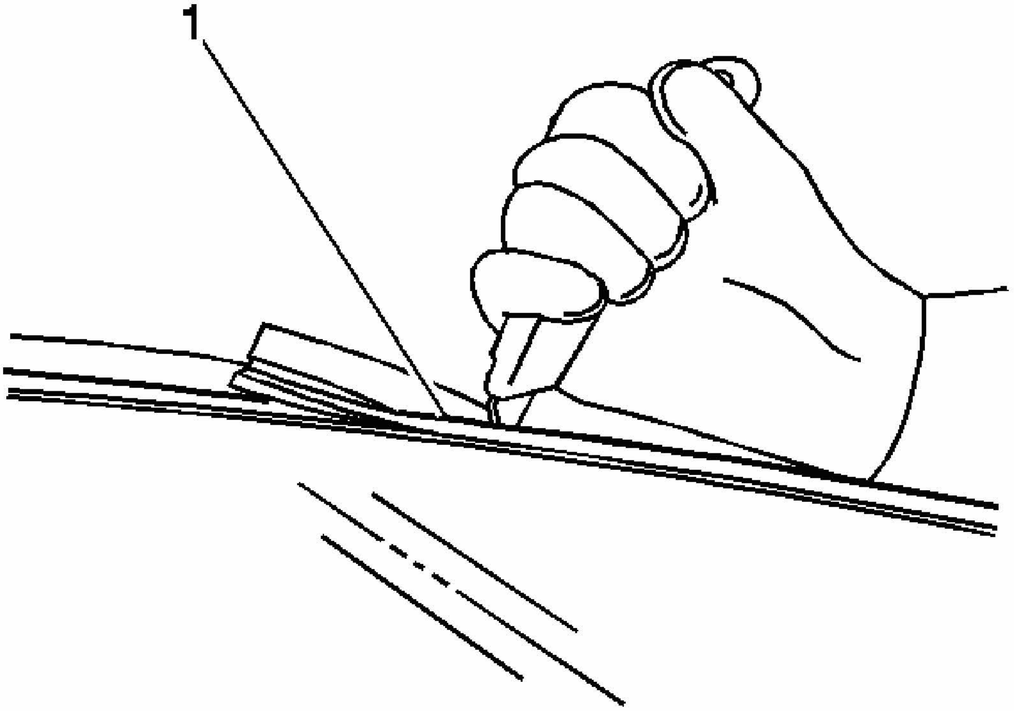


Fig. 52: Using Utility Knife To Remove Reveal Molding
Courtesy of GENERAL MOTORS CORP.

7. Remove the rear window reveal molding (1). Refer to **Rear Window Reveal Molding Replacement**.

   Grasp the lower corner of the window reveal molding by hand and slowly pull the reveal molding away from the window.

   If the rear window reveal molding will not release, use a utility knife in order to cut around the rear window in order to remove the window reveal molding.

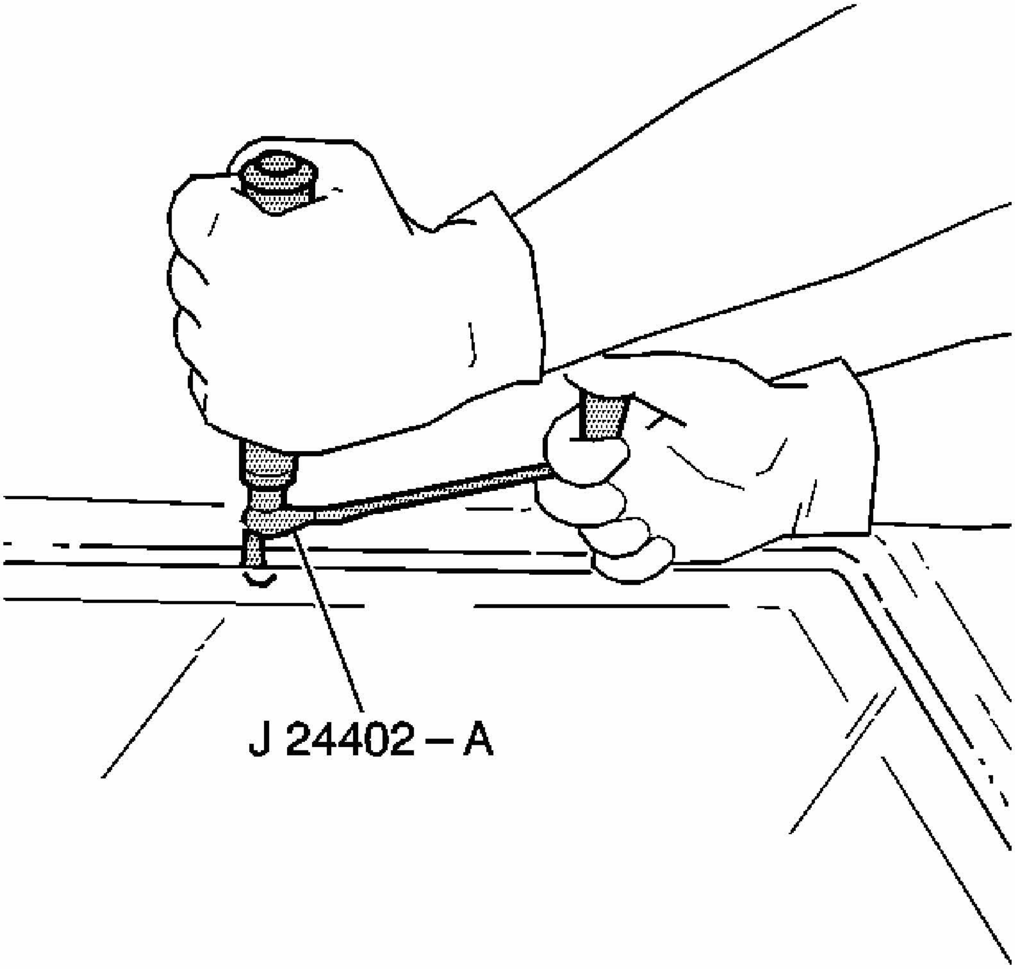


Fig. 53: Separating Urethane Adhesive From Window
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Keep the cutting edge of the tool against the window.

8. This will allow the urethane adhesive to be separated from the window.
   - Leave a base of urethane on the pinch-weld flange.
   - The only suitable lubrication is clear water.
   - Use**J 24402-A** , **J 39032** or equivalent in order to remove the window. See **Special Tools**.

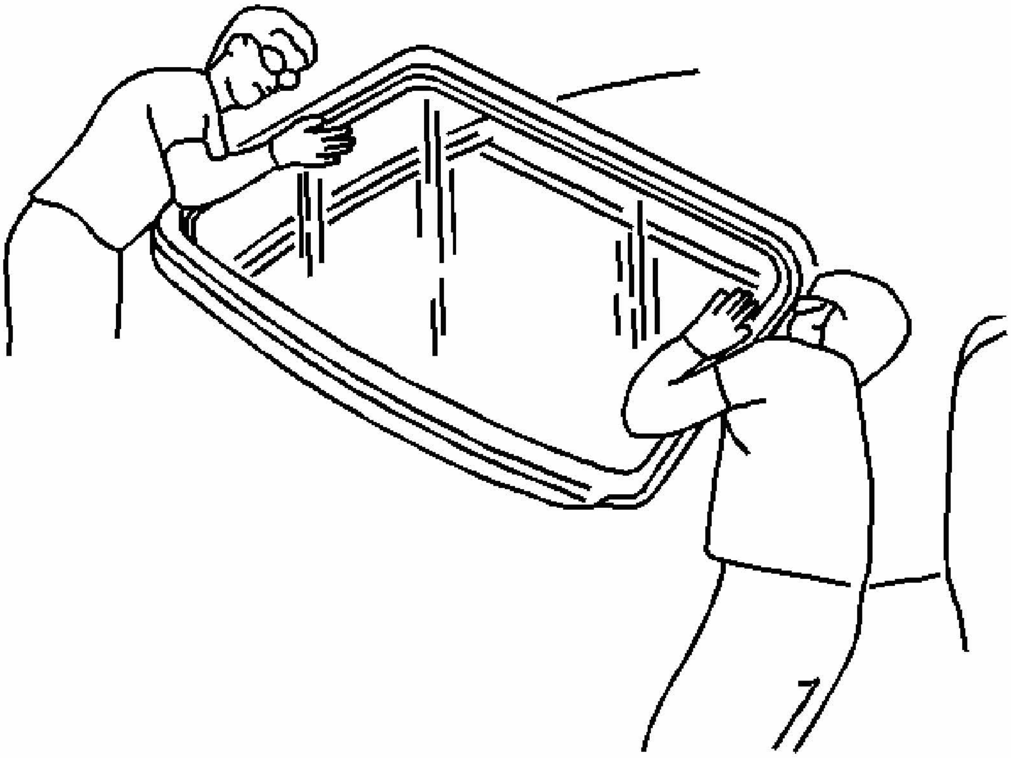


Fig. 54: Removing/Installing Rear Window
Courtesy of GENERAL MOTORS CORP.

9. With the aid of an assistant, use the suction cups in order to lift the rear window from the opening.

Installation Procedure

1. Install the rear window into the opening. Refer to **Urethane Adhesive Installation of Stationary Windows**.
2. Connect the OnStar® connector, if equipped.

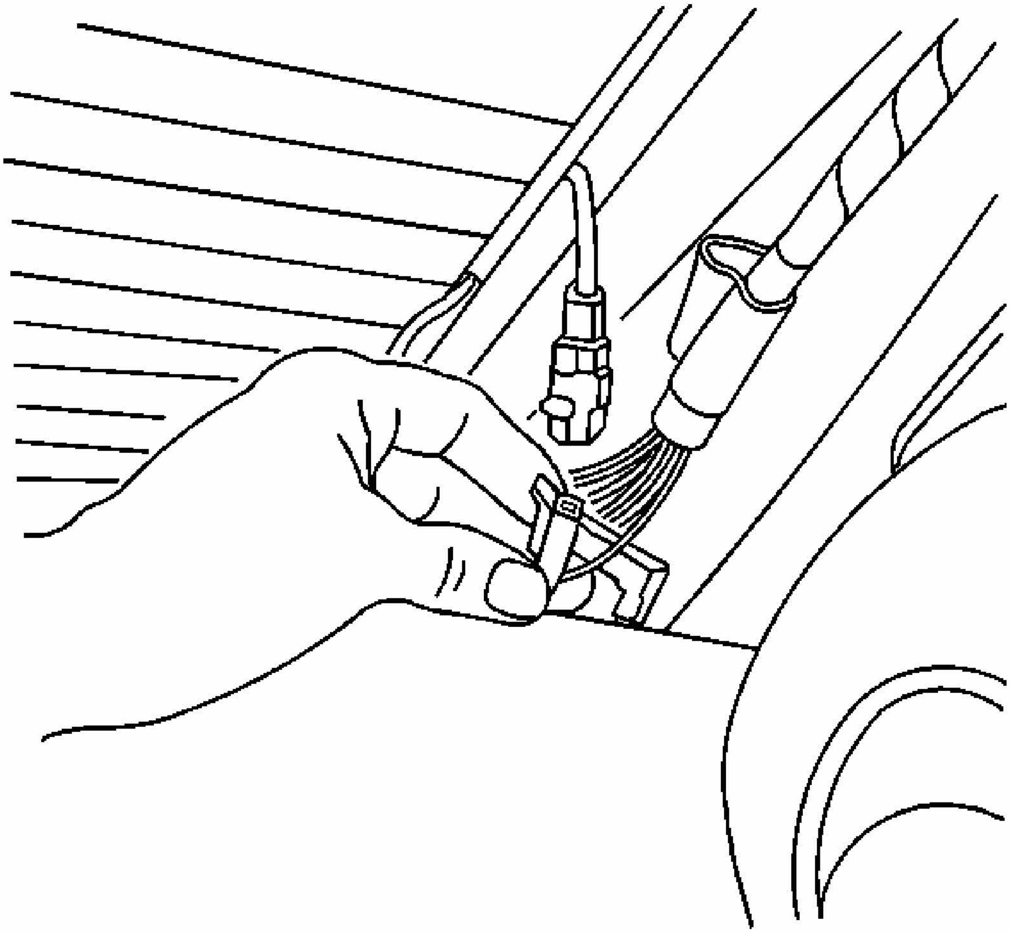


Fig. 55: Locating Rear Window Defogger Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the rear window defogger electrical connector, if equipped.

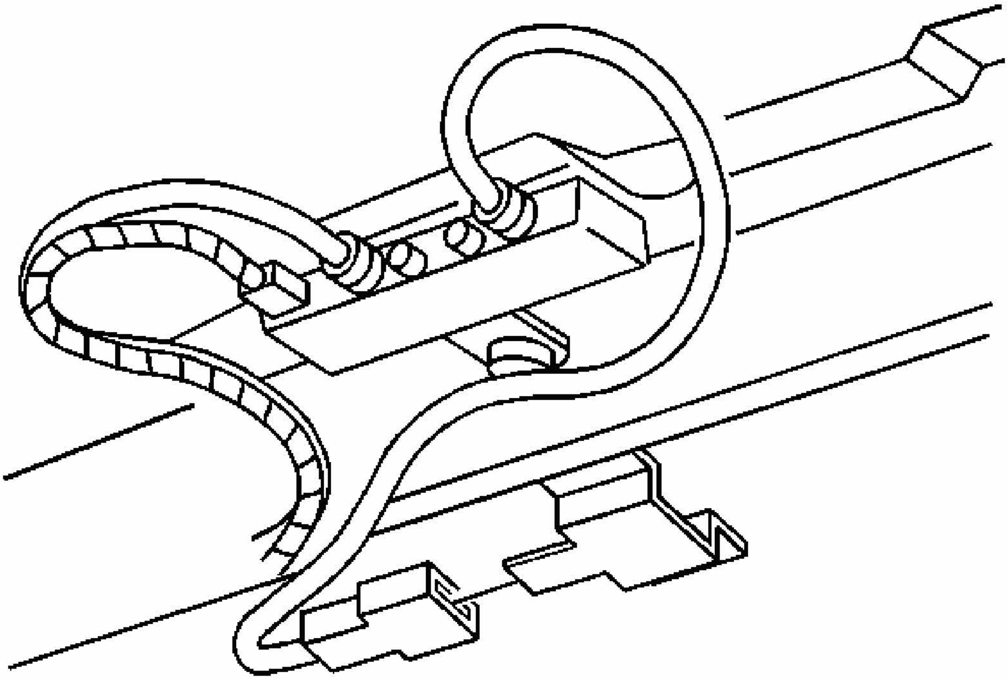


Fig. 56: Rear Window Radio Antenna Connector
Courtesy of GENERAL MOTORS CORP.

4. Connect the rear window radio antenna connector.
5. Connect the OnStar® system.
6. Verify the radio and the OnStar® has reception.
7. Close the rear compartment lid.
8. Remove the double layer of masking tape around the perimeter of the painted surfaces and the interior trim.

DESCRIPTION AND OPERATION

ADHESIVE SERVICE KIT DESCRIPTION

The GM of Canada Adhesive Caulking Kit, P/N 10952983, contains the following items:

- Four different primers
- A tube of urethane adhesive with a nozzle
- Four daubers
- Instructions with warnings

Use the urethane adhesive caulking kit for replacement of any urethane adhesive-installed window using the full cut method.

In the United States or Canada, you may use any of the following equivalent urethane adhesive systems which meet GM Specification GM 3651G:

- Dow Automotive - Essex 400HV. One part and requires associated primers.
- Dow Automotive - Essex U216. Two part and requires associated primers.

  Call Dow Automotive at 1-800-453-3779 for more information.

- 3M™ "Fast Cure" Auto Glass Urethane. One part and requires associated primers.

  Call 3M™ at 1-877-666-2277 for more information.

Use these materials based on specific manufacturer. Do NOT intermix primers or adhesives from one manufacturer to another.

Always follow the system manufacturer's instructions for application, handling, and curing.

FULL-CUT METHOD DESCRIPTION

Use only the full cut method, also known in the field as full strip method, when installing windows.

This method includes the following:

- The replacement of a majority of the urethane adhesive bead. Remove all but approximately 2 mm (3/64 in) of the existing bead of urethane adhesive from the pinch-weld flange.
- Apply pinch-weld primer to any exposed painted areas on the pinch-weld flange.

No mounds or loose pieces of urethane adhesive should remain on the pinch-weld flange. Do not remove all traces of urethane adhesive.

IMPORTANT:

- **If corrosion of the pinch-weld flange is present, or if sheet metal repairs or replacements are required, refinish the pinch-weld flange in order to present a clean, primer-only surface.**
- **If paint repairs are required, mask the flange bonding area, prior to applying the color coat, in order to provide a clean, primer-only surface.**
- **Appropriate materials for these primer applications are typically 2 component catalyzed products. Use materials**

such as BASF DE15®, DuPont 2610®, Sherwin-Williams PSE 4600 and NP70® and Martin-Semour 5120,5130®, PPG DP90LF SPIES/HECKER 3688/8590 - 3688/5150 - 4070/5090 STANDOX 11158/13320 - 14653/14980 products are approved for this application. Follow the manufacturer's directions for the mix, the application, and the drying times.

- **After repairing the opening as indicated, shake the pinch-weld primer black #3 well. Using a new dauber, apply the primer to the primed surface of the flange in the bonding area. Allow the primer to dry for 10 minutes.**

STATIONARY WINDOW DESCRIPTION

Most stationary windows, specifically windshields, are retained to the body with urethane adhesive which adheres the window to the body, increasing structural integrity. The reinstallation of the windows with urethane adhesive requires complete replacement of the urethane adhesive bead, and is known as the full cut method.

REAR WINDOW DEFOGGER DESCRIPTION AND OPERATION

Rear Window Defogger

The rear window defogger system consists of the following components:

- Body Control Module (BCM)
- Electronic compass
- HVAC control module
- Instrument Panel Cluster (IPC)
- Rear window defogger grid
- REAR WINDOW DEFOGGER relay

Battery positive voltage is supplied at all times from the BATT MAIN 3 fuse in the underhood fuse block to the coil and switch side of the REAR WINDOW DEFOGGER relay in the instrument panel (I/P) fuse block. When the rear defogger switch is pressed in the HVAC control module, a class 2 data signal is sent to the BCM. The BCM then applies a ground to the REAR WINDOW DEFOGGER relay. This energizes the relay and allows the battery positive voltage to be applied through the switched side of the relay to the rear window defogger grid. The rear window defogger grid is grounded at all times at G301.

When you start the engine and press the rear window defogger switch for the first time, the defogger cycle last for approximately 15 minutes. Further operations result in a 7.5 minute cycle. The defogger cycle is reset to 15 minutes when you cycle the ignition to the OFF position then back to the ON position.

If the battery is low, the BCM will disable the rear window defogger by removing the ground supplied to the REAR WINDOW DEFOGGER relay.

AUTOMATIC DAY-NIGHT MIRROR DESCRIPTION AND OPERATION

Inside Rearview Mirror with Automatic Day-Night System

The automatic day-night system consists of the following components:

- Body Control Module (BCM)
- Inside rearview mirror
- SUN ROOF Fuse 20A

The inside rearview mirror consist of 2 photocell sensors. The headlight sensor, located on the front of the mirror is used to determine light conditions present at the mirror face from sources behind the vehicle. The ambient light sensor, located on the rear of the mirror is used to determine exterior light conditions present at the mirror. At night, with the automatic day-night feature enabled, the inside rearview mirror will automatically darken to reduce glare from headlamps behind the vehicle.

In daytime conditions, the mirror operates at a normal, clear state due to the high exterior light conditions that are indicated by the ambient light sensor. When the vehicles gear selector is placed in the REVERSE position, backup lamp voltage is supplied as an input to the inside rearview mirror. In night time conditions only, the inside rearview mirror monitors the backup lamp voltage to disable the automatic day-night feature. This allows the inside rearview mirror face to gradually change to a normal, clear state and allow the driver to see objects in the mirror clearly when backing up.

Inside Rearview Mirror with Automatic Day-Night Switch Operation

The inside rearview mirror with only the automatic day-night feature has 2 switches that perform the following functions:

- The AUTO switch is used to enable the automatic day-night feature of the inside rearview mirror. To enable the automatic day-night feature, turn the ignition ON and depress the AUTO switch. A green indicator will illuminate on the inside rearview mirror when the automatic day-night feature is enabled.
- The OFF switch is used to disable the automatic day-night feature of the inside rearview mirror.

Inside Rearview Mirror with Automatic Day-Night and OnStar® Switch Operation

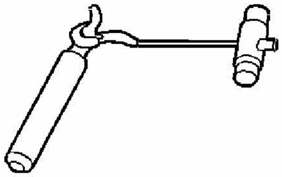
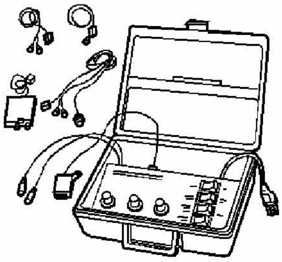
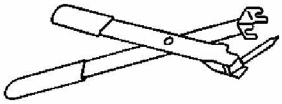
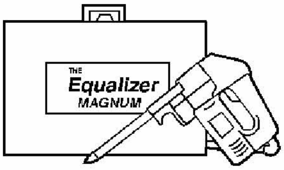
The inside rearview mirror with automatic day-night and OnStar features has 4 switches that perform the following functions:

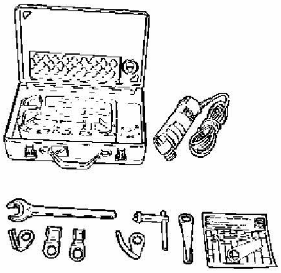
- The on/off switch is used to enable/disable the automatic day-night feature of the inside rearview mirror. To enable the automatic day-night feature, turn the ignition ON and depress the on/off switch. A green indicator will illuminate on the inside rearview mirror when the automatic day-night feature is enabled. To disable the automatic day-night feature depress the on/off switch.
- The three switches on the right side of the mirror are for OnStar® operation. For more information, refer to **OnStar Description and Operation** in Cellular Communication.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description
	J-24402-A Glass Sealant Cold Knife Remover
	J-33431-C Signal Generator and Instrument Panel Tester
	J-34946 Window Pin Remover
	J-39032 Stationary Glass Removal Tool

	J-39040 Quarter Window Remover

2006 STEERING

Steering Wheel and Column - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Intermediate Shaft to the Steering Column Pinch Bolt	47 N.m	35 lb ft
Intermediate Shaft to the Steering Gear Pinch Bolt	48 N.m	35 lb ft
Linear Shift Assembly Screws	10 N.m	89 lb in
Shift Lever Screw	20 N.m	15 lb ft
Steering Column Mounting Bolts (Tighten in Sequence)	24 N.m	18 lb ft
Turn Signal Multifunction Switch Screws	1 N.m	9 lb in

SCHEMATIC AND ROUTING DIAGRAMS

COLUMN/IGNITION LOCK SCHEMATICS

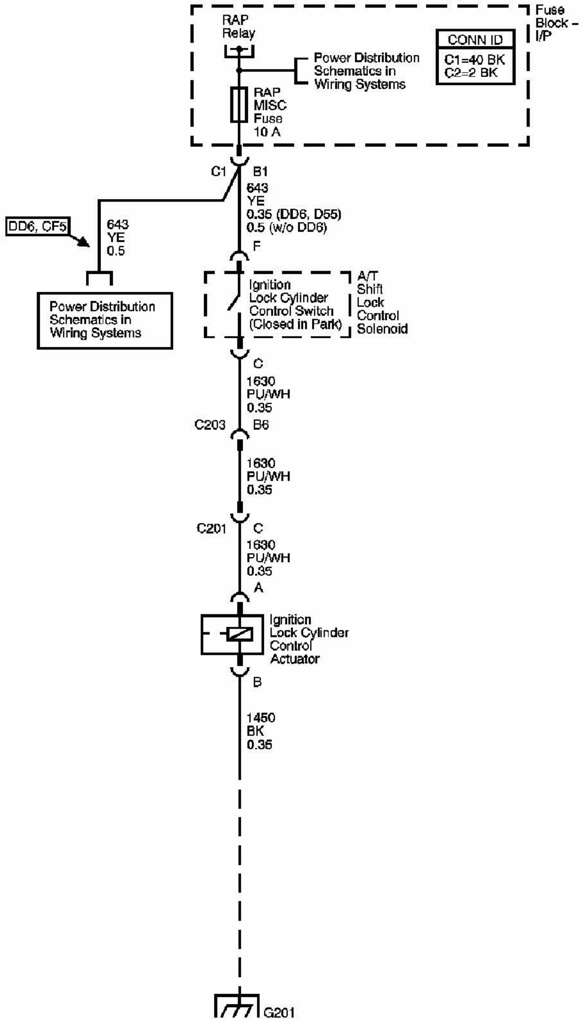

Fuse Block - I/P
RAP Relay
Power Distribution Schematics in Wiring Systems
CONN ID
C1=40 BK
C2=2 BK
RAP MISC Fuse 10 A
C1
B1
643 YE 0.35 (DD6, D55) 0.5 (w/o DD6)
DD6, CF5
643 YE 0.5
Power Distribution Schematics in Wiring Systems
F
Ignition Lock Cylinder Control Switch (Closed in Park)
A/T Shift Lock Control Solenoid
C
1630 PU/WH 0.35
C203
B6
1630 PU/WH 0.35
C201
C
1630 PU/WH 0.35
A
Ignition Lock Cylinder Control Actuator
B
1450 BK 0.35
G201

Fig. 1: Column/Ignition Lock Schematics - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

STEERING WHEEL SCHEMATICS

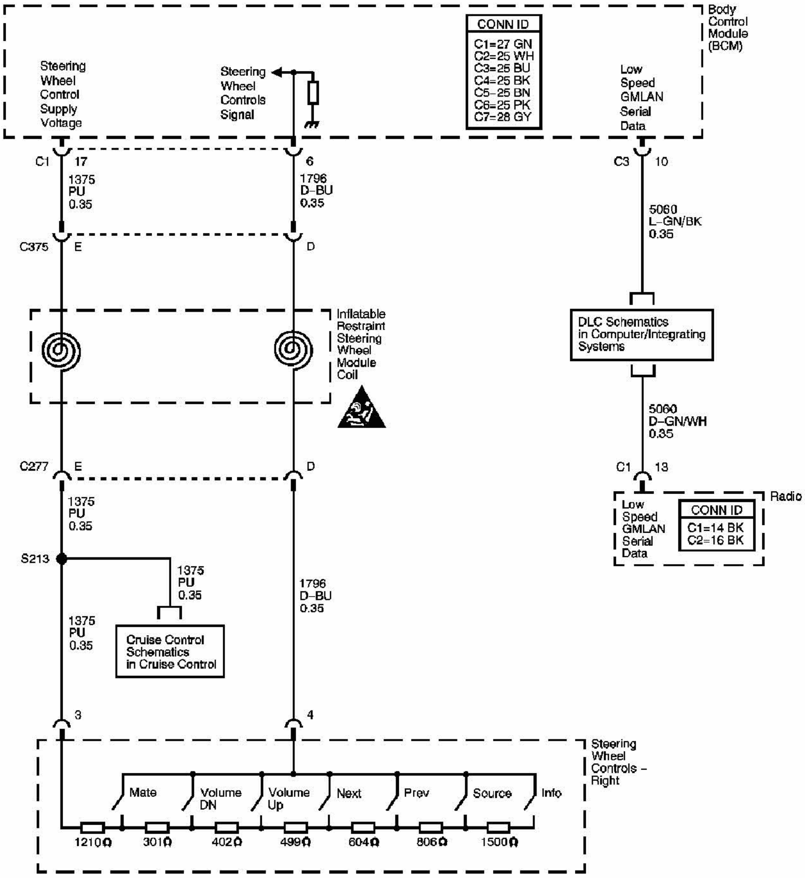

Body Control Module (BCM)
Steering Wheel Control Supply Voltage
Steering Wheel Controls Signal
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Low Speed GMLAN Serial Data
C1 17
1375 PU 0.35
6
1796 D-BU 0.35
C3 10
5060 L-GN/BK 0.35
C375 E
D
Inflatable Restraint Steering Wheel Module Coil
DLC Schematics in Computer/Integrating Systems
5060 D-GN/WH 0.35
C1 13
Radio
Low Speed GMLAN Serial Data
CONN ID
C1=14 BK
C2=16 BK
C277 E
D
1375 PU 0.35
S213
1375 PU 0.35
1375 PU 0.35
Cruise Control Schematics in Cruise Control
1796 D-BU 0.35
3
4
Steering Wheel Controls - Right
Mate
Volume DN
Volume Up
Next
Prev
Source
Info
1210Ω
301Ω
402Ω
499Ω
604Ω
806Ω
1500Ω

Fig. 2: Steering Wheel Schematics - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

STEERING COLUMN DISASSEMBLED VIEW (COLUMN SHIFT)

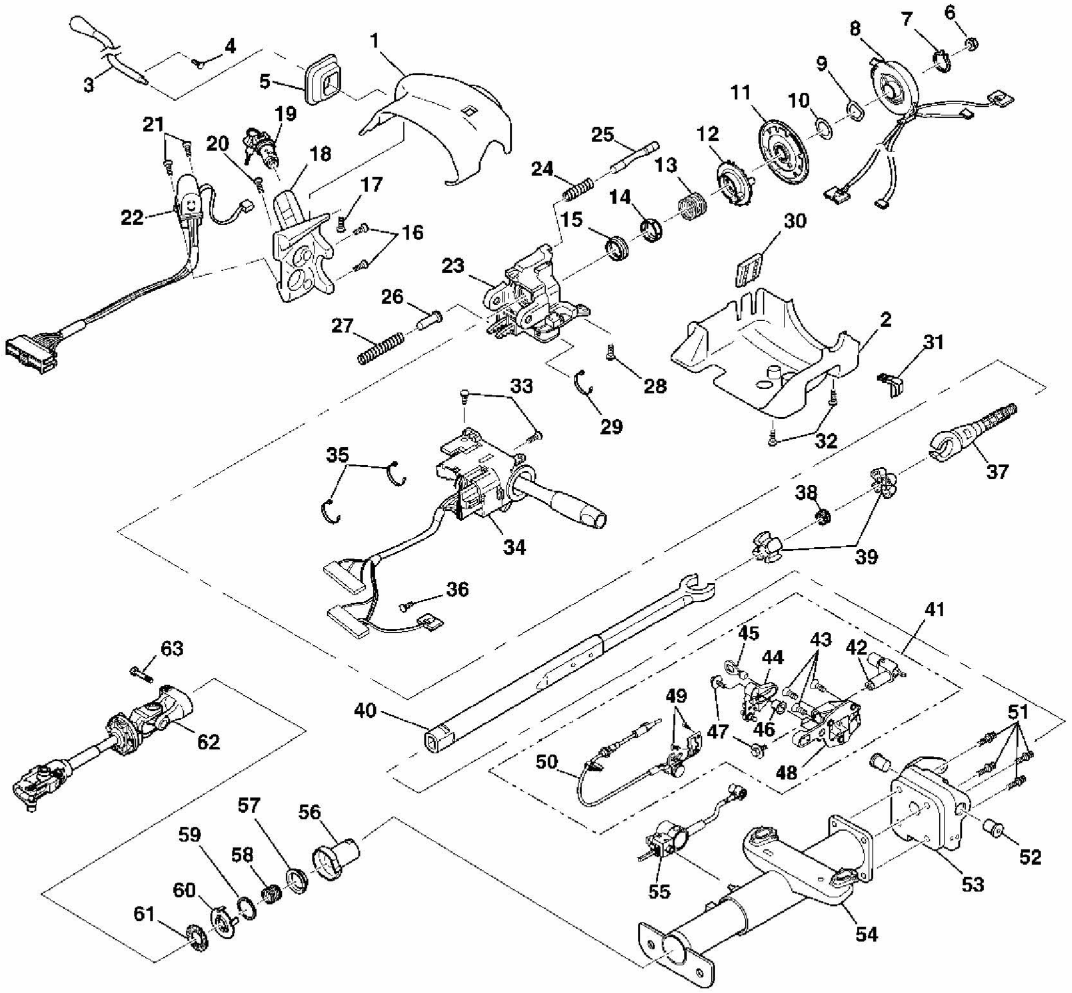

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Fig. 3: Tilt Steering Column Disassembled View, Column Shift
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Upper Trim Cover
2	Lower Trim Cover
3	Shift Lever Assembly
4	Shift Lever Screw
5	Shift Lever Seal
6	Flanged Prevailing Torque Nut
7	Retaining Ring
8	SIR Coil
9	Wave Washer
10	Bearing Retainer

11	Shaft Lock Shield Assembly
12	Turn Signal Cancel Cam Assembly
13	Upper Bearing Spring
14	Upper Bearing Inner Race Seat
15	Inner Race
16	Pan Head Tapping Screws
17	TORX® Head Screw
18	Ignition Lock Cylinder Case Assembly
19	Steering Column Lock Cylinder Set
20	Pan Head Tapping Screw
21	Tapping Screws
22	Ignition Switch Assembly
23	Steering Column Tilt Head Housing Assembly
24	Lock Bolt Spring
25	Lock Bolt Assembly
26	Spring Guide
27	Tilt Spring
28	TORX® Head Screw
29	Wire Harness Strap
30	Trim Cover Protector
31	Tilt Knob
32	TORX® Head Screws
33	Pan Head Tapping Screws
34	Turn Signal and Multifunction Switch Assembly
35	Wire Harness Straps
36	Position Assurance Connector
37	Race and Upper Shaft Assembly
38	Joint Preload Spring
39	Centering Sphere
40	Lower Steering Shaft Assembly
41	Linear Shift Assembly
42	Shift Lever Clevis
43	Flat Head 6-Lobed Soc Tap Screws
44	Cable Shift Cam Assembly
45	Ball and Actuator Assembly
46	Cam Bushing
47	Hexagon Flange Head Bolts
48	Gear Shift Lever Assembly Support Bracket

	Oval Head 6-Lobed Soc Tap Screws
50	Park Lock Cable System
51	TORX® Head Screws
52	Pivot Pins
53	Steering Column Support Assembly
54	Steering Column Jacket Assembly
55	Automatic Transmission Shift Lock Control
56	Adapter and Bearing Assembly
57	Lower Bearing Seat
58	Lower Bearing Spring
59	Lower Spring Retainer
60	Retainer
61	Steering Shaft Seal
62	Intermediate Steering Shaft Assembly
63	Pinch Bolt

STEERING COLUMN DISASSEMBLED VIEW (FLOOR SHIFT)

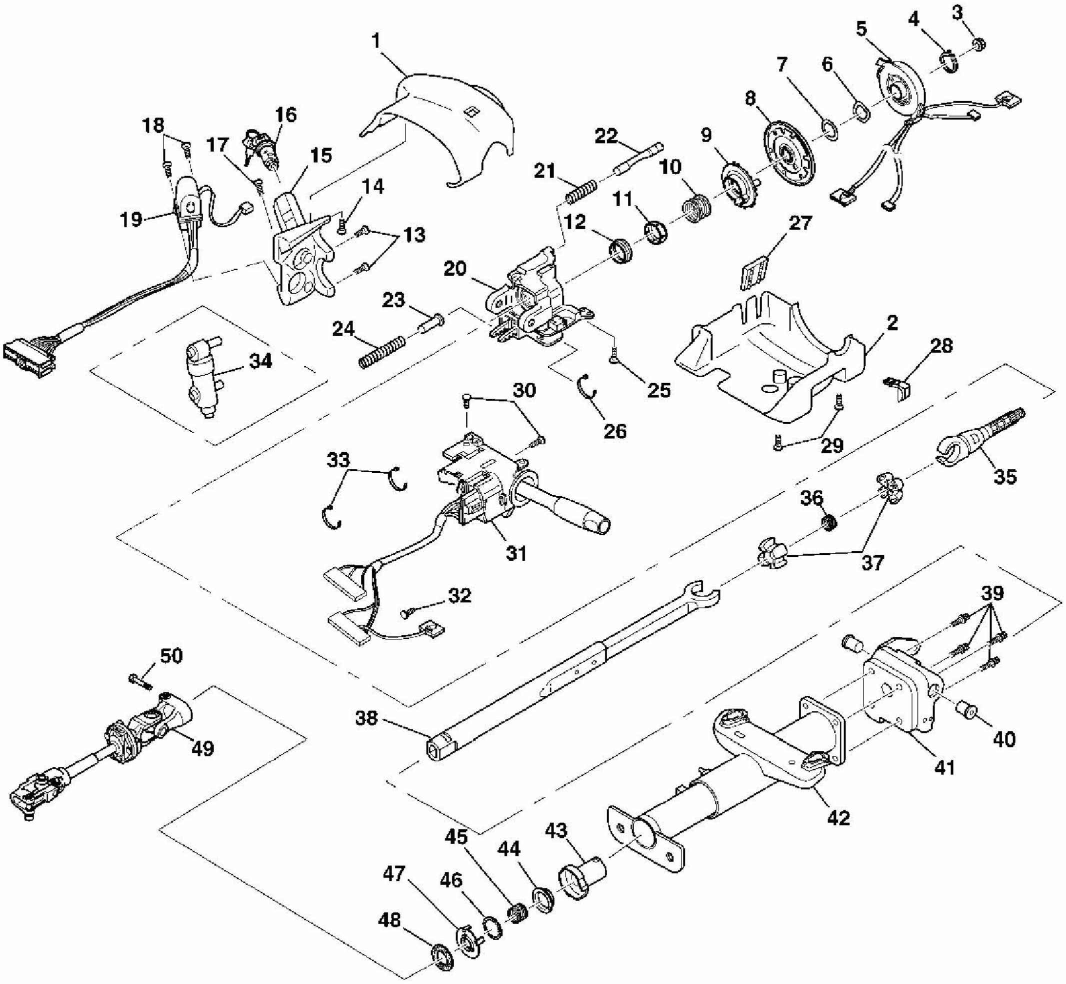
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Fig. 4: Tilt Steering Column Disassembled View, Floor Shift
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	Upper Trim Cover
2	Lower Trim Cover
3	Flanged Prevailing Torque Nut
4	Retaining Ring
5	SIR Coil
6	Wave Washer
7	Bearing Retainer
8	Shaft Lock Shield Assembly
9	Turn Signal Cancel Cam Assembly
10	Upper Bearing Spring

11	Upper Bearing Inner Race Seat
12	Inner Race
13	Pan Head Tapping Screws
14	TORX® Head Screw
15	Ignition Lock Cylinder Case Assembly
16	Steering Column Lock Cylinder Set
17	Pan Head Tapping Screw
18	Tapping Screws
19	Ignition Switch Assembly
20	Steering Column Tilt Head Assembly
21	Lock Bolt Spring
22	Lock Bolt Assembly
23	Spring Guide
24	Tilt Spring
25	TORX® Head Screw
26	Wire Harness Strap
27	Trim Cover Protector
28	Tilt Knob
29	Pan Head Tapping Screws
30	Pan Head Tapping Screws
31	Turn Signal and Multifunction Switch Assembly
32	Position Assurance Connector
33	Wire Harness Straps
34	Steering Wheel Theft Deterrent Park Lock
35	Race and Upper Shaft Assembly
36	Joint Preload Spring
37	Centering Sphere
38	Lower Shaft Assembly
39	TORX® Head Screws
40	Pivot Pins
41	Steering Column Support Assembly
42	Steering Column Jacket Assembly
43	Adapter and Bearing Assembly
44	Lower Bearing Seat
45	Lower Bearing Spring
46	Lower Spring Retainer
47	Retainer
48	Steering Shaft Seal

	Intermediate Steering Shaft Assembly
50	Pinch Bolt

STEERING WHEEL AND COLUMN COMPONENT VIEWS

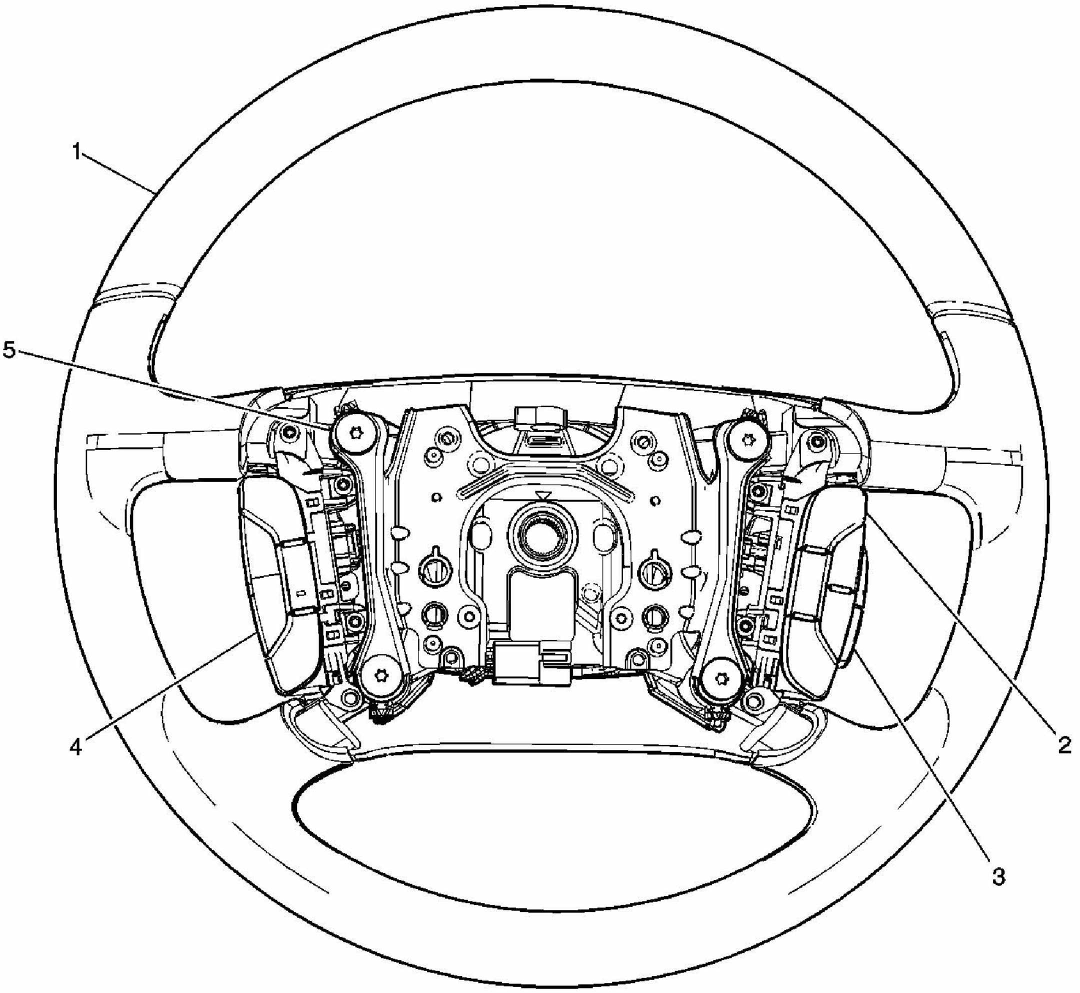


Fig. 5: Steering Wheel Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
1	Steering Wheel
2	Steering Wheel Controls-Right
3	Radio Controls
4	Steering Wheel Control-Right
5	Horn Contact Plate

STEERING WHEEL AND COLUMN CONNECTOR END VIEWS

Ignition Lock Cylinder Control Actuator

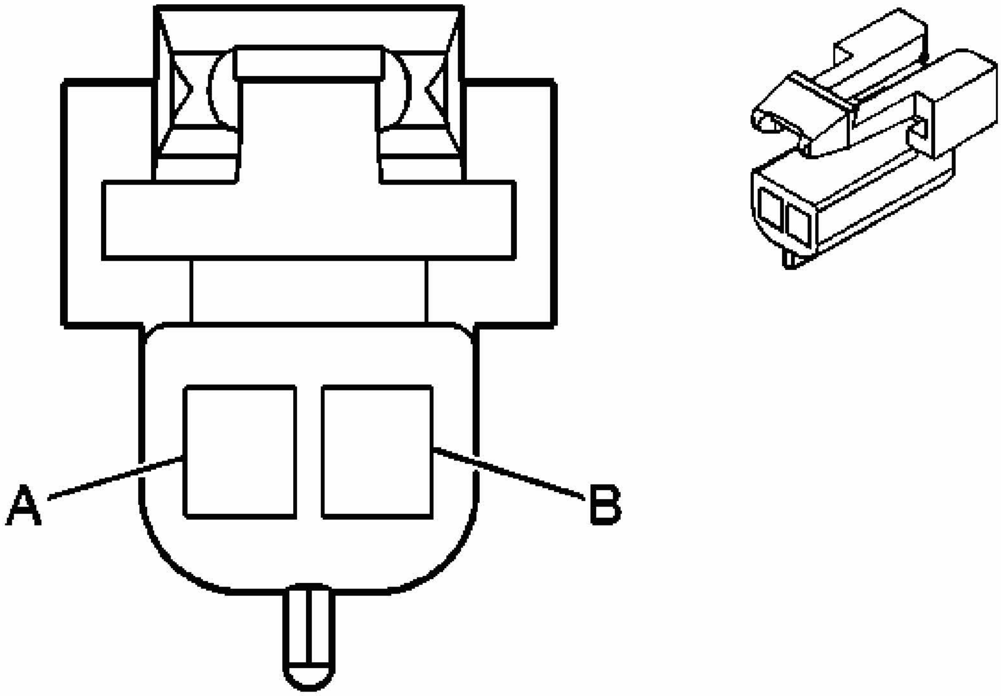


Fig. 6: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Steering Wheel and Column Connector End Views

Connector Part Information

- OEM: 12052832
- Service: 12101825
- Description: 2-Way F Metri-Pack 150 (BK)

Terminal Part Information

- Terminal/Tray: 12064971/5
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Ignition Lock Cylinder Control Actuator

Pin	Wire Color	Circuit No.	Function
A	D-GN/WH	1135	A/T Shift Lock Control Solenoid Supply Voltage
B	BK	1450	Ground
A	PU/WH	1630	Steering Column Key Cylinder Lock Solenoid Control
B	BK	1450	Ground

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - STEERING WHEEL CONTROLS

Begin the system diagnosis with **Diagnostic System Check - Vehicle** . The Diagnostic System Check - Vehicle will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check - Vehicle will identify the correct procedure for diagnosing the system and where the procedure is located.

DTC B3622

DTC Descriptor

DTC B3622 07

Steering Wheel Controls Signal Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The body control module (BCM) supplies 12 volts to the audio steering wheel control multiple momentary contact switches and monitors the steering wheel controls signal circuit. Each switch is associated to a set resistance value. When pressed, a specific voltage drop occurs through a series of resistors unique to that switch. The BCM identifies the selection, then sends a serial data message that is received by the component controlled, activating the feature.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

BCM detects voltage higher than normal

Action Taken When the DTC Sets

BCM will ignore the switch command

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Diagnostic Aids

- This diagnostic is for the audio steering wheel controls.
- Before diagnosis of the steering wheel controls, ensure the primary controls of the associated component are functioning properly.
- Review schematic when testing switch resistance values.

Reference Information

Schematic Reference

Steering Wheel Schematics

Connector End View Reference

- **Steering Wheel and Column Connector End Views**
- **Computer/Integrating Systems Connector End Views**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Testing

CAUTION: Refer to SIR Caution .

1. Ignition OFF, disconnect the harness connector at the audio steering wheel control switch.
2. Ignition ON, connect a test lamp between the steering wheel controls signal circuit and ground at the switch harness connector and verify it does not illuminate.
    - If test lamp illuminates, test the signal circuit for short to voltage. If circuit tests normal, replace the BCM.
3. If circuits tests normal, test or replace the switch.

Component Testing

CAUTION: Refer to SIR Caution .

1. Ignition OFF, disconnect the harness connector at the audio steering wheel control switch.
2. Test the switch for infinite resistance between the remote radio control supply voltage terminal and the steering wheel controls signal terminal with the switch in the open position.
    - If less than infinite resistance, replace the switch.
3. Test resistance values between the supply voltage terminal and the signal terminal with the switch closed in each position and verify readings are approximate to what the schematic reads.
    - If values do not, replace the switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Steering Wheel Control Switch Assembly Replacement**
- **Control Module References** for BCM replacement, setup, and programming

STEERING WHEEL CONTROLS INOPERATIVE

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The body control module (BCM) supplies 12 volts to the audio steering wheel control multiple momentary contact switches and monitors the return signal. Each switch is associated to a set resistance value, when pressed a specific voltage drop occurs through a series of resistors unique to that switch. The BCM identifies the selection, then sends a serial data message that is received by the component controlled, activating the feature.

Diagnostic Aids

- This diagnostic is for the audio steering wheel controls.
- Before diagnosis of the steering wheel controls, ensure the primary controls of the associated component are functioning properly.
- Review schematic when testing switch resistance values.

Reference Information

Schematic Reference

Steering Wheel Schematics

Connector End View Reference

- **Steering Wheel and Column Connector End Views**
- **Computer/Integrating Systems Connector End Views**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Testing

CAUTION: Refer to SIR Caution .

1. Ignition OFF, disconnect the harness connector at the audio steering wheel control switch.
2. Ignition ON, test for 12 volts between the remote radio control supply voltage circuit and ground at the switch harness connector.
    - If less than 10 volts, test the voltage circuit for a short to ground or an open/high resistance. If circuit test normal, replace the BCM.
3. Ignition ON, connect a test lamp between the signal circuit to the BCM and ground at the switch connector.
    - If test lamp illuminates, test the signal circuit for short to voltage. If circuit test

normal, replace the BCM.

4. Ignition OFF, test for less than 1 ohm of resistance between the signal circuit and ground, at the switch harness connector.
   - If greater than 1 ohm, test the signal circuit for an open/high resistance. If circuit tests normal, replace the BCM.
5. Ignition OFF, disconnect the harness connector at the BCM and switches.
6. Test for infinite resistance between the signal circuit and ground at the switch harness connector.
   - If less than infinite resistance, test the signal circuit for a short to ground.
7. If circuit tests normal, test or replace the switch.

Component Testing

CAUTION: Refer to SIR Caution .

1. Ignition OFF, disconnect the harness connector at the audio steering wheel control switch.
2. Test for infinite resistance between the supply voltage terminal and the signal terminal with the switch in the open position.
   - If less than infinite resistance, replace the switch.
3. Test resistance values between the supply voltage terminal and the signal terminal with the switch closed in each position and verify readings are approximate to what the schematic reads.
   - If values do not, replace the switch.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Steering Wheel Control Switch Assembly Replacement**
- **Control Module References** for BCM replacement, setup, and programming

SYMPTOMS - STEERING WHEEL CONTROLS

IMPORTANT:

1. **Perform the Diagnostic System Check - Vehicle , before using the Symptom Tables in order to verify that all of the following conditions are true:**
   - **There are no DTCs set.**
   - **The control modules can communicate via the serial**

data link.

2. **Review the system operation in order to familiarize yourself with the system functions. Refer to Steering Wheel Controls Description and Operation.**

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the Steering Wheel Controls System. Refer to **Checking Aftermarket Accessories** .
- Inspect for easily accessible or visible system components for obvious damage or conditions which may cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to **Steering Wheel Controls Inoperative** in order to diagnose the symptom.

STEERING COLUMN TILT FUNCTION INOPERATIVE

Steering Column Tilt Function Inoperative

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and Operation and perform the necessary inspections?	Go to **Step 2**	Go to **Steering Wheel and Column Description and Operation**
2	Verify that the steering column tilt function is inoperative. Does the steering column tilt function operate normally?	System OK	Go to **Step 3**
3	Verify that the shoe is not seized on the pivot pin. Is the shoe seized on the pivot pin?	Go to **Step 9**	Go to **Step 4**
4	Inspect the shoe grooves for dirt, burrs, or rust. Are the shoe grooves free of dirt, burrs, and rust?	Go to **Step 9**	Go to **Step 5**
5	Inspect weak or broken shoe lock spring. Is the shoe lock spring weak or broken?	Go to **Step 9**	Go to **Step 6**
	Inspect the pivot pins for binding.		

6	Are the pivot pins binding?	Go to **Step 10**	Go to **Step 7**
7	Inspect for a weak or broken wheel tilt spring. Is the wheel tilt spring weak or broken?	Go to **Step 11**	Go to **Step 8**
8	Inspect the steering column wiring harness for tightness. Is the steering column wiring harness too tight?	Go to **Step 12**	Go to **Step 3**
9	Replace the tilt head. Refer to **Steering Shaft, Lower Bearing, and Jacket Replacement**. Is the repair complete?	Go to **Step 13**	-
10	Replace the pivot pins. Refer to **Steering Shaft, Lower Bearing, and Jacket Replacement**. Is the repair complete?	Go to **Step 13**	-
11	Replace the tilt spring. Refer to **Tilt Spring Replacement**. Is the repair complete?	Go to **Step 13**	-
12	Reroute the steering column wiring harness to the correct location. Is the steering column wiring harness routed properly?	Go to **Step 13**	-
13	Operate the steering column tilt function in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

LOCK SYSTEM DOES NOT UNLOCK

Lock System Does Not Unlock

Step	Action	Yes	No
DEFINITION: The lock system does not allow the key to rotate out of the OFF position.			
1	Did you review the Steering Wheel and Column Description and Operation?	Go to **Step 2**	Go to **Steering Wheel and Column Description and Operation**
2	Verify that the lock system does not unlock. Does the lock system operate normally?	System OK	Go to **Step 3**
3	Inspect for an incorrect, worn, or damaged key.		

	Is the key incorrect, worn, or damaged?	Go to **Step 7**	Go to **Step 4**
4	Inspect for a faulty lock cylinder. Is the lock cylinder damaged?	Go to **Step 8**	Go to **Step 5**
5	Inspect the ignition lock cylinder case assembly for looseness. Is the ignition lock cylinder case assembly loose?	Go to **Step 9**	Go to **Step 6**
6	Inspect the ignition switch assembly for damage. Is the ignition switch assembly damaged?	Go to **Step 10**	Go to **Step 3**
7	Replace the key. Refer to **Key and Lock Cylinder Coding** in General Information. Did you complete the repair?	Go to **Step 11**	-
8	Replace the lock cylinder. Refer to **Ignition Lock Cylinder Replacement**. Did you complete the repair?	Go to **Step 11**	-
9	Tighten the ignition lock cylinder case assembly. Refer to **Fastener Tightening Specifications**. Did you complete the repair?	Go to **Step 11**	-
10	Replace the ignition switch. Refer to **Ignition Switch Replacement**. Did you complete the repair?	Go to **Step 11**	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

LOCK SYSTEM DOES NOT LOCK

Lock System Does Not Lock

Step	Action	Yes	No
DEFINITION: The lock system will not allow the key to be turned to the OFF lock position.			
1	Did you review the Steering Wheel and Column Description and Operation?	Go to **Step 2**	Go to **Steering Wheel and Column Description and Operation**
2	Verify that the lock system does not lock. Does the lock system operate normally?	System OK	Go to **Step 3**
3	Inspect for a faulty lock cylinder or release button.		

	Is the lock cylinder or release button damaged?	Go to **Step 7**	Go to **Step 4**
4	Inspect the shift cable adjustment. Is the shift linkage adjusted incorrectly?	Go to **Step 8**	Go to **Step 5**
5	Inspect the ignition switch for damage. Is the ignition switch damaged?	Go to **Step 9**	Go to **Step 6**
6	Inspect the steering wheel theft deterrent lock for damage. Is the steering wheel theft deterrent lock damaged?	Go to **Step 10**	Go to **Step 3**
7	Replace the lock cylinder. Refer to **Ignition Lock Cylinder Replacement**. Did you complete the repair?	Go to **Step 11**	-
8	Adjust the shift cable. Refer to **Automatic Transmission Range Selector Cable Adjustment** or to **Park Lock Cable Adjustment** in Automatic Transaxle - 4T65E. Did you complete the repair?	Go to **Step 11**	-
9	Replace the ignition switch. Refer to **Ignition Switch Replacement**. Did you complete the repair?	Go to **Step 11**	-
10	Replace the steering wheel theft deterrent lock. Refer to **Steering Wheel Theft Deterrent Lock Replacement**. Did you complete the repair?	Go to **Step 11**	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

LOCK SYSTEM STICKS IN START

Lock System Sticks in Start

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and Operation?	Go to **Step 2**	Go to **Steering Wheel and Column Description and Operation**
2	Verify that the lock system sticks in the START position. Does the lock system operate normally?	System OK	Go to **Step 3**

3	Inspect the ignition lock cylinder case assembly for damage. Is the ignition lock cylinder case assembly damaged?	Go to **Step 6**	Go to **Step 4**
4	Inspect the lock cylinder for damage. Is the lock cylinder damaged?	Go to **Step 7**	Go to **Step 5**
5	Inspect the ignition switch for damage. Is the ignition switch damaged?	Go to **Step 8**	Go to **Step 3**
6	Tighten the ignition lock cylinder case assembly mounting bolts. Refer to **Fastener Tightening Specifications**. Did you complete the repair?	Go to **Step 9**	-
7	Replace the lock cylinder. Refer to **Ignition Lock Cylinder Replacement**. Did you complete the repair?	Go to **Step 9**	-
8	Replace the ignition switch. Refer to **Ignition Switch Replacement**. Did you complete the repair?	Go to **Step 9**	-
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

KEY CANNOT BE REMOVED IN THE OFF LOCK POSITION

Key Cannot Be Removed in the Off Lock Position

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and Operation?	Go to **Step 2**	Go to **Steering Wheel and Column Description and Operation**
2	Verify that the key cannot be removed from the lock cylinder in the OFF position. Does the lock system operate normally?	System OK	Go to **Step 3**
3	Inspect for incorrect, worn, or damaged key. Is the key incorrect, worn, or damaged?	Go to **Step 5**	Go to **Step 4**
4	Inspect for a faulty lock cylinder or release button. Is the lock cylinder or release button damaged?	Go to **Step 6**	Go to **Step 3**
	Replace the key. Refer to **Key and Lock**		

5	**Cylinder Coding** in General Information. Did you complete the repair?	Go to **Step 7**	-
6	Replace the lock cylinder. Refer to **Ignition Lock Cylinder Replacement**. Did you complete the repair?	Go to **Step 7**	-
7	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

HIGH LOCK EFFORT

High Lock Effort

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and Operation?	Go to **Step 2**	Go to **Steering Wheel and Column Description and Operation**
2	Verify that the lock system has a high lock effort. Does the lock system operate normally?	System OK	Go to **Step 3**
3	Inspect for an incorrect, worn, or damaged key. Is the key incorrect, worn, or damaged?	Go to **Step 7**	Go to **Step 4**
4	Inspect for a faulty lock cylinder. Is the lock cylinder damaged?	Go to **Step 8**	Go to **Step 5**
5	Inspect the ignition lock cylinder case assembly for damage. Is the ignition lock cylinder case assembly damaged?	Go to **Step 9**	Go to **Step 6**
6	Inspect the ignition switch assembly for damage. Is the ignition switch assembly damaged?	Go to **Step 10**	Go to **Step 7**
7	Replace the key. Refer to **Key and Lock Cylinder Coding** in General Information. Did you complete the repair?	Go to **Step 11**	-
8	Replace the lock cylinder. Refer to **Ignition Lock Cylinder Replacement**. Did you complete the repair?	Go to **Step 11**	-
9	Tighten the ignition lock cylinder case assembly. Refer to **Fastener Tightening Specifications**.		

	Did you complete the repair?	Go to **Step 11**	-
10	Replace the ignition switch. Refer to **Ignition Switch Replacement**. Did you complete the repair?	Go to **Step 11**	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

NOISE IN STEERING COLUMN

Noise in Steering Column

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and Operation and perform the necessary inspections?	Go to **Step 2**	Go to **Steering Wheel and Column Description and Operation**
2	Verify that noise is present in the steering column during operation. Is noise present in the steering column during operation?	Go to **Step 3**	System OK
3	Inspect the steering column components for looseness. Is the steering column components loose?	Go to **Step 10**	Go to **Step 4**
4	Inspect the SIR coil for noise. Is the SIR coil noisy?	Go to **Step 11**	Go to **Step 5**
5	Inspect the horn contact ring for lubrication. Is the horn contact ring lubricated?	Go to **Step 6**	Go to **Step 12**
6	Inspect the lock plate retaining ring for the correct installation. Is the lock plate retaining ring installed properly?	Go to **Step 7**	Go to **Step 13**
7	Inspect the shaft bearing for the following conditions: • Damage • Lubrication • Wear • Proper seating Are the bearings in need of repair or		

	replacement?	Go to **Step 14**	Go to **Step 8**
8	Inspect the spherical joint for lubrication. Is the spherical joint lubricated?	Go to **Step 9**	Go to **Step 15**
9	Inspect the steering column coupling for looseness. Is the steering column coupling loose?	Go to **Step 16**	Go to **Step 3**
10	**NOTE:** **Refer to Fastener Notice in Cautions and Notices.** Tighten the steering column components to specifications. Refer to **Fastener Tightening Specifications**.Did you complete the repair?	Go to **Step 17**	-
11	Replace the SIR coil. Refer to **Inflatable Restraint Steering Wheel Module Coil Replacement (Coil)** in SIR. Did you complete the repair?	Go to **Step 17**	-
12	Lubricate the horn contact ring. Did you complete the repair?	Go to **Step 17**	-
13	Install the lock plate retaining ring properly. Did you complete the repair?	Go to **Step 17**	-
14	Repair the shaft bearings as necessary. Refer to **Steering Shaft, Lower Bearing, and Jacket Replacement**. Did you complete the repair?	Go to **Step 17**	-
15	Lubricate the spherical joints. Did you complete the repair?	Go to **Step 17**	-
16	Tighten the steering column coupling to specifications. Refer to **Fastener Tightening Specifications**. Did you complete the repair?	Go to **Step 17**	-
17	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

LOOSENESS IN STEERING COLUMN

Looseness in Steering Column

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and Operation and perform the necessary inspections?		Go to **Steering Wheel and Column**

		Go to **Step 2**	**Description and Operation**
2	Verify that the steering column is loose. Is the steering column loose?	Go to **Step 3**	System OK
3	Inspect the steering column mounting brackets for looseness. Are the steering column mounting brackets loose?	Go to **Step 8**	Go to **Step 4**
4	Verify that the steering column bracket capsule is not sheared. Is the steering column bracket capsule sheared?	Go to **Step 9**	Go to **Step 5**
5	Inspect the support screws for looseness. Are the support screws loose?	Go to **Step 10**	Go to **Step 6**
6	Inspect the intermediate shaft for worn joints or looseness. Is the intermediate joint worn or loose?	Go to **Step 11**	Go to **Step 7**
7	Inspect the tilt head, support and pivot pins for looseness. Are there any loose components?	Go to **Step 12**	Go to **Step 2**
8	**NOTE:** **Refer to Fastener Notice in Cautions and Notices.** Tighten the brackets to specifications. Refer to **Fastener Tightening Specifications**.Did you complete the repair?	Go to **Step 13**	-
9	Replace the jacket assembly. Refer to **Steering Shaft, Lower Bearing, and Jacket Replacement**. Did you complete the replacement?	Go to **Step 13**	-
10	Tighten the support screws to specifications. Refer to **Fastener Tightening Specifications**. Did you complete the repair?	Go to **Step 13**	-
11	Tighten or replace the intermediate shaft as needed. Refer to **Intermediate Steering Shaft Replacement**. Did you complete the repair?	Go to **Step 13**	-
12	Repair or replace the tilt head, support and pivot pins as necessary. Refer to **Steering Shaft, Lower Bearing, and Jacket Replacement**.		

	Did you complete the replacement?	Go to **Step 13**	-
13	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

REPAIR INSTRUCTIONS

SEAL REPLACEMENT - INTERMEDIATE STEERING SHAFT

Removal Procedure

1. Turn the ignition OFF and remove the key from the ignition lock cylinder in order to lock the steering column.
2. Remove the intermediate shaft seal from the steering column.
3. Disconnect the intermediate shaft from the steering column. Refer to **Intermediate Steering Shaft Replacement**.
4. Push the intermediate shaft down in order to collapse the intermediate shaft.

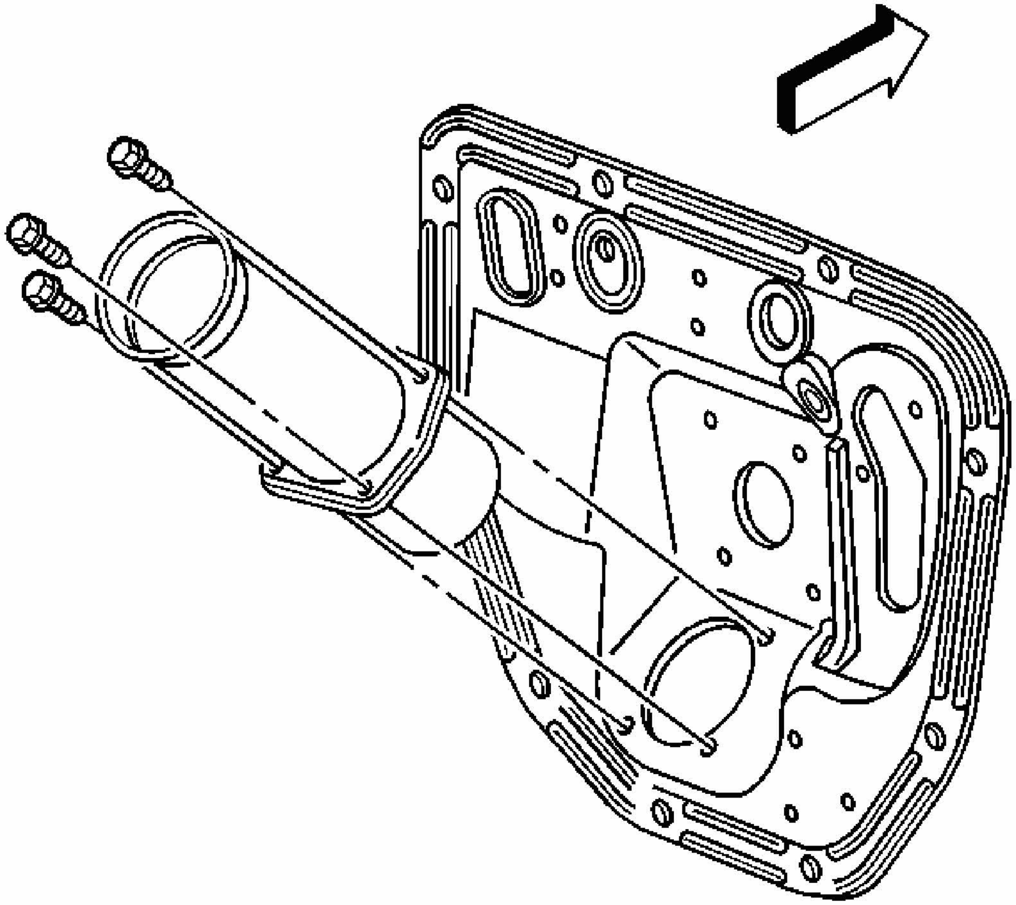


Fig. 7: Locating Intermediate Shaft Seal Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the intermediate shaft seal bolts.

IMPORTANT: It may be necessary to remove the lower portion of the intermediate shaft seal from the steering gear.

6. Remove the intermediate shaft seal.

Installation Procedure

1. Install the intermediate shaft lower seal over the intermediate shaft and to the steering gear.
2. Install the intermediate shaft upper seal over the lower seal and to the instrument panel.
3. Connect the intermediate shaft to the steering column. Refer to **Intermediate Steering**

Shaft Replacement.

4. Install the intermediate shaft seal to the steering column.

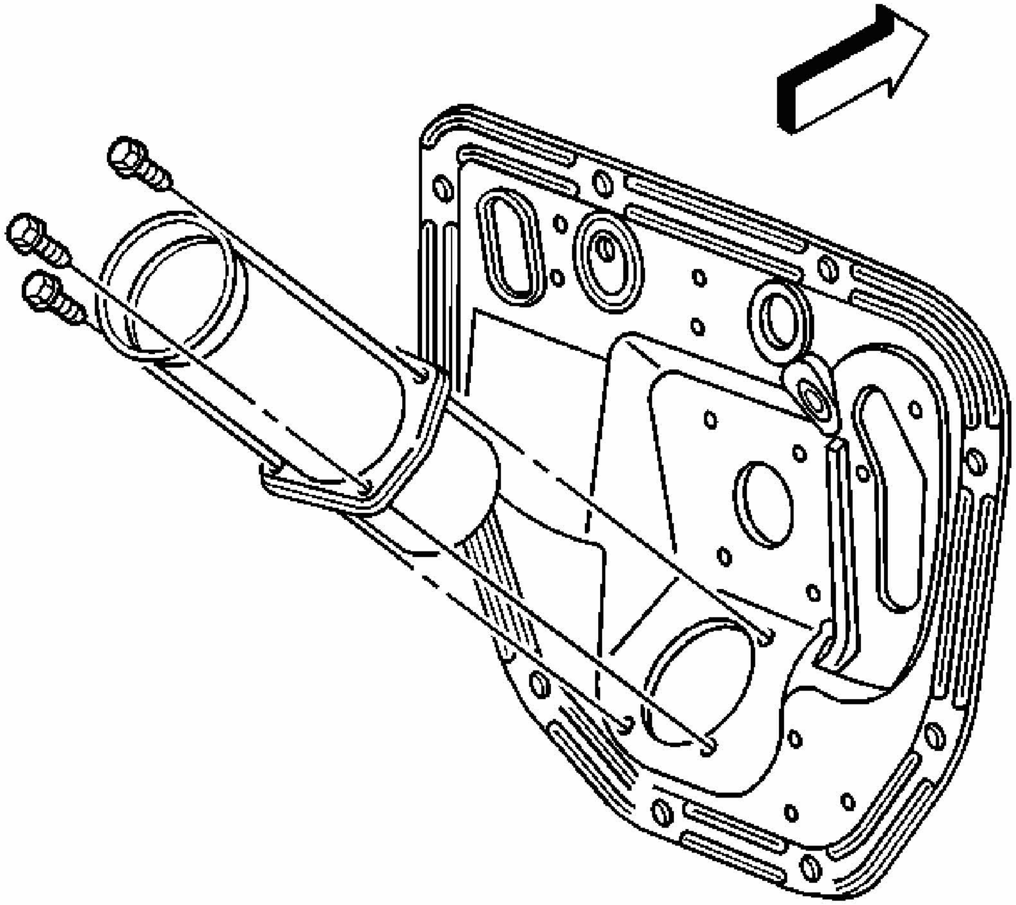


Fig. 8: Locating Intermediate Shaft Seal Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

5. Install the intermediate shaft seal bolts.

Tighten: Tighten the intermediate shaft seal bolts to 3 N.m (27 lb in).

INTERMEDIATE STEERING SHAFT REPLACEMENT

Tools Required

J 42640 Steering Column Anti-Rotation Pin

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

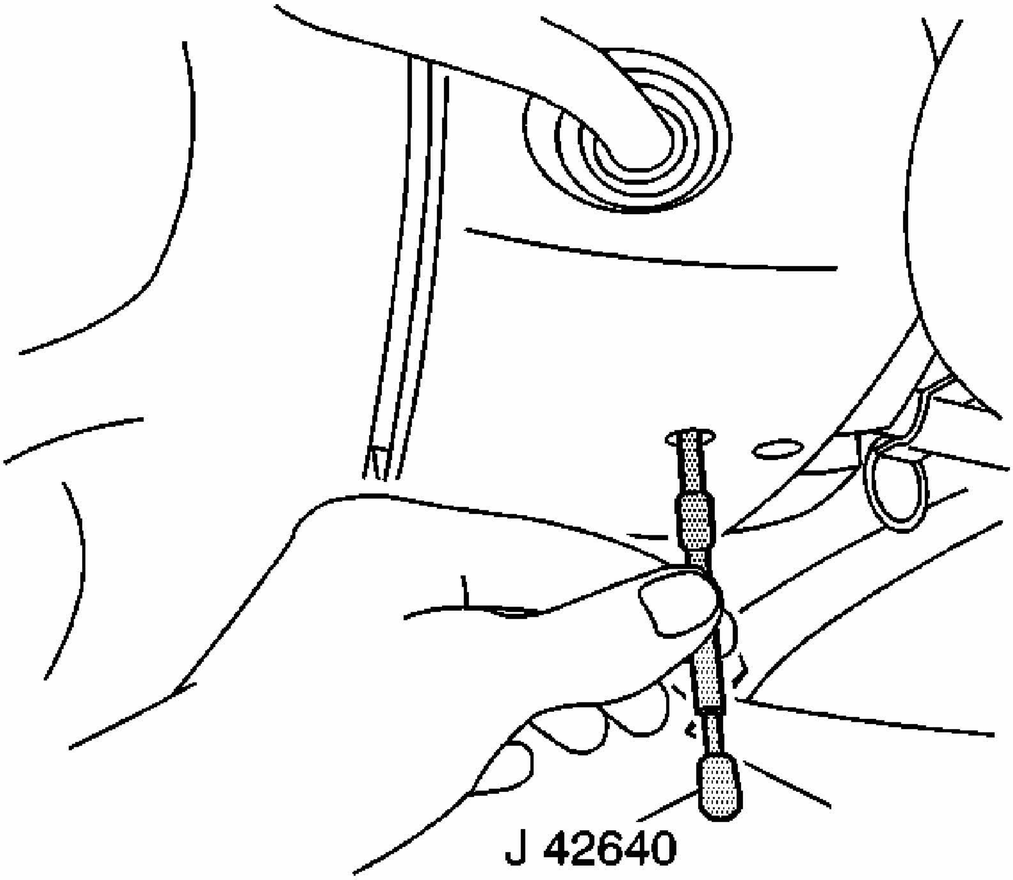


Fig. 9: Identifying J 42640
Courtesy of GENERAL MOTORS CORP.

NOTE: **The front wheels of the vehicle must be maintained in the straight ahead position and the steering column must be in the LOCK position before disconnecting the steering column or intermediate shaft. Failure to follow these procedures will cause improper alignment of some components during**

installation and result in damage to the SIR coil assembly.

3. Install **J 42640** into the bottom of the steering column.

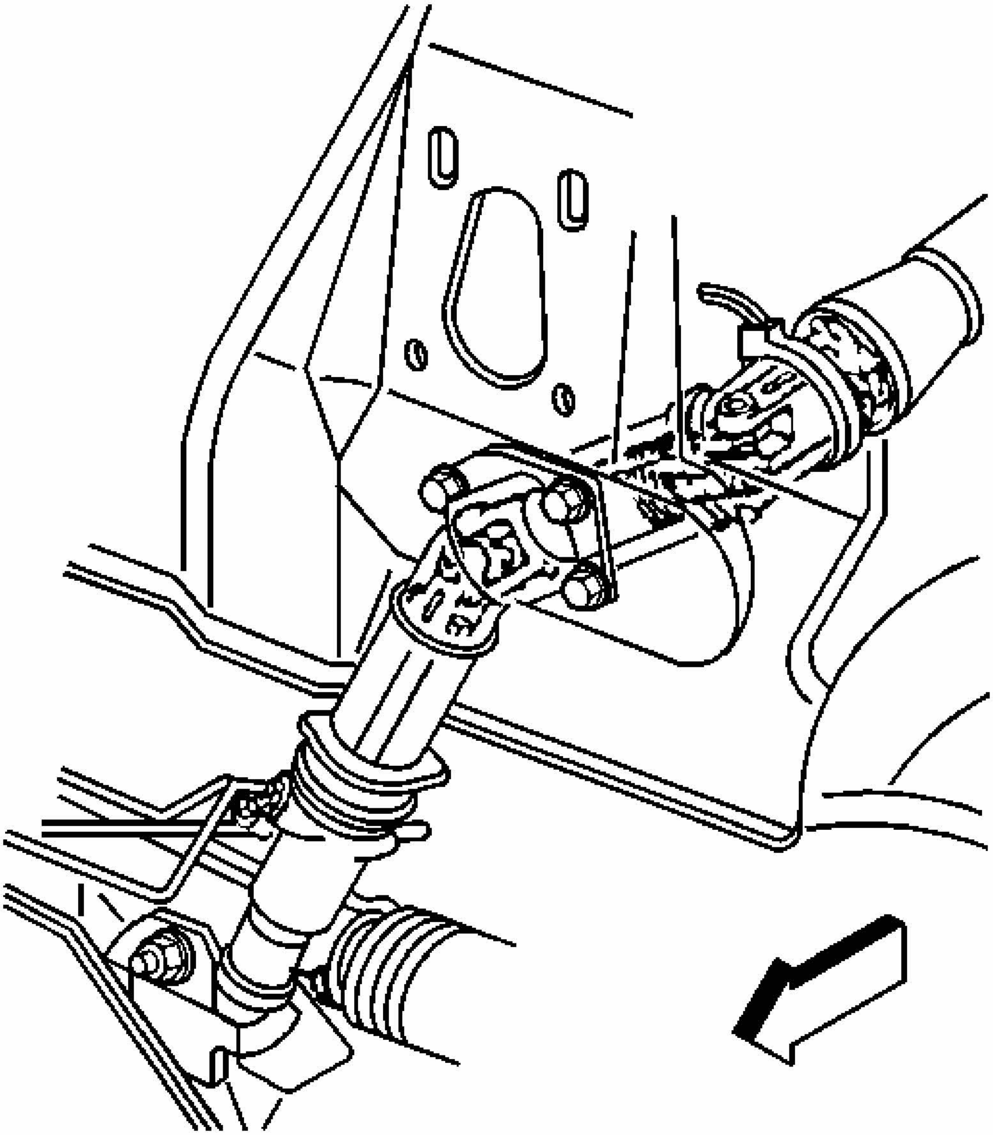


Fig. 10: Providing Access To Intermediate Steering Shaft Lower Pinch Bolt
Courtesy of GENERAL MOTORS CORP.

4. Position the intermediate steering shaft seal in order to provide access to the lower pinch bolt.

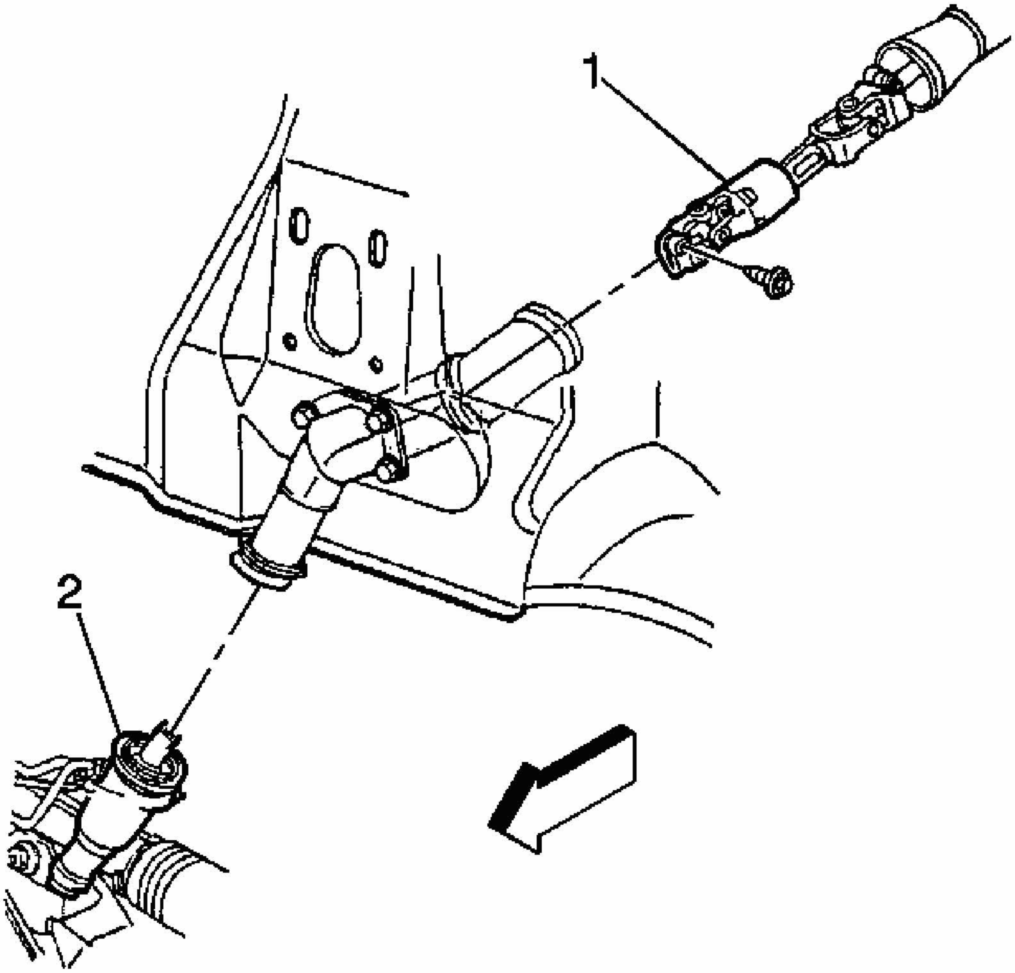


Fig. 11: View Of Intermediate Steering Shaft To Power Steering Gear Stub Shaft
Courtesy of GENERAL MOTORS CORP.

5. Remove the lower pinch bolt from the power steering gear stub shaft (2).
6. Remove the intermediate steering shaft (1) from the power steering gear stub shaft (2).
7. Lower the vehicle.
8. Remove the left instrument panel insulator. Refer to **Closeout/Insulator Panel Replacement - Left** in Instrument Panel, Gages and Console.

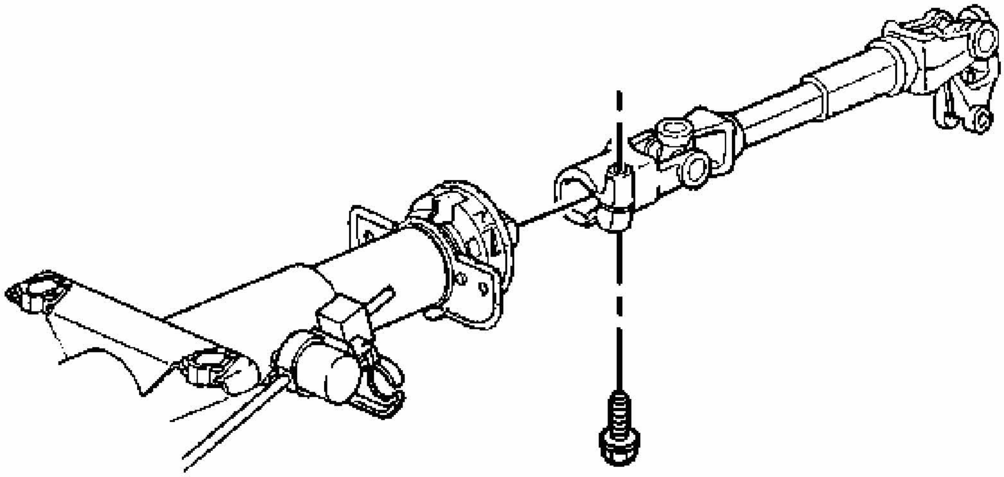


Fig. 12: View Of Upper Pinch Bolt Of Intermediate Steering Shaft
Courtesy of GENERAL MOTORS CORP.

9. Reposition the intermediate steering shaft seal in order to gain access to the upper pinch bolt.
10. Remove the upper pinch bolt from the intermediate steering shaft.
11. Disconnect the intermediate steering shaft from the steering column.
12. Remove the intermediate steering shaft.

Installation Procedure

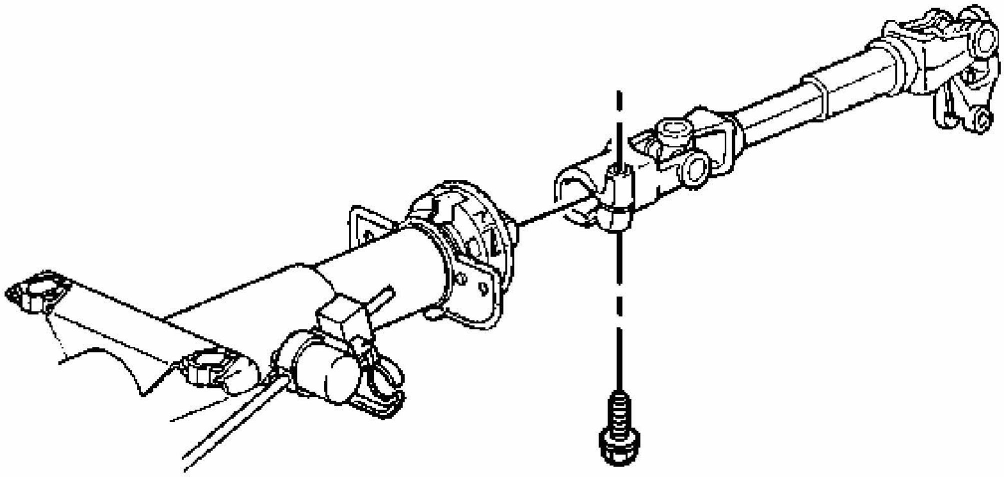


Fig. 13: View Of Upper Pinch Bolt Of Intermediate Steering Shaft
Courtesy of GENERAL MOTORS CORP.

1. Position the intermediate steering shaft into place.

NOTE: Refer to Fastener Notice in Cautions and Notices.

Install the upper pinch bolt which secures the intermediate steering shaft to the steering column.

Tighten: Tighten the pinch bolt to 48 N.m (35 lb ft).

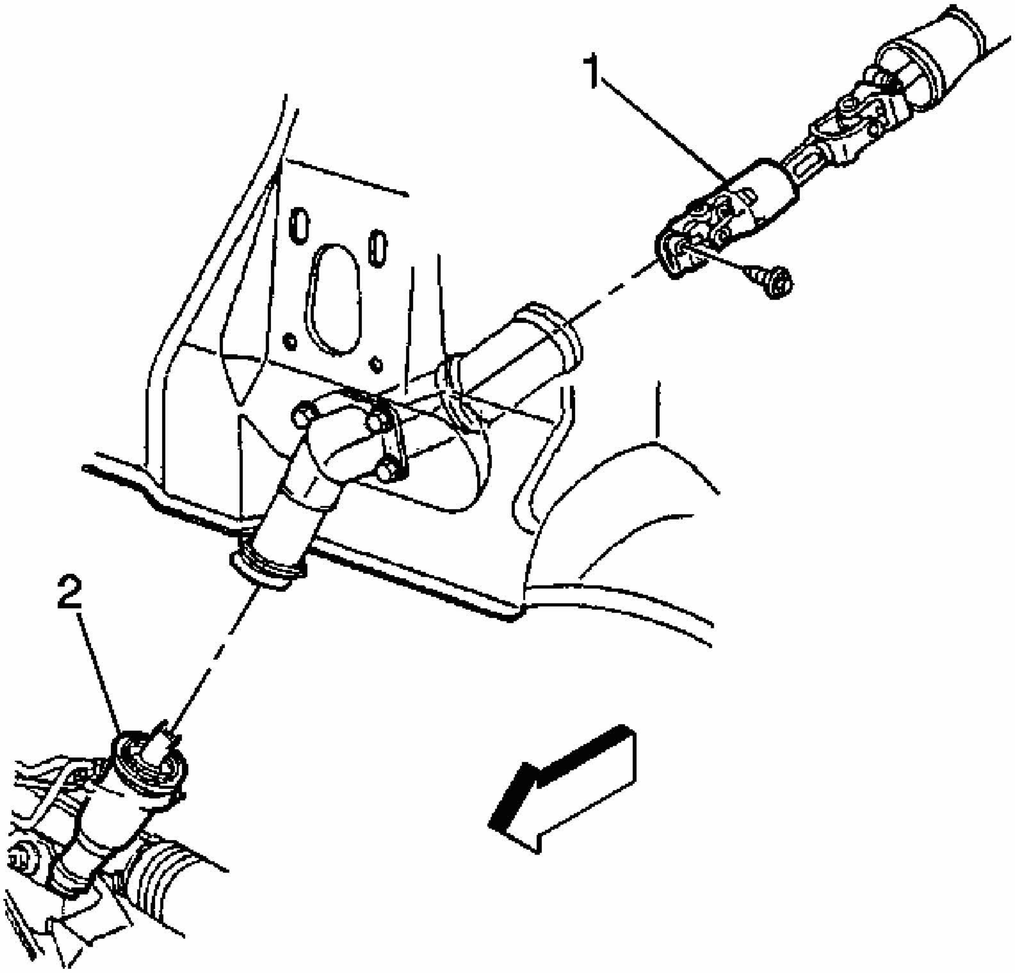


Fig. 14: View Of Intermediate Steering Shaft To Power Steering Gear Stub Shaft
Courtesy of GENERAL MOTORS CORP.

2. Install the intermediate steering shaft seal onto the steering column.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Install the intermediate steering shaft (1) to the power steering gear stub shaft (2).
5. Install the lower pinch bolt which secures the intermediate steering shaft to the power steering gear stub shaft.

Tighten: Tighten the pinch bolt to 48 N.m (35 lb ft).

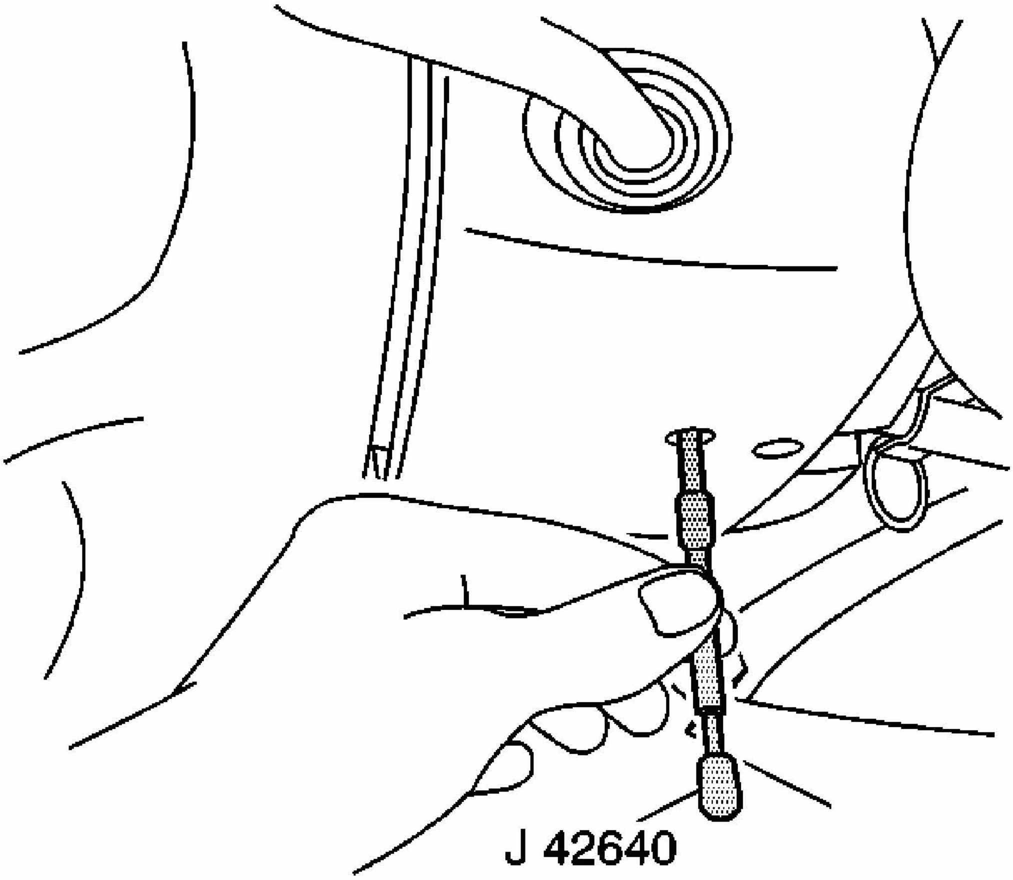


Fig. 15: Identifying J 42640
Courtesy of GENERAL MOTORS CORP.

6. Remove the **J 42640** from the steering column.

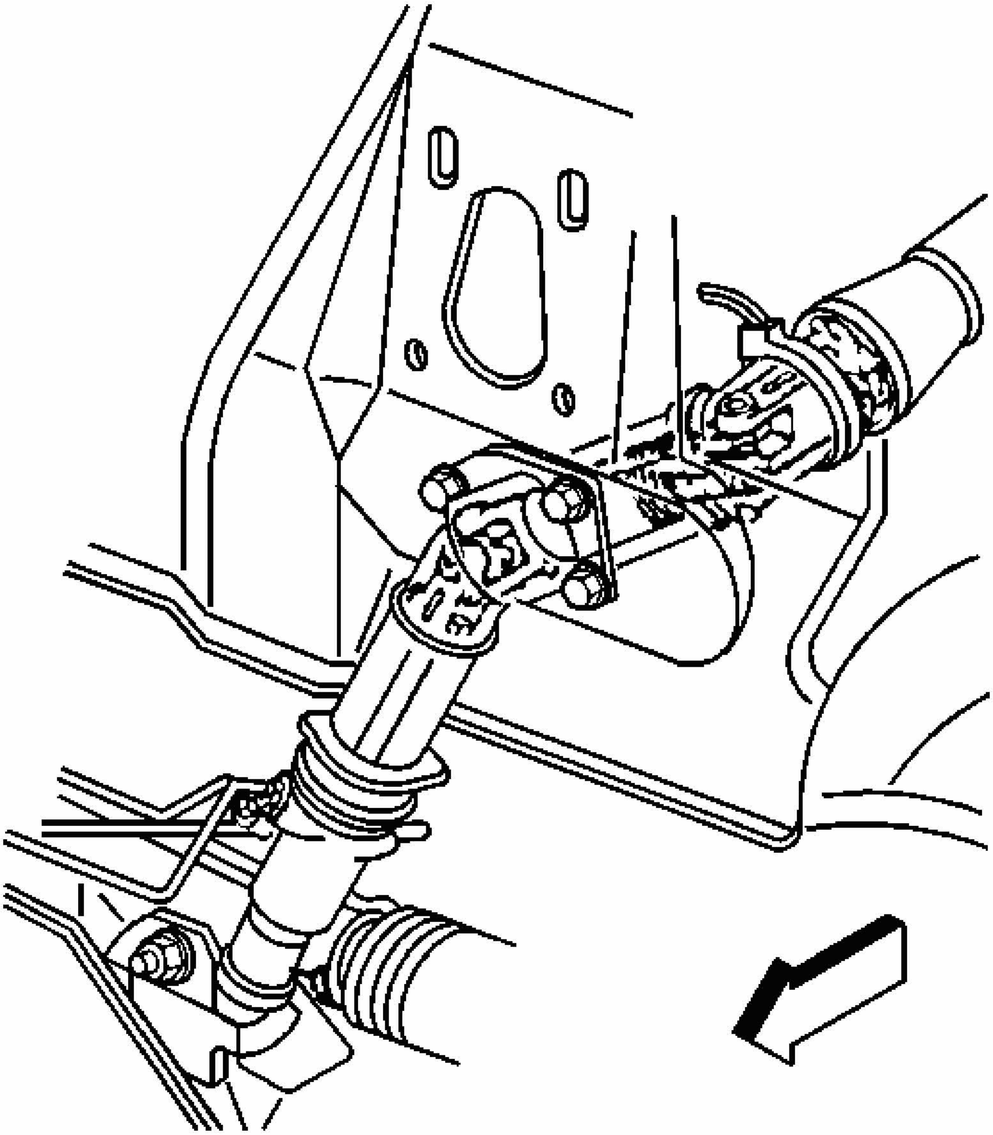


Fig. 16: Providing Access To Intermediate Steering Shaft Lower Pinch Bolt
Courtesy of GENERAL MOTORS CORP.

7. Install the intermediate steering shaft seal onto the power steering gear.
8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
9. Lower the vehicle.
10. Install the left instrument panel insulator. Refer to **Closeout/Insulator Panel Replacement - Left** in Instrument Panel, Gages and Console.

STEERING COLUMN ACCIDENT DAMAGE INSPECTION

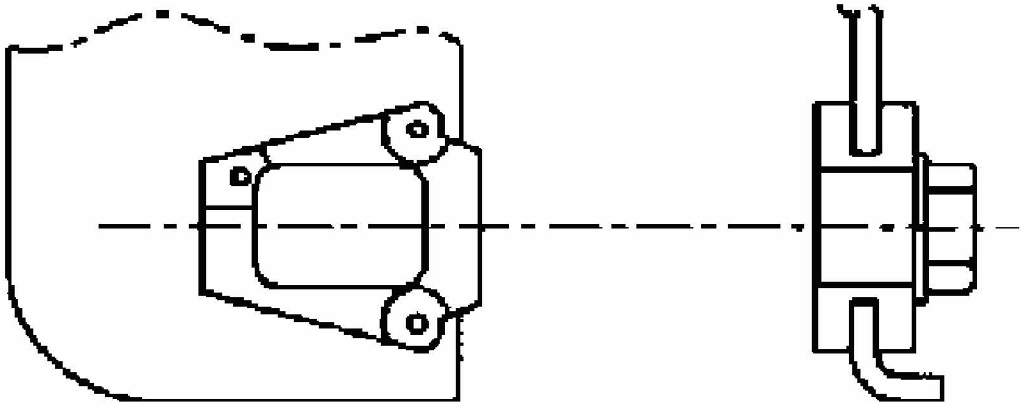


Fig. 17: Inspecting Capsules On Steering Column Bracket Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: Vehicles involved in accidents that result in any of the following kinds of damage or situations, may also have a damaged or misaligned steering column:

- **Frame damage**
- **Major body damage**
- **Sheet metal damage**
- **If the steering column has been impacted**
- **If the supplemental inflatable restraints system was deployed**

- Inspect the capsules on the steering column bracket assembly. All capsules must be securely seated in the bracket slots and inspected for any loose conditions when pushed or pulled by hand.
- Observe how the bracket is attached to the jacket assembly.
  - If the capsules are not securely seated and the bracket is bolted to the jacket assembly, replace only the bracket.
  - If the capsules are not securely seated and the bracket is welded to the jacket assembly, replace only the jacket assembly.

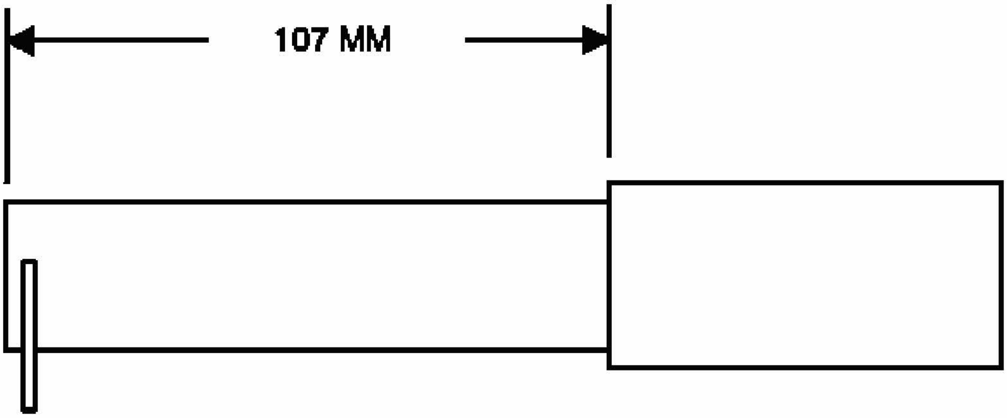


Fig. 18: Measuring Distance From Lower Edge Of Upper Jacket To A Defined Point On Lower Jacket
Courtesy of GENERAL MOTORS CORP.

- Inspect for jacket assembly collapse by measuring the distance from the lower edge of the upper jacket to a defined point on the lower jacket. Replace the jacket assembly if the measured dimensions are not within specifications.

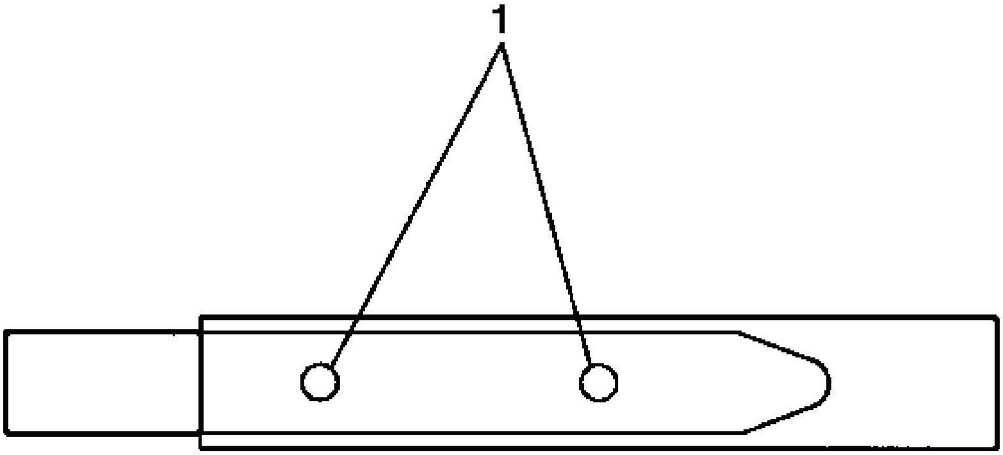


Fig. 19: Inspecting Steering Shaft For Sheared Injected Plastic
Courtesy of GENERAL MOTORS CORP.

- Visually inspect the steering shaft for sheared injected plastic (1). If the steering shaft shows sheared plastic (1), replace the steering shaft.
- Any frame damage that could cause a bent steering shaft must have the steering shaft runout checked. Using a dial indicator at the lower end of the steering shaft, rotate the steering wheel. The runout must not exceed 1.60 mm (0.06 in).

STEERING COLUMN TRIM COVERS REPLACEMENT

Removal Procedure

CAUTION: Refer to SIR Caution in Cautions and Notices.

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

CAUTION: Refer to BATTERY DISCONNECT CAUTION in Cautions and Notices.

2. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** in Engine Electrical.
3. Remove the steering wheel. Refer to **Steering Wheel Replacement**.
4. Remove the steering column filler. Refer to **Steering Column Filler Replacement** in Instrument Panel, Gages, and Console.

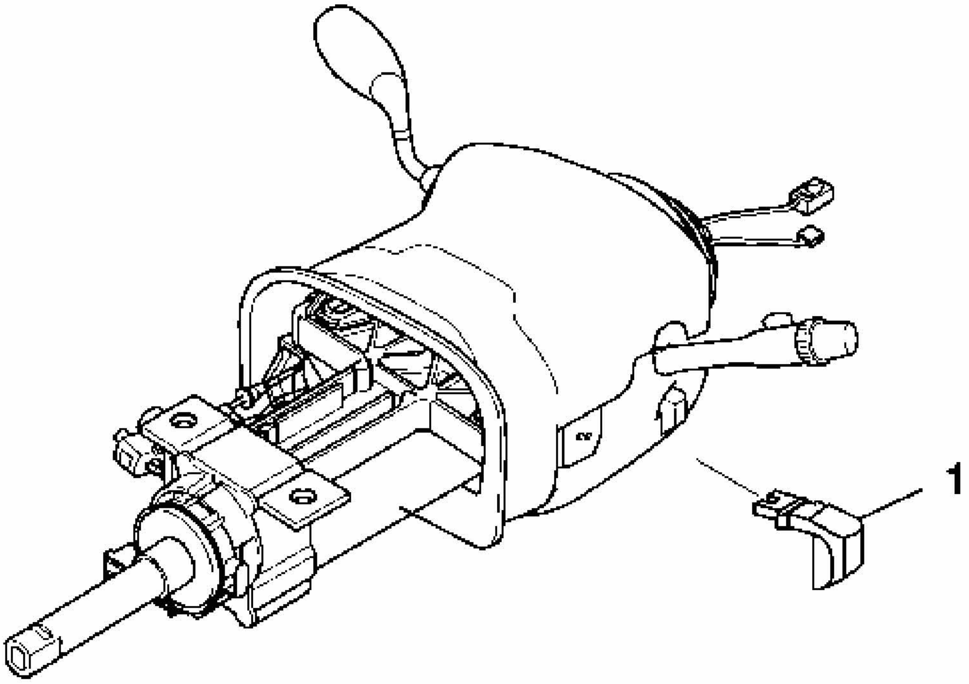


Fig. 20: View Of Tilt Lever
Courtesy of GENERAL MOTORS CORP.

5. Remove the tilt lever (1).

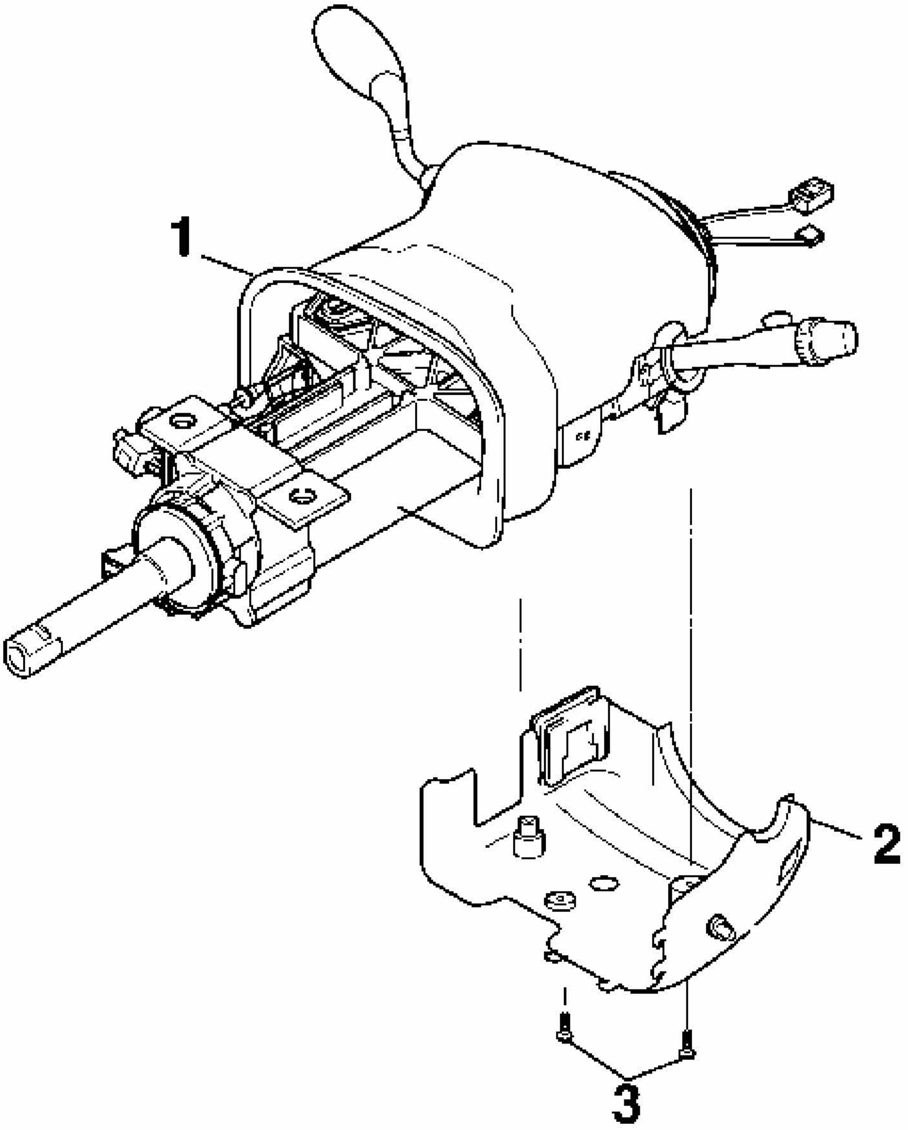


Fig. 21: View Of Lower Steering Column Trim Cover & Screws
Courtesy of GENERAL MOTORS CORP.

6. Remove the retaining screws (3) from the lower steering column trim cover.
7. Disconnect the closeout shroud from the lower steering column trim cover.

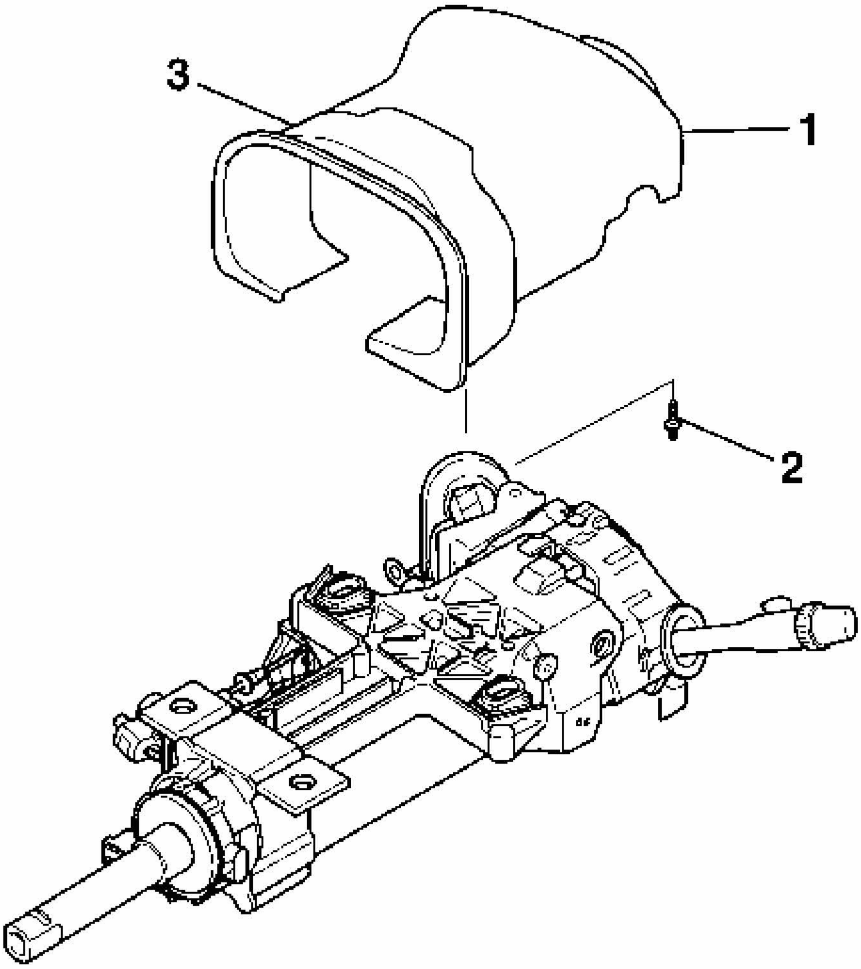


Fig. 22: View Of Upper Steering Column Trim Cover & Screw
Courtesy of GENERAL MOTORS CORP.

8. Remove the retaining screw (2) from the upper steering column trim cover (1).

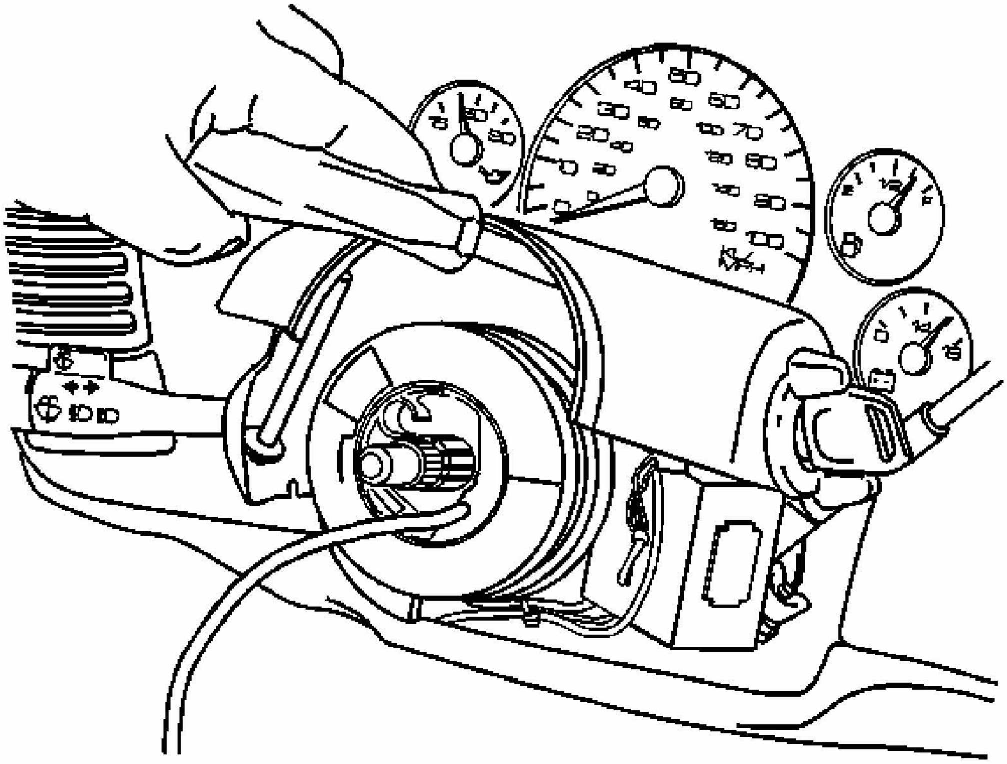


Fig. 23: View of Lock Cylinder Access Hole
Courtesy of GENERAL MOTORS CORP.

9. Lift the upper trim cover to gain access to the lock cylinder access hole.
10. Using a bent tip awl, insert the tip into the access hole in the ignition lock cylinder.

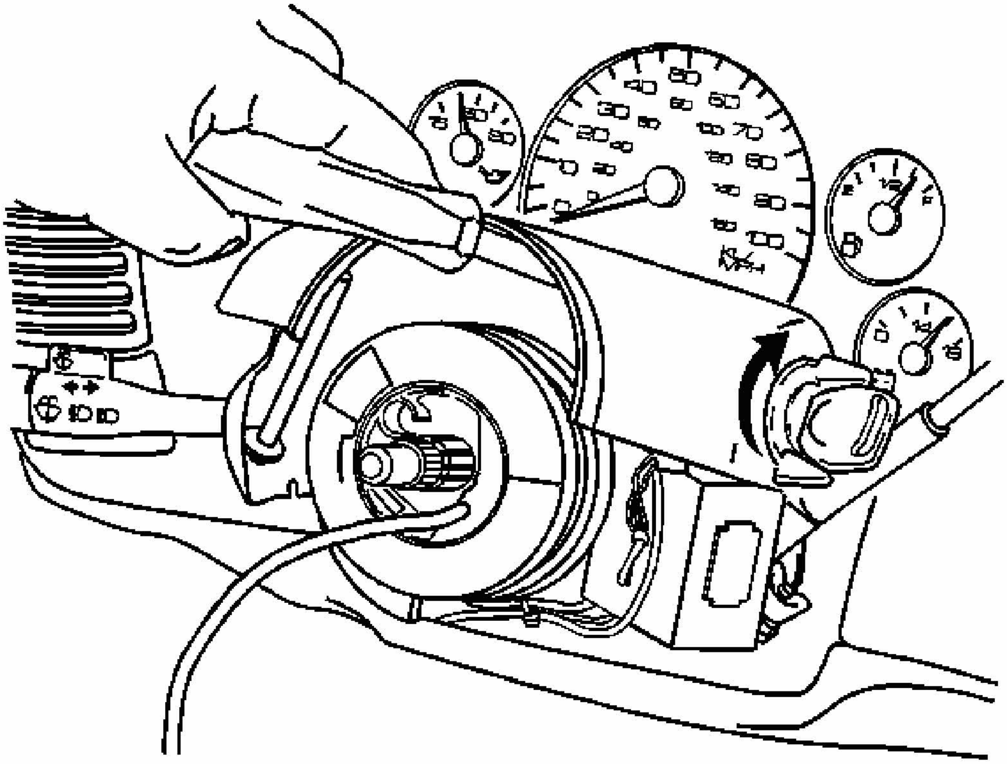


Fig. 24: View of Ignition Lock Cylinder
Courtesy of GENERAL MOTORS CORP.

11. Turn the ignition lock cylinder to the START position.
12. Using the bent tip awl push down on the retaining pin of the ignition lock cylinder.
13. Release the ignition lock cylinder to the RUN position and remove the lock cylinder.
14. Remove the upper trim cover.
15. Remove the closeout shroud from the upper trim cover.

Installation Procedure

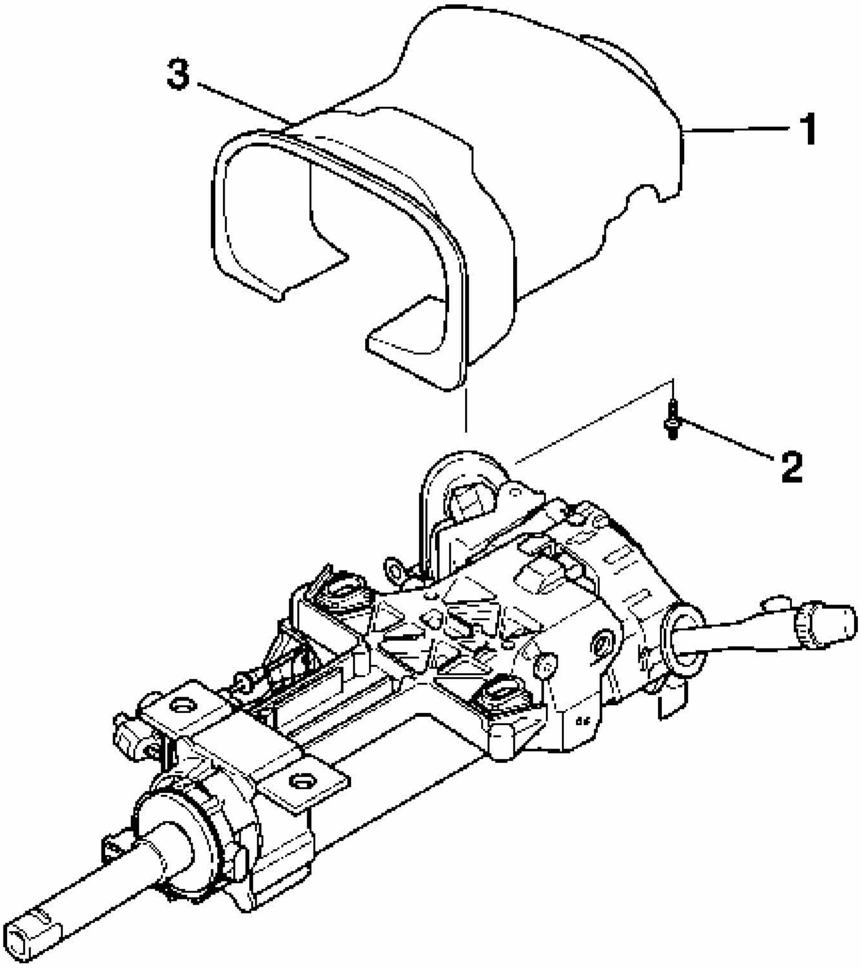


Fig. 25: View Of Upper Steering Column Trim Cover & Screw
Courtesy of GENERAL MOTORS CORP.

1. Install the upper steering column trim cover (1) to the closeout shroud.
2. Install the upper trim cover (1) to the steering column.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

3. Install the retaining screw (2) to the upper steering column trim cover.

Tighten: Tighten the screw to 1.5 N.m (13 lb in).

4. Install the Ignition lock cylinder.

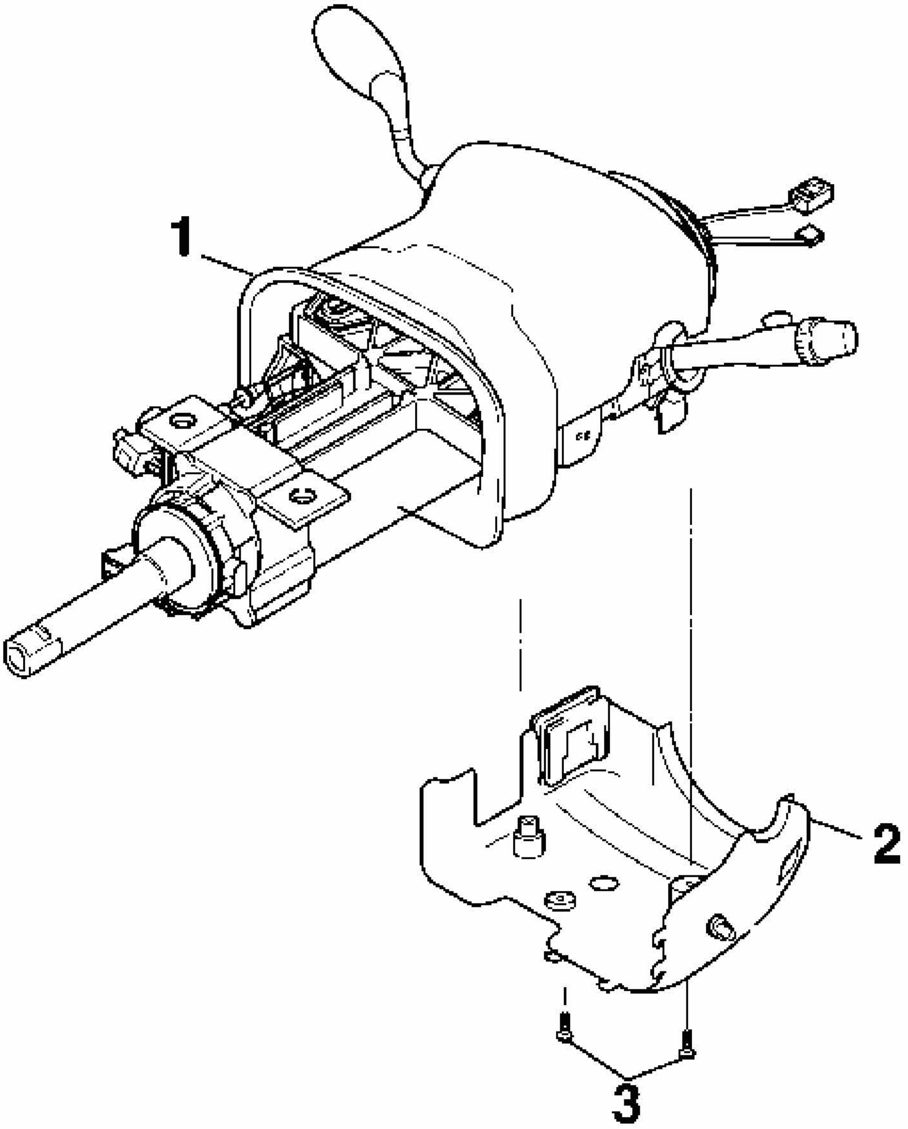


Fig. 26: View Of Lower Steering Column Trim Cover & Screws
Courtesy of GENERAL MOTORS CORP.

5. Install the lower trim cover (2) and ensure that the tabs engage with the tabs on the upper trim cover (1). Snap the tabs together.
6. Connect the lower steering column trim cover to the closeout shroud.
7. Install the retaining screws (3) to the lower steering column trim cover.

Tighten: Tighten the screws to 3 N.m (27 lb in).

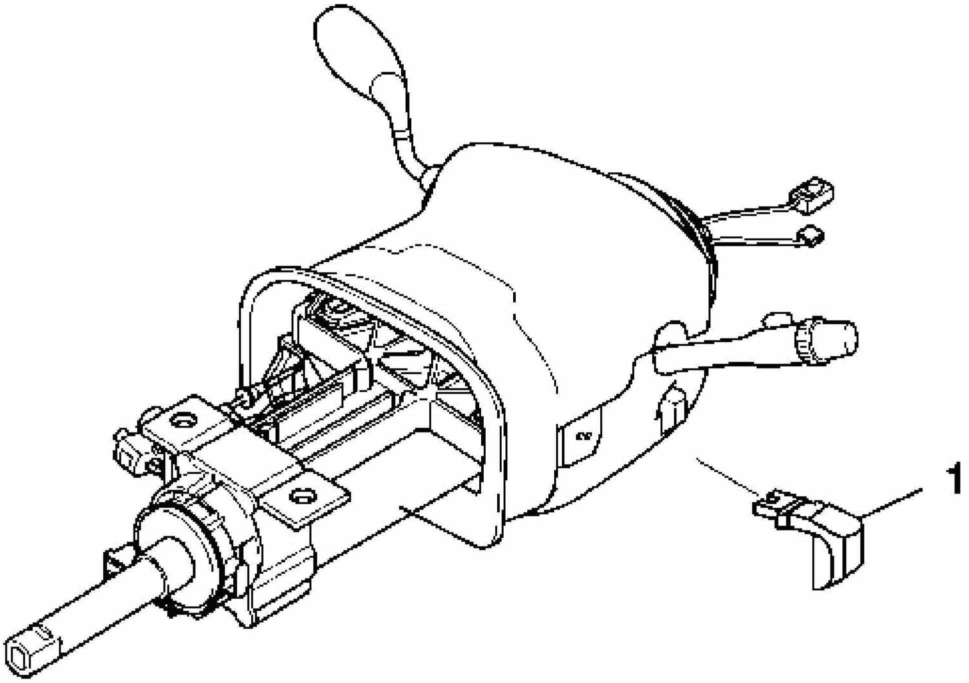


Fig. 27: View Of Tilt Lever
Courtesy of GENERAL MOTORS CORP.

8. Install the tilt lever (1).
9. Install the steering column filler. Refer to **Steering Column Filler Replacement** in Instrument Panel, Gages, and Console.
10. Install the steering wheel. Refer to **Steering Wheel Replacement**.
11. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9)** or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** in Engine Electrical.
12. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

IGNITION SWITCH REPLACEMENT

Removal Procedure

CAUTION: Refer to SIR Caution in Cautions and Notices.

1. Disable the SIR system **SIR Disabling and Enabling Zone 3** in SIR.
2. Remove the upper and lower trim covers. Refer to **Steering Column Trim Covers Replacement**.
3. Remove the ignition lock cylinder. Refer to **Ignition Lock Cylinder Replacement**.

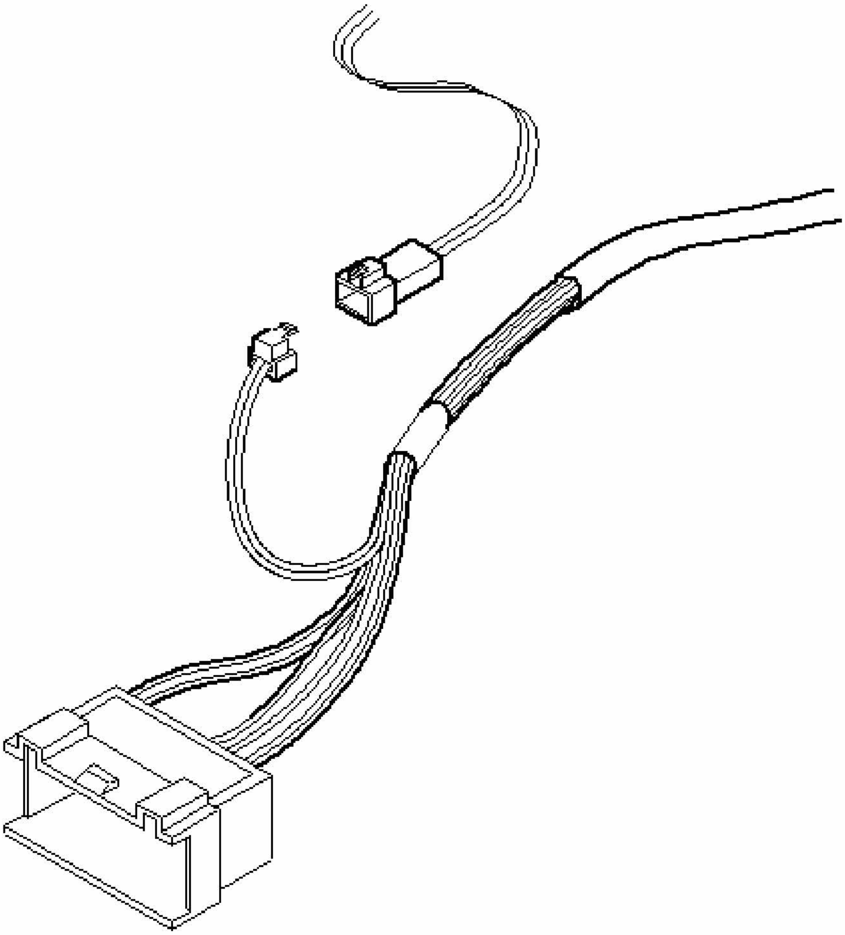


Fig. 28: Disconnecting/Reconnecting Theft Deterrent Control Module Connector
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the theft deterrent control module connector.
5. Disconnect the fused jumper assembly connector.

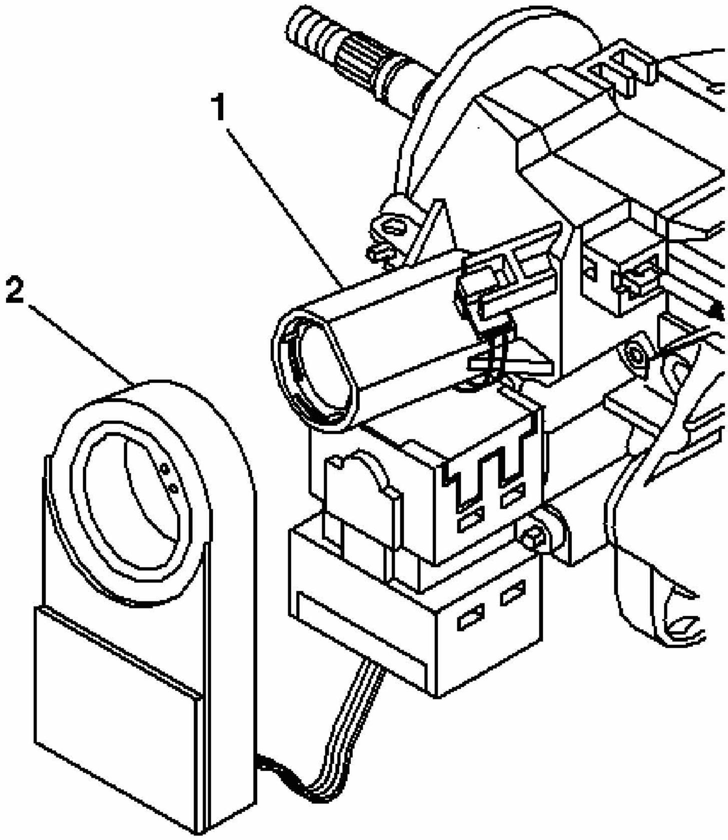


Fig. 29: Locating Theft Deterrent Module & Ignition Lock Cylinder Case Assembly
Courtesy of GENERAL MOTORS CORP.

6. Slide the theft deterrent control module (2) from the ignition lock cylinder case (1).

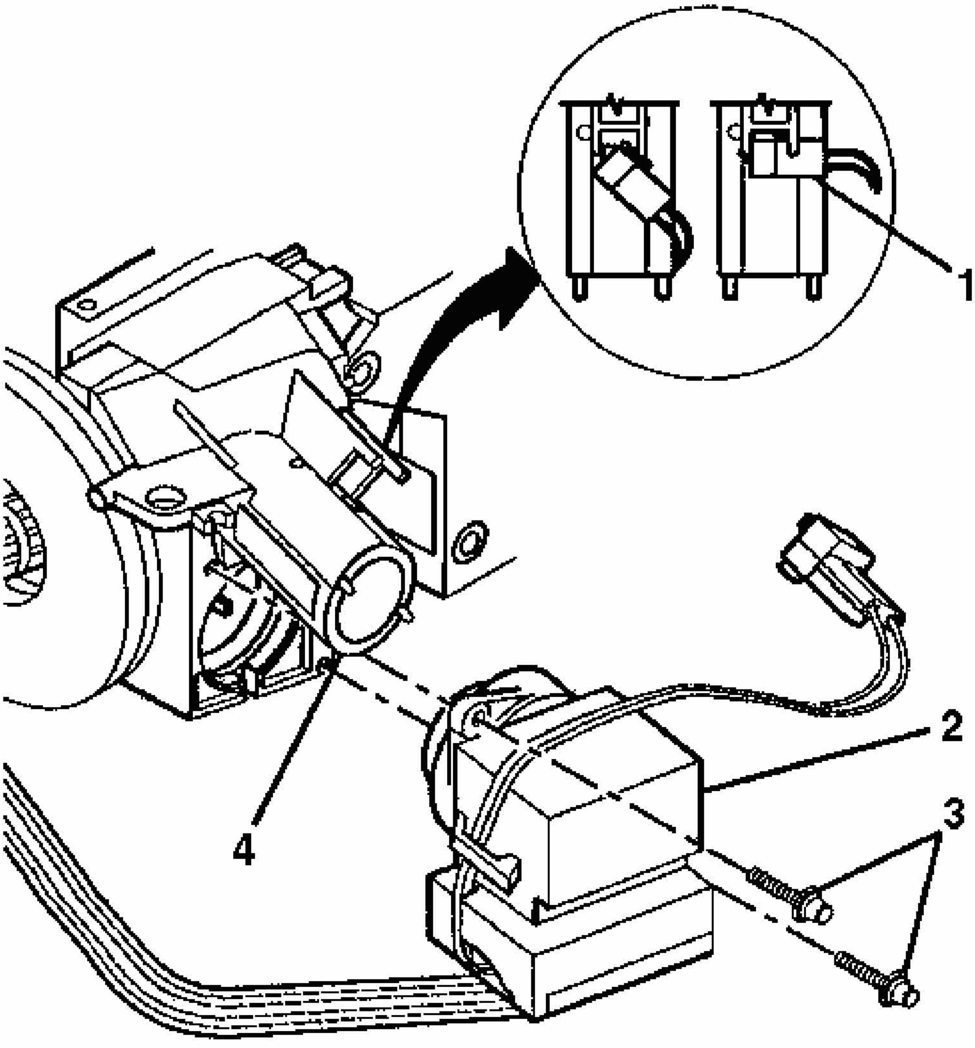


Fig. 30: Removing/Installing Key Alarm Connector To/From Ignition Lock Cylinder Case
Courtesy of GENERAL MOTORS CORP.

7. Remove the key alarm connector (1) from the ignition lock cylinder case (4).
8. Remove the 2 tapping screws (3) from the ignition switch assembly (2).

Installation Procedure

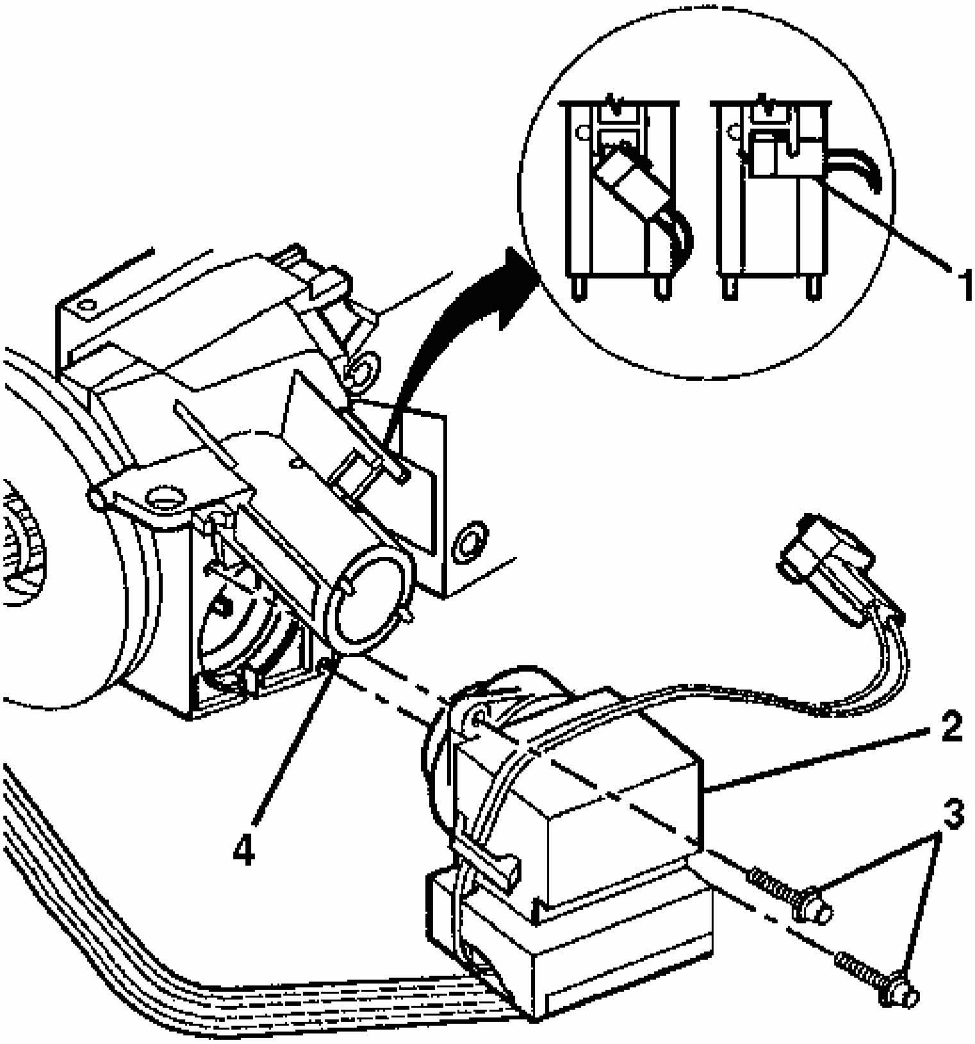


Fig. 31: Removing/Installing Key Alarm Connector To/From Ignition Lock Cylinder Case
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the ignition switch assembly (2) and secure by using 2 tapping screws (3).

   Tighten: Tighten the screws to 7 N.m (62 lb in).

2. Install the ignition switch assembly connector (1) onto the ignition lock cylinder case

(4).

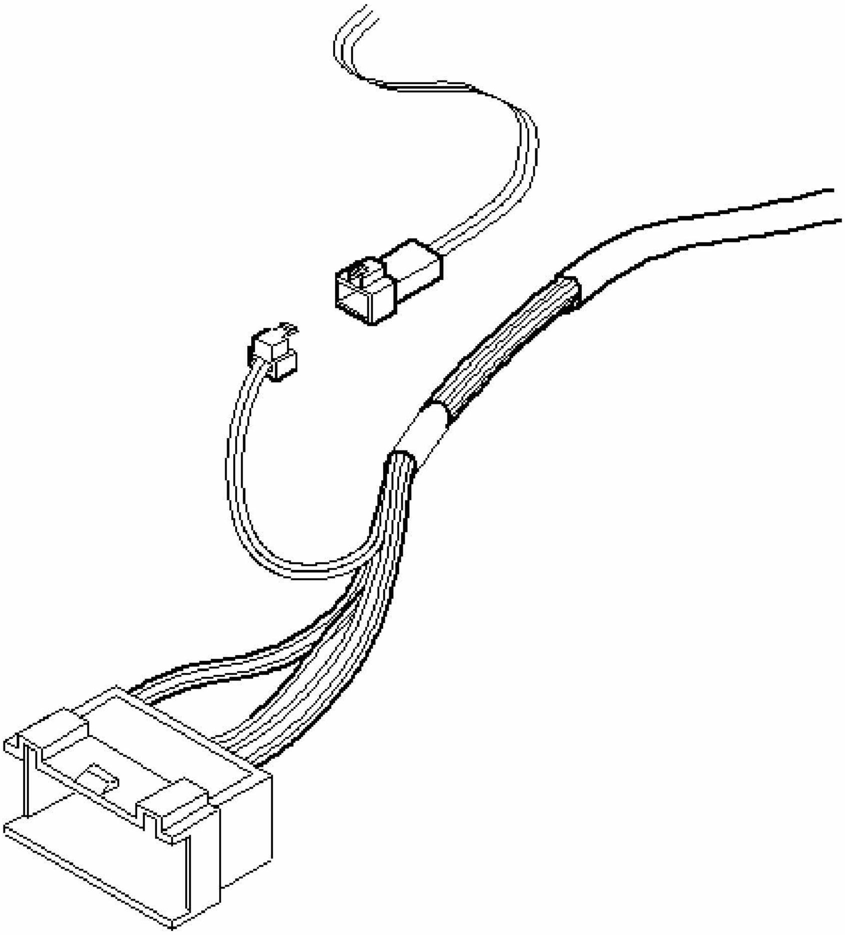


Fig. 32: Disconnecting/Reconnecting Theft Deterrent Control Module Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the theft deterrent control module connector.
4. Connect the fused jumper assembly connector.

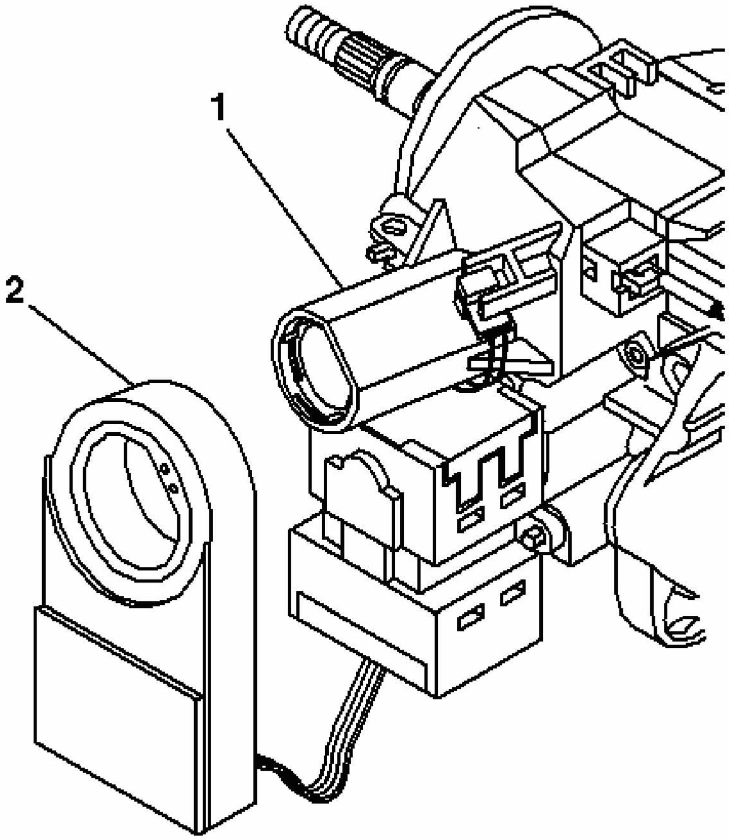


Fig. 33: Locating Theft Deterrent Module & Ignition Lock Cylinder Case Assembly
Courtesy of GENERAL MOTORS CORP.

5. Install the theft deterrent control module (2) onto the ignition lock cylinder case (1).
6. Install the ignition lock cylinder. Refer to **Ignition Lock Cylinder Replacement**.
7. Install the upper and lower trim covers. Refer to **Steering Column Trim Covers Replacement**.
8. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

IGNITION LOCK CYLINDER REPLACEMENT

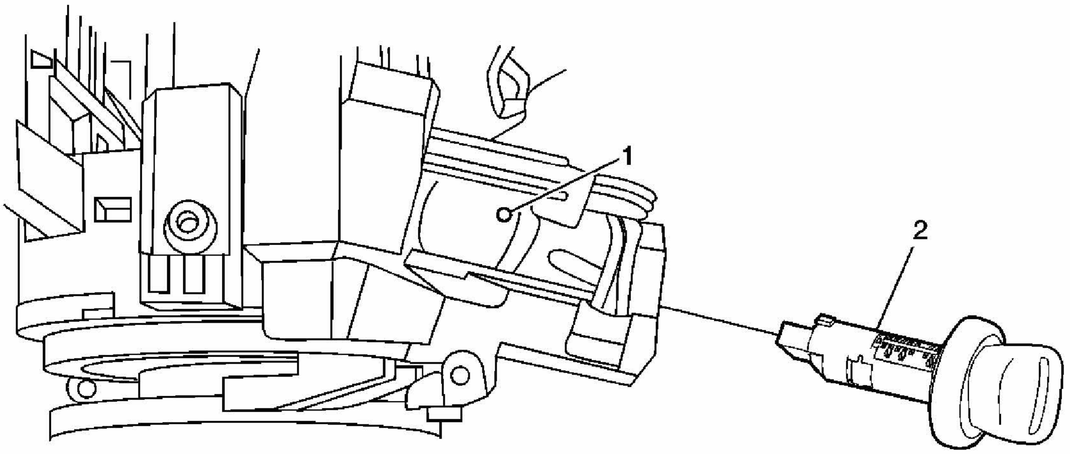


Fig. 34: Replacing Ignition Lock Cylinder
Courtesy of GENERAL MOTORS CORP.

Ignition Lock Cylinder Replacement

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">
CAUTION:
Refer to SIR Caution .

CAUTION:
Refer to Battery Disconnect Caution .

Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.

Preliminary Procedure

1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9) or Battery Negative Cable Disconnect/Connect Procedure (RPO LS4) .
2. Disable the SIR system. Refer to SIR Disabling and Enabling Zone 3 .
3. Remove the tilt lever. Refer to Tilt Lever Replacement.
4. Remove the steering wheel. Refer to Steering Wheel Replacement.
5. Remove the steering column trim covers. Refer to Steering Column Trim Covers Replacement.
6. Perform passkey relearn after the ignition lock cylinder has been replaced. Refer to Control Module References .
</td></tr>
<tr><td></td><td>Access Hole, Ignition Lock Cylinder Retaining Pin
Tip:</td></tr>
</table>

1	1. Rotate the ignition lock cylinder to the crank position. 2. Use a suitable tool to depress the lock cylinder retaining pin thorough the access hole. 3. Release the lock cylinder the to run position.
2	Cylinder, Ignition Lock **Tip:** Pull the ignition lock cylinder from the steering column.

IGNITION LOCK CYLINDER CASE REPLACEMENT

Removal Procedure

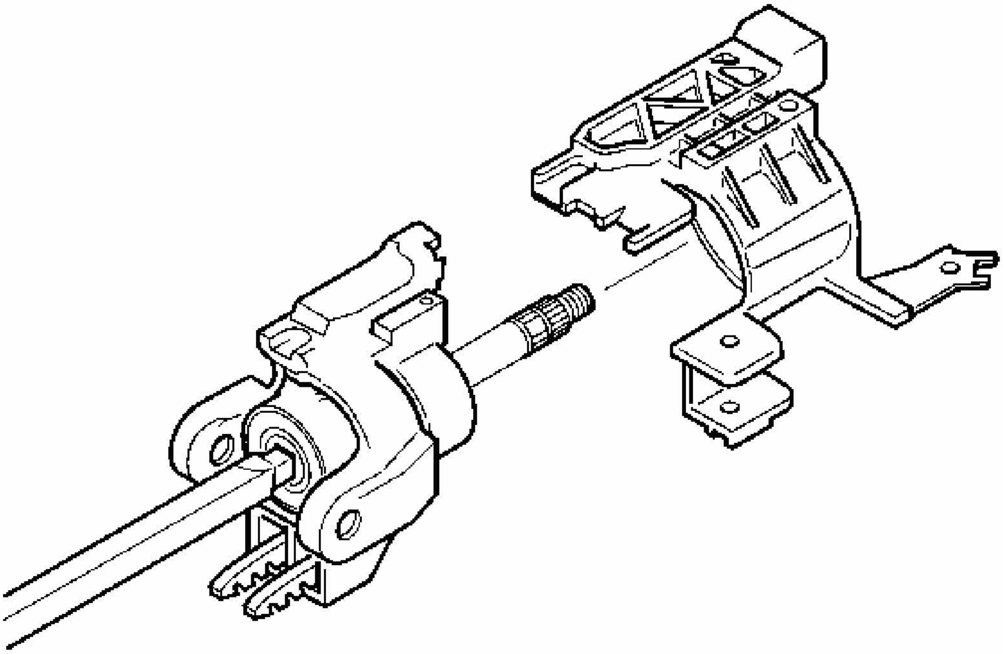


Fig. 35: View Of Turn Signal Switch Housing & Steering Column Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SIR Caution in Cautions and Notices.

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.
2. Remove the ignition lock cylinder. Refer to **Ignition Lock Cylinder Replacement**.
3. Remove the ignition switch. Refer to **Ignition Switch Replacement**.

4. Remove the steering column tilt head components. Refer to **Turn Signal Cancel Cam and Steering Shaft Upper Bearing Spring Replacement**.
5. Remove the turn signal switch housing. Refer to **Turn Signal Switch Housing Replacement**.
6. Remove the turn signal and multifunction switch assembly only. Refer to **Multifunction, Turn Signal Switch Replacement**.

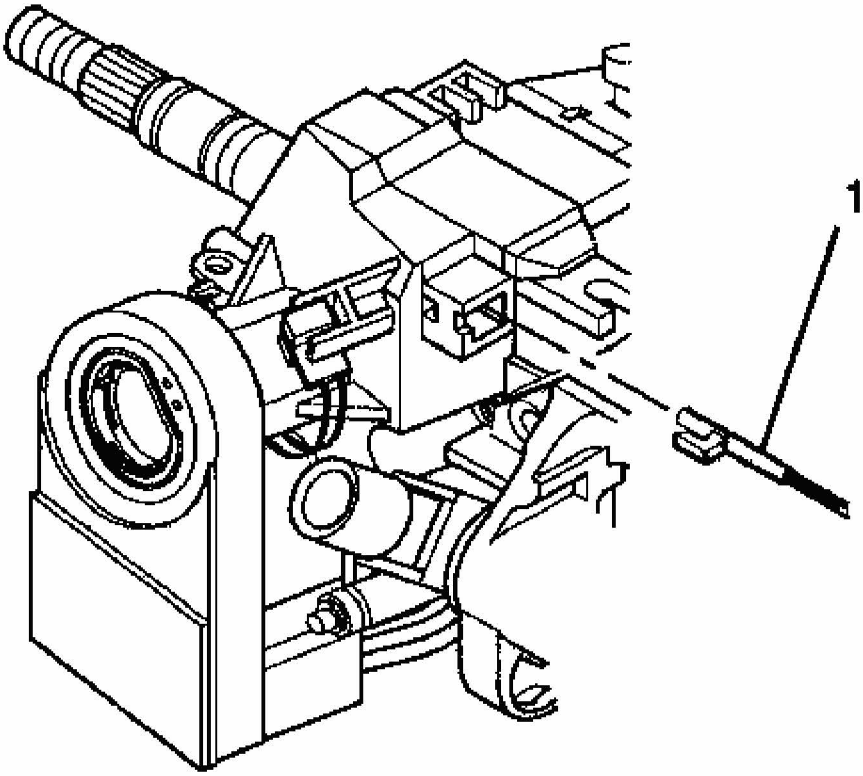


Fig. 36: Identifying Park Lock Cable At Ignition Lock Cylinder
Courtesy of GENERAL MOTORS CORP.

7. Remove the park lock cable assembly (1) from the ignition lock cylinder case in the following way:
   1. Use a small blade to push against the locking tab on the end of the park lock cable assembly (1).
   2. Disconnect the park lock cable assembly (1) from the ignition lock cylinder case.

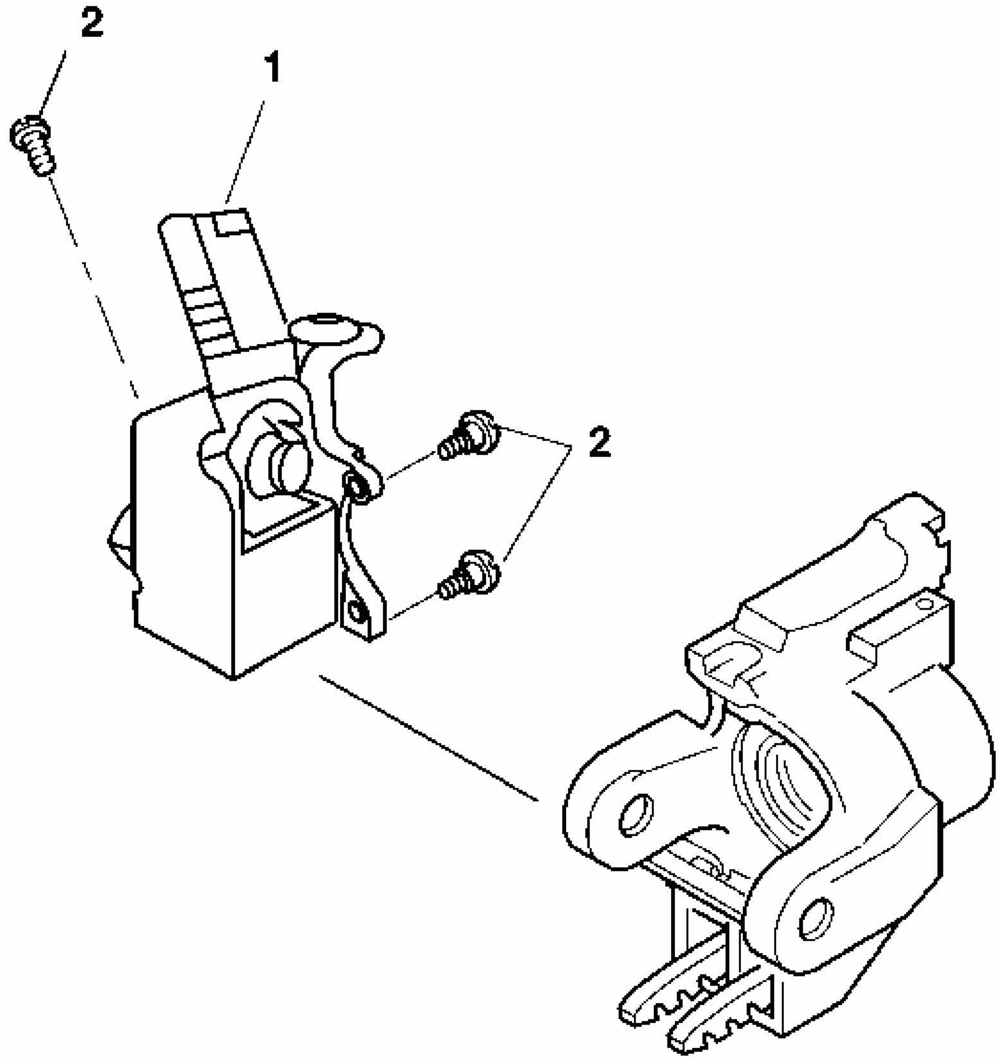


Fig. 37: View Of Ignition Lock Cylinder Case Assembly & Screws
Courtesy of GENERAL MOTORS CORP.

8. Remove the 3 TORX® screws (2) from the ignition lock cylinder case (1).
9. Remove the ignition lock cylinder case (1) from the steering column tilt head assembly.

Installation Procedure

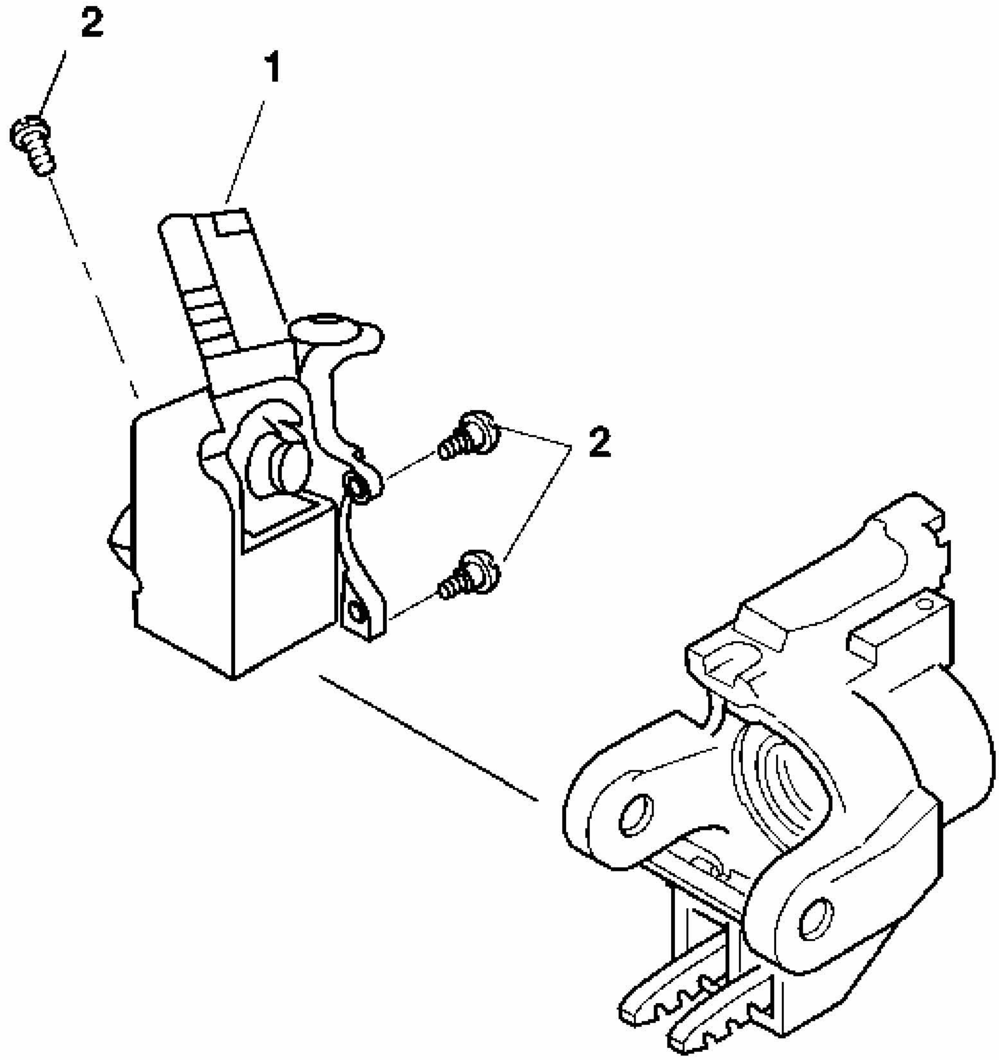


Fig. 38: View Of Ignition Lock Cylinder Case Assembly & Screws
Courtesy of GENERAL MOTORS CORP.

1. Align the ignition lock cylinder case (1) with the steering column tilt head assembly.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Screw the 3 TORX® screws (2) into the ignition lock cylinder case (1).

Tighten: Tighten the 3 TORX® screws to 7 N.m (62 lb in).

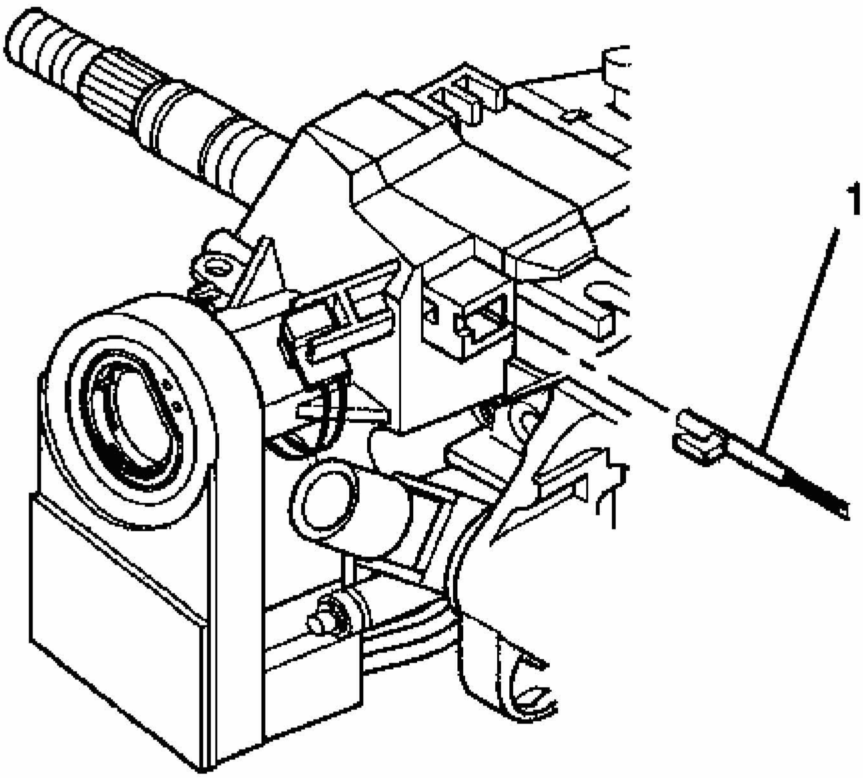


Fig. 39: Identifying Park Lock Cable At Ignition Lock Cylinder
Courtesy of GENERAL MOTORS CORP.

3. Press the locking tab on the end of the park lock cable assembly (1) into the slot in the ignition lock cylinder case.

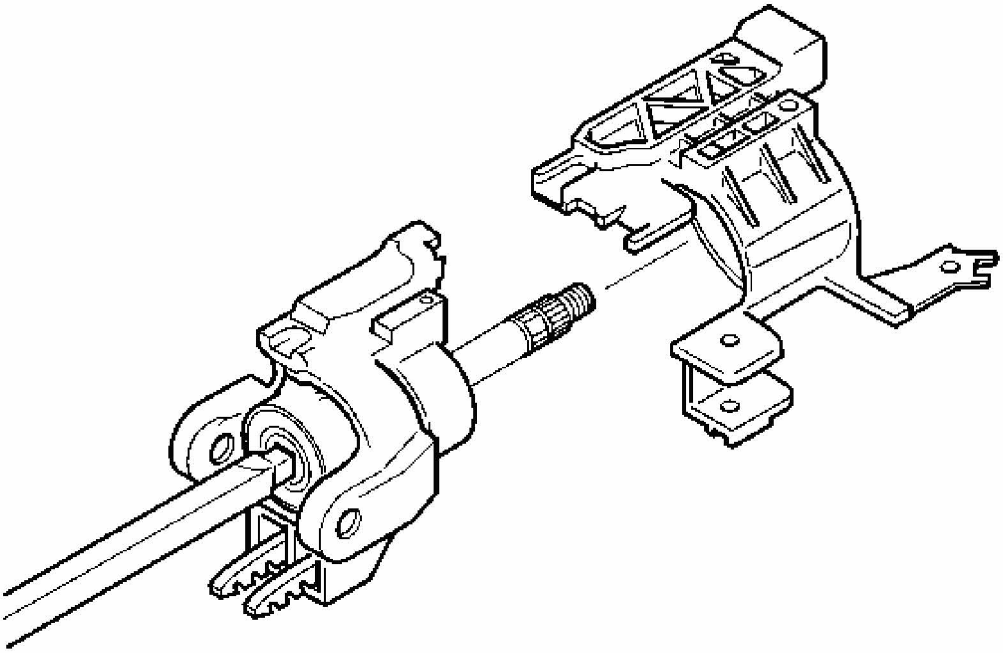


Fig. 40: View Of Turn Signal Switch Housing & Steering Column Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Press the turn signal switch housing firmly against the steering column tilt head in order for the screws from the turn signal and multifunction switch assembly to align.

4. Install the turn signal switch housing. Refer to **Turn Signal Switch Housing Replacement**
5. Install the turn signal and multifunction switch assembly only. Refer to **Multifunction, Turn Signal Switch Replacement**.
6. Install the steering column tilt head components. Refer to **Turn Signal Cancel Cam and Steering Shaft Upper Bearing Spring Replacement**.
7. Install the ignition switch only. Refer to **Ignition Switch Replacement**.
8. Install the ignition lock cylinder. Refer to **Ignition Lock Cylinder Replacement**.
9. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

TURN SIGNAL CANCEL CAM AND STEERING SHAFT UPPER BEARING SPRING REPLACEMENT

Tools Required

- **J 23653-SIR** Steering Column Lock Plate Compressor
- **J 42137** Steering Column Lock Plate Compressor Adapter. See **Special Tools**.

Removal Procedure

CAUTION: Refer to SIR Caution in Cautions and Notices.

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.
2. Remove the SIR coil. Refer to **Inflatable Restraint Steering Wheel Module Coil Replacement (Coil)** in SIR.

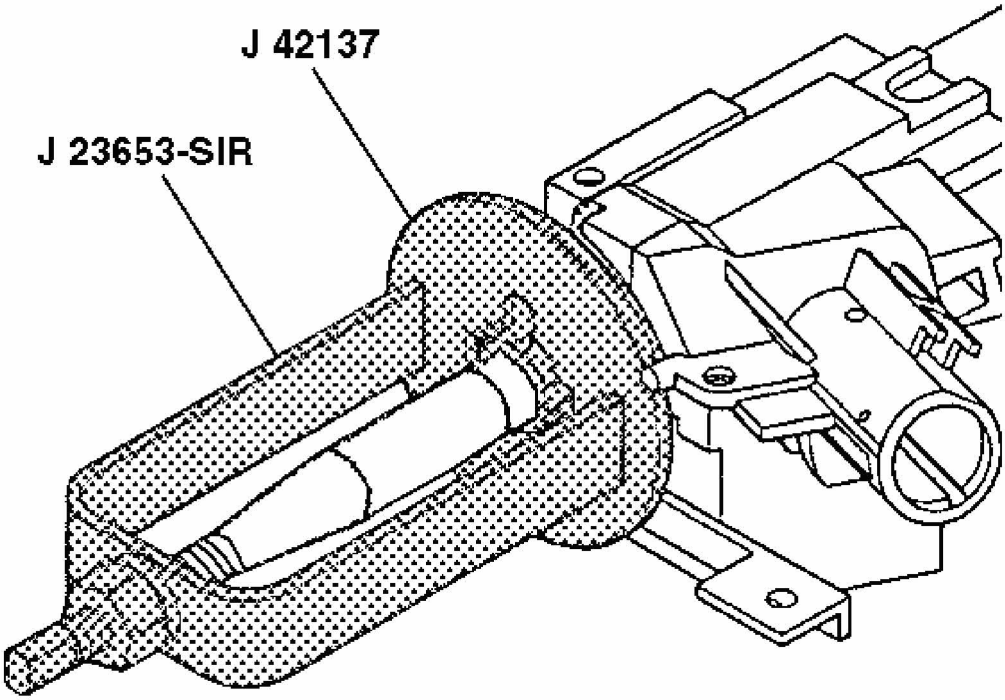


Fig. 41: Compressing Cam Orientation Plate Using J 23653-SIR & J 42137
Courtesy of GENERAL MOTORS CORP.

3. Remove the bearing retainer using **J 23653-SIR** and **J 42137** and dispose of it. See

Special Tools.

4. Remove **J 23653-SIR** and **J 42137** from the steering shaft assembly. See Special Tools.

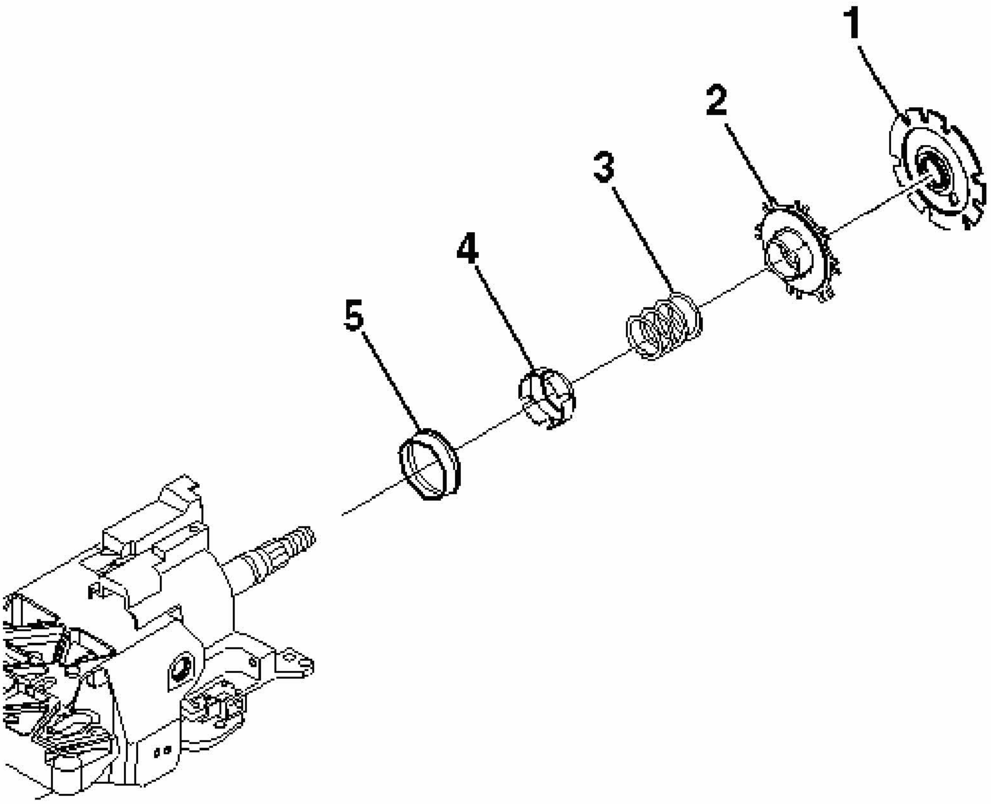


Fig. 42: View of Shaft Lock Shield Assembly, Turn Signal Cancel Cam Assembly, Upper Bearing Spring, Bearing Inner Race Seat and Inner Race
Courtesy of GENERAL MOTORS CORP.

5. Remove the shaft lock shield assembly (1).
6. Remove the turn signal cancel cam assembly (2).
7. Remove the upper bearing spring (3).
8. Remove the upper bearing inner race seat (4).
9. Remove the inner race (5).

Installation Procedure

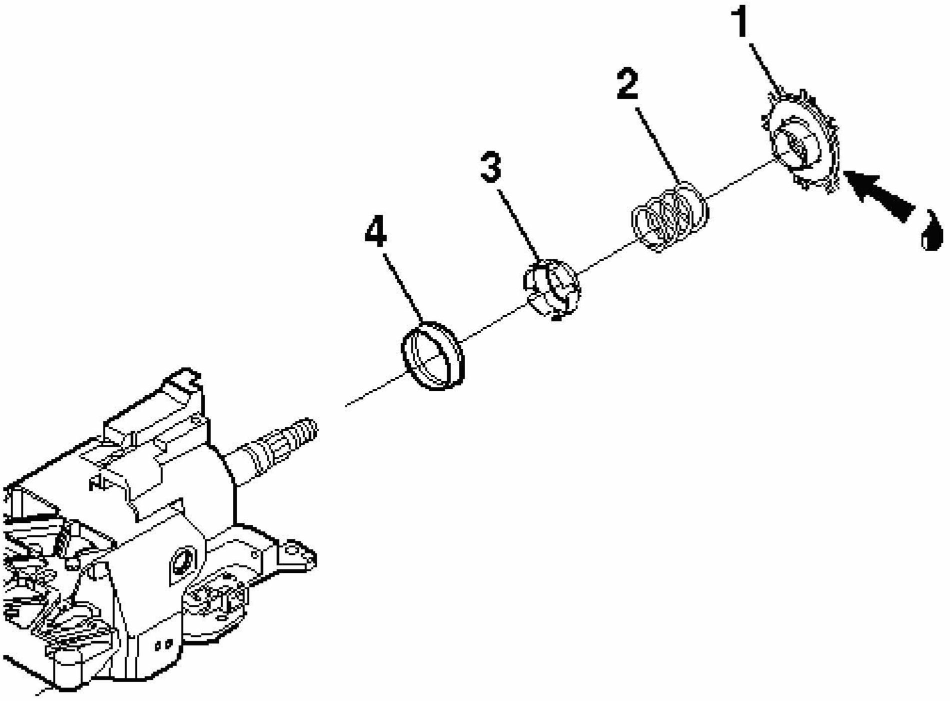


Fig. 43: View of Inner Race, Upper Bearing Inner Race Seat, Upper Bearing Spring, and Turn Signal Cancel Cam Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the inner race (4).
2. Install the upper bearing inner race seat (3).
3. Install the upper bearing spring (2).
4. Lubricate the turn signal cancel cam assembly (1) with GM P/N 12377900 (Canadian P/N 10953529).
5. Install the turn signal cancel cam assembly (1).

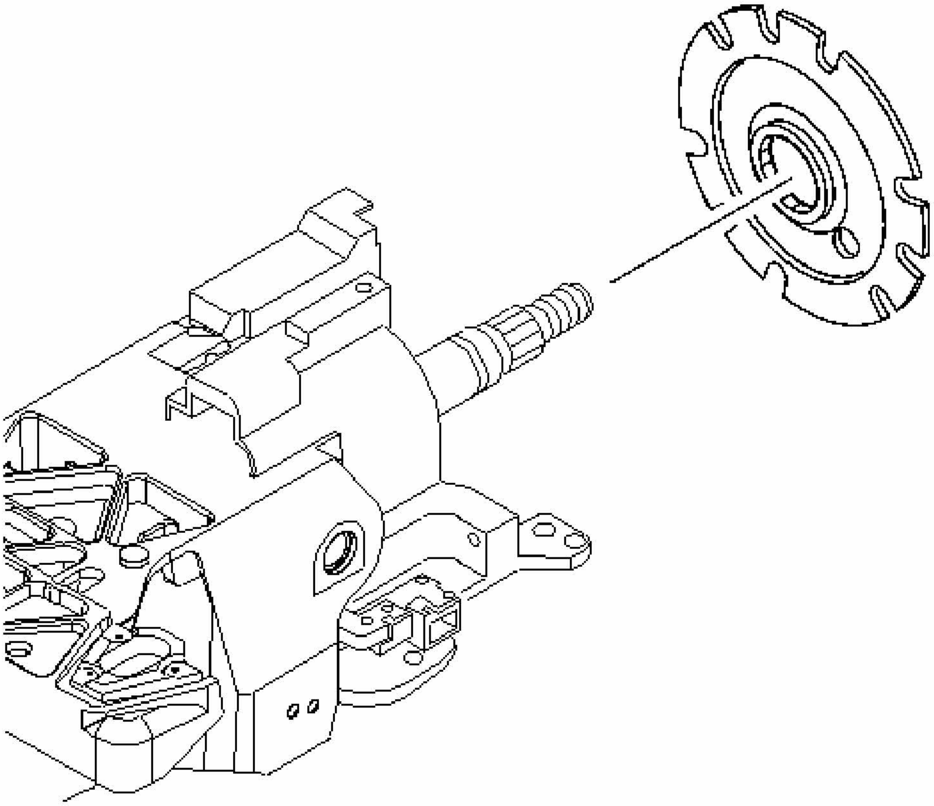


Fig. 44: View of Shaft Lock Shield Assembly
Courtesy of GENERAL MOTORS CORP.

6. Install the shaft lock shield assembly.

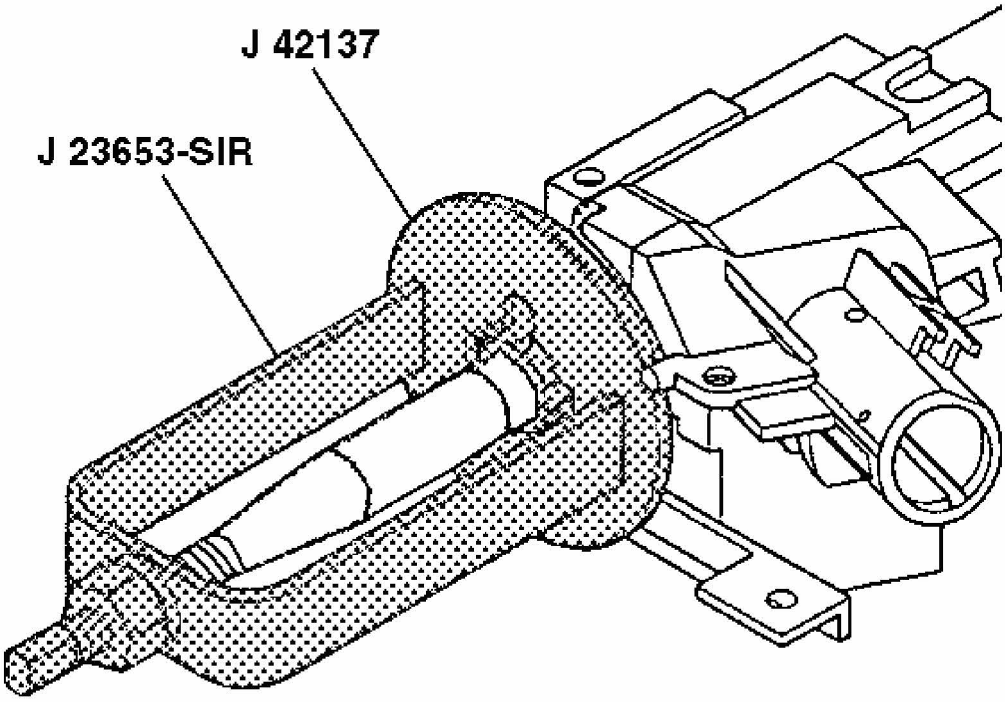


Fig. 45: Compressing Cam Orientation Plate Using J 23653-SIR & J 42137
Courtesy of GENERAL MOTORS CORP.

7. Install the new bearing retainer using **J 23653-SIR** and **J 42137** . See **Special Tools**.
8. Remove **J 23653-SIR** and **J 42137** from the steering shaft assembly. See **Special Tools**.
9. Install the SIR coil. Refer to **Inflatable Restraint Steering Wheel Module Coil Replacement (Coil)** in SIR.
10. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

MULTIFUNCTION, TURN SIGNAL SWITCH REPLACEMENT

Removal Procedure

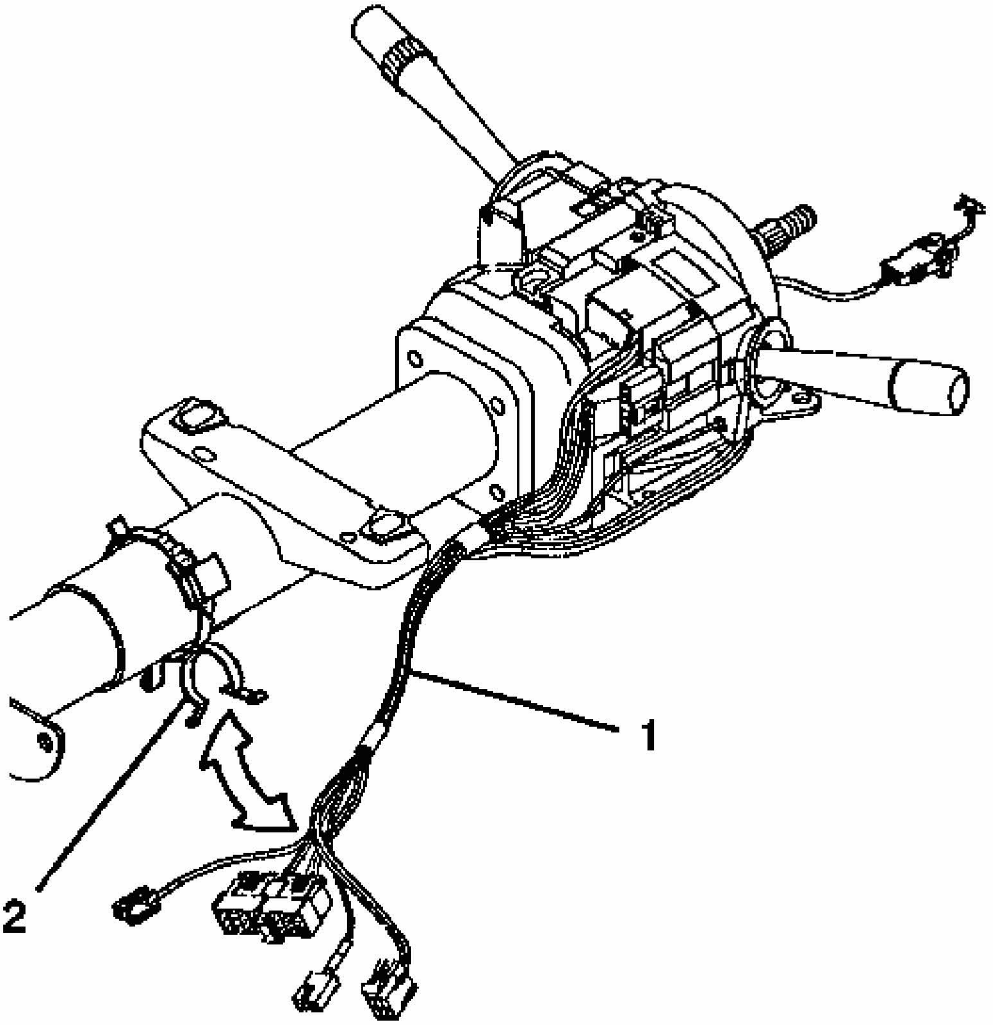


Fig. 46: View Of Steering Column Wire Harness Assembly & Wire Harness Strap
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SIR Caution in Cautions and Notices.

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.
2. Remove the upper and lower trim covers. Refer to **Steering Column Trim Covers Replacement**.

IMPORTANT: The abrasion sleeve located on the steering column wire

harness assembly must be reinstalled. Make note of what connector is coming out of the abrasion sleeve for installation purposes.

3. Remove the wire harness assembly (1) from the wire harness strap (2).
4. Disconnect the turn signal and multifunction switch assembly connector from the SIR system coil connector.

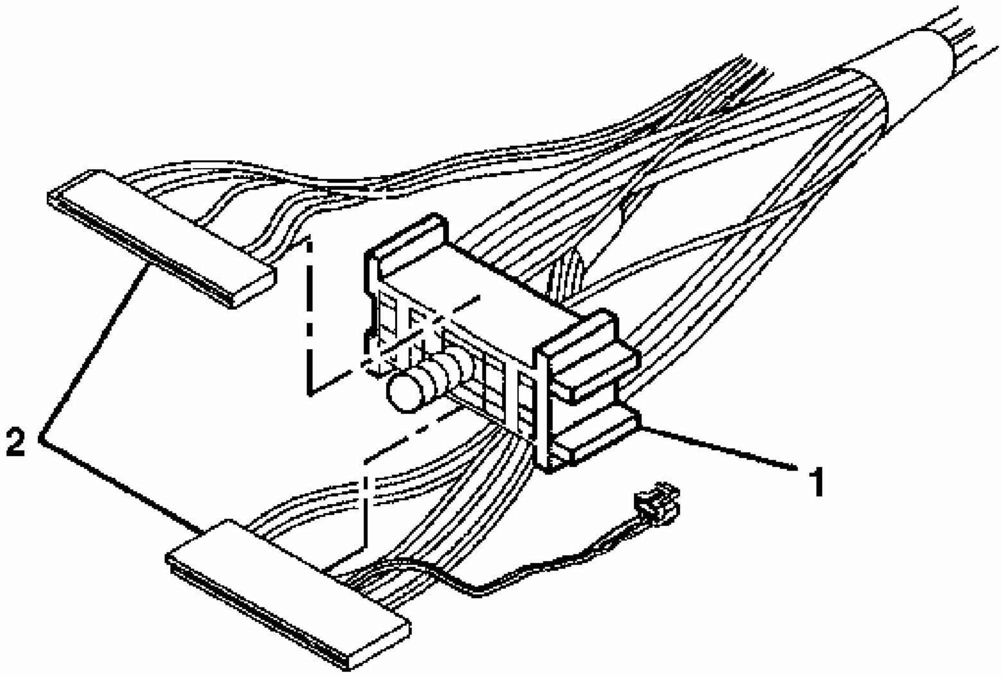


Fig. 47: Turn Signal & Multifunction Switch Assembly Connectors
Courtesy of GENERAL MOTORS CORP.

5. Slide the 2 connectors (2) of the turn signal and multifunction switch assembly out of the bulkhead connector (1).

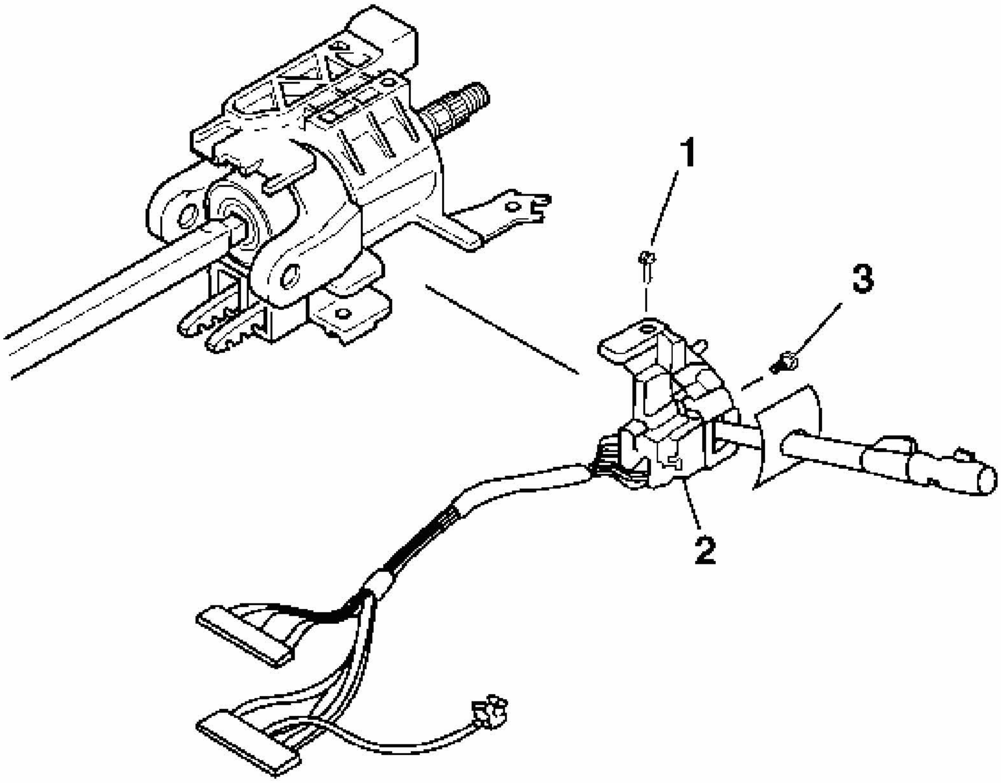


Fig. 48: View Of Turn Signal & Multifunction Switch Assembly
Courtesy of GENERAL MOTORS CORP.

6. Remove the 2 pan head tapping screws (1) and (3) from the turn signal and multifunction switch assembly (2).
7. Remove the turn signal and multifunction switch assembly (2) from the steering column tilt head assembly.

Installation Procedure

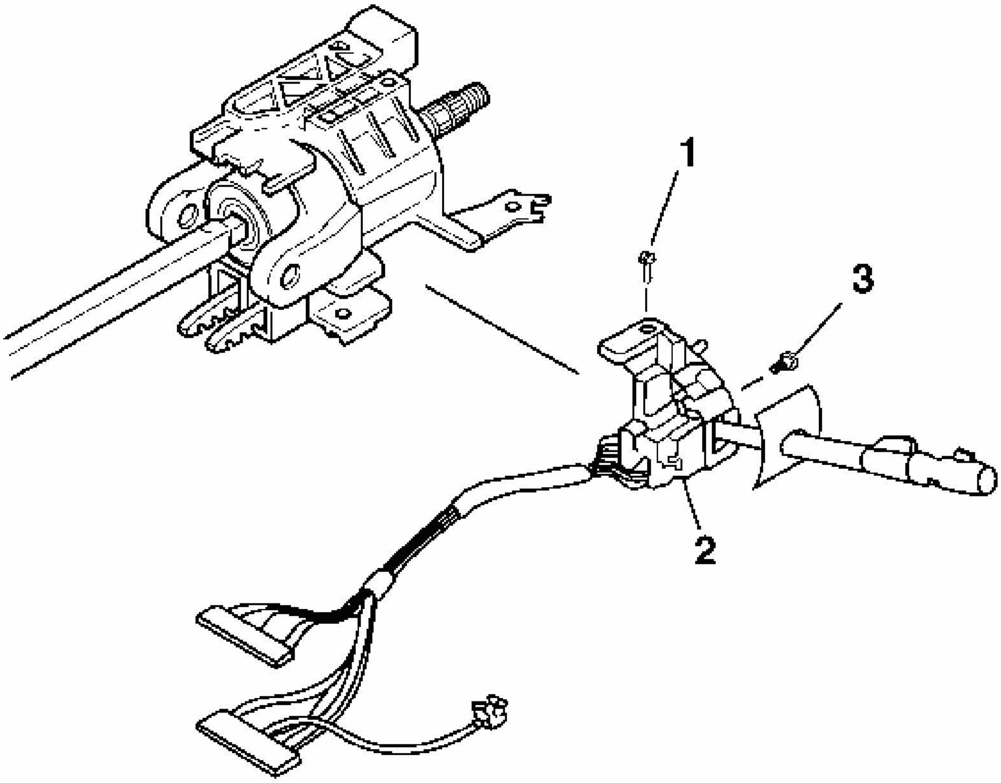


Fig. 49: View Of Turn Signal & Multifunction Switch Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the turn signal and multifunction switch assembly (2) onto the steering column tilt head assembly.

   NOTE: Refer to Fastener Notice in Cautions and Notices.

   IMPORTANT: Be sure that the electrical contact of the turn signal and multifunction switch assembly (2) rests on the turn signal cancel cam assembly.

2. Screw the 2 pan head tapping screws (1) and (3) into the turn signal and multifunction assembly (2).

   Tighten: Tighten the pan head tapping screws (1) and (3) to 1 N.m (11 lb in).

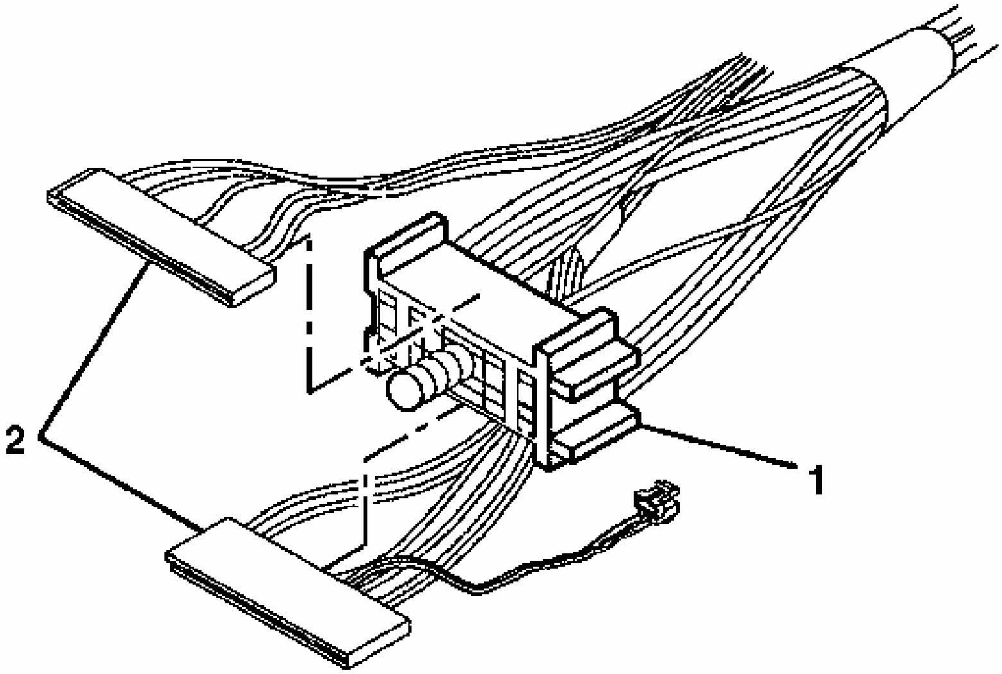


Fig. 50: Turn Signal & Multifunction Switch Assembly Connectors
Courtesy of GENERAL MOTORS CORP.

3. Slide the 2 connectors (2) of the turn signal and multifunction switch assembly into the bulkhead connector (1).

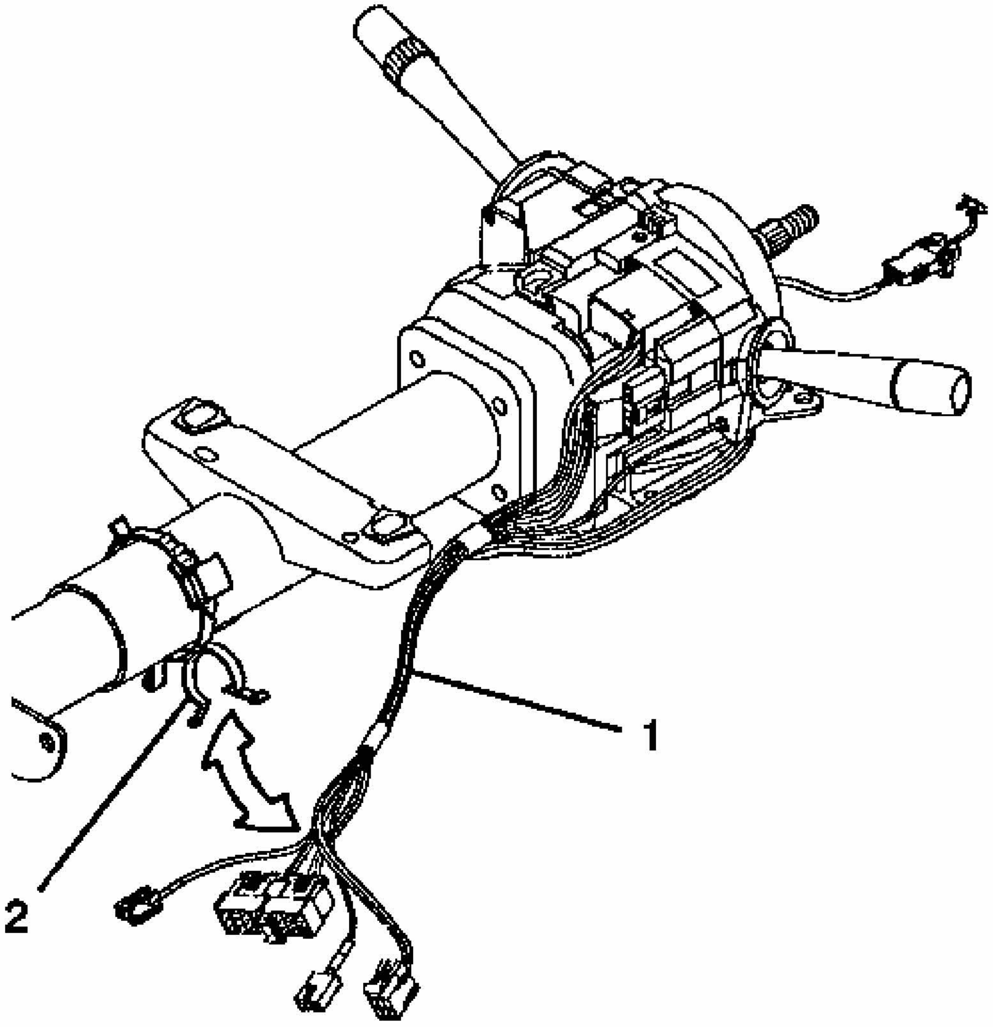


Fig. 51: View Of Steering Column Wire Harness Assembly & Wire Harness Strap
Courtesy of GENERAL MOTORS CORP.

4. Connect the turn signal and multifunction switch assembly connector to the SIR coil connector.

IMPORTANT: The abrasion sleeve must be installed back onto the steering column wire harness assembly. The ignition lock cylinder case wires and connector must be hanging out of the middle of the abrasion sleeve.

5. Install the wire harness assembly (1) into the wire harness strap (2).

6. Install the upper and lower trim covers. Refer to **Steering Column Trim Covers Replacement**.
7. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

TURN SIGNAL SWITCH HOUSING REPLACEMENT

Removal Procedure

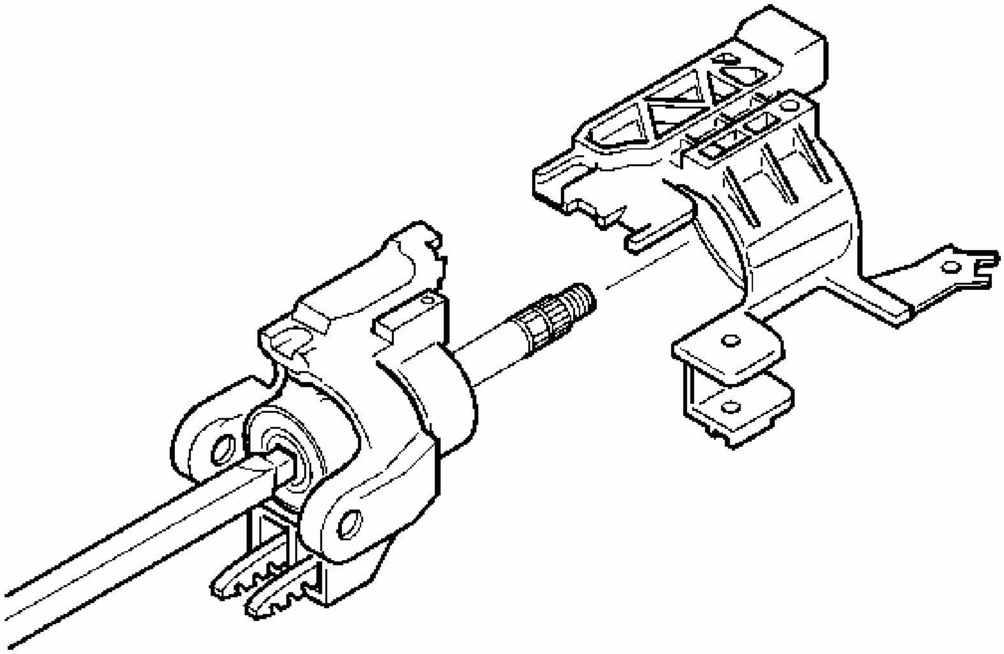


Fig. 52: View Of Turn Signal Switch Housing & Steering Column Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

> **CAUTION: Refer to SIR Caution in Cautions and Notices.**

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.
2. Remove the tilt head components. Refer to **Turn Signal Cancel Cam and Steering Shaft Upper Bearing Spring Replacement**.
3. Remove the turn signal and multifunction switch assembly only. Refer to **Multifunction, Turn Signal Switch Replacement**.
4. Slide the turn signal switch housing off of the steering column shaft assembly.

Installation Procedure

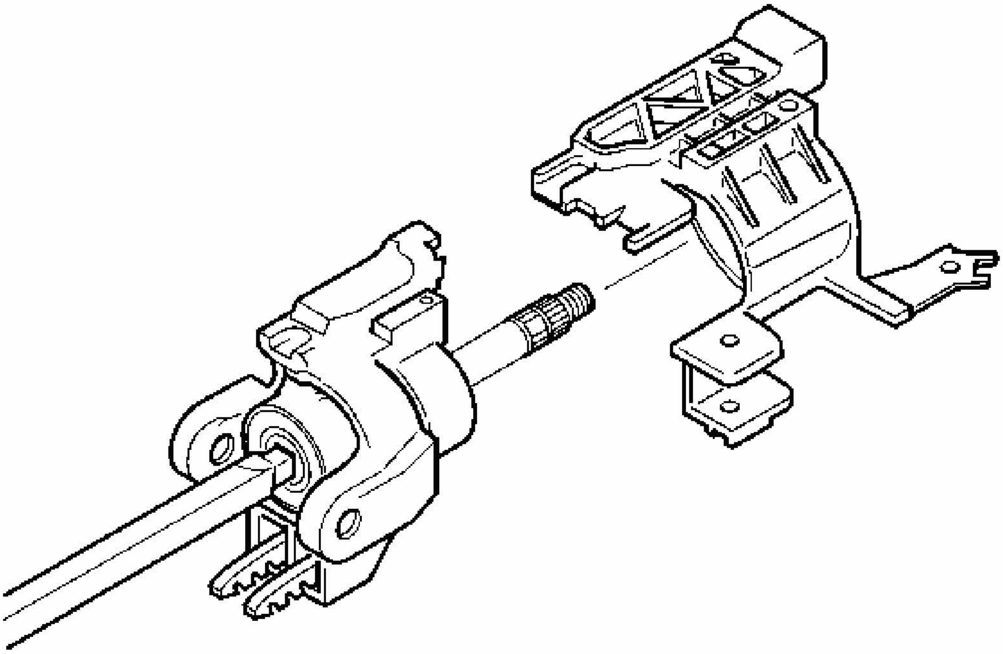


Fig. 53: View Of Turn Signal Switch Housing & Steering Column Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The switch mounting bracket must be pressed firmly against the steering column tilt head.

1. Slide the turn signal switch housing onto the steering column shaft assembly.
2. Install the turn signal and multifunction switch assembly only. Refer to **Multifunction, Turn Signal Switch Replacement**.
3. Install the tilt head components. Refer to **Turn Signal Cancel Cam and Steering Shaft Upper Bearing Spring Replacement**.
4. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

SHIFT LEVER REPLACEMENT

Removal Procedure

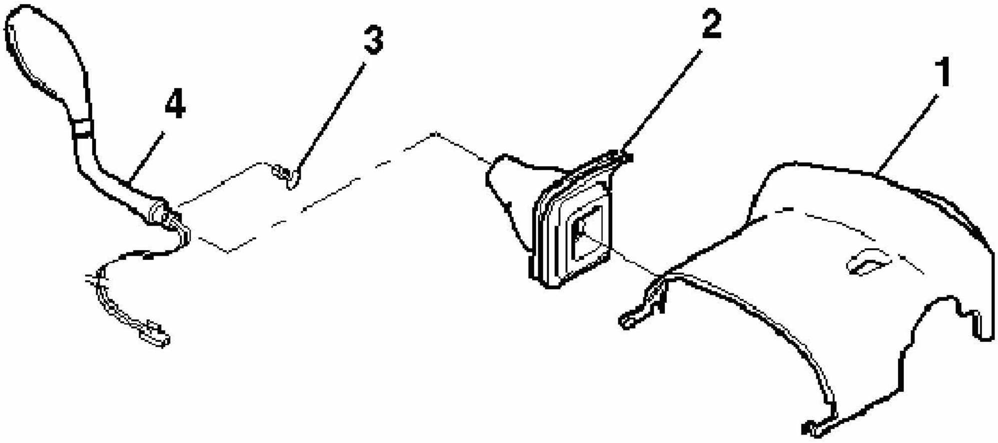


Fig. 54: View Of Shift Lever, Seal (Boot), Screw & Upper Trim Cover
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SIR Caution in Cautions and Notices.

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.
2. Slide the shift lever seal (2) up the shift lever (4).
3. If necessary, remove the steering column trim covers. Refer to **Steering Column Trim Covers Replacement**.
4. Disconnect the shift lever connector at the base of the column.
5. Remove the shift lever screw (3) from the shift lever assembly (4).
6. Remove the shift lever and seal from the linear shift assembly.

IMPORTANT: The shift lever seal must be removed by sliding the shift lever seal towards the narrow section of the shift lever.

7. Remove the shift lever seal (2) from the shift lever (4).

Installation Procedure

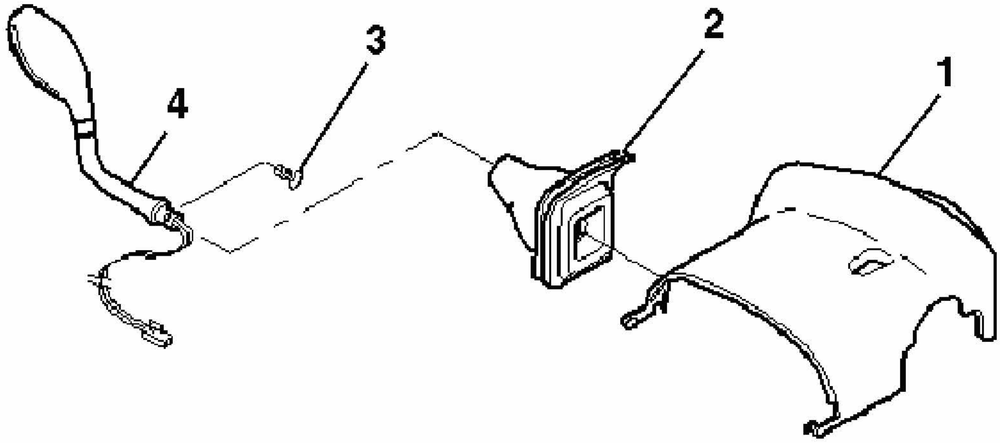


Fig. 55: View Of Shift Lever, Seal (Boot), Screw & Upper Trim Cover
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The shift lever seal must be installed to the narrow end of the shift lever.

1. Install the shift lever seal (2) onto the shift lever assembly (4).
2. Install the shift lever assembly (4) to linear shift assembly.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the shift lever screw (3) into the shift lever assembly (4).

   Tighten: Tighten the screw to 20 N.m (15 lb ft).

4. Slide the shift lever seal (2) down the shift lever assembly (4).
5. Align the shift lever seal into the steering column trim covers.
6. If necessary, install the steering column trim covers. Refer to **Steering Column Trim Covers Replacement**.
7. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

LINEAR SHIFT ASSEMBLY REPLACEMENT

Removal Procedure

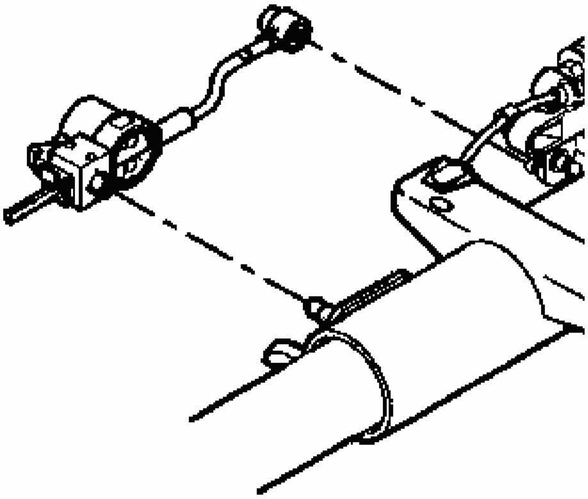


Fig. 56: View Of Automatic Transmission Shift Lock Control Actuator
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SIR Caution in Cautions and Notices.

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.
2. Remove the upper and lower trim covers. Refer to **Steering Column Trim Covers Replacement**.
3. Remove the shift lever assembly. Refer to **Shift Lever Replacement**.
4. With a screwdriver carefully pry the automatic transmission shift lock control away from the steering column jacket.

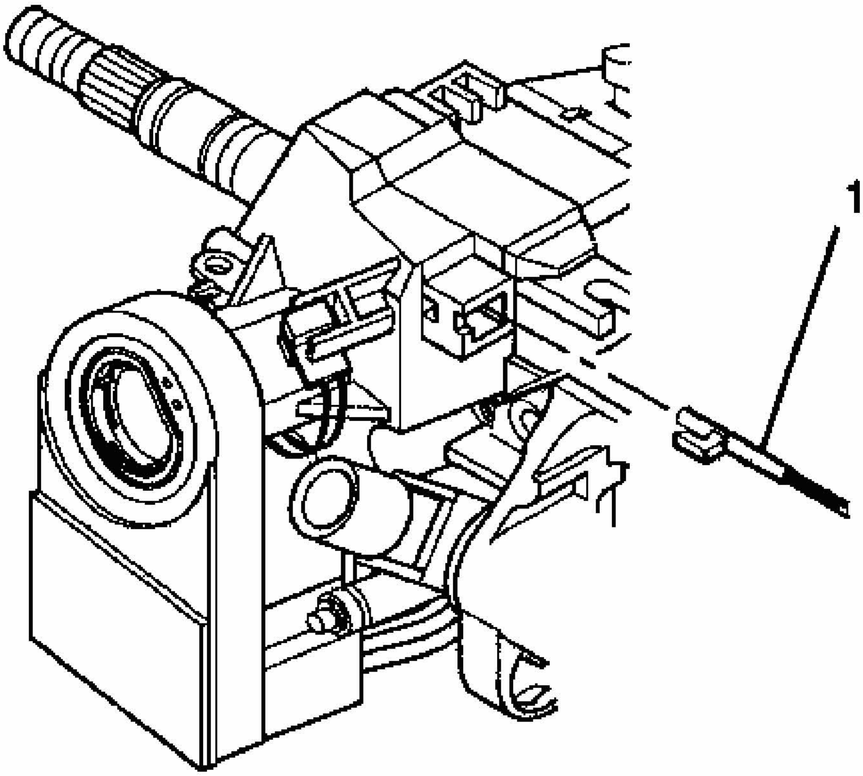


Fig. 57: Identifying Park Lock Cable At Ignition Lock Cylinder
Courtesy of GENERAL MOTORS CORP.

5. The lock cylinder should be in the OFF-LOCK position.

IMPORTANT: Do NOT remove the tape on the park lock cable. If the tape is removed from the park lock cable, you MUST order a new linear shift assembly.

6. Insert a small screwdriver into the slot on the ignition lock cylinder case and push against the locking tab to remove the park lock cable assembly (1).

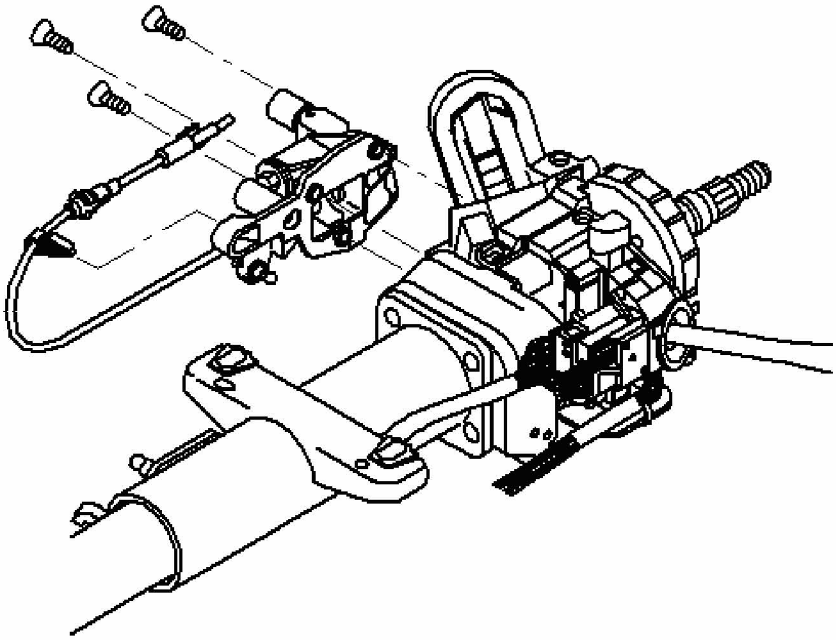


Fig. 58: Flat-Head 6-Lobed Socket Tap Screws & Linear Shift Assembly
Courtesy of GENERAL MOTORS CORP.

7. Remove the 3 flat-head 6-lobed socket tap screws from the linear shift assembly.
8. Remove the linear shift assembly.

Installation Procedure

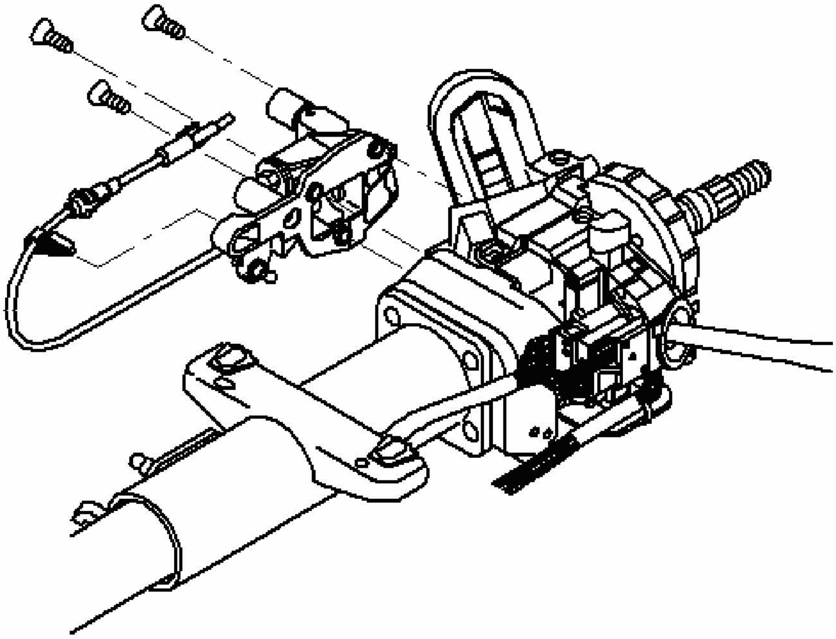


Fig. 59: Flat-Head 6-Lobed Socket Tap Screws & Linear Shift Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

IMPORTANT: Do NOT remove the tape on the park lock cable. If so, the linear shift assembly MUST be replaced.

1. Install the linear shift assembly and secure by using 3 flat-head 6-lobed socket tap screws.

   The linear shift assembly must be out of the PARK position to install the lower socket tap screw.

Tighten: Tighten the screws to 10 N.m (89 lb in).

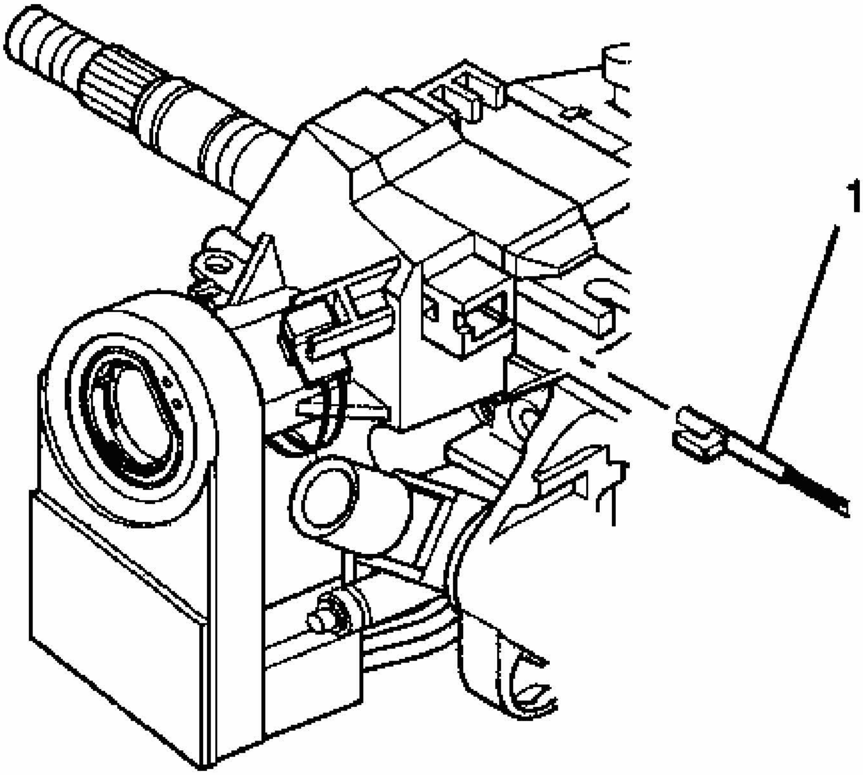


Fig. 60: Identifying Park Lock Cable At Ignition Lock Cylinder
Courtesy of GENERAL MOTORS CORP.

2. Connect the park lock cable assembly (1) into the ignition lock cylinder case.
    - The lock cylinder should be in the OFF-LOCK position.
    - The locking tab at the end of the park lock cable assembly (1) must be installed into the ignition lock cylinder case.

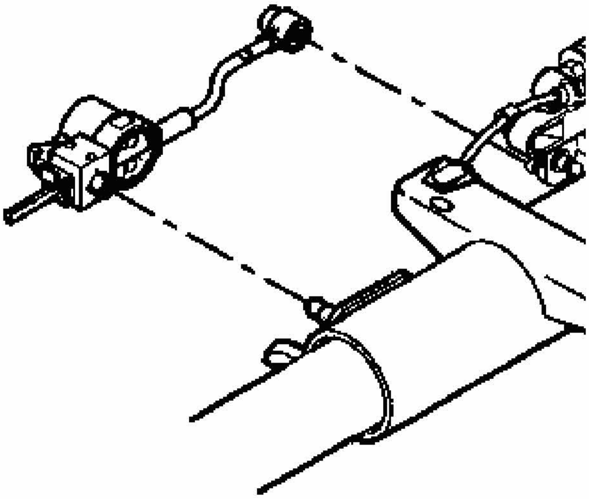


Fig. 61: View Of Automatic Transmission Shift Lock Control Actuator
Courtesy of GENERAL MOTORS CORP.

3. Install the automatic transmission shift lock control.
4. Install the gear shift lever and put the column in the NEUTRAL position.

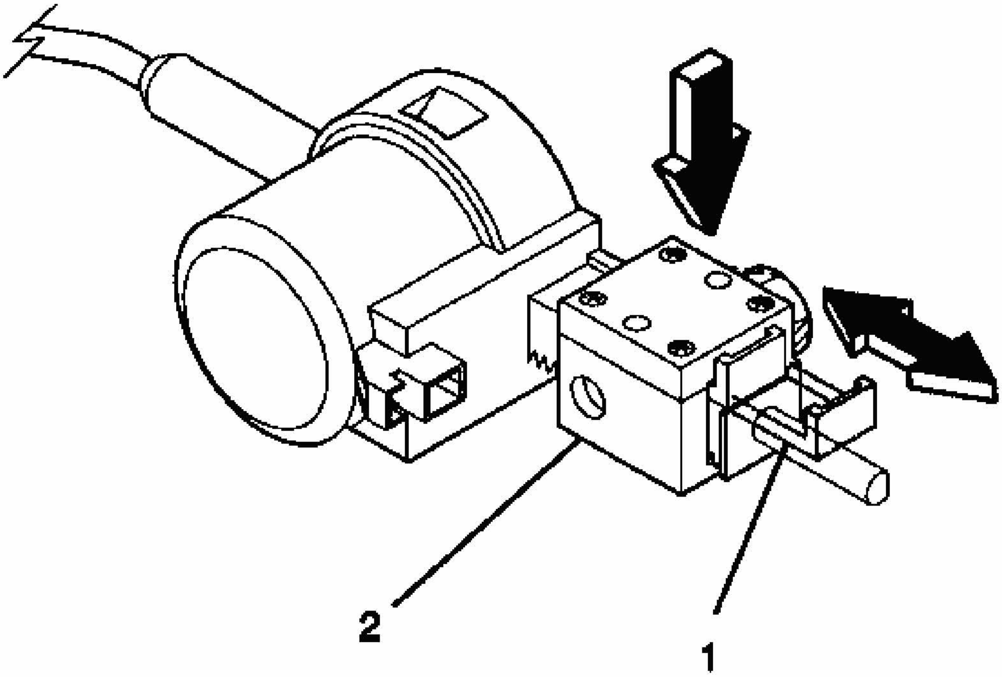


Fig. 62: Adjusting Automatic Transmission Shift Lock Control Actuator
Courtesy of GENERAL MOTORS CORP.

5. Adjust the automatic transmission shift lock control.
    1. Pull the tab (1) out on the block side (2) of the automatic transmission shift lock control.
    2. Press on the adjuster block (2) to compress the internal adjuster spring to disengage the adjuster teeth. Slide the adjuster block as far away from the solenoid as possible.
    3. Lock in place by pushing the tab (1) back in.
6. Inspect the automatic transmission shift lock control.
    1. The automatic transmission shift lock control must lock the gear shift lever when it is put into the PARK position.
    2. When the column is installed in the vehicle you will not be able to shift the gear shift lever out of the PARK position without pressing on the brake pedal. The solenoid will be energized.
    3. Readjust if needed.
7. Install the shift lever assembly. Refer to **Shift Lever Replacement**.
8. Install the upper and lower trim covers. Refer to **Steering Column Trim Covers**

Replacement.

9. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

TILT LEVER REPLACEMENT

Removal Procedure

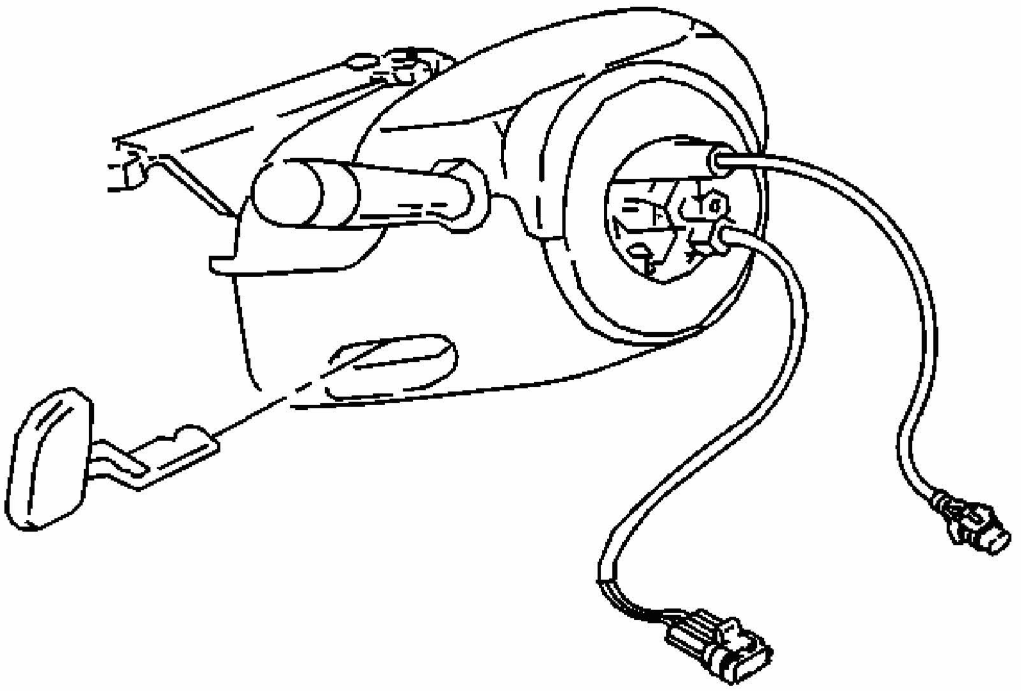


Fig. 63: Identifying Tilt Lever
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SIR Caution in Cautions and Notices.

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.
2. Pull the tilt lever out from the steering column.

Installation Procedure

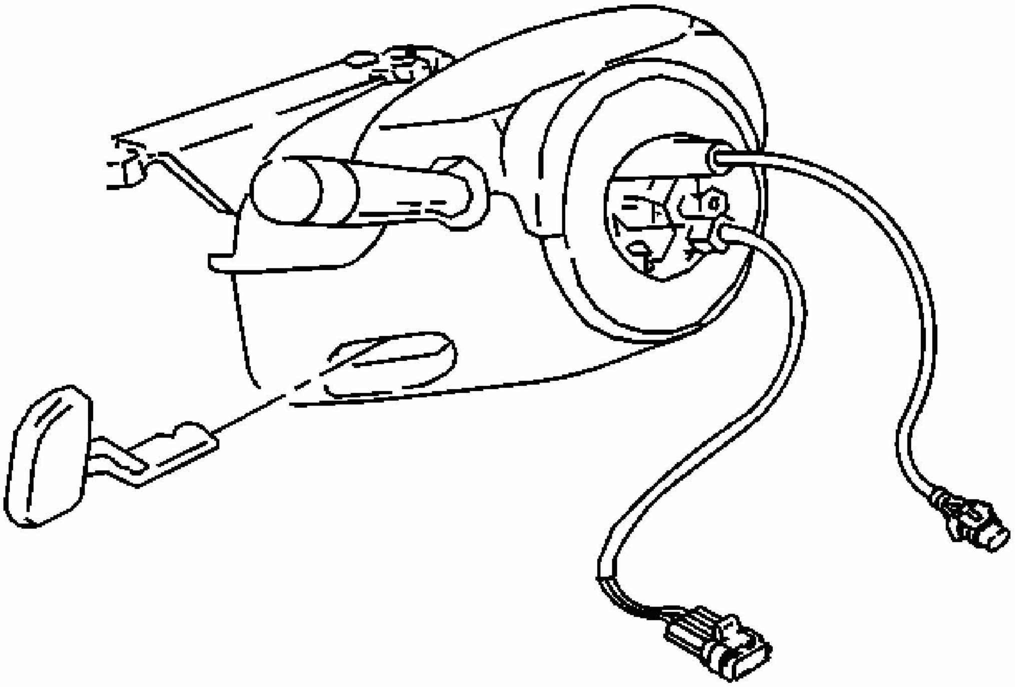


Fig. 64: Identifying Tilt Lever
Courtesy of GENERAL MOTORS CORP.

1. Push the tilt lever into the steering column.
2. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

STEERING WHEEL CONTROL SWITCH ASSEMBLY REPLACEMENT

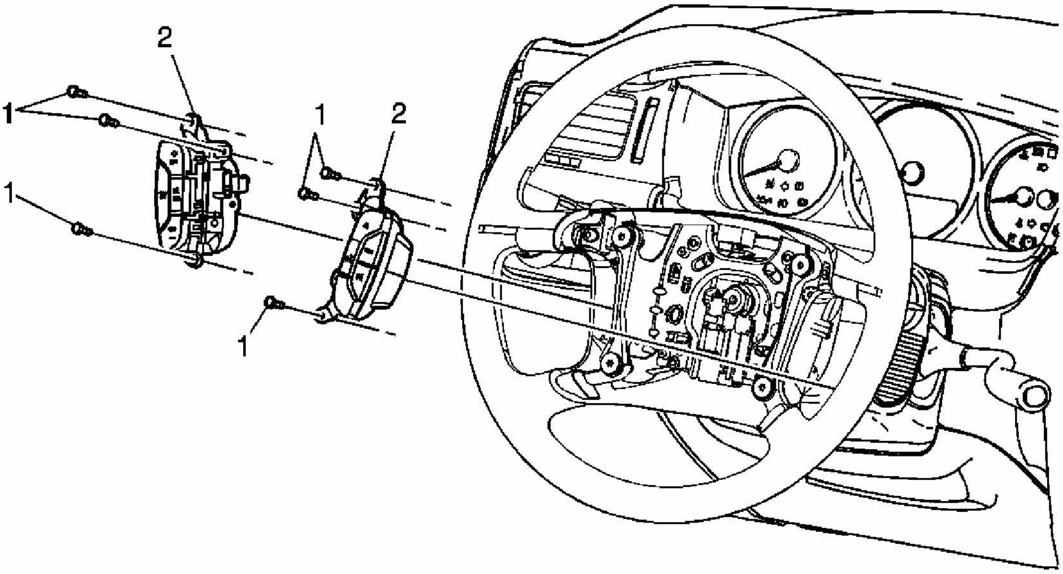


Fig. 65: Replacing Steering Wheel Control Switch Assembly
Courtesy of GENERAL MOTORS CORP.

Steering Wheel Control Switch Assembly Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the inflatable restraint steering wheel module. Refer to **Inflatable Restraint Steering Wheel Module Replacement** .	
1	Bolt/Screw, Steering Wheel Switch **Tip:** Disconnect the electrical connector. **Tighten:** 2 N.m (18 lb in)
2	Switch Assembly, Radio, HVAC and Cruise Control Assembly

STEERING WHEEL REPLACEMENT

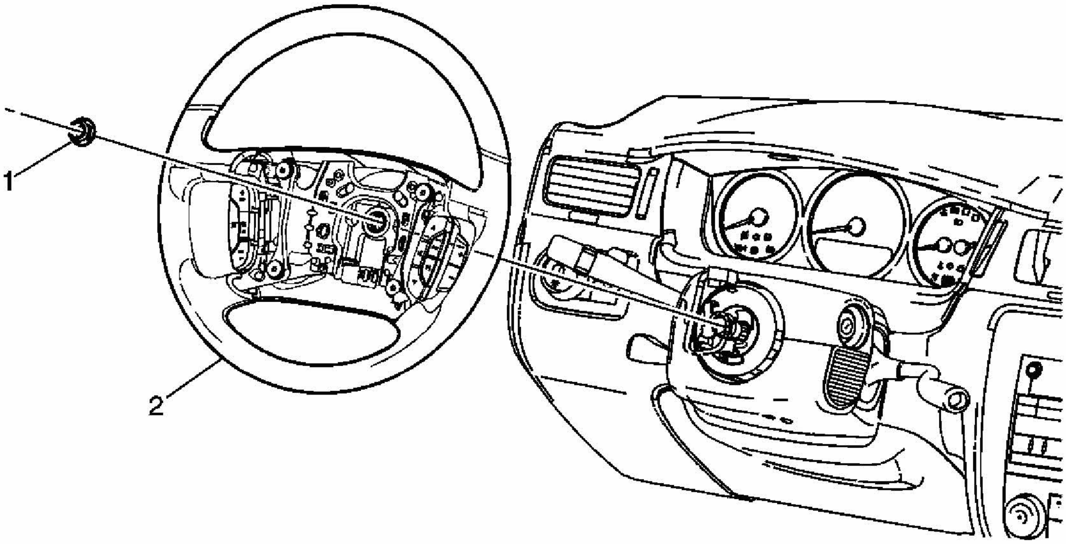


Fig. 66: Replacing Steering Wheel
Courtesy of GENERAL MOTORS CORP.

Steering Wheel Replacement

Callout	Component Name
NOTE: Refer to Fastener Notice . **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Tools Required** • **J 1859-A** Countergear and Steering Wheel Puller. See **Special Tools**. • **J 42578** Steering Wheel Puller Legs. See **Special Tools**. **Preliminary Procedure:** Remove the inflatable restraint steering wheel module. Refer to **Inflatable Restraint Steering Wheel Module Replacement** .	
1	Nut, Steering Wheel Assembly **Tighten:** 41 N.m (30 lb ft)
2	Wheel Assembly, Steering

STEERING WHEEL THEFT DETERRENT LOCK REPLACEMENT

Removal Procedure

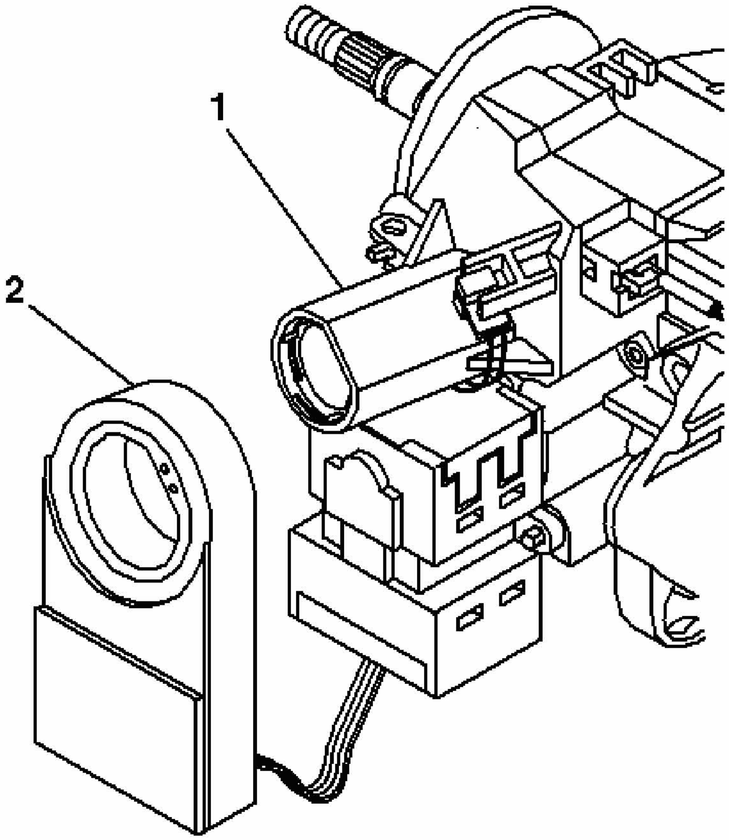


Fig. 67: Locating Theft Deterrent Module & Ignition Lock Cylinder Case Assembly
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SIR CAUTION in Cautions and Notices.

1. Disable the inflatable restraint steering wheel module. Refer to **SIR Disabling and Enabling Zone 3** in SIR.
2. Remove the upper and lower trim covers. Refer to **Steering Column Trim Covers Replacement**.
3. Remove the lock cylinder. Refer to **Ignition Lock Cylinder Replacement**.
4. Disconnect the connector from the theft deterrent control module.
5. If necessary, disconnect the connector from the ignition lock cylinder case (1).

6. Remove the theft deterrent control module (2)from ignition lock cylinder case assembly (1).

Installation Procedure

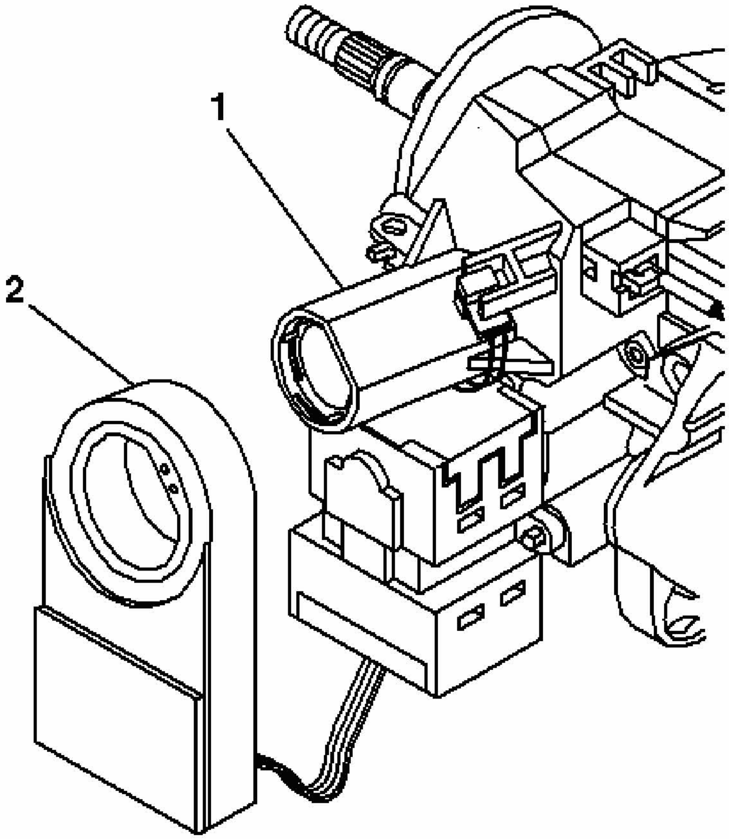


Fig. 68: Locating Theft Deterrent Module & Ignition Lock Cylinder Case Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the theft deterrent control module (2)onto the ignition lock cylinder case assembly (1).

CAUTION: Refer to SIR INFLATOR MODULE COIL CAUTION in Cautions and Notices.

2. Connect the connector to the theft deterrent control module.
3. If necessary, connect the connector to the ignition lock cylinder case.
4. Install the lock cylinder. Refer to **Ignition Lock Cylinder Replacement**.
5. Install the upper and lower trim covers. Refer to **Steering Column Trim Covers Replacement**.
6. Enable the inflatable restraint steering wheel module. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

TILT SPRING REPLACEMENT

Removal Procedure

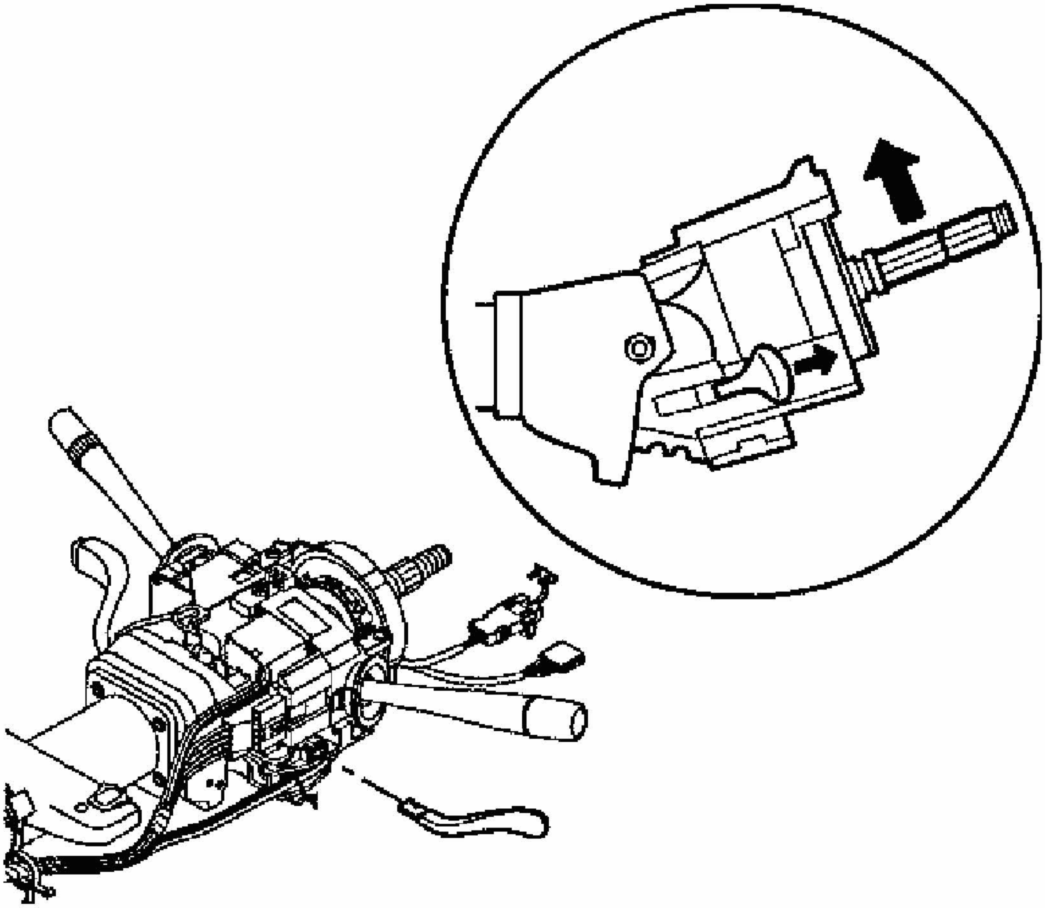


Fig. 69: Tilting Column To Up Position
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SIR Caution in Cautions and Notices.

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.
2. Remove the upper and lower trim covers. Refer to **Steering Column Trim Covers Replacement**.
3. Install the tilt lever onto the steering column tilt head assembly.
4. Use the tilt lever to tilt the column to the UP position.

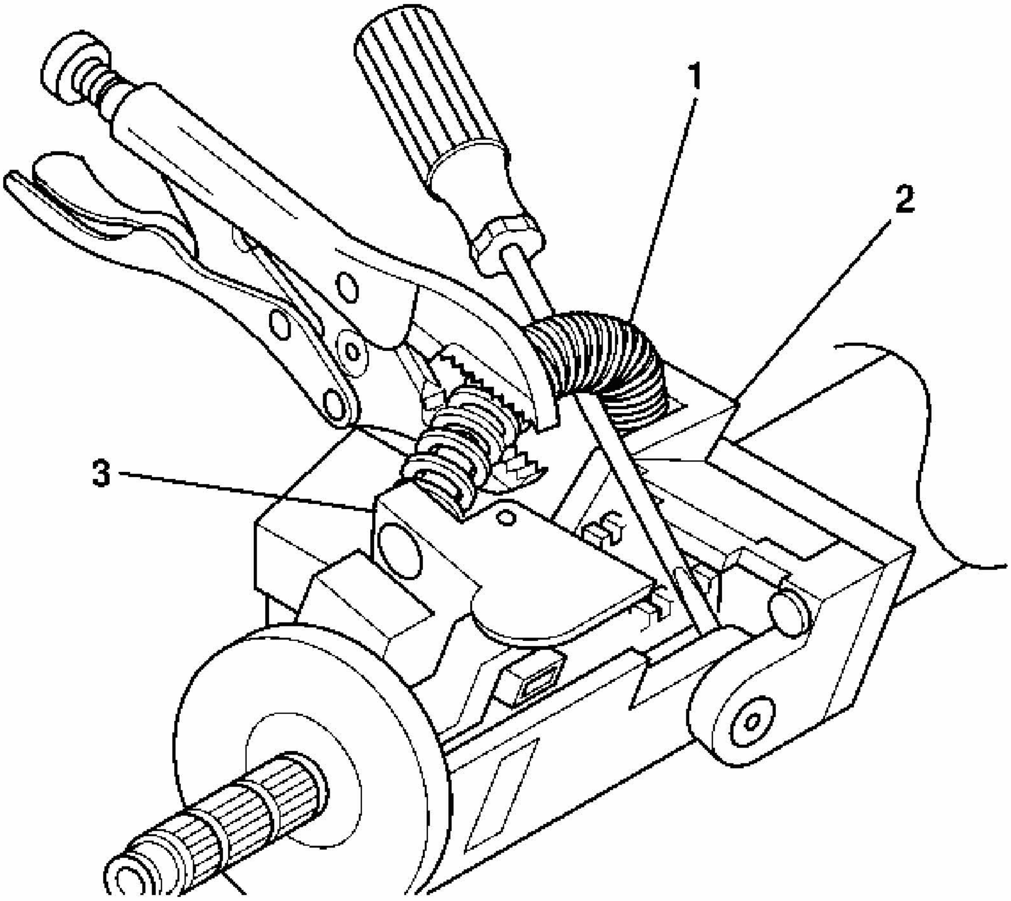


Fig. 70: Removing Tilt Spring From Steering Column Support Assembly
Courtesy of GENERAL MOTORS CORP.

CAUTION: The tilt spring and the spring guide are under pressure. The tilt spring and the spring guide may become a projectile. Secure the spring with locking pliers during removal. Secure the spring with locking pliers during installation. Bodily injury may result during removal and installation of the tilt spring and the spring guide.

Always use caution during removal and installation of the tilt spring and the spring guide.

5. Remove the tilt spring (1) from the steering column support assembly (2) and from the steering column tilt head assembly (3) by using the following procedure:
    1. Pry up the tilt spring (1) until a bulge occurs and most of the tilt spring tension is removed.
    2. Secure the tilt spring (1) with locking pliers.
    3. Continue prying up the tilt spring (1) until the tilt spring disengages from the post on the steering column support assembly (2) and from the steering column tilt head assembly (3).

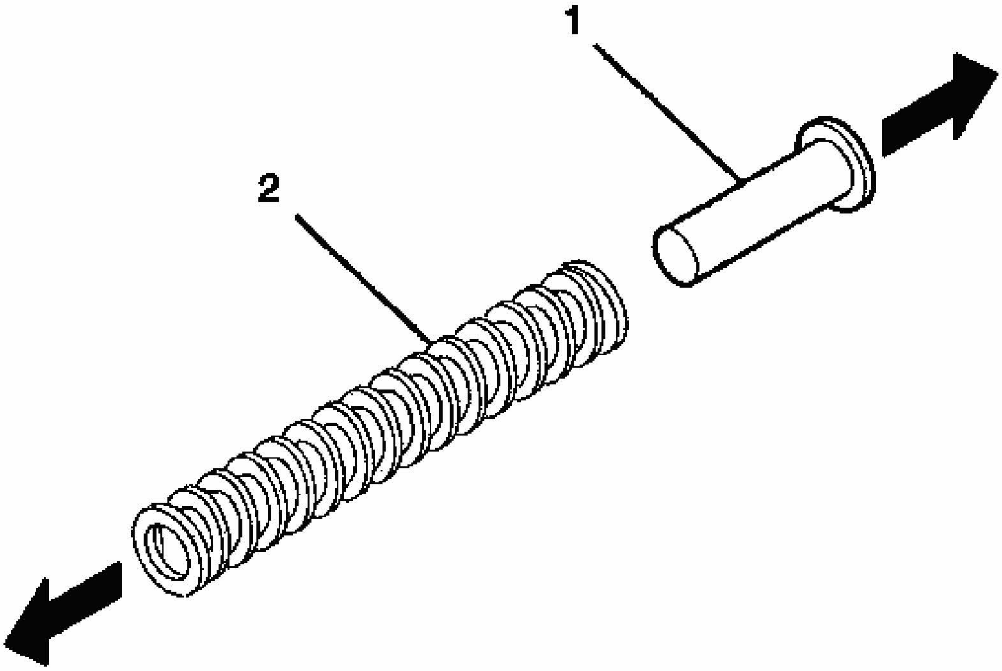


Fig. 71: Identifying Spring Guide Components
Courtesy of GENERAL MOTORS CORP.

6. Remove the spring guide (1) from the tilt spring (2).

Installation Procedure

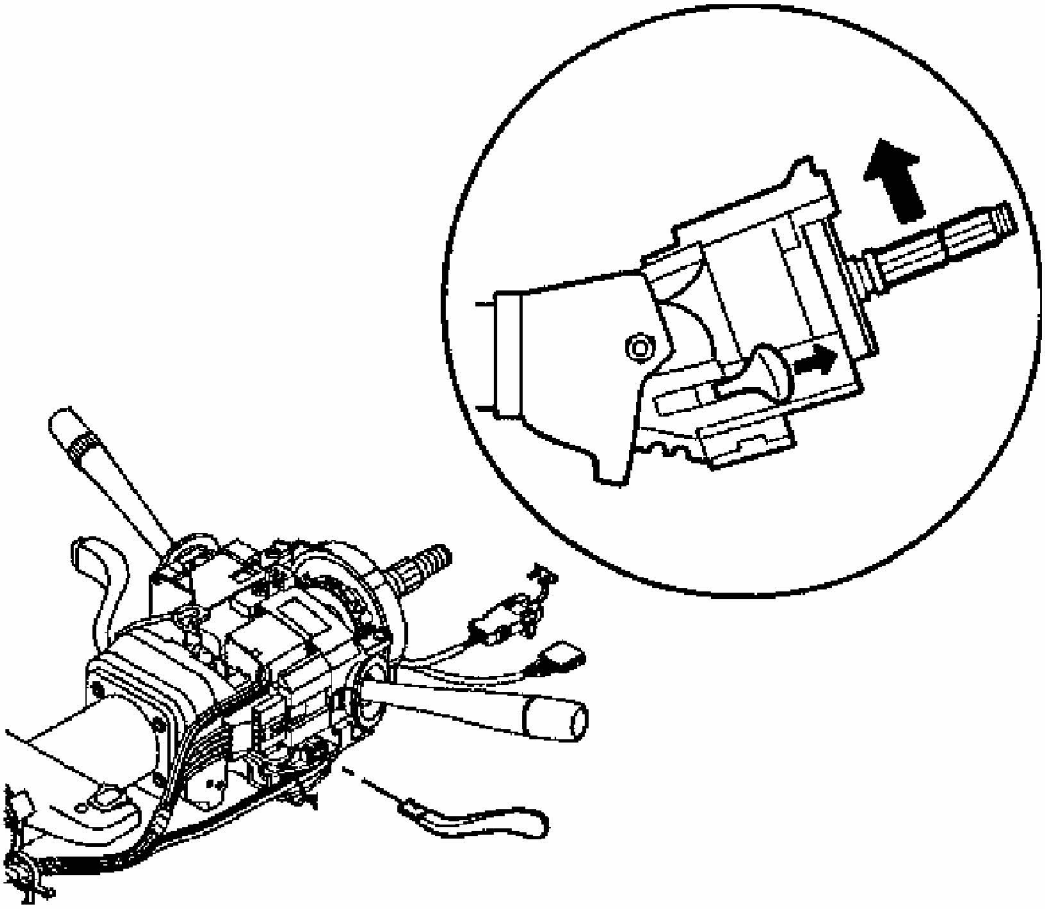


Fig. 72: Tilting Column To Up Position
Courtesy of GENERAL MOTORS CORP.

1. Use the tilt lever to tilt the column to the UP position.

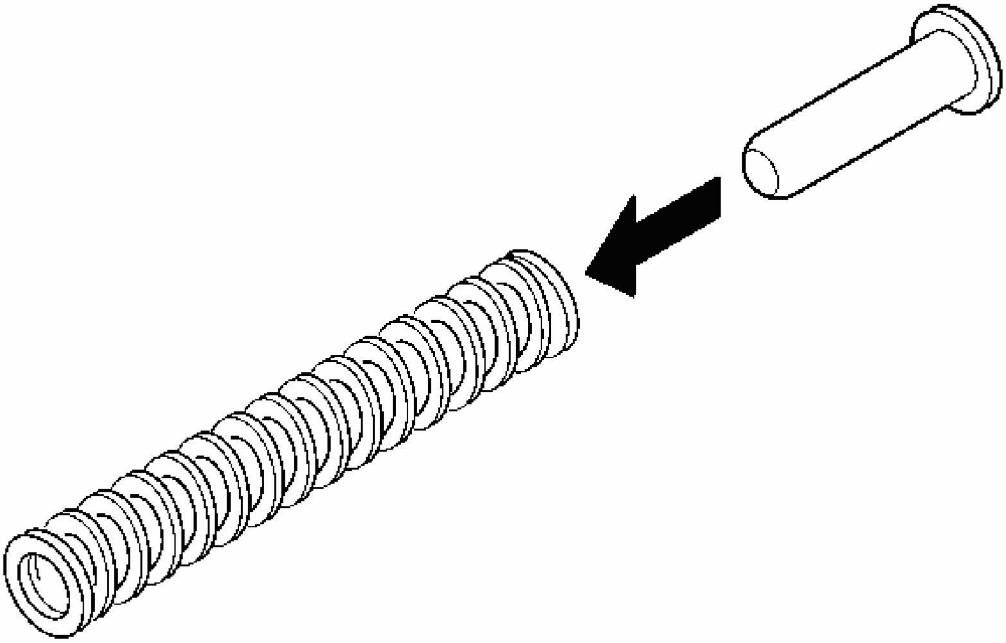


Fig. 73: Spring Guide & Tilt Spring
Courtesy of GENERAL MOTORS CORP.

2. Install the spring guide into the tilt spring.

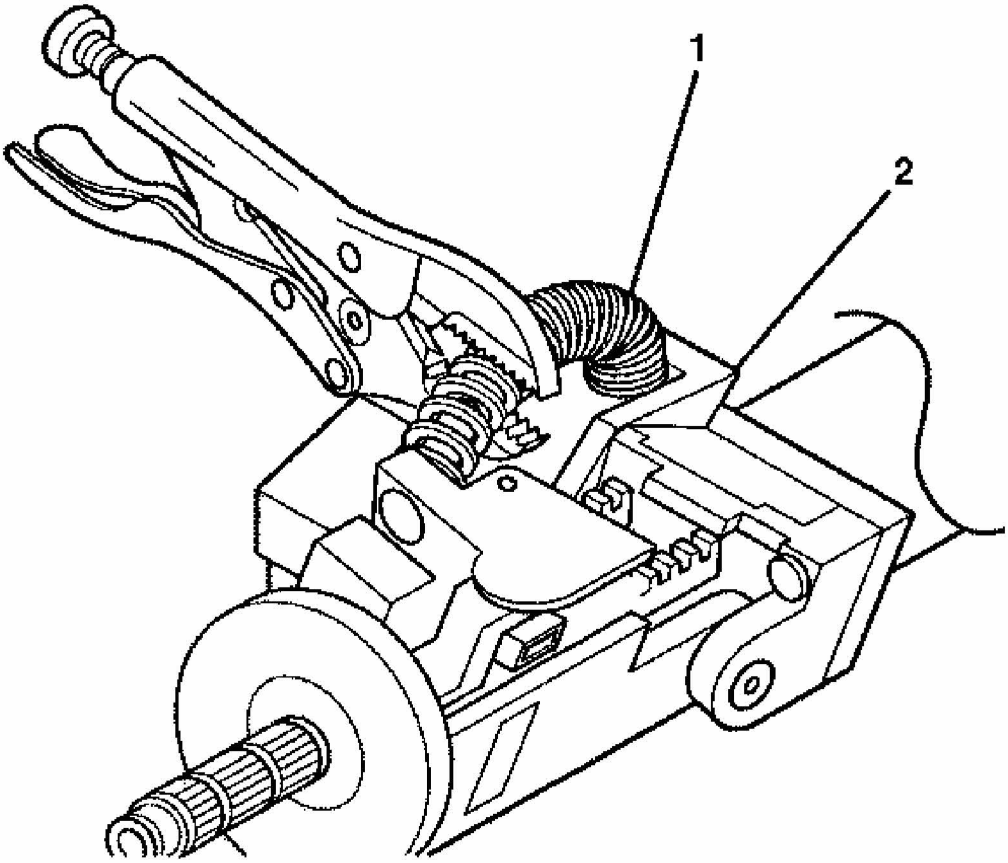


Fig. 74: Installing Tilt Spring Onto The Steering Column Support Assembly
Courtesy of GENERAL MOTORS CORP.

CAUTION: The tilt spring and the spring guide are under pressure. The tilt spring and the spring guide may become a projectile. Secure the spring with locking pliers during removal. Secure the spring with locking pliers during installation. Bodily injury may result during removal and installation of the tilt spring and the spring guide. Always use caution during removal and installation of the tilt spring and the spring guide.

3. Install the tilt spring (1) onto the steering column support assembly (2) and onto the steering column tilt head assembly by using the following procedure:
    1. Install the tilt spring (1) onto the steering column tilt head assembly.
    2. Install the tilt spring (1) onto the post on the steering column support assembly

(2).

4. Install the upper and lower trim covers. Refer to **Steering Column Trim Covers Replacement**.
5. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

STEERING COLUMN TILT HEAD REPLACEMENT

Tools Required

- **J 21854-01** Pivot Pin Remover. See **Special Tools**.
- **J 23653-SIR** Steering Column Lock Plate Compressor
- **J 42137** Cam Orientation Plate Adapter. See **Special Tools**.

Removal Procedure

CAUTION: Refer to SIR Caution in Cautions and Notices.

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

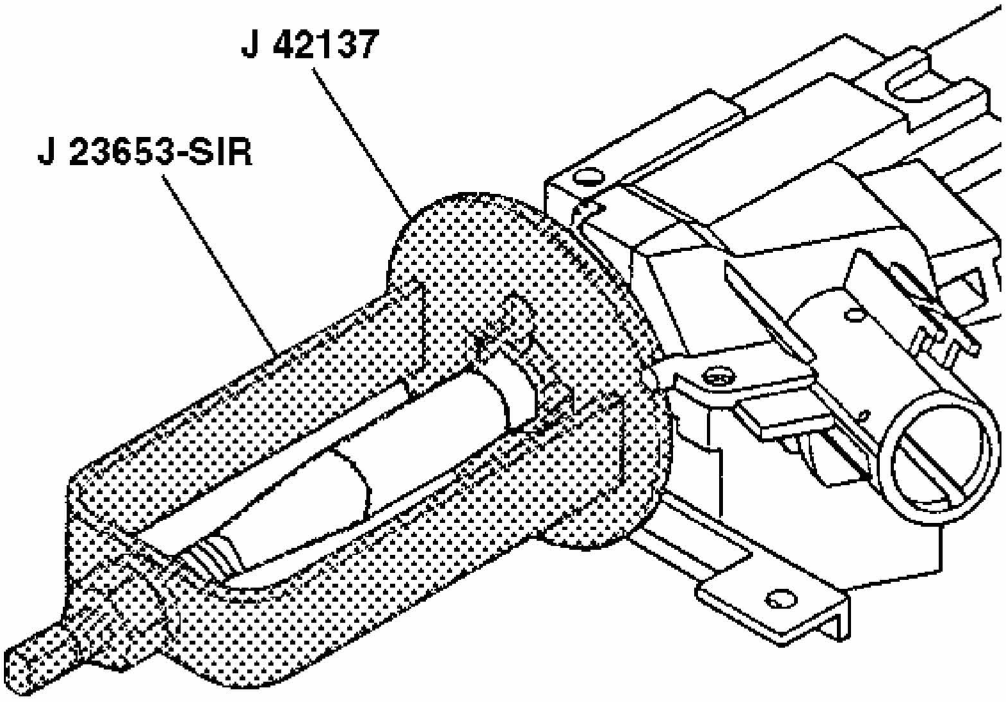


Fig. 75: Compressing Cam Orientation Plate Using J 23653-SIR & J 42137
Courtesy of GENERAL MOTORS CORP.

2. Remove the SIR coil. Refer to **Inflatable Restraint Steering Wheel Module Coil Replacement (Coil)** in SIR.
3. Compress the cam orientation plate using **J 23653-SIR** and **J 42137** . See **Special Tools**.

   Remove the bearing retainer from the shaft.

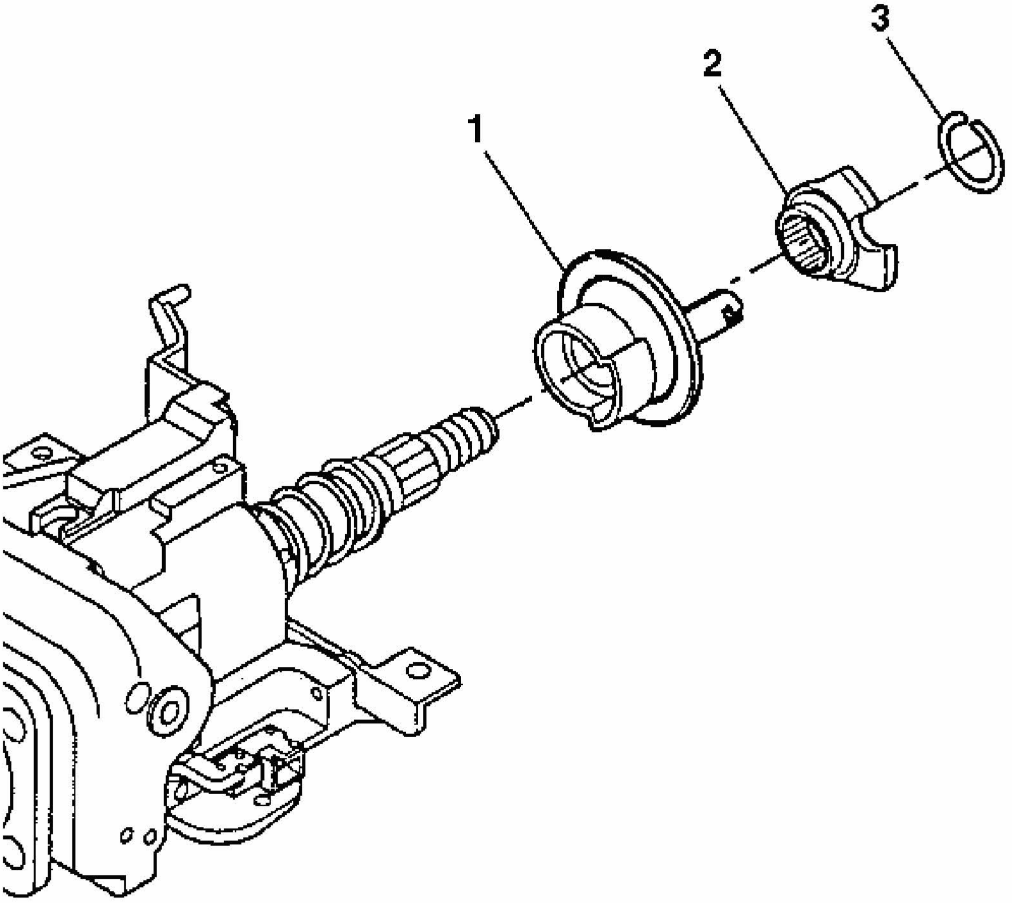


Fig. 76: View Of Turn Signal Cancel Cam Assembly, Cam Orientation Plate & Bearing Retainer
Courtesy of GENERAL MOTORS CORP.

4. Remove **J 23653-SIR** and **J 42137** from the steering column. See **Special Tools**.
5. Remove and dispose the bearing retainer (3).
6. Remove the cam orientation plate (2).
7. Remove the turn signal cancel cam assembly (1).

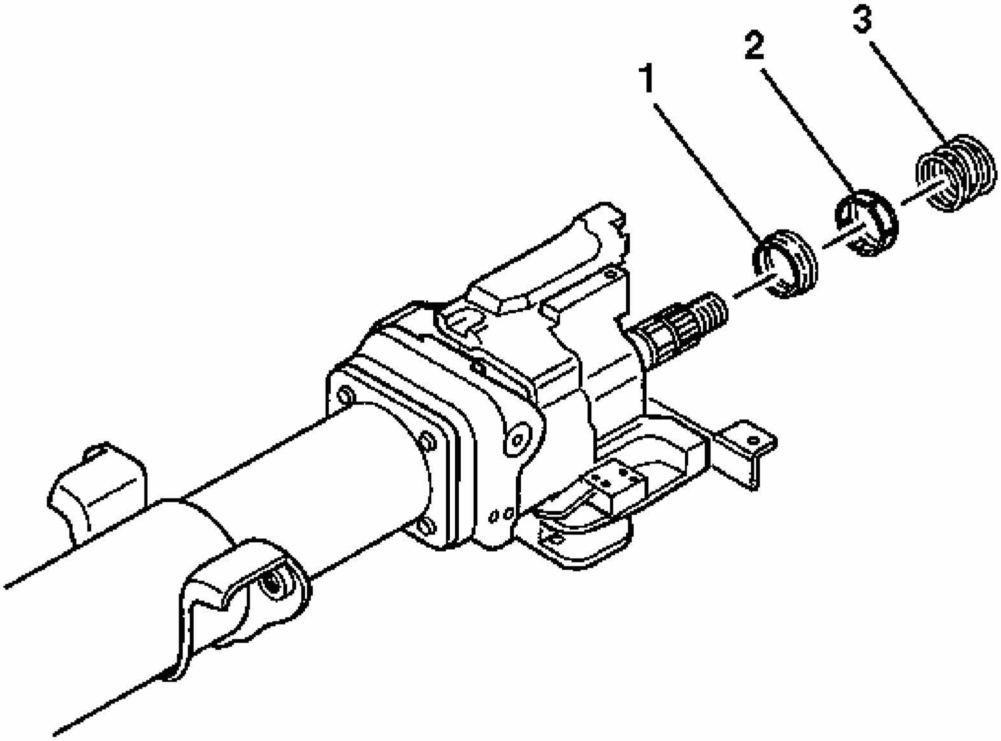


Fig. 77: View Of Upper Bearing Spring, Inner Race Seat & Inner Race
Courtesy of GENERAL MOTORS CORP.

8. Remove the upper bearing spring (3).
9. Remove the upper bearing inner race seat (2).
10. Remove the inner race (1).

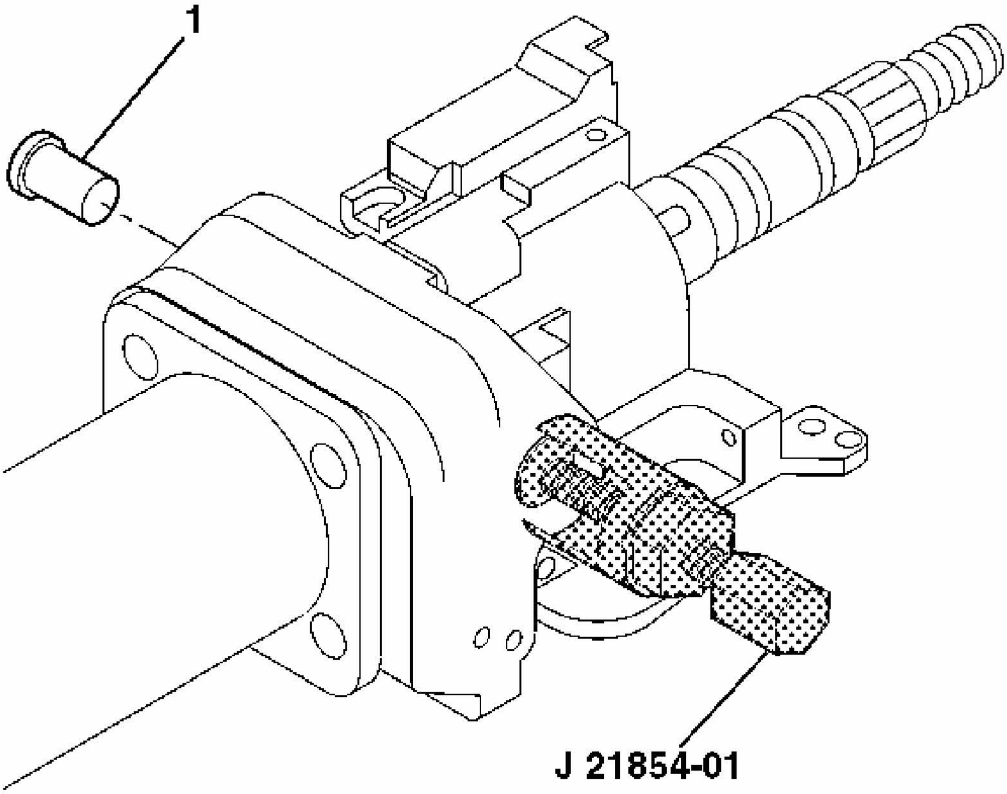


Fig. 78: Identifying J 21854-01
Courtesy of GENERAL MOTORS CORP.

11. Remove the pivot pins (1) using **J 21854-01** . See **Special Tools**.

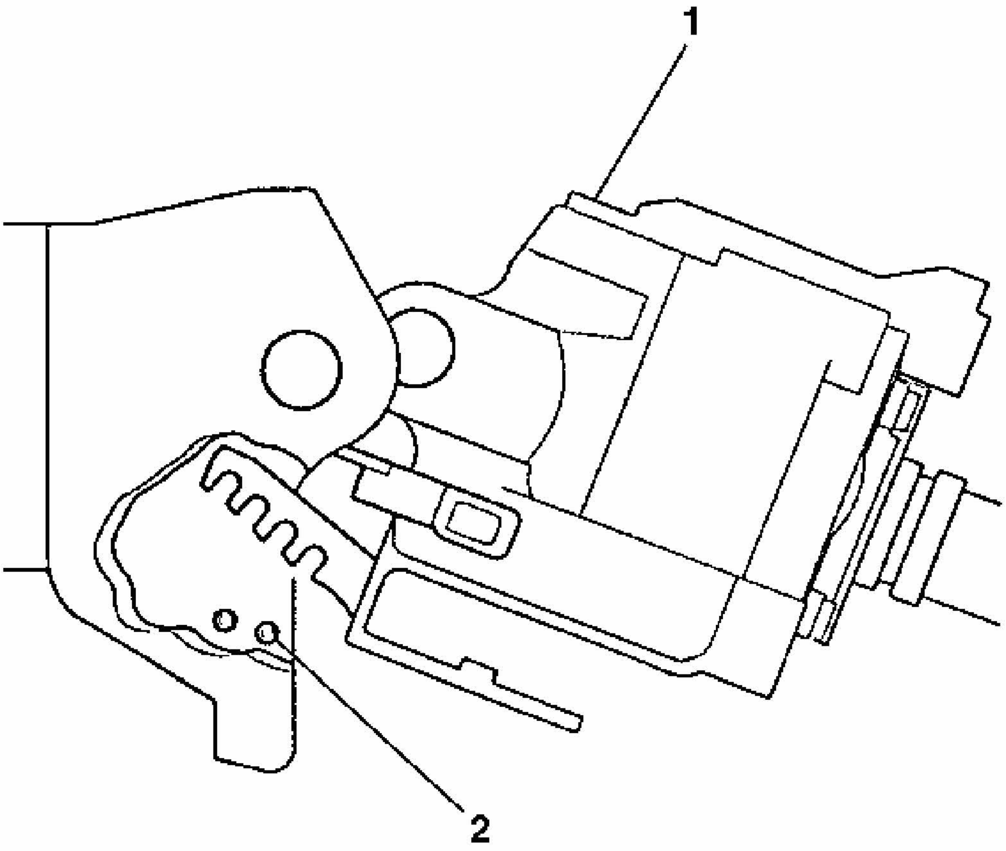


Fig. 79: Disengaging Steering Wheel Lock Shoes From Dowel Pins
Courtesy of GENERAL MOTORS CORP.

12. Pull the tilt arm in order to disengage the steering wheel lock shoes from the dowel pins (2) in the steering column support assembly.

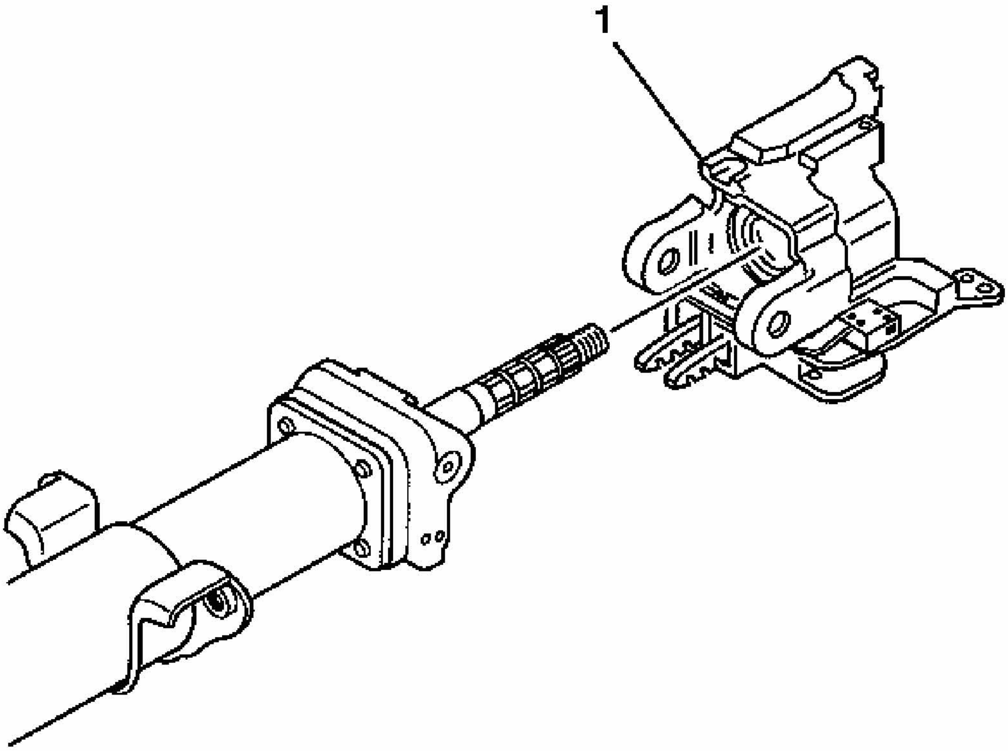


Fig. 80: View Of Steering Column Housing And Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

13. Remove the housing and bearing assembly (1).

Installation Procedure

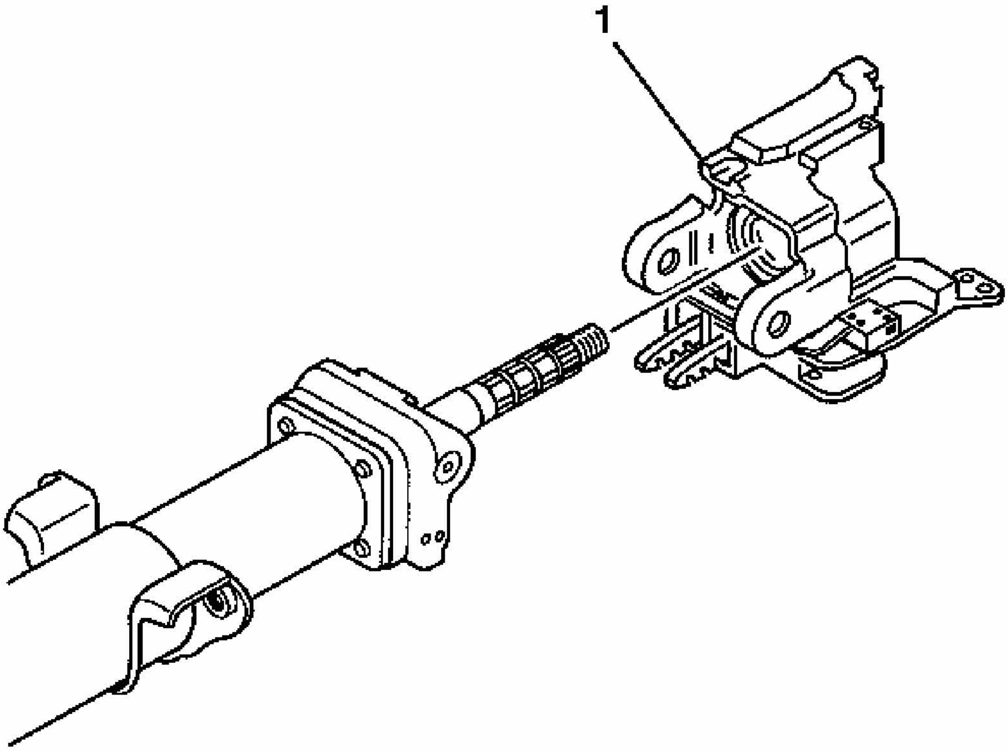


Fig. 81: View Of Steering Column Housing And Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the housing and bearing assembly (1).

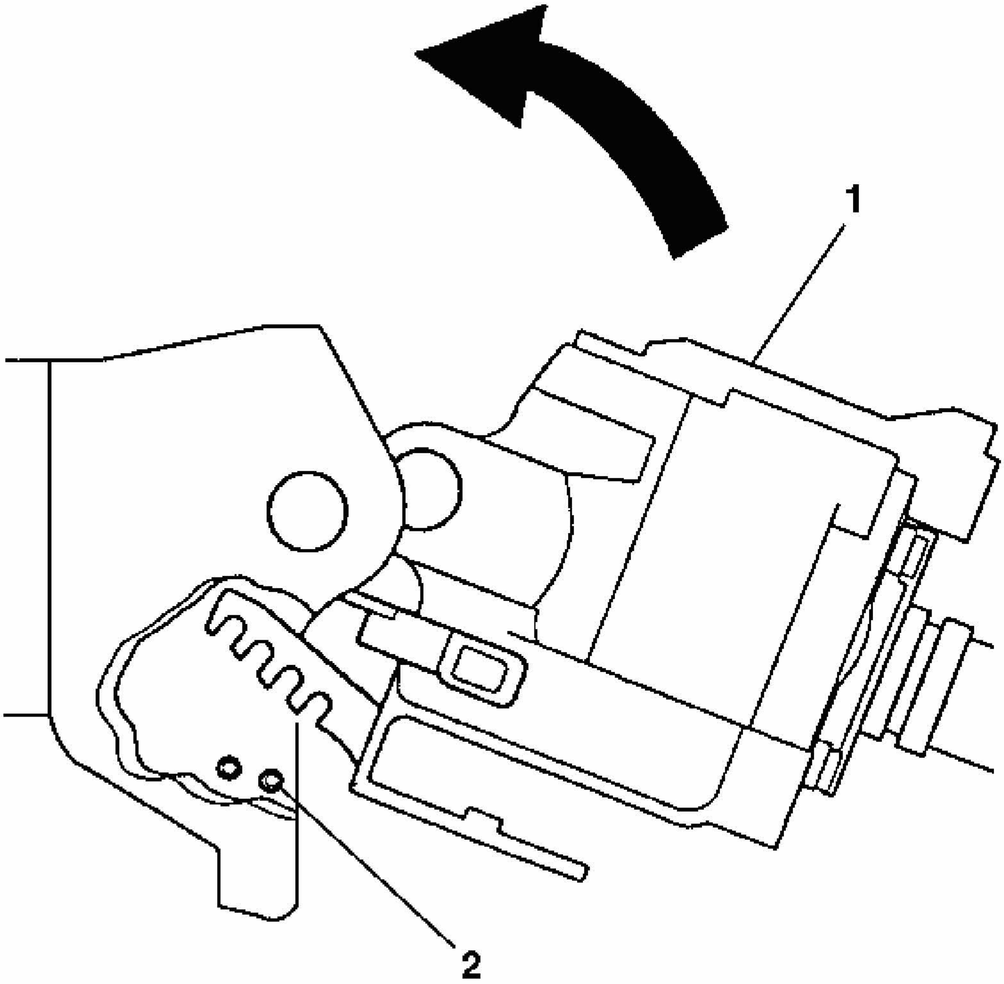


Fig. 82: Locking Shoes To Dowel Pins
Courtesy of GENERAL MOTORS CORP.

2. Using the tilt lever position, lock the shoes to the dowel pins (2).
3. Rotate the tilt head assembly (1) in order to align the holes for the pivot pins.

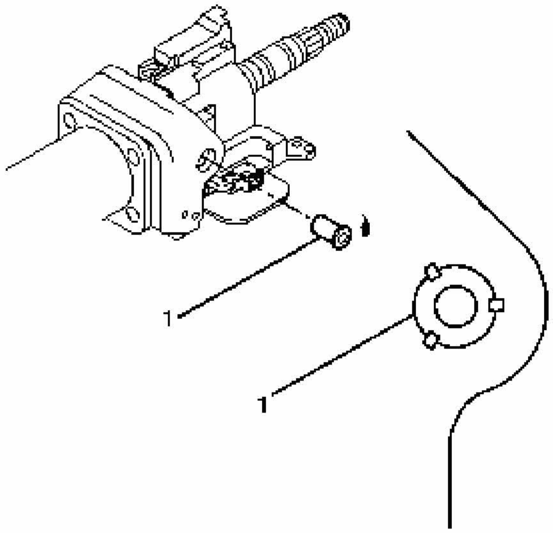


Fig. 83: View Of Pivot Pins At Steering Column Assembly
Courtesy of GENERAL MOTORS CORP.

4. Install the 2 pivot pins by performing the following steps:
    1. Lubricate the pivot pins (1) with, GM P/N 12346293 (Canadian P/N 992723).
    2. Press the pivot pins (1) until the pins are firmly seated.
    3. Stake the pivot pins at three new locations (1).

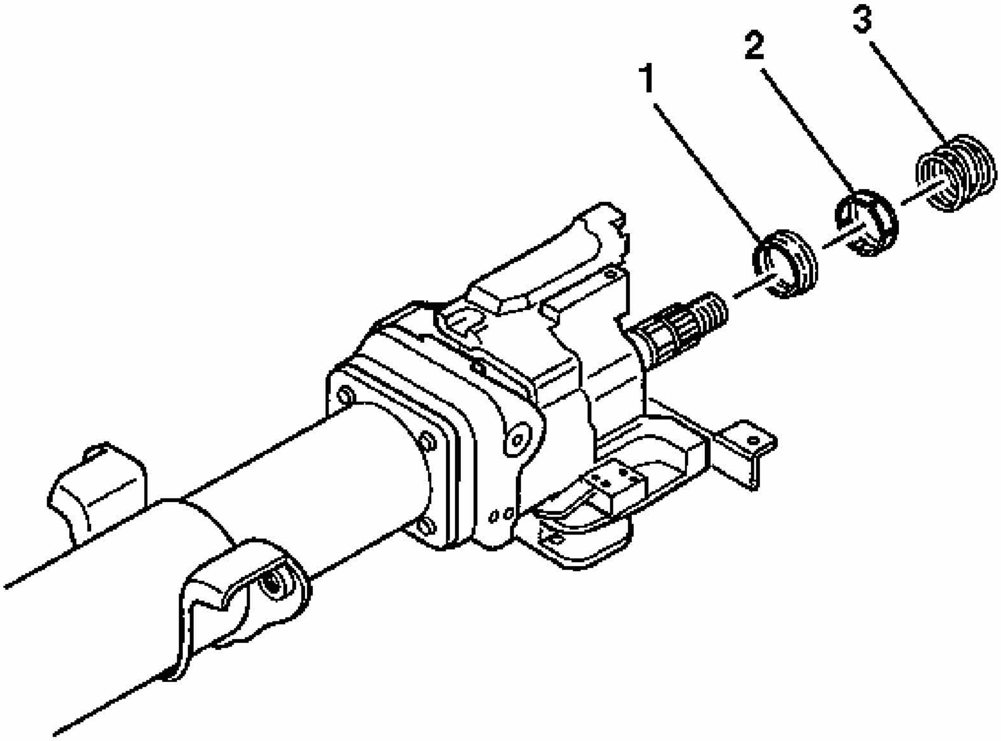


Fig. 84: View Of Upper Bearing Spring, Inner Race Seat & Inner Race
Courtesy of GENERAL MOTORS CORP.

5. Install the inner race (1).
6. Install the upper bearing inner race seat (2).
7. Install the upper bearing spring (3).

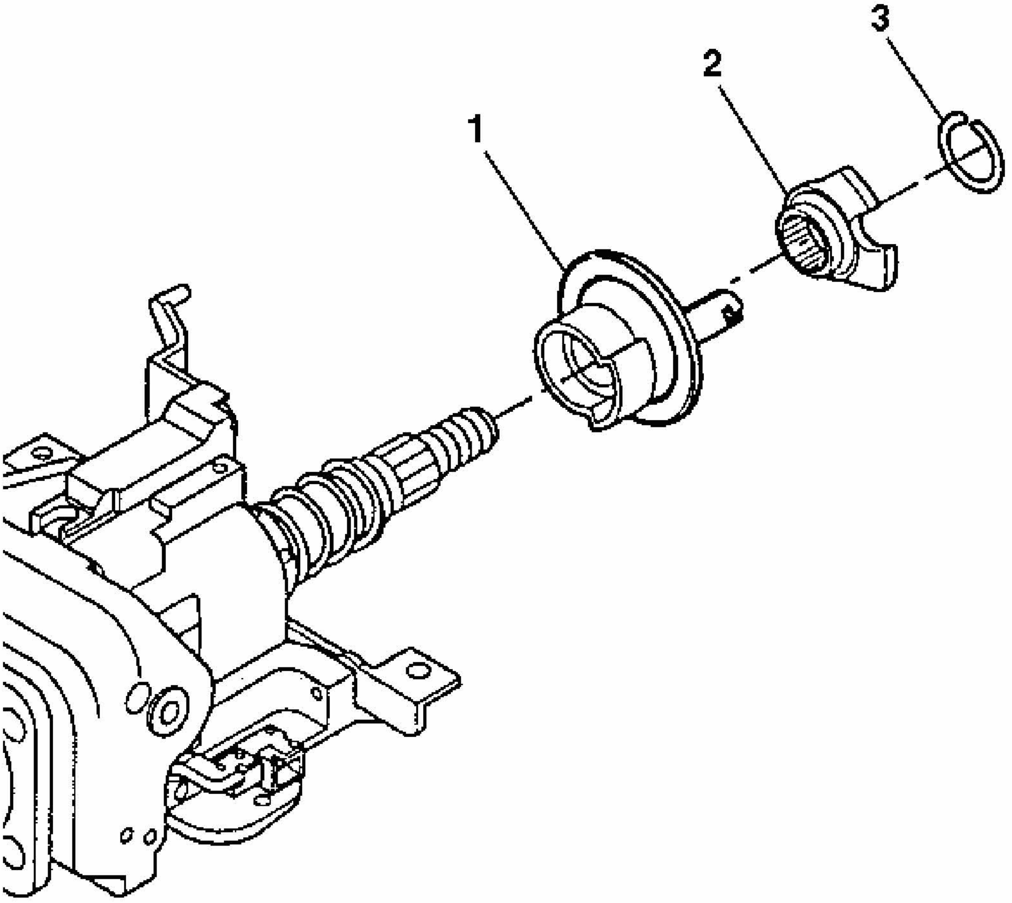


Fig. 85: View Of Turn Signal Cancel Cam Assembly, Cam Orientation Plate & Bearing Retainer
Courtesy of GENERAL MOTORS CORP.

8. Install the turn signal cancel cam assembly (1).
9. Install the cam orientation plate (2).
10. Install the bearing retainer (3).

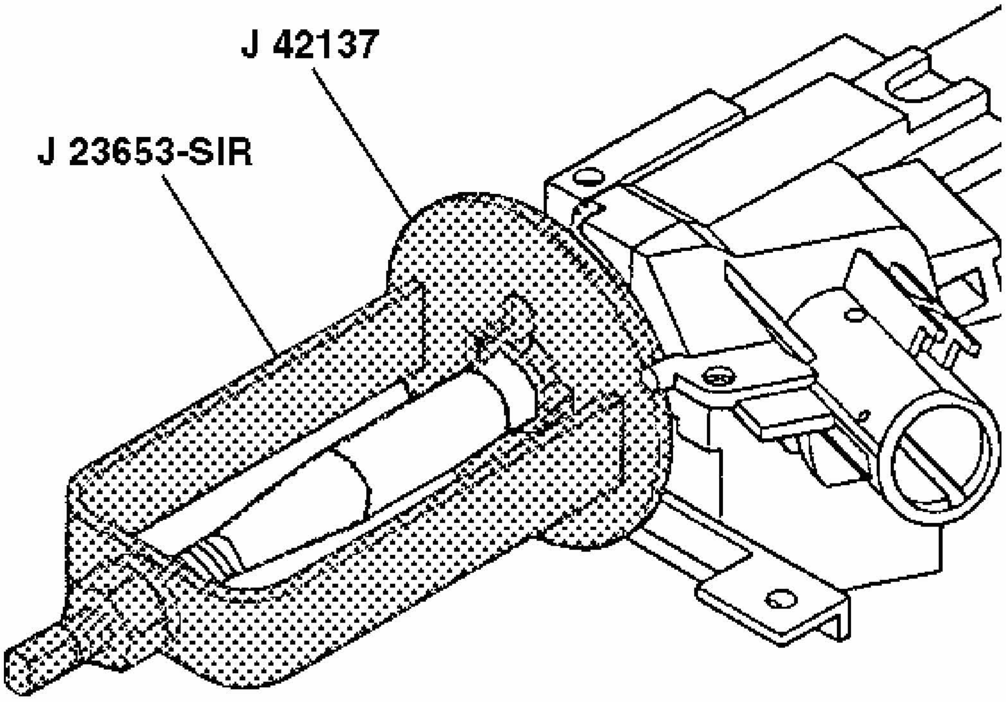


Fig. 86: Compressing Cam Orientation Plate Using J 23653-SIR & J 42137
Courtesy of GENERAL MOTORS CORP.

11. Install the bearing retainer ring to the steering shaft.

    Compress the cam orientation plate using **J 23653-SIR** and **J 42137** . See **Special Tools**.

12. Remove **J 23653-SIR** and **J 42137** . See **Special Tools**.
13. Install the SIR coil. Refer to **Inflatable Restraint Steering Wheel Module Coil Replacement (Coil)** in SIR.
14. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

STEERING COLUMN REPLACEMENT

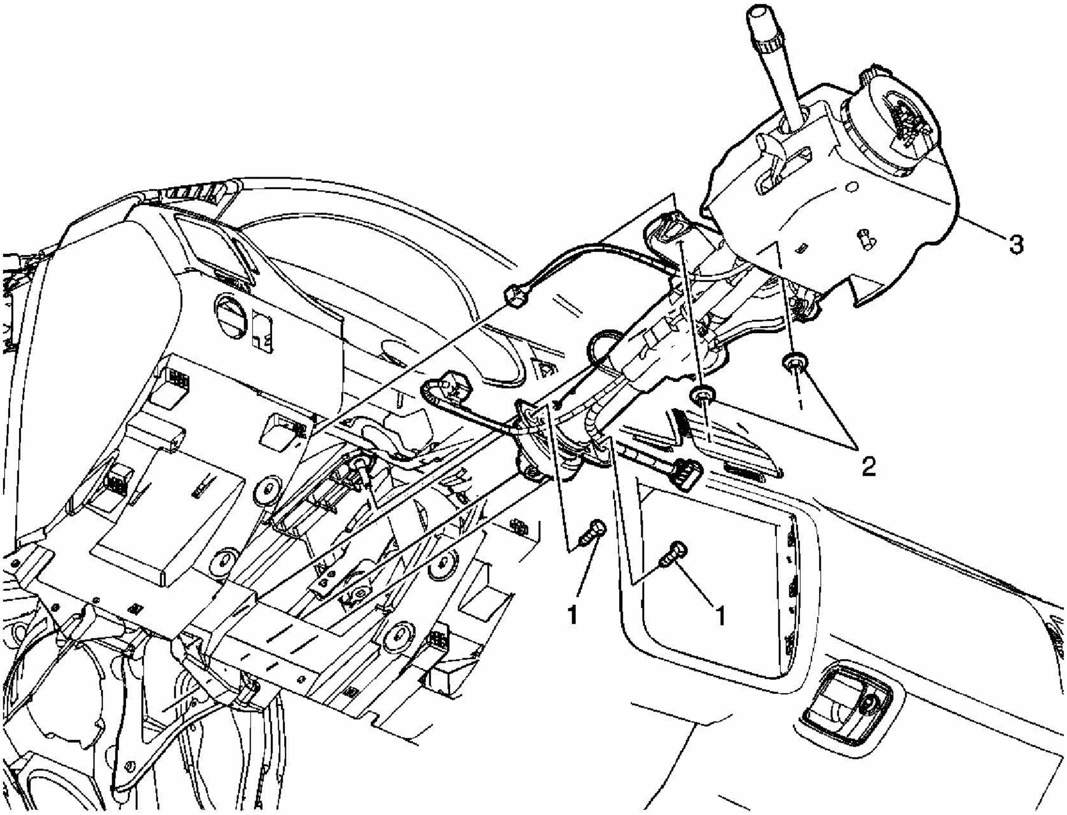


Fig. 87: Replacing Steering Column
Courtesy of GENERAL MOTORS CORP.

Steering Column Replacement

Callout	Component Name
CAUTION: **Refer to SIR Caution .** **CAUTION:** **Refer to Battery Disconnect Caution .** **NOTE:** **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedure** 1. Disconnect the negative battery cable. Refer to **Battery Negative Cable**	

Disconnect/Connect Procedure (RPOs LZE/LZ4/LZ9) or **Battery Negative Cable Disconnect/Connect Procedure (RPO LS4)** .

2. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** .
3. Remove the steering wheel. Refer to **Steering Wheel Replacement**.
4. Remove the left closeout/insulator panel. Refer to **Closeout/Insulator Panel Replacement - Left** .
5. Remove the steering column filler panel. Refer to **Steering Column Filler Replacement** .
6. Remove the knee bolster reinforcement. Refer to **Knee Bolster Reinforcement Replacement (Impala)** or **Knee Bolster Reinforcement Replacement (Monte Carlo)** .
7. Remove the intermediate shaft from the bottom of the steering column. Refer to **Intermediate Steering Shaft Replacement**.
8. Perform passkey relearn after the ignition lock cylinder has been replaced. Refer to **Control Module References** .

1	Bolt, Steering Column (Qty: 2) **Tip:** Disconnect the steering column electrical connectors. **Tighten:** 24 N.m (18 lb ft)
2	Nut, Steering Column (Qty: 2) **Tip:** Tighten the steering column bolts first on installation. **Tighten:** 24 N.m (18 lb ft)
3	Column, Steering

STEERING WHEEL POSITION SENSOR OR STEERING SHAFT LOWER BEARING REPLACEMENT

Removal Procedure

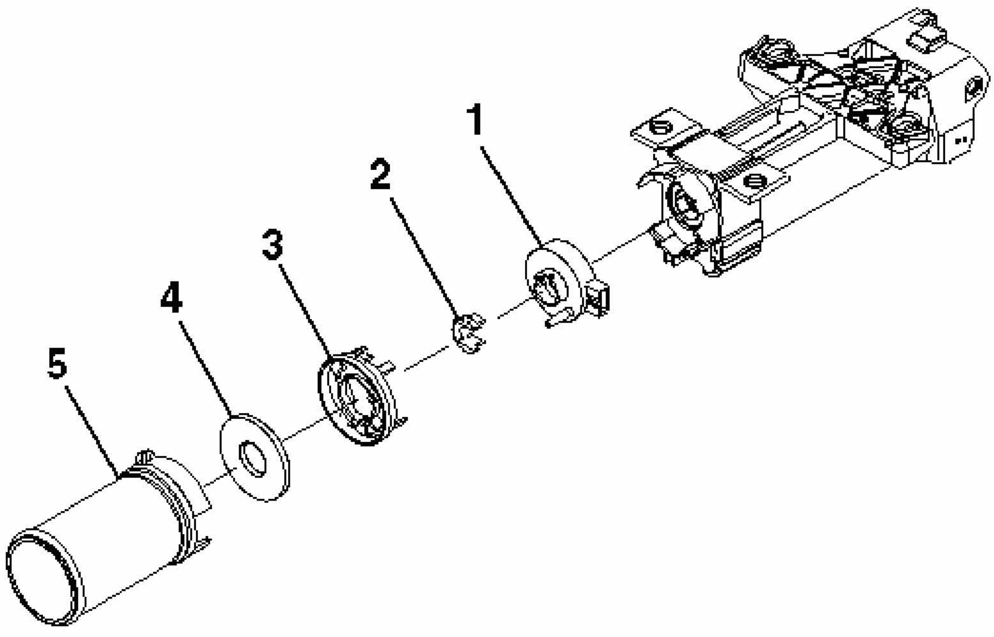


Fig. 88: Identifying Lower Steering Column Components
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SIR Caution in Cautions and Notices.

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.
2. Remove the steering column from the vehicle. Refer to **Steering Column Replacement**.
3. Remove the following from the steering shaft:
    1. The boot seal (5)
    2. The steering shaft seal (4)
    3. The sensor retainer (3)
    4. The sensor locator (2)
4. Remove the steering wheel position sensor (1). Refer to **Steering Wheel Position Sensor Centering**.

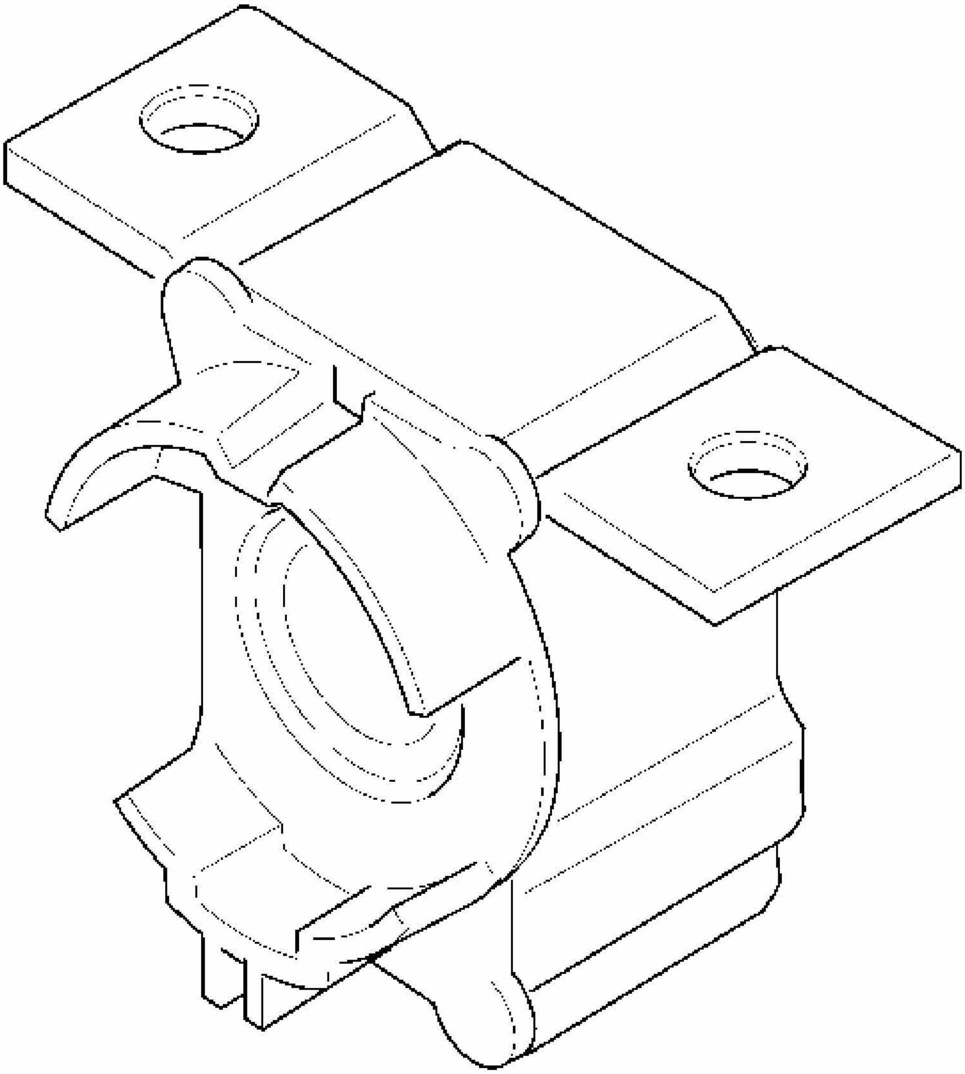


Fig. 89: View Of Lower Bearing Adapter
Courtesy of GENERAL MOTORS CORP.

5. Remove the adapter and bearing assembly from the steering jacket assembly.

Installation Procedure

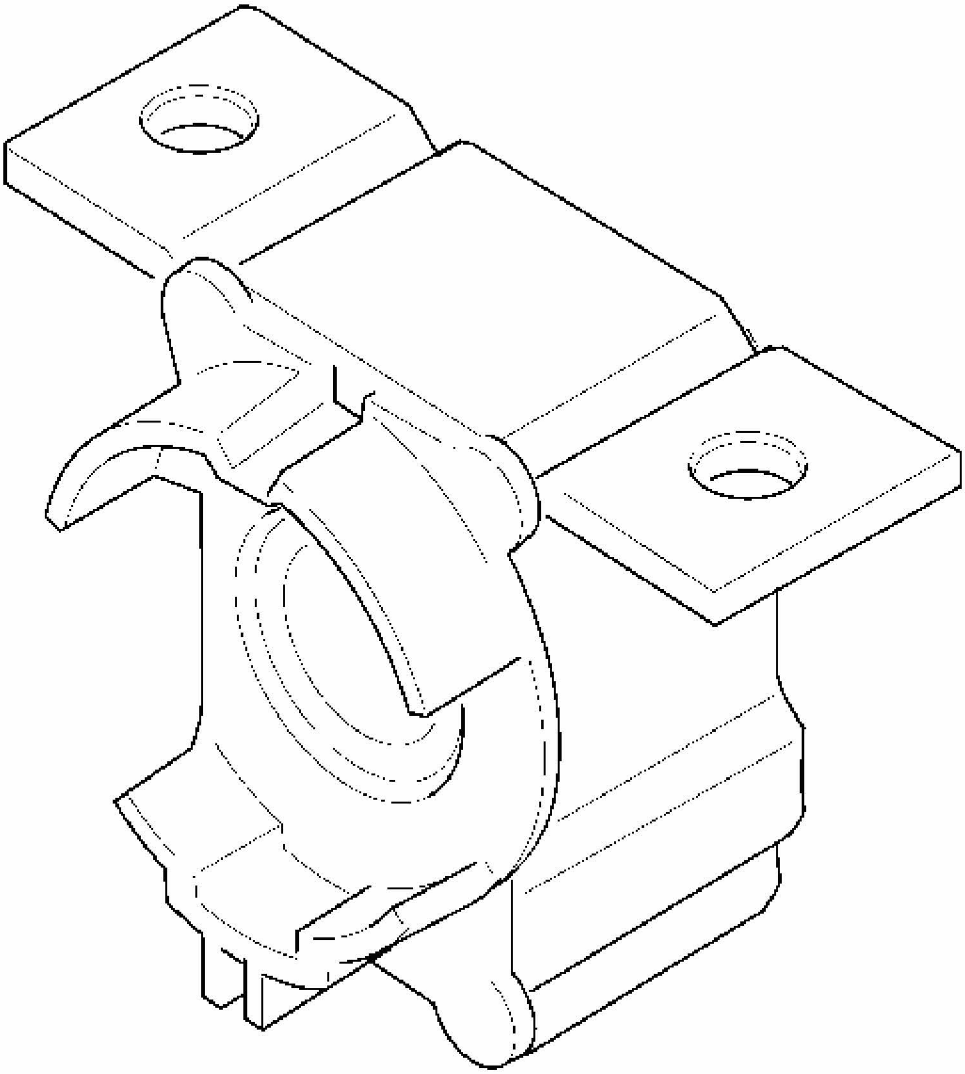


Fig. 90: View Of Lower Bearing Adapter
Courtesy of GENERAL MOTORS CORP.

1. Install the adapter and bearing assembly to the steering jacket assembly.

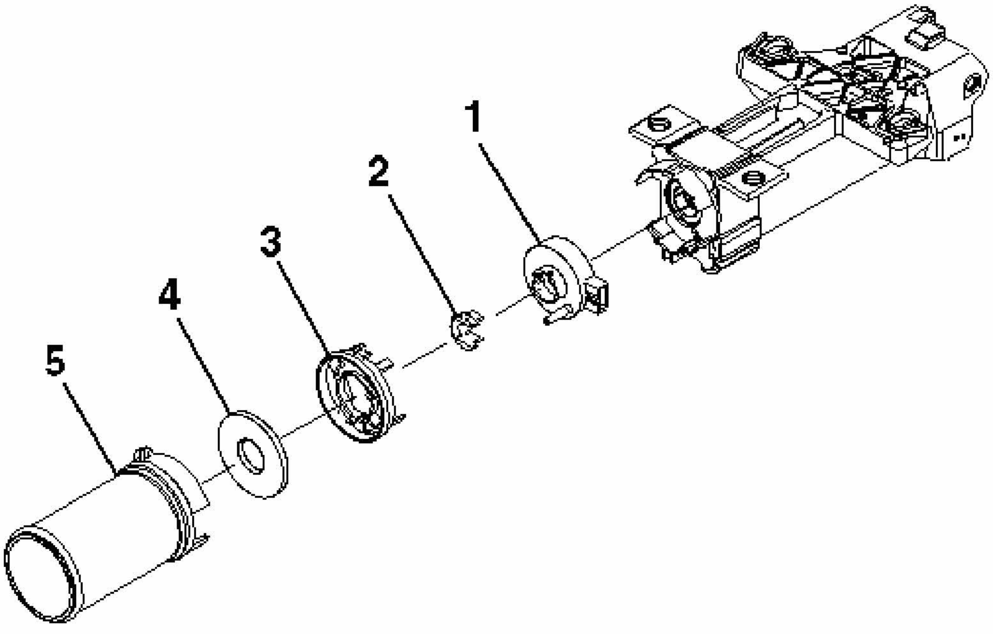


Fig. 91: Identifying Lower Steering Column Components
Courtesy of GENERAL MOTORS CORP.

2. Install the following onto the steering shaft:
    1. The steering wheel position sensor (1) Refer to **Steering Wheel Position Sensor Centering**.
    2. The sensor locator (2)
    3. The sensor retainer (3)
    4. The steering shaft seal (4)
    5. The boot seal (5)
3. Install the steering column into the vehicle. Refer to **Steering Column Replacement**.
4. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

STEERING WHEEL POSITION SENSOR CENTERING

Removal Procedure

IMPORTANT: Identify the type of steering wheel position sensor from the illustrations shown BEFORE removing the sensor from the steering column. Once you have identified the steering wheel position sensor, follow the instructions listed in the removal

procedure.

1. Verify the type of steering wheel position sensor.

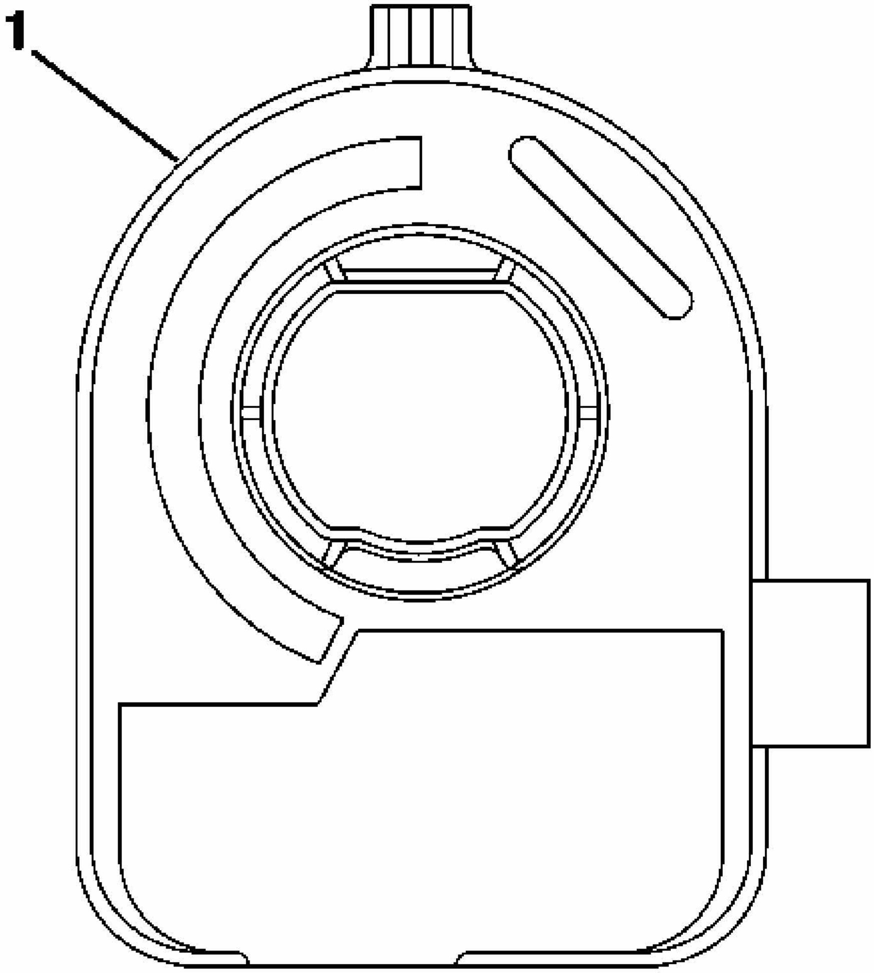


Fig. 92: Front Of The Sensor Connector Will Be On The Right
Courtesy of GENERAL MOTORS CORP.

2. From the technicians point of view, the FRONT of the sensor (1) connector will be on the right.

IMPORTANT: If reusing the existing sensor, you do not have to align the sensor before removal. Centering is not required when it is time to reinstall.

3. Remove the connector from the sensor.
4. Remove the sensor (1) from the adapter and bearing assembly.
5. To install the sensor, proceed to step 1 in the installation section.

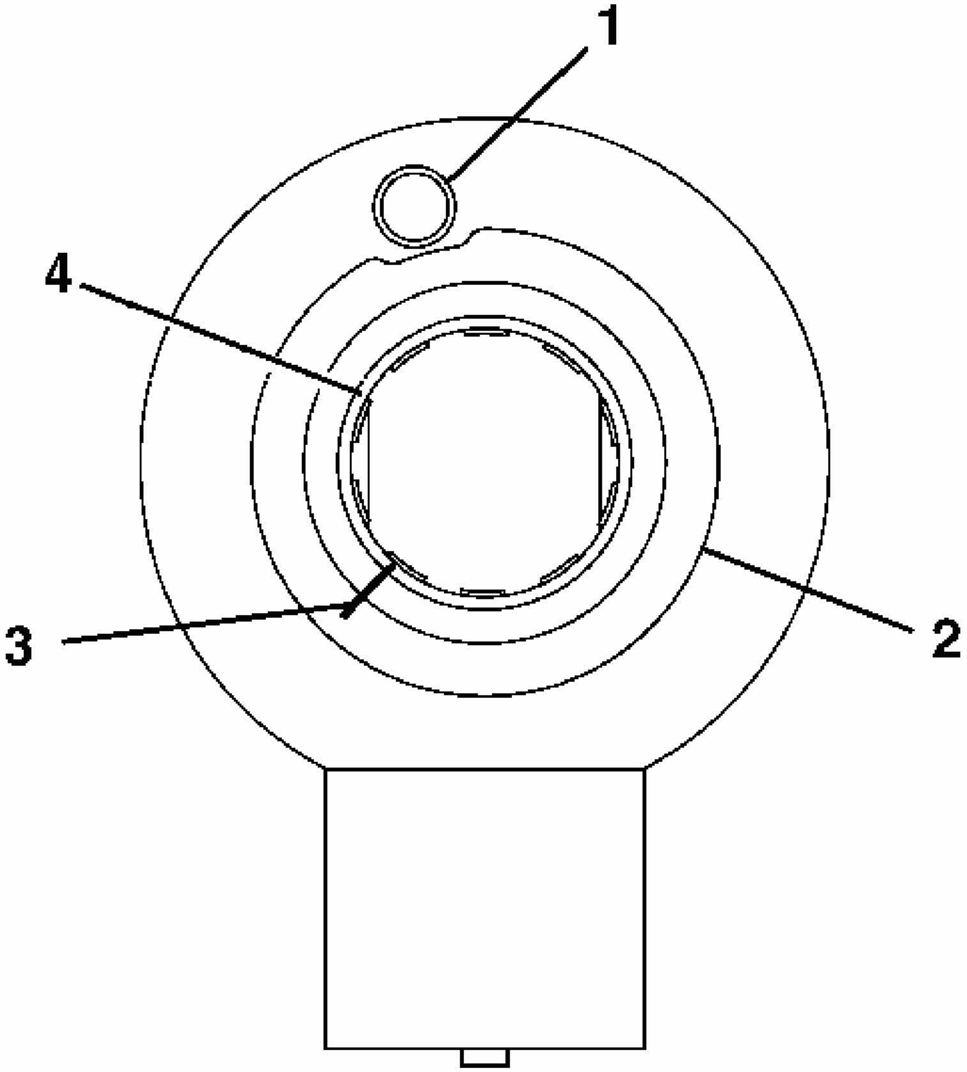


Fig. 93: Steering Wheel Position Sensor Foam Ring, Pin Hole And Rotor Flange Cuff
Courtesy of GENERAL MOTORS CORP.

6. From the technicians point of view, the FRONT of the sensor will have:
    - A foam ring (2)

- A pin hole (1) for centering the pin. Note the location of the pin hole.
- A flush rotor flange cuff (4)

IMPORTANT: If reusing the existing sensor, you must make an alignment mark on the rotor flange cuff (3) before removing the sensor. Failure to do so will cause misalignment when installing the sensor. A new sensor will be required if misaligned.

7. Make an alignment mark on the flush rotor flange cuff (3).
8. Remove the connector from the sensor.
9. Remove the sensor from the adapter and bearing assembly.
10. To install the sensor, proceed to step 5 in the installation procedure.

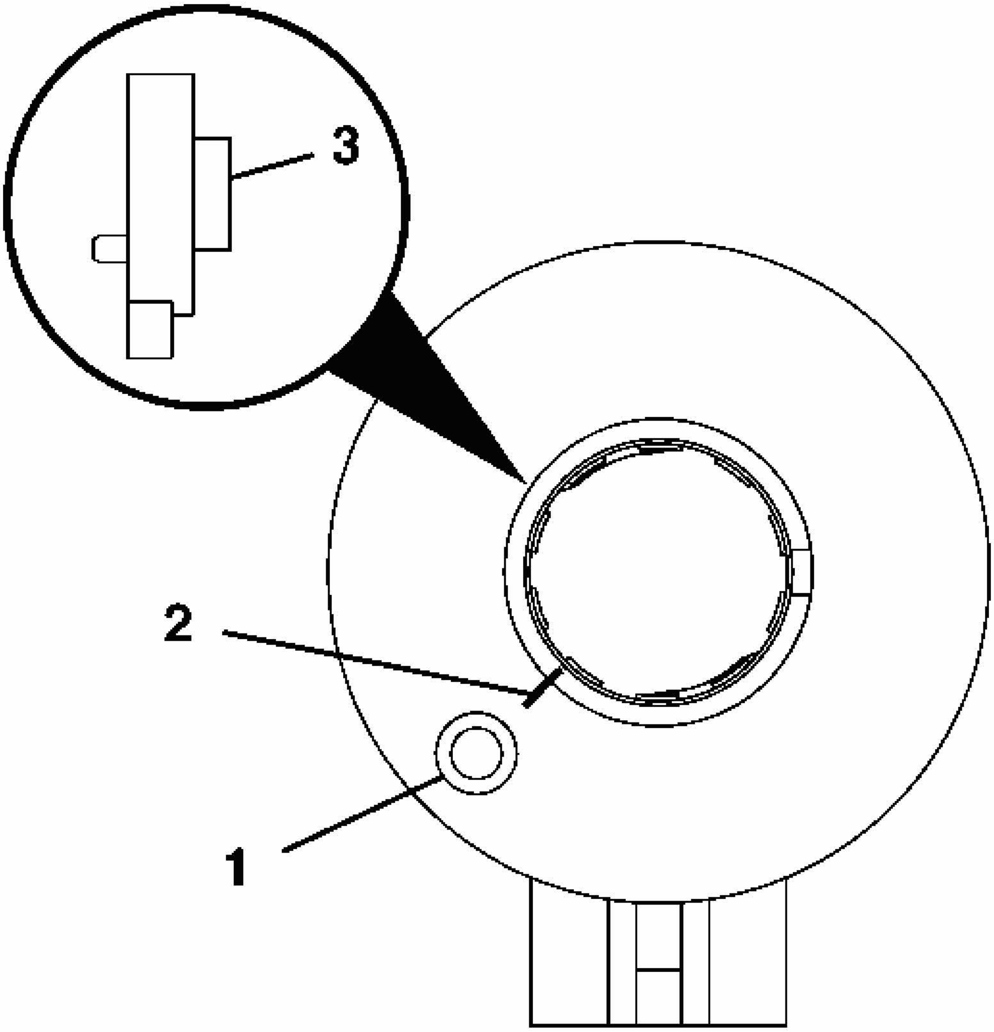


Fig. 94: Steering Wheel Position Sensor Alignment Mark
Courtesy of GENERAL MOTORS CORP.

11. From the technicians point of view, the FRONT of the sensor will have:
    - A raised rotor flange cuff (3)
    - An alignment mark (2) on the rotor flange cuff (3) for installation
    - A pin hole (1) for the centering pin. Note the location of the pin hole.
12. Remove the connector from the sensor.
13. Remove the sensor from the adapter and bearing assembly.
14. To install the sensor, proceed to step 9 in the installation procedure.

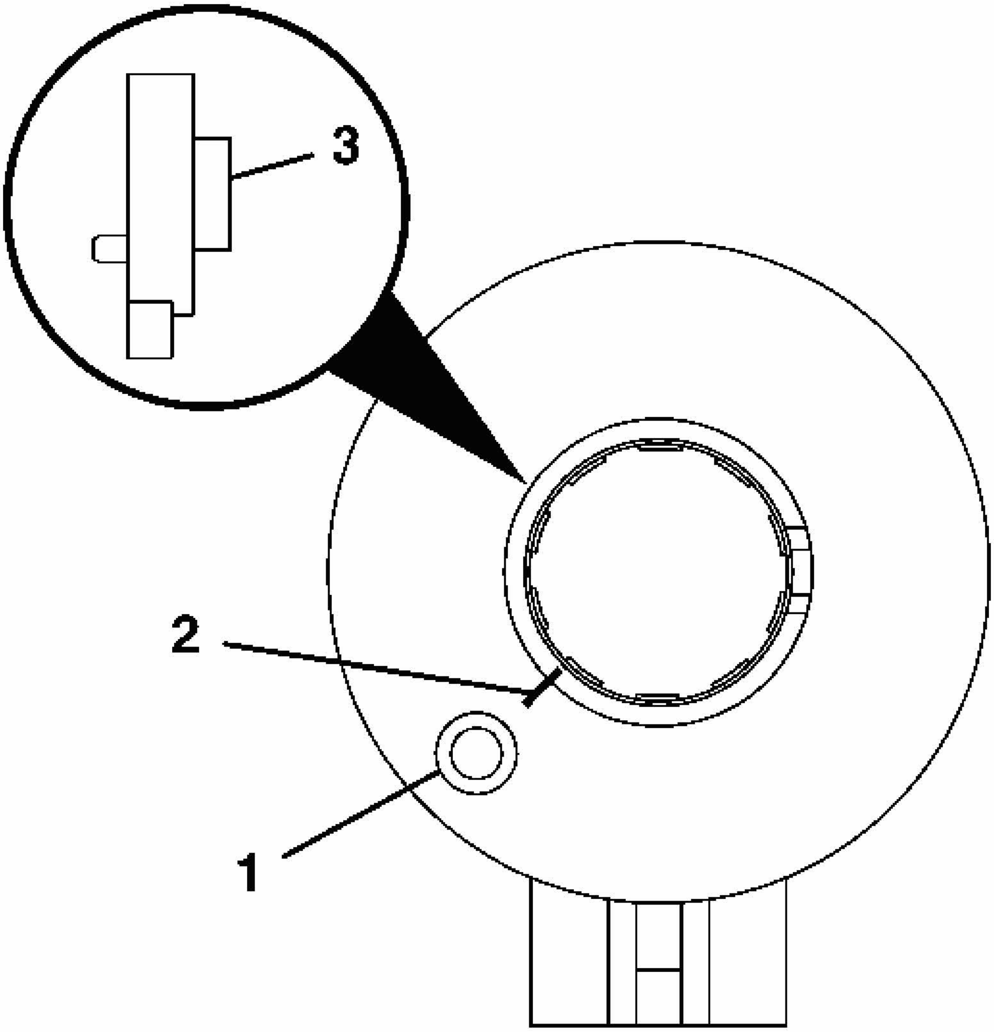


Fig. 95: Steering Wheel Position Sensor Alignment Mark
Courtesy of GENERAL MOTORS CORP.

15. From the technicians point of view, the FRONT of the sensor will have:
    - A raised rotor flange cuff (3)
    - An alignment mark (2) on the rotor flange cuff (3) for installation
    - A pin hole (1) for the centering pin. Note location of the pin hole.
    - A sensor clip in FRONT of the sensor
16. Remove the connector from the sensor.
17. Remove the sensor clip from the sensor.
18. Remove the sensor from the adapter and bearing assembly.

19. To install the sensor, proceed to step 13 in the installation procedure.

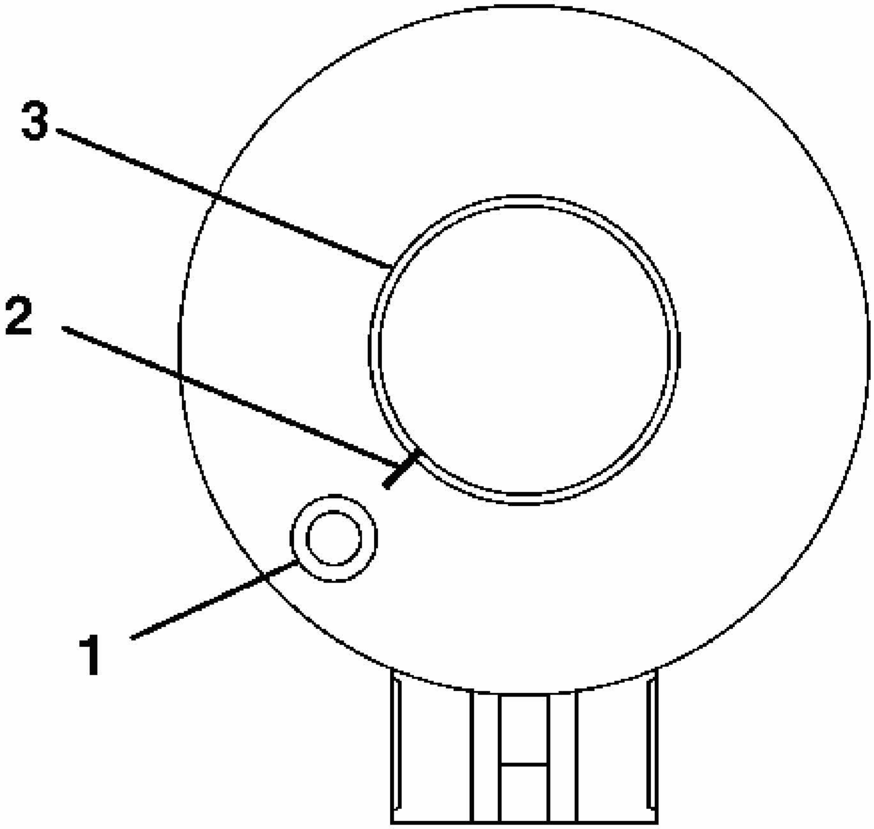


Fig. 96: Steering Wheel Position Sensor Rotor Flange Cuff, Centering Pin Hole And Alignment Mark
Courtesy of GENERAL MOTORS CORP.

20. From the technicians point of view, the FRONT of the sensor will have:
    - A flush rotor flange cuff (3)
    - A pin hole (1) for the centering pin. Note the location of the pin hole.
    - An alignment mark (2) on the flush rotor flange cuff (3) for installation
21. Remove the connector from the sensor.
22. Remove the sensor from the adapter and bearing assembly.
23. To install the sensor, proceed to step 17 in the installation procedure.

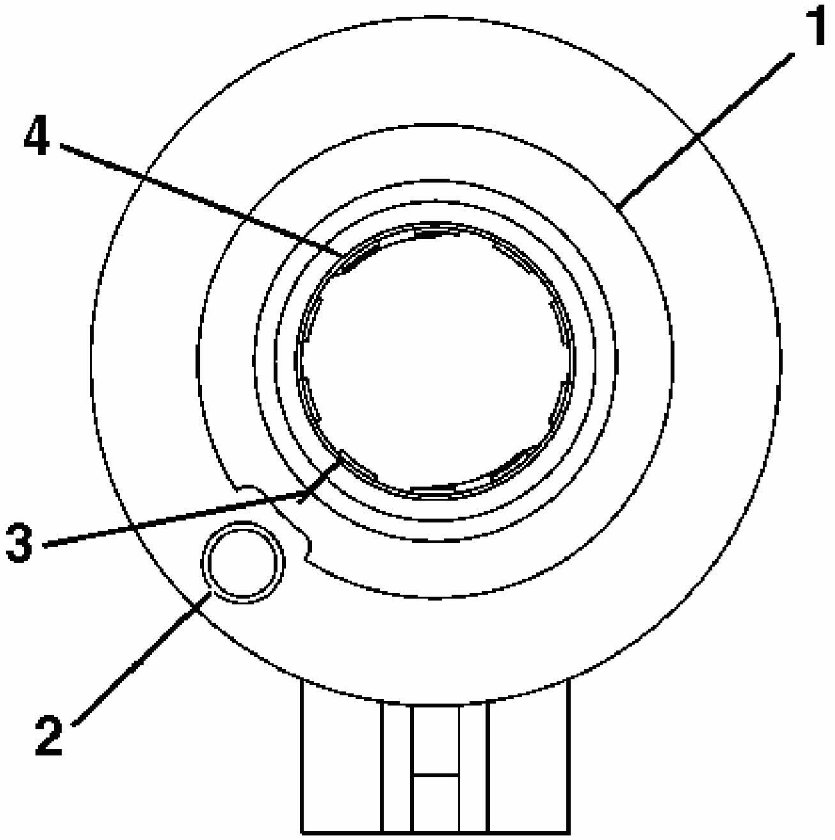


Fig. 97: Steering Wheel Position Sensor Rotor Flange Cuff, Centering Pin Hole, Alignment Mark And Foam Ring
Courtesy of GENERAL MOTORS CORP.

24. From the technicians point of view, the FRONT of the sensor will have:
    - A flush rotor flange cuff (4)
    - A pin hole (2) for the centering pin-Note the location of the pin hole.
    - An alignment mark (3) on the flush rotor flange cuff (4) for installation
    - A foam ring (1)
25. Remove the connector from the sensor.
26. Remove the sensor from the adapter and bearing assembly.
27. To install the sensor, proceed to step 21 in the installation procedure.

Installation Procedure

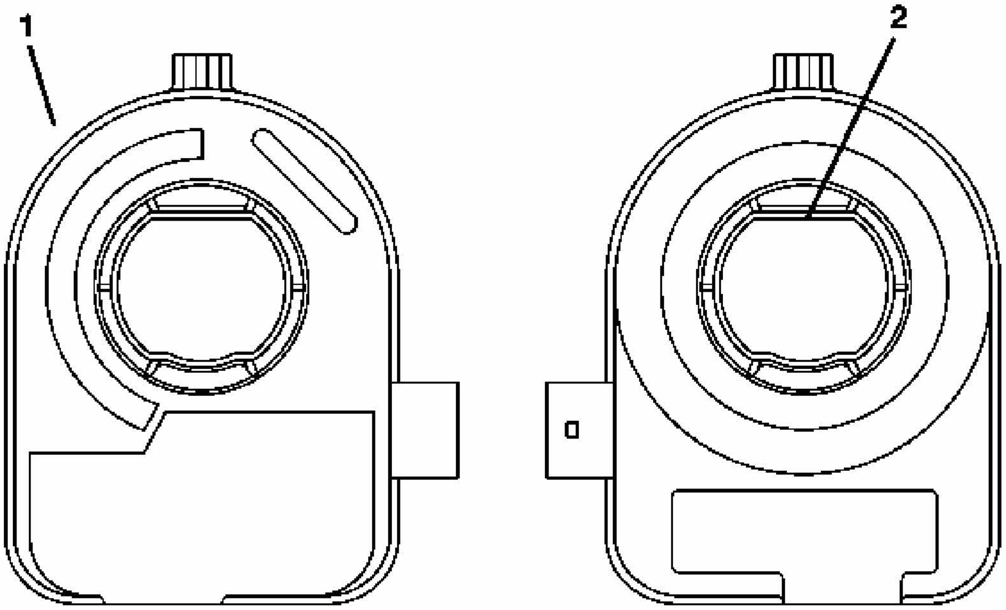


Fig. 98: Front And Back Views Of Steering Wheel Position Sensor
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If reusing the existing sensor, no centering of the sensor is required.

1. If installing a new sensor, it will come with a pin installed in the sensor. Do not remove the pin until the sensor is seated.
2. From the technicians point of view, the FRONT of the sensor (1) connector will be on your right.

   From the technicians point of view, the BACK of the sensor (2) connector will be on your left.

3. Looking at the FRONT of the sensor, align the sensor with the steering shaft and install into the adapter and bearing assembly.
4. Install the connector to the sensor.

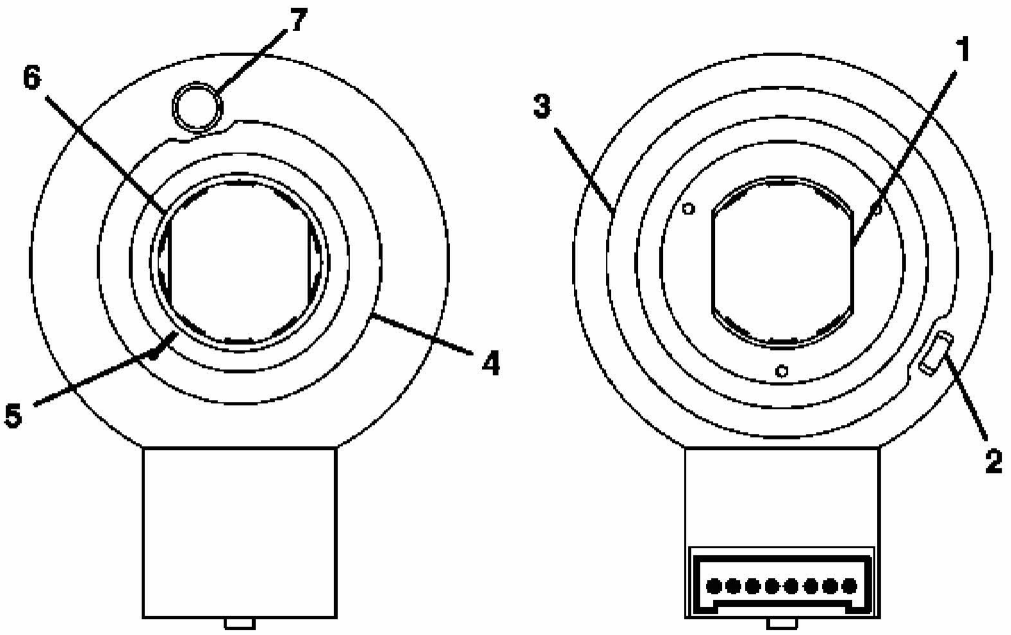


Fig. 99: Steering Wheel Position Sensor Identification Points
Courtesy of GENERAL MOTORS CORP.

5. From the technicians point of view, the FRONT of the sensor will have:
    - A foam ring (4)
    - A pin hole (7) for the centering pin-Note the location of the pin hole.
    - A flushed rotor flange cuff (6)
    - An alignment mark (5) for installation
6. From the technicians point of view, the BACK of the sensor will have:
    - Double D flats (1)
    - A foam ring (3)
    - An alignment tab (2) for installing into the adapter and bearing assembly
    - A view of the inside of the connector

IMPORTANT: If reusing the existing sensor, you must align the marks on the flush rotor flange cuff before installation. The alignment mark must stay aligned until the sensor is seated into the adapter and bearing assembly.
If installing a new sensor, it will come with a pin installed in the sensor. Do not remove the pin until the sensor is

seated. If the new sensor did not come with a pin installed, you must reorder a new sensor.

7. Looking at the FRONT of the sensor, align the sensor with the steering shaft and install into the adapter and bearing assembly.
8. Install the connector to the sensor.

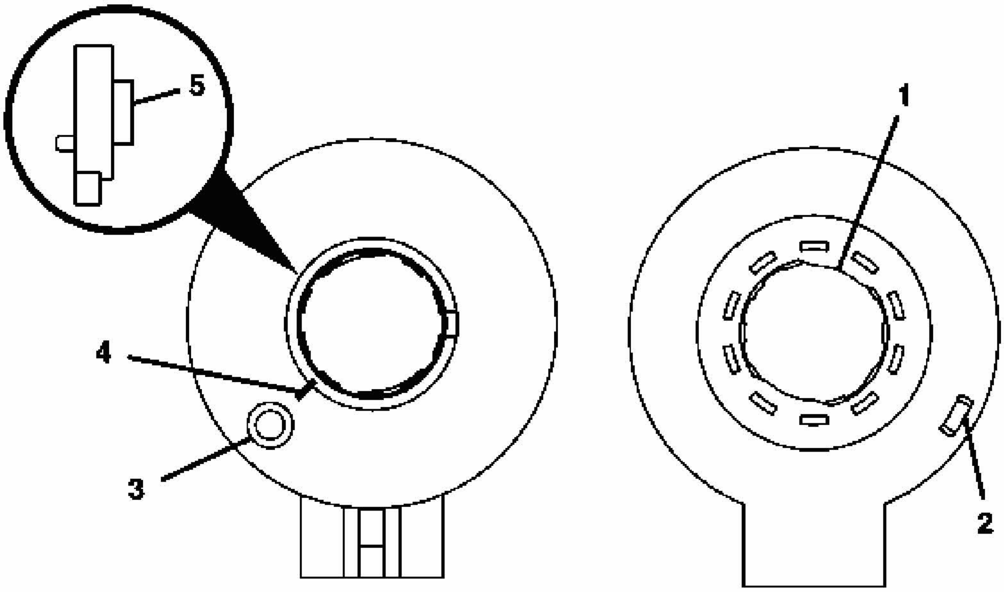


Fig. 100: Steering Wheel Position Sensor Front View
Courtesy of GENERAL MOTORS CORP.

9. From the technicians point of view, the FRONT of the sensor will have:
    - A pin hole (3) for the centering pin-Note location of the pin hole.
    - A raised rotor flange cuff (5)
    - An alignment mark (4) for installation
10. From the technicians point of view, the BACK of the sensor will have:
    - Double D flats (1)
    - An alignment tab (2) for installing into the adapter and bearing assembly

IMPORTANT: If reusing the existing sensor, you must align the marks on the raised rotor flange cuff before installation. The alignment mark must stay aligned until the sensor is

seated into the adapter and bearing assembly. If installing a new sensor, it will come with a pin installed in the sensor. Do not remove the pin until the sensor is seated. If the new sensor did not come with a pin installed, you must reorder a new sensor.

11. Looking at the FRONT of the sensor, align the sensor with the steering shaft and install into the adapter and bearing assembly.
12. Install the connector to the sensor.

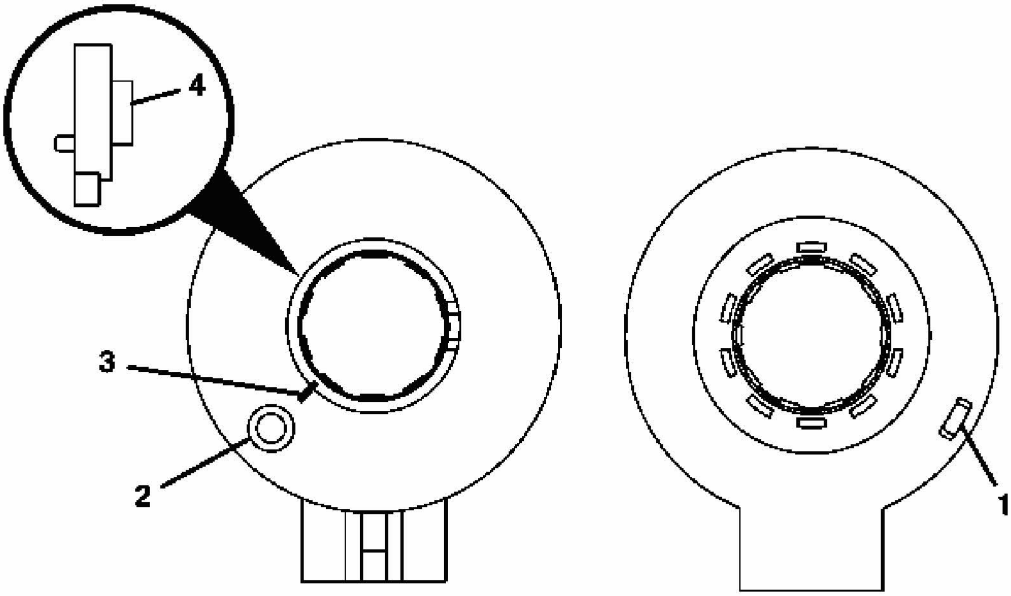


Fig. 101: Steering Wheel Position Sensor Centering Pin Hole, Rotor Flange Cuff And Alignment Mark
Courtesy of GENERAL MOTORS CORP.

13. From the technicians point of view, the FRONT of the sensor will have:
    - A pin hole (2) for the centering pin- Note the location of the pin hole.
    - A raised rotor flange cuff (4)
    - An alignment mark (3) for installation
14. From the technicians point of view, the BACK of the sensor will have an alignment tab (1) for installation. This sensor does not have double D flats.

IMPORTANT: If reusing the existing sensor, you must align the marks on

the raised rotor flange cuff before installation. The alignment mark must stay aligned until the sensor is seated into the adapter and bearing assembly.
If installing a new sensor, it will come with a pin installed in the sensor. Do not remove the pin until the sensor is seated. If the new sensor did not come with a pin installed, you must reorder a new sensor.

15. Looking at the FRONT of the sensor, align the sensor with the steering shaft and install into the adapter and bearing assembly.
16. Install the connector to the sensor.

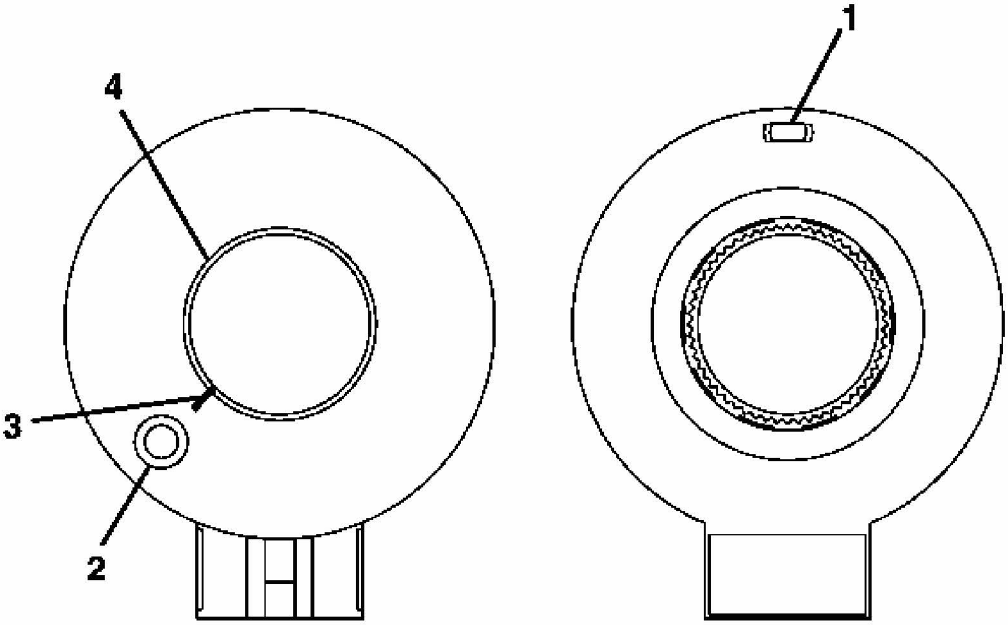


Fig. 102: Steering Wheel Position Sensor Center Pin, Rotor Flange Cuff And Installation Alignment Mark
Courtesy of GENERAL MOTORS CORP.

17. From the technicians point of view, the FRONT of the sensor will have:
    - A pin hole (2) for the centering pin-Note the location of the pin hole.
    - A flush rotor flange cuff (4)
    - An alignment mark (3) for installation
18. From the technicians point of view, the BACK of the sensor will have an alignment tab

(1) for installation. This sensor does not have double D flats.

IMPORTANT: If reusing the existing sensor, you must align the marks on the flush rotor flange cuff before installation. The alignment mark must stay aligned until the sensor is seated into the adapter and bearing assembly.
If installing a new sensor, it will come with a pin installed in the sensor. Do not remove the pin until the sensor is seated. If the new sensor did not come with a pin installed, you must reorder a new sensor.

19. Looking at the FRONT of the sensor, align the sensor with the steering shaft and install into the adapter and bearing assembly.
20. Install the connector to the sensor.

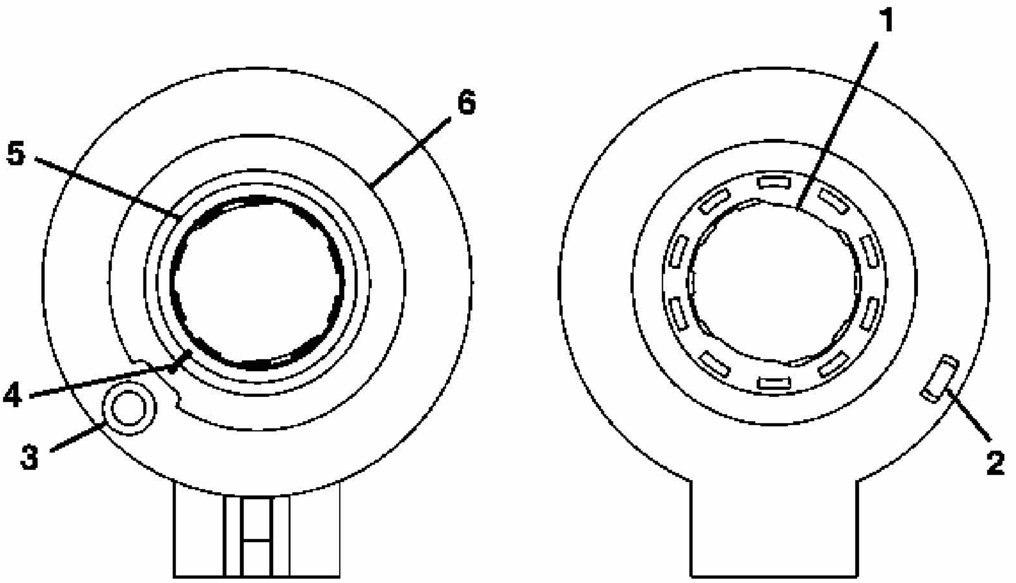


Fig. 103: Steering Wheel Position Sensor Double D Flats
Courtesy of GENERAL MOTORS CORP.

21. From the technicians point of view, the FRONT of the sensor will have:
    - A pin hole (3) for the centering pin-Note location of the pin hole.
    - A flush rotor flange cuff (5)
    - An alignment mark (4) for installation
    - A foam ring (6)

22. From the technicians point of view, the BACK of the sensor will have:
    - Double D flats (1)
    - An alignment tab (2) for installing into the adapter and bearing assembly

IMPORTANT: If reusing the existing sensor, you must align the marks on the flush rotor flange cuff before installation. The alignment mark must stay aligned until the sensor is seated into the adapter and bearing assembly.
If installing a new sensor, it will come with a pin installed in the sensor. Do not remove the pin until the sensor is seated. If the new sensor did not come with a pin installed, you must reorder a new sensor.

23. Looking at the FRONT of the sensor, align the sensor with the steering shaft and install into the adapter and bearing assembly.
24. Install the connector to the sensor.

STEERING SHAFT, LOWER BEARING, AND JACKET REPLACEMENT

Tools Required

- **J 21854-01** Pivot Pin Remover. See **Special Tools**.
- **J 41688** Centering Sphere Installer Tool. See **Special Tools**.

Removal Procedure

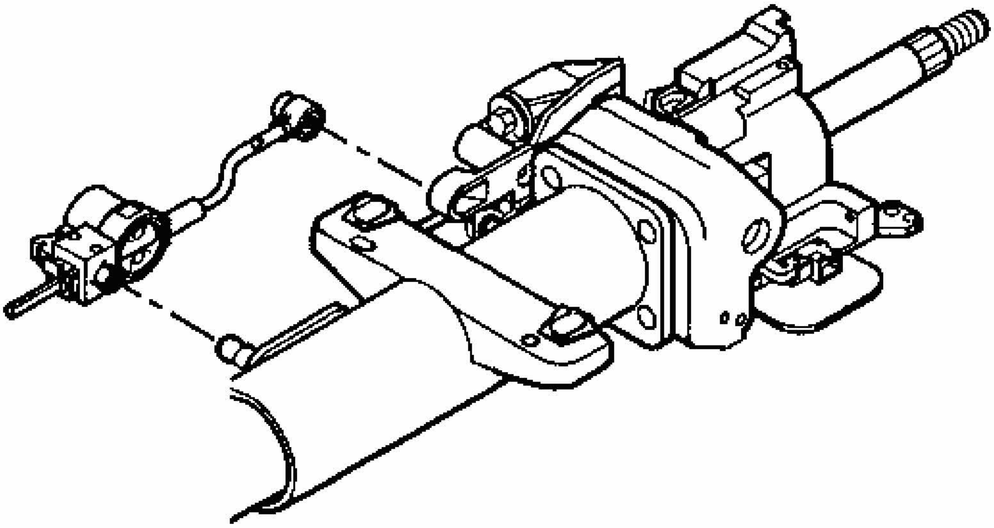


Fig. 104: Automatic Transmission Shift Lock Control
Courtesy of GENERAL MOTORS CORP.

1. Remove the ignition lock cylinder case. Refer to **Ignition Lock Cylinder Case Replacement**.
2. Remove the tilt spring assembly only. Refer to **Tilt Spring Replacement**.
3. Remove the automatic transmission shift lock control.
4. Use a screwdriver to pry the automatic transmission shift lock control from the steering column jacket assembly.

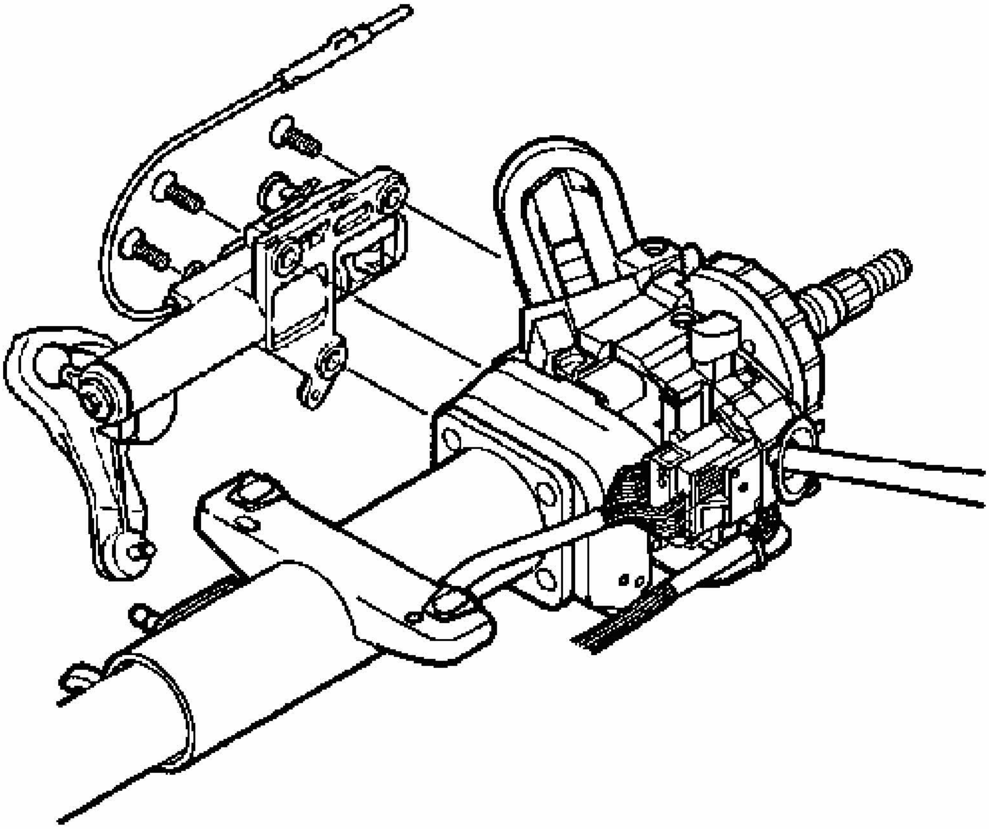


Fig. 105: View Of Linear Shift Assembly And Retaining Screws
Courtesy of GENERAL MOTORS CORP.

5. Remove the 3 flat-head 6-lobed socket tapping screws from the linear shift assembly.

   Remove the linear shift assembly.

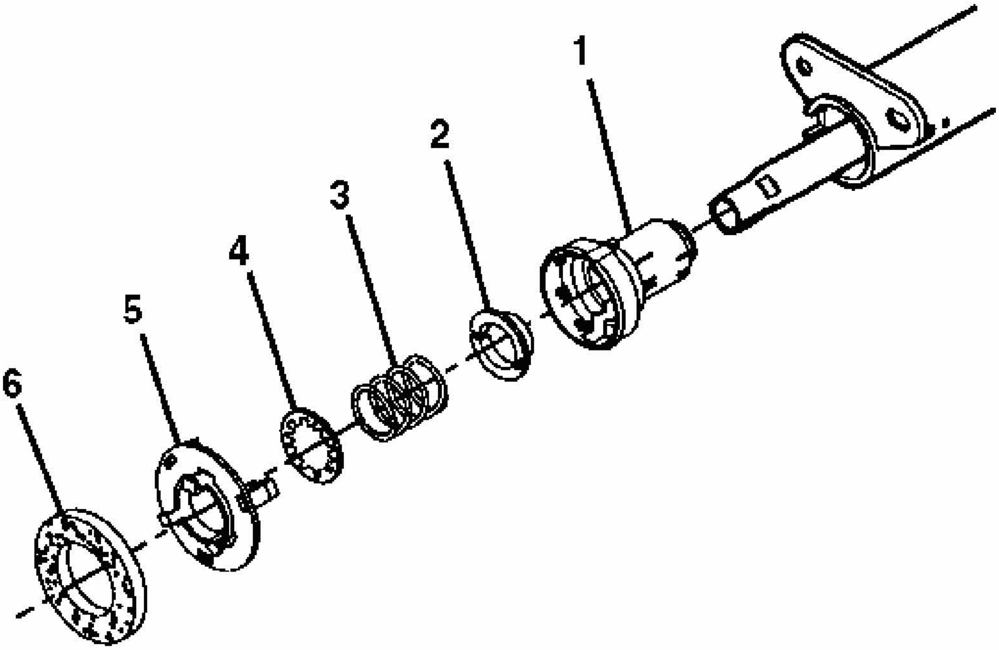


Fig. 106: Locating Steering Shaft Assembly Components
Courtesy of GENERAL MOTORS CORP.

6. Remove the following items from the steering shaft assembly:
    1. The steering shaft seal (6)
    2. The sensor retainer (5)
    3. The lower spring retainer (4)
    4. The lower bearing spring (3)
    5. The lower bearing seat (2)
    6. The adapter and bearing assembly (1)
7. Dispose of the lower spring retainer (4).

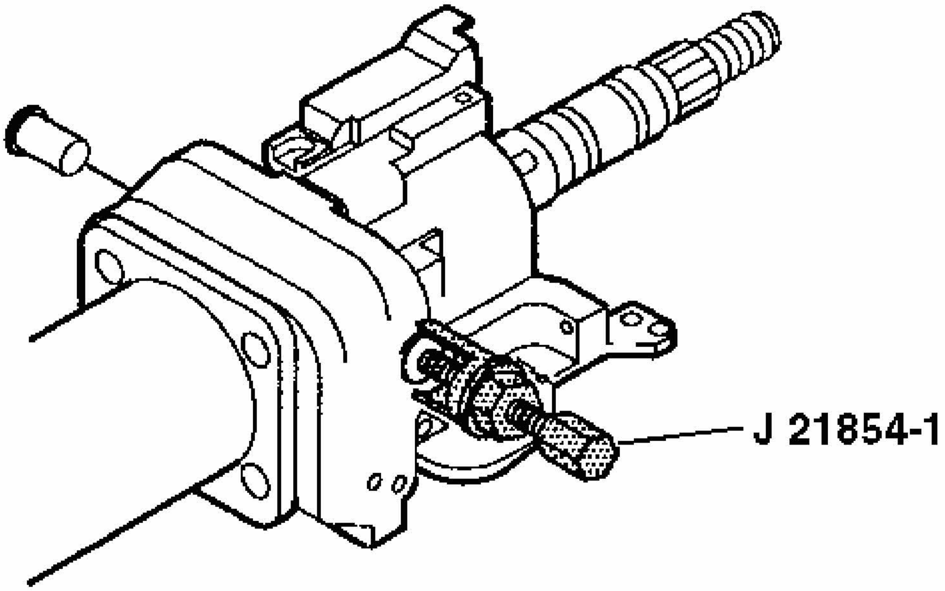


Fig. 107: Removing Pivot Pins From Steering Column Support Assembly
Courtesy of GENERAL MOTORS CORP.

8. Remove the 2 pivot pins from the steering column support assembly with**J 21854-01** . See **Special Tools**.

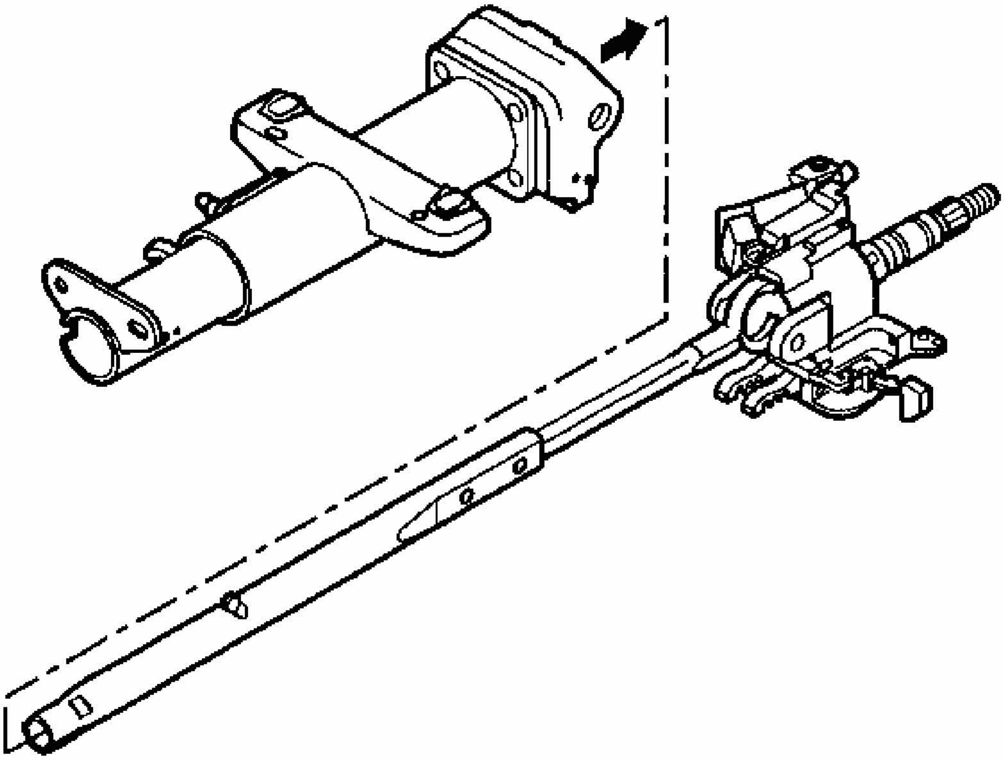


Fig. 108: Removing Upper Tilt Head Assembly With Steering Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

9. Install the tilt knob and tilt the column to the upright position.
10. Remove the upper tilt head assembly with the steering shaft assembly.

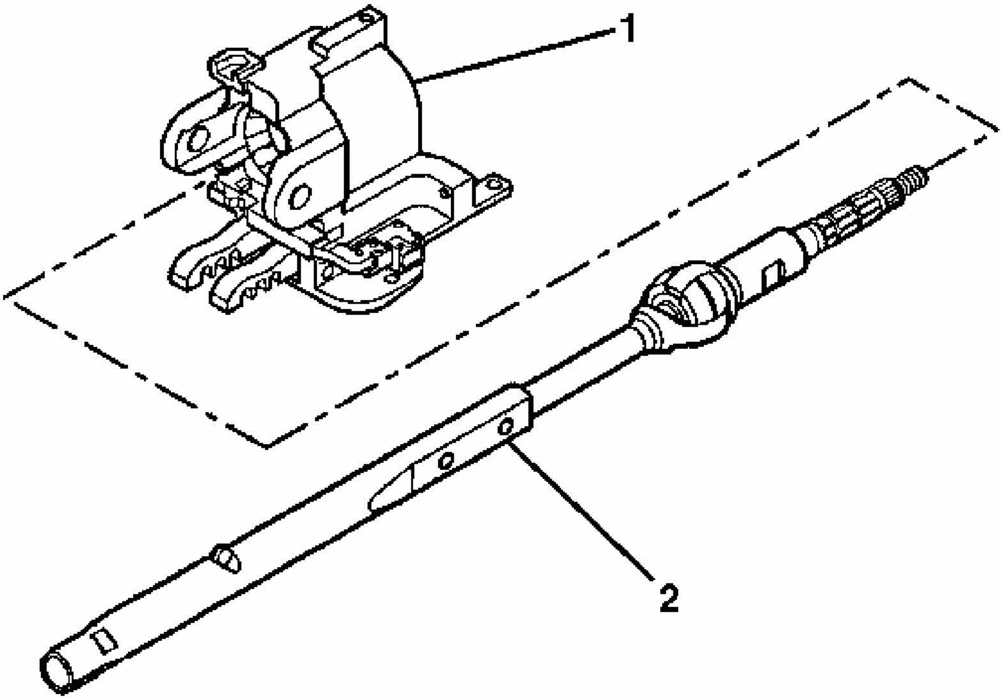


Fig. 109: Steering Shaft Assembly & Steering Column Tilt Head Housing Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Mark the race and upper shaft assembly and the lower shaft assembly to ensure proper assembly. Failure to assemble properly will cause the steering wheel to be turned 180 degrees.

11. Remove the steering shaft assembly (2) from the steering column tilt head assembly (1).

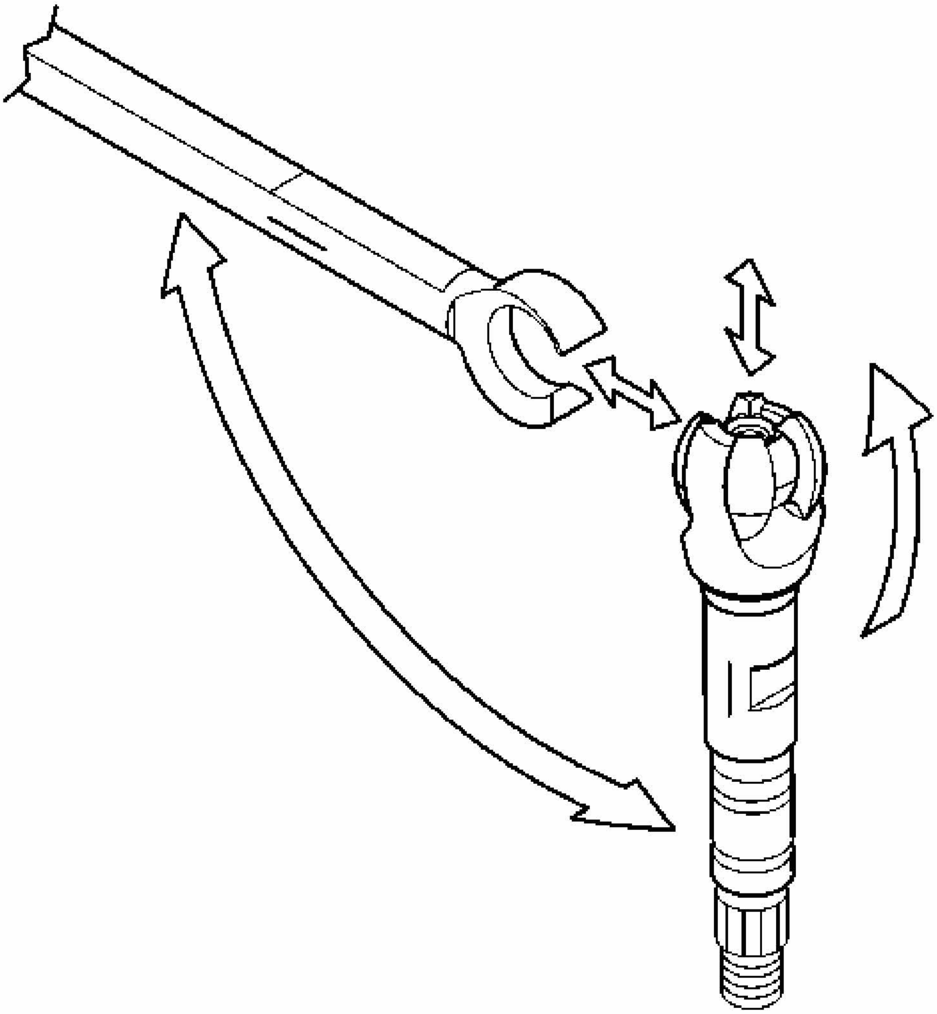


Fig. 110: Disengaging Race & Upper Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

12. Tilt the race and upper shaft assembly 90 degrees to the lower shaft assembly and disengage. If necessary, remove and discard the old centering sphere and spring.

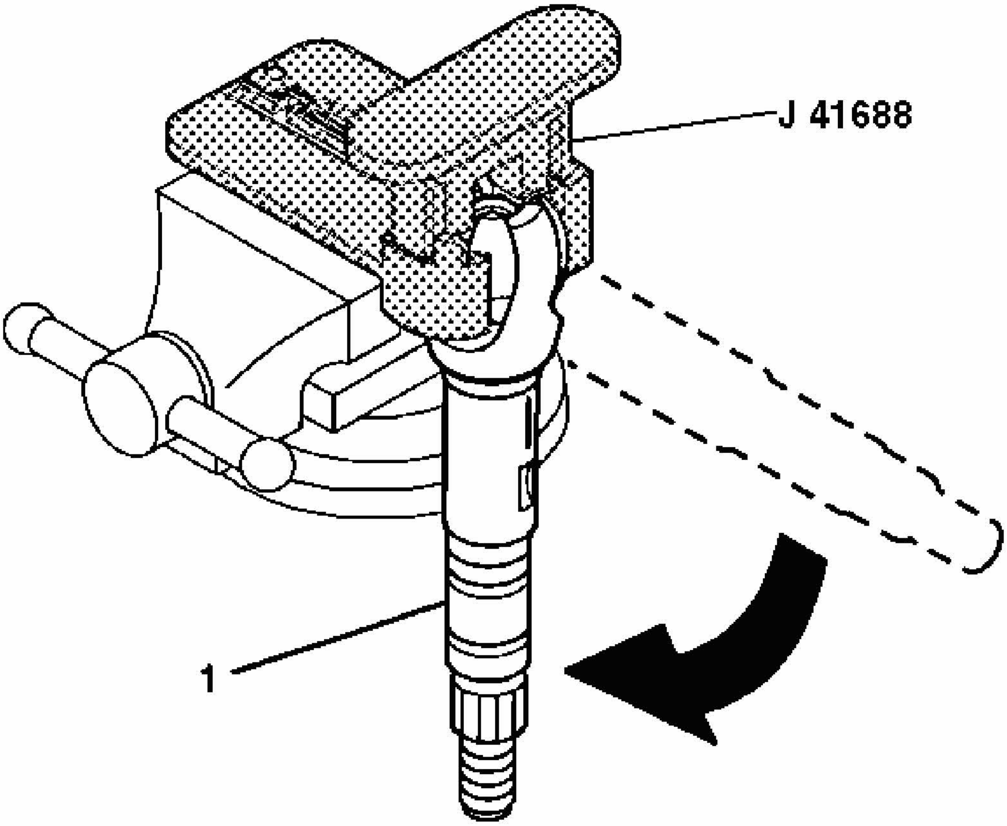


Fig. 111: Rotating Upper Shaft Assembly 90 Degrees
Courtesy of GENERAL MOTORS CORP.

13. Insert the race and upper shaft assembly (1) into **J 41688** . See **Special Tools**.
14. Rotate the driver 90 degrees in the counterclockwise direction in order to disengage the centering sphere.
15. Remove the shaft preload spring and the centering sphere from **J 41688** . See **Special Tools**.
16. If necessary, discard the old centering sphere and the old joint preload spring.

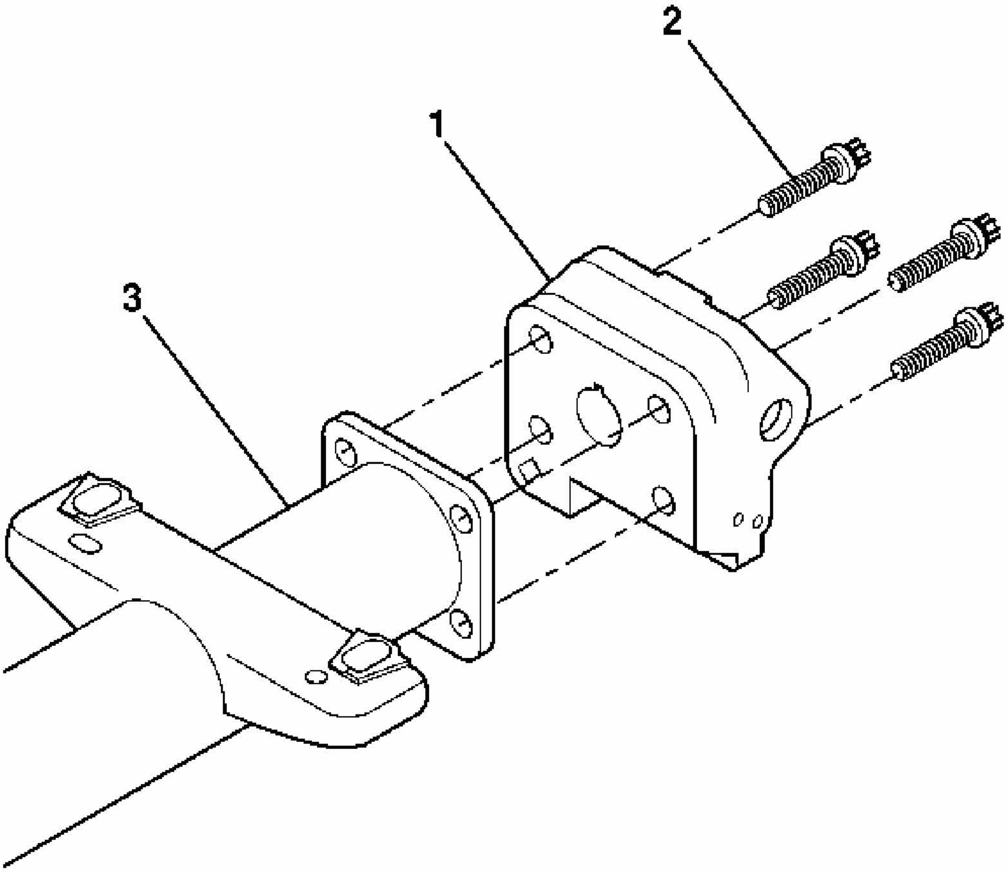


Fig. 112: View Of Steering Column Support Assembly, Steering Column Jacket Assembly & Screws
Courtesy of GENERAL MOTORS CORP.

17. Remove the 4 steering column support TORX® screws from the steering column support assembly (1).
18. Dispose of the 4 steering column support TORX® screws (2).
19. Remove the steering column support assembly (1) from the steering column jacket assembly (3).
20. Inspect the steering column for accident damage. Refer to **Steering Column Accident Damage Inspection**.

Installation Procedure

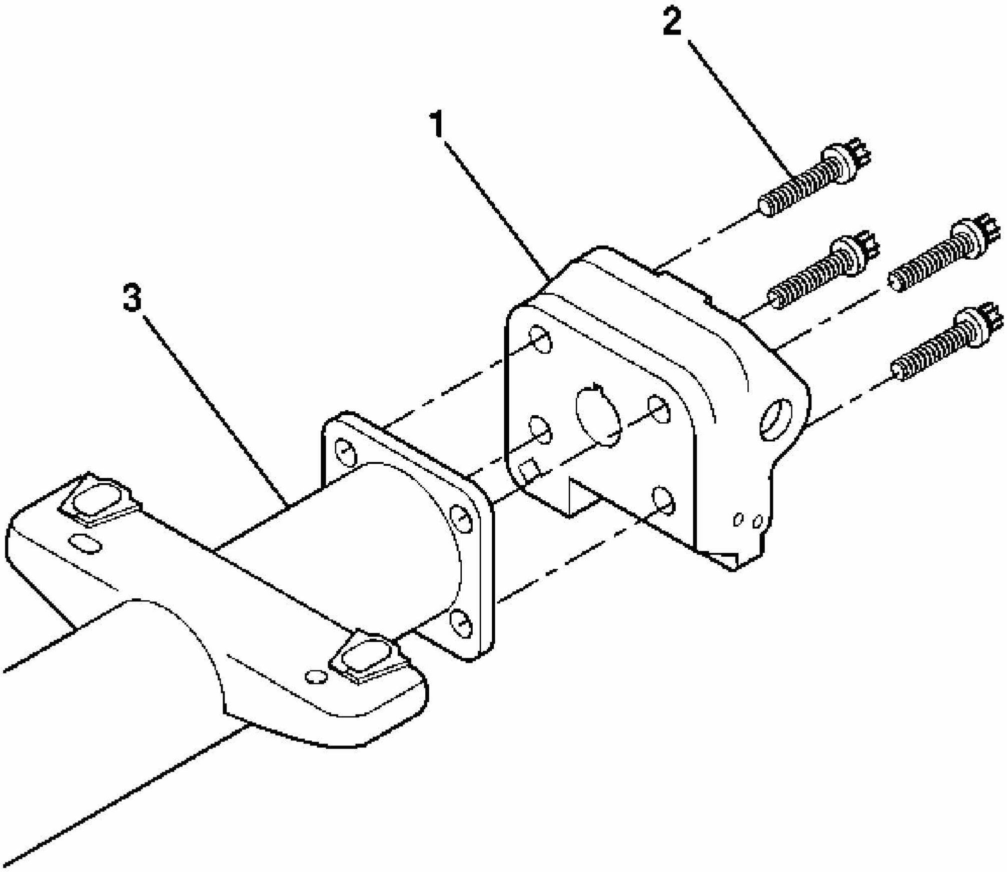


Fig. 113: View Of Steering Column Support Assembly, Steering Column Jacket Assembly & Screws
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Once the steering column support assembly has been staked 3 times, it must be replaced.

1. Install the steering column support assembly (1) to the steering column jacket assembly (3).

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the 4 new steering column support TORX® screws (2).

Tighten: Tighten the 4 steering column support TORX® screws to 17 N.m (13 lb ft).

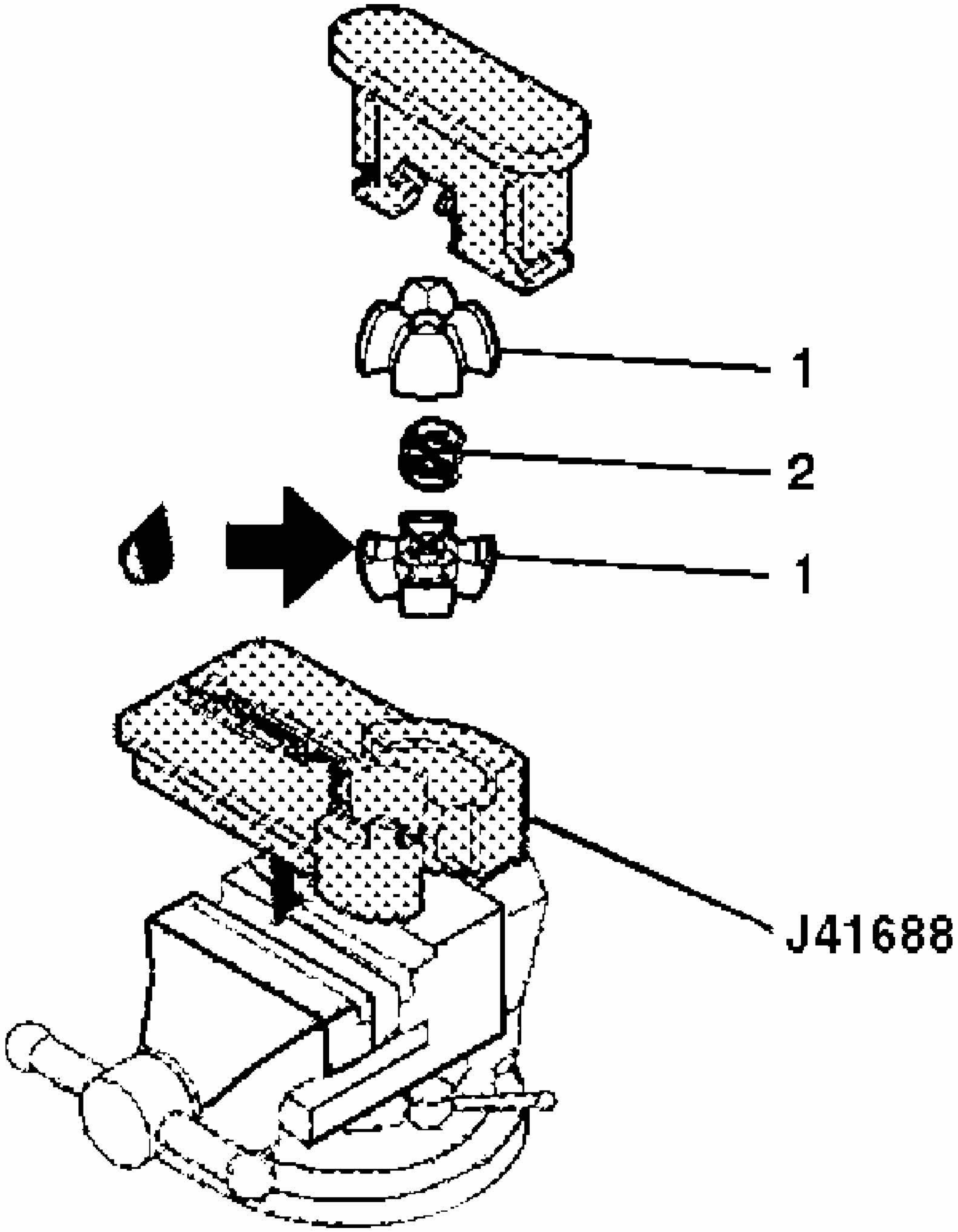


Fig. 114: Lubricating Centering Sphere
Courtesy of GENERAL MOTORS CORP.

3. Lubricate the centering sphere (1) with GM P/N 12345718 (Canadian P/N 10953516).
4. Install the centering sphere (1) and the joint preload spring (2) into **J 41688** . See **Special Tools**.

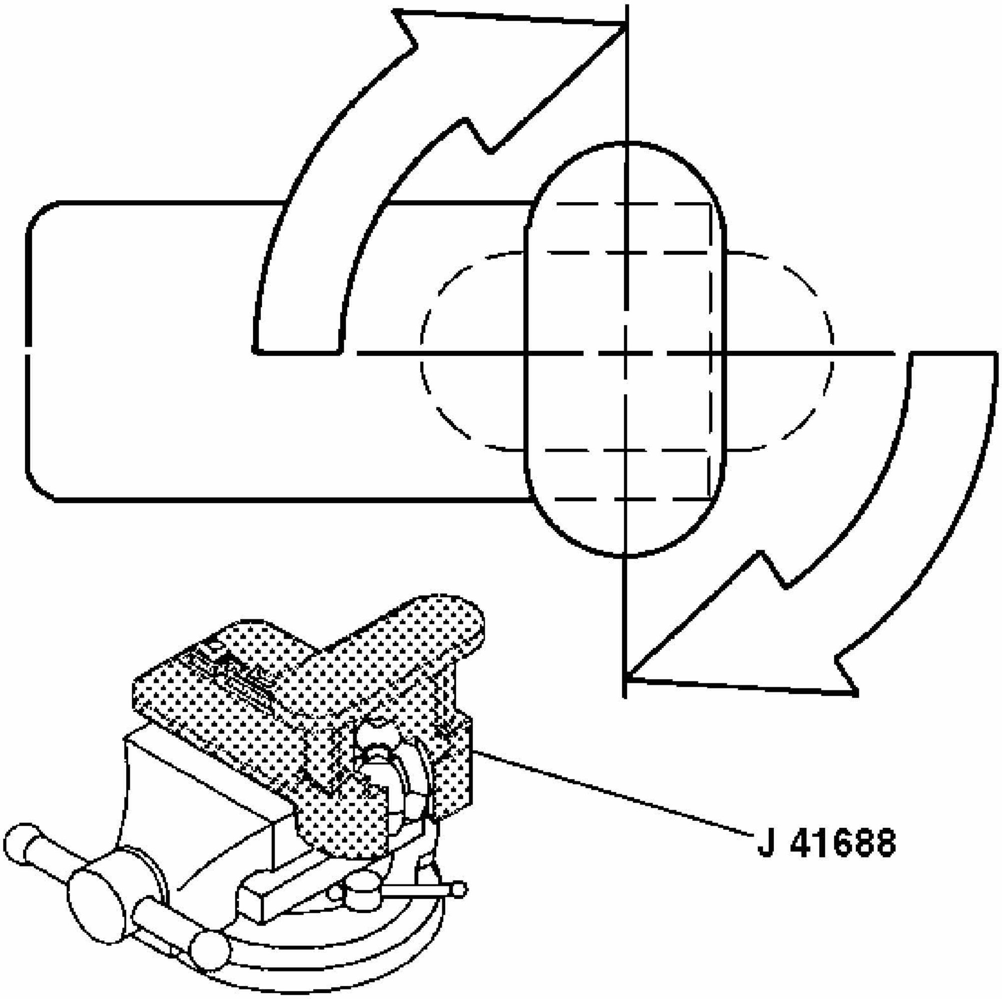


Fig. 115: Centering Sphere
Courtesy of GENERAL MOTORS CORP.

5. Compress the centering sphere and joint preload spring. Rotate the driver 90 degrees in the clockwise direction until the arms lock in place.

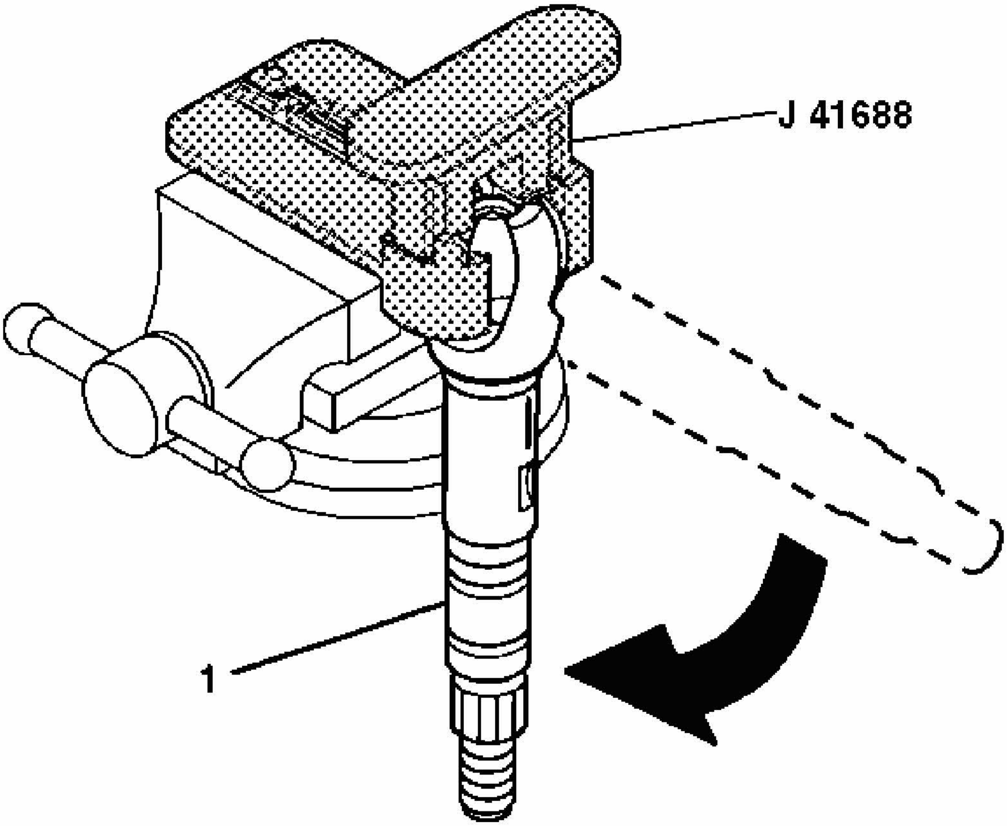


Fig. 116: Rotating Upper Shaft Assembly 90 Degrees
Courtesy of GENERAL MOTORS CORP.

6. Install the race and upper shaft assembly (1) into **J 41688** . See **Special Tools**.
7. Rotate the race and upper shaft assembly (1) 90 degrees.

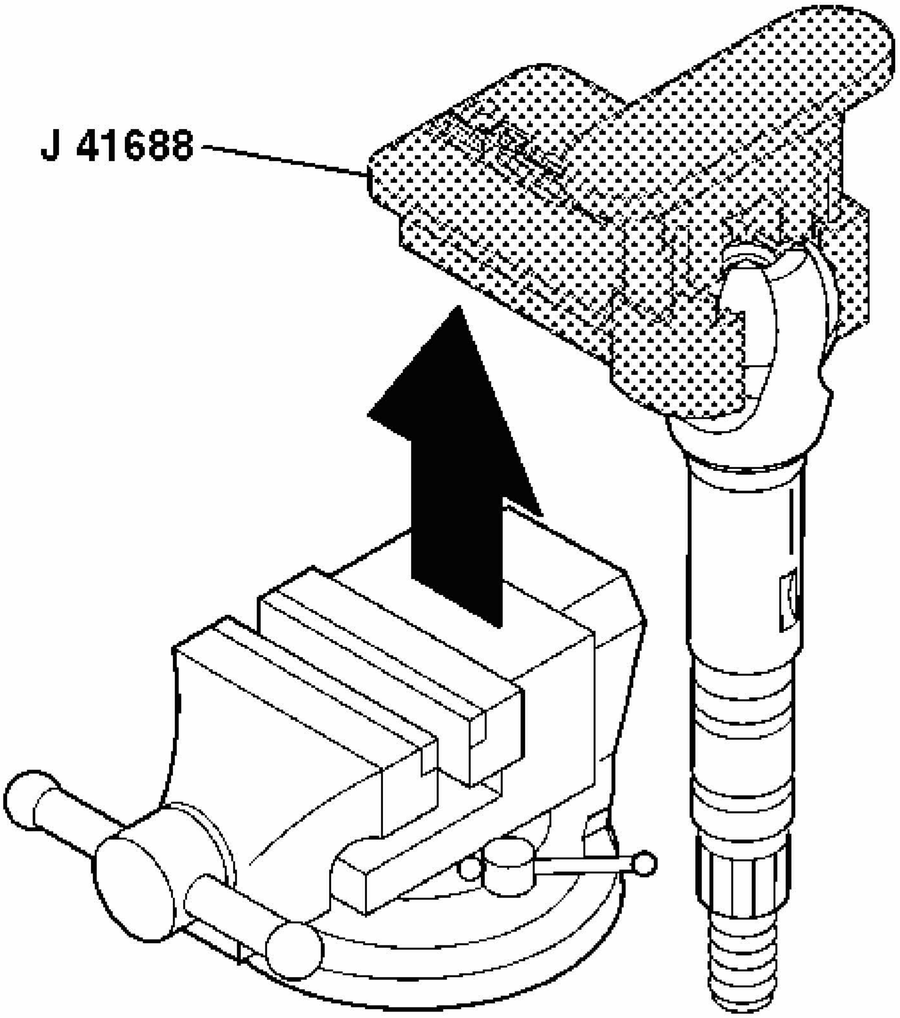


Fig. 117: Removing J 41688 From Vise
Courtesy of GENERAL MOTORS CORP.

8. Remove the race and upper shaft assembly with **J 41688** . See **Special Tools**.
9. Rotate the race and upper shaft assembly 90 degrees from **J 41688** and remove with the race and upper shaft assembly. See **Special Tools**.

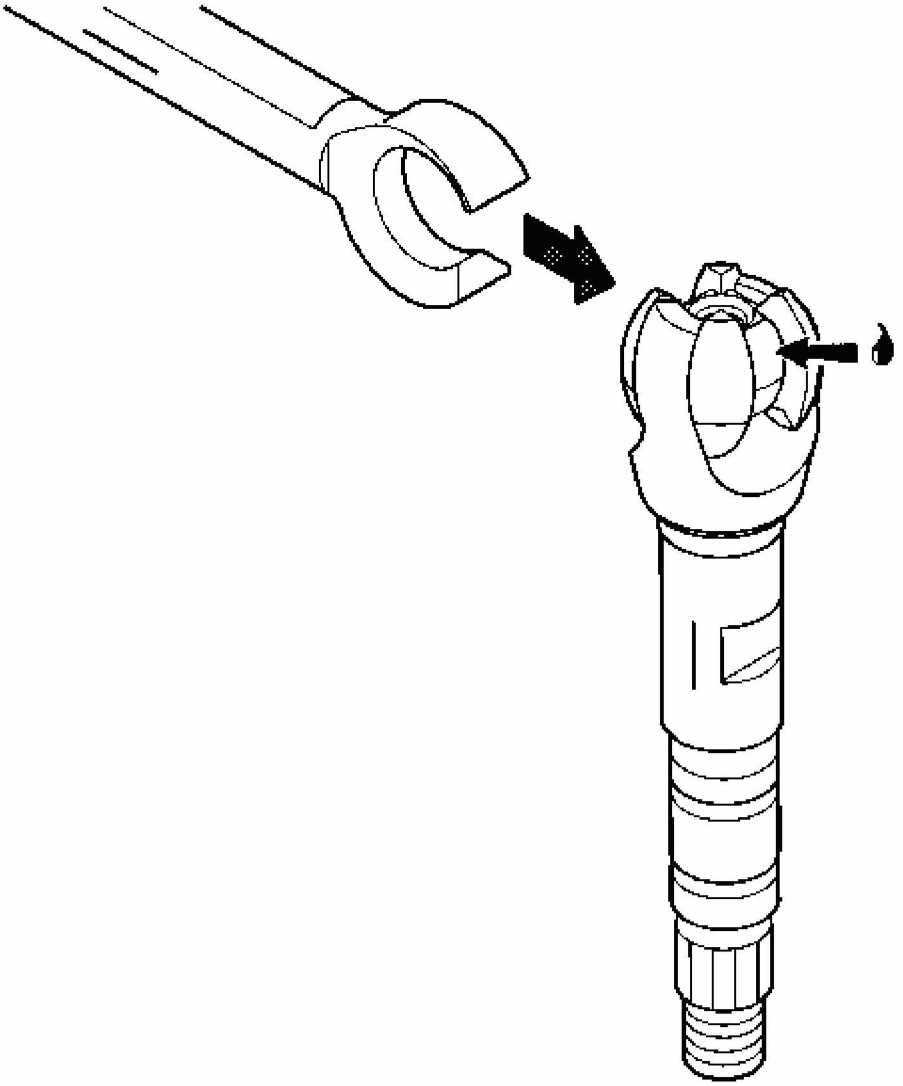


Fig. 118: Race & Upper Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

10. Lubricate the centering sphere with GM P/N 12345718 (Canadian P/N 10953516).
11. Install the lower shaft assembly to the race and upper shaft assembly.

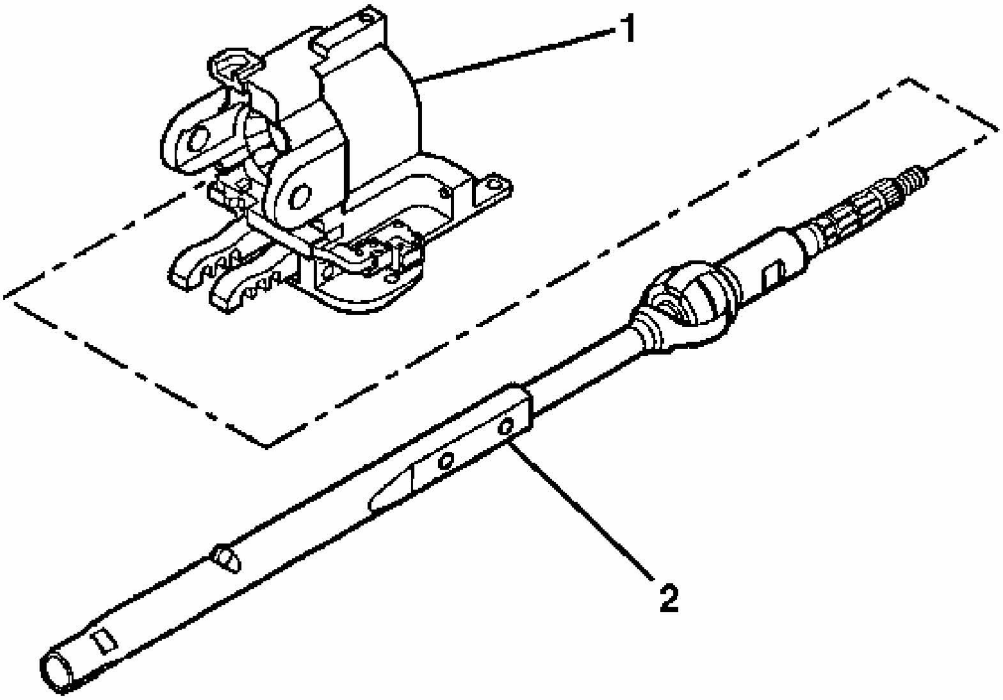


Fig. 119: Steering Shaft Assembly & Steering Column Tilt Head Housing Assembly
Courtesy of GENERAL MOTORS CORP.

12. Install the steering shaft assembly (2) into the steering column tilt head assembly (1).

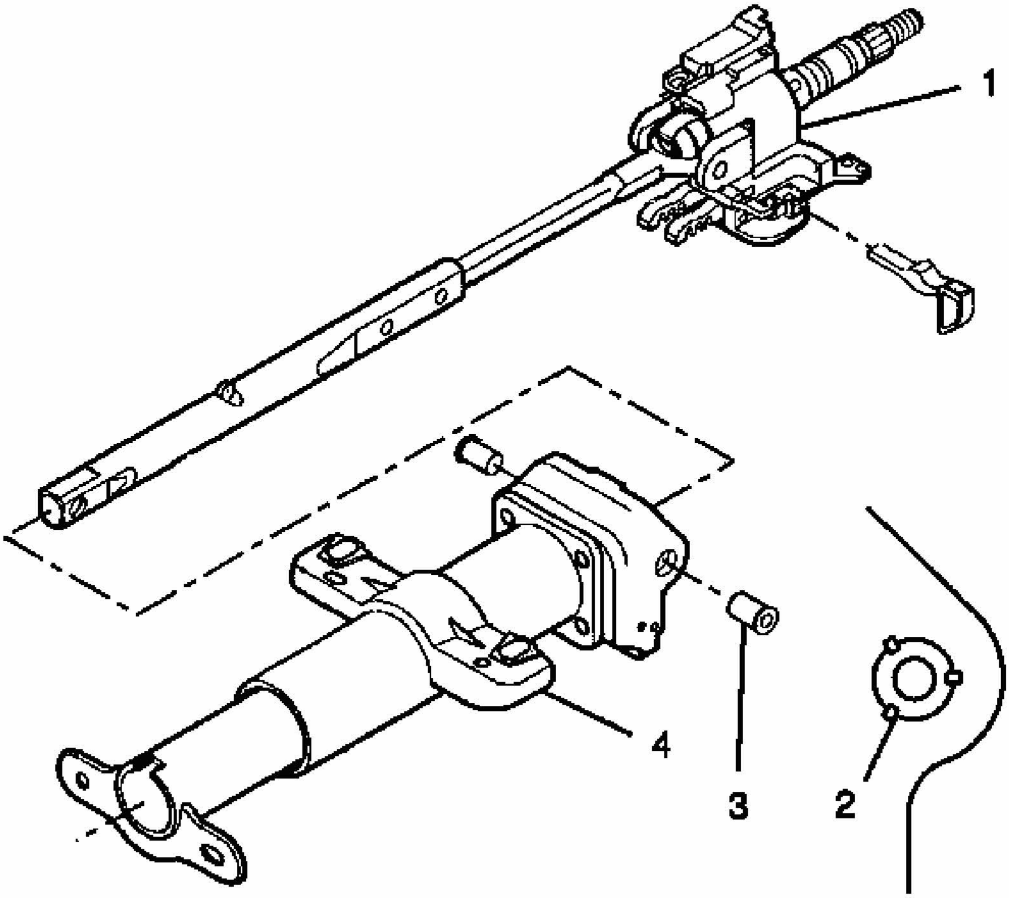


Fig. 120: Assembling Steering Column Lock Shoes Onto Steering Column Support Assembly
Courtesy of GENERAL MOTORS CORP.

13. Install the steering column tilt head assembly (1) to the steering column jacket assembly (4).
14. Install the 2 pivot pins (3).
15. Stake the pivot pins location (2).

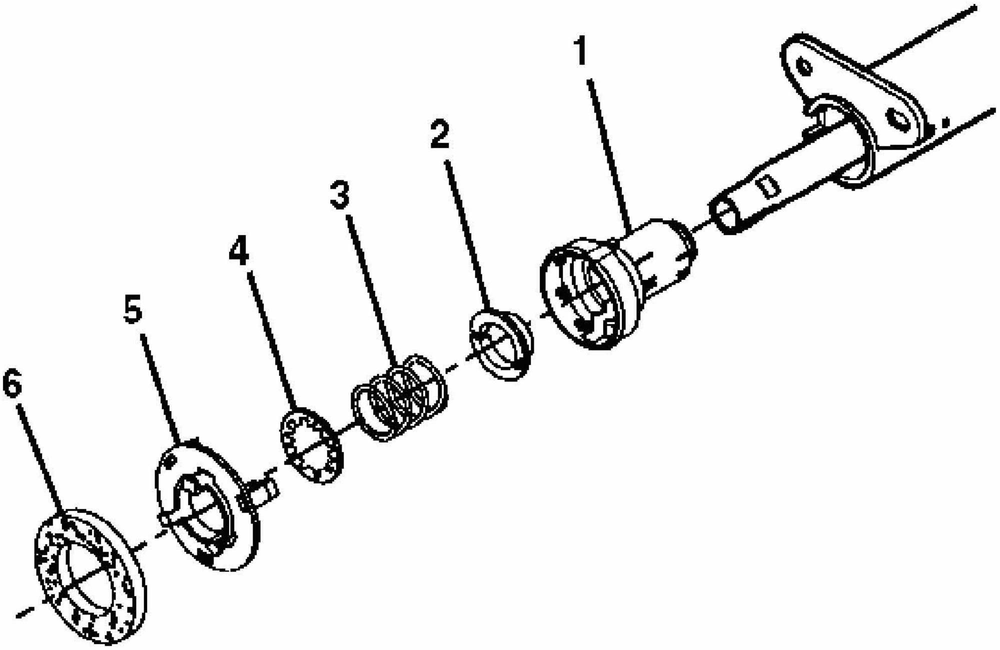


Fig. 121: Locating Steering Shaft Assembly Components
Courtesy of GENERAL MOTORS CORP.

16. Install the following components onto the steering shaft assembly:
    1. The adapter and bearing assembly (1)
    2. The lower bearing seat (2)
    3. The lower bearing spring (3)
    4. The lower spring retainer (4)
    5. The sensor retainer (5)
    6. The steering shaft seal (6)

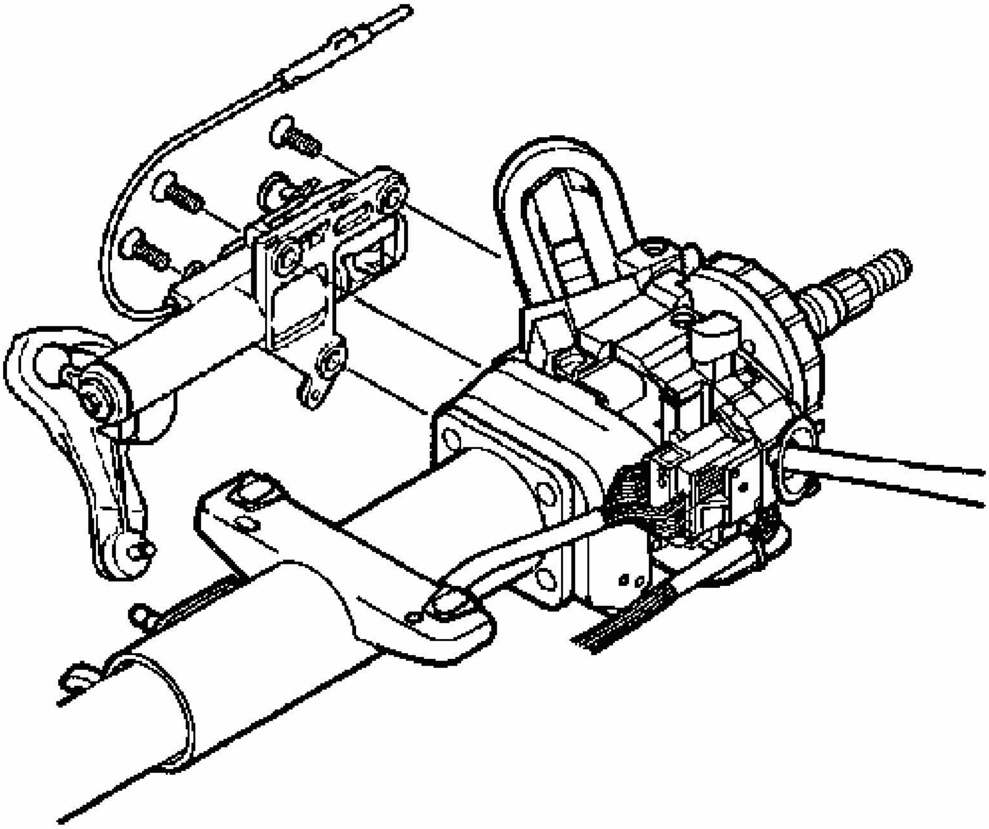


Fig. 122: View Of Linear Shift Assembly And Retaining Screws
Courtesy of GENERAL MOTORS CORP.

17. Install the linear shift assembly.
18. Install the 3 flat-head 6-lobed socket tapping screws

    The linear shift assembly must be out of the PARK position to install the lower socket tapping screw.

    Tighten: Tighten the 3 flat-head 6-lobed lobed socket tapping screws to 10 N.m (89 lb in).

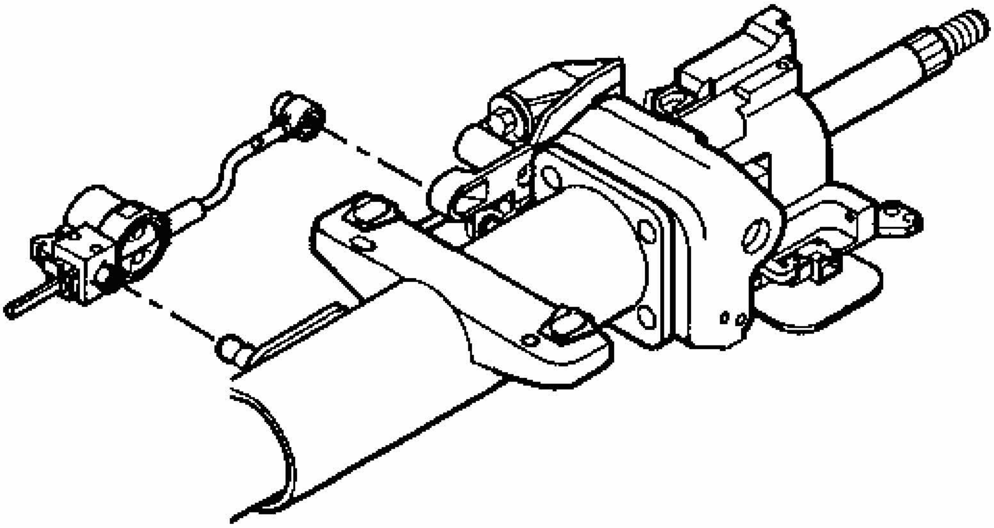


Fig. 123: Automatic Transmission Shift Lock Control
Courtesy of GENERAL MOTORS CORP.

19. Install the automatic transmission shift lock control.
20. Install the gear shift lever and put the column in the NEUTRAL position.

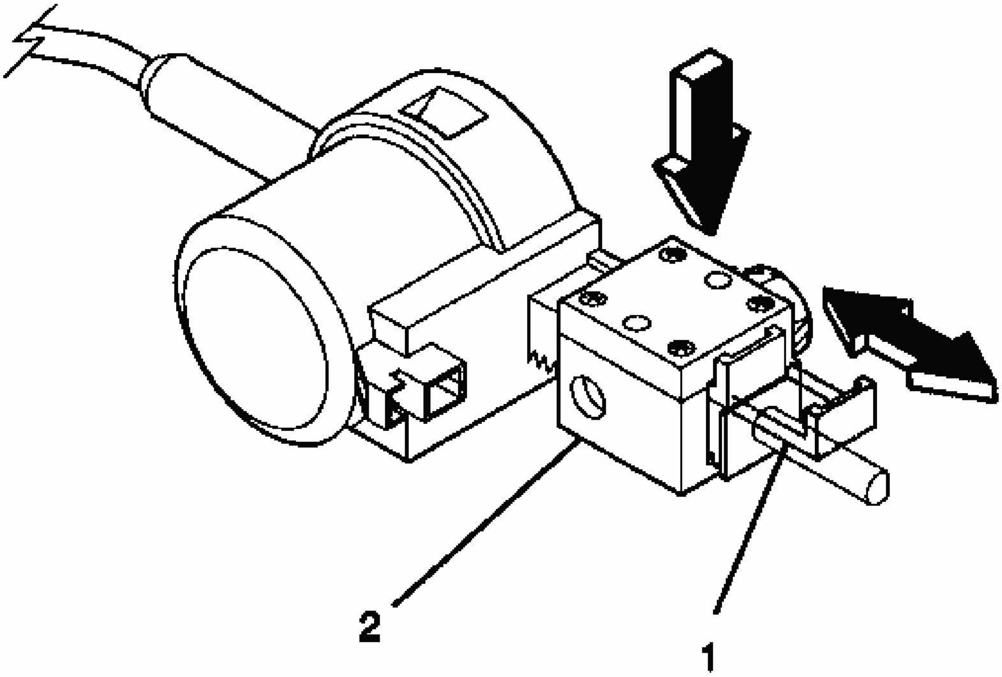


Fig. 124: Adjusting Automatic Transmission Shift Lock Control Actuator
Courtesy of GENERAL MOTORS CORP.

21. Adjust the automatic transmission shift lock control using the following steps:
    1. Pull the tab (1) out on the block side (2) of the automatic transmission shift lock control.
    2. Press on the adjuster block (2) to compress the internal adjuster spring to disengage the adjuster teeth. Slide the adjuster block (2) as far away from the solenoid as possible.
    3. Lock in place by pushing the tab (1) back in.
22. Inspect the automatic transmission shift lock control using the following steps:
    1. The automatic transmission shift lock control must lock the shift lever clevis when it is put into the PARK position.
    2. When the column is installed in the vehicle you will not be able to shift the gear shift lever out of the PARK position without pressing on the brake pedal. The solenoid will be energized.
    3. Readjust if needed.
23. Install the tilt spring assembly only. Refer to **Tilt Spring Replacement**.
24. Install the ignition lock cylinder case. Refer to **Ignition Lock Cylinder Case**

Replacement.

WIRE HARNESS ASSEMBLY REPLACEMENT (MANUAL TILT COLUMN)

Removal Procedure

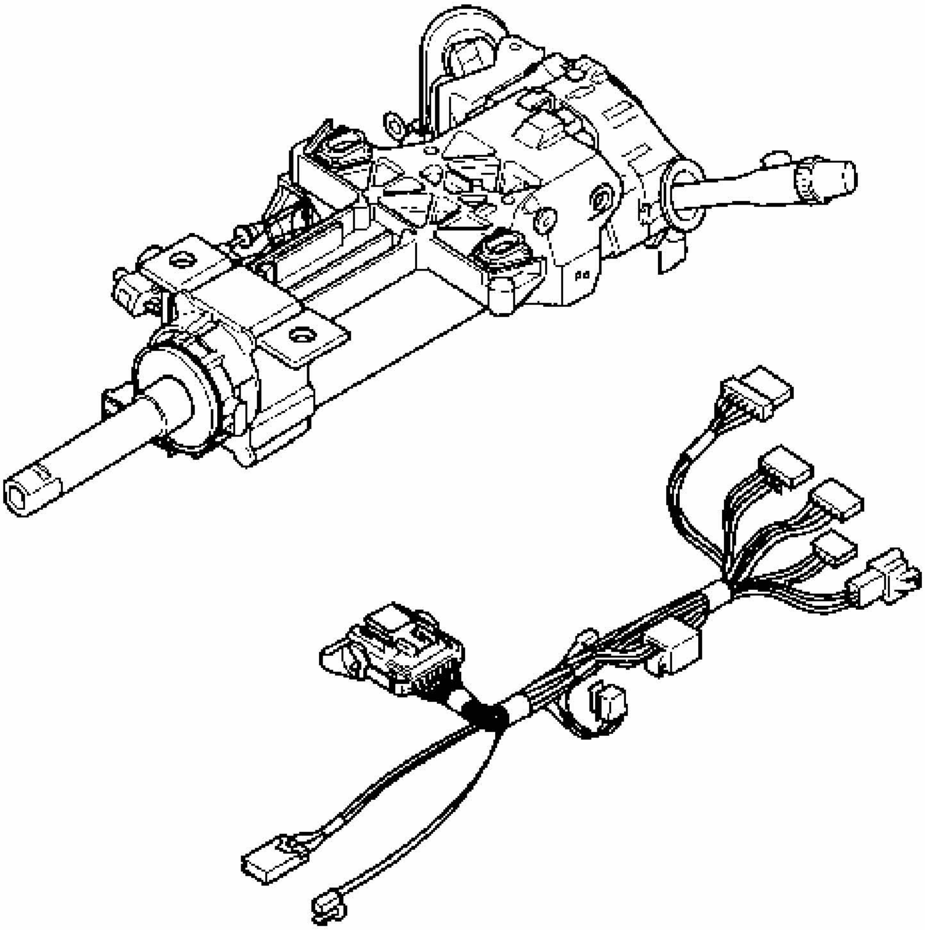


Fig. 125: View Of Steering Column And Wire Harness Assembly
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SIR Caution in Cautions and Notices.

IMPORTANT: Check the main wiring harness assembly for burned 2 amp fuses before doing this procedure.

1. Disable the SIR coil. Refer to **SIR Disabling and Enabling Zone 3** in SIR.
2. Remove the steering wheel from the column. Refer to **Steering Wheel Replacement**.
3. Remove the steering column from the vehicle. Refer to **Steering Column Replacement**.
4. Inspect the steering column for accident damage. Refer to **Steering Column Accident Damage Inspection**.
5. Remove the upper and lower trim cover. Refer to **Steering Column Trim Covers Replacement**.
6. Disconnect all connectors attached to the wire harness assembly.
7. Remove the bulkhead connector.

Installation Procedure

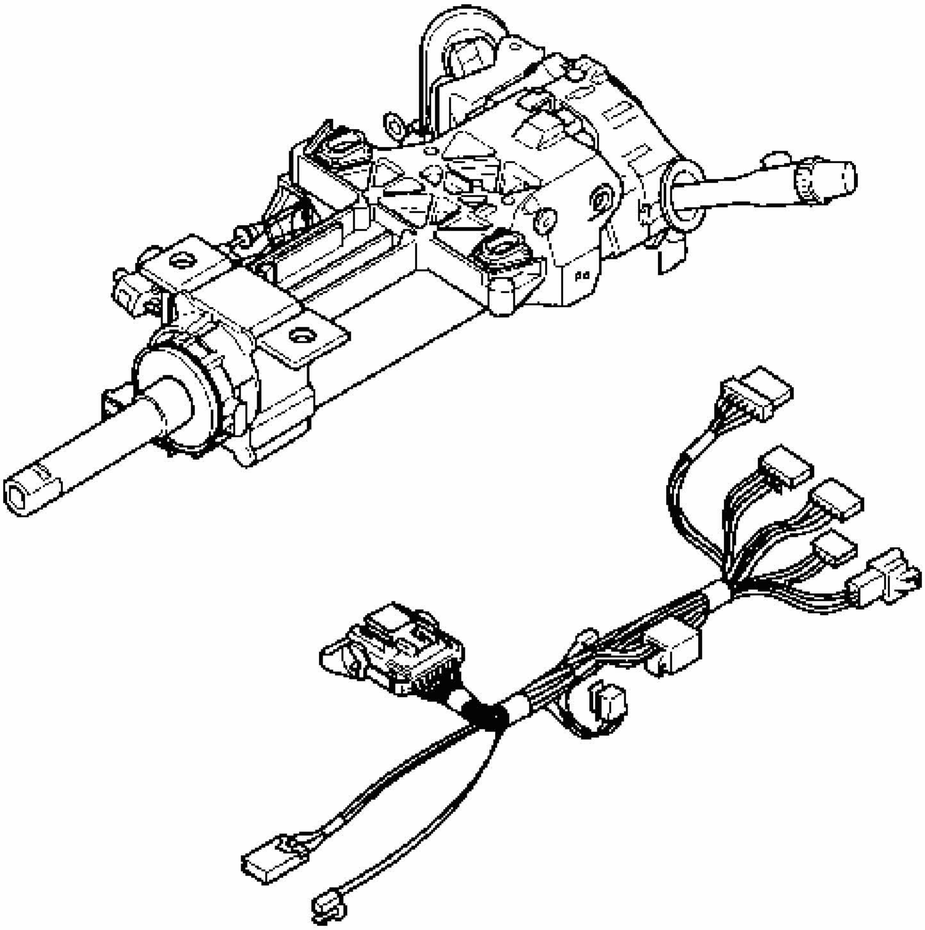


Fig. 126: View Of Steering Column And Wire Harness Assembly
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SIR INFLATOR MODULE COIL CAUTION in Cautions and Notices.

1. Slide the bulkhead connector into the steering column.
2. Connect all of the connectors to the wire harness assembly.
3. Install the upper and lower trim cover. Refer to **Steering Column Trim Covers Replacement**.
4. Install the steering column into the vehicle. Refer to **Steering Column Replacement**.
5. Install the steering wheel onto the steering column. Refer to **Steering Wheel Replacement**.
6. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 3** in SIR.

INFLATABLE RESTRAINT STEERING WHEEL MODULE COIL CENTERING

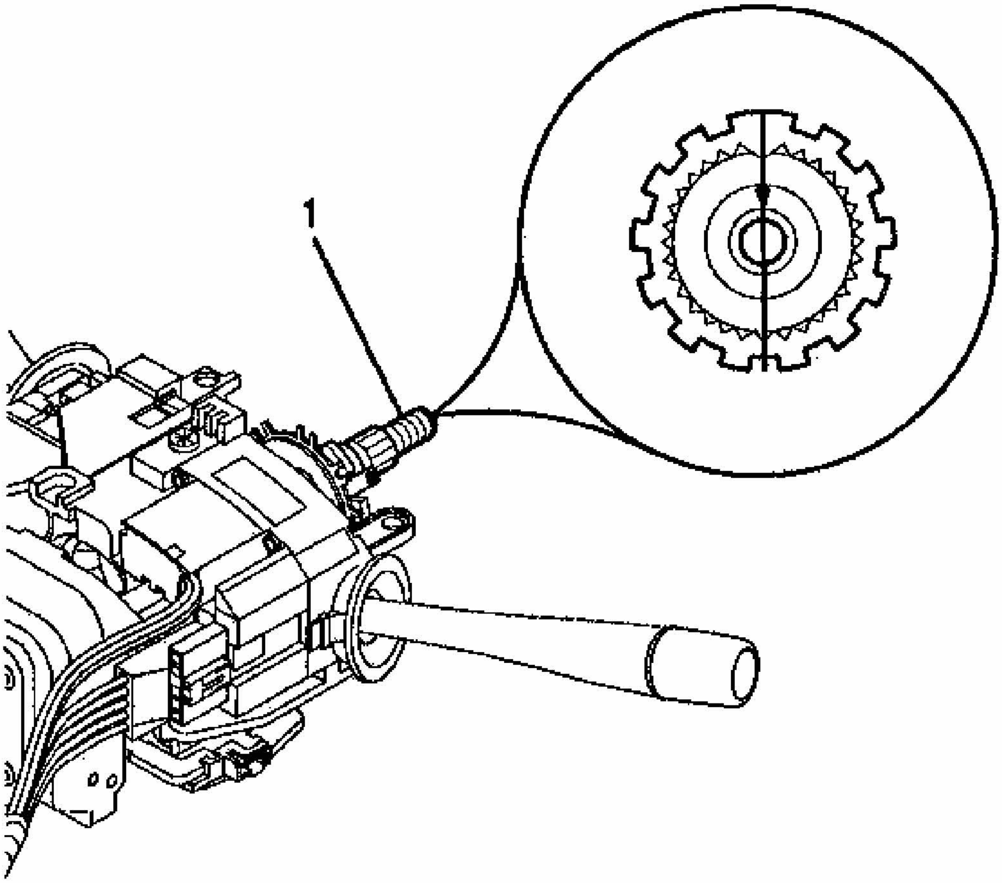


Fig. 127: View Of Block Tooth Of Steering Shaft Assembly In 12 O'clock Position
Courtesy of GENERAL MOTORS CORP.

NOTE: **The new SIR coil assembly will be centered. Improper alignment of the SIR coil assembly may damage the unit, causing an inflatable restraint malfunction.**

IMPORTANT: **If double wire harness strap is installed onto the wire harness assembly and column, you must reuse the holder for the wire straps during installation.**
Remove the wire harness strap(s) where necessary.

1. Verify the following conditions before centering the SIR coil:
    - The wheels on the vehicle are straight ahead.
    - The block tooth (1) of the steering shaft assembly is in the 12 o'clock position.

- The ignition switch is in the LOCK position.

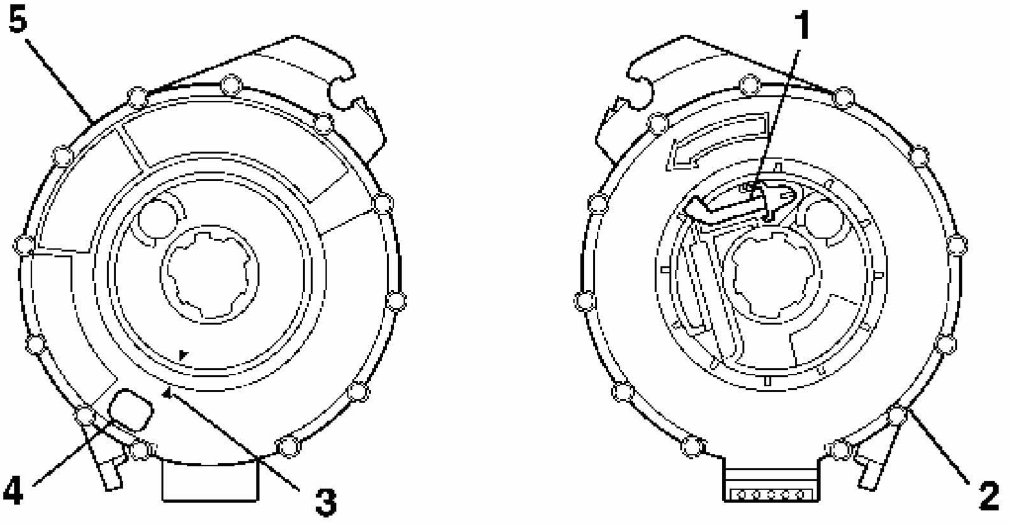


Fig. 128: Centering SIR Coil (With Centering Window & Spring Service Lock)
Courtesy of GENERAL MOTORS CORP.

2. If the front (5) of the SIR coil has a centering window (4), and the back side (2) includes a spring service lock (1), perform the following steps:
    1. Hold the SIR coil with the face up.
    2. While depressing the spring service lock, rotate the coil hub clockwise until the coil ribbon stops.
    3. Rotate the coil hub slowly, counterclockwise, until the centering window appears yellow and both arrows (3) line up.
    4. Release spring service lock between the locking tab. The SIR coil is now centered.
    5. Align the centered SIR coil with the horn tower and slide onto the steering shaft assembly.

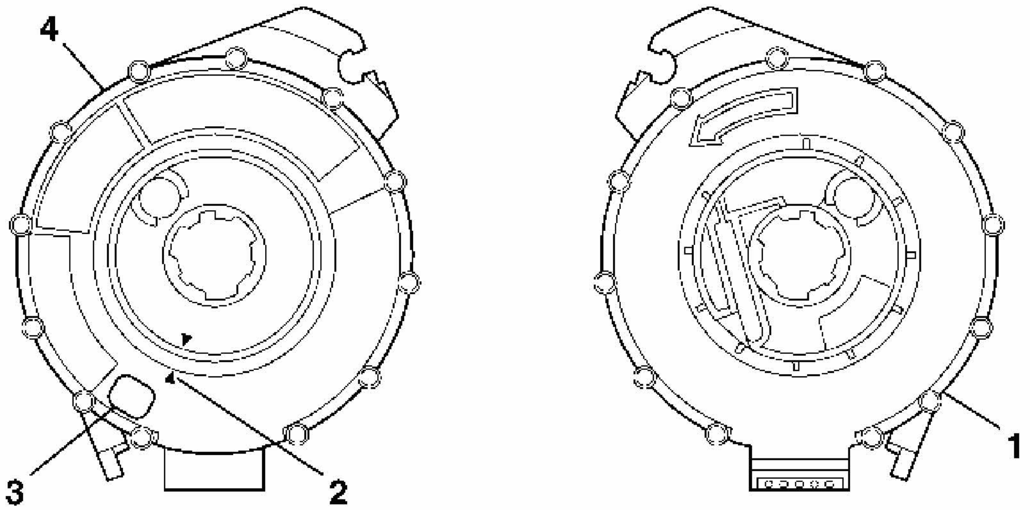


Fig. 129: Centering SIR Coil (With Centering Window, Without Spring Service Lock)
Courtesy of GENERAL MOTORS CORP.

3. If the front (4) of the SIR coil has a centering window (3), and the back side (1) includes NO spring service lock, perform the following steps:
    1. Hold the SIR coil with the face up.
    2. Rotate the coil hub clockwise until the coil ribbon stops.
    3. Rotate the coil hub slowly, counterclockwise until the centering window appears yellow and both arrows (2) line up. This is the CENTER position.
    4. While holding the coil hub in the CENTER position, align the SIR coil with the horn tower and slide onto the steering shaft assembly.

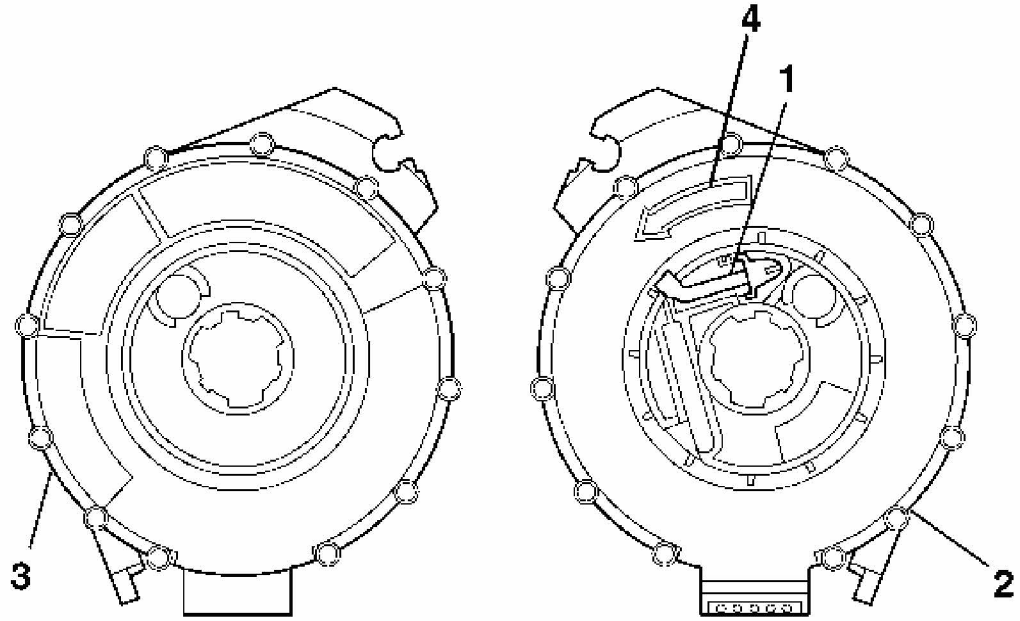


Fig. 130: Centering SIR Coil (No Centering Window, But Back Side Includes A Spring Service Lock)
Courtesy of GENERAL MOTORS CORP.

4. If the front side (3) of the SIR coil has NO centering window, but the back side (2) includes a spring service lock (1), perform the following steps:
   1. Hold the SIR coil with the back side up.
   2. While depressing the spring service lock, rotate the coil hub in the direction of the arrow (4) until the coil ribbon stops.
   3. Still pressing the spring service lock, rotate the coil hub in the opposite direction 21/2 revolutions.
   4. Release the spring service lock between locking tabs. The SIR coil is now centered.
   5. Align the centered SIR coil with the horn tower and slide onto the steering shaft assembly.

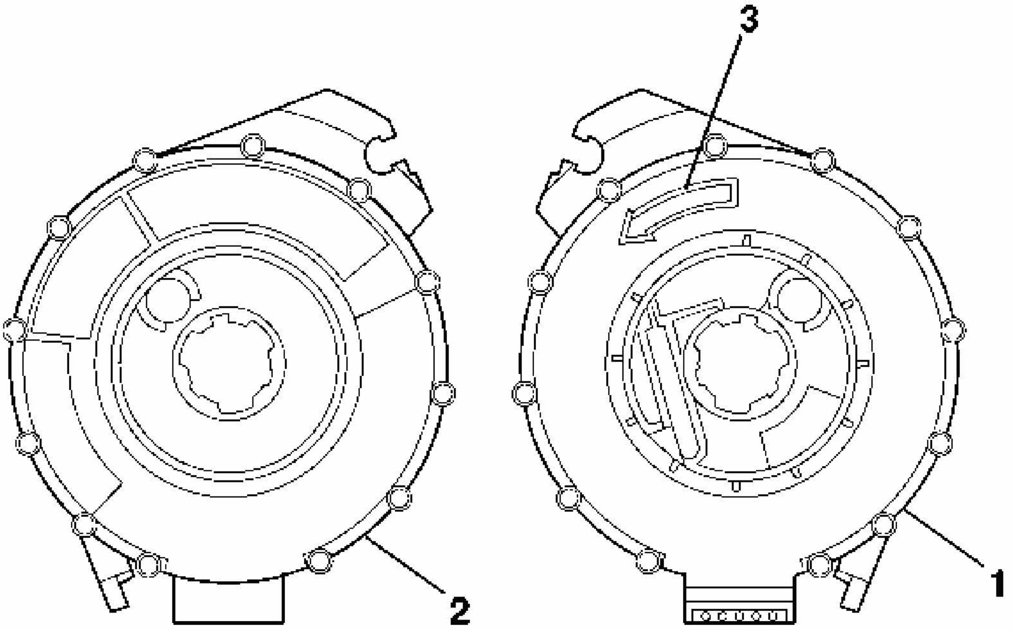


Fig. 131: Centering SIR Coil (Without Centering Window, Without Spring Service Lock)
Courtesy of GENERAL MOTORS CORP.

5. If the front side (2) of the SIR coil has NO centering window, and the back side (1) includes NO spring service lock, perform the following steps:
    1. Hold the SIR coil with the face up.
    2. Rotate the coil hub in the direction of the arrow until the coil ribbon stops.
    3. Rotate the coil hub, slowly, counterclockwise, for 21/2 revolutions. This is the CENTER position.
    4. While maintaining the coil hub in the CENTER position, align the centered SIR coil with the horn tower and slide onto the steering shaft assembly.
6. If double wire harness strap is installed onto the wire harness assembly and column, you must route the wires up against the steering column. One wire harness strap will surround one lead from the coil to the steering column. The other wire harness strap will surround all leads to the steering column.

DESCRIPTION AND OPERATION

STEERING WHEEL CONTROLS DESCRIPTION AND OPERATION

The steering wheel control switches duplicate the function of the primary controls of the associated component, through a network of multiple momentary contact switches and a series of resistors. The body control module (BCM) supplies voltage to the switches and monitors the return signal for when a switch is pressed, a specific voltage drop occurs. The BCM identifies the one selected, then sends a serial data message that is received by the component controlled, activating the feature.

This article is intended to diagnosis the circuits between the BCM and the steering wheel control switches. If the primary control for the device is inoperative, refer to the appropriate information for the component the steering wheel control switch is functioning.

STEERING WHEEL AND COLUMN DESCRIPTION AND OPERATION

The steering wheel and column has 4 primary functions:

- Vehicle steering
- Vehicle security
- Driver convenience
- Driver safety

Vehicle Steering

The steering wheel is the first link between the driver and the vehicle. The steering wheel is fastened to a steering shaft within the column. At the lower end of the column, the intermediate shaft connects the column to the steering gear.

Vehicle Security - Some Vehicle Models

Theft deterrent components are mounted and designed into the steering column. The following components allow the column to be locked in order to minimize theft:

- The ignition switch
- The steering column lock
- The ignition cylinder

Driver Convenience

The steering wheel and column may also have driver controls attached for convenience and comfort. The following controls may be mounted on or near the steering wheel or column.

- The turn signal switch
- The hazard switch
- The headlamp dimmer switch
- The wiper/washer switch
- The horn pad/cruise control switch

- The redundant radio/entertainment system controls
- The tilt or tilt/telescoping functions
- The navigation OnStar® features
- The HVAC controls

Driver Safety

In the event of a front-end collision the energy-absorbing steering column compresses, which reduces the chance of injury to the driver. The mounting capsules break away from the mounting bracket in the event of an accident.

Ignition Lock Cylinder Control Actuator

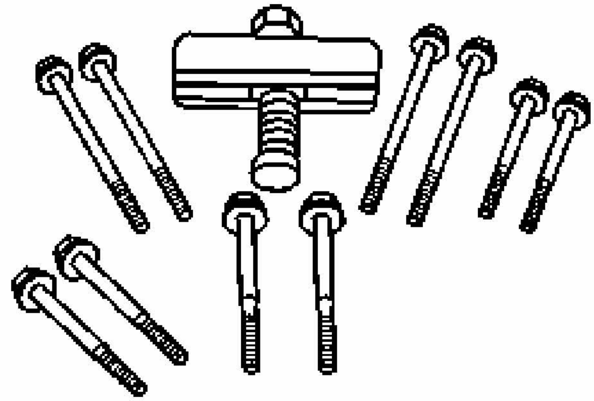
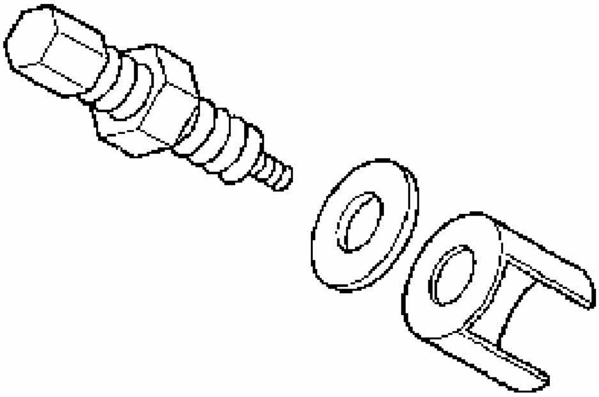
If the vehicle is equipped with a floor-mounted console gear shifter, an added safety feature is an ignition lock cylinder control actuator system in the steering column. The ignition lock cylinder control actuator system prevents the steering wheel from being locked when the transmission is in gear and the vehicle may be moving. The column ignition lock system consists of a ignition lock cylinder control actuator and a ignition lock cylinder control switch, that is located in the A/T shift lock control switch. The ignition lock cylinder control actuator contains a spring-loaded pin that mechanically prevents the ignition key cylinder from being turned to the Lock position when the transmission is not in the Park position. If vehicle power is lost or the transmission is not in the Park position, the operator will not be able to turn the ignition key to the Lock position and will not be able to remove the ignition key from the column.

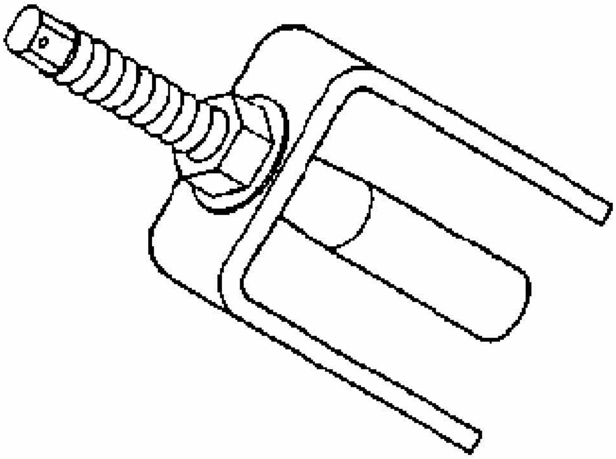
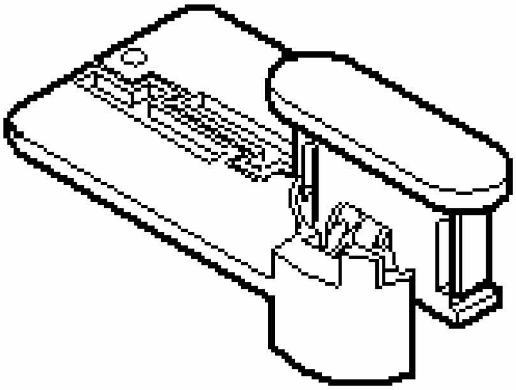
SPECIAL TOOLS AND EQUIPMENT

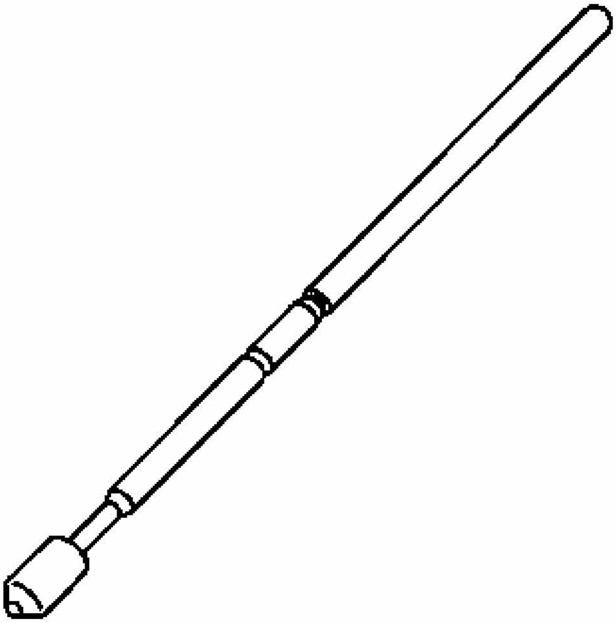
SPECIAL TOOLS

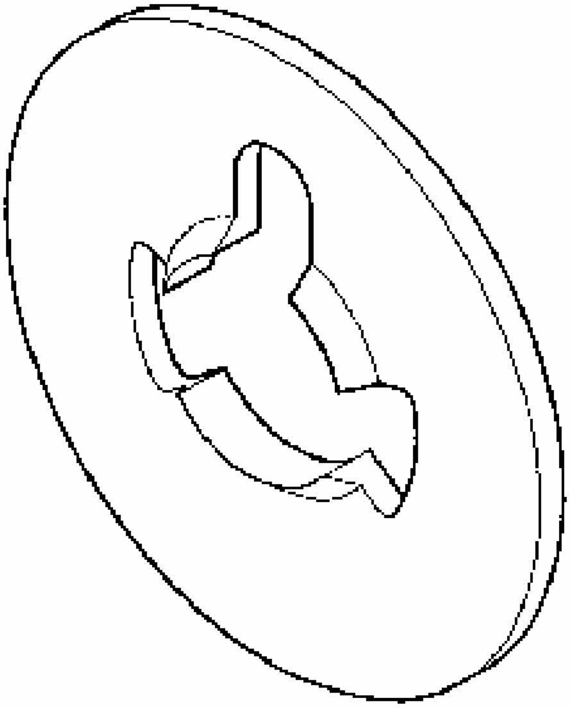
Special Tools

Illustration	Tool Number/ Description
	J 1859-A Countergear and Steering Wheel Puller

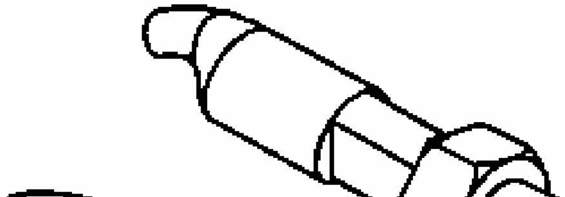
	
	J 21854-01 Pivot Pin Remover

	J 23653-SIR Steering Column Lock Plate Compressor
	J 41688 Centering Sphere Installer - Tilt Steering Wheel

	J 42640 Steering Column Anti-Rotation Pin
	J 42137 Cam Orientation Plate Adapter



J 42578
Steering Wheel Puller Legs



2006 ACCESSORIES & EQUIPMENT

Roof - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Deflector, Air	3 N.m	26 lb in
Sunroof Motor/Actuator Bolts	4 N.m	35 lb in
Sunroof Module Bolts	10 N.m	89 lb in
Sunroof Opening Position Switch Screw	2 N.m	18 lb in
Sunroof Window Screws	4 N.m	35 lb ft
Sunshade Stop Screw	2 N.m	18 lb in

SCHEMATIC AND ROUTING DIAGRAMS

POWER SUNROOF SCHEMATICS

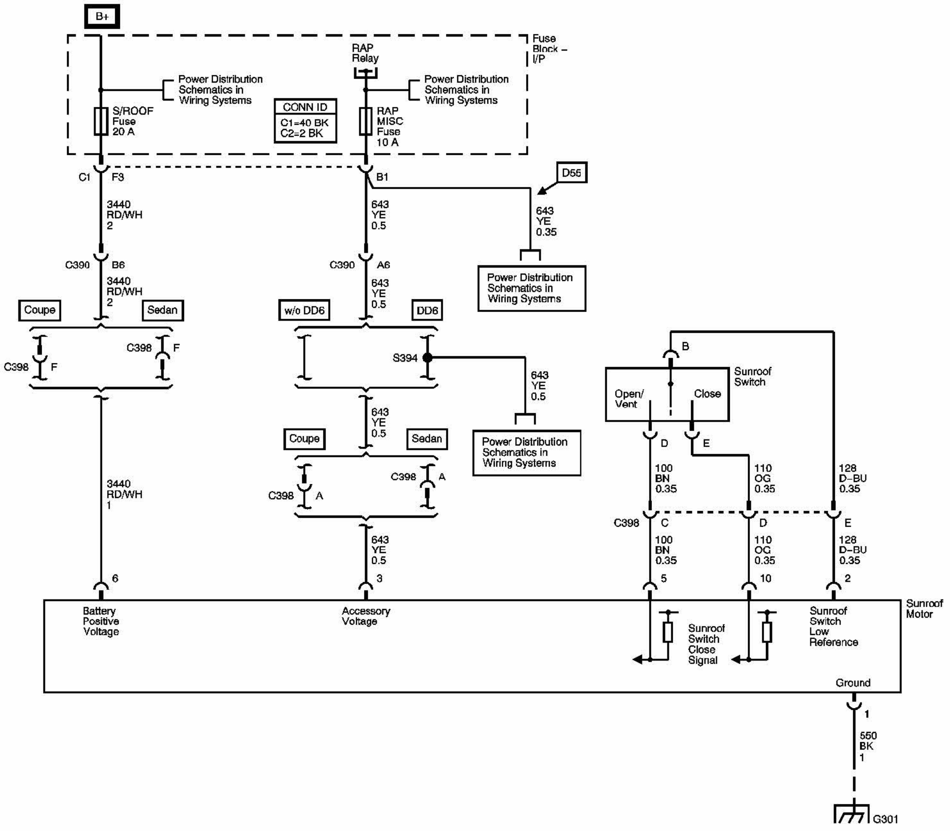

B+
Fuse Block – I/P
Power Distribution Schematics in Wiring Systems
RAP Relay
Power Distribution Schematics in Wiring Systems
S/ROOF Fuse 20 A
CONN ID
C1=40 BK
C2=2 BK
RAP MISC Fuse 10 A
C1
F3
B1
D55
3440 RD/WH 2
643 YE 0.5
643 YE 0.35
C390
B6
C390
A6
Power Distribution Schematics in Wiring Systems
3440 RD/WH 2
643 YE 0.5
Coupe
Sedan
w/o DD6
DD6
C398
F
C398
F
S394
643 YE 0.5
Power Distribution Schematics in Wiring Systems
643 YE 0.5
Coupe
Sedan
C398
A
C398
A
3440 RD/WH 1
643 YE 0.5
B
Sunroof Switch
Open/ Vent
Close
D
E
100 BN 0.35
110 OG 0.35
128 D-BU 0.35
C398
C
D
E
100 BN 0.35
110 OG 0.35
128 D-BU 0.35
6
3
5
10
2
Battery Positive Voltage
Accessory Voltage
Sunroof Switch Close Signal
Sunroof Switch Low Reference
Sunroof Motor
Ground
1
550 BK 1
G301

Fig. 1: Power Sunroof Schematics - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

POWER ROOF SYSTEMS COMPONENT VIEWS

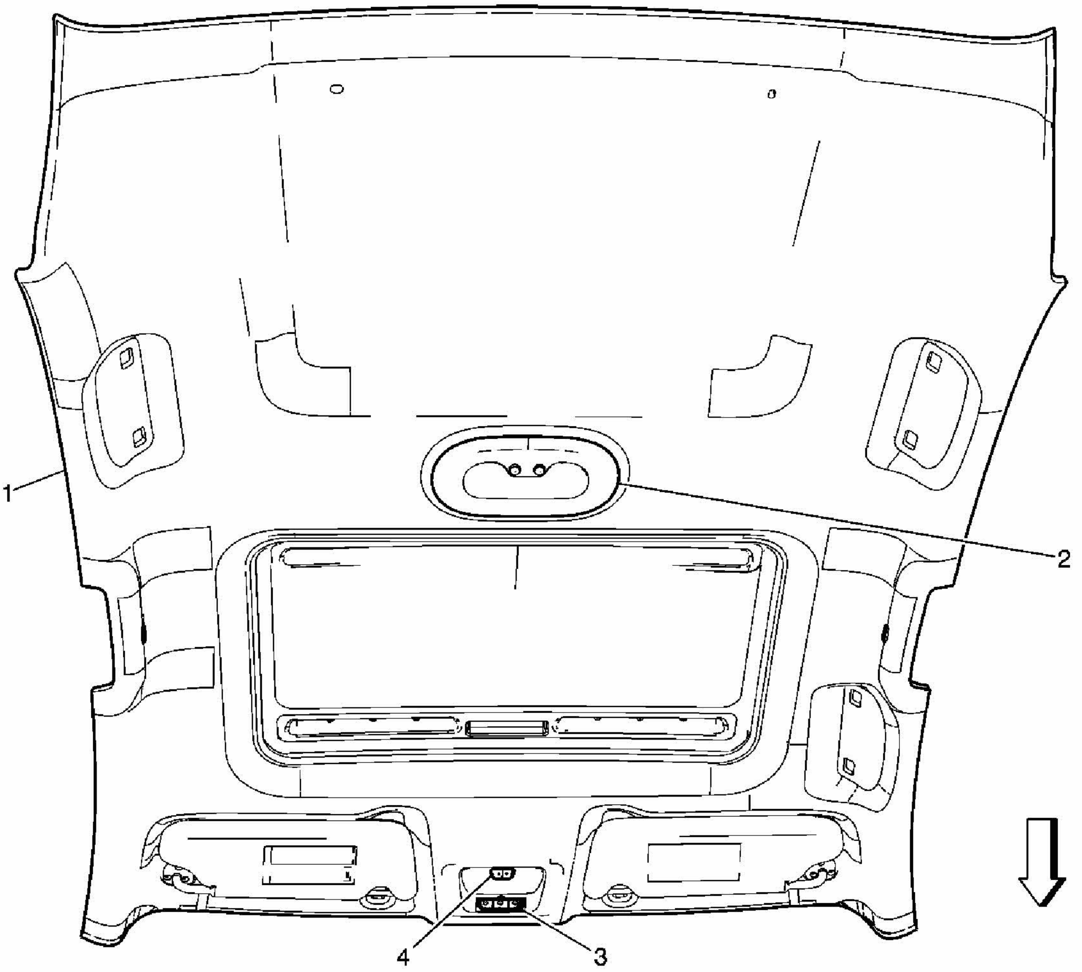


Fig. 2: Headliner Components - Bottom View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	Headliner
2	Dome Lamp
3	Home Link Buttons
4	Sunroof Switch

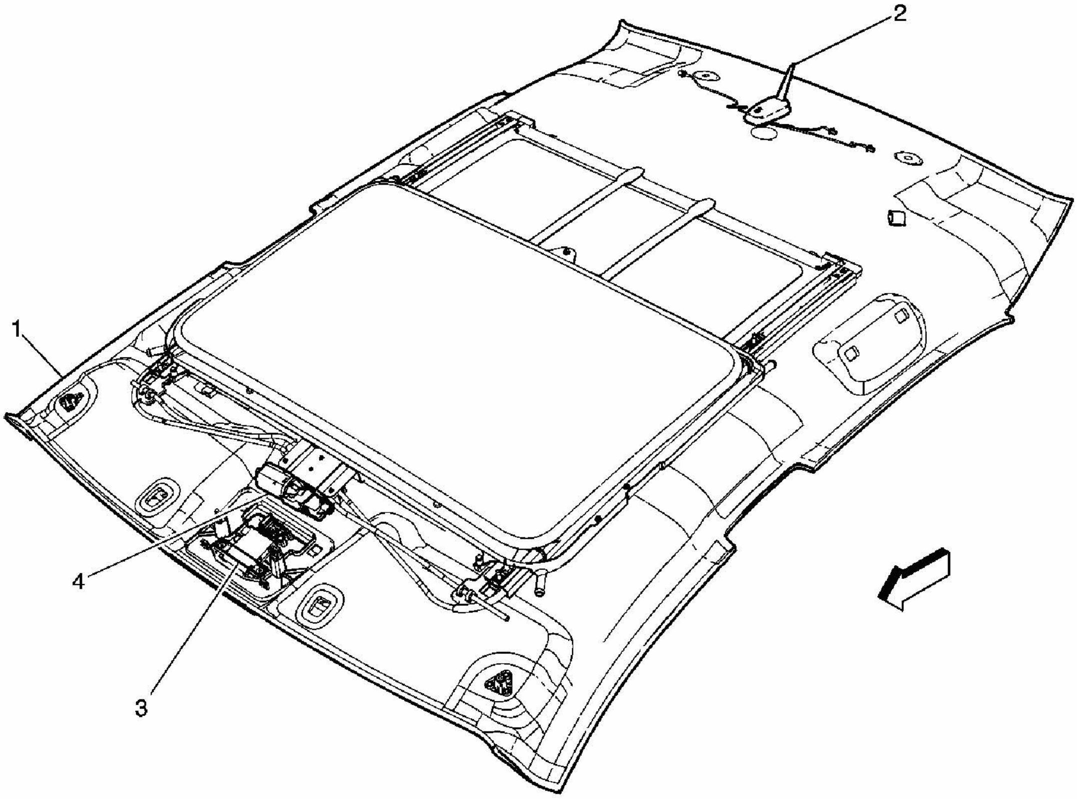


Fig. 3: Headliner Components - Top View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Headliner
2	Cellular and Navigation Antenna (UE1)
3	Sunroof Switch (CF5)
4	Sunroof Module (CF5)

POWER ROOF SYSTEMS CONNECTOR END VIEWS

Sunroof Switch (CF5)

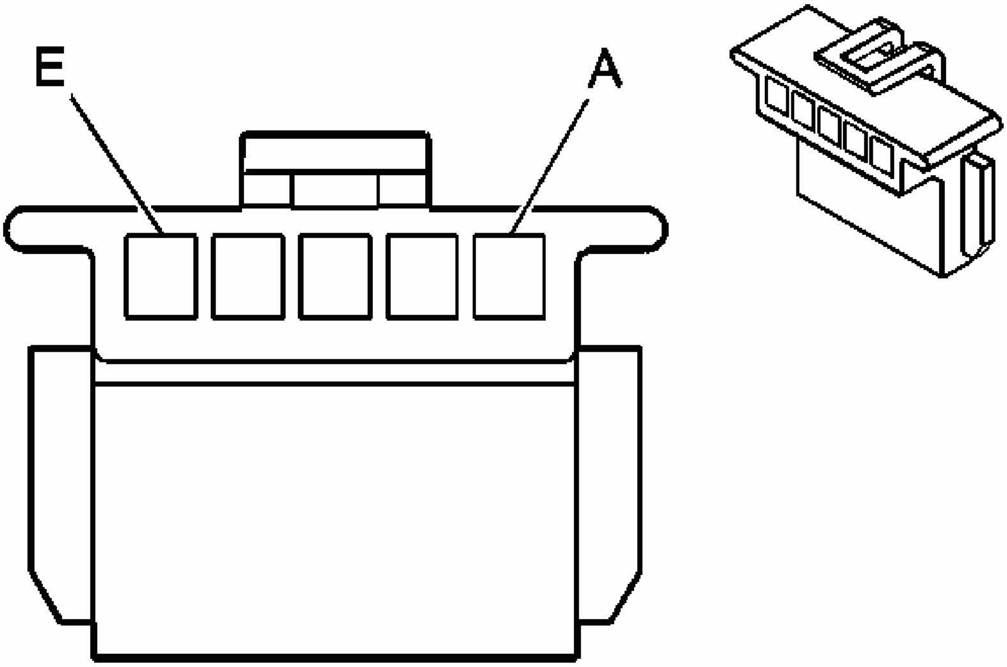


Fig. 4: Door Lock Switch Connector End View
Courtesy of GENERAL MOTORS CORP.

Power Roof Systems Connector End Views

Connector Part Information

- OEM: 12124997
- Service: 12167130
- Description: 5-Way F Metri-Pack 150RT Angled (BK)

Terminal Part Information

- Pins: B, D, E
- Terminal/Tray: 12103359/18
- Core/Insulation Crimp: E/C
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Sunroof Switch (CF5)

Pin	Wire Color	Circuit No.	Function
A	-	-	Not Used
B	D-BU	128	Sunroof Switch Low Reference

C	-	-	Not Used
D	BN	100	Sunroof Systems Sunroof Switch Open Signal
E	OG	110	Sunroof Systems Sunroof Switch Close Signal

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - ROOF

Begin the system diagnosis with the **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

Symptoms

When no DTCs are present, begin symptom diagnosis by reviewing the **Sunroof Description and Operation**. Reviewing the Description and Operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the Description and Operation information will also help you determine if the condition described by the customer is normal operation. Refer to the **Symptoms - Roof** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

SYMPTOMS - ROOF

IMPORTANT: Review the system operation in order to familiarize yourself with the system functions. Refer to Sunroof Description and Operation.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Power Sunroof system. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect for mechanical binding.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Symptom List

Refer to the symptom diagnostic procedure **Power Sunroof Inoperative (W/RPO CF5)** in order to diagnose the symptom.

POWER SUNROOF INOPERATIVE (W/RPO CF5)

Diagnostic Aids

- The sunroof motor and sunroof control module are integral parts of the sunroof motor/actuator assembly and are not serviced separately.
- If voltage is not measured on the sunroof switch open signal or sunroof switch close signal circuits, the fault could be in the accessory voltage circuit, battery positive voltage circuit, or sunroof motor/actuator ground circuit. If the sunroof motor/actuator is not being powered, neither will the sunroof switch signal circuits.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: This step is used to determine the correct diagnostic path. The path depends on if the sunroof is inoperative and in the open position, or if the sunroof is inoperative and in the closed position.

5: This step tests the sunroof switch open switch.

8: This step tests the sunroof switch close switch.

Power Sunroof Inoperative (W/RPO CF5)

Step	Action	Values	Yes	No
Schematic Reference: Power Sunroof Schematics **Connector End View Reference: Power Roof Systems Connector End Views**				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Attempt to operate the sunroof through its full range of functions in order to verify that the power sunroof inoperative fault is present. Does the power sunroof system	-	Go to **Testing for Intermittent Conditions and Poor**	

	operate normally?		**Connections**	Go to **Step 3**
3	Perform the sunroof re-initialization. Refer to **Sunroof Control Module Programming and Setup** . Does the sunroof operate normally?	-	Go to **Step 25**	Go to **Step 4**
4	Is the sunroof in the fully closed position?	-	Go to **Step 5**	Go to **Step 8**
5	1. Disconnect the sunroof switch. 2. Turn ON the ignition, with the engine OFF. 3. Connect a 3-amp fused jumper wire to the low reference circuit of the sunroof switch harness connector. 4. Connect the other end of the 3-amp fused jumper wire to the sunroof switch open signal circuit of the sunroof switch harness connector, for 3 seconds. Did the sunroof open?	-	Go to **Step 18**	Go to **Step 6**
6	1. Disconnect the 3-amp fused jumper wire. 2. Measure the voltage from the sunroof switch open signal circuit of the sunroof switch harness connector to the low reference circuit of the sunroof switch harness connector. Does the voltage measure near the specified value?	5 V	Go to **Step 14**	Go to **Step 7**
7	Measure the voltage from the sunroof switch open signal circuit of the sunroof switch harness connector to a good ground. Does the voltage measure near the specified value?	5 V	Go to **Step 15**	Go to **Step 11**
	1. Disconnect the sunroof switch. 2. Turn ON the ignition, with the engine OFF.			

8	3. Connect a 3-amp fused jumper wire to the low reference circuit of the sunroof switch harness connector. 4. Connect the other end of the 3-amp fused jumper wire to the sunroof switch close signal circuit of the sunroof switch harness connector, for 3 seconds. Did the sunroof close?	-	Go to **Step 18**	Go to **Step 9**
9	1. Disconnect the 3-amp fused jumper wire. 2. Measure the voltage from the sunroof switch close signal circuit of the sunroof switch harness connector to the low reference circuit of the sunroof switch harness connector. Does the voltage measure near the specified value?	5 V	Go to **Step 16**	Go to **Step 10**
10	Measure the voltage from the sunroof switch close signal circuit of the sunroof switch harness connector to a good ground. Does the voltage measure near the specified value?	5 V	Go to **Step 15**	Go to **Step 11**
11	1. Disconnect the sunroof motor/actuator harness connector. 2. Measure the voltage from the battery positive voltage circuit of the sunroof motor/actuator harness connector to a good ground. Does the voltage measure near the specified value?	B+	Go to **Step 12**	Go to **Step 20**
12	Measure the voltage from the accessory voltage circuit of the sunroof motor/actuator harness	B+		

	connector to a good ground. Does the voltage measure near the specified value?		Go to **Step 13**	Go to **Step 21**
13	1. Turn OFF the ignition. 2. Measure the resistance from the ground circuit of the sunroof motor/actuator harness connector to a good ground. Does the resistance measure less than or equal to the specified value?	5 ohms	Go to **Step 17**	Go to **Step 22**
14	Test the sunroof switch close signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 19**
15	Test the sunroof switch low reference circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 19**
16	Test the sunroof switch open signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 19**
17	Test the appropriate sunroof switch signal circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 19**
18	Inspect for poor connections at the harness connector of the sunroof switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 23**

19	Inspect for poor connections at the harness connectors of the sunroof motor/actuator assembly. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 24**
20	Repair the short to ground or open in the battery positive voltage circuit of the sunroof motor/actuator assembly. Refer to **Wiring Repairs** and **Connector Repairs** . Did you complete the repair?	-	Go to **Step 25**	-
21	Repair the short to ground or open in the accessory voltage circuit of the sunroof motor/actuator assembly. Refer to **Wiring Repairs** and **Connector Repairs** . Did you complete the repair?	-	Go to **Step 25**	-
22	Repair the open in the ground circuit of the sunroof motor/actuator assembly. Refer to **Wiring Repairs** and **Connector Repairs** . Did you complete the repair?	-	Go to **Step 25**	-
23	Replace the sunroof switch. Refer to **Sunroof Switch Replacement (Impala)** or **Sunroof Switch Replacement (Monte Carlo)**. Did you complete the replacement?	-	Go to **Step 25**	-
24	Replace the sunroof motor/actuator assembly. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 25**	-
25	Operate the system in order to verify the repair. Did you find and correct the condition?	-	System OK	Go to **Step 2**

POWER SUNROOF DOES NOT CLOSE

Perform the Initialization/Teach Process any time a new sunroof motor actuator is installed in the vehicle or any time an existing sunroof motor actuator is removed from the vehicle. Refer to **Sunroof Motor/Actuator Initilization/Teach Process**.

POWER SUNROOF WINDOW IS SKEWED

Parallel positioning of the window track guides or lift mechanism and cable is crucial to the proper function of the system. If the guides are misaligned, refer to **Sunroof Track Timing/Synchronization**.

POWER SUNROOF WHEN OPERATED FROM VENT TO CLOSE ONE SIDE WILL DROP BEFORE THE OTHER

Parallel positioning of the window track guides or lift mechanism and cable is crucial to the proper function of the system. If the guides are misaligned, refer to **Sunroof Track Timing/Synchronization**.

POWER SUNROOF WHEN CLOSING FROM THE VENT POSITION THE WINDOW WILL REVERSE DIRECTION

Perform the Initialization/Teach Process any time a new sunroof motor actuator is installed in the vehicle or any time an existing sunroof motor actuator is removed from the vehicle. Refer to **Sunroof Motor/Actuator Initilization/Teach Process**.

POWER SUNROOF WILL STOP AT THE WRONG LOCATION

Perform the Initialization/Teach Process any time a new sunroof motor actuator is installed in the vehicle or any time an existing sunroof motor actuator is removed from the vehicle. Refer to **Sunroof Motor/Actuator Initilization/Teach Process**.

POWER SUNROOF WILL OVER TRAVEL THE OPEN POSITION AND STALL THE MOTOR

Perform the Initialization/Teach Process any time a new sunroof motor actuator is installed in the vehicle or any time an existing sunroof motor actuator is removed from the vehicle. Refer to **Sunroof Motor/Actuator Initilization/Teach Process**.

POWER SUNROOF WILL OVER TRAVEL THE CLOSE POSITION AND STALL THE MOTOR

Perform the Initialization/Teach Process any time a new sunroof motor actuator is installed in the vehicle or any time an existing sunroof motor actuator is removed from the vehicle. Refer to **Sunroof Motor/Actuator Initilization/Teach Process**.

REPAIR INSTRUCTIONS

SUNROOF WINDOW HEIGHT AND OPENING FIT ADJUSTMENT

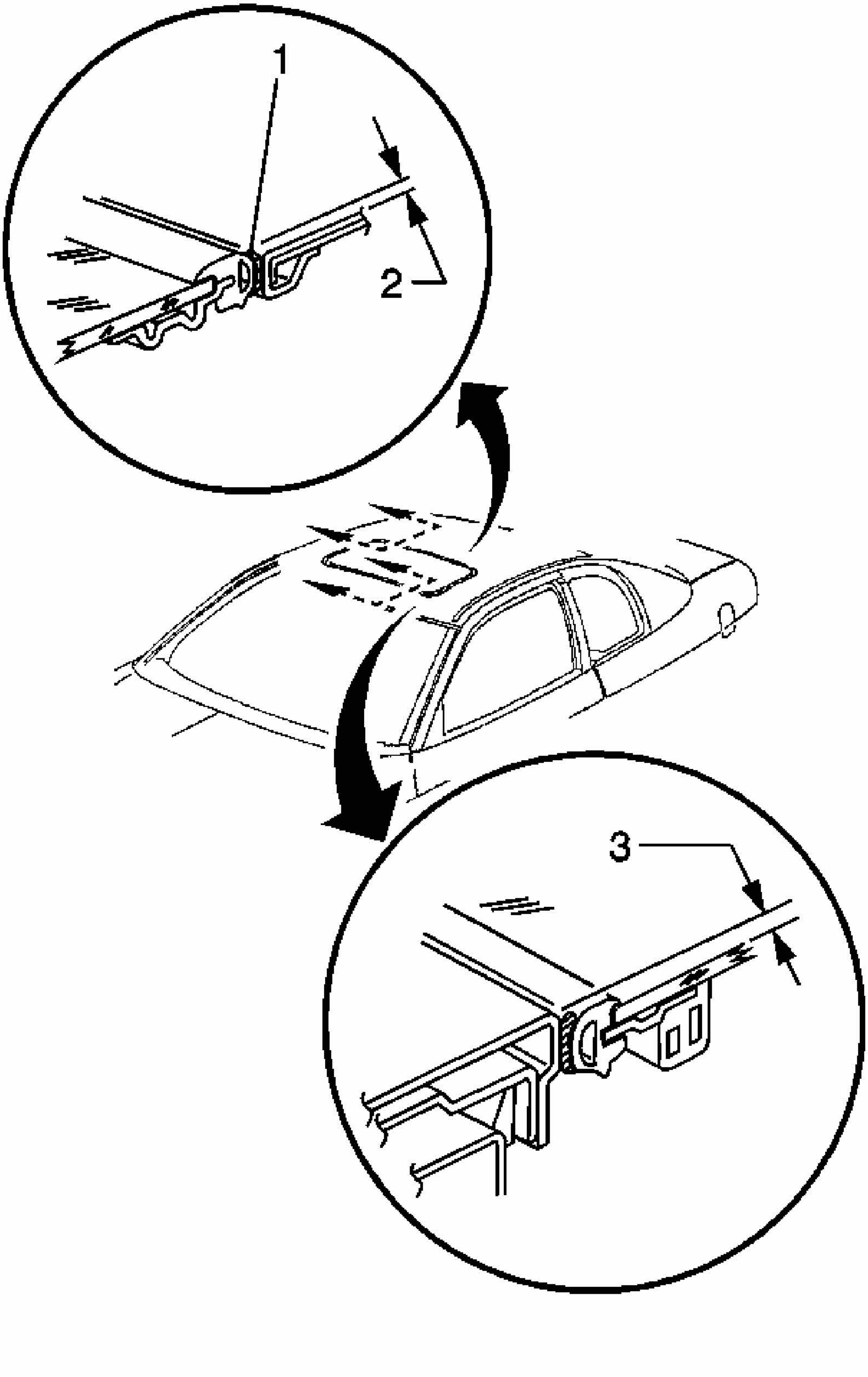


Fig. 5: Adjusting Sunroof Window Panel

Courtesy of GENERAL MOTORS CORP.

1. Slide the sunroof sunshade to the open position.
2. Move the sunroof glass panel to the fully closed position.
3. Loosen the sunroof glass panel screws.
4. Individually adjust the 4 corners (1) of the sunroof glass panel.
5. Adjust the front of the sunroof glass panel to 1.5 mm (0.050 in) below the top surface of the roof panel (3).
6. Adjust the rear of the sunroof glass panel to 1.5 mm (0.050 in) above the top surface of the roof panel (2).

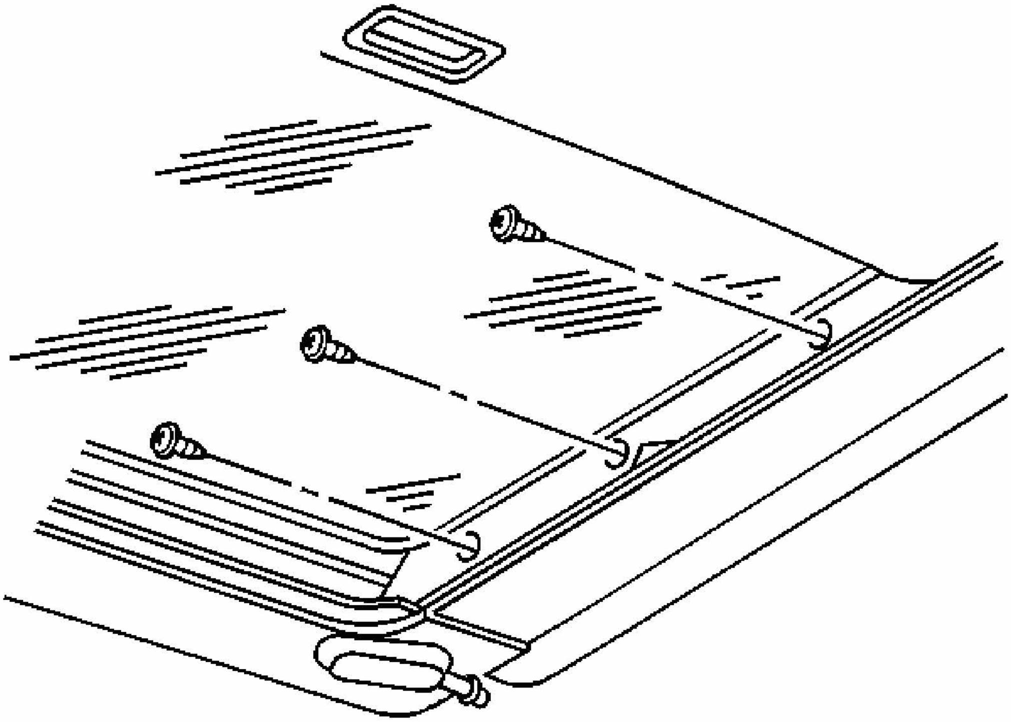


Fig. 6: View Of Sunroof Window Panel Screws
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to FASTENER NOTICE in Cautions and Notices.**

7. Tighten the sunroof glass panel screws.

Tighten: Tighten the screws to 4 N.m (35 lb in).

SUNROOF TRACK TIMING/SYNCHRONIZATION

Removal Procedure

1. Remove the headliner. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** .
2. Disconnect the electrical connector from the motor/actuator.
3. Remove the motor/actuator. Refer to **Sunroof Motor/Actuator Replacement**.
4. Remove the sunroof window. Refer to **Sunroof Window Replacement**.
5. Manually slide the mechanism forward in the track until the mechanism reaches the hard stop.

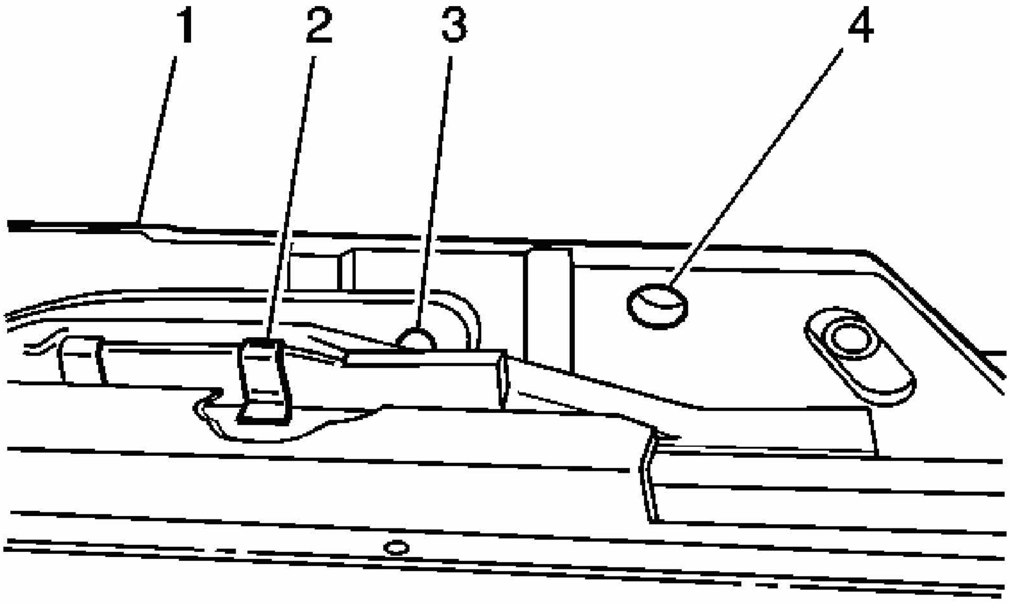


Fig. 7: View Of Cam Assembly, Timing Hole & Lifter Arm
Courtesy of GENERAL MOTORS CORP.

6. Push the cam assembly (2) forward until the timing hole (3) in the cam is aligned with the timing hole (4) in the lifter arm (1).

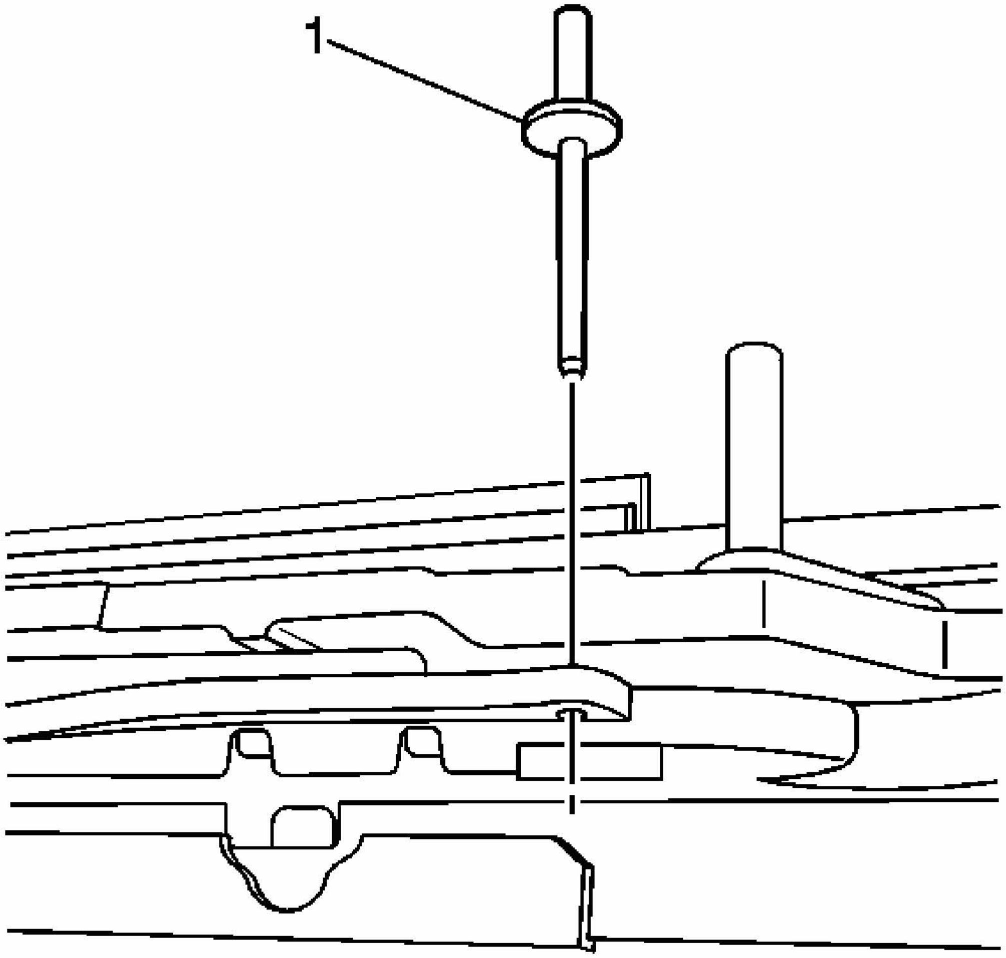


Fig. 8: View Of Pin & Drive Motor
Courtesy of GENERAL MOTORS CORP.

7. Insert a pin (1) in the holes to hold the position while installing the drive motor.

IMPORTANT: Both mechanisms should now be in the closed position.

8. Repeat this procedure for the opposite side.

Installation Procedure

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the sunroof window. Refer to **Sunroof Window Replacement**.

   Tighten: Tighten the screws to 4 N.m (35 lb in).

2. Install the motor/actuator. Refer to **Sunroof Motor/Actuator Replacement**.

   Tighten: Tighten the motor attachment screws to 3.5 N.m (31 lb in).

3. Connect the electrical connector to the motor/actuator.

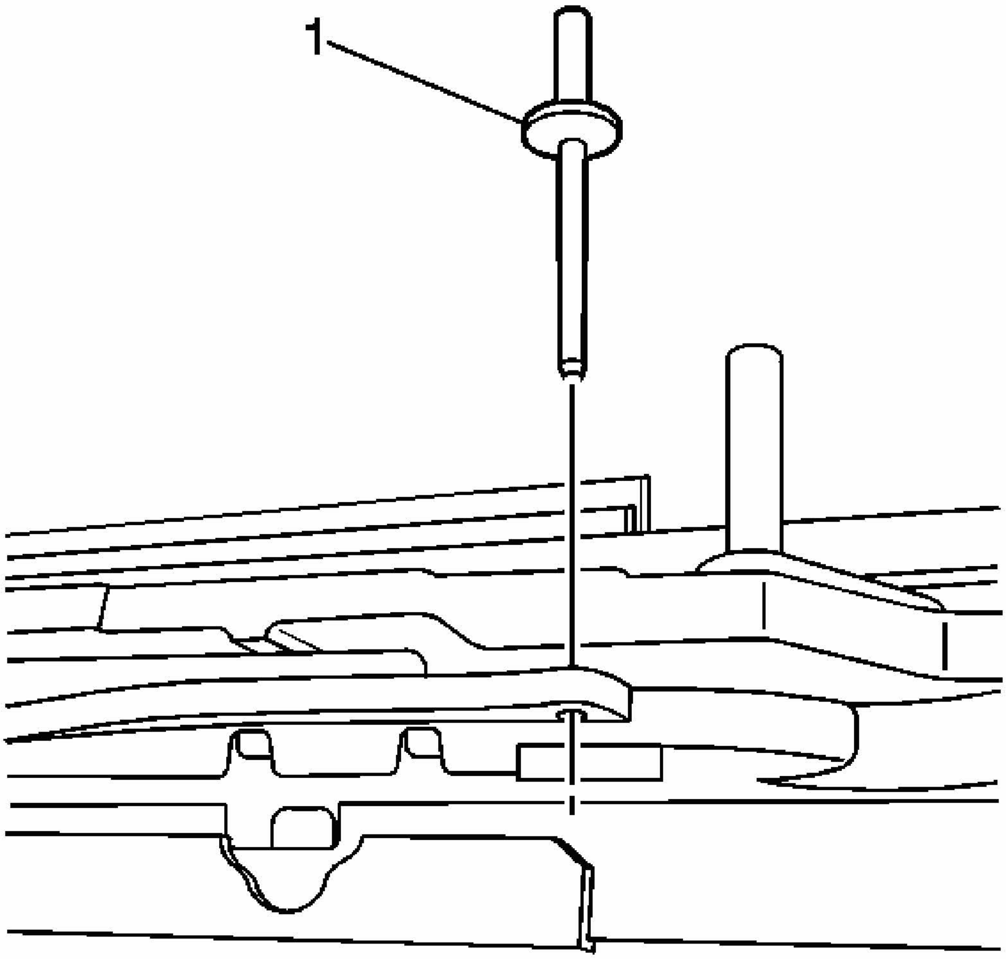


Fig. 9: View Of Pin & Drive Motor
Courtesy of GENERAL MOTORS CORP.

4. Remove the pin (1) from the holes that held the position while installing the drive motor.

5. Install the headliner. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** .
6. Perform the Initialization/Teach Procedure. Refer to **Sunroof Motor/Actuator Initilization/Teach Process**.
7. Verify the operation of the sunroof.

SUNROOF DRAIN HOSE REPLACEMENT - FRONT (MONTE CARLO)

Removal Procedure

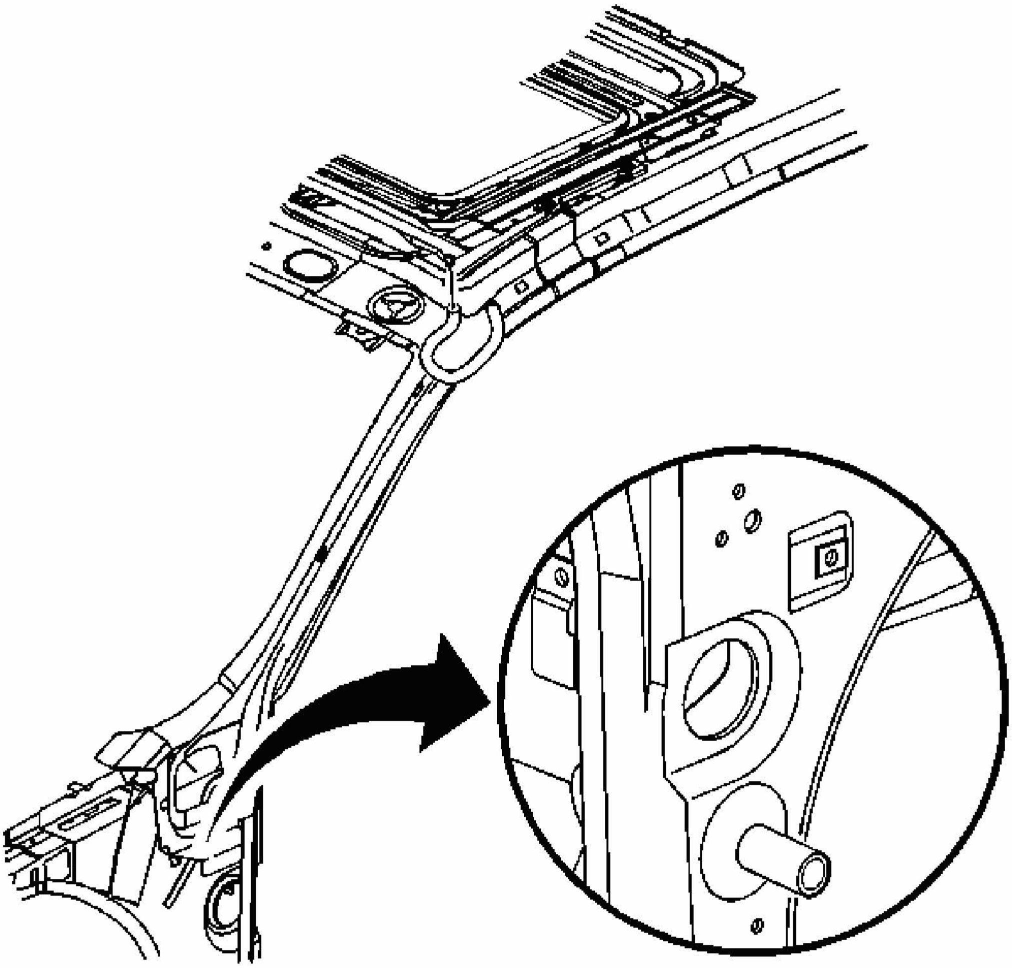


Fig. 10: Front Panel Access Hole (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

1. Remove the front carpet retainer. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** .

2. Remove the headliner. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** .
3. Pull back the carpet in order to gain access to the access hole in the front pillar.
4. Remove the insulator panel.
5. Disconnect the front sunroof drain hose from the sunroof module front drain tube.
6. Tie a string to the end of the module end of the front sunroof drain hose.
7. Remove the grommet at the end of the front sunroof drain hose from the hole in the front pillar.
8. Remove the front sunroof drain hose from the front pillar, by pulling the hose from the access hole in the front pillar, allowing the string to remain in the pillar.

Installation Procedure

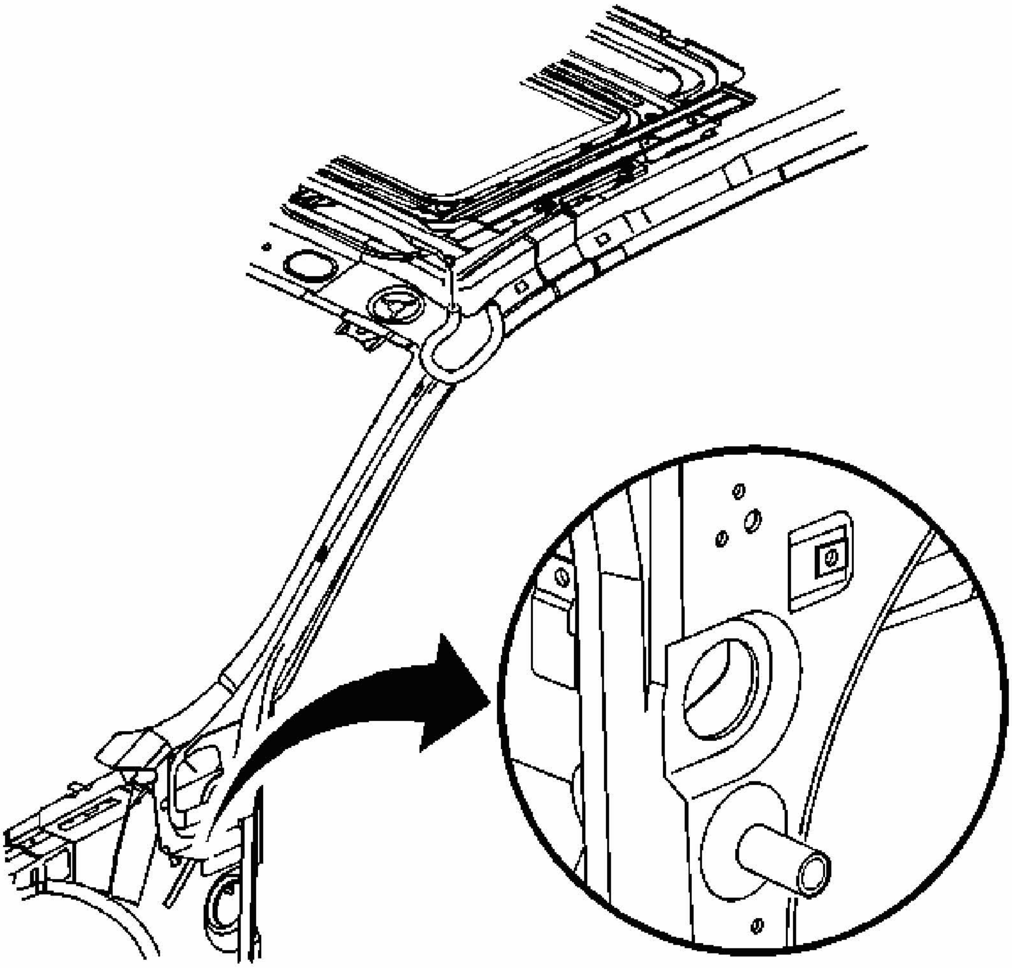


Fig. 11: Front Panel Access Hole (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

1. Tie the string to the end of the front sunroof drain hose at the sunroof module.
2. Install the front sunroof drain hose, by pulling the string from the front pillar access hole and routing the front sunroof drain hose through the front pillar.
3. Remove the string from the front sunroof drain hose.
4. Install the end of the front sunroof drain hose to the grommet in hole in the front pillar.
5. Connect the front sunroof drain hose to the sunroof module front drain tube.
6. Inspect the front sunroof drain hose for proper installation.
7. Install the insulator panel.
8. Position the carpet back in place.
9. Install the front carpet retainer. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** .
10. Install the headliner. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** .

FRONT SUNROOF DRAIN HOSE REPLACEMENT (IMPALA)

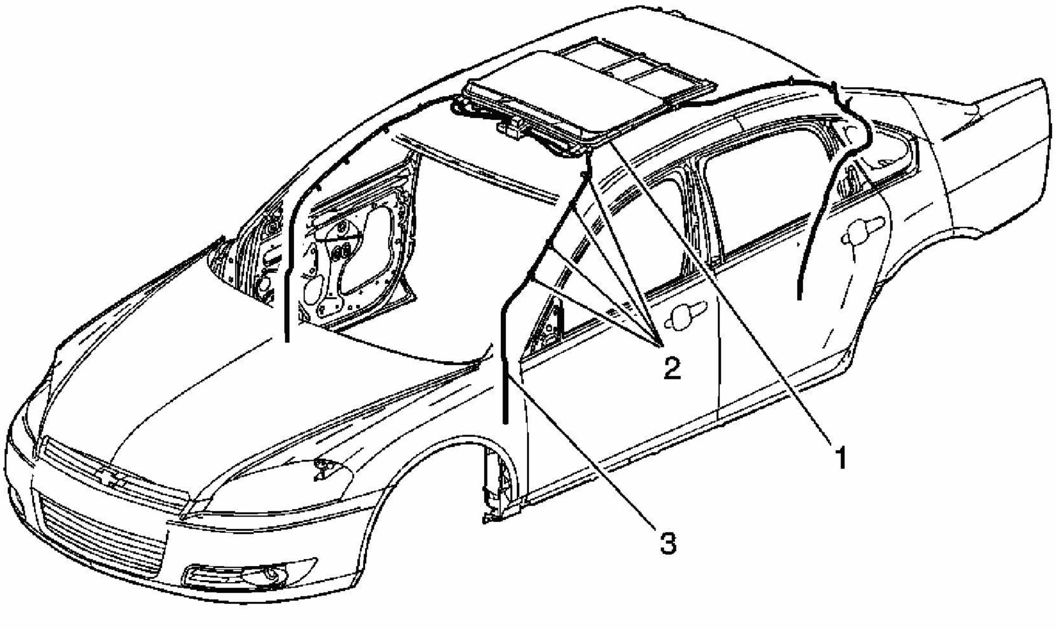


Fig. 12: Replacing Front Sunroof Drain Hose
Courtesy of GENERAL MOTORS CORP.

Sunroof Drain Hose Replacement - Front (Impala)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.

Preliminary Procedures
Remove the carpet retainer. Refer to Carpet Retainer Replacement - Front (Impala) or Carpet Retainer Replacement - Front (Monte Carlo) .
Remove the sunshade. Refer to Sunshade Replacement .
Remove the pillar garnish molding. Refer to Garnish Molding Replacement - Windshield Pillar (Impala) or Garnish Molding Replacement - Windshield Pillar (Monte Carlo) .
Remove the upper center pillar. Refer to Trim Panel Replacement - Upper Center Pillar .
Remove the rear upper quarter trim. Trim Panel Replacement - Rear Quarter Upper (Impala) or Trim Panel Replacement - Rear Quarter Upper (Monte Carlo) .
Remove the rear window trim. Refer to Trim Panel Replacement - Rear Window Shelf .
Remove the headliner. Refer to Headliner Replacement (Impala) or Headliner Replacement (Monte Carlo) .</td></tr>
<tr><td>1</td><td>Hose, Sunroof Drain
Tip:
Reposition the carpet in order to gain access to the access hole in the front pillar.
Disconnect the front sunroof drain hose from the sunroof module front spigot.
Tie a string to the hose at the module end of the front sunroof drain hose.
Remove the grommet at the end of the front sunroof drain hose from the hole in the front pillar.
Remove the front sunroof drain hose from the front pillar, by pulling the hose from the access hole in the front pillar, allowing the string to remain in the pillar.</td></tr>
</table>

SUNROOF DRAIN HOSE REPLACEMENT - REAR (MONTE CARLO)

Removal Procedure

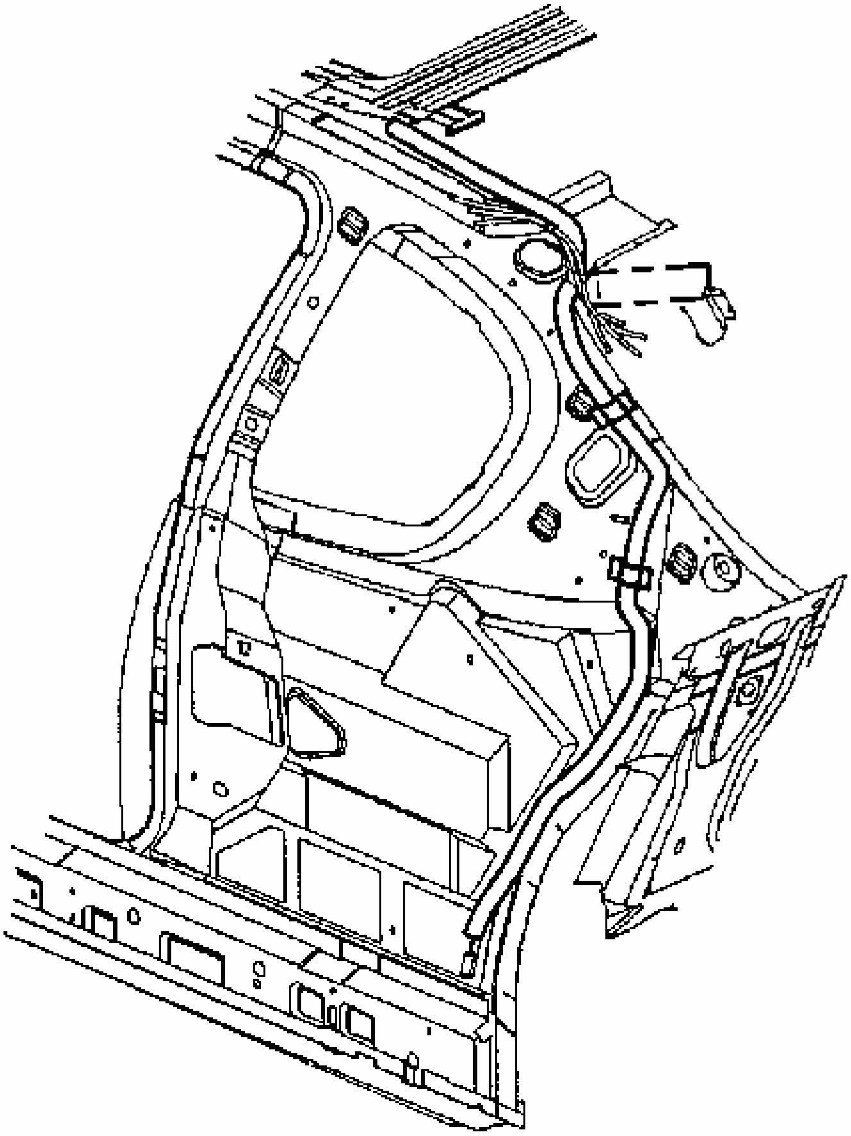


Fig. 13: Rear Sunroof Drain Hose (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

1. Remove the headliner. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** .
2. Remove the rear quarter lower trim. Refer to **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)** .
3. Remove the tape from rear sunroof drain hose on the rear quarter upper inner panel.

4. Disconnect the rear sunroof drain hose from the sunroof module rear drain tube.

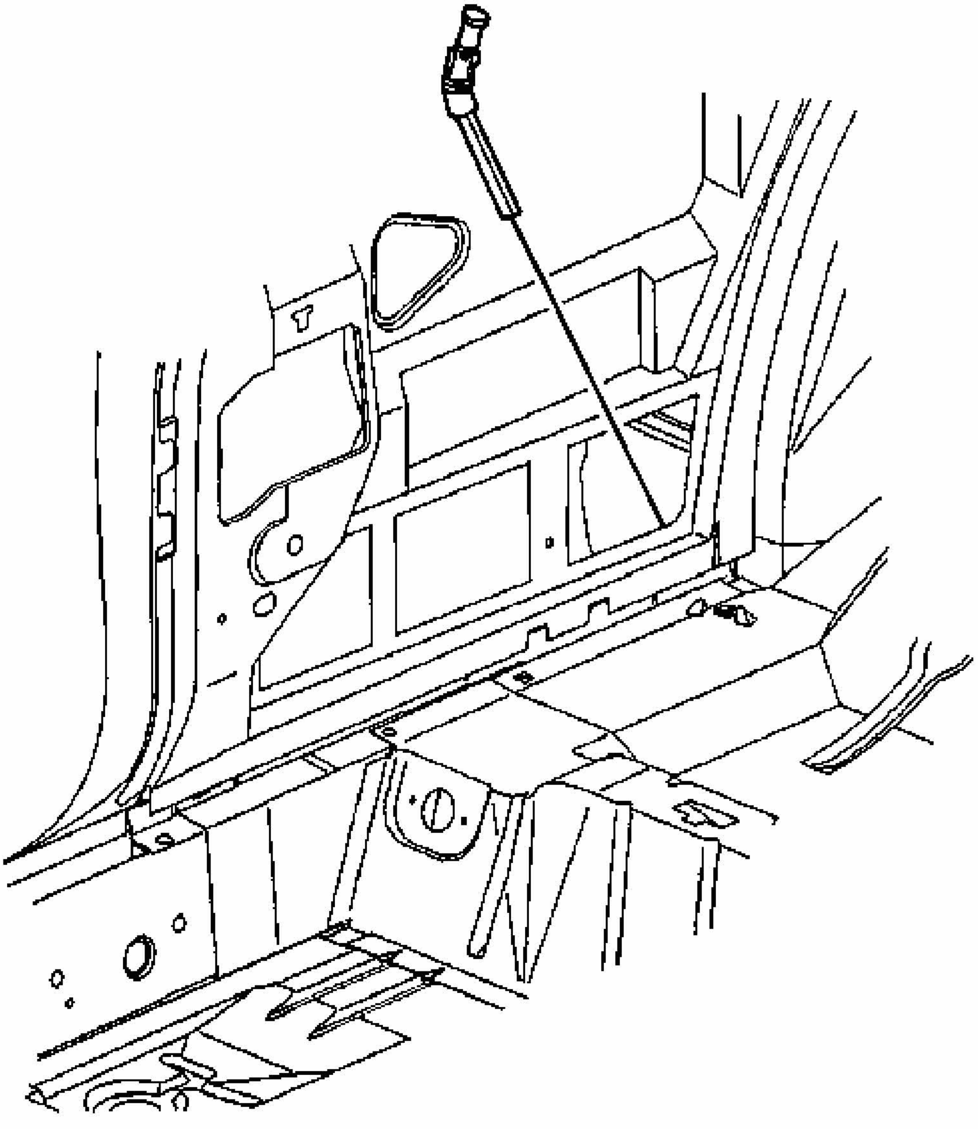


Fig. 14: Disconnecting Sunroof Drain Hose From Tube (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the rear sunroof drain hose from the rear sunroof drain tube.

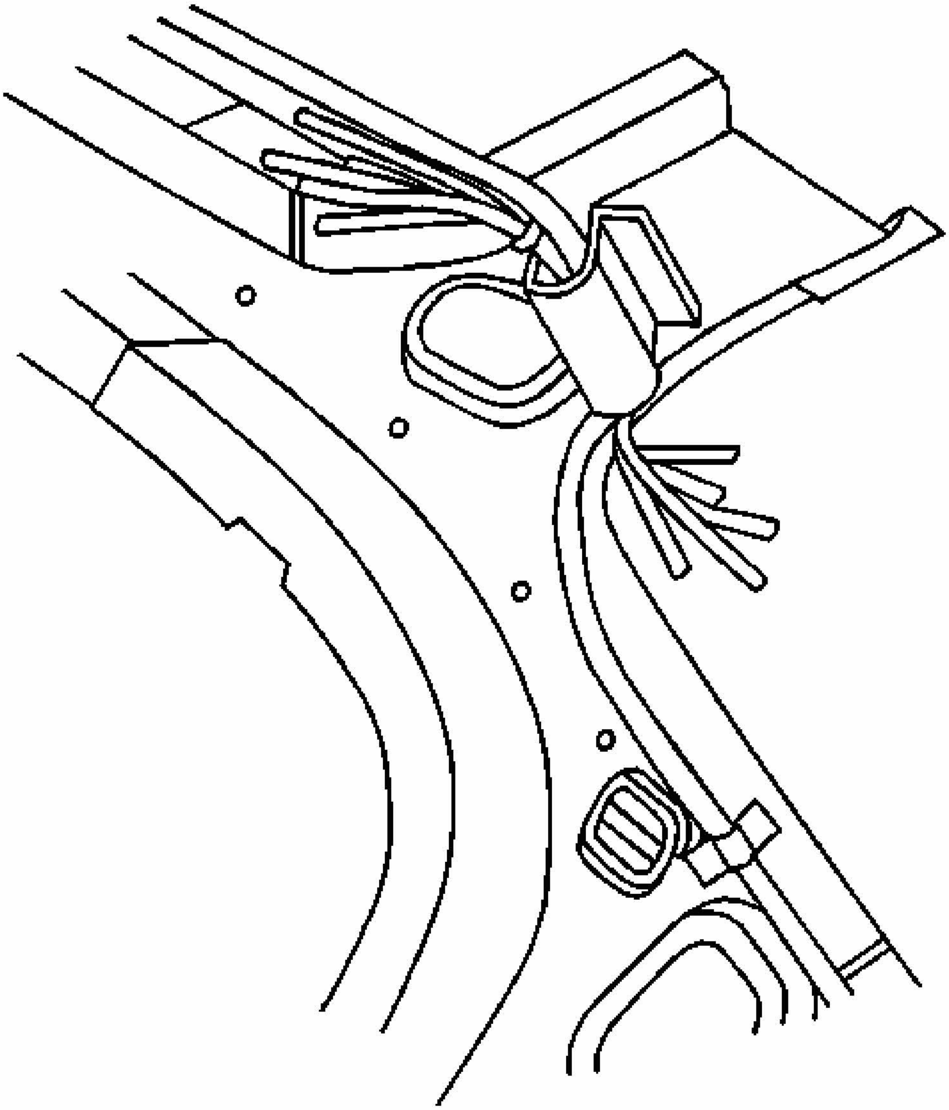


Fig. 15: Removing Rear Sunroof Drain Hose From Rear Quarter Upper Inner Panel (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

6. Remove the rear sunroof drain hose from the rear quarter upper inner panel.

Installation Procedure

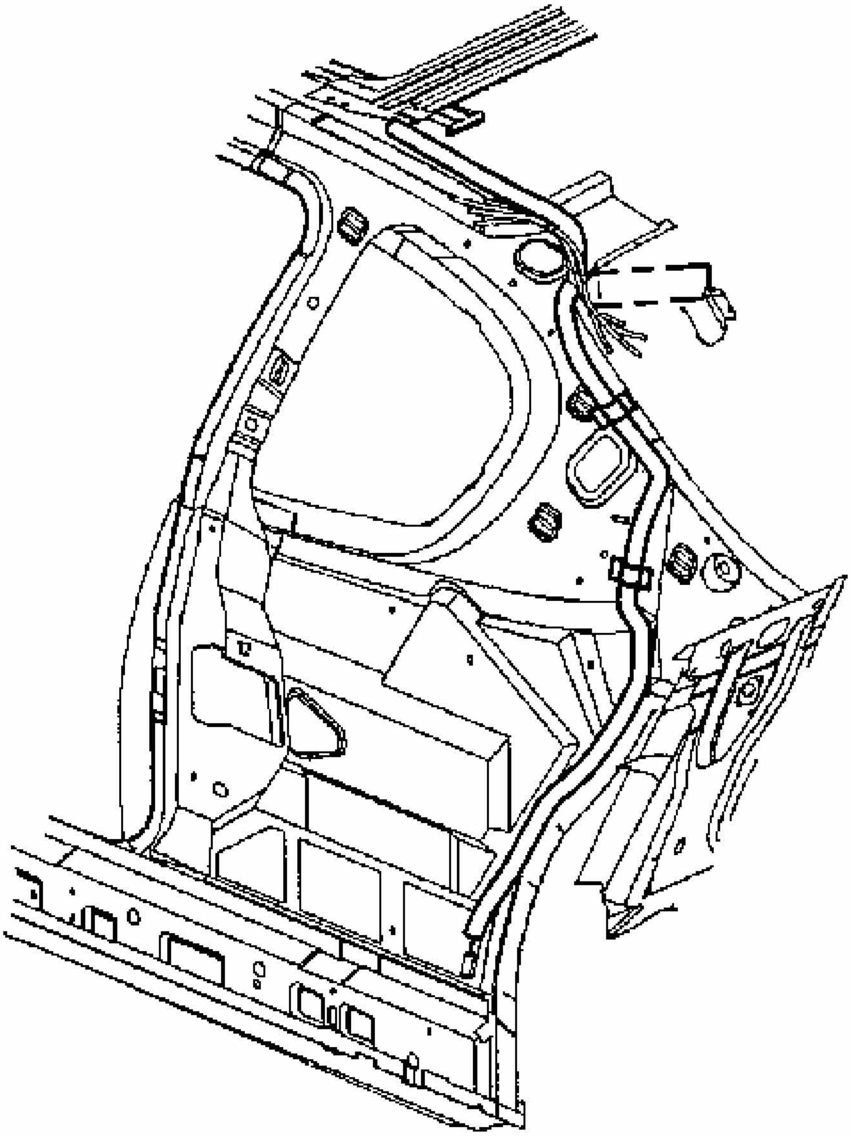


Fig. 16: Rear Sunroof Drain Hose (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

1. Position the rear sunroof drain hose to the rear quarter upper inner panel.
2. Route the rear sunroof drain hose above the rear quarter window, through the drain hose protector, along the rear window frame and down the rear quarter inner panel.
3. Install tape to rear sunroof drain hose on the rear quarter upper inner panel.
4. Connect the rear sunroof drain hose to the sunroof module rear spigot.

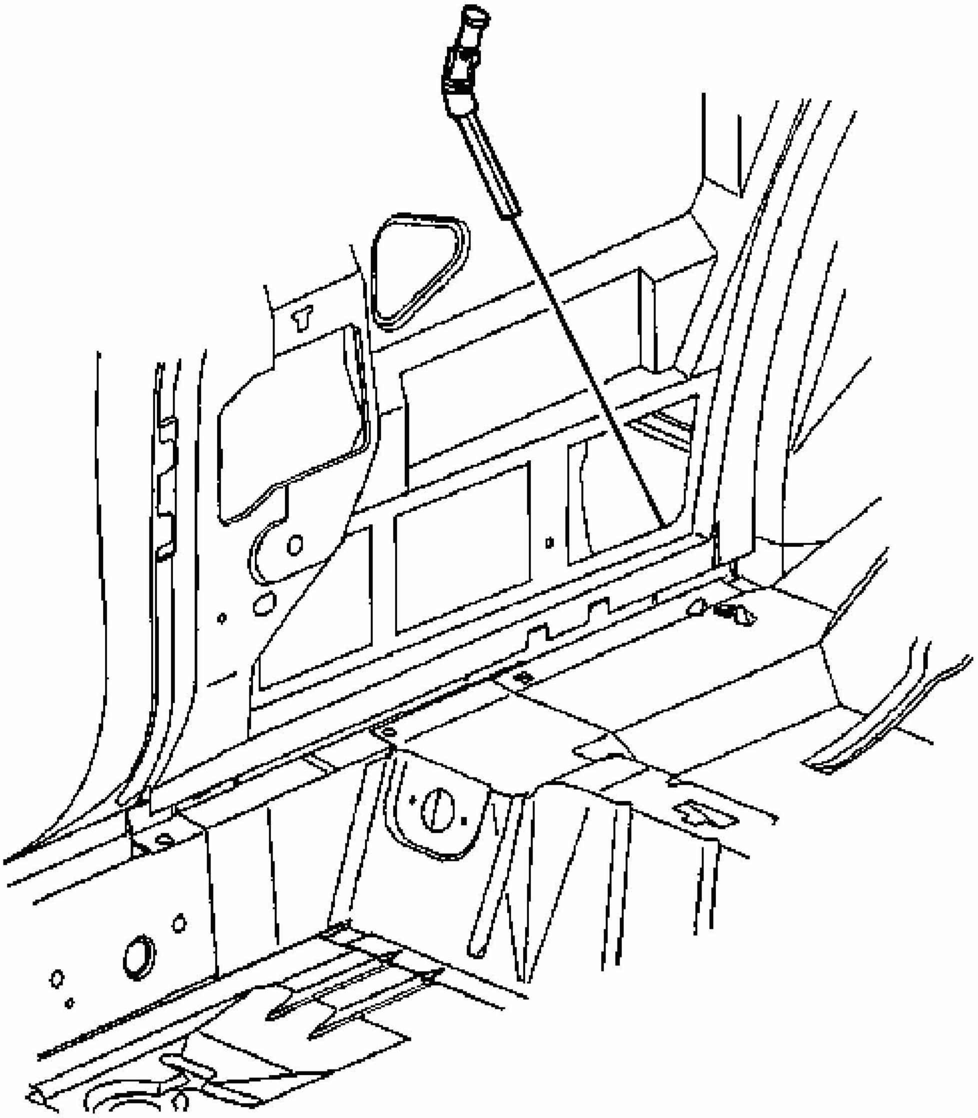


Fig. 17: Disconnecting Sunroof Drain Hose From Tube (Monte Carlo)
Courtesy of GENERAL MOTORS CORP.

5. Connect the rear sunroof drain hose to the rear sunroof drain hose tube.
6. Install the rear lower quarter trim. Refer to **Trim Panel Replacement - Rear Quarter Lower (Impala)** or **Trim Panel Replacement - Rear Quarter Lower (Monte Carlo)** .
7. Install the headliner. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** .

REAR SUNROOF DRAIN HOSE REPLACEMENT (IMPALA)

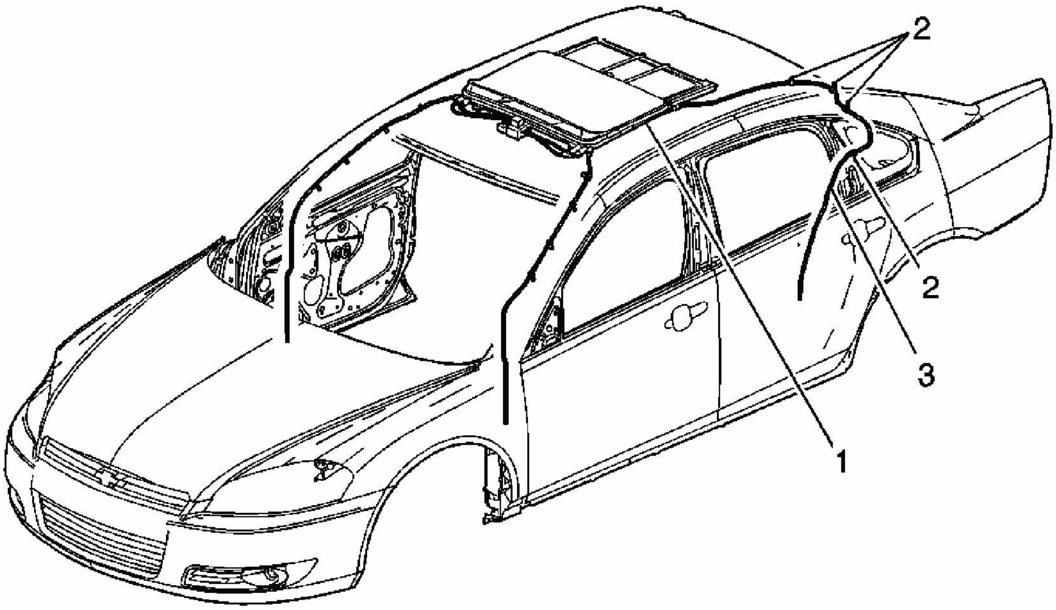


Fig. 18: Replacing Rear Sunroof Drain Hose
Courtesy of GENERAL MOTORS CORP.

Sunroof Drain Hose Replacement - Rear (Impala)

Callout	Component Name

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedures

1. Remove the carpet retainer. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** .
2. Remove the sunshade. Refer to **Sunshade Replacement** .
3. Remove the pillar garnish molding. Refer to **Garnish Molding Replacement - Windshield Pillar (Impala)** or **Garnish Molding Replacement - Windshield Pillar (Monte Carlo)** .
4. Remove the upper center pillar. Refer to **Trim Panel Replacement - Upper Center Pillar** .
5. Remove the rear upper quarter trim. **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .
6. Remove the rear window trim. Refer to **Trim Panel Replacement - Rear Window Shelf** .

7. Remove the rear seat. Refer to **Seat Back Replacement - Rear (Impala)** or **Seat Back Replacement - Rear (Monte Carlo)** . 8. Remove the headliner. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** .	
1	Hose, Sunroof Drain **Tip:** 1. Reposition the carpet in order to gain access to the access hole in the rear quarter panel. 2. Disconnect the rear sunroof drain hose from the sunroof module rear spigot. 3. Tie a string to the hose at the module end of the rear sunroof drain hose. 4. Remove the grommet at the rear end of the sunroof drain hose from the hole in the quarter panel. 5. Remove the rear sunroof drain hose from the rear quarter panel, by pulling the hose from the access hole in the rear quarter panel, allowing the string to remain in the quarter panel.

SUNROOF DRAIN INSPECTION AND CLEANING

Drain Hose Routing

A drain trough encircles the sunroof window panel and water is drained off by the drain hoses located at each corner of the housing. A drain channel spans across the sunroof module at the rear of the window panel and directs water into the trough.

1. Check to ensure the front drain hoses are routed down the windshield pillars and out the center of the pillar between the door hinges. Make sure the hoses are not kinked. Replace any torn or cracked hose. Refer to **Sunroof Drain Hose Replacement - Front (Monte Carlo)** or **Sunroof Drain Hose Replacement - Front (Impala)**.
2. Check to ensure the rear drain hoses are routed through the rear pillars and out of the rocker panel. Make sure the rear hoses are properly routed in the metal roof slot and taped in place. Replace any torn or cracked hose. Refer to **Sunroof Drain Hose Replacement - Rear (Monte Carlo)** or **Sunroof Drain Hose Replacement - Rear (Impala)**.

Plugged Drain Hose

If a waterleak has occurred check for a plugged drain hose at each corner of drainage system.

1. Open the sunroof window.
2. To test for blockage, pour a small container of water into the module housing drain

trough. Check each corner to confirm the drain hose is draining water.

CAUTION: Wear safety glasses in order to avoid eye damage.

3. Use compressed air, 241 kpi (35 psi) or less to blow out any drain hose that is plugged.
4. Test the system again.
5. If the hose remains plugged, check to see it is properly routed and does not have a kink. Refer to **Drain Hose Routing**.
6. Remove any hoses that remain plugged.
   - For front hoses, Refer to **Sunroof Drain Hose Replacement - Front (Monte Carlo)** or **Sunroof Drain Hose Replacement - Front (Impala)**
   - For rear hoses, Refer to **Sunroof Drain Hose Replacement - Rear (Monte Carlo)** or **Sunroof Drain Hose Replacement - Rear (Impala)**
7. Remove the blockage using the following steps.
   1. Push mechanics wire through the hose to remove the obstruction.
   2. Use compressed air in order to blow out any remaining material.
   3. Reinstall the hose. Refer to **Drain Hose Routing**.

Disconnected Drain Hose

Inspect the drainage system for disconnected drain hoses. Complete the following steps in order to obtain partial access to drain hoses and check for a disconnected hose.

1. Open the sunroof window panel.
2. Lower the headliner as needed. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** in Interior Trim.
3. Connect any disconnected hoses.
4. Ensure that the rear drain hoses are properly routed in the metal roof slot and taped in place.

SUNROOF SUNSHADE PANEL REPLACEMENT

Removal Procedure

1. Open the sunroof window.
2. Close the sunshade to within a hand-width of full closure.
3. From the top of the vehicle, push the sunshade toward the far side of the sunroof window track assembly.

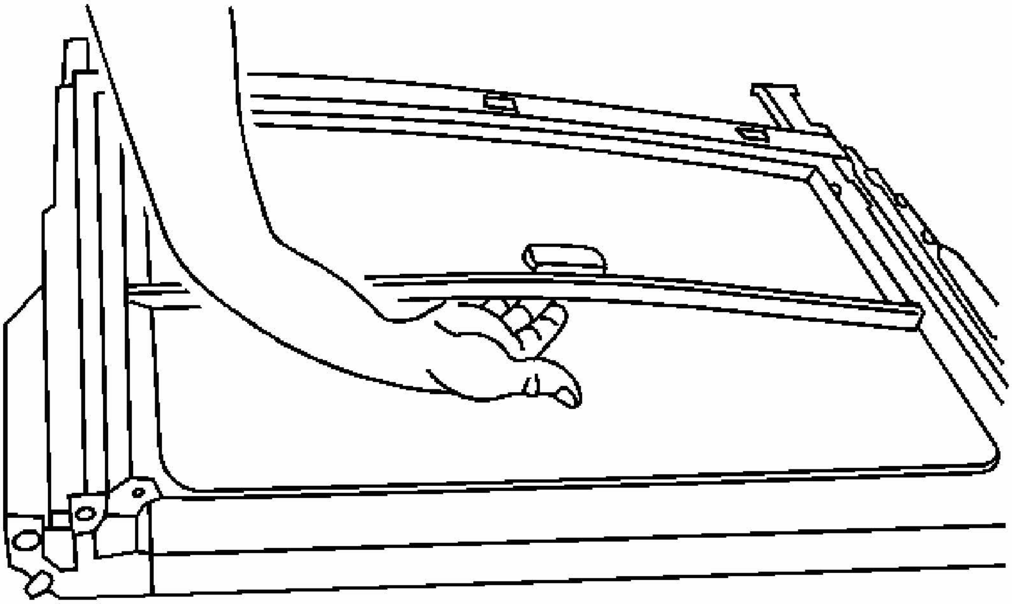


Fig. 19: Arching Sunshade Upward
Courtesy of GENERAL MOTORS CORP.

4. Carefully arch the sunshade upward at the center of the forward edge.
5. Lift upward on the forward edge of the sunshade until the front sunshade guide is released from the track assembly.
6. Slightly rotate the sunshade forward. Carefully arch the sunshade upward at the center of the rearward edge.
7. Lift upward on the rearward edge of the sunshade until the rear sunshade guide is released from the track assembly.

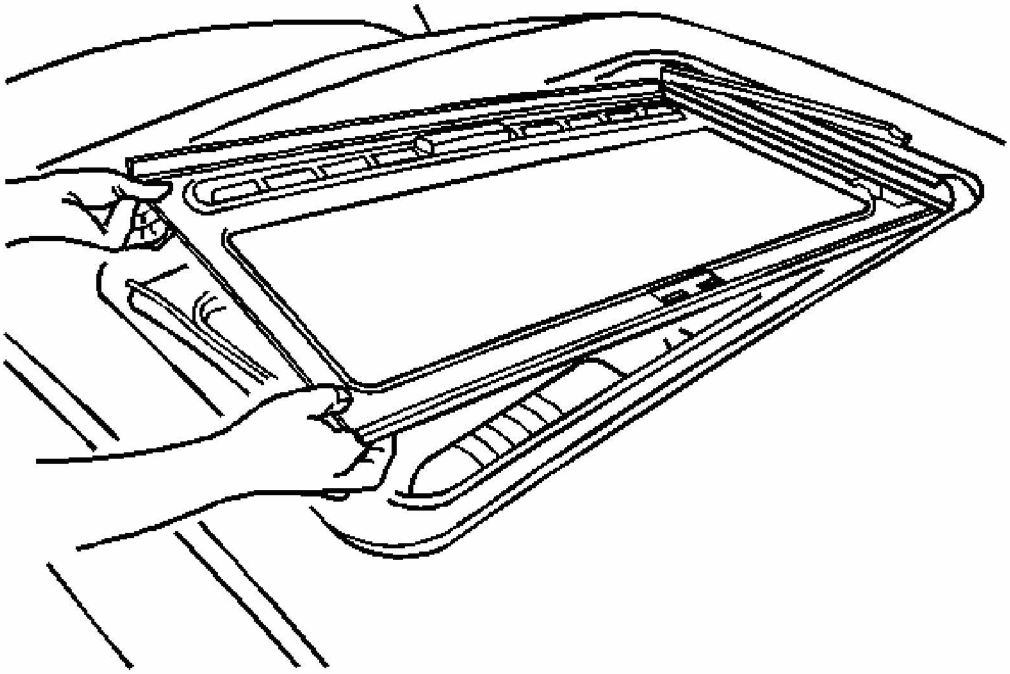


Fig. 20: Identifying Sunshade Retainers
Courtesy of GENERAL MOTORS CORP.

8. Lift upward and pull the sunshade to release the front and the rear guides from the track on the far side.
9. Remove the sunshade from the sunroof module. Ensure that the guides are still retained to the tabs on the sunshade.

Installation Procedure

1. If you are replacing the sunroof sunshade, transfer the 4 sunshade guides from the original sunshade to the new part.
2. When installing the guides into the track assembly, lightly push down on the guide's top spring feature, allowing the guide to seat in the track.

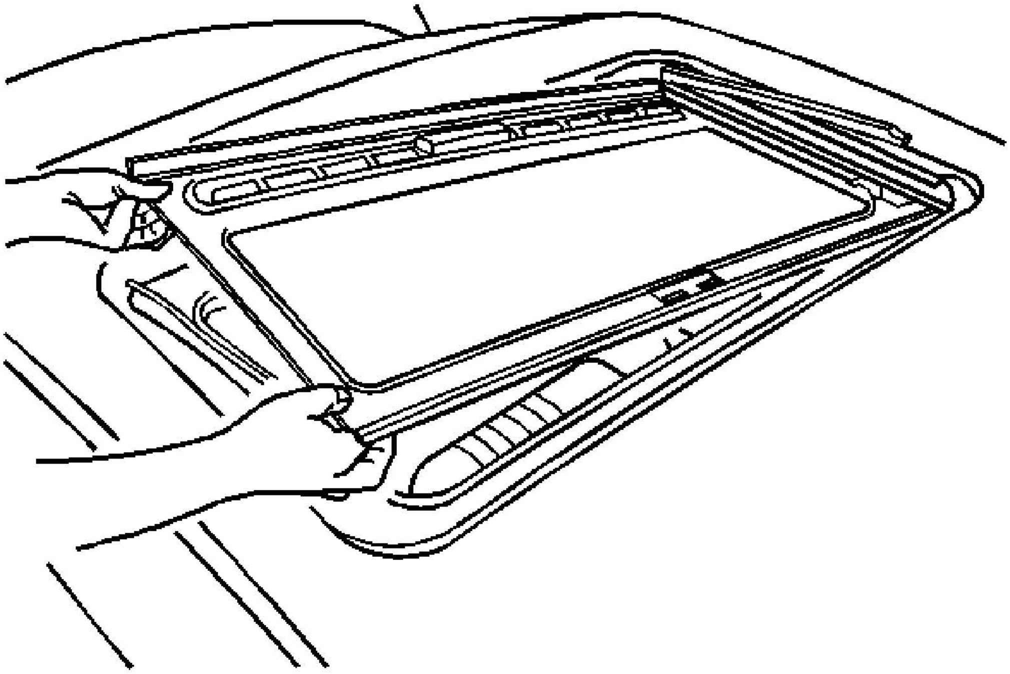


Fig. 21: Identifying Sunshade Retainers
Courtesy of GENERAL MOTORS CORP.

3. From the top of the vehicle, install the sunshade and the sunshade guides into the track assembly on the far side.
4. Carefully arch the sunshade upward at the center of the rearward edge.
5. Lift upward on the rearward edge of the sunshade until the rear sunshade guide can be positioned and seated into the track assembly.

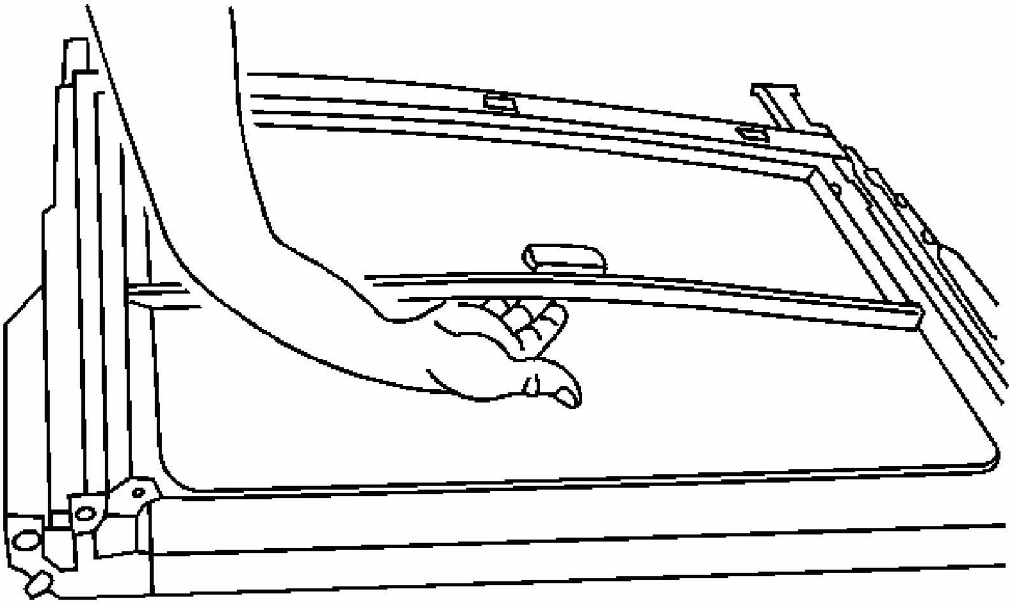


Fig. 22: Arching Sunshade Upward
Courtesy of GENERAL MOTORS CORP.

6. Slightly rotate the sunshade forward. Carefully arch the sunshade upward at the center of the forward edge.
7. Lift upward on the forward edge of the sunshade until the front sunshade guide can be positioned and seated into the track assembly.
8. Inspect the sunshade for proper operation.
9. Close the sunroof window.

SUNROOF AIR DEFLECTOR REPLACEMENT

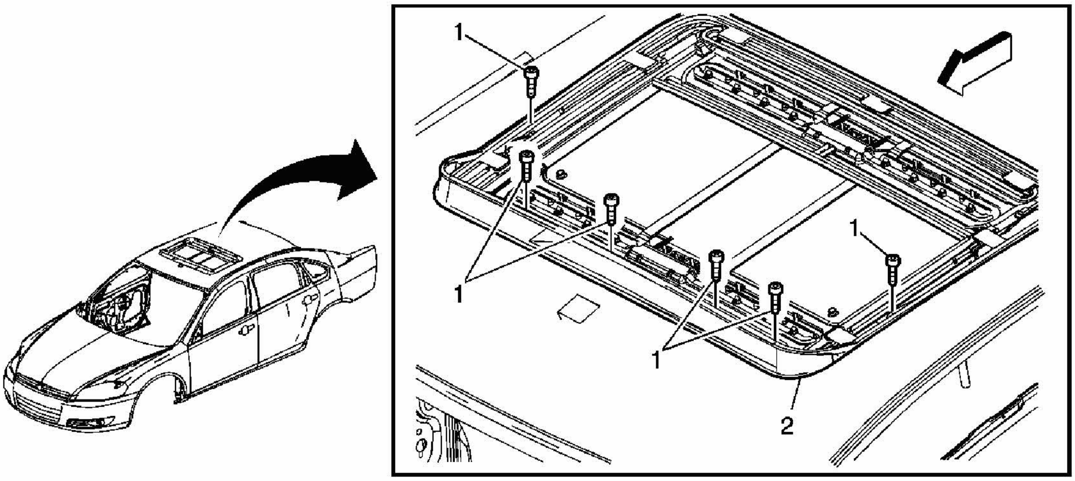


Fig. 23: Replacing Sunroof Air Deflector
Courtesy of GENERAL MOTORS CORP.

Sunroof Air Deflector Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the sunroof window. Refer to **Sunroof Window Replacement** 2. Power the sunroof window tracks to the full rear position. 3. Remove the actuators locator at the front of each window track.	
1	Screws, Deflector Air (Qty: 6) **Tighten:** 3N.m (26 lb in)
2	Deflector, Air **Tip:** Sliding the air deflector rearward working from side to side to release it from the sunroof module.

SUNROOF WINDOW REPLACEMENT

Removal Procedure

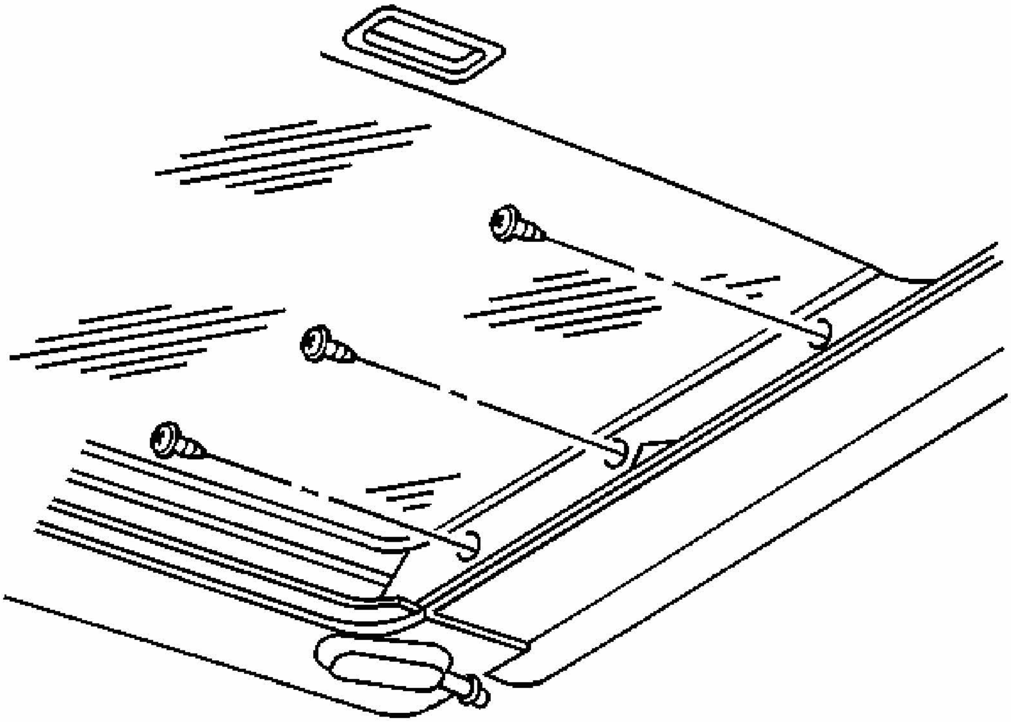


Fig. 24: View Of Sunroof Window Panel Screws
Courtesy of GENERAL MOTORS CORP.

1. Position the sunshade panel fully rearward.
2. Position the sunroof window panel to the vent position.
3. Remove the sunroof window panel screws from the sunroof window panel.
4. Remove the sunroof window panel from the sunroof module.

Installation Procedure

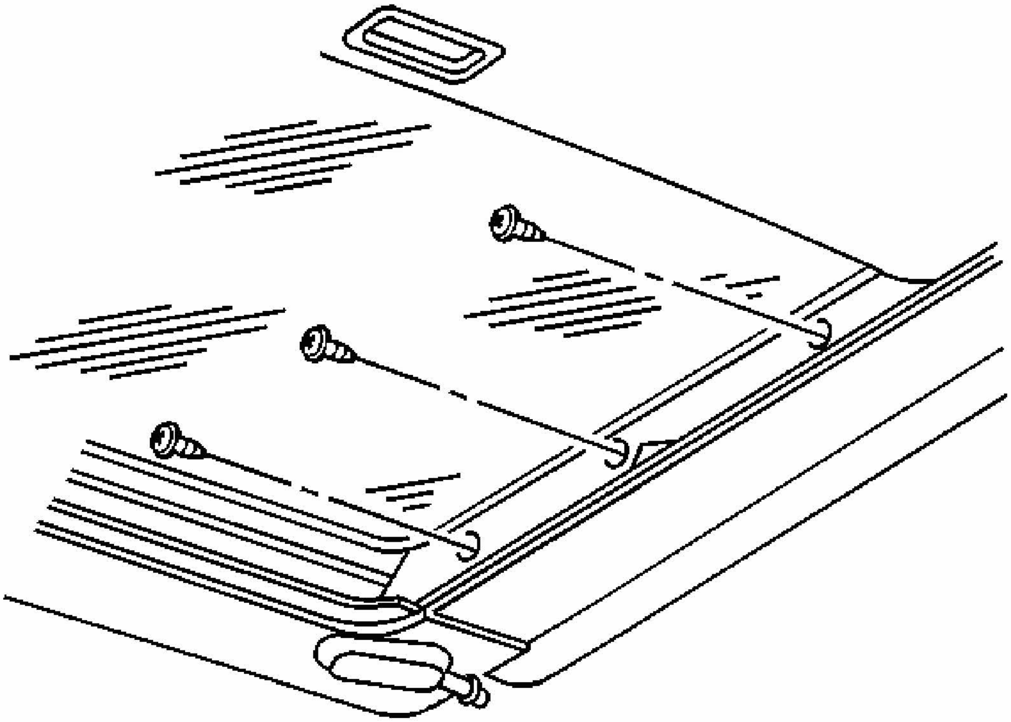


Fig. 25: View Of Sunroof Window Panel Screws
Courtesy of GENERAL MOTORS CORP.

1. Position the sunroof window panel to the sunroof module.

   Ensure that the information logo stencil is towards the rear of the sunroof opening.

   NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the sunroof window panel screws to the sunroof window panel.

   Tighten: Tighten the sunroof window panel screws to 4 N.m (35 lb in).

3. Adjust the sunroof window panel as necessary. Refer to **Sunroof Window Height and Opening Fit Adjustment**.
4. Inspect the sunroof window panel for proper operation.

SUNROOF WINDOW SEAL REPLACEMENT

Removal Procedure

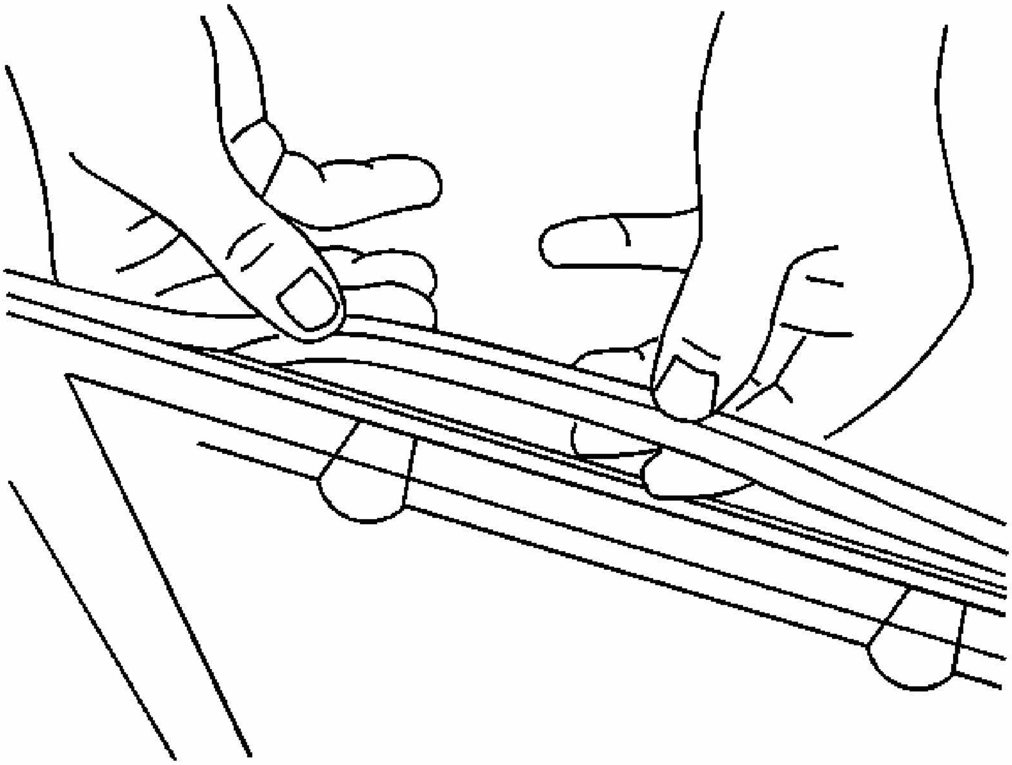


Fig. 26: Sunroof Window Weatherstrip
Courtesy of GENERAL MOTORS CORP.

1. Remove the sunroof window. Refer to **Sunroof Window Replacement**.
2. Remove the sunroof window seal from the sunroof window frame by pulling the sunroof window seal away at one point and continuing around the perimeter of the sunroof window frame.
3. Wipe the perimeter of the sunroof window frame area with a clean, dampened cloth using window cleaner GM P/N 1050427 (Canadian P/N 992727), or isopropyl alcohol in order to clean the surface of the perimeter of the sunroof window frame.

   Allow to air dry.

Installation Procedure

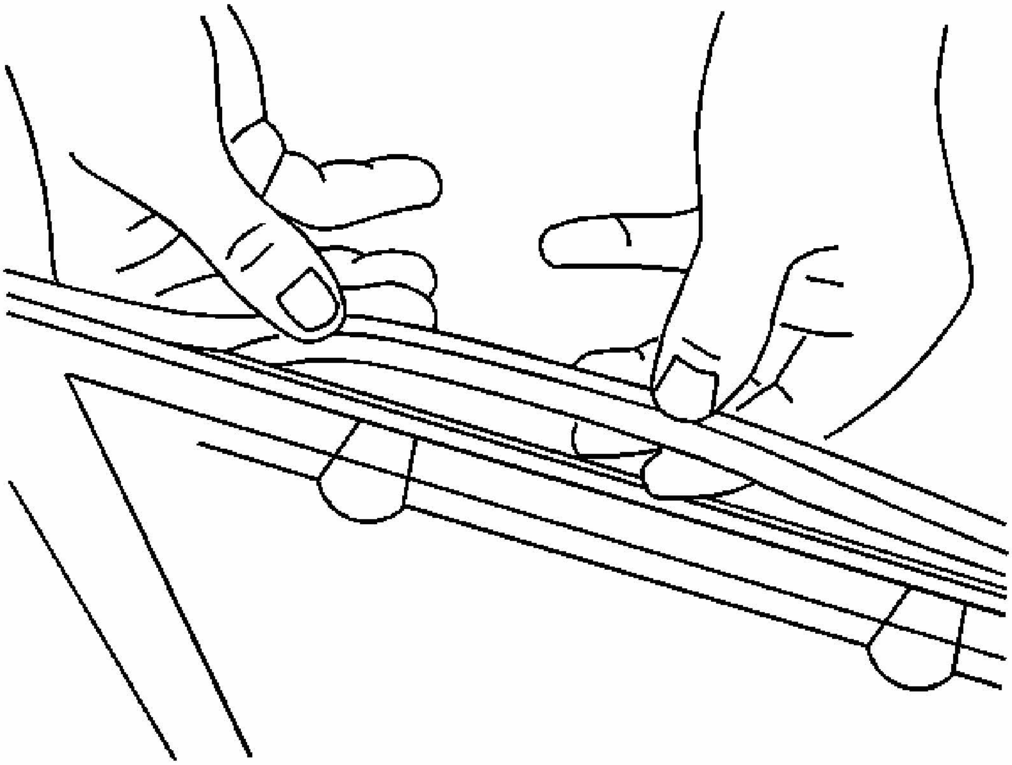


Fig. 27: Sunroof Window Weatherstrip
Courtesy of GENERAL MOTORS CORP.

1. Position the sunroof window seal into the gutter of the sunroof window frame.

IMPORTANT: Ensure that the sunroof window seal is properly seated around the entire perimeter of the sunroof window frame.

2. Firmly press the sunroof window seal into place.
3. Install the sunroof window. Refer to **Sunroof Window Replacement**.

SUNROOF SWITCH REPLACEMENT (IMPALA)

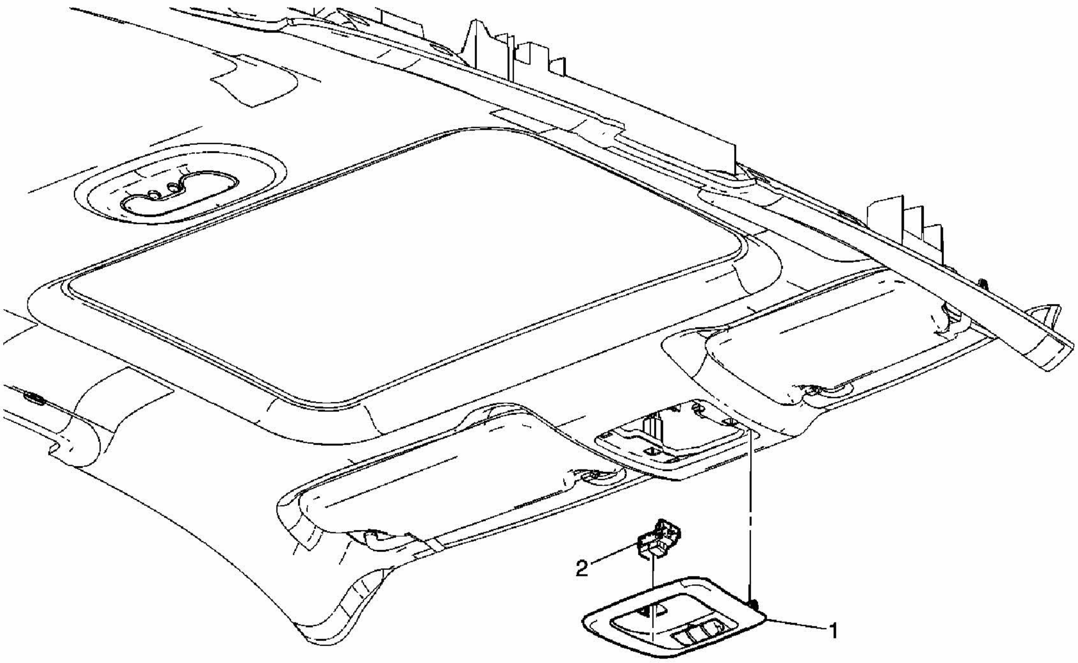


Fig. 28: Replacing Sunroof Switch
Courtesy of GENERAL MOTORS CORP.

Sunroof Switch Replacement (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .	
1	Overhead Console Assembly Refer to **Console Replacement - Overhead** **Tip:** Disconnect the electrical connector.
2	Sunroof Switch Assembly

SUNROOF SWITCH REPLACEMENT (MONTE CARLO)

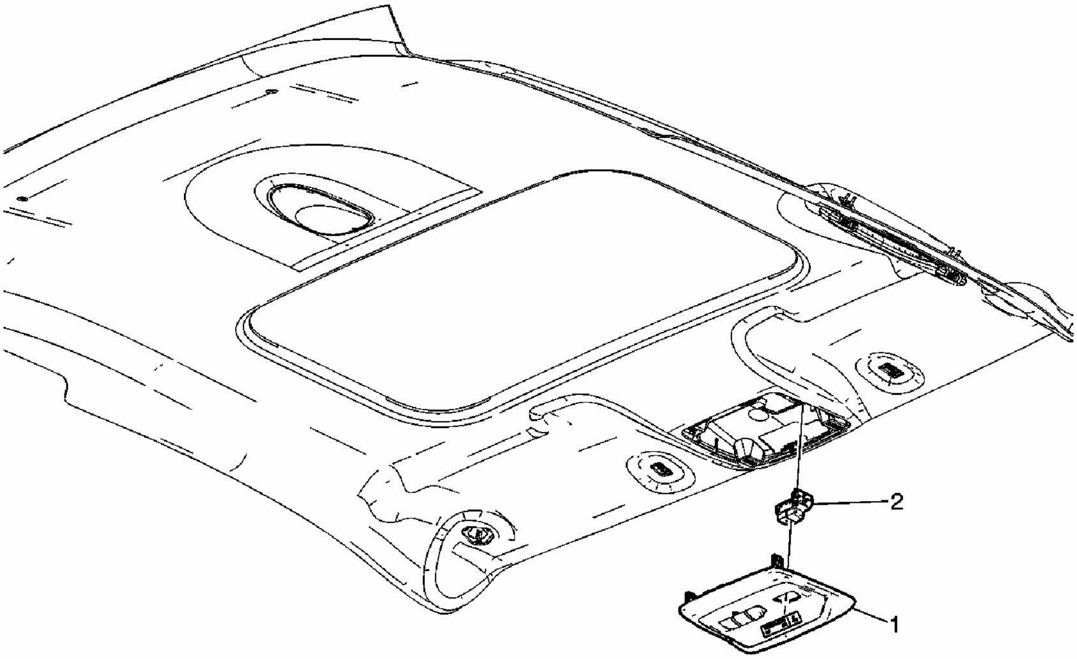


Fig. 29: Replacing Sunroof Switch
Courtesy of GENERAL MOTORS CORP.

Sunroof Switch Replacement (Monte Carlo)

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications** .	
1	Overhead Console Assembly Refer to **Console Replacement - Overhead** **Tip:** Disconnect the electrical connector.
2	Sunroof Switch Assembly

SUNROOF MOTOR/ACTUATOR REPLACEMENT

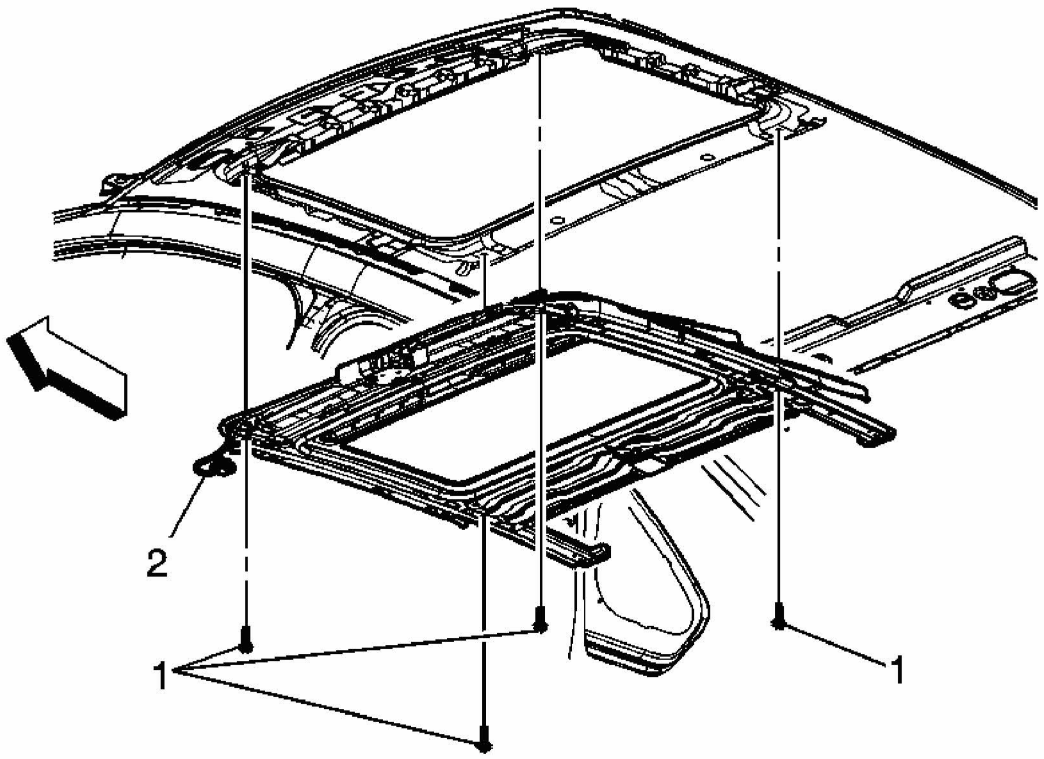


Fig. 30: Replacing Sunroof Motor/Actuator
Courtesy of GENERAL MOTORS CORP.

Sunroof Motor/Actuator Replacement

Callout	Component Name

NOTE:
Refer to Fastener Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedures

1. Remove the carpet retainer. Refer to **Carpet Retainer Replacement - Front (Impala)** or **Carpet Retainer Replacement - Front (Monte Carlo)** .
2. Remove the sunshade. Refer to **Sunshade Replacement** .
3. Remove the pillar garnish molding. Refer to **Garnish Molding Replacement - Windshield Pillar (Impala)** or **Garnish Molding Replacement - Windshield Pillar (Monte Carlo)** .
4. Remove the upper center pillar. Refer to **Trim Panel Replacement - Upper**

Center Pillar .

5. Remove the rear upper quarter trim. **Trim Panel Replacement - Rear Quarter Upper (Impala)** or **Trim Panel Replacement - Rear Quarter Upper (Monte Carlo)** .
6. Remove the rear window trim. Refer to **Trim Panel Replacement - Rear Window Shelf** .
7. Remove the headliner. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** .
8. Remove the sunroof motor/actuator. Refer to **Sunroof Motor/Actuator Replacement**.

1	Bolts, Module Sunroof (Qty: 4) **Tighten:** 10N.m (89 lb in)
2	Module, Sunroof

SUNROOF MOTOR/ACTUATOR INITILIZATION/TEACH PROCESS

Perform the Initialization/Teach Process any time a new sunroof motor actuator is installed in the vehicle.

1. Ensure that the electrical harness on the headliner is connected to the sunroof.
2. Press the sunroof switch to the close position until the window stops at the front hard stop in the fully closed position, then moves slightly back to the soft stop position. Release the switch. (This is the initialization portion).
3. Within 6 seconds, press and hold the close switch again. After 3 more seconds, the sunroof window will move toward the open position. (This is the teach portion).
4. Continue holding the switch until the sunroof window moves back to the close and stops at the closed position. Release the button. The initialization/Teach procedure is complete.
5. Verify the operation of the sunroof.

IMPORTANT: Re-Initialization/Teach for the original motor.

1. Perform the Reinitialization/Teach process any time the sunroof motor in removed form the sunroof.
2. Ensure that the electrical harness on the headliner is connected to the sunroof.
3. Press the sunroof switch to the close position until the window stops at the front soft stop in the fully closed position. Release the switch then press to the close position again and hold for 10 seconds or greater. The sunroof will then stall at the hard stop, and move back sightly to the soft stop position. Release the switch. (This is the re-

initialization portion).

4. Within 6 seconds, press and hold the close switch again. After 3 more seconds, the sunroof window will move toward the open position. (This is the teach portion).
5. Continue holding the switch until the sunroof window moves back to the close and stops at the closed position. Release the button. The initialization/Teach procedure is complete.
6. Verify the operation of the sunroof.

IMPORTANT: If in the Initialization/Teach Process is not complete, the following actions must take place before the initialization cycle is done:

- **The sunroof switch is not held in the close position.**
- **The ignition and/or battery power has been removed.**
- **The glass panel has not reached the closed position.**

The Initialization/Teach Process must be restarted if the procedure is not carried out completely.

SUNROOF MODULE ASSEMBLY REPLACEMENT

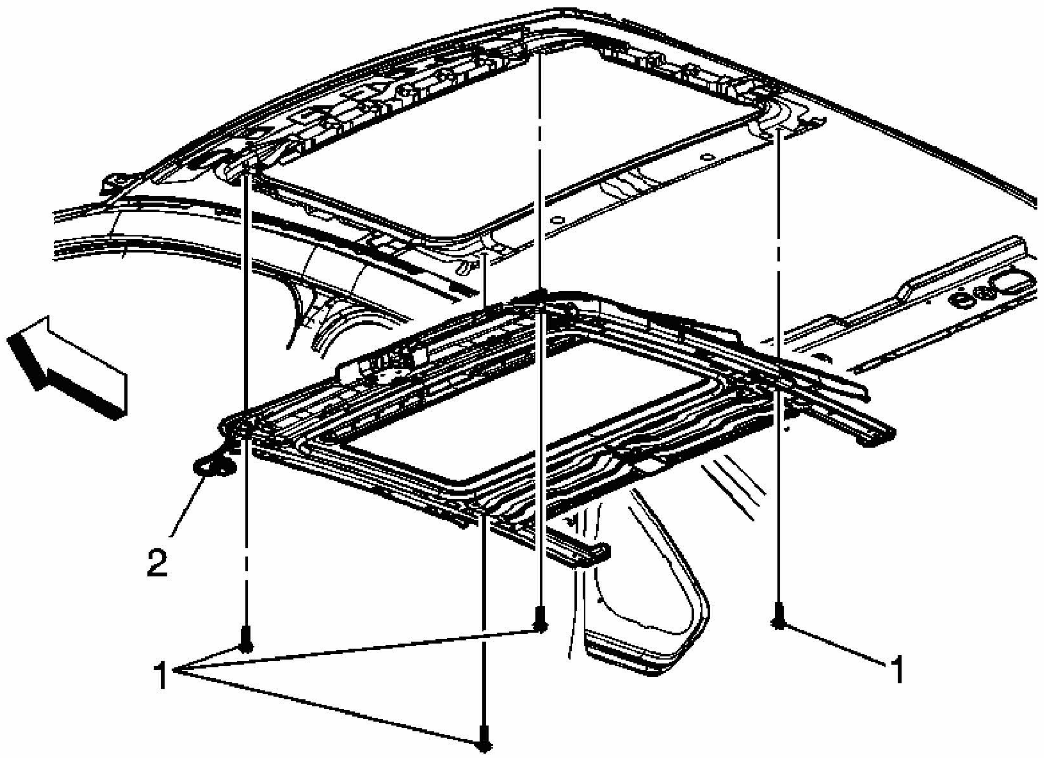


Fig. 31: Replacing Sunroof Module Assembly
Courtesy of GENERAL MOTORS CORP.

Sunroof Module Assembly Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the headliner. Refer to **Headliner Replacement (Impala)** or **Headliner Replacement (Monte Carlo)** . 2. Remove the sunroof motor/actuator. Refer to **Sunroof Motor/Actuator Replacement**.	
1	Bolts, Module Sunroof (Qty: 4) **Tighten:** 10 N.m (89 lb in)
2	Module, Sunroof

SUNROOF FINISHING LACE REPLACEMENT

Removal Procedure

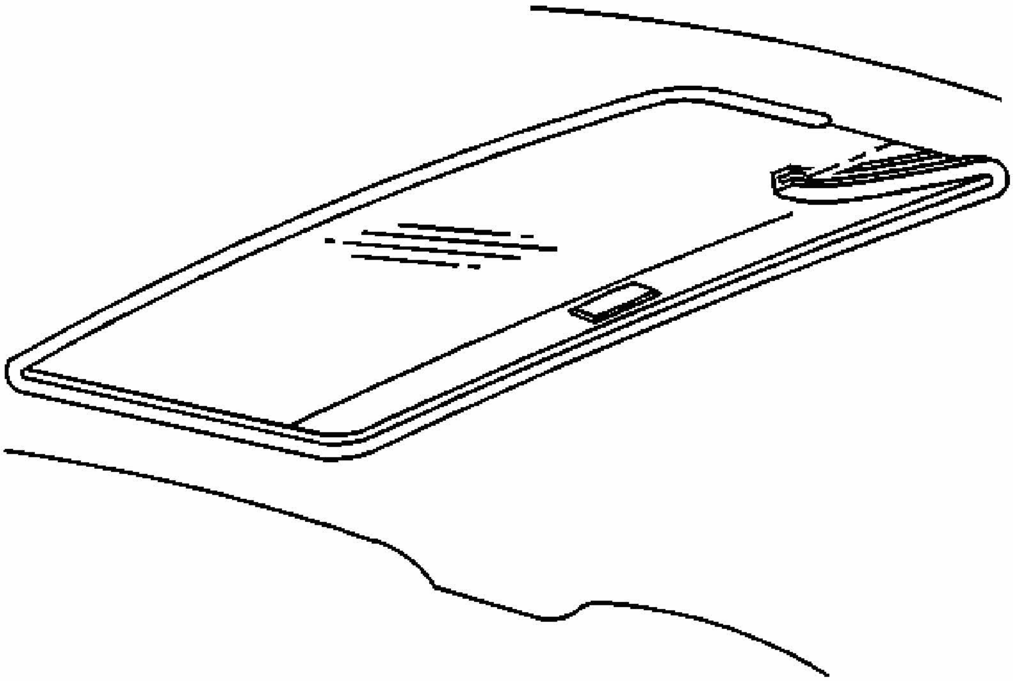


Fig. 32: Identifying Sunroof Opening Finishing Lace
Courtesy of GENERAL MOTORS CORP.

1. Beginning at the joint, pull the sunroof opening trim lace from the headliner.
2. Remove the sunroof opening trim lace from the headliner.

Installation Procedure

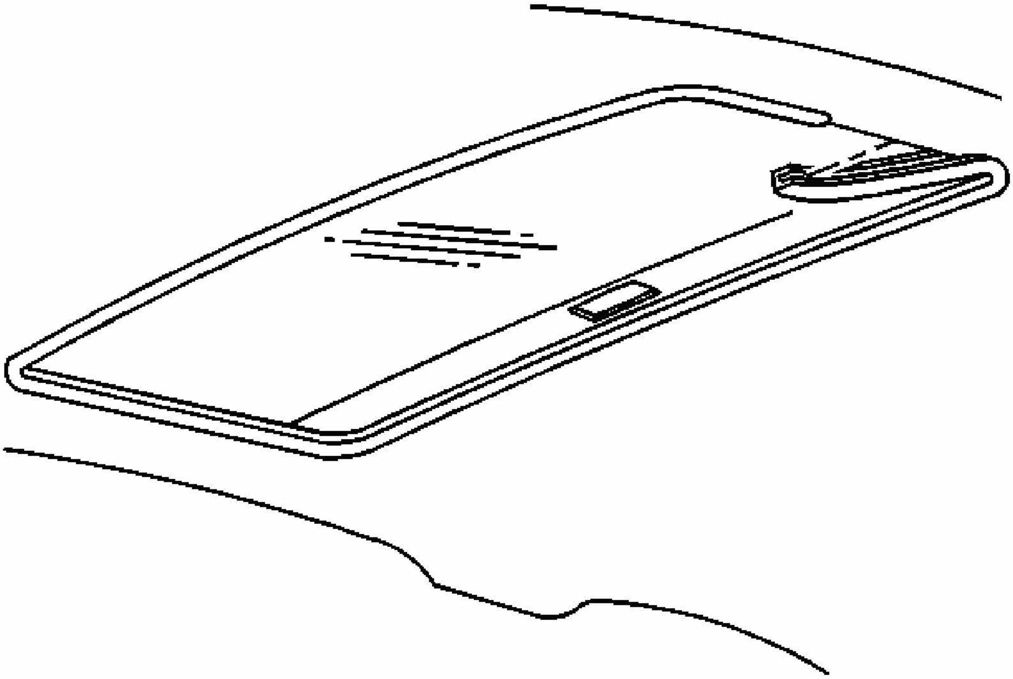


Fig. 33: Identifying Sunroof Opening Finishing Lace
Courtesy of GENERAL MOTORS CORP.

1. Beginning at the joint, install the sunroof opening trim lace into place around the sunroof opening.
2. Ensure the sunroof trim lace is fully seated to the headliner.

DESCRIPTION AND OPERATION

SUNROOF DESCRIPTION AND OPERATION

The sunroof system is controlled by the sunroof switch and the sunroof control module/motor assembly, which is also known as the motor/actuator assembly.

The sunroof control module is supplied battery positive voltage at all times through the 15-amp SUNROOF fuse located in the rear fuse block. Whenever the ignition is turned to RUN or ACCESSORY, or when the retained accessory power (RAP) system is active, the module is also supplied voltage through the accessory voltage circuit and the 10-amp SUNROOF/HTD SEAT fuse located in the body control module (BCM). The sunroof control module is grounded through the ground circuit and rear fuse block to a body ground stake.

The sunroof control module/motor is located between the headliner and the roof structure, while the sunroof switch is located above the rearview mirror. The sunroof control module supplies voltage to the contacts of the sunroof switch through the sunroof switch close signal circuit and the sunroof switch open signal circuit. The sunroof control module also supplies ground to the switch contacts through the sunroof switch low reference circuit. When the switch is operated, the contacts and signal circuit for the selected mode are closed to ground, the voltage is pulled low in the module, and the appropriate signal is recognized by the control module. The control module then internally applies battery positive voltage and ground to the appropriate circuits of the reversible power sunroof motor in order to move the sunroof glass panel to the open, close, or vent position.

Both the sunroof control module and the sunroof motor are integral parts of the sunroof control module/motor assembly and are not service separately.

To operate the sunroof, the ignition must be in the RUN or ACCESSORY position, or the RAP system must be active. When the sunroof panel is in the closed position, it can be raised to the vent position by pressing the OPEN/VENT side of the switch lever once. The panel may then be either expressed to the fully opened position by momentarily pressing the OPEN/VENT side of the switch lever a second time, or it may be adjusted to any preferred open position by pressing and holding the OPEN/VENT side of the switch lever until the panel has reached the desired position. To fully close the sunroof panel, press and hold the CLOSE side of the switch lever. Release the CLOSE side of the switch lever in order to stop the panel at any preferred closed position. Whenever the sunroof panel is in the express open mode, it can be stopped by momentarily pressing either side of the switch.

As the sunroof panel opens, it moves the sunshade to the open position as well. The sunshade can be manually opened and closed from inside of the vehicle while the glass panel is in the closed position. The sunshade is designed to stay in the open position while the glass panel is in the open position.

IMPORTANT:

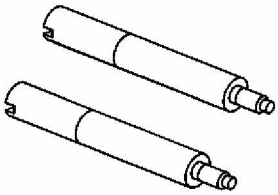
- **If, during service, the sunroof control module has lost battery positive voltage or ground, or has been replaced, it will be necessary to initialize the control module once service has been completed. Refer to Sunroof Control Module Programming and Setup in Programming and Setup.**
- **The sunroof can be manually cycled with a regular screwdriver, once the headliner is removed. This screwdriver fits into the drive gear, and when turned will operate the sunroof drive cables and simultaneously open or close the sunroof.**

Any water that passes the roof seal is drained from the sunroof tray by 4 tubes that lead from the corners of the tray to the rocker panels of the vehicle. The tray which acts as a framework for the sunroof assembly, has a water channel that encircles the sunroof opening and directs the water to the drain tubes.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description
	J 41718 Sunroof Timing Pins

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Tire Pressure Sensor Nut	7 N·m	62 lb in

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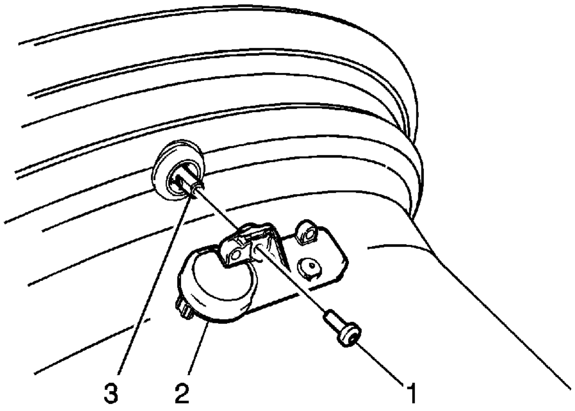
Tire Pressure Indicator Sensor Replacement (Snap In Style)

Removal Procedure

1. Raise the vehicle on a suitable support. Refer to Lifting and Jacking the Vehicle.
2. Remove the tire/wheel assembly from the vehicle. Refer to Tire and Wheel Removal and Installation.
3. Dismount the tire from the rim. Refer to Tire Dismounting and Mounting.



Note: When servicing the tire pressure sensor always use a new Schrader® tire pressure monitor (TPM) and a new TORX screw during installation.

4. Remove the TORX screw (1) from the tire pressure sensor (2) and pull it straight off the tire pressure valve stem (3).

Caution: Do not scratch or damage the clear coating on aluminum wheels with the tire changing equipment. Scratching the clear coating could cause the aluminum wheel to corrode and the clear coating to peel from the wheel.

5. Remove the tire pressure valve stem by pulling it through the rim.

Installation Procedure

Caution: Refer to Fastener Caution in the Preface section.

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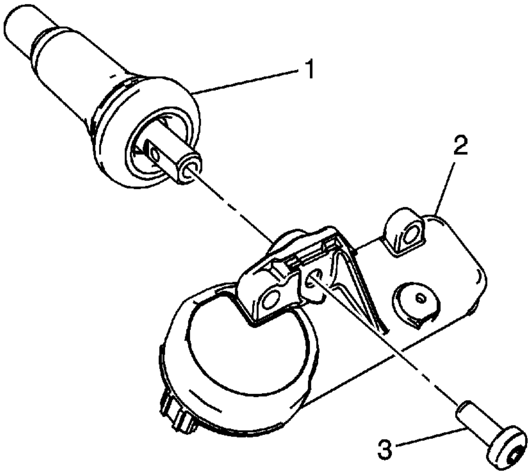


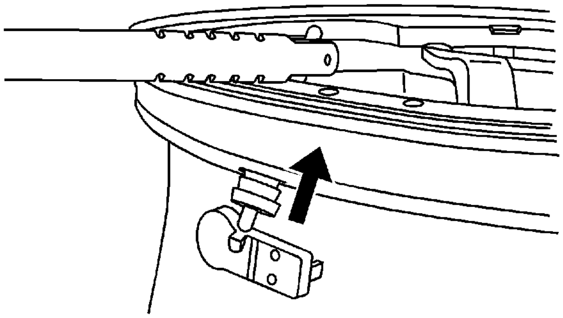
Note:

- Ensure the flat of the valve, lines up with the flats of the snap in the enclosure.
- TPM valves and TORX screws are one-time use only.

1. Assemble the tire pressure sensor (2) to the valve stem and install the new TORX screw (3) and tighten to **1.3 N·m (11.5 lb in)**.

   Note: Use and approved tire mounting lubricant. DO NOT use silicon or corrosive base compounds to lubricate the tire bead and the wheel rim. A corrosive type compound can cause tire or rim deterioration.

2. Apply tire soap to the rubber portion of the valve stem (1).



3. Using a tire valve stem mounting tool, pull the valve stem through in a direction parallel to the valve hole on the rim.

   Note: Snap Fit TPM sensors are still shipped in the OFF mode. However, the TPM no longer needs to be spun to remove it from the OFF mode. The sensor will exit its OFF state when the tire is inflated. The technician can then program the vehicle as normal.

4. Mount the tire to the rim. Refer to Tire Dismounting and Mounting.
5. Install the tire/wheel assembly on the vehicle. Refer to Tire and Wheel Removal and Installation.
6. Lower the vehicle.
7. Learn the tire pressure sensors. Refer to Tire Pressure Indicator Sensor Learn.

Tire Pressure Indicator Sensor Learn

Special Tools

J-46079 Tire Pressure Monitor Diagnostic Tool

Learn Mode Description

The tire pressure monitor (TPM) system uses the instrument panel cluster (IPC), body control module (BCM), remote control door lock receiver (RCDLR), keyless entry transmitter, 4 radio frequency transmitting pressure sensors, and the serial data circuit to perform the TPM learn mode functions. The sensor learn procedure must be performed after every tire rotation, RCDLR replacement, or sensor replacement. Once the learn mode has been enabled, each of the sensors unique identification codes can be learned into the RCDLR memory. When a sensor ID has been learned, the RCDLR sends a serial data message to the BCM to sound a horn chirp. This verifies the sensor has transmitted its ID and the RCDLR has received and learned it. The RCDLR must learn the sensor IDs in the proper sequence to determine correct sensor location. The first learned ID is assigned to the left front location, the second to right front, the third to right rear and the fourth to left rear. The turn signals will individually illuminate indicating which location is to be learned in the proper sequence.

Sensor Functions Using J-46079

Each sensor has an internal low frequency coil. When the J-46079 is used in activate mode, it produces a low frequency transmission that activates the sensor. The sensor responds to a low frequency activation by transmitting in learn mode. When the RCDLR receives a learn mode transmission while in TPM learn mode, it will assign that sensors ID to the location on the vehicle relative to the order in which it was learned.

Sensor Functions Using Pressure Increase / Decrease Method

Each sensor takes a pressure measurement sample once every 30 seconds while in stationary mode. If the tire pressure increases, or decreases by more than 8.3 kPa (1.2 psi) from the last pressure measurement, another measurement will occur immediately to verify the change in pressure. If a pressure change has indeed occurred, the sensor transmits in Learn mode. When the RCDLR receives a Learn mode transmission while in TPM learn mode, it will assign that sensor's ID to the location on the vehicle relative to the order in which it was learned.

Learn Mode Cancellation

The learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any sensor that has not been learned. If the learn mode is cancelled before the first sensor is learned, the original sensor IDs will be maintained. If the learn mode is canceled after the first sensor is learned, the following will occur:

- All stored sensor IDs will be invalidated in the RCDLR memory.
- If equipped, the DIC will display dashes instead of tire pressures.
- DTC C0775 will be set.

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These conditions will now require the learn procedure to be repeated for the system to function properly.

TPM Learn Procedure

Note: If using the scan tool to enable the learn mode, the J-46079 must be used to activate the sensors. When this preferred method is used, any stray sensor signals will not affect the learn procedure. In the event a particular sensor's information is displayed on the special tool upon activation but the horn does not chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component.

If using the keyless entry transmitter or DIC buttons to enable the learn mode, the J-46079 or Pressure Increase/Decrease Method may be used. Before proceeding with this method, ensure that no other learn procedure is being performed simultaneously or that tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Stray signals from other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn chirps are heard from the vehicle while performing the learn procedure, most likely a stray sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component.

Preferred Scan Tool Learn Enable Method

1. Using a scan tool, initiate the TPM Learn Mode. A double horn chirp will sound indicating the Learn Mode has been enabled. The left front turn signal will also be illuminated.
2. Starting with the left front tire, active the sensor by holding the antenna of the J-46079 aimed upward against the tire sidewall close to the wheel rim at the valve stem location. Press and release the Activate button and wait for a horn chirp. Once the horn chirp has sounded, the sensor information is learned and the turn signal in the next location to be learned will illuminate.
3. After the horn chirp has sounded and the right front turn signal is illuminated, repeat step 2 for the remaining 3 sensors in the following order:
   - 3.1. Right front
   - 3.2. Right rear
   - 3.3. Left rear
4. When the left rear sensor has been learned and a double horn chirp has sounded, the learn process is complete and the RCDLR exits the learn mode.
5. Ignition OFF, adjust all tires to the recommended pressures. Refer to Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label.

Alternate Keyless Entry Transmitter or DIC Learn Enable Method

1. Ignition ON, initiate the TPM Learn Mode using one of the following procedures:
   - On vehicles equipped with keyless entry, simultaneously press the keyless entry transmitters lock and unlock buttons until a double horn chirp sounds indicating the Learn Mode has been enabled. The left front turn signal will also be illuminated.
   - On vehicles not equipped with keyless entry, press and release the driver information center (DIC) INFO button until the TIRE LEARN message appears on the DIC display.

Press and hold the SET/RESET button until a double horn chirp sounds indicating the Learn Mode has been enabled. The left front turn signal will also be illuminated.

2. Starting with the left front tire, learn the tire pressure using one of the following methods:
   - Hold the antenna of the J-46079 aimed upward against the tire sidewall close to the wheel rim at the valve stem location. Press and release the activate button and wait for a horn chirp. Once the horn chirp has sounded, the sensor information is learned and the turn signal in the next location to be learned will illuminate.

     Warning: Over inflating tires may cause personal injury or damage to the tires and wheels. When increasing tire pressure do not exceed the maximum inflation pressure as noted on the tire sidewall.

   - Increase/decrease the tire pressure for 8-10 seconds then wait for a horn chirp. The horn chirp may occur before or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached. Once the horn chirp has sounded, the sensor information is learned and the turn signal in the next location to be learned will illuminate.
3. After the horn chirp has sounded and the right front turn signal is illuminated, repeat step 2 for the remaining 3 sensors in the following order:
   - 3.1. Right front
   - 3.2. Right rear
   - 3.3. Left rear
4. When the left rear sensor has been learned and a double horn chirp has sounded, the learn process is complete and the RCDLR exits the learn mode.
5. Ignition OFF, adjust all tires to the recommended pressures. Refer to Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label.

2006 Driveline/Axle

Wheel Drive Shafts - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Wheel Drive Shaft Nut	160 N.m	118 lb ft
Drive Axle Seal Clamp	174 N.m	130 lb ft

COMPONENT LOCATOR

WHEEL DRIVE SHAFTS DISASSEMBLED VIEWS

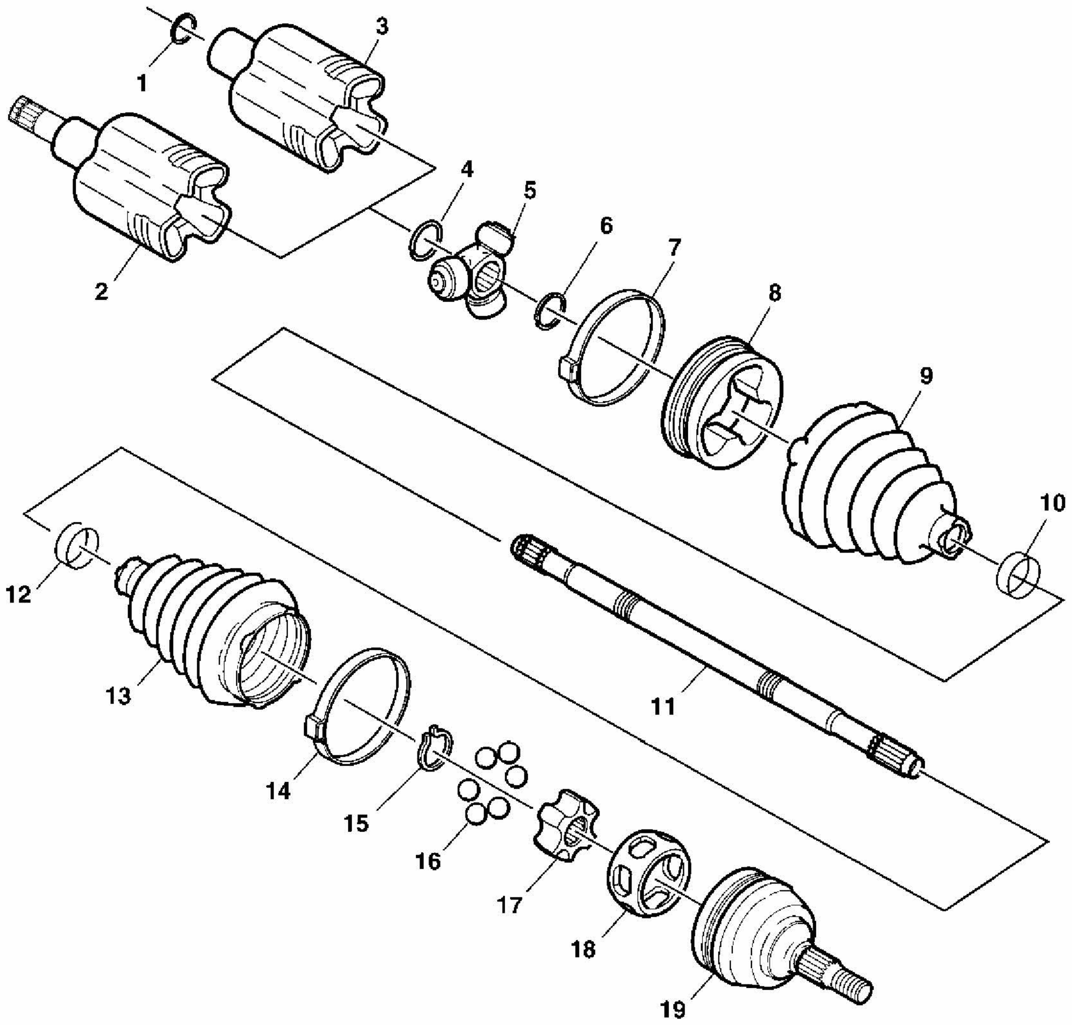


Fig. 1: Identifying Wheel Drive Shaft Components
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 1

Callout	Component Name
1	Retaining Ring
2	Housing Assembly
3	Retainer and Housing Assembly
4	Spacer Ring
5	Tripot Joint Spider Assembly
6	Spacer Ring (If Equipped)
7	Boot Retaining Clamp
8	Trilobal Tripot Bushing
9	Tripot Joint Boot

10	Swage Ring
11	Halfshaft Bar
12	Swage Ring
13	CV Joint Boot
14	Boot Retaining Clamp
15	Race Retaining Ring
16	Chrome Alloy Ball
17	CV Joint Inner Race
18	CV Joint Cage
19	CV Joint Outer Race

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - WHEEL DRIVE SHAFTS

Begin the wheel drive shaft system diagnosis with **Diagnostic Starting Point - Vibration Diagnosis and Correction** in Vibration Diagnosis and Correction. The use of the Diagnostic Starting Point will lead to the identification of the correct procedure for diagnosing the system and where the procedure is located.

REPAIR INSTRUCTIONS

WHEEL DRIVE SHAFT REPLACEMENT

Tools Required

- **J 2619-01** Slide Hammer
- **J 29794** Axle Shaft Remover Extension
- **J 33008-A** Axle Shaft Remover
- **J 42129** Hub Spindle Remover

Removal Procedure

CAUTION: To prevent personal injury and/or component damage, do not allow the weight of the vehicle to load the front wheels, or attempt to operate the vehicle, when the wheel drive shaft(s) or wheel drive shaft nut(s) are removed. To do so may cause the inner bearing race to separate, resulting in damage to brake and suspension components and loss of vehicle control.

NOTE: Wheel drive shaft boots, seals and clamps should be protected from sharp objects any time service is performed on or near the

wheel drive shaft(s). Damage to the boot(s), the seal(s) or the clamp(s) may cause lubricant to leak from the joint and lead to increased noise and possible failure of the wheel drive shaft.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the wheel and the tire. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Remove the stabilizer shaft link. Refer to **Stabilizer Shaft Link Replacement** in Front Suspension.

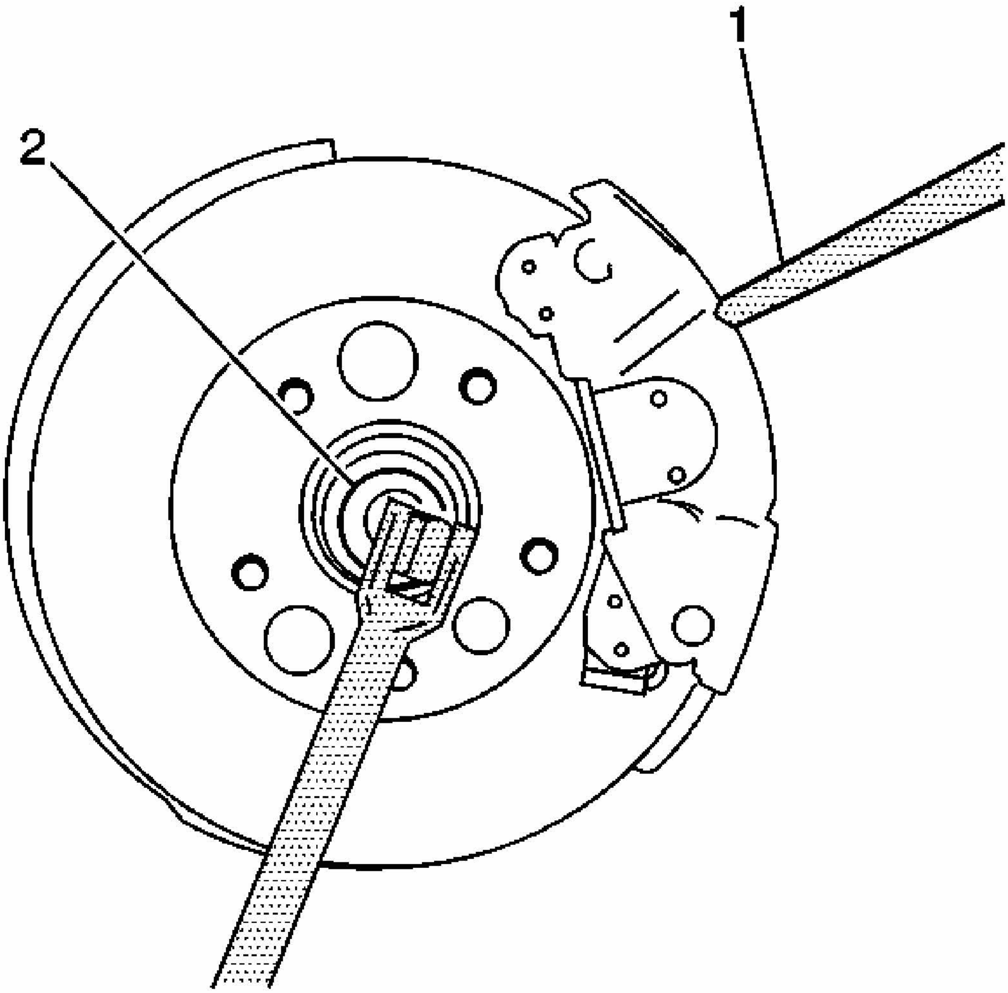


Fig. 2: Preventing Rotor Turning Using Drift Or Punch
Courtesy of GENERAL MOTORS CORP.

4. Remove the front wheel drive shaft nut (2). Insert a drift or a flat-bladed tool (1) into the caliper and the rotor to prevent the rotor from turning.
5. Disconnect the outer tie rod assembly from the steering knuckle. Refer to **Rack and Pinion Outer Tie Rod End Replacement** in Power Steering System.
6. Separate the ball joint from the steering knuckle. Refer to **Lower Ball Joint Replacement** in Front Suspension.
7. Separate the front wheel drive axle from the front wheel drive shaft bearing using the **J 42129** . The nut can be partially re-installed to protect the threads.

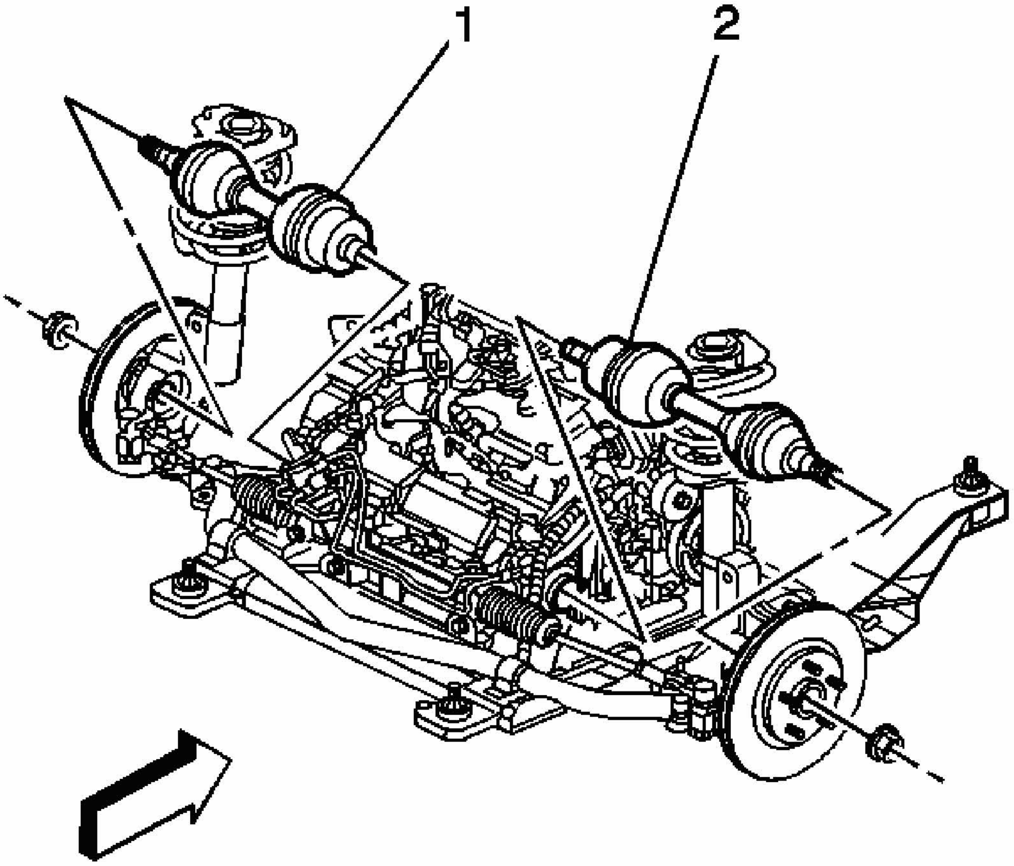


Fig. 3: Left & Right Front Wheel Drive Axles
Courtesy of GENERAL MOTORS CORP.

8. If necessary, remove the left front wheel drive axle (1) from the transaxle.

   If necessary, remove the right front wheel drive axle (2) from the transaxle.

Use the **J 33008-A** , the **J 29794** and the **J 2619-01** to separate the axle from the transaxle.

Installation Procedure

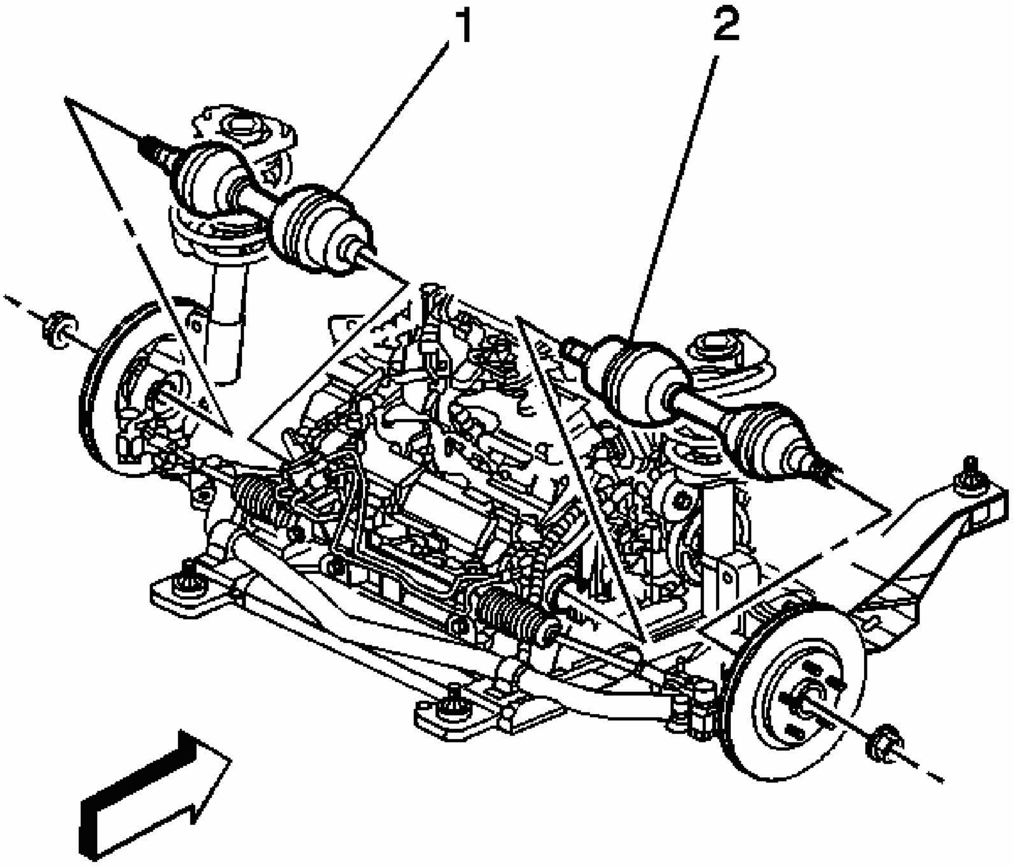


Fig. 4: Left & Right Front Wheel Drive Axles
Courtesy of GENERAL MOTORS CORP.

1. Install the front wheel drive axle (1, 2) into the transaxle.
2. Verify that the front wheel drive shaft retaining ring is properly seated:
    - Grasp the inner housing and pull the inner housing outward. Do not pull on the front wheel drive axle shaft.
    - The front wheel drive axle will remain in place when the front wheel drive shaft retaining ring is properly seated.
3. Install the front wheel drive axle into the front wheel drive shaft bearing.
4. Connect the ball joint to the steering knuckle. Refer to **Lower Ball Joint Replacement**

in Front Suspension.

5. Connect the outer tie rod assembly to the steering knuckle. Refer to **Rack and Pinion Outer Tie Rod End Replacement** in Power Steering System.

NOTE: Refer to Fastener Notice in Cautions and Notices.

6. Install a new front wheel drive shaft nut. Insert a drift or a flat-bladed tool into the caliper and the rotor to prevent the rotor from turning.

   Tighten: Tighten the nut to 160 N.m (118 lb ft).

7. Install the stabilizer shaft link. Refer to **Stabilizer Shaft Link Replacement** in Front Suspension.
8. Install the wheel and the tire. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
9. Lower the vehicle.
10. Inspect the transaxle fluid level.
11. Inspect the wheel alignment. Refer to **Measuring Wheel Alignment** .

WHEEL DRIVE SHAFT INNER JOINT AND SEAL REPLACEMENT

Tools Required

- **J 8059** Snap Ring Pliers (Parallel Jaw). See **Special Tools**.
- **J 35910** Drive Axle Seal Clamp Pliers
- **J 41048** Drive Axle Swage Ring Clamp. See **Special Tools**.

Removal Procedure

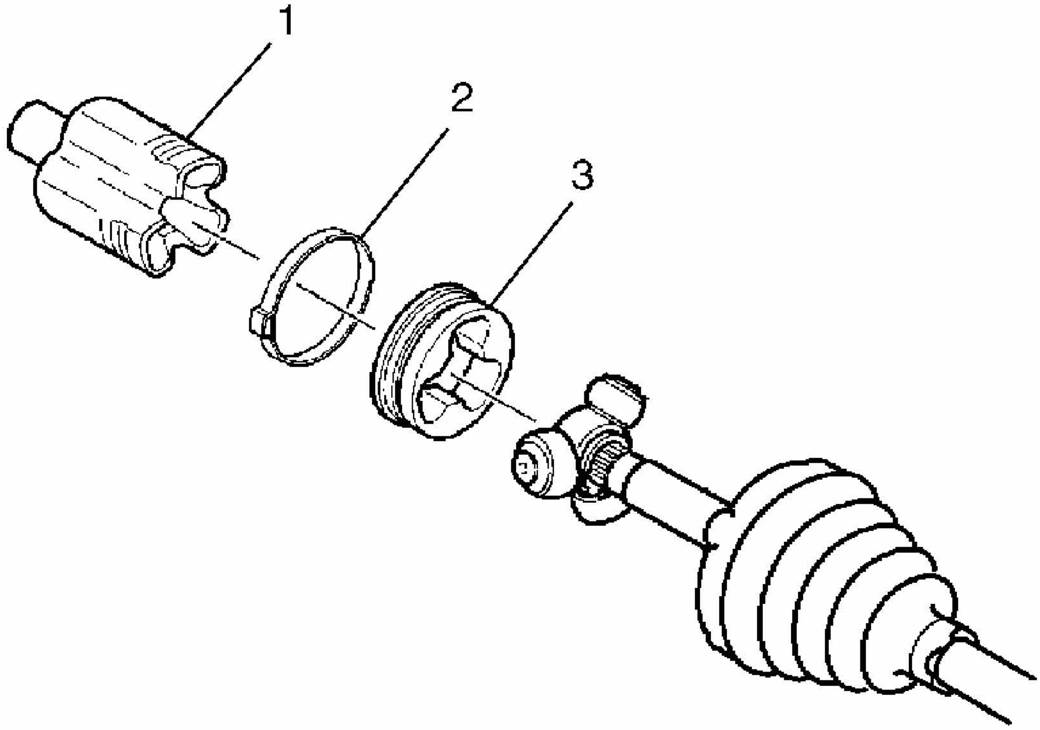


Fig. 5: Locating Wheel Drive Shaft Inner Joint Components
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not cut through the wheel drive shaft inboard seal during service. Cutting through the seal may damage the sealing surface of the housing and the tripot bushing. Damage to the sealing surface may lead to water and dirt intrusion and premature wear of the constant velocity joint.

1. Disconnect the swage ring from the halfshaft bar using a hand grinder to cut through the ring, taking care not to damage the halfshaft bar.
2. Remove the large seal retaining clamp (2) from the tripot joint with side cutters. Discard the large seal retaining clamp.
3. Separate the inboard seal from the trilobal tripot bushing (3) at the large diameter.
4. Slide the seal away from the joint along the halfshaft bar.

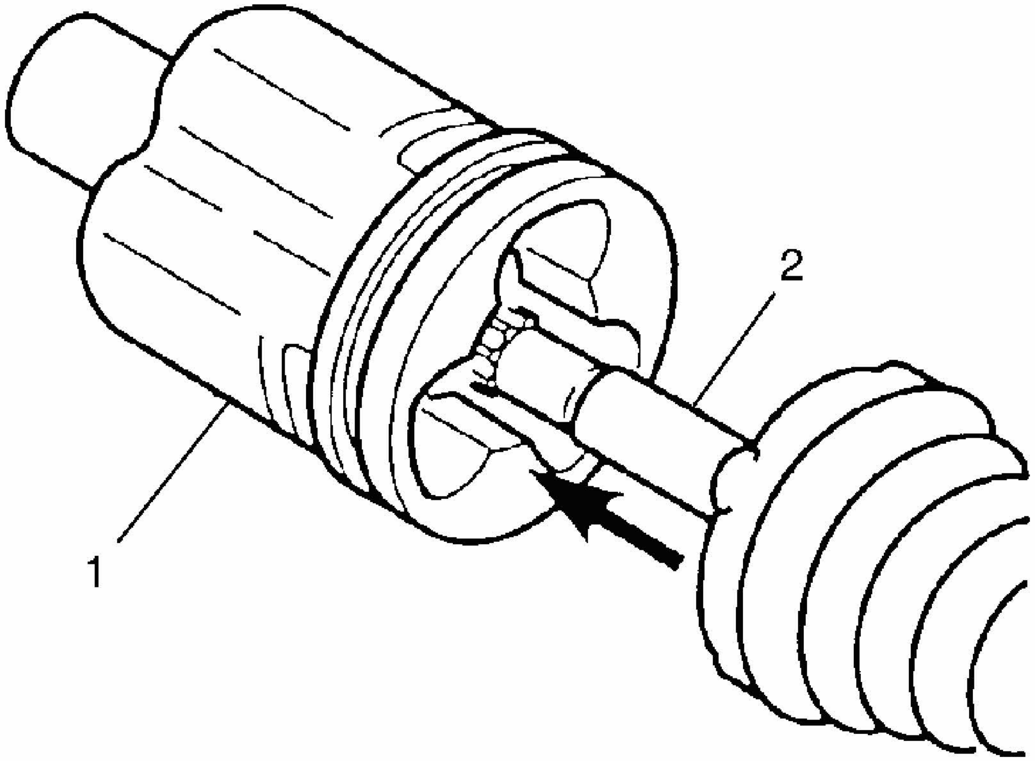


Fig. 6: View Of Housing, Tripot Joint Spider & Halfshaft Bar
Courtesy of GENERAL MOTORS CORP.

5. Remove the housing (1) from the tripot joint spider and the halfshaft bar (2).

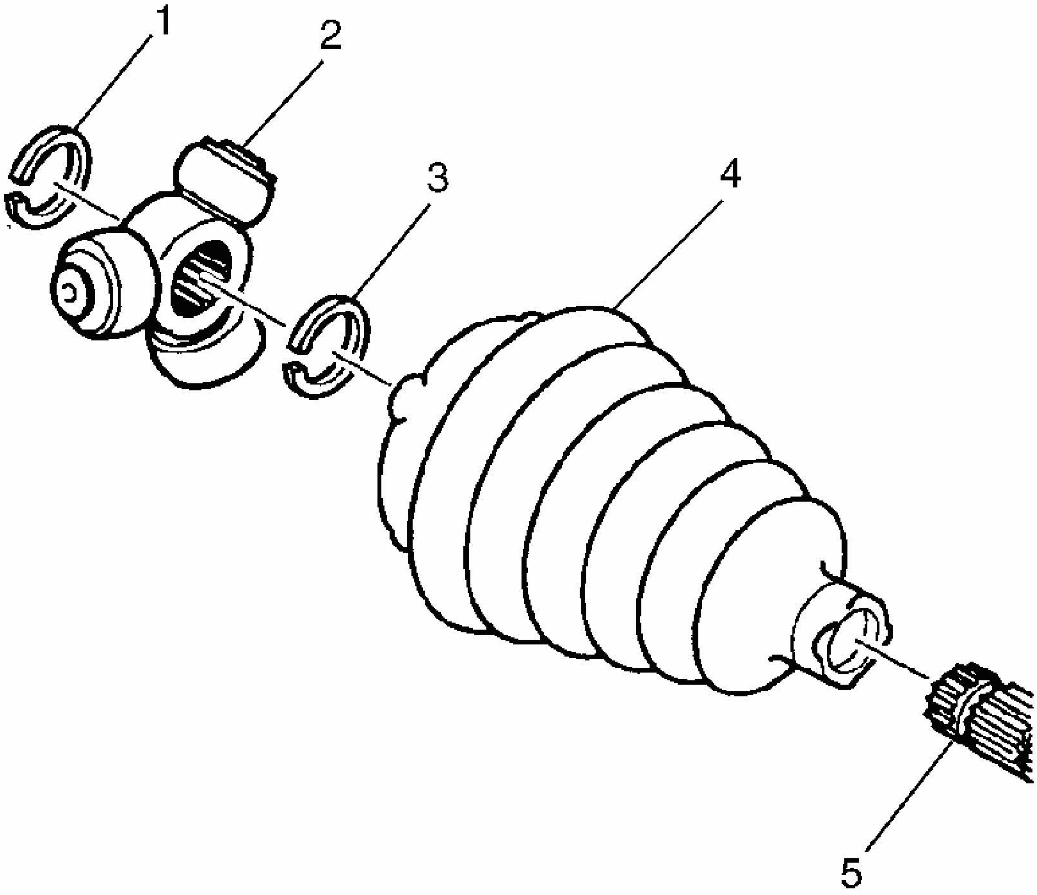


Fig. 7: View Of Spider Assembly, Rings & Tripot Boot
Courtesy of GENERAL MOTORS CORP.

6. Remove the spacer ring (1), spider assembly (2), spacer ring (3) (if equipped) using **J 8059** , and tripot boot (4). See **Special Tools**. Discard the boot and rings.
7. Clean the halfshaft bar (5). Use a wire brush in order to remove any rust in the boot mounting area (grooves).
8. Inspect the needle rollers, needle bearings, and trunnion. Check the tripot housing for unusual wear, cracks, or other damage. Replace any damaged parts with the appropriate kit.

Installation Procedure

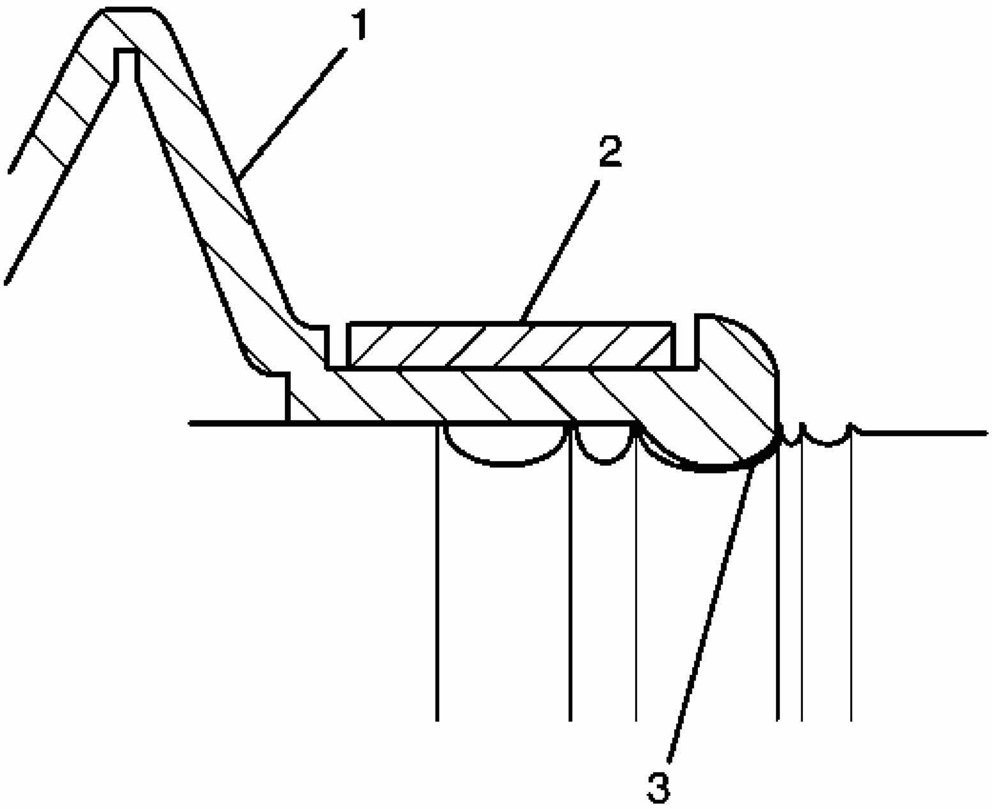


Fig. 8: Installing Seal Clamp On Neck Of Seal
Courtesy of GENERAL MOTORS CORP.

1. Place the new small swage ring (2) onto the small end of the joint seal (1). Slide the joint seal (1) and the small swage ring (2) onto the halfshaft bar.
2. Position the small end of the joint seal (1) into the joint seal groove (3) on the halfshaft bar.

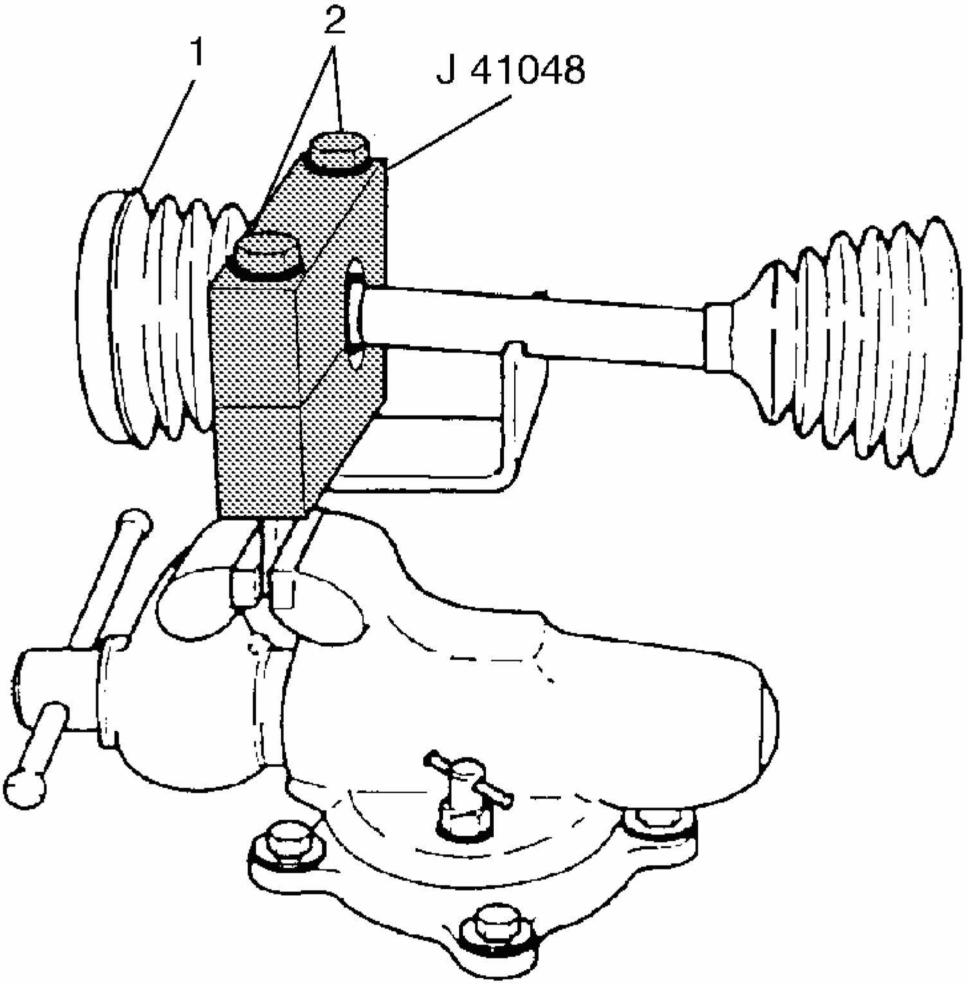


Fig. 9: Swaging Retaining Clamp Ring
Courtesy of GENERAL MOTORS CORP.

3. Mount **J 41048** in a vise and proceed as follows: See **Special Tools**.
    1. Position the inboard end (1) of the halfshaft assembly in tool **J 41048** . See **Special Tools**.
    2. Align the top of seal neck on the bottom die using the indicator.
    3. Place the top half of the **J 41048** on the lower half. See **Special Tools**.
    4. Before proceeding, ensure there are no pinch points on the halfshaft inboard seal. This could cause damage to the halfshaft inboard seal.
    5. Insert the bolts (2).
    6. Tighten the bolts by hand until snug.

NOTE: **Refer to Fastener Notice in Cautions and**

Notices.

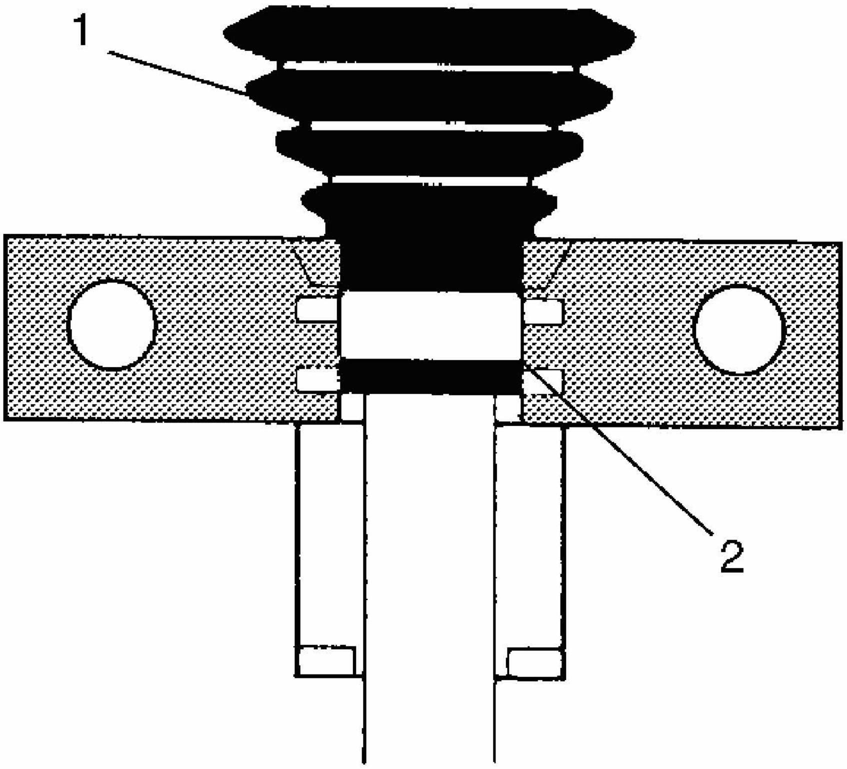


Fig. 10: Identifying Halfshaft Inboard Seal & Swage Ring
Courtesy of GENERAL MOTORS CORP.

4. Align the following items:
    - The halfshaft inboard seal (1)
    - The halfshaft bar
    - The swage ring (2)

    Tighten: Tighten each bolt of **J 41048** 180 degrees at a time using a ratchet wrench. See **Special Tools**. Alternate between each bolt until both sides are bottomed.

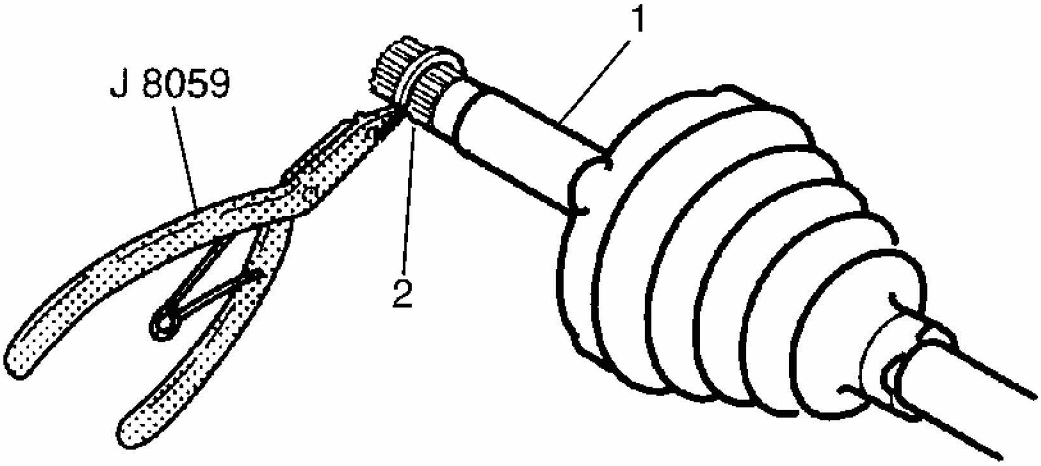


Fig. 11: Installing Spacer Ring
Courtesy of GENERAL MOTORS CORP.

5. If equipped, install the spacer ring (2) into the groove of the halfshaft bar using **J 8059** . See **Special Tools**.

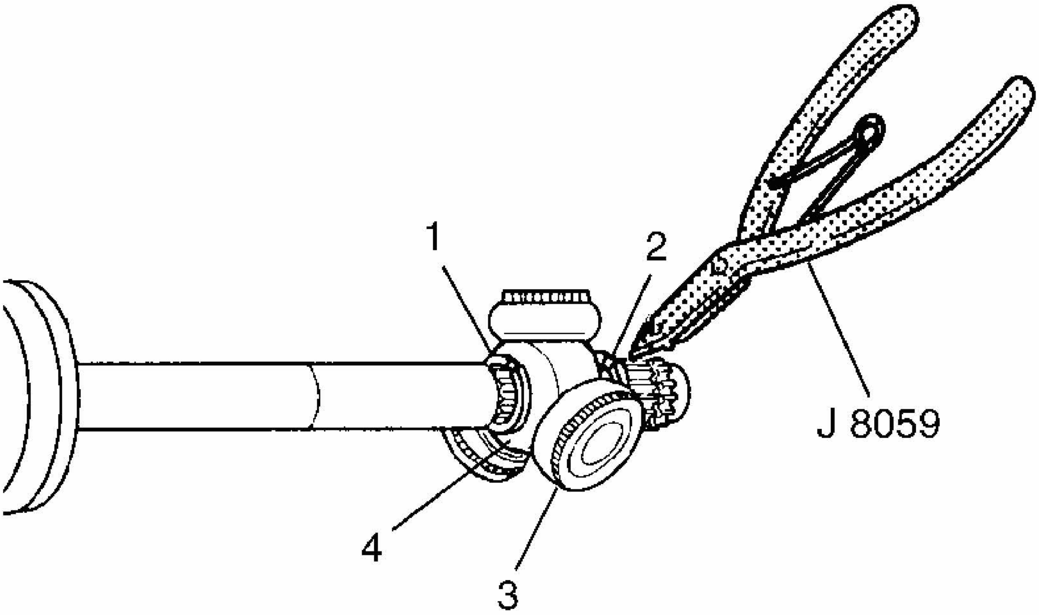


Fig. 12: Installing Spider Assembly & Spacer Rings
Courtesy of GENERAL MOTORS CORP.

6. Slide the tripot joint spider assembly (4) as far as it will go on the halfshaft bar.
7. Install the spacer ring (2) into the groove of the halfshaft bar **J 8059** . See **Special Tools**.

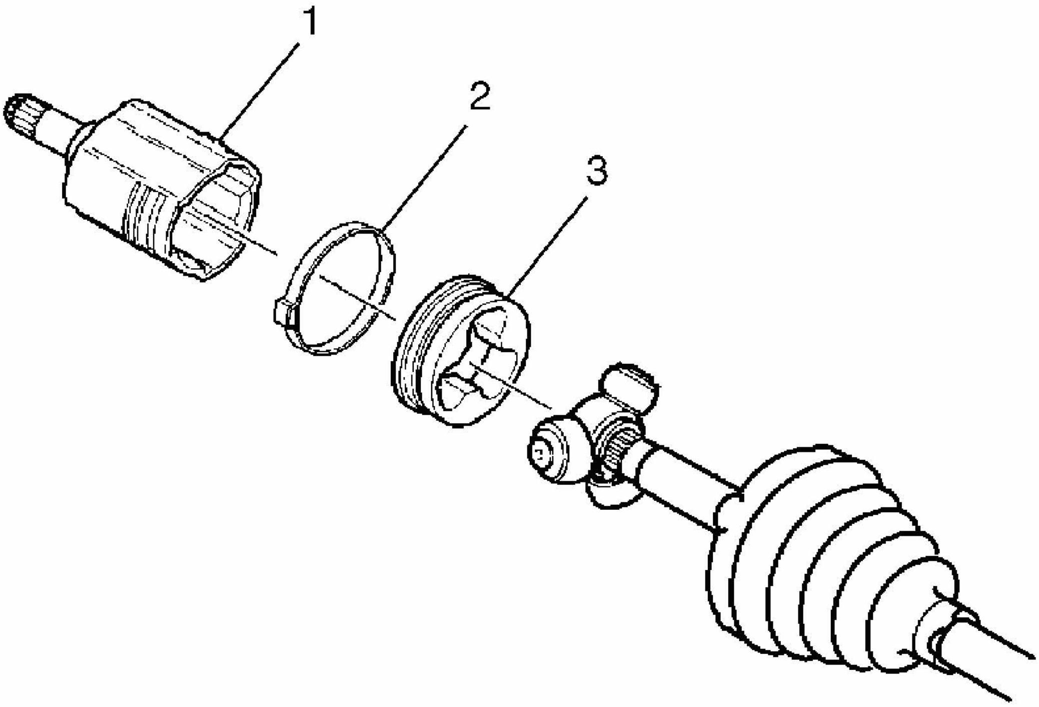


Fig. 13: Seal Retaining Clamp, Tripot Bushing & Housing
Courtesy of GENERAL MOTORS CORP.

8. Place approximately half of the grease from the service kit in the halfshaft inboard seal. Use the remainder of the grease to repack the housing.

IMPORTANT: Ensure the trilobal tripot bushing (3) is flush with the face of the housing (1).

9. Install the new trilobal tripot bushing (3) to housing (1).
10. Position the larger new seal retaining clamp (2) on the halfshaft inboard seal.
11. Slide the housing (1) over the tripot joint spider assembly on the halfshaft bar.

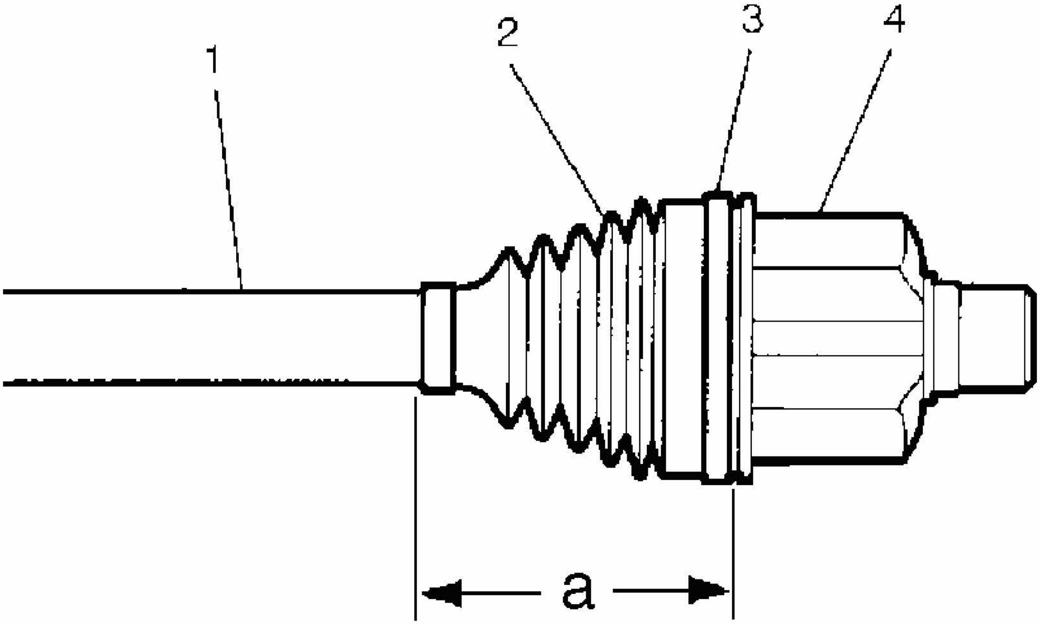


Fig. 14: Identifying Axle Shaft/CV Joint Assembly Compontents And Installed Boot Measurement Dimension
Courtesy of GENERAL MOTORS CORP.

12. Slide the large diameter of the halfshaft inboard seal (2), with the larger clamp (3) in place, over the outside of the trilobal tripot bushing and locate the lip of the seal in the groove.

IMPORTANT: The halfshaft inboard seal must not be dimpled, stretched out or out of shape in any way. If the halfshaft inboard seal is not shaped correctly, carefully insert a thin flat blunt tool, no sharp edges, between the large seal opening and the trilobal tripot bushing in order to equalize the pressure. Shape the halfshaft inboard seal properly by hand. Remove the tool.

13. Position the joint assembly at the proper vehicle dimension.
    - For 4.6L V8 engines, dimension a = 107 mm (4.21 in).
    - For 4.0L V6 engines, dimension a = 111 mm (4.37 in).
    - For 3.8L supercharged V6 engines, dimension a = 111 mm (4.37 in).
    - For all others, dimension a = 95 mm (3.75 in).

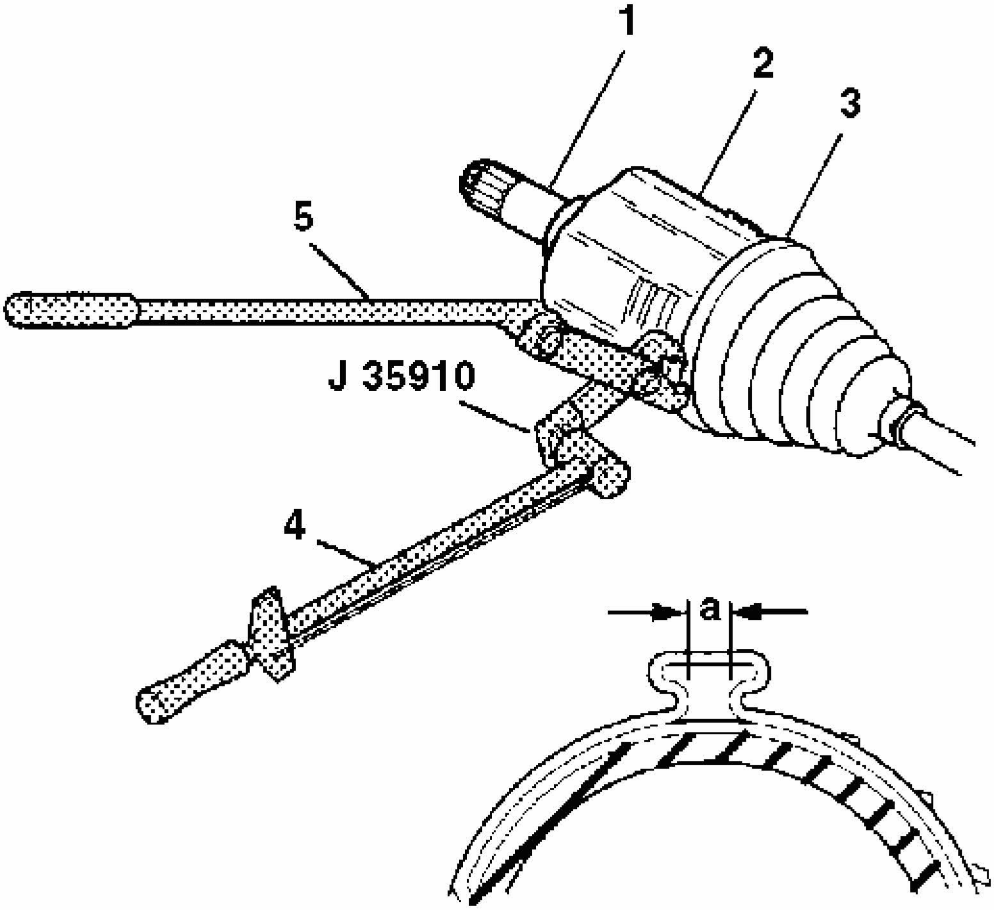


Fig. 15: Adjusting CV Joint Boot Clamp Gap Dimension
Courtesy of GENERAL MOTORS CORP.

14. Align the following items while latching:
    - The halfshaft inboard seal
    - The tripot housing (2)
    - The large seal retaining clamp (3)

    Tighten: Crimp the seal retaining clamp with **J 35910** to 176 N.m (130 lb ft). Add the breaker bar (5) and the torque wrench (4) to **J 35910** if necessary.

15. Check the gap dimension (a) on the clamp ear. If gap dimension is larger than shown, continue tightening until gap dimension of 2.60 mm (0.102 in) is reached.
16. Fully stroke the joint several times to disperse the grease.

WHEEL DRIVE SHAFT OUTER JOINT AND SEAL REPLACEMENT

Tools Required

- **J 41048** Drive Axle Swage Ring Clamp. See **Special Tools**.
- **J 8059** Snap Ring Pliers. See **Special Tools**.
- **J 35910** Drive Axle Seal Clamp Pliers

Disassembly Procedure

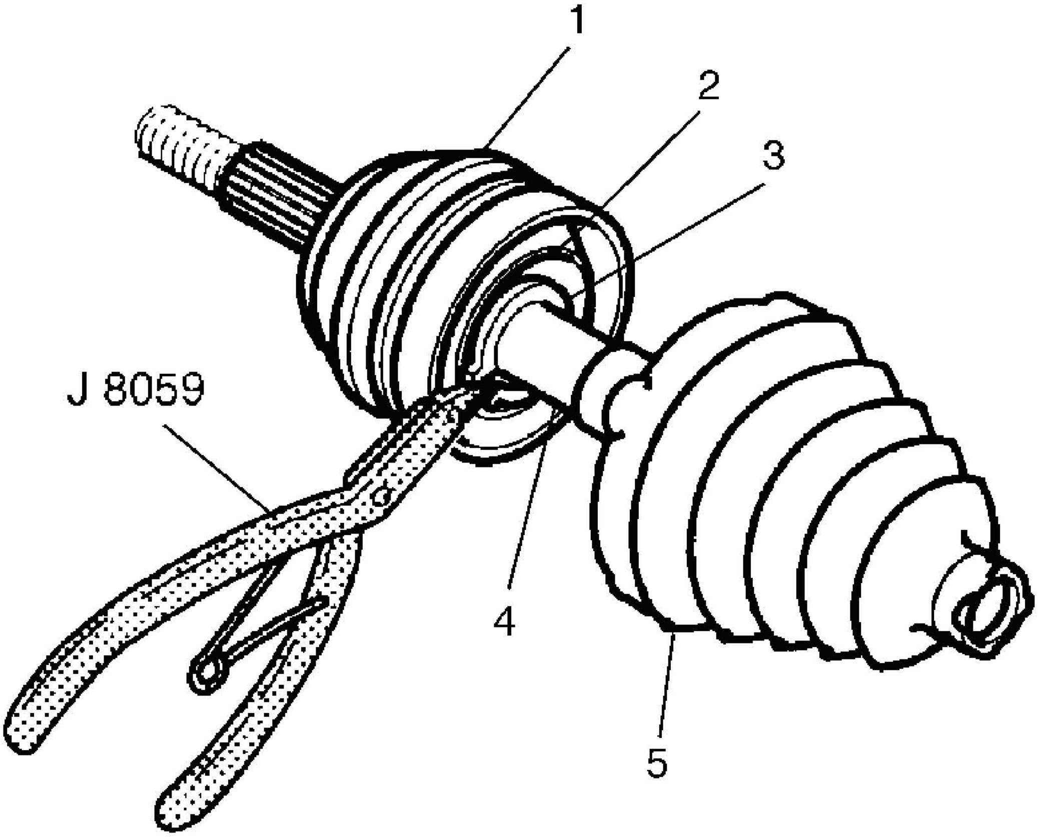


Fig. 16: Removong Race Retaining Ring
Courtesy of GENERAL MOTORS CORP.

1. Remove the large seal retaining clamp from the CV joint with a side cutter. Discard the seal retaining clamp.

NOTE: **Do not cut through the wheel drive shaft inboard seal during service. Cutting through the seal may damage the sealing surface of the housing and the tripot bushing. Damage to the**

sealing surface may lead to water and dirt intrusion and premature wear of the constant velocity joint.

2. Use a hand grinder to cut through the swage ring in order to remove the swage ring.
3. Separate the halfshaft outboard seal from CV joint outer race (1) at large diameter.
4. Slide the seal (5) away from joint along halfshaft bar (4).
5. Wipe the grease from the face of the CV joint inner race (2).
6. Spread the ears on the race retaining ring (3) with **J 8059** . See **Special Tools**.
7. Remove the CV joint assembly (1) from the halfshaft bar (4).
8. Remove the halfshaft outboard seal (5) from the halfshaft bar (4).
9. Discard the old outboard seal.

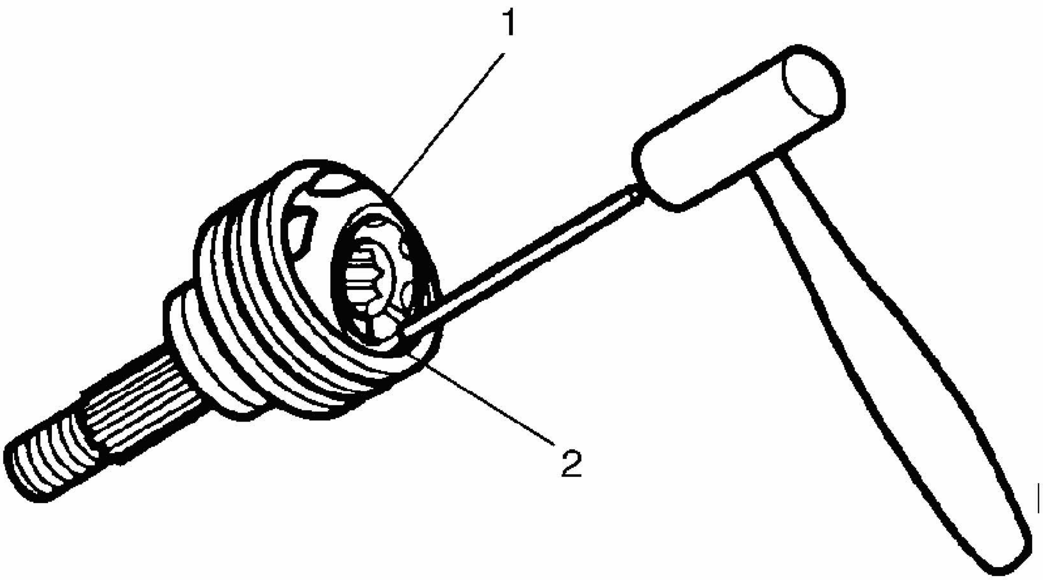


Fig. 17: Taping Gently On Brass Drift With A Hammer In Order To Tilt Cage
Courtesy of GENERAL MOTORS CORP.

10. Place a brass drift against the CV joint cage (1).
11. Tap gently on the brass drift with a hammer in order to tilt the cage (1).
12. Remove the first chrome alloy ball (2) when the CV joint cage (1) tilts.
13. Tilt the CV joint cage (1) in the opposite direction to remove the opposing chrome alloy ball (2).
14. Repeat this process to remove all 6 of the balls.

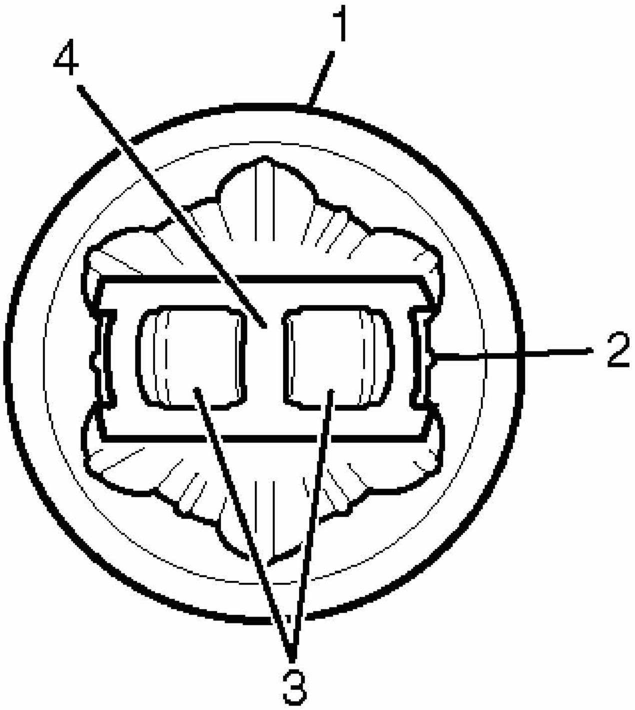


Fig. 18: View Of Outer Race, Inner Race, Cage Window & CV Joint Cage
Courtesy of GENERAL MOTORS CORP.

15. Pivot the CV joint cage (4) and the inner race 90 degrees to the center line of the outer race (2). At the same time, align the cage windows (3) with the lands of the outer race.
16. Lift out the cage (4) and the inner race.

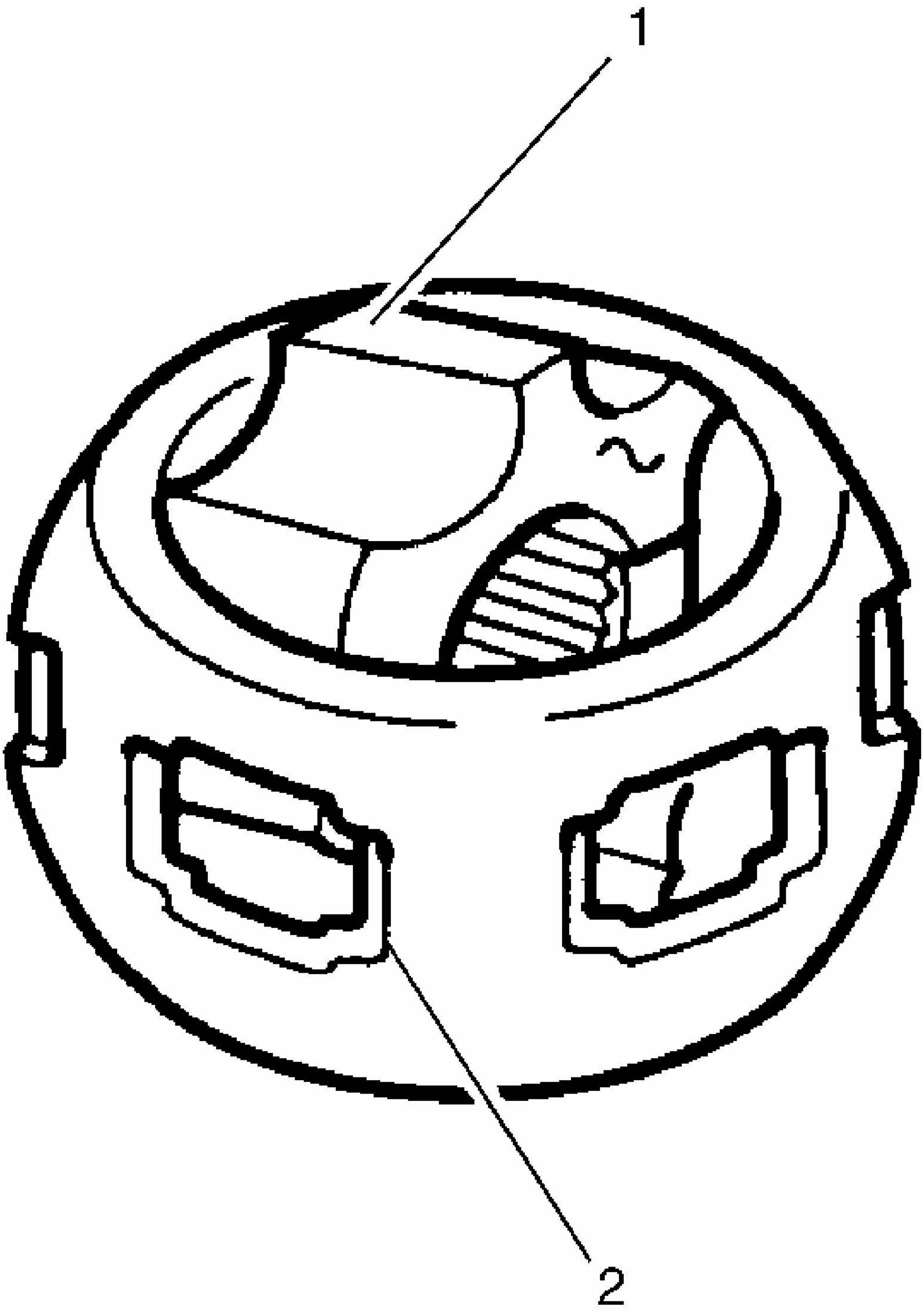


Fig. 19: View Of Inner Race & Cage
Courtesy of GENERAL MOTORS CORP.

17. Remove the inner race (1) from the cage (2) by rotating the inner race (1) upward.
18. Clean the following items thoroughly with cleaning solvent. Remove all traces of old grease and any contaminates.
    - The inner and outer race assemblies
    - The CV joint cage
    - The chrome alloy balls
19. Dry all the parts.
20. Check the CV joint assembly for the following items:
    - Unusual wear
    - Cracks
    - Damage
21. Replace any damaged parts.
22. Clean the halfshaft bar. Use a wire brush to remove any rust in the seal mounting area (grooves).

Assembly Procedure

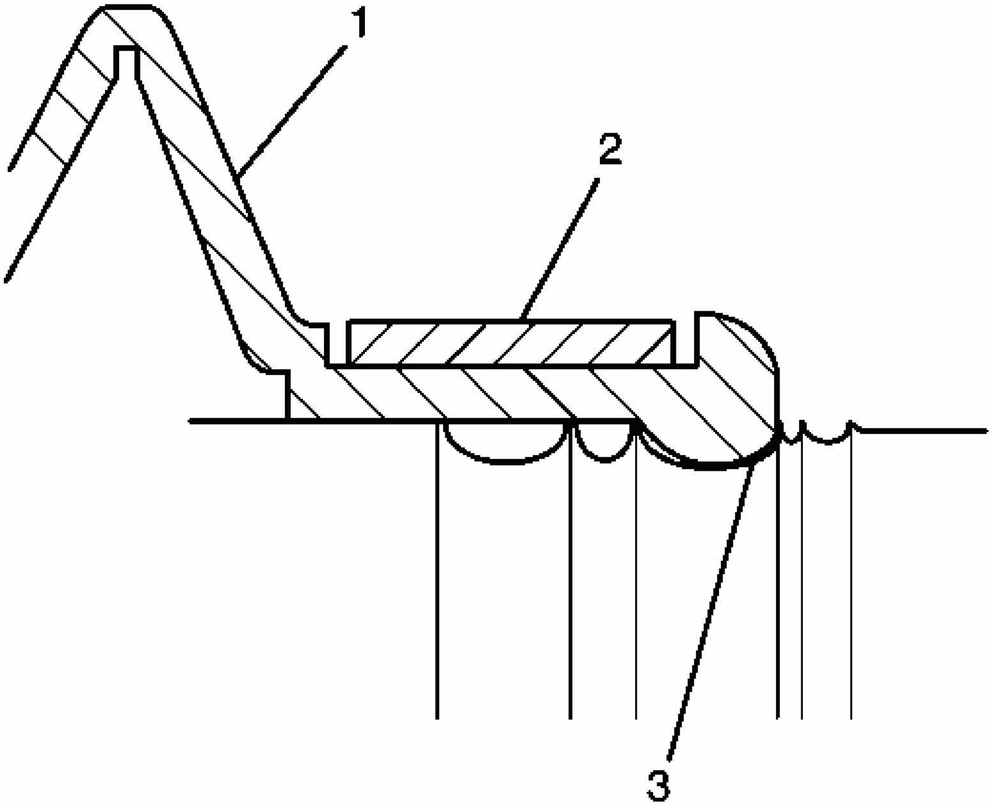


Fig. 20: Installing Seal Clamp On Neck Of Seal
Courtesy of GENERAL MOTORS CORP.

1. Install the new swage ring (2) on the neck of the outboard seal (1). Do not swage.
2. Slide the outboard seal (1) onto the halfshaft bar and position the neck of the outboard seal (1) in the seal groove on the halfshaft bar. The largest groove below the sight groove on the halfshaft bar is the seal groove (3).

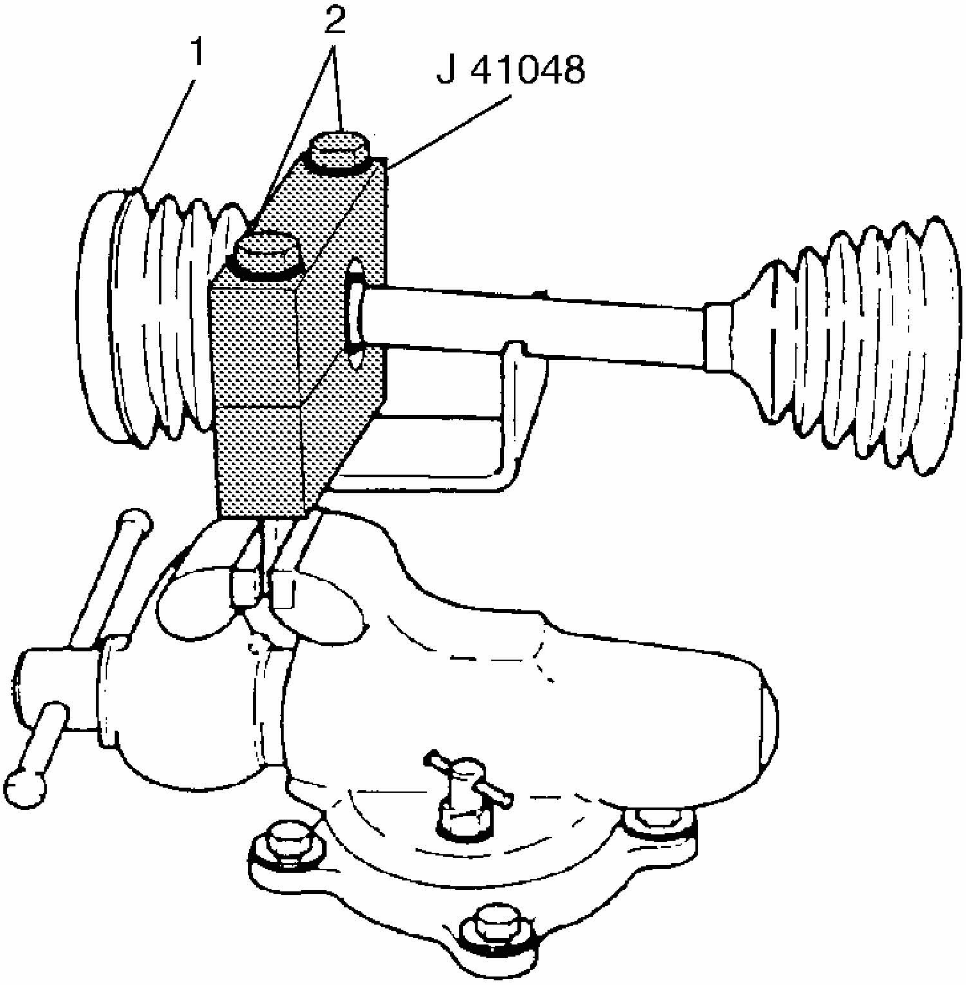


Fig. 21: Swaging Retaining Clamp Ring
Courtesy of GENERAL MOTORS CORP.

3. The swage ring is swaged using **J 41048** by the following method: See **Special Tools**.
    1. Position the outboard end of the halfshaft assembly (1) in **J 41048** . See **Special Tools**.
    2. Align the swage ring.
    3. Place the top half of **J 41048** on the lower half of **J 41048** . See **Special Tools**.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

NOTE: **Do not cut through the wheel drive shaft inboard seal during service. Cutting through the seal may damage the**

sealing surface of the housing and the tripot bushing. Damage to the sealing surface may lead to water and dirt intrusion and premature wear of the constant velocity joint.

IMPORTANT: Align the following items during this procedure:

- **The outboard seal (1)**
- **The halfshaft bar**
- **The swage ring**

4. Insert the bolts (2) and tighten by hand until snug.

   Tighten: Tighten each bolt 180 degrees at a time using a ratchet wrench. Alternate between each bolt until both sides are bottomed.

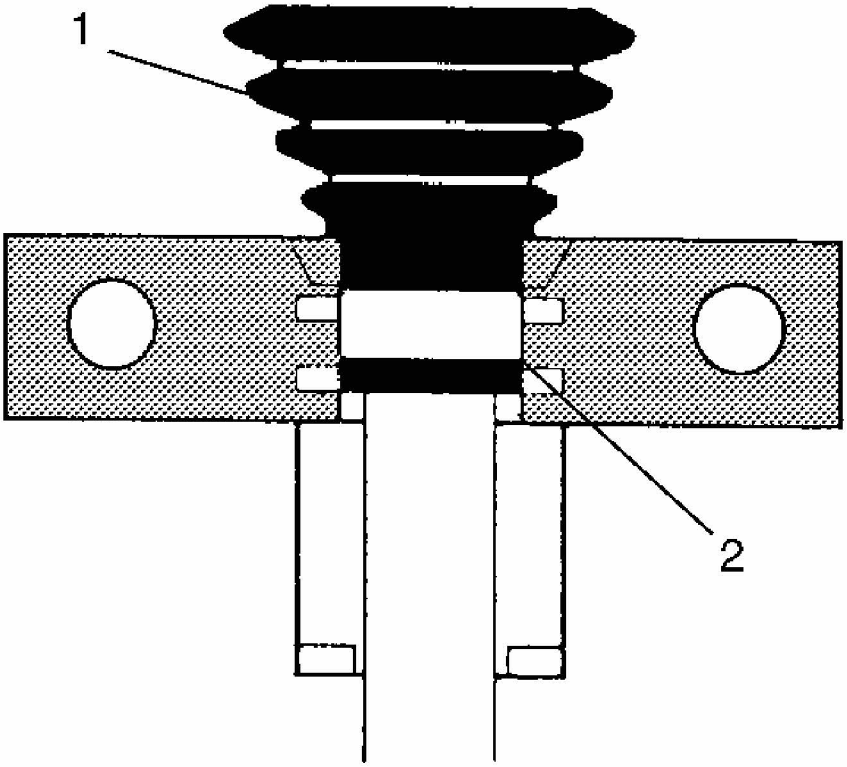


Fig. 22: Identifying Halfshaft Inboard Seal & Swage Ring
Courtesy of GENERAL MOTORS CORP.

4. Loosen the bolts and separate the dies.
5. Check swaged ring (2) for any lip deformities. If present, place the ring (2) back into the **J 41048** making sure the ring covers the whole swaging area. See **Special Tools**. If necessary, re-swage the ring.

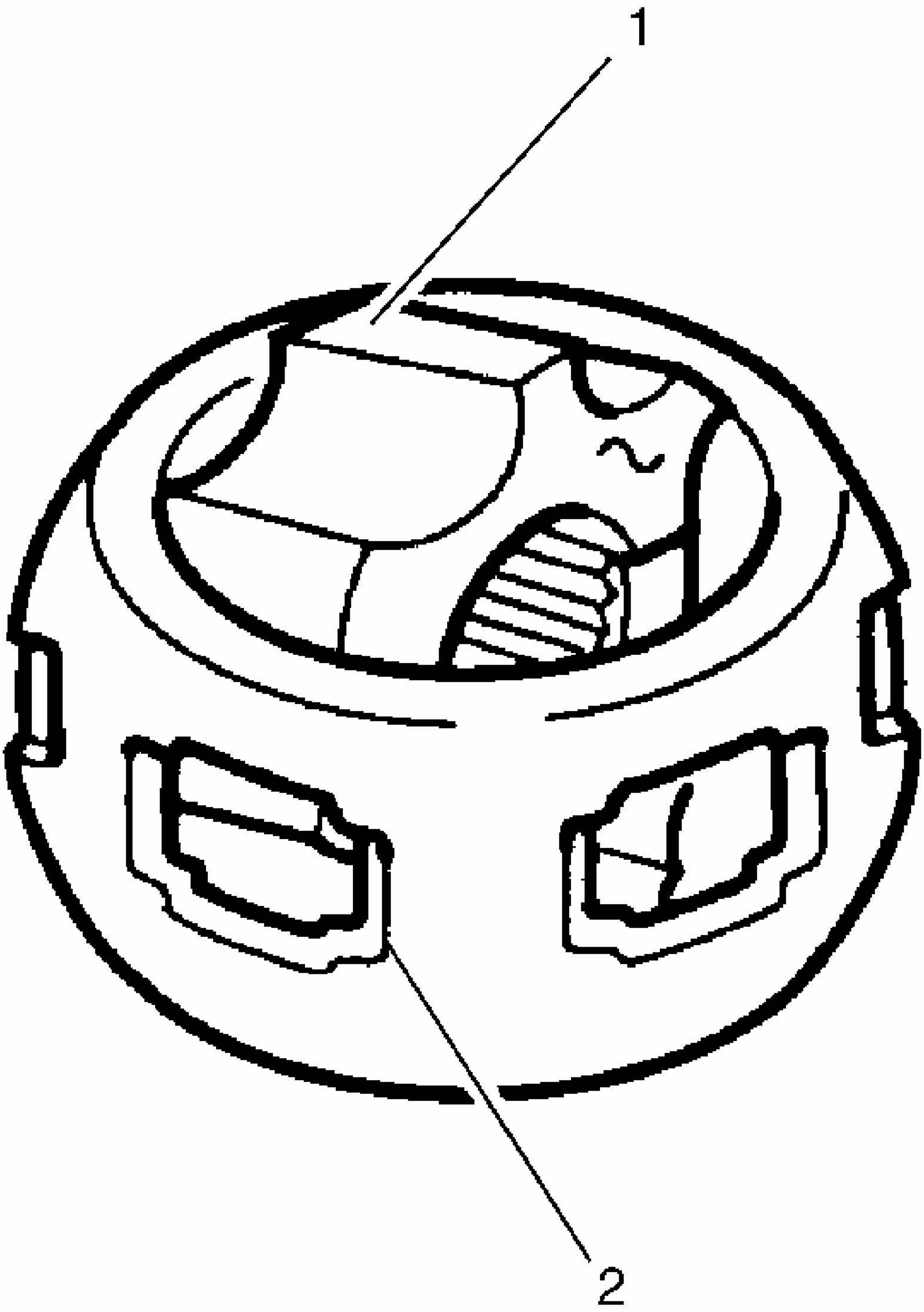


Fig. 23: View Of Inner Race & Cage
Courtesy of GENERAL MOTORS CORP.

6. Put a light coat of grease from the service kit on the ball grooves of the inner race and the outer race.
7. Hold the inner race 90 degrees to centerline of cage with the lands of the inner race (1) aligned with the windows of the cage (2) and insert the inner race into the cage.

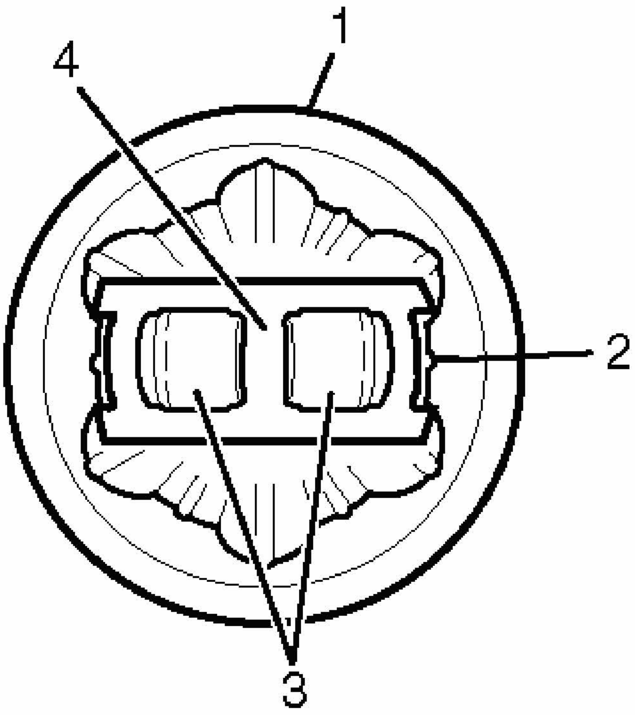


Fig. 24: View Of Outer Race, Inner Race, Cage Window & CV Joint Cage
Courtesy of GENERAL MOTORS CORP.

8. Hold the cage and the inner race 90 degrees to centerline of the outer race (1) and align the cage windows (3) with the lands of the outer race.

IMPORTANT: Be sure that the retaining ring side of the inner race faces the halfshaft bar.

9. Place the cage and the inner race into the outer race.
10. Insert the first chrome ball then tilt the cage in the opposite direction to insert the opposing ball.
11. Repeat this process until all 6 balls are in place.
12. Place approximately half the grease from the service kit inside the outboard seal and

pack the CV joint with the remaining grease.

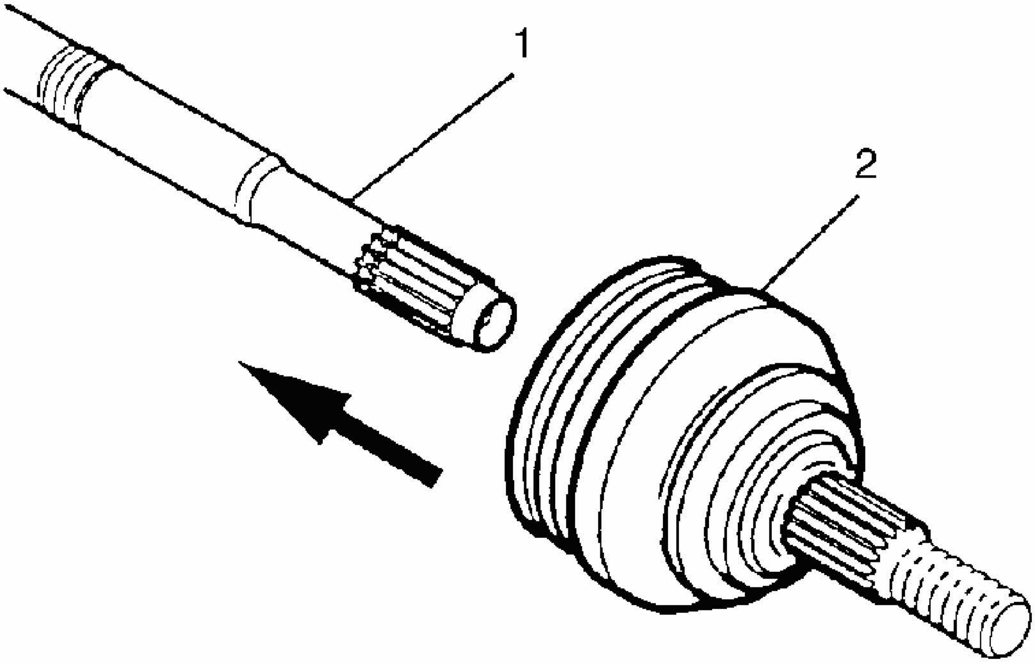


Fig. 25: Pushing CV Joint Onto Halfshaft
Courtesy of GENERAL MOTORS CORP.

13. Push the CV joint (2) onto the halfshaft bar (1) until the retaining ring is seated in the groove on the halfshaft bar.

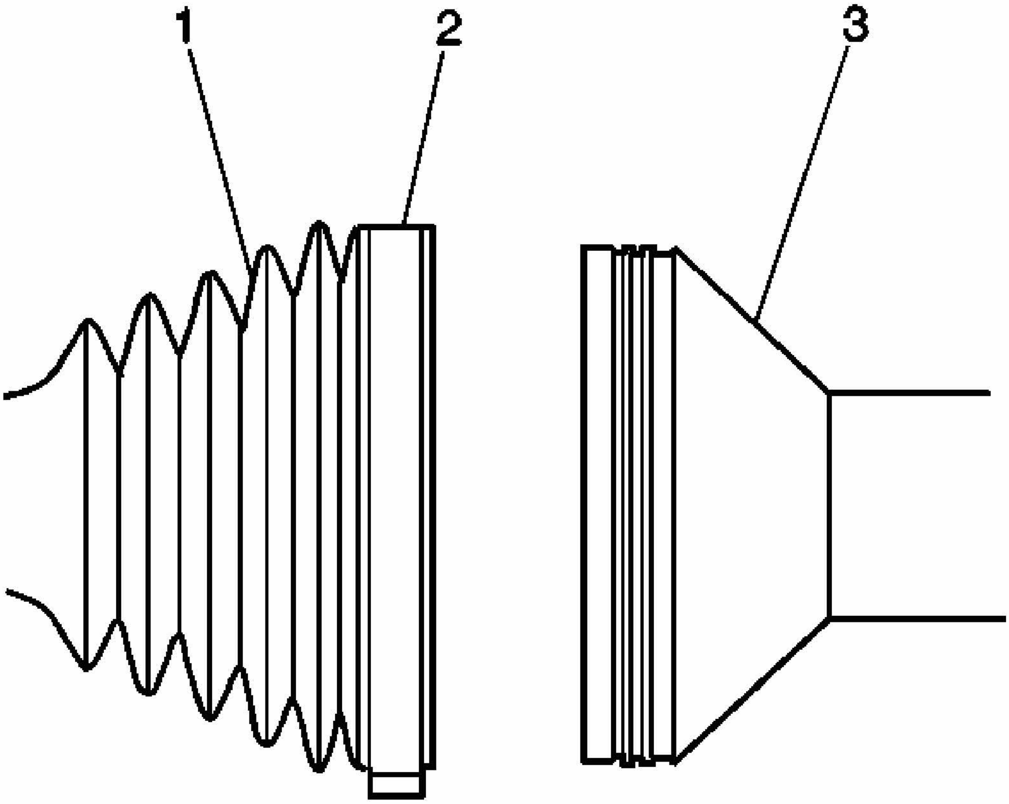


Fig. 26: View Of Boot And Large Seal Retaining Clamp
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The outboard seal (1) must not be dimpled, stretched or out of shape in any way. If the outboard seal (1) is not shaped correctly, equalize the pressure in the outboard seal (1) and shape the seal properly by hand.

14. Slide large diameter of the outboard seal (1) with the large seal retaining clamp (2) in place over the outside of the CV joint outer race (3) and locate the seal lip in the groove on the CV joint outer race.

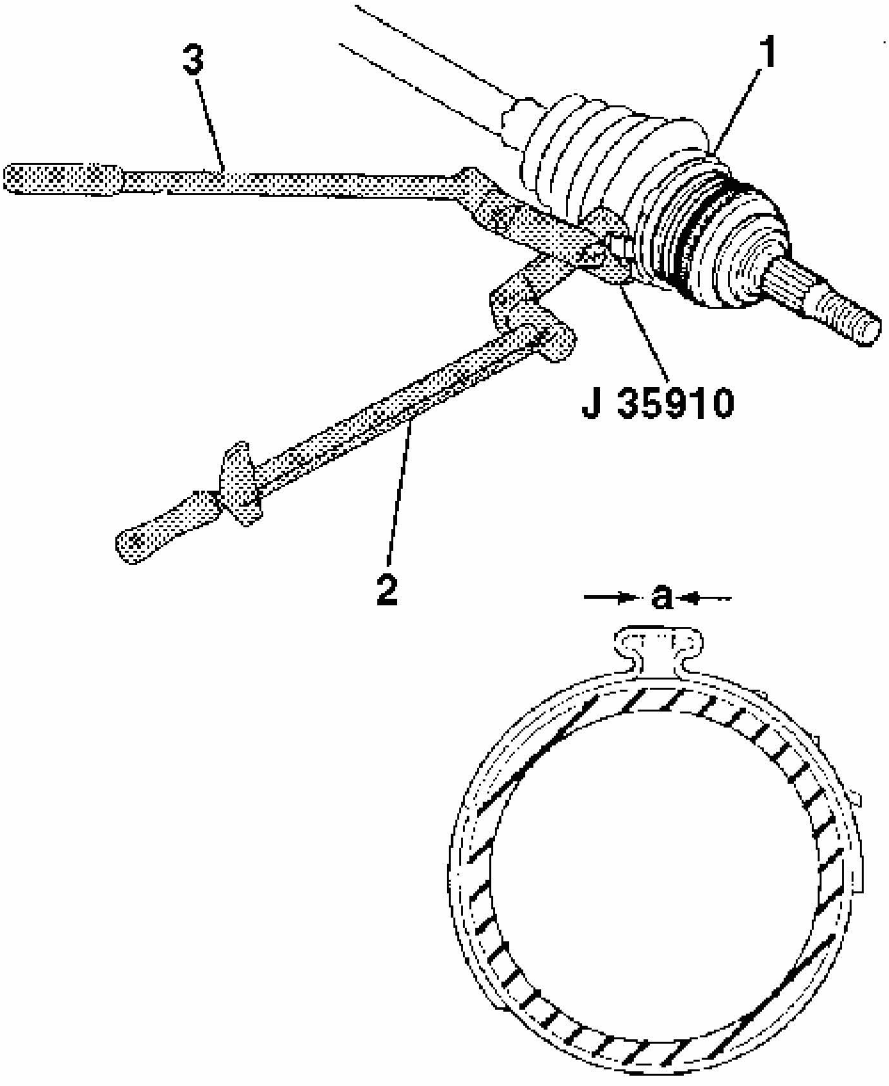


Fig. 27: Crimping Seal Retaining Clamp
Courtesy of GENERAL MOTORS CORP.

15. Crimp the seal retaining clamp (1) using **J 35910** .

    Tighten: Crimp the clamp (1) to 174 N.m (130 lb ft).

16. Check the gap dimension on the clamp ear. Continue tightening until the gap dimension is reached. Dimension a= 1.9 mm (5/64 in).

DESCRIPTION AND OPERATION

WHEEL DRIVE SHAFTS DESCRIPTION AND OPERATION

Front wheel drive axles are flexible assemblies.

Front wheel drive axles consist of the following components:

- A front wheel drive shaft tri-pot joint (inner joint)
- A front wheel drive shaft constant velocity joint (outer joint)
- A front wheel drive shaft

  The front wheel drive shaft connects the front wheel drive shaft tri-pot joint and the front wheel drive shaft constant velocity joint.

The front wheel drive shaft tri-pot joint is completely flexible. The front wheel drive shaft tri-pot joint can move in and out.

The front wheel drive shaft constant velocity joint is flexible, but the front wheel drive shaft constant velocity joint cannot move in and out.

Boots (Seals) And Clamps

The front wheel drive shaft constant velocity joint and the front wheel drive shaft tri-pot joint boots (seals) in the front wheel drive axle are made of a thermoplastic material.

The clamps in front wheel drive axle are made of stainless steel.

The boot (seal) provides the following functions:

- Protection of the internal parts of the front wheel drive shaft constant velocity joint and the front wheel drive shaft tri-pot joint.

  The boot (seal) protects the grease from the following sources of damage:

  - Harmful atmospheric conditions (such as extreme temperatures or ozone gas)
  - Foreign material (such as dirt or water)
- Allows angular movement and the axial movement of the front wheel drive shaft tri-pot joint.
- Allows angular movement of the front wheel drive shaft constant velocity joint.

IMPORTANT: Protect the boots (seals) from sharp tools and from the sharp edges of the surrounding components.
Any damage to the boots (seals) or the clamps will result in leakage. Leakage will allow water to leak into the front wheel drive shaft tri-pot joint and the front wheel drive shaft constant

velocity joints. Leakage will also allow grease to leak out of the front wheel drive shaft tri-pot joints and the front wheel drive shaft constant velocity joints.
Leakage may cause noisy front wheel drive axle operation and eventual failure of the internal components.

The clamps provide a leak proof connection for the front wheel drive shaft tri-pot joint and the front wheel drive shaft constant velocity joint at the following locations:

- The housing
- The front wheel drive shaft

The thermoplastic material performs well under normal conditions and normal operation. However, the material is not strong enough to withstand the following conditions:

- Abusive handling
- Damage from sharp objects (such as sharp tools or any sharp edges of the surrounding components in the vehicle).

Front Wheel Drive Shaft Tri-pot Joint (Inner Joint)

The front wheel drive shaft tri-pot joint is made with the tri-pot design without an over-extension limitation retainer.

The joint is constructed as follows for vehicles that are equipped with an automatic transmission:

- The left front wheel drive axle has a female spline. The female spline installs over a stub shaft that protrudes from the transaxle.
- The right front wheel drive axle has a male spline. The right front wheel drive axle uses barrel type snap rings in order to interlock with the transaxle gears.

Front Wheel Drive Shaft Constant Velocity Joint (Outer Joint)

The front wheel drive shaft constant velocity joint is made with the Rzeppa joint design.

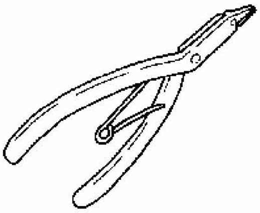
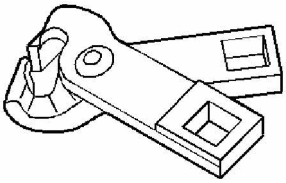
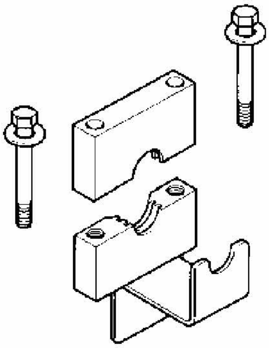
The shaft end (which mates with the knuckle/hub) has a helical spline. The helical spline ensures a tight, press-type fit.

This design prevents end play between the hub bearing and the front wheel drive axle.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description
	J 8059 Snap Ring Pliers
	J 35910 Drive Axle Seal Clamp Pliers
	J 41048 Drive Axle Swage Ring Clamp

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Wheel Drive Shaft Nut	160 N·m	118 lb ft
Drive Axle Seal Clamp	174 N·m	130 lb ft

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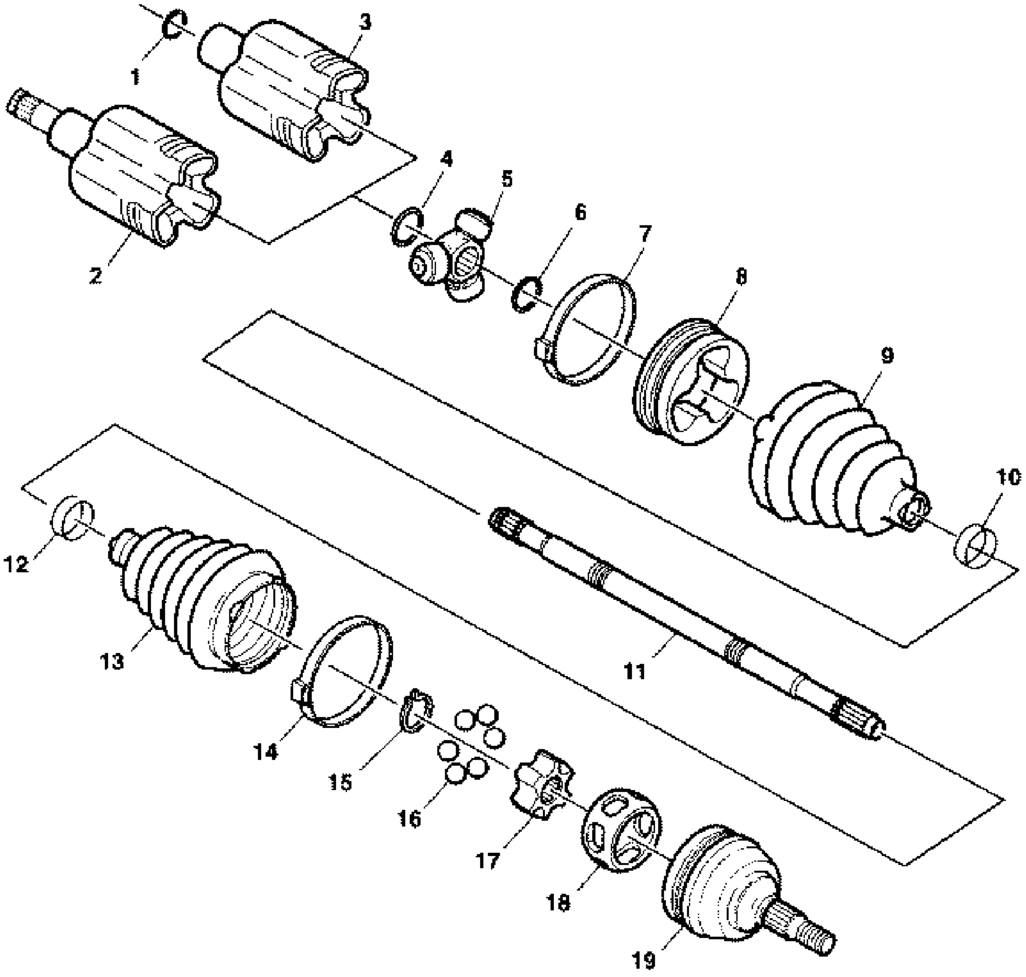
Wheel Drive Shafts Disassembled Views



(1) Retaining Ring
(2) Housing Assembly
(3) Retainer and Housing Assembly
(4) Spacer Ring
(5) Tripot Joint Spider Assembly
(6) Spacer Ring (If Equipped)
(7) Boot Retaining Clamp
(8) Trilobal Tripot Bushing
(9) Tripot Joint Boot
(10) Swage Ring
(11) Halfshaft Bar
(12) Swage Ring

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(13) CV Joint Boot
(14) Boot Retaining Clamp
(15) Race Retaining Ring
(16) Chrome Alloy Ball
(17) CV Joint Inner Race
(18) CV Joint Cage
(19) CV Joint Outer Race

2009 Chevrolet Impala | Impala (VIN W) Service Manual | Driveline/Axle | Wheel Drive Shafts | Repair Instructions |
Document ID: 2154676

Wheel Drive Shaft Replacement

Special Tools

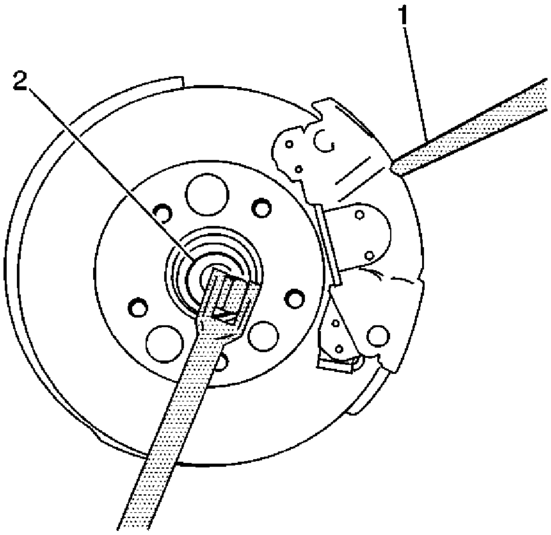
- J 2619-01 Slide Hammer
- J 29794 Axle Shaft Remover Extension
- J 33008-A Axle Shaft Remover
- J 42129 Hub Spindle Remover

Removal Procedure

Warning: To prevent personal injury and/or component damage, do not allow the weight of the vehicle to load the front wheels, or attempt to operate the vehicle, when the wheel drive shaft(s) or wheel drive shaft nut(s) are removed. To do so may cause the inner bearing race to separate, resulting in damage to brake and suspension components and loss of vehicle control.

Caution: Wheel drive shaft boots, seals and clamps should be protected from sharp objects any time service is performed on or near the wheel drive shaft(s). Damage to the boot(s), the seal(s) or the clamp(s) may cause lubricant to leak from the joint and lead to increased noise and possible failure of the wheel drive shaft.

1. Raise and suitably support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Remove the wheel and the tire. Refer to Tire and Wheel Removal and Installation.
3. Remove the stabilizer shaft link. Refer to Stabilizer Shaft Link Replacement.



4. Remove the front wheel drive shaft nut (2). Insert a drift or a flat-bladed tool (1) into the caliper and the rotor to prevent the rotor from turning.
5. Disconnect the outer tie rod assembly from the steering knuckle. Refer to Steering Linkage Outer Tie Rod Replacement.

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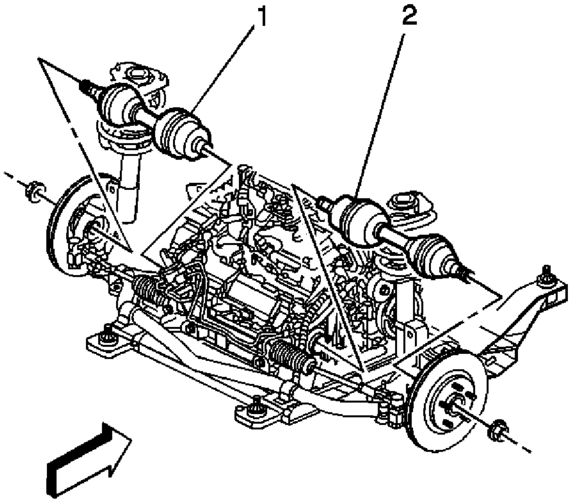
6. Separate the ball joint from the steering knuckle. Refer to Lower Control Arm Ball Joint Replacement.
7. Separate the front wheel drive axle from the front wheel drive shaft bearing using the J 42129 . The nut can be partially re-installed to protect the threads.

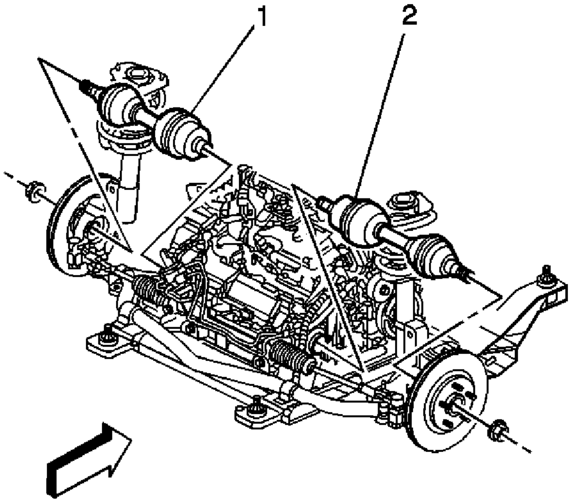


8. If necessary, remove the left front wheel drive axle (1) from the transaxle.

   If necessary, remove the right front wheel drive axle (2) from the transaxle.

   Use the J 33008-A , the J 29794 and the J 2619-01 to separate the axle from the transaxle.

Installation Procedure



1. Install the front wheel drive axle (1, 2) into the transaxle.
2. Verify that the front wheel drive shaft retaining ring is properly seated:
   - Grasp the inner housing and pull the inner housing outward. Do not pull on the front wheel drive axle shaft.
   - The front wheel drive axle will remain in place when the front wheel drive shaft retaining ring is properly seated.
3. Install the front wheel drive axle into the front wheel drive shaft bearing.
4. Connect the ball joint to the steering knuckle. Refer to Lower Control Arm Ball Joint Replacement.
5. Connect the outer tie rod assembly to the steering knuckle. Refer to Steering Linkage Outer Tie Rod Replacement.

   Caution: Refer to Fastener Caution in the Preface section.

6. Install a new front wheel drive shaft nut. Insert a drift or a flat-bladed tool into the caliper and the rotor to prevent the rotor from turning.

   Tighten
   Tighten the nut to 160 N·m (118 lb ft).

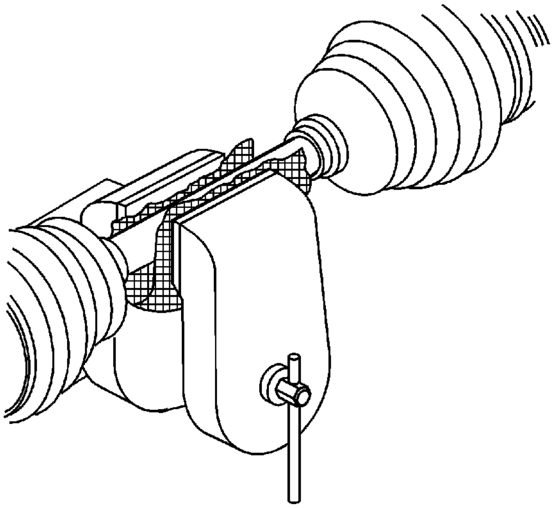
7. Install the stabilizer shaft link. Refer to Stabilizer Shaft Link Replacement.
8. Install the wheel and the tire. Refer to Tire and Wheel Removal and Installation.
9. Lower the vehicle.
10. Inspect the transaxle fluid level.
11. Inspect the wheel alignment. Refer to Wheel Alignment Measurement.

Wheel Drive Shaft Inner Joint and Boot Replacement

Special Tools

- J 35910 Drive Axle Seal Clamp Pliers
- J 41048 Drive Axle Swage Ring Clamp

Disassemble Procedure



1. Clamp the wheel drive shaft in a soft jawed vise.

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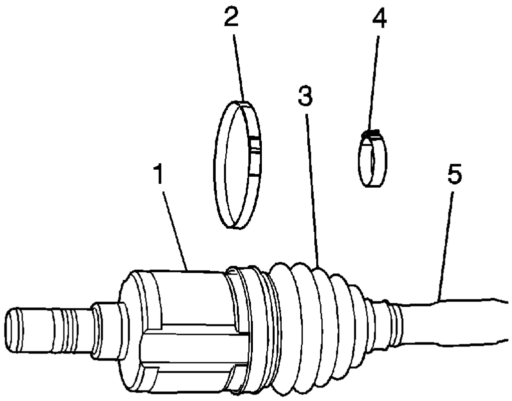
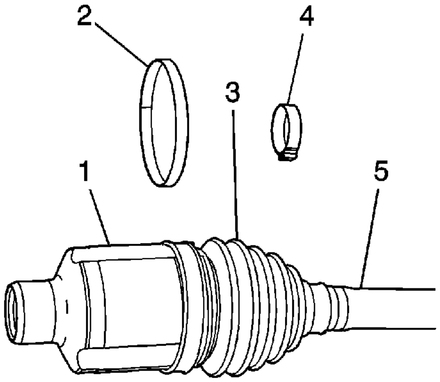
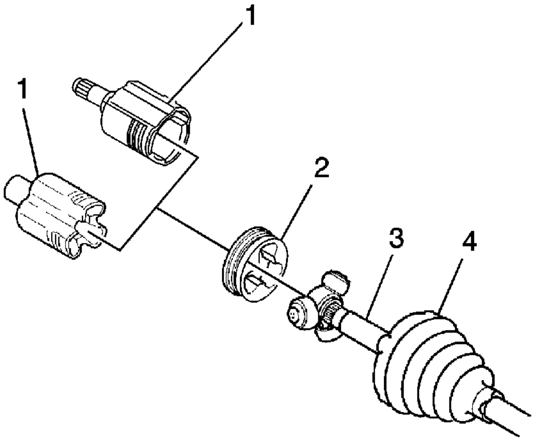




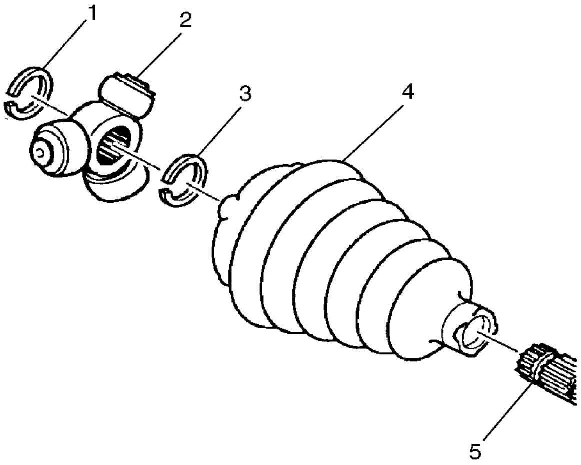
Caution: Do not cut through the wheel drive shaft inboard or outboard boot during service. Cutting through the boot may damage the sealing surface of the housing and the tripot or the constant velocity joint bushing. Damage to the sealing surface may lead to water and dirt intrusion and premature wear of the constant velocity joint.

Note: The following service procedure is for those vehicles equipped a swage style boot clamp. For all others, proceed to step 3.

2. Using a hand grinder, remove the boot retaining clamp (4) and discard the clamp.
3. Using a pair of side cutters, remove the boot clamp (4) and discard the clamp.
4. Using the appropriate tool, remove the large boot retaining clamp (2) and discard the retaining clamp.



5. Remove the boot (4) from the tripod bushing (2).
6. Remove the inner tripod housing (1) and the tripod bushing (2) from the wheel drive shaft (3).



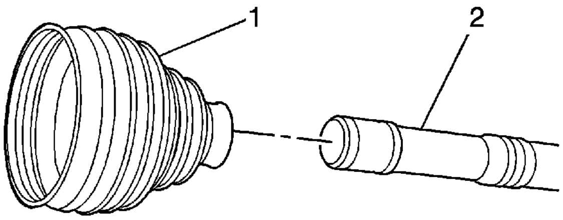
7. Using the appropriate tool, remove the outer retaining ring (1) from the wheel drive shaft (5).
8. Remove the tripod (2) from the wheel drive shaft (5).

Note: If the tripod has a retaining ring located after it, proceed to step 9. If not, skip step 9 and proceed to step 10.

9. Using the appropriate tool, remove the inner retaining ring (1) from the wheel drive shaft (5).
10. Remove the boot (4) from the wheel drive shaft (5).

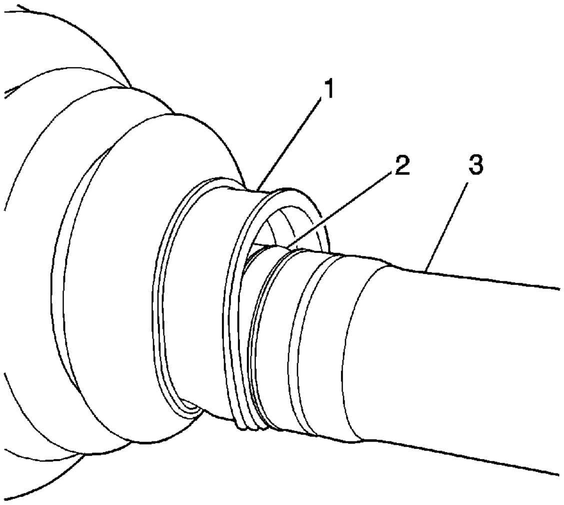
11. Inspect the inner wheel drive shaft joint. Refer to Wheel Drive Shaft Inner Joint Inspection.

Assemble Procedure

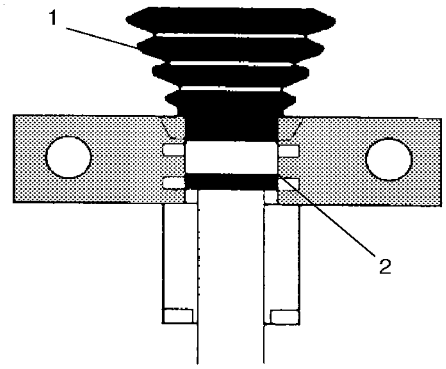


Note: Steps 1 thru 8 are is for those vehicles equipped a swage style boot clamp. For all others, proceed to step 9.

1. Install the swage clamp and boot (1) on to the wheel drive shaft (2).



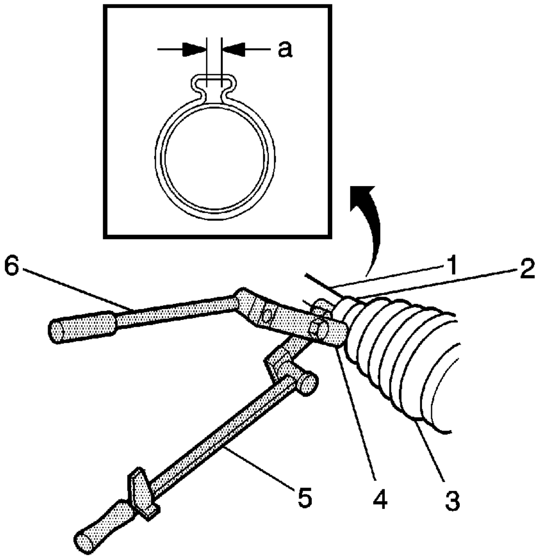
2. Ensure that the boot (1) is properly seated in the groove (2) in the wheel drive shaft (3).



3. Install the J 41048 in a vise.
4. Position the swage clamp (2) so that it is properly seated on the boot (1).
5. Align the boot with the indicator on the bottom die.
6. Position the upper die and bolts (2) on the wheel drive shaft (1).
7. Hand tighten the bolts (2) until the gap between the upper and lower die are the same.

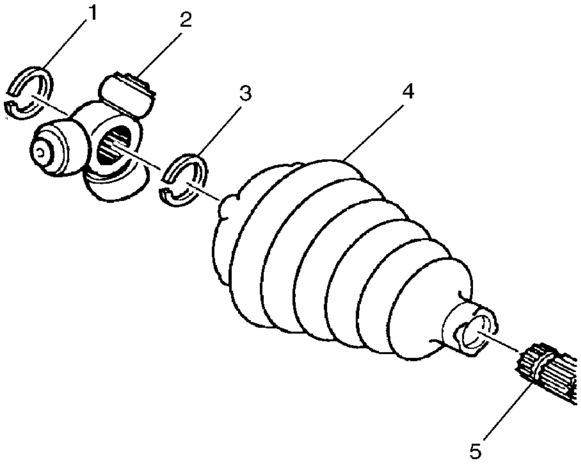
Note: Before tightening the swage clamp, ensure that the swage clamp is seated properly so that it will not distort or damage the boot.

8. Tighten the bolts (2) equally one at a time until both of the bolts have bottom out.

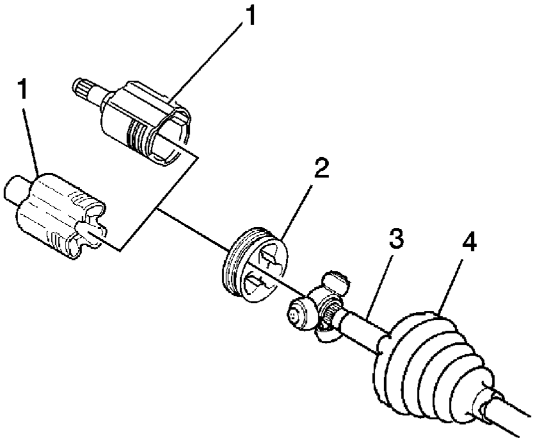


9. Install the boot clamp on the boot.
10. Install the boot (3) and the clamp (2) on the wheel drive shaft (1).
11. Using the J 35910 (4), torque wrench (5) and the breaker bar (6), tighten the clamp until

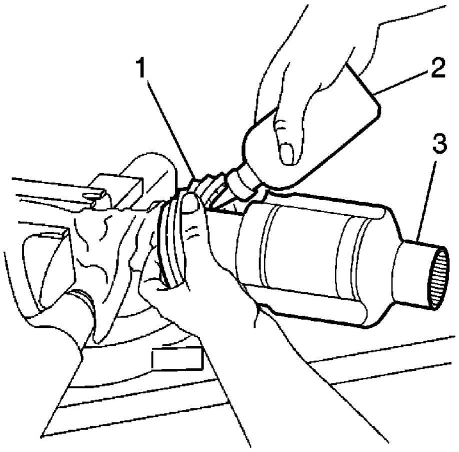
the gap (A) in the clamp reaches 2.15 mm (.085 inch).



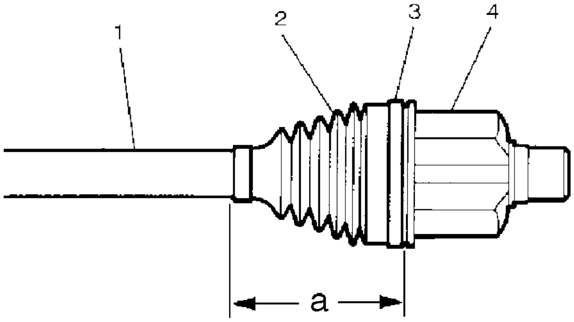
12. Using the appropriate tool, install the inner retaining ring (3), if equipped.
13. Install the tripod (2) on the wheel drive shaft (5).
14. Using the appropriate tool, install the outer retaining ring (1).



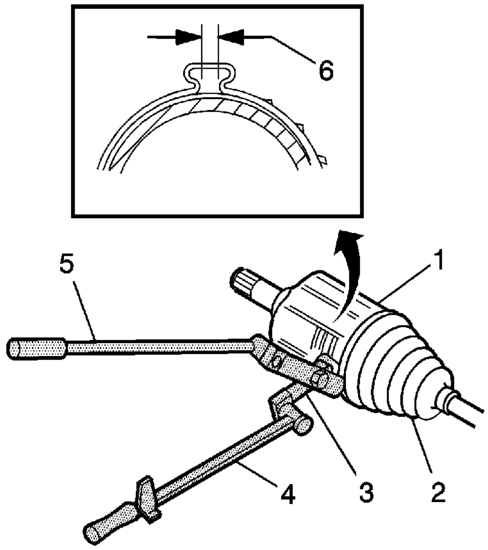
15. Install the tripod bushing (2), the tripod housing (1) on to the wheel drive shaft (3).
16. Install the tripod housing (1) on the boot (4).



17. Place approximately half the container of grease from the service kit in the boot and the half in the tripod housing.
18. Install the outer boot clamp (3) on the boot (2) and the tripod housing and the bushing (4).



19. Measure the distance from the rear of the boot to the front of the boot clamp (a).
    - For vehicles equipped with the 3.8L supercharged V 6 engines, distance a will equal 111 mm (4.75 inch)
    - For all others, distance a will equal 95 mm (3.75 inch)



20. Using the J 35910 (3), torque wrench (4), and the breaker bar (5), tighten the clamp (2).

    Tighten
    Tighten the clamp (2) to 176 N·m (130 lb ft).

    Note: If the gap dimension is larger than the given specification, continue to tighten the clamp until the specification is reached.

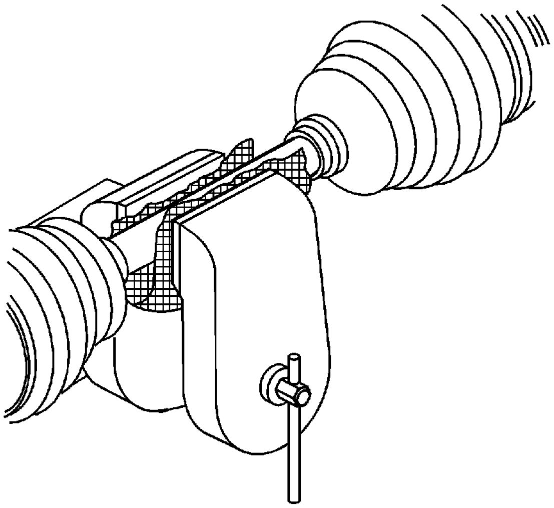
21. The gap of (A) should be 2.60 mm (0.102 inch).
22. Remove the wheel drive shaft from the J 41048 and rotate the tripod housing several times to distribute the grease.

Wheel Drive Shaft Outer Joint and Boot Replacement

Special Tools

- CH-48894 Wheel Drive Shaft Boot Clamp Pliers
- J 35910 Drive Axle Seal Clamp Pliers

Removal Procedure



1. Clamp the drive axle shaft in a soft jawed vice.

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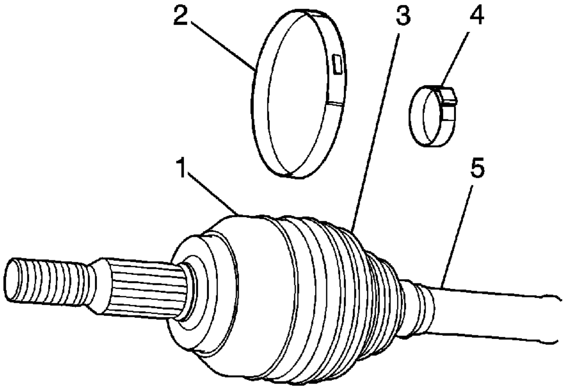
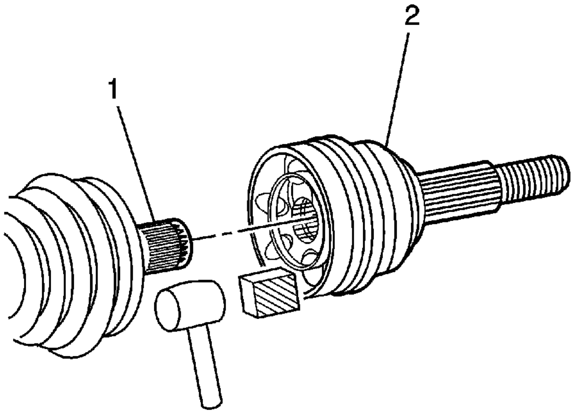
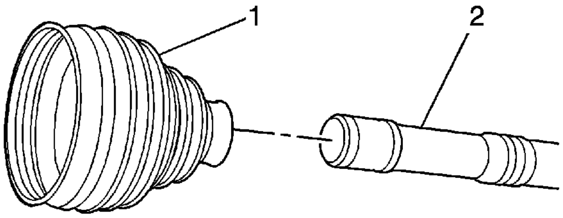


Caution: Do not cut through the wheel drive shaft inboard or outboard boot during service. Cutting through the boot may damage the sealing surface of the housing and the tripot or the constant velocity joint bushing. Damage to the sealing surface may lead to water and dirt intrusion and premature wear of the constant velocity joint.

2. Use a flat-bladed tool, remove the boot clamp (2) from the constant velocity (CV) joint (1) and the boot (3).
3. Using a pair of side cutters, remove the boot clamp (4) from the boot (3) and the wheel drive shaft (5).
4. Discard the boot clamps (2) and (4). Use NEW clamps only.

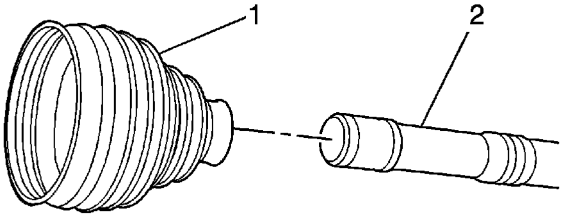


5. Using a block of wood and a hammer, remove the CV joint (2) from the wheel drive shaft (1).

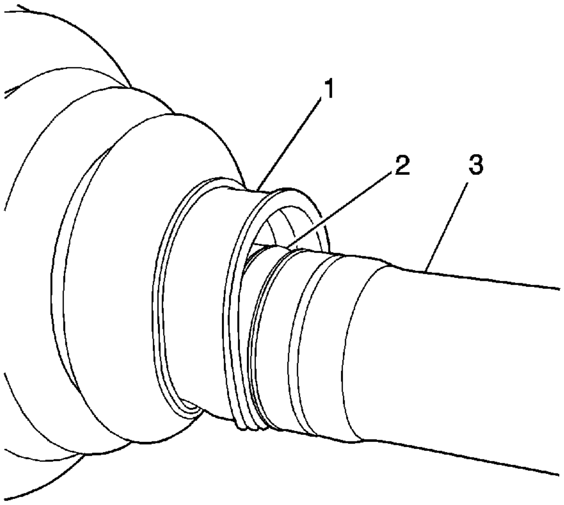


6. Remove the boot (1) from the wheel drive shaft (2).
7. Inspect the outer CV joint for damage and wear. Refer to Wheel Drive Shaft Outer Joint Inspection.

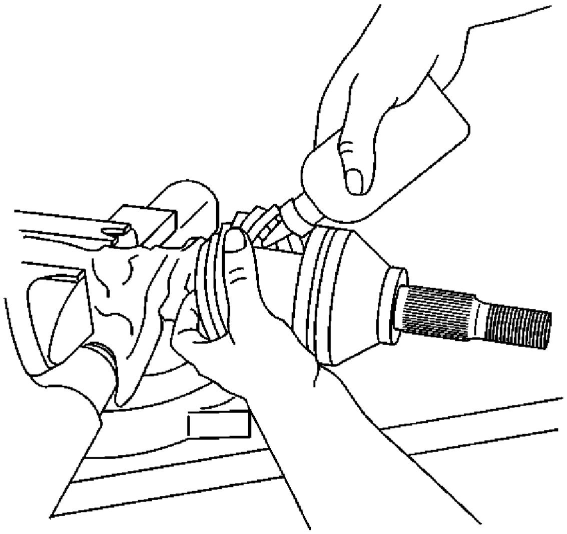
Installation Procedure



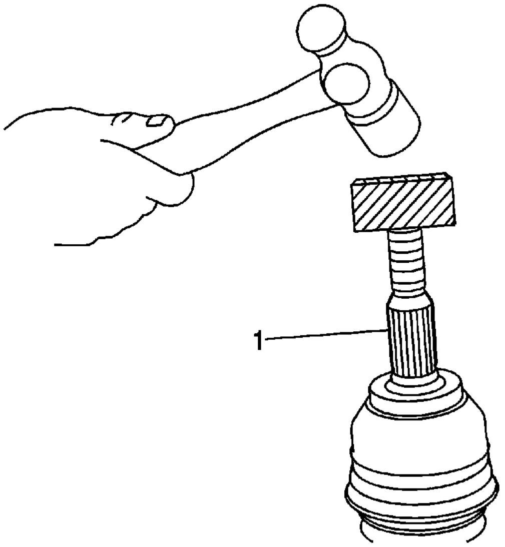
1. Position the boot (1) on the wheel drive shaft (2).



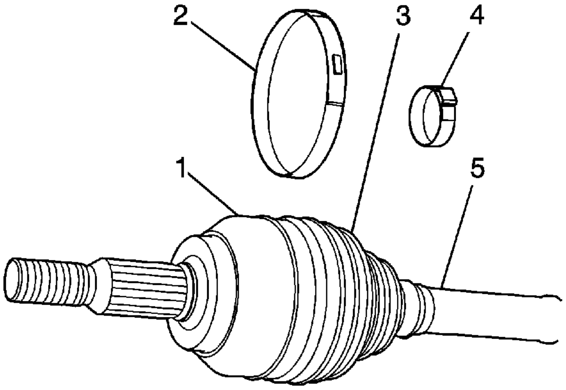
2. Ensure that the boot (1) is properly seated in the groove (2) in the wheel drive shaft (3).



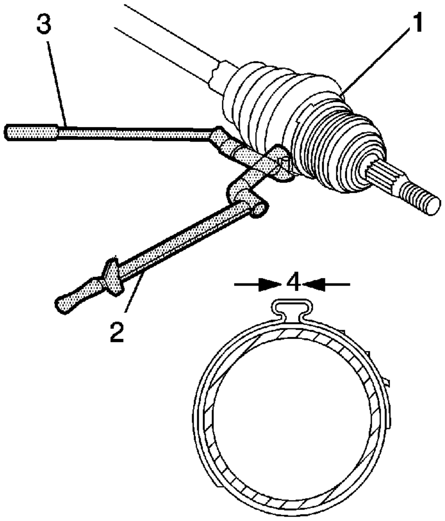
3. Place approximately half the grease from the service kit inside the outboard boot and pack the CV joint with the remaining grease.



4. Using a block of wood and a hammer, install the CV joint on the wheel drive shaft (1).



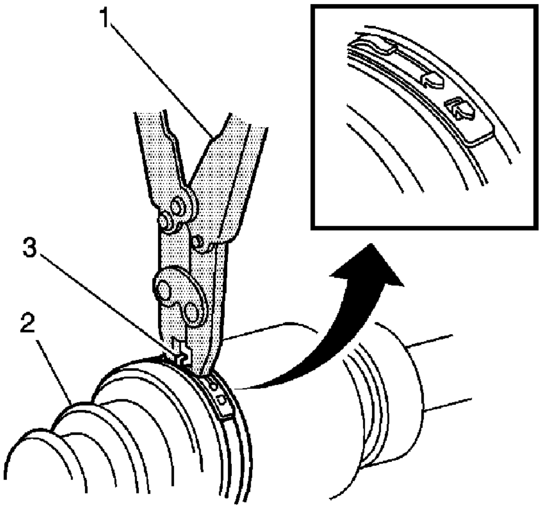
5. Install the boot clamp (4) on the boot (3) and the wheel drive shaft (5).
6. Install the boot clamp (2) on the boot (3) and the CV joint housing (1).



Note: Ensure that the boot clamp is properly positioned around the entire circumference of the boot.

7. Using the J 35910 (3), crimp the boot clamp (1).
8. Tighten the boot clamp.

Tighten
Tighten the boot clamp to 174 N·m (130 lb ft).



9. Using the CH-48894 (1) , close the boot clamp (3). Ensure the boot clamp (3) is securely closed and seated properly on the boot (2).

10. Remove the wheel drive shaft from the bench vise.
11. Distribute the grease within the outer CV joint by rotating the joint in a circular motion four to five times.

2009 Chevrolet Impala | Impala (VIN W) Service Manual | Driveline/Axle | Wheel Drive Shafts | Repair Instructions |
Document ID: 2056656

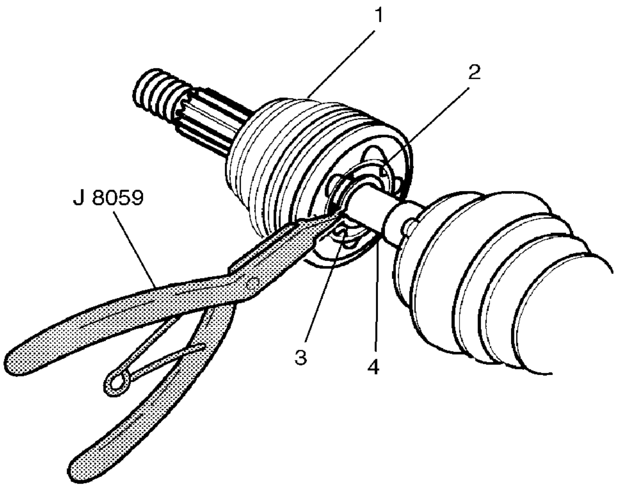
Wheel Drive Shaft Outer Joint Inspection

Special Tools

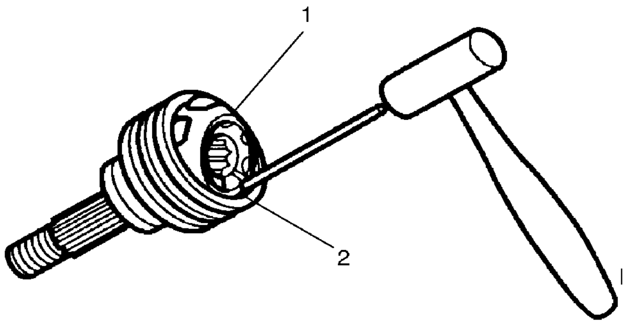
J 8059 Snap Ring Pliers

Disassembly Procedure

1. Remove the outer constant velocity (CV) joint and boot from the wheel drive shaft. Refer to Wheel Drive Shaft Replacement.
2. Remove any grease from the CV joint.



3. Using the J 8059 , remove the retaining ring (3) from the wheel drive shaft (4).



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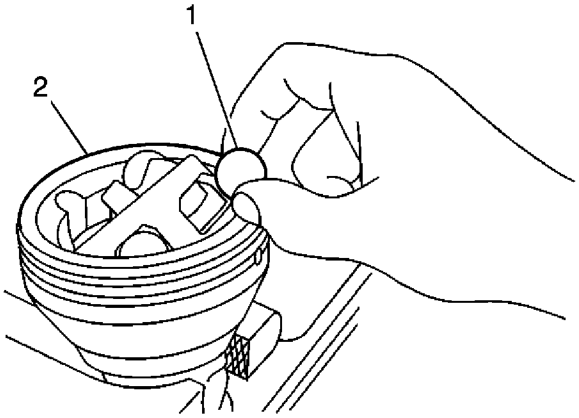
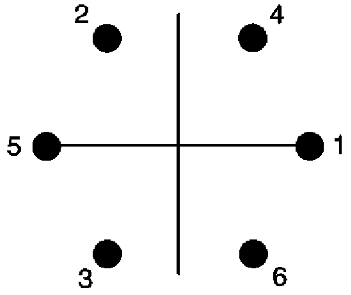
4. Install the outer CV joint assembly in a vise.

Important: The following procedure will have to be repeated until all the ball bearing are removed form the cage.

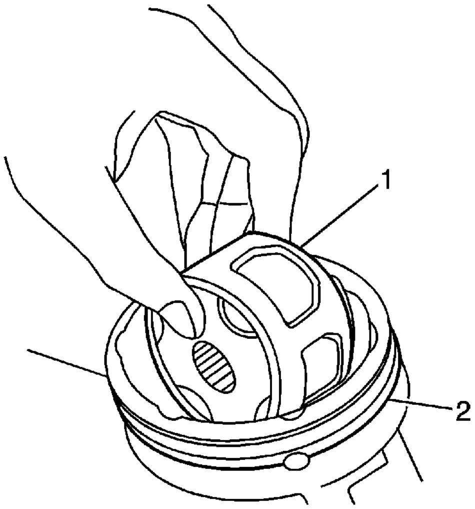
5. Using a brass drift (1), gentle tap the cage until the ball bearing can be removed from the cage.



6. Using a small screwdriver, remove the ball bearings from the CV joint.
7. Position the CV joint housing (2) so they are level.

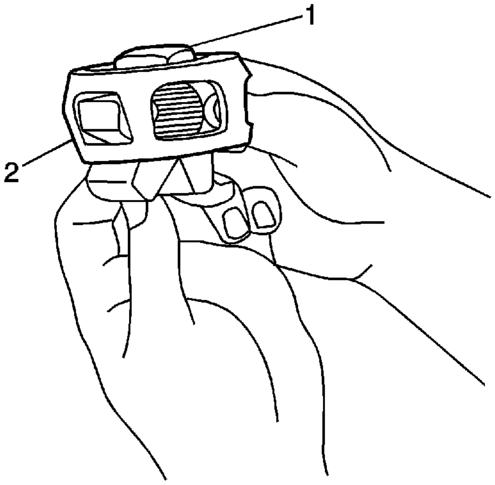


8. Remove the ball bearings from the CV joint in sequence.



Important: Position the cage so that the larger radius corners of the cage windows are facing up.

9. Position the cage (1) at 90 degrees to the centerline of the outer race.
10. Align the cage windows with the lands of the outer race.
11. Lift and remove the cage and the inner race from the outer race.



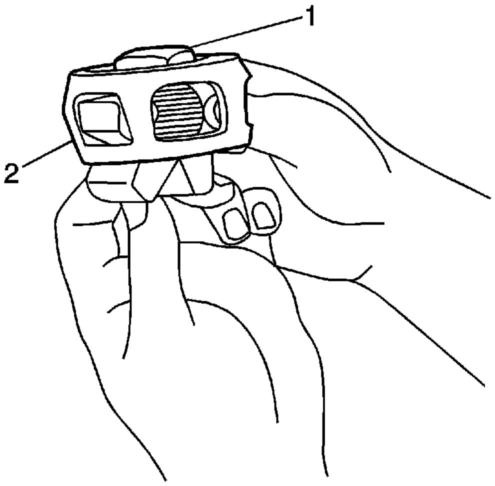
12. Position the cage (2) and the inner race (1) so that the larger radius corners of the cage windows are up.
13. Rotate the inner race 90 degrees to the center line of the cage.
14. Align the lands of the inner race with the windows of the cage.
15. Move the inner race land into the cage window.
16. Rotate the inner race down and remove it from the cage.

17. Clean the following items thoroughly with the proper cleaning solvent:
    - The inner race
    - The outer race
    - The cage
    - The ball bearings
    - The exposed end of the wheel drive shaft

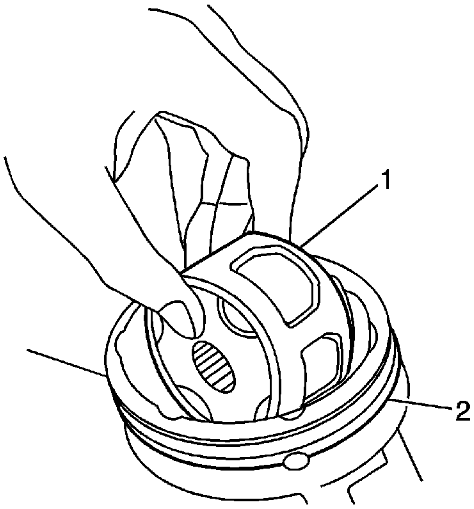
    Important: The internal parts of the CV joint are NOT SERVICED separately. The outer CV joint is serviced as an assembly.

18. If any of the above items are found to have excessive wear or are damaged, replace the outer CV joint as an assembly.

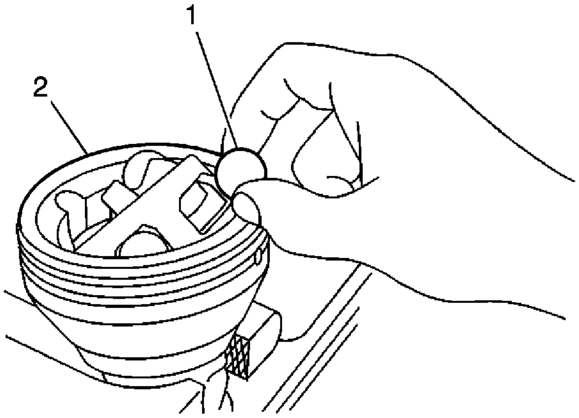
Assembly Procedure



1. Position the cage (2) so that the larger radius corners of the cage windows are up.
2. Position the inner race 90 degrees to the centerline of the cage.
3. Insert the inner race through the bottom of the cage.
4. Align the lands of the inner race with the windows of the cage.
5. Move the inner race land into the cage window.
6. Rotate the inner race down and remove it from the cage.
7. Rotate the inner race within the cage so that the grooved surface of the inner race is facing up.
8. Align the inner race ball bearing tracks with the cage windows.



9. Wrap a clean shop towel around the CV joint outer race splined shaft.
10. Place the outer race vertically in a bench vise.
11. Position the cage (1) and the inner race at 90 degrees to the centerline of the outer race.
12. With the inner race and the cage assembly in a vertical position, insert the cage and the inner race into the outer race.



Important: The larger radius corners of the cage windows should be positioned up and the grooved surface of the inner race should be visible.

13. Position the housing (2) and the inner race so that they are level in the vise.
14. Rotate the appropriate components, and align the cage windows and the inner race ball bearing tracks with the outer race ball bearing (1) tracks.
15. Position a cage window and the inner race ball bearing track for the ball bearing installation.

Important: When performing the following procedure, the opposing cage window and the inner ball bearing track will be accessible for the ball bearing installation.

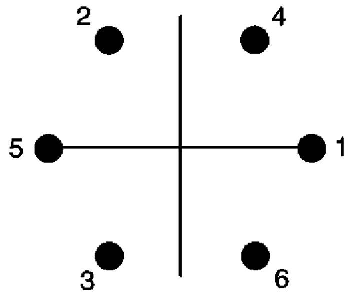
16. Press down on the cage following one of the outer race ball bearing tracks.
17. Install the ball bearing through the cage window onto the inner race ball bearing track.

Important: The following service procedure will have to be performed after each ball bearing has been installed.

18. After the first ball bearing has been installed, use a brass drift and a hammer and gently tap the cage in order to drive the cage and the inner race down completely in the outer race.

Important: After the ball bearing has been installed, there should be NO GAP between the ball bearing and the inner race.

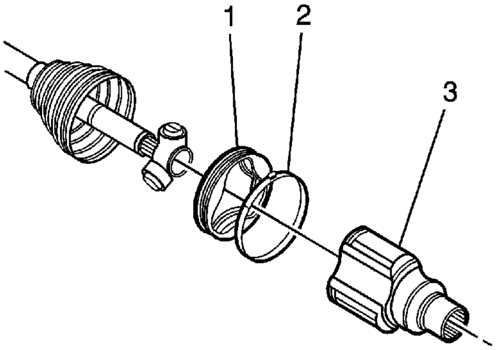
19. Position the cage and the inner race so that they are level.
20. Using a plastic hammer, lightly tap the ball bearing into place.



21. Install the ball bearings in sequence.
22. Repeat steps 18-20 until all the ball bearings are installed.
23. If any of the internal parts are found to be defective, replace the outer joint. Refer to Wheel Drive Shaft Outer Joint and Boot Replacement.

Wheel Drive Shaft Inner Joint Inspection

Inspection Procedure



1. Remove the wheel drive shaft tripod bushing (1) from the tripod housing (5).
2. Remove the wheel drive shaft tripod housing (1) from the wheel drive shaft.
3. Remove the wheel drive shaft tripod joint boot bushing (1).
4. Using a suitable cleaner, remove the excess grease from the tripod assembly.
5. Inspect the following items for damage or excessive wear:
   - The wheel drive shaft tripod boot
   - The wheel drive shaft tripod assembly
   - The wheel drive shaft tripod joint housing
   - The wheel drive shaft tripod joint bushing
   - The wheel drive shaft
6. If any of the internal parts are found to be excessively worn or damaged, replace the wheel drive shaft inner joint and boot. Refer to Wheel Drive Shaft Inner Joint and Boot Replacement.

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2006 ACCESSORIES & EQUIPMENT

Wipers/Washer Systems - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Washer Solvent Container Nuts	10 N.m	89 lb in
Wiper Arm Nut	35 N.m	25 lb ft
Wiper Module Bolts	10 N.m	89 lb in
Wiper Motor Bolts	4.5 N.m	40 lb in
Wiper Motor Support Bracket Screws	5.5 N.m	49 lb in

SCHEMATIC AND ROUTING DIAGRAMS

WIPER/WASHER SYSTEM SCHEMATICS

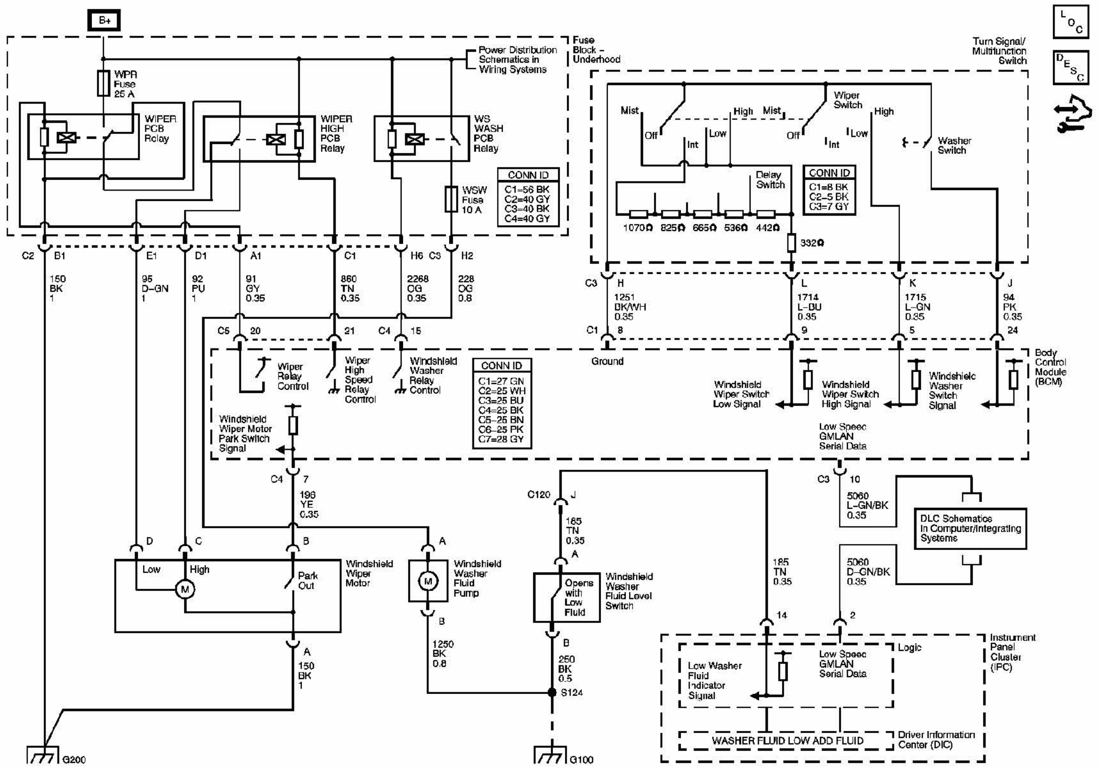
B+
Fuse Block - Underhood
Power Distribution Schematics in Wiring Systems
WPR Fuse 25 A
WIPER PCB Relay
WIPER HIGH PCB Relay
WS WASH PCB Relay
WSW Fuse 10 A
CONN ID
C1=56 BK
C2=40 GY
C3=40 BK
C4=40 GY
C2 B1 E1 D1 A1 C1 H6 C3 H2
150 BK 1
95 D-GN 1
92 PU 1
91 GY 0.35
860 TN 0.35
2268 OG 0.35
228 OG 0.8
C5 20 21 C4 15
Wiper Relay Control
Wiper High Speed Relay Control
Windshield Washer Relay Control
CONN ID
C1=27 GN
C2=25 WH
C3=25 BU
C4=25 BK
C5-25 BN
C6-25 PK
C7=28 GY
Windshield Wiper Motor Park Switch Signal
C4 7
196 YE 0.35
D C B A
Low
High
M
Park Out
Windshield Wiper Motor
Windshield Washer Fluid Pump
B
1250 BK 0.8
A
150 BK 1
G200
Turn Signal/ Multifunction Switch
Mist
Off
Int
Low
High
Mist
Off
Int
Low
Wiper Switch
High
Washer Switch
Delay Switch
CONN ID
C1=8 BK
C2-5 BK
C3=7 GY
1070Ω 825Ω 665Ω 536Ω 442Ω
332Ω
C3 H L K J
1251 BK/WH 0.35
1714 L-BU 0.35
1715 L-GN 0.35
94 PK 0.35
C1 8 9 5 24
Ground
Windshield Wiper Switch Low Signal
Windshield Wiper Switch High Signal
Windshield Washer Switch Signal
Body Control Module (BCM)
Low Speed GMLAN Serial Data
C3 10
5060 L-GN/BK 0.35
DLC Schematics In Computer/Integrating Systems
5060 D-GN/BK 0.35
C120 J
185 TN 0.35
A
Opens with Low Fluid
Windshield Washer Fluid Level Switch
B
250 BK 0.5
S124
G100
185 TN 0.35
14 2
Logic
Low Washer Fluid Indicator Signal
Low Speed GMLAN Serial Data
Instrument Panel Cluster (IPC)
WASHER FLUID LOW ADD FLUID
Driver Information Center (DIC)

Fig. 1: Wiper/Washer System Schematics - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

WIPER/WASHER SYSTEM COMPONENT VIEWS

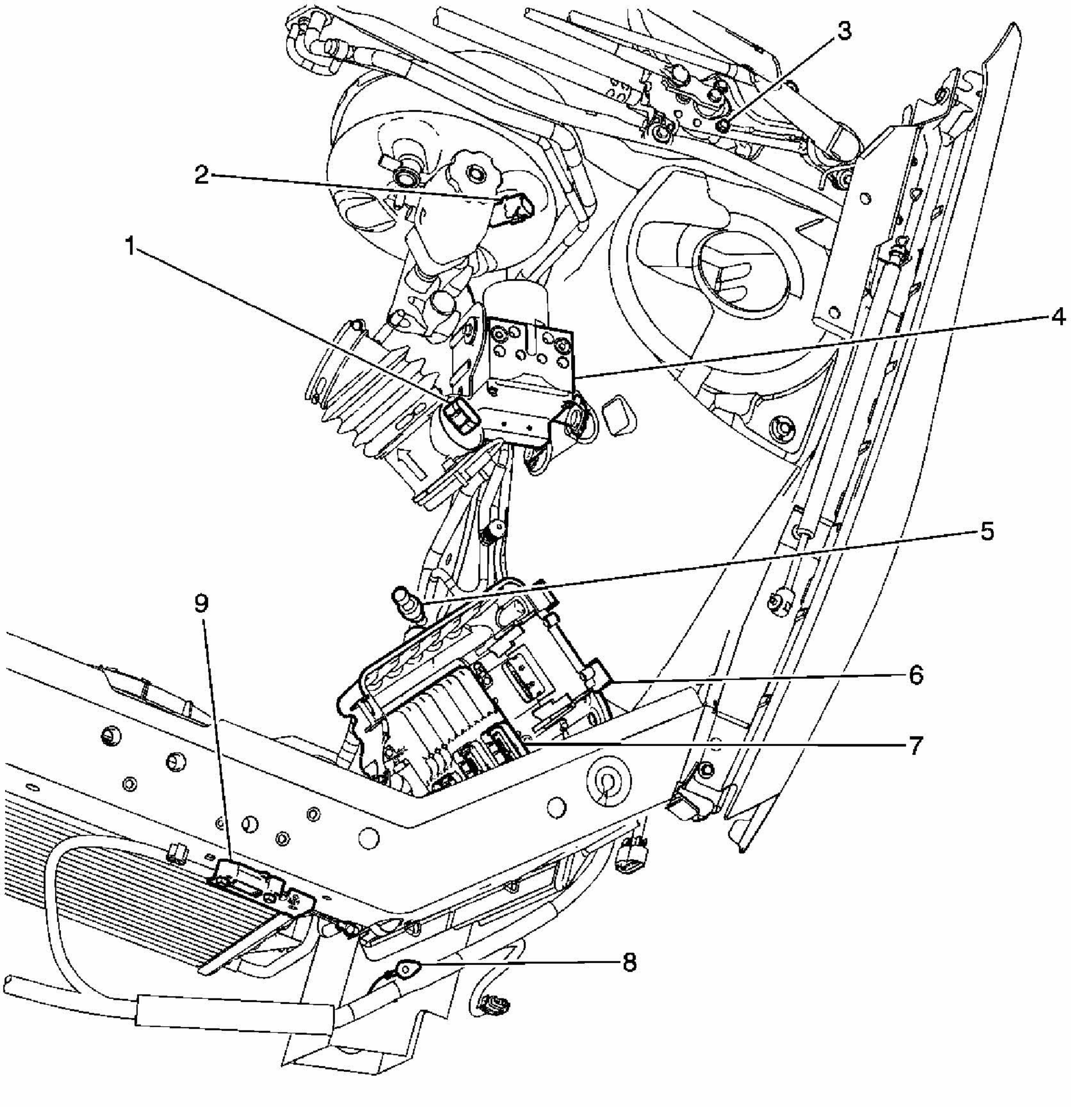

Fig. 2: LF of the Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	Mass Air Flow (MAF) / Intake Air Temperature (IAT) Sensor
2	Brake Fluid Level Switch
3	Windshield Wiper Motor
4	Electronic Brake Control Module (EBCM)
5	A/C Refrigerant Pressure Sensor

6	Transmission Control Module (TCM)
7	Engine Control Module (ECM)
8	G101
9	Inflatable Restraint Front end Sensor - Left

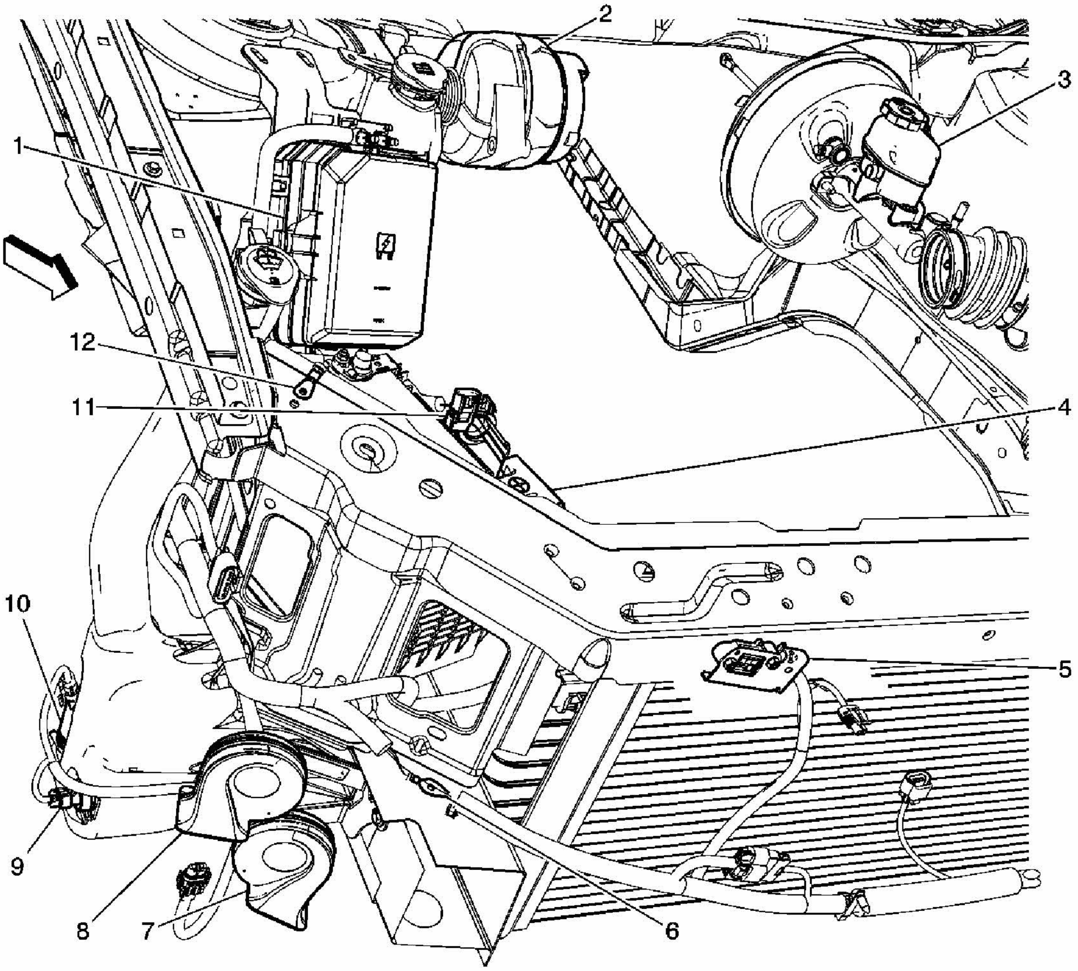

Fig. 3: RF of the Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Fuse Block - Underhood
2	Generator
3	Brake Fluid Level Switch
4	Battery
5	Inflatable Restraint Front end Sensor - Right
6	G100

7	Horn Assembly
8	Windshield Washer Fluid Container
9	Windshield Washer Fluid Level Switch
10	Windshield Washer Fluid Pump
11	Battery Current Sensor
12	G102

WIPER/WASHER SYSTEM CONNECTOR END VIEWS

Windshield Washer Fluid Level Switch

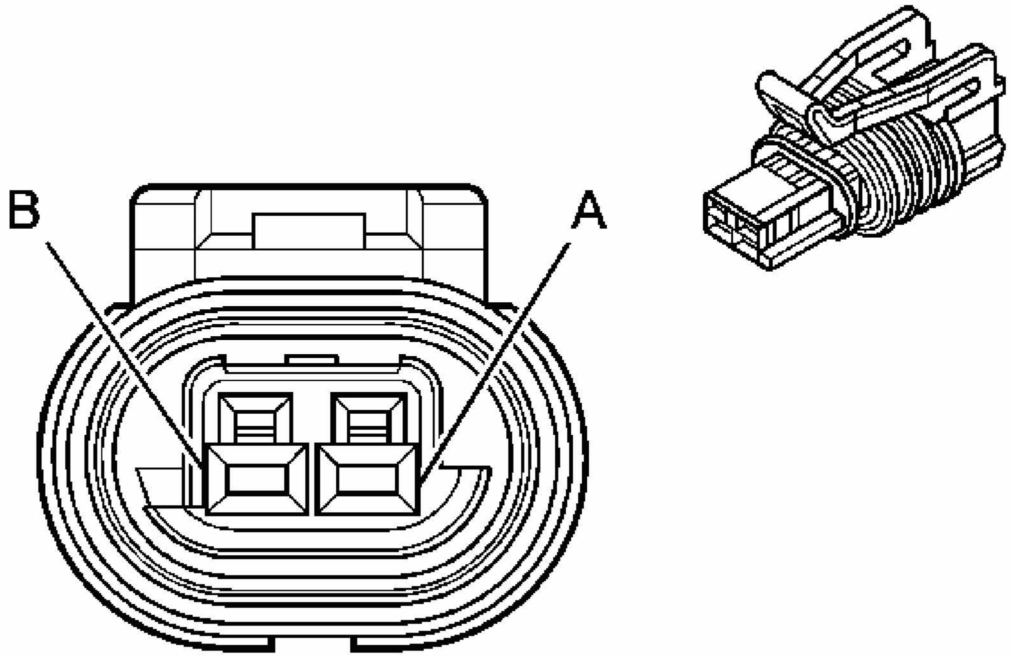

Fig. 4: Windshield Washer Fluid Level Switch End View
Courtesy of GENERAL MOTORS CORP.

Wiper/Washer System Connector End Views

Connector Part Information • OEM: 15449028 • Service: 88987978 • Description: 2-Way F GT 150 Sealed (BK)
Terminal Part Information

- Pins: A, B
- Terminal/Tray: 15326267/19
- Core/Insulation Crimp: Pins A - See Terminal Repair Kit
- Core/Insulation Crimp: Pins B - E/4
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Windshield Washer Fluid Level Switch

Pin	Wire Color	Circuit No.	Function
A	TN	185	Low Washer Fluid Indicator Control
B	BK	1250	Ground

Windshield Washer Fluid Pump

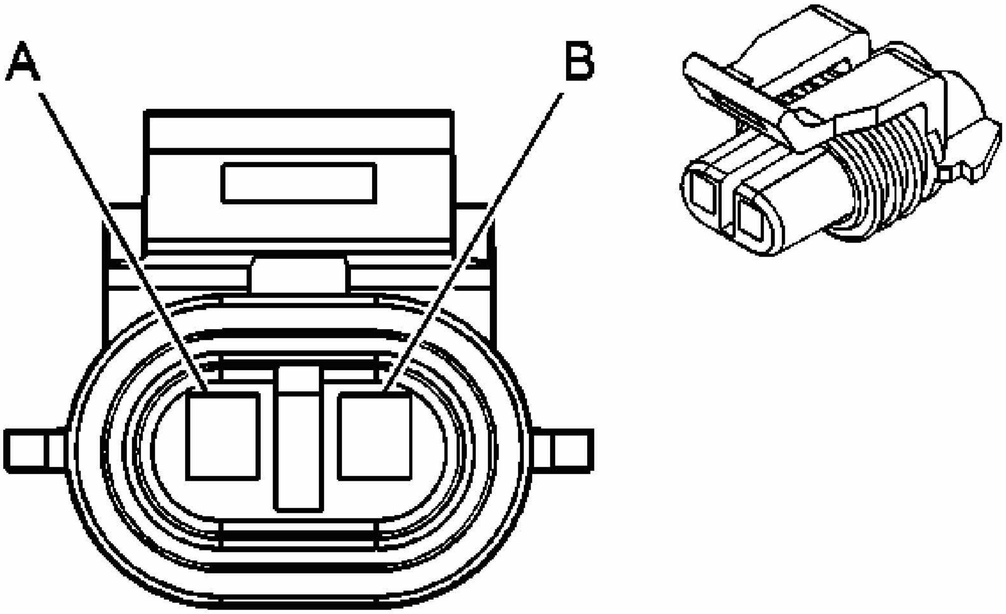

Fig. 5: Connector End Views
Courtesy of GENERAL MOTORS CORP.

Wiper/Washer System Connector End Views

Connector Part Information

- OEM: 12052641
- Service: 12102747

- Description: 2-Way F Metri-Pack 150 Sealed (BK)

Terminal Part Information

- Terminal/Tray: 12048074/2
- Core/Insulation Crimp: E/1
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Windshield Washer Fluid Pump

Pin	Wire Color	Circuit No.	Function
A	OG	228	Windshield Washer Pump Control
B	BK	1250	Ground

Windshield Wiper Motor

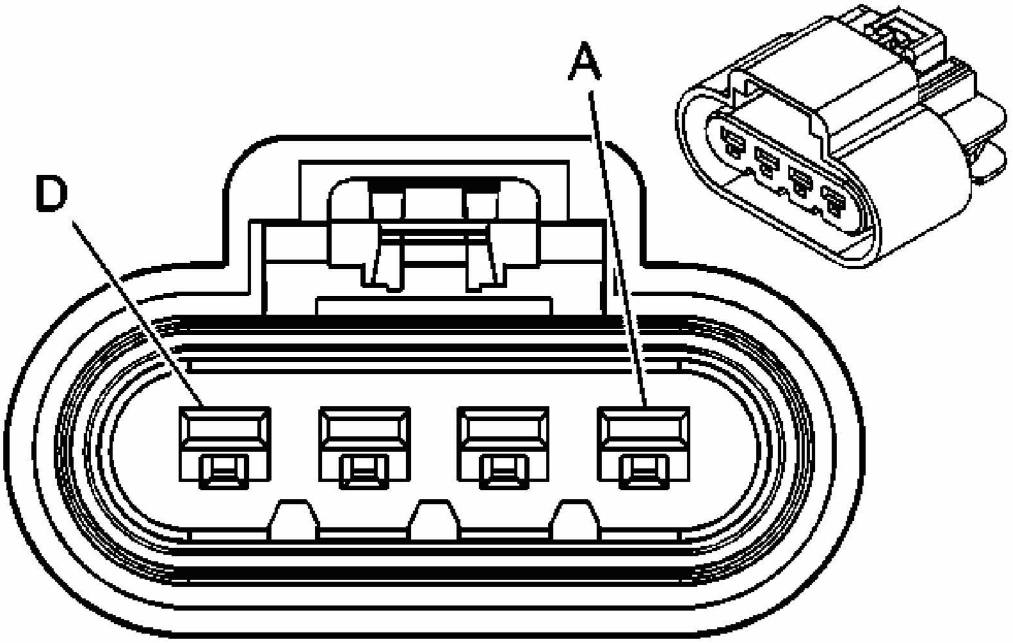

Fig. 6: Windshield Wiper Motor Connector End View
Courtesy of GENERAL MOTORS CORP.

Wiper/Washer System Connector End Views

Connector Part Information

- OEM: 15326631

- Service: 15306360
- Description: 4-Way F GT 280 Sealed (BK)

Terminal Part Information

- Pins: A, C, D, B
- Terminal/Tray: 15304719/19
- Core/Insulation Crimp: Pins A, C, D - See Terminal Repair Kit
- Core/Insulation Crimp: Pins B - E/5
- Release Tool/Test Probe: 15315247/J-35616-4A (PU)

Windshield Wiper Motor

Pin	Wire Color	Circuit No.	Function
A	BK	150	Ground
B	YE	196	Windshield Wiper Motor Park Switch Signal
C	PU	92	Windshield Wiper Motor High Speed Control
D	D-GN	95	Windshield Washer Switch Signal

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B3715	Front Wiper Relay Drive Circuit
DTC B3873	Front Washer Relay Circuit
DTC B3875	Wiper High Speed Relay Circuit
DTC B3922	Front Wiper Function Select Circuit

DIAGNOSTIC STARTING POINT - WIPER/WASHER SYSTEMS

Begin diagnosis with the **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL OUTPUT CONTROLS

Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection	Description
Wiper Motor Relay	Miscellaneous Test	This output control commands the wiper 1 relay On and Off. The wiper motor will operate at Low speed when the wiper 1 relay is On.
Wiper Motor Low/Hi Speed Relay	Miscellaneous Test	This output control commands the wiper Hi relay On or Off.

SCAN TOOL DATA LIST

Scan Tool Data List

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition On/Engine Off			
Low Washer Fluid	Inputs	Low/OK	OK
Wiper High Speed Switch	Inputs	On/Off	Off
Wiper Motor Low/Hi Speed Relay	Outputs	On/Off	Off
Wiper Motor Park Switch	Inputs	Active/Inactive	Active
Wiper Motor Relay	Outputs	On/Off	Off
Wiper Washer Motor	Outputs	On/Off	Off
Wiper Washer Switch	Inputs	Active/Inactive	Off

SCAN TOOL DATA DEFINITIONS

Use the scan tool data display values and definitions information in order to assist in diagnosing vehicle malfunctions. Compare the vehicles actual scan tool data display with the typical data value in the table. Use the data in order to aid in understanding the nature of the concern when the vehicle data display does not match the typical data values. Refer to **Scan Tool Data List**.

The typical scan tool data values were taken from a known good vehicle under the following conditions:

- The ignition switch is in the ON position.
- The windshield wiper/washer switch is OFF.

Low Washer Fluid

This input displays the washer fluid level. Low is displayed when the level is Low and OK is displayed if it is above the switch threshold.

Wiper High Speed Switch

This input displays On if the wiper washer switch is in the Hi position.

Wiper Motor Low/Hi Speed Relay

This output displays the state of the wiper Hi relay. On is wipers Hi speed and Off is wipers Low speed.

Wiper Motor Park Switch

The body control module (BCM) uses this input to determine if the wipers are approaching the park position. The scan tool displays Active when the BCM detects ground on the windshield wiper motor park switch signal circuit.

Wiper Motor Relay

This output displays whether or not the BCM is providing voltage for the wiper relay. ON is displayed when the BCM detects the correct signal from the windshield wiper switch.

Wiper Washer Motor

This output displays the operation mode of the washer pump.

Wiper Washer Switch

The BCM uses this input to determine if the wash switch is depressed. If it is depressed, the BCM commands the wiper 1 relay ON and keeps it ON until 2 wipe cycles have completed after the switch has been released.

DTC B3715

Circuit Description

The body control module (BCM) monitors the control circuit of the wiper ON/OFF relay. The voltage level should be low while the wiper relay is de-energized and near system voltage when the relay is energized. After the BCM receives a low, intermittent, or mist signal from the wiper/washer switch, it responds by applying battery voltage through the wiper relay control circuit to the coil side of the relay, energizing the WIPER relay. Ground is supplied at all times to the coil side of the WIPER relay from G104.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B3715

Front Wiper Relay Drive Circuit

Conditions for Running the DTC

This DTC can set only when the output is actively being requested by the CPU.

Conditions for Setting the DTC

If the BCM detects a short to ground or an open in the WIPER relay control circuit.

Action Taken When the DTC Sets

The BCM will not activate the output.

Conditions for Clearing the DTC

- The current DTC will become history when the request for the output is removed or when the condition for setting the fault is corrected.
- The history DTC will clear after 50 consecutive ignition cycles without a fault present.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step tests for constant voltage in the control circuit of the wiper relay.

4: This step verifies that the BCM is applying voltage through the control circuit to the wiper relay.

5: This step tests for an open in the ground circuit of the wiper relay.

DTC B3715

Step	Action	Yes	No
Schematic Reference: Wiper/Washer System Schematics **Connector End View Reference: Wiper/Washer System Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
	1. Turn ON the ignition.	Go to **Testing for Intermittent**	

2	2. Turn the wiper switch to LOW. Do the low speed wipers operate?	**Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Remove the WIPER relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . 3. Turn ON the ignition, with the engine OFF. 4. Turn the wiper switch to the OFF position. 5. Connect a test lamp from the control circuit of the wiper relay socket to a good ground. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 4**
4	With the test lamp still connected to the control circuit of the wiper relay, turn the wiper switch to the low speed position. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 6**
5	1. Connect the test lamp between the control circuit of the wiper relay and the ground circuit of the wiper relay. 2. Turn the wiper switch to the low speed position Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 10**
6	Test the control circuit of the wiper relay for a short to ground or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**
7	1. Turn ON the ignition, with the engine OFF. 2. Test the control circuit of the wiper relay for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.		

	Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**
8	Inspect for poor connections at the connector of the wiper relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 11**
9	Inspect for poor connections at the harness connector of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 12**
10	Repair the open in the ground circuit of the wiper relay. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 13**	-
11	Replace the wiper relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	Go to **Step 13**	-
12	Replace the BCM. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 13**	-
13	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC. Does the DTC reset?	Go to **Step 2**	System OK

DTC B3873

Circuit Description

The body control module (BCM) monitors the windshield washer pump low reference circuit only when a wash cycle is active. When a wash cycle is requested, the BCM responds by applying a ground through the windshield washer pump low reference circuit to the coil side of the relay, energizing the windshield washer relay.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B3873

Front Washer Relay Circuit

Conditions for Running the DTC

This DTC can set only when the BCM output to the windshield washer relay is active.

Conditions for Setting the DTC

The BCM detects an short to battery voltage in the windshield washer pump low reference circuit.

Action Taken When the DTC Sets

The BCM will not activate the output to the windshield washer relay.

Conditions for Clearing the DTC

- The current DTC will become history when the request for the output is removed or when condition for setting the fault is corrected.
- The history DTC will clear after 50 consecutive ignition cycles without a fault present.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step tests for constant ground in the low reference circuit of the wiper relay.

4: This step verifies that the BCM is applying a ground through the low reference circuit to the wiper relay.

5: This step tests for an open in the battery positive voltage circuit of the wiper relay.

DTC B3873

Step	Action	Yes	No
Schematic Reference: Wiper/Washer System Schematics **Connector End View Reference: Wiper/Washer System Connector End Views**			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information

2	1. Turn ON the ignition. 2. Press the windshield washer switch. Do the windshield washers operate?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Remove the windshield washer relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . 3. Turn ON the ignition, with the engine OFF. 4. Turn the wiper switch to the OFF position. 5. Connect a test lamp between the low reference circuit of the windshield washer relay socket and battery voltage. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 4**
4	With the test lamp still connected to the low reference circuit of the windshield washer relay, press the windshield washer switch. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 6**
5	1. Connect the test lamp between the low reference circuit of the windshield washer relay and the battery positive voltage circuit of the windshield washer relay. 2. Press the windshield washer switch. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 10**
6	Test the low reference circuit of the windshield washer relay for a short to battery voltage or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**
	1. Turn ON the ignition, with the engine		

7	OFF. 2. Test the low reference circuit of the windshield washer relay for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**
8	Inspect for poor connections at the connector of the windshield washer relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 11**
9	Inspect for poor connections at the harness connector of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 12**
10	Repair the short to ground or open in the battery positive voltage circuit of the windshield washer relay. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 13**	-
11	Replace the windshield washer relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	Go to **Step 13**	-
12	Replace the BCM. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 13**	-
13	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC. Does the DTC reset?	Go to **Step 2**	System OK

DTC B3875

Circuit Description

The body control module (BCM) monitors the wiper high speed relay control circuit only when wiper high speed mode is active. When the wiper high speed mode is requested, the BCM responds by applying a ground through the wiper high speed relay control circuit to the coil side of the relay, energizing the wiper high relay.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B3875

Wiper High Speed Relay Circuit

Conditions for Running the DTC

This DTC can set only when the BCM output to the wiper high relay is be requested by PCU.

Conditions for Setting the DTC

The BCM will set this DTC if it detects a short to ground or an open in the control circuit of the wiper high relay.

Action Taken When the DTC Sets

The BCM will not activate the output to the relay.

Conditions for Clearing the DTC

- The current DTC will become history when the request for the output is removed or when the condition for setting the fault is corrected.
- The history DTC will clear after 50 consecutive ignition cycles without a fault present.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step tests for constant ground in the control circuit of the wiper relay.

4: This step verifies that the BCM is applying a ground through the control circuit to the wiper relay.

5: This step tests for an open in the battery positive voltage circuit of the wiper relay.

DTC B3875

Step	Action	Yes	No

Schematic Reference: Wiper/Washer System Schematics
Connector End View Reference: Wiper/Washer System Connector End Views

1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn the ignition to the ON position. 2. Turn the wiper switch to HIGH. Do the high speed wipers operate?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Remove the WIPER HI relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . 3. Turn ON the ignition, with the engine OFF. 4. Turn the wiper switch to the OFF position. 5. Connect a test lamp from the control circuit of the wiper high relay to a good ground. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 4**
4	With the test lamp still connect to the control circuit of the wiper high relay, place the wiper switch in the HIGH speed position. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 6**
5	1. Connect a test lamp between the control circuit of the wiper high relay and the ground circuit of the wiper high relay. 2. Place the wiper switch in the HIGH speed position. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 10**
	Test the control circuit of the wiper high speed relay for a short to ground or an open.		

6	Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**
7	Test the control circuit of the wiper high speed relay for a short to battery positive voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**
8	Inspect for poor connections at the connector of the WIPER HI relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 11**
9	Inspect for poor connections at the harness connector of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 12**
10	Repair the open in the ground circuit of the wiper high relay. Refer to **Wiring Repairs**	Go to **Step 13**	-
11	Replace the WIPER HI relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** . Did you complete the replacement?	Go to **Step 13**	-
12	Replace the body control module (BCM). Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 13**	-
13	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions For Running the DTC as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

DTC B3922

Circuit Description

The body control module (BCM) monitors the windshield wiper switch low signal circuit. When the wiper switch is place in the low position, battery voltage is applied through the switch contacts, a series of resistors, and the wiper switch low signal circuit to the BCM. The BCM then applies battery positive voltage to the wiper relay control circuit which energizes the wiper relay. This allows battery voltage from the WIPER/WS fuse through the switch side of the relay to the windshield wiper motor.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B3922

Front Wiper Function Select Circuit

Conditions for Running the DTC

- The ignition is ON.
- The ignition voltage is between 9-16 volts.

Conditions for Setting the DTC

The BCM detects a short to ground or a short to battery voltage on the windshield wiper switch low signal circuit.

Action Taken When the DTC Sets

- The BCM will not activate the low speed output.
- The windshield wipers will only operate in the high speed mode.

Conditions for Clearing the DTC

- The DTC will clear on current status after the condition for setting the fault is corrected.
- A history DTC will clear after 50 consecutive ignition cycles without a fault present.

Diagnostic Aids

Perform a visual inspection for loose or poor connections at all related components. Refer to **Testing for Intermittent Conditions and Poor Connections** .

DTC B3922

Step	Action	Yes	No
Schematic Reference: Wiper/Washer System Schematics **Connector End View Reference: Master Electrical Component List**			
	Did you perform the Diagnostic System		Go to

1	Check - Vehicle?	Go to **Step 2**	**Diagnostic System Check - Vehicle**
2	1. Turn the ignition to the ON position. 2. Rotate the windshield wiper switch through all positions. Does the windshield wipers operate correctly?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	1. Turn the ignition OFF. 2. Disconnect the windshield wiper switch connector. 3. With a scan tool, observe the Windshield Wiper Switch parameter in the Body Control Module data list. 4. Turn ON the ignition, with the engine OFF. Does the Windshield Wiper Switch parameter display OFF?	Go to **Step 5**	Go to **Step 4**
4	Test the wiper switch low signal circuit for the following conditions: - A short to ground - A short to battery voltage Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 9**	Go to **Step 6**
5	Inspect for poor connections at the harness connector of the windshield wiper/washer switch. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 9**	Go to **Step 7**
6	Inspect for poor connections at the harness connector of the body control module (BCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 9**	Go to **Step 8**

7	Replace the windshield wiper switch. Did you complete the replacement?	Go to **Step 9**	-
8	Replace the body control module (BCM). Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 9**	-
9	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions For Funning the DTC as specified in the supporting text. Does the DTC reset?	Go to **Step 2**	System OK

SYMPTOMS - WIPER/WASHER SYSTEMS

IMPORTANT: The following steps must be completed before using the symptom tables:

1. **Perform the Diagnostic System Check - Vehicle , in order to verify that all of the following conditions are true.**
    - **No DTCs are set.**
    - **The control modules can communicate via the serial data link.**
2. **Review the system operation in order to familiarize yourself with the system functions. Refer to Wiper/Washer System Description and Operation.**

Visual/Physical Inspection

- Inspect the washer fluid reservoir for the proper fluid level and condition.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect for aftermarket devices which could affect the operation of the Windshield Wiper/Washer System.

Intermittent

- If the wipers operate at low speed for approximately 3 seconds and then stop, the wiper motor park switch, or its signal circuit, may be malfunctioning. Refer to **Wipers Inoperative - One or More Modes**.
- Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Washers Always On**
- **Washers Inoperative**
- **Wipers Always On**
- **Wipers Inoperative - All Modes**
- **Wipers Inoperative - One or More Modes**

WASHERS ALWAYS ON

Washers Always On

Step	Action	Yes	No
Schematic Reference: Wiper/Washer System Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Turn the ignition to the ON position. Is the windshield washer pump ON?	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems
3	Disconnect the windshield wiper/washer switch. Does the washer turn OFF?	Go to **Step 7**	Go to **Step 4**
4	Disconnect the body control module (BCM) connector C3. Does the washer turn OFF?	Go to **Step 8**	Go to **Step 5**
5	Disconnect the BCM connector C1. Does the washer turn OFF?	Go to **Step 9**	Go to **Step 6**
6	Test for a short to battery positive voltage in the windshield washer pump control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 10**

7	Replace the windshield wiper/washer switch. Refer to **Multifunction, Turn Signal Switch Replacement** in Steering Wheel and Column. Did you complete the replacement?	Go to **Step 11**	-
8	Repair a short to ground in the windshield washer switch signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 11**	-
9	Replace the BCM. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 11**	-
10	Replace the windshield washer fluid pump. Refer to **Washer Pump Replacement**. Did you complete the replacement?	Go to **Step 11**	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

WASHERS INOPERATIVE

Washers Inoperative

Step	Action	Yes	No
Schematic Reference: Wiper/Washer System Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Turn the ignition to the ON position. 2. Press the windshield washer switch. Does the windshield washer pump operate?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
	1. Disconnect the body control module		

3	(BCM) connector C1. 2. Install a fused jumper between battery positive voltage and the windshield washer pump control circuit. Does the windshield washer fluid pump operate?	Go to **Step 6**	Go to **Step 4**
4	1. Disconnect the windshield washer pump. 2. Connect the BCM connector C1. 3. Using a test lamp probe between windshield washer pump control circuit and ground. 4. Turn the ignition to the ON position. 5. Press the washer switch. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 8**
5	Test for a poor connection or an open in the ground circuit of the windshield washer fluid pump. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 9**
6	1. Disconnect the windshield wiper/washer switch. 2. Install a jumper between windshield washer switch signal circuit and ground. 3. Turn the ignition to the ON position. Does the windshield washer fluid pump operate?	Go to **Step 10**	Go to **Step 7**
7	Test for a poor connection, an open, or a short to battery positive voltage in the windshield washer switch signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 11**
8	Repair a poor connection, an open, or a short to ground in the windshield washer pump control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring		

	Systems. Did you complete the repair?	Go to **Step 12**	-
9	Replace the windshield washer fluid pump. Refer to **Washer Pump Replacement**. Did you complete the replacement?	Go to **Step 12**	-
10	Replace the windshield washer switch. Refer to **Multifunction, Turn Signal Switch Replacement** in Steering Wheel and Column. Did you complete the replacement?	Go to **Step 12**	-
11	Replace the BCM. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 12**	-
12	Operate the system to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

WIPERS ALWAYS ON

Wipers Always On

Step	Action	Yes	No
Schematic Reference: Wiper/Washer System Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	Turn the ignition to the ON position. Are the windshield wipers ON?	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems
3	Remove the WPR2 relay. Are the windshield wipers ON?	Go to **Step 4**	Go to **Step 7**
4	Are the windshield wipers operating at a high speed?	Go to **Step 5**	Go to **Step 6**
	Test for a short to battery positive voltage in the windshield wiper motor high speed		

5	circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 24**	Go to **Step 20**
6	Test for a short to battery positive voltage in the windshield wiper motor low speed circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 24**	Go to **Step 20**
7	Using a test lamp connected to ground, probe the WPR2 relay control circuit at the underhood fuse block. Does the test lamp illuminate?	Go to **Step 13**	Go to **Step 8**
8	1. Install the WPR2 relay. 2. Remove the WPR1 relay. Are the windshield wipers ON?	Go to **Step 20**	Go to **Step 9**
9	Using a test lamp connected to ground, probe the WPR1 relay control circuit. Does the test lamp illuminate?	Go to **Step 10**	Go to **Step 21**
10	1. Install the WPR1 relay. 2. Disconnect the windshield wiper/washer switch. Are the windshield wipers ON?	Go to **Step 11**	Go to **Step 22**
11	1. Disconnect the body control module (BCM) connector C3. 2. Using a test lamp connected to battery positive voltage, probe the windshield wiper switch low signal circuit at the windshield wiper/washer switch. Does the test lamp illuminate?	Go to **Step 17**	Go to **Step 12**
12	1. Disconnect the BCM connector C1. 2. Remove the WPR1 relay. 3. Using a test lamp connected to ground, probe the WPR1 relay control circuit at the underhood electrical center. Does the test lamp illuminate?	Go to **Step 18**	Go to **Step 23**
	1. Disconnect the windshield wiper/washer switch.		

13	2. Using a test lamp connected to ground, probe the WPR1 relay control circuit at the underhood electrical center. Does the test lamp illuminate?	Go to **Step 14**	Go to **Step 22**
14	1. Disconnect the BCM connector C3. 2. Using a test lamp connected to battery positive voltage, probe the windshield wiper switch high signal circuit. Does the test lamp illuminate?	Go to **Step 19**	Go to **Step 15**
15	1. Disconnect the BCM connector C1. 2. Using a test lamp connected to ground, probe the WPR2 relay control circuit at the BCM. Does the test lamp illuminate?	Go to **Step 16**	Go to **Step 23**
16	Test for a short to ground in the WPR2 relay control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 24**	Go to **Step 20**
17	Repair a short to ground in the windshield wiper switch low signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 24**	-
18	Repair a short to battery positive voltage in the WPR1 relay control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 24**	-
19	Repair a short to ground in the windshield wiper switch high signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 24**	-
20	Replace the underhood electrical fuse block. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems. Did you complete the replacement?	Go to **Step 24**	-
	Replace the WPR1 relay. Refer to **Relay**		

21	**Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** in Wiring Systems. Did you complete the replacement?	Go to **Step 24**	-
22	Replace the windshield wiper/washer switch. Refer to **Multifunction, Turn Signal Switch Replacement** in Steering Wheel and Column. Did you complete the repair?	Go to **Step 24**	-
23	Replace the BCM. Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 24**	-
24	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

WIPERS INOPERATIVE - ALL MODES

Wipers Inoperative - All Modes

Step	Action	Yes	No
Schematic Reference: Wiper/Washer System Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Turn the ignition to the ON position. 2. Attempt to operate the wipers in each mode. Are the wipers inoperative in all modes?	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems
3	1. Disconnect the windshield wiper motor. 2. Using a test lamp connected to ground, probe the windshield wiper motor low speed circuit. 3. Turn the ignition to the ON position.		

	4. Turn the windshield wipers to a low speed. Does the test lamp illuminate?	Go to **Step 4**	Go to **Step 5**
4	Test for a poor connection or an open in the ground circuit of the windshield wiper motor. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 16**	Go to **Step 11**
5	1. Connect the windshield wiper motor. 2. Remove the WPR2 relay from the underhood fuse block. 3. Using a test lamp connected to battery positive voltage, probe the WPR2 relay switched input circuit. 4. Turn the wiper switch OFF. 5. Turn the ignition to the OFF position. Does the test lamp illuminate?	Go to **Step 9**	Go to **Step 6**
6	1. Remove the WPR1 relay. 2. Using a test lamp connected to battery positive voltage, probe the ground circuit of the WPR1 relay. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 12**
7	Using a test lamp connected to ground, probe the FRT WPR fuse circuit of the WPR1 relay. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 13**
8	Replace the WPR1 relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** in Wiring Systems. Do the windshield wipers operate normally?	Go to **Step 16**	Go to **Step 13**
9	1. Disconnect the windshield wiper/washer switch. 2. Install a jumper between the ground circuit and the windshield wiper switch low signal circuit at the windshield wiper/washer switch connector. 3. Turn the ignition to the ON position.		

	Do the windshield wipers operate normally?	Go to **Step 14**	Go to **Step 10**
10	Test for a poor connection or an open in the ground circuit of the windshield wiper/washer switch. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 16**	Go to **Step 15**
11	Replace the windshield wiper motor. Refer to **Wiper Motor Replacement (Impala)** or **Wiper Motor Replacement (Monte Carlo)**. Did you complete the replacement?	Go to **Step 16**	-
12	Repair a poor connection or an open in the ground circuit of the WPR1 relay. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 16**	-
13	Replace the underhood fuse block. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems. Did you complete the replacement?	Go to **Step 16**	-
14	Replace the windshield wiper/washer switch. Refer to **Multifunction, Turn Signal Switch Replacement** in Steering Wheel and Column. Did you complete the replacement?	Go to **Step 16**	-
15	Replace the body control module (BCM). Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 16**	-
16	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

WIPERS INOPERATIVE - ONE OR MORE MODES

Wipers Inoperative - One or More Modes

Step	Action	Yes	No
Schematic Reference: Wiper/Washer System Schematics **Connector End View Reference: Master Electrical Component List** in Wiring Systems			

1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle** in Vehicle DTC Information
2	1. Turn the ignition to the ON position. 2. Attempt to operate the wipers in each mode. Are the wipers inoperative in all modes?	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems
3	Are the wiper inoperative in high speed mode?	Go to **Step 5**	Go to **Step 4**
4	Are all of the low speed mode inoperative?	Go to **Step 13**	Go to **Step 18**
5	1. Disconnect the windshield wiper motor. 2. Using a test lamp connected to ground, probe the windshield wiper motor high speed circuit. 3. Turn the ignition to the ON position. 4. Turn the wiper to the high speed setting. Does the test lamp illuminate?	Go to **Step 19**	Go to **Step 6**
6	1. Connect the windshield wiper motor. 2. Remove the WPR2 relay. 3. Using a test lamp connected to battery positive voltage, probe the ground circuit of the WPR2 relay. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 20**
7	1. Using a test lamp connected to ground, probe the WPR2 relay control circuit at the WPR1 relay. 2. Turn the ignition to the ON position. 3. Turn the wipers to the high speed setting. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 10**
	1. Leave the switch in the high position.		

8	2. Using a test lamp, probe between the WPR2 relay control circuit and the windshield wiper motor high speed circuit. Does the test lamp illuminate?	Go to **Step 22**	Go to **Step 9**
9	Test for a poor connection, an open or a short to ground in the windshield wiper motor high speed circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 23**	Go to **Step 20**
10	1. Disconnect the windshield wiper switch. 2. Install the WPR2 relay. 3. Install a jumper between ground and windshield wiper switch high signal circuit. 4. Turn the ignition to the ON position. Do the high speed wipers operate?	Go to **Step 18**	Go to **Step 11**
11	Test for a poor connection, short to battery or an open in the windshield wiper switch high signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 23**	Go to **Step 12**
12	Test for a poor connection, short to ground or an open in the WPR2 relay control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 23**	Go to **Step 21**
13	1. Disconnect the windshield wiper motor. 2. Using a test lamp connected to ground, probe the windshield wiper motor low speed circuit. 3. Turn the ignition to the ON position. 4. Turn the wiper switch to a low position. Does the test lamp illuminate?	Go to **Step 19**	Go to **Step 14**

14	1. Connect the windshield wiper motor. 2. Leave the windshield wiper switch in a low position. 3. Disconnect the WPR2 relay. 4. Using a test lamp connected between battery positive voltage and the windshield wiper motor low control circuit. Does the test lamp illuminate?	Go to **Step 16**	Go to **Step 15**
15	Test for a poor connection or an open in the windshield wiper motor low control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 23**	Go to **Step 20**
16	1. Disconnect the windshield wiper/washer switch. 2. Install the WPR1 relay. 3. Install a jumper between ground and the windshield wiper switch low signal circuit. 4. Turn the ignition to the ON position. Does the windshield wiper turn ON in a low position?	Go to **Step 18**	Go to **Step 17**
17	Test for a poor connection or an open in the windshield wiper switch low signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 23**	Go to **Step 21**
18	Replace the windshield wiper/washer switch. Refer to **Multifunction, Turn Signal Switch Replacement** in Steering Wheel and Column. Did you complete the replacement?	Go to **Step 23**	-
19	Replace the windshield wiper motor. Refer to **Wiper Motor Replacement (Impala)** or **Wiper Motor Replacement (Monte Carlo)**. Did you complete the replacement?	Go to **Step 23**	-
	Replace the underhood fuse block. Refer to		

20	**Underhood Electrical Center or Junction Block Replacement** in Wiring Systems. Did you complete the replacement?	Go to **Step 23**	-
21	Replace the body control module (BCM). Refer to **Control Module References** in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 23**	-
22	Replace the WPR2 relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** in Wiring Systems. Did you complete the replacement?	Go to **Step 23**	-
23	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

WIPER ARM TIP PRESSURE CHECK

Wiper Arm Pressure Check

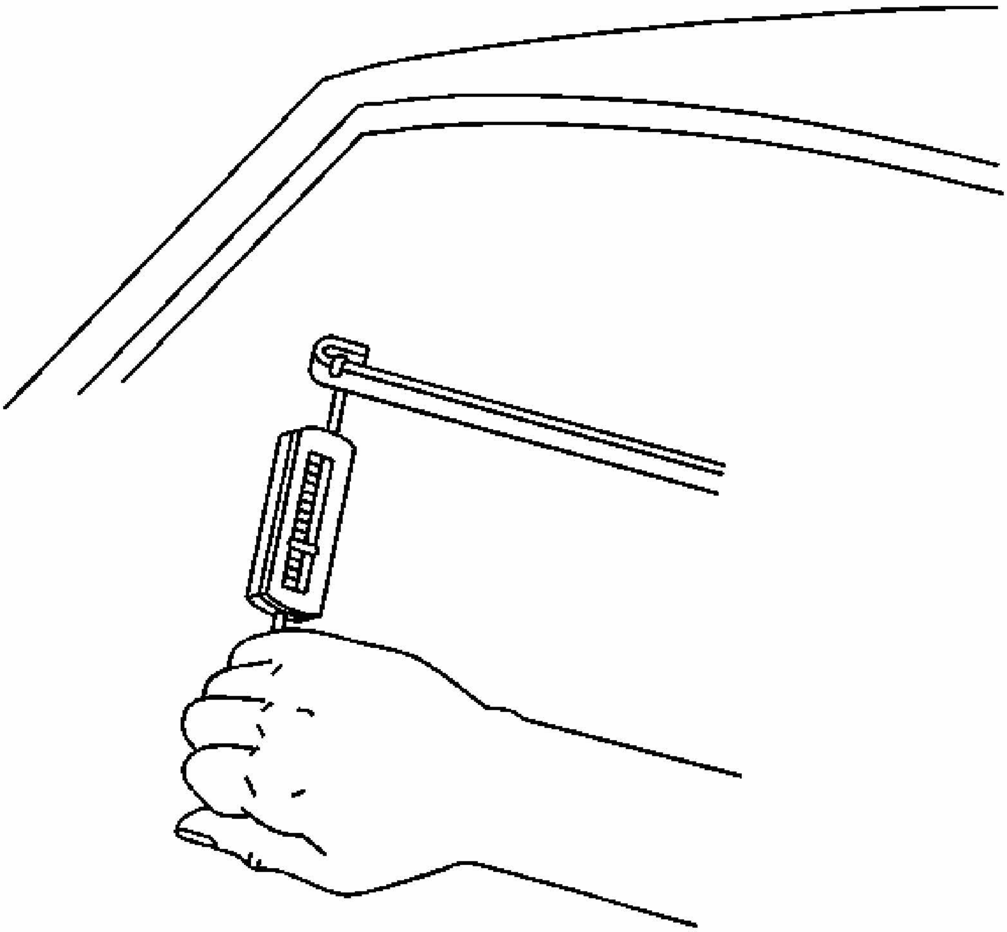

Fig. 7: Attaching A Scale To End Of Wiper Arm
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the wiper arms are set to the PARK position.
2. Remove the wiper blades from the wiper arms. Refer to **Wiper Arm Blade Replacement**.
3. Attach a scale to the end of the wiper arm and measure the force required to lift the wiper arm perpendicular to the windshield to normal working height (height with the blade attached).
4. Replace the wiper arm if the measurement is not within the specification. Refer to **Wiper Arm Replacement**.

Driver Side Tip Pressure: 7.4-9.1 N (27-33 oz)

Passenger Side Tip Pressure: 7.2-8.8 N (26-32 oz)

5. Install the wiper blades on the wiper arms. Refer to **Wiper Arm Blade Replacement**.

WIPER BLADE ELEMENT CHECK

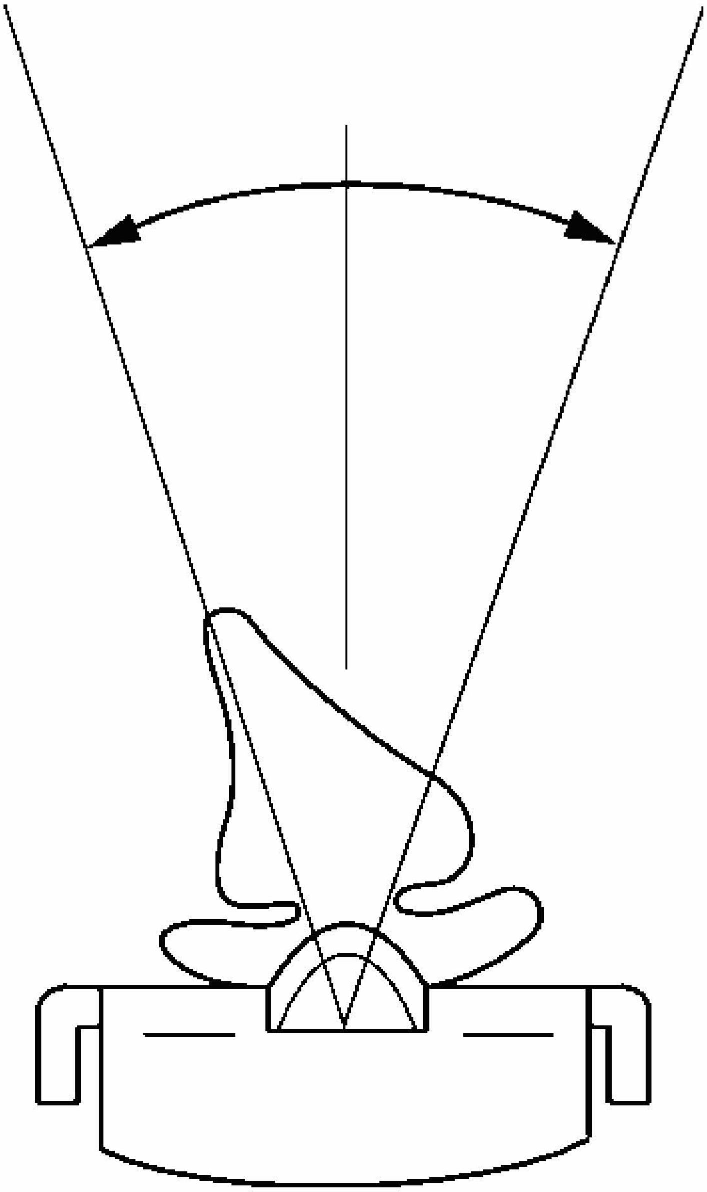

Fig. 8: Measuring Wiper Blade Element Centerline Contact
Courtesy of GENERAL MOTORS CORP.

1. Remove the wiper blades from the wiper arms. Refer to **Wiper Arm Blade**

Replacement.

2. Look down the length of the blade element.
3. Replace the wiper blade element if the rubber element which contacts the glass is deflected more than 15 degrees from the centerline of the blade. Refer to **Wiper Blade Element Replacement**.
4. Install the wiper blades on the wiper arms. Refer to **Wiper Arm Blade Replacement**.

REPAIR INSTRUCTIONS

WASHER SOLVENT CONTAINER REPLACEMENT

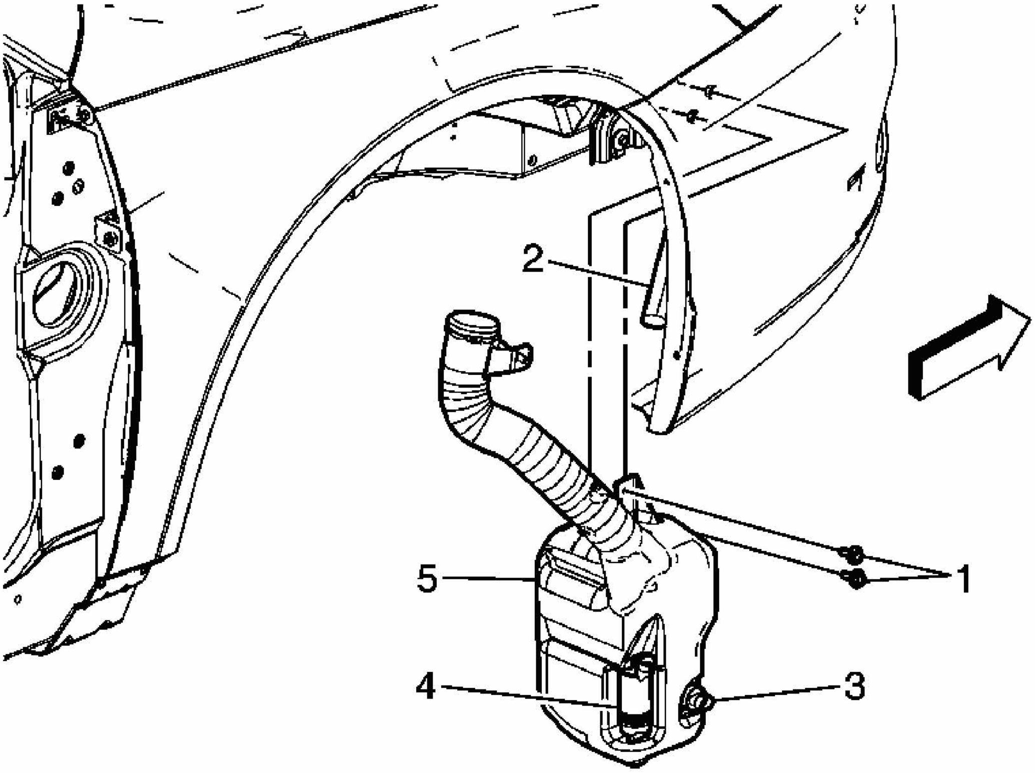

Fig. 9: Replacing Washer Solvent Container
Courtesy of GENERAL MOTORS CORP.

Washer Solvent Container Replacement

Callout	Component Name
NOTE: Refer to Fastener Notice .	

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedures

1. Remove the right front wheelhouse panel liner. Refer to **Front Fender Liner Replacement** .
2. Disconnect the electrical connector from the windshield washer solvent level sensor switch.
3. Disconnect the electrical connector at the windshield washer pump.
4. Lower the vehicle.
5. Remove the push pin for the filler neck from the RF fender flange.
6. Remove the washer solvent container filler cap.

1	Windshield Washer Solvent Container Bolts (Qty: 2) **Tighten:** 6 N.m (53 lb in) **Tip:** Transfer the cap and lower mounting bracket on the container to the new washer solvent container.
2	Windshield Washer Pump Hose Assembly **Tip:** Disconnect the hose from the windshield washer pump spout and drain washer solvent into a suitable clean container.
3	Windshield Washer Level Sensor Switch
4	Windshield Washer Pump **Tip:** Discard old grommet and replace with a new grommet. Transfer the old pump to the new container.
5	Windshield Washer Container Assembly **Tip:** Lower the windshield washer container from RH chassis rail in between the RF fender bracket and bumper fascia.

WASHER SOLVENT CONTAINER LEVEL SENSOR REPLACEMENT

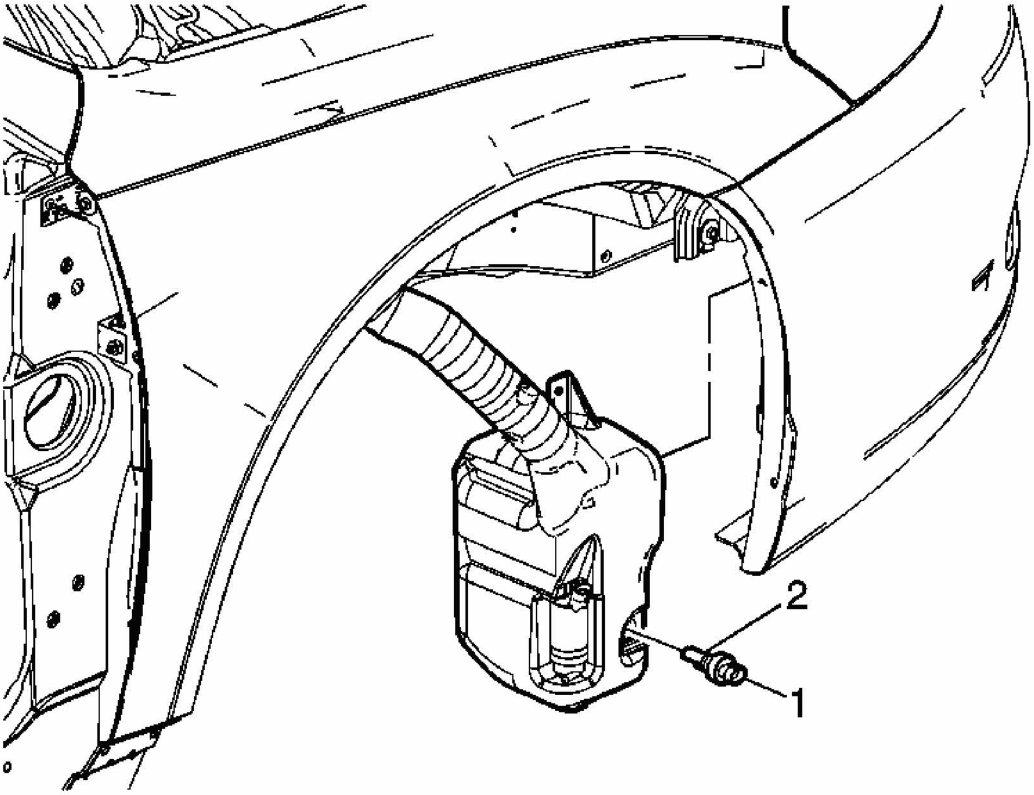

Fig. 10: Replacing Washer Solvent Container Level Sensor
Courtesy of GENERAL MOTORS CORP.

Washer Solvent Container Level Sensor Replacement

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the right front wheelhouse panel liner. Refer to **Front Fender Liner Replacement** . 2. Remove the windshield washer solvent container. Refer to **Washer Solvent Container Replacement**. 3. Drain the washer solvent into a suitable clean container.	
1	Switch, Windshield Washer Level Sensor **Tip:** Use two flat-bladed tools and pry outward in order to release the level sensor from the washer solvent container grommet.
	Grommet, Windshield Washer Level Sensor

2	**Tip** 1. Discard the old level sensor grommet. 2. Install a new grommet into the washer solvent container prior to installing the new level sensor. 3. Lubricate the new grommet with straight washer fluid.

WASHER PUMP REPLACEMENT

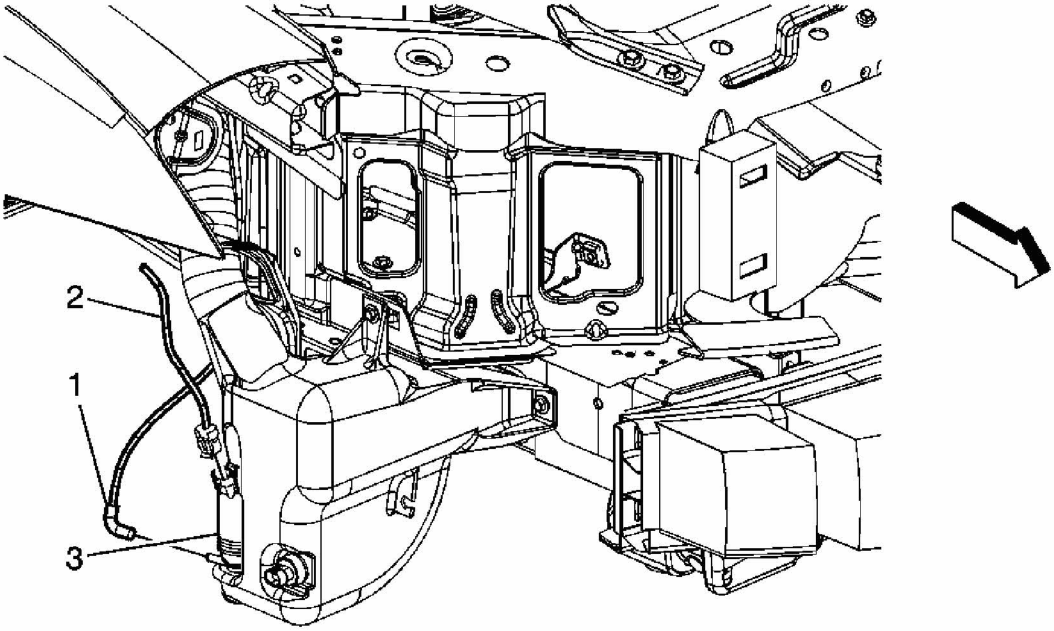

Fig. 11: Replacing Washer Pump
Courtesy of GENERAL MOTORS CORP.

Washer Pump Replacement

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the right front wheelhouse panel liner. Refer to **Front Fender Liner Replacement** . 3. Drain the washer solvent into a suitable clean container.	
1	Hose, Windshield Washer Pump
	Connector, Washer Pump Electrical

2	**Tip:** Disconnect and position out of the way.
3	Pump, Windshield Washer **Tip** 1. Use two flat-bladed tools and pry upward in order to release the washer pump from the washer solvent container grommet. 2. Discard the old washer pump grommet. 3. Install a new grommet into the washer solvent container prior to installing the new washer pump. 4. Lubricate the new grommet with straight washer fluid. 5. Secure the new pump to the washer solvent container.

WINDSHIELD WASHER HOSE REPLACEMENT (IMPALA)

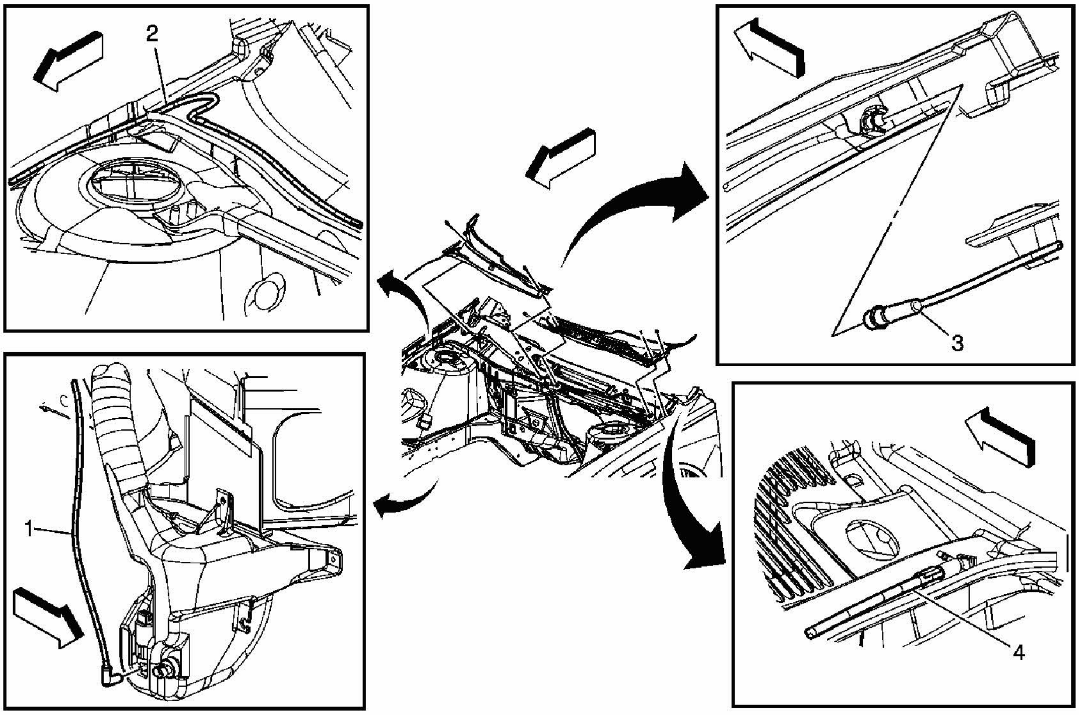

Fig. 12: Replacing Windshield Washer Hose
Courtesy of GENERAL MOTORS CORP.

Hose Replacement - Windshield Washer (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .**	

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedures

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the washer hose from the washer pump spout.
3. Drain the washer solvent into a suitable container.
4. Lower the vehicle.
5. Open the hood.
6. Remove the passenger side wiper arm. Refer to **Wiper Arm Replacement**.
7. Remove the passenger side air inlet grille panel. Refer to **Air Inlet Grille Panel Replacement** .

1	Connection, Windshield Washer Hose to Washer Pump
2	Hose, Washer Pump **Tip:** Note the routing of the washer hose to the air inlet grille panel.
3	Hose, Windshield Washer Solvent Pump to Driver Side Washer Hose **Tip:** Ensure washer hose is re-connected upon passenger side air inlet grille installation.
4	Hose, Windshield Washer Container **Tip:** Remove the washer hose from the large hole in behind the right front headlamp and fender assembly bracket.

WINDSHIELD WASHER HOSE REPLACEMENT (MONTE CARLO)

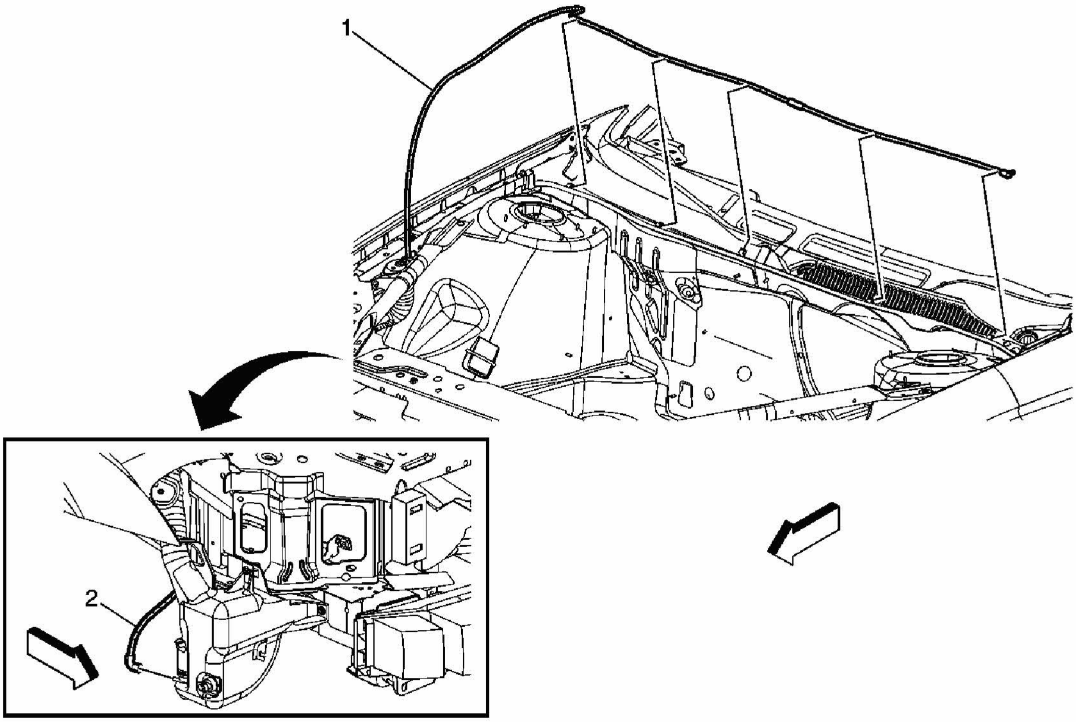

Fig. 13: Replacing Windshield Washer Hose
Courtesy of GENERAL MOTORS CORP.

Hose Replacement - Windshield Washer (Monte Carlo)

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.
Preliminary Procedures
1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Remove the right front fender liner in order to access the washer pump. Refer to Front Fender Liner Replacement .
3. Remove the washer hose from the washer pump spout.
4. Drain the washer solvent into a suitable container.
5. Lower the vehicle. Refer to Lifting and Jacking the Vehicle .
6. Open the hood.
7. Disconnect the washer hose from the driver side wiper hose.
8. Remove the washer hose from the plenum flange clips.</td></tr>
<tr><td>1</td><td>Windshield Washer Hose
Tip: Note the routing of the washer hose to the air inlet grille panel.</td></tr>
<tr><td>2</td><td>Windshield Washer Hose to Washer Pump</td></tr>
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WIPER ARM REPLACEMENT

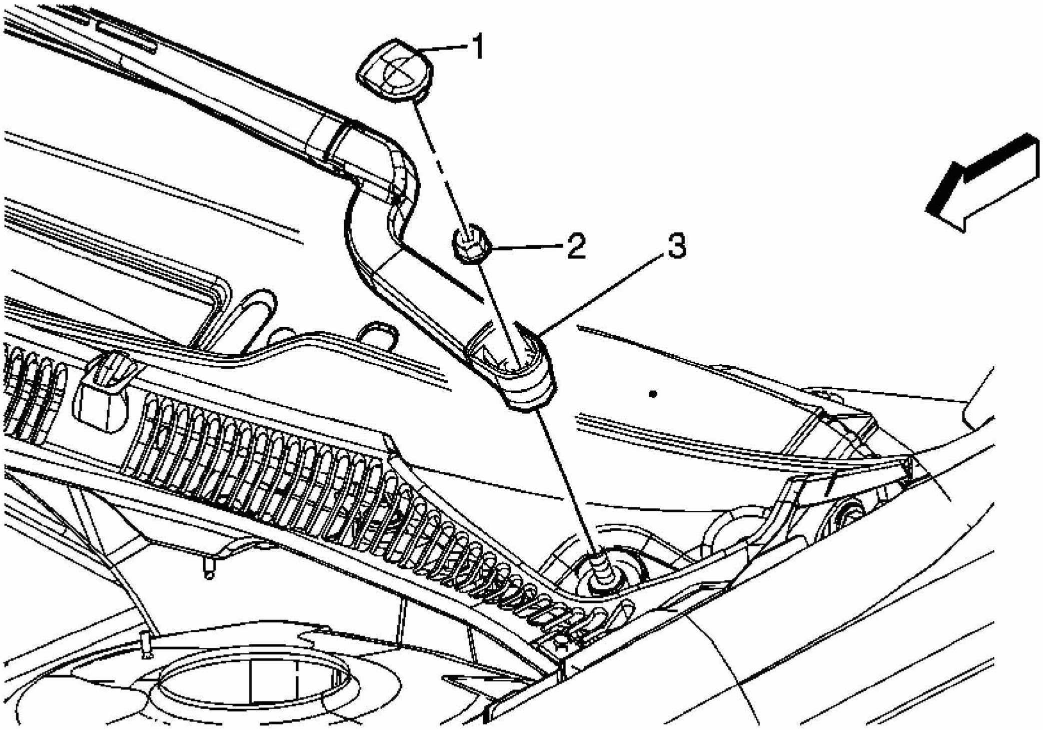


Fig. 14: Replacing Wiper Arm
Courtesy of GENERAL MOTORS CORP.

Wiper Arm Replacement

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**.**Preliminary Procedure:** Remove the wiper arm blades. Refer to **Wiper Arm Blade Replacement**.	
1	Cap, Windshield Washer Transmission Nut **Tip:** Use a small flat-bladed tool to remove the transmission cap.
2	Nut, Windshield Washer Transmission Support **Tip:** Hold the wiper arm blade tip to the target points in the lower blackout area of the windshield while tightening the nut. **Tighten:** 32 N.m (24 lb ft).
	Arm Assembly, Windshield Washer

3	**Tip:** Use a **J 39637** or slightly rock the arm on the wiper pivot shaft to remove. See **Special Tools**.

WIPER ARM BLADE REPLACEMENT

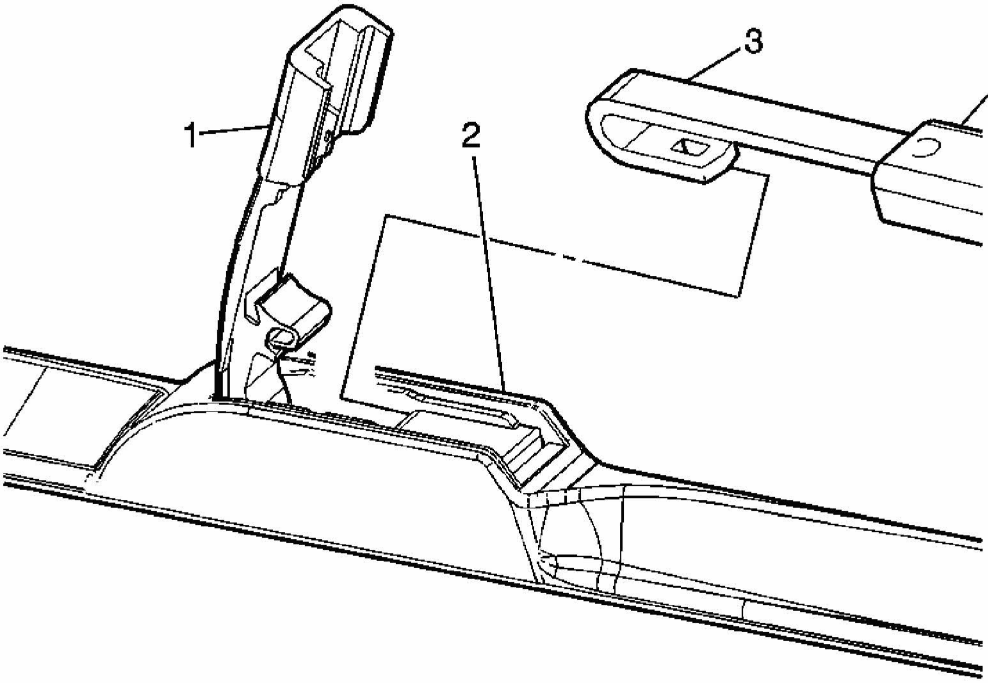


Fig. 15: Replacing Wiper Arm Blade
Courtesy of GENERAL MOTORS CORP.

Wiper Arm Blade Replacement

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Open the hood. 2. Raise the wiper blade off the glass.	
1	Retention Clip, Windshield Wiper Blade **Tip:** Lift the locking tab away from the wiper arm hook in order to disengage the wiper arm from the wiper blade.
2	Blade, Windshield Wiper Arm
3	Hook, Wiper Arm Sheep **Tip:** Push the wiper blade assembly onto the hook, pull the blade outward

	then secure the locking tab to the arm assembly.
4	Arm Assembly, Windshield Wiper

WIPER BLADE ELEMENT REPLACEMENT

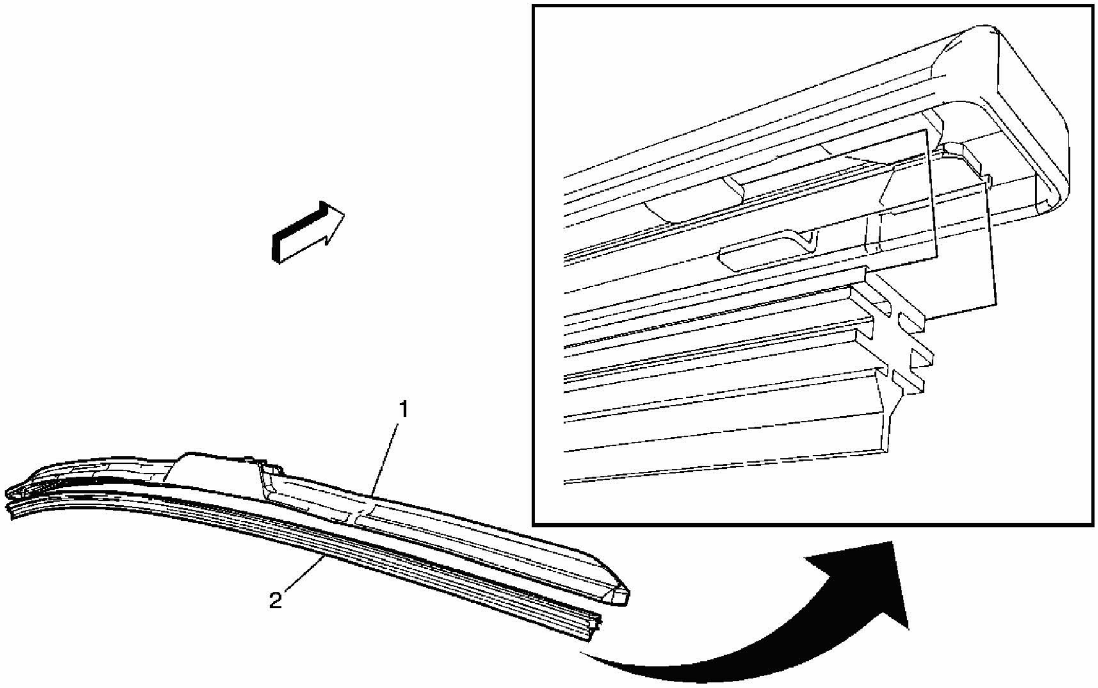


Fig. 16: Replacing Wiper Blade Element
Courtesy of GENERAL MOTORS CORP.

Wiper Blade Element Replacement

Callout	Component Name
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Position the wiper blade at a mid-wipe on the windshield. 2. Cycle the ignition key to the OFF position. 3. Raise the wiper blade off the glass.	
1	Blade Assembly, Windshield Washer
2	Element Assembly, Windshield Washer **Tip:** With a small pair of needle-nose pliers, secure the end of the wiper element and pull outward from the wiper blade claws in order to remove the element.

WIPER DRIVE SYSTEM MODULE REPLACEMENT (IMPALA)

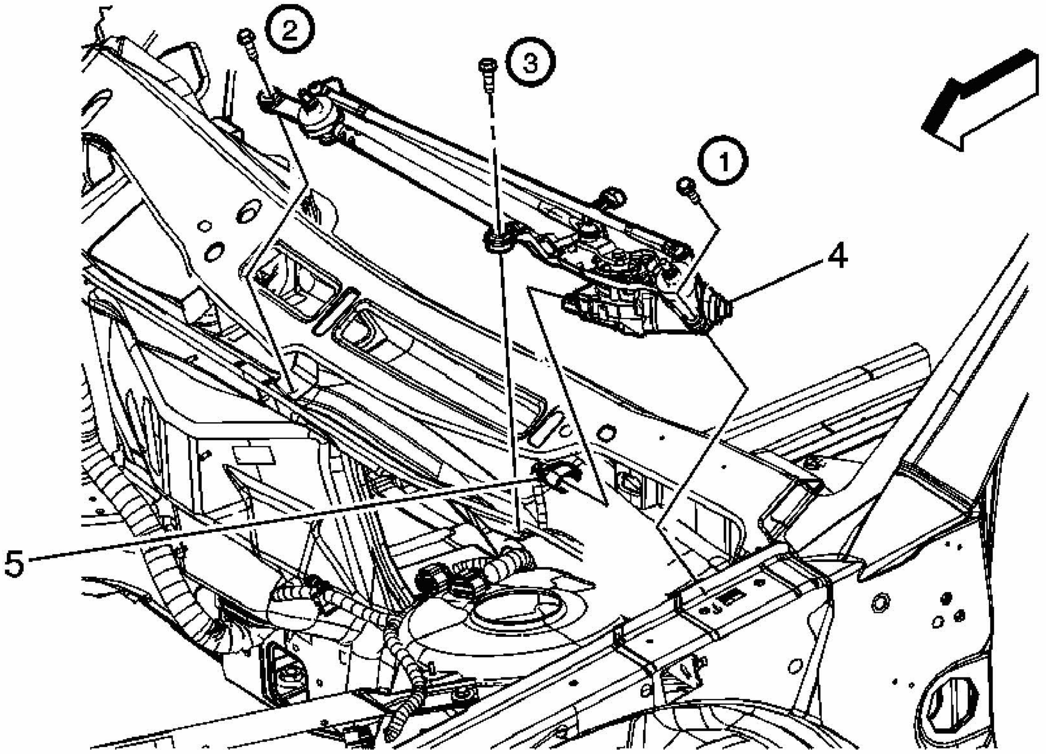


Fig. 17: Replacing Wiper Drive System Module
Courtesy of GENERAL MOTORS CORP.

Wiper Drive System Module Replacement (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the wiper arms. Refer to **Wiper Arm Replacement**. 2. Remove the air inlet grille panels. Refer to **Air Inlet Grille Panel Replacement** .	
1	Bolt, Windshield Wiper Module **IMPORTANT:** **Tighten bolts in sequence as shown upon installation.**

	Tighten: 9 N.m (80 lb in)
2	Bolt, Windshield Wiper Module **Tighten:** 9 N.m (80 lb in)
3	Bolt, Windshield Wiper Module **Tighten:** 9 N.m (80 lb in)
4	Module Assembly, Windshield Washer System 1. Raise the forward edge of the windshield washer module assembly out of the plenum panel first followed by disconnecting the wiper motor electrical connector. 2. Upon installation of the windshield washer module, turn the module 180 degrees, slide the module under the hood and align the rear locator to the backside of the plenum. 3. Tighten the bolts in sequence as shown.
5	Connector, Windshield Wiper Motor **Tip:** Connect the electrical connector to the wiper motor prior to installing the module assembly back into the plenum.

WIPER DRIVE SYSTEM MODULE REPLACEMENT (MONTE CARLO)

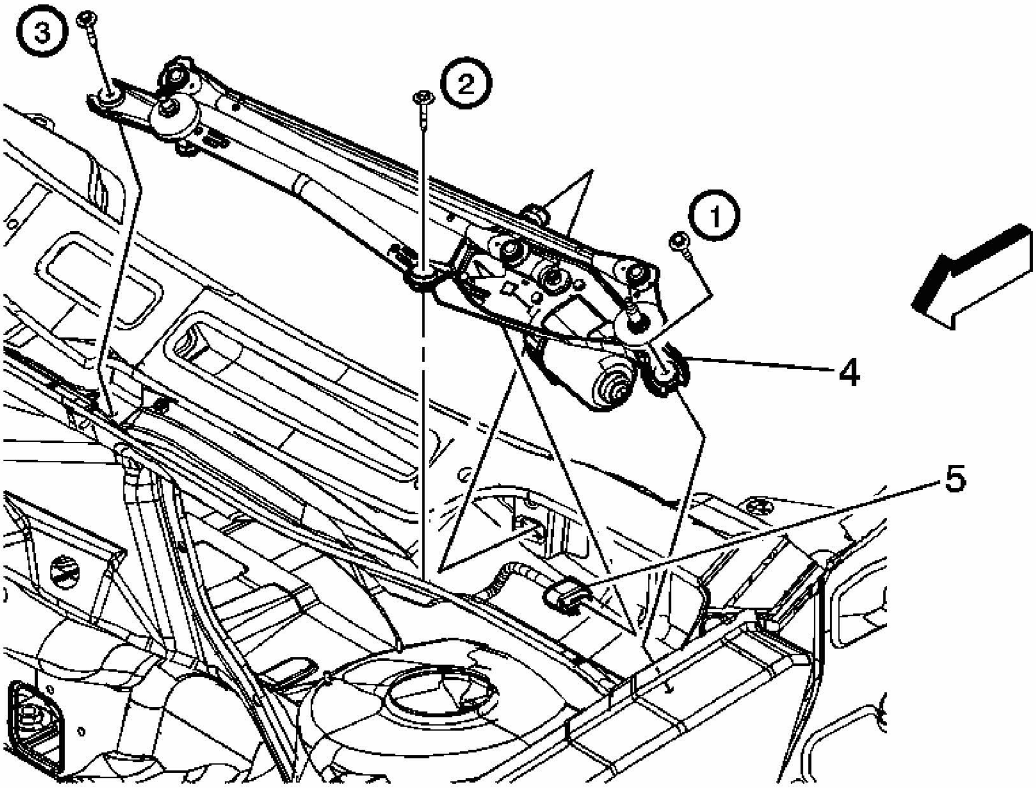


Fig. 18: Replacing Wiper Drive System Module
Courtesy of GENERAL MOTORS CORP.

Wiper Drive System Module Replacement (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Fastener Tightening Specifications:** Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the wiper arms. Refer to **Wiper Arm Replacement**. 2. Remove the air inlet grille panels. Refer to **Air Inlet Grille Panel Replacement** .	
1	Windshield Wiper Module Bolt **Tip:** Tighten bolts in sequence to the specified torque value. **Tighten:** 9 N.m (80 lb in)
	Windshield Wiper Module Bolt

2	**Tighten:** 9 N.m (80 lb in)
3	Windshield Wiper Module Bolt **Tighten:** 9 N.m (80 lb in)
4	Module Assembly, Windshield Washer System 1. Raise the forward edge of the windshield washer module assembly out of the plenum panel first followed by disconnecting the wiper motor electrical connector. 2. Upon installation of the windshield washer module, turn the module 180 degrees, slide the module under the hood and align the rear locator to the backside of the plenum. 3. Tighten the bolts in sequence as shown.
5	Windshield Wiper Motor Electrical Connector **Tip:** Connect the electrical connector to the wiper motor prior to installing the module assembly back into the plenum.

WIPER MOTOR REPLACEMENT (IMPALA)

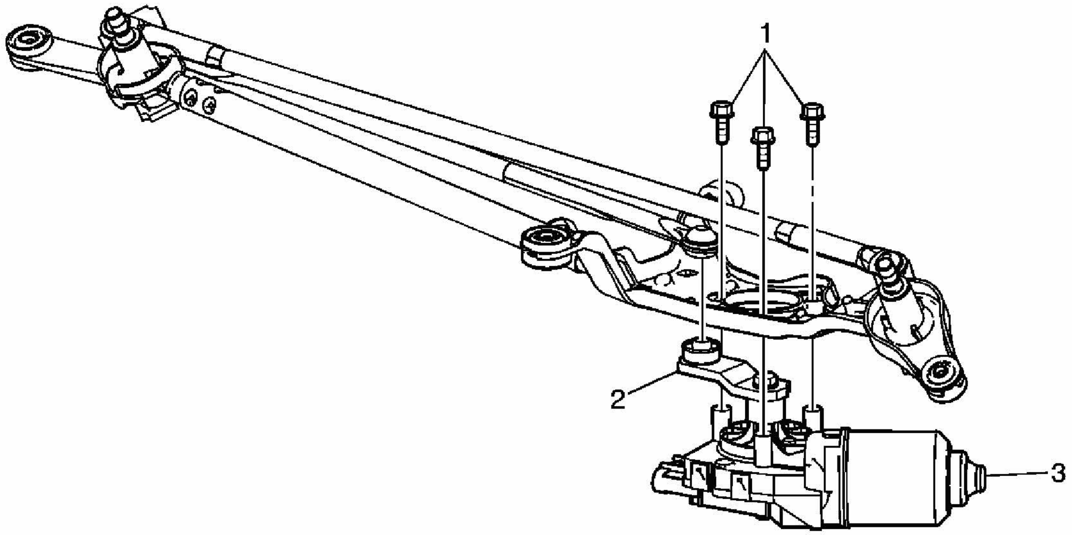


Fig. 19: Replacing Wiper Motor
Courtesy of GENERAL MOTORS CORP.

Wiper Motor Replacement (Impala)

Callout	Component Name
NOTE: **Refer to Fastener Notice .**	

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the wiper arms. Refer to **Wiper Arm Replacement**. 2. Remove the air inlet grille panel. Refer to **Air Inlet Grille Panel Replacement** . 3. Remove the wiper drive system module. Refer to **Wiper Drive System Module Replacement (Impala)** or **Wiper Drive System Module Replacement (Monte Carlo)**.	
1	Windshield Wiper Motor Bolts (Qty: 3) **Tighten:** 8 N.m (71 lb in)
2	Windshield Wiper Motor Crank Arm **Tip:** 1. Use the **J 39232** or equivalent to separate the transmission arm from the wiper motor crank arm pivot. 2. Use the **J 39529** or equivalent to install the transmission arm onto the wiper motor crank arm pivot.
3	Windshield Wiper Motor

WIPER MOTOR REPLACEMENT (MONTE CARLO)

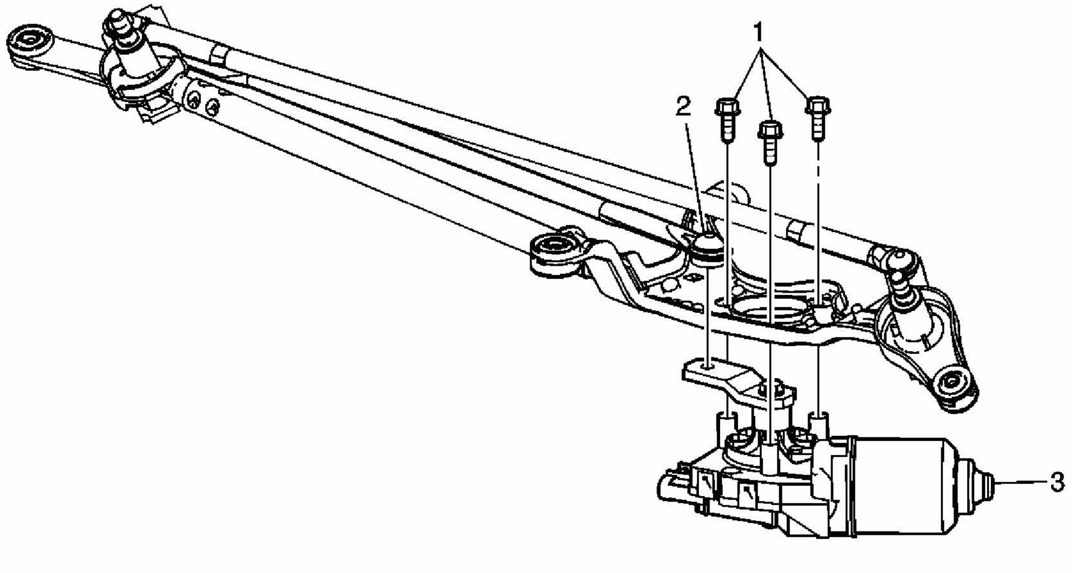


Fig. 20: Replacing Wiper Motor
Courtesy of GENERAL MOTORS CORP.

Wiper Motor Replacement (Monte Carlo)

Callout	Component Name
NOTE: **Refer to Fastener Notice .**	
Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**. **Preliminary Procedures** 1. Remove the wiper arms. Refer to **Wiper Arm Replacement**. 2. Remove the air inlet grille panel. Refer to **Air Inlet Grille Panel Replacement** . 3. Remove the wiper drive system module. Refer to **Wiper Drive System Module Replacement (Impala)** or **Wiper Drive System Module Replacement (Monte Carlo)**.	
1	Windshield Wiper Motor Bolts (Qty: 3) **Tighten:** 8 N.m (71 lb in)
2	Windshield Wiper Motor Crank Arm **Tip:** 1. Use the **J 39232** or equivalent to separate the transmission arm from the wiper motor crank arm pivot. 2. Use the **J 39529** or equivalent to install the transmission arm onto the wiper motor crank arm pivot.
3	Windshield Wiper Motor

WIPER CHATTER REPAIR

Some vehicles may exhibit a condition where the windshield wipers chatter and/or wipe unevenly. Several items may contribute to this condition. To completely repair this condition, ALL of the items listed should be tested and repaired as necessary.

- Clean the windshield glass. Refer to **Windshield Glass Cleaning**.
- Clean the wiper blade elements. Refer to **Blade Element Cleaning**.
- Perform the wiper arm tip pressure test. Refer to **Wiper Arm Tip Pressure Check**.
- Inspect the wiper blade element set. Refer to **Wiper Blade Element Check**.

WINDSHIELD GLASS CLEANING

Clean the windshield with windshield cleaner, GM P/N 1050011 (Canadian P/N 992727) or equivalent. The cleaner should not harm the paint finish or scratch the glass. The glass is clean when the water no longer beads, but sheets across the entire glass surface.

BLADE ELEMENT CLEANING

Lift each blade assembly off of the windshield and clean the element with a cloth saturated with full strength washer solvent. Then rinse the blade assemblies with clear water.

DESCRIPTION AND OPERATION

WIPER/WASHER SYSTEM DESCRIPTION AND OPERATION

Wiper/Washer System Components

The Wiper/Washer System consists of the following components:

- Windshield wiper/washer switch
- Body control module (BCM)
- WPR1 relay
- WPR2 relay
- Windshield wiper motor
- Windshield washer pump

Refer to **Wiper/Washer System Component Views**.

Wiper/Washer System Description

The body control module (BCM) controls wiper motor low speed operation, washer pump and high speed operation. The windshield wiper/washer switch supplies a low or ground on the signal circuits to the BCM for windshield wiper/washer operation. When WASH, MIST, DELAY, LOW, or HIGH is detected, the BCM energizes the WPR1 relay by suppling low signal to the relay coil. This allows battery voltage from the FRT WPR fuse to flow through the relay switched input then through the contacts and out the relay switched output to the WPR2 relay switched contacts. Since the WPR2 relay switched contacts are normally closed to the low speed circuit of the windshield wiper motor, the motor will operate at low speed. For HI speed operation, the BCM supplies the same low signal to the WPR1 relay control circuit and also supplies a low signal to the WPR2 relay control circuit. The WPR2 relays normally opened contacts are now in series with the current supplying WPR1 relay contacts. The WPR2 relay normally open contact at this point supply current to the wiper motors HI input.

Wash Operation

In the WASH position windshield wiper/washer switch supplies a ground signal to the body control module (BCM). The BCM monitors for a low signal condition on this circuit to detect when a WASH cycle is requested. After a short delay, the BCM energizes the wiper relay which will operate the windshield wiper motor at low speed. The wiper motor will continue to operate for 2 wipe cycles after the wash switch is released.

Mist Operation

Windshield wiper/washer system MIST operation is identical to LOW operation, except that the MIST switch is a press and release type switch. When the wiper switch is moved to the MIST position and released, low speed wiper motor operation is started and will continue until one cycle is complete. If the wiper switch is moved to the MIST position and held, the wiper motor will operate in the LOW mode until the switch is released.

In the MIST position, voltage is supplied through an internal resistor to the signal circuit of the windshield wiper/washer switch of the body control module (BCM). The BCM will energize the wiper relay which will operate the windshield wiper motor at low speed.

Intermittent Operation

Windshield wiper DELAY operation is a low speed wiper motor function with a variable delay interval between the wiper motor cycles. The DELAY interval is determined by a series of 5 resistors within the wiper/washer switch. During DELAY wiper operation the signal circuit voltage is further reduced through the DELAY resistors. The body control module (BCM) monitors the voltage on the signal circuit to determine the delay interval between the low speed wiper motor cycles.

If the wiper switch is moved from a longer delay interval to a shorter delay interval, the BCM will command an immediate wipe cycle, and reset the delay timer to the shorter delay interval.

Low Speed Operation

When the wiper switch is in the Low position, voltage is supplied through an internal resistor to the signal circuit. The body control module (BCM) monitors the windshield wiper switch signal circuit, and energizes the wiper relay which will operate the windshield wiper motor. The wiper motor will operate at low speed, since the wiper HI relay is de-energized. Low speed can also be commanded with a scan tool, by commanding wiper relay ON and OFF. Refer to **Scan Tool Output Controls**.

High Speed Operation

In the High position, the windshield wiper/washer switch supplies voltage to both the wiper and wiper HI relay coils. This energizes both relays and allows battery voltage from the wiper relay switched output to the switched input of the wiper HI relay through its contacts and out the switched output of the wiper HI relay to the high speed circuit of the windshield wiper motor. The windshield wiper motor will operate at high speed.

Park Position Operation

Windshield wiper motor park operation is controlled by the body control module (BCM) using an input from the park switch within the wiper motor assembly. The BCM monitors the windshield wiper motor park switch circuit to determine if the windshield wiper blades are at the bottom of the glass. The circuit will be pulled to ground by the wiper motor park switch while the windshield wiper motor is operating. When the wiper switch is turned to the OFF position while the wiper motor is somewhere in mid-cycle, the BCM will continue to operate the motor until the wipers reach the park position. If the ignition is turned OFF while the wipers are in mid-cycle, the wipers will stop immediately where they are. The BCM will park the wipers the next time the ignition is cycled ON.

The BCM provides stall protection for the wiper motor by monitoring the park switch. If the park switch does not transition for 3 seconds while the wipers are operating, the BCM will assume that the wiper motor is stalled, and will de-energize the wiper relay until the wiper switch is cycled OFF and ON again.

Windshield Wiper/Washer System Power and Ground

The power source for the wiper system is supplied from the fuse block underhood. The WIPER/WS fuse supplies the current for the drive motor. The WASHER/RVC fuse supplies current to the body control module (BCM) for the control of the washer pump. G100 supplies the ground for the washer pump and washer fluid level switch. Refer to **Wiper/Washer System Schematics**.

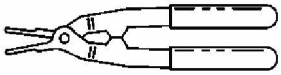
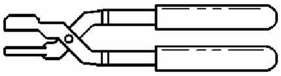
G200 provides ground for the following:

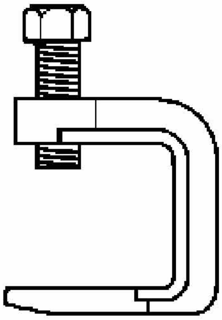
- Windshield wiper motor
- WPR1 relay
- WPR2 relay

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description
	J 39232 Wiper Linkage Separator
	J 39529 Wiper Linkage Installer

	J 39637 Wiper Arm Remover Tool

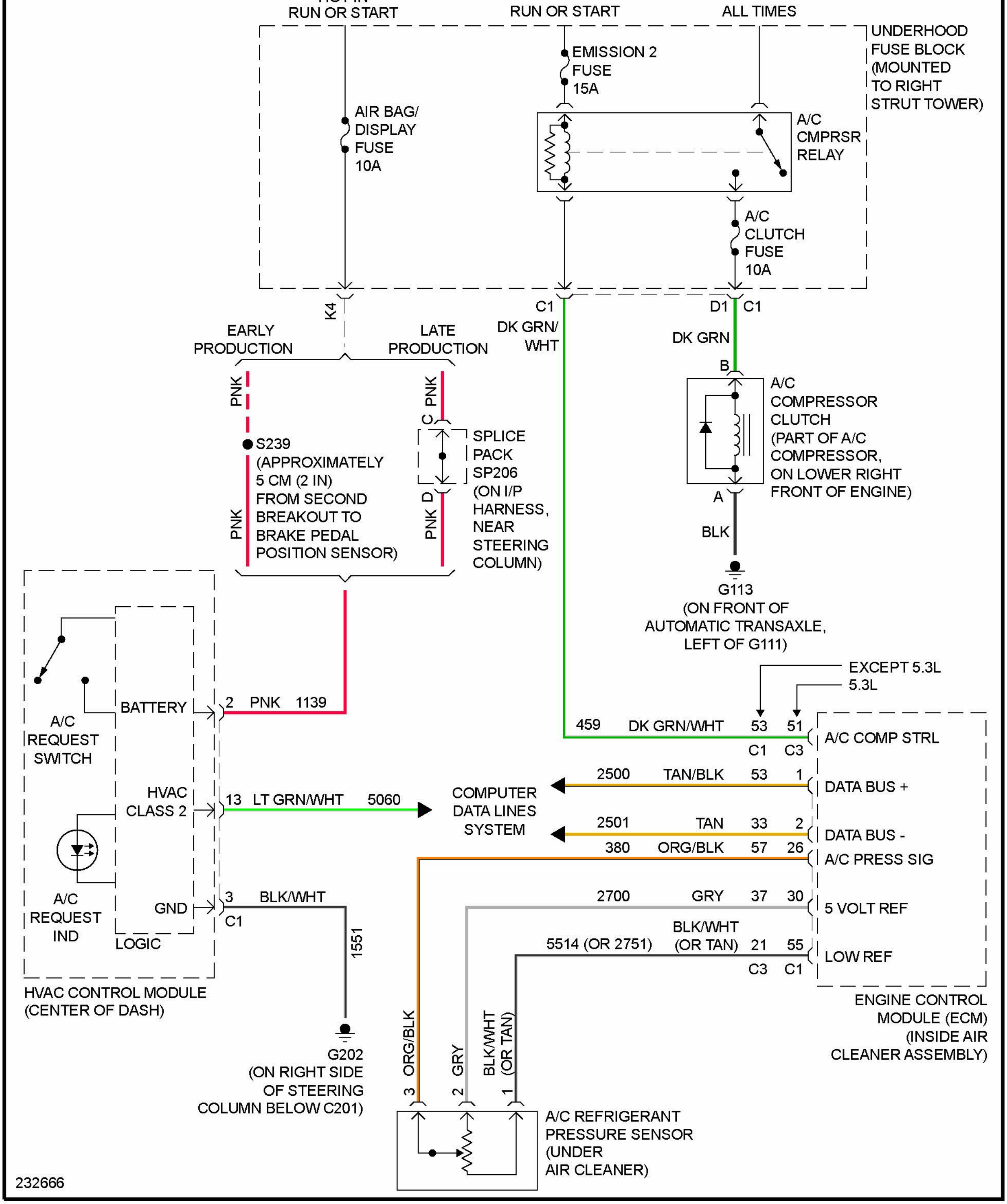

RUN OR START
RUN OR START
ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
EMISSION 2 FUSE 15A
AIR BAG/ DISPLAY FUSE 10A
A/C CMPRSR RELAY
A/C CLUTCH FUSE 10A
K4
C1
D1
C1
EARLY PRODUCTION
LATE PRODUCTION
DK GRN/ WHT
DK GRN
B
A/C COMPRESSOR CLUTCH (PART OF A/C COMPRESSOR, ON LOWER RIGHT FRONT OF ENGINE)
A
BLK
G113 (ON FRONT OF AUTOMATIC TRANSAXLE, LEFT OF G111)
PNK
PNK
S239 (APPROXIMATELY 5 CM (2 IN) FROM SECOND BREAKOUT TO BRAKE PEDAL POSITION SENSOR)
PNK
C
SPLICE PACK SP206 (ON I/P HARNESS, NEAR STEERING COLUMN)
D
PNK
A/C REQUEST SWITCH
BATTERY
2 PNK 1139
HVAC CLASS 2
13 LT GRN/WHT 5060
COMPUTER DATA LINES SYSTEM
A/C REQUEST IND
GND
LOGIC
3 BLK/WHT
C1
1551
HVAC CONTROL MODULE (CENTER OF DASH)
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
EXCEPT 5.3L
5.3L
459 DK GRN/WHT 53 51
C1 C3
A/C COMP STRL
2500 TAN/BLK 53 1
DATA BUS +
2501 TAN 33 2
DATA BUS -
380 ORG/BLK 57 26
A/C PRESS SIG
2700 GRY 37 30
5 VOLT REF
5514 (OR 2751) BLK/WHT (OR TAN) 21 55
LOW REF
C3 C1
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
3 ORG/BLK
2 GRY
1 BLK/WHT (OR TAN)
A/C REFRIGERANT PRESSURE SENSOR (UNDER AIR CLEANER)
232666

Fig. 1: Compressor Circuit

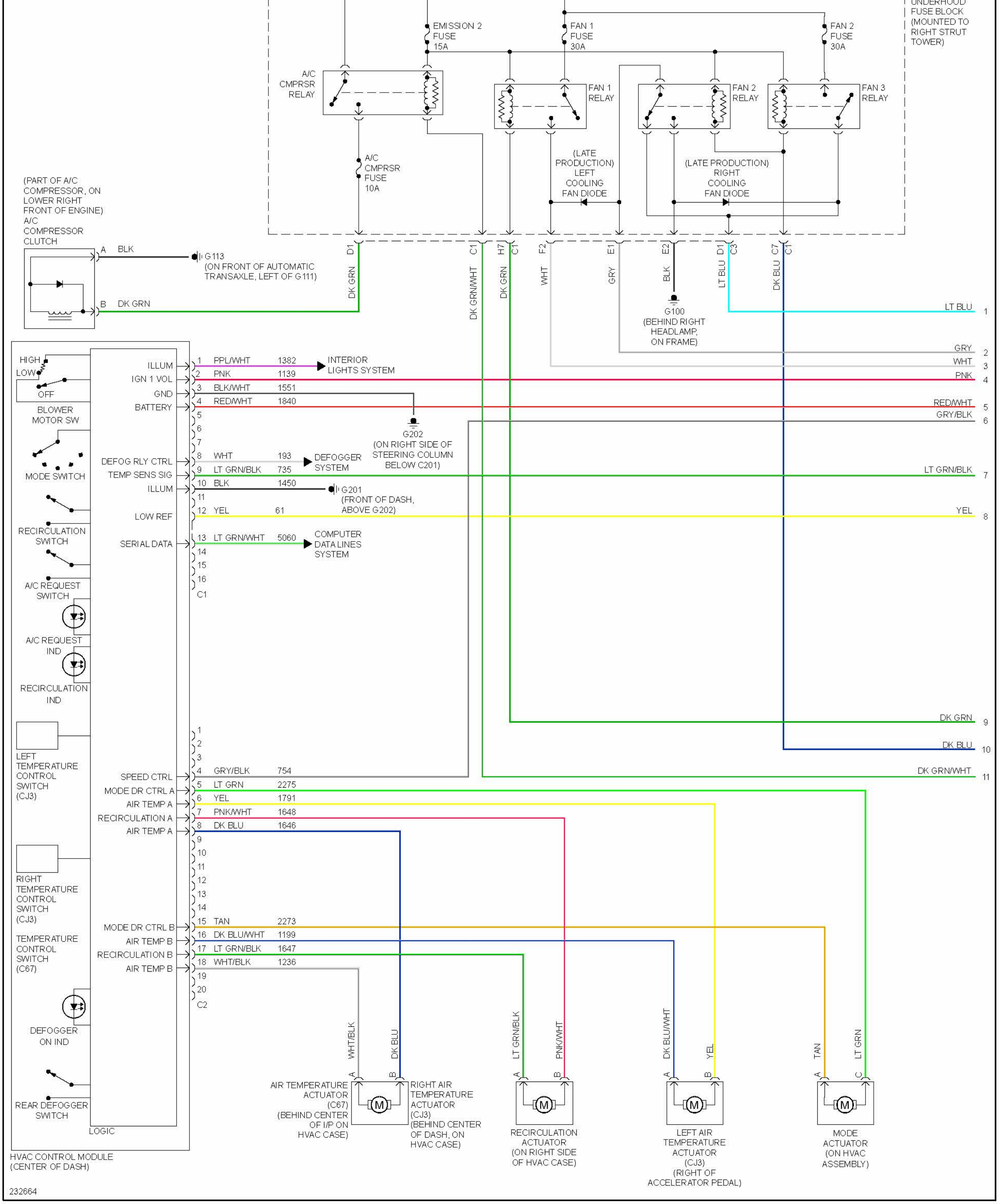

UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
EMISSION 2 FUSE 15A
FAN 1 FUSE 30A
FAN 2 FUSE 30A
A/C CMPRSR RELAY
FAN 1 RELAY
FAN 2 RELAY
FAN 3 RELAY
A/C CMPRSR FUSE 10A
(LATE PRODUCTION) LEFT COOLING FAN DIODE
(LATE PRODUCTION) RIGHT COOLING FAN DIODE
D1 C1 H7 C1 F2 E1 E2 D1 C3 C7 C1
DK GRN
DK GRN/WHT
DK GRN
WHT
GRY
BLK
LT BLU
DK BLU
G100 (BEHIND RIGHT HEADLAMP, ON FRAME)
(PART OF A/C COMPRESSOR, ON LOWER RIGHT FRONT OF ENGINE) A/C COMPRESSOR CLUTCH
A BLK
G113 (ON FRONT OF AUTOMATIC TRANSAXLE, LEFT OF G111)
B DK GRN
LT BLU 1
GRY 2
WHT 3
PNK 4
RED/WHT 5
GRY/BLK 6
LT GRN/BLK 7
YEL 8
DK GRN 9
DK BLU 10
DK GRN/WHT 11
HIGH
LOW
OFF
BLOWER MOTOR SW
MODE SWITCH
RECIRCULATION SWITCH
A/C REQUEST SWITCH
A/C REQUEST IND
RECIRCULATION IND
LEFT TEMPERATURE CONTROL SWITCH (CJ3)
RIGHT TEMPERATURE CONTROL SWITCH (CJ3)
TEMPERATURE CONTROL SWITCH (C67)
DEFOGGER ON IND
REAR DEFOGGER SWITCH
LOGIC
HVAC CONTROL MODULE (CENTER OF DASH)
ILLUM 1 PPL/WHT 1382 INTERIOR LIGHTS SYSTEM
IGN 1 VOL 2 PNK 1139
GND 3 BLK/WHT 1551
BATTERY 4 RED/WHT 1840
5
6
7
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
DEFOG RLY CTRL 8 WHT 193 DEFOGGER SYSTEM
TEMP SENS SIG 9 LT GRN/BLK 735
ILLUM 10 BLK 1450 G201 (FRONT OF DASH, ABOVE G202)
11
LOW REF 12 YEL 61
SERIAL DATA 13 LT GRN/WHT 5060 COMPUTER DATA LINES SYSTEM
14
15
16
C1
1
2
3
SPEED CTRL 4 GRY/BLK 754
MODE DR CTRL A 5 LT GRN 2275
AIR TEMP A 6 YEL 1791
RECIRCULATION A 7 PNK/WHT 1648
AIR TEMP A 8 DK BLU 1646
9
10
11
12
13
14
MODE DR CTRL B 15 TAN 2273
AIR TEMP B 16 DK BLU/WHT 1199
RECIRCULATION B 17 LT GRN/BLK 1647
AIR TEMP B 18 WHT/BLK 1236
19
20
C2
WHT/BLK A
DK BLU B
M
AIR TEMPERATURE ACTUATOR (C67) (BEHIND CENTER OF I/P ON HVAC CASE)
RIGHT AIR TEMPERATURE ACTUATOR (CJ3) (BEHIND CENTER OF DASH, ON HVAC CASE)
LT GRN/BLK A
PNK/WHT B
RECIRCULATION ACTUATOR (ON RIGHT SIDE OF HVAC CASE)
DK BLU/WHT A
YEL B
LEFT AIR TEMPERATURE ACTUATOR (CJ3) (RIGHT OF ACCELERATOR PEDAL)
TAN A
LT GRN C
MODE ACTUATOR (ON HVAC ASSEMBLY)
232664

Fig. 2: Manual A/C Circuit (1 of 2)

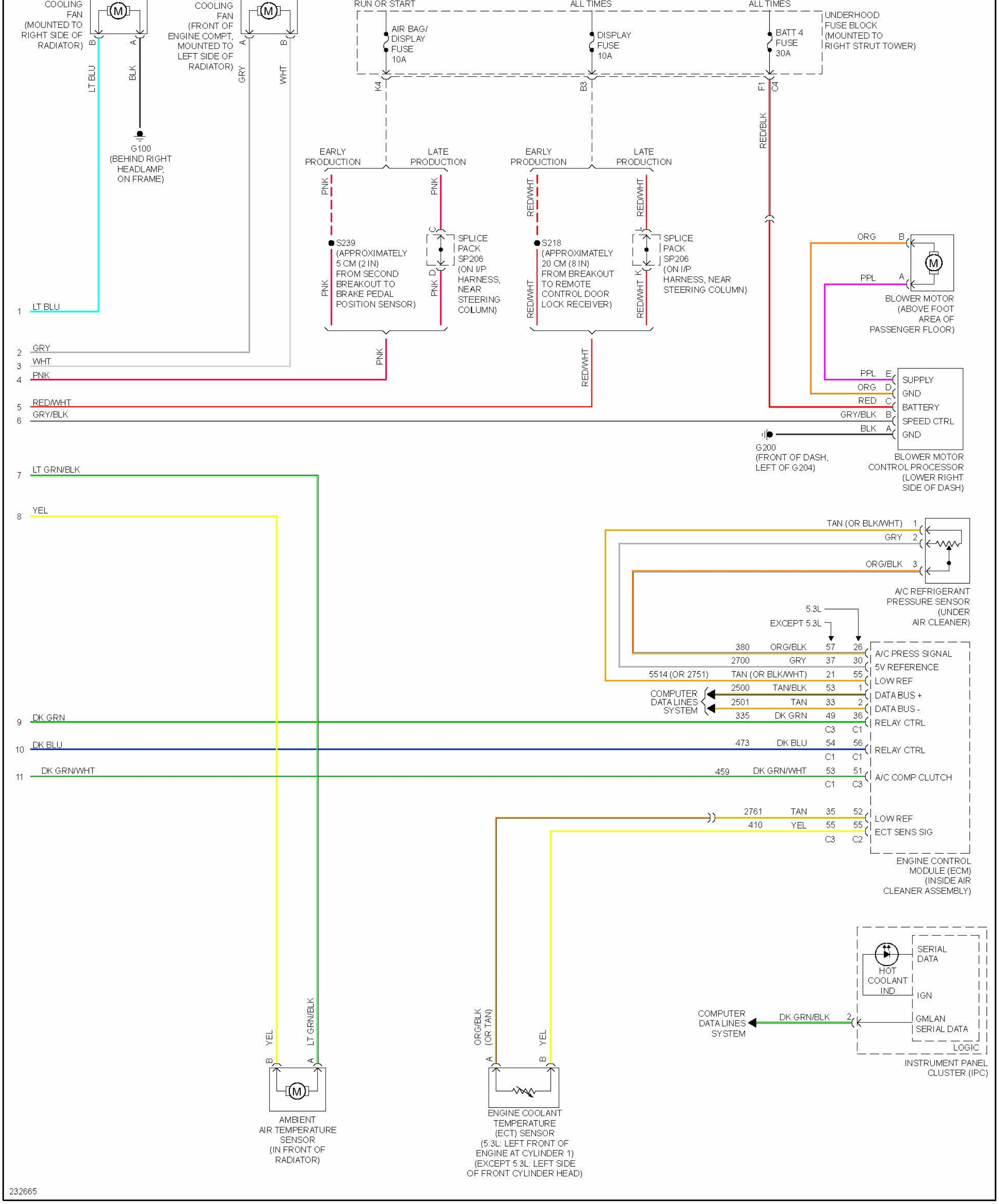

COOLING FAN (MOUNTED TO RIGHT SIDE OF RADIATOR)
COOLING FAN (FRONT OF ENGINE COMPT, MOUNTED TO LEFT SIDE OF RADIATOR)
RUN OR START
ALL TIMES
ALL TIMES
AIR BAG/ DISPLAY FUSE 10A
DISPLAY FUSE 10A
BATT 4 FUSE 30A
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
K4
B3
F1
C4
LT BLU
BLK
GRY
WHT
G100 (BEHIND RIGHT HEADLAMP, ON FRAME)
EARLY PRODUCTION
LATE PRODUCTION
EARLY PRODUCTION
LATE PRODUCTION
PNK
RED/WHT
RED/BLK
S239 (APPROXIMATELY 5 CM (2 IN) FROM SECOND BREAKOUT TO BRAKE PEDAL POSITION SENSOR)
SPLICE PACK SP206 (ON I/P HARNESS, NEAR STEERING COLUMN)
S218 (APPROXIMATELY 20 CM (8 IN) FROM BREAKOUT TO REMOTE CONTROL DOOR LOCK RECEIVER)
SPLICE PACK SP206 (ON I/P HARNESS, NEAR STEERING COLUMN)
ORG
PPL
BLOWER MOTOR (ABOVE FOOT AREA OF PASSENGER FLOOR)
1 LT BLU
2 GRY
3 WHT
4 PNK
5 RED/WHT
6 GRY/BLK
7 LT GRN/BLK
8 YEL
9 DK GRN
10 DK BLU
11 DK GRN/WHT
PPL E SUPPLY
ORG D GND
RED C BATTERY
GRY/BLK B SPEED CTRL
BLK A GND
G200 (FRONT OF DASH, LEFT OF G204)
BLOWER MOTOR CONTROL PROCESSOR (LOWER RIGHT SIDE OF DASH)
TAN (OR BLK/WHT) 1
GRY 2
ORG/BLK 3
A/C REFRIGERANT PRESSURE SENSOR (UNDER AIR CLEANER)
5.3L
EXCEPT 5.3L
380 ORG/BLK 57 26 A/C PRESS SIGNAL
2700 GRY 37 30 5V REFERENCE
5514 (OR 2751) TAN (OR BLK/WHT) 21 55 LOW REF
COMPUTER DATA LINES SYSTEM
2500 TAN/BLK 53 1 DATA BUS +
2501 TAN 33 2 DATA BUS -
335 DK GRN 49 36 RELAY CTRL
C3 C1
473 DK BLU 54 56 RELAY CTRL
C1 C1
459 DK GRN/WHT 53 51 A/C COMP CLUTCH
C1 C3
2761 TAN 35 52 LOW REF
410 YEL 55 55 ECT SENS SIG
C3 C2
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
HOT COOLANT IND
SERIAL DATA
IGN
GMLAN SERIAL DATA
LOGIC
COMPUTER DATA LINES SYSTEM
DK GRN/BLK 2
INSTRUMENT PANEL CLUSTER (IPC)
YEL
LT GRN/BLK
B
A
AMBIENT AIR TEMPERATURE SENSOR (IN FRONT OF RADIATOR)
ORG/BLK (OR TAN)
YEL
ENGINE COOLANT TEMPERATURE (ECT) SENSOR (5.3L: LEFT FRONT OF ENGINE AT CYLINDER 1) (EXCEPT 5.3L: LEFT SIDE OF FRONT CYLINDER HEAD)
232665

Fig. 3: Manual A/C Circuit (2 of 2)

ANTI-LOCK BRAKES

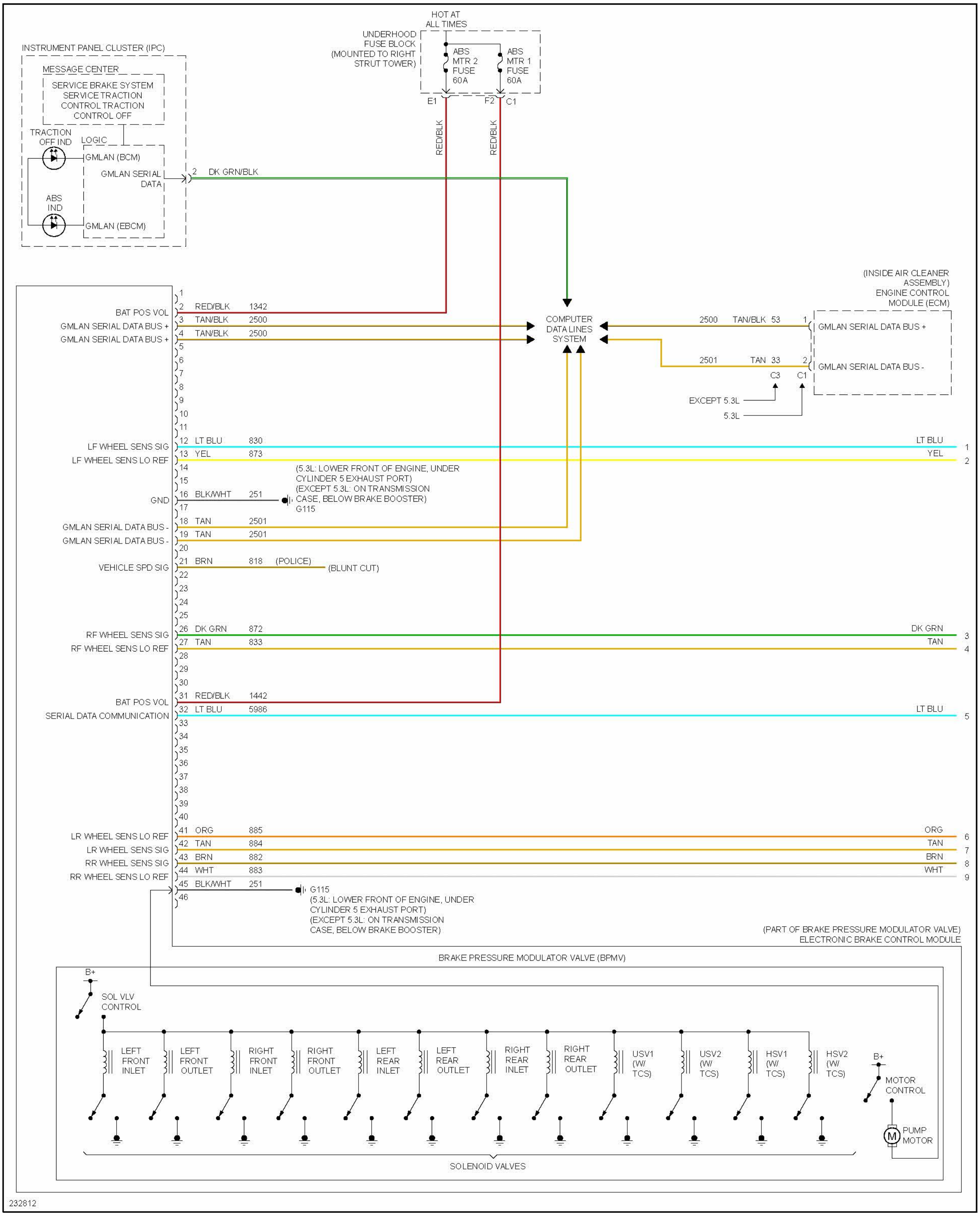

HOT AT
ALL TIMES
UNDERHOOD
FUSE BLOCK
(MOUNTED TO RIGHT
STRUT TOWER)
ABS
MTR 2
FUSE
60A
ABS
MTR 1
FUSE
60A
E1
F2
C1
RED/BLK
RED/BLK
INSTRUMENT PANEL CLUSTER (IPC)
MESSAGE CENTER
SERVICE BRAKE SYSTEM
SERVICE TRACTION
CONTROL TRACTION
CONTROL OFF
TRACTION
OFF IND
LOGIC
GMLAN (BCM)
GMLAN SERIAL
DATA
2
DK GRN/BLK
ABS
IND
GMLAN (EBCM)
(INSIDE AIR CLEANER
ASSEMBLY)
ENGINE CONTROL
MODULE (ECM)
COMPUTER
DATA LINES
SYSTEM
2500
TAN/BLK
53
1
GMLAN SERIAL DATA BUS +
2501
TAN
33
2
GMLAN SERIAL DATA BUS -
C3
C1
EXCEPT 5.3L
5.3L
1
2
RED/BLK
1342
BAT POS VOL
3
TAN/BLK
2500
GMLAN SERIAL DATA BUS +
4
TAN/BLK
2500
GMLAN SERIAL DATA BUS +
5
6
7
8
9
10
11
12
LT BLU
830
LF WHEEL SENS SIG
13
YEL
873
LF WHEEL SENS LO REF
14
15
16
BLK/WHT
251
GND
17
(5.3L: LOWER FRONT OF ENGINE, UNDER
CYLINDER 5 EXHAUST PORT)
(EXCEPT 5.3L: ON TRANSMISSION
CASE, BELOW BRAKE BOOSTER)
G115
18
TAN
2501
GMLAN SERIAL DATA BUS -
19
TAN
2501
GMLAN SERIAL DATA BUS -
20
21
BRN
818
(POLICE)
VEHICLE SPD SIG
(BLUNT CUT)
22
23
24
25
26
DK GRN
872
RF WHEEL SENS SIG
27
TAN
833
RF WHEEL SENS LO REF
28
29
30
31
RED/BLK
1442
BAT POS VOL
32
LT BLU
5986
SERIAL DATA COMMUNICATION
33
34
35
36
37
38
39
40
41
ORG
885
LR WHEEL SENS LO REF
42
TAN
884
LR WHEEL SENS SIG
43
BRN
882
RR WHEEL SENS SIG
44
WHT
883
RR WHEEL SENS LO REF
45
BLK/WHT
251
46
G115
(5.3L: LOWER FRONT OF ENGINE, UNDER
CYLINDER 5 EXHAUST PORT)
(EXCEPT 5.3L: ON TRANSMISSION
CASE, BELOW BRAKE BOOSTER)
LT BLU
1
YEL
2
DK GRN
3
TAN
4
LT BLU
5
ORG
6
TAN
7
BRN
8
WHT
9
(PART OF BRAKE PRESSURE MODULATOR VALVE)
ELECTRONIC BRAKE CONTROL MODULE
BRAKE PRESSURE MODULATOR VALVE (BPMV)
B+
SOL VLV
CONTROL
LEFT
FRONT
INLET
LEFT
FRONT
OUTLET
RIGHT
FRONT
INLET
RIGHT
FRONT
OUTLET
LEFT
REAR
INLET
LEFT
REAR
OUTLET
RIGHT
REAR
INLET
RIGHT
REAR
OUTLET
USV1
(W/
TCS)
USV2
(W/
TCS)
HSV1
(W/
TCS)
HSV2
(W/
TCS)
B+
MOTOR
CONTROL
M
PUMP
MOTOR
SOLENOID VALVES
232812

Fig. 4: Anti-lock Brakes Circuit (1 of 2)

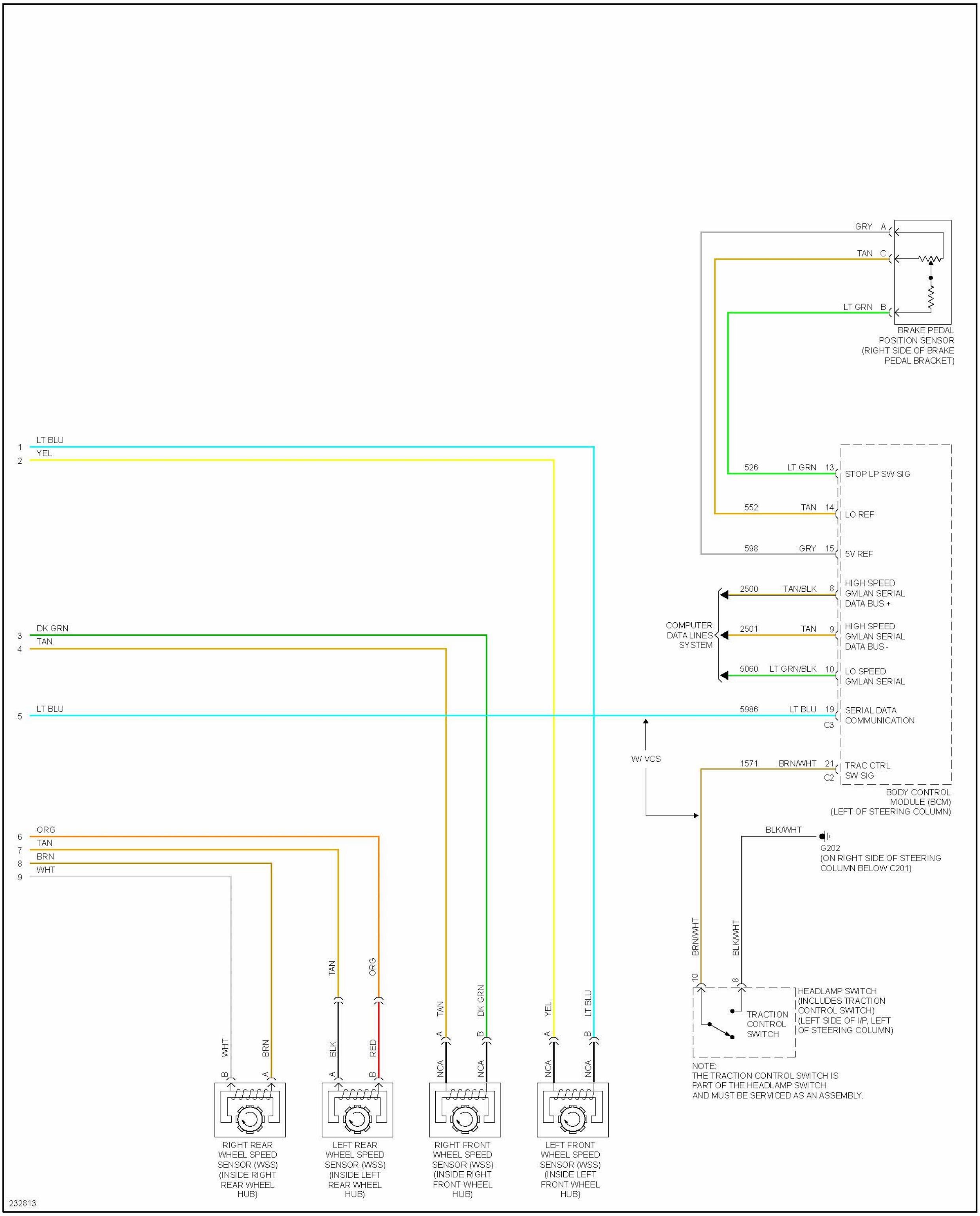

GRY A
TAN C
LT GRN B
BRAKE PEDAL POSITION SENSOR (RIGHT SIDE OF BRAKE PEDAL BRACKET)
1 LT BLU
2 YEL
3 DK GRN
4 TAN
5 LT BLU
6 ORG
7 TAN
8 BRN
9 WHT
526 LT GRN 13 STOP LP SW SIG
552 TAN 14 LO REF
598 GRY 15 5V REF
2500 TAN/BLK 8 HIGH SPEED GMLAN SERIAL DATA BUS +
2501 TAN 9 HIGH SPEED GMLAN SERIAL DATA BUS -
5060 LT GRN/BLK 10 LO SPEED GMLAN SERIAL
5986 LT BLU 19 SERIAL DATA COMMUNICATION
C3
COMPUTER DATA LINES SYSTEM
W/ VCS
1571 BRN/WHT 21 TRAC CTRL SW SIG
C2
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
BLK/WHT
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
BRN/WHT
BLK/WHT
10
8
HEADLAMP SWITCH (INCLUDES TRACTION CONTROL SWITCH) (LEFT SIDE OF I/P, LEFT OF STEERING COLUMN)
TRACTION CONTROL SWITCH
NOTE: THE TRACTION CONTROL SWITCH IS PART OF THE HEADLAMP SWITCH AND MUST BE SERVICED AS AN ASSEMBLY.
TAN
ORG
TAN
DK GRN
YEL
LT BLU
WHT
BRN
BLK
RED
A
B
NCA
B A
A B
RIGHT REAR WHEEL SPEED SENSOR (WSS) (INSIDE RIGHT REAR WHEEL HUB)
LEFT REAR WHEEL SPEED SENSOR (WSS) (INSIDE LEFT REAR WHEEL HUB)
RIGHT FRONT WHEEL SPEED SENSOR (WSS) (INSIDE RIGHT FRONT WHEEL HUB)
LEFT FRONT WHEEL SPEED SENSOR (WSS) (INSIDE LEFT FRONT WHEEL HUB)
232813

Fig. 5: Anti-lock Brakes Circuit (2 of 2)

ANTI-THEFT

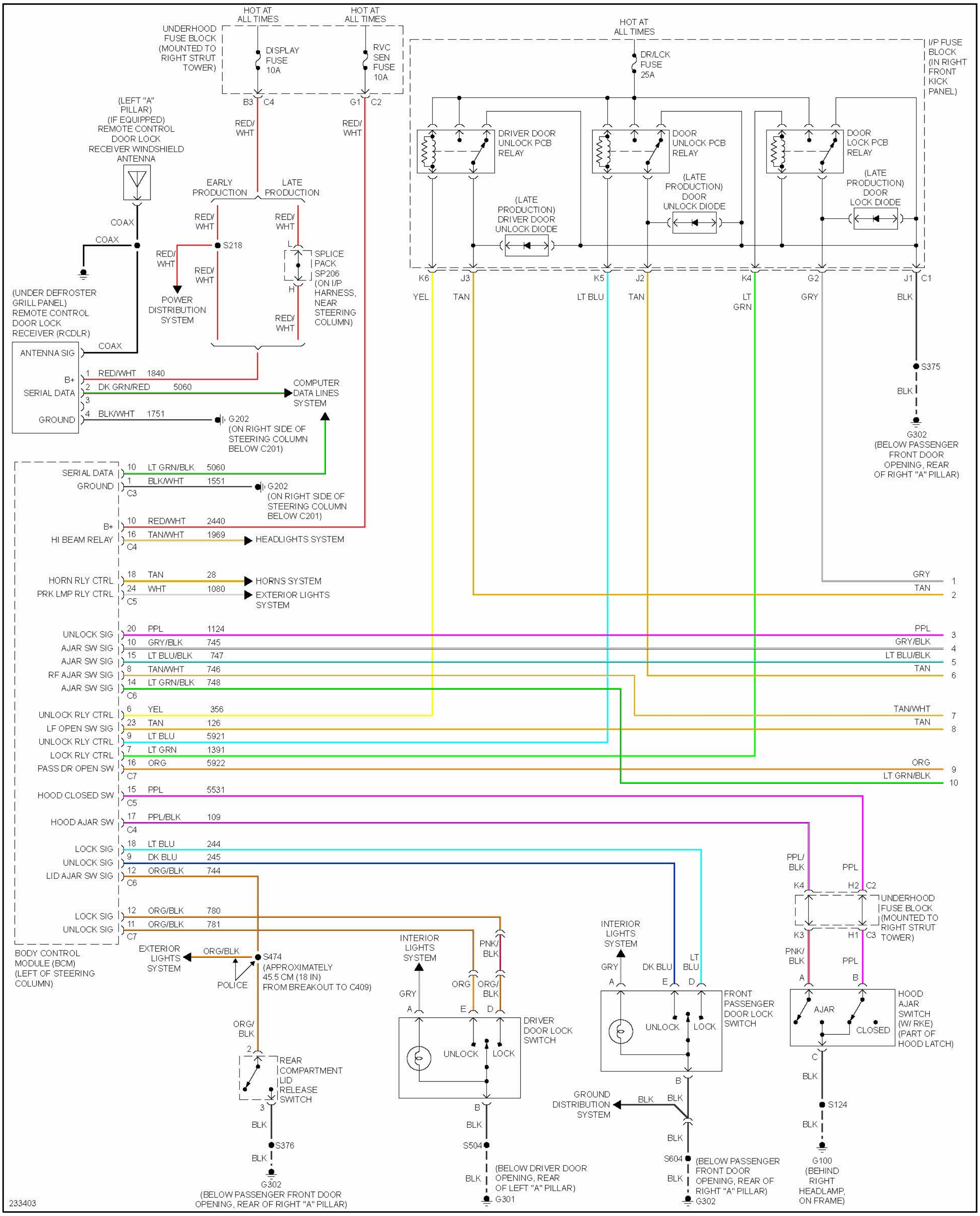

HOT AT ALL TIMES
HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
DISPLAY FUSE 10A
RVC SEN FUSE 10A
B3 C4
G1 C2
RED/WHT
RED/WHT
EARLY PRODUCTION
LATE PRODUCTION
RED/WHT
RED/WHT
S218
RED/WHT
RED/WHT
POWER DISTRIBUTION SYSTEM
L
H
SPLICE PACK SP206 (ON I/P HARNESS, NEAR STEERING COLUMN)
RED/WHT
(LEFT "A" PILLAR) (IF EQUIPPED) REMOTE CONTROL DOOR LOCK RECEIVER WINDSHIELD ANTENNA
COAX
COAX
(UNDER DEFROSTER GRILL PANEL) REMOTE CONTROL DOOR LOCK RECEIVER (RCDLR)
COAX
ANTENNA SIG
B+
SERIAL DATA
GROUND
1 RED/WHT 1840
2 DK GRN/RED 5060
3
4 BLK/WHT 1751
COMPUTER DATA LINES SYSTEM
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
HOT AT ALL TIMES
DR/LCK FUSE 25A
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
DRIVER DOOR UNLOCK PCB RELAY
DOOR UNLOCK PCB RELAY
DOOR LOCK PCB RELAY
(LATE PRODUCTION) DRIVER DOOR UNLOCK DIODE
(LATE PRODUCTION) DOOR UNLOCK DIODE
(LATE PRODUCTION) DOOR LOCK DIODE
K6
J3
K5
J2
K4
G2
J1 C1
YEL
TAN
LT BLU
TAN
LT GRN
GRY
BLK
S375
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT "A" PILLAR)
SERIAL DATA 10 LT GRN/BLK 5060
GROUND 1 BLK/WHT 1551
C3
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
B+ 10 RED/WHT 2440
HI BEAM RELAY 16 TAN/WHT 1969
C4
HEADLIGHTS SYSTEM
HORN RLY CTRL 18 TAN 28
PRK LMP RLY CTRL 24 WHT 1080
C5
HORNS SYSTEM
EXTERIOR LIGHTS SYSTEM
UNLOCK SIG 20 PPL 1124
AJAR SW SIG 10 GRY/BLK 745
AJAR SW SIG 15 LT BLU/BLK 747
RF AJAR SW SIG 8 TAN/WHT 746
AJAR SW SIG 14 LT GRN/BLK 748
C6
UNLOCK RLY CTRL 6 YEL 356
LF OPEN SW SIG 23 TAN 126
UNLOCK RLY CTRL 9 LT BLU 5921
LOCK RLY CTRL 7 LT GRN 1391
PASS DR OPEN SW 16 ORG 5922
C7
HOOD CLOSED SW 15 PPL 5531
C5
HOOD AJAR SW 17 PPL/BLK 109
C4
LOCK SIG 18 LT BLU 244
UNLOCK SIG 9 DK BLU 245
LID AJAR SW SIG 12 ORG/BLK 744
C6
LOCK SIG 12 ORG/BLK 780
UNLOCK SIG 11 ORG/BLK 781
C7
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
GRY 1
TAN 2
PPL 3
GRY/BLK 4
LT BLU/BLK 5
TAN 6
TAN/WHT 7
TAN 8
ORG 9
LT GRN/BLK 10
EXTERIOR LIGHTS SYSTEM
ORG/BLK
S474 (APPROXIMATELY 45.5 CM (18 IN) FROM BREAKOUT TO C409)
POLICE
ORG/BLK
2
REAR COMPARTMENT LID RELEASE SWITCH
3
BLK
S376
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT "A" PILLAR)
INTERIOR LIGHTS SYSTEM
GRY
ORG
PNK/BLK
ORG/BLK
A E D
DRIVER DOOR LOCK SWITCH
UNLOCK
LOCK
B
BLK
S504
BLK
G301 (BELOW DRIVER DOOR OPENING, REAR OF LEFT "A" PILLAR)
INTERIOR LIGHTS SYSTEM
GRY
DK BLU
LT BLU
A E D
FRONT PASSENGER DOOR LOCK SWITCH
UNLOCK
LOCK
B
GROUND DISTRIBUTION SYSTEM
BLK
BLK
BLK
S604
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT "A" PILLAR)
PPL/BLK
PPL
K4
H2 C2
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
K3
H1 C3
PNK/BLK
PPL
A
B
HOOD AJAR SWITCH (W/ RKE) (PART OF HOOD LATCH)
AJAR
CLOSED
C
BLK
S124
BLK
G100 (BEHIND RIGHT HEADLAMP, ON FRAME)
233403

Fig. 6: Forced Entry Circuit (1 of 2)

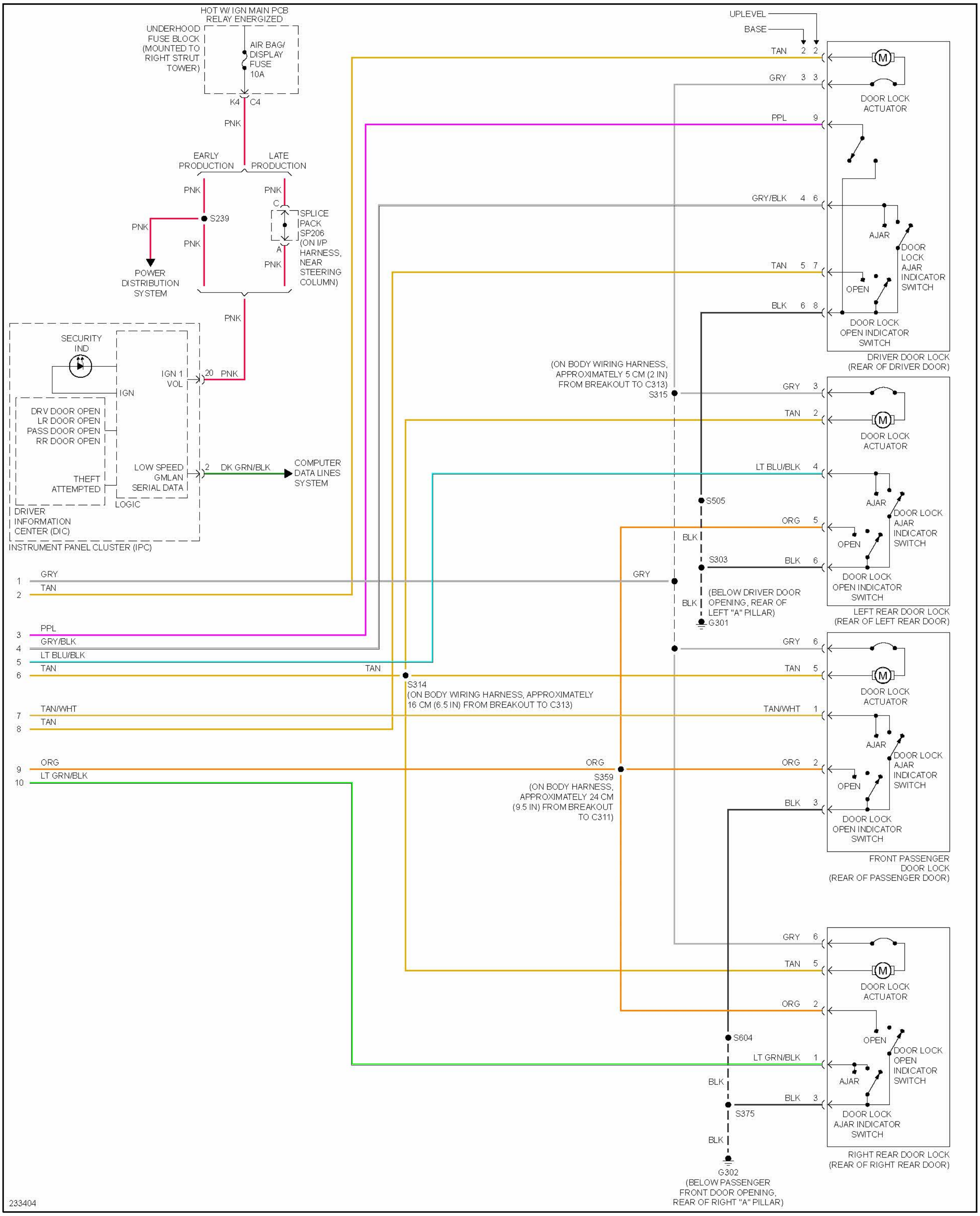

HOT W/ IGN MAIN PCB RELAY ENERGIZED
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
AIR BAG/ DISPLAY FUSE 10A
K4
C4
PNK
EARLY PRODUCTION
LATE PRODUCTION
S239
C
SPLICE PACK SP206 (ON I/P HARNESS, NEAR STEERING COLUMN)
A
POWER DISTRIBUTION SYSTEM
SECURITY IND
IGN
IGN 1 VOL
20
DRV DOOR OPEN
LR DOOR OPEN
PASS DOOR OPEN
RR DOOR OPEN
THEFT ATTEMPTED
LOW SPEED GMLAN SERIAL DATA
2
DK GRN/BLK
COMPUTER DATA LINES SYSTEM
LOGIC
DRIVER INFORMATION CENTER (DIC)
INSTRUMENT PANEL CLUSTER (IPC)
1 GRY
2 TAN
3 PPL
4 GRY/BLK
5 LT BLU/BLK
6 TAN
7 TAN/WHT
8 TAN
9 ORG
10 LT GRN/BLK
UPLEVEL
BASE
TAN 2 2
GRY 3 3
DOOR LOCK ACTUATOR
PPL 9
GRY/BLK 4 6
AJAR
DOOR LOCK AJAR INDICATOR SWITCH
TAN 5 7
OPEN
BLK 6 8
DOOR LOCK OPEN INDICATOR SWITCH
DRIVER DOOR LOCK (REAR OF DRIVER DOOR)
(ON BODY WIRING HARNESS, APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO C313)
S315
GRY 3
TAN 2
DOOR LOCK ACTUATOR
LT BLU/BLK 4
S505
AJAR
DOOR LOCK AJAR INDICATOR SWITCH
ORG 5
OPEN
BLK
S303
BLK 6
DOOR LOCK OPEN INDICATOR SWITCH
(BELOW DRIVER DOOR OPENING, REAR OF LEFT "A" PILLAR)
G301
LEFT REAR DOOR LOCK (REAR OF LEFT REAR DOOR)
GRY
GRY 6
TAN
S314 (ON BODY WIRING HARNESS, APPROXIMATELY 16 CM (6.5 IN) FROM BREAKOUT TO C313)
TAN 5
DOOR LOCK ACTUATOR
TAN/WHT 1
AJAR
DOOR LOCK AJAR INDICATOR SWITCH
ORG
S359 (ON BODY HARNESS, APPROXIMATELY 24 CM (9.5 IN) FROM BREAKOUT TO C311)
ORG 2
OPEN
BLK 3
DOOR LOCK OPEN INDICATOR SWITCH
FRONT PASSENGER DOOR LOCK (REAR OF PASSENGER DOOR)
GRY 6
TAN 5
DOOR LOCK ACTUATOR
ORG 2
OPEN
DOOR LOCK OPEN INDICATOR SWITCH
S604
LT GRN/BLK 1
AJAR
BLK
BLK 3
S375
DOOR LOCK AJAR INDICATOR SWITCH
RIGHT REAR DOOR LOCK (REAR OF RIGHT REAR DOOR)
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT "A" PILLAR)
233404

Fig. 7: Forced Entry Circuit (2 of 2)

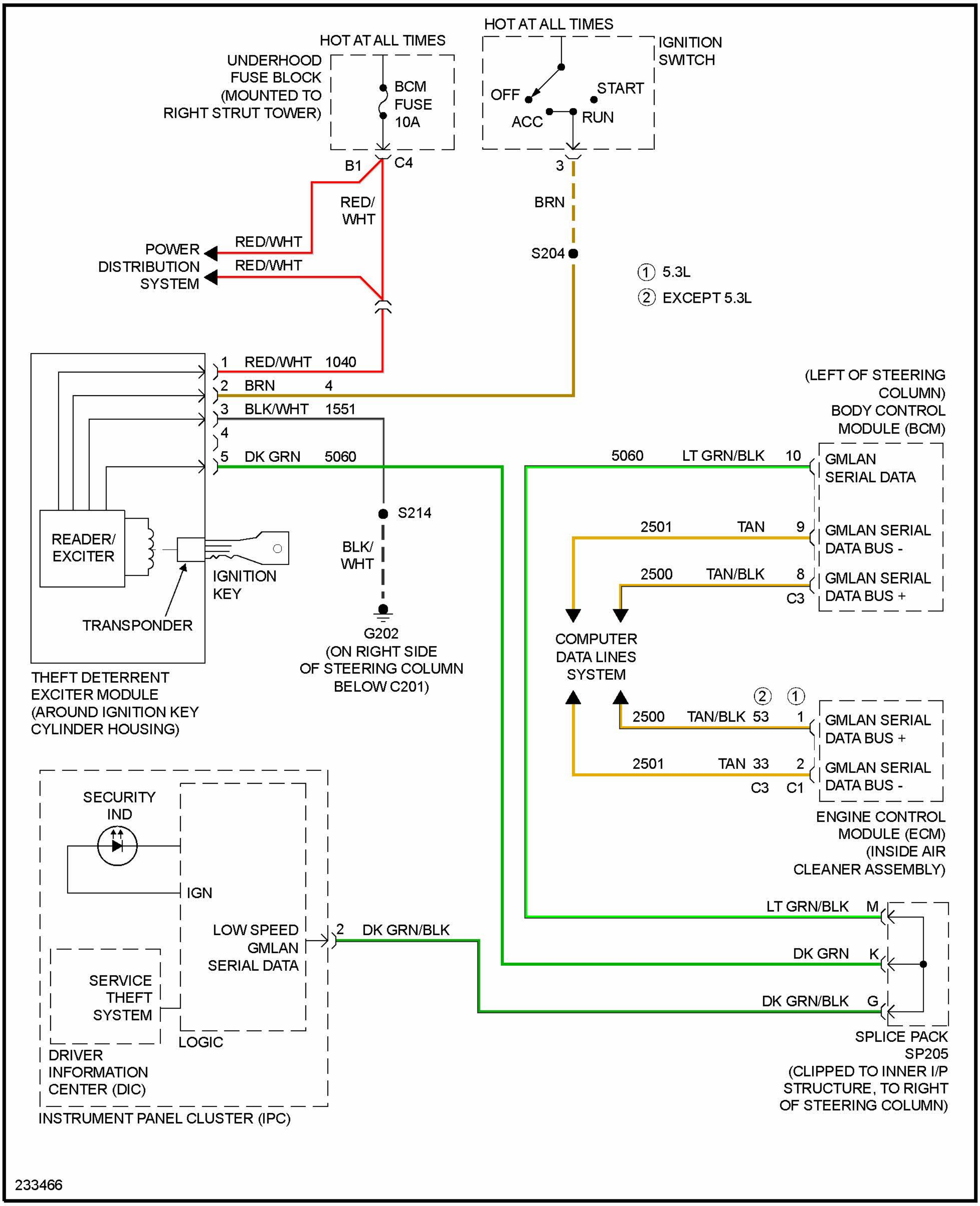

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
BCM FUSE 10A
B1
C4
HOT AT ALL TIMES
IGNITION SWITCH
OFF
ACC
START
RUN
3
BRN
S204
RED/ WHT
RED/WHT
RED/WHT
POWER DISTRIBUTION SYSTEM
① 5.3L
② EXCEPT 5.3L
1 RED/WHT 1040
2 BRN 4
3 BLK/WHT 1551
4
5 DK GRN 5060
READER/ EXCITER
IGNITION KEY
TRANSPONDER
THEFT DETERRENT EXCITER MODULE (AROUND IGNITION KEY CYLINDER HOUSING)
S214
BLK/ WHT
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
(LEFT OF STEERING COLUMN) BODY CONTROL MODULE (BCM)
5060 LT GRN/BLK 10
GMLAN SERIAL DATA
2501 TAN 9
GMLAN SERIAL DATA BUS -
2500 TAN/BLK 8
C3
GMLAN SERIAL DATA BUS +
COMPUTER DATA LINES SYSTEM
② ①
2500 TAN/BLK 53 1
GMLAN SERIAL DATA BUS +
2501 TAN 33 2
GMLAN SERIAL DATA BUS -
C3 C1
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
SECURITY IND
IGN
LOW SPEED GMLAN SERIAL DATA
2 DK GRN/BLK
SERVICE THEFT SYSTEM
LOGIC
DRIVER INFORMATION CENTER (DIC)
INSTRUMENT PANEL CLUSTER (IPC)
LT GRN/BLK M
DK GRN K
DK GRN/BLK G
SPLICE PACK SP205 (CLIPPED TO INNER I/P STRUCTURE, TO RIGHT OF STEERING COLUMN)
233466

Fig. 8: Pass-Key Circuit

BODY CONTROL MODULES

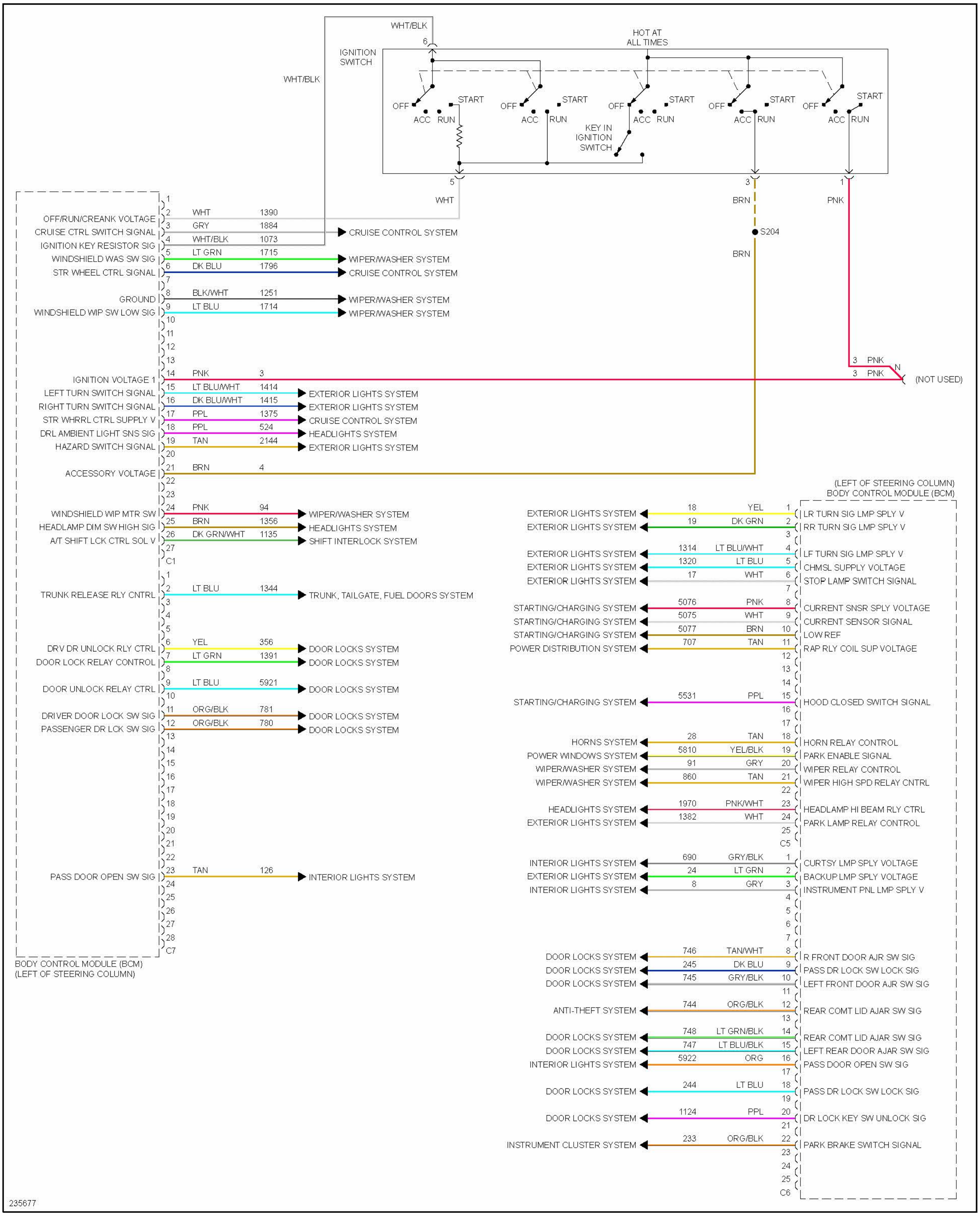

WHT/BLK
HOT AT ALL TIMES
IGNITION SWITCH
WHT/BLK
OFF ACC RUN START
KEY IN IGNITION SWITCH
5 WHT
3 BRN
1 PNK
S204
BRN
1
2 WHT 1390 OFF/RUN/CREANK VOLTAGE
3 GRY 1884 CRUISE CTRL SWITCH SIGNAL → CRUISE CONTROL SYSTEM
4 WHT/BLK 1073 IGNITION KEY RESISTOR SIG
5 LT GRN 1715 WINDSHIELD WAS SW SIG → WIPER/WASHER SYSTEM
6 DK BLU 1796 STR WHEEL CTRL SIGNAL → CRUISE CONTROL SYSTEM
7
8 BLK/WHT 1251 GROUND → WIPER/WASHER SYSTEM
9 LT BLU 1714 WINDSHIELD WIP SW LOW SIG → WIPER/WASHER SYSTEM
10
11
12
13
14 PNK 3 IGNITION VOLTAGE 1
3 PNK N
3 PNK (NOT USED)
15 LT BLU/WHT 1414 LEFT TURN SWITCH SIGNAL → EXTERIOR LIGHTS SYSTEM
16 DK BLU/WHT 1415 RIGHT TURN SWITCH SIGNAL → EXTERIOR LIGHTS SYSTEM
17 PPL 1375 STR WHRRL CTRL SUPPLY V → CRUISE CONTROL SYSTEM
18 PPL 524 DRL AMBIENT LIGHT SNS SIG → HEADLIGHTS SYSTEM
19 TAN 2144 HAZARD SWITCH SIGNAL → EXTERIOR LIGHTS SYSTEM
20
21 BRN 4 ACCESSORY VOLTAGE
22
23
24 PNK 94 WINDSHIELD WIP MTR SW → WIPER/WASHER SYSTEM
25 BRN 1356 HEADLAMP DIM SW HIGH SIG → HEADLIGHTS SYSTEM
26 DK GRN/WHT 1135 A/T SHIFT LCK CTRL SOL V → SHIFT INTERLOCK SYSTEM
27
C1
1
2 LT BLU 1344 TRUNK RELEASE RLY CNTRL → TRUNK, TAILGATE, FUEL DOORS SYSTEM
3
4
5
6 YEL 356 DRV DR UNLOCK RLY CTRL → DOOR LOCKS SYSTEM
7 LT GRN 1391 DOOR LOCK RELAY CONTROL → DOOR LOCKS SYSTEM
8
9 LT BLU 5921 DOOR UNLOCK RELAY CTRL → DOOR LOCKS SYSTEM
10
11 ORG/BLK 781 DRIVER DOOR LOCK SW SIG → DOOR LOCKS SYSTEM
12 ORG/BLK 780 PASSENGER DR LCK SW SIG → DOOR LOCKS SYSTEM
13
14
15
16
17
18
19
20
21
22
23 TAN 126 PASS DOOR OPEN SW SIG → INTERIOR LIGHTS SYSTEM
24
25
26
27
28
C7
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
(LEFT OF STEERING COLUMN) BODY CONTROL MODULE (BCM)
EXTERIOR LIGHTS SYSTEM 18 YEL 1 LR TURN SIG LMP SPLY V
EXTERIOR LIGHTS SYSTEM 19 DK GRN 2 RR TURN SIG LMP SPLY V
3
EXTERIOR LIGHTS SYSTEM 1314 LT BLU/WHT 4 LF TURN SIG LMP SPLY V
EXTERIOR LIGHTS SYSTEM 1320 LT BLU 5 CHMSL SUPPLY VOLTAGE
EXTERIOR LIGHTS SYSTEM 17 WHT 6 STOP LAMP SWITCH SIGNAL
7
STARTING/CHARGING SYSTEM 5076 PNK 8 CURRENT SNSR SPLY VOLTAGE
STARTING/CHARGING SYSTEM 5075 WHT 9 CURRENT SENSOR SIGNAL
STARTING/CHARGING SYSTEM 5077 BRN 10 LOW REF
POWER DISTRIBUTION SYSTEM 707 TAN 11 RAP RLY COIL SUP VOLTAGE
12
13
14
STARTING/CHARGING SYSTEM 5531 PPL 15 HOOD CLOSED SWITCH SIGNAL
16
17
HORNS SYSTEM 28 TAN 18 HORN RELAY CONTROL
POWER WINDOWS SYSTEM 5810 YEL/BLK 19 PARK ENABLE SIGNAL
WIPER/WASHER SYSTEM 91 GRY 20 WIPER RELAY CONTROL
WIPER/WASHER SYSTEM 860 TAN 21 WIPER HIGH SPD RELAY CNTRL
22
HEADLIGHTS SYSTEM 1970 PNK/WHT 23 HEADLAMP HI BEAM RLY CTRL
EXTERIOR LIGHTS SYSTEM 1382 WHT 24 PARK LAMP RELAY CONTROL
25
C5
INTERIOR LIGHTS SYSTEM 690 GRY/BLK 1 CURTSY LMP SPLY VOLTAGE
EXTERIOR LIGHTS SYSTEM 24 LT GRN 2 BACKUP LMP SPLY VOLTAGE
INTERIOR LIGHTS SYSTEM 8 GRY 3 INSTRUMENT PNL LMP SPLY V
4
5
6
7
DOOR LOCKS SYSTEM 746 TAN/WHT 8 R FRONT DOOR AJR SW SIG
DOOR LOCKS SYSTEM 245 DK BLU 9 PASS DR LOCK SW LOCK SIG
DOOR LOCKS SYSTEM 745 GRY/BLK 10 LEFT FRONT DOOR AJR SW SIG
11
ANTI-THEFT SYSTEM 744 ORG/BLK 12 REAR COMT LID AJAR SW SIG
13
DOOR LOCKS SYSTEM 748 LT GRN/BLK 14 REAR COMT LID AJAR SW SIG
DOOR LOCKS SYSTEM 747 LT BLU/BLK 15 LEFT REAR DOOR AJAR SW SIG
INTERIOR LIGHTS SYSTEM 5922 ORG 16 PASS DOOR OPEN SW SIG
17
DOOR LOCKS SYSTEM 244 LT BLU 18 PASS DR LOCK SW LOCK SIG
19
DOOR LOCKS SYSTEM 1124 PPL 20 DR LOCK KEY SW UNLOCK SIG
21
INSTRUMENT CLUSTER SYSTEM 233 ORG/BLK 22 PARK BRAKE SWITCH SIGNAL
23
24
25
C6
235677

Fig. 9: Body Control Modules Circuit (1 of 2)

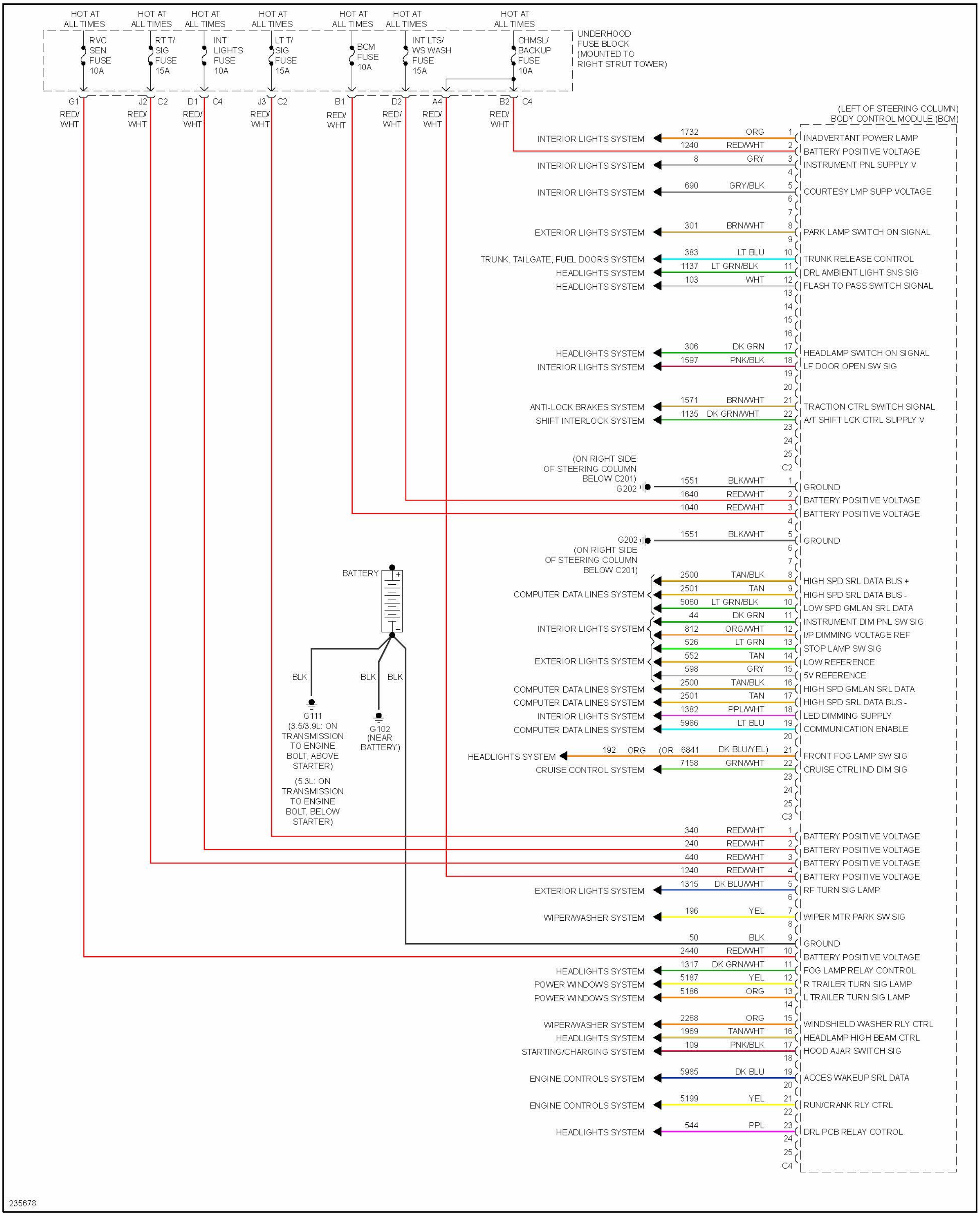

HOT AT ALL TIMES
RVC SEN FUSE 10A
RT T/ SIG FUSE 15A
INT LIGHTS FUSE 10A
LT T/ SIG FUSE 15A
BCM FUSE 10A
INT LTS/ WS WASH FUSE 15A
CHMSL/ BACKUP FUSE 10A
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
G1 J2 C2 D1 C4 J3 C2 B1 D2 A4 B2 C4
RED/ WHT
(LEFT OF STEERING COLUMN) BODY CONTROL MODULE (BCM)
INTERIOR LIGHTS SYSTEM 1732 ORG 1 INADVERTANT POWER LAMP
1240 RED/WHT 2 BATTERY POSITIVE VOLTAGE
INTERIOR LIGHTS SYSTEM 8 GRY 3 INSTRUMENT PNL SUPPLY V
4
INTERIOR LIGHTS SYSTEM 690 GRY/BLK 5 COURTESY LMP SUPP VOLTAGE
6
7
EXTERIOR LIGHTS SYSTEM 301 BRN/WHT 8 PARK LAMP SWITCH ON SIGNAL
9
TRUNK, TAILGATE, FUEL DOORS SYSTEM 383 LT BLU 10 TRUNK RELEASE CONTROL
HEADLIGHTS SYSTEM 1137 LT GRN/BLK 11 DRL AMBIENT LIGHT SNS SIG
HEADLIGHTS SYSTEM 103 WHT 12 FLASH TO PASS SWITCH SIGNAL
13
14
15
16
HEADLIGHTS SYSTEM 306 DK GRN 17 HEADLAMP SWITCH ON SIGNAL
INTERIOR LIGHTS SYSTEM 1597 PNK/BLK 18 LF DOOR OPEN SW SIG
19
20
ANTI-LOCK BRAKES SYSTEM 1571 BRN/WHT 21 TRACTION CTRL SWITCH SIGNAL
SHIFT INTERLOCK SYSTEM 1135 DK GRN/WHT 22 A/T SHIFT LCK CTRL SUPPLY V
23
24
25
C2
(ON RIGHT SIDE OF STEERING COLUMN BELOW C201) G202 1551 BLK/WHT 1 GROUND
1640 RED/WHT 2 BATTERY POSITIVE VOLTAGE
1040 RED/WHT 3 BATTERY POSITIVE VOLTAGE
4
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201) 1551 BLK/WHT 5 GROUND
6
7
COMPUTER DATA LINES SYSTEM 2500 TAN/BLK 8 HIGH SPD SRL DATA BUS +
2501 TAN 9 HIGH SPD SRL DATA BUS -
5060 LT GRN/BLK 10 LOW SPD GMLAN SRL DATA
INTERIOR LIGHTS SYSTEM 44 DK GRN 11 INSTRUMENT DIM PNL SW SIG
812 ORG/WHT 12 I/P DIMMING VOLTAGE REF
EXTERIOR LIGHTS SYSTEM 526 LT GRN 13 STOP LAMP SW SIG
552 TAN 14 LOW REFERENCE
598 GRY 15 5V REFERENCE
COMPUTER DATA LINES SYSTEM 2500 TAN/BLK 16 HIGH SPD GMLAN SRL DATA
COMPUTER DATA LINES SYSTEM 2501 TAN 17 HIGH SPD SRL DATA BUS -
INTERIOR LIGHTS SYSTEM 1382 PPL/WHT 18 LED DIMMING SUPPLY
COMPUTER DATA LINES SYSTEM 5986 LT BLU 19 COMMUNICATION ENABLE
20
HEADLIGHTS SYSTEM 192 ORG (OR 6841 DK BLU/YEL) 21 FRONT FOG LAMP SW SIG
CRUISE CONTROL SYSTEM 7158 GRN/WHT 22 CRUISE CTRL IND DIM SIG
23
24
25
C3
340 RED/WHT 1 BATTERY POSITIVE VOLTAGE
240 RED/WHT 2 BATTERY POSITIVE VOLTAGE
440 RED/WHT 3 BATTERY POSITIVE VOLTAGE
1240 RED/WHT 4 BATTERY POSITIVE VOLTAGE
EXTERIOR LIGHTS SYSTEM 1315 DK BLU/WHT 5 RF TURN SIG LAMP
6
WIPER/WASHER SYSTEM 196 YEL 7 WIPER MTR PARK SW SIG
8
50 BLK 9 GROUND
2440 RED/WHT 10 BATTERY POSITIVE VOLTAGE
HEADLIGHTS SYSTEM 1317 DK GRN/WHT 11 FOG LAMP RELAY CONTROL
POWER WINDOWS SYSTEM 5187 YEL 12 R TRAILER TURN SIG LAMP
POWER WINDOWS SYSTEM 5186 ORG 13 L TRAILER TURN SIG LAMP
14
WIPER/WASHER SYSTEM 2268 ORG 15 WINDSHIELD WASHER RLY CTRL
HEADLIGHTS SYSTEM 1969 TAN/WHT 16 HEADLAMP HIGH BEAM CTRL
STARTING/CHARGING SYSTEM 109 PNK/BLK 17 HOOD AJAR SWITCH SIG
18
ENGINE CONTROLS SYSTEM 5985 DK BLU 19 ACCES WAKEUP SRL DATA
20
ENGINE CONTROLS SYSTEM 5199 YEL 21 RUN/CRANK RLY CTRL
22
HEADLIGHTS SYSTEM 544 PPL 23 DRL PCB RELAY COTROL
24
25
C4
BATTERY
BLK
BLK BLK
G111 (3.5/3.9L: ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER) (5.3L: ON TRANSMISSION TO ENGINE BOLT, BELOW STARTER)
G102 (NEAR BATTERY)
235678

Fig. 10: Body Control Modules Circuit (2 of 2)

COMPUTER DATA LINES

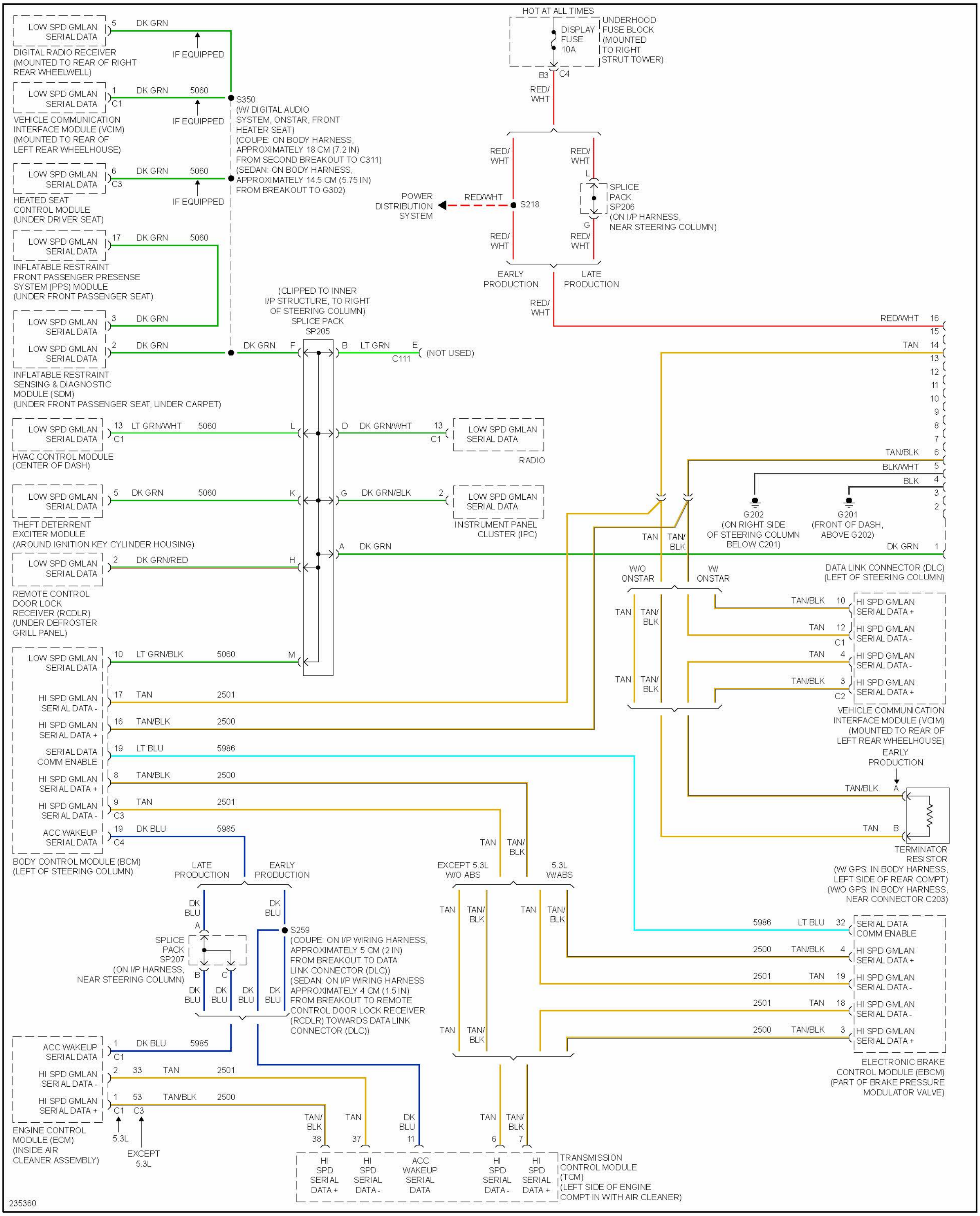

HOT AT ALL TIMES
DISPLAY FUSE 10A
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
B3 C4
RED/WHT
POWER DISTRIBUTION SYSTEM
S218
SPLICE PACK SP206 (ON I/P HARNESS, NEAR STEERING COLUMN)
L
G
EARLY PRODUCTION
LATE PRODUCTION
LOW SPD GMLAN SERIAL DATA
DIGITAL RADIO RECEIVER (MOUNTED TO REAR OF RIGHT REAR WHEELWELL)
5 DK GRN
IF EQUIPPED
1 DK GRN 5060 C1
VEHICLE COMMUNICATION INTERFACE MODULE (VCIM) (MOUNTED TO REAR OF LEFT REAR WHEELHOUSE)
S350 (W/ DIGITAL AUDIO SYSTEM, ONSTAR, FRONT HEATER SEAT) (COUPE: ON BODY HARNESS, APPROXIMATELY 18 CM (7.2 IN) FROM SECOND BREAKOUT TO C311) (SEDAN: ON BODY HARNESS, APPROXIMATELY 14.5 CM (5.75 IN) FROM BREAKOUT TO G302)
6 DK GRN 5060 C3
HEATED SEAT CONTROL MODULE (UNDER DRIVER SEAT)
17 DK GRN 5060
INFLATABLE RESTRAINT FRONT PASSENGER PRESENSE SYSTEM (PPS) MODULE (UNDER FRONT PASSENGER SEAT)
3 DK GRN
2 DK GRN
INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE (SDM) (UNDER FRONT PASSENGER SEAT, UNDER CARPET)
(CLIPPED TO INNER I/P STRUCTURE, TO RIGHT OF STEERING COLUMN) SPLICE PACK SP205
DK GRN F
B LT GRN E C111 (NOT USED)
13 LT GRN/WHT 5060 C1 L
HVAC CONTROL MODULE (CENTER OF DASH)
D DK GRN/WHT 13 C1
RADIO
5 DK GRN 5060 K
THEFT DETERRENT EXCITER MODULE (AROUND IGNITION KEY CYLINDER HOUSING)
G DK GRN/BLK 2
INSTRUMENT PANEL CLUSTER (IPC)
2 DK GRN/RED H
A DK GRN
REMOTE CONTROL DOOR LOCK RECEIVER (RCDLR) (UNDER DEFROSTER GRILL PANEL)
10 LT GRN/BLK 5060 M
HI SPD GMLAN SERIAL DATA -
HI SPD GMLAN SERIAL DATA +
SERIAL DATA COMM ENABLE
ACC WAKEUP SERIAL DATA
17 TAN 2501
16 TAN/BLK 2500
19 LT BLU 5986
8 TAN/BLK 2500
9 TAN 2501 C3
19 DK BLU 5985 C4
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
RED/WHT 16
15
TAN 14
13 12 11 10 9 8 7
TAN/BLK 6
BLK/WHT 5
BLK 4
3 2
DK GRN 1
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
G201 (FRONT OF DASH, ABOVE G202)
DATA LINK CONNECTOR (DLC) (LEFT OF STEERING COLUMN)
TAN TAN/BLK
W/O ONSTAR
W/ ONSTAR
HI SPD GMLAN SERIAL DATA +
HI SPD GMLAN SERIAL DATA -
TAN/BLK 10
TAN 12 C1
TAN 4
TAN/BLK 3 C2
VEHICLE COMMUNICATION INTERFACE MODULE (VCIM) (MOUNTED TO REAR OF LEFT REAR WHEELHOUSE)
EARLY PRODUCTION
TAN/BLK A
TAN B
TERMINATOR RESISTOR (W/ GPS: IN BODY HARNESS, LEFT SIDE OF REAR COMPT) (W/O GPS: IN BODY HARNESS, NEAR CONNECTOR C203)
LATE PRODUCTION
EARLY PRODUCTION
DK BLU
A
S259 (COUPE: ON I/P WIRING HARNESS, APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO DATA LINK CONNECTOR (DLC)) (SEDAN: ON I/P WIRING HARNESS, APPROXIMATELY 4 CM (1.5 IN) FROM BREAKOUT TO REMOTE CONTROL DOOR LOCK RECEIVER (RCDLR) TOWARDS DATA LINK CONNECTOR (DLC))
SPLICE PACK SP207 (ON I/P HARNESS, NEAR STEERING COLUMN)
B C
EXCEPT 5.3L W/O ABS
5.3L W/ABS
TAN TAN/BLK
5986 LT BLU 32 SERIAL DATA COMM ENABLE
2500 TAN/BLK 4 HI SPD GMLAN SERIAL DATA +
2501 TAN 19 HI SPD GMLAN SERIAL DATA -
2501 TAN 18 HI SPD GMLAN SERIAL DATA -
2500 TAN/BLK 3 HI SPD GMLAN SERIAL DATA +
ELECTRONIC BRAKE CONTROL MODULE (EBCM) (PART OF BRAKE PRESSURE MODULATOR VALVE)
ACC WAKEUP SERIAL DATA
1 DK BLU 5985 C1
2 33 TAN 2501
1 53 TAN/BLK 2500
C1 C3
5.3L
EXCEPT 5.3L
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
TAN/BLK 38
TAN 37
DK BLU 11
TAN 6
TAN/BLK 7
HI SPD SERIAL DATA +
HI SPD SERIAL DATA -
ACC WAKEUP SERIAL DATA
HI SPD SERIAL DATA -
HI SPD SERIAL DATA +
TRANSMISSION CONTROL MODULE (TCM) (LEFT SIDE OF ENGINE COMPT IN WITH AIR CLEANER)
235360

Fig. 11: Computer Data Lines Circuit

COOLING FAN

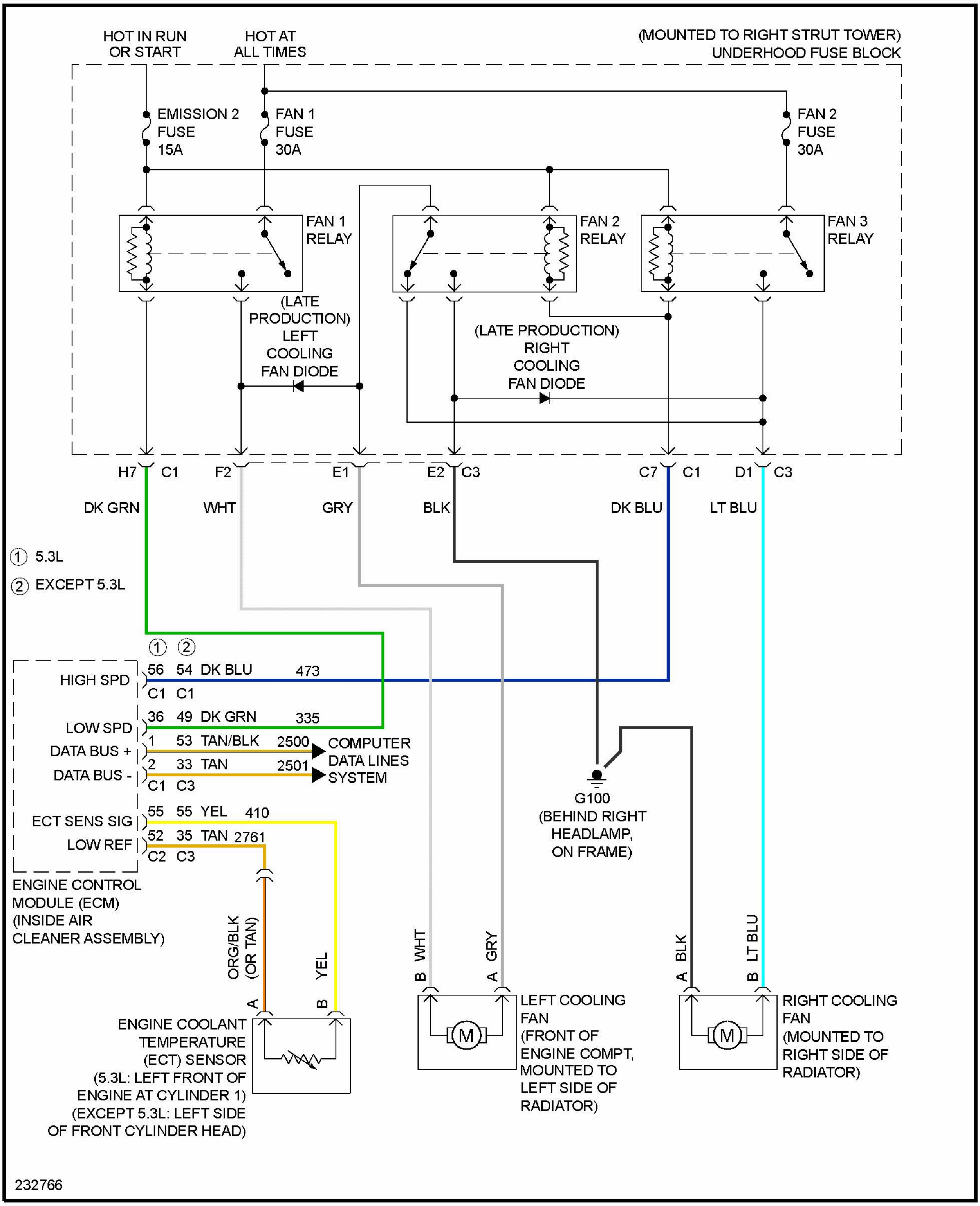

HOT IN RUN OR START
HOT AT ALL TIMES
(MOUNTED TO RIGHT STRUT TOWER) UNDERHOOD FUSE BLOCK
EMISSION 2 FUSE 15A
FAN 1 FUSE 30A
FAN 2 FUSE 30A
FAN 1 RELAY
FAN 2 RELAY
FAN 3 RELAY
(LATE PRODUCTION) LEFT COOLING FAN DIODE
(LATE PRODUCTION) RIGHT COOLING FAN DIODE
H7
C1
F2
E1
E2
C3
C7
C1
D1
C3
DK GRN
WHT
GRY
BLK
DK BLU
LT BLU
① 5.3L
② EXCEPT 5.3L
① ②
HIGH SPD
56 54 DK BLU 473
C1 C1
LOW SPD
36 49 DK GRN 335
DATA BUS +
1 53 TAN/BLK 2500
DATA BUS -
2 33 TAN 2501
C1 C3
COMPUTER DATA LINES SYSTEM
ECT SENS SIG
55 55 YEL 410
LOW REF
52 35 TAN 2761
C2 C3
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
G100 (BEHIND RIGHT HEADLAMP, ON FRAME)
ORG/BLK (OR TAN)
YEL
A
B
ENGINE COOLANT TEMPERATURE (ECT) SENSOR (5.3L: LEFT FRONT OF ENGINE AT CYLINDER 1) (EXCEPT 5.3L: LEFT SIDE OF FRONT CYLINDER HEAD)
B WHT
A GRY
M
LEFT COOLING FAN (FRONT OF ENGINE COMPT, MOUNTED TO LEFT SIDE OF RADIATOR)
A BLK
B LT BLU
M
RIGHT COOLING FAN (MOUNTED TO RIGHT SIDE OF RADIATOR)
232766

Fig. 12: Cooling Fan Circuit

CRUISE CONTROL

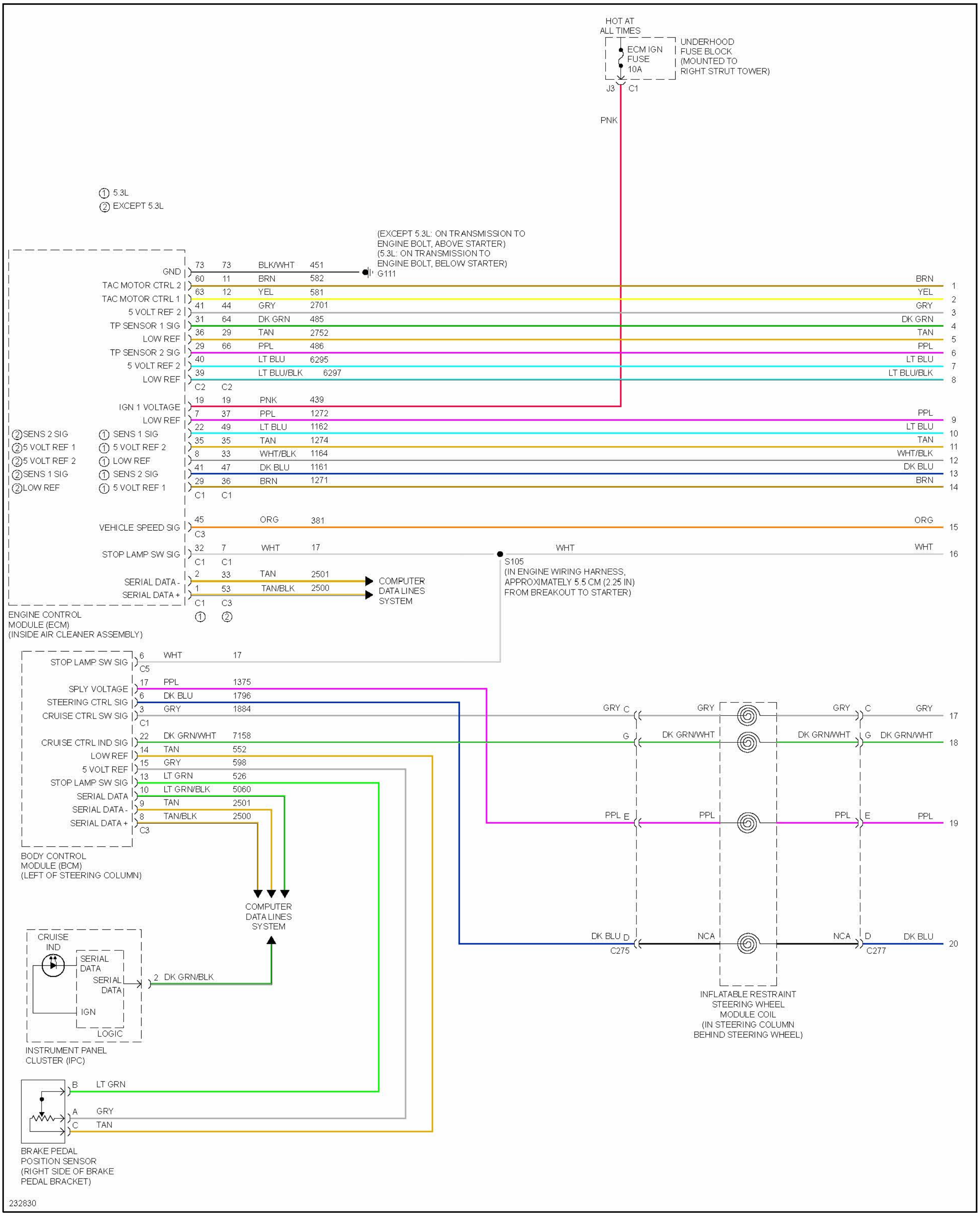

HOT AT ALL TIMES
ECM IGN FUSE 10A
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
J3 C1
PNK
① 5.3L
② EXCEPT 5.3L
(EXCEPT 5.3L: ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER) (5.3L: ON TRANSMISSION TO ENGINE BOLT, BELOW STARTER) G111
GND 73 73 BLK/WHT 451
TAC MOTOR CTRL 2 60 11 BRN 582 BRN 1
TAC MOTOR CTRL 1 63 12 YEL 581 YEL 2
5 VOLT REF 2 41 44 GRY 2701 GRY 3
TP SENSOR 1 SIG 31 64 DK GRN 485 DK GRN 4
LOW REF 36 29 TAN 2752 TAN 5
TP SENSOR 2 SIG 29 66 PPL 486 PPL 6
5 VOLT REF 2 40 LT BLU 6295 LT BLU 7
LOW REF 39 LT BLU/BLK 6297 LT BLU/BLK 8
C2 C2
IGN 1 VOLTAGE 19 19 PNK 439
LOW REF 7 37 PPL 1272 PPL 9
②SENS 2 SIG ①SENS 1 SIG 22 49 LT BLU 1162 LT BLU 10
②5 VOLT REF 1 ①5 VOLT REF 2 35 35 TAN 1274 TAN 11
②5 VOLT REF 2 ①LOW REF 8 33 WHT/BLK 1164 WHT/BLK 12
②SENS 1 SIG ①SENS 2 SIG 41 47 DK BLU 1161 DK BLU 13
②LOW REF ①5 VOLT REF 1 29 36 BRN 1271 BRN 14
C1 C1
VEHICLE SPEED SIG 45 ORG 381 ORG 15
C3
STOP LAMP SW SIG 32 7 WHT 17 WHT WHT 16
C1 C1
S105 (IN ENGINE WIRING HARNESS, APPROXIMATELY 5.5 CM (2.25 IN) FROM BREAKOUT TO STARTER)
SERIAL DATA - 2 33 TAN 2501
SERIAL DATA + 1 53 TAN/BLK 2500
COMPUTER DATA LINES SYSTEM
C1 C3
① ②
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
STOP LAMP SW SIG 6 WHT 17
C5
SPLY VOLTAGE 17 PPL 1375
STEERING CTRL SIG 6 DK BLU 1796
CRUISE CTRL SW SIG 3 GRY 1884
C1
CRUISE CTRL IND SIG 22 DK GRN/WHT 7158
LOW REF 14 TAN 552
5 VOLT REF 15 GRY 598
STOP LAMP SW SIG 13 LT GRN 526
SERIAL DATA 10 LT GRN/BLK 5060
SERIAL DATA - 9 TAN 2501
SERIAL DATA + 8 TAN/BLK 2500
C3
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
GRY C GRY GRY C GRY 17
G DK GRN/WHT DK GRN/WHT G DK GRN/WHT 18
PPL E PPL PPL E PPL 19
DK BLU D NCA NCA D DK BLU 20
C275 C277
INFLATABLE RESTRAINT STEERING WHEEL MODULE COIL (IN STEERING COLUMN BEHIND STEERING WHEEL)
COMPUTER DATA LINES SYSTEM
CRUISE IND
SERIAL DATA
SERIAL DATA
IGN
LOGIC
2 DK GRN/BLK
INSTRUMENT PANEL CLUSTER (IPC)
B LT GRN
A GRY
C TAN
BRAKE PEDAL POSITION SENSOR (RIGHT SIDE OF BRAKE PEDAL BRACKET)
232830

Fig. 13: Cruise Control Circuit (1 of 2)

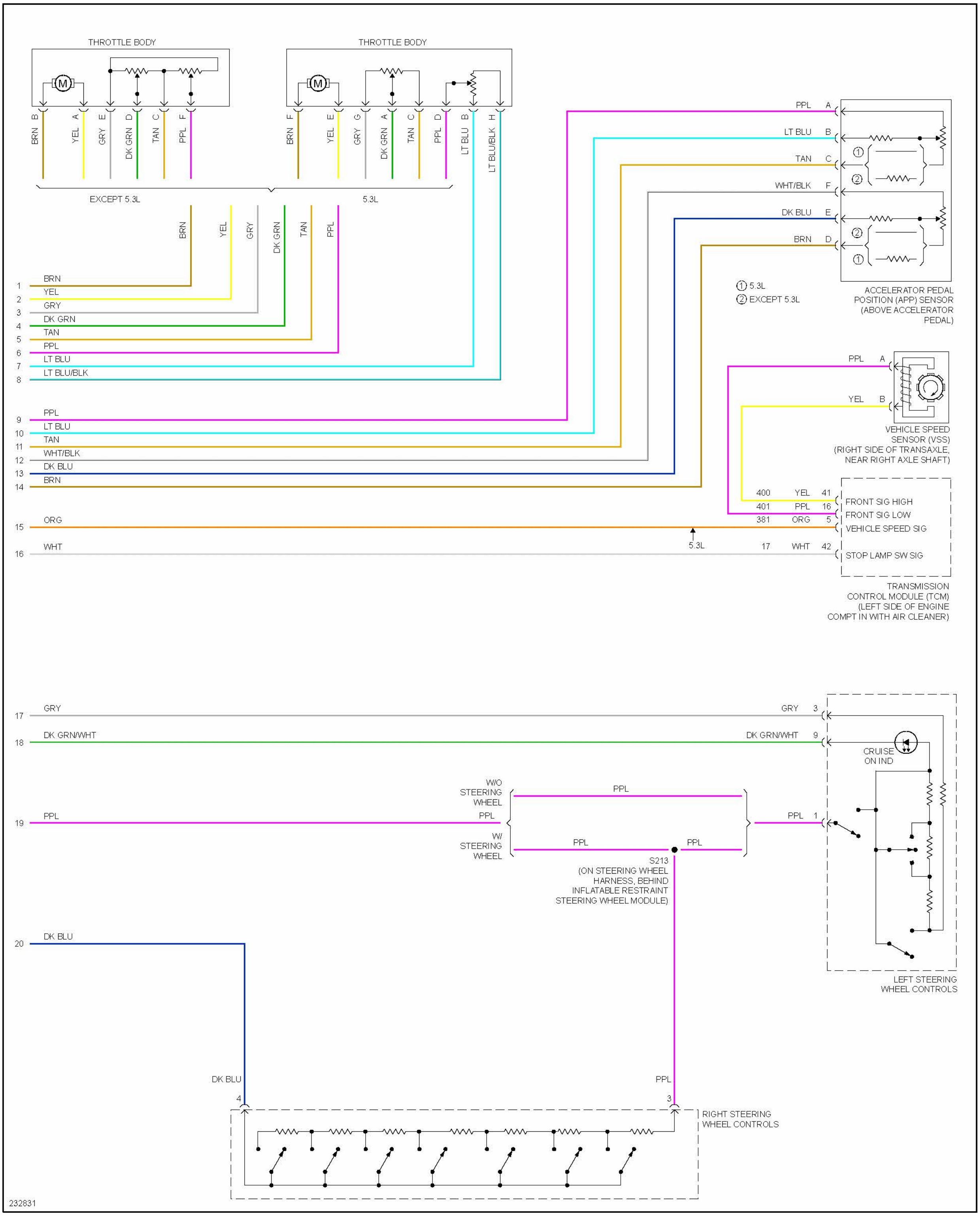

THROTTLE BODY
THROTTLE BODY
M
BRN B
YEL A
GRY E
DK GRN D
TAN C
PPL F
BRN F
YEL E
GRY G
DK GRN A
TAN C
PPL D
LT BLU B
LT BLU/BLK H
EXCEPT 5.3L
5.3L
BRN
YEL
GRY
DK GRN
TAN
PPL
1 BRN
2 YEL
3 GRY
4 DK GRN
5 TAN
6 PPL
7 LT BLU
8 LT BLU/BLK
9 PPL
10 LT BLU
11 TAN
12 WHT/BLK
13 DK BLU
14 BRN
15 ORG
16 WHT
17 GRY
18 DK GRN/WHT
19 PPL
20 DK BLU
PPL A
LT BLU B
TAN C
WHT/BLK F
DK BLU E
BRN D
① 5.3L
② EXCEPT 5.3L
ACCELERATOR PEDAL POSITION (APP) SENSOR (ABOVE ACCELERATOR PEDAL)
PPL A
YEL B
VEHICLE SPEED SENSOR (VSS) (RIGHT SIDE OF TRANSAXLE, NEAR RIGHT AXLE SHAFT)
400 YEL 41 FRONT SIG HIGH
401 PPL 16 FRONT SIG LOW
381 ORG 5 VEHICLE SPEED SIG
5.3L
17 WHT 42 STOP LAMP SW SIG
TRANSMISSION CONTROL MODULE (TCM) (LEFT SIDE OF ENGINE COMPT IN WITH AIR CLEANER)
GRY 3
DK GRN/WHT 9
CRUISE ON IND
W/O STEERING WHEEL
PPL
PPL
W/ STEERING WHEEL
PPL
PPL
PPL 1
S213 (ON STEERING WHEEL HARNESS, BEHIND INFLATABLE RESTRAINT STEERING WHEEL MODULE)
LEFT STEERING WHEEL CONTROLS
DK BLU 4
PPL 3
RIGHT STEERING WHEEL CONTROLS
232831

Fig. 14: Cruise Control Circuit (2 of 2)

DEFOGGERS

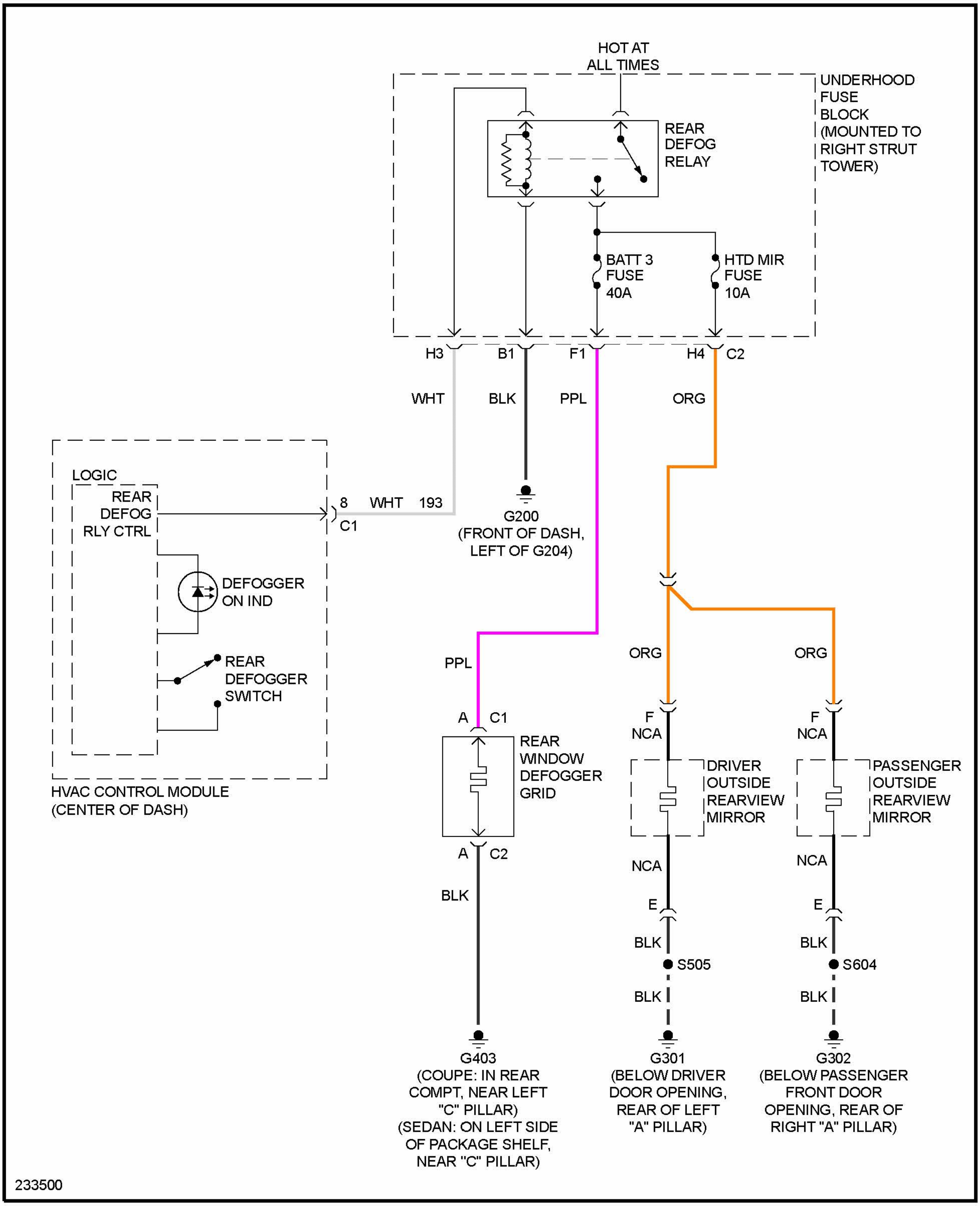

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
REAR DEFOG RELAY
BATT 3 FUSE 40A
HTD MIR FUSE 10A
H3
B1
F1
H4
C2
WHT
BLK
PPL
ORG
LOGIC
REAR DEFOG RLY CTRL
8
WHT
193
C1
DEFOGGER ON IND
REAR DEFOGGER SWITCH
HVAC CONTROL MODULE (CENTER OF DASH)
G200 (FRONT OF DASH, LEFT OF G204)
PPL
A
C1
REAR WINDOW DEFOGGER GRID
A
C2
BLK
G403 (COUPE: IN REAR COMPT, NEAR LEFT "C" PILLAR) (SEDAN: ON LEFT SIDE OF PACKAGE SHELF, NEAR "C" PILLAR)
ORG
F
NCA
DRIVER OUTSIDE REARVIEW MIRROR
NCA
E
BLK
S505
BLK
G301 (BELOW DRIVER DOOR OPENING, REAR OF LEFT "A" PILLAR)
ORG
F
NCA
PASSENGER OUTSIDE REARVIEW MIRROR
NCA
E
BLK
S604
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT "A" PILLAR)
233500

Fig. 15: Defoggers Circuit

ENGINE PERFORMANCE

3.5L VIN K

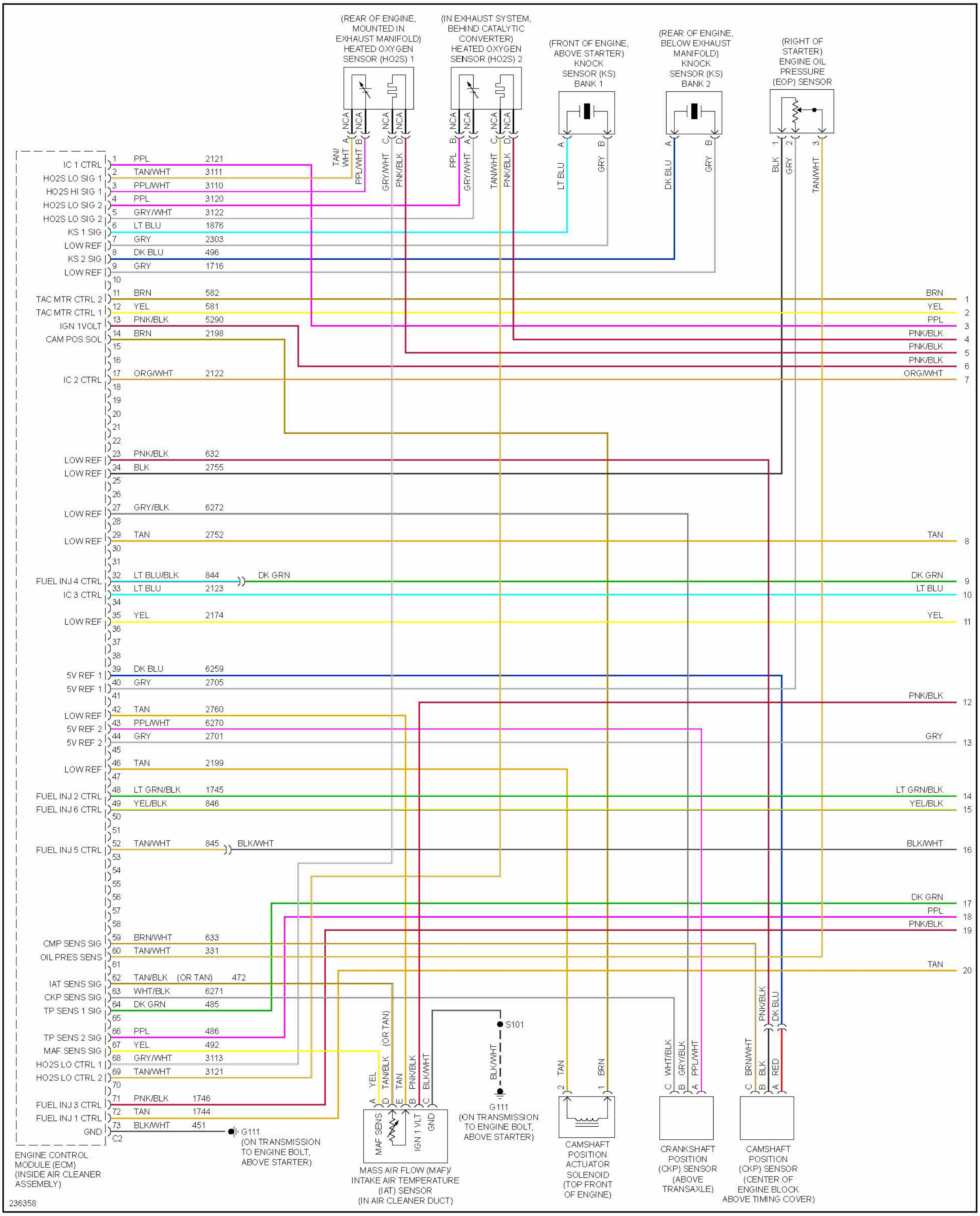

(REAR OF ENGINE, MOUNTED IN EXHAUST MANIFOLD) HEATED OXYGEN SENSOR (HO2S) 1
(IN EXHAUST SYSTEM, BEHIND CATALYTIC CONVERTER) HEATED OXYGEN SENSOR (HO2S) 2
(FRONT OF ENGINE, ABOVE STARTER) KNOCK SENSOR (KS) BANK 1
(REAR OF ENGINE, BELOW EXHAUST MANIFOLD) KNOCK SENSOR (KS) BANK 2
(RIGHT OF STARTER) ENGINE OIL PRESSURE (EOP) SENSOR
NCA
TAN/WHT
PPL/WHT
GRY/WHT
PNK/BLK
PPL
TAN/WHT
LT BLU
GRY
DK BLU
BLK
TAN/WHT
1 PPL 2121 IC 1 CTRL
2 TAN/WHT 3111 HO2S LO SIG 1
3 PPL/WHT 3110 HO2S HI SIG 1
4 PPL 3120 HO2S LO SIG 2
5 GRY/WHT 3122 HO2S LO SIG 2
6 LT BLU 1876 KS 1 SIG
7 GRY 2303 LOW REF
8 DK BLU 496 KS 2 SIG
9 GRY 1716 LOW REF
10
11 BRN 582 TAC MTR CTRL 2
12 YEL 581 TAC MTR CTRL 1
13 PNK/BLK 5290 IGN 1VOLT
14 BRN 2198 CAM POS SOL
15
16
17 ORG/WHT 2122 IC 2 CTRL
18
19
20
21
22
23 PNK/BLK 632 LOW REF
24 BLK 2755 LOW REF
25
26
27 GRY/BLK 6272 LOW REF
28
29 TAN 2752 LOW REF
30
31
32 LT BLU/BLK 844 DK GRN FUEL INJ 4 CTRL
33 LT BLU 2123 IC 3 CTRL
34
35 YEL 2174 LOW REF
36
37
38
39 DK BLU 6259 5V REF 1
40 GRY 2705 5V REF 1
41
42 TAN 2760 LOW REF
43 PPL/WHT 6270 5V REF 2
44 GRY 2701 5V REF 2
45
46 TAN 2199 LOW REF
47
48 LT GRN/BLK 1745 FUEL INJ 2 CTRL
49 YEL/BLK 846 FUEL INJ 6 CTRL
50
51
52 TAN/WHT 845 BLK/WHT FUEL INJ 5 CTRL
53
54
55
56
57
58
59 BRN/WHT 633 CMP SENS SIG
60 TAN/WHT 331 OIL PRES SENS
61
62 TAN/BLK (OR TAN) 472 IAT SENS SIG
63 WHT/BLK 6271 CKP SENS SIG
64 DK GRN 485 TP SENS 1 SIG
65
66 PPL 486 TP SENS 2 SIG
67 YEL 492 MAF SENS SIG
68 GRY/WHT 3113 HO2S LO CTRL 1
69 TAN/WHT 3121 HO2S LO CTRL 2
70
71 PNK/BLK 1746 FUEL INJ 3 CTRL
72 TAN 1744 FUEL INJ 1 CTRL
73 BLK/WHT 451 GND
C2
BRN 1
YEL 2
PPL 3
PNK/BLK 4
PNK/BLK 5
PNK/BLK 6
ORG/WHT 7
TAN 8
DK GRN 9
LT BLU 10
YEL 11
PNK/BLK 12
GRY 13
LT GRN/BLK 14
YEL/BLK 15
BLK/WHT 16
DK GRN 17
PPL 18
PNK/BLK 19
TAN 20
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
G111 (ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER)
S101
BLK/WHT
G111 (ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER)
YEL TAN/BLK (OR TAN) TAN PNK/BLK BLK/WHT
A D E B C
MAF SENS IGN 1 VLT GND
MASS AIR FLOW (MAF)/ INTAKE AIR TEMPERATURE (IAT) SENSOR (IN AIR CLEANER DUCT)
TAN BRN
2 1
CAMSHAFT POSITION ACTUATOR SOLENOID (TOP FRONT OF ENGINE)
WHT/BLK GRY/BLK PPL/WHT
C B A
CRANKSHAFT POSITION (CKP) SENSOR (ABOVE TRANSAXLE)
BRN/WHT BLK RED
PNK/BLK DK BLU
C B A
CAMSHAFT POSITION (CKP) SENSOR (CENTER OF ENGINE BLOCK ABOVE TIMING COVER)
236358

Fig. 16: 3.5L VIN K, Engine Performance Circuit (1 of 4)

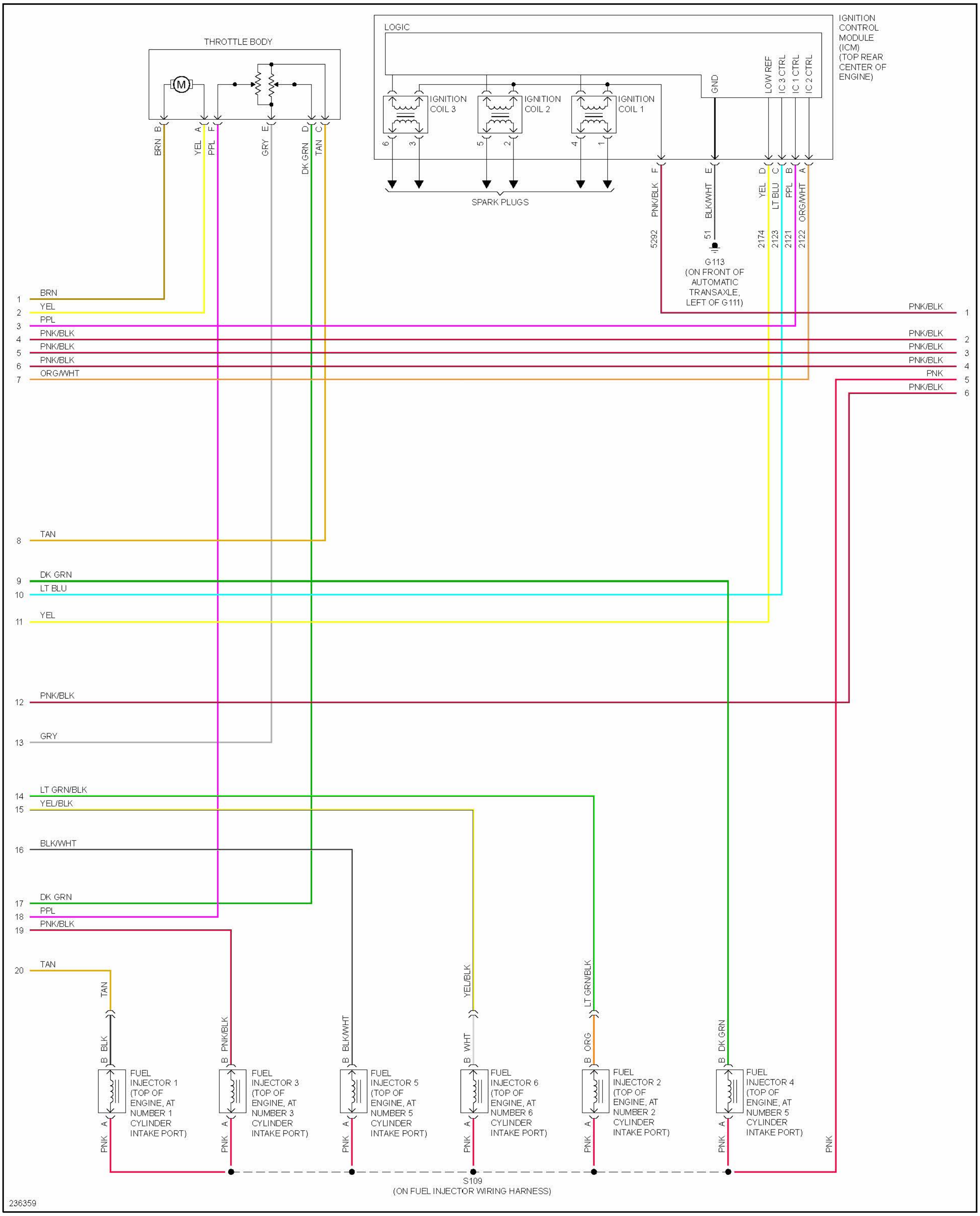

THROTTLE BODY
M
B BRN
A YEL
F PPL
E GRY
D DK GRN
C TAN
LOGIC
IGNITION CONTROL MODULE (ICM) (TOP REAR CENTER OF ENGINE)
IGNITION COIL 3
IGNITION COIL 2
IGNITION COIL 1
6 3 5 2 4 1
SPARK PLUGS
GND
LOW REF
IC 3 CTRL
IC 1 CTRL
IC 2 CTRL
F PNK/BLK 5292
E BLK/WHT 51
D YEL 2174
C LT BLU 2123
B PPL 2121
A ORG/WHT 2122
G113 (ON FRONT OF AUTOMATIC TRANSAXLE, LEFT OF G111)
1 BRN
2 YEL
3 PPL
4 PNK/BLK
5 PNK/BLK
6 PNK/BLK
7 ORG/WHT
8 TAN
9 DK GRN
10 LT BLU
11 YEL
12 PNK/BLK
13 GRY
14 LT GRN/BLK
15 YEL/BLK
16 BLK/WHT
17 DK GRN
18 PPL
19 PNK/BLK
20 TAN
PNK/BLK 1
PNK/BLK 2
PNK/BLK 3
PNK/BLK 4
PNK 5
PNK/BLK 6
TAN
B BLK
A PNK
FUEL INJECTOR 1 (TOP OF ENGINE, AT NUMBER 1 CYLINDER INTAKE PORT)
B PNK/BLK
A PNK
FUEL INJECTOR 3 (TOP OF ENGINE, AT NUMBER 3 CYLINDER INTAKE PORT)
B BLK/WHT
A PNK
FUEL INJECTOR 5 (TOP OF ENGINE, AT NUMBER 5 CYLINDER INTAKE PORT)
YEL/BLK
B WHT
A PNK
FUEL INJECTOR 6 (TOP OF ENGINE, AT NUMBER 6 CYLINDER INTAKE PORT)
LT GRN/BLK
B ORG
A PNK
FUEL INJECTOR 2 (TOP OF ENGINE, AT NUMBER 2 CYLINDER INTAKE PORT)
B DK GRN
A PNK
FUEL INJECTOR 4 (TOP OF ENGINE, AT NUMBER 5 CYLINDER INTAKE PORT)
PNK
S109 (ON FUEL INJECTOR WIRING HARNESS)
236359

Fig. 17: 3.5L VIN K, Engine Performance Circuit (2 of 4)

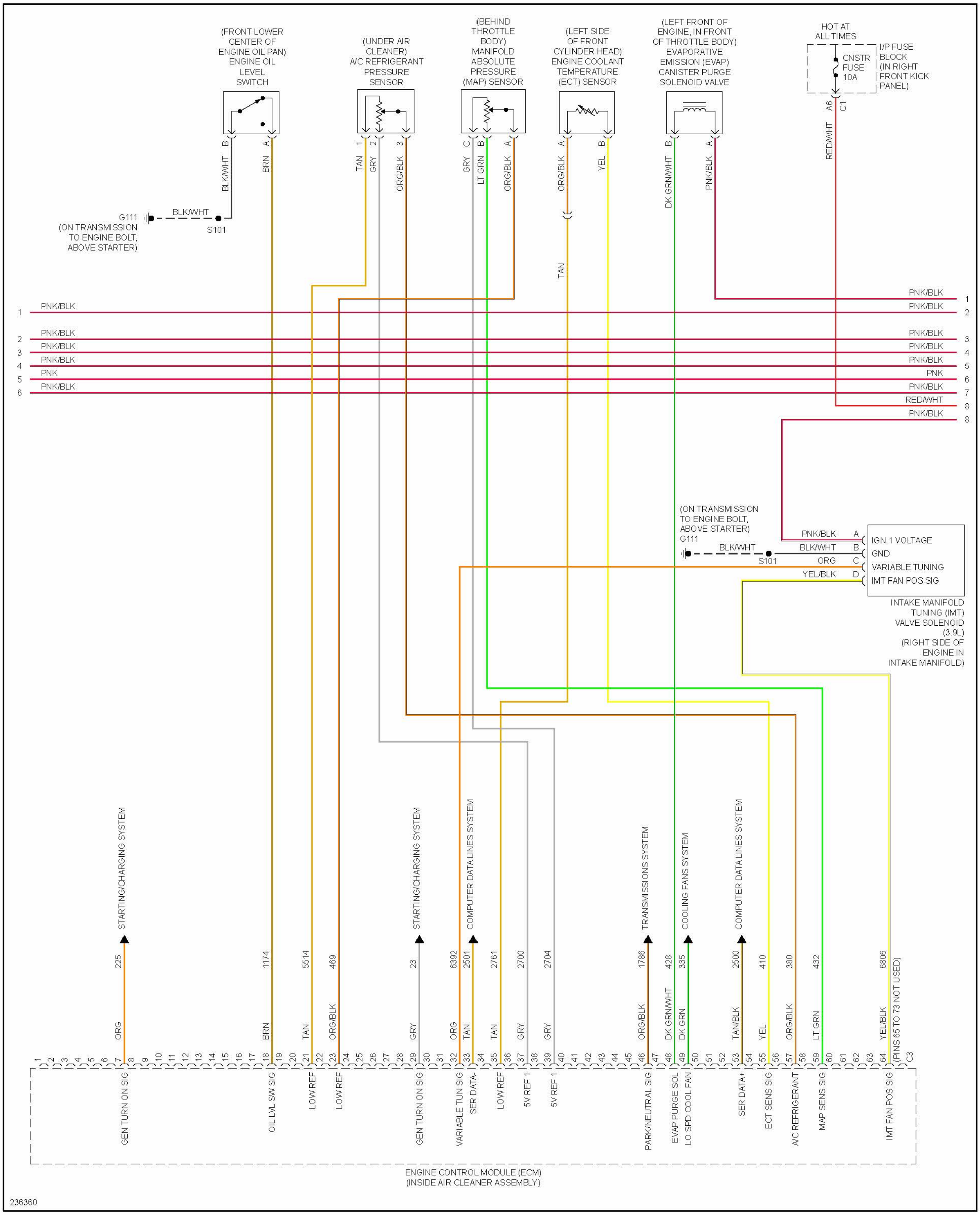

(FRONT LOWER CENTER OF ENGINE OIL PAN) ENGINE OIL LEVEL SWITCH
(UNDER AIR CLEANER) A/C REFRIGERANT PRESSURE SENSOR
(BEHIND THROTTLE BODY) MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR
(LEFT SIDE OF FRONT CYLINDER HEAD) ENGINE COOLANT TEMPERATURE (ECT) SENSOR
(LEFT FRONT OF ENGINE, IN FRONT OF THROTTLE BODY) EVAPORATIVE EMISSION (EVAP) CANISTER PURGE SOLENOID VALVE
HOT AT ALL TIMES
CNSTR FUSE 10A
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
A6
C1
RED/WHT
B
A
BLK/WHT
BRN
1
2
3
TAN
GRY
ORG/BLK
C
B
A
GRY
LT GRN
ORG/BLK
A
B
ORG/BLK
YEL
TAN
B
A
DK GRN/WHT
PNK/BLK
G111
BLK/WHT
S101
(ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER)
1 PNK/BLK
2 PNK/BLK
3 PNK/BLK
4 PNK/BLK
5 PNK
6 PNK/BLK
PNK/BLK 1
PNK/BLK 2
PNK/BLK 3
PNK/BLK 4
PNK/BLK 5
PNK 6
PNK/BLK 7
RED/WHT 8
PNK/BLK 8
(ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER)
G111
BLK/WHT
S101
PNK/BLK A
BLK/WHT B
ORG C
YEL/BLK D
IGN 1 VOLTAGE
GND
VARIABLE TUNING
IMT FAN POS SIG
INTAKE MANIFOLD TUNING (IMT) VALVE SOLENOID (3.9L) (RIGHT SIDE OF ENGINE IN INTAKE MANIFOLD)
STARTING/CHARGING SYSTEM
STARTING/CHARGING SYSTEM
COMPUTER DATA LINES SYSTEM
TRANSMISSIONS SYSTEM
COOLING FANS SYSTEM
COMPUTER DATA LINES SYSTEM
225
1174
5514
469
23
6392
2501
2761
2700
2704
1786
428
335
2500
410
380
432
6806
ORG
BRN
TAN
ORG/BLK
GRY
ORG
TAN
TAN
GRY
GRY
ORG/BLK
DK GRN/WHT
DK GRN
TAN/BLK
YEL
ORG/BLK
LT GRN
YEL/BLK
(PINS 65 TO 73 NOT USED)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64
C3
GEN TURN ON SIG
OIL LVL SW SIG
LOW REF
LOW REF
GEN TURN ON SIG
VARIABLE TUN SIG
SER DATA-
LOW REF
5V REF 1
5V REF 1
PARK/NEUTRAL SIG
EVAP PURGE SOL
LO SPD COOL FAN
SER DATA+
ECT SENS SIG
A/C REFRIGERANT
MAP SENS SIG
IMT FAN POS SIG
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
236360

Fig. 18: 3.5L VIN K, Engine Performance Circuit (3 of 4)

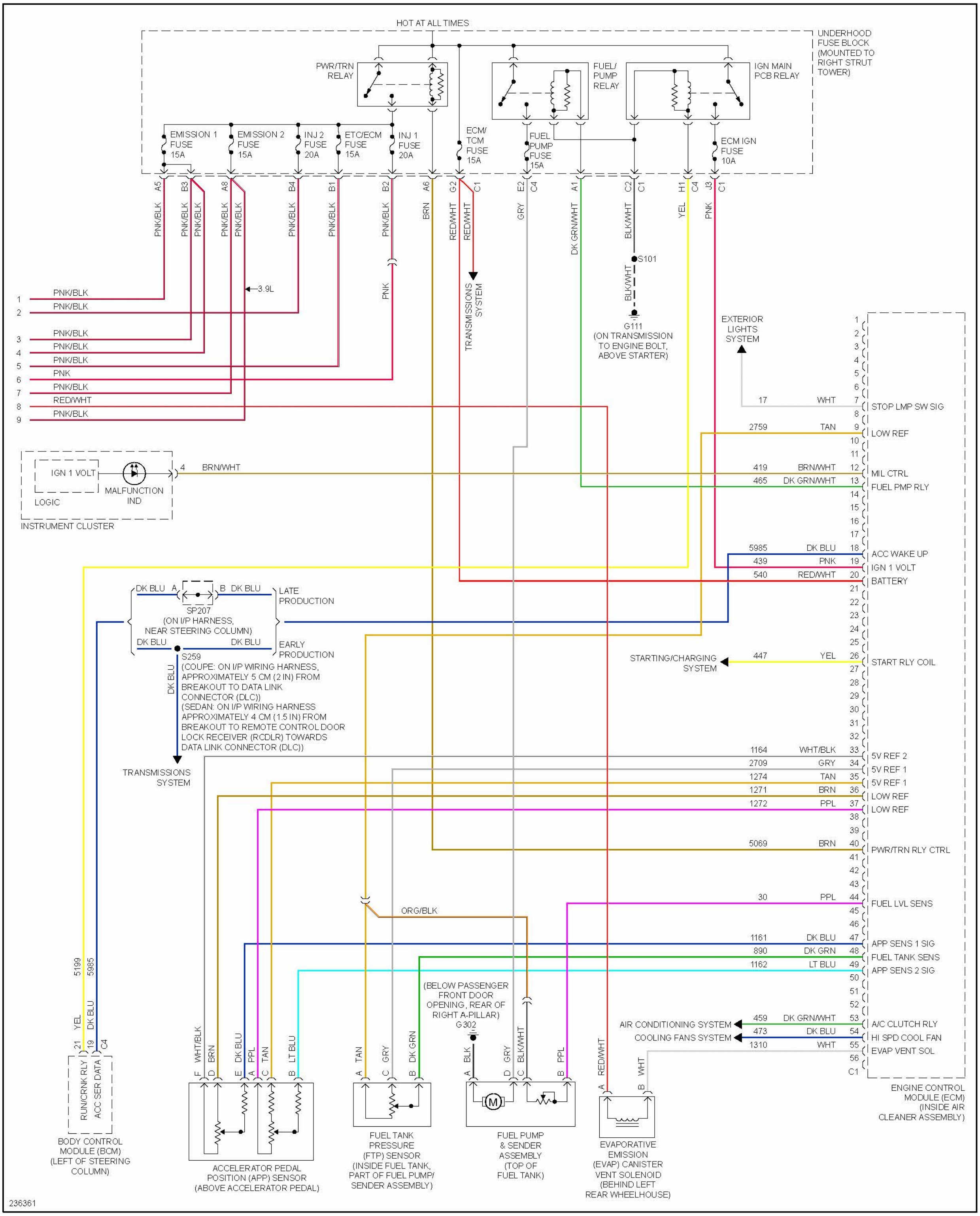

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
PWR/TRN RELAY
FUEL/ PUMP RELAY
IGN MAIN PCB RELAY
EMISSION 1 FUSE 15A
EMISSION 2 FUSE 15A
INJ 2 FUSE 20A
ETC/ECM FUSE 15A
INJ 1 FUSE 20A
ECM/ TCM FUSE 15A
FUEL PUMP FUSE 15A
ECM IGN FUSE 10A
A5 B3 A8 B4 B1 B2 A6 G2 C1 E2 C4 A1 C2 C1 H1 C4 J3 C1
PNK/BLK
RED/WHT
BRN
GRY
DK GRN/WHT
BLK/WHT
YEL
PNK
3.9L
TRANSMISSIONS SYSTEM
S101
G111 (ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER)
EXTERIOR LIGHTS SYSTEM
1 PNK/BLK
2 PNK/BLK
3 PNK/BLK
4 PNK/BLK
5 PNK/BLK
6 PNK
7 PNK/BLK
8 RED/WHT
9 PNK/BLK
IGN 1 VOLT
MALFUNCTION IND
LOGIC
INSTRUMENT CLUSTER
4 BRN/WHT
17 WHT 7 STOP LMP SW SIG
2759 TAN 9 LOW REF
419 BRN/WHT 12 MIL CTRL
465 DK GRN/WHT 13 FUEL PMP RLY
5985 DK BLU 18 ACC WAKE UP
439 PNK 19 IGN 1 VOLT
540 RED/WHT 20 BATTERY
447 YEL 26 START RLY COIL
STARTING/CHARGING SYSTEM
1164 WHT/BLK 33 5V REF 2
2709 GRY 34 5V REF 1
1274 TAN 35 5V REF 1
1271 BRN 36 LOW REF
1272 PPL 37 LOW REF
5069 BRN 40 PWR/TRN RLY CTRL
30 PPL 44 FUEL LVL SENS
1161 DK BLU 47 APP SENS 1 SIG
890 DK GRN 48 FUEL TANK SENS
1162 LT BLU 49 APP SENS 2 SIG
459 DK GRN/WHT 53 A/C CLUTCH RLY
473 DK BLU 54 HI SPD COOL FAN
1310 WHT 55 EVAP VENT SOL
AIR CONDITIONING SYSTEM
COOLING FANS SYSTEM
C1
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
DK BLU A SP207 B DK BLU
LATE PRODUCTION
(ON I/P HARNESS, NEAR STEERING COLUMN)
DK BLU DK BLU
EARLY PRODUCTION
S259
(COUPE: ON I/P WIRING HARNESS, APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO DATA LINK CONNECTOR (DLC))
(SEDAN: ON I/P WIRING HARNESS APPROXIMATELY 4 CM (1.5 IN) FROM BREAKOUT TO REMOTE CONTROL DOOR LOCK RECEIVER (RCDLR) TOWARDS DATA LINK CONNECTOR (DLC))
DK BLU
TRANSMISSIONS SYSTEM
ORG/BLK
(BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
G302
5199 YEL 21
5985 DK BLU 19
C4
RUN/CRNK RLY
ACC SER DATA
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
WHT/BLK BRN DK BLU PPL TAN LT BLU
F D E A C B
ACCELERATOR PEDAL POSITION (APP) SENSOR (ABOVE ACCELERATOR PEDAL)
TAN GRY DK GRN
A C B
FUEL TANK PRESSURE (FTP) SENSOR (INSIDE FUEL TANK, PART OF FUEL PUMP/ SENDER ASSEMBLY)
BLK GRY BLK/WHT PPL
A D C B
M
FUEL PUMP & SENDER ASSEMBLY (TOP OF FUEL TANK)
RED/WHT WHT
A B
EVAPORATIVE EMISSION (EVAP) CANISTER VENT SOLENOID (BEHIND LEFT REAR WHEELHOUSE)
236361

Fig. 19: 3.5L VIN K, Engine Performance Circuit (4 of 4)

3.9L VIN 1

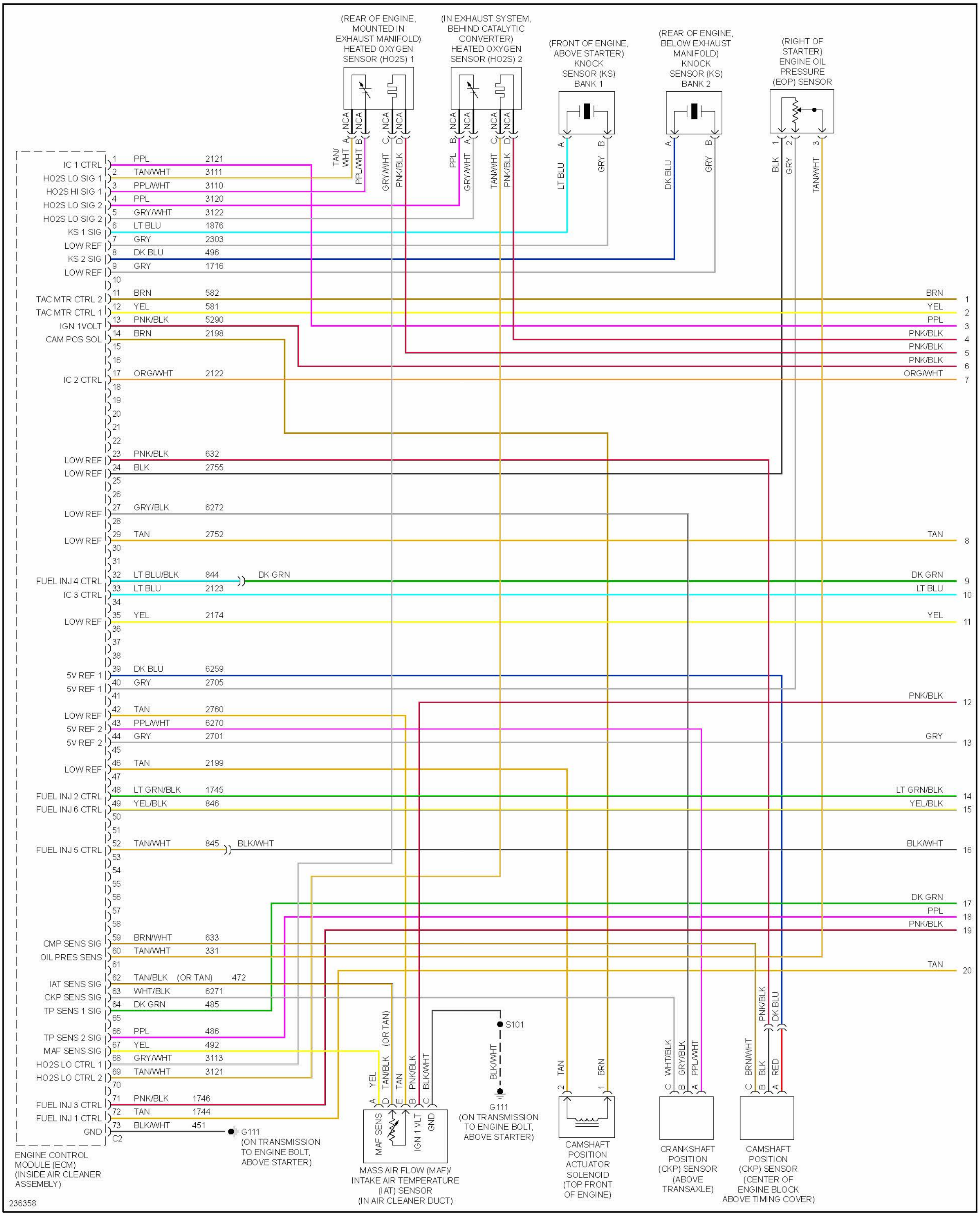

(REAR OF ENGINE, MOUNTED IN EXHAUST MANIFOLD) HEATED OXYGEN SENSOR (HO2S) 1
(IN EXHAUST SYSTEM, BEHIND CATALYTIC CONVERTER) HEATED OXYGEN SENSOR (HO2S) 2
(FRONT OF ENGINE, ABOVE STARTER) KNOCK SENSOR (KS) BANK 1
(REAR OF ENGINE, BELOW EXHAUST MANIFOLD) KNOCK SENSOR (KS) BANK 2
(RIGHT OF STARTER) ENGINE OIL PRESSURE (EOP) SENSOR
NCA
A TAN/WHT
B PPL/WHT
C GRY/WHT
D PNK/BLK
B PPL
A GRY/WHT
C TAN/WHT
D PNK/BLK
A LT BLU
B GRY
A DK BLU
B GRY
1 BLK
2 GRY
3 TAN/WHT
IC 1 CTRL 1 PPL 2121
HO2S LO SIG 1 2 TAN/WHT 3111
HO2S HI SIG 1 3 PPL/WHT 3110
HO2S LO SIG 2 4 PPL 3120
HO2S LO SIG 2 5 GRY/WHT 3122
KS 1 SIG 6 LT BLU 1876
LOW REF 7 GRY 2303
KS 2 SIG 8 DK BLU 496
LOW REF 9 GRY 1716
10
11 BRN 582
TAC MTR CTRL 2 12 YEL 581
TAC MTR CTRL 1 13 PNK/BLK 5290
IGN 1VOLT 14 BRN 2198
CAM POS SOL 15
16
17 ORG/WHT 2122
IC 2 CTRL 18
19
20
21
22
LOW REF 23 PNK/BLK 632
LOW REF 24 BLK 2755
25
26
LOW REF 27 GRY/BLK 6272
28
LOW REF 29 TAN 2752
30
31
FUEL INJ 4 CTRL 32 LT BLU/BLK 844 DK GRN
IC 3 CTRL 33 LT BLU 2123
34
LOW REF 35 YEL 2174
36
37
38
5V REF 1 39 DK BLU 6259
5V REF 1 40 GRY 2705
41
LOW REF 42 TAN 2760
5V REF 2 43 PPL/WHT 6270
5V REF 2 44 GRY 2701
45
LOW REF 46 TAN 2199
47
FUEL INJ 2 CTRL 48 LT GRN/BLK 1745
FUEL INJ 6 CTRL 49 YEL/BLK 846
50
51
FUEL INJ 5 CTRL 52 TAN/WHT 845 BLK/WHT
53
54
55
56
57
58
CMP SENS SIG 59 BRN/WHT 633
OIL PRES SENS 60 TAN/WHT 331
61
IAT SENS SIG 62 TAN/BLK (OR TAN) 472
CKP SENS SIG 63 WHT/BLK 6271
TP SENS 1 SIG 64 DK GRN 485
65
TP SENS 2 SIG 66 PPL 486
MAF SENS SIG 67 YEL 492
HO2S LO CTRL 1 68 GRY/WHT 3113
HO2S LO CTRL 2 69 TAN/WHT 3121
70
FUEL INJ 3 CTRL 71 PNK/BLK 1746
FUEL INJ 1 CTRL 72 TAN 1744
GND 73 BLK/WHT 451
C2
G111 (ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER)
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
BRN 1
YEL 2
PPL 3
PNK/BLK 4
PNK/BLK 5
PNK/BLK 6
ORG/WHT 7
TAN 8
DK GRN 9
LT BLU 10
YEL 11
PNK/BLK 12
GRY 13
LT GRN/BLK 14
YEL/BLK 15
BLK/WHT 16
DK GRN 17
PPL 18
PNK/BLK 19
TAN 20
S101
BLK/WHT
G111 (ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER)
A YEL
D TAN/BLK (OR TAN)
E TAN
B PNK/BLK
C BLK/WHT
MAF SENS
IGN 1 VLT
GND
MASS AIR FLOW (MAF)/ INTAKE AIR TEMPERATURE (IAT) SENSOR (IN AIR CLEANER DUCT)
2 TAN
1 BRN
CAMSHAFT POSITION ACTUATOR SOLENOID (TOP FRONT OF ENGINE)
C WHT/BLK
B GRY/BLK
A PPL/WHT
CRANKSHAFT POSITION (CKP) SENSOR (ABOVE TRANSAXLE)
PNK/BLK
DK BLU
C BRN/WHT
B BLK
A RED
CAMSHAFT POSITION (CKP) SENSOR (CENTER OF ENGINE BLOCK ABOVE TIMING COVER)
236358

Fig. 20: 3.9L VIN 1, Engine Performance Circuit (1 of 4)

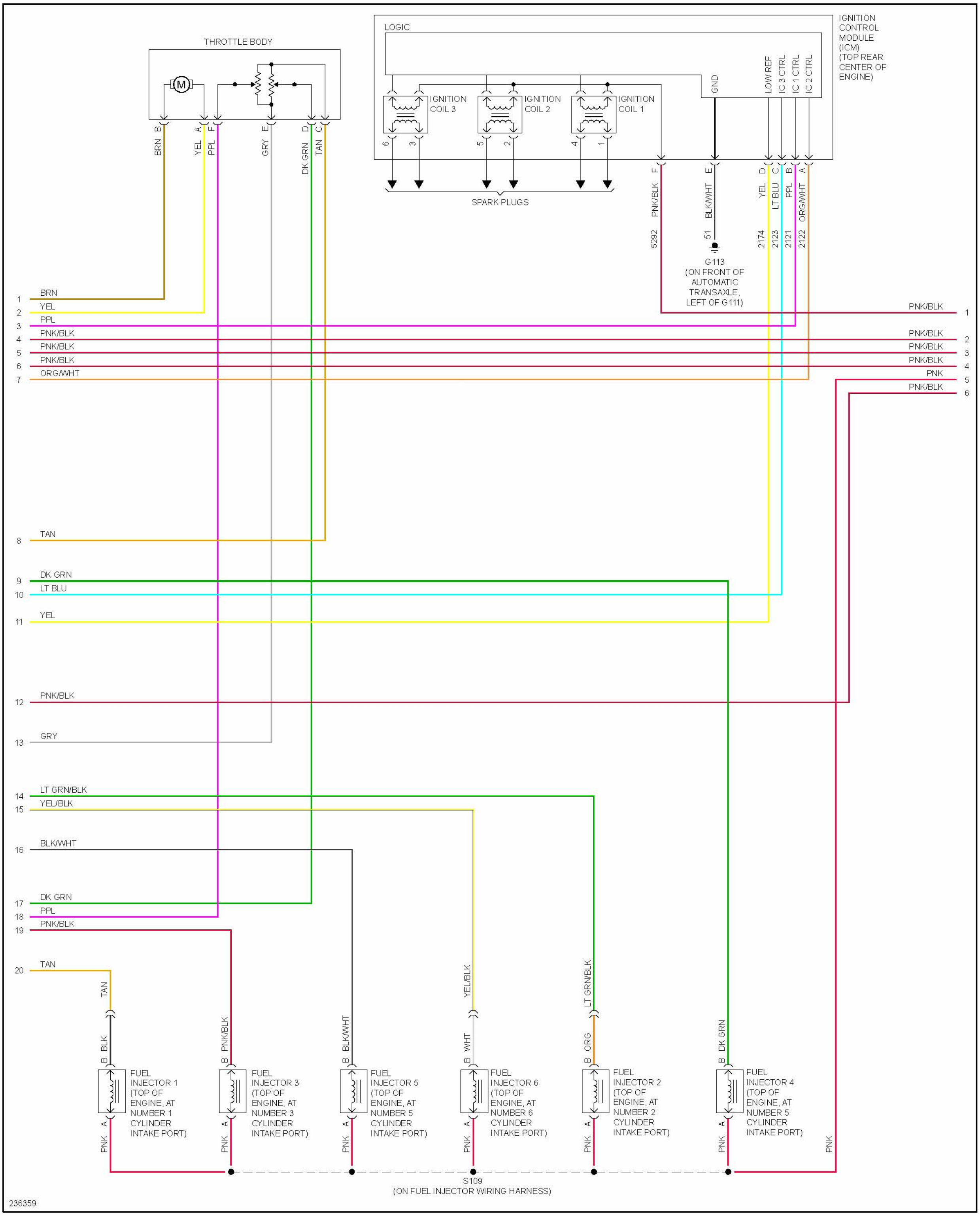

THROTTLE BODY
M
B BRN
A YEL
F PPL
E GRY
D DK GRN
C TAN
LOGIC
IGNITION CONTROL MODULE (ICM) (TOP REAR CENTER OF ENGINE)
IGNITION COIL 3
IGNITION COIL 2
IGNITION COIL 1
6 3 5 2 4 1
SPARK PLUGS
GND
LOW REF
IC 3 CTRL
IC 1 CTRL
IC 2 CTRL
F PNK/BLK 5292
E BLK/WHT 51
D YEL 2174
C LT BLU 2123
B PPL 2121
A ORG/WHT 2122
G113 (ON FRONT OF AUTOMATIC TRANSAXLE, LEFT OF G111)
1 BRN
2 YEL
3 PPL
4 PNK/BLK
5 PNK/BLK
6 PNK/BLK
7 ORG/WHT
8 TAN
9 DK GRN
10 LT BLU
11 YEL
12 PNK/BLK
13 GRY
14 LT GRN/BLK
15 YEL/BLK
16 BLK/WHT
17 DK GRN
18 PPL
19 PNK/BLK
20 TAN
PNK/BLK 1
PNK/BLK 2
PNK/BLK 3
PNK/BLK 4
PNK 5
PNK/BLK 6
TAN
YEL/BLK
LT GRN/BLK
B BLK
B PNK/BLK
B BLK/WHT
B WHT
B ORG
B DK GRN
FUEL INJECTOR 1 (TOP OF ENGINE, AT NUMBER 1 CYLINDER INTAKE PORT)
FUEL INJECTOR 3 (TOP OF ENGINE, AT NUMBER 3 CYLINDER INTAKE PORT)
FUEL INJECTOR 5 (TOP OF ENGINE, AT NUMBER 5 CYLINDER INTAKE PORT)
FUEL INJECTOR 6 (TOP OF ENGINE, AT NUMBER 6 CYLINDER INTAKE PORT)
FUEL INJECTOR 2 (TOP OF ENGINE, AT NUMBER 2 CYLINDER INTAKE PORT)
FUEL INJECTOR 4 (TOP OF ENGINE, AT NUMBER 5 CYLINDER INTAKE PORT)
A PNK
PNK
S109 (ON FUEL INJECTOR WIRING HARNESS)
236359

Fig. 21: 3.9L VIN 1, Engine Performance Circuit (2 of 4)

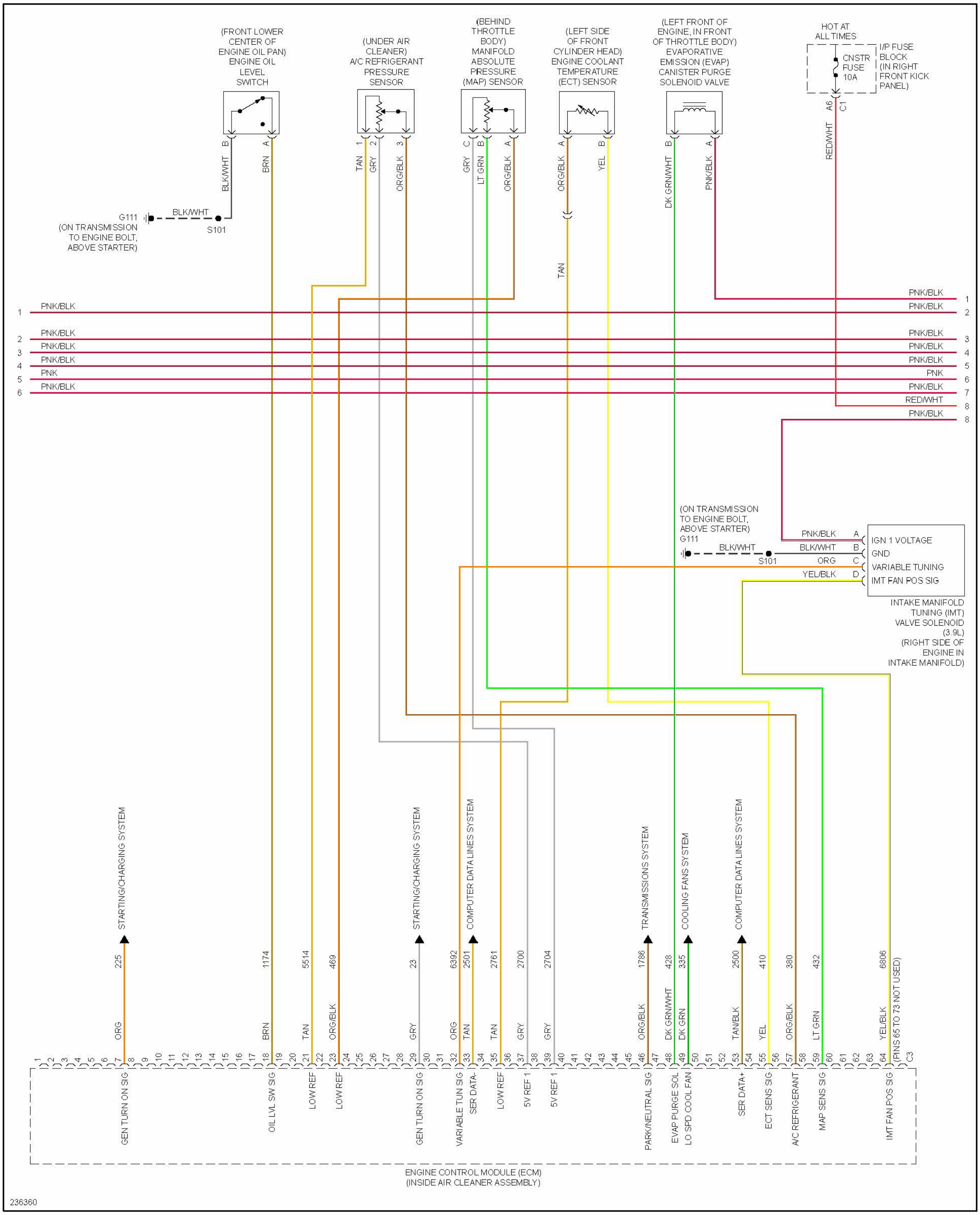

(FRONT LOWER CENTER OF ENGINE OIL PAN) ENGINE OIL LEVEL SWITCH
(UNDER AIR CLEANER) A/C REFRIGERANT PRESSURE SENSOR
(BEHIND THROTTLE BODY) MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR
(LEFT SIDE OF FRONT CYLINDER HEAD) ENGINE COOLANT TEMPERATURE (ECT) SENSOR
(LEFT FRONT OF ENGINE, IN FRONT OF THROTTLE BODY) EVAPORATIVE EMISSION (EVAP) CANISTER PURGE SOLENOID VALVE
HOT AT ALL TIMES
CNSTR FUSE 10A
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
A6 C1
RED/WHT
B A
BLK/WHT BRN
1 2 3
TAN GRY ORG/BLK
C B A
GRY LT GRN ORG/BLK
A B
ORG/BLK YEL
TAN
B A
DK GRN/WHT PNK/BLK
G111 (ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER)
BLK/WHT
S101
1 PNK/BLK
2 PNK/BLK
3 PNK/BLK
4 PNK/BLK
5 PNK
6 PNK/BLK
PNK/BLK 1
PNK/BLK 2
PNK/BLK 3
PNK/BLK 4
PNK/BLK 5
PNK 6
PNK/BLK 7
RED/WHT 8
PNK/BLK 8
(ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER) G111
BLK/WHT
S101
PNK/BLK A
BLK/WHT B
ORG C
YEL/BLK D
IGN 1 VOLTAGE
GND
VARIABLE TUNING
IMT FAN POS SIG
INTAKE MANIFOLD TUNING (IMT) VALVE SOLENOID (3.9L) (RIGHT SIDE OF ENGINE IN INTAKE MANIFOLD)
STARTING/CHARGING SYSTEM
STARTING/CHARGING SYSTEM
COMPUTER DATA LINES SYSTEM
TRANSMISSIONS SYSTEM
COOLING FANS SYSTEM
COMPUTER DATA LINES SYSTEM
225 ORG
1174 BRN
5514 TAN
469 ORG/BLK
23 GRY
6392 ORG
2501 TAN
2761 TAN
2700 GRY
2704 GRY
1786 ORG/BLK
428 DK GRN/WHT
335 DK GRN
2500 TAN/BLK
410 YEL
380 ORG/BLK
432 LT GRN
6806 YEL/BLK
(PINS 65 TO 73 NOT USED)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 C3
GEN TURN ON SIG
OIL LVL SW SIG
LOW REF
LOW REF
GEN TURN ON SIG
VARIABLE TUN SIG
SER DATA-
LOW REF
5V REF 1
5V REF 1
PARK/NEUTRAL SIG
EVAP PURGE SOL
LO SPD COOL FAN
SER DATA+
ECT SENS SIG
A/C REFRIGERANT
MAP SENS SIG
IMT FAN POS SIG
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
236360

Fig. 22: 3.9L VIN 1, Engine Performance Circuit (3 of 4)

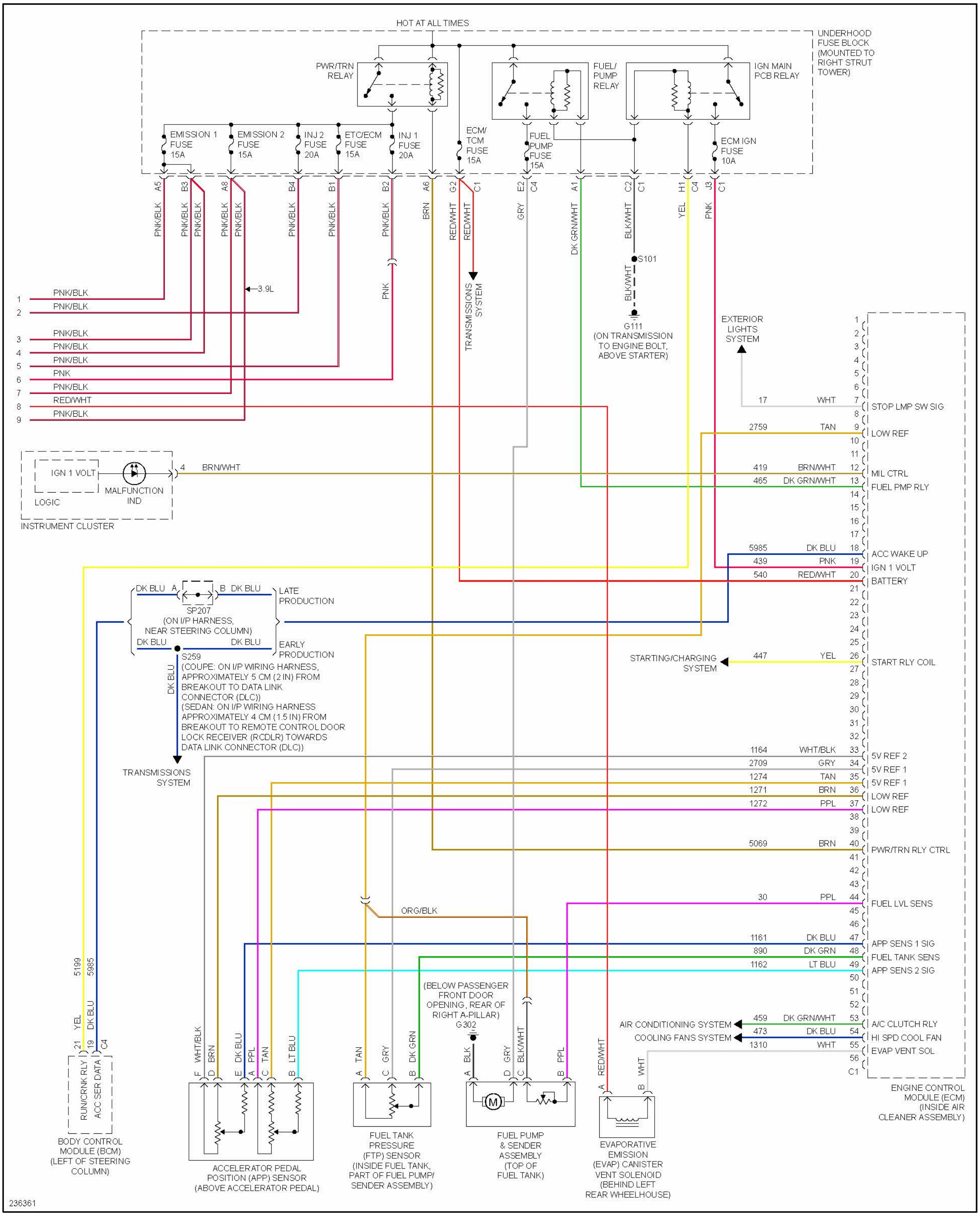

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
PWR/TRN RELAY
FUEL/ PUMP RELAY
IGN MAIN PCB RELAY
EMISSION 1 FUSE 15A
EMISSION 2 FUSE 15A
INJ 2 FUSE 20A
ETC/ECM FUSE 15A
INJ 1 FUSE 20A
ECM/ TCM FUSE 15A
FUEL PUMP FUSE 15A
ECM IGN FUSE 10A
A5 B3 A8 B4 B1 B2 A6 G2 C1 E2 C4 A1 C2 C1 H1 C4 J3 C1
PNK/BLK
RED/WHT
BRN
GRY
DK GRN/WHT
BLK/WHT
YEL
PNK
TRANSMISSIONS SYSTEM
S101
G111 (ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER)
3.9L
1 PNK/BLK
2 PNK/BLK
3 PNK/BLK
4 PNK/BLK
5 PNK/BLK
6 PNK
7 PNK/BLK
8 RED/WHT
9 PNK/BLK
EXTERIOR LIGHTS SYSTEM
IGN 1 VOLT
MALFUNCTION IND
LOGIC
INSTRUMENT CLUSTER
4 BRN/WHT
DK BLU A B DK BLU
SP207 (ON I/P HARNESS, NEAR STEERING COLUMN)
LATE PRODUCTION
EARLY PRODUCTION
DK BLU DK BLU
S259 (COUPE: ON I/P WIRING HARNESS, APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO DATA LINK CONNECTOR (DLC)) (SEDAN: ON I/P WIRING HARNESS APPROXIMATELY 4 CM (1.5 IN) FROM BREAKOUT TO REMOTE CONTROL DOOR LOCK RECEIVER (RCDLR) TOWARDS DATA LINK CONNECTOR (DLC))
TRANSMISSIONS SYSTEM
STARTING/CHARGING SYSTEM
17 WHT 7 STOP LMP SW SIG
2759 TAN 9 LOW REF
419 BRN/WHT 12 MIL CTRL
465 DK GRN/WHT 13 FUEL PMP RLY
5985 DK BLU 18 ACC WAKE UP
439 PNK 19 IGN 1 VOLT
540 RED/WHT 20 BATTERY
447 YEL 26 START RLY COIL
1164 WHT/BLK 33 5V REF 2
2709 GRY 34 5V REF 1
1274 TAN 35 5V REF 1
1271 BRN 36 LOW REF
1272 PPL 37 LOW REF
5069 BRN 40 PWR/TRN RLY CTRL
30 PPL 44 FUEL LVL SENS
1161 DK BLU 47 APP SENS 1 SIG
890 DK GRN 48 FUEL TANK SENS
1162 LT BLU 49 APP SENS 2 SIG
AIR CONDITIONING SYSTEM 459 DK GRN/WHT 53 A/C CLUTCH RLY
COOLING FANS SYSTEM 473 DK BLU 54 HI SPD COOL FAN
1310 WHT 55 EVAP VENT SOL
1 2 3 4 5 6 8 10 11 14 15 16 17 21 22 23 24 25 27 28 29 30 31 32 38 39 41 42 43 45 46 50 51 52 56 C1
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
ORG/BLK
(BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR) G302
5199 5985
YEL DK BLU
21 19 C4
RUN/CRNK RLY
ACC SER DATA
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
WHT/BLK BRN DK BLU PPL TAN LT BLU
F D E A C B
ACCELERATOR PEDAL POSITION (APP) SENSOR (ABOVE ACCELERATOR PEDAL)
TAN GRY DK GRN
A C B
FUEL TANK PRESSURE (FTP) SENSOR (INSIDE FUEL TANK, PART OF FUEL PUMP/ SENDER ASSEMBLY)
BLK GRY BLK/WHT PPL
A D C B
M
FUEL PUMP & SENDER ASSEMBLY (TOP OF FUEL TANK)
RED/WHT WHT
A B
EVAPORATIVE EMISSION (EVAP) CANISTER VENT SOLENOID (BEHIND LEFT REAR WHEELHOUSE)
236361

Fig. 23: 3.9L VIN 1, Engine Performance Circuit (4 of 4)

5.3L VIN C

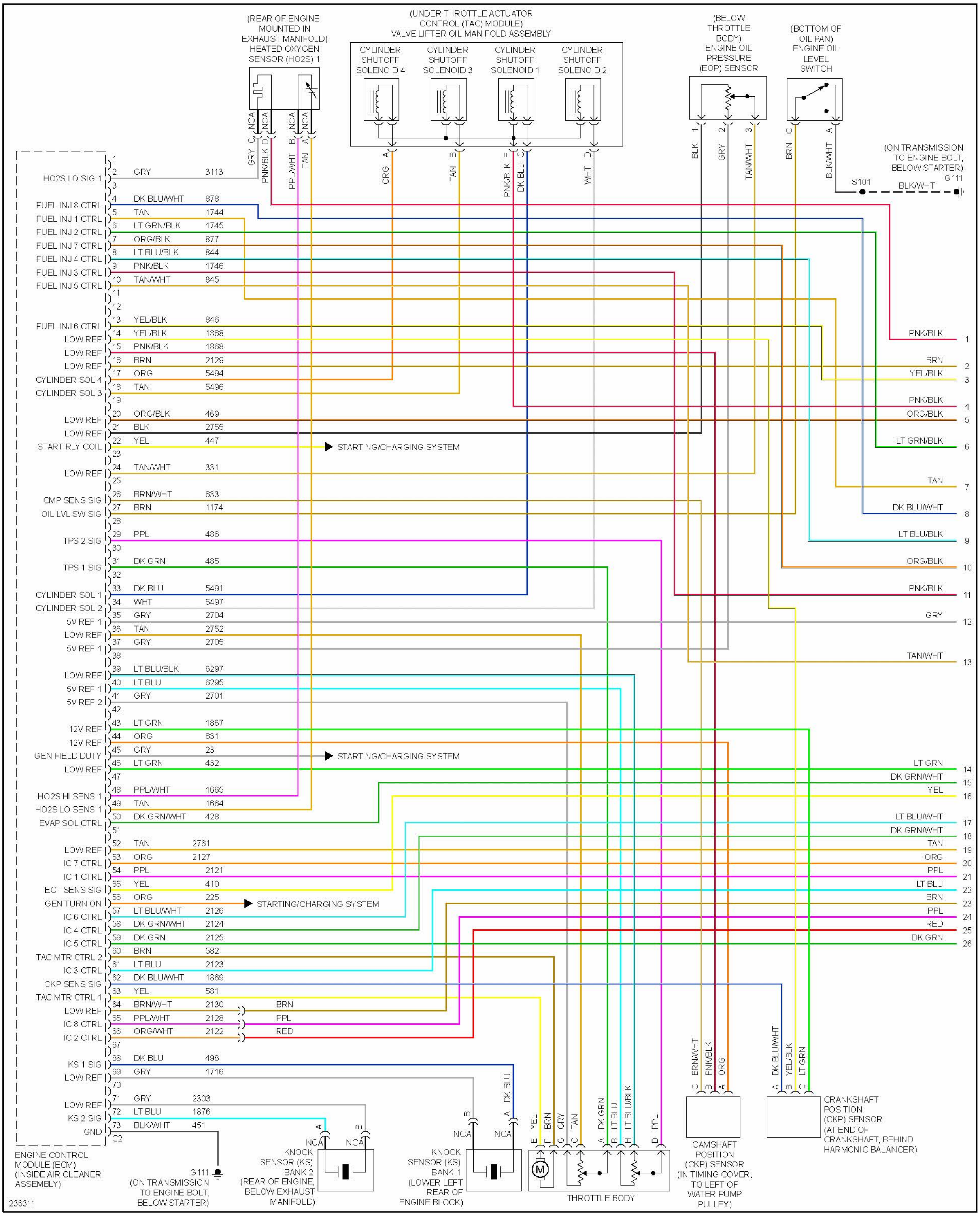

(REAR OF ENGINE, MOUNTED IN EXHAUST MANIFOLD) HEATED OXYGEN SENSOR (HO2S) 1
(UNDER THROTTLE ACTUATOR CONTROL (TAC) MODULE) VALVE LIFTER OIL MANIFOLD ASSEMBLY
CYLINDER SHUTOFF SOLENOID 4
CYLINDER SHUTOFF SOLENOID 3
CYLINDER SHUTOFF SOLENOID 1
CYLINDER SHUTOFF SOLENOID 2
(BELOW THROTTLE BODY) ENGINE OIL PRESSURE (EOP) SENSOR
(BOTTOM OF OIL PAN) ENGINE OIL LEVEL SWITCH
(ON TRANSMISSION TO ENGINE BOLT, BELOW STARTER) G111
S101
BLK/WHT
GRY C NCA
PNK/BLK D NCA
PPL/WHT B NCA
TAN A NCA
ORG A
TAN B
PNK/BLK E
DK BLU C
WHT D
BLK 1
GRY 2
TAN/WHT 3
BRN C
BLK/WHT A
1
HO2S LO SIG 1 2 GRY 3113
3
FUEL INJ 8 CTRL 4 DK BLU/WHT 878
FUEL INJ 1 CTRL 5 TAN 1744
FUEL INJ 2 CTRL 6 LT GRN/BLK 1745
FUEL INJ 7 CTRL 7 ORG/BLK 877
FUEL INJ 4 CTRL 8 LT BLU/BLK 844
FUEL INJ 3 CTRL 9 PNK/BLK 1746
FUEL INJ 5 CTRL 10 TAN/WHT 845
11
12
FUEL INJ 6 CTRL 13 YEL/BLK 846
LOW REF 14 YEL/BLK 1868
LOW REF 15 PNK/BLK 1868
LOW REF 16 BRN 2129
CYLINDER SOL 4 17 ORG 5494
CYLINDER SOL 3 18 TAN 5496
19
20 ORG/BLK 469
LOW REF 21 BLK 2755
LOW REF 22 YEL 447
START RLY COIL STARTING/CHARGING SYSTEM
23
LOW REF 24 TAN/WHT 331
25
CMP SENS SIG 26 BRN/WHT 633
OIL LVL SW SIG 27 BRN 1174
28
TPS 2 SIG 29 PPL 486
30
TPS 1 SIG 31 DK GRN 485
32
CYLINDER SOL 1 33 DK BLU 5491
CYLINDER SOL 2 34 WHT 5497
5V REF 1 35 GRY 2704
LOW REF 36 TAN 2752
5V REF 1 37 GRY 2705
38
LOW REF 39 LT BLU/BLK 6297
5V REF 1 40 LT BLU 6295
5V REF 2 41 GRY 2701
42
12V REF 43 LT GRN 1867
12V REF 44 ORG 631
GEN FIELD DUTY 45 GRY 23 STARTING/CHARGING SYSTEM
LOW REF 46 LT GRN 432
47
HO2S HI SENS 1 48 PPL/WHT 1665
HO2S LO SENS 1 49 TAN 1664
EVAP SOL CTRL 50 DK GRN/WHT 428
51
LOW REF 52 TAN 2761
IC 7 CTRL 53 ORG 2127
IC 1 CTRL 54 PPL 2121
ECT SENS SIG 55 YEL 410
GEN TURN ON 56 ORG 225 STARTING/CHARGING SYSTEM
IC 6 CTRL 57 LT BLU/WHT 2126
IC 4 CTRL 58 DK GRN/WHT 2124
IC 5 CTRL 59 DK GRN 2125
TAC MTR CTRL 2 60 BRN 582
IC 3 CTRL 61 LT BLU 2123
CKP SENS SIG 62 DK BLU/WHT 1869
TAC MTR CTRL 1 63 YEL 581
LOW REF 64 BRN/WHT 2130 BRN
IC 8 CTRL 65 PPL/WHT 2128 PPL
IC 2 CTRL 66 ORG/WHT 2122 RED
67
KS 1 SIG 68 DK BLU 496
LOW REF 69 GRY 1716
70
LOW REF 71 GRY 2303
KS 2 SIG 72 LT BLU 1876
GND 73 BLK/WHT 451
C2
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
PNK/BLK 1
BRN 2
YEL/BLK 3
PNK/BLK 4
ORG/BLK 5
LT GRN/BLK 6
TAN 7
DK BLU/WHT 8
LT BLU/BLK 9
ORG/BLK 10
PNK/BLK 11
GRY 12
TAN/WHT 13
LT GRN 14
DK GRN/WHT 15
YEL 16
LT BLU/WHT 17
DK GRN/WHT 18
TAN 19
ORG 20
PPL 21
LT BLU 22
BRN 23
PPL 24
RED 25
DK GRN 26
G111 (ON TRANSMISSION TO ENGINE BOLT, BELOW STARTER)
A NCA B NCA
KNOCK SENSOR (KS) BANK 2 (REAR OF ENGINE, BELOW EXHAUST MANIFOLD)
B NCA DK BLU A NCA
KNOCK SENSOR (KS) BANK 1 (LOWER LEFT REAR OF ENGINE BLOCK)
YEL E
BRN F
GRY G
TAN C
DK GRN A
LT BLU B
LT BLU/BLK H
PPL D
M
THROTTLE BODY
BRN/WHT C
PNK/BLK B
ORG A
CAMSHAFT POSITION (CKP) SENSOR (IN TIMING COVER, TO LEFT OF WATER PUMP PULLEY)
DK BLU/WHT A
YEL/BLK B
LT GRN C
CRANKSHAFT POSITION (CKP) SENSOR (AT END OF CRANKSHAFT, BEHIND HARMONIC BALANCER)
236311

Fig. 24: 5.3L VIN C, Engine Performance Circuit (1 of 4)

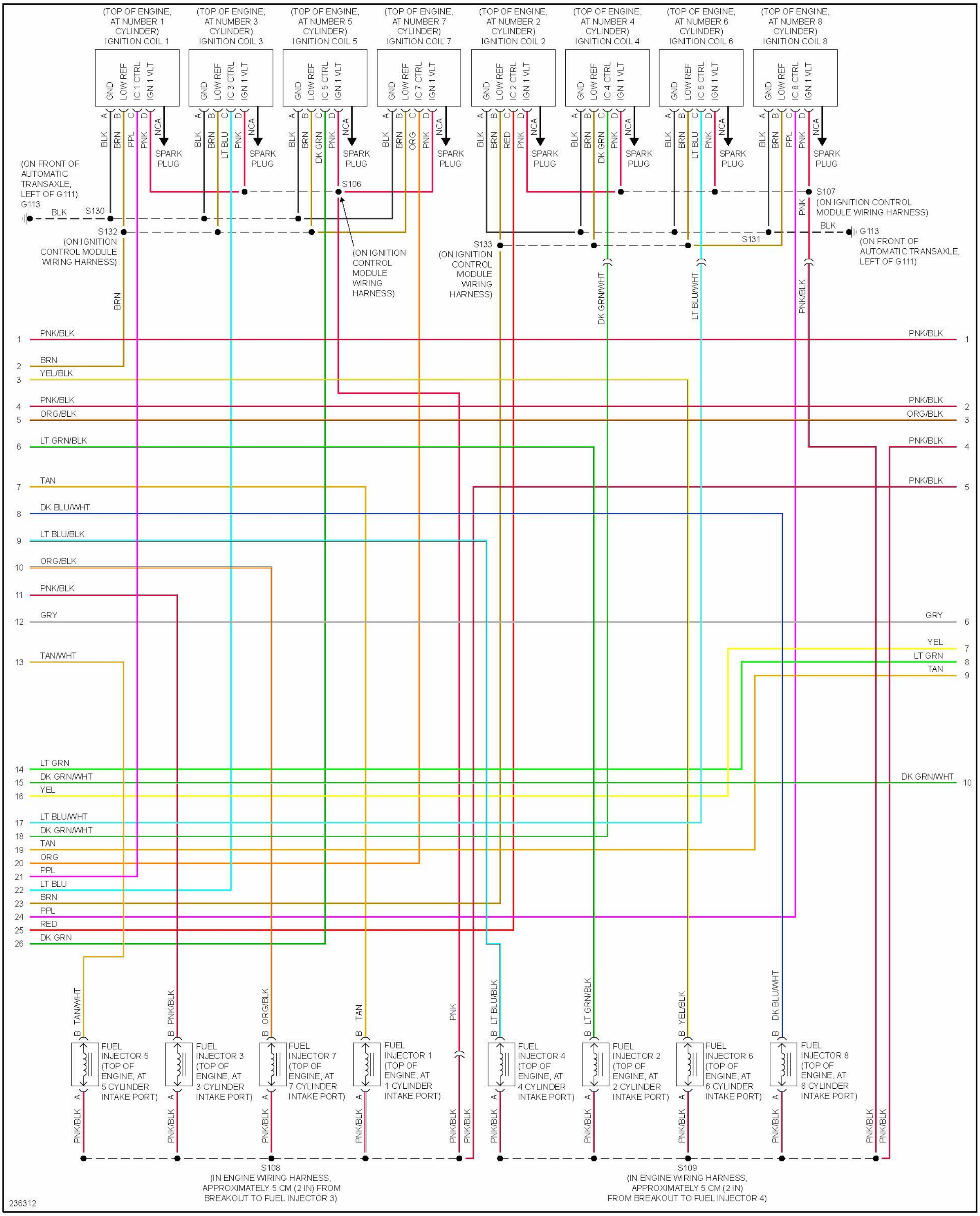

(TOP OF ENGINE, AT NUMBER 1 CYLINDER) IGNITION COIL 1
(TOP OF ENGINE, AT NUMBER 3 CYLINDER) IGNITION COIL 3
(TOP OF ENGINE, AT NUMBER 5 CYLINDER) IGNITION COIL 5
(TOP OF ENGINE, AT NUMBER 7 CYLINDER) IGNITION COIL 7
(TOP OF ENGINE, AT NUMBER 2 CYLINDER) IGNITION COIL 2
(TOP OF ENGINE, AT NUMBER 4 CYLINDER) IGNITION COIL 4
(TOP OF ENGINE, AT NUMBER 6 CYLINDER) IGNITION COIL 6
(TOP OF ENGINE, AT NUMBER 8 CYLINDER) IGNITION COIL 8
GND
LOW REF
IC 1 CTRL
IC 3 CTRL
IC 5 CTRL
IC 7 CTRL
IC 2 CTRL
IC 4 CTRL
IC 6 CTRL
IC 8 CTRL
IGN 1 VLT
A
B
C
D
BLK
BRN
PPL
LT BLU
DK GRN
ORG
RED
PNK
NCA
SPARK PLUG
(ON FRONT OF AUTOMATIC TRANSAXLE, LEFT OF G111)
G113
S130
S132
(ON IGNITION CONTROL MODULE WIRING HARNESS)
S106
S107
(ON IGNITION CONTROL MODULE WIRING HARNESS)
S133
S131
(ON FRONT OF AUTOMATIC TRANSAXLE, LEFT OF G111)
DK GRN/WHT
LT BLU/WHT
PNK/BLK
1 PNK/BLK
2 BRN
3 YEL/BLK
4 PNK/BLK
5 ORG/BLK
6 LT GRN/BLK
7 TAN
8 DK BLU/WHT
9 LT BLU/BLK
10 ORG/BLK
11 PNK/BLK
12 GRY
13 TAN/WHT
14 LT GRN
15 DK GRN/WHT
16 YEL
17 LT BLU/WHT
18 DK GRN/WHT
19 TAN
20 ORG
21 PPL
22 LT BLU
23 BRN
24 PPL
25 RED
26 DK GRN
PNK/BLK 1
PNK/BLK 2
ORG/BLK 3
PNK/BLK 4
PNK/BLK 5
GRY 6
YEL 7
LT GRN 8
TAN 9
DK GRN/WHT 10
TAN/WHT
PNK/BLK
ORG/BLK
TAN
PNK
LT BLU/BLK
LT GRN/BLK
YEL/BLK
DK BLU/WHT
FUEL INJECTOR 5 (TOP OF ENGINE, AT 5 CYLINDER INTAKE PORT)
FUEL INJECTOR 3 (TOP OF ENGINE, AT 3 CYLINDER INTAKE PORT)
FUEL INJECTOR 7 (TOP OF ENGINE, AT 7 CYLINDER INTAKE PORT)
FUEL INJECTOR 1 (TOP OF ENGINE, AT 1 CYLINDER INTAKE PORT)
FUEL INJECTOR 4 (TOP OF ENGINE, AT 4 CYLINDER INTAKE PORT)
FUEL INJECTOR 2 (TOP OF ENGINE, AT 2 CYLINDER INTAKE PORT)
FUEL INJECTOR 6 (TOP OF ENGINE, AT 6 CYLINDER INTAKE PORT)
FUEL INJECTOR 8 (TOP OF ENGINE, AT 8 CYLINDER INTAKE PORT)
S108 (IN ENGINE WIRING HARNESS, APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO FUEL INJECTOR 3)
S109 (IN ENGINE WIRING HARNESS, APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO FUEL INJECTOR 4)
236312

Fig. 25: 5.3L VIN C, Engine Performance Circuit (2 of 4)

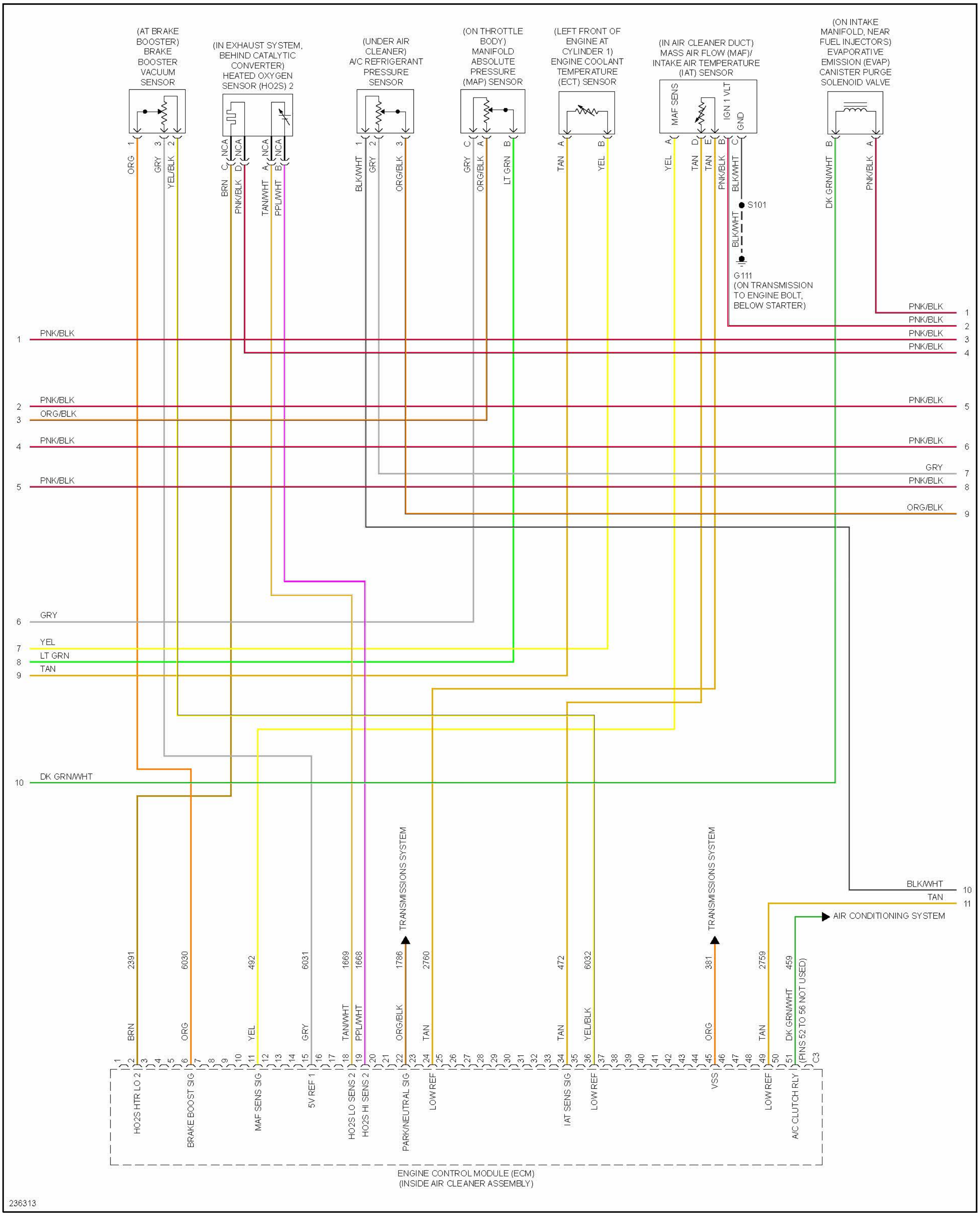

(AT BRAKE BOOSTER) BRAKE BOOSTER VACUUM SENSOR
(IN EXHAUST SYSTEM, BEHIND CATALYTIC CONVERTER) HEATED OXYGEN SENSOR (HO2S) 2
(UNDER AIR CLEANER) A/C REFRIGERANT PRESSURE SENSOR
(ON THROTTLE BODY) MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR
(LEFT FRONT OF ENGINE AT CYLINDER 1) ENGINE COOLANT TEMPERATURE (ECT) SENSOR
(IN AIR CLEANER DUCT) MASS AIR FLOW (MAF)/ INTAKE AIR TEMPERATURE (IAT) SENSOR
(ON INTAKE MANIFOLD, NEAR FUEL INJECTORS) EVAPORATIVE EMISSION (EVAP) CANISTER PURGE SOLENOID VALVE
1 ORG
3 GRY
2 YEL/BLK
C NCA BRN
D NCA PNK/BLK
A NCA TAN/WHT
B NCA PPL/WHT
1 BLK/WHT
2 GRY
3 ORG/BLK
C GRY
A ORG/BLK
B LT GRN
A TAN
B YEL
MAF SENS
IGN 1 VLT
GND
A YEL
D TAN
E TAN
B PNK/BLK
C BLK/WHT
B DK GRN/WHT
A PNK/BLK
S101
BLK/WHT
G111 (ON TRANSMISSION TO ENGINE BOLT, BELOW STARTER)
1 PNK/BLK
2 PNK/BLK
3 ORG/BLK
4 PNK/BLK
5 PNK/BLK
6 GRY
7 YEL
8 LT GRN
9 TAN
10 DK GRN/WHT
PNK/BLK 1
PNK/BLK 2
PNK/BLK 3
PNK/BLK 4
PNK/BLK 5
PNK/BLK 6
GRY 7
PNK/BLK 8
ORG/BLK 9
BLK/WHT 10
TAN 11
TRANSMISSIONS SYSTEM
TRANSMISSIONS SYSTEM
AIR CONDITIONING SYSTEM
2391 BRN
6030 ORG
492 YEL
6031 GRY
1669 TAN/WHT
1668 PPL/WHT
1786 ORG/BLK
2760 TAN
472 TAN
6032 YEL/BLK
381 ORG
2759 TAN
459 DK GRN/WHT
(PINS 52 TO 56 NOT USED)
C3
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51
HO2S HTR LO 2
BRAKE BOOST SIG
MAF SENS SIG
5V REF 1
HO2S LO SENS 2
HO2S HI SENS 2
PARK/NEUTRAL SIG
LOW REF
IAT SENS SIG
LOW REF
VSS
LOW REF
A/C CLUTCH RLY
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
236313

Fig. 26: 5.3L VIN C, Engine Performance Circuit (3 of 4)

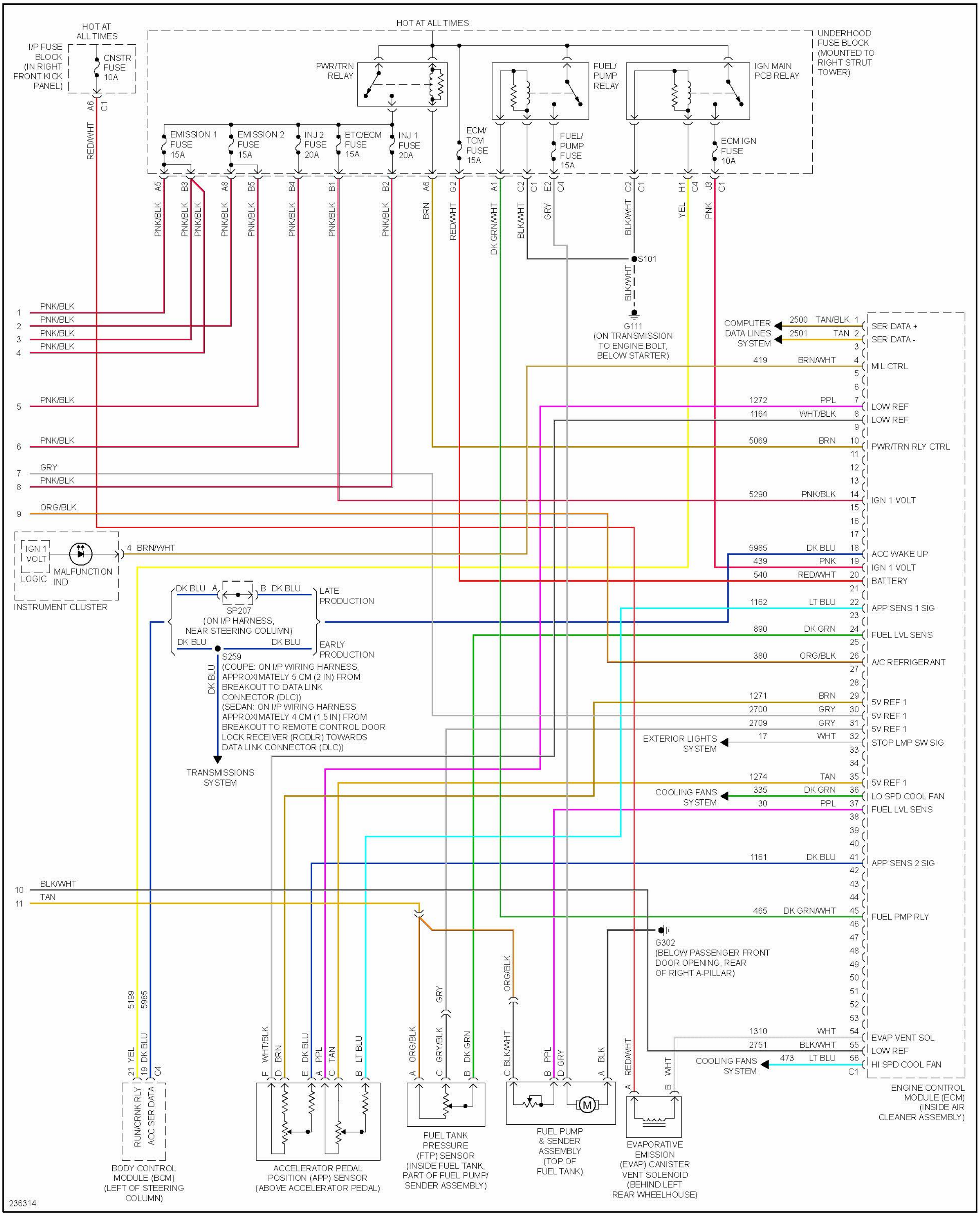

HOT AT ALL TIMES
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
CNSTR FUSE 10A
HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
PWR/TRN RELAY
FUEL/ PUMP RELAY
IGN MAIN PCB RELAY
EMISSION 1 FUSE 15A
EMISSION 2 FUSE 15A
INJ 2 FUSE 20A
ETC/ECM FUSE 15A
INJ 1 FUSE 20A
ECM/ TCM FUSE 15A
FUEL/ PUMP FUSE 15A
ECM IGN FUSE 10A
A6 C1 RED/WHT
A5 B3 A8 B5 B4 B1 B2 A6 G2 A1 C2 C1 E2 C4 C2 C1 H1 C4 J3 C1
PNK/BLK PNK/BLK PNK/BLK PNK/BLK PNK/BLK PNK/BLK PNK/BLK PNK/BLK BRN RED/WHT DK GRN/WHT BLK/WHT GRY BLK/WHT YEL PNK
S101
BLK/WHT
G111 (ON TRANSMISSION TO ENGINE BOLT, BELOW STARTER)
1 PNK/BLK
2 PNK/BLK
3 PNK/BLK
4 PNK/BLK
5 PNK/BLK
6 PNK/BLK
7 GRY
8 PNK/BLK
9 ORG/BLK
IGN 1 VOLT
LOGIC
MALFUNCTION IND
4 BRN/WHT
INSTRUMENT CLUSTER
DK BLU A SP207 B DK BLU
LATE PRODUCTION
(ON I/P HARNESS, NEAR STEERING COLUMN)
DK BLU DK BLU
EARLY PRODUCTION
S259
(COUPE: ON I/P WIRING HARNESS, APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO DATA LINK CONNECTOR (DLC))
(SEDAN: ON I/P WIRING HARNESS APPROXIMATELY 4 CM (1.5 IN) FROM BREAKOUT TO REMOTE CONTROL DOOR LOCK RECEIVER (RCDLR) TOWARDS DATA LINK CONNECTOR (DLC))
DK BLU
TRANSMISSIONS SYSTEM
COMPUTER DATA LINES SYSTEM
2500 TAN/BLK 1 SER DATA +
2501 TAN 2 SER DATA -
3
419 BRN/WHT 4 MIL CTRL
5
6
1272 PPL 7 LOW REF
1164 WHT/BLK 8 LOW REF
9
5069 BRN 10 PWR/TRN RLY CTRL
11
12
13
5290 PNK/BLK 14 IGN 1 VOLT
15
16
17
5985 DK BLU 18 ACC WAKE UP
439 PNK 19 IGN 1 VOLT
540 RED/WHT 20 BATTERY
21
1162 LT BLU 22 APP SENS 1 SIG
23
890 DK GRN 24 FUEL LVL SENS
25
380 ORG/BLK 26 A/C REFRIGERANT
27
28
1271 BRN 29 5V REF 1
2700 GRY 30 5V REF 1
2709 GRY 31 5V REF 1
EXTERIOR LIGHTS SYSTEM
17 WHT 32 STOP LMP SW SIG
33
34
1274 TAN 35 5V REF 1
COOLING FANS SYSTEM
335 DK GRN 36 LO SPD COOL FAN
30 PPL 37 FUEL LVL SENS
38
39
40
1161 DK BLU 41 APP SENS 2 SIG
42
43
44
465 DK GRN/WHT 45 FUEL PMP RLY
46
47
48
49
50
51
52
53
1310 WHT 54 EVAP VENT SOL
2751 BLK/WHT 55 LOW REF
COOLING FANS SYSTEM
473 LT BLU 56 HI SPD COOL FAN
C1
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
10 BLK/WHT
11 TAN
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
5199 5985
21 YEL 19 DK BLU C4
RUN/CRNK RLY ACC SER DATA
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
F WHT/BLK D BRN E DK BLU A PPL C TAN B LT BLU
ACCELERATOR PEDAL POSITION (APP) SENSOR (ABOVE ACCELERATOR PEDAL)
GRY ORG/BLK
A ORG/BLK C GRY/BLK B DK GRN
FUEL TANK PRESSURE (FTP) SENSOR (INSIDE FUEL TANK, PART OF FUEL PUMP/ SENDER ASSEMBLY)
C BLK/WHT B PPL D GRY A BLK
M
FUEL PUMP & SENDER ASSEMBLY (TOP OF FUEL TANK)
A RED/WHT B WHT
EVAPORATIVE EMISSION (EVAP) CANISTER VENT SOLENOID (BEHIND LEFT REAR WHEELHOUSE)
236314

Fig. 27: 5.3L VIN C, Engine Performance Circuit (4 of 4)

EXTERIOR LIGHTS

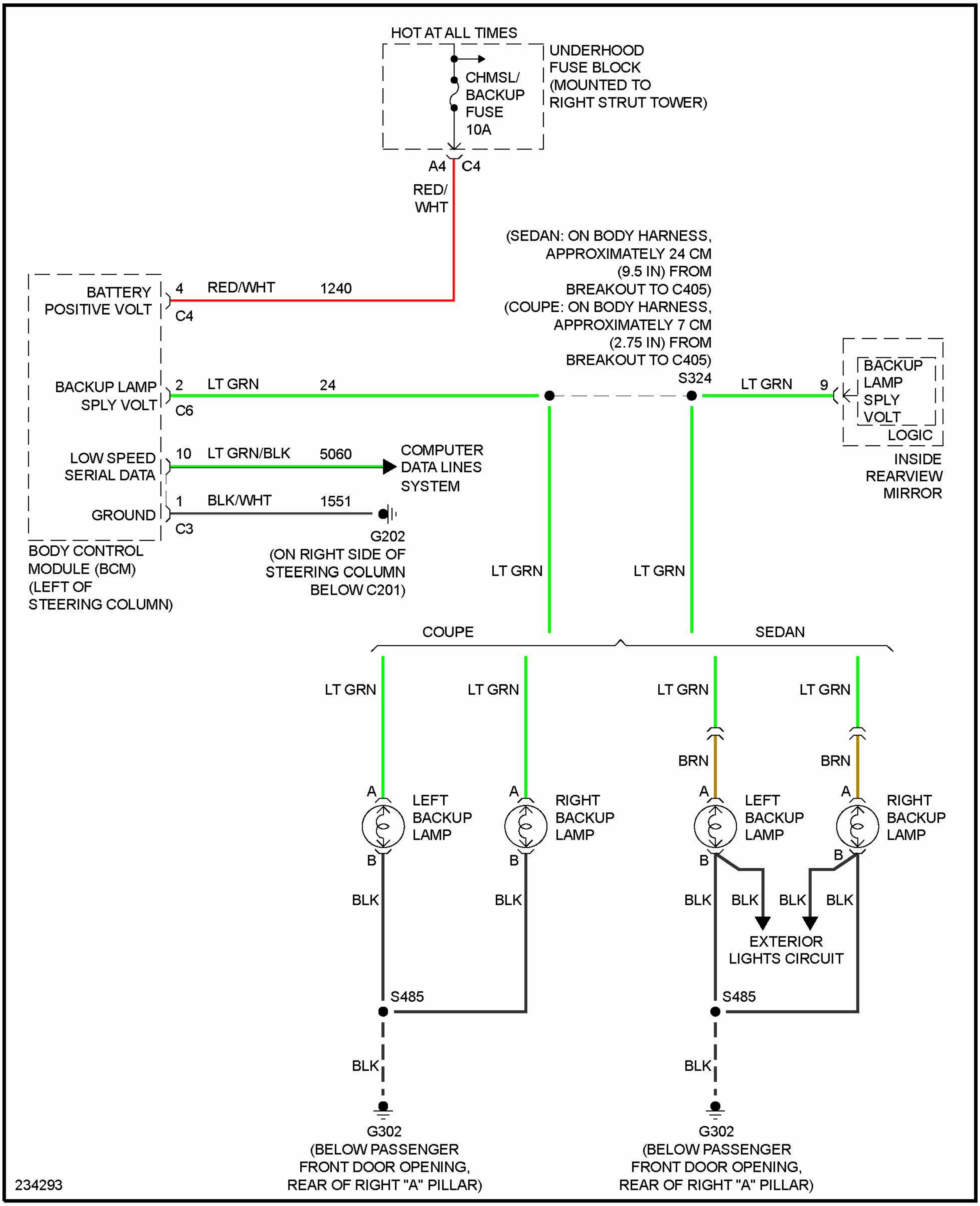

HOT AT ALL TIMES
CHMSL/
BACKUP
FUSE
10A
UNDERHOOD
FUSE BLOCK
(MOUNTED TO
RIGHT STRUT TOWER)
A4
C4
RED/
WHT
BATTERY
POSITIVE VOLT
4
C4
RED/WHT
1240
(SEDAN: ON BODY HARNESS,
APPROXIMATELY 24 CM
(9.5 IN) FROM
BREAKOUT TO C405)
(COUPE: ON BODY HARNESS,
APPROXIMATELY 7 CM
(2.75 IN) FROM
BREAKOUT TO C405)
S324
BACKUP LAMP
SPLY VOLT
2
C6
LT GRN
24
LT GRN
9
BACKUP
LAMP
SPLY
VOLT
LOGIC
INSIDE
REARVIEW
MIRROR
LOW SPEED
SERIAL DATA
10
LT GRN/BLK
5060
COMPUTER
DATA LINES
SYSTEM
GROUND
1
C3
BLK/WHT
1551
G202
(ON RIGHT SIDE OF
STEERING COLUMN
BELOW C201)
BODY CONTROL
MODULE (BCM)
(LEFT OF
STEERING COLUMN)
LT GRN
LT GRN
COUPE
SEDAN
LT GRN
LT GRN
LT GRN
LT GRN
BRN
BRN
A
LEFT
BACKUP
LAMP
B
A
RIGHT
BACKUP
LAMP
B
A
LEFT
BACKUP
LAMP
B
A
RIGHT
BACKUP
LAMP
B
BLK
BLK
BLK
BLK
BLK
BLK
EXTERIOR
LIGHTS CIRCUIT
S485
S485
BLK
BLK
G302
(BELOW PASSENGER
FRONT DOOR OPENING,
REAR OF RIGHT "A" PILLAR)
G302
(BELOW PASSENGER
FRONT DOOR OPENING,
REAR OF RIGHT "A" PILLAR)
234293

Fig. 28: Back-up Lamps Circuit

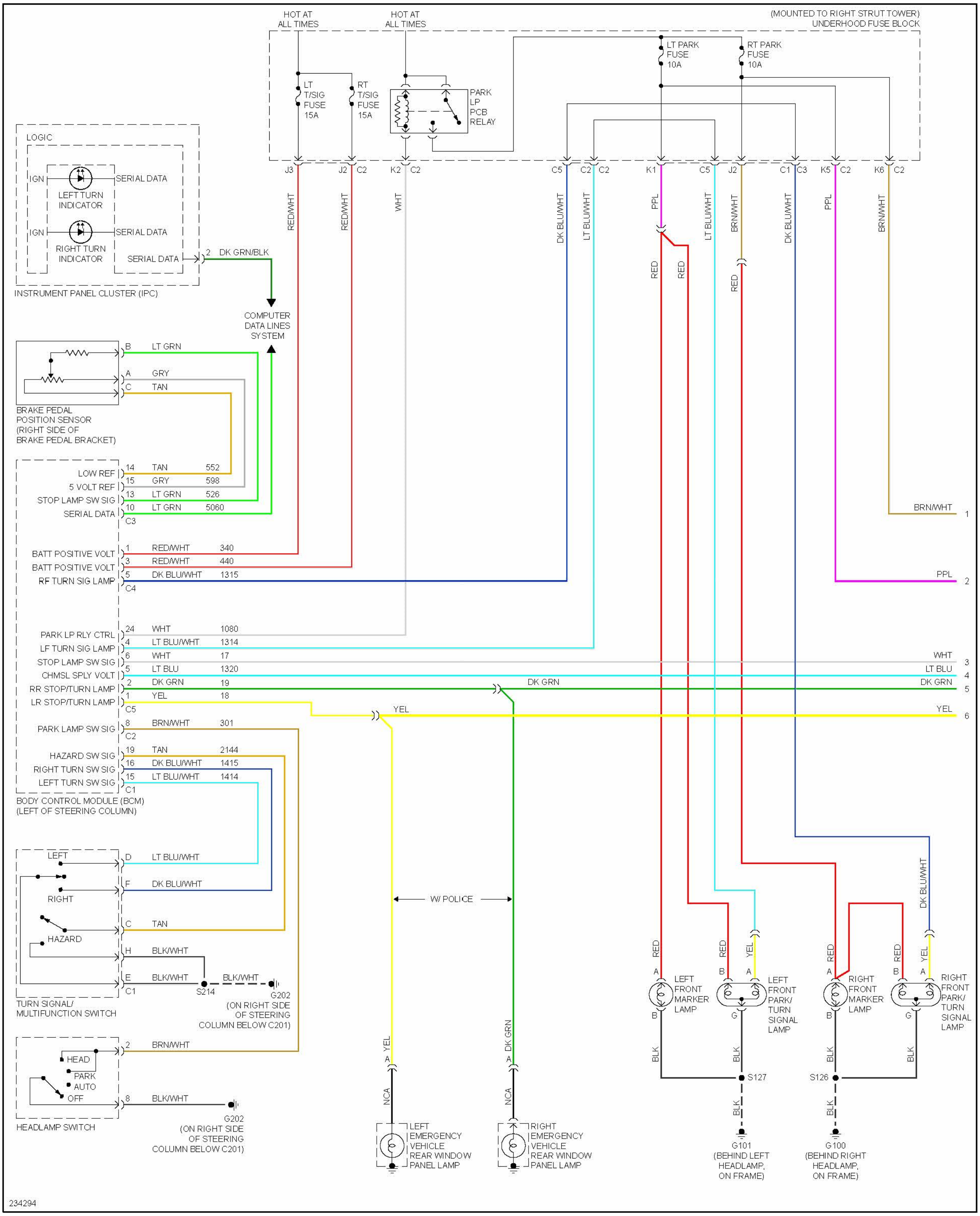

HOT AT ALL TIMES
HOT AT ALL TIMES
(MOUNTED TO RIGHT STRUT TOWER) UNDERHOOD FUSE BLOCK
LT PARK FUSE 10A
RT PARK FUSE 10A
LT T/SIG FUSE 15A
RT T/SIG FUSE 15A
PARK LP PCB RELAY
J3
J2 C2
K2 C2
C5
C2 C2
K1
C5
J2
C1 C3
K5 C2
K6 C2
RED/WHT
RED/WHT
WHT
DK BLU/WHT
LT BLU/WHT
PPL
LT BLU/WHT
BRN/WHT
DK BLU/WHT
PPL
BRN/WHT
RED
RED
RED
LOGIC
IGN
SERIAL DATA
LEFT TURN INDICATOR
IGN
SERIAL DATA
RIGHT TURN INDICATOR
SERIAL DATA
2 DK GRN/BLK
INSTRUMENT PANEL CLUSTER (IPC)
COMPUTER DATA LINES SYSTEM
B LT GRN
A GRY
C TAN
BRAKE PEDAL POSITION SENSOR (RIGHT SIDE OF BRAKE PEDAL BRACKET)
LOW REF 14 TAN 552
5 VOLT REF 15 GRY 598
STOP LAMP SW SIG 13 LT GRN 526
SERIAL DATA 10 LT GRN 5060
C3
BATT POSITIVE VOLT 1 RED/WHT 340
BATT POSITIVE VOLT 3 RED/WHT 440
RF TURN SIG LAMP 5 DK BLU/WHT 1315
C4
PARK LP RLY CTRL 24 WHT 1080
LF TURN SIG LAMP 4 LT BLU/WHT 1314
STOP LAMP SW SIG 6 WHT 17
CHMSL SPLY VOLT 5 LT BLU 1320
RR STOP/TURN LAMP 2 DK GRN 19
LR STOP/TURN LAMP 1 YEL 18
C5
PARK LAMP SW SIG 8 BRN/WHT 301
C2
HAZARD SW SIG 19 TAN 2144
RIGHT TURN SW SIG 16 DK BLU/WHT 1415
LEFT TURN SW SIG 15 LT BLU/WHT 1414
C1
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
BRN/WHT 1
PPL 2
WHT 3
LT BLU 4
DK GRN 5
YEL 6
DK GRN
YEL
LEFT
D LT BLU/WHT
RIGHT
F DK BLU/WHT
C TAN
HAZARD
H BLK/WHT
E BLK/WHT
C1
S214
BLK/WHT
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
TURN SIGNAL/ MULTIFUNCTION SWITCH
HEAD
PARK
AUTO
OFF
2 BRN/WHT
8 BLK/WHT
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
HEADLAMP SWITCH
W/ POLICE
YEL
A
NCA
DK GRN
A
NCA
LEFT EMERGENCY VEHICLE REAR WINDOW PANEL LAMP
RIGHT EMERGENCY VEHICLE REAR WINDOW PANEL LAMP
DK BLU/WHT
RED
A
LEFT FRONT MARKER LAMP
B
RED
B
YEL
A
LEFT FRONT PARK/ TURN SIGNAL LAMP
G
RED
A
RIGHT FRONT MARKER LAMP
B
RED
B
YEL
A
RIGHT FRONT PARK/ TURN SIGNAL LAMP
G
BLK
BLK
S127
BLK
BLK
S126
BLK
BLK
G101 (BEHIND LEFT HEADLAMP, ON FRAME)
G100 (BEHIND RIGHT HEADLAMP, ON FRAME)
234294

Fig. 29: Exterior Lamps Circuit (1 of 2)

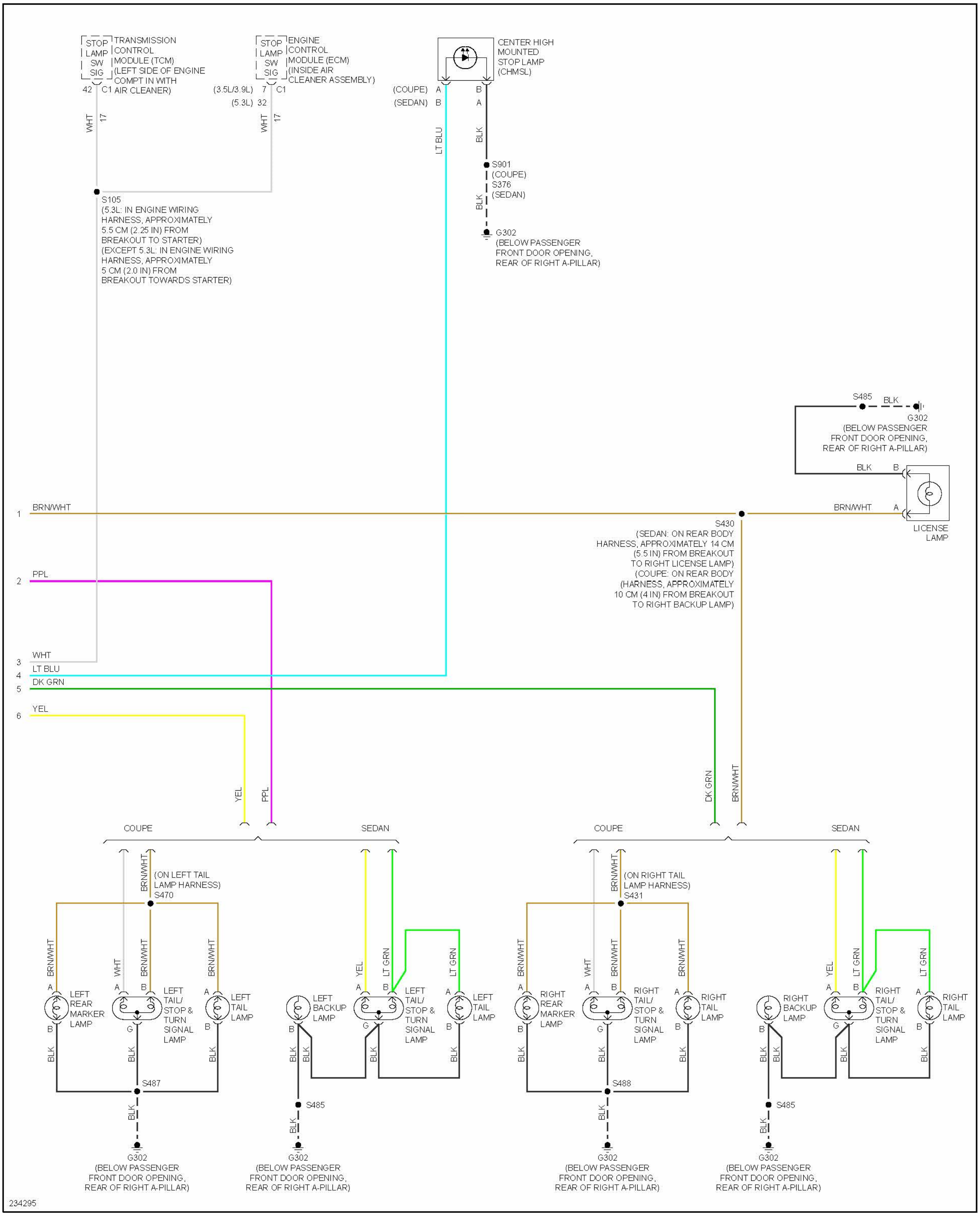

STOP LAMP SW SIG
TRANSMISSION CONTROL MODULE (TCM) (LEFT SIDE OF ENGINE COMPT IN WITH AIR CLEANER)
42 C1
WHT 17
STOP LAMP SW SIG
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
(3.5L/3.9L) 7 C1
(5.3L) 32
WHT 17
CENTER HIGH MOUNTED STOP LAMP (CHMSL)
(COUPE) A
(SEDAN) B
B
A
LT BLU
BLK
S901 (COUPE)
S376 (SEDAN)
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
S105 (5.3L: IN ENGINE WIRING HARNESS, APPROXIMATELY 5.5 CM (2.25 IN) FROM BREAKOUT TO STARTER) (EXCEPT 5.3L: IN ENGINE WIRING HARNESS, APPROXIMATELY 5 CM (2.0 IN) FROM BREAKOUT TOWARDS STARTER)
S485
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
BLK B
BRN/WHT A
LICENSE LAMP
1 BRN/WHT
S430 (SEDAN: ON REAR BODY HARNESS, APPROXIMATELY 14 CM (5.5 IN) FROM BREAKOUT TO RIGHT LICENSE LAMP) (COUPE: ON REAR BODY (HARNESS, APPROXIMATELY 10 CM (4 IN) FROM BREAKOUT TO RIGHT BACKUP LAMP)
2 PPL
3 WHT
4 LT BLU
5 DK GRN
6 YEL
YEL
PPL
DK GRN
BRN/WHT
COUPE
SEDAN
COUPE
SEDAN
BRN/WHT
(ON LEFT TAIL LAMP HARNESS) S470
BRN/WHT
WHT
BRN/WHT
BRN/WHT
A LEFT REAR MARKER LAMP B
A B LEFT TAIL/ STOP & TURN SIGNAL LAMP G
A LEFT TAIL LAMP B
BLK
BLK
BLK
S487
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
YEL
LT GRN
LT GRN
LEFT BACKUP LAMP B
A B LEFT TAIL/ STOP & TURN SIGNAL LAMP G
A LEFT TAIL LAMP B
BLK
BLK
BLK
BLK
S485
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
BRN/WHT
(ON RIGHT TAIL LAMP HARNESS) S431
BRN/WHT
WHT
BRN/WHT
BRN/WHT
A RIGHT REAR MARKER LAMP B
A B RIGHT TAIL/ STOP & TURN SIGNAL LAMP G
A RIGHT TAIL LAMP B
BLK
BLK
BLK
S488
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
YEL
LT GRN
LT GRN
RIGHT BACKUP LAMP B
A B RIGHT TAIL/ STOP & TURN SIGNAL LAMP G
A RIGHT TAIL LAMP B
BLK
BLK
BLK
BLK
S485
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
234295

Fig. 30: Exterior Lamps Circuit (2 of 2)

GROUND DISTRIBUTION

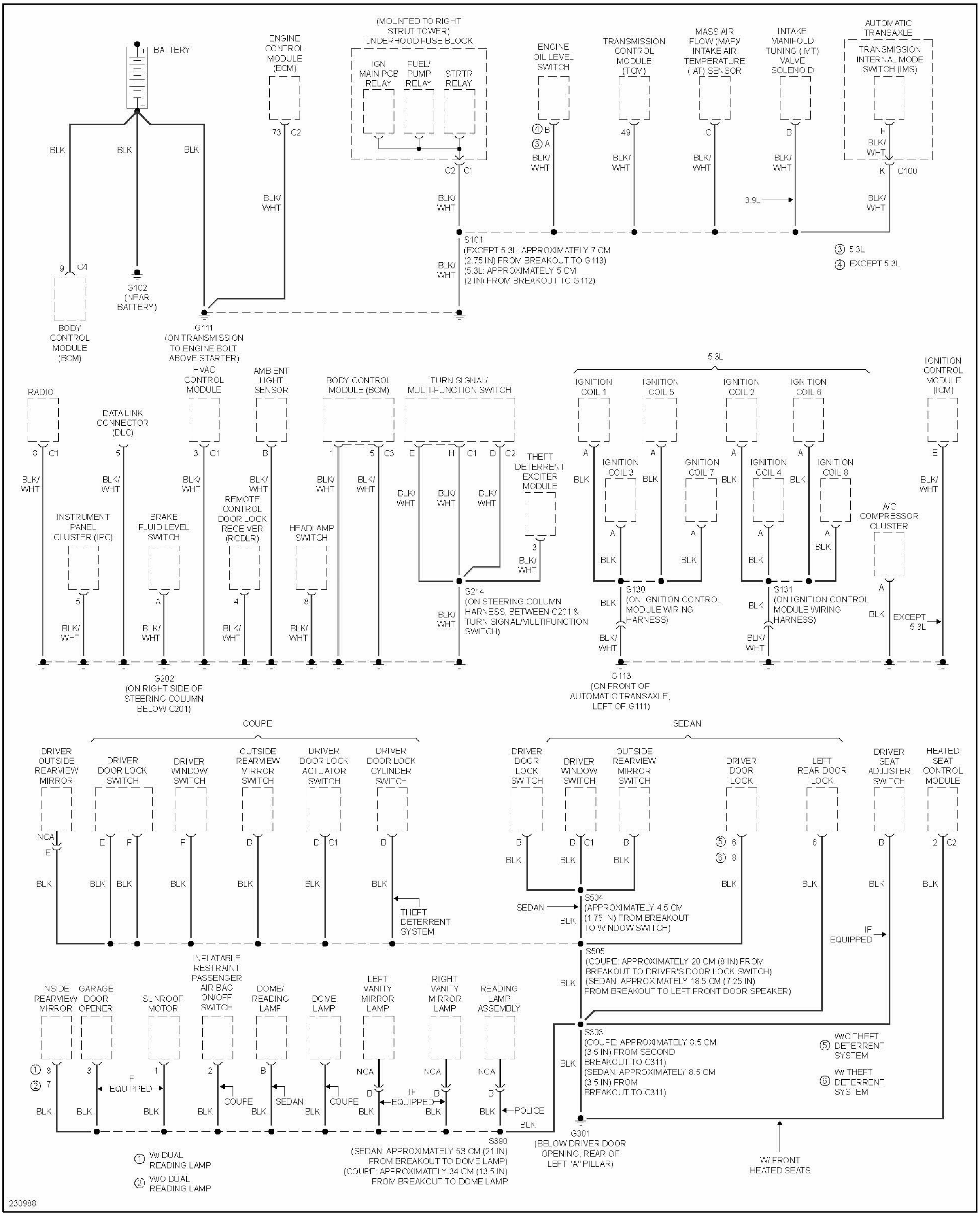

BATTERY
BLK
BLK
BLK
9 C4
BODY CONTROL MODULE (BCM)
G102 (NEAR BATTERY)
G111 (ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER)
ENGINE CONTROL MODULE (ECM)
73 C2
BLK/WHT
(MOUNTED TO RIGHT STRUT TOWER) UNDERHOOD FUSE BLOCK
IGN MAIN PCB RELAY
FUEL/PUMP RELAY
STRTR RELAY
C2 C1
BLK/WHT
S101 (EXCEPT 5.3L: APPROXIMATELY 7 CM (2.75 IN) FROM BREAKOUT TO G113) (5.3L: APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO G112)
ENGINE OIL LEVEL SWITCH
④ B
③ A
TRANSMISSION CONTROL MODULE (TCM)
49
MASS AIR FLOW (MAF)/ INTAKE AIR TEMPERATURE (IAT) SENSOR
C
INTAKE MANIFOLD TUNING (IMT) VALVE SOLENOID
B
3.9L
AUTOMATIC TRANSAXLE
TRANSMISSION INTERNAL MODE SWITCH (IMS)
F
K C100
③ 5.3L
④ EXCEPT 5.3L
RADIO
8 C1
DATA LINK CONNECTOR (DLC)
5
HVAC CONTROL MODULE
3 C1
AMBIENT LIGHT SENSOR
B
BODY CONTROL MODULE (BCM)
1 5 C3
TURN SIGNAL/ MULTI-FUNCTION SWITCH
E H C1 D C2
THEFT DETERRENT EXCITER MODULE
3
INSTRUMENT PANEL CLUSTER (IPC)
5
BRAKE FLUID LEVEL SWITCH
A
REMOTE CONTROL DOOR LOCK RECEIVER (RCDLR)
4
HEADLAMP SWITCH
8
S214 (ON STEERING COLUMN HARNESS, BETWEEN C201 & TURN SIGNAL/MULTIFUNCTION SWITCH)
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
5.3L
IGNITION COIL 1
IGNITION COIL 5
IGNITION COIL 2
IGNITION COIL 6
IGNITION COIL 3
IGNITION COIL 7
IGNITION COIL 4
IGNITION COIL 8
A
S130 (ON IGNITION CONTROL MODULE WIRING HARNESS)
S131 (ON IGNITION CONTROL MODULE WIRING HARNESS)
G113 (ON FRONT OF AUTOMATIC TRANSAXLE, LEFT OF G111)
IGNITION CONTROL MODULE (ICM)
E
A/C COMPRESSOR CLUSTER
A
EXCEPT 5.3L
COUPE
DRIVER OUTSIDE REARVIEW MIRROR
NCA E
DRIVER DOOR LOCK SWITCH
E F
DRIVER WINDOW SWITCH
F
OUTSIDE REARVIEW MIRROR SWITCH
B
DRIVER DOOR LOCK ACTUATOR SWITCH
D C1
DRIVER DOOR LOCK CYLINDER SWITCH
B
THEFT DETERRENT SYSTEM
SEDAN
DRIVER DOOR LOCK SWITCH
B
DRIVER WINDOW SWITCH
B C1
OUTSIDE REARVIEW MIRROR SWITCH
B
DRIVER DOOR LOCK
⑤ 6
⑥ 8
LEFT REAR DOOR LOCK
6
DRIVER SEAT ADJUSTER SWITCH
B
HEATED SEAT CONTROL MODULE
2 C2
S504 (APPROXIMATELY 4.5 CM (1.75 IN) FROM BREAKOUT TO WINDOW SWITCH)
SEDAN
S505 (COUPE: APPROXIMATELY 20 CM (8 IN) FROM BREAKOUT TO DRIVER'S DOOR LOCK SWITCH) (SEDAN: APPROXIMATELY 18.5 CM (7.25 IN) FROM BREAKOUT TO LEFT FRONT DOOR SPEAKER)
IF EQUIPPED
INSIDE REARVIEW MIRROR
① 8
② 7
GARAGE DOOR OPENER
3
SUNROOF MOTOR
1
IF EQUIPPED
INFLATABLE RESTRAINT PASSENGER AIR BAG ON/OFF SWITCH
2
COUPE
DOME/ READING LAMP
B
SEDAN
DOME LAMP
COUPE
LEFT VANITY MIRROR LAMP
NCA B
RIGHT VANITY MIRROR LAMP
NCA B
IF EQUIPPED
READING LAMP ASSEMBLY
NCA B
POLICE
S390 (SEDAN: APPROXIMATELY 53 CM (21 IN) FROM BREAKOUT TO DOME LAMP) (COUPE: APPROXIMATELY 34 CM (13.5 IN) FROM BREAKOUT TO DOME LAMP)
S303 (COUPE: APPROXIMATELY 8.5 CM (3.5 IN) FROM SECOND BREAKOUT TO C311) (SEDAN: APPROXIMATELY 8.5 CM (3.5 IN) FROM BREAKOUT TO C311)
G301 (BELOW DRIVER DOOR OPENING, REAR OF LEFT "A" PILLAR)
⑤ W/O THEFT DETERRENT SYSTEM
⑥ W/ THEFT DETERRENT SYSTEM
W/ FRONT HEATED SEATS
① W/ DUAL READING LAMP
② W/O DUAL READING LAMP
BLK
BLK/WHT
230988

Fig. 31: Ground Distribution Circuit (1 of 3)

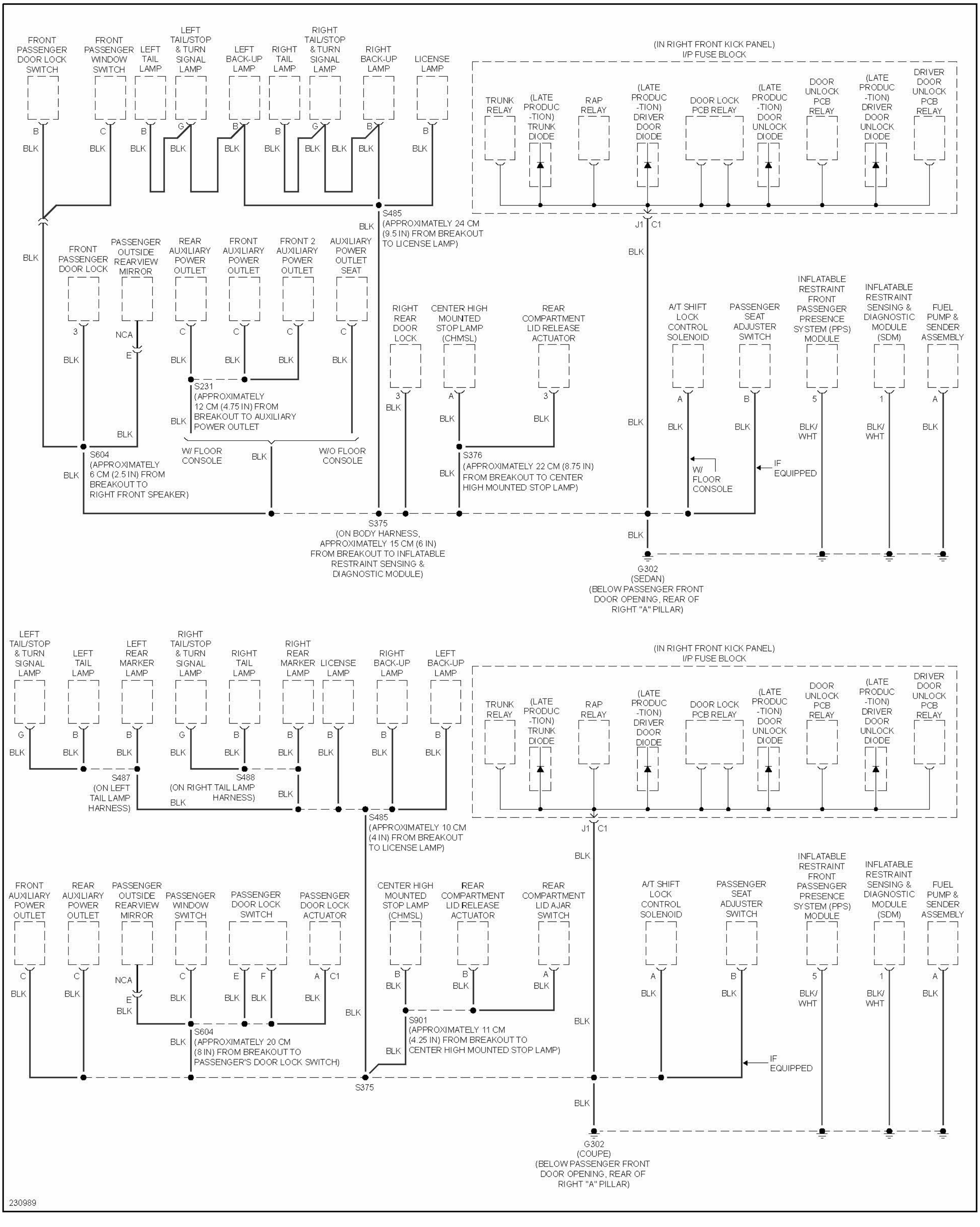

FRONT PASSENGER DOOR LOCK SWITCH
FRONT PASSENGER WINDOW SWITCH
LEFT TAIL LAMP
LEFT TAIL/STOP & TURN SIGNAL LAMP
LEFT BACK-UP LAMP
RIGHT TAIL LAMP
RIGHT TAIL/STOP & TURN SIGNAL LAMP
RIGHT BACK-UP LAMP
LICENSE LAMP
(IN RIGHT FRONT KICK PANEL) I/P FUSE BLOCK
TRUNK RELAY
(LATE PRODUC -TION) TRUNK DIODE
RAP RELAY
(LATE PRODUC -TION) DRIVER DOOR DIODE
DOOR LOCK PCB RELAY
(LATE PRODUC -TION) DOOR UNLOCK DIODE
DOOR UNLOCK PCB RELAY
(LATE PRODUC -TION) DRIVER DOOR UNLOCK DIODE
DRIVER DOOR UNLOCK PCB RELAY
B
C
G
BLK
S485 (APPROXIMATELY 24 CM (9.5 IN) FROM BREAKOUT TO LICENSE LAMP)
J1
C1
FRONT PASSENGER DOOR LOCK
PASSENGER OUTSIDE REARVIEW MIRROR
REAR AUXILIARY POWER OUTLET
FRONT AUXILIARY POWER OUTLET
FRONT 2 AUXILIARY POWER OUTLET
AUXILIARY POWER OUTLET SEAT
3
NCA
E
S231 (APPROXIMATELY 12 CM (4.75 IN) FROM BREAKOUT TO AUXILIARY POWER OUTLET
W/ FLOOR CONSOLE
W/O FLOOR CONSOLE
S604 (APPROXIMATELY 6 CM (2.5 IN) FROM BREAKOUT TO RIGHT FRONT SPEAKER)
RIGHT REAR DOOR LOCK
CENTER HIGH MOUNTED STOP LAMP (CHMSL)
REAR COMPARTMENT LID RELEASE ACTUATOR
A
S376 (APPROXIMATELY 22 CM (8.75 IN) FROM BREAKOUT TO CENTER HIGH MOUNTED STOP LAMP)
A/T SHIFT LOCK CONTROL SOLENOID
PASSENGER SEAT ADJUSTER SWITCH
INFLATABLE RESTRAINT FRONT PASSENGER PRESENCE SYSTEM (PPS) MODULE
INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE (SDM)
FUEL PUMP & SENDER ASSEMBLY
5
1
BLK/ WHT
W/ FLOOR CONSOLE
IF EQUIPPED
S375 (ON BODY HARNESS, APPROXIMATELY 15 CM (6 IN) FROM BREAKOUT TO INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE)
G302 (SEDAN) (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT "A" PILLAR)
LEFT TAIL/STOP & TURN SIGNAL LAMP
LEFT TAIL LAMP
LEFT REAR MARKER LAMP
RIGHT TAIL/STOP & TURN SIGNAL LAMP
RIGHT TAIL LAMP
RIGHT REAR MARKER LAMP
LICENSE LAMP
RIGHT BACK-UP LAMP
LEFT BACK-UP LAMP
S487 (ON LEFT TAIL LAMP HARNESS)
S488 (ON RIGHT TAIL LAMP HARNESS)
S485 (APPROXIMATELY 10 CM (4 IN) FROM BREAKOUT TO LICENSE LAMP)
FRONT AUXILIARY POWER OUTLET
REAR AUXILIARY POWER OUTLET
PASSENGER OUTSIDE REARVIEW MIRROR
PASSENGER WINDOW SWITCH
PASSENGER DOOR LOCK SWITCH
PASSENGER DOOR LOCK ACTUATOR
F
S604 (APPROXIMATELY 20 CM (8 IN) FROM BREAKOUT TO PASSENGER'S DOOR LOCK SWITCH)
CENTER HIGH MOUNTED STOP LAMP (CHMSL)
REAR COMPARTMENT LID RELEASE ACTUATOR
REAR COMPARTMENT LID AJAR SWITCH
S901 (APPROXIMATELY 11 CM (4.25 IN) FROM BREAKOUT TO CENTER HIGH MOUNTED STOP LAMP)
S375
G302 (COUPE) (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT "A" PILLAR)
230989

Fig. 32: Ground Distribution Circuit (2 of 3)

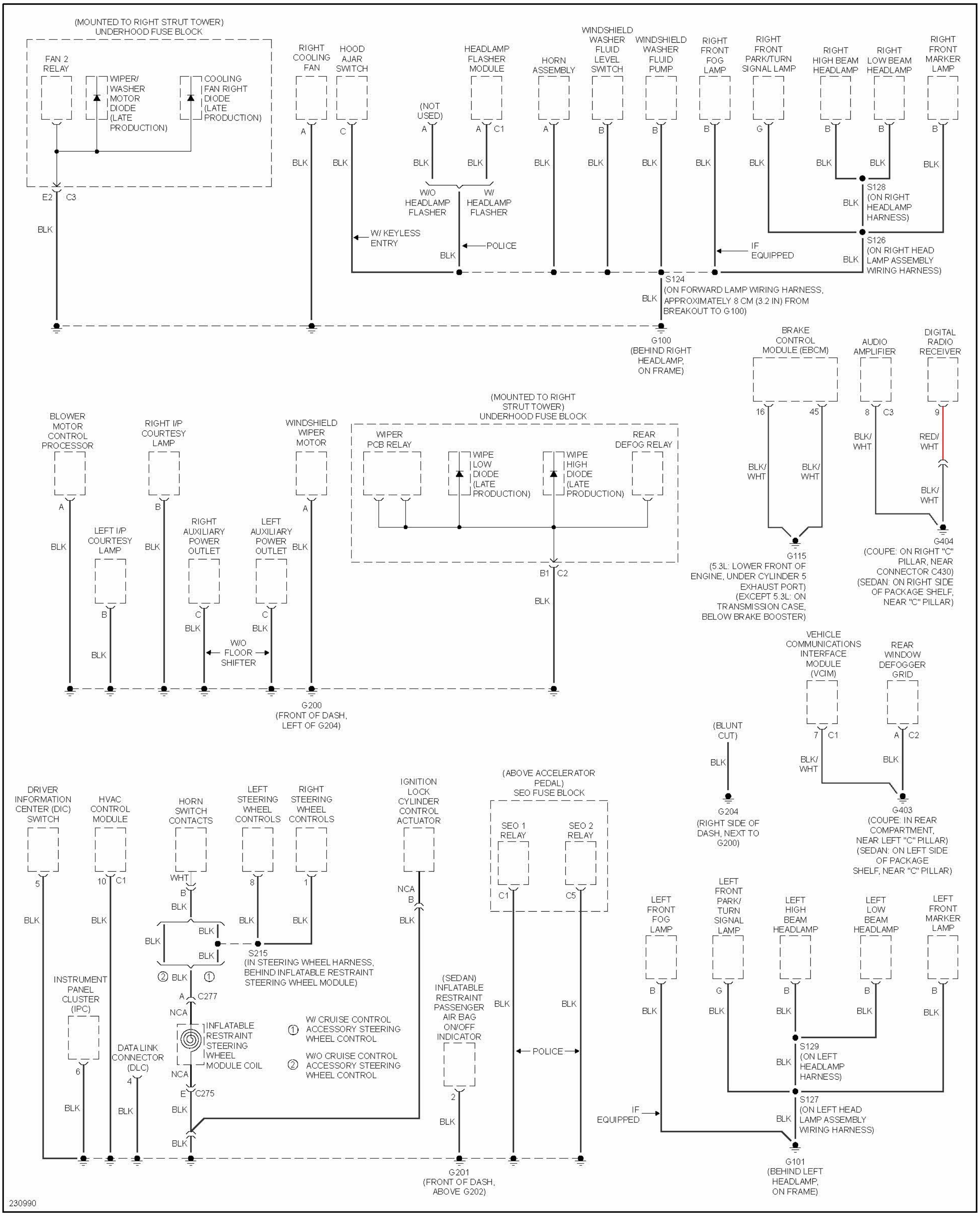

(MOUNTED TO RIGHT STRUT TOWER) UNDERHOOD FUSE BLOCK
FAN 2 RELAY
WIPER/ WASHER MOTOR DIODE (LATE PRODUCTION)
COOLING FAN RIGHT DIODE (LATE PRODUCTION)
E2 C3
BLK
RIGHT COOLING FAN
A
BLK
HOOD AJAR SWITCH
C
BLK
W/ KEYLESS ENTRY
(NOT USED)
A
BLK
HEADLAMP FLASHER MODULE
A C1
BLK
W/O HEADLAMP FLASHER
W/ HEADLAMP FLASHER
POLICE
BLK
HORN ASSEMBLY
A
BLK
WINDSHIELD WASHER FLUID LEVEL SWITCH
B
BLK
WINDSHIELD WASHER FLUID PUMP
B
BLK
RIGHT FRONT FOG LAMP
B
BLK
IF EQUIPPED
RIGHT FRONT PARK/TURN SIGNAL LAMP
G
BLK
RIGHT HIGH BEAM HEADLAMP
B
BLK
RIGHT LOW BEAM HEADLAMP
B
BLK
RIGHT FRONT MARKER LAMP
B
BLK
S128 (ON RIGHT HEADLAMP HARNESS)
BLK
S126 (ON RIGHT HEAD LAMP ASSEMBLY WIRING HARNESS)
BLK
S124 (ON FORWARD LAMP WIRING HARNESS, APPROXIMATELY 8 CM (3.2 IN) FROM BREAKOUT TO G100)
BLK
G100 (BEHIND RIGHT HEADLAMP, ON FRAME)
BRAKE CONTROL MODULE (EBCM)
16
45
BLK/ WHT
BLK/ WHT
G115 (5.3L: LOWER FRONT OF ENGINE, UNDER CYLINDER 5 EXHAUST PORT) (EXCEPT 5.3L: ON TRANSMISSION CASE, BELOW BRAKE BOOSTER)
AUDIO AMPLIFIER
8 C3
BLK/ WHT
DIGITAL RADIO RECEIVER
9
RED/ WHT
BLK/ WHT
G404 (COUPE: ON RIGHT "C" PILLAR, NEAR CONNECTOR C430) (SEDAN: ON RIGHT SIDE OF PACKAGE SHELF, NEAR "C" PILLAR)
BLOWER MOTOR CONTROL PROCESSOR
A
BLK
RIGHT I/P COURTESY LAMP
B
BLK
LEFT I/P COURTESY LAMP
B
BLK
RIGHT AUXILIARY POWER OUTLET
C
BLK
LEFT AUXILIARY POWER OUTLET
C
BLK
W/O FLOOR SHIFTER
WINDSHIELD WIPER MOTOR
A
BLK
(MOUNTED TO RIGHT STRUT TOWER) UNDERHOOD FUSE BLOCK
WIPER PCB RELAY
WIPE LOW DIODE (LATE PRODUCTION)
WIPE HIGH DIODE (LATE PRODUCTION)
REAR DEFOG RELAY
B1 C2
BLK
G200 (FRONT OF DASH, LEFT OF G204)
VEHICLE COMMUNICATIONS INTERFACE MODULE (VCIM)
7 C1
BLK/ WHT
REAR WINDOW DEFOGGER GRID
A C2
BLK
G403 (COUPE: IN REAR COMPARTMENT, NEAR LEFT "C" PILLAR) (SEDAN: ON LEFT SIDE OF PACKAGE SHELF, NEAR "C" PILLAR)
(BLUNT CUT)
BLK
G204 (RIGHT SIDE OF DASH, NEXT TO G200)
DRIVER INFORMATION CENTER (DIC) SWITCH
5
BLK
HVAC CONTROL MODULE
10 C1
BLK
INSTRUMENT PANEL CLUSTER (IPC)
6
BLK
DATA LINK CONNECTOR (DLC)
4
BLK
HORN SWITCH CONTACTS
WHT
B
BLK
BLK
BLK
BLK
② BLK ①
A C277
NCA
INFLATABLE RESTRAINT STEERING WHEEL MODULE COIL
NCA
E C275
BLK
BLK
LEFT STEERING WHEEL CONTROLS
8
BLK
RIGHT STEERING WHEEL CONTROLS
1
BLK
S215 (IN STEERING WHEEL HARNESS, BEHIND INFLATABLE RESTRAINT STEERING WHEEL MODULE)
① W/ CRUISE CONTROL ACCESSORY STEERING WHEEL CONTROL
② W/O CRUISE CONTROL ACCESSORY STEERING WHEEL CONTROL
IGNITION LOCK CYLINDER CONTROL ACTUATOR
NCA
B
BLK
(SEDAN) INFLATABLE RESTRAINT PASSENGER AIR BAG ON/OFF INDICATOR
2
BLK
G201 (FRONT OF DASH, ABOVE G202)
(ABOVE ACCELERATOR PEDAL) SEO FUSE BLOCK
SEO 1 RELAY
C1
BLK
SEO 2 RELAY
C5
BLK
POLICE
LEFT FRONT FOG LAMP
B
BLK
IF EQUIPPED
LEFT FRONT PARK/ TURN SIGNAL LAMP
G
BLK
LEFT HIGH BEAM HEADLAMP
B
BLK
LEFT LOW BEAM HEADLAMP
B
BLK
LEFT FRONT MARKER LAMP
B
BLK
S129 (ON LEFT HEADLAMP HARNESS)
BLK
S127 (ON LEFT HEAD LAMP ASSEMBLY WIRING HARNESS)
BLK
G101 (BEHIND LEFT HEADLAMP, ON FRAME)
230990

Fig. 33: Ground Distribution Circuit (3 of 3)

HEADLIGHTS

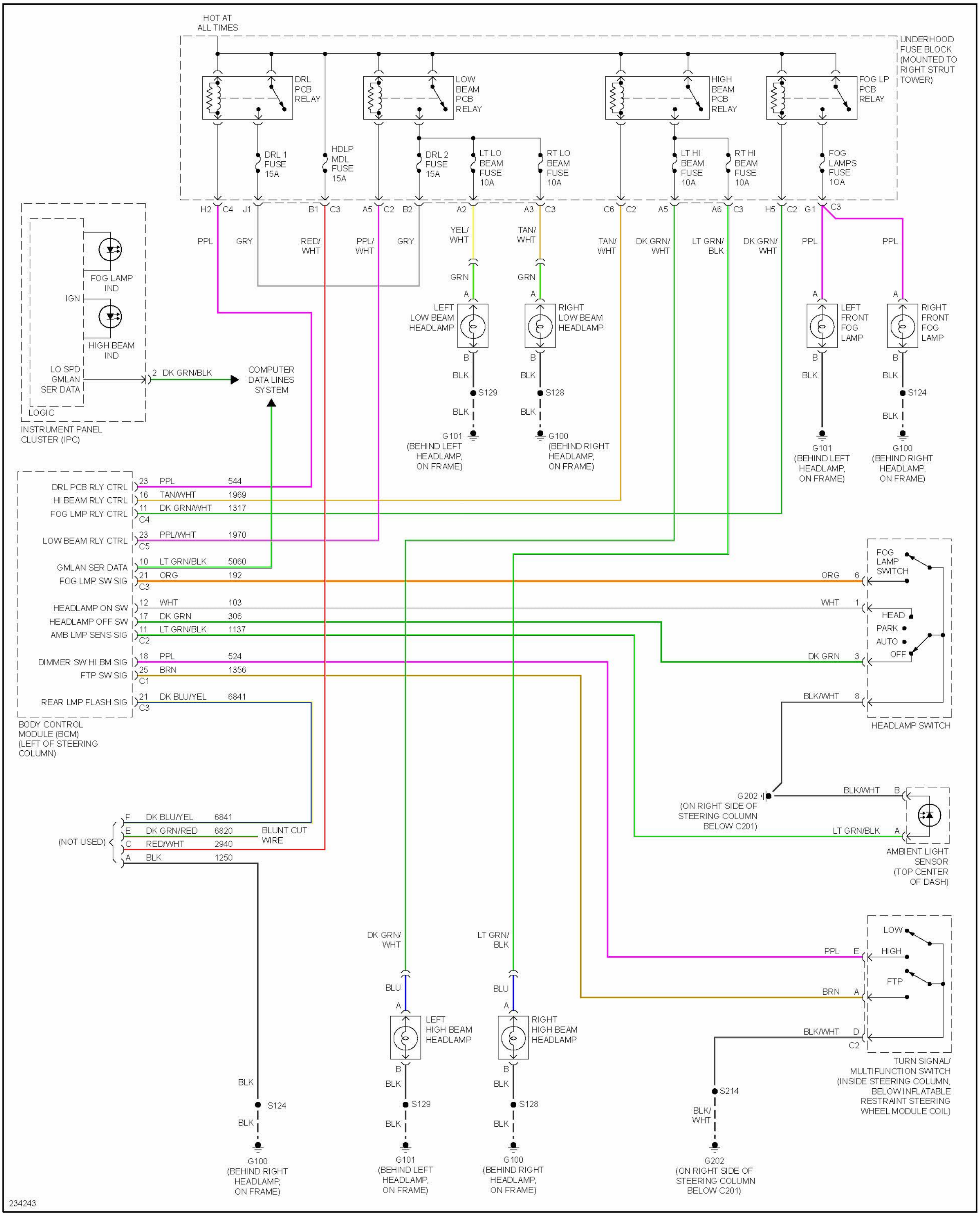

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
DRL PCB RELAY
LOW BEAM PCB RELAY
HIGH BEAM PCB RELAY
FOG LP PCB RELAY
DRL 1 FUSE 15A
HDLP MDL FUSE 15A
DRL 2 FUSE 15A
LT LO BEAM FUSE 10A
RT LO BEAM FUSE 10A
LT HI BEAM FUSE 10A
RT HI BEAM FUSE 10A
FOG LAMPS FUSE 10A
H2 C4
J1
B1 C3
A5 C2
B2
A2
A3 C3
C6 C2
A5
A6 C3
H5 C2
G1 C3
PPL
GRY
RED/ WHT
PPL/ WHT
GRY
YEL/ WHT
TAN/ WHT
TAN/ WHT
DK GRN/ WHT
LT GRN/ BLK
DK GRN/ WHT
PPL
PPL
GRN
GRN
A
LEFT LOW BEAM HEADLAMP
RIGHT LOW BEAM HEADLAMP
B
BLK
S129
S128
G101 (BEHIND LEFT HEADLAMP, ON FRAME)
G100 (BEHIND RIGHT HEADLAMP, ON FRAME)
LEFT FRONT FOG LAMP
RIGHT FRONT FOG LAMP
S124
FOG LAMP IND
IGN
HIGH BEAM IND
LO SPD GMLAN SER DATA
LOGIC
INSTRUMENT PANEL CLUSTER (IPC)
2 DK GRN/BLK
COMPUTER DATA LINES SYSTEM
DRL PCB RLY CTRL 23 PPL 544
HI BEAM RLY CTRL 16 TAN/WHT 1969
FOG LMP RLY CTRL 11 DK GRN/WHT 1317
C4
LOW BEAM RLY CTRL 23 PPL/WHT 1970
C5
GMLAN SER DATA 10 LT GRN/BLK 5060
FOG LMP SW SIG 21 ORG 192
C3
HEADLAMP ON SW 12 WHT 103
HEADLAMP OFF SW 17 DK GRN 306
AMB LMP SENS SIG 11 LT GRN/BLK 1137
C2
DIMMER SW HI BM SIG 18 PPL 524
FTP SW SIG 25 BRN 1356
C1
REAR LMP FLASH SIG 21 DK BLU/YEL 6841
C3
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
ORG 6
FOG LAMP SWITCH
WHT 1
HEAD
PARK
AUTO
OFF
DK GRN 3
BLK/WHT 8
HEADLAMP SWITCH
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
BLK/WHT B
LT GRN/BLK A
AMBIENT LIGHT SENSOR (TOP CENTER OF DASH)
F DK BLU/YEL 6841
E DK GRN/RED 6820
C RED/WHT 2940
A BLK 1250
(NOT USED)
BLUNT CUT WIRE
LOW
HIGH
FTP
PPL E
BRN A
BLK/WHT D
C2
TURN SIGNAL/ MULTIFUNCTION SWITCH (INSIDE STEERING COLUMN, BELOW INFLATABLE RESTRAINT STEERING WHEEL MODULE COIL)
DK GRN/ WHT
LT GRN/ BLK
BLU
LEFT HIGH BEAM HEADLAMP
RIGHT HIGH BEAM HEADLAMP
S214
BLK/ WHT
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
234243

Fig. 34: Headlights Circuit, W/ Police Option

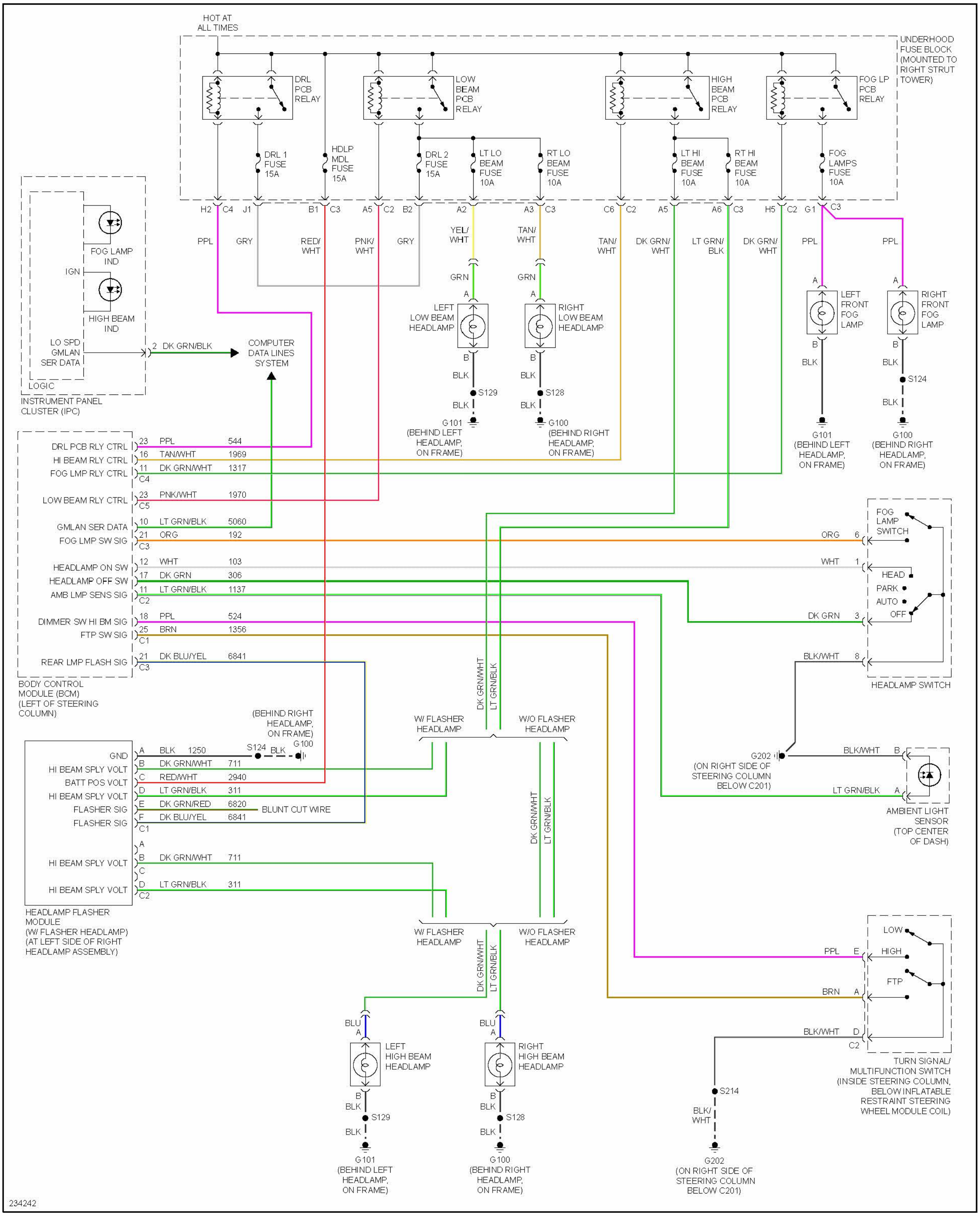

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
DRL PCB RELAY
LOW BEAM PCB RELAY
HIGH BEAM PCB RELAY
FOG LP PCB RELAY
DRL 1 FUSE 15A
HDLP MDL FUSE 15A
DRL 2 FUSE 15A
LT LO BEAM FUSE 10A
RT LO BEAM FUSE 10A
LT HI BEAM FUSE 10A
RT HI BEAM FUSE 10A
FOG LAMPS FUSE 10A
H2 C4 J1 B1 C3 A5 C2 B2 A2 A3 C3 C6 C2 A5 A6 C3 H5 C2 G1 C3
PPL GRY RED/WHT PNK/WHT GRY YEL/WHT TAN/WHT TAN/WHT DK GRN/WHT LT GRN/BLK DK GRN/WHT PPL PPL
GRN
LEFT LOW BEAM HEADLAMP
RIGHT LOW BEAM HEADLAMP
LEFT FRONT FOG LAMP
RIGHT FRONT FOG LAMP
BLK
S129
S128
S124
G101 (BEHIND LEFT HEADLAMP, ON FRAME)
G100 (BEHIND RIGHT HEADLAMP, ON FRAME)
FOG LAMP IND
IGN
HIGH BEAM IND
LO SPD GMLAN SER DATA
LOGIC
INSTRUMENT PANEL CLUSTER (IPC)
2 DK GRN/BLK
COMPUTER DATA LINES SYSTEM
DRL PCB RLY CTRL 23 PPL 544
HI BEAM RLY CTRL 16 TAN/WHT 1969
FOG LMP RLY CTRL 11 DK GRN/WHT 1317
C4
LOW BEAM RLY CTRL 23 PNK/WHT 1970
C5
GMLAN SER DATA 10 LT GRN/BLK 5060
FOG LMP SW SIG 21 ORG 192
C3
HEADLAMP ON SW 12 WHT 103
HEADLAMP OFF SW 17 DK GRN 306
AMB LMP SENS SIG 11 LT GRN/BLK 1137
C2
DIMMER SW HI BM SIG 18 PPL 524
FTP SW SIG 25 BRN 1356
C1
REAR LMP FLASH SIG 21 DK BLU/YEL 6841
C3
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
FOG LAMP SWITCH
ORG 6
WHT 1
HEAD
PARK
AUTO
OFF
DK GRN 3
BLK/WHT 8
HEADLAMP SWITCH
(BEHIND RIGHT HEADLAMP, ON FRAME)
S124 BLK G100
GND A BLK 1250
HI BEAM SPLY VOLT B DK GRN/WHT 711
BATT POS VOLT C RED/WHT 2940
HI BEAM SPLY VOLT D LT GRN/BLK 311
FLASHER SIG E DK GRN/RED 6820 BLUNT CUT WIRE
FLASHER SIG F DK BLU/YEL 6841
C1
A
HI BEAM SPLY VOLT B DK GRN/WHT 711
C
HI BEAM SPLY VOLT D LT GRN/BLK 311
C2
HEADLAMP FLASHER MODULE (W/ FLASHER HEADLAMP) (AT LEFT SIDE OF RIGHT HEADLAMP ASSEMBLY)
W/ FLASHER HEADLAMP
W/O FLASHER HEADLAMP
DK GRN/WHT
LT GRN/BLK
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
BLK/WHT B
LT GRN/BLK A
AMBIENT LIGHT SENSOR (TOP CENTER OF DASH)
LOW
HIGH
FTP
PPL E
BRN A
BLK/WHT D
C2
TURN SIGNAL/ MULTIFUNCTION SWITCH (INSIDE STEERING COLUMN, BELOW INFLATABLE RESTRAINT STEERING WHEEL MODULE COIL)
BLU
LEFT HIGH BEAM HEADLAMP
RIGHT HIGH BEAM HEADLAMP
S214
BLK/WHT
234242

Fig. 35: Headlights Circuit, W/O Police Option

HORN

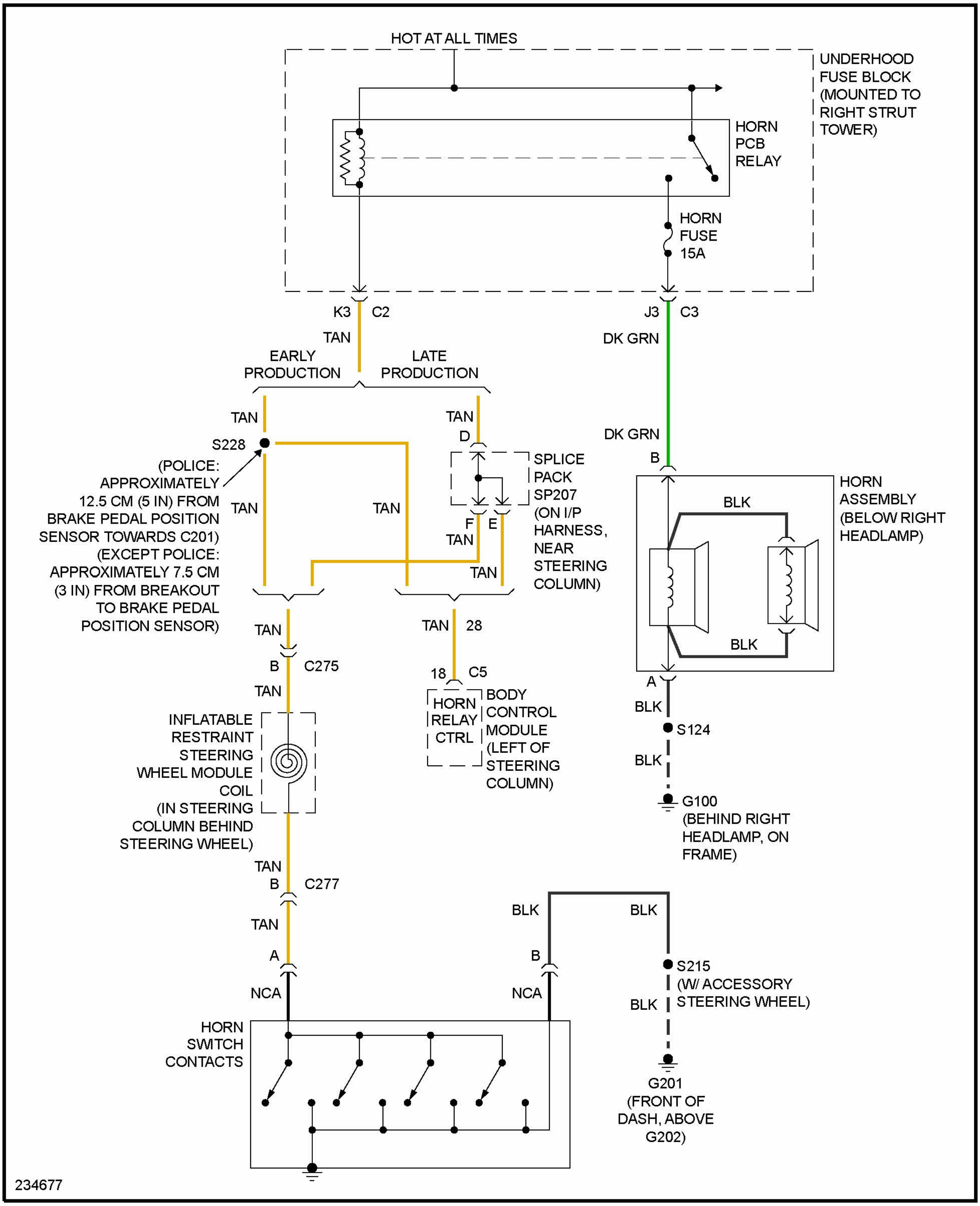

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
HORN PCB RELAY
HORN FUSE 15A
K3
C2
J3
C3
TAN
DK GRN
EARLY PRODUCTION
LATE PRODUCTION
TAN
TAN
D
S228
(POLICE: APPROXIMATELY 12.5 CM (5 IN) FROM BRAKE PEDAL POSITION SENSOR TOWARDS C201) (EXCEPT POLICE: APPROXIMATELY 7.5 CM (3 IN) FROM BREAKOUT TO BRAKE PEDAL POSITION SENSOR)
SPLICE PACK SP207 (ON I/P HARNESS, NEAR STEERING COLUMN)
TAN
TAN
F
E
TAN
TAN
DK GRN
B
HORN ASSEMBLY (BELOW RIGHT HEADLAMP)
BLK
BLK
A
BLK
S124
BLK
G100 (BEHIND RIGHT HEADLAMP, ON FRAME)
TAN
B
C275
TAN
TAN
28
18
C5
HORN RELAY CTRL
BODY CONTROL MODULE (LEFT OF STEERING COLUMN)
INFLATABLE RESTRAINT STEERING WHEEL MODULE COIL (IN STEERING COLUMN BEHIND STEERING WHEEL)
TAN
B
C277
TAN
A
NCA
BLK
BLK
B
NCA
S215 (W/ ACCESSORY STEERING WHEEL)
BLK
G201 (FRONT OF DASH, ABOVE G202)
HORN SWITCH CONTACTS
234677

Fig. 36: Horn Circuit

INSTRUMENT CLUSTER

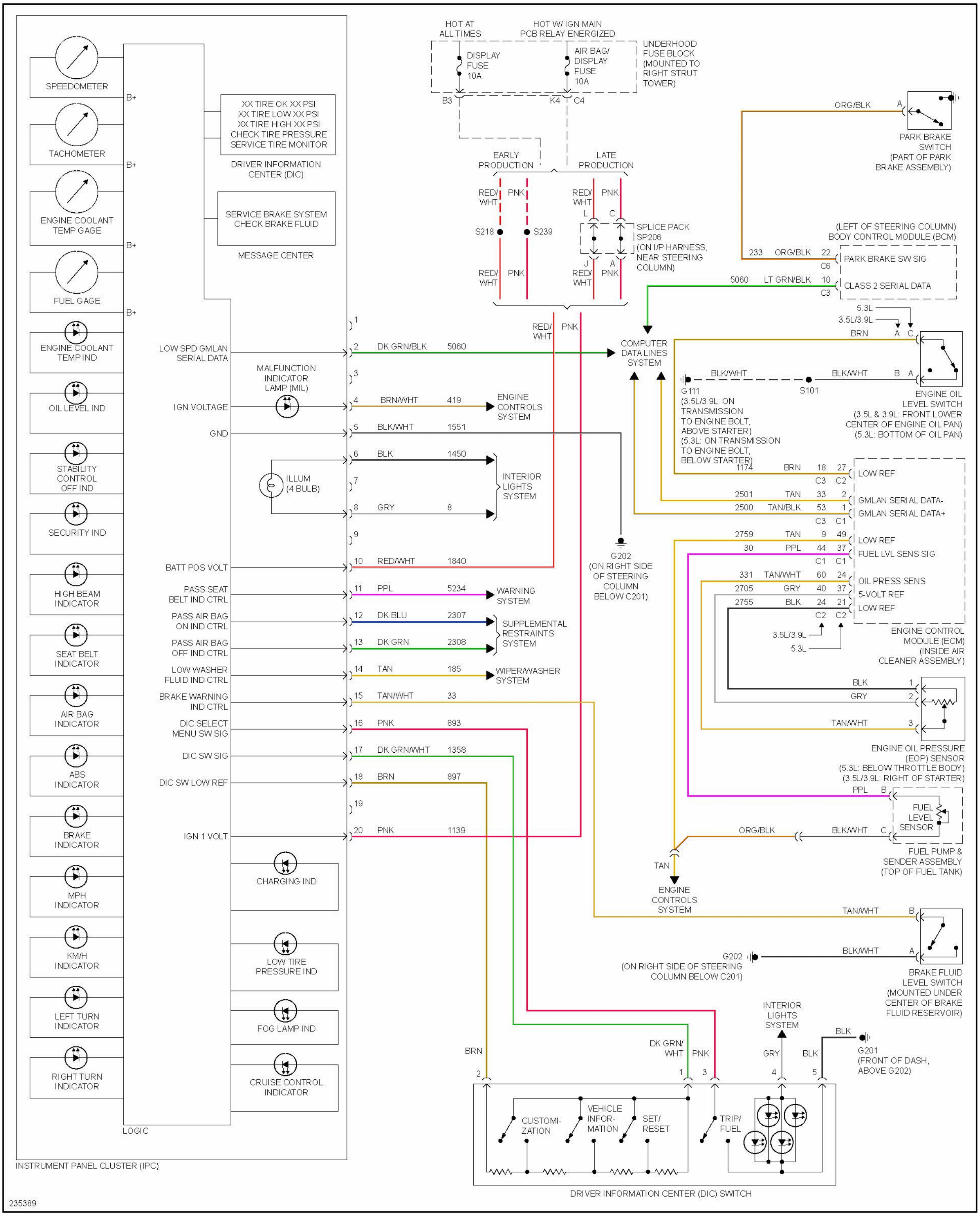

HOT AT ALL TIMES
HOT W/ IGN MAIN PCB RELAY ENERGIZED
DISPLAY FUSE 10A
AIR BAG/ DISPLAY FUSE 10A
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
B3
K4 C4
EARLY PRODUCTION
LATE PRODUCTION
RED/ WHT
PNK
S218
S239
SPLICE PACK SP206 (ON I/P HARNESS, NEAR STEERING COLUMN)
ORG/BLK
PARK BRAKE SWITCH (PART OF PARK BRAKE ASSEMBLY)
(LEFT OF STEERING COLUMN) BODY CONTROL MODULE (BCM)
233 ORG/BLK 22 C6 PARK BRAKE SW SIG
5060 LT GRN/BLK 10 C3 CLASS 2 SERIAL DATA
SPEEDOMETER
TACHOMETER
ENGINE COOLANT TEMP GAGE
FUEL GAGE
B+
XX TIRE OK XX PSI
XX TIRE LOW XX PSI
XX TIRE HIGH XX PSI
CHECK TIRE PRESSURE
SERVICE TIRE MONITOR
DRIVER INFORMATION CENTER (DIC)
SERVICE BRAKE SYSTEM CHECK BRAKE FLUID
MESSAGE CENTER
ENGINE COOLANT TEMP IND
OIL LEVEL IND
STABILITY CONTROL OFF IND
SECURITY IND
HIGH BEAM INDICATOR
SEAT BELT INDICATOR
AIR BAG INDICATOR
ABS INDICATOR
BRAKE INDICATOR
MPH INDICATOR
KM/H INDICATOR
LEFT TURN INDICATOR
RIGHT TURN INDICATOR
CHARGING IND
LOW TIRE PRESSURE IND
FOG LAMP IND
CRUISE CONTROL INDICATOR
LOGIC
INSTRUMENT PANEL CLUSTER (IPC)
MALFUNCTION INDICATOR LAMP (MIL)
ILLUM (4 BULB)
LOW SPD GMLAN SERIAL DATA 2 DK GRN/BLK 5060
IGN VOLTAGE 4 BRN/WHT 419
GND 5 BLK/WHT 1551
6 BLK 1450
8 GRY 8
BATT POS VOLT 10 RED/WHT 1840
PASS SEAT BELT IND CTRL 11 PPL 5234
PASS AIR BAG ON IND CTRL 12 DK BLU 2307
PASS AIR BAG OFF IND CTRL 13 DK GRN 2308
LOW WASHER FLUID IND CTRL 14 TAN 185
BRAKE WARNING IND CTRL 15 TAN/WHT 33
DIC SELECT MENU SW SIG 16 PNK 893
DIC SW SIG 17 DK GRN/WHT 1358
DIC SW LOW REF 18 BRN 897
IGN 1 VOLT 20 PNK 1139
1 3 7 9 19
COMPUTER DATA LINES SYSTEM
ENGINE CONTROLS SYSTEM
INTERIOR LIGHTS SYSTEM
WARNING SYSTEM
SUPPLEMENTAL RESTRAINTS SYSTEM
WIPER/WASHER SYSTEM
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
5.3L
3.5L/3.9L
BRN
BLK/WHT
G111 (3.5L/3.9L: ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER) (5.3L: ON TRANSMISSION TO ENGINE BOLT, BELOW STARTER)
S101
ENGINE OIL LEVEL SWITCH (3.5L & 3.9L: FRONT LOWER CENTER OF ENGINE OIL PAN) (5.3L: BOTTOM OF OIL PAN)
1174 BRN 18 27 C3 C2 LOW REF
2501 TAN 33 2 GMLAN SERIAL DATA-
2500 TAN/BLK 53 1 C3 C1 GMLAN SERIAL DATA+
2759 TAN 9 49 LOW REF
30 PPL 44 37 C1 C1 FUEL LVL SENS SIG
331 TAN/WHT 60 24 OIL PRESS SENS
2705 GRY 40 37 5-VOLT REF
2755 BLK 24 21 C2 C2 LOW REF
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
BLK 1
GRY 2
TAN/WHT 3
ENGINE OIL PRESSURE (EOP) SENSOR (5.3L: BELOW THROTTLE BODY) (3.5L/3.9L: RIGHT OF STARTER)
PPL B
FUEL LEVEL SENSOR
ORG/BLK
BLK/WHT C
TAN
FUEL PUMP & SENDER ASSEMBLY (TOP OF FUEL TANK)
TAN/WHT B
BLK/WHT A
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
BRAKE FLUID LEVEL SWITCH (MOUNTED UNDER CENTER OF BRAKE FLUID RESERVOIR)
INTERIOR LIGHTS SYSTEM
BLK
G201 (FRONT OF DASH, ABOVE G202)
BRN 2
DK GRN/ WHT 1
PNK 3
GRY 4
BLK 5
CUSTOMI- ZATION
VEHICLE INFOR- MATION
SET/ RESET
TRIP/ FUEL
DRIVER INFORMATION CENTER (DIC) SWITCH
235389

Fig. 37: Instrument Cluster Circuit

INTERIOR LIGHTS

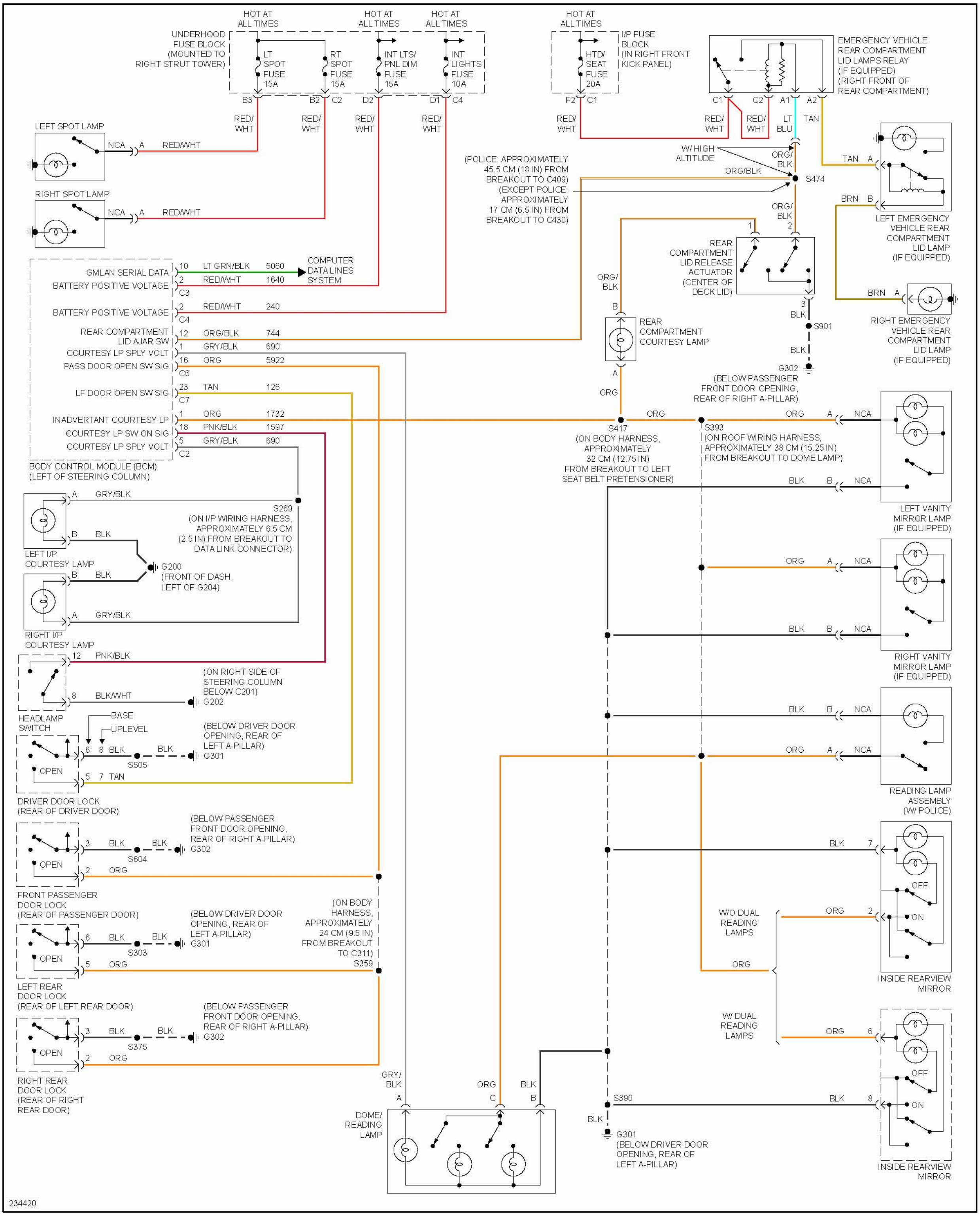

HOT AT ALL TIMES
HOT AT ALL TIMES
HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
LT SPOT FUSE 15A
RT SPOT FUSE 15A
INT LTS/ PNL DIM FUSE 15A
INT LIGHTS FUSE 10A
B3
B2
C2
D2
D1
C4
HOT AT ALL TIMES
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
HTD/ SEAT FUSE 20A
F2
C1
EMERGENCY VEHICLE REAR COMPARTMENT LID LAMPS RELAY (IF EQUIPPED) (RIGHT FRONT OF REAR COMPARTMENT)
C1
C2
A1
A2
RED/ WHT
LT BLU
TAN
LEFT SPOT LAMP
NCA
A
RED/WHT
RIGHT SPOT LAMP
NCA
A
RED/WHT
W/ HIGH ALTITUDE
ORG/ BLK
ORG/BLK
S474
(POLICE: APPROXIMATELY 45.5 CM (18 IN) FROM BREAKOUT TO C409) (EXCEPT POLICE: APPROXIMATELY 17 CM (6.5 IN) FROM BREAKOUT TO C430)
TAN
A
BRN
B
LEFT EMERGENCY VEHICLE REAR COMPARTMENT LID LAMP (IF EQUIPPED)
1
2
REAR COMPARTMENT LID RELEASE ACTUATOR (CENTER OF DECK LID)
ORG/ BLK
B
REAR COMPARTMENT COURTESY LAMP
A
ORG
3
BLK
S901
BLK
G302
(BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
BRN
A
RIGHT EMERGENCY VEHICLE REAR COMPARTMENT LID LAMP (IF EQUIPPED)
GMLAN SERIAL DATA
10
LT GRN/BLK
5060
COMPUTER DATA LINES SYSTEM
BATTERY POSITIVE VOLTAGE
2
RED/WHT
1640
C3
BATTERY POSITIVE VOLTAGE
2
RED/WHT
240
C4
REAR COMPARTMENT LID AJAR SW
12
ORG/BLK
744
COURTESY LP SPLY VOLT
1
GRY/BLK
690
PASS DOOR OPEN SW SIG
16
ORG
5922
C6
LF DOOR OPEN SW SIG
23
TAN
126
C7
INADVERTANT COURTESY LP
1
ORG
1732
COURTESY LP SW ON SIG
18
PNK/BLK
1597
COURTESY LP SPLY VOLT
5
GRY/BLK
690
C2
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
ORG
ORG
S417 (ON BODY HARNESS, APPROXIMATELY 32 CM (12.75 IN) FROM BREAKOUT TO LEFT SEAT BELT PRETENSIONER)
S393 (ON ROOF WIRING HARNESS, APPROXIMATELY 38 CM (15.25 IN) FROM BREAKOUT TO DOME LAMP)
A
NCA
BLK
B
NCA
LEFT VANITY MIRROR LAMP (IF EQUIPPED)
A
GRY/BLK
S269 (ON I/P WIRING HARNESS, APPROXIMATELY 6.5 CM (2.5 IN) FROM BREAKOUT TO DATA LINK CONNECTOR)
B
BLK
LEFT I/P COURTESY LAMP
B
BLK
G200 (FRONT OF DASH, LEFT OF G204)
A
GRY/BLK
RIGHT I/P COURTESY LAMP
ORG
A
NCA
BLK
B
NCA
RIGHT VANITY MIRROR LAMP (IF EQUIPPED)
12
PNK/BLK
(ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
8
BLK/WHT
G202
HEADLAMP SWITCH
BASE
UPLEVEL
6
8
BLK
BLK
S505
G301
(BELOW DRIVER DOOR OPENING, REAR OF LEFT A-PILLAR)
OPEN
5
7
TAN
DRIVER DOOR LOCK (REAR OF DRIVER DOOR)
BLK
B
NCA
ORG
A
NCA
READING LAMP ASSEMBLY (W/ POLICE)
(BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
3
BLK
BLK
S604
G302
OPEN
2
ORG
FRONT PASSENGER DOOR LOCK (REAR OF PASSENGER DOOR)
BLK
7
OFF
ON
W/O DUAL READING LAMPS
ORG
2
ORG
INSIDE REARVIEW MIRROR
(BELOW DRIVER DOOR OPENING, REAR OF LEFT A-PILLAR)
(ON BODY HARNESS, APPROXIMATELY 24 CM (9.5 IN) FROM BREAKOUT TO C311)
S359
6
BLK
BLK
S303
G301
OPEN
5
ORG
LEFT REAR DOOR LOCK (REAR OF LEFT REAR DOOR)
(BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
3
BLK
BLK
S375
G302
OPEN
2
ORG
RIGHT REAR DOOR LOCK (REAR OF RIGHT REAR DOOR)
W/ DUAL READING LAMPS
ORG
6
OFF
ON
GRY/ BLK
A
ORG
C
BLK
B
DOME/ READING LAMP
S390
BLK
8
BLK
G301 (BELOW DRIVER DOOR OPENING, REAR OF LEFT A-PILLAR)
INSIDE REARVIEW MIRROR
234420

Fig. 38: Courtesy Lamps Circuit

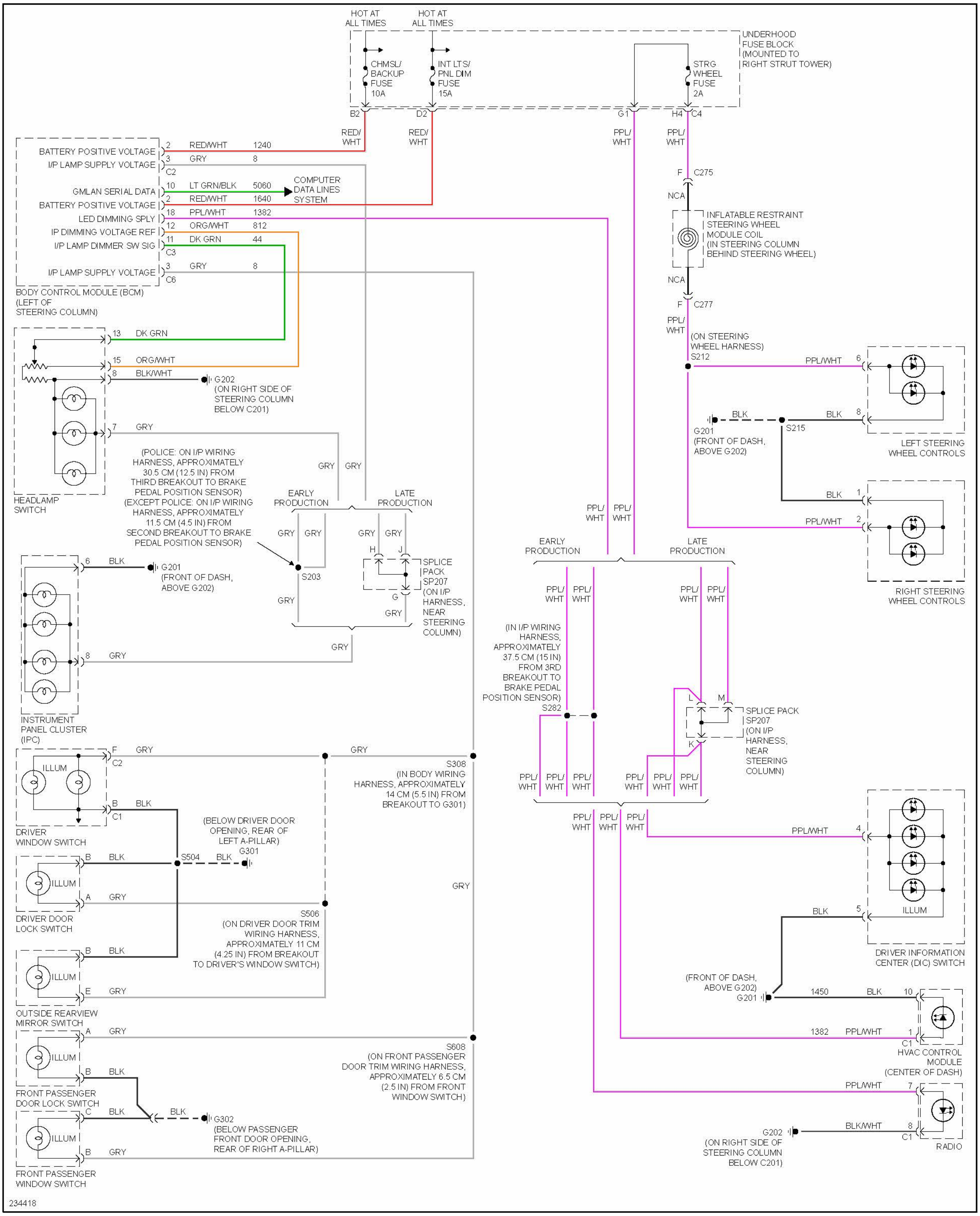

HOT AT ALL TIMES
HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
CHMSL/ BACKUP FUSE 10A
INT LTS/ PNL DIM FUSE 15A
STRG WHEEL FUSE 2A
B2
D2
G1
H4
C4
RED/ WHT
RED/ WHT
PPL/ WHT
PPL/ WHT
BATTERY POSITIVE VOLTAGE
I/P LAMP SUPPLY VOLTAGE
2 RED/WHT 1240
3 GRY 8
C2
GMLAN SERIAL DATA
BATTERY POSITIVE VOLTAGE
LED DIMMING SPLY
IP DIMMING VOLTAGE REF
I/P LAMP DIMMER SW SIG
10 LT GRN/BLK 5060
2 RED/WHT 1640
18 PPL/WHT 1382
12 ORG/WHT 812
11 DK GRN 44
C3
COMPUTER DATA LINES SYSTEM
I/P LAMP SUPPLY VOLTAGE
3 GRY 8
C6
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
F C275
NCA
INFLATABLE RESTRAINT STEERING WHEEL MODULE COIL (IN STEERING COLUMN BEHIND STEERING WHEEL)
NCA
F C277
PPL/ WHT
(ON STEERING WHEEL HARNESS) S212
13 DK GRN
15 ORG/WHT
8 BLK/WHT
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
7 GRY
HEADLAMP SWITCH
PPL/WHT 6
BLK
BLK 8
G201 (FRONT OF DASH, ABOVE G202)
S215
LEFT STEERING WHEEL CONTROLS
BLK 1
PPL/WHT 2
RIGHT STEERING WHEEL CONTROLS
(POLICE: ON I/P WIRING HARNESS, APPROXIMATELY 30.5 CM (12.5 IN) FROM THIRD BREAKOUT TO BRAKE PEDAL POSITION SENSOR) (EXCEPT POLICE: ON I/P WIRING HARNESS, APPROXIMATELY 11.5 CM (4.5 IN) FROM SECOND BREAKOUT TO BRAKE PEDAL POSITION SENSOR)
GRY GRY
EARLY PRODUCTION
LATE PRODUCTION
GRY GRY
GRY GRY
H J
SPLICE PACK SP207 (ON I/P HARNESS, NEAR STEERING COLUMN)
G
GRY
S203
GRY
GRY
PPL/ WHT
PPL/ WHT
EARLY PRODUCTION
LATE PRODUCTION
PPL/ WHT
PPL/ WHT
PPL/ WHT
PPL/ WHT
6 BLK
G201 (FRONT OF DASH, ABOVE G202)
8 GRY
INSTRUMENT PANEL CLUSTER (IPC)
(IN I/P WIRING HARNESS, APPROXIMATELY 37.5 CM (15 IN) FROM 3RD BREAKOUT TO BRAKE PEDAL POSITION SENSOR)
S282
L M
SPLICE PACK SP207 (ON I/P HARNESS, NEAR STEERING COLUMN)
K
PPL/ WHT
PPL/ WHT
PPL/ WHT
PPL/ WHT
PPL/ WHT
PPL/ WHT
F GRY
C2
ILLUM
GRY
S308 (IN BODY WIRING HARNESS, APPROXIMATELY 14 CM (5.5 IN) FROM BREAKOUT TO G301)
B BLK
C1
DRIVER WINDOW SWITCH
PPL/ WHT
PPL/ WHT
PPL/ WHT
PPL/WHT 4
ILLUM
BLK 5
DRIVER INFORMATION CENTER (DIC) SWITCH
(BELOW DRIVER DOOR OPENING, REAR OF LEFT A-PILLAR) G301
B BLK
S504 BLK
ILLUM
A GRY
DRIVER DOOR LOCK SWITCH
S506 (ON DRIVER DOOR TRIM WIRING HARNESS, APPROXIMATELY 11 CM (4.25 IN) FROM BREAKOUT TO DRIVER'S WINDOW SWITCH)
GRY
B BLK
ILLUM
E GRY
OUTSIDE REARVIEW MIRROR SWITCH
(FRONT OF DASH, ABOVE G202) G201
1450 BLK 10
1382 PPL/WHT 1
C1
HVAC CONTROL MODULE (CENTER OF DASH)
A GRY
ILLUM
B BLK
FRONT PASSENGER DOOR LOCK SWITCH
S608 (ON FRONT PASSENGER DOOR TRIM WIRING HARNESS, APPROXIMATELY 6.5 CM (2.5 IN) FROM FRONT WINDOW SWITCH)
PPL/WHT 7
C BLK
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
ILLUM
B GRY
FRONT PASSENGER WINDOW SWITCH
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
BLK/WHT 8
C1
RADIO
234418

Fig. 39: Instrument Illumination Circuit

POWER DISTRIBUTION

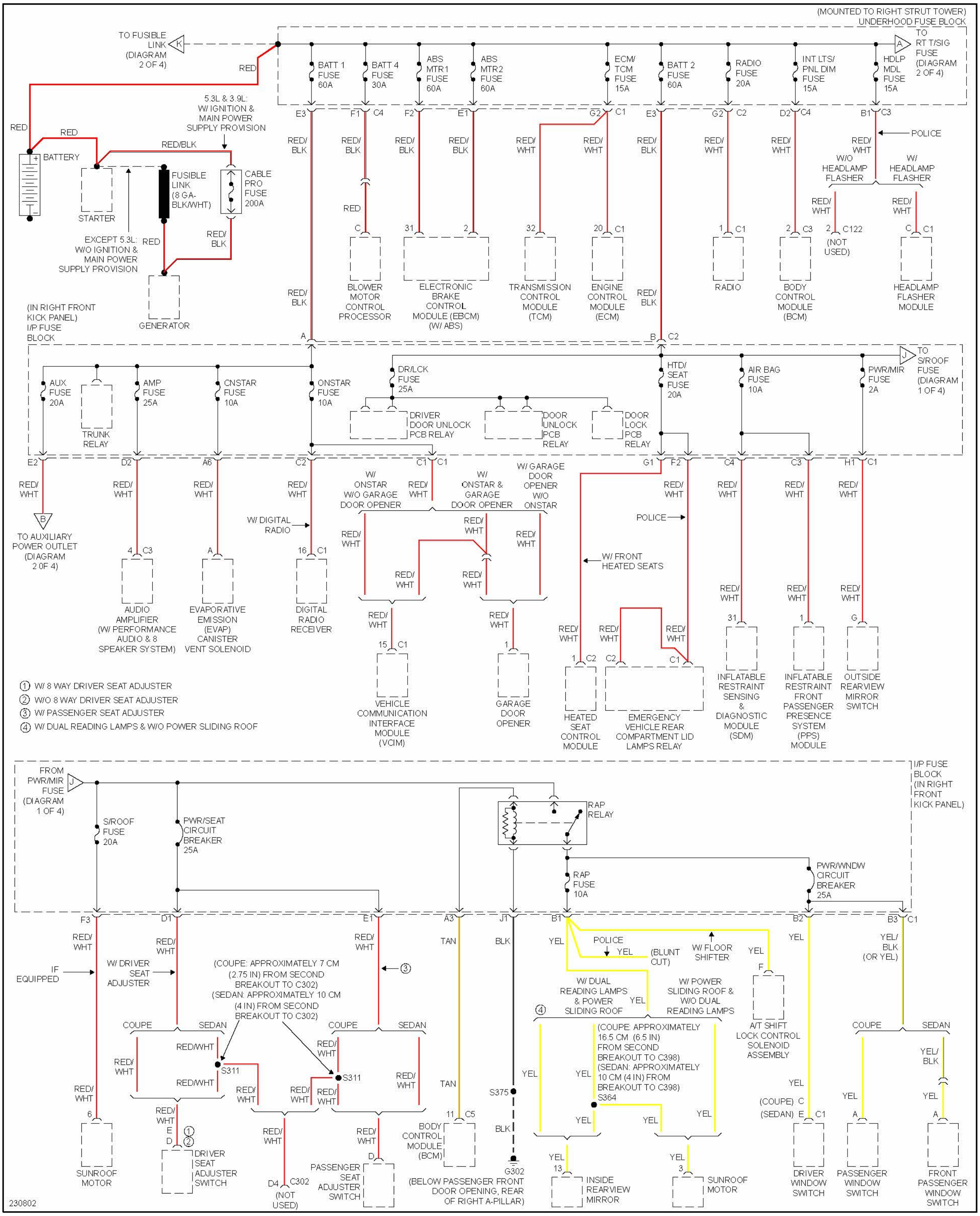

(MOUNTED TO RIGHT STRUT TOWER)
UNDERHOOD FUSE BLOCK
TO FUSIBLE LINK (DIAGRAM 2 OF 4)
K
RED
BATT 1 FUSE 60A
BATT 4 FUSE 30A
ABS MTR1 FUSE 60A
ABS MTR2 FUSE 60A
ECM/ TCM FUSE 15A
BATT 2 FUSE 60A
RADIO FUSE 20A
INT LTS/ PNL DIM FUSE 15A
HDLP MDL FUSE 15A
A
TO RT T/SIG FUSE (DIAGRAM 2 OF 4)
E3
F1 C4
F2
E1
G2 C1
E3
G2 C2
D2 C4
B1 C3
POLICE
5.3L & 3.9L: W/ IGNITION & MAIN POWER SUPPLY PROVISION
RED
RED
RED/BLK
BATTERY
STARTER
FUSIBLE LINK (8 GA-BLK/WHT)
CABLE PRO FUSE 200A
EXCEPT 5.3L: W/O IGNITION & MAIN POWER SUPPLY PROVISION
RED
RED/ BLK
GENERATOR
RED/ BLK
RED/ BLK
RED/ BLK
RED/ BLK
RED/ WHT
RED/ WHT
RED/ BLK
RED/ WHT
RED/ WHT
RED/ WHT
W/O HEADLAMP FLASHER
W/ HEADLAMP FLASHER
RED
RED/ WHT
RED/ WHT
C
31
2
32
20 C1
1 C1
2 C3
2 C122
C C1
(NOT USED)
BLOWER MOTOR CONTROL PROCESSOR
ELECTRONIC BRAKE CONTROL MODULE (EBCM) (W/ ABS)
TRANSMISSION CONTROL MODULE (TCM)
ENGINE CONTROL MODULE (ECM)
RADIO
BODY CONTROL MODULE (BCM)
HEADLAMP FLASHER MODULE
RED/ BLK
RED/ BLK
(IN RIGHT FRONT KICK PANEL) I/P FUSE BLOCK
A
B C2
J
TO S/ROOF FUSE (DIAGRAM 1 OF 4)
AUX FUSE 20A
TRUNK RELAY
AMP FUSE 25A
CNSTAR FUSE 10A
ONSTAR FUSE 10A
DR/LCK FUSE 25A
DRIVER DOOR UNLOCK PCB RELAY
DOOR UNLOCK PCB RELAY
DOOR LOCK PCB RELAY
HTD/ SEAT FUSE 20A
AIR BAG FUSE 10A
PWR/MIR FUSE 2A
E2
D2
A6
C2
C1 C1
G1
F2
C4
C3
H1 C1
RED/ WHT
RED/ WHT
RED/ WHT
RED/ WHT
W/ ONSTAR W/O GARAGE DOOR OPENER
RED/ WHT
W/ ONSTAR & GARAGE DOOR OPENER
W/ GARAGE DOOR OPENER W/O ONSTAR
RED/ WHT
RED/ WHT
RED/ WHT
RED/ WHT
B
TO AUXILIARY POWER OUTLET (DIAGRAM 2 OF 4)
W/ DIGITAL RADIO
POLICE
RED/ WHT
RED/ WHT
RED/ WHT
W/ FRONT HEATED SEATS
4 C3
A
16 C1
RED/ WHT
RED/ WHT
AUDIO AMPLIFIER (W/ PERFORMANCE AUDIO & 8 SPEAKER SYSTEM)
EVAPORATIVE EMISSION (EVAP) CANISTER VENT SOLENOID
DIGITAL RADIO RECEIVER
RED/ WHT
RED/ WHT
15 C1
1
VEHICLE COMMUNICATION INTERFACE MODULE (VCIM)
GARAGE DOOR OPENER
RED/ WHT
RED/ WHT
RED/ WHT
1 C2
C2
C1
HEATED SEAT CONTROL MODULE
EMERGENCY VEHICLE REAR COMPARTMENT LID LAMPS RELAY
RED/ WHT
RED/ WHT
RED/ WHT
31
1
G
INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE (SDM)
INFLATABLE RESTRAINT FRONT PASSENGER PRESENCE SYSTEM (PPS) MODULE
OUTSIDE REARVIEW MIRROR SWITCH
① W/ 8 WAY DRIVER SEAT ADJUSTER
② W/O 8 WAY DRIVER SEAT ADJUSTER
③ W/ PASSENGER SEAT ADJUSTER
④ W/ DUAL READING LAMPS & W/O POWER SLIDING ROOF
FROM PWR/MIR FUSE (DIAGRAM 1 OF 4)
J
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
S/ROOF FUSE 20A
PWR/SEAT CIRCUIT BREAKER 25A
RAP RELAY
RAP FUSE 10A
PWR/WNDW CIRCUIT BREAKER 25A
F3
D1
E1
A3
J1
B1
B2
B3 C1
RED/ WHT
RED/ WHT
RED/ WHT
TAN
BLK
YEL
POLICE
YEL
(BLUNT CUT)
W/ FLOOR SHIFTER
YEL
YEL
YEL/ BLK (OR YEL)
IF EQUIPPED
W/ DRIVER SEAT ADJUSTER
(COUPE: APPROXIMATELY 7 CM (2.75 IN) FROM SECOND BREAKOUT TO C302) (SEDAN: APPROXIMATELY 10 CM (4 IN) FROM SECOND BREAKOUT TO C302)
③
F
W/ DUAL READING LAMPS & POWER SLIDING ROOF
YEL
W/ POWER SLIDING ROOF & W/O DUAL READING LAMPS
A/T SHIFT LOCK CONTROL SOLENOID ASSEMBLY
COUPE
SEDAN
COUPE
SEDAN
COUPE
SEDAN
④
RED/WHT
RED/ WHT
RED/ WHT
S311
RED/WHT
S311
RED/ WHT
TAN
S375
YEL
YEL
(COUPE: APPROXIMATELY 16.5 CM (6.5 IN) FROM SECOND BREAKOUT TO C398) (SEDAN: APPROXIMATELY 10 CM (4 IN) FROM SECOND BREAKOUT TO C398)
S364
YEL
YEL/ BLK
RED/ WHT
RED/ WHT
RED/ WHT
RED/ WHT
RED/ WHT
YEL
YEL
YEL
YEL
(COUPE) C
(SEDAN) E C1
YEL
YEL
6
RED/ WHT
E ①
D ②
RED/ WHT
RED/ WHT
D
11 C5
BLK
A
A
SUNROOF MOTOR
DRIVER SEAT ADJUSTER SWITCH
D4 C302 (NOT USED)
PASSENGER SEAT ADJUSTER SWITCH
BODY CONTROL MODULE (BCM)
G302
(BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
YEL
13
INSIDE REARVIEW MIRROR
YEL
3
SUNROOF MOTOR
DRIVER WINDOW SWITCH
PASSENGER WINDOW SWITCH
FRONT PASSENGER WINDOW SWITCH
230802

Fig. 40: Power Distribution Circuit (1 of 4)

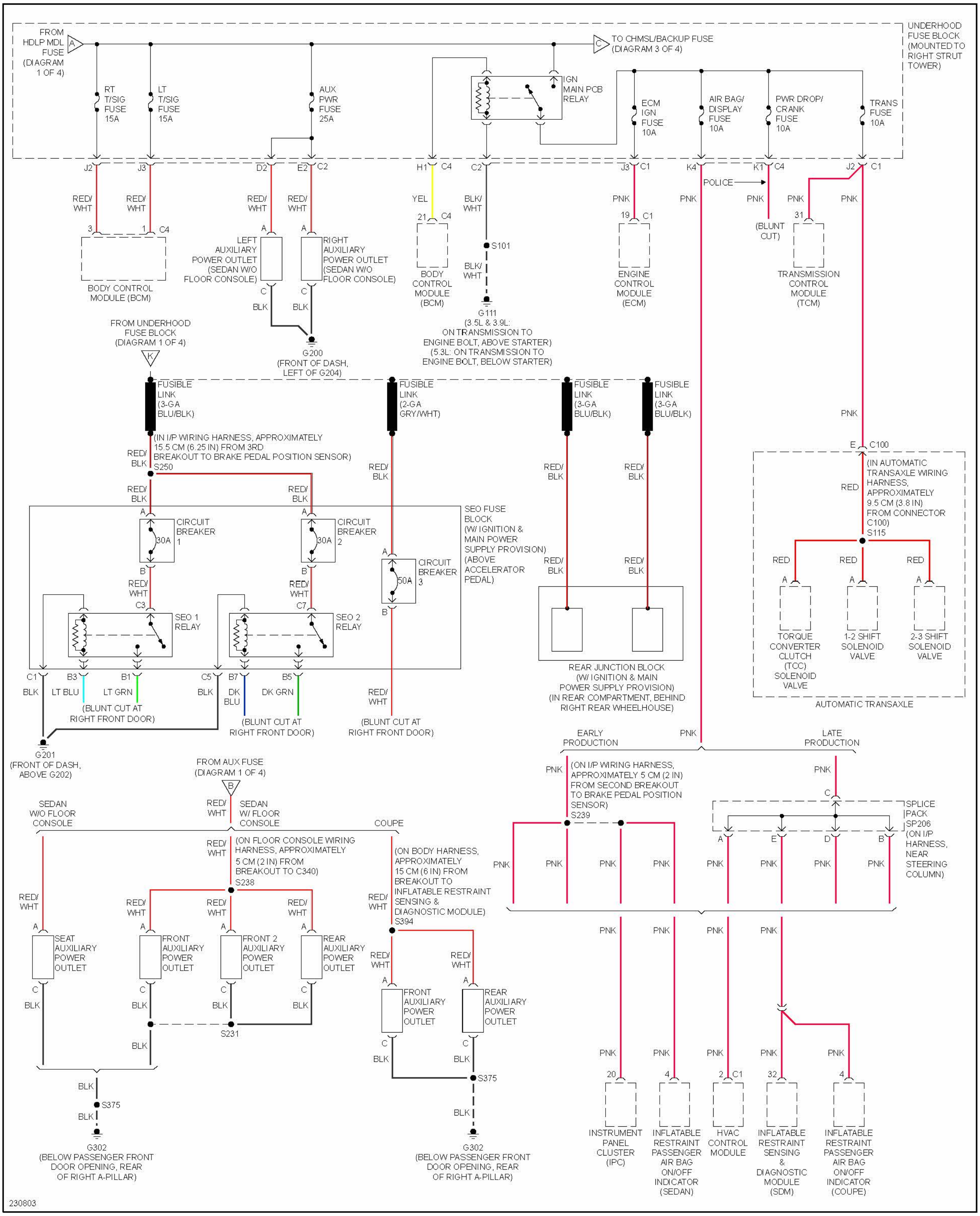

FROM HDLP MDL FUSE (DIAGRAM 1 OF 4)
A
TO CHMSL/BACKUP FUSE (DIAGRAM 3 OF 4)
C
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
RT T/SIG FUSE 15A
LT T/SIG FUSE 15A
AUX PWR FUSE 25A
IGN MAIN PCB RELAY
ECM IGN FUSE 10A
AIR BAG/ DISPLAY FUSE 10A
PWR DROP/ CRANK FUSE 10A
TRANS FUSE 10A
J2
J3
D2
E2 C2
H1 C4
C2
J3 C1
K4
K1 C4
J2 C1
POLICE
RED/ WHT
RED/ WHT
RED/ WHT
RED/ WHT
YEL
BLK/ WHT
PNK
PNK
PNK
PNK
PNK
3
1 C4
BODY CONTROL MODULE (BCM)
LEFT AUXILIARY POWER OUTLET (SEDAN W/O FLOOR CONSOLE)
RIGHT AUXILIARY POWER OUTLET (SEDAN W/O FLOOR CONSOLE)
21 C4
BODY CONTROL MODULE (BCM)
S101
BLK/ WHT
G111 (3.5L & 3.9L: ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER) (5.3L: ON TRANSMISSION TO ENGINE BOLT, BELOW STARTER)
19 C1
ENGINE CONTROL MODULE (ECM)
(BLUNT CUT)
31
TRANSMISSION CONTROL MODULE (TCM)
BLK
BLK
G200 (FRONT OF DASH, LEFT OF G204)
FROM UNDERHOOD FUSE BLOCK (DIAGRAM 1 OF 4)
K
FUSIBLE LINK (3-GA BLU/BLK)
FUSIBLE LINK (2-GA GRY/WHT)
FUSIBLE LINK (3-GA BLU/BLK)
FUSIBLE LINK (3-GA BLU/BLK)
(IN I/P WIRING HARNESS, APPROXIMATELY 15.5 CM (6.25 IN) FROM 3RD BREAKOUT TO BRAKE PEDAL POSITION SENSOR)
RED/ BLK
S250
RED/ BLK
RED/ BLK
RED/ BLK
RED/ BLK
PNK
E C100
(IN AUTOMATIC TRANSAXLE WIRING HARNESS, APPROXIMATELY 9.5 CM (3.8 IN) FROM CONNECTOR C100)
RED
S115
SEO FUSE BLOCK (W/ IGNITION & MAIN POWER SUPPLY PROVISION) (ABOVE ACCELERATOR PEDAL)
CIRCUIT BREAKER 1
30A
CIRCUIT BREAKER 2
30A
CIRCUIT BREAKER 3
50A
RED/ WHT
RED/ WHT
C3
C7
SEO 1 RELAY
SEO 2 RELAY
RED/ BLK
RED/ BLK
RED
RED
RED
TORQUE CONVERTER CLUTCH (TCC) SOLENOID VALVE
1-2 SHIFT SOLENOID VALVE
2-3 SHIFT SOLENOID VALVE
AUTOMATIC TRANSAXLE
C1
B3
B1
C5
B7
B5
BLK
LT BLU
LT GRN
BLK
DK BLU
DK GRN
RED/ WHT
(BLUNT CUT AT RIGHT FRONT DOOR)
(BLUNT CUT AT RIGHT FRONT DOOR)
(BLUNT CUT AT RIGHT FRONT DOOR)
REAR JUNCTION BLOCK (W/ IGNITION & MAIN POWER SUPPLY PROVISION) (IN REAR COMPARTMENT, BEHIND RIGHT REAR WHEELHOUSE)
G201 (FRONT OF DASH, ABOVE G202)
EARLY PRODUCTION
PNK
LATE PRODUCTION
(ON I/P WIRING HARNESS, APPROXIMATELY 5 CM (2 IN) FROM SECOND BREAKOUT TO BRAKE PEDAL POSITION SENSOR)
S239
SPLICE PACK SP206 (ON I/P HARNESS, NEAR STEERING COLUMN)
FROM AUX FUSE (DIAGRAM 1 OF 4)
B
SEDAN W/O FLOOR CONSOLE
SEDAN W/ FLOOR CONSOLE
COUPE
(ON FLOOR CONSOLE WIRING HARNESS, APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO C340)
S238
(ON BODY HARNESS, APPROXIMATELY 15 CM (6 IN) FROM BREAKOUT TO INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE)
S394
SEAT AUXILIARY POWER OUTLET
FRONT AUXILIARY POWER OUTLET
FRONT 2 AUXILIARY POWER OUTLET
REAR AUXILIARY POWER OUTLET
FRONT AUXILIARY POWER OUTLET
REAR AUXILIARY POWER OUTLET
S231
S375
S375
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
20
4
2 C1
32
4
INSTRUMENT PANEL CLUSTER (IPC)
INFLATABLE RESTRAINT PASSENGER AIR BAG ON/OFF INDICATOR (SEDAN)
HVAC CONTROL MODULE
INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE (SDM)
INFLATABLE RESTRAINT PASSENGER AIR BAG ON/OFF INDICATOR (COUPE)
230803

Fig. 41: Power Distribution Circuit (2 of 4)

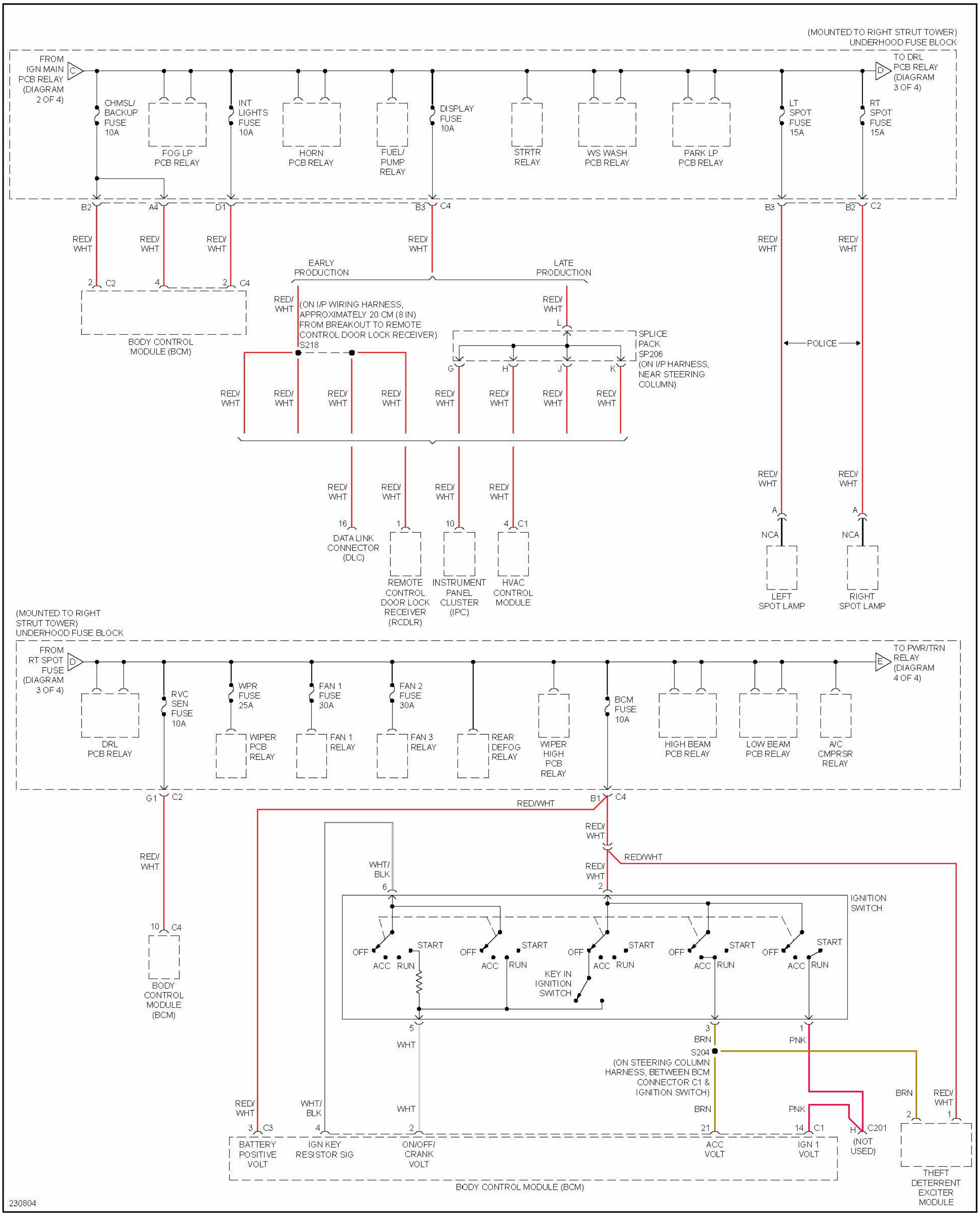

(MOUNTED TO RIGHT STRUT TOWER) UNDERHOOD FUSE BLOCK
FROM IGN MAIN PCB RELAY (DIAGRAM 2 OF 4)
C
TO DRL PCB RELAY (DIAGRAM 3 OF 4)
D
CHMSL/ BACKUP FUSE 10A
FOG LP PCB RELAY
INT LIGHTS FUSE 10A
HORN PCB RELAY
FUEL/ PUMP RELAY
DISPLAY FUSE 10A
STRTR RELAY
WS WASH PCB RELAY
PARK LP PCB RELAY
LT SPOT FUSE 15A
RT SPOT FUSE 15A
B2
A4
D1
B3 C4
B3
B2 C2
RED/ WHT
2 C2
4
2 C4
BODY CONTROL MODULE (BCM)
EARLY PRODUCTION
LATE PRODUCTION
(ON I/P WIRING HARNESS, APPROXIMATELY 20 CM (8 IN) FROM BREAKOUT TO REMOTE CONTROL DOOR LOCK RECEIVER) S218
L
SPLICE PACK SP206 (ON I/P HARNESS, NEAR STEERING COLUMN)
G
H
J
K
POLICE
16
DATA LINK CONNECTOR (DLC)
1
REMOTE CONTROL DOOR LOCK RECEIVER (RCDLR)
10
INSTRUMENT PANEL CLUSTER (IPC)
4 C1
HVAC CONTROL MODULE
A
NCA
LEFT SPOT LAMP
RIGHT SPOT LAMP
(MOUNTED TO RIGHT STRUT TOWER) UNDERHOOD FUSE BLOCK
FROM RT SPOT FUSE (DIAGRAM 3 OF 4)
D
TO PWR/TRN RELAY (DIAGRAM 4 OF 4)
E
DRL PCB RELAY
RVC SEN FUSE 10A
WPR FUSE 25A
WIPER PCB RELAY
FAN 1 FUSE 30A
FAN 1 RELAY
FAN 2 FUSE 30A
FAN 3 RELAY
REAR DEFOG RELAY
WIPER HIGH PCB RELAY
BCM FUSE 10A
HIGH BEAM PCB RELAY
LOW BEAM PCB RELAY
A/C CMPRSR RELAY
G1 C2
B1 C4
RED/WHT
WHT/ BLK
6
2
IGNITION SWITCH
OFF
ACC
RUN
START
KEY IN IGNITION SWITCH
10 C4
BODY CONTROL MODULE (BCM)
5
WHT
3
BRN
S204
(ON STEERING COLUMN HARNESS, BETWEEN BCM CONNECTOR C1 & IGNITION SWITCH)
1
PNK
3 C3
BATTERY POSITIVE VOLT
4
IGN KEY RESISTOR SIG
2
ON/OFF/ CRANK VOLT
21
ACC VOLT
14 C1
IGN 1 VOLT
H C201
(NOT USED)
BODY CONTROL MODULE (BCM)
2
1
THEFT DETERRENT EXCITER MODULE
230804

Fig. 42: Power Distribution Circuit (3 of 4)

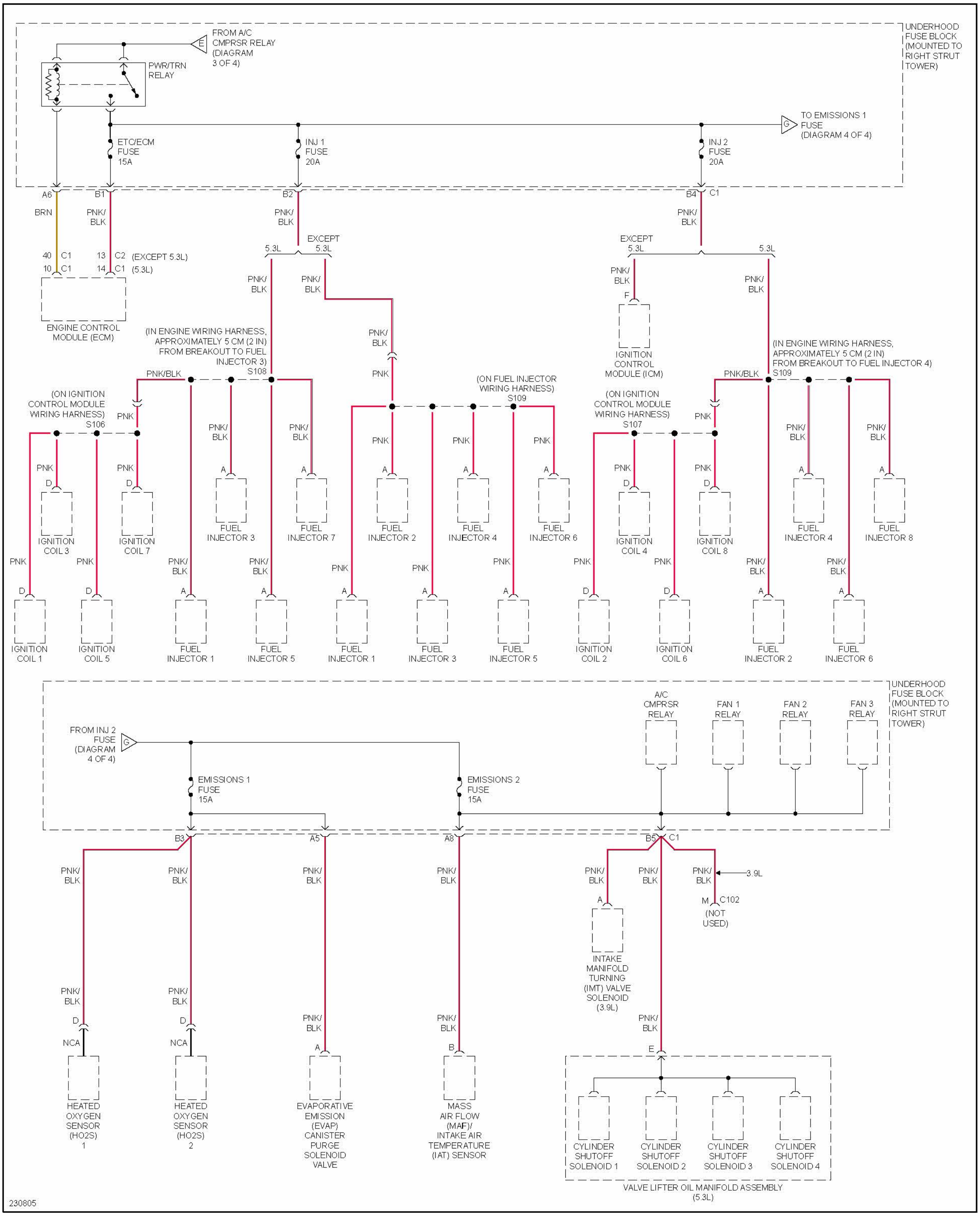

UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
FROM A/C CMPRSR RELAY (DIAGRAM 3 OF 4)
E
PWR/TRN RELAY
TO EMISSIONS 1 FUSE (DIAGRAM 4 OF 4)
G
ETC/ECM FUSE 15A
INJ 1 FUSE 20A
INJ 2 FUSE 20A
A6
B1
B2
B4
C1
BRN
PNK/BLK
40 C1
10 C1
13 C2 (EXCEPT 5.3L)
14 C1 (5.3L)
ENGINE CONTROL MODULE (ECM)
5.3L
EXCEPT 5.3L
(IN ENGINE WIRING HARNESS, APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO FUEL INJECTOR 3)
S108
PNK/BLK
PNK
(ON IGNITION CONTROL MODULE WIRING HARNESS)
S106
(ON FUEL INJECTOR WIRING HARNESS)
S109
F
IGNITION CONTROL MODULE (ICM)
(ON IGNITION CONTROL MODULE WIRING HARNESS)
S107
(IN ENGINE WIRING HARNESS, APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO FUEL INJECTOR 4)
S109
A
D
IGNITION COIL 3
IGNITION COIL 7
FUEL INJECTOR 3
FUEL INJECTOR 7
FUEL INJECTOR 2
FUEL INJECTOR 4
FUEL INJECTOR 6
IGNITION COIL 4
IGNITION COIL 8
FUEL INJECTOR 4
FUEL INJECTOR 8
IGNITION COIL 1
IGNITION COIL 5
FUEL INJECTOR 1
FUEL INJECTOR 5
FUEL INJECTOR 1
FUEL INJECTOR 3
FUEL INJECTOR 5
IGNITION COIL 2
IGNITION COIL 6
FUEL INJECTOR 2
FUEL INJECTOR 6
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
A/C CMPRSR RELAY
FAN 1 RELAY
FAN 2 RELAY
FAN 3 RELAY
FROM INJ 2 FUSE (DIAGRAM 4 OF 4)
G
EMISSIONS 1 FUSE 15A
EMISSIONS 2 FUSE 15A
B3
A5
A8
B5
C1
3.9L
M
C102
(NOT USED)
INTAKE MANIFOLD TURNING (IMT) VALVE SOLENOID (3.9L)
NCA
B
E
HEATED OXYGEN SENSOR (HO2S) 1
HEATED OXYGEN SENSOR (HO2S) 2
EVAPORATIVE EMISSION (EVAP) CANISTER PURGE SOLENOID VALVE
MASS AIR FLOW (MAF)/ INTAKE AIR TEMPERATURE (IAT) SENSOR
CYLINDER SHUTOFF SOLENOID 1
CYLINDER SHUTOFF SOLENOID 2
CYLINDER SHUTOFF SOLENOID 3
CYLINDER SHUTOFF SOLENOID 4
VALVE LIFTER OIL MANIFOLD ASSEMBLY (5.3L)
230805

Fig. 43: Power Distribution Circuit (4 of 4)

POWER DOOR LOCKS

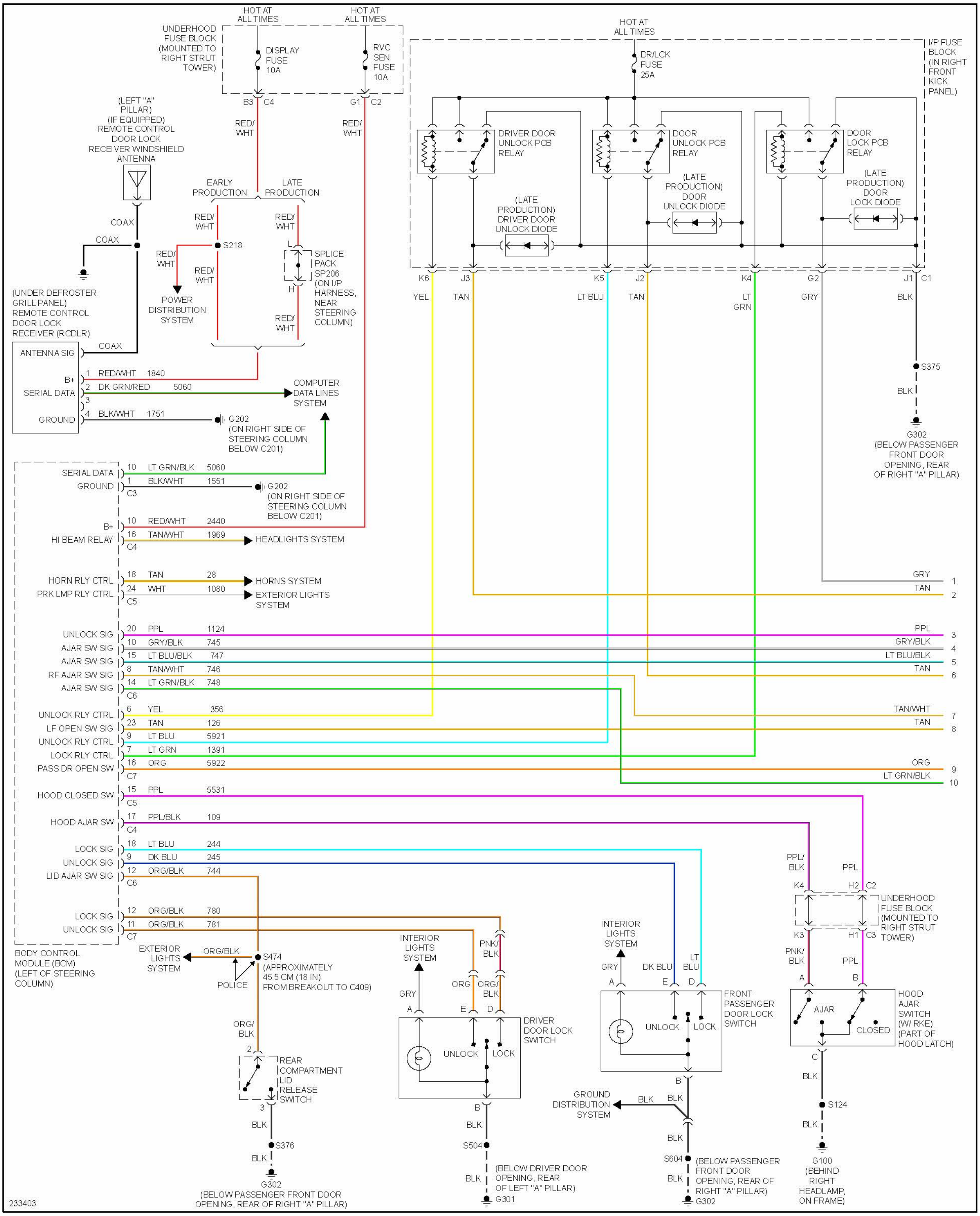

HOT AT ALL TIMES
HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
DISPLAY FUSE 10A
RVC SEN FUSE 10A
B3 C4
G1 C2
RED/WHT
RED/WHT
HOT AT ALL TIMES
DR/LCK FUSE 25A
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
DRIVER DOOR UNLOCK PCB RELAY
DOOR UNLOCK PCB RELAY
DOOR LOCK PCB RELAY
(LATE PRODUCTION) DRIVER DOOR UNLOCK DIODE
(LATE PRODUCTION) DOOR UNLOCK DIODE
(LATE PRODUCTION) DOOR LOCK DIODE
K6 J3 K5 J2 K4 G2 J1 C1
YEL TAN LT BLU TAN LT GRN GRY BLK
S375
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT "A" PILLAR)
(LEFT "A" PILLAR) (IF EQUIPPED) REMOTE CONTROL DOOR LOCK RECEIVER WINDSHIELD ANTENNA
COAX
COAX
EARLY PRODUCTION
LATE PRODUCTION
RED/WHT
RED/WHT
S218
RED/WHT
RED/WHT
POWER DISTRIBUTION SYSTEM
L
SPLICE PACK SP206 (ON I/P HARNESS, NEAR STEERING COLUMN)
H
RED/WHT
(UNDER DEFROSTER GRILL PANEL) REMOTE CONTROL DOOR LOCK RECEIVER (RCDLR)
COAX
ANTENNA SIG
B+ 1 RED/WHT 1840
SERIAL DATA 2 DK GRN/RED 5060
3
GROUND 4 BLK/WHT 1751
COMPUTER DATA LINES SYSTEM
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
SERIAL DATA 10 LT GRN/BLK 5060
GROUND 1 BLK/WHT 1551
C3
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
B+ 10 RED/WHT 2440
HI BEAM RELAY 16 TAN/WHT 1969
C4
HEADLIGHTS SYSTEM
HORN RLY CTRL 18 TAN 28
PRK LMP RLY CTRL 24 WHT 1080
C5
HORNS SYSTEM
EXTERIOR LIGHTS SYSTEM
GRY 1
TAN 2
UNLOCK SIG 20 PPL 1124
AJAR SW SIG 10 GRY/BLK 745
AJAR SW SIG 15 LT BLU/BLK 747
RF AJAR SW SIG 8 TAN/WHT 746
AJAR SW SIG 14 LT GRN/BLK 748
C6
PPL 3
GRY/BLK 4
LT BLU/BLK 5
TAN 6
UNLOCK RLY CTRL 6 YEL 356
LF OPEN SW SIG 23 TAN 126
UNLOCK RLY CTRL 9 LT BLU 5921
LOCK RLY CTRL 7 LT GRN 1391
PASS DR OPEN SW 16 ORG 5922
C7
TAN/WHT 7
TAN 8
ORG 9
LT GRN/BLK 10
HOOD CLOSED SW 15 PPL 5531
C5
HOOD AJAR SW 17 PPL/BLK 109
C4
LOCK SIG 18 LT BLU 244
UNLOCK SIG 9 DK BLU 245
LID AJAR SW SIG 12 ORG/BLK 744
C6
LOCK SIG 12 ORG/BLK 780
UNLOCK SIG 11 ORG/BLK 781
C7
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
EXTERIOR LIGHTS SYSTEM
ORG/BLK
S474 (APPROXIMATELY 45.5 CM (18 IN) FROM BREAKOUT TO C409)
POLICE
ORG/BLK
2
REAR COMPARTMENT LID RELEASE SWITCH
3
BLK
S376
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT "A" PILLAR)
INTERIOR LIGHTS SYSTEM
GRY
A
ORG
E
PNK/BLK
ORG/BLK
D
DRIVER DOOR LOCK SWITCH
UNLOCK
LOCK
B
BLK
S504
BLK
G301 (BELOW DRIVER DOOR OPENING, REAR OF LEFT "A" PILLAR)
INTERIOR LIGHTS SYSTEM
GRY
DK BLU
LT BLU
A E D
FRONT PASSENGER DOOR LOCK SWITCH
UNLOCK
LOCK
B
GROUND DISTRIBUTION SYSTEM
BLK
BLK
BLK
S604
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT "A" PILLAR)
PPL/BLK
PPL
K4
H2 C2
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
K3
H1 C3
PNK/BLK
PPL
A
B
HOOD AJAR SWITCH (W/ RKE) (PART OF HOOD LATCH)
AJAR
CLOSED
C
BLK
S124
BLK
G100 (BEHIND RIGHT HEADLAMP, ON FRAME)
233403

Fig. 44: Power Door Locks Circuit (1 of 2)

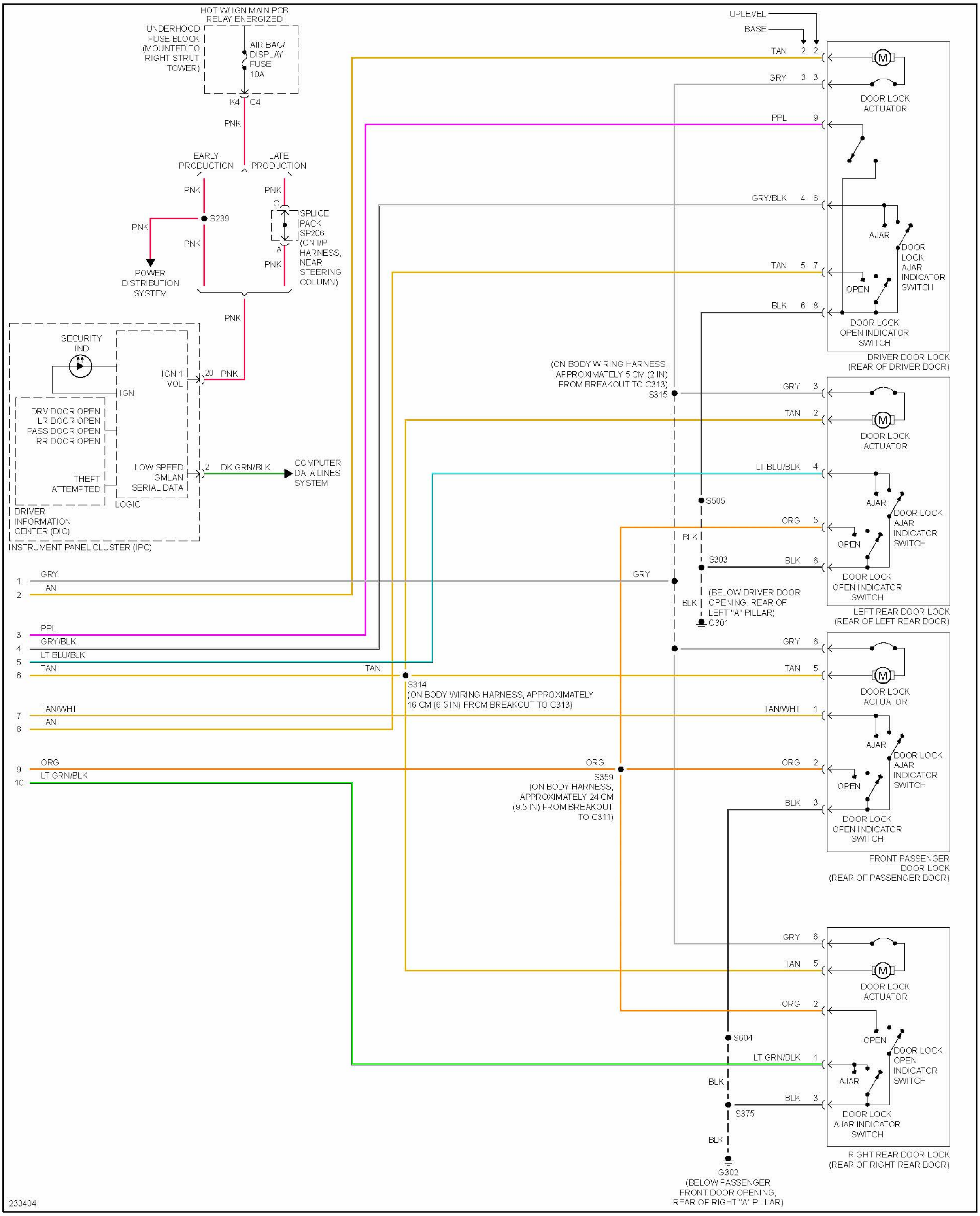

HOT W/ IGN MAIN PCB RELAY ENERGIZED
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
AIR BAG/ DISPLAY FUSE 10A
K4 C4
PNK
EARLY PRODUCTION
LATE PRODUCTION
S239
SPLICE PACK SP206 (ON I/P HARNESS, NEAR STEERING COLUMN)
C
A
POWER DISTRIBUTION SYSTEM
SECURITY IND
IGN
IGN 1 VOL
20 PNK
DRV DOOR OPEN
LR DOOR OPEN
PASS DOOR OPEN
RR DOOR OPEN
THEFT ATTEMPTED
LOW SPEED GMLAN SERIAL DATA
2 DK GRN/BLK
COMPUTER DATA LINES SYSTEM
LOGIC
DRIVER INFORMATION CENTER (DIC)
INSTRUMENT PANEL CLUSTER (IPC)
1 GRY
2 TAN
3 PPL
4 GRY/BLK
5 LT BLU/BLK
6 TAN
7 TAN/WHT
8 TAN
9 ORG
10 LT GRN/BLK
UPLEVEL
BASE
TAN 2 2
GRY 3 3
PPL 9
GRY/BLK 4 6
TAN 5 7
BLK 6 8
M
DOOR LOCK ACTUATOR
AJAR
OPEN
DOOR LOCK AJAR INDICATOR SWITCH
DOOR LOCK OPEN INDICATOR SWITCH
DRIVER DOOR LOCK (REAR OF DRIVER DOOR)
(ON BODY WIRING HARNESS, APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO C313) S315
GRY 3
TAN 2
LT BLU/BLK 4
S505
ORG 5
BLK
S303
BLK 6
(BELOW DRIVER DOOR OPENING, REAR OF LEFT "A" PILLAR)
G301
LEFT REAR DOOR LOCK (REAR OF LEFT REAR DOOR)
GRY
GRY 6
TAN
TAN 5
S314 (ON BODY WIRING HARNESS, APPROXIMATELY 16 CM (6.5 IN) FROM BREAKOUT TO C313)
TAN/WHT 1
ORG
ORG 2
S359 (ON BODY HARNESS, APPROXIMATELY 24 CM (9.5 IN) FROM BREAKOUT TO C311)
BLK 3
FRONT PASSENGER DOOR LOCK (REAR OF PASSENGER DOOR)
GRY 6
TAN 5
ORG 2
S604
LT GRN/BLK 1
BLK 3
S375
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT "A" PILLAR)
RIGHT REAR DOOR LOCK (REAR OF RIGHT REAR DOOR)
233404

Fig. 45: Power Door Locks Circuit (2 of 2)

POWER MIRRORS

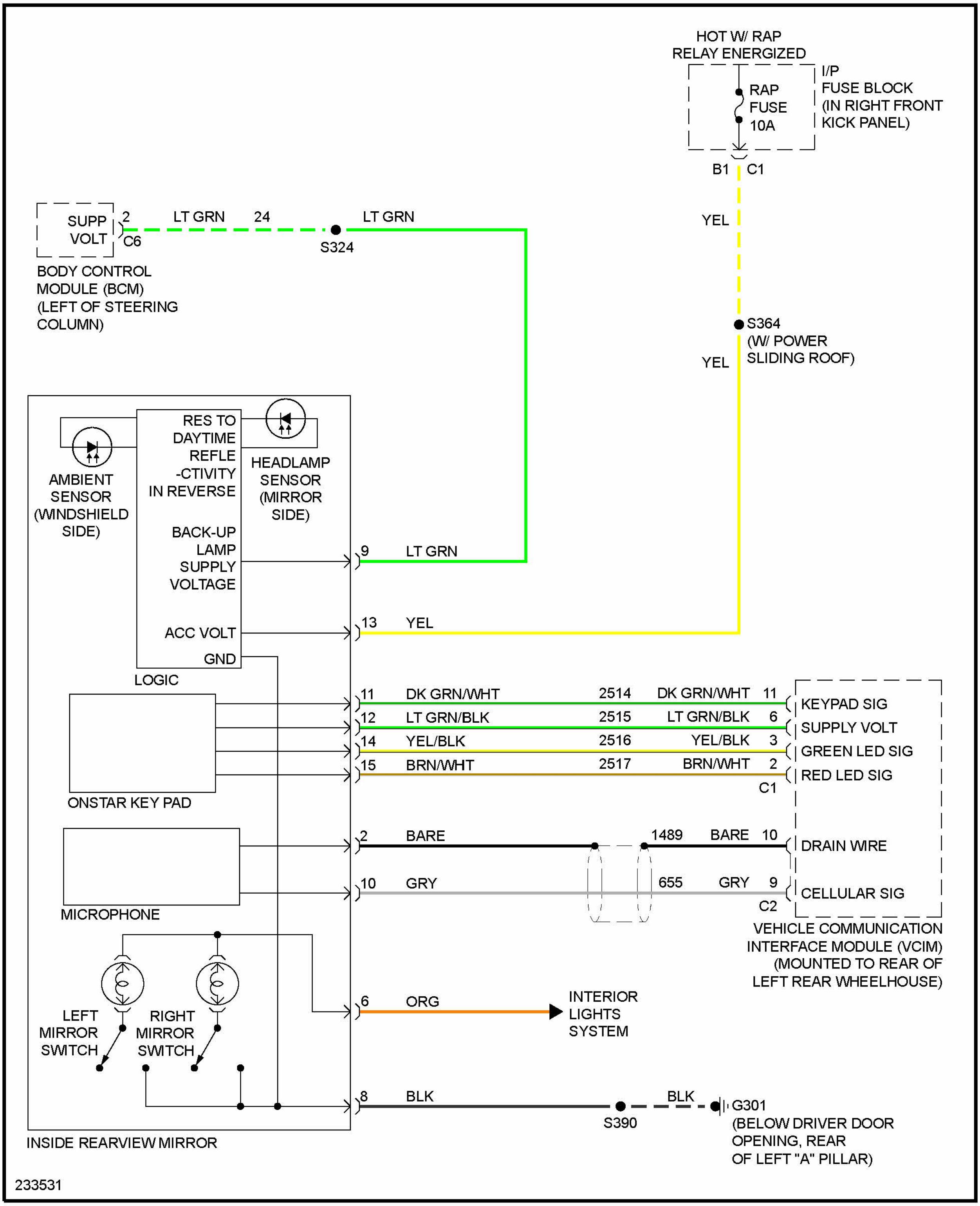

HOT W/ RAP
RELAY ENERGIZED
RAP
FUSE
10A
I/P
FUSE BLOCK
(IN RIGHT FRONT
KICK PANEL)
B1
C1
YEL
S364
(W/ POWER
SLIDING ROOF)
YEL
SUPP
VOLT
2
C6
LT GRN
24
LT GRN
S324
BODY CONTROL
MODULE (BCM)
(LEFT OF STEERING
COLUMN)
RES TO
DAYTIME
REFLE
-CTIVITY
IN REVERSE
AMBIENT
SENSOR
(WINDSHIELD
SIDE)
HEADLAMP
SENSOR
(MIRROR
SIDE)
BACK-UP
LAMP
SUPPLY
VOLTAGE
9
LT GRN
ACC VOLT
13
YEL
GND
LOGIC
11
DK GRN/WHT
2514
DK GRN/WHT
11
KEYPAD SIG
12
LT GRN/BLK
2515
LT GRN/BLK
6
SUPPLY VOLT
14
YEL/BLK
2516
YEL/BLK
3
GREEN LED SIG
15
BRN/WHT
2517
BRN/WHT
2
RED LED SIG
C1
ONSTAR KEY PAD
2
BARE
1489
BARE
10
DRAIN WIRE
10
GRY
655
GRY
9
CELLULAR SIG
C2
MICROPHONE
VEHICLE COMMUNICATION
INTERFACE MODULE (VCIM)
(MOUNTED TO REAR OF
LEFT REAR WHEELHOUSE)
6
ORG
INTERIOR
LIGHTS
SYSTEM
LEFT
MIRROR
SWITCH
RIGHT
MIRROR
SWITCH
8
BLK
S390
BLK
G301
(BELOW DRIVER DOOR
OPENING, REAR
OF LEFT "A" PILLAR)
INSIDE REARVIEW MIRROR
233531

Fig. 46: Electrochromic Mirror Circuit

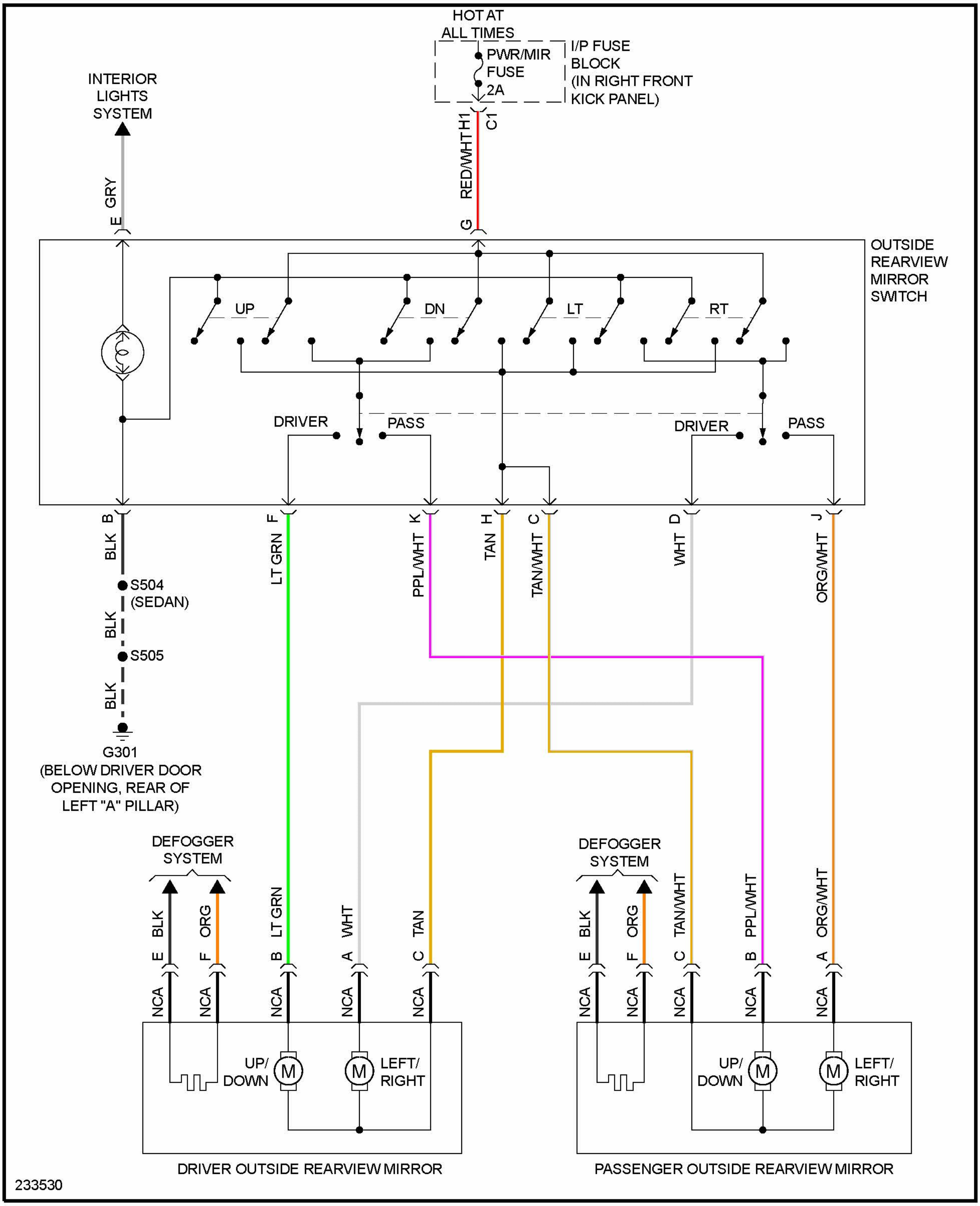

HOT AT ALL TIMES
PWR/MIR FUSE 2A
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
H1
C1
RED/WHT
G
INTERIOR LIGHTS SYSTEM
GRY
E
OUTSIDE REARVIEW MIRROR SWITCH
UP
DN
LT
RT
DRIVER
PASS
DRIVER
PASS
B
BLK
F
LT GRN
K
PPL/WHT
H
TAN
C
TAN/WHT
D
WHT
J
ORG/WHT
S504 (SEDAN)
BLK
S505
BLK
G301 (BELOW DRIVER DOOR OPENING, REAR OF LEFT "A" PILLAR)
DEFOGGER SYSTEM
E BLK
F ORG
B LT GRN
A WHT
C TAN
NCA
NCA
NCA
NCA
NCA
UP/ DOWN
M
M
LEFT/ RIGHT
DRIVER OUTSIDE REARVIEW MIRROR
DEFOGGER SYSTEM
E BLK
F ORG
C TAN/WHT
B PPL/WHT
A ORG/WHT
NCA
NCA
NCA
NCA
NCA
UP/ DOWN
M
M
LEFT/ RIGHT
PASSENGER OUTSIDE REARVIEW MIRROR
233530

Fig. 47: Power Mirrors Circuit

POWER SEATS

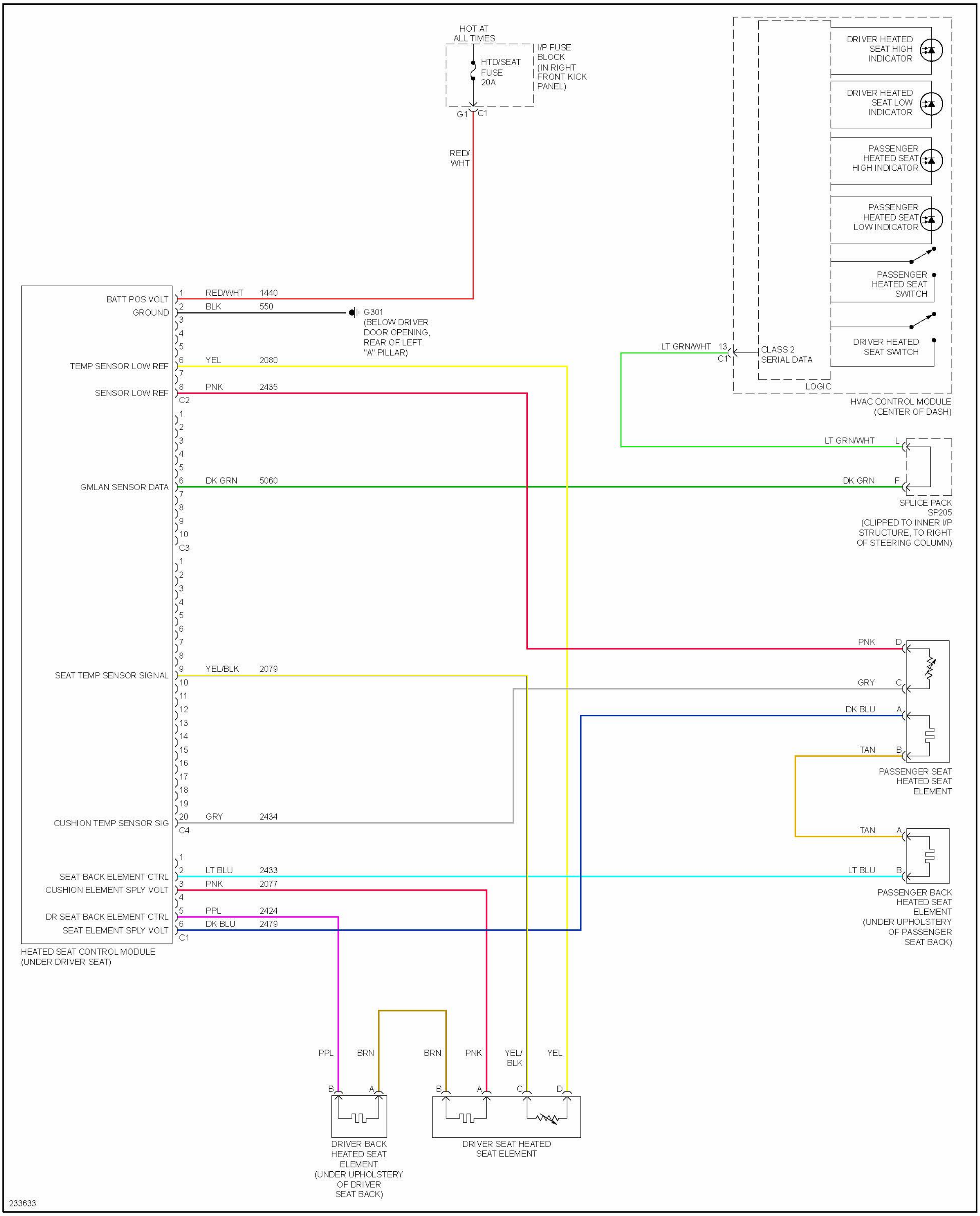

HOT AT ALL TIMES
HTD/SEAT FUSE 20A
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
G1 C1
RED/ WHT
DRIVER HEATED SEAT HIGH INDICATOR
DRIVER HEATED SEAT LOW INDICATOR
PASSENGER HEATED SEAT HIGH INDICATOR
PASSENGER HEATED SEAT LOW INDICATOR
PASSENGER HEATED SEAT SWITCH
DRIVER HEATED SEAT SWITCH
LT GRN/WHT 13 C1
CLASS 2 SERIAL DATA
LOGIC
HVAC CONTROL MODULE (CENTER OF DASH)
BATT POS VOLT 1 RED/WHT 1440
GROUND 2 BLK 550
G301 (BELOW DRIVER DOOR OPENING, REAR OF LEFT "A" PILLAR)
3
4
5
TEMP SENSOR LOW REF 6 YEL 2080
7
SENSOR LOW REF 8 PNK 2435
C2
1
2
3
4
5
GMLAN SENSOR DATA 6 DK GRN 5060
7
8
9
10
C3
LT GRN/WHT L
DK GRN F
SPLICE PACK SP205 (CLIPPED TO INNER I/P STRUCTURE, TO RIGHT OF STEERING COLUMN)
1
2
3
4
5
6
7
8
SEAT TEMP SENSOR SIGNAL 9 YEL/BLK 2079
10
11
12
13
14
15
16
17
18
19
CUSHION TEMP SENSOR SIG 20 GRY 2434
C4
PNK D
GRY C
DK BLU A
TAN B
PASSENGER SEAT HEATED SEAT ELEMENT
TAN A
LT BLU B
PASSENGER BACK HEATED SEAT ELEMENT (UNDER UPHOLSTERY OF PASSENGER SEAT BACK)
1
SEAT BACK ELEMENT CTRL 2 LT BLU 2433
CUSHION ELEMENT SPLY VOLT 3 PNK 2077
4
DR SEAT BACK ELEMENT CTRL 5 PPL 2424
SEAT ELEMENT SPLY VOLT 6 DK BLU 2479
C1
HEATED SEAT CONTROL MODULE (UNDER DRIVER SEAT)
PPL BRN BRN PNK YEL/ BLK YEL
B A B A C D
DRIVER BACK HEATED SEAT ELEMENT (UNDER UPHOLSTERY OF DRIVER SEAT BACK)
DRIVER SEAT HEATED SEAT ELEMENT
233633

Fig. 48: Heated Seats Circuit

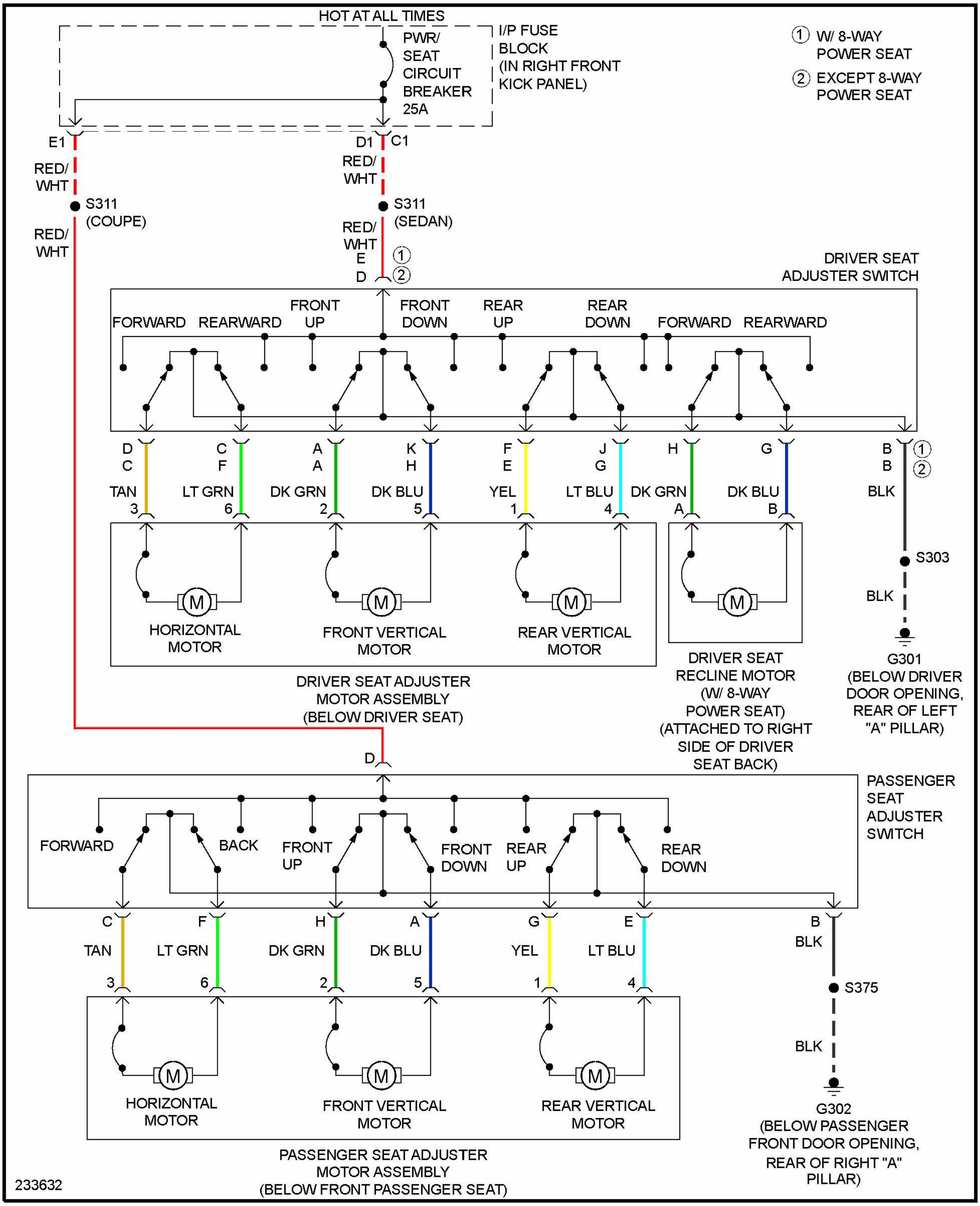

HOT AT ALL TIMES
PWR/ SEAT CIRCUIT BREAKER 25A
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
① W/ 8-WAY POWER SEAT
② EXCEPT 8-WAY POWER SEAT
E1
D1
C1
RED/ WHT
S311 (COUPE)
S311 (SEDAN)
E ①
D ②
DRIVER SEAT ADJUSTER SWITCH
FORWARD
REARWARD
FRONT UP
FRONT DOWN
REAR UP
REAR DOWN
FORWARD
REARWARD
D C TAN 3
C F LT GRN 6
A A DK GRN 2
K H DK BLU 5
F E YEL 1
J G LT BLU 4
H DK GRN A
G DK BLU B
B ① B ② BLK
S303
BLK
G301 (BELOW DRIVER DOOR OPENING, REAR OF LEFT "A" PILLAR)
HORIZONTAL MOTOR
FRONT VERTICAL MOTOR
REAR VERTICAL MOTOR
DRIVER SEAT ADJUSTER MOTOR ASSEMBLY (BELOW DRIVER SEAT)
DRIVER SEAT RECLINE MOTOR (W/ 8-WAY POWER SEAT) (ATTACHED TO RIGHT SIDE OF DRIVER SEAT BACK)
D
PASSENGER SEAT ADJUSTER SWITCH
FORWARD
BACK
FRONT UP
FRONT DOWN
REAR UP
REAR DOWN
C TAN 3
F LT GRN 6
H DK GRN 2
A DK BLU 5
G YEL 1
E LT BLU 4
B BLK
S375
BLK
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT "A" PILLAR)
HORIZONTAL MOTOR
FRONT VERTICAL MOTOR
REAR VERTICAL MOTOR
PASSENGER SEAT ADJUSTER MOTOR ASSEMBLY (BELOW FRONT PASSENGER SEAT)
233632

Fig. 49: Power Seat Circuit

POWER TOP/SUNROOF

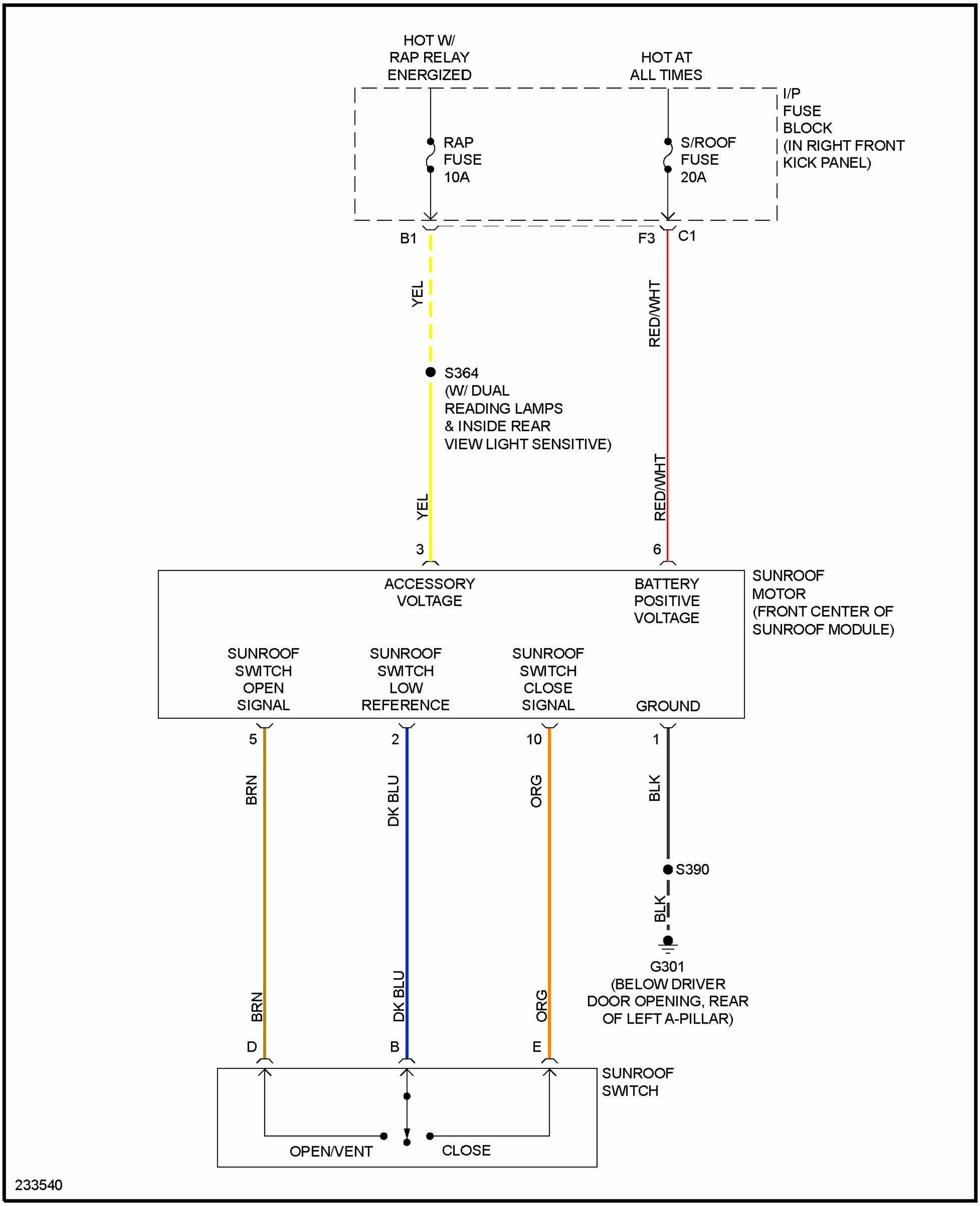

HOT W/ RAP RELAY ENERGIZED
HOT AT ALL TIMES
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
RAP FUSE 10A
S/ROOF FUSE 20A
B1
F3
C1
YEL
RED/WHT
S364 (W/ DUAL READING LAMPS & INSIDE REAR VIEW LIGHT SENSITIVE)
YEL
RED/WHT
3
6
ACCESSORY VOLTAGE
BATTERY POSITIVE VOLTAGE
SUNROOF MOTOR (FRONT CENTER OF SUNROOF MODULE)
SUNROOF SWITCH OPEN SIGNAL
SUNROOF SWITCH LOW REFERENCE
SUNROOF SWITCH CLOSE SIGNAL
GROUND
5
2
10
1
BRN
DK BLU
ORG
BLK
S390
BLK
G301 (BELOW DRIVER DOOR OPENING, REAR OF LEFT A-PILLAR)
BRN
DK BLU
ORG
D
B
E
SUNROOF SWITCH
OPEN/VENT
CLOSE
233540

Fig. 50: Power Top/Sunroof Circuit

POWER WINDOWS

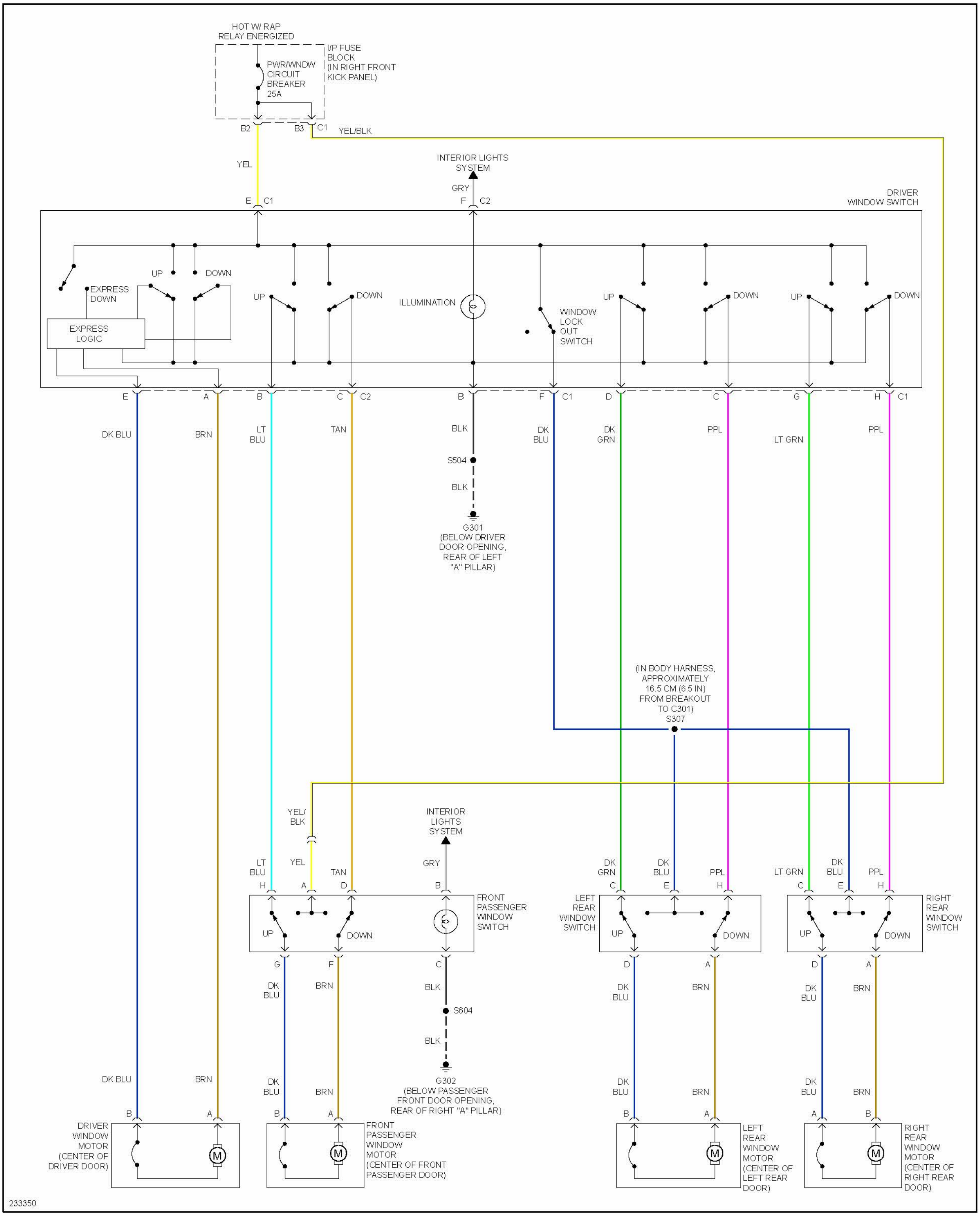

HOT W/ RAP
RELAY ENERGIZED
PWR/WNDW
CIRCUIT
BREAKER
25A
I/P FUSE
BLOCK
(IN RIGHT FRONT
KICK PANEL)
B2
B3
C1
YEL/BLK
YEL
INTERIOR LIGHTS
SYSTEM
GRY
E
C1
F
C2
DRIVER
WINDOW SWITCH
UP
DOWN
EXPRESS
DOWN
EXPRESS
LOGIC
UP
DOWN
ILLUMINATION
WINDOW
LOCK
OUT
SWITCH
UP
DOWN
UP
DOWN
E
A
B
C
C2
B
F
C1
D
C
G
H
C1
DK BLU
BRN
LT
BLU
TAN
BLK
S504
BLK
G301
(BELOW DRIVER
DOOR OPENING,
REAR OF LEFT
"A" PILLAR)
DK
BLU
DK
GRN
PPL
LT GRN
PPL
(IN BODY HARNESS,
APPROXIMATELY
16.5 CM (6.5 IN)
FROM BREAKOUT
TO C301)
S307
YEL/
BLK
INTERIOR
LIGHTS
SYSTEM
LT
BLU
YEL
TAN
GRY
H
A
D
B
FRONT
PASSENGER
WINDOW
SWITCH
UP
DOWN
G
F
C
DK
BLU
BRN
BLK
S604
BLK
G302
(BELOW PASSENGER
FRONT DOOR OPENING,
REAR OF RIGHT "A" PILLAR)
DK
GRN
DK
BLU
PPL
C
E
H
LEFT
REAR
WINDOW
SWITCH
UP
DOWN
D
A
DK
BLU
BRN
LT GRN
DK
BLU
PPL
C
E
H
RIGHT
REAR
WINDOW
SWITCH
UP
DOWN
D
A
DK
BLU
BRN
DK BLU
BRN
B
A
DRIVER
WINDOW
MOTOR
(CENTER OF
DRIVER DOOR)
M
DK
BLU
BRN
B
A
M
FRONT
PASSENGER
WINDOW
MOTOR
(CENTER OF FRONT
PASSENGER DOOR)
DK
BLU
BRN
B
A
M
LEFT
REAR
WINDOW
MOTOR
(CENTER OF
LEFT REAR
DOOR)
DK
BLU
BRN
A
B
M
RIGHT
REAR
WINDOW
MOTOR
(CENTER OF
RIGHT REAR
DOOR)
233350

Fig. 51: Power Windows Circuit

RADIO

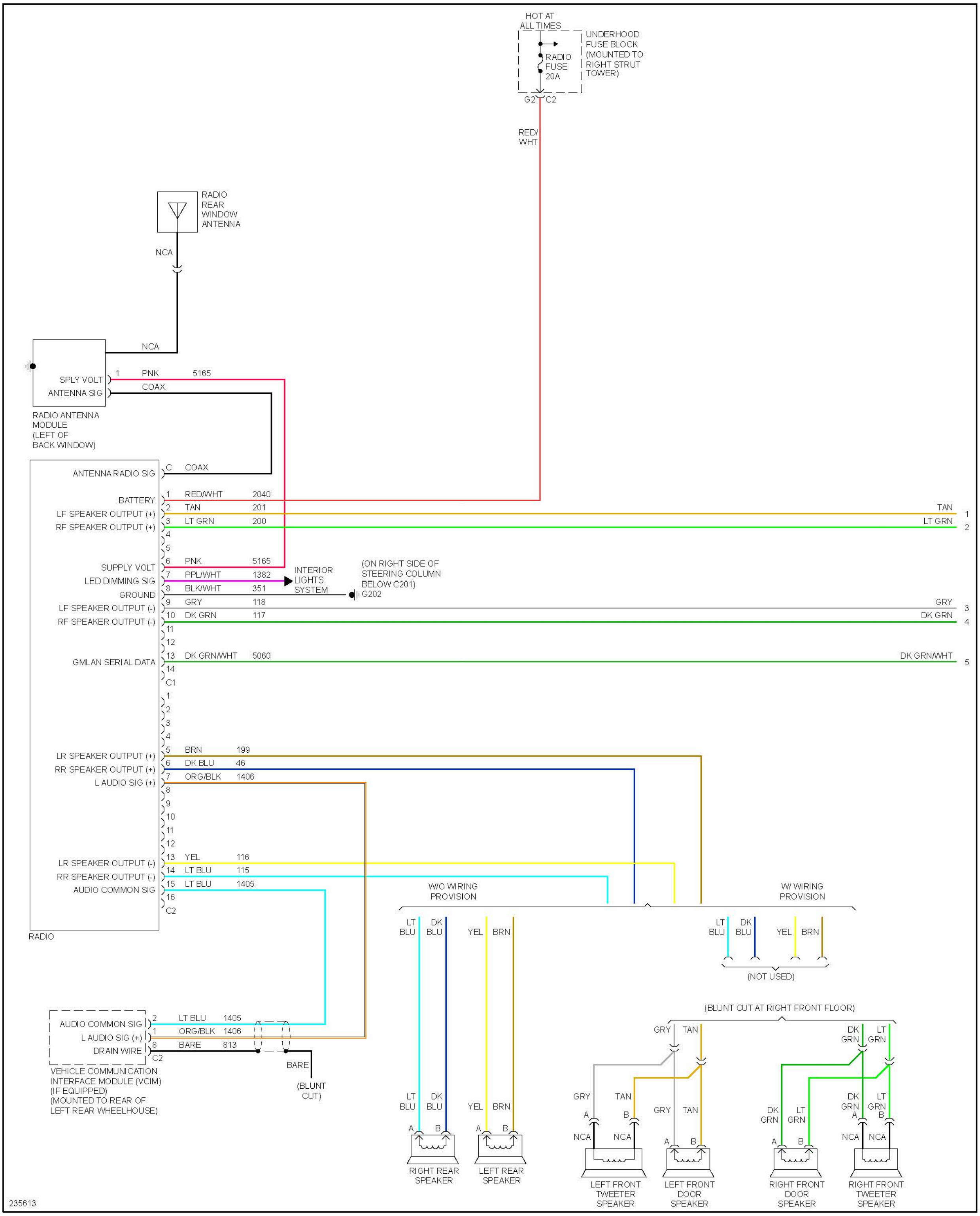

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
RADIO FUSE 20A
G2 C2
RED/ WHT
RADIO REAR WINDOW ANTENNA
NCA
NCA
1 PNK 5165
COAX
SPLY VOLT
ANTENNA SIG
RADIO ANTENNA MODULE (LEFT OF BACK WINDOW)
ANTENNA RADIO SIG C COAX
BATTERY 1 RED/WHT 2040
LF SPEAKER OUTPUT (+) 2 TAN 201
RF SPEAKER OUTPUT (+) 3 LT GRN 200
4
5
SUPPLY VOLT 6 PNK 5165
LED DIMMING SIG 7 PPL/WHT 1382
GROUND 8 BLK/WHT 351
LF SPEAKER OUTPUT (-) 9 GRY 118
RF SPEAKER OUTPUT (-) 10 DK GRN 117
11
12
GMLAN SERIAL DATA 13 DK GRN/WHT 5060
14
C1
INTERIOR LIGHTS SYSTEM
(ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
G202
TAN 1
LT GRN 2
GRY 3
DK GRN 4
DK GRN/WHT 5
1
2
3
4
LR SPEAKER OUTPUT (+) 5 BRN 199
RR SPEAKER OUTPUT (+) 6 DK BLU 46
L AUDIO SIG (+) 7 ORG/BLK 1406
8
9
10
11
12
LR SPEAKER OUTPUT (-) 13 YEL 116
RR SPEAKER OUTPUT (-) 14 LT BLU 115
AUDIO COMMON SIG 15 LT BLU 1405
16
C2
RADIO
W/O WIRING PROVISION
W/ WIRING PROVISION
LT BLU
DK BLU
YEL
BRN
(NOT USED)
AUDIO COMMON SIG 2 LT BLU 1405
L AUDIO SIG (+) 1 ORG/BLK 1406
DRAIN WIRE 8 BARE 813
C2
BARE
(BLUNT CUT)
VEHICLE COMMUNICATION INTERFACE MODULE (VCIM) (IF EQUIPPED) (MOUNTED TO REAR OF LEFT REAR WHEELHOUSE)
(BLUNT CUT AT RIGHT FRONT FLOOR)
GRY
TAN
DK GRN
LT GRN
A
B
NCA
RIGHT REAR SPEAKER
LEFT REAR SPEAKER
LEFT FRONT TWEETER SPEAKER
LEFT FRONT DOOR SPEAKER
RIGHT FRONT DOOR SPEAKER
RIGHT FRONT TWEETER SPEAKER
235613

Fig. 52: Radio Circuit, Police Option (1 of 2)

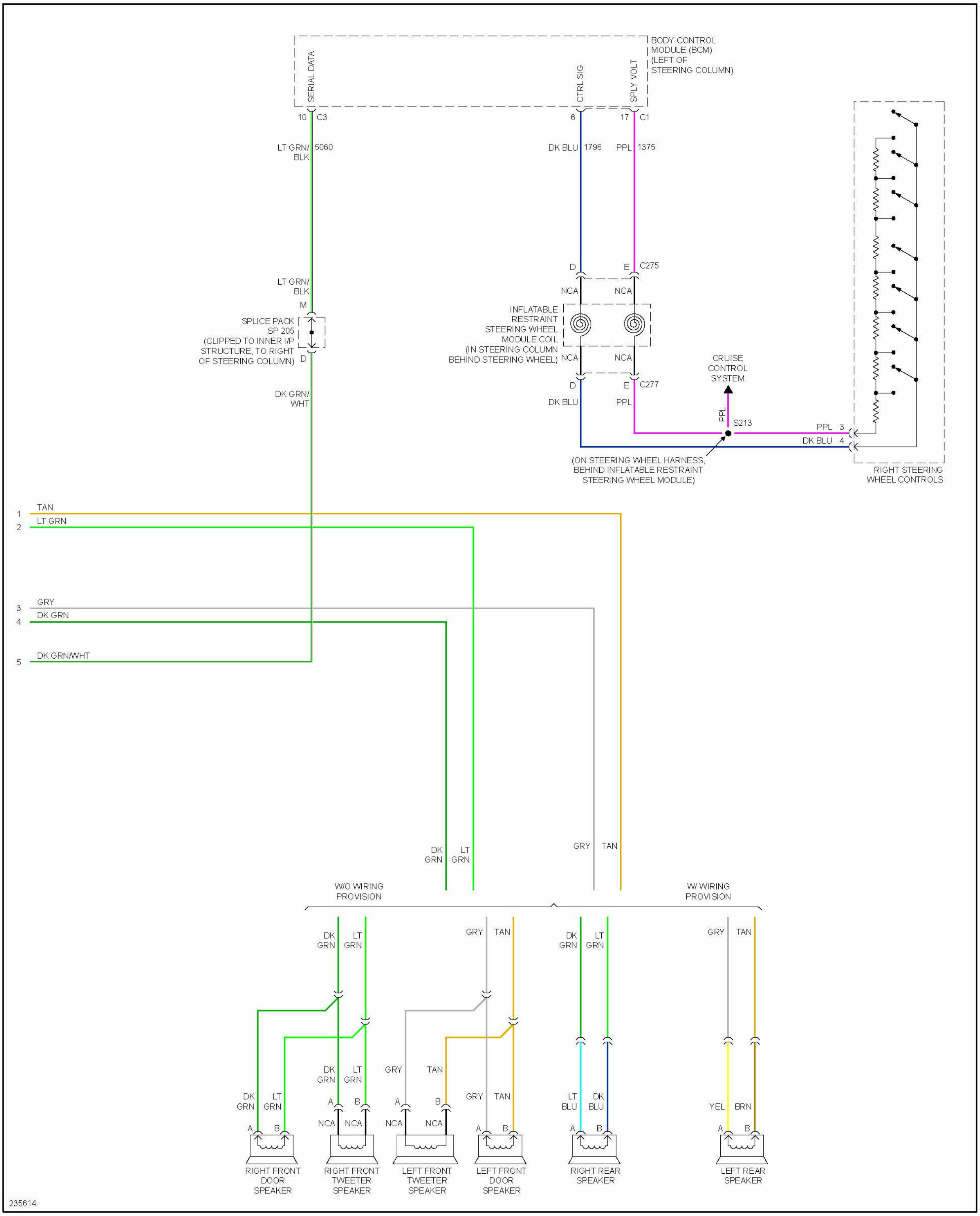

BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
SERIAL DATA
CTRL SIG
SPLY VOLT
10 C3
6
17 C1
LT GRN/ BLK 5060
DK BLU 1796
PPL 1375
C275
NCA
INFLATABLE RESTRAINT STEERING WHEEL MODULE COIL (IN STEERING COLUMN BEHIND STEERING WHEEL)
C277
SPLICE PACK SP 205 (CLIPPED TO INNER I/P STRUCTURE, TO RIGHT OF STEERING COLUMN)
DK GRN/ WHT
CRUISE CONTROL SYSTEM
S213
(ON STEERING WHEEL HARNESS, BEHIND INFLATABLE RESTRAINT STEERING WHEEL MODULE)
RIGHT STEERING WHEEL CONTROLS
1 TAN
2 LT GRN
3 GRY
4 DK GRN
5 DK GRN/WHT
W/O WIRING PROVISION
W/ WIRING PROVISION
LT BLU
YEL
BRN
RIGHT FRONT DOOR SPEAKER
RIGHT FRONT TWEETER SPEAKER
LEFT FRONT TWEETER SPEAKER
LEFT FRONT DOOR SPEAKER
RIGHT REAR SPEAKER
LEFT REAR SPEAKER
235614

Fig. 53: Radio Circuit, Police Option (2 of 2)

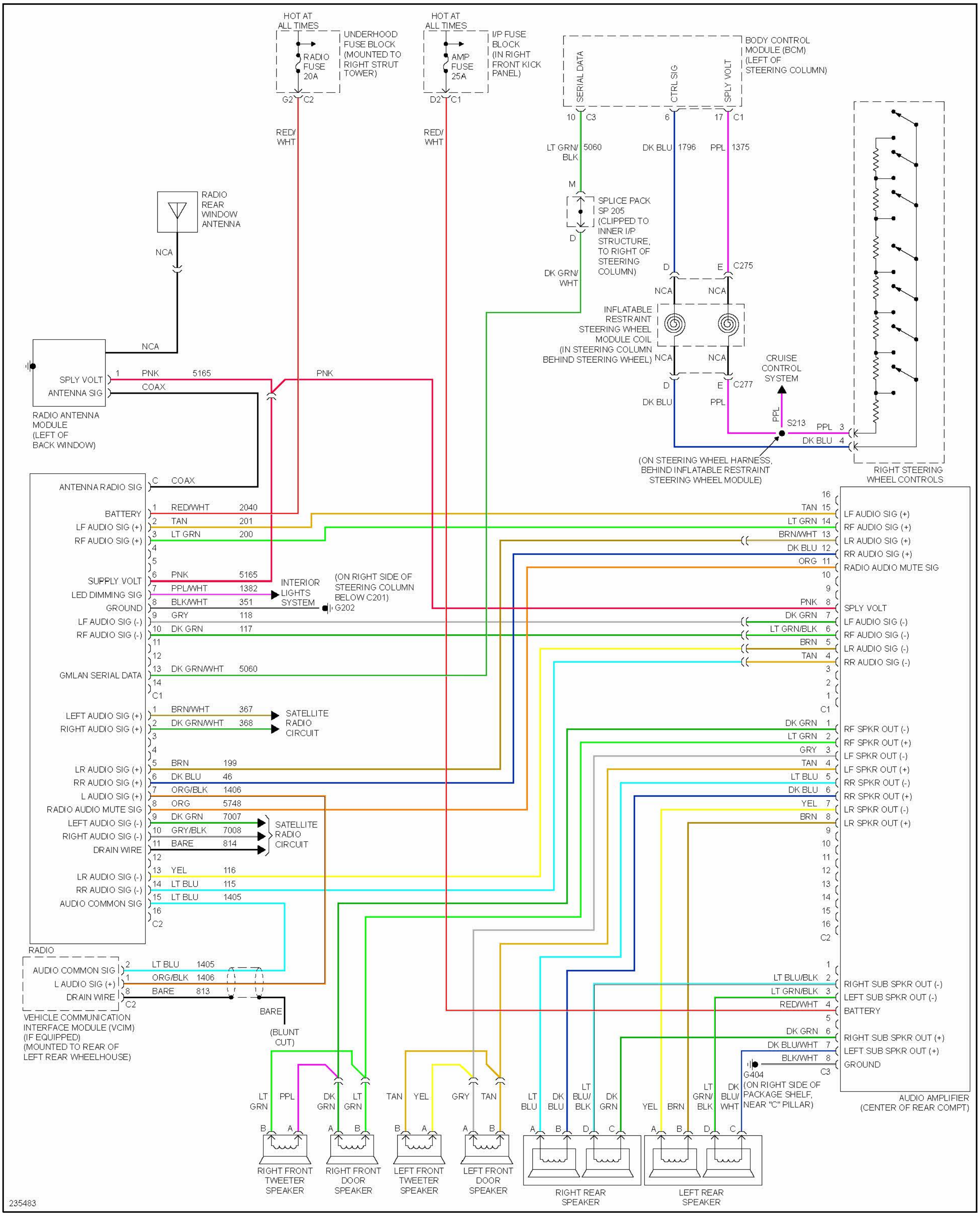

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
RADIO FUSE 20A
G2 C2
RED/WHT
HOT AT ALL TIMES
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
AMP FUSE 25A
D2 C1
RED/WHT
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
SERIAL DATA
CTRL SIG
SPLY VOLT
10 C3
6
17 C1
LT GRN/BLK 5060
DK BLU 1796
PPL 1375
M
SPLICE PACK SP 205 (CLIPPED TO INNER I/P STRUCTURE, TO RIGHT OF STEERING COLUMN)
D
DK GRN/WHT
D
E C275
NCA
NCA
INFLATABLE RESTRAINT STEERING WHEEL MODULE COIL (IN STEERING COLUMN BEHIND STEERING WHEEL)
NCA
NCA
D
E C277
DK BLU
PPL
CRUISE CONTROL SYSTEM
PPL
S213
PPL 3
DK BLU 4
(ON STEERING WHEEL HARNESS, BEHIND INFLATABLE RESTRAINT STEERING WHEEL MODULE)
RIGHT STEERING WHEEL CONTROLS
RADIO REAR WINDOW ANTENNA
NCA
NCA
SPLY VOLT
ANTENNA SIG
1 PNK 5165
COAX
PNK
RADIO ANTENNA MODULE (LEFT OF BACK WINDOW)
ANTENNA RADIO SIG
C COAX
BATTERY
1 RED/WHT 2040
LF AUDIO SIG (+)
2 TAN 201
RF AUDIO SIG (+)
3 LT GRN 200
4
5
SUPPLY VOLT
6 PNK 5165
LED DIMMING SIG
7 PPL/WHT 1382
INTERIOR LIGHTS SYSTEM
GROUND
8 BLK/WHT 351
(ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
G202
LF AUDIO SIG (-)
9 GRY 118
RF AUDIO SIG (-)
10 DK GRN 117
11
12
GMLAN SERIAL DATA
13 DK GRN/WHT 5060
14
C1
LEFT AUDIO SIG (+)
1 BRN/WHT 367
RIGHT AUDIO SIG (+)
2 DK GRN/WHT 368
SATELLITE RADIO CIRCUIT
3
4
LR AUDIO SIG (+)
5 BRN 199
RR AUDIO SIG (+)
6 DK BLU 46
L AUDIO SIG (+)
7 ORG/BLK 1406
RADIO AUDIO MUTE SIG
8 ORG 5748
LEFT AUDIO SIG (-)
9 DK GRN 7007
RIGHT AUDIO SIG (-)
10 GRY/BLK 7008
DRAIN WIRE
11 BARE 814
SATELLITE RADIO CIRCUIT
12
LR AUDIO SIG (-)
13 YEL 116
RR AUDIO SIG (-)
14 LT BLU 115
AUDIO COMMON SIG
15 LT BLU 1405
16
C2
RADIO
AUDIO COMMON SIG
2 LT BLU 1405
L AUDIO SIG (+)
1 ORG/BLK 1406
DRAIN WIRE
8 BARE 813
C2
BARE
(BLUNT CUT)
VEHICLE COMMUNICATION INTERFACE MODULE (VCIM) (IF EQUIPPED) (MOUNTED TO REAR OF LEFT REAR WHEELHOUSE)
16
TAN 15
LF AUDIO SIG (+)
LT GRN 14
RF AUDIO SIG (+)
BRN/WHT 13
LR AUDIO SIG (+)
DK BLU 12
RR AUDIO SIG (+)
ORG 11
RADIO AUDIO MUTE SIG
10
9
PNK 8
SPLY VOLT
DK GRN 7
LF AUDIO SIG (-)
LT GRN/BLK 6
RF AUDIO SIG (-)
BRN 5
LR AUDIO SIG (-)
TAN 4
RR AUDIO SIG (-)
3
2
1
C1
DK GRN 1
RF SPKR OUT (-)
LT GRN 2
RF SPKR OUT (+)
GRY 3
LF SPKR OUT (-)
TAN 4
LF SPKR OUT (+)
LT BLU 5
RR SPKR OUT (-)
DK BLU 6
RR SPKR OUT (+)
YEL 7
LR SPKR OUT (-)
BRN 8
LR SPKR OUT (+)
9
10
11
12
13
14
15
16
C2
1
LT BLU/BLK 2
RIGHT SUB SPKR OUT (-)
LT GRN/BLK 3
LEFT SUB SPKR OUT (-)
RED/WHT 4
BATTERY
5
DK GRN 6
RIGHT SUB SPKR OUT (+)
DK BLU/WHT 7
LEFT SUB SPKR OUT (+)
BLK/WHT 8
GROUND
C3
G404 (ON RIGHT SIDE OF PACKAGE SHELF, NEAR "C" PILLAR)
AUDIO AMPLIFIER (CENTER OF REAR COMPT)
LT GRN
PPL
DK GRN
LT GRN
TAN
YEL
GRY
TAN
LT BLU
DK BLU
LT BLU/BLK
DK GRN
YEL
BRN
LT GRN/BLK
DK BLU/WHT
B A
A B
B A
A B
A B D C
A B D C
RIGHT FRONT TWEETER SPEAKER
RIGHT FRONT DOOR SPEAKER
LEFT FRONT TWEETER SPEAKER
LEFT FRONT DOOR SPEAKER
RIGHT REAR SPEAKER
LEFT REAR SPEAKER
235483

Fig. 54: Radio Circuit, W/ Amplifier

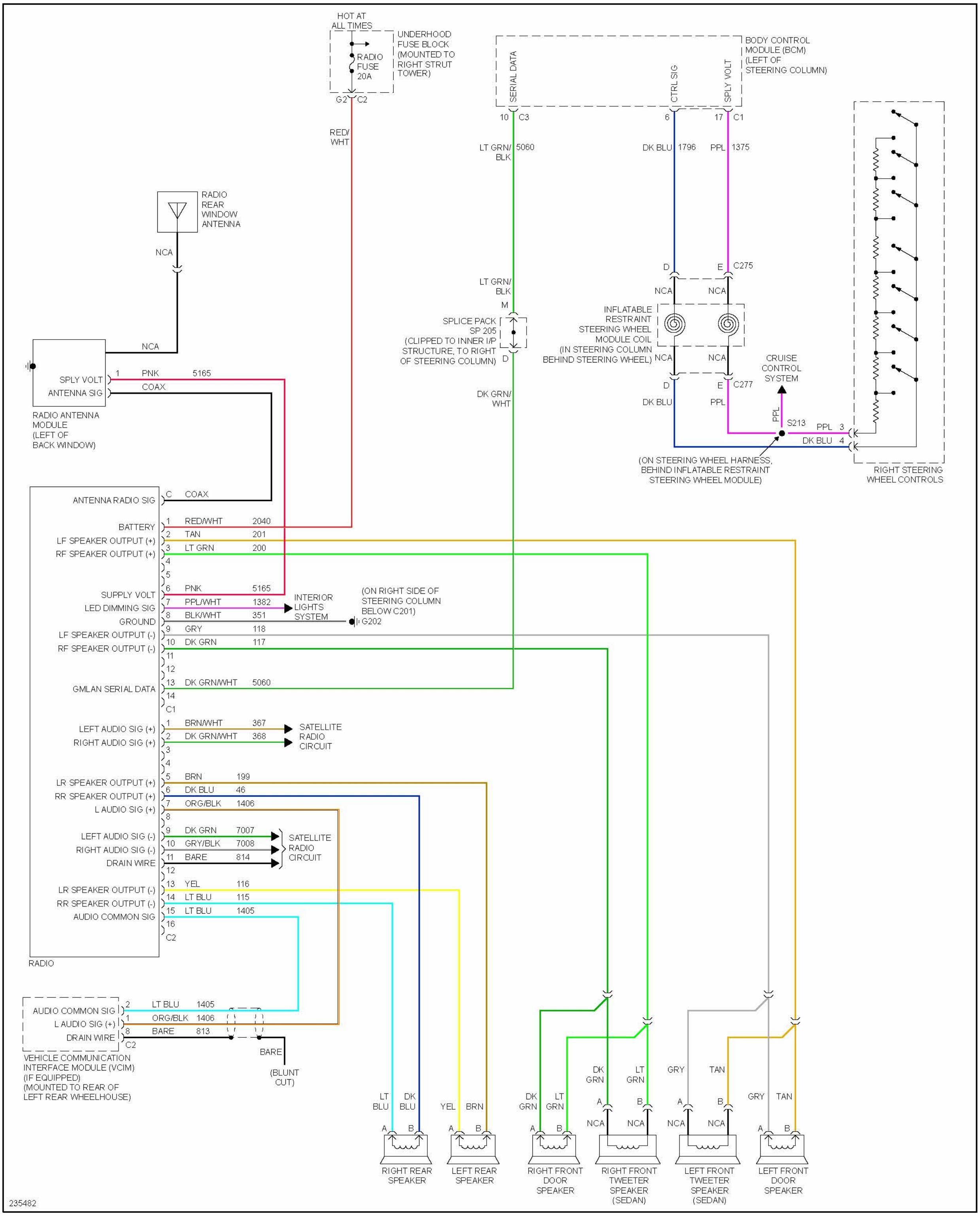

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
RADIO FUSE 20A
G2 C2
RED/WHT
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
SERIAL DATA
CTRL SIG
SPLY VOLT
10 C3
6
17 C1
LT GRN/BLK 5060
DK BLU 1796
PPL 1375
RADIO REAR WINDOW ANTENNA
NCA
D
E C275
LT GRN/BLK
M
SPLICE PACK SP 205 (CLIPPED TO INNER I/P STRUCTURE, TO RIGHT OF STEERING COLUMN)
D
INFLATABLE RESTRAINT STEERING WHEEL MODULE COIL (IN STEERING COLUMN BEHIND STEERING WHEEL)
NCA
NCA
NCA
NCA
D
E C277
DK BLU
PPL
CRUISE CONTROL SYSTEM
PPL
S213
PPL 3
DK BLU 4
(ON STEERING WHEEL HARNESS, BEHIND INFLATABLE RESTRAINT STEERING WHEEL MODULE)
RIGHT STEERING WHEEL CONTROLS
NCA
SPLY VOLT 1 PNK 5165
ANTENNA SIG COAX
RADIO ANTENNA MODULE (LEFT OF BACK WINDOW)
DK GRN/WHT
ANTENNA RADIO SIG C COAX
BATTERY 1 RED/WHT 2040
LF SPEAKER OUTPUT (+) 2 TAN 201
RF SPEAKER OUTPUT (+) 3 LT GRN 200
4
5
SUPPLY VOLT 6 PNK 5165
LED DIMMING SIG 7 PPL/WHT 1382
INTERIOR LIGHTS SYSTEM
GROUND 8 BLK/WHT 351
(ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
G202
LF SPEAKER OUTPUT (-) 9 GRY 118
RF SPEAKER OUTPUT (-) 10 DK GRN 117
11
12
GMLAN SERIAL DATA 13 DK GRN/WHT 5060
14
C1
LEFT AUDIO SIG (+) 1 BRN/WHT 367
RIGHT AUDIO SIG (+) 2 DK GRN/WHT 368
SATELLITE RADIO CIRCUIT
3
4
LR SPEAKER OUTPUT (+) 5 BRN 199
RR SPEAKER OUTPUT (+) 6 DK BLU 46
L AUDIO SIG (+) 7 ORG/BLK 1406
8
LEFT AUDIO SIG (-) 9 DK GRN 7007
RIGHT AUDIO SIG (-) 10 GRY/BLK 7008
DRAIN WIRE 11 BARE 814
SATELLITE RADIO CIRCUIT
12
LR SPEAKER OUTPUT (-) 13 YEL 116
RR SPEAKER OUTPUT (-) 14 LT BLU 115
AUDIO COMMON SIG 15 LT BLU 1405
16
C2
RADIO
AUDIO COMMON SIG 2 LT BLU 1405
L AUDIO SIG (+) 1 ORG/BLK 1406
DRAIN WIRE 8 BARE 813
C2
BARE
(BLUNT CUT)
VEHICLE COMMUNICATION INTERFACE MODULE (VCIM) (IF EQUIPPED) (MOUNTED TO REAR OF LEFT REAR WHEELHOUSE)
LT BLU
DK BLU
YEL
BRN
DK GRN
LT GRN
DK GRN
LT GRN
GRY
TAN
GRY
TAN
NCA
NCA
NCA
NCA
A B
RIGHT REAR SPEAKER
LEFT REAR SPEAKER
RIGHT FRONT DOOR SPEAKER
RIGHT FRONT TWEETER SPEAKER (SEDAN)
LEFT FRONT TWEETER SPEAKER (SEDAN)
LEFT FRONT DOOR SPEAKER
235482

Fig. 55: Radio Circuit, W/O Amplifier

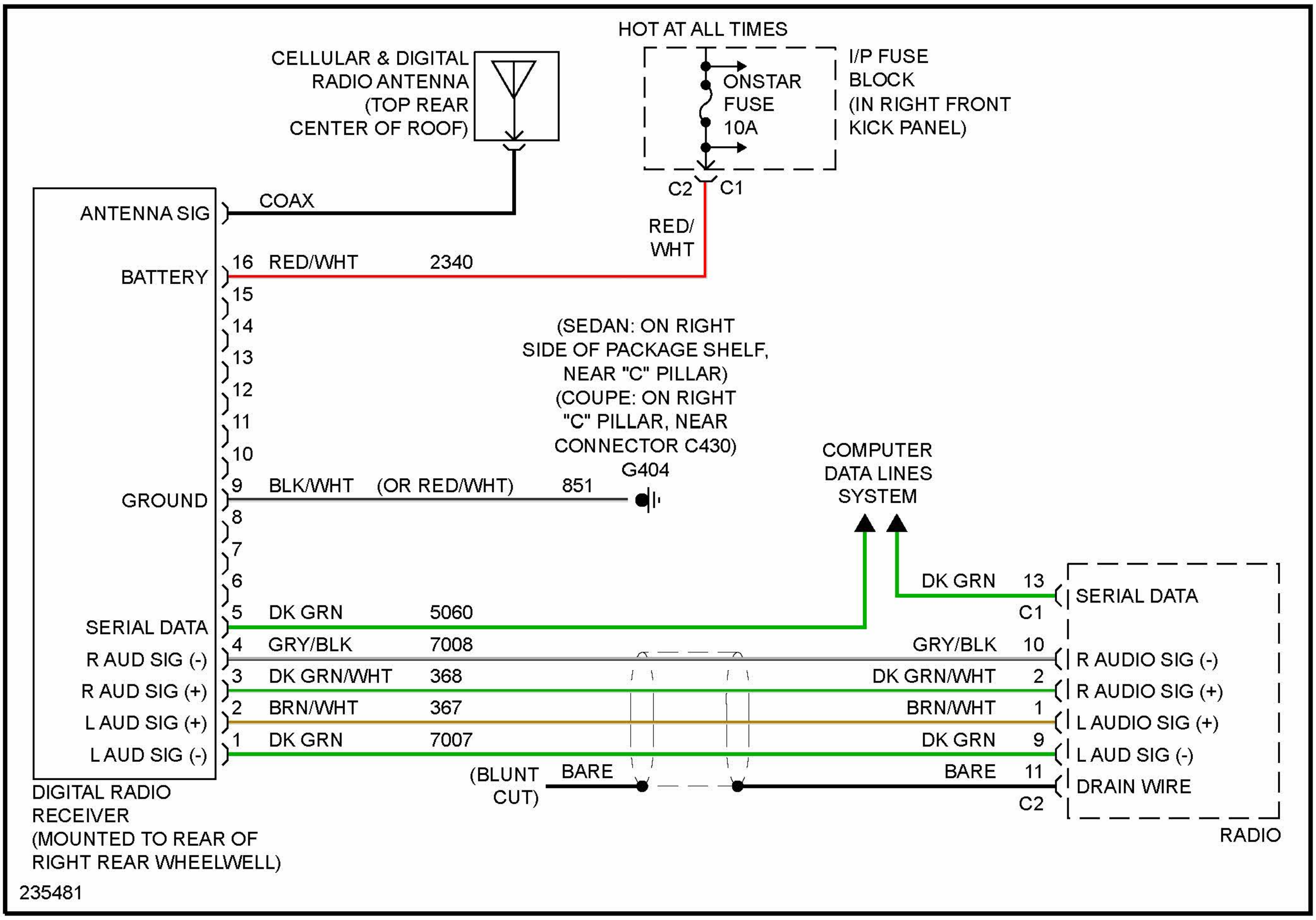

HOT AT ALL TIMES
CELLULAR & DIGITAL RADIO ANTENNA (TOP REAR CENTER OF ROOF)
ONSTAR FUSE 10A
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
C2 C1
RED/ WHT
COAX
ANTENNA SIG
BATTERY
16 RED/WHT 2340
15
14
13
12
11
10
(SEDAN: ON RIGHT SIDE OF PACKAGE SHELF, NEAR "C" PILLAR) (COUPE: ON RIGHT "C" PILLAR, NEAR CONNECTOR C430)
G404
GROUND
9 BLK/WHT (OR RED/WHT) 851
8
7
6
COMPUTER DATA LINES SYSTEM
DK GRN 13
SERIAL DATA
C1
SERIAL DATA
5 DK GRN 5060
R AUD SIG (-)
4 GRY/BLK 7008
GRY/BLK 10
R AUDIO SIG (-)
R AUD SIG (+)
3 DK GRN/WHT 368
DK GRN/WHT 2
R AUDIO SIG (+)
L AUD SIG (+)
2 BRN/WHT 367
BRN/WHT 1
L AUDIO SIG (+)
L AUD SIG (-)
1 DK GRN 7007
DK GRN 9
L AUD SIG (-)
(BLUNT CUT)
BARE
BARE 11
DRAIN WIRE
C2
RADIO
DIGITAL RADIO RECEIVER (MOUNTED TO REAR OF RIGHT REAR WHEELWELL)
235481

Fig. 56: Satellite Radio Circuit

SHIFT INTERLOCK

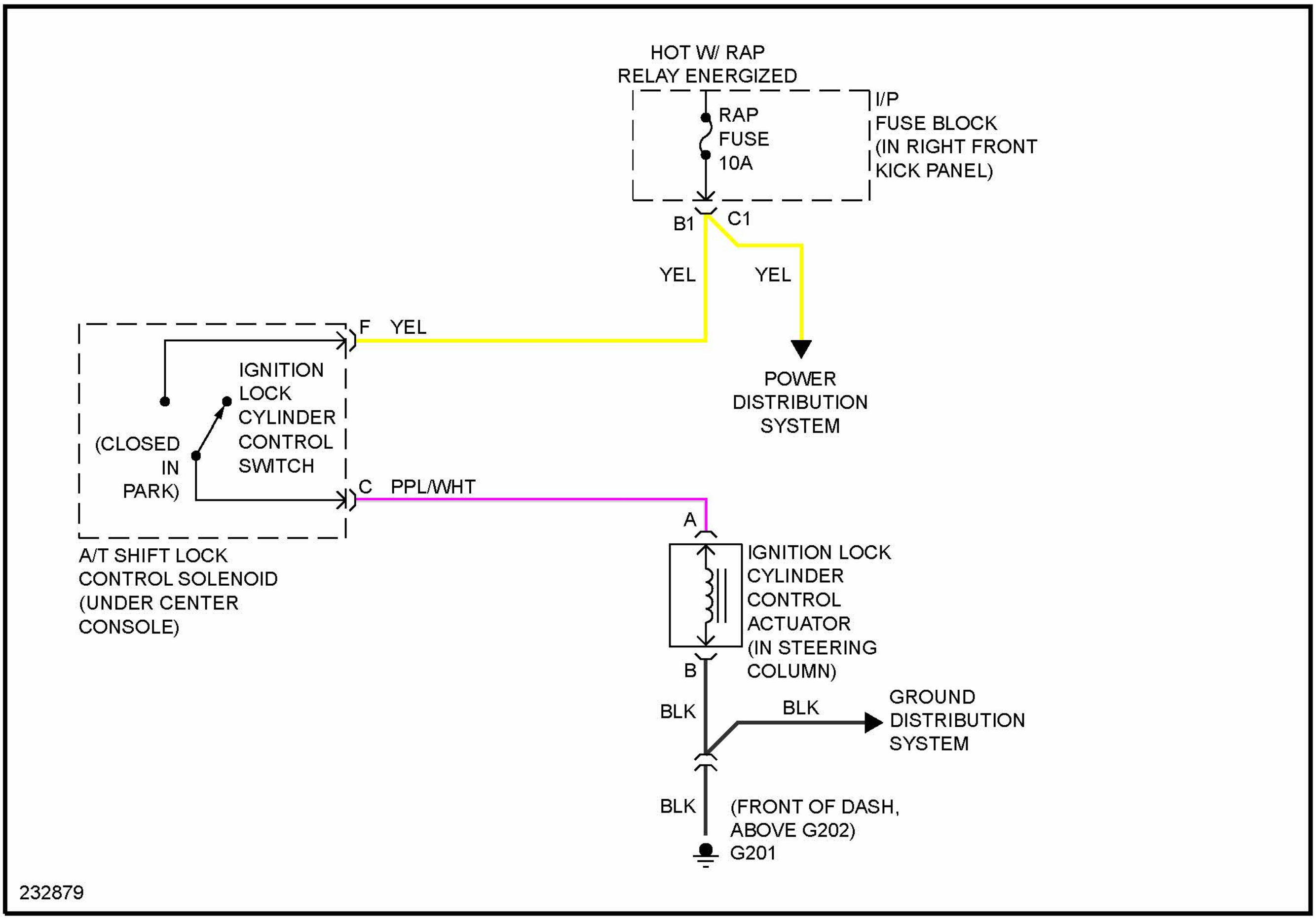

HOT W/ RAP
RELAY ENERGIZED
RAP
FUSE
10A
I/P
FUSE BLOCK
(IN RIGHT FRONT
KICK PANEL)
B1
C1
YEL
YEL
F
YEL
POWER
DISTRIBUTION
SYSTEM
IGNITION
LOCK
CYLINDER
CONTROL
SWITCH
(CLOSED
IN
PARK)
C
PPL/WHT
A/T SHIFT LOCK
CONTROL SOLENOID
(UNDER CENTER
CONSOLE)
A
IGNITION LOCK
CYLINDER
CONTROL
ACTUATOR
(IN STEERING
COLUMN)
B
BLK
BLK
GROUND
DISTRIBUTION
SYSTEM
BLK
(FRONT OF DASH,
ABOVE G202)
G201
232879

Fig. 57: Ignition Lock Solenoid Circuit

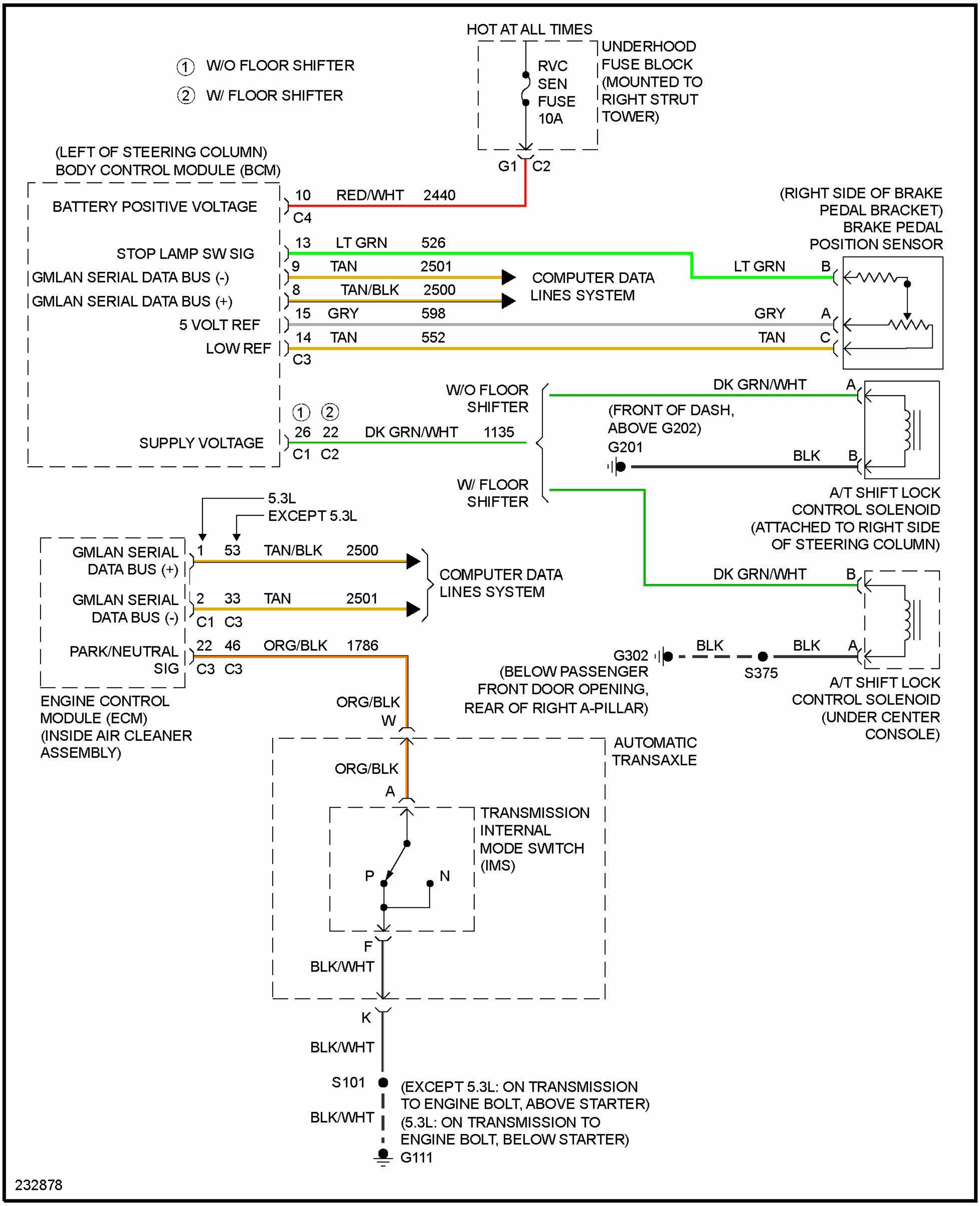

HOT AT ALL TIMES
① W/O FLOOR SHIFTER
② W/ FLOOR SHIFTER
RVC SEN FUSE 10A
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
G1 C2
(LEFT OF STEERING COLUMN) BODY CONTROL MODULE (BCM)
BATTERY POSITIVE VOLTAGE
10 RED/WHT 2440
C4
STOP LAMP SW SIG
13 LT GRN 526
GMLAN SERIAL DATA BUS (-)
9 TAN 2501
GMLAN SERIAL DATA BUS (+)
8 TAN/BLK 2500
COMPUTER DATA LINES SYSTEM
5 VOLT REF
15 GRY 598
LOW REF
14 TAN 552
C3
(RIGHT SIDE OF BRAKE PEDAL BRACKET) BRAKE PEDAL POSITION SENSOR
LT GRN B
GRY A
TAN C
SUPPLY VOLTAGE
① ②
26 22 DK GRN/WHT 1135
C1 C2
W/O FLOOR SHIFTER
W/ FLOOR SHIFTER
DK GRN/WHT A
(FRONT OF DASH, ABOVE G202)
G201
BLK B
A/T SHIFT LOCK CONTROL SOLENOID (ATTACHED TO RIGHT SIDE OF STEERING COLUMN)
5.3L
EXCEPT 5.3L
GMLAN SERIAL DATA BUS (+)
1 53 TAN/BLK 2500
GMLAN SERIAL DATA BUS (-)
2 33 TAN 2501
C1 C3
COMPUTER DATA LINES SYSTEM
PARK/NEUTRAL SIG
22 46 ORG/BLK 1786
C3 C3
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
DK GRN/WHT B
G302
BLK
BLK A
S375
(BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
A/T SHIFT LOCK CONTROL SOLENOID (UNDER CENTER CONSOLE)
ORG/BLK
W
AUTOMATIC TRANSAXLE
ORG/BLK
A
TRANSMISSION INTERNAL MODE SWITCH (IMS)
P
N
F
BLK/WHT
K
BLK/WHT
S101
BLK/WHT
(EXCEPT 5.3L: ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER) (5.3L: ON TRANSMISSION TO ENGINE BOLT, BELOW STARTER)
G111
232878

Fig. 58: Shift Interlock Circuit

STARTING/CHARGING

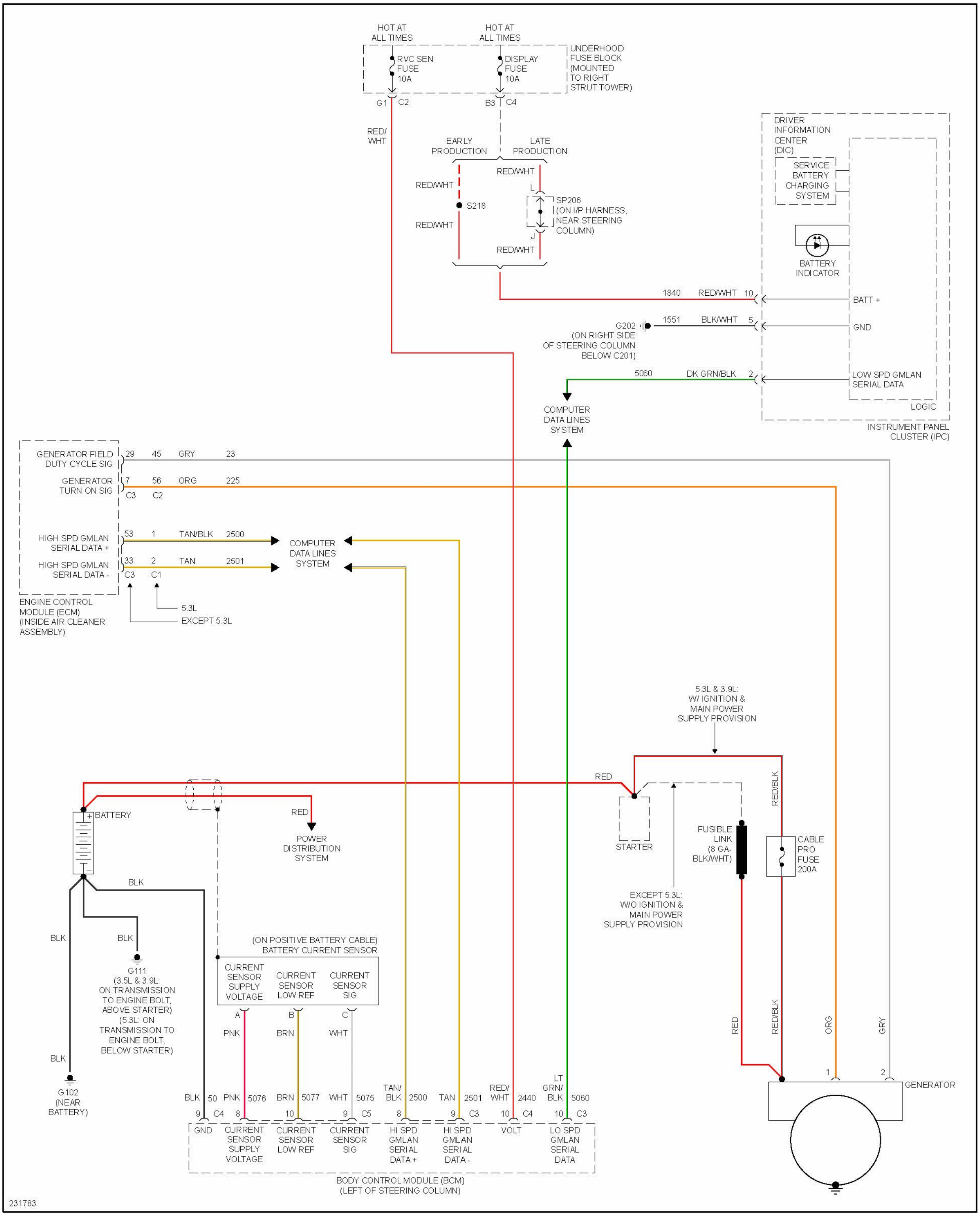

HOT AT ALL TIMES
HOT AT ALL TIMES
RVC SEN FUSE 10A
DISPLAY FUSE 10A
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
G1 C2
B3 C4
RED/WHT
EARLY PRODUCTION
LATE PRODUCTION
RED/WHT
RED/WHT
S218
RED/WHT
L
SP206 (ON I/P HARNESS, NEAR STEERING COLUMN)
J
RED/WHT
RED/WHT
DRIVER INFORMATION CENTER (DIC)
SERVICE BATTERY CHARGING SYSTEM
BATTERY INDICATOR
1840 RED/WHT 10
BATT +
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
1551 BLK/WHT 5
GND
5060 DK GRN/BLK 2
LOW SPD GMLAN SERIAL DATA
LOGIC
INSTRUMENT PANEL CLUSTER (IPC)
COMPUTER DATA LINES SYSTEM
GENERATOR FIELD DUTY CYCLE SIG
29 45 GRY 23
GENERATOR TURN ON SIG
7 56 ORG 225
C3 C2
HIGH SPD GMLAN SERIAL DATA +
53 1 TAN/BLK 2500
HIGH SPD GMLAN SERIAL DATA -
33 2 TAN 2501
C3 C1
COMPUTER DATA LINES SYSTEM
5.3L
EXCEPT 5.3L
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
5.3L & 3.9L: W/ IGNITION & MAIN POWER SUPPLY PROVISION
RED
RED/BLK
BATTERY
RED
POWER DISTRIBUTION SYSTEM
STARTER
FUSIBLE LINK (8 GA-BLK/WHT)
CABLE PRO FUSE 200A
EXCEPT 5.3L: W/O IGNITION & MAIN POWER SUPPLY PROVISION
BLK
BLK
BLK
G111 (3.5L & 3.9L: ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER) (5.3L: ON TRANSMISSION TO ENGINE BOLT, BELOW STARTER)
BLK
G102 (NEAR BATTERY)
(ON POSITIVE BATTERY CABLE) BATTERY CURRENT SENSOR
CURRENT SENSOR SUPPLY VOLTAGE
CURRENT SENSOR LOW REF
CURRENT SENSOR SIG
A B C
PNK BRN WHT
RED RED/BLK ORG GRY
1 2
GENERATOR
BLK 50 PNK 5076 BRN 5077 WHT 5075 TAN/BLK 2500 TAN 2501 RED/WHT 2440 LT GRN/BLK 5060
9 C4 8 10 9 C5 8 9 C3 10 C4 10 C3
GND
CURRENT SENSOR SUPPLY VOLTAGE
CURRENT SENSOR LOW REF
CURRENT SENSOR SIG
HI SPD GMLAN SERIAL DATA +
HI SPD GMLAN SERIAL DATA -
VOLT
LO SPD GMLAN SERIAL DATA
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
231783

Fig. 59: Charging Circuit

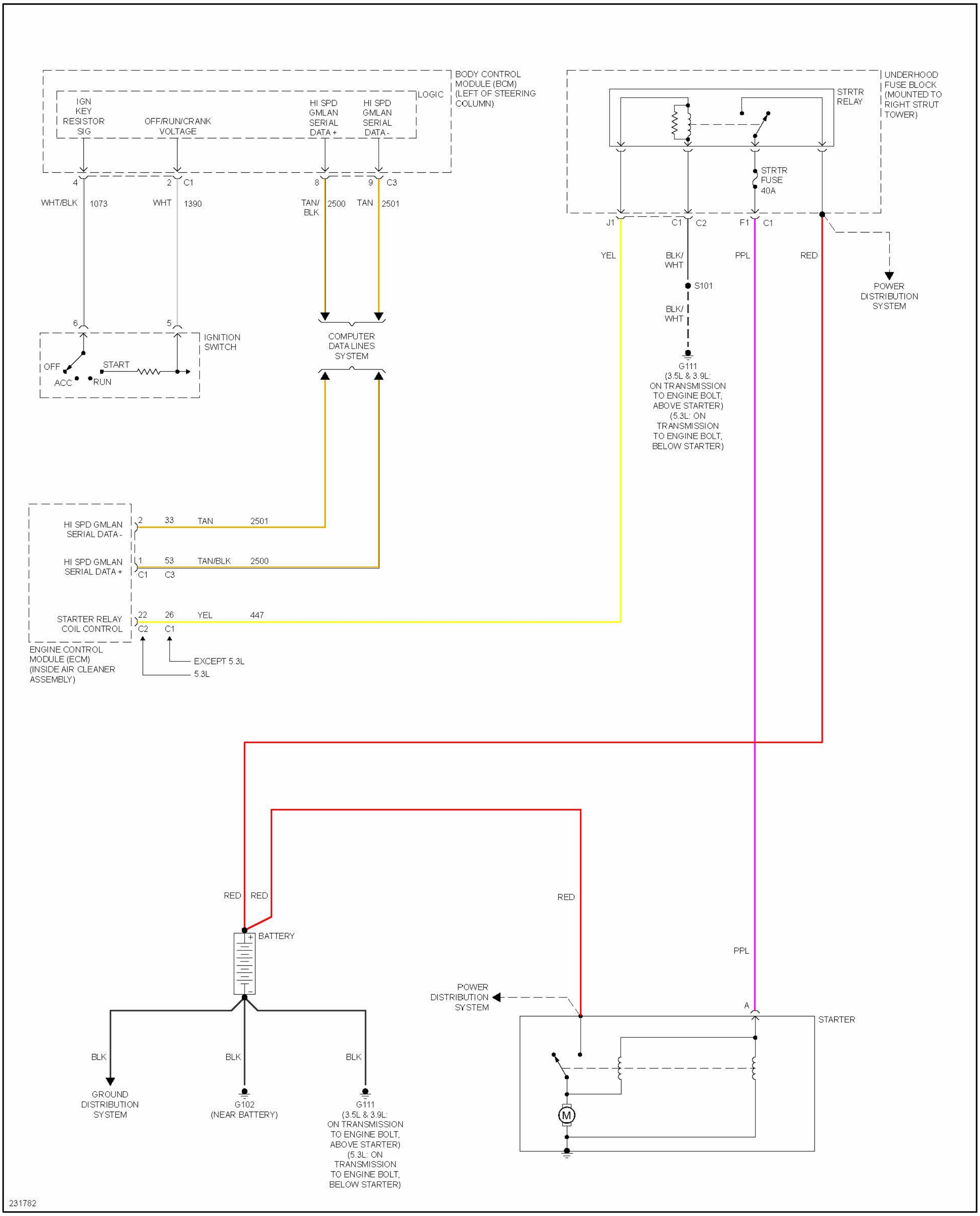
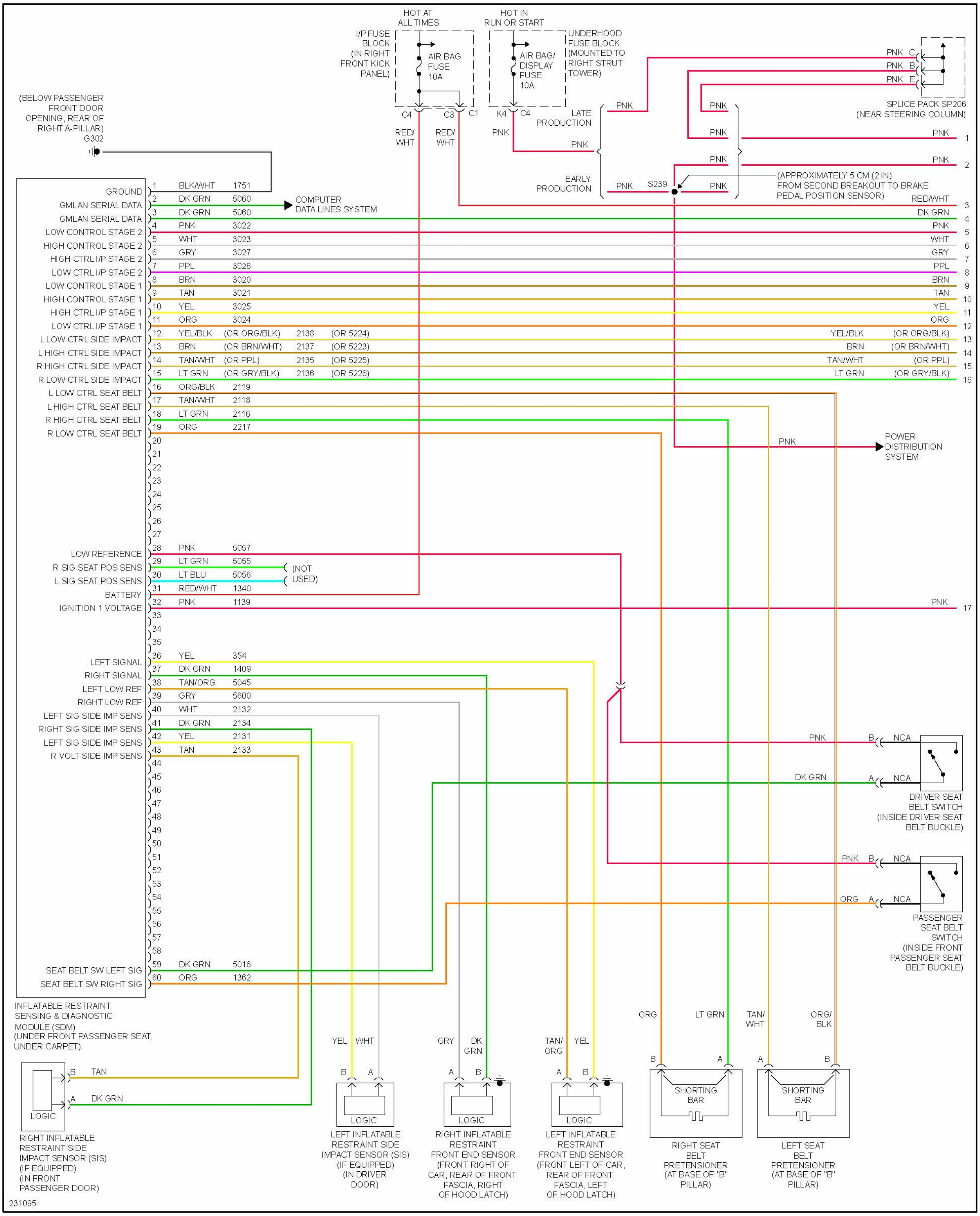

BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
LOGIC
IGN KEY RESISTOR SIG
OFF/RUN/CRANK VOLTAGE
HI SPD GMLAN SERIAL DATA +
HI SPD GMLAN SERIAL DATA -
4
2
C1
8
9
C3
WHT/BLK
1073
WHT
1390
TAN/BLK
2500
TAN
2501
6
5
IGNITION SWITCH
OFF
START
ACC
RUN
COMPUTER DATA LINES SYSTEM
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
STRTR RELAY
STRTR FUSE 40A
J1
C1
C2
F1
C1
YEL
BLK/WHT
PPL
RED
S101
BLK/WHT
G111 (3.5L & 3.9L: ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER) (5.3L: ON TRANSMISSION TO ENGINE BOLT, BELOW STARTER)
POWER DISTRIBUTION SYSTEM
HI SPD GMLAN SERIAL DATA -
2
33
TAN
2501
HI SPD GMLAN SERIAL DATA +
1
53
TAN/BLK
2500
C1
C3
STARTER RELAY COIL CONTROL
22
26
YEL
447
C2
C1
ENGINE CONTROL MODULE (ECM) (INSIDE AIR CLEANER ASSEMBLY)
EXCEPT 5.3L
5.3L
RED
RED
RED
BATTERY
PPL
POWER DISTRIBUTION SYSTEM
A
STARTER
M
BLK
BLK
BLK
GROUND DISTRIBUTION SYSTEM
G102 (NEAR BATTERY)
G111 (3.5L & 3.9L: ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER) (5.3L: ON TRANSMISSION TO ENGINE BOLT, BELOW STARTER)
231782

Fig. 60: Starting Circuit

SUPPLEMENTAL RESTRAINTS



HOT AT ALL TIMES
HOT IN RUN OR START
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
AIR BAG FUSE 10A
AIR BAG/ DISPLAY FUSE 10A
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
C4
C3
C1
K4
C4
RED/ WHT
RED/ WHT
PNK
LATE PRODUCTION
EARLY PRODUCTION
S239
(APPROXIMATELY 5 CM (2 IN) FROM SECOND BREAKOUT TO BRAKE PEDAL POSITION SENSOR)
SPLICE PACK SP206 (NEAR STEERING COLUMN)
PNK C
PNK B
PNK E
(BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
G302
GROUND 1 BLK/WHT 1751
GMLAN SERIAL DATA 2 DK GRN 5060
GMLAN SERIAL DATA 3 DK GRN 5060
COMPUTER DATA LINES SYSTEM
LOW CONTROL STAGE 2 4 PNK 3022
HIGH CONTROL STAGE 2 5 WHT 3023
HIGH CTRL I/P STAGE 2 6 GRY 3027
LOW CTRL I/P STAGE 2 7 PPL 3026
LOW CONTROL STAGE 1 8 BRN 3020
HIGH CONTROL STAGE 1 9 TAN 3021
HIGH CTRL I/P STAGE 1 10 YEL 3025
LOW CTRL I/P STAGE 1 11 ORG 3024
L LOW CTRL SIDE IMPACT 12 YEL/BLK (OR ORG/BLK) 2138 (OR 5224)
L HIGH CTRL SIDE IMPACT 13 BRN (OR BRN/WHT) 2137 (OR 5223)
R HIGH CTRL SIDE IMPACT 14 TAN/WHT (OR PPL) 2135 (OR 5225)
R LOW CTRL SIDE IMPACT 15 LT GRN (OR GRY/BLK) 2136 (OR 5226)
L LOW CTRL SEAT BELT 16 ORG/BLK 2119
L HIGH CTRL SEAT BELT 17 TAN/WHT 2118
R HIGH CTRL SEAT BELT 18 LT GRN 2116
R LOW CTRL SEAT BELT 19 ORG 2217
20 21 22 23 24 25 26 27
LOW REFERENCE 28 PNK 5057
R SIG SEAT POS SENS 29 LT GRN 5055
L SIG SEAT POS SENS 30 LT BLU 5056
(NOT USED)
BATTERY 31 RED/WHT 1340
IGNITION 1 VOLTAGE 32 PNK 1139
33 34 35
LEFT SIGNAL 36 YEL 354
RIGHT SIGNAL 37 DK GRN 1409
LEFT LOW REF 38 TAN/ORG 5045
RIGHT LOW REF 39 GRY 5600
LEFT SIG SIDE IMP SENS 40 WHT 2132
RIGHT SIG SIDE IMP SENS 41 DK GRN 2134
LEFT SIG SIDE IMP SENS 42 YEL 2131
R VOLT SIDE IMP SENS 43 TAN 2133
44 45 46 47 48 49 50 51 52 53 54 55 56 57 58
SEAT BELT SW LEFT SIG 59 DK GRN 5016
SEAT BELT SW RIGHT SIG 60 ORG 1362
PNK 1
PNK 2
RED/WHT 3
DK GRN 4
PNK 5
WHT 6
GRY 7
PPL 8
BRN 9
TAN 10
YEL 11
ORG 12
YEL/BLK (OR ORG/BLK) 13
BRN (OR BRN/WHT) 14
TAN/WHT (OR PPL) 15
LT GRN (OR GRY/BLK) 16
PNK 17
PNK
POWER DISTRIBUTION SYSTEM
PNK B NCA
DK GRN A NCA
DRIVER SEAT BELT SWITCH (INSIDE DRIVER SEAT BELT BUCKLE)
PNK B NCA
ORG A NCA
PASSENGER SEAT BELT SWITCH (INSIDE FRONT PASSENGER SEAT BELT BUCKLE)
INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE (SDM) (UNDER FRONT PASSENGER SEAT, UNDER CARPET)
B TAN
A DK GRN
LOGIC
RIGHT INFLATABLE RESTRAINT SIDE IMPACT SENSOR (SIS) (IF EQUIPPED) (IN FRONT PASSENGER DOOR)
YEL WHT
B A
LOGIC
LEFT INFLATABLE RESTRAINT SIDE IMPACT SENSOR (SIS) (IF EQUIPPED) (IN DRIVER DOOR)
GRY DK GRN
A B
LOGIC
RIGHT INFLATABLE RESTRAINT FRONT END SENSOR (FRONT RIGHT OF CAR, REAR OF FRONT FASCIA, RIGHT OF HOOD LATCH)
TAN/ ORG YEL
A B
LOGIC
LEFT INFLATABLE RESTRAINT FRONT END SENSOR (FRONT LEFT OF CAR, REAR OF FRONT FASCIA, LEFT OF HOOD LATCH)
ORG LT GRN
B A
SHORTING BAR
RIGHT SEAT BELT PRETENSIONER (AT BASE OF "B" PILLAR)
TAN/ WHT ORG/ BLK
A B
SHORTING BAR
LEFT SEAT BELT PRETENSIONER (AT BASE OF "B" PILLAR)
231095

Fig. 61: Supplemental Restraints Circuit (1 of 3)

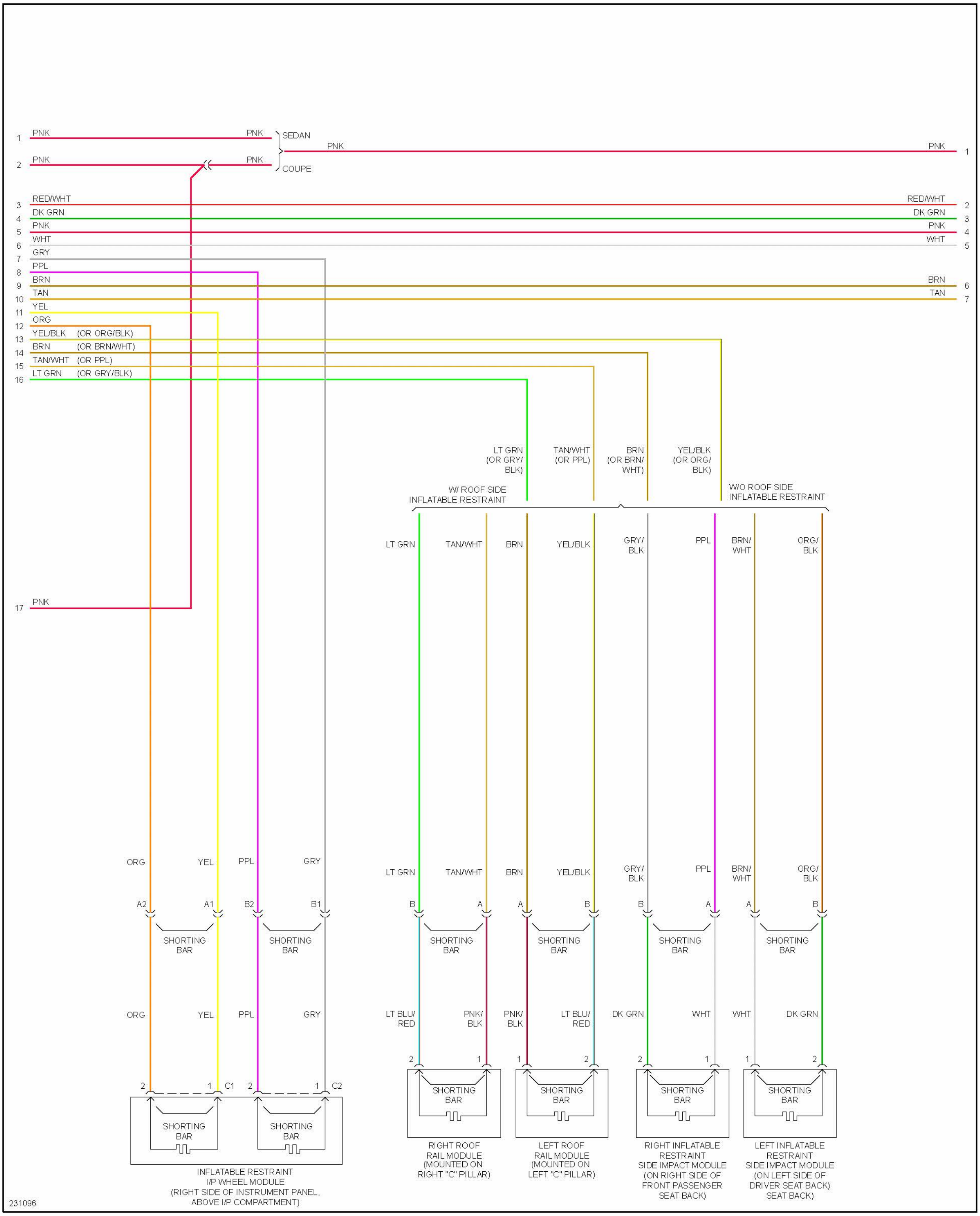

1 PNK PNK SEDAN
2 PNK PNK COUPE
PNK PNK 1
3 RED/WHT RED/WHT 2
4 DK GRN DK GRN 3
5 PNK PNK 4
6 WHT WHT 5
7 GRY
8 PPL
9 BRN BRN 6
10 TAN TAN 7
11 YEL
12 ORG
13 YEL/BLK (OR ORG/BLK)
14 BRN (OR BRN/WHT)
15 TAN/WHT (OR PPL)
16 LT GRN (OR GRY/BLK)
17 PNK
LT GRN (OR GRY/ BLK)
TAN/WHT (OR PPL)
BRN (OR BRN/ WHT)
YEL/BLK (OR ORG/ BLK)
W/ ROOF SIDE INFLATABLE RESTRAINT
W/O ROOF SIDE INFLATABLE RESTRAINT
LT GRN
TAN/WHT
BRN
YEL/BLK
GRY/ BLK
PPL
BRN/ WHT
ORG/ BLK
ORG
YEL
PPL
GRY
A2
A1
B2
B1
B
A
A
B
B
A
A
B
SHORTING BAR
SHORTING BAR
SHORTING BAR
SHORTING BAR
SHORTING BAR
SHORTING BAR
LT BLU/ RED
PNK/ BLK
PNK/ BLK
LT BLU/ RED
DK GRN
WHT
WHT
DK GRN
2
1
C1
2
1
C2
2
1
1
2
2
1
1
2
SHORTING BAR
SHORTING BAR
SHORTING BAR
SHORTING BAR
SHORTING BAR
SHORTING BAR
INFLATABLE RESTRAINT I/P WHEEL MODULE (RIGHT SIDE OF INSTRUMENT PANEL, ABOVE I/P COMPARTMENT)
RIGHT ROOF RAIL MODULE (MOUNTED ON RIGHT "C" PILLAR)
LEFT ROOF RAIL MODULE (MOUNTED ON LEFT "C" PILLAR)
RIGHT INFLATABLE RESTRAINT SIDE IMPACT MODULE (ON RIGHT SIDE OF FRONT PASSENGER SEAT BACK)
LEFT INFLATABLE RESTRAINT SIDE IMPACT MODULE (ON LEFT SIDE OF DRIVER SEAT BACK)
231096

Fig. 62: Supplemental Restraints Circuit (2 of 3)

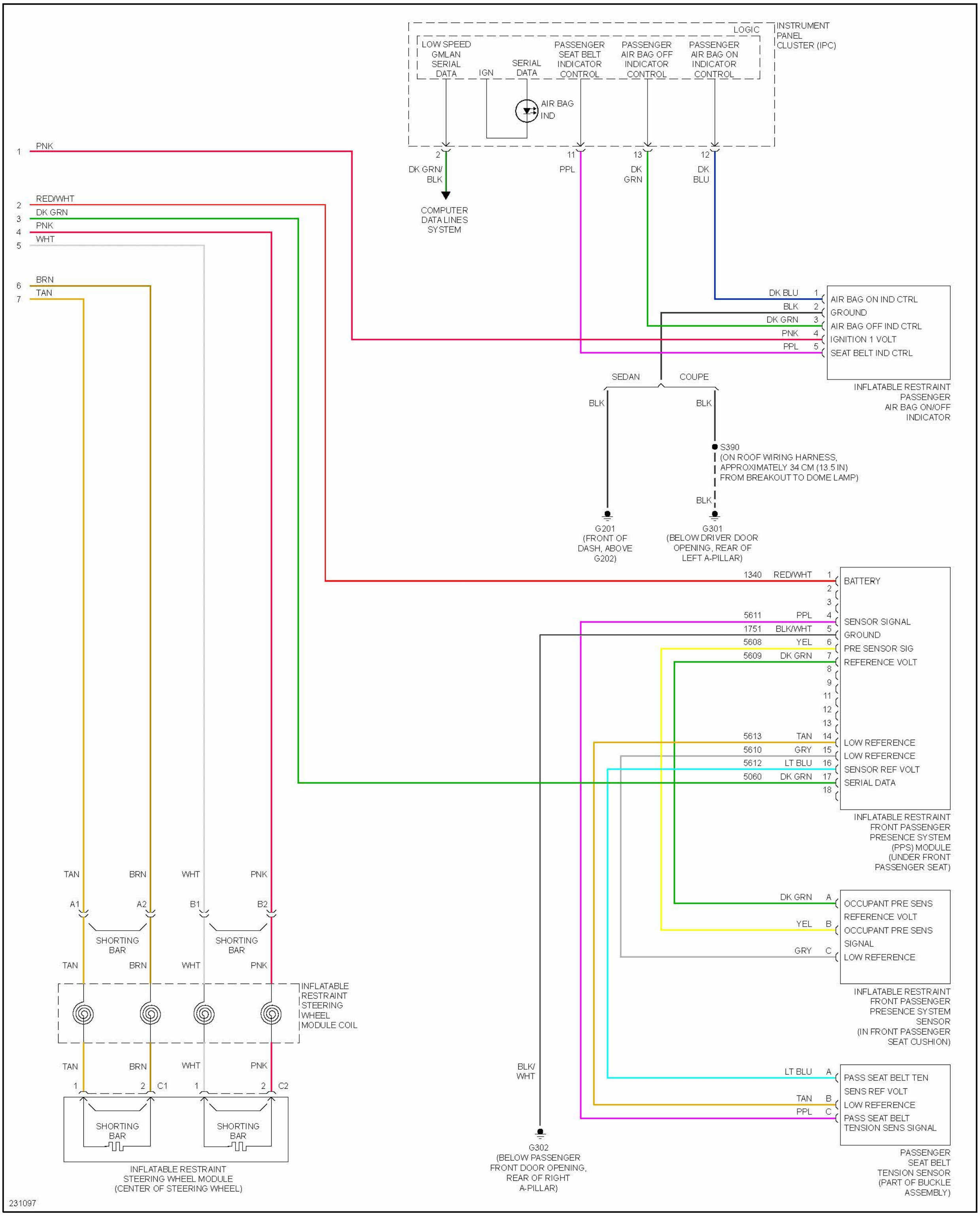

LOGIC
INSTRUMENT PANEL CLUSTER (IPC)
LOW SPEED GMLAN SERIAL DATA
IGN
SERIAL DATA
PASSENGER SEAT BELT INDICATOR CONTROL
PASSENGER AIR BAG OFF INDICATOR CONTROL
PASSENGER AIR BAG ON INDICATOR CONTROL
AIR BAG IND
2
DK GRN/ BLK
COMPUTER DATA LINES SYSTEM
11
PPL
13
DK GRN
12
DK BLU
1 PNK
2 RED/WHT
3 DK GRN
4 PNK
5 WHT
6 BRN
7 TAN
DK BLU 1 AIR BAG ON IND CTRL
BLK 2 GROUND
DK GRN 3 AIR BAG OFF IND CTRL
PNK 4 IGNITION 1 VOLT
PPL 5 SEAT BELT IND CTRL
INFLATABLE RESTRAINT PASSENGER AIR BAG ON/OFF INDICATOR
SEDAN
COUPE
BLK
BLK
S390 (ON ROOF WIRING HARNESS, APPROXIMATELY 34 CM (13.5 IN) FROM BREAKOUT TO DOME LAMP)
BLK
G201 (FRONT OF DASH, ABOVE G202)
G301 (BELOW DRIVER DOOR OPENING, REAR OF LEFT A-PILLAR)
1340 RED/WHT 1 BATTERY
2
3
5611 PPL 4 SENSOR SIGNAL
1751 BLK/WHT 5 GROUND
5608 YEL 6 PRE SENSOR SIG
5609 DK GRN 7 REFERENCE VOLT
8
9
11
12
13
5613 TAN 14 LOW REFERENCE
5610 GRY 15 LOW REFERENCE
5612 LT BLU 16 SENSOR REF VOLT
5060 DK GRN 17 SERIAL DATA
18
INFLATABLE RESTRAINT FRONT PASSENGER PRESENCE SYSTEM (PPS) MODULE (UNDER FRONT PASSENGER SEAT)
DK GRN A OCCUPANT PRE SENS REFERENCE VOLT
YEL B OCCUPANT PRE SENS SIGNAL
GRY C LOW REFERENCE
INFLATABLE RESTRAINT FRONT PASSENGER PRESENCE SYSTEM SENSOR (IN FRONT PASSENGER SEAT CUSHION)
LT BLU A PASS SEAT BELT TEN SENS REF VOLT
TAN B LOW REFERENCE
PPL C PASS SEAT BELT TENSION SENS SIGNAL
PASSENGER SEAT BELT TENSION SENSOR (PART OF BUCKLE ASSEMBLY)
TAN
BRN
WHT
PNK
A1
A2
B1
B2
SHORTING BAR
SHORTING BAR
TAN
BRN
WHT
PNK
INFLATABLE RESTRAINT STEERING WHEEL MODULE COIL
TAN
BRN
WHT
PNK
1
2
C1
1
2
C2
SHORTING BAR
SHORTING BAR
INFLATABLE RESTRAINT STEERING WHEEL MODULE (CENTER OF STEERING WHEEL)
BLK/ WHT
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
231097

Fig. 63: Supplemental Restraints Circuit (3 of 3)

TRANSMISSION

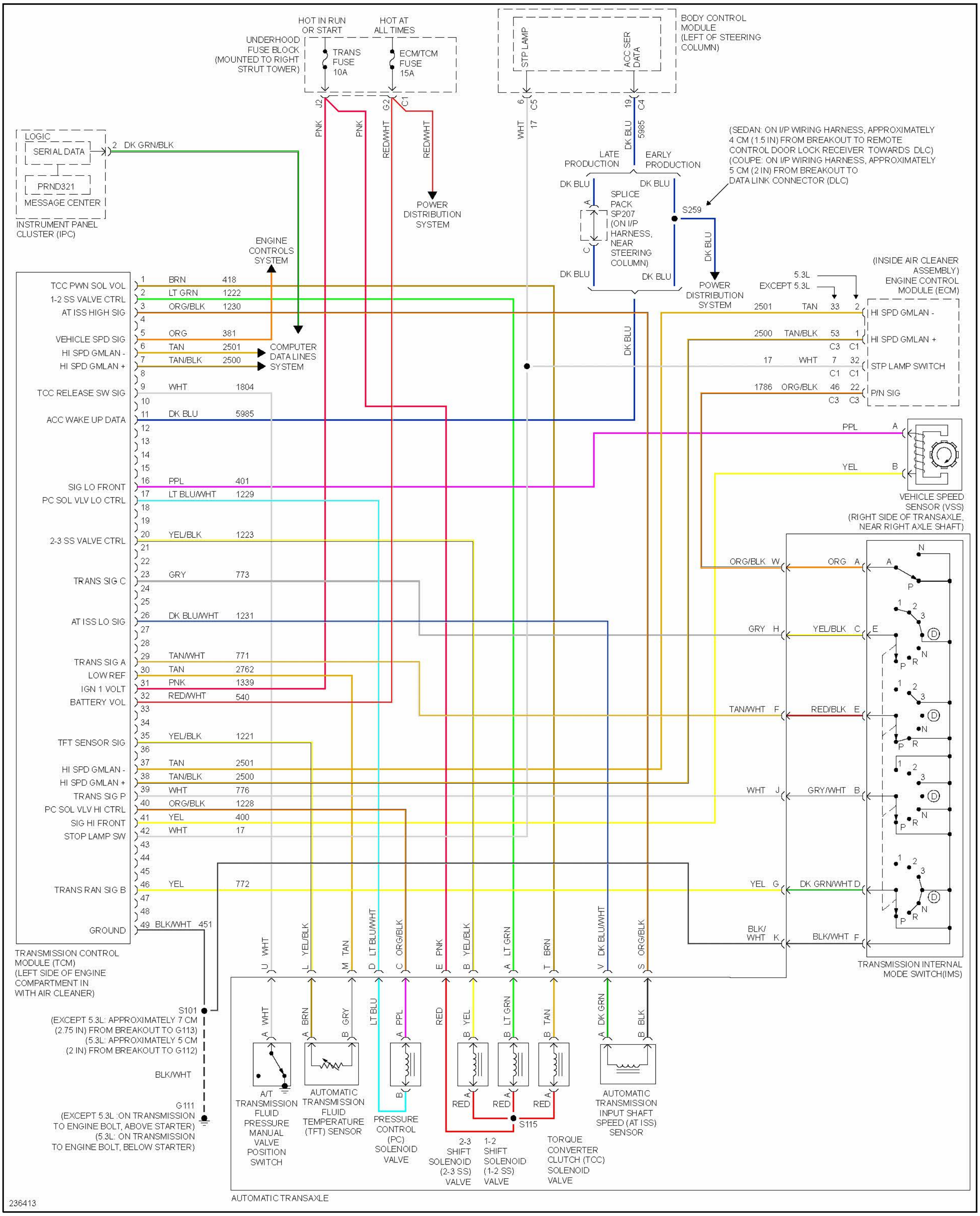

HOT IN RUN OR START
HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
TRANS FUSE 10A
ECM/TCM FUSE 15A
J2 PNK
PNK
G2 RED/WHT
C1 RED/WHT
POWER DISTRIBUTION SYSTEM
STP LAMP
ACC SER DATA
BODY CONTROL MODULE (LEFT OF STEERING COLUMN)
6 C5 WHT 17
19 C4 DK BLU 5985
LATE PRODUCTION
EARLY PRODUCTION
DK BLU
SPLICE PACK SP207 (ON I/P HARNESS, NEAR STEERING COLUMN)
S259
(SEDAN: ON I/P WIRING HARNESS, APPROXIMATELY 4 CM (1.5 IN) FROM BREAKOUT TO REMOTE CONTROL DOOR LOCK RECEIVER TOWARDS DLC) (COUPE: ON I/P WIRING HARNESS, APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO DATA LINK CONNECTOR (DLC)
POWER DISTRIBUTION SYSTEM
LOGIC
SERIAL DATA
2 DK GRN/BLK
PRND321
MESSAGE CENTER
INSTRUMENT PANEL CLUSTER (IPC)
ENGINE CONTROLS SYSTEM
COMPUTER DATA LINES SYSTEM
TCC PWN SOL VOL 1 BRN 418
1-2 SS VALVE CTRL 2 LT GRN 1222
AT ISS HIGH SIG 3 ORG/BLK 1230
4
VEHICLE SPD SIG 5 ORG 381
HI SPD GMLAN - 6 TAN 2501
HI SPD GMLAN + 7 TAN/BLK 2500
8
TCC RELEASE SW SIG 9 WHT 1804
10
ACC WAKE UP DATA 11 DK BLU 5985
12
13
14
15
SIG LO FRONT 16 PPL 401
PC SOL VLV LO CTRL 17 LT BLU/WHT 1229
18
19
2-3 SS VALVE CTRL 20 YEL/BLK 1223
21
22
TRANS SIG C 23 GRY 773
24
25
AT ISS LO SIG 26 DK BLU/WHT 1231
27
28
TRANS SIG A 29 TAN/WHT 771
LOW REF 30 TAN 2762
IGN 1 VOLT 31 PNK 1339
BATTERY VOL 32 RED/WHT 540
33
34
TFT SENSOR SIG 35 YEL/BLK 1221
36
HI SPD GMLAN - 37 TAN 2501
HI SPD GMLAN + 38 TAN/BLK 2500
TRANS SIG P 39 WHT 776
PC SOL VLV HI CTRL 40 ORG/BLK 1228
SIG HI FRONT 41 YEL 400
STOP LAMP SW 42 WHT 17
43
44
45
TRANS RAN SIG B 46 YEL 772
47
48
GROUND 49 BLK/WHT 451
TRANSMISSION CONTROL MODULE (TCM) (LEFT SIDE OF ENGINE COMPARTMENT IN WITH AIR CLEANER)
5.3L
EXCEPT 5.3L
(INSIDE AIR CLEANER ASSEMBLY) ENGINE CONTROL MODULE (ECM)
2501 TAN 33 2 HI SPD GMLAN -
2500 TAN/BLK 53 1 HI SPD GMLAN +
C3 C1
17 WHT 7 32 STP LAMP SWITCH
C1 C1
1786 ORG/BLK 46 22 P/N SIG
C3 C3
PPL A
YEL B
VEHICLE SPEED SENSOR (VSS) (RIGHT SIDE OF TRANSAXLE, NEAR RIGHT AXLE SHAFT)
ORG/BLK W ORG A
GRY H YEL/BLK C
TAN/WHT F RED/BLK E
WHT J GRY/WHT B
YEL G DK GRN/WHT D
BLK/WHT K BLK/WHT F
N A P 1 2 3 D R
TRANSMISSION INTERNAL MODE SWITCH(IMS)
U WHT
L YEL/BLK
M TAN
D LT BLU/WHT
C ORG/BLK
E PNK
B YEL/BLK
A LT GRN
T BRN
V DK BLU/WHT
S ORG/BLK
A WHT
A BRN
B GRY
LT BLU
A PPL
RED
B YEL
B LT GRN
B TAN
A DK GRN
B BLK
S101 (EXCEPT 5.3L: APPROXIMATELY 7 CM (2.75 IN) FROM BREAKOUT TO G113) (5.3L: APPROXIMATELY 5 CM (2 IN) FROM BREAKOUT TO G112)
BLK/WHT
G111 (EXCEPT 5.3L :ON TRANSMISSION TO ENGINE BOLT, ABOVE STARTER) (5.3L: ON TRANSMISSION TO ENGINE BOLT, BELOW STARTER)
A/T TRANSMISSION FLUID PRESSURE MANUAL VALVE POSITION SWITCH
AUTOMATIC TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR
B
PRESSURE CONTROL (PC) SOLENOID VALVE
A RED
A RED
A RED
S115
2-3 SHIFT SOLENOID (2-3 SS) VALVE
1-2 SHIFT SOLENOID (1-2 SS) VALVE
TORQUE CONVERTER CLUTCH (TCC) SOLENOID VALVE
AUTOMATIC TRANSMISSION INPUT SHAFT SPEED (AT ISS) SENSOR
AUTOMATIC TRANSAXLE
236413

Fig. 64: A/T Circuit

TRUNK, TAILGATE, FUEL DOOR

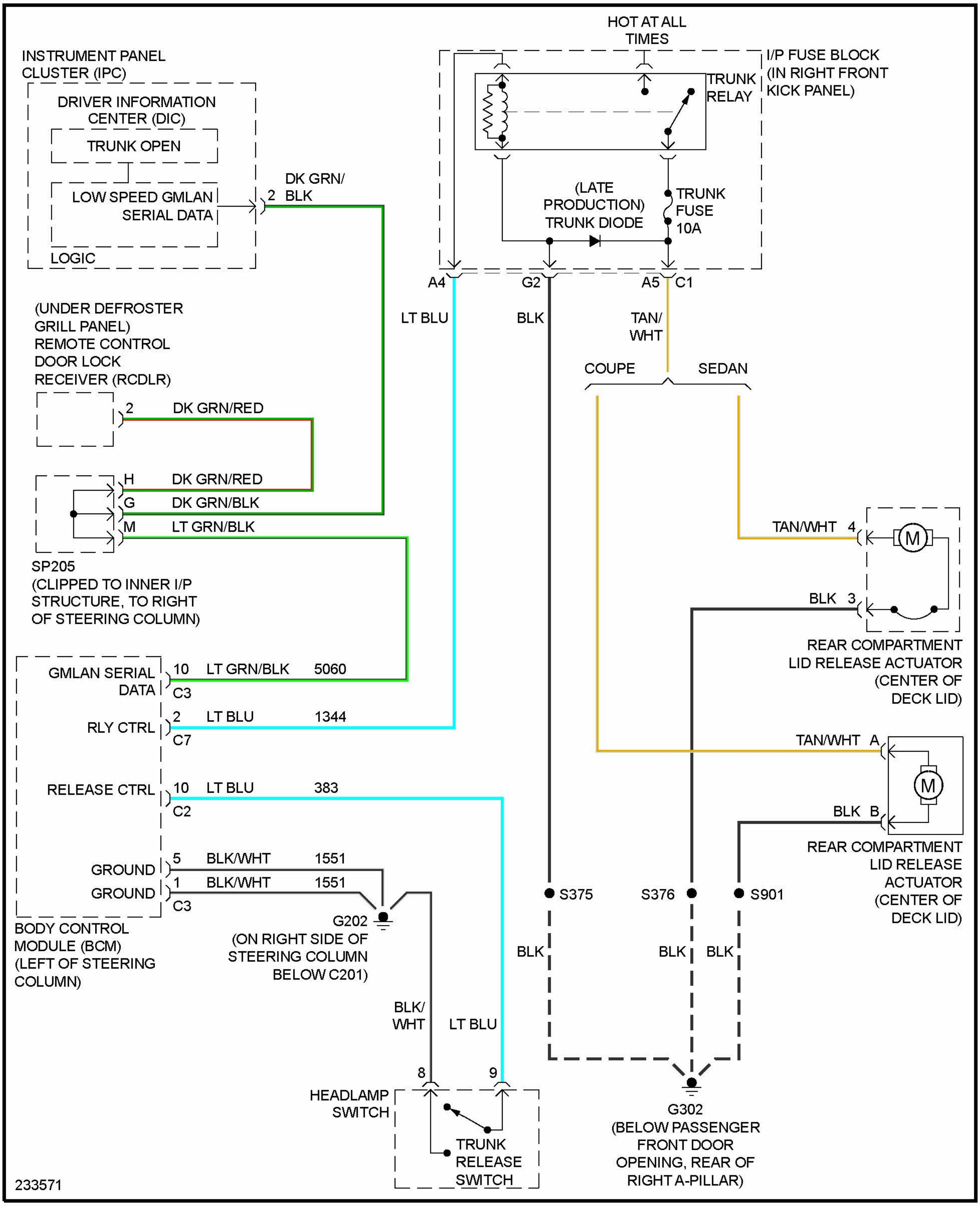

HOT AT ALL TIMES
I/P FUSE BLOCK (IN RIGHT FRONT KICK PANEL)
TRUNK RELAY
(LATE PRODUCTION) TRUNK DIODE
TRUNK FUSE 10A
A4
G2
A5
C1
INSTRUMENT PANEL CLUSTER (IPC)
DRIVER INFORMATION CENTER (DIC)
TRUNK OPEN
LOW SPEED GMLAN SERIAL DATA
LOGIC
2
DK GRN/ BLK
LT BLU
BLK
TAN/ WHT
COUPE
SEDAN
(UNDER DEFROSTER GRILL PANEL) REMOTE CONTROL DOOR LOCK RECEIVER (RCDLR)
2
DK GRN/RED
H
DK GRN/RED
G
DK GRN/BLK
M
LT GRN/BLK
SP205 (CLIPPED TO INNER I/P STRUCTURE, TO RIGHT OF STEERING COLUMN)
TAN/WHT 4
M
BLK 3
REAR COMPARTMENT LID RELEASE ACTUATOR (CENTER OF DECK LID)
GMLAN SERIAL DATA
10
LT GRN/BLK
5060
C3
RLY CTRL
2
LT BLU
1344
C7
RELEASE CTRL
10
LT BLU
383
C2
TAN/WHT A
M
BLK B
REAR COMPARTMENT LID RELEASE ACTUATOR (CENTER OF DECK LID)
GROUND
5
BLK/WHT
1551
GROUND
1
BLK/WHT
1551
C3
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
S375
S376
S901
BLK
BLK
BLK
BLK/ WHT
LT BLU
8
9
HEADLAMP SWITCH
TRUNK RELEASE SWITCH
G302 (BELOW PASSENGER FRONT DOOR OPENING, REAR OF RIGHT A-PILLAR)
233571

Fig. 65: Trunk Release Circuit

WARNING SYSTEMS

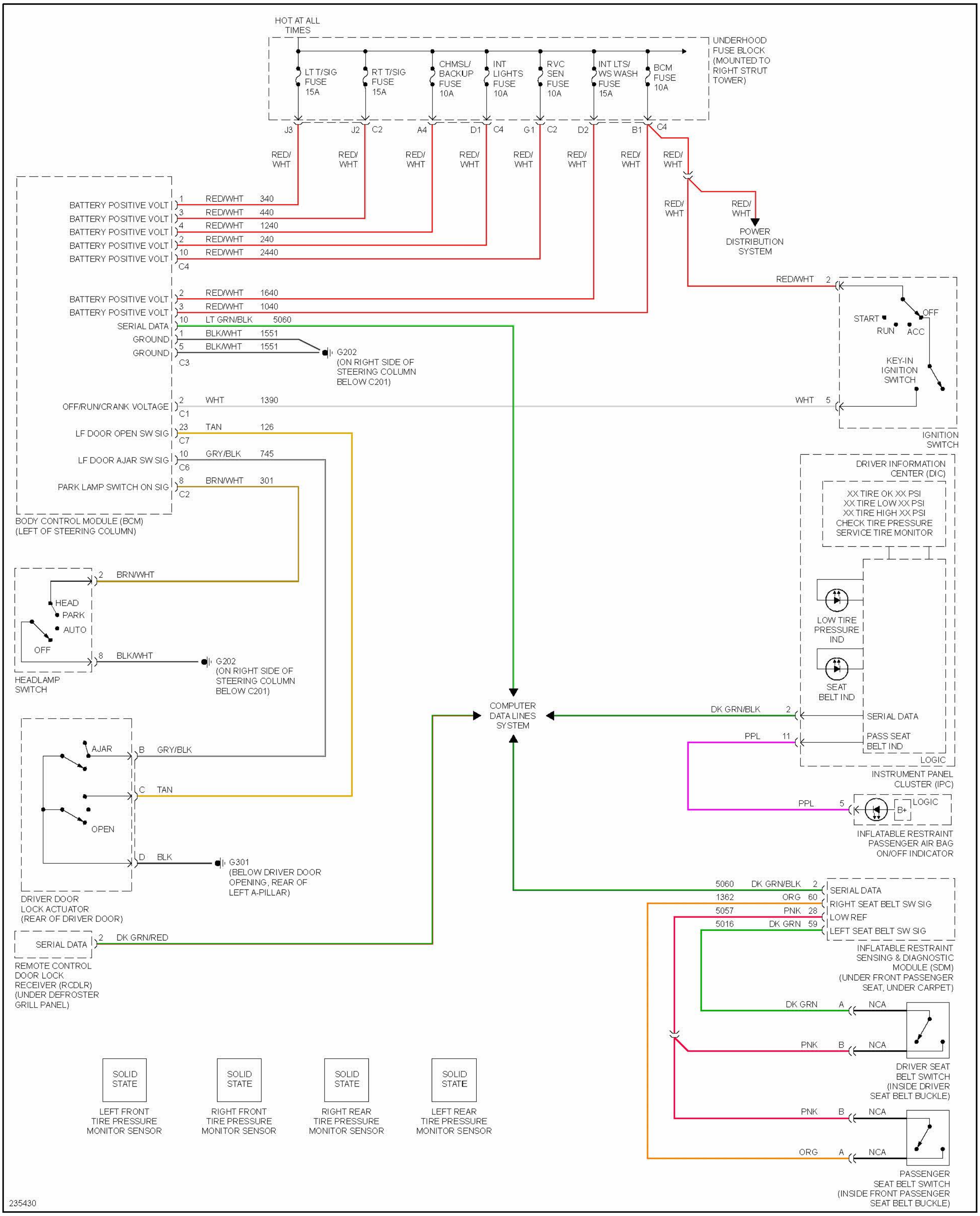

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
LT T/SIG FUSE 15A
RT T/SIG FUSE 15A
CHMSL/ BACKUP FUSE 10A
INT LIGHTS FUSE 10A
RVC SEN FUSE 10A
INT LTS/ WS WASH FUSE 15A
BCM FUSE 10A
J3
J2
C2
A4
D1
C4
G1
C2
D2
B1
C4
RED/ WHT
POWER DISTRIBUTION SYSTEM
BATTERY POSITIVE VOLT
SERIAL DATA
GROUND
OFF/RUN/CRANK VOLTAGE
LF DOOR OPEN SW SIG
LF DOOR AJAR SW SIG
PARK LAMP SWITCH ON SIG
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
RED/WHT 340
RED/WHT 440
RED/WHT 1240
RED/WHT 240
RED/WHT 2440
RED/WHT 1640
RED/WHT 1040
LT GRN/BLK 5060
BLK/WHT 1551
WHT 1390
TAN 126
GRY/BLK 745
BRN/WHT 301
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
START
RUN
ACC
OFF
KEY-IN IGNITION SWITCH
IGNITION SWITCH
DRIVER INFORMATION CENTER (DIC)
XX TIRE OK XX PSI
XX TIRE LOW XX PSI
XX TIRE HIGH XX PSI
CHECK TIRE PRESSURE
SERVICE TIRE MONITOR
LOW TIRE PRESSURE IND
SEAT BELT IND
SERIAL DATA
PASS SEAT BELT IND
LOGIC
INSTRUMENT PANEL CLUSTER (IPC)
DK GRN/BLK
PPL
B+
INFLATABLE RESTRAINT PASSENGER AIR BAG ON/OFF INDICATOR
HEAD
PARK
AUTO
OFF
BRN/WHT
BLK/WHT
HEADLAMP SWITCH
COMPUTER DATA LINES SYSTEM
AJAR
OPEN
GRY/BLK
TAN
BLK
G301 (BELOW DRIVER DOOR OPENING, REAR OF LEFT A-PILLAR)
DRIVER DOOR LOCK ACTUATOR (REAR OF DRIVER DOOR)
SERIAL DATA
DK GRN/RED
REMOTE CONTROL DOOR LOCK RECEIVER (RCDLR) (UNDER DEFROSTER GRILL PANEL)
5060 DK GRN/BLK
1362 ORG
5057 PNK
5016 DK GRN
RIGHT SEAT BELT SW SIG
LOW REF
LEFT SEAT BELT SW SIG
INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE (SDM) (UNDER FRONT PASSENGER SEAT, UNDER CARPET)
NCA
DRIVER SEAT BELT SWITCH (INSIDE DRIVER SEAT BELT BUCKLE)
PASSENGER SEAT BELT SWITCH (INSIDE FRONT PASSENGER SEAT BELT BUCKLE)
SOLID STATE
LEFT FRONT TIRE PRESSURE MONITOR SENSOR
RIGHT FRONT TIRE PRESSURE MONITOR SENSOR
RIGHT REAR TIRE PRESSURE MONITOR SENSOR
LEFT REAR TIRE PRESSURE MONITOR SENSOR
235430

Fig. 66: Warning Systems Circuit

WIPER/WASHER

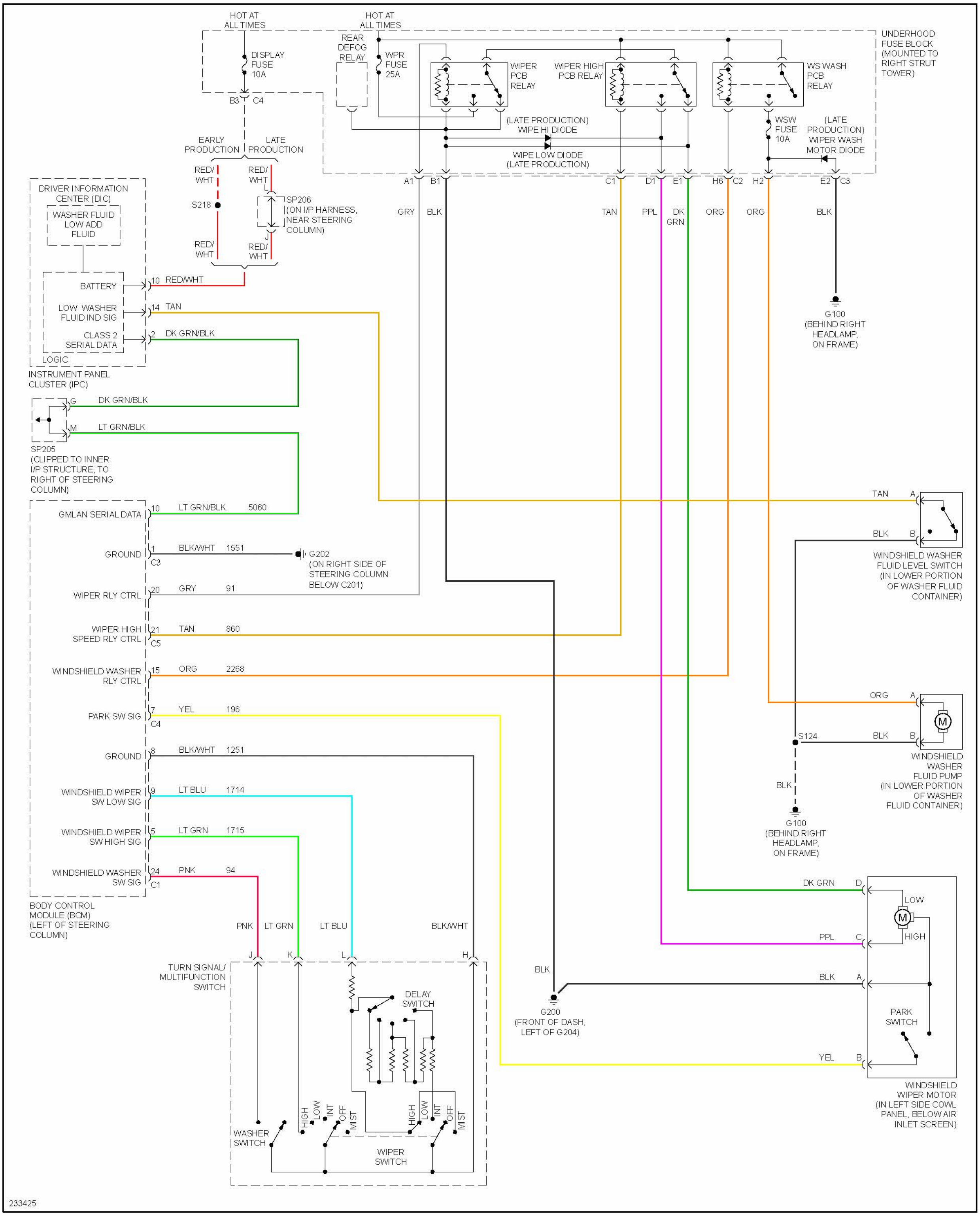

HOT AT ALL TIMES
HOT AT ALL TIMES
REAR DEFOG RELAY
DISPLAY FUSE 10A
WPR FUSE 25A
WIPER PCB RELAY
WIPER HIGH PCB RELAY
WS WASH PCB RELAY
UNDERHOOD FUSE BLOCK (MOUNTED TO RIGHT STRUT TOWER)
B3
C4
(LATE PRODUCTION) WIPE HI DIODE
WIPE LOW DIODE (LATE PRODUCTION)
WSW FUSE 10A
(LATE PRODUCTION) WIPER WASH MOTOR DIODE
EARLY PRODUCTION
LATE PRODUCTION
RED/WHT
S218
SP206 (ON I/P HARNESS, NEAR STEERING COLUMN)
L
J
A1
B1
C1
D1
E1
H6
C2
H2
E2
C3
GRY
BLK
TAN
PPL
DK GRN
ORG
ORG
BLK
G100 (BEHIND RIGHT HEADLAMP, ON FRAME)
DRIVER INFORMATION CENTER (DIC)
WASHER FLUID LOW ADD FLUID
BATTERY
LOW WASHER FLUID IND SIG
CLASS 2 SERIAL DATA
LOGIC
INSTRUMENT PANEL CLUSTER (IPC)
10 RED/WHT
14 TAN
2 DK GRN/BLK
G DK GRN/BLK
M LT GRN/BLK
SP205 (CLIPPED TO INNER I/P STRUCTURE, TO RIGHT OF STEERING COLUMN)
GMLAN SERIAL DATA 10 LT GRN/BLK 5060
GROUND 1 C3 BLK/WHT 1551
G202 (ON RIGHT SIDE OF STEERING COLUMN BELOW C201)
WIPER RLY CTRL 20 GRY 91
WIPER HIGH SPEED RLY CTRL 21 C5 TAN 860
WINDSHIELD WASHER RLY CTRL 15 ORG 2268
PARK SW SIG 7 C4 YEL 196
GROUND 8 BLK/WHT 1251
WINDSHIELD WIPER SW LOW SIG 9 LT BLU 1714
WINDSHIELD WIPER SW HIGH SIG 5 LT GRN 1715
WINDSHIELD WASHER SW SIG 24 C1 PNK 94
BODY CONTROL MODULE (BCM) (LEFT OF STEERING COLUMN)
TAN A
BLK B
WINDSHIELD WASHER FLUID LEVEL SWITCH (IN LOWER PORTION OF WASHER FLUID CONTAINER)
ORG A
S124
BLK B
M
WINDSHIELD WASHER FLUID PUMP (IN LOWER PORTION OF WASHER FLUID CONTAINER)
BLK
G100 (BEHIND RIGHT HEADLAMP, ON FRAME)
PNK
LT GRN
LT BLU
BLK/WHT
J
K
L
H
TURN SIGNAL/ MULTIFUNCTION SWITCH
DELAY SWITCH
WASHER SWITCH
HIGH
LOW
INT
OFF
MIST
WIPER SWITCH
BLK
G200 (FRONT OF DASH, LEFT OF G204)
DK GRN D
LOW
M
PPL C
HIGH
BLK A
PARK SWITCH
YEL B
WINDSHIELD WIPER MOTOR (IN LEFT SIDE COWL PANEL, BELOW AIR INLET SCREEN)
233425

Fig. 67: Wiper/Washer Circuit